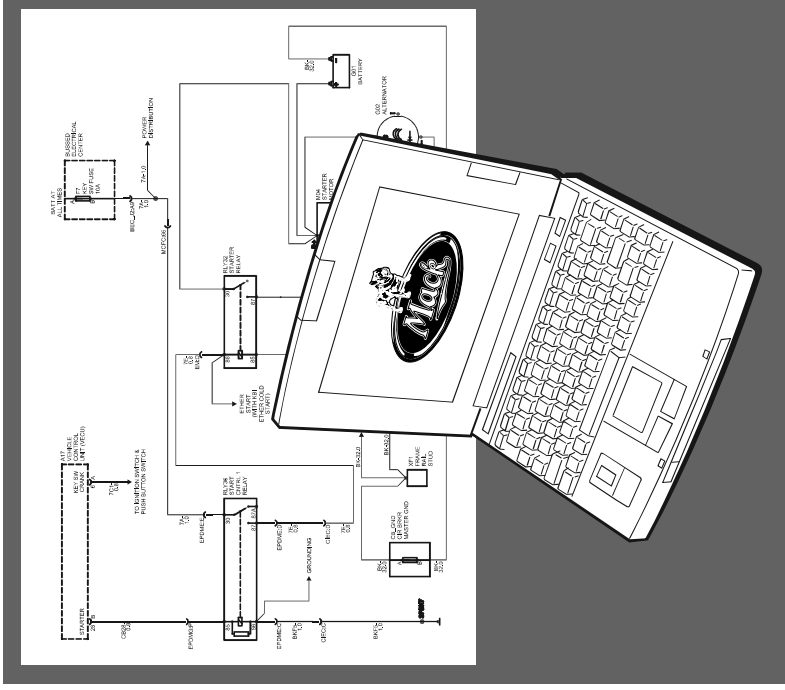




ELECTRICAL SYSTEM TROUBLE SHOOTING

for GU (Granite™), CHU and CXU (Pinnacle™), and TD (Titan™) Series Chassis

(includes Wiring Diagrams)



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ATTENTION

The information in this manual is not all-inclusive and cannot take into account all unique situations. Note that some illustrations are typical and may not reflect the exact arrangement of every component installed on a specific chassis.

The information, specifications, and illustrations in this publication are based on information that was current at the time of publication.

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1. Preliminary Information

This Electrical Troubleshooting Manual contains wiring diagrams for the vehicle's electrical systems. It is intended to provide the technician with the information necessary to diagnose and repair the vehicle's electrical systems.

The information in this manual is not all-inclusive and cannot take into account all unique situations. Although every effort has been made to ensure that all the information is as accurate as possible, due to our product upgrades, some information may not be applicable to all chassis. Not all chassis are equally equipped, and care should be taken to determine exactly what equipment is installed on the vehicle.

The information, specifications, and illustrations in this publication are based on information that was current at the time of publication. We reserve the right to make changes at any time, without notice.

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2. Safety Information

Please take the time to familiarize yourself with the contents of this manual before attempting to work on a vehicle. Make sure you completely understand the instructions for performing a test before beginning the test procedure.

Correctly performed service procedures are critical for technician safety for safe, reliable operation of the vehicle.

Cautionary *signal words* ("Danger", "Warning", "Caution") may appear in various locations throughout this manual. Information accented by one of these signal words must be observed to minimize the risk of personal injury to service personnel, or the possibility of improper service methods which may damage the vehicle or render it unsafe. Additional *Notes* and *Service Hints* are utilized to emphasize areas of procedural importance and to provide suggestions for ease of repair.

Particular service operations may require the use of special tools for specific purposes. These special tools should be used in the manner described, whenever specified in the instructions.

Anyone using a service procedure or tool not recommended in this manual must first satisfy himself thoroughly that neither his safety nor vehicle safety

will be jeopardized by the service method he selects. Individuals deviating in any manner from the instructions provided assume all risks of consequential personal injury or damage to equipment involved.

Mack Trucks, Inc. cannot anticipate every possible occurrence that may involve a potential hazard. Accidents can be avoided by recognizing potentially hazardous situations and taking the necessary precautions. Performing service procedures correctly is critical to technician safety and safe, reliable vehicle operation.

