

***Rio* Body Electrical System**

GENERAL	BE - 2
MULTI FUNCTION SWITCH	BE - 9
HORNS	BE -12
ETACS (ELECTRONIC TIME AND ALARM CONTROL SYSTEM)	BE -13
FUSES AND RELAYS	BE -19
INDICATORS AND GAUGES	BE -24
POWER DOOR LOCKS	BE -29
POWER DOOR MIRRORS	BE -30
POWER WINDOWS	BE -32
REAR WINDOW DEFOGGER	BE -35
WINDSHIELD WIPER/WASHER	BE -37
REAR WIPER/WASHER	BE -41
LIGHTING SYSTEM	BE -44
HEAD LAMPS	BE -45
HEAD LAMP LEVELLING DEVICE	BE -48
TURN/HAZARD LAMPS	BE -50
FRONT FOG LAMPS	BE -51
IMMOBILIZER CONTROL SYSTEM	BE -52

GENERAL

SPECIFICATIONS EED0554B6

MULTIFUNCTION SWITCH

Items	Specifications
Rated Voltage	DC 12V
Operating temperature range	-30 °C ~ +80 °C (-22 ~ + 176 °F)
Rated load Dimmer & passing switch Lighting switch Turn signal switch & lane change Wiper switch Washer switch	High : 120 W Low : 110 W Passing : 120 W Lighting : 0.2 A 0.2 A (Relay load) Low, int : 6.0 A (Motor load) High : 6.5 A (Motor load) 3.8 A (Motor load)

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
Pre tension	1.4	Red
Rear fog	1.4	Amber
Rear defroster	1.4	Amber
Door ajar	1.4	Red
O/D OFF	1.4	Amber
Air bag	1.4	Red
Engine check	1.4	Amber
Oil pressure	1.4	Red
Parking brake	1.4	Red
Battery charge	1.4	Red
Tail gate open	1.4	Amber
ABS	1.4	Amber
Seat belt	1.4	Red
Immobilizer check	1.4	Amber
Low fuel	3.0	Amber
A/T		
R	1.4	Red
P, N, D, 2, 1	1.4	Green

GENERAL

BE -3

SERVICE SPECIFICATIONS

INDICATORS AND GAUGES

Items	Specifications																																																																																				
Speedometer Type	Electric type - (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>-</td><td>-</td></tr><tr><td>Tolerance (%)</td><td>+0</td><td>+0</td><td>+0</td><td>+0</td><td>-</td><td>-</td></tr><tr><td></td><td>-5</td><td>-5</td><td>-5</td><td>-5</td><td>-</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>-6.8</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	-	-	Tolerance (%)	+0	+0	+0	+0	-	-		-5	-5	-5	-5	-	-	Velocity (MPH)	10	20	40	60	80	100	Tolerance (%)	+0	+0	+0	+0	+0	+0		-13.6	-6.8	-5.7	-5	-5	-5	Velocity (MPH)	120	-	-	-	-	-	Tolerance (%)	+0	-	-	-	-	-		-5	-	-	-	-	-
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	-12	-1.5	-	-	-	-	-																																																																														
Fuel gauge Type	- Tap the tachometer to prevent hysteresis effects during inspection. - 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><td>Level</td><td>Gauge</td><td>Gauge angle (°)</td></tr><tr><td></td><td>Resistance (Ω)</td><td></td></tr><tr><td>E (Empty)</td><td>95</td><td>-30</td></tr><tr><td>1/2</td><td>32.5</td><td>0</td></tr><tr><td>F (Full)</td><td>6.5</td><td>30</td></tr></table> - Inspection order : E → F → E The level must be reached within 7 minutes after the resistance is set for Full or Empty. - 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	1/2	32.5	0	F (Full)	6.5	30																																																																					
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BE -4

BODY ELECTRICAL SYSTEM

Items	Specifications				
Temperature gauge Type Indication standard	o Cross - coil type (Zero return type-Middle temp satisfaction type)				
	Temperature		Angle (°)		
	122°F (50°C)		-30		
	185°F (85°C) - 221°F (105°C)		-5 ~ 5		
	Red zone (over 257°F (125°C))		30		
Resistance of temperature sender (NTC)	o Inspection order : OFF → C → H				
	Temperature [°F(°C)]	122 (50)	185 (85)	221 (105)	250 (125)
	Resistance (Ω)	180.5	48.7	26.5	15.9

BT2D002B

LIGHTING SYSTEM

Items	Bulb wattage (w)
Head lamp	60W / 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	21W
License plate lamp	5W
Room lamp	10W
Over head lamp (Map lamp)	10W
Luggage compartment	5W
High mount stop lamp	21W (4DOOR), 5W x 5 (5DOOR)
Rear fog lamp	21W
Side repeat lamp	5W

GENERAL

BE -5

TROUBLESHOOTING

EEC0E391B

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

GENERAL

BE -7

Symptom	Possible cause	Remedy
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

BE -8

BODY ELECTRICAL SYSTEM

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

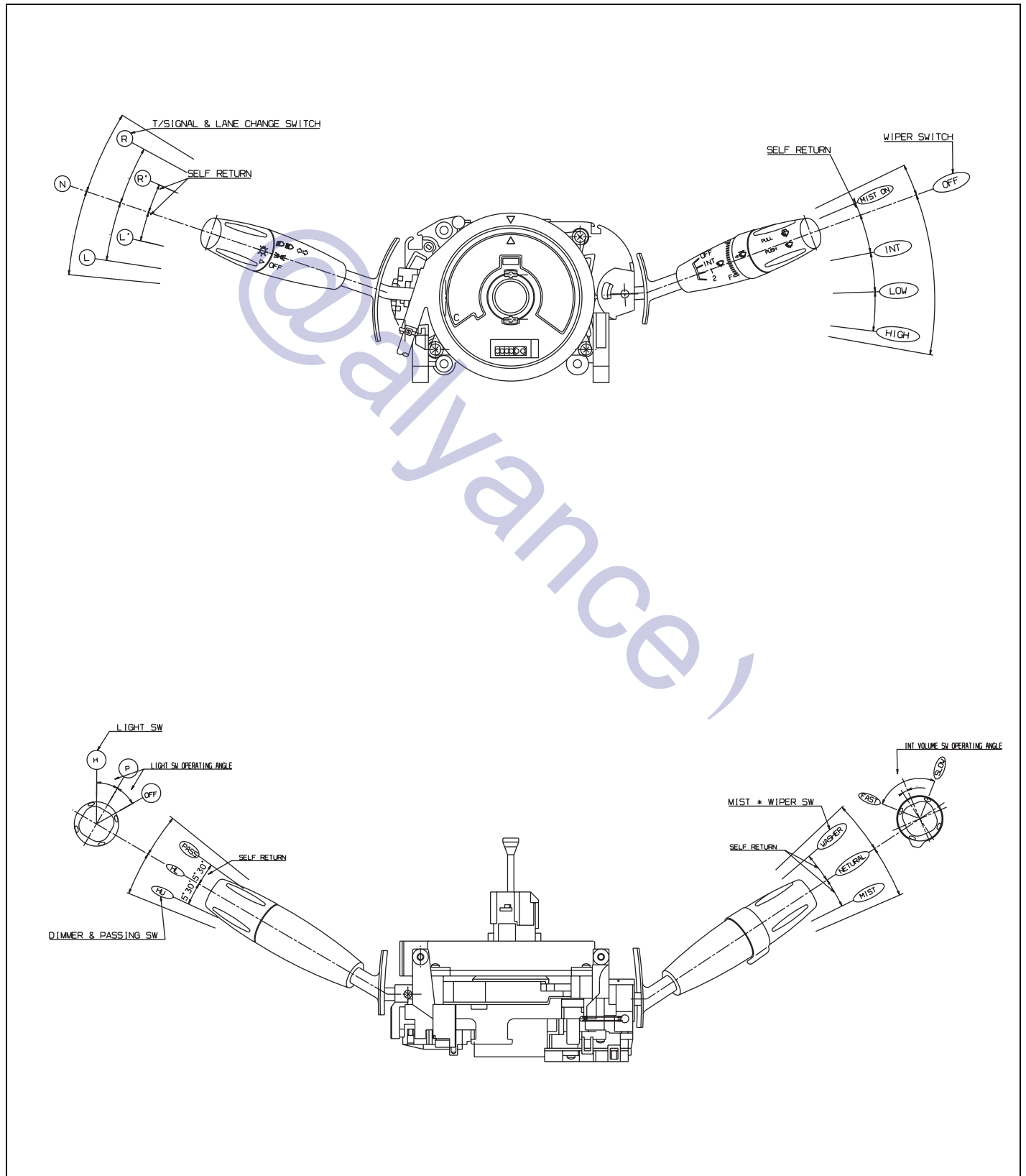
MULTI FUNCTION SWITCH

BE -9

MULTI FUNCTION SWITCH

MULTI FUNCTION SWITCH

COMPONENTS EE7A27F4B



BE -10

BODY ELECTRICAL SYSTEM

REMOVAL AND INSTALLATION

EE82A9C5E

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

EEF2819E2

Check the continuity between the terminals while operating the switch.

LIGHTING SWITCH

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

LT8C011H

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

LT8C011B

TURN SIGNAL AND LANE CHANGE SWITCH

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

LT8C011C

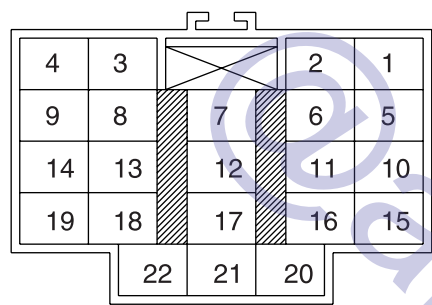
MULTI FUNCTION SWITCH

BE -11

WIPER & WASHER SWITCH

Terminal Position		9	13	18	15	4	8
OFF	OFF	○	○				
	MIST		○	○			
INT		○	○		○	○	
LOW			○		○		
HI				○	○		
WASHER					○		○

LT8C011D

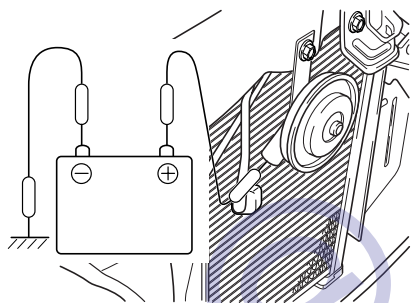


AT8C011A

HORNS

INSPECTION E9CF70FB

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.



AT2D013B

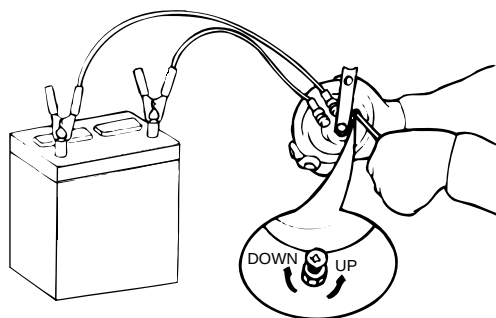
ADJUSTMENT

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



NOTE

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

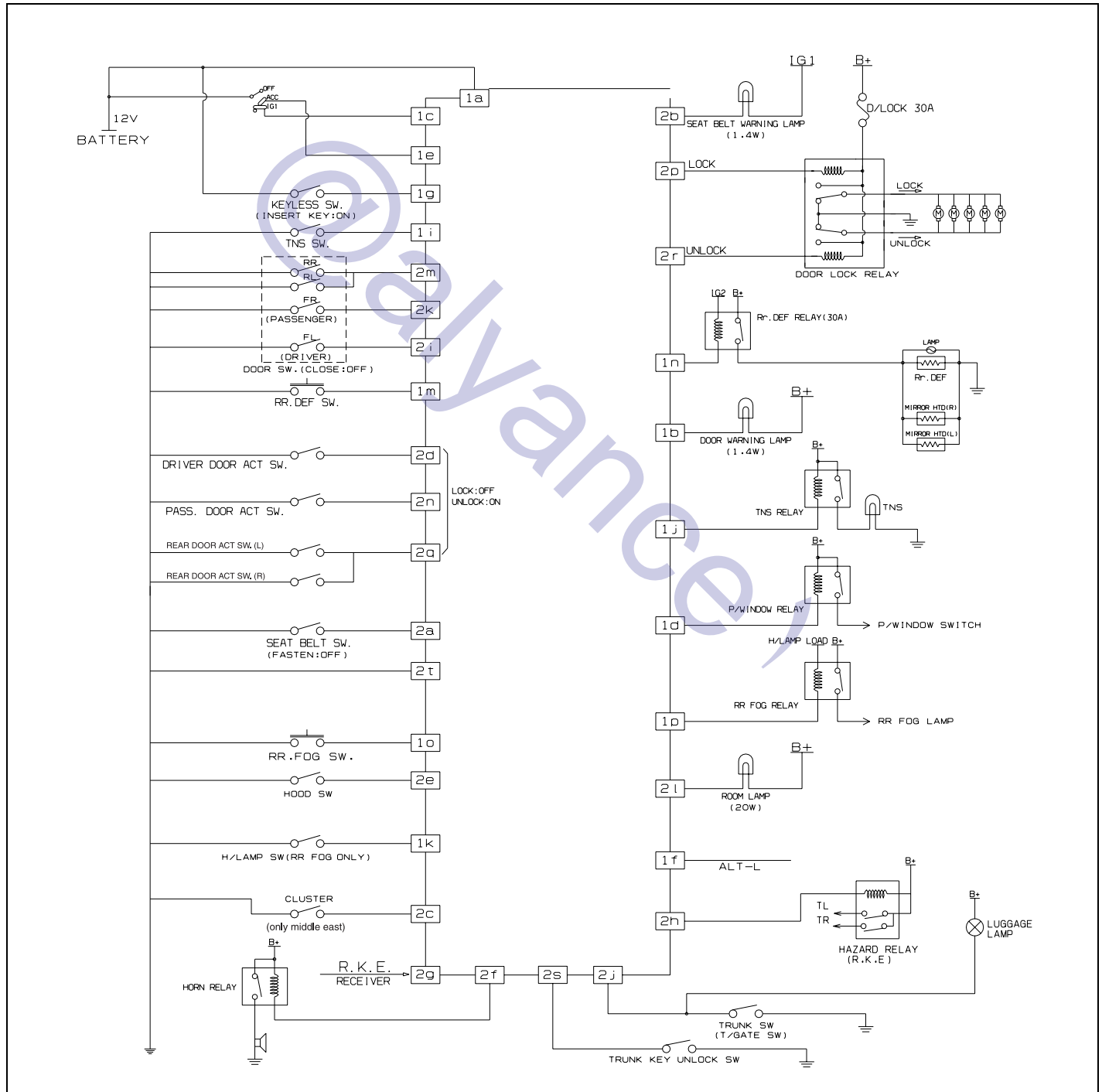


LTAC013A

ETACS (ELECTRONIC TIME AND ALARM CONTROL SYSTEM)

ELECTRONIC TIME AND ALARM CONTROL MODULE

CIRCUIT DIAGRAM EEABD4C8E



ETACS PIN NO. AND

DESCRIPTION EEEEADF990

2s	2q	2o	2m	2k	2i	2g	2e	2c	2a	1o	1m	1k	1i	1g	1e	1c	1a
2t	2r	2p	2n	2l	2j	2h	2f	2d	2b	1p	1n	1l	1j	1h	1f	1d	1b

AT8C033A

Pin No.	Connector "A"	Pin No.	Connector "B"
1a	B+	2a	SEAT BELT SW
1b	DOOR WARNING LAMP	2b	S/BELT W/LAMP
1c	IG 1	2c	CLUSTER OVER SPEED (MIDDLE EAST)
1d	P/WINDOW RELAY	2d	DRIVER ACT. SW (UNLOCK)
1e	ACC	2e	HOOD SW
1f	ALTERNATOR -L	2f	HORN RELAY
1g	KEYLESS SW	2g	RKE RECEIVER
1h	N.C	2h	HAZARD RELAY
1i	TNS SW	2i	DRIVER DOOR SW
1j	TNS RELAY	2j	TRUNK SW (TAIL GATE SW)
1k	H/LAMP SW	2k	ASSIST DOOR SW
1l	N.C	2l	ROOM LAMP
1m	RR.DEF SWITCH	2m	RR.DOOR SW
1n	RR.DEF RELAY	2n	ASSIST DOOR LOCK SW (UNLOCK)
1o	RR.FOG SW	2o	N.C
1p	RR.FOG RELAY	2p	DOOR LOCK RELAY
		2q	REAR DOOR ACTUATOR SWITCH (L/R)
		2r	DOOR UNLOCK RELAY
		2s	TRUNK KEY UNLOCK SWITCH
		2t	GND

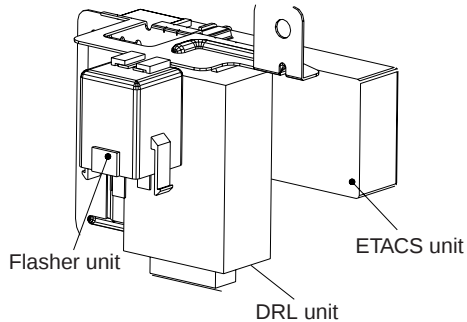
ETACS (ELECTRONIC TIME AND ALARM CONTROL SYSTEM)

BE -15

INSPECTION EEEE8DBAB

This is installed at the lower of A-pillar.

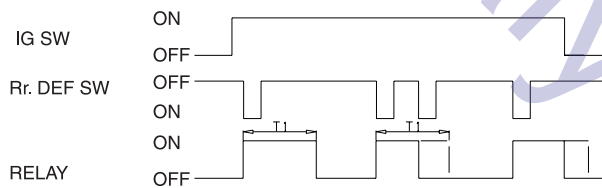
While operating the components, check whether the operations are normal with timing chart.



