02- Engine

Charging system

Technical specifications

General specifications

Name	Specification
Generator speed	1200 rpm
The starter is running slowly	13.5V±0.25V
Generator voltage specification	90A

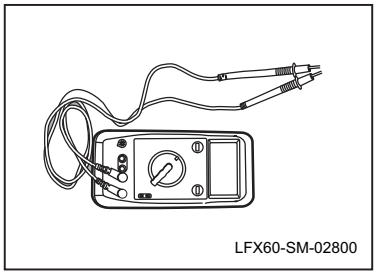
Precautions

Precautions

1. Do not disconnect the battery connector when the engine is running.
2. When checking the charging system, you first need to check if the connectors and harness connectors are solid and reliable.
3. When disassembling the generator, do not damage the insulation paste outside the coil.

Preparation

Special general-purpose tools

No.	Tool name	Tool figure	Tool code	Remarks
1	Multimeter	 LFX60-SM-02800	-	Measure the current, voltage, or resistance

General Inspection

General Inspection

Inspection of battery

1. Battery appearance inspection:

The battery surface should have no traces of leakage, the shell should have no cracks or damage, the electrodes are not corroded, and electrodes are wired reliable.

2. Check with a discharge detector

Press the corresponding contacts onto the corresponding positive and negative electrodes of the battery. When the discharge detector's pointer is in the green range and keeps for about 2s, the battery capacity is sufficient to meet high-current start requirements; when the discharge detector's pointer is in the red range without other abnormalities, the battery capacity is insufficient and must be charged.

3. Use headlamps as load and check with a voltmeter

Connect the voltmeter to the battery according to the method of measuring the battery voltage, and read the battery voltage; turn on the headlamps, and if the battery keeps at over 10V without voltage drop, the battery can be used to start the vehicle after being charged. If battery voltage decreases quickly after turning on headlamp, charge the battery to restore its function. For the battery that is not used for long time, charge it with longer time and for more times to fully activate it.

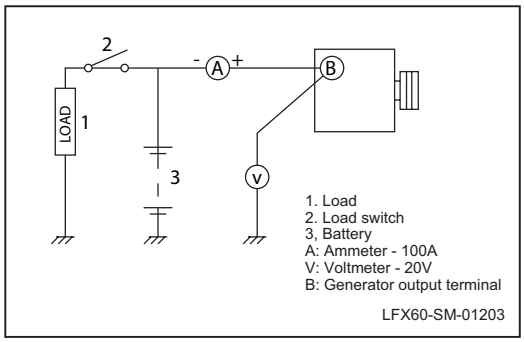
Note:

For the charging/discharging or freshly charged battery, it is inappropriate to use discharging tester to check it, because it will produce large amount of oxy-hydrogen gas during charging process. By using discharging tester or resistance fuse to perform checking, it will produce sparkle to explode the gas to cause physical injury and property loss.

Power generation test of generator

1. Connect test equipment

Select appropriate scale and connect voltmeter between connecting column of alternator B and ground. Connect ammeter between B connecting column of alternator and positive column of battery.



2. No-load test

Start the engine to increase its rotational speed from idle speed to 2,000 rpm / min, and read the number in the instrument.

Note:

- **Consider that voltage can be different depending on different temperature of voltage regulator. Do not perform this test on discharged battery. Fully charge the battery before the test.**
- **When the engine is running, do not dismantle connecting column of battery, or it will damage electronic parts.**

Standard current: 10A (max.)

Standard voltage: under 25℃ , 14.2 ~ 14.8 V

3. Load test

Keep engine running at the speed of 2,000 rpm, and connect front headlamp and heating motor. If the measured current is less than 20 A, repair or replace.

Battery parasitic current test

If the battery continuously lacks of power, the following test procedure should be performed to check if the battery produces parasitic current.

1. Disconnect negative wire of battery.
2. Connect positive pen of multi-meter to the negative wire of battery and connect negative pen to the negative pole of battery.
3. Ensure that all electrical units of tested vehicle are shut off. The door, engine cover and trunk cover are well closed.
4. Select mA scale of multi-meter.
5. Measure parasitic current after vehicle module is in dormancy.

Note:

Module in dormancy can vary depending on different equipment level.