3. General Shop Safety Practices

The following list of general shop safety practices can help technicians avoid potentially hazardous situations and reduce the risk of personal injury.

- Perform all service work on a flat, level surface. Block wheels to prevent vehicle from rolling.
- DO NOT wear loose-fitting or torn clothing. Remove any jewelry before servicing vehicle.
- ALWAYS wear safety glasses and protective shoes. Avoid injury by being aware of sharp corners and jagged edges.
- Use hoists or jacks to lift or move heavy objects.
- NEVER run engine indoors unless exhaust fumes are adequately vented to the outside.
- Be aware of hot surfaces. Allow engine to cool sufficiently before performing any service or tests in the vicinity of the engine.
- Keep work area clean and orderly. Clean up any spilled oil, grease, fuel, hydraulic fluid, etc.
- Only use tools that are in good condition, and always use accurately calibrated torque wrenches to tighten all fasteners to specified torques. In instances where procedures require the use of special tools that are designed for a specific purpose, use only in the manner described in the instructions.
- Do not store natural gas-powered vehicles indoors for an extended period of time (overnight) without first removing the fuel.
- Never smoke around a natural gas-powered vehicle.



4. Definitions

The following definitions indicate the use of these signal words as they appear throughout the manual:

Service Hint: A helpful suggestion that can make the service or procedure being performed quicker and/or easier while possibly reducing service costs.

Note: Indicates a procedure, practice, or condition that must be followed in order to have the vehicle or component function in the manner intended.

Caution: Indicates an unsafe practice where damage to the product could occur.

Warning: Indicates an unsafe practice that could result in personal injury.

Personal injury: Means that the injury is of a temporary nature and that full recovery is expected.

Danger: Indicates an unsafe practice that could result in death or serious personal injury. Serious personal injury is considered to be permanent injury from which full recovery is NOT expected, resulting in a change in life style.

5. How To Use This Manual

The following section describes how this manual is organized, the type of information this manual contains, what the information means, and how to use the information to troubleshoot electrical problems.

Circuit schematics divide the entire electrical system into individual systems. Each circuit is shown completely and independently in each system. Other components that are connected to the circuit may not be shown unless they influence the circuit operation.

Many of the electrical schematic diagrams in this manual show multiple occurrences of the vehicle control unit, the engine control unit, or other control modules. The diagrams are formatted in this way for clarity and ease of use, and do not imply that more than one vehicle control unit, engine control unit, or other control modules are installed on any vehicle.

All wiring connections between components are shown as they exist in the vehicle; however, it is important to realize that no attempt has been made on the wiring diagram to represent components and wiring as they physically appear on the vehicle. For example, a four-foot length of wire is treated no differently in a schematic from one that is only a few inches long. Also, to aid in understanding electrical (electronic) operation, wiring inside complicated components may have been simplified.

Each system normally starts with the component that powers the circuit, such as a fuse or ignition switch. Current flow is shown from the power source at the top of the page to ground at the bottom of the page. In order to concentrate on the essential parts of the system, power supply and ground connections are sometimes simplified in the wiring diagrams. A full representation of the power supply of a fuse or the power distribution from a fuse to various components is given in the Power Distribution diagrams. A full representation of the ground connections is given in the Ground Distribution diagrams.

Within the wiring diagrams, switches, relays, and sensors are shown *at rest*, as if the ignition switch were OFF.

Circuit Schematics

Each schematic represents one circuit. A circuit's wiring and components are arranged to show current flow, from power at the top of the page to ground at the bottom of the page. Note that circuits may share power or ground connections with the circuit shown.



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Wires

Wires are identified by circuit number and gauge number. For example, 13A-2.0, as shown in *Figure 1* — “2.0” indicates a metric gauge 2 wire on circuit “A” coming from fuse “13”.

Wires are also identified by their location in a connector. For example, MCFC: 50 — the number “50” after the colon means that those terminals join in cavity 50 within connector MCFC.

Symbols

A description of schematic symbols is located in the symbols library.

Power Distribution Schematics

Power distribution schematics show how power is supplied from the positive battery terminal to the various circuits in the vehicle. Refer to the Power Distribution schematics section to get a detailed picture of how power is supplied to the specific circuit you are working on.