BT2D030A

ETACS FUCTION

1. Rear window defogger and side mirror defogger.

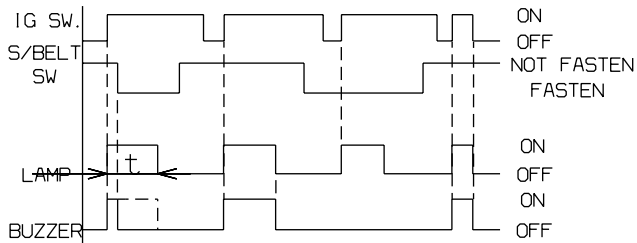


BT2D035C

Time specification

T1 : 20±3min.

2. Seat belt warning



AT8C035D

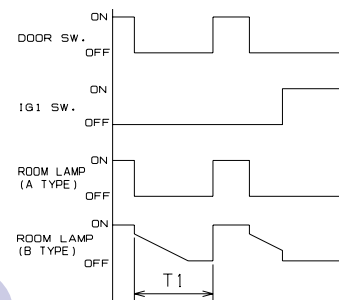
Time specification

T1 : 6 ± 1.5 sec.

3. Buglar alarm

- 1) Horn operates ON/OFF for 0.5 second while it is armed.
- 2) Arm/disarm is operated by only the remote key-less entry.
- 3) If any of entrances aren't opened for 30 second in disarm state. It will generate the door lock output, and it is armed.
- 4) Upon receiving the TX lock signal in the arm state, it doesn't generate lock output signal, but it generates the hazard lamp output 1 time for 1 second.
- 5) Upon receiving the TX unlock signal in the disarm state, it generates unlock output signal, hazard lamp output twice.

4. Decayed room lamp



AT2D035F

Time specification

T1 : 4-5 sec.

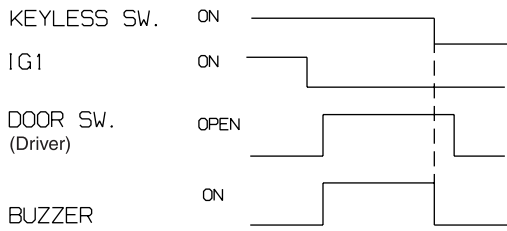
T2 : 20 ± 5 min.

- 1) Upon the door open with the keyless switch OFF, the room lamp turns on for T2. The room lamp declines to 75% at once when the door close.
- 2) Upon the door switch OFF with the ACC is OFF the room lamp declines 75% to 0% for T1. Upon the door switch OFF with the ACC is ON the room lamp turns on for T1.

BE -16

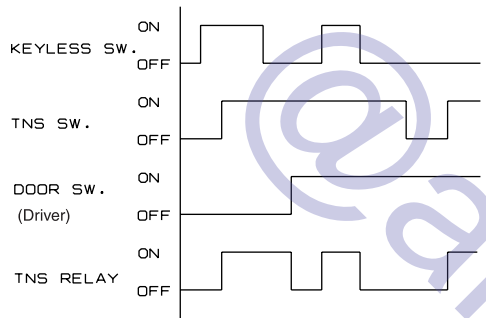
BODY ELECTRICAL SYSTEM

5. Ignition key reminder



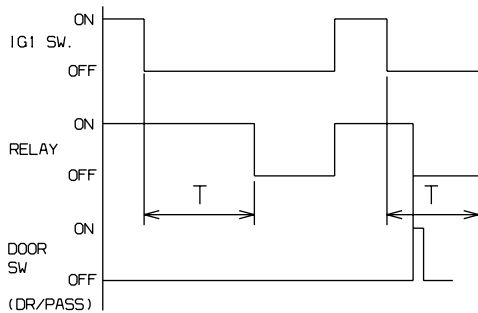
LT8C035G

6. Battery saver.



BT2D035H

7. Power window timer

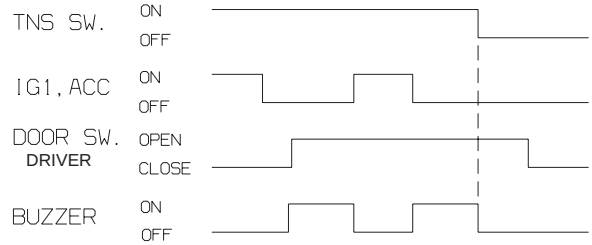


AT8C035I

Time specification
T : 30 ± 5 sec.

8. Lightr ajar

Alarm occurs while the door opened when the TNS switch is ON and IG switch is ON.



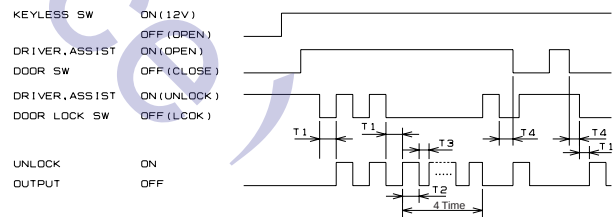
LT8C018Z

9. Central door lock / unlock

Input	Door lock output
RKE TX	Lock / Unlock
Driver key switch or passenger key switch	↑
Driver door knob	↑

LT8C018P

10. Key reminder unlock



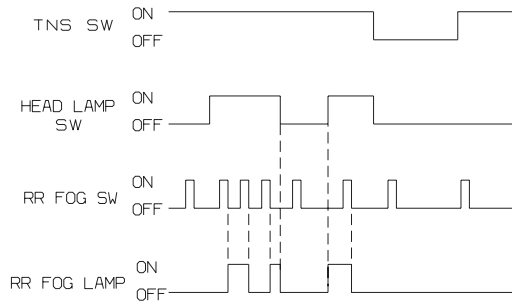
LT2D035D

Time specification
T1 : less than 0.1 sec
T2 : 1.0 sec.
T3 : 0.5 sec.
T4 : Max 0.5 sec.

ETACS (ELECTRONIC TIME AND ALARM CONTROL SYSTEM)

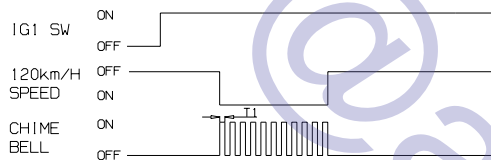
BE -17

11. Rear fog lamp control



LT8C018K

12. Over speed warning (Middle east area)

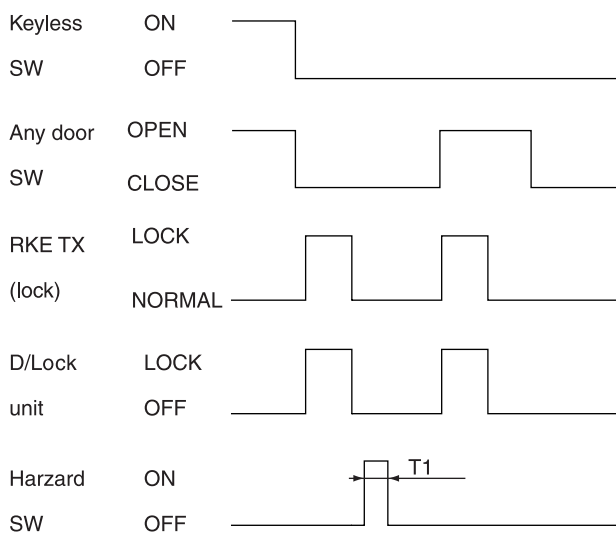


LTAC018M

Time specification
T1 : 0.5 ± 0.1 sec

13. Remote keyless entry system

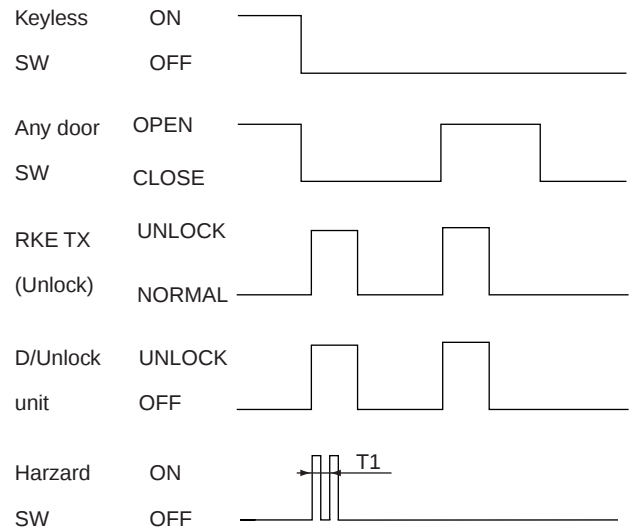
1) Door lock



AT8C038A

Time specification
T1 : 1.0 ± 0.2 sec.

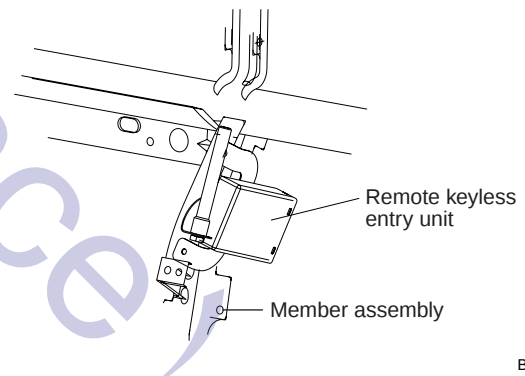
2) Door unlock



AT8C038B

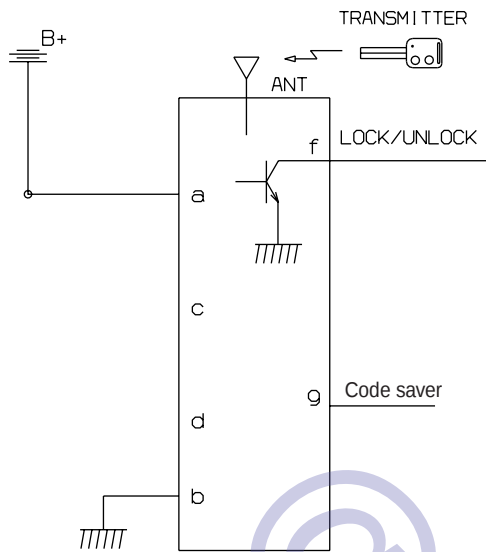
Time specification
T1 : 1.0 ± 0.2 sec.

14. Remote keyless entry code saving



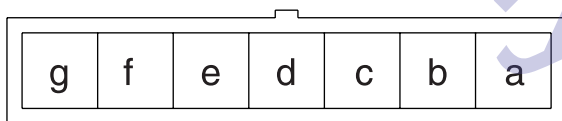
BT2D036A

- 1) Store the transmitter code by using Hi-scan pro.



AT2D039A

- 2) Connector pin arrangement.



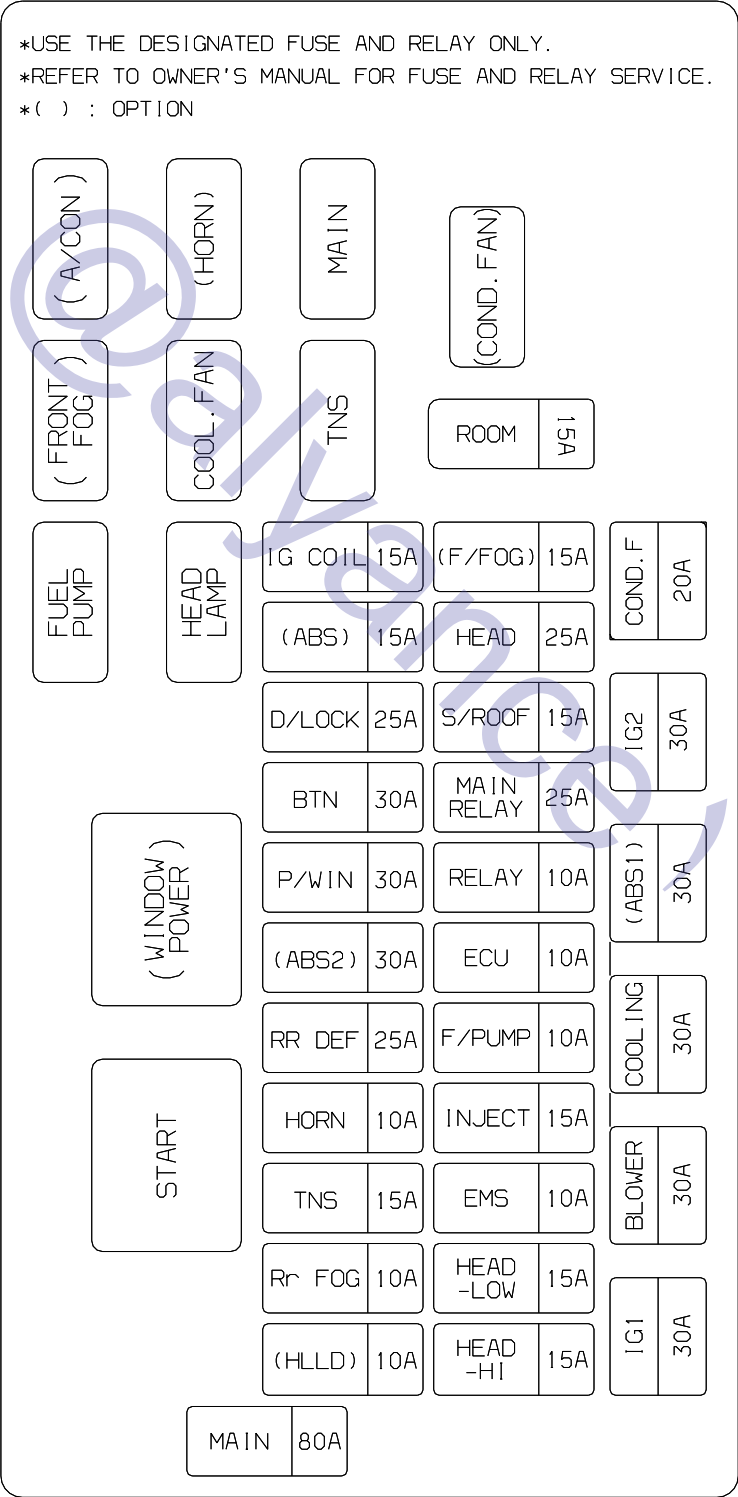
a : B+
 b : GND
 c : NC
 d : NC
 e : NC
 f : LOCK/UNLOCK (TO ETACS)
 g : CODE SAVER

AT2D039B

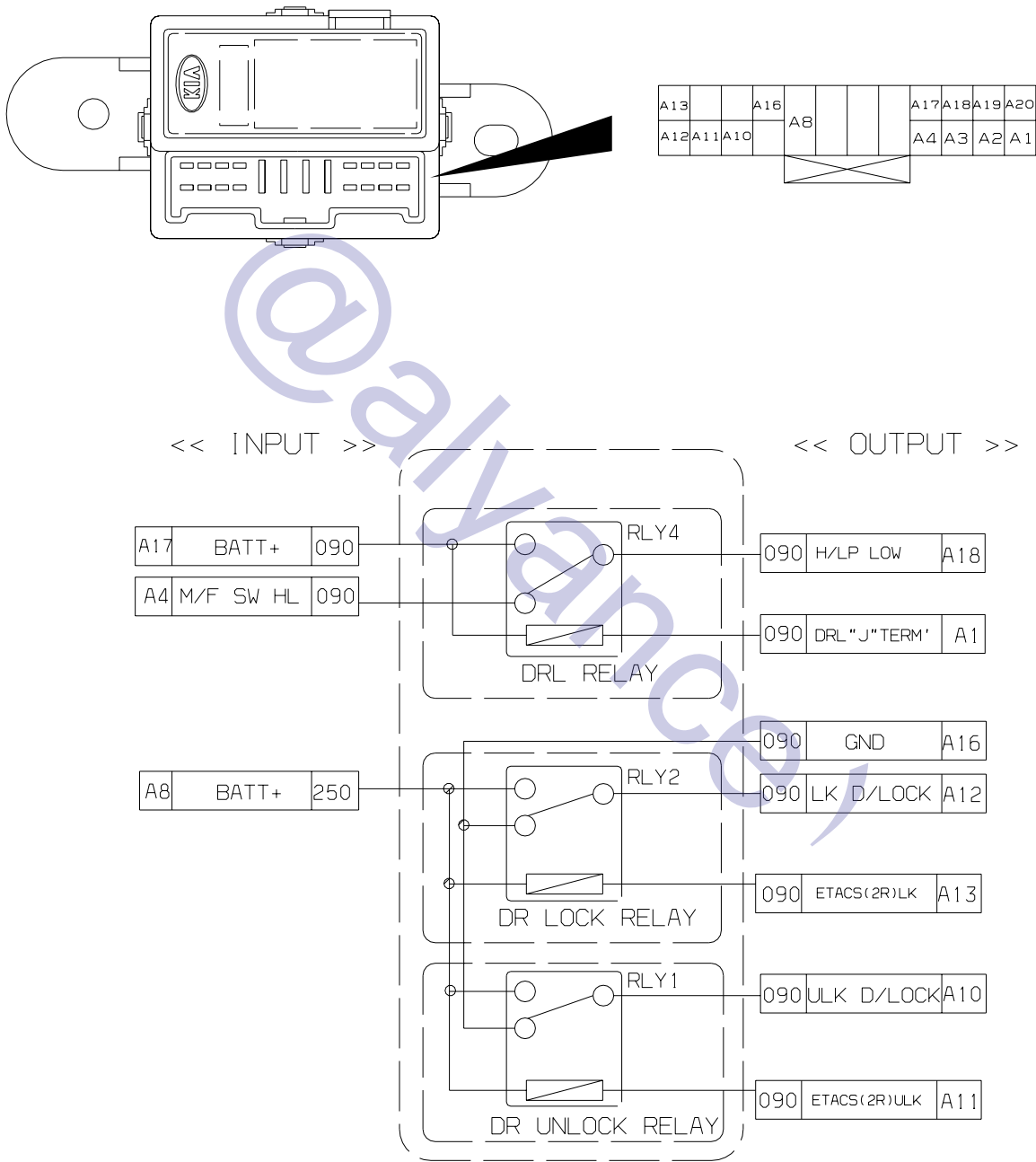
FUSES AND RELAYS

RELAY BOX (ENGINE COMPARTMENT)