Standard value of parasitic current: less than 30 mA

Operating Principle

System Overview

Self discharging of battery

Theoretically speaking, self discharging battery is unavoidable. Self discharging of maintenance-free battery is far less than ordinary battery, but it still has automatic discharging to some degree. Even it is placed with open circuit for long time, the battery will be consumed obviously. Self discharging of battery is mainly affected by the following factors:

1. The higher the temperature is, the ratio of self discharging will be. Generally, for every increase in temperature by 10 ℃ , the ratio of self discharging will increase by about 2.7 fold. Therefore, self discharging of vehicle battery will vary greatly in summer and winter.
2. The condition of storage site will have great impact. High humidity and dust will increase self discharging of battery.

Battery capacity loss after loading

After being loaded on vehicle, battery will lose capacity in the following ways:

1. Electricity lost in debugging process.
2. Some electrical appliances on the car can always consume power, such as the security alarm system.
3. Electric leakage of components caused by poor insulation performance.
4. Power loss caused by static current or power leaking due to connected negative wire.

Note:

The standing time of battery is dependent on many factors. Generally, fully charged batter can still start the vehicle 6 months after disconnecting negative wire.

Charging system

One feature of alternator is that it has a solid regulator inside. All the parts of regulator are installed in a closed box. The regulator together with electric brush assembly are mounted on sliding ring and frame. Set voltage of alternator cannot be regulated.

As rotor bearing of alternator has enough lubricating grease, there is no need to lubricate it regularly. Two electric brushes will enable current to flow to excitation coil through two sliding rings. Under normal circumstances, there is no need to maintain electric brushes for long time.

Stator winding is mounted inside laminated core, which is alternator frame component. The rectifier connected to stator winding is composed by 6 LEDs which transform AC voltage on stator to DC voltage on alternator output column. Center diode is used to transform central point voltage into DC and increase alternator output.

The capacitor mounted on regulator assembly will provide voltage protection for diode and control interference of radio wave.

