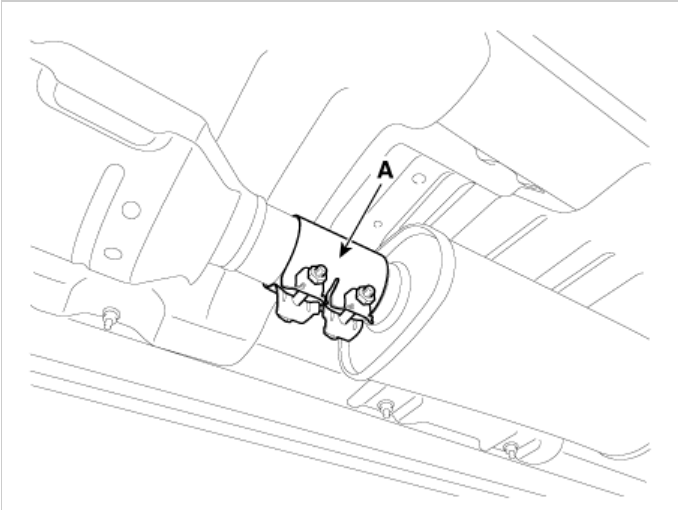
Tightening torque :
39.2-58.8 N·m (4.0 - 6.0 kgf·m, 28.9-43.4 lb·ft)

(4) Compare the gap between the tail pipe(or tail trim) and the rear bumper with the record measured before removing the center muffler assembly.

NOTICE
If the tail pipe is installed differently compared to the initial position, the bumper might be damaged by the pipe heat or interfere between the tail pipe and the rear bumper.

(5) Do not tighten the clamp at a time. Tighten the clamp nuts to the specified torque, by turns.

Tightening torque :
17.6-23.5 N·m (1.8 - 2.4 kgf·m, 13.0-17.4lb·ft)



NOTICE
Do not reuse the clamp that was tightened completely. It may cause leak to reuse the clamp that was tightened completely.

Specification

Ignition System

Spark plug

Item	Specification
Type	SILKR8E8G
Gap	0.7 - 0.8 mm (0.028 - 0.31 in.)

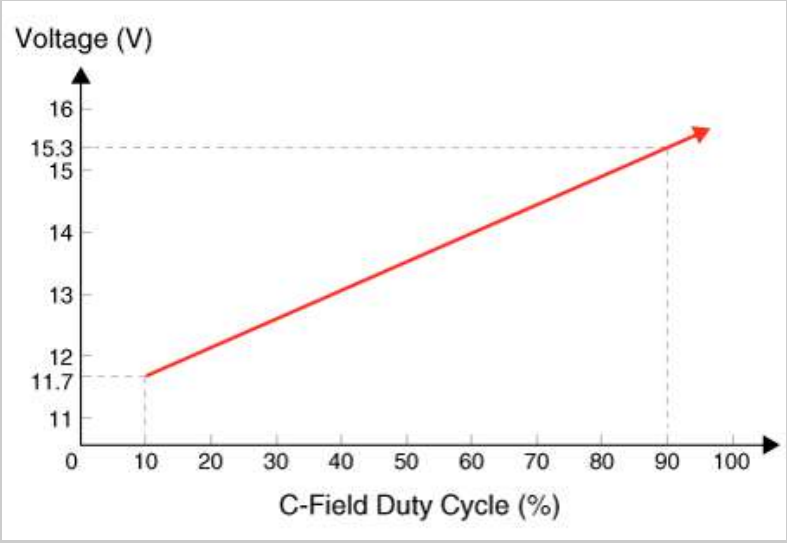
Condenser

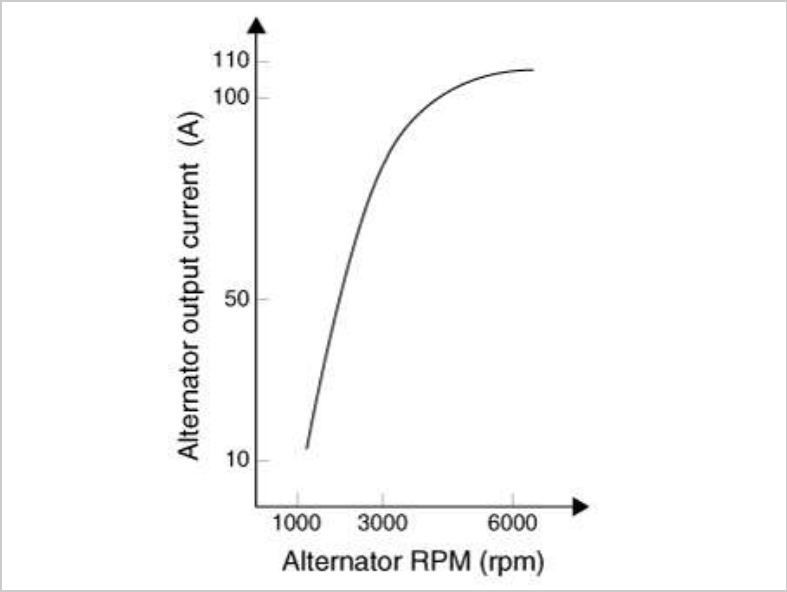
Item	Specification
Capacitance (uF)	0.47 [1KHz]
Insulation resistance (MΩ)	1,000 [DC 500 V/1 Min]

Charging System

Alternator

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 ± 0.3V
Temperature Gradient	External mode	0 ± 3 mV / °C
	Internal mode	-3.5 ± 2mV / °C
Pulley		OAP





Information

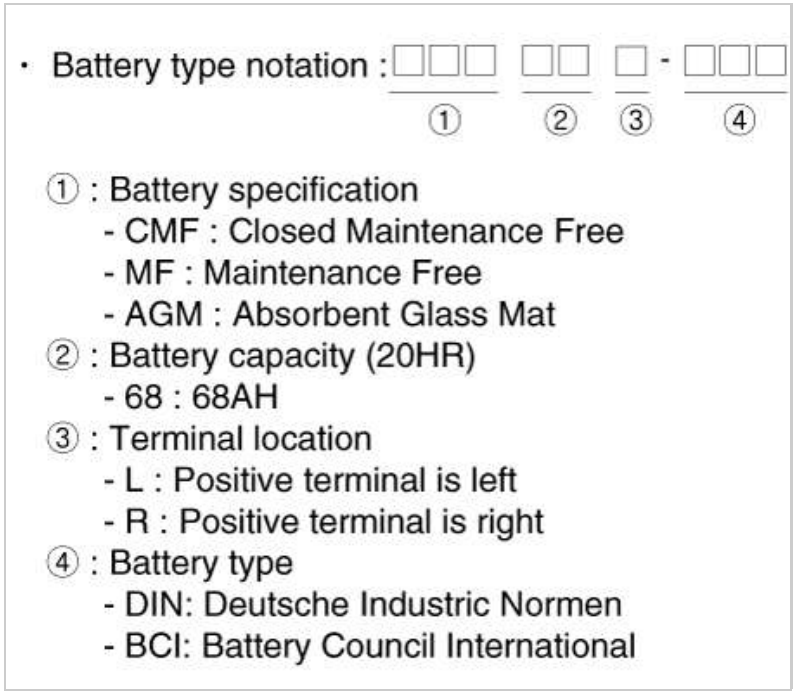
OAP : Over runing Alternator Pulley

Battery

Item	Specification
Model type	CMF68L-DIN
Cold Cranking Amperage (A)	600 (SAE) / 600 (EN)
Reserve Capacity (Min)	110

Information

• Model type description



• 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.

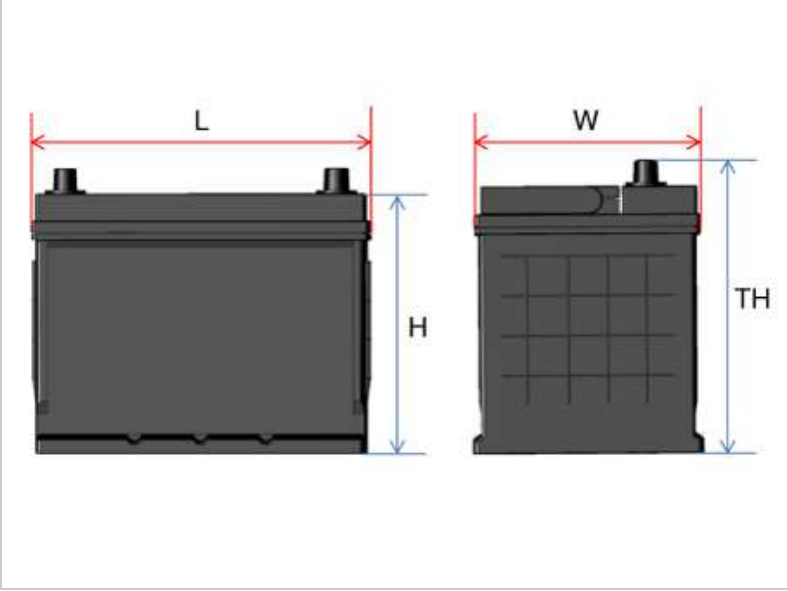
– The rating is the number of minutes a battery at 26.7°C(80°F) can be discharged at 25 amps and maintain a voltage of 10.5 volts for a 12 volt battery.

– The higher the reserve rating, the longer your vehicle can operate should your alternator or fan belt fail.

Information

BCI Type

Capacity (5 hr / 20 hr)	Length	Width	Height	Total Height
	L (mm)	W (mm)	H (mm)	TH (mm)
28/35	188 - 192	126 - 130	198 - 202	218 - 222
32/40	194 - 198	133 - 137	199 - 203	223 - 227
36/45	203 - 207	173 - 177	200 - 204	221 - 225
44/55	213 - 217	173 - 177	198 - 202	218 - 222
48/60	228 - 232	173 - 177	200 - 204	221 - 225
54/68	258 - 262	173 - 177	198 - 202	220 - 224
56/70	258 - 262	173 - 177	198 - 202	223 - 227
64/80	274 - 278	170 - 174	198 - 202	221 - 225
70/88	349 - 353	172 - 176	186 - 200	183 - 187
72/90	300 - 304	170 - 174	200 - 204	221 - 225
76/95	294 - 298	172 - 176	198 - 202	220 - 224
80/100	326 - 330	170 - 174	203 - 207	225 - 229



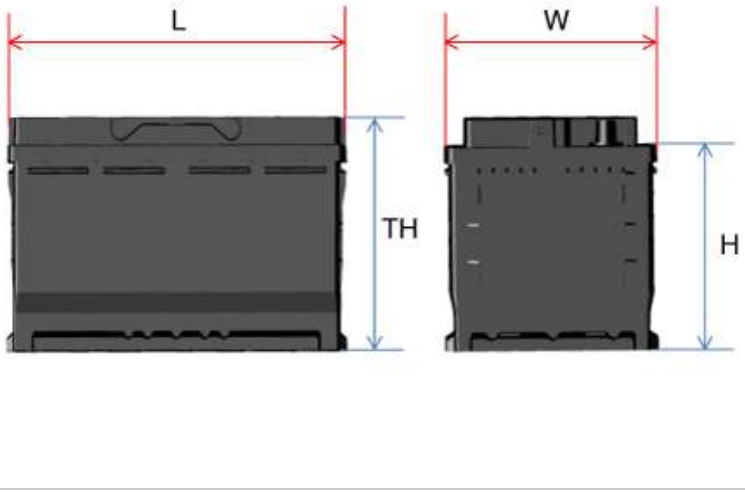
DIN Type

Capacity (5 hr / 20 hr)	Length	Width	Height	Total Height
	L (mm)	W (mm)	H (mm)	TH (mm)
36/45	205 - 207	173 - 175	164 - 168	188 - 190
48/60	240 - 242	173 - 175	164 - 168	188 - 190
54/68	276 - 278	173 - 175	164 - 168	188 - 190
64/80	313 - 315	173 - 175	164 - 168	188 - 190

72/90	351 - 353	173 - 175	164 - 168	188 - 190
80/100	351 - 353	173 - 175	164 - 168	188 - 190
88/110	392 - 394	173 - 175	164 - 168	188 - 190

AGM DIN Type

Capacity (5 hr / 20 hr)	Length	Width	Height	Total Height
	L (mm)	W (mm)	H (mm)	TH (mm)
40/50	205 - 207	173 - 175	164 - 168	188 - 190
48/60	227 - 229	173 - 175	164 - 168	188 - 190
56/70	276 - 278	173 - 175	164 - 168	188 - 190
64/80	312 - 314	173 - 175	164 - 168	188 - 190
72/90	351 - 353	173 - 175	164 - 168	188 - 190
84/105	392 - 394	173 - 175	164 - 168	188 - 190



Starting System

Starter

Item		Specification
Rated voltage		12 V, 0.9 kW
The number of pinion teeth		11
Performance [No-load, 11.5 V]	Ampere	Max. 85 A
	Speed	Min. 3,300 rpm

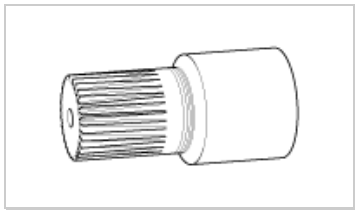
Tightening Torques

Item	N·m	kgf·m	lb·ft
Ignition coil mounting 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
Alternator mounting bolt [12 mm (0.47 in.)]	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Alternator mounting 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 I tightening nut	4.0 - 6.0	0.4 - 0.6	3.0 - 4.4

Battery mounting bracket bolt	8.8 - 13.7	0.9 -1.4	6.5 - 10.1
Battery tray mounting bolt	8.8 - 13.7	0.9 -1.4	6.5 - 10.1
Battery sensor cable mounting bolt	29.4 - 31.4	3.0 - 3.2	21.7 - 23.1
Starter mounting 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		Used for removing / installing alternator pulley

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-pro grammed 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

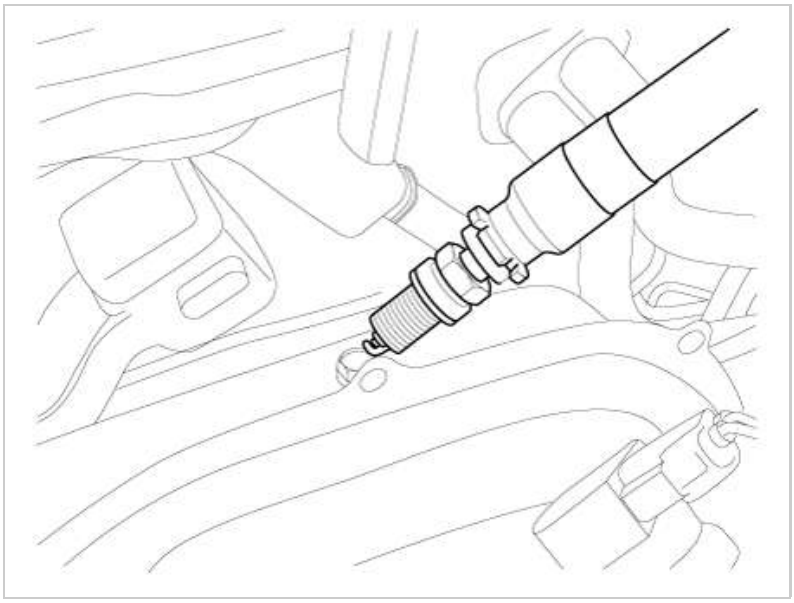
On-vehicle Inspection

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 cylinder head center cover.
   (3) Remove the ignition coils.
   (4) Using a spark plug wrench, remove the spark plugs.
   (5) Disconnect the 4 injector connectors.
   (6) Ground the spark plug to the engine.

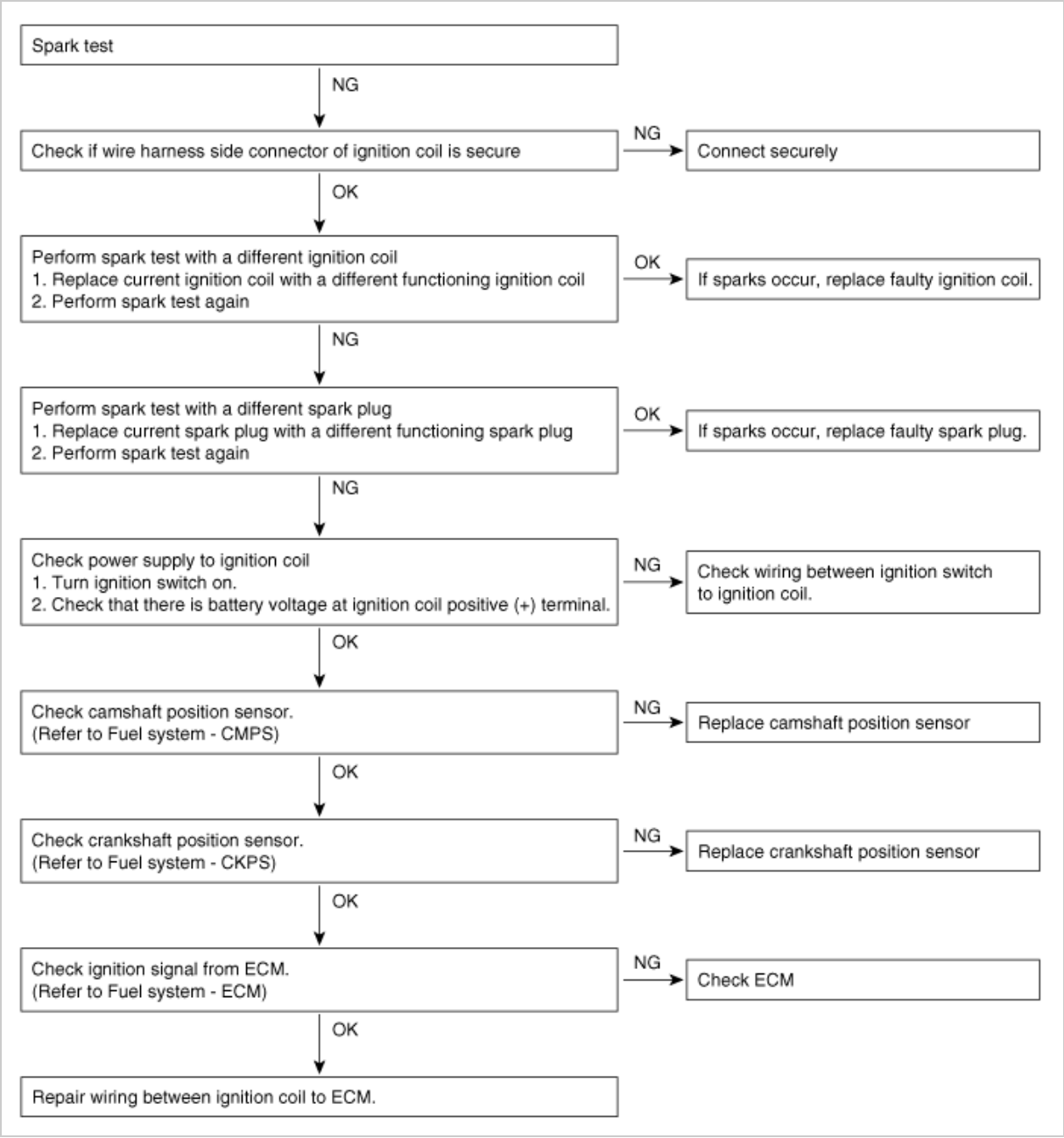


(7) Check if sparks occur at each spark plug while engine is being cranked.

NOTICE

- Do not crank the engine for more then 5 seonds.

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.

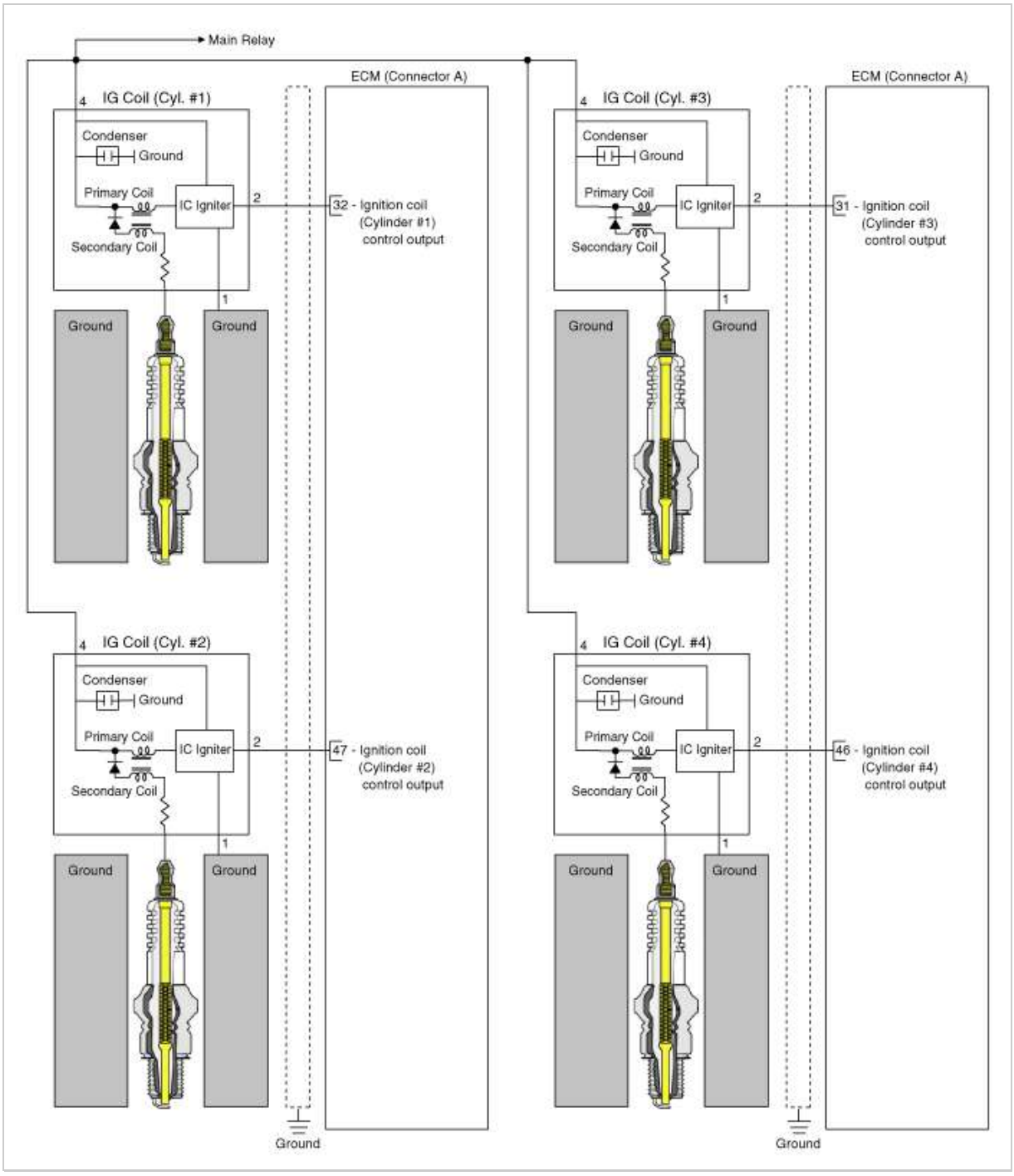
Engine Electrical System

Description

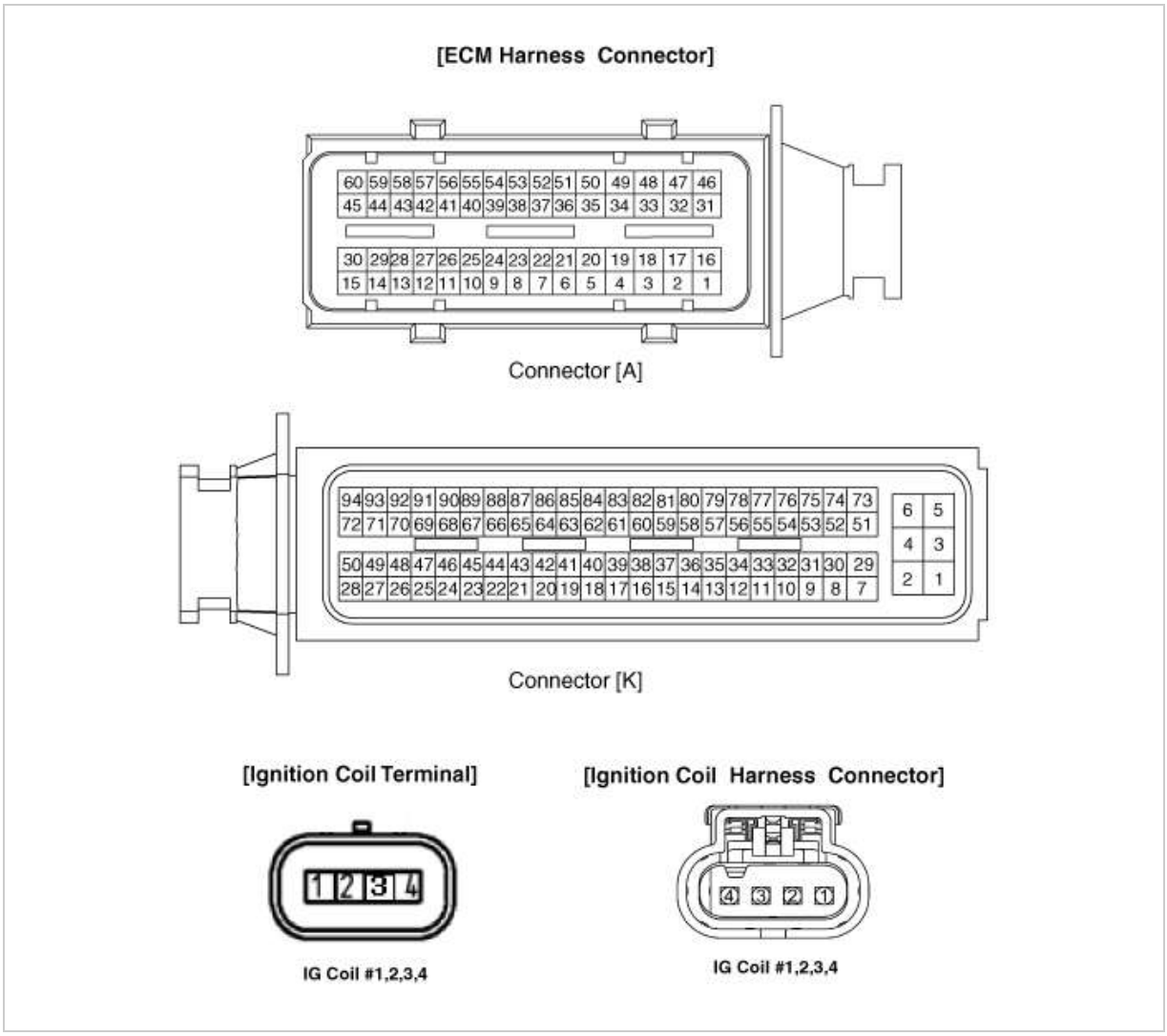
An ignition coil is an induction coil in an engine"s ignition system which transforms the battery"s low voltage to the high voltage needed to create an electric spark in the spark plugs to ignite the fuel. Coils have an internal resistor while others rely on a resistor wire or an external resistor to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

Engine Electrical System

Circuit Diagram



Connector View



Ignition Coil Terminal Function

Ignition Coil (Cylinder #1)

Pin No.	Description	Connected to
1	Ground	Chassis
2	ignition Coil #1 Control output	ECM Connector A (32)
3	-	
4	Battery power (B+)	Main Relay

Ignition Coil (Cylinder #2)

Pin No.	Description	Connected to
1	Ground	Chassis
2	ignition Coil #2 Control output	ECM Connector A (47)
3	-	
4	Battery power (B+)	Main Relay

Ignition Coil (Cylinder #3)

Pin No.	Description	Connected to
1	Ground	Chassis

2	ignition Coil #3 Control output	ECM Connector A (31)
3	-	
4	Battery power (B+)	Main Relay

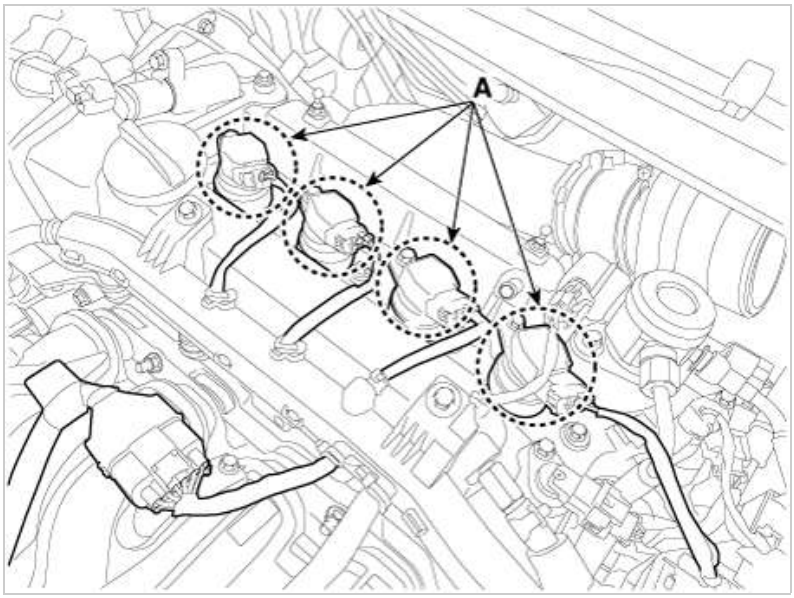
Ignition Coil (Cylinder #4)

Pin No.	Description	Connected to
1	Ground	Chassis
2	ignition Coil #4 Control output	ECM Connector A (46)
3	-	
4	Battery power (B+)	Main Relay

Engine Electrical System

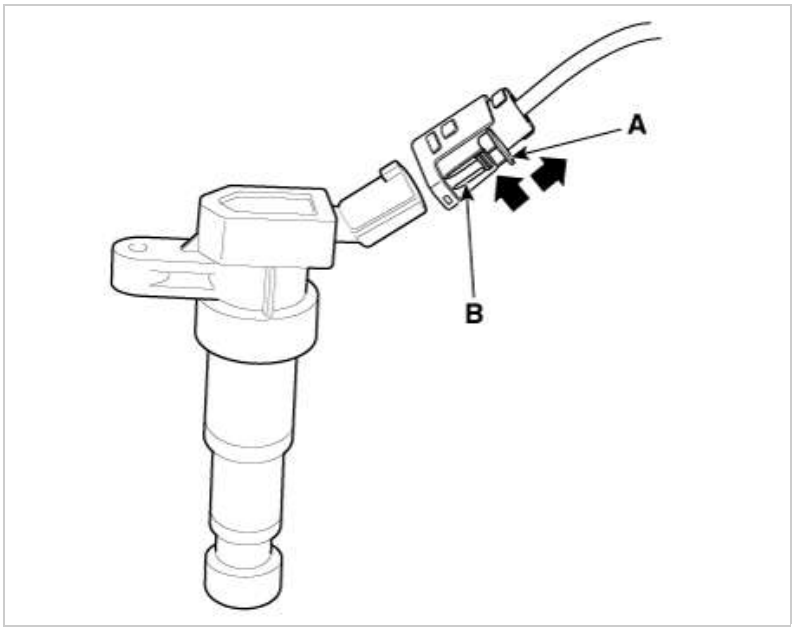
Removal

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

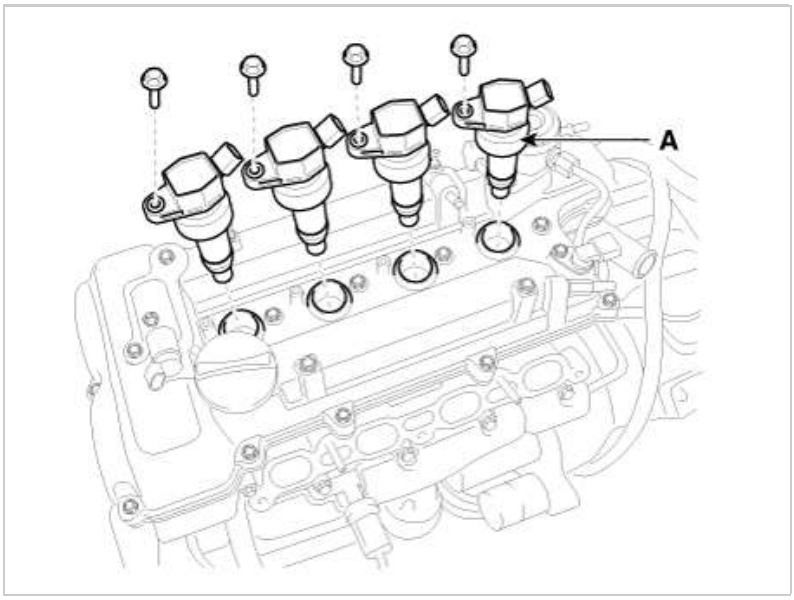


NOTICE

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



4. Remove the ignition coil (A).



Installation

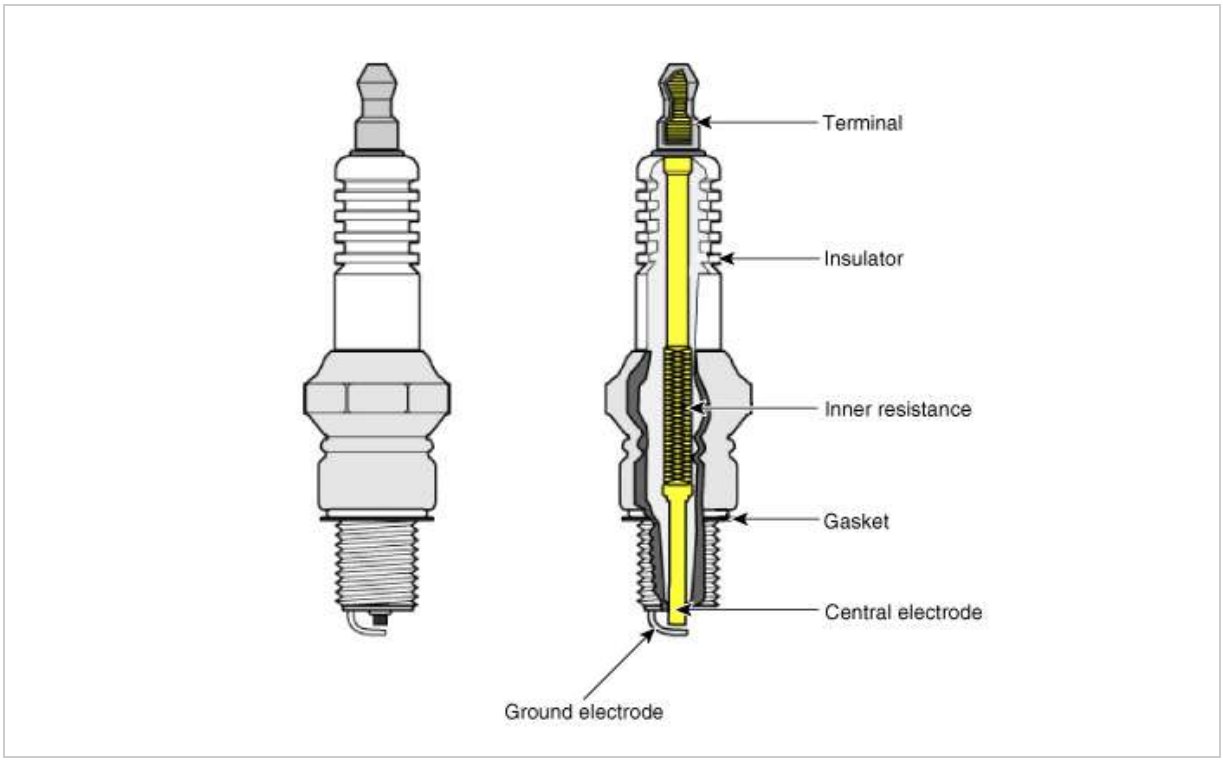
1. Install in the reverse order of removal.

Ignition coil mounting bolts:
9.8 - 11.8 N·m (1.0 - 1.2 kgf·m, 7.2 - 8.7 lb·ft)

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	SILKR8E8G
Gap	0.7 - 0.8 mm (0.028 - 0.31 in.)

Engine Electrical System

Inspection

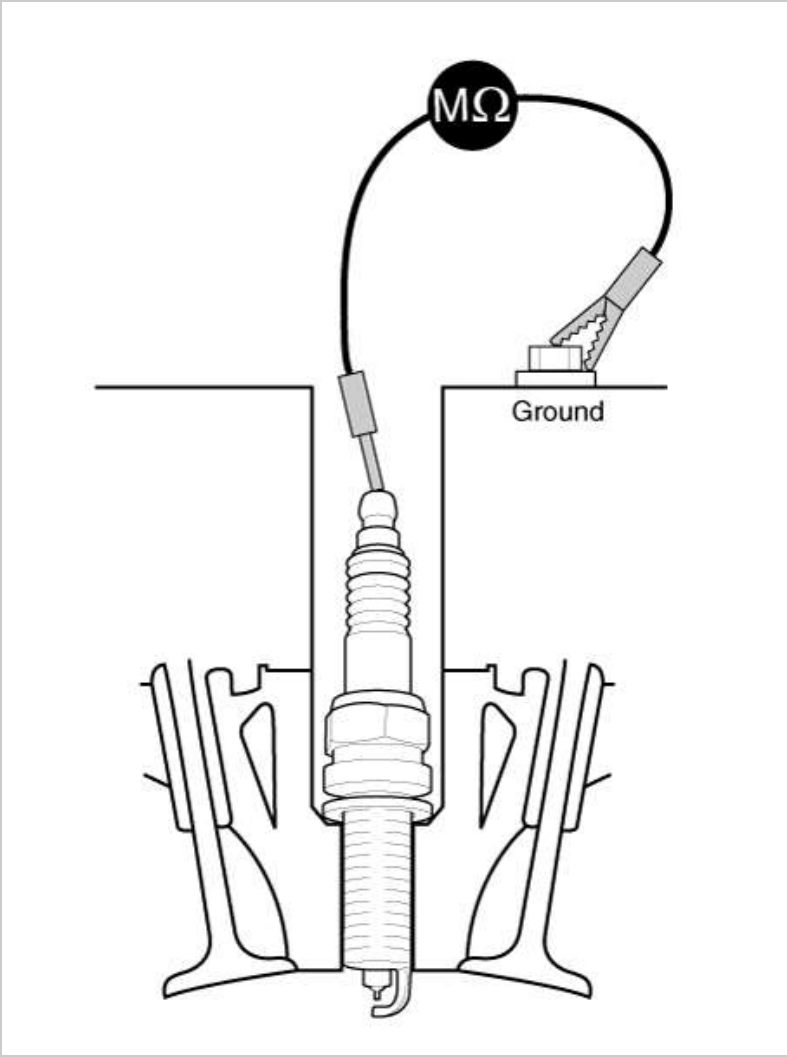
[On vehicle inspection]

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 MΩ or more

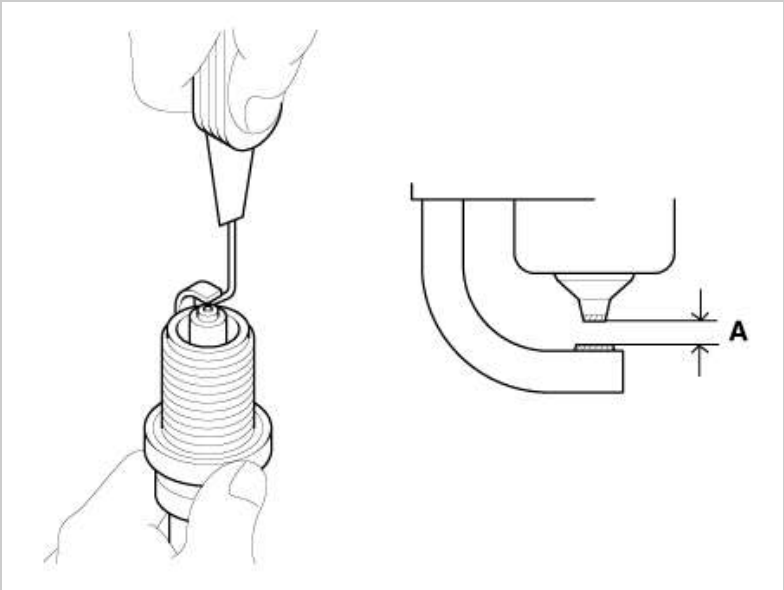


3. Check the spark plug electrode gap.
   If the gap is greater than the maximum, replace the spark plug.

Specification:0.7 - 0.8 mm (0.028 - 0.031 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.

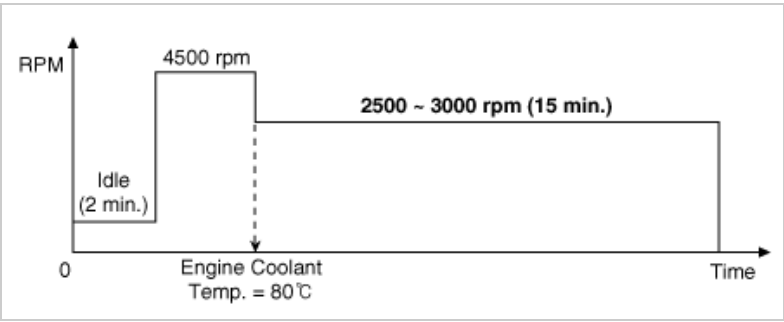


Cleaning

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]

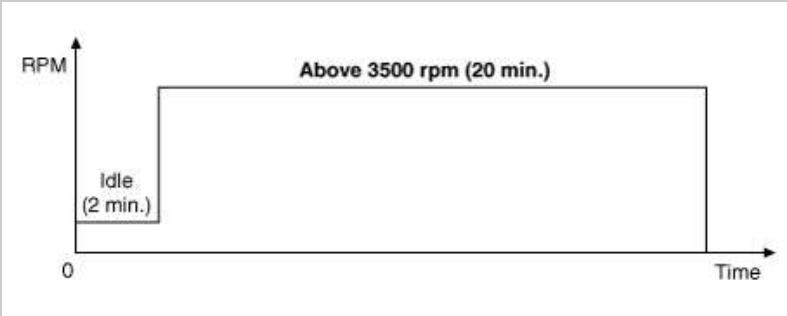
NOTICE

- 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.

