

Engine Electrical System



Specification

Ignition System

Ignition Coil

Item	Specification
Primary Coil Resistance (Ω)	$0.75 \pm 15\%$ [20°C (68°F)]
Secondary Coil Resistance (k Ω)	$5.9 \pm 15\%$ [20°C (68°F)]

Spark plug

Item	Specification
Type	SILZKR7B11
Gap	1.0 ~ 1.1 (0.0394 ~ 0.0433)

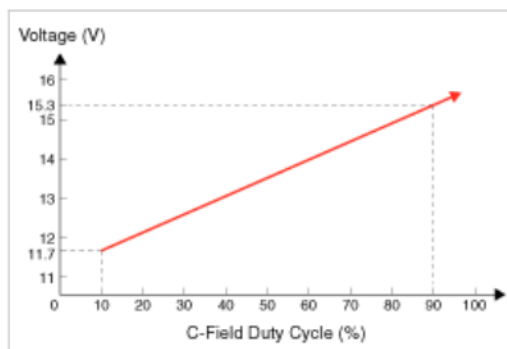
Condenser

Item	Specification
Capacitance (μ F)	0.47 [1KHz]
Insulation resistance (M Ω)	1,000 [DC 500 V/1 Min]

Charging System

Alternator [Non-ISG type]

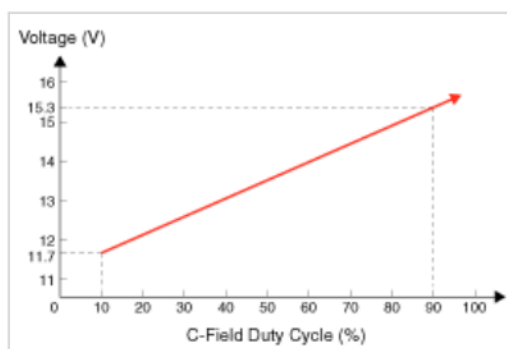
Item		Specification
Rated voltage		13.5V, 90A
Speed in use		1,000 ~ 18,000 rpm
Voltage regulator		IC Regulator built-in type
Regulator Setting Voltage	External mode	Refer to below graph
	Internal mode	14.55 ± 0.3 V
Temperature Gradient	External mode	0 ± 3 mV / °C
	Internal mode	-3.5 ± 2 mV / °C



※ Regulator Setting Voltage (External mode)

Alternator [ISG type]

Item		Specification
Rated voltage		13.5V, 120A
Speed in use		1,000 ~ 18,000 rpm
Voltage regulator		IC Regulator built-in type
Regulator Setting Voltage	External mode	Refer to below graph
	Internal mode	14.55 ± 0.3 V
Temperature Gradient	External mode	0 ± 3 mV / °C
	Internal mode	-3.5 ± 2 mV / °C



※ Regulator Setting Voltage (External mode)

Battery [Non-ISG type]

Item	Specification
Model type	CMF60L-DIN
Capacity [20HR / 5HR] (AH)	60 / 48
Cold Cranking Amperage (A)	550 (SAE) / 440 (EN)
Reserve Capacity (Min)	92

AGM Battery [ISG type]

Item	Specification
Model type	AGM 70L-DIN
Capacity [20HR / 5HR] (AH)	70 / 56
Cold Cranking Amperage (A)	760 (SAE) / 610 (EN)
Reserve capacity (Min)	120

Information

- Model type description

• Battery type notation : -

① ② ③ ④

- ① : Battery specification
 - CMF : Closed Maintenance Free
 - MF : Maintenance Free
 - AGM : Absorbent Glass Mat
- ② : Battery capacity (20HR)
 - 68 : 68AH
- ③ : Terminal location
 - L : Positive terminal is left
 - R : Positive terminal is right
- ④ : Battery type
 - DIN: Deutsche Industrie Normen
 - BCI: Battery Council International

- Cold Cranking Ampere (CCA): Cold Cranking Amps is a rating used in the battery industry to define a battery's ability to start an engine in cold temperatures.
- The rating is the number of amps a new, fully charged battery can deliver at -18 °C(-0.4 °F) for 30 seconds, while maintaining a voltage of at least 7.2 volts for a 12 volt battery.
- The higher the CCA rating, the greater the starting power of the battery.
- RESERVE CAPACITY (RC) : Reserve Capacity is a battery industry rating, defining a battery's ability to power a vehicle with an inoperative alternator or fan belt.
- The rating is the number of minutes a battery at 26.7 °C(80 °F) can be discharged at 25 amps and maintain a voltage of 10.5 volts for a 12 volt battery.
- The higher the reserve rating, the longer your vehicle can operate should your alternator or fan belt fail.

Starting System

Starter [Non-ISG type]

Item	Specification
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Rated voltage		12 V, 1.2 kW
The number of pinion teeth		13
Performance [No-load, 11 V]	Ampere	Max. 70 A
	Speed	Min. 2,400 rpm

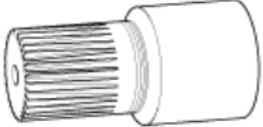
Starter [ISG type]

Item		Specification
Rated voltage		12 V, 1.4 kW
The number of pinion teeth		15
Performance [No-load, 11.5 V]	Ampere	Max. 100 A
	Speed	Min. 1,915 rpm

Tightening Torques

Item	N.m	kgf.m	lb-ft
Ignition coil installation bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Spark plug installation	14.7 ~ 24.5	1.5 ~ 2.5	10.9 ~ 18.1
Condenser bracket installation bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Alternator installation bolt [12 mm (0.47 in.)]	21.6 ~ 32.4	2.2 ~ 3.3	15.9 ~ 23.9
Alternator installation bolt [14 mm (0.55 in.)]	29.4 ~ 41.2	3.0 ~ 4.2	21.7 ~ 30.4
Battery (+) terminal tightening nut	7.8 ~ 9.8	0.8 ~ 1.0	5.2 ~ 8.7
Battery (-) terminal tightening nut	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3
Battery mounting bracket bolt	8.8 ~ 13.7	0.9 ~ 1.4	6.5 ~ 10.1
Battery tray installation bolt	8.8 ~ 13.7	0.9 ~ 1.4	6.5 ~ 10.1
Battery sensor cable installation bolt	10.8 ~ 13.7	1.1 ~ 1.4	8.0 ~ 10.1
Starter installation bolt	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0

Engine Electrical System**Special Service Tools**

Tool Name / Number	Illustration	Description
Alternator pulley remover wrench 09373-27000		Removal and installation of alternator pulley

Engine Electrical System**Troubleshooting****Ignition System**

Symptom	Suspect Area	Remedy
Engine will not start or is hard to start (Crank OK)	Ignition lock switch	Inspect ignition lock switch, or replace as required
	Ignition coil	Inspect ignition coil, or replace as required
	Spark plugs	Inspect spark plugs, or replace as required
	Ignition wiring disconnected or broken	Repair wiring, or replace as required
Rough idle or stalls	Ignition wiring	Repair wiring, or replace as required
	Ignition coil	Inspect ignition coil, or replace as required
Engine hesitates/poor acceleration	Spark plugs and spark plug cables	Inspect spark plugs / cable, or replace as required
	Ignition wiring	Repair wiring, or replace as required

Poor mileage	Spark plugs and spark plug cables	Inspect spark plugs / cable, or replace as required
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Charging System

Symptom	Suspect Area	Remedy
Charging warning indicator does not light with ignition switch "ON" and engine off.	Fuse blown	Check fuses
	Light burned out	Replace light
	Wiring connection loose	Tighten loose connection
	Electronic voltage regulator	If light turns off, replace voltage regulator.
Charging warning indicator does not go out with engine running. (Battery requires frequent recharging)	Drive belt loose or worn	Adjust belt tension or replace belt
	Battery cable loose, corroded or worn	Inspect cable connection, repair or replace cable
	Electronic voltage regulator or alternator	If light turns off, replace voltage regulator or alternator
	Wiring	Repair or replace wiring
Overcharge	Electronic voltage regulator	If light turns off, replace voltage regulator.
	Voltage sensing wire	Repair or replace wiring
Discharge	Drive belt loose or worn	Adjust belt tension or replace belt
	Wiring connection loose or short circuit	Inspect wiring connection, repair or replace wiring
	Electronic voltage regulator or alternator	If light turns off, replace voltage regulator or alternator
	Poor grounding	Inspect ground or repair
	Worn battery	Replace battery

Starting System

Symptom	Suspect Area	Remedy
Engine will not crank	Battery charge low	Charge or replace battery
	Battery cables loose, corroded or worn out	Repair or replace cables
	Transaxle range switch (Vehicle with automatic transaxle only)	Refer to AT group-automatic transaxle
	Fuse blown	Replace fuse
	Starter motor faulty	Replace
	Ignition switch faulty	Replace
Engine cranks slowly	Battery charge low	Charge or replace battery
	Battery cables loose, corroded or worn out	Repair or replace cables
	Starter motor faulty	Replace
Starter keeps running	Starter motor faulty	Replace
	Ignition switch	Replace
Starter spins but engine will not crank	Short in wiring	Repair or replace wiring
	Pinion gear teeth broken or starter motor	Replace
	Ring gear teeth broken	Replace fly wheel or torque converter

Engine Electrical System



Description

Ignition timing is controlled by the electronic control ignition timing system.

The standard reference ignition timing data for the engine operating conditions are pre-programmed in the memory of the ECM (Engine Control Module).

The engine operating conditions (speed, load, warm-up condition, etc.) are detected by the various sensors. Based on these sensor signals and the ignition timing data, signals to interrupt the primary current are sent to the ECM.

The ignition coil is activated, and timing is controlled.

Engine Electrical System



On-vehicle Inspection

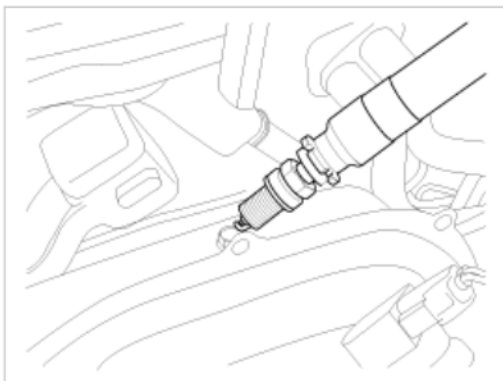
Inspect ignition coil assembly and Perform spark test

1. Check for DTCs.

NOTICE

- If a DTC is present, perform troubleshooting in accordance with the procedure for that DTC. (Refer to DTC guide)

2. Check if sparks occur.
 - (1) Remove the engine cover.
 - (2) Remove the ignition coils.
 - (3) Using a spark plug wrench, remove the spark plugs.
 - (4) Disconnect the 4 injector connectors.
 - (5) Ground the spark plug to the engine.

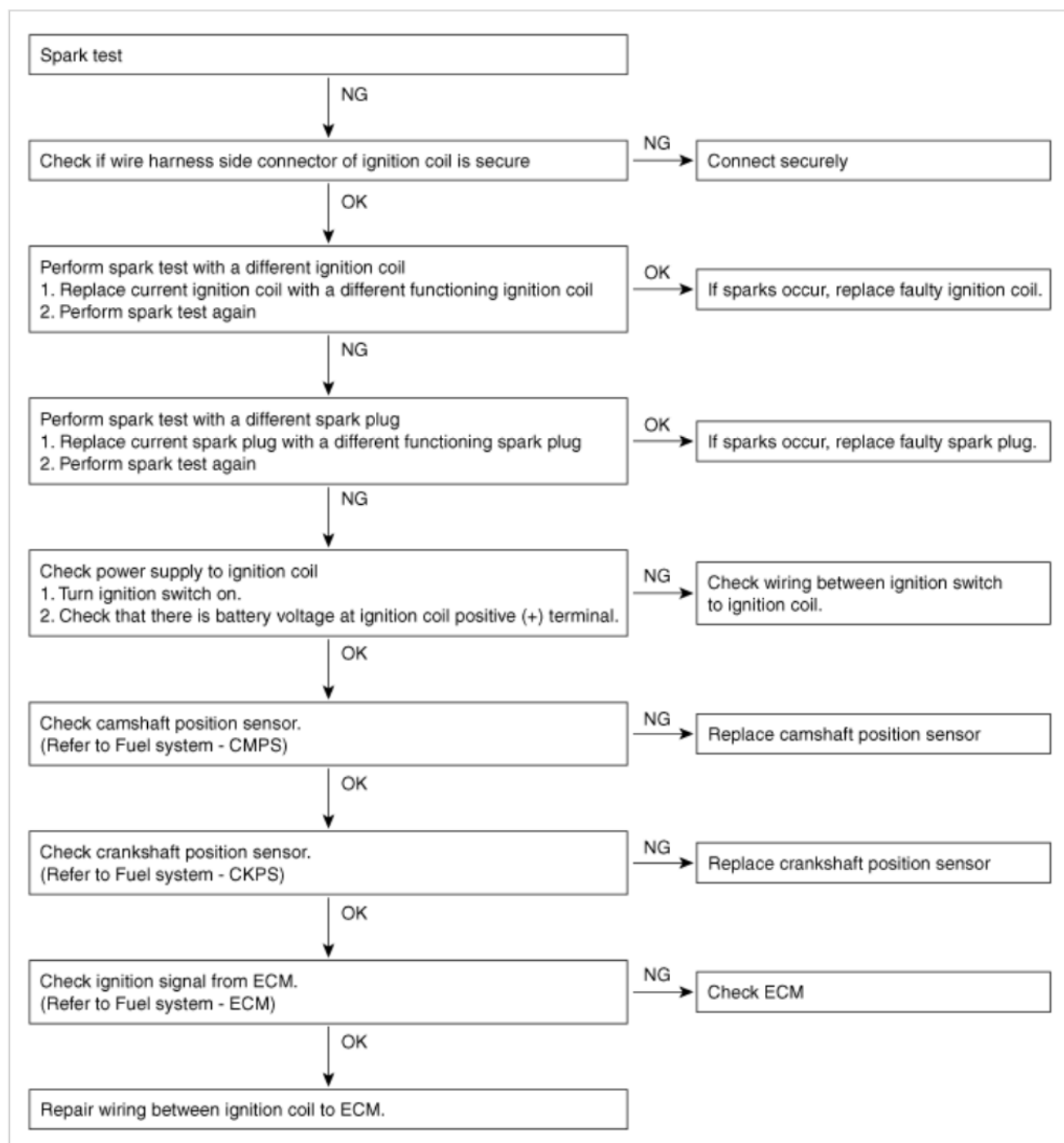


- (6) Check if sparks occur at each spark plug while engine is being cranked.

NOTICE

- Do not crank the engine for more than 5 seconds.

3. If sparks do not occur, perform the following test.



4. Using a spark plug wrench, install spark plugs.
5. Install the ignition coils.
6. Install the cylinder head center cover and the engine cover.

Engine Electrical System



Description

An ignition coil is an induction coil in an engine's ignition system which transforms the battery's low voltage to the high voltage needed to create an electric spark in the spark plugs to ignite the fuel. Coils have an internal resistor while others rely on a resistor wire or an external resistor to limit the current flowing into the coil from the battery 12 V supply.

Engine Electrical System



Specification

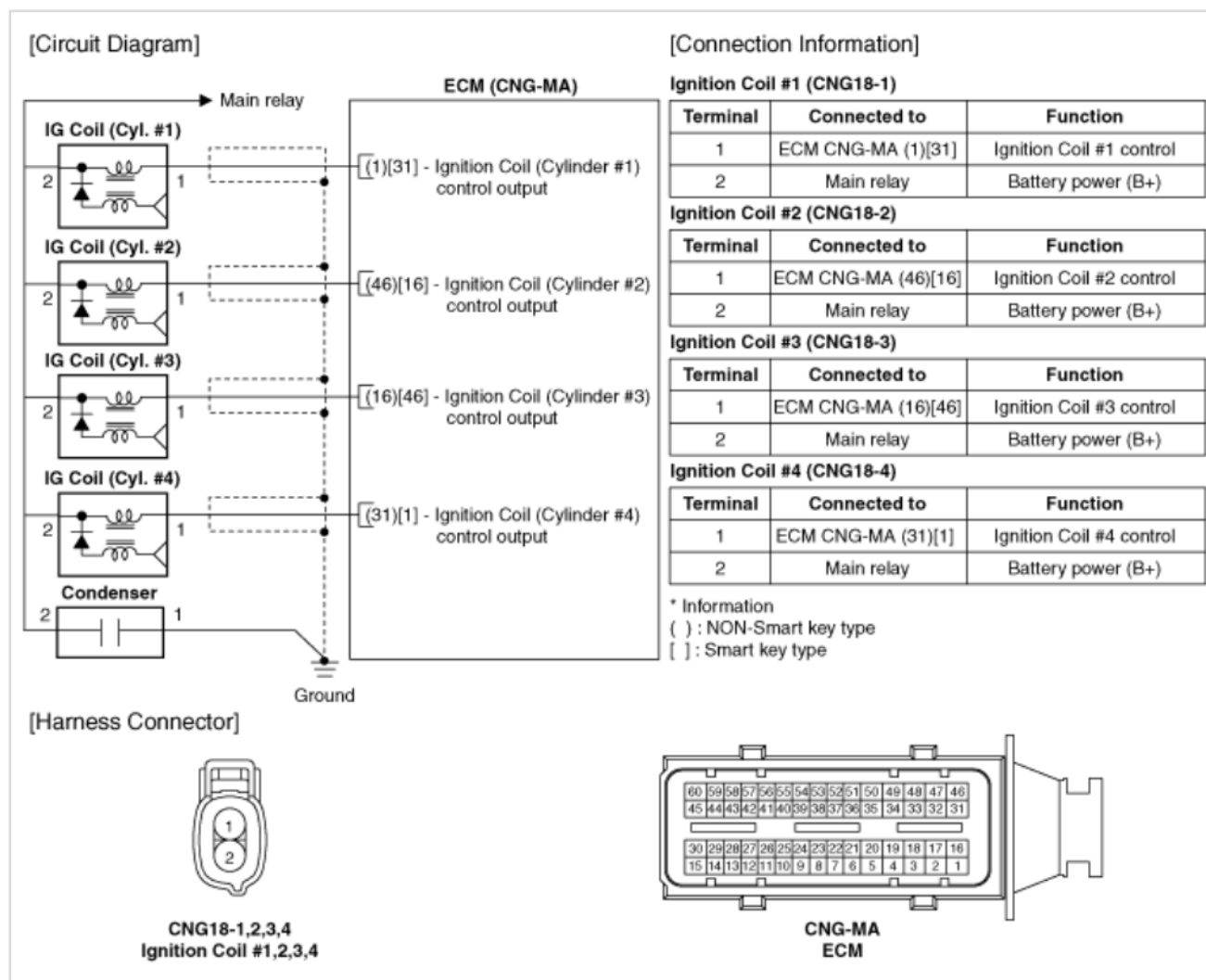
Item	Specification
Primary Coil Resistance (Ω)	$0.75 \pm 15\%$ [20°C (68°F)]
Secondary Coil Resistance (k Ω)	$5.9 \pm 15\%$ [20°C (68°F)]

Engine Electrical System



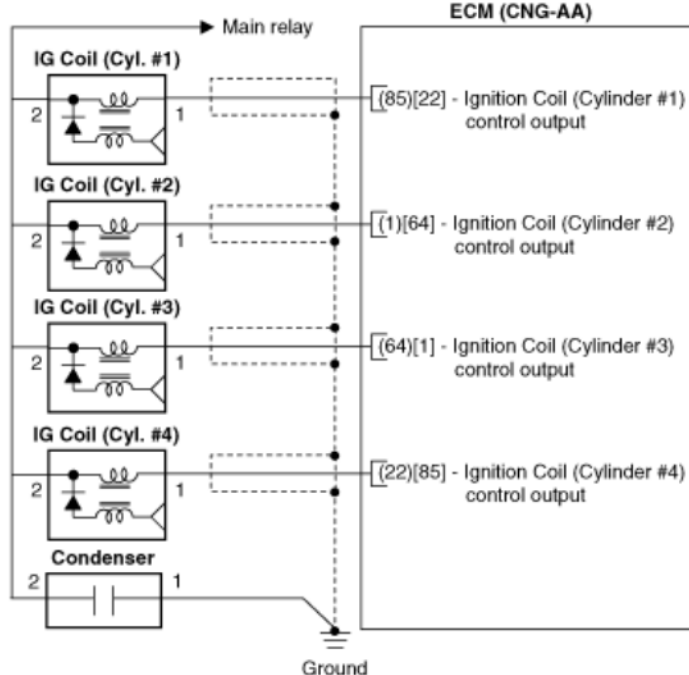
Circuit Diagram

[M/T]