COMPONENTS EEE8DEE27



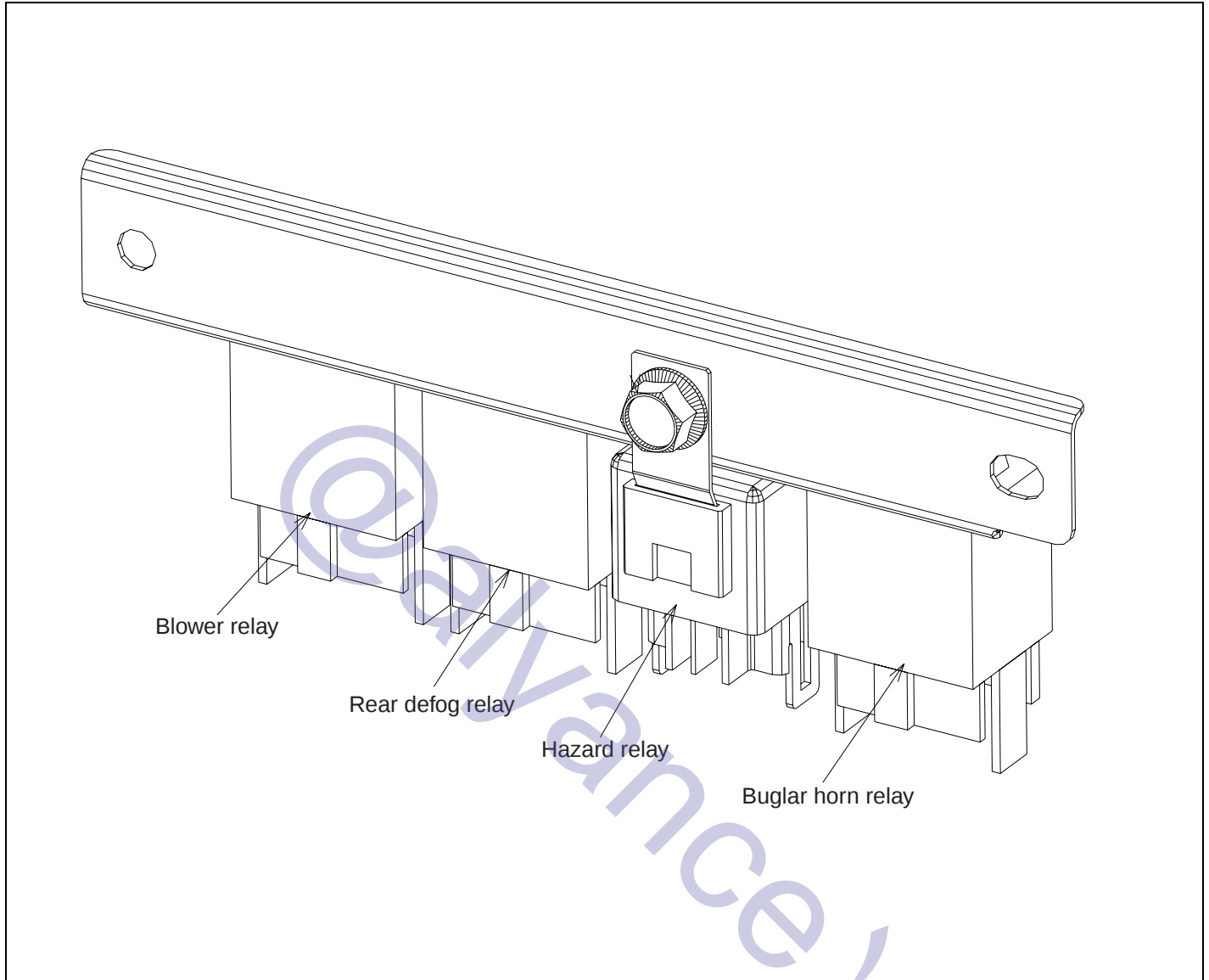
ICM RELAY



FUSES AND RELAYS

BE -21

RELAY BOX (ROOM)



BT2D040C

INSPECTION EEDDDBB39

1. ICM relay is installed at the lower of A-pillar, and general relay is installed at the lag bracket of audio.
2. Check for a burnt fusible link with an ohmmeter.
3. 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.

FUSES

SPECIFICATION

EE6D4C7DC

ILLUMI 10A	MIRROR DEF 10A	TAIL (RH) 10A	WIPER (FRT) 15A	* USE THE DESIGNATED FUSE ONLY. * REFER TO OWNER'S MANUAL FOR FUSE SERVICE. * () : OPTION.
START 10A	POWER SOCKET 15A	TAIL (LH) 10A	WIPER (RR) 15A	
(A/BAG) 10A	HAZARD 10A	CIGAR 15A	(WARMER) 15A	
METER 10A	STOP 15A	AUDIO 10A	TURN LAMP 10A	

LT2D044A

FUSES AND RELAYS

BE -23

INSPECTION

EE76BD269

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.



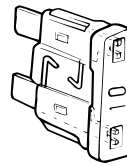
CAUTION

Never use a fuse of higher capacity than specified.

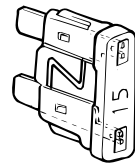
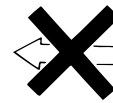


CAUTION

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



10A



15 A

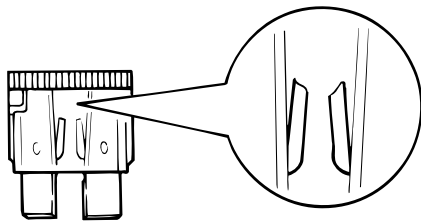
LTAC024C

INSPECTION OF FUSES

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

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

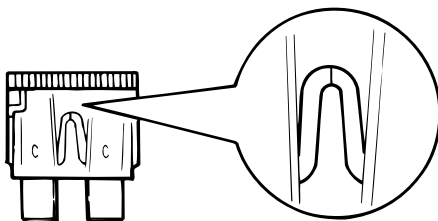
Blown fuse due to overcurrent



LTAC024A

2. Fuse blown due to repeated on-off current.
Normally, this type of problem occurs after a fairly long period of use, and is less frequent than #1 above. In this case, you may simply replace with a new fuse of the same capacity.

Blown fuse due to thermal fatigue

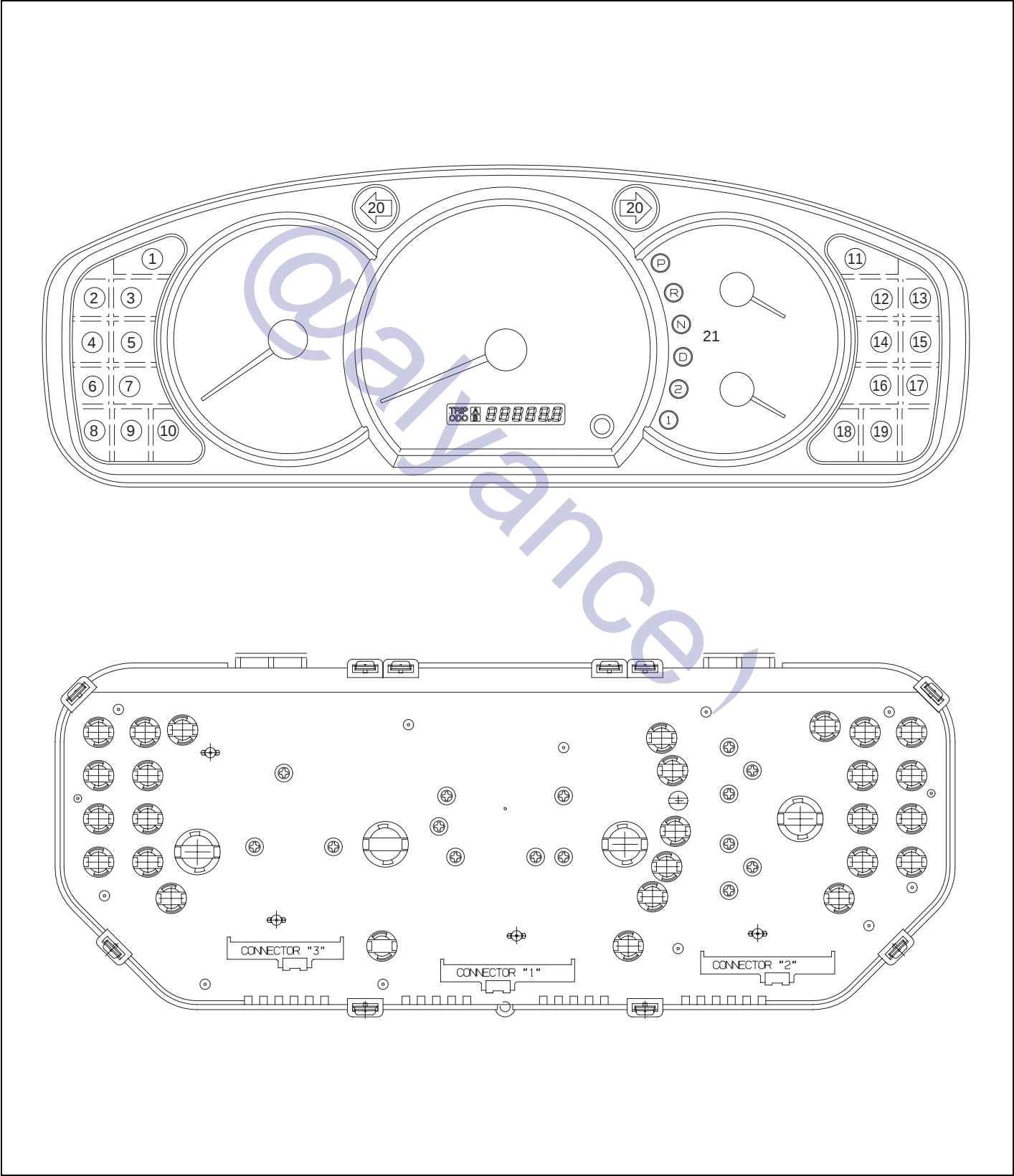


LTAC024B

INDICATORS AND GAUGES

INSTRUMENT CLUSTER

SPECIFICATION EE879EE75

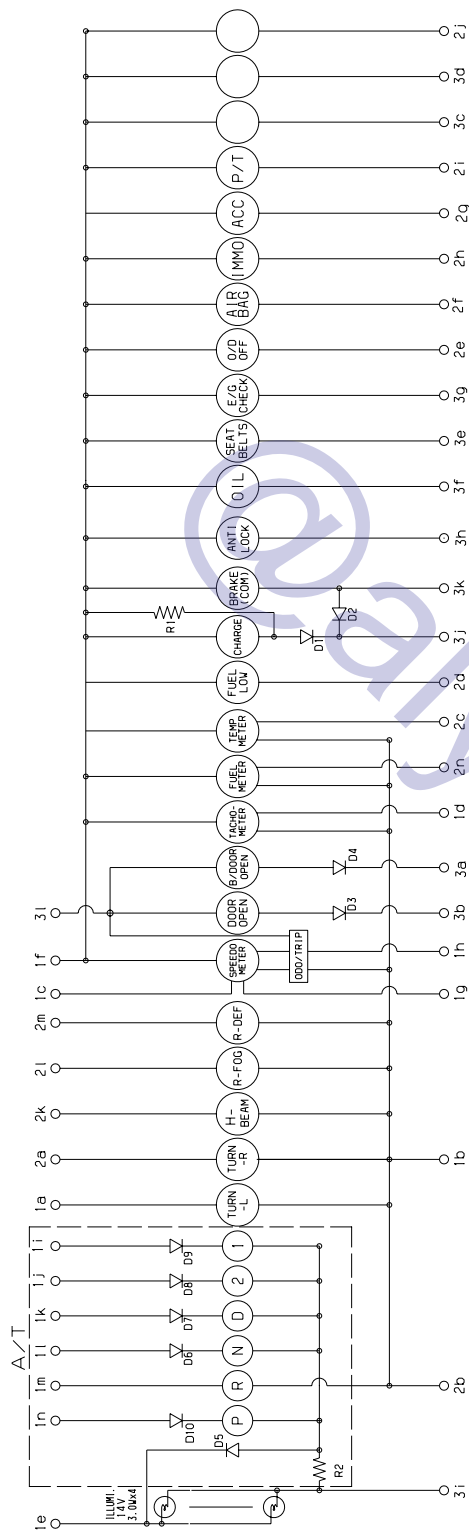


INDICATORS AND GAUGES

BE -25

No.	Item		Specification	
			Bulb wattage(w)	Color
1	Engine check		1.4W	Amber
2	Door ajar		1.4W	Red
3	Oil pressure		1.4W	Red
4	Tail gate open		1.4W	Amber
5	Seat belt		1.4W	Red
6	-		-	-
7	Charge		1.4W	Red
8	-		-	-
9	Parking brake		1.4W	Red
10	ABS		1.4W	Amber
11	Immobilizer Check		1.4W	Amber
12	-		-	-
13	High beam		1.4W	Blue
14	Air bag		1.4W	Red
15	Rear fog		1.4W	Amber
16	O/D OFF		1.4W	Amber
17	Rear defogger		1.4W	Amber
18	Fuel low		3.0W	Red
19	Pre tension		1.4W	Red
20	Turn signal (LH, RH)		1.4W	Green
21	A/T	P, N, D, 2, 1	1.4W	Green
		R	1.4W	Red

CIRCUIT DIAGRAM EEDA6FF13



Terminal No.		Description
CONNECTOR "1"	1a	TURN-L
	1b	GND
	1c	CHIME BELL
	1d	TACHO METER
	1e	ILL (+)
	1f	IG (+)
	1g	SPEED OUTPUT
	1h	SPEED INPUT
	1i	1
	1j	2
	1k	D
	1l	N
	1m	R
	1n	P
CONNECTOR "2"	2a	TURN-R
	2b	GND
	2c	TEMP METER
	2d	LOW FUEL
	2e	O/D OFF
	2f	AIR BAG
	2g	ACC
	2h	IMMO
	2i	PRE TENSIONE
	2j	-
	2k	H-BEAM
	2l	R-FOG
	2m	R-DEF
	2n	FUEL METER
CONNECTOR "3"	3a	T/GATE OPEN
	3b	DOOR OPEN
	3c	-
	3d	-
	3e	SEAT BELT
	3f	OIL
	3g	E/G CHECK
	3h	ABS
	3i	ILL (-)
	3j	CHARGE
	3k	BRAKE (COM)
	3l	B (+)

INDICATORS AND GAUGES

BE -27

INSPECTION OF COMPONENTS EE70CACBF

SPEEDOMETER

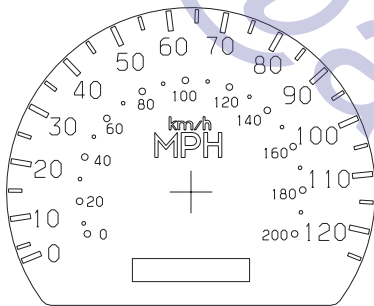
1. Adjust the pressure of the tires to the specified level.
2. Drive the vehicle onto a speedometer tester. Use wheel chocks as appropriate.
3. Check if the speedometer indicator range is within the standard values in the service specifications.

CAUTION

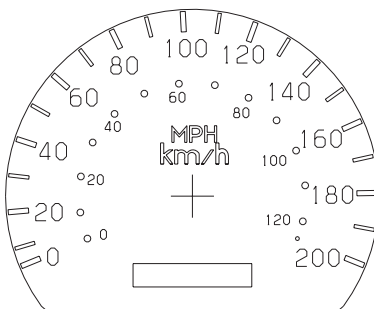
Do not operate the clutch suddenly or increase/decrease speed rapidly while testing.

NOTE

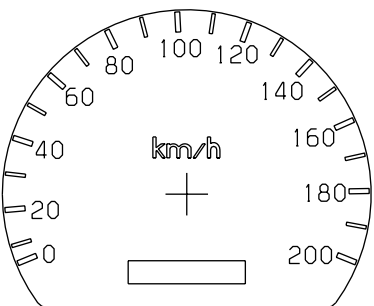
Tire wear and tire over or under inflation will increase the indication error.



LT8C029B



LT8C029G



AT8C050B

BE -28

BODY ELECTRICAL SYSTEM

TACHOMETER

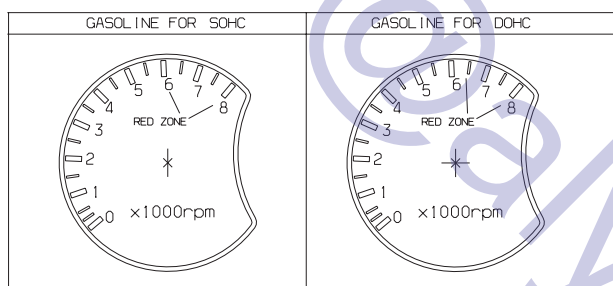
1. Connect the scan tool to the diagnostic link connector or install a tachometer.
2. With the engine started, compare the readings of the tester with that of the tachometer. Replace the tachometer if the tolerance is exceeded.



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	+7.5 -1.5	+6	+6	+6	+6	+6	Gasoline



AT2D050A

TEMPERATURE GAUGE

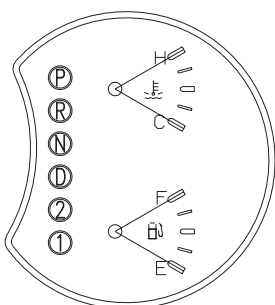
1. Remove the instrument cluster.
2. Check the temperature gauge by changing the resistance between the terminals.
3. Apply battery voltage to the terminal 1f, ground the terminal 1b, and connect the resistance to the terminal 2c and then check that the pointer is moved as shown in below table.