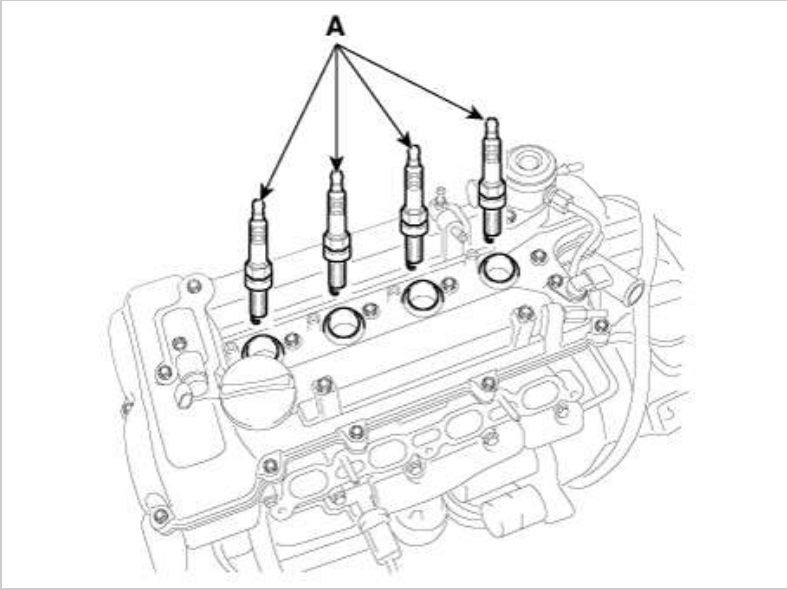


Removal

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 contaminates 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

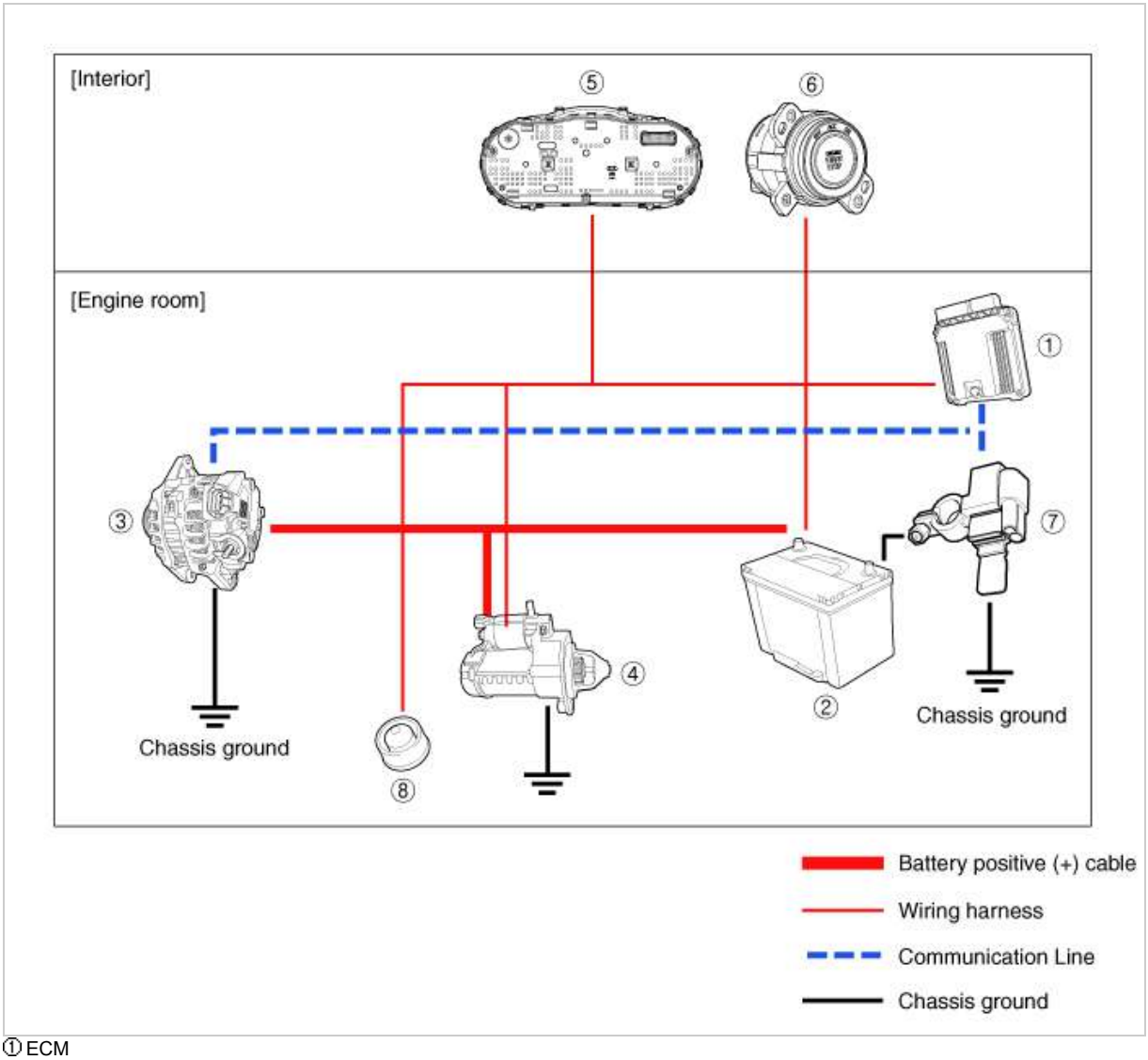
Troubleshooting

Symptom	Suspect Area	Remedy
Engine will not start or is hard to start (Cranks 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

Engine Electrical System

Components



① ECM
② Battery
③ Alternator
④ Starter
⑤ Instrument Cluster
⑥ Ignition switch or start/stop button
⑦ Battery sensor
⑧ Hood switch

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

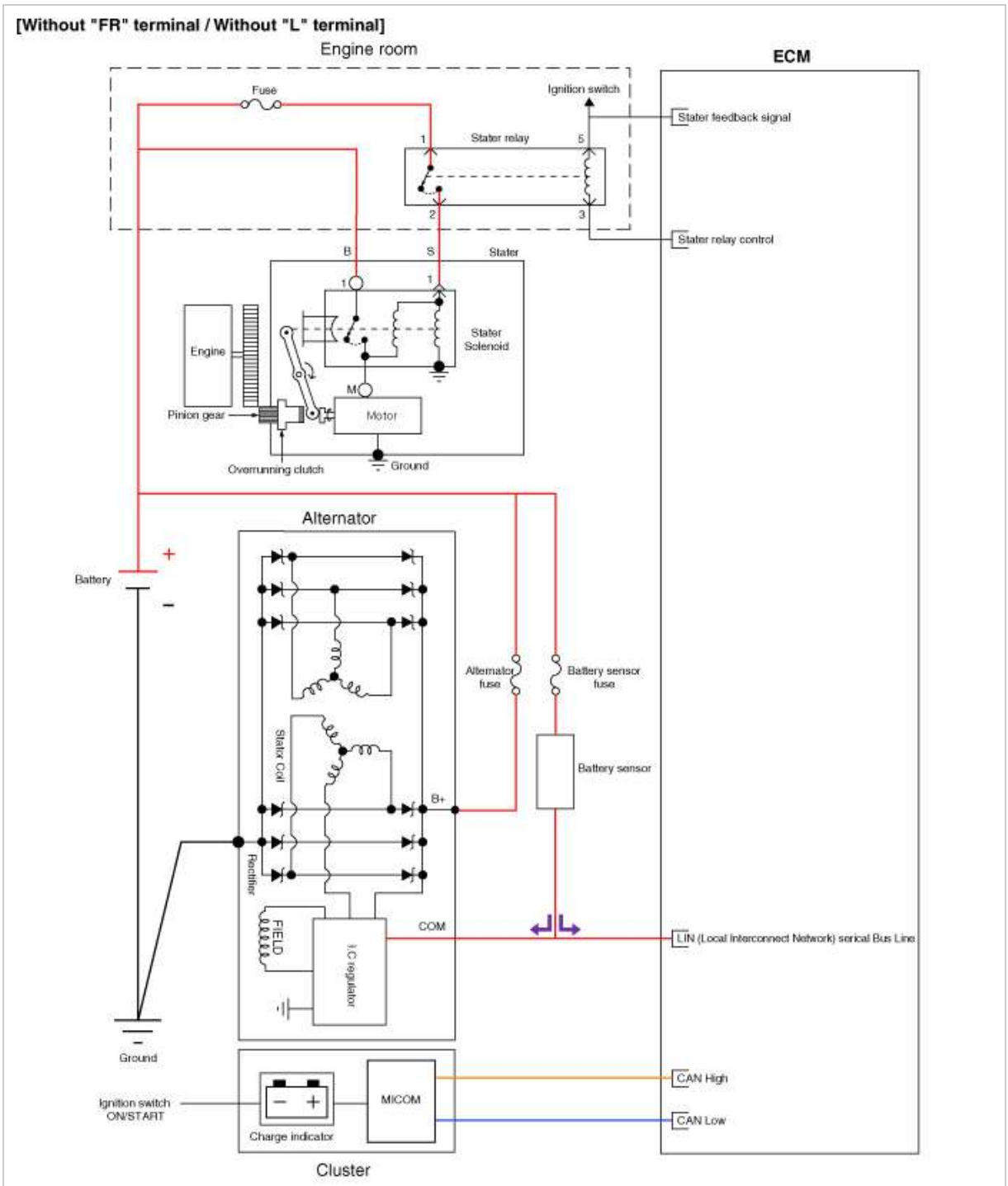
Alternator management system controls the charging voltage set point in order to improve fuel economy, manage alternator load under various operating conditions, keep the battery charged, and protect the battery from over-charging. ECM controls generating voltage by duty cycle (charging control, discharging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

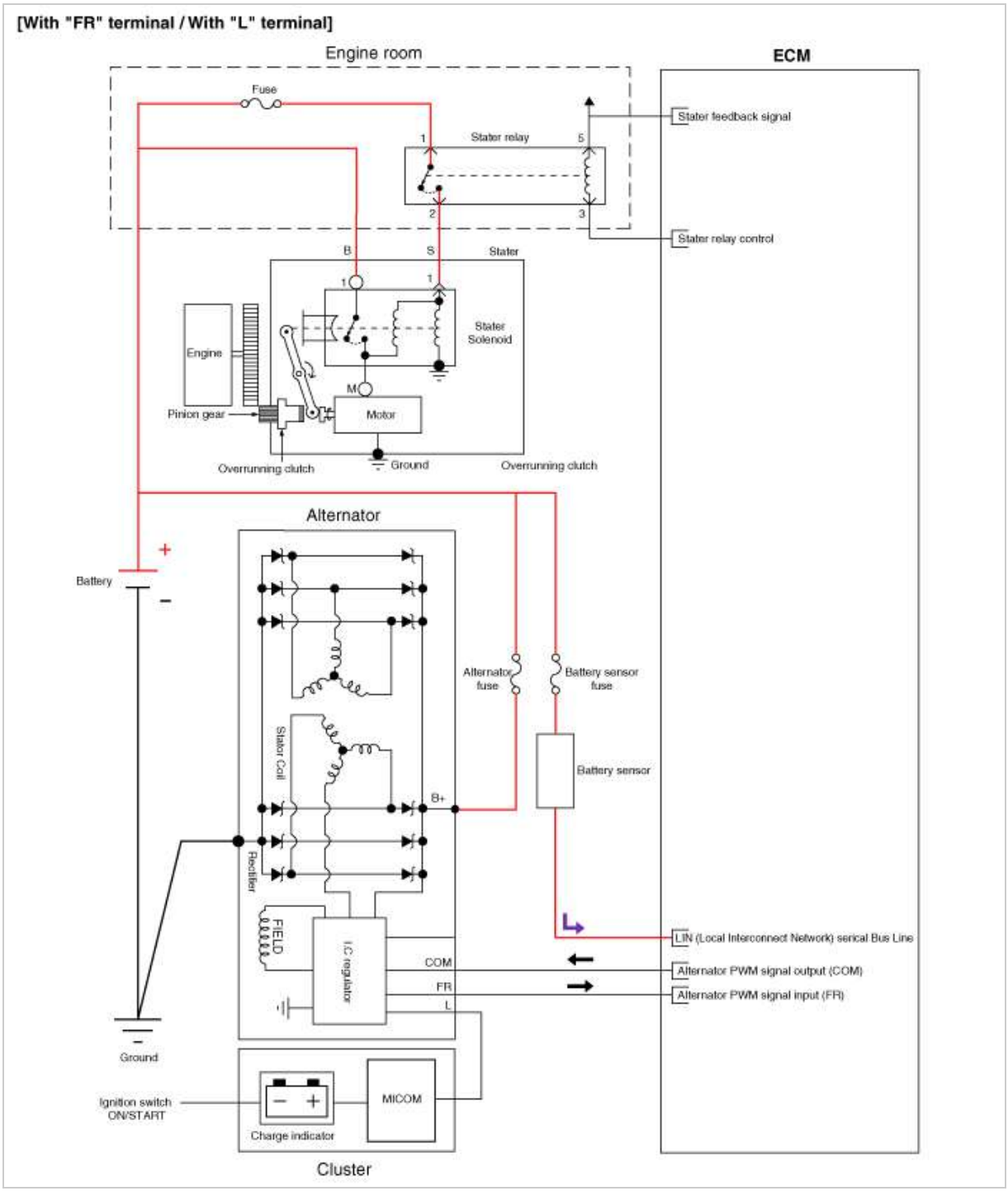
The system conducts charging control when decelerating a vehicle. Vehicle increases an alternator load and charges a battery.

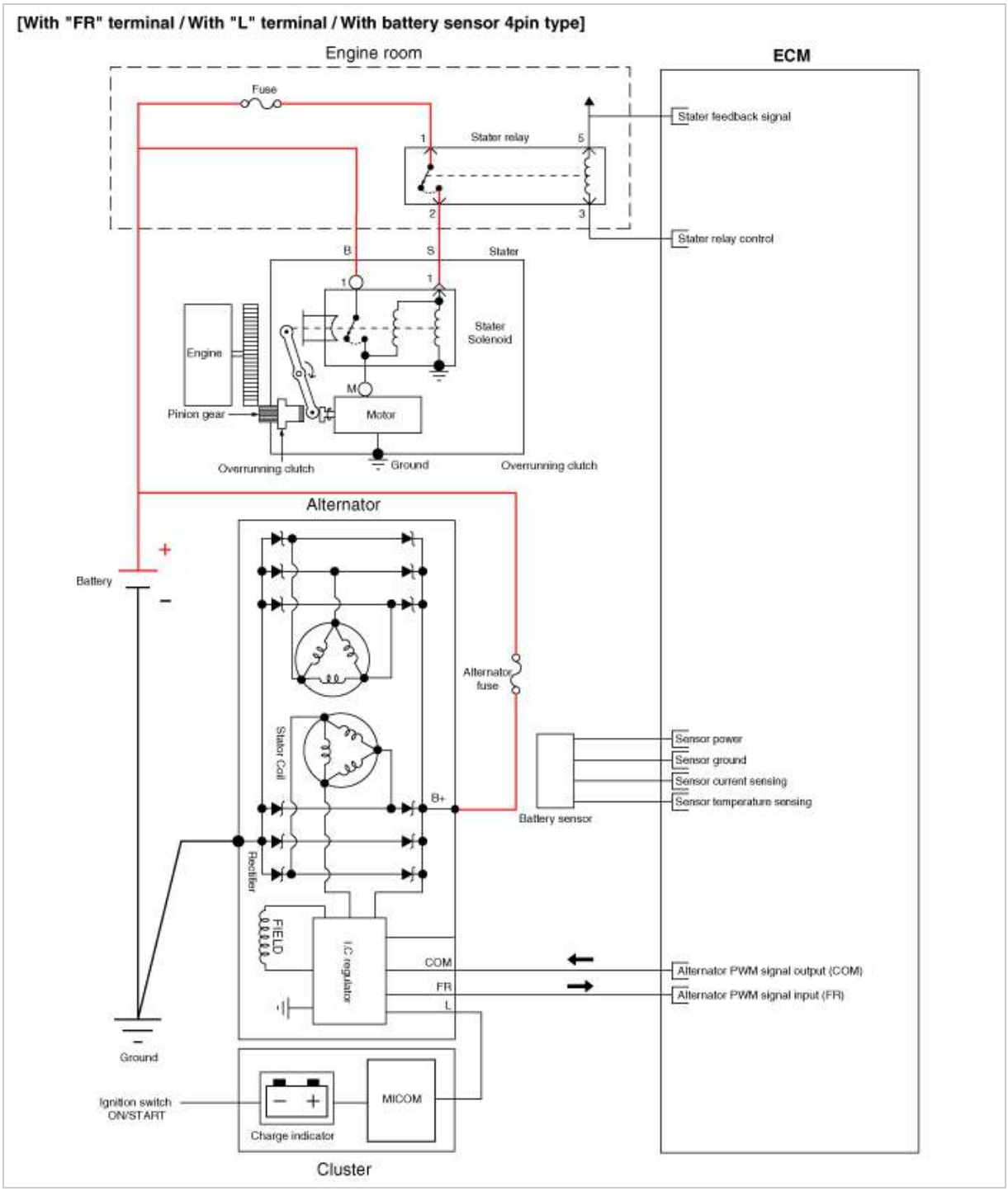
Engine Electrical System

Circuit Diagram



[With "FR" terminal / With "L" terminal]





Engine Electrical System

Inspection

Inspection Item

- Battery efficiency inspection
- Battery voltage inspection
- Charging voltage insptection
- General inspection
- Terminal tightening state inspection
- Engine/ transaxle ground state inspection
- Wiring harness ground state inspection
- Electrical Specified Value Inspection

- Vehicle parasitic current inspection
- Battery capacity inspection

Battery Efficiency Inspection

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.

NOTICE

Inspect the battery test using the load tester and battery tester.

Battery Voltage Inspection

1. After having driven the vehicle and in the case that 20 minutes have not passed after having stopped the engine, turn the ignition switch ON and turn on the electrical system (headlamp, blower motor, rear defogger etc.) for 60 seconds to remove the surface charge.
2. Turn the ignition switch OFF and turn off the electrical systems.
3. Measure the battery voltage between the negative (-) and positive (+) terminals of the battery.

   Standard voltage :

   Approximately 12.5 - 12.9 V [20°C (68°F)]

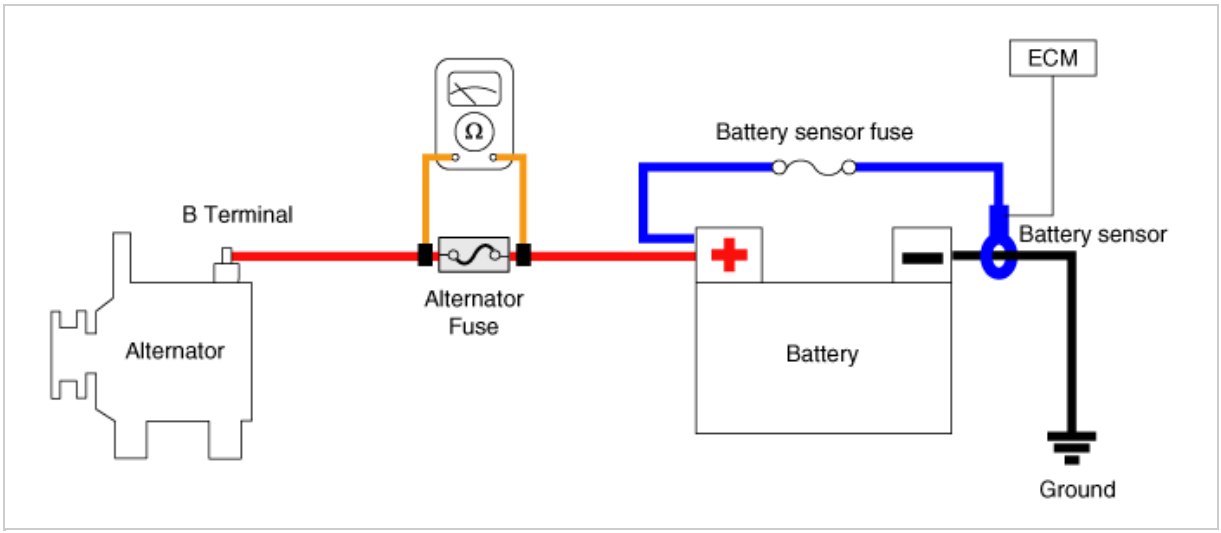
   If the voltage is less than specification, charge the battery.

General Inspection

1. Check that the battery terminals are not loose or corroded.
   (Refer to Charging System - "Battery")
2. Check the fuses for continuity.

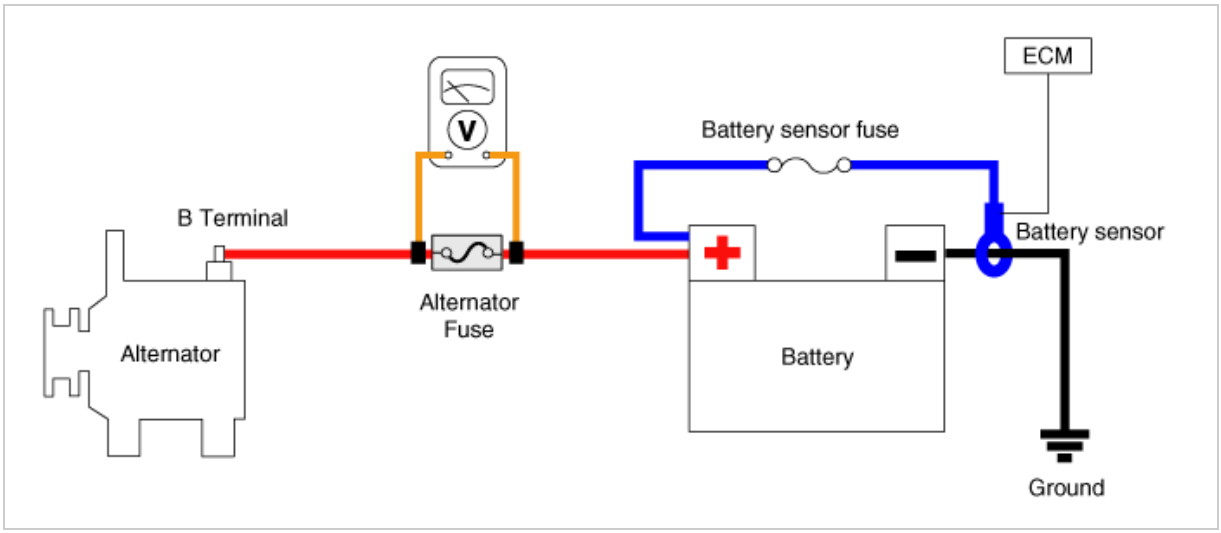
Alternator Fuse

(1) Check the alternator fuse for continuity.



(2) Measure the voltage as shown in the image below.

Standard value : Approximately 0 V



(3) If the alternator fuse is blown, replace it as in the procedure below:

a. Turn ignition switch OFF and disconnect the battery negative (-) terminal.

b. Remove the battery positive (+) cable mounting nuts.

c. Replace the norminal alternator fuse or battery cable.

d. Install in the reverse order of removal.

Battery Sensor Fuse

(1) Check the battery sensor fuse (A) for continuity.

(2) Replace the norminal battery sensor fuse.

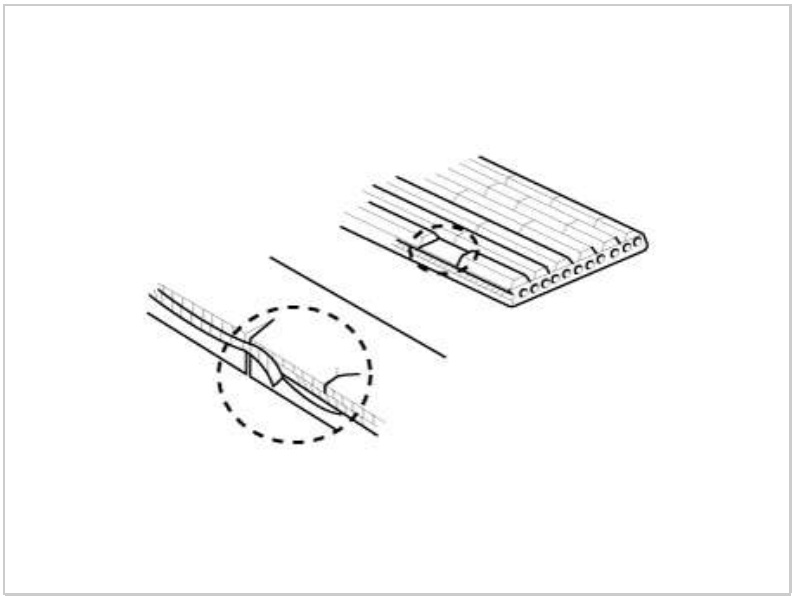
(3) Measure the voltage.

Standard value : Approximately 0 V

3. 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.



4. Measure and adjust drive belt tension.
(Refer to Engine Mechanical System - "Drive Belt")

5. 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.

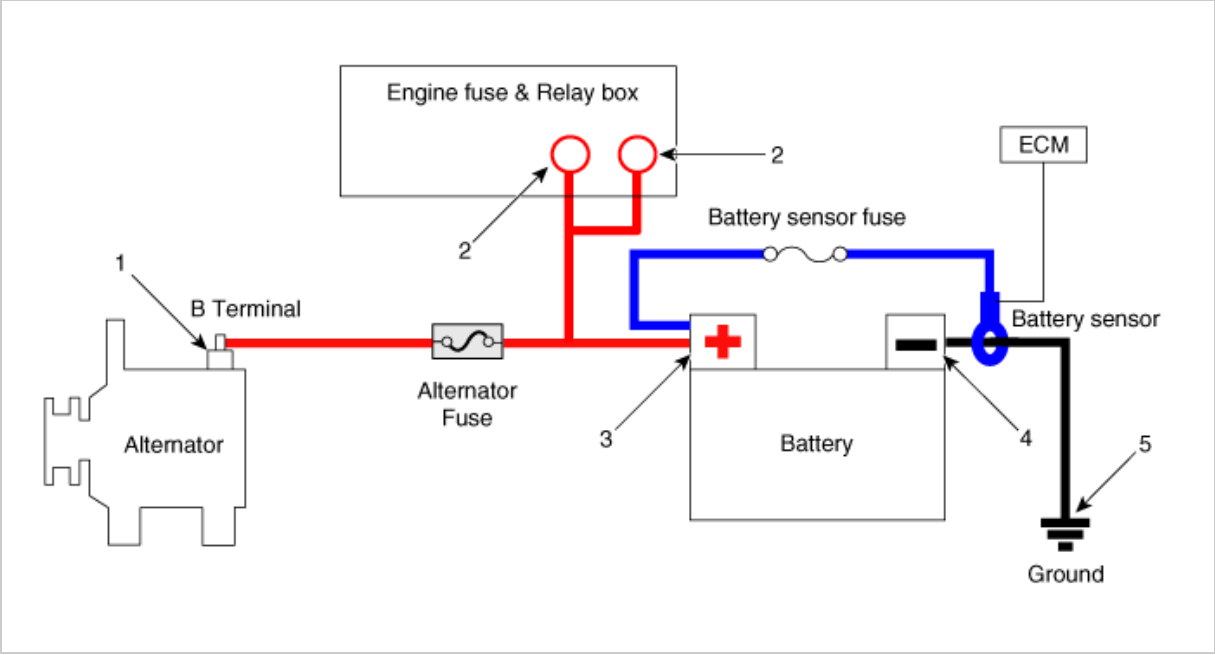
6. Check Discharge Warning Light Circuit
   (1) Warm up the engine and then turn it off.
   (2) Turn off all accessories.
   (3) Turn the ignition switch "ON". Check that the discharge warning light is lit.
   (4) Start the engine. Check that the light is lit.
   If the light does not go off as specified, troubleshoot the discharge light circuit.

Terminal Tightening State Inspection

NOTICE

- Alternator B+ terminal state
- Alternator B+ termina tightening nut
- Battery positive (+) terminal state
- Battery positive (+) terminal tightening nut state
- Battery negative (-) terminal state
- Battery negative (-) terminal tightening nut state
- Battery negative (-) terminal mounting bolt tightening state (Chassis ground)
- Battery sensor negative (-) terminal state (With battery sensor)
- Battery sensor negative (-) terminal tightening nut state (With battery sensor)
- Battery sensor negative (-) terminal mounting bolt tightening state (Chassis ground) [With battery sensor]
- Engine room fuse & relay box positive (+) harness state
- Engine room fuse & relay box positive (+) harness tightening nut state
- Check the status of ground fault by chassis paint

Inspection Component Location



1. Alternator B+ terminal
2. Engine room fuse & relay box positive (+) terminal
3. Battery negative (+) terminal
4. Battery negative (-) terminal
5. Chassis ground

Engine/ Transaxle Ground State Inspection

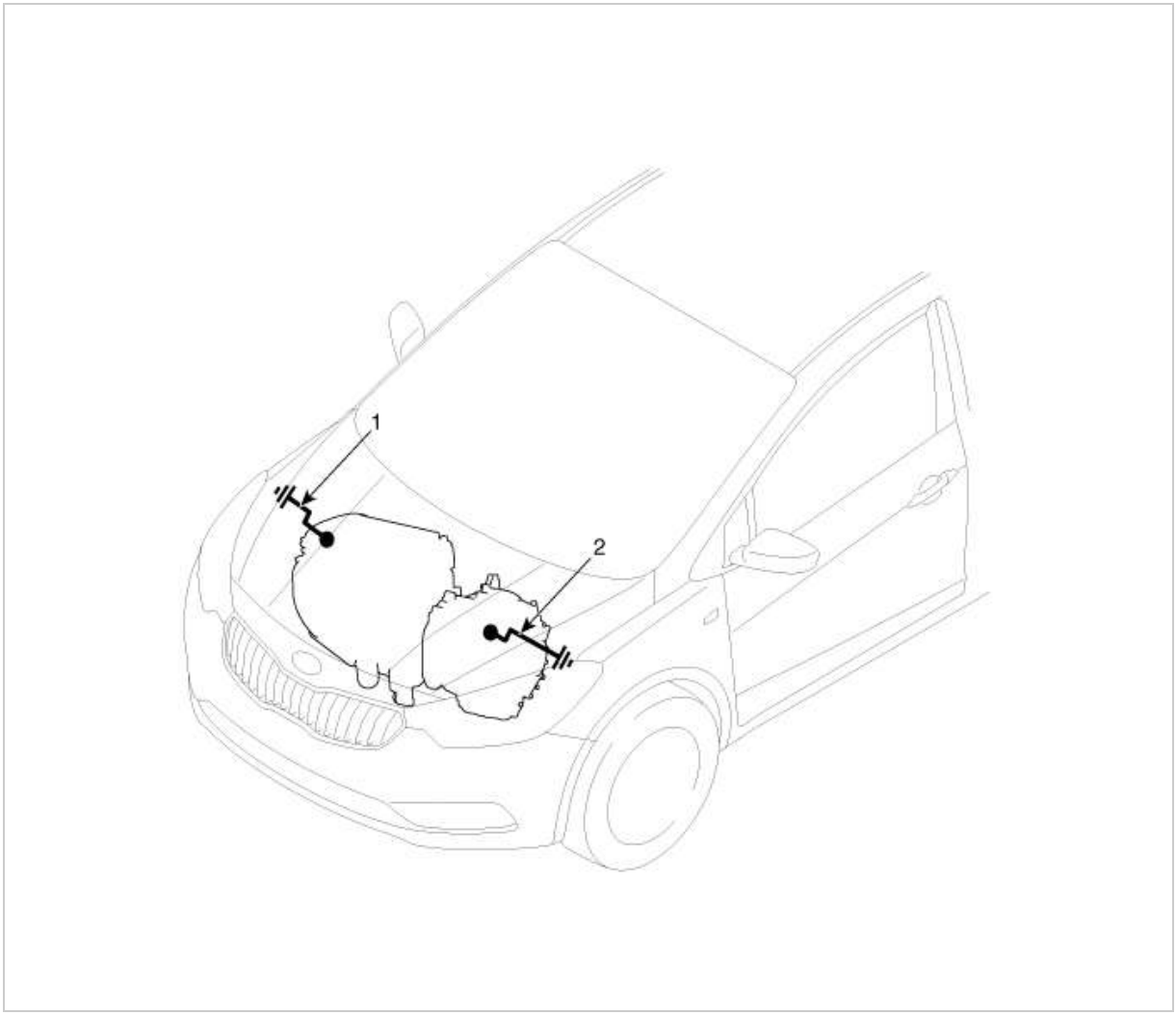
NOTICE

- Ground state
- Mounting bolt tightening state (Chassis)
- Mounting bolt tightening state (Engine)
- Check the status of ground fault by chassis paint

Wiring harness ground state inspection

NOTICE

- Ground state
- Mounting bolt tightening state (Chassis)
- Mounting bolt tightening state (Engine)
- Check the status of ground fault by chassis paint



1. Engine ground (Engine ↔ Chassis)
2. Transaxle ground (Transaxle ↔ Chassis)

NOTICE

Check the ground point.
(Refer to ETM Harness Layout - "Ground Point")

Electrical Specified Value Inspection (Using the Voltmeter and Ammeter)

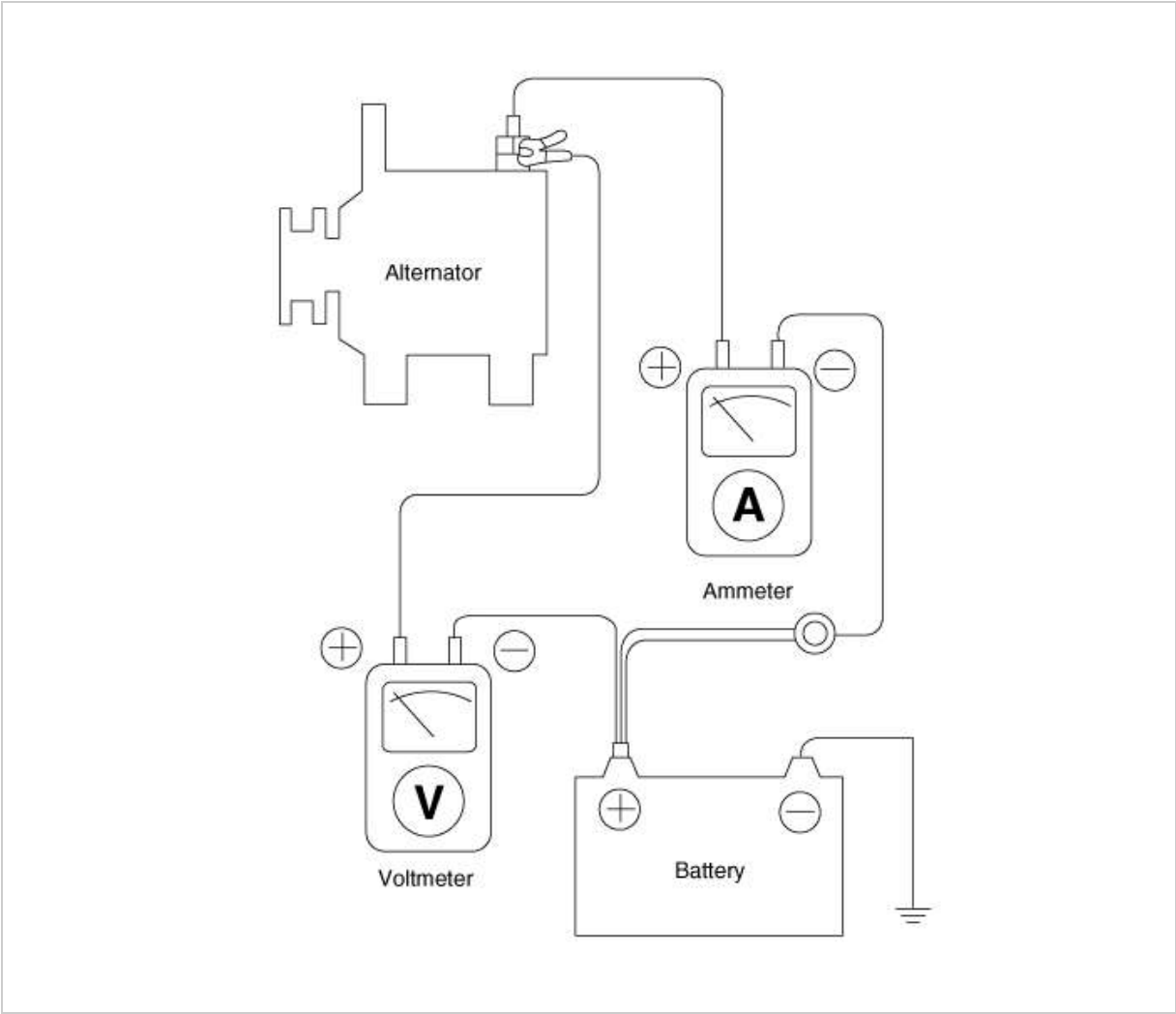
1. Voltage Drop Test of Alternator Output Wire

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, adjust the engine speed until the ammeter indicates 20A and read the voltmeter.

(3) Result

a. The voltmeter may indicate the standard value.

Standard value :0.2 V 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 over-heated 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. Refer to the "Battery" section for checking battery.

The battery used to test the output current should be 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. Refer to the "Inspect drive belt" section for checking the belt tension.

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 150 A) 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.

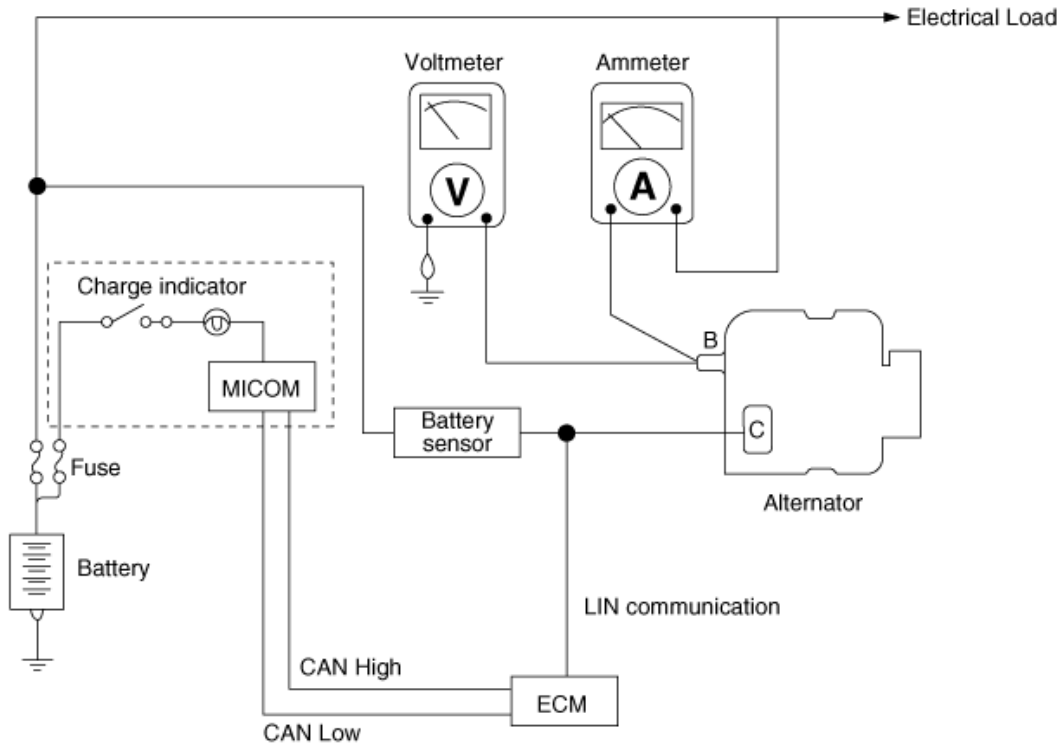
> **NOTICE**
> Tighten each connection securely, as a heavy current will flow. Do not rely on clips.

f. Connect a voltmeter (0 to 20 V) between the "B" terminal and ground. Connect the (+) lead wire to the alternator "B" terminal and (-) lead wire to a good ground.

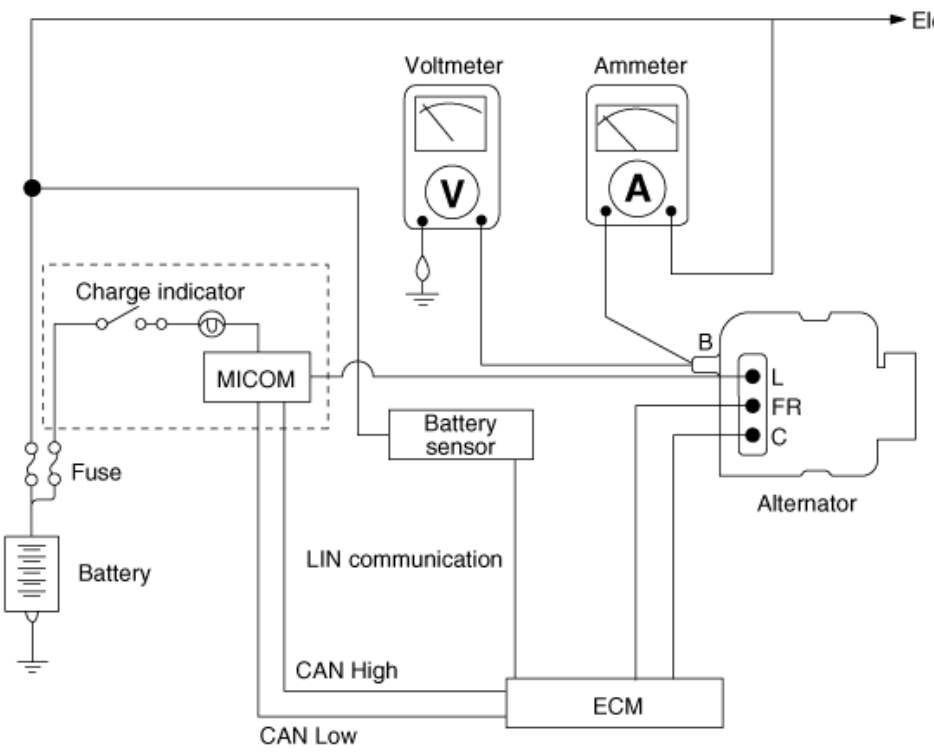
g. Connect the battery ground cable.

h. Leave the engine hood open.

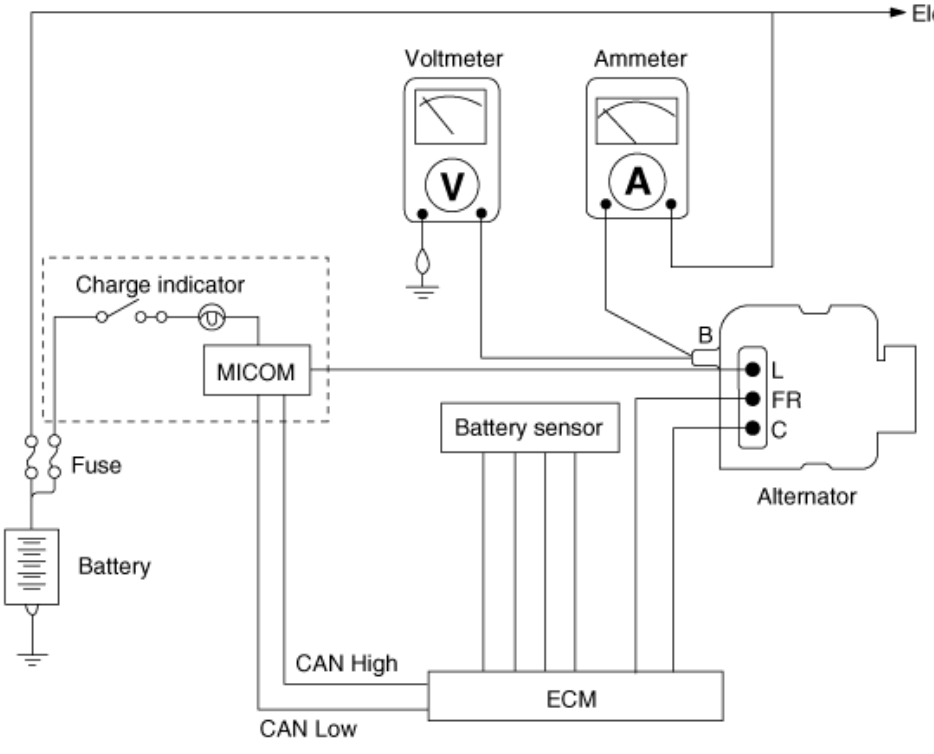
[Without "FR" terminal / Without "L" terminal]



[With "FR" terminal / With "L" terminal]



[With "FR" terminal / With "L" terminal]



(2) Test

a. Check to see that the voltmeter reads the same value as the battery voltage. If the voltmeter reads 0V, open circuit in the wire between alternator "B" terminal and battery (+) terminal or poor grounding is suspected.

b. Start the engine and turn on the headlamps.

c. 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

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

Limit value :60% of the current rate

> **Information**
>
> The nominal output current value is shown on the nameplate affixed to the alternator body.

> **NOTICE**
>
> 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 to discharge the battery or use lights of other vehicles 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.

b. Upon completion of the output current test, lower the engine speed to idle and turn off the ignition switch.

c. Disconnect the battery negative (-) terminal.

d. Remove the ammeter and voltmeter and the engine tachometer.

e. Connect the alternator output wire to the alternator "B" terminal.

f. Connect the battery negative (-) terminal.

3. Regulated Voltage Test

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

(1) Preparation

a. Prior to the test, check the following items and correct if necessary.

Check that the battery installed on the vehicle is fully charged. Refer to the "Battery" section for checking the battery.

Check the alternator drive belt tension. Refer to the "Inspect drive belt" section for checking the belt tension.

b. Turn ignition switch to "OFF".

c. Disconnect the battery negative (-) terminal.