Individual circuit schematics begin with a fuse; so if Power Distribution shows that an inoperative circuit and another circuit share the same fuse, check a component in the other circuit. If the other circuit works, you know the fuse is good and power is available to the inoperative circuit.

Ground Distribution Schematics

Ground Distribution schematics show how components are grounded from the negative battery terminal and vehicle body to the various circuits in the vehicle. Refer to the Ground Distribution schematics section to get a detailed picture of how ground is supplied to the specific circuit you are working on.

If Ground Distribution shows that an inoperative circuit and another circuit share the same ground point, check a component in the other circuit. If the other circuit works, you know the ground connection is good to the same splice point and ground is available to the inoperative circuit.

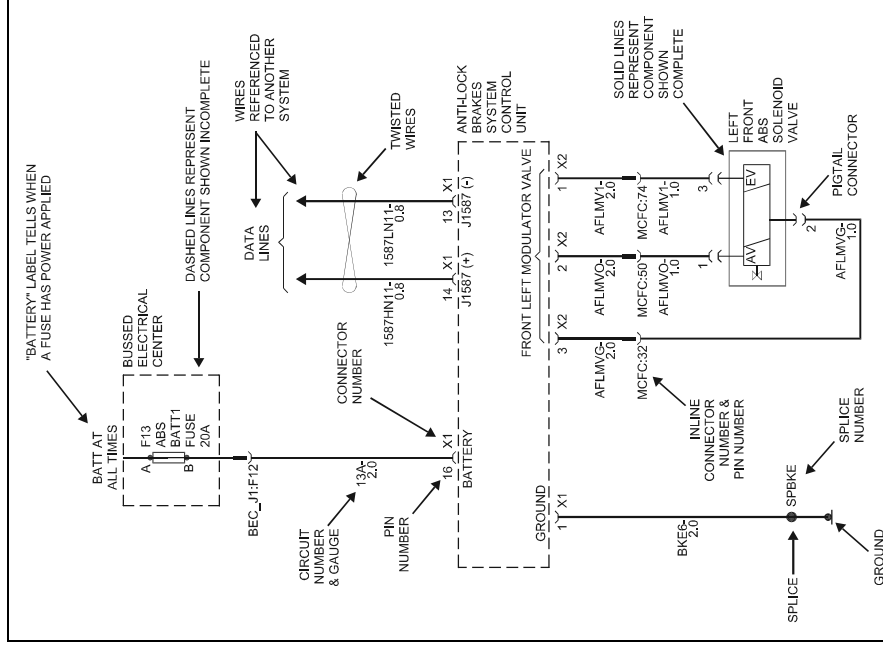


Figure 1. Schematics with descriptions, and how to use them



6. Electrical Testing Procedures

This portion of the manual shows common tests the technician will need to know in order to properly diagnose and repair the vehicle's electrical systems. The following six testing steps provide a good method to use when diagnosing an electrical system:

Step 1. Verify the complaint/problem

Operate the complete system (duplicate the complaint) and see all symptoms for yourself, in order to:

- Check the accuracy and completeness of the customer's complaint.
- Learn more that might give a clue to the nature of the problem:
 - Check power
 - Clean terminals
 - Tighten connections
 - Check alternator belts
 - Turn on lights to check batteries

Step 2. Narrow down the problem

Narrow down the possible causes and locations of the problems in order to more quickly find the exact cause:

- Refer to the wiring diagrams and schematics.
- Refer to service bulletins and letters.
- Check the easy items first:
 - Circuit breakers and fuses
 - Light bulbs
 - Connectors
 - Switches

Step 3. Test the cause

Use electrical test procedures to find the specific cause of the symptoms. You may also find the *Additional Troubleshooting Help* section to provide helpful suggestions.

- Test voltage
- Test continuity

Step 4. Verify the cause

Confirm that you have found the correct cause by operating the parts of the circuit you think are good.

Step 5. Make the repair

Repair or replace the faulty component.

Step 6. Verify the repair

Operate the system as in Step 1 and check that your repair has relieved all symptoms, as well as has not caused any new symptoms.



