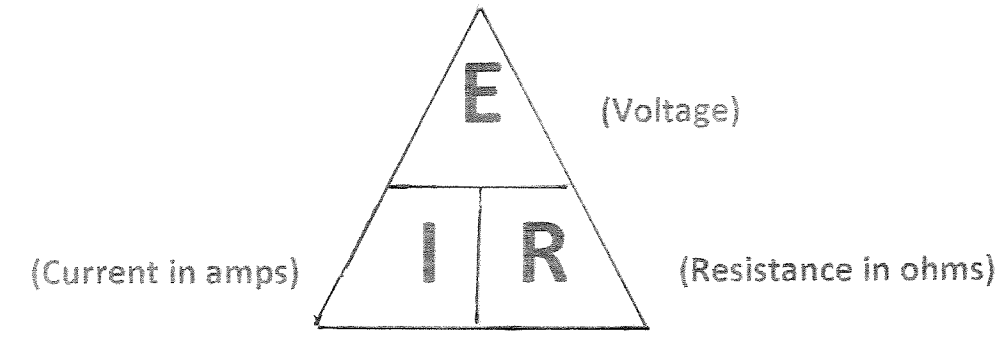
Ohm's law



Ohm's law explains how voltage, current, and resistance are related in any circuit.

A. If voltage increases and resistance stays the same, current flow will increase in the same proportion as the voltage increased (directly proportional)
B. If resistance increases and voltage stays the same, current flow will decrease in the same proportion as the resistance increased (inversely proportional)
C. If two of the values are known, the third can be calculated
    1. Cover the symbol for the unknown value
    2. Calculate the unknown value by doing the arithmetic
        a. Divide current into voltage to find resistance
        b. Divide resistance into voltage to find current
        c. Multiply current times resistance to find voltage

In its most useful form, Ohm's law predicts how current flow behaves in a circuit:

A. If current flow has increased (overheating, blown fuse or breaker, burned out component) either voltage is too high (not usually a problem) or resistance is too low (short or ground?)
B. If current flow has decreased (dim bulbs, slow or no operation of components) either voltage is too low (check supply) or resistance is too high (check voltage drop)

Electrical Conductivity of Metals

Metal	Relative Conductivity
Silver	106
Copper	100
Gold	65
Aluminum	30-59
Chromium	55
Iron (pure)	18
Steel	3-15
Iron (cast)	2-12
Tin	13
Lead	7

The resistance of any conductor depends on:

Type of material

Length of conductor

Diameter of conductor

Temperature of conductor

Electrical components:

Wires, bulbs, motors, relays, solenoids, switches, etc

Conducting material is made of copper, aluminum, iron, and other metals

Tend to be somewhat durable- do not break easily

Increased temperature reduces current flow

Not affected by properly connected test devices

Not usually affected by electrostatic discharge

Electronic components:

Diodes, transistors, thermistors, integrated circuits, etc

Conducting material is made of silicon "doped" to produced desired characteristics

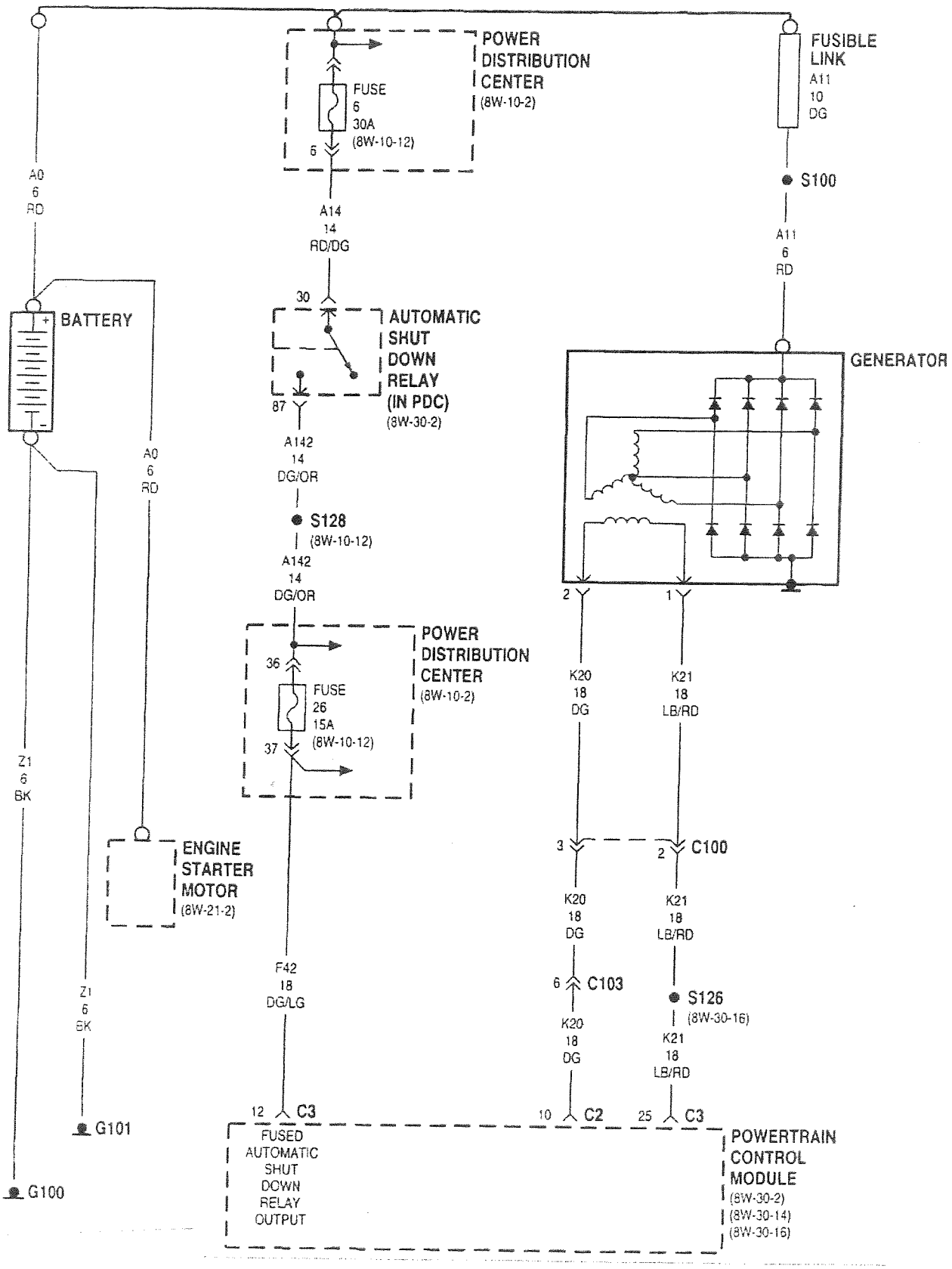
Somewhat fragile- can be damaged by rough handling

Increased temperature increases current flow (thermal runaway)

May be damaged by low impedance test devices (VM's and test lamps)

