



Body Electrical System

General Information



Troubleshooting

Instrument and warning system

Symptom	Possible cause	Remedy
Tachometer does not operate	Fuse blown	Check for short and replace fuse
	Tachometer faulty	Check tachometer
	Wiring faulty	Repair if necessary
Fuel gauge does not operate	Fuse blown	Check for short and replace fuse
	Fuel gauge faulty	Check gauge
	Fuel sender faulty	Check fuel sender
	Wiring faulty	Repair if necessary
Low fuel warning lamp does not light	Fuse blown	Check for short and replace fuse
	Bulb burned out	Replace bulb
	Fuel level sensor faulty	Check sensor
	Wiring or ground faulty	Repair if necessary
Water temperature gauge does not operate	Fuse blown	Check for short and replace fuse
	Water temperature gauge faulty	Check gauge
	Water temperature sender faulty	Check sender
	Wiring or ground faulty	Repair if necessary
Oil pressure warning lamp does not light	Fuse blown	Check for short and replace fuse
	Bulb burned out	Replace bulb
	Oil pressure sender faulty	Check sender
	Wiring or ground faulty	Repair if necessary
Low brake fluid warning lamp does not light	Fuse blown	Check for short and replace fuse
	Bulb burned out	Replace bulb
	Brake fluid level warning switch faulty	Check switch
	Parking brake switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary
Open door warning lamp does not light	Fuse blown	Check for connection
	Bulb burned out	Replace bulb
	Door switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary
Seat belt warning lamp does not light	Fuse blown	Check for short and replace fuse
	Bulb burned out	Replace bulb
	Buckle switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary

Lighting system

Symptom	Possible cause	Remedy
One lamp does not light (all exterior)	Bulb burned out	Replace bulb
	Socket, wiring or ground faulty	Repair if necessary
Head lamps do not light	Bulb burned out	Replace bulb
	Fuse blown - Low beam	Check for short and replace fuse
	Fuse blown - high beam	Check for short and replace fuse
	Head lamp relay faulty	Check relay
	Lighting switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary
Tail lamps do not light	Tail lamp fuse blown	Replace fuse and check for short
	Fusible link blown	Replace fusible link
	Tail lamp relay faulty	Check relay
	Lighting switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary
Stop lamps do not light	Fuse blown	Replace fuse and check for short
	Stop lamp switch faulty	Adjust or replace switch
	Wiring or ground faulty	Repair if necessary
	Stop lamp relay faulty	Replace relay
Stop lamps stay on	Stop lamp switch faulty	Adjust or replace switch
	Stop lamp relay faulty	Replace relay
Instrument lamps do not light (Tail lamps light)	Rheostat faulty	Check rheostat
	Wiring or ground faulty	Repair if necessary
Turn signal lamp does not flash on one side	Bulb burned out	Replace bulb
	Turn signal switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary
Turn signal lamps do not operate	Fuse blown	Replace fuse and check for short
	Flasher faulty	Check flasher
	Turn signal switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary
Hazard warning lamps do not operate	Fuse blown	Replace fuse and check for short
	Flasher faulty	Check flasher
	Hazard switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary
Flasher rate too slow or too fast	Lamps' wattages are smaller or larger than specified	Replace lamps
	Defective flasher	Replace flasher
Back up lamps do not light up	Fuse blown	Replace fuse and check for short
	Back up lamp switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary

Overhead console lamp does not light up	Fuse blown	Check for short and replace fuse
	Wiring or ground faulty	Repair if necessary

Windshild wiper

Symptom	Possible cause	Remedy
Wipers do not operate or return to off position.	Wiper fuse blown	Check for short and replace fuse
	Wiper motor faulty	Check motor
	Wiper switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary
Wipers do not operate in INT position	ETACS Module faulty	Check ETACS Module
	Wiper switch faulty	Check switch
	Wiper motor faulty	Check motor
	Wiring or ground faulty	Repair if necessary

Power window

Symptom	Possible cause	Remedy
No windows operate from the main switch on the driver's door	Fuse blown	Check for short and replace fuse
	Poor ground	Clean and retighten the ground terminal mounting bolt
	Defective power window main switch	Check the switch Replace if necessary
	Open circuit in wires or loose or disconnected connector	Repair or replace
Driver's side window does not operate	Defective power window main switch	Check for driver's window switch
	Defective motor or circuit breaker	Replace the motor
	Open circuit in wires or loose or disconnected connector	Check the harness and the connector
Passenger's side window does not operate	Defective power window subswitch	Replace the switch
	Defective motor or circuit breaker	Replace the motor
	Wiring faulty or disconnected connector	Repair if necessary

Power door mirror

Symptom	Possible cause	Remedy
No mirrors operate	Fuse blown	Check the circuit and replace fuse
	Poor ground	Clean and retighten the ground terminal mounting bolt
	Defective mirror switch	Check the switch Replace if necessary
	Open circuit in wires or loose or disconnected connector	Repair or replace

One mirror does not operate	Defective mirror switch	Check the switch Replace if necessary
	Defective mirror actuator	Replace the actuator
	Open circuit wires or loose or disconnected connector	Repair or replace



Instruments and warning system

Illumination		3.0w x 4EA	
Warning lamps	Bulb wattage (w)	Color	
Turn signal (LH, RH)	1.4	Green	
High beam	1.4	Blue	
Sediment	1.4	Red	
Front fog	1.4	Green	
Rear fog	1.4	Amber	
Front defog	1.4	Amber	
Rear defog	1.4	Amber	
Back door open	1.4	Red	
Door ajar	1.4	Red	
O/D OFF	1.4	Amber	
Air bag	1.4	Red	
Engine check	1.4	Amber	
Auto cruise	1.4	Green	
Oil pressure	1.4	Red	
Parking brake	1.4	Red	
Battery charge	1.4	Red	
Glow	1.4	Amber	
ABS	1.4	Amber	
Power	1.4	Amber	
Seat belt	1.4	Red	
Hold	1.4	Amber	
Immobilizer	1.4	Amber	
Low fuel	1.4	Amber	
A/T			
R, P	1.4	Red	
N, D, 2, 3, L	1.4	Green	

Service specifications

Indicators and gauges

Items	Specifications																																																																																				
Speedometer																																																																																					
Type	o Cross - coil type																																																																																				
Standard values	<table><tr><td>Velocity (Km/h)</td><td>20</td><td>40</td><td>60</td><td>80</td><td>100</td><td>120</td></tr><tr><td>Tolerance (%)</td><td>+0</td><td>+0</td><td>+0</td><td>+0</td><td>+0</td><td>+0</td></tr><tr><td></td><td>-12.6</td><td>-7.3</td><td>-5.9</td><td>-5.2</td><td>-5</td><td>-5</td></tr><tr><td>Velocity (Km/h)</td><td>140</td><td>160</td><td>180</td><td>200</td><td>220</td><td>-</td></tr><tr><td>Tolerance (%)</td><td>+0</td><td>+0</td><td>+0</td><td>+0</td><td>+0</td><td>-</td></tr><tr><td></td><td>-5</td><td>-5</td><td>-5</td><td>-5</td><td>-5</td><td>-</td></tr></table> <table><tr><td>Velocity (MPH)</td><td>10</td><td>20</td><td>40</td><td>60</td><td>80</td><td>100</td></tr><tr><td>Tolerance (%)</td><td>+0</td><td>+0</td><td>+0</td><td>+0</td><td>+0</td><td>+0</td></tr><tr><td></td><td>-13.6</td><td>-8.8</td><td>-5.7</td><td>-5</td><td>-5</td><td>-5</td></tr><tr><td>Velocity (MPH)</td><td>120</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr><tr><td>Tolerance (%)</td><td>+0</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr><tr><td></td><td>-5</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr></table>	Velocity (Km/h)	20	40	60	80	100	120	Tolerance (%)	+0	+0	+0	+0	+0	+0		-12.6	-7.3	-5.9	-5.2	-5	-5	Velocity (Km/h)	140	160	180	200	220	-	Tolerance (%)	+0	+0	+0	+0	+0	-		-5	-5	-5	-5	-5	-	Velocity (MPH)	10	20	40	60	80	100	Tolerance (%)	+0	+0	+0	+0	+0	+0		-13.6	-8.8	-5.7	-5	-5	-5	Velocity (MPH)	120	-	-	-	-	-	Tolerance (%)	+0	-	-	-	-	-		-5	-	-	-	-	-
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Tachometer	o Tap the speedometer to prevent hysteresis effects during inspection.																																																																																				
Type	o Cross - coil type (J3 TCI : 4pulses/rev, Σ3.5 : 3pulses/rev, GV6 : 3pulses/rev)																																																																																				
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Fuel gauge	o Tap the tachometer to prevent hysteresis effects during inspection.																																																																																				
Type	o Cross - coil type (Fixed point type : Pointer should not fall into the "E" point but indicate remaining fuel level when the ignition is off)																																																																																				
Standard values	<table><tr><th rowspan="2">Level</th><th>Gauge</th><th rowspan="2">Gauge angle (°)</th></tr><tr><th>Resistance (Ω)</th></tr><tr><td>E (Empty)</td><td>95</td><td>-30 ± 2.4</td></tr><tr><td>1/2</td><td>32.5</td><td>0 ±5.0</td></tr><tr><td>F (Full)</td><td>6.5</td><td>30 ± 2.4</td></tr></table> o Inspection order : E → F → E The level must be reached within 7 minutes after the resistance is set for Full or Empty. o Point stability tolerance : Within 9° Apply power for 10 minutes. Then turn off the power for 30 minutes and read the position of the pointer.	Level	Gauge	Gauge angle (°)	Resistance (Ω)	E (Empty)	95	-30 ± 2.4	1/2	32.5	0 ±5.0	F (Full)	6.5	30 ± 2.4																																																																							
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Items	Specifications				
Temperature gauge Type Indication standard	o Cross - coil type (Intermedia stability type).				
	Temperature		Angle (°)		
	122°F (50°C)		-30		
	181.4°F~221°F (83°C - 105°C)		-10 ~ 10		
	Red zone (over 257°F (125°C))		30		
Resistance of temperature sender (NTC)	o Inspection order : OFF → C → H				
	Temperature [°F(°C)]	122(50)	181.4(83)	221(105)	250(125)
	Resistance (Ω)	180.5	48.7	26.7	15.9

Lighting system

Items	Bulb wattage(W)
Head lamp	55W / 55W (High / Low)
Front turn signal lamp	21W
Front position lamp	5W
Front fog lamp	27W
Rear combination lamps	5W / 21W
Tail/stop lamp	
Back up lamp	
Turn signal lamp	
Rear fog lamp	21W
Side repeater lamp	5W
License plate lamp	5W
Sun visor illumi.lamp	5W
Room lamp (Center / Cargo)	10W
Over head lamp	10W
Courtesy lamp	5W
High mount stop lamp	21W

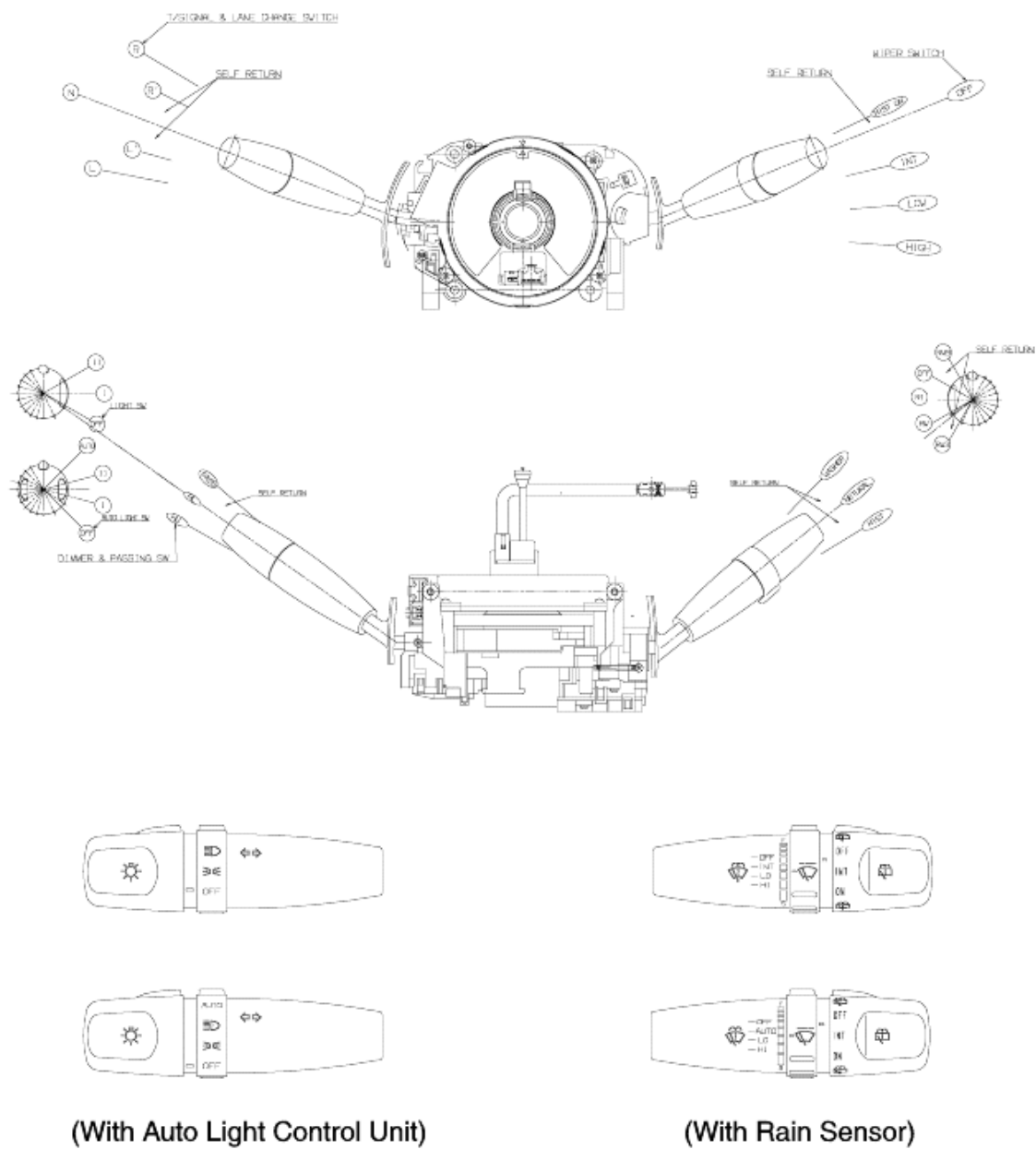


Body Electrical System

Multifunction Switch



Components





Removal and installation

Prior to removing of the multi function switch assembly in vehicles equipped with air bags, be careful to follow the following:

CAUTION

- 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°C(200°F).
- After deployment of an air bag, replace the clock spring with a new one.
- Wear gloves and safety glasses when handling 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.

Inspection

Check the continuity between the terminals while operating the switch.

Lighting switch

Terminal Position	15	5	10
OFF			
I	○	○	
II	○	○	○

Dimmer and passing switch

Terminal Position	7	12	16	17
HU	○	○		
HL			○	○
P	○			○

HU : Head lamp high beam

HL : Head lamp low beam

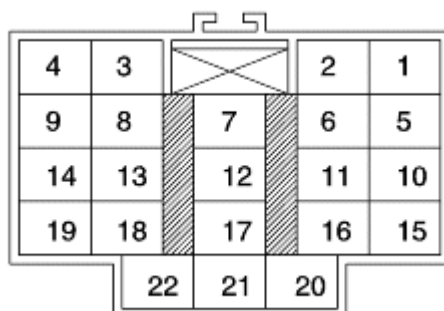
P : Head lamp passing switch

Turn signal and lane change switch

Terminal		6	2	11
Hazard switch	Turn signal switch			
OFF	L		○ — ○	
	N			
	R	○ — ○		

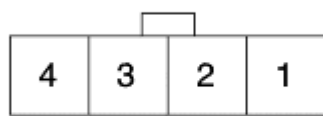
Wiper & washer switch (With rain sensor)

Terminal		9	13	18	3	4 (14)	8
Position							
OFF	OFF	○ — ○					
	MIST		○ — ○				
	INT (Auto)	○ — ○			○ — ○		
	LOW		○ — ○				
	HI			○ — ○			
	WASHER				○ — ○		○



Rear wiper & washer switch

Terminal		1	2	3	4
Position					
	Washer	○ — ○			○
	OFF				
	INT	○ — ○			
	ON	○ — ○		○	
	Washer	○ — ○			○





Body Electrical System

Horn



Inspection

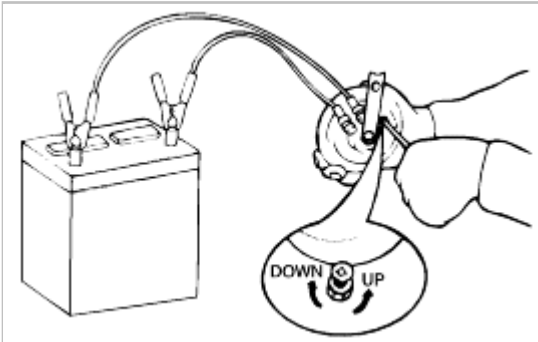
1. Test the horn by connecting battery voltage to the 1 terminal and ground the 2 terminal.
2. The horn should make a sound. If the horn fails to make a sound, replace it.

Adjustment

Operate the horn, and adjust the tone to a suitable level by turning the adjusting screw.

NOTICE

After adjustment, apply a small amount of paint around the screw head to keep it from loosening.



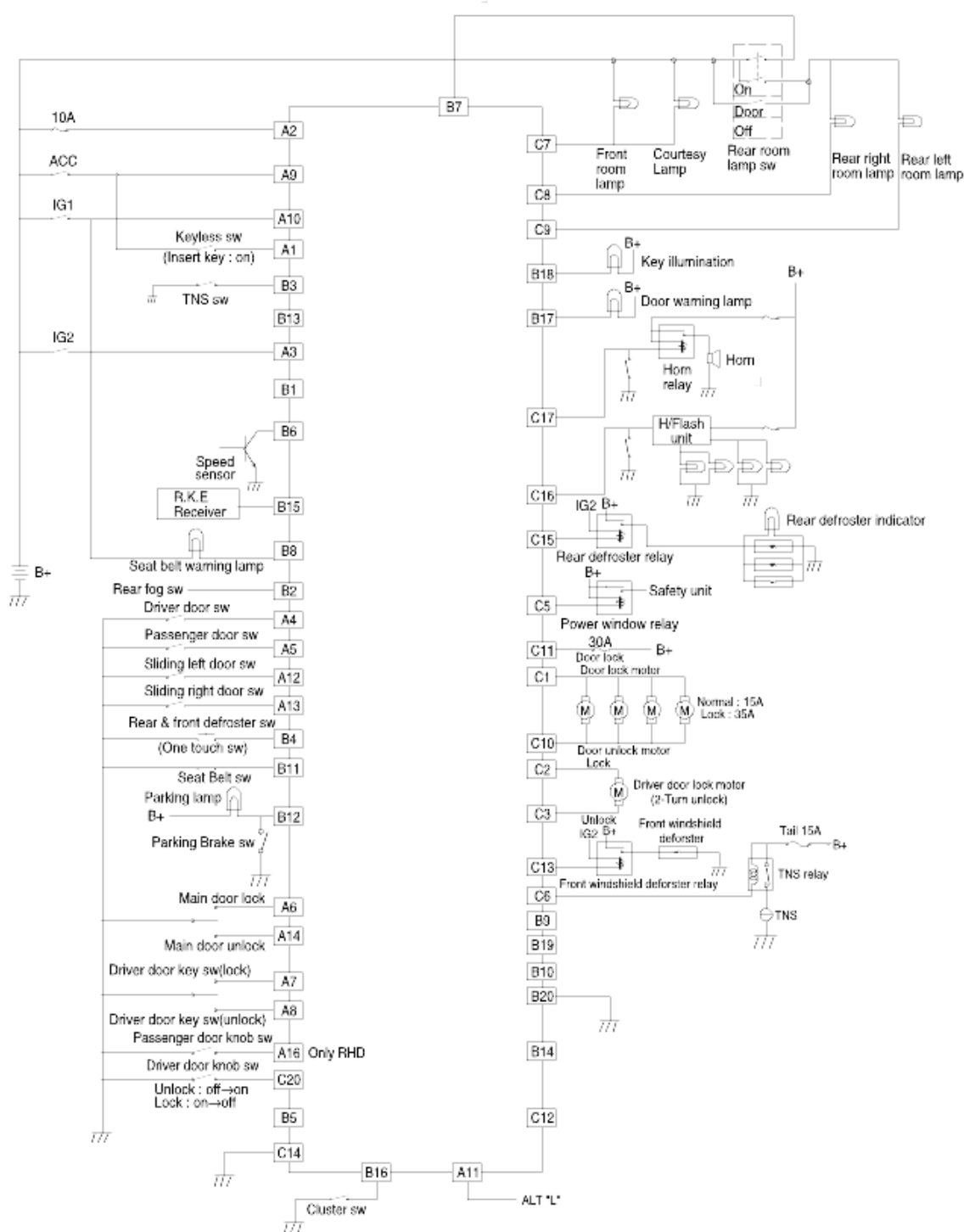


Body Electrical System

ETACS



Circuit diagram



Etacs pin no. and description

8★	7★	6	5	4	3	2	1
16	15	14	13	12	11	10	9

Connetor "A"

10	9	8	7	6	5	4	3	2	1
20	19	18	17	16	15	14	13	12	11

Connetor "B"

9	8	7	6		5	4	3★	2★	1
20	19	18	17	16	15	14	13	12	11

Connetor "C"

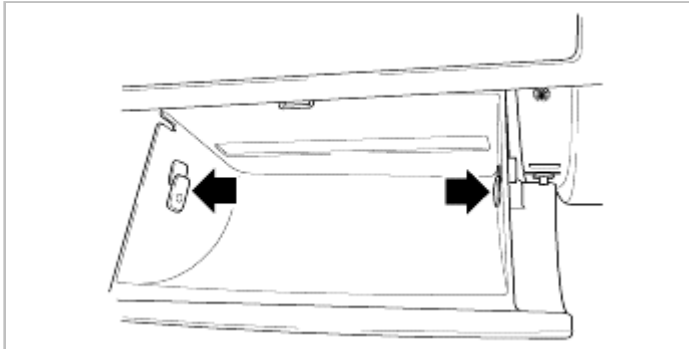
The mark(★) is the item for Middle East(3.5G E/G)

PIN NO.	CONNECTOR "A"	PIN NO.	CONNECTOR "B"	PIN NO.	CONNECTOR "C"
1	Keyless sw	1	-	1	Door lock motor
2	B+	2	Rear fog sw	2	2-Turn unlock motor (lock)
3	IG2	3	TNS sw	3	2-Turn unlock motor (unlock)
4	Driver door sw	4	Rear & front	4	-
5	Passenger	5	-	5	Power window relay
6	Main door lock sw	6	Speed sensor	6	TNS relay
7	Driver door key sw (lock)	7	Rear room lamp sw	7	Door courtesy lamp
8	Driver door key sw (unlock)	8	Seat belt lamp	8	Rear right room lamp
9	ACC	9	-	9	Rear left room lamp
10	IG1	10	-	10	Door unlock motor
11	ALT "L"	11	Seat belt sw	11	B+
12	Sliding left door sw	12	Parking brake sw	12	-
13	Sliding right door sw	13	-	13	Front windshield defroster relay
14	Main door unlock sw	14	-	14	Ground
15	-	15	R.K.E	15	Rear defroster relay
16	-	16	Cluster sw	16	Flasher unit
		17	Door warning lamp	17	Horn relay
		18	Key illumination lamp	18	-
		19	-	19	-
		20	Ground	20	Driver door knob sw

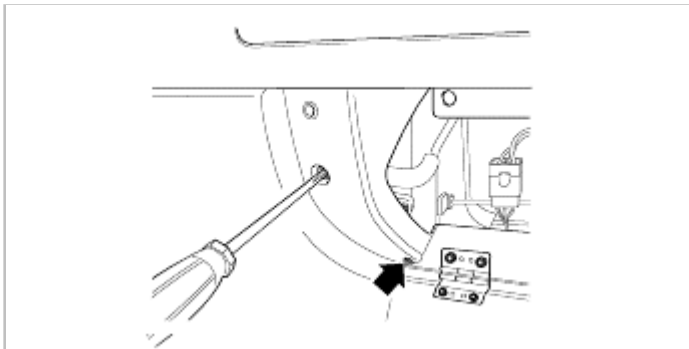


Removal and installation

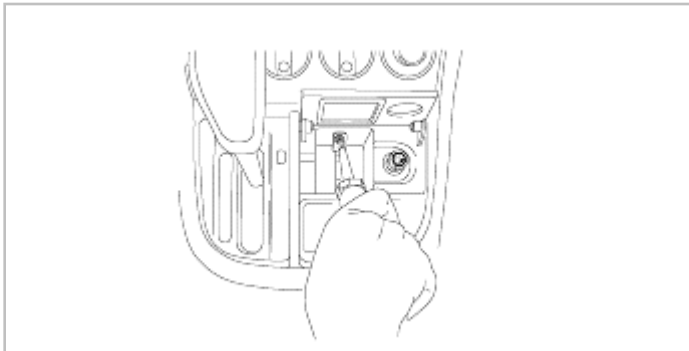
1. Disconnect the negative battery terminal.
2. Open the glove box and remove the release checker to open fully.



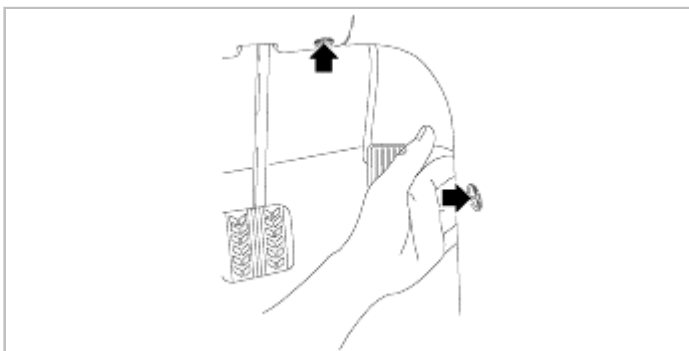
3. Loosen the screw of the center console.