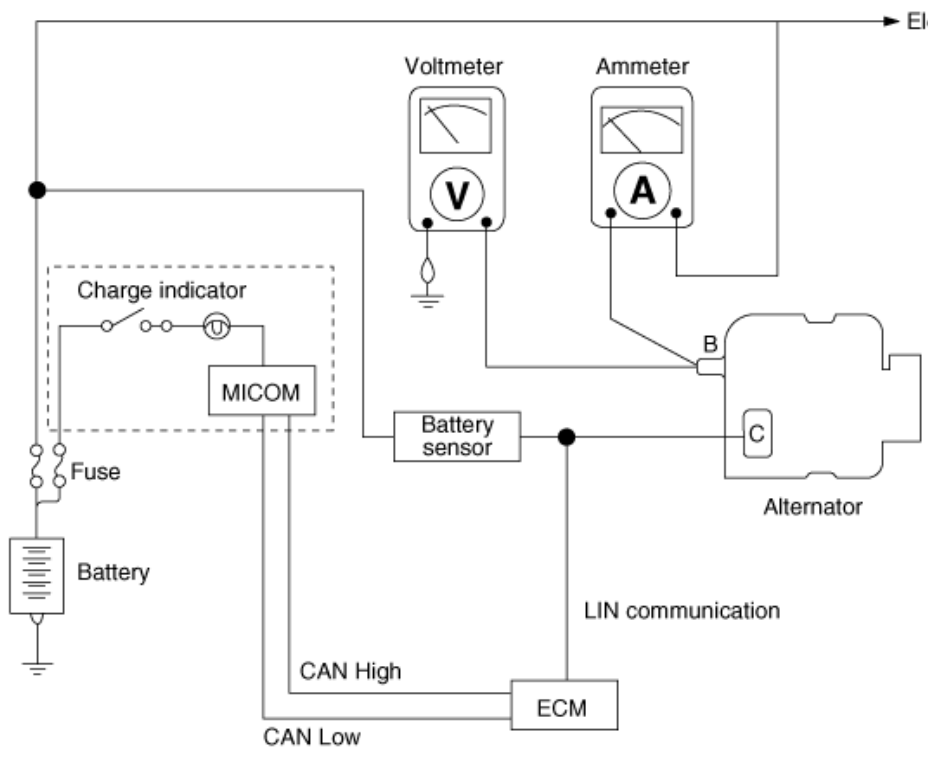
d. Connect a digital voltmeter between the "B" terminal of the alternator and ground. Connect the (+) lead of the voltmeter to the "B" terminal of the alternator. Connect the (-) lead to good ground or the battery (-) terminal.

e. Disconnect the alternator output wire from the alternator "B" terminal.

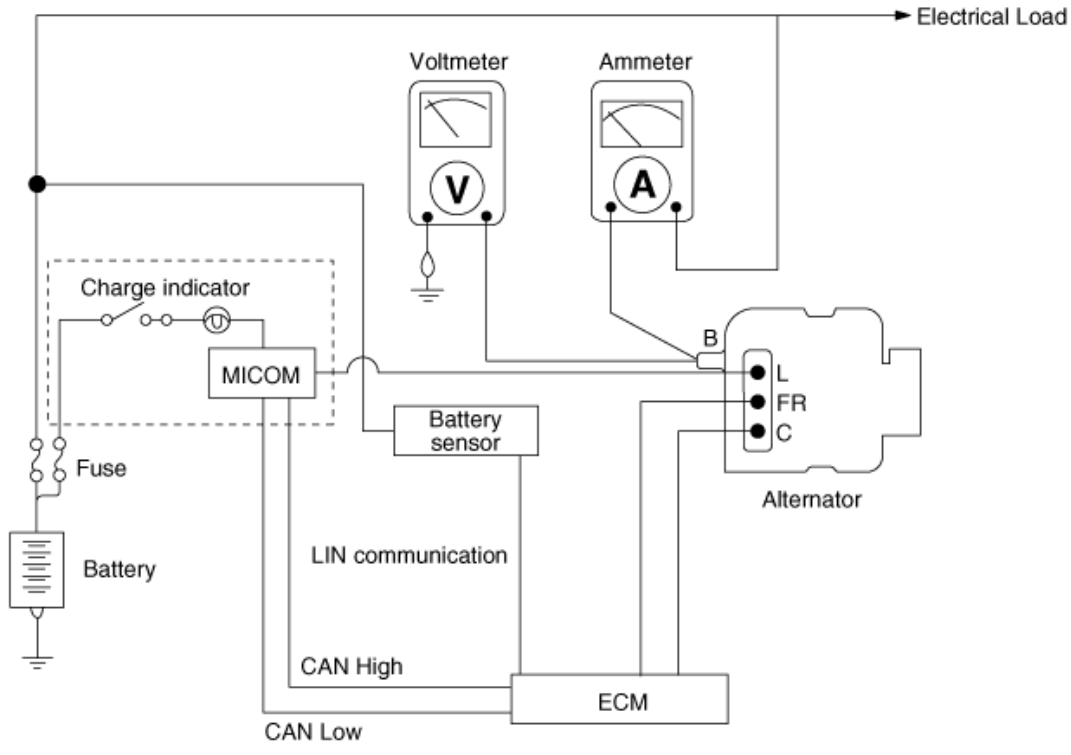
f. Connect a DC ammeter (0 to 150A) in series between the "B" terminal and the disconnected output wire. Connect the (-) leadwire of the ammeter to the disconnected output wire.

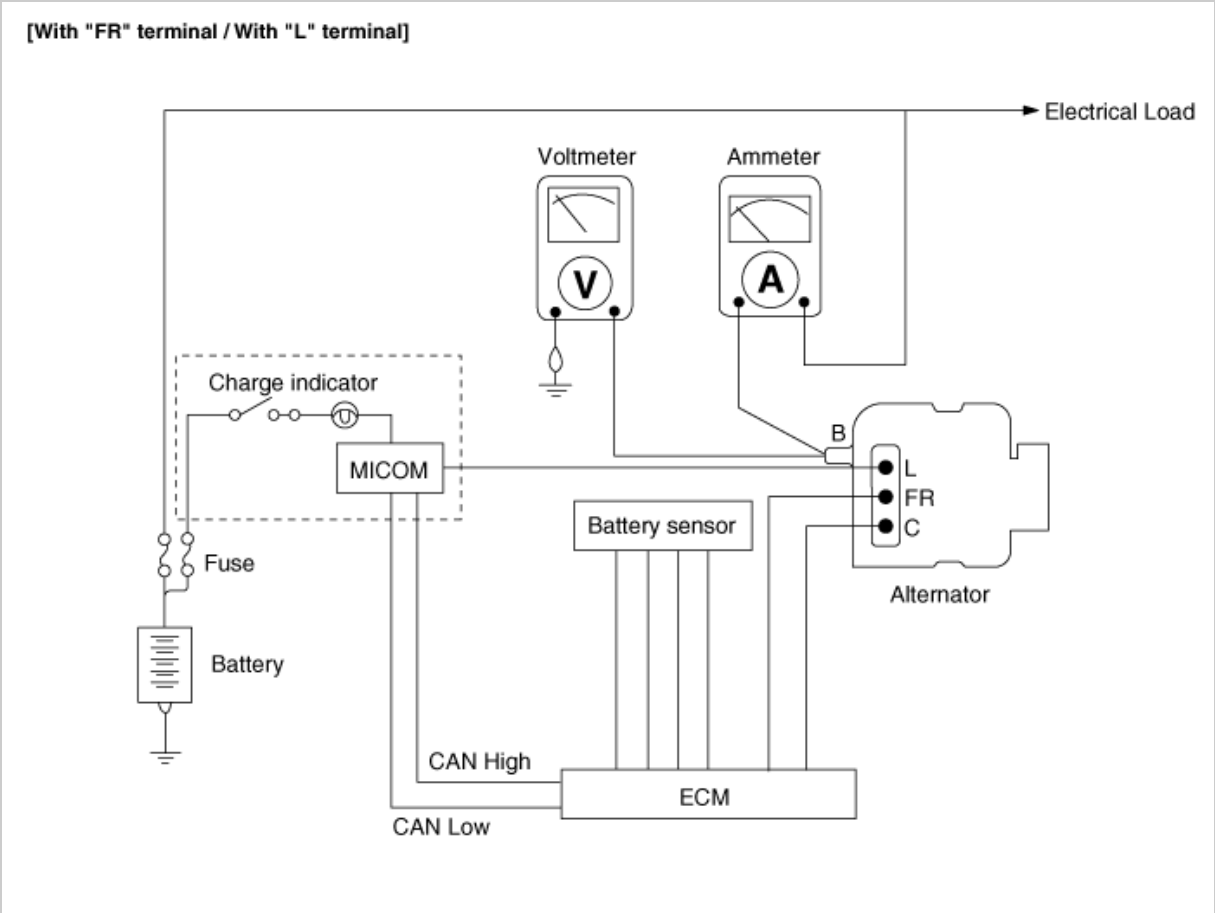
g. Connect the battery negative (-) terminal.

[Without "FR" terminal / Without "L" terminal]



[With "FR" terminal / With "L" terminal]





(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 0 V, 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 10 A or less

(3) Result

a. If the voltmeter reading doesn"t agree with the standard value, the voltage regulator or the alternator is faulty.

Regulated Voltage :11.7 - 15.3 V

b. If the voltmeter reading doesn"t agree with the standard value, the voltage regulator or the alternator is faulty.

c. Disconnect the battery negative (-) terminal.

d. Remove the voltmeter and ammeter.

e. Connect the alternator output wire to the alternator "B" terminal.

f. Connect the battery negative (-) terminal.

Electrical Specified Value Inspection (Using the Voltmeter and Clamp type Ammeter)

1. Voltage Drop Test of Alternator Output Wire

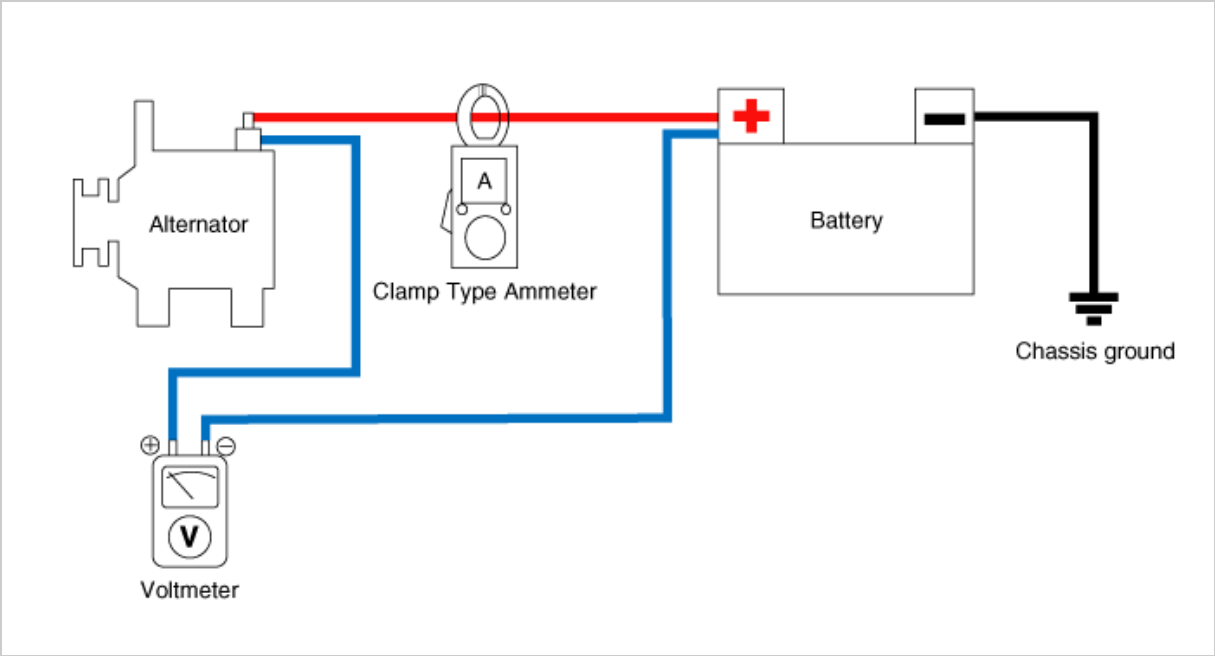
This test determines whether or not the wiring between the alternator "B" terminal and the battery (+) terminal is good by the voltage drop method.

(1) Preparation

a. Turn the ignition switch to "OFF".

b. Install the clamp type ammeter between battery positive (+) and alternator "B" terminal.

c. 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, adjust the engine speed until the ammeter indicates 20A and read the voltmeter.

(3) Result

a. The voltmeter may indicate the standard value.

Standard value :0.2 V max

b. If the value of the voltmeter is higher than expected (above 0.2 V 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 over-heated 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 good condition. Refer to the "Battery" section for checking the battery.

The battery used to test the output current should be 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. Refer to the "Inspect drive belt" section for checking the belt tension.

b. Turn off the ignition switch.

c. Disconnect the battery negative (-) terminal.

d. Install the clamp type ammeter between battery positive (+) and alternator "B" terminal.

e. Connect a DC ammeter (0 to 150 A) 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.

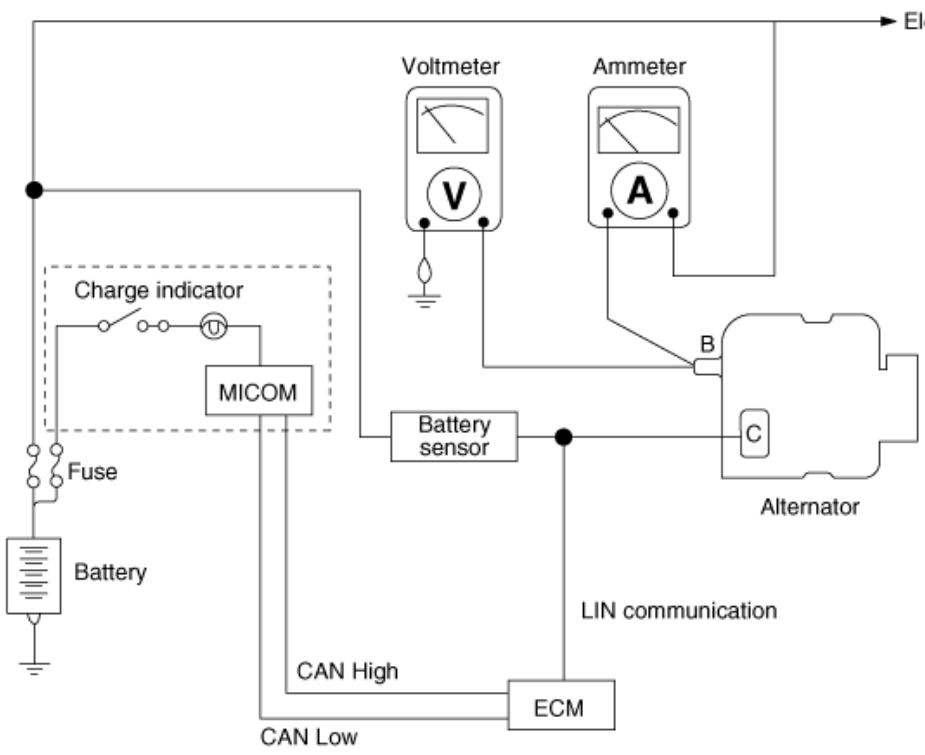
> ***NOTICE***
>
> Tighten each connection securely, as a heavy current will flow. Do not rely on clips.

f. Connect a voltmeter (0 to 20 V) between the "B" terminal and ground. Connect the (+) lead wire to the alternator "B" terminal and (-) lead wire to a good ground.

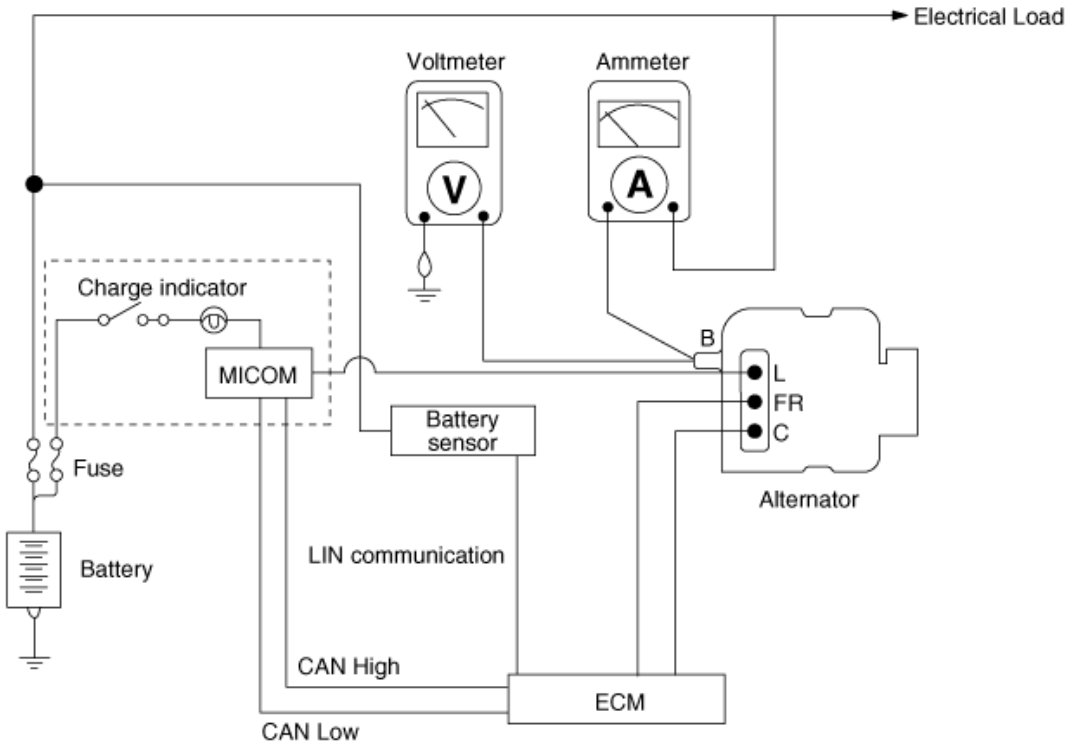
g. Connect the battery negative (-) terminal.

h. Leave the engine hood open.

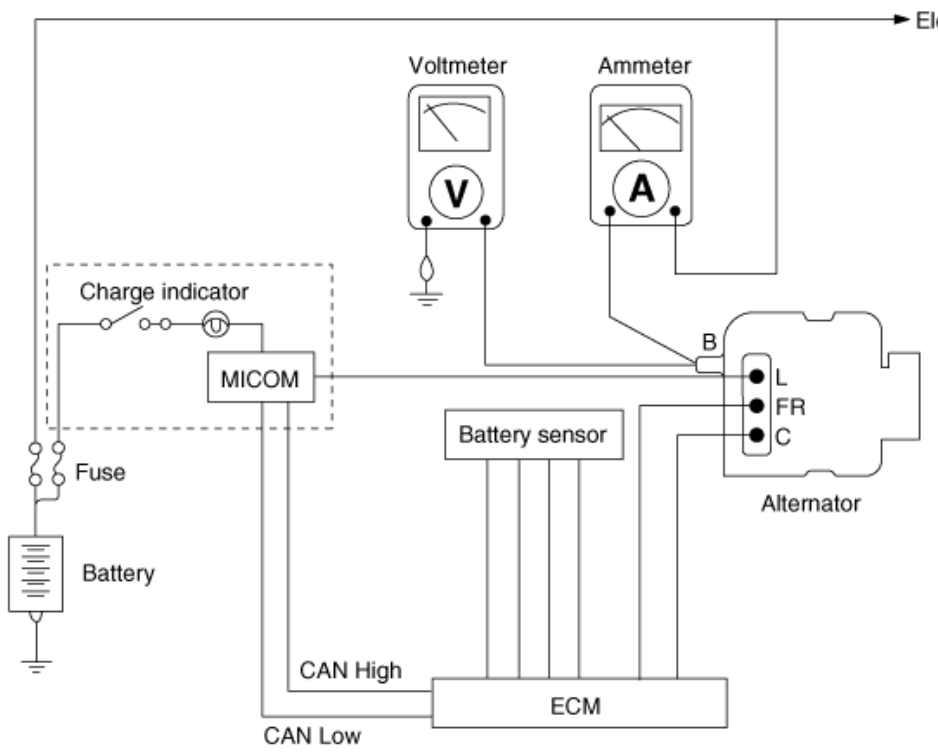
[Without "FR" terminal / Without "L" terminal]



[With "FR" terminal / With "L" terminal]



[With "FR" terminal / With "L" terminal]



(2) Test

a. Check to see that the voltmeter reads the same value as the battery voltage. If the voltmeter reads 0V, open circuit in the wire between alternator "B" terminal and battery (+) terminal or poor grounding is suspected.

b. Start the engine and turn on the headlamps.

c. 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

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

Limit value :60% of the voltage rate

> **Information**
> The nominal output current value is shown on the nameplate affixed to the alternator body.

> **NOTICE**
> 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 to discharge the battery or use lights of other vehicles 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.

b. Upon completion of the output current test, lower the engine speed to idle and turn off the ignition switch

c. Disconnect the battery negative (-) terminal.

d. Remove the ammeter and voltmeter and the engine tachometer.

e. Connect the alternator output wire to the alternator "B" terminal.

f. Connect the battery negative (-) terminal.

3. Regulated Voltage Test

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

(1) Preparation

a. Prior to the test, check the following items and correct if necessary.

Check that the battery installed on the vehicle is fully charged. Refer to the "Battery" section for checking the battery.

Check the alternator drive belt tension. Refer to the "Inspect drive belt" section for checking the belt tension.

b. Turn ignition switch to "OFF".

c. Disconnect the battery negative (-) terminal.

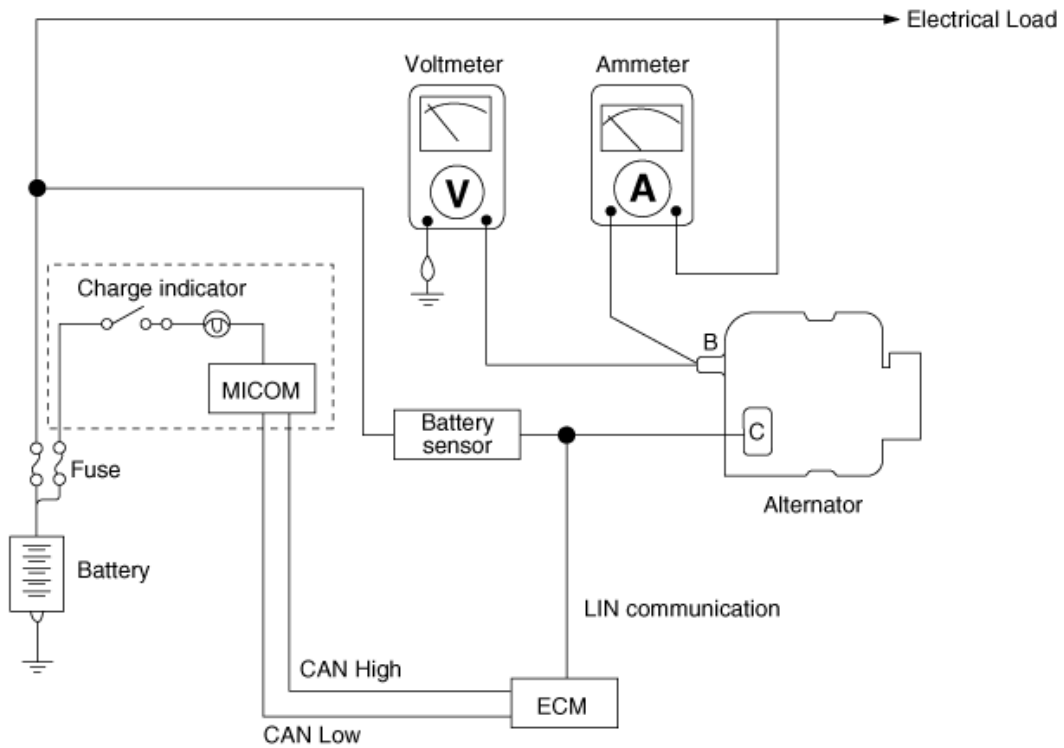
d. Connect a digital voltmeter between the "B" terminal of the alternator and ground. Connect the (+) lead of the voltmeter to the "B" terminal of the alternator. Connect the (-) lead to good ground or the battery (-) terminal.

e. Disconnect the alternator output wire from the alternator "B" terminal.

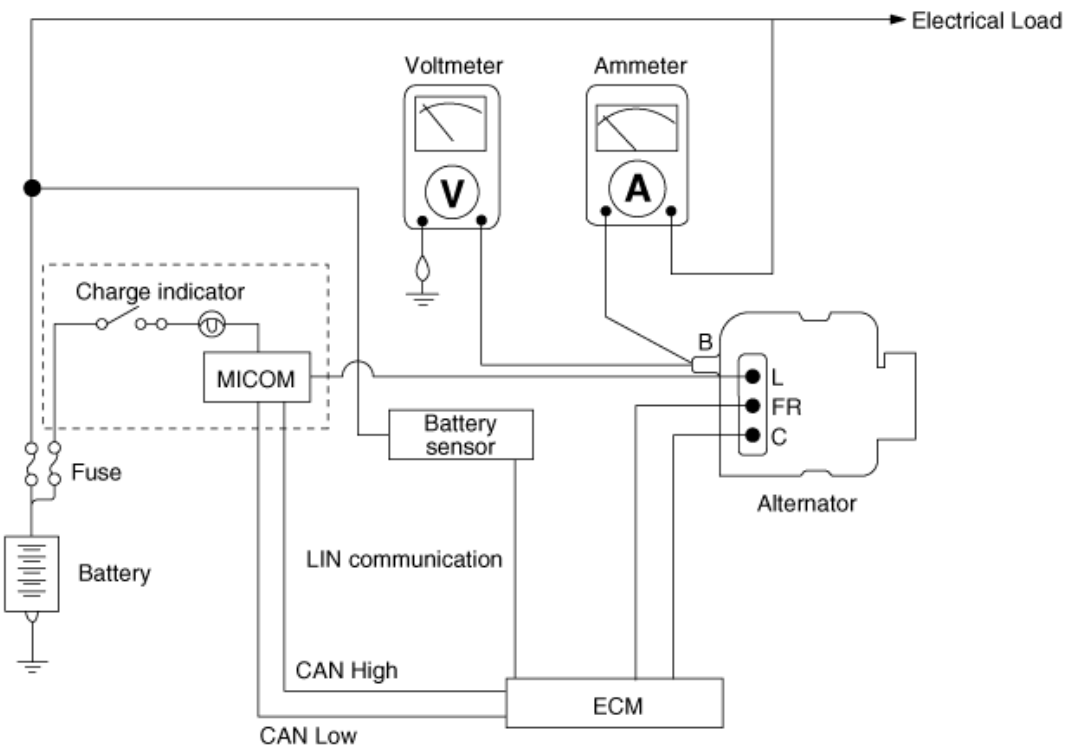
f. Connect a DC ammeter (0 to 150A) in series between the "B" terminal and the disconnected output wire.Connect the (-) lead wire of the ammeter to the disconnected output wire.

g. Connect the battery negative (-) terminal.

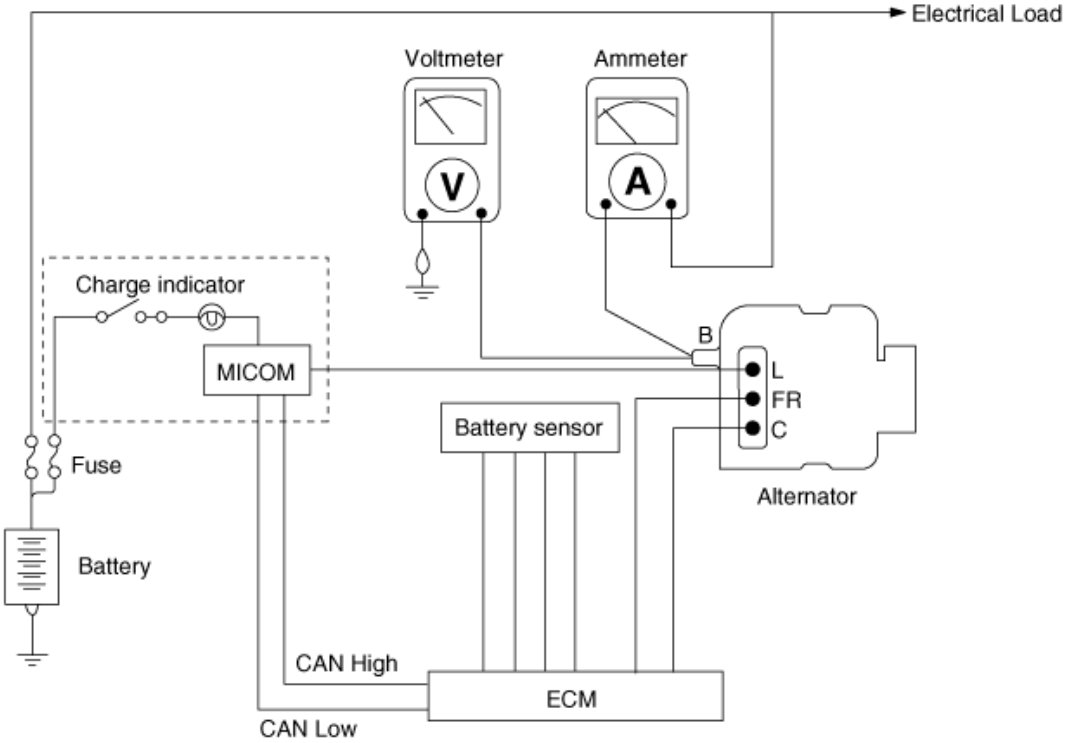
[Without "FR" terminal / Without "L" terminal]



[With "FR" terminal / With "L" terminal]



[With "FR" terminal / With "L" terminal]



(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 does not agree with the standard value, the voltage regulator or the alternator is faulty.

Regulated Voltage :11.7 - 15.3 V

b. If the voltmeter reading does not agree with the standard value, the voltage regulator or the alternator is faulty.

c. Disconnect the battery negative (-) terminal.

d. Remove the voltmeter and ammeter.

e. Connect the alternator output wire to the alternator "B" terminal.

f. Connect the battery negative (-) terminal.

Vehicle parasitic current inspection

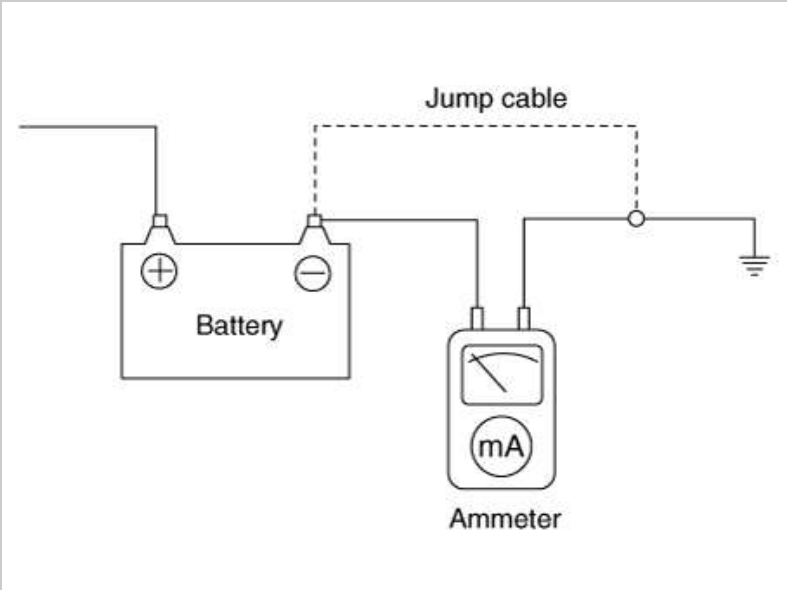
[Using the Ammeter]

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 for 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.
   - If the parasitic current is over the limit value, search for abnormal circuit by removing the fuses one by one and checking for parasitic current.
   - Reconnect only the fuse suspected of parasitic current and search for the trouble unit by removing the components connected to the circuit one by one until the parasitic draw drops below limit value.

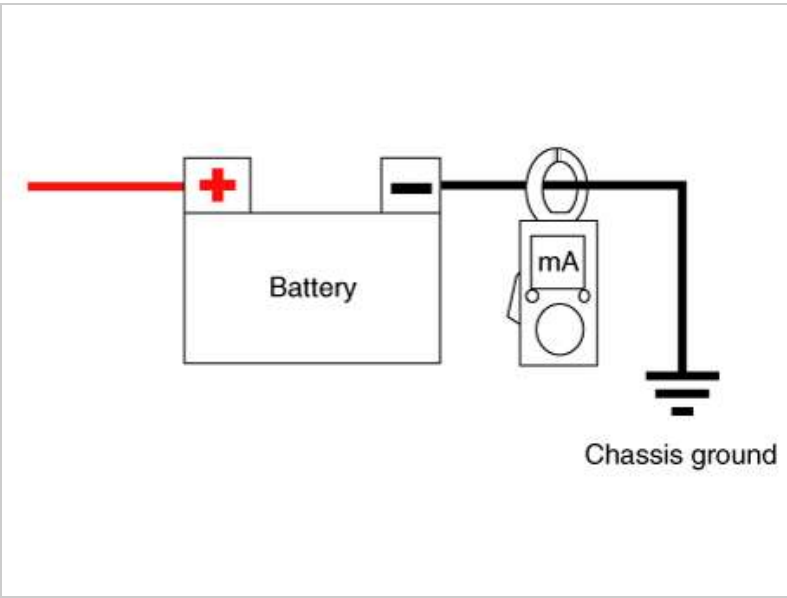
Limit value (after 10 - 20 min.) : Below 50 mA

[Using the Clamp type Ammeter]

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 for 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. Install the clamp type ammerter on battery negative (-) terminal.



5. Read the current value of the ammeter.
   - If the parasitic current is over the limit value, search for abnormal circuit by removing the fuses one by one and checking for parasitic current.
   - Reconnect only the fuse suspected of parasitic current and search for the trouble unit by removing the components connected to the circuit one by one until the parasitic draw drops below limit value.

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

Engine Electrical System

Troubleshooting

NOTICE

- Be careful not to short-circuit the wiring by the body or other wirings.
- In case of discharging problem, measure dark current at all times.
  (Charging System - "Dark Current Inspection").
- When checking the alternator main fuse, perform continuity test and voltage test between terminals as well as visual check to confirm normal operation.
- When checking the ground, repair or replace after inspecting for defective ground cable, defective installation or defective contact due to foreign object.
- It is not recommended to use non-authentic parts as installing non-authentic parts may cause malfunction of charging system.
- Be careful as misassembly may cause short-circuit of wiring, which may result in battery discharge.
- As it will reset and appear as normal if the battery negative (-) terminal is disconnected while measuring dark current, measure by using a hook meter without disconnecting the negative (-) terminal.
- Note that there may be various phenomenons / possible causes / repair measures apart from above.
- For more effective repairs, refer to DTC guide and ETM.

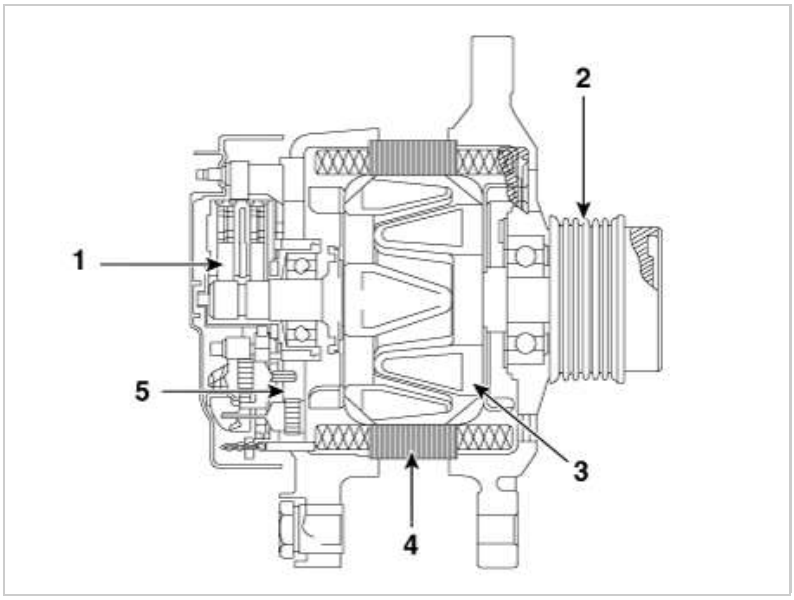
Symptom	Suspected Area	Remedy
Charging warning lamp does not turn on during IG ON.	Broken alternator main fuse	Inspect / Repair / Replace fuse.
	Broken instrument cluster fuse	Inspect / Repair / Replace fuse.
	Broken instrument cluster internal bulb	Inspect / Repair / Replace instrument cluster.
	Defective connection of wiring connector	Inspect / Repair / Replace wiring connection.
	Defective voltage regulator or alternator	Inspect / Repair / Replace voltage regulator or alternator.
	Defective connection of battery terminal	Inspect tightening of (+) and (-) battery terminals to specified torque.
	Communication error	Inspect wiring between regulator and ECM.
		Inspect transmission signal of ECM.
		Inspect / Repair / Replace alternator if the wiring and ECM are normal.
Charging warning lamp does not turn off during engine running.	Worn drive belt or lack of tension	Inspect / Repair / Replace drive belt.
	Defective connection, corroded or worn battery cable	Inspect connection of battery cable and Inspect / Repair / Replace cable.
	Broken alternator main fuse	Inspect / Replace alternator main fuse or battery cable.
	Defective voltage regulator or alternator	Inspect / Replace voltage regulator or alternator.
	Defective wiring	Inspect / Replace wiring.
	Defective instrument cluster	Inspect / Replace instrument cluster
	Slip in alternator pulley	Inspect / Replace alternator pulley.
		Adjust tension / Replace drive belt.
	Defective connection of battery terminal	Inspect tightening of (+) and (-) battery terminals to specified torque.
Charging warning lamp turns on.	Slip, worn or lack of tension in drive belt	Adjust tension / Replace drive belt.
		Inspect / Replace auto tensioner (only for auto tensioner type).
	Error in Alternator Management System (AMS) voltage	Inspect battery sensor connecting harness and connection with body.
	Error in battery sensor	Inspect / Repair / Replace battery sensor.

	Short between battery sensor wiring and body	Inspect / Repair / Replace battery sensor.
	Defective alternator L terminal output power	Inspect / Repair / Replace alternator or regulator.
	Degradation due to defective contact of battery (+) terminal	Check tightening to specified torque / Inspect / Repair / Replace battery wiring.
	Short in alternator connecting extension connector internal pin	Inspect / Repair / Replace wiring.
	Short circuit between body and mission ground	Inspect / Repair / Replace ground.
	Communication error	Inspect / Repair / Replace wiring between regulator and ECM.
		Inspect transmission signal of ECM.
		Inspect / Repair / Replace alternator if wiring and ECM are normal.
	Short in the middle of connection to alternator L terminal (L terminal applied vehicle model)	Inspect / Repair / Replace wiring.
	Drive belt rotation stops due to slip in crankshaft damper pulley or defective pulley.	Inspect or replace crankshaft damper pulley / Inspect, repair or replace drive belt tensioner bearing.
	Slip, worn or lack of tension in drive belt	Adjust tension / Inspect / Repair / Replace drive belt.
	Defective voltage regulator	Inspect / Repair / Replace voltage regulator.
	Defective alternator	Inspect / Repair / Replace alternator.
	Broken alternator main fuse	Inspect / Repair / Replace alternator main fuse or battery wiring cable.
	Defective ground	Inspect / Repair / Replace ground.
	Discharged battery	Adjust tension / Inspect / Repair / Replace drive belt.
		Inspect / Repair / Replace wiring connection.
		Inspect / Repair / Replace alternator main fuse.
		Inspect / Repair / Replace alternator.
		Inspect / Repair / Replace voltage regulator.
		Inspect / Repair / Replace battery unit.
		Inspect for dark current / Repair / Replace.
		Learn / Inspect / Repair / Replace battery sensor.
		Inspect for short / Repair / Replace battery cable.
		Inspect / Repair / Replace ECM.
		Inspect / Repair / Replace body electrical related parts.
		Inspect / Repair / Replace installation status of alternator connector.
		Inspect / Repair / Replace tightening of (+) and (-) battery terminals to specified torque.
Swollen battery	Defective battery	Inspect / Replace battery.
	Defective voltage regulator or alternator	Inspect / Repair / Replace voltage regulator or alternator.
	Defective charging related parts or wiring	Inspect / Repair / Replace charging related parts and wiring.
After inspection, repair or replace related parts in case of malfunction.		

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.



