

BEC

Student Learning Guide

Course Introduction



**Automotive
Electrical Course**

KIA

SERVICE TRAINING

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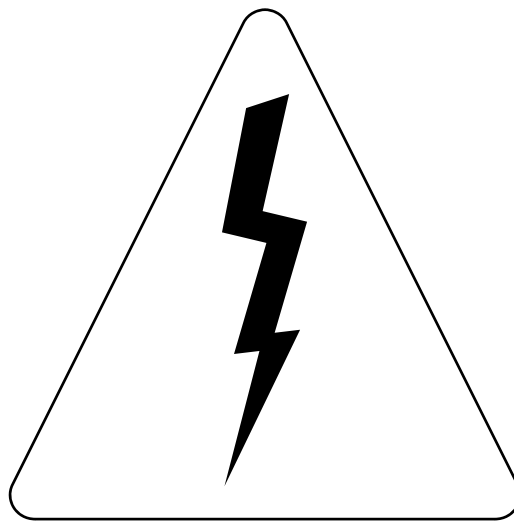
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EF1

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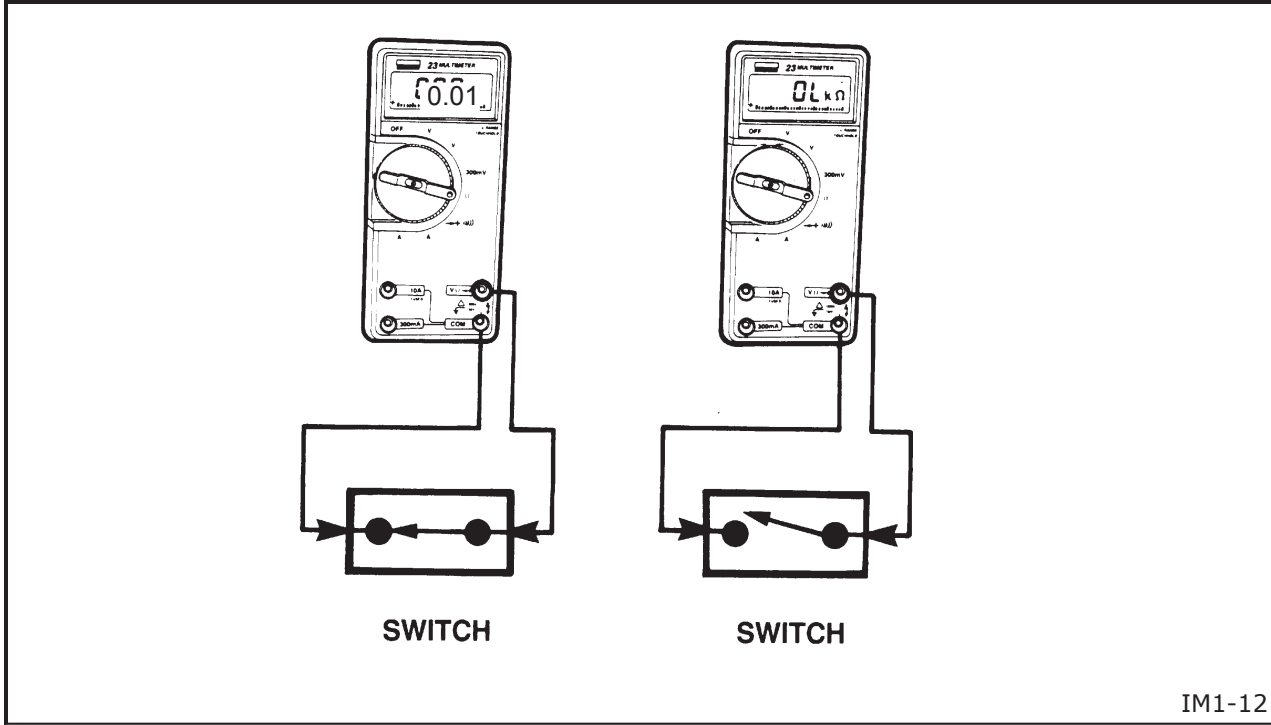
Electrical Fundamentals



**Automotive
Electrical Course**



S E R V I C E T R A I N I N G



IM1-12

MEASURING RESISTANCE

The *ohmmeter* function is used to check continuity and to measure resistance in a circuit. A zero resistance reading indicates continuity or a short circuit. An out of limits (OL) reading indicates that there is an infinite amount of resistance or an open in a circuit.