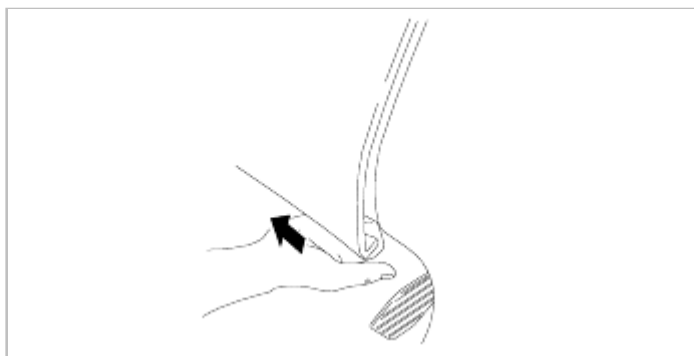
4. Remove the ashtray and loosen the screw to remove the center fascia.



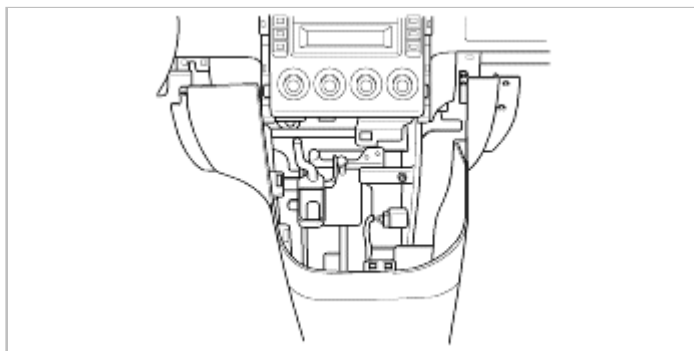
5. Loosen the screw of the panel and the center console.



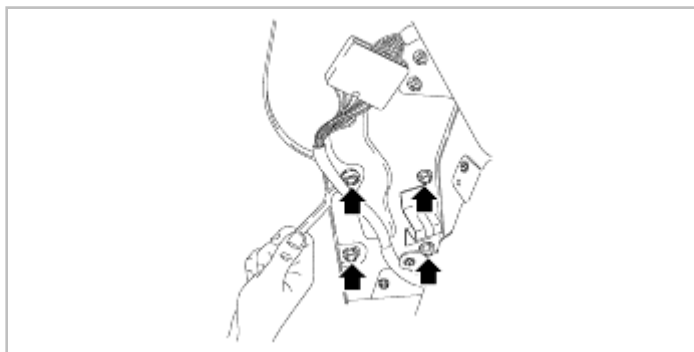
6. Pull the panel to loosen the screw of the center console.



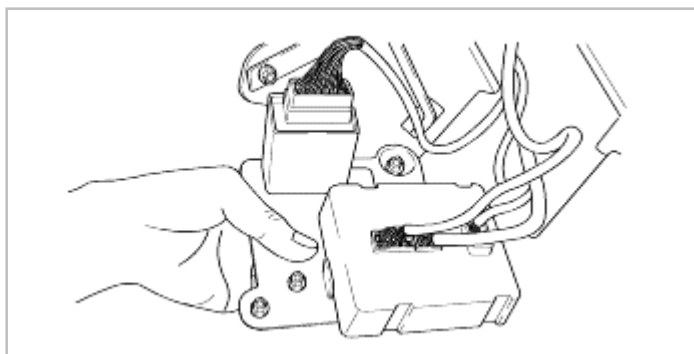
7. Remove the center console.



8. Loosen the bolts of the in panel member bracket.



9. Disconnect the connector.



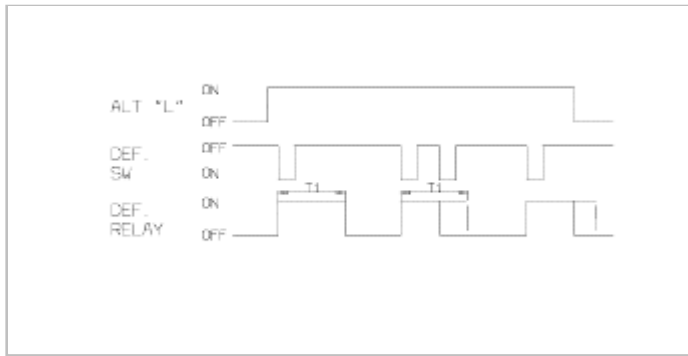
10. Installation is the reverse of removal.

Inspection

While operating the components, check whether the operations are normal with timing chart.

Etacs fuction

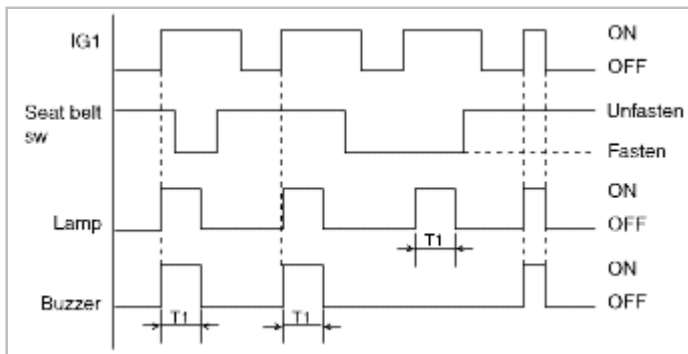
1. Rear window defroster and front windshield defroster.



Time specification

T1 : 15 ± 3 min.

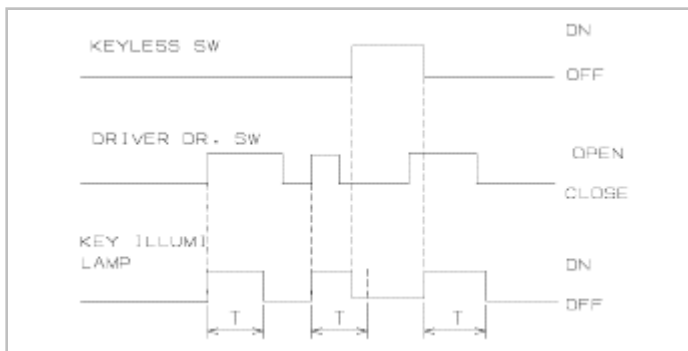
2. Seat belt warning



Time specification

T1 : 6 ± 1.5 sec.

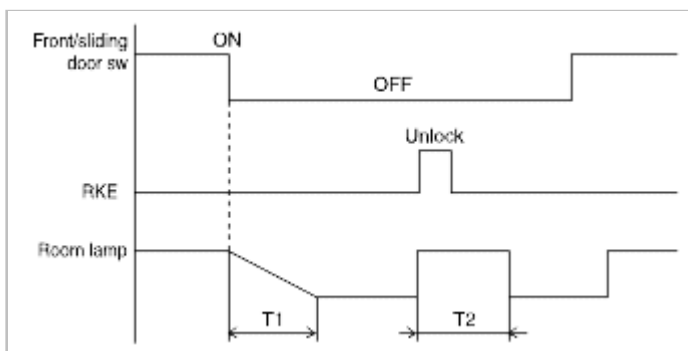
3. Ignition key hole illumination



Time specification

T : 30 ± 10 sec.

4. Delayed out room lamp



Time specification

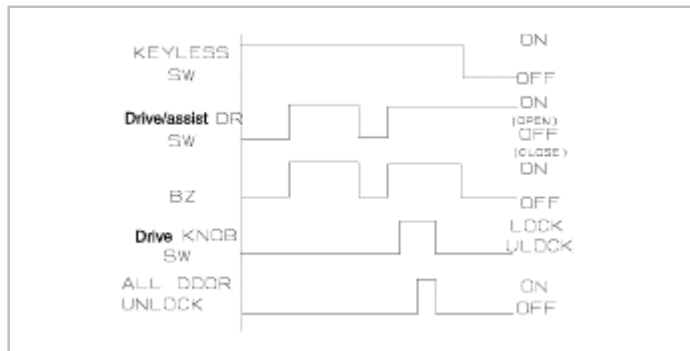
T1 : 4.5 ± 1.0 sec.

T2 : 10 ± 2.0 sec.

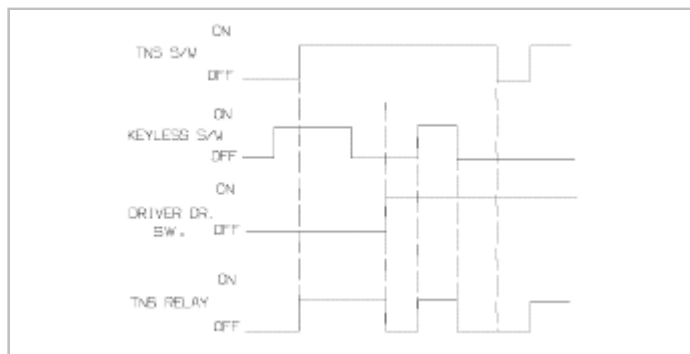
T3 : 20 ± 2 min.

- (1) Upon the front door or sliding door open with keyless switch OFF, the room lamp and courtesy lamp turns on for T3.
- (2) Upon the door switch OFF with ACC is OFF, the room lamp declines 100% to 0% for T1.
- (3) Upon the door switch OFF with ACC is ON, the room lamp turns on for T1.
- (4) The room lamp turns on for T1 when the door unlock signal is ON by RKE.

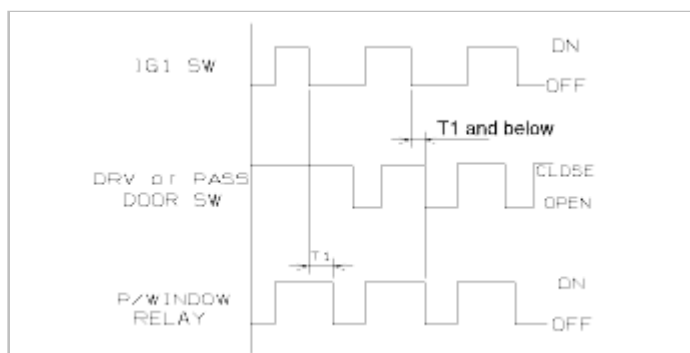
5. Ignition key reminder



6. Battery saver.



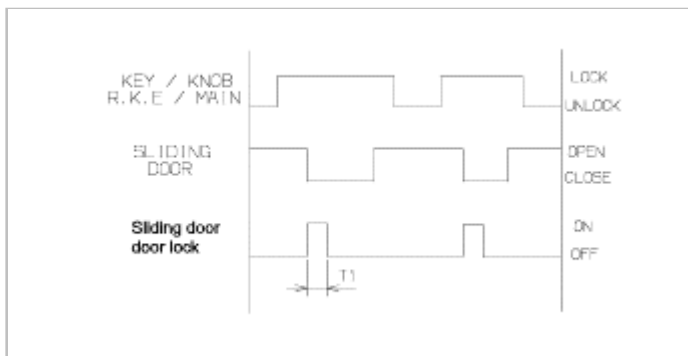
7. Time lag power window timer



Time specification

T1 : 30 ± 6 sec.

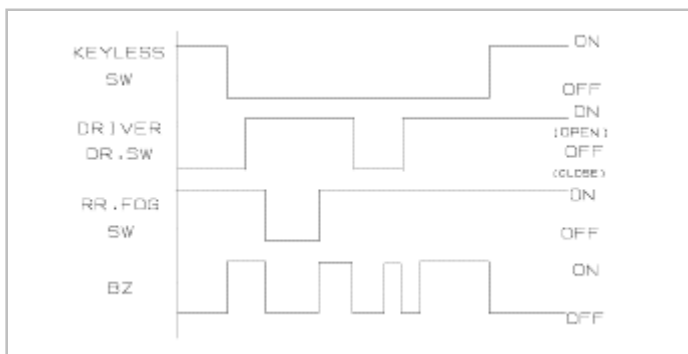
8. Sliding door lock



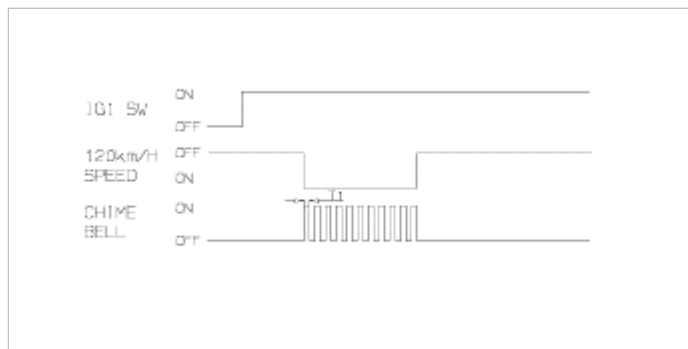
Time specification

T1 : 0.5 ± 0.1 sec.

9. Rear fog lamp warning



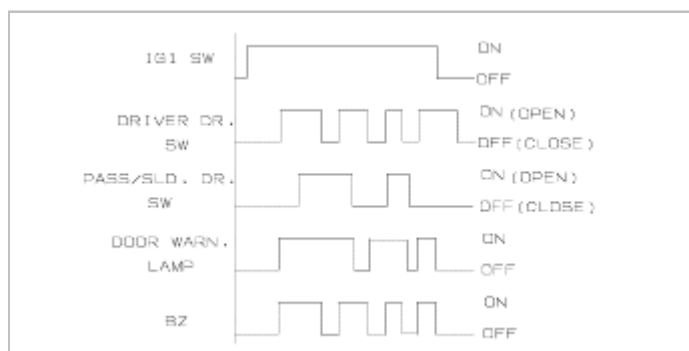
10. Over speed warning (Middle east area)



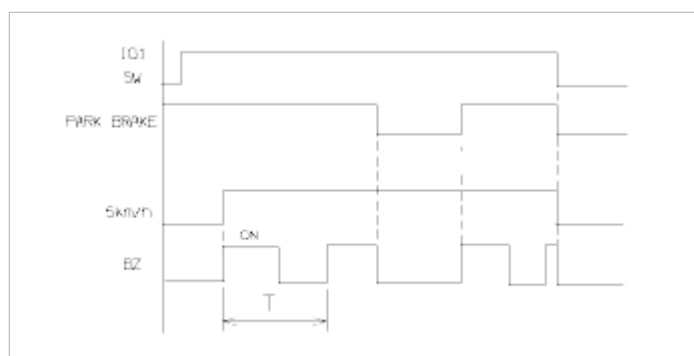
Time specification

T1 : 0.5 ± 0.1 sec.

11. Door ajar warning



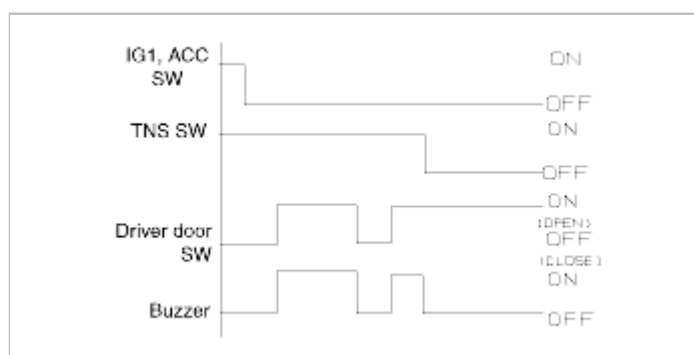
12. Parking on drive warning



Time specification

T1 : 0.5 ± 0.1 sec.

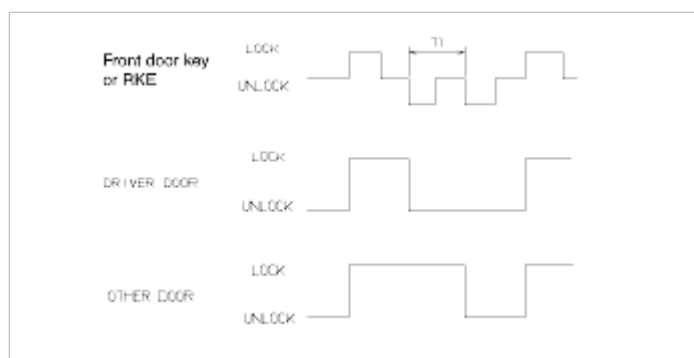
13. Light warning



14. Central door lock/unlock.

Input	Door	Region		
		LHD	RHD	Middle eas (3.5G E/G)
R.K.E TX	Lock	All lock	All lock	All lock
	Unlock	All unlock	All unlock	All unlock (Tow turn unlock)
Driver door key	Lock	All lock	All lock	All lock
	Unlock	All unlock	All unlock	All unlock (Tow turn unlock)
Passenger door key	Lock	-	All lock	-
	Unlock	-	All unlock	-
Diriver knob Switch	Lock	All lock	All lock	All lock
	Unlock	All unlock	All unlock	-
Passenger knob Switch	Lock	-	All lock	-
	Unlock	-	All unlock	-
Main door lock switch	Lock	All lock	All lock	All lock
	Unlock	All unlock	All unlock	All unlock

15. Two turn unlock (Only middle east : 3.5G E/G)

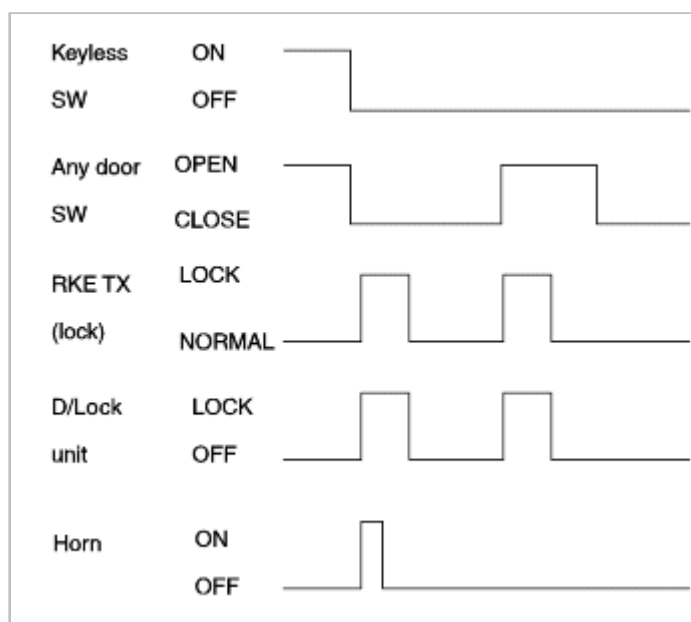


Time specification

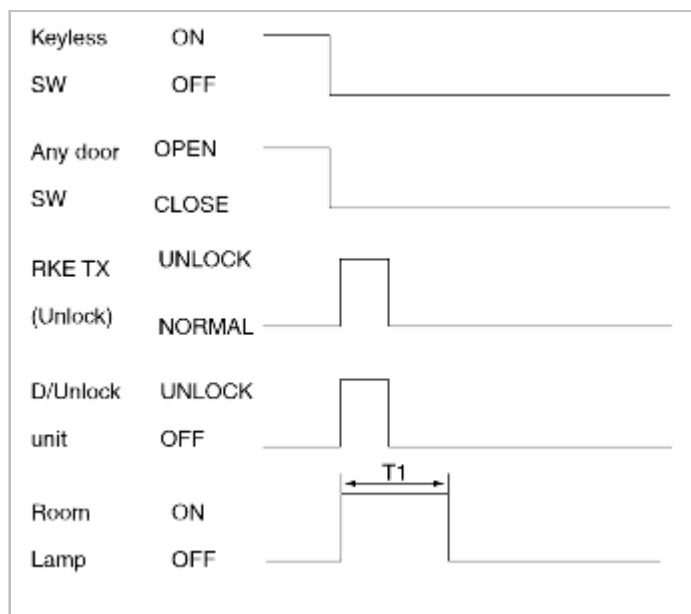
$T_1 : 3 \pm 0.5 \text{ sec.}$

16. Remote Keyless Entry(R.K.E) system.

(1) Door lock



(2) Door unlock

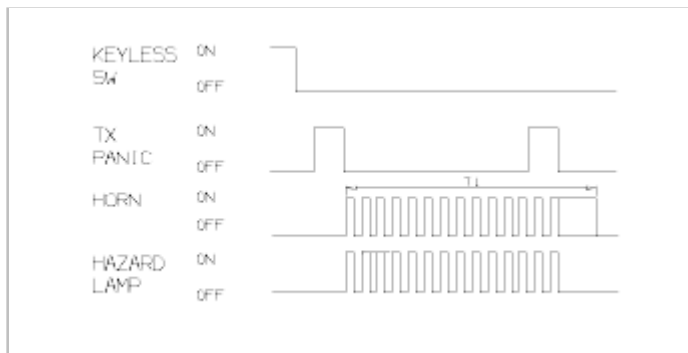


Time specification

T1 : 1.0 ± 2.0 sec.

If the door will not be opened within 30 seconds, the door will be locked automatically.

(3) Panic (Only middle east : 3.5G E/G)

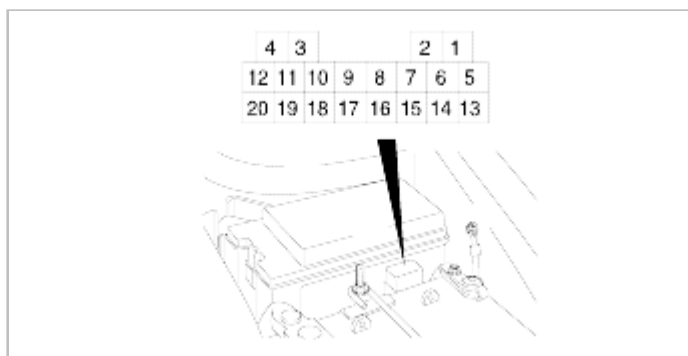


Time specification

T1 : 27 ± 2 sec.

17. Code saving method

- (1) Connect the coding connector to the Diagnosis connector in order to jump between terminal 12 and terminal 16 if you have a coding connector, use a jumper wire between the above-mentioned terminals.
- (2) Turn the ignition switch to "ON" position.
- (3) Press LOCK button of transmitter two times. If success, the buzzer will operate for approximately one second.
- (4) Turn the ignition switch to "OFF" position and remove ignition key from key set.
- (5) Disconnect the coding connector from the diagnosis connector.
- (6) Check for LOCK and UNLOCK operation.



Body Electrical System

Fuses And Relays - Relay Box
(Engine Compartment)



Components



(Gasoline)



(Diesel)

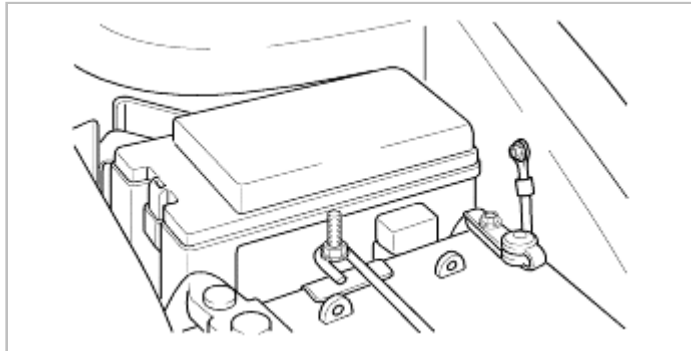


Inspection

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.



Body Electrical System

Fuses And Relays - Fuses



Specification

1	W/SHD 15A	2	S/ROOF 20A	3	START 10A
4	HAZARD 15A	5	P/SCK(FRT) 20A	6	CIGAR 20A
7	OBD-11 10A	8	WIPER(FRT) 20A	9	P/SCK(RR) 30A
10	F/HEATER 15A	11	WIPER(RR) 10A	12	ACC 10A
13	R/FOG 15A	14	AT 15A	15	
16	ROOM LAMP 15A	17	H/SEAT(LH) 15A	18	H/SEAT(RH) 15A
19	STOP LAMP 20A	20	TURN LAMP 10A	21	A/BAG 10A
22	METER 10A	23		24	ENGINE 10A

* USE THE DESIGNATED FUSES ONLY.

* () IS OPTION.

OK52A



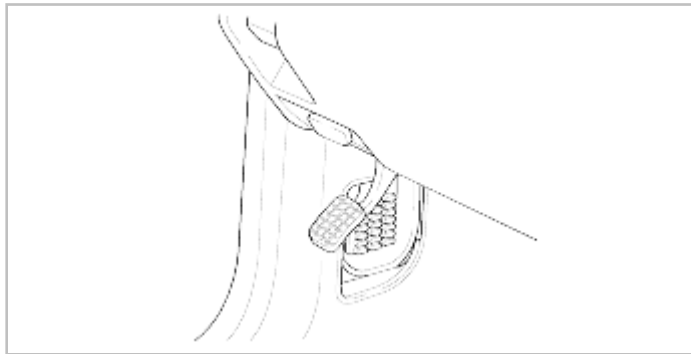
Inspection

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.

CAUTION

Never use a fuse of higher capacity than specified.

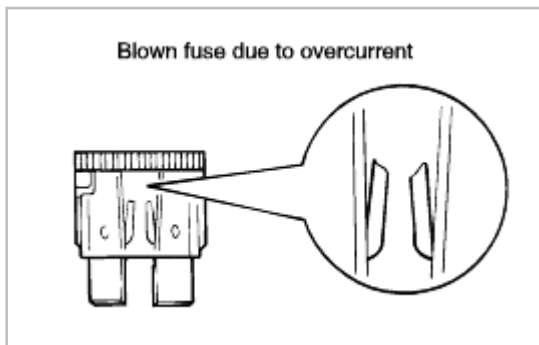


Inspection of fuses

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.