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 1f, ground the terminal 1b, and connect the resistance to the terminal 2n and then check that the pointer is moved as shown in below table.

Temperature [°F (°C)]	Resistance (Ω)	Angle (°)
122 (50)	180.5	-30
185(85)~221(105)	48.7~26.5	-5 ~ 5
over 250 (125)	15.9	30

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



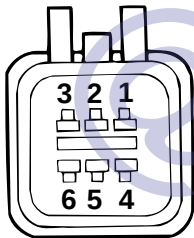
AT2D050C

POWER DOOR LOCKS

POWER DOOR LOCK
ACTUATORS

INSPECTION EE811C9C4

- 1. Disconnect the actuator connector from the wiring harness.
- 2. Apply battery voltage (12V) to each terminal as shown in the table and verify that the actuator operates correctly.



AT2D101A

Terminal	Position	
	1	2
Open	⊖	⊕
Close	⊕	⊖

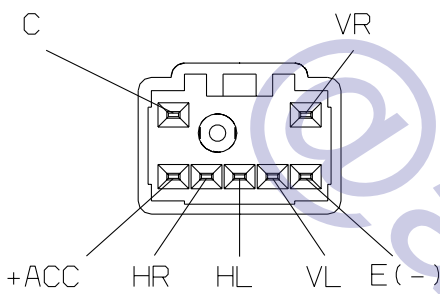
LT8C101B

POWER DOOR MIRRORS

POWER DOOR MIRROR SWITCH

INSPECTION EE9BFDC59

- 1. Remove the power door mirror switch from the door trim panel.
- 2. Check for continuity between the terminals in each switch position according to the table.
If continuity is not as specified, replace the power door mirror switch.



AT2D101C

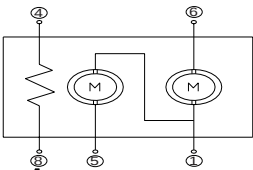
DIR		VL	HL	VR	HR	C	ACC+	E
LH	UP	☐	☐			☐	☐	☐
	DOWN	☐	☐			☐	☐	☐
	OFF	☐	☐			☐	☐	☐
	LEFT	☐	☐			☐	☐	☐
	RIGHT	☐	☐			☐	☐	☐
RH	UP			☐	☐	☐	☐	☐
	DOWN			☐	☐	☐	☐	☐
	OFF			☐	☐	☐	☐	☐
	LEFT			☐	☐	☐	☐	☐
	RIGHT			☐	☐	☐	☐	☐

AT2D101D

POWER DOOR MIRROR
ACTUATOR

INSPECTION EE69F096A

- 1. Disconnect the power door mirror connector from the harness.
- 2. Apply battery voltage to each terminal as shown in the table and verify that the mirror operates properly.



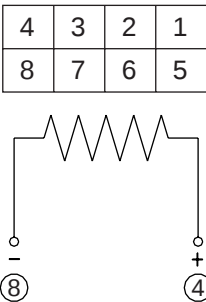
4	3	2	1
8	7	6	5

AT8C105A

Terminal Position		①	⑤	①	⑤	⑥	+	-
LH	UP	○	○				○	○
	DOWN	○	○				○	○
	OFF	○	○				○	
	RIGHT	○				○	○	○
	LEFT	○	○				○	○
RH	UP			○	○		○	○
	DOWN			○	○		○	○
	OFF			○	○		○	
	RIGHT			○		○	○	○
	LEFT			○		○	○	○

LT8C105B

MIRROR HEATING INSPECTION



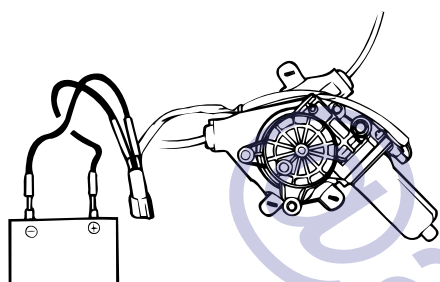
AT8C105E

POWER WINDOWS

POWER WINDOW MOTOR

INSPECTION EEA3CF3E9

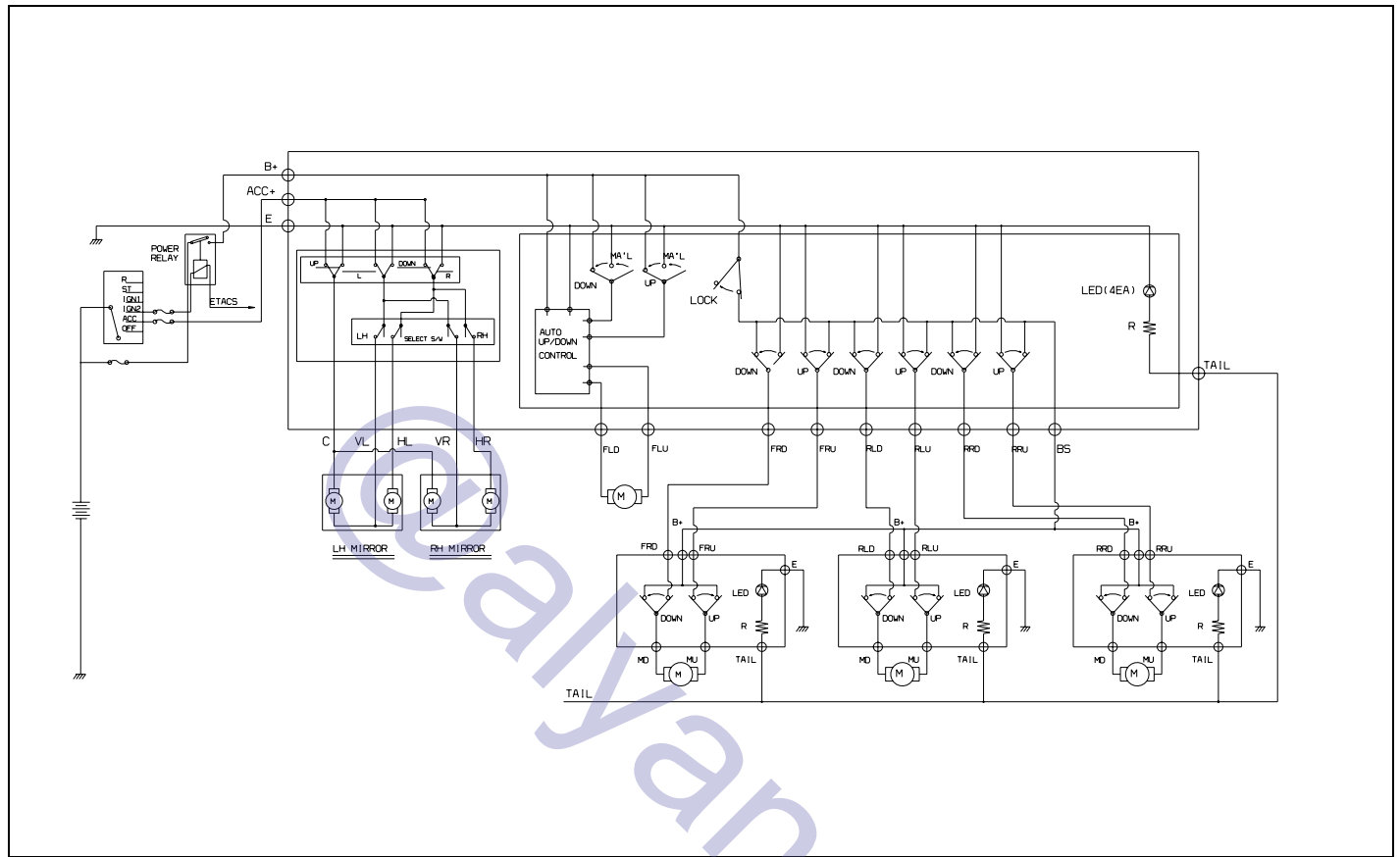
Connect the motor terminals directly to battery voltage(12V) and check that the motor operates smoothly. Next, reverse the polarity and check that the motor operates smoothly in the reverse direction. If the operation is abnormal, replace the motor.



ATAC108B

POWER WINDOW SWITCH

CIRCUIT DIAGRAM EE2C2189D



INSPCETION EE9A2D40E

POWER WINDOW SUB SWITCH

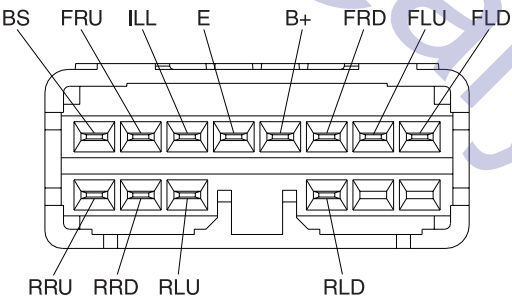
POWER WINDOW MAIN SWITCH

- 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.

SW POSITION \ TML NAME	FR. LH				FR. RH			
	B+	FLU	FLD	E	B+	FRU	FRD	E
UP	○	○	○	○	○	○	○	○
OFF						○	○	○
DOWN	○		○	○	○	○	○	○

SW POSITION \ TML NAME	RR. LH				RR. RH			
	B+	RLU	RLD	E	B+	RRU	RRD	E
UP	○	○	○	○	○	○	○	○
OFF		○	○	○		○	○	○
DOWN	○		○	○	○	○	○	○

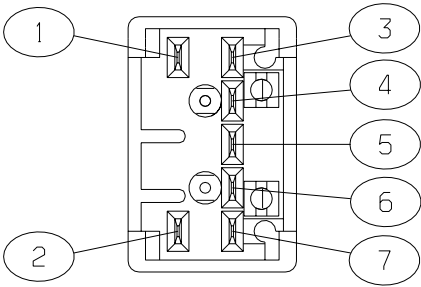
AT2D111A



AT2D111B

P \ T	5	7	3	1	2
UP	○		○	○	○
OFF		○	○	○	○
DOWN	○	○		○	○

AT2D111D



AT2D111E

DOOR LOCK SWITCH

P \ T	B	BS
NORMAL	○	○
LOCK		

B+

AT2D111C

REAR WINDOW DEFOGGER

BE -35

REAR WINDOW DEFOGGER

REAR WINDOW DEFOGGER PRINTED HEATER

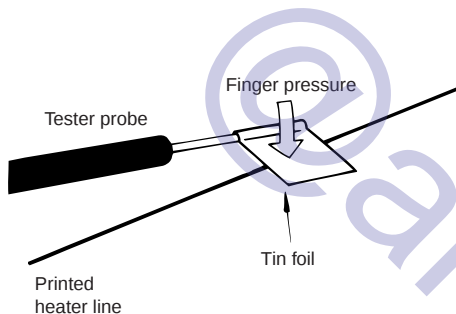
INSPECTION EE01AFFB2



CAUTION

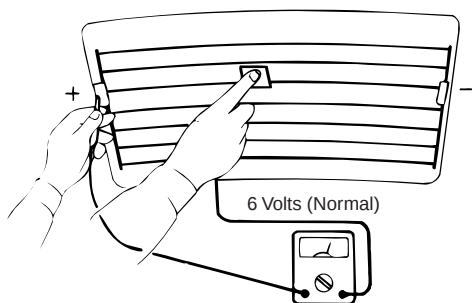
Wrap tin foil around the end of the voltmeter test lead to prevent damaging the heater line. Apply finger pressure on the tin foil, moving the tin foil along the grid line to check for open circuits.

1.



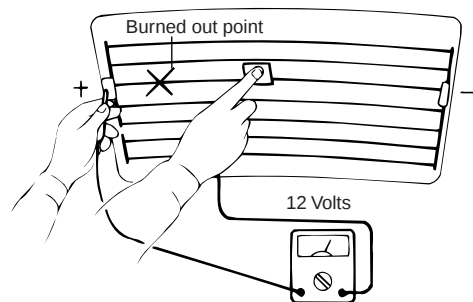
LTAC112A

2. 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.



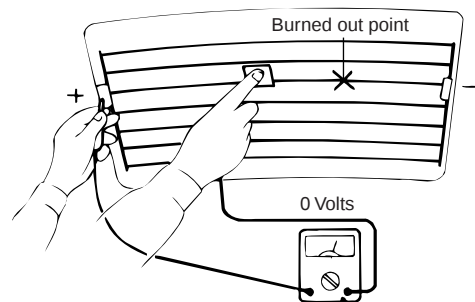
LTAC112B

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



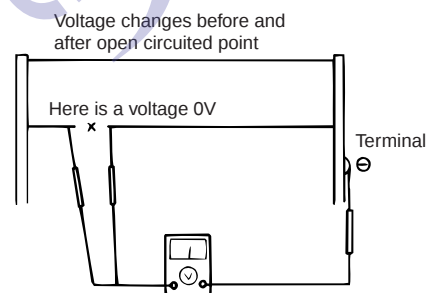
LTAC112C

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



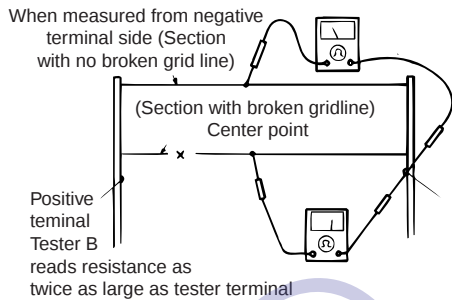
LTAC112D

5. 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.



LTAC112E

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



LTAC112F

REPAIR OF BROKEN HEATER LINE

Prepare the following items:

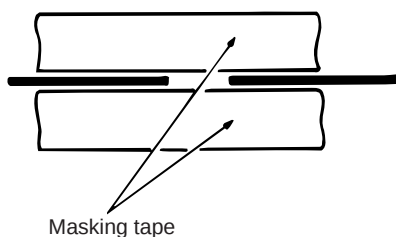
1. Conductive paint.
2. Paint thinner.
3. Masking tape.
4. Silicone remover.
5. Thin brush.

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



CAUTION

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

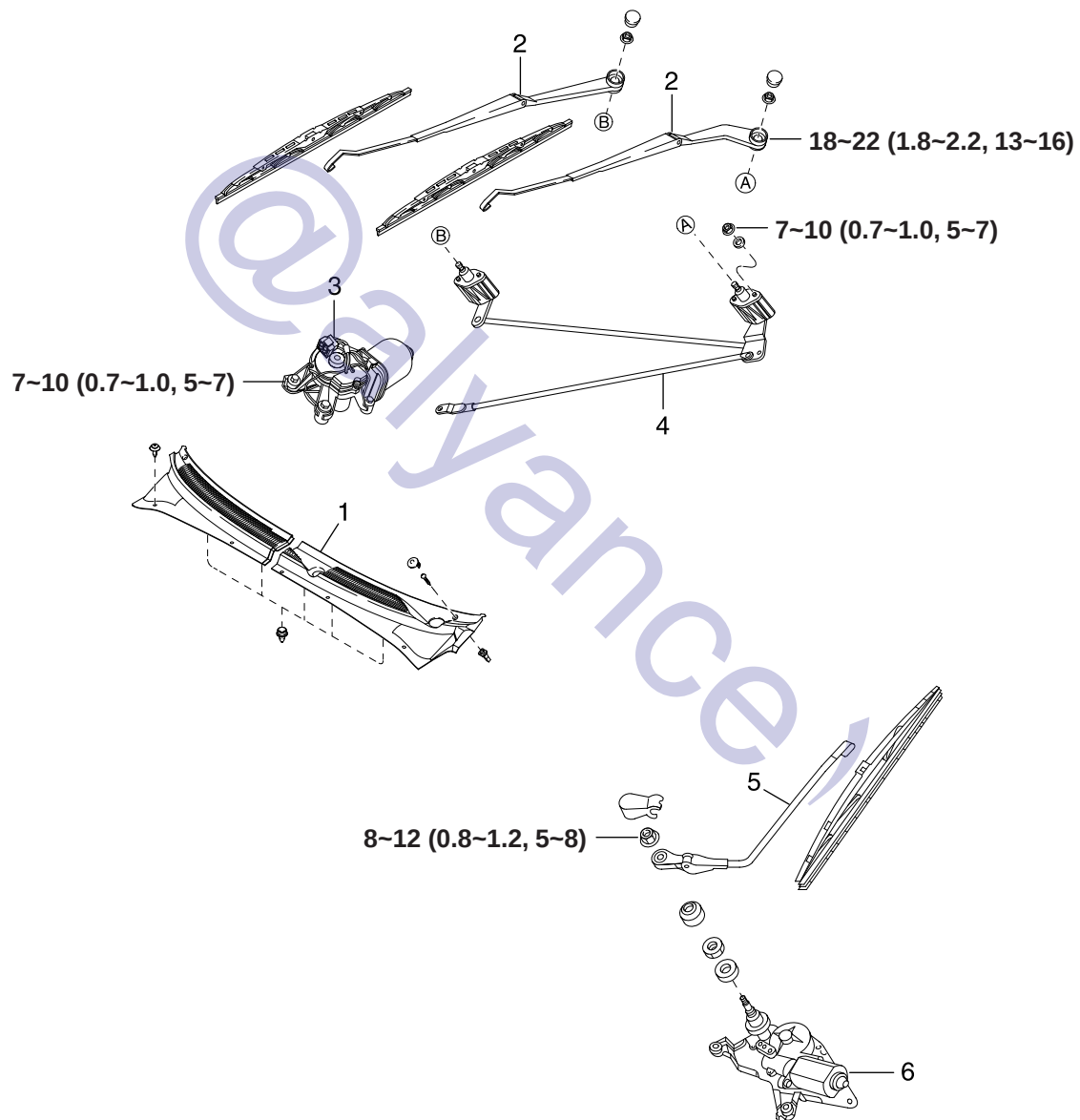


LTAC112G

WINDSHIELD WIPER/WASHER

FRONT WIPER MOTOR

COMPONENT EEBB8AC3E



N·m (kg·m, lb·ft)

1. Cowl grille
2. Wiper arm
3. Front wiper motor assembly

4. Front wiper link assembly
5. Rear wiper arm
6. Rear wiper motor assembly

BE -38

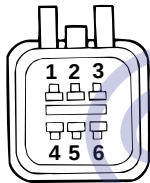
BODY ELECTRICAL SYSTEM

INSPECTION

EE190E7D9

SPEED OPERATION CHECK

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



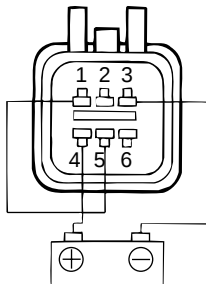
1. Low
2. High
3. Ground

4. IGN+
5. Parking
6. Blank

LTAC115A

AUTOMATIC STOP OPERATION CHECK

1. Operate the motor at low speed.
2. Stop the motor operation anywhere except at the off position by disconnecting terminal 1.
3. Connect terminals 1 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.



