General Information

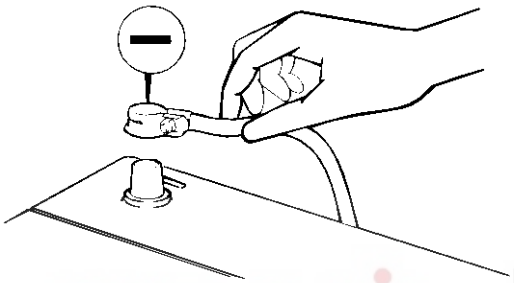
Servicing the electrical system

1. Prior to servicing the electrical system, be sure to turn off the ignition switch and disconnect the battery ground cable.

   NOTICE

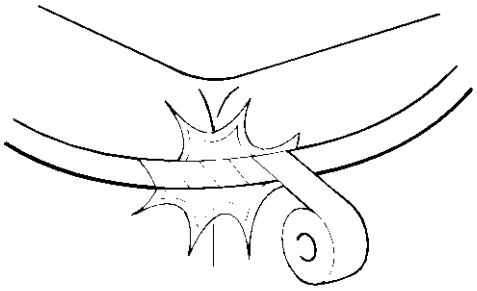
   In the course of MFI or ELC system diagnosis, when the battery cable is removed, any diagnostic code retained by the computer will be cleared.

   Therefore, if necessary, read the diagnostic codes before removing the battery cable.



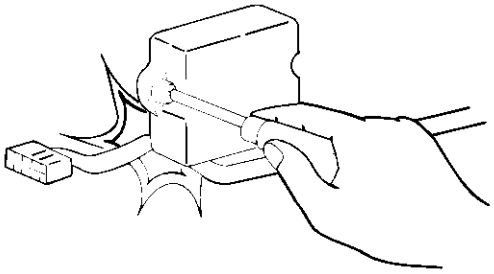
ATAC001A

2. Secure the siring harnesses by using clamps so that there is no slack. However, for any harness which passes to the engine or other vibrating parts of the vehicle, allow some slack within a range that does not allow the engine vibrations tocause the harness to come into contact with any of the surrounding parts, and then secure the harness by using a clamp.
3. If any section of a wiring harness interferes with the edge of a part or a corner, wrap the section of the harness with tape or something similar in order to protect it from damage.



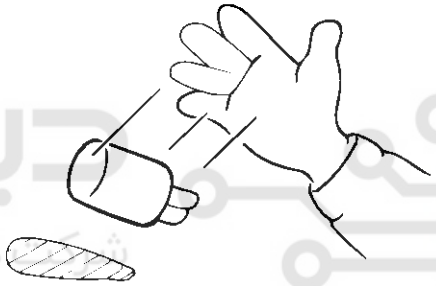
ATAC001B

4. When installing any of the vehicle parts, be careful not to pinch or damage any of the wiring harnesses.



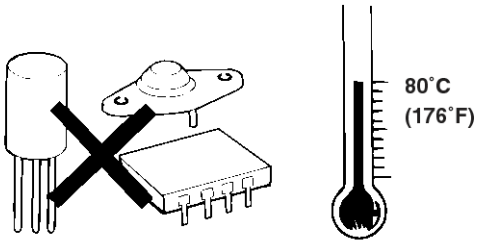
ATAC001C

5. The sensors, relays, and electrical parts, must never be subjected to strong shocks. Do not allow them to fall and do not throw them when handling.



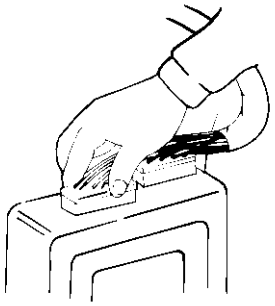
ATAC001E

6. The electronic parts used in the computer, relays, etc. are readily damaged by heat. If there is a need for service operations that may cause the temperature to exceed 80℃ (176˚F), remove the electronic parts beforehand.



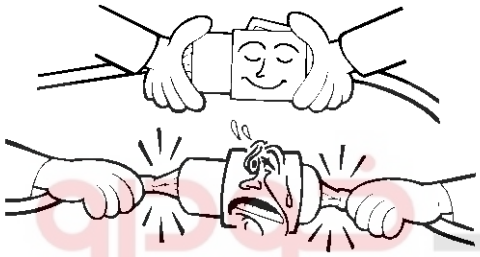
ATAC001F

7. Loose connectors could be troubled. Make sure that connected are connceted securely.



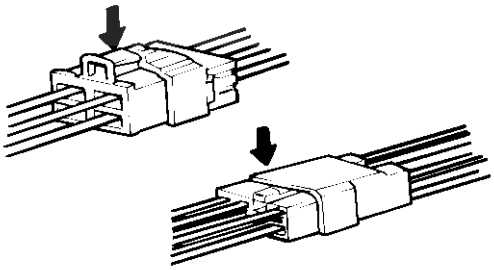
ATAC001G

8. When removing a connector, be sure to pull only the connector, not the harness.



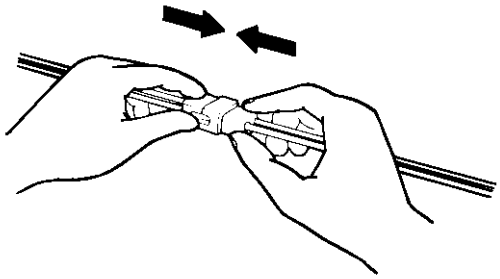
ATAC001H

9. Remove connectors which have catches by pressing in the direction indicated by the arrows in the illustration.



ATAC001I

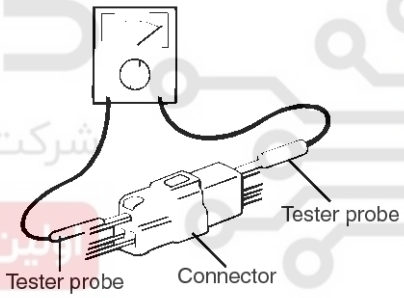
10. Connect connectors which have catches by inserting the connectors until a "snap" noise is heard.



ATAC001J

11. When using a circuit tester to perform continuity or voltage checks on connector terminals, insert the test probe from the harness side.

    If the connector is a sealed connector, insert the test probe in through the hole in the rubber cap for the electrical wires, being careful not to damage the insulation of the wires; continue to insert the test probe until it contacts the terminal.

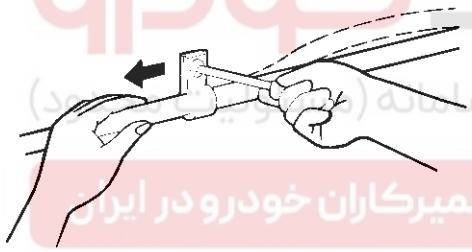


LTCD001K

12. In order to avoid overloading the wiring, take the electrical current load of the optional equipment into consideration, and determine the appropriate wire size.

Checking cables and wires

1. Check the terminal for tightness.
2. Check terminals and wires for corrosion by battery electrolyte, etc.
3. Check terminals and wires for open circuit or impending open circuit.
4. Check wire insulation and coating for damage, cracks and degrading.
5. Check conductive parts of terminals for contact with other metallic parts. (vehicle body and other parts)
6. Check grounding parts to verify that there is complete continuity between mounting bolt(s) and vehicle body.
7. Check for incorrect wiring.
8. Check that wirings are clamped so as to prevent contact with sharp corners of the vehicle body, etc. or hot parts (exhaust manifold, pipe, ect.)
9. Check that wirings are clamped firmly to secure enough clearance from the fan pulley, fan belt and other rotating or moving parts.



ATAC001M

10. Check that the wirings between the fixed parts such as the vehicle body and the vibrating parts such as the engine are made with adequate allowance for vibrations.

Checking fuses

A blade type fuse has test taps provided to allow checking of the fuse itself without removing it from the fuse block. The fuse is okay if the test lamp comes on when its one lead is connected to the test taps (one at a time) and the other lead is grounded. (Change the ignition switch position adequately so that the fuse circuit becomes live.)

Installation of radio equipment

The electronic control system has been designed so that external radio waves will not interfere with their operation.

However, if the antenna or cable of the amateur transceiver is routed near the computers, it may affect the operation ofthe computers, even if the output of the transceiver is no more than 25W.

To protect each of the computers from interference by transmitter (hum, transceiver, etc.) the following should be observed.

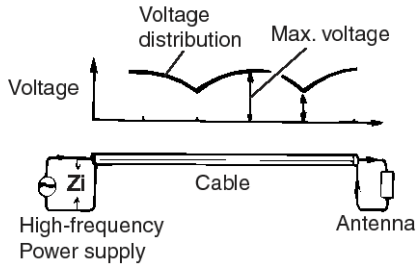
1. Install the antenna on the roof or rear bumper.
2. Because radio waves are emitted from the coaxial cable of the antenna, keep it 200mm (8in.) away from the computers and the wiring harness. If the cable must cross the siring harness, route it so that it runs at right angles to the wiring harness.
3. The antenna and the cable should be well matched, and the standing-wave ratio* should be kept low.
4. A transmitter having a large output should not be installed in the vehicle.
5. After installation of transmitter, run the engine at idle, emit radio waves from the transmitter and make sure that the engine is not affected.

*Standing-wave ratio

STANDING-WAVE RATIO If an antenna and a cable having different impedances are connected, the input impedance Zi will vary in accordance with the length of the cable and the frequency of the transmitter, and the voltage distribution will also vary in accordance with the location.

The ratio between this maximum voltage and minimum voltage is called the standing-wave ratio. It can also be representedby the ratio between the impedances of the antenna and the cable.

The amount of radio waves emitted from the cable increases as the standing-wave ratio increases, and this increases thepossibility of the electronic components being adversely affected.



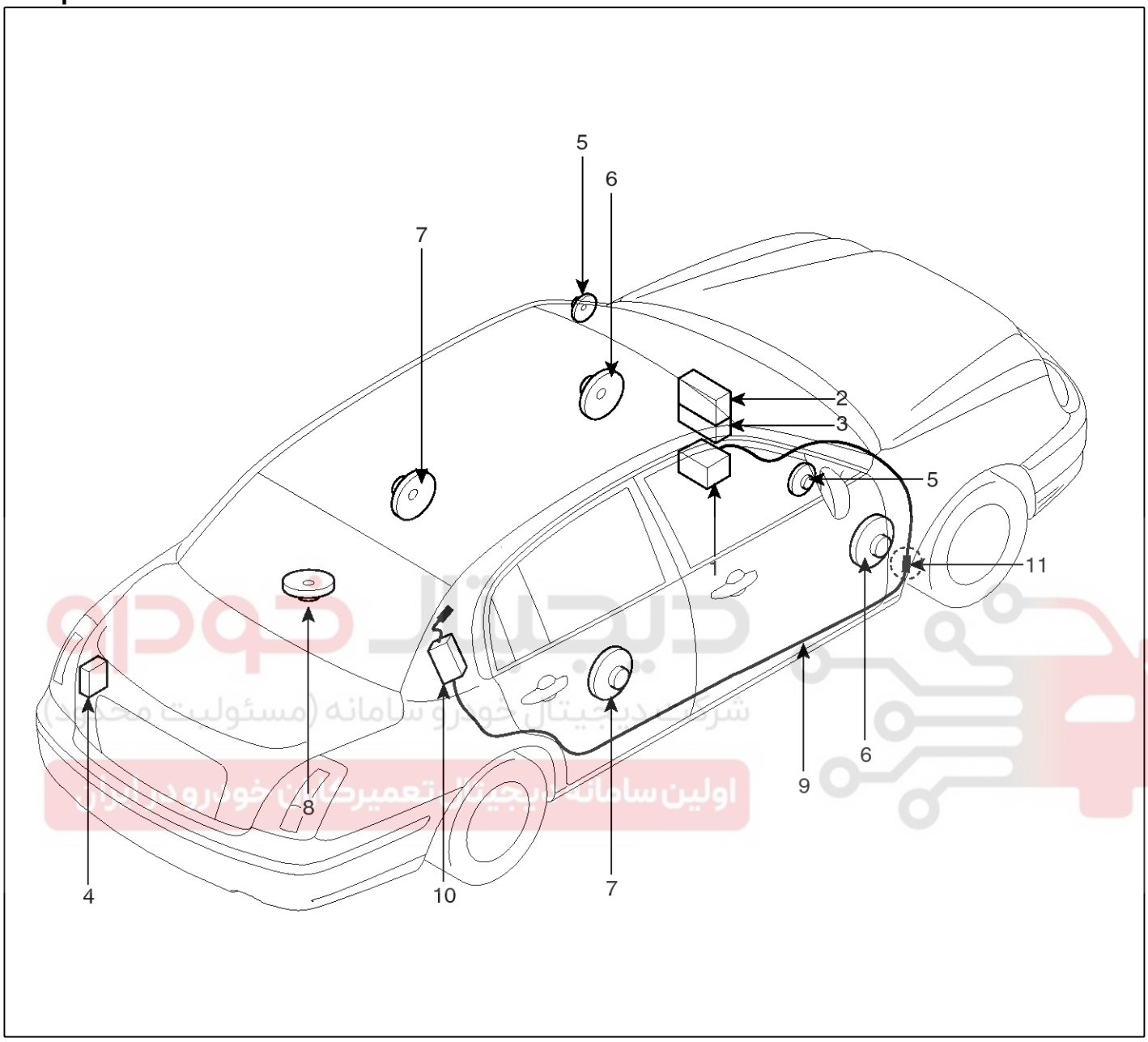
ATCD001N

Audio

Specification

Item		Specification	
Model		Radio/MP3/CD (PA710)	Radio/MP3/CDC (PA760)
Power supply		DC 14.4V	
Rated output		Max 43W x 4	Max 35W x 6
Antenna		80PF 75Ω	
Load Impedance		4 ohm X 4	
Tuning type		PLL synthesized type	
Other device		Internal Amplifier	External Amplifier
Frequency range / Channel space	FM	87.5~108.0 MHz / 100KHz (General)	
	AM	531~1602 KHz / 9KHz (General)	
	FM	87.5~108.0 MHz / 50KHz (Europe)	
	MW	522~1620 KHz / 9KHz (Europe)	
	LW	153~279 KHz / 1KHz (Europe)	

Component Location



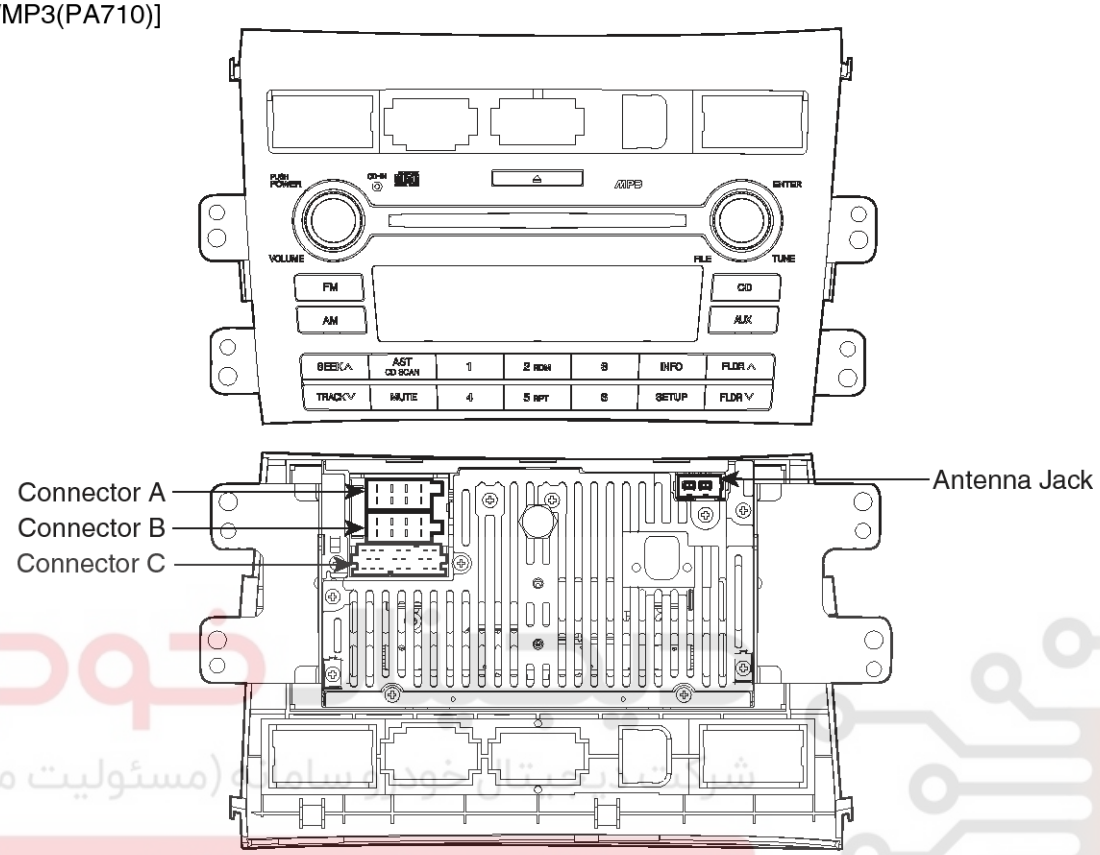
SGHBE9001L

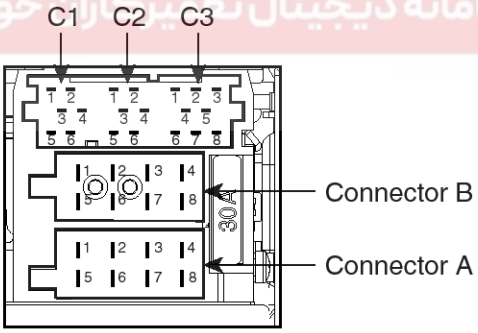
1. Audio head unit
2. Audio monitor
3. Audio keyboard
4. External amplifier
5. Tweeter speaker
6. Front door speaker
7. Rear door speaker
8. Sub woofer speaker
9. Antenna feeder cable
10. Glass antenna amplifier
11. Feeder cable joint connector

Audio Unit

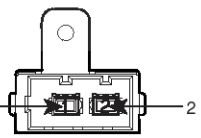
Component Location

[RADIO/CD/MP3(PA710)]





Antenna Jack

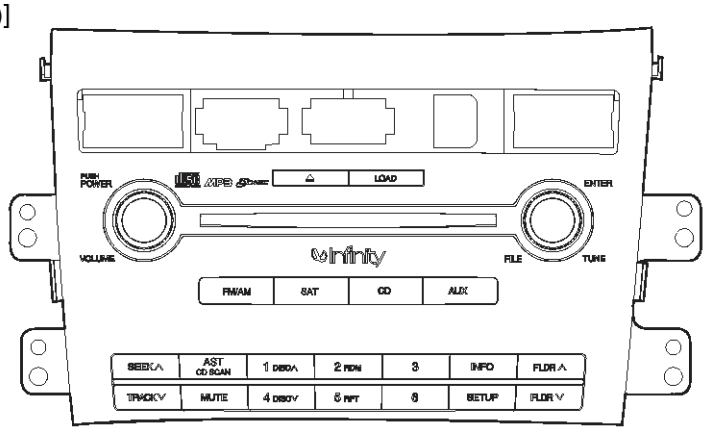


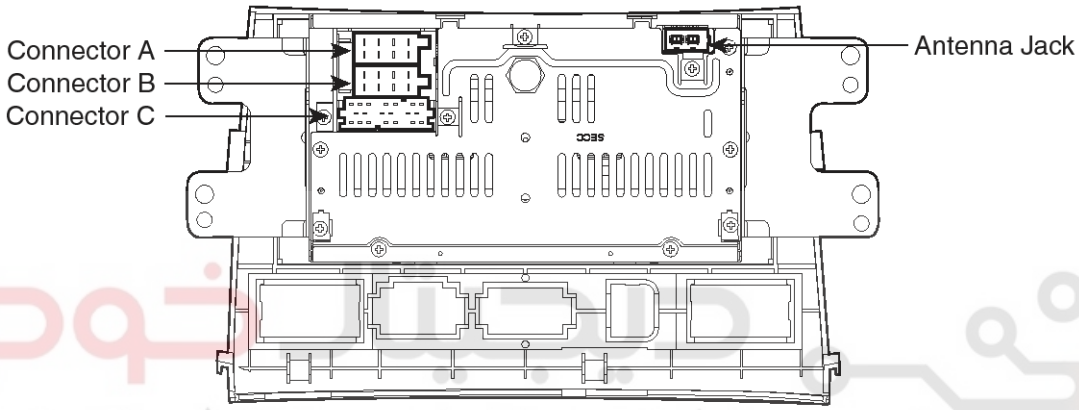
Pin no.	Name
1	FM1/AM
2	FM2

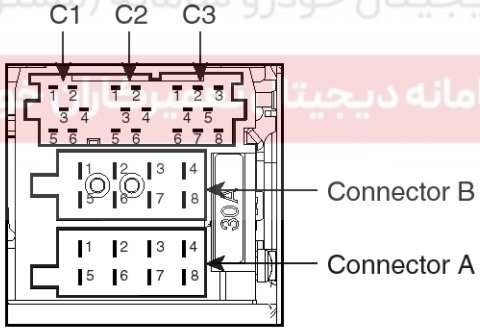
NO	Connector A	Connector B	Connector C1	Connector C2	Connector C3
1	Vehicle speed	Rear right speaker(+)	-	AUX input(R)	-
2	Illumination (+)	Front right speaker(+)	-	AUX input(L)	USB D-
3	Remote control antenna	Front left speaker(+)	EQ Sel	AUX REF	-
4	Battery +	Rear left speaker(+)	Rear arm remote	AUX Detect	USB D+
5	-	Rear right speaker(-)	Tel mute	Remote control(+)	IPOD/USB GND
6	ACC	Front right speaker(-)	-	Remote Ground	Amp. remote
7	Illumination (-)	Front left speaker(-)			USB/IPOD VDO
8	Ground(Power)	Rear left speaker(-)			-

SGHBE9002L

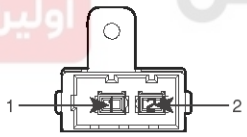
[RADIO/MP3/CDC (PA760)]







Antenna Jack

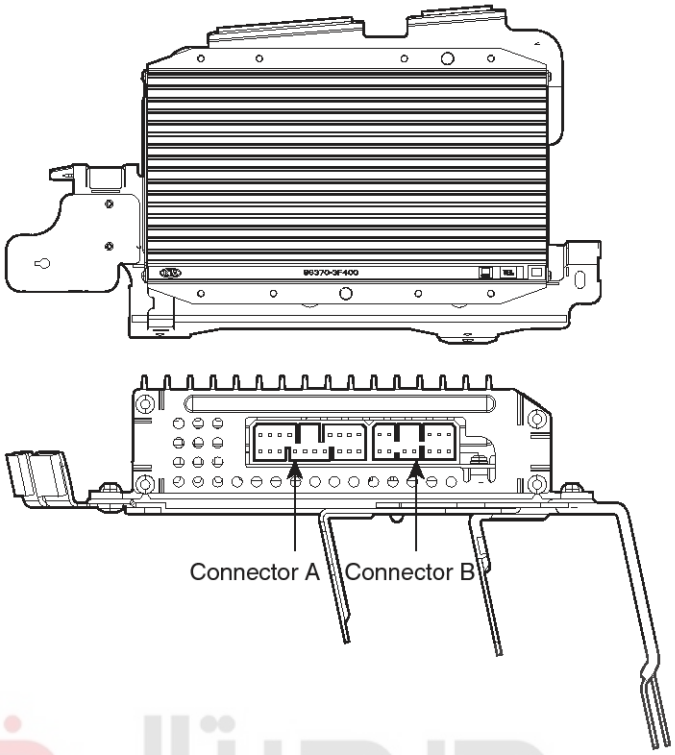


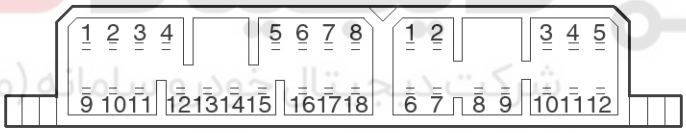
Pin no.	Name
1	FM1/AM
2	FM2

NO	Connector A	Connector B	Connector C1	Connector C2	Connector C3
1	Vehicle speed	Rear right speaker(+)	-	AUX input(R)	Monitor key
2	Illumination (+)	Front right speaker(+)	-	AUX input(L)	USB D-
3	Remote control antenna	Front left speaker(+)	External Amp. select	AUX REF	CAN L
4	Battery +	Rear left speaker(+)	-	AUX Detect	USB D+
5	Temp.	Rear right speaker(-)	Tel mute	Remote control(+)	IPOD/USB GND
6	ACC	Front right speaker(-)	-	Remote Ground	Amp. Remote
7	Illumination (-)	Front left speaker(-)			USB/IPOD VDO
8	Ground(Power)	Rear left speaker(-)			CAN H

SGHBE9003L

[External Amplifier]

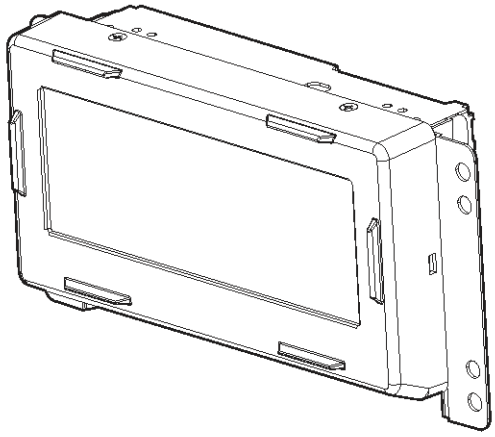


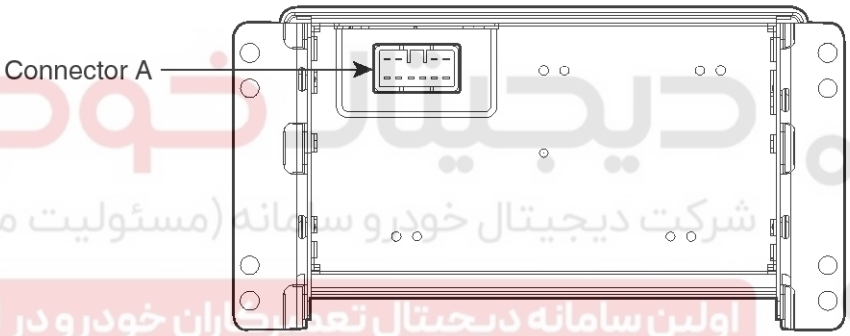


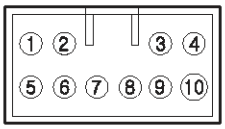
Pin no.	Connector A	Pin no.	Connector A
1	-	1	14.4 VDC
2	Rear deck sub woofer 1(+)	2	Power ground
3	-	3	Rear right in (+)
4	-	4	Front right in (+)
5	Rear right door (-)	5	Front left in (+)
6	Front right door (-)	6	14.4 VDC
7	Front left door (-)	7	Power ground
8	Remote ON/OFF line	8	Rear left in (-)
9	-	9	Rear left in (+)
10	Rear deck sub woofer 1(-)	10	Rear right in (-)
11	-	11	Front right in (-)
12	-	12	Front left in (-)
13	Rear left door (+)		
14	Rear left door (-)		
15	Rear right door (+)		
16	Front right door (+)		
17	Front left door (+)		
18	-		

SGHBE9004L

[Monitor]

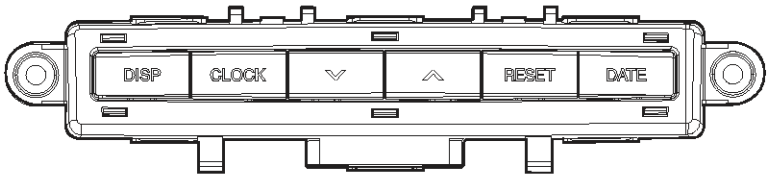


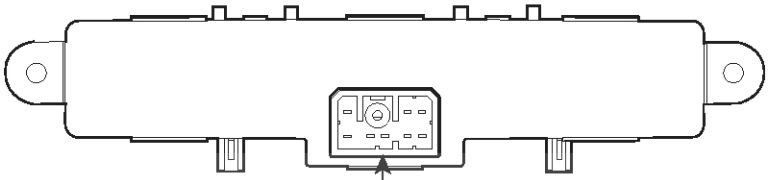


Connector A	Pin	Name	Pin	Name
	1	-	6	-
	2	Auto light	7	CAN -
	3	-	8	CAN +
	4	Power ground	9	ACC
	5	Illumination +	10	Battery +

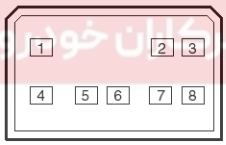
SGHBE9005N

[Keyboard]





Connector A

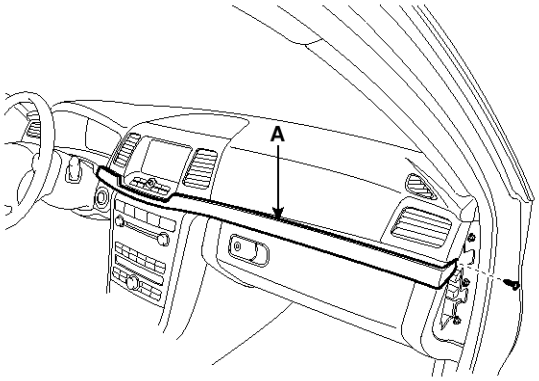
Connector A	Pin	Name	Pin	Name
	1	Illumination -	5	-
	2	-	6	-
	3	Remote control ground	7	-
	4	Illumination +	8	Remote control key

SGHBE9006N

Removal

Audio Head Unit

1. Disconnect the negative (-) battery terminal.
2. Remove the crash pad plate (A).

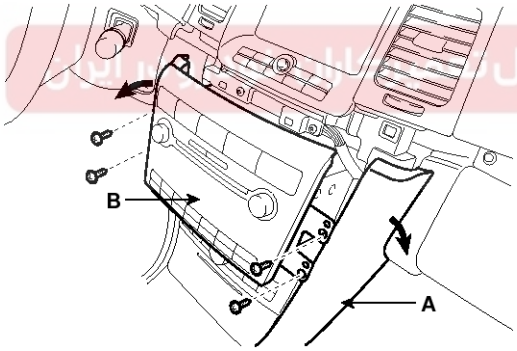


SGHBE9008D

3. Loosen the audio (B) mounting screws after opening both of center fascia side garnishes (A) out a little bit to remove the audio head unit.

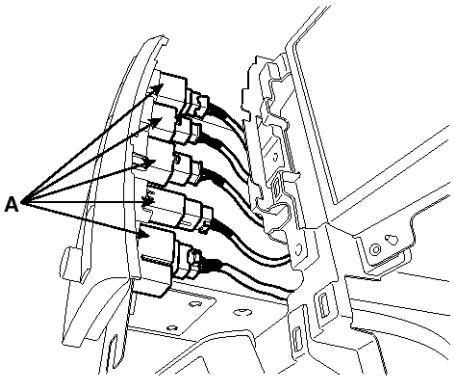
NOTICE

- *Be careful not to damage the side garnish.*

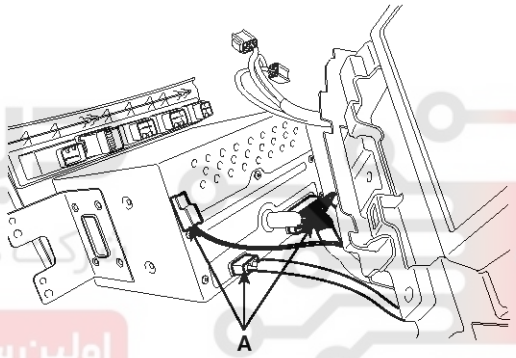


SGHBE9009D

4. Remove the audio head unit after disconnecting the connectors and antenna cables (A).



SGHBE9022D



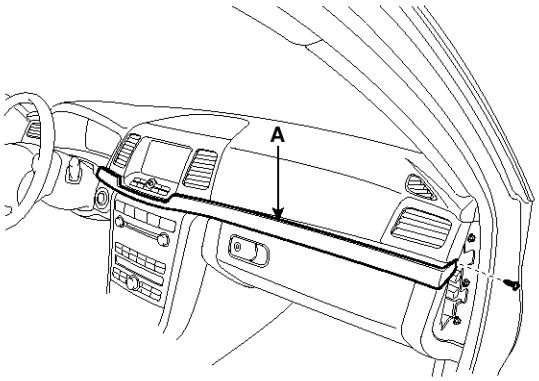
SGHBE9023D

NOTICE

- *Be careful not to damage the connectors and cables when disconnecting them.*

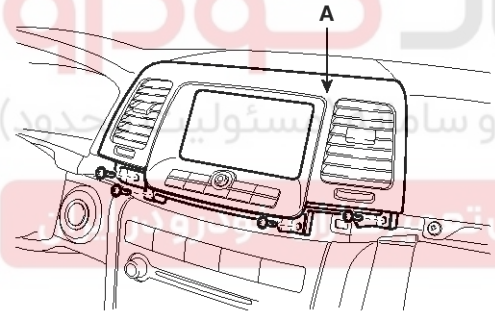
Monitor

1. Disconnect the negative (-) battery terminal.
2. Remove the crash pad plate (A).



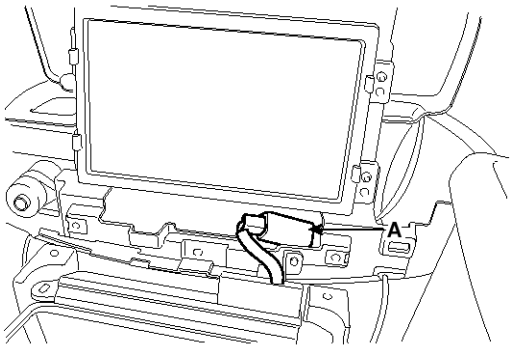
SGHBE9008D

3. Remove the monitor keyboard and air vent (A) after loosening the screws.



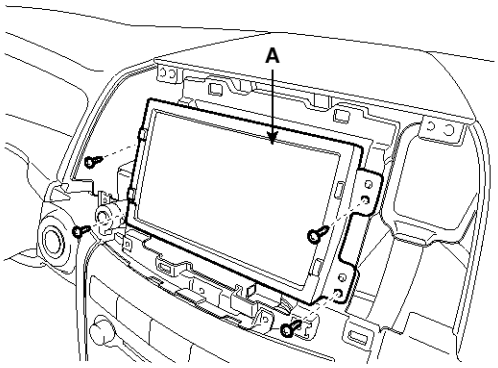
SGHBE9010D

4. Disconnect the monitor keyboard connector (A).



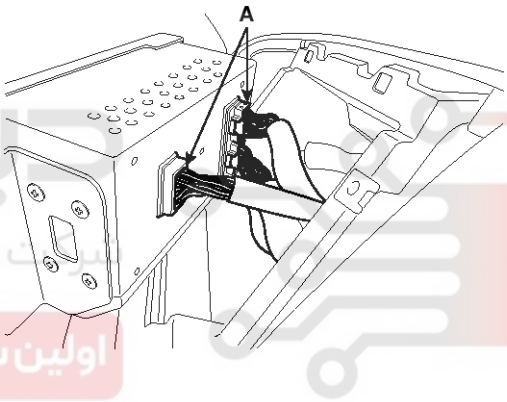
SGHBE9011D

5. Remove the monitor (A) after loosening the screws.



SGHBE9012D

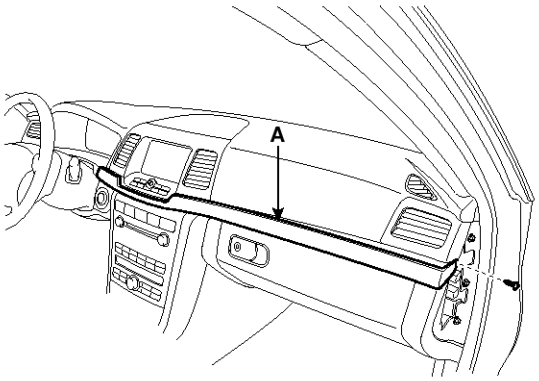
6. Disconnect the monitor connector (A).



SGHBE9013D

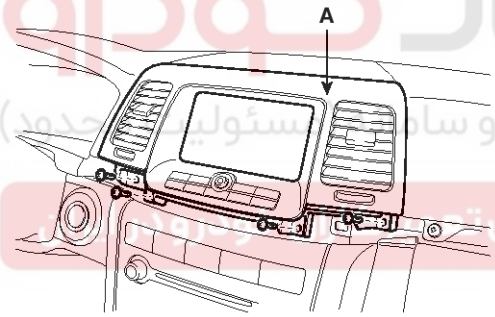
Monitor Keyboard

1. Disconnect the negative (-) battery terminal.
2. Remove the crash pad plate (A).



SGHBE9008D

3. Remove the monitor keyboard and air vent (A) after loosening the screws.



SGHBE9010D

4. Disconnect the monitor keyboard connector).
5. Remove the monitor keyboard from the air vent panel.

Installation

Audio Head Unit

1. Install the connectors and antenna cable.
2. Install the audio head unit.
3. Install the center fasia side garnishes.
4. Install the crash pad plate.
5. Reconnect the negative (-) battery terminal.

NOTICE

- *Make sure the audio head unit connectors are plugged in properly, and the antenna cable is connected properly.*
- *Check the audio system.*

Monitor

1. Install the monitor.
2. Install the monitor keyboard and air vent.
3. Install the crash pad plate.

NOTICE

- *Make sure the audio head unit connectors are plugged in properly, and the antenna cable is connected properly.*
- *Check the audio system.*

Monitor Keyboard

1. Install the keyboard to the air vent panel.
2. Install the monitor keyboard and air vent.
3. Install the crash pad plate.

NOTICE

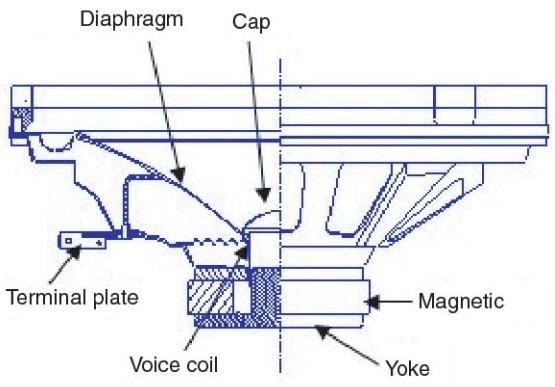
- *Make sure the audio head unit connectors are plugged in properly, and the antenna cable is connected properly.*
- *Check the audio system.*

Speakers

Inspection

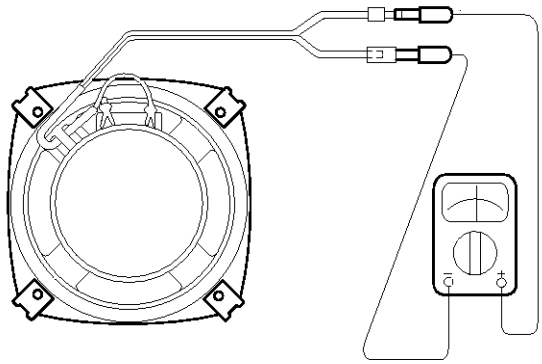
1. Troubleshooting for Speaker
   1) Basic inspection of speaker

      Inspect the sound from speaker after verifying that the speaker mounting screws is removed and the wiring connector is connected precisely to remove vibration transmitted from body trims and surrounding parts.



SNFBE8015N

2) Case Troubleshooting

No.	Case	Inspection/Remedy
1	Trembling sound	1. Before replacing the speaker, inspect that the mounting screw is installed normally. 2. After re-installing the speaker, verify that no trembling sound is heard. 3. When hearing a trembling sound again, replace the speaker with new one.
2	Noise	1. Check if the wiring connector is connected normally. If not, reconnect the wiring connector. 2. In case of radio static, check if there is a noise from CD player. 3. When a noise is heard on turning radio and CD on, replace the speaker with new one. **NOTICE** *In case there is only radio static, this causes from poor radio reception. Thus the speaker needs no repair and replacement.*
3	Poor working	Inspection of the wiring connection between the battery and the speaker 1. Before replacing the speaker, inspect the wiring connection between the battery and the speaker is normal. 2. Check the supplying power to the speaker and the resistance, and then inspect the sound quality. ■ Specified impedance : 2 ~ 4Ω  KTMB060A 3. If the speaker works poorly, replace it with new one.

CAUTION

- **During dealing of speaker**
- **Do not damage the speaker with impact as like a drop and a throw.**
- **Be careful not to cover water and oil over the speaker.**
- **Caution during dealing of speaker because the material of diaphragm is paper which is easy to be torn by impact and external force.**
- **When modifying audio system as customer pleases, this does electric damage to speaker.**
- **And, in this case the speakers are not covered by the manufacturer's warranty.**

Replacement

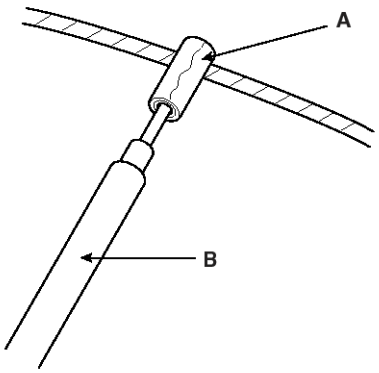
Refer to the body group - External

Antenna

Inspection

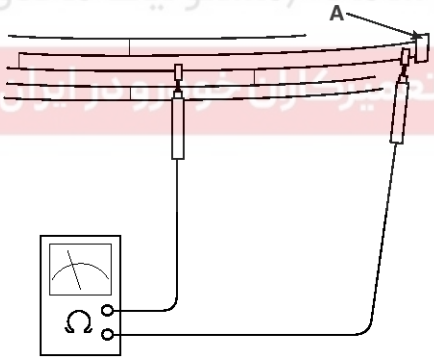
Glass Antenna Test

1. Wrap aluminum foil (A) around the tip of the tester probe (B) as shown.



ETKD003A

2. Touch one tester probe to the glass antenna terminal (A) hear, and move the other tester probe along the antenna wires to check that continuity exists.



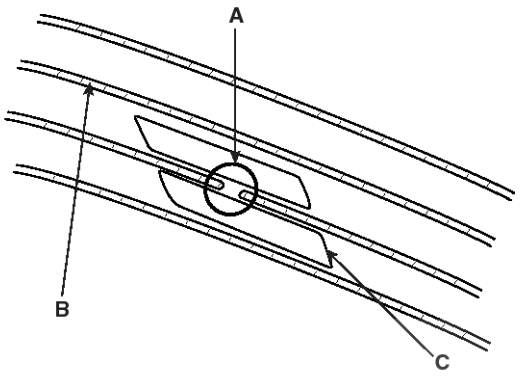
ETKD004A

Glass Antenna Repair

NOTICE

To make an effective repair, the broken section must be no longer than one inch.

1. Lightly rub the area around the broken section (A) with fine steel wool, and then clean it with alcohol.

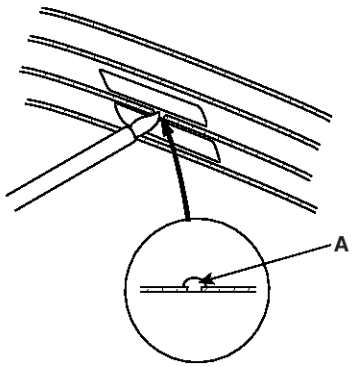


ETKD004K

2. Carefully mask above and below the broken portion of the glass antenna wire (B) with cellophane tape (C).
3. Using a small brush, apply a heavy coat of silver conductive paint (A) extending about 1/8″on both sides of the break. Allow 30 minutes to dry.

NOTICE

Thoroughly mix the paint before use.

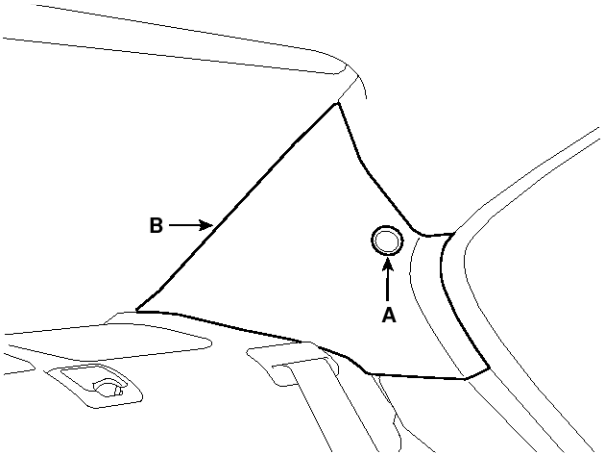


ETKD006Z

4. Check for continuity in the repaired wire.
5. Apply a second coat of paint in the same way. Let it dry three hours before removing the tape.

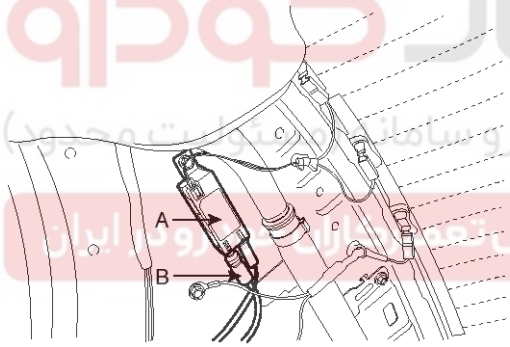
Glass Antenna Circuit Inspection

1. Remove the rear pillar trim (B) after removing the cap (A).

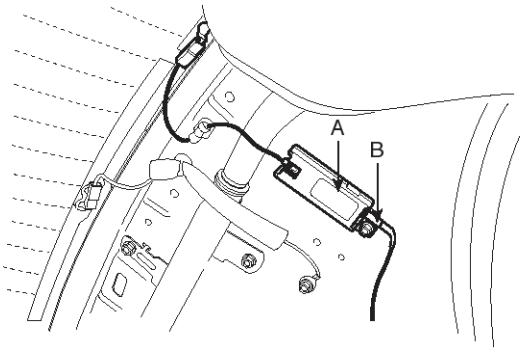


SGHBE9033N

2. Disconnect the antenna feeder cable (B) and connector from the glass antenna amplifier (A).



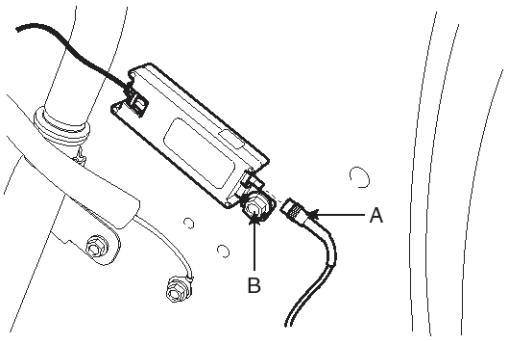
SGHBE9014N



SGHBE9015N

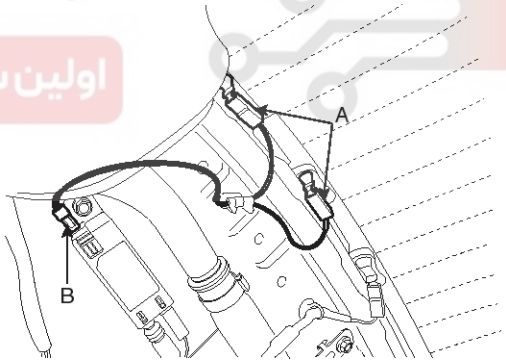
3. Turn the radio ON.
4. Measure the voltage between the antenna feeder cable (A) and body ground (B).

OK : approximately 12V (ACC+)

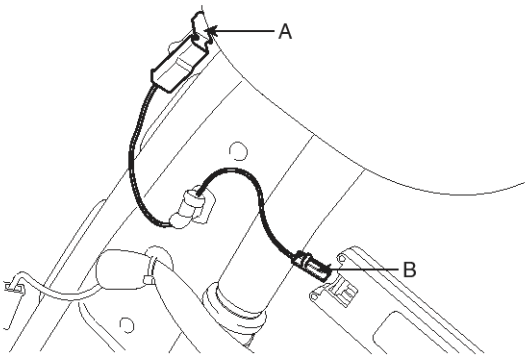


SGHBE9008N

5. Disconnect the connector of radio wiring from the glass antenna amplifier.
6. Check the continuity between terminals of harness side connector (B) and antenna grid AM/FM terminals (A).



SGHBE9009N



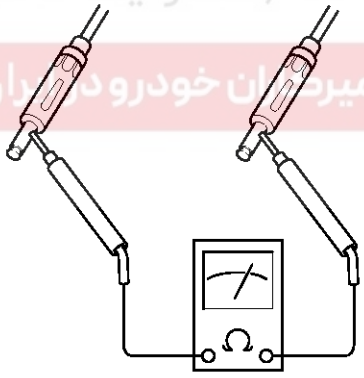
SGHBE9010N

7. Check the grid lines that continuity exists.
8. When a poor radio reception is not repairing through the above inspection methods, replace the amplifier.

   If the radio reception is still poor, check the radio cable for short and radio head unit for failure.

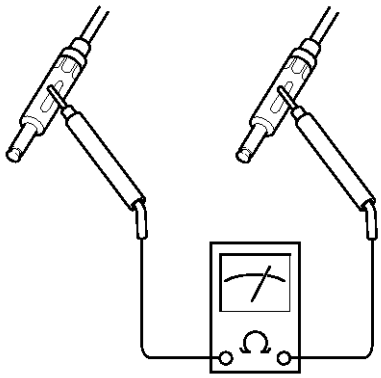
Antenna Cable

1. Remove the antenna jack from the audio unit and antenna.
2. Check for continuity between the center poles of antenna cable.



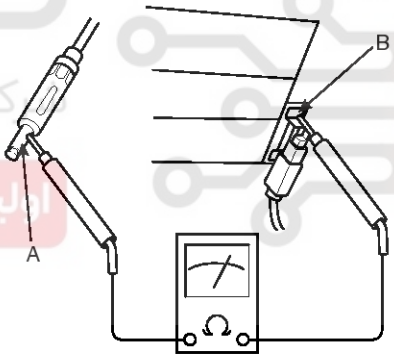
ATJF023C

3. Check for continuity between the outer poles of antenna cable. There should be continuity.



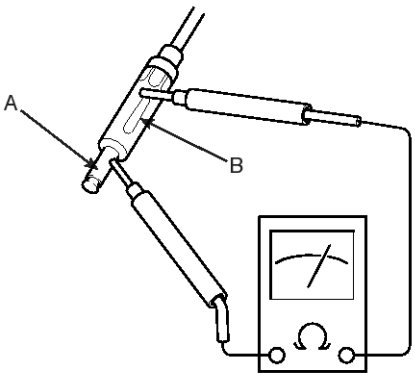
ATJF023D

4. If there is no continuity, replace the antenna cable.
5. Check for continuity between the center pole of antenna cable and terminal of glass antenna. There should be continuity.



ATJF023E

6. If there is no continuity, replace the antenna amplifier.
7. Check for continuity between the center pole (A) and outer pole (B) of antenna cable. There should be no continuity.



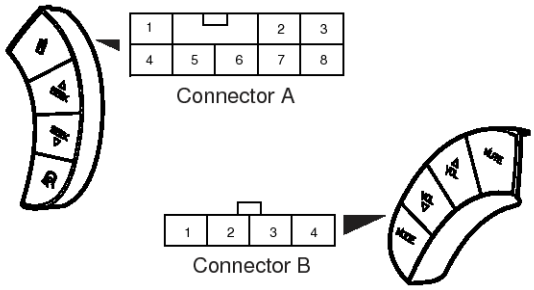
ATJF023F

8. If there is continuity, replace the antenna cable.

Audio Remote control

Inspection

1. Check for resistance between No.2 and No.3 terminals in each switch position.



SGHBE9032N

Connector A

Switch	Connector terminal	Resistance (±5%)
Call	4 - 5	3.11 kΩ
Center	4 - 5	2.11 kΩ
Seek Down	2 - 3	1.11 kΩ
Seek Up	2 - 3	430 Ω

Connector B

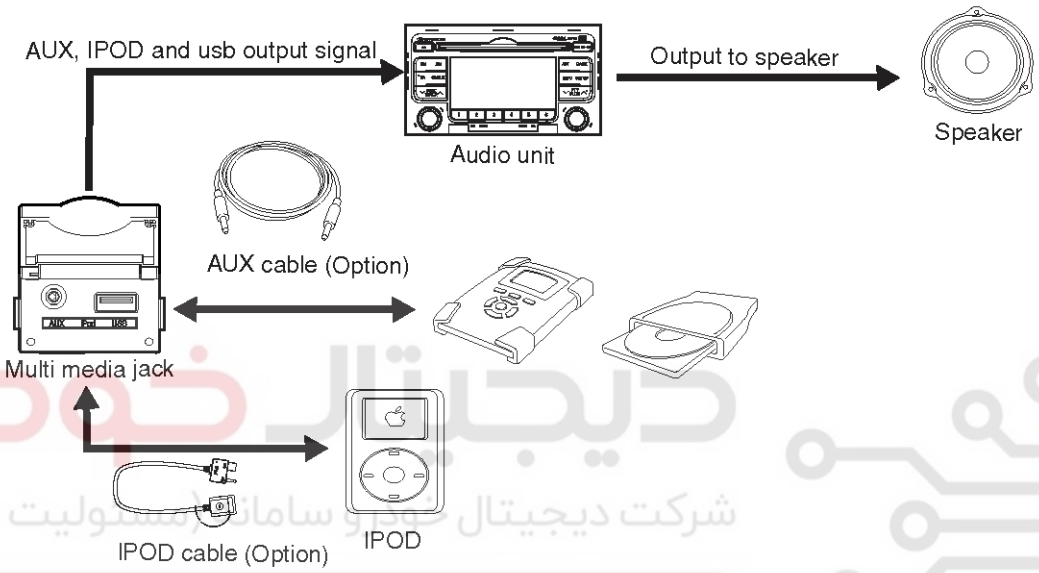
Switch	Connector terminal	Resistance (±5%)
Mode	1 - 2	2.11 kΩ
Mute	1 - 2	3.11 kΩ
VOL. Up	1 - 2	4.61
VOL. Down	1 - 2	6.81

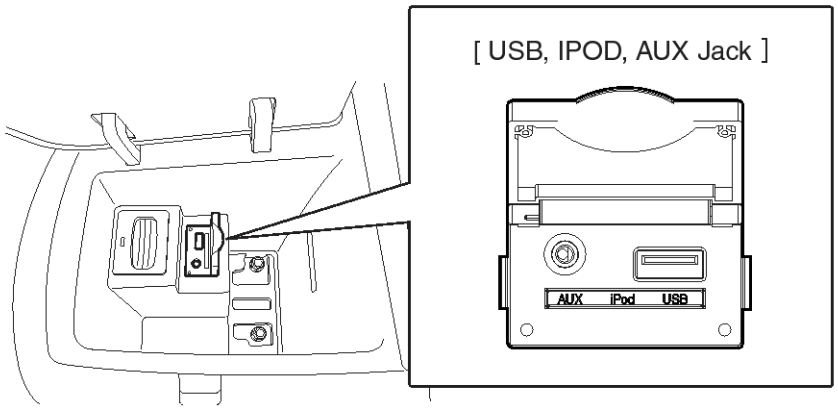
Multimedia jack

Description

The AUX, IPOD and USB JACK on the center console is for customers who like to listen to external portable music players like the MP3, iPOD, USB memory stick, CD player and etc., through the vehicle's sound system when it is linked to this jack. The customer has this added option.

If the audio distortion is present, check the volume settings on the device connected to the AUX jack.

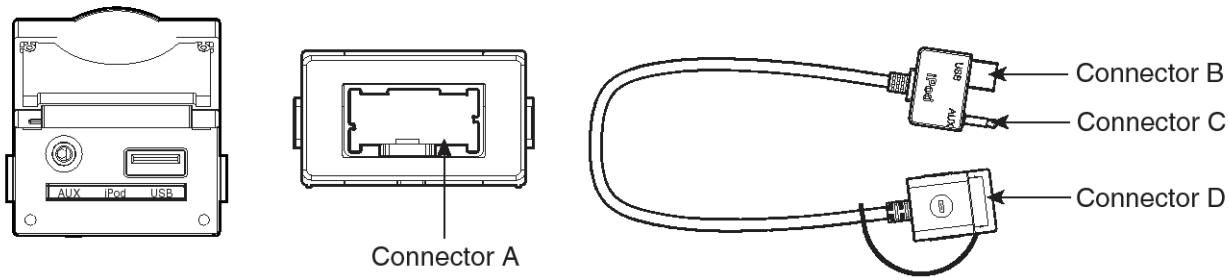


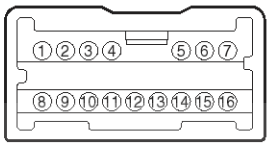
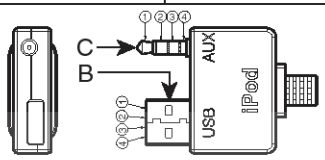
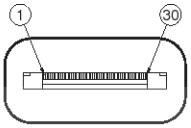


SGHBE9011N

Components

[AUX, USB, IPOD] [Jack Connector] [IPOD Cable]

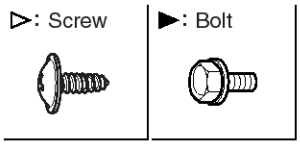


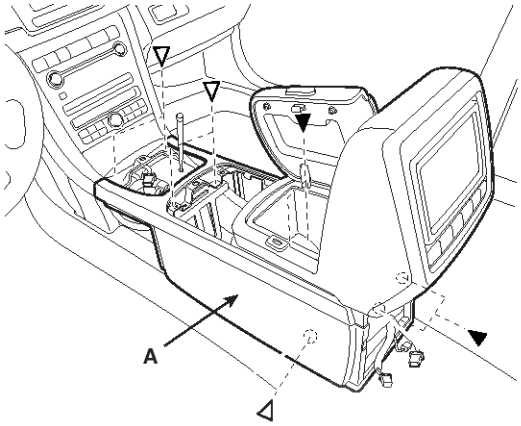
Name	Multi-media Jack Connector A (USB/AUX/IPOD)	USB Connector B	AUX Connector C	IPOD Connector D
Connector				
1	USB/IPOD 5V	USB/IPOD 5V	AUX1 L IN	-
2	USB D-/ IPOD TX	USB D-/IPOD TX	AUX1 R IN	-
3	USB D+/ IPOD RX	USB D+/ IPOD RX	-	-
4	USB/ IPOD GND	USB/IPOD GND	AUX1 GND	D+
5	-			-
6	AUX1 REF			D-
7	AUX1 L IN			-
8	ILL+			5V
9	USB shield			-
10	-			ACC ID
11	Multi media ground			-
12	Video IN			-
13	Video GND			-
14	AUX DET			-
15	AUX shield GND			GND
16	AUX1 R IN			GND
17				-
18				RX
19				TX
20				GND
21				-
22				-
23				-
24				-
25				-
26				-
27				AUX1 L IN
28				AUX1 R IN
29				Audio REF
30				Signal wire GND

SGHBE9012N

Removal

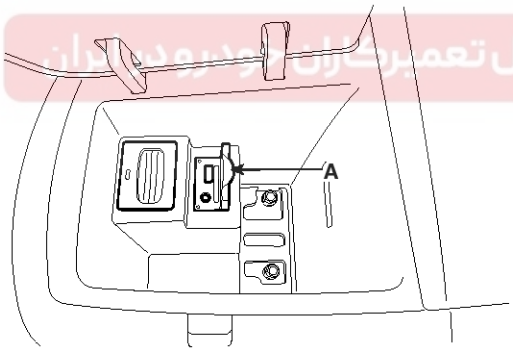
1. Remove the floor console (A). (Refer to BD group - "Console")





SGHBE9013N

2. Disconnect the connector from the floor console.
3. Remove the multi media jack (A) from the floor console.



SGHBE9021D

Installation

1. Install the Multi media jack.
2. Reconnect the connector
3. Install the floor console.

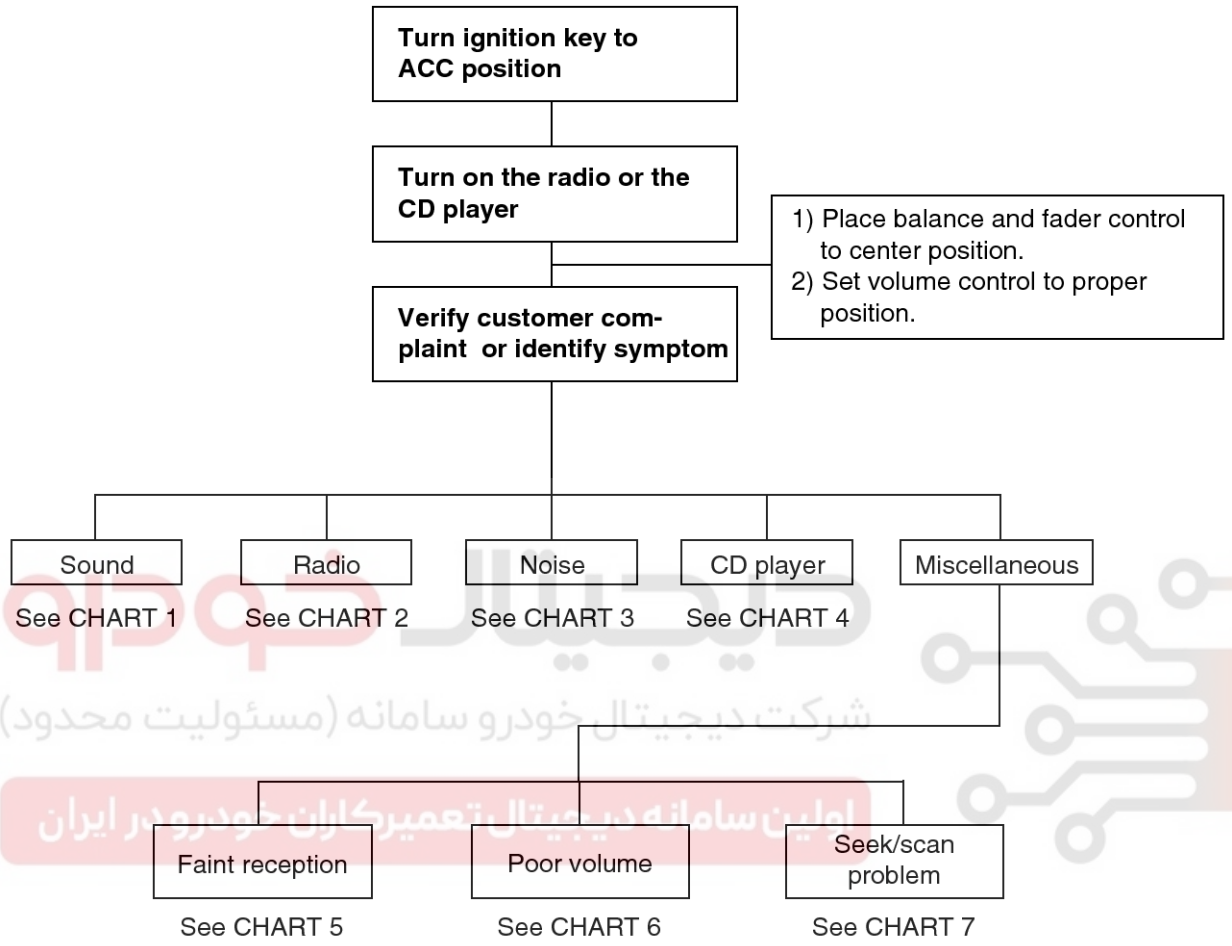
Troubleshooting

Customer Complaint Analysis Check Sheet

TROUBLE IN	☐ ALL ☐ AM ☐ FM ☐ CD ☐ MP3 ☐ CD changer ☐ AMP ☐ Others
TROUBLE OCCURS	☐ Always ☐ Engine start ☐ Engine Running ☐ Cold ☐ Warm ☐ Sometimes ☐ Most of the time ☐ Engine off
TYPE OF TROUBLE	☐ Will not play ☐ Weak ☐ Squealing noise ☐ Display/illumination poor ☐ CD skips & jumps ☐ CD will not eject or insert ☐ Others (Describe) :
OTHERS	▶ Customer complaint contents : ▶ Have you checked customer's defects :
* Using the customer complaint analysis check sheet for reference, ask the customer for as much detail as possible about the problem.	

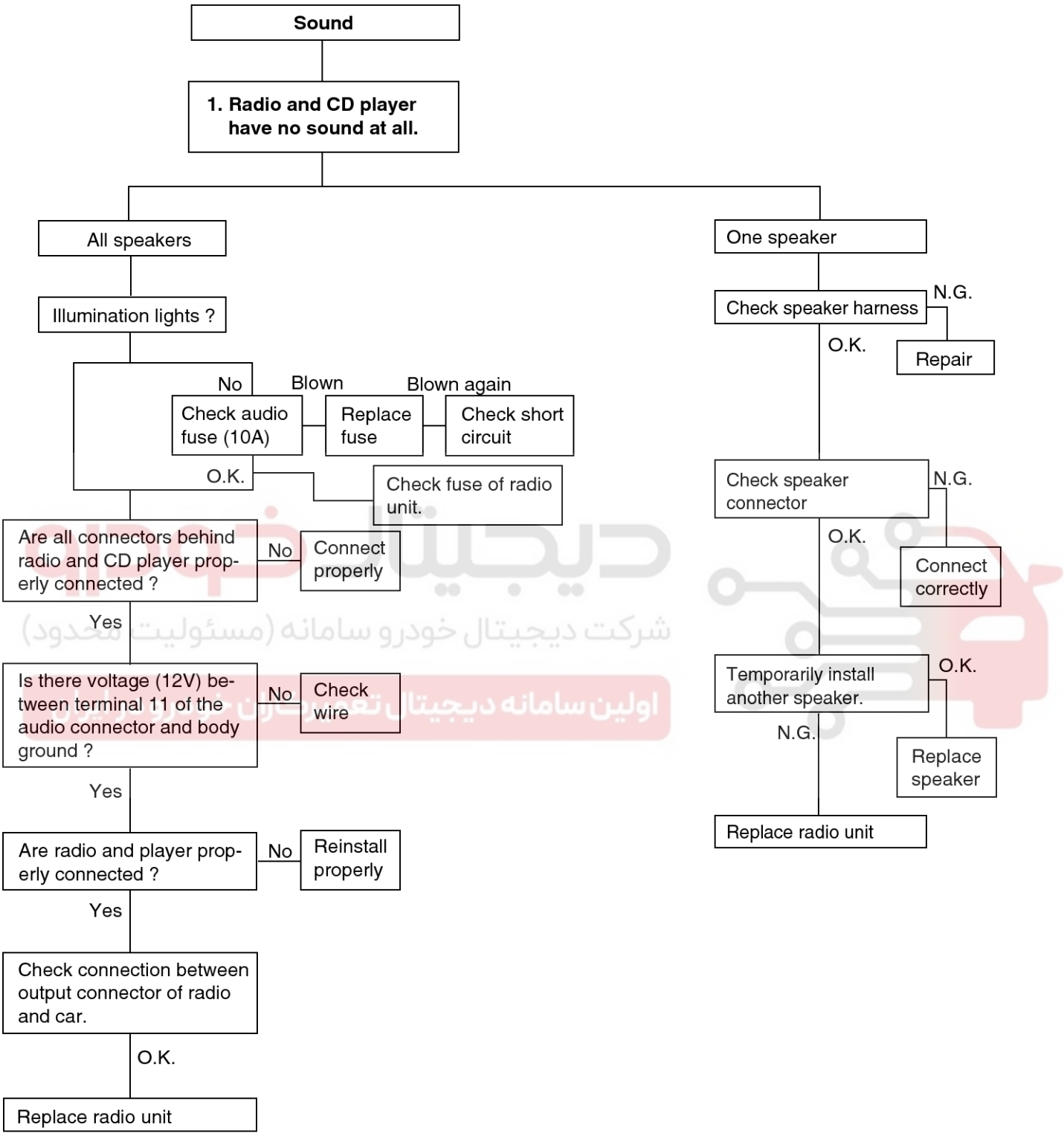
STGBE9041N

There are six areas where a problem can occur: wiring harness, the radio, the CD player, and speaker. Troubleshooting enables you to confine the problem to a particular area.

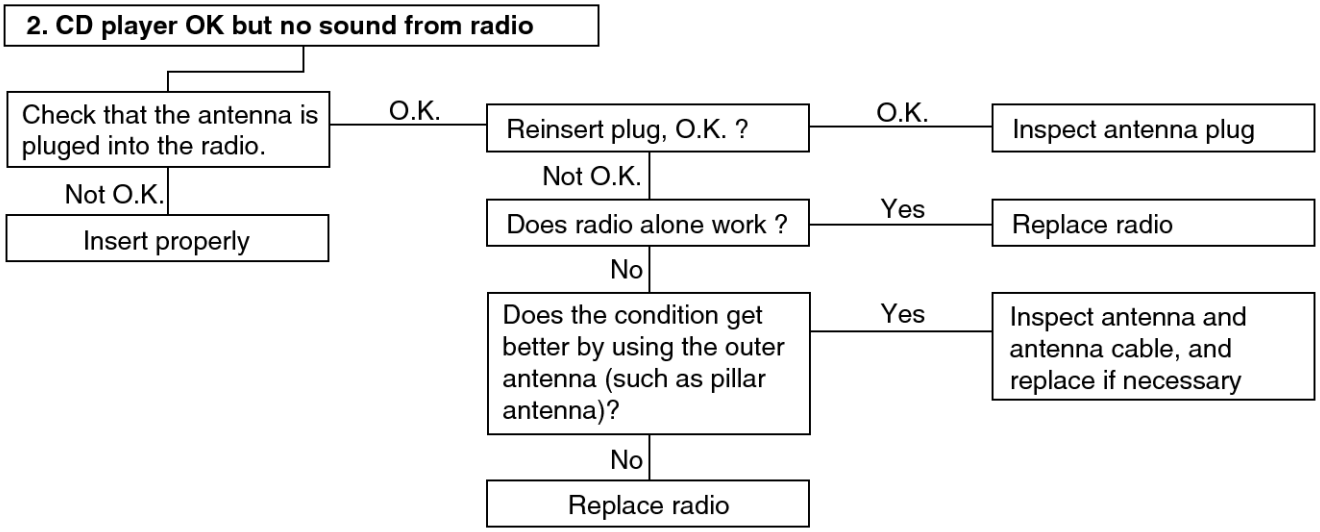


SENBE7047L

Chart 1

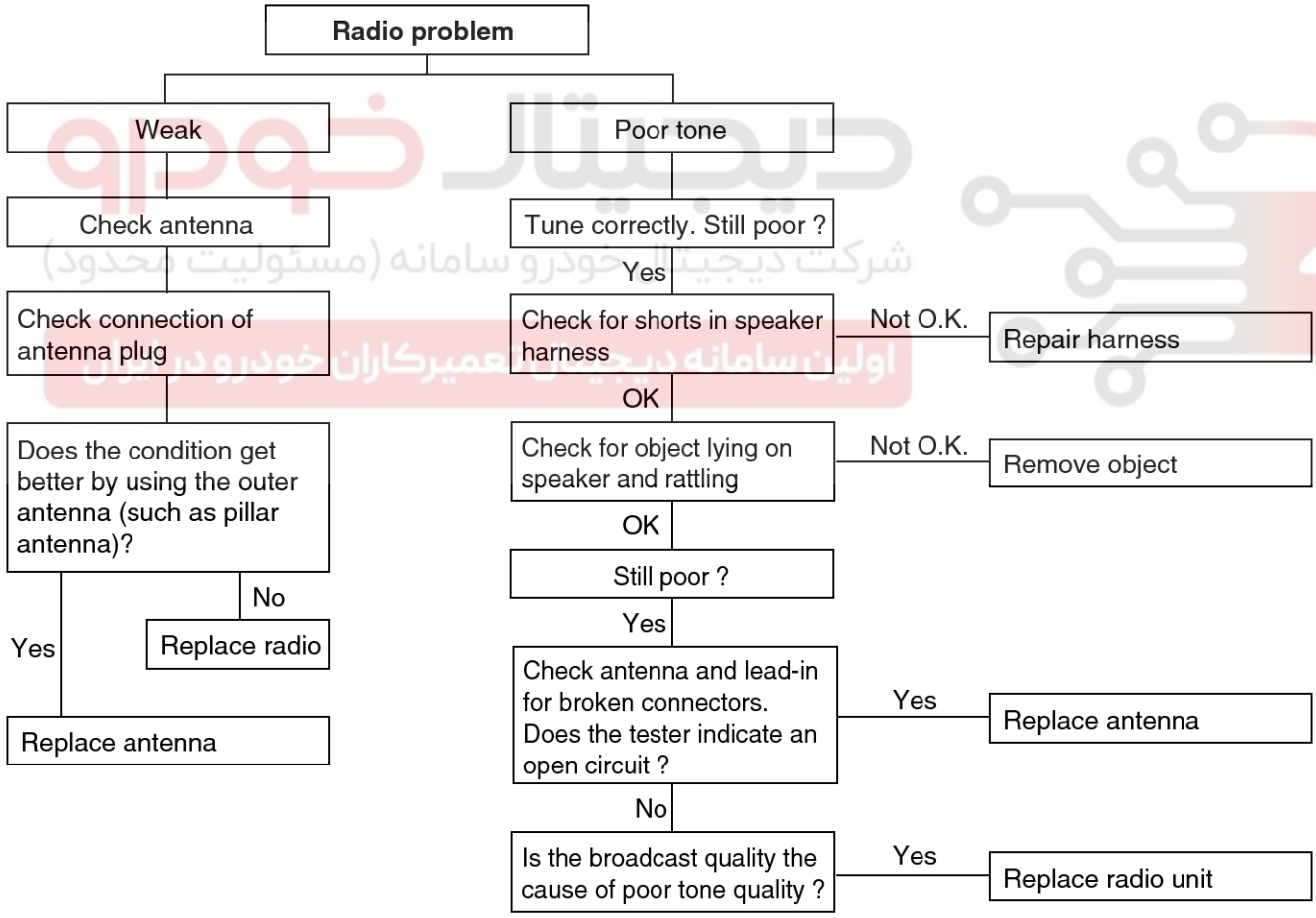


SENBE7048L



SGHBE9009L

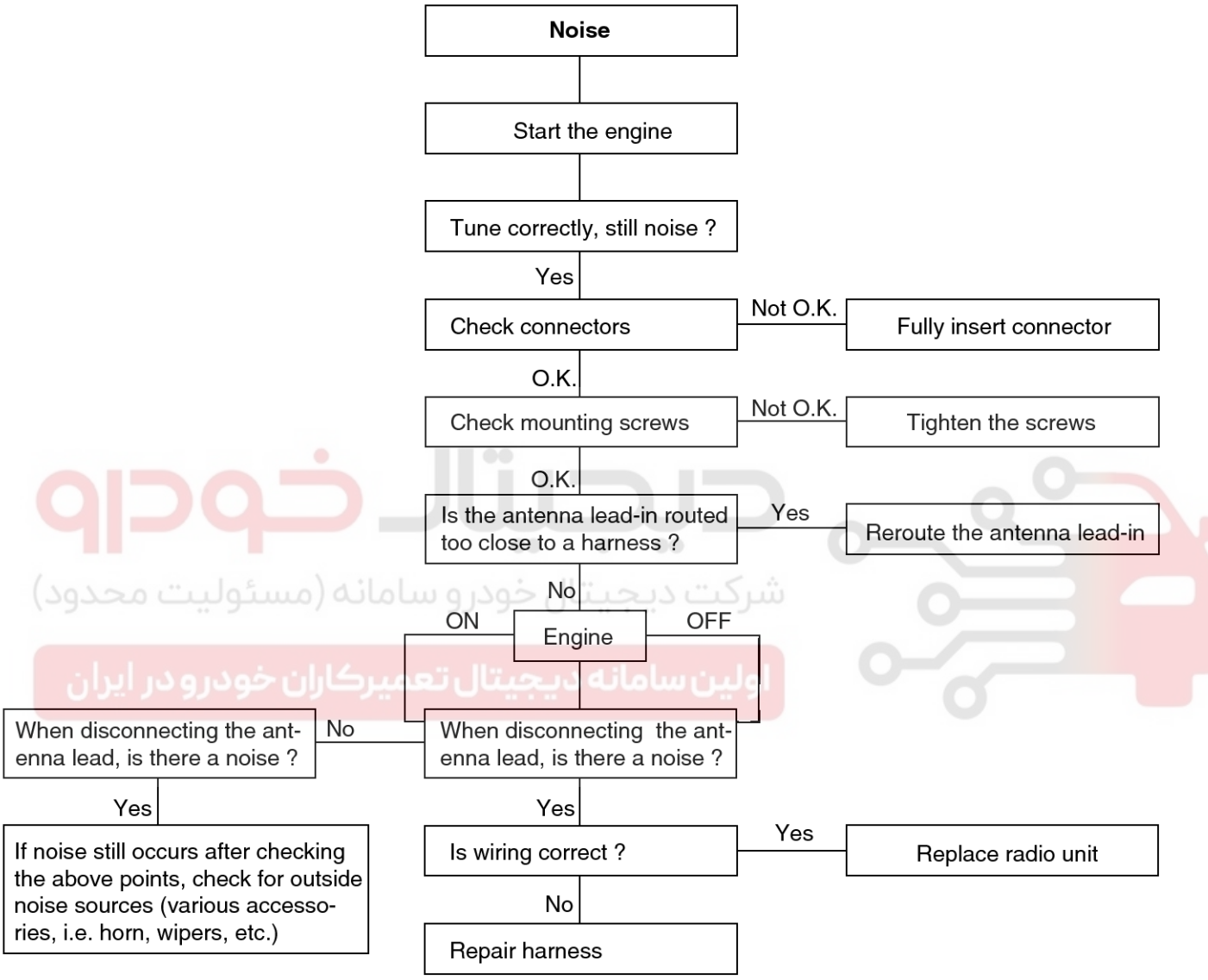
Chart 2



LTIF001D

Chart 3

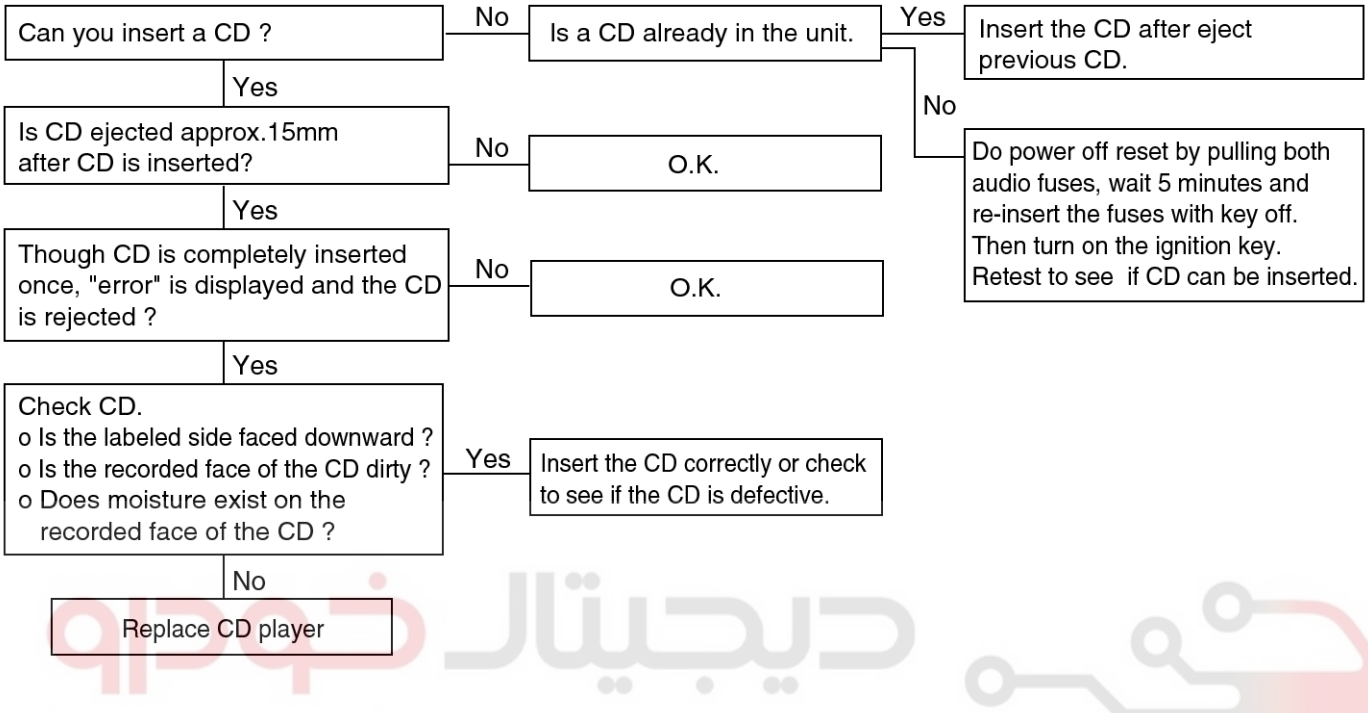
1. RADIO



LTIF001F

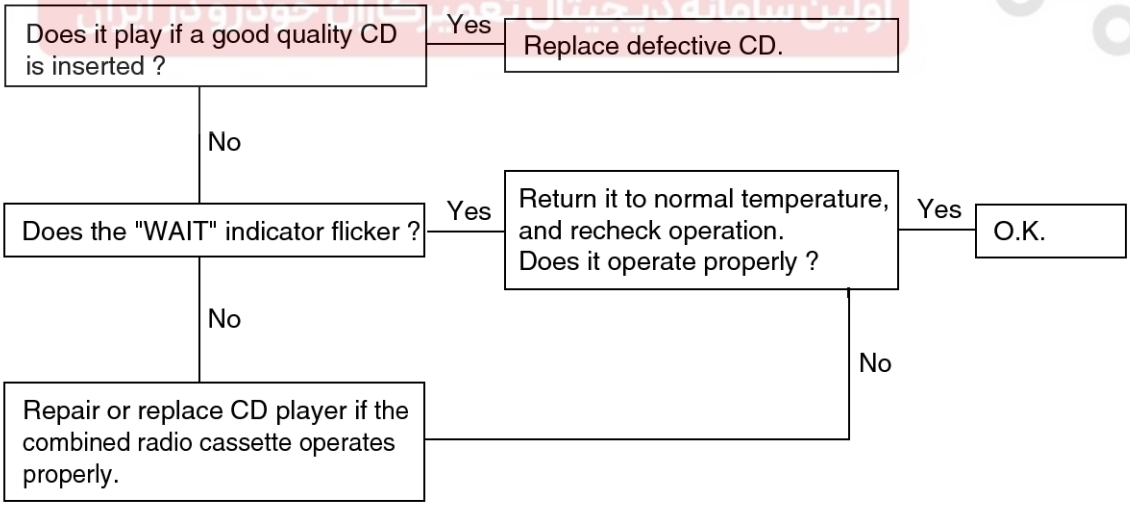
Chart 4

1. CD WILL NOT BE ACCEPTED



LTIF001H

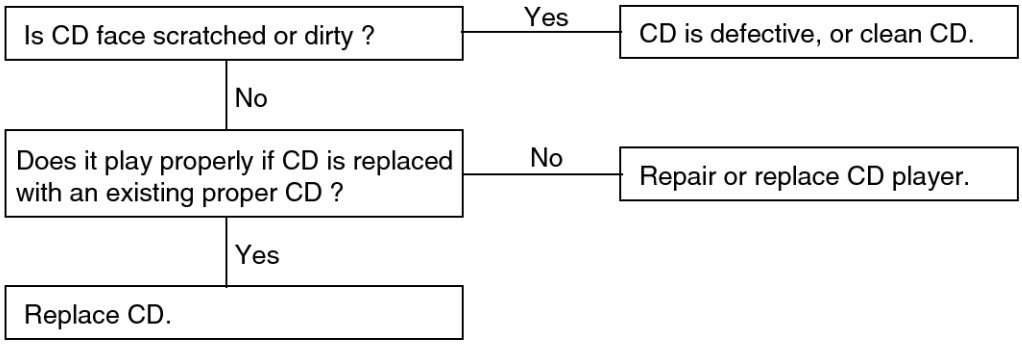
2. NO SOUND



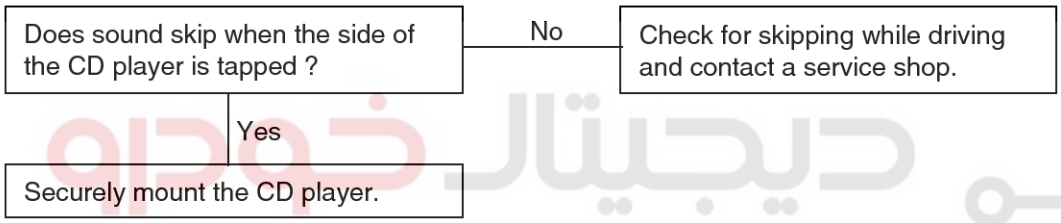
LTIF001I

3. CD SOUND SKIPS

1) Sound sometimes skips when parking.

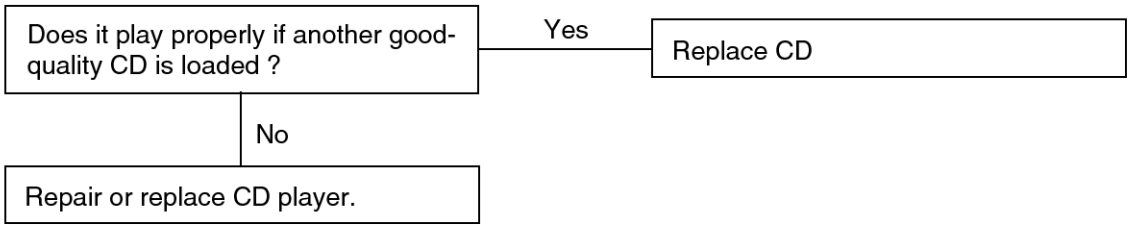


2) Sound sometimes skips when driving.
(Stop vehicle, and check it.)
(Check by using a CD which is free of scratches, dirt or other damage.)

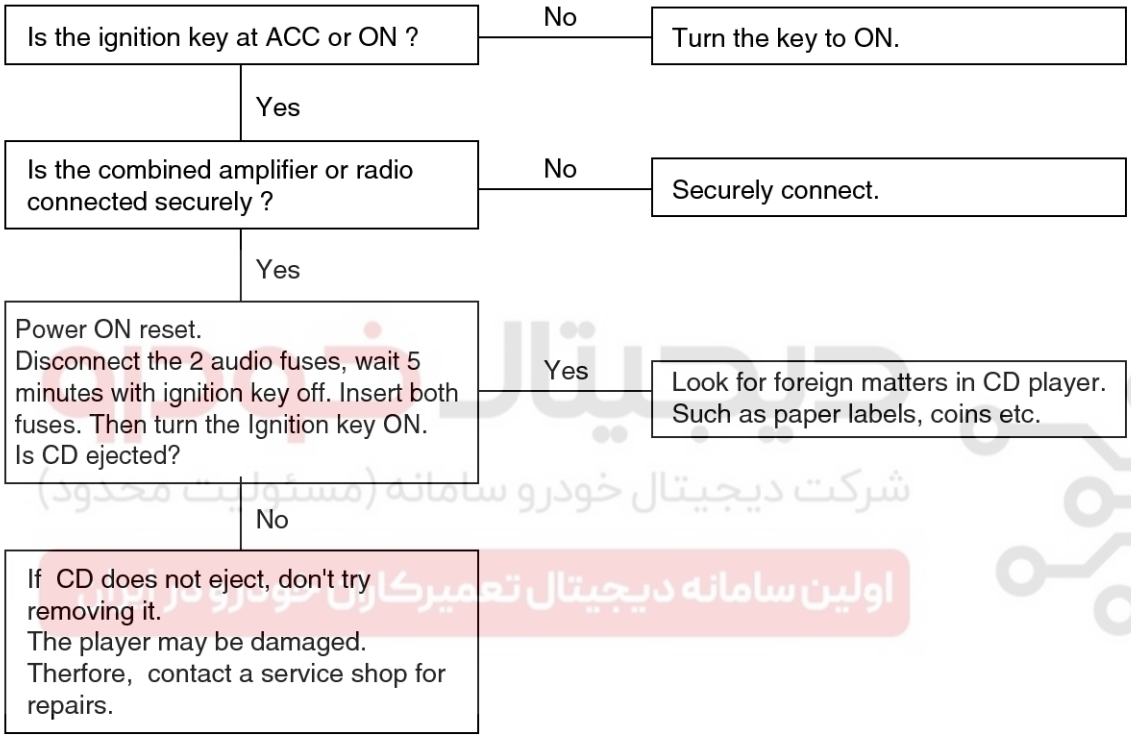


LTIF001J

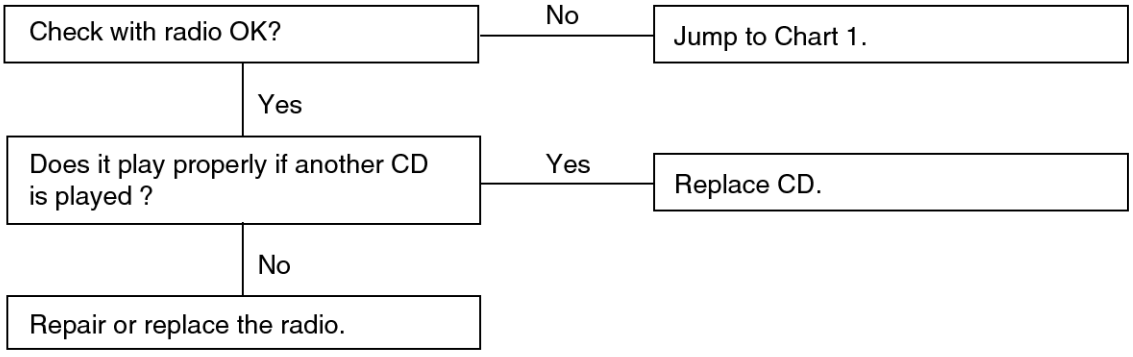
4. SOUND QUALITY IS POOR



5. CD WILL NOT EJECT

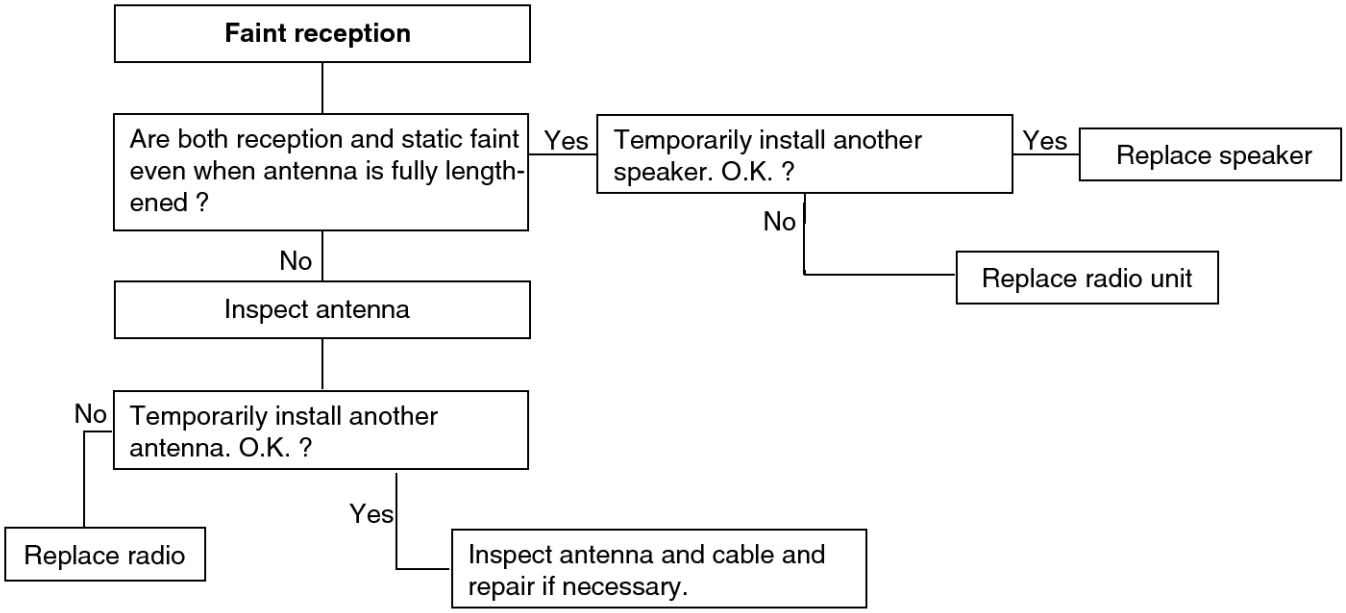


6. NO SOUND FROM ONE SPEAKER



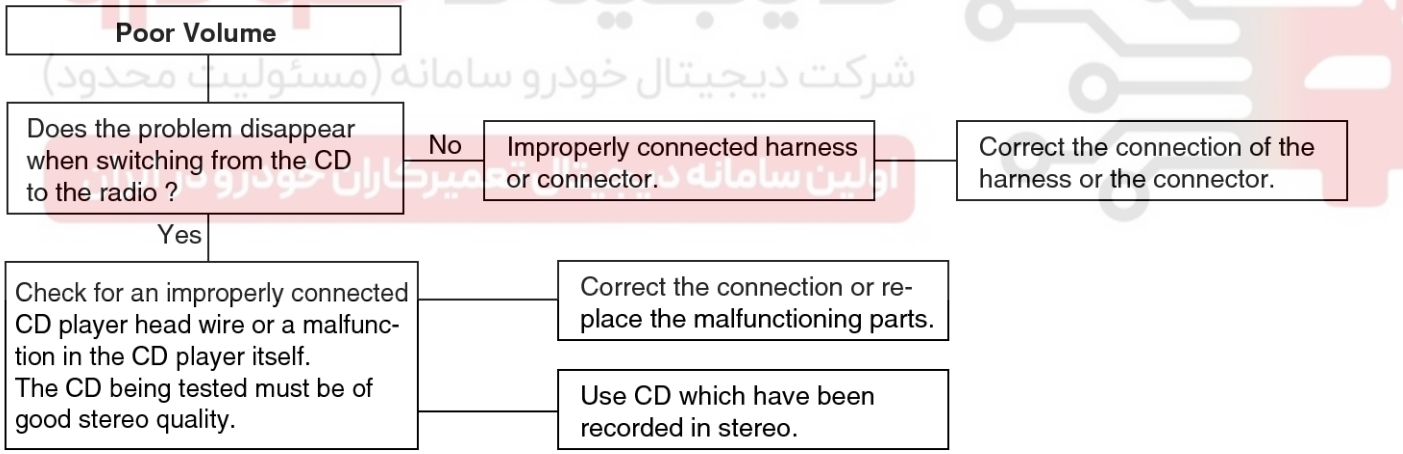
LTIF001K

Chart 5



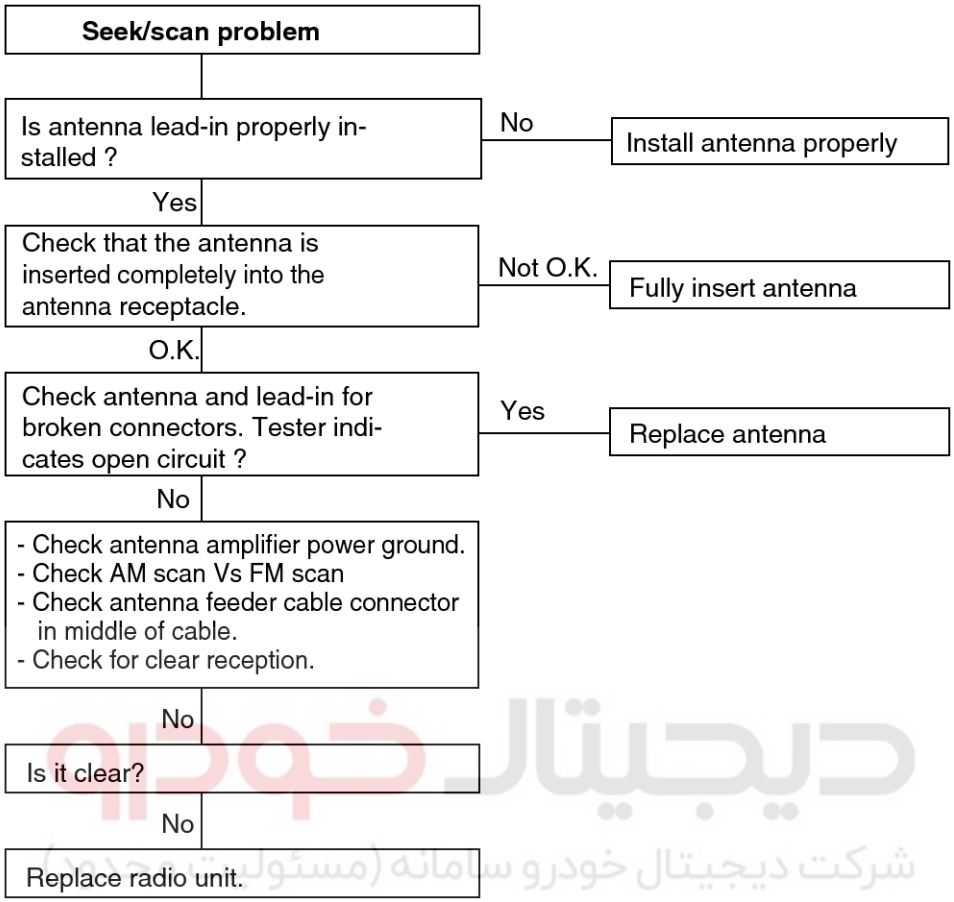
LTIF001L

Chart 6



SENBE7039L

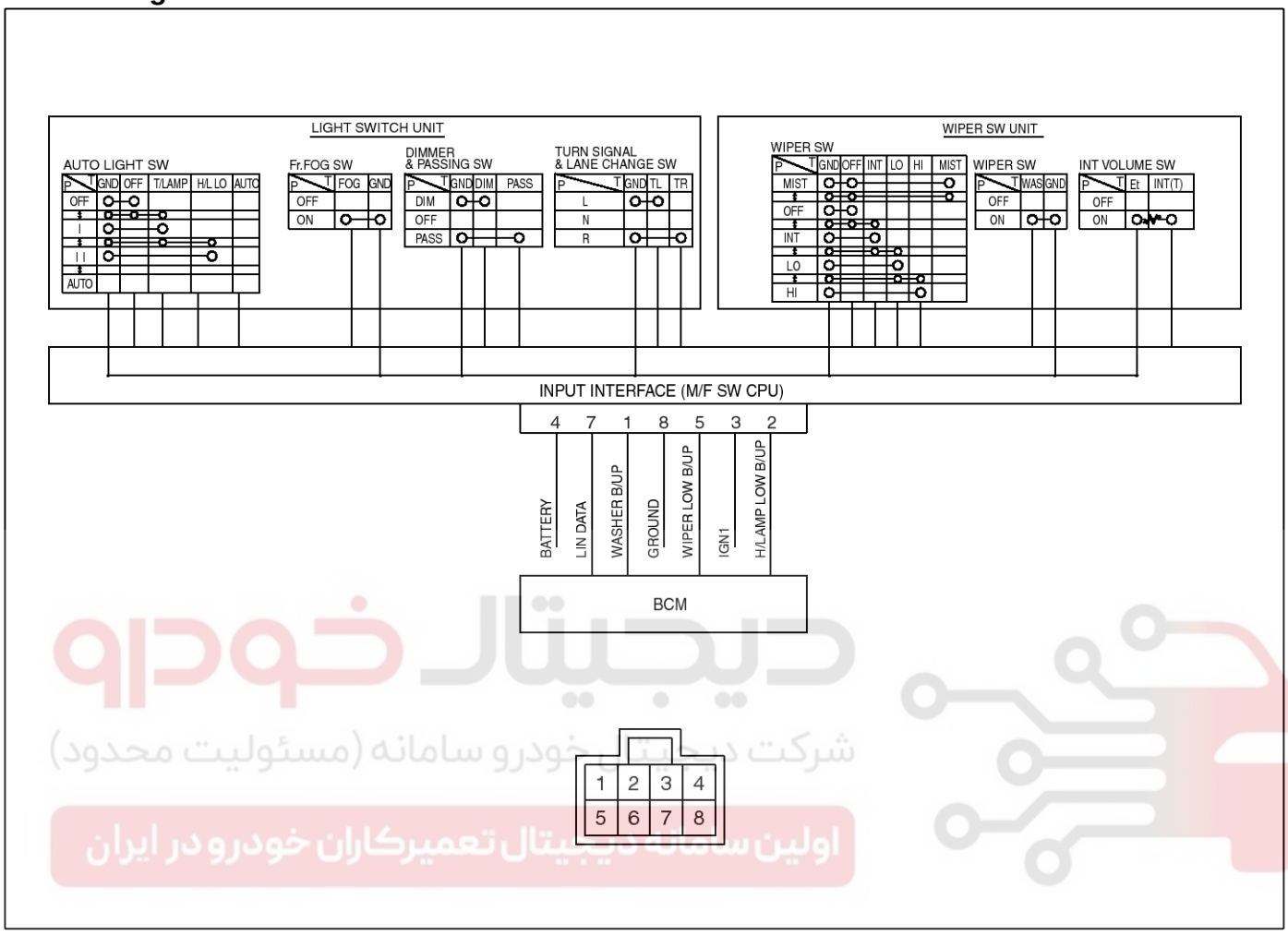
Chart 7



LTIF001N

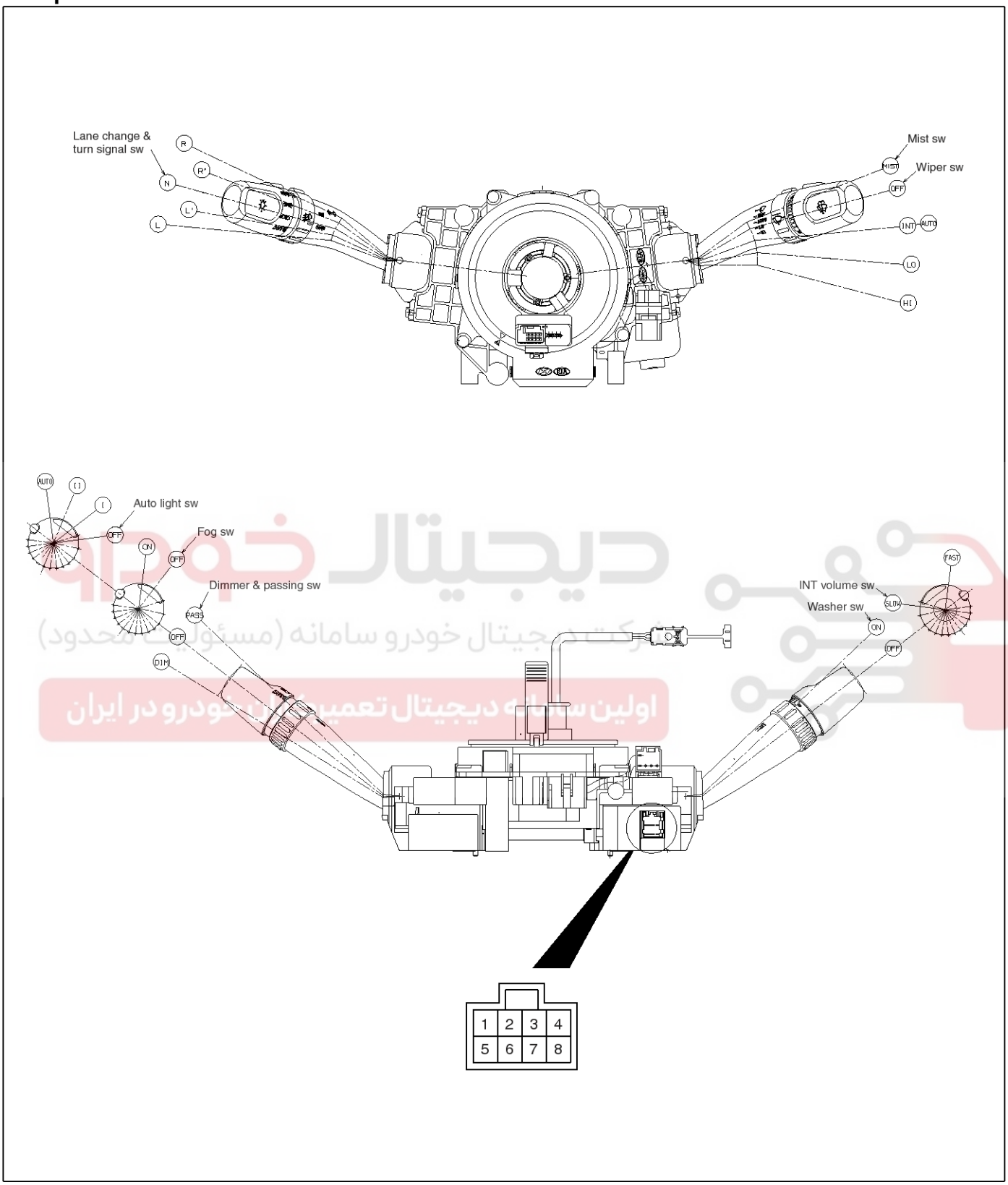
Multifunction switch

Circuit diagram



ATCD011A

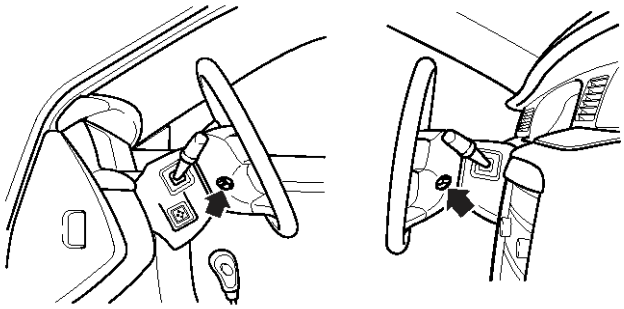
Component



ATCD009A

Removal and installation

1. Disconnect the negative battery terminal from the battery.
2. Remove the airbag module.



APCD007A

WARNING

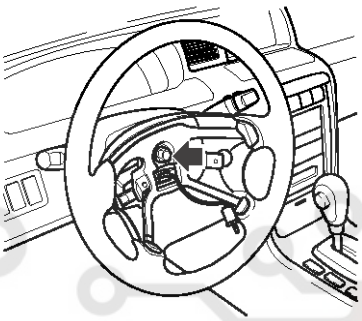
The SRS is designed to retain enough power to deploy the air bag for about 30 seconds even after the battery has been disconnected, so serious injury may result from unintended air bag deployment if service is done on the SRS immediately after the battery cable is disconnected.

- Never attempt to disassemble or repair the air bag module or clock spring. If faulty, replace it.
- Do not drop the air bag module or clock spring or allow contact with water, grease or oil. Replace if a dent, crack, deformation or rust is detected.
- The air bag module should be stored on a flat surface and placed so that the pad surface is facing upward. Do not place anything on top of it.
- Do not expose the air bag module to temperatures over 93℃(200˚F).
- After deployment of an air bag, replace the clock spring with a new one.
- Wear gloves and safety glasses when handing an air bag that has been deployed.
- An undeployed air bag module should only be disposed of in accordance with the procedures mentioned in the restraints section.
- When you disconnect the air bag module-clock spring connector, take care not to apply excessive force.
- The removed air bag module should be stored in a clean, dry place.
- Prior to installing the clock spring, align the mating mark and "NEUTRAL" position indicator of the clock spring, and after turning the front wheels to the straight-ahead position, install the clock spring to the column switch. If the mating mark of the clock spring is not properly aligned, the steering wheel may not completely rotate during a turn, or the flat cable within the clock spring may be broken obstructing normal operation of the SRS and possibly leading to serious injury to the vehicle's driver. To inspect the clock spring, refer to the restraints section.

3. Remove the steering wheel lock nut and washer.
4. Mark the steering column shaft and steering wheel for fitting positions used for re-installation using the special tool. Remove the steering wheel.

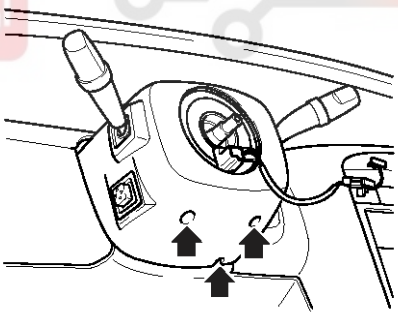
NOTICE

Do not use a hammer on the steering wheel to remove it.



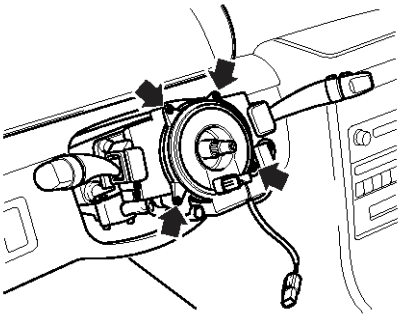
APCD007B

5. Remove the steering column lower and upper shroud.



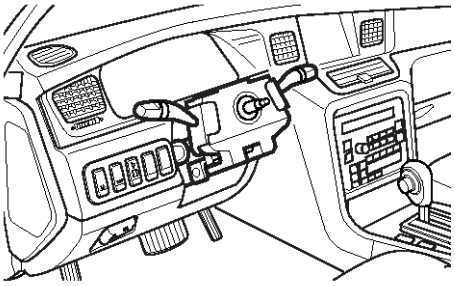
APCD007C

6. Remove the clock spring.



APCD007D

7. Disconnect the connectors and remove the multi-function switch.



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8. Installation is the reverse of removal.

Inspection

Check the continuity between the terminals while operating the switch.

Position \ Terminal	1	2	5	8
Head lamp (LOW)		○		○
Wiper (LOW)			○	○
Washer	○			○

LTCD011B

NOTICE

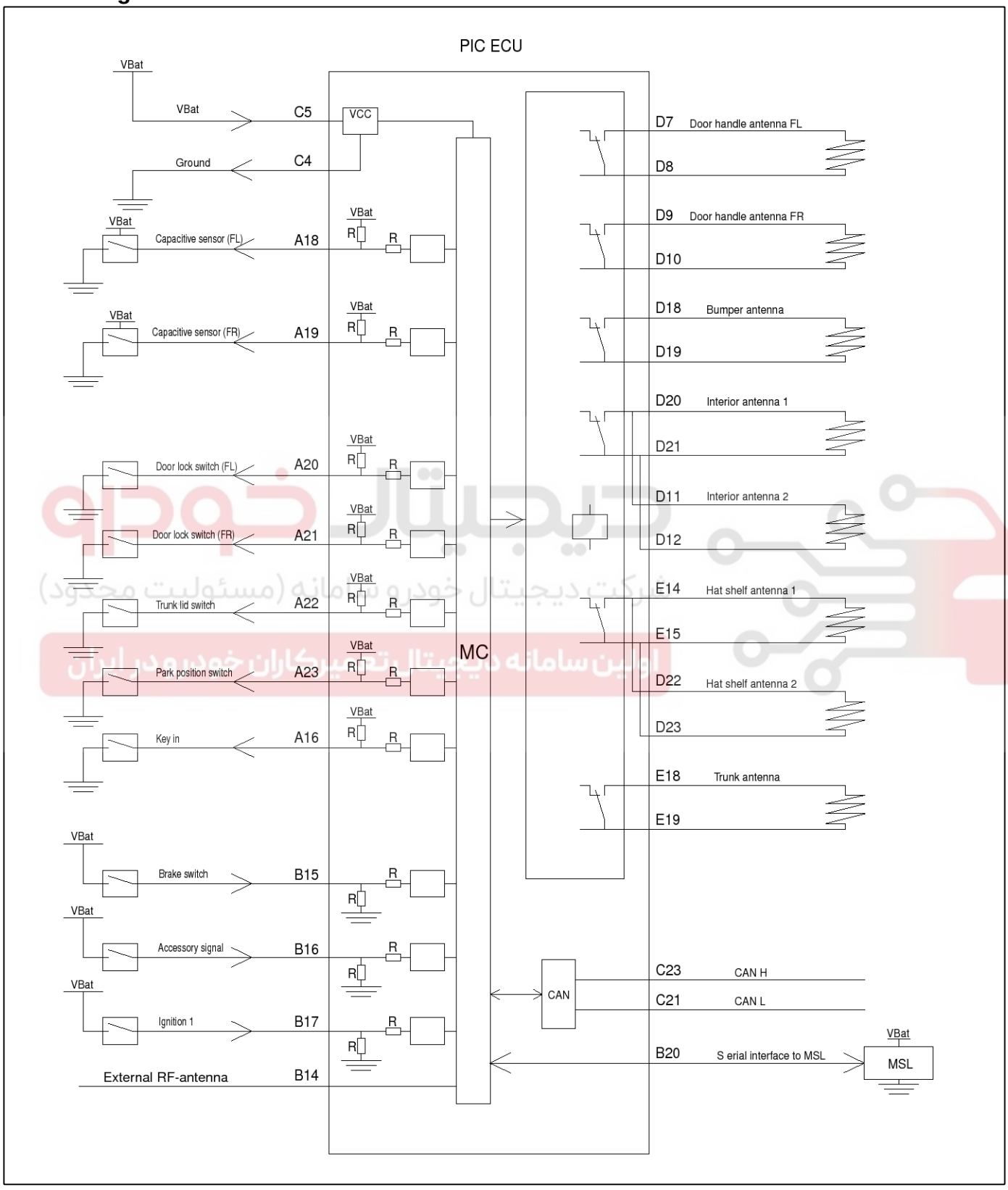
The others function is operated by LIN communication, so test them by using the Hi-Scan.

