



UNIT I: ELECTRICAL FUNDAMENTALS





INTRODUCTION

Every vehicle contains hundreds of circuits—some simple, others complex. Whether you're wiring a headlight or diagnosing an ECU fault, you must understand how current travels through a system. Circuits determine how electricity flows, how components are powered, and how failures occur. This lesson introduces the major types of circuits used in automotive systems and how they behave.



LEARNING OBJECTIVES

By the end of this lesson, students should be able to:

1. Differentiate between the three basic types of circuits: series, parallel, and series-parallel.
2. Describe how each type of circuit affects voltage, current, and resistance.
3. Identify common automotive systems that use each circuit type.



SECTION 1: WHAT IS AN ELECTRICAL CIRCUIT?

A circuit is a closed path through which electricity flows. It must contain:

- A power source (e.g., battery)
- A load (e.g., bulb or motor)
- Conductors (wires)
- Control device (e.g., switch)

If the path is broken → circuit is open → no current flows.



SECTION 2: TYPES OF CIRCUITS

- SERIES

Series Circuit:

- One continuous path
- Current flows through every component in order
- If one component fails → entire circuit stops

Characteristics:

- Current is the same everywhere
- Voltage is divided between components
- Total resistance = sum of all resistances

Example: Old Christmas lights, Dashboard indicator circuits



SECTION 2: TYPES OF CIRCUITS

- PARALLEL

Parallel Circuit:

- Multiple branches; current splits across paths
- Each branch has its own connection to power and ground
- If one branch fails → others keep working

Characteristics:

- Voltage is the same across each branch
- Current divides based on resistance
- Total resistance is reduced

Example: Car lighting system, Headlamps, Tail lights, Dome lights



SECTION 2: TYPES OF CIRCUITS

- SERIES-PARALLEL

Series-Parallel Circuit:

- Combination of both
- Some parts are in series, others in parallel
- Used to balance current, protect sensitive parts, or control groups

Example: HVAC blower fan circuits, ECMs, Sensor networks

SECTION 3: VOLTAGE AND CURRENT IN EACH TYPE

Circuit Type	Current	Voltage	Resistance
Series	Same in all parts	Divides among loads	Adds up
Parallel	Divides by branch	Same across branches	Total drops
Series-Parallel	Mixed	Mixed	Calculated in segments

SECTION 4: WHY CIRCUIT TYPE MATTERS IN AUTO WORK

Application	Circuit Type	Reason
Headlight system	Parallel	Allows individual bulbs to work independently
Door lock control	Series-Parallel	Combines relays and motors for synchronized function
Fuse box	Parallel	Supplies many branches from one source
Battery charging	Series	Battery cells are linked in series to provide 12V total



RECOMMENDED VIDEO

Video: “Types of Electrical Circuits –

Region 10 ESC

Source: https://www.youtube.com/watch?v=RQ3dj0s_LY8

Covers:

- Visual examples of series, parallel, and series-parallel circuits
- Simulations of what happens when one part fails
- Real-world examples in vehicles





SECTION 5: COMMON MISCONCEPTIONS

- “All circuits in a car are the same” → Different functions require different circuit types
- “One broken bulb stops all others” → Only true in series circuits
- “Parallel circuits always draw more power” → Depends on the number and size of the loads



SUMMARY – KEY POINTS

- Series circuits: one path, shared current, voltage divided
- Parallel circuits: multiple paths, same voltage, current divides
- Series-parallel: used for complex control and sensor networks
- Knowing the type of circuit helps technicians predict behavior, diagnose faults, and design modifications safely



REFERENCES

- Auto Electrical System Module – Competency-Based Learning Material

<https://www.scribd.com/document/601714455/Auto-Electrical-System-Module-PDF>

TESDA Training Regulations – Automotive Servicing NC II

<https://www.tesda.gov.ph>

YouTube – The Engineering Mindset

“Types of Electrical Circuits Explained – Automotive”

https://www.youtube.com/watch?v=Wq_DX4wuQAI