To measure continuity or resistance, set the selector switch in the Ω mode. Then connect one test lead to one end of the circuit you are testing and the other test lead to the other end of the circuit. When measuring the resistance of a component, the component must be isolated or disconnected from the rest of the circuit.

Ohmmeters can be connected to the circuit without regard to polarity unless the circuit contains a diode. They have their own internal battery and should never be connected to an operating circuit.

Unit Conversions

Refer to the illustration to make unit conversions.

1 Kilo - ohm = 1000 ohms
 1 Mega - ohm = 1,000,000 ohms

To convert $k\Omega$ to Ω , move the decimal point to the right three places.

Example: $10k\Omega = 10,000 \Omega$

To convert $M\Omega$ to Ω , move the decimal point to the right six places.

Example: $10M\Omega = 10,000,000 \Omega$

IM1-13



After completing this module, you will be able to identify how different types of automotive electrical circuits are designed to operate and the methods used in controlling electrical behavior in a circuit.

LEARNING OBJECTIVES

To enable you to diagnose and repair Kia automotive electrical problems faster and more effectively.

- Identify circuit elements: power source, load, protection device and ground
- Identify the different types of circuits and circuit control methods
- Determine what is required to make the circuit operate
- Apply the relationship between volts, amps and ohms to diagnose a faulty electrical circuit

EC1-1

MODULE DIRECTIONS

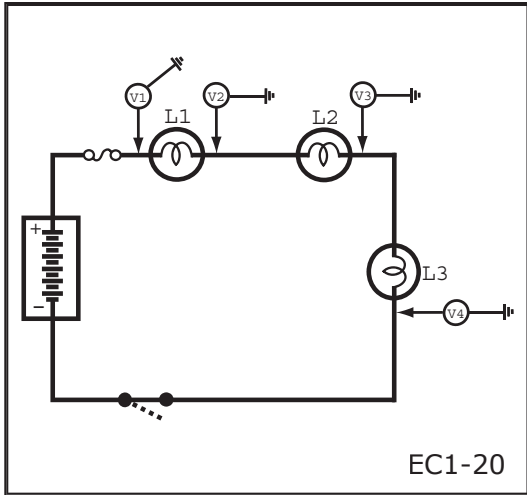
Carefully read this material. Study each illustration as you read the material. Feel free to ask questions any time something is not clear. Be sure to answer the questions at the end of the module.

THINGS YOU WILL NEED

- Module
- Electrical project board and accessories
- DVOM

ACTIVITY

VOLTAGE : LOADS CONNECTED IN SERIES



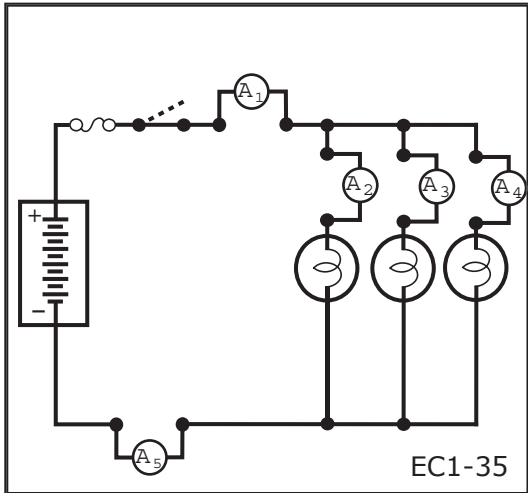
EC1-20

V_1	Source Voltage	V
V_2	Lamp 1	V
V_3	Lamp 2	V
V_4	Lamp 3	V

In the space below explain what the voltage measurements you obtained tell us about voltage in a series circuit.