Specifications

Items	Specifications
Rated Voltage	DC 12V
Operating temperature range	-30℃- +80℃ (-22 - +176°F)
Rated load	
Lighting switch (Low beam)	0.5A (Relay load)
Wiper switch (Low speed)	0.5A (Relay load)
Washer switch	0.5A (Relay load)

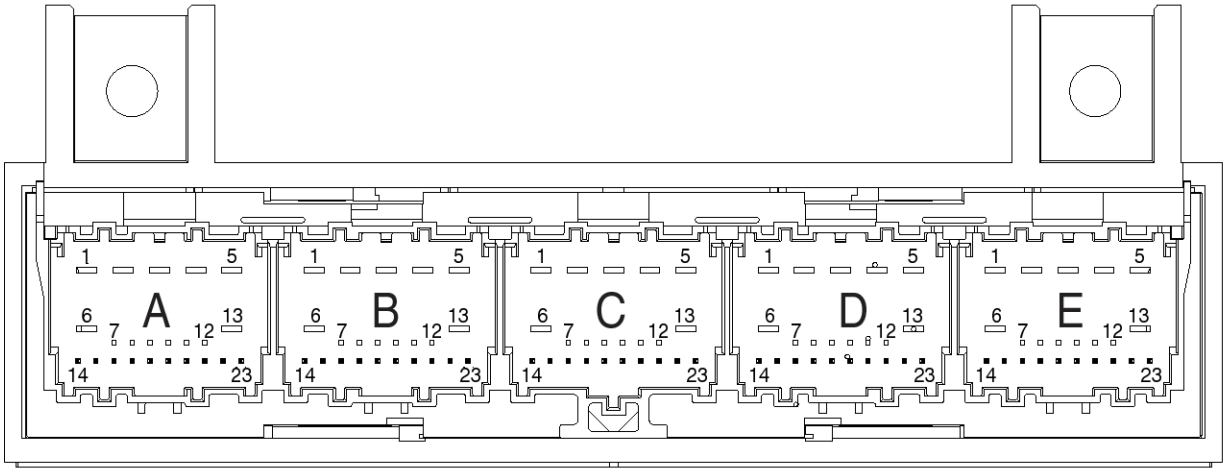
Smart key System

Circuit diagram



LTCD372A

Connector configurations



	PIN NR.	Description		PIN NR.	Description		PIN NR.	Description		PIN NR.	Description	ICAVITY	PIN NR.	Description
A	1	NC	B	1	NC	C	1	NC	D	1	NC	E	1	NC
	2	NC		2	NC		2	NC		2	NC		2	NC
	3	NC		3	NC		3	NC		3	NC		3	NC
	4	NC		4	NC		4	Ground		4	NC		4	NC
	5	NC		5	NC		5	Battery		5	NC		5	NC
	6	NC		6	NC		6	NC		6	NC		6	NC
	7	NC		7	NC		7	NC		7	Door handle antenna FL		7	NC
	8	NC		8	NC		8	NC		8	Door handle antenna FL		8	NC
	9	NC		9	NC		9	NC		9	Door handle antenna FR		9	NC
	10	NC		10	NC		10	NC		10	Door handle antenna FR		10	NC
	11	NC		11	NC		11	NC		11	Interior antenna 2		11	NC
	12	NC		12	NC		12	NC		12	Interior antenna 2		12	NC
	13	NC		13	NC		13	NC		13	NC		13	NC
	14	NC		14	Serial Interface To Ext.RX		14	NC		14	NC		14	Hat shelf antenna 1
	15	NC		15	Brake switch		15	NC		15	NC		15	Hat shelf antenna 1
	16	Key in detect		16	Accessory signal		16	NC		16	NC		16	NC
	17	NC		17	Ignition1		17	NC		17	NC		17	NC
	18	State of capacitive sensor FL		18	NC		18	NC		18	Bumper antenna		18	Trunk antenna
	19	State of capacitive sensor FR		19	NC		19	NC		19	Bumper antenna		19	Trunk antenna
	20	Door lock switch FL		20	Serial Interface To MSL		20	NC		20	Interior antenna 1		20	NC
	21	Door lock switch FR		21	NC		21	CAN L		21	Interior antenna 1		21	NC
	22	Trunk unlock button (Trunk Lid)		22	NC		22	NC		22	Hat shelf antenna 2		22	NC
	23	Park position		23	NC		23	CAN H		23	Hat shelf antenna 2		23	NC

LTCD372B

Description

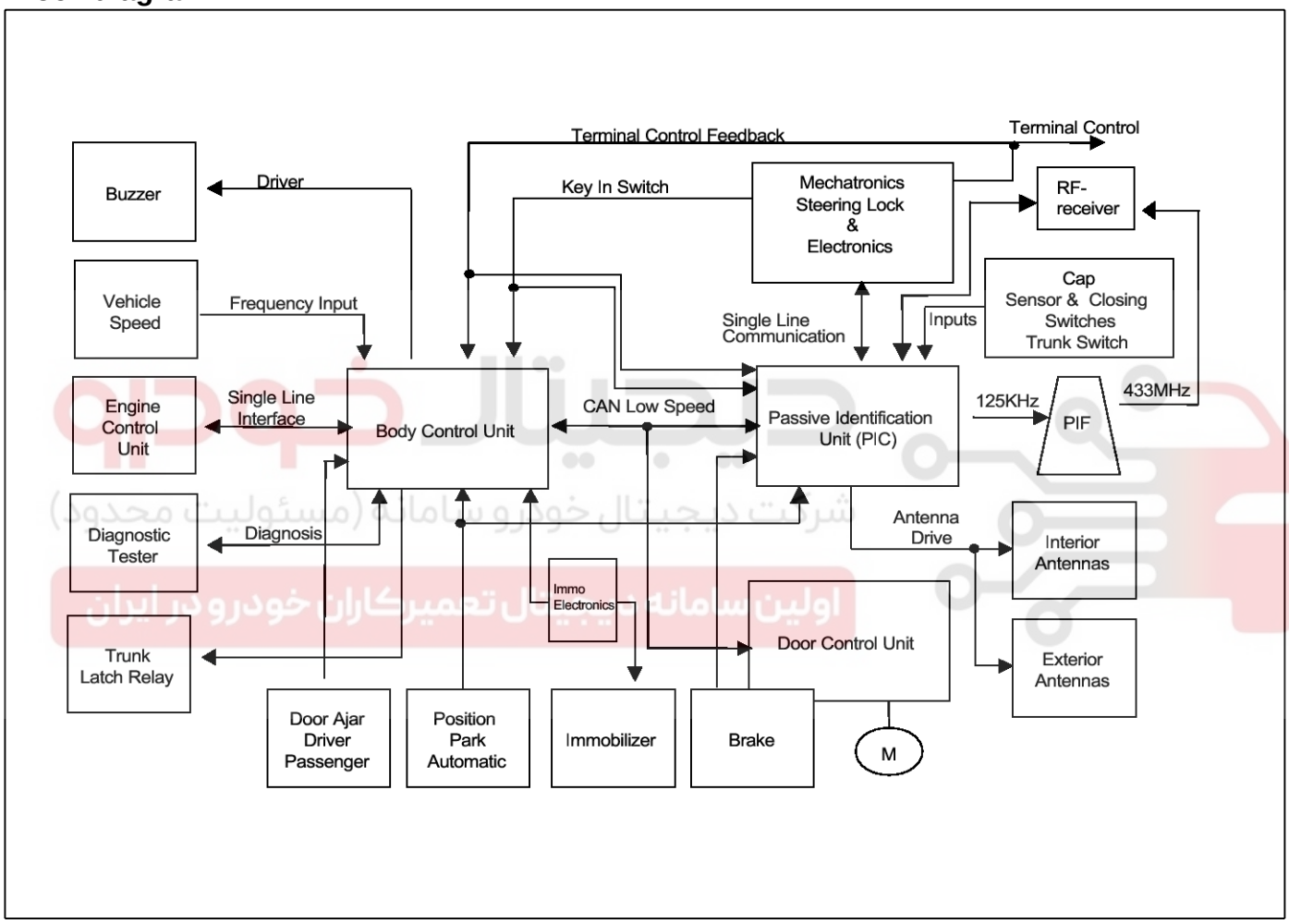
A system allows the user to access and operate a vehicle in a very convenient way. To access the vehicle no traditional key or remote control unit is needed.

The user carries a PIC FOB which itself does not require any conscious actions by the user (e.g. operate a button). The PIC system is triggered by activating a capacitive sensor integrated into the door handle.

After being triggered the vehicle sends out a request in a limited range. If the PIC FOB receives this request, it automatically sends a response to the vehicle. Then the system decides whether to perform a particular action (unlocking, locking…) or remain inactive.

In a similar manner the vehicle's Mechatronics Steering Lock (MSL) is released. Again, a communication between the vehicle and the PIC FOB is needed before any actions will be performed.

Block diagram



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General operation

Door unlock

1. A user who has a FOB approaches within radius 0.7~1m from out side handle and put the hand into the grip of the out sidehandle. The capacitive sensor captures this movement and the PIC-System is started.
2. The PIC ECU sends LF(125 KHz) signal to the FOB driven by ferrite core antenna, and the FOB sends RF 433 MHz) signal to the PIC ECU for authentication.
3. If the RF(433 MHz) signal of the FOB is approved, the PIC ECU will send door unlocking command via CAN (Controller Area Network) communication and realize unlocking of all the doors. The reaction time for door unlocking is within 220ms.

Door lock

1. Only when the steering lock is in the lock position, all doors are closed, a user who has a FOB is within radius 0.7~1m from out side handle and pushes lock button, the locking procedure of the PIC-System can be started.
2. The PIC ECU sends LF(125 KHz) signal to the FOB driven by ferrite core antenna, and the FOB sends RF(433 MHz) signal to the PIC ECU for authentication.
3. If the RF(433 MHz) signal of the FOB is approved, the PIC ECU will send central door locking command via CAN (ControllerArea Network) communication and realize locking of all the doors.

Trunk open

1. Only when all doors are locked, a user who has a FOB is within radius 0.7~1m from trunk handle switch and pushes trunk handle switch, the opening procedure of the PIC-System can be started.
2. The PIC ECU sends LF(125 KHz) signal to the FOB driven by ferrite core antenna, and the FOB sends RF(433 MHz) signal to the PIC ECU for authentication.
3. If the RF(433 MHz) signal of the FOB is approved, the PIC ECU will send trunk opening command via CAN (Controller Area Network) communication and realize opening of trunk.

Trunk reopen

1. Place the FOB in the trunk, and then close the trunk door.
2. The PIC ECU searches a valid FOB via trunk antenna.
3. If the FOB is founded inside trunk, the PIC ECU will send trunk opening command via CAN (Controller Area Network) communication and realize reopening of trunk.

The unlocking the steering column and ignition of the engine-FOB mode (Immobilize)

1. In case of failure of FOB, insert FOB into the hole of knob
2. BCM drive antenna coil(LF:125KHz) to check if the code of transponder inside FOB correspond to code of BCM.
3. If correspond BCM notice PIC ECU that code is valid.
4. In case PIC ECU is noticed that code is valid, PIC ECU command steering lock controller to unblock the knob.
5. Steering lock controller drive solenoid to unblock the knob for 10 seconds. User can turn the knob to position ‘START’for Ignition.
6. If the knob is not turned for the 10 seconds, the system has to be retriggered by pressing the brake pedal again.
7. If the knob is turn to position ‘START’Engine ECU request BCM to judge if the engine can be ignited.
8. BCM can allow engine ECU to ignite in case BCM get valid notice from PIC ECU.

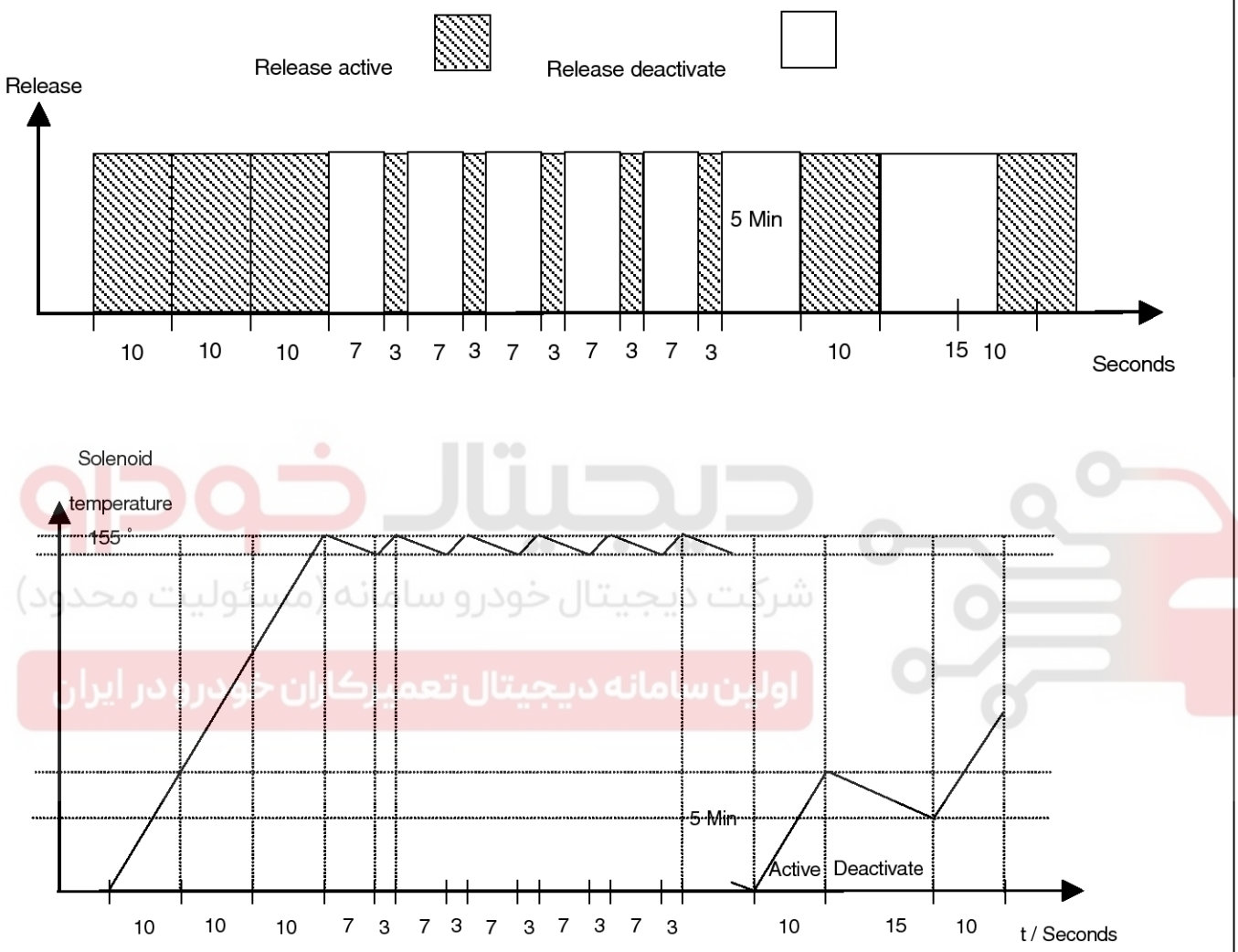
The unlocking the steering column and ignition of the engine-PIC mode

1. User with FOB presses the brake pedal. But as soon as user release the brake pedal, steering lock will be locked.
2. PIC ECU drive interior antenna(LF:125KHz) to wake-up FOB and check if code is valid.
3. If valid PIC ECU sends command to release block and inform BCM that code is valid.
4. Steering lock controller drive solenoid to unblock the knob for 10 seconds. User can turn the knob to position ‘START’for Ignition. If the knob is not turned for 10 seconds, the system has to be retriggered by pressing the brake pedal again.
5. If the knob is turn to position ‘START’, Engine ECU request BCM to judge if the engine can be ignited.
6. BCM can allow engine ECU to ignite in case BCM get valid notice from PIC ECU.

NOTICE

The rotary knob can be turned for a time of 10 seconds(as parameter) after the brake pedal has been pressed. If the knobhas not been turned in the defined time range, the system has to be retriggered.

As protection for the solenoid's overheating up to approximately 155℃ the rotary knob will be released only for 3 seconds after 3 times of activation as shown in the following table.



LTCD373A

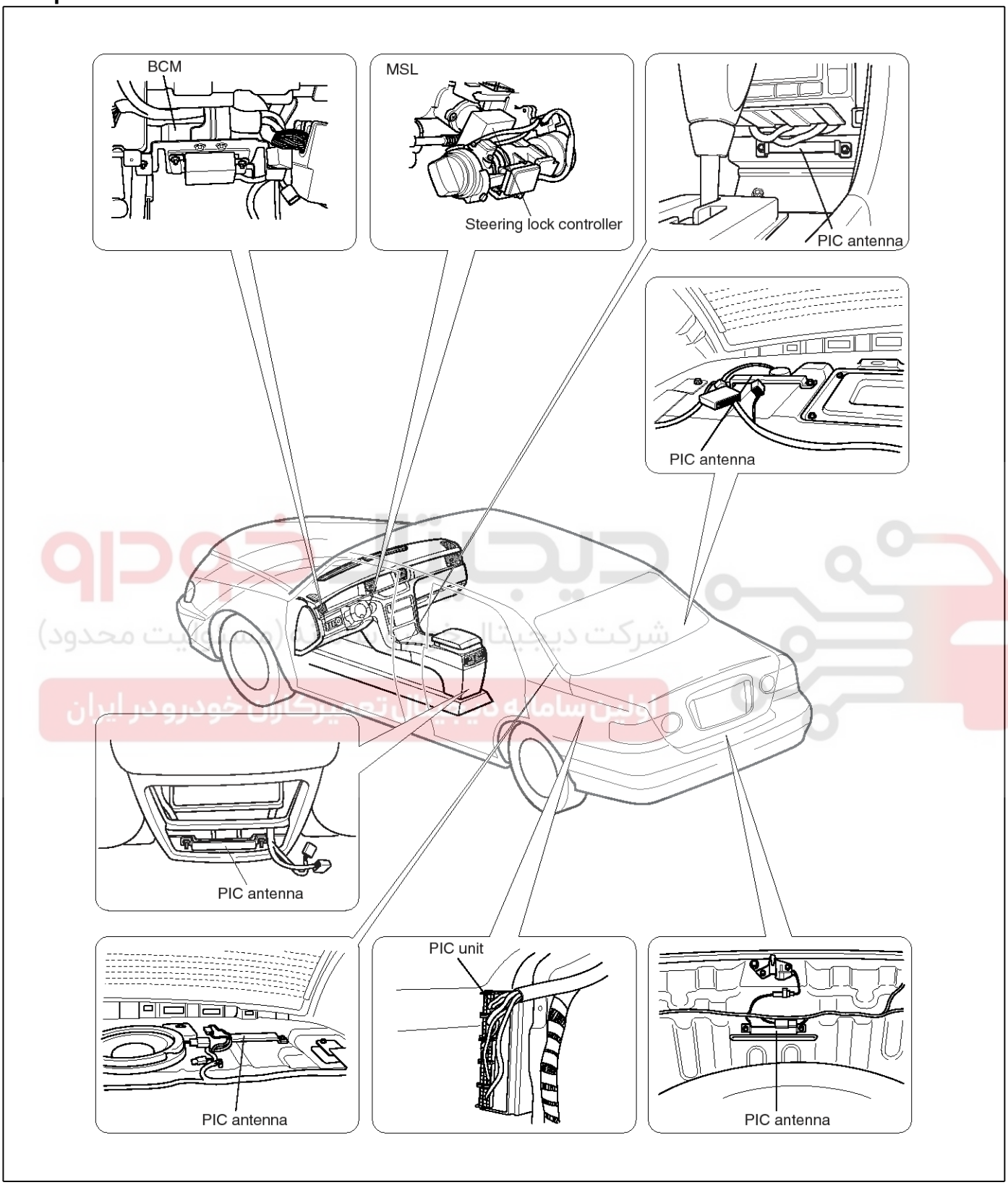
Steering column locking is automatically fulfilled under below condition and must not be locked besides below condition

1. PIC Mode : P position of AT Lever, lock position of ignition switch, Key in switch off
2. FOB Mode : P position of AT Lever, lock position of ignition switch, FOB pulled out(Key in switch on to off)

Key inter lock system

The knob can be turned from acc to lock position after the AT Lever is moved to 'P'position by means of mechanical cables connecting steering lock and AT Lever.

Component



LTCD370A

System components

1. PIC ECU

   The PIC ECU manages all functions related to “Passive Access”, “Passive Unlocking” and “Passive Authorization for Operation".

   It reads the inputs (Capacitive Sensor / Lock Button, Brake Pedal, Key In contact), controls the outputs (e.g. exterior and interior antennas), and communicates via the CAN network as well as a single line interface to further devices of the car.

   For communication with the PIC FOB, the PIC ECU generates a request (challenge) as an encoded and modulated 125kHz signal at the inductive antenna outputs and receives the PIC FOB's response via the external RF receiver.

2. PIC FOB

   The system supports up to 2 PIC FOBs to be used with one vehicle; actually, the PIC system is planned with 2 PIC FOBs.

   The main functions of the PIC FOB are:

   - Provides passive functionality: receives LF-challenge and sends automatically RF response.
   - Contains three push buttons.
   - Contains a mechanical key blade for opening the doors.

   Contains a transponder in case of a flat battery or a disturbed communication.

3. Antennas

   Emitting LF Antennas :

   Inductive antennas in and at the vehicle are used to transform the current, fed by the PIC ECU's antenna driver, into a 125kHz magnetic field, which is the carrier for the PIC ECU's challenge.

   Three antennas cover the vehicle’s exterior: Two antennas in the Door Handles (DS and PS) cover the area around the front doors. One antenna in the rear bumper covers the area around the trunk.

   Five antennas cover the vehicle’s interior and the trunk interior: two in the passenger compartment, two at the hat shelf and one in the trunk

   All antennas are ferrite coil antennas and have a pig tail connector.

4. Bi-directional Immobilizer Antenna (for Limp Home):

   The Immobilizer Backup Antenna is used for sending and receiving data: it emits a 125kHz magnetic field (challenge) and receives changes in the field strength (response of Transponder).

5. External Receiver

   The PIC FOB’s response is received via the external RF receiver which is connected to the PIC ECU via a serial communication line.

   The PIC ECU provides a connector pin for the serial communication line.

6. Door handle

   The door handles of the two front doors (driver side / passenger side) are equipped with ferrite coil antennas to emit the 125 kHz signals. Both door handles are also equipped with a capacitive sensor and a lock button.

7. Capacitive sensor / lock button

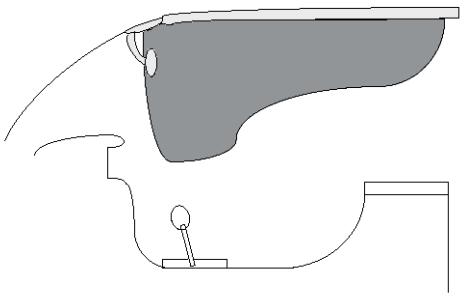
   The capacitive sensor as well as the lock button serves as a trigger to indicate the user’s intent to unlock or lock thevehicle. Both switching elements are installed at the front doors, integrated into the door handles. Another button is installed at the trunk lid, integrated into the trunk lid handle.

8. Mechatronics steering lock (MSL)

   The MSL is needed to block the steering wheel and the turning knob in order to prevent unauthorized usage of the vehicle. In this system proposal the Failsafe function for start is performed by using the transponder integrated in the PIC FOB. When the PIC FOB is inserted into the MSL the BCM reads the transponder and releases the MSL if the transponder codeis valid.

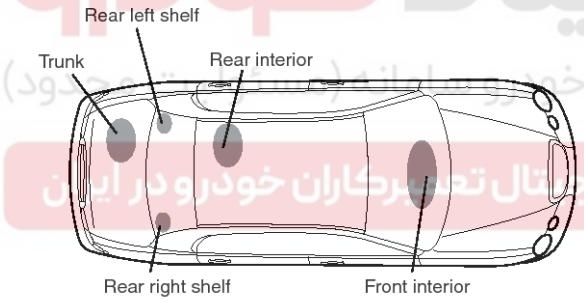
Check of interior antenna working

1. Check the starting of the FOB by placing it on the shaded parts of the following figure after FOB key learning.



ATCD371A

2. If it starts, it means that the antenna is working properly.
3. Operate the antenna with the Hi-scan at the interior antenna drive mode.
4. After placing the FOB key at the corresponding weak points and operating the antenna, check LED of FOB key for blinking.



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5. If LED of FOB key do not blink, then check the antenna for the installation.

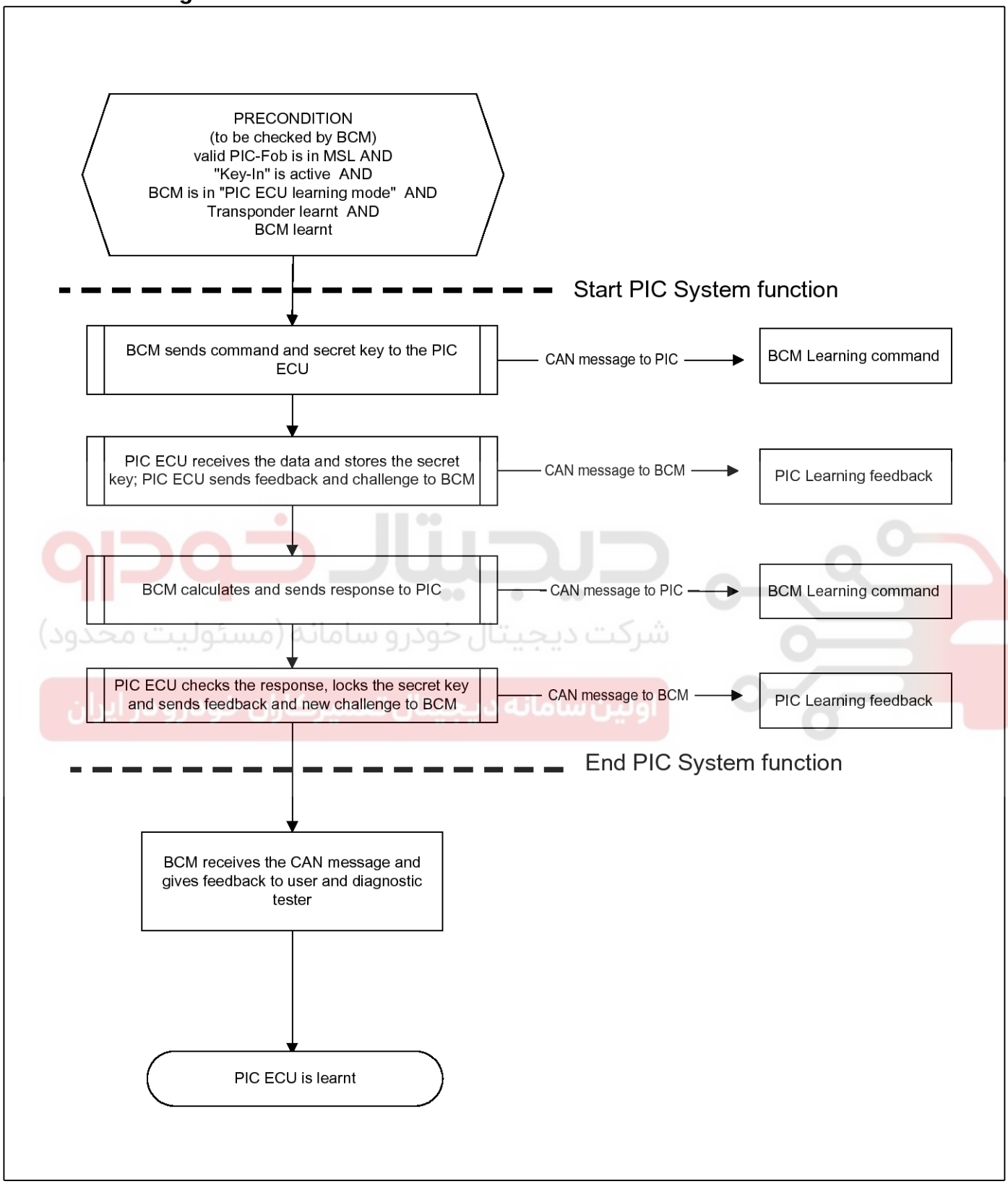
LEARNING

The secret key(PIN code) must be available in the BCM before the learning of the PIC ECU or the FOB or the MSL starts, the BCM must be learned before starting the PIC learning. Also, the transponder must be learned before.

It exists only one secret key(PIN code) for each vehicle, the secret key(PIN code) will be fixed for the vehicle during its lifetime.

For learning of the PIC ECU, the FOB or the MSL, the diagnostic tester must be active; the tester starts all actions.

PIC ECU learning



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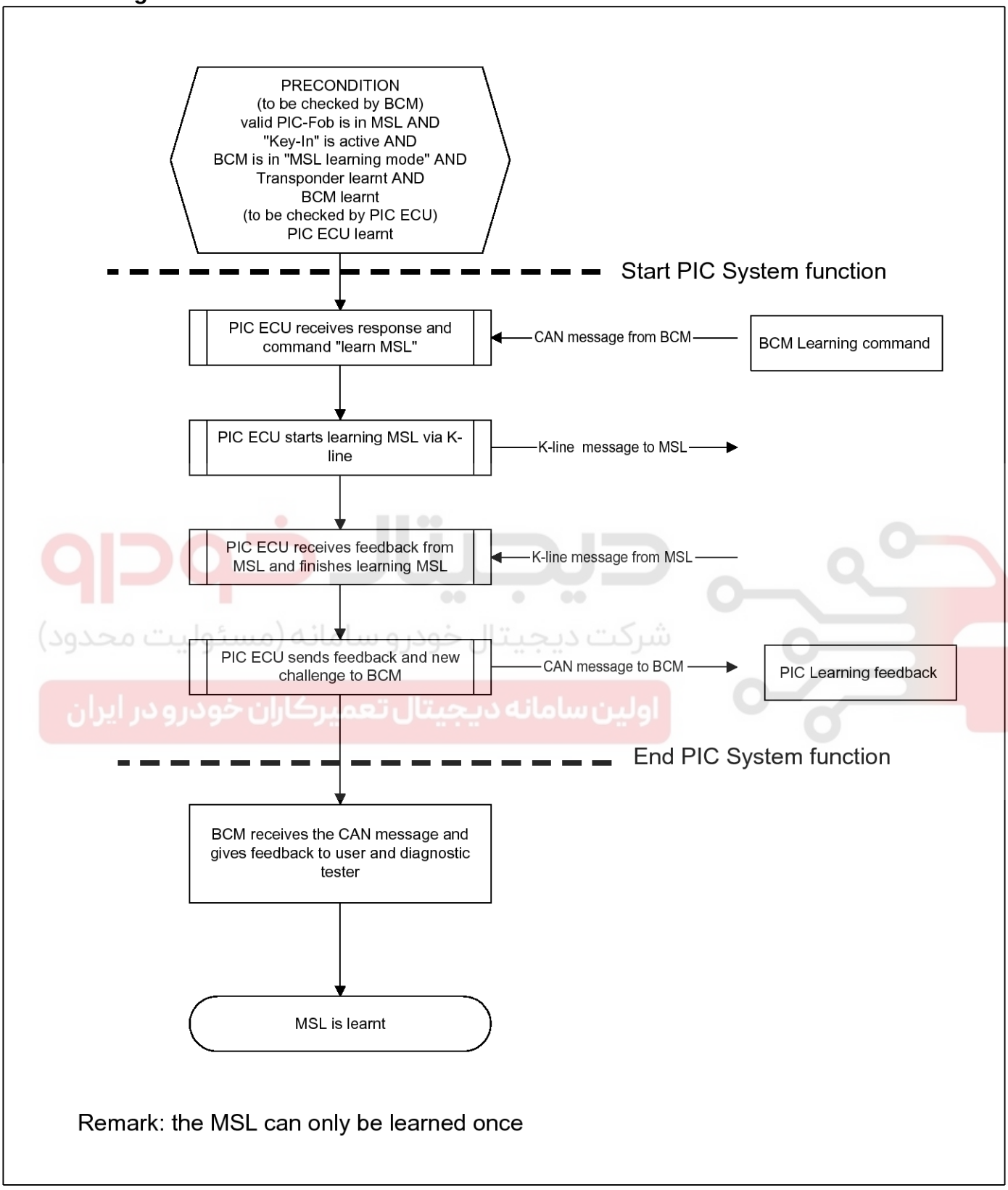
MSL learning



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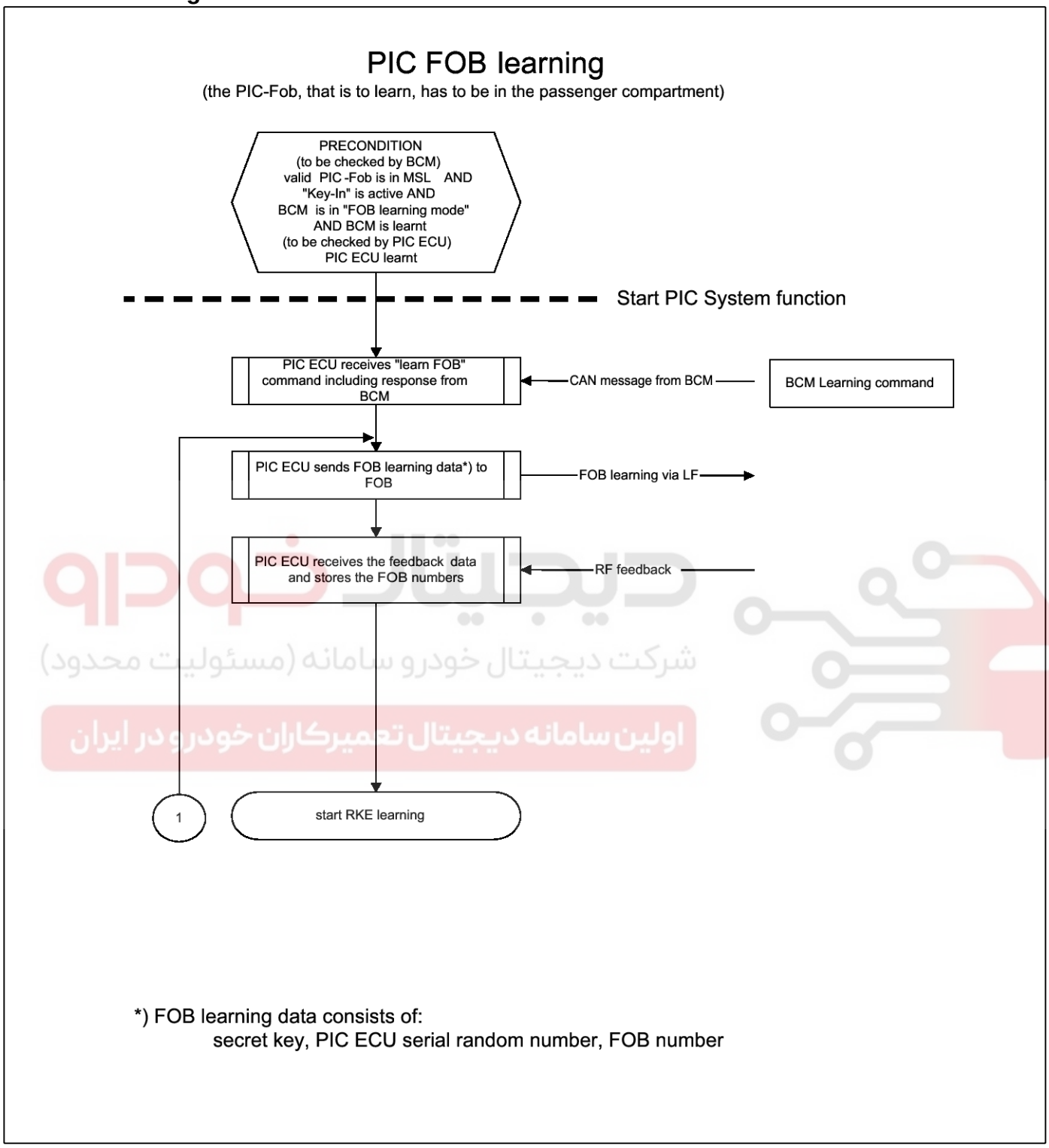
PIC FOB learning



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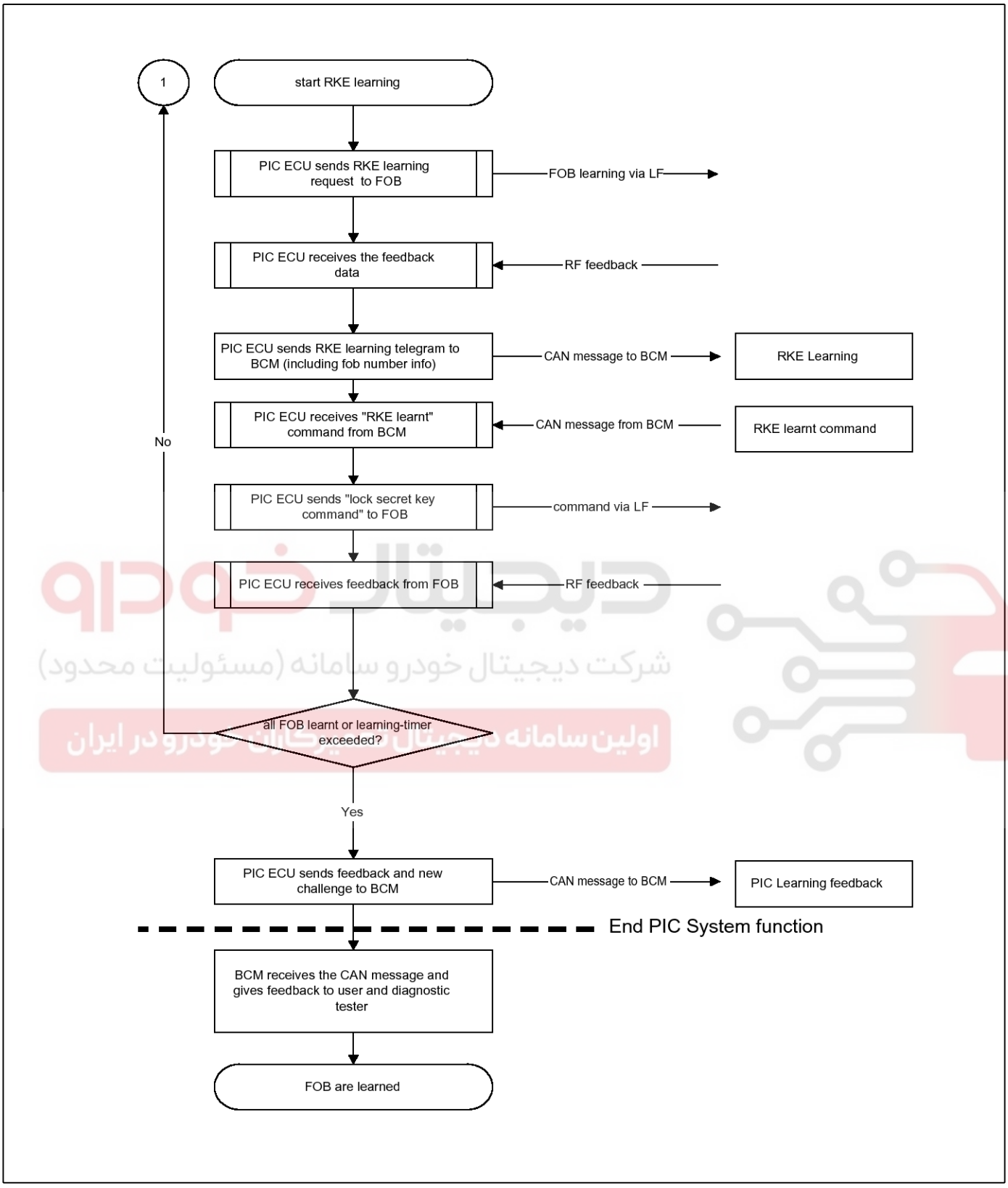


LTCD374D

Troubleshooting

SMK DTC List

NO	DTC code	Spec Discription
1	B1602	CAN Error
2	B1603	CAN Bus Off
3	B1604	CAN Timeout between SMK and (IPM or BCM)
4	B1605	CAN Timeout between SMK and DDM
5	B1606	CAN Timeout between SMK and ADM
6	B1625	ECM Communication Data Failure
7	B1629	Lin Reception Error
8	B1689	CAN Time-out PDM
9	B1971	Parking Position Input Error
10	B1978	Electric Steering Column Lock Failure
11	P1676	Immobilizer-Smartra Message Error
12	P1690	Immobilizer-Smartra No Response
13	P1696	Immobilizer-Authentication Fail
14	P1699	Immobilizer-Twice Overtrial

B1602 CAN Error

General Description

CAN Communication is a circuit, consists of CAN LOW and CAN HIGH, in order to communicate among control units. Control Modules are respectively communicating via CAN line in order to control Body Electrical.

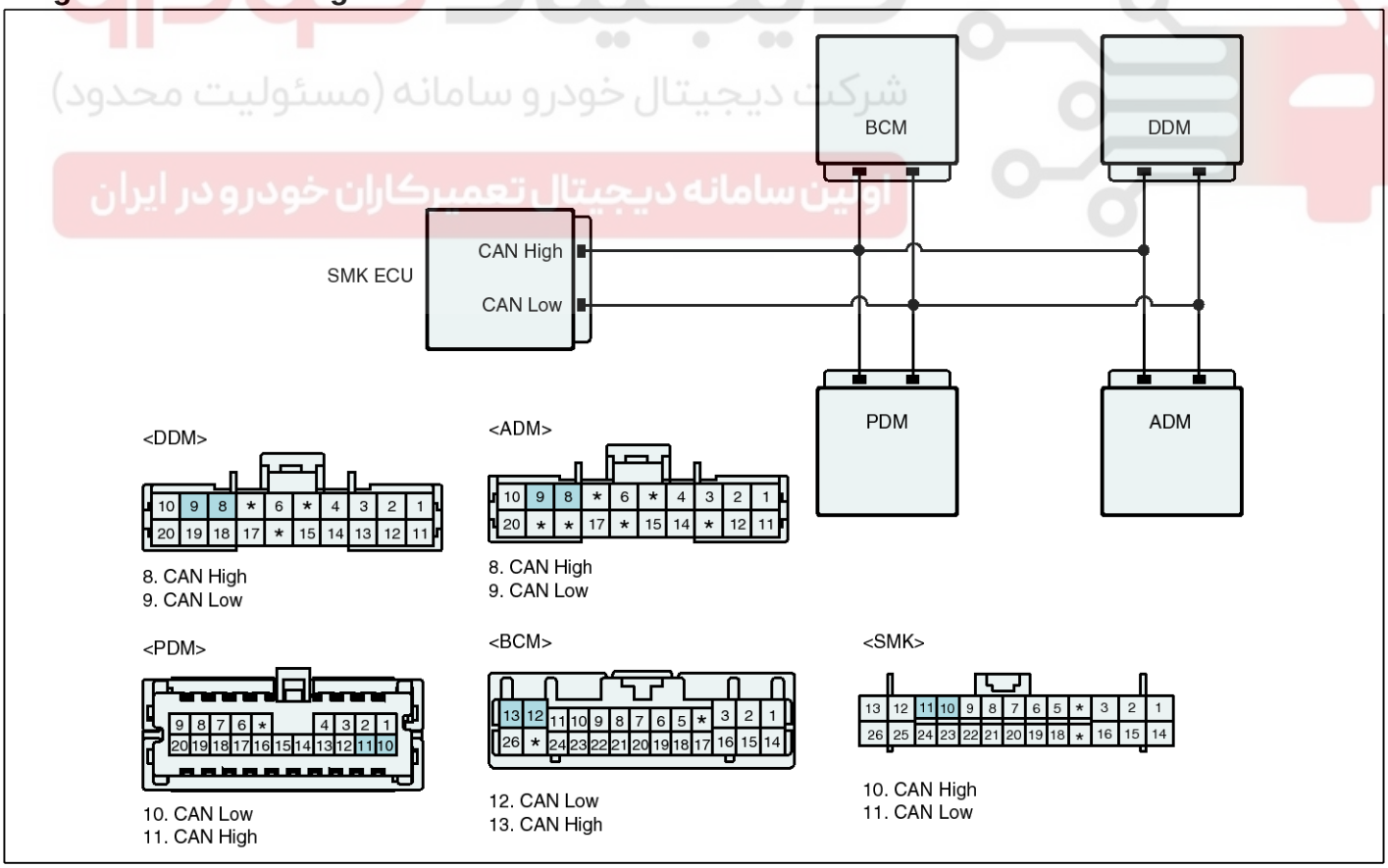
DTC Description

DTC B1602 is set if Smartkey Module detects that CAN HIGH or CAN LOW is short to battery, short to ground, open and short between CAN High and CAN Low each other.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN Signal Check	• Poor Connection • Power source to Smart Key module • Short to battery in CAN communication • Short to ground in CAN communication • Short between CAN high and CAN low each other • Faulty Smartkey Module • Faulty each modules
Enable Conditions	• IG ON	
Threshold value	• CAN communication error for 2 sec.	
Failsafe	• Lamp OFF	

Diagnostic Circuit Diagram



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Signal Waveform

SGHBE9B11L

Monitor Scantool data

■ Check DTC

1. Check DTC with scantool.
2. Check DTC related CAN communication is set on Smartkey Module and every modules.
3. If there is DTC related Module Check the DTC according to troubleshooting guide
4. Repair and erase the DTC with Scantool.
5. Is the DTC erased ?

▶ Check poor connection between harness connector and Smartkey Module or ECM : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

▶ Go to next procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration,or damage.
3. Has a problem been found?

▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

▶ Go to 'Check CAN communication Line" procedure

CAN communication Line Inspection

■ Check CAN communication

1. Connect all of control module connector.
2. IG KEY ON.
3. Make CAN communication is wake up status (Ex. . ON/OFF Door SW)
4. Measure signal waveform of B-CAN-HIGH terminal of SMK Module connector and chassis ground.
5. Measure signal waveform of B-CAN-LOW terminal of SMK Module connector and chassis ground.

Specification : Refer to Signal waveform and Data

6. Is the measrured signal waveform normal ?

▶ Check poor connection between harness connector and Smartkey Module :
Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

▶ Disconnect SMK Module, BCM, PDM, DDM and ADM one by one and then, check that DTC is erased with scantool.

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

▶ If the measured value is battery voltage, check short to battery in CAN line. Repair or replace as necessary. And then, go to "Verification of Vehicle Repair" procedure. In case that Communication is in sleep mode, 12V will be measured. Therefore, check that communication is in Wake up status.

▶ If 0V is detected, Check short to ground, short between CAN high and low each other or open in CAN high or CAN low harness. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

▶ Go to the applicable troubleshooting procedure.

▶ System is performing to specification at this time.

B1603 CAN Bus Off

General Description

CAN Communication is a circuit, consists of CAN LOW and CAN HIGH, in order to communicate among control units. Control Modules are respectively communicating via CAN line in order to control Body Electrical.

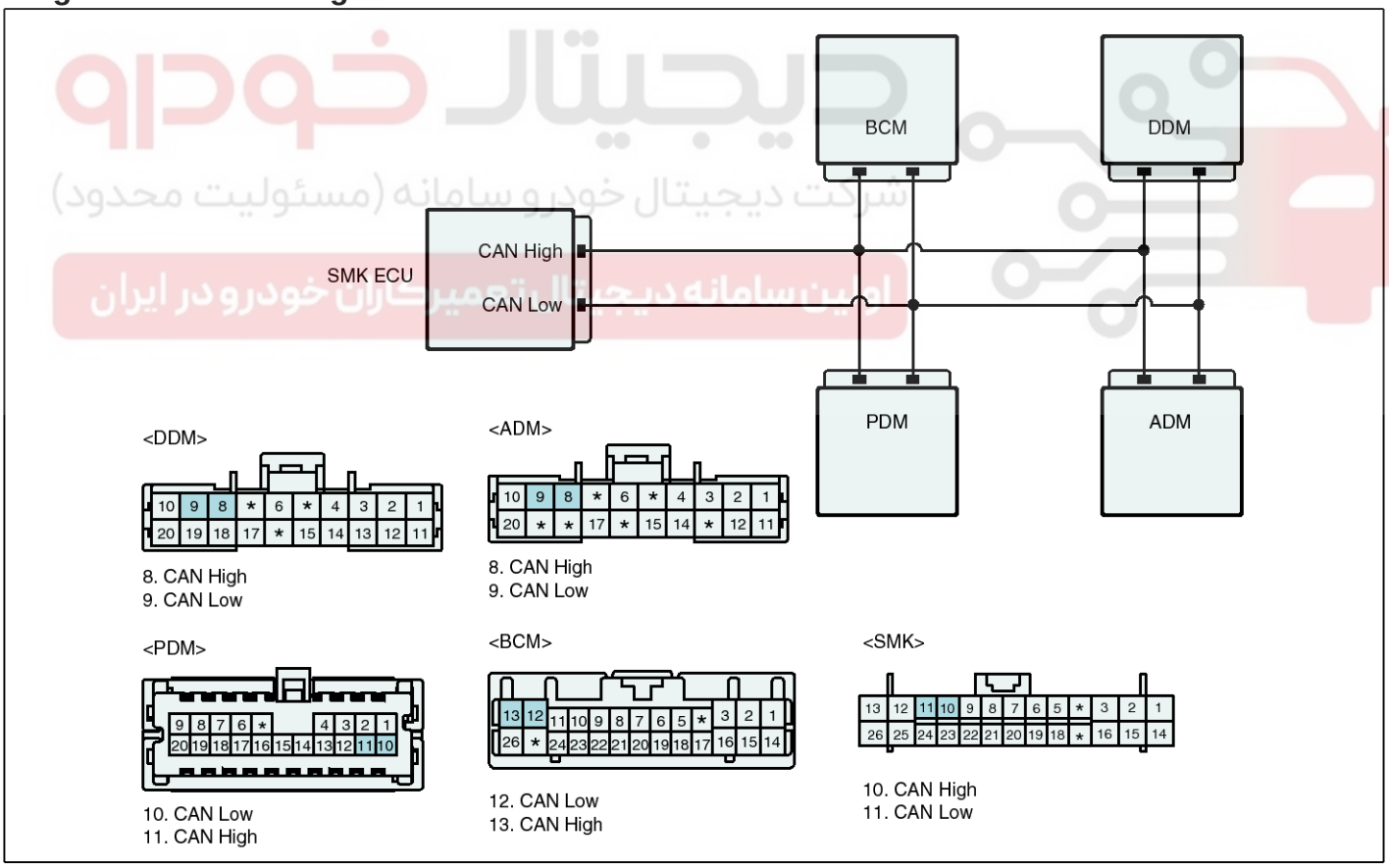
DTC Description

Smartkey Module sets DTC B1603 if smart key module detects short to battery, short to ground in CAN HIGH and CAN low simultaneously. This DTC means that both CAN HIGH and CAN LOW line are error. Therefore, CAN communication is not available.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN Signal Check	• Poor Connection • Power Source to smart key module • Short to battery in CAN HIGH LOW or ground simultaneously . • Faulty Smartkey Module
Enable Conditions	• IG ON	
Threshold value	• CAN communication error for 2 sec.	
Failsafe	• -	

Diagnostic Circuit Diagram



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Signal Waveform

SGHBE9B11L

Monitor Scantool data

■ Check DTC

1. Check DTC with scantool.
2. Check DTC related CAN communication is set on Smartkey Module and every modules.
3. If there is DTC related Module Check the DTC according to troubleshooting guide
4. Repair and erase the DTC with Scantool.
5. Is the DTC erased ?

▶ Check poor connection between harness connector and Smartkey Module or ECM : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

▶ Go to next procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration,or damage.
3. Has a problem been found?

▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

▶ Go to 'Check CAN communication Line" procedure

CAN communication Line Inspection

■ Check CAN communication

1. Connect all of control module connector.
2. IG KEY ON.
3. Make CAN communication is wake up status (Ex. . ON/OFF Door SW)
4. Measure signal waveform of B-CAN-HIGH terminal of SMK Module connector and chassis ground.
5. Measure signal waveform of B-CAN-LOW terminal of SMK Module connector and chassis ground.

Specification : Refer to Signal waveform and Data

6. Is the measrured signal waveform normal ?

▶ Check poor connection between harness connector and Smartkey Module :
Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

▶ Disconnect SMK Module, BCM, PDM, DDM and ADM one by one and then, check that DTC is erased with scantool.

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

▶ If the measured value is battery voltage, check short to battery in CAN line. Repair or replace as necessary. And then, go to "Verification of Vehicle Repair" procedure. In case that Communication is in sleep mode, 12V will be measured. Therefore, check that communication is in Wake up status.

▶ If 0V is detected, Check short to ground, short between CAN high and low each other or open in CAN high or CAN low harness. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

▶ Go to the applicable troubleshooting procedure.

▶ System is performing to specification at this time.

B1604 CAN Timeout between SMK and (IPM or BCM)

General Description

CAN Communication is a circuit, consists of CAN LOW and CAN HIGH, in order to communicate among control units.

Control Modules are respectively communicating via CAN line in order to control Body Electrical.

Both Smartkey Module and BCM communicate with each other in order to control a burglar alarm funtion.

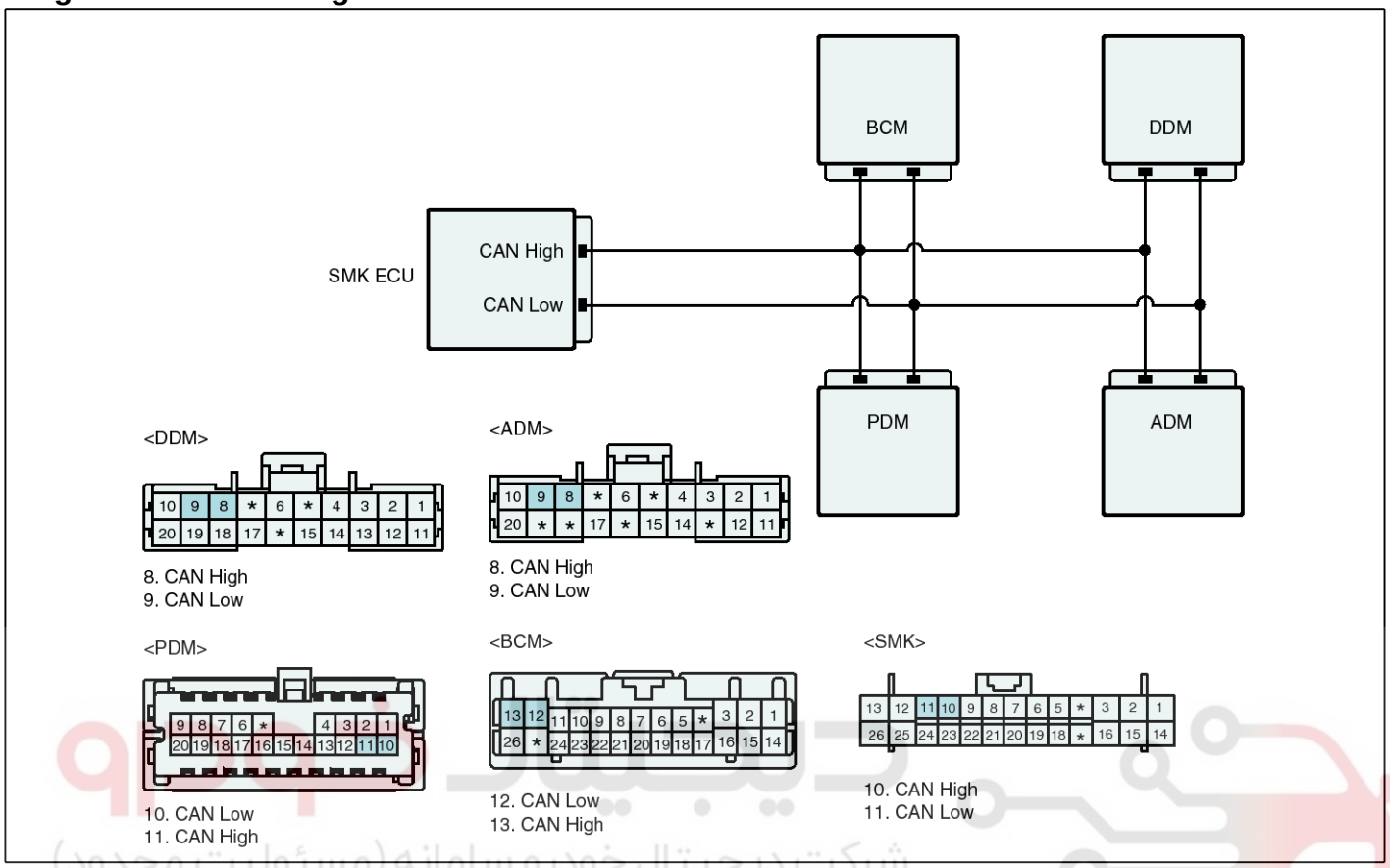
DTC Description

Smart Key module sets DTC B1604 if Smartkey Module have not received CAN signal from BCM for 3 sec.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN signal check	• Poor Connection • Power source to Smart Key module • Power source to BCM • Short to battery in CAN communication line • Short to ground in CAN communication line • Short between CAN HIGH AND LOW communication line each other • Faulty Smartkey Module • Faulty BCM
Enable Conditions	• IG ON	
Threshold value	• No can signal message from BCM for 3 sec.	
Failsafe	• -	

Diagnostic Circuit Diagram



SGHBE9B01L

Signal Waveform

SGHBE9B11L

Monitor Scantool data

■ Check DTC

1. Check DTC with scantool.
2. Check DTC related CAN communication is set on BCM.
3. If there is DTC related BCM, Check the DTC according to troubleshooting guide
4. Repair and erase the DTC with Scantool.
5. Is the DTC erased ?

▶ Check poor connection between harness connector and each module : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

▶ Go to next procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration,or damage.
3. Has a problem been found?

▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

▶ Go to 'Check CAN communication Line" procedure

CAN communication Line Inspection

■ Check CAN communication

1. Connect all of control module connector.
2. IG KEY ON.
3. Make CAN communication is wake up status (Ex. . ON/OFF Door SW)
4. Measure signal waveform of B-CAN-HIGH terminal of Smartkey Module connector and chassis ground.
5. Measure signal waveform of B-CAN-LOW terminal of Smartkey Module connector and chassis ground.
6. Is the measrured signal waveform normal ?

▶ Go to next procedure.

▶ If the measured value is battery voltage, check short to battery in CAN line. Repair or replace as necessary. And then, go to "Verification of Vehicle Repair" procedure. In case that Communication is in sleep mode, 12V will be measured. Therefore, check that communication is in Wake up status.

▶ If 0V is detected, Check short to ground, short between CAN high and low each other or open in CAN high or CAN low harness. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

■ Check open in CAN communication line

1. IG KEY OFF.
2. Disconnect Smartkey Module and BCM connector.
3. Measure resistance between communication line terminal of Smartkey Module connector and communication line of BCM harness connector.
4. Is the measured resistance within specification ?

▶ Check poor connection between harness connector and Smartkey Module or BCM : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then,

▶ Repair or replace open in CAN communication line and go to 'Verification of Vehicle Repair " procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

▶ Go to the applicable troubleshooting procedure.

▶ System is performing to specification at this time.

B1605 CAN Timeout Between SMK and DDM

General Description

CAN Communication is a circuit, consists of CAN LOW and CAN HIGH, in order to communicate among control units.

Control Modules are respectively communicating via CAN line in order to control Body Electrical.

Both Smartkey Module and DDM communicate with each other for the purpose of contolling a Key reminder warning function, Locking or unlocking function of doors.

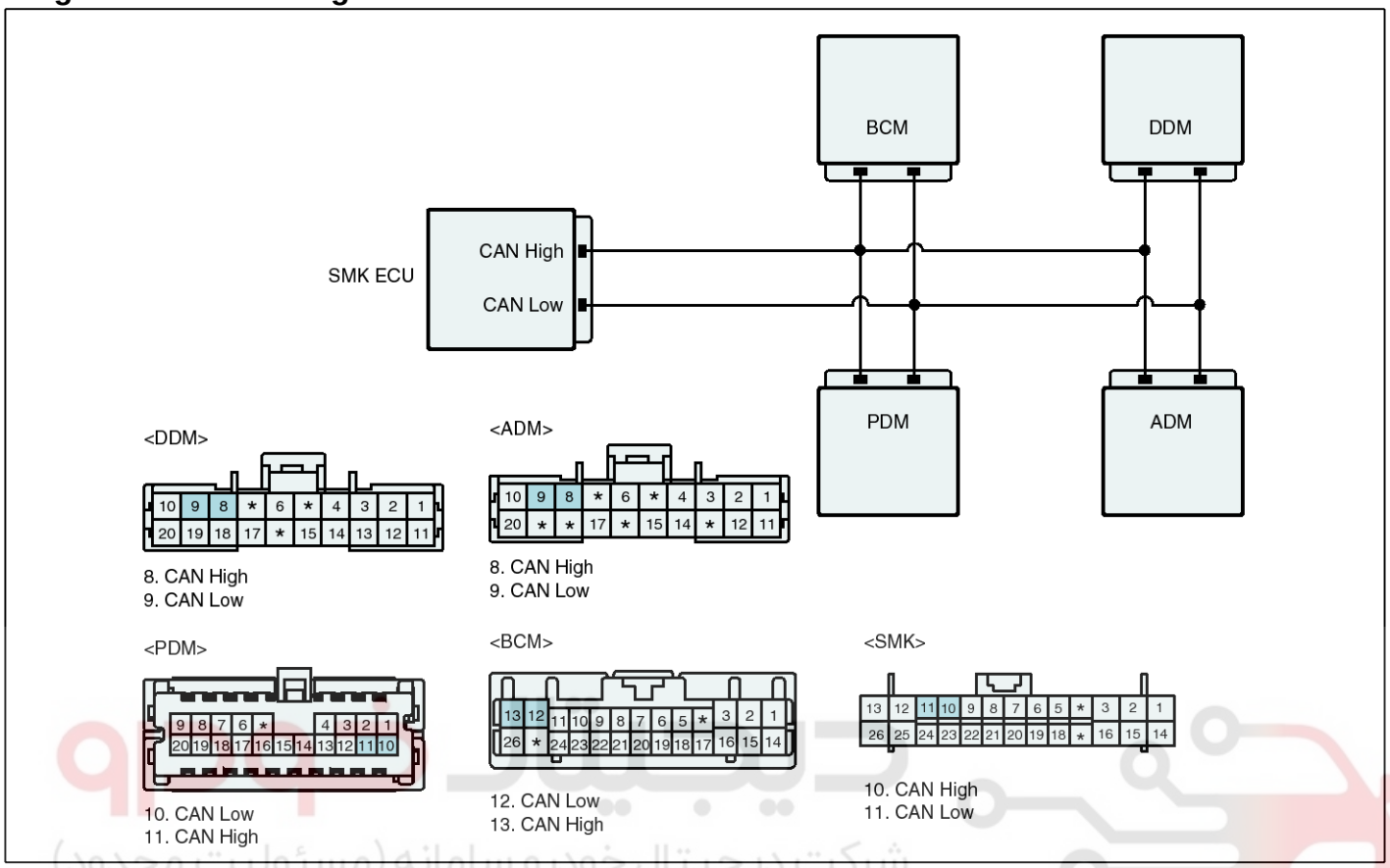
DTC Description

Smart Key module sets DTC B1605 if Smartkey Module have not received CAN signal from DDM for 3 sec.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN signal check	• Poor Connection • Power source to Smart Key module • Power source to BCM • Short to battery in CAN communication line • Short to ground in CAN communication line • Short between CAN HIGH AND LOW communication line each other • Faulty Smartkey Module • Faulty BCM
Enable Conditions	• IG ON	
Threshold value	• No can signal message from BCM for 3 sec.	
Failsafe	• -	

Diagnostic Circuit Diagram



SGHBE9B01L

Signal Waveform

SGHBE9B11L

Monitor Scantool data

■ Check DTC

1. Check DTC with scantool.
2. Check DTC related CAN communication is set on DDM.
3. If there is DTC related DDM, Check the DTC according to troubleshooting guide.
4. Repair and erase the DTC with Scantool.
5. Is the DTC erased ?

▶ Check poor connection between harness connector and each module :
Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

▶ Go to next procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration,or damage.
3. Has a problem been found?

▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

▶ Go to 'Check CAN communication Line" procedure

CAN communication Line Inspection

■ Check CAN communication

1. Connect all of control module connector.
2. IG KEY ON.
3. Make CAN communication is wake up status (Ex. . ON/OFF Door SW)
4. Measure signal waveform of B-CAN-HIGH terminal of Smartkey Module connector and chassis ground.
5. Measure signal waveform of B-CAN-LOW terminal of Smartkey Module connector and chassis ground.

Specification : Refer to Signal waveform and Data

6. Is the measrured signal waveform normal ?

▶ Go to next procedure.

▶ If the measured value is battery voltage, check short to battery in CAN line. Repair or replace as necessary. And then, go to "Verification of Vehicle Repair" procedure. In case that Communication is in sleep mode, 12V will be measured. Therefore, check that communication is in Wake up status.

▶ If 0V is detected, Check short to ground, short between CAN high and low each other or open in CAN high or CAN low harness. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

■ Check open in CAN communication line

1. IG KEY OFF.
2. Disconnect Smartkey Module and DDM connector.
3. Measure resistance between communication line terminal of Smartkey Module connector and communication line of DDM harness connector.

Specification : About below 1Ω

4. Is the measured resistance within specification ?

▶ Check poor connection between harness connector and Smartkey Module or DDM : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

▶ Repair or replace open in CAN communication line and go to 'Verification of Vehicle Repair " procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

▶ Go to the applicable troubleshooting procedure.

▶ System is performing to specification at this time.

B1606 CAN Timeout Between SMK and ADM

General Description

CAN Communication is a circuit, consists of CAN LOW and CAN HIGH, in order to communicate among control units.

Control Modules are respectively communicating via CAN line in order to control Body Electrical.

Both Smartkey Module and ADM communicate with each other for the purpose of contolling a Key reminder warning function, Locking or unlocking function of doors.

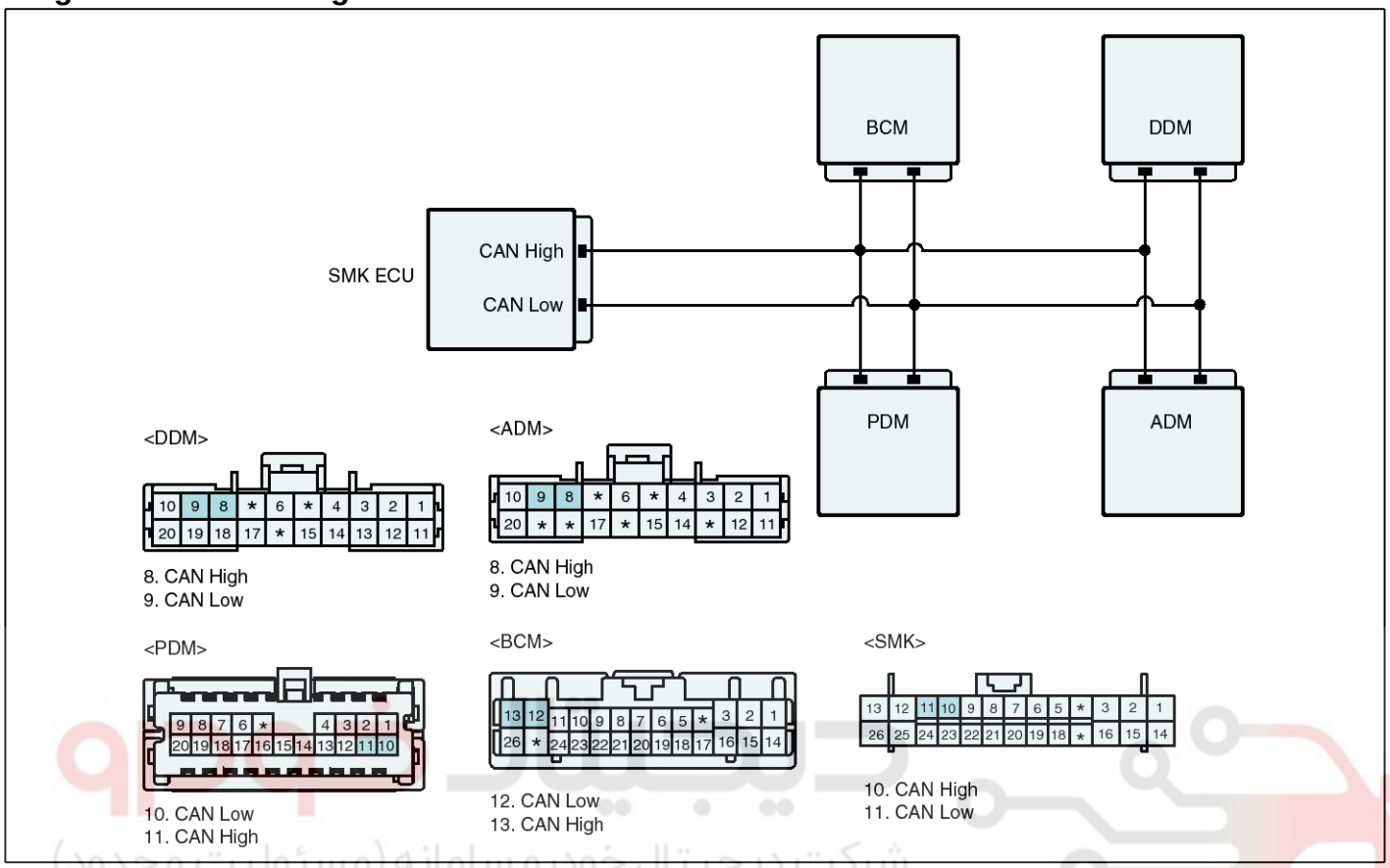
DTC Description

Smart Key module sets DTC B1606 if Smartkey Module have not received CAN signal from ADM for 3 sec.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN signal check	• Poor Connection • Power source to Smart Key module • Power source to DDM • Short to battery in CAN communication line • Short to ground in CAN communication line • Short between CAN HIGH AND LOW communication line each other • Faulty Smartkey Module • FaultyADM
Enable Conditions	• IG ON	
Threshold value	• No can signal message from ADM for 3 sec.	
Failsafe	• -	

Diagnostic Circuit Diagram



SGHBE9B01L

Signal Waveform

SGHBE9B11L

Monitor Scantool data

■ Check DTC

1. Check DTC with scantool.
2. Check DTC related CAN communication is set on ADM.
3. If there is DTC related ADM, Check the DTC according to troubleshooting guide.
4. Repair and erase the DTC with Scantool.
5. Is the DTC erased ?

▶ Check poor connection between harness connector and each module :
Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

▶ Go to next procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration,or damage.
3. Has a problem been found?

▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

▶ Go to 'Check CAN communication Line" procedure

CAN communication Line Inspection

■ Check CAN communication

1. Connect all of control module connector.
2. IG KEY ON.
3. Make CAN communication is wake up status (Ex. . ON/OFF Door SW)
4. Measure signal waveform of B-CAN-HIGH terminal of Smartkey Module connector and chassis ground.
5. Measure signal waveform of B-CAN-LOW terminal of Smartkey Module connector and chassis ground.

Specification : Refer to Signal waveform and Data

6. Is the measrured signal waveform normal ?

▶ Go to next procedure.

▶ If the measured value is battery voltage, check short to battery in CAN line. Repair or replace as necessary. And then, go to "Verification of Vehicle Repair" procedure. In case that Communication is in sleep mode, 12V will be measured. Therefore, check that communication is in Wake up status.

▶ If 0V is detected, Check short to ground, short between CAN high and low each other or open in CAN high or CAN low harness. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

■ Check open in CAN communication line

1. IG KEY OFF.
2. Disconnect Smartkey Module and ADM connector.
3. Measure resistance between communication line terminal of Smartkey Module connector and communication line of ADM harness connector.

Specification : About below 1Ω

4. Is the measured resistance within specification ?

▶ Check poor connection between harness connector and Smartkey Module or ADM : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

▶ Repair or replace open in CAN communication line and go to 'Verification of Vehicle Repair " procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

▶ Go to the applicable troubleshooting procedure.

▶ System is performing to specification at this time.

B1625 ECM Communication Data Failure

General Description

Smartkey Module communicates with ECM through the serial communication line. If ECM requests authetication from Smartkey Module after IG ON, Smartkey Module check authentication with transponder then, sends this signal to ECM whether authentication is O.K or not.

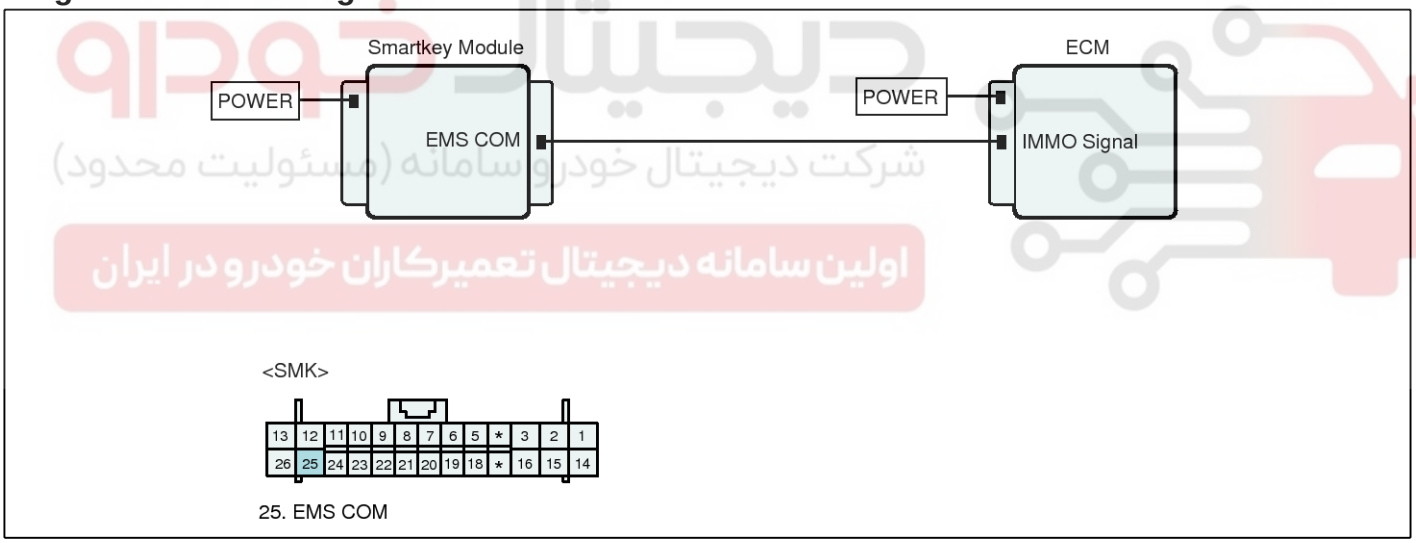
DTC Description

Smartkey Module sets DTC B1625 if Data from ECM is error such as check sum error, Data Frame error, ID Unknown error, Data length error and Time out error.

DTC Detecting Condition

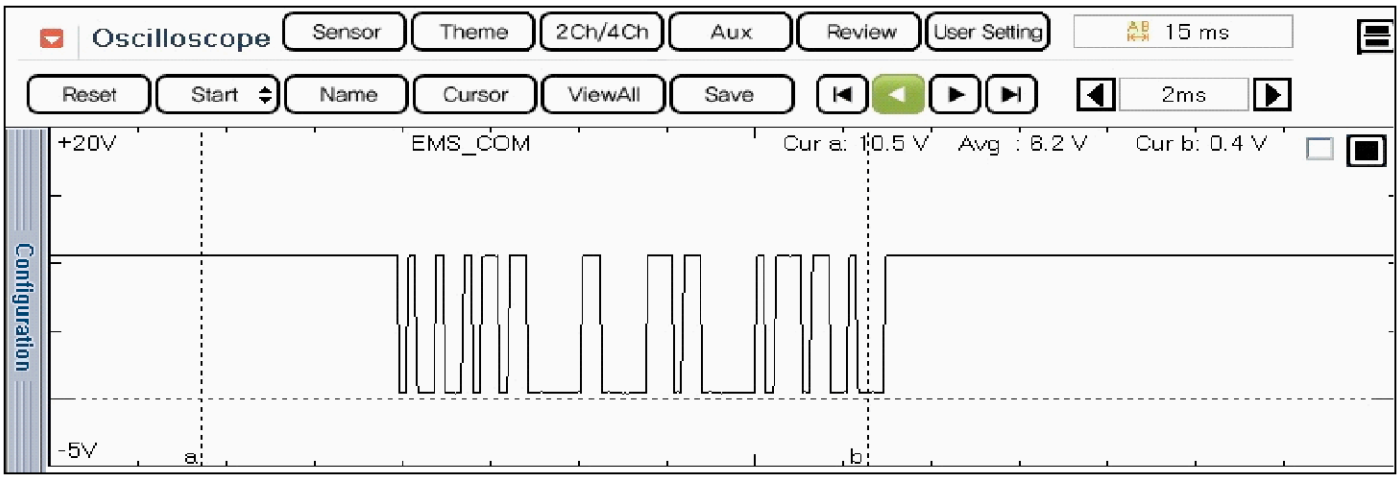
Item	Detecting Condition	Possible cause
DTC Strategy	• Check received Data Status from ECM	• Poor Connection in Harness • Input Power to Smartkey Module • Open or short in EMS communication line. • Faulty Smartkey Module • Faulty ECM
Enable Conditions	• Data that Smartkey Module received from ECM is error after IGN OFF to IGN ON.	
Threshold value	• Received data error from ECM.	
Failsafe	• -	

Diagnostic Circuit Diagram



SGHBE9B02L

Signal Waveform



SGHBE9B12L

Monitor Scantool data

■ Check DTC status

1. Check DTC on the ECM with Scantool.
2. Check that there is any DTC related ECM.
3. Perform Troubleshooting the DTC from ECM with appropriate DTC Troubleshooting Guide first.
4. Repair or replace as necessary after erasing DTC with Scantool.
5. Check DTC on SMK Module side and erase the DTC with scantool.
6. Has the DTC gone after erasing with scantool ?

   ▶ Check poor connection between harness connector and Smartkey Module or ECM : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

   ▶ Go to " Inspection & Repair " procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration,or damage.
3. Has a problem been found?

   ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

   ▶ Go to " Check serial commuication Cricuti Inspection" as follow.

Serial Communicatin Circuit Inspection

■ Check short in serial communication line

1. "IG KEY OFF"
2. Disconnect Smartkey Module connector and ECM connector.
3. Measure resistance between serial communication signal terminal of ECM harness connector and chassis ground.

Specificatin : Infinite (∞)

4. Is the measured resistance within specification ?

▶ Go to open in harness as follow

▶ Check short to ground in harness. And then, repair or replace as necessary. Finally, go to " Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG KEY OFF.
2. Disconnect Smartkey Module connector and ECM connector.
3. Measure resistance between signal terminal of Smartkey Module harness connector and signal terminal of ECM harness connector.

Specification : About below 1Ω

4. Is the measured resistance within specification ?

▶ Check poor connection between harness connector and Smartkey Module or ECM : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

▶ Check open in signal harness. And, repair or replace as necessary then, go to "Verification of Vehicle Repair " procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

▶ Go to the applicable troubleshooting procedure.

▶ System is performing to specification at this time.

B1629 Lin Reception Error

General Description

The Smartkey Module communicates with Instrument Cluster by LIN commuction and it gives a dashboard the messages about FOB.

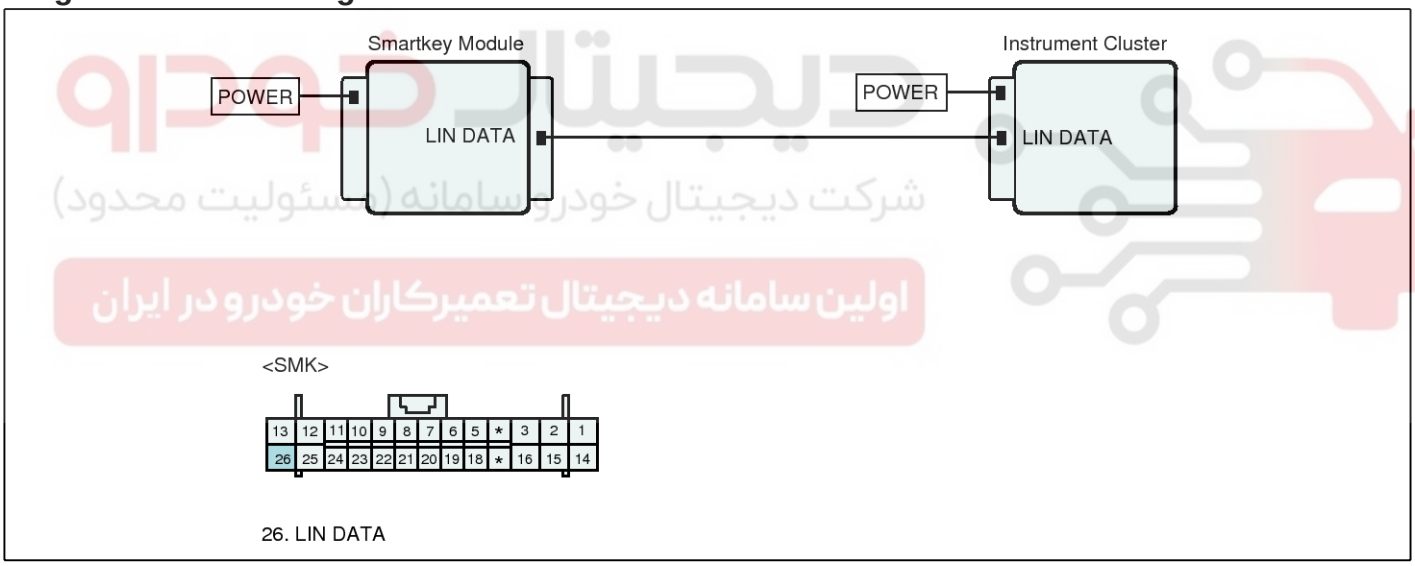
DTC Description

Smartkey Module sets DTC B1629 if Data from Instrument Cluster is error such as check sum error, Data Frame error, ID Unknown error, Data length error and Time out error.

DTC Detecting Condition

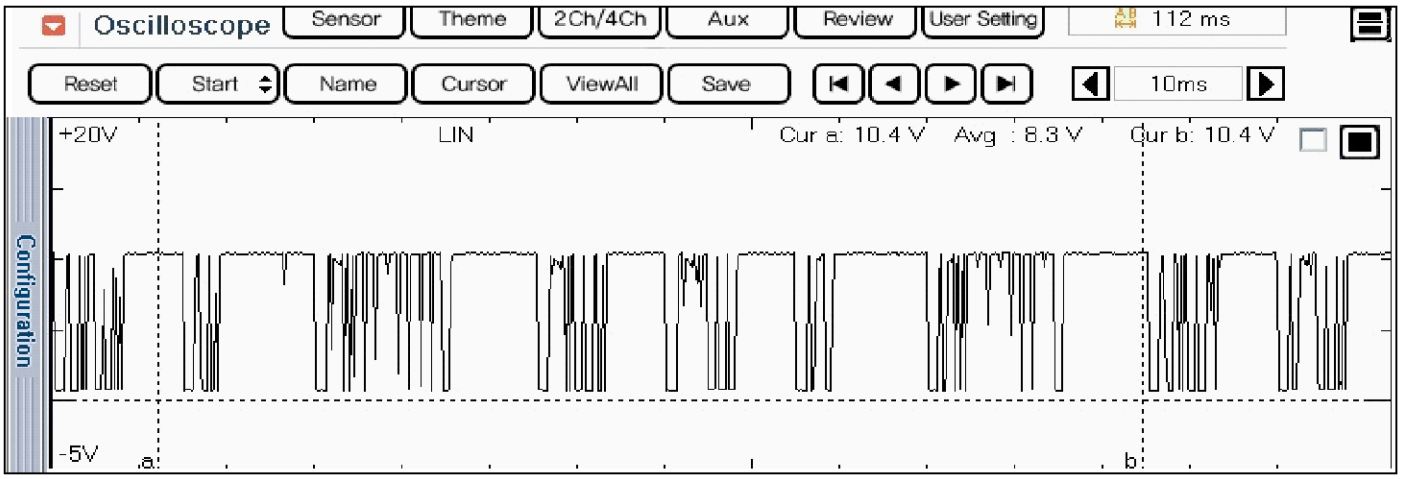
Item	Detecting Condition	Possible cause
DTC Strategy	• Check received Data Status from Instrument Cluster	• Poor Connection in Harness • Input Power to Smartkey Module • Open or short in Instrument Cluster communication line. • Faulty Smartkey Module • Faulty Instrument Cluster
Enable Conditions	• Data that Smartkey Module received from Instrument Cluster is error after IGN OFF to IGN ON.	
Threshold value	• Received data error from Instrument Cluster.	
Failsafe	• -	

Diagnostic Circuit Diagram



SGHBE9B03L

Signal Waveform



SGHBE9B13L

Monitor Scantool data

■ Check DTC status

1. Check DTC on the Instrument Cluster with Scantool.
2. Check that there is any DTC related Instrument Cluster.
3. Perform Troubleshooting the DTC from ECM with appropriate DTC Troubleshooting Guide first.
4. Repair or replace as necessary after erasing DTC with Scantool.
5. Check DTC on SMK Module side and erase the DTC with scantool.
6. Has the DTC gone after erasing with scantool ?

   ▶ Check poor connection between harness connector and Smartkey Module or Instrument Cluster : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

   ▶ Go to " Inspection & Repair " procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration,or damage.
3. Has a problem been found?

   ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

   ▶ Go to " Check serial commuication Cricuti Inspection" as follow.

Serial Communicatin Circuit Inspection

■ Check short in serial communication line

1. "IG KEY OFF"
2. Disconnect Smartkey Module connector and Instrument Cluster connector.
3. Measure resistance between serial communication signal terminal of Instrument Cluster harness connector and chassis ground.

Specificatin : Infinite (∞)

4. Is the measured resistance within specification ?

▶ Go to open in harness as follow.

▶ Check short to ground in harness. And then, repair or replace as necessary. Finally, go to " Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG KEY OFF.
2. Disconnect Smartkey Module connector and Instrument Cluster connector.
3. Measure resistance between signal terminal of Smartkey Module harness connector and signal terminal of Instrument Cluster harness connector.

Specification : About below 1Ω

4. Is the measured resistance within specification ?

▶ Check poor connection between harness connector and Smartkey Module or Instrument Cluster : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

▶ Check open in signal harness. And, repair or replace as necessary then, go to "Verification of Vehicle Repair " procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

▶ Go to the applicable troubleshooting procedure.

▶ System is performing to specification at this time.

B1689 CAN Time-out PDM

General Description

CAN Communication is a circuit, consists of CAN LOW and CAN HIGH, in order to communicate among control units. Control Modules are respectively communicating via CAN line in order to control Body Electrical.

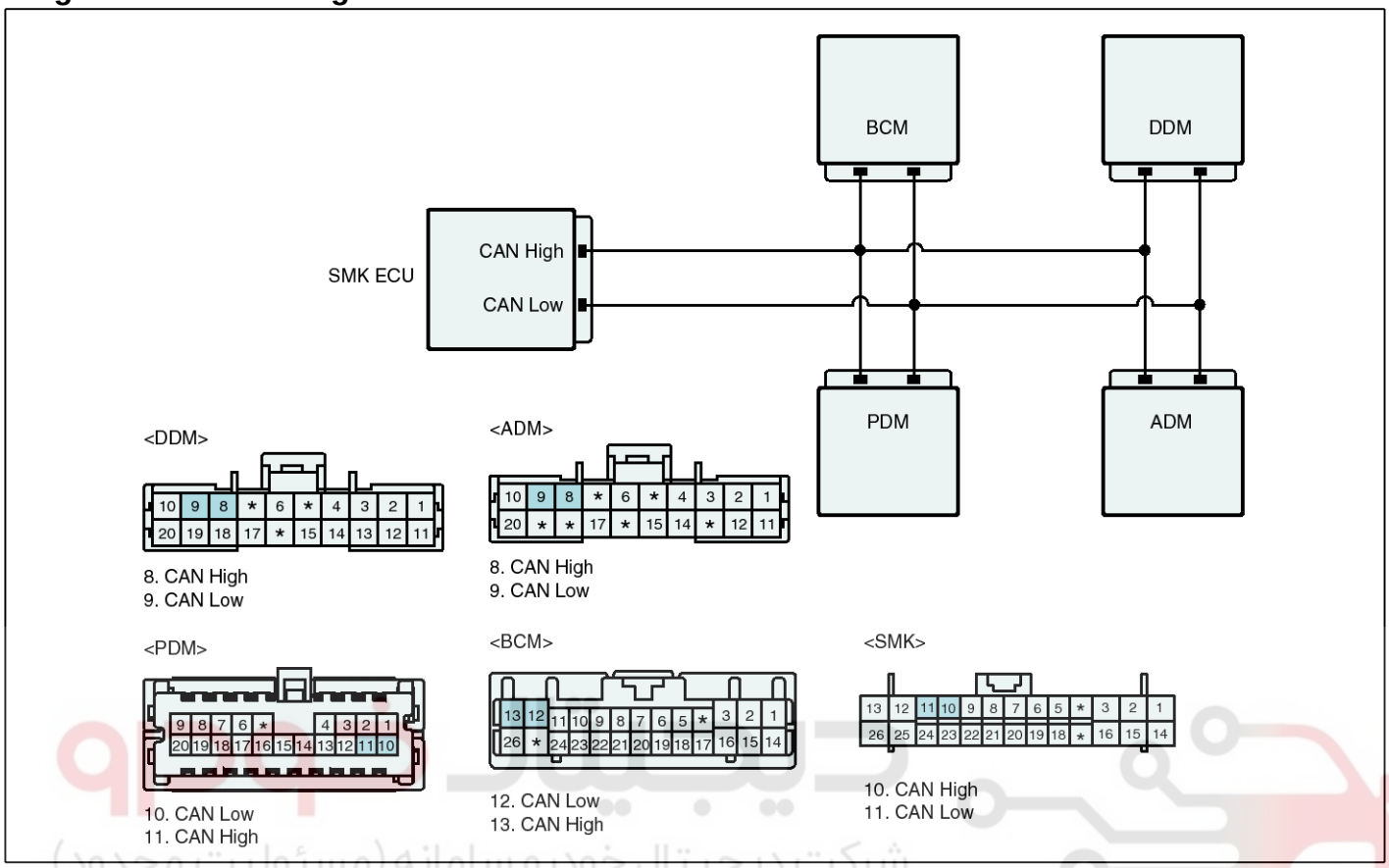
DTC Description

Smart Key module sets DTC B1689 if Smartkey Module have not received CAN signal from PDM for 3 sec.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN signal check	• Poor Connection • Power source to Smart Key module • Power source to PDM • Short to battery in CAN communication line • Short to ground in CAN communication line • Short between CAN HIGH AND LOW communication line each other • Faulty Smartkey Module • Faulty PDM
Enable Conditions	• IG ON	
Threshold value	• No can signal message from PDM for 3 sec.	
Failsafe	• -	

Diagnostic Circuit Diagram



SGHBE9B01L

Signal Waveform

SGHBE9B11L

Monitor Scantool data

■ Check DTC

1. Check DTC with scantool.
2. Check DTC related CAN communication is set on PDM.
3. If there is DTC related PDM, Check the DTC according to troubleshooting guide
4. Repair and erase the DTC with Scantool.
5. Is the DTC erased ?

▶ Check poor connection between harness connector and each module : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then , go to "Verification of Vehicle Repair" procedure.

▶ Go to " Inspection & Repair " procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration,or damage.
3. Has a problem been found?

▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

▶ Go to 'Check CAN communication Line" procedure.

CAN communication Line Inspection

■ Check CAN communication

1. Connect all of control module connector.
2. IG KEY ON.
3. Make CAN communication is wake up status (Ex. . ON/OFF Door SW)
4. Measure signal waveform of B-CAN-HIGH terminal of Smartkey Module connector and chassis ground.
5. Measure signal waveform of B-CAN-LOW terminal of Smartkey Module connector and chassis ground.

Specification : Refer to Signal waveform and Data

6. Is the measrured signal waveform normal ?

▶ Go to next procedure.

▶ If the measured value is battery voltage, check short to battery in CAN line. Repair or replace as necessary. And then, go to "Verification of Vehicle Repair" procedure. In case that Communication is in sleep mode, 12V will be measured. Therefore, check that communication is in Wake up status.

▶ If 0V is detected, Check short to ground, short between CAN high and low each other or open in CAN high or CAN low harness. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

■ Check open in CAN communication line

1. IG KEY OFF.
2. Disconnect Smartkey Module and PDM connector.
3. Measure resistance between communication line terminal of Smartkey Module connector and communication line of PDM harness connector.

Specification : About below 1Ω

4. Is the measured resistance within specification ?

▶ Check poor connection between harness connector and Smartkey Module or PDM : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

▶ Repair or replace open in CAN communication line and go to 'Verification of Vehicle Repair " procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

▶ Go to the applicable troubleshooting procedure.

▶ System is performing to specification at this time.

B1971 Parking Position Input Error

General Description

Parking Position Switch indicates that Shift Lever is in P range or not. Smartkey Module decides that engine starting is enable after receiving Parking Position Switch signal.

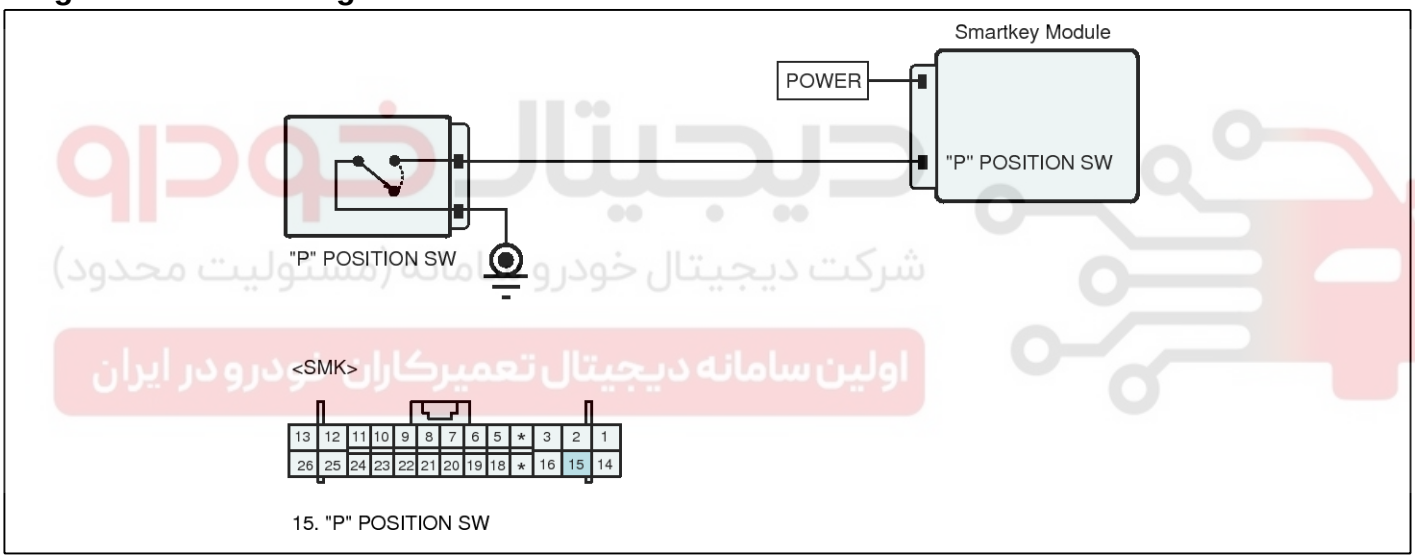
DTC Description

SMARTKEY Module sets DTC B1971 if vehicle speed is over 3km/h while parking switch signal is ON.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Check Voltage	• Poor Connection in harness • Faulty Parking Switch • Faulty Smartkey Module
Enable Conditions	• After battery Voltage is energized to Smartkey Module	
Threshold value	• After IGN ON, Vehicle speed is over 3km/h with brake switch ON for 10 seconds.	
Failsafe	• -	

Diagnostic Circuit Diagram



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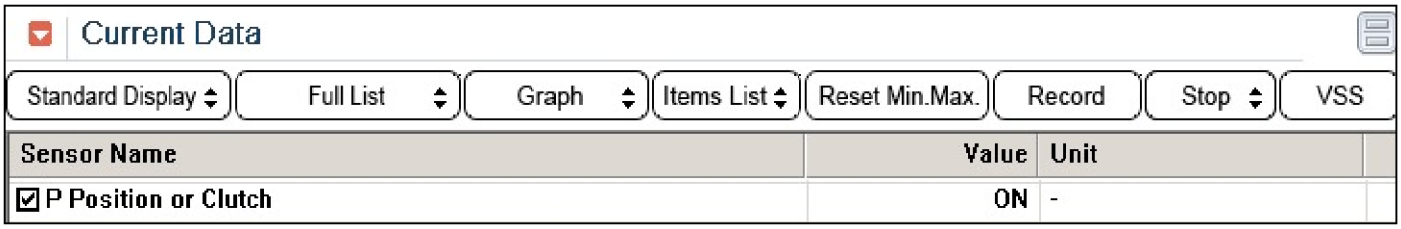
Monitor Scantool data

■ Check parking position switch status.

1. Connect scantool with diagnostic connector.
2. Check current data with scantool.
3. Check "Shift lever P position" parameter on current data.
4. Check that data is appropriately changeable according to the shift lever position in P or others.

Specification : P position : ON, Not in P position : OFF.



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5. Is the shift lever P position normal ?

▶ Check poor connection between harness connector and Parking Postion switch or Smartkey Module : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

▶ Go to " Inspection & Repair " procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration,or damage.
3. Has a problem been found?

▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

▶ Go to check "signal circuit Inspection" procedure.

Signal Circuit Inspection

■ Check Signal Circuit

1. IG KEY OFF.
2. Disconnect parking position switch connector.
3. IG KEY ON.
4. Measure voltage between signal terminal of parking position switch harness connector and chassis ground.

Specification : Battery Voltage

5. Is the measured voltage within specification ?

▶ Check open in ground harness. And then, repair or replace as necessary, Finally go to "Verification of Vehicle Repair " procedure.

▶ Check open or short to ground in signal harness. And then, repair or replace as necessary finally go to "Verification of Vehicle Repair " procedure.

Component Inspection

■ Check Parking Position Switch

1. IG KEY OFF.
2. Disconnect Parking Position switch connector.
3. Measure resistance between one and the other connector when parking postion switch ON and OFF.

Specification : Measurement 1 : Infinite (∞)
Measurement 2 : About below 1Ω

4. Is the measured resistance within specification ?

▶ Check poor connection between harness connector and Parking Postion switch or Smartkey Module : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

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

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

▶ Go to the applicable troubleshooting procedure.

▶ System is performing to specification at this time.

B1978 Electric Steering Column Lock Failure

General Description

ESCL(Electronic Steering Column Lock) is a system to control the lock or unlock of the Steering Column.It is installed on steering column and Smartkey Module is located inside of instrument panel, left knee of driver side.It consists of ESCL control Module, Smartkey Module, PDM and SSB(engine Start Stop Button)

It is operating as follows1.Pushing SSB → 2. Switch 1 signal goes to PDM, Switch 2 signal goes to SMARTKEY Module → 3.PDM supplies power supply to ESCL → 4.Smartkey Module sends ENABLE signal and operation signal to ESCL → 5.ESCL controls bolt to lock or unlock ESCL → 6.PDM detects ESCL Unlock signal.

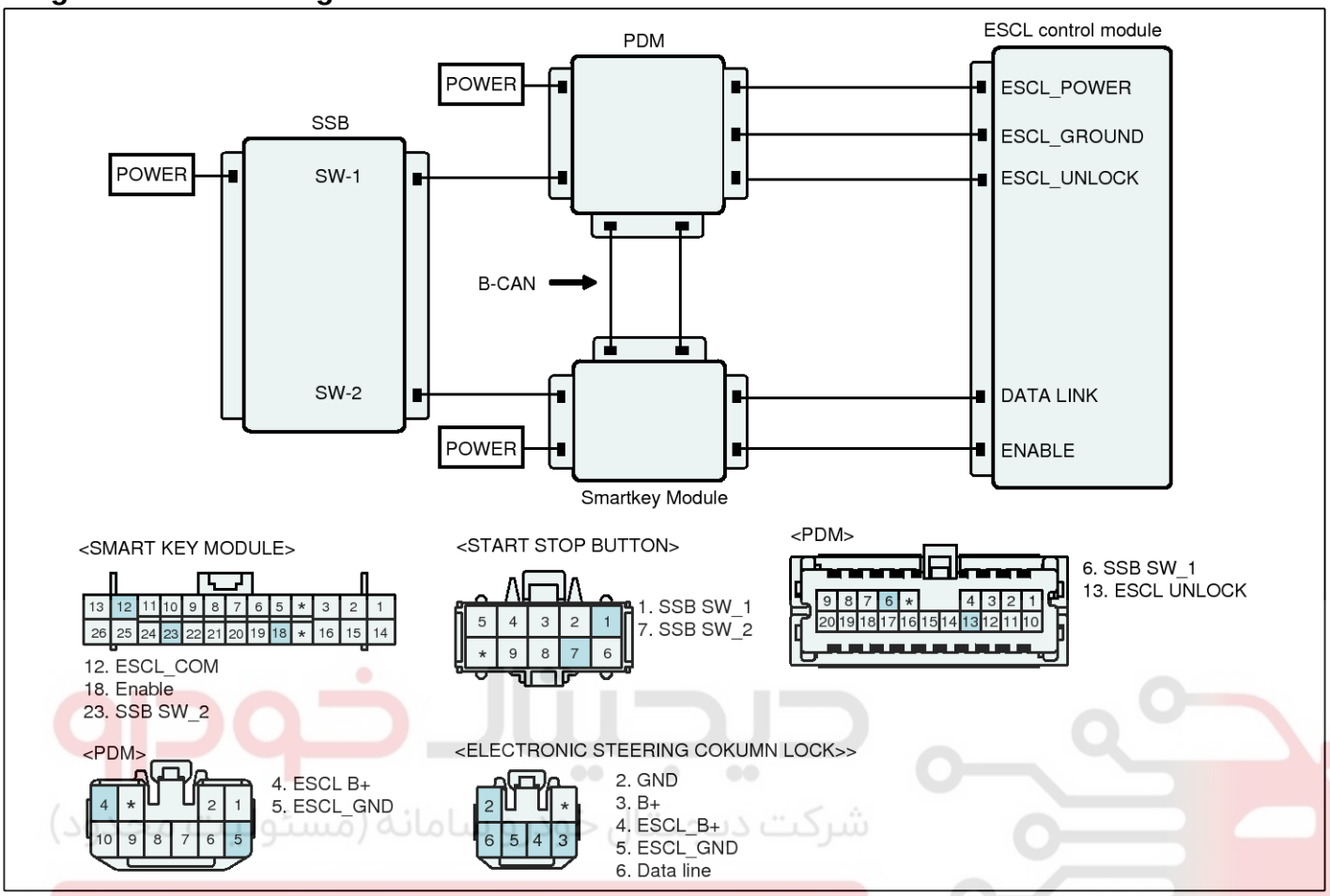
DTC Description

Smartkey Module receives ESCL lock or unlock stuatus signal from ESCL and PDM(via CAN). And then, Smartkey Module compares PDM is lock or unlock signal with ESCL is lock or unlock signal. If the both signals are unmathing, Smartkey Module sets DTC B1971.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Check voltage and Data	• Poor connection in harness or connector. • After battery voltage is supplied to Smartkey Module - If IPM detects pins related ESCL are failed 1. Faulty ESCL control Module 2. Open or short in battery / ground curcuit of ESCL 3. Open or short to battery / ground in communicantion circuit of ESCL 4. Open in O_ESCL Enable circuit from Smartkey Module 5. Open or short in ESCL_Unlock circuit to PDM - DTC is set although it is not ESCL fault 6. No battery voltage to PDM 7. Short to battery in power relay on the PDM line such as ACC, IGN1, IGN2, Starter Rly 8. When actuation test for PDM 9. It is leant status but not with same PIN code for all Smartkey Module/PDM/ESCL • Faulty Smartkey Module • Faulty PDM • Faulty ESCL control Module
Enable Conditions	• After battery voltage is suppiled to Smartkey Module	
Threshold value	• When both signal from ESCL lock or unlock status and PDM lock or unlock stuatus are unmatching	
Failsafe	• -	

Diagnostic Circuit Diagram



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Monitor Scantool data

■ Check DTC status

1. Check DTC on PDM side with scantool.
2. Check that there is any DTC on PDM side or ESCL side.
3. Inspect DTC related ESCL first if there is any DTC on the PDM side according to DTC troubleshooting guide.
4. After inspetion and repair, erase DTC related ESCL.
5. Erase DTC B1971 ESCL failure on Smartkey Module side.
6. Has the DTC gone after erasing DTC with scantool ?

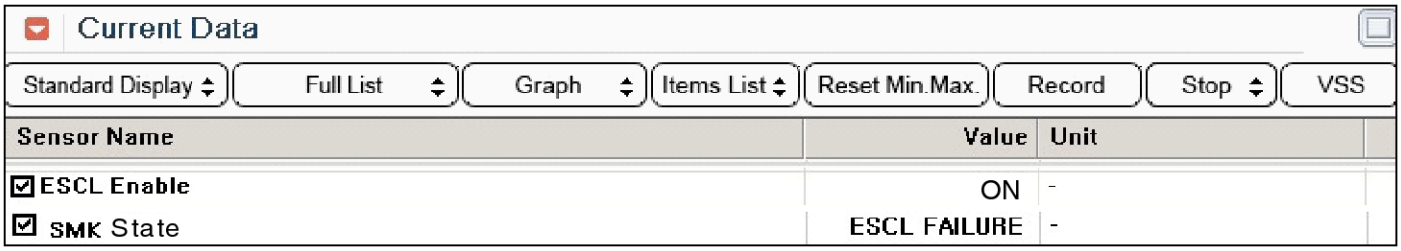
▶ Check poor connection between harness connector and ESCL, PDM or Smartkey Module
: Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

▶ Go to check current dat as follows if there is DTC B1971 ESCL failure.

■ Check current Data

1. Select current data parameters related Smartkey Module with scantool.
2. Monitor "ESCL ENABLE" and "SMK State" are normal.
3. Select current data parameter related PDM.
4. Monitor "ESCL BATTERY OUTPUT" , "ESCL GND OUTPUT" and "ESCL UNLOCK STATE INPUT" are normal.

Specification : - Current Data parameter related Smartkey Module -
1.ESCL ENABLE : It is ON, if IPM sends enable signal to ESCL
2.SMK State : It shows ESCL current status. It shows ESCL FAULURE if there is a failure



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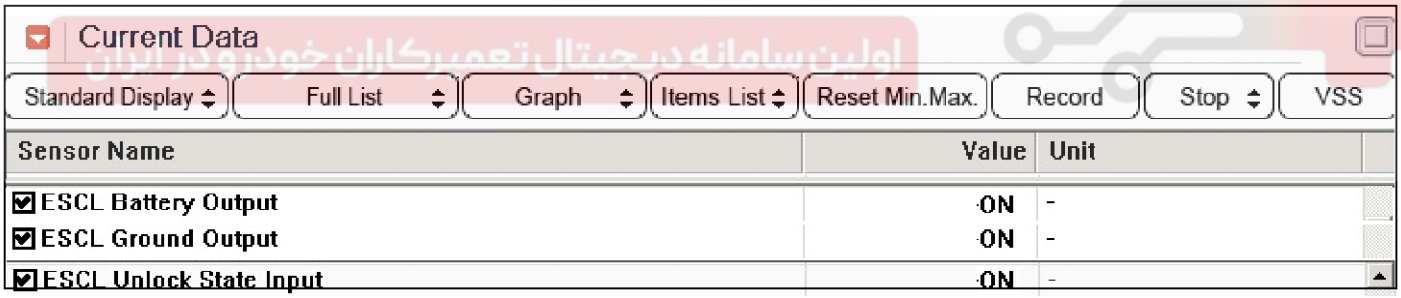
Specification : - Current Data parameter related PDM -
1.ESCL BATTERY OUTPUT : It will be changed form OFF to ON when PDM supplies operation voltage with PDM.
2.ESCL GND OUTPUT : It will be changed form OFF to ON when PDM supplies operation voltage with PDM.
3.ESCL UNLOCK STATE INPUT : In case that ESCL bolts is unlock, it will be ON.



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5. Are all parameters related ESCL funtioning normally ?

▶ Check poor connection between harness connector and ESCL, PDM or Smartkey Module
: Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

▶ Check harness and system related ESCL if " SMK STATE" is shown ESCL FAILURE
▶ If there is any parameter on the system or harness displayed abnormal, check harness and system
▶ Go to "Inspection & Repair " procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration,or damage.
3. Has a problem been found?

▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

▶ Go to "Check ESCL Circuit " procedure.

Check ESCL circuit

■ Check short to ground in ESCL circuit.

1. IG KEY OFF
2. Disconnect ESCL control Module, PDM and Smartkey Module connector.
3. Measure resistance between all the terminals of ESCL harness connector and chassis ground.

Specification : Infinite

4. Is the measured resistance within specification ?

▶ Go to "Check short to battery in ESCL harness " procedure.

▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair"procedure.

■ Check short to battery in ESCL harness

1. IG KEY OFF.
2. Disconnect ESCL control Module, PDM and Smartkey Module connector.
3. Measure resistance between each terminal of ESCL control Module harness connector and chassis ground.

Specification : About 0V

4. Is the measured voltage within specification ?

▶ Go to "check open in ESCL harness " as follows

▶ Repair or replace the short to battery as necessary and then, go to 'Verification of Vehicle Repair" procedure.

■ Check open in ESCL harness

1. IG KEY OFF.
2. Disconnect ESCL control Module, PDM and Smartkey Module connector.
3. Measure resistance between one and the other terminal of ESCL control module harness connector or IPM harness connector.

Specification : About below 1Ω

4. Is the measured resistance within specification ?

▶ Check poor connection between harness connector and ESCL Control Module, PDM or Smartkey
Module : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

▶ Go to check current dat as follows if there is DTC B1971 ESCL failure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

▶ Go to the applicable troubleshooting procedure.

▶ System is performing to specification at this time.

P1676 Immobilizer-Smartra Message Error

General Description

1. The secret key code is porgrammed in memory of Smart Key ECM, ESCL, PDM, FOB key.
2. The learnt FOB Key identifiers are stored in Smart Key ECM and PDM memory.
3. Corresponding PIN code is learnt and memorized in the Engine ECM

Communication between smart key ECM and ECM has 2 phase that is IG ON and Engine ON.

After this first IG ON transition phase or starting phase, a commnication between Smart Key ECM and Engine ECM takes place.

■ IG ON Phase (FOB key or Fob Key in Fob holder)

1. Communication between Smart key ECM and ECM starts from wake-up signal from ECM.
2. After receiving wake-up signal from ECM, Smart Key ECM sends lock or unlock starting signal to ECM.

■ Starting Phase (FOB key or FOB key in Fob Holder)

1. In case driver tries to start engine, although Engine ECM is locked status for starting at IG ON, Engine ECM should send re-authentication to Smart Key ECM. According to the results of re-authentication, it would be decided to start engine or not.

   The Engine ECM controls the engine, in a normal way for starting and running, and starts communication with the Smart Key ECM, sending a PIN request to the Smart Key ECM and waiting for valid release message from it until the release time period has ended.

   In case of Smart Key ECM immobilizer function is locked, the Smart Key ECM answer is the no release message. Engine ECM enters in the locked state, which causes theactivation of the imobilization actions of the engine.

   In case of Smart Key ECM immobilizer function state is released, the Smart Key ECM answer is the release message, including the information Smart Key ECM inlearnt mode and the PIN code.

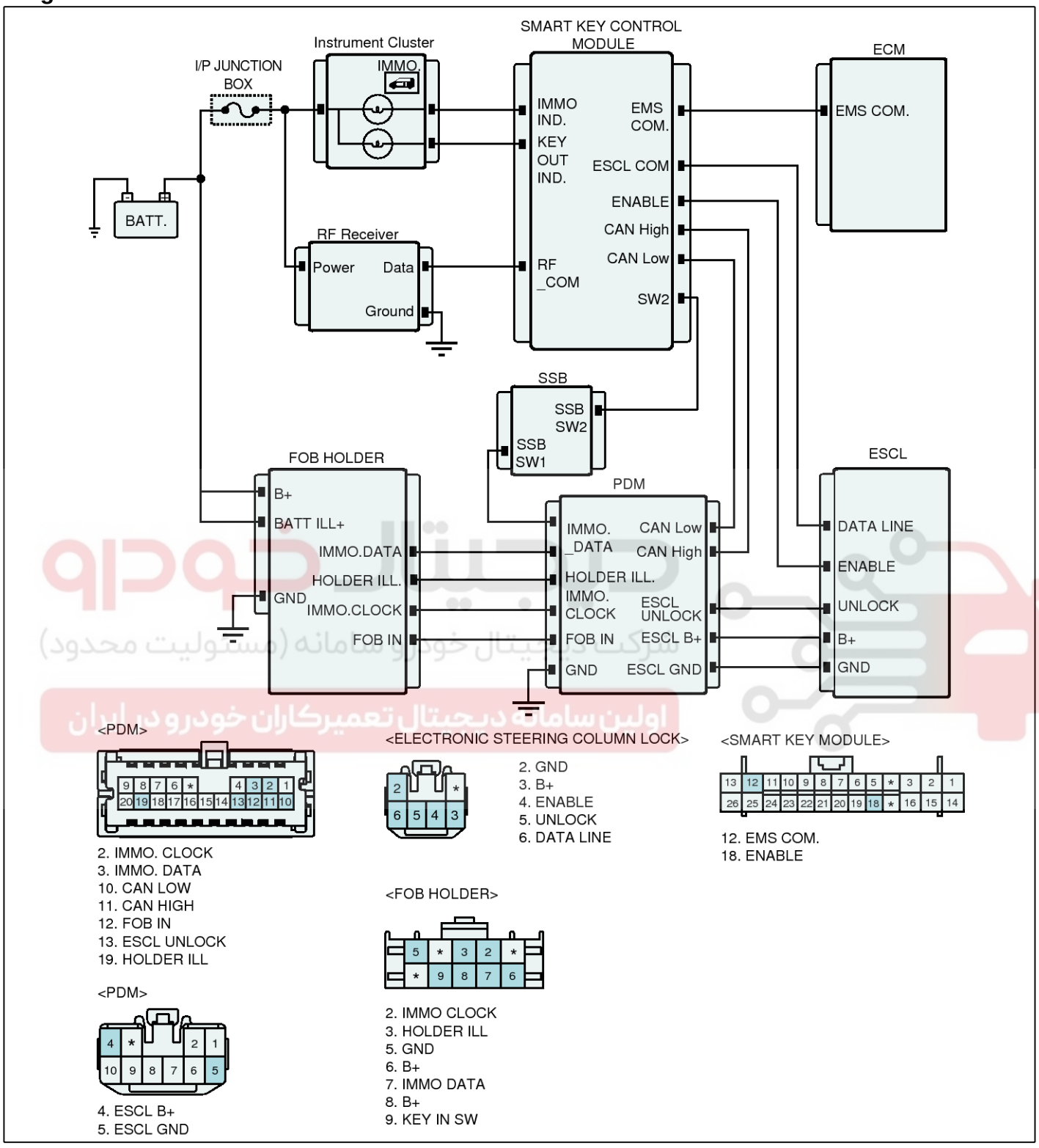
DTC Description

This DTC is set, after Engine ECM sends wake-up signal, if response signal from Smart key ECM is abnormal structure or is not valid message during engine ECM communication.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
Enable Conditions	• IG ON	• Faulty Smart Key ECM
Detecting time	• 1.5 sec	
Threshold value	• Data error or timing error 1. Data error : Head value error, checksum value error, Smart Key status unknown error 2. Timing Error : : Interval time of response from Smart key ECM after ECM request signal is longer than 40mS	

Diagnostic Circuit



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Monitor Scantool Data

1. IG KEY "ON" & Engine "OFF".
2. Erase DTC after connecting GDS.
3. Check Smart key status if DTC is retrieved.

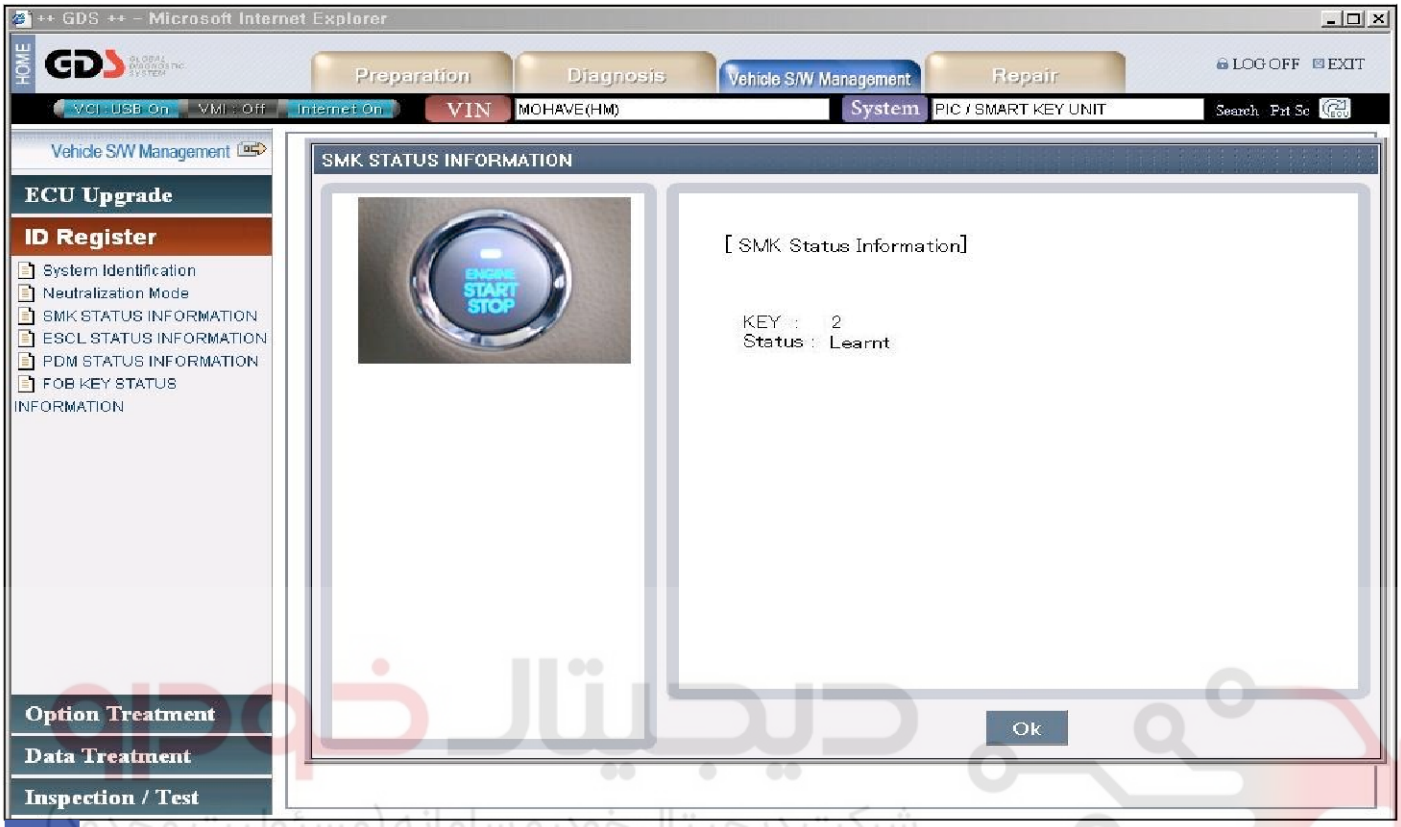

FIG.1

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Fig.1) It shows that 2(two) FOB key is registered, Smart Key ECM(integerated in IPM) is learnt status.