Part instructions

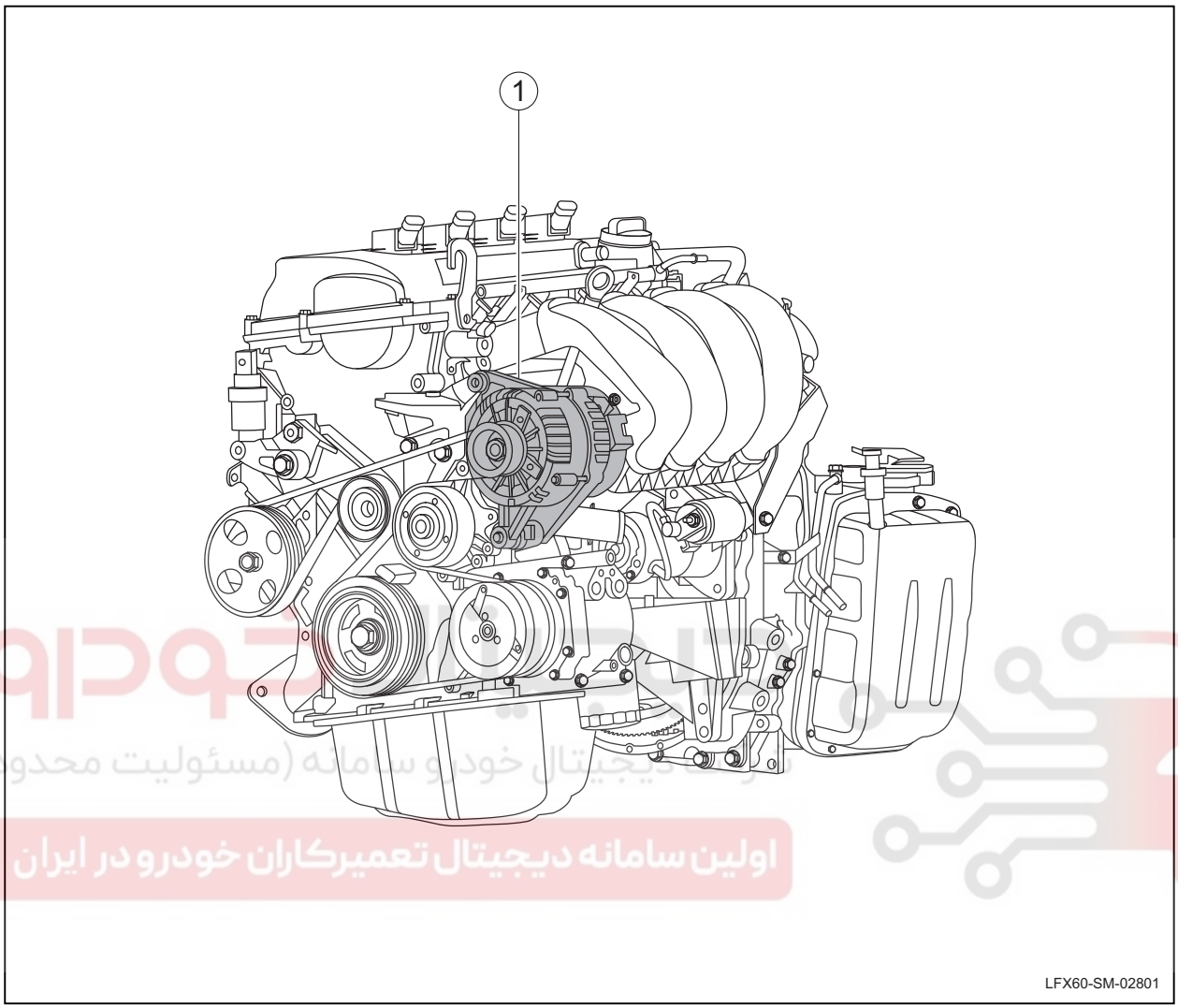
Battery

If the battery is tested to be good, but it always has under-voltage or failure to start overnight. Consider the following causes for failure:

1. There is electric unit that is not switched off for the whole night.
2. The vehicle is running at low speed and stops at intervals.
3. The vehicle electrical load exceeds alternator output, especially when the vehicle is installed with after-sales additions.
4. There is some problem in charging system, such as electrical short circuit, sliding alternator belt, failed alternator or voltage regulator.
5. The battery is not properly used, such as failure to keep clean and tight battery terminal or loosened battery fixing plate.
6. Mechanical failure in electrical system, such as wire short circuit or clamping.

Structure and installation location

Component Location Plan



No.	Part Name
1	Generator

No.	Part Name

Diagnostic Information and Procedures

Diagnosis Instructions

Before starting to diagnose a fault in the charging system, familiarize yourself with the operating principle of the charging system, and then start the system diagnostics, which helps to determine the correct troubleshooting steps in the event of a failure. More importantly, this also helps to determine whether the customer's situation belongs to normal operation.

Any troubleshooting of the charging system should begin with the charging system check, so as to instruct the service personnel to take the next logical step to troubleshoot. Comprehend and correctly use the diagnostic flow chart to shorten the diagnosis time and avoid the misjudgement.

General equipment

Digital universal meter
Diagnostic equipment of vehicle

Visual Inspection

1. Confirm the problem of the customer.
2. Visually check whether there is any obvious mechanical or electrical damage sign.

Visual inspection table

Mechanical	Electrical
• Alternator • Driving belt	• Fuse • Harness or plug • Battery • Positive and negative terminals on battery • Charging system warning light

3. If the observed or proposed problem is obvious and its cause is identified, rectify the cause before proceeding with next step.
4. If for the problem, there are no obvious findings, then confirm the fault and refer to the symptom table.

List of fault symptoms

If the vehicle fails, no trouble code is detected by the engine control module (ECM), and no significant fault location is found after visual inspection and general inspection, it is recommended that troubleshooting should be carried out according to diagnostic ideas and processes of the table below.