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7. Additional Troubleshooting Help

Intermittent and Poor Connections

Most intermittent electrical problems are caused by faulty electrical connections or wiring, although a sticking component or relay might also cause a problem. Before condemning a component or wiring assembly, check the following items:

- Connectors are fully seated
- Spread terminals, or terminal push-out
- Terminals in the wiring assembly seated into the connector/component and locked into position
- Dirt or corrosion on the terminals, any amount of which could cause an intermittent problem
- Damaged connector/component casing, exposing the item to dirt or moisture
- Wire insulation that has rubbed through, causing a short to ground
- Broken wiring strands inside the insulation

Basic Electrical Knowledge

Without a basic knowledge of electricity, it will be difficult to use the diagnostic procedures needed to repair a vehicle. You should understand the basic theory of electricity and know the meaning of voltage, current (amps or amperes), and resistance (ohms). You should understand what happens in a circuit with an open or a shorted wire. You should be able to read and understand a wiring diagram.

To aid in understanding electrical flow, the following information illustrates the similarities between electrical and coolant circuits in a chassis:

Power Sources: Alternator/Battery $\approx$ Pump

Pathways: Wires/Terminals $\approx$ Hoses

Power Users: Light $\approx$ Engine/Radiator

Power Control: Breaker/Switch $\approx$ Thermostat

Units of Measure

Flow Volume: Volume of electrical current

Ampere (amps) $\approx$ Gallons per minute

Pressure: Potential difference between positive (+) and negative (-) power source poles