4. Is the Smart key ECM learnt status ?

▶ Fault is intermittent caused by poor contact in Smart key ECM and/or ECM's connector or was repaired and Smart key ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

▶ Go to "Component Inspection" procedure.

Component Inspection

■ Check Smart Key ECM Insepction

1. IG KEY "ON" & Engine "OFF"
2. Neutralize smart key ECM with GDS.
3. Perform key teaching procedure for smart key ECM with GDS.

⚠CAUTION
Pin code must be prepared to Neutralize Smart Key ECM and to perform key teaching procedure.

4. Is the neutralization of Smart Key ECM, Engine ECM and key teaching normal ?

▶ Fault is intermittent caused by poor contact in Smart Key ECM and/or ECM's connector or was repaired and Smart key ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

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

NOTICE

■ *PIN code is programmed in Smart key ECM, Transponder, ESCL, PDM and FOB.*

1. *If the Smart key ECM is not registered with PIN, key teaching process is not proceeded .*
2. *Registering PIN is available after Smart Key ECM is neutralized.*
3. *Neutralization of Engine ECM is available with GDS (Registering PIN code)*
4. *If the virgin engine ECM is installed on vehicle, Engine ECM is automatically programmed PIN code by Smart Key ECM.*
5. *Registering PIN code is only possible for virgin or neutralized status.*

■ *It is possible to acess to All of the learning procedue only with GDS.*

And, FOB key must be inserted in FOB holder in order to proceed learning procedure.

(There is only one menu for registering Smart key on the GDS that makes registering all of the component. In case of replacing each module, New registration should be done with GDS)

- *Smart Key ECM Learning*

1. Before learning procedure for FOB Key, PDM or ESCL, Smart Key ECM should be registered PIN code first.

2. In case of replacing Smart Key ECM, All of the keys should be newly registered again.

3. In case that Smart Key ECM receives 3 times with wrong PIN, It is not allowed for neutralization and Key Teaching for 1 hour.

4. If the battery is discharged during neutralization or Teaching, Timer will start again from begining. Therefore, it is avoidable to wait for 1 hour.

- *PDM Learning*

1. It is O.K for registering PDM just one time. And, it is available for PDM to neutrailze and re-teach with same PIN code.

2. In case that Power supply is shut off to ESCL right before first FOB key is registered, Every component status is moved to right before power shut off and previous PIN is used for communication with PDM and IPM

- *ESCL Learning*

1. It is O.K for registering ESCL just one time. And, it is available for ESCL to neutrailze and re-teach with same PIN code.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect GDS and check "No. of Key learnt, ECM status and Smartkey ECM status
2. Selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC
3. Operate the vehicle within the enable condition and monitor the DTC on the GDS.
4. Are any DTCs present ?

▶ Go to the applicable troubleshooting procedure.

▶ System is performing to specification at this time.

P1690 Immobilizer-Smartra No Response

General Description

1. The secret key code is porgrammed in memory of Smart Key ECM, ESCL, PDM, FOB key.
2. The learnt FOB Key identifiers are stored in Smart Key ECM and PDM memory.
3. Corresponding PIN code is learnt and memorized in the Engine ECM

Communication between smart key ECM and ECM has 2 phase that is IG ON and Engine ON.

After this first IG ON transition phase or starting phase, a commnication between Smart Key ECM and Engine ECM takes place.

■ IG ON Phase (FOB key or Fob Key in Fob holder)

1. Communication between Smart key ECM and ECM starts from wake-up signal from ECM.
2. After receiving wake-up signal from ECM, Smart Key ECM sends lock or unlock starting signal to ECM.

■ Starting Phase (FOB key or FOB key in Fob Holder)

1. In case driver tries to start engine, although Engine ECM is locked status for starting at IG ON, Engine ECM should send re-authentication to Smart Key ECM. According to the results of re-authentication, it would be decided to start engine or not.

   The Engine ECM controls the engine, in a normal way for starting and running, and starts communication with the Smart Key ECM, sending a PIN request to the Smart Key ECM and waiting for valid release message from it until the release time period has ended.

   In case of Smart Key ECM immobilizer function is locked, the Smart Key ECM answer is the no release message. Engine ECM enters in the locked state, which causes theactivation of the imobilization actions of the engine.

   In case of Smart Key ECM immobilizer function state is released, the Smart Key ECM answer is the release message, including the information Smart Key ECM inlearnt mode and the PIN code.

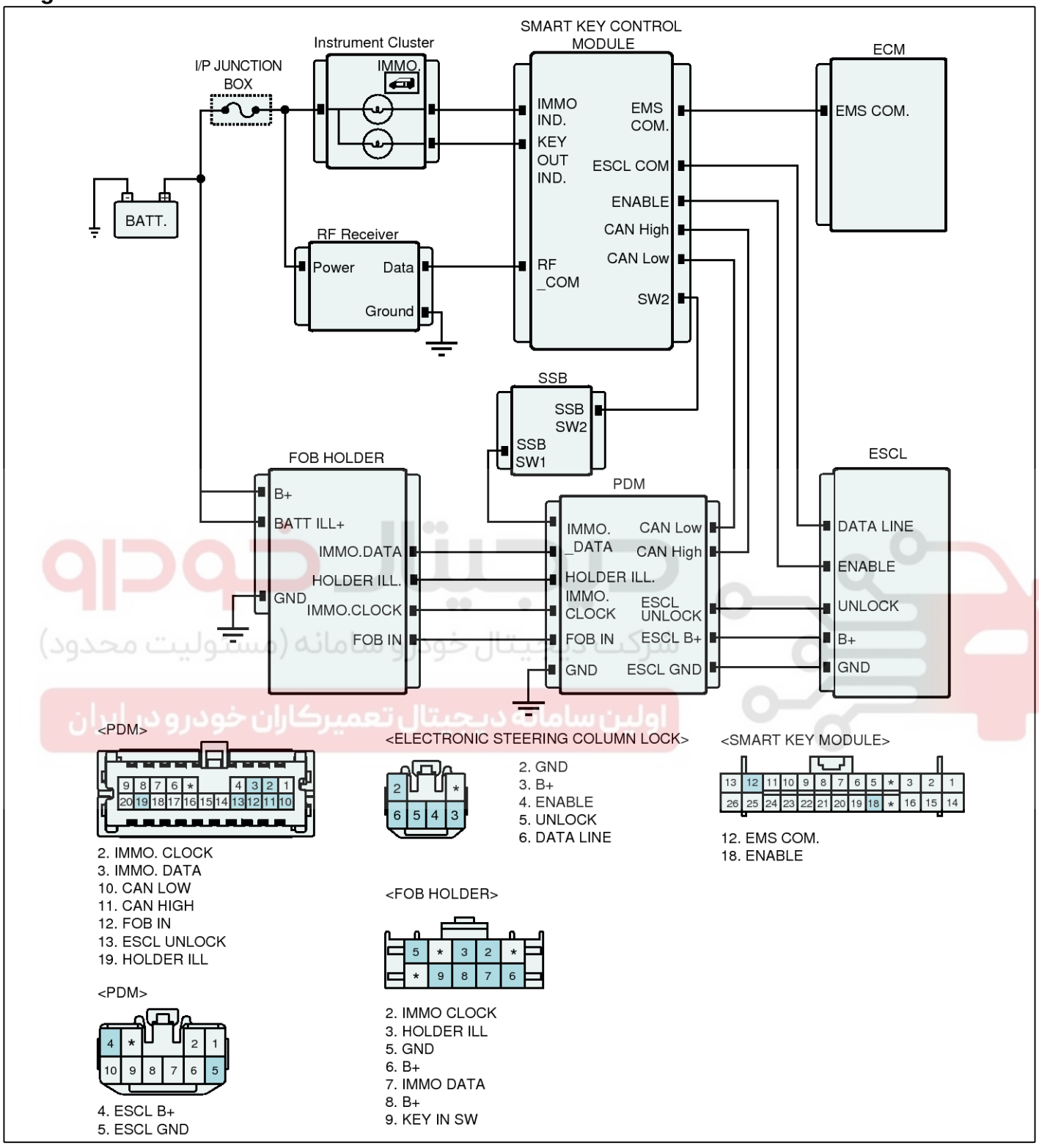
DTC Description

DTC P1690 is set Engine ECM has not received any signals related starting engine, Although Engine ECM sends wake up signal to Smart Key ECM.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
Enable Conditions	• IG ON	• Open or short in circuit • Faulty Smart Key ECM
Detecting time	• 1.5 seconds	
Threshold value	• No response form Smart Key ECM (Communication line error -Open or short)	

Diagnostic Circuit



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Monitor Scantool Data

1. IG KEY "ON" & Engine "OFF".
2. Erase DTC after connecting GDS.
3. Check Smart Key ECM status parameter if DTC is retrieved.

FIG.1

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Fig.1) It shows that 2(two) FOB key is registered, Smart Key ECM is learnt status.

4. Is the smart Key ECM learnt ?

   ▶ Fault is intermittent caused by poor contact in Smart key ECM and/or ECM's connector or was repaired and Smart key ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

   ▶ Go to "Wire Harness Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminal connections.

   Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

   ▶ Repair as necessary and go to "Verification Vehicle Repair" procedure.

   ▶ Go to "Signal Circuit Inspection" procedure.

Signal Circuit Inspection

1. IG KEY OFF.
2. Disconnect Engine ECM connector.
3. IG KEY "ON"
4. Measure voltage between signal terminal of ECM harness connector and chassis ground.

Specification : About 12V

5. Is the measured voltage within specification ?

▶ Go to "Component Inspection" procedure.

▶ Check open or short to signal circuit and then, go to "Verification of Vehicle Repair " procedure.

Component Inspection

■ Check Smart Key ECM Insepction

1. IG KEY "ON" & Engine "OFF"
2. Neutralize smart key ECM with GDS.
3. Perform key teaching procedure for smart key ECM with GDS.

⚠CAUTION

Pin code must be prepared to Neutralize Smart Key ECM and to perform key teaching procedure.

4. Is the neutralization of Smart Key ECM, Engine ECM and key teaching normal ?

▶ Fault is intermittent caused by poor contact in Smart Key ECM and/or ECM's connector or was repaired and Smart key ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

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

NOTICE

■ *PIN code is programmed in Smart key ECM, Transponder, ESCL, PDM and FOB.*

1. *If the Smart key ECM is not registered with PIN, key teaching process is not proceeded .*
2. *Registering PIN is available after Smart Key ECM is neutralized.*
3. *Neutralization of Engine ECM is available with GDS (Registering PIN code)*
4. *If the virgin engine ECM is installed on vehicle, Engine ECM is automatically programmed PIN code by Smart Key ECM.*
5. *Registering PIN code is only possible for virgin or neutralized status.*

■ *It is possible to acess to All of the learning procedue only with GDS.*

And, FOB key must be inserted in FOB holder in order to proceed learning procedure.

(There is only one menu for registering Smart key on the GDS that makes registering all of the component. In case of replacing each module, New registration should be done with GDS)

- *Smart Key ECM Learning*

  1. Before learning procedure for FOB Key, PDM or ESCL, Smart Key ECM should be registered PIN code first.

  2. In case of replacing Smart Key ECM, All of the keys should be newly registered again.

  3. In case that Smart Key ECM receives 3 times with wrong PIN, It is not allowed for neutralization and Key Teaching for 1 hour.

  4. If the battery is discharged during neutralization or Teaching, Timer will start again from begining. Therefore, it is avoidable to wait for 1 hour.

- *PDM Learning*

  1. It is O.K for registering PDM just one time. And, it is available for PDM to neutrailze and re-teach with same PIN code.

  2. In case that Power supply is shut off to ESCL right before first FOB key is registered, Every component status is moved to right before power shut off and previous PIN is used for communication with PDM and IPM

- *ESCL Learning*

  1. It is O.K for registering ESCL just one time. And, it is available for ESCL to neutrailze and re-teach with same PIN code.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect GDS and check "No. of Key learnt, ECM status and Smartkey ECM status
2. Selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC
3. Operate the vehicle within the enable condition and monitor the DTC on the GDS.
4. Are any DTCs present ?

   ▶ Go to the applicable troubleshooting procedure.

   ▶ System is performing to specification at this time.

P1696 Immobilizer-Authentication Fail

General Description

Smart key System consists of transponder, which is in the FOB key head, and Smart key ECM. Smart Key System has FOB holder, which includes antenna coil, to communicate with transponder for immobilizer communication.

Smart Key ECM communicates with PDM via serial communication line so that Smart Key ECM sends signal, FOB key is inserted in FOB holder, to PDM.

FOB is requested authentication from Smart Key ECM by using the LF antenna with LF communication. And then, FOB sends authentication signal through the SRx with RF communication.

With this procedure, Smart Key ECM sends authentication signal to Engine ECM in order to allow the engine start. Finally, ESCL control module release steering lock with authentication.

Authentication for immobilizer is classified two different way. one is pre- authentication and the other is general authentication.

Regardless of success or failure, Pre-authentication makes Immoblizer lamp remains OFF. However, General authentication makes Immobilizer lamp is ON for 30 seconds If authentication is successful. However, if authentication is failed, Immobilizer lamp is OFF for 10 seconds.

■ Condition for Pre-authentication.

1. OFF and Driver door is open when FOB is in passenger compartment (Seek every 3 seconds for 30 seconds.)
2. OFF and Driver door is close when FOB is in passenger compartment
3. FOB is inserted in FOB Holder
4. Pressing Brake padel when FOB is in passenger compartment

■ Condition for general authentication

1. Pressing start butteon when FOB is in the passenger compartment

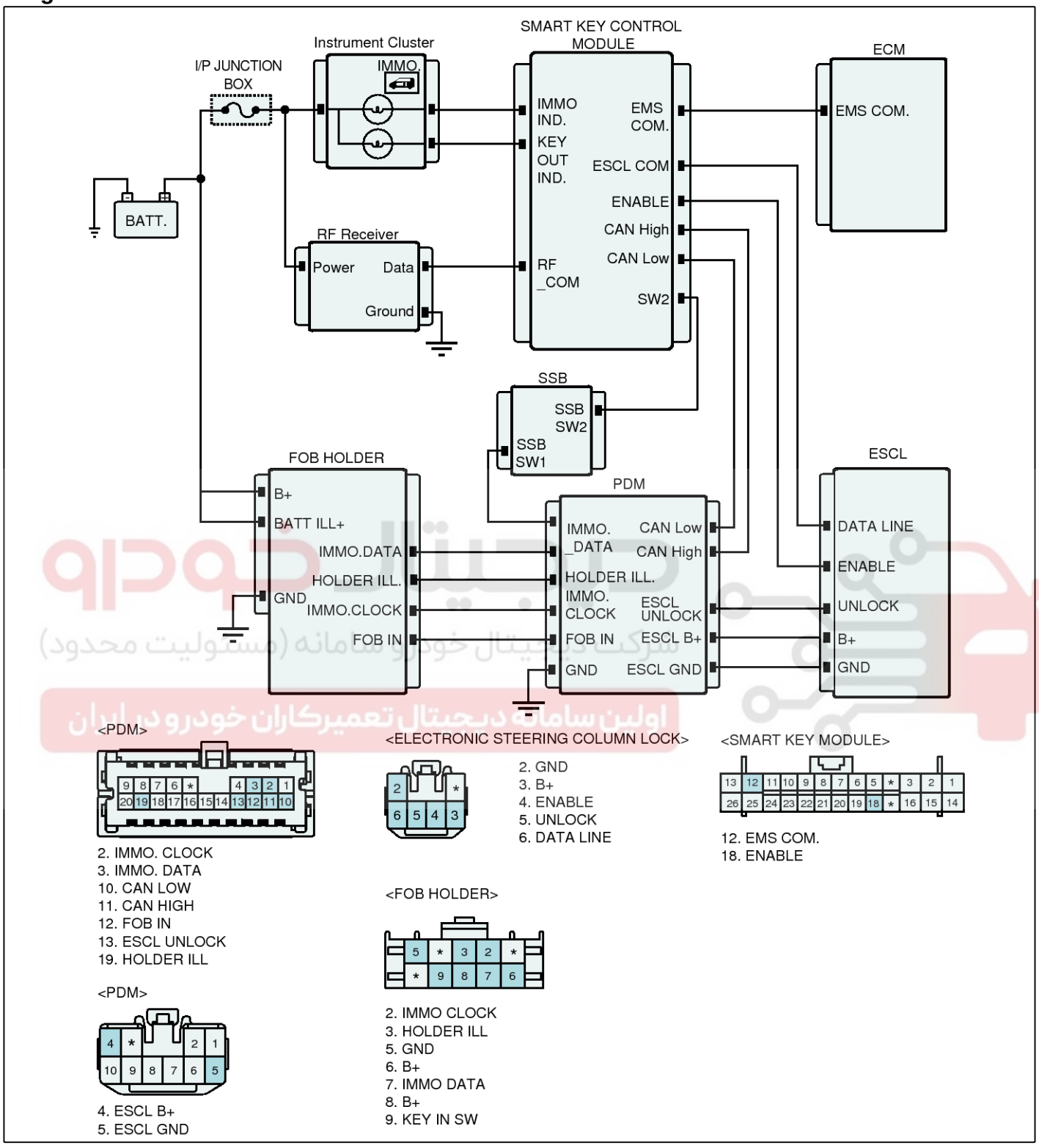
DTC Description

During the Immobilizer authentication, If there is any wrong VIN(Vehicle Identification Number) or MIN(Model Identification Number) signal on the communication message, ECM sets DTC P1696.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
Enable Conditions	• IG ON	• Faulty Smart key ECM
Detecting time	• 1 time	
Threshold value	• Wrong VIN(Vehicle Identification Number), MIN(Model Identification Number) - No DTC P1676 but wrong VIN or MIN	

Diagnostic Circuit



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Monitor Scantool Data

1. IG KEY "ON" & Engine "OFF".
2. Erase DTC after connecting GDS.
3. Check Smart key status if DTC is retrieved.

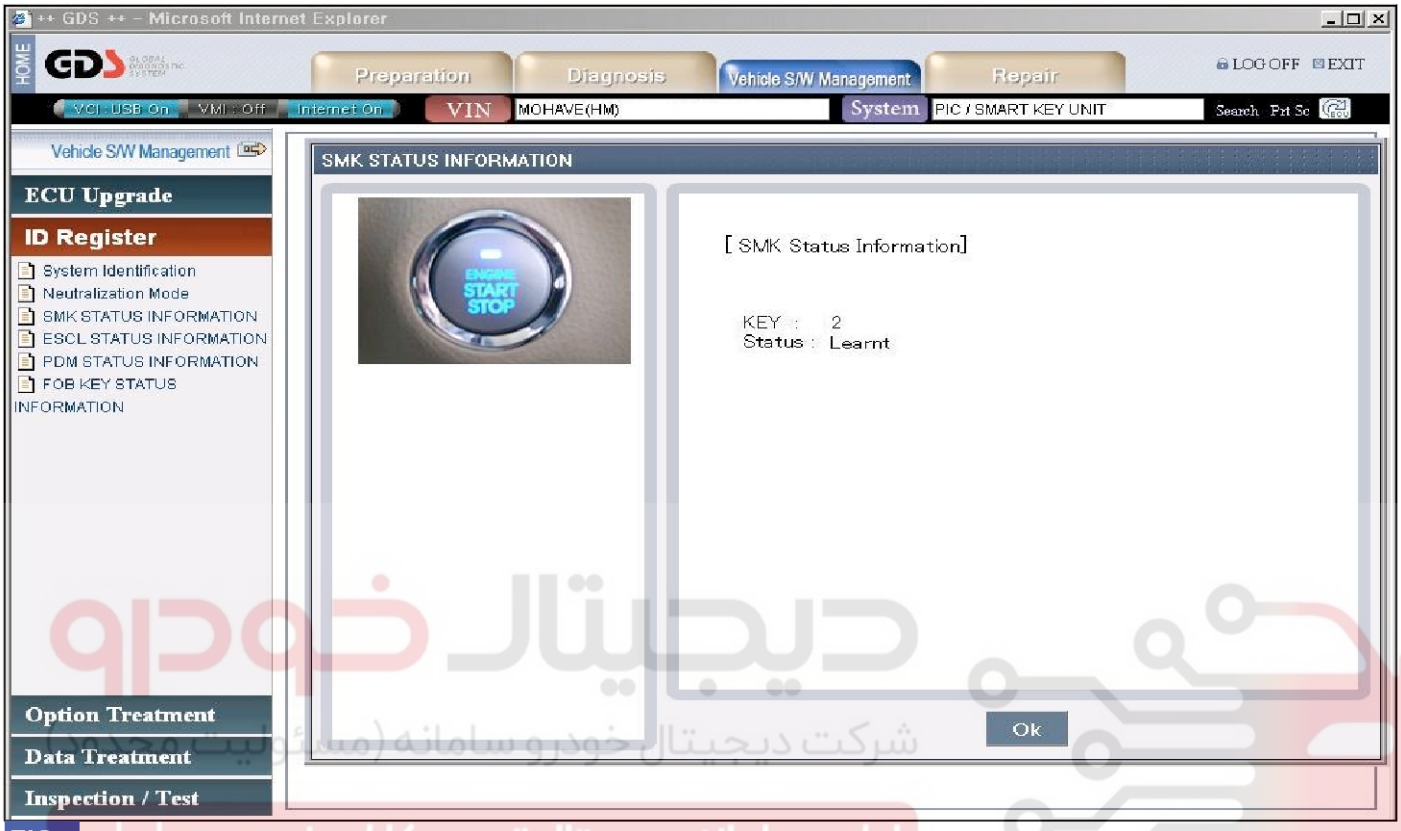

FIG.1

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Fig.1) It shows that 2(two) FOB key is registered, Smart Key ECM(integerated in IPM) is learnt status.

4. Is the Smart key ECM learnt status ?

▶ Fault is intermittent caused by poor contact in Smart key ECM and/or ECM's connector or was repaired and Smart key ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

▶ Go to "Component Inspection" procedure.

Component Inspection

■ Check Smart Key ECM Insepction

1. IG KEY "ON" & Engine "OFF"
2. Neutralize smart key ECM with GDS.
3. Perform key teaching procedure for smart key ECM with GDS.

⚠CAUTION
Pin code must be prepared to Neutralize Smart Key ECM and to perform key teaching procedure.

4. Is the neutralization of Smart Key ECM, Engine ECM and key teaching normal ?

▶ Fault is intermittent caused by poor contact in Smart Key ECM and/or ECM's connector or was repaired and Smart key ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

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

NOTICE

■ *PIN code is programmed in Smart key ECM, Transponder, ESCL, PDM and FOB.*

1. *If the Smart key ECM is not registered with PIN, key teaching process is not proceeded .*
2. *Registering PIN is available after Smart Key ECM is neutralized.*
3. *Neutralization of Engine ECM is available with GDS (Registering PIN code)*
4. *If the virgin engine ECM is installed on vehicle, Engine ECM is automatically programmed PIN code by Smart Key ECM.*
5. *Registering PIN code is only possible for virgin or neutralized status.*

■ *It is possible to acess to All of the learning procedue only with GDS.*

And, FOB key must be inserted in FOB holder in order to proceed learning procedure.

(There is only one menu for registering Smart key on the GDS that makes registering all of the component. In case of replacing each module, New registration should be done with GDS)

- *Smart Key ECM Learning*

  1. Before learning procedure for FOB Key, PDM or ESCL, Smart Key ECM should be registered PIN code first.

  2. In case of replacing Smart Key ECM, All of the keys should be newly registered again.

  3. In case that Smart Key ECM receives 3 times with wrong PIN, It is not allowed for neutralization and Key Teaching for 1 hour.

  4. If the battery is discharged during neutralization or Teaching, Timer will start again from begining. Therefore, it is avoidable to wait for 1 hour.

- *PDM Learning*

  1. It is O.K for registering PDM just one time. And, it is available for PDM to neutrailze and re-teach with same PIN code.

  2. In case that Power supply is shut off to ESCL right before first FOB key is registered, Every component status is moved to right before power shut off and previous PIN is used for communication with PDM and IPM

- *ESCL Learning*

  1. It is O.K for registering ESCL just one time. And, it is available for ESCL to neutrailze and re-teach with same PIN code.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect GDS and check "No. of Key learnt, ECM status and Smartkey ECM status
2. Selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC
3. Operate the vehicle within the enable condition and monitor the DTC on the GDS.
4. Are any DTCs present ?

▶ Go to the applicable troubleshooting procedure.

▶ System is performing to specification at this time.

P1699 Immobilizer-Twice Overtrial

General Description

This is special function that engine can be started for moving to an area where the key learning is processed with twice IG ON. This function is only performed in condtion that Engine EMS, Smart key ECM (integrated in IPM), Transponder, PDM and ESCL are all virgin status.

Engine can be started by the sequence.

■ Ignition ON with no cranking , Ignition OFF, Ignition ON with cranking within a time interval

■ The following timing conditions have to be fulfilled for successful start :

- Engine EMS, Smart key ECM (integrated in IPM), Transponder, PDM and ESCL are all virgin status

1. First Ignition ON more than 0.5 seconds and less than 1.5 seconds.
2. Ignition OFF time is limited by the minimum of 0.2 seconds and the maximum of 1.5 seconds.
3. Ignition ON

The number of engine starts by "twice ignition on" is limited. The maximum value is 32 times regardless of cranking.

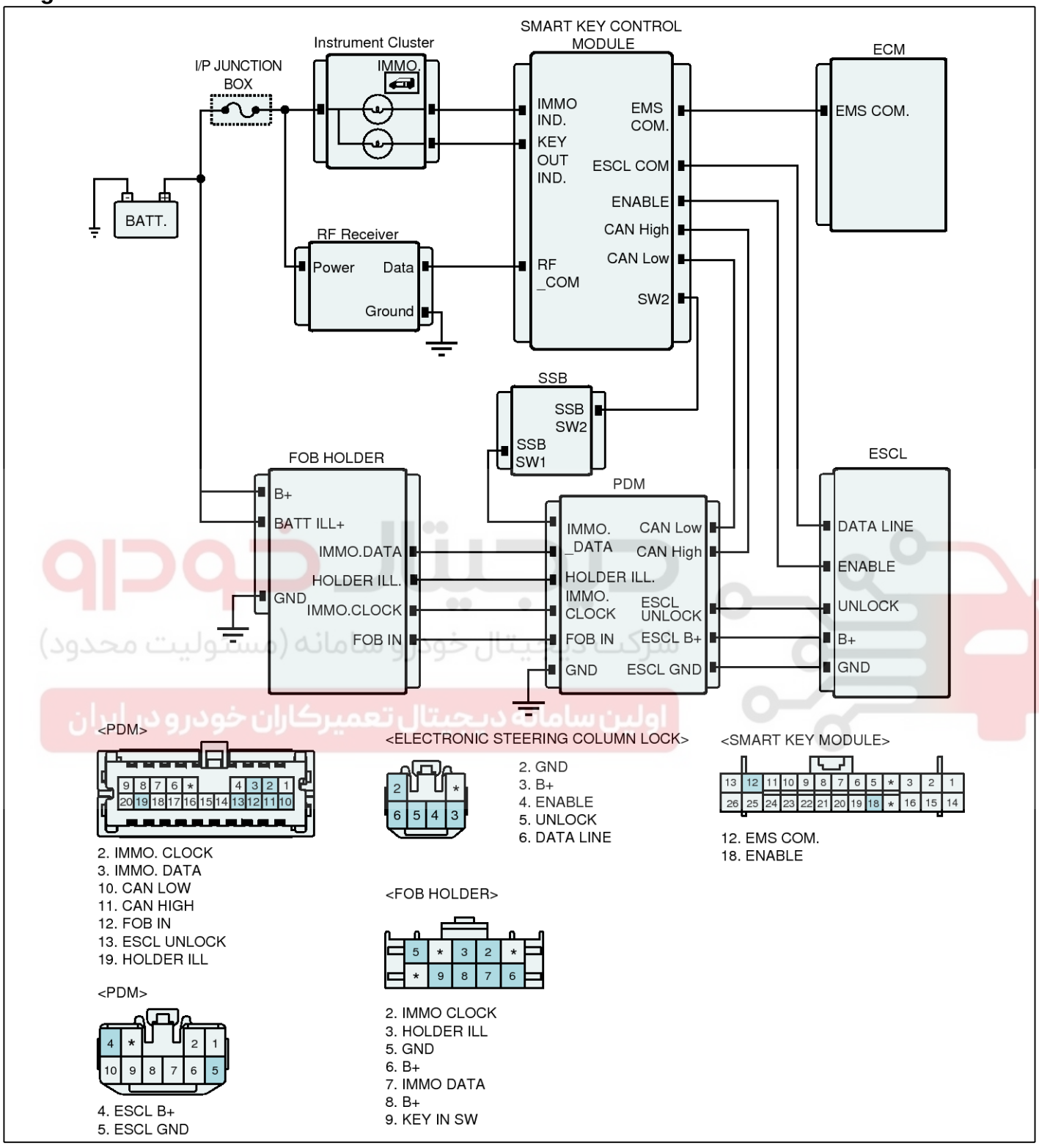
DTC Description

DTC P1699 is set if twice ignition ON exceeds maximum limit over 32 times.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
Enable Conditions	• IG ON	• Exceed the maximum limit of Twice IGN ON
Detecting time	• Exceed the maximum limit of Twice IGN ON (Over 32 times)	

Diagnostic Circuit



SGHBE9A01L

Monitor Scantool Data

1. IG KEY "ON" & Engine "OFF"
2. Connect GDS and select ID Register
3. Check Engine status parameter with GDS

FIG.1

SGHBE9A12L

Fig.1) It shows that ECU is learnt status.

4. Is the ECM status displayed "Lock" ?

   ▶ Wait for 1 hour until ECM status is unlock with IG ON.
   After ECM status is unlock, perform the key teaching procedure. Finally, go to 'Verification of Vehicle Repair"procedure.

   ▶ Fault is intermittent caused by poor contact in Smart Key ECM and/or ECM's connector or was repaired and Smart key ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NOTICE

■ *PIN code is programmed in Smart key ECM, Transponder, ESCL, PDM and FOB.*

1. *If the Smart key ECM is not registered with PIN, key teaching process is not proceeded .*
2. *Registering PIN is available after Smart Key ECM is neutralized.*
3. *Neutralization of Engine ECM is available with GDS (Registering PIN code)*
4. *If the virgin engine ECM is installed on vehicle, Engine ECM is automatically programmed PIN code by Smart Key ECM.*
5. *Registering PIN code is only possible for virgin or neutralized status.*

■ *It is possible to acess to All of the learning procedue only with GDS.*

And, FOB key must be inserted in FOB holder in order to proceed learning procedure.

(There is only one menu for registering Smart key on the GDS that makes registering all of the component. In case of replacing each module, New registration should be done with GDS)

- *Smart Key ECM Learning*

  1. Before learning procedure for FOB Key, PDM or ESCL, Smart Key ECM should be registered PIN code first.

  2. In case of replacing Smart Key ECM, All of the keys should be newly registered again.

  3. In case that Smart Key ECM receives 3 times with wrong PIN, It is not allowed for neutralization and Key Teaching for 1 hour.

  4. If the battery is discharged during neutralization or Teaching, Timer will start again from begining. Therefore, it is avoidable to wait for 1 hour.

- *PDM Learning*

  1. It is O.K for registering PDM just one time. And, it is available for PDM to neutrailze and re-teach with same PIN code.

  2. In case that Power supply is shut off to ESCL right before first FOB key is registered, Every component status is moved to right before power shut off and previous PIN is used for communication with PDM and IPM

- *ESCL Learning*

  1. It is O.K for registering ESCL just one time. And, it is available for ESCL to neutrailze and re-teach with same PIN code.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

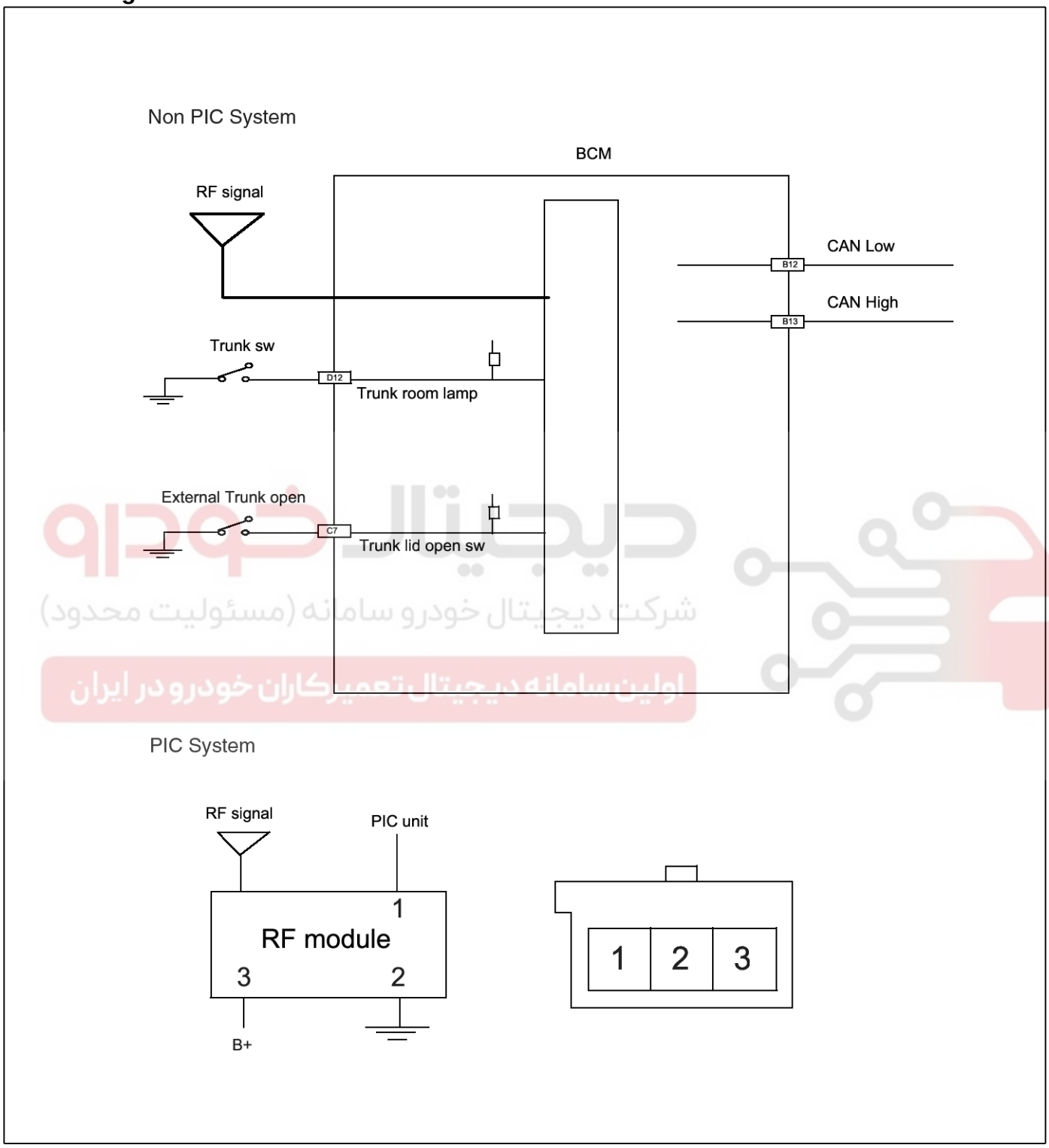
1. Connect GDS and check "No. of Key learnt, ECM status and Smartkey ECM status
2. Selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC
3. Operate the vehicle within the enable condition and monitor the DTC on the GDS.
4. Are any DTCs present ?

   ▶ Go to the applicable troubleshooting procedure.

   ▶ System is performing to specification at this time.

Keyless Entry And

Circuit diagram



LTCD038A

Description

The keyless entry and burglar alarm system consists of ETACS components, Transmitter and receiver (without PIC system).

When anybody attempts to forcibly enter the car or open trunk lid or engine hood without a key, or when the battery terminals are removed and reconnected, the burglar alarm system sounds the siren for about 30 seconds as an alert.

At the same time, it locks the entire door and electrically disconnects the starting system.

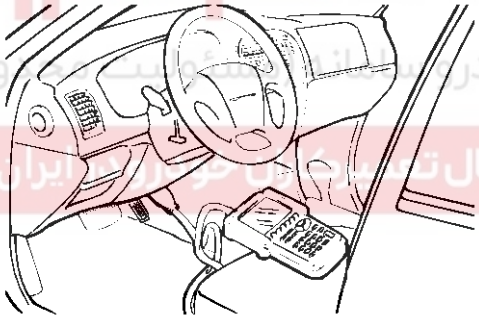
Also, the keyless entry system is able to lock and unlock all of the doors, open the trunk at a distance, transmitting a weak radio wave from a transmitter.

NOTICE

- *The receiver is located at the back of the glove box.*
- *In case of non PIC system, the receiver is integrated in the BCM.*

Transmitter code saving method

1. To store transmitter code, connect Hi-scan adapter to the OBD connector (16 pins) in driver side crash pad lower panel, turn the power on hi-scan.



EFA9100A

2. Select "OPIRUS" and then do "CODE SAVING".
3. After selecting "CODE SAVING" menu, button "ENTER" key, then the screen will be shown as below.

KEYLESS ENTRY CODE SAVING

REMOVE THE IG. KEY FROM KEY CYLINDER.

PRESS [ENTER], IF YOU ARE READY!

ETAC065M

4. After removing the ignition key from key cylinder, push "ENTER" key to proceed to the next mode for code saving.

KEYLESS ENTRY CODE SAVING

1. PRESS THE TRANSMITTER [LOCK] BUTTON ABOVE 1 SECOND.
2. IF SAVE ONE MORE PRESS OTHER TRANSMITTER [LOCK] BUTTON ABOVE 1 SECOND.
3. TURN THE HI-SCAN OFF, AND CHECK THE KEYLESS ENTRY SYSTEM.

ETAC065N

5. Follow steps 1 to 3 and then code saving is completed.

NOTICE

If button is pushed twice, code saving procedure will be finished when the first transmitter code saving.

6. Disconnect Hi-scan adapter from OBD connector and then check the function of transmitter.

NOTICE

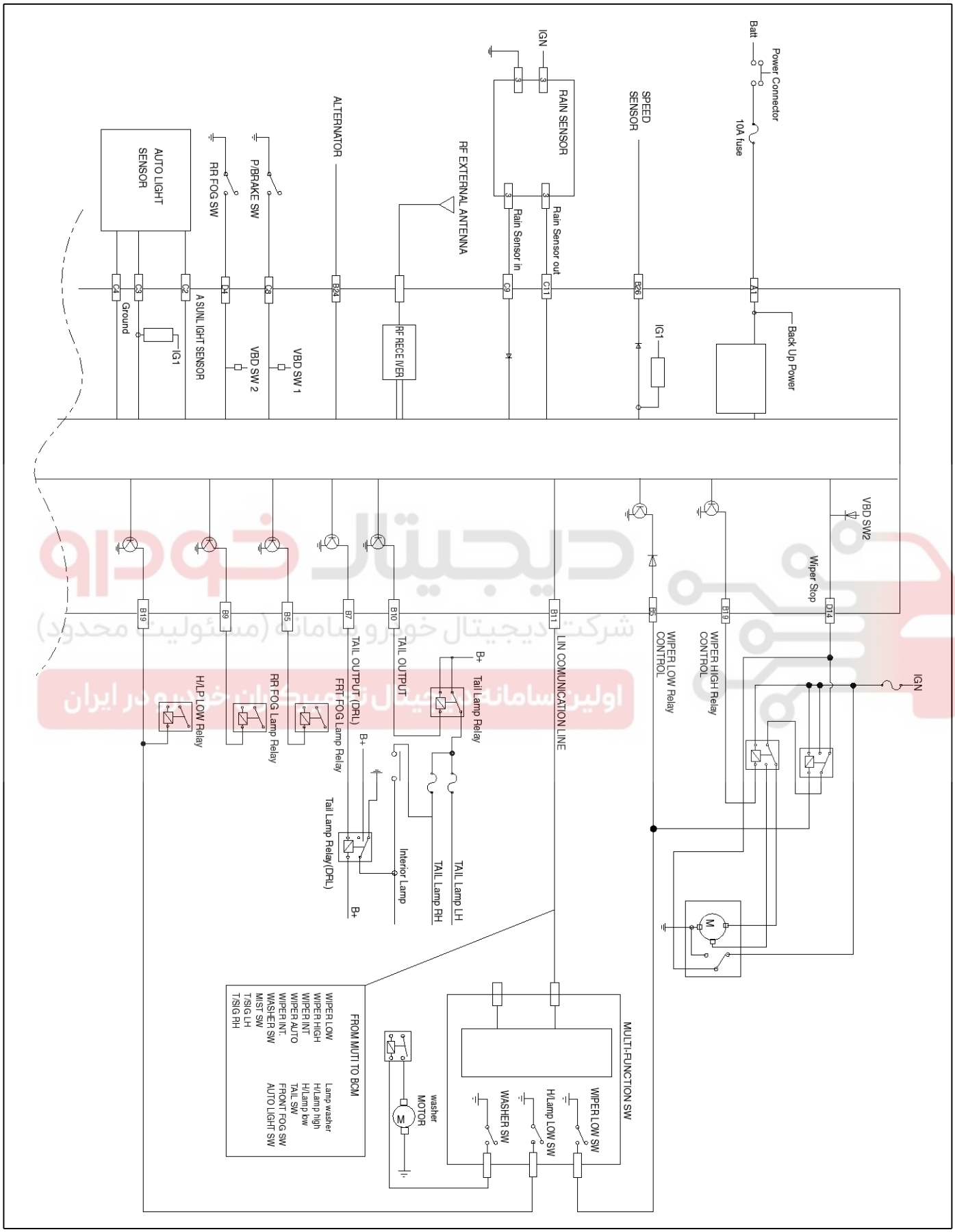
Once the coding procedure is finished, the operator has to push the door lock button of each coded transmitter to check transmitters are operational, a door lock / unlock action is done.

Specifications

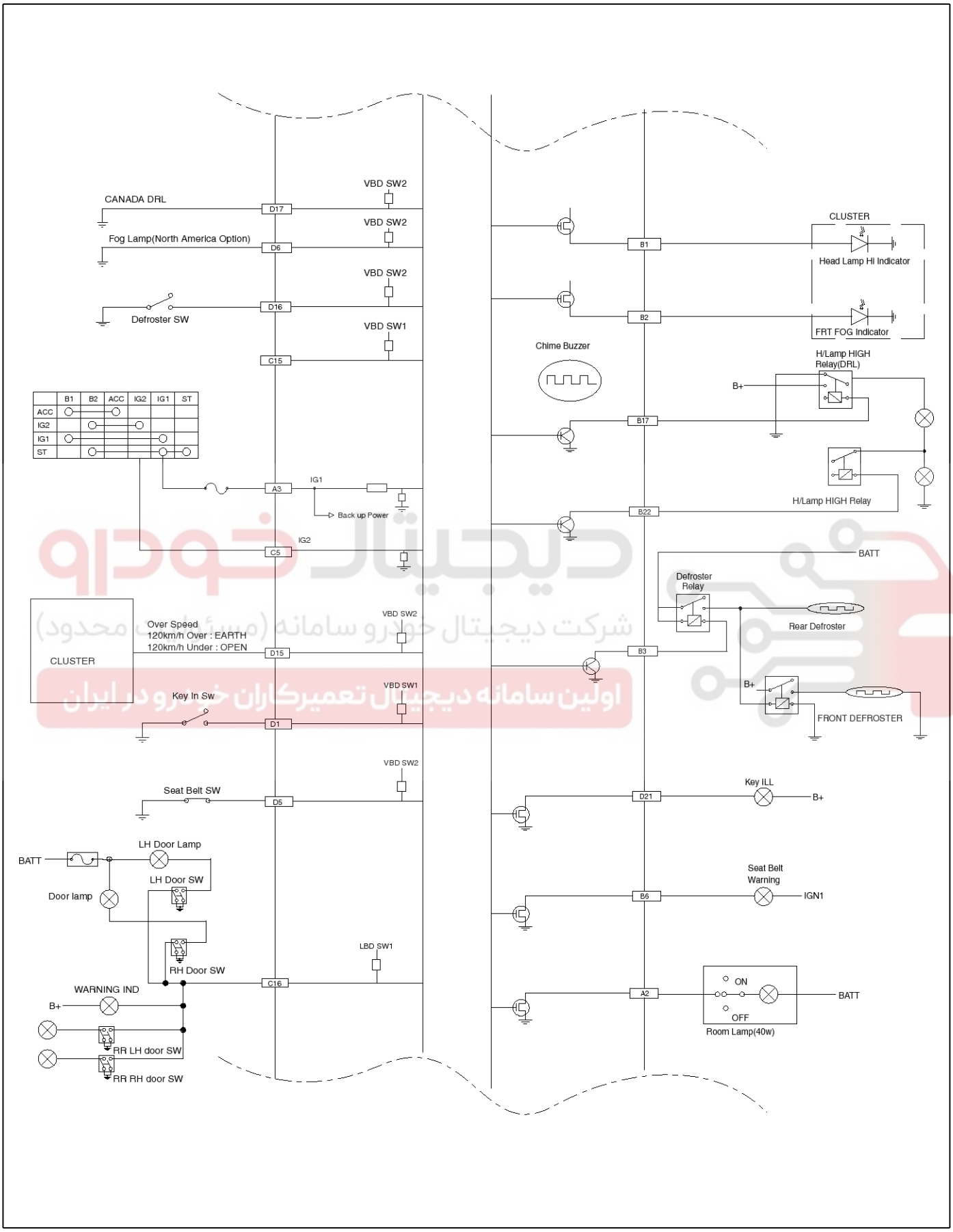
Items	Specifications
Keyless entry transmitter	
Power source	Lithium 3V battery (1EA)
Transmissible distance	10m or more
Life of battery	2 years or more (at 20 times per day)
Button	Door lock, door unlock, trunk lid open
Transmission frequency	433 MHz (Europe / General)
Receiver	
Operating voltage	DC 9V ~ 16V
Operating temperature range	-30℃ ~ +75℃
Maximum standby current	3mA or less
Output pattern	Door lock, door unlock, trunk lid open
Modulation type	ASK (Amplitude Shift Keying)

ETACS (Electronic Time

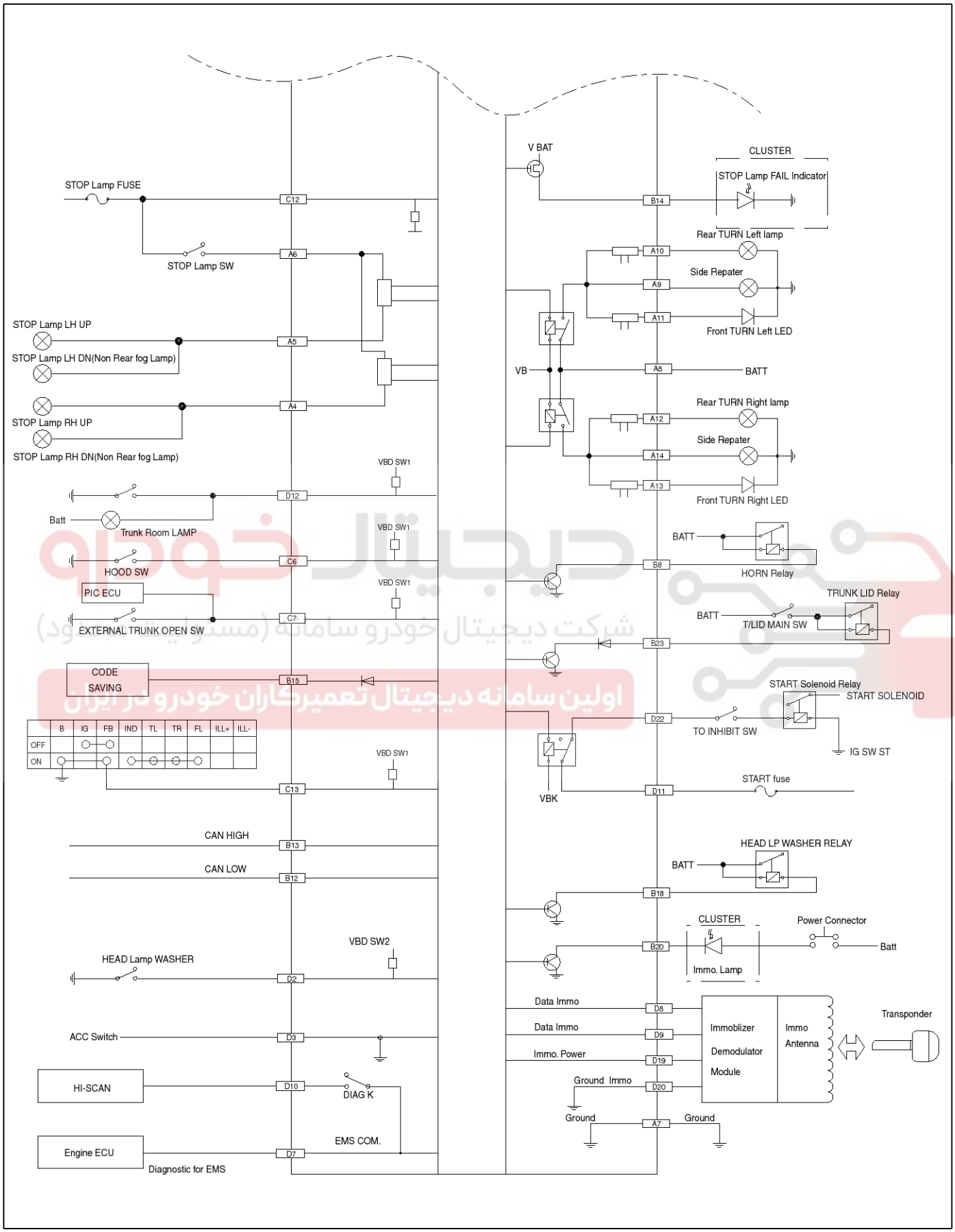
Circuit diagram



LTCD399A

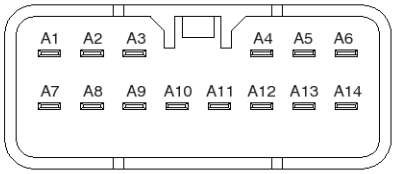


LTCD399C

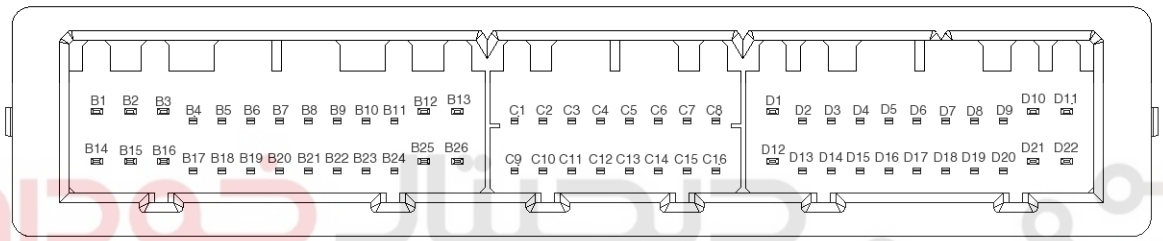


LTCD399D

Connector configurations



CONNECTOR A	
Pin. No.	DESCRIPTION
A1	BATTERY
A2	ROOM LAMP
A3	IG1
A4	BRAKE RH
A5	BRAKE LH
A6	BRAKE SW
A7	GROUND
A8	TURN
A9	TURN LH S
A10	TURN LH R
A11	TURN LH F
A12	TURN RH R
A13	TURN RH F
A14	TURN RH S



CONNECTOR B	
Pin. No.	DESCRIPTION
B1	H/L HIGH IND
B2	FRONT FOG IND
B3	DEFFROSTER RELAY
B4	N/C
B5	WIPER LOW RELAY
B6	SEAT BELT
B7	DRL RELAY
B8	HORN RELAY
B9	REAR FOG RELAY
B10	TAIL LAMP RELAY
B11	LIN
B12	CAN L
B13	CAN H
B14	STOP LAMP FAIL IND
B15	CODE SAVE
B16	H/L LOW RELAY
B17	DRL CANADA
B18	HEAD LAMP WASHER
B19	WIPER HIGH RELAY
B20	IMMO LAMP
B21	FRONT FOG RELAY
B22	H/L HIGH RELAY
B23	TRUNK LID RELAY
B24	ALT L
B25	N/C
B26	SPEED SENSOR

CONNECTOR C	
Pin. No.	DESCRIPTION
C1	N/C
C2	SUNLIGHT SENSOR
C3	SUNLIGHT VOLTAGE
C4	GROUND
C5	IG2
C6	HOOD
C7	TRUNK OPEN SW
C8	PARK BRAKE
C9	RAIN SENSOR
C10	N/C
C11	RAIN SENSOR
C12	BRAKE FUSE
C13	HAZARD
C14	N/C
C15	N/C
C16	ALL DOOR OPEN

CONNECTOR D	
Pin. No.	DESCRIPTION
D1	KEY IN
D2	HEAD LAMP WASHER
D3	ACC
D4	REAR FOG
D5	SEAT BELT
D6	FOG(NORTH AMERICA)
D7	EMS COM
D8	DATA IMMO
D9	DATA IMMO
D10	DIAG K
D11	START
D12	TRUNK LAMP SW
D13	N/C
D14	WIPER STOP
D15	OVERSPEED
D16	DEFROSTER
D17	DRL CANADA
D18	N/C
D19	IMMO POWER
D20	GND IMMO
D21	KEY ILL
D22	BURGLAR ALARM

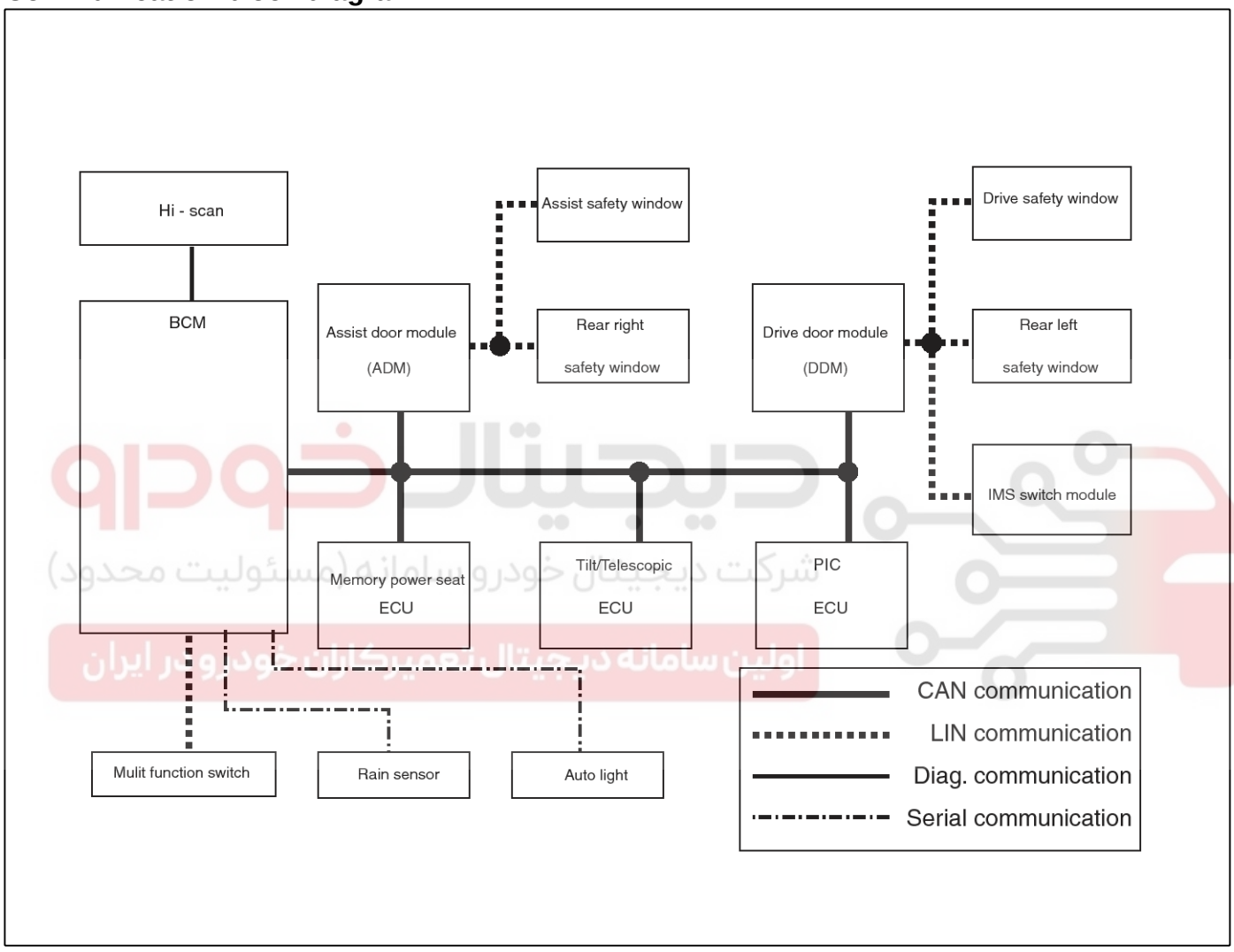
LTCD399B

Description

Body control module(BCM) unifies the function of ETACS module, mirror folding unit, immobilizer unit, flasher unit, door lock relay, chime bell and keyless entry antenna.

BCM practices diagnosis with Hi-scan to find out input or output error.

Communication block diagram.



LTCD390A

General operation

1. Wiper and washer control(Rain sensor)
2. Lamp control(Head lamp, Tail lamp, Fog lamp, Stop lamp, Daytime running light, Turn signal lamp, Auto light)
3. Magnetic buzzer sound and timer control
4. Anti-theft and Radio frequency remote control
5. Multi-mode keyless entry function
6. Immobilizer (refer to the immobilizer system)
7. Self diagnostic function

Wiper and washer control (Rain sensor)

Wiper control

1. Low speed control

   In IGN2 ON State, if there is wiper low input (LIN communication), then wiper low relay output is turned ON.

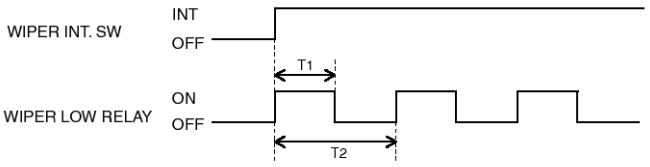
2. High speed control

   In IGN2 ON State, if there is wiper high input (LIN communication), then both wiper low and wiper high relay outputs are turned ON.

3. Speed sensing int. wiper (without rain sensor option)

   Vehicle speed and int. time volume control the interval time of int. wiper.

   In IGN2 ON State, if there is wiper int. input (LIN communication), then wiper is controlled by vehicle speed and wiper int.



T1 : 0.7±0.1 sec, T2 : Interval time

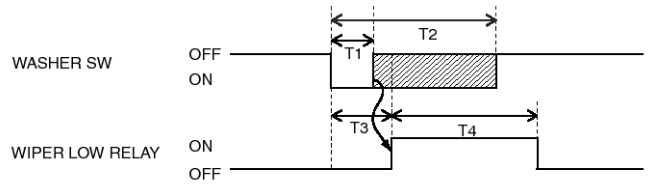
LTCD391A

4. Wiper control by mist sw(multi-function sw)

   In IGN2 ON state, if mist sw input is ON then wiper low relay output is turned ON until mist sw is OFF.

Wiper motor control for washer

1. Mist mode washing(washer sw input : 0.2sec ~ 0.6sec)
   a. Washer sw is OFF
   b. If the duration of washer sw input is measured from 0.2sec to 0.6sec.
   c. After T3, the wiper low relay output is ON for 0.7sec. (For 1 Time wiping)

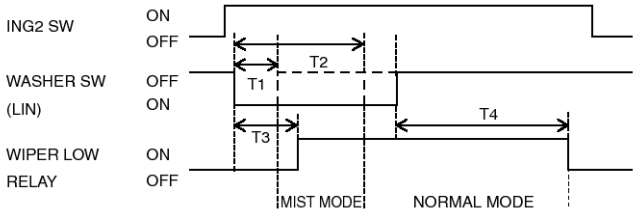


T1:0.2sec, T2:0.6sec, T3:0.3sec, T4:0.7±0.1sec

LTCD391B

2. Nominal mode washing(washer sw input : more 0.6 sec)
   1) Condition 1
      a. Washer sw is OFF
      b. If washer sw is ON more than 0.6 sec.
      c. The wiper activation output is on after T3(0.3sec)
   2) Condition 2
      a. Nominal mode washing & washer sw on
      b. If washer sw is OFF
      c. The wiper motor stops wiper after 2.5 ~ 3.8 sec later.

      (Wiper low relay is OFF after 3 sec later)



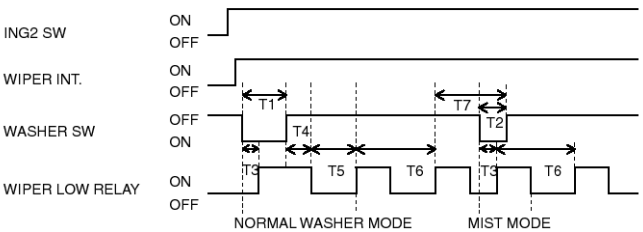
T1:0.2sec, T2:0.6sec, T3:0.3sec, T4:3sec

LTCD391C

3. Washer function during wiper int. mode
   1) Condition 1
      a. IGN2 SW ON & wiper int. mode
      b. If washer sw is ON more than 0.6sec
      c. The wiper activation output is on after T3 (0.3 sec.)
   2) Condition 2
      a. Washer mode (During wiper int.)
      b. If washer sw is OFF
      c. The wiper motor will stop wiper after 2.5 ~ 3.8 sec later.

      (Wiper low relay is OFF after 3 sec later)

      (i.e. Resume wiper int. mode after 2.5sec~3.8sec)
   3) Condition 3
      a. Wiper int. mode
      b. The duration of wiper sw input is measured from 0.2sec to 0.6sec.
      c. After T3, the wiper low relay output is ON for 0.7sec.

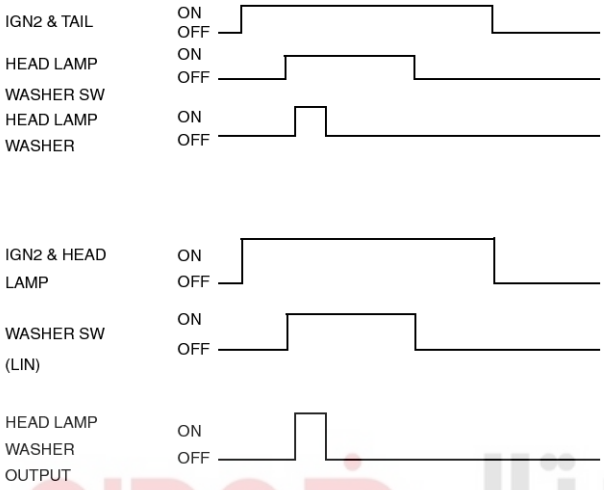


T1:more than 0.6sec, T2:0.2~0.6sec, T3:0.3sec, T4:3sec
T5:0.6~0.7sec, T6:INT. time, T7:T6 within T6

LTCD391D

Head lamp washer function

1. In case of IGN2 = ON & TAIL LAMP = ON status, if head lamp washer switch input is detected, head lamp washer output is turned ON.
2. In case of IGN2 = ON & HEAD LAMP = ON status, if washer switch input is detected, head lamp washer output is turned ON.



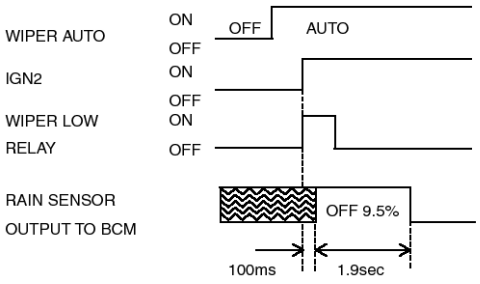
ATCD392A

Rain sensing wiper

In IGN2 ON state, if auto sw input (LIN communication) is ON then both wiper low relay and wiper high relay outputs are controlled by the rain sensor input signal 1.

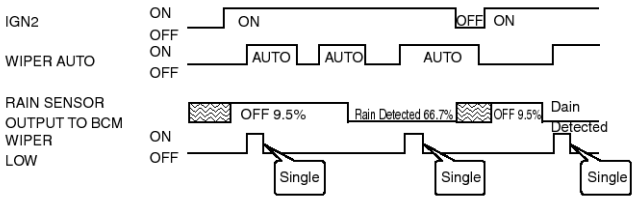
When the wiper switch is moved to auto position and the Ignition switch is in IGN2 position, the Rain sensor is considered to be in “automatic” mode

1. If the wiper switch has been left in automatic mode with the vehicle ignition OFF, and then the vehicle ignition switch is turned on, a single wipe will be performed.



ATCD392B

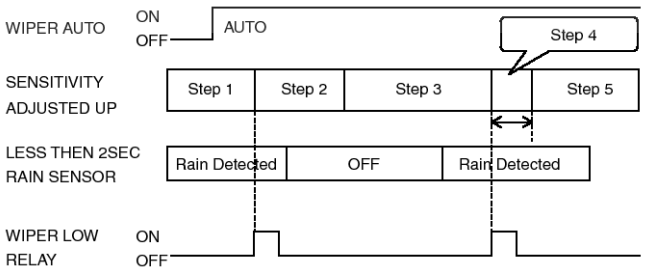
2. A single wipe will be performed whenever rain has been detected(Rain Detected signal from Rain sensor) and the wiper switch is moved to the AUTO position. But a single wipe will not be performed when the wiper switch is moved to the AUTO position and OFF signal is being received from Rain sensor. But if the wiper switch is moved to AUTO position for the first time since vehicle ignition switch is turned on then a single wipe will be performed regardless of rain detected or OFF signal.



ATCD392C

3. Sensitivity Adjustment Function (Instant Wipe Function)

   The drive may adjust the rain sensor performance by adjusting the sensitivity input. When in AUTOMATIC mode, the BCM will perform a single wipe each time the sensitivity is adjusted upward to a more sensitive setting(downward more then onestep). This single wipe will only be performed if Rain Detected signal is being received from the Rain sensor. If thesensitivity adjustment is adjusted upward more than one sensitivity, the BCM will only perform a single wipe unless thetime between Increases is more than 2 seconds.



LTCD392D

Lamp control (Head lamp, Tail lamp, Fog lamp, Daytime Running Light, Stop lamp, Turn signal lamp, Auto light)

Tail lamp auto cut

1. General control

   In battery ON State, if tail sw input is ON, tail lamp relay output is ON

2. Tail lamp auto cut in non-pic option

The auto-cut strategy ensures that tail lamps are turned off even if the driver forgets to turn them off.

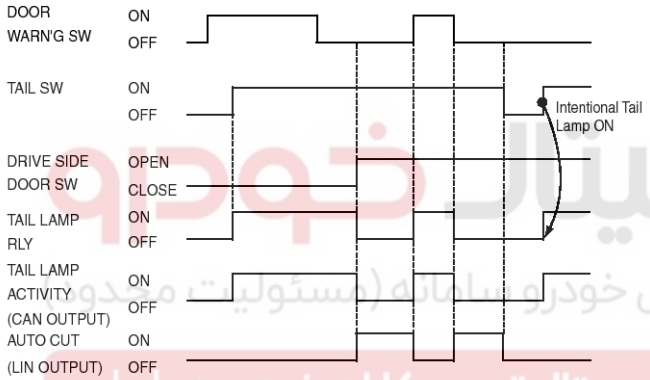
The tail lamp is turned On by tail sw after door warning sw (KEY IN) ON, then after if the user sets door warning sw (KEY IN) OFF and opens the driver side door, the tail lamp is automatically cut.

Also at the state door warning sw(KEY IN) ON, when door warning sw(KEY IN) is turned OFF after opens the driver side door, the tail lamp is automatically cut.

(The switch detection sequence of door warning sw (KEY IN) and driver door sw is ignored.)

After “AUTO CUT”, the “AUTO CUT” function is disabled and tail lights are turned On if the driver turns ON the tail sw or key in.

If tail lamps are turned ON again by key in sw or tail lamp sw, the AUTO CUT function is disabled.



ATCD393A

3. Tail lamp auto cut function in PIC option
   1) The case of without limp home condition

      The state of ACC OFF and tail lamp output On, if Driver side Door is opened, the tail lamp is automatically cut.

      Also after driver side door is opened, if ACC is turned OFF, the tail lamp is automatically cut.

   2) The case of Limp Home condition

      Tail lamp auto cut function is operated the same method of Non-PIC option.

Head lamp control

1. In IGN1 ON State, if there is head lamp low sw input (LIN communication), head lamp low relay output is turned ON.
2. In IGN1 ON State, If head lamp high sw input (LIN communication) and head lamp low relay is detected then head lamp highrelay output is turned ON. Which means the head lamp high relay and also the head lamp high indicator on the cluster.
3. In IGN1 ON State, If head lamp passing input (LIN communication) is detected then head lamp high relay output and head lamp low relay are turned ON.

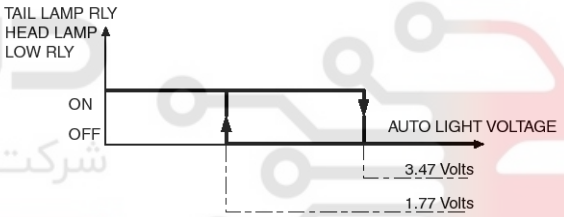
Auto light control

In the state of IGN1 On, when multi function sw module detects auto light sw on, tail lamp relay output and head lamp low relay output are controlled according to auto light sensor’s input.

The auto light control doesn't work if the pin sunlight supply (5V regulated power from Ignition 1 power to sunlight sensor) is in short circuit with the ground.

If IGN1 = ON, The BCM monitors the range of this supply and raises up a failure as soon as the supply’s voltage is out of range. Then this failure occurs and as long as this is present, the head lamp must be turned on without taking care about the sunlight level provided by the sensor.

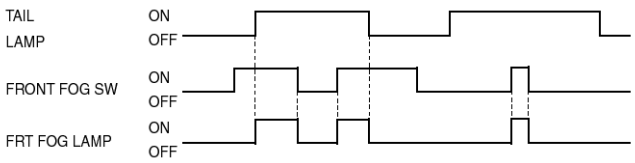
This is designed to prevent any head lamp cut off when the failure occurs during the night.



LTCD393B

Front fog lamp control

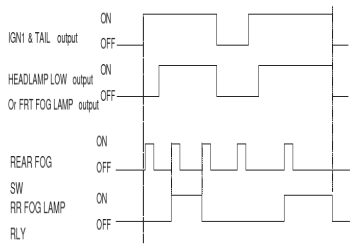
In case of tail lamp output = ON status, if front fog sw input is detected (LIN communication), front fog lamp relay output is turned ON.



ATCD393C

Rear fog lamp control

In case of (IGN1 & tail output) and [(head lamp low output) or (front fog lamp output) is turned ON], if rear fog sw is pushed, rear fog lamp is turned ON.



LTCD393G

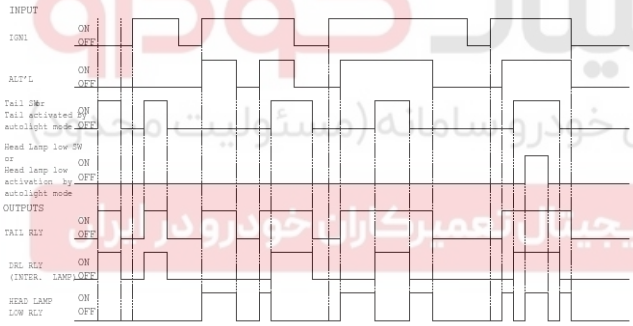
Daytime running light control

1. The DRL relay is to manage the Interior lamp when tail activity activated by tail M/F switch is set or auto light is set (out of DRL activating the Tail).
2. Release condition :

   Tail lamp activated by M/F or ALCS or Head lamp Low activated by M/F or ALCS

NOTICE

Head lamp low/tail lamp outputs include cases of activation by switches and also by auto light.



LTCD393H

Turn signal and hazard control

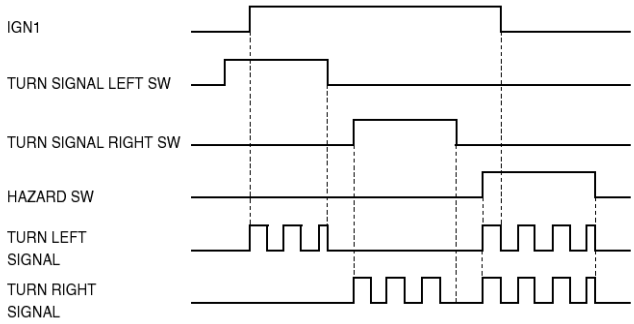
1. Normal operating condition

   Turn signal period : 85+/-10 period/min

   While IGN2 is on, if turn signal left sw or turn signal right sw or hazard sw input is detected, then turn signal outputs are turned ON following the switch input (left, right or hazard).

NOTICE

Priority : hazard > turn signal



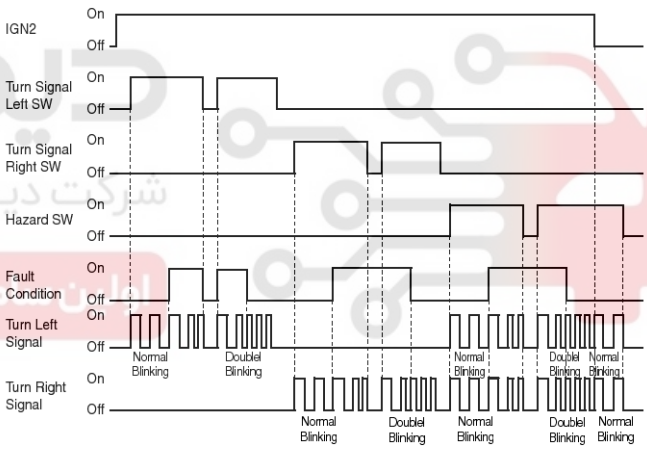
ATCD393D

2. Lamp failure condition

   When one of the front or rear is broken-down (Lamp failure), the turn signal blinks with double frequency.

   The double blinking works at IGN2 ON condition, double blinking for Hazard: Except side lamp, if any error condition is detected then triggered the double blinking.

   Period : More than 120 Cycle/min



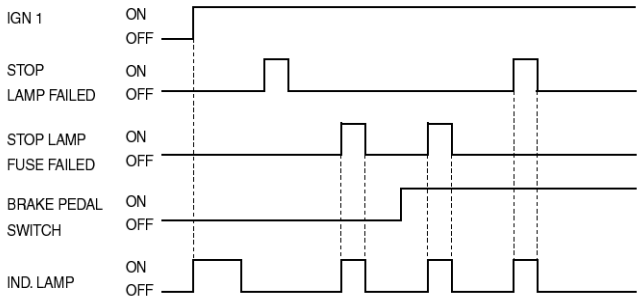
ATCD393E

Stop lamp failure control

The purpose of this function is to indicate stop lamp(s) failure and brake fuse failure. Depending on foot brake pedal switch input, brake fuse and lamp failure is detected.

In IGN1 ON State, when stop lamp fuse is failed (stop lamp failed = ON) or when a stop lamp failure is detected (stop lamp fuse failed = ON), then indicator lamp output is turned ON.

When Brake pedal is pedaled, the stop lamp failure is detected. The stop lamp failure is confirmed after a delay of 200 ms.. When the failure disappears the present failure is cleared thanks to the fault manager.



ATCD393F

Magnetic buzzer sound and timer control

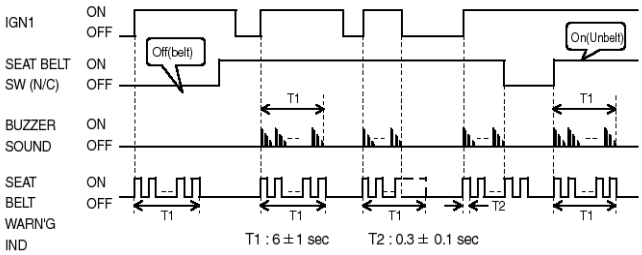
Magnetic buzzer sound control

Sound priority

- 1st : Diagnostic sound (provided to test the Buzzer by way of Diagnostic tool)
- 2nd : Seatbelt warning
- 3rd : Overspeed warning (Middle east area)
- 4th : FOB key operated warning
- 5th : Gear box selector lever warning (PIC option only)
- 6th : “MSL not blocked” warning (PIC option only)
- 7th : Key learning sound (Learning with diagnostic tool)
- 8th : Warnings for PIC system (2 warnings - PIC option only)

1. SEAT BELT WARNING TIMER
   1) Seat belt warning lamp and warning sound stop at IGN1 OFF during the operation.

      With a seat belt sw on, warning sound stops immediately but seat belt warning indicator continues working for the remained time.
   2) Warning lamp and warning sound are always activated for one period if seat belt is released after seatbelt was fastened during IGN1 ON status.
   3) If IGN1 is turned OFF during seat belt warning, the seat belt warning indicator and buzzer stops immediately.
   4) Whether the seat belt is fasten or not, BCM detected IGN ON signal, Seat belt warning Indicator should be triggered for defined timing but buzzer warning should follow the status of seat belt switch.



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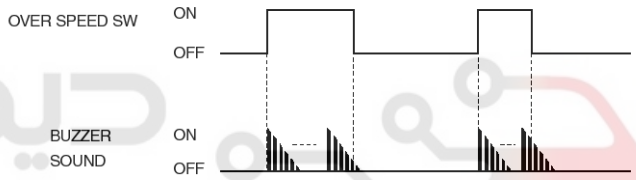
2. Overspeed warning Function Description (Middle east area)

   If vehicle runs over 120km/h, the cluster input is to be set.

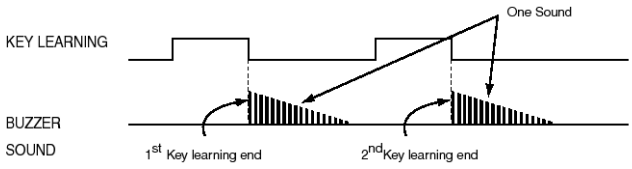
   When the cluster input indicates that vehicle runs over 120km/h, the over speed warning starts



ATCD394B

3. FOB key learning sound

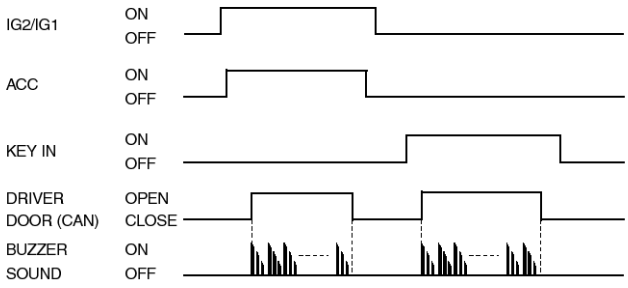
   When each Key’s learning is ended, magnetic buzzer is operated, every one time.



ATCD394C

4. Key operated warning (Key reminder warning)
   1) While IGN KEY is inserted into the key cylinder or ACC is on or IGN2 is on or IGN1 is on, if driver side door is opened. Key operated warning starts.
   2) If the key is pulled out from key cylinder and ACC = IGN2 = IGN1 = OFF, or if driver side door is closed, then the key operated warning stops immediately.

3) Duration : Permanent (The key operated warning continues permanently if the condition has not changed)



ATCD394D

5. Gear box selector lever warning (PIC option only)

   While the gear box selector lever is not in P-position and driver door is open, the buzzer warning sound is activated.

   The above condition is tested by PIC ECU and informed via CAN.

   If BCM does not receive the CAN signal, Gear Box selector lever warning sound is stopped after 5 sec.

6. MSL not blocked" warning (PIC option only)

   While the MSL (Mechatronics Steering Lock) is not blocked and driver door is open, the buzzer warning sound is activated.

   The above condition is tested by PIC ECU and informed via CAN.

   If BCM does not receive the CAN signal, "MSL not blocked" warning sound is stopped after 5 sec.

7. PIC system warnings (PIC option only)

   2 warning sounds are necessary for the PIC system in the following cases :

   FOB out warning

   When receiving the "FOB out warning" command from PIC ECU via CAN (meaning that FOB is found outside the vehicle), the warning sound starts.

   Deactivation of FOB

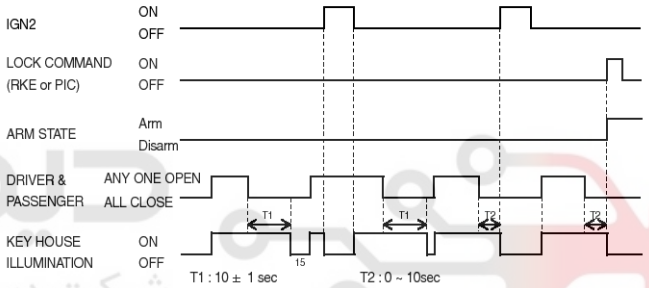
   When receiving the "Deactivation of FOB" warning command from PIC ECU via CAN (meaning that FOB are deactivated), the warning sound starts.

   The "Deactivation of FOB" warning sound stops, when Anti Theft Warning System status is "disarmed" (disarm, auto lock timer or wait mode).

IGN key hole illumination

1. Turn On Condition
   a. IGN2 OFF
   b. Door open ((front left door sw = ON) OR (front right door sw = ON))
   c. IGN key hole illumination is turned on. key hole illumination = ON
2. 10 sec illumination condition
   a. Turn on condition
   b. Door close ((front left door sw = OFF) and (front right door sw = OFF))
   c. The IGN key hole is illuminated for 10 sec.

   If doors open again during 10sec illumination, the turn ON condition starts again.
3. Illumination stops condition
   a. IGN key hole is illuminated
   b. IGN ON or Entered arm mode (by RKE or PIC)
   c. IGN key hole illumination is turned off immediately. key hole illumination = OFF



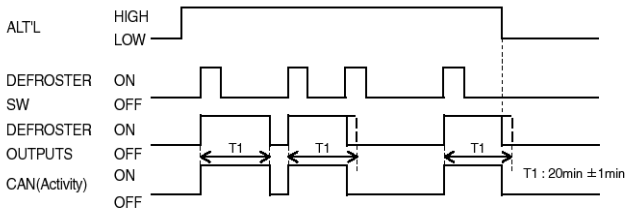
ATCD394E

Defroster timer

1. Condition 1
   a. Alternator level high & defroster is OFF

   (Defroster relay = OFF and defogger activity = OFF)
   b. Defroster is activated (defroster sw = ON)
   c. Defroster outputs are turned ON
2. Condition 2
   a. Alternator level high & defroster is ON
   b. Defroster sw Input pushed again or T1 delay has elapsed since defroster has been turned on
   c. Defroster outputs are turned OFF
3. Condition 3

   If alternator input is changed to low, defroster outputs should be turned OFF immediately.



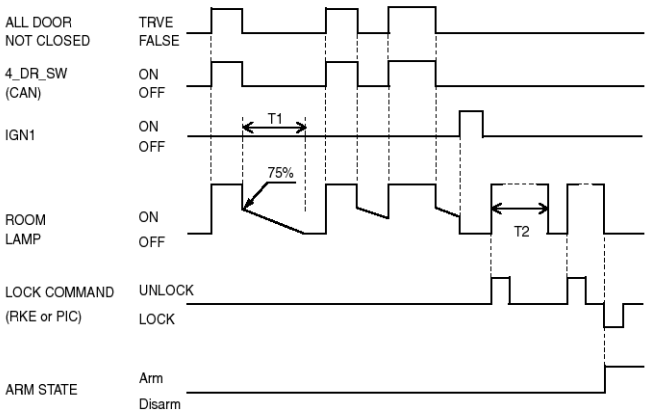
ATCD394F

Decayed room lamp

1. Condition 1
   a. (IGN1 is OFF) & (door are closed) & (room lamp is OFF)
   b. A door is opened more than 0.1sec (all door not closed = ON)
   c. Room lamp is turned ON
2. Condition 2
   a. (IGN1 is OFF) & (a door at least is open)
   b. All door are closed (all door not closed = OFF)
   c. The power of room lamp is reduced from 100% to 75% to indicate that the door is closed. And then the lamp is slowly decayed off during 5 ~ 6 sec.
3. Condition 3
   a. (IGN1 is OFF) & (room lamp is decaying)
   b. IGN1 ON
   c. Stop decaying operation immediately
4. Condition 4
   a. (Room lamp is OFF) & (IGN1 is OFF) & (door are closed)
   b. Unlock(by RKE or PIC)
   c. Room lamp is turned ON for 30 sec

NOTICE
While room lamp is turned ON by UNLOCK(by RKE or PIC) signal (for 30 sec), if UNLOCK(by RKE or PIC) input is acquired again, Room lamp timer should be initialized to 30sec.

5. Condition 5
   a. UNLOCK (RKE or PIC) & Room lamp is ON or door are closed & room lamp is decaying
   b. If the vehicle has changed to ARM state by lock (by RKE or PIC)
   c. Room lamp is turned OFF, immediately.



ATCD394G

Anti-theft and radio frequency remote control

Anti-theft

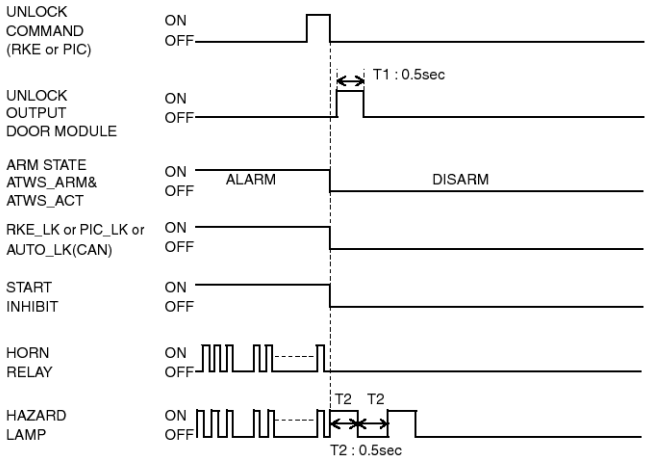
1. Disarm
   1) Condition 1
      a. Disarm state and any door open(include hood or trunk)
      b. UNLOCK (unlock by RKE or PIC)
      c. No state change

      The unlock command is requested via CAN and hazard flashing
   2) Condition 2
      a. Alarm state or during alarming
      b. UNLOCK (Unlock by RKE or PIC) or trunk(trunk open by RKE or PIC) or IGN KEY ON during 30[sec] or FOB is authenticated.
      c. The state goes to disarm state

      Trunk release command is executed when received trunk (Trunk Open by RKE or PIC)

      The Unlock command is requested via CAN and hazard flashing 2 times when received UNLOCK(Unlock by RKE or PIC)

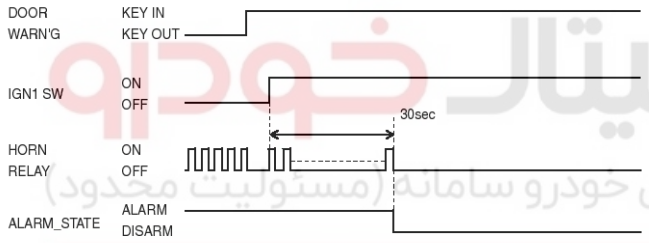
      Hazard flashing, horn and engine start inhibit are off



ATCD395A

NOTICE

ATWS : Alarm Thief warning System



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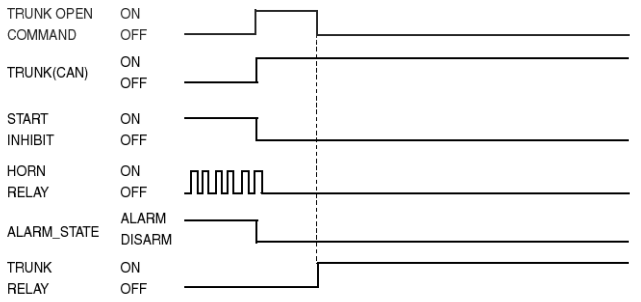


ATCD395C

3) Condition 3
   a. Wait state
   b. UNLOCK (Unlock by RKE or PIC) or IGN KEY ON or FOB is authenticated
   c. The state goes to disarm state

   The unlock command is requested via CAN and hazard flashing 2 times when received UNLOCK (Unlock by RKE or PIC)

4) Condition 4
   a. Auto-lock timer state
   b. Any door open or hood open or Trunk open or IGN KEY ON or FOB is authenticated.
   c. The state goes to disarm state

5) Condition 5
   a. Arm state or arm hole state
   b. IGN key ON or FOB is authenticated.
   c. The state goes to disarm state

6) Condition 6
   a. Rearm state
   b. UNLOCK (Unlock by RKE or PIC) or trunk(Trunk Open by RKE or PIC) or IGN KEY ON during 30[sec] or FOB is authenticated
   c. The state goes to disarm state

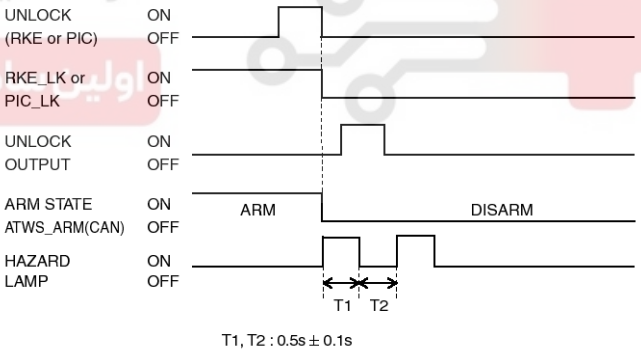
   Trunk release command is executed when received trunk (trunk open by RKE or PIC)

   The unlock command is requested via CAN and hazard flashing 2 times when received UNLOCK(unlock by RKE or PIC)

   Engine start inhibit off

NOTICE

When entered disarm mode, engine start inhibit and horn are OFF.



ATCD395D

CAUTION

We cannot disarm anti-theft by unlocking the door with mechanical key directly from the door lock.

7) Condition 7
   a. Arm hold state
   b. UNLOCK (unlock by RKE or PIC)
   c. The state goes to disarm state

   The unlock command is requested via CAN and hazard flashing

2. ARM
   1) Condition 1

a. IGN key out and all entrances closed (door, hood, trunk)
b. LOCK (lock by RKE or PIC)
c. The lock command is sent to door module to drive door lock (request via CAN com.)

And if door module responses during 5sec that the doors are locked (rear left knob UNLOCK = 0, rear right knob UNLOCK = 0, front left knob UNLOCK = 0 and front right knob UNLOCK = 0 via CAN communication) Then, Hazard lamp is flashed 1 timeand then the state goes to ARM mode.

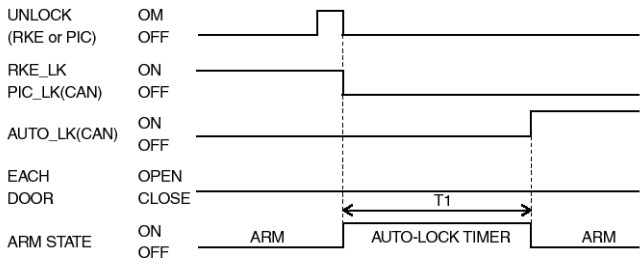
Else : disarm state (no flashing)

If LOCK(Lock by RKE or PIC)signal is received during the ARM mode, Hazard lamp is flashed “1” time. (drive door lock request again via CAN communication.)

2) Condition 2
a. Wait state
b. All door close (door and hood and trunk)
c. The state goes to ARM state and The hazard lamp is flashed “1” time

3) Condition 3
a. Auto-lock timer state
b. Time (30sec)(Can be calibrated(Auto lock Timeout)) expired or LOCK(Lock by RKE or PIC)
c. The lock command is sent to door module to drive door lock (request via CAN com.) And if door module responses during 5sec that the doors are locked (REAR LEFT KNOB UNLOCK = 0, REAR RIGHT KNOB UNLOCK = 0, FRONT LEFT KNOB UNLOCK = 0 and FRONRIGHT KONB UNLOCK = 0 via CAN communication) Then, Hazard lamp is flashed “1” time. The state goes to ARM mode

Else : DISARM state(No flashing)



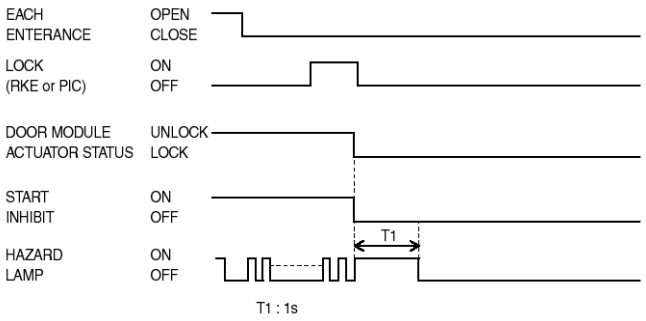
ATCD395E

4) Condition 4
a. Alarm state or during alarming
b. All door close(door and hood and trunk) and LOCK(Lock by RKE or PIC)
c. The state goes to ARM state.

The hazard lamp is flashed “1” time

Horn and Engine start inhibit are OFF

Requests LOCK command via CAN



ATCD395F

5) Condition 5
a. Arm hold state
b. Trunk close at least 30 [sec]
c. The state goes to ARM state

6) Condition 6
a. Arm state
b. LOCK (Lock by RKE or PIC)
c. The state goes to ARM state

The hazard lamp is flashed “1” time

Engine start inhibit is OFF

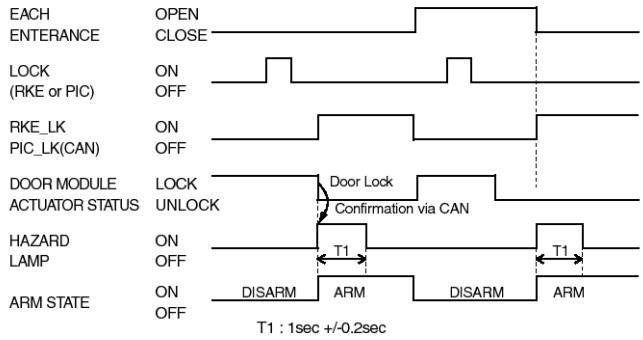
Requests LOCK command via CAN

7) Condition 7
a. Arm state
b. LOCK (Lock by RKE or PIC)
c. No state changes and the hazard lamp is flashed “1” time

Requests LOCK command via CAN

NOTICE

The only way to make ARM state is to receive LOCK(Lock by RKE or PIC)signal. The mechanic Key cannot make ARM state.



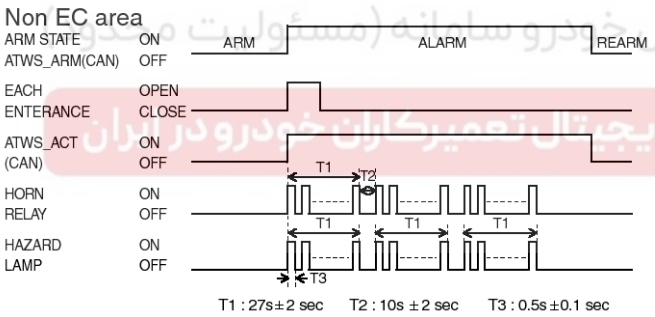
ATCD395G

3. Alarm
   1) Condition 1
      a. Arm state
      b. Any entrance open (doors, trunk, or hood)
      c. Non -EC Area: The horn rings 3 times with 27sec(±2sec) on 10sec(±2sec) off.

         EC Area: The horn is ON one time for 27sec(±2sec) The hazard is driven also (During Horn driving)

         Engine start Inhibit is ON

         The state goes to ALARM mode



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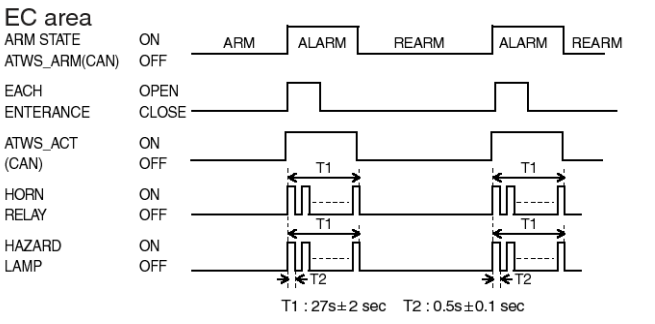


LTCD395O

   2) Condition 2
      a. Arm hold state
      b. Any door open or Hood open
      c. Non-EC Area: The horn rings 3 times with 27sec(±2sec) on 10sec(±2sec) off.

         EC Area: The horn is ON one time for 27sec(±2sec)

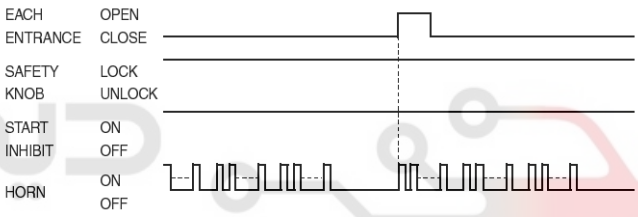
         The hazard is driven and Engine Start Inhibit is ON

         The state goes to ALARM state
   3) Condition 3
      a. Rearm state
      b. Any door open or hood open or trunk open
      c. Non- EC Area: The horn rings 3 times with 27sec(±2sec) on 10sec(±2sec) off

         EC Area: The horn is ON one time for 27sec(±2sec)

         The hazard is driven also (during horn driving)

         The state goes to ALARM state



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   4) Condition 4
      a. Alarm state (ALARM expired and (any door open or hood open or trunk open))
      b. Any door open or hood open or Trunk open
      c. And there is no horn & hazard output

         BCM keeps engine start inhibit = ON

         No state change

NOTICE

- *External trunk open sw, mechanical key, trunk open command through CAN communication (DDM or PIC) or RKE trunk open signal are able to open the trunk.*
- *During ARM State, if the mechanical key opens the trunk, then activate the ALARM*
- *During ARM state, if the BCM receives the trunk release command by Door module(DDM) or External Trunk open sw than the BCM does not take trunk release action.*
- *During ARM State, if the trunk is opened by trunk release(RKE or PIC), suspend the*

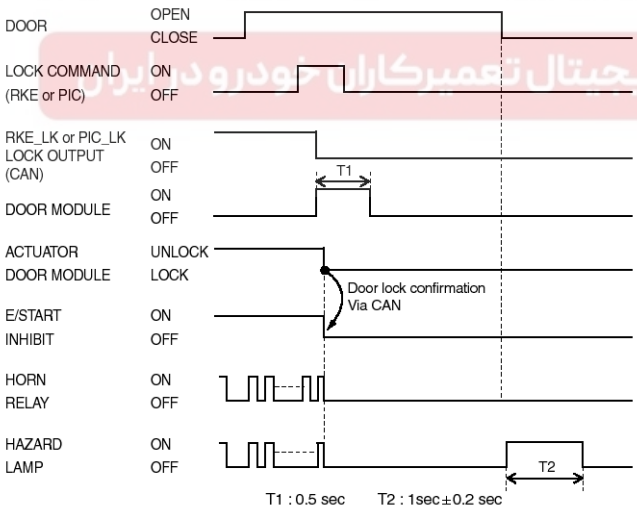
ALARM. (The BCM continues to monitor the other entrances in ARM State.)

4. Wait
   1) Condition 1
      a. Disarm state & IGN KEY OUT & any entrances open (doors, hood, trunk)
      b. Lock (lock by RKE or PIC)
      c. The lock command is sent to door module to drive door lock (request via CAN com.) And if door module responses during 5sec that the doors are locked (rear left knob unlock = 0, rear right knob unlock = 0, front left knob unlock = 0 and front right knob unlock = 0 via CAN communication) Then The state goes to ARM mode.

         Else : DISARM state(No flashing)
   2) Condition 2
      a. (Alarm statue or Alarming) and Any entrances open (doors, hood, trunk)
      b. LOCK (Lock by RKE or PIC)
      c. The LOCK command is requested to Door module via CAN

         The state goes to WAIT state

         Horn and Engine Start Inhibit are off



ATCD395J

   3) Condition 3
      a. Arm hold state
      b. LOCK (Lock by RKE or PIC)
      c. The LOCK command is requested to door module via CAN

         The state goes to the wait state

5. Rearm mode
   1) Condition
      a. Alarm state
      b. All entrance is closed & alarm expired
      c. The state goes to rearm state
6. Auto-lock timer
   1) Condition 1
      - Arm state
      - UNLOCK (unlock by RKE or PIC)
      - BCM requests the unlock command via CAN communication hazard lamp is flashed “2” times

        The state goes to the AUTO-LOCK TIMER state

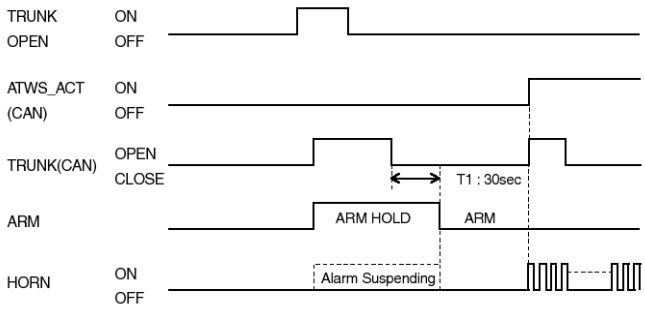
        Start inhibition are OFF
   2) Condition 2
      a. Auto-lock timer state
      b. UNLOCK (Unlock by RKE or PIC)
      c. BCM requests the unlock command via CAN Hazard lamp is flashed “2” times.

         The timer restates

         No state change
   3) Condition 3
      a. Disarm state and all door closed(include hood and trunk)
      b. UNLOCK (Unlock by RKE or PIC)
      c. BCM requests the unlock command via CAN Hazard lamp is flashed “2” times.

         The state goes to the auto-lock timer state
7. Arm hold
   1) Condition 1
      a. Arm state
      b. Trunk is opened by trunk (trunk open by RKE or PIC)
      c. The alarm for the trunk is only suspended

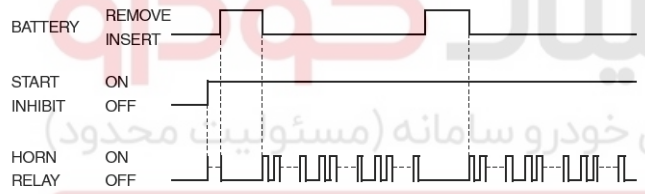
         But the alarm for doors and hood keeps on arming
   2) Condition 2
      a. Condition 1
      b. Trunk is closed and maintained more than 30 sec
      c. Return ARM State



ATCD395K

8. Reset
   1) In case of taking the battery out during the ALARM state
      a. During ALARM, ALARM finished, REARM
      b. Taking the battery out (reset)
      c. The horn is ON 3 times a new (No remained time of warning signal)

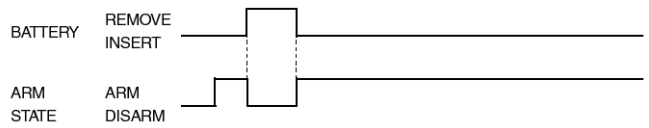
         Hazard lamp is flashing during making horn



ATCD395L

   2) In case of taking the battery out during arm
      a. ARM state
      b. Taking the battery out (reset)

         Maintained ARM state



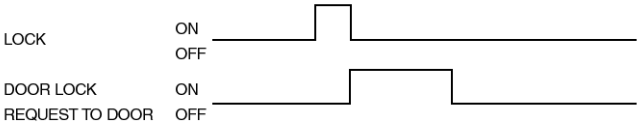
ATCD395M

Multi-mode keyless entry function

1. Door lock function

   If LOCK SW on (RKE or PIC) is pushed, LOCK data is sent to door module.

   Door module controls the lock output.

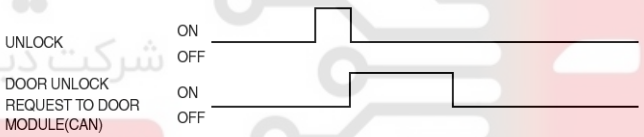


ATCD397A

2. Door unlock function

   If unlock SW on (RKE or PIC) is pushed, unlock data is sent to door module.

   Door module controls the unlock output.



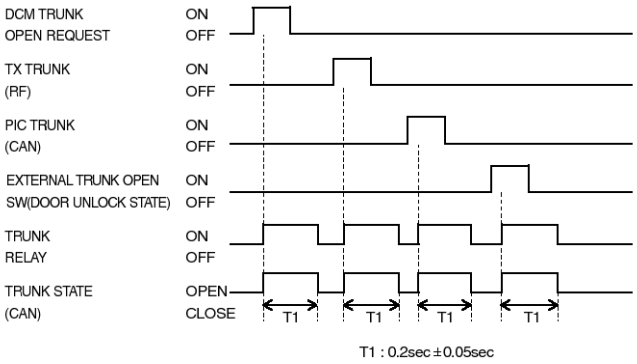
ATCD397B

3. Trunk open function

   If the trunk open data frame has been received by BCM, the trunk open relay is driven for 0.2sec (Trunk release on time)

   NOTICE

   - *This function is inactivated state during trunk motor inhibition time on reset (default 0.2sec) after reset.*
   - *If door is lock state, trunk can not be opened by external trunk open SW or trunk lid open SW*
   - *ATWS state, if the BCM receives the trunk release command by door module (DCM) than the BCM does not take trunk release action.*
   - *During trunk open state, if the BCM receives the trunk release command via CAN, external trunk open SW, PIC or RKE than the BCM does not take trunk release action.*

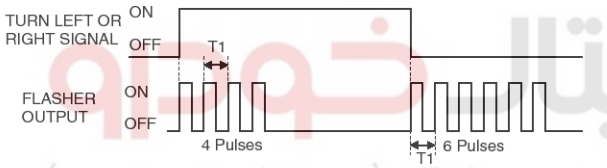


ATCD397C

NOTICE

- *If key is inserted in IGN key cylinder, keyless function is disabled.*

FLASHER OUTPUT OPERATION



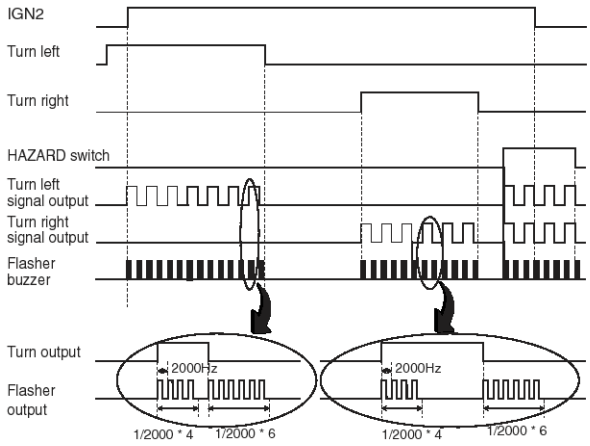
SGHBE6152L

1. NORMAL OPERATING CONDITION

   Turn signal period: 85 ± 10 period/min (regulation: 90 ± 30 period/min)

   While IGN2 is on, if TURN SIGNAL LEFT switch or TURN SIGNAL RIGHT switch or HAZARD switch input is detected, turn signal outputs are turned on following the switch input (LEFT, RIGHT or HAZARD).

   Priority: HAZARD > TURN SIGNAL

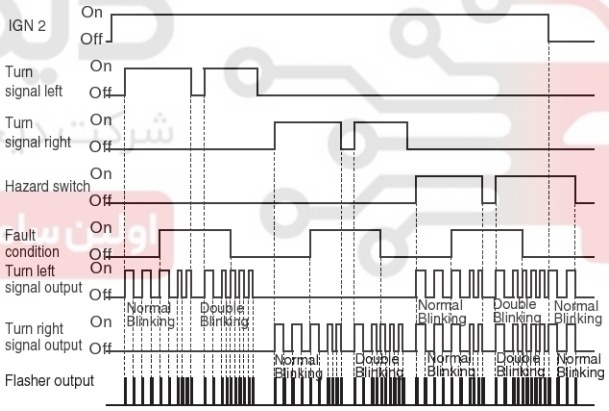


SGHBE6150L

Normal : 85±10 Period/min

2. DOUBLE BLINKING CONDITION

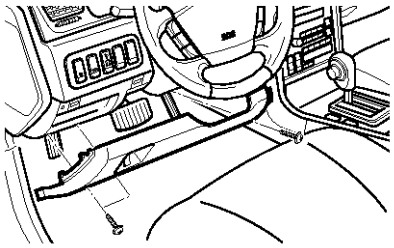
   When one of the FRONT or REAR is broken-down (Lamp failure), the turn signal blinks with double frequency. Lamp failure condition as indicated below.



SGHBE6151L

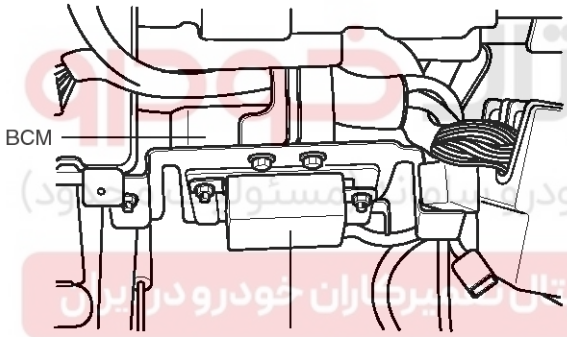
Removal and installation

1. Disconnect the negative(-) battery terminal.
2. Remove the drive lower crash panel after removing the side mounting cover.



ATCD380B

3. Loosen the BCM mounting bolt and disconnect the connector.
4. Installation is the reverse of removal procedures.



LTCD380A

NOTICE

If the battery voltage is disconnected for more than about 10 seconds, BCM is reset.

WARNING

When learning the BCM after replacing it, enter the correct PIN code.

Once if enter the correct PIN code, BCM cannot be reused.

Check the BCM state by using Hi-scan.

Self-diagnostic function

1. If the self-diagnostic function is in operation, CAN communication stops and LIN communication is converted into self-diagnostic communication.
2. Only BCM communicates directly with Hi-scan, and the other units perform self-diagnostic function by BCM through the mediator of CAN or LIN.
3. Self-diagnostic functions of the units.

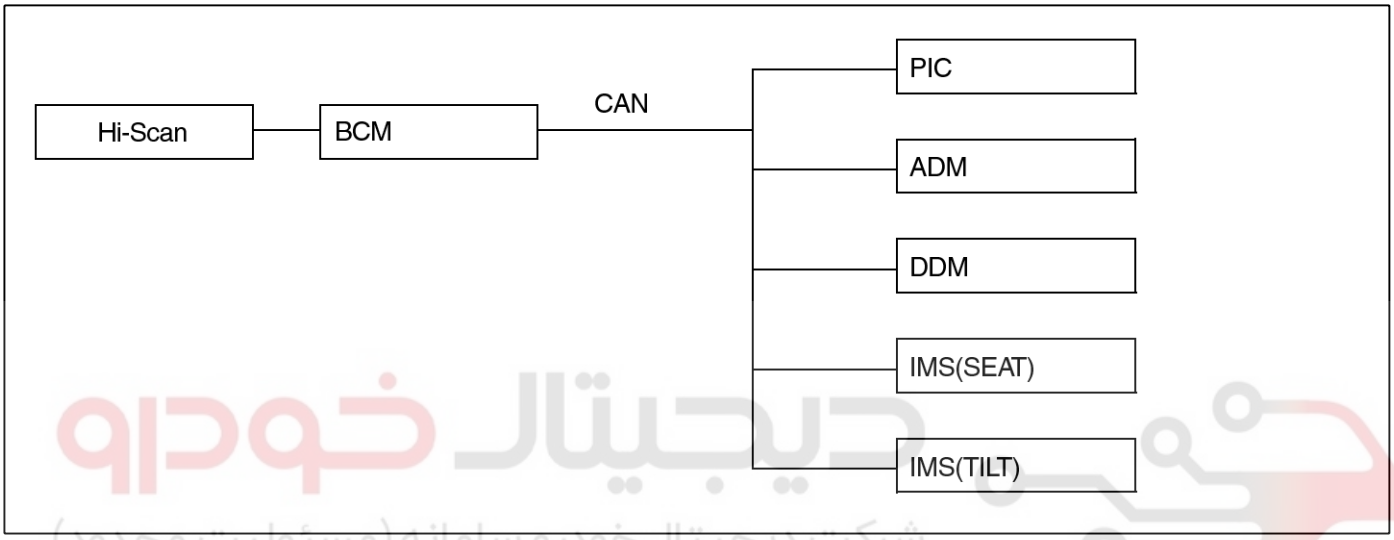
Types	Input display	Failure diagnosis	Forced drive
Body Control Module	O	O	O
PIC system	O	O	O
Driver's Door Module	O	O	O
Assistant Door Module	O	O	O
Multi Function Switch	O		
Safety Power Window ECU	O	O	O
IMS Switch Module	O		

BCM self diagnostic function

1. It performs input display, failure diagnosis and forced drive through the direct communication with Hi-scan.
2. Input display : It displays the input, power level and speed sensor outputs.
3. Failure diagnosis : It displays the failure diagnosable in the BCM.
4. Forced drive : All loads controlled directly by the BCM can be driven directly by Hi-scan.

PIC, ADM, DDM, IMS self diagnostic function

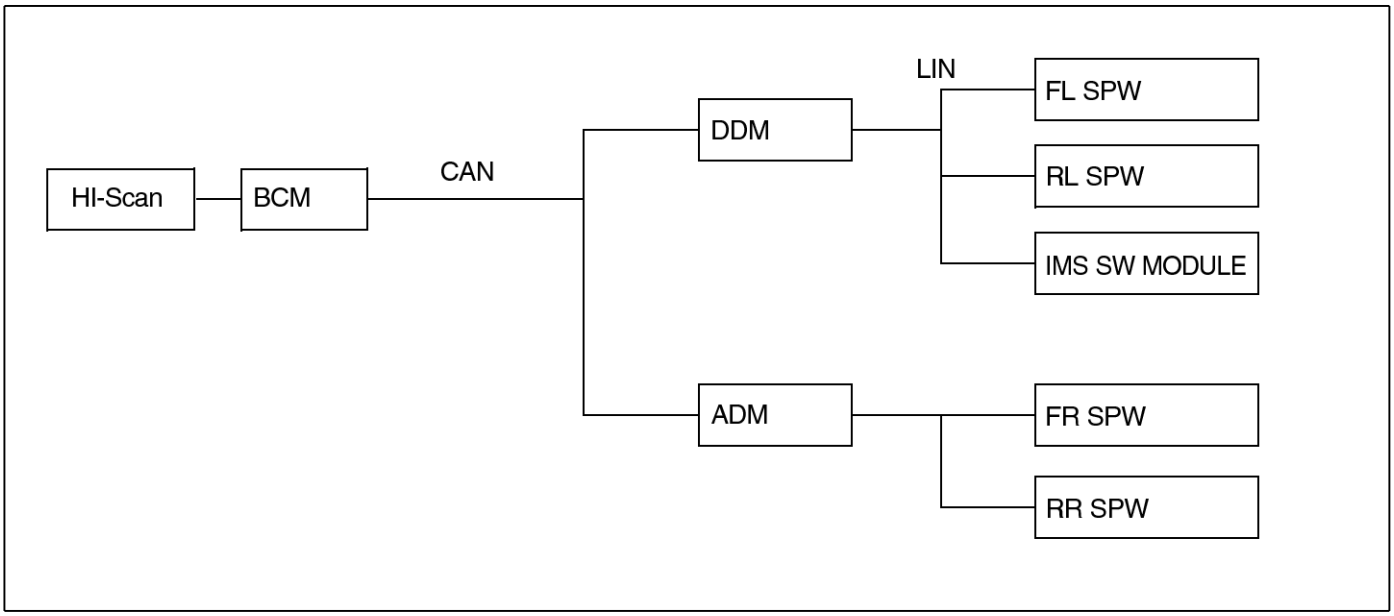
1. It can be communicated with Hi-scan by way of BCM.
2. BCM receives the commands from hi-scan and remits to PIC, ADM, DDM, and IMS units with CAN. BCM receives the response from the units with CAN inversely, and feedback to Hi-scan with CAN.
3. Input display and output forced drive can be performed in each of PIC, ADM, DDM, and IMS units. Though, failure diagnosis is limited to the certain diagnosis ranges.