Symptom	Possible point of failure	Recommended Measures
Alternator noises	• Accessory driving belt • Bearing • Stator and rotor	**Refer to: Diagnosis process for generator noise**
The battery is charged insufficiently	• Accessory driving belt • Alternator governor • Alternator	**Refer to: Diagnosis process for battery undercharge**
Battery is overly charged	• Alternator governor • Alternator	**Refer to: Diagnosis process for battery overcharge**
Charging indicator is always on.	• Drive belt wear • Damage of drive belt tightener of accessories • Alternator • Charge indicator line fault • Instrument cluster	**Refer to: Diagnosis process for charging indicator which is normally on**
Charging indicator is off.	• Panel charging indicator • Line fault • Poor contact between brush and slip ring • Voltage regulator	**Refer to: Diagnosis process for charging indicator which is not on**

Diagnosis process of alternator noises

Note:

Generator noise may be from electrical or mechanical noise. Electrical noise (whine) usually changes with the changes in electrical load applied to the generator, which is the normal operating feature of all generators. You should know this during the maintenance or diagnosis, or it will cause unnecessary complaints from the customers. For the alternator diagnosed with mechanical noises, check if the parts around alternator are loosened or mutually interfered. In some cases, gentle noises inside cabin will be heard in passenger cabin. In this case, you cannot resolve the problem by replacing alternator. You will misjudge it in this case.

Test condition	Details/results/measures
1. Check the drive belt of accessories	
	A. Check if accessory drive belt is lacking teeth. B. Check tensioning force of accessory drive belt. Is accessory drive belt working properly. →**Yes** To step 2. →**No** Repair accessory drive belt.
2. Check the engine noise	
	A. Dismantle accessory drive belt. B. Start the engine to run. Does the noise still exist? →**Yes** Check the engine itself for noise. →**No** To step 3.
3. Check the noise from compressor and water pump.	
	A. Dismantle accessory drive belt. B. Turn the compressor and water pump pulley by hand. Is there noise? →**Yes** Repair and eliminate the abnormal noise from compressor or water pump. →**No** To step 4.
4. Check the noise from power steering pump and belt tensioner pulley of accessories.	
	A. Dismantle accessory drive belt. B. Check the power steering pump and belt tensioner pulley of accessories. Is there noise? →**Yes** Repair and eliminate the abnormal noise from power steering pump and belt tensioner pulley of accessories. →**No** To step 5.

Test condition	Details/results/measures
5. Check alternator.	
	A. Replace the alternator. **Refer to: Replacement of alternator** Confirm that the fault has been ruled out.

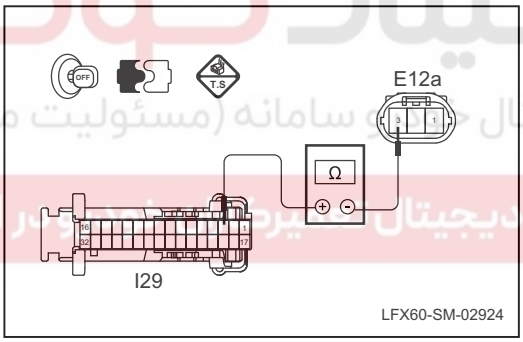
Diagnosis process of inadequate charging of battery

Test condition	Details/results/measures
1. Check the generator charging voltage.	
	A. Start the alternator to increase alternator rotational speed from idle speed to 2,000 rpm. B. Measure the battery voltage with the multimeter. Check if the voltage is no less than 14.2 V. →**Yes** To step 2. →**No** To step 3.
2. Check parasitic current of battery.	
	A. Perform the process to check battery parasitic current. Is it OK after checking? →**Yes** To step 3. →**No** Repair failed wiring or electric unit.
3. Check alternator.	
	A. Perform alternator test process. Is it OK after testing? →**Yes** Charge the battery or replace the battery. **Refer to: Replacement of battery** →**No** Check the generator or replace the generator. **Refer to: Replacement of alternator**

Diagnosis of over-charging of battery

Test condition	Details/results/measures
1. Check the generator charging voltage.	
	A. Start the engine to increase alternator rotational speed from idle speed to 2,000 rpm. B. Measure the battery voltage with the multimeter. Is the voltage higher than 14.8V? →**Yes** To step 2. →**No** System normal.
2. Check alternator regulator.	
	A. Replace alternator regulator. Is alternator charging voltage is OK? →**Yes** System normal. →**No** Check the alternator separately.