ATAC115B

ADJUSTMENT

EE8D01BD1

1. Starting with passenger side arm, place wiper arms on pivot shaft.
2. Install nut and tighten.

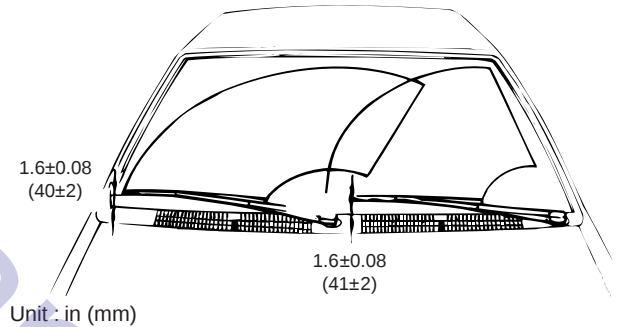
Tighten nut to
13~16 lb-ft (18~22 N·m, 1.8~2.2 kg·m)



NOTE

You should not run windshield wipers on a dry windshield.

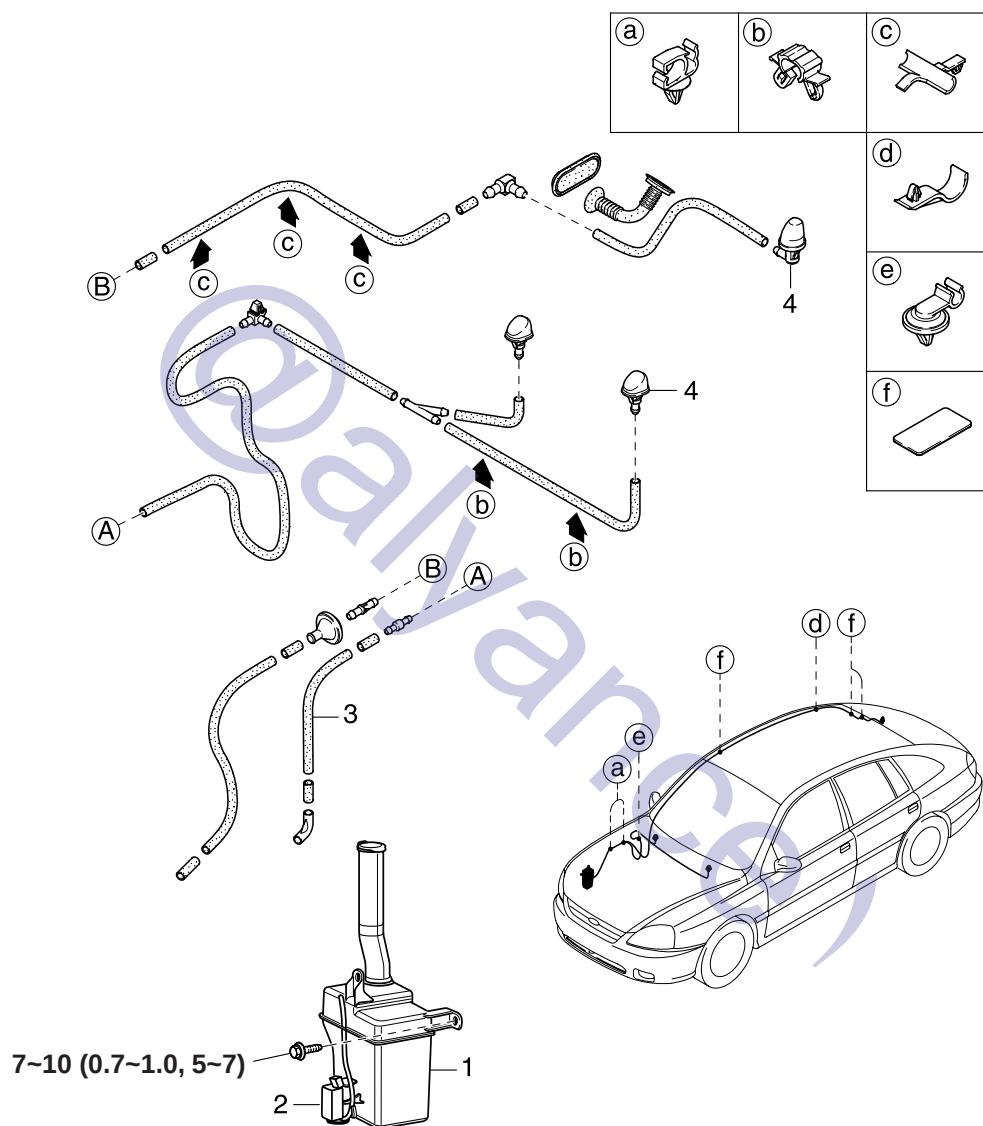
3. Install nut cover and check arm movement across windshield. Wiper arms should stop 1.6 inch (41mm) (Driver side) and 1.6 inch (40mm) (Passenger side) from lower edge of windshield.



BS2C040B

FRONT WASHER MOTOR

COMPONENTS EEF7F377E



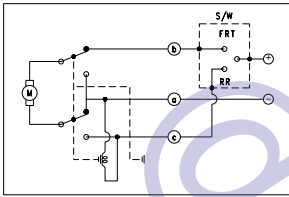
1. Washer tank
2. Washer motor

3. Washer hose
4. Nozzle

INSPECTION

EEA76DBF2

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

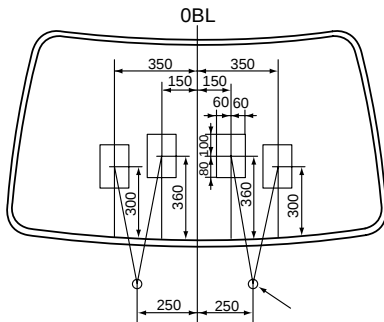


AT2D117A

ADJUSTMENT (WASHER NOZZLE)

EEED607A4

1. Spray should center on driver and passenger sides of front windshield. If off-line, adjust by slightly turning the nozzle.
2. If clogged or restricted, use a needle or wire to clear nozzle exit.



Unit : mm

BT2D114D

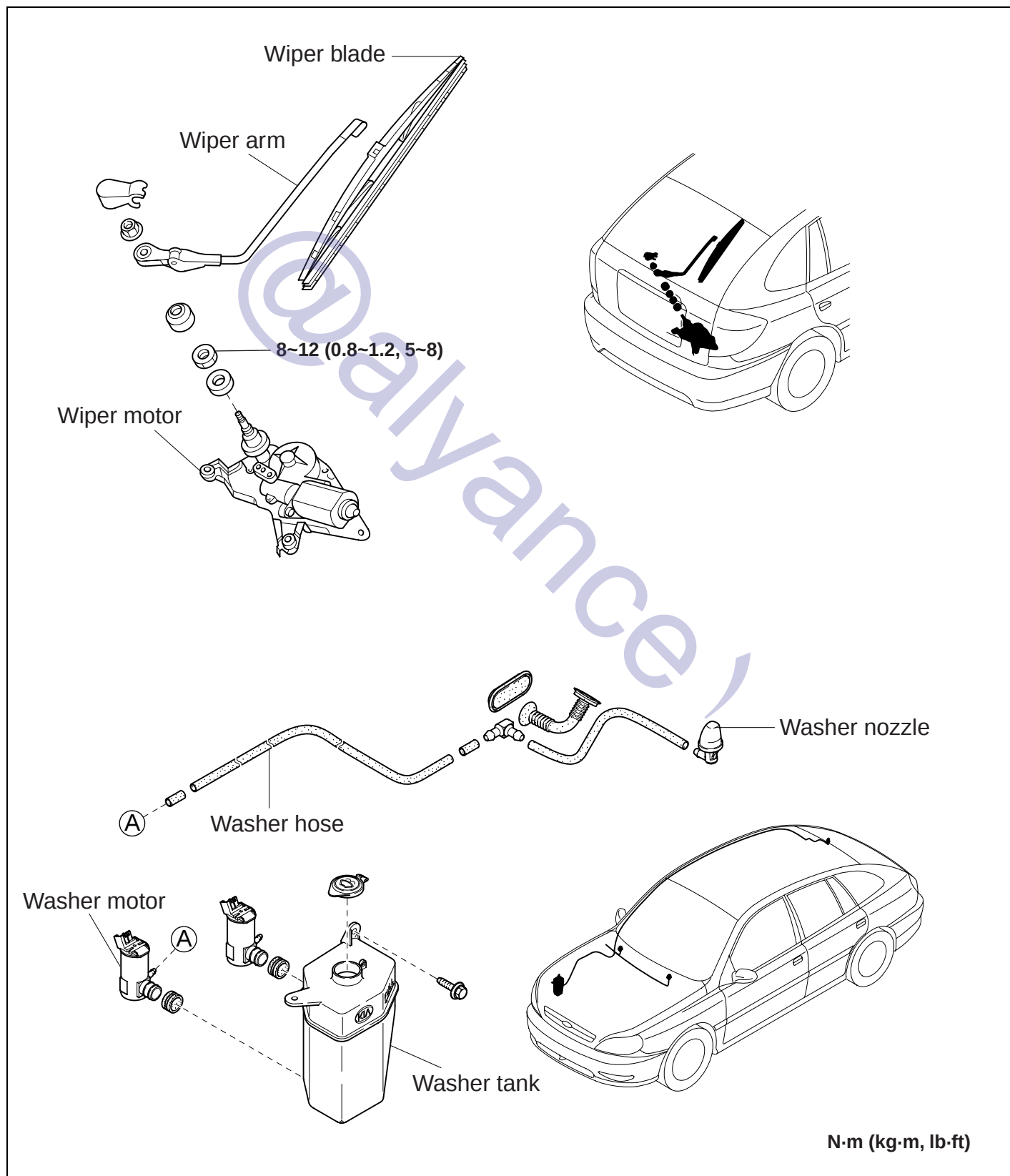
REAR WIPER/WASHER

BE -41

REAR WIPER/WASHER

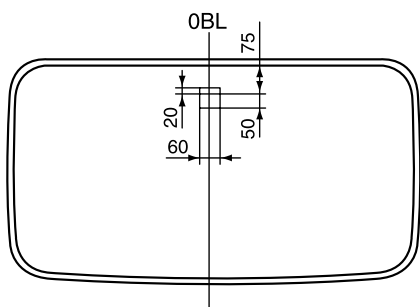
REAR WIPER MOTOR

COMPONENT EEF5C2B1F



ADJUSTMENT (WASHER NOZZLE) EEAB8A35A

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



Unit : mm

BT2D124B

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REAR WASHER SWITCH

INSPECTION EEABDB866

1. Check the continuity between the terminals while operating the switch.

C P T	WIPER SW		WASHER SW		REMARK
	ON	OFF	ON	OFF	
b					WIPER
c					E
d					IG2
e					WASHER
a					ILL (+)
f					ILL (-)

a b c d e f

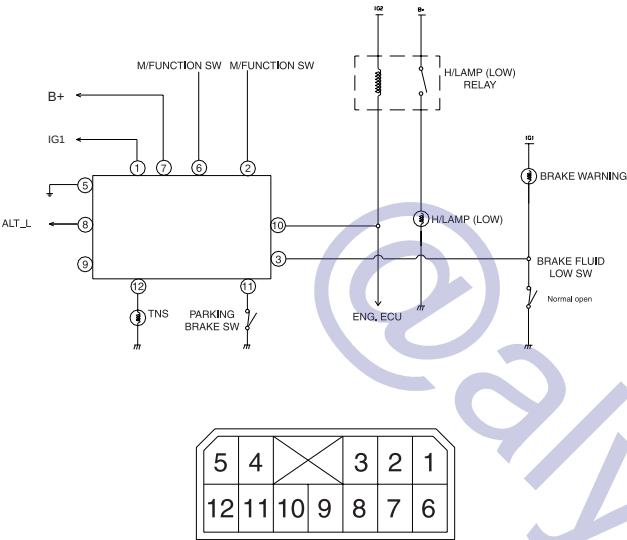
AT2D125B

LIGHTING SYSTEM

DAYTIME RUNNING LIGHTS

INSPECTION EEF0D74E8

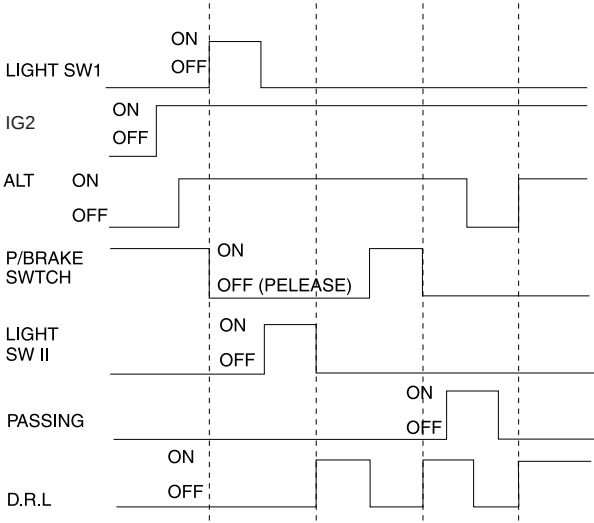
CIRCUIT DIAGRAM



LT2D050A

OPERATION CHECK

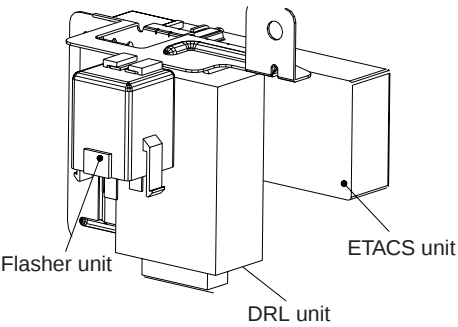
Check that the lights operate according to the following timing chart.



LT2D051A

REMOVAL AND INSTALLATION EEF049FFC

- 1. It is installed at the lower of A-pillar.



BT2D030A

HEAD LAMPS

BE -45

HEAD LAMPS

HEAD LAMP AIMING

INSTRUCTIONS EE0AB1C09

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

NOTE

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:

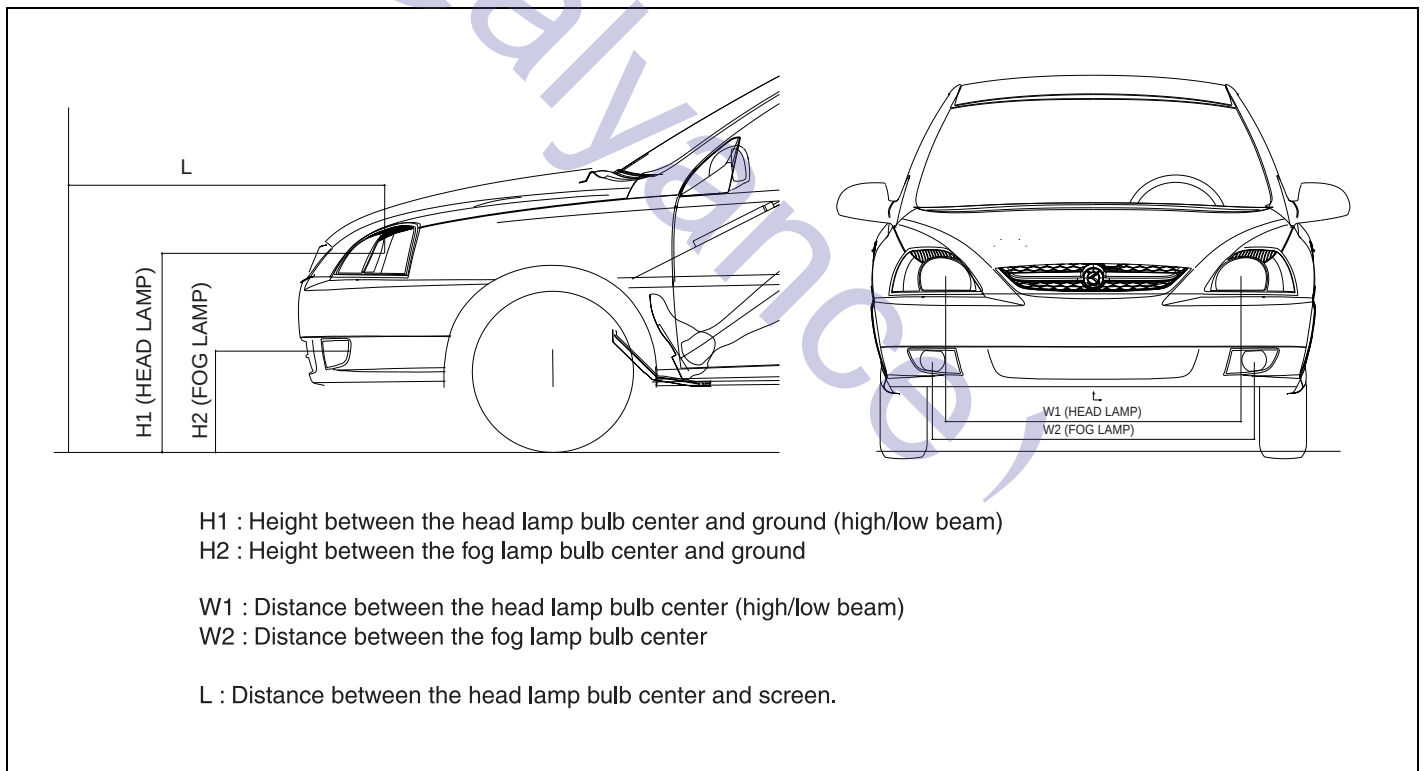
1. Inflate the tires to the specified pressure and remove any loads from the vehicle except the driver, spare tire, and tools.