LTCD398A

Self-diagnostic function of safety ECU and switch module

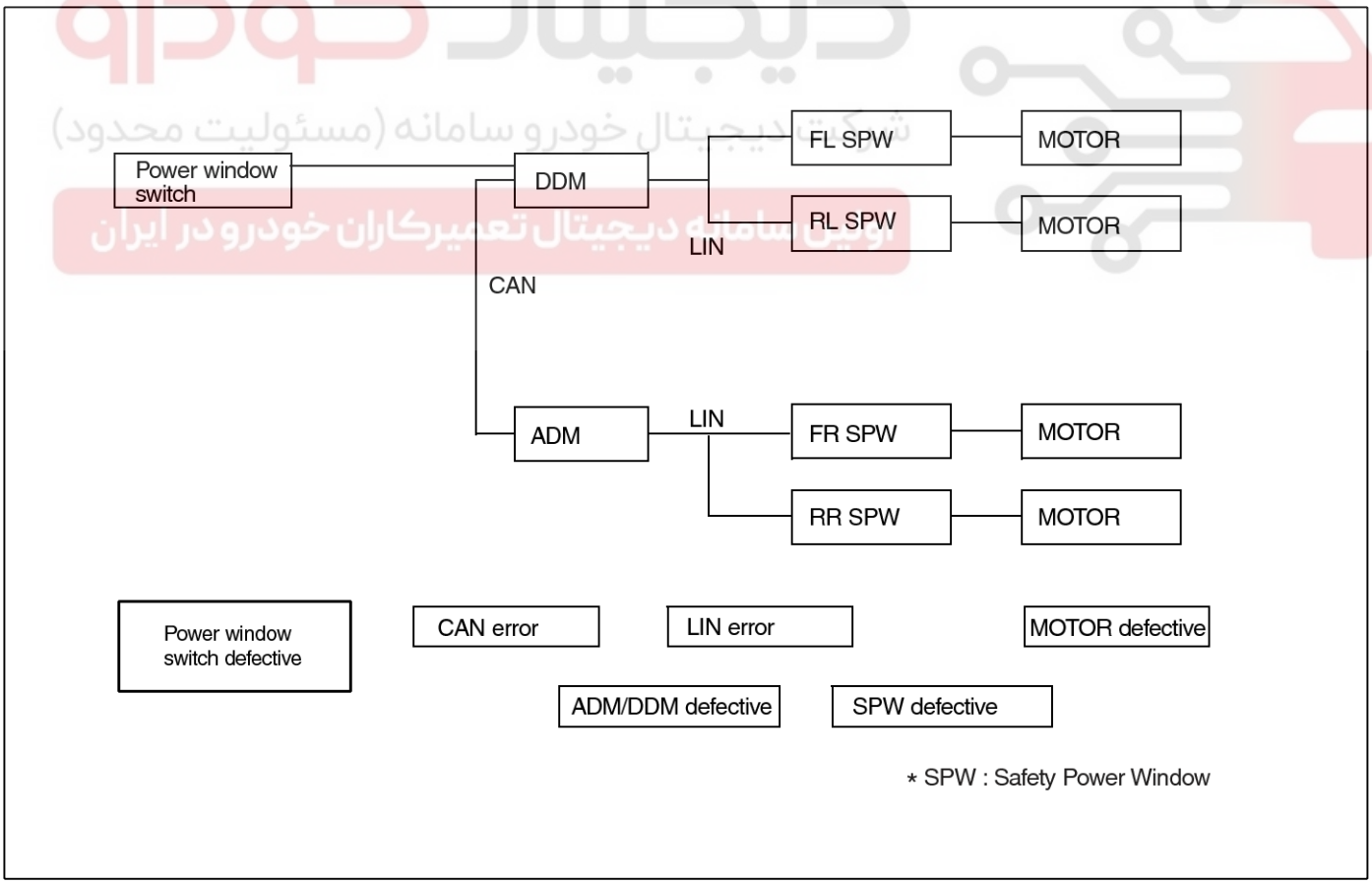
1. It can be communicated by way of BCM.
2. BCM receives the command from Hi-scan and remits to ADM and DDM through CAN, and ADM and DDM remits to safety ECU with LIN. As for the responses of units, safety
3. Safety ECU can perform all three functions of input display, forced drive and failure diagnosis. Though, switch module can only performs input display.



LTCD398B

Failure diagnosis

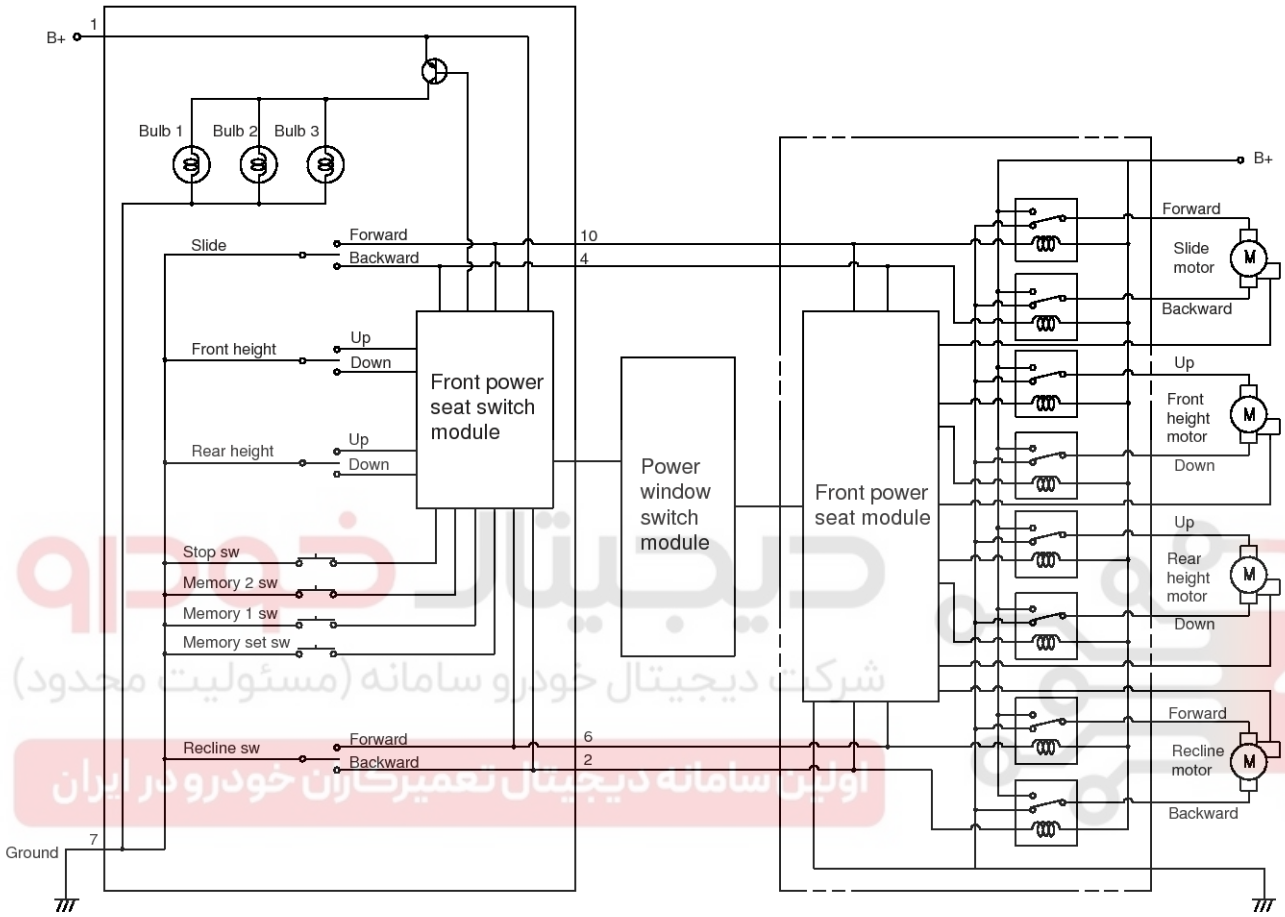
Example) when the power window switch cannot raise the power window.

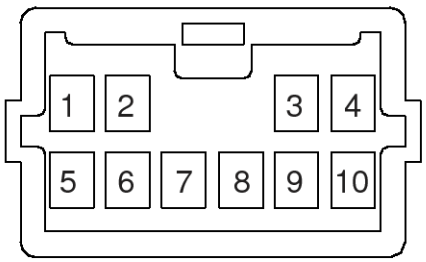


LTCD398C

IMS (Integrated Memory

Circuit diagram



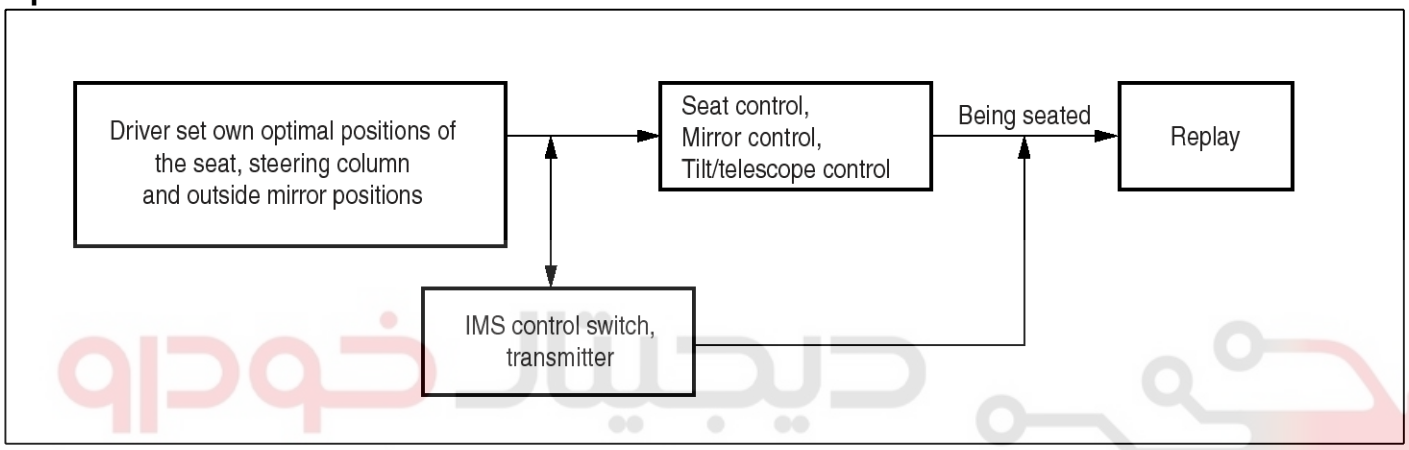


ATCD195B

Description

Seat, steering column and mirror positions set by the driver are memorized in the IMS control unit by the position sensors. So, those positions can be returned to the memorized positions by the IMS control switch and keyless control even when the seat, steering column and mirror positions are changed. (This is called replay operation). In addition, LIN communication is performed between power seat control unit and power window. For the sake of safety, replay is prohibited during driving and replay operation can be stopped immediately.

Operation flow chart



LTCD190A

Function

1. Manual operation of the seat, mirror and steering column by the manual switches.
2. Memory and replay (memory and replay operation) of seat, mirror and steering column positions by the IMS control switch: up to 2 driver's.
3. Auto memory in case of lock of the keyless and replay (keyless memory and replay operation) in case of unlock: up to 2 drivers.
4. Down operation of the outside mirror in case of backup.
5. Functional controls.
   1) Up/down and left/right controls of the driver's outside mirror
   2) Up /down and left/right controls of the passenger's outside mirror
   3) Driver's power seat
      - Forward and backward control of the reclining seat.
      - Up and down control of the seat height.
      - Up and down control of the tilt.
      - Forward and backward control of the slide.
   4) Up and down control of steering column tilt.
   5) Forward and backward control of steering column telescope

Operation

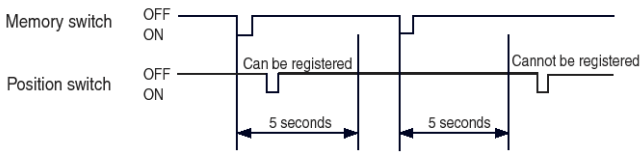
Manual operation

1. Mirror switch on the power window main drives mirror motor.
2. Seat manual switch sets seat position and operates 4 way simultaneously.
3. Manual seat control is made by the motor regardless of CPU.
4. Tilt/Telescope position is set by the Tilt/Telescope manual switch operation.
5. Tilt/Telescope manual operation is controlled by the CPU.

Memory operation

1. If the position switch is pressed within the 5 seconds after pressing the memory switch when the ignition is ON, then, current positions of the seat, Tilt/Telescope and mirror are registered. (Memory permits status lasts for 5 seconds after the memory switch is on, and the memory permit status is cleared thereafter. In other words, current position is registered only if the

position switch is pressed in memory permit status.)



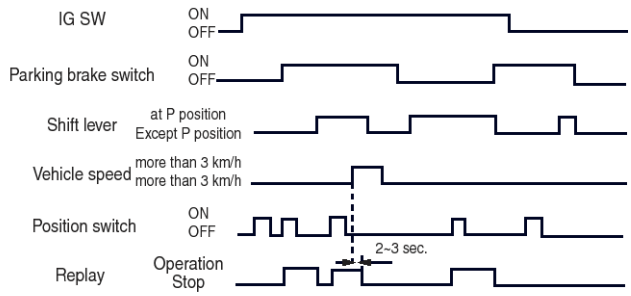
LTCD195C

2. Memory permits status will be cleared if any of the following conditions is met.
   - After 5 seconds from the memory switch ON.
   - When the manual switch of seat and Tilt/Telescope is ON.
   - When the ignition is OFF.
   - When the STOP switch is ON.
   - When the memory registration is completed.
3. If two position switches are pressed ON simultaneously in memory or replay, it operates by the switch recognized first.
4. Memory setting cannot be performed if the vehicle speed is more than the specified one or shift lever is not in the P position when the parking brake is released.

Memory replay operation

1. Seat, Tilt/Telescope and mirror are returned to the registered positions as each position switch is pressed while the ignition is ON.
2. Memory replay operation will be performed only if the memory is registered.
3. If the position switch is pressed while the memory replay is in operation, the final switch is effective.
4. It sounds buzzer once while the memory replay operation (Position switch is ON).
5. Replay inhibition condition

   If any of the following conditions is met, memory replay is prohibited and operation will stop if it is in replay operation.
   - Ignition OFF
   - When parking brake is released (switch OFF)
   - When the shift lever is at the position other than P
   - When the parking brake is released.
   - When the vehicle speed is more than 3 km/h
   - When the STOP switch is turned ON during the replay operation
   - When the manual switch is in operation



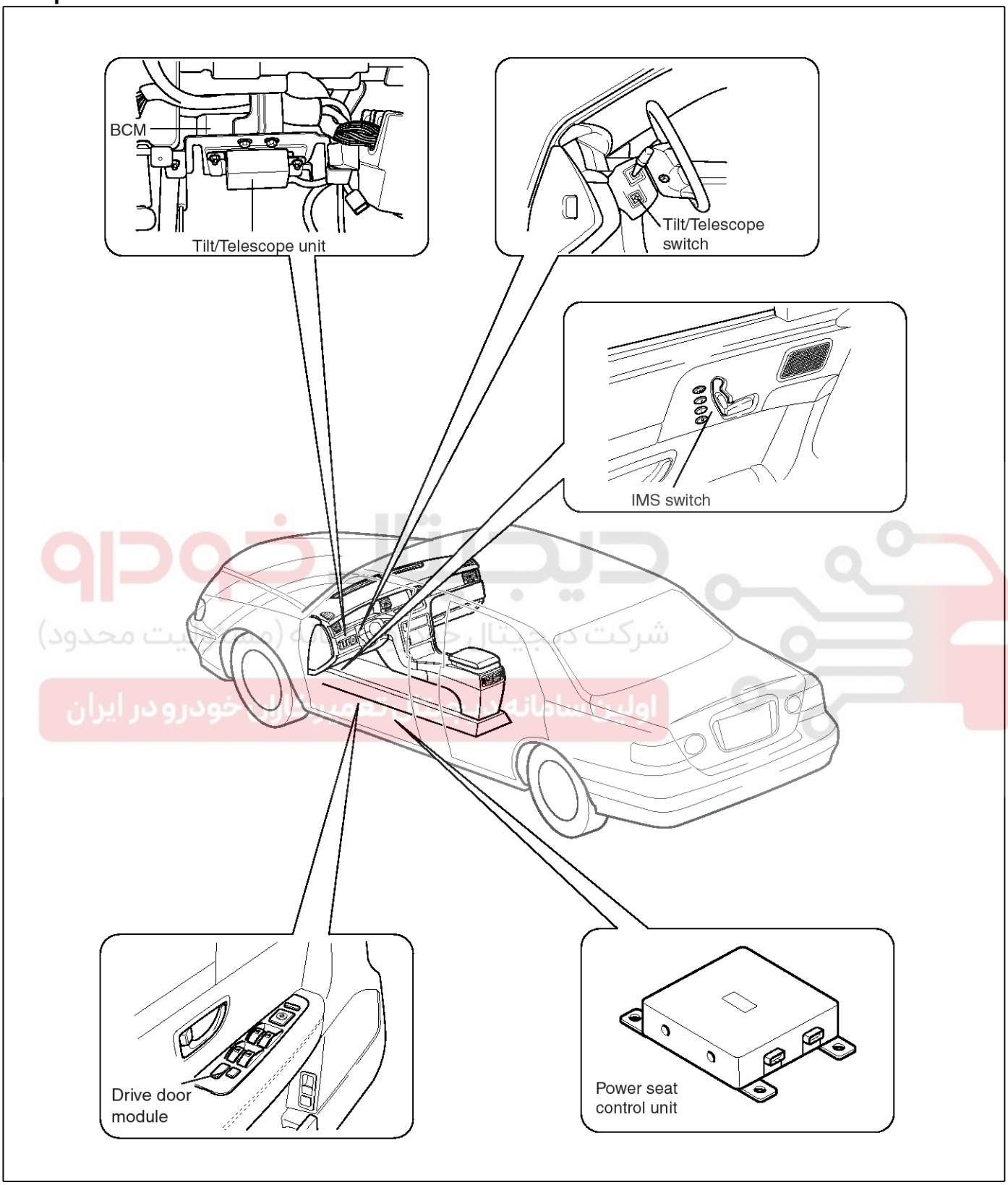
LTCD195D

Keyless memory and replay operation

1. Keyless memory operation
   1) Ignition ON positions are registered corresponding to the keyless codes.
   2) Keyless codes are determined by the keyless door lock operation.
2. Keyless replay operation
   1) Upon the door unlock operation by the keyless when the ignition is OFF, it automatically sets the registered positions corresponding to the keyless codes.
   2) Keyless replay prohibiting condition

      If any of the following conditions is met, memory replay is prohibited and operation will stop if it is in replay operation
      - When parking brake is released (switch OFF)
      - When the manual switch is in operation

Component

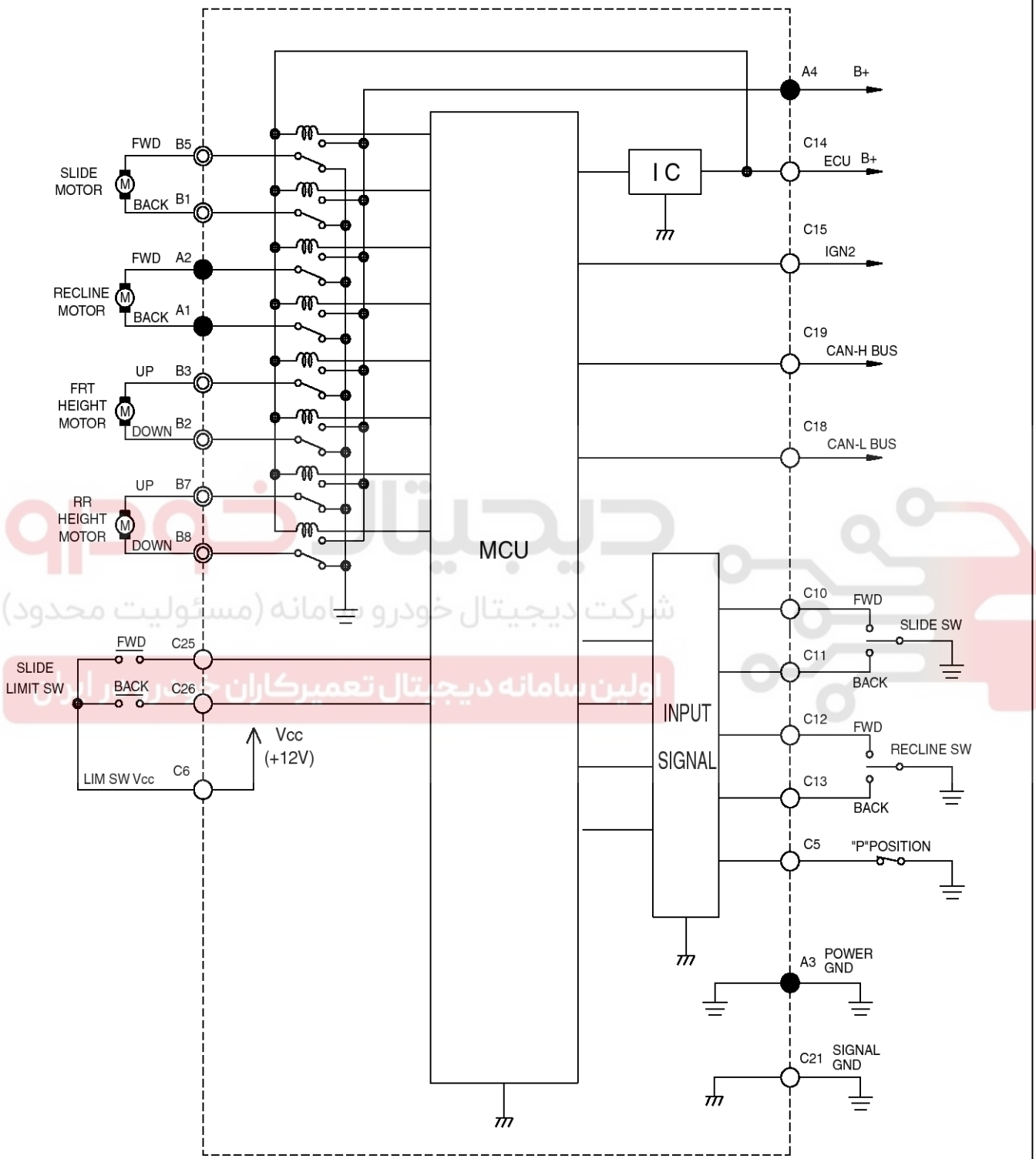


LTCD195A

IMS Power Seat Control

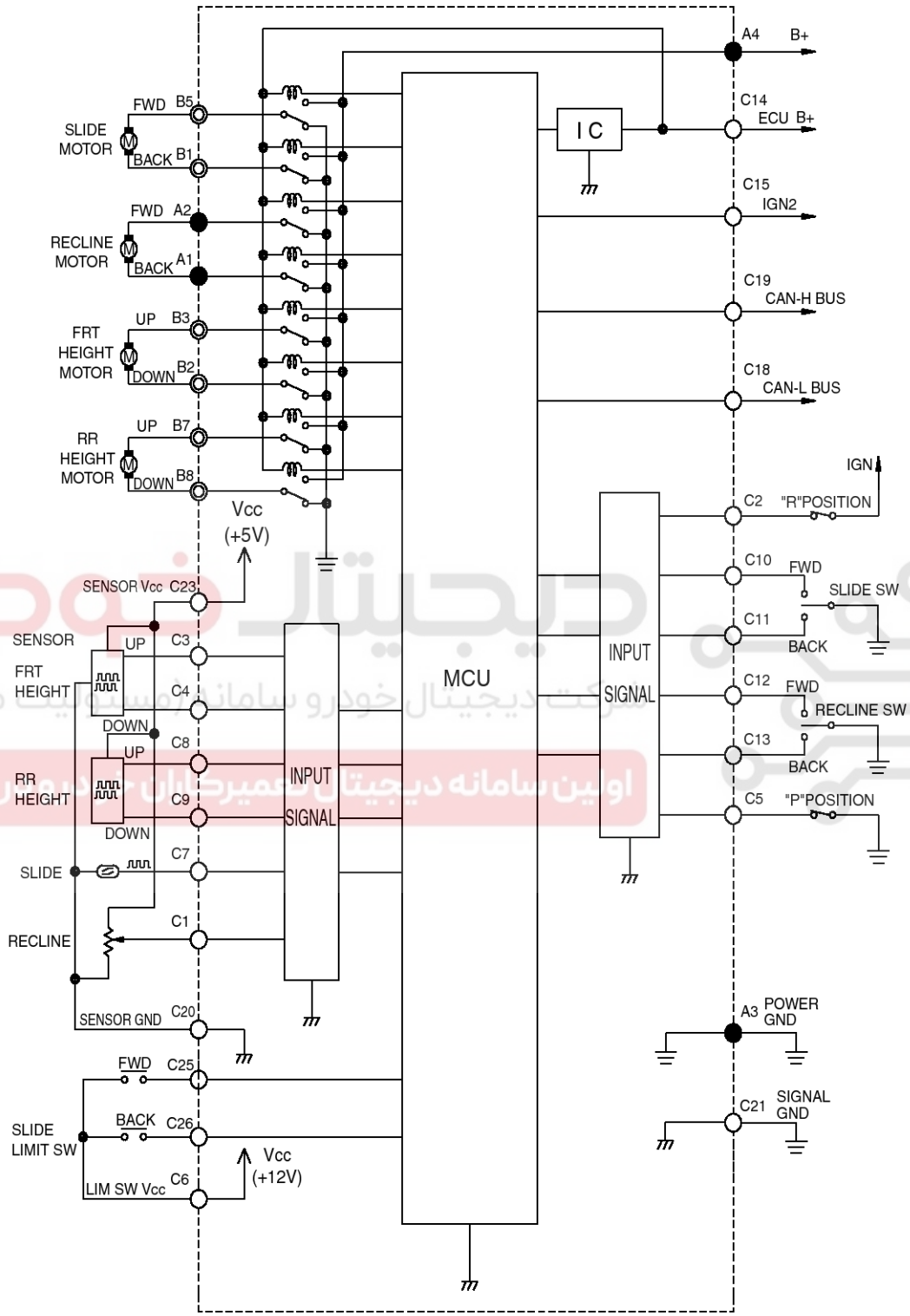
Circuit diagram

<Power seat>



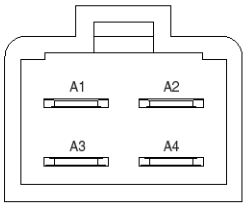
LTCD313A

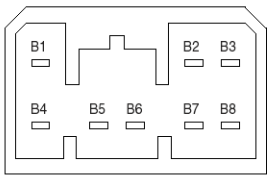
<Memory power seat>

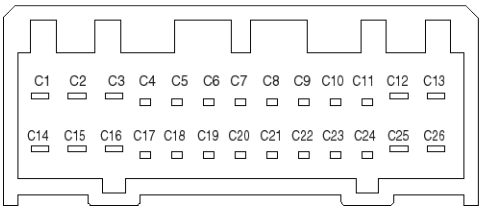


LTCD313C

Connector configuration







NO	CONNECTOR - A
A1	RECLINE MOTER BACK
A2	RECLINE MOTOR FWD
A3	POWER GND
A4	B+

NO	CONNECTOR - A
A1	RECLINE MOTER BACK
A2	RECLINE MOTOR FWD
A3	POWER GND
A4	B+

NO	CONNECTOR - B
B1	SLIDE MTR BACK
B2	FRT HEIGHT MTR DOWN
B3	FRT HEIGHT MTR UP
B4	NC
B5	SLIDE MTR FWD
B6	NC
B7	RR HEIGHT MTR UP
B8	RR HEIGHT MTR DOWN

NO	CONNECTOR - B
B1	SLIDE MTR BACK
B2	FRT HEIGHT MTR DOWN
B3	FRT HEIGHT MTR UP
B4	NC
B5	SLIDE MTR FWD
B6	NC
B7	RR HEIGHT MTR UP
B8	RR HEIGHT MTR DOWN

NO	CONNECTOR - C
C1	NC
C2	NC
C3	NC
C4	NC
C5	"P" POSITION
C6	LIMIT SW Vcc
C7	NC
C8	NC
C9	NC
C10	SLIDE FWD SW
C11	SLIDE BACK SW
C12	RECLINE FWD SW
C13	RECLINE BACK SW
C14	ECU B+
C15	IGN2
C16	NC
C17	NC
C18	CNA-L BUS
C19	CAN-H BUS
C20	NC
C21	SIGNAL GND
C22	NC
C23	NC
C24	NC
C25	SLIDE FWD LIMIT SW
C26	SLIDE BACK LIMIT SW

<Power seat>

NO	CONNECTOR - C
C1	RECLINE SENSOR
C2	"R" POSITION
C3	FRONT HEIGHT UP SENSOR
C4	FRONT HEIGHT DOWN SENSOR
C5	"P" POSITION
C6	LIMIT SW Vcc
C7	SLIDE SENSOR
C8	REAR HEIGHT UP SENSOR
C9	REAR HEIGHT DOWN SENSOR
C10	SLIDE FWD SW
C11	SLIDE BACK SW
C12	RECLINE FWD SW
C13	RECLINE BACK SW
C14	ECU B+
C15	IGN2
C16	NC
C17	NC
C18	CNA-L BUS
C19	CAN-H BUS
C20	SENSOR GND
C21	SIGNAL GND
C22	NC
C23	SENSOR Vcc
C24	NC
C25	SLIDE FWD LIMIT SW
C26	SLIDE BACK LIMIT SW

<Memory power seat>

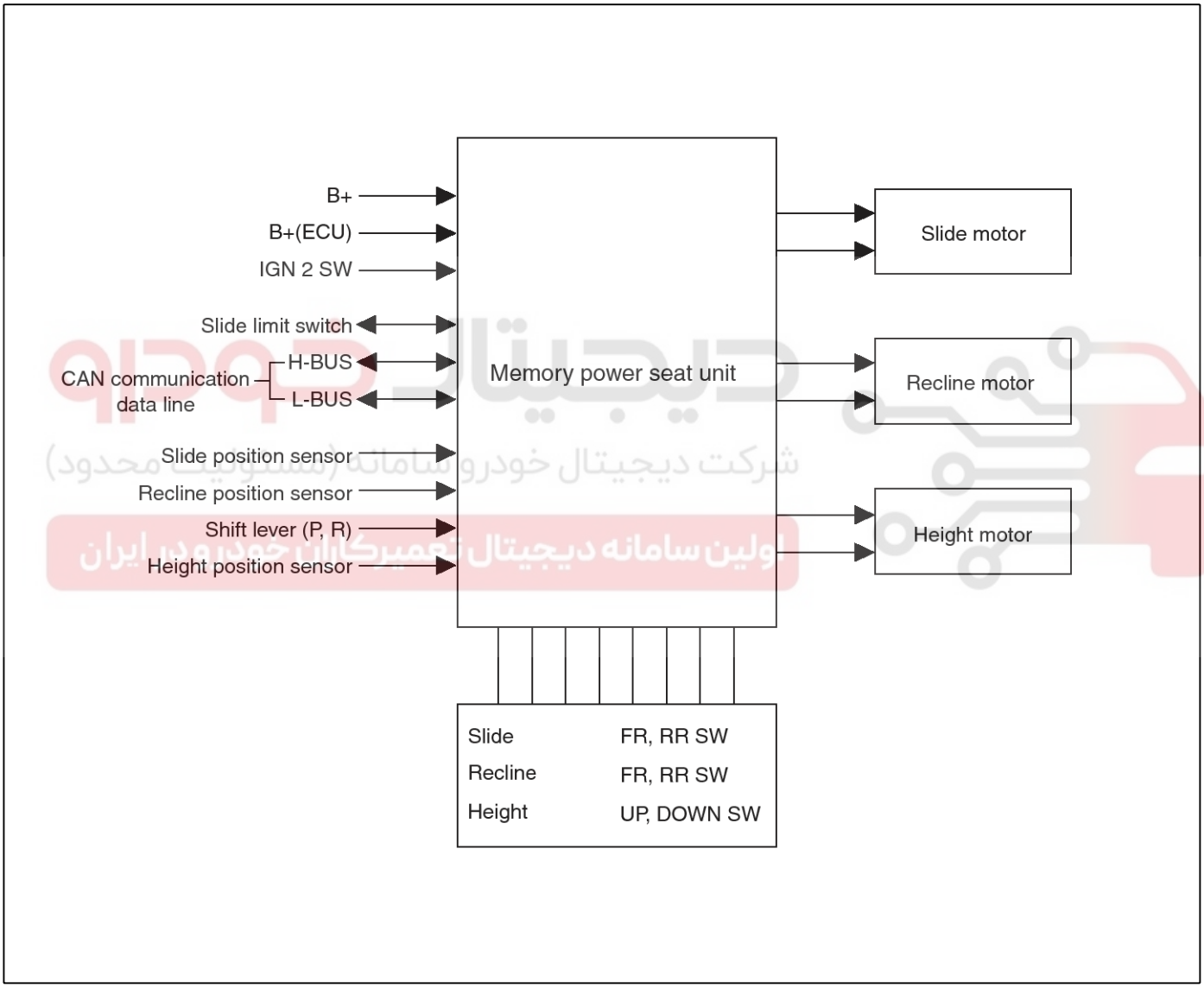
LTCD313B

Description

Driver may choose and store the best seat position at the memory power seat unit using the memory switch and the position sensor, in order to restore the seat position at once.

There are CAN communication for data transmission and reception between the memory power seat unit and the driver side door module. The operation is inhibited for safety during driving.

I/O DIAGRAM



LTCD311A

Feature

1. Manual operation of the seats by the manual switch. (manual operation)
2. Memory and regeneration operation of the seats by memory switch. (memory and replay operation) : for 2 persons.
3. Auto memory upon the keyless LOCK and regeneration upon the UNLOCK. (keyless memory and regeneration operation) : for 2 persons
4. Function description
   1) Driver power seat, sliding control, forward and backward

2) Driver power seat, reclining control, forward and backward

3) Driver power seat, height control, up and down

Operations by the functions

Manual operation

1. Motor operation by the seat manual switch (Slide, reclining, front height and rear height control)
2. Seat position setting and 4-way simultaneous operation can be made by the manual switch operation.
3. Seat slide and reclining operation can be made directly in case of communication failure.

Memory registration

1. Data related to the registration are received through the CAN communication from the power window main on the CAN line.
2. If any of the following conditions is met, memory permit status is released.

   After 5 seconds from the memory switch ON.

   When the ignition is OFF.

   When the stop switch is ON.

   When the manual switch is ON.

   When the memory registration is complete.
3. If 2 position switches are pressed ON simultaneously (within time interval of 50 ms) in memory registration, none of theswitches are valid, and the first pressed switch is valid if the time interval is greater than 50 ms.
4. If the vehicle speed is over the limit speed of 3km/h or shift lever is at the position other than P, registration cannot be performed.
5. Registration can be revised without any limitation.
6. Memory will be cleared if the battery is removed.
7. If the memory registration is permitted (memory switch is ON), it sounds the buzzer.

Memory replay operation

1. Data related to the memory replay are received through the CAN communication from the power window main on the CAN line.
2. Seat is set to the registered position as each position switch is pressed when the ignition is ON.
3. Memory replay will not be performed unless it is registered.
4. If the position switch is pressed while the memory replay is in operation, the final switch is effective. Though, if theswitches are pressed within the time interval of 50 ms, replay will not be performed.
5. When the replay is in operation (position switch is ON), buzzer will sounds once.
6. If any of the following conditions is met, replay is prohibited and operation will stop if it is in replay.

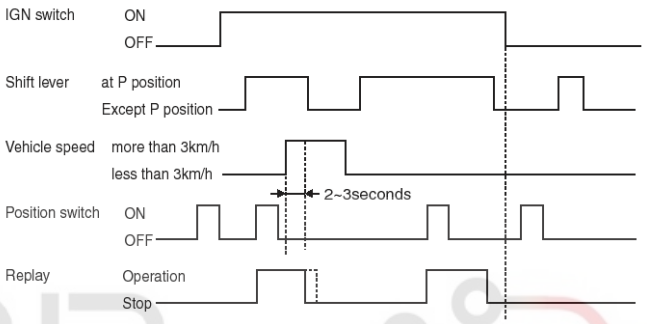
   When the ignition is OFF

   When the “P” position switch is OFF (when the shift lever is at the position other than “P”)

   When the vehicle speed is over 3 km/h (when it last more than 2 or 3 seconds)

   When the manual switch in relation to the seat is in operation. (Seat related replay operation stops)

   When the stop switch is ON



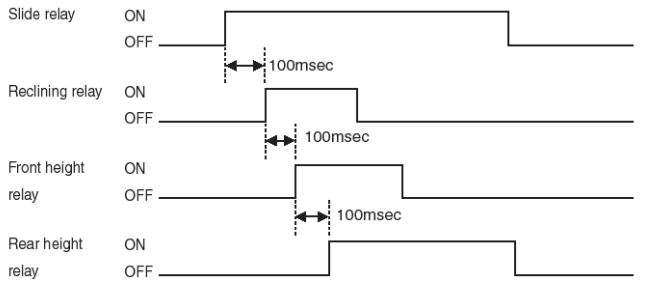
LTCD312A

7. Control in reverse operation

   When the motor is driven reverse during the operation, it performs reverse operation after 60±10 ms and 100±10 ms from completing the current operation in slide, reclining and front/rear height respectively.
8. Determining operational priority

   In order to prevent overlapping of rushing current when the motor starts up, motor start-up is delayed for 100 ± 10 ms respectively and its operational priority is as follows.

   Slide>Reclining>Front height>Rear height



LTCD312B

9. Sequential timer settings for motor start-up.

   Slide : 20±2 seconds (in memory replay)

Reclining : 35±3 seconds (in memory replay)

Front /Rear height: 10±1 seconds

※Slide, Reclining: It operates depending on the switch input time in manual switch input (direct drive type)

Registration and replay by the keyless

1. Keyless registration operation
   1) Ignition ON and OFF positions are registered corresponding to the keyless codes.
   2) Keyless codes are determined by the keyless door lock operation.
2. Keyless replay operation
   1) Upon door unlock operation when the ignition is OFF, it automatically set the registered positions corresponding to the keyless code. However, seat slide is automatically set to the following positions.
   2) If any of the following conditions is met, keyless replay operation is prohibited and operation stops if it is in operation.
      - When the P position switch is OFF
      - When the switch is in manual operation
      - When the stop switch is ON

Buzzer output

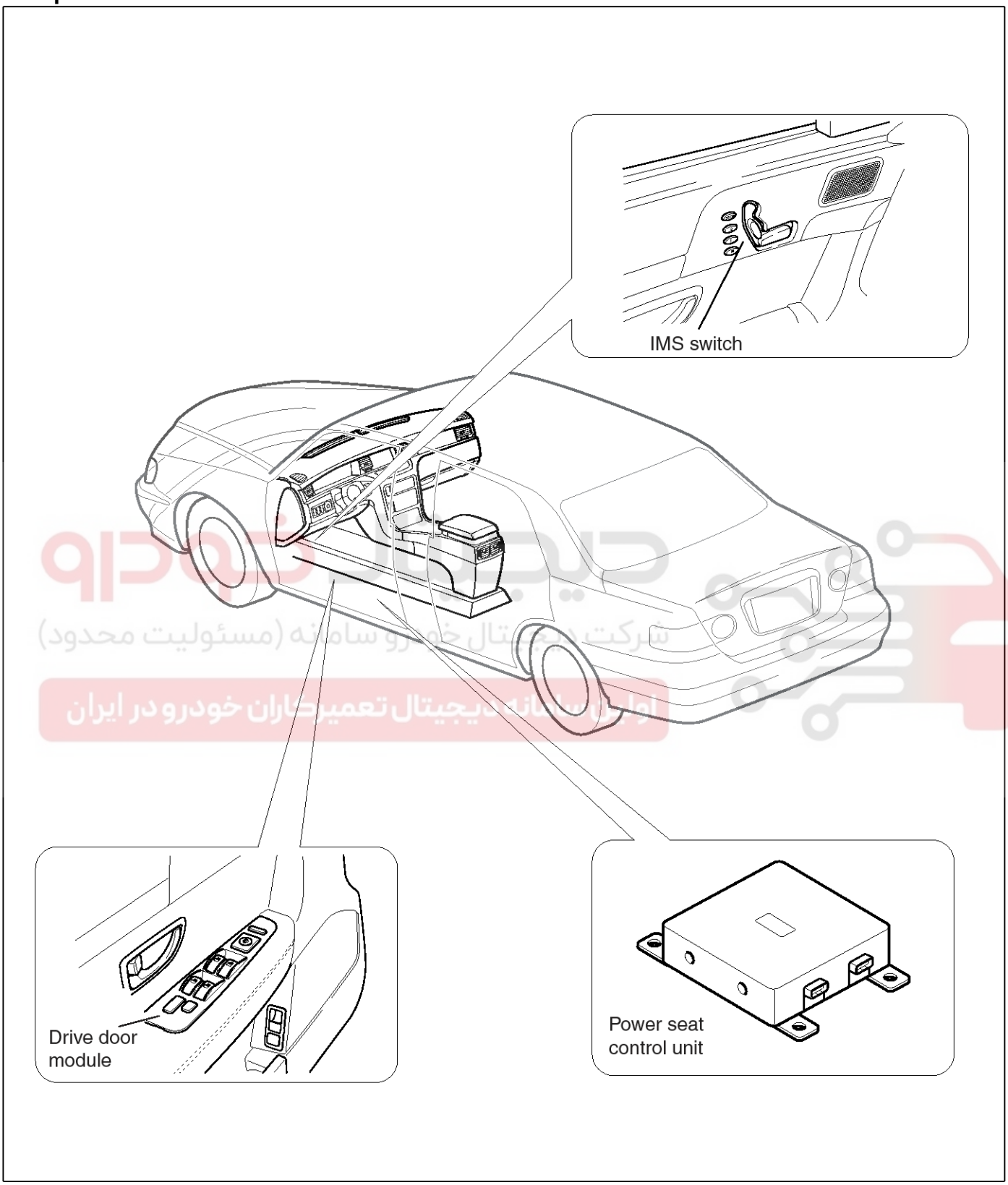
1. In case of memory permit status (memory switch is ON): once
2. When memory registration is complete (position switch is ON): twice
3. When the memory replay is in operation (position switch is ON): once
4. When error is detected due to the sensor failure: 10 times

Error detection

1. If the sensor fluctuations of slide and front/rear height for one second after motor start-up are less than 6 pulses and4 pulses respectively, and if the sensor fluctuation of reclining for 3.5 seconds is less than 50mV, it is determined that the harness is short or sensor is fail.
2. Countermeasure when error is detected.

   Stop the operation if it is in auto replay. Though, it should be operable manually. When the failure is completely repaired, it can be automatically adjusted from the stop of auto replay. If the position sensor senses the pulse from the position sensor by the manual operation (in case of reclining, sensor fluctuation for 3.5 seconds is greater than 50 mV), we judge it is complete. This is called stop release of automatic operation.

Components



LTCD310A

Specification

Item			Specification
Position Sensor	Type		Slide : Reed switch Recline : Potentiometer Front/rear height : Hall I.C
	ON:OFF ration		Slide, Recline : 50 ± 30% Front/rear height : 50± 15%
	Contact current		20mA
	Chattering		None
	Pre stroke	Slide	240mm ± 5
		Recline	73° + 4/-2
		Front height	36mm ± 2
		Rear height	41mm ± 2
	Pre pulse number	Slide	1536 ± 100/-50
		Recline	-
		Front height	149 ± 6
		Rear height	211 ± 6
	Moving speed	Slide	Forward : 7.0 ± 3mm/sec Backward : 20.5 ± 3mm/sec
		Recline	3.5° /sec
		Front height	9.5 ± 2mm/sec
		Rear height	8 ± 2mm/sec
	Resolution	Slide	0.15625 mm/pulse
		Recline	0.146° / pulse
		Front height	0.24182 mm/pulse
		Rear height	0.19452 mm/pulse
Manual switch	Type		SELF RETURN TYPE
	Contact current		MAX 7A
	Chattering		MAX 10msec
IMS control switch (M-emory switch, position switch, stop switch)	Type		SELF RETURN TYPE
	Contact current		MIN 10mA
	Chattering		MAX 0.5msec
Limit switch	Type		Open at the control limit
	Contact current		8A

IMS Mirror Control

Description

Optimal mirror position setting can be registered in the mirror control unit by IMS control switch and mirror position sensor by the driver. (This is so called registration operation No.1). Therefore, registered position can be replayed by one touch even after the mirror position has been changed. (This is replay operation No.1). In addition, the keyless can restore the original mirror position that it used be when the driver left the vehicle. (Only if the mirror position has been changed). (This is called replay operation No.2). Abovementioned function can accommodate 2 drivers in maximum.

Function

Mirror position control

Mirror position sensor reads each mirror motor displacement all the time. Mirror position is registered by the registration command through the IMS switch operation. Likewise, mirror position replay is performed by the replay command through the IMS switch operation. As shown in the system component diagram, manual control of mirror position is performed by the input from the mirror switch, which has the priority over registration and replay control.

Motor drive control

1. Driving sequence

   In principle, driving sequence is from horizontal direction to vertical direction. As for the displacement in one direction while the mirror is driving in the other direction, hysteresis of target value ± 0.06V is set.

2. Control in memory replay

   1) View range setting

      View range should satisfy the following criteria considering the structure of the mirror.

      - Horizontal direction: 1.5~3.5V
      - Vertical direction: 1.5~3.5V

      Specifically speaking, view range here indicates the following

      - Mirror control range not limited by the mechanical lock in the unit itself.
      - Mirror control range not affecting the sensor characteristics (sensing linearity)

   2) Determination of driving path

      Since mirror can be mechanically locked due to the structure outside the view range, it is wise to set the driving path while driving the mirror to prevent those mechanical locks.

   3) Detection of the lock

      Motor driving time is monitored using the timer to detect the lock.

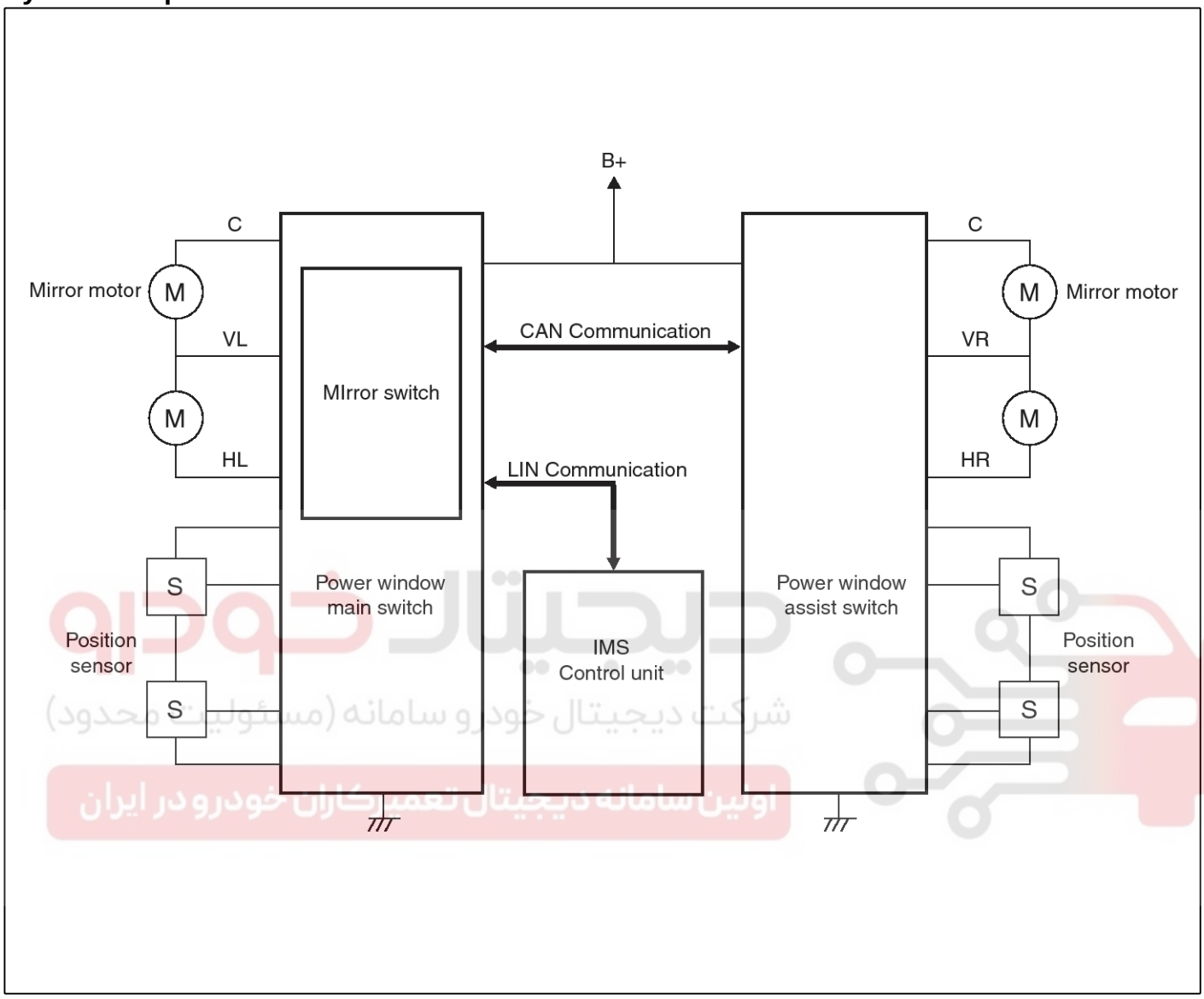
      Monitoring of the replay execution time: If the replay operation does not complete within the 40 seconds after the start of the replay control, then stop the motor output and terminates the control.

3. Outside mirror auto-reverse function

   1) When the “R” of the shift lever is changed from 0 to 1, pull down the outside mirror for 5 degrees by the position of mirror selection switch.
   2) When the “R” is changed from 1 to 0, it returns to the registered position. (previous position before “R” is changed to 1 from 0)
   3) When the mirror selection switch is in L: Left and right outside mirror all moves together.
   4) When the mirror selection switch is in R: only the right outside mirror moves.
   5) When the mirror selection switch is in neutral: Nothing moves.
   6) Manual switch input during the mirror down operation: It stops the current operation and operates only by the manual switch, and returns to the registered position when “R” is changed to 0 form 1.
   7) Mirror switch input during the mirror down operation: It stops the current operation and returns to the registered position when “R” is changed to 0 form 1.
   8) Manual switch input during the returning operation: It stops the returning operation and operates by the switch input.
   9) Position switch input during the returning operation: It completes the returning operation if it is replay-prohibiting condition, otherwise it performs the replay operation.
   10) If the stop switch is inputted during the operation, it stops the operation and returns to the previously registered position when “R” is changed to 0 from 1. It stops returning if it is in returning operation.
   11) Auto-reverse prohibiting operation
      - When the ignition OFF
      - When the auto switch is OFF
      - When the stop switch is ON

- When the manual switch is ON

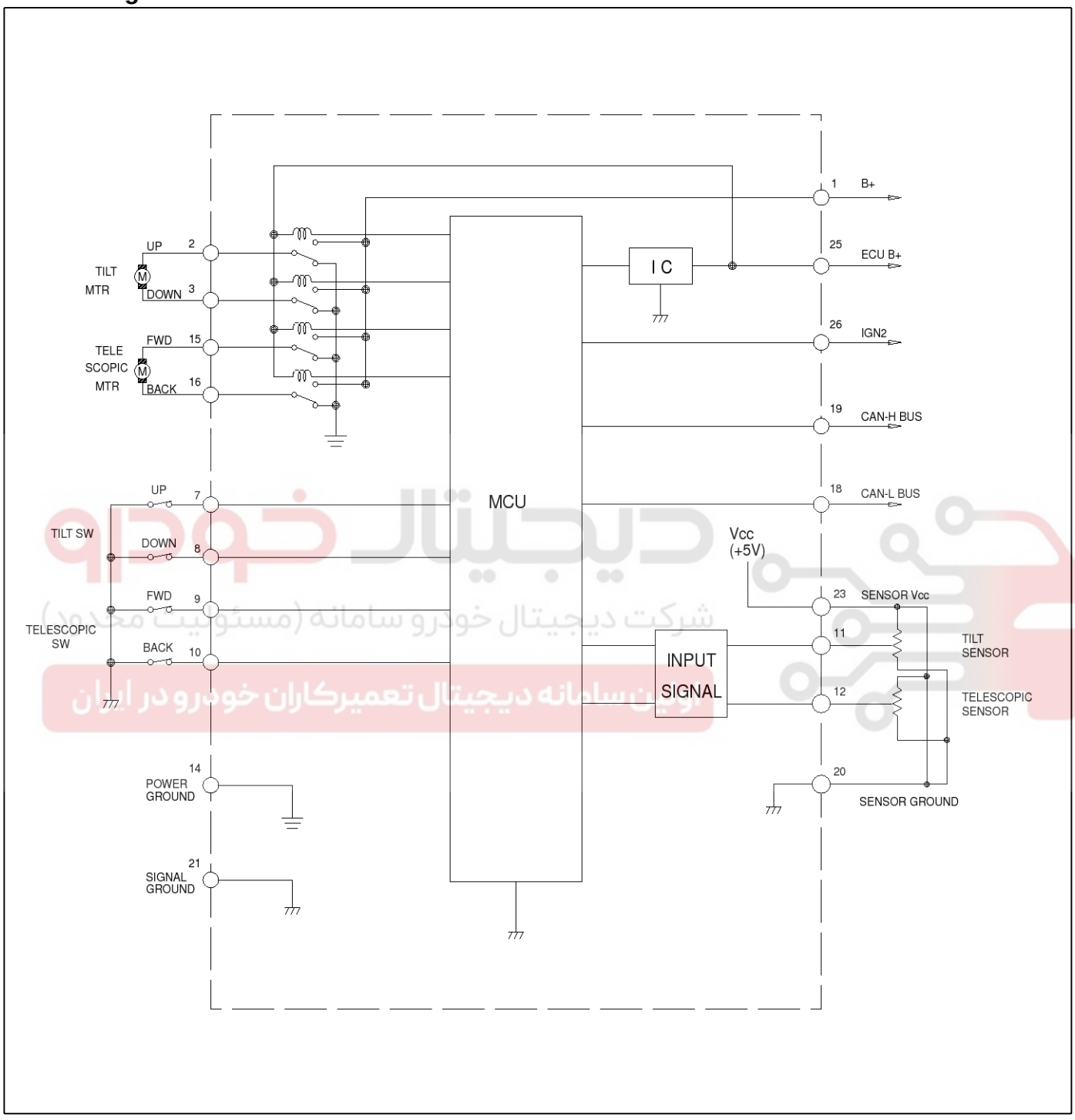
System composition



LTCD230A

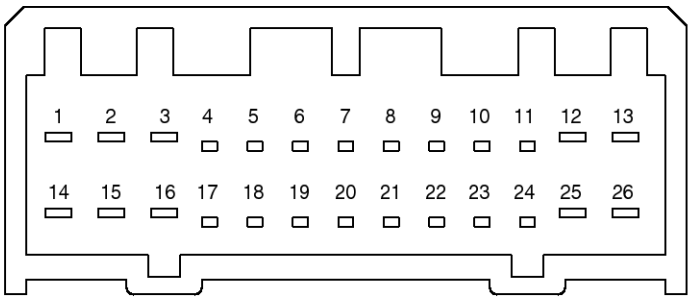
IMS Tilt and Telenodeope Control

Circuit diagram



ATCD323A

Connector configuration



1	B+
2	TILT Motor UP
3	TILT Motor DOWN
4	NC
5	NC
6	NC
7	TILT UP SW
8	TILT DOWN SW
9	TELESCOPIC Forward SW
10	TELESCOPIC Back SW
11	TILT SENSOR
12	TELESCOPIC SENSOR
13	NC
14	POWER GROUND
15	TELESCOPIC Motor forward

16	Telescopic Motor back
17	NC
18	CAN-L Bus
19	CAN-H Bus
20	Sensor Ground
21	Signal Ground
22	NC
23	Sensor Vcc
24	NC
25	ECU B+
26	IG2

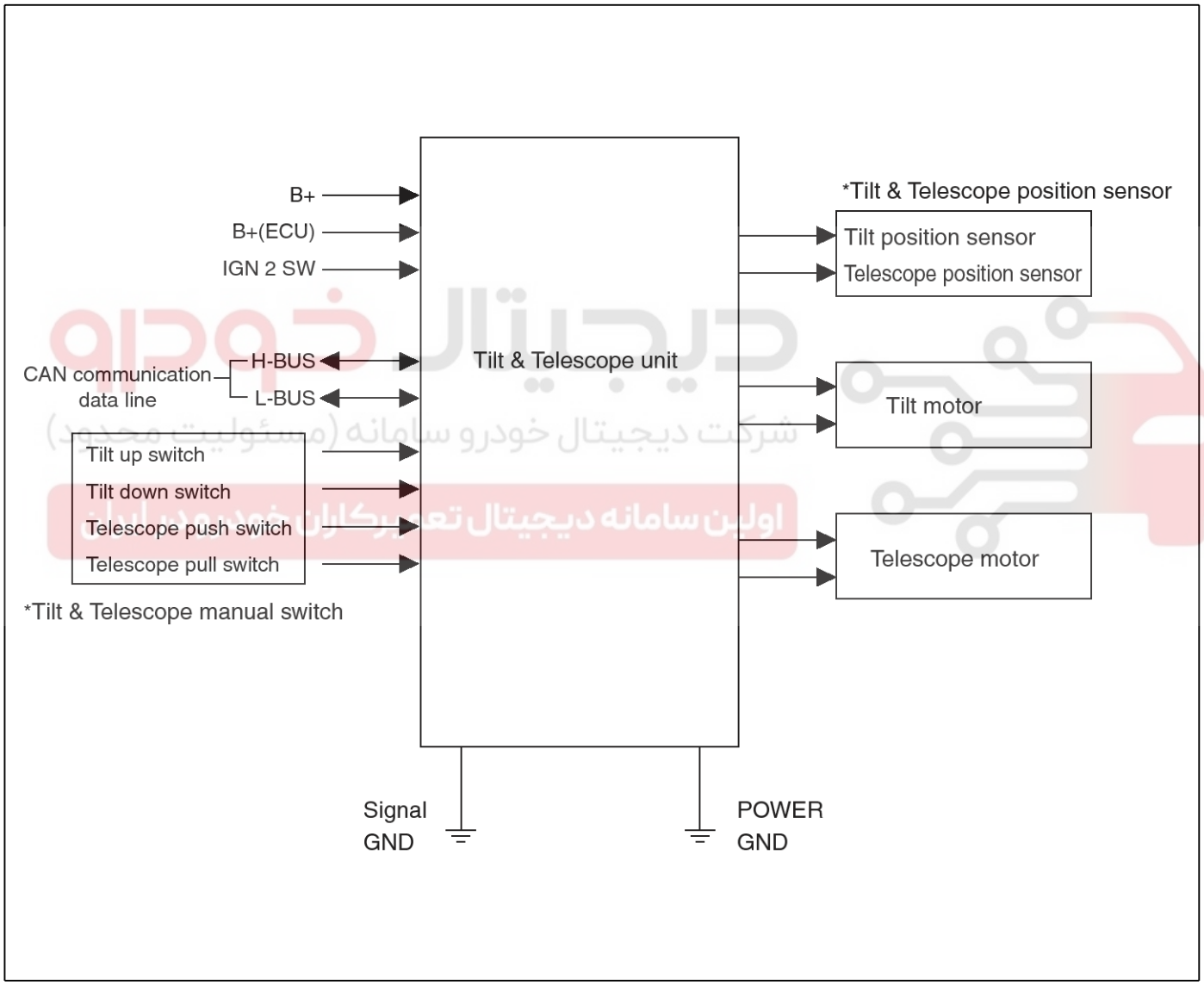
ATCD322A

Description

It will store the optimum the steering position selected by the driver at the unit using the switch and the position. Upon change of the steering position, it will provide one touch replay of the steering positions selected by the driver for 2 persons. There will be the data transmission and reception between the tilt and telescope unit and the driver side door module via CAN communication.

Inhibit replay feature is provided for safety to inhibit the replay operation during running.

I/O DIAGRAM



LTCD320B

Function

1. Manual operation

   Up and down control of steering column tilt and forward and backward control of telescope by motor control with the manual switch.

   The signal input by the manual switch changes the steering column position by driving the relay.

2. Memory registration/replay operation

   It can register and replay the tilt/telescope position by the IMS memory switch up to 2 drivers.

   Optimal steering column position setting can be registered in the control unit by IMS control switch and position sensor by the driver. Therefore, registered position can be replayed by one touch even after the steering column position has been changed.

3. Keyless registration/replay operation

   Keyless operation provides registration and replay function up to 2 drivers. (Auto registration in keyless lock and replay operation in keyless unlock)

Operation

Manual operation

1. Up /down control of steering column tilt and forward/backward control of telescope

   Manual switch provides position setting and simultaneous 2-way operation of the steering column

Memory replay operation

1. Data related to the registration operation is received by way of CAN communication from power window main on the CAN line.
2. If any of the following conditions is met, memory permit status will be released.

   After elapse of 5 seconds from the memory switch ON.

   When the ignition switch is OFF

   When the stop switch is ON

   When the manual switch is ON

   When the memory registration is complete
3. If 2 position switches are pressed ON simultaneously (within time interval of 50 ms) in memory registration, none of the switches are valid, and the first pressed switch is valid if the time interval is greater than 50 ms
4. If the vehicle speed is over the limit speed of 3 km/h or shift lever is at the position other than P, registration cannot be performed.
5. Registration may be revised without any limitation.
6. memory will be cleared if the battery is removed.
7. If the memory registration is permitted (memory switch is ON), it sounds the buzzer.

Memory replay operation

1. Data related to the memory replay are received through the CAN communication from the power window main on the CAN line.
2. Steering column is set to the registered position as each position switch is pressed when the ignition is ON.
3. Memory replay will not be performed unless it is registered.
4. If the position switch is pressed while the memory replay is in operation, the final switch is effective. Though, if the switches are pressed within the time interval of 50 ms, replay will not be performed.
5. When the replay is in operation (position switch is ON), buzzer will sounds once.
6. If any of the following conditions is met, replay is prohibited and operation will stop if it is in replay.

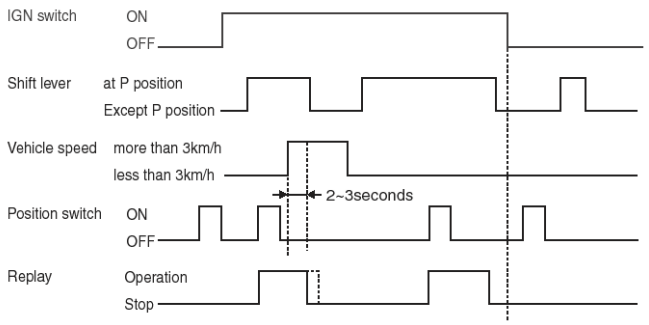
   When the ignition is OFF

   When the “P” position switch is OFF (when the shift lever is in the position other than “P”)

   When the vehicle speed is over 3 km/h (when it last more than 2 or 3 seconds)

   When the manual switch operated. (Only steering column related replay operation stops)

   When the stop switch is ON



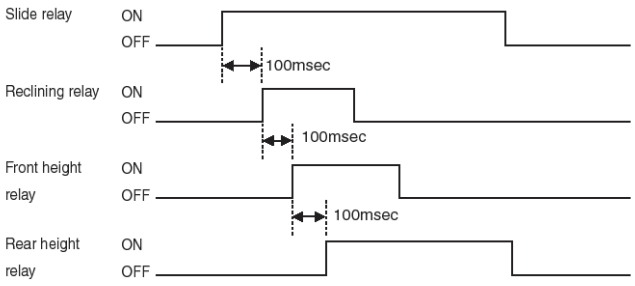
LTCD312A

7. Control in reverse operation

   When the motor is driven reverse during the operation, it performs reverse operation after 100±10 ms from completing the current operation.
8. Determining operational priority

   In order to prevent overlapping of rushing current when the motor starts up, motor start-up is delayed for 100 ms respectively and its operational priority is as follows.

Tilt>Telescope



LTCD312B

9. Sequential timer settings for motor start-up.

   Tilt : 10± 1 seconds

   Telescope : 10± 1 seconds

10. If the difference between registered position and current position is less than the specification in replay operation, motor will not drive.

    Steering and telescope: within 100mV

Registration and replay by the keyless

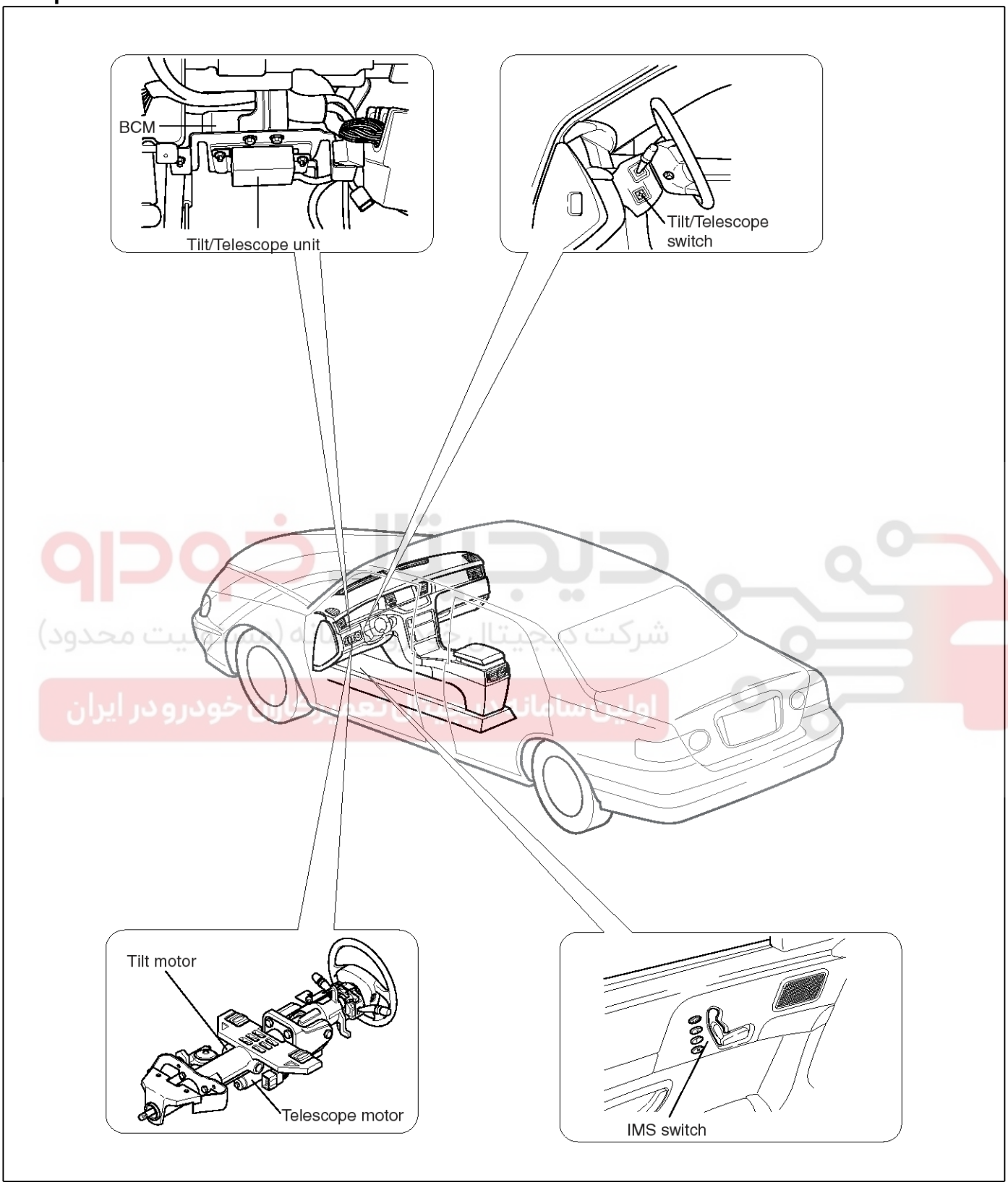
1. Keyless registration operation
   1) Ignition ON and OFF positions are registered corresponding to the keyless codes.
   2) Keyless codes are determined by the keyless door lock operation.
2. Keyless replay operation
   1) Upon door unlock operation when the ignition is OFF, it automatically sets the registered positions corresponding to the keyless code.
   2) If any of the following conditions is met, keyless replay operation is prohibited and operation stops if it is in operation.
      - When the P position switch is OFF
      - When the manual switch is in operation.
      - When the stop switch is ON

Error detection

1. If the sensor variation of tilt and telescope for one second after motor start-up is less than 100 mV, and if the sensor fluctuation of reclining for 3.5 seconds is less than 50mV, it is determined that the harness is short or sensor is fail.
2. Countermeasure when error is detected.

   Stop the operation if it is in auto replay. Though, it should be operable manually. When the failure is completely repaired, it returns to automatic control from the auto control stop status. If the position sensor senses the variation above 100 mV by manual operation, we judge auto control stopping status is complete. This is called stop release of automatic operation.

Components



LTCD320A

IMS (Integrated Memory BE-153

Specification

Item		Specification
Position Sensor	Type	Variable resistor, 5.0kΩ ± 20%
	Voltage rated	DC 5V
	Output tolerance	± 3% (Rated straightness)
Manual switch	Type	Momentary switch
	Contact current	MAX 50mA
	Chattering	MAX 30msec
Actuator	Voltage rated	12V
	Current rated	5A
	Restraint current	15A

Trunk lid

COMPONENT LOCATION

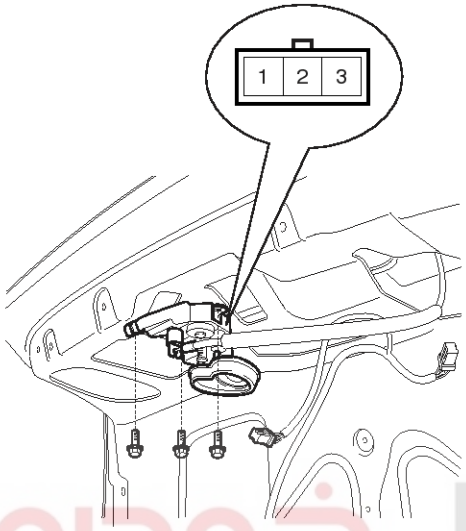
1. Trunk lid open switch
2. Trunk lid release actuator

SGHBE6160L

Trunk Lid Release Actuator

INSPECTION

1. Remove the trunk lid trim panel. (Refer to the Body group-trunk lid)
2. Disconnect the 3P connector from the actuator.



SGHBE6161D

3. Check actuator operation by connecting power and ground according to the table. To prevent damage to the actuator, apply battery voltage only momentarily.

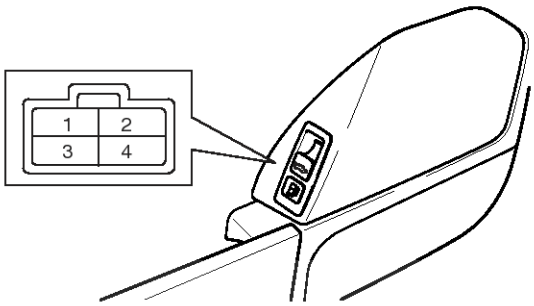
Terminal / Position	2	3
Open	⊕	⊖

SGHBE6162L

Trunk Lid Open Switch

INSPECTION

1. Remove the front door trim panel. (Refer to the Body group-front door)
2. Check the switch for continuity between the No. 3 and No. 4 terminals.
3. If the continuity is not as specified, replace the switch.

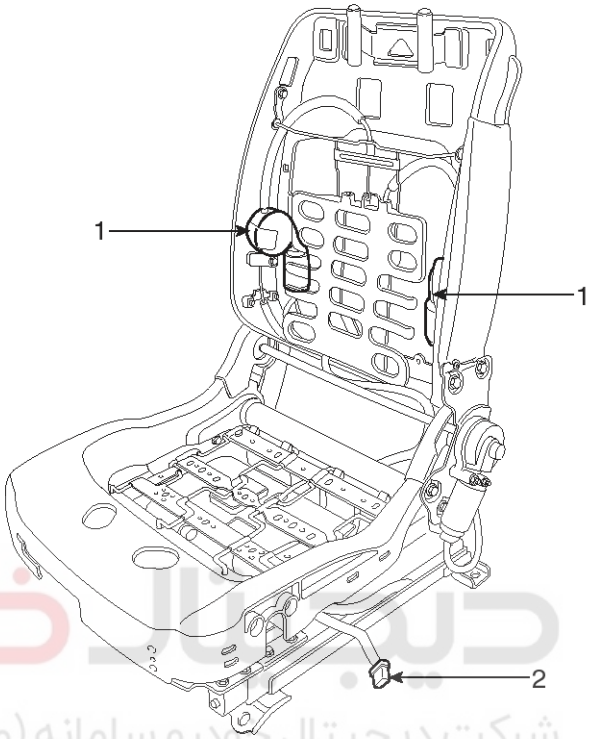


SGHBE6163D

Seat Electrical

COMPONENTS

[POWER LUMBAR SUPPORT]



1. Lumbar support motor
2. Lumbar support control switch connector

SGHBE6440L

Power Seat Motor

Climate Seat Unit

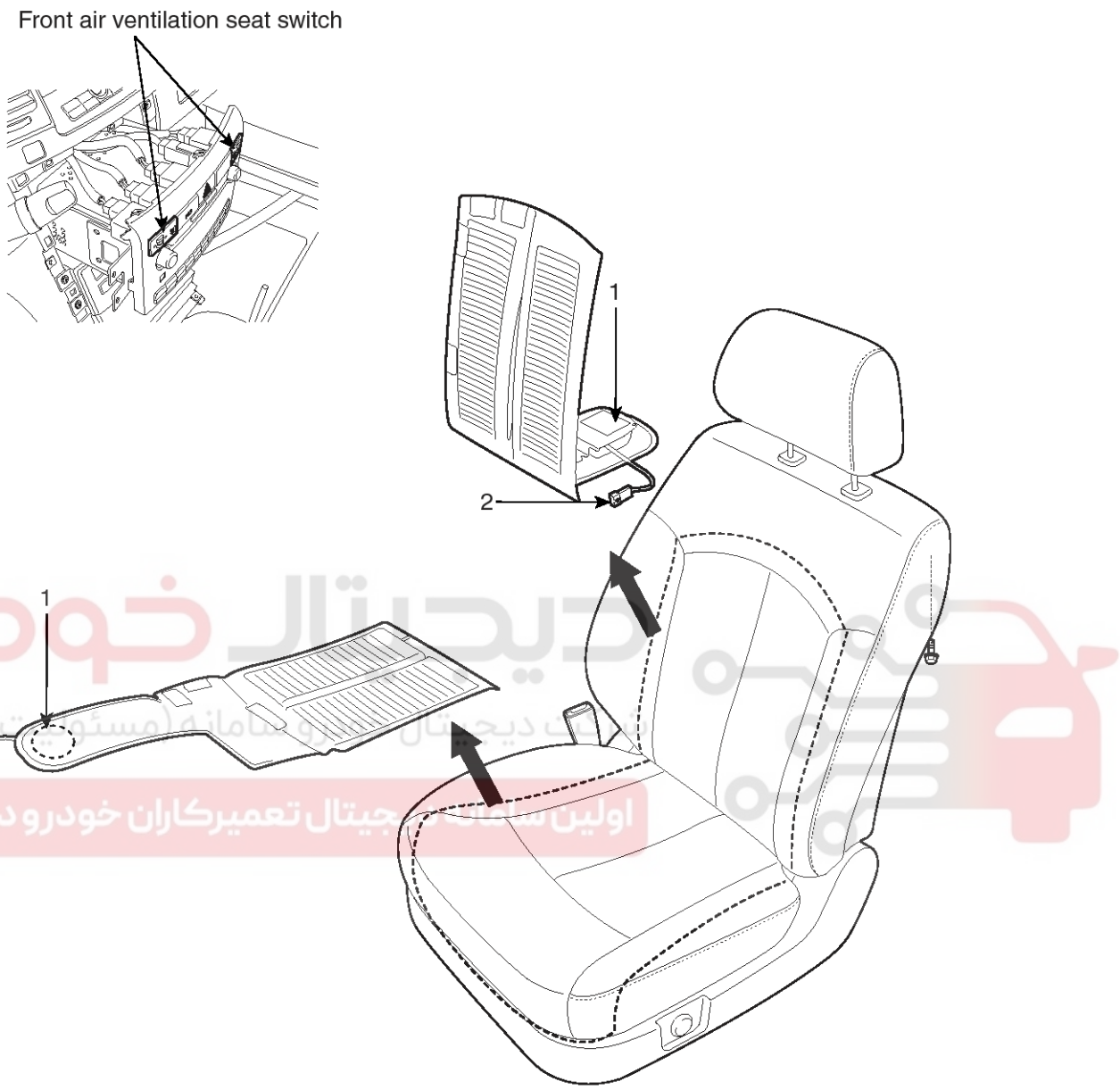
DESCRIPTION

Using the indraft power of FAN on seat, remove the moisture, sweat and warmth from occupants and surface of seats.

NOTICE

1. *Make sure not to spoil drink or water on the seat when equipping with climate control system seat.*
2. *When equipping with front air ventilation seat, make sure not to prevent the filter from getting the vinyl or book into behind the seat.*
3. *Because of inhaling the slight air, it is difficult to feel the air strength by the sense of touch.*

COMPONENTS



[Front air ventilation seat]

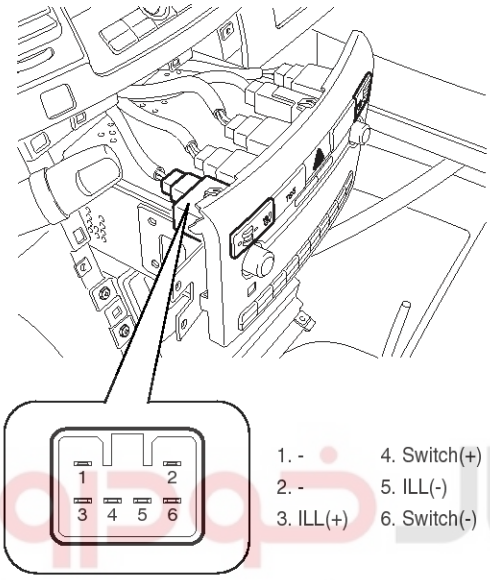
1. FAN
2. FAN Connector(2P)

SGHBE6256L

INSPECTION

FRONT AIR VENTILATION SEAT SWITCH

1. Remove the front air ventilation seat switch assembly after removing the center facia panel.
   (Refer to the Body group - Interior trim)
2. Remove the front air ventilation seat switch (Drive, Assist) Connectors(6P).



SGHBE6257L

3. Cheek the resistance between switch connector terminals 4 and 6 at each switch position if the resistance is not as specified, replace the switch.

SWITCH(SEAT WARMER ONLY)

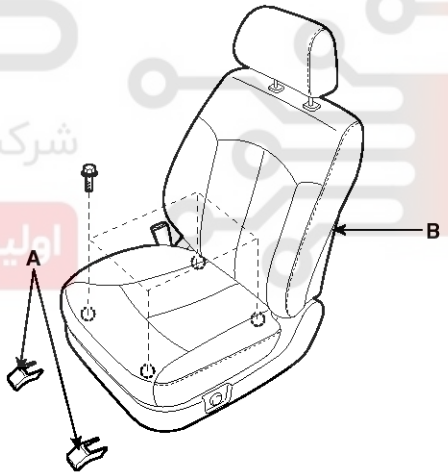
Position	Switch angle	Resistance(Ω)
0	0°	-
1	47	8000
2	94	6300
3	141	4760
4	188	2500
5	238	470

SWITCH(SEAT WARMER AND AIR VENTILATION)

Position	Switch angle	Resistance(KΩ)
3	0	1.62
2	22	3.72
1	44	6.39
0	66	9.95
1	88	14.95
2	110	22.63
3	132	35.33
4	154	60.23
5	175	105.53

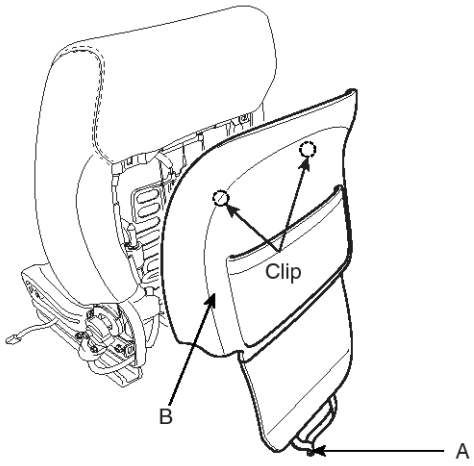
BACK FAN

1. Remove the seat assembly mounting cover (A). After loosening the seat assembly mounting bolts, remove the seat assembly (B).



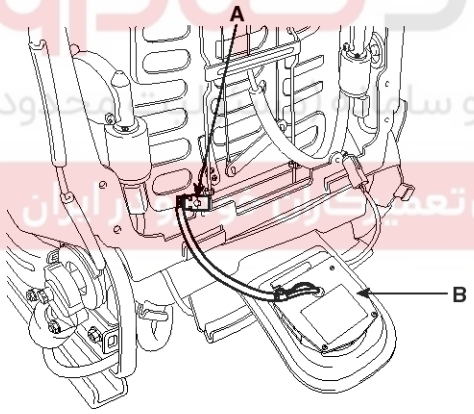
SGHBE6260D

2. After disconnecting the scuff band (A), remove the seat back panel (B).



SGHBE6261L

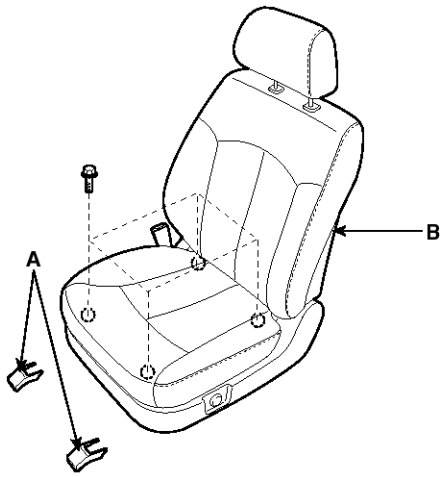
3. Disconnect the connector (A) from the seat cover. And if the FAN (B) is not operating properly, change the FAN.



SGHBE6262D

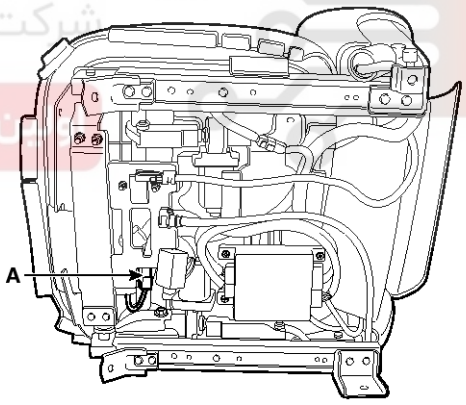
CUSHION FAN

1. Remove the seat assembly mounting cover (A). After loosening the seat assembly mounting bolts, remove the seat assembly (B).



SGHBE6260D

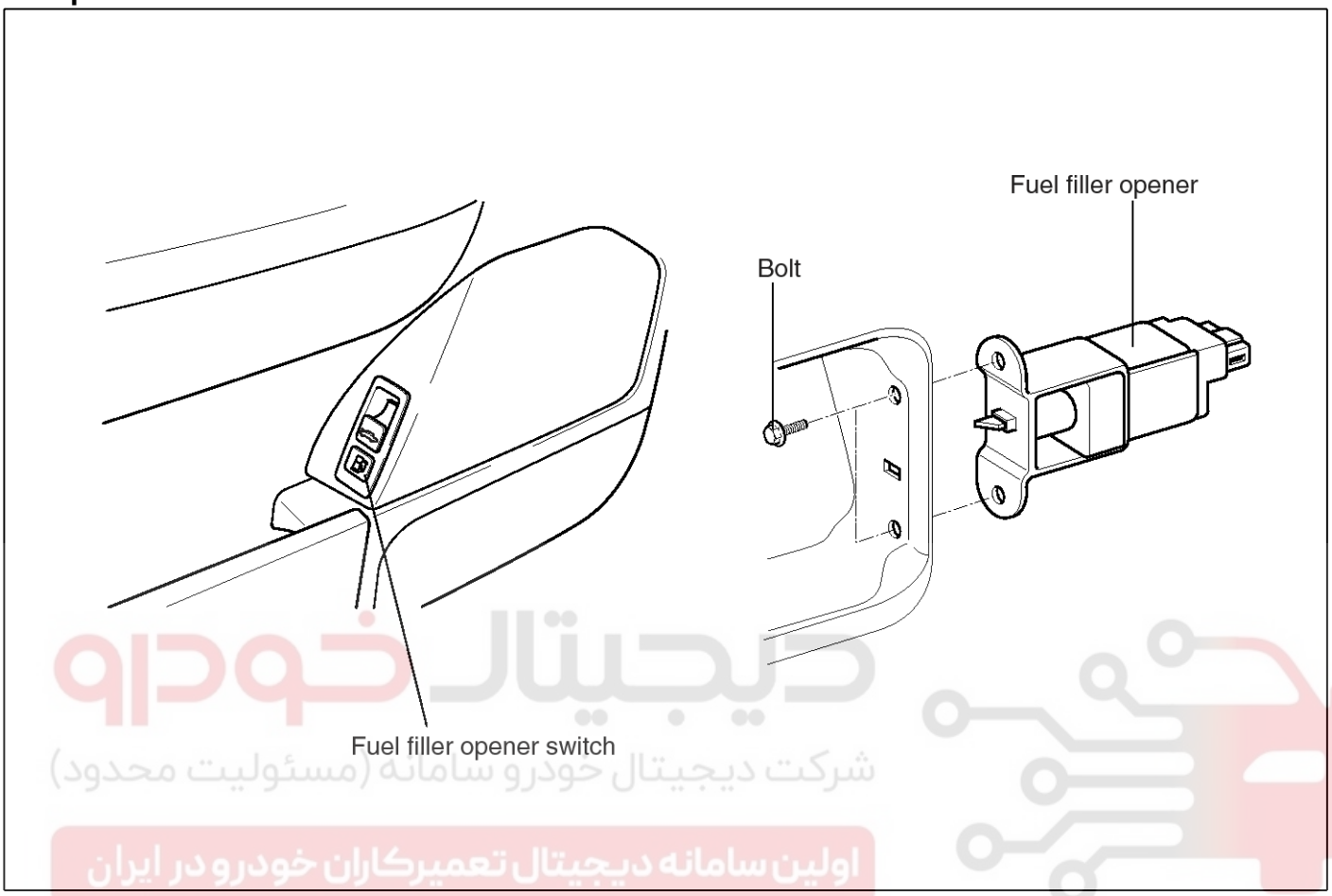
2. Disconnect the connector (A) from the seat cover. And if the FAN (B) is not operating properly, change the FAN.



SGHBE6264D

Fuel Filler Door

Components

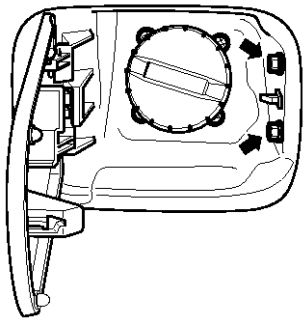


LTCD270A

Fuel Filler Door Release Actuator

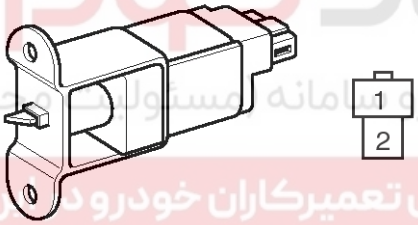
Inspection

1. Remove the trunk room trim.
2. Open the fuel filler door and remove the fuel filler door opener.



KFWG044A

3. Check for continuity between terminal 1 and 2. If there is no continuity replace the fuel filler door opener.

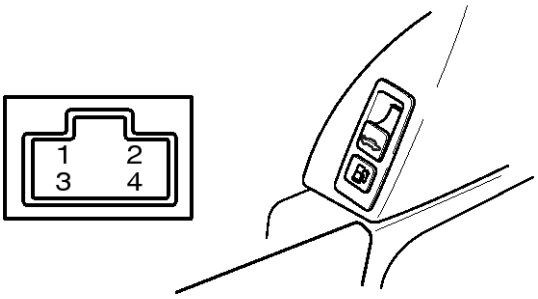


KTBC275A

Fuel Filler Door Open Switch

Inspection

Check the switch for continuity between the terminal 1 and 2. If the continuity is not as specified, replace the switch.

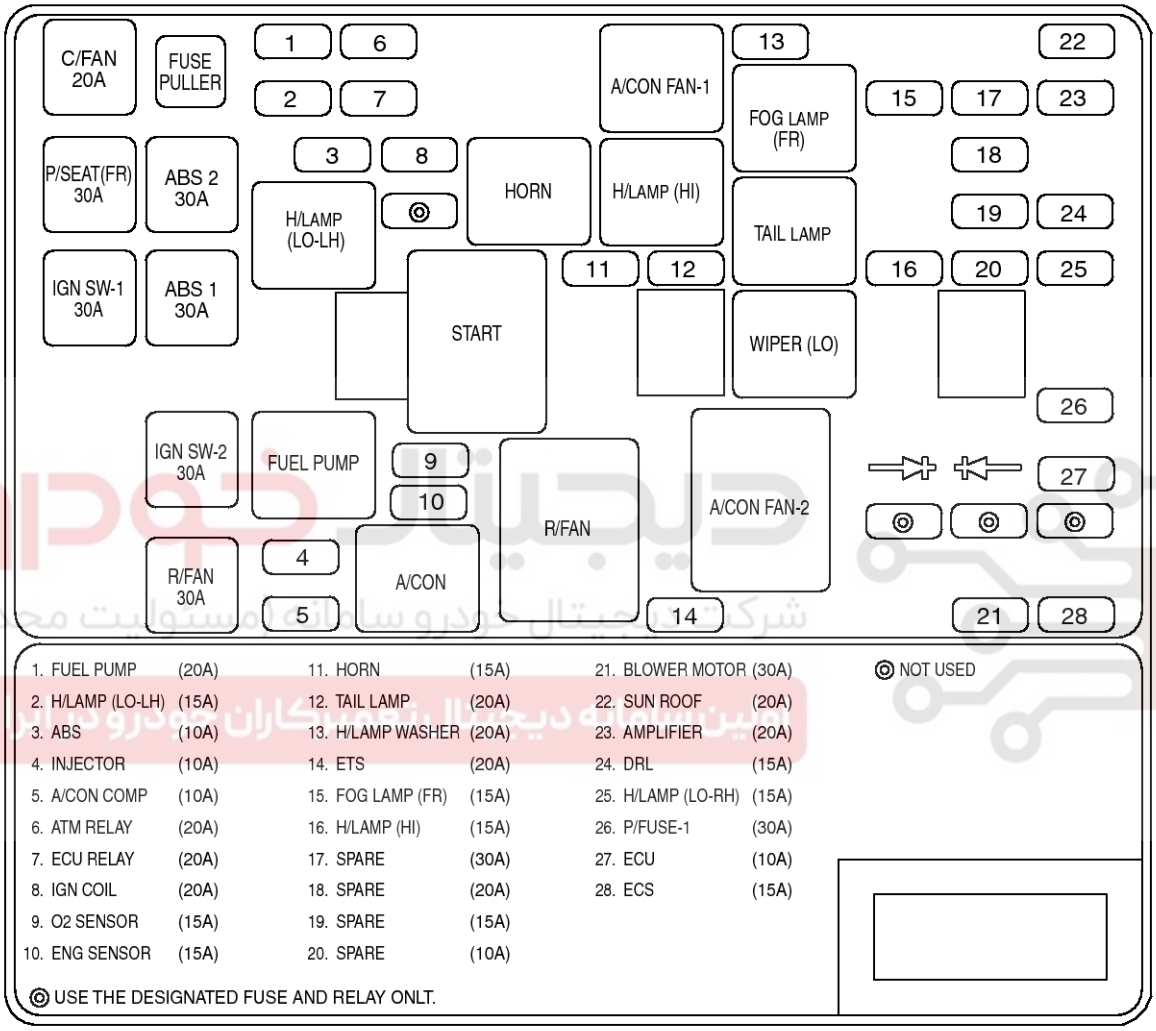


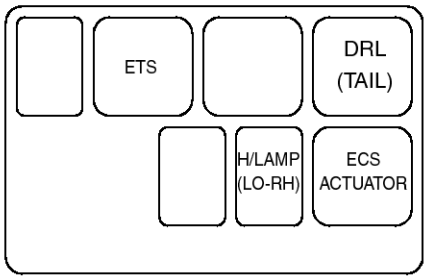
ATCD275B

Fuses And Relays

Relay Box (Engine Compartment)

Components



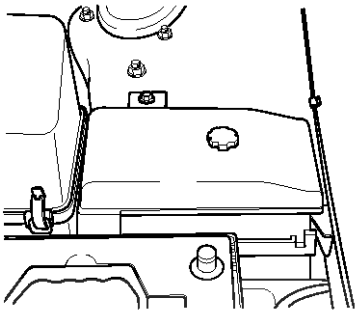


LTCD040A

Inspection

1. Check for a burnt fusible link with an ohmmeter.
2. If a fusible link burns out, there is a short or some other problem in the circuit. Carefully determine the cause and correct it before replacing the fusible link.

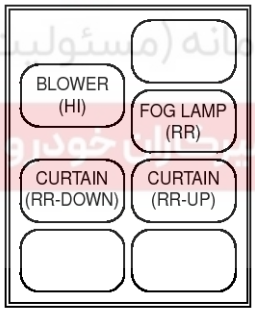
⚠CAUTION
The fusible link will burn out within 15 seconds if a higher than specified current flows through the circuit.



ATCD041A

Relay (Assist side cover)

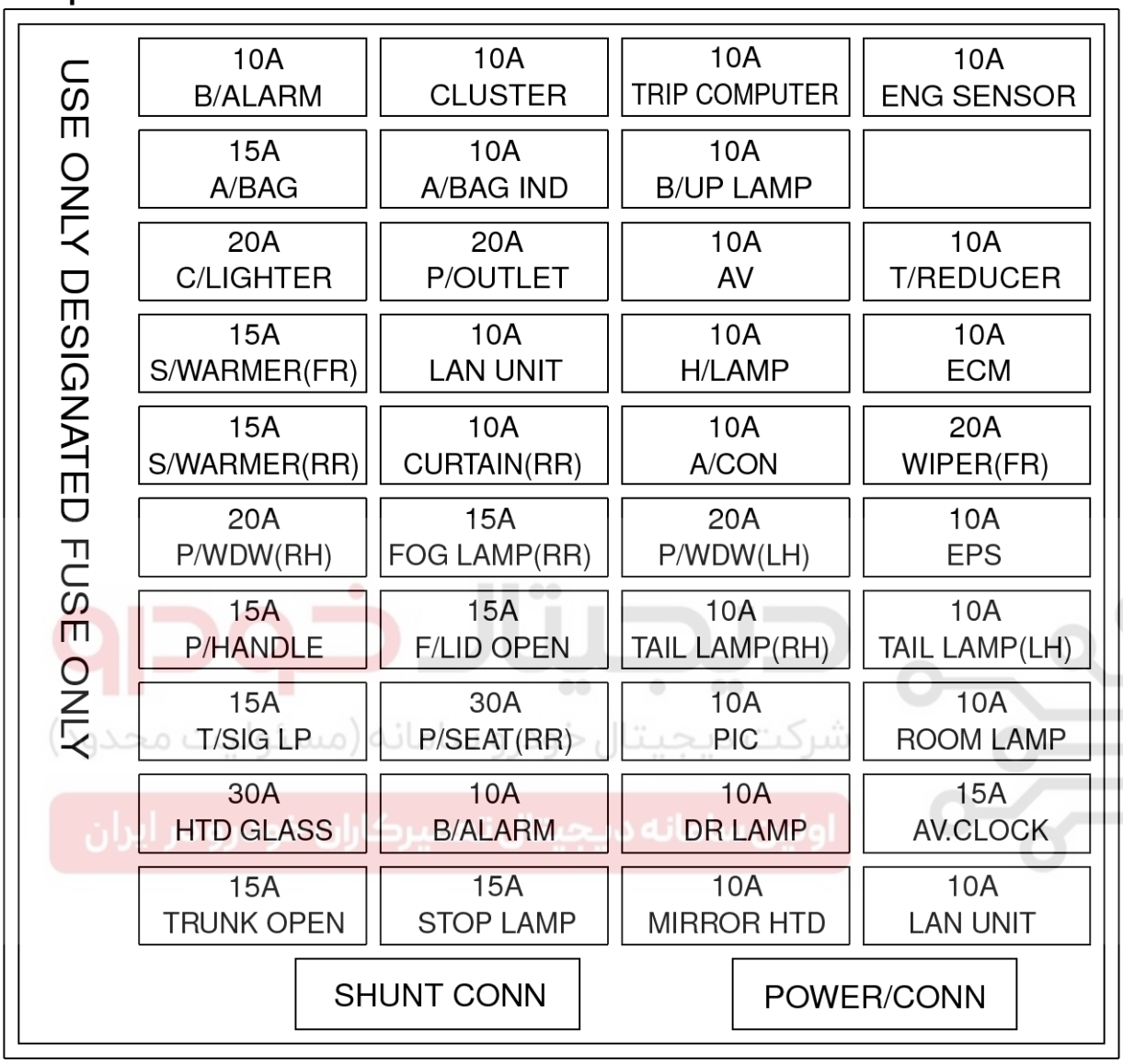
Components



LTCD046A

Fuses

Components

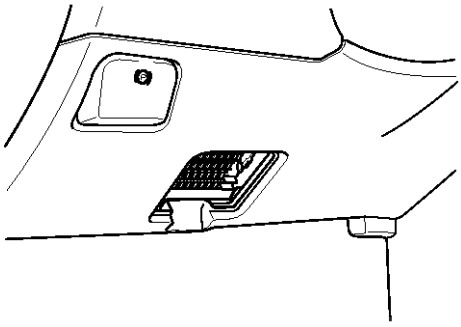


LTCD044A

Inspection

1. Be sure there is no play in the fuse holders, and that the fuses are held securely.
2. Are the fuse capacities for each circuit correct?
3. Are there any blown fuses?

   If a fuse is to be replaced, be sure to use a new fuse of the same capacity. Always determine why the fuse blew first and completely eliminate the problem before installing a new fuse.



ATCD045A

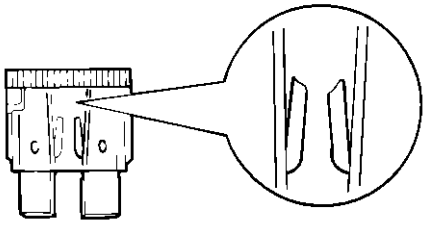
Inspection of fuses

When a fuse is blown, there are two probable causes. The two causes can easily be determined by a visual check after removing the fuses.

1. Fuse blown due to over-current.

   Prior to replacing the fuse with a new one, check the circuit for a short and the related parts for abnormal conditions.Only after the correction of a short or replacement of abnormal parts, should a fuse with the same ampere rating be installed.

Blown fuse due to overcurrent

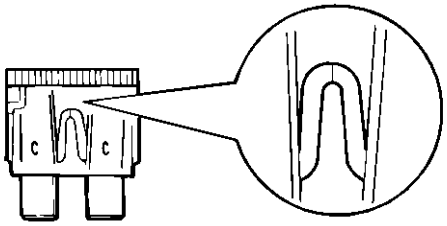


LTAC024A

2. Fuse blown due to repeated on-off current.

   Normally, this type of problem occurs after a fairly long period of use, and is less frequent than #1 above. In this case, you may simply replace with a new fuse of the same capacity.

Blown fuse due to thermal fatigue



LTAC024B

⚠CAUTION

A blade type fuse is identified by the numbered value in amperes. If the fuse is blown, be sure to replace a fuse with the same ampere rating. If a fuse of higher capacity than specified is used, parts may be damaged and a danger of fire exists. To remove or insert a fuse, use the fuse puller in the fuse box.

10A 15 A

LTAC024C

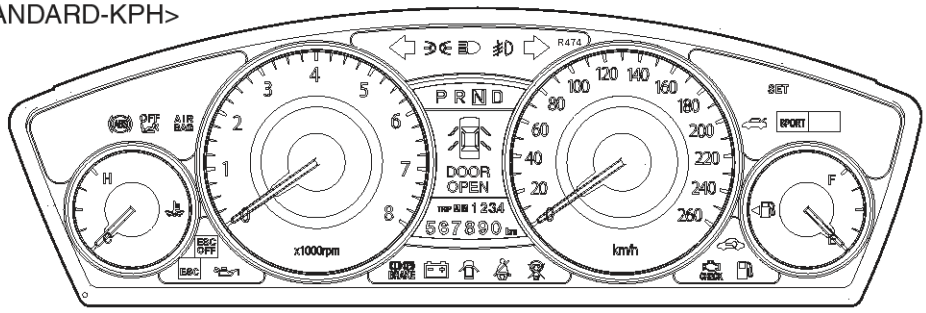
Indicators And Gauges

Instrument Cluster

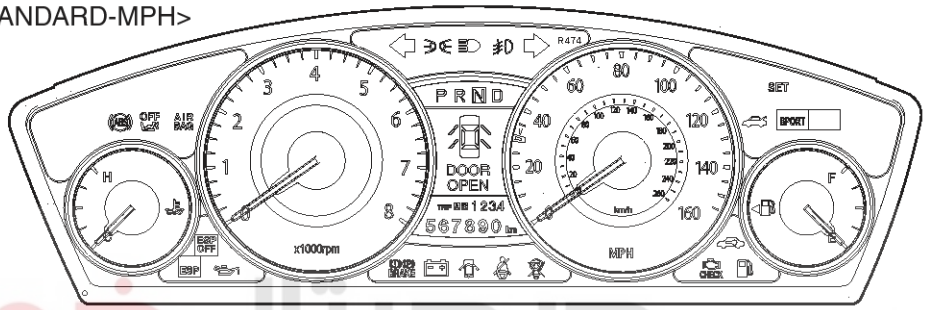
COMPONENTS

<FRONT>

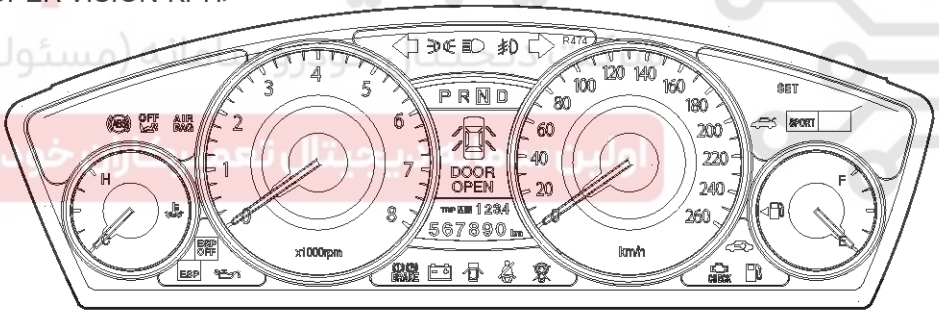
<STANDARD-KPH>



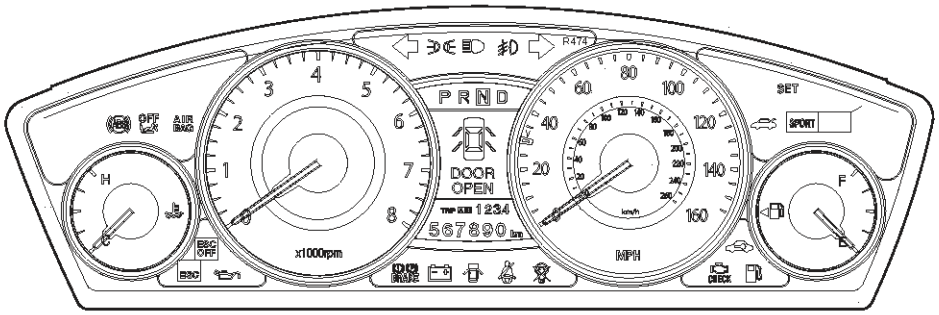
<STANDARD-MPH>



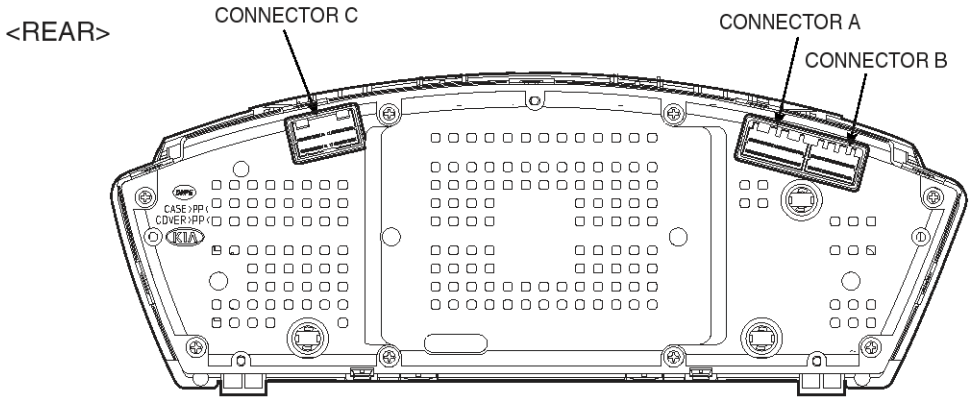
<SUPER VISION-KPH>

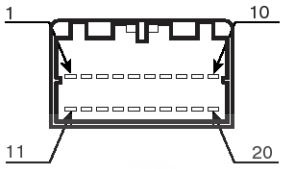


<SUPER VISION-MPH>



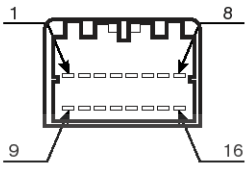
SGHBE7221L





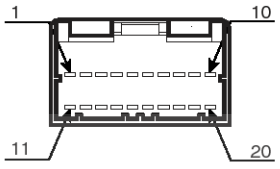
CONNECTOR A

NO.	CONNECTOR A
1	LEFT INDICATOR
2	
3	HIGH BEAM INPUT
4	FRONT FOG LAMP
5	RIGHT INDICATOR
6	P
7	R
8	N
9	D
10	PWM SIGNAL
11	POWER GND
12	FBWS
13	TRIP SW
14	TRIP RESET SW
15	LOW WASHER
16	T/LID OPEN
17	EPS
18	SPEED WARNING
19	CHECK ENGINE
20	IMMOBILIZER



CONNECTOR B

NO.	CONNECTOR B
1	EPS OFF
2	ABS/EBD
3	OIL PRESSURE
4	BRAKE
5	BATT CHARGE
6	SEAT BELT
7	PAB(+)
8	PAB(-)
9	DOOR OPEN F/L
10	DOOR OPEN F/R
11	DOOR OPEN R/L
12	DOOR OPEN R/R
13	STOP LAMP FAIL
14	AIR BAG(+)
15	AIR BAG(-)
16	SPARE



CONNECTOR C

NO.	CONNECTOR C
1	-
2	CRUISE
3	-
4	SPORT
5	SET
6	TEMP INPUT
7	BUZZER
8	FUEL INPUT
9	SPEED INPUT
10	TACHO INPUT
11	-
12	-
13	-
14	-
15	IGN-1
16	BATTERY
17	SIGNAL GND
18	FUEL GND
19	ILL(+)
20	ILL(-)

SGHBE7222L

INSPECTION

SPEEDOMETER

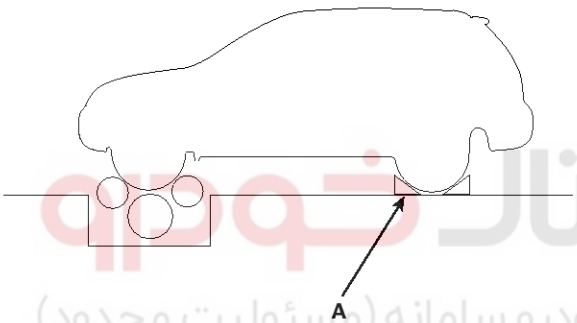
1. Adjust the pressure of the tires to the specified level.
2. Drive the vehicle onto a speedometer tester. Use wheel chocks as appropriate.
3. Check if the speedometer indicator range is within the standard values.

CAUTION

Do not operate the clutch suddenly or increase/ decrease speed rapidly while testing.

NOTICE

Tire wear and tire over or under inflation will increase the indication error.



SCMBE6203L

[km/h]

Velocity (km/h)	20	40	60	80	100	120
Tolerance - All (km/h)	+4.0 +0	+5.5 +2.0	+6.0 +2.0	+7.0 +2.5	+8.0 +3.0	+10.0 +4.0
Tolerance - CANADA (km/h)	+2.5 +0.5	+3.0 +0.5	+4.0 +1.0	+5.5 +1.5	+6.5 +1.5	+7.5 +2.0
Velocity (km/h)	140	160	180	200	220	240
Tolerance - All (km/h)	+10.0 +4.0	+11.0 +4.0	+12.5 +4.0	+13.5 +5.0	+14.5 +6.0	+12.0 +4.0
Tolerance - CANADA (km/h)	+9.0 +2.5	+9.0 +2.5	+10.0 +3.0	+11.0 +3.5	+11.5 +4.0	+12.0 +4.0

[MPH]

Velocity (MPH)	10	20	40	60	80
Tolerance (MPH)	+2.7 +0.7	+3.0 +0.8	+5.0 +1.2	+6.0 +1.5	+6.0 +2.0
Velocity (MPH)	100	120	140	160	
Tolerance (MPH)	+7.5 +2.5	+8.5 +3.0	+10.0 +3.5	+10.0 +5.0	

TACHOMETER

1. Connect the scan tool to the diagnostic link connector or install a tachometer.
2. With the engine started, compare the readings of the tester with that of the tachometer. Replace the tachometer if the tolerance is exceeded.

CAUTION

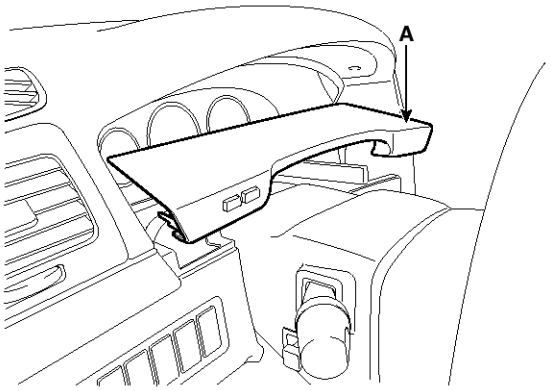
a. Reversing the connections of the tachometer will damage the transistor and diodes inside.

b. When removing or installing the tachometer, be careful not to drop it or subject it to severe shock.

Revolution (RPM)	1000	2000	3000	4000
Tolerance (RPM) MAX. 8000rpm	±120	±140	±170	±170
FREQUENCY	3000RPM (150Hz)			
Revolution (RPM)	5000	6000	7000	8000
Tolerance (RPM) MAX. 8000rpm	±200	±240	±260	±260
FREQUENCY	3000RPM (150Hz)			

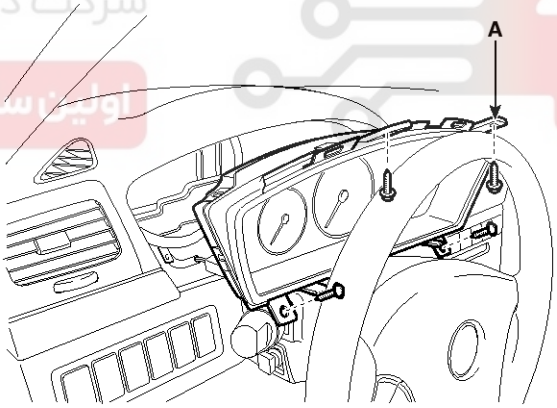
REMOVAL

1. Disconnect the negative (-) battery terminal.
2. Remove the cluster lower facia panel (A) after loosening 2 screws.
3. Disconnect trip switch connector.



SGHBE6223D

4. Remove the cluster upper facia panel(A) after loosening 2 screws.
5. Pull out the cluster (A) from the housing after removing 4 screws.



SGHBE6224D

6. Disconnect the cluster connecters and then remove the cluster.

INSTALLATION

1. Assemble the cluster after connecting the cluster connectors.
2. Install the cluster with 4 screws.
3. Install the cluster upper facia panel.
4. Install the cluster lower facia panel after connecting the trip switch connectors.