Diagnosis process of charging indicator that is always on

Test condition	Details/results/measures
1. Check the engine DTC.	
	A. Read the instrument cluster system for DTC with the diagnostic meter. Is there a DTC? →**Yes** **Refer to: Diagnostic trouble code (DTC) list. Perform DTC diagnostic procedure.** →**No** To step 2.
2. Check the generator charging voltage.	
	A. Start the alternator to increase alternator rotational speed from idle speed to 2,000 rpm. B. Measure the alternator output voltage with the multimeter. Is the output voltage 12.8 ~ 14.8V? →**Yes** To step 3. →**No** To step 5.
3. Check the generator's charging indicator signal line.	
	A. Operate the ignition switch to turn the power to OFF state. B. Disconnect the battery negative connector. C. Disconnect the instrument cluster harness plug I29. D. Disconnect the harness plug E12a of generator regulator. E. Use a multimeter to measure the resistance between the terminal 3 of integrated instrument harness plug I29 and the terminal 3 of harness plug E12a of generator regulator. **Standard value:Less than 5Ω** Is the resistance normal? →**Yes** To step 4. →**No** Check the generator's charging indicator signal line.
4. Check the instrument cluster.	
	A. Operate the ignition switch to turn the power to OFF state. B. Replace the integrated instrument. **Refer to: Replacement of instrument cluster**

Test condition	Details/results/measures
5. Check the generator charging voltage.	
	A. Check if the accessory drive belt is slipping or too loose. Is it OK after checking? →**Yes** To step 6. →**No** Adjust or replace accessory drive belt and/or belt tensioner.
6. Check alternator regulator.	
	A. Replace alternator regulator. **Refer to: Replacement of alternator** Is the charging indicator normal? →**Yes** Replace the generator regulator. →**No** To step 7.
7. Check alternator.	
	A. Replace the alternator. **Refer to: Replacement of alternator** Confirm that the fault has been ruled out.

Diagnosis process of charging indicator that is not on

Test condition	Details/results/measures
1. Check the engine DTC.	
	A. Read the instrument cluster system for DTC with the diagnostic meter. Is there a DTC? →**Yes** **Refer to: Diagnostic trouble code (DTC) list.** →**No** To step 2.
2. Check the generator charging voltage.	
	A. Start the alternator to increase alternator rotational speed from idle speed to 2,000 rpm. B. Measure the alternator output voltage with the multimeter. Is the output voltage 12.8 ~ 14.8V? →**Yes** System normal. →**No** To step 3.
3. Check the instrument cluster.	
	A. Replace the instrument cluster. **Refer to: Replacement of instrument cluster** Make sure the problem has been solved.