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.



BT2D132A

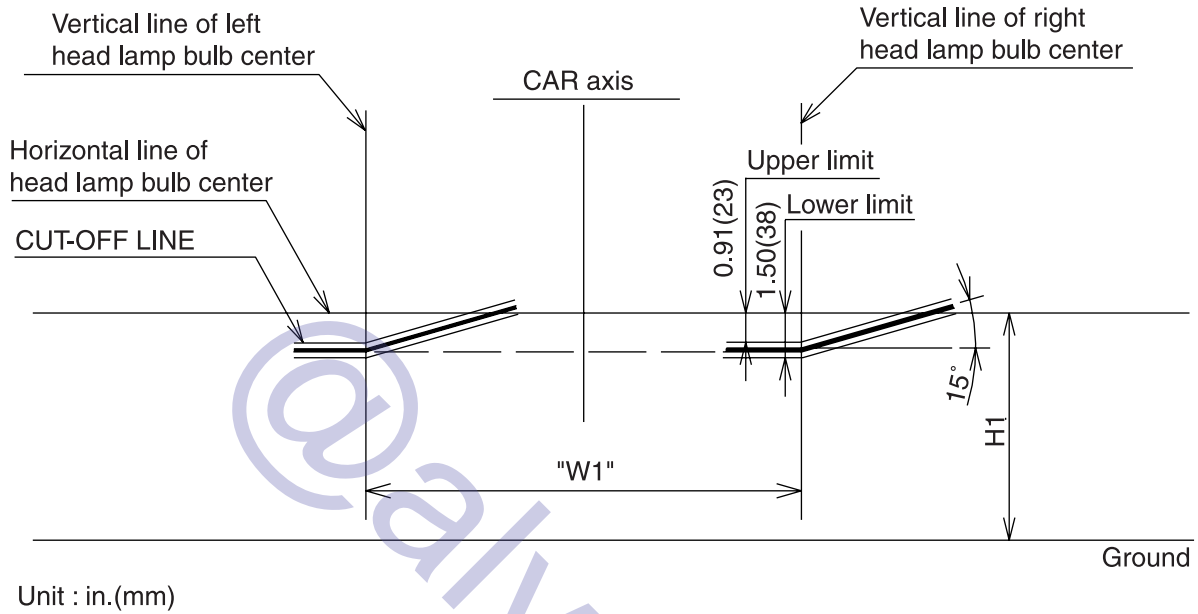
Unit : mm

Vehicle condition	H1	H2	W1	W2	L
Without driver	689	366	1,128	1,215	3,000
With driver	679	356			

BT2D132E

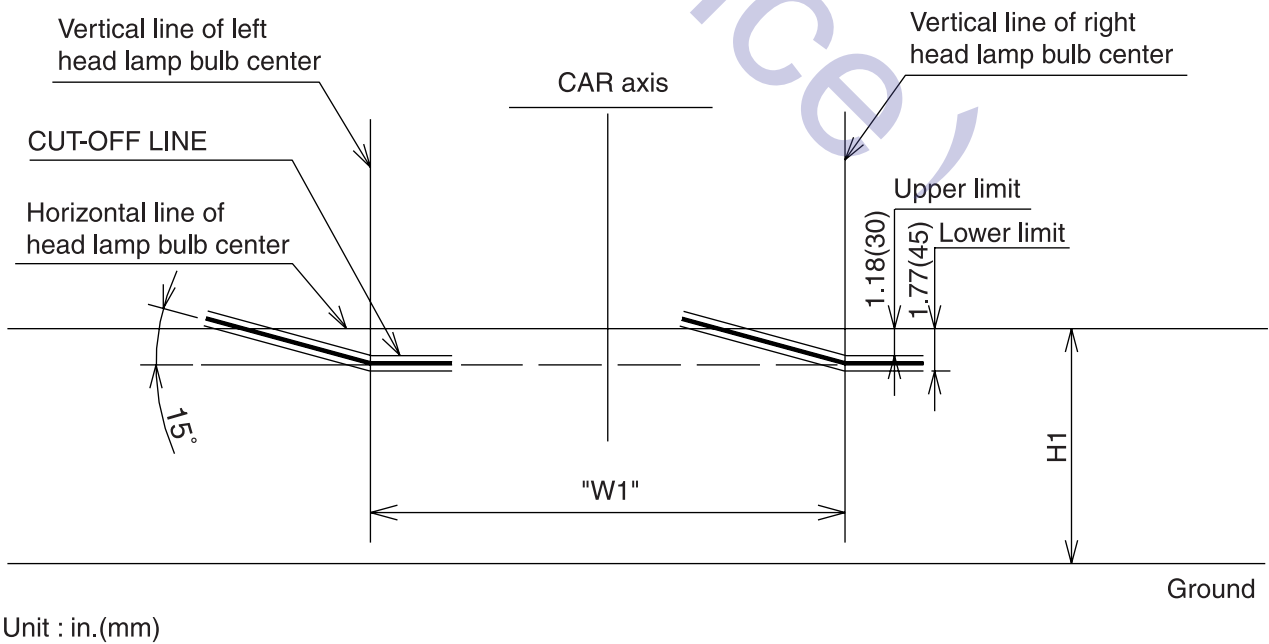
1. Turn the low beam on without the driver aboard.
The cut-off line should be projected in the allowable range (shaded region).

(LHD Type)



LT2D132B

(RHD Type)

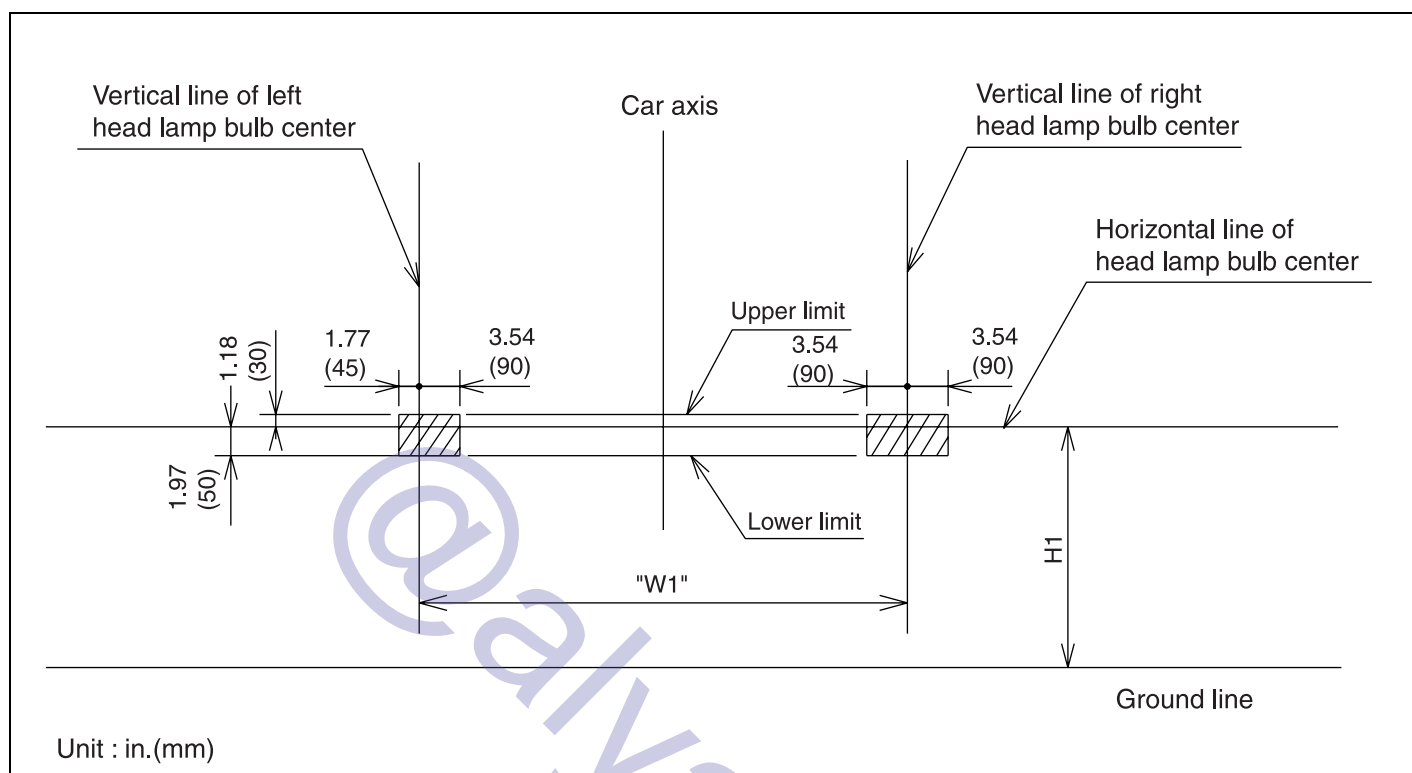


LT2D132F

HEAD LAMPS

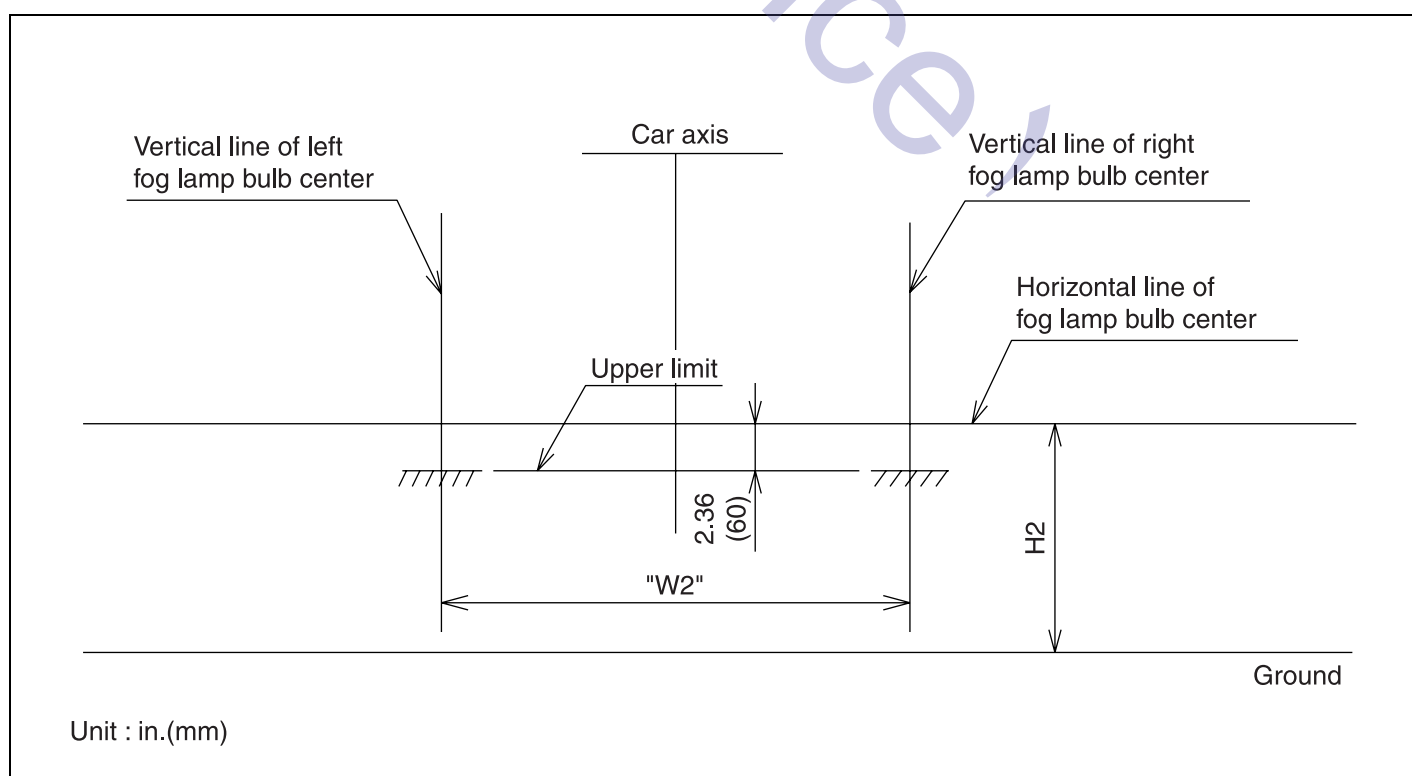
BE -47

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



LT2D132C

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

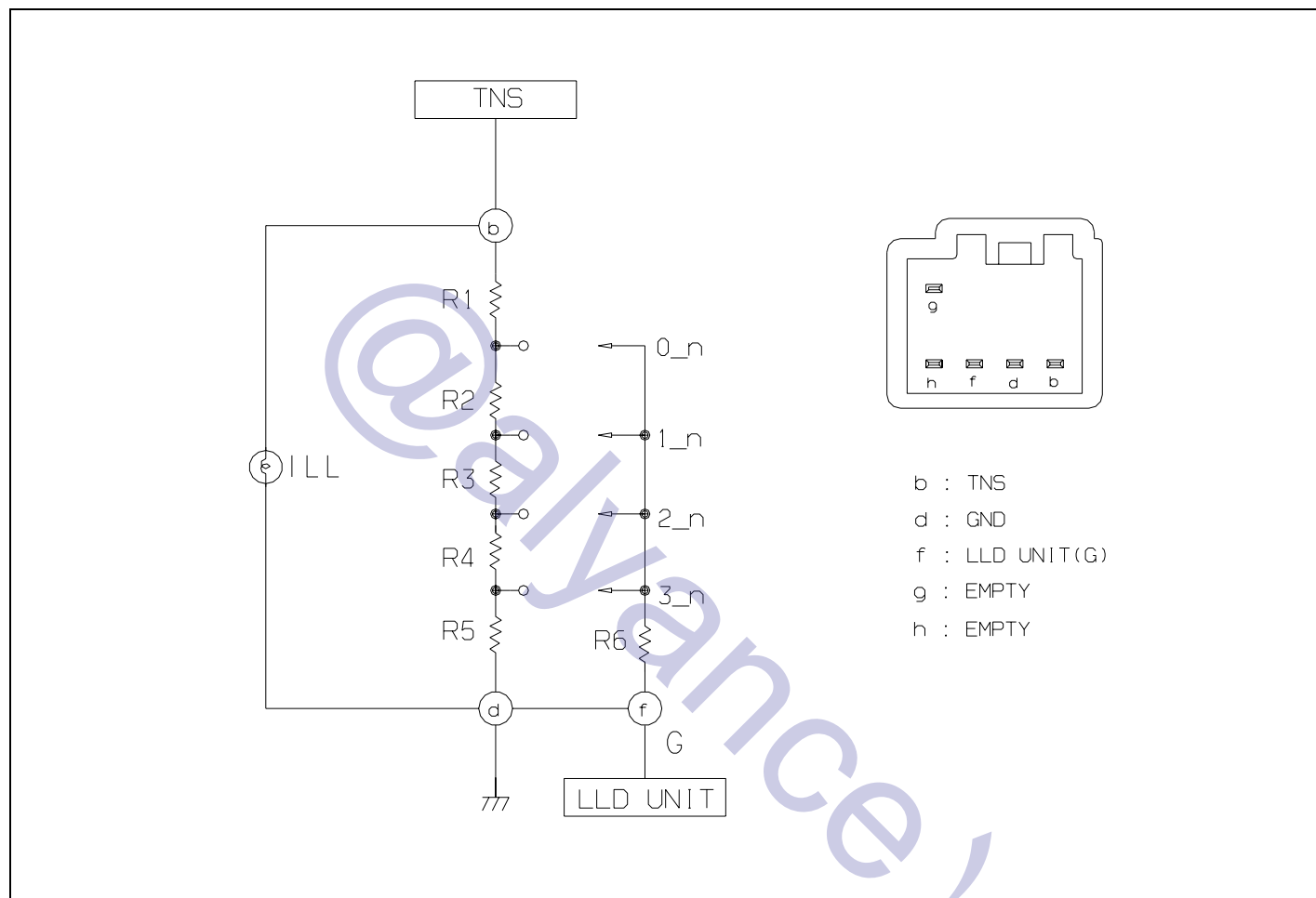


LT8C132D

HEAD LAMP LEVELLING DEVICE

HEAD LAMP LEVELLING SWITCH E5BEF0D9

CIRCUIT DIAGRAM



HEAD LAMP LEVELLING DEVICE

BE -49

HEAD LAMP LEVELING SWITCH

INSPECTION

ED791F3D

1. Disconnect the switch from harness side, lower panel.
2. Connect the battery voltage between terminals 5 and 4 (Reference voltage=VB).
3. Measure the voltage between terminals 3 and 4 (V).
4. Check the percent ratio ($V/VB \times 100\%$) between voltages VB and V at each position.