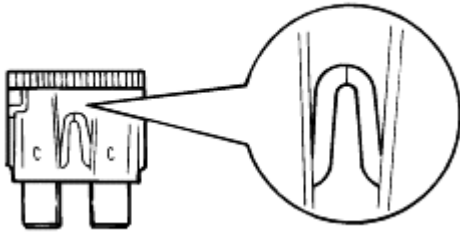
Prior to replacing the fuse with a new one, check the circuit for a short and the related parts for abnormal conditions. Only after the correction of a short or replacement of abnormal parts, should a fuse with the same ampere rating be installed.



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

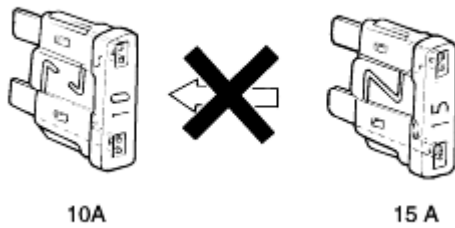
Normally, this type of problem occurs after a fairly long period of use, and is less frequent than #1 above. In this case, you may simply replace with a new fuse of the same capacity.

Blown fuse due to thermal fatigue



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.

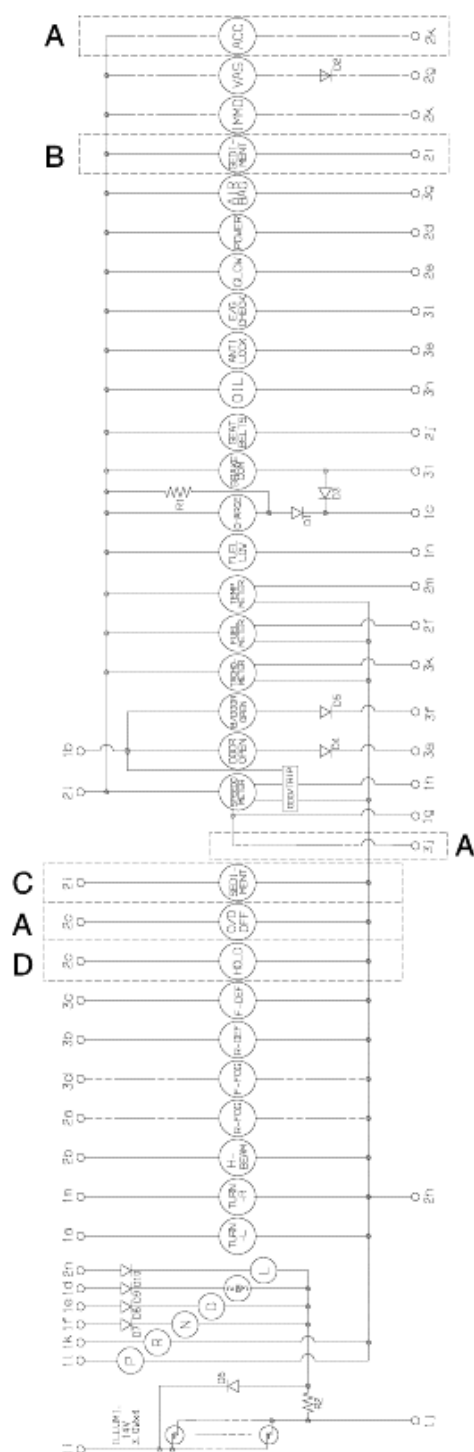


Body Electrical System

Indicators And Gauges - Instrumental Cluster



Circuit diagram



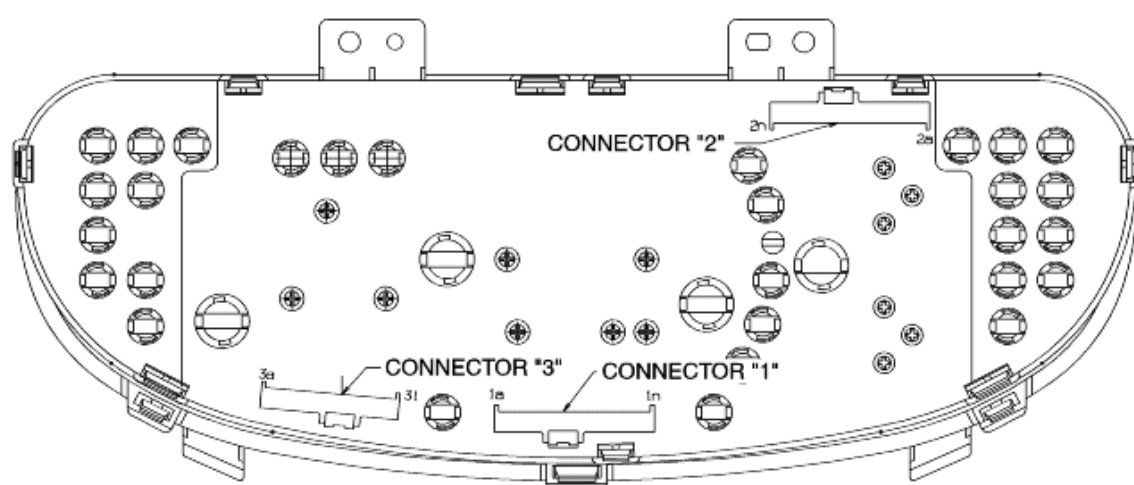
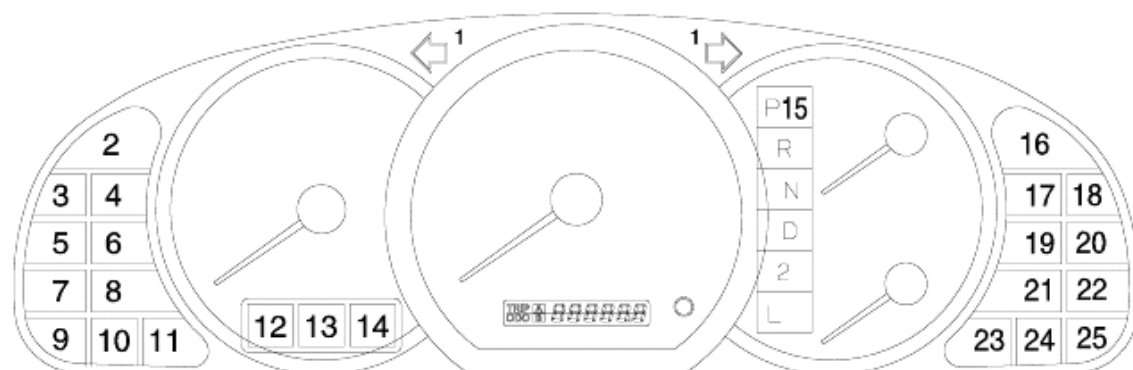
Terminal No.	Terminal Name		
CONNECTOR "1"	1a	TURN-L	←
	1b	B(+)	←
	1c	CHARGE	←
	1d	2	3
	1e	D	←
	1f	N	←
	1g	SPEED OUT	←
	1h	SPEED INPUT	←
	1i	IN5(+)	←
	1j	ILL(-)	←
	1k	R	←
	1l	P	←
	1m	TURN-R	←
	1n	FUEL/L	←
CONNECTOR "2"	2a	R-FOG	-
	2b	H-BEAM	←
	2c	HOLD	HOLD O/D OFF
	2d	POWER	←
	2e	GLCW	←
	2f	FUEL UNIT	←
	2g	-	-
	2h	GND	←
	2i	SEDIMENT	←
	2j	SEAT BELT	←
	2k	IMMO CHECK	IMMO CHECK/AUTO CRUISE
	2l	IG(+)	←
	2m	TEMP UNIT	←
	2n	L	←
CONNECTOR "3"	3a	DOOR	←
	3b	R-DEF	←
	3c	F-DEF	←
	3d	F-FOG	←
	3e	ABS	←
	3f	B/DOOR	←
	3g	AIR BAG	←
	3h	OIL	←
	3i	BRAKE	←
	3j	-	O/SPEED WARNING
	3k	TACHO INPUT	←
	3l	E/G CHECK	←
MARKET	Europe, General	2.5/2.9	3.5
		Middle east	

※ Note

A : Middle east, B : Except Europe,
C : Europe, D : Europe, General



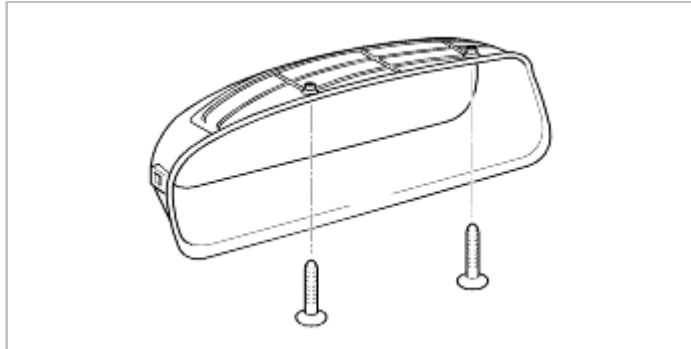
Component



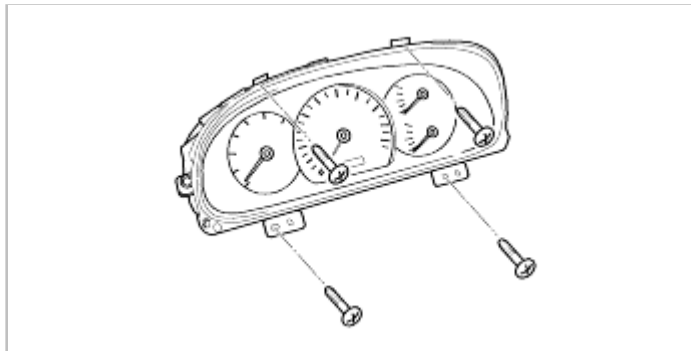


Removal and installation

1. Disconnect the negative (-) battery terminal.
2. Remove the cluster housing after removing 2 screws.



3. Remove the 4 screws holding the cluster and remove the instrument cluster.



4. Installation is the reverse of removal.

Inspection of components

Speedometer

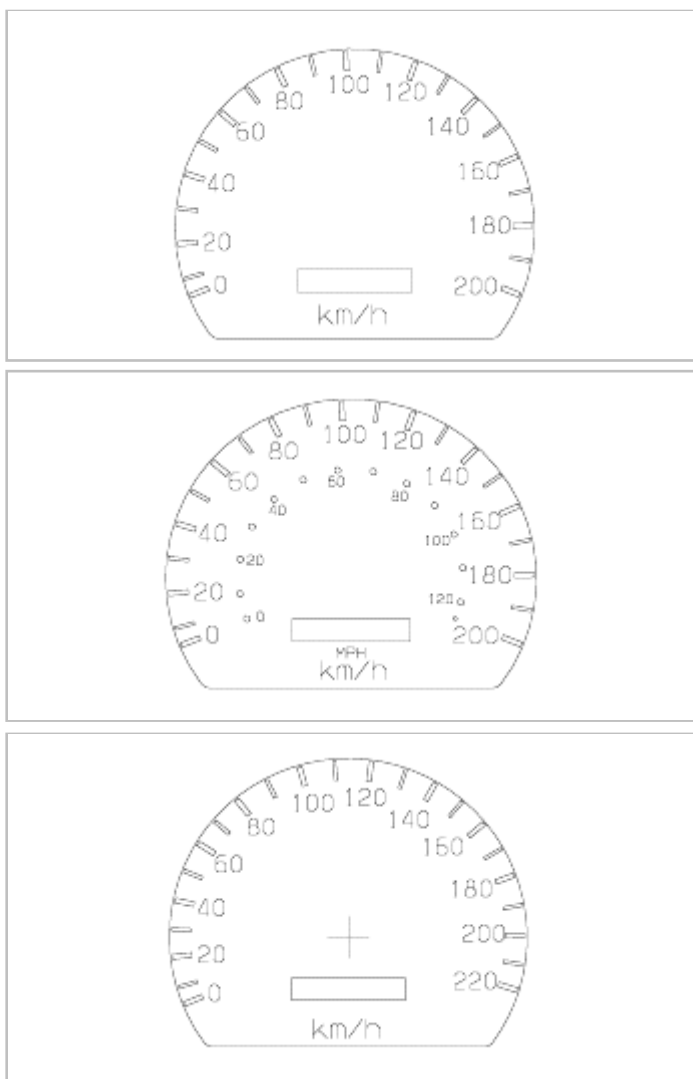
1. Adjust the pressure of the tires to the specified level.
2. Drive the vehicle onto a speedometer tester. Use wheel chocks as appropriate.
3. Check if the speedometer indicator range is within the standard values in the service specifications.

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.



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

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

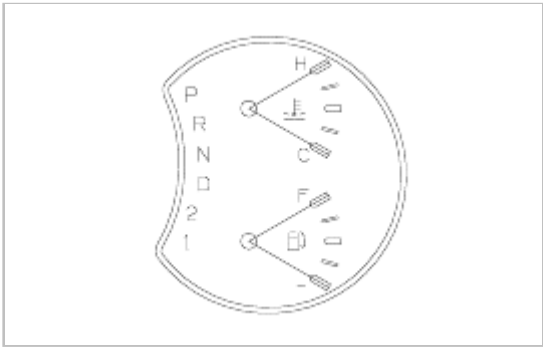
Revolution (RPM)	1,000	2,000	3,000	4,000	5,000	6,000	7,000	Remark
Tolerance (%)	+6 -12	±6	±5	±4.5	±4.2	-	-	Diesel
Tolerance (%)	+6 -12	+7.5 -1.5	+6	+6	+6	+6	+6	Gasoline

Fuel gauge

1. Remove the instrument cluster.
2. Check the fuel gauge by changing the resistance between the terminals.
Apply battery voltage to the terminal 2ℓ, ground the terminal 2h, and connect the resistance to the terminal

3k and then check that the pointer is moved as shown in below table.

Resistance (Ω)	Gauge level
95	E (Empty)
32.5	1/2
6.5	F (Full)



Temperature gauge

- 1. Remove the instrument cluster.
- 2. Check the temperature gauge by changing the resistance between the terminals.
- 3. Apply battery voltage to the terminal 2l, ground the terminal 2h, and connect the resistance to the terminal 2m and then check that the pointer is moved as shown in below table.

Temperature (°C)	Resistance (Ω)	Angle (°)
50	180.5	-30
83 ~ 105	48.7 ~ 26.7	-10 ~ 10
over 125	15.9	30



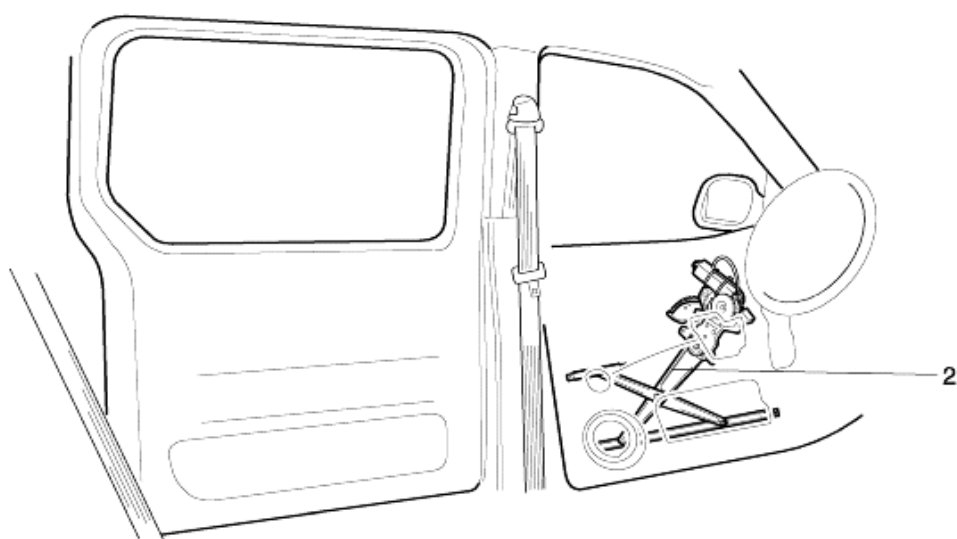
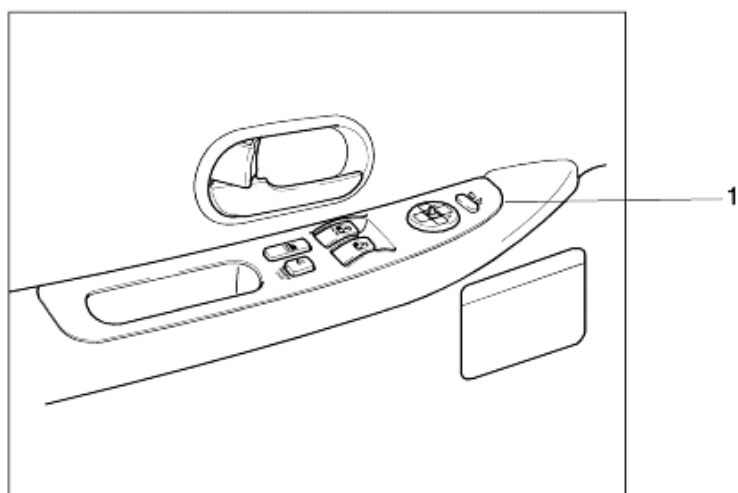
Specification

No.	Item		Specification	
			Bulb capacity	Color
1	Turn signal (RH, LH)		1.4W	Green
2	Rear window defogger		1.4W	Amber
3	Front fog		1.4W	Green
4	Front window defogger		1.4W	Amber
5	ABS		1.4W	Amber
7	Rear door open		1.4W	Red
8	Door ajar		1.4W	Red
9	Air bag		1.4W	Red
10	Check engine		1.4W	Amber
12	Oil pressure		1.4W	Red
13	Parking brake		1.4W	Red
14	Battery charge		1.4W	Red
15	A/T indicator	N, D, 2, 3, L	1.4W	Green
		P,R	1.4W	Red
16	Low fuel		1.4W	Amber
17	Seat belt		1.4W	Red
18	Immobilizer check		1.4W	Amber
19	Sediment		1.4W	Red
21	Glow		1.4W	Amber
22	Power		1.4W	Amber
23	Hold / O/D OFF (Middle east)		1.4W	Amber
24	High beam		1.4W	Green
25	Rear fog		1.4W	Amber



Body Electrical System

Power Windows

**Component**

1. Power window switch assembly
2. Power window regulator assembly

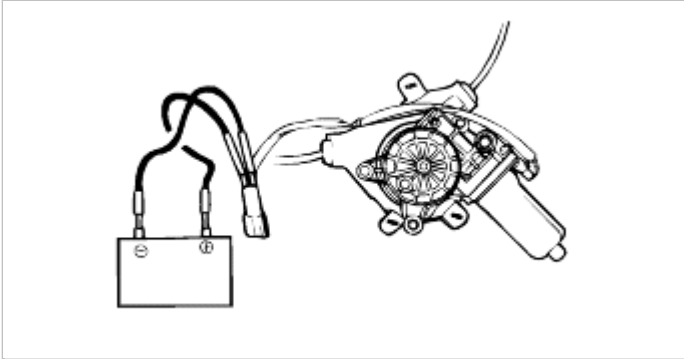
Body Electrical System

Power Windows - Power Window Motor



Inspection

Connect the motor terminals directly to battery voltage(12V) and check that the motor operates smoothly. Next, reverse the polarity and check that the motor operates smoothly in the reverse direction. If the operation is abnormal, replace the motor.

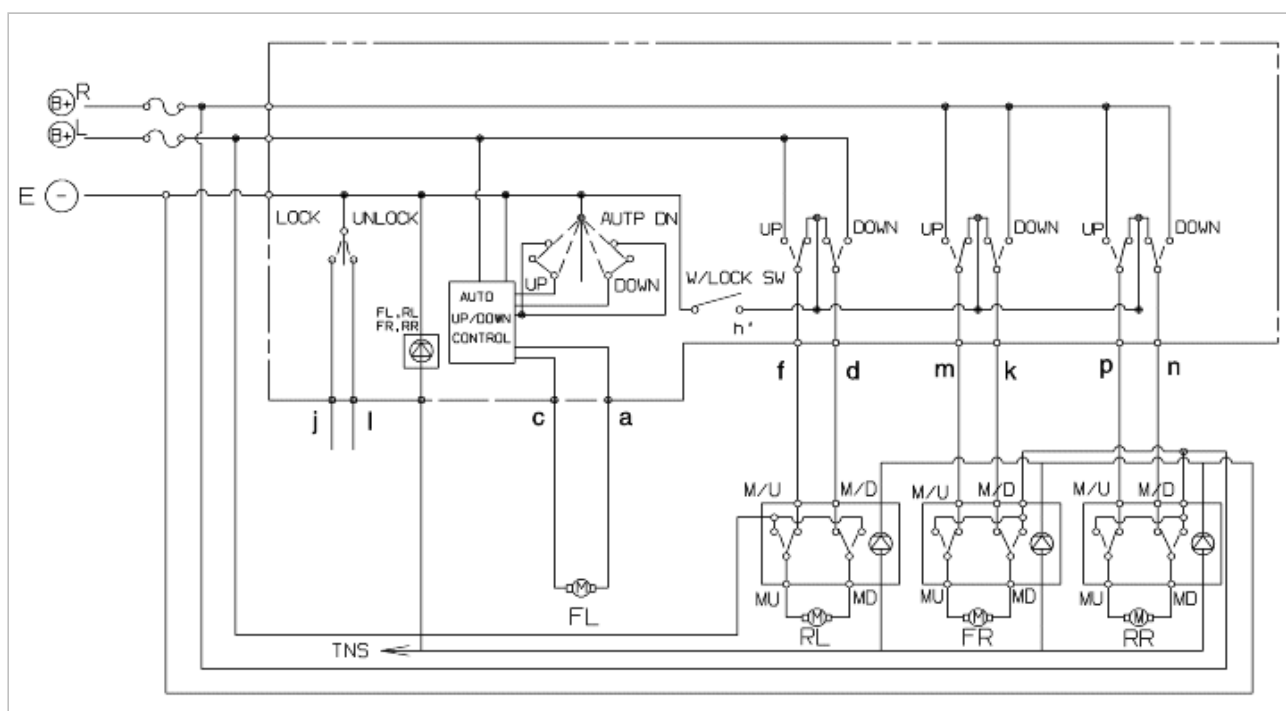


Body Electrical System

Power Windows - Power Window Switch



Circuit diagram



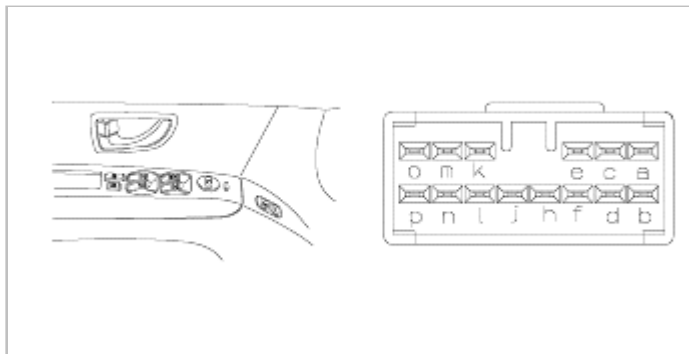


Inspection

Power window main switch

1. Remove the switch from the door trim panel.
2. Check for continuity between the terminals. If continuity is not as specified in the table, replace the power window switch.

Switch Terminal Position	POWER WINDOW SWITCH															
	Front (LH)				Front (RH)				Rear (LH)				Rear (RH)			
	b	a	c	h	o	j	m	h	f	j	d	h	p	j	n	h
UP		○	—	○	○	—	○	○	○	—	○	○	○	—	○	○
OFF					○	—	○	○	○	—	○	○	○	—	○	○
DOWN			○	○	○	—	○	○	○	—	○	○	○	—	○	○
AUTO UP	○	○	—	○												
AUTO DOWN	○	—	○	○												



Power window sub switch

Terminal Position	e	l	h
LOCK	○	—	○
OFF			
UNLOCK		○	○

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Body Electrical System

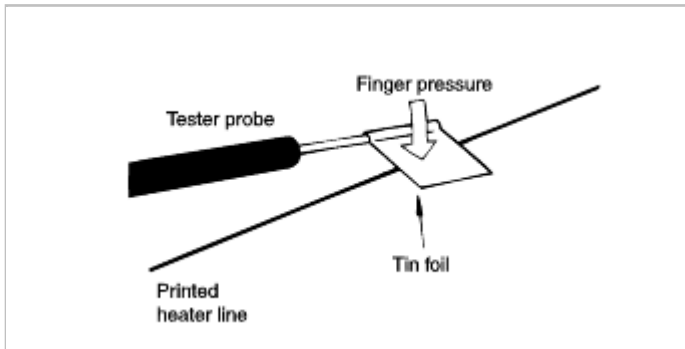
Rear Window Defogger - Rear Window
Defogger Printed Heater



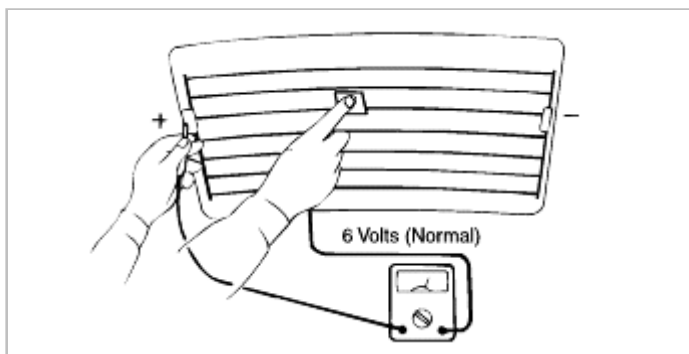
Inspection

CAUTION

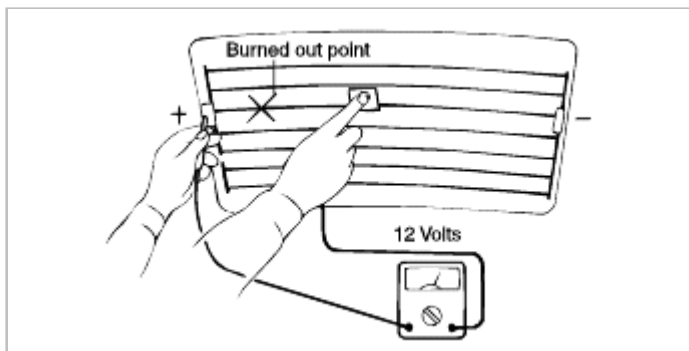
Wrap tin foil around the end of the voltmeter test lead to prevent damaging the heater line. Apply finger pressure on the tin foil, moving the tin foil along the grid line to check for open circuits.