ACTIVITY

CURRENT: LOADS CONNECTED IN PARALLEL

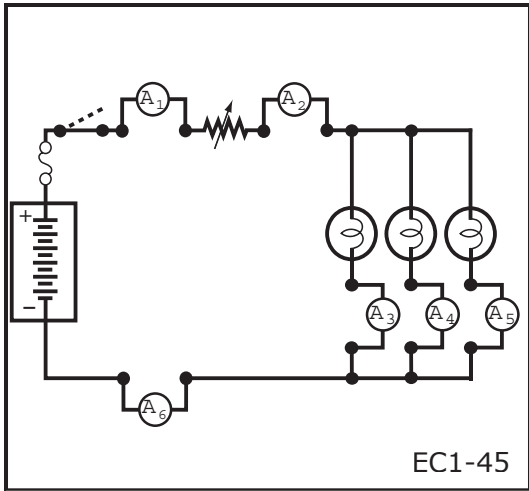


A ₁	Source Current	A
A ₂	Lamp 1	A
A ₃	Lamp 2	A
A ₄	Lamp 3	A
A ₅	Total	A

In the space below explain what the current measurements you obtained tell us about current in a parallel circuit.

ACTIVITY

CURRENT: LOADS CONNECTED IN SERIES-PARALLEL



A ₁	Source Current	A
A ₂	Potentiometer	A
A ₃	Lamp 1	A
A ₄	Lamp 2	A
A ₅	Lamp 3	A
A	Total Current	A

In the space below explain what the current measurements you obtained tell us about current in a series-parallel circuit.

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- Diodes
- Transistors

EC1-62

ELECTRONIC CIRCUIT CONTROL METHODS

With the advancements in today's technology the automobile has become much more complex. Computerized systems consisting of electronic or solid state devices are now being used to control emissions, deploy airbags, monitor engine operation, control alarm systems and many other operations taking place in the vehicle. The most common of the electronic control devices that the technician may become involved with are diodes and transistors. These devices are known as semiconductors.

- Part conductor; part insulator
- Usually made of silicon or germanium
- Can be N-Type or P-Type
- When joined together current can move only in one direction

EC1-63

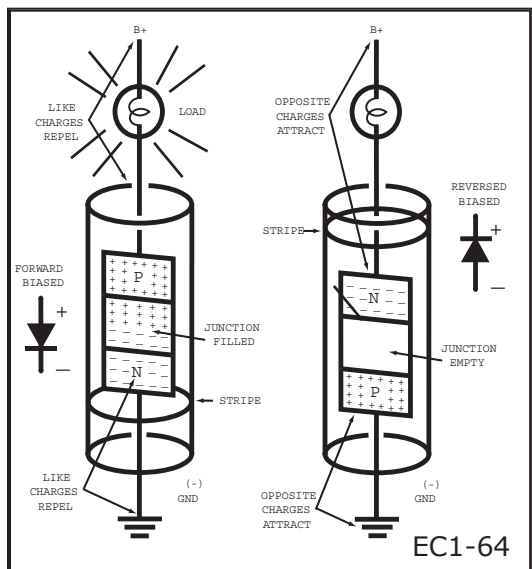
Semiconductors

A semiconductor is a solid material whose electrical conductivity at room temperature lies between that of a conductor and that of an insulator. At high temperatures its conductivity approaches that of a metal and at low temperatures it acts as an insulator.

The elements silicon and germanium are typically used as semiconductor material. Both have only 4 electrons in their outer valence shell. When certain impurities such as arsenic, bismuth or antimony, which have 5 electrons in their outer shells, are alloyed with them the resultant material becomes an **N-Type** material. N-Type semiconductors have extra electrons free to move about so they are called donors.

When silicon or germanium is alloyed with boron, indium or gallium, which have only 3 electrons in their outer shells, there will be holes formed in the outer ring which will accept electrons from an outside source. The material is now a **P-Type** material and is an acceptor.

The N-Type materials are negative charged and the P-Type materials are positive charged. Just like magnets, the "likes" repel and the "opposites" attract.