Removal and Installation

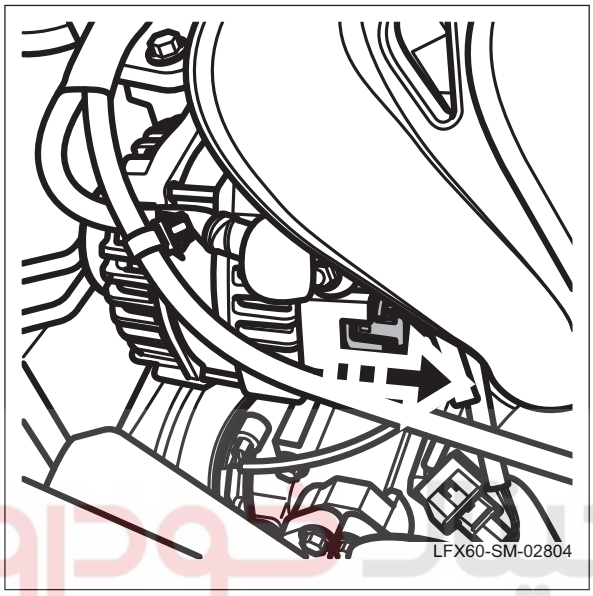
Replacement of generator

Removal

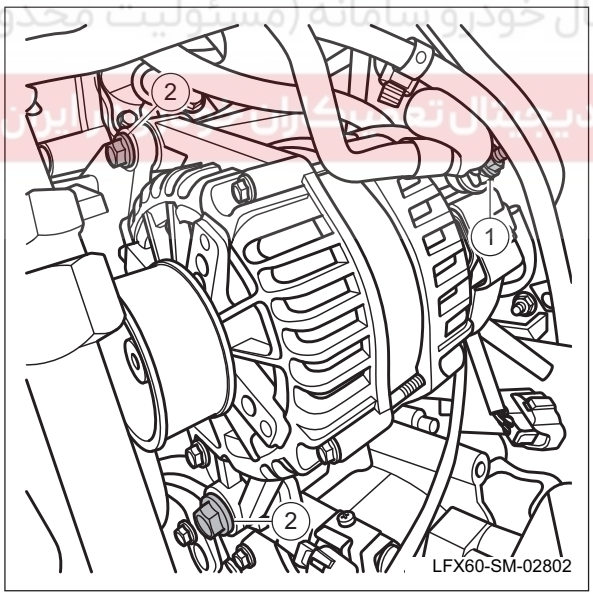
1. Dismantle the alternator.

(a). Disconnect the battery negative terminal.

(b). Remove the accessory belt. **Refer to replacement of accessory belt.**



(c). Disconnect the generator harness plug.



(d). Remove the harness connector nut 1 from the generator regulator.

(e). Remove the generator bolt 2.

(f). Remove the generator assembly.

Installation

1. Installation alternator.

(a). The installation sequence is the reverse of the disassembly order.

Note:

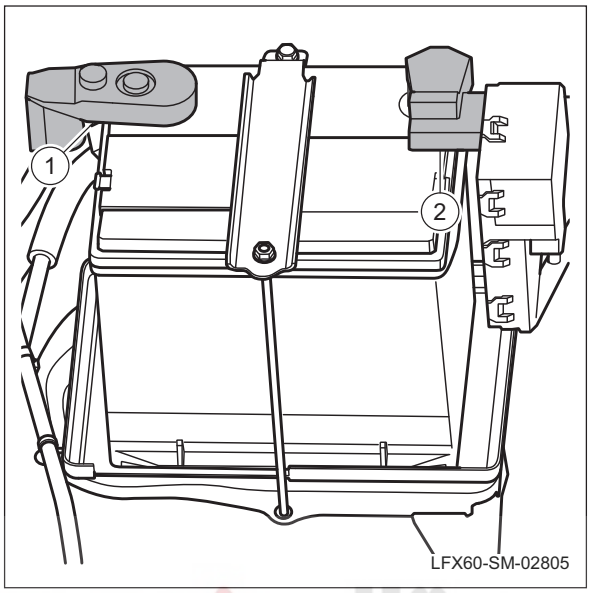
Please install the accessory drive belt to the pulley in place.

Replacement of battery

Removal

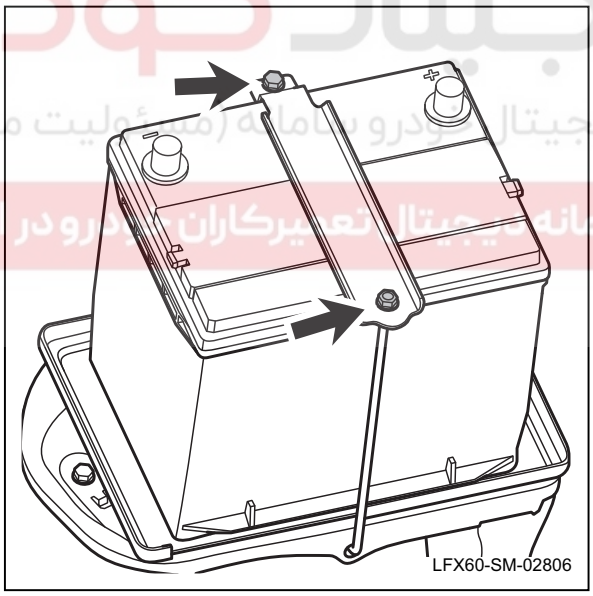
1. Dismantle the battery.

(a). Remove the front ventilation cover. **Reference: Replacement of front ventilation cover.**



(b). Disconnect the negative terminal 1 from the battery.

(c). Disconnect the positive terminal 2 from the battery.



(d). Remove the battery holder fixing bolts.

(e). Remove the battery

Installation

1. Installation the battery.

(a). The installation sequence is the reverse of the disassembly order.