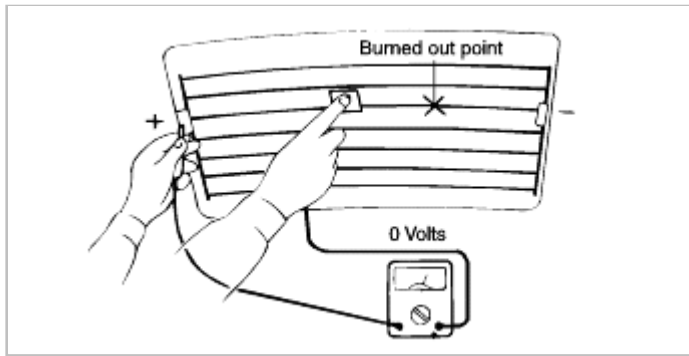
1. Turn on the defogger switch and use a voltmeter to measure the voltage of each heater line at the glass center point. If a voltage of approximately 6V is indicated by the voltmeter, the heater line of the rear window is considered satisfactory.



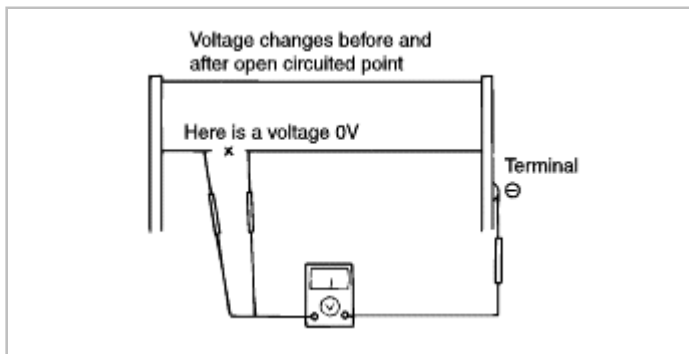
2. If a heater line is burned out between the center point and (+) terminal, the voltmeter will indicate 12V.



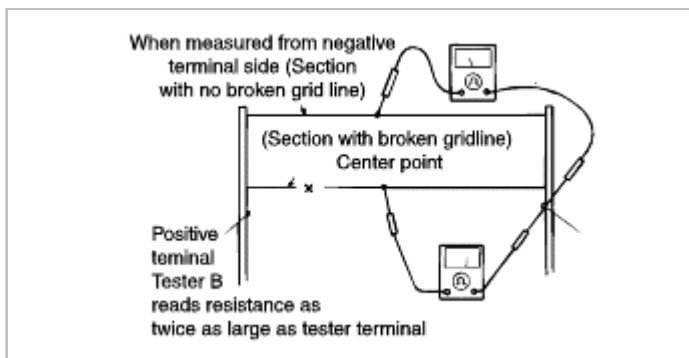
3. If a heater line is burned out between the center point and (-) terminal, the voltmeter will indicate 0V.



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



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.



Repair of broken heater line

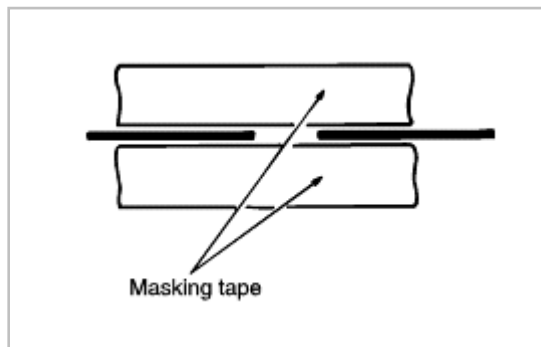
Prepare the following items:

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

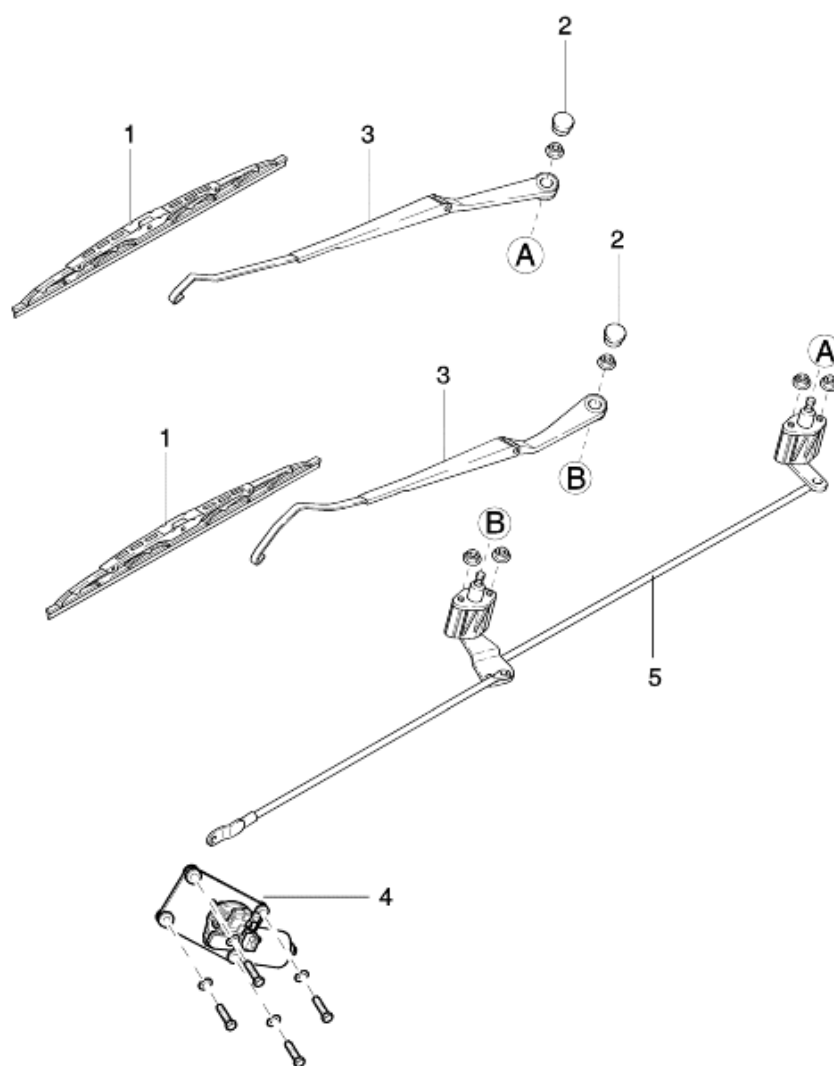
After repairing, clean the glass with a soft dry cloth or wipe along the grid line with a slightly moistened cloth.





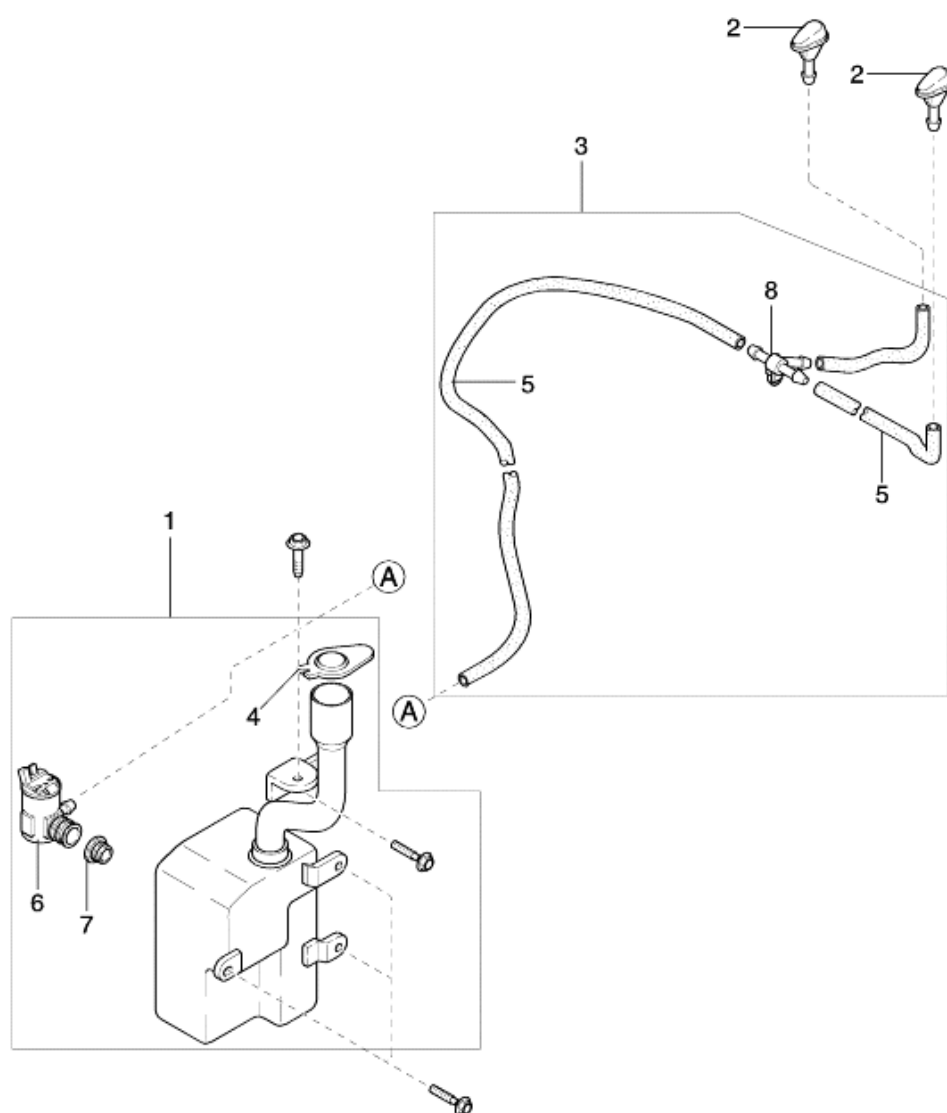
Body Electrical System

Windshield Wiper / Washer

**Front wiper (Component)**

1. Wiper blade
2. Wiper arm cover
3. Wiper arm
4. Motor assembly
5. Link assembly

Front washer (Component)



- 1. Washer tank assembly
- 2. Washer nozzle
- 3. Pipe assembly
- 4. Tank cap

- 5. Hose
- 6. Motor assembly
- 7. Grommet
- 8. Pipe clip

Body Electrical System

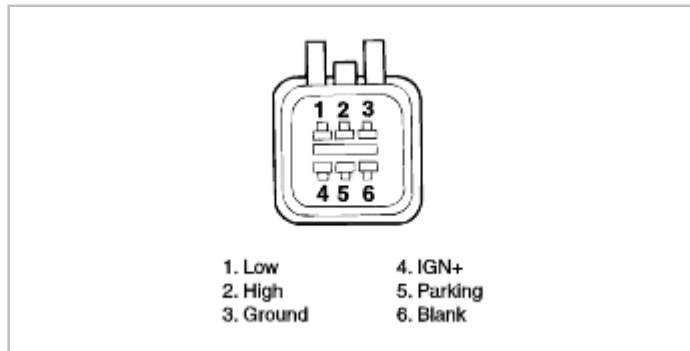
Windshield Wiper / Washer - Windshield
Wiper / Washer Switch



Inspection

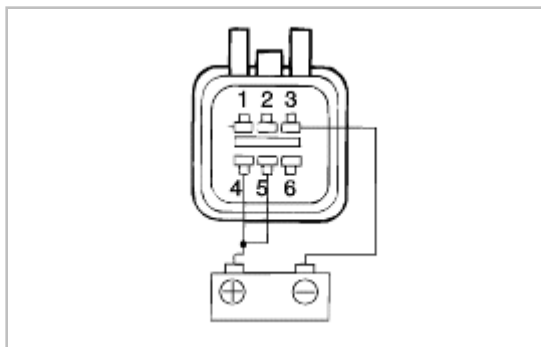
Speed operation check

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



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 3.
3. Connect terminals 4 and 5
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.





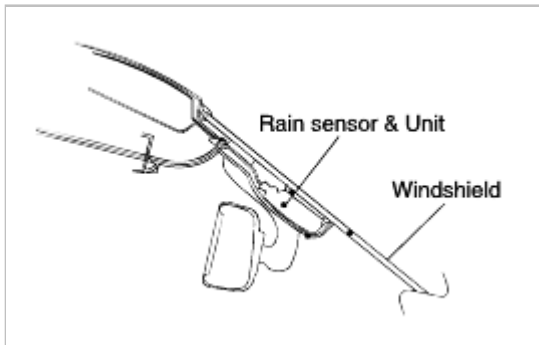
Body Electrical System

Windshield Wiper / Washer - Rain Sensor



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 washer, provides automatic control of automatic int, automatic low, and automatic high speeds.



MULTI FUNCTION SWITCH POSITION	RAINSENSOR OPERATING MODE	SENSOR ACTION
MIST	MIST	Mist is controlled by the column switch 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 9 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 runs 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 operates only one time.

Off mode

With the wiper switch "OFF" 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".

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 "innerwipe/park" until the rain sensor determines that the dwell time at that position is appropriate for the amount of precipitation an the windshield, rain sensor provides input to the wiper motor to activate the wipers to clear the precipitation from the windshield.

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.

Automatic low

Automatic low speed operation is utilized when the amount of precipitation impinging on the windshield exceeds the automatic int to automatic low threshold.

This threshold includes sufficient hysteresis to prevent cycling between automatic int and automatic low speed operation with a steady amount of precipitation accumulation on the windshield.

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.

Washer mode

The rain sensor monitors the multifunction switch to determine if the washer function is selected.

Rain sensor enables the wiper motor to run in low speed during the washer mode and performs wipes from 2.5 to 3.8 sec.

Manual mode

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

Replacement

The rain sensor module is mounted to the coupler using two snap fit stainless steel clips.

This allows the rain sensor module to be easily removed and replaced in the event of a rain sensor module failure.

If the windshield requires replacement, the existing rain sensor module may be unsnapped from the original windshield and reinstalled onto the new windshield.

It is snap-fit to the new coupler, an integral portion of the replacement windshield as delivered by the replacement windshield manufacturer.

Troubleshooting

The rain sensor has two levels of fault detection as described below.

Fault A

Fault A is indicated when the sensor has detected that the sensor servo operating point is above the expected limits. This is an indication of damage to the windscreen in the area of the coupler of the sensor has been removed from the coupler.

Fault B

Fault B is indicated when the sensor has detected that it no longer is responding to rain signals.

This is an indication of damage to the windscreen in the area of the coupler or, more likely, that the sensor has detected an electrical failure within the sensor.

Attachment grade value

Attachment grade is used to determine when fault in A is detected. The attachment grade value is set at 140. This allows the product to operate in all conditions other than the most severe damage to the windscreen.

Use sensitivity adjustment to indicate fault

A method to indicate detected faults is available to a service garage technician by using the sensitivity input and the wipers as an indicator. The service method is described as follows.

1. With ignition "ON", move the sensitivity adjustment to the high sensitivity setting.
2. Decrease the sensitivity by one setting.

3. If a wipe occurs, then Fault A has been detected and the service technician should assure that the coupler area on the windscreen is not damaged and the sensor is secured to the coupler.
4. Decrease the sensitivity one more setting.
5. If a wipe occurs, then fault B has been detected and the sensor should be remove and replaced with a known good sensor.

CAUTION

When the ignition key is "ON" and the multi function switch is in the auto position the wiper could operate in the following conditions.

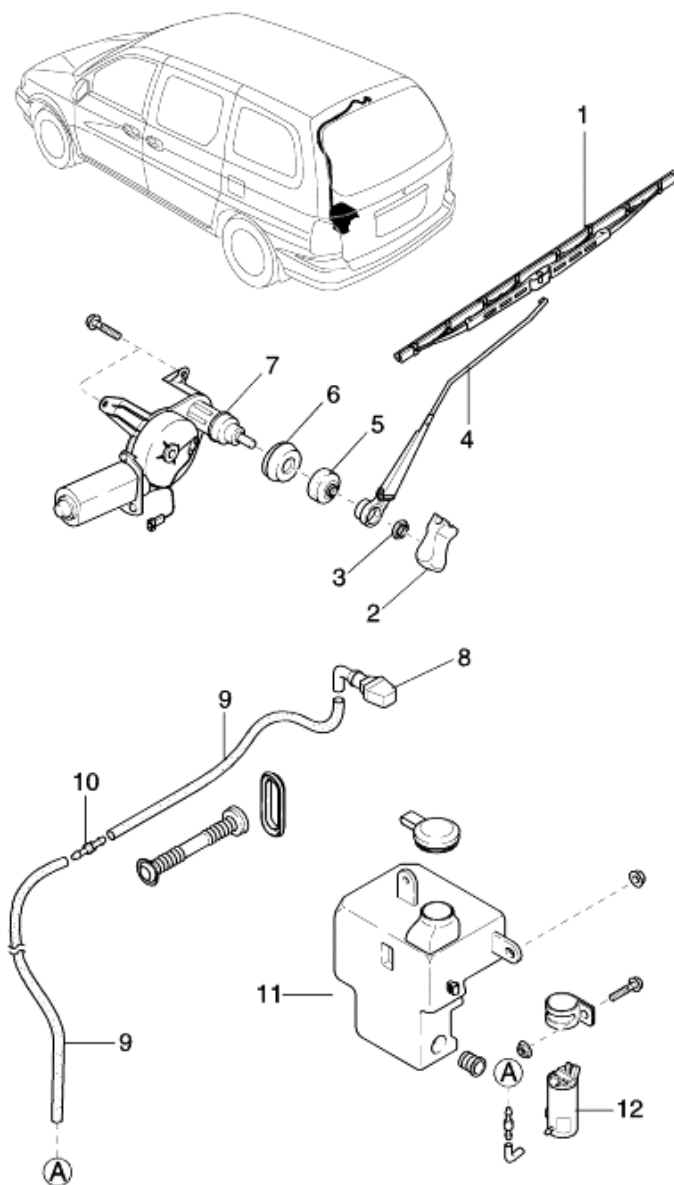
- Be careful not to touch the upper sensor front window glass.
- Be careful not to touch the upper sensor front window glass with a cloth.
- Be careful not to vibrate the front window glass.

Body Electrical System

Rear Wiper / Washer



Component



- 1. Wiper blade
- 2. Wiper arm cover
- 3. Nut
- 4. Wiper arm

- 5. Cap seal
- 6. Outer bush
- 7. Motor assembly
- 8. Washer nozzle

- 9. Hose
- 10. Check valve
- 11. Washer tank assembly
- 12. Washer motor

Body Electrical System

Rear Wiper/Washer - Rear Wiper Motor

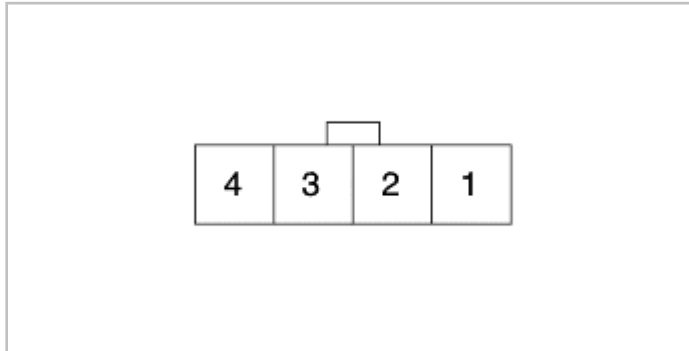


Rear wiper motor

Inspection

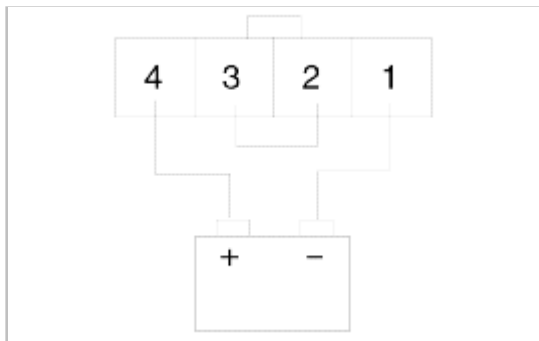
Speed operation check

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



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 1 and 2.
4. Connect the positive (+) lead from the battery to terminal 4 and the negative (-) lead to terminal 1.
5. Check that the motor stops running at the off position.

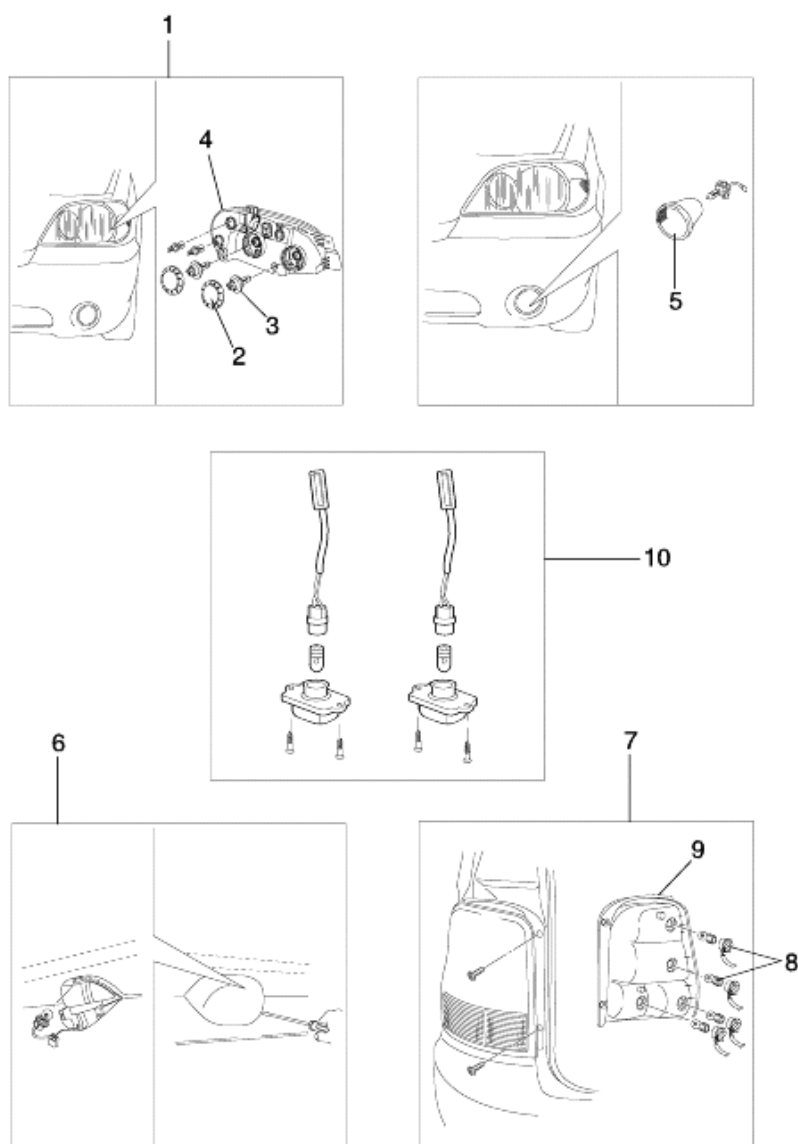


Body Electrical System

Lighting System - Head Lamps



Headlight / combination light & fog lights component



1. Headlight & Combination light assembly
2. Dust cover
3. Bulb
4. Housing
5. Fog light

6. High-mounted brake light assembly
7. Rear combination light
8. Socket and bulb
9. Housing
10. License plate light assembly



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.

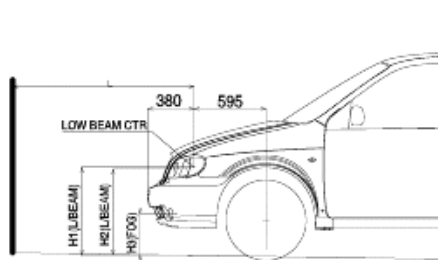
Alternately turn the adjusting gear to adjust the headlamp aiming. If beam-setting equipment is not available, proceed as follows:

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 and horizontal adjustments to the lower beam using the adjusting wheel.