[A/T]

[Circuit Diagram]



[Harness Connector]



[Connection Information]

Ignition Coil #1 (CNG18-1)

Terminal	Connected to	Function
1	ECM CNG-AA (85)[22]	Ignition Coil #1 control
2	Main relay	Battery power (B+)

Ignition Coil #2 (CNG18-2)

Terminal	Connected to	Function
1	ECM CNG-AA (1)[64]	Ignition Coil #2 control
2	Main relay	Battery power (B+)

Ignition Coil #3 (CNG18-3)

Terminal	Connected to	Function
1	ECM CNG-AA (64)[1]	Ignition Coil #3 control
2	Main relay	Battery power (B+)

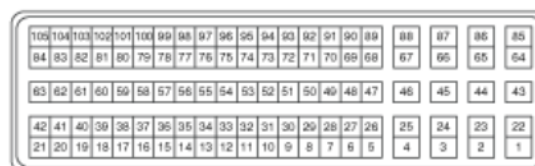
Ignition Coil #4 (CNG18-4)

Terminal	Connected to	Function
1	ECM CNG-AA (22)[85]	Ignition Coil #4 control
2	Main relay	Battery power (B+)

* Information

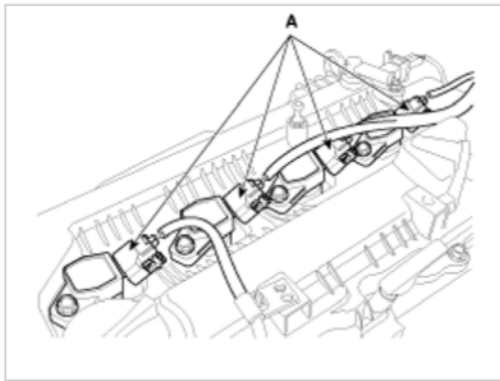
() : NON-Smart key type

[] : Smart key type

**CNG-AA****CNG-AB****Engine Electrical System****Removal**

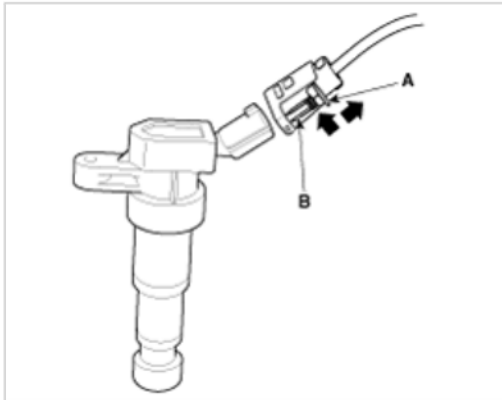
1. Disconnect the battery negative terminal.
2. Remove the engine cover.
3. Disconnect the ignition coil connectors (A).



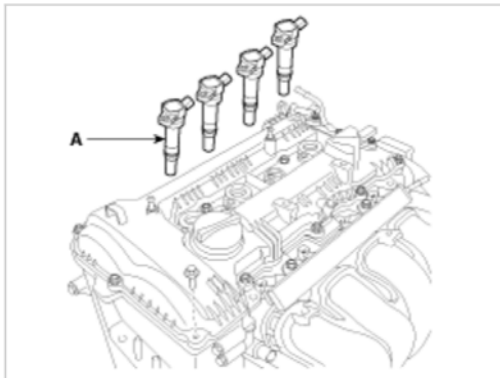


NOTICE

- When removing the ignition coil connector, pull the lock pin (A) and push the clip (B).



4. Remove the ignition coil (A).



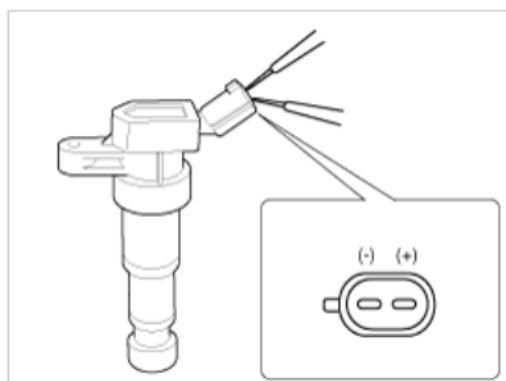
Installation

1. Install in the reverse order of removal.

Ignition coil installation bolts: 9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

Inspection

1. Measure the primary coil resistance between terminals (+) and (-).



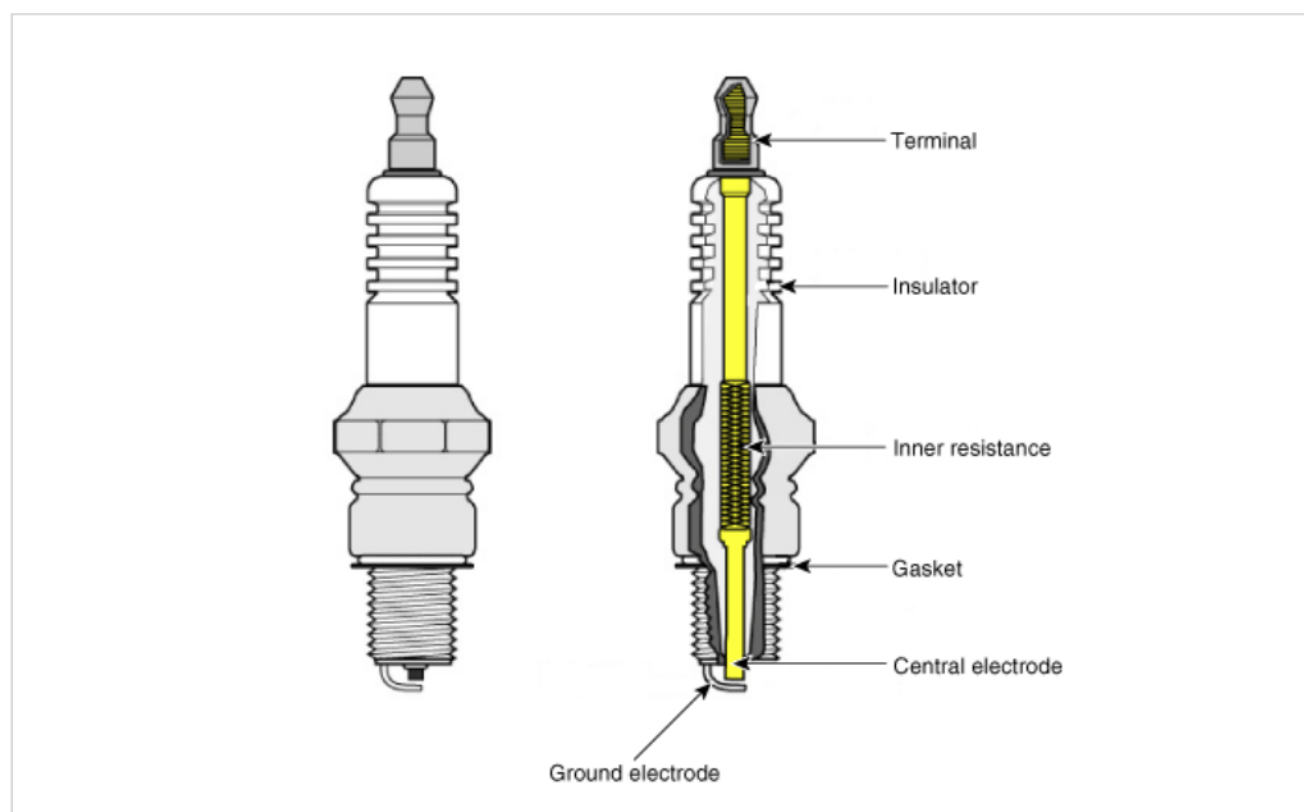
Standard value: $0.75\Omega \pm 15\%$

Engine Electrical System



Description

A spark plug is a device for delivering electric current from an ignition system to the combustion chamber of a spark-ignition engine to ignite the compressed fuel/air mixture therein by means of an electric spark, while containing combustion pressure within the engine. A spark plug has a metal threaded shell, electrically isolated from a central electrode by a porcelain insulator.



Engine Electrical System



Specification

Item	Specification
Type	SILZKR7B11
Gap	1.0 ~ 1.1 (0.0394 ~ 0.0433)

Engine Electrical System



Inspection

[On vehicle inspection]

1. Accelerate the engine to about 3,000 rpm 3 times or more.
2. Remove the spark plug.
3. Check the spark plug visually.

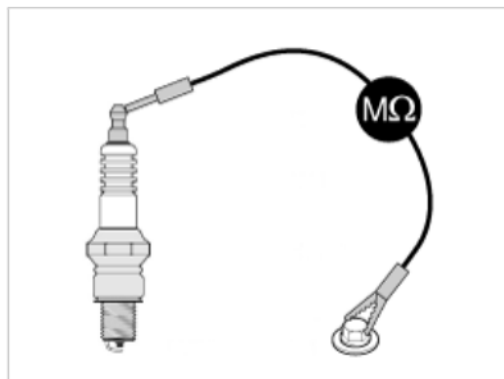
If the electrode is dry, the spark plug is normal.

If the electrode is wet, check the damage and electrode gap as below.

[Component Inspection]

1. Check the spark plug for any damage on its thread and insulator.
If there is damage, replace the spark plug.
2. Check the electrode. Measure the insulation resistance with an ohmmeter.
If the resistance is less than the specified value, adjust the electrode gap.

Specification: 10 M Ω or more



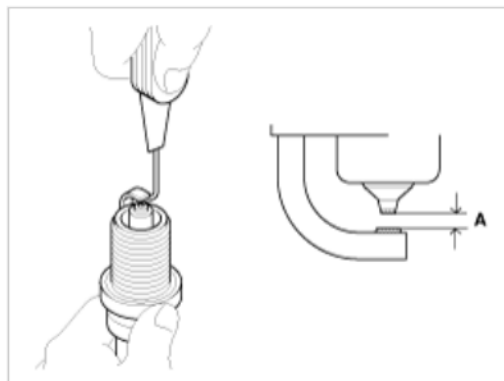
3. Check the spark plug electrode gap.

If the gap is greater than the maximum, replace the spark plug.

Specification: 1.0 ~ 1.1 mm (0.0394 ~ 0.0433 in.)

NOTICE

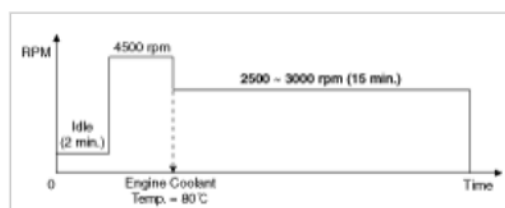
- If adjusting the gap of a new spark plug, bend only the base of the ground electrode. Do not touch the tip.
Never attempt to adjust the gap on a used plug.

**Cleaning**

The combustion temporarily becomes unstable, due to the aged fuel and the carbon deposits accumulated on the spark plug(s) after long-term storage.

[1st Method]

1. Start the engine and keep the engine running at idle for 2 minutes.
2. Step on the accelerator pedal and hold it steady at 4500 rpm with the shift lever in N position to warm up the engine until the temperature of the engine coolant reaches 80°C.
3. Keep the engine running at 2500~3000 rpm in the N position for 15 minutes.



[2nd Method]

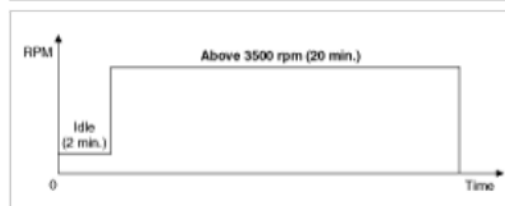
NOTICE

- The 2nd method should be performed only if the 1st method fails (the misfire-related codes recur).

1. Start the engine and keep the engine running at idle for 2 minutes.
2. Drive the vehicle for over 20 minutes, keeping the engine speed above 3500 rpm.

NOTICE

- If equipped with manual transaxle, shift the gear properly for keeping the engine speed above 3500 rpm.

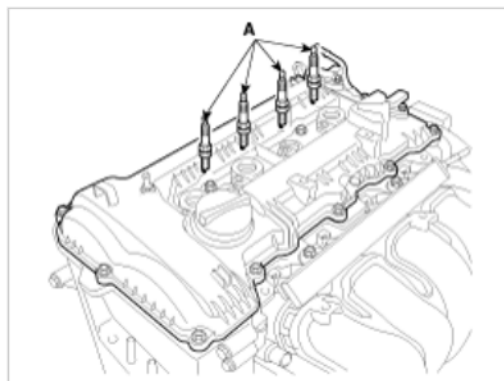


Removal

1. Remove the ignition coil.
(Refer to Ignition System - "Ignition Coil")
2. Using a spark plug wrench, remove the spark plug (A).

NOTICE

- Be careful that no contaminants enter into spark plug holes.



Installation

1. Install in the reverse order of removal.

Tightening torque:

14.7 ~ 24.5 N.m (1.5 ~ 2.5 kgf.m, 10.8 ~ 18.0 lb-ft)

Engine Electrical System



Description

The charging system included a battery, an alternator with a built-in regulator, and the charging indicator light and wire.

The Alternator has eight built-in diodes, each rectifying AC current to DC current.

Therefore, DC current appears at alternator "B" terminal.

In addition, the charging voltage of this alternator is regulated by the battery voltage detection system.

The alternator is regulated by the battery voltage detection system. The main components of the alternator are the rotor, stator, rectifier, capacitor brushes, bearings and V-ribbed belt pulley. The brush holder contains a built-in electronic voltage regulator.

Alternator Management System

Alternator management system controls the charging voltage set point in order to improve fuel economy, manage alternator load under various operating conditions, keep the battery charged, and protect the battery from over-charging. ECM controls generating voltage by duty cycle (charging control, discharging control, normal control) based on the battery conditions and vehicle operating conditions.

The system conducts discharging control when accelerating a vehicle. Vehicle reduces an alternator load and consumes an electric power from a battery.

The system conducts charging control when decelerating a vehicle. Vehicle increases an alternator load and charges a battery.

Engine Electrical System



On-vehicle Inspection

i Information

- First of all, check for DTCs. If a DTC is present, perform troubleshooting in accordance with the procedure for that DTC. (Refer to DTC guide)

⚠ CAUTION

- Check that the battery cables are connected to the correct terminals.
- Disconnect the battery cables when the battery is given a quick charge.
- Never disconnect the battery while the engine is running.

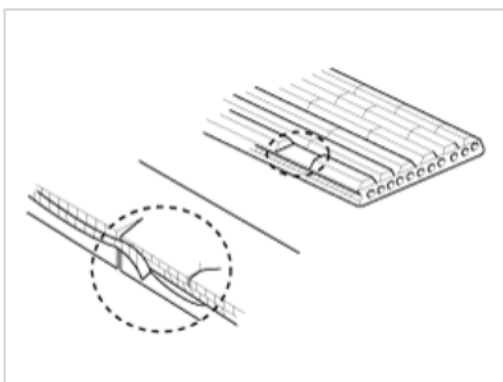
[General Inspection]

1. Check The Battery Terminals And Fuses
 - (1) Check that the battery terminals are not loose or corroded.
 - (2) Check the fuses for continuity.
2. Inspect Drive Belt
 - (1) Visually check the belt for excessive wear, frayed cords etc.

If any defect has been found, replace the drive belt.

NOTICE

- Cracks on the rib side of a belt are considered acceptable. If the belt has chunks missing from the ribs, it should be replaced.



3. Drive belt tension measurement and adjustment (Refer to Engine Mechanical System - "Drive Belt")
4. Visually Check Alternator Wiring And Listen For Abnormal Noises
 - (1) Check that the wiring is in good condition.
 - (2) Check that there is no abnormal noise from the alternator while the engine is running.
5. Check Discharge Warning Light Circuit
 - (1) Warm up the engine and then turn it off.
 - (2) Turn off all accessories.
 - (3) Turn the ignition switch "ON". Check that the discharge warning light is lit.
 - (4) Start the engine. Check that the light is lit.

If the light does not go off as specified, troubleshoot the discharge light circuit.

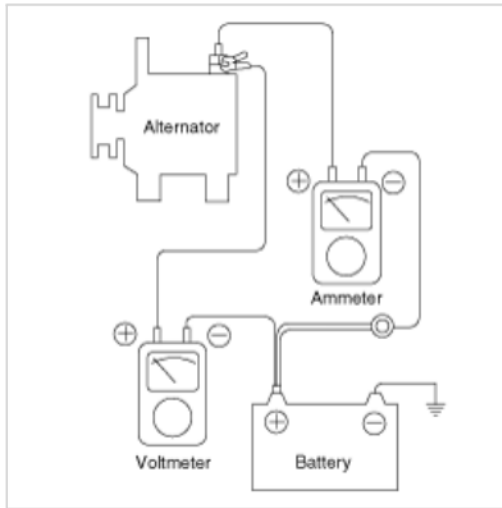
[Electrical Specified Value Inspection]

1. Voltage Drop Test Of Alternator Output Wire

This test determines whether or not the wiring between the alternator "B" terminal and the battery (+) terminal is good by the voltage drop method.

 - (1) Preparation
 - A. Turn the ignition switch to "OFF".
 - B.

Disconnect the output wire from the alternator "B" terminal. Connect the (+) lead wire of ammeter to the "B" terminal of alternator and the (-) lead wire of ammeter to the output wire. Connect the (+) lead wire of voltmeter to the "B" terminal of alternator and the (-) lead wire of voltmeter to the (+) terminal of battery.



(2) Test

- A. Start the engine.
- B. Turn on the headlamps and blower motor, and set the engine speed until the ammeter indicates 20A. And then, read the voltmeter at this time.

(3) Result

- A. The voltmeter may indicate the standard value.

Standard value :0.2V max

- B. If the value of the voltmeter is higher than expected (above 0.2V max.), poor wiring is suspected. In this case check the wiring from the alternator "B" terminal to the battery (+) terminal. Check for loose connections, color change due to an overheated harness, etc. Correct them before testing again.
- C. Upon completion of the test, set the engine speed at idle. Turn off the headlamps, blower motor and the ignition switch.

2. Output Current Test

This test determines whether or not the alternator gives an output current that is equivalent to the normal output.

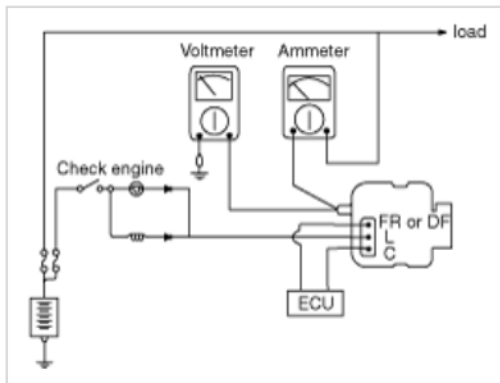
(1) Preparation

- A. Prior to the test, check the following items and correct as necessary.
Check the battery installed in the vehicle to ensure that it is in good condition. The battery checking method is described in the section "Battery".
The battery that is used to test the output current should be one that has been partially discharged. With a fully charged battery, the test may not be conducted correctly due to an insufficient load.
Check the tension of the alternator drive belt. The belt tension check method is described in the section "Inspect drive belt".
- B. Turn off the ignition switch.
- C. Disconnect the battery ground cable.
- D. Disconnect the alternator output wire from the alternator "B" terminal.
- E. Connect a DC ammeter (0 to 150A) in series between the "B" terminal and the disconnected output wire. Be sure to connect the (-) lead wire of the ammeter to the disconnected output wire.

NOTICE

- Tighten each connection securely, as a heavy current will flow. Do not rely on clips.

- F. Connect a voltmeter (0 to 20V) between the "B" terminal and ground. Connect the (+) lead wire to the alternator "B" terminal and (-) lead wire to a good ground.
- G. Attach an engine tachometer and connect the battery ground cable.
- H. Leave the engine hood open.



