Automotive Electricity

Electricity is put to work in many ways on today’s Toyotas. A knowledge of component operation and wiring diagrams is needed for diagnosis and testing.
ELECTRICAL COMPONENTS

POWER SUPPLY SYSTEM
- Battery
- Fuse & Fusible Link

STARTING & IGNITION SYSTEMS
- Starter
- Ignition Coil
- Capacitor (Condenser)

CHARGING SYSTEM
- Alternator
- Voltage Regulator

BODY ELECTRICAL SYSTEM
- Headlight
- Cigarette Lighter
- Horn
- Blower Motor

Chemical Action of Electric Current
- Heat and Light Generation

Heating Action of Electric Current
- Static Electricity

Electromagnetic Induction
- Magnetic Action of Electric Current
AUTOMOTIVE CIRCUITS

1. BATTERY (POWER SOURCE)
2. FUSE (PROTECTION)
3. LAMP (LOAD)
4. SWITCH (CONTROL)
5. BODY OR FRAME (GROUND)

Diagram showing a simple electrical circuit with a battery, fuse, lamp, switch, and ground connections.
ELECTRICAL SYMBOLS
POWER SOURCES

12-VOLT BATTERY

40-80 AMP ALTERNATOR
TYPICAL ELECTRICAL LOADS

- LAMPS
- HORN
- GAUGES AND ACCESSORIES
- COILS
- MOTORS
- LIGHTER
FIXED - VALUE RESISTORS

<table>
<thead>
<tr>
<th>BAND 1</th>
<th>BAND 2</th>
<th>BAND 3</th>
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<tbody>
<tr>
<td>1ST DIGIT</td>
<td>2ND DIGIT</td>
<td>(NUMBER OF ZEROS)</td>
</tr>
<tr>
<td>COLOR</td>
<td>DIGIT</td>
<td>COLOR</td>
</tr>
<tr>
<td>BLACK</td>
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</tr>
<tr>
<td>BROWN</td>
<td>1</td>
<td>BROWN</td>
</tr>
<tr>
<td>RED</td>
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<tr>
<td>ORANGE</td>
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<td>YELLOW</td>
<td>4</td>
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<td>BLUE</td>
<td>6</td>
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<tr>
<td>VIOLET</td>
<td>7</td>
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<td>GRAY</td>
<td>8</td>
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<td>WHITE</td>
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RESISTANCE TOLERANCE

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<tr>
<td>SILVER</td>
<td>±10%</td>
</tr>
<tr>
<td>GOLD</td>
<td>±5%</td>
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<tr>
<td>RED</td>
<td>±2%</td>
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<tr>
<td>BROWN</td>
<td>±1%</td>
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WIRE - WOUND RESISTORS
STEPPED RESISTORS
RHEOSTAT - VARIABLE RESISTOR
POTENTIOMETER- VARIABLE RESISTOR

Diagram of a potentiometer with labels for Fc, E1, E2, Vs, Ve, Vc, and THA.
NTC AND PTC THERMISTORS

- NTC THERMISTOR
- PTC THERMISTOR
- ORDINARY METALS

RESISTANCE (Ω) vs TEMPERATURE (°C)
RELAYS AND SOLENOIDS

**Construction**

**Relays**
- From power source
- Control circuit
- Power circuit
- Armature
- Electromagnetic coil
- To load

**Solenoids**
- Moveable iron core

**Principle**

**“Pulling” Type**
- Soft iron

**“Push-Pull” Type**
- Permanent magnet
- Fields in opposition

**Operation**

**Relays**
- From power source
- Control circuit
- Power circuit
- Armature
- To load

**Solenoids**
- Moveable iron core
CAPACITORS

METAL PLATE A
INSULATOR
METAL PLATE B
CAPACITOR TYPES

- **PAPER AND FOIL**
- **CERAMIC**
- **ELECTROLYTIC**

**Details:**
- **1 5 1 K**
- **Metal Oxide Surface**
- **Aluminum Film**
- **Positive Terminal**
- **Negative Terminal**
- **Metal Films**
- **Insulating Paper**
- **Paper & Electrolyte**
CAPACITOR SYMBOLS

CAPACITOR

OR

ELECTROLYTIC CAPACITOR
SEMICONDUCTORS - DIODES

ORDINARY DIODE

ZENER DIODE

LIGHT-EMITTING DIODE

PHOTODIODE

COLOR LINE

DOT

GRAPHIC SYMBOL
SEMICONDUCTORS - TRANSISTORS

TRANSISTOR

COLLECTOR INDICATION MARK

COLLECTOR CURRENT

BASE CURRENT

EMITTER CURRENT

NPN TYPE

PNP TYPE

MICROPROCESSOR

CHIP CONTAINING INTEGRATED CIRCUITS
PROTECTION DEVICES

Fuses

Fuse and Circuit Breaker Locations

Diesel-Powered Vehicles
Engine Compartment (Fuses)

Passenger's Side Kick Panel (Fuse and Circuit Breaker)

Gasoline Powered Vehicles
Engine Compartment (Fuses)

Driver's Side Kick Panel (Fuses and Circuit Breakers)

Checking and Replacing Fuses

Driver's Side Kick Panel

Passenger's Side Kick Panel

Engine Compartment

Spare Fuses (7.5 A and 15 A)

Pull-Out Tool

Good

Blown
PROTECTION DEVICES
Fusible Links and Circuit Breakers

CHECKING THE FUSIBLE LINKS

GASOLINE-POWERED VEHICLES
GOOD
MELTED

DIESEL-POWERED VEHICLES
GOOD
MELTED

CHECKING CIRCUIT BREAKERS

LOW-EXPANSION METAL
HIGH-EXPANSION METAL
CONTACTS
TERMINALS
CURRENT FLOW

AUTOMATICALLY RESET TYPE
MANUALLY RESET TYPE

Reseting manually-reset type circuit breakers
(a) Insert a pin into the reset hole and push it.
(b) Using an ohmmeter, check that there is continuity between both terminals of the circuit breaker.
If there is no continuity, replace the circuit breaker.