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

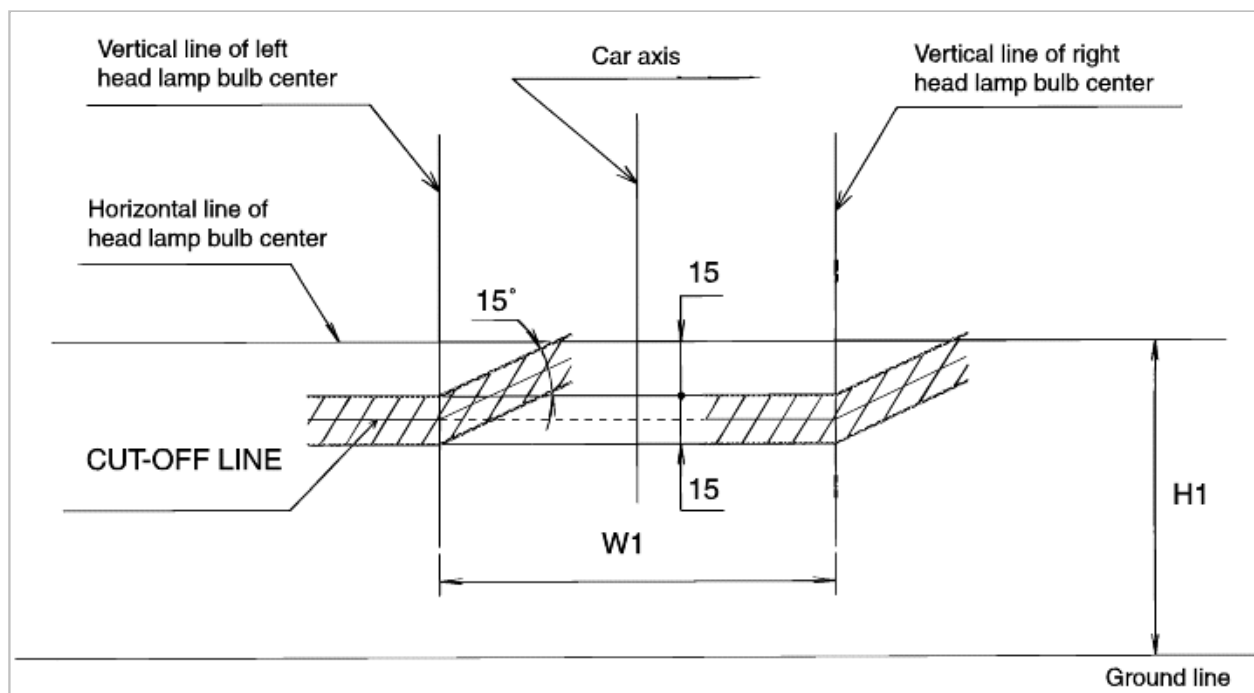
L : Distance between the head lamp bulb center and screen.

Unit : mm

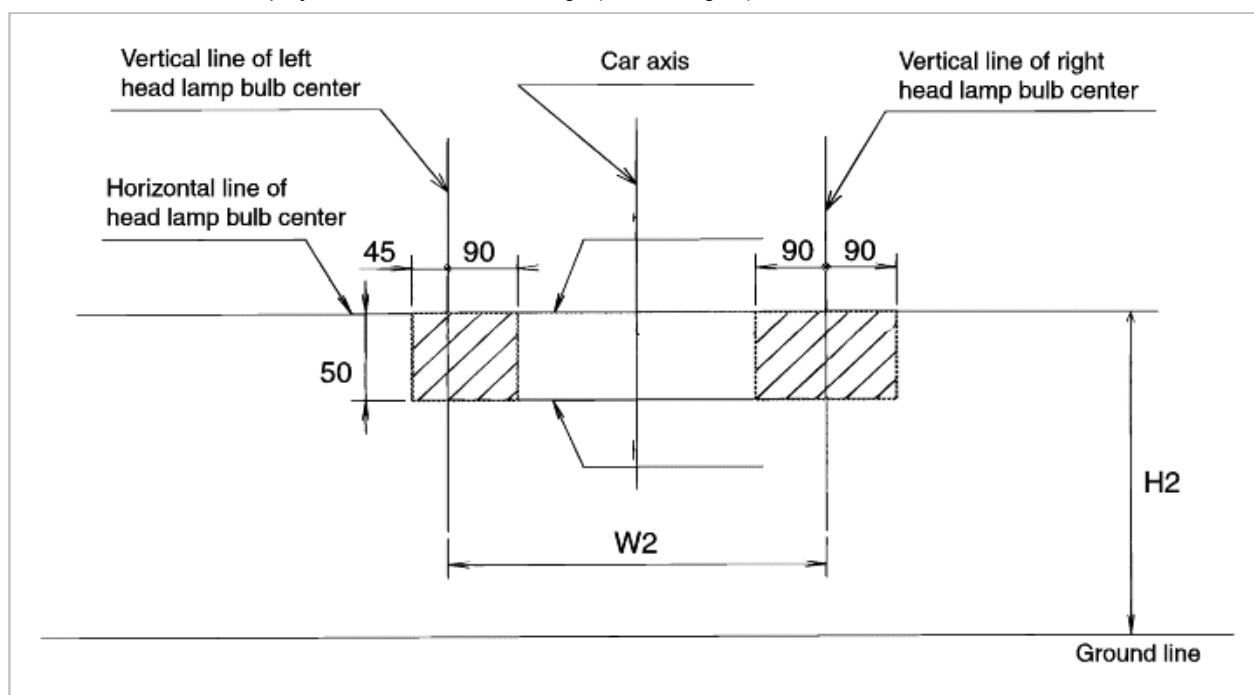
Vehicle condition	H1	H2	H3	W1	W2	W3	L
Without driver	690	674.5	341	1,367	1,087	1,315	3,000
With driver	685	669.5	329				

1. Turn the low beam on without the driver aboard.

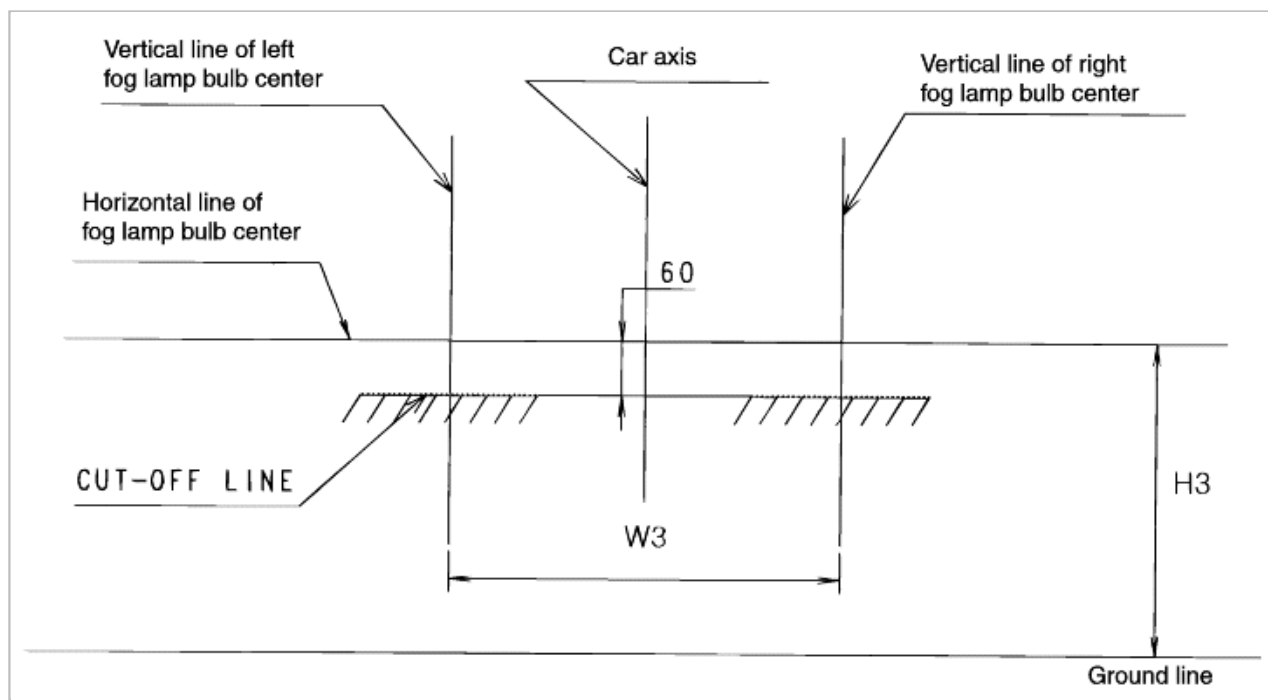
The cut-off line should be projected in the allowable range (shaded region).



2. Turn the high beam on without the driver aboard.
The cut-off line should be projected in the allowable range (shaded region).



3. Turn the front fog lamp on without the driver aboard.
The cut-off line should be projected in the allowable range (shaded region).





Body Electrical System

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.



Specifications

Items		Specifications
Rated voltage		12 V
Load		Max. 200mA (Relay)
Detection illumination	Tail lamp	ON : 23.1 ± 1.4 (Lux), 0.79 ± 0.04 (V)
		OFF : 48 ± 1.4 (Lux), 1.38 ± 0.04 (V)
	Head lamp	ON : 23.1 ± 1.4 (Lux), 0.79 ± 0.04 (V)
		OFF : 48 ± 1.4 (Lux), 1.38 ± 0.04 (V)

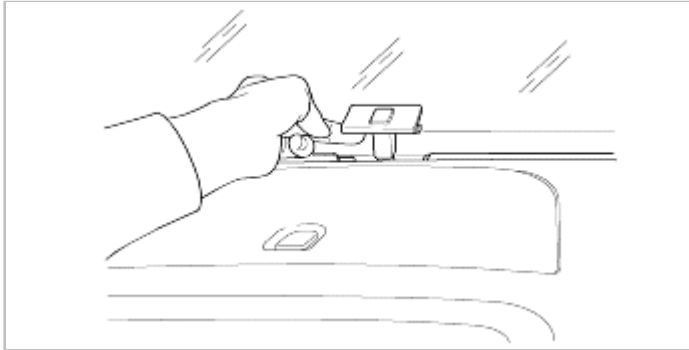
Body Electrical System

Auto Lighting Control System - Auto Lighting
Control Unit



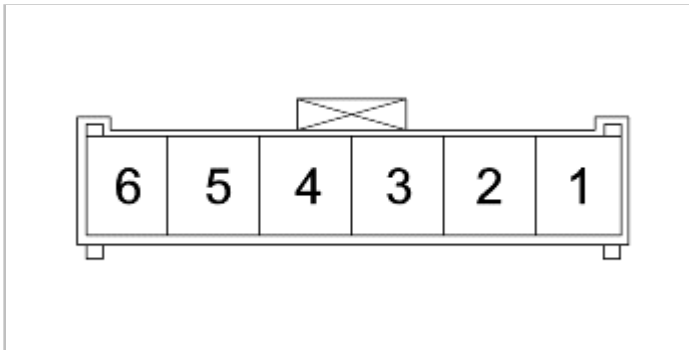
Removal

1. Removal the sensor unit from the defroster nozzle cover using the suitable tool.



Inspection

1. Apply the battery voltage to terminal 1 and ground the terminal 6.
2. Expose the ALCS unit to the sun
3. Check the continuity between the terminals 2 & 4 and the terminals 2 & 5.





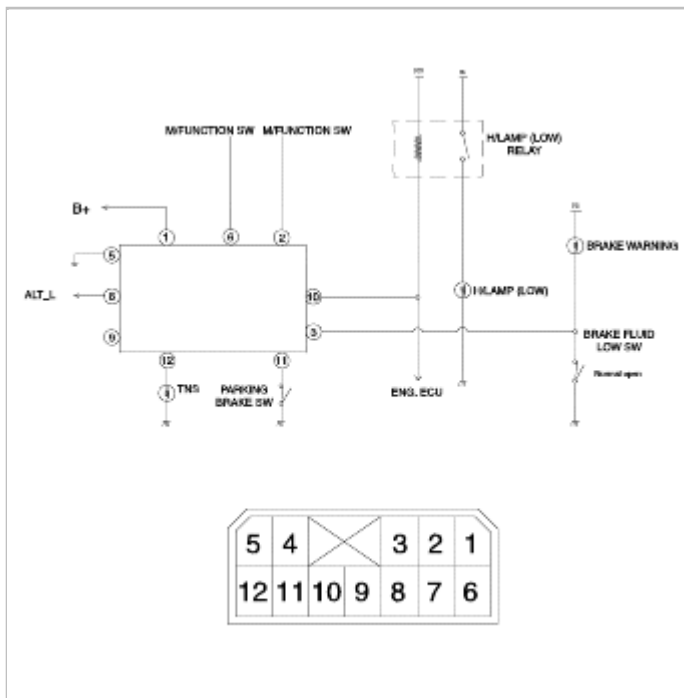
Body Electrical System

Daytime Running Lights



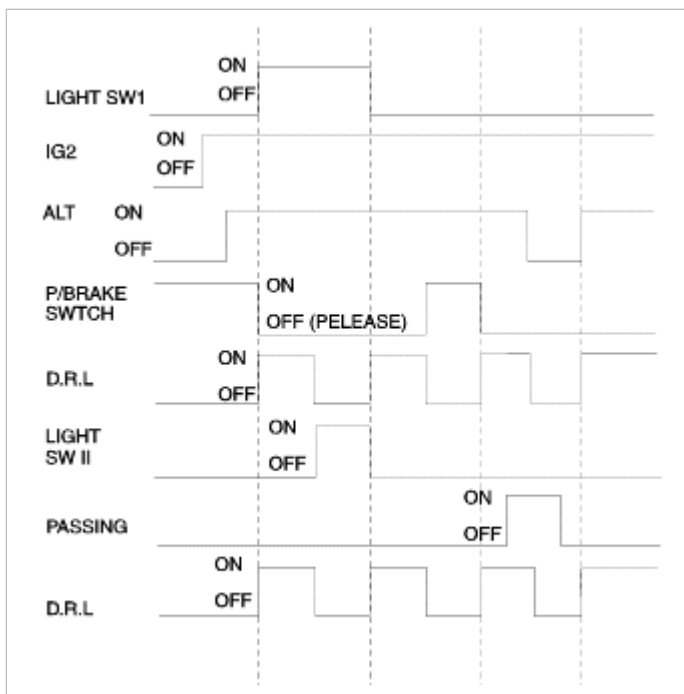
Inspection

Circuit diagram



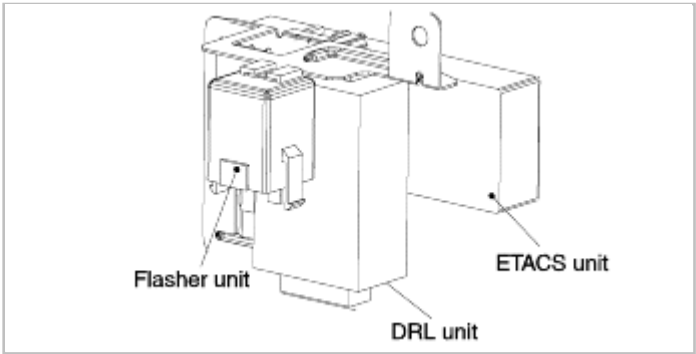
Operation check

Check that the lights operate according to the following timing chart.



Remove and installation

1. It is installed in the center console.





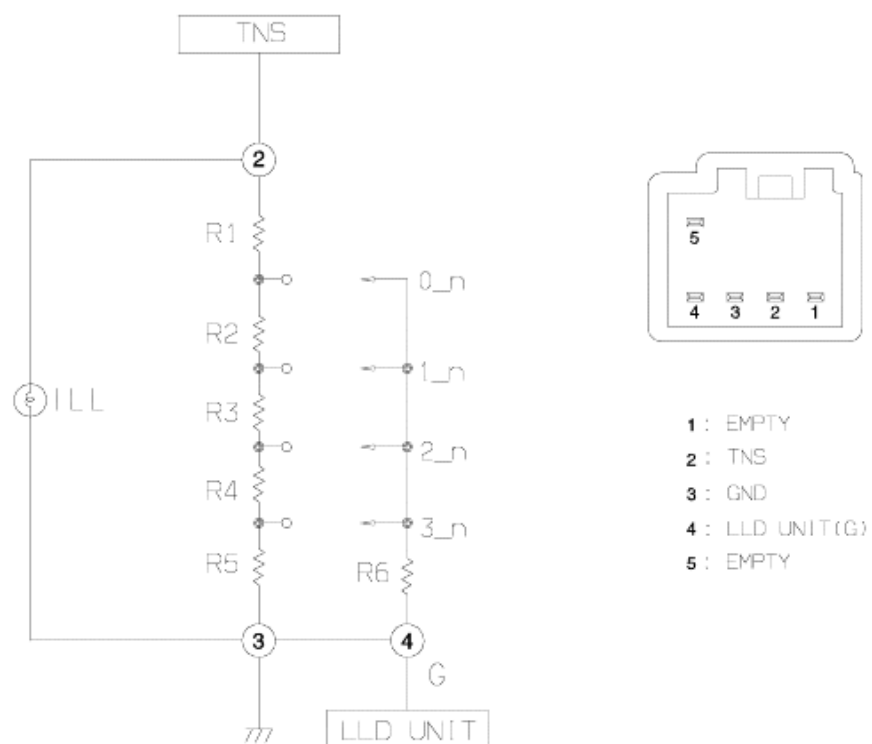
Body Electrical System

Head Lamp Leveling Device



Head lamp levelling switch

Circuit diagram



Body Electrical System

Head Lamp Leveling Device - Head Lamp
Leveling Switch



Inspection

1. Disconnect the switch from harness side, lower panel.
2. Connect the battery voltage between terminals 2 and 3 (Reference voltage = V_b).
3. Measure the voltage between terminals 3 and 4 (V).
4. Check the percent ratio ($V/V_b \times 100\%$) between voltages V_b and V at each position.

Positions No.	Rotation	Ratio ($\pm 5\%$)	Voltage (V)
0	0 °	89.9 %	$12.14 \pm 0.5 \text{ V}$
1	20 °	74.6 %	$10.07 \pm 0.5 \text{ V}$
2	40 °	62.3 %	$8.41 \pm 0.5 \text{ V}$
3	60 °	52.1 %	$7.04 \pm 0.5 \text{ V}$

5. If the voltage is not as specified, replace the head lamp levelling switch.



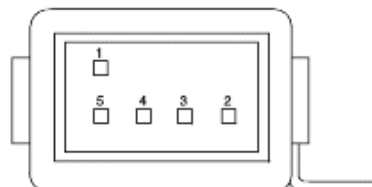
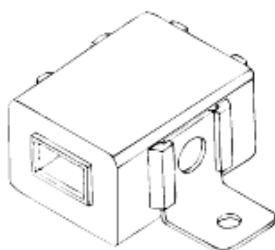
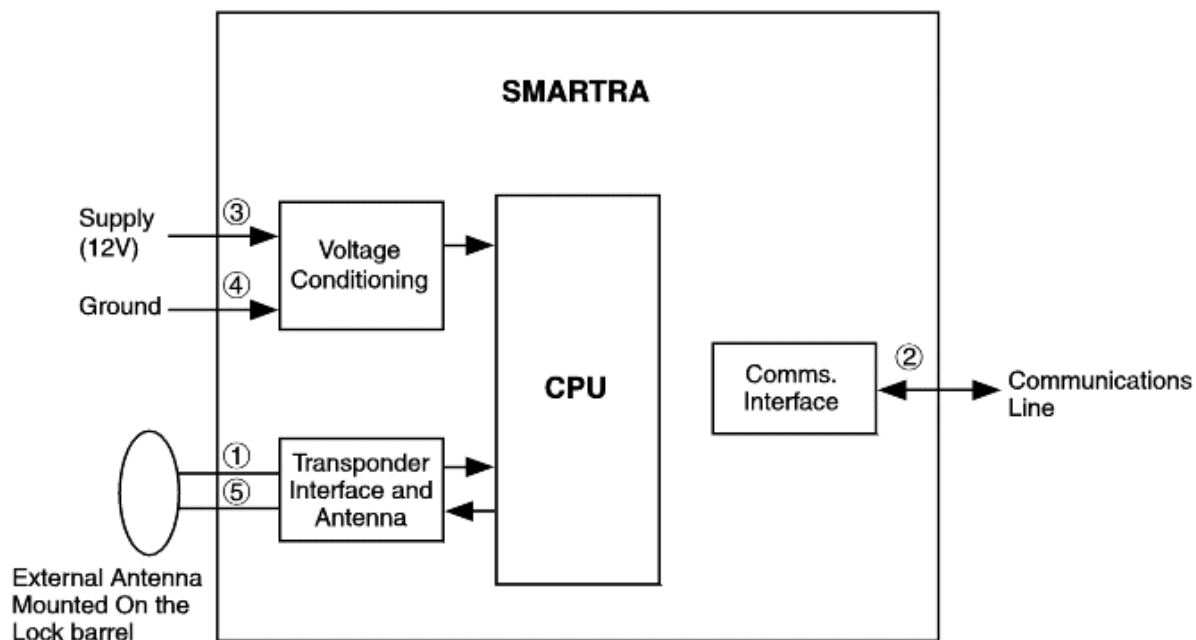
Body Electrical System

Immobilizer System



Smartra immobilizer (for europe)

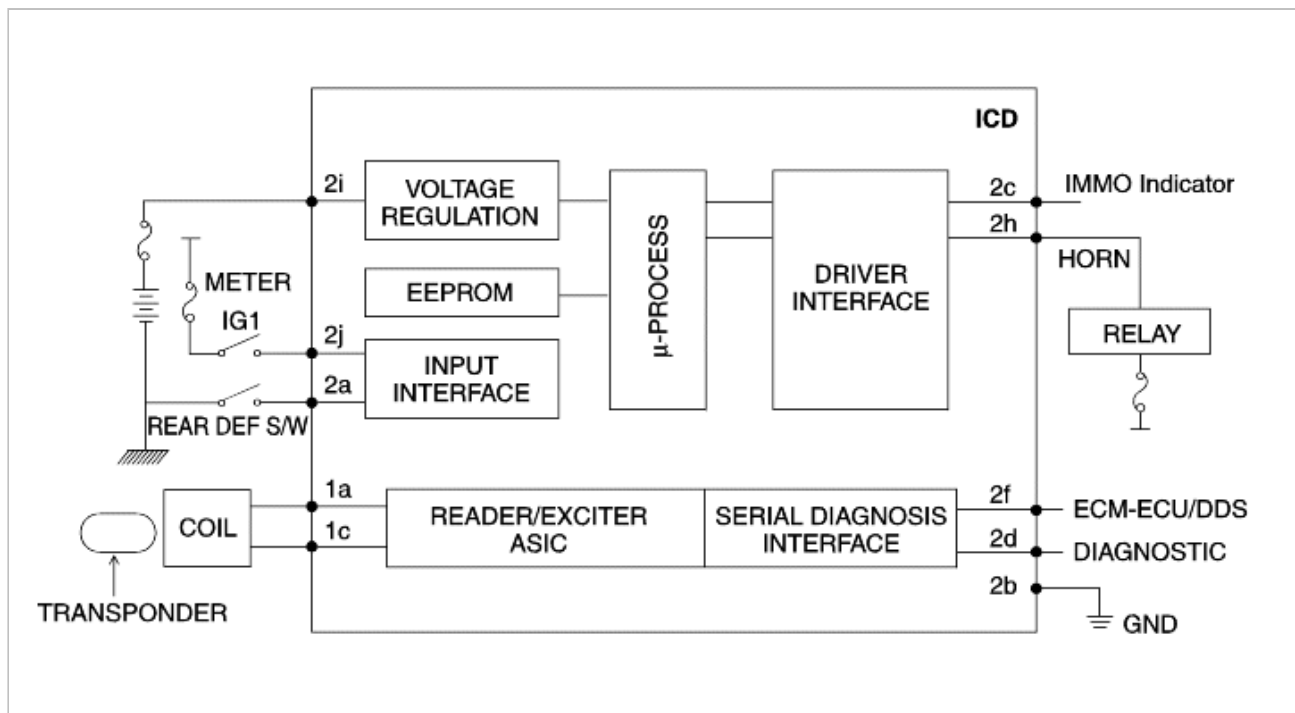
Schematic diagram



Pin	Description	Pin	Description
1	Antenna	4	Ground
2	EMS-ECU	5	Antenna
3	IG 1		

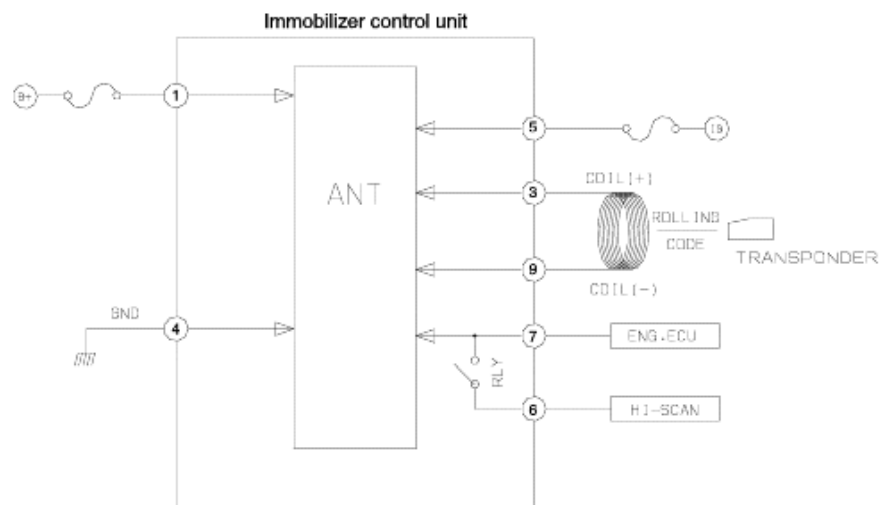
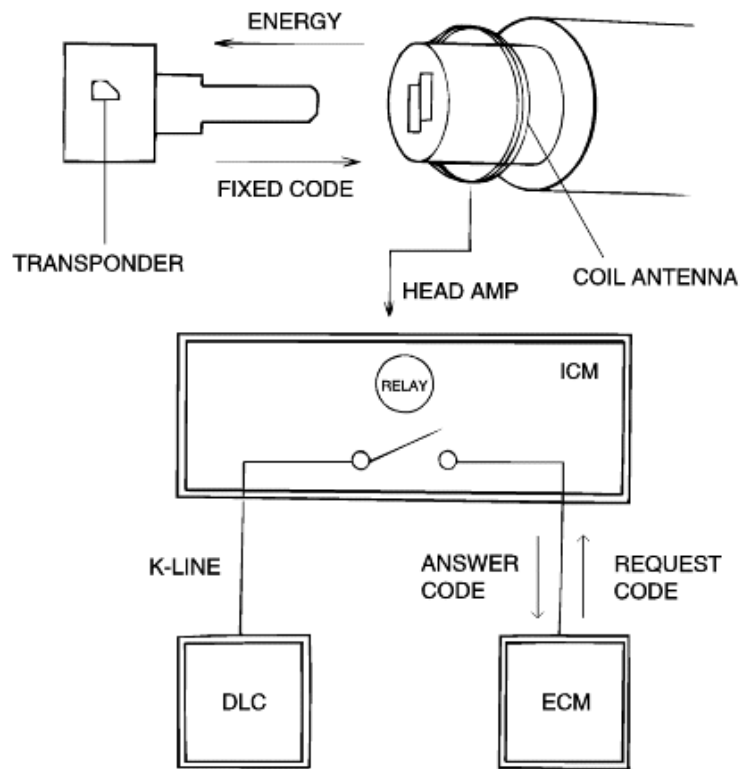
Inkey immobilizer (except europe)

Schematic diagram



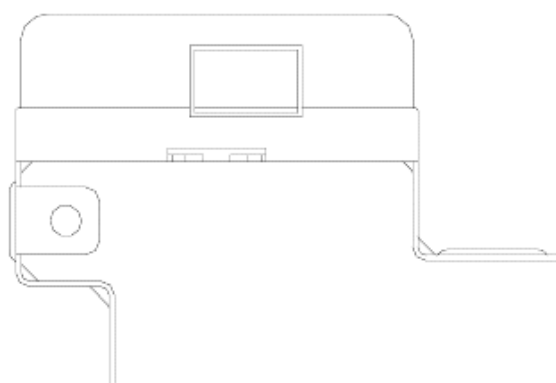
Shinchang Immobilizer (Σ3.5 E/G)


System block diagram



Shinchang Immobilizer (Σ3.5 E/G)

Pin connection



4	3		2	1	
10	9	8	7	6	5

PIN CONNECTION

No.	Terminal
1	Battery
2	-
3	Coil antenna (+)
4	Ground
5	IGN. 1
6	DIAG. Tester (Hi-scan)
7	ENG - ECU
8	-
9	Coil antenna (-)
10	-



Smartra immobilizer (for europe)

Description and operation

This describes the function of EMS(Engine Management System) for vehicle immobilizing in conjunction with the SMARTRA device(SMART Transponder Antenna).