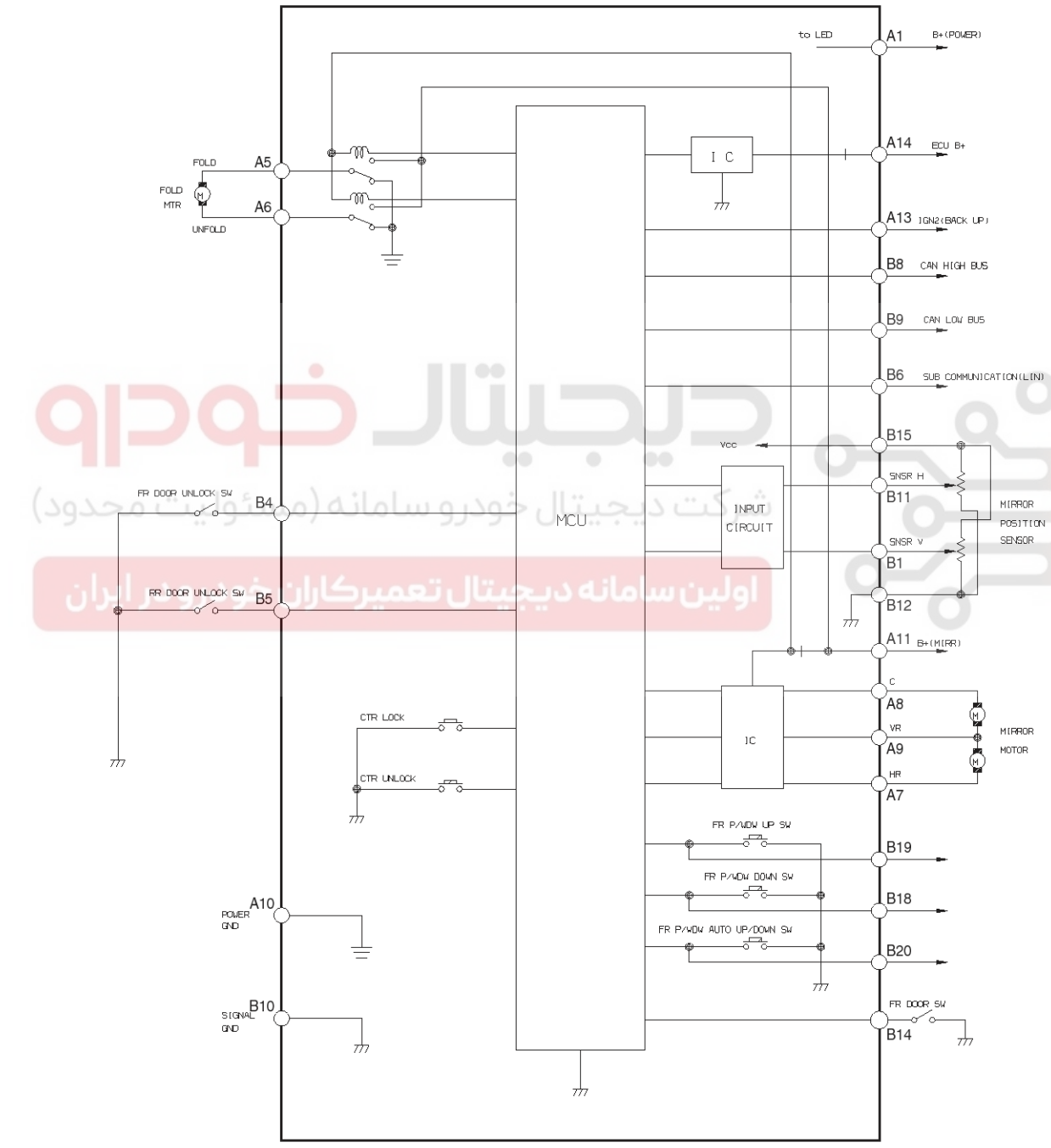
Power Door Locks

Power Door Locks

Power Door Lock Switch

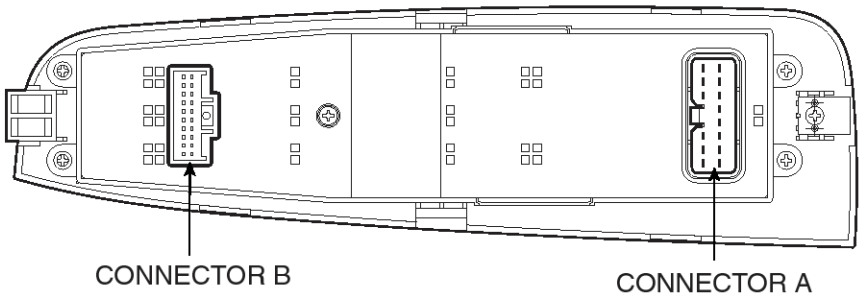
CIRCUIT DIAGRAM

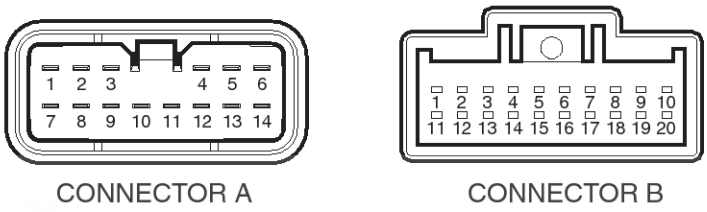
[ASSIST POWER DOOR LOCK SWITCH CONNECTOR]



SGHBE6240L

COMPONENT LOCATION



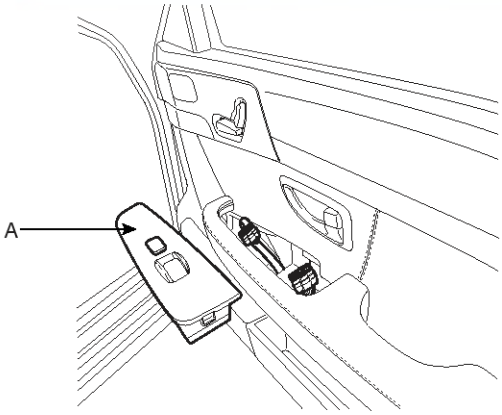


SGHBE6241L

INSPECTION

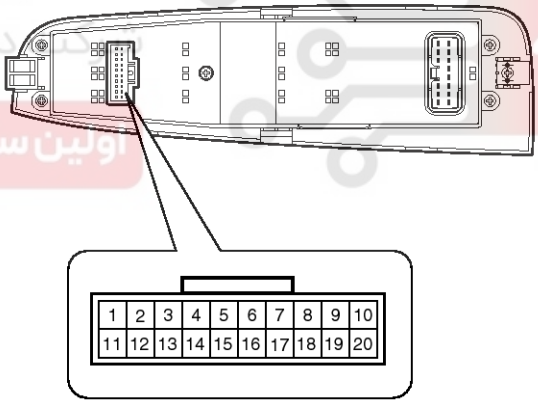
ASSIST DOOR LOCK SWITCH

1. Disconnect the negative (-) battery terminal.
2. Remove the front door trim and power window switch module(A). (Refer to the Body group - front door)



SGHBE6248D

3. Disconnect the connector from the switch.



SGHBE6249D

4. Check for continuity between the terminals in each switch position according to the table.

Terminal / Position	5	4	GND
Lock		○——	——○
Unlock	○——		——○

SGHBE6251L

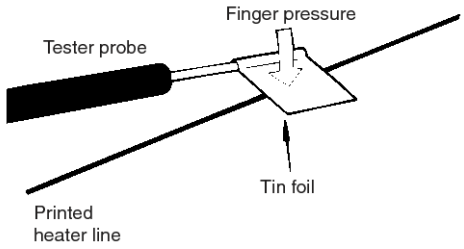
Rear Window Defogger

Rear Window Defogger Printed Heater

Inspection

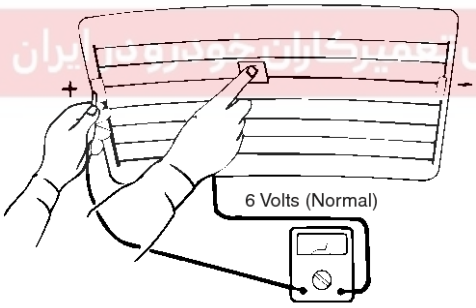
CAUTION

Wrap tin foil around the end of the voltmeter test lead to prevent damaging the heater line. Apply finger pressure on the tin foil, moving the tin foil along the grid line to check for open circuits.



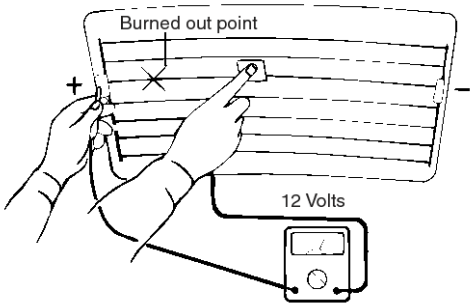
LTAC112A

1. Turn on the defogger switch and use a voltmeter to measure the voltage of each heater line at the glass center point. Ifa voltage of approximately6V is indicated by the voltmeter, the heater line of the rear window is considered satisfactory.



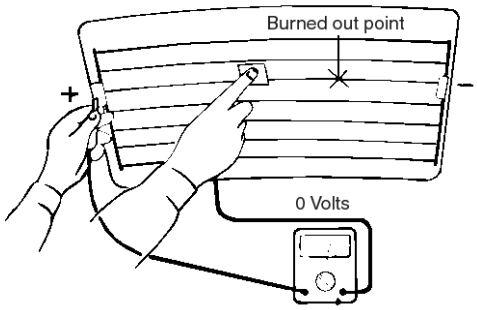
LTAC112B

2. If a heater line is burned out between the center point and (+) terminal, the voltmeter will indicate 12V.



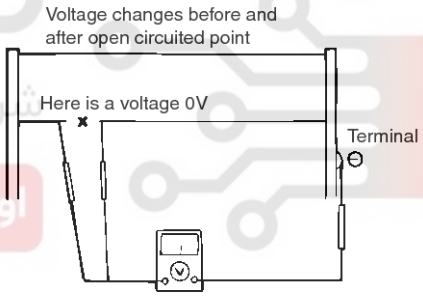
LTAC112C

3. If a heater line is burned out between the center point and (-) terminal, the voltmeter will indicate 0V.



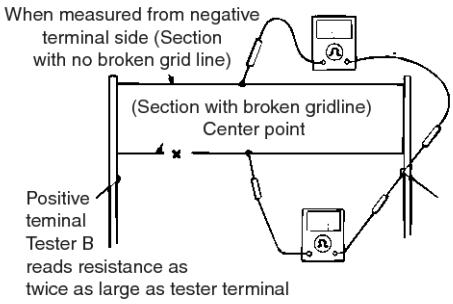
LTAC112D

4. To check for open circuits, slowly move the test lead in the direction that the open circuit seems to exist. Try to finda point where a voltage is generated or changes to 0V. The point where the voltage has changed is the open-circuit point.



LTAC112E

5. Use an ohmmeter to measure the resistance of each heater line between a terminal and the center of a grid line, and between the same terminal and the center of one adjacent heater line. The section with a broken heater line will have a resistance twice as that in other sections. In the affected section, move the test lead to a position where the resistance sharply changes.



LTAC112F

Repair of broken heater line

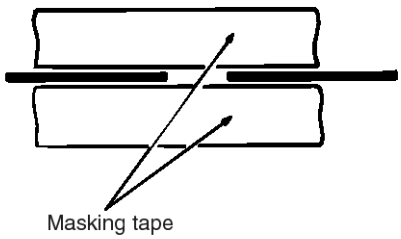
Prepare the following items:

1. Conductive paint.
2. Paint thinner.
3. Masking tape.
4. Silicone remover.
5. Thin brush.

Wipe the glass adjacent to the broken heater line, clean with silicone remover and attach the masking tape as shown. Shake the conductive paint container well, and apply three coats with a brush at intervals of about 15 minutes apart. Remove the tape and allow sufficient time for drying before applying power. For a better finish, scrape away excess deposits with a knife after the paint has completely dried. (allow 24 hours).

⚠CAUTION

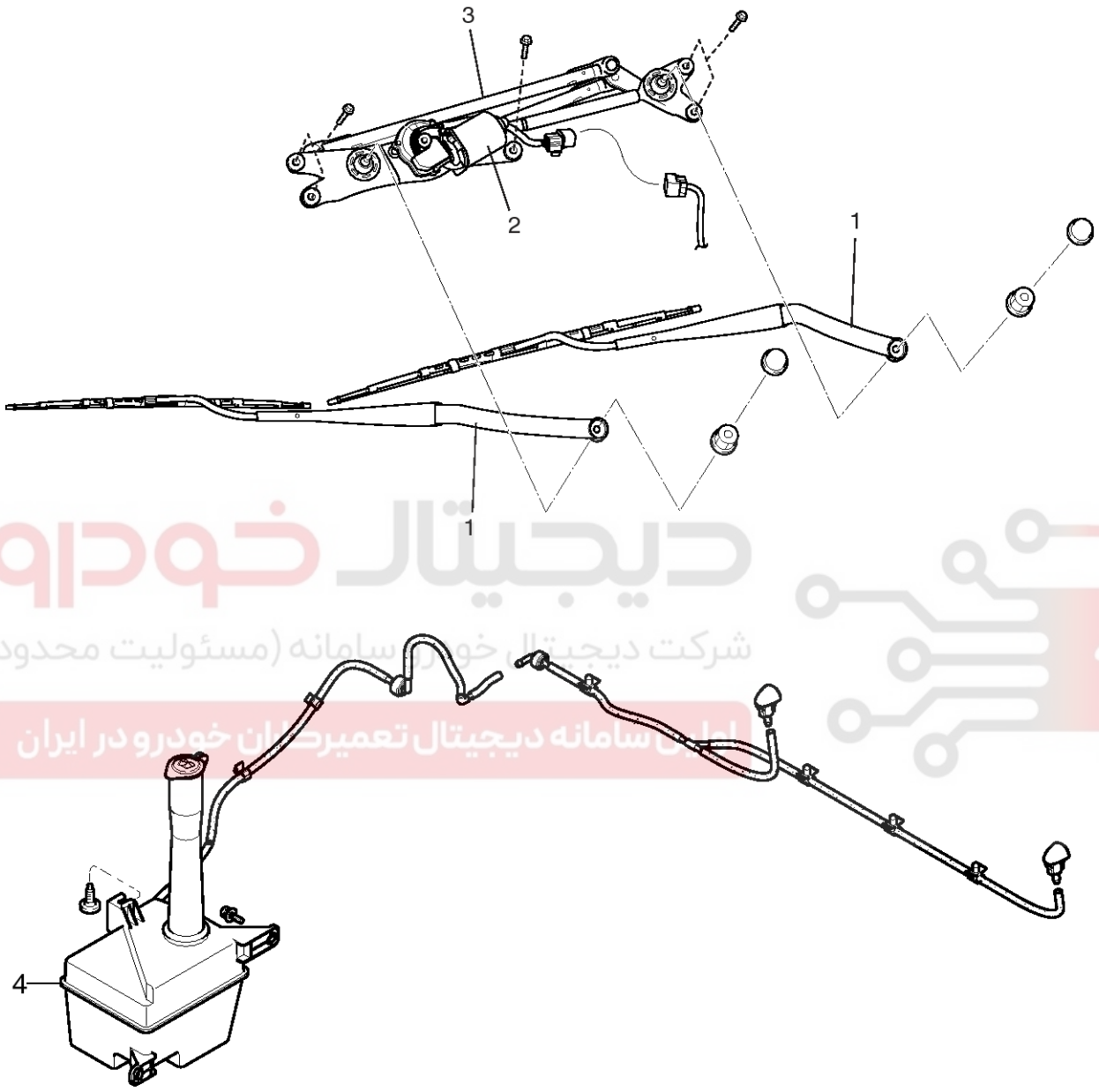
After repairing, clean the glass with a soft dry cloth or wipe along the grid line with a slightly moistened cloth.



LTAC112G

Windshield Wiper/Washer

Component



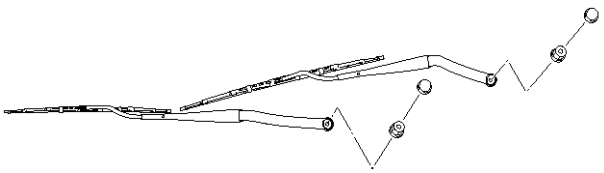
1. Wiper arm
2. Wiper motor
3. Wiper link
4. Washer tank

LTCD113A

Front Wiper Motor

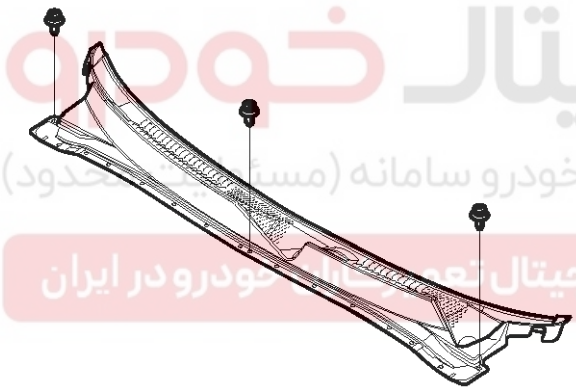
Removal

1. Remove the wiper arm



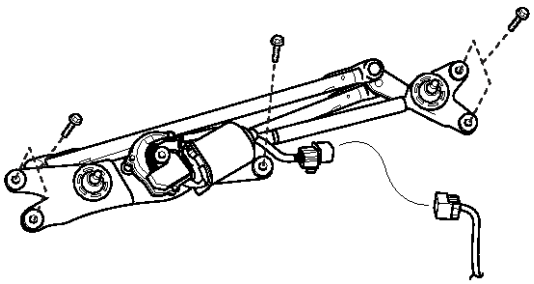
ATCD114A

   1) Remove the wiper arm cap.
   2) Loosen the wiper arm nut (2).
2. Remove the cowl top cover.



ASCD017D

   1) Remove the fastener of cowl top cover.
   2) Remove the cowl top cover.
3. Remove the wiper motor and link assembly.



ATCD114B

   1) Remove the bolt (5) of wiper link assembly.
   2) Disconnect the wiper motor connector.

Installation

1. Install the wiper motor and link assembly.
   1) Install the bolt of wiper link assembly.

Tightening torque :
7~11 N·m (0.7~1.1 kg·m, 5.1~8.0 lb·ft)

   2) Connect the wiper motor connector.
2. Install the cowl top cover.
   1) Install the fastener of cowl top cover.
3. Install the wiper arm.
   1) Align the wiper arm and blade at the original position.
   2) Tighten the nut (2) of wiper arm.

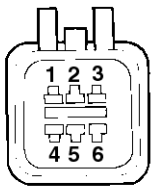
Tighten torque :
28~33 N·m (2.8~3.3 kg·m, 20~24 lb·ft)

   3) Install the cap of wiper arm.

Inspection

Speed operation check

1. Remove the connector from the wiper motor.
2. Attach the positive (+) lead from the battery to terminal 4 and the negative (-) lead to terminal 1.
3. Check that the motor operates at low speed.
4. Connect the positive (+) lead from the battery to terminal 4 and the negative (-) lead to terminal 2.
5. Check that the motor operates at high speed.

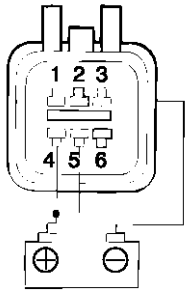


1. Low
2. High
3. Ground
4. IGN+
5. Parking
6. Blank

LTAC115A

Automatic stop operation check

1. Operate the motor at low speed.
2. Stop the motor operation anywhere except at the off position by disconnecting terminal 1.
3. Connect terminals 5 and 1.
4. Connect the positive (+) lead from the battery to terminal 4 and the negative (-) lead to terminal 3.
5. Check that the motor stops running at the off position.

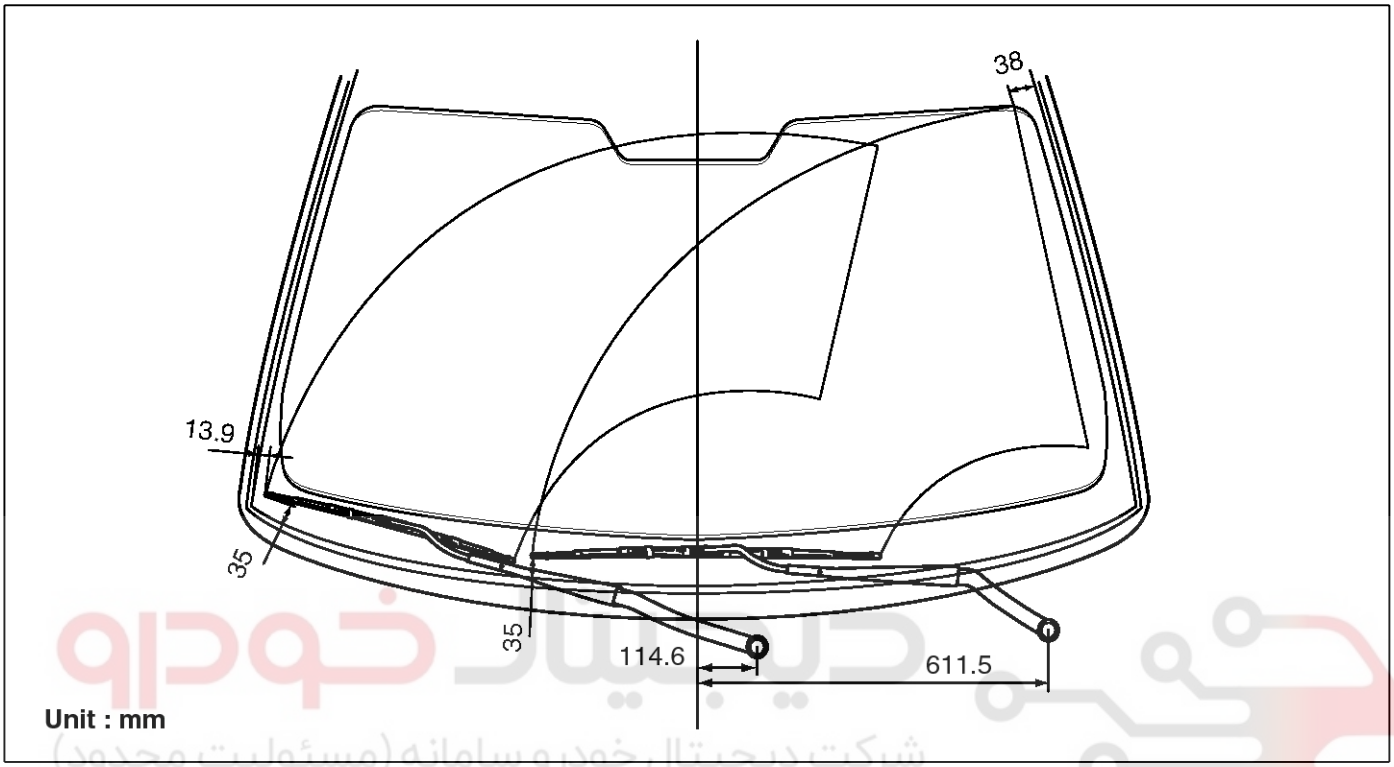


BTAD115B

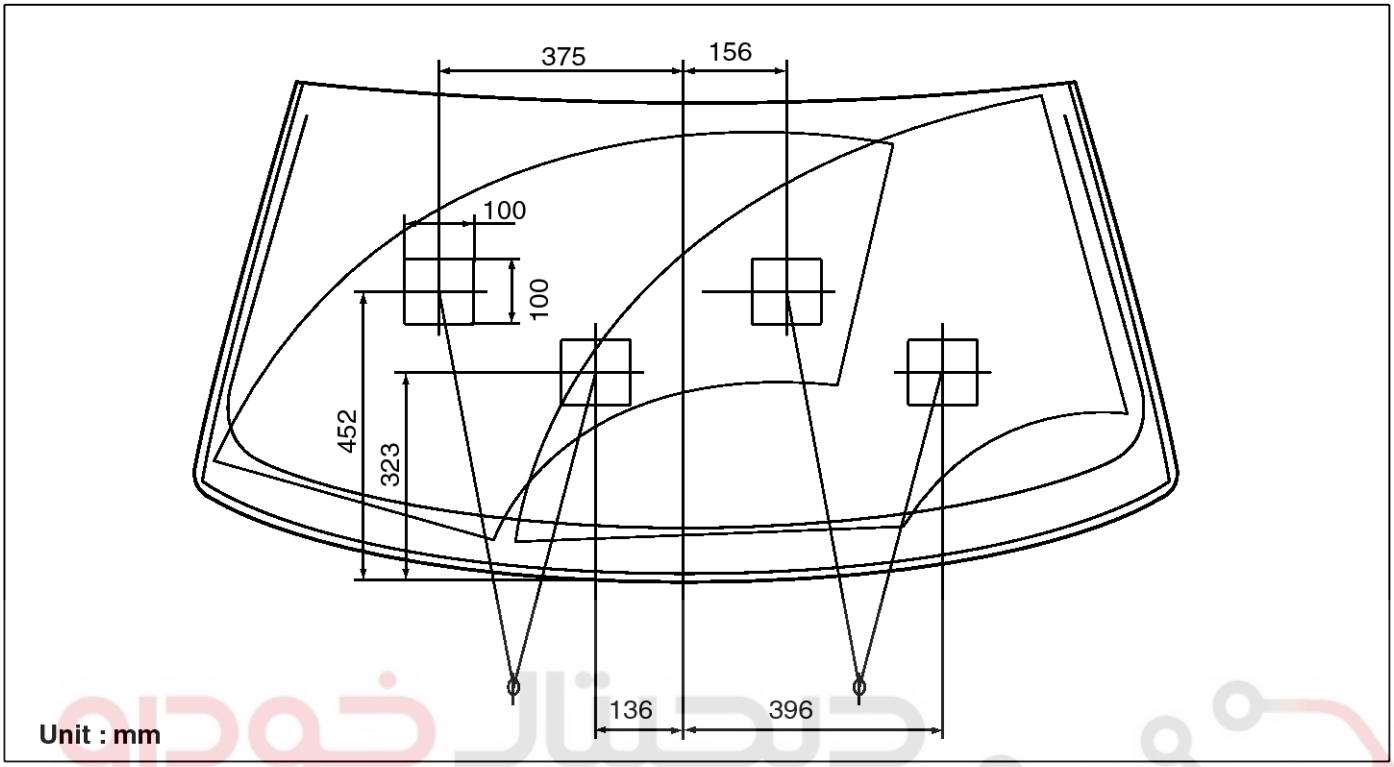
Wiper Arm

Installation

1. Install the wiper blade to the specified position.



2. Set the washer nozzle on the specified spray position.

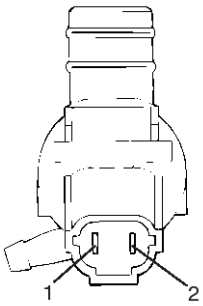


ATCD116B

Front Washer Motor

Inspection

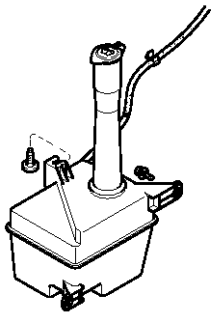
1. With the washer motor connected to the reservoir tank, fill the reservoir tank with water.
2. Apply the battery voltage to the terminal 2 and ground the terminal 1 to see that the washer motor runs and water sprays from the nozzles.
3. Check that the motor operates normally.



ATCD117A

Removal

1. Loosen the fastener and screw of wheel house cover, and then bend back the house cover.
2. Remove the bolt (2) of washer tank.

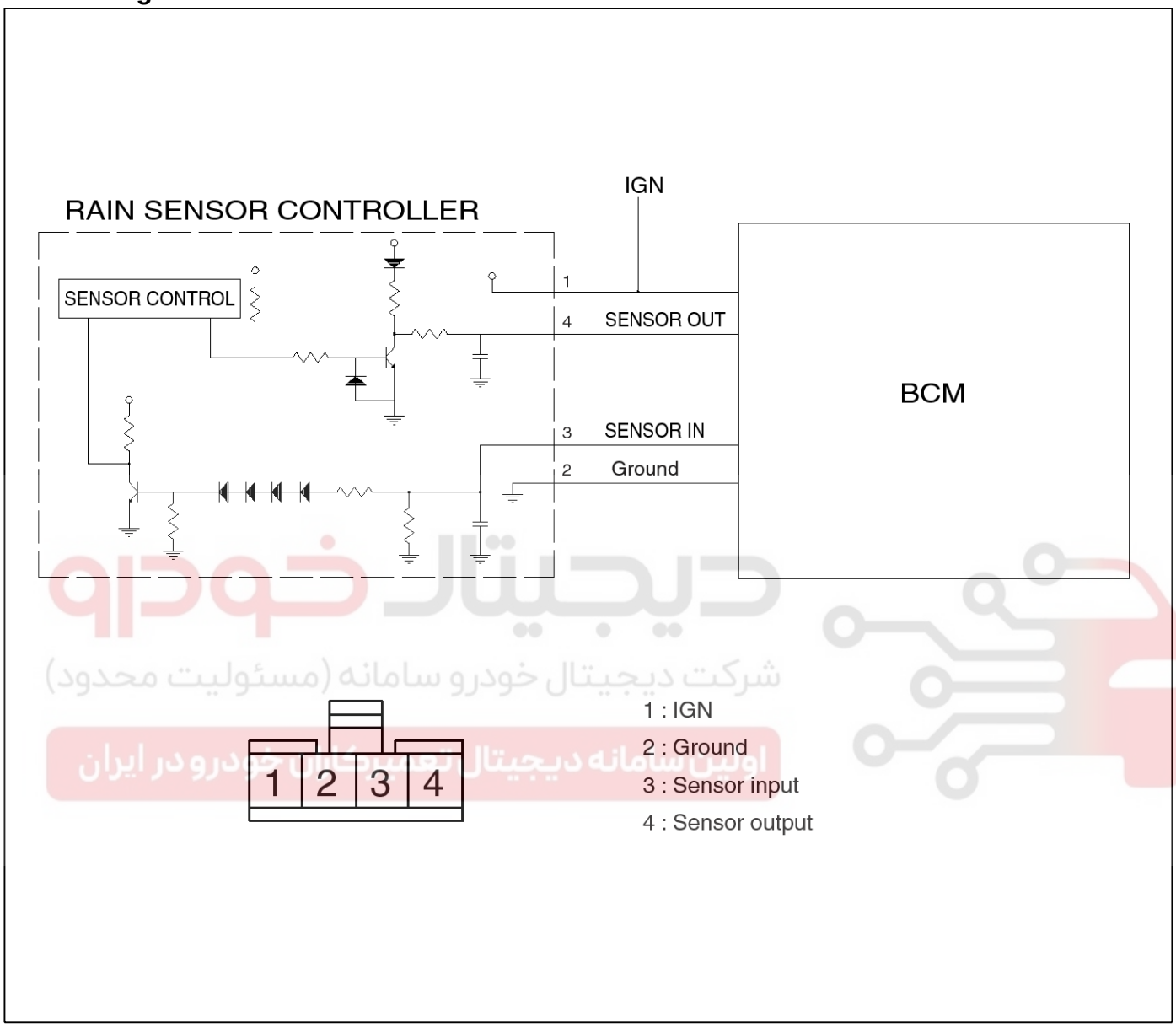


ATCD114C

3. Disconnect the connector of washer motor.
4. Installation is reverse of removal.

Rain Sensor

Circuit diagram

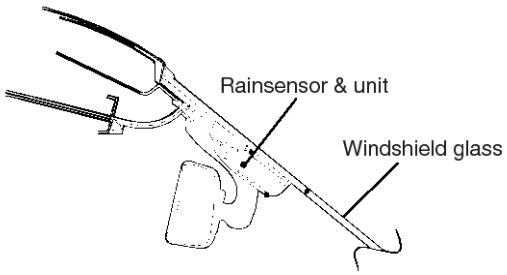


LTCD119A

Description

The Rain sensing windshield wiper system is a wiper system that, in addition to providing normal wiper functions off, mist, manual low speed, manual high speed, and wash, provides automatic control of automatic intermittent automatic low, and automatic high speeds.

When the ignition key is in the ON position, the rain sensor will be activated.



ETBD195A

Operating modes

MULTIFUNCTION SWITCH POSITION	RAIN SENSOR OPERATING MODE	SENSOR ACTION
MIST	MIST	The column switch controls mist. The sensor has no affect on this function.
OFF	OFF	If not already parked, wiper motor moves with low speed until blades are in the depressed park position.
AUTOMATIC Automatic mode has 5 sensitivity settings	AUTOMATIC	Automatic INT/speed control The sensitivity to raindrop accumulation on the windshield is set by the multifunction switch sensitivity adjustment.
LOW SPEED	MANUAL	Wiper motor runs continuously in low speed, for example 45 wipes/minute. The sensor has no affect on this function.
HI SPEED	MANUAL	Wiper motor moves continuously with high speed, for example 60 wipes/minute. The sensor has no affect on this function.
WASHER When washer switch is turned on during 0.6 sec or more	WASHER	If washer switch is turned on during 0.6 sec or more, the wiper operate during 2.5~3.8 sec
WASHER When washer switch is turned on during 0.6 sec or less	WASHER	If washer switch is turned on during 0.6 sec or less, the wiper operate only one time

1. OFF MODE

   With the wiper switch "OFF" and the ignition switch "ON", the rain sensor is considered to be in the "OFF" mode. In this mode, the sensor commands the wiper motor to be "OFF".

2. AUTOMATIC MODE

   When the multifunction switch is moved to auto position and the ignition switch is in the run or accessory positions, the rain sensor is considered to be in "automatic" mode. Once a single "instant wipe" has occurred, the wipers remain at "inner wipe/park" until the rain sensor determines that the dwell time at that position is appropriate for the amount of precipitation on the windshield, rain sensor provides input to the wiper motor to activate the wipers to clear the precipitation from the windshield.

3. AUTOMATIC INT

   For all automatic int. operations the rain sensor commands the wipers to operate in low speed for one wipe, followed by a variable dwell period in the inner wipe position.

4. AUTOMATIC LOW

   Automatic low speed operation is utilized when the amount of precipitation impinging on the windshield exceeds the automatic intermittent to automatic low threshold. This threshold includes sufficient hysteresis to prevent cycling between automatic intermittent and automatic low speed operation with a

steady amount of precipitation accumulation on the windshield.

5. AUTOMATIC HIGH

   Automatic high speed operation utilized when the amount of precipitation impinging on the windshield exceeds the automatic low to automatic high threshold. This threshold includes sufficient hysteresis to prevent cycling between automatic low and automatic high speed operation with a steady amount of precipitation accumulation on the windshield.

6. WASHER MODE

   The rain sensor monitors the multifunction switch to determine if the washer function is selected. Rain sensor enables thewiper motor to run in low speed during the wash mode and performs wipes from 2.5 to 3.8 sec.

7. MANUAL MODE

   The rain sensor determines when a manual mode such as manual low, mist, off or manual high is selected. The column switch performs these modes and the rain sensor has no affect.

Inspection

1. Wiper blade

   Check the wear of wiper blade. If it is excessively worn, wipe out clean to sense the rain amount accurately.

2. Coupler

   Check the coupler surface on the windshield glass for any excessive bubble. Presence of bubble within the sensing range prevents the accurate sensing. Check the coupler for its correct installation. Especially, check the sensing points of the coupler whether it is located within the opening area of ceramic coating area. If the sensing area around the ceramic coating area is blocked, infrared light of the sensor cannot penetrate to result in the failure of accurate sensing.

3. Glass

   Check the windshield glass surface beyond the sensing range for the excessive wear, scratch or crack. Though, sensor covers the wear to a certain level, sensor fails to sense accurately if it exceeds a certain level. This is confirmed by the self-diagnosis of sensor.

4. Exterior cover

   Check the exterior cover of rain sensor. Check the cover locking for loosening whether it causes impact on the sensor. In addition, check glass or inside rear view mirror for any interference.

5. Spring clip

   Check the spring clip after removal of exterior cover if the rain sensor is disconnected from the coupler.

6. Connector

   1) Check the terminal inside the connector and wiring for compression, and check the terminal whether it is inserted and locked correctly.
   2) In addition, check the wiring connector and rain sensor connector for assembly and confirm to prevent poor connection.

7. Relay

   Check the low-speed relay and high-speed relay for normal operation. Since wiper motor cannot operate when melted, wiper blade does not respond in auto mode.

8. Circuit

   Check the circuits. Especially check the variable resistance of the wiper switch. Turn the variable resistance knob step by step from slow to fast to check this out. It is normal if it wipes once at every click. (This is so called single wipe.) In addition, check the wiper motor parking signal whether it operates correctly. If parking signal is not inputted, it may cause more wiping than normal, and wiping is not smooth due to the inaccurate shift timing.

Self-diagnosis

1. Rain sensor has 3 types of self-diagnosis test mode as follows.

   1) FAULT 1 self diagnosis

      When the error is detected in inside, software or hardware, error is always expressed in terms of rain sensor. This signal detects the problem of sensor module.

   2) FAULT 2 self diagnosis

      If the rain sensor servo operating point is above the predetermined one by the software, it means FAULT A. This phenomenon occurs if the windshield glass is damaged where coupler is installed, or sensor is removed from the coupler.

   3) FAULT 3 self diagnosis

      Rain sensor shows that input signal is not detected from rain sensor to BCM at least for 0.5 second. Wiper does not operate without input signal. It cannot be known by the INT volume sensitivity adjustment.

      NOTICE

      In the auto mode, wiper continues to operate in the same mode even if sensor detects the input

signal, but it stops operation when turned off.

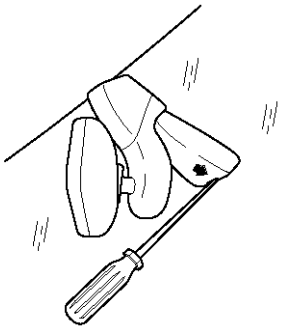
2. Types of failures when INT volume sensitivity is adjusted.

   Following is the self-diagnosis by the sensitivity adjustment and wiper motion.

   1) Wiper switch sets the INT volume sensitivity to 1st level in IGN ON and AUTO position.
   2) Shift the sensitivity from 1 to 2 in this condition.
   3) If wiper operates once, then it is in FAULT 2 self-diagnosis. In service shop, check the windshield glass for the damage and rain sensor for its installation.
   4) Shift the sensitivity from 2 to 3 after checking the above mentioned 3).
   5) If the wiper operates once, then it is in FAULT 1 self diagnosis, and the rain sensor should be replaced with new one.

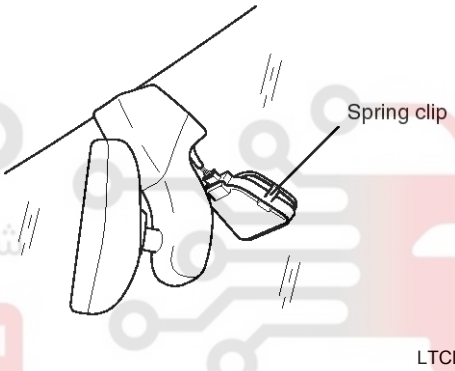
Removal

1. Remove the cover first. Be careful not to damage the cover latch by applying excessive force. To remove the latch, pull aside the latch using the cover hole with the little (-) screwdriver.



ATCD119B

2. When removing the rain sensor from coupler, remove the spring clip using the (-) screwdriver.

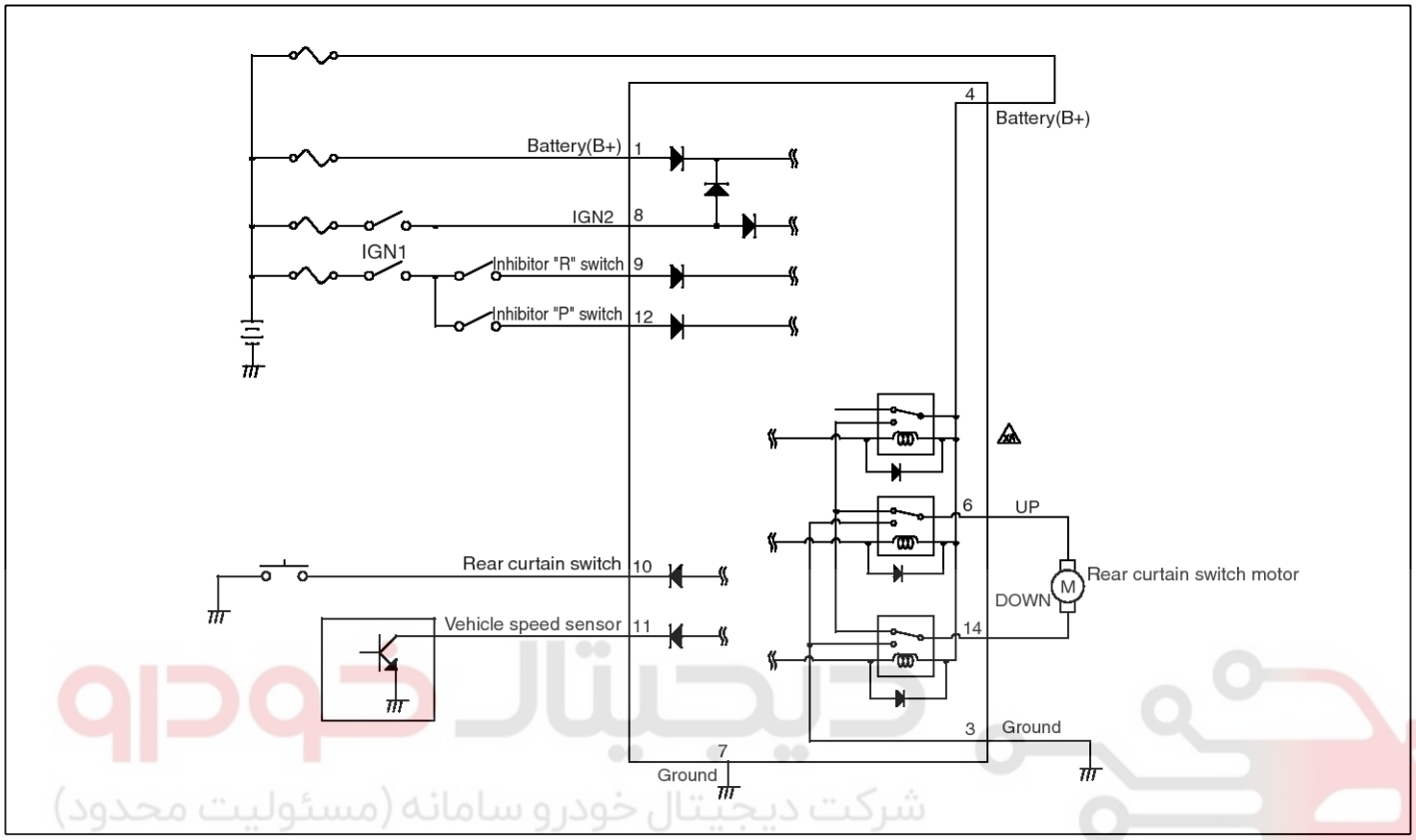


LTCD119C

3. Remove the wiring harness connector from sensor.
4. Rain sensor module is attached to the front windshield with 2 stainless spring clips so that it can be easily replaced when replacing rain sensor module. When replacing the front windshield, remove the rain sensor module from the existing front windshield and install on the new front windshield.

Rear Curtain System

CIRCUIT DIAGRAM



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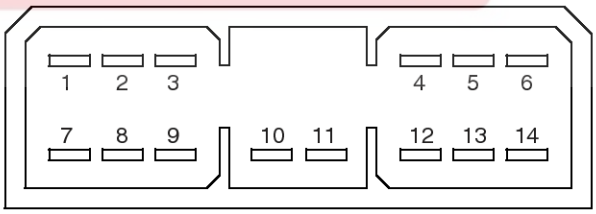
REAR CURTAIN UNIT CONNECTOR



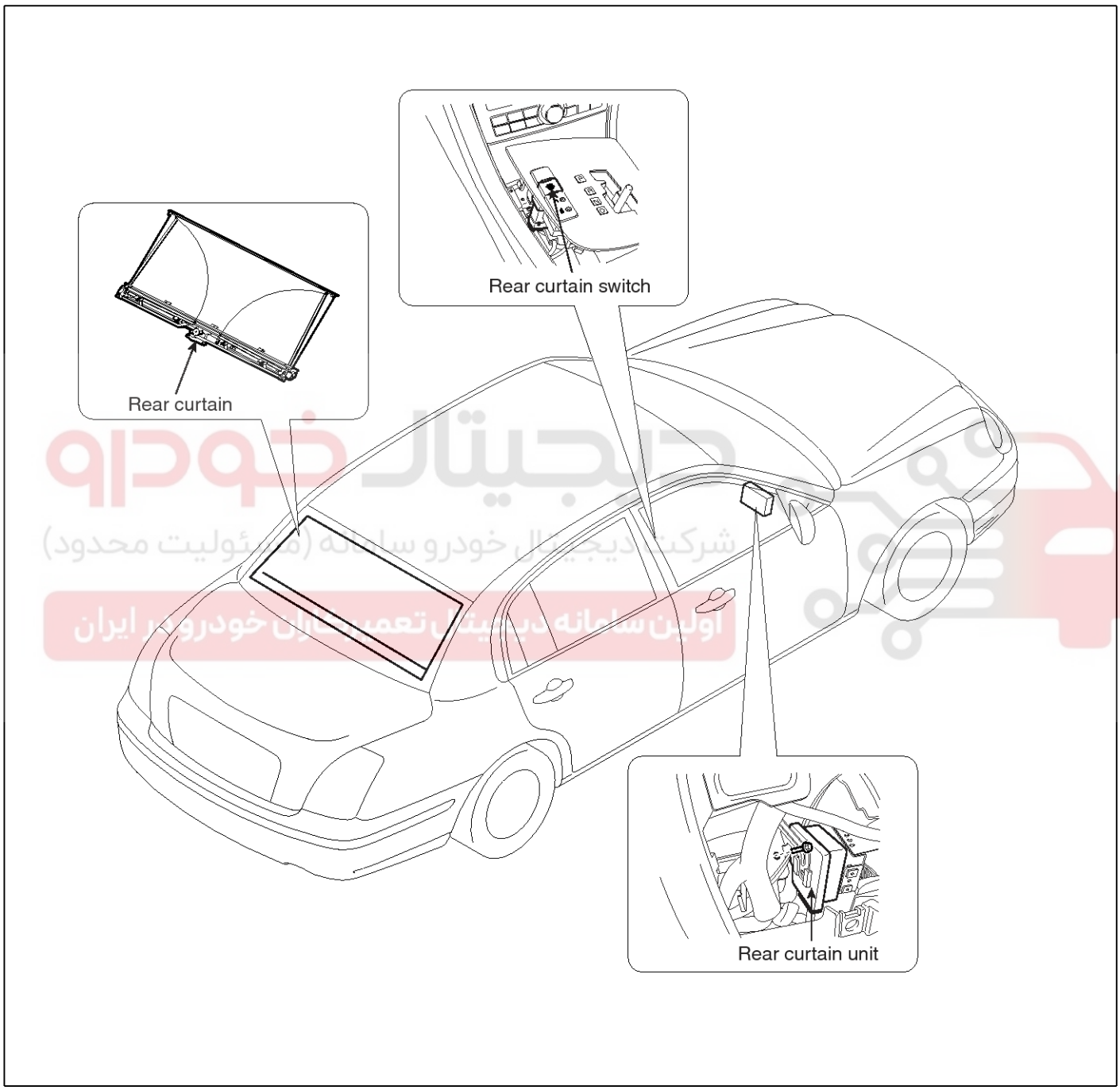
KTCF390B

PIN NO.	Connector	PIN NO.	Connector
1	B+	8	IG2
2	-	9	Inhibitor “R” switch
3	Ground	10	Rear curtain switch
4	B+	11	Vehicle speed sensor
5	-	12	Inhibitor “P” switch
6	Motor UP	13	-
7	Ground	14	Motor DOWN

DESCRIPTION

You can up & down rear curtain automatically by pressing the rear curtain switch. Rear curtain protect passenger from a direct ray of light by covering rear glass.

COMPONENT LOCATION



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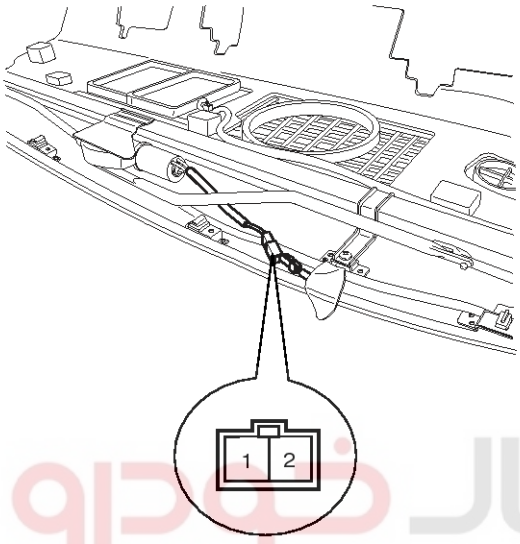
Rear Curtain

INSPECTION

Connect the battery voltage and check the rear curtain motor rotation. If the motor does not operate properly, substitute with a known-good rear curtain motor and check for proper operation.



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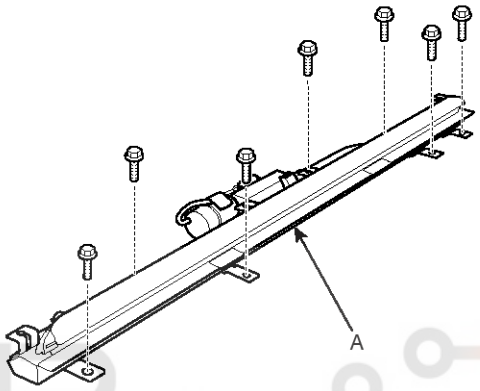
REMOVAL

1. Disconnect the negative (-) battery terminal.
2. Remove the rear package tray after removing the rear seat. (Refer to the Body group- interior trim)
3. Remove the connector of the rear curtain and 6 mounting bolts.
4. Remove the rear curtain (A) from the rear package trim.



SGHBE6392D

INSTALLATION

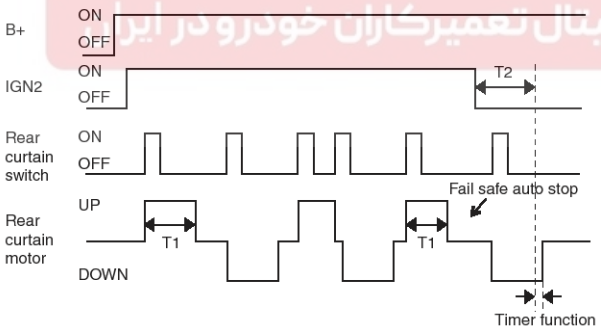
1. Reassemble the rear curtain to the rear package trim.
2. Connect the rear curtain connector.
3. Reassemble the rear package tray.

Rear Curtain Unit

INSPECTION

1. AUTO UP/AUTO DOWN FUNCTION
   1) IGN ON, if you press the rear curtain switch, rear curtain motor operates the reverse direction of the before direction. (UP/DOWN)
   2) After replacing battery, if you operates rear curtain switch, rear curtain is operated auto up.
   3) If the switch input occurred during rear curtain auto up or auto down, rear curtain is operated to the reverse direction after making a pause.
   4) AUTO function stop when detect an excess current.
2. TIMER FUNCTION
   1) It can be possible to operate rear curtain for 30 sec after IGN OFF.
   2) It can be possible to operate rear curtain operation by the end of motor operation although timer is finished during auto up/ down.
3. FAIL SAFE FUNCTION

   If motor operation doesn't stop more than 10 sec after starting, motor is stopped by inner relay auto OFF.

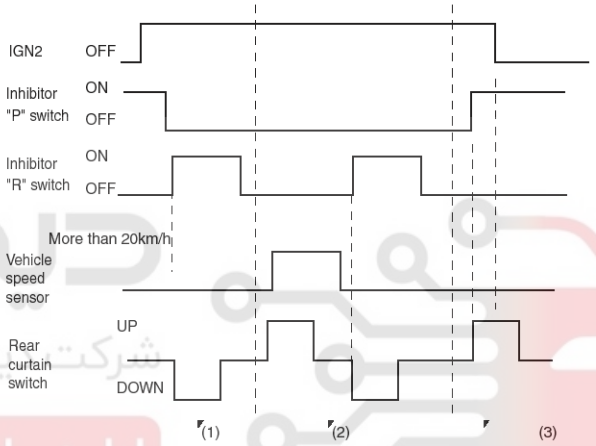


ETBF392B

T1 : MAX 10 sec,

T2 : 30 sec.

4. RETROGRESSION GEARING FUNCTION
   1) When, rear curtain motor IGN ON, rear curtain UP and shift lever "P" position, rear curtain motor linked with the signal makes auto down.
   2) When the vehicle speed is above 20 km/h from 1) condition, rear curtain motor linked with the signal makes auto up. Only, the motor does not operate below 20 km/h.
   3) When shift lever position will be changed from R to P from 1) condition, rear curtain motor linked with the signal makes auto up. Only, the case where the driver presses the knock-down switch is excepted.
   4) To the case where the driver presses the down switch from rear curtain up condition motor does not do a retrogression gearing operation and the up return operation due to a vehicle speed. After that, when driver presses the switch and the motor becomes auto up, the retrogression gearing operation is possible again.



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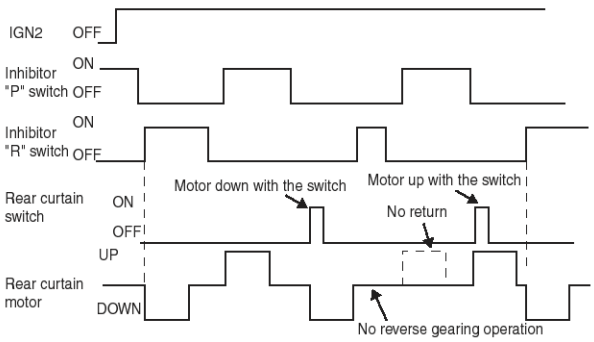
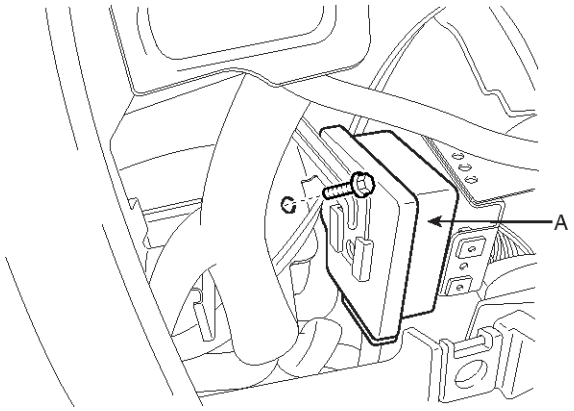


ETBF392D

REMOVAL

1. Disconnect the negative (-) battery terminal.
2. Remove the center facia panel. (Refer to the Body group - Crash pad)
3. Remove the rear curtain unit (A) after removing a mounting nut and connector.



SGHBE6393D

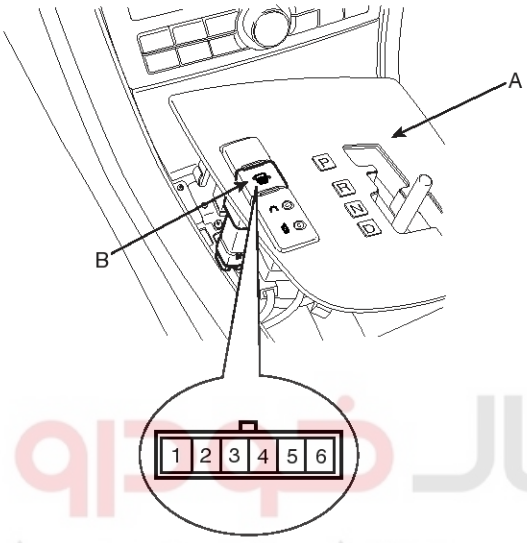
INSTALLATION

1. Reassemble the rear curtain unit and then connect the connector.
2. Reassemble the center facia panel.

Rear Curtain Switch

INSPECTION

1. Disconnect the negative (-) battery terminal.
2. Remove the console upper cover (A) by using the scrapper.
3. Remove the rear curtain switch (B) from the console upper cover (A) after removing the connector.



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4. Check for continuity between the terminals. If the continuity is not as specified, replace the rear curtain switch.

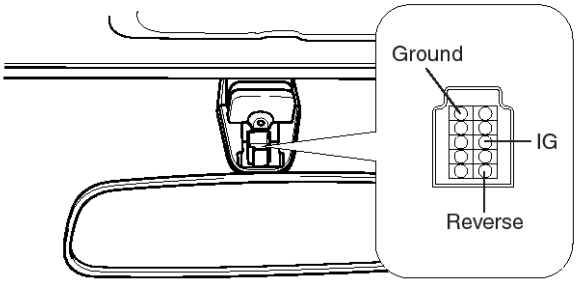
Terminal / Position	5	6	4	3
ON	○	○ (Illumination)	○	○
OFF				

ETBF393B

Electro chromic Inside

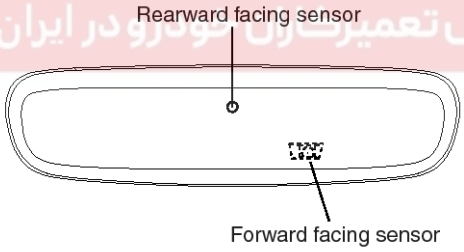
Description

The electrochromic(EC) inside rear view mirror receives power, ground, and a reverse signal on the three wires that connect to it. It uses two light sensors to sense glare.



LTCD405B

1. The forward facing sensor determines if the outside light levels are low enough for the mirror to operate.
2. The rearward facing sensor detects glare from lights behind the mirror. When glare is detected, it outputs a signal to the mirror to dim at the required level.
3. The mirror dims to the level as directed by the rearward facing sensor. When the glare is no longer detected, the mirror returns to normal.



LTCD405A

Inspection

To determine if the EC mirror will dim, check it as the below procedure.

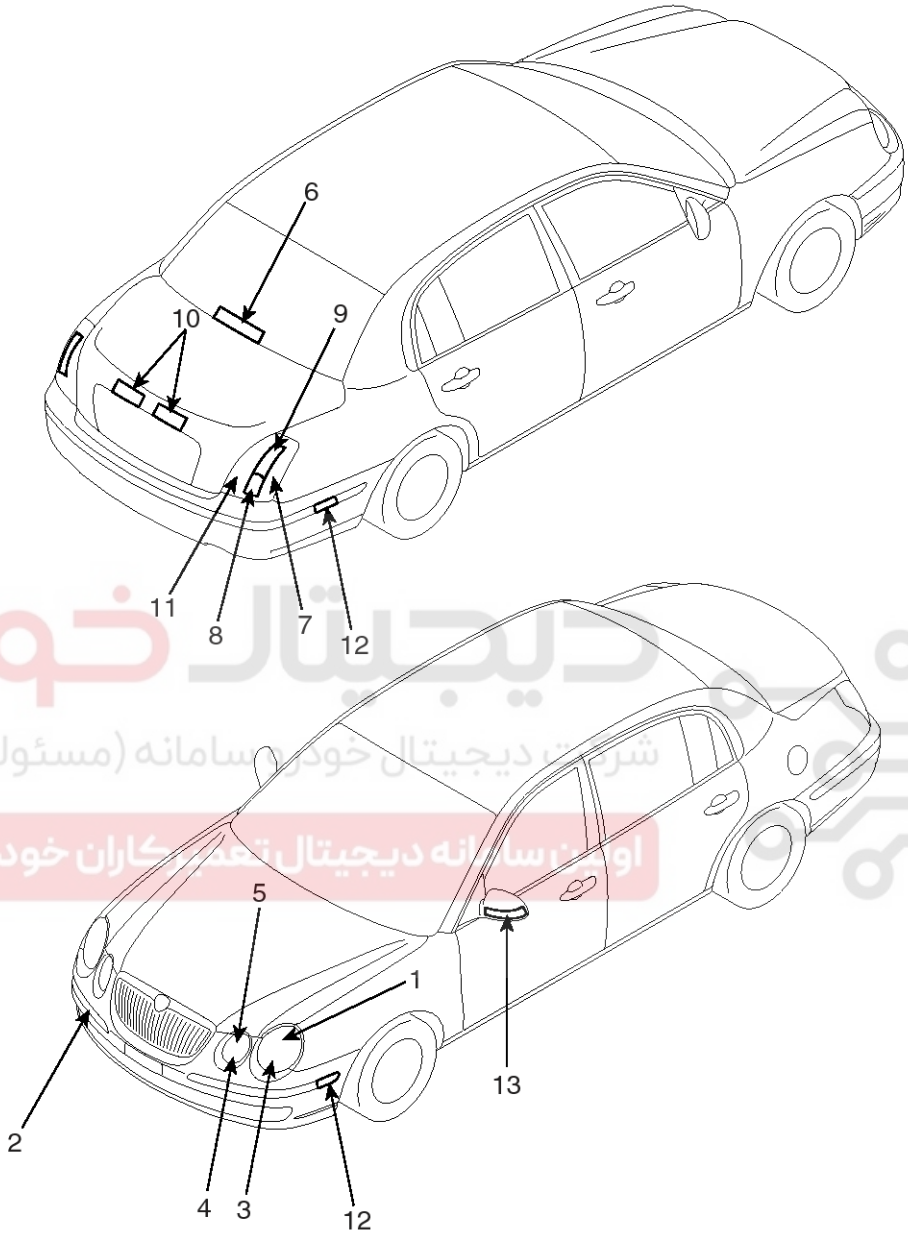
1. Turn the ignition key to the "ON" position.
2. Cover the forward facing sensor.
3. Shine a flashlight into the rearward facing sensor.
4. The mirror should dim as soon as the rearward facing sensor detects the high light level.

   NOTICE

   If this test is performed in a bright area, the mirror may darken as soon as the forward facing sensor is covered.
5. Put the vehicle into reverse, the mirror should not dim.
6. Aim a flashlight at the forward sensor and another flashlight at the rearward sensor. The mirror should not darken.

Lighting System

COMPONENT LOCATION



1. Head lamp (Low)
2. Front turn signal lamp
3. Front fog lamp
4. Position lamp
5. Head lamp (High)
6. High mounting stop lamp
7. Tail lamp
8. Back up lamp
9. Rear turn signal lamp
10. License plate lamp
11. Stop lamp
12. Side marker lamp
13. Trun signal lamp (Door Mirror)

SGHBE6430L

SPECIFICATION

Items	Bulb Wattage (W)
Head lamp (High)	55
Head lamp (Low)	35
Front turn signal lamp	14.5 (LED) / 5 (BULB)
Front position lamp	5
Front fog lamp	55
Rear stop/tail lamp (Outside)	27/8
Back up lamp	18
Rear turn signal lamp	28
Rear fog lamp	5
License plate lamp	5
Side repeater	5
Room lamp	10
Overhead console lamp	5
High mounted stop lamp	2.5 LED
Glove box lamp	5
Trunk lamp	5

Head Lamps

Head lamp aiming instructions

The headlamps should be aimed with the proper beam-setting equipment, and in accordance with the equipment manufacturer's instructions.

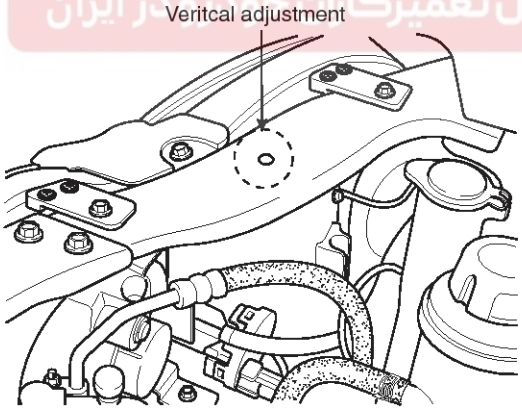
NOTICE

If there are any regulations pertinent to the aiming of headlamps in the area where the vehicle is to be used, adjust so as to meet those requirements.

Alternately turn the adjusting gear to adjust the headlamp aiming. If beam-setting equipment is not available, proceed as follows:

1. Inflate the tires to the specified pressure and remove any loads from the vehicle except the driver, spare tire, and tools.
2. The vehicle should be placed on a flat floor.
3. Draw vertical lines (Vertical lines passing through respective headlamp centers) and a horizontal line (Horizontal line passing through center of headlamps) on the screen.
4. With the headlamp and battery in normal condition, aim the headlamps so the brightest portion falls on the horizontal and vertical lines.

   Make vertical adjustments to the lower beam using the adjusting wheel.



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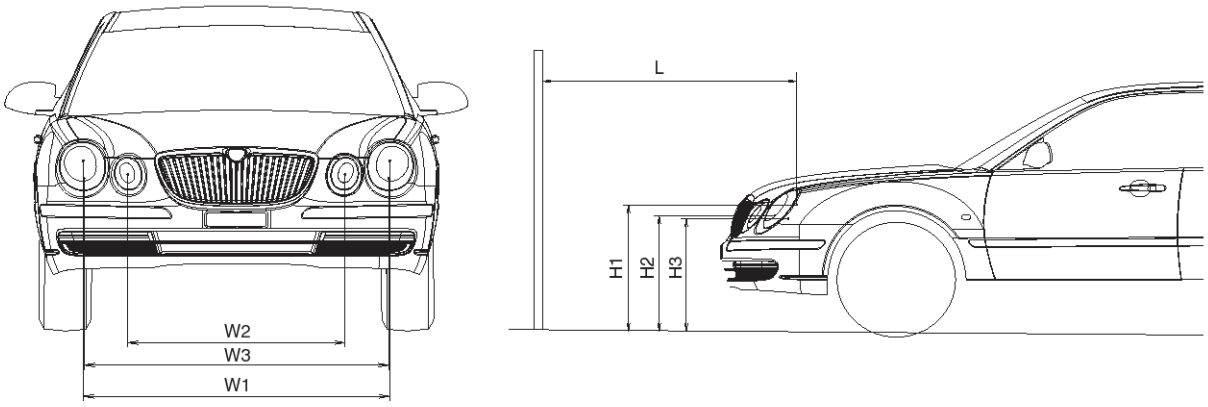
Front fog lamp

The front fog lamps should be aimed as the same manner of the head lamps aiming.

With the front fog lamps and battery normal condition, aim the front fog lamps by turning the adjusting gear.



H1 : Height between the head lamp bulb center and ground (low beam)
H2 : Height between the head lamp bulb center and ground (high beam)
H3 : Height between the fog lamp bulb center and ground

W1 : Distance between the head lamp bulb center (low beam)
W2 : Distance between the head lamp bulb center (high beam)
W3 : Distance between the fog lamp bulb center

L : Distance between the head lamp bulb center and screen.

SGHBE7456N

Vehicle condition	H1	H2	H3	W1	W2	W3	L
Without driver	754(29.6)	690(27.1)	671(26.4)	1,395(54.9)	988(38.8)	1,387(54.6)	3,000(118)
With driver	744(29.2)	680(26.7)	661(26.0)				

Unit : mm (in)

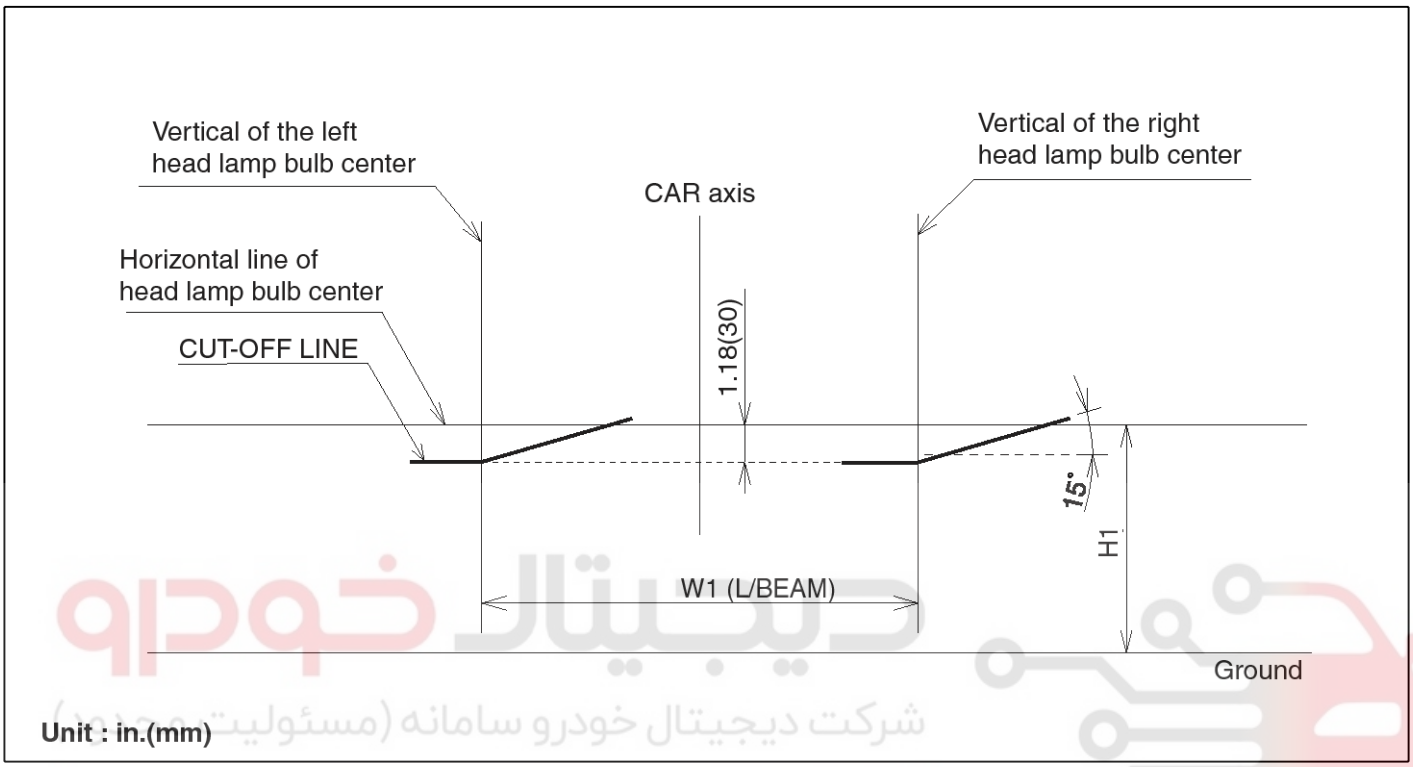
1. Turn the low beam on with driver.

   The cut-off line should be projected in the allowable range (shaded region).

   In case of equipping with the manual leveling device, set the leveling device switch on the "O" position.

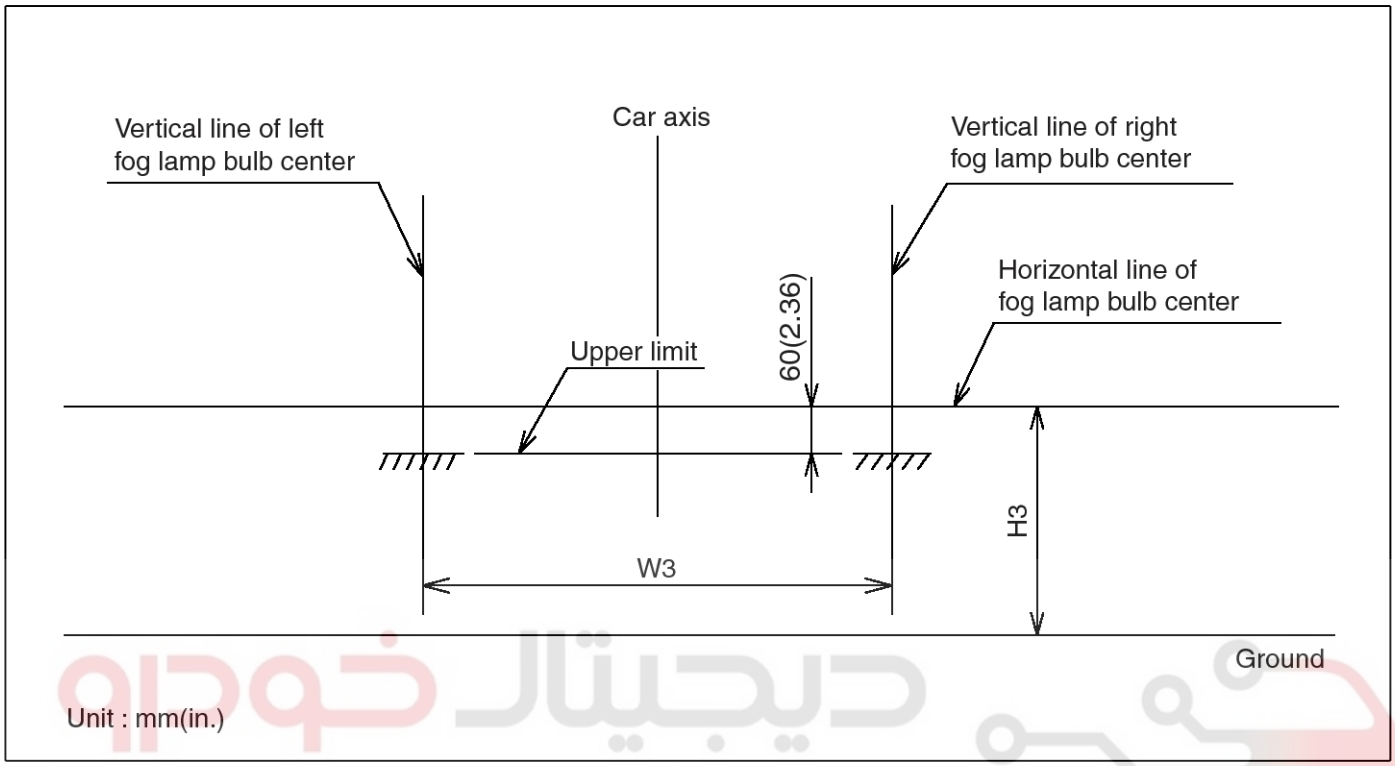
   In case of equipping with the auto leveling device, set the initialization by using the diagnostic tool before aiming.

   In case of high beam, head lamp do not need aiming with proper beam-setting equipment.



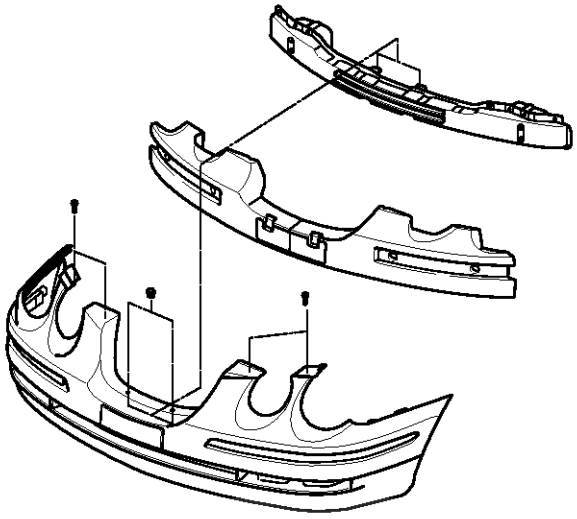
SBHBE9471L

2. Turn the front fog lamp on with driver.
   The cut-off line should be projected in the allowable range (shaded region)



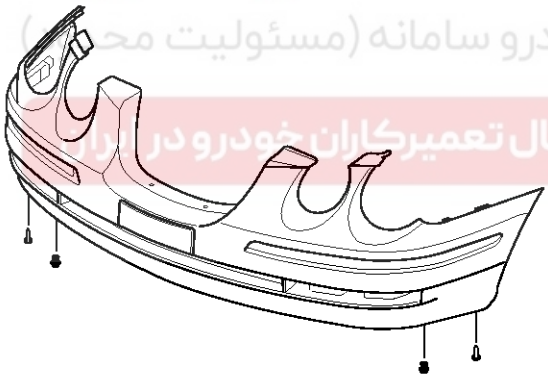
Removal and installation

1. Remove the battery negative(-) terminal.
2. Loosen the bolts(4) and fasteners(2) from the upper of bumper cover.



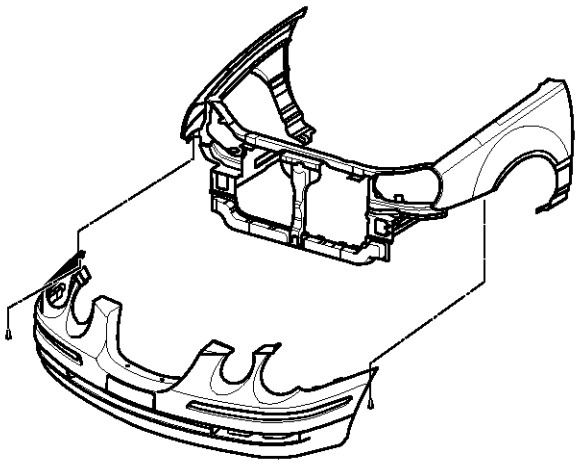
ASCD023B

3. Loosen the screws(2) and fasteners(2) from the lower of bumper cover.



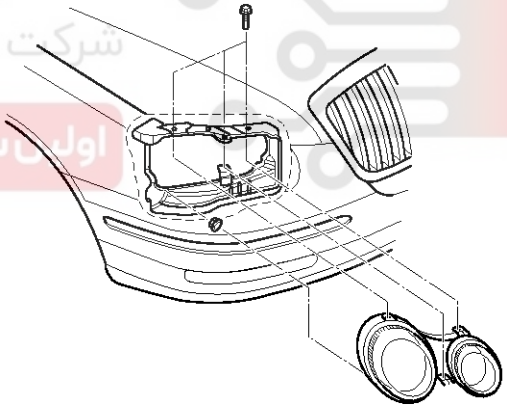
ASCD023C

4. Loosen the screws(2) from the side of bumper cover.



ASCD023D

5. Disconnect the connector of turn signal lamp from the back of bumper cover.
6. Remove the front bumper and energy absorber.
7. Loosen the bolts(3) and disconnect the connector of head lamp/front combination lamp.
8. Remove the head lamp/front combination lamp.



ATCD131A

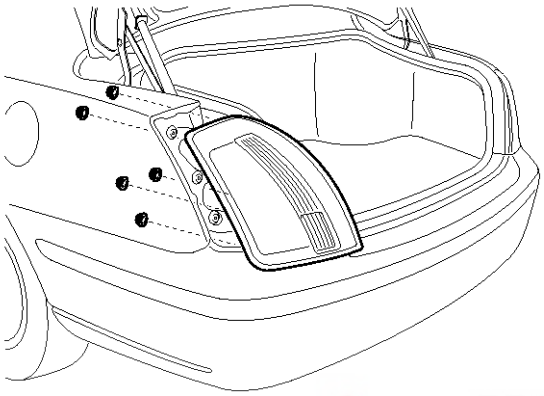
9. Installation is reverse of removal.

Turn Signal Lamp

REMOVAL

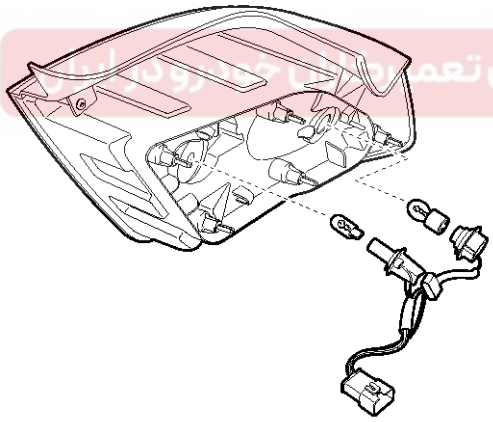
REAR COMBINATION LAMP

1. Disconnect the negative (-) battery terminal.
2. Loose the nuts (5EA) holding the rear combination lamp then disconnect the connector then remove the outside rear combination lamp.



SGHBE6449D

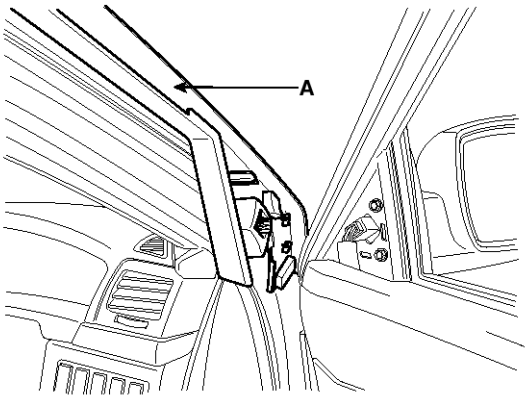
3. Replace the bulbs (2EA) after disconnecting the rear combination lamp assembly.



SGHBE6450D

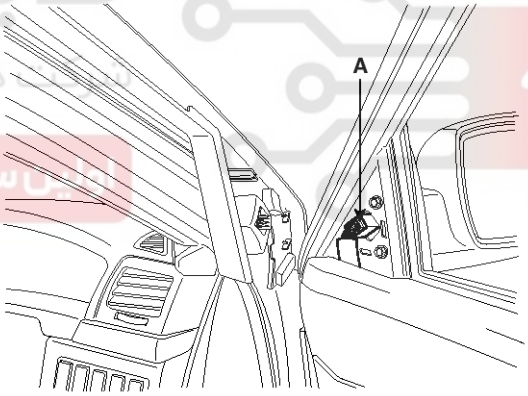
TURN SIGNAL LAMP(DOOR MIRROR)

1. Disconnect the negative (-) battery terminal.
2. Remove the tweeter speaker cover (A). (Refer to the BD group - "Front Door")



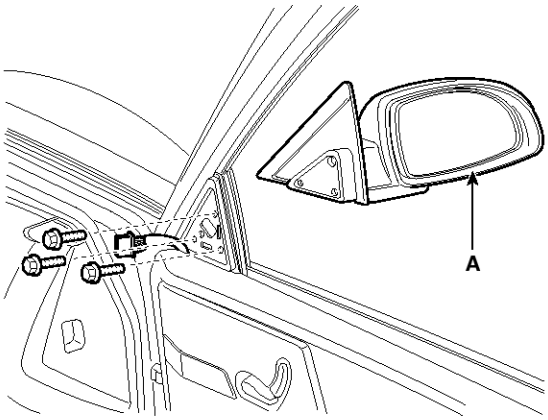
SGHBE6451D

3. Disconnect the door mirror connector (A).



SGHBE6452D

4. Loosen the 3 bolts and screw then remove the door mirror(A).



SGHBE6453D

⚠CAUTION
Turn signal lamp of door mirror is used LED (Light-emitting Diode).

INSTALLATION

REAR COMBINATION LAMP

1. Connect the bulbs to the rear combination lamp assembly.
2. Connect the rear combination lamp connector.
3. Reassemble the rear combination lamp assembly.

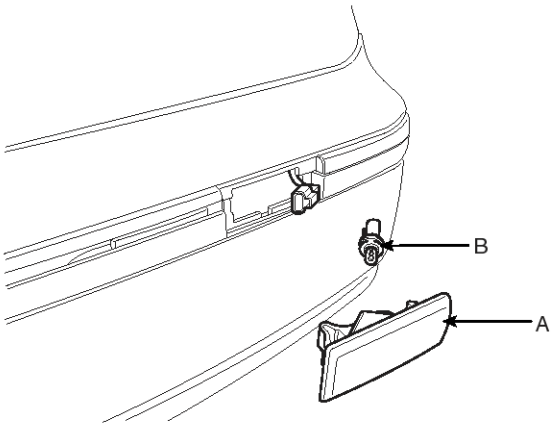
TURN SIGNAL LAMP(DOOR MIRROR)

1. Reassemble the door mirror to the door.
2. Connect the door mirror connector.
3. Reassemble the tweeter speaker.

License Lamps

REMOVAL

1. Disconnect the negative (-) battery terminal.
2. Remove the side repeater lens (A) from the panel using the scraper.



SGHBE6455L

3. Replace the bulb(B).

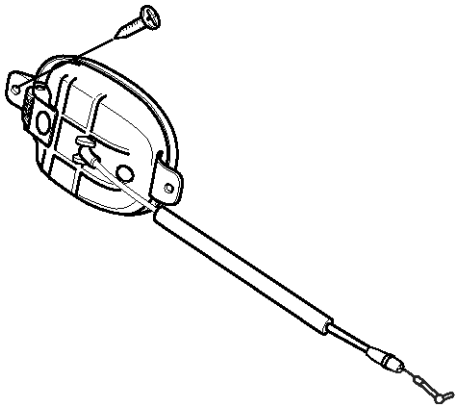
INSTALLATION

1. Install the bulb.
2. Install the side repeater lamp lens.

Back-up Lamps

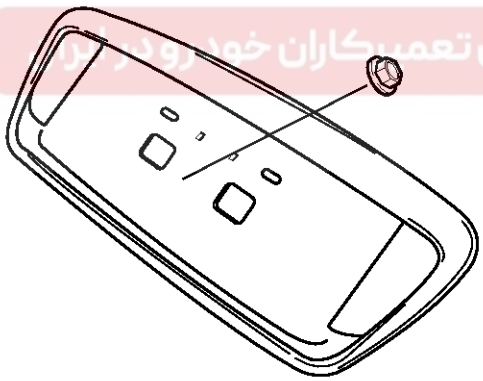
Removal and installation

1. Remove the battery negative(-) terminal.
2. Loosen the screws(2) of trunk lid inner handle.
3. Remove the rod of trunk lid inner handle, and then remove the trunk lid inner handle.



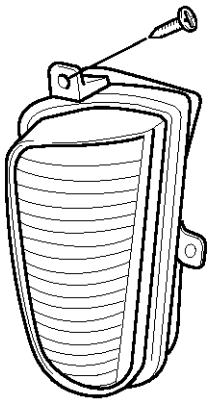
ASCD003E

4. Loosen the nuts(11) of trunk lid license plate.
5. Disconnect the connector of trunk lid license lamp, and then remove the trunk lid license plate panel.



ASCD003D

6. Loosen the screws(3) of back up lamp.
7. Remove the back up lamp from the license plate panel of trunk lid.



ASCD003F

8. Installation is reverse of removal.

NOTICE

If only the bulb replace, replace the bulb after removing the trunk trim.

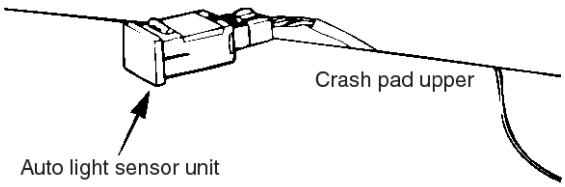
Auto Lighting Control System

Description

The auto light control system operates by using the auto light switch, and turns the head lamp and tail lamp on or off automatically in accordance with the detection illumination.

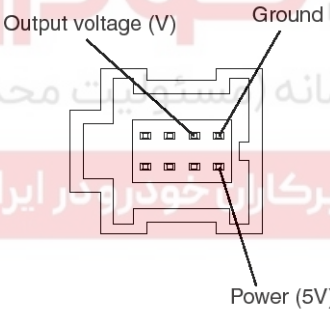
Inspection

1. Detach the sensor unit from the crash pad upper.



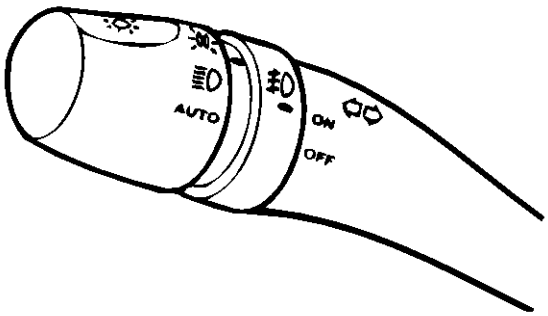
LTCD082A

2. Check the continuity between terminal power and terminal ground.



LTCD082B

3. Check the continuity between the terminals while operating the switch.



ETB9010E

4. Install the illuminant at 10cm distance from the auto light sensor in the darkroom.
5. Check the output voltage by adjusting the illumination.

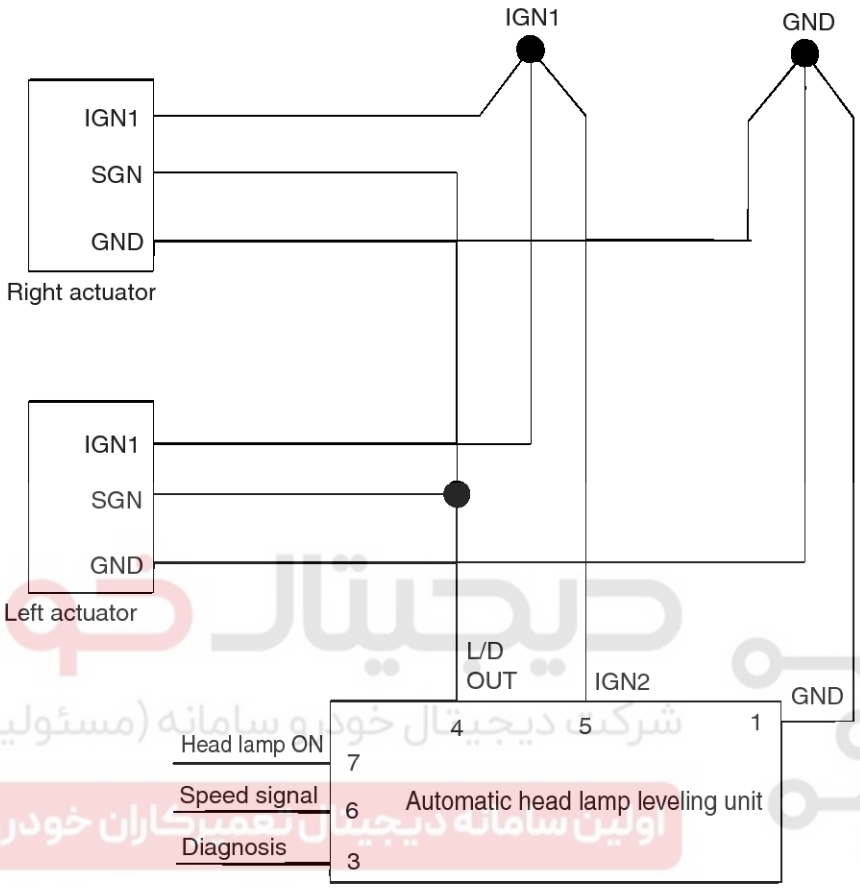
Illumination (Lux)	1	10	20	30	40	50
Output voltage (V)	0.47	1.46	2.85	2.71	3.22	3.66

Specifications

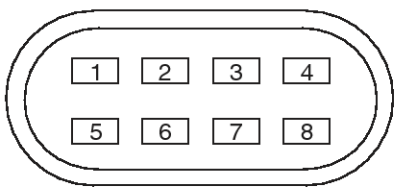
Items	Specifications
Rated voltage	12V
Load	Max. 200mA (Relay)
Detection illuminations Tail lamp/Head lamp	ON : 1.77 ± 0.08 (V) OFF : 3.47 ± 0.10 (V)

Head lamp leveling Device

Circuit diagram



ETZB200I



PIN CONNECTION

Terminal	Description
1	Ground
2	-
3	Diagnosis
4	Leveling actuator
5	IGN1
6	Speed signal
7	Head lamp ON
8	-

LTCD498A

Description

According to driving environment and loading state of vehicle, head lamp lighting direction is changed to keep the driver's visibility range and to protect the deriver's vision from glare, aiming at safety driving.

Sensor integrated ECU mounting on the rear center arm drives the actuator mounting on the head lamp since sensing the input signal following the vehicle's statical changes.

Head lamp beam is automatically operated by chassis tilt.

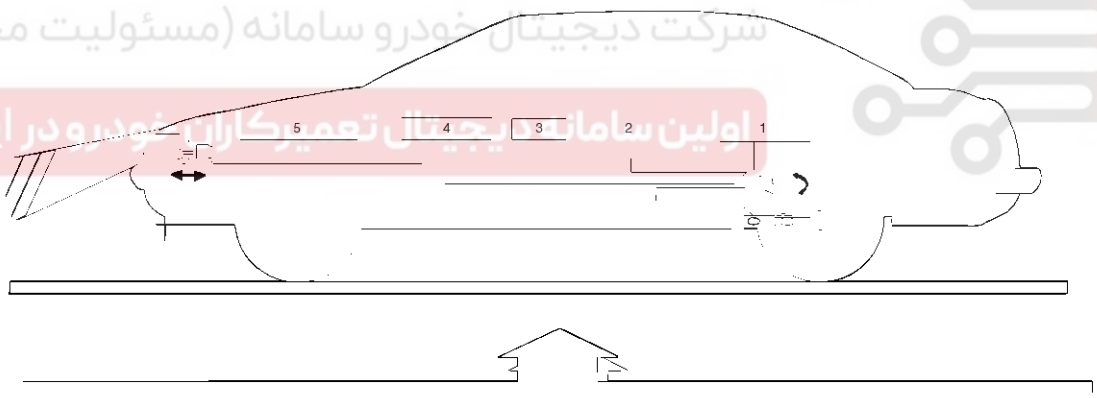
Operating procedure

1. Suspension angle change resulted from vehicle's load change
2. Sensor angle change.
3. Microprocessor calculates necessary head lamp angle change amount.
4. Sending a proper signal to head lamp levelling device and driving actuator.

Operating condition

1. Ignition on
2. Low beam on
3. On stop : If sensor lever change is 2° and above, head lamp is operated after max. 1.5 sec.
4. On driving : If vehicle velocity is over 4km/h, velocity change is not over 0.8-1.6km/h per second, and loading condition is changed, then head lamp is operated.

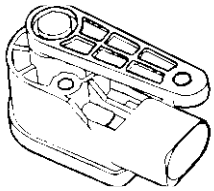
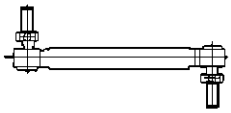
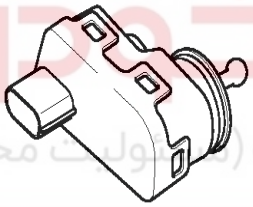
System block diagram



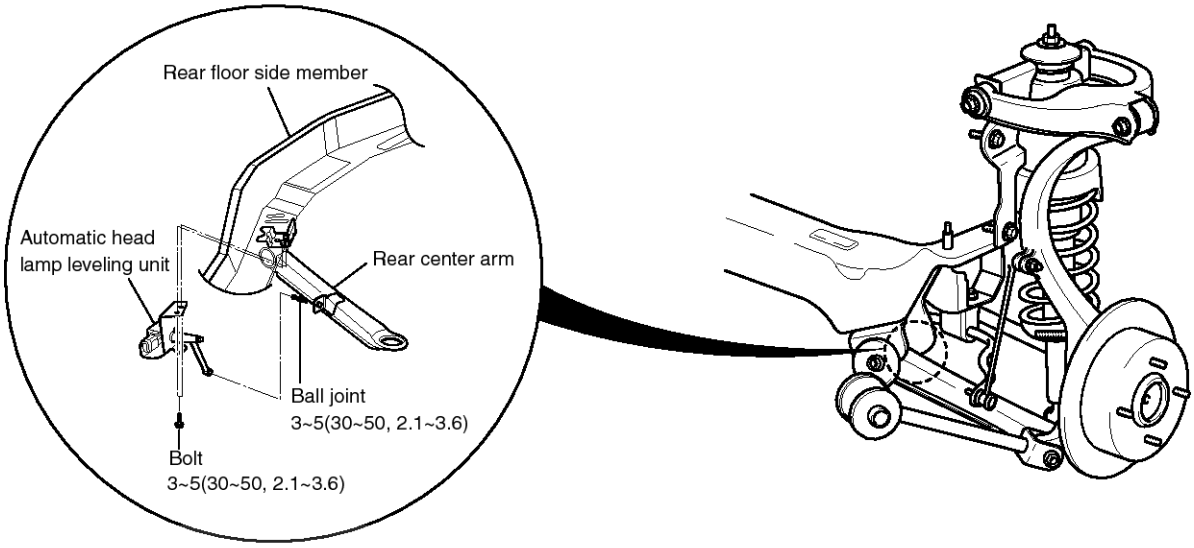
1. Automatic head lamp leveling unit
2. Speed signal (T/M)
3. Diagnosis
4. Head lamp ON
5. Actuator

LTCD150A

System components

Component	Description
Automatic head lamp levelling unit 	• Using a Micro-processor, percept the operation lever's mechanical angle change or speed signal. • As an actuator control device of inner control program, mounting on the rear center arm.
Linkage 	• Sending vehicle's tilt by connecting automatic head lamp levelling unit lever and suspension. • Applying the hexagonal flange. • Lever length is differentiated by vehicle's automatic head lamp levelling unit and suspension layout.
Actuator 	• Change the head lamp lighting direction up or down since automatic head lamp levelling unit sensing the input signal following the vehicle's statical changes.

Component

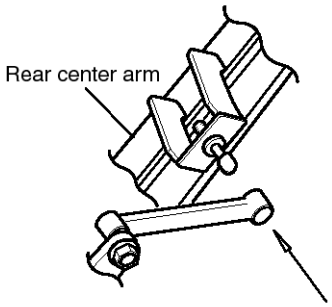


TORQUE: N-m (kg-cm, lb-ft)

LTCD495A

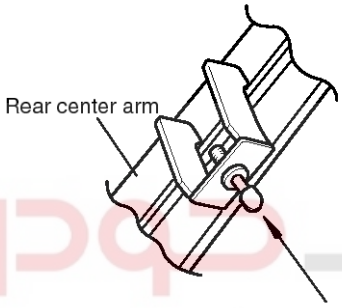
Removal

1. Remove the ball joint from the link assembly.



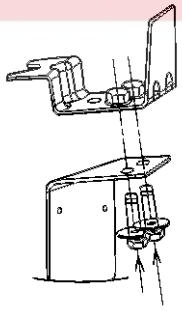
LTCD496A

2. Loosen the nut and remove the bolt of ball joint from the rear center arm.



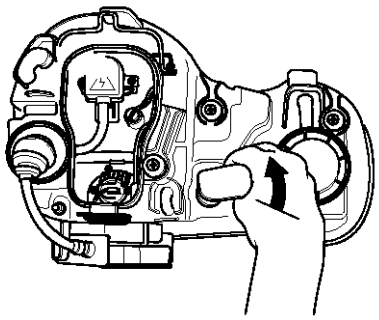
LTCD496B

3. Loosen the mounting bolts of automatic head lamp levelling unit.



ATCD496C

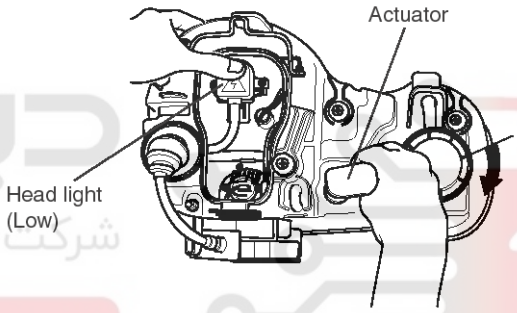
4. Disconnect the connector the automatic head lamp leveling unit.
5. Remove the head lamp assembly and then remove the actuator by rotating in counter clockwise.



ATCD496D

Installation

1. Install is reverse of removal.
2. Install the actuator at the hook with pushing the connector of head lamp (Low) and then rotate the actuator in clockwise direction.



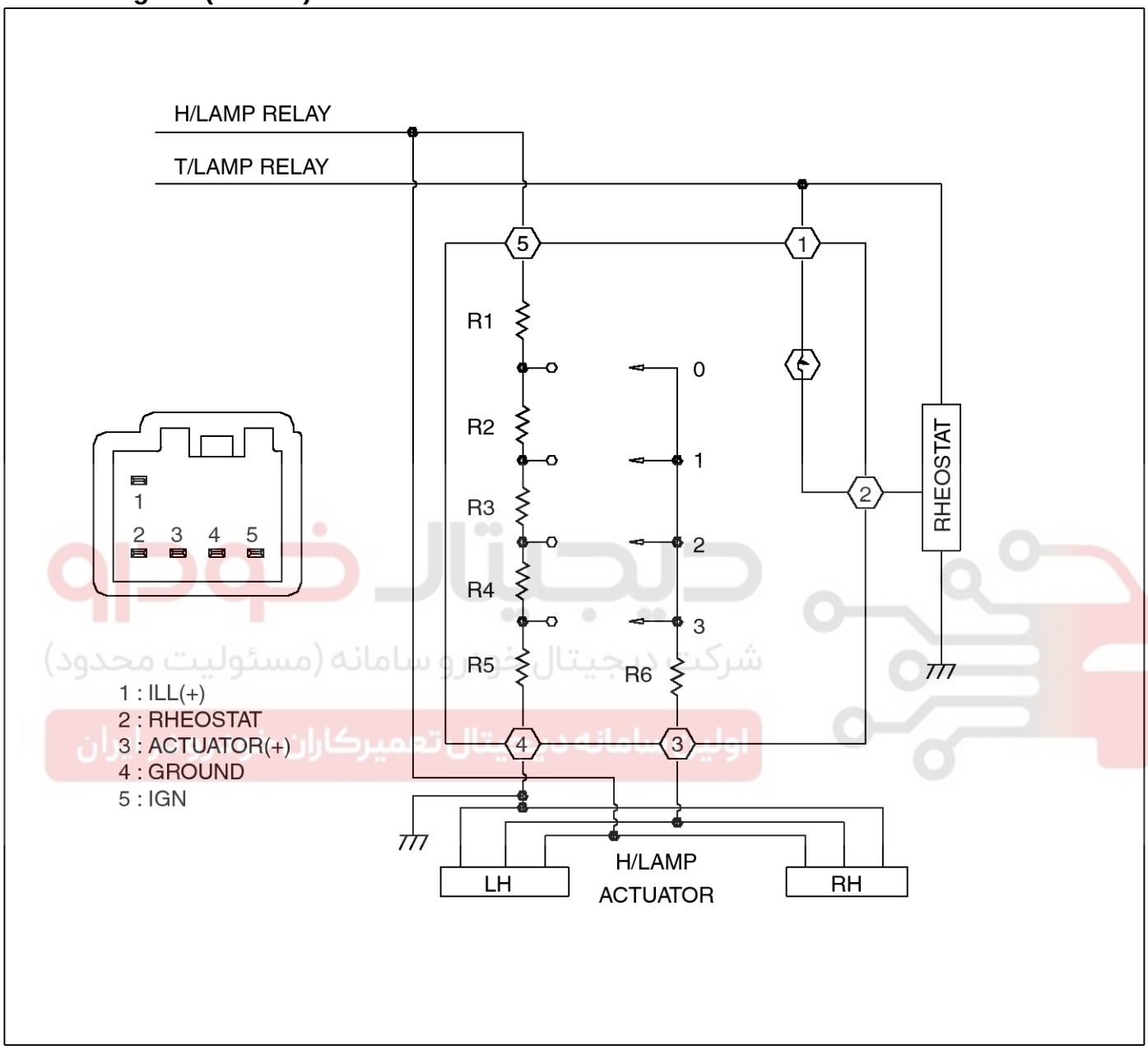
LTCD496E

Diagnostic trouble codes

Fault Code	Tester Display	Faults Description
C1604	ECU	Control unit defective
C1606	ECU software	Control unit not coded
C1620	First setup not completed	Control unit not adjusted
C1522	H/Lamp switch	Light signal line open
C1212	Vehicle speed signal	Speed signal is not plausible
C2226	Output voltage short to Batt/GND	Output signal short to Plus/GND
C1255	Height sensor rear circuit	Leveling unit lever overturned (over 90˚)
C1621	Excessive operating temperature	Excessive temperature.

Auto Head lamp leveling Unit

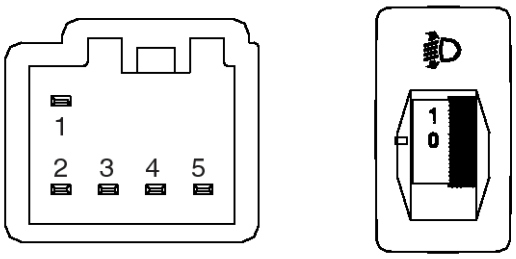
Circuit diagram (Manual)



LTCD280A

Switch inspection

1. Disconnect the switch from harness side at the crash panel.



LTCD280B

2. Connect the battery voltage between terminals 5 and 4 (Reference voltage = Vb).
3. Measure the voltage between terminals 3 and 4(V).
4. Check the percent ratio (V/Vb x 100%) between voltages Vb and V at each position.

Position No.	Rotation	Ratio (±5%)	Voltage(V)
0	0°	90%	12.09 ± 0.5V
1	20°	73%	10.15 ± 0.5V
2	40°	64%	8.70 ± 0.5V
3	60°	57%	7.70 ± 0.5V

5. If the voltage is not as specified, replace the head lamp levelling switch.

Immobilizer System

Description

The purpose of the immobilizer system is to provide an additional anti-theft to the vehicle which is installed in, preventing it from an unauthorized use. Checking of user authorization is done by use of an ignition key which head integrates a crypto-transponder.

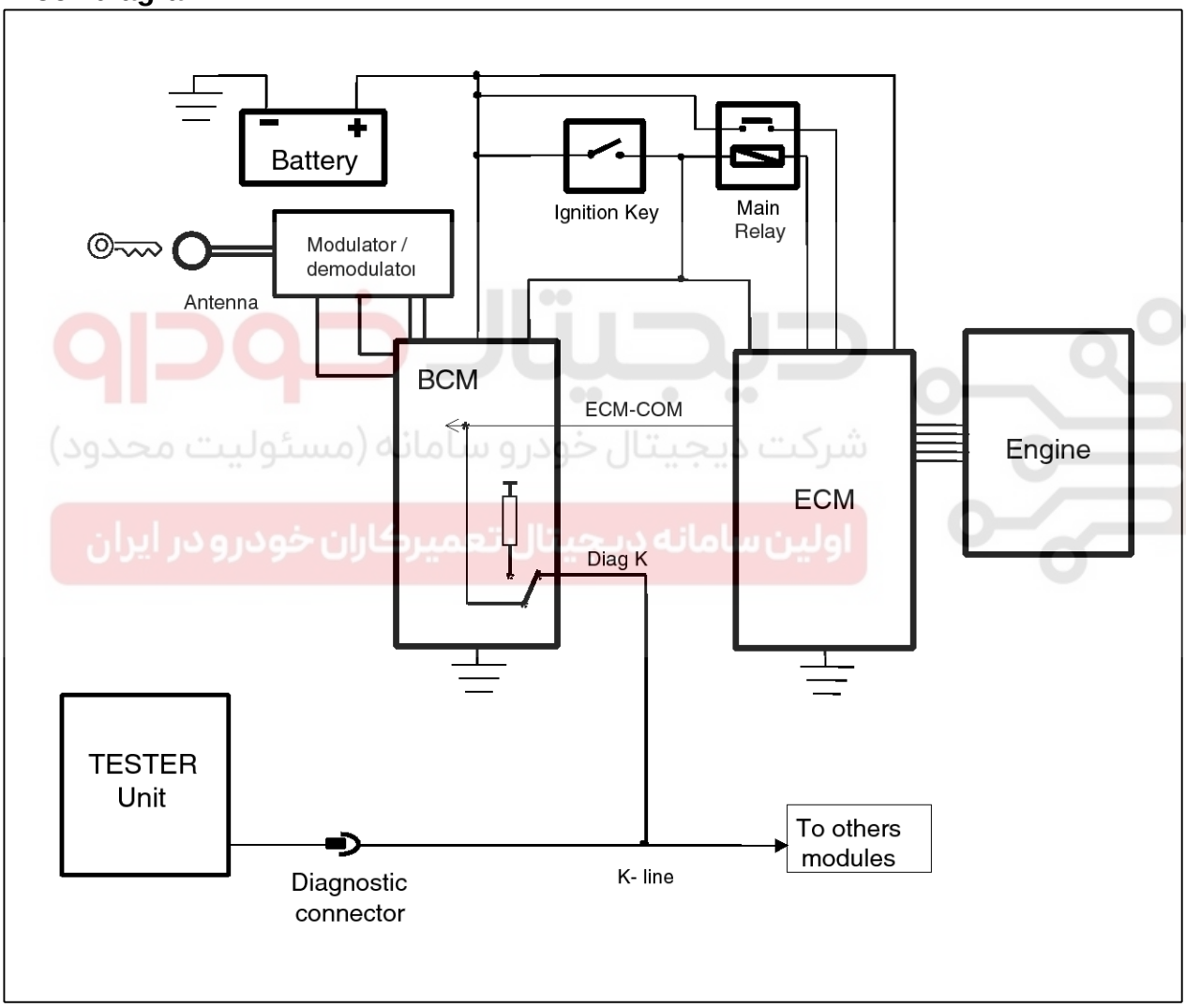
In case of PIC option installed, checking of user authorization is done by use of a PIC Fob integrating a transmitter/receiver and a crypto-transponder.

In case of a blocked Immobilizer system (unauthorized key), the ECM control unit locks the engine control by cutting off the ignition circuit and the injector circuit.

To secure the system, the information exchanged between BCM and ECM through the K-line is coded.

The key teaching and the diagnostic of both control units (BCM & ECM) are realized by diagnostic services with the diagnosis tool.

Block diagram



LTCD360A

Glossary

Blocked :

State of BCM Immobilizer function, in which the vehicle should be immobilized.

In this state, cranking is not possible if the optional cranking relay is present.

Released :

State of BCM Immobilizer function, in which the vehicle can be mobilized.

In this state, cranking is possible.

Locked :

State of ECM Immobilizer function, in which the starting and running of the engine is disabled ; immobilizing actions are executed

Unlocked :

State of ECM Immobilizer function, in which the starting and running of the engine is enabled in a normal way

Release message communication :.

Communication phase between BCM and ECM during which Immobilizer status and information are exchanged

MIN code : Model Identification Number

VIN code : Vehicle Specific Identification Number (VIN)

PIN code : P Identification Number (Vehicle Secret Code)

User Password :

4 digit decimal numbers that are saved in BCM EEPROM via diagnostic tool at service center. Only learnt BCM can save this 'User Password', and this 'User Password' only makes 'Released' Status at 'Limp Home Mode'.

Challenge :

The Random number (40bits), which BCM sends to Transponder.

Transponder Serial Number :

The Unique numbers (24bits) which are stored in Transponder memory.

Signature :

The calculation result (24bits), and Transponder calculates this value based on Challenge and Encryption Key.

Transponder Response :

The transponder response which is composed with Transponder Serial Number and Signature.

PIC (Personal Identification Card) :

The card or the Fob used as identifier for Keyless Passive Entry and Go functionality (option).

MSL : Mechatronics Steering Lock.

BCM : Body Control Module.

ECM : Engine Control Module.

KTR :

Secret Encryption Key programmed into TRansponder memory and used for encrypted communication.

Component

General

- Up to 3 ignition keys with transponder integrated in the key head
- The antenna (toroïdal coil) for energizing and communicate with the transponder with its integrated electronic modulator/demodulator driver
- The BCM control unit (Body Control Module), in which Immobilizer function is managed
- The ECM control unit (Engine Control Management)
- The serial data link between BCM and ECM control unit
- The data link and supply link between BCM control unit and antenna

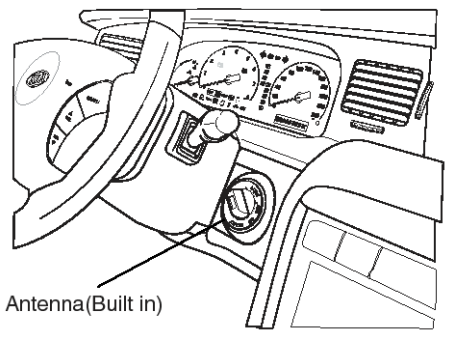
In case of PIC option (Passive Entry and Go function), following products are added :

- The PIC control unit, in which Passive Entry and Go function is managed
- The MSL control unit (Mechatronic Steering Lock)
- The PIC Fob, able to communicate via LF/RF waves
- The serial data link between BCM and PIC ECU (CAN network)
- The serial data link between PIC ECU and MSL

General operation

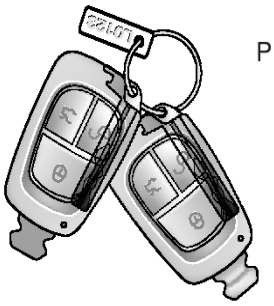
Key recognizing principle

The Immobilizer system is based on the recognizing of the key before each cranking request (inserting the key into the steering lock), by way of an inductive link between the transponder device (integrated in the key head) and the vehicle (toroïdal coil placed around the steering lock and wired with the BCM).



LTCD360C

Key recognizing is based on a challenge/response principle with an encryption algorithm whose parameter is a secret key (KTR). The algorithm is determined by the transponder supplier.



PIC Fob

LTCD360D

There is one and only one secret key for each vehicle.

The secret key is generated during the first key teaching in the car production line. It must be saved in the non-volatile memory of the BCM and the transponder, associated to the vehicle identification number(VIN) of the production line.

NOTICE

The Special equipment in Car Production line will produce "Vehicle Secret Code" (PIN code) which is induced from "Vehicle Serial Identification Number".

This "Vehicle Secret Code" (PIN code) allows the teaching of new keys and BCM and/or keys replacement

When the BCM learns this "Vehicle Secret Code" (PIN code), two other codes are determined during the first key teaching.

- The KTR secret key
- The VIN-code, used in the communication between

Communication principle between BCM and ECM

The immobilizer system needs a medial of communication between the BCM control unit (which manages the Immobilizer function, including the key recognizing) and the ECM control unit (which controls the engine). This communication is named: release message communication.

The information exchange is necessary to lock or unlock the engine control, or to synchronize the Immobilizer system after the first key teaching.

This information is based on the Vehicle Specific Identification Number (VIN), coded in 2 bytes.

The VIN-code is calculated by the BCM at the first key teaching using data from PIN code ; the value 0FFFFh is not authorized (reserved for virgin ECM).

The VIN-code is transmitted from the BCM in the release message communication (only in case of authorized key) using an encoding algorithm.

The ECM automatically learns the VIN-code after receiving the first release response message (that is: after the first key teaching, the ECM internal state being in virgin mode or neutral mode).

The ECM VIN-code is equal 0FFFFh when leaving electronic production.

To get a synchronized Immobilizer system (same VIN-codes in BCM and ECM control units, authorized and programmed keys), virgin keys and virgin control units have to be got and special procedures have to be executed (After Market teaching - see Key teaching procedures chapter). Some procedures use the Diagnostic tool equipment; the usage of this tool equipment is restricted to the authorized persons.

In addition BCM and ECM exchange another information: the Model Identification Number (MIN), coded in 1 byte. The MIN isfixed constant value(01H) . The MIN-code is checked by the ECM to authorize the engine running, and checked by the BCM,in order to inhibit any unauthorized use of BCM or ECM in a different system model.

Communication Line & System constraint

The exchange of the immobilization status between ECM and BCM is made on the current K-line. The BCM is inserted on the K-line between the ECM and the diagnosis connector, and manages an internal switch that opens the K-line during the exchange of status after the reset of ECM, or Key Off/On transient under power latch, as soon as the fast wake up pattern from the ECM is recognized.

This configuration keeps the K-line accessible by the tool at the diagnosis connector. The only constraint is during theimmobilizer communication where BCM and ECM cannot be addressed by the tool for diagnosis.

System working in nominal mode

The nominal mode supposes that the different elements of the system are programmed (synchronized Immobilizer system)

- The secret key code is programmed in BCM & keys memory
- The learnt keys identifiers are stored in BCM memory
- The corresponding VIN-code is learnt and memorized in the ECM memory

1. Ignition ON transition phase :

   Introducing a valid key into the steering lock, the system wakes up and BCM control unit sends to the key transponder a random data question (named

challenge).

Transponder and BCM calculate the corresponding response by the encryption algorithm, and the response is sent back by transponder to the BCM which compares it with its own response.

If they match, the BCM Immobilizer function switches in released state.

If they do not match, the BCM Immobilizer function switches in blocked state.

Then, turning ON the ignition, the BCM switches its internal K-line relay to isolate BCM & ECM control units from the system K-line, and in order to allow communication between BCM and ECM during a predefined tuned time window.

⚠CAUTION

If the user waits for more than a predefined tuned time (10 sec.) between inserting of valid key and turning ON the ignition, the BCM Immobilizer function switches back in blocked state after this delay ;

In this case, or if transponder communication has failed, a new communication with key transponder is carried out at Ignition ON transition to evaluate again Immobilizer state.

2. BCM-ECM Communication phase

After this first “Ignition ON transition” phase, a communication between BCM & ECM control units takes place.

Turning ON the ignition, the ECM control unit controls the engine in a normal way for starting and running, and starts communication with the BCM, sending a VIN request to the BCM and waiting for a valid release message from it until the release time period has ended.

In case of BCM Immobilizer function state is “blocked”, the BCM answer is the “no release” message. ECM enters into the locked state, which causes the activation of the immobilization actions of the engine.

In case of BCM Immobilizer function state is “released”, the BCM answer is the “ release” message, including the information “BCM in learnt mode” and the VIN-code.

- If VIN-code received by the BCM is the same as ECM VIN-code, and if MIN-code received by the BCM is the same as ECM MIN-code, ECM enters in the unlocked state, which allows continuing the running of the engine.
- If VIN-code received by the BCM is different than ECM VIN-code, or if MIN-code received by the BCM is the different thanECM MIN-code, ECM enters in the locked state, which causes the activation of the immobilization actions of the engine.
- If the ECM doesn't receive a response message from the BCM within the release time period, ECM enters in the locked state, which causes the activation of the immobilization actions of the engine.
- If the BCM doesn't receive any ECM request within the defined time, the BCM Immobilizer function switches in released state.
- If the ECM request contains a MIN-code different than BCM MIN-code, the BCM Immobilizer function switches in blocked state.

3. Ignition OFF transition phase :

Turning OFF the ignition, the BCM Immobilizer function stays in released state (if already in this state) during a predefined tuned time (10 sec.), allowing a fast restart of engine without key transponder communication, and then returns inblocked state.

After that, to restart the engine, a new communication with key transponder will be carried out :

- By removing and inserting again the key in the steering lock
- By turning ON again the ignition

Additional requirements for PIC option

In case of PIC option, before each cranking request, an authorization is given to unlock the MSL (Mechatronics Steering Lock) and the engine control.

Authorization principle is based on the recognition of

- The PIC Fob control unit (transmitter/receiver) for Passive Start function

  This passive recognition is done with an encryption algorithm.

  Or the PIC Fob transponder (located into PIC Fob housing), as a backup solution :

  This recognition needs the PIC Fob to be inserted into the steering lock.

The same secret key (KTR) is used for the PIC components (PIC Fob, PIC control unit and MSL) and for the Transponder (TR). In the same way, the secret key is generated during the first key (TR) teaching in the car production line, and then learnt to the other PIC components.

The nominal mode supposes that the different elements

of the system are programmed (synchronized Immobilizer system) :

- The secret key code is programmed in memory of BCM, TRs, PIC control unit, MSL, PIC Fob
- The learnt TRs identifiers are stored in BCM memory
- The corresponding VIN-code is learnt and memorized in the ECM memory

1. Ignition ON transition phase(using PIC Fob)

   Pressing the Brake pedal, the system wakes up and the PIC ECU authenticates the PIC Fob with encrypted LF/RF communication, releasing the MSL (allowing to turn the Ignition knob) and sends a release command to BCM via CAN encrypted communication.