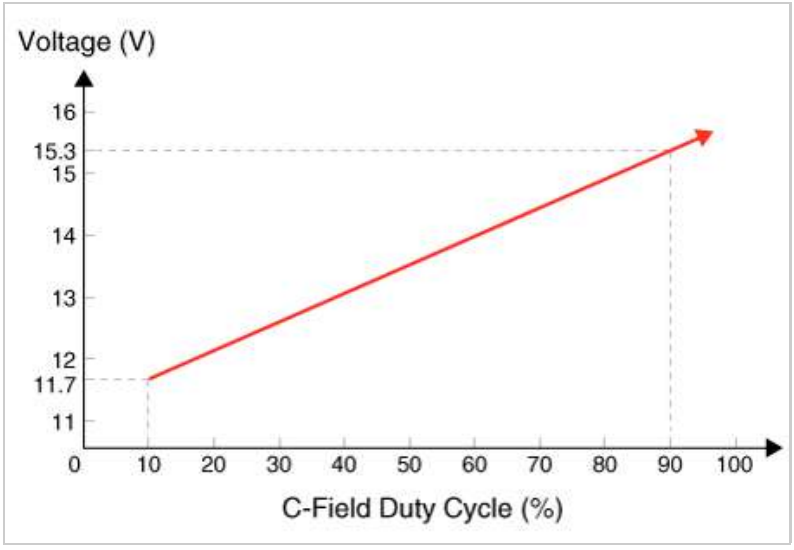
1. Brush
2. Overrunning Alternator Pulley (OAP)
3. Rotor
4. Stator
5. Rectifier

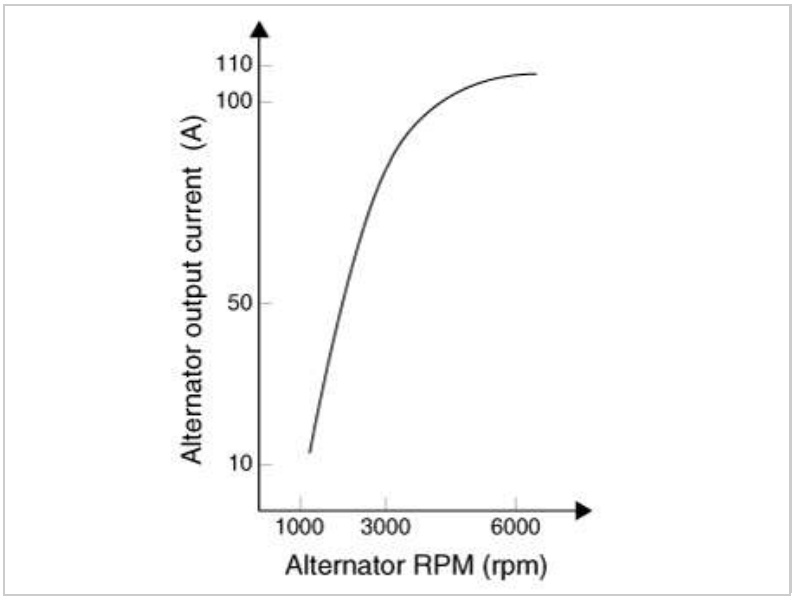
Engine Electrical System

Specification

Alternator

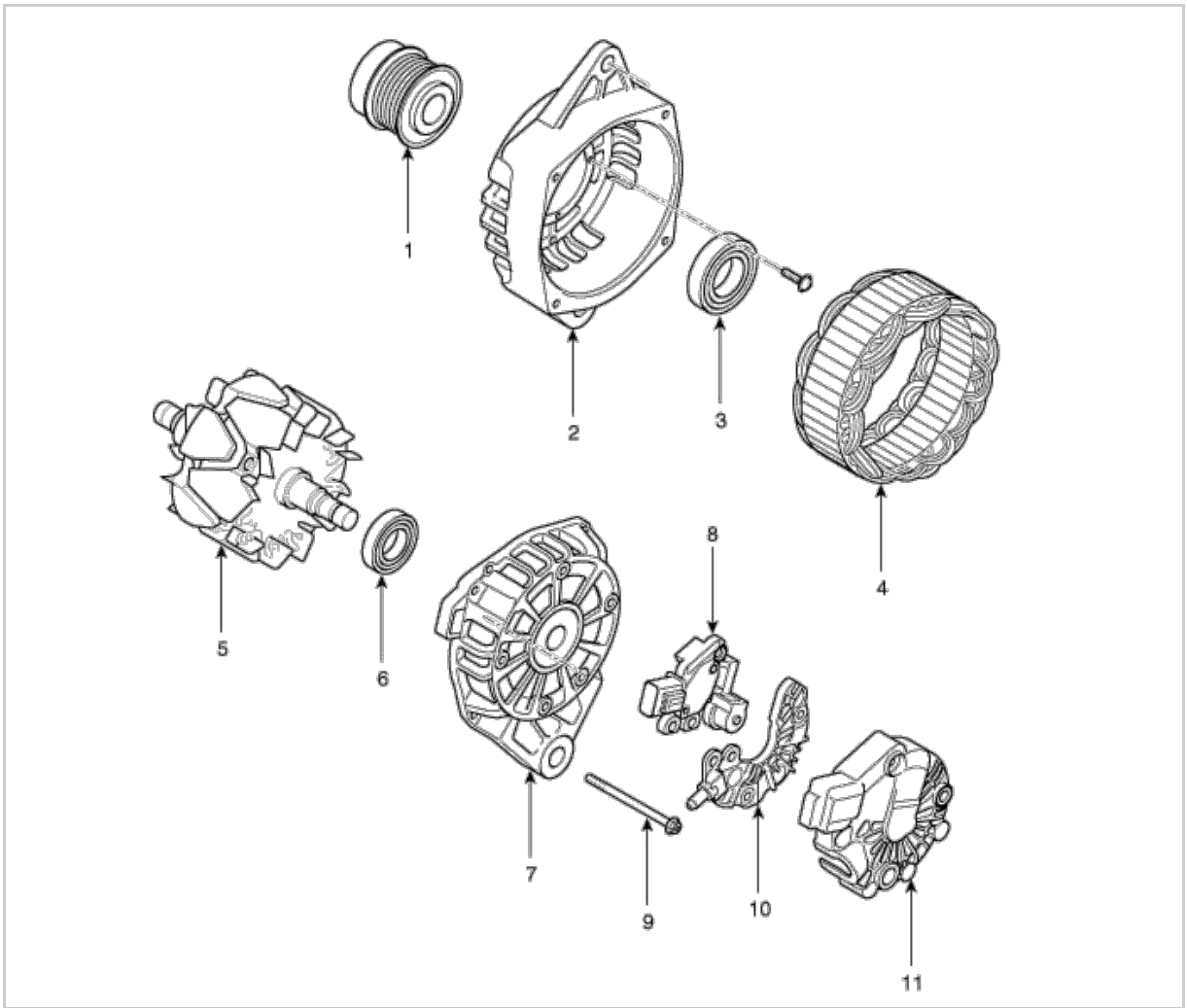
Item		Specification
Rated voltage		13.5V, 120A
Speed in use		1,000 - 18,000 rpm
Voltage regulator		IC Regulator built-in type
Regulator Setting Voltage	External mode	Refer to below graph
	Internal mode	14.55 ± 0.3V
Temperature Gradient	External mode	0 ± 3 mV / °C
	Internal mode	-3.5 ± 2mV / °C





Engine Electrical System

Components

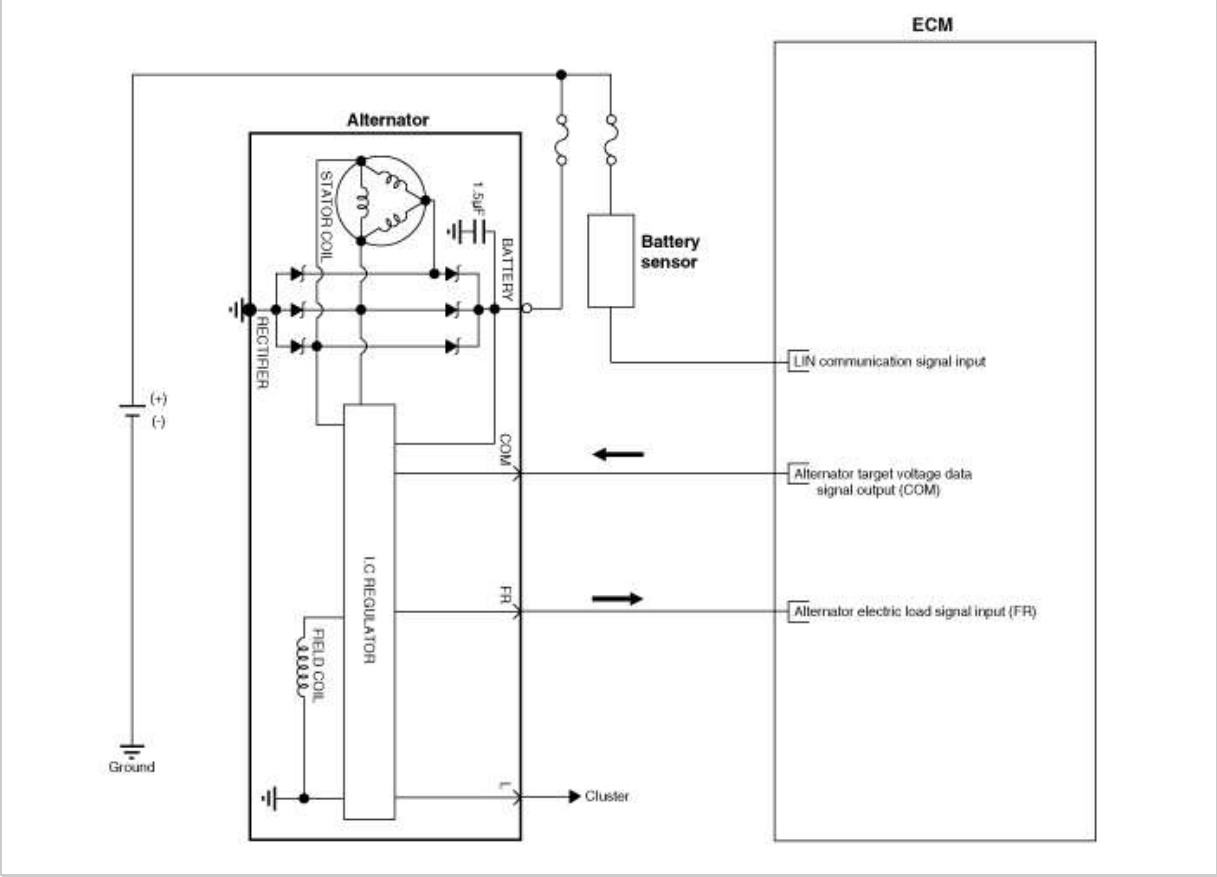


1. Overrunning Alternator Pulley (OAP)
2. Front housing
3. Front bearing
4. Stator
7. Rear housing
8. Regulator assembly
9. Through bolt
10. Rectifier assembly

5. Rotor
6. Rear bearing
11. Rear cover

Engine Electrical System

Circuit Diagram



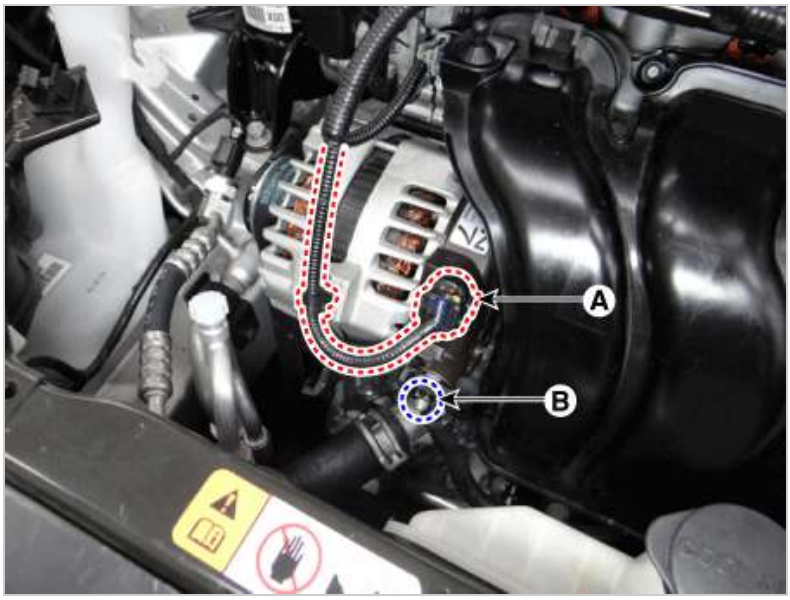
Information

- **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. Turn ignition switch OFF and disconnect the battery negative (-) terminal.
2. Disconnect the alternator connector (A).
3. Disconnect the alternator "B" terminal (B) after loosening the mounting nut.



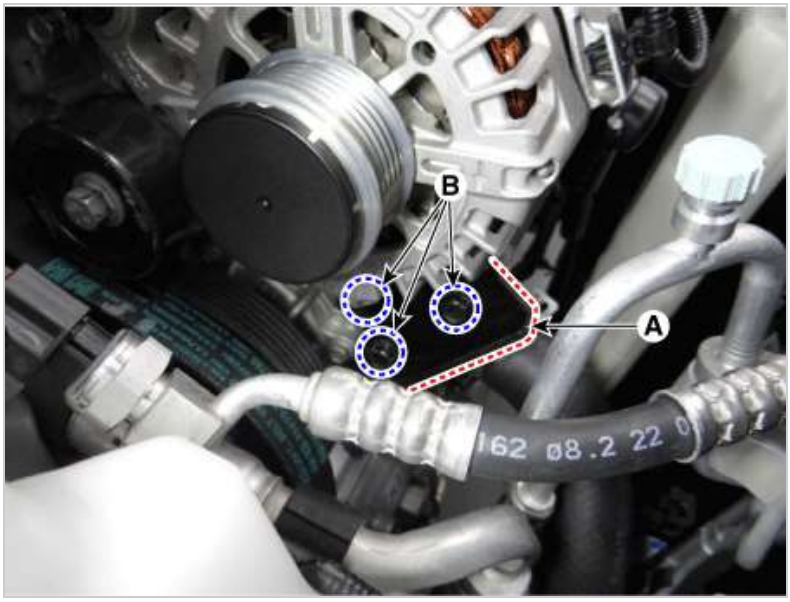
4. Using the hexagon wrench, turn the tensioner (A) counterclockwise and loosen.

5. Remove the alternator upper mounting bolt (A).

Alternator upper mounting bolt :
29.4 - 41.2 N·m (3.0 - 4.2 kgf·m, 21.7 - 30.4 lb·ft)

6. Remove the alternator mounting bracket (A) after loosening the lower mounting bolts (B).

Alternator bracket & lower mounting bolt :
21.6 - 32.4 N·m (2.2 - 3.3 kgf·m, 15.9 - 23.9 lb·ft)



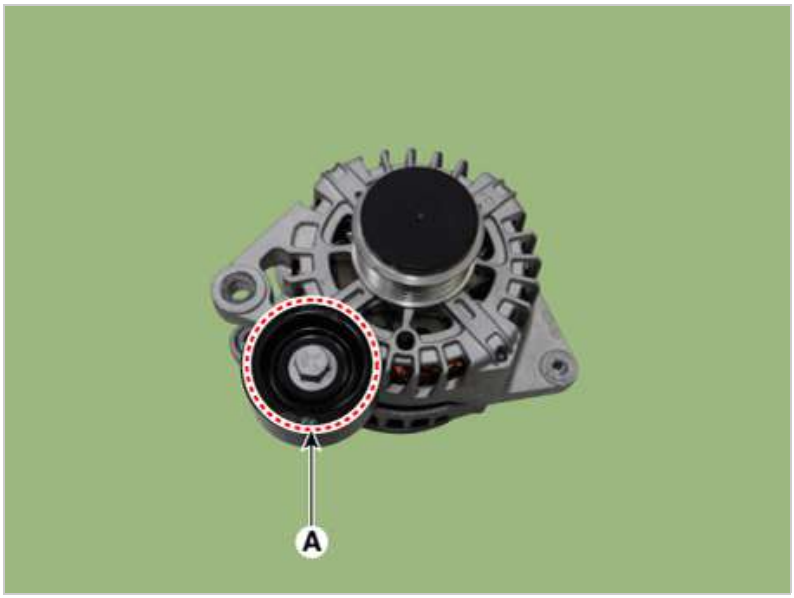
7. Remove the alternator (A).

Installation

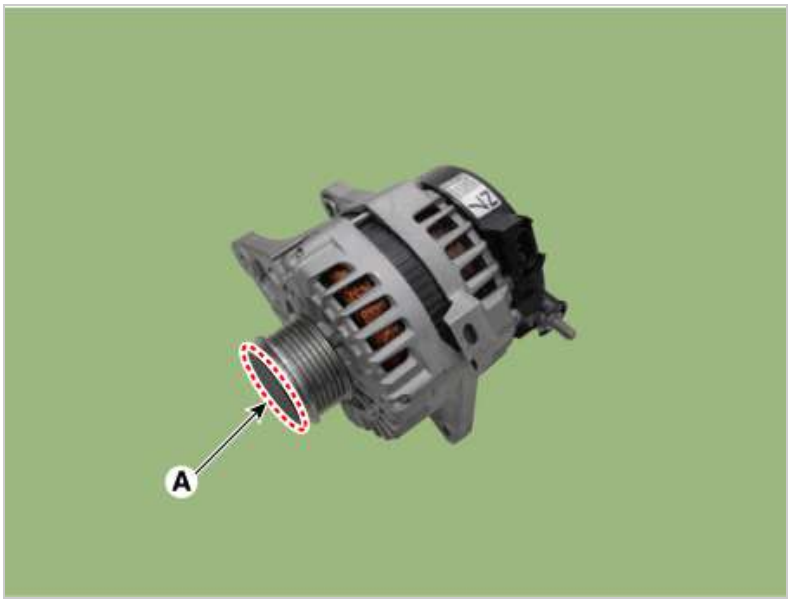
1. Install in the reverse order of removal.

Disassembly

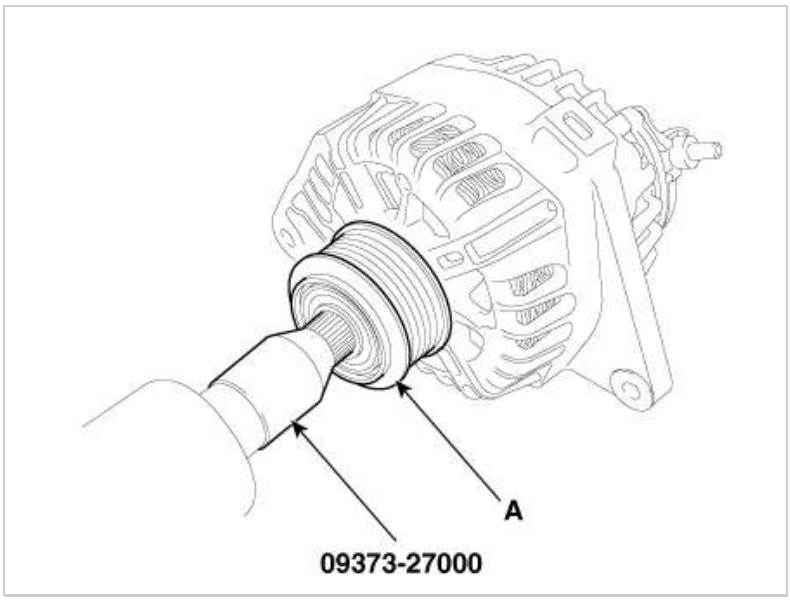
1. Remove the pully (A) after loosening the mounting bolt.



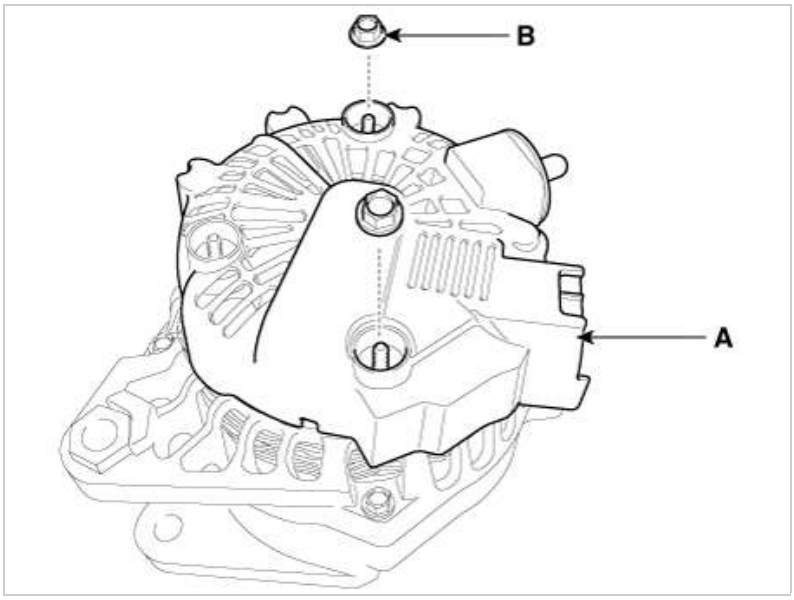
2. Remove the OAP cap (A).



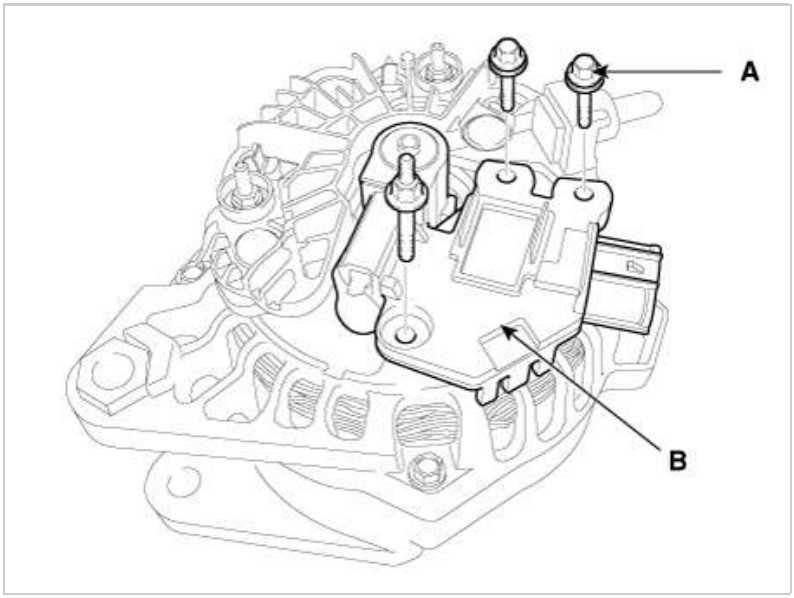
3. Using the SST (09373-27000), remove the OAP pulley (A).



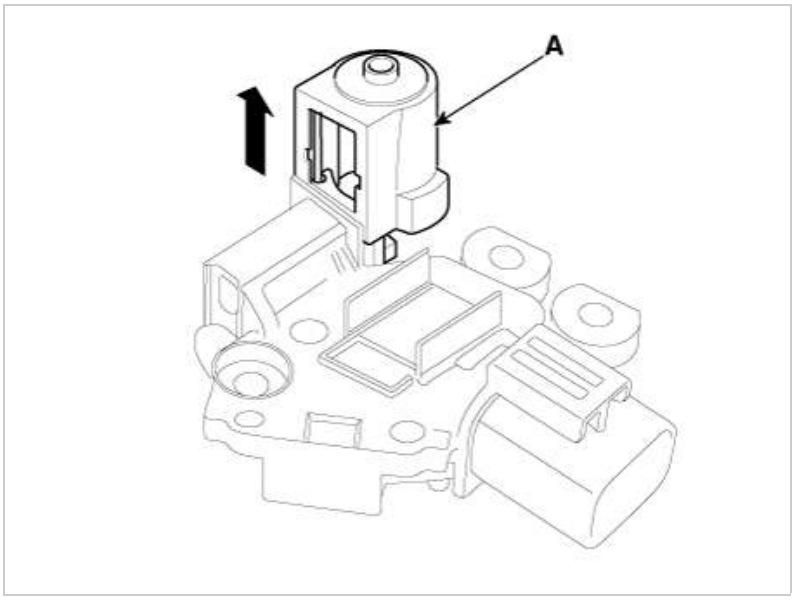
4. Remove the rear cover (A) after removing nuts (B).



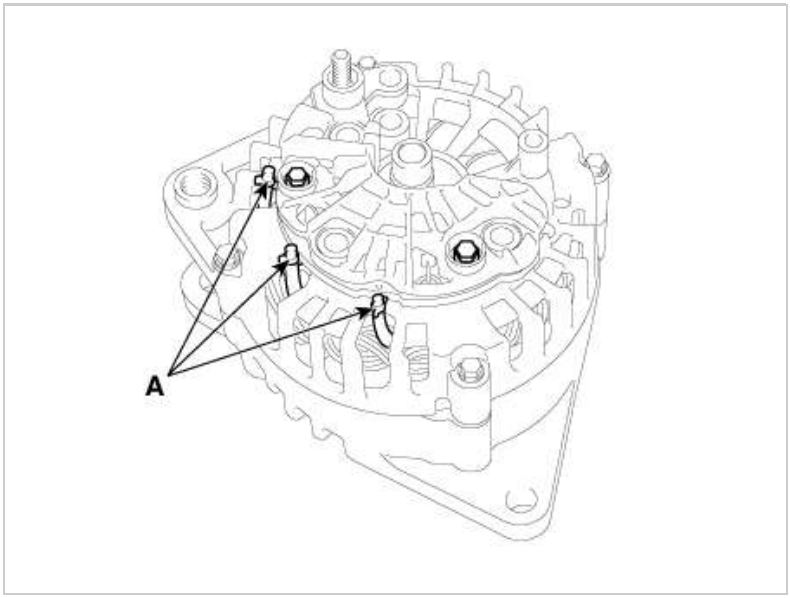
5. Remove the mounting bolts (A) and the regulator assembly (B).



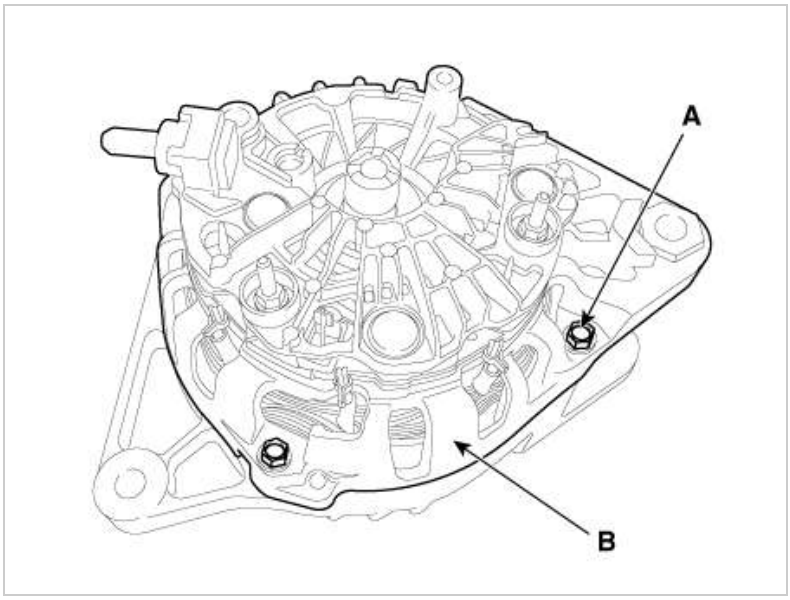
6. Remove the slip ring guide (A) after pulling it.



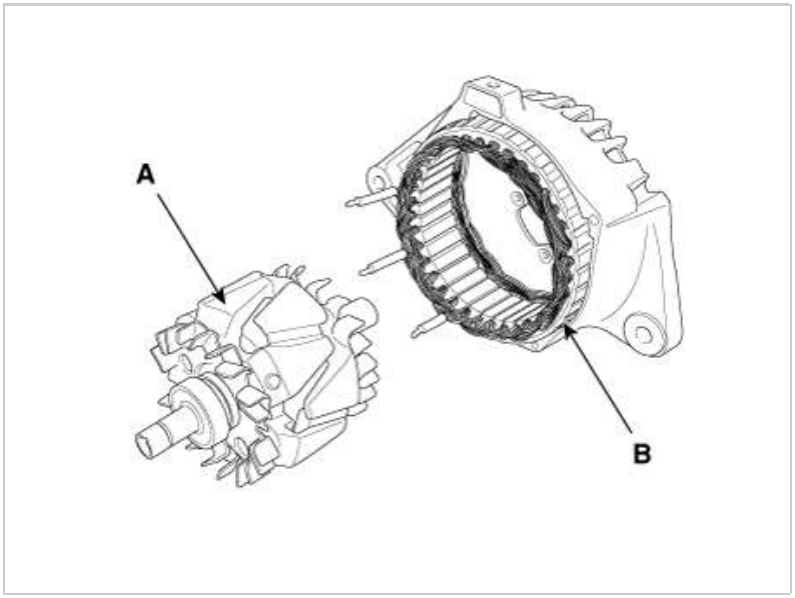
7. Unsolder the 3 stator leads (A).



8. Remove the 4 through bolts (A).



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



Reassembly

1. Reassemble in the reverse order of disassembly.

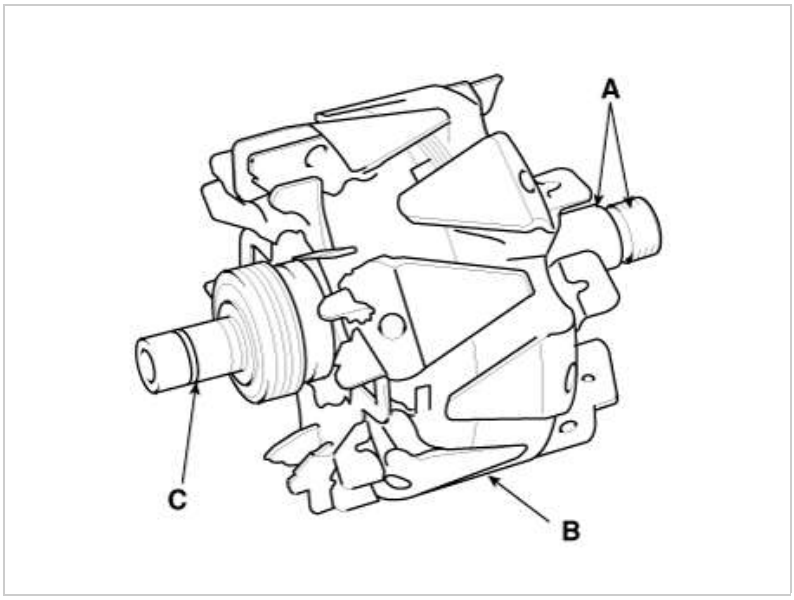
NOTICE

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

Inspection

[Rotor]

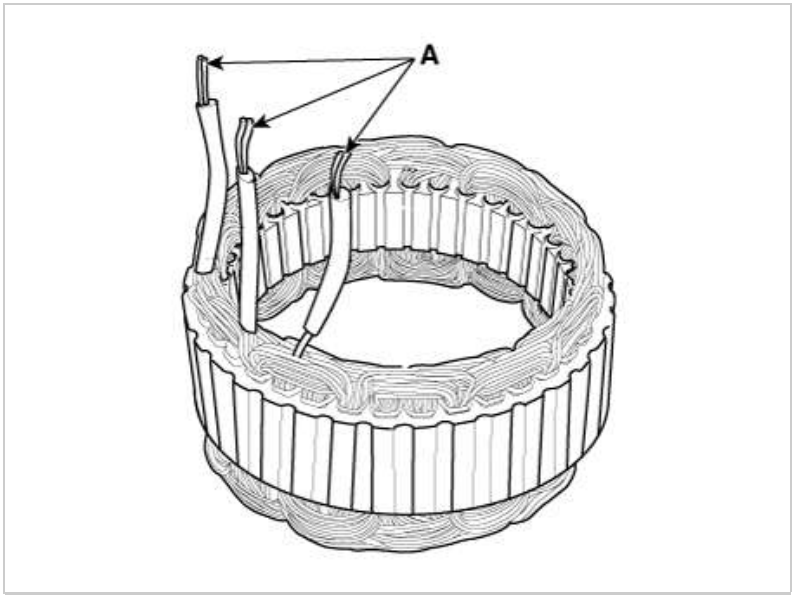
1. Check that there is continuity between the slip rings (C).



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).

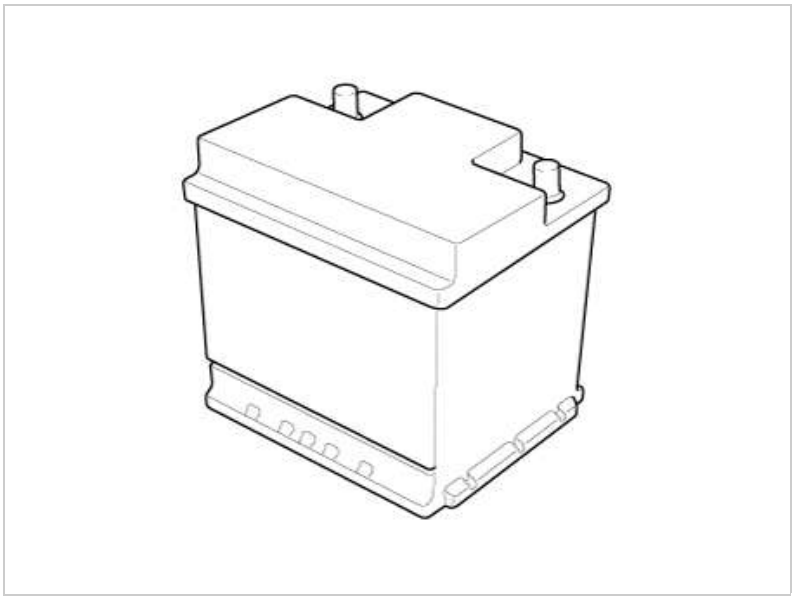


2. Check that there is no continuity between each lead and the coil core.
3. If the coil fails either continuity check, replace the alternator.

Engine Electrical System

Description

1. The CMF(Closed Maintenance Free) battery is, as the name implies, totally maintenance free and has no removable battery cell caps.
2. The CMF(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.



Information

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

Engine Electrical System

Removal

Information

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

Battery

1. Turn the ignition switch OFF.
2. Disconnect the negative (-) battery terminal (A).

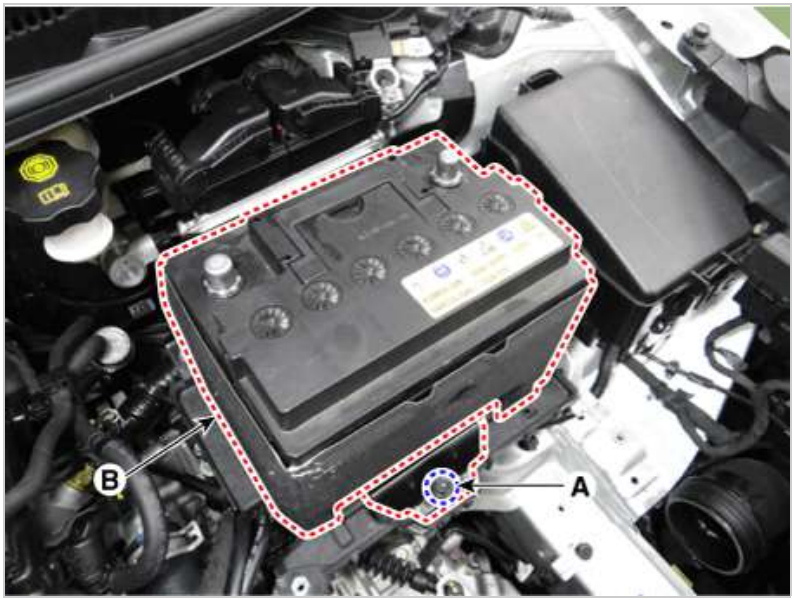
Battery (-) terminal mounting :
4.0 - 6.0 N·m (0.4 - 0.6 kgf·m, 3.0 - 4.4 lb·ft)

3. Disconnect the positive (+) battery terminal (A).

Battery (+) terminal mounting :
7.8 - 9.8 N·m (0.8 - 1.0 kgf·m, 5.8 - 7.2 lb·ft)

4. Remove the air duct and air cleaner assembly.
   (Refer to Engine Mechanical System - "Air Cleaner")
5. Remove the battery mounting bracket (A) after loosening the mounting bolt.
6. Remove the battery (B).

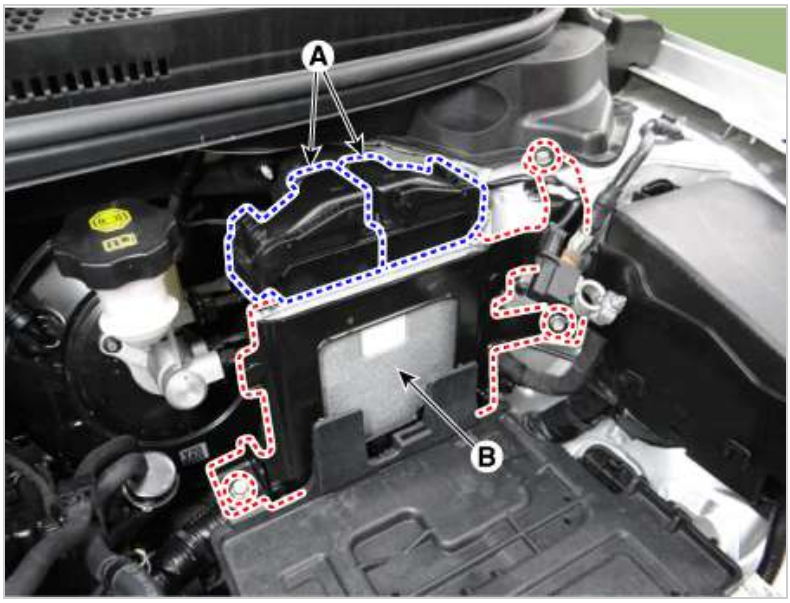
Battery mounting bracket mounting bolt :
8.8 - 13.7 N·m (0.9 - 1.4 kgf·m, 6.5 - 10.1 lb·ft)



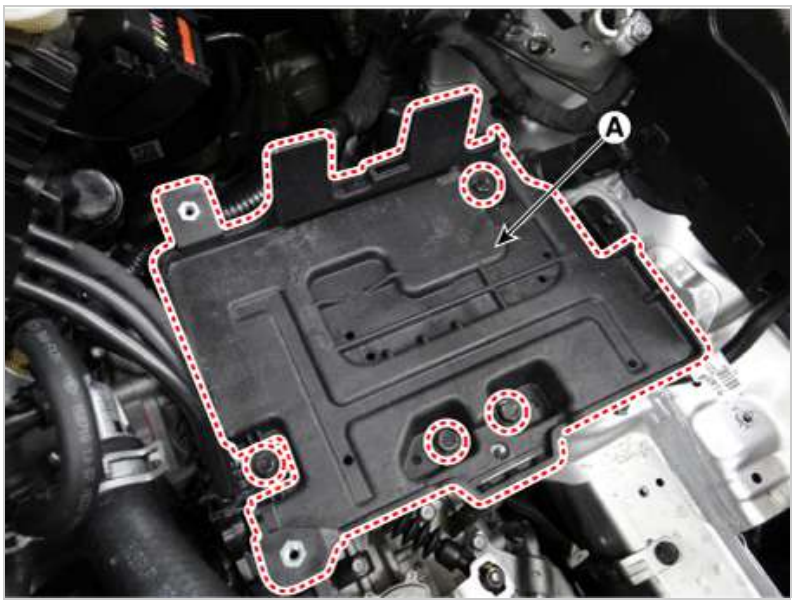
Battery Tray

1. Remove the battery.
   (Reter to Engine Electrical System - "Battery")
2. Disconnect the ECM Connector (A).
3. Remove the mounting bolts and nut, and then remove the ECM bracket assembly (B).

ECM bracket mounting bolts/nut :
9.8 - 11.8 N·m (1.0 - 1.2 kgf·m, 7.2 - 8.7 lb·ft)



4. Remove the battery tray (A) after loosening the mounting bolts.



Installation

1. Install in the reverse order of removal.

> **NOTICE**
> When installing the battery, fix the mounting bracket on the tray correctly.

Inspection

Battery Voltage and Status

Check the battery voltage and status by using a battery tester.

Battery Terminal

1. Move back and forth to check if the battery terminals (A) are loose or corroded. Clean any corroded terminals.

If the battery positive connection is loose, disconnect the ground (GND) cable first before attempting to remove or tighten the positive connection to prevent personal injury.

2. If the battery clamp on positive (+) battery terminal is not seated securely:
   (1) Turn ignition switch OFF and disconnect the battery negative (-) terminal.
   (2) Tighten battery clamp (A) on positive (+) battery terminal.

Battery (+) terminal mounting :
7.8 - 9.8 N·m (0.8 - 1.0 kgf·m, 5.8 - 7.2 lb·ft)

3. If the battery clamp on negative (-) battery terminal is not seated securely:
   (1) Tighten battery clamp (A) on negative (-) battery terminal.

   Battery (-) terminal mounting :
   4.0 - 6.0 N·m (0.4 - 0.6 kgf·m, 3.0 - 4.4 lb·ft)

Check the battery for damage or deformation. If severe damage, deformation or leakage is found, replace the battery.

Vehicle parasitic current inspection

[Using an Ammeter]

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.

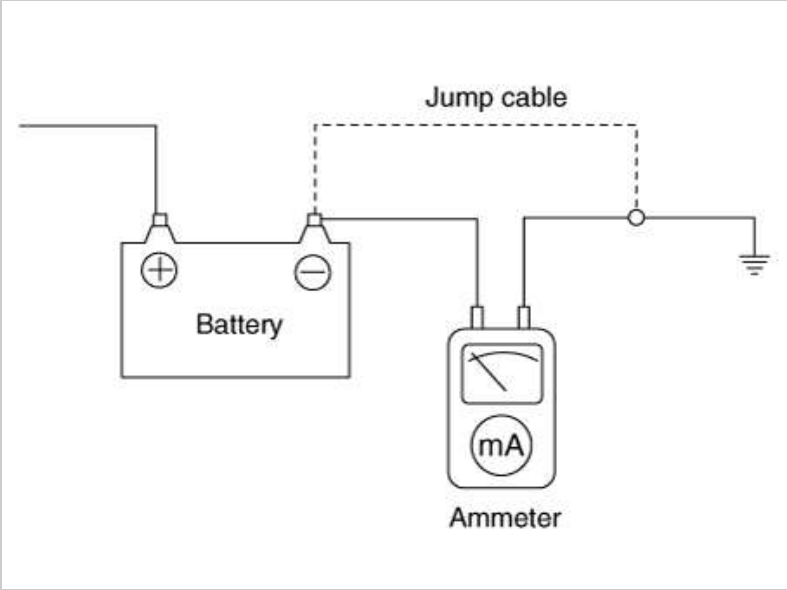
To prevent the battery from being reset during the inspection,

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.
   - 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.
   - Reconnect only the fuse suspected of parasitic current and search for the problematic unit by removing the components connected to the circuit one by one until the parasitic draw drops below limit value.

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

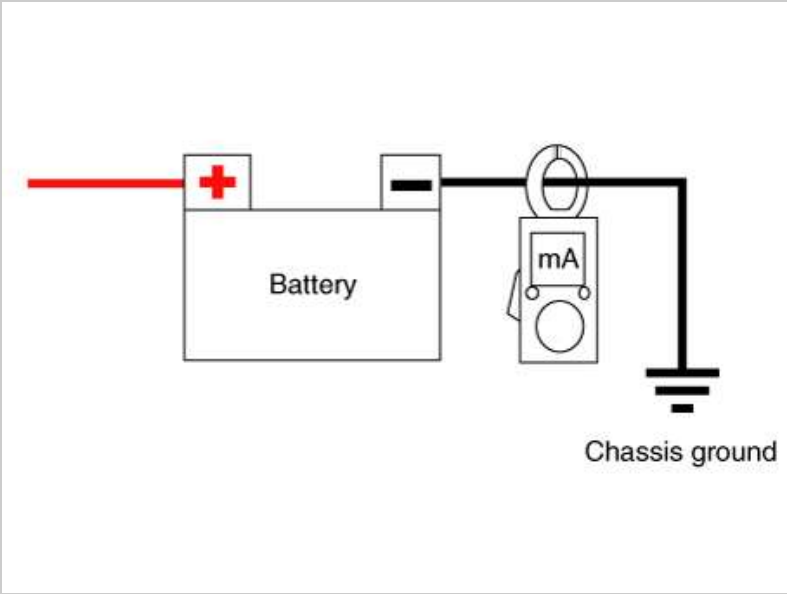
[Using a Clamp type Ammeter]

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 be in 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. Install the clamp type ammerter on battery negative (-) terminal.



5. Read the current value of the ammeter.
   - 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.
   - Reconnect only the fuse suspected of parasitic current and search for the problematic unit by removing the components connected to the circuit one by one until the parasitic draw drops below limit value.

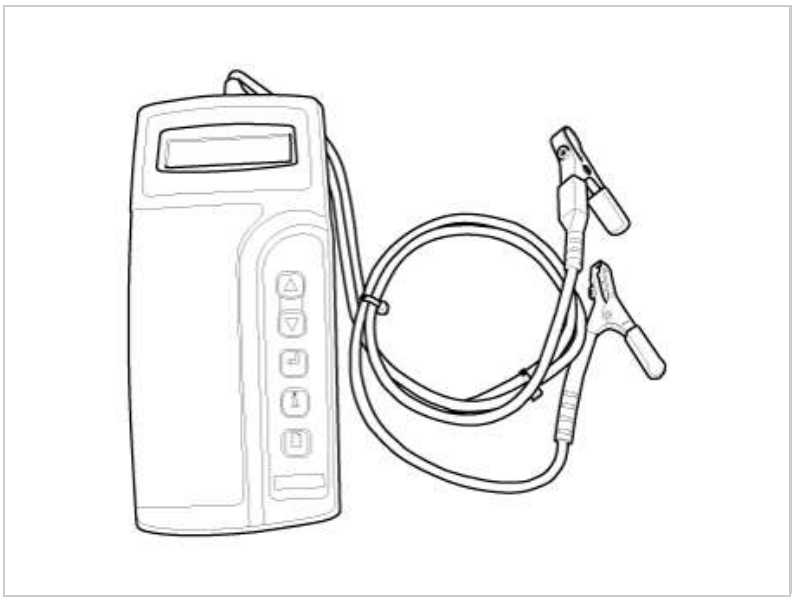
Limit value (after 10 - 20 min.) :Below 50mA

The Micro 570 Analyzer

By using the Micro 570 Analyzer, the charging and starting systems including the battery, starter and alternator can be tested.

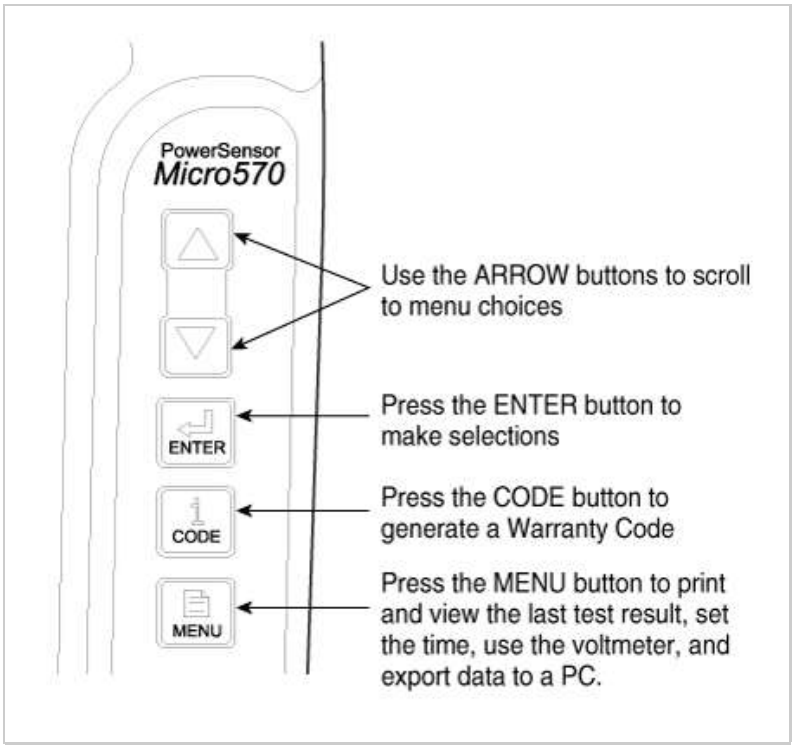
⚠ CAUTION

- Due to the possibility of personal injury, always take extreme caution and wear appropriate eye protection when working on batteries.
- When charging the battery based on test result, it must be fully charged.
  When retesting after charging the battery, test after the surface voltage of the battery have subsided for an accurate test result. (Refer to "Battery Test Result" below.)