(2) Test

- Check to see that the voltmeter reads as the same value as the battery voltage. If the voltmeter reads 0V, and the open circuit in the wire between alternator "B" terminal and battery (+) terminal or poor grounding is suspected.
- Start the engine and turn on the headlamps.
- Set the headlamps to high beam and the heater blower switch to HIGH, quickly increase the engine speed to 2,500 rpm and read the maximum output current value indicated by the ammeter.

NOTICE

- After the engine start up, the charging current quickly drops. Therefore, the above operation must be done quickly to read the maximum current value correctly.

(3) Result

- The ammeter reading must be higher than the limit value. If it is lower but the alternator output wire is in good condition, remove the alternator from the vehicle and test it.

Limit value : 60% of the voltage rate

NOTICE

- The nominal output current value is shown on the nameplate affixed to the alternator body.
- The output current value changes with the electrical load and the temperature of the alternator itself. Therefore, the nominal output current may not be obtained. If such is the case, keep the headlamps on the cause discharge of the battery, or use the lights of another vehicle to increase the electrical load.
- The nominal output current may not be obtained if the temperature of the alternator itself or ambient temperature is too high. In such a case, reduce the temperature before testing again.

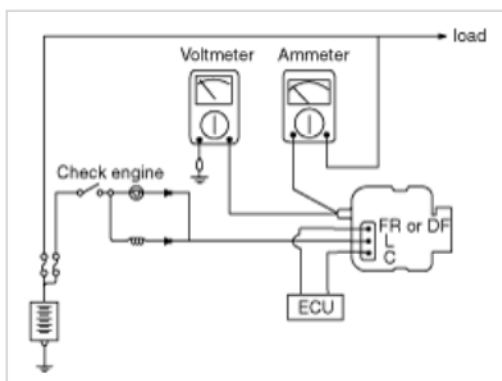
- Upon completion of the output current test, lower the engine speed to idle and turn off the ignition switch.
- Disconnect the battery ground cable.
- Remove the ammeter and voltmeter and the engine tachometer.
- Connect the alternator output wire to the alternator "B" terminal.
- Connect the battery ground cable.

3. Regulated Voltage Test

The purpose of this test is to check that the electronic voltage regulator controls voltage correctly.

(1) Preparation

- Prior to the test, check the following items and correct if necessary.
 - Check that the battery installed on the vehicle is fully charged. The battery checking method is described in the section "Battery".
 - Check the alternator drive belt tension. The belt tension check method is described in the section "Inspect drive belt".
- Turn ignition switch to "OFF".
- Disconnect the battery ground cable.
- Connect a digital voltmeter between the "B" terminal of the alternator and ground. Connect the (+) lead of the voltmeter to the "B" terminal of the alternator. Connect the (-) lead to good ground or the battery (-) terminal.
- Disconnect the alternator output wire from the alternator "B" terminal.
- Connect a DC ammeter (0 to 150A) in series between the "B" terminal and the disconnected output wire.
 - Connect the (-) lead wire of the ammeter to the disconnected output wire.
- Attach the engine tachometer and connect the battery ground cable.



(2) Test

- A. Turn on the ignition switch and check to see that the voltmeter indicates the following value.

Voltage: Battery voltage

If it reads 0V, there is an open circuit in the wire between the alternator "B" terminal and the battery and the battery (-) terminal.

- B. Start the engine. Keep all lights and accessories off.

- C. Run the engine at a speed of about 2,500 rpm and read the voltmeter when the alternator output current drops to 10A or less

(3) Result

- A. If the voltmeter reading doesn't agree with the standard value, the voltage regulator or the alternator is faulty.
 B. Upon completion of the test, reduce the engine speed to idle, and turn off the ignition switch.
 C. Disconnect the battery ground cable.
 D. Remove the voltmeter and ammeter and the engine tachometer.
 E. Connect the alternator output wire to the alternator "B" terminal.
 F. Connect the battery ground cable.

Engine Electrical System



Description

The Alternator has eight built-in diodes, each rectifying AC current to DC current.

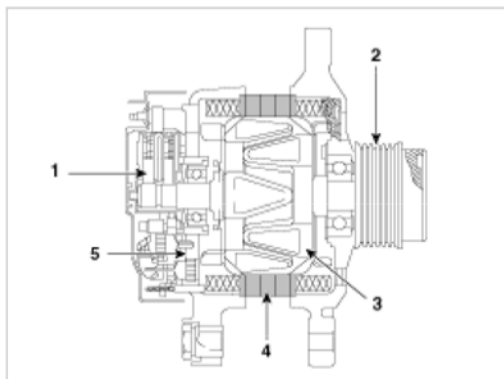
Therefore, DC current appears at alternator "B" terminal.

In addition, the charging voltage of this alternator is regulated by the battery voltage detection system.

The alternator is regulated by the battery voltage detection system.

The main components of the alternator are the rotor, stator, rectifier, capacitor brushes, bearings and V-ribbed belt pulley.

The brush holder contains a built-in electronic voltage regulator.



1. Brush
2. OAD (Overrunning Alternator Decoupler) pulley
3. Rotor
4. Stator
5. Rectifier

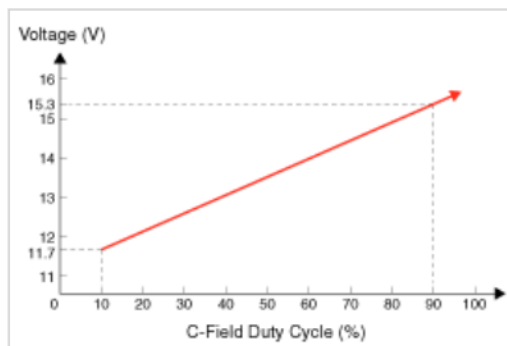
Engine Electrical System



Specification

Alternator [Non-ISG type]

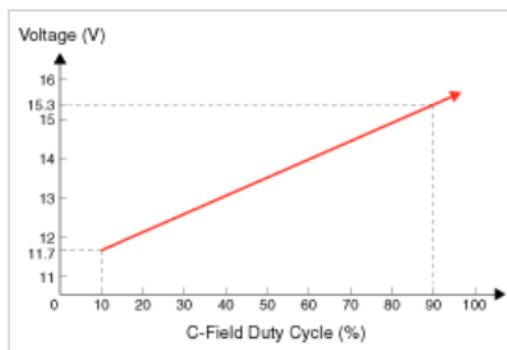
Item		Specification
Rated voltage		13.5V, 90A
Speed in use		1,000 ~ 18,000 rpm
Voltage regulator		IC Regulator built-in type
Regulator Setting Voltage	External mode	Refer to below graph
	Internal mode	$14.55 \pm 0.3V$
Temperature Gradient	External mode	$0 \pm 3 \text{ mV} / ^\circ\text{C}$
	Internal mode	$-3.5 \pm 2 \text{ mV} / ^\circ\text{C}$



※ Regulator Setting Voltage (External mode)

Alternator [ISG type]

Item		Specification
Rated voltage		13.5V, 120A
Speed in use		1,000 ~ 18,000 rpm
Voltage regulator		IC Regulator built-in type
Regulator Setting Voltage	External mode	Refer to below graph
	Internal mode	$14.55 \pm 0.3V$
Temperature Gradient	External mode	$0 \pm 3 \text{ mV} / ^\circ\text{C}$
	Internal mode	$-3.5 \pm 2 \text{ mV} / ^\circ\text{C}$

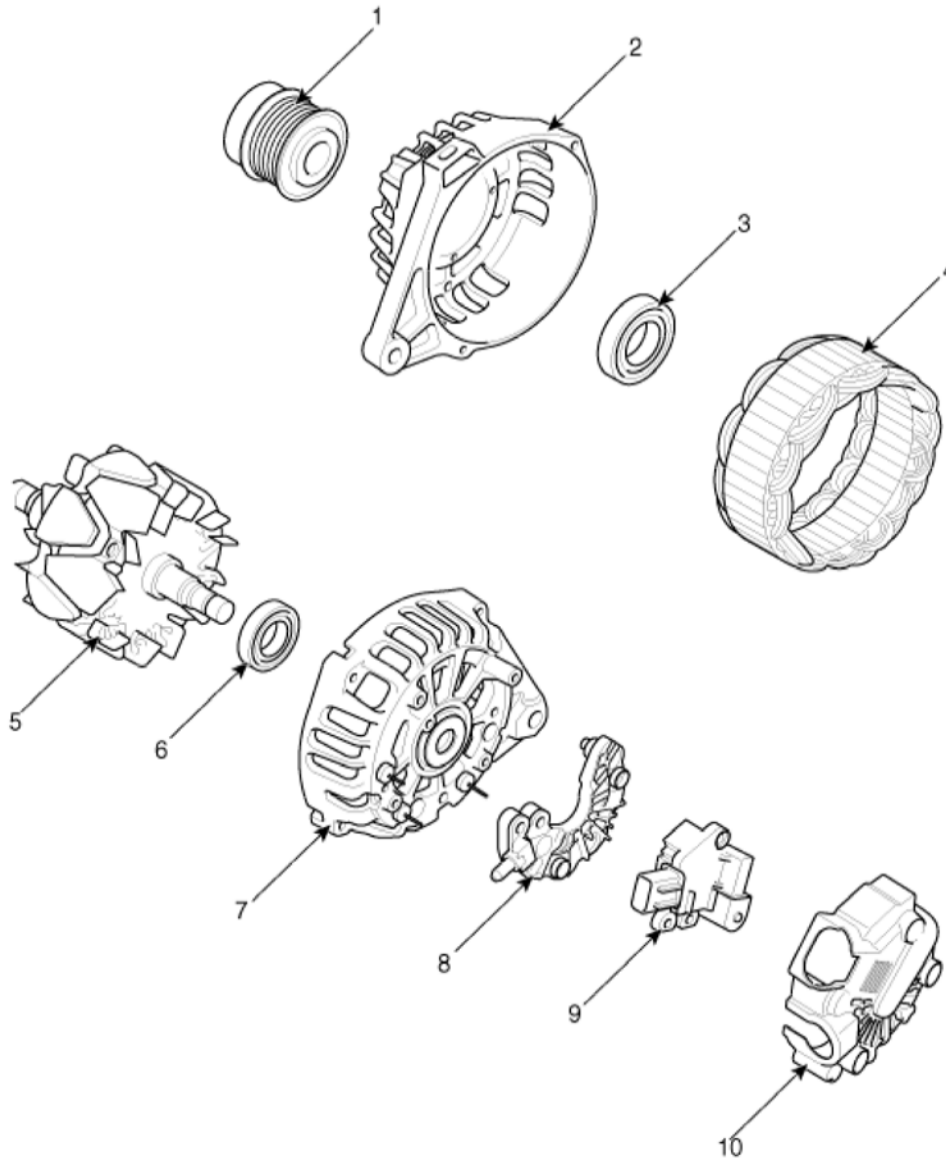


※ Regulator Setting Voltage (External mode)

Engine Electrical System



Components



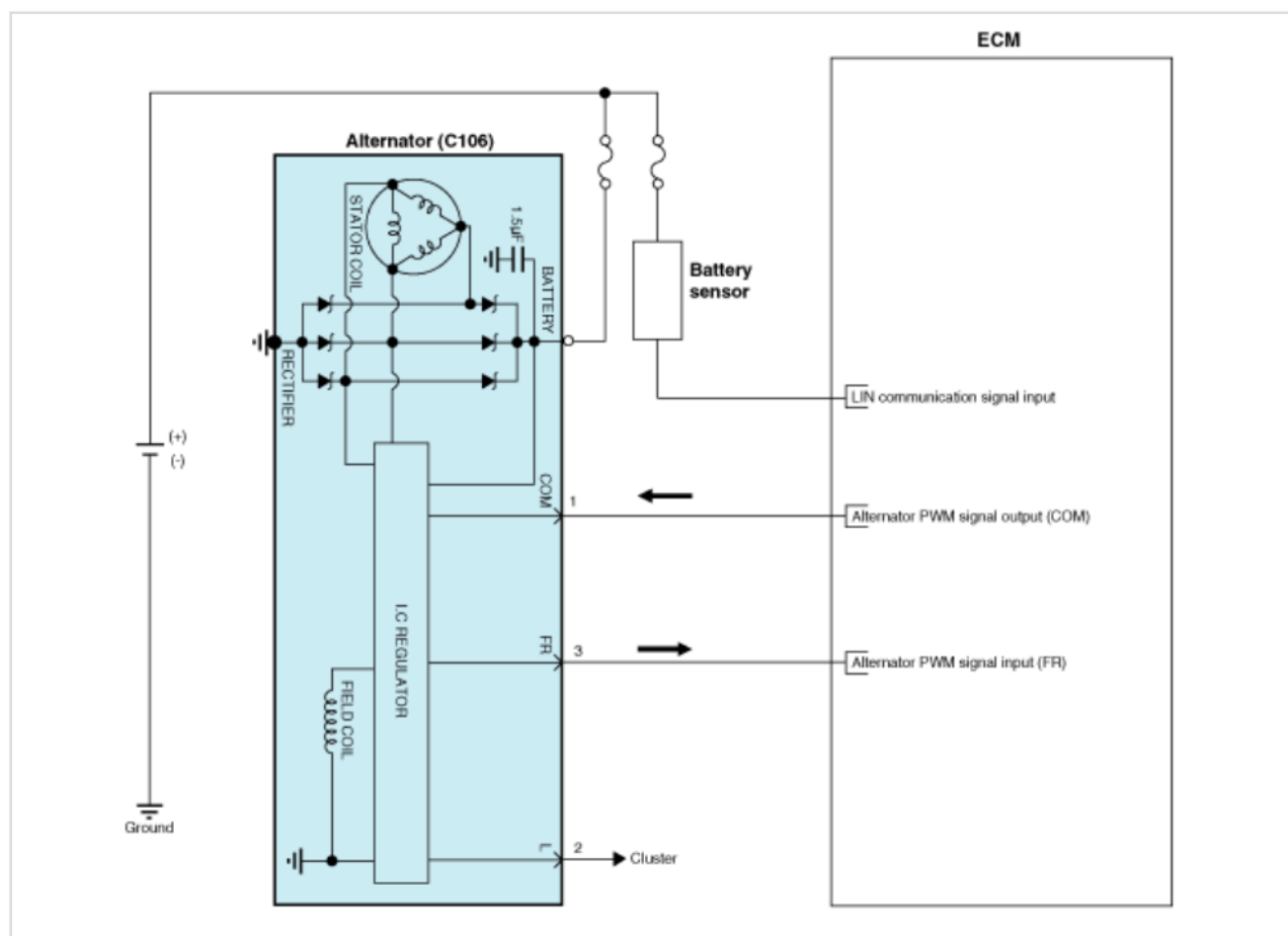
1. OAD (Overrunning Alternator Decoupler) pulley
2. Front housing
3. Front bearing
4. Stator
5. Rotor

6. Rear bearing
7. Rear housing
8. Rectifier assembly
9. Regulator assembly
10. Rear cover

Engine Electrical System



Circuit Diagram



Information

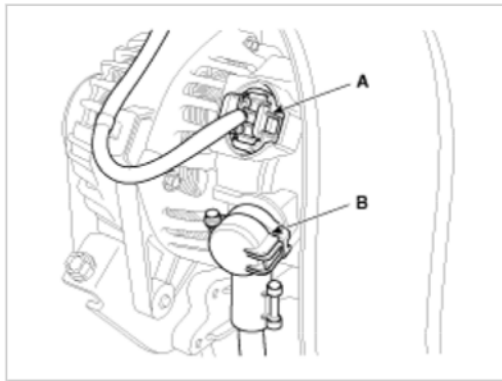
- **COM signal**
 - When controlling the voltage generated, the ECM sends the target voltage data to the alternator via a PWM signal. (High voltage: 4V or higher, low voltage: 2V or lower)
- **FR signal -**
 - The transistor activation signal inside the alternator monitors the voltage generated by the alternator to control the excitation current before it sends the FR signal to the ECM. (At certain RPM/electric loads, the FR duty can remain static. However, more often, the RPM, electric load, target voltage, etc. are always changing in the vehicle, so the FR must also change constantly)
- **L signal -**
 - Turns on the battery warning lamp on the dashboard when the battery charging system malfunctions. (Conditions for turning on the lamp - overcharge, over discharge, a field coil blown inside the alternator)
- **B+ terminal -** The output voltage from the generator travels to the battery via the B+ terminal.

Engine Electrical System

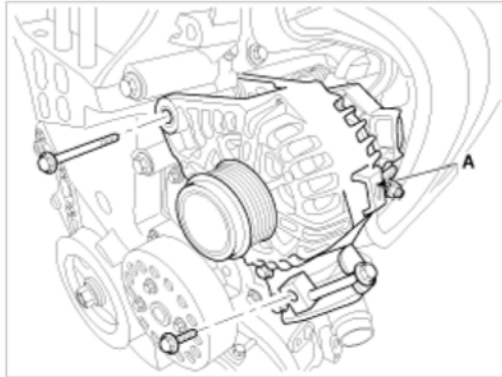


Removal

1. Disconnect the battery negative terminal.
2. Remove the drive belt.
(Refer to Engine Mechanical System - "Drive Belt")
3. Disconnect the alternator connector (A) and the cable (B) from alternator "B" terminal.



4. Pull out the through bolt and then remove the alternator (A).



Installation

1. Install in the reverse order of removal.
2. Adjust the alternator belt tension after installation.
(Refer to Engine Mechanical System - "Drive Belt")

Alternator installation bolt:

[M10] 29.4 ~ 41.2 N.m (3.0 ~ 4.2 kgf.m, 21.7 ~ 30.4 lb-ft)

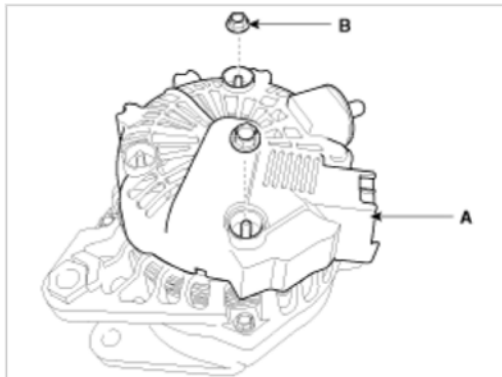
[M8] 21.6 ~ 32.4 N.m (2.2 ~ 3.3 kgf.m, 15.9 ~ 23.9 lb-ft)

Alternator brace mounting bolt:

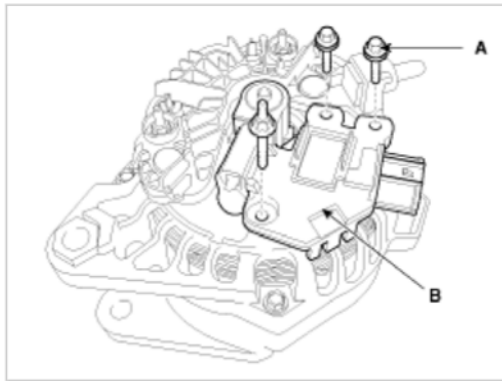
21.6 ~ 32.4 N.m (2.2 ~ 3.3 kgf.m, 15.9 ~ 23.9 lb-ft)

Disassembly

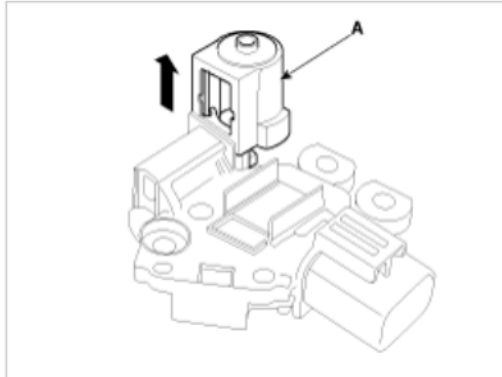
1. Remove the rear cover (A) after removing nuts (B).