   If release command succeeds, the BCM Immobilizer function switches in released state.

   If release command is not sent or doesn't succeed, the BCM Immobilizer function switches in blocked state.

   Then, turning ON the ignition switch, the BCM switches its internal K-line relay to isolate BCM & ECM control units from the system K-line, and in order to allow communication between BCM and ECM during a predefined time.

   ⚠CAUTION

   If the user waits for more than a predefined tuned time (10 sec.) between pressing of brake pedal and turning ON the ignition, the BCM Immobilizer function switches back in blocked state after this delay.

   In this case, or if release command from PIC has failed, a new release command is waited from PIC ECU at Ignition ON transition to evaluate again Immobilizer state.

2. Ignition ON transition phase (backup solution with PIC Fob transponder)

   In case the PIC Fob transmitter/receiver is out of order, it should be inserted into steering lock to allow communication with the Transponder located in the housing.

   If transponder is valid, the system wakes up and BCM control unit sends to the transponder a random data question (named challenge).

   Transponder and BCM calculate the corresponding response by the encryption algorithm, and the response is sent back by transponder to the BCM which compares it with its own response.

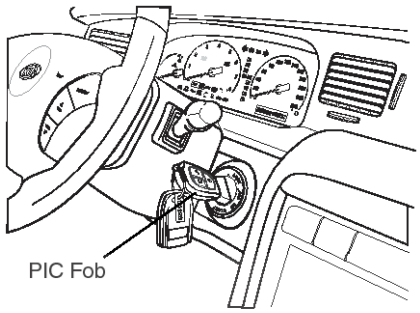
   If they match, the BCM Immobilizer function switches in released state, and BCM sends to PIC ECU a MSL release command via CAN encrypted communication.

   MSL and ECM are both unlocked.

   Then, turning ON the ignition switch, the BCM switches its internal K-line relay to isolate BCM & ECM control units from the system K-line, and in order to allow communication between BCM and ECM during a predefined tuned time.

   If they do not match, the BCM Immobilizer function switches in blocked state.

   MSL and ECM are both kept locked. It is impossible to turn ON the ignition switch.



LTCD360E

   ⚠CAUTION

   If the user waits for more than a predefined tuned time (10 sec.) between inserting of valid transponder and turning ON the ignition, the BCM Immobilizer function switches back in blocked state after this delay ;

   In this case, or if transponder communication has failed, a new communication with transponder is carried out at ignition ON transition to evaluate again Immobilizer state.

3. BCM-ECM Communication phase :

   Same as non PIC option

4. Ignition OFF transition phase

   Turning OFF the ignition, the BCM Immobilizer function stays in released state (if already in this state) during a predefined tuned time (10 sec.), allowing a fast restart of engine without key transponder communication, and then returns inblocked state.

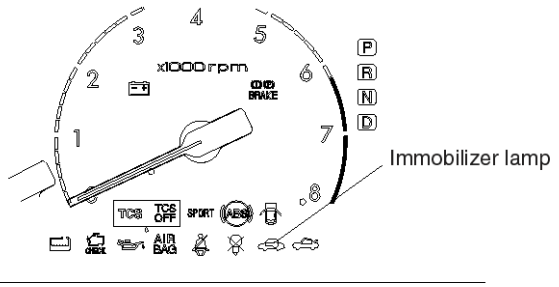
   After that, to restart the engine, a new communication with key transponder will be carried out:

   - By pressing again the brake pedal
   - By turning ON again the ignition
   - By removing and inserting again the PIC Fob in the steering lock (backup solution)

Immobilizer lamp

The status indicator is a LAMP indicator. It is indicator the state of BCM immobilizer function, start of LIMPHOME and complete of key teaching.

BCM contains the LAMP driver hardware for direct connection of one LAMP.



LTCD361A

Global rules for status LED pattern

Non PIC option :

1. Lamp should be turned OFF, when IGN off, or when engine is running.
2. Immo lamp is on in case : IGN1 is ON and (TP identified correctly or Limp Home Password entered correctly)

   NOTICE

   In case BCM-EMS communication error, then immo lamp off after 2 sec.
3. Immo lamp is blinking

   In case: (TP identification failed and Limp Home Password not running and Limp Home Password is not success) or (Limp Home Password entering failed and TP identification not running and TP identification not success)

   Except if (BCM virgin and TP identification failed), Then lamp is off
4. During Limp Home Password entering sequence, the lamp reflects the IGN1 signal state : if IGN1 is ON, then lamp is ON, if IGN1 is OFF, then lamp is OFF

PIC option

1. Cases of success (OK means):
   - TP is OK → Lamp max 10 sec ON if IGN1 OFF (Lamp 2 sec ON if IGN1 ON)
   - PIC FOB is OK → BCM receive Auth command → BCM send positive → Lamp max 10 sec ON if IGN1 OFF (Lamp max 2 sec ON if IGN1 ON)
   - Fast restart → During IGN OFF, Keep the Lamp ON during 10 sec after IGN OFF(if EMS has been correctly released)
   - In case door open and close à Re-authentication (receive re-enable Auth command

     ACC status : lamp re-10sec ON

     IGN1 status : keep previous Lamp status
2. Cases of non success (NG means):
   - TP is not good → BLINKING
   - PIC ID is not good → BLINKING

     A blinking pattern started on IGN ON mustn't be interrupted by an IGN OFF, and if a failure pattern is in progress whilea new IGN OFF to ON, then the failure pattern should be restarted.
   - Fast restart time out :
     - BCM time out → OFF
     - Receive Cancel Auth command → OFF
   - Door open close “PIC FOB is out” (receive FOB out warning command) :
     - IGN1 OFF and ACC ON → Lamp OFF/ Chime ON

       IGN1 OFF and ACC OFF → Lamp OFF/Chime ON
     - IGN1 ON : keep precondition/Chime ON
   - TP key out → Receive Cancel Auth command → OFF
   - ACC OFF with FOB → Receive Cancel Auth command → OFF
   - BRAKE released and ACC ON with FOB within 10sec → Receive Cancel Auth command → OFF
   - MSL not released because of MSL overheat protection or MSL communication problem → Receive Cancel Auth command → OFF
3. IGN ON transition

   IGN ON with successful Authentication : Lamp is ON

   IGN ON with unsuccessful Authentication : Lamp is BLINKING

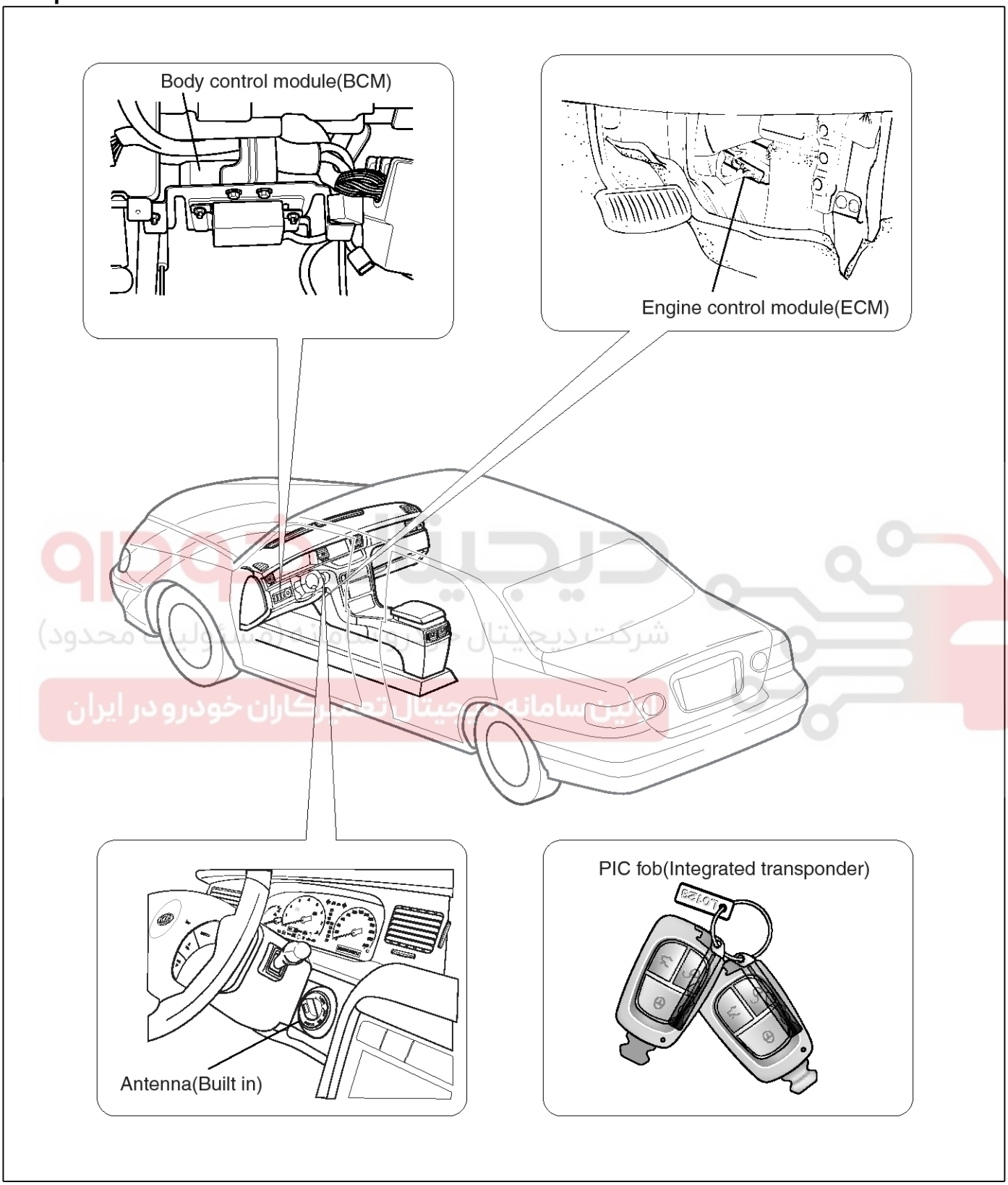
   IGN ON with successful Authentication & EMS COM error : after 2 sec Lamp OFF

   (so if a fast restart was in progress this one has to be cancelled)
4. With IGN ON and Lamp action started, BCM has to ignore the CAN data, which could change the Immo lamp status.
5. Behavior during learning procedures.

   While a TP key learning procedure is in progress, the Lamp is switched OFF

   In addition, Lamp is ON for 700 ms after each successful TP key learnt.

Component



LTCD360F

Limp home mode (non PIC option)

A Limp Home mode is provided in order to allow starting the engine in case of transponder or antenna failure (backup solution).

This mode is only available for the “non PIC” option.

In case of PIC option, the PIC Fob transponder is itself the Limp Home (backup solution) of the Passive Start functionality.

The user password for LIMP HOME is taught at service station. The owner of the vehicle can define a number with four digitals.

The user password teaching is only accepted by “learnt” BCM(No necessary to check “learnt” ECM).

Before first teaching of user password to BCM the status of this password is “virgin". LIMP HOME function is impossible.

User password setting procedure

The teaching is started by ignition ON with a valid key and sending the user password by tool. The communication messageare described ”Diagnostic tool display”. After successful teaching the status of user password changes from “virgin" to“learnt".

The “learnt” user password can also be changed. This can be done if user password status is “learnt” and the tool sends for authorization of access either the old user password or PIN code (Only access PIN code is applied in MUT tool).

After correct authorization the BCM requests new “User Password”. The status remains in “learnt“ and the new user password will be valid.

If wrong user passwords or PIN code has been sent to BCM three times, the BCM will reject the request of password changing for one hour. Disconnecting the battery or other manipulation cannot reduce this time. After connecting the battery the timer starts again for one hour. When a valid TP is authenticated before tentatives’ counter value reaches to limit, the tentative’ counter is reset, but the timer counter (1 hour) is not affected.

NOTICE

It's recommended setting “User Password” whenever the car be sold. If the password has not been set at dealer shop, the Password can be set by the thieves and then the vehicle might allow the Limp Home Mode.

Limp home tool

If the BCM detects a fault of antenna or transponder, the BCM will allow limp home function of immobilizer.

Limp home mode is only possible if the user password (4 digits) has been learnt to the BCM before.

This password can be defined by end user and is programmed at the service station .

The BCM informs the driver about the limp home condition by driven the status indicator. Then the user password can be sent to the BCM by special tool menu.

The diagnostic messages are described in ”Diagnostic tool display".

Only if the BCM is in status “learnt“ and the user password status is “learnt“ and the “User password” is the correct one, the BCM is “released“ and send “unlock“ request to ECM for the time (typical 30sec). The engine can only be started during this time. After elapsing of timer no engine start is possible.

The number of starts by tester is limited to 255.

If wrong user passwords have been sent to BCM three times, the BCM will reject the request of limp home for one hour. Disconnecting the battery or other manipulation cannot reduce this time. After the connecting of battery to ECM the timer starts again for one hour. When a valid TP is authenticated before counter value reaches to limit, the ten counter is reset, but the timer counter (1 hour) is not affected.

Limp home by ignition key

The limp home can be activated also by the ignition key.

The BCM informs the driver by driven the status indicator about the limp home condition.

Then the input of user password to BCM can be done by special sequence of ignition on/off. The timing is described in the following diagram.

- Ignition On period : 0.2sec ~5 sec
- Ignition Off period : 0.2sec ~3 sec
- Pausing duration between two passwords input : 3sec ~ 10sec

If wrong user password is recognized by BCM three times, the BCM will reject the request of limp home for one hour. Disconnecting the battery or other manipulation cannot reduce this time. After the connecting of battery to ECM the timer starts again for one hour. When a valid TP is authenticated before counter value reaches to limit, the counter is reset, but the timer counter (1 hour) is not affected.

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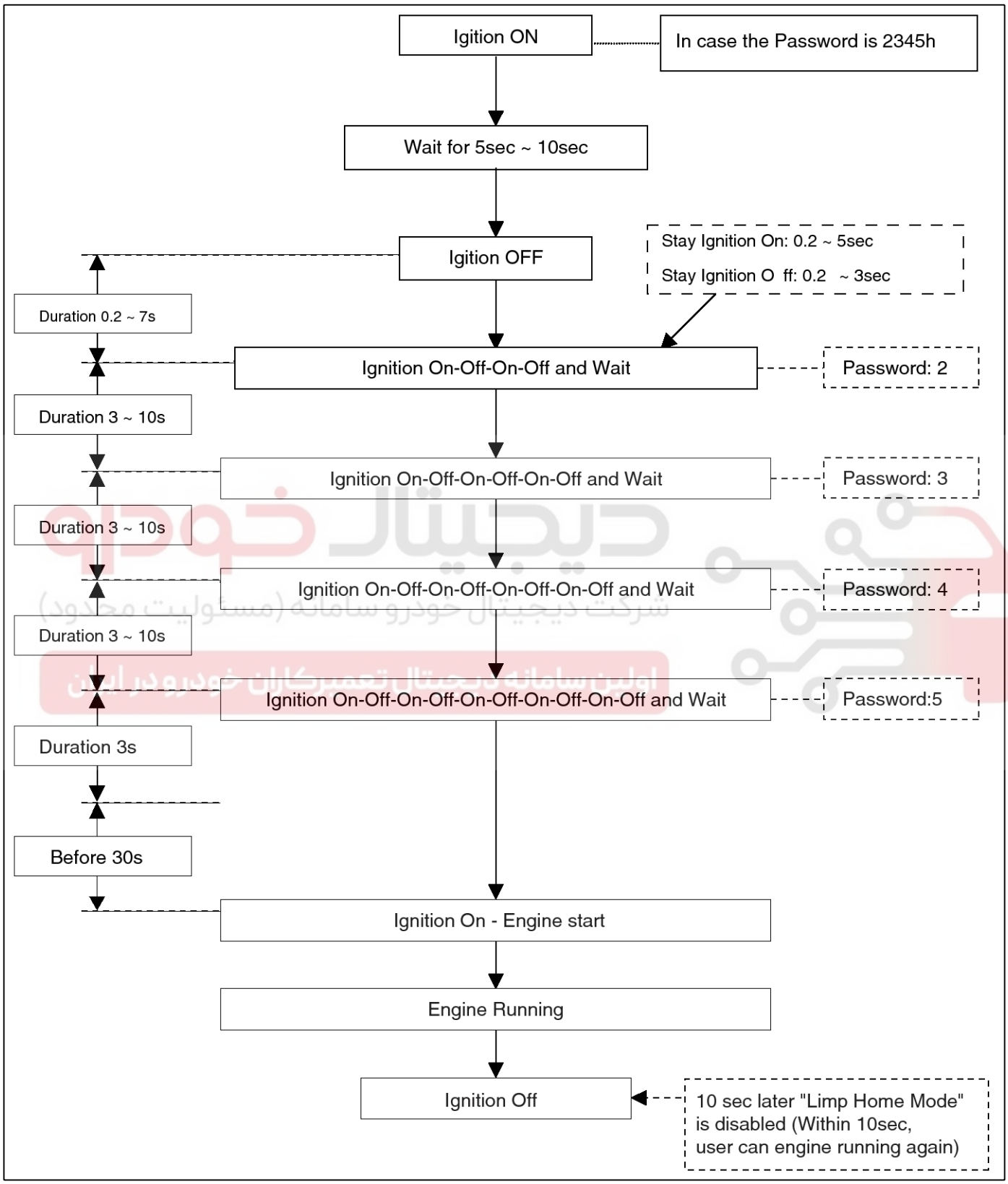
After ignition off the BCM is blocked and the ECM is

locked (typical 10sec) is elapsed. For next start the input of user password is requested again.



LTCD360B

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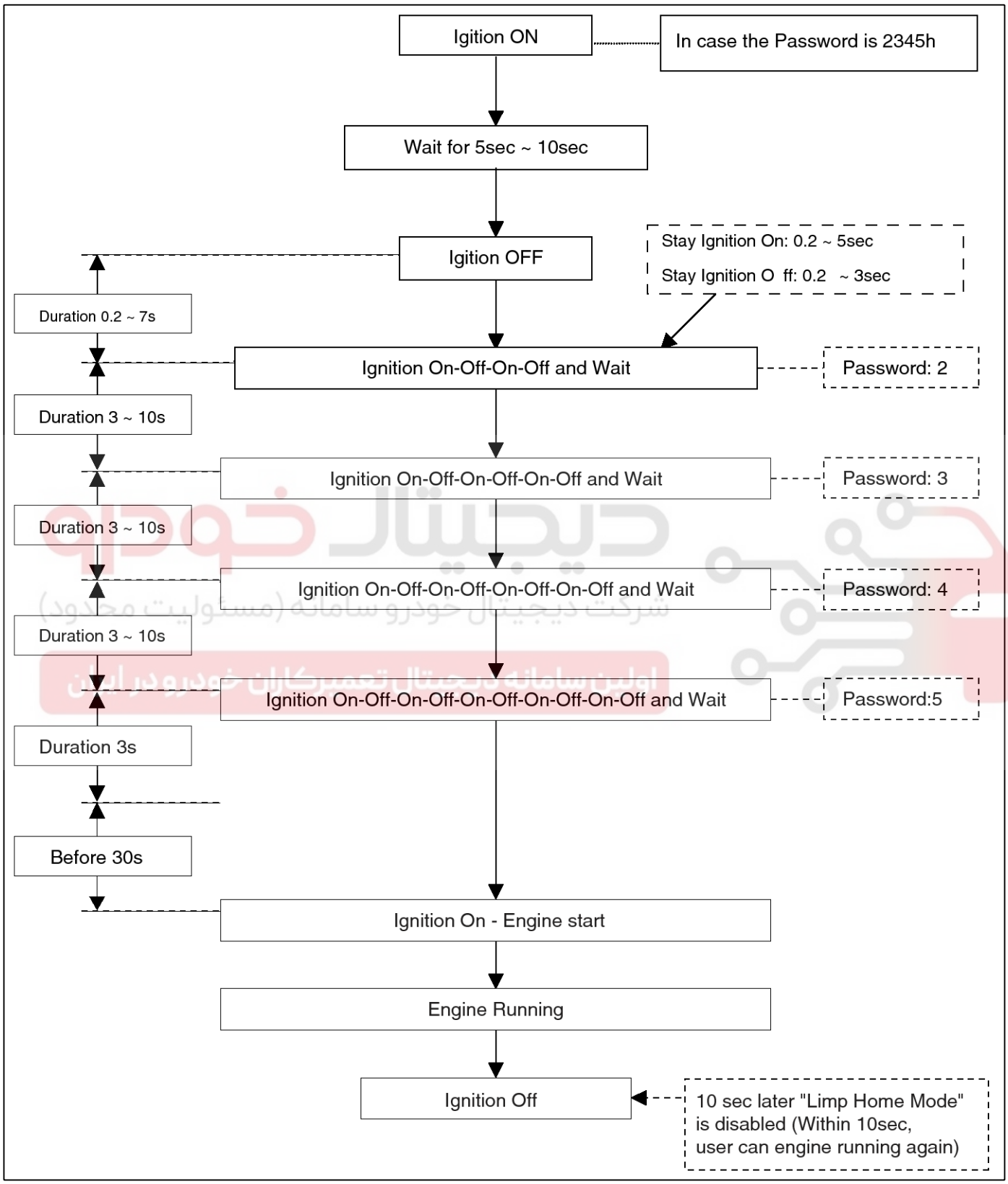


LTCD360B

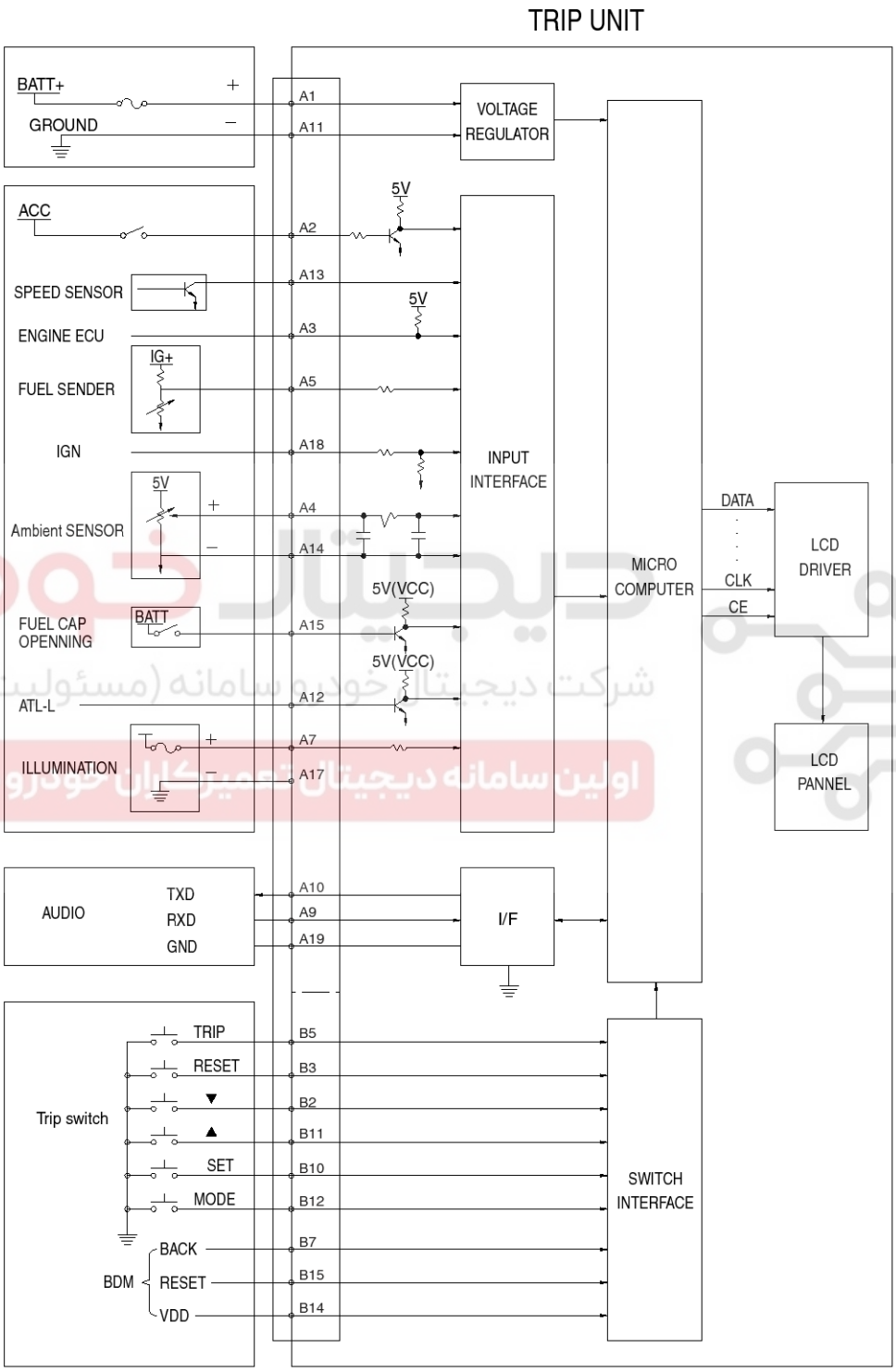
Troubleshooting

Immobilizer (Smartra) Dtc List

No.	Fault code	Monitor strategy description
1	P1674	Transponder status error
2	P1675	Transponder programming error
3	P1676	SMARTRA message error
4	P1690	SMARTRA no response
5	P1691	Antenna coil error
6	P1693	Transponder no response error / Invalid response
7	P1694	EMS message error
8	P1695	EMS memory error
9	P1696	Authentication fail
10	P1697	Hi-Scan message error
11	P1699	Twice overtrial

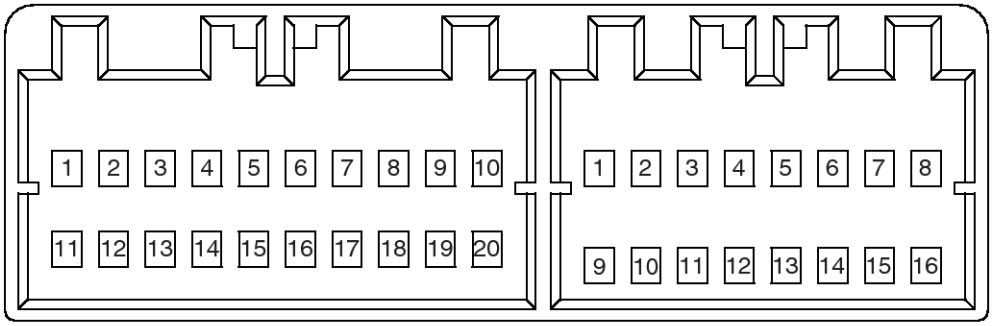
Trip Computer

Circuit diagram



LTCD332A

Connector configuration



"A" connector "B" connector

	PIN NO	SPEC
A	1	BATTERY B+
	2	ACC
	3	ENGINE ECU
	4	TEMPERATURE SENSOR
	5	FUEL SENDER SENSOR
	6	N.C
	7	ILL+
	8	N.C
	9	AUDIO RxD
	10	AUDIO TxD
	11	POWER GND
	12	ATL-L
	13	SPEED PULSE
	14	TEMPERATURE GND
	15	FUEL CAP OPEN SWITCH
	16	N.C
	17	ILL-
	18	IGN
	19	AUDIO GND
	20	N.C

	PIN NO	SPEC
B	1	N.C
	2	▼
	3	RESET
	4	N.C
	5	TRIP
	6	N.C
	7	BDM BACKGROUND
	8	N.C
	9	N.C
	10	SET
	11	▲
	12	MODE
	13	N.C
	14	BDM VDD
	15	BDM RESET
	16	N.C

LTCD332B

Description

Trip computer receives all the information related to the trip and displays various data including the average speed from the ignition ON till the ignition OFF, average fuel consumption, current fuel consumption, driving time, outside temperature, time (including month and date) and distance to empty with the remaining fuel displaying them on the LCD of radio of audio system, tape and CD.

Switches and functions

Multi function key has switches such as “TRIP”, “RESET”, “▲ “, “▼”, “SET” and “DATE".

1. TRIP switch

   Mode is changed as shown whenever the switch is pressed once.

   Distance to empty → Driving distance → Average speed → Average fuel consumption → Current fuel consumption → Driving time → Outside temperature

   When the TRIP switch is pressed for more than a second, monitor turns off, and the monitor turns on if pressed again.

2. RESET switch

   The system is initialized if the reset button is pressed for more than a second in the mode except distance to empty, outside temperature and current fuel consumption.

   If the switch is pressed in outside temperature mode, it converts from Fahrenheit to Centigrade and vice versa.

   If the reset button is pressed when the monitor is off, then monitor turns on.

3. ▲ switch

   It operates while the “DATE” button is pressed.

   Number increases one by one in every switch press in “MONTH”, “DATE”, “HOUR” and “MINUTE” reset mode. It increases quickly with the interval of 200 msec if the switch is pressed for more than 2 seconds.

4. ▼ switch

   It operates while the “DATE” button is pressed.

   Number decreases one by one in every switch press in “MONTH”, “DATE”, “HOUR” and “MINUTE” reset mode. It decreases quickly with the interval of 200 msec if the switch is pressed for more than 2 seconds.

5. SET switch

   It operates while the “DATE” button is pressed.

   Release the button if it is “DATE or HOUR’ reset mode. Then, it starts from the 0 second again.

6. DATA switch

   "DATE or HOUR" is changed if the “DATE” switch is pressed. Mode changes as follow whenever the switch is pressed once. Corresponding icon blinks.

   HOUR → MINUTE → MONTH → DATE → SETTING completed

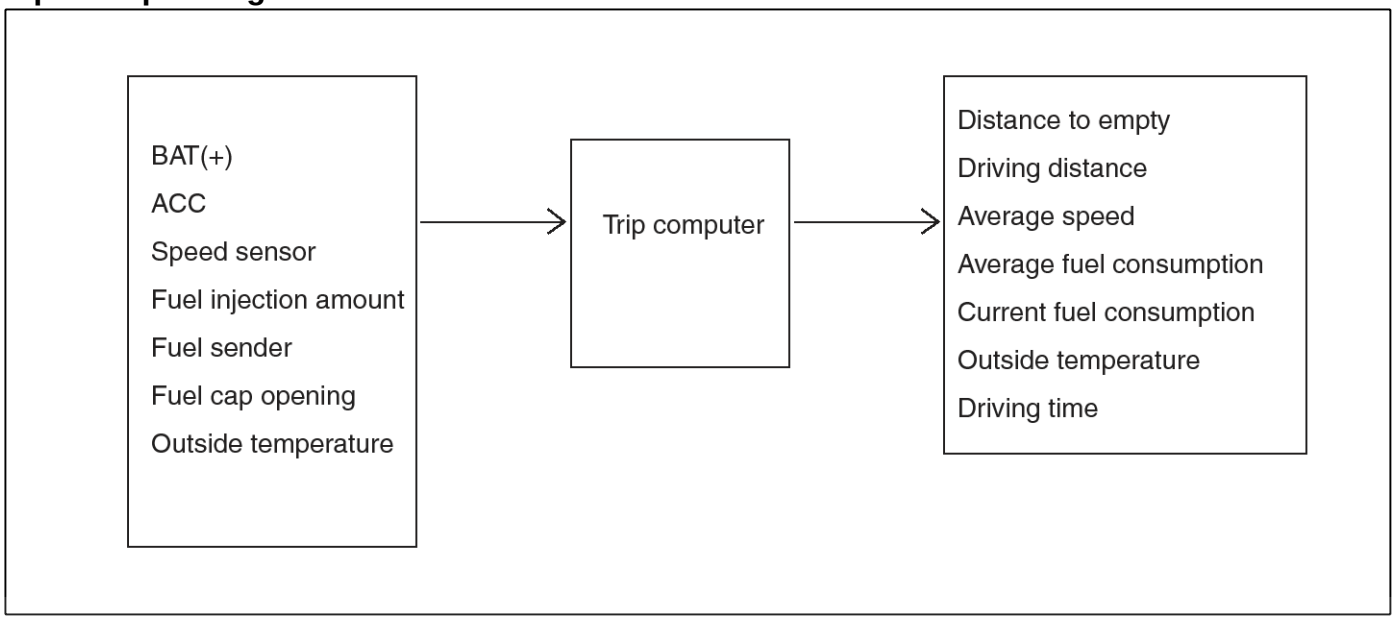
   If the setting is complete, press the “MODE” switch again when the “MINUTE” blinks.

NOTICE

If “TRIP” + “RESET” switches are pressed simultaneously for more than 5 seconds, all settings are initialized.

Input/output characteristics

Input/output diagram



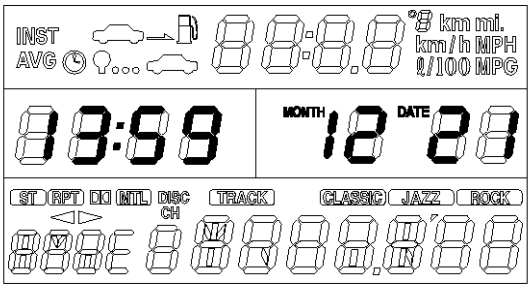
LTCD331B

Input specification

1. BAT (+)
   It is connected to the vehicle battery (DC 13.5V).
2. Speed sensor
   Vehicle condition that keeps the speed of 60km/h at 637 RPM
   637x 4 pulse/60sec=60km/h
3. Engine ECU (Fuel injection amount)
   80mcc of fuel is injected per pulse.
4. ILL(+): Tail lamp switch
   It is inputted from the switch to turn on the headlamp and tail lamp at night.
   When the LCD is on, the brightness of LCD is reduced to the 80% of the daytime level.
5. Fuel sender
   Input signal from fuel sender is the voltage detected in the fuel sender is almost proportional to the fuel level.
6. Fuel cap opening switch
   This switch inputs B+ voltage for a while to judge the fuel filling status.
7. Outside temperature sensor
   Voltage depending on the ambient temperature is inputted when the ignition is on.

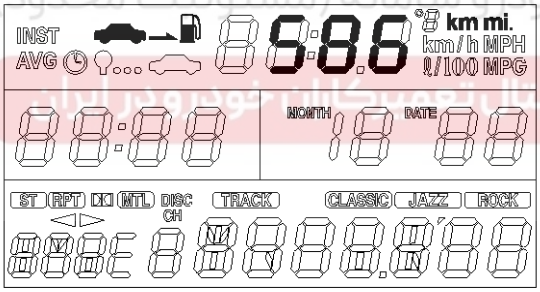
Output specification

1. Watch and date
   - Display range :
     Watch : 24 hour mode (00:00 ~23:59)
     Month : 01~12
     Date :01~31
   - Tolerance : ±2sec/day
   - It is displayed all the time after ACC
   - Mode is changed in the following sequence when the “DATE” button is pressed.
     HOUR→ MINUTE → MONTH →DATE
   - Current reset mode is release when the “SET” button is pressed. Then, the second display starts with 0 again.
   - If “▲” and ”▼” button is not pressed within 10 seconds after “SET” button pressing, then the mode will be released.
   - Letter “:” between hour and minute blinks all the time.
   - Watch is set by the “DATE”, “▲”, “▼” and “SET” button operation.



ATCD331C

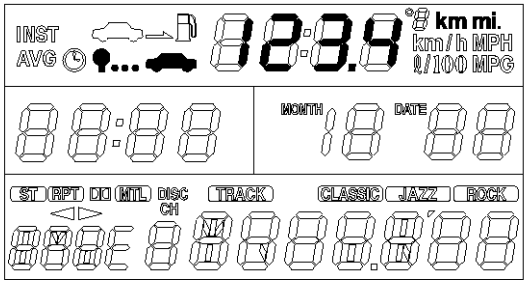
2. Distance to empty (DTE)
   - Display range: 50 km ~, 31 MILES ~
   - Tolerance : ± 30km, ± 20 miles
   - It displays the driving distance with the remaining fuel by applying the variable fuel consumption.
   - Since the display is not operative before the ignition on, only "---" is displayed.
   - If DTE is less than 50km, 31 miles, LCD displays "---" mark on and off with the time interval of 0.5 sec. (Audio installed vehicle)
   - DTE reduction in idle state (stopping at the traffic signal or temporary stopping) is based on the official fuel economy.



ATCD331D

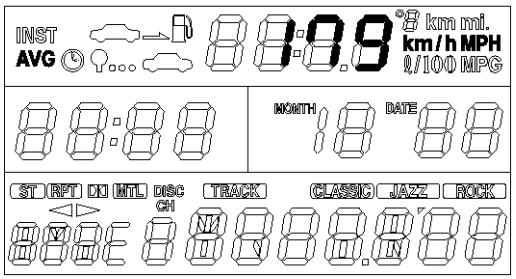
3. Driving distance (DD)
   - Display range: 0 ~ 999.9 km, 0 ~ 621.3 miles
   - Resolution : 0.1 km, 0.1 mile
   - Tolerance : ± 1km/100km, ± 2 miles / 130 miles
   - Since the vehicle speed is not provided before the ignition on, only "---" is displayed.
   - When the reset switch is turned on, accumulated driving distance is reset to 0
   - Accumulated driving distance is on display until engine cut off and ACC off. And it displays the accumulated driving distance after engine start, and keeps accumulating thereafter.

     Accumulated driving distance remains even after ACC off.
   - Driving distance = Accumulated No. of pulses of vehicle speed



ATCD331G

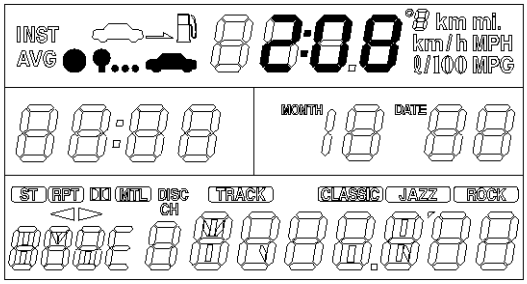
4. Average vehicle speed (AVS)
   - Display range: 0 ~ 250 km/h, 0 ~ 120 MPH
   - Tolerance : ± 3km/h, ± 2 miles / 130 miles
   - It starts calculating after 4-speed pulse from the ignition on.
   - Upon ACC on, the last average speed is reset to zero.
   - Upon restart, the previous average speed is reset to zero.
   - Upon reset switch on, current accumulated value will be reset to zero.
   - It displays average speed by calculating the accumulated speed from ignition on to ignition off.
   - Speed display is updated every second.
   - Average speed = Driving distance (accumulated) / driving time (accumulated)



ATCD331I

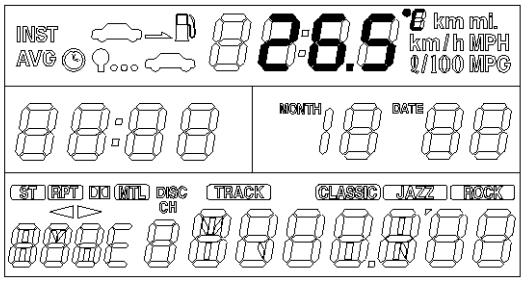
5. Driving time (DT)
   - Display range: 00:00 ~ 99.59 hour
   - Tolerance : 2 min/ 99 hour
   - It starts calculating after 4-speed pulse from the ignition on.
   - Upon reset switch on, current accumulated value will be reset to zero.

- It displays “---” before the ignition on because there is speed input.
- It displays driving time by calculating the accumulated distance from ignition on to ignition off. Driving time remains unchanged even after the ACC off. And it revives the existing value and keeps accumulating.



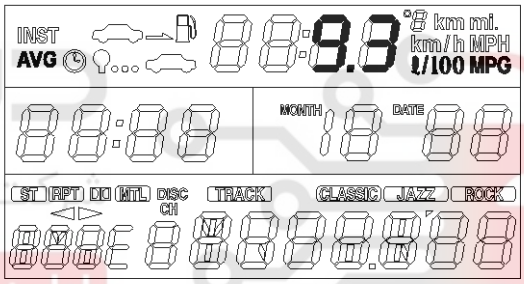
ATCD331K

6. Ambient temperature (AT)
   - Display range: -40.0 ~ 80.0 ℃, 0~176˚F
   - Resolution : 0.5℃, 0.5˚F
   - Tolerance : ± 3℃, ± 5˚F
   - Reset switch converts Fahrenheit to centigrade vice versa. It displays the average temperature for 1 second using the ambient temperature sensor installed on the vehicle. Temperature display increases at 0.5 ℃ per 90 seconds and decreases at 0.5 ℃ per 2 seconds
   - Temperature display does not increase if the vehicle speed is below 10 km/h. (Though, temperature display decreases regardless of vehicle speed)
   - It displays -40 ℃ if the temperature is below -40 ℃, and displays 80 ℃ if the temperature is above 80 ℃.
   - It displays “---“ before the ignition on because sensor is not operating.



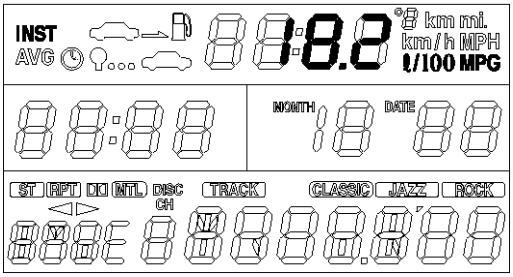
ATCD331M

7. Average fuel consumption (AFC)
   - Display range: 0~20ℓ/100km, 0~9 MPG
   - Tolerance : ±1ℓ/100km, ± 0.5MPG
   - It starts calculating after 4-speed pulse from the ignition on.
   - It starts displaying AFC information after driving 500m.
   - It displays the information by calculating the cumulative driving distance and fuel injection from ignition on to ignition off. And it keeps the previous average fuel economy information even after the ACC off.
   - Accumulated data is reset to zero if the RESET button is pressed.
   - It displays “---“ before the ignition on because sensor is not operating.
   - Average fuel consumption = injector injection amount / driving distance



ATCD331O

8. Momentary fuel consumption (MFC)
   - Display range: 0~50ℓ/100km, 0~23 MPG
   - Tolerance : ±1ℓ/100km, ± 0.5MPG
   - It starts calculating after 4-speed pulse from the ignition on.
   - It displays the information by calculating the cumulative driving distance and fuel injection for every 0.5 second.
   - It displays “---” before the ignition on because sensor is not operating.
   - When the speed = 0 km/h and ENG = ON, it displays “---“. Besides, it displays “---“ (in MPG), if there is no fuel consumption while driving.
   - Momentary fuel consumption = injector injection amount / driving distance



ATCD331Q

Specification

Item	Specification
Rated voltage	DC 12V
Operating voltage range	DC 9V~16V
Operating temperature range	-30℃~70℃
Operating current	Max 1.0A (DC 13.5V)
Dark current	Max 3.5mA

Back Warning System

DESCRIPTION

When reversing or parking, the driver is not easy to find objects in the blind spots and to determine the distance from the object. In order to provide the driver safety and convenience, back warning system will operate upon shifting to "R" Ultrasonic sensor will emit ultrasonic wave rearward and detect the reflected wave. Control unit will calculate distance to the object using the sensor signal input and output buzzer alarm in three steps (first, second and third alarm)..

OPERATION

OPERATING CONDITION

1. If the ignition switch is on,
2. If the operating switch is on,
3. The valid operating speed of vehicle

   ; When the vehicle moving forward less than 10km/h and backward less than 15 km/h.
4. Front warning sensor operating case - In state of any state except 'P'range, 'R'range.

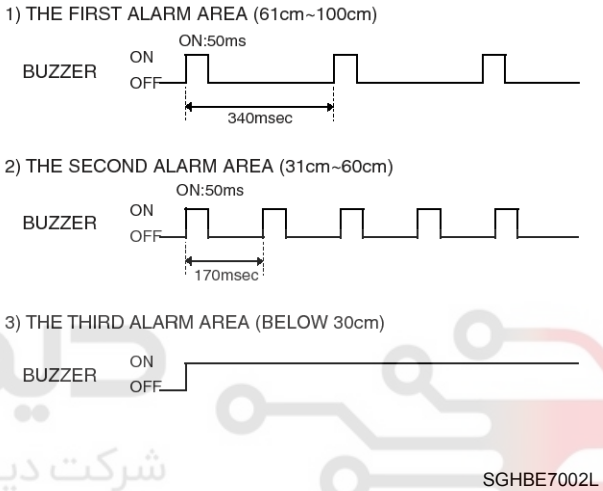
   Back warning sensor operating case - In state of 'R' range.
5. The state of 'Parking brake' is released.

When above 1, 2, 3, 4, 5 are in 'and' condition, it operates properly.

Distance measurement and warning method

- It may not operate if it's distance from the object is already less than approximately 30 cm when the system is ON..
- Self diagnosis alarm flashes all indicators of each sensor in 0.5 seconds..
- The third distance alarm flashes the third alarm indicator of each sensor in every 0.5 second.

1. Rear side of the vehicle



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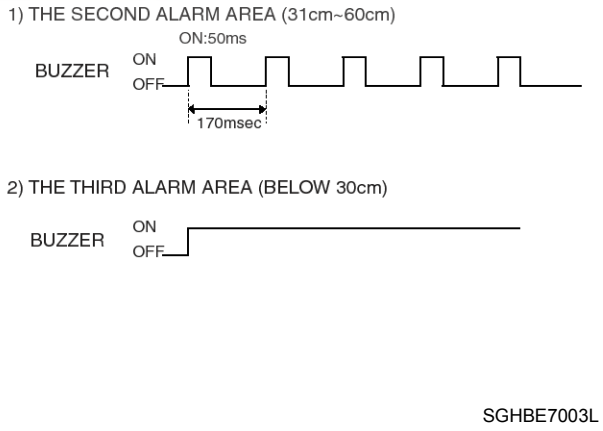
2. Front side of the vehicle



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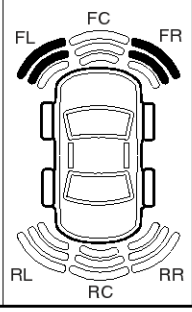
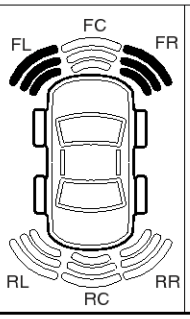
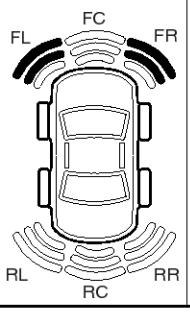
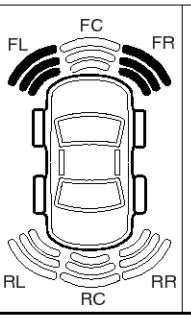
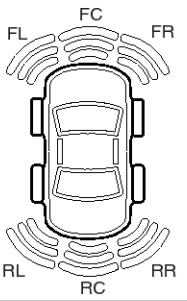
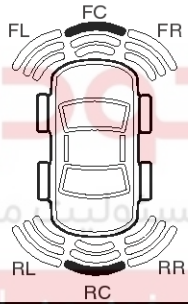
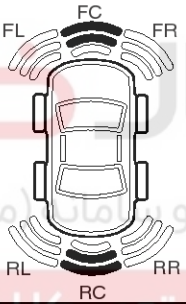
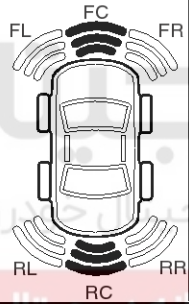
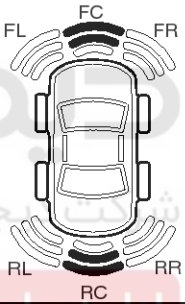
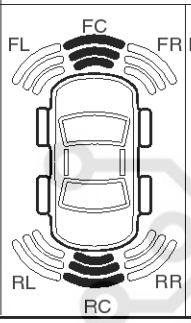
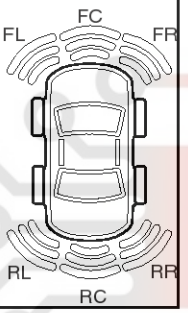
3. Indicator state

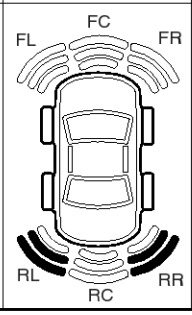
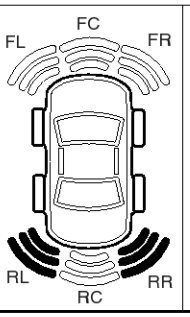
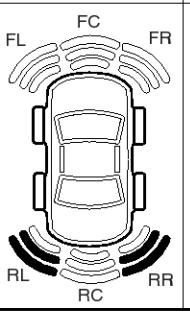
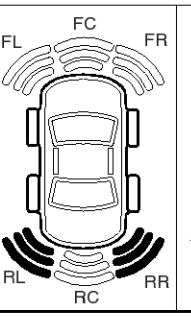
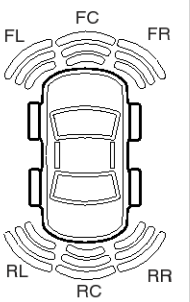
[Front side]

위치	Second alarm	Third alarm		Self diagnosis	
FL					
FR					

[Front/rear center]

위치	First alarm	Second alarm	Third alarm		Self diagnosis	
FC						
RC						

[Rear side]

위치	Second alarm	Third alarm		Self diagnosis	
RL					
RR					

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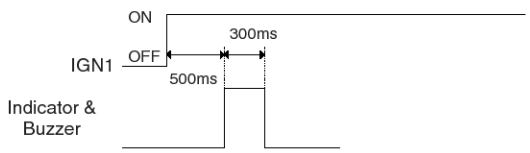
4. When backing the vehicle



SGHBE7006L

Operate with ignition switch on and shift the lever to position "R".

If no trouble, it generates buzzer alarm sound ON for 0.3 seconds after 0.5 seconds.

NOTICE USING THIS PRODUCT

This product is an assistant device in order to enhance a convenience under driving which gives the alarm according to the adjacent degree to the object by monitoring an object between the front & back 100cm and the corner 60cm when slowly moving forward at 15[km/h],or parked at 10[km/h].

This system can't monitor an obstacle because the detectable range and object are limited, so be careful.

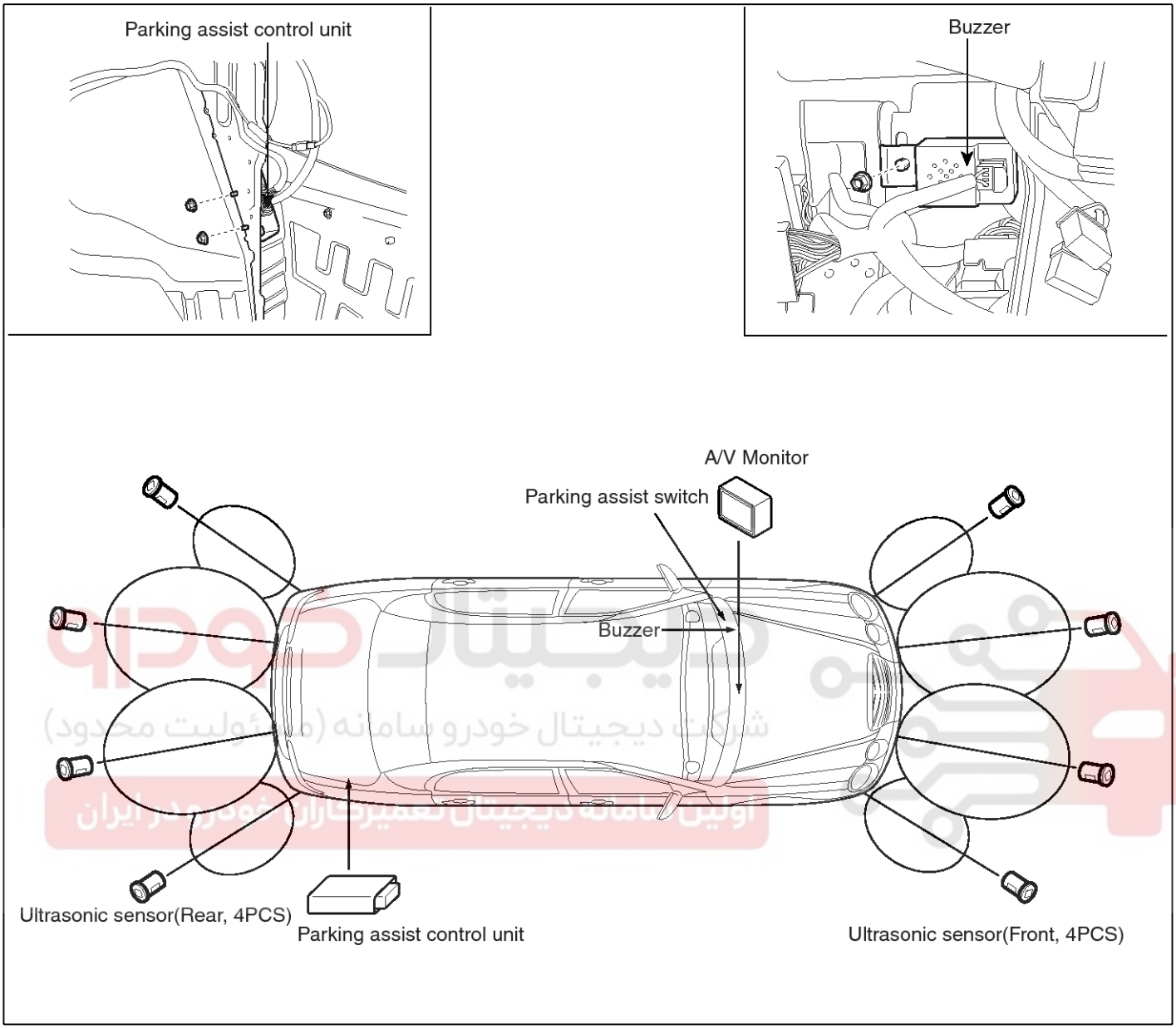
Don't guarantee the vehicle accident and damage resulted from the defect of the product.

1. Can't normally operate in the following cases.
   1) When the sensor is frozen.(normally operate if it is thawed)
   2) When covering the sensor surface with the materials such as a snow or water drop etc.

      (normally operate if it is removed or the obstacle of the sensor face is removed.)
2. The monitoring range can become narrow in the following cases.
   1) When the materials such as a snow or waterdrop,etc. are attatched to the monitoring part of the sensor.

      (recover the normal monitoring range if it is removed.)
   2) A scorcher or severe cold.
   3) An object smaller than the diameter 14cm, length 1m.
3. Can malfunction in the following cases.
   1) When backing the vehicle on an uneven road, gravel road, sloping road, grass.
   2) In the case that the object occurring the ultrasonic wave such as the vehicle horn, motorcylce's engine sound and full-size sedan's air brake,etc. is adjacent.
   3) In the case that is overtaken by the rainstorm or raises the spray
   4) When using the wireless apparatus which has the transmission function near the sensor.
   5) When the sensor is covered with a snow.
4. The following objects may not be monitored.
   1) A sharp object or a thin object such as a rope
   2) An object easy to absorb the sound wave such as a cotton or sponge, snow, etc.
5. The others
   1) The danger alarm amy not be made successively according to the traveling speed, or target' shape.
   2) Can malfunction in the following cases; the bumper height or the sensor' fitting status is changed, or an accessory besides the vehicle when delivered is attached to the sensor adjacent to the bumper within the detectable area.
   3) Even if the object exists within 30cm from the sensor, it may not be detected, so be careful.
   4) If the sensor indicate the error, check the sensor' state because the sensor is frozen or a snow, water drop are covered, and then remove by using a soft material when stained.
   5) Don't the following actions which result in the damage of the sensor surface; press the surface of the sensor by force, or impact it with a hard object, or scratch with a sharp object.

COMPONENT LOCATION

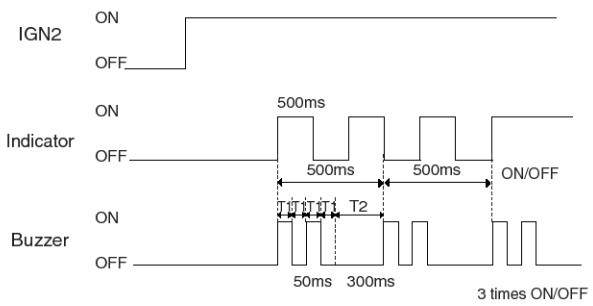


SGHBE7001L

SELF-DIAGNOSIS

If the system is supplied with the power(when the ignition is on), MICOM shall check the abnormal conditions of the system and sensors exist or not.

1. When the system is out of order



T1 : 50ms, T2 : 300ms.

SGHBE7007L

- Sensors with something wrong mark as follows using the indicator and the buzzer, and other sensors with no wrong performs monitoring function normally.

2. When both the normal and abnormal state of sensors show at the same time

   When there is a problem in any sensors and indicator shows the state of sensors' malfunction, other sensors perform monitoring function normally, or in reverse case, indicator marks the state of sensor's malfunction,but buzzer normally alarms the nearest obstacle from the vehicle.

3. Alarm priority condition(buzzer only)

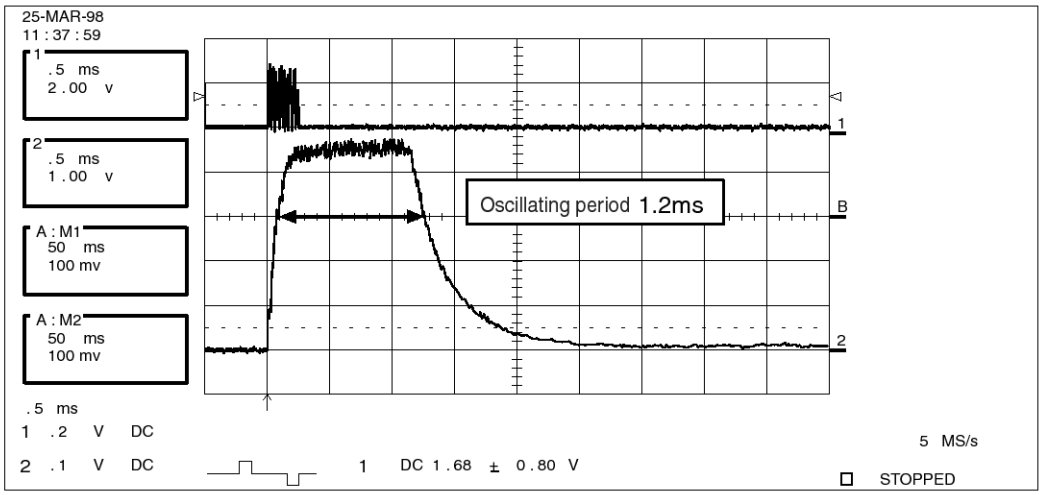
   When multiple sensors detect obstacles, the nearest one is alarmed without Division in sensors.

4. Sensor connection checking

   Transmit ultrasonic wave to the sensors, boost input signal, and detect wave.

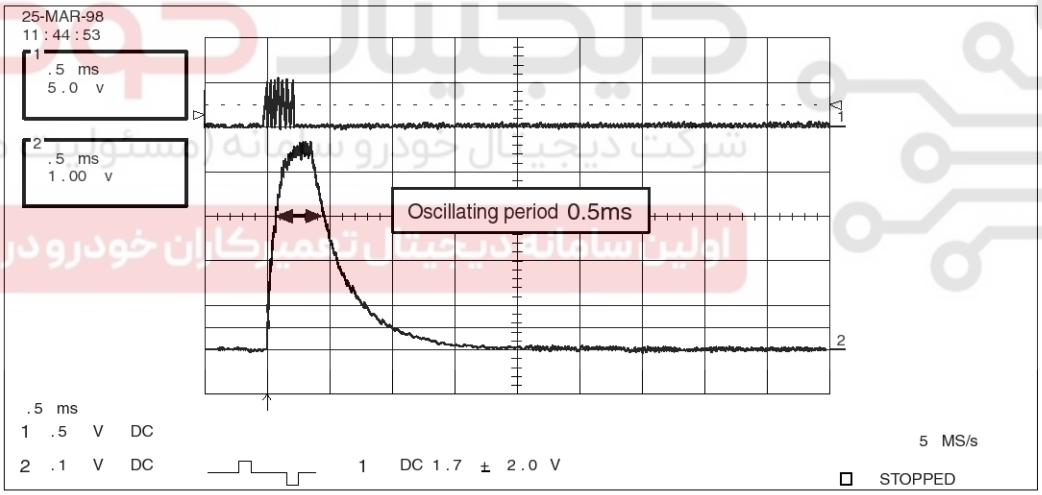
   Waveform will be found, oscillating for a certain period of time.

   1) Waveform for a normal sensor connection



BTKG230F

2) Waveform for a failed sensor connection



BTKG230G

NOTICE

Sensor connection will be checked for oscillating period of input signal 3V. If oscillating period is more than 0.8ms, it is normal.

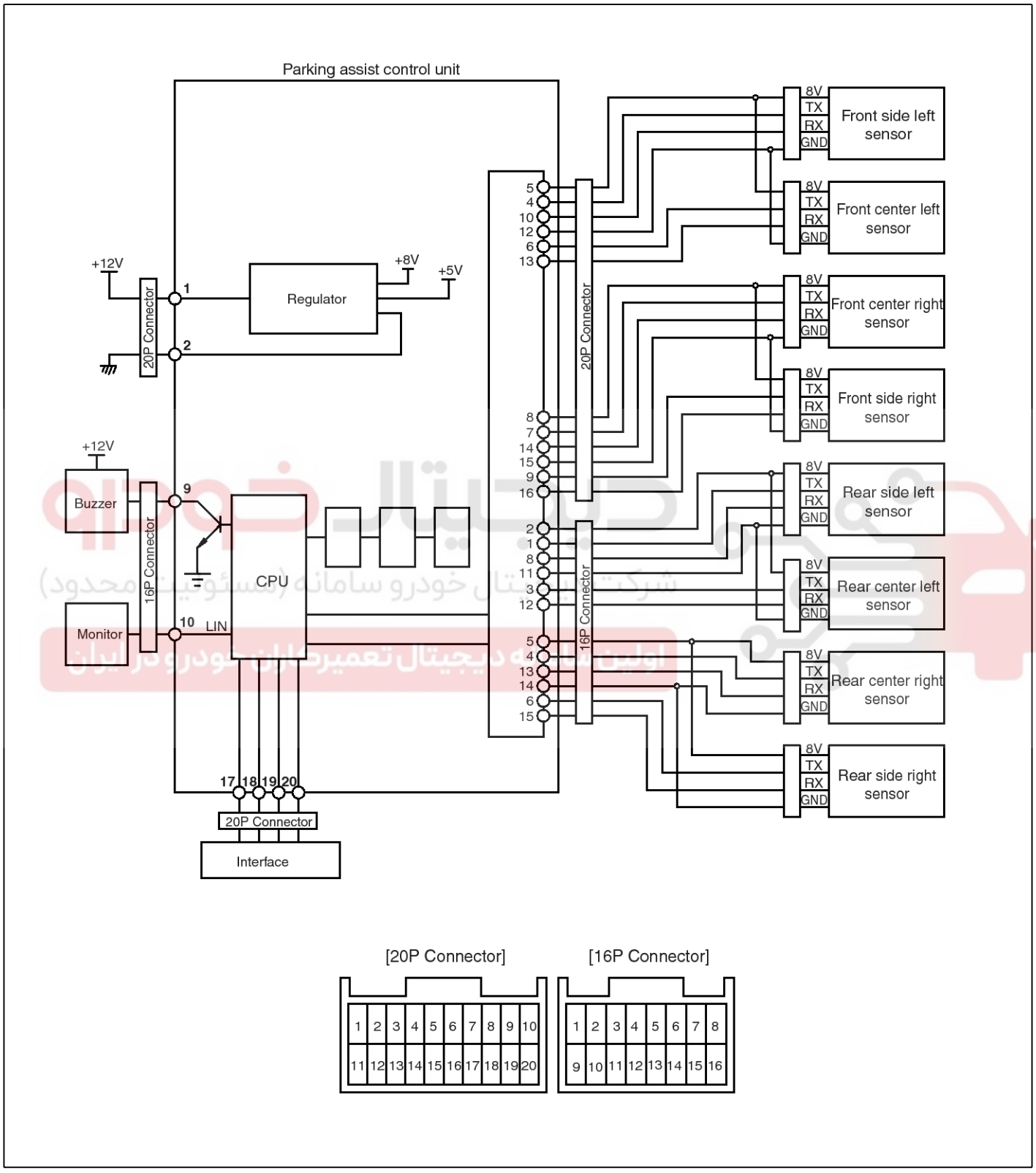
Back Warning System BE-241

SPECIFICATION

Item		Specification
Parking assist control unit	Rated voltage	DC 12V
	Operating voltage	DC 9 ~ 16V
	Operating temperature	-30°C ~ +80°C
	Operating temperature	-40°C ~ +85°C
	Operating current	600mA MAX
	Reseving frequency	48 ± 5 KHZ
	Monitoring method	The front sides - less than 10km/h The rear sides - less than 15km/h
	Alarm method	Direct & Indirect monitoring
Ultrasonic sensor	Rated voltage	DC 8V
	Operating voltage	DC 6 ~ 9V
	Operating current	100mA MAX
	Operating temperature	-30°C ~ +80°C
	Reserving temperature	-40°C ~ +85°C
	Beam width	Horizental 100°/Vertical 40°
	Operating frequency	48 ± 5KHZ
	Sensors number	8PCS (Front 4, Rear 4)
Piezo buzzer	Rated voltage	DC 12V
	Operating voltage	DC 9 ~ 16V
	Operating temperature	-30°C ~ +80°C
	Reserving temperature	-35°C ~ +85°C
	Operating current	60mA MAX
	Sound, Tone	Oscillation frequency : 2.2 ± 0.5KHZ Sound level : 70dB (DC 13V, /m)

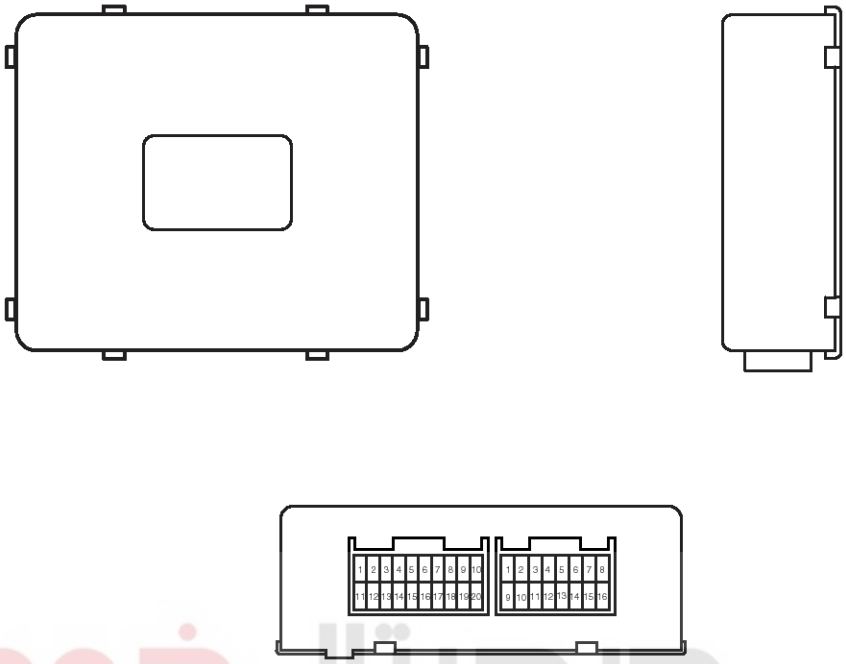
Back Warning Control unit

CIRCUIT DIAGRAM



SGHBE7140L

CONTROL UNIT TERMINAL ALIGNMENT AND INSPECTION



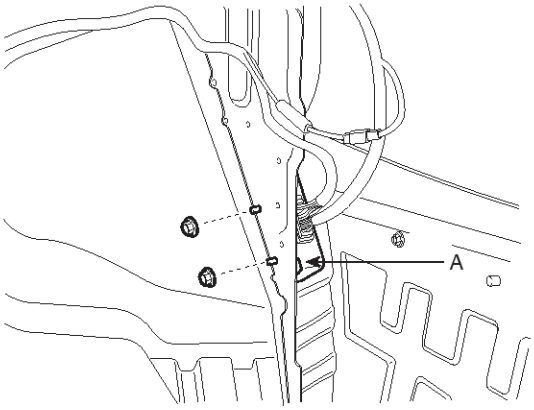
단자점검

CONNECTOR(20P)		CONNECTOR(16P)	
PIN NO.	Connector	PIN NO.	Connector
1	POWER	1	RL-TX(RL:REAR LEFT)
2	GND(MAIN)	2	RL & RCL POWER
3	-	3	RCL-TX (RCL : REAR CENTER LEFT)
4	FL-TX(FL:FRONT LEFT)	4	RCR-TX(RCR : REAR CENTER RIGHT)
5	FL & FCL POWER	5	RR & RCR POWER
6	FCL-TX(FCL:FRONT CENTER LEFT)	6	RR- TX(RR : REAR RIGHT)
7	FCR-TX(FCR:FRONT CENTER RIGHT)	7	-
8	FR & FCR POWER	8	RL-RX
9	FR-TX(FR:FRONT RIGHT)	9	BUZZER
10	FL-RX	10	LIN
11	-	11	RL & RCL GND
12	FL & FCL GND	12	RCL - RX
13	FCL-RX	13	RCR - RX
14	FCR-RX	14	RR & RCR GND
15	FR&FCR GND	15	RR - RX
16	FR-RX	16	-
17	P-RANGE		
18	R-BRAKE		
19	R-GEAR		
20	SPEED-SEN		

SGHBE7008L

REMOVAL

1. Remove the right side trim of the trunk.
2. Loosen the mounting nuts and disconnect the connector.
3. Remove the parking assist control unit(A).



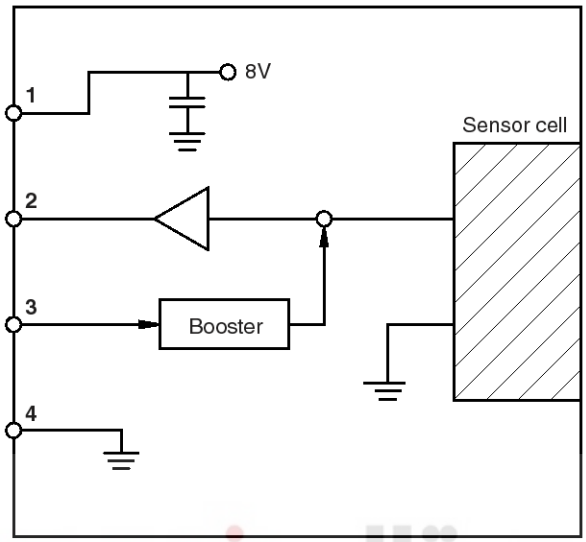
SGHBE6009D

INSTALLATION

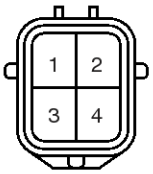
1. Reassemble the parking assist control unit.
2. Connect the connector and then reassemble the right side trim of the trunk.

Ultrasonic Sensor

CIRCUIT DIAGRAM



[Ultra sonic sensor connector]



1 : +8V
2 : RX
3 : TX
4 : GND

SGHBE7014L

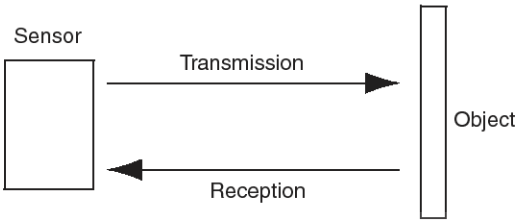
OPERATION PRINCIPLE

The sensor emits ultrasonic wave to the objects, and it measures the time until reflected wave returns, and calculates the distance to the object.

DISTANCE DETECTION TYPE

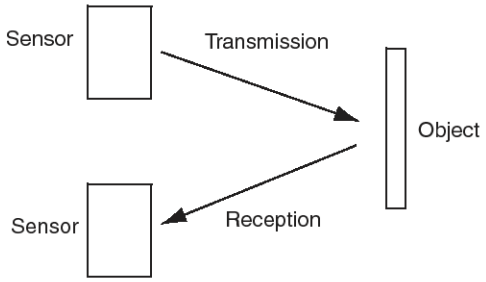
Direct detection type and indirect detection type are used together for improving effectiveness of the detection.

1. Direct detection type: One sensor transmits and receives signals to measure the distance.



ETRF762A

2. Indirect detection type: One sensor transmits signals and the other sensor receives the signals to measure the distance.



ETRF762B

MEASUREMENT PRINCIPLE

Back warning system (BWS) is a complementary device for reversing. BWS detects objects behind vehicle and provides the driver with buzzer alarm finding objects in a certain area, using ultrasonic wave propagation speed and time.

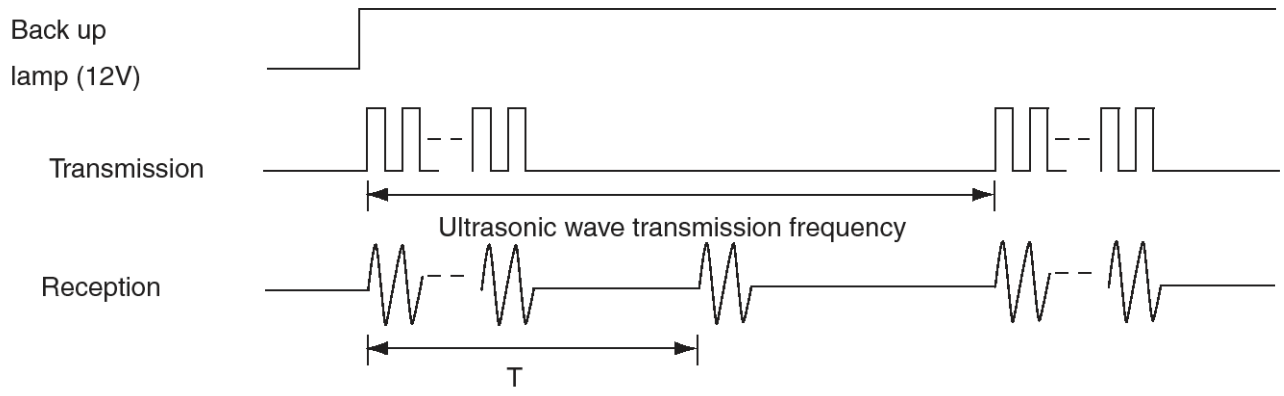
The propagation speed formula of ultrasonic wave in air is following :

$v=331.5 + 0.6t$ (m/s)

v=ultrasonic wave propagation speed

t=ambient temperature

The basic principle of distance measurement using ultrasonic wave is :



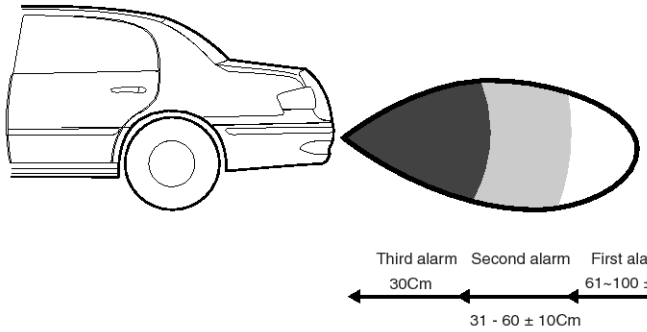
D = (T X V)/2[m]
D = Distance to object

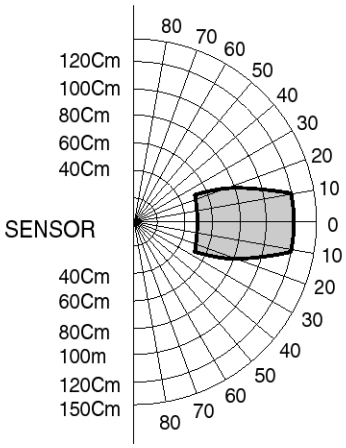
V = Ultrasonic wave speed [340m/s]
T = Ultrasonic wave propagation time

LTLG762C

Sensor detection range

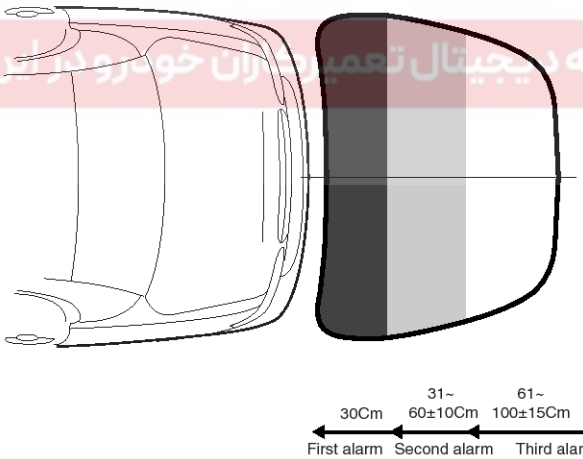
[Vertical range]

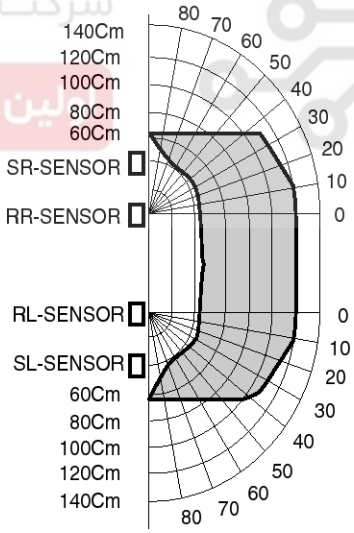




1. Distance tolerance(Messured at the front of sensor)
   - 61~100cm : ±15cm
   - 31~60cm : ±10cm
   - 30cm : ±10cm
2. Detection tolerance
   - At 30cm :30˚ ± 15˚
   - At 60cm : 15˚ ± 15˚
   - At 100cm : 10˚ ± 15˚
3. At nearer distance than 30cm detection may occur.
4. Measurement condition : Room temperature (20℃), 90mm diameter, 3m length rod.

[Horizontal range]





1. Distance tolerance(Messured at the front of sensor)
   - 61~100cm : ±15cm
   - 31~60cm : ±10cm
   - 30cm : ±10cm
2. Detection tolerance
   - At 60cm : 70˚ ± 20˚
   - At 100cm : 20˚ ± 20˚
3. At nearer distance than 30Cm detection may occur.
4. Measurement condition : Room temperature (20℃), 140mm diameter, 3m length rod.

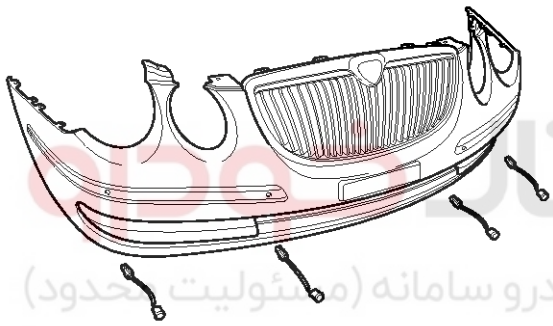
SGHBE7011L

NOTICE

1. *14cm (dia.) plastic rod is used for the test target.*
2. *The test result may differ by a different target object.*
3. *Detection range may be reduced by dirt accumulated on sensor, and extremely hot or cold weather.*
4. *The following object may not be detected.*
   - *Sharp object or thin object like rope.*
   - *Cotton sponge, snow or other materials absorbing sonic wave.*
   - *Smaller objects than 9cm (dia.), 1m length.*

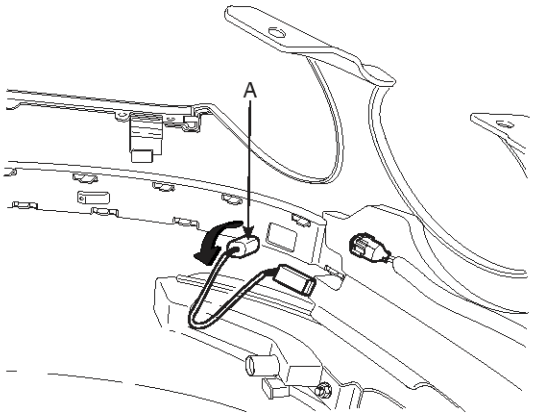
REMOVAL

1. Disconnect the negative(-) battery terminal.
2. Remove the front and rear bumper (Refer to the Body group - "Front/Rear bumper").



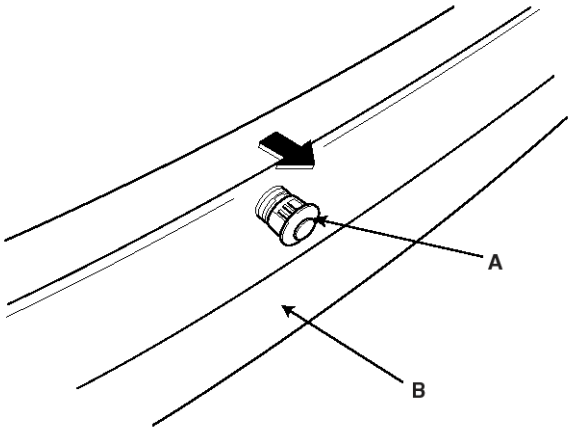
SGHBE6012D

3. Disconnect the sensor connector at the inside of the rear bumper, and then remove the ultrasonic sensor(A) from the housing.



SGHBE6013D

4. Remove the ultrasonic sensor(A) from the housing(B).



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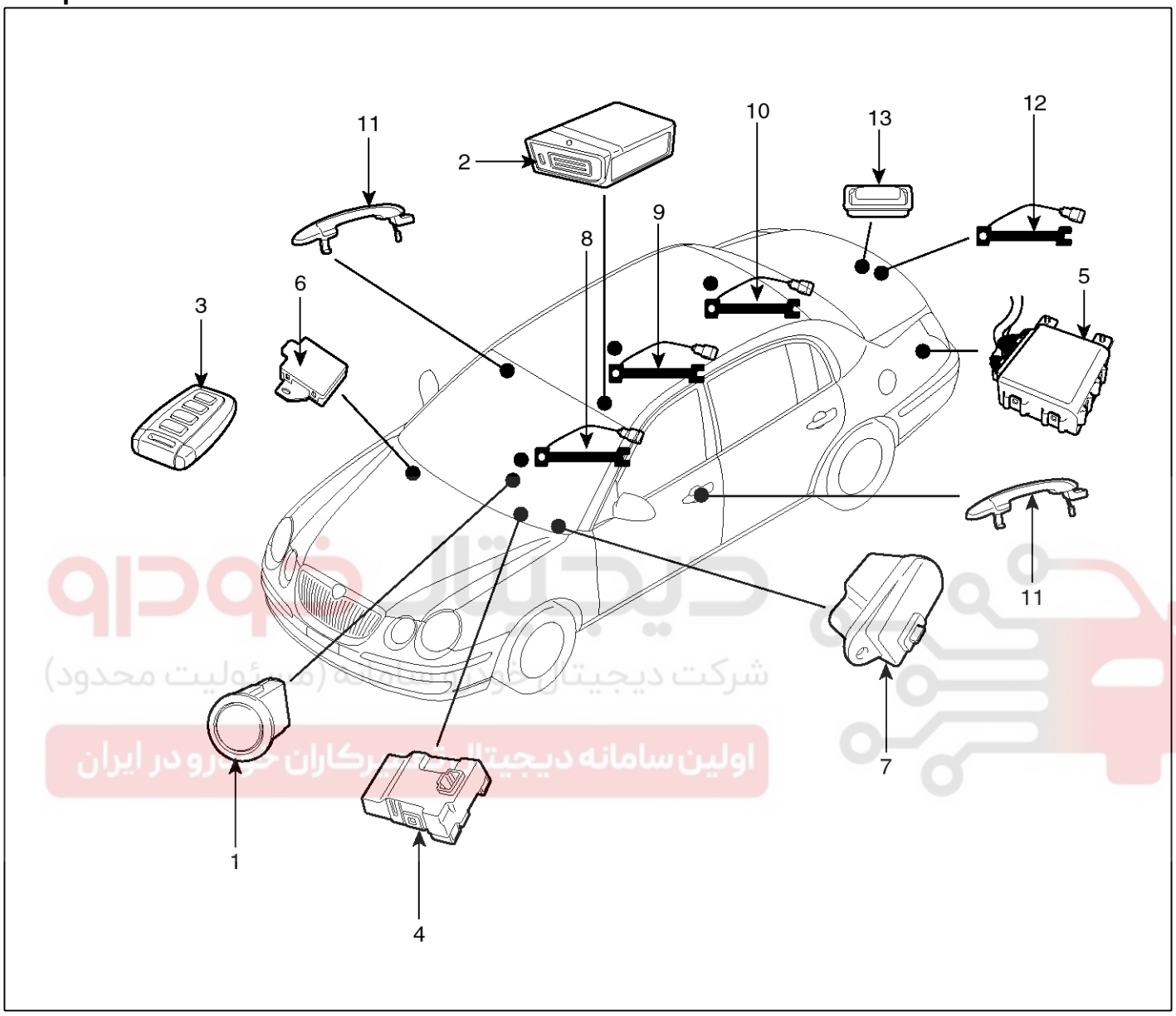
INSTALLATION

1. Reassemble the ultrasonic sensor and connect the connector.
2. Reassemble the front and rear bumper.

Button Engine Start System

Component Location

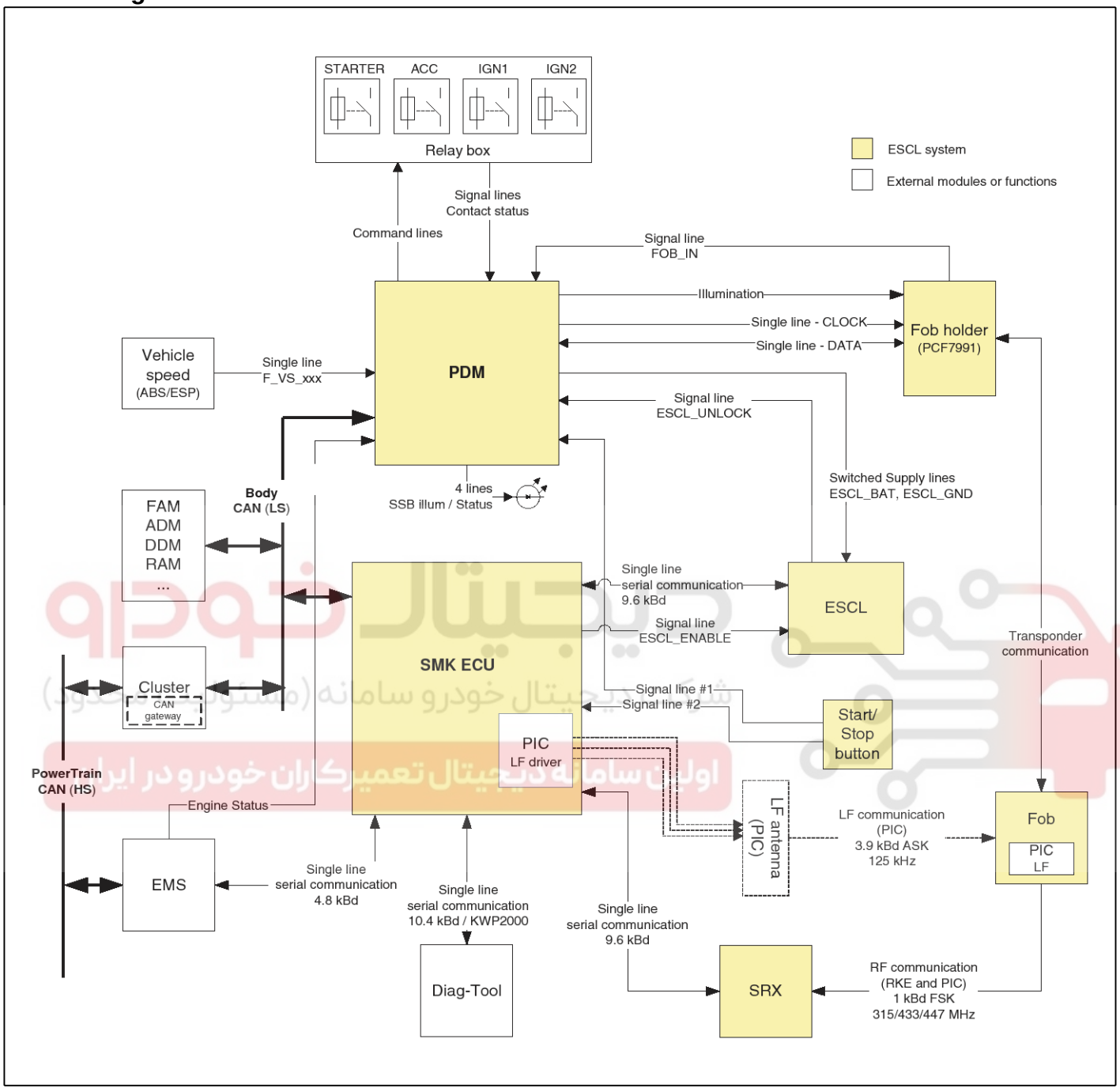


SGHBE9024D

1. Start Stop Button(SSB)
2. FOB key holder
3. FOB key
4. PDM(Power Distribution Module)
5. Smart key unit
6. RF receiver
7. ESCL(Electrical Steering Column Lock)
8. Interior antenna 1
9. Interior antenna 2
10. Interior antenna 3
11. Door handle & door antenna
12. Bumper antenna
13. Tailgate switch

Button Engine Start System BE-251

Circuit Diagram



SHMBE9001L

Description

System Overview

The System offers the following features:

- Human machine interface through a 1-stage button, for terminal switching and engine start.
- Control of external relays for ACC / IGN1 / IGN2 terminal switching and STARTER, without use of mechanical ignition switch.
- Steering column locking with an ESCL device; Monitoring of the vehicle status to insure safe activation of the ESCL.
- Indication of vehicle status through LED or explicit messages on display.
- Immobilizer function by LF transponder communication between fob and fob holder.
- Redundant architecture for high system dependability .
- Interface with Low Speed CAN vehicle communication network.
- Interface with LIN vehicle communication network depending on platform.

The RKE and SMART KEY functions are not considered part of this Button Engine Start system and are specified in separated system.

System Main Function

- Steering column locking/unlocking with ESCL.
- Switching of ACC / IGN1 / IGN2 terminals.
- Control of the STARTER relay BAT line (high side) based on communication with EMS ECU.
- Management of the Immobilizer function.
- Management of BES warning function.

Button Engine Start System

The Button Start System allows the driver to operate the vehicle by simply pressing a button (called as SSB) instead of using a standard mechanical key. It also manages the locking and the unlocking of the steering column (called as ESCL)without any specific actions by the driver.

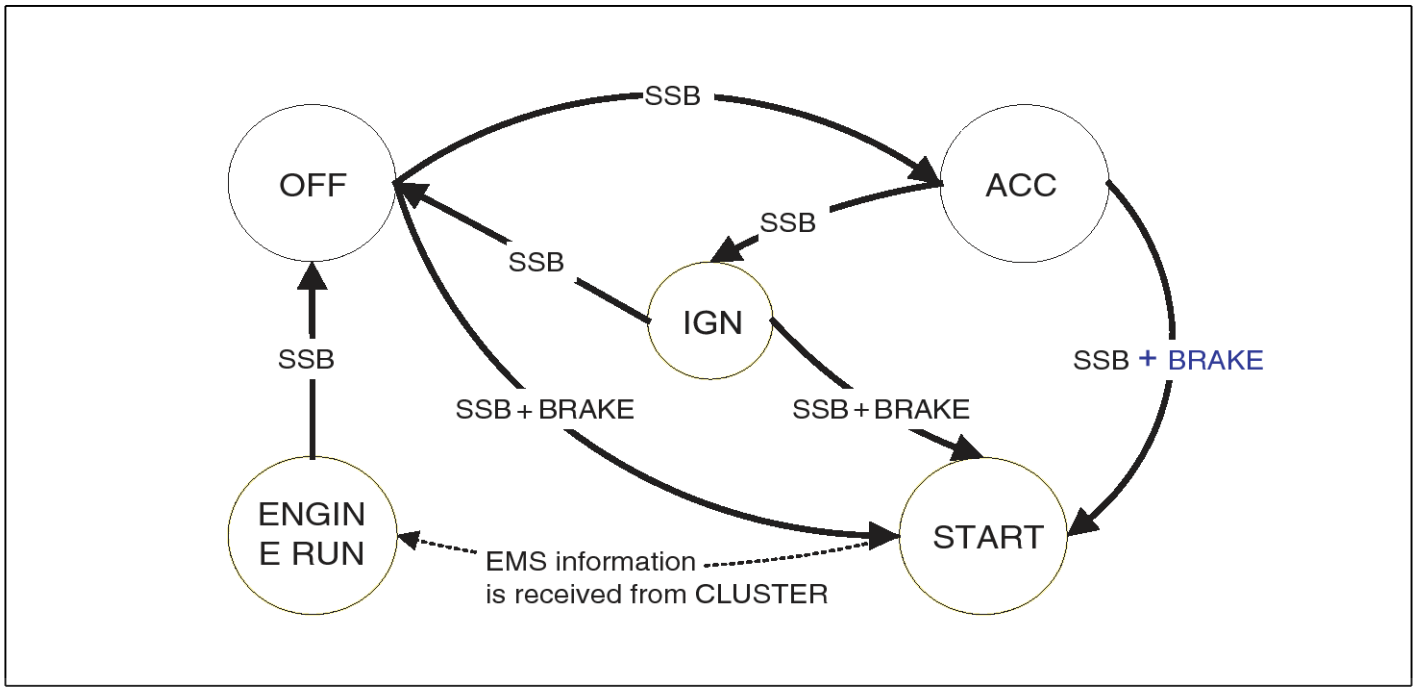
If the driver press the SSB while prerequisites on brakes, fob authentication and transmission status are satisfied, the BES System will proceed with the locking/unlocking of the steering column, the control of the terminal, and the cranking of the engine.

The driver can release the SSB as soon as this sequence initiated. After positive response from immobilizer interrogation, the system will activate the starter motor and communicate with the EMS to check the engine running status for starter release.

The driver will be able to stop the engine by a short push on the SSB if the vehicle is already in standstill. Emergency engine stop will be possible by a long press of the SSB or 3 consecutive presses in case the vehicle is in ENGINE RUNNING.

If the conditions for engine cranking are not satisfied while a push on the SSB is detected and a valid fob authenticated, the system will unlock the steering column and switch the terminals to IGN. Another push on the SSB will be necessary to start the engine.

In case of a vehicle equipped with SMART KEY system, fob authentication will not require any action from the driver. For limp home start or in case of vehicle without SMART KEY, the driver will have to insert the fob into the fob holder.



SHMBE9002L

- Control Ignition and engine ON/OFF by Sending signal to IPM and PDM.
- Display status by LED Lamp ON/OFF. (Amber or Green)

Indicator ON/OFF Condition At Ignition Key Off Condition

No.	Character lamp	Conditions
1	Indicator Lamp ON	Door open, Tail lamp ON, ACC, IG ON
2	Indicator Lamp 30sec ON → Lamp OFF	Door close, Tail lamp OFF, IG OFF
3	Indicator Lamp OFF	Remote LOCK, Passive LOCK
4	Rheostat at tail lamp ON (Illumination lamp)	

Indicator ON/OFF Condition According To Ignition Key's Position

No.	Ignition conditions	Start Button LED status
1	IG OFF	LED OFF
2	IG ACC	Amber color LED ON
3	IG ON (Engine OFF)	Green color LED ON
4	Cranking	Maintain LED status before cranking
5	Engine running	LED OFF

The shift of Ignition Position

IGN. Position	Shift Lever Position						
	P Position			N Position		Other Position (D or R)	
	Push	Brake + Push	Over 1HR	Push	Brake + Push	Push	Brake + Push
Off							
ACC.							
IG1 & 2							
Start							

Transfer possibility, after Smart key certification

Transfer possibility without Smart key certification

Transfer possibility without Smart key certification

● **Condition of stop engine while driving**

- Press 3 times button within s seconds.
- Press button more than 2 seconds

SHMBE9003L

Wireless Communication

Electromagnetic waves are used to exchange information between the vehicle and the FOB. Two types of RKE Key can supplement the BES system:

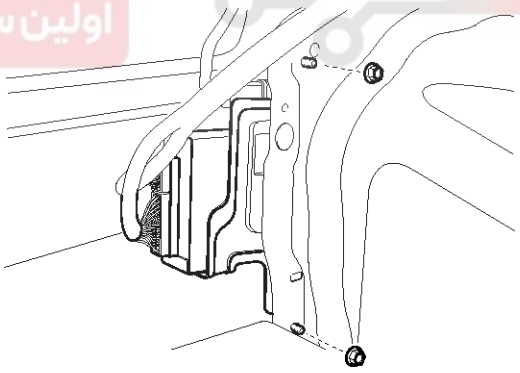
- Non-PIC RKE
- SMART KEY FOB

Currently the BES system comprises with SMART KEY FOB always.

The transmitter, receiver and antennas required for the communication between the fob and the vehicle will differ depending on functionalities and regional areas.

The RKE and SMART KEY functions are in separated documents. Refer to Smart key system for more detailed information about SMART KEY function.

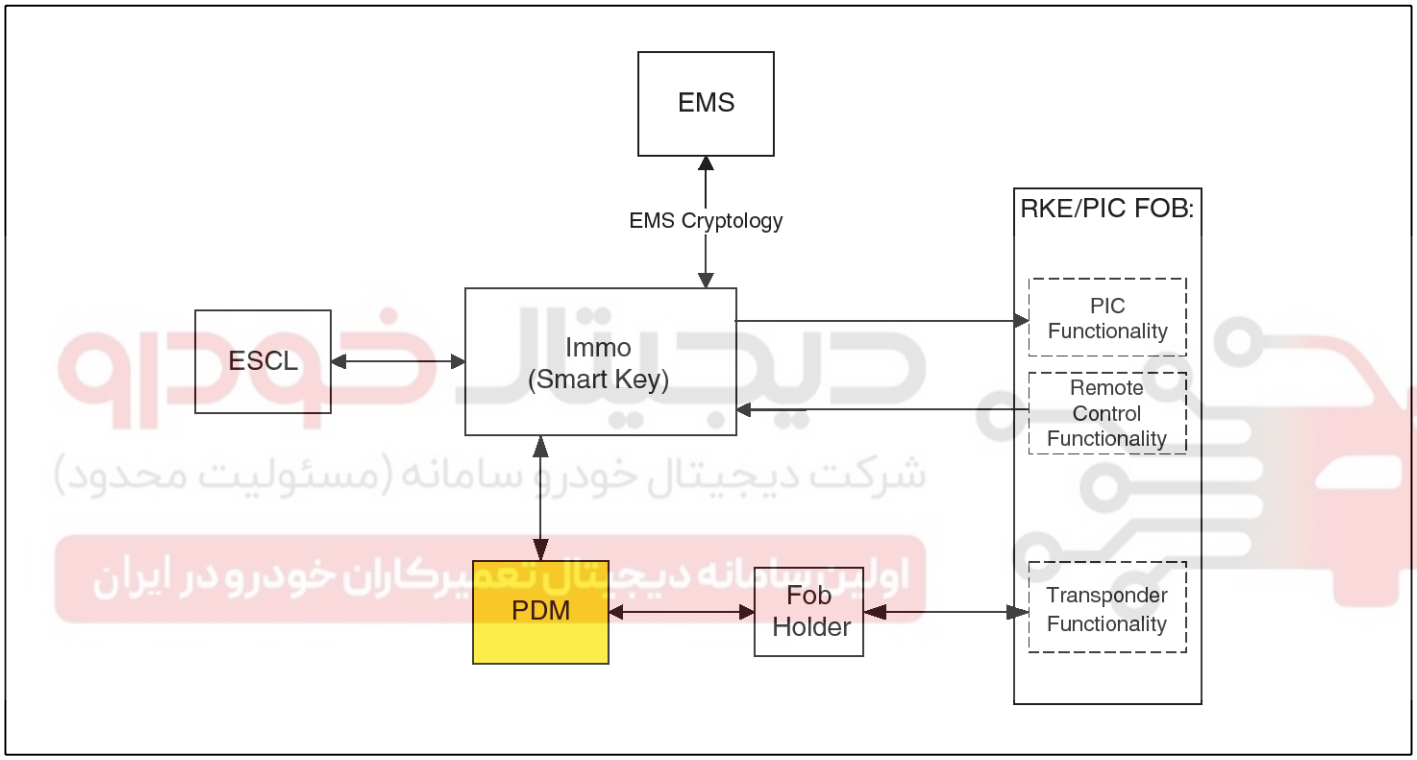
Smart Key



SGHBE9016N

The SMK manages all function related to:

- "Start Stop Button (SSB) monitoring",
- "Immobilizer communication" (with Engine Management System unit for immobilizer release),
- "ESCL control",
- "Authentication server" (Validity of Transponder and in case of Smart Key option Passive Fob authentication),
- "System consistency monitoring",
- "System diagnosis",
- Control of display message / warning buzzer.



SGHBE9017N

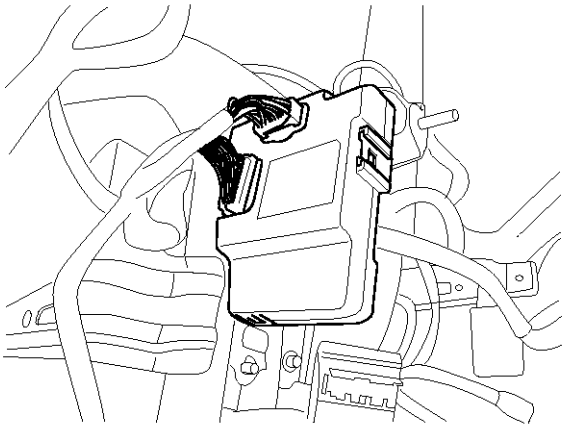
The unit behaves as Master role in the whole system.

In case of SMART KEY application, for example “Passive Access”, “Passive Locking” and “Passive Authorization are integrated for ESCL/Terminal switching Operations”.

It collects information about vehicle status from other modules (vehicle speed, alarm status, driver door open...), reads the inputs (e.g. SSB, Capacitive Sensor / Lock Button, PARK position Switch), controls the outputs (e.g. exterior and interior antennas), and communicates with others devices via the CAN network as well as a single line interfaces.

The diagnosis and learning of the components of the BES System are also handled by the SMK.

PDM



SGHBE9040D

The PDM manages the functions related to the "terminal control" by activating external relays for ACC, IGN1 and IGN2. This unit is also responsible for the control of the STARTER relay.

It controls also the power supply of the ESCL by switching the power and ground ESCL supply lines depending on vehicle status. The purpose of this function is to prevent the ESCL to be energized if ACC or IGN are switched on.

The PDM is also controlling the illumination of the SSB as well as the "system status indicator", which consists of 2 LEDs of different color. The illumination of the fob holder is also managed by the PDM.

The PDM reads the inputs (Engine fob_in, vehicle speed, relays contact status, ESCL lock status), controls the outputs (Engine relay output drivers, ESCL power), and communicates with others devices via the CAN.

The internal architecture of the PDM is defined in a way that the control of the terminal and of the ESCL power is secured even in case of failure of one of the two microcontrollers, system inconsistency or interruption of communication on the CAN network.

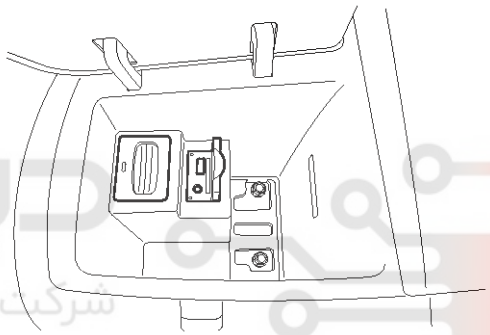
In case, failure of one of the two controllers, the remaining controller shall disable the starter relay and the ESCL power supply. The IGN1 and IGN2 terminals relays shall be maintained in the state memorized before the failure and the driver shall be able to switch those IGN terminals off by pressing the SSB with EMERGENCY_STOP pressing sequence. However, engine restart will not be allowed. The state of the ACC relay will depend on the type of failure.

The PDM is diagnosed through theSMK MUT service, using the CAN network.

The main functions of the PDM are:

- Control of Terminal relays
- Monitoring of the Vehicle speed received from sensor or ABS/ESP ECU.
- Control of SSB LEDs (illumination, clamp state) and FOB HOLDER illumination.
- Control of ESCL power lines and monitoring of the ESCL unlock status
- Control of the base station located in fob holder through direct serial interface.
- System consistency monitoring to diagnose SMK failure and to switch to relevant limp home mode.
- Providing vehicle speed information

Fob Holder



SGHBE9018N

This unit is used for transponder authentication. In case of a vehicle equipped with Smart key, this transponder authentication is necessary in case of failure of the passive fob authentication (Engine loss of RF or LF link with the fob).

The Fob holder module integrates a slot where to insert the fob. The fob is maintained in position with a push-push mechanical locking (not electrically driven) and a signal (FOB_IN) is sent back to the PDM as soon as its insertion is detected.

The power supply of the fob holder is active only if a communication is initiated by the PDM.

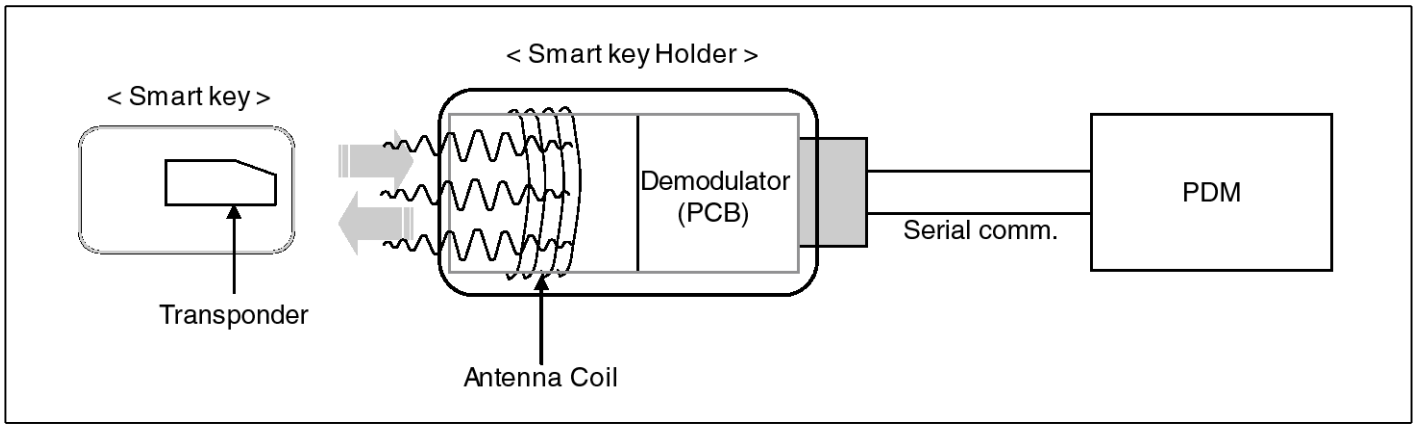
The insertion of the fob into the holder and the communication with the transponder should be possible regardless of the insertion direction of fob to the holder (buttons facing up or bottom).

A lighting device is also integrated for illumination of the Fob Holder and it is driven directly by the PDM,

The main functions of the Fob holder are:

- Transponder base station
- Fob mechanical lock
- Illumination

Transponder



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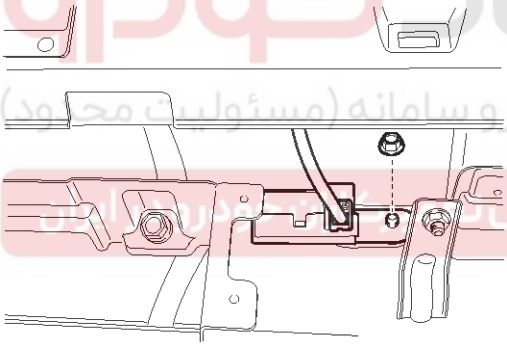
External Receiver(SRX)



SGHBE9019N

The data transmitted by the RKE or Smart key Fob is received by an external RF receiver called as SRX. This receiver will be same as that one for the SMK applications, with respect to electronics, housing, connector and software.

This receiver is connected to the SMK via a serial communication line.

Terminal And Starter Relays

Relays will be used to switch the terminals ACC / IGN1 / IGN2. Those normally-open relays will be driven by the PDM and located either in the passenger or engine compartment depending on the vehicle architecture.

Only one relay coil is connected to the terminal outputs of the PDM.

Those relays should integrate a resistor connected in parallel to the coil in order to reduce the transients during commutation.

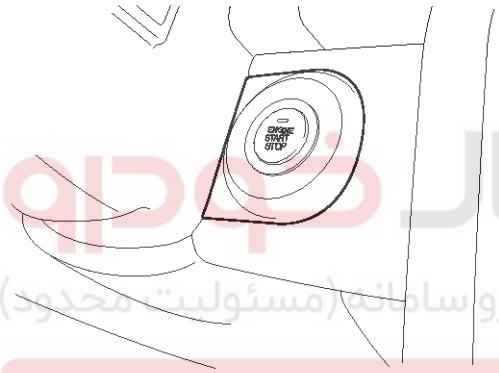
Start/Stop Button(SSB)

A single stage push button is used for the driver to operate the vehicle. Pressing this button allows:

- To activate the power modes ‘Off’, ’Accessory’, ‘Ignition’ and 'Start' by switching the corresponding terminals
- To start the engine
- To stop the engine

The contact will be insured by a micro-switch and a backlighting is provided to highlight the marking of the button whenever necessary.

Two (2) LED colors are located in the center of the button to display of the status of the system. Another illumination LED is also integrated into the SSB for the lighting of the "Engine Start/Stop" characters.

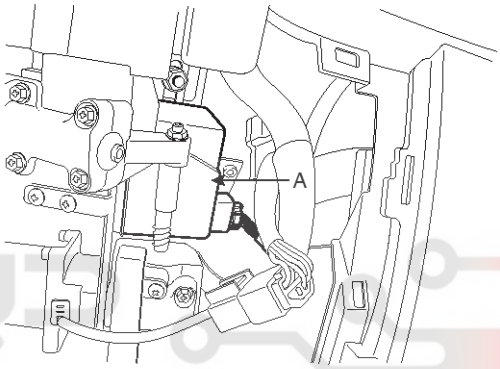


SGHBE9020N

Electronic Steering Column Lock (ESCL)

The ESCL(A) is needed to lock the steering column in order to prevent unauthorized usage of the vehicle. In order to achieve the required safety integrity level, the ESCL is controlled and monitored by 2 independent units, the SMK and the PDM. Such redundant architecture guarantees that the ESCL motor is supplied only during locking/unlocking operation and that it is disconnected from the battery and ground lines otherwise to avoid unexpected operation while the vehicle is in motion.

Data are exchanged between the ESCL and SMK through an encrypted serial communication interface.



SGHBE9021N

Bes System State Chart

System STATES in LEARNT MODE

In learnt mode, the BES System can be set in 6 different sates, depending on the status of the terminals, ESCL and Engine status:

System State	Terminal Status	ESCL Status	Engine status
1. OFF - Locked	OFF	Locked	Stopped
2. OFF - Unlocked	OFF	Unlocked	Stopped
3. ACC	ACC	Unlocked	Stopped
4. IGN	IGN1, IGN2, ACC	Unlocked	Stopped
5. Start	IGN1, Start	Unlocked	Cranking
6. IGN - Engine	IGN1, IGN2, ACC	Unlocked	Running
			(means "self-running")

Referring to the terminals, the system states described in the table above are same as those one found in a system based on a mechanical ignition switch.

The one of distinction with Mechanical-Ignition-Switch based system is that the BES system allows specific transition from [OFF] to [START] without going through [ACC] and [IGN] states.

System STATES IN VIRGIN MODE

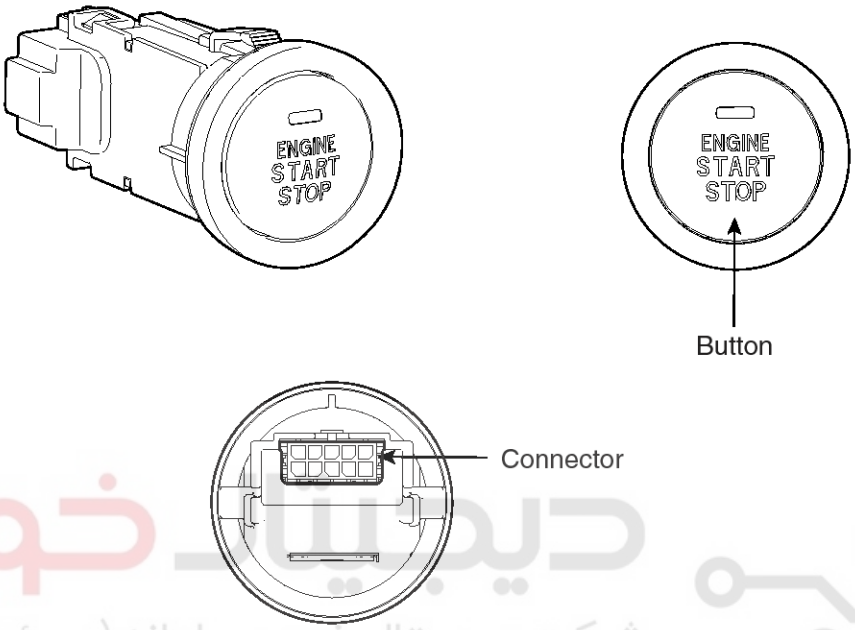
The BES System can be set in 5 different states (OFF LOCKED is not available in virgin mode), depending on the status of the terminals, ESCL and Engine status:

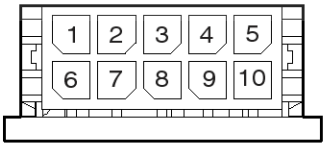
System State	Terminal Status	ESCL Status	Engine status
1. OFF - UNLOCKED	OFF	Unlocked	Stopped
2. ACC	ACC	Unlocked	Stopped
3. IGN	IGN1, IGN2, ACC	Unlocked	Stopped
4. Start	IGN1, START with special p-attern of activation see Chap 6.2.1 for details	Unlocked	Cranking
5. IGN - Engine	IGN1, IGN2, ACC	Unlocked	Running
			(means "self-running")

Referring to the terminals, the system states described in the table above are same as those one found in a system based on a mechanical ignition switch. The one of distinction with Mechanical-Ignition-Switch based system is that the BES system allows specific transition from [OFF] to [START] without going through [ACC] and [IGN] states.

Start/Stop Button

Component

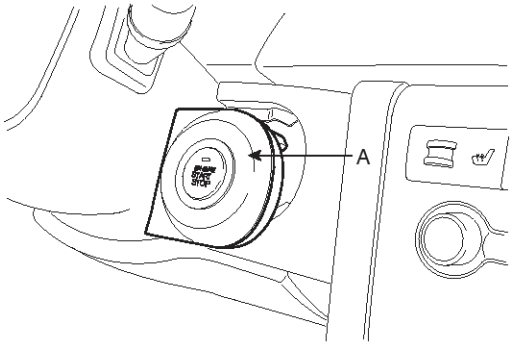


Connector (10 pins)			
Pin No.	Description	Pin No.	Description
1	Start/Stop button switch1(PDM)	6	Battery
2	Battery illumination	7	Start/Stop button switch2(SMK)
3	Start/Stop button LED Amber(PDM)	8	Start/Stop button LED Green(PDM)
4	Start/Stop button illum. GND(PDM)	9	Rheostat
5	Start/Stop button illum. power	10	-

SGHBE9022N

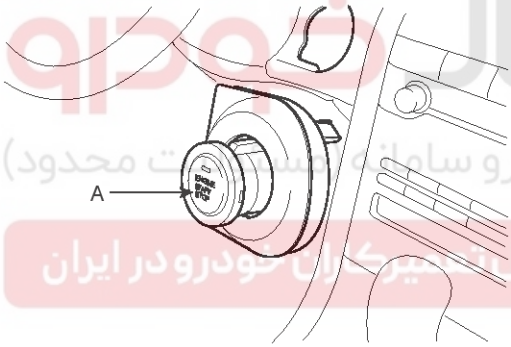
Removal

1. Disconnect the negative(-) battery terminal.
2. Remove the switch cover (A).



SGHBE9023N

3. Remove the start/stop button switch (A).



SGHBE9024N

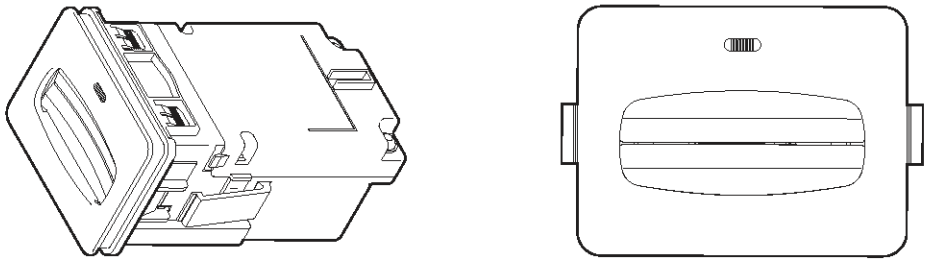
4. Disconnect the connector.