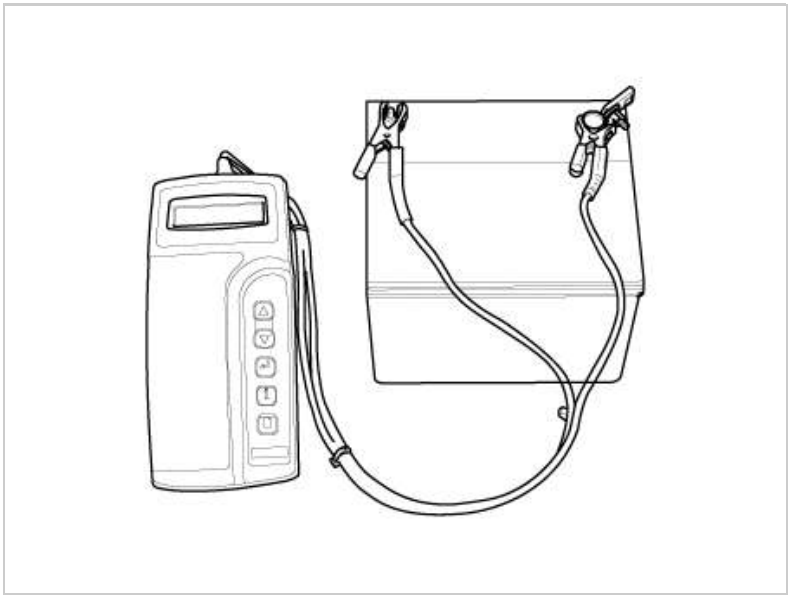
Keypadz

The Micro 570 buttons on the keypad provide the following functions:



Battery Test Procedure

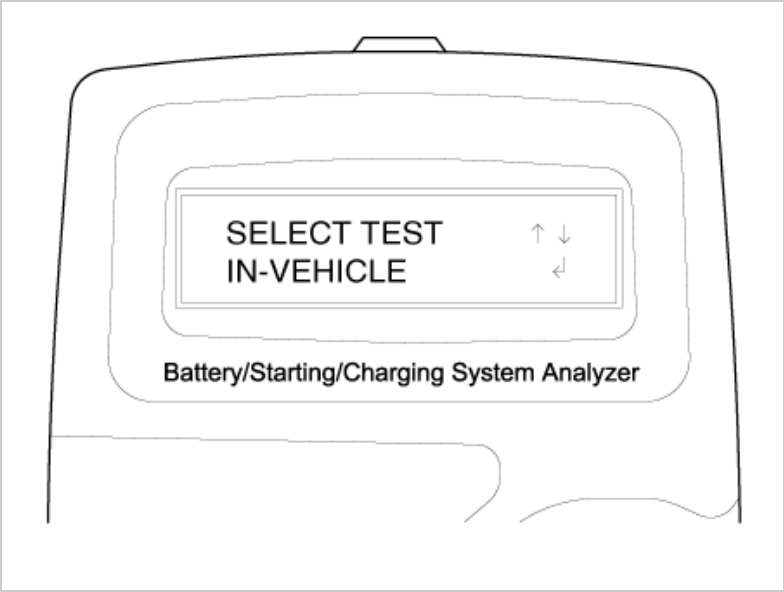
1. Connect the tester to the battery.
   – Red clamp to positive (+) battery terminal
   – Black clamp to negative (-) battery terminal



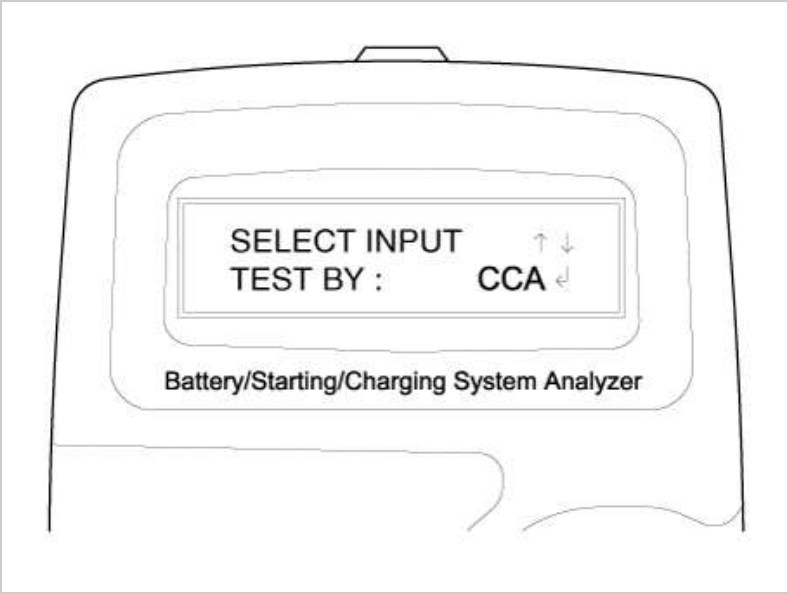
⚠ CAUTION

• Connect clamps securely. If "CHECK CONNECTION" message is displayed on the screen, reconnect clamps securely.

2. The tester will ask if the battery is connected "IN-VEHICLE" or "OUT-OF-VEHICLE". Make your selection by pressing the arrow buttons; then press ENTER.



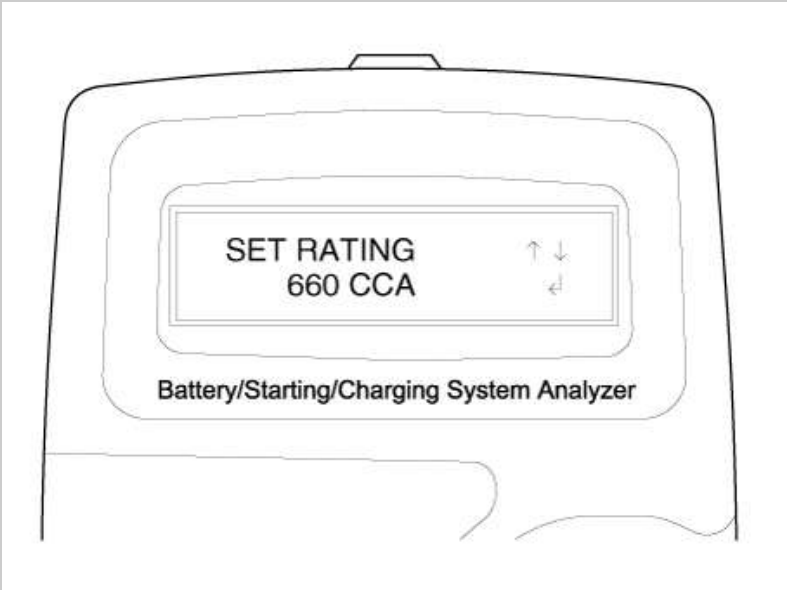
3. Select CCA and press the ENTER button.



NOTICE

- CCA : Cold cranking amps, is an SAE specification for cranking batteries at -0.4°F (-18°C).

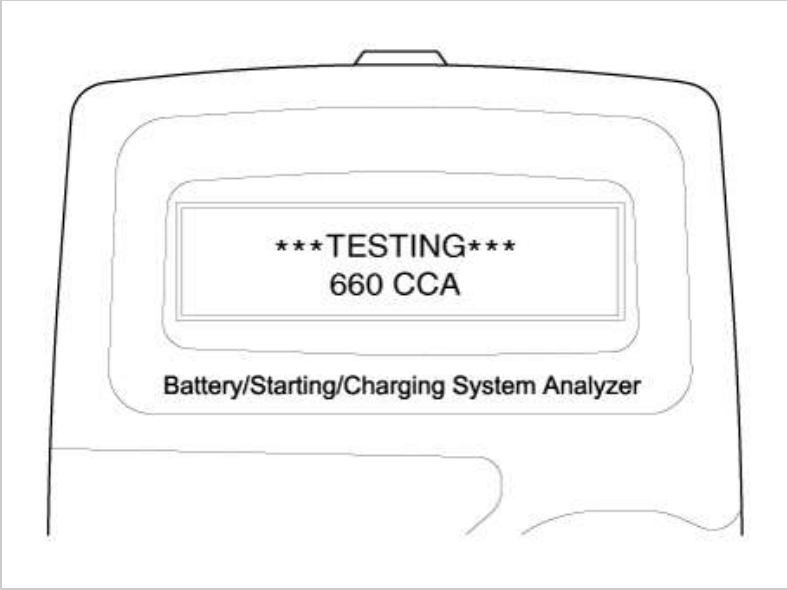
4. Set the CCA value displayed on the screen to the CCA value marked on the battery label by pressing up and down buttons and pressing ENTER.



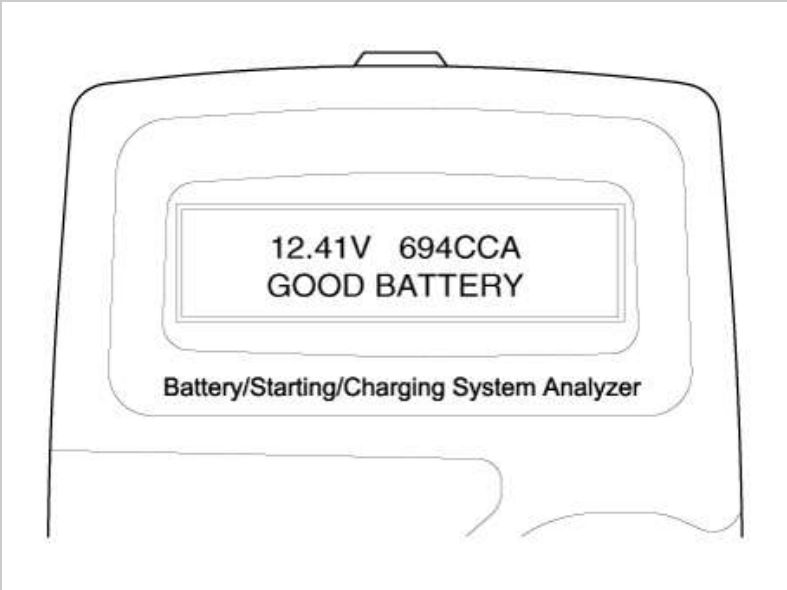
NOTICE

- The battery ratings (CCA) displayed on the tester must be identical to the ratings marked on battery label.

5. The tester will conduct battery test.



6. The tester displays battery test results including voltage and battery ratings.
   Refer to the following table and take the appropriate action as recommended by the Micro 570.



Battery Test Results

Result On Printer	Remedy
GOOD BATTERY	No action is required.
GOOD - RECHARGE	Battery is in a good state. Recharge the battery for use. • Follow the instruction below when charging and retesting the battery, otherwise the test result may be inaccurate. (See 'Charging and Retesting after charging battery' below.)
CHARGE & RETEST	Battery is not charged properly. – Charge and test the battery again. • Follow the instruction below when charging and retesting the battery, otherwise the test result may be inaccurate. (See 'Charging and Retesting after charging battery' below.)
REPLACE BATTERY	Replace battery and recheck the charging system. – Improper connection between battery and vehicle cables may prompt "REPLACE BATTERY" message. Retest the battery after removing cables and connecting the tester to the battery terminal directly prior to replacing the battery.
BAD CELL-REPLACE	Charge and retest the battery. – If "REPLACE BATTERY" is prompted on Micro 570, replace the battery and recheck the charging system.

[Charging and Retesting after charging battery]

Charging battery

Set battery charger to 'Auto Mode' (the Mode that charging current drops as the battery charges) and charge battery until charging current drops down close to zero or the charger alerts with an alarm when charging is complete.

(Minimum charging time recommended: More than 3 hours in Auto Mode explained above)

- If battery is not fully charged, battery surface voltage will be high while the amount of current charged (CCA) in battery is low. If the battery is tested in this condition, the tester may misjudge that battery sulfation has occurred as the level of current in battery is too low in comparison with battery voltage.

  * Surface voltage: When battery is charged electrolyte temperature increases and chemical reaction become active resulting in an excessive increase of battery voltage.

  It is known that it takes approximate one day to subside this increased surface voltage completely.

Testing battery after charging

Do not test the battery immediately after charging. Test the battery after the battery surface voltage has subsided as instructed in the following procedure.

(1) When battery charging is complete, install the battery to the vehicle.

(2) Turn IG ON, turn on the headlamps at low beam, and wait for 5 minutes. (Discharge for 5 minutes.)

(3) Turn off the headlamps at IG ON, and wait for 5 minutes. (Wait for 5 minutes.)

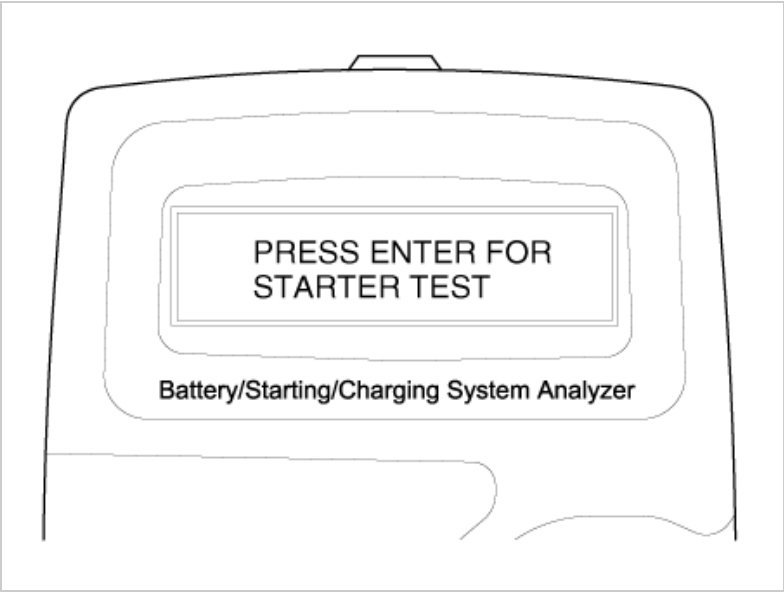
(4) Remove +, - cables from the battery and test battery.

WARNING

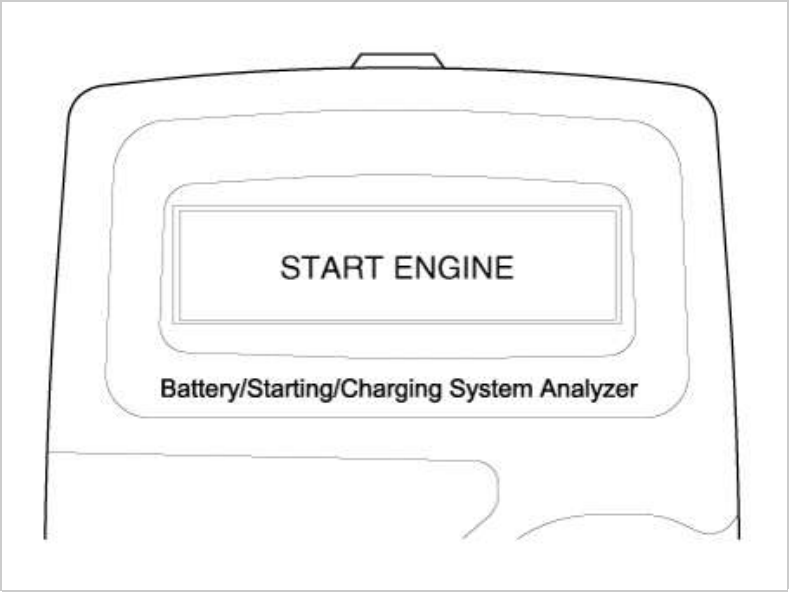
- Whenever filing a claim for battery, the print out of the battery test results must be attached.

Starter Test Procedure

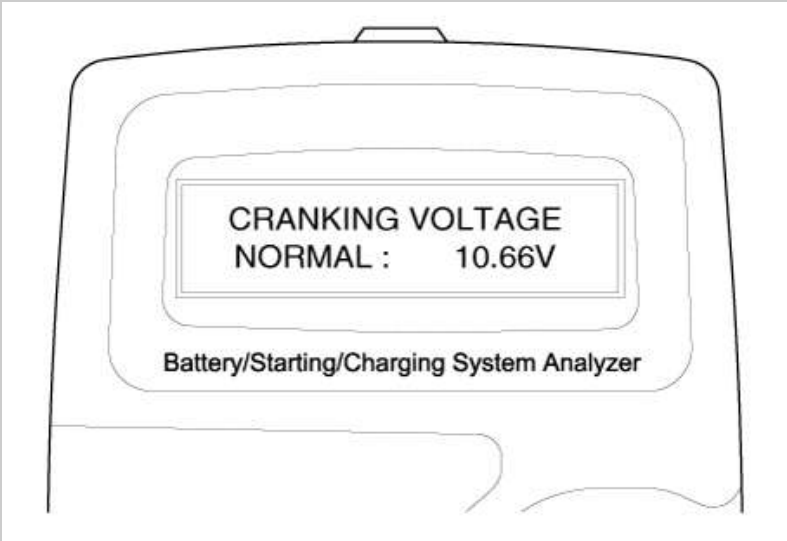
7. After the battery test, press ENTER immediately for the starter test.



8. Start the engine.



9. Cranking voltage and starter test results will be displayed on the screen.
   Refer to the following table and take the appropriate action as recommended by the Micro 570.



Starter Test Results

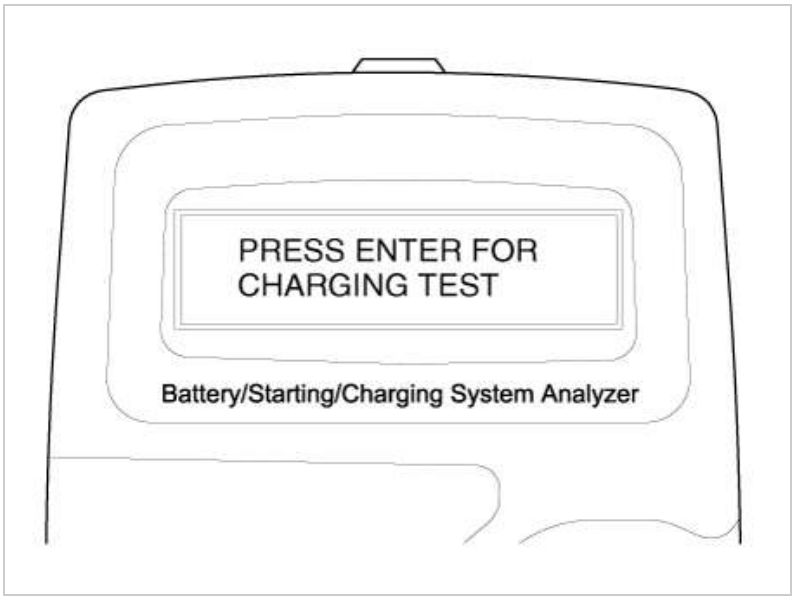
Result On Printer	Remedy
CRANKING VOLTAGE NORMAL	System shows a normal starter draw.
CRANKING VOLTAGE LOW	Cranking voltage is lower than normal level. – Check starter.
CHARGE BATTERY	The battery level is too low for the test. – Charge the battery and retest.
REPLACE BATTERY	Replace battery. – If the vehicle cannot be started even though "GOOD BATTERY" is displayed, check wiring for open circuit, battery cable connection and starter, and repair or replace as necessary. – If the engine does not crank, check fuel system.

NOTICE

- When testing a vehicle with an old diesel engine, the test result may not be favorable if the glow plug is not heated. Conduct the test after warming up the engine for 5 minutes.

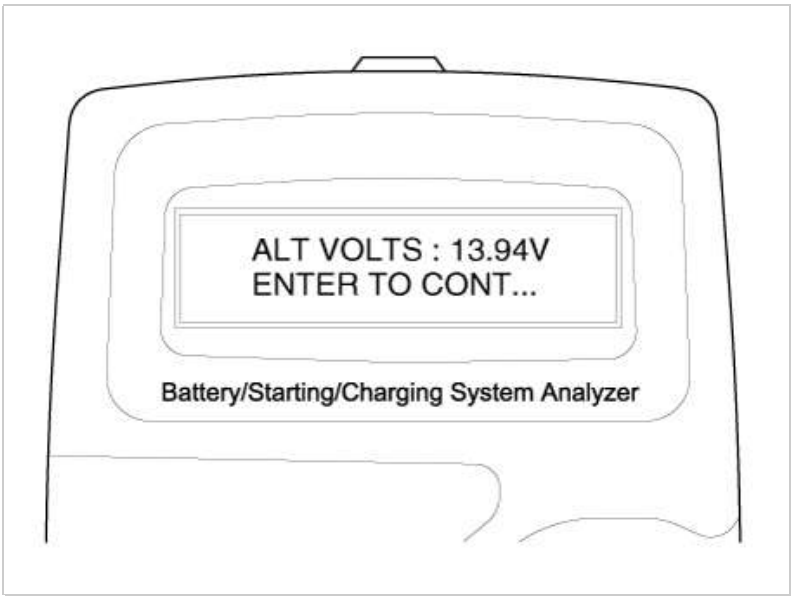
Charging System Test Procedure

10. Press ENTER to begin charging system test.

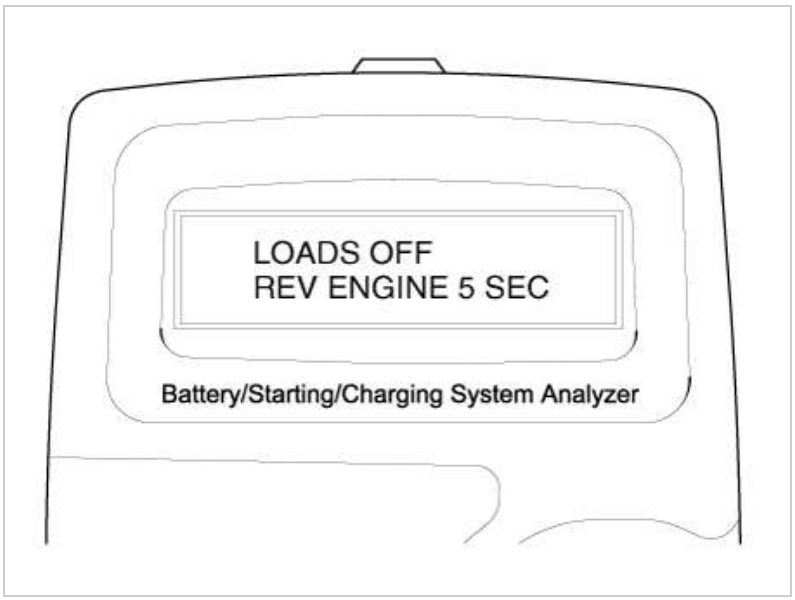


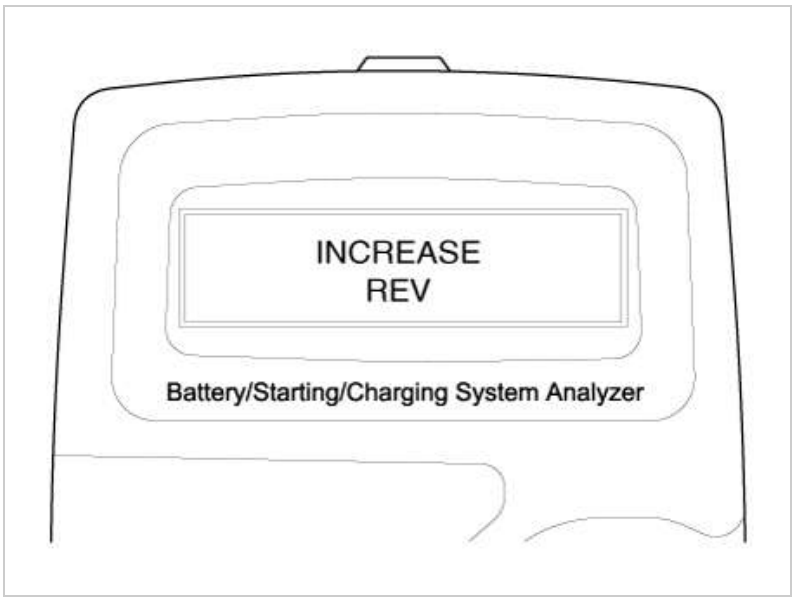
11. The tester displays the actual voltage of alternator.

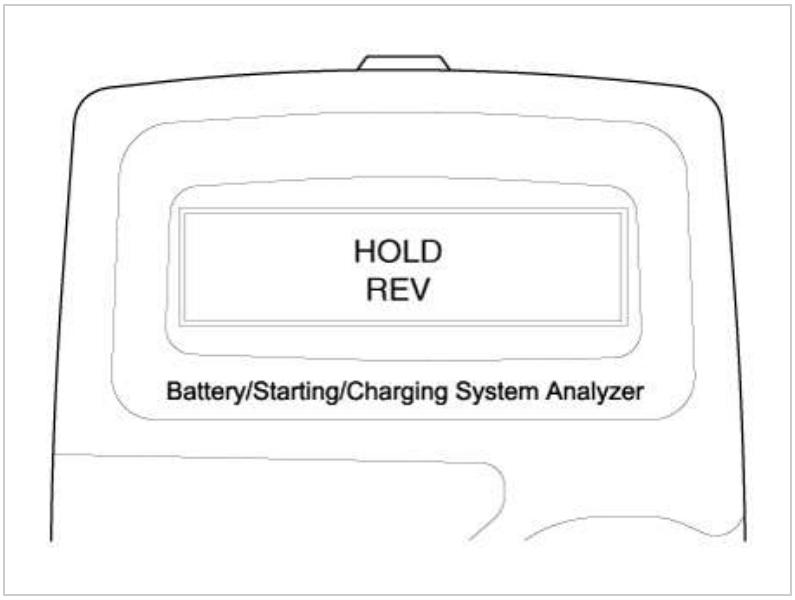
Press ENTER to continue.



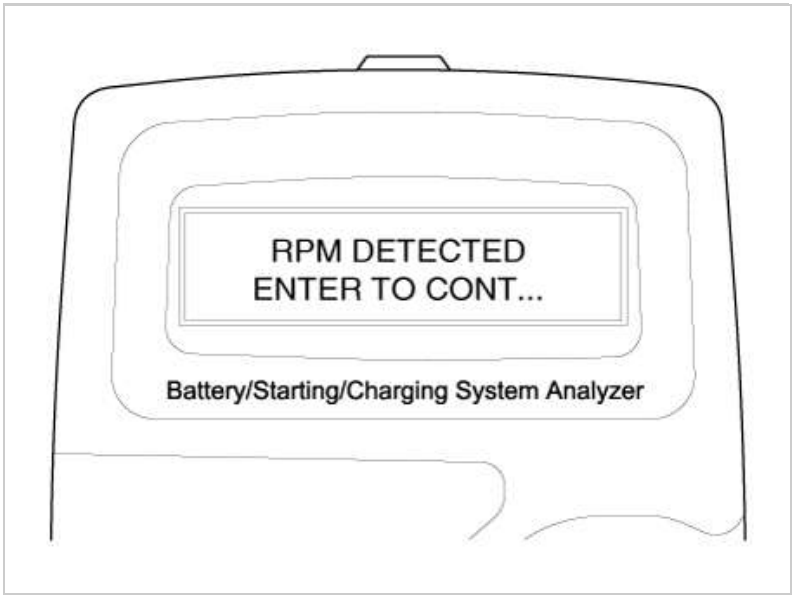
12. Turn off all electrical loads and rev up the engine for 5 seconds by pressing the accelerator pedal. (Follow the instructions on the screen)



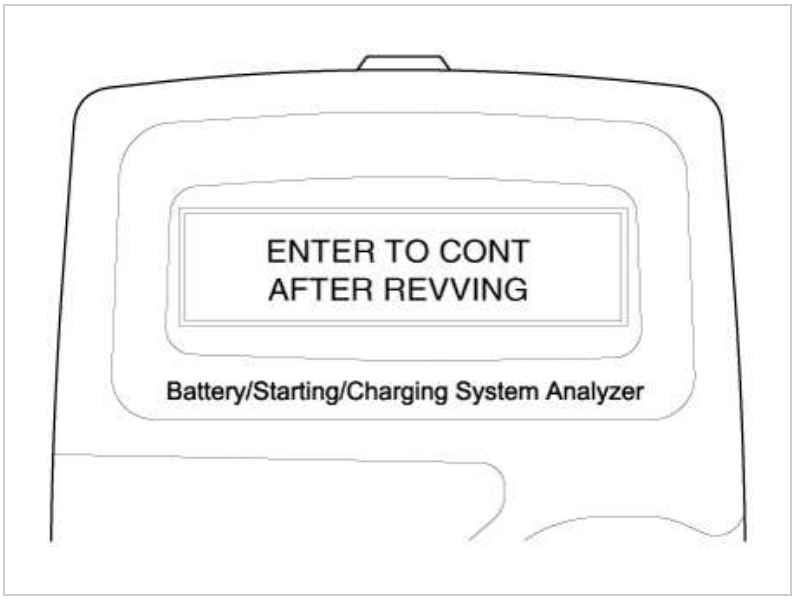




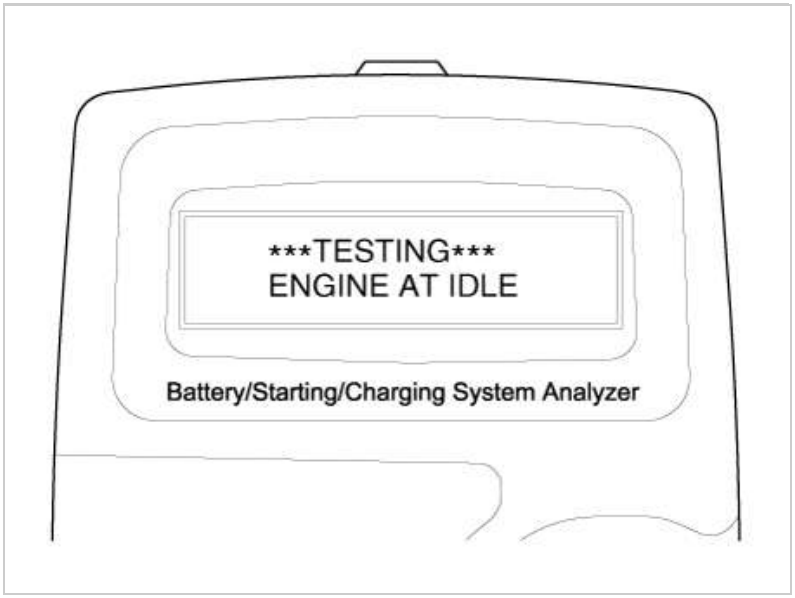
13. The message that engine RPM is detected will be displayed on the screen. Press ENTER to continue.

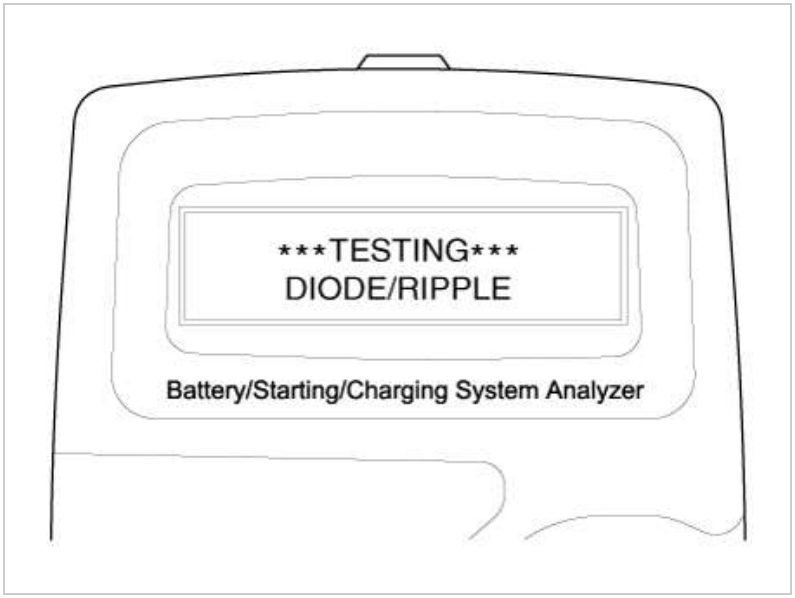


14. If the engine RPM is not detected, press ENTER after revving up the engine.

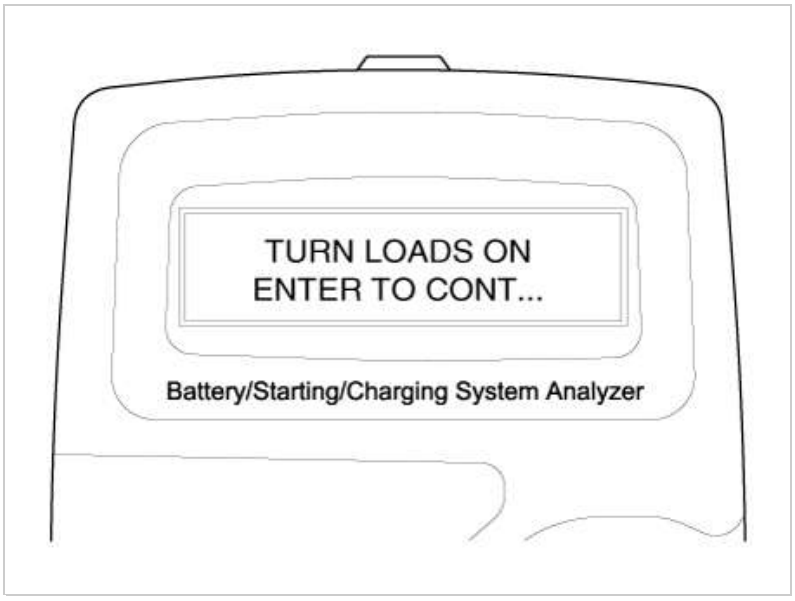


15. The tester will conduct charging system test during loads off.

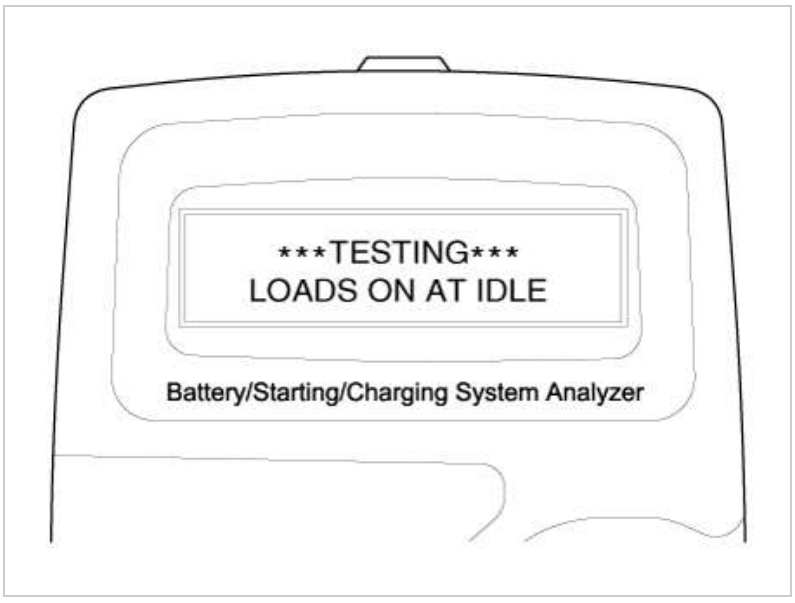




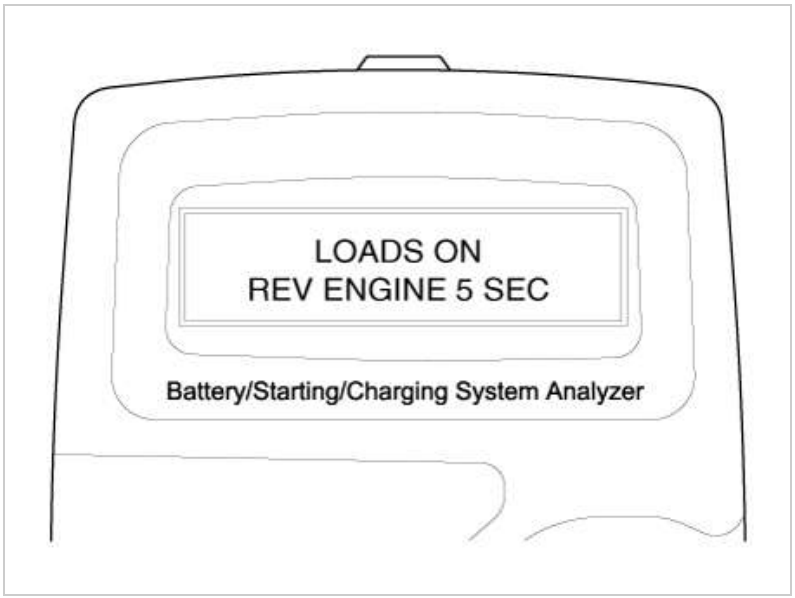
16. Rev up the engine with the electrical loads on.

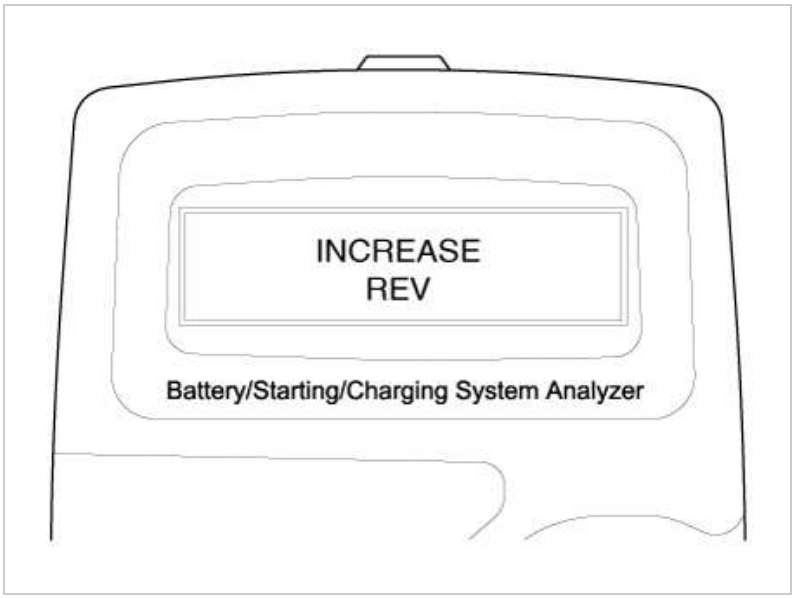


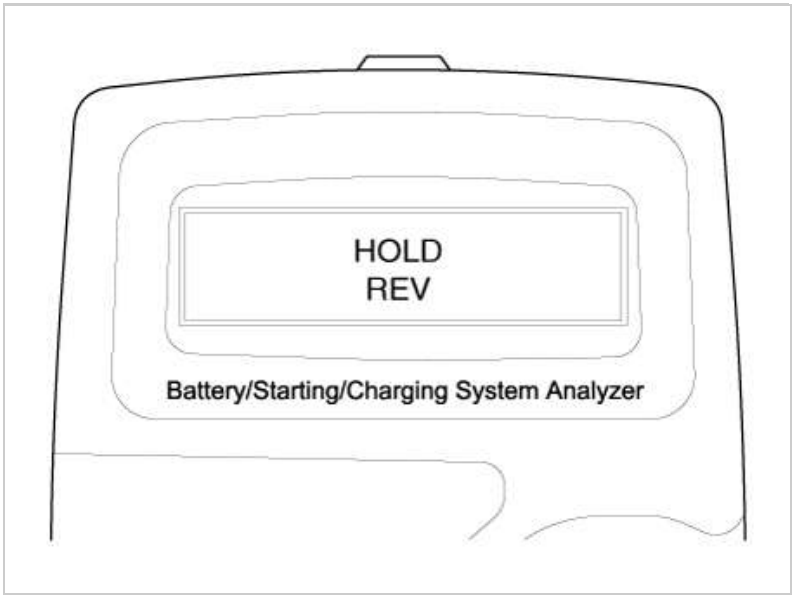
17. The tester will conduct charging system test during loads on.



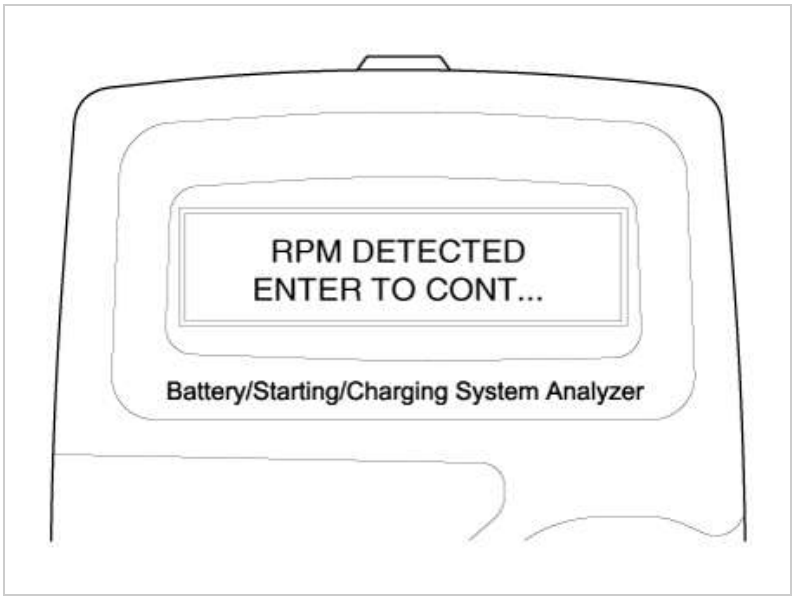
18. Rev up the engine for 5 seconds by pressing the accelerator pedal. (Follow the instructions on the screen.)



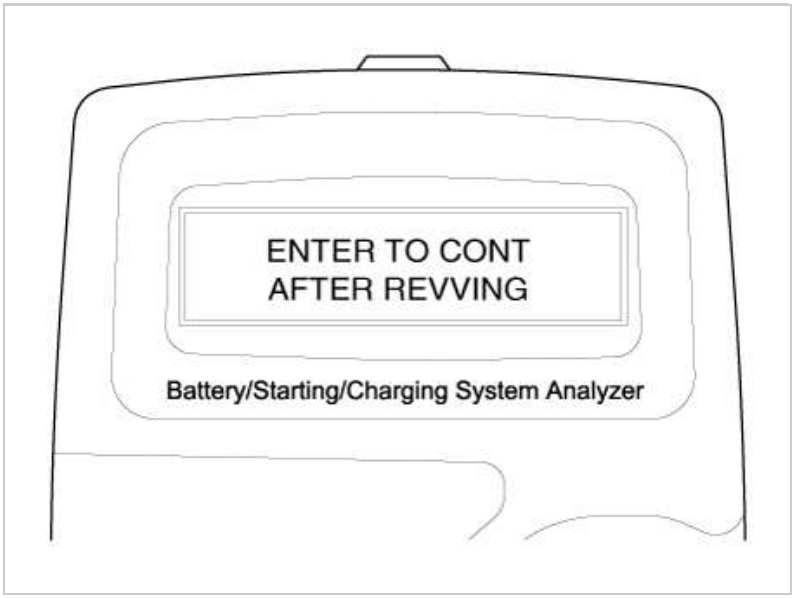




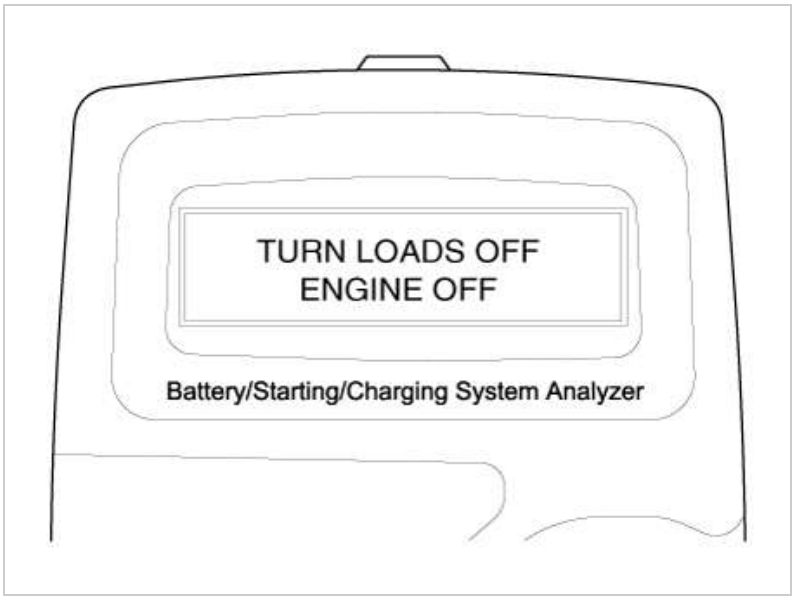
19. The message that engine RPM is detected will be displayed on the screen. Press ENTER to continue.