2. Remove the mounting bolts (A) and the regulator assembly (B).



3. Remove the slip ring guide (A) after pulling it.

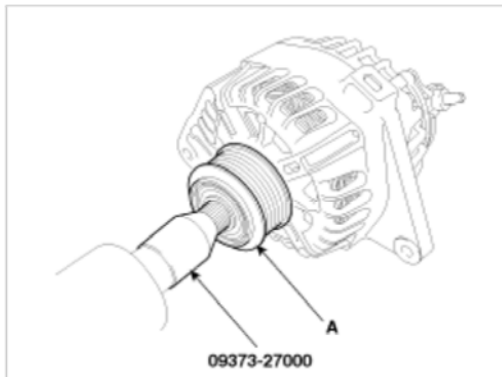


4. Remove the OAD(Overrunning Alternator Decoupler) cap.

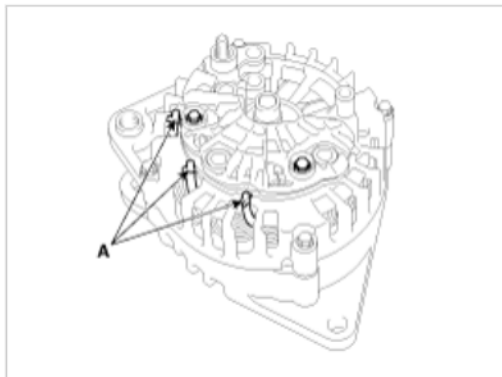
NOTICE

- When installing, replace with new OAD cap.

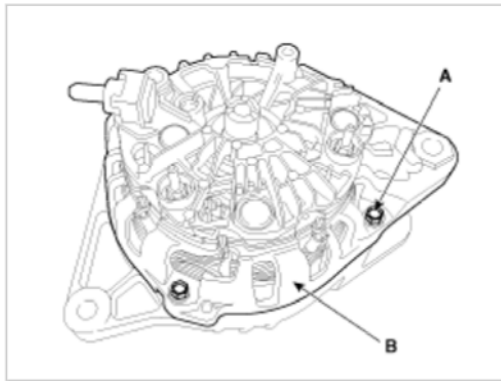
5. Remove the OAD(Overrunning Alternator Decoupler) pulley (A) using the special tool.



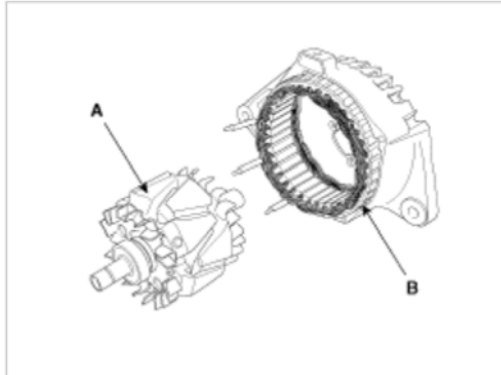
6. Unsolder the 3 stator leads (A).



7. Remove the 4 through bolts (A).



8. Disconnect the rotor (A) and housing (B).



Reassembly

1. Reassemble in the reverse order of disassembly.

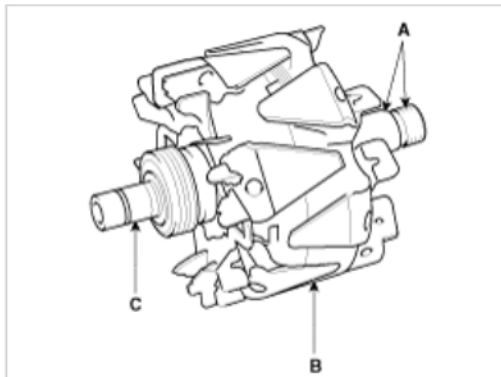
NOTICE

- When reassembling OAD pulley, replace with new OAD cap.

Inspection

[Rotor]

1. Check that there is continuity between the slip rings (C).



2. Check that there is no continuity between the slip rings and the rotor (B) or rotor shaft (A).
3. If the rotor fails either continuity check, replace the alternator.

[Stator]

1. Check that there is continuity between each pair of leads (A).



2. Check that there is no continuity between each lead and the coil core.
3. If the coil fails either continuity check, replace the alternator.

Engine Electrical System



Description

Due to the considerably more frequent occurrence of starting operations, the electrical load that occurs often leads to voltage dips in the vehicle network.

In order to stabilize the power supply for certain voltage-sensitive electrical components, a DC/DC converter is used in conjunction with the ISG function.

The DC DC converter supplies the relay with a voltage that also remains constant during the starting operation.

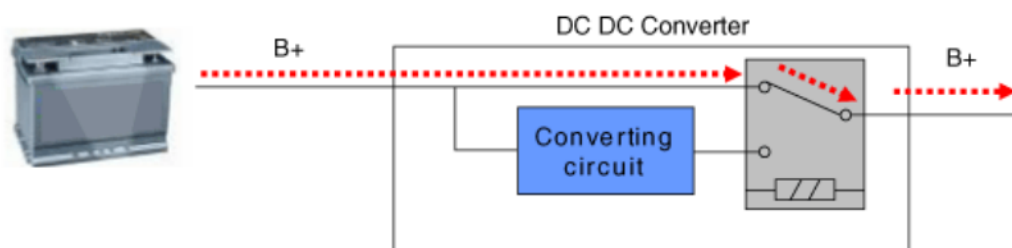
The DC/DC converter is fitted at the behind of the glove box.

Via the test leads for input voltage and the start relay, the electronics decide whether the power is supplied to the output via the bypass or the DC/DC converter.

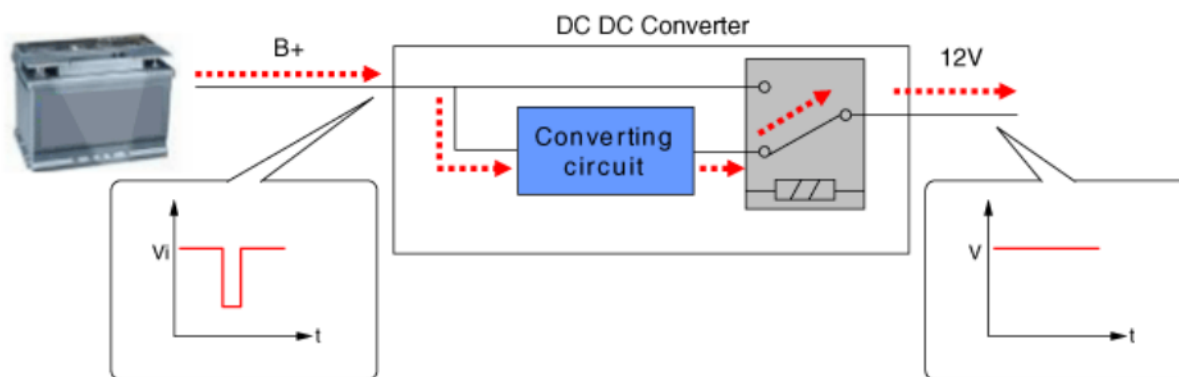
In the bypass mode, the on-board supply voltage is not fed across the DC/DC converter, rather is transferred directly to the outputs. In the booster phase, the vehicle voltage is adapted.

Operation Principle

[Normal Driving]



[Auto Starting or Idle Starting]



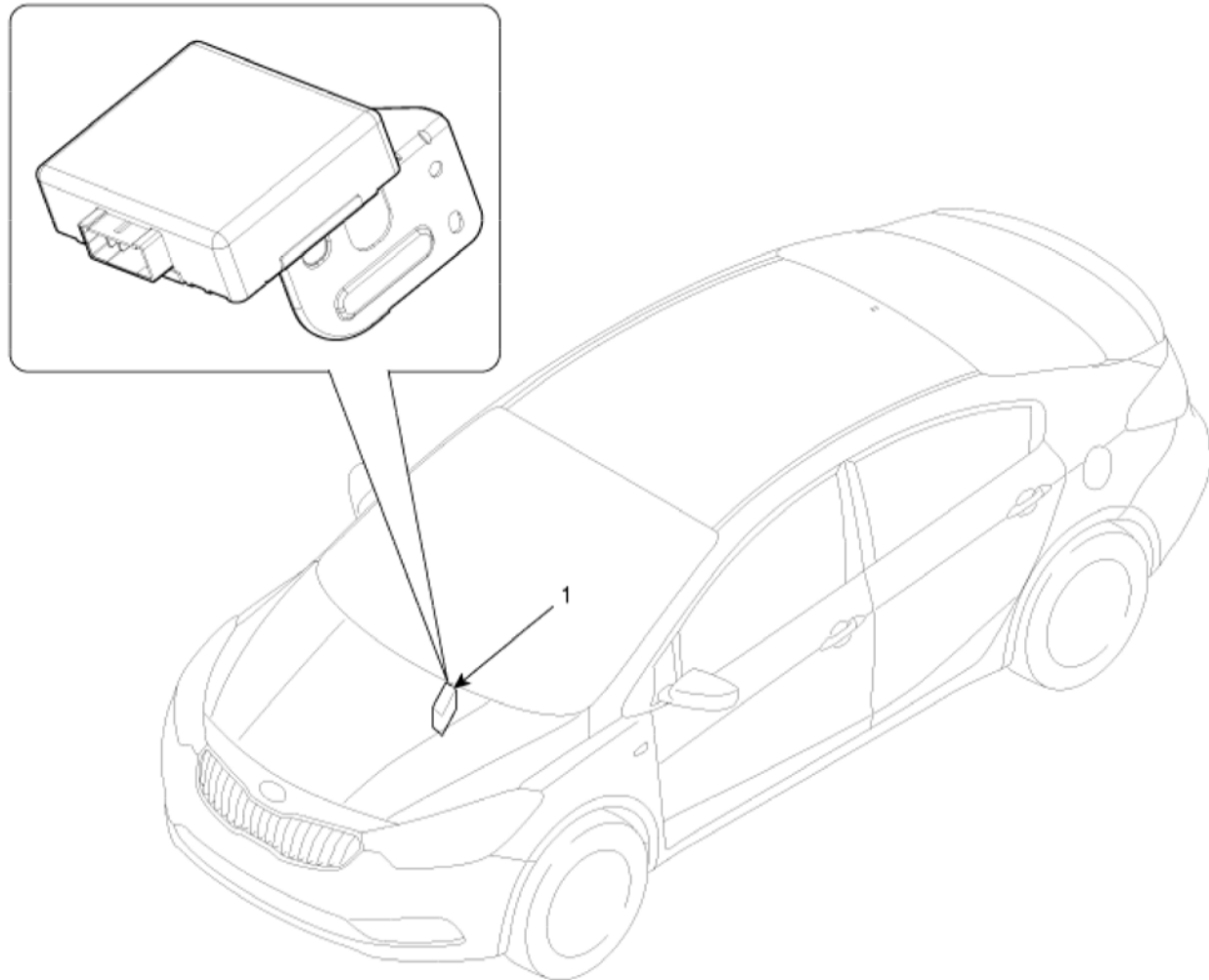
Information

In the ISG mode, if the power of an audio system turns OFF by drawdown while "Auto Starting" or "Idle Starting" function operates, replace the DC/DC converter.

Engine Electrical System



Component Location

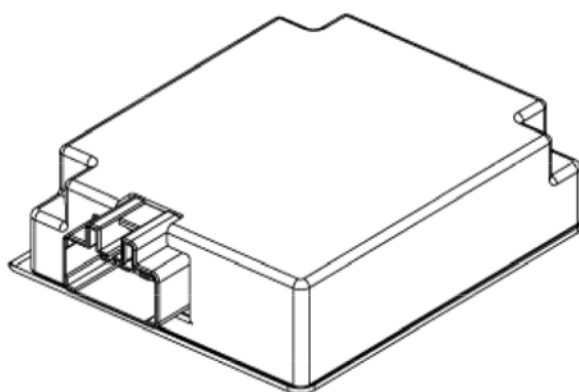
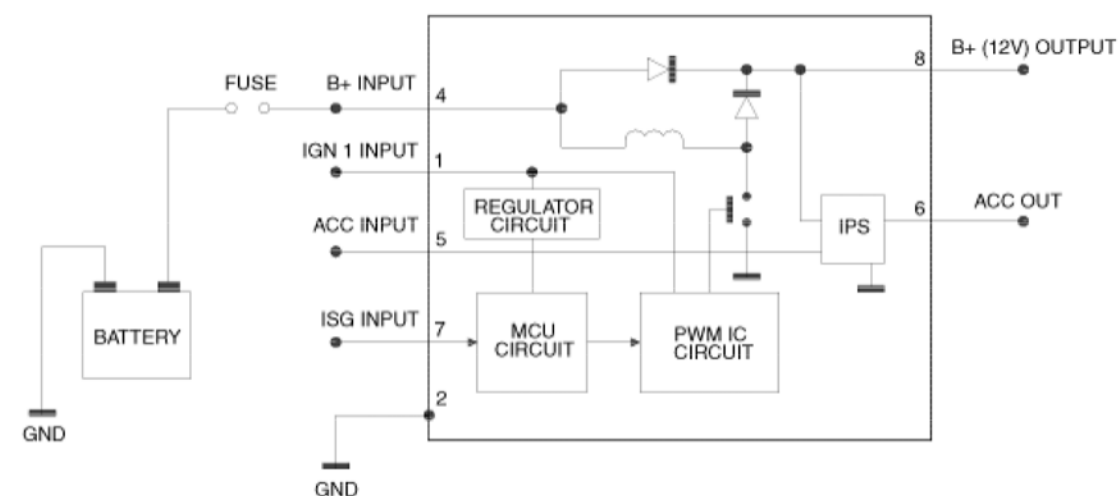


1. DC/DC Converter [200W]

Engine Electrical System

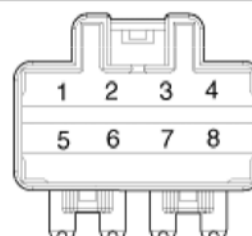


Circuit Diagram



[DC/DC CONVERTER]

CONNECTOR



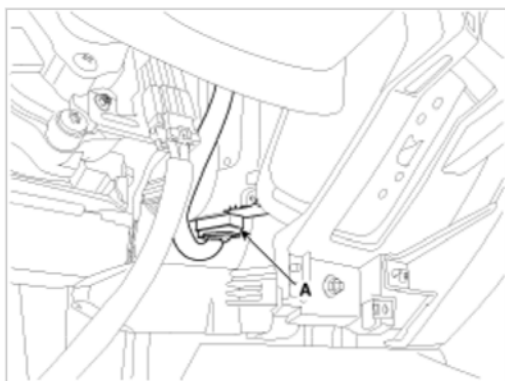
PIN No.	DESCRIPTION
1	IGN 1 INPUT
2	GROUND
3	-
4	B+ INPUT
5	ACC INPUT
6	ACC OUT
7	ISG INPUT
8	B+ (12V) OUTPUT

NOTICE

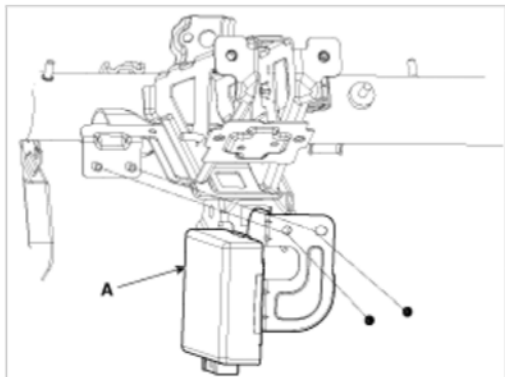
In the ISG mode, if the power of an audio system turns OFF by drawdown while "Auto Starting" or "Idle Starting" function operates, replace the DC/DC converter.

Engine Electrical System**Removal**

1. Disconnect the battery negative (-) cable.
2. Remove the crash pad lower panel.
(Refer to Body - Crash pad lower panel.)
3. Disconnect the DC/DC converter connector (A).



4. Remove the DC/DC converter (A).



Installation

1. Install in the reverse order of removal.

NOTICE

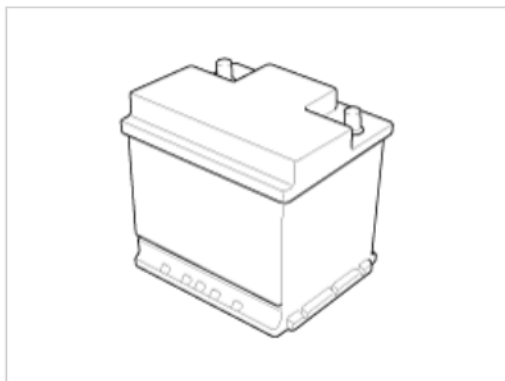
If the battery negative (-) cable is reconnected after disconnecting, the ISG function does not operate until the system is stabilized for about 4 hours.

Engine Electrical System



Description

1. The CMF(Closed Maintenance Free) battery is, as the name implies, totally maintenance free and has no removable battery cell caps.
2. The MF(Closed Maintenance Free) battery does not require water replenishment for the repair.
3. The battery is completely sealed, except for small vent holes in the cover.



i Information

- After disconnecting then reconnecting the battery negative cable, reset some parts that require the reset procedures. (Refer to Body Electrical System – "General Information")

[AGM Battery for ISG System]

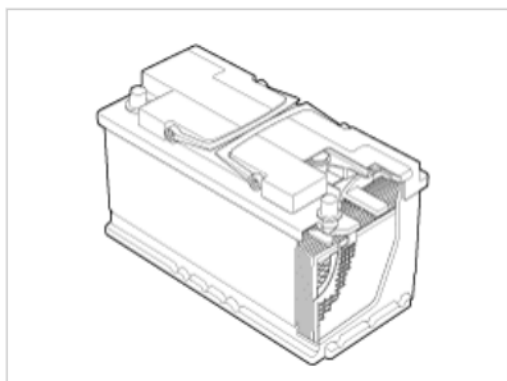
AGM battery is used for especially heavy load on the vehicle network depending on equipment and requirements. AGM stands for Absorbent Glass Material Battery; that is absorbent glass fibre fleece. AGM batteries are fitted in models with electrical loads/consumers which have a high energy demand.

The constantly increasing energy demand of modern vehicle electrical systems calls for ever more powerful battery solutions.

The power consumption is considerable even when the vehicle is parked.