The EMS carries out the immobilizer function and the key management. The immobilizer function is the unlocking of EMS only after detection of a valid ignition key and the locking of EMS only after detection of invalid ignition key and the locking of EMS after switching off the engine. The key management is the storing of relevant information after the teaching of key by vehicle manufacturer or teaching of additional keys at service station. Additionally the EMS allows limp home by user password in case of faults of transponder or SMARTRA.

This immobilizer system consists of the EMS, the SMARTRA and ignition keys with built-in transponder. The EMS carries out the check of ignition key by special encryption algorithm that runs in the transponder and in the EMS in parallel. Only if the results are equal the engine can be started. The data of all transponder that are valid for the vehicle are stored in the EMS. The EMS and the SMARTRA communicate by dedicated line. During this communication of EMS and SMARTRA the K line of EMS can not be used for communication.

Unlocking of ems

This is the release of fuel injection and ignition by EMS for successful start of the engine. The normal operation is with valid key. A key is valid after successful programming of vehicle specific data to the transponder and storing of relevant data of the transponder in the EMS.

Additionally there is a limp home function implemented to cover faults of transponder or SMARTRA.

The unlocked status remains for approximately 30 seconds. After elapsing of timer the EMS is locked again. By using a valid key a new authentication runs after begin of cranking. In case of limp home new inputs are requested.

Unlocking with transponder

This is the normal operation of the system in case of authorized using.

After ignition on the authentication procedure starts. At first the unique code is checked. If it is equal to one of the transponder known to EMS the authentication procedure starts. The authenticator, the code and a random number are converted into the encrypted lock password and transferred to the transponder via the SMARTRA. The transponder compares the data with its calculation result. If the results are equal. The transponder sends back the encrypted key password to EMS. If this is equal to the calculation result of EMS, the EMS will be unlocked until switching off ignition. The unlocked EMS releases fuel injection and control of ignition.

The "IMMO" lamp is ON until the detection of minimum engine speed for ECU operation (begin of engine cranking).

If the unique code is unknown or the calculation result from the transponder is different from the EMS calculation result, the EMS will not be unlocked. If the messages from SMARTRA are disturbed and therefore the checksum of data is wrong, the authentication will be repeated twice. After three attempts with fault the EMS remains locked and an error is stored. After the next ignition on the EMS is set into the limp home mode.

Limp home by hi-scan pro (refer to hi-scan pro manual)

If the EMS detects a fault of SMARTRA or transponder, the EMS will allow limp home function of immobilizer. Limp home is only possible if the user password(four digits)has been taught to the EMS before. This password is programmed at the service station.

Only if the EMS is in status "learnt" and the user password status is " learnt" and the user password is the correct one, the EMS is unlocked for approximately 30 seconds. The engine can only be started during this time. After elapsing of timer no engine start is possible. If wrong user passwords have been sent to EMS three times, the EMS will reject the request of limp home for one hour. This time can not be reduced by disconnecting battery. EMS timer starts again for one hour. After the connecting of battery.

Shinchang immobilizer (Σ3.5 E/G)

Description

The immobilizer system is an anti-theft device which enables starting to be possible only when the mechanical and wireless secret codes are aligned simultaneously.

The transponder built in the ignition key signals its unique frequency code and at this time the ICM compares it with the memorized code.


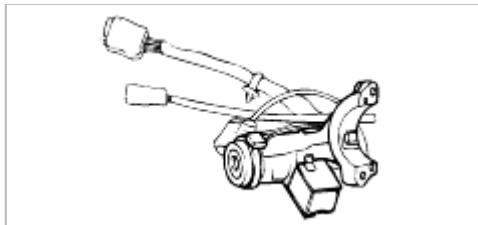
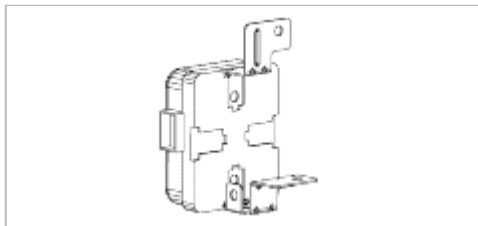
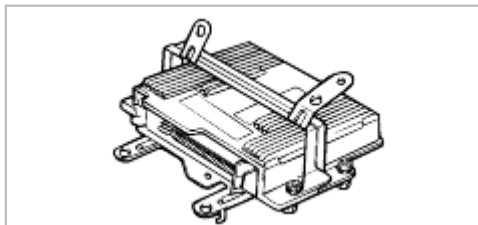
when the codes are aligned, the ICM sends signals to the ECM so that starting is possible.

ICM : Immobilizer Control Module

ECM : Engine Control Module

Shinchang immobilizer (Σ3.5 e/g)

System components

COMPONENT		DESCRIPTION
KEYS	ID KEY	Must be used first to register unique ID code in the ICM. This ID code is then recorded into the master keys.
	MASTER KEY	Once the ID code is recorded into the MASTER KEY, this key is for general use.
	TRANSPONDER (built-in-keys)	When ignition is ON, the coil supplies energy to the transponder, which in turn accumulates energy in the condenser. Once the energy supplied from the coil has stopped, using the stored energy in the condenser, the transponder transmits the ID code.
COIL ANTENNA		 Supplies energy to the transponder. Receives signal from the transponder. Sends transponder signal to the ICM.
IMMOBILIZER CONTROL MODULE		
		Supplies power to the coil antenna. Receives and analyses signal from the coil antenna. Transmits signal to ECM. Stores VIN which is composed of ID code and password.
ENGINE CONTROL MODULE		 In the ignition ON position, the ECM receives information from the ICM and permits injection to take place.
DATA LINK CONNECTOR		

4	3					2	1
12	11	10	9	8	7	6	5
20	19	18	17	16	15	14	13

code can be read.

DIAGNOSTIC TESTER



Has the function of ICM, ECM, and keys diagnosis and change.



Smartra immobilizer (for europe)

Diagnostic trouble codes and associated procedures

1. Locate the data link connector (DLC) in the engine compartment and install the Hi-Scan Pro Tool.
2. Turn the ignition switch to ON and record any Diagnostic Trouble Codes displayed by Hi-Scan Pro Tool.
3. Refer to Diagnostic Trouble Code Chart, for fault description and actions.

Diagnostic trouble code (dtc) chart (gv6 gasoline)

Diagnostic Trouble Code	Fault Description	MIL
P1610	<ul style="list-style-type: none"> • SMARTRA unit defective <ul style="list-style-type: none"> - No answer from smartra - Invalid message from smartra to EMS 	OFF
P1801	<ul style="list-style-type: none"> • SMARTRA transponder fault. <ul style="list-style-type: none"> - Smartra code 02h invalid Tp data. - Smartra code 04h passive mode invalid. - Smartra 11.....17h program error. 	
P1802	<ul style="list-style-type: none"> • SMARTRA unit fault <ul style="list-style-type: none"> - Smartra code 01h antenna error 	
P1803	<ul style="list-style-type: none"> • SMARTRA unit fault <ul style="list-style-type: none"> - Smartra code 03h invalid request 	
P1805	<ul style="list-style-type: none"> • ECU status error <ul style="list-style-type: none"> - Inconsistent data of EEPROM - Invalid write operation to EEPROM - Not plausible E/G data stored at ECU - No valid data from smartra after 3 attempts by EMS. 	
P0648	<ul style="list-style-type: none"> • Immobilizer lamp powerstage malfunction 	

Diagnostic trouble code (dtc) chart (j3 tci diesel)

Diagnostic Trouble Code	Fault Description	MIL
P1611	Transponder fault	OFF
P1612	SAMRTRA fault	
P1613	Immobilizer communication fault	
P1614	ECU status error	ON
P1626	Immobilizer lamp fault	OFF

System check

Step	Action	Normal results
1	<ul style="list-style-type: none"> • Observe "IMMO" indicator. • Turn the ignition switch to ON. 	"IMMO" indicator illuminates for approximately 30 seconds and goes out.
2	<ul style="list-style-type: none"> • Turn the ignition switch to OFF and START. 	Engine starts.

3	<ul style="list-style-type: none"> Perform limp home with original correct user password. 	"IMMO" indicator illuminates for approximately 30 seconds and goes out.
4	<ul style="list-style-type: none"> Turn the ignition switch to START. 	Engine starts.

Inkey immobilizer (except europe)

Diagnostic trouble codes and associated procedures

- Turn ignition switch to ON.
- The immobilizer check lamp turns on.
- Turn the ignition switch to LOCK.
- Locate the data link connector (DLC) in the engine compartment and install the Hi-Scan Pro Tool.
- Turn the ignition switch to ON and record any Diagnostic Trouble Codes displayed by Hi-Scan Pro Tool.
- Refer to Diagnostic Trouble Code Chart, for fault description and actions.

Diagnostic trouble code (dtc) chart

Diagnostic Trouble Code	Fault Description	Warning light(MIL)	Remark
P1614	Communication (Time-out)	OFF	GASOLINE(GV6)
P1631	Immobilizer fail <ul style="list-style-type: none"> Anti-Theft device password error. 		
P1642	Non-immo.ECU <ul style="list-style-type: none"> Non-Immobilizer ECU connected to an Immo. unit 		

Diagnostic trouble code troubleshooting

DTC	Fault Description	Possible cause	Action
P1614	No receiving any answer after elapsing timeout of communication or no receiving correct answer for communication time.	1. Harness or connection failure. 2. ICU failure.	Erase DTC Repair or replace Replace
P1631	ICU & ECU mismatching.	Unmatched between ICU and ECU.	Erase DTC Perform Normal Coding
P1642	No answer from ICU.	Harness or connection failure. ICU failure.	Erase DTC Repair or replace Replace

Symptom table

Fault	Possible Symptom	Action
<ul style="list-style-type: none"> Defective Key transponder No Key matching Defective Antenna coils Defective Harness between ICU and antenna coils 	<ul style="list-style-type: none"> Engine does not start. "IMMO" indicator blinks continuously at 2Hz . When disconnecting antenna coil and then performing limphome with original correct PIN, "IMMO" indicator blinks from 2Hz to 0.5Hz. When turning the ignition switch to OFF and START after limphome, engine starts. 	Refer to procedure1

<ul style="list-style-type: none"> • The rest of system is OK. 		
<ul style="list-style-type: none"> • ICU virgin • The rest of system is OK. 	<ul style="list-style-type: none"> • Engine does not start. • "IMMO" indicator illuminates for approximately two seconds and then goes out. • When disconnecting antenna coil connector and turning the ignition switch to ON, "IMMO" indicator blinks at three times for approximately one second and then goes out. 	Perform "Normal Coding" procedures with original correct PIN.
<ul style="list-style-type: none"> • Defective ECU • Harness between ICU and ECU • Starting system • The rest of system is OK 	<ul style="list-style-type: none"> • Engine does not start. • "IMMO" indicator illuminates for approximately two seconds and then goes out. • When disconnecting antenna coil connector and turning the ignition switch to ON, "IMMO" indicator blinks at 2Hz continuously. 	Refer to procedure2
<ul style="list-style-type: none"> • Defective ICU • Defective ECU • Defective harness between ICU and ECU. • The rest of system is OK. 	<ul style="list-style-type: none"> • Engine does not start. • When disconnecting antenna coil and then performing limphome with original correct PIN, "IMMO" indicator does not blink from 2Hz to 0.5Hz (The PIN entry is correct). • MIL indicator illuminates (there are any Diagnostic Trouble Codes related to Inkey Immobilizer System). 	Refer to procedure3

Procedure 1

Step	Inspection		Action
1	<ul style="list-style-type: none"> • Perform "Key Only Matching" with the original correct PIN. • Is key matching results OK? 	Yes	Turn the ignition switch to START. If engine starts, system is OK.
		No	Go to step2.
2	<ul style="list-style-type: none"> • Turn the ignition switch to OFF. • Check if connection and wire harness between antenna coils and ICU are normal. 	Yes	Go to step3.
		No	Repair or replace wire harness
3	<ul style="list-style-type: none"> • Check if antenna coils are normal. 	Yes	Go to step4.
		No	Replace antenna coils
4	<ul style="list-style-type: none"> • Perform "Key Only Matching" with the original correct. • Is key matching results OK? 	Yes	Go to step5
		No	Recheck system.
5	<ul style="list-style-type: none"> • Turn the ignition switch to OFF and ON • Check if "IMMO" indicator illuminates for pproximately two seconds and goes out. 	Yes	Go to step6.
		No	Recheck system.
6	<ul style="list-style-type: none"> • Turn the ignition switch to START. • Check if engine starts. 	Yes	System is OK.
		No	Refer to "Symptom table"

Procedure 2

Step	Inspection	Action
------	------------	--------

1	<ul style="list-style-type: none"> • Perform "VIM CHECK" with original correct PIN. • Check if ICU's status and condition are "Learnt" and "Unlocked". 	Yes	ICU is normal.
		No	Go to step2.
2	<ul style="list-style-type: none"> • Check if connection and wire harness between ICU and ECU is normal. 	Yes	Go to step3.
		No	Repair or replace wire harness.
3	<ul style="list-style-type: none"> • Perform "Normal Coding" with original correct PIN. • Turn the ignition switch to OFF and ON. • Check if "IMMO" indicator illuminates for approximately two seconds and goes out. 	Yes	Go to step4.
		No	Recheck system or check if PIN entry is correct.
4	<ul style="list-style-type: none"> • Perform "ECM CHECK" with original correct PIN. • Check if ECU condition is "Unlocked" 	Yes	Check Starting System.
		No	Go to step5.
5	<ul style="list-style-type: none"> • Recheck if connection and wire harness between ICU and ECU are normal. 	Yes	Go to step6.
		No	Repair or replace wire harness.
6	<ul style="list-style-type: none"> • Perform "Neutralization" and "Normal Coding" with original correct PIN. • Turn the ignition switch to START. • Check if engine starts. 	Yes	System is OK.
		No	Go to step7.
7	<ul style="list-style-type: none"> • Before replacing ECU, must remember and recorded the original correct PIN. • Perform "Neutralization" with the original correct PIN and turn the ignition switch to OFF. • Remove ECU and store the ECU with the tag recorded serial inspection. • Install new virgin or neutralized ECU. • Perform "Normal Coding" with the original correct PIN. • Turn the ignition switch to START. correct PIN. • Check if engine starts. 	Yes	System is OK.
		No	Perform "Neutralization" with the original correct PIN, remove new ECU, and install original ECU. Perform "Normal coding" with the original correct PIN. Recheck system.

Procedure 3

Perform "ECM CHECK" and "VIM CHECK" with Hi-Scan Pro Tool. The ECU and ICU installed in vehicle must be in Learnt Status because they were first encoded by Kia Motor.

Step	Inspection		Action
1	<ul style="list-style-type: none"> • Perform "Neutralization" and "Normal Coding" with the original correct PIN. • Turn the ignition switch to START. • Check if engine starts. 	Yes	System is OK
		No	Go to step2.
2	<ul style="list-style-type: none"> • Turn the ignition switch to OFF and disconnect antenna coils connector from ICU. 	Yes	Go to step3.

	<ul style="list-style-type: none"> • Turn the ignition switch to ON and perform "Limphome" with the original correct PIN through RR DEF SW. • Observe if "IMMO" indicator blinks from 2Hz to 0.5Hz 	No	Go to step6.
3	<ul style="list-style-type: none"> • Turn the ignition switch to START. • Check if engine starts. 	Yes	System is OK.
		No	Go to step4.
4	<ul style="list-style-type: none"> • Check if connection and wire harness between ICU and ECU is normal. 	Yes	Go to step5.
		No	Repair or replace wire harness.
5	<ul style="list-style-type: none"> • Before replacing ECU, must remember and recorded the original correct PIN. • Perform "Neutralization" with the original correct PIN and turn the ignition switch to OFF. • Remove ECU and store the ECU with the tag recorded serial inspection. • Install new virgin or neutralized ECU. • Perform "Normal Coding" with the original correct PIN. • Perform "Limphome" with the original correct PIN and turn the ignition switch to START. Check if engine starts. 	Yes	System is OK.
		No	Go to step6.
6	<ul style="list-style-type: none"> • Before replacing ICU, must remember and recorded the original correct PIN. • Perform "Neutralization" with the original correct PIN and turn the ignition switch to OFF. • Removal ICU and store the ICU with the tag recorded a serial inspection. • Install new virgin or neutralized ICU. • Perform "Normal Coding" with the original correct PIN. • Perform "Limphome" and turn the ignition switch to START. • Check if engine starts. 	Yes	System is OK.
		No	Go to step7.
7	<ul style="list-style-type: none"> • Check if connection and wire harness between ICU and ECU is normal. 	Yes	Go to step8
		No	Repair or replace wire harness.
8	<ul style="list-style-type: none"> • Perform "VIM CHECK" and "ECM CHECK" with the original correct PIN. • Check if ICU and ECU status is "Unlocked" 	Yes	Check starting system.
		No	Perform "Neutralization" with the original correct PIN, remove new ECU and ICU, and install original ECU and ICU. Perform "Normal coding" with the original correct PIN. Recheck system.



Inkey immobilizer (except europe)

System check

Step	Action	Normal results
1	<ul style="list-style-type: none"> Observe "IMMO" indicator. Turn the ignition switch to ON. 	"IMMO" indicator illuminates for approximately two seconds and goes out.
2	<ul style="list-style-type: none"> Turn the ignition switch to START 	Engine starts.
3	<ul style="list-style-type: none"> Turn the ignition switch to OFF. Disconnect antenna coil connector from ICU. Turn the ignition switch to ON. Observe "IMMO" indicator. 	"IMMO" indicator blinks continuously (2HZ).
4	<ul style="list-style-type: none"> Perform limphome with original correct PIN. 	"IMMO" indicator blinks from 2Hz to 0.5 Hz.
5	<ul style="list-style-type: none"> Turn the ignition switch to START. 	Engine starts.

Icu status by "IMMO" indicator

Action	Virgin	Neutralized/Learnt
<ul style="list-style-type: none"> Disconnect antenna coil connector. Turn the ignition switch to ON. 	"IMMO" indicator blinks at three times for approximately one second.	"IMMO" indicator blinks continuously (2HZ).

Inkey immobilizer (except europe)

Before servicing

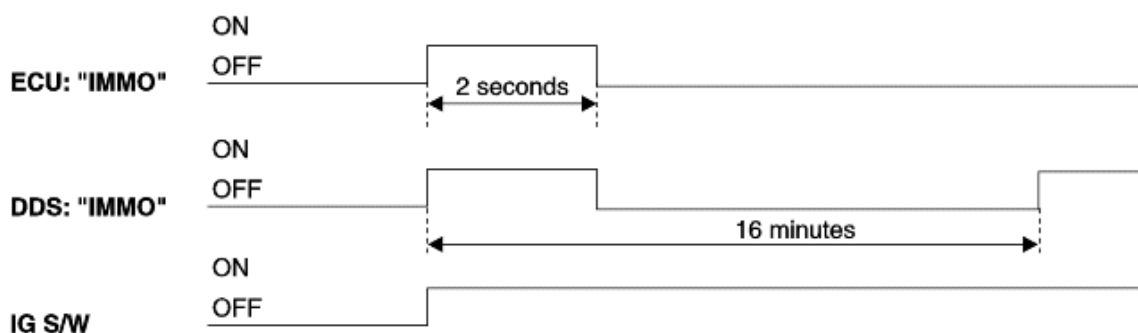
Step	Inspection	Yes	No
1	<ul style="list-style-type: none"> Turn the ignition switch to ON. Check if "IMMO" indicator illuminates or blinks. 	Go to step7	Go to step2
2	<ul style="list-style-type: none"> Turn the ignition switch to OFF. Disconnect the immobilizer harness connector from the ICU. Check if battery voltage is applied to the terminal 2I of the harness connector. 	Go to step3	Repair or replace
3	<ul style="list-style-type: none"> Check if the terminal 2B of the harness connector is grounded. 	Go to step4	Repair or replace
4	<ul style="list-style-type: none"> Check if battery voltage is applied to the terminal 2H of the harness connector. 	Go to step5	Repair or replace
5	<ul style="list-style-type: none"> Turn the ignition switch to ON. Check the battery voltage is applied to the terminal 2J and 2C of the harnessconnector. 	Go to step6	Repair or replace
6	<ul style="list-style-type: none"> Turn the ignition switch to OFF and connect the immobilizer harness connector tothe ICU. Turn the ignition switch to ON. 		
7	<ul style="list-style-type: none"> Check if "IMMO" indicator illuminates for approximately two seconds and then goes out. 	Go to step8.	Go to "Symptom table"
8	<ul style="list-style-type: none"> The ICU is normal. Check if engine starts. 	System is OK	Go to "Symptom table"

NOTICE

- While performing a coding procedure, the period of ON and OFF must be maintained for approximately two seconds in order to confirm a communication time between the ICU and ECU or DDS (diesel).
- After completing to perform a coding procedure, if engine does not start in spite that "IMMO" indicator is normal, disconnect the antenna coil connector from the ICU and then perform a limphome procedure,. In case of observing

that "IMMO" indicator is normal, the ICU is normal. Therefore, check for ECU or DDS (diesel) including the starting system.

- After a neutralization or replacement of ICU, must perform "Normal Coding" procedure with the original correct PIN.
- When performing a "Key Only Matching" procedure, must code key one by one.
- With the ignition switch ON, perform a limphome procedure through a "IMMO" indicator by RR. DEF switch. If succeed, "IMMO" indicator blinks from 2Hz. If not, "IMMO" indicator goes out.
- If a limphome procedure is succeed, must turn the ignition switch to OFF and then start engine within 20 seconds.
- On ECU (gasoline engine) or DDS (diesel engine) neutralization, refer to Hi-Scan Pro Tool Manual in detail
 - 1) Turn the ignition switch to OFF and set the Hi-Scan Pro Tool to your vehicle.
 - 2) Select the neutralization mode and turn the ignition switch to ON.
 - 3) Must maintain the ignition switch in ON more than two seconds in case of ECU. If so, "IMMO" indicator illuminates for approximately two seconds and then goes out (DDS: must maintain above 16 minutes. If so, the indicator illuminates for approximately two seconds and then goes out. However, the indicator illuminates again after 16 minutes until turning the ignition switch to OFF).
 - 4) Turn the ignition switch to OFF.