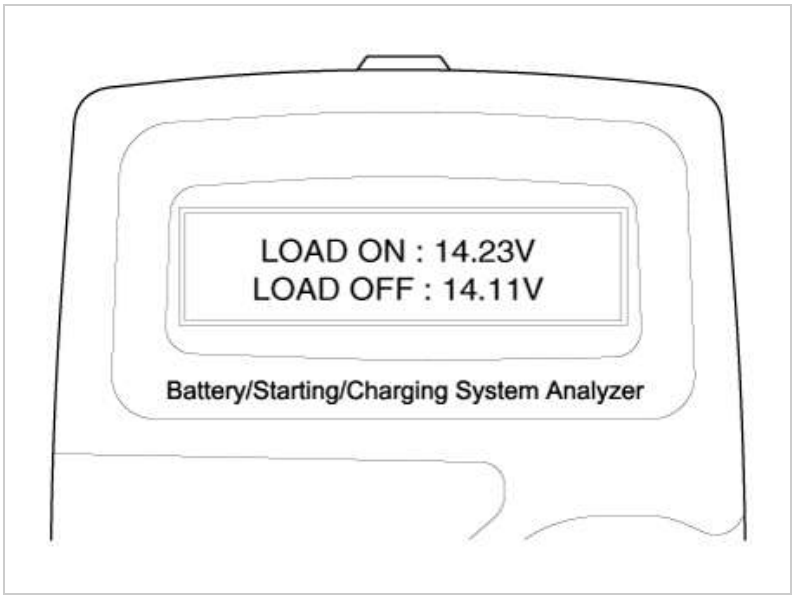
20. If the engine RPM is not detected, press ENTER after revving up the engine.

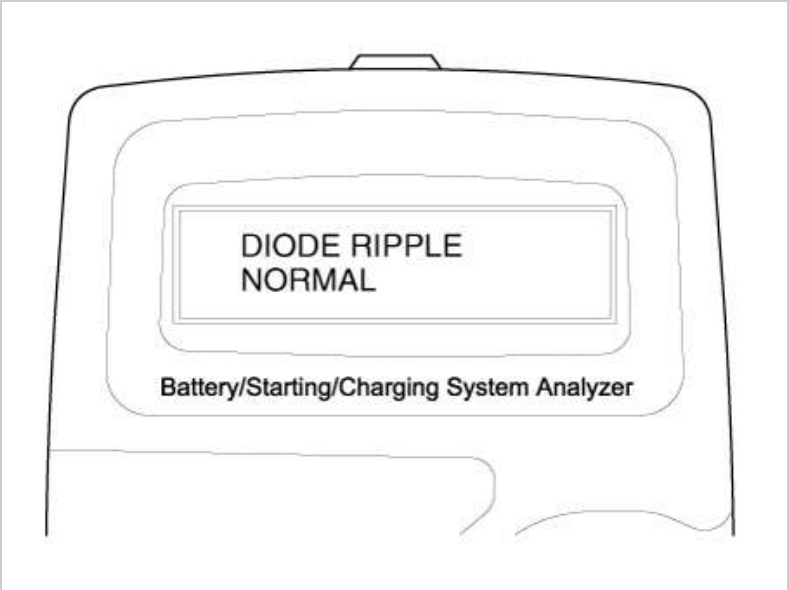


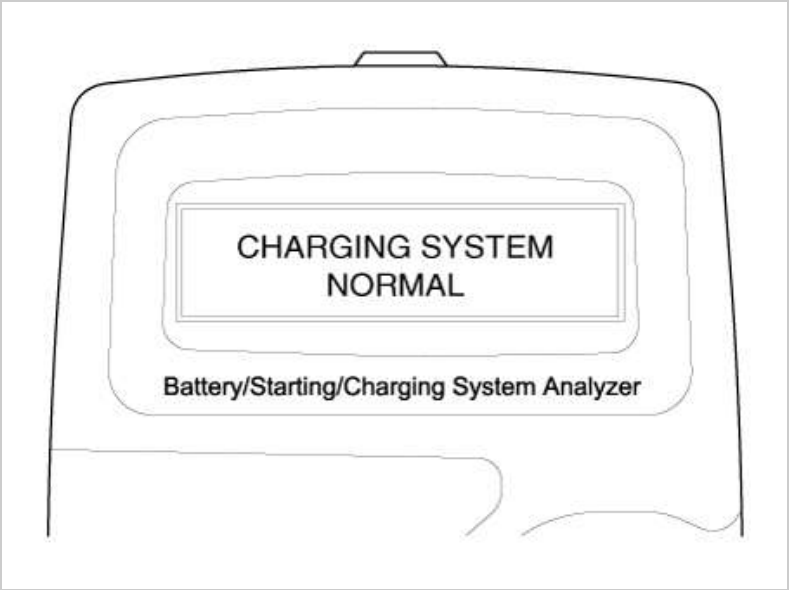
21. Turn off electrical loads (air conditioner, lamps, audio and etc). Turn the engine off.



22. Charging voltage and charging system test results will be displayed on the screen.
    Shut off the engine and disconnect the tester clamps from the battery. Refer to the following table and take the appropriate action as recommended by the Micro 570.







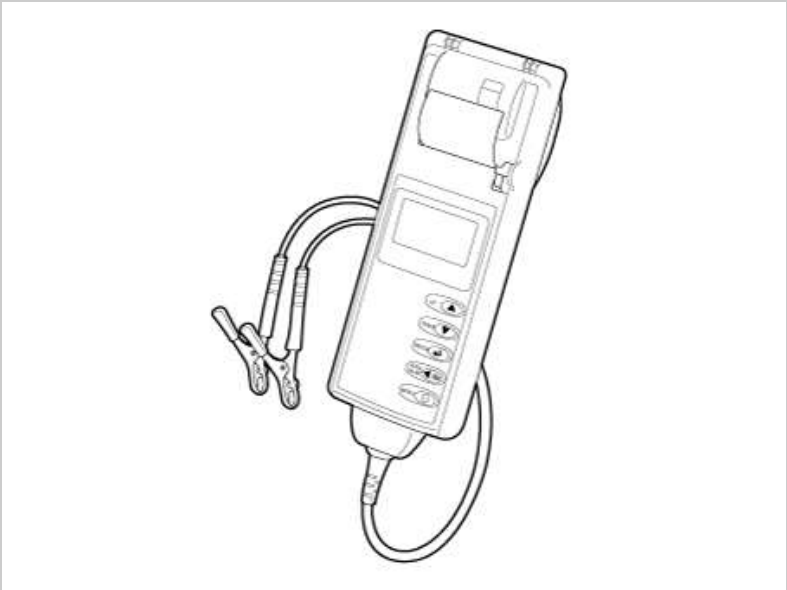
Charging System Test Results

Result On Printer	Remedy
CHARGING SYSTEM NORMAL / DIODE RIPPLE NORMAL	Charging system is normal.
NO CHARGING VOLTAGE	Alternator does not supply charging current to battery. – Check belts, connection between alternator and battery and replace belts, or cable or alternator as necessary.
LOW CHARGING VOLTAGE	Alternator does not supply charging current to battery and electrical load to system fully. – Check belts and alternator and replace as necessary.
HIGH CHARGING VOLTAGE	The voltage from alternator to battery is higher than normal limit during voltage regulation. – Check connection and ground and replace regulator as necessary. – Check electrolyte level in the battery.
EXCESS RIPPLE DETECTED	One or more diodes in the alternator is not functioning properly. – Check alternator mounting and belts and replace as necessary.

The MDX-670P Analyzer

The MDX-670P battery conductance and electrical system analyzer tests batteries as well as starting and charging systems of the vehicle.

It displays the test results in seconds and features a built-in printer to provide a copy of the results.

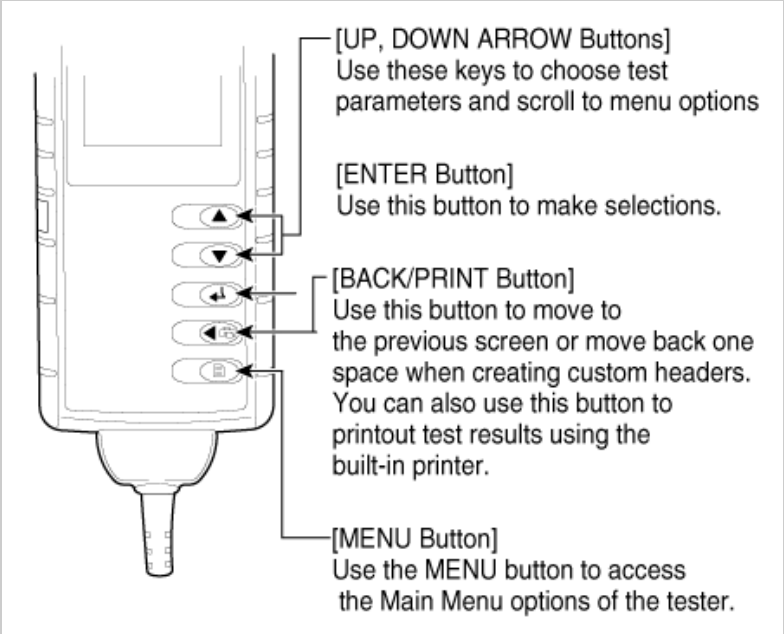


⚠ CAUTION

1) Because of the possibility of personal injury, always use extreme caution and appropriate eye protection when working with batteries.
2) When charging a battery based on test result, it must be fully charged. For an accurate test result, test the battery when the battery surface voltage has subsided completely after charging it. (Refer to Battery Test Results below.)

NOTICE

- When testing a vehicle with an old diesel engine, the test result may not be favorable if the glow plug is not heated. Conduct the test after warming up the engine for 5 minutes.

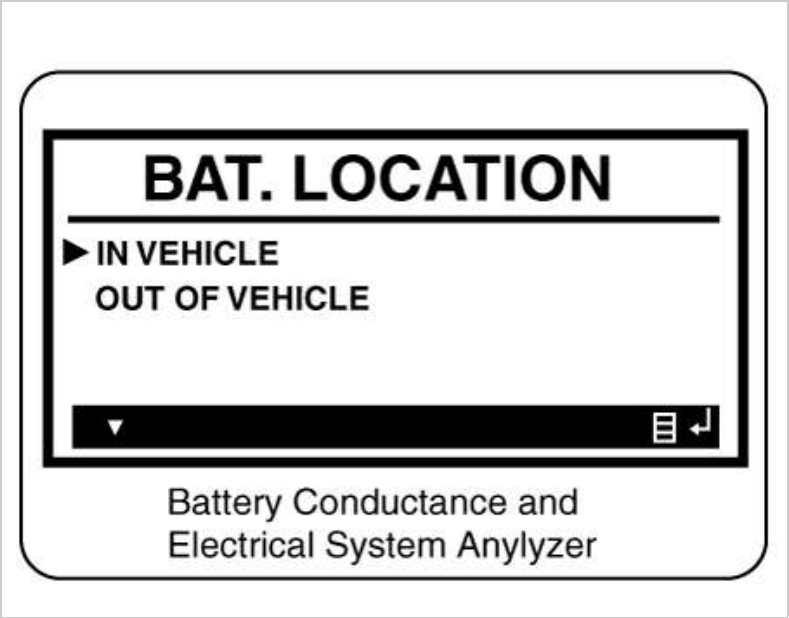


1. Connect the red clamp to the positive (+) terminal and the black clamp to the negative (–) terminal.

NOTICE

- For a proper connection, rock the clamps back and forth. The tester requires that both sides of each clamp be firmly connected before testing. A poor connection may prompt CHECK CONNECTION or WIGGLE CLAMPS message. If the message appears, clean the terminals and reconnect the clamps.

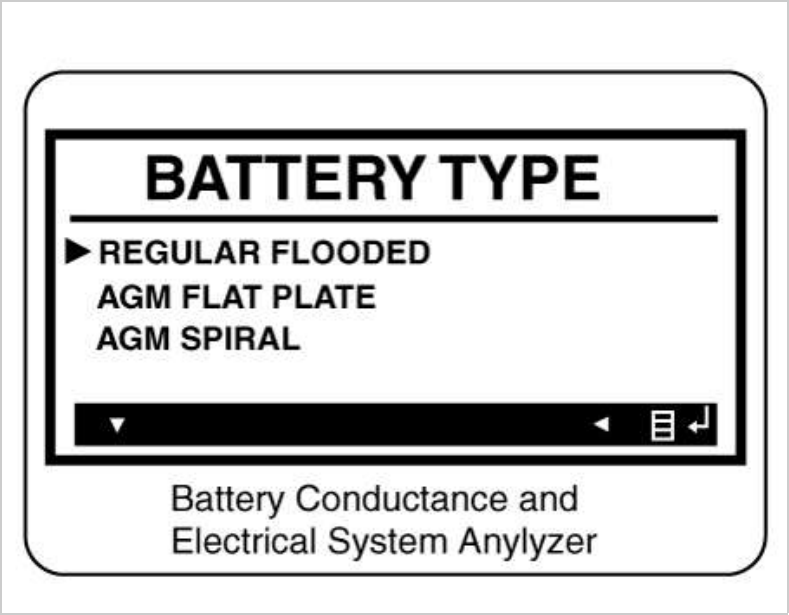
2. Scroll to and select IN VEHICLE or OUT OF VEHICLE for a battery not connected to a vehicle.



NOTICE

- Following an IN VEHICLE test you will be prompted to test the starting and charging systems.

3. Scroll to and select REGULAR FLOODED, AGM FLAT PLATE, or AGM SPIRAL where applicable.



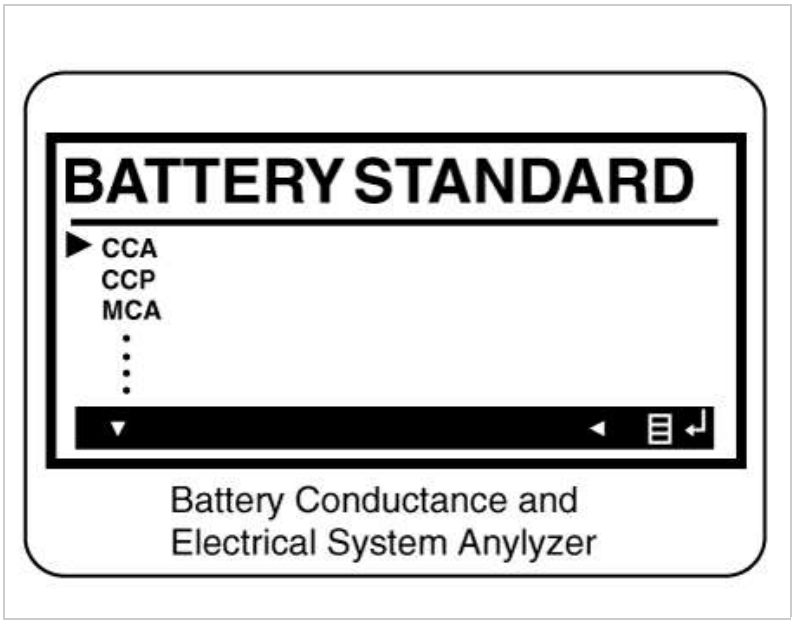
NOTICE

- For a vehicle equipped with ISG function, select the AGM FLAT PLATE.

4. Scroll to and select the battery's rating system.

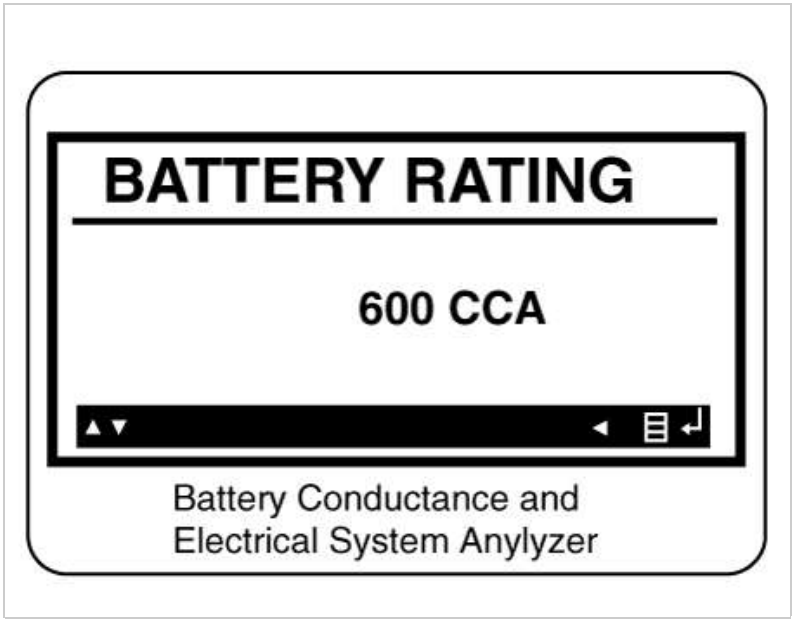
NOTICE

- In most cases, the CCA value is marked on the battery label, but sometimes it is substituted with the EN or SEA value. Select any of them.

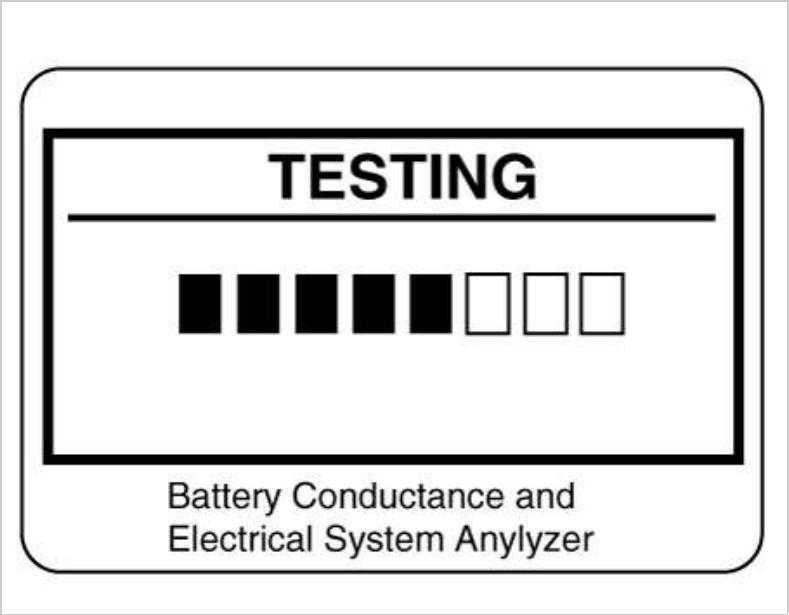


– CCA: Cold Cranking Amps, as specified by SAE, is the most common rating for cranking batteries at 0°F (-17.8°C).
– EN: Europe-Norm
– SAE: Society of Automotive Engineers, the European labeling of CCA

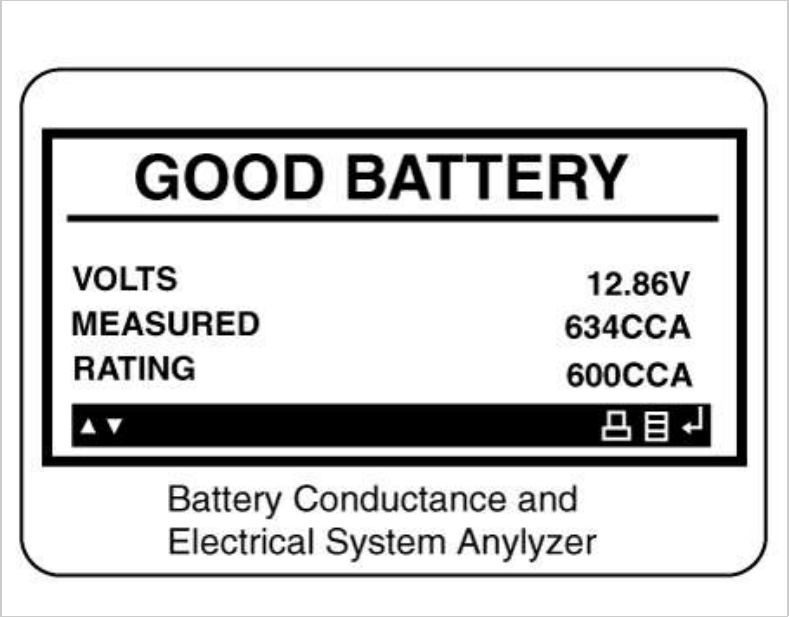
5. Set the selected rating value displayed on the screen to the value marked on the battery label by pressing up and down arrow buttons.



6. Press ENTER to start test.



7. After several seconds, the tester will display the battery condition and the measured voltage. The tester will also display the battery rating and the rating units.



Battery Test Results

Result On Printer	Remedy
GOOD BATTERY	No action is required.
GOOD - RECHARGE	Battery is in a good state. Recharge the battery for use. • Follow the instruction below when charging and retesting the battery, otherwise the test result may be inaccurate. (See 'Charging and Retesting after charging battery' below.)
CHARGE & RETEST	Battery is not charged properly. – Charge and test the battery again. • Follow the instruction below when charging and retesting the battery, otherwise the test result may be inaccurate. (See 'Charging and Retesting after charging battery' below.)
REPLACE BATTERY	Replace battery and recheck the charging system. – Improper connection between battery and vehicle cables may prompt "REPLACE BATTERY" message. Retest the battery after removing cables and connecting the tester to the battery terminal directly prior to replacing the battery.

BAD CELL - REPLACE	Charge and retest the battery. – If "REPLACE BATTERY" is prompted on MDX-670P Analyzer, replace the battery and recheck the charging system.

[Charging and Retesting after charging battery]

Charging battery

Set battery charger to 'Auto Mode' (the Mode that charging current drops as the battery charges) and charge battery until charging current drops down close to zero or the charger alerts with an alarm when charging is complete. (Minimum charging time recommended: More than 3 hours in Auto Mode explained above)

- If battery is not fully charged, battery surface voltage will be high while the amount of current charged (CCA) in battery is low. If the battery is tested in this condition, the tester may misjudge that battery sulfation has occurred as the level of current in battery is too low in comparison with battery voltage.

  * Surface voltage: When battery is charged, electrolyte temperature increases and chemical reaction becomes active resulting in an excessive increase in battery voltage.

  It is known that it takes approximate one day to subside this increased surface voltage completely.

Testing battery after charging

Do not test the battery immediately after charging. Test the battery after the battery surface voltage has subsided as instructed in the following procedure.

(1) When battery charging is complete, install the battery to the vehicle.

(2) Turn IG ON, turn on the headlamps at low beam, and wait for 5 minutes. (Discharge for 5 minutes.)

(3) Turn off the headlamps at IG ON, and wait for 5 minutes. (Wait for 5 minutes.)

(4) Remove +, - cables from the battery and test battery.

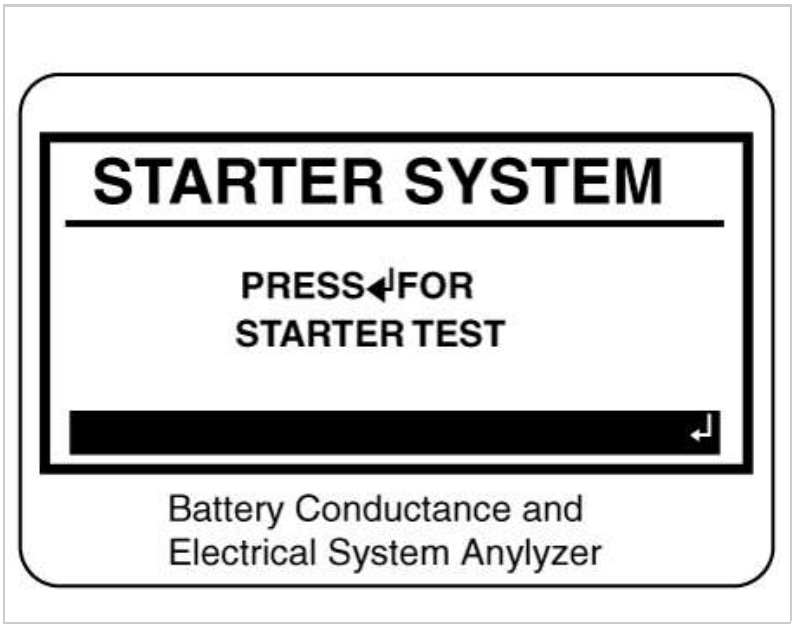
NOTICE

- For an in-vehicle test, the display alternates between the test results and the message "PRESS FOR STARTER TEST.

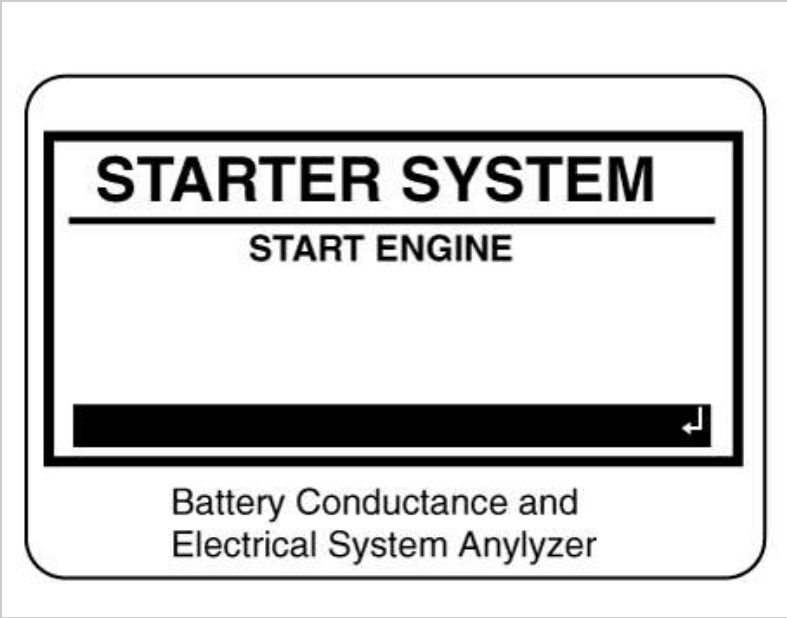
NOTICE

- Before starting the test, inspect the alternator drive belt. A belt that is glazed or worn, or lacks the proper tension, will prevent the engine from achieving the rpm levels needed for the test.

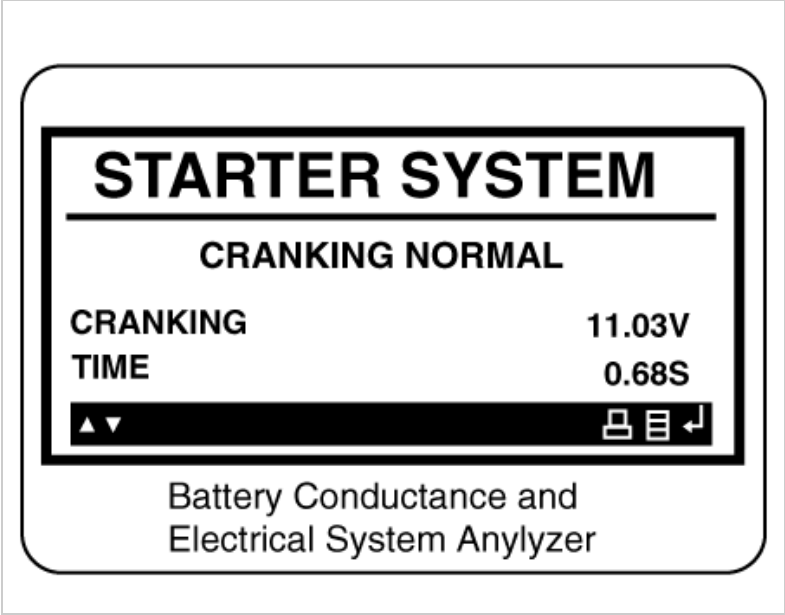
8. Press the ENTER button to proceed with the starter test.



9. Start the engine when prompted.



10. The tester displays the status of the starter system, cranking voltage, and cranking time in milliseconds.



Starter Test Results

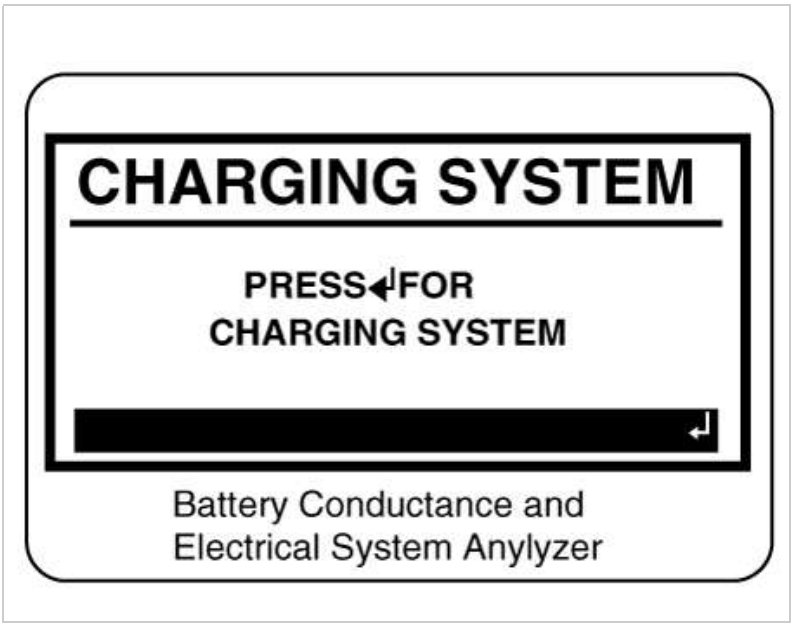
Result On Printer	Remedy
CRANKING VOLTAGE NORMAL	System shows a normal starter draw.
CRANKING VOLTAGE LOW	Cranking voltage is lower than normal level. – Check starter.
CHARGE BATTERY	The battery level is too low for the test. – Charge the battery and retest.
REPLACE BATTERY	Replace battery. – If the vehicle cannot be started even though "GOOD BATTERY" is displayed, check wiring for open circuit, battery cable connection and starter, and repair or replace as necessary. – If the engine does crank, check fuel system.

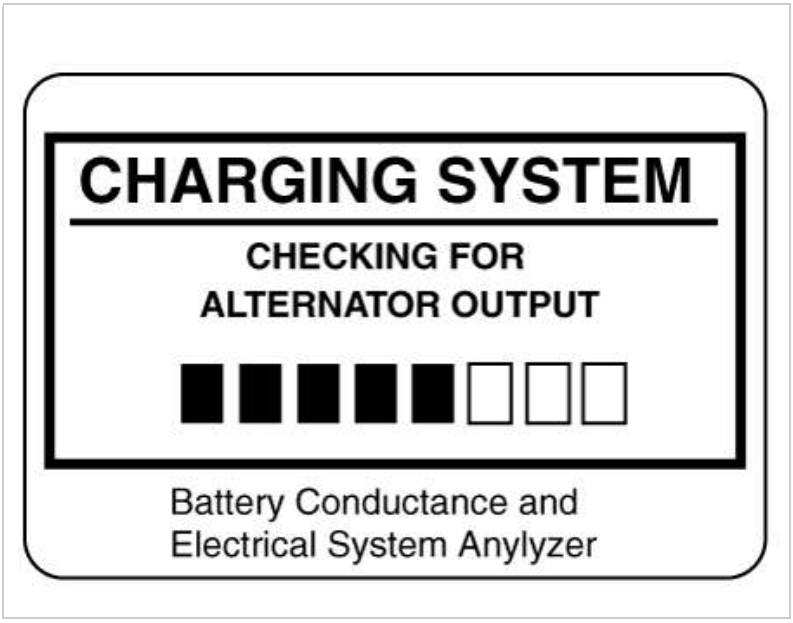
NOTICE

• For an in-vehicle test, the display alternates between the test results and the message “PRESS FOR CHARGING TEST.

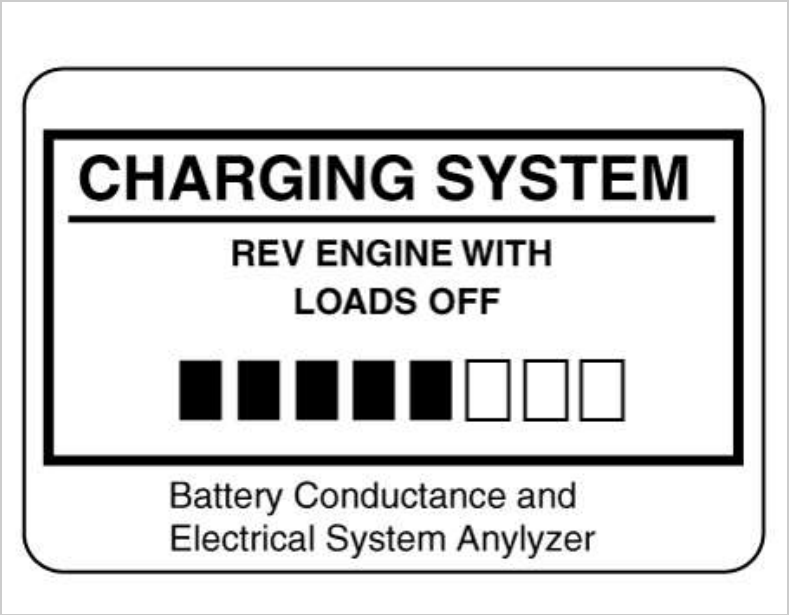
Step 3: Charging System Test

11. Press the ENTER button to proceed with the charging test.

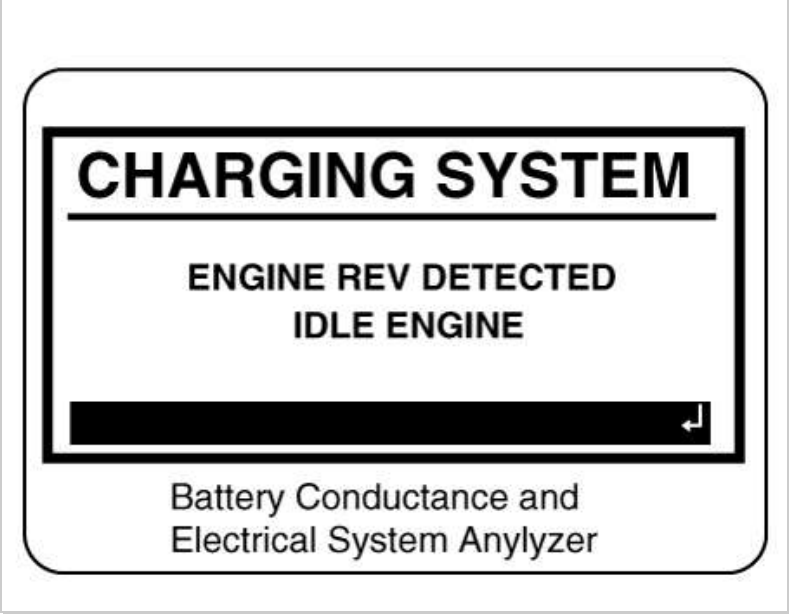




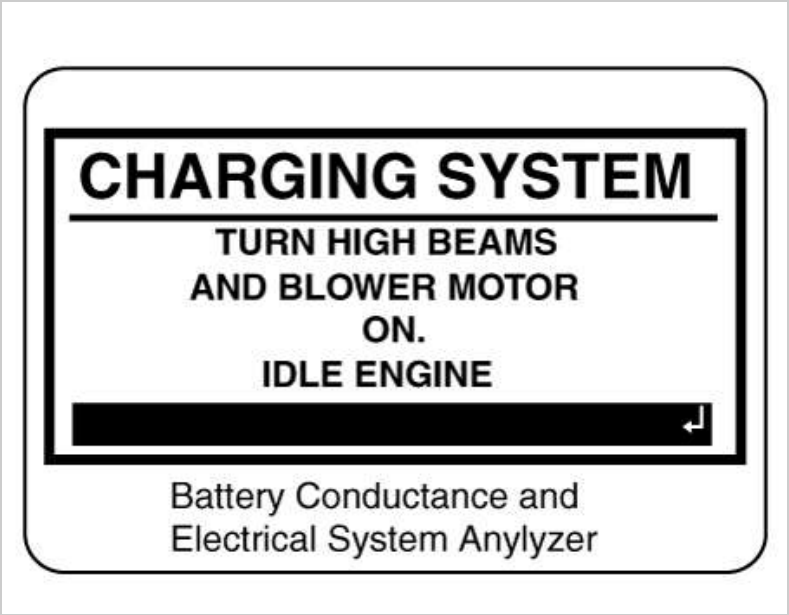
12. Rev up the engine with loads off. (Following the on-screen prompts)



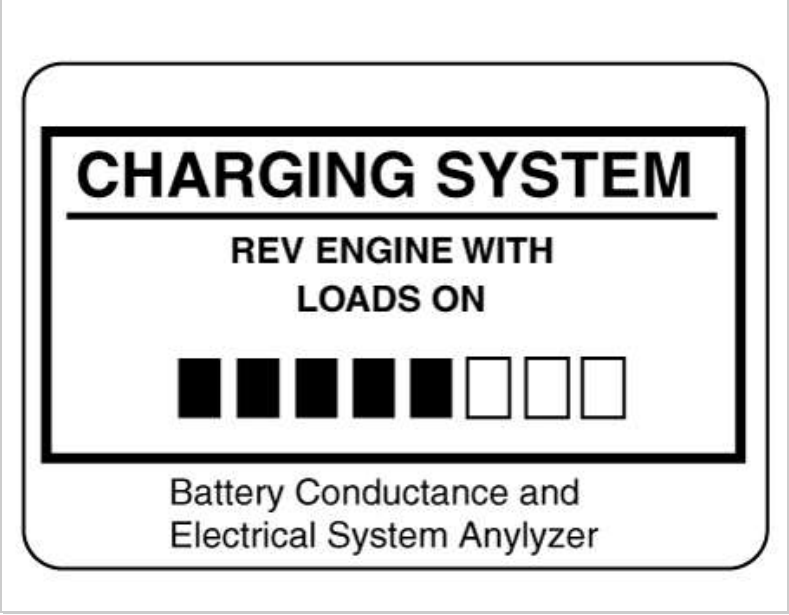
13. The message that engine RPM is detected will be displayed on the screen. Idle the engine.



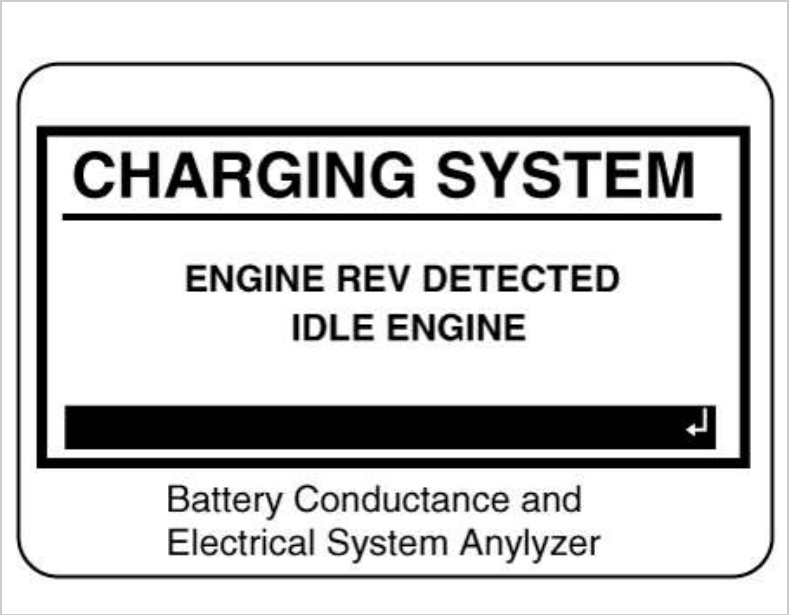
14. Turn on electrical loads (air conditioner, lamps, audio and etc). Press ENTER to continue.



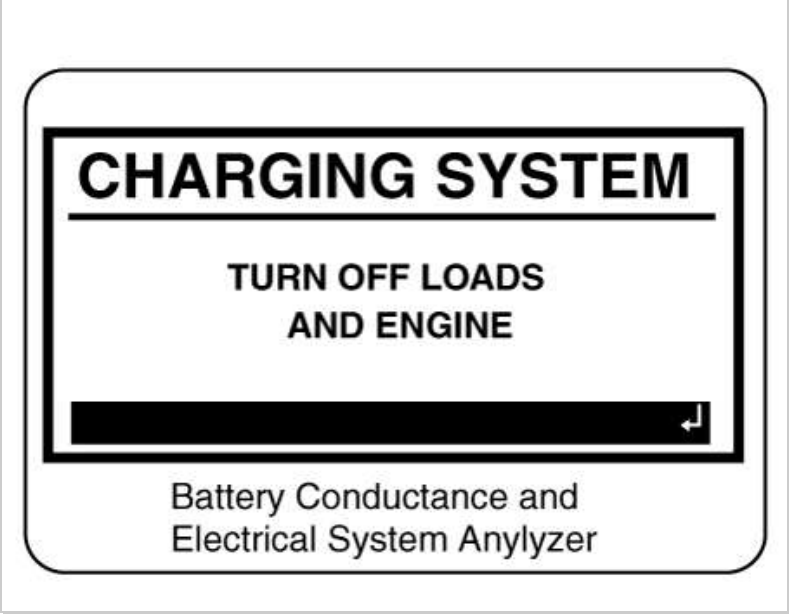
15. Turn on electrical loads (air conditioner, lamps, audio and etc). Press ENTER to continue.



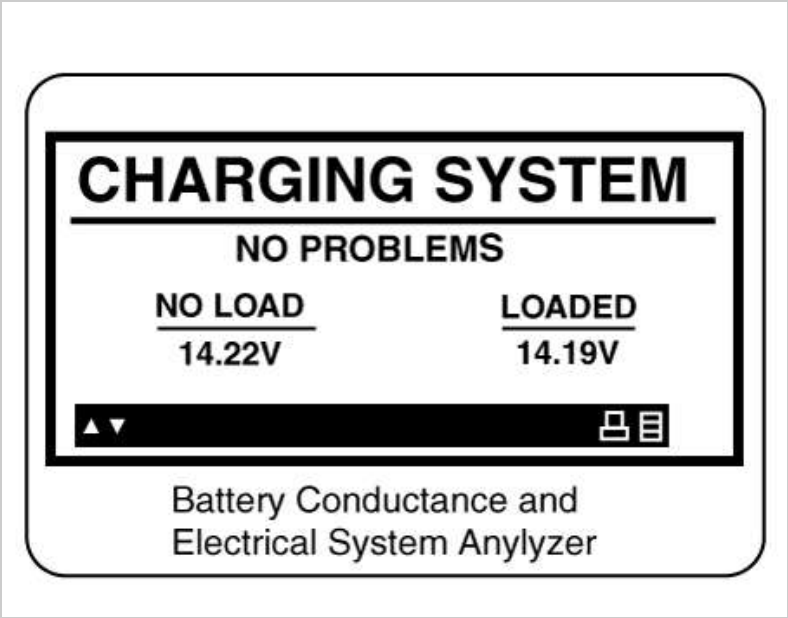
16. The message that engine RPM is detected will be displayed on the screen. Idle the engine.



17. Turn off loads and engine.



18. The status of the Charging System is displayed at the end of the procedure.



Result On Printer	Remedy
NO PROBLEMS	System is showing normal output from the alternator.
NO OUTPUT	No alternator output detected. – Check all connections to and from the alternator, especially the connection to the battery. If the connection is loose or heavily corroded, clean or replace the cable and retest. – If the belts and connections are in good working condition, replace the alternator. (Older vehicles use external voltage regulators, which may require replacement of the voltage regulator only.)
LOW OUTPUT	Alternator does not supply charging current to battery and electrical load to system fully. – Check belts and alternator and replace as necessary.
HIGH OUTPUT	The voltage from alternator to battery is higher than normal limit during voltage regulation. – Check connection and ground and replace regulator as necessary. – Check electrolyte level in the battery.
EXCESSIVE RIPPLE	The voltage from alternator to battery is higher than normal limit during voltage regulation. – Check alternator mounting and belts and replace as necessary.
CHARGE BATTERY	The starter voltage is low and the battery is discharged. Fully charge the battery and repeat the starter system test.
REPLACE BATTERY	Battery must be replaced before the starting system can be tested.

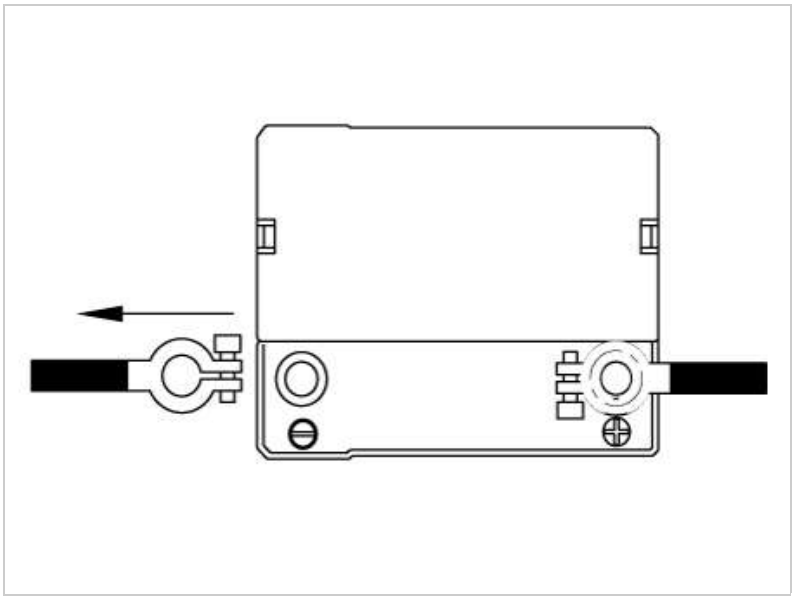
19. Press the BACK/PRINT button to print the test results or MENU to return to the Options Menu.