The somewhat higher price compared with a battery of similar size is fully balanced by the following benefits:

- Significantly longer service life
- Increased starting reliability at low temperatures
- 100 % freedom from maintenance
- Low risk in event of an accident (reduced risk to the environment)



Engine Electrical System



Specifications

Battery [Non-ISG type]

Item	Specification
Model type	CMF60L-DIN
Capacity [20HR / 5HR] (AH)	60 / 48
Cold Cranking Amperage (A)	550 (SAE) / 440 (EN)
Reserve Capacity (Min)	92

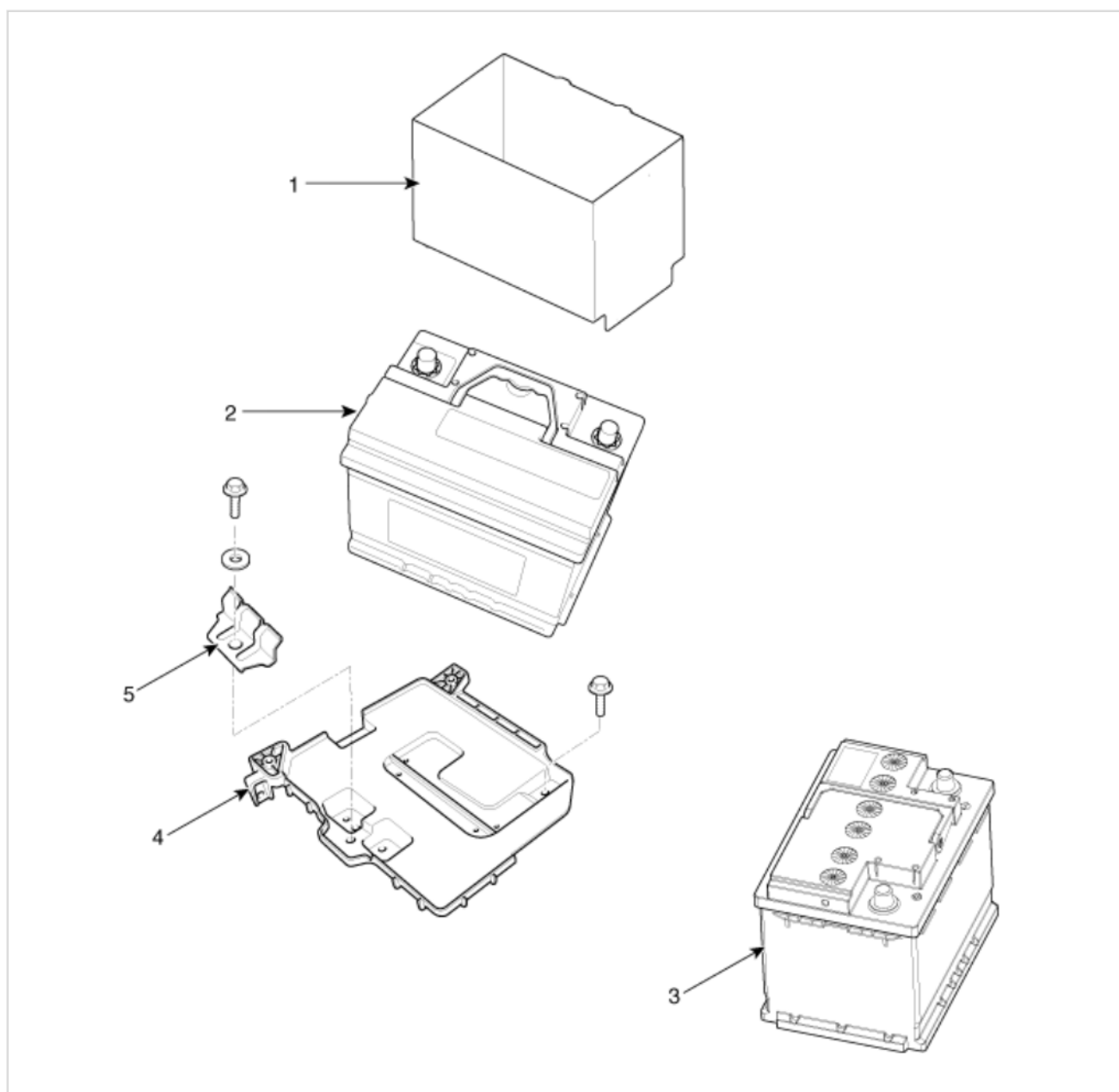
AGM Battery [ISG type]

Item	Specification
Model type	AGM 70L-DIN
Capacity [20HR / 5HR] (AH)	70 / 56
Cold Cranking Amperage (A)	760 (SAE) / 610 (EN)
Reserve capacity (Min)	120

Engine Electrical System



Components



- 1. Battery insulation pad
- 2. Battery (Non-ISG Type)
- 3. Battery (ISG Type)

- 4. Battery tray
- 5. Battery mounting bracket

Engine Electrical System



Adjustment

Battery charging

In general, vehicle battery charging system has three forms.

1. Constant current charge: The battery voltage gradually rises by charging with setting a constant current. If charging current and time are not managed correctly, the battery is over-charged, therefore charging should be stopped after confirming the completion of charging.
 - A. General charge: Charging the battery for a long time with low current
 - B. Quick charge: Charging the battery for a short time with high current
2. Constant voltage charge: The battery charge current is gradually reduced by charging with setting a constant voltage.
3. Constant current-Constant voltage charge: Charging with constant current and voltage to protect the battery damage

- (1) Initial Stage: Charging with constant current
- (2) Last Stage: Charging with constant voltage

CAUTION

Refer to the instruction manual provided by the battery charger equipment manufacturers for detailed charging procedures and precautions.

[AGM battery charging]

AGM battery should be charged with constant voltage or constant current-constant voltage in order to minimize performance degradation due to the charging.

If charging the battery with constant current, overcharging may occur. It can cause damage to the internal battery and will give an adverse effect on battery life.

NOTICE

Do not charge with more than 14.8V or quick charge mode.

[Constant voltage charge conditions]

Charging voltage / time: 14.7V [68°F ~ 86°F (20°C ~ 30°C)] / approximately 24 hours

The minimum charge voltage: 14.4V [68°F ~ 86°F (20°C ~ 30°C)]

The maximum charging voltage: 14.8V [68°F ~ 86°F (20°C ~ 30°C)]

Information

Battery temperature should be maintained at about 68°F ~ 86°F (20°C ~ 30°C) during charging of the battery.

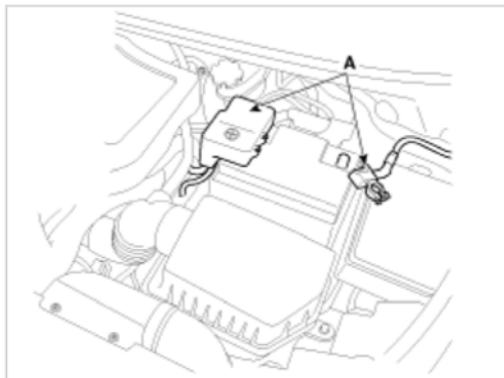
CAUTION

If the battery is charged directly at the battery terminals on vehicles with battery sensor, misinterpretations of battery condition and under certain circumstances also unwanted Check Control messages or fault memory entire can occur.

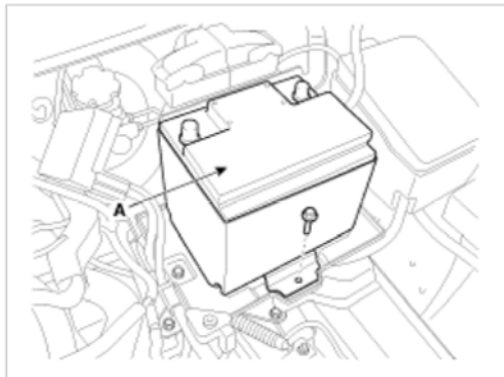
After recharging finished, let the battery stand for over 10 hours with normal temperature for battery stabilization.

Removal

1. Disconnect the battery terminals (A).
- (1)



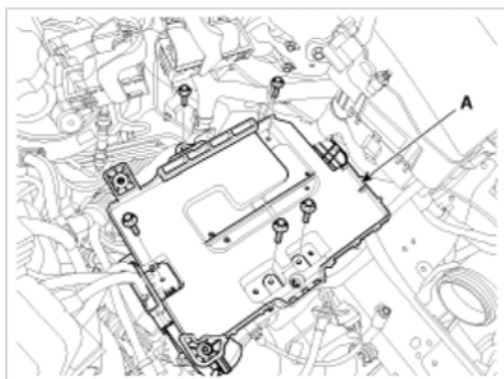
2. Remove the air duct and air cleaner assembly.
(Refer to Engine Mechanical System - "Air Cleaner")
3. Remove the battery insulation pad.
4. Remove the battery (A) after removing the mounting bracket.



5. Remove the ECM.

(Refer to Engine Control/Fuel System - "Engine Control Module (ECM)")

6. Remove the battery tray (A) after removing the bolts.



Installation

1. Install in the reverse order of removal.

Battery (-)terminal installation:

4.0 ~ 6.0 N.m (0.4 ~ 0.6 kgf.m, 3.0 ~ 4.4 lb-ft)

Battery (+)terminal installation:

7.8 ~ 9.8 N.m (0.8 ~ 1.0 kgf.m, 5.8 ~ 7.2 lb-ft)

Battery mounting bracket and the insulation pad installation:

8.8 ~ 13.7 N.m (0.9 ~ 1.4 kgf.m, 6.5 ~ 10.1 lb-ft)

Battery tray installation bolts:

8.8 ~ 13.7 N.m (0.9 ~ 1.4 kgf.m, 6.5 ~ 10.1 lb-ft)

NOTICE

- When installing the battery, fix the mounting bracket on the tray correctly.

NOTICE

- ISG (Idle stop & go) system equipped vehicle always use the AGM battery only. If flooded battery has installed, this can potentially lead to engine electrical trouble or ISG system error.
- Replace same capacity of the AGM battery.

NOTICE

- Ensure an AGM battery is fitted.
- In all cases, an AGM battery must be installed and registered in the vehicle for the ISG function to work perfectly.
- The vehicle with the new battery must be placed in the ignition switch OFF and door closed, hood switch OFF state for at least 4 hours.
- ISG system's stabilization may take 4 hours after new battery installation.
- ISG function is operates about 4 hours later and 2 times cranking by user.
But first 25 times, the ISG function can operates regardless of ISG system stability for ISG function operating check.

⚠ WARNING

- Do not open the AGM battery.
The AGM battery must not be opened under any circumstances as the introduction of oxygen from the air will cause the battery to lose its chemical equilibrium and rendered non-operational.

Vehicle parasitic current inspection

1. Turn the all electric devices OFF, and then turn the ignition switch OFF.
2. Close all doors except the engine hood, and then lock all doors.
 - (1) Disconnect the hood switch connector.
 - (2) Close the trunk lid.
 - (3) Close the doors or remove the door switches.
3. Wait a few minutes until the vehicle's electrical systems go to sleep mode.

NOTICE

- For an accurate measurement of a vehicle parasitic current, all electrical systems should go to sleep mode. (It takes at least one hour or at most one day.) However, an approximate vehicle parasitic current can be measured after 10~20 minutes.

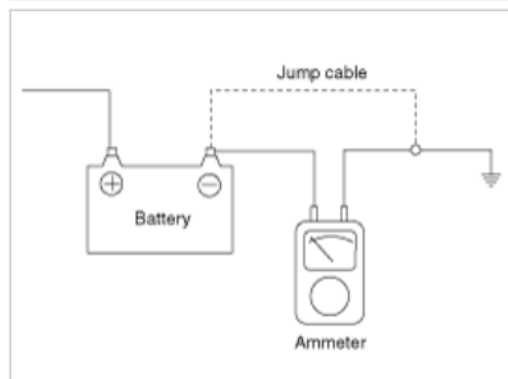
4. Connect an ammeter in series between the battery (-) terminal and the ground cable, and then disconnect the clamp from the battery (-) terminal slowly.

NOTICE

- Be careful that the lead wires of an ammeter do not come off from the battery (-) terminal and the ground cable to prevent the battery from being reset. In case the battery is reset, connect the battery cable again, and then start the engine or turn the ignition switch ON for more than 10 sec. Repeat the procedure from No. 1.

To prevent the battery from being reset during the inspection,

- 1) Connect a jump cable between the battery (-) terminal and the ground cable.
- 2) Disconnect the ground cable from the battery (-) terminal.
- 3) Connect an ammeter between the battery (-) terminal and the ground cable.
- 4) After disconnecting the jump cable, read the current value of the ammeter.



5. Read the current value of the ammeter.
 - A. If the parasitic current is over the limit value, search for abnormal circuit by removing a fuse one by one and checking the parasitic current.
 - B. Reconnect the suspected parasitic current draw circuit fuse only and search for suspected unit by removing a compoconnected with the circuit one by one until the parasitic draw drops below limit value.

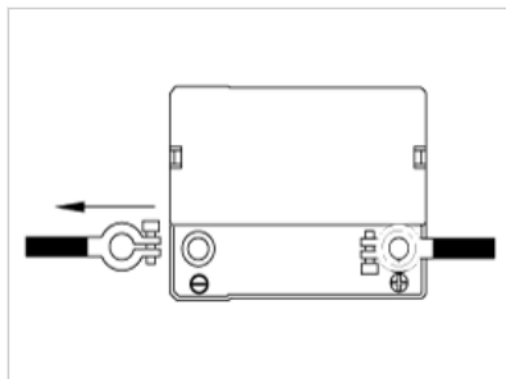
Limit value (after 10~20 min.) : Below 50mA

Cleaning

1. Make sure the ignition switch and all accessories are in the OFF position.
2. Disconnect the battery cables (negative first).
3. Remove the battery from the vehicle.

CAUTION

- Care should be taken in the event the battery case is cracked or leaking, to protect your skin from the electrolyte. Heavy rubber gloves (not the household type) should be worn when removing the battery.



4. Inspect the battery tray for damage caused by the loss of electrolyte. If acid damage is present, it will be necessary to clean the area with a solution of clean warm water and baking soda. Scrub the area with a stiff brush and wipe off with a cloth moistened with baking soda and water.
5. Clean the top of the battery with the same solution as described above.
6. Inspect the battery case and cover for cracks. If cracks are present, the battery must be replaced.
7. Clean the battery posts with a suitable battery post tool.
- 8.

Clean the inside surface of the terminal clamps with a suitable battery cleaning tool. Replace damaged or frayed cables and broken terminal clamps.

9. Install the battery in the vehicle.
10. Connect the cable terminals to the battery post, making sure tops of the terminals are flush with the tops of the posts .
11. Tighten the terminal nuts securely.
12. Coat all connections with light mineral grease after tightening.

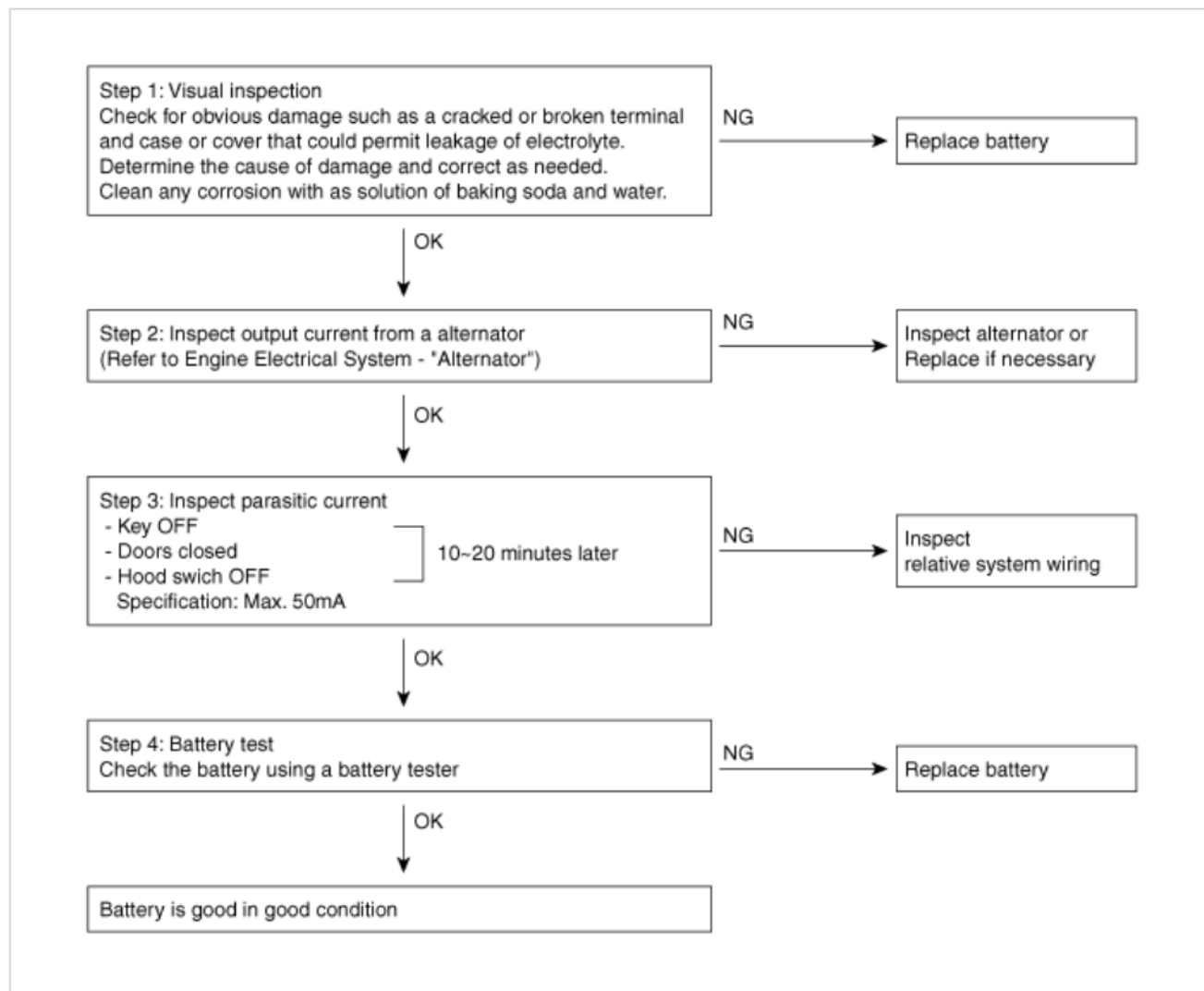
⚠ CAUTION

- When batteries are being charged, an explosive gas forms beneath the cover of each cell. Do not smoke near batteries being charged or which have recently been charged. Do not break live circuit at the terminals of batteries being charged. A spark will occur when the circuit is broken. Keep open flames away from battery.

Engine Electrical System



Troubleshooting



Engine Electrical System



Description

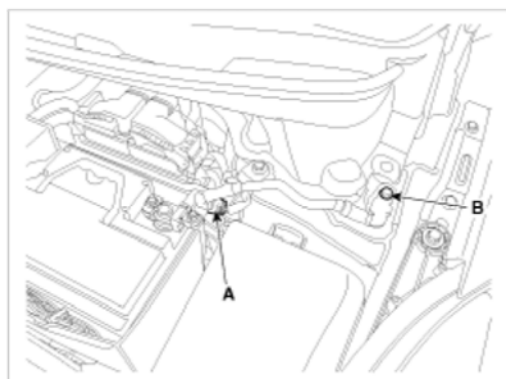
Vehicles have many control units that use more electricity. These units control their own system based on information from diverse sensors. It is important to have a stable power supply as there diverse sensors giving a variety of information. Battery sensor (A) is mounted on battery (-) terminal. It transmits battery voltage, current, temperature information to ECM. ECM controls generating voltage by duty cycle based on these signals.

Engine Electrical System



Removal

1. Disconnect the battery negative (-) cable.
2. Disconnect the battery sensor connector (A).
3. Remove the battery negative (-) cable after removing the bolt (B).



Installation

1. Install in the reverse order of removal.

Battery sensor cable installation bolt: 10.8 ~ 13.7 N.m (1.1 ~ 1.4 kgf.m, 8.0 ~ 10.1 lb-ft)

Battery (-) terminal I tightening nut: 3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

NOTICE

- After reconnecting the battery negative cable, AMS and ISG function does not operate until the system is stabilized, about 4 hours.
If disconnecting the negative (-) battery cable from the battery during repair work for the vehicle equipped with ISG function, Battery sensor recalibration procedure should be performed after finishing the repair work. (Refer to Battery Sensor Recalibration Procedure)

NOTICE

- For the vehicle equipped with a battery sensor, be careful not to damage the battery sensor when the battery is replaced or recharged.
1. When replacing the battery, it should be same one (type, capacity and brand) that is originally installed on your vehicle. If a battery of a different type is replaced, the battery sensor may recognize the battery to be abnormal.
 2. When installing the ground cable on the negative post of battery, tighten the clamp with specified torque. An excessive tightening torque can damage the PCB internal circuit and the battery terminal.
 3. When recharging the battery, ground the negative terminal of the booster battery to the vehicle body.

Engine Electrical System



Description

The starting system includes the battery, starter, solenoid switch, ignition switch, inhibitor switch (A/T), clutch pedal switch (M/T), ignition lock switch, connection wires and the battery cable.

When the ignition key is turned to the start position, current flows and energizes the starter motor's solenoid coil.

The solenoid plunger and clutch shift lever are activated, and the clutch pinion engages the ring gear.

The contacts close and the starter motor cranks.

In order to prevent damage caused by excessive rotation of the starter armature when the engine starts, the clutch pinion gear overruns.

In conjunction with the ISG function, the starter motor must do a great deal more work. Therefore, the starter motor is configured for a significantly higher number of start cycles. The components of the starter motor have been adapted to the higher requirements.

NOTICE

- There are two kinds of starter, ISG type starter and Non-ISG type.
When replace the starter, confirm that the part number and connector shape.

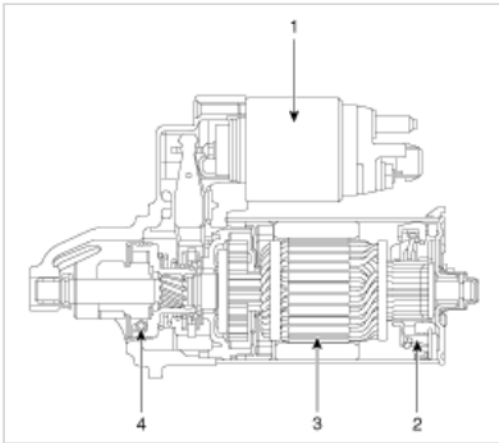
CAUTION

- ISG (Idle stop & go) system equipped vehicle always use the ISG type starter only. If the other starter has installed, this can potentially lead to engine electrical trouble or ISG system error.