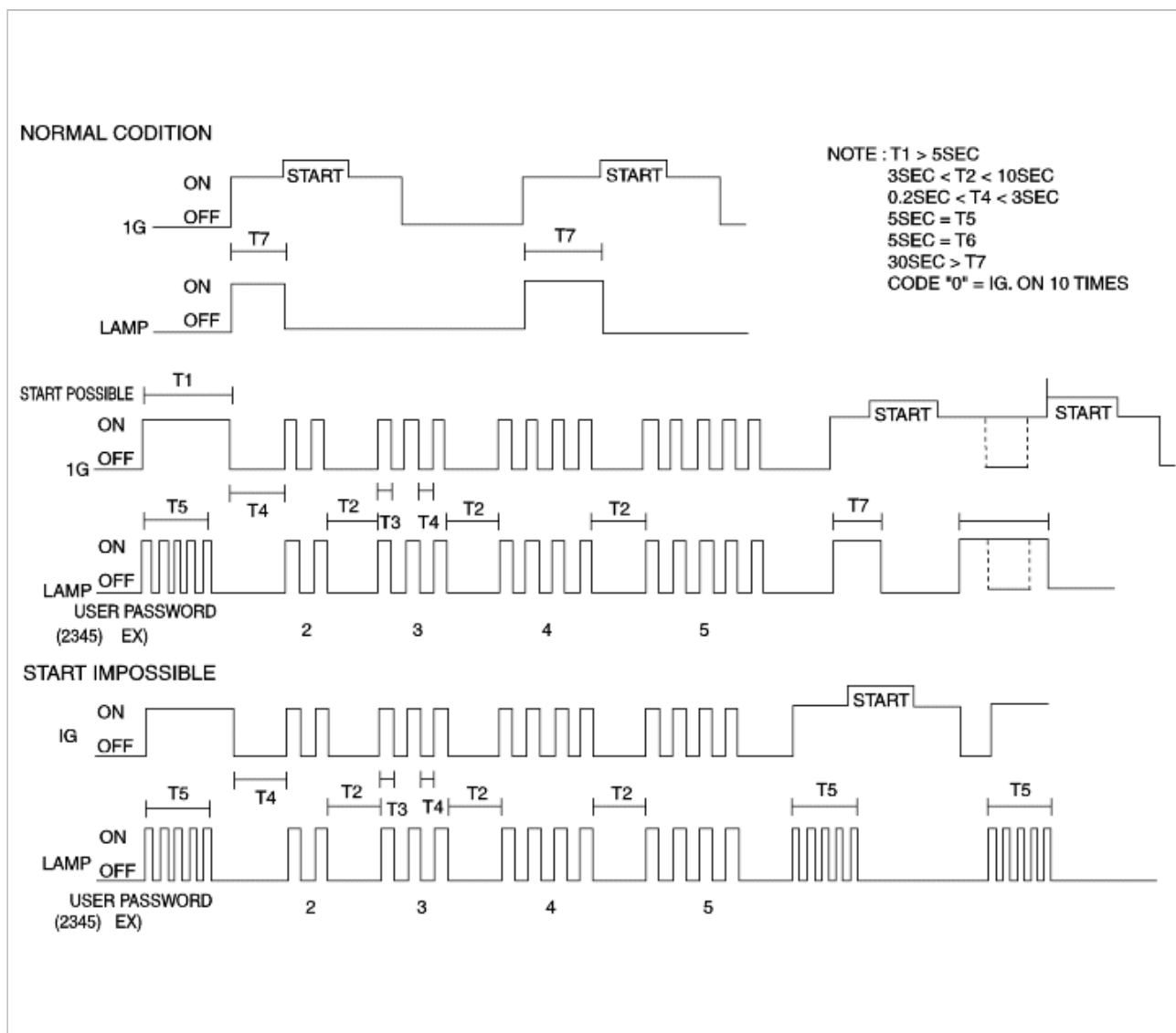


Smartra immobilizer (for europe)

Limp home (override) procedure by ignition key

This procedure allows the unlocking of the EMS by entering the user password via the IG SW, in case the transponder code cannot be read or is unknown after ignition-ON, a valid transponder code must have been received, otherwise the EMS will remain "Locked" and the lamp will start blinking. This can happen through a malfunction of the transponder, the reading device or an unknown transponder code. The following grid indicates whether the passage into limp home procedure is possible according to the status of the ECU:

ECU Status	Is limp home procedure possible?
Learnt	Yes
Neutralized	No
Virgin	No



Only if the EMS is in status "learnt" and the user password status is "learnt" and the user password is the correct one, the EMS is unlocked for approximately 30 seconds. The engine can be started during this time. After elapsing of timer no engine start is possible. After new input of user password the time starts again. After ignition off the EMS is locked. For next start the input of user password is requested again.

Smartra immobilizer (for europe)

Status of ems and user password

The status of EMS defines the possibility of vehicle operation related to the immobilizer and the teaching of Keys. This status depends on the handling of EMS by tester operation.

The status of user password defines the possibility of limp home function.

After request from the tester the EMS sends the status information. The status of EMS is one of the following:

- Not yet checked
The status is stored in EEPROM. In case of not plausible data from this circuit the EMS cannot check the status and EMS sends 00.
- Learnt
At least one Key has been taught successfully.
- Virgin
This is the status at the end of EMS production line before delivery to final customer.
- Neutral
By special command from tester this status can be set.
- Locked by timer
After a certain number of incorrect inputs the EMS is locked for one hour and no inputs are accepted during this time.

The following table describes the functions depending on EMS status.

Status	Engine start with valid key	Engine start by limp home	Teaching of Key	Teaching or changing of user password
Not yet checked	No	No	No	No
Virgin	No	No	Yes	No
Learnt	Yes	Yes, with learnt user password	Yes	Yes
Neutral	No	No	Yes	No
Locked by timer	No	No	No	No

Locking of ems

By engine shut off (ignition off by key) the EMS is locked after elapsing the timer (approximately 1.5 seconds). EMS accepts new start within this time without considering the result of new authentication.

In case of engine stalling the timing of EMS locking is as follows: without ignition off there is no time limit for repeated engine start, after ignition off the time for repeated engine start is limited to the time (approximately 1.5 seconds)

After elapsing this time new authentication is done or in case of limp home the input of user password is requested again.

Key teaching procedure (refer to hi-scan pro manual)

The Key teaching is done at end of line of vehicle manufacturer, after replacing defective EMS at service station or for providing or additional keys to the vehicle owner.

The procedure starts with EMS request of vehicle specific data from tester. The "virgin" EMS stores the vehicle specific data and the key teaching can be started. The "learnt" EMS compares the vehicle specific data from tester with the stored data. If the data are correct, the key teaching can be started.

If wrong vehicle specific data have been sent to EMS three times, the EMS will reject the request of key teaching for one hour. This time cannot be reduced by disconnecting the battery or other manipulation. After connecting the battery the timer starts again for one hour.

The key teaching is done by ignition on with key and additional tester command. The EMS stores the relevant data in the EEPROM and in the transponder. Then the EMS runs the authentication for confirmation of teaching process. The successful programming is confirmed by message to tester.

If the key is already known to EMS from previous teaching the authentication will run and the EEPROM data are updated.

There is no change of transponder content (this is impossible for learnt transponder).

The attempt of repeated teaching of a key which has been taught already during the same teaching cycle is recognised by EMS. The EMS rejects this key and a message is sent to the tester.

The EMS rejects invalid keys which are presented for teaching. A message is sent to the tester. The key can be invalid due to faults of transponder or other reasons which result into not successful programming of data. If the EMS detects different authenticators of transponder and EMS, the key is considered to be invalid.

If an error occurs during the Immobilizer Service Menu, the EMS status remains unchanged and a specific fault code is stored. If the ECU status and the key status do not match for teaching of keys, the tester procedure will be stopped and a specific fault code is stored at EMS.

User password teaching procedure (refer to hi-scan manual)

The user password for limp home is taught at service station. The owner of the vehicle can define a number with four digits.

The user password teaching is only accepted by "learnt" EMS. Before first teaching of user password to EMS the status of this password is "virgin". No limp home function is possible.

The teaching is started by ignition on with a valid key and sending the user password by tester.

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 the user password status is "learnt" and the tester sends for authorisation of access either the old user password or the vehicle specific data. After correct authorisation the EMS requests new user password. The status remains in "learnt" and the new user password will be valid for next limp home mode.

If wrong user passwords or wrong vehicle specific data have been sent to EMS three times, the EMS will reject the request of password changing for one hour. This time cannot be reduced by disconnecting the battery. After connecting the battery the timer starts again for one hour.

The user password can be in the status.

- Not yet checked
The status is stored in EEPROM. In case of not plausible data from this circuit the EMS cannot check the status.
- Learnt
The password has been taught successfully to EMS.
- Virgin

This is the status at the end of EMS production line before delivery to final customer.

- Locked by timer
After a certain number of incorrect inputs the EMS is locked for one hour and no inputs are accepted during this time.
- Teaching not accepted
This status is set if the EMS is in neutral status.

Shinchang Immobilizer (Σ3.5 E/G)

Password setting

Password can be used to register the master keys when you lost the ID key by using a tester (such as Hi-scan pro).

1. Initial password

The initial password for ICM has been set by the manufacturer as 2345.

Key can be registered and corrected by using the initial password until a new password is registered.

2. Password registration and change

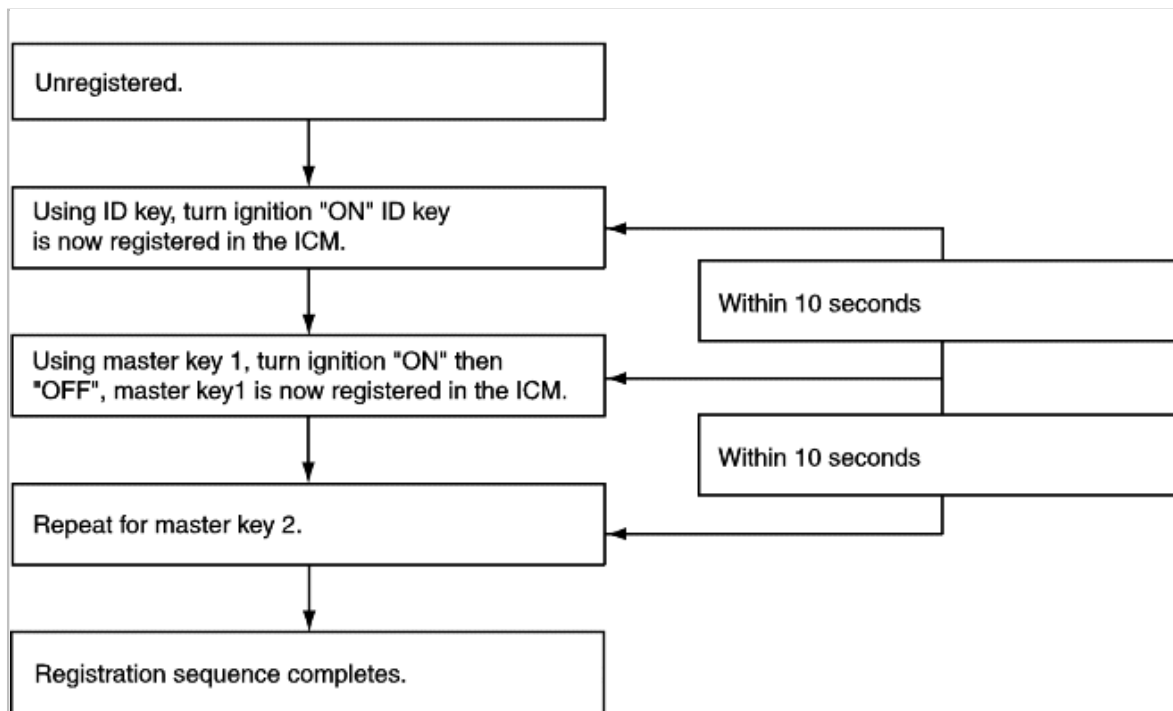
Using a tester(Hi-scan pro), the initial password(preset as 2345 all) can be replaced by a new password nominated by the owner.

4 numbers among 0-9 can be registered as password.

Once the password has been changed from 2345, the ICM is ready to record the ID code.

Keys registration and correction

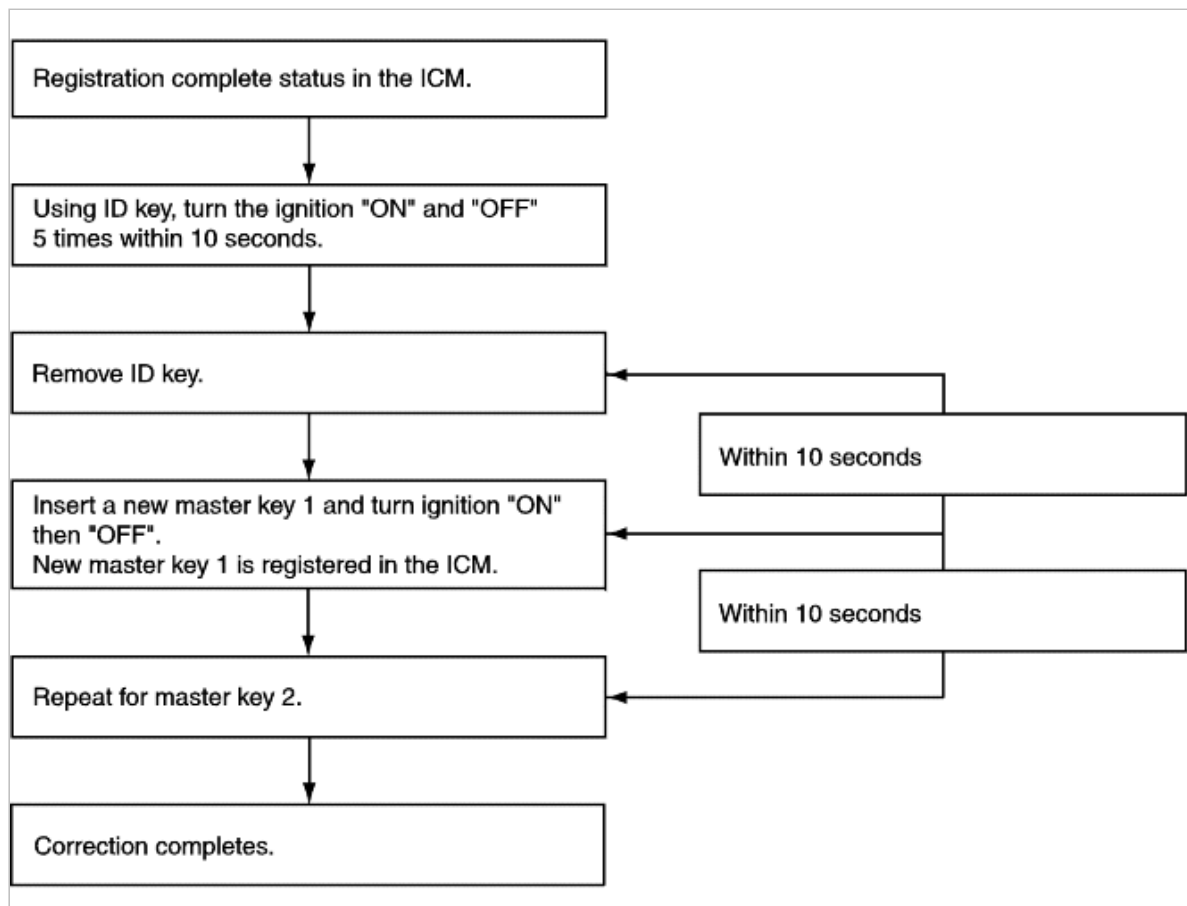
1. Initial registration method



2. Registration correction for master keys

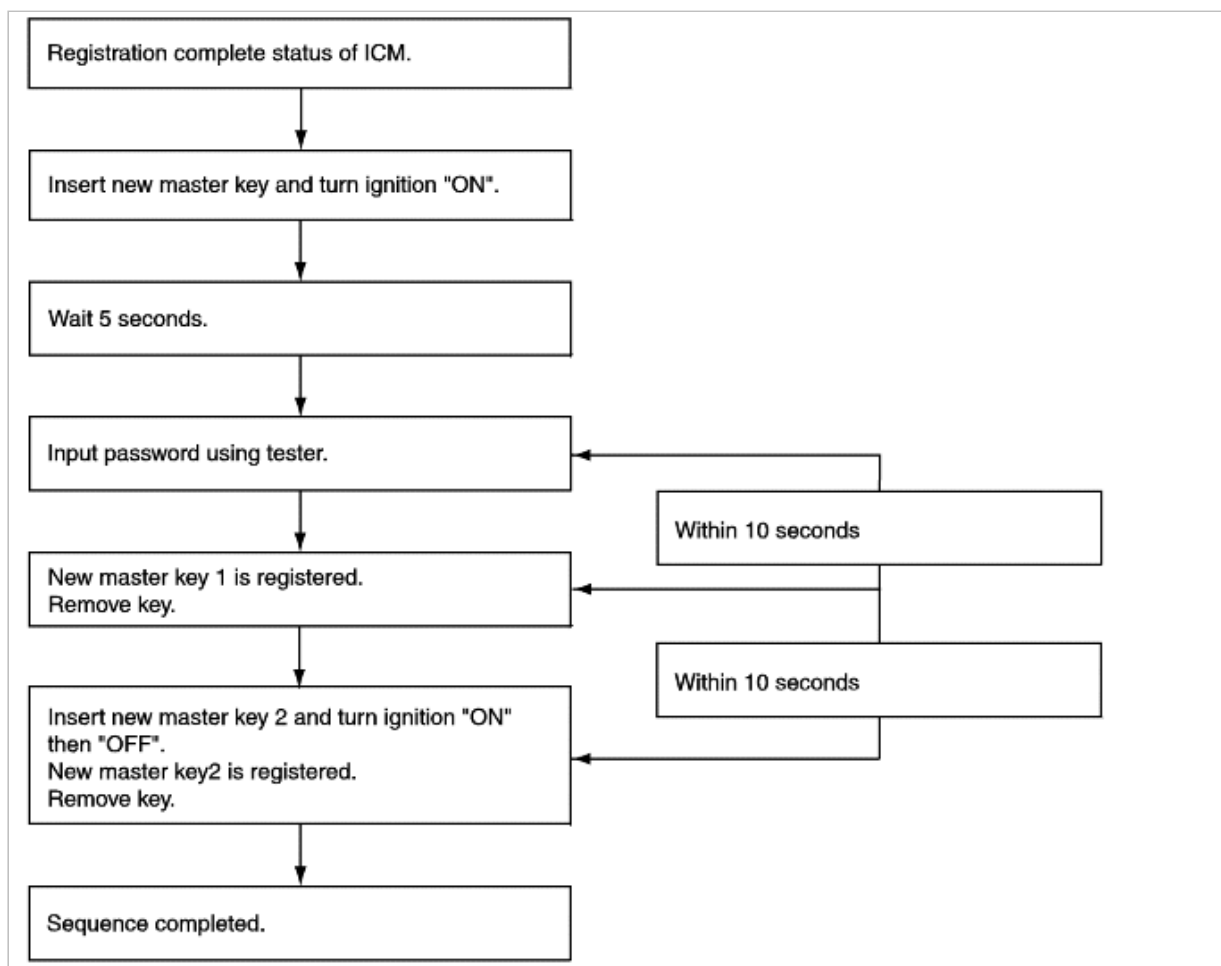
In cases when the master key is lost or where a new set of master keys need to be produced, it can be achieved using two methods.

- (1) Using ID key



(2) Using password

When the customers lost the ID key, new master keys can be registered by using Hi-scan pro only.
ID key can not be corrected and reproduced.



NOTICE

Once the password is mis-registered, it is impossible to register new password during 10 seconds regardless of ignition ON/OFF.

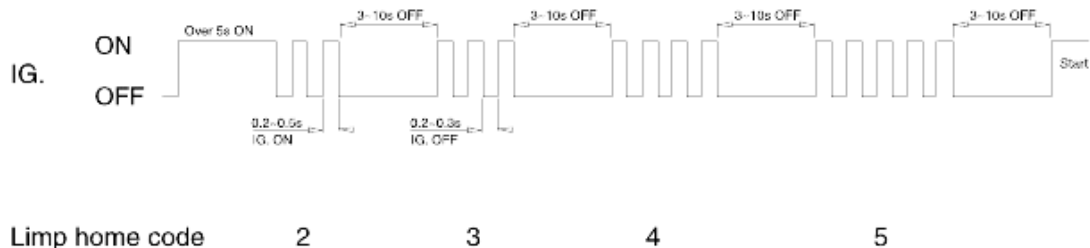
When the new master keys have been registered, the codes for existing master keys are all cleared.

Limp home (override) procedure by ignition key

This procedure allows the unlocking of the EMS by entering the user password via the IG SW, in case the transponder code cannot be read or is unknown after ignition-ON, a valid transponder code must have been received, otherwise the EMS will remain "Locked" and the lamp will start blinking. This can happen through a malfunction of the transponder, the reading device or an unknown transponder code.

The number of IG ON/OFF must coincide with the password.

ECU Status	Is limp home procedure possible?
Learnt	Yes
Neutralized	No
Virgin	No



Only if the EMS is in status "learnt" and the user password status is "learnt" and the user password is the correct one, the EMS is unlocked for approximately 10 seconds. The engine can be started during this time. After elapsing of timer no engine start is possible. After new input of user password the time starts again.

After ignition off the EMS is locked. For next start the input of user password is requested again.

Inkey immobilizer (except europe)

System check

Step	Action	Normal results
1	<ul style="list-style-type: none"> Observe "IMMO" indicator. Turn the ignition switch to ON. 	"IMMO" indicator illuminates for approximately two seconds and goes out.
2	<ul style="list-style-type: none"> Turn the ignition switch to START 	Engine starts.
3	<ul style="list-style-type: none"> Turn the ignition switch to OFF. Disconnect antenna coil connector from ICU. Turn the ignition switch to ON. Observe "IMMO" indicator. 	"IMMO" indicator blinks continuously (2HZ).
4	<ul style="list-style-type: none"> Perform limphome with original correct PIN. 	"IMMO" indicator blinks from 2Hz to 0.5 Hz.
5	<ul style="list-style-type: none"> Turn the ignition switch to START. 	Engine starts.

Icu status by "IMMO" indicator

Action	Virgin	Neutralized/Learnt
<ul style="list-style-type: none"> Disconnect antenna coil connector. Turn the ignition switch to ON. 	"IMMO" indicator blinks at three times for approximately one second.	"IMMO" indicator blinks continuously (2HZ).

Inkey immobilizer (except europe)

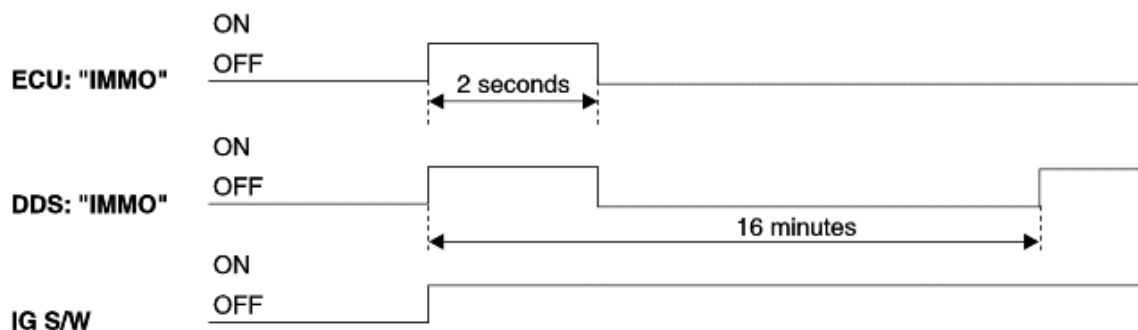
Before servicing

Step	Inspection	Yes	No
1	<ul style="list-style-type: none"> Turn the ignition switch to ON. Check if "IMMO" indicator illuminates or blinks. 	Go to step7	Go to step2
2	<ul style="list-style-type: none"> Turn the ignition switch to OFF. Disconnect the immobilizer harness connector from the ICU. Check if battery voltage is applied to the terminal 2I of the harness connector. 	Go to step3	Repair or replace
3	<ul style="list-style-type: none"> Check if the terminal 2B of the harness connector is grounded. 	Go to step4	Repair or replace
4	<ul style="list-style-type: none"> Check if battery voltage is applied to the terminal 2H of the harness connector. 	Go to step5	Repair or replace
5	<ul style="list-style-type: none"> Turn the ignition switch to ON. Check the battery voltage is applied to the terminal 2J and 2C of the harnessconnector. 	Go to step6	Repair or replace

6	<ul style="list-style-type: none"> • Turn the ignition switch to OFF and connect the immobilizer harness connector to the ICU. • Turn the ignition switch to ON. 		
7	• Check if "IMMO" indicator illuminates for approximately two seconds and then goes out.	Go to step 8.	Go to "Symptom table"
8	• The ICU is normal. Check if engine starts.	System is OK	Go to "Symptom table"

NOTICE

- While performing a coding procedure, the period of ON and OFF must be maintained for approximately two seconds in order to confirm a communication time between the ICU and ECU or DDS (diesel).
- After completing to perform a coding procedure, if engine does not start in spite that "IMMO" indicator is normal, disconnect the antenna coil connector from the ICU and then perform a limphone procedure. In case of observing that "IMMO" indicator is normal, the ICU is normal. Therefore, check for ECU or DDS (diesel) including the starting system.
- After a neutralization or replacement of ICU, must perform "Normal Coding" procedure with the original correct PIN.
- When performing a "Key Only Matching" procedure, must code key one by one.
- With the ignition switch ON, perform a limphone procedure through a "IMMO" indicator by RR. DEF switch. If succeed, "IMMO" indicator blinks from 2Hz. If not, "IMMO" indicator goes out.
- If a limphone procedure is succeed, must turn the ignition switch to OFF and then start engine within 20 seconds.
- On ECU (gasoline engine) or DDS (diesel engine) neutralization, refer to Hi-Scan Pro Tool Manual in detail
 - 1) Turn the ignition switch to OFF and set the Hi-Scan Pro Tool to your vehicle.
 - 2) Select the neutralization mode and turn the ignition switch to ON.
 - 3) Must maintain the ignition switch in ON more than two seconds in case of ECU. If so, "IMMO" indicator illuminates for approximately two seconds and then goes out (DDS: must maintain above 16 minutes. If so, the indicator illuminates for approximately two seconds and then goes out. However, the indicator illuminates again after 16 minutes until turning the ignition switch to OFF).
 - 4) Turn the ignition switch to OFF.



Smartra immobilizer (for europe)

Replacing of ems and smartra

In case of defective EMS it has to be replaced by "virgin" or "neutral" EMS. All keys have to be taught to the new EMS. keys which are not taught to EMS are invalid for the new EMS. For key teaching procedure refer to "key teaching procedure". The vehicle specific data has to be unchanged due to the unique programming of transponder.

In case of defective SMARTRA there are no special procedures required. A new SMARTRA device simply replaces the old one. There are no transponder related data stored in this device.

Neutralizing of ems

The EMS can be set to the status "neutral" by tester. A valid ignition key is inserted and after ignition on the EMS requests the vehicle specific data from tester. After successful receiving of data the EMS is neutralized.

The EMS remains locked. The limp home mode function is accepted by EMS.

The teaching of keys follows the procedure described for virgin EMS. The vehicle specific data has to be unchanged due to the unique programming of transponder. If data should be changed, new keys with virgin transponder are requested.