Position No.	Rotation	Ratio ($\pm 5\%$)	Voltage (V)
0	0 °	90 %	12.15 $\pm$ 0.5V
1	20 °	73 %	9.86 $\pm$ 0.5V
2	40 °	64 %	8.64 $\pm$ 0.5V
3	60 °	57 %	7.7 $\pm$ 0.5V

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

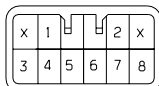
TURN/HAZARD LAMPS

HAZARD SWITCH INSPECTION

EE88BDF A1

1. Check for the continuity between the terminals while operating the switch.

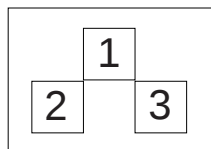
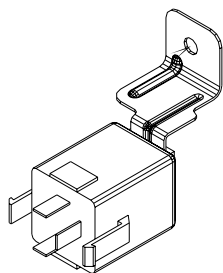
P T	ON (PUSH)	OFF (FREE)	REMARK
3		○	IGN +
5	○	○	B +
6	○	○	F/UNIT INPUT
4	○		F/UNIT OUTPUT
8	○		TL
7	○		TR
1	○	○	ILL +
2	○	○	ILL -



AT2D085A

FLASHER UNIT INSPECTION

1. Remove the flasher unit from the relay box.
2. Connect 2-turn signal lamps between terminal 1 and 2.



AT2D086A

3. Apply the battery voltage to the terminal 2 and ground the terminal 3.
4. Check the blinking frequency.
If abnormal, replace the flasher unit.
Blinking frequency : 60~120 times/minute

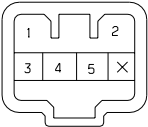
FRONT FOG LAMPS

FOG LAMP SWITCH

EEE54BB33

1. Check for the continuity between the terminals while operating the switch.

P T	ON (PUSH)	OFF (FREE)	REMARK
3			
4			
1			
5			
2			



AT2D204A

IMMOBILIZER CONTROL SYSTEM

SPECIFICATION E8CCBEDD

Type		Encrypt type
ICU part number		0K2AD 67 7B0
Manufacture		Shinchang Electronics Co. Ltd.
Label color of ICU		White
Antenna coil tube color		Blue
Key knob color		Bluish green
Limp home function switch		Ignition Key SW
"IMMO" indicator	Before coding	"IMMO" indicator blinks at three times for approximately two seconds.
	After coding	OK "IMMO" indicator illuminates for approximately two seconds and goes out.
	NG	"IMMO" indicator blinks at 2 Hz for 5 seconds and then the indicator blink at 0.6 Hz for approximately 17 seconds.

DIAGNOSTIC TROUBLE CODES AND ASSOCIATED PROCEDURES E1C3AC71

1. Turn ignition switch to ON position.
2. The immobilizer check lamp turns on.
3. Turn the ignition switch to LOCK.

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

DIAGNOSTIC TROUBLE CODE (DTC) CHART

Diagnostic Trouble Code	Fault Description
P1600	Communication error (ECU-VIM)
P1611	No answer from immobilizer
P1612	Checksum message wrong

DIAGNOSTIC TROUBLE CODE TROUBLESHOOTING

DTC	Fault Description	Possible cause	Action
P1600 P1611	No receiving any answer on K-line after elapsing timeout of communication or no receiving correct answer for communication time.	Harness or connection failure. ICU failure.	Erase DTC Repair or replace
P1612	Check sum message from ICU is wrong	ICU failure.	Erase DTC Replace

IMMOBILIZER CONTROL SYSTEM

BE -53

SYSTEM CHECK

Step	Action	Normal results
1	- Observe "IMMO" indicator. - Turn the ignition switch to ON.	"IMMO" indicator illuminates for approximately two seconds and goes out.
2	Turn the ignition switch to START	Engine starts.
3	- Turn the ignition switch to OFF. - Disconnect antenna coil connector from ICU. - Turn the ignition switch to ON. - Observe "IMMO" indicator.	"IMMO" indicator blinks at 2 Hz for 5 seconds and then the indicator blinks at 0.6 Hz for approximately 17 seconds.
4	Perform limp home with original correct PIN	"IMMO" indicator illuminates for approximately two seconds and goes out
5	Turn the ignition switch to START.	Engine starts.

ICU STATUS BY "IMMO" INDICATOR

Action	Part number	Virgin	Neutralized/Learnt
- Disconnect antenna coil connector. - Turn ignition switch to ON.	OK2AD 67 7B0	"IMMO" indicator blinks at three times for two seconds.	"IMMO" indicator blinks at 2 Hz for 5 seconds and then blinks at 0.6 Hz for approximately 17 seconds (LIMPHOME MODE).

BEFORE SERVICING

Step	Inspection	Yes	No
1	- Turn the ignition switch to ON. - Check if "IMMO" indicator illuminates or blinks.	Go to step 6.	Go to step 2.
2	- Disconnect the immobilizer harness connector from the ICU. - Check if battery voltage is applied to the terminal 2i of the harness connector.	Go to step 3.	Repair or replace
3	Check if the terminal 2B of the harness connector is grounded.	Go to step 4.	Repair or replace
4	- Turn the ignition switch to ON. - Check the battery voltage is applied to the terminal 2J and 2C of the harness connector.	Go to step 5.	Repair or replace
5	- Turn the ignition switch to OFF and connect the immobilizer harness connector to the ICU. - Turn the ignition switch to ON.		
6	Check if "IMMO" indicator illuminates for approximately two seconds and then goes out	Go to step 7.	Go to "Symptom table"
7	The ICU is normal. Check if engine starts	System is OK	Go to "Symptom table"

SYMPOTM TABLE

Fault	Possible symptom	Action
- Defective Key transponder - No Key matching - Defective Antenna coils - Defective Harness between ICU and antenna coils - The rest of system is OK.	- Engine does not start. "IMMO" indicator blinks at 2 Hz for 5 seconds and then blinks at 0.6 Hz. "IMMO" indicator illuminates for approximately two seconds and then goes out. When turning the ignition switch to OFF and START after limp home, engine starts.	Refer to procedure 1
- ICU virgin (0K2AD 67 7B0) - The rest of system is OK.	- Engine does not start. "IMMO" indicator illuminates at three times for approximately two seconds and then goes out. - When disconnecting antenna coil connector and turning the ignition switch to ON, "IMMO" indicator illuminates at three times for approximately two seconds and then goes out (0K2AD 67 7B0).	Perform "Normal Coding" procedures with original correct PIN.
- Defective ECU - Harness between ICU and ECU - Starting system - The rest of system is OK	- 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 2 Hz and then the indicator blinks at 0.6 Hz for approximately 17 seconds.	Refer to procedure 2
- Defective ICU - Defective ECU - Defective harness between ICU and ECU - The rest of system is OK.	- Engine does not start. - When disconnecting antenna coil and then performing limp home with original correct PIN, "IMMO" indicator does not blink from 2 Hz to 0.5 Hz (The PIN entry is correct). - MIL indicator illuminates (there are any Diagnostic Trouble Codes related to Inkey Immobilizer System).	Refer to procedure 3

IMMOBILIZER CONTROL SYSTEM

BE -55

PROCEDURE 1

Step	Inspection		Action
1	Perform "Key Only Matching" with the original correct PIN. Are key matching results well?	Yes	Turn the ignition switch to START
		No	Go to step 2.
2	Turn the ignition switch to OFF. Check if connection and wire harness between antenna coils and ICU are normal.	Yes	Go to step 3.
		No	Repair or replace wire harness
3	Check if antenna coils are normal	Yes	Go to step 4.
		No	Replace antenna coils
4	Perform "Key Only Matching" with the original correct PIN. Are key matching results OK?	Yes	Go to step 5.
		No	Recheck system
5	Turn the ignition switch to OFF and ON Check if "IMMO" indicator illuminates for approximately two seconds and goes out.	Yes	Go to step 6.
		No	Recheck system
6	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	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 step 2.
2	Check if the connection and wire harness between ICU and ECU is normal.	Yes	Go to step 3.
		No	Replace or replace wire harness.
3	Perform "Normal Coding" with original correct PIN.	Yes	Go to step 4.
		No	Recheck system or check if PIN entry is correct
4	Perform "ECM CHECK" with original correct PIN. Check if ECU condition is "Unlocked".	Yes	check starting system.
		No	Go to step 5.
5	Recheck if connection and wire harness between ICU and ECU is normal	Yes	Go to step 6.
		No	Repair or replace wire harness.
6	Perform "Neutralization" and "Normal Coding" with original correct PIN. Turn the ignition switch to START. Check if engine starts.	Yes	System is OK
		No	Recheck system.
7	Before replacing ECU, must remember and record 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 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.

IMMOBILIZER CONTROL SYSTEM

BE -57

PROCEDURE 3

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

Step	Inspection		Action
1	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 step 2.
2	Turn the ignition switch to OFF and disconnect antenna coils connector. Turn the ignition switch to ON and perform "Limp home" with the original correct PIN through IG SW. Observe if "IMMO" indicator illuminates for approximately 2 seconds and then goes out.	Yes	Go to step 3.
		No	Go to step 6.
3	Turn the ignition switch to START. Check if engine starts.	Yes	System is OK.
		No	Go to step 4.
4	Check if connection and wire harness between ICU and ECU is normal.	Yes	Go to step 5.
		No	Repair or replace wire harness.
5	Before replacing ECU, must remember and record 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 step 6.
6	Before replacing ICU, must remember and record the original correct PIN. Perform "Neutralization" with the original correct PIN and turn the ignition switch to OFF. Remove ICU and store the ICU with the tag recorded serial inspection. Install new virgin or neutralized ICU 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 step 7.
7	Check if connection and wire harness between ICU and ECU is normal.	Yes	Go to step 8.
		No	Repair or replace wire harness.

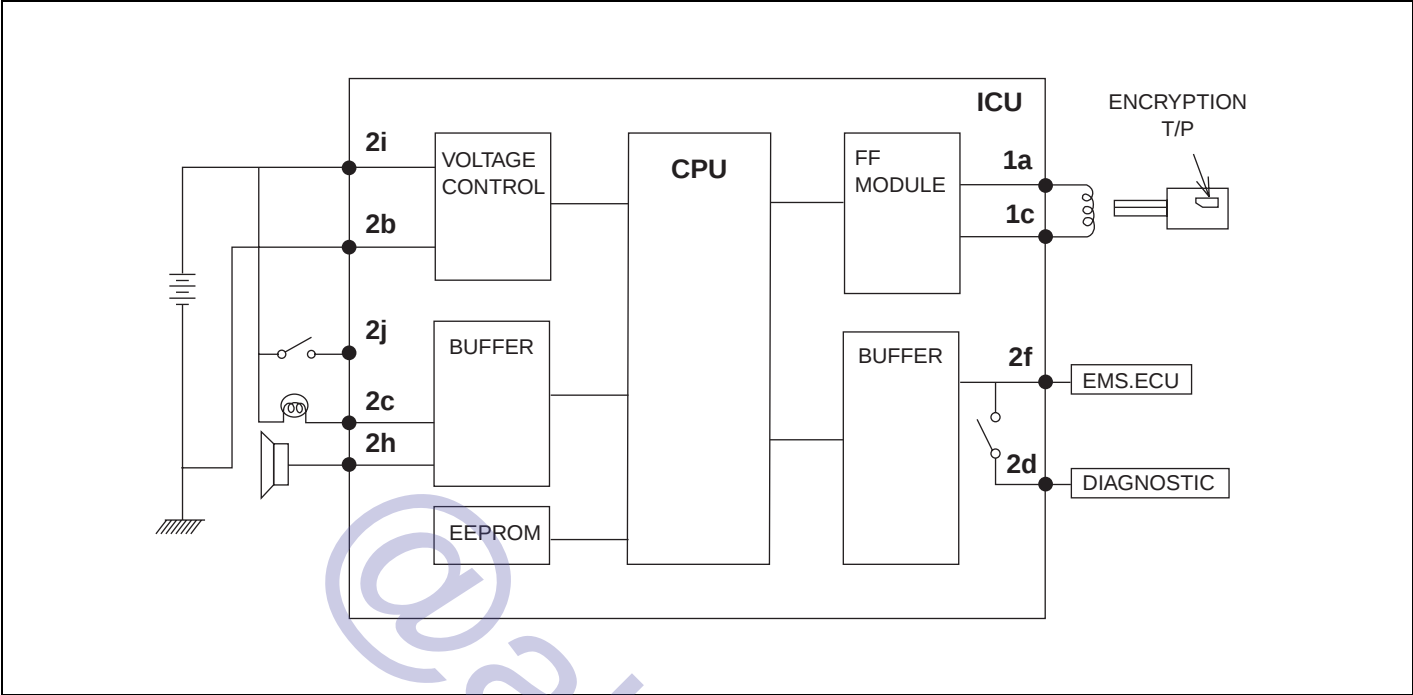
BE -58

BODY ELECTRICAL SYSTEM

Step	Inspection		Action
8	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

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SCHEMATIC DIAGRAM E35C5FA4



LT2D300A

2i			2c	2a				
2j	2h	2f	2d	2b		1c	1b	1a

Pin	Description	Pin	Description
2a	NC (Not connected)	1a	Coil ⊕
2b	GND	1b	NC (Not connected)
2c	IMMO indicator	1c	Coil ⊖
2d	Serial communication (Diagnosis)		
2f	EMS-ECU		
2h	Horn		
2i	B ⊕		
2j	⊕ IG1		

LT2D300B



NOTE

- While performing a coding procedure, the period of ON and OFF must maintain approximately two seconds in order to confirmed communication time between ICU and ECU.
- After completing to perform a coding procedure, if engine does not start in spite that "MMO" indicator is normal, disconnect the antenna coil connector from the ICU and then perform a limp home procedure. In case of observing that "MMO" indicator is normal, the ICU is normal. So, check for ECU including the starting system.
- After a neutralization or replacement of ICU, must perform a 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 limp home procedure through a "IMMO" indicator. If succeed, "IMMO" indicator illuminates for approximately 2 seconds and then goes out. If not, "IMMO" indicator blinks at 2 Hz continuously.
- If a limp home procedure is succeed, start engine within 20 seconds.
- In case of virgin ICU, the Key Only Matching is not allowed.

DIAGNOSTIC FUNCTION

EA24C458

An external diagnostic tool (Hi-Scan Pro Tool) initiates the diagnostic communication. Its purpose is to :

- Perform an end-of-line test at the car assembly plant consisting of :
 - Programming the PIN
 - matching the ECM to the ICU
 - matching the transponder keys
 - doing a complete check of the system
- Program a replacement ECM or ICU (neutralization)
- Program replacement keys

DIAGNOSTIC SERVICE

Refer to Hi-Scan Pro Tool Manual.

- Normal coding
- Neutralization
- Code change
- Key only matching
- VIM check
- ECM check
- Key check

PASSCODE (OR PIN) REQUEST

This service is used to enter the PIN.

TEST SEQUENCE REQUEST

This frame is sent immediately after the pass code frame and starts a test sequence either with or without transponder key matching. If the test sequence request is not received before the end of the time-out, the ICU sends a response frame containing \$FF FF as status.



NOTE

This service can be allowed only when the ICU status is not learnt by setting an EEPROM. In case of learnt status, the sequence is not processed and the PIN is not changed

IMMOBILIZER CONTROL SYSTEM

BE -61

Consider a virgin ICU. By performing a full test sequence :

- either without key matching,
- or with key matching,

The ICU becomes learnt, and unlocked. The ICU will remain unlocked while the ignition is turned ON. However, if a full test sequence is performed with key matching (and two keys are matched: the sequence was successful), then the ICU is learnt and unlocked, but a passive arming is armed. In that case, once the passive arming is elapsed, or if ignition is turned ON with an unknown key, the ICU is locked.

KEY MANAGEMENT :

In case of key matching (from a full test sequence or a key matching only) :

- No key is learnt : the previous keys are kept,
- At least 1 key is learnt : the previous keys are erased, and replaced by the new ones.

CASE OF VIRGIN ICU

In virgin status the key matching service is not allowed.

DIAGNOSTIC SEQUENCE

1. The operator inserts a transponder key.
2. The test tool sends the PIN with option full test (program PIN) and a diagnostic request to the ICU.
3. The PIN is programmed and the ICU status changes to learnt.
4. The ICU activates the horn for 30ms.
5. The operator turns the key to IG ON position.
6. The ICU communicates with the ECM and unlocks it.
7. The operator turns the key to IG OFF position.
8. The horn sounds for 30ms.
9. The operator turns the key to IG ON position.
10. The first transponder key is learned.
11. If the programming was OK, The lamp is ON for 2 seconds.
12. The operator turns the key to IG OFF position and replaces it by the second key in less than 10 seconds.
13. The operator turns the key to IG ON position.
14. The second transponder key is learned.

15. If the programming was OK, the lamp is ON for 2 seconds the horn is activated for 30ms.

16. The operator turns the key to IG OFF position.

17. The status of the ICU is sent to the test tool(Hi-Scan Pro Tool).

TRANSPONDER KEY MATCHING (ICU LEARNT STATE ONLY)

Transponder matching sequence: this procedure corresponds to matching keys procedure

1. The operator inserts a transponder key.
2. The test tool sends the PIN to the ICU with option transponder matching and the number of keys to be programmed.
3. The ICU activates the horn for 30ms.
4. The operator turns the key to IG ON position.
5. The first transponder key is learnt.
6. The lamp lights.
7. The operator turns the key to IG OFF position and replaces it by the next key.
8. The operator turns the key to IG ON position.
9. The second transponder key is learnt.
10. The lamp lights.
11. Step 7 to 10 are repeated depending on the number of keys to be programmed.
12. The status of the ICU is sent to the test tool.

Also, during the Ignition test, the VIM detects the ECM type connected to it and stores the type in EEPROM.

ECM (OR ECU) COMMUNICATION

The ECM communication is initiated by the ECM. The ICU decrypts this request to get three bytes of fix code; it compares this fix code with ICU? MIN. If they are different or if the ICU is in the locked condition, ICU answers ECM with dummy data. Otherwise, the answer is got from encrypted different code according the ICU status.

The ECM type is extracted from the ECM request and stored in EEPROM of ICU.