WARNING

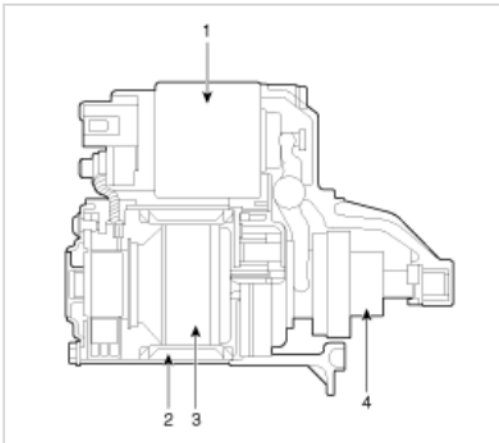
- Do not disassemble the ISG type starter.
If the starter troubles occur, replace the starter.

[ISG Type]



1. Solenoid
2. Brush assembly
3. Armature
4. Overrun clutch

[Non-ISG Type]



1. Switch assembly
2. Yoke assembly
3. Armature
4. Over running clutch

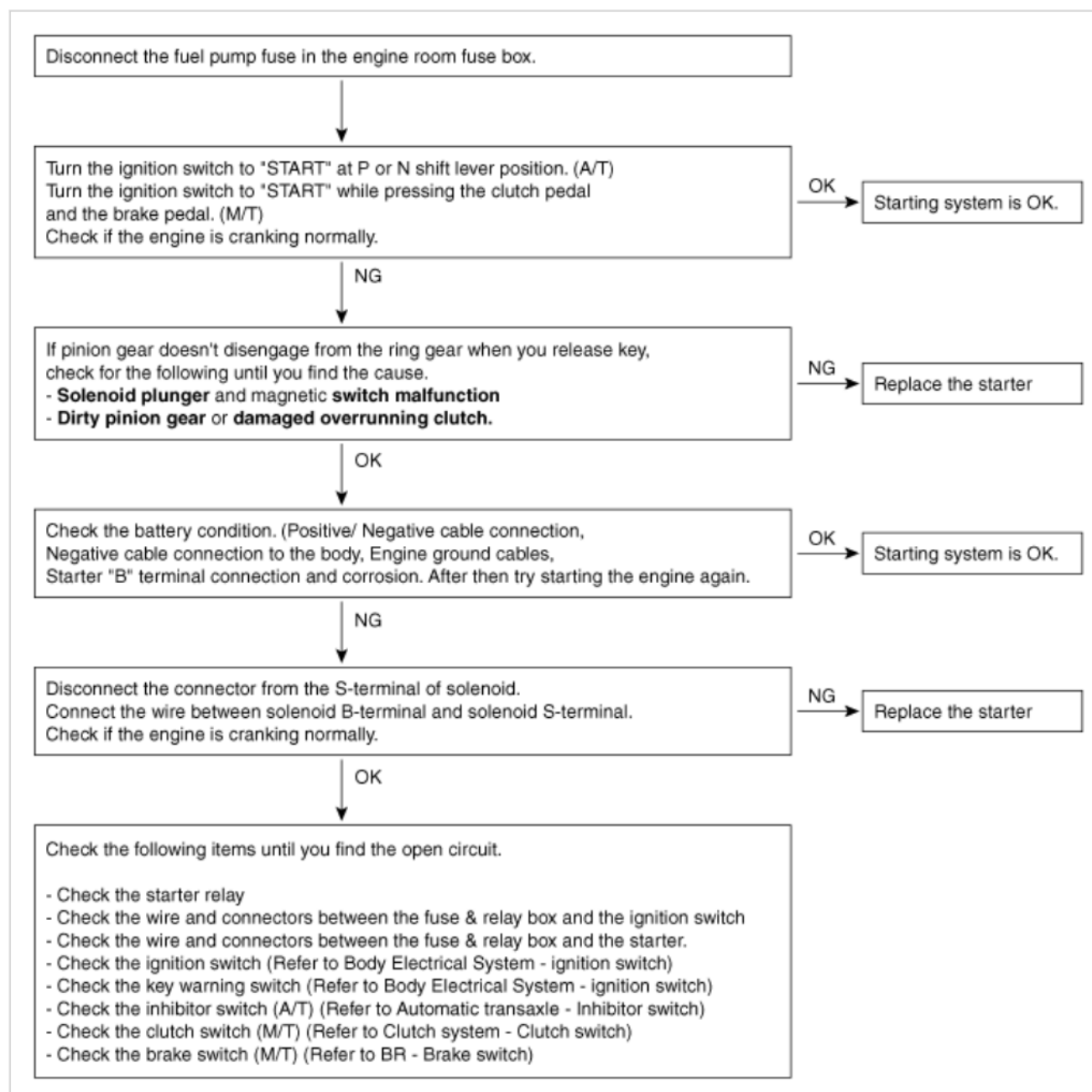
Engine Electrical System



Troubleshooting

NOTICE

- The battery must be in good condition and fully charged for this troubleshooting.



Engine Electrical System



Description

The starting system includes the battery, starter, solenoid switch, ignition switch, inhibitor switch (A/T), clutch pedal switch (M/T), ignition lock switch, connection wires and the battery cable.

When the ignition key is turned to the start position, current flows and energizes the starter motor's solenoid coil.

The solenoid plunger and clutch shift lever are activated, and the clutch pinion engages the ring gear. The contacts close and the starter motor cranks.

In order to prevent damage caused by excessive rotation of the starter armature when the engine starts, the clutch pinion gear overruns.

In conjunction with the ISG function, the starter motor must do a great deal more work. Therefore, the starter motor is configured for a significantly higher number of start cycles. The components of the starter motor have been adapted to the higher requirements.

Engine Electrical System



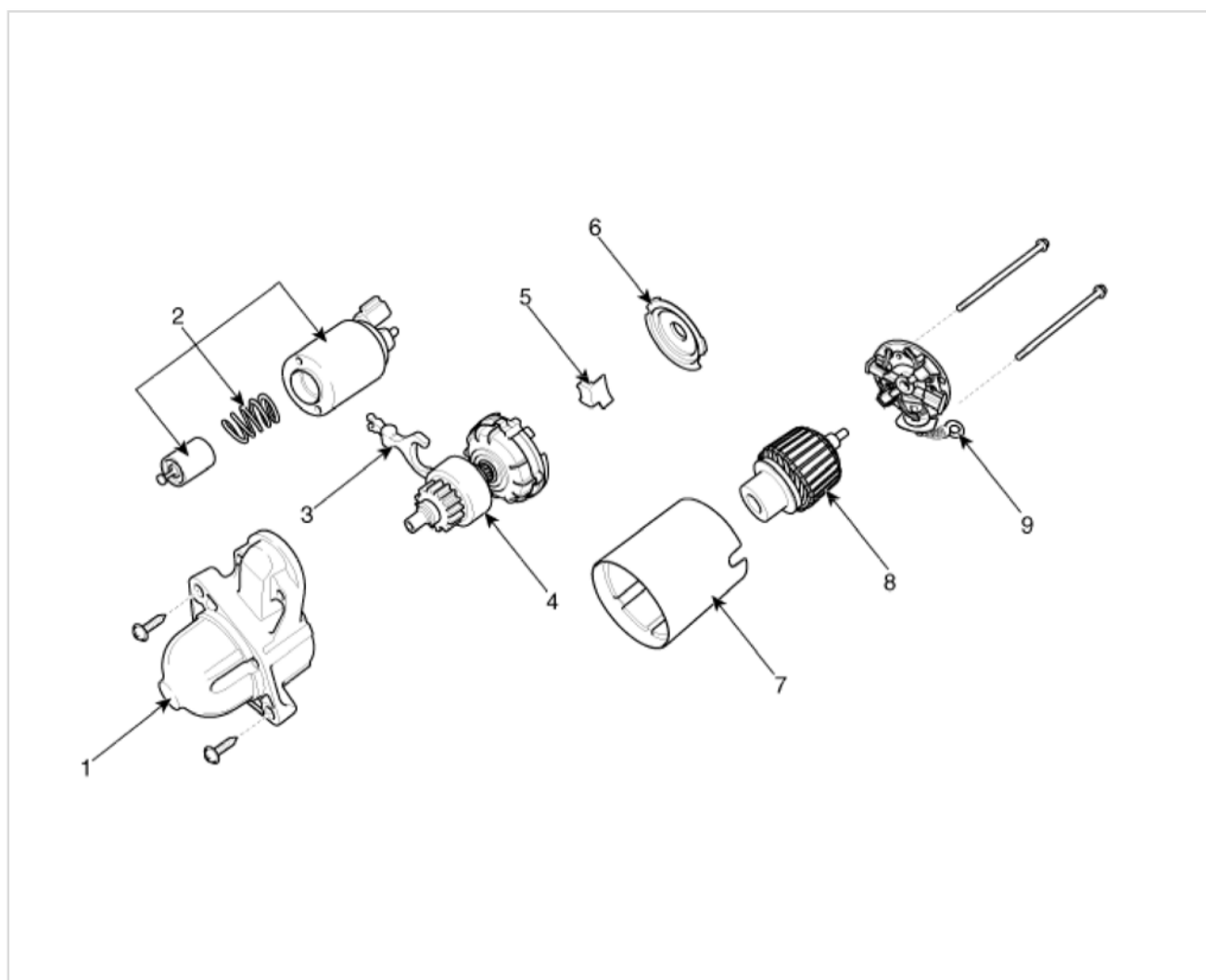
Specification

Starter [Non-ISG type]

Item		Specification
Rated voltage		12 V, 1.2 kW
The number of pinion teeth		13
Performance [No-load, 11 V]	Ampere	Max. 70 A
	Speed	Min. 2,400 rpm

Starter [ISG type]

Item		Specification
Rated voltage		12 V, 1.4 kW
The number of pinion teeth		15
Performance [No-load, 11.5 V]	Ampere	Max. 100 A
	Speed	Min. 1,915 rpm

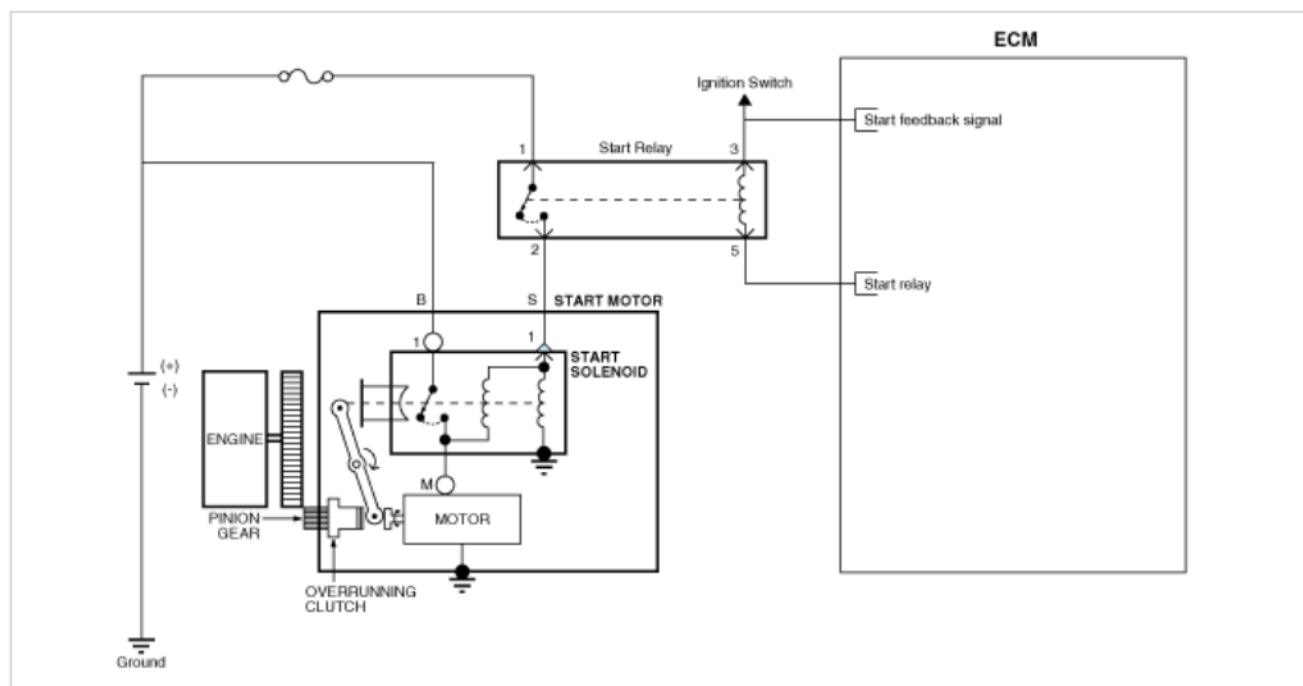
Engine Electrical System**Components****[NON-ISG Type]**

1. Front bracket assembly
2. Magnet switch assembly
3. Lever
4. Reducer assembly
5. Lever stop

6. Gasket sheet
7. Yoke assembly
8. Armature assembly
9. Brush holder assembly

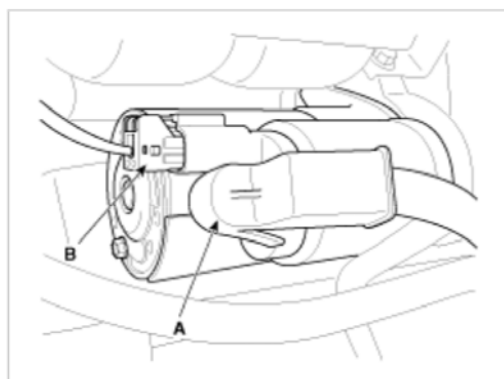


Circuit Diagram

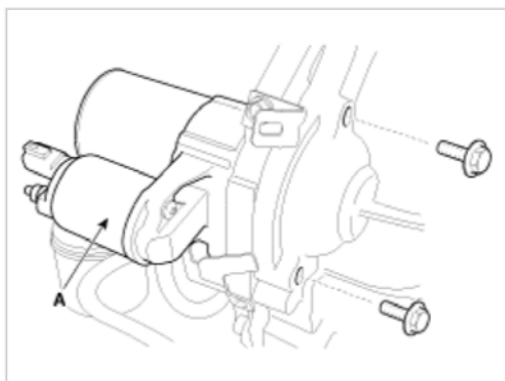


Removal

1. Disconnect the battery negative terminal.
2. Remove the air duct and air cleaner assembly.
(Refer to Engine Mechanical System - "Air Cleaner")
3. Disconnect the starter cable (A) from the B terminal on the solenoid then disconnect the connector from the S terminal (B).



4. Remove the 2 bolts holding the starter, then remove the starter (A).



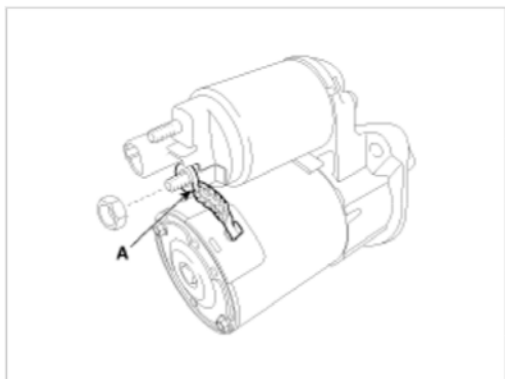
Installation

1. Install in the reverse order of removal.

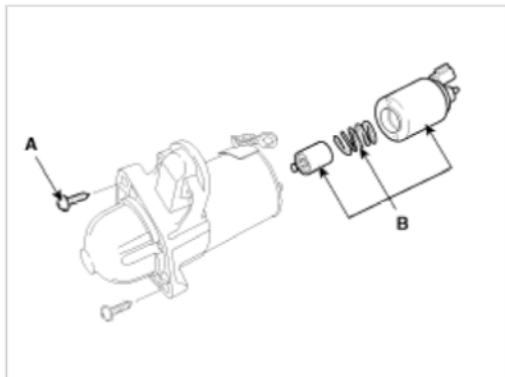
Starter installation bolt: 49.0 ~ 63.7 N.m (5.0 ~ 6.5 kgf.m, 36.2 ~ 47.0 lb-ft)

Disassembly (NON-ISG Type)

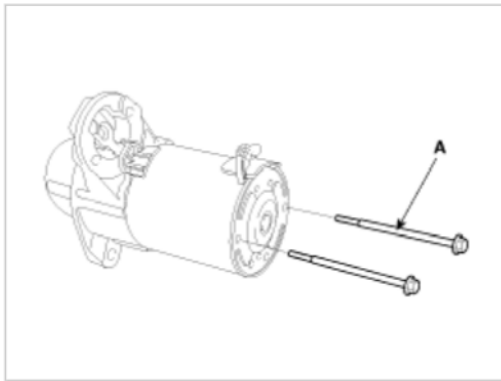
1. Disconnect the M-terminal (A) on the magnet switch assembly.



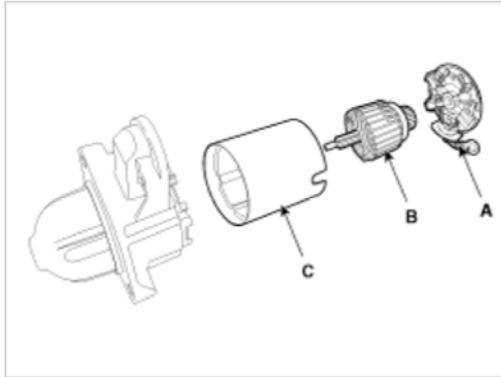
2. After loosening the screws (A), detach the magnet switch assembly (B).



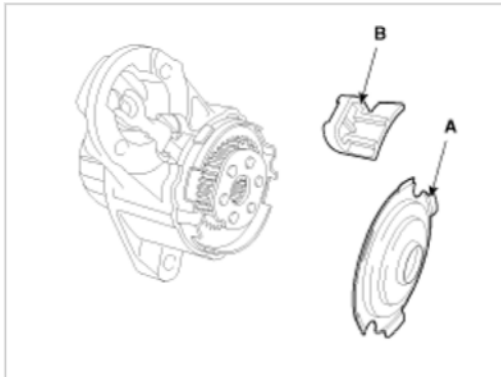
3. Loosen the through bolts (A).



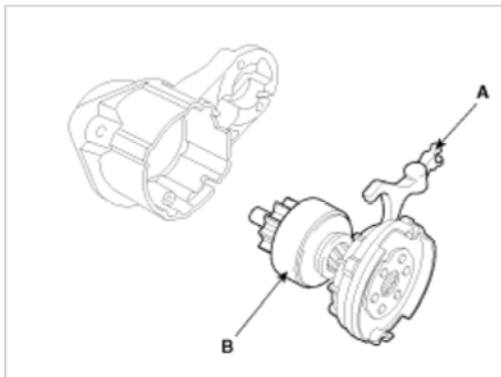
4. Remove the brush holder assembly (A), armature assembly (B) and yoke assembly (C).



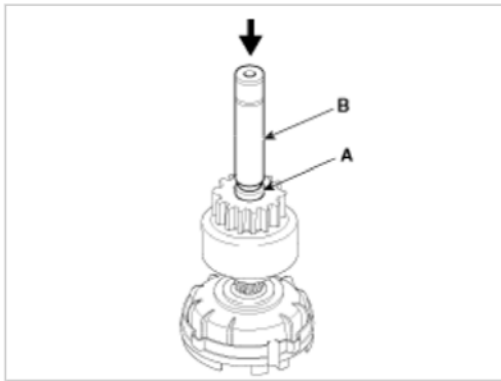
5. Remove the gasket sheet (A) and lever stop (B).