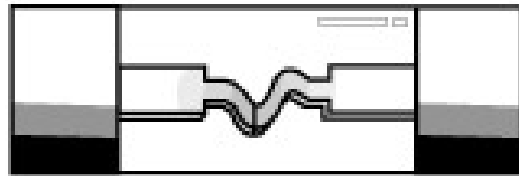
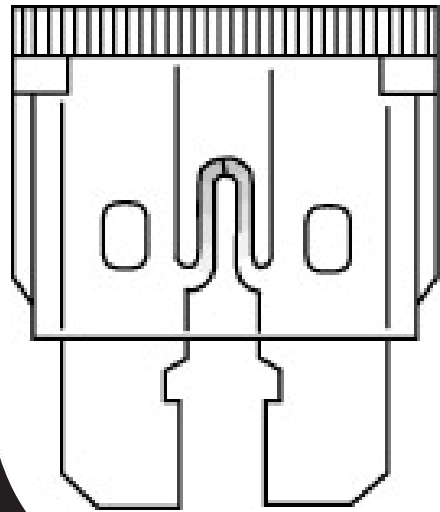


EC1-64

ED1

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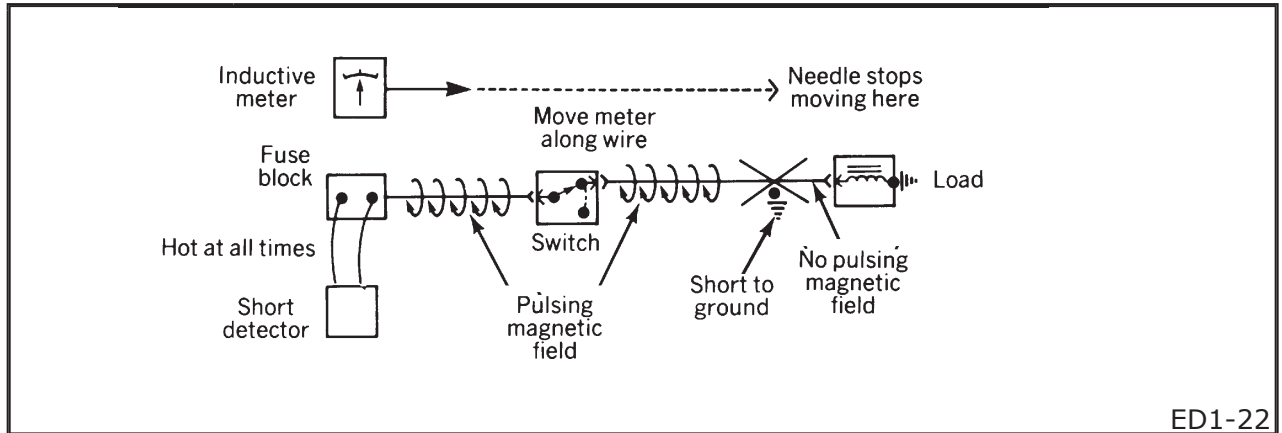
Electrical Diagnosis



**Automotive
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S E R V I C E T R A I N I N G



DIAGNOSING SHORT CIRCUITS

Short circuits that result in excessive current flow will normally blow the circuit protection device. Because the circuit will not operate, voltage drop tests cannot be made.

There is a commercially available short detector that pulses current intermittently through the shorted circuit. An inductive ammeter, included with the kit, traces this flow of current through the faulty circuit. The ammeter needle will move with each of the current pulses as it is moved along the circuit. When it gets to the short, the needle will stop.

The most common use for this tester is for wiring harness shorts to ground.

PARASITIC DRAW

Parasitic current draw flows when all the switches on the vehicle are in the off position. A small amount of current is necessary to enable the various electronic control units and alarm systems to retain their programming when the ignition switch is turned off.

Parasitic current draw is normally less than 20 milliamps but may be higher with an aftermarket alarm system installed.

- Flows when all switches are off
 - Necessary to retain computer memory
 - Above 20 milliamps may indicate a problem
- ED1-23



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Fast charging

- High rate of current for short time
Max. current = 20 amps

Slow charging (recommended)

- Complete recharge
Current = 1/10 of battery's AH rating

ES1 - 16

Battery Charging

To recharge a battery, current must be applied to the battery in the opposite direction of the discharge flow. This restores the imbalance of electrons in the battery. There are two basic methods of charging the battery: **fast charging** and **slow charging**.