Signal modes by the lamp

The following table shows the behavior of the lamp depending on the current mode of operation:

Mode	Lamp	Duration
ICU locked IG OFF	OFF	Permanent
ICU unlocked IG OFF	OFF	Permanent
ICU locked IG ON	Blinking	For approximately 5 seconds
ICU unlocked IG ON	ON	30 seconds
After user password entry (correct code)	ON	For approximately 30 seconds
After user password entry (incorrect code)	Blinking	For approximately 5 seconds



Smartra immobilizer (For Europe)

Specification

Part number	Type	Encrypt type
Manufacture		Bosch
Limp home function switch		Ignition Key SW
"IMMO" indicator		"IMMO" indicator illuminates for approximately 30 seconds and goes out.

Inkey immobilizer (Except Europe)

Specification

Part number	Type	Encrypt type
Antenna coil		Common
Key knob color		Deep blue
"IMMO" indicator	Before coding	"IMMO" indicator blinks at three times for approximately 2.4 seconds
	After coding	OK "IMMO" indicator illuminates for approximately two seconds and goes out.
	NG	"IMMO" indicator blinks continuously (2HZ).

Body Electrical System

Back Warning System



General

When reversing, 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).



Specification

Item		Specification
CONTROL UNIT	Voltage rating	DC 12V
	Operation voltage	DC 9 ~ 16 V
	Operation temperature	-30°C ~ +80°C
	Storage temperature	-40°C ~ +90°C
	Operation current	MAX 600mA
	Operation frequency	40 ± 5 KHz
	Detective method	Direct or indirect detection
ULTRASONIC SENSOR	Voltage rating	DC 8V
	Detecting range	25cm ~ 120 cm
	Operation voltage	DC 9~16
	Operation current	20 mA
	Operation temperature	-40°C ~ +90°C
	Beam width	Horizontal : 110cm, / Vertical : 50cm
	Number of sensors	4
PIEZO BUZZER	Voltage rating	DC 12V
	Operation voltage	DC 9 ~ 16 V
	Operation temperature	-30°C ~ +80°C
	Storage temperature	-40°C ~ +85°C
	Operation current	MAX 60 mA
	Sound, tone	Oscillation frequency : 2.2 ± 0.5 KHz
		Sound level : 70 dB (DC 13V, /m)

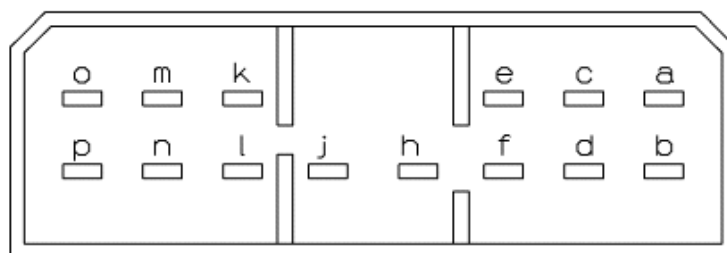
Body Electrical System

Back Warning System - Back Warning
Control Unit



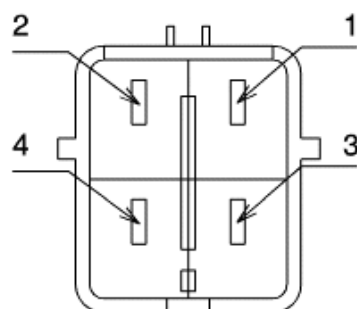
Control unit & sensor terminal alignment

Back warning unit



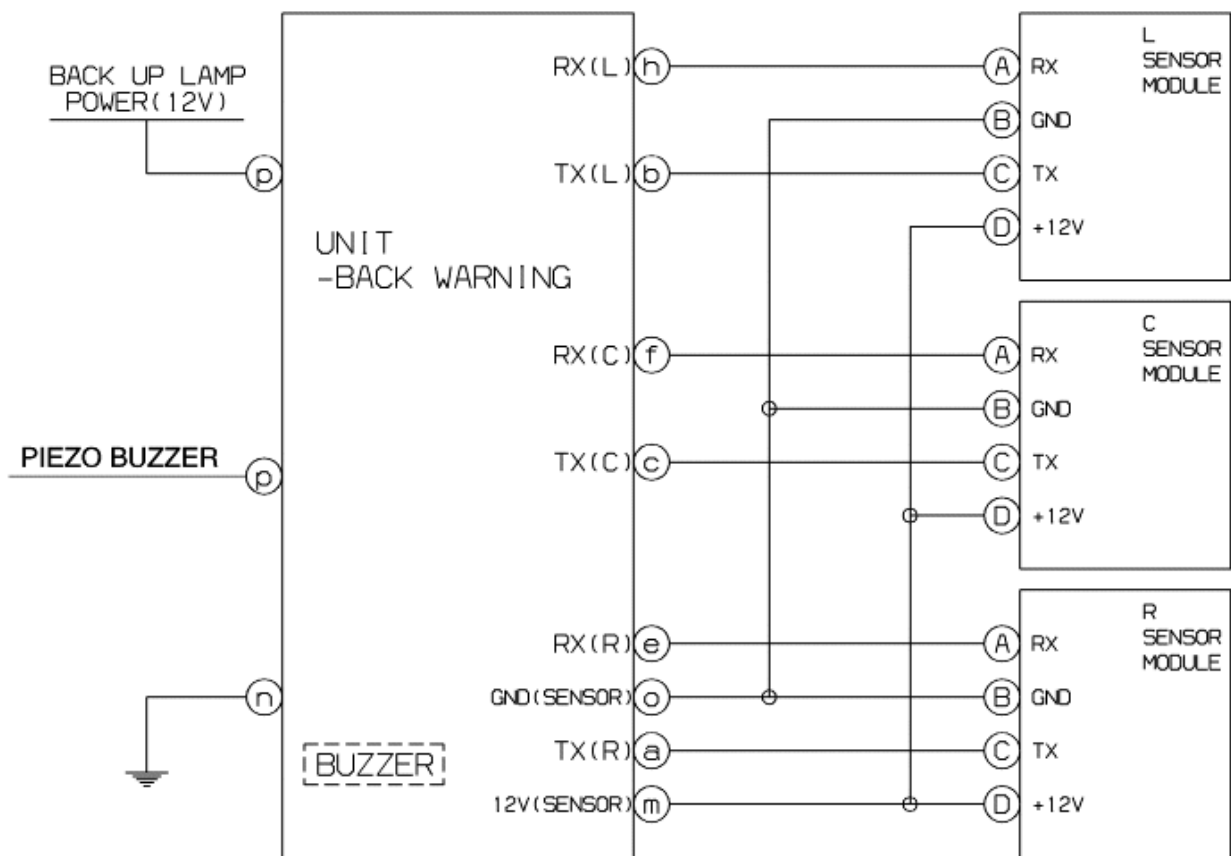
PIN	FUNCTION	PIN	FUNCTION
a	TX, R SENSOR	j	N.C
b	TX, L SENSOR	k	PIEZO BUZZER
c	TX, C SENSOR	l	N.C
d	N.C	m	SENSOR 12V
e	RX, R SENSOR	n	GND
f	RX, C SENSOR	o	SENSOR GND
h	RX, L SENSOR	p	BWS SW. (POWER 12V)

Sensor



PIN	FUNCTION
2	RX
4	GND, SENSOR
1	TX
3	12V, SENSOR

Control unit outside circuit diagram





Description

Control unit is installed in the rear washer compartment, located in the left side storage in the cargo area.

Control unit will control the ultrasonic transmission and reception timing, determine the presence of objects, and detect a broken circuit.



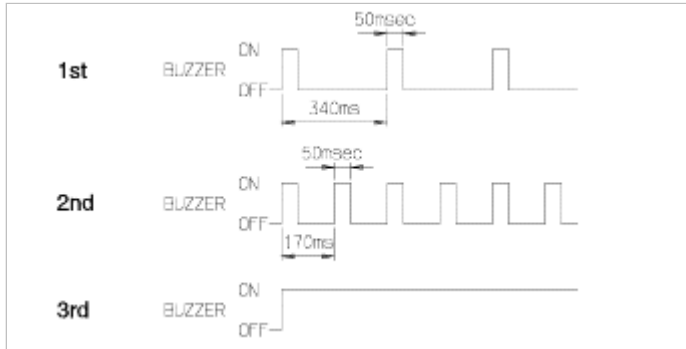
Alarm range

Upon detecting an object at each range out of 3 ranges as stated below within the operation range, it will generate alarm.

First alarm : Object comes near to the sensor located at the rear of vehicle, within 81-120cm

Second alarm : Object comes near to the sensor located at the rear of vehicle, within 41-80cm

Third alarm : Object comes near to the sensor located at the rear of vehicle, within 40cm

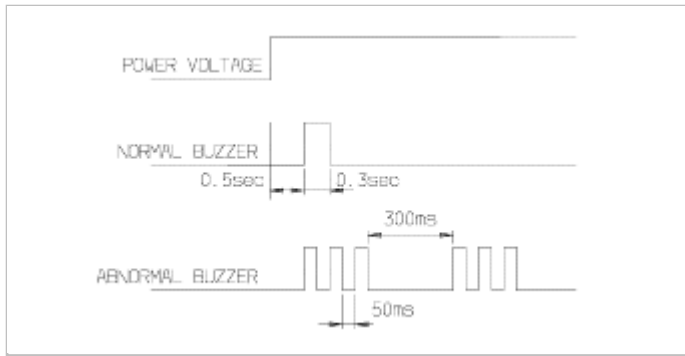


NOTICE

1. Time tolerance of the above waveform : Time \pm 10%
2. At nearer distance than 25cm, detection may not occur.
3. Alarm will be generated with vehicle reversing speed 5km/h or less.
For moving target, maximum operation speed shall be target approach speed of 5km/h.
4. When the vehicle or the target is moving, sequential alarm generation or effective alarm may be failed.
5. Misalarm may occur in the following conditions.
 - Irregular road surface, gravel road, reversing toward grass.
 - Horn, motorcycle engine noise, large vehicle air brake, or other object generating ultrasonic wave is near.
 - When a wireless transmitter is used near to the sensor.
 - Dirt on the sensor.
6. Sequential alarm may not occur due to the reversing speed or the target shape.

Diagnosis and indication

1. Operate with ignition switch on and shift the lever to position "R".
2. Then it checks the system condition.
If no trouble, it generates buzzer alarm sound for 0.065 seconds. In case of system failure, buzzer alarm is generated 3 times continuously with the interval of 0.05 seconds or it does not generate.
3. Effective operation range is 5km/h or less for the vehicle speed.
 - (1) Diagnosis
Ignition switch on and shift the lever to position "R" MICOM checks the sensor condition, and generates buzzer sound for 0.3 seconds if it is O.K.



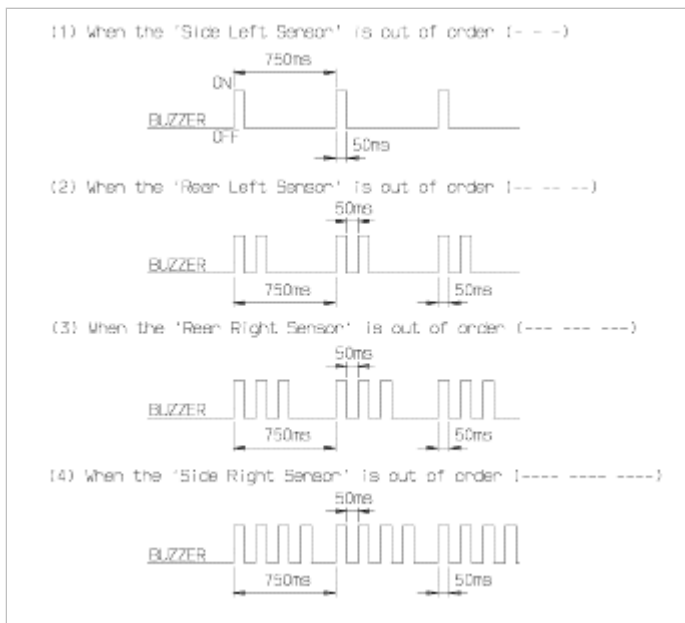
(2) Diagnosis mode

In case of system failure, turns on the repair switch that is installed at the back warning unit then it indicates the failed point as follows.

- A. Side left sensor failure : beep-beep
- B. Rear left sensor failure : beep beep-beep beep-beep beep-
- C. Rear right sensor failure : beep beep beep-beep beep beep-beep beep beep-
- D. Side right sensor failure : beep beep beep beep-beep beep beep beep

NOTICE

Upon failure of two or more sensors, it generates alarm in the order of SL-RL-RR-SR sensor.



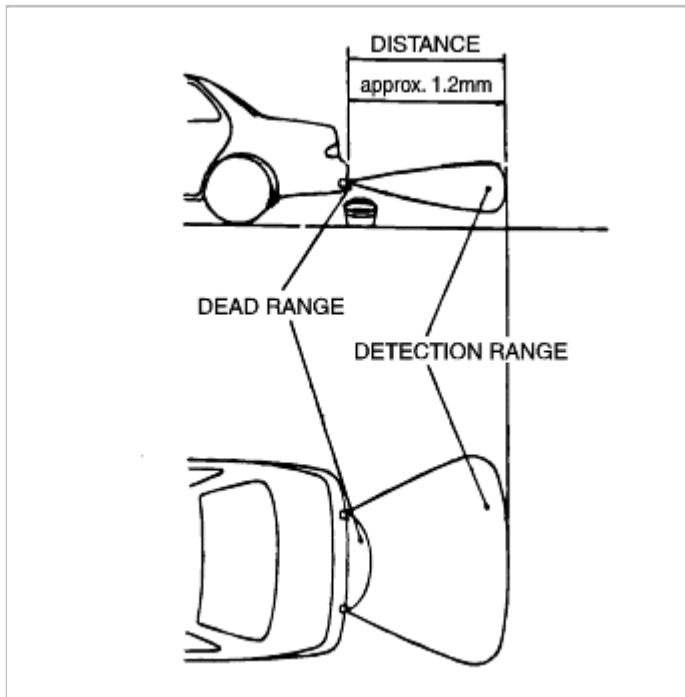
Body Electrical System

Back Warning System - Ultrasonic Sensor

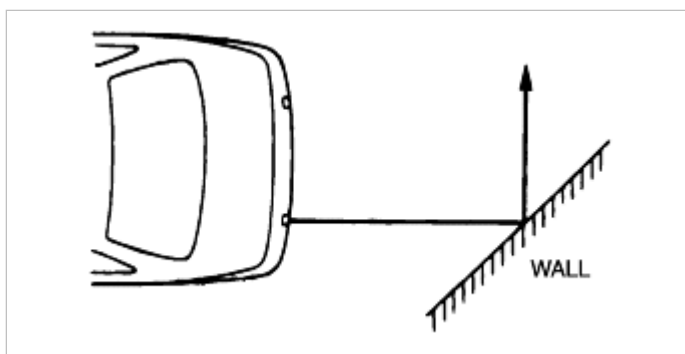


Warning

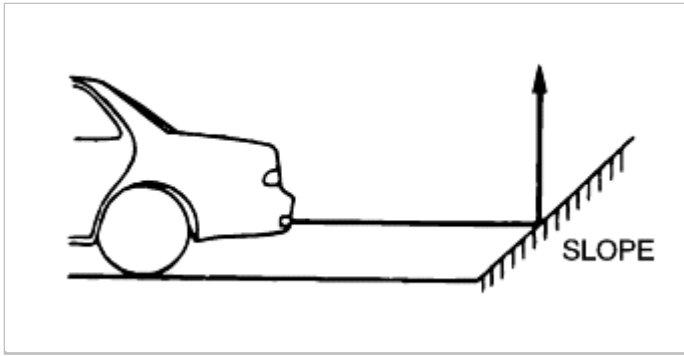
1. Range detected by back sensors is limited.
Watch back before reversing.
2. There is a blind spot below the bumper. Low objects (for example boundary barrier) may be detected from minimum 1.2m away unable to detect at nearer.
3. Besides there are some materials unable to be detected even in detection range as follows.
 - (1) Needles, ropes, rods, or other thin objects
 - (2) Cotton, snow and other material absorbing ultrasonic wave
(for example, fire extinguisher device covered with snow)



- (3) Reversing toward the sloped walls.



- (4) Reversing toward the sloped terrain.



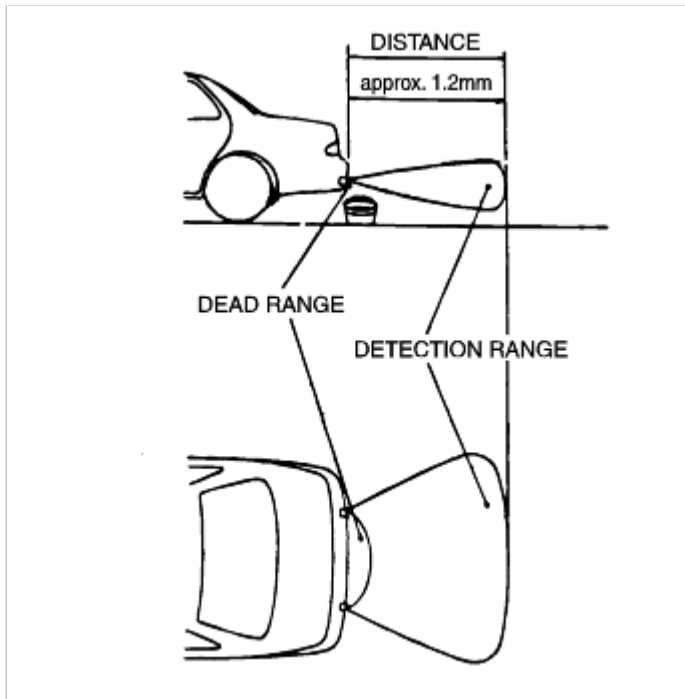
4. False alarm may operate in the following condition : irregular road surface, gravel road, sloped road, grass. Upon alarm generation by grass the alarm may be generated by rock behind grass. Be sure to check for the safety.
Back monitoring sensor cannot discriminate among glass, stake, and rock.
5. Sensors may not operate correctly in the below conditions.
Ensure sensors clean from mud or dirt.
When spraying the bumper, the sensor opening should be covered with something in order not to be contaminated.
 - (1) If sensor opening is contaminated with mud, snow, or dirt, detection range will be reduced and alarm may not be generated under the crash condition. Dirt accumulated on the sensor opening shall be removed with water.
Do not wipe or scrape sensor with a rod or a hard object.
 - (2) If the sensor is frozen, alarm may not operate until sensor thaws.
 - (3) If a vehicle stays under extremely hot or cold environment, the detection range may be reduced. It will be restored at the normal temperature.
 - (4) When heavy cargo is loaded in trunk, it changes the vehicle balance, which reduces the detection range.
 - (5) When other vehicle's horn, motorcycle engine noise, or other ultra-sonic wave sources are near.
 - (6) Under heavy rain.
 - (7) When reversing towards a vertical wall and the gap between the vehicle and the wall is 15cm. (Alarm may sound despite of no barrier)
 - (8) If radio antenna is installed at the rear.
 - (9) If the vehicle rear wiring is re-routed or and electrical component is added at the rear part.
 - (10) Vehicle balance is changed due to the replacement of the rear spring.
 - (11) The unit will operate normally when the vehicle speed is 5km/h or less. Above the speed, the unit may not operate normally.
6. Check the rear bumper for installation condition and deformation. If installed improperly or the sensor orientation is deviated, it may cause malfunction.
7. Be careful not to apply shock during sensor installation on the transmission or reception unit.
8. When adding electrical devices or modifying harness at the rear body of the vehicle, ensure not the change the transmission and reception unit wiring. Tagging the transmission side and reception side, it may cause malfunction.
9. High power radio transmitter (above 10W) may cause malfunction. Do not install it on the vehicle.
10. Be careful that heating or sharp objects shall not touch BWS ultrasonic sensor surface.
Besides do not cover the sensor opening or press the sensor.

Warning

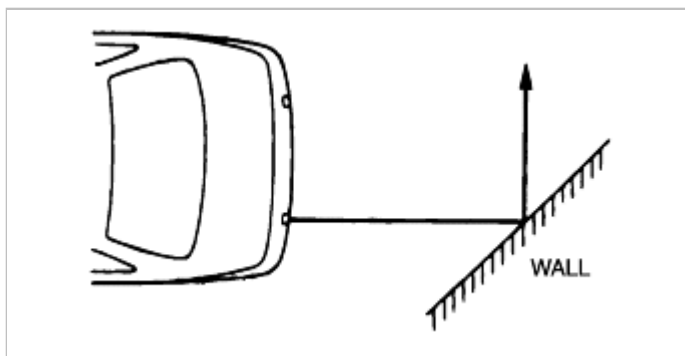
1. Range detected by back sensors is limited.

Watch back before reversing.

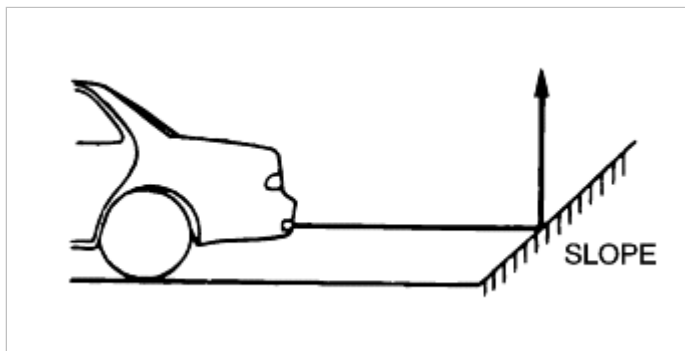
2. There is a blind spot below the bumper. Low objects (for example boundary barrier) may be detected from minimum 1.2m away unable to detect at nearer.
3. Besides there are some materials unable to be detected even in detection range as follows.
 - (1) Needles, ropes, rods, or other thin objects
 - (2) Cotton, snow and other material absorbing ultrasonic wave (for example, fire extinguisher device covered with snow)



- (3) Reversing toward the sloped walls.



- (4) Reversing toward the sloped terrain.



4. False alarm may operate in the following condition : irregular road surface, gravel road, sloped road, grass.

Upon alarm generation by grass the alarm may be generated by rock behind grass. Be sure to check for the safety.

Back monitoring sensor cannot discriminate among glass, stake, and rock.

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10. Be careful that heating or sharp objects shall not touch BWS ultrasonic sensor surface.

Besides do not cover the sensor opening or press the sensor.



Ultrasonic sensor

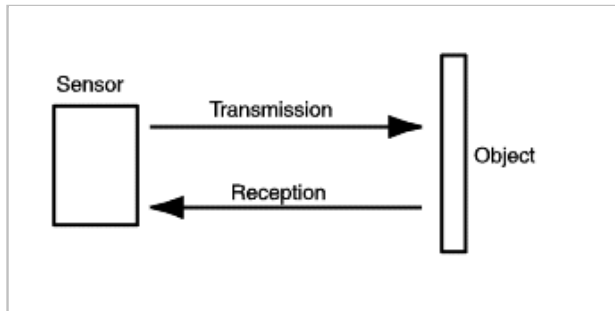
Operation principle

The sensor emits ultrasonic wave to the objects, and it measures the time until reflected wave returns, and calculates the distance to the object.

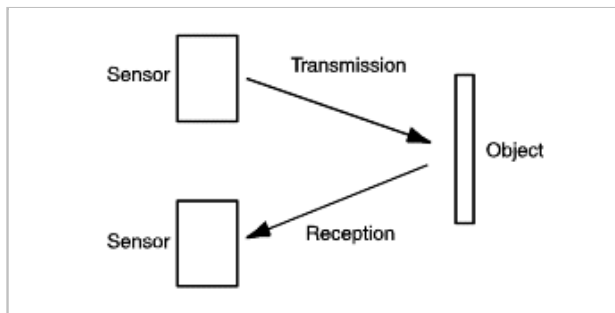
Distance detection type

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.



2. Indirect detection type : One sensor transmits signals and the other sensor receives the signals to measure the distance.



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.

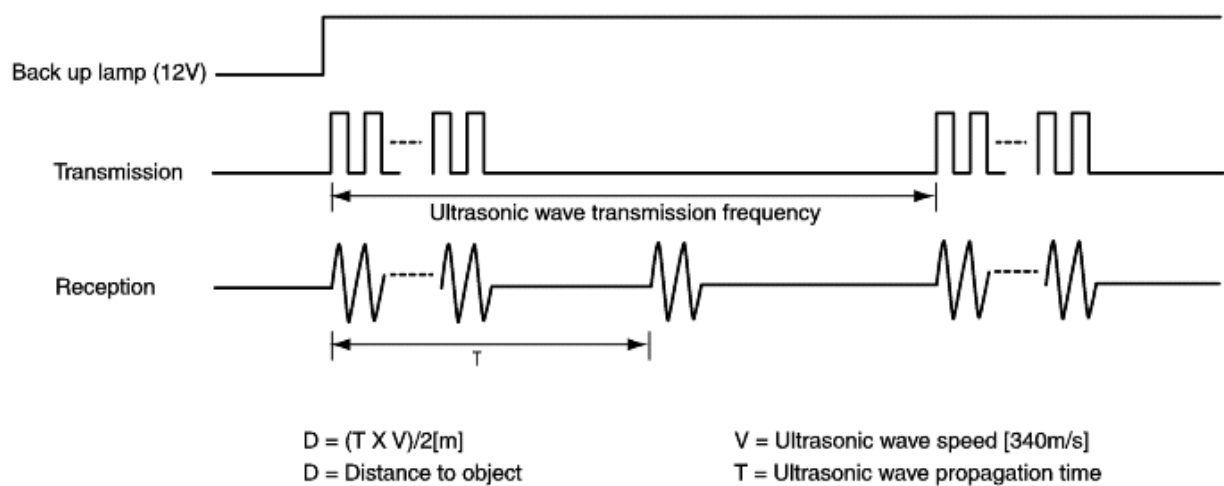
The propagation speed formula of ultrasonic wave in air is following:

$$v = 331.5 + 0.6t \text{ (m/s)}$$

v =ultrasonic wave propagation speed

t =ambient temperature

The basic principle of distance measurement using ultrasonic wave is:



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 14cm (dia.), 1m length.