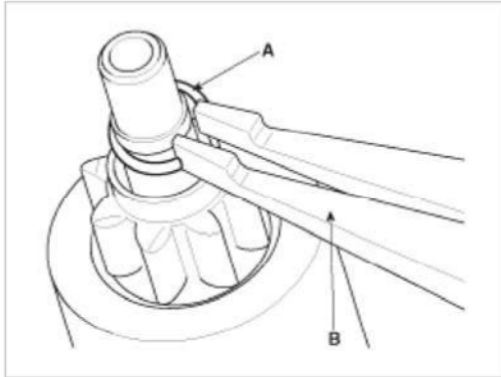
6. Remove the reducer assembly (A) and lever (B).



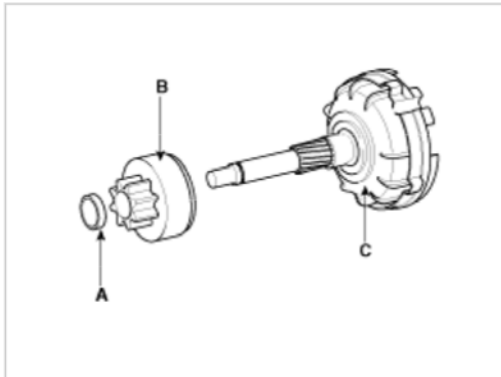
7. Press the stopper (A) using a socket (B).



8. After removing the stop ring (A) using stop ring pliers (B).

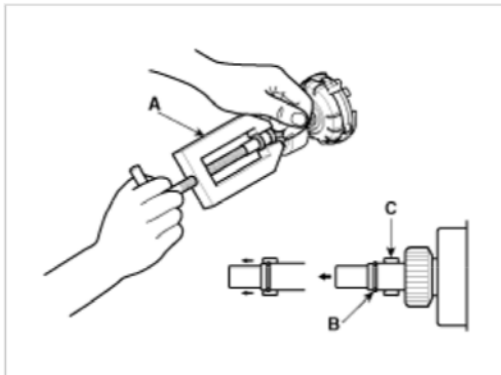


9. Disconnect the stopper (A), overrunning clutch (B) and internal gear (C).



NOTICE

Using a suitable pulling tool (A), pull the overrunning clutch stopper (C) over the stop ring (B).



10. Reassembly is the reverse of disassembly.

Reassembly

1. Reassemble in the reverse order of disassembly.

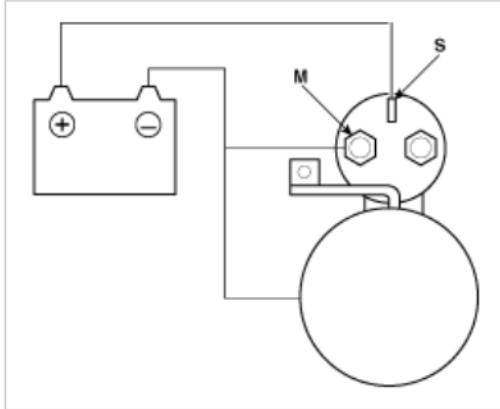
Inspection

Starter Solenoid Inspection

1. Disconnect the lead wire from the M-terminal of solenoid switch.
2. Connect the battery as shown. If the starter pinion pops out, it is working properly.

NOTICE

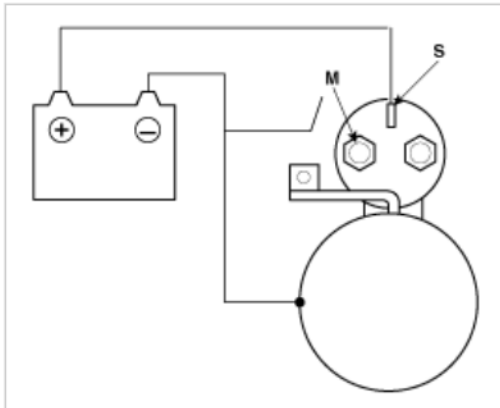
- To avoid damaging the starter, do not leave the battery connected for more than 10 seconds.



3. Disconnect the battery from the M terminal.
If the pinion does not retract, the hold-in coil is working properly.

NOTICE

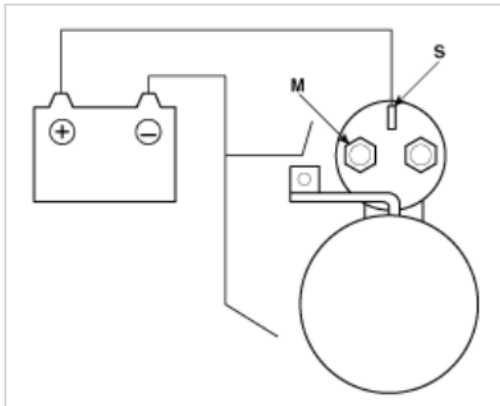
- To avoid damaging the starter, do not leave the battery connected for more than 10 seconds.



4. Disconnect the battery also from the body. If the pinion retracts immediately, it is working properly.

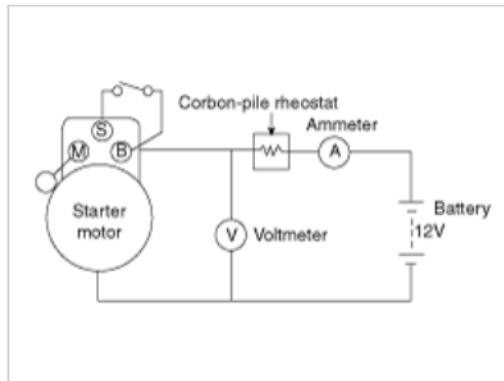
NOTICE

- To avoid damaging the starter, do not leave the battery connected for more than 10 seconds.



Free Running Inspection

1. Place the starter motor in a vise equipped with soft jaws and connect a fully-charged 12-volt battery to starter motor as follows.
2. Connect a test ammeter (150-ampere scale) and carbon pile rheostats shown in the illustration.
3. Connect a voltmeter (15-volt scale) across starter motor.

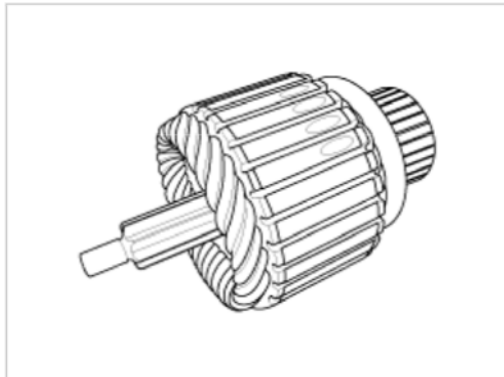


4. Rotate carbon pile to the off position.
5. Connect the battery cable from battery's negative post to the starter motor body.
6. Adjust until battery voltage shown on the voltmeter reads 11volts.
7. Confirm that the maximum amperage is within the specifications and that the starter motor turns smoothly and freely.

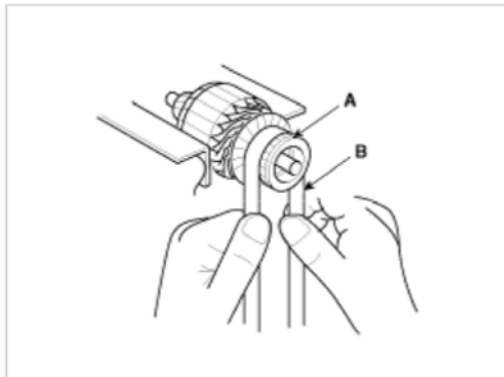
Items	Current (Max.)	Speed (Min.)
ISG type	70 A	2,400 rpm
Non-ISG type	100 A	1,950 rpm

Armature Inspection And Test

1. Remove the starter.
2. Disassemble the starter as shown at the beginning of this procedure.
3. Inspect the armature for wear or damage from contact with the permanent magnet. If there is wear or damage, replace the armature.



4. Check the commutator (A) surface. If the surface is dirty or burnt, resurface with emery cloth or a lathe within the following specifications, or recondition with #500 or #600 sandpaper (B).



5. Check the commutator diameter. If the diameter is below the service limit, replace the armature.

Commutator diameter

Standard (New): 27.0 mm (1.06 in.)

Service limit: 26.0 mm (1.02 in.)



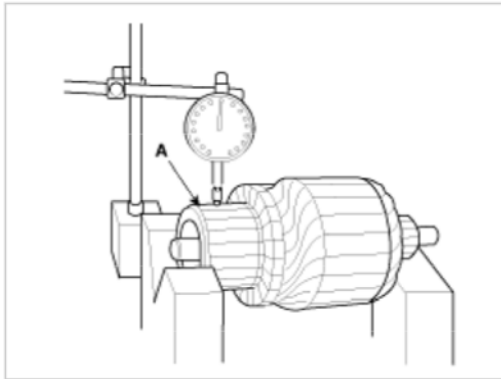
6. Measure the commutator (A) runout.

- A. If the commutator runout is within the service limit, check the commutator for carbon dust or brass chips between the segments.
- B. If the commutator run out is not within the service limit, replace the armature.

Commutator runout

Standard (New): 0.05 mm (0.0019 in.) max

Service limit: 0.08 mm (0.0031 in.)

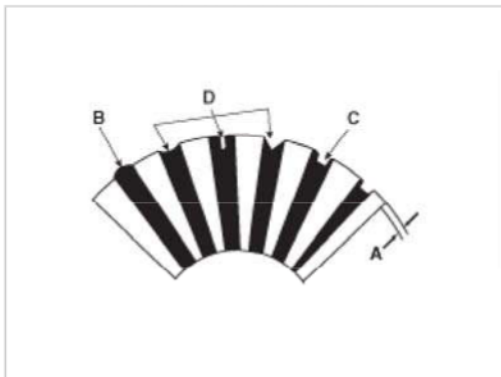


7. Check the mica depth (A). If the mica is too high (B), undercut the mica with a hacksaw blade to the proper depth. Cut away all the mica (C) between the commutator segments. The undercut should not be too shallow, too narrow, or v-shaped (D).

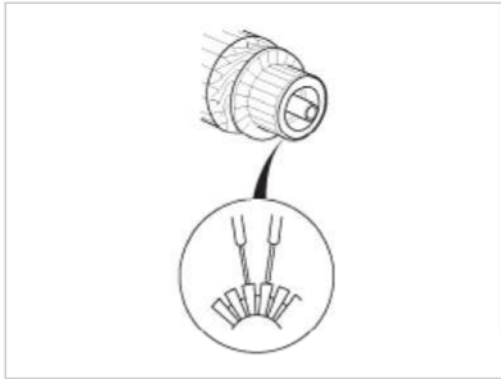
Commutator mica depth

Standard (New): 0.8 mm (0.0314 in.)

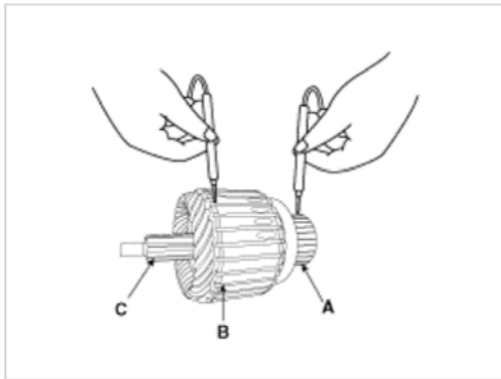
Limit: 0.2 mm (0.0079 in.)



8. Check for continuity between the segments of the commutator. If an open circuit exists between any segments, replace the armature.

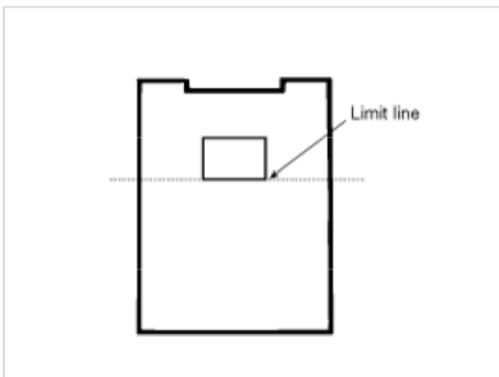


9. Check with an ohmmeter that no continuity exists between the commutator (A) and armature coil core (B), and between the commutator and armature shaft (C). If continuity exists, replace the armature.



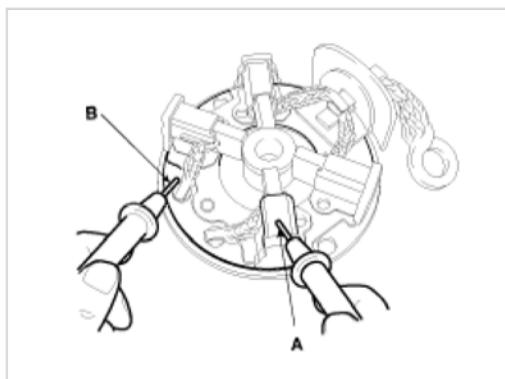
Inspect Starter Brush

Brushes that are worn out, or oil-soaked, should be replaced.



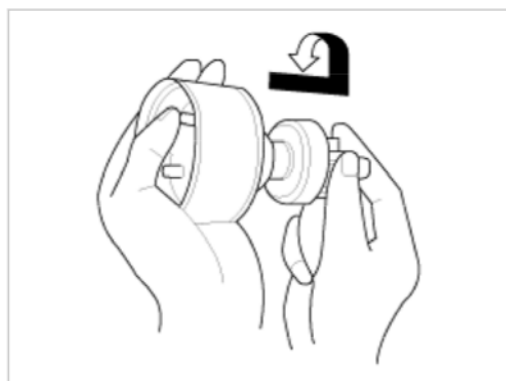
Starter Brush Holder Test

Make sure there is no continuity between the (+) brush holder (A) and (-) plate (B). If there is continuity, replace the brush holder assembly.



Overrunning Clutch

1. Slide the overrunning clutch along the shaft.
Replace it if it does not slide smoothly.
2. Rotate the overrunning clutch both ways.
Does it lock in one direction and rotate smoothly in reverse? If it does not lock in either direction or it locks in both directions, replace it.



3. If the starter drive gear is worn or damaged, replace the overrunning clutch assembly. (the gear is not available separately).
Check the condition of the flywheel or torque converter ring gear if the starter drive gear teeth are damaged.

Cleaning

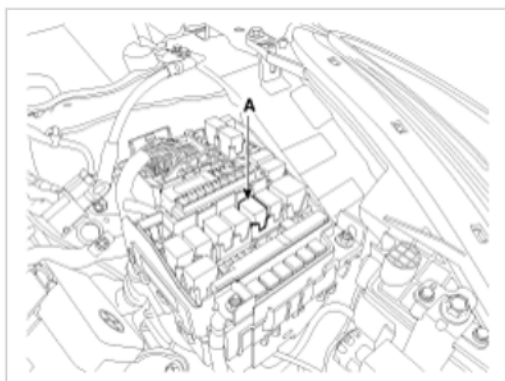
1. Do not immerse parts in cleaning solvent.
Immersing the yoke assembly and/or armature will damage the insulation wipe these parts with a cloth only.
2. Do not immerse the drive unit in cleaning solvent.
The overrun clutch is pre-lubricated at the factory and solvent will wash lubrication from the clutch.
3. The drive unit may be cleaned with a brush moistened with cleaning solvent and wiped dry with a cloth.

Engine Electrical System



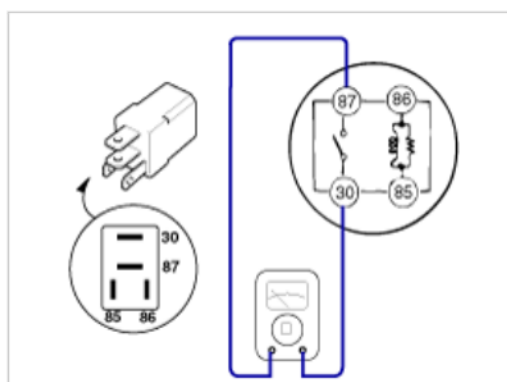
Inspection

1. Disconnect the battery negative terminal.
2. Remove the fuse box cover.
3. Remove the starter relay (A).



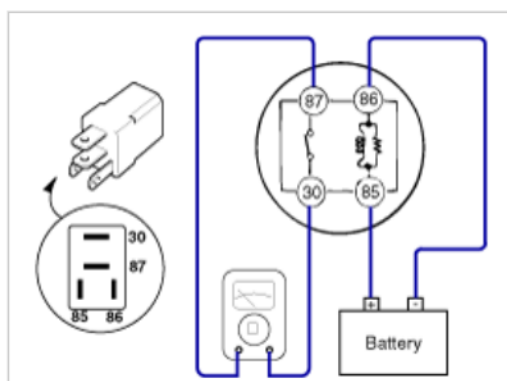
4. Using an ohmmeter, check that there is continuity between each terminal.

Terminal	Value	Measure
30 - 87	1M Ω or Higher	If there is continuity, replace the relay.
85 - 86	continuity	If there is no continuity, replace the relay.



5. Apply 12V to terminal 85 and ground to terminal 86.
Check for continuity between terminals 30 and 87.

Terminal	Continuity
30 - 87	Below 1 Ω
85 - 86	Apply 12V



6. If there is no continuity, replace the starter relay.
7. Install the starter relay.
8. Install the fuse box cover.

Engine Electrical System



Cruise Control

The cruise control system is engaged by the cruise "ON/OFF" main switch located on right of steering wheel column. The system has the capability to cruise, coast, accelerate and resume speed.

It also has a safety interrupt, engaged upon depressing brake or shifting select lever.

The ECM is the control module for this system. The main components of cruise control system are mode control switches, transmission range switch, brake switch, vehicle speed sensor, ECM and ETS motor that connect throttle body.

The ECM contains a low speed limit which will prevent system engagement below a minimum speed of 40km/h (25mph).

The operation of the controller is controlled by mode control switches located on steering wheel.

Transmission range switch and brake switch are provided to disengage the cruise control system. The switches are on brake pedal bracket and transmission. When the brake pedal is depressed or select lever shifted, the cruise control system is electrically disengaged and the throttle is returned to the idle position.

Cruise main switch (ON/OFF)

The cruise control system is engaged by pressing the cruise "ON/OFF" main switch. Pressing the cruise "ON/OFF" main switch again releases throttle, clears cruise memory speed, and puts vehicle in a non-cruise mode.

Set/Coast switch (SET/-)

The "SET/-" switch located on right of steering wheel column has two functions.

The set function - Push the "SET/-" switch and release it at the desired speed. The SET indicator light in the instrument cluster will illuminate. Release the accelerator pedal. The desired speed will automatically be maintained.

The coast function - Push the "SET/-" switch and hold it when the cruise control is on. The vehicle will gradually slow down. Release the switch at the desired speed. The desired speed will be maintained.

Push the "SET/-" switch and release it quickly. The cruising speed will decrease by 2km/h or 1mph.

Resume/Accel switch (RES/+)

The "RES/+" switch located on right of steering wheel column has two functions.

The resume function - If any method other than the cruise "ON/OFF" main switch was used to cancel cruising speed temporarily and the system is still activated, the most recent set speed will automatically resume when the "RES/+" switch is pushed. It will not resume, however, if the vehicle speed has dropped below approximately 40km/h (25mph).

The accel function - Push the "RES/+" switch and hold it when the cruise control is on. The vehicle will gradually accelerate. Release the switch at the desired speed. The desired speed will be maintained.

Push the "RES/+" switch and release it quickly. The cruising speed will increase by 2km/h or 1mph.