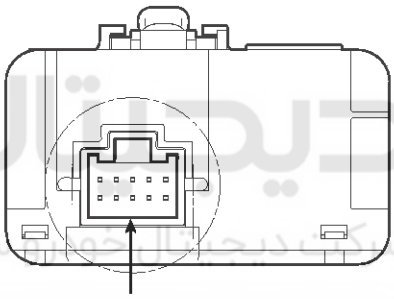
Installation

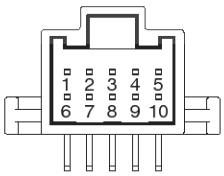
1. Install the start/stop button.
2. Install the start/stop button cover.
3. Install the crash pad lower panel.

Fob Holder

Component



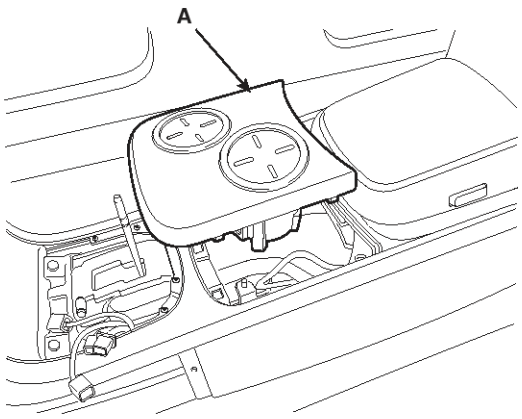


Connector (10 pins)			
Pin No.	Description	Pin No.	Description
1	-	6	Battery
2	Immobilizer clock	7	Immobilizer data
3	Holder illumination(PDM)	8	Illumination battery
4	-	9	Fob in (PDM)
5	GND	10	-

SGHBE9025N

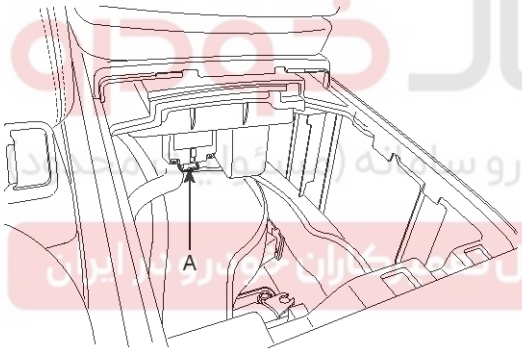
Removal

1. Disconnect the negative(-) battery terminal.
2. Remove the console upper cover (A).



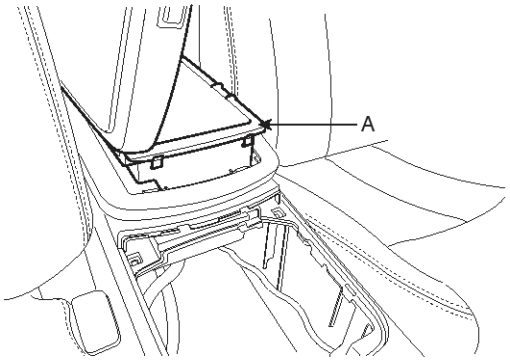
SGHBD6008D

3. Disconnect the fob holder connector (A).



SGHBE9026N

4. Remove the storage box (A) after loosening the screws.

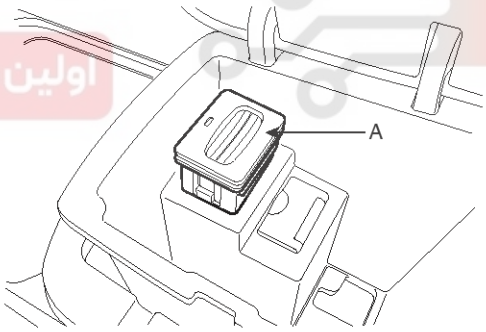


SGHBE9027N

NOTICE

- *Be careful not to damage Aux jack assembly and connector.*
- *When removing storage box, remove it after disconnecting the Aux jack and fob holder connector.*

5. Remove the Fob holder assembly (A).



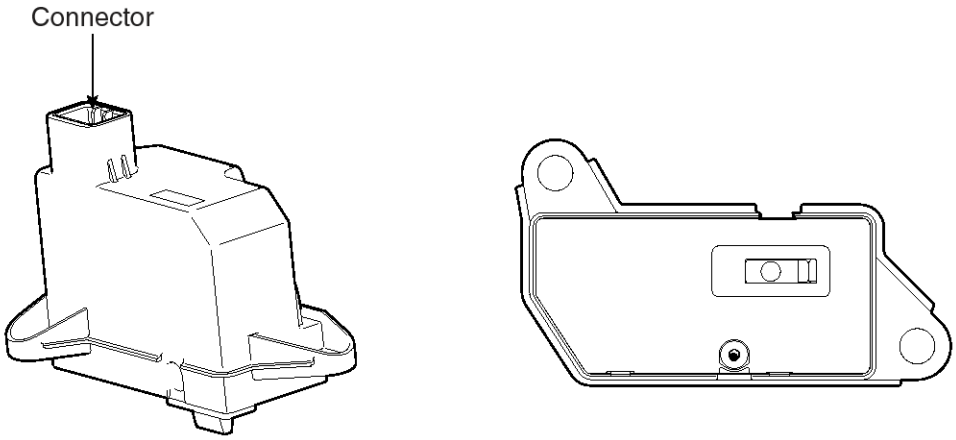
SGHBE9028N

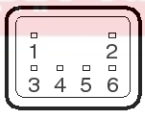
Installation

1. Install the fob hoder assembly.
2. Install the storage box.
3. Install the console upper cover.

ESCL(Electronic Steering Column Lock)

Component





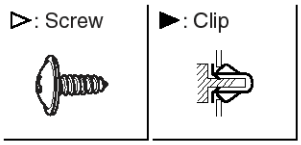
Connector (6 pins)

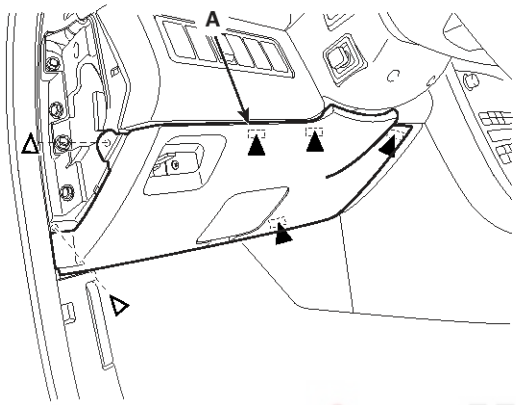
Pin No.	Description
1	-
2	Ground
3	Power(12V)
4	ESCL-Enable (Lock)
5	ESCL- Unlock
6	Data line

SHMBE9008L

Removal

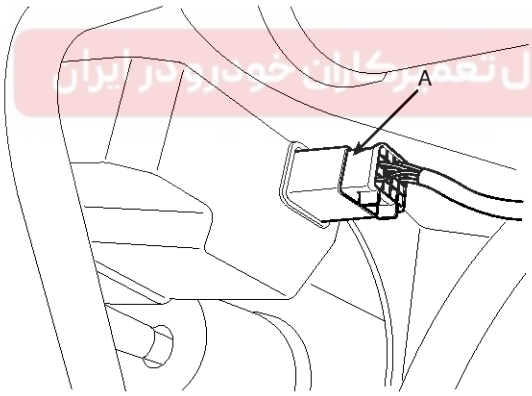
1. Disconnect the negative(-) battery terminal.
2. Remove the crash pad lower panel(A).
   (Refer to Body group-"Crash pad")





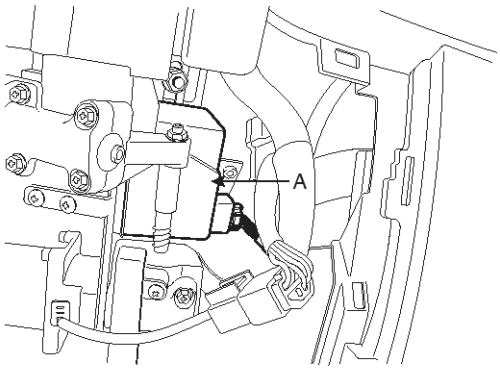
SGHBE9031N

3. Disconnect the electronic steering column lock connector(A).



SHMB18005D

4. Remove the electronic steering column lock(A).
   (Refer to Steering system - "Steering column and shaft")



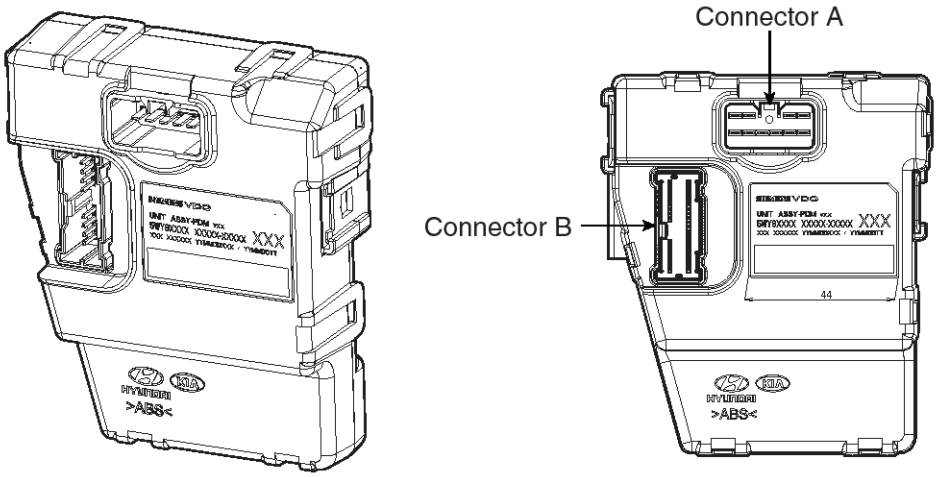
SGHBE9021N

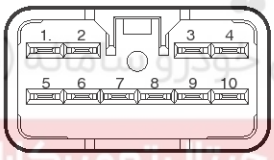
Installation

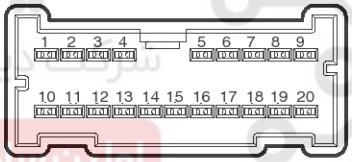
1. Install the electronic steering column lock.
2. Install the crash pad lower panel.

PDM(Power Distribution Module)

Component



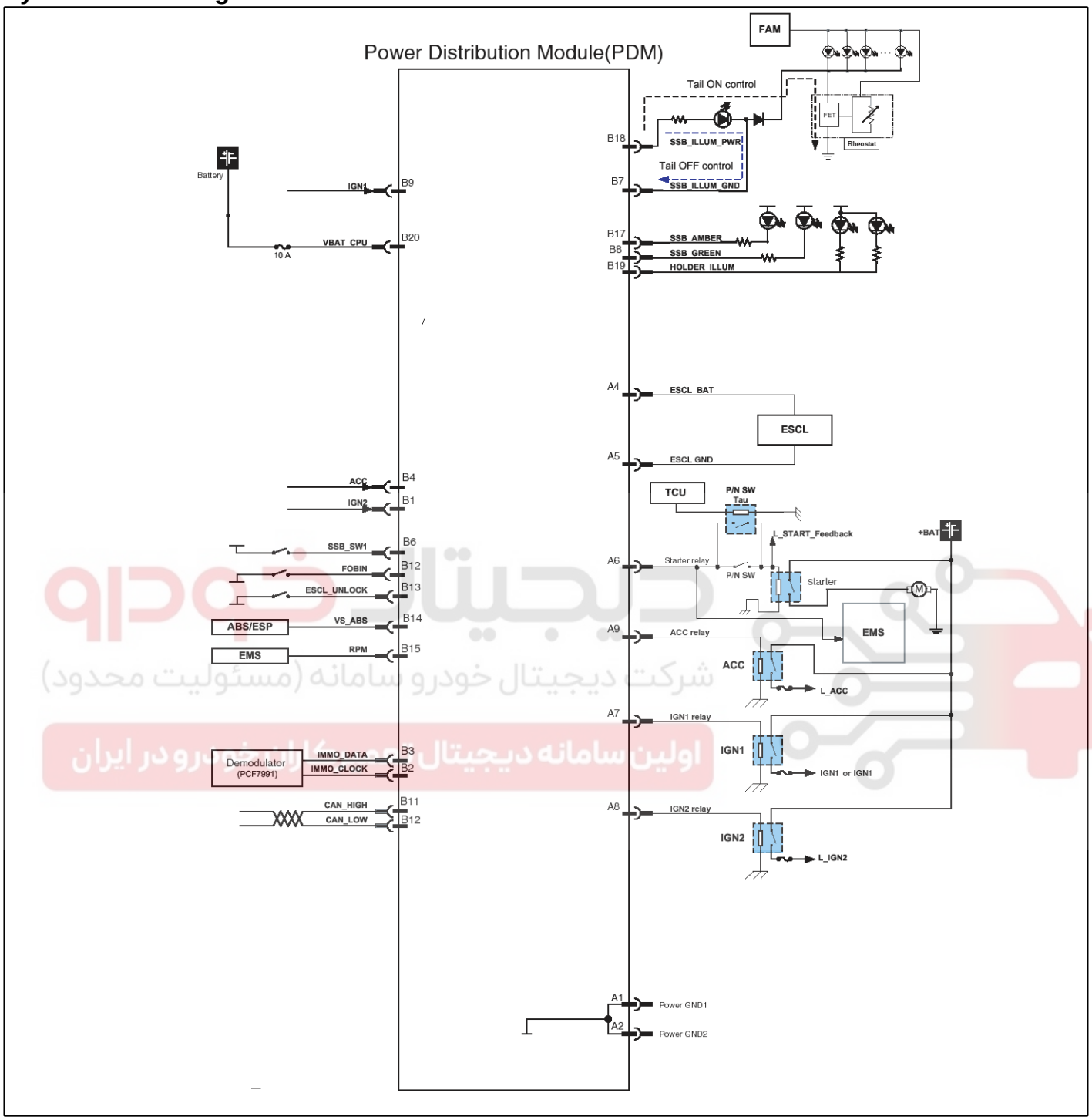




Pin No.	Connector A (10 pin)	Connector B (20 pin)
1	Power ground 1	IGN2
2	Power ground 2	Immobilizer clock
3	-	Immobilizer data
4	ESCL battery	ACC
5	ESCL ground	-
6	Starter relay	SSB switch1
7	IGN1 relay	SSB illumination ground
8	IGN2 relay	SSB LED green
9	ACC relay	IGN1
10	Battery load	CAN L
11		CAN H
12		Fob in
13		ESCL unlock
14		Vehicle speed/ ABS
15		Start EMS
16		-
17		SSB LED amber
18		SSB illumination power
19		Holder illumination
20		CPU battery

SHMBE9009L

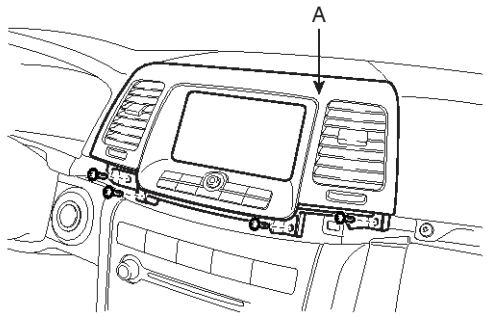
System circuit diagram



SHMBE9010L

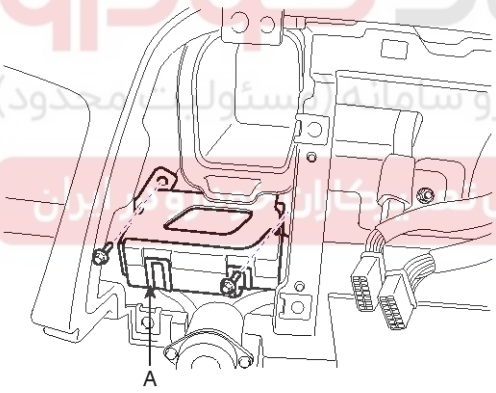
Removal

1. Disconnect the negative(-) battery terminal.
2. Remove the audio monitor and air vent (A).
   (Refer to Body group-"Audio system")



SGHBE9029N

3. Remove the power distribution module (A) after loosening bolts.



SGHBE9030N

4. Disconnect the PDM connector.

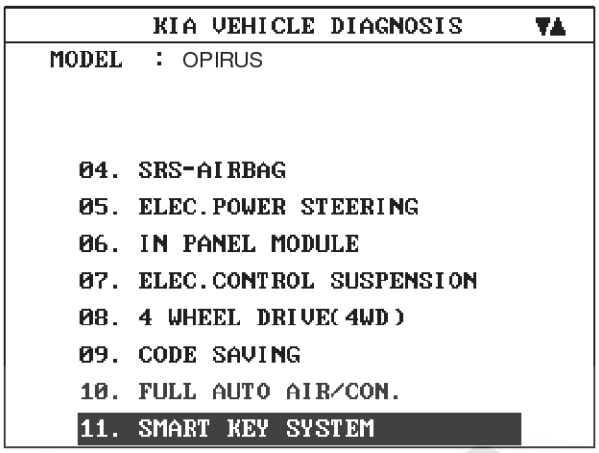
Installation

1. Install the power distribution module.
2. Install the audio monitor and air vent.

Inspection

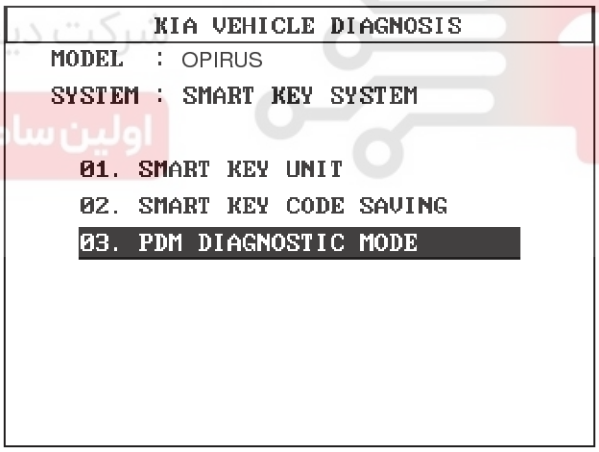
PDM Diagnosis With Scan Tool

1. It will be able to diagnose defects of Smart key with scan tool quickly. Scan tool can operates actuator forcefully, input/output value monitoring and self diagnosis.
2. Select model and "Smart key system(Button start)" menu if you want to check PDM.



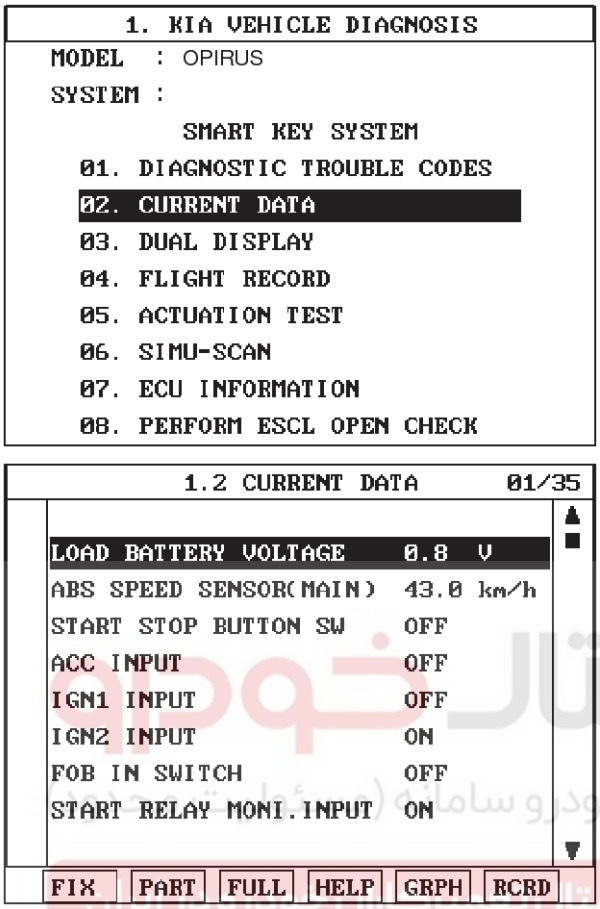
SGHBE9005L

3. Select "PDM" in the manu.



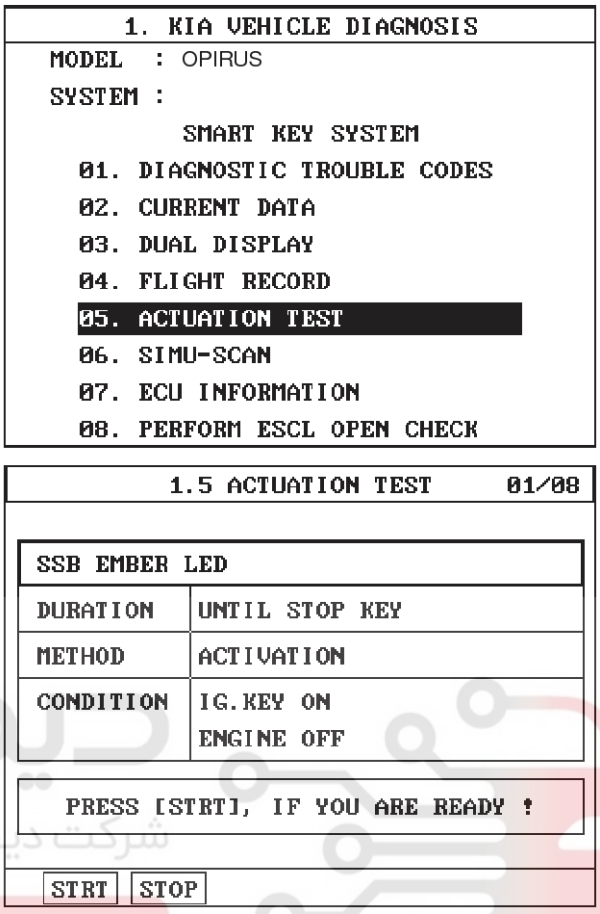
SGHBE9006L

4. Select "Current data", if you want to check current data of PDM. It provides the input/output status of each module.



SGHBE9007L

5. If you want to check PDM data operation forcefully, select "Actuation test".



SGHBE9008L

BE-270 Body Electrical System

DTC code list

No.	DTC CODE	Description
1	B1987	Sub micom Failed
2	B1602	CAN ERR
3	B1603	CAN Communication Bus Off
4	B1988	ESCL BAT Short To BAT
5	B1989	ESCL GND Short To BAT
6	B1990	ESCL BAT Short To GND
7	B1991	IMMO TX Short To GND

Input/Output current data

No.	Description	Unit
1	Load Battery Voltage	V
2	Abs Speed Sensor(main)	Km/h
3	Start Stop Button SW	Off/On
4	ACC input	Off/On
5	IGN1 Input	Off/On
6	IGN2 Input	Off/On
7	Fob In Switch	Release/Insert
8	Start Relay Monitoring Input	
9	SSB Ember LED Output	Off/On
10	SSB Green LED Output	Off/On
11	Fob Holder Illumination Output	Off/On
12	SSB Illumination Output	Off/On
13	ACC Relay Output	Off/On
14	IGN1 Relay Output	Off/On
15	IGN2 Relay Output	Off/On
16	Start Relay S1 Output	Off/On
17	ESCL Battery Output	Off/On
18	ESCL GND Output	Off/On
19	CPU Battery Voltage	V
20	Engine Speed	Data*1.0
21	ACC Relay SCB	Off/On
22	IGN1 Relay SCB	Off/On
23	IGN2 Relay SCB	Off/On
24	Start Relay SCB	Off/On
25	SCC Relay Open	Off/On

26	IGN1 Relay Open	Off/On
27	IGN2 Relay Open	Off/On
28	ACC Output SCB	Off/On
29	IGN1 Output SCB	Off/On
30	IGN2 Output SCB	Off/On
31	Start Output SCB	Off/On
32	ACC Output SCG	Off/On
33	IGN1 Output SCG	Off/On
34	IGN2 Output SCG	Off/On
35	Start Output SCG	Off/On

Actuator List

No.	Description
1	SSB Ember LED
2	SSB Green LED
3	FOB Holder Illumination
4	SSB Illumination
5	ACC Output
6	ING1 Output
7	ING2 Output
8	START Output
9	Perform Escl Open Check

Troubleshooting

PDM DTC List

NO	DTC code	Spec Discription
1	B1602	CAN Error
2	B1603	CAN Bus Off
3	B1987	Sub Micom Failed
4	B1988	ESCL Battery Short Circuit To Battery
5	B1989	ESCL Ground Short Circuit To Battery
6	B1990	ESCL Battery Short Circuit To Ground
7	B1991	Immobilizer TX Short Circuit To Ground

B1602 CAN Error

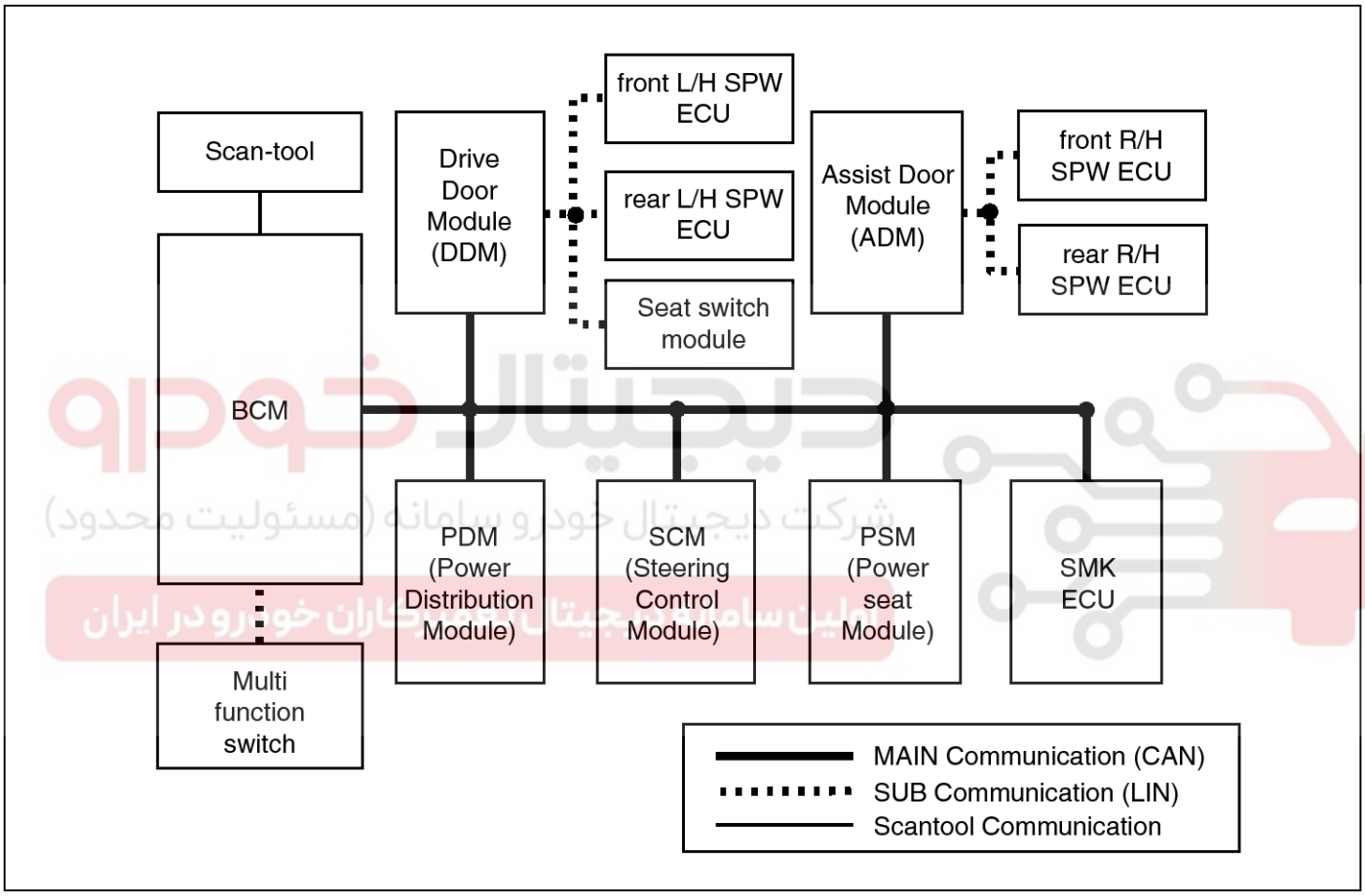
General Description

This is DTC which is related with communication error between BCM and other units.

(※ Control Units : BCM (Body Control Module), PDM(Power Distribution Module), DDM(Drive Door Module), ADM(Assist Door Module), PSM(Power Seat Module), SCM(Steering Control Module), SMK(Smart Key) ECU.

*1 CAN (Controller Area Network) : CAN is serial bus communication type which links not only communication system but also control units each other.

*2 LIN (Local Interconnect Network) : LIN is serial communication type which is used in electrical control system. (This is less expensive.)



SGHBE9501L

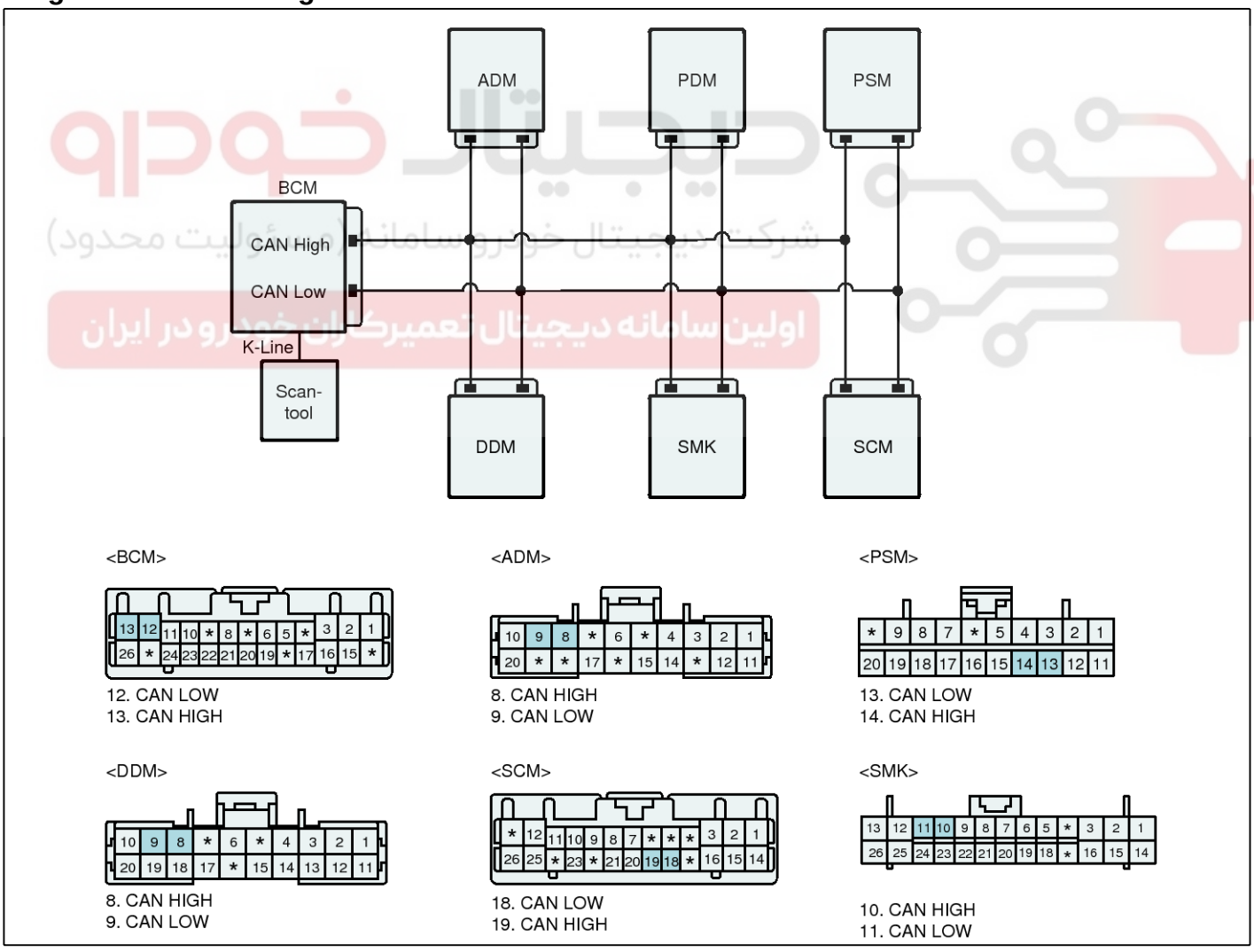
DTC Description

Pattern	Status	
1	Open in CAN High circuit	Communication is normal but DTC set if BCM detects 7 error status as follows. ① Short to battery in CAN High circuit ② Short to ground in CAN High circuit ③ Short to battery in CAN Low circuit ④ Short to ground in CAN Low circuit ⑤ Short between CAN High and Low circuit ⑥ Open or Poor connection in CAN Low circuit ⑦ Open or Poor connection in CAN High circuit
2	Open in CAN Low circuit	
3	Short to battery in CAN High circuit	
4	Short to battery in CAN Low circuit	
5	Short to ground in CAN High circuit	
6	Short to ground in CAN Low circuit	
7	Short between CAN High and Low circuit	

DTC Detecting Condition

Item	Detecting Condition			Possible Cause
DTC Strategy	• CAN communication status			• Short to battery / ground in CAN high circuit • Short to battery / ground in CAN low circuit • Short between CAN high and CAN low circuit • Open or poor connection in CAN high and low circuit • Faulty IPM
Enable Conditions	• IG "ON" • Engine "START" • B/T voltage engerzied to BCM			
Threshold Value	CAN high	0 V	Short to ground	
		B+ V	Short to battery	
	CAN low	0 V	Short to ground	
		B+ V	Short to battery	
Diagnostic Time	• Failure has been continued for 2sec.			
DTC Erasing Time	• DTC is erased immediately after trouble fixed (In case of the past error, perform DTC erasing procedure.)			

Diagnostic Circuit Diagram



SGHBE9521L

Signal Waveform & Data

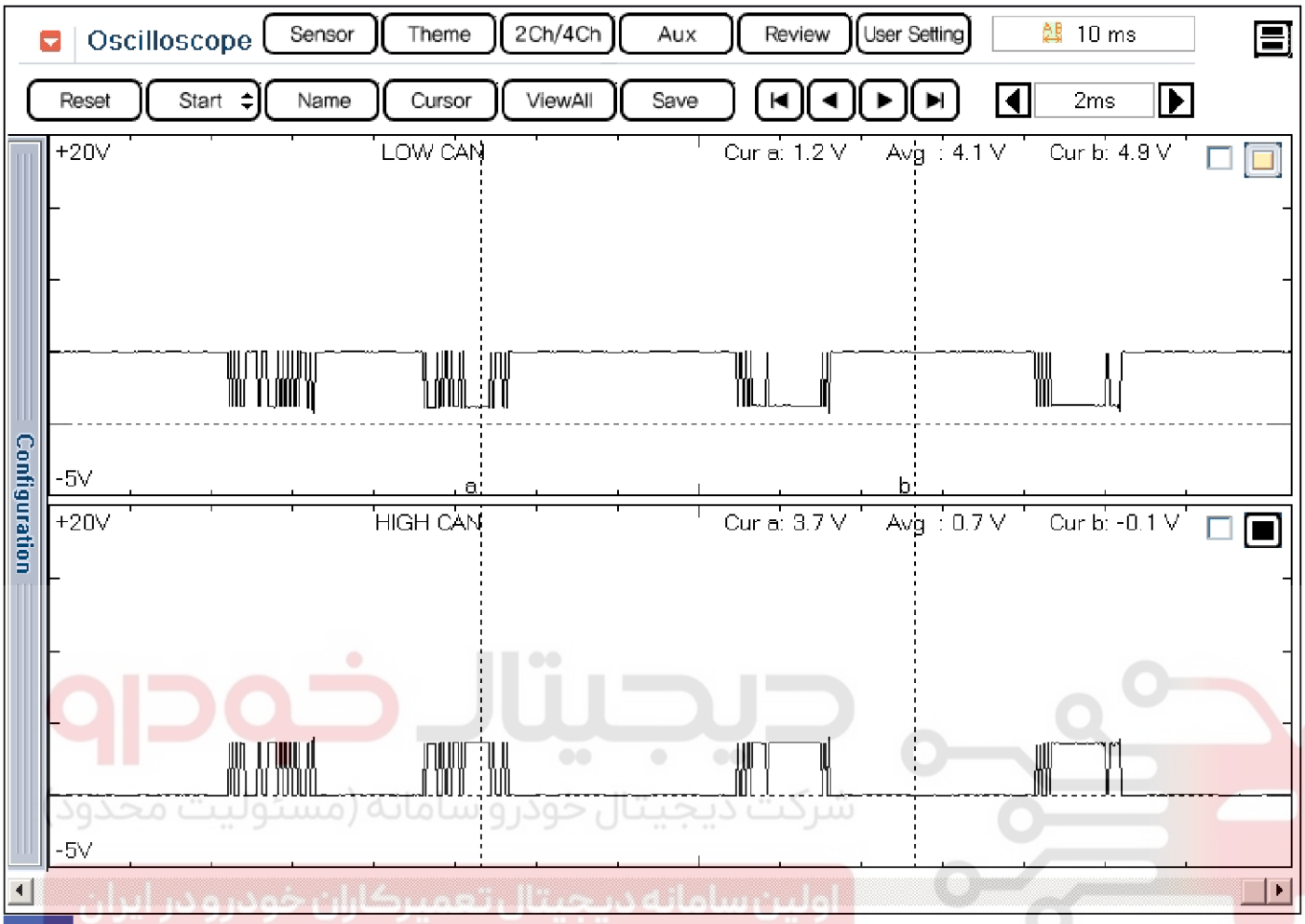


FIG.1

SGHBE9502L

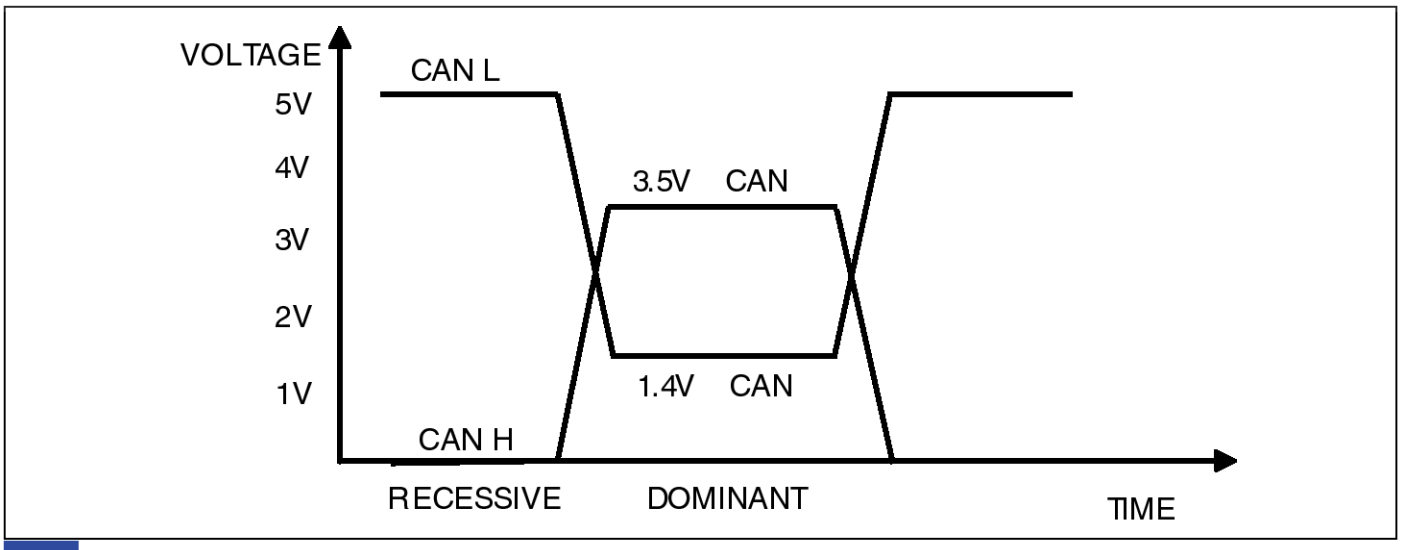


FIG.2

SGHBE9503L

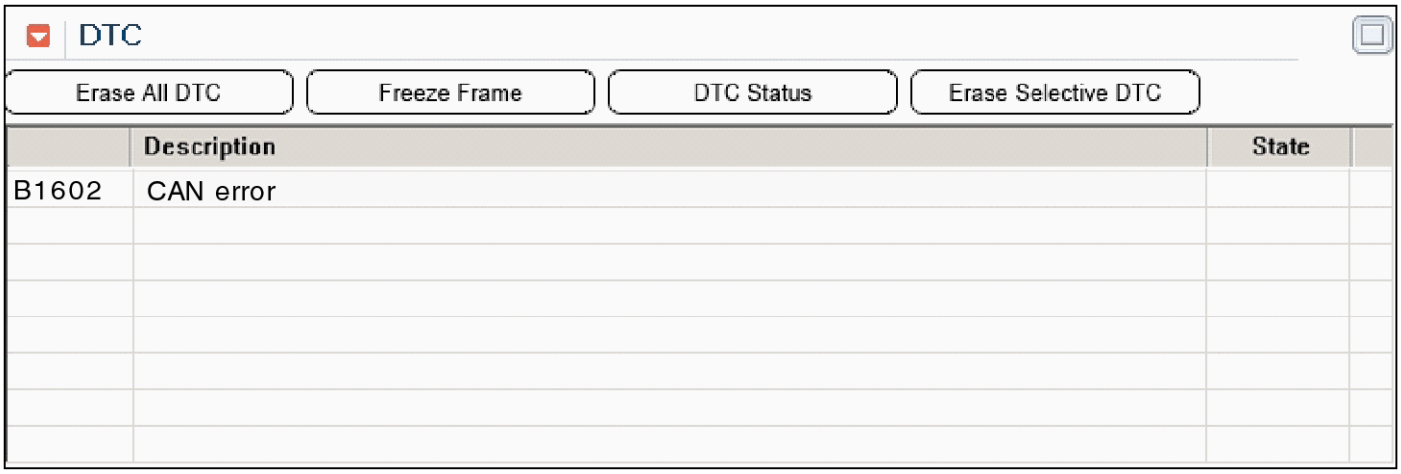
Fig.1) Signal waveform of CAN Low and HIGH

Fig.2) CAN BUS VOLTAGE LEVEL (LOW SPEED CAN)

Monitor Scantool Data

■ Check DTC

1. Connect GDS.
2. IG "ON" and engine "OFF".
3. Select "DTC Analysis" mode.
4. After erase DTC, keep the vehicle condition within "the enable conditions"
   (Refer to "DTC Detecting Condition" table)



SGHBE9504L

5. Is the same DTC occurred again?

   ▶ Go to next procedure.

   ▶ Fault is intermittent caused by poor contact in the sensor's and/or PDM's connector or was repaired and PDM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

   ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

   ▶ Go to " Signal Circuit Inpsection " procedure .

Signal Circuit Inpsection

■ Check CAN high circuit

1. IG "ON" & ENG "OFF".
2. Connect GDS and select Scope meter fucntion.
3. Measure signal waveform of PDM CAN High line.

Specification : Refer to signal waveform and data

4. Is the measured signal waveform of CAN high circuit normal ?

   ▶ Go to next procedure

   ▶ Check short to battery / ground in CAN high circuit, and repair or replace as necessary. Go to "Verification of Vehicle Repair" procedure.

■ Check CAN Low circuit

1. IG "ON" & ENG "OFF"
2. Connect GDS and select Scope meter fucntion.
3. Measure signal waveform of PDM CAN Low line.

Specification : Refer to signal waveform and data

4. Is the measured signal waveform of CAN low circuit normal ?

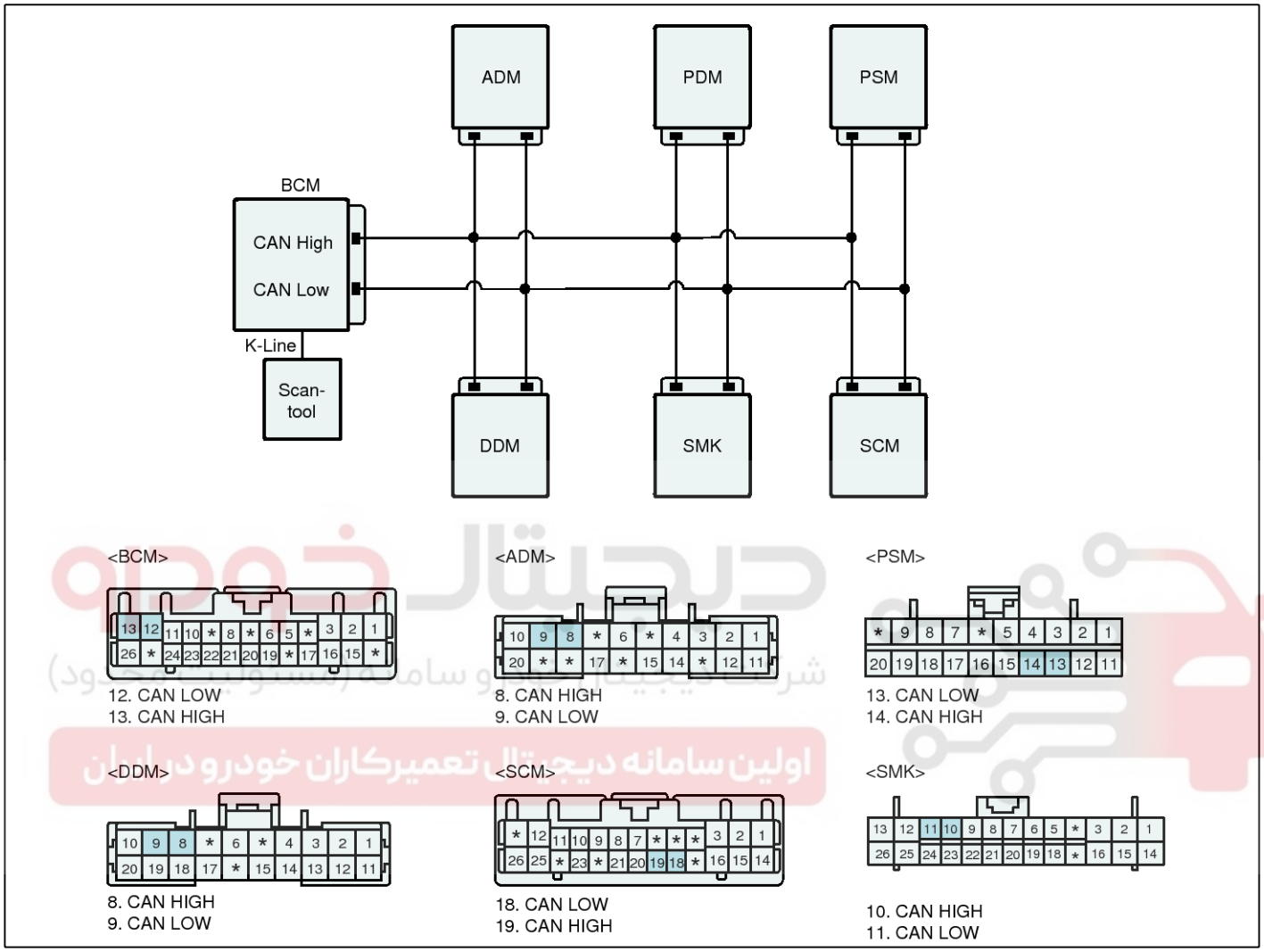
   ▶ Go to next procedure.

   ▶ Check short to battery / ground in CAN low circuit and, repair or replace as necessary. And then, go to 'Verification of Vehicle Repair" procedure.

Component Inspection

■ Check internal errors of CAN communication units

1. Connect GDS.
2. IG "ON" and engine "OFF".
3. Select "DTC Analysis" mode.
4. Disconnect CAN communication units one by one and monitor DTC to find the cause.



SGHBE9521L

*CAN communication units : BCM (Body Control Module), PDM(Power Distribution Module), DDM(Drive Door Module), ADM(Assist Door Module), PSM(Power Seat Module), SCM(Steering Control Module), SMK(Smart Key) ECU.

5. Is the code erased?

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

▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scan tool and select "DTC Analysis" mode.
2. Clear the DTCs and Operate the vehicle within DTC Enable conditions in General information.
3. Is any DTC outputted again?

▶ Go to the applicable troubleshooting procedure.

▶ System performing to specification at this time.

B1603 CAN Bus Off

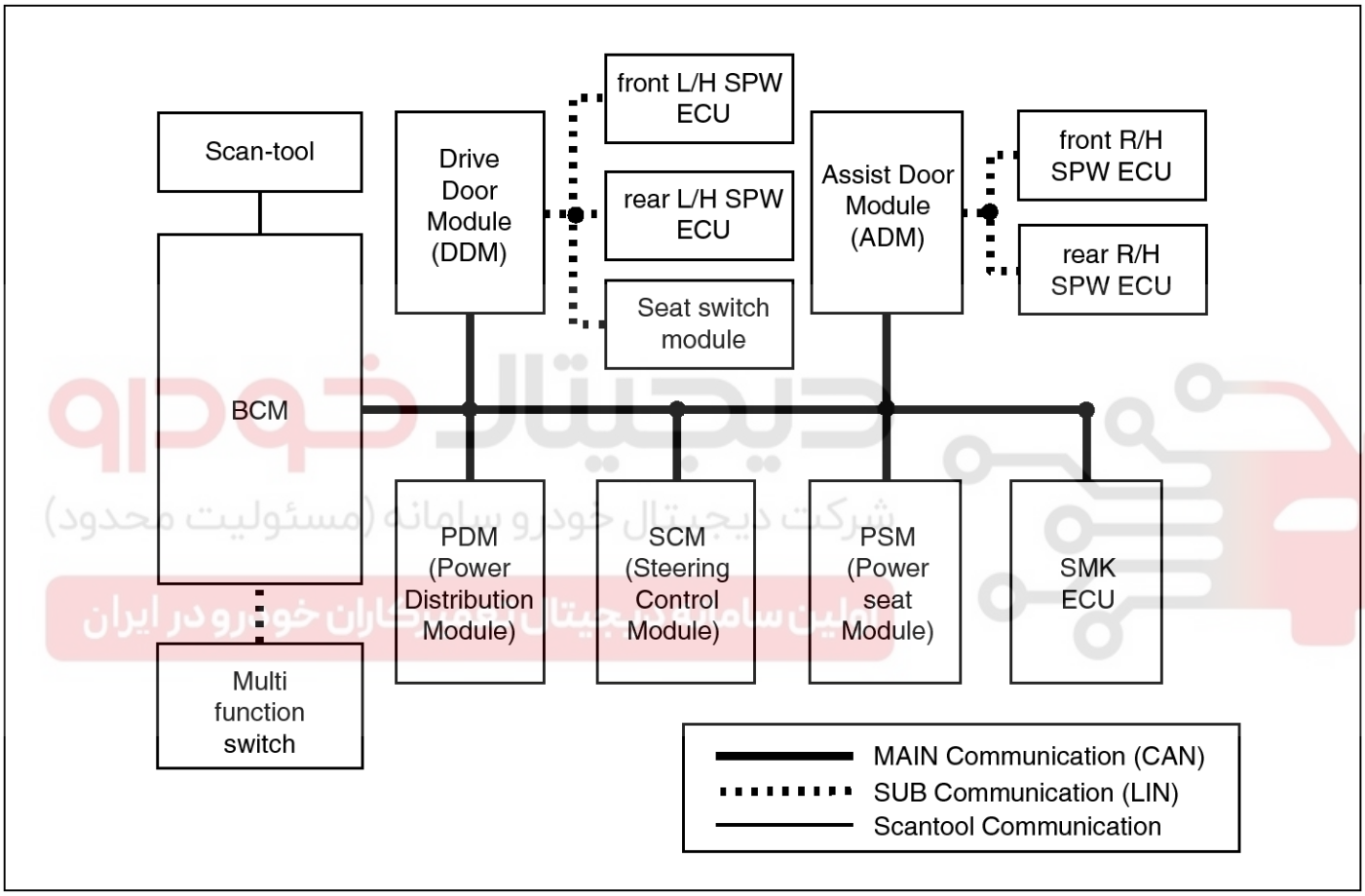
General Description

This is DTC which is related with communication error between BCM and other units.

(※ Control Units : BCM (Body Control Module), PDM(Power Distribution Module), DDM(Drive Door Module), ADM(Assist Door Module), PSM(Power Seat Module), SCM(Steering Control Module), SMK(Smart Key) ECU.

*1 CAN (Controller Area Network) : CAN is serial bus communication type which links not only communication system but also control units each other.

*2 LIN (Local Interconnect Network) : LIN is serial communication type which is used in electrical control system.



SGHBE9501L

DTC Description

This is DTC which is related with communication error between BCM and other units.

(※ Control Units : BCM (Body Control Module), PDM(Power Distribution Module), DDM(Drive Door Module), ADM(Assist Door Module), PSM(Power Seat Module), SCM(Steering Control Module), SMK(Smart Key) ECU.

Case1: After short between PDM CAN Low Line and High Line, short to ground together.

Case2: After short between PDM CAN Low Line and High Line, short to power together.

※ This code is occurred when It is not possible to transmit data by CAN Line in those way of Software and Hardware. But, It is possible to receive data by CAN Line.

This code reports BUS OFF status when data transmit error count number is over 255. The purpose is to verify the status of CAN controller and CAN communication line when error is detected.

According to operation condition, some of module which are connected to CAN line may not detect B1603.

Also, B1602 coincides with B1603 at all times.

CAUTION

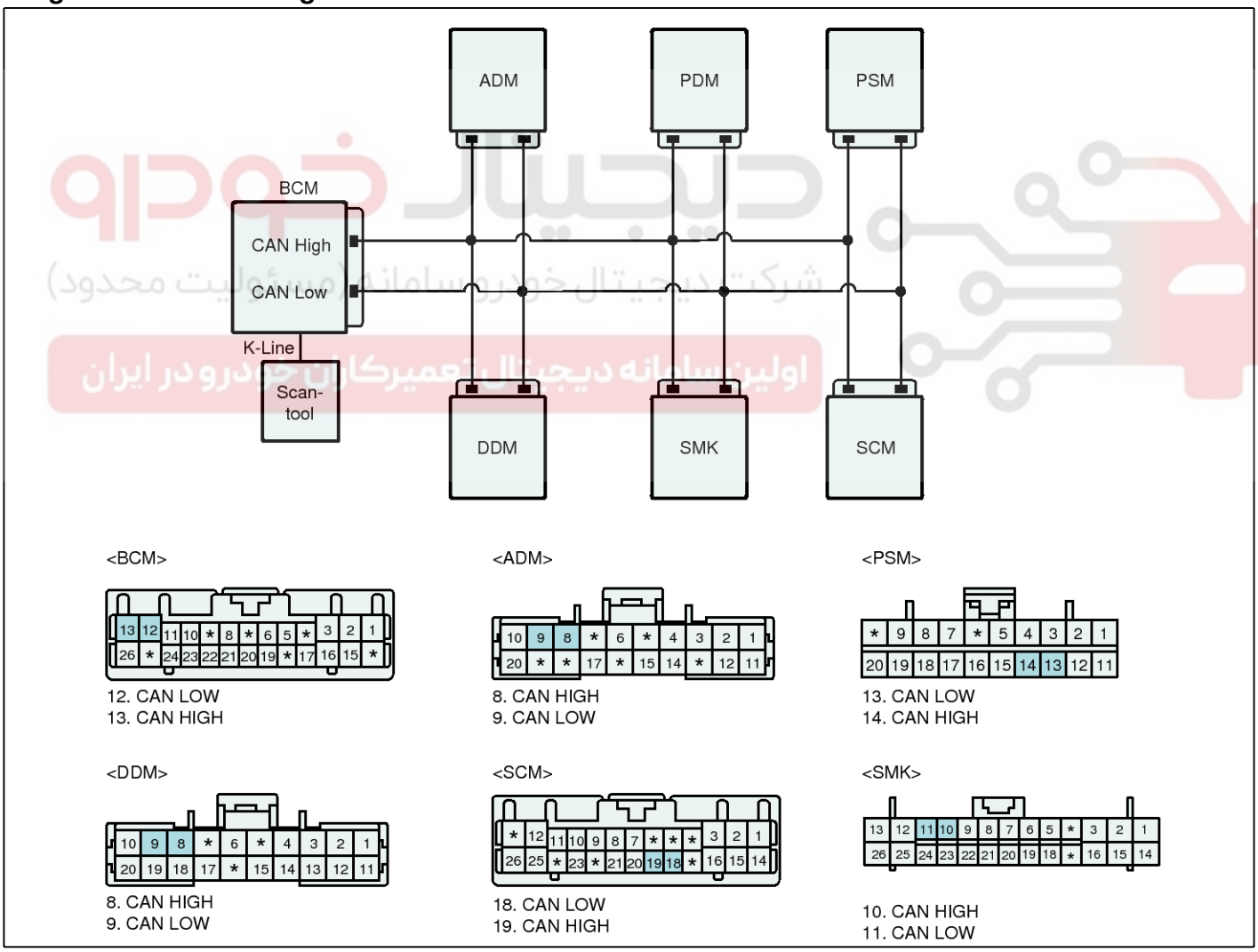
Difference between CAN ERROR and CAN BUS ERROR

CAN Error : MIL On, CAN Bus Error : No MIL

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• CAN Communication Check	• BCM,PDM are not Sleep condition 1. CAN High and Low Line short to ground coincident 2. CAN High and Low Line short to battery coincident
Enable Conditions	• BCM, PDM power on	
Threshold Value	• CAN High/Low : 0V or B+	
Diagnostic Time	• Immediately	
DTC Erasing Time	• DTC is erased immediately after trouble fixed.	

Diagnostic Circuit Diagram



SGHBE9521L

Signal Waveform & Data

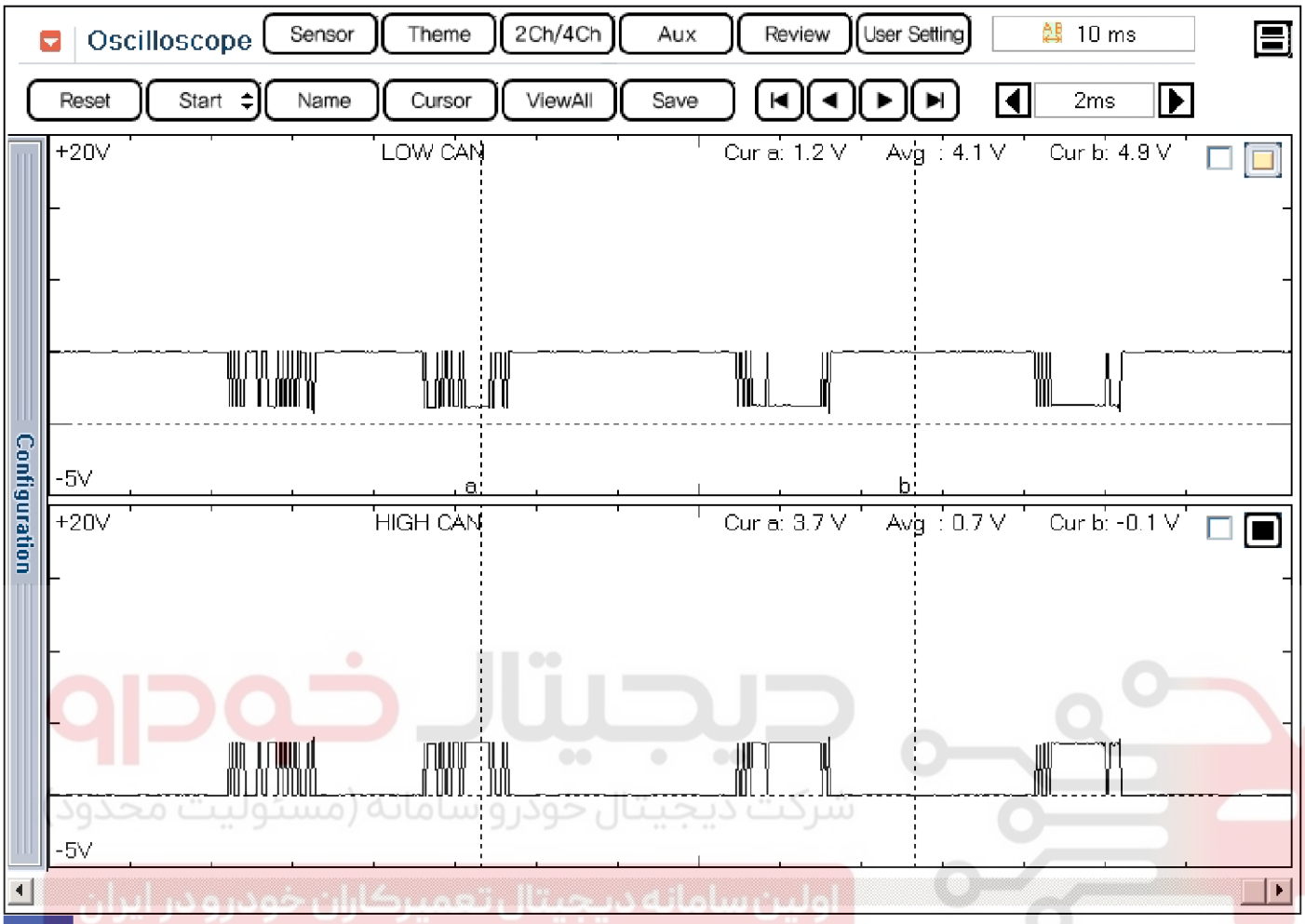


FIG.1

SGHBE9502L

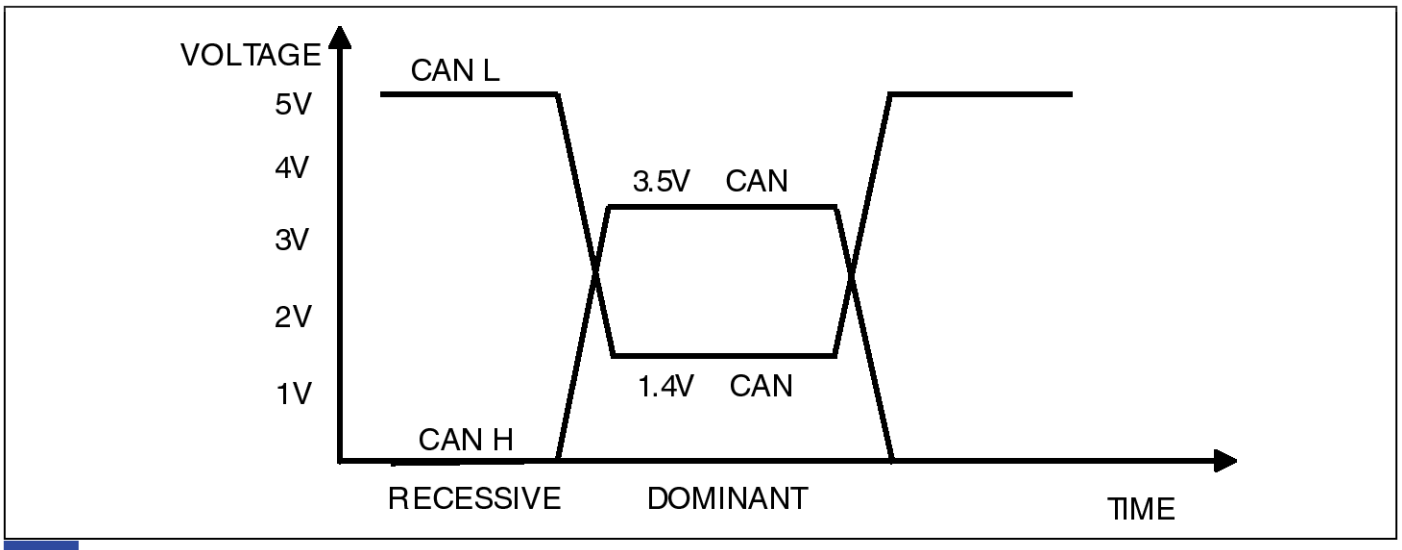


FIG.2

SGHBE9503L

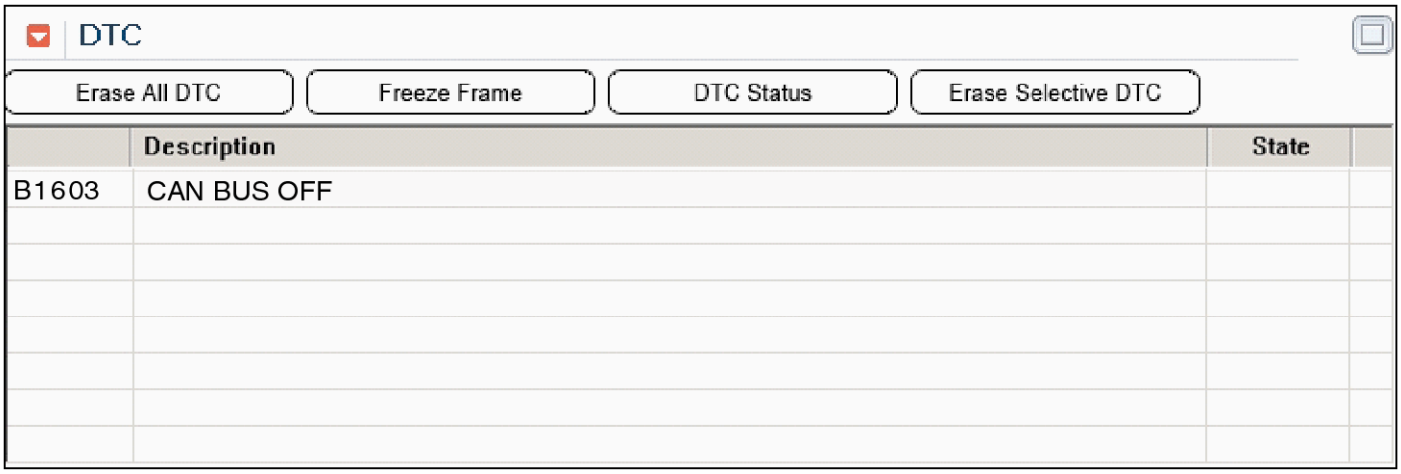
Fig.1) Signal waveform of CAN Low and HIGH

Fig.2) CAN BUS VOLTAGE LEVEL (LOW SPEED CAN)

Monitor Scantool Data

■ Check DTC

1. Connect GDS.
2. IG "ON" and engine "OFF".
3. Select "DTC Analysis" mode.
4. After erase DTC, keep the vehicle condition within "the enable conditions"
   (Refer to "DTC Detecting Condition" table)



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5. Is the same DTC occurred again?

   ▶ Go to next procedure.

   ▶ Fault is intermittent caused by poor contact in the sensor's and/or PDM's connector or was repaired and PDM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

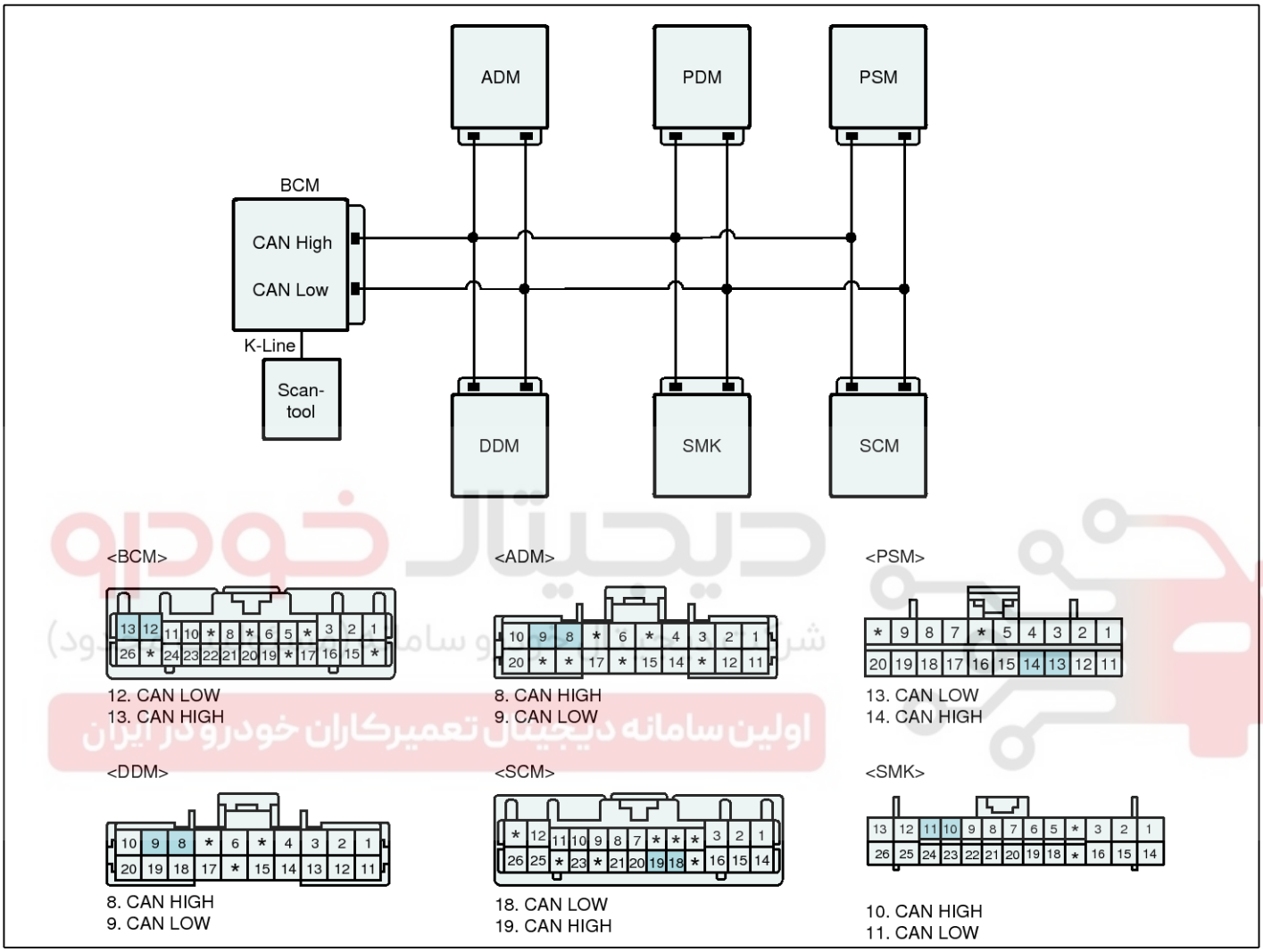
   ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

   ▶ Go to "Component Inspection" procedure.

Component Inspection

■ Check internal errors of CAN communication in PDM

1. Replace with a known-good PDM after removing installed PDM.
2. Connect GDS.
3. IG "ON" and engine "OFF".
4. Select "DTC Analysis" mode.



SGHBE9521L

5. Is the code erased?

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

▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scan tool and select "DTC Analysis" mode.
2. Clear the DTCs and Operate the vehicle within DTC Enable conditions in General information.
3. Is any DTC outputted again?

▶ Go to the applicable troubleshooting procedure.

▶ System performing to specification at this time.

B1987 Sub Micom Failed

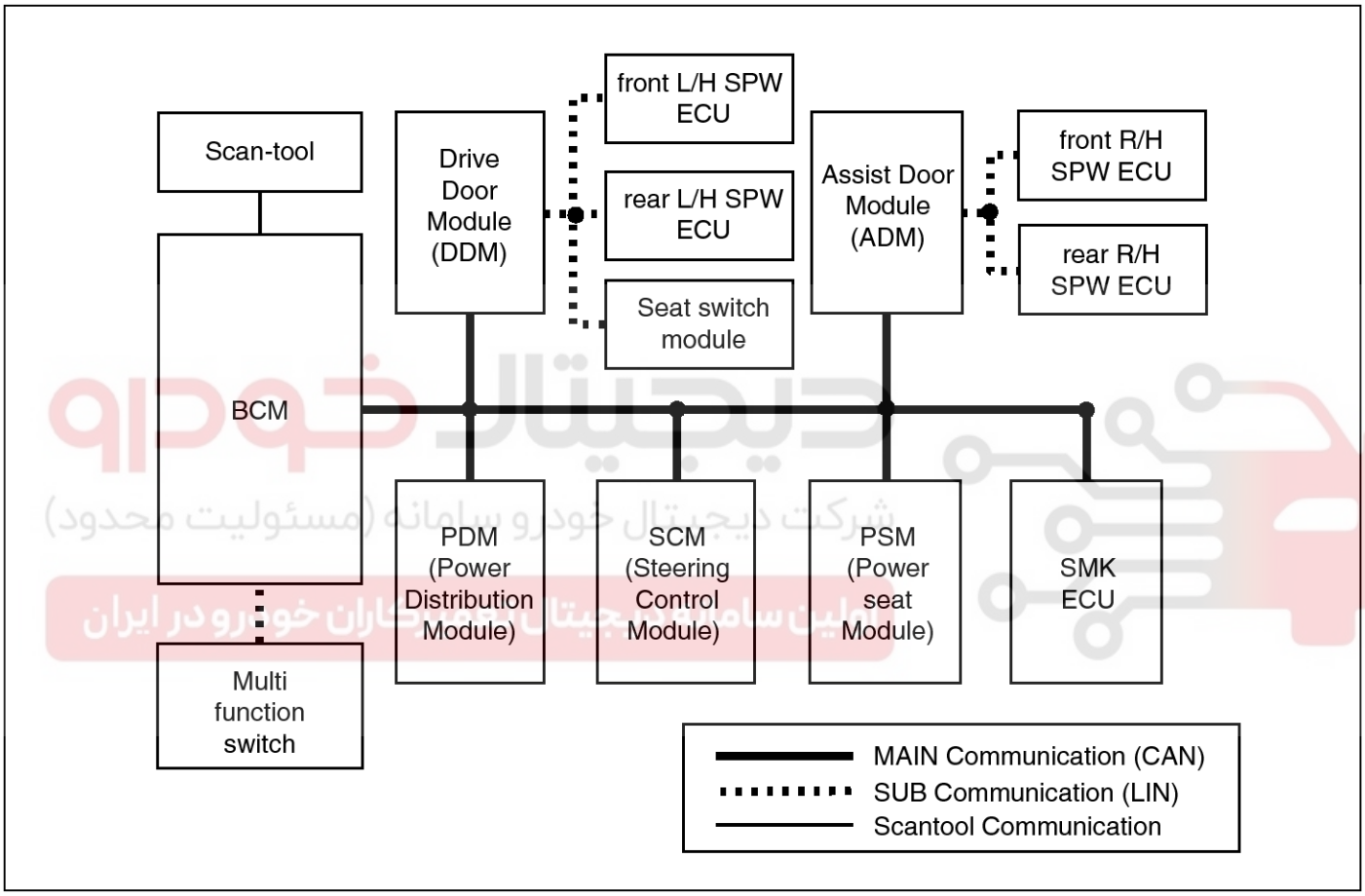
General Description

The body electrical system is comprised of seven ECU applied CAN*¹ communication nodes.

(※ Control Units : BCM (Body Control Module), PDM(Power Distribution Module), DDM(Drive Door Module), ADM(Assist Door Module), PSM(Power Seat Module), SCM(Steering Control Module), SMK(Smart Key) ECU.

*¹ CAN (Controller Area Network) : CAN is serial bus communication type which links not only communication system but also control units each other.

*² LIN (Local Interconnect Network) : LIN is serial communication type which is used in electrical control system. (This is less expensive.)



SGHBE9501L

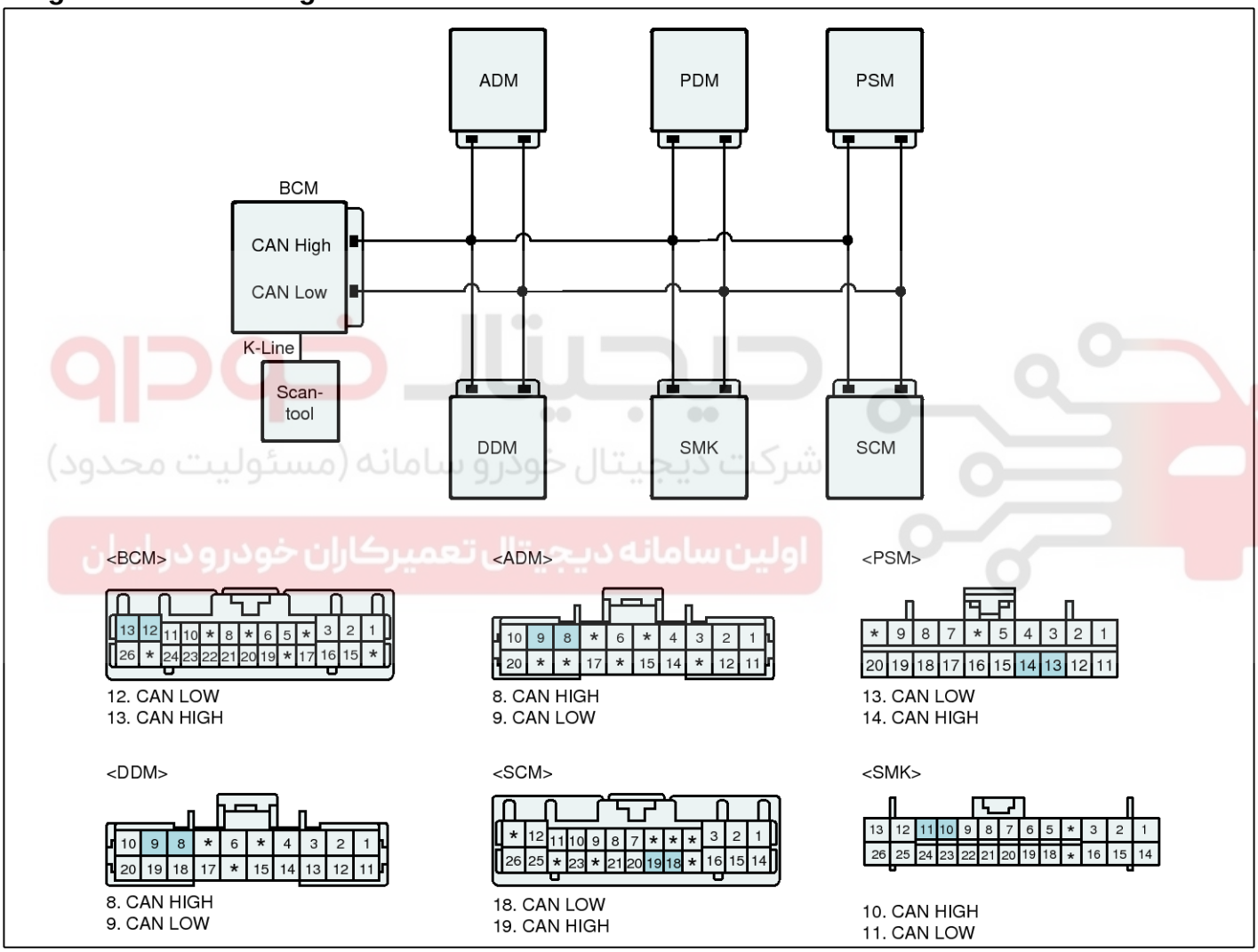
DTC Description

This code reports the malfunction of NEC MCU inside PDM. This is the case which there is the NEC MCU communication error.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• NEC MCU Communication Check	• Short to ground/power or open in communication circuit of NE-C MCU inside PDM • Replace PDM (In case It is unable to verify the cause.)
Enable Conditions	• PDM power on	
Threshold Value	• Communication error	
Diagnostic Time	• Immediately	
DTC Erasing Time	• DTC is erased immediately after trouble fixed.	

Diagnostic Circuit Diagram



SGHBE9521L

Signal Waveform & Data

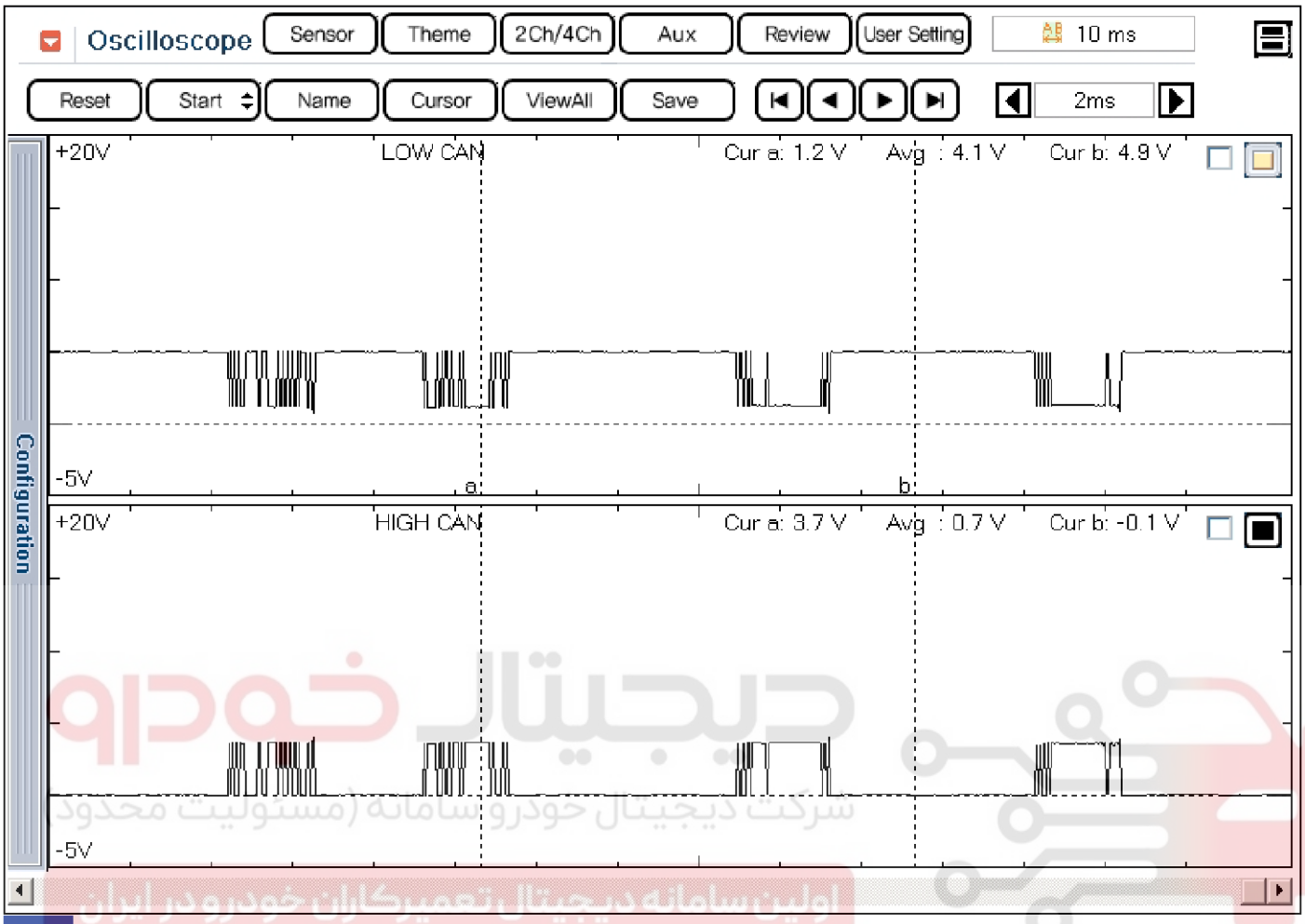


FIG.1

SGHBE9502L

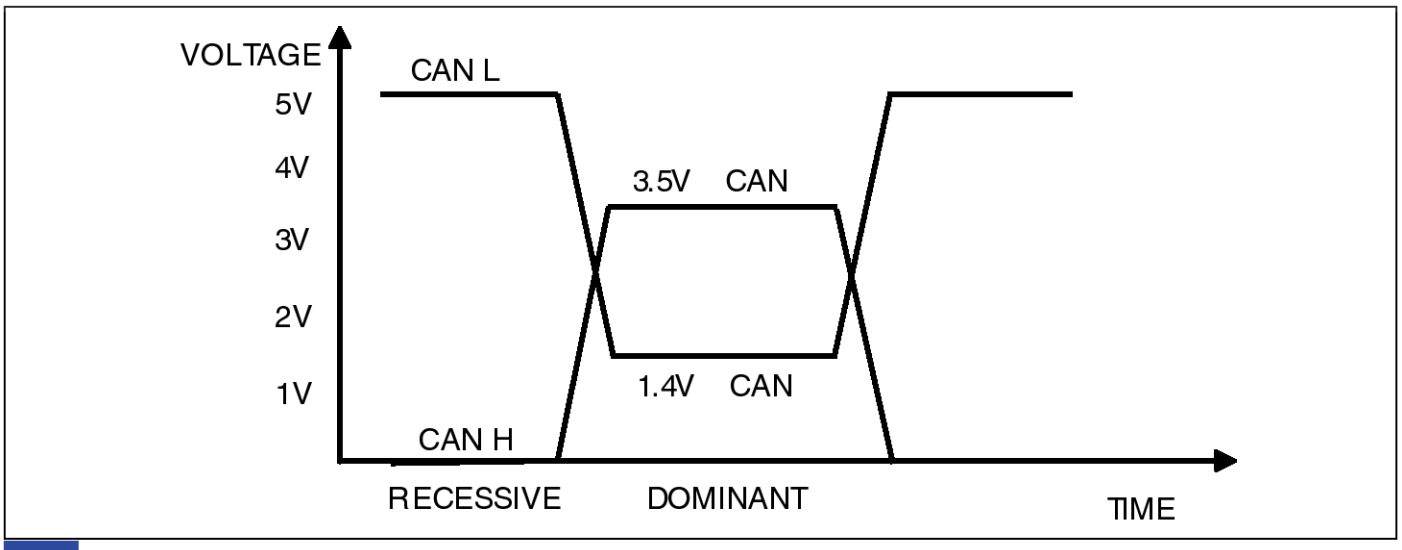


FIG.2

SGHBE9503L

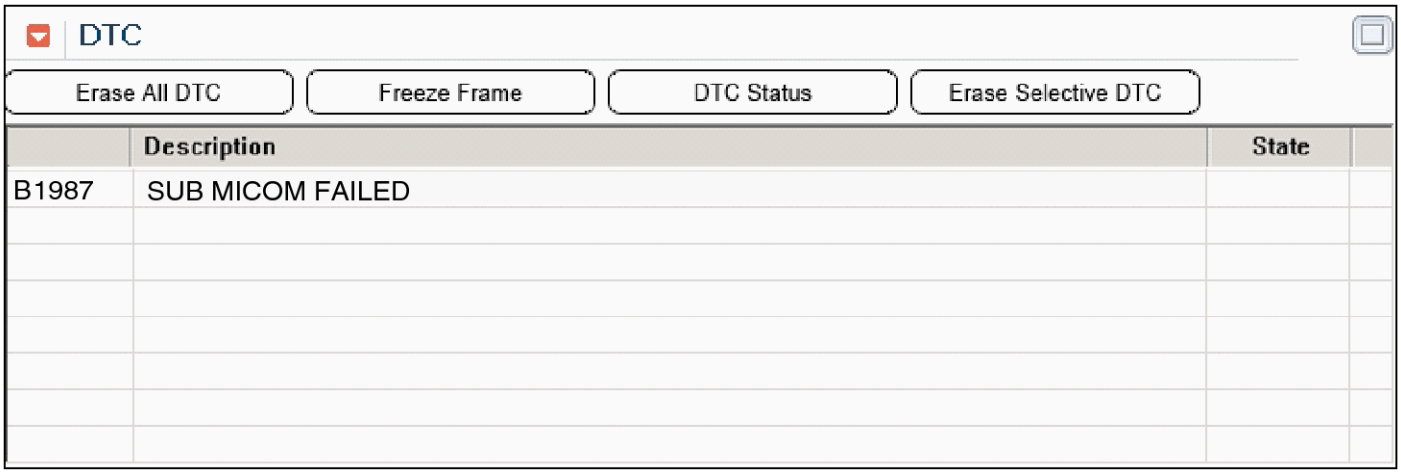
Fig.1) Signal waveform of CAN Low and HIGH

Fig.2) CAN BUS VOLTAGE LEVEL (LOW SPEED CAN)

Monitor Scantool Data

■ Check DTC

1. Connect GDS.
2. IG "ON" and engine "OFF".
3. Select "DTC Analysis" mode.
4. After erase DTC, keep the vehicle condition within "the enable conditions"
   (Refer to "DTC Detecting Condition" table)



SGHBE9506L

5. Is the same DTC occurred again?

   ▶ Go to next procedure.

   ▶ Fault is intermittent caused by poor contact in the sensor's and/or PDM's connector or was repaired and PDM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

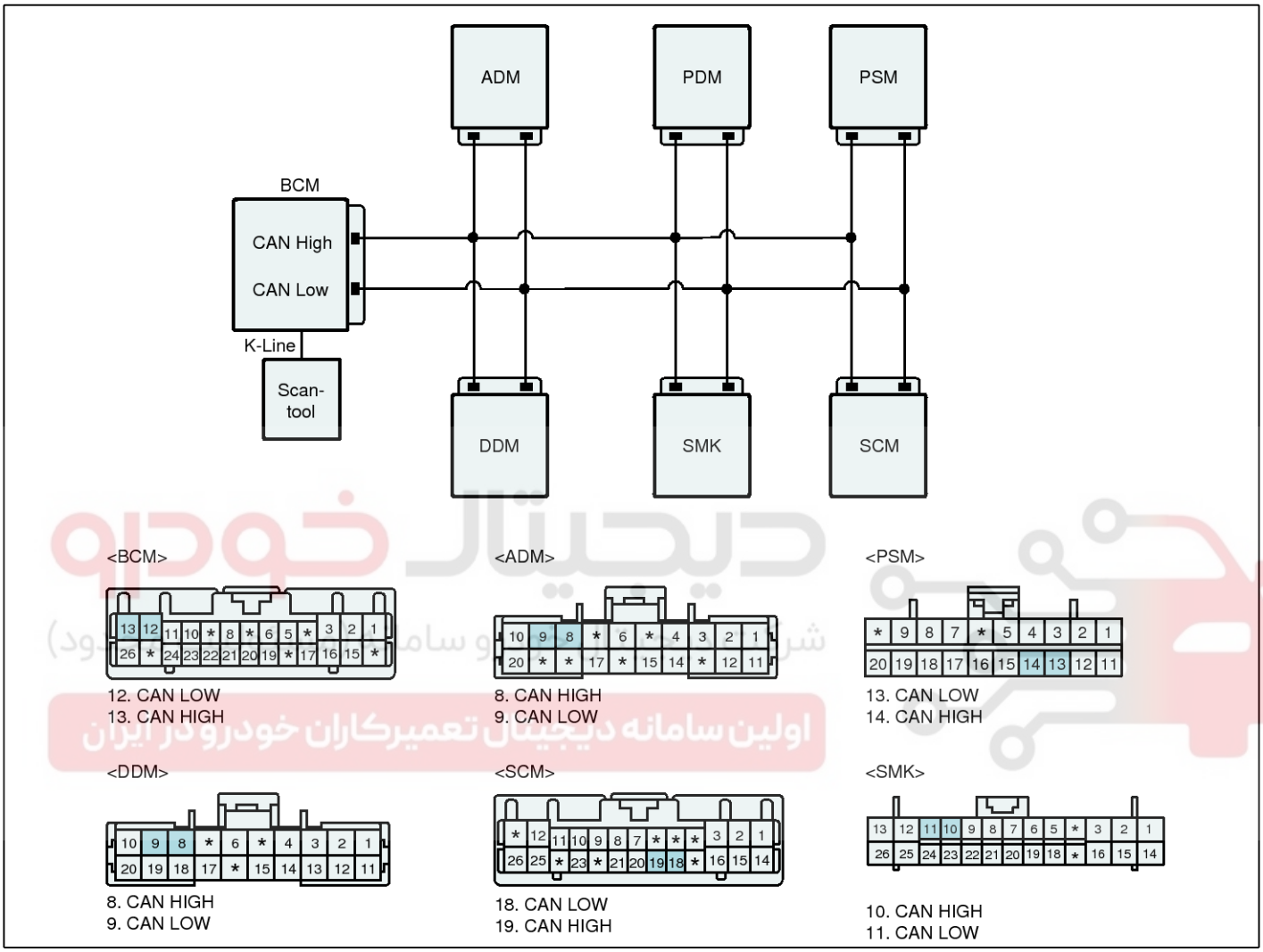
   ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

   ▶ Go to "Component Inspection" procedure.

Component Inspection

■ Check internal errors of CAN communication in PDM

1. Replace with a known-good PDM after removing installed PDM.
2. Connect GDS.
3. IG "ON" and engine "OFF".
4. Select "DTC Analysis" mode.



SGHBE9521L

5. Is the code erased?

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

   ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scan tool and select "DTC Analysis" mode.
2. Clear the DTCs and Operate the vehicle within DTC Enable conditions in General information.
3. Is any DTC outputted again?

   ▶ Go to the applicable troubleshooting procedure.

   ▶ System performing to specification at this time.

B1988 ESCL Battery Short Circuit To Battery

General Description

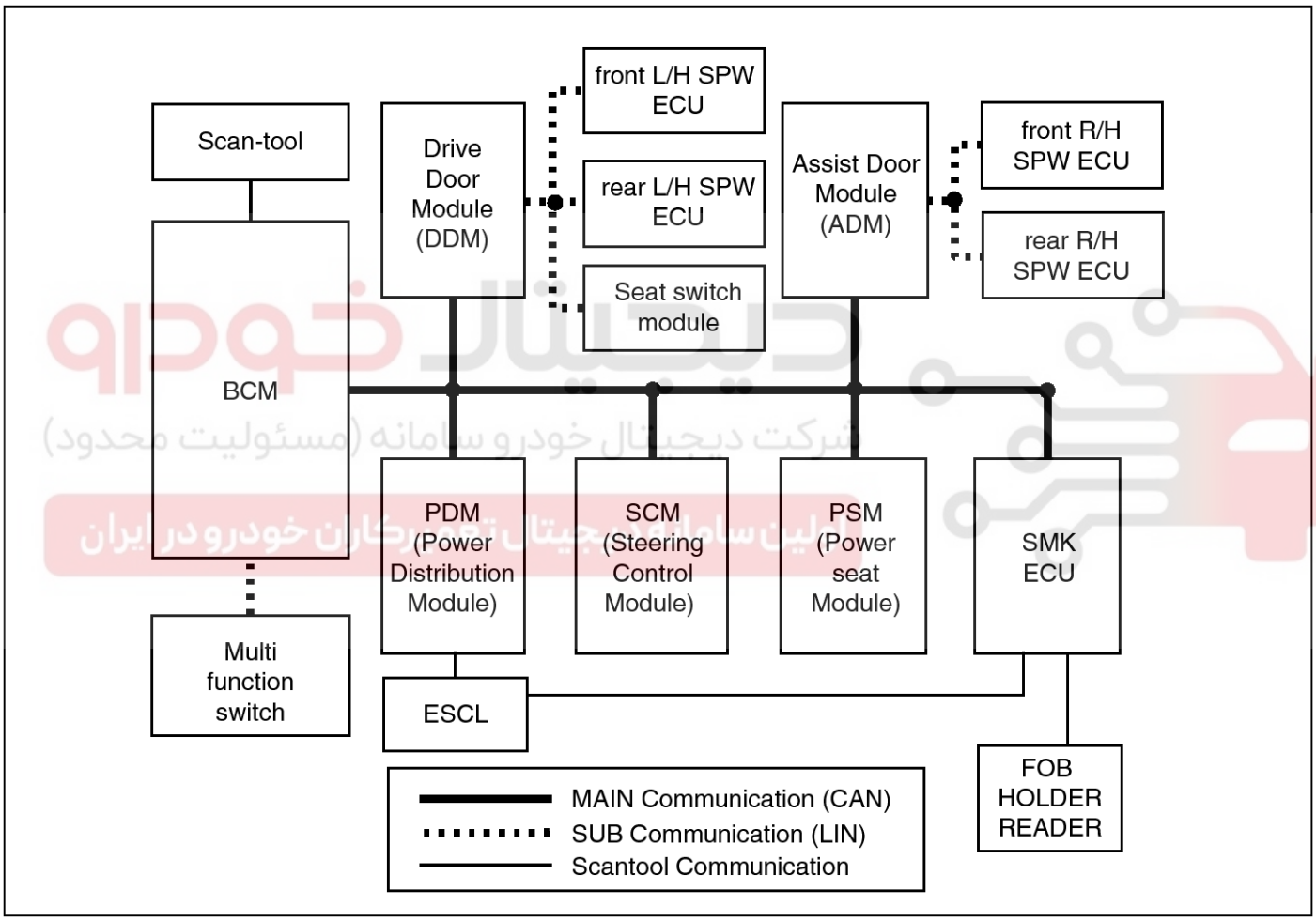
This is DTC which is related with communication error between IPM and other units.

(※ Control Units : IPM(Inter Panel Module), FAM(Front Area Module), PDM(Power Distribution Module), DDM(Drive Door Module), ADM(Assist Door Module), CLU(Cluster), PSM(Power Seat Module), SCM(Steering Control Module), RAM(Rear Area Module), SMK(Smart Key)

The steering wheel lock/unlock state of ESCL and the required data when EMS(Engine Management System) controls starting are sent to PDM by the serial communication line.

*1 CAN (Controller Area Network) : CAN is serial bus communication type which links not only communication system but also control units each other.

*2 LIN (Local Interconnect Network) : LIN is serial communication type which is used in electrical control system.



SGHBE9517L

DTC Description

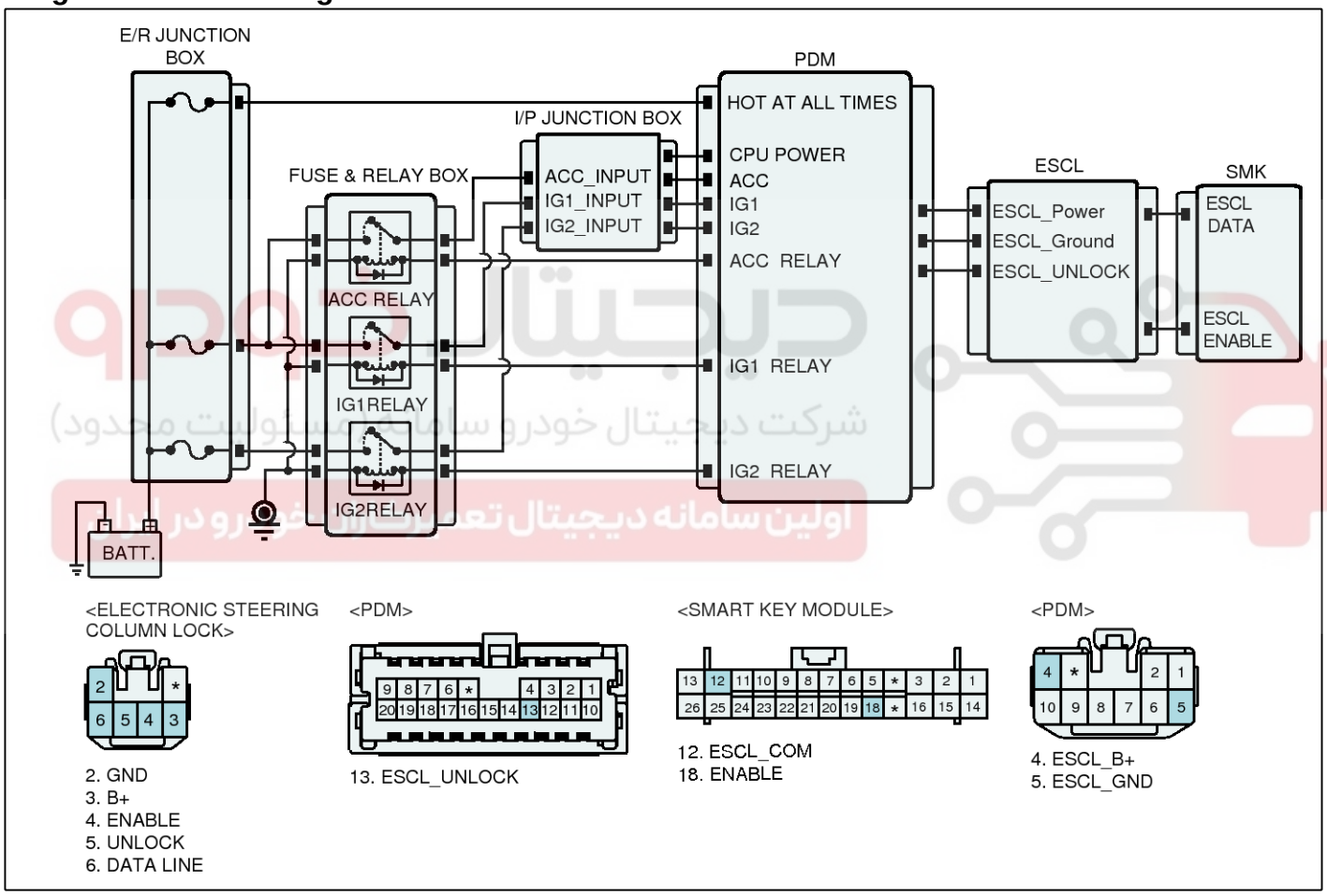
This code is outputted when power circuit is shorted to battery.

(During no power supply from PDM to ESCL)

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• ESCL power output line check (by voltage monitoring)	• Short to power in ESCL power circuit
Enable Conditions	• No power supply from PDM to ESCL	
Threshold Value	• ESCL power circuit is shorted to power (7V and above)	
Diagnostic Time	• Immediately	
DTC Erasing Time	• DTC is erased immediately after trouble fixed. (Under no power supply from PDM to ESCL state)	

Diagnostic Circuit Diagram



SGHBE9522L

Signal Waveform & Data

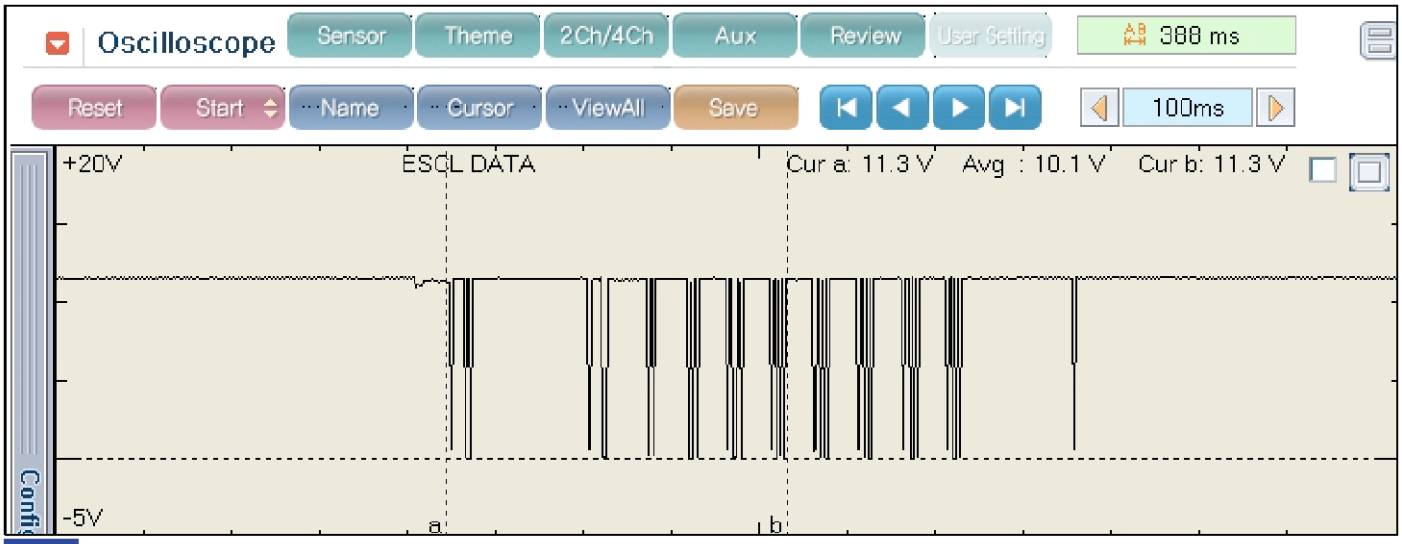


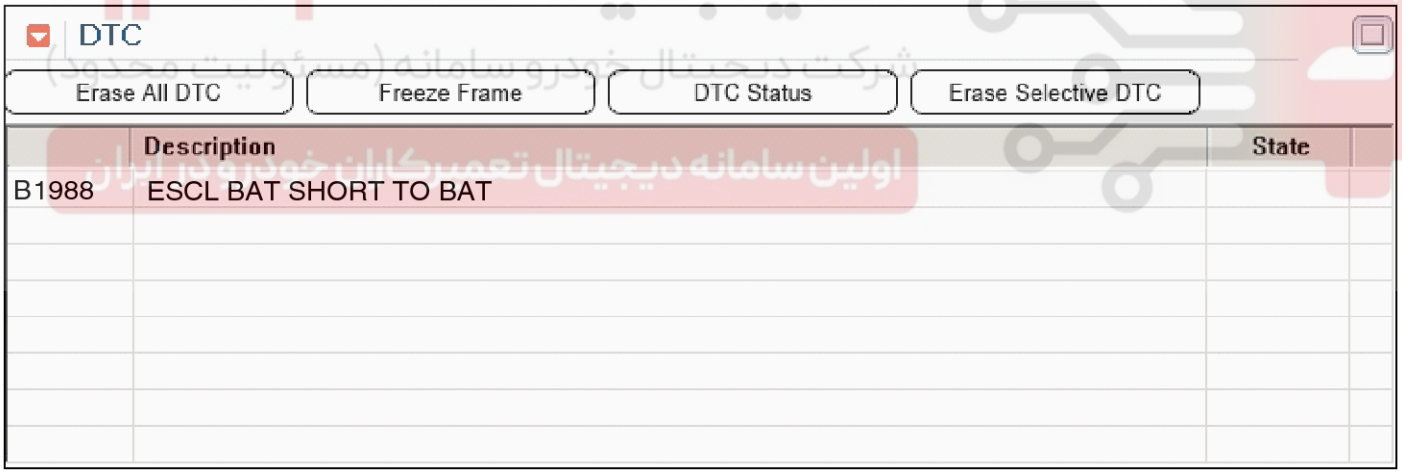
FIG.1

SGHBE9507L

Fig.1) ESCL Data Signal Waveform

Scantool Data Analysis

1. Connect GDS.
2. IG "ON" and engine "OFF".
3. Select "DTC Analysis" mode.
4. After erase DTC, keep the vehicle condition within "the enable conditions" (Refer to "DTC Detecting Condition" table).



SGHBE9508L

5. Is the same DTC occurred again?

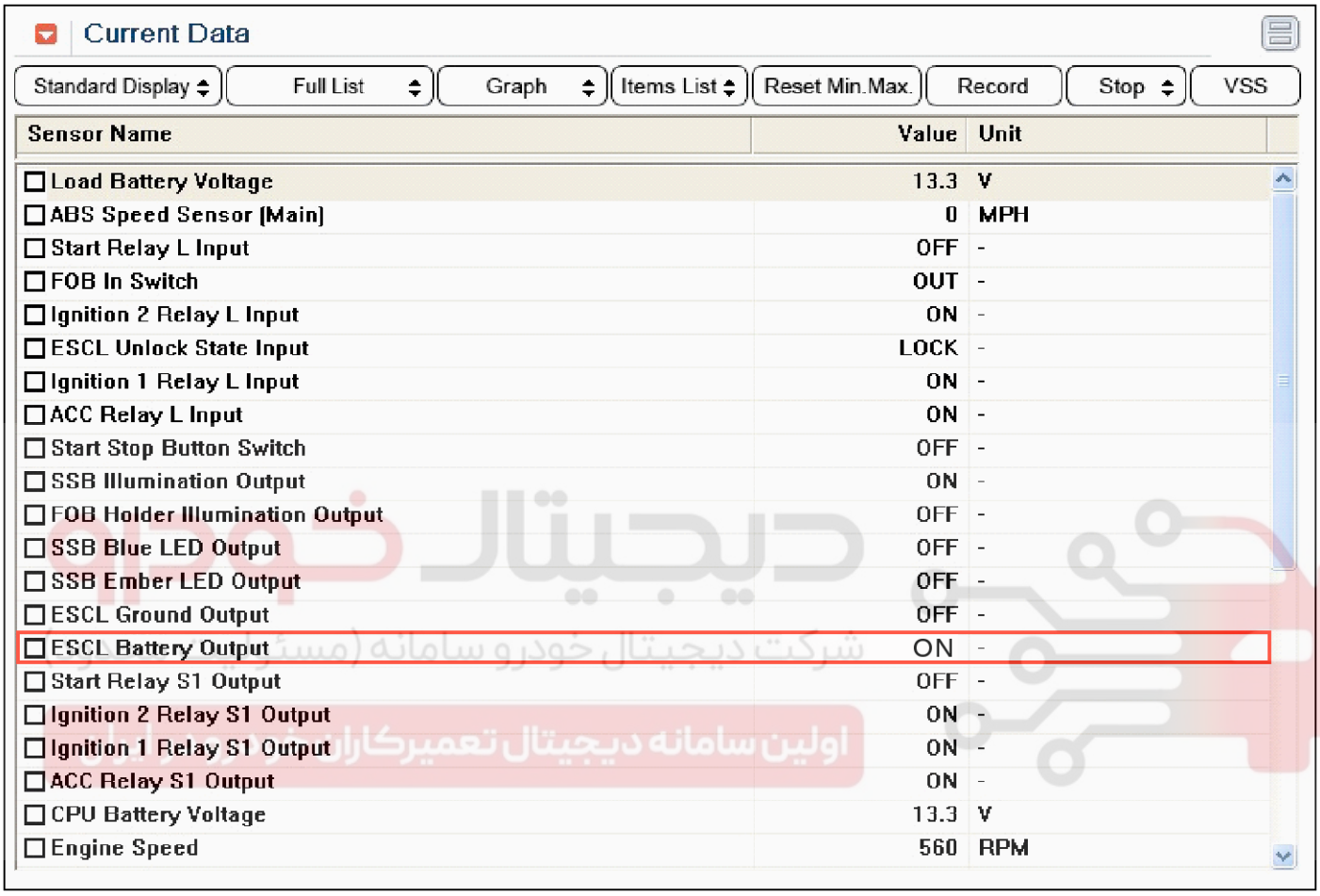
▶ Go to next procedure.

▶ Fault is intermittent caused by poor contact in ESCL's and/or PDM's connector or was repaired and PDM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

Service Data Analysis

1. IG "OFF" and connect GDS.
2. IG "ON" and select "Current Data" menu.
3. Check the service data of ESCL BATT.

Specification : OFF



SGHBE9509L

4. Is the service data within specifications?

▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

▶ Go to next procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

▶ Go to "Component Inspection" procedure.

PDM Ground Circuit Inspection

■ Check short at power terminal of PDM

1. IG "ON" & ENG "OFF".
2. Measure voltage between ESCL power terminal of PDM and chassis ground.
   (Measure the voltage while ESCL doesn't work.)

Specification : Approx. 0 V

3. Is the measured voltage within specifications?

   ▶ Go to next procedure.

   ▶ Check open or short on the power circuit between PDM and ESCL.
   Repair as necessary and go to "Verification of Vehicle Repair"

■ Check short to power on ESCL power circuit

1. IG "ON" & ENG "OFF"
2. Disconnect the connectors of IPM, PDM, ESCL.
3. Measure voltage between ESCL power terminal and chassis ground.

Specification : Approx. 0 V

4. Is the measured voltage within specifications?

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

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

   ▶ Repair as necessary and go to "Verification of Vehicle Repair".

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scan tool and select "DTC Analysis" mode.
2. Clear the DTCs and Operate the vehicle within DTC Enable conditions in General information.
3. Is any DTC outputted again?

   ▶ Go to the applicable troubleshooting procedure.

   ▶ System performing to specification at this time.

B1989 ESCL Ground Short Circuit To Battery

General Description

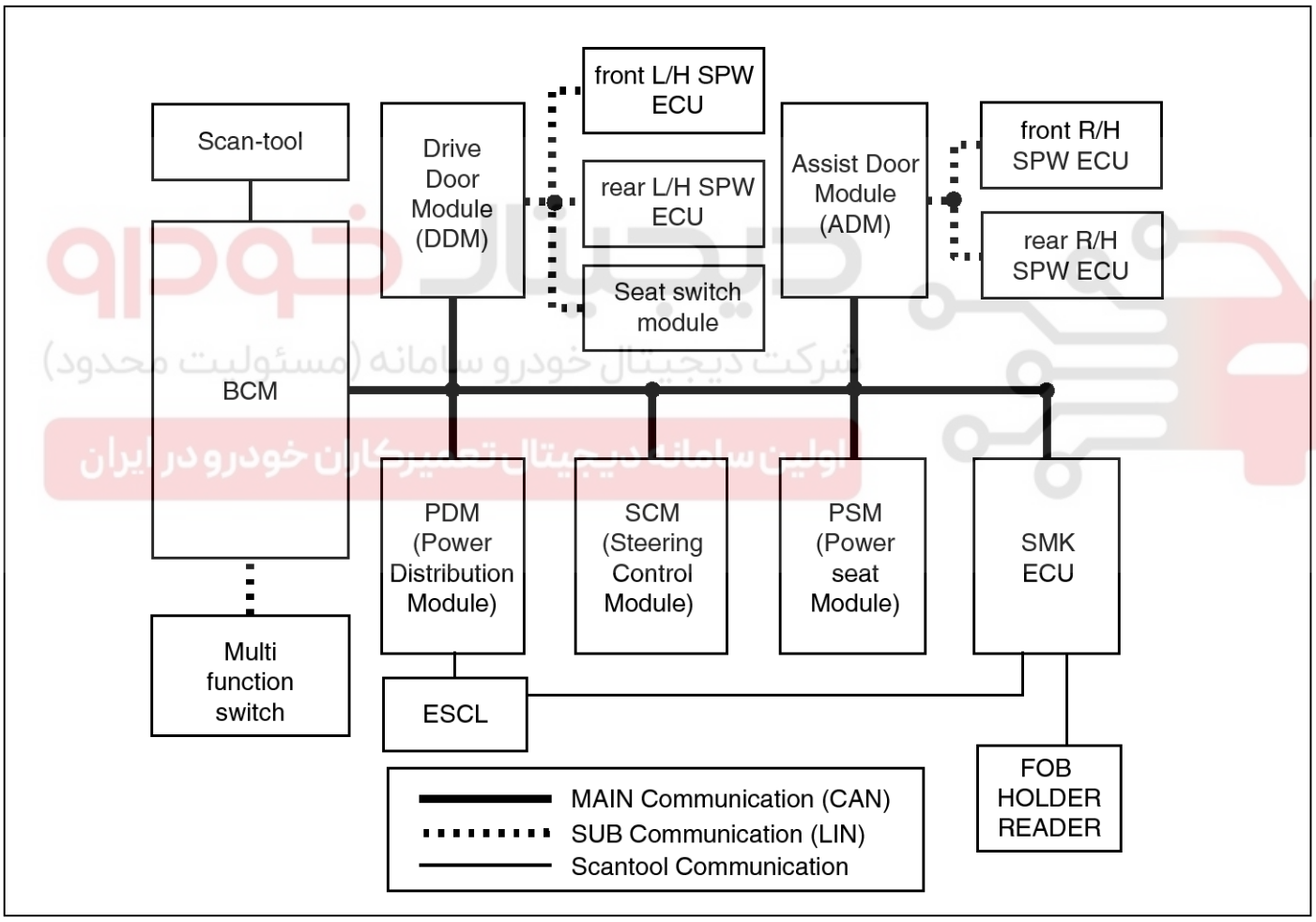
The body electrical system is comprised of seven ECU applied CAN*¹ communication nodes.