Fast charging is done by applying a high rate of current to the battery for a short period of time. The fast charge method should not be used on a completely discharged battery, to prevent damage to the battery. The maximum recommended charging current is 20 amperes.

The **slow charge** method will completely recharge the battery by charging with a lower current for a longer period of time. The maximum charging current should be less than 1/10th of the battery capacity. For instance, a 40 AH battery should be slow charged at 4 amps or less.

CHARGE RATE CHART*

RC Rating	AH Rating	5A	10A	20A	30A	40A
less than 75	less than 48	10 hrs	5 hrs	2.5 hrs	2 hrs	
75 - 115	48 - 75	15 hrs	7.5 hrs	3.25 hrs	2.5 hrs	2 hrs
115 - 160	75 - 100	20 hrs	10 hrs	5 hrs	3 hrs	2.5 hrs
160 - 245	100 - 150	30 hrs	15 hrs	7.5 hrs	5 hrs	3.5 hrs

* For fully discharged batteries

ES1 - 17

Kia Specifications

CAUTION

Remember that a battery may lose its charge while the vehicle is sitting on the lot waiting for sale (lot rot). To avoid an embarrassing moment with a customer or the replacement of a battery, be sure to start vehicle inventory often enough to maintain a full charge on the battery.

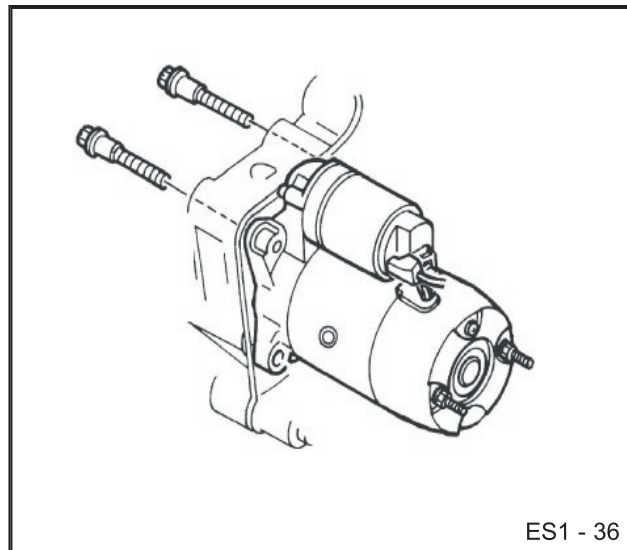
ES1 - 18

THE STARTING SYSTEM

One of the most important functions of the vehicle's electrical system is starting the engine. This is accomplished by the starting system which consists of two major components, the starter motor and the battery. Other related components that make up the starting system are the ignition switch and the automatic transmission range switch or starter clutch pedal position switch.

The starter motor converts electricity from the battery into rotational movement to turn the flywheel connected to the engine's crankshaft. The starter must crank the engine fast enough and for a sufficient length of time until the Engine Control Module has ensured the proper fuel and ignition are provided in order to keep the engine running.

Once the engine is running the starting system's job is done and is no longer needed until the next time the engine needs to be started.



ES1 - 36

- Direct drive (manual)
- Gear reduction (automatic)

ES1 - 37

Starter Motor Types

Two different types of starter motors are used on Kia vehicles, a **direct drive** starter motor or a **gear reduction** starter motor. The conventional starter motor is used on Kia models with manual transmission/transaxle. The gear reduction starter motor is designed to reduce the speed and increase the torque required to start vehicles with automatic transmission/transaxles.

The two starter motors are different mechanically but electrically they operate identically. Both starters consist of a motor, a solenoid, a drive pinion and a housing.



ACTIVITY

Battery Testing

In this exercise you will be assigned to a vehicle and will do the following checks.

- Battery visual inspection
- Specific Gravity Test
- Open Circuit Voltage Test
- Capacity or Load Test

VISUAL INSPECTION

Check	Condition	Recommendation
1. Case	_____	_____
2. Terminals	_____	_____
3. Cables	_____	_____
4. Connectors	_____	_____
5. Hold-Down	_____	_____
6. Drive Belt	_____	_____
7. Electrolyte	_____	_____
8. Plates	_____	_____

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