Voltage $\approx$ Pounds per square inch

Resistance: Resistance to current flow

Ohms $\approx$ Restriction

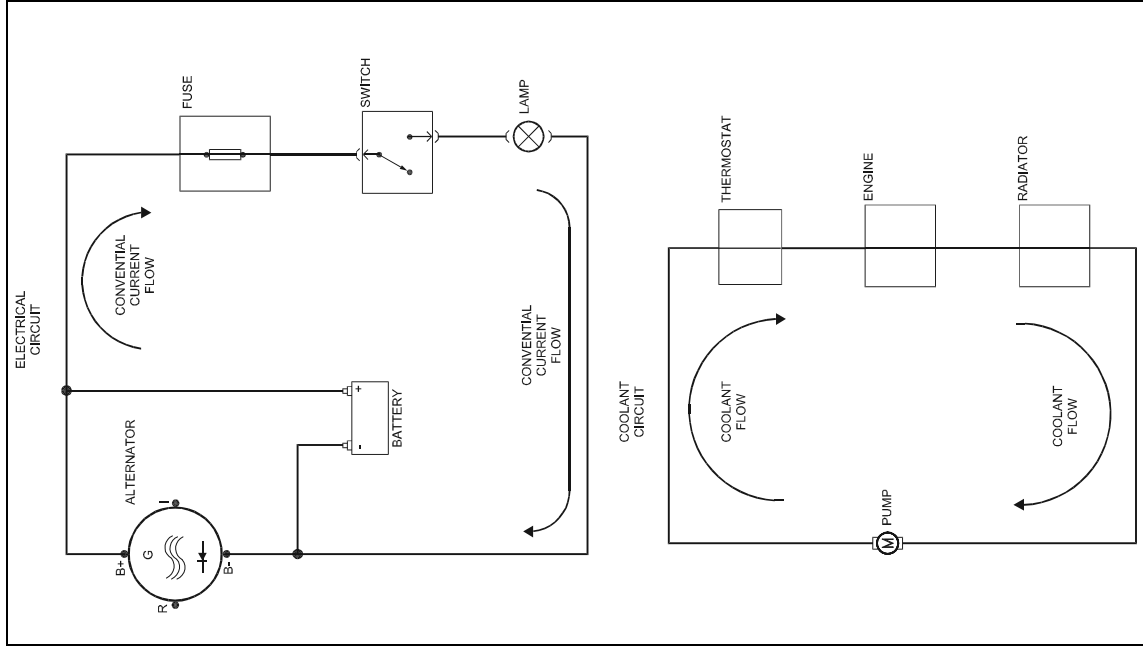


Figure 2. *Electrical and Coolant Circuits*

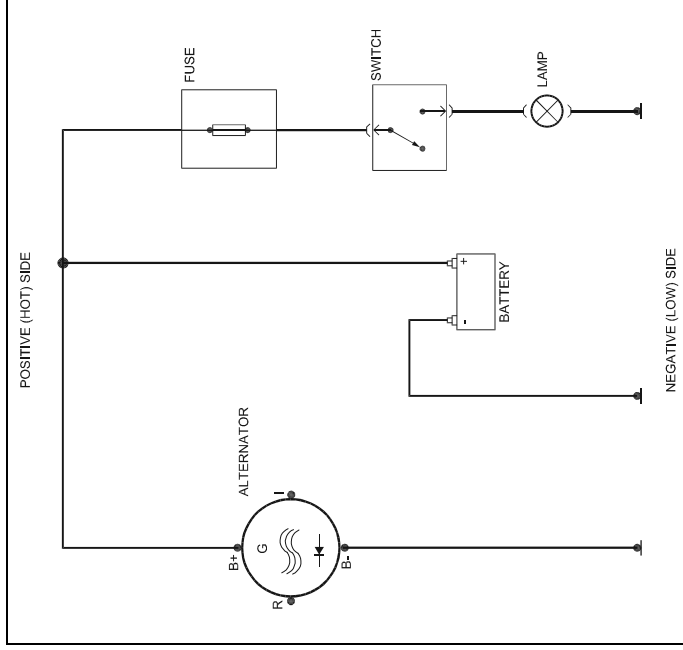


Figure 3. *Basic Electrical Circuit*



Introduction

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Power Sources:

- Battery: - Electro-chemical
- Storage
- Alternator: - Electro-magnetic
- Mechanically-driven

Power Controls:

- Circuit breakers/Fuses
- Switches
- Relays
- Solenoids
- Rheostats

Power Consumers:

- Lights
- Motors
- Instruments
- Solenoids
- Radios

Power Conductors:

- Wires
- Terminals
- Cab/Chassis
- Component cases

Types of Electrical Circuits

Closed Circuit

A closed circuit has a continuous path to ground. Current flows from the positive terminal of the battery through each component (fuse, switch, lamp) to ground.

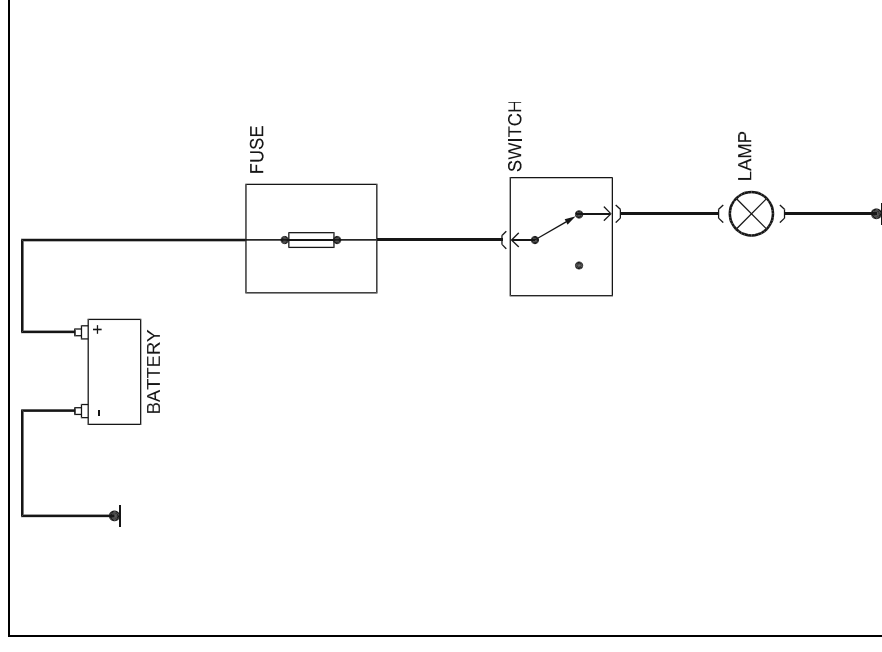


Figure 4. Closed Circuit



Open Circuit

An open circuit has the current path from positive to ground broken. Some causes are normal, such as a switch in the OFF position. Some causes are not normal, such as a blown fuse, a lamp filament open, or a broken wire to ground, as shown in *Figure 5*.