(※ Control Units : BCM (Body Control Module), PDM(Power Distribution Module), DDM(Drive Door Module), ADM(Assist Door Module), PSM(Power Seat Module), SCM(Steering Control Module), SMK(Smart Key) ECU.

The steering wheel lock/unlock state of ESCL and the required data when EMS(Engine Management System) controls starting are sent to PDM by the serial communication line.

*¹ CAN (Controller Area Network) : CAN is serial bus communication type which links not only communication system but also control units each other.

*² LIN (Local Interconnect Network) : LIN is serial communication type which is used in electrical control system. (This is less expensive.)



SGHBE9517L

DTC Description

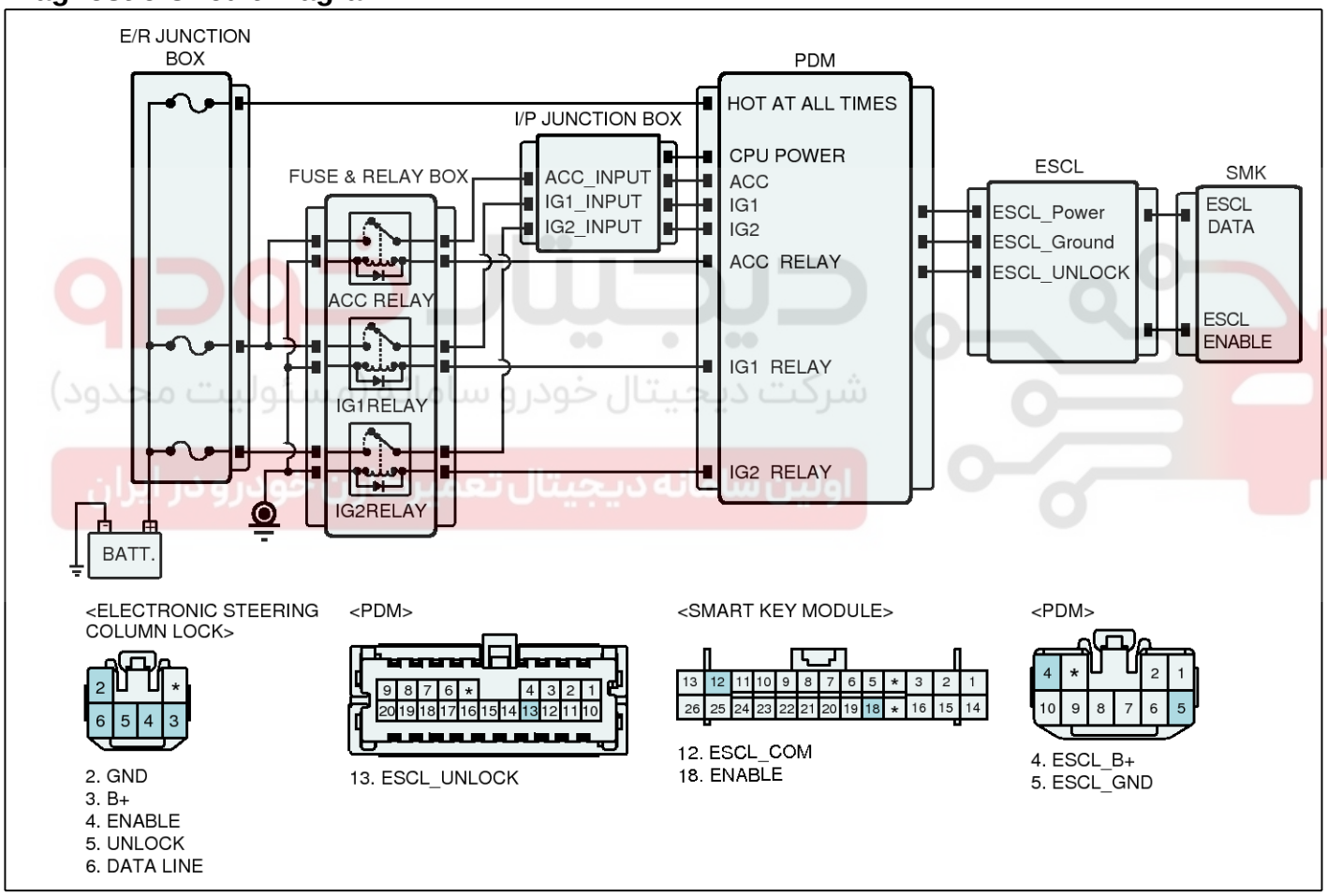
This code is outputted when ground circuit is shorted to battery.

(During no power supply from PDM to ESCL)

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• ESCL ground output line check (by voltage monitoring)	• Short to power in ESCL ground circuit
Enable Conditions	• No power supply from PDM to ESCL	
Threshold Value	• ESCL ground circuit is shorted to power (7V and above)	
Diagnostic Time	• Immediately	
DTC Erasing Time	• DTC is erased immediately after trouble fixed. (Under no power supply from PDM to ESCL state)	

Diagnostic Circuit Diagram



SGHBE9522L

Signal Waveform & Data

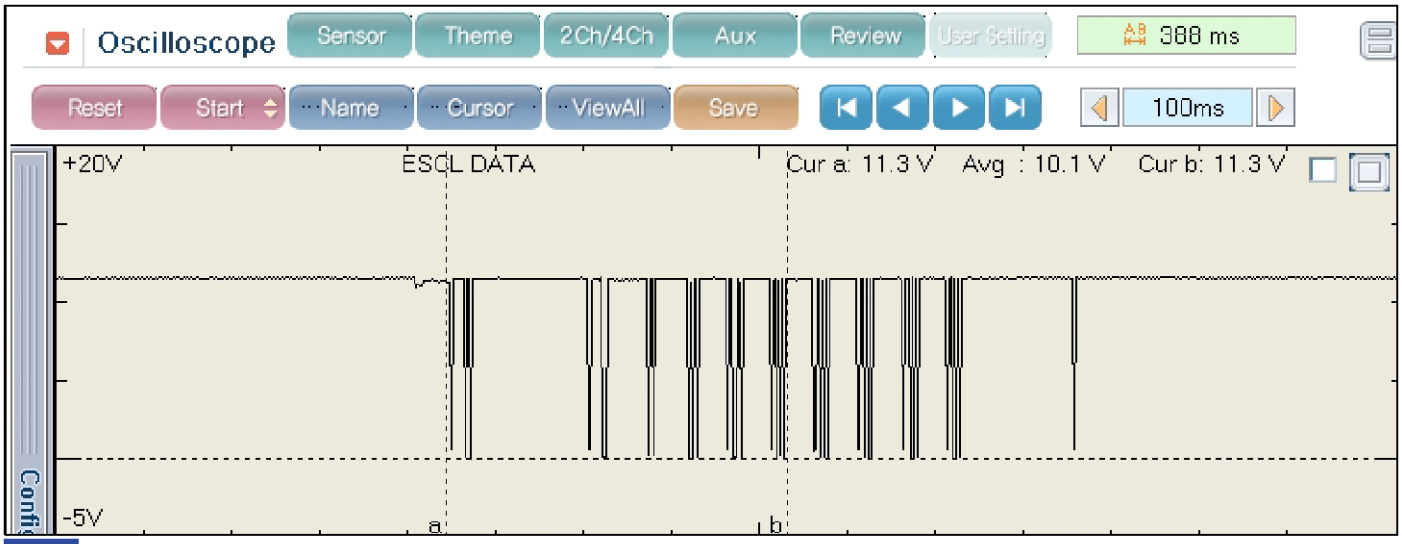


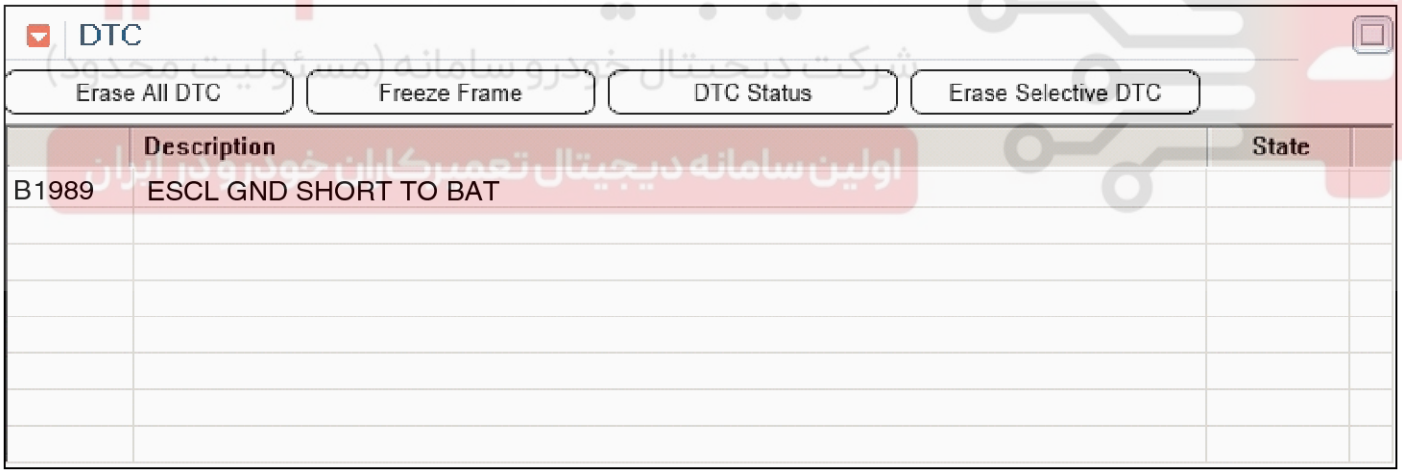
FIG.1

SGHBE9507L

Fig.1) ESCL Data Signal Waveform

Scantool Data Analysis

1. Connect GDS.
2. IG "ON" and engine "OFF".
3. Select "DTC Analysis" mode.
4. After erase DTC, keep the vehicle condition within "the enable conditions" (Refer to "DTC Detecting Condition" table).



SGHBE9510L

5. Is the same DTC occurred again?

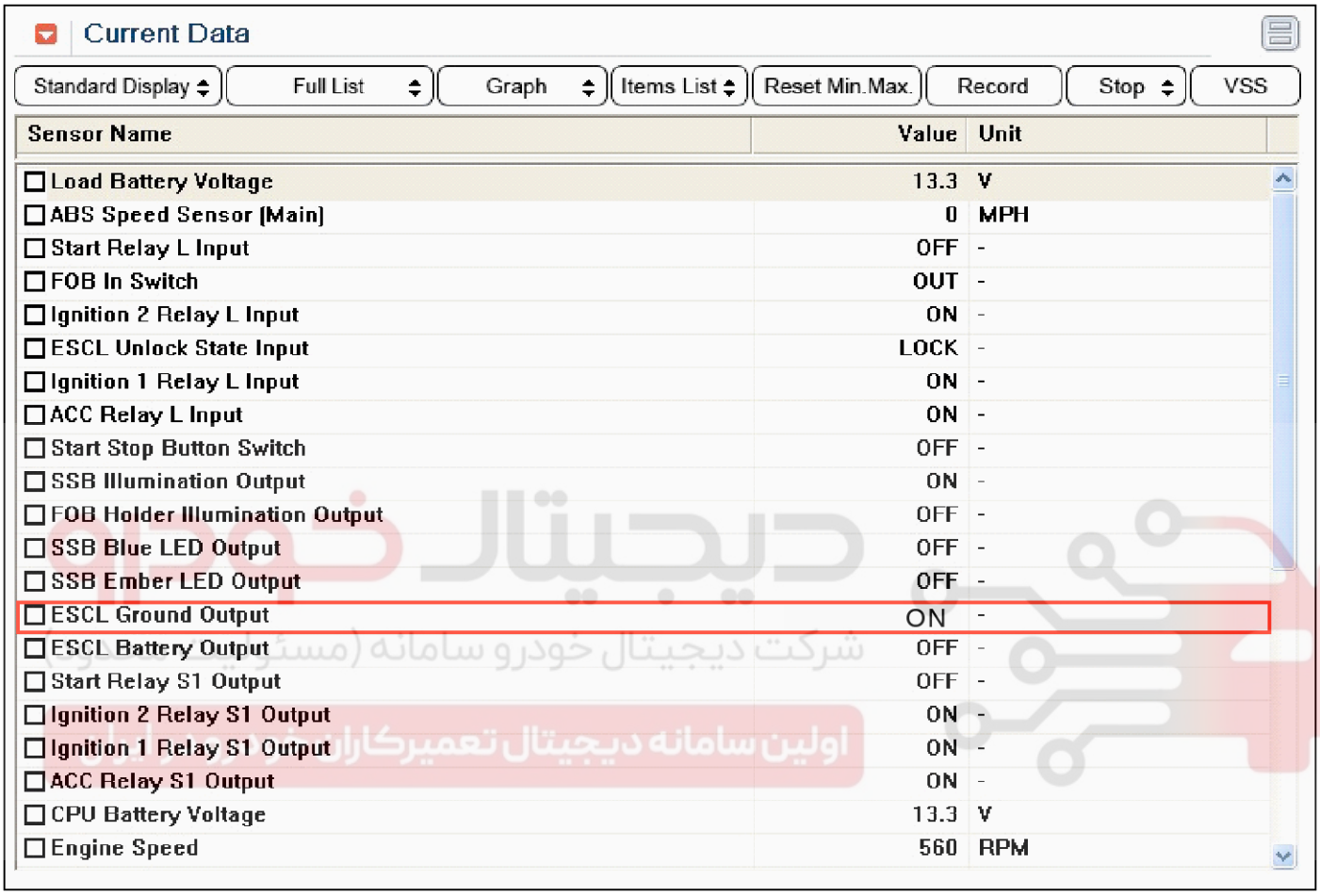
▶ Go to next procedure.

▶ Fault is intermittent caused by poor contact in ESCL's and/or PDM's connector or was repaired and PDM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

Service Data Analysis

1. IG "OFF" and connect GDS.
2. IG "ON" and select "Current Data" menu.
3. Check the service data of ESCL GND.

Specification : OFF



SGHBE9511L

4. Is the service data within specifications?

▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

▶ Go to next procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

▶ Go to "Component Inspection" procedure.

PDM Ground Circuit Inspection

■ Check short at ground terminal of PDM

1. IG "ON" & ENG "OFF".
2. Measure voltage between ESCL ground terminal of PDM and chassis ground.
   (Measure the voltage while ESCL doesn't work.)

Specification : Approx. 0 V

3. Is the measured voltage within specifications?

   ▶ Go to next procedure.

   ▶ Check open or short on the ground circuit between PDM and ESCL.
   Repair as necessary and go to "Verification of Vehicle Repair"

■ Check short to power on ESCL GND circuit

1. IG "ON" & ENG "OFF"
2. Disconnect the connectors of IPM, PDM, ESCL.
3. Measure voltage between ESCL ground terminal and chassis ground.

Specification : Approx. 0 V

4. Is the measured voltage within specifications?

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

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

   ▶ Repair as necessary and go to "Verification of Vehicle Repair".

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scan tool and select "DTC Analysis" mode.
2. Clear the DTCs and Operate the vehicle within DTC Enable conditions in General information.
3. Is any DTC outputted again?

   ▶ Go to the applicable troubleshooting procedure.

   ▶ System performing to specification at this time.

B1990 ESCL Battery Short Circuit To Ground

General Description

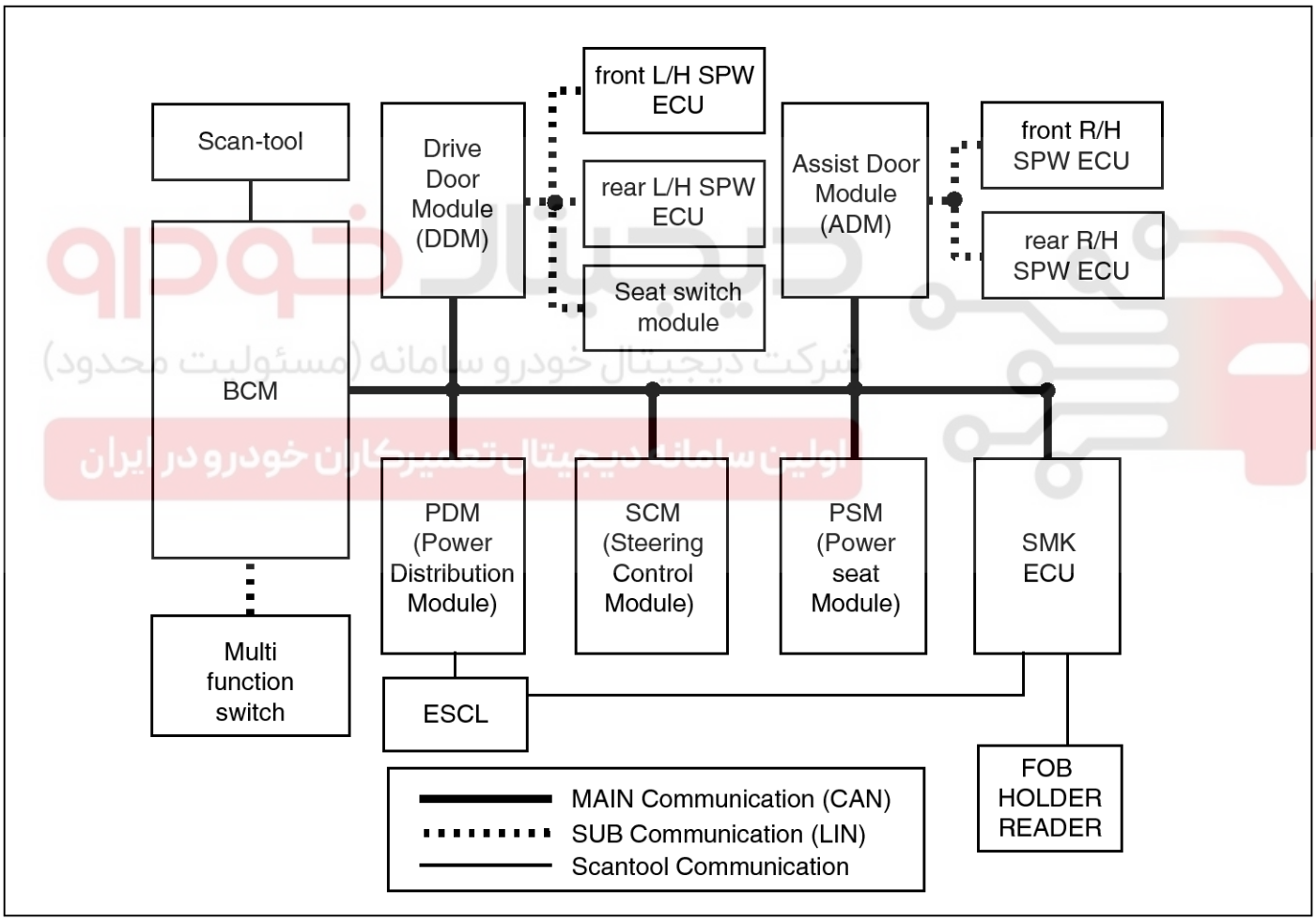
The body electrical system is comprised of seven ECU applied CAN*¹ communication nodes.

(※ Control Units : BCM (Body Control Module), PDM(Power Distribution Module), DDM(Drive Door Module), ADM(Assist Door Module), PSM(Power Seat Module), SCM(Steering Control Module), SMK(Smart Key) ECU.

The steering wheel lock/unlock state of ESCL and the required data when EMS(Engine Management System) controls starting are sent to PDM by the serial communication line.

*¹ CAN (Controller Area Network) : CAN is serial bus communication type which links not only communication system but also control units each other.

*² LIN (Local Interconnect Network) : LIN is serial communication type which is used in electrical control system. (This is less expensive.)



SGHBE9517L

DTC Description

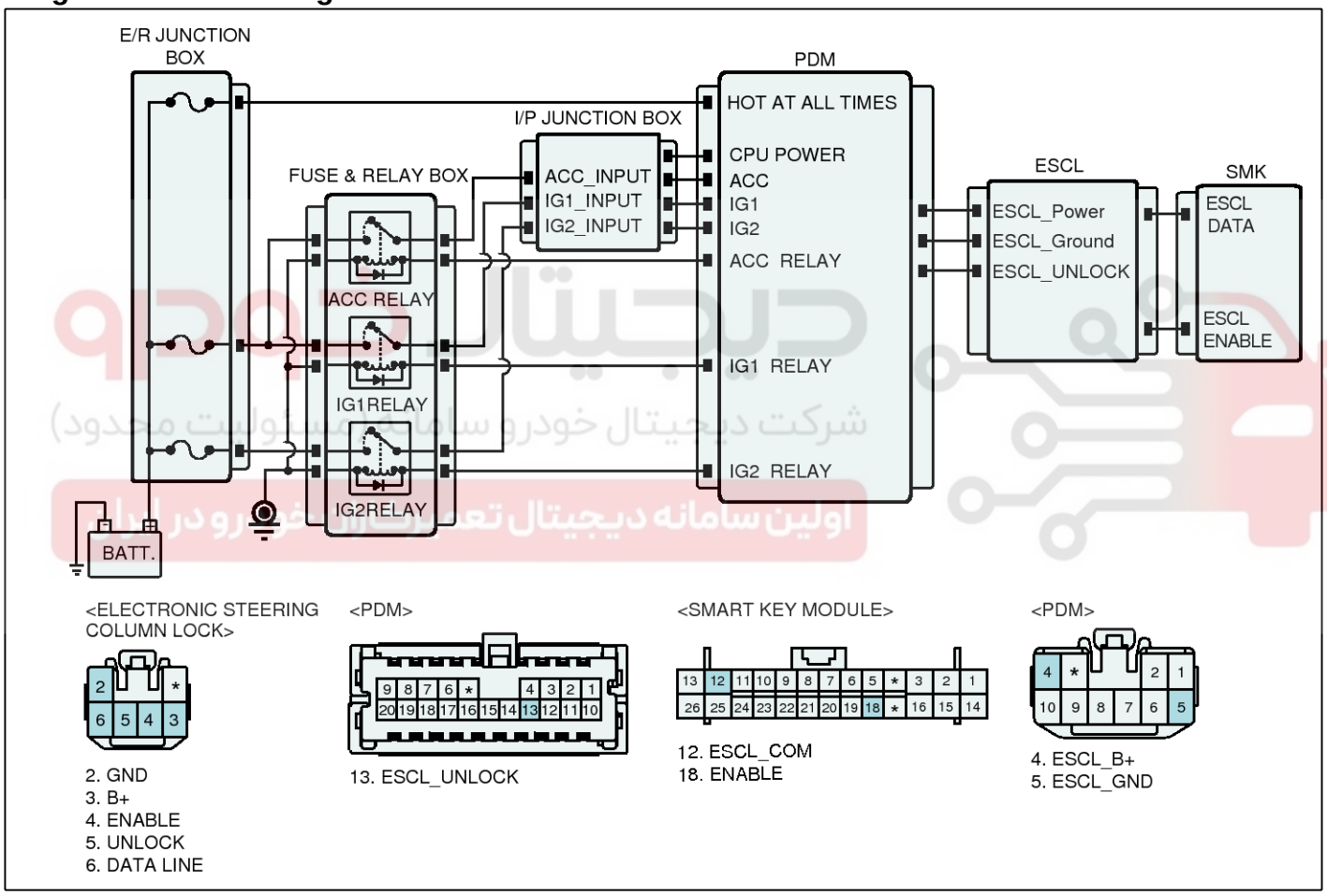
This code is outputted when power circuit is shorted to ground.

(During power supply from PDM to ESCL)

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• ESCL power output line check (by voltage monitoring)	• Short to ground in ESCL power circuit
Enable Conditions	• Under power supply from PDM to ESCL	
Threshold Value	• ESCL power circuit is shorted to ground(2V and below)	
Diagnostic Time	• Immediately	
DTC Erasing Time	• DTC is erased immediately after trouble fixed. (Under power supply from PDM to ESCL state)	

Diagnostic Circuit Diagram



SGHBE9522L

Signal Waveform & Data

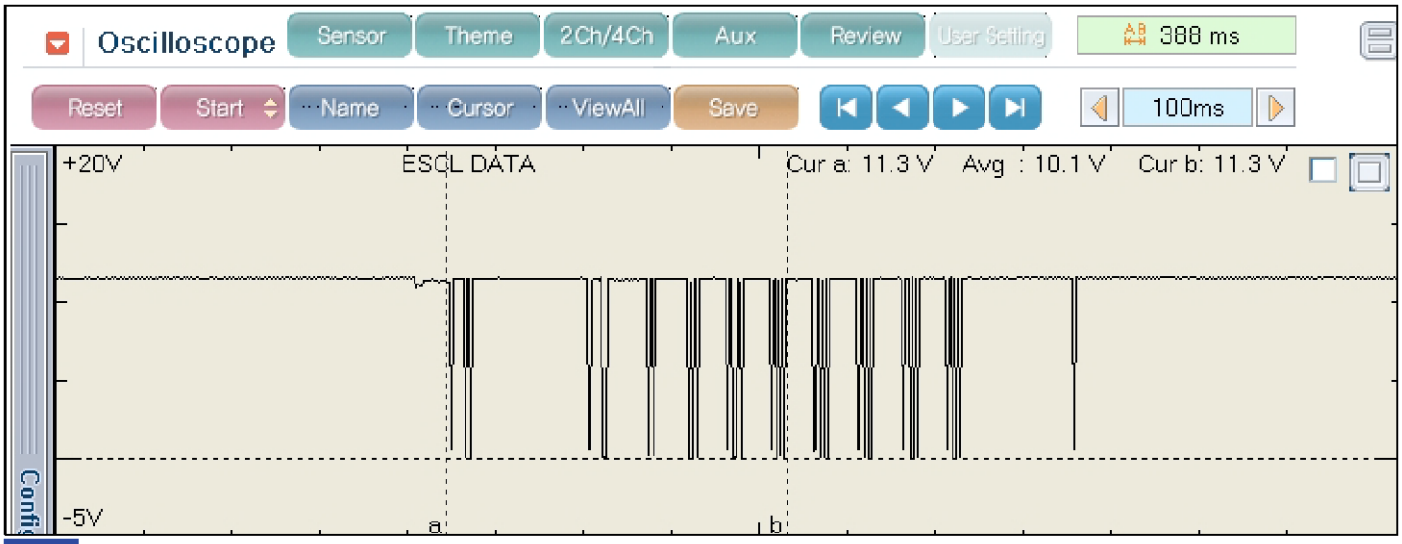


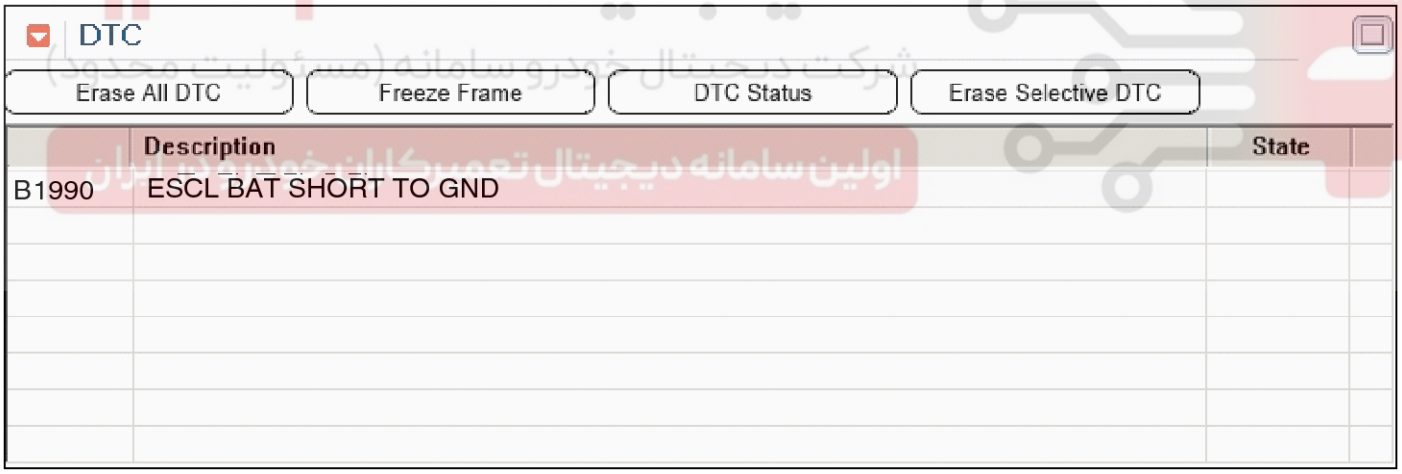
FIG.1

SGHBE9507L

Fig.1) ESCL Data Signal Waveform

Scantool Data Analysis

1. Connect GDS.
2. IG "ON" and engine "OFF".
3. Select "DTC Analysis" mode.
4. After erase DTC, keep the vehicle condition within "the enable conditions" (Refer to "DTC Detecting Condition" table).



SGHBE9513L

5. Is the same DTC occurred again?

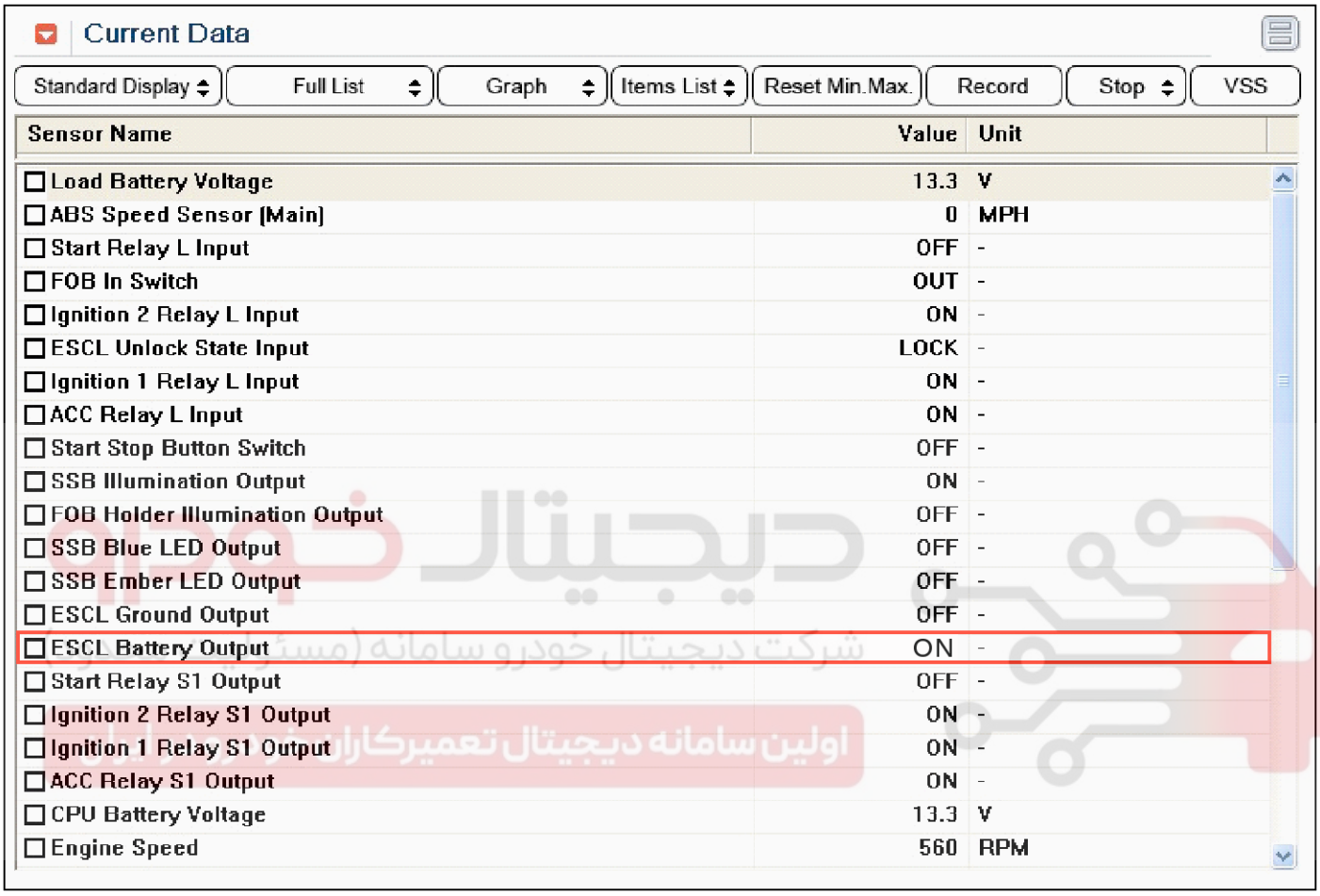
▶ Go to next procedure.

▶ Fault is intermittent caused by poor contact in ESCL's and/or PDM's connector or was repaired and PDM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

Service Data Analysis

1. IG "OFF" and connect GDS.
2. IG "ON" and select "Current Data" menu.
3. Check the service data of ESCL BATT.

Specification : ON



SGHBE9509L

4. Is the service data within specifications?

▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

▶ Go to next procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

▶ Go to "Component Inspection" procedure.

PDM Ground Circuit Inspection

■ Check short at power terminal of PDM

1. IG "ON" & ENG "OFF".
2. Measure voltage between ESCL power terminal of PDM and chassis ground.
   (Measure the voltage while ESCL works.)

Specification : Approx. 12 V

3. Is the measured voltage within specifications?

   ▶ Go to next procedure.

   ▶ Check open or short on the power circuit between PDM and ESCL.
   Repair as necessary and go to "Verification of Vehicle Repair"

■ Check short to ground on ESCL power circuit

1. IG "ON" & ENG "OFF"
2. Disconnect the connectors of IPM, PDM, ESCL.
3. Measure resistance between ESCL power terminal and chassis ground.

Specification : ∞ Ω

4. Is the measured resistance within specifications?

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

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

   ▶ Repair as necessary and go to "Verification of Vehicle Repair".

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scan tool and select "DTC Analysis" mode.
2. Clear the DTCs and Operate the vehicle within DTC Enable conditions in General information.
3. Is any DTC outputted again?

   ▶ Go to the applicable troubleshooting procedure.

   ▶ System performing to specification at this time.

B1991 Immobilizer TX Short Circuit To Ground

General Description

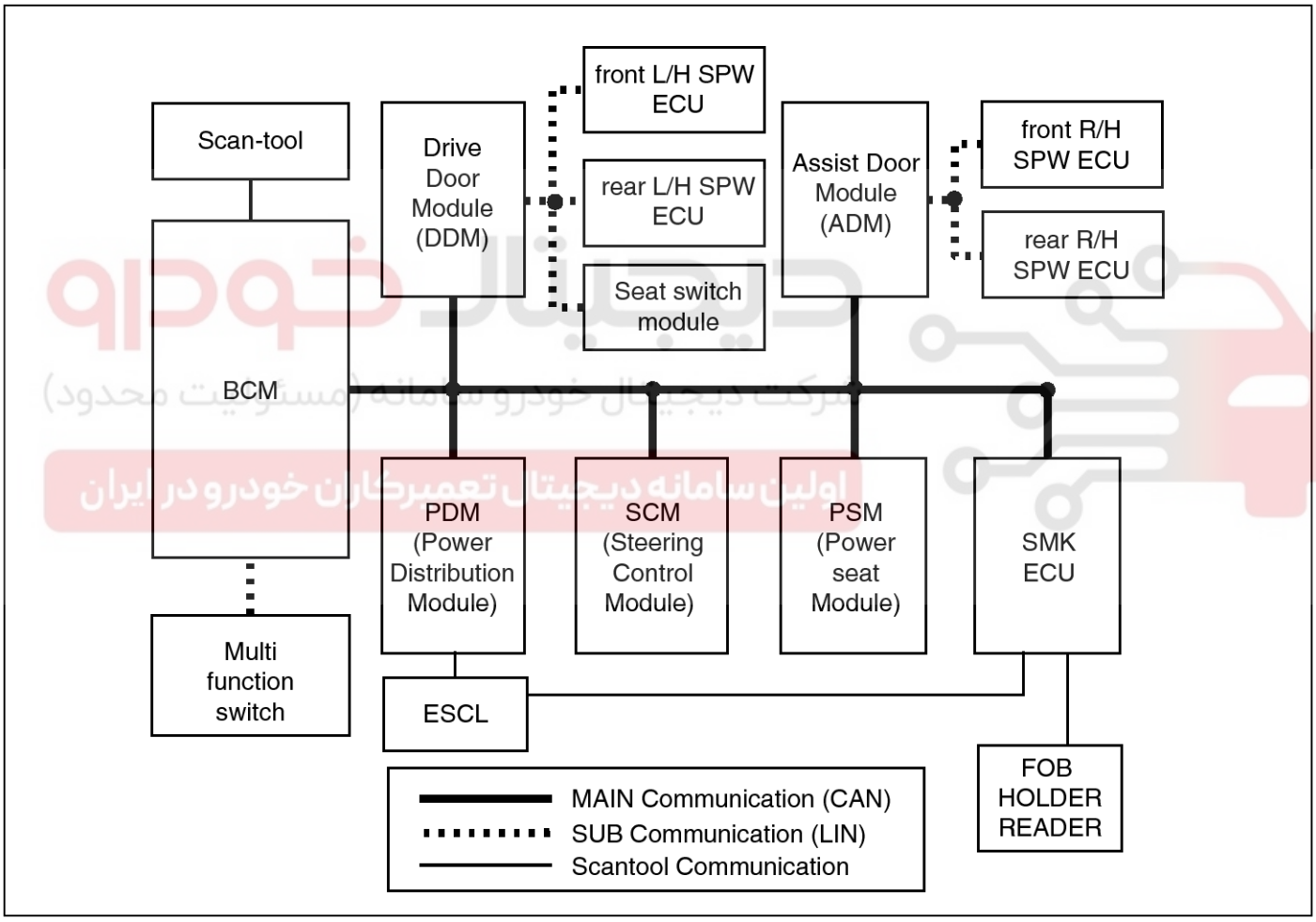
The body electrical system is comprised of seven ECU applied CAN*¹ communication nodes.

(※ Control Units : BCM (Body Control Module), PDM(Power Distribution Module), DDM(Drive Door Module), ADM(Assist Door Module), PSM(Power Seat Module), SCM(Steering Control Module), SMK(Smart Key) ECU.

After insert the fob into the fob holder, press SSB button. Then, the communication state between the fob and the immobilizer is inputted to PDM.

*¹ CAN (Controller Area Network) : CAN is serial bus communication type which links not only communication system but also control units each other.

*² LIN (Local Interconnect Network) : LIN is serial communication type which is used in electrical control system. (This is less expensive.)



SGHBE9517L

DTC Description

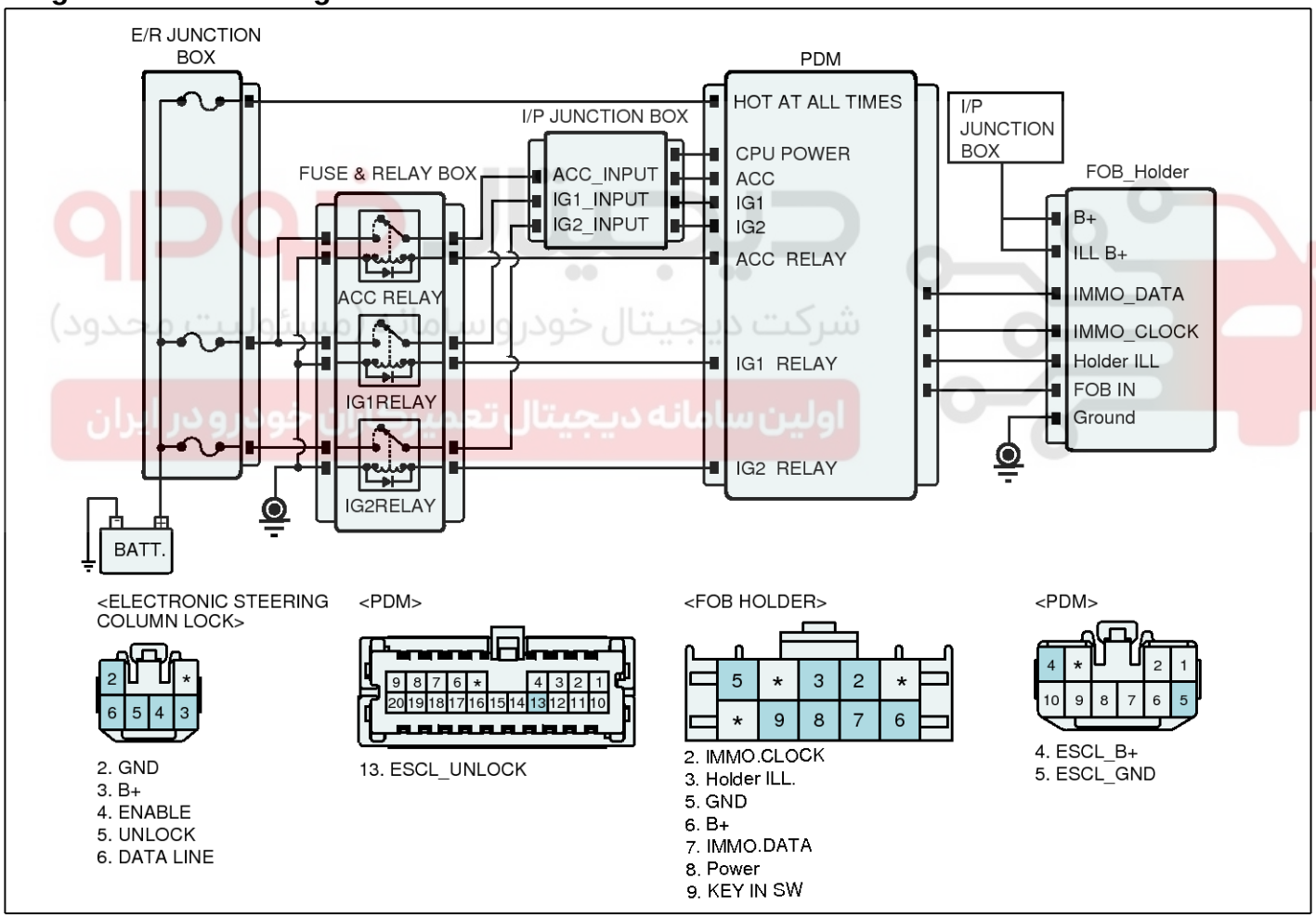
This code is outputted when the immobilizer data circuit is shorted to ground.

(In this case, it is not possible to get authorization although the fob is in the holder.)

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Immobilizer data line check (by voltage monitoring)	• Short to ground in immobilizer data circuit
Enable Conditions	• The communication state between the fob and the fob holder when SSB button is pushed. (The fob is in the h-older.)	
Threshold Value	• Short to ground in immobilizer data circuit (2V and belo-w)	
Diagnostic Time	• Immediately	
DTC Erasing Time	• DTC is erased immediately after trouble fixed. (After co-mmunication recovery)	

Diagnostic Circuit Diagram



SGHBE9523L

Button Engine Start System BE-305

Signal Waveform & Data

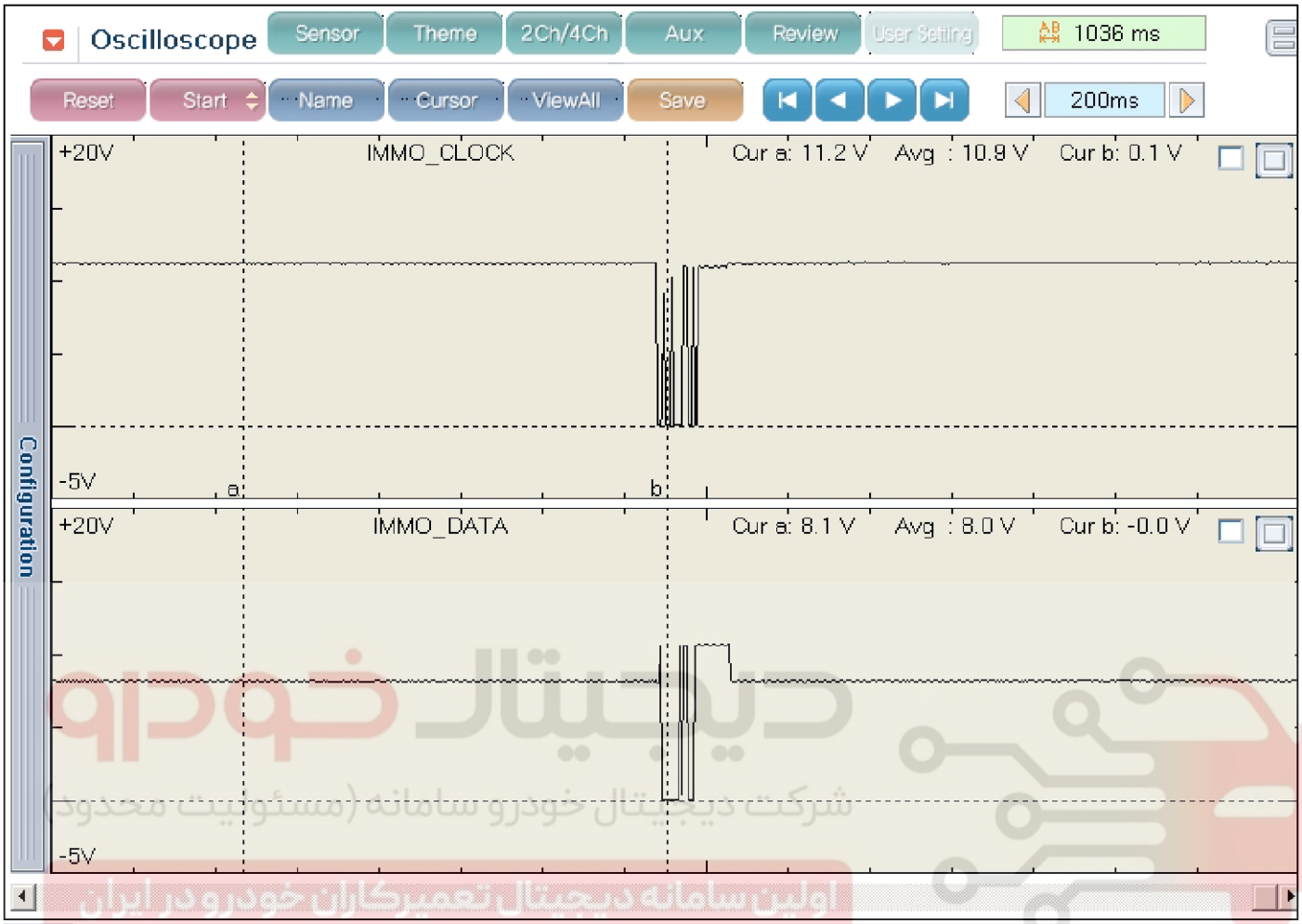


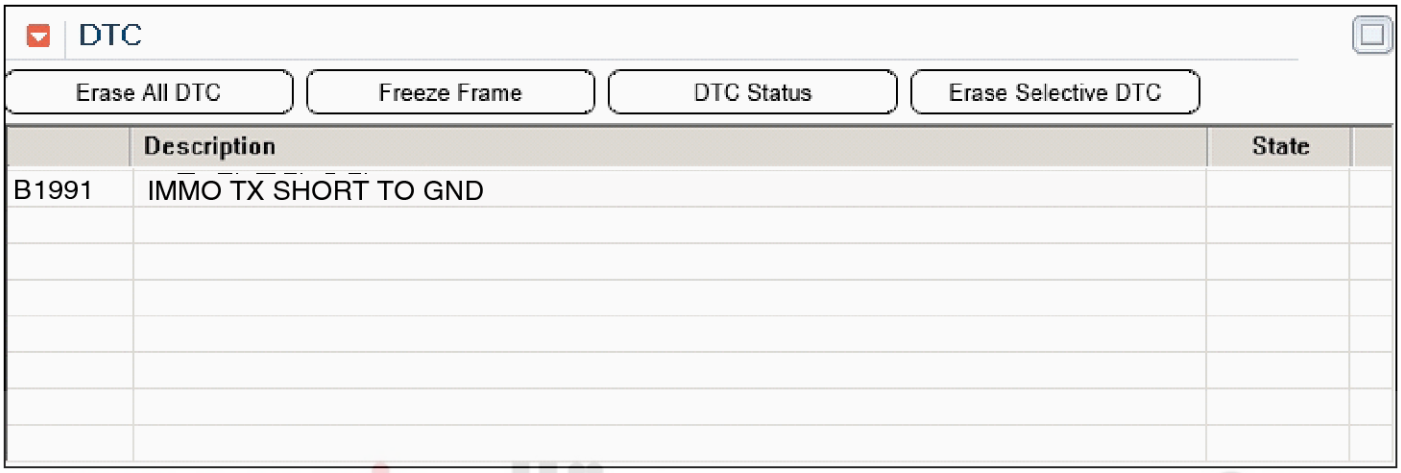
FIG.1

SGHBE9514L

Fig.1) IMMO_CLOCK & IMMO_DATE signal waveform

Scantool Data Analysis

1. Connect GDS.
2. IG "ON" and engine "OFF".
3. Select "DTC Analysis" mode.
4. After erase DTC, keep the vehicle condition within "the enable conditions" (Refer to "DTC Detecting Condition" table).



SGHBE9515L

5. Is the same DTC occurred again?

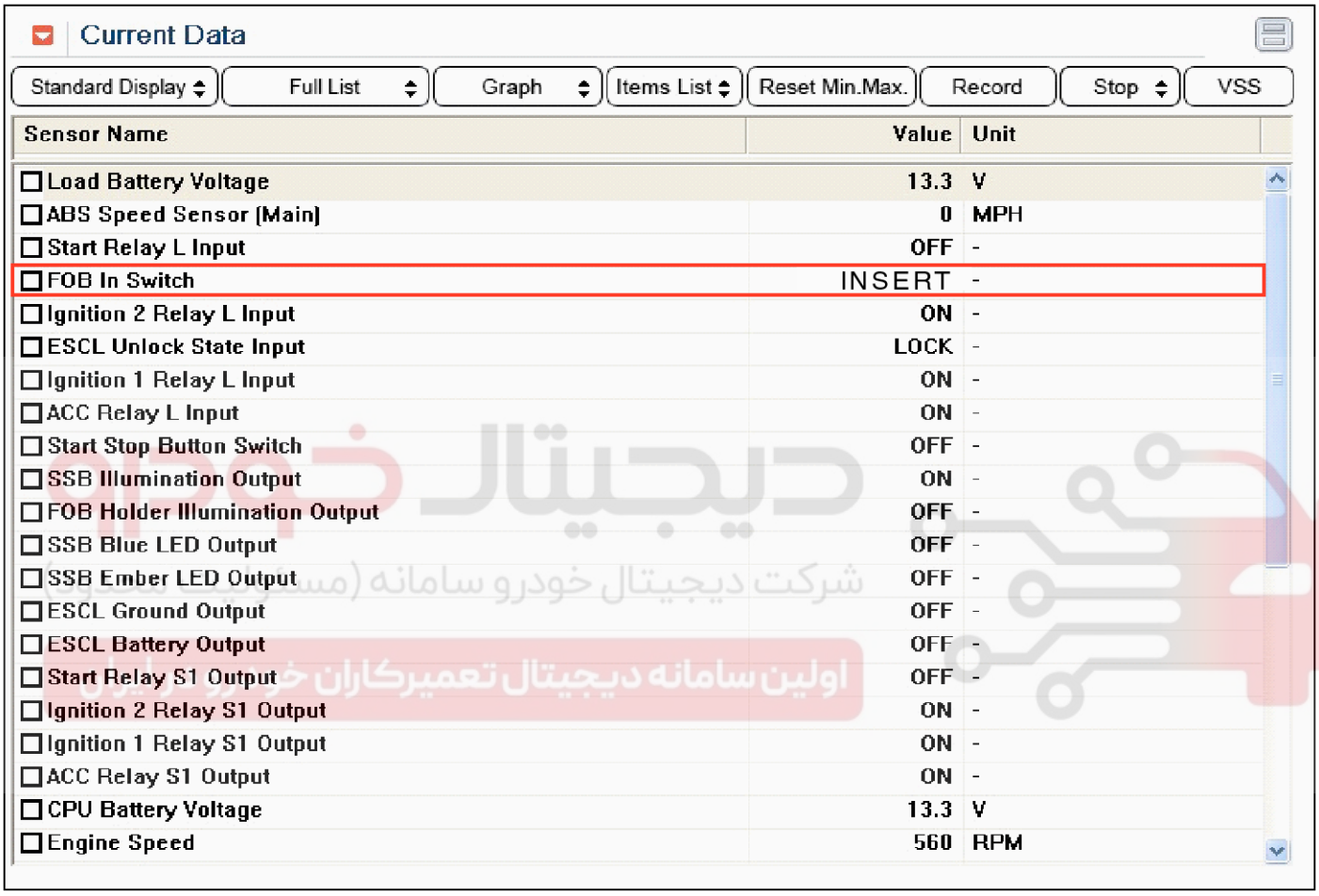
   ▶ Go to next procedure.

   ▶ Fault is intermittent caused by poor contact in PDM's connector or was repaired and PDM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

Service Data Analysis

1. IG "OFF" and connect GDS.
2. IG "ON" and select "Current Data" menu.
3. Check the service data of SMART KEY HOLDER INSERT SIGNAL.

Specification : INSERT (When the fob is inserted in the holder.)



Sensor Name	Value	Unit
Load Battery Voltage	13.3	V
ABS Speed Sensor [Main]	0	MPH
Start Relay L Input	OFF	-
FOB In Switch	INSERT	-
Ignition 2 Relay L Input	ON	-
ESCL Unlock State Input	LOCK	-
Ignition 1 Relay L Input	ON	-
ACC Relay L Input	ON	-
Start Stop Button Switch	OFF	-
SSB Illumination Output	ON	-
FOB Holder Illumination Output	OFF	-
SSB Blue LED Output	OFF	-
SSB Ember LED Output	OFF	-
ESCL Ground Output	OFF	-
ESCL Battery Output	OFF	-
Start Relay S1 Output	OFF	-
Ignition 2 Relay S1 Output	ON	-
Ignition 1 Relay S1 Output	ON	-
ACC Relay S1 Output	ON	-
CPU Battery Voltage	13.3	V
Engine Speed	560	RPM

SGHBE9516L

4. Is the service data within specifications?

▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

▶ Go to next procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

▶ Go to next procedure.

Immobilizer TX Terminal Inspection

■ Check short to ground on IMMO TX terminal

1. IG "ON" & ENG "OFF".
2. Disconnect the connectors of IPM,PDM,ESCL.
3. Measure resistance between IMMO TX terminal and chassis ground.

Specification : ∞ Ω

5. Is the measured resistance within specifications?

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

▶ Substitute with a known - good fob holder and check for proper operation.
If the problem is corrected, replace the unit and go to "Verification of Vehicle Repair" procedure.

▶ Repair as necessary and go to "Verification of Vehicle Repair".

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scan tool and select "DTC Analysis" mode.
2. Clear the DTCs and Operate the vehicle within DTC Enable conditions in General information.
3. Is any DTC outputted again?

▶ Go to the applicable troubleshooting procedure.

▶ System performing to specification at this time.

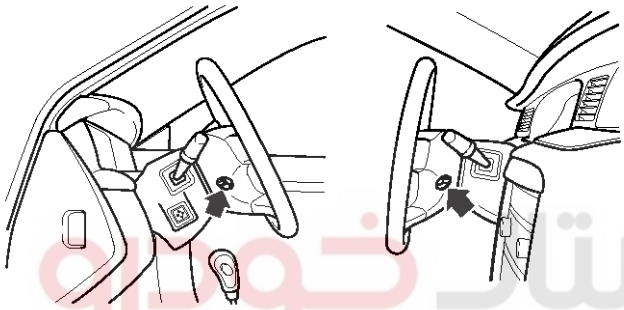
Ignition System

Removal and installation

1. Disconnect the negative battery terminal from the battery.
2. Remove the airbag module.

WARNING

The SRS is designed to retain enough power to deploy the air bag for about 30 seconds even after the battery has been disconnected, so serious injury may result from unintended air bag deployment if service is done on the SRS immediately after the battery cable is disconnected.

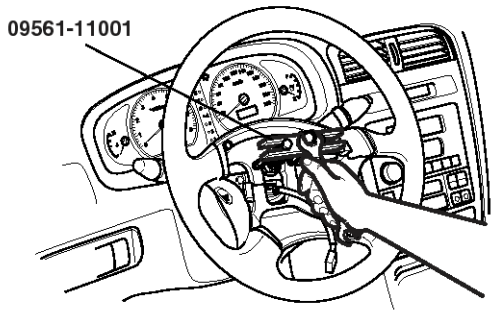


APCD007A

3. Remove the steering wheel lock nut and the washer.
4. Mark the steering column shaft and steering wheel for fitting positions used for re-installation using the special tool. Remove the steering wheel.

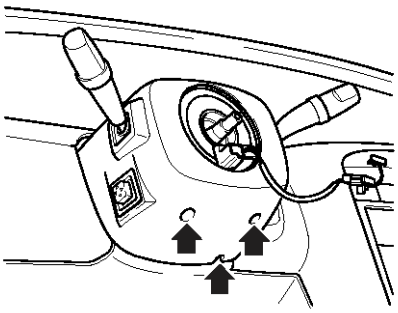
NOTICE

Do not use hammer on the steering wheel to remove it.



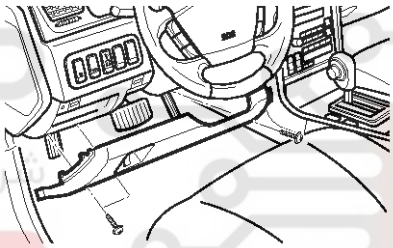
ATCD420B

5. Remove the steering column lower and upper shroud.



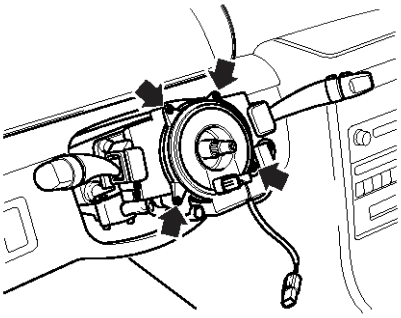
APCD007C

6. Remove the side lower crash pad after removing the side mounting cover.
   1) Remove the hood release cable.
   2) Remove the parking brake release lever.



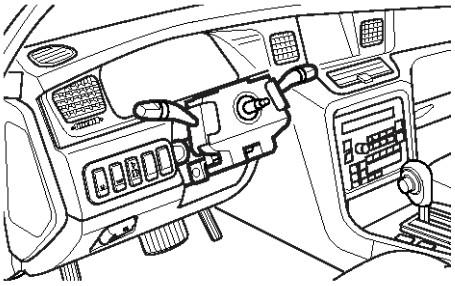
ATCD380B

7. Remove the clock spring.



APCD007D

8. Disconnect the connectors and remove the multi-function switch.



ATCD010A

9. Remove the ignition switch (key box) from the steering column.
10. Installation is the reverse of removal.

Inspection

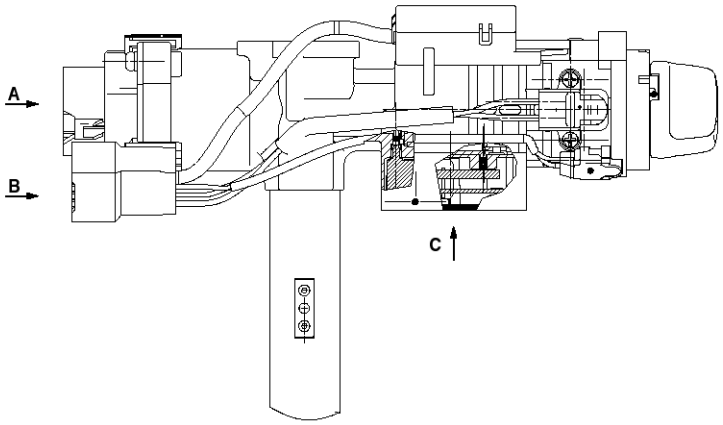
1. Disconnect the connector under the steering column.
2. Check the switch continuity between the terminals.
3. If continuity is not as specified, replace the switch.

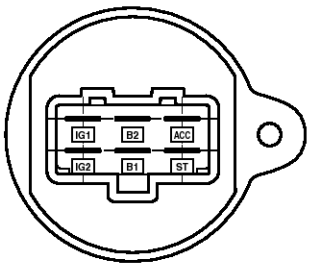
Terminal / Position	KEY	IGN SW B1	IGN SW ACC	IGN SW IG1	IGN SW B2	IGN SW IG2	IGN SW ST	STEERING TRAVEL	STEERING TRAVEL	KEY WARNING SWITCH W(+)	KEY WARNING SWITCH W(-)	KEY ILLUMINATION SWITCH
LOCK	DISCONNECTED							L				
LOCK	CONNECTED							L	F			
ACC	CONNECTED	○—○	○—○							○—○		
ON	CONNECTED	○—○	○—○	○—○	○—○	○—○		F				
START	CONNECTED	○—○	○—○	○—○	○—○	○—○	○—○					

NOTE

1. ○—○ : Indicates that there is continuity between the terminels.
2. L : LOCK
3. F : UNLOCK

LTCD085A





Starting switch
VIEW A

1		2	3
4	5	6	7	8

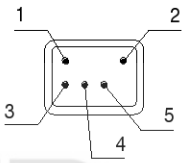
< PIC Type >

3	2		1
8	7	6	5	4

< General >

VIEW B
Key set switch

NO	단 자	비고
1	W(-)	
2	F DATA IMMO	PIC Type
3	O DATA IMMO	PIC Type
4	W(+)	
5	ILL(+)	
6	ILL(-)	
7	GND IMMO	PIC Type
8	IMMO POWER	PIC Type



VIEW C

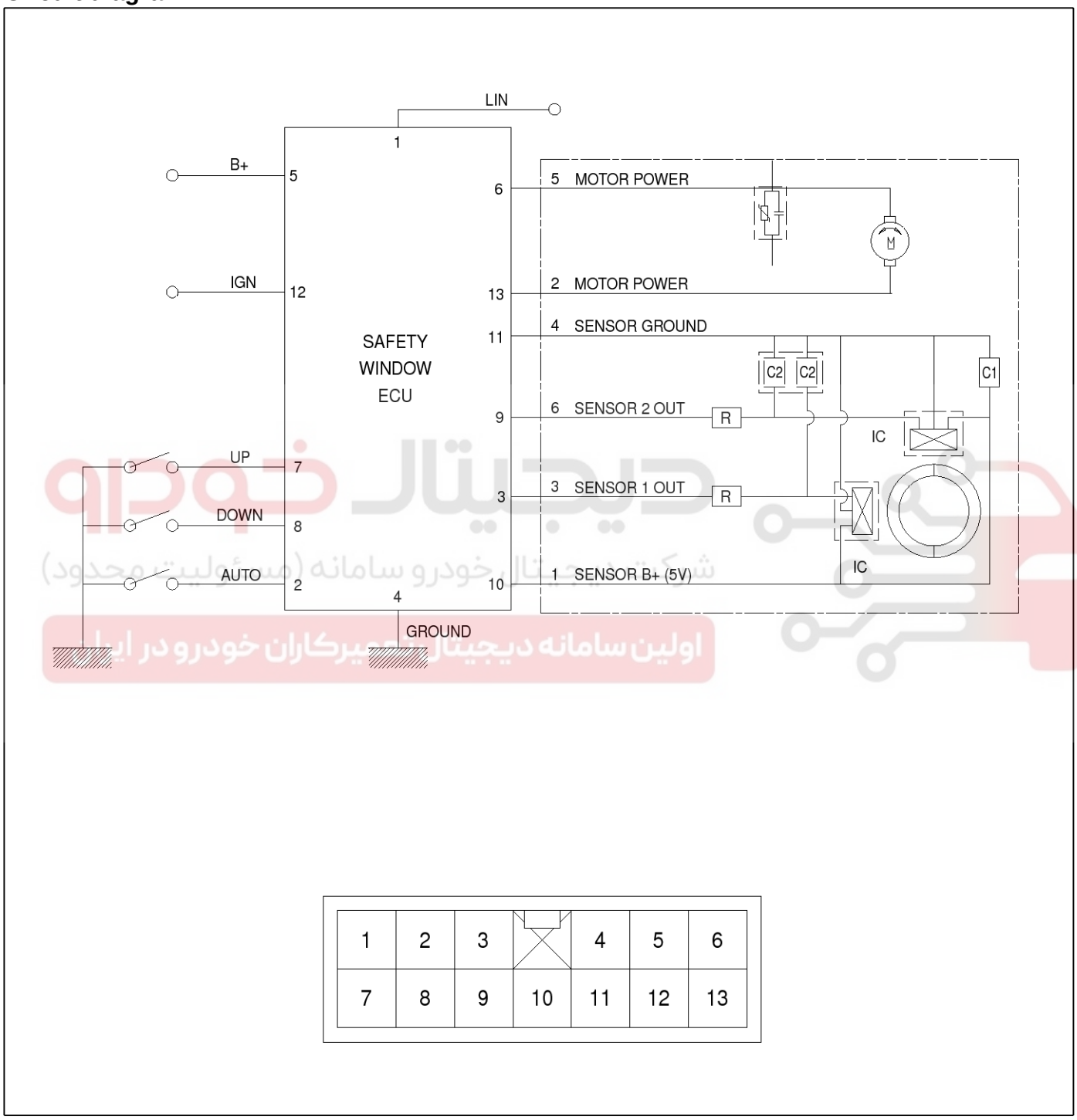
NO	단 자
1	DATA LINE
2	POWER (+12V)
3	GROUND
4	-
5	-

LTCD085B

Multiplex Communication

Safety Window ECU

Circuit diagram



1	2	3		4	5	6
7	8	9	10	11	12	13

ATCD302A

Description

Safety window ECU is installed on each door and receives the power window control signal from the driver side door module via LIN communication with the driver side door module and controls the power window up/down motor operation output.

Besides the safety window ECU will detect motor rotation pulse signal via hole IC installed on each motor. The pulse signal is used to detect the stick by foreign material during the power widow up operation or the manual up operation.

Upon detection safety window, ECU reverses the motor operation output (150mm down). It is called the safety window control.

General operation

1. Control the power window motor by means of LIN communication between Safety power window ECU and Power Window Main / Assist, or direct Up/Down switching.
2. Software recognizes the error on the system. For example, Hall IC error (impossible to determine the window position), Wrong normalization information or EEPROM (hardware error) error. ECU will get an execution of software reset. Exception position data, RAM data will be preserved.

   NOTICE

   If software system reset generates, All kinds of window movement (Manual, Auto Up/Down) become terminated immediately except the reverse movement by safety function.
3. Software provides an algorithm in order to prevent the motor from thermal overheating under the specified conditions like EEPROM Data valid. After power on reset, the software thermal counter takes an initial value. In case of motor running, software increases the thermal counter by using the motor heating characteristic, otherwise the thermal counter decrease by using the motor cooling characteristic.

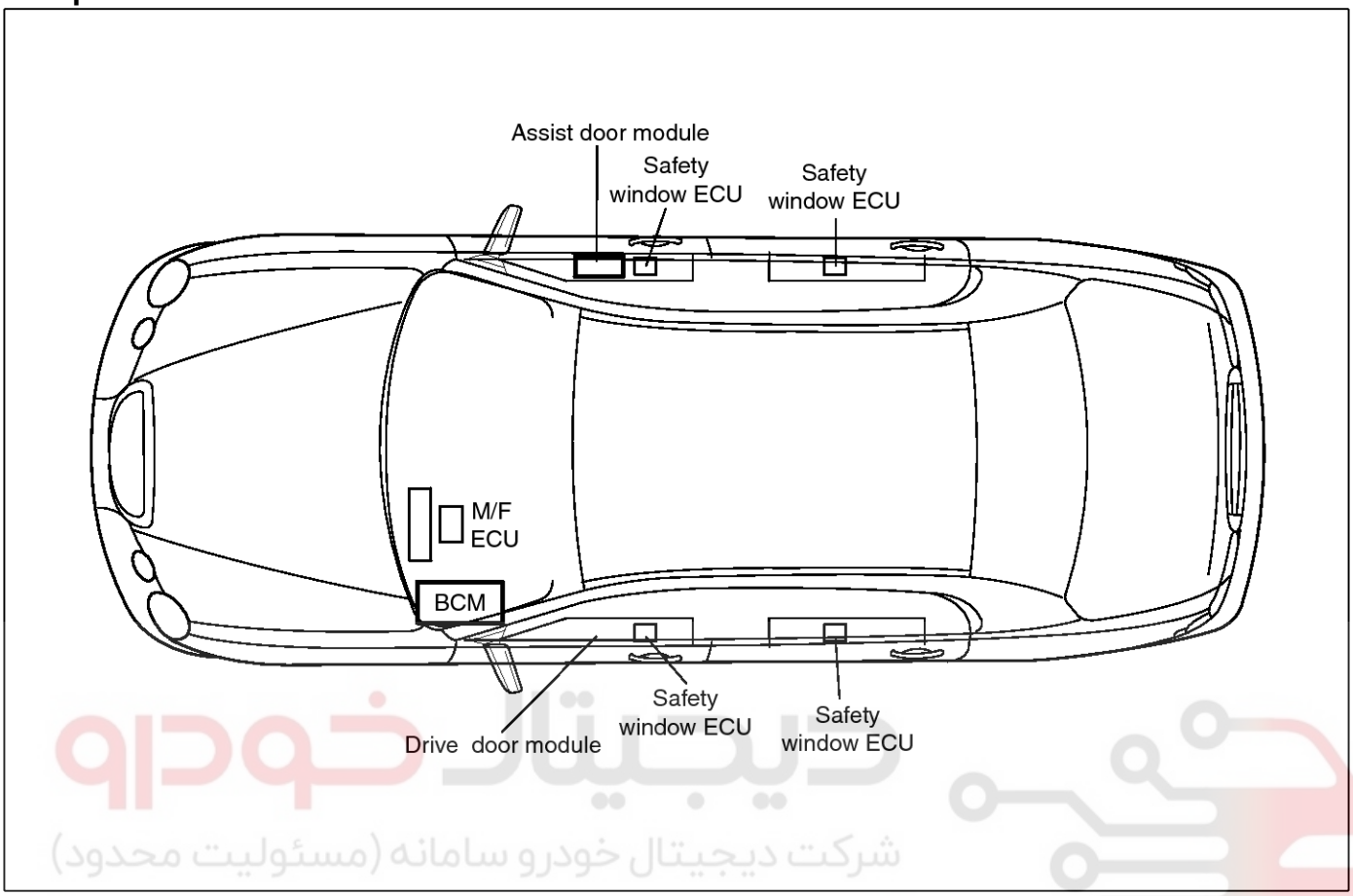
   There are 2 thermal protection limits. If the software thermal counter passes the first limit and actual movement is finished, motor movement is disabled until software thermal counter decreases to the release limit temperature value. If the software thermal counter passes the second limit (while motor running) movement will stop at once until release temperature value is reached (reversing will not be interrupted by software thermal protection).
4. After power on reset or error detection, the motor has to be normalized at the top travel position of window.

   How to initialize:

   Use Up function to move the window into the fully closed position. As the window reaches the fully closed position, pressthe power window switch for 200ms. If block detection recognizes the top travel position of window, a system state changes to normalized.

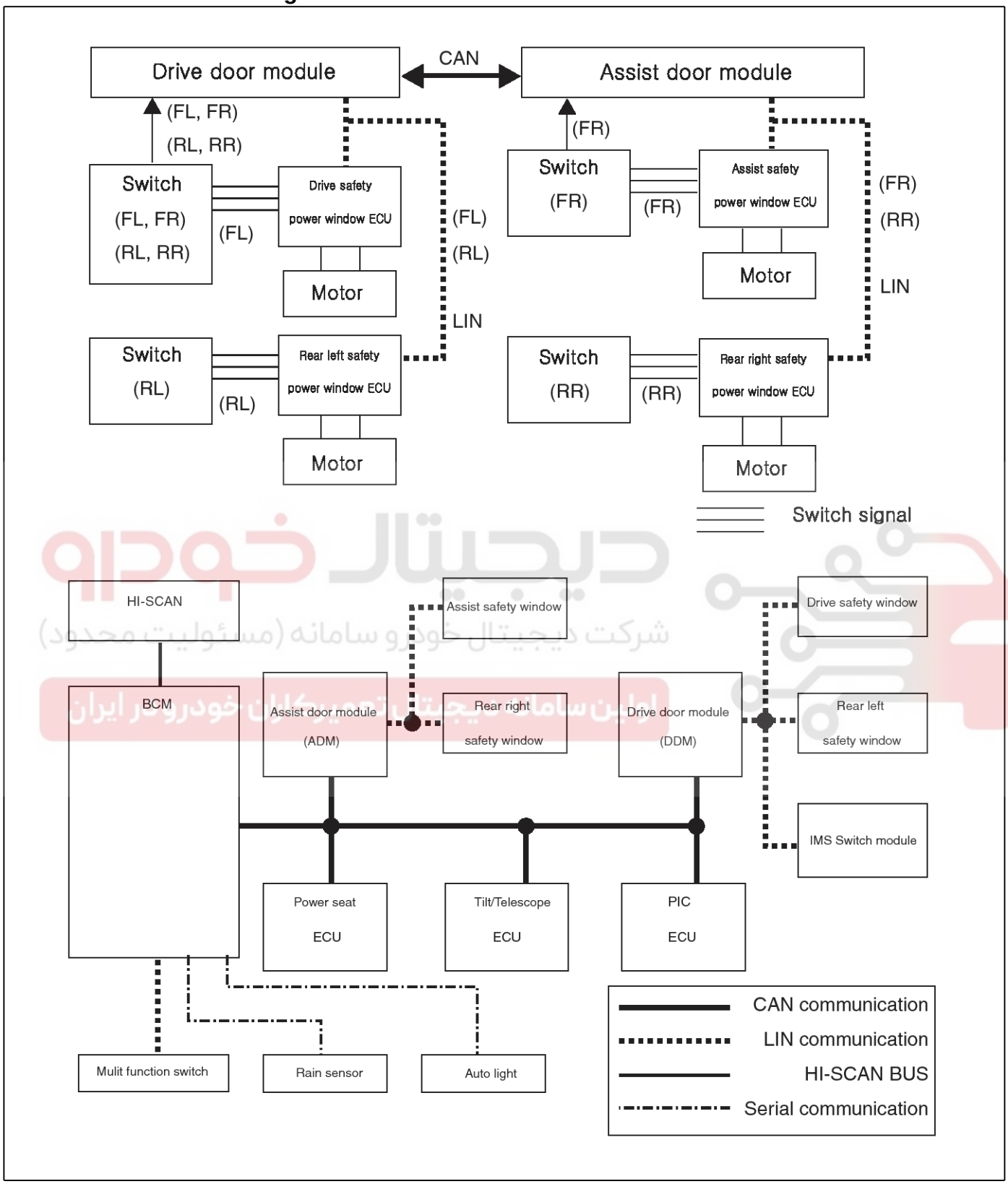
   After system is normalized, move the window 5 times upwards and downwards completely in order to adapt the system on door characteristics.
5. As the safety function is active, ECU will stop all sort of auto-up function at once and the motor moves to the down direction 150mm from the point where the safety function becomes activated. As motor reaches the 150mm down position from or the bottom travel position of window, the motor stops. Reversing can't be interrupted by any other function, except hardware reset. If the system generates a software system reset (e.g. detection of failed hall sensor signals) the reversing time will be limited to (5±0.4) seconds.

Components



LTCD300A

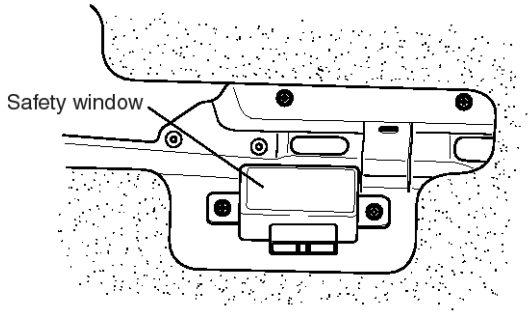
Communication block diagram



LTCD300B

Removal

1. Remove the door trim, refer to the body group.
2. Disconnect the connector and loosen the screw, and then remove the safety window ECU.



LTCD304A

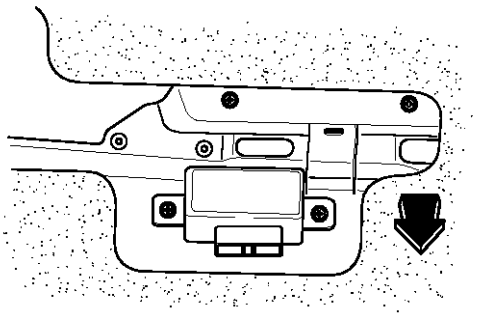
CAUTION

The safety window ECU must never be subjected to strong shocks. Do not allow it to fall and do not threw it when handling.

Do not disassembly the safety window ECU.

Installation

1. Install the safety window ECU as below figure.



ATCD301A

2. Make sure of the color of safety window ECU label before installation.

NOTICE

The color of safety window ECU label

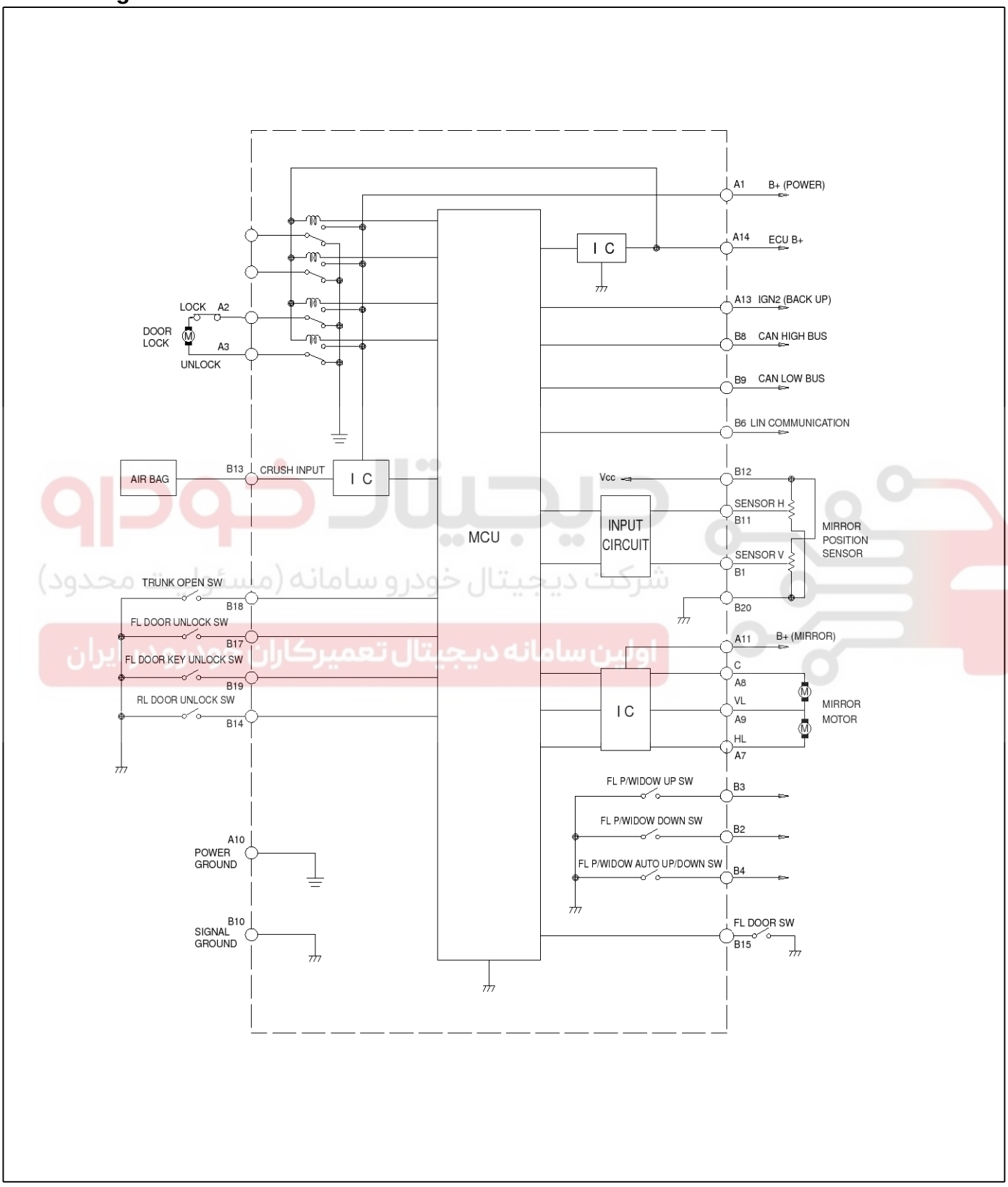
Drive : White

Assist : Yellow

Rear : Blue

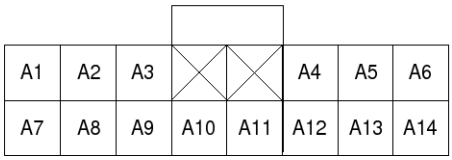
Driver Door Module

Circuit diagram

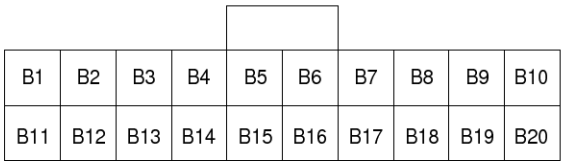


LTCD342A

Connector configration



"A" CONNECTOR



"B" CONNECTOR

NO	"A" CONNECTOR
A1	B+(POWER)
A2	DR LOCK OUT
A3	DR UNLOCK OUT
A4	NC
A5	NC
A6	NC
A7	MIRROR HL
A8	MIRROR C
A9	MIRROR VL
A10	POWER GROUND
A11	B+(MIRROR)
A12	NC
A13	IGN2 (BACK UP)
A14	ECU B+

NO	"B" CONNECTOR
B1	MIRROR SENSOR V
B2	FL P/WIDOW DOWN SW
B3	FL P/WIDOW UP SW
B4	FL P/WIDOW AUTO UP/DOWN SW
B5	NC
B6	LIN COMMUNICATION LINE
B7	NC
B8	CAN HIGH
B9	CAN LOW
B10	SIGNAL GND
B11	MIRROR SENSOR H
B12	MIRROR SENSOR Vcc
B13	CRUSH INPUT
B14	RL DOOR UNLOCK SW
B15	FL DOOR SW
B16	NC
B17	FL DOOR UNLOCK SW
B18	TRUNK OPEN SW
B19	FL DOOR KEY UNLOCK SW
B20	MIRROR SENSOR GROUND

LTCD342B

Description

Driver side power window switch, a component of CAN, performs CAN communication with BCM, seat ECU, tilt ECU, passenger side power window switch and PIC module, and it also performs LIN communication with switch module and safety ECU. Driver controls driver side power window switch button located inside of the driver side door to operate power window, mirror, door lock and unlock.

1. It performs 4 types of operation of manual up/down and automatic up/down operation for 4 power windows.
2. It performs manual operation of the mirror position by manual switch. (up/down and left/right)
3. It performs registration and replay of mirror position by the mirror switch up to 2 drivers.
4. It performs central door lock and unlock function
5. It loads trunk-opening signal on the BUS through the CAN communication.

Function

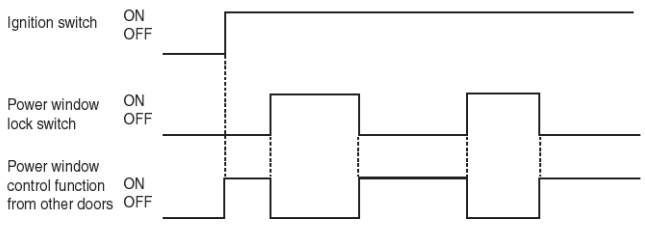
Power window control

1. This switch controls power window up/down, automatic up/down from driver side. Driver's power window switch sends input signal through CAN communication by the manual up/down and automatic up/down switch input. At the same time passenger side sends manual up/down and automatic up/down signals to the wires.

   → Each safety window ECU receives the signal and performs manual up/down and automatic up/down functions.

2. Power window lock

   When the driver's power window lock switch is ON, each safety window ECU receives the power window lock command to prohibit the operation by the passenger side doors except the driver's door.



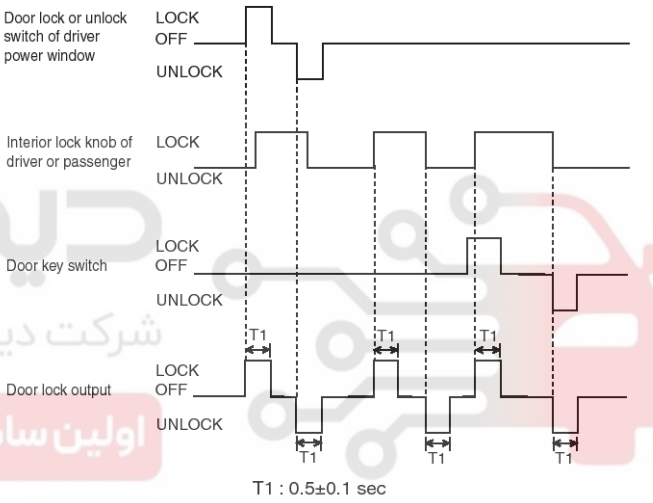
LTCD341A

3. Timer function

   Power window switch can be controlled for 30 seconds after the ignition is turned off. This function stops immediately even within 30 seconds if the front door is opened.

Central door lock/unlock

1. Door lock/unlock switch of the driver side power window controls lock and unlock of all doors. (However, it cannot be unlocked when BCM receives the boundary mode through CAN communication, and it cannot be locked until the ignition off in case of crash unlock.)
2. When the door is locked by the interior lock knob of the driver's (or passenger side door), all doors can be locked. (Though, unlocking is not feasible)
3. When locking or unlocking with the door key switch from driver side, all doors can be locked or unlocked.



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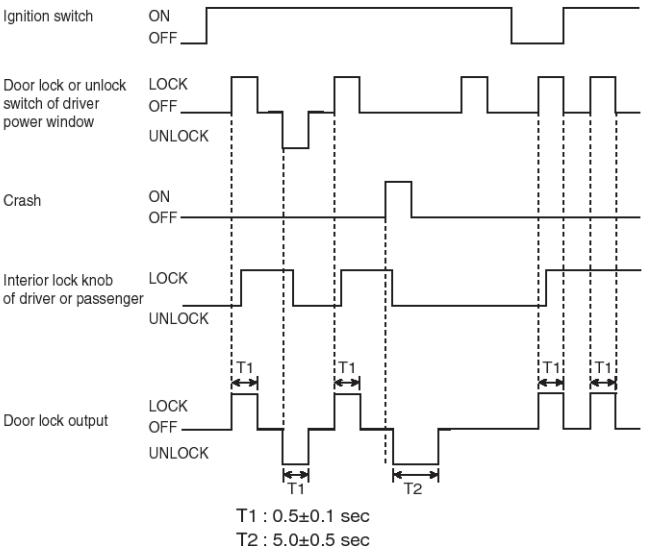


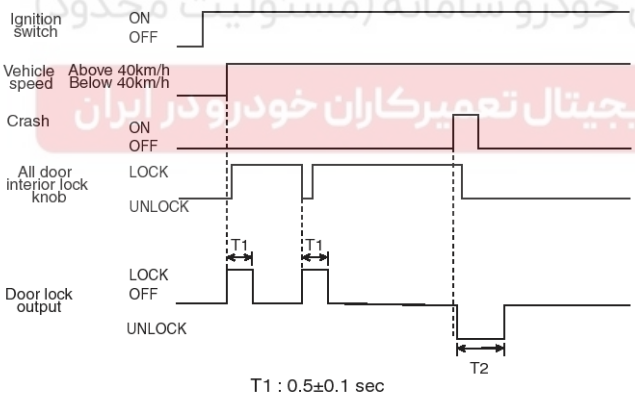
LTCD341C

Crash unlock

1. When locking or unlocking with the door key switch from driver side (or passenger side), all doors can be locked or unlocked)

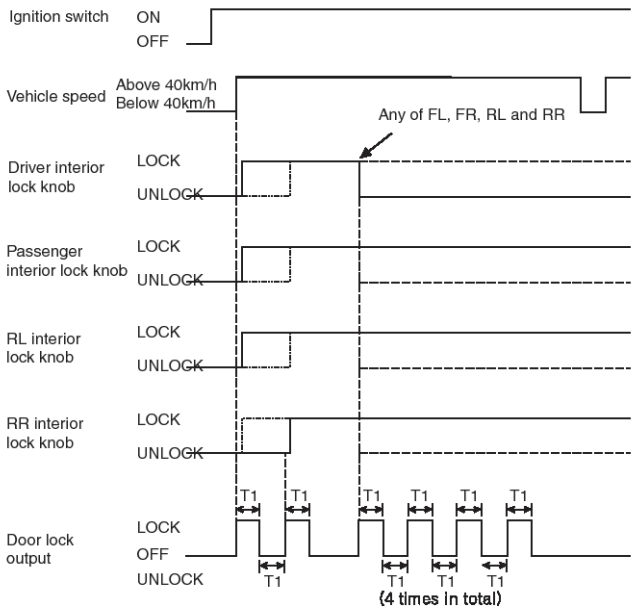
Auto door lock

1. When the vehicle speed exceeds 40km/h under ignition on (BCM receives from CAN communication), it outputs lock command if any of the all door locks is unlocked. (0.5±0.1 sec)
2. While the vehicle speed is above 40 km/h and any of the door lock gets unlocked, it outputs lock command (0.5 ±0.1 sec)
3. If any of the door lock is unlocked even after the above 1 and 2, it outputs lock command (ON: 0.5 ± 0.1 sec, OFF: 0.5 ±0.1 sec) for 3 times in maximum (4 times in total). If any of the door lock is unlocked hereafter, it does not execute above 1, and it performs this function when the ignition is turned on again.
4. This function has the priority over the key reminder function of the auto door lock.
5. Auto door lock is not executed under crash unlock condition. When the ignition turned on from off, it executes the auto door lock function.



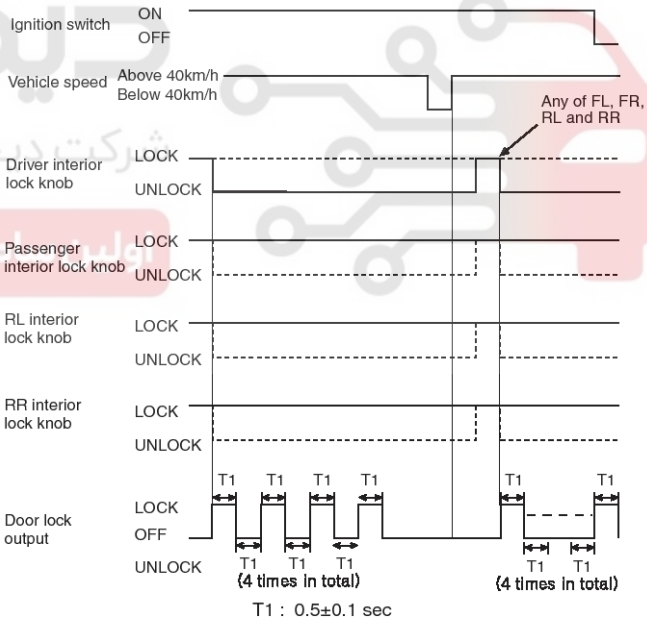
T1 : 0.5±0.1 sec
T2 : 5.0±0.5 sec

LTCD341E



T1 : 0.5±0.1 sec

LTCD341F



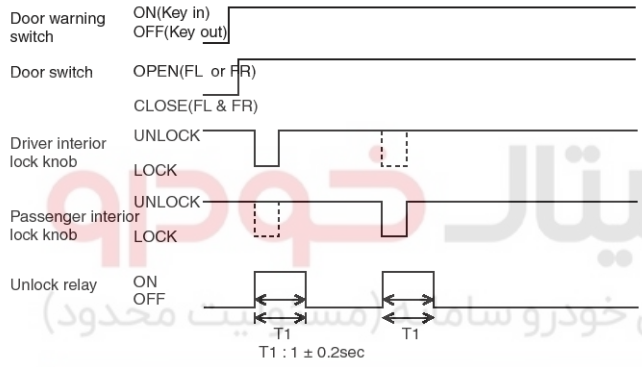
T1 : 0.5±0.1 sec

LTCD341G

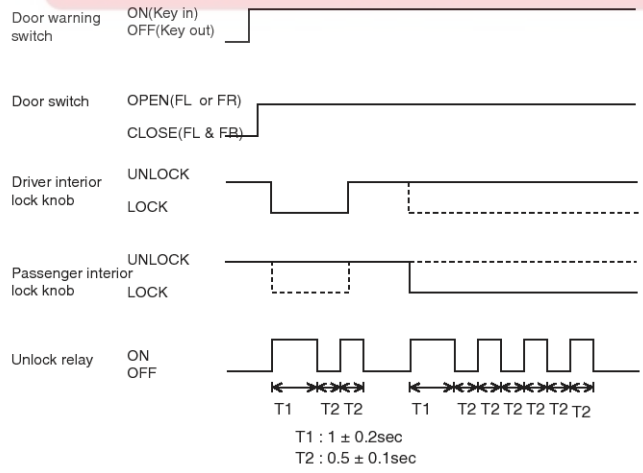
Key reminder

1. If the door switch of driver side or passenger side is locked when door warning switch is turned on and (CAN communication reception), driver side or passenger side door is open, it executes unlock output for 1 second. If the passenger sidedoor remains locked even after the unlock output, it repeats on and off 3 times with the time interval of 0.5 second.

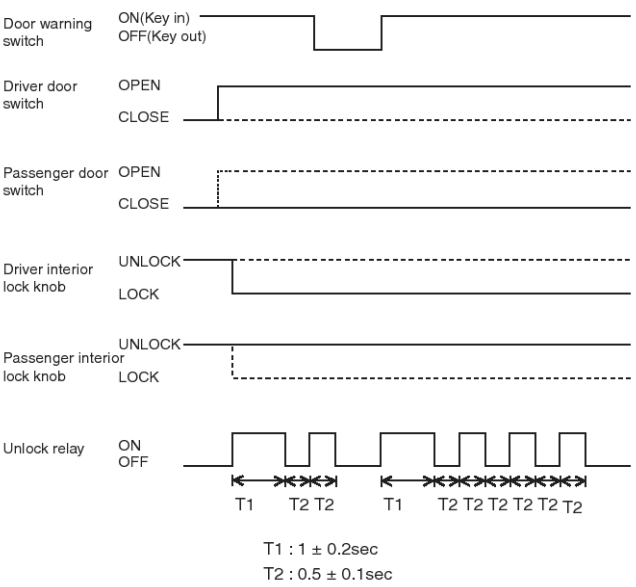
2. If it is converted into unlock during the output of three times, it stops the output. (It stops the next trial)
3. If the door-warning switch turns off during the output of three times, it stops the output. (It stops the next trial)
4. If the door warning switch doesn't turn on when driver door or passenger door is open, or driver side door or passenger side door is locked, it outputs unlock command.
5. If the driver side or passenger side door is locked within 0.5 second after driver side or passenger side door is closed, it outputs unlock command for 1 second.
6. When the vehicle speed is over 3~5km/h (CAN communication reception), key reminder does not operate.



LTCD341H



LTCD341I

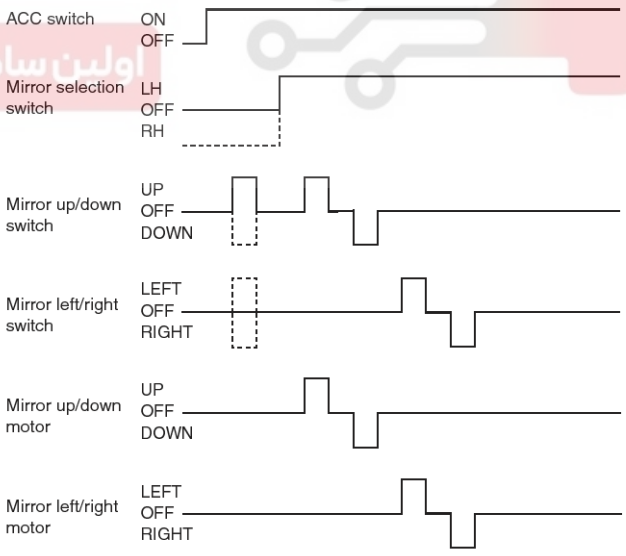


LTCD341J

Outside mirror control by the switch

1. Manual control of left outside mirror

   If the mirror direction switch (up, down, left and right) is pressed when mirror selection switch on driver side power window switch is in outside LH under ACC ON condition, then mirror motor moves to the corresponding direction.



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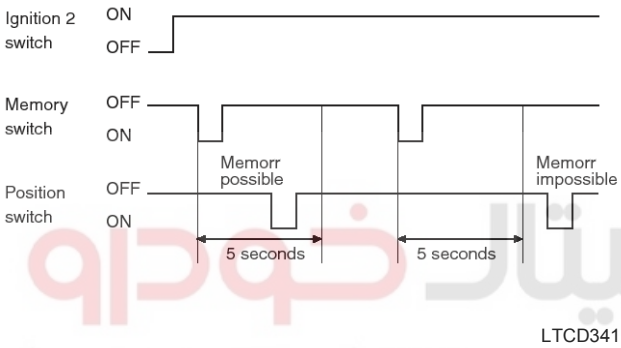
2. Manual control of right outside mirror

   If the mirror direction switch (up, down, left and right) is pressed when mirror selection switch on driver side power window switch is in outside RH under ACC ON condition, then operating signal is sent to passenger side power window switch through CAN

communication.

Outside mirror memory operation by the memory switch

1. If position switch (POS1 or POS2) is pressed within 5 seconds after pressing the memory switch under ignition 2 on, it registers current mirror position. (Switch module sends in LIN communication). (Memory permit status lasts for 5 seconds after memory switch ON. After 5 seconds, memory permits status terminates. In other words, current position is registeredif the position switch (POS1 or POS2) is turned on, during the memory permit status). However, RH side mirror position is not registered during the LH side mirror manual switch operation.



2. Memory permit status is released if any of the following conditions is met.
   - After 5 seconds elapse from memory switch ON.
   - When the ignition 2 is OFF
   - When the memory stop switch is ON
   - When memory registration is complete
3. If more than 2 switches are pressed simultaneously between memory switch and position switches (POS1 or POS2), input is ignored. (Switch module sends in LIN communication)
4. Memory registration cannot be performed if the vehicle speed is over the speed limit or shift lever is not in “P” while the parking brake is released.
5. Memory is cleared if the battery is removed.

Outside mirror replay operation by the memory switch

1. Mirror is returned to the registered position as each position switch is pressed while the ignition 2 is ON.
2. Memory replay operation will be performed only if the memory is registered.(POS1 or POS2)
3. If the position switch (POS1 or POS2) is pressed while the memory replay is in operation, the final switch is effective.
4. Replay inhibit condition
   - When inhibit “P” switch is OFF
   - When the ignition 2 is OFF
   - When LH side mirror switch is pressed
   - When the vehicle speed is more than 3 km/h
   - When the memory STOP switch is turned ON

Outside mirror memory and replay operation by keyless

1. Memory operation
   - Outside mirror LH position is registered in the driver side power window switch when the ignition is turned off from on.
   - When door is locked by the keyless, outside mirror position is registered corresponding to the keyless code.
   - Data related to the memory operation is received from BCM in CAN communication.
2. Replay operation
   - When door is unlocked by the keyless under ignition off state, it replays the position corresponding to the keyless code.
   - Data related to the replay operation is received from BCM in CAN communication on CAN line.
3. Replay prohibit condition
   - When the inhibit “P” switch is OFF
   - When LH side mirror switch is pressed
   - When mirror switch is pressed after ignition on
   - When the vehicle speed is over 3km/h
   - When the memory stop switch is ON

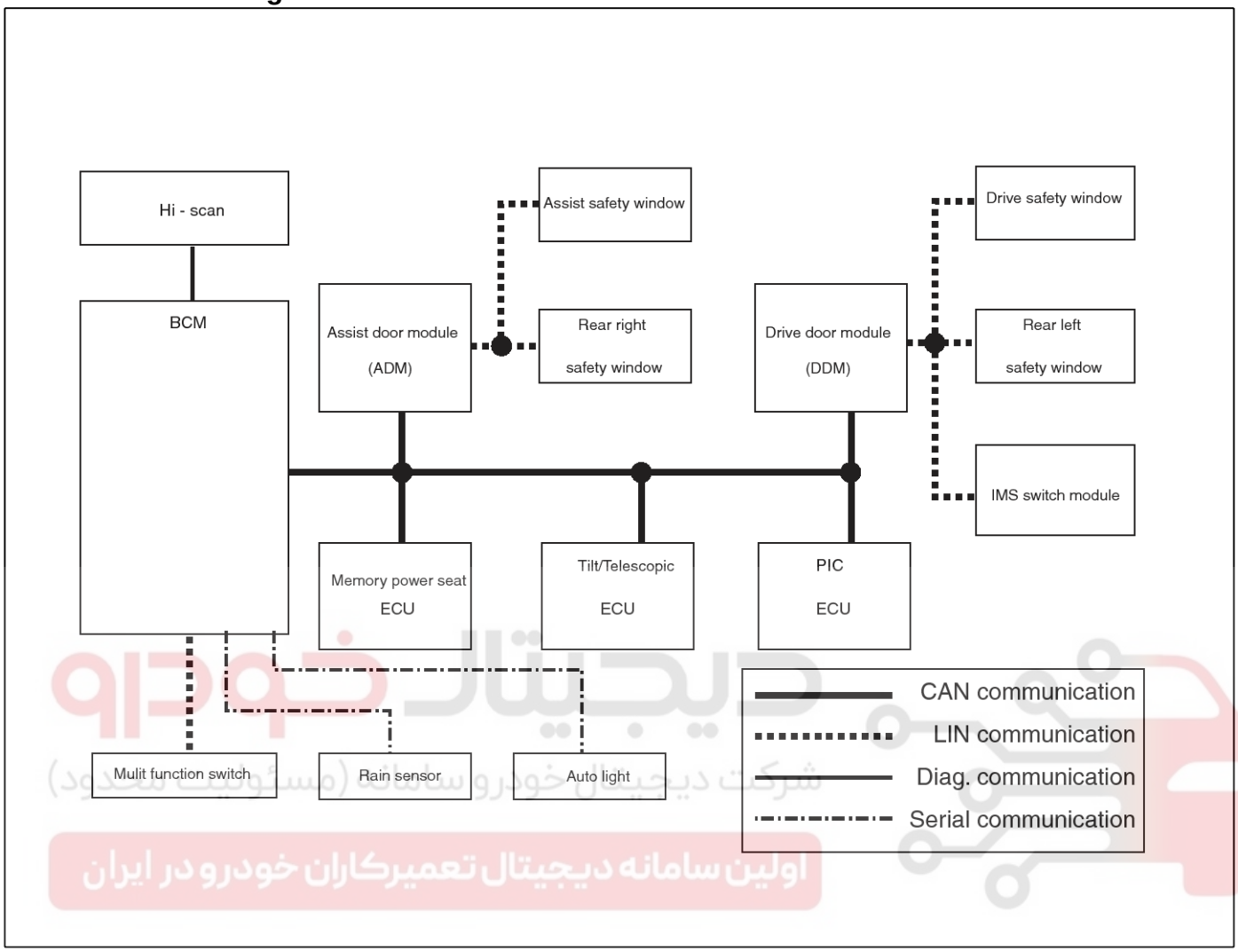
Fail-safe function

1. If the position sensor shows no input change (driving for 5 seconds) above 60 mV while the motor is in operation, it automatically stops the operation judging that wire short, motor failure, or sensor failure.
2. Mirror drive signal cannot be outputted for more than 15 seconds in one direction. (In case of memory replay or manual switch operation)
3. Monitoring of replay execution time
   - If replay operation does not complete within 40 seconds from replay starting time, mirror motor stops the output and terminates the replay control.

Trunk open

When the trunk open switch is on, this data are loaded on the BUS through CAN communication.

Communication diagram



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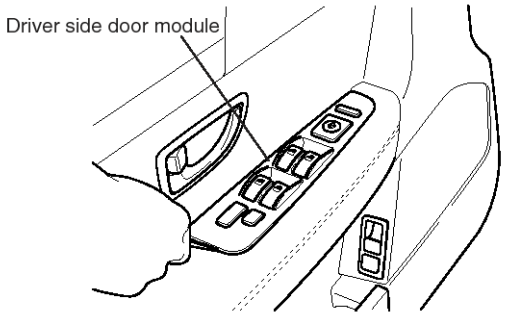
Removal and installation

1. Remove the connector after lifting up the rear of driver side door module.



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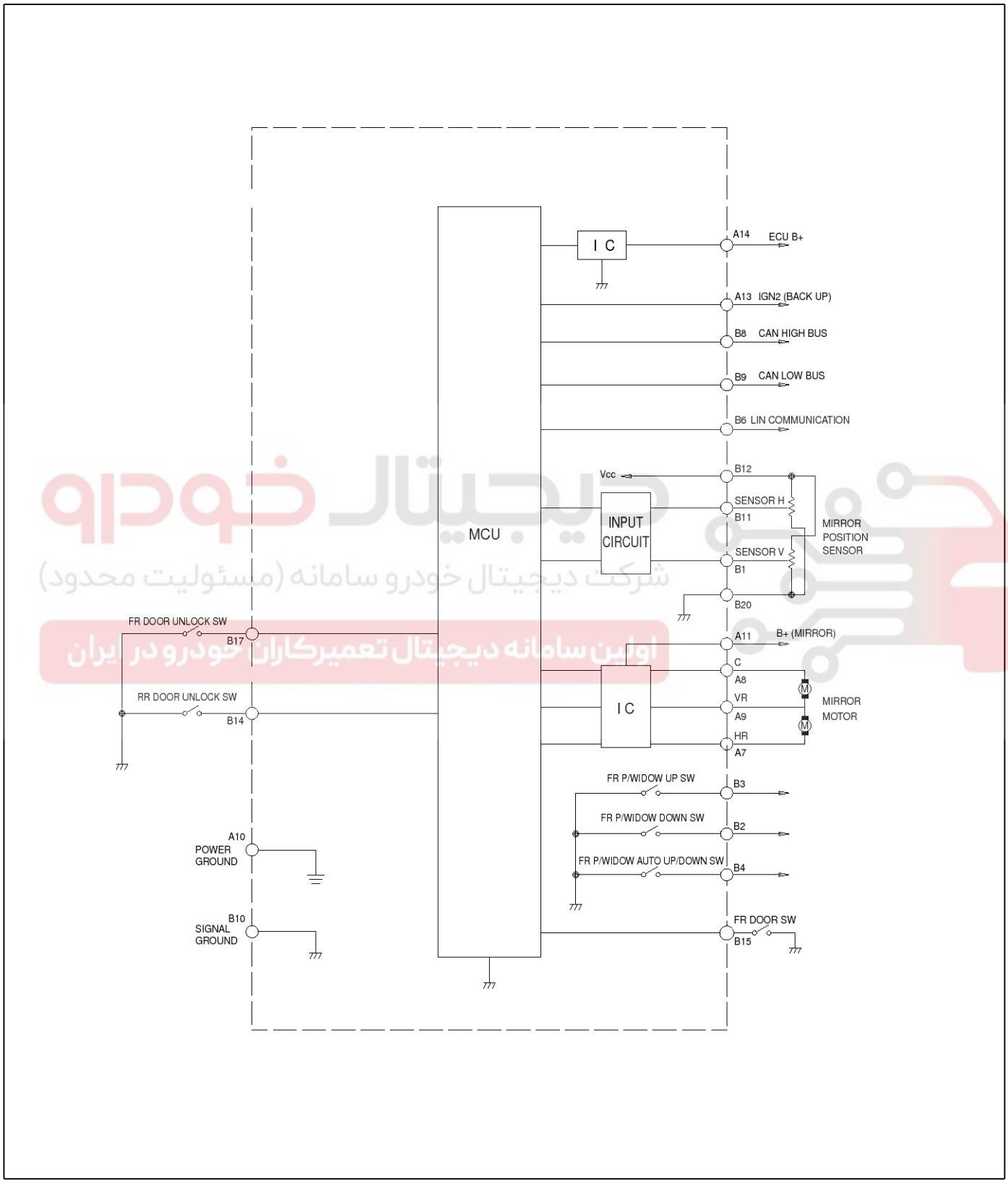
Assist Door Module

CIRCUIT DIAGRAM



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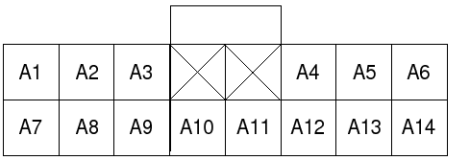
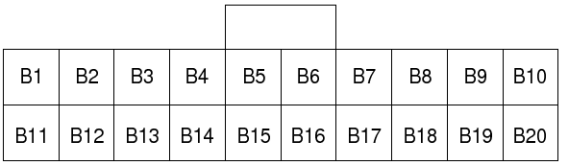
CONNECTOR CONFIGRATION



"A" CONNECTOR



"B" CONNECTOR

NO	"A" CONNECTOR
A1	NC
A2	NC
A3	NC
A4	NC
A5	NC
A6	NC
A7	MIRROR HR
A8	MIRROR C
A9	MIRROR VR
A10	POWER GROUND
A11	B+(MIRROR)
A12	NC
A13	IGN2 (BACK UP)
A14	ECU B+

NO	"B" CONNECTOR
B1	MIRROR SENSOR V
B2	FR P/WIDOW DOWN SW
B3	FR P/WIDOW UP SW
B4	FR P/WIDOW AUTO UP/DOWN SW
B5	NC
B6	LIN COMMUNICATION LINE
B7	NC
B8	CAN HIGH
B9	CAN LOW
B10	SIGNAL GND
B11	MIRROR SENSOR H
B12	MIRROR SENSOR Vcc
B13	NC
B14	RR DOOR UNLOCK SW
B15	FR DOOR SW
B16	NC
B17	FR DOOR UNLOCK SW
B18	NC
B19	NC
B20	MIRROR SENSOR GROUND

LTCD352B

Description

Assist power window switch, a component of CAN, performs CAN communication with BCM, seat ECU, tilt ECU, driver power window switch and PIC module, and it also performs LIN communication with switch module and safety ECU. Passenger controlsassist power window switch button located inside of the assist door to operate power window, mirror, door lock and unlock.

1. It performs 4 types of operation of manual up/down and automatic up/down operation for 4 power windows.
2. It performs manual operation of the mirror position by manual switch. (up/down and left/right)
3. It performs registration and replay of mirror position by the mirror switch up to 2 drivers.

Function

Power window control

1. This switch controls power window up/down, automatic up/down from assist side.

   Assist's power window switch sends input signal through LIN communication by the manual up/down and automatic up/down switch input. At the same time manual up/down and automatic up/down signals sends to the wires

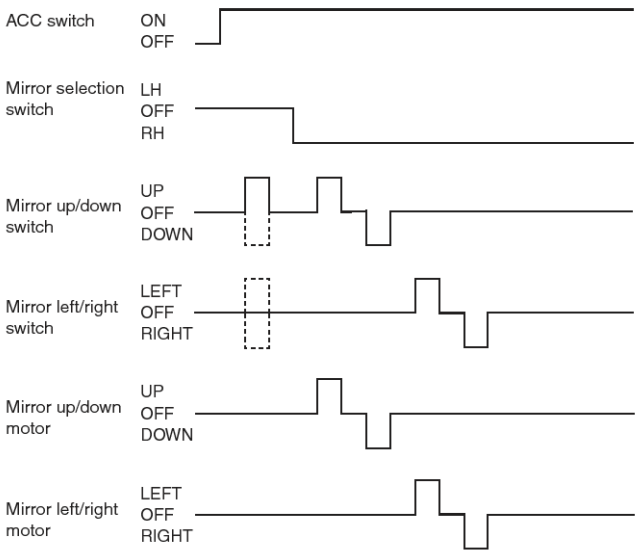
   → Assist safety window ECU receives the signal and performs manual up/down and automatic up/down functions.
2. Timer function

   Power window switch can be controlled for 30 seconds after the ignition is turned off. This function stops immediately even within 30 seconds if the front door is opened.

Outside mirror control by the switch

1. Manual control of right outside mirror

   If the mirror direction switch (up, down, left and right) is pressed when mirror selection switch on driver power windowswitch is in outside RH under ACC ON condition, then operating signal is sent to assist power window switch through CANcommunication.



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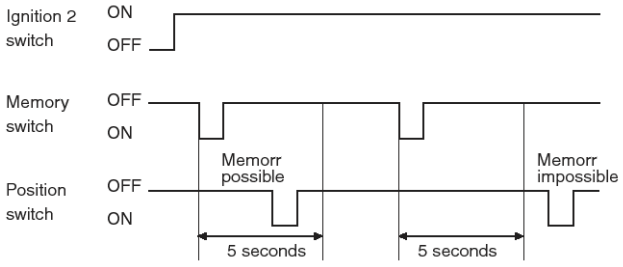
Outside mirror memory operation by the memory switch

1. If position switch (POS1 or POS2) is pressed within 5 seconds after pressing the memory switch under ignition 2 on, it registers current mirror position. (Switch module sends in LIN communication). (Memory permit status lasts for 5 seconds after memory switch ON. After 5 seconds, memory permits status terminates. In other words, current position is registeredif the position switch (POS1 or POS2) is turned on, during the memory permit status). However, RH side mirror position is not registered during the LH side mirror manual switch operation.



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2. Memory permit status is released if any of the following conditions is met.
   - After 5 seconds elapse from memory switch ON.
   - When the ignition 2 is OFF
   - When the memory stop switch is ON
   - When memory registration is complete
3. If more than 2 switches are pressed simultaneously

between memory switch and position switches (POS1 or POS2), input is ignored. (Switch module sends in LIN communication)

4. Memory registration cannot be performed if the vehicle speed is over the speed limit or shift lever is not in “P” while the parking brake is released.
5. Memory is cleared if the battery is removed.

Outside mirror replay operation by the memory switch

1. Mirror is returned to the registered position as each position switch is pressed while the ignition 2 is ON.
2. Memory replay operation will be performed only if the memory is registered.(POS1 or POS2)
3. If the position switch (POS1 or POS2) is pressed while the memory replay is in operation, the final switch is effective.
4. Replay inhibit condition
   - When inhibit “P” switch is OFF
   - When the ignition 2 is OFF
   - When RH side mirror switch is pressed
   - When the vehicle speed is more than 3 km/h
   - When the memory STOP switch is turned ON

Outside mirror memory and replay operation by keyless

1. Memory operation
   - Outside mirror LH position is registered in the driver side power window switch when the ignition is turned off from on.
   - When door is locked by the keyless, outside mirror position is registered corresponding to the keyless code.
   - Data related to the memory operation is received from BCM in CAN communication.
2. Replay operation
   - When door is unlocked by the keyless under ignition off state, it replays the position corresponding to the keyless code.
   - Data related to the replay operation is received from BCM in CAN communication on CAN line.
3. Replay prohibit condition
   - When the inhibit “P” switch is OFF
   - When RH side mirror switch is pressed
   - When mirror switch is pressed after ignition on
   - When the vehicle speed is over 3km/h
   - When the memory stop switch is ON

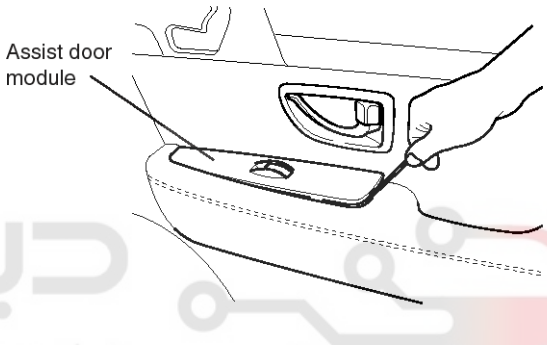
Fail-safe function

1. If the position sensor shows no input change (driving for 5 seconds) above 60 mV while the motor is in operation, it automatically stops the operation judging that wire short, motor failure, or sensor failure.
2. Mirror drive signal cannot be outputted for more than 15 seconds in one direction. (In case of memory replay or manual switch operation)
3. Monitoring of replay execution time

   If replay operation does not complete within 40 seconds from replay starting time, mirror motor stops the output and terminates the replay control.

Removal and installation

1. Remove the connector after lifting up the rear of assist door module.



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