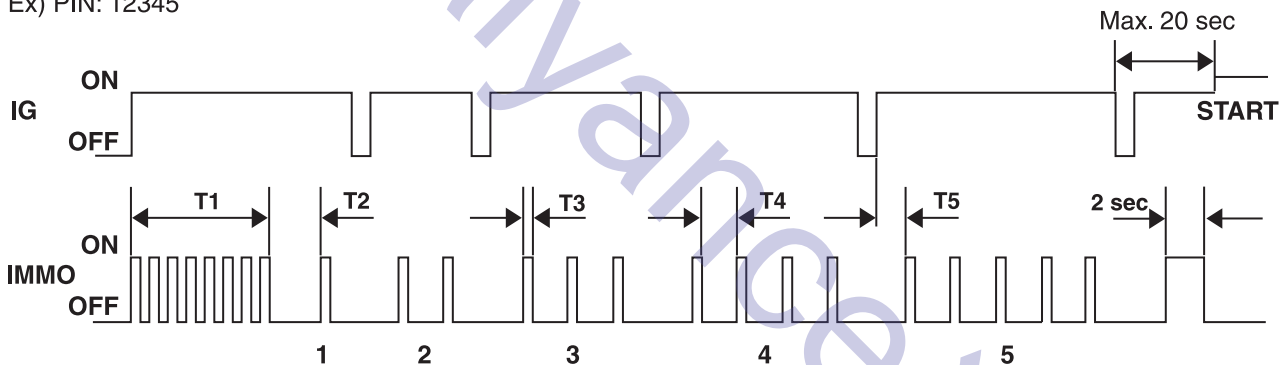
IMMOBILIZER CONTROL SYSTEM

BE -63

THE PIN HAS TO BE ENTERED USING THE FOLLOWING PROCEDURE :

1. Turn the IG SW to ON. The "IMMO" indicator will blink at 2 Hz (duty cycle ON/OFF=1) for approximately 5 seconds.
2. "IMMO" indicator will go out for approximately 1.65 seconds.
3. "IMMO" indicator will blink at 0.6 Hz (duty cycle ON/OFF=0.2).
4. Turn the IG SW to ACC when the "IMMO" indicator blinks the same times as the number of PIN's (so-called passcode) first digit. Refer to following figure ;
 - If the IG SW is not turned to ACC after tenth, exit limp home procedure.
 - If the IG SW is not returned to ON within approximately 10 seconds, exit limp home procedure.
5. Turn the IG SW to ON within approximately 10 seconds. Then, the "IMMO" indicator will blink at 0.6Hz (duty cycle ON/OFF=0.2) after approximately 1.4 seconds. If the IG SW is not turned to ON within this time-out, the limp home procedure is aborted.
6. Repeat step 3 and step 4 for entering the rest of the PIN's digits.
 - If the PIN entered correspond to the PIN of ICU, the "IMMO" indicator illuminates for approximately 2 seconds and then goes out. ICU is unlocked and cranking is allowed during approximately 20 seconds.
 - If the PIN entry is incorrect, the "IMMO" indicator blinks at 2 Hz continuously and cranking is not allowed. Repeat limp home procedure.
7. Start the engine within 20 seconds. Do not turn the IG SW to ON and OFF for this time-out.

Ex) PIN: 12345



- T1:5 sec, T2: 1.65 sec, T3: 0.27 sec, T4: 1.4 sec, T5: 1.4 sec.
- If the IG SW is not turned to OFF after the tenth flash, "IMMO" indicator blinks at 2 hZ continuously.

CORRECT PIN ENTERED

If the entered PIN corresponds to the stored PIN, the ICU is unlocked and the passive arming delay is set to a calibration value (i.e. 20 seconds) specific to the limp home procedure. While the PIN is being entered, the ICU is locked. Therefore, the ECM may continuously send ECM's request to the ICU. When the user enters the correct PIN, the ICU becomes unlocked and answers the ECM request with unlock status. "IMMO" indicator goes out.

If the ignition is switched off for more than the passive arming delay (i.e. 20 seconds), the ICU is locked again.

INCORRECT PIN ENTERED

If the entered PIN does not correspond to the stored PIN, the ICU is locked and the lamp will be blinking at 2Hz permanently. If you want to restart the limp home procedure, you have to turn off the ignition key and then turn on the ignition key again. This product has no inhibition time.

SIGNAL MODES BY THE LAMP

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

Mode	Lamp	Frequency	Duty-cycle ON/OFF	Duration
ICU locked IG OFF	OFF	-	-	Permanent
ICU unlocked IG OFF	OFF	-	-	Permanent
ICU locked IG ON	Blinking	2Hz	1	For approximately 5 seconds or ignition is turned to OFF
ICU unlocked IG ON	ON	-	-	2 seconds
Limp home procedure: digit entry	Blinking	0.6Hz	0.2	Ignition is turned OFF or 10 blinks
After PIN entry (correct code)	ON	-	-	For approximately 2 seconds or ignition is turned OFF.
After PIN entry (incorrect code)	Blinking	2Hz	1	Permanent
ICU virgin IG ON	ON	1.25Hz	1	3 blinks (2.4 seconds)

IMMOBILIZER CONTROL SYSTEM

BE -65

DESCRIPTION AND OPERATION

EC2B6ADA

The product described in these specifications is a transponder-based immobilizer for vehicle. This product is called ICU

(Inkey Control Unit) communicates with the engine management system in order to allow or not the cranking depending the recognition or not of the transponder inserted in the Key. This product complies with European directives applicable in anti-thaft systems for vehicles. The transponder is inserted in the Key; two Keys are associated to vehicle. The identification of a transponder by the ICU is done by a rising edge on the plus ignition input. The recognition of a transponder identifier puts the ICU in an unlocked state until a falling edge in ignition input; otherwise, it is in the locked state. The unlocked state allows cranking. The ICU communicates with Hi-Scan Pro tool in order to :

- Proceed with key (transponder) matching at the end of vehicle manufacturing line.
- Initialize the engine management system.
- Proceed with auto-test of the product (check of antenna connections and W line output).

In case of a transponder failure, the immobilizer can be unlocked with a procedure called Limp Home Procedure by entering a personal code with the IG SW.

ICU

- Transponder reader / exciter interface
- 5V power supply regulation
- Serial communication interface
- Lamp relay drivers
- Micro controller and software

Transponder reader/exciter

The communication with the transponder is done by an integrated circuit(ASIC) which integrates in addition to the transponder reader / exciter :

- 5V voltage regulator for internal use and micro controller power supply.
- Watch dog circuit
- W line driver used for the communication with the ECM

Electrical characteristics of the ASIC :

- The antenna driver is a differential driver (H bridge)
- Output current of the transmitter : $\pm 100\text{mA}$
- Input signal of the receiver : ± 100
- Power in reset threshold : $V < -0.5\text{ V}$
- DC supply voltage maximum ratings : $-0.5\text{V} \sim 35\text{ V}$
- DC operational supply voltage : $6\text{V} \sim 16\text{V}$
- 5V voltage regulator output : $4.8\text{V} \sim 5.2\text{V}$

TRANSPONDER

The transponder used is the encrypt type in wedge package. The transponder is inserted in the Key by over molding procedure at the steering column lock factory.

ANTENNA

The antenna is composed of :

- Coil
- Plastic holder for the coil and envelop
- 0.45 meter of one pair of twisted wires cable
- AMP 3 position connector

FUNCTIONS

E5FAC041

ABBREVIATIONS

ECU	Electronic Control Unit or Engine Control Unit
EMS	Engine Management System
ECM	Engine Control Module (Same As EMS)
VIM	Vehicle Immobilizer
ICU	Inkey Control Unit
MIN	Model Identification Number
PIN	Personal Identification Number (i.e. passcode)

FUNCTION LIST

Transponder communication : reads the transponder code and decide (in normal mode) the immobilizer condition "Locked" or "Unlocked".

ECM communication : answers the requests from engine management system.

Diagnostic communication : answers the requests from diagnostic tool (Hi-Scan Pro Tool).

Limp home function : manages the ignition SW input and handles the override procedure for the Limp home and key learning sequence.

ICU CONDITION AND STATUS

The ICU has two possible conditions: "Locked" or "Unlocked".

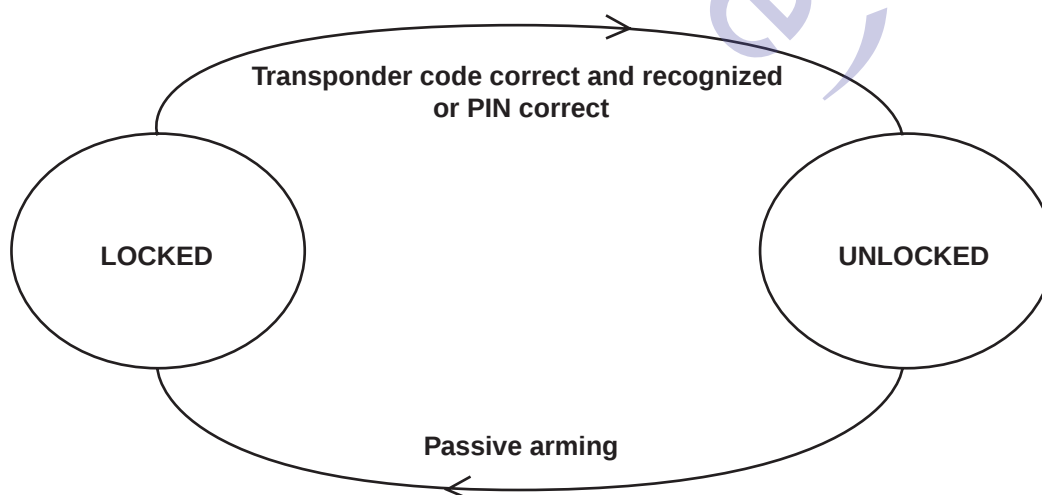
In addition, three possible statuses: "Virgin", "Learnt" and "Neutralized".

LOCKED CONDITION

The ICU will stay in the locked condition as long as no valid transponder code has been received. The ICU will automatically go to lock condition a regular time after key OFF. As long as the ICU is in the locked condition, engine start is impossible, since the ICU answers any ECM request with dummy data. Exceptions to this rule are made if either the ECM or the ICU is in virgin state.

UNLOCKED CONDITION

Only if the ICU is in the unlocked condition, engine start is allowed. if the conditions about the MIN and the respective status of the ICU and the ECM are verified.



IMMOBILIZER CONTROL SYSTEM**BE -67****VIRGIN STATUS**

This status represents the delivery condition of the ICU. The MIN has been programmed at the factory in EEPROM. The VIN has not been programmed yet; it will be programmed at the car manufacturer's end-of-line test. In this status, if the ECM is also in virgin state and the MIN of the ECM and the ICU are the same, engine start is allowed.

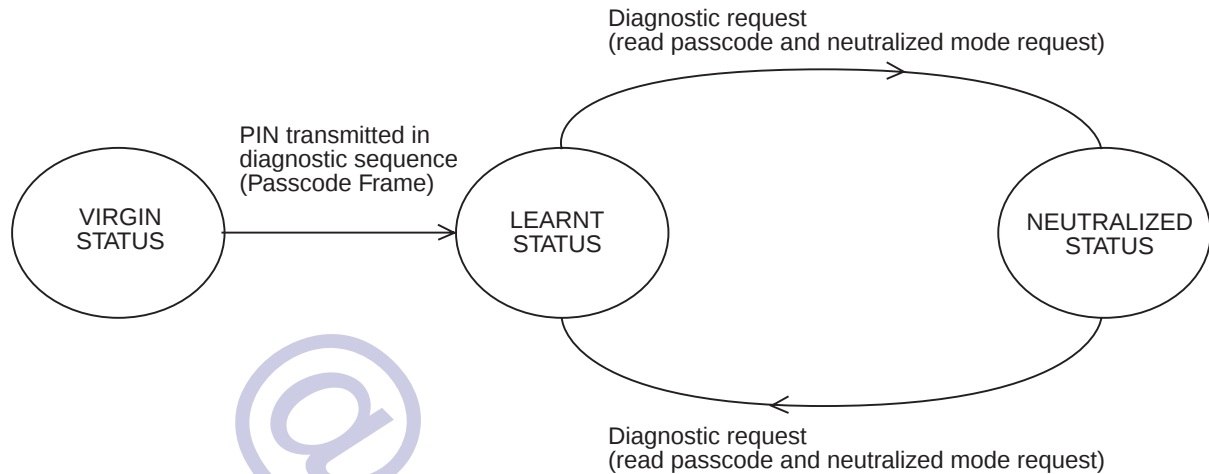
LEARNT STATUS

This represents the normal operating condition of the ICU, where the VIN has been learned. When the ECM sends a request containing the same MIN, then if the ICU is unlocked, the response to the ECM will contain a code based on the VIN. If the ICU is locked, the response will contain dummy data.

NEUTRALIZED STATUS

To replace a part of the system (ICU, ECM), the ICU and the ECM have to be set to neutralized state by a <read passcode> request from the diagnostic tool. In this status, engine start is never possible.

**FOLLOWING FLOW DIAGRAM SHOWS
THE POSSIBLE TRANSITIONS BETWEEN
STATUSES :** EEEBFFD7



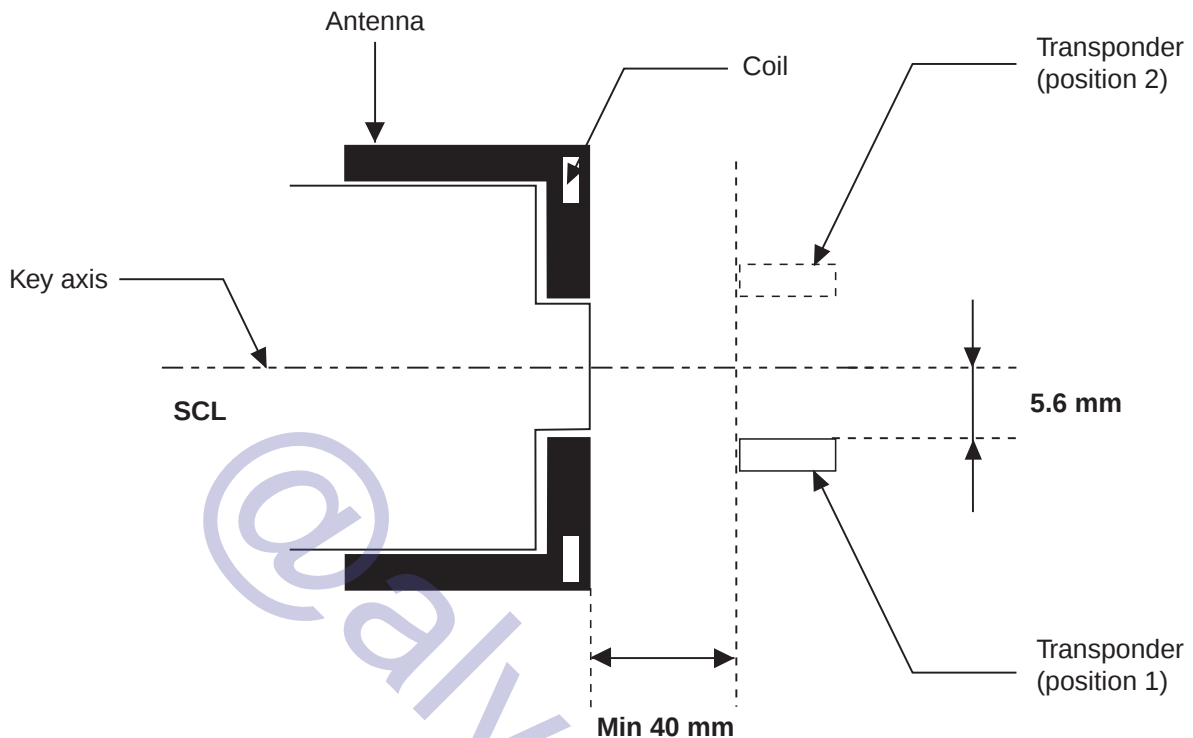
LT2D300F

STATUS VS CONDITION

The following table shows the possible conditions according the different possible status of the ICU :

Status	Condition	Condition for locked/unlocked	Remark
Virgin	Unlocked	Always	Cranking is allowed provided the ECU is virgin
Neutralized	Locked	Ignition ON with an unknown key	
	Unlocked	Ignition On with a known key or override procedure	ICU may neutralize an ECU provided they both have similar MIN and VIN.
Learnt	Locked	Ignition ON with an unknown key	
	Unlocked	Ignition ON with a known key or override procedure	Cranking is allowed provided ICU and ECU have similar MIN and VIN.

NORMAL ENVIRONMENT OF COIL/TRANSPONDER



LT2D300G

The transponder(inserted in the Key) has two stable positions(position1 and position2 on the figure above).

Reading the transponder in these conditions should be possible at 100% rate :

- In the temperature range
- In case of extreme values intervening in the coupling between transponder and coil, which are :
 - carrier frequency
 - tuning frequency of the antenna resonant circuit
 - tuning frequency of the transponder coil
 - minimum magnetic field of transponder good operation
 - mechanical tolerances of positioning (transponder in the key and coil on the SCL)
- When the system is submitted to an electromagnetic field

FUNCTIONAL DESCRIPTION

The reading transponder procedure is initiated by a rising edge on the Ignition input. The transponder reading should be completed during a delay of one second after + ignition rising edge. This time includes two includes 5 possible tentative of transponder reading.

During this delay, all other requests are ignored.

Four transponders in total can be programmed in the EEPROM.

The result of this function execution is an EEPROM variable which contains the ICU condition, locked or unlocked. The ICU is unlocked if the transponder code read is known and belongs to the list in the EEPROM and if the transponder has been authenticated successfully. ICU switches to the locked state after approximately one second after the (+) ignition falling edge (Passive arming). The ICU is locked if the transponder is absent or the code read is unknown.