Cleaning

1. Make sure that the ignition switch and all accessories are turned OFF.
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 duty rubber gloves (not the household type) should be worn when removing the battery.



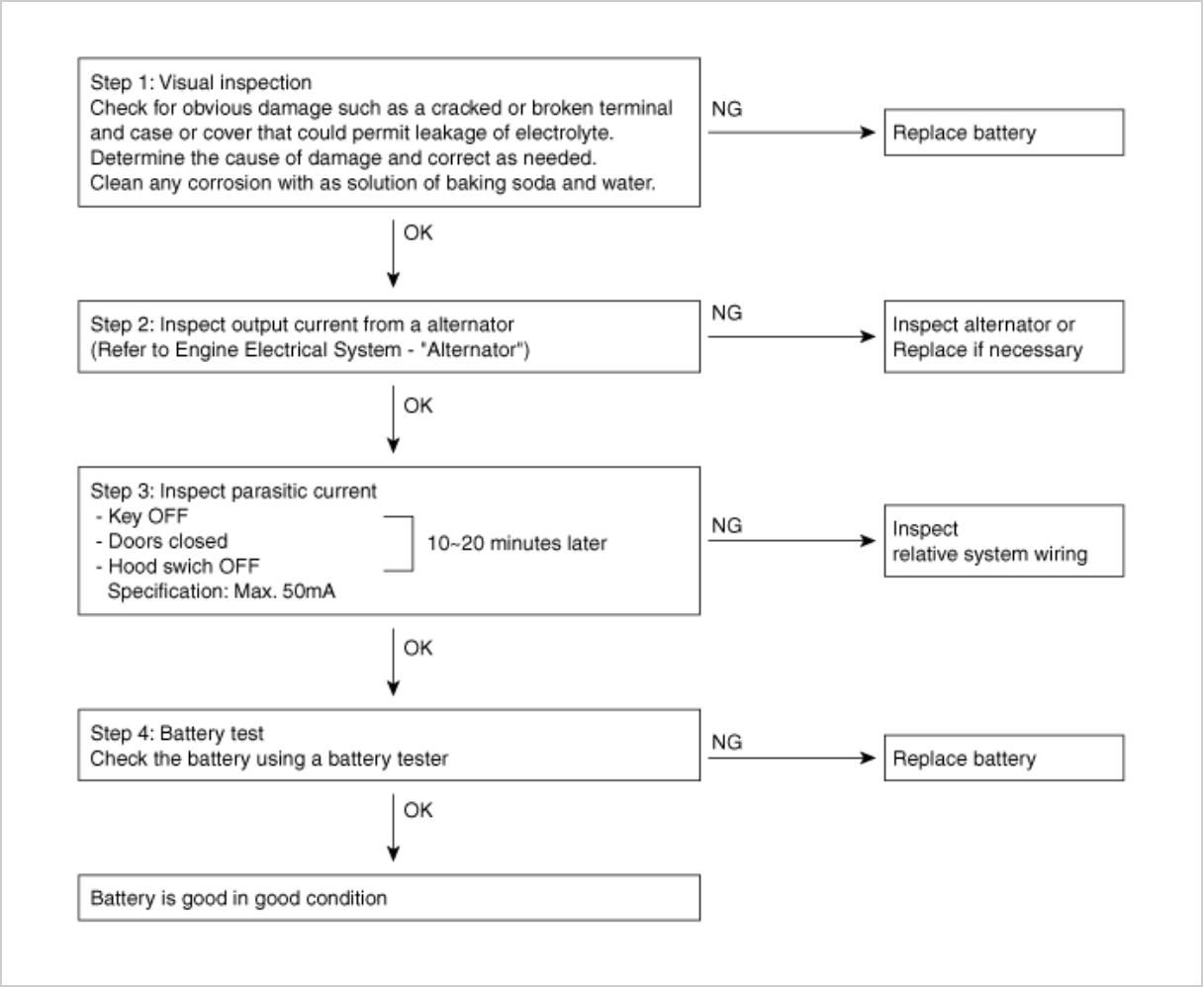
4. Inspect the battery tray for damage caused by the loss of electrolyte. If acid damage is present, it will be necessary to clean the area with a solution of clean warm water and baking soda. Scrub the area with a stiff brush and wipe off with a cloth moistened with baking soda and water.
5. Clean the 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 (-) terminal.
2. Disconnect the battery sensor connector (A).
3. Remove the battery negative (-) terminal after removing the bolts.

Battery sensor terminal mounting bolt:
29.4 - 31.4 N·m (3.0 - 3.2 kgf·m, 21.7 - 23.1 lb·ft)
Battery (-) terminal tightening nut:
4.0 - 6.0 N·m (0.4 - 0.6 kgf·m, 3.0 - 4.4 lb·ft)

Installation

1. Install in the reverse order of removal.

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.

Battery Sensor Recalibration Procedure

After reconnecting the battery negative cable, AMS function does not operates 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 AMS function, Battery sensor recalibration procedure should be performed after finishing the repair work.

1. Turn the Iginition switch ON and OFF.
2. Park the vehicle for about 4 hours with the hood and all doors closed.

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.

Engine Electrical System

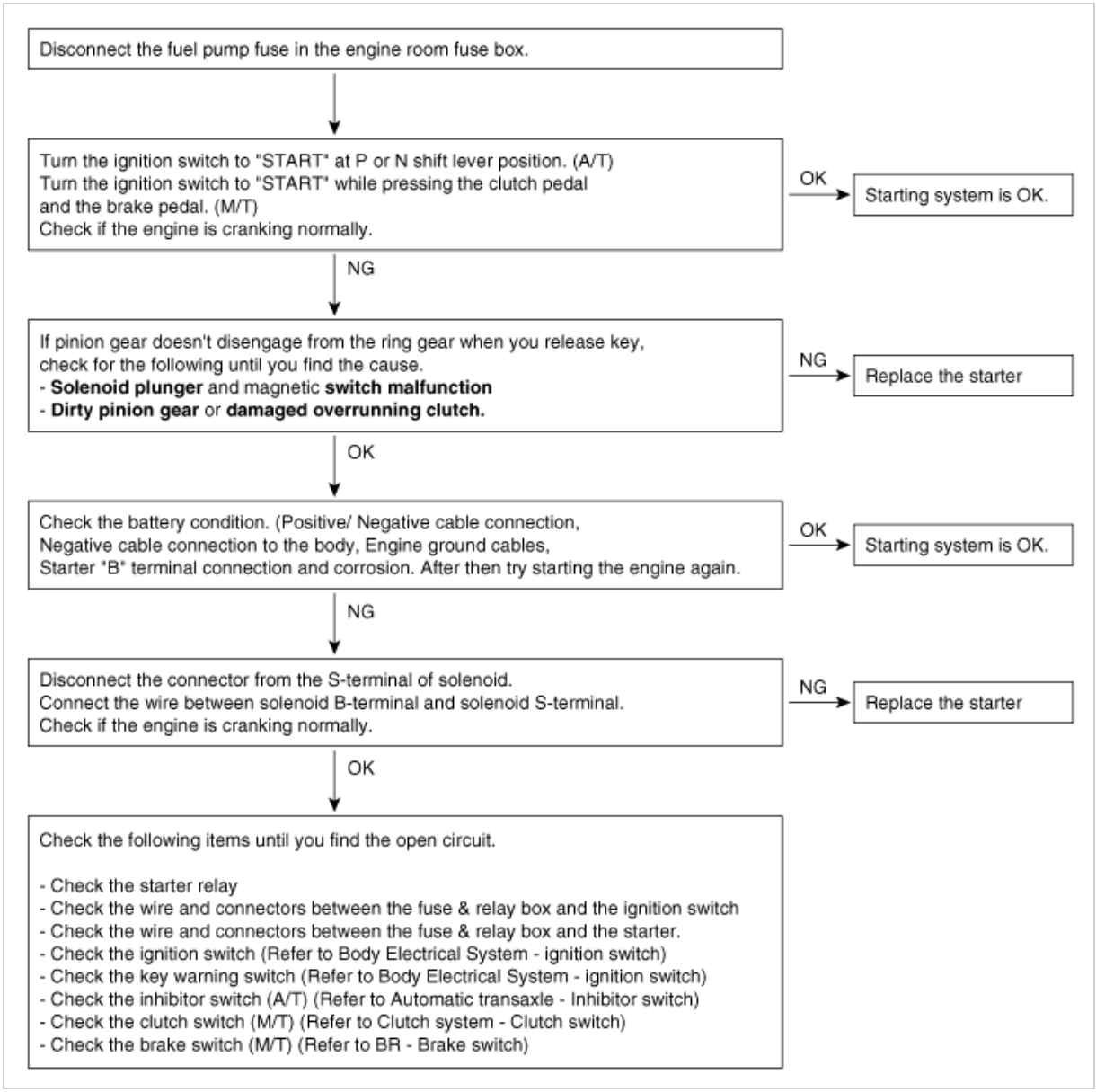
Troubleshooting

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

NOTICE

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



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
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Engine Electrical System

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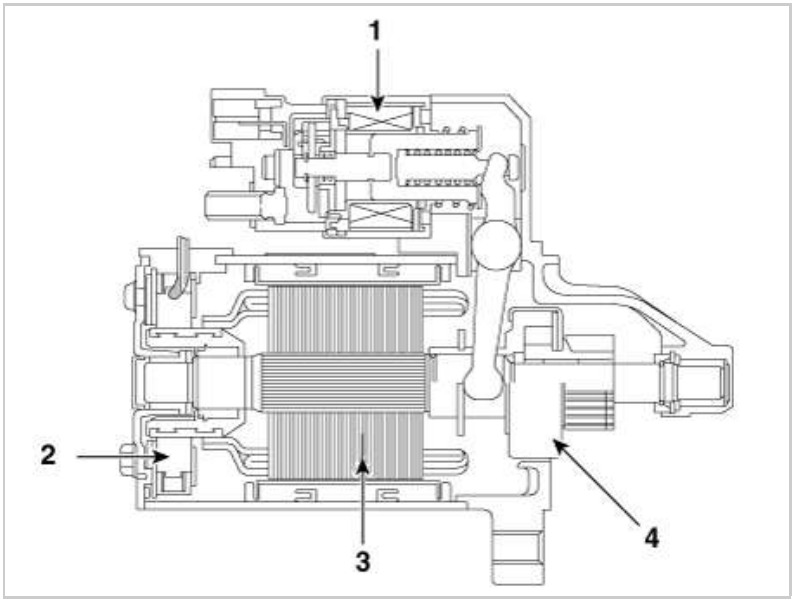
The solenoid plunger and clutch shift lever are activated, and the clutch pinion engages the ring gear.The contacts close and the starter motor cranks.

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.



1. Solenoid
2. Brush assembly
3. Armature
4. Over runing clutch

Engine Electrical System

Specification

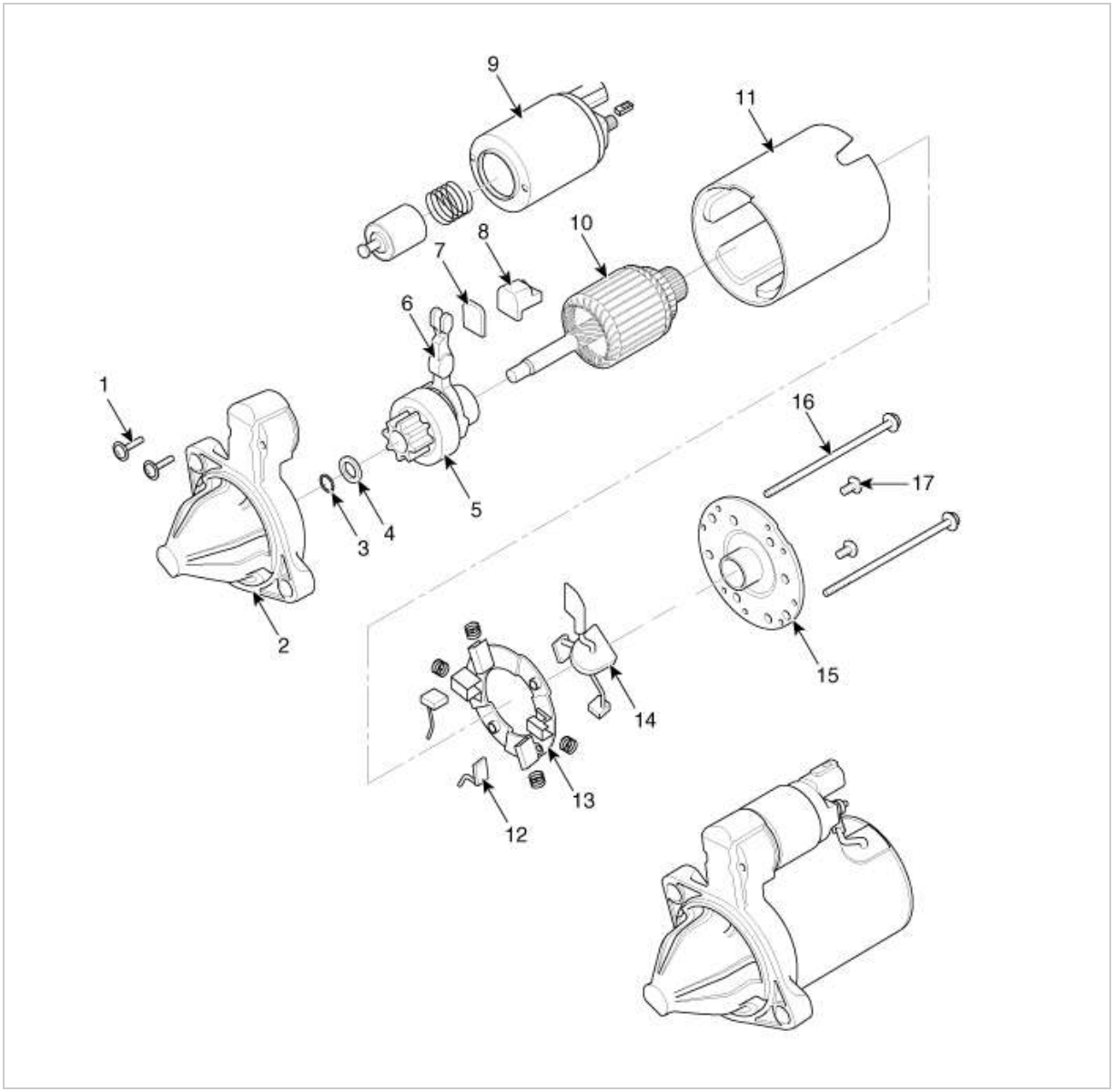
Starter

Item	Specification
Rated voltage	12 V, 0.9 kW
The number of pinion teeth	11

Performance [No-load, 11.5 V]	Ampere	Max. 85 A
	Speed	Min. 3,300 rpm

Engine Electrical System

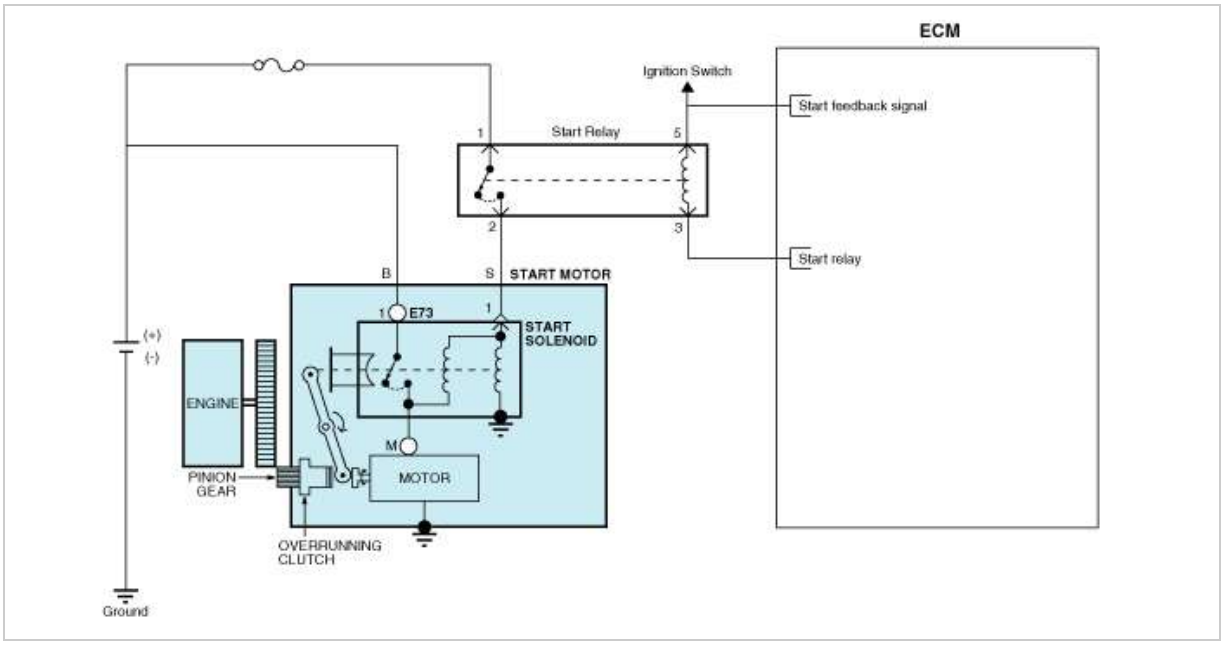
Components



1. Screw
2. Front housing
3. Stop ring
4. Stopper
5. Overrunning clutch
6. Lever
7. Lever plate
8. Lever packing
9. Magnet switch assembly
10. Armature assembly
11. Yoke assembly
12. Brush (-)
13. Brush holder
14. Brush (+)
15. Rear bracket
16. Through bolt
17. Screw

Engine Electrical System

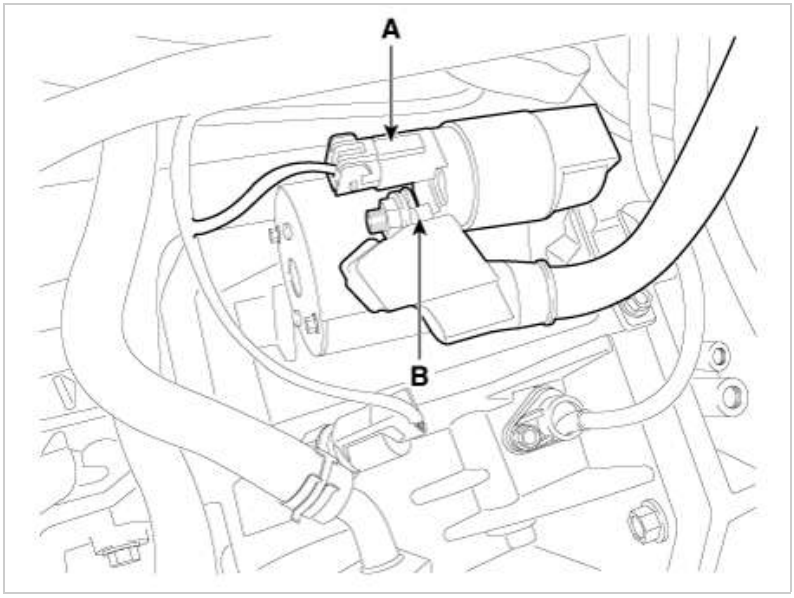
Circuit Diagram



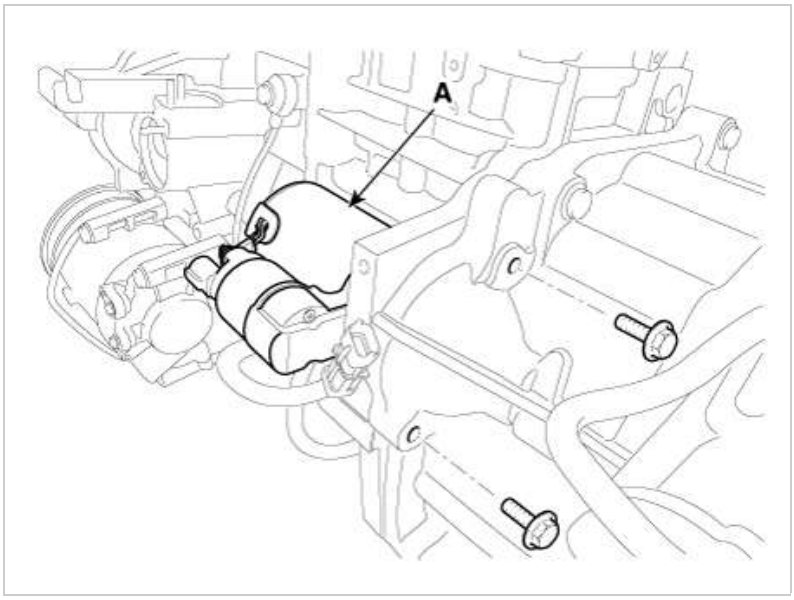
Engine Electrical System

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 (B) from the B terminal on the solenoid then disconnect the connector (A) from the S terminal.



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



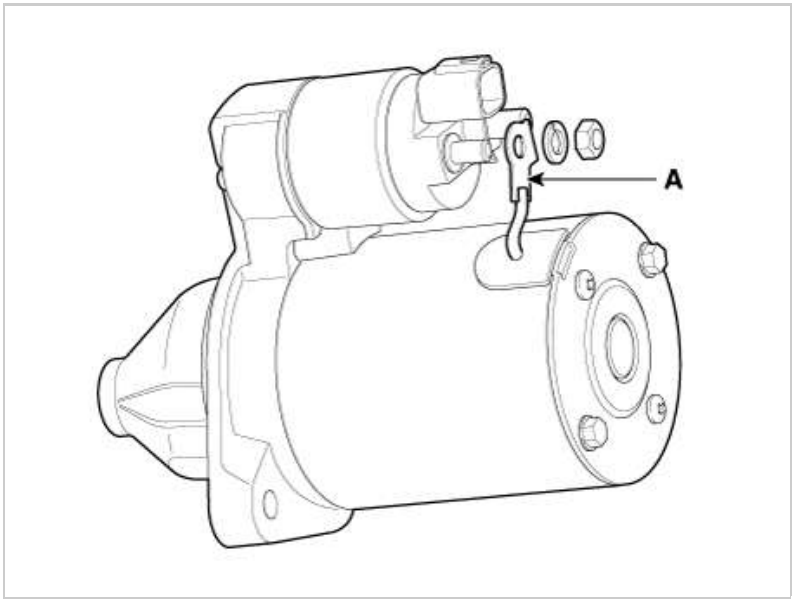
Installation

1. Install in the reverse order of removal.

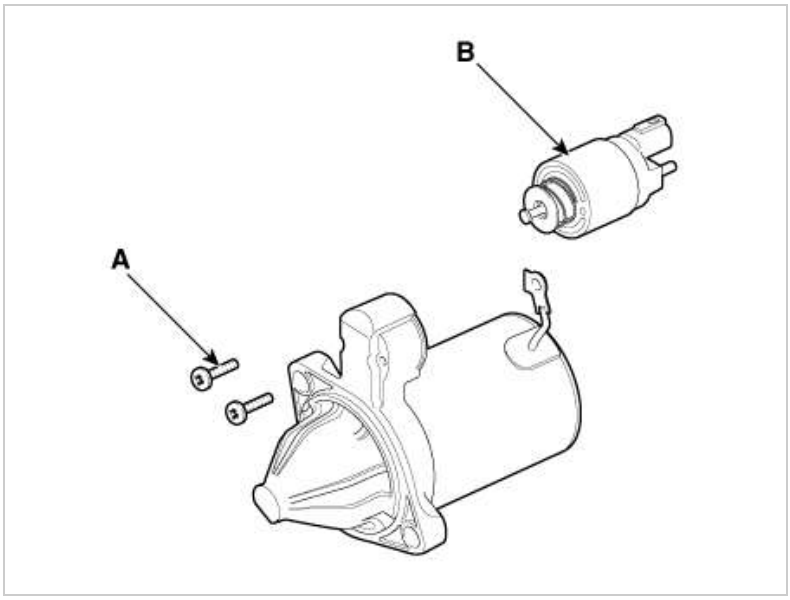
Starter mounting bolt:
49.0 - 63.7 N·m (5.0 - 6.5 kgf·m, 36.2 - 47.0 lb·ft)

Disassembly

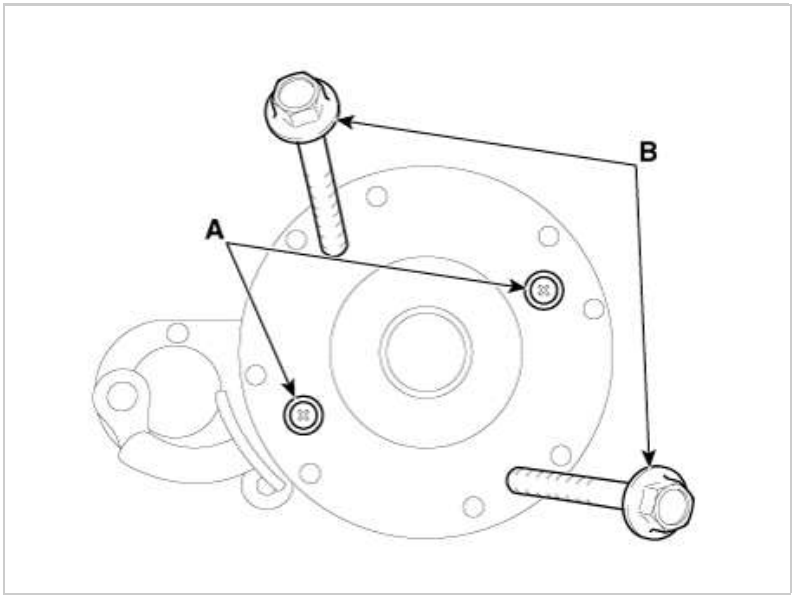
1. Disconnect the M-terminal (A) on the magnet switchassembly.



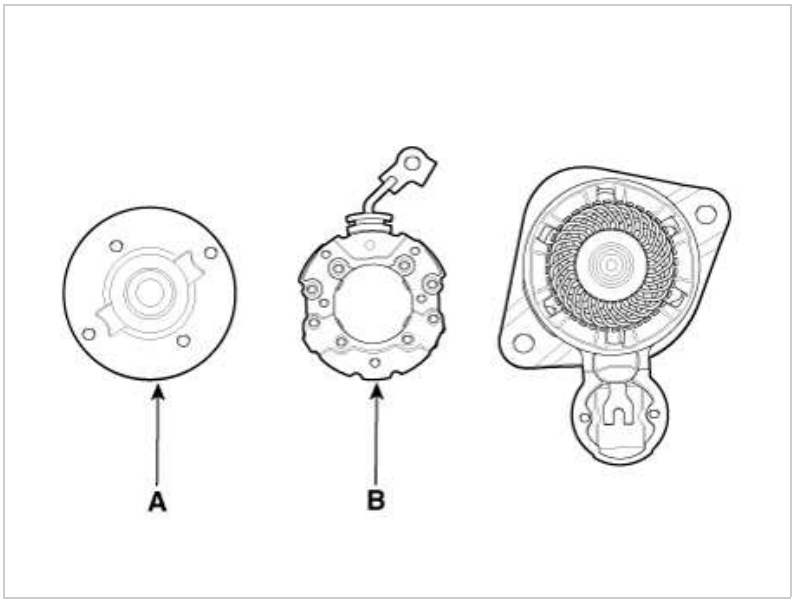
2. After loosening the 2 screws (A), detach the magnetswitch assembly (B).



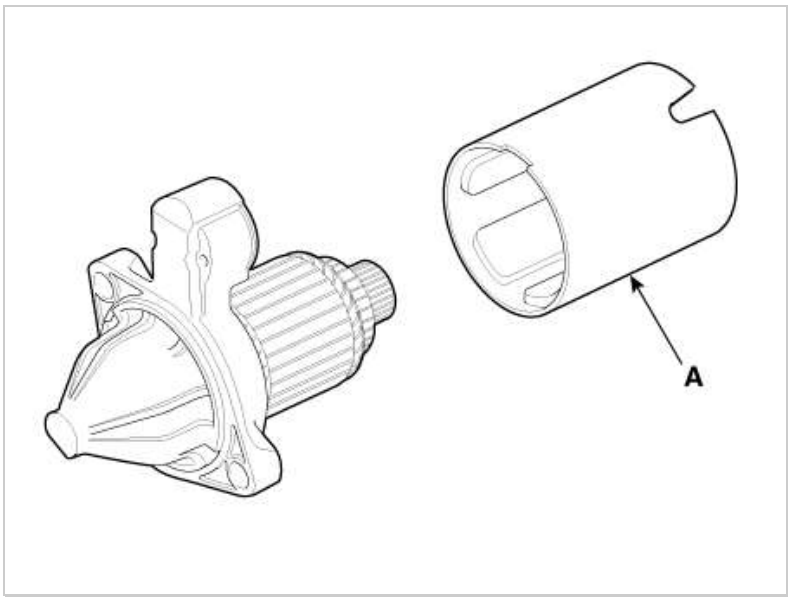
3. Loosen the brush holder mounting screw (A) and the trough bolts (B).



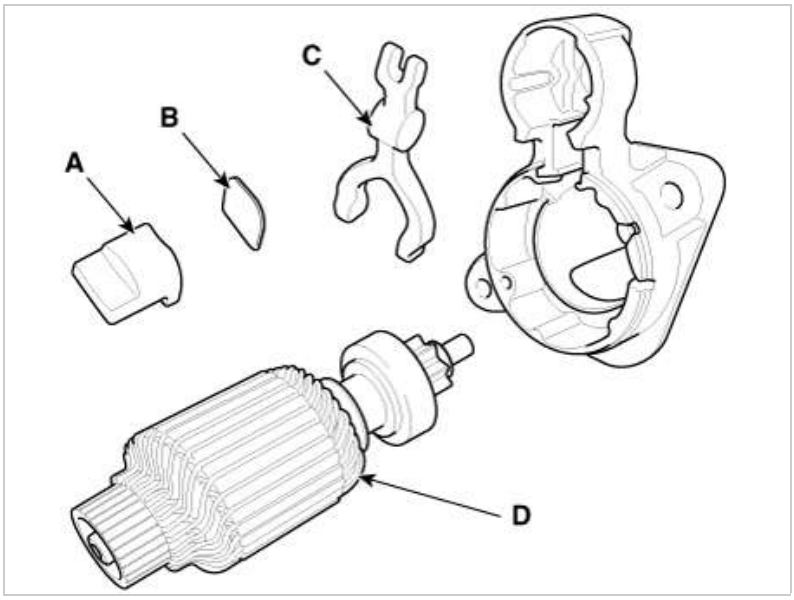
4. Remove the rear bracket (A) and brush holder assembly (B).



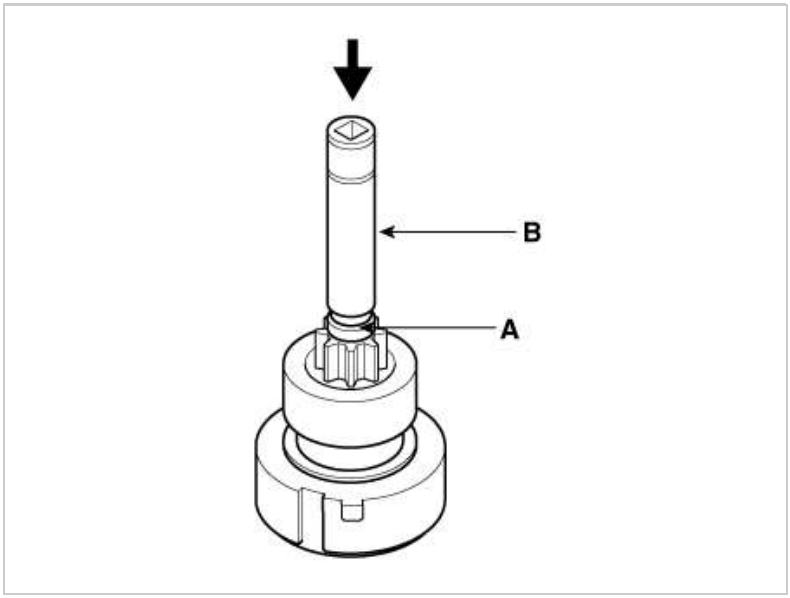
5. Remove the yoke (A).



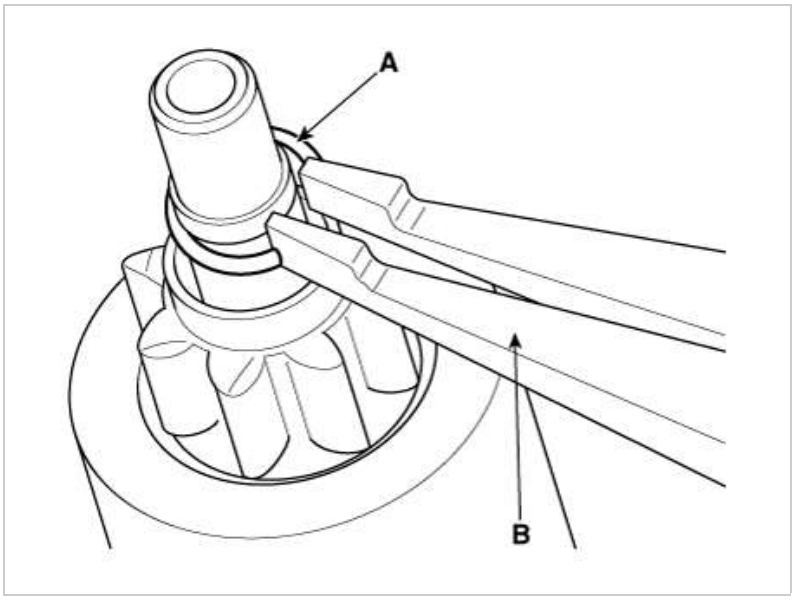
6. Remove the packing (A), lever plate (B), lever (C), armature (D).



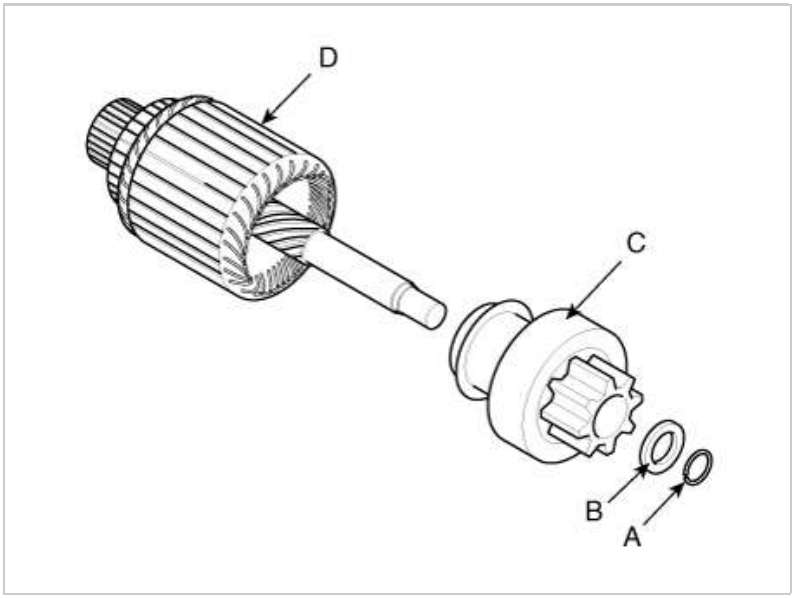
7. Press the stopper (A) using a socket (B).



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

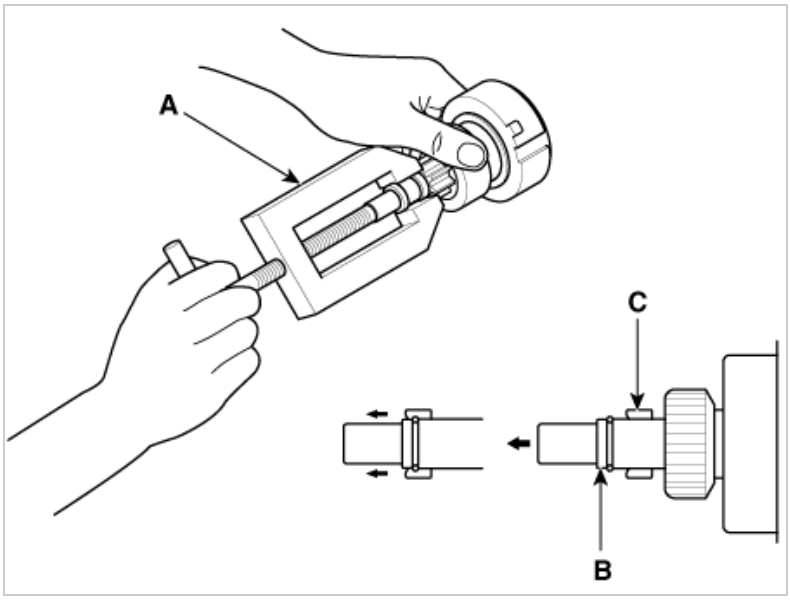


9. Remove the stop ring (B), stopper (A), overrunningclutch (C) and armature (D).



Information

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



Reassembly

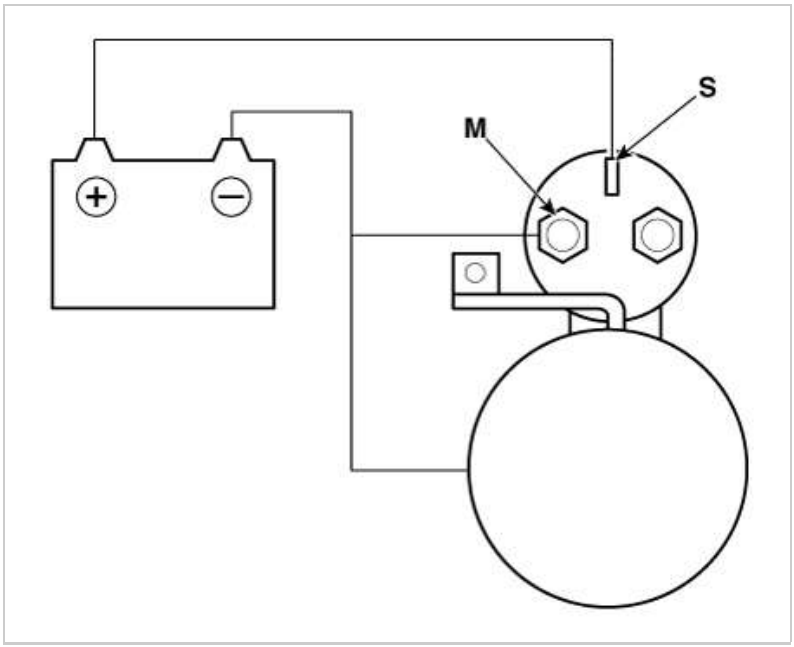
1. Reassemble in the reverse order of disassembly.

Inspection

Starter Solenoid Inspection

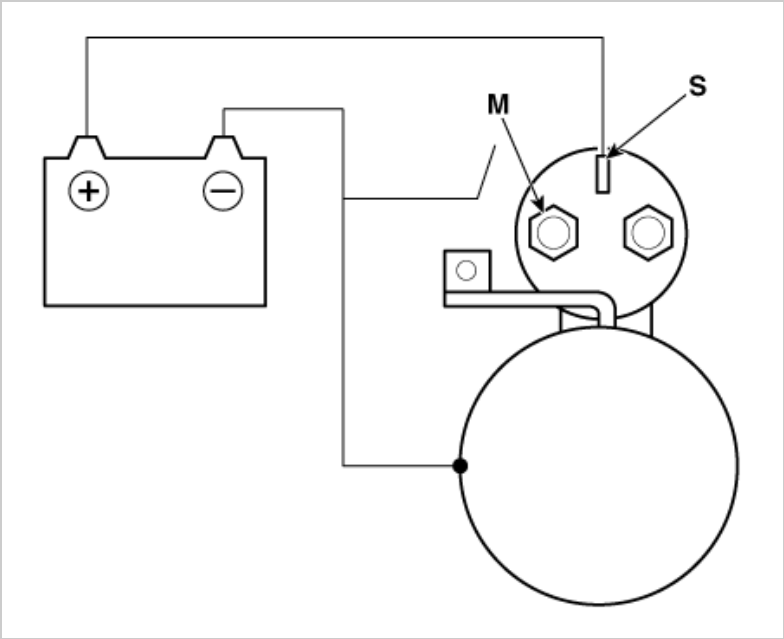
1. Disconnect the lead wire from the M-terminal of solenoid switch.
2. Connect the battery as shown. If the starter pinion pops out, it is working properly.

> **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.

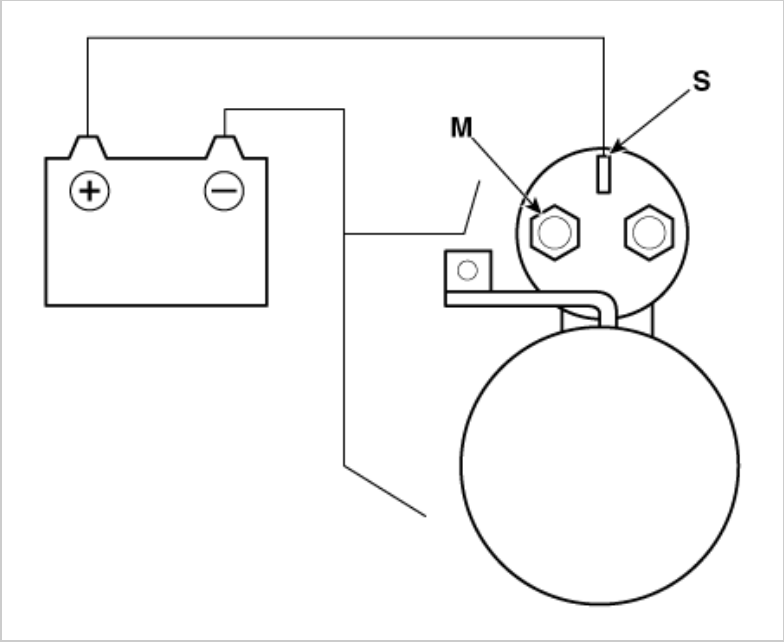
> **NOTICE**
> • To avoid damaging the starter, do not leave the battery connected for more than 10 seconds.



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

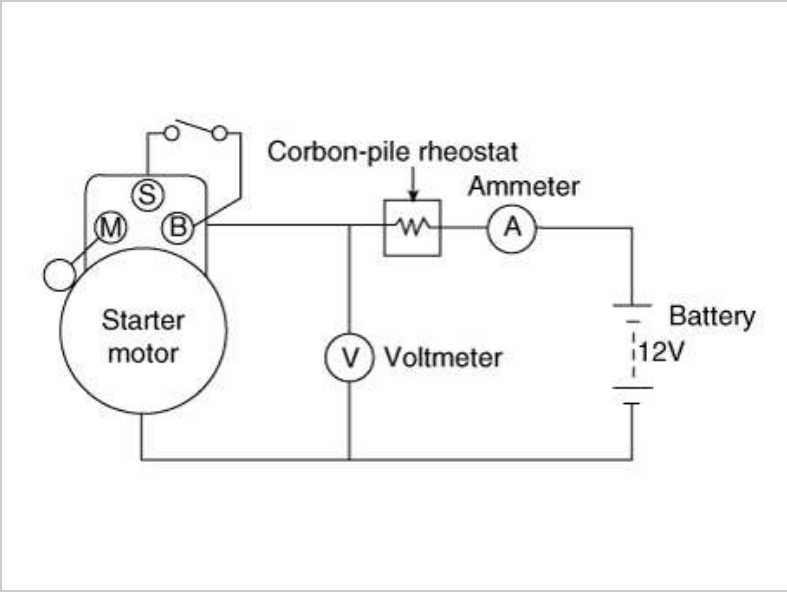
NOTICE

- 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 is the illustration.
3. Connect a voltmeter (15-volt scale) across starter motor.