Cancel switch (CANCEL)

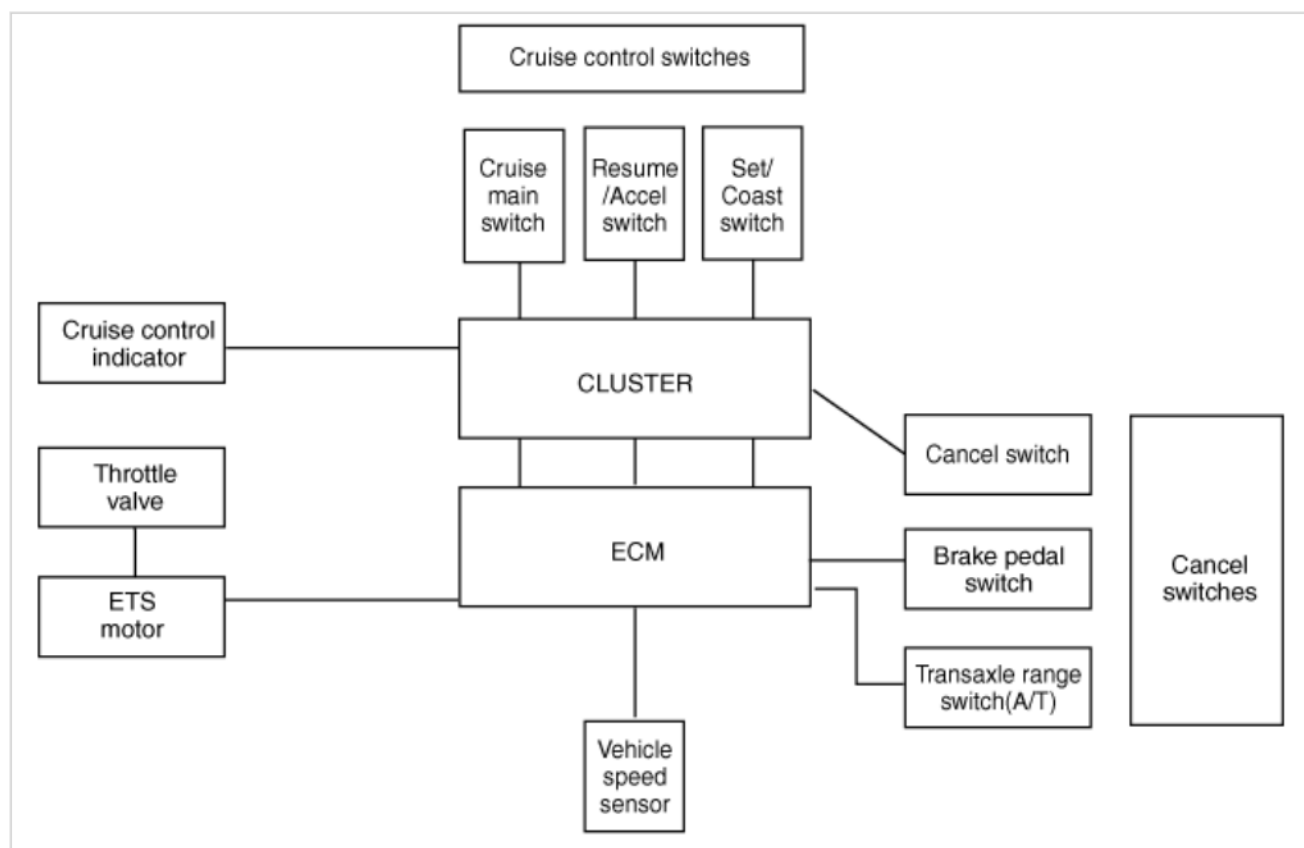
The cruise control system is temporarily disengaged by pushing the "CANCEL" switch.

Cruise speed canceled by this switch can be recovered by pushing the "RES/+" switch.

Engine Electrical System



System Block Diagram



Component Parts And Function Outline

Component part		Function
Vehicle-speed sensor		Converts vehicle speed to pulse.
ECM		Receives signals from sensor and control switches.
Cruise control indicator		Illuminate when CRUISE main switch is ON (Built into cluster)
Cruise Control switches	ON/OFF switch	Switch for automatic speed control power supply.
	Resume/Accel switch	Controls automatic speed control functions by Resume/Accel switch (Set/Coast switch)
	Set/Coast switch	
Cancel switches	Cancel switch	Sends cancel signals to ECM.
	Brake-pedal switch	
	Transaxle range switch (A/T)	
ETS motor		Regulates the throttle valve to the set opening by ECM.

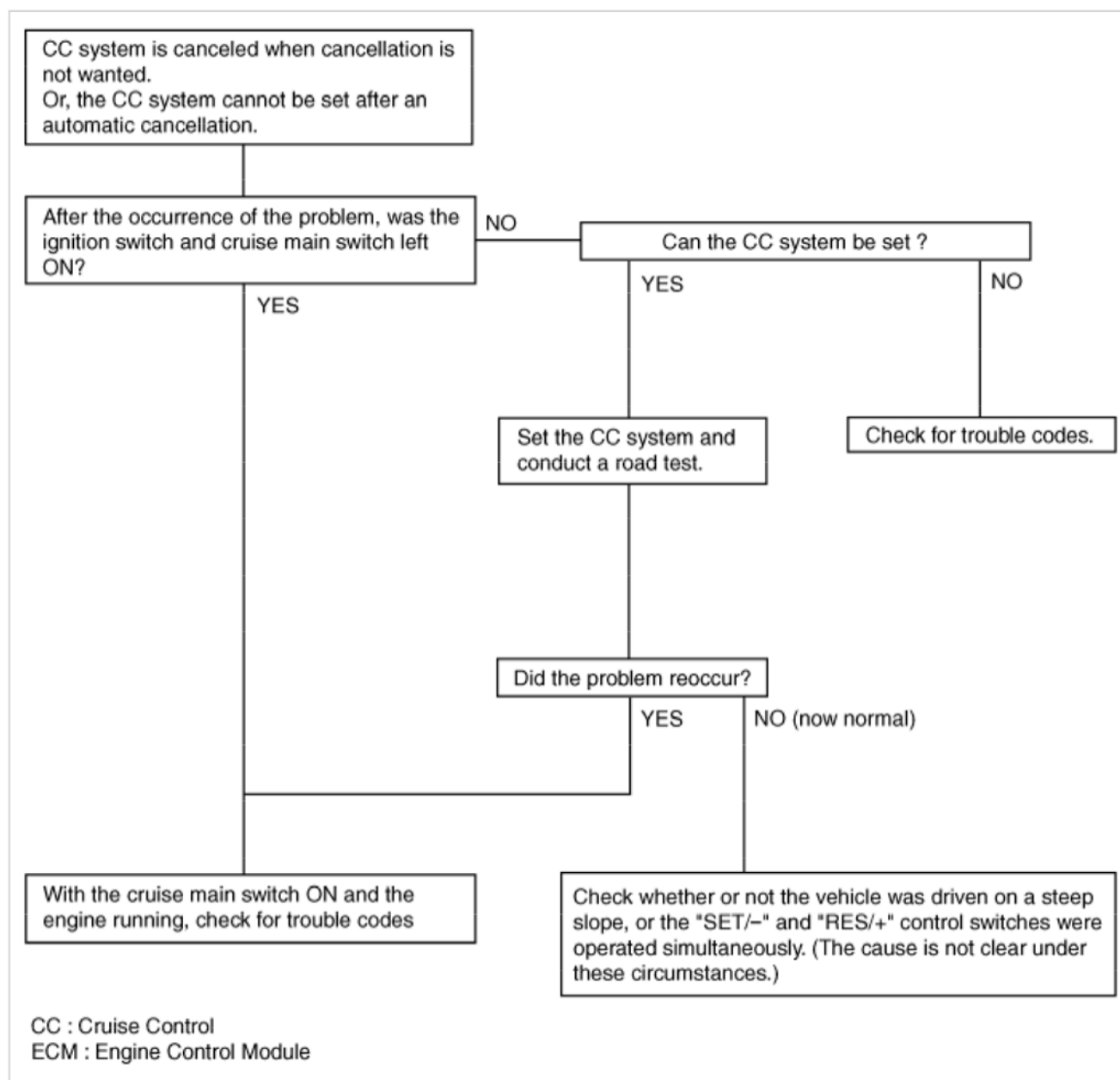
* ETS : Electronic Throttle System

Engine Electrical System



Trouble Symptom Charts

Trouble Symptom 1



Trouble Symptom 2

Trouble symptom	Probable cause	Remedy
The set vehicle speed varies greatly upward or downward "Surging" (repeated alternating acceleration and deceleration) occurs after setting	Malfunction of the vehicle speed sensor circuit	Repair the vehicle speed sensor system, or replace the part
	Malfunction of ECM	Check input and output signals at ECM

Trouble Symptom 3

Trouble symptom	Probable cause	Remedy
The CC system is not canceled when the brake pedal is depressed	Damaged or disconnected wiring of the brake pedal switch	Repair the harness or replace the brake pedal switch
	Malfunction of the ECM signals	Check input and output signals at ECM

Trouble Symptom 4

Trouble symptom	Probable cause	Remedy

The CC system is not canceled when the shift lever is moved to the "N" position (It is canceled, however, when the brake pedal is depressed)	Damaged or disconnected wiring of inhibitor switch input circuit	Repair the harness or repair or replace the inhibitor switch
	Improper adjustment of inhibitor switch	
	Malfunction of the ECM signals	Check input and output signals at ECM

Trouble Symptom 5

Trouble symptom	Probable cause	Remedy
Cannot decelerate (coast) by using the "SET/—" switch	Temporary damaged or disconnected wiring of "SET/—" switch input circuit	Repair the harness or replace the "SET/—" switch
	Malfunction of the ECM signals	Check input and output signals at ECM

Trouble Symptom 6

Trouble symptom	Probable cause	Remedy
Cannot accelerate or resume speed by using the "RES/+" switch	Damaged or disconnected wiring, or short circuit, or "RES/+" switch input circuit	Repair the harness or replace the "RES/+" switch
	Malfunction of the ECM signals	Check input and output signals at ECM

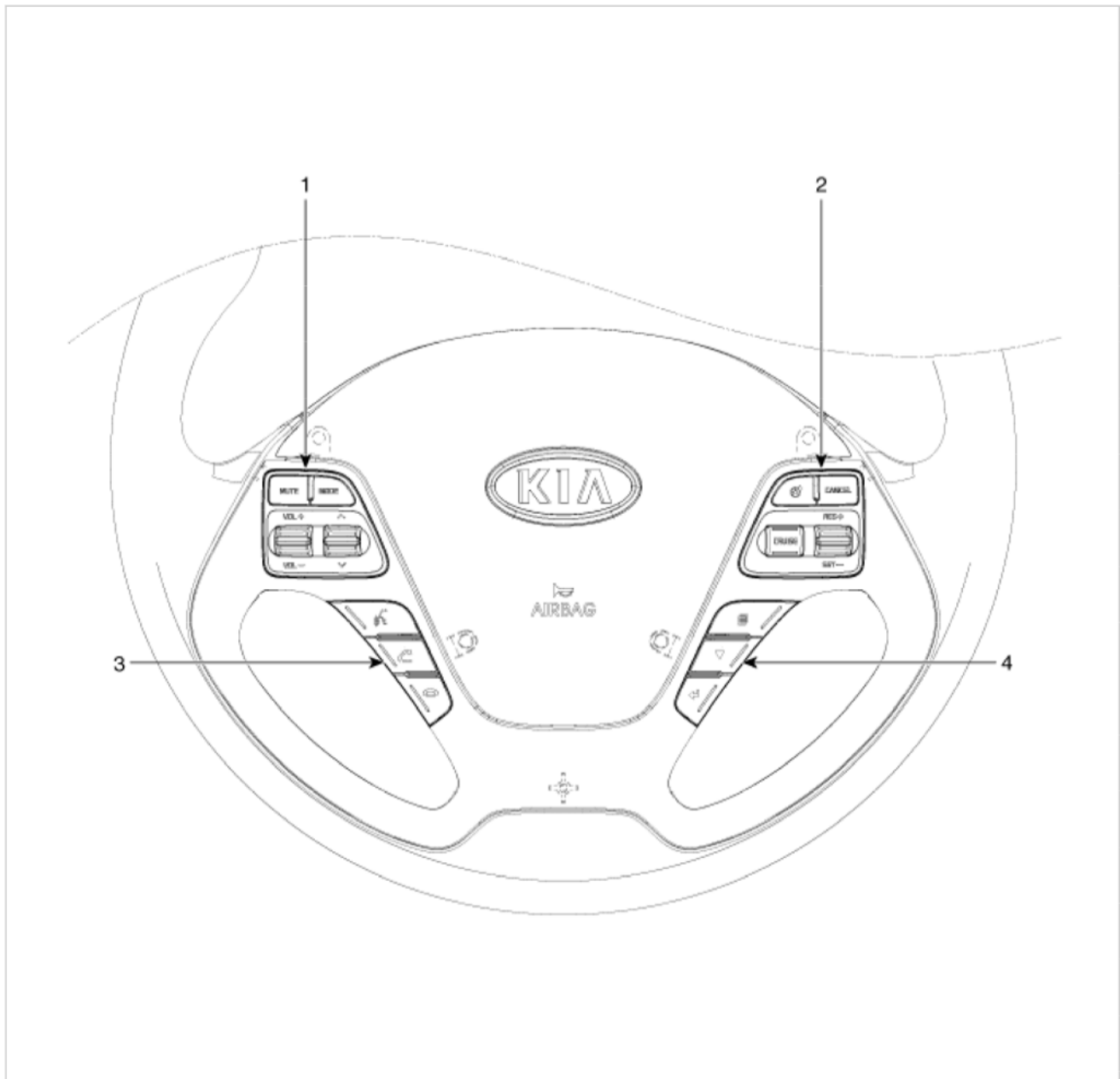
Trouble Symptom 7

Trouble symptom	Probable cause	Remedy
CC system can be set while driving at a vehicle speed of less than 40km/h (25mph), or there is no automatic cancellation at that speed	Malfunction of the vehicle-speed sensor circuit	Repair the vehicle speed sensor system, or replace the part
	Malfunction of the ECM signals	Check input and output signals at ECM

Trouble Symptom 8

Trouble symptom	Probable cause	Remedy
The cruise main switch indicator lamp does not illuminate (But CC system is normal)	Damaged or disconnected bulb of cruise main switch indicator lamp	Repair the harness or replace the part.
	Harness damaged or disconnected	

Engine Electrical System**Component Location**



1. Remote control switch(LH)

2. Remote control switch(RH)

3. Bluetooth hands free switch

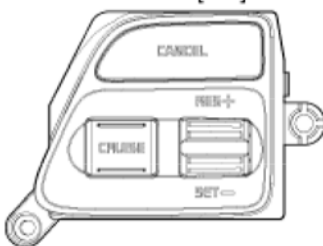
4. Trip switch

Engine Electrical System



Circuit Diagram

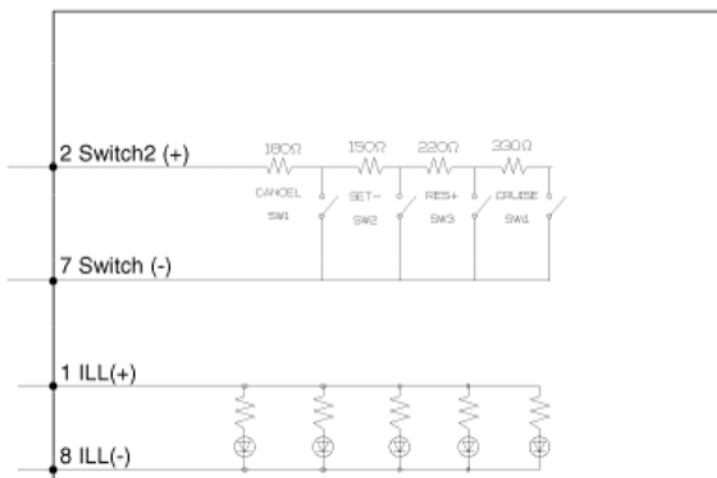
Cruise [RH]



Connector



No.	Description
1	Illumination (+)
2	Switch 2 (+)
3	-
4	-
5	-
6	-
7	Switch (-)
8	Illumination (-)



Engine Electrical System



Inspection

[Measuring Resistance]

1. Check for resistance between terminals in each switch position.



Function switch	Connector terminal	Resistance (±5%)
CANCEL	2-7	180 Ω
SET-	2-7	330 Ω
RES+	2-7	550 Ω
CRUISE	2-7	880 Ω

[Measuring Voltage]

1. Connect the cruise control switch connector to the control switch.



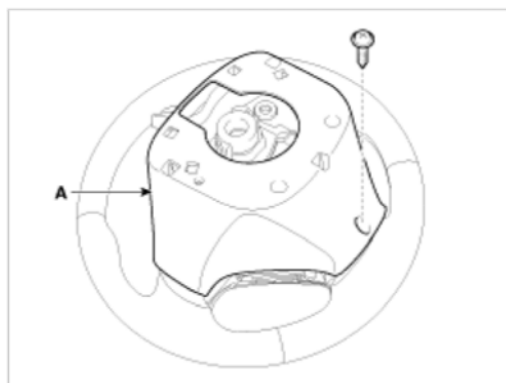
2. Measure voltage between terminals on the harness side connector when each function switch is ON (switch is depressed).

Function switch	Connector terminal	Voltage (V)
CANCEL	2-7	0.61 ~ 0.91
SET-	2-7	1.04 ~ 1.44
RES+	2-7	1.55 ~ 1.99
CRUISE	2-7	2.24 ~ 2.44

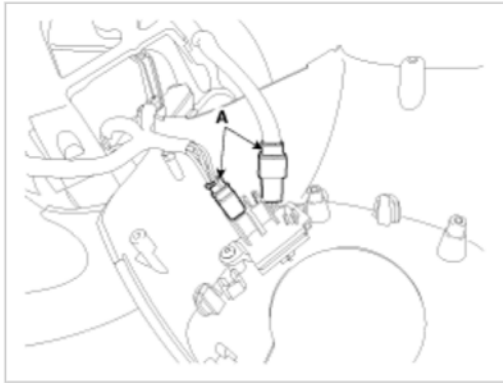
3. If not within specification, inspect the control switch resistance.
The measuring resistance value is not within specification, replace the switch and measure the voltage again.
4. If resistance is OK but, measuring voltage is not within specification, inspect the wiring harness and connectors between the switch and the ECM.

Removal

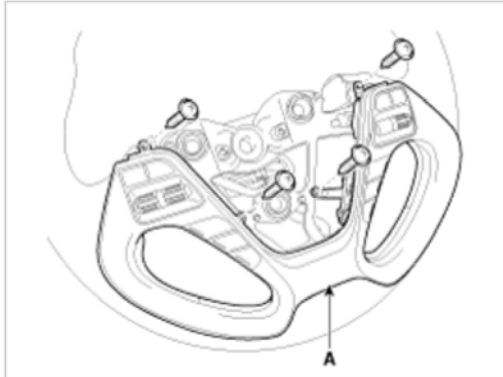
1. Disconnect the negative (-) battery terminal.
2. Remove the driver airbag module.
(Refer to Restraint - "Driver Airbag (DAB) Module and Clock Spring")
3. Remove the steering wheel.
(Refer to Steering System - "Steering Column and Shaft")
4. Remove the steering wheel cover (A) after loosening the screw.



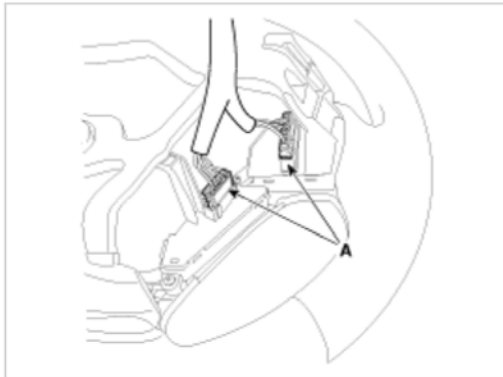
5. Disconnect the steering heater connectors (A).



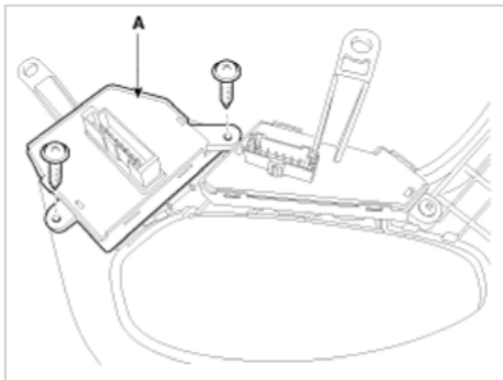
6. Remove the steering remote control switch assembly after loosening the mounting screws (4EA).



7. Disconnect the switch connectors (A).



8. Remove the cruise control switch (A) after loosening the mounting screws.



Installation

1. Reassemble the cruise control switch after connecting the connector.
2. Reassemble the driver airbag module.

NOTICE

Make sure the audio remote control switch and the airbag module connectors are plugged in properly.