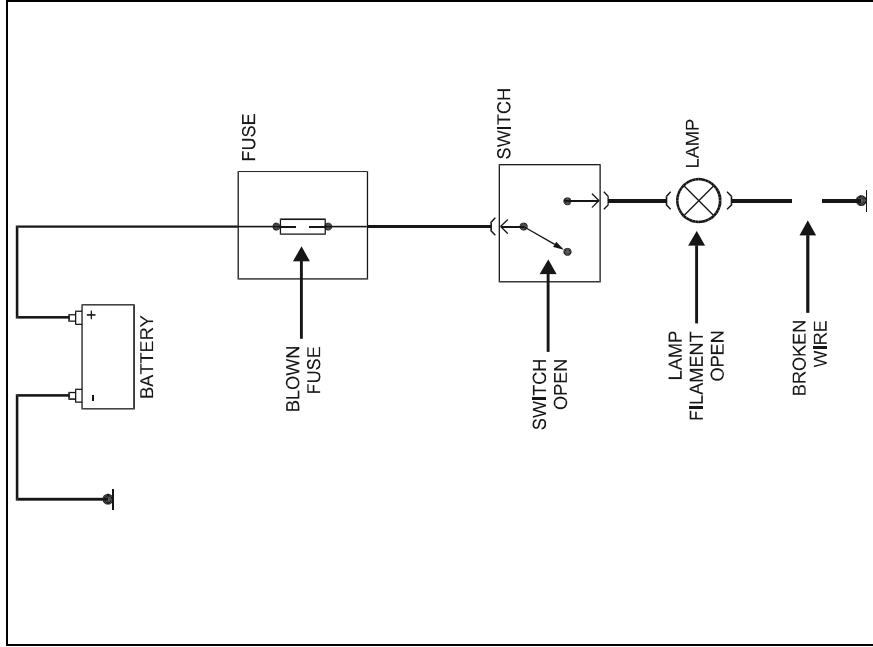


Figure 5. Open Circuit

Short to Ground

A short to ground is when current path is rerouted to ground, leaving out part of the original circuit and causing some or all of the circuit not to function properly. Some causes are wire insulation broken or worn through to bare wire, or a smashed wire between two pieces of metal. The most likely result of the instance shown in *Figure 6* would be a blown fuse when the switch is closed.

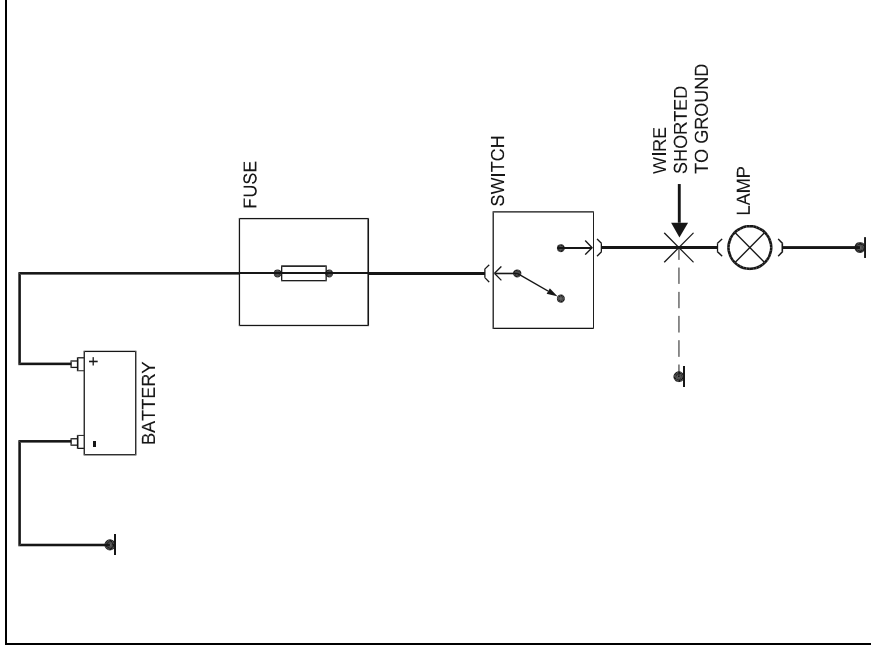


Figure 6. Short to Ground