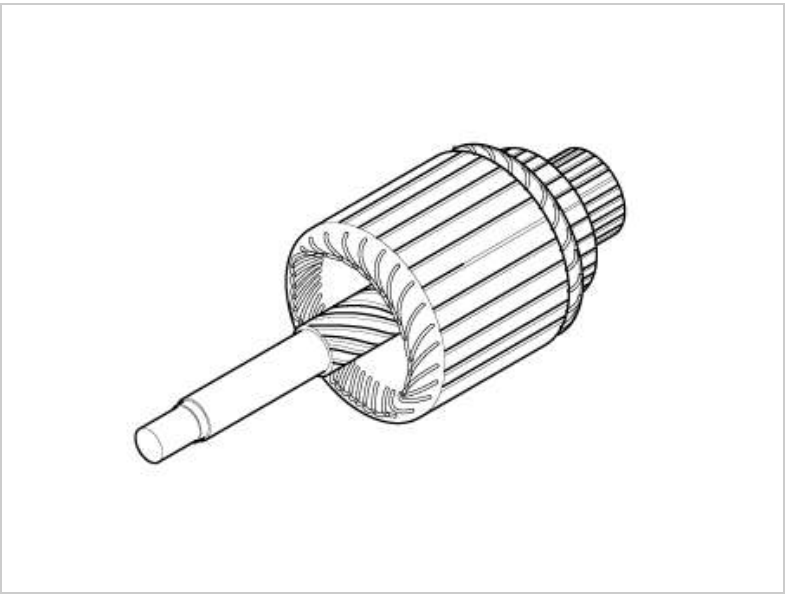


4. Rotate carbon pile to the off position.
5. Connect the battery cable from battery"s negative post to the starter motor body.
6. Adjust until battery voltage shown on the voltmeter reads 11.5 volts.
7. Confirm that the maximum amperage is within the specifications and that the starter motor turns smoothly and freely.

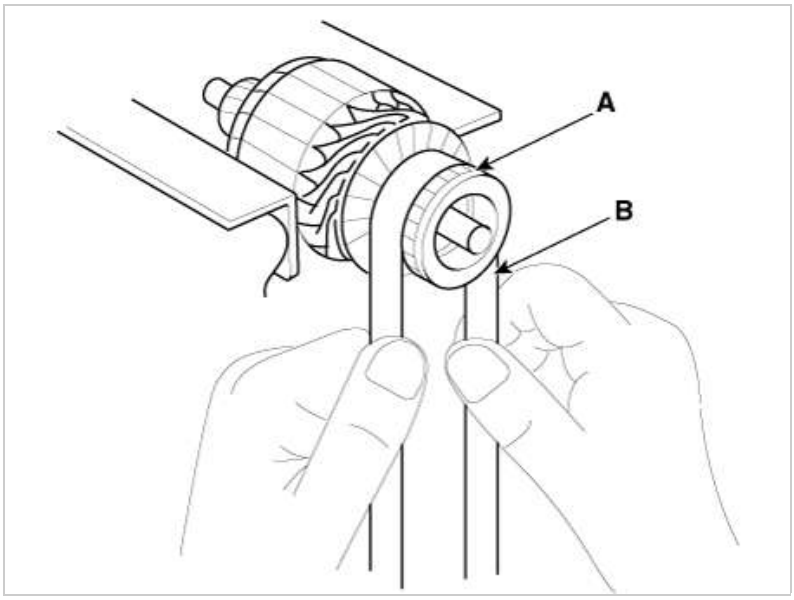
Current (Max.)	Speed (Min.)
85 A	3,300 rpm

Armature

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).

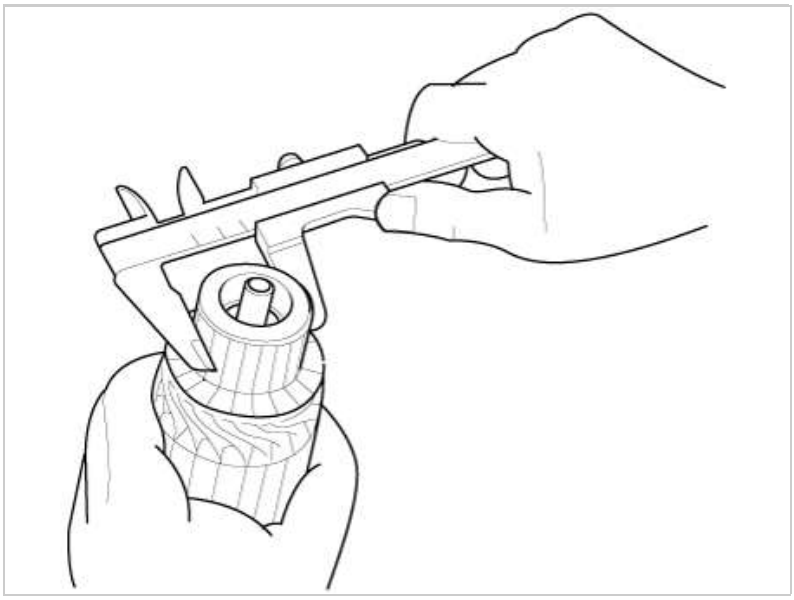


5. Check the commutator diameter. If the diameter is below the service limit, replace the armature.

Commutator diameter

Standard (New) : 29.4 mm (1.1575 in)

Service limit : 28.8 mm (1.1339 in)

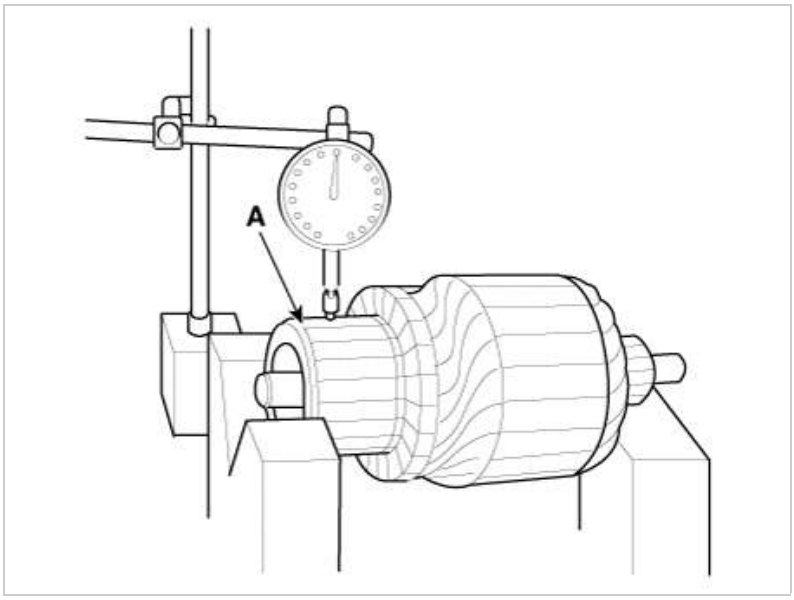


6. Measure the commutator (A) runout.
   - If the commutator runout is within the service limit, check the commutator for carbon dust or brass chips between the segments.
   - If the commutator run out is not within the service limit, replace the armature.

Commutator runout

Standard (New) : 0.05mm (0.0020in.) max

Service limit : 0.10mm (0.0039in.) max

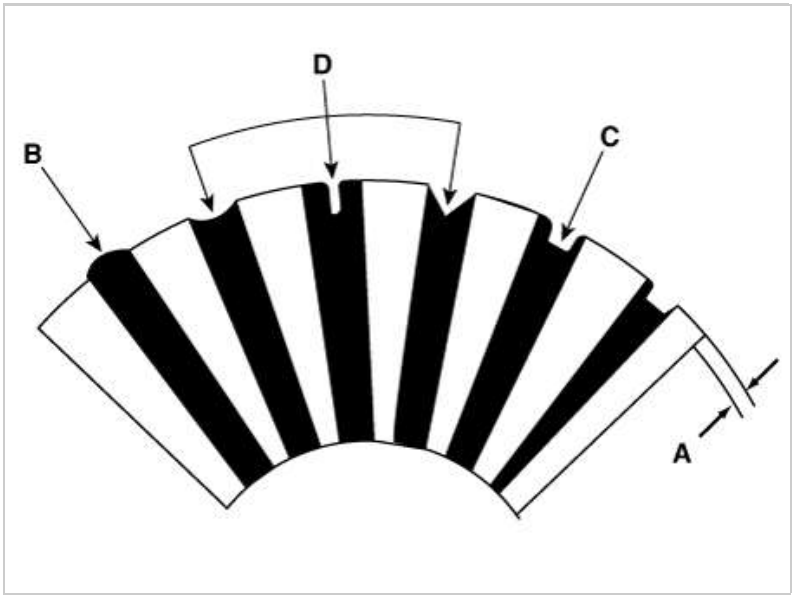


7. Check the mica depth (A). If the mica is too high (B), undercut the mica with a hacksaw blade to the proper depth. Cut away all the mica (C) between the commutator segments. The undercut should not be too shallow, too narrow, or v-shaped (D).

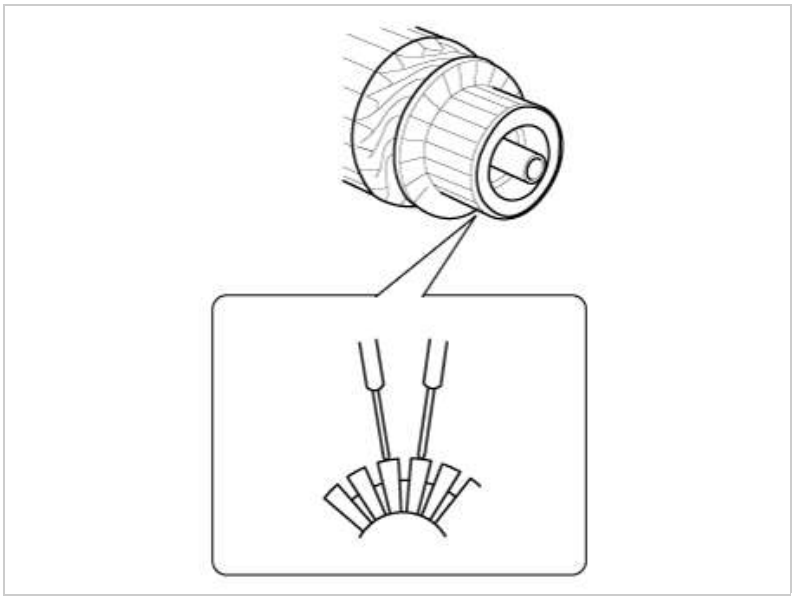
Commutator mica depth

Standard (New) : 0.5 mm (0.0197 in.)

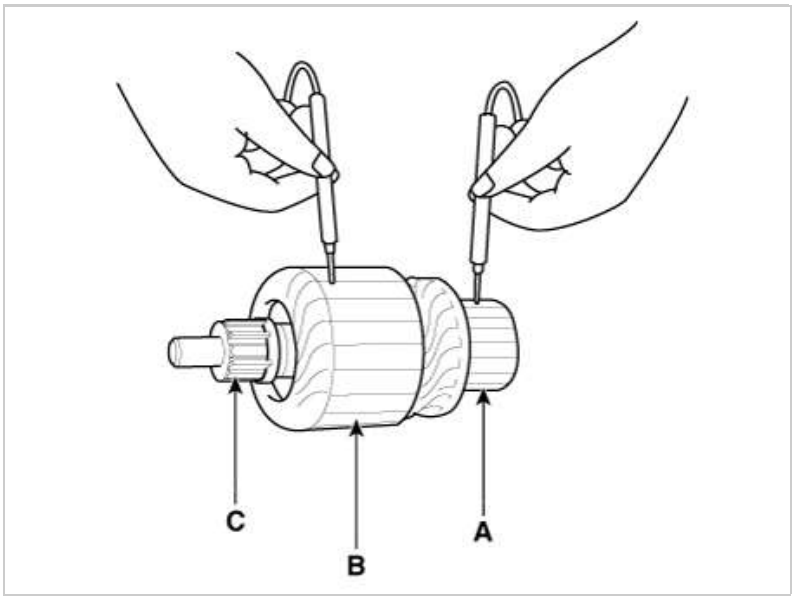
Limit : 0.2mm (0.0079 in.)



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.



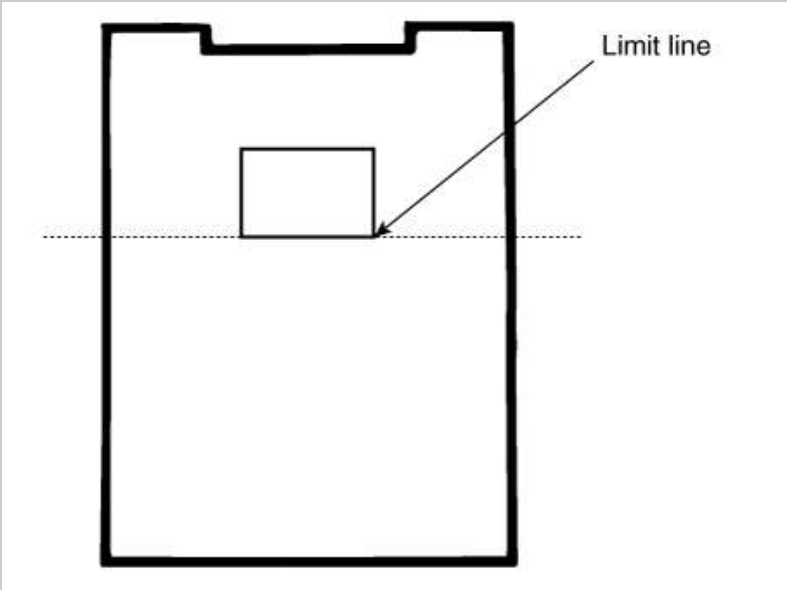
Starter Brush

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

Bruch length

Standard : 12.3 mm (0.4843 in)

Service linit : 5.5 mm (0.2165 in)

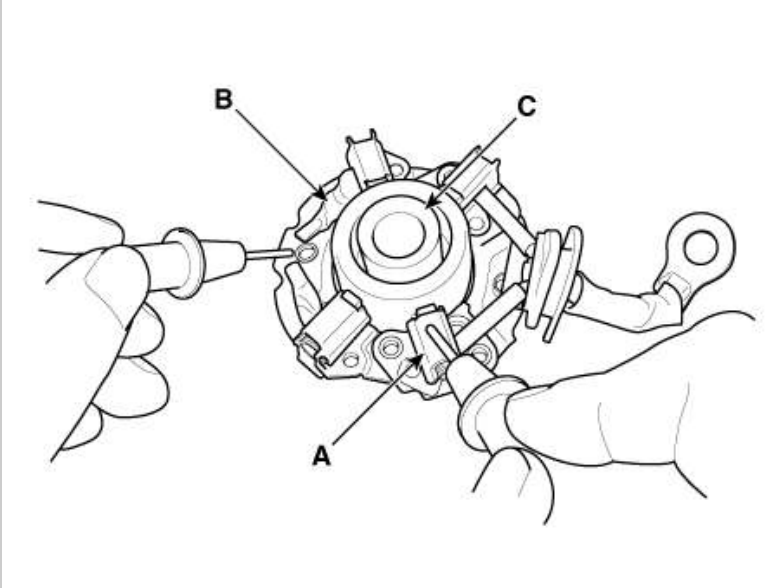


NOTICE

- To seat new brushes, slip a strip of #500 or #600 sandpaper, with the grit side up, between the commutator and each brush, and smoothly rotate the armature. The contact surface of the brushes will be sanded to the same contour as the commutator.

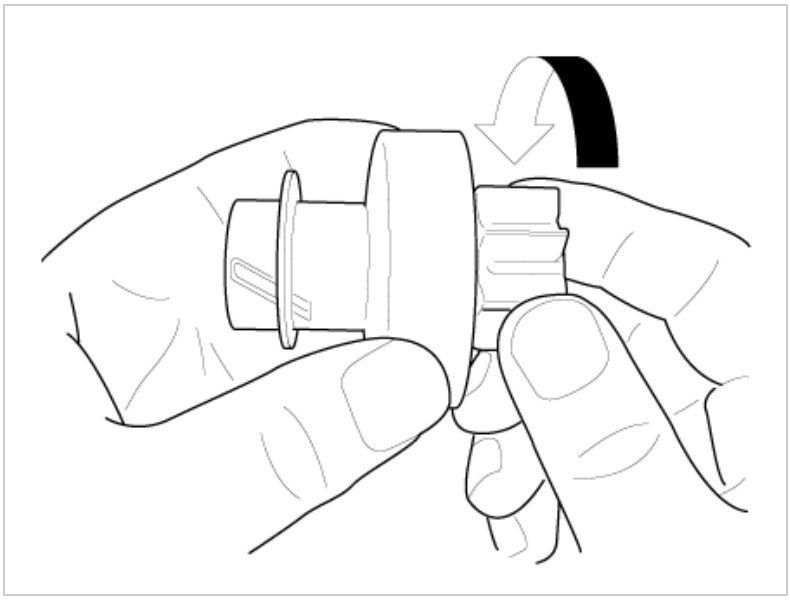
Starter Brush Holder

1. Check that 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 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 of 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 sol-vent 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

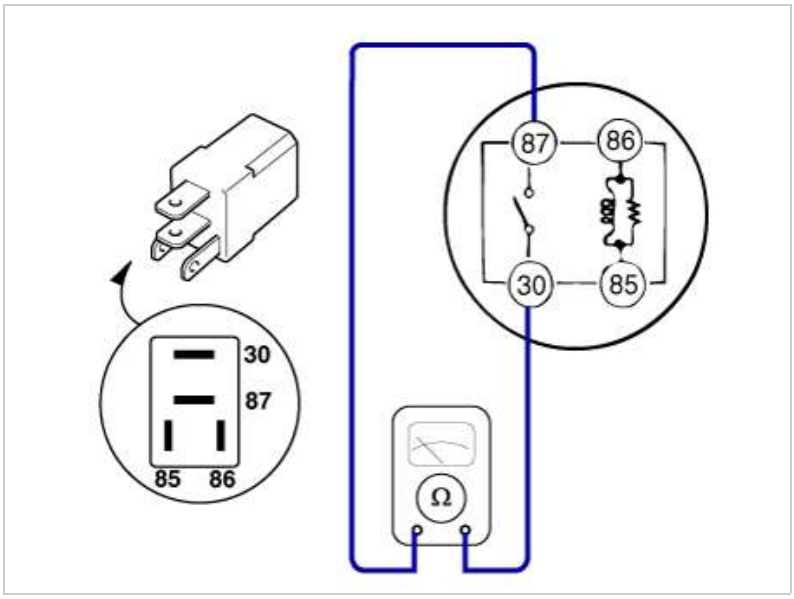
Inspection

1. Turn ignition switch OFF and disconnect the negative (-) battery terminal.
2. Remove the fuse box cover.
3. Remove the starter relay (A).

4. Check for continuity between the terminals (30 and 87) using an ohmmeter.

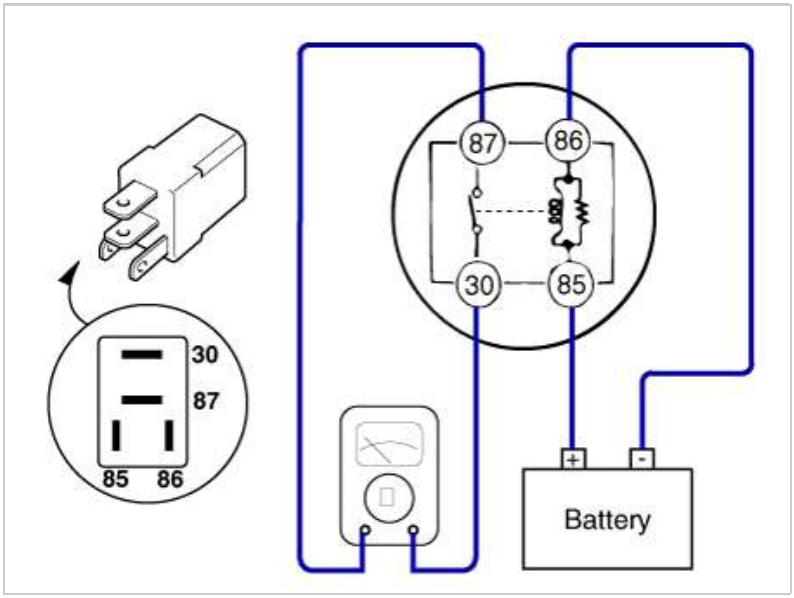
Terminal	Resistance	Measure

30 - 87	1MΩ or higher	If there is continuity between the terminals, replace the relay.



5. Apply 12V to the terminal 85 and ground to the terminal 86 and then check for continuity between the terminals (30 and 87).

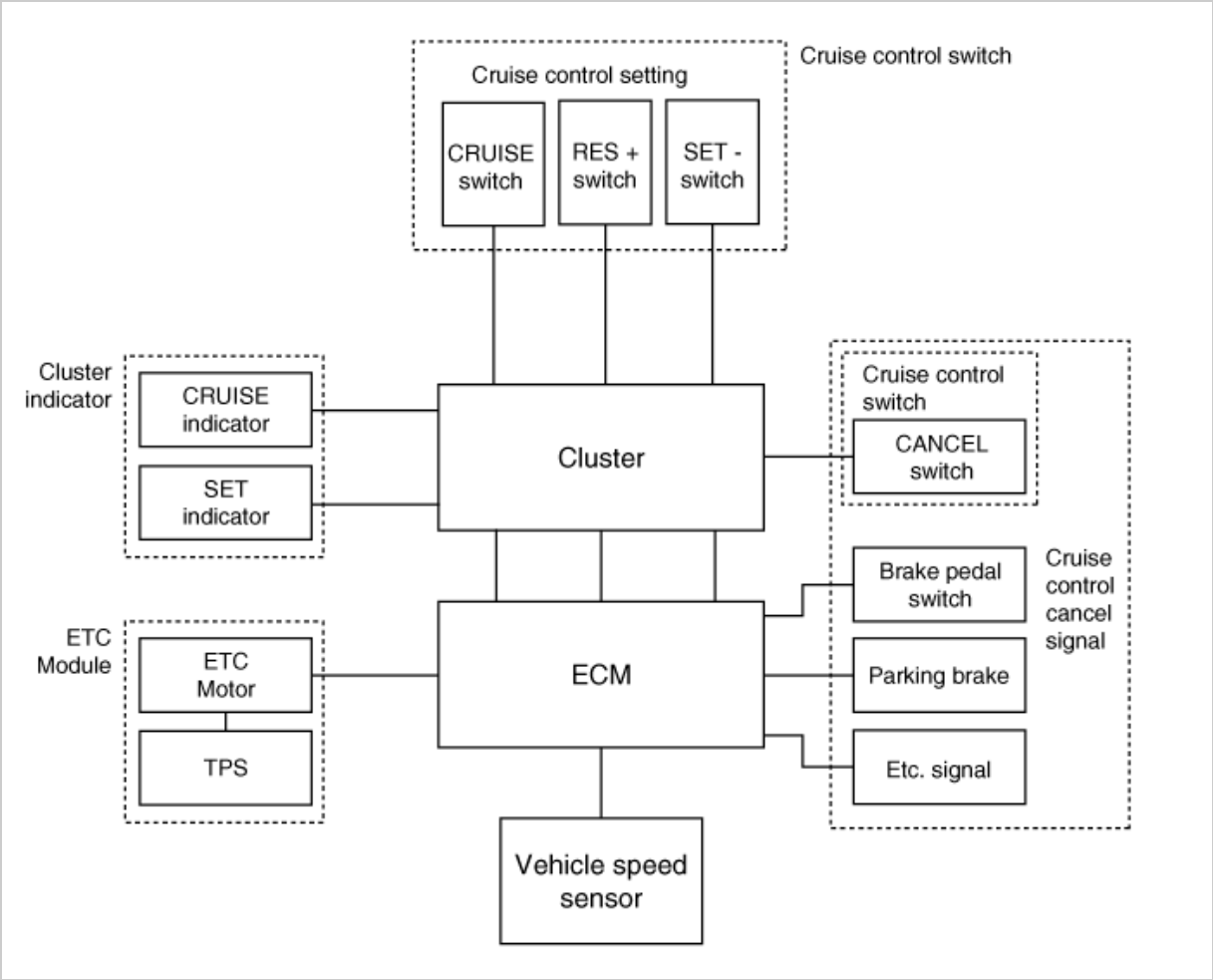
Terminal	Resistance	Measure
30 - 87	1Ω or less	If there is no continuity between the terminals, replace the relay.



6. Install the starter relay.
7. Install the fuse box cover.

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)	
ETC motor		Regulates the throttle valve to the set opening by ECM.

* ETC : Electronic Throttle Control System

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 2.0km/h (1.2mph) or 1.6km/h (1.0mph).

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 2.0km/h (1.2mph) or 1.6km/h (1.0mph).

Cancel switch (CANCEL)

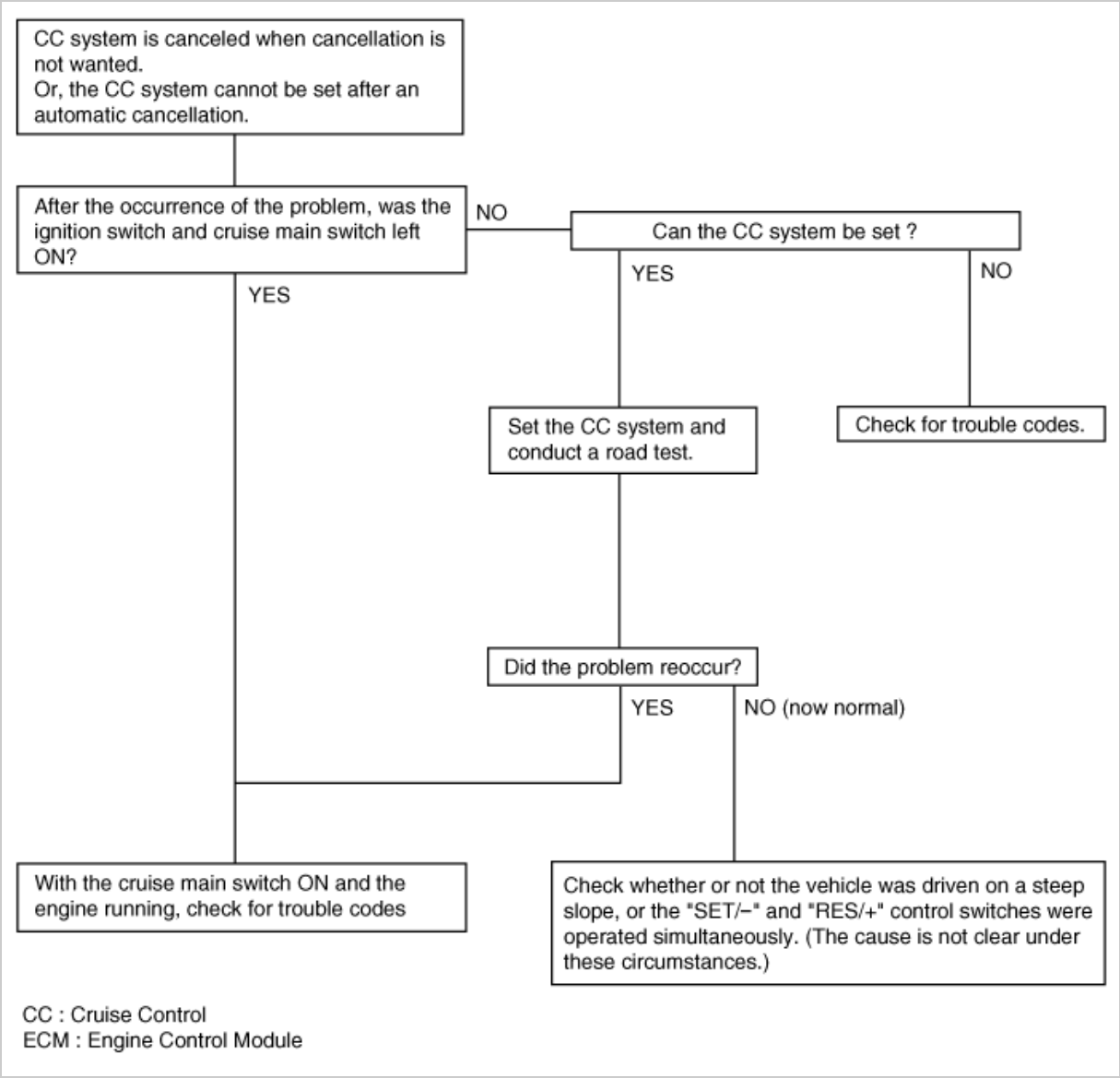
The cruise control system is temporarily disengaged by pushing the "CANCEL" switch.

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

Engine Electrical System

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

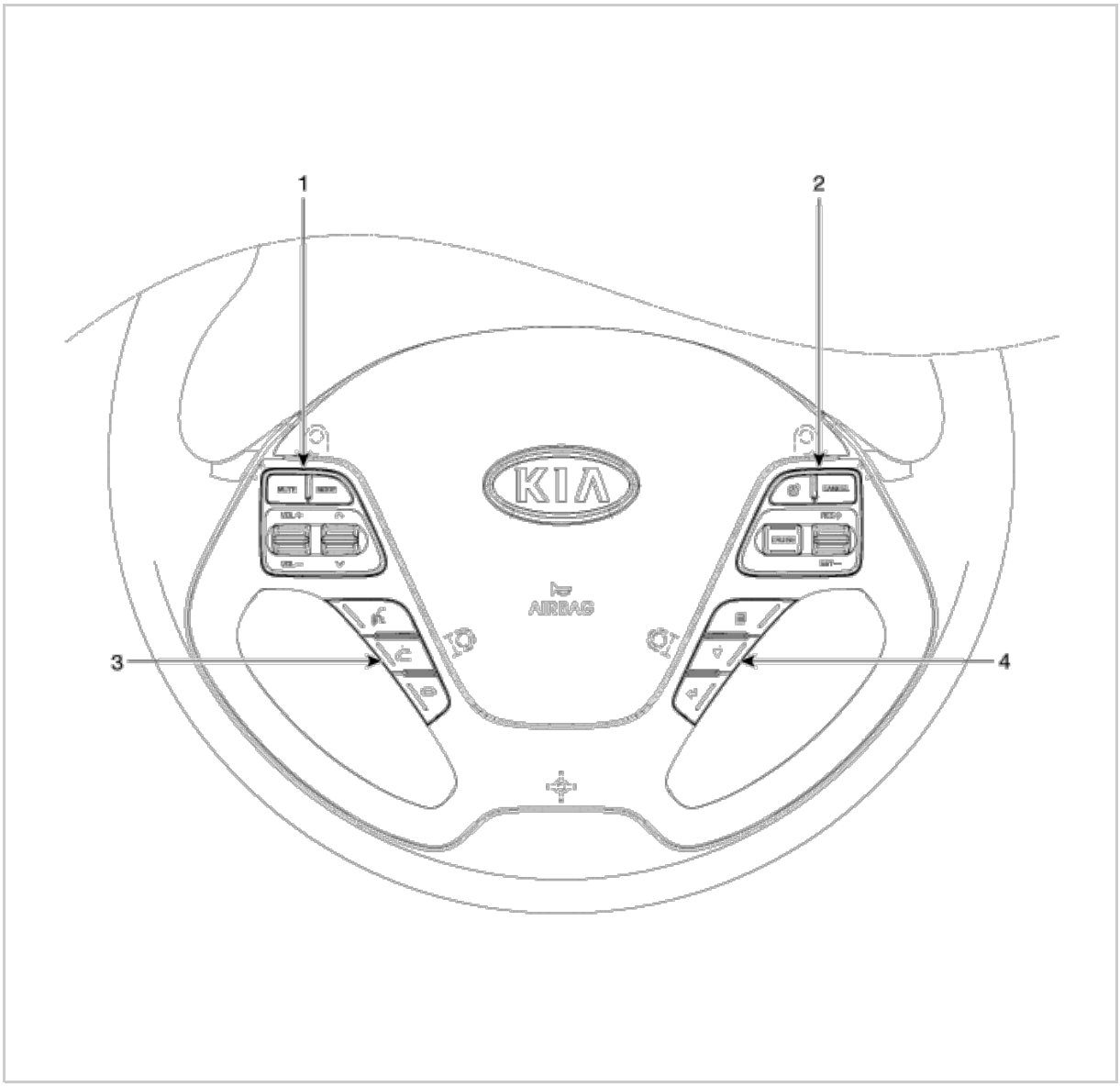
Trouble symptom	Probable cause	Remedy
CC system can be set while driving at a vehicle speed of less than 40km/h (25mph), or there is no automatic cancellation at that speed	Malfunction of the vehicle-speed sensor circuit	Repair the vehicle speed sensor system, or replace the part
	Malfunction of the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

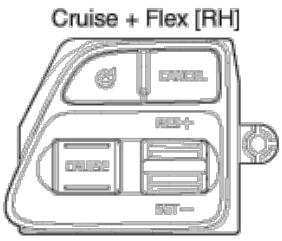
Component Location



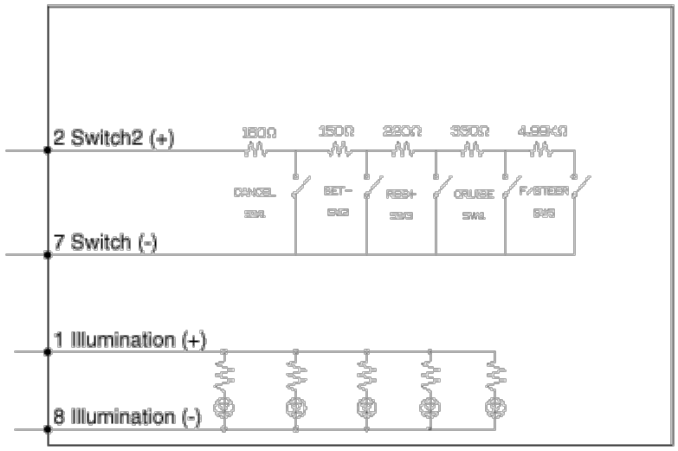
1. Remote control switch (Audio)
2. Remote control switch (Cruise)
3. Blue tooth hands free switch
4. Trip switch

Engine Electrical System

Circuit Diagram



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

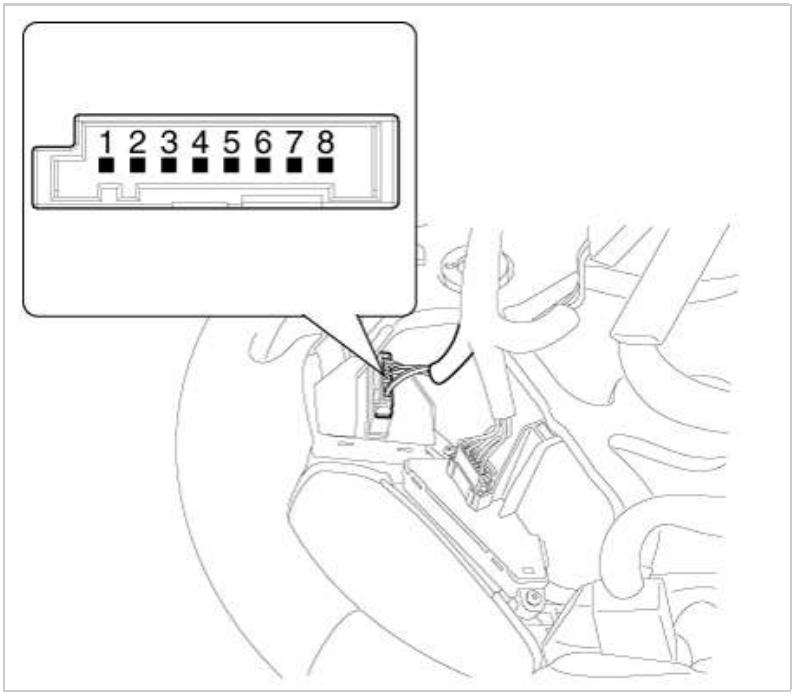


Engine Electrical System

Inspection

[Measuring Resistance]

1. Disconnect the cruise control switch connector from the control switch.



2. Measure the resistance between the terminals below when the function switch is ON.

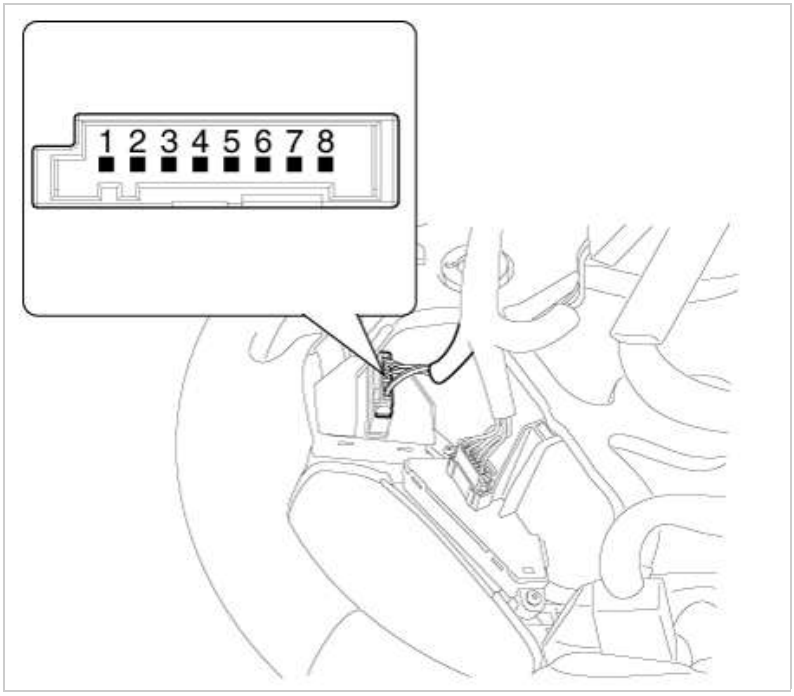
Function switch	Connector terminal	Resistance (±5%)
CANCEL	2-7	180 Ω
SET-	2-7	330 Ω
RES+	2-7	550 Ω
CRUISE	2-7	880 Ω

Flex steer	2-7	5.54 kΩ

3. If the measured value is not within the specification, replace the switch.

[Measuring Voltage]

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



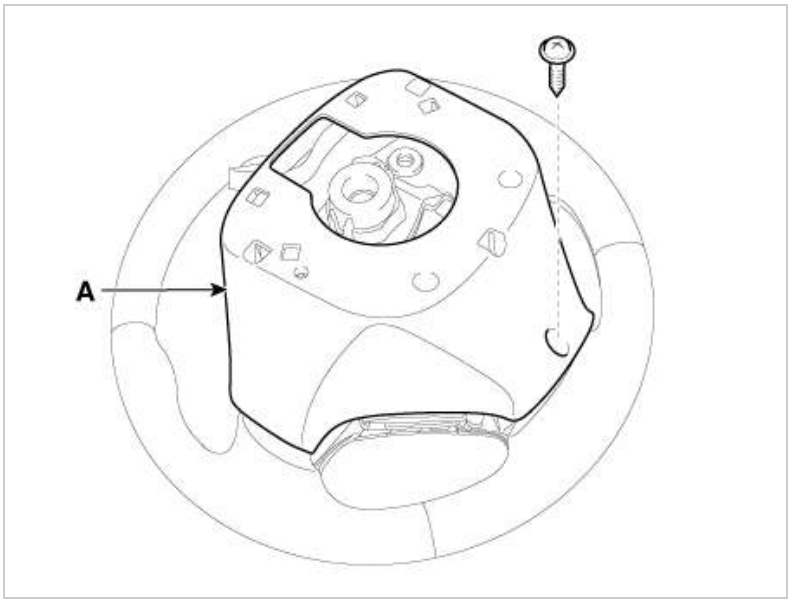
2. Measure the voltage between the terminals below when the function switch is ON.

Function switch	Connector terminal	Voltage (V)
CANCEL	2-7	0.6 - 0.9
SET-	2-7	1.04 - 1.44
RES+	2-7	1.55 - 1.99
CRUISE	2-7	2.24 - 2.44
Flex steer	2-7	4.01 - 4.47

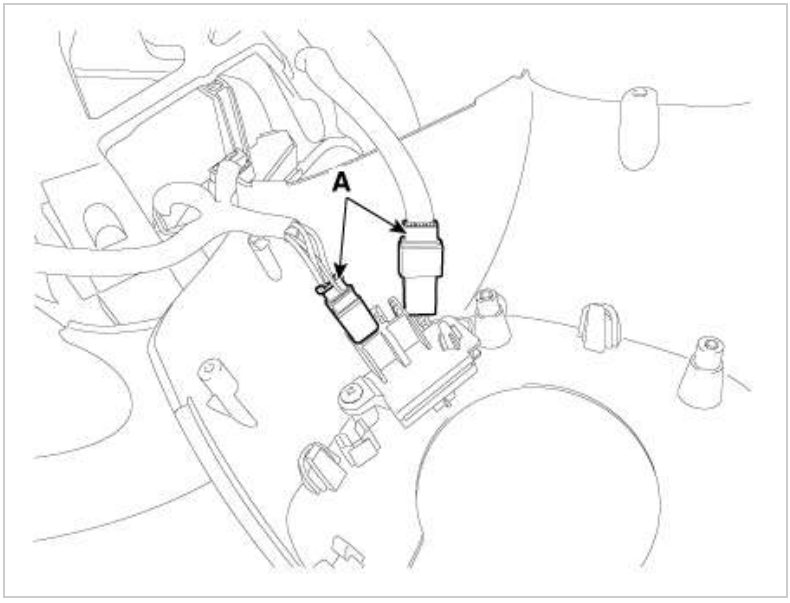
3. If the measured value is not within specification, inspect the control switch resistance.

Removal

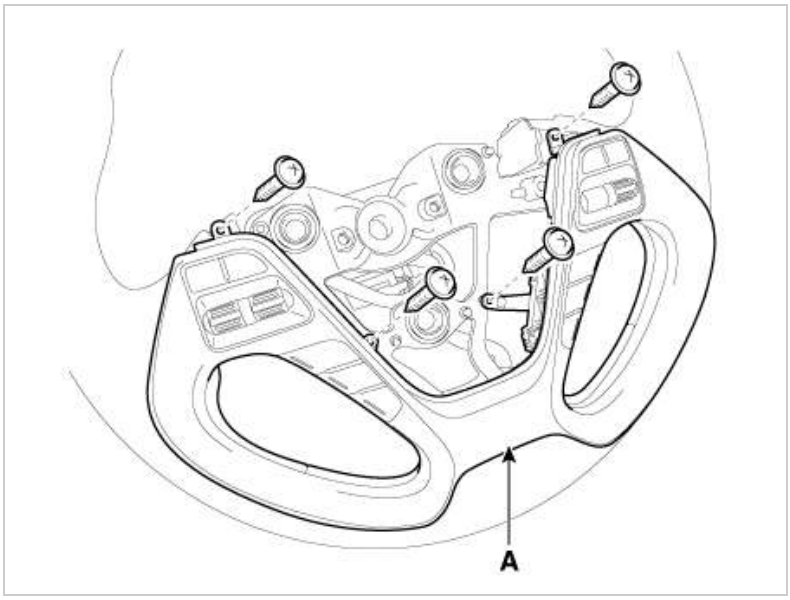
1. Disconnect the negative (-) battery terminal.
2. Remove the driver airbag module.
   (Refer to Restraint - "Driver Airbag (DAB) Module and Clock Spring")
3. Remove the steering wheel.
   (Refer to Steering System - "Steering Column and Shaft")
4. Remove the steering wheel cover (A) after loosening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



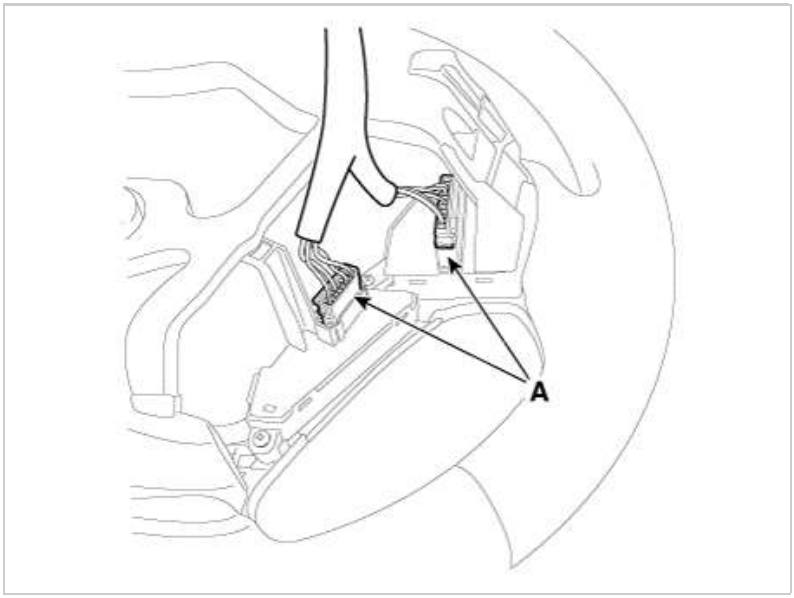
5. Disconnect the steering heater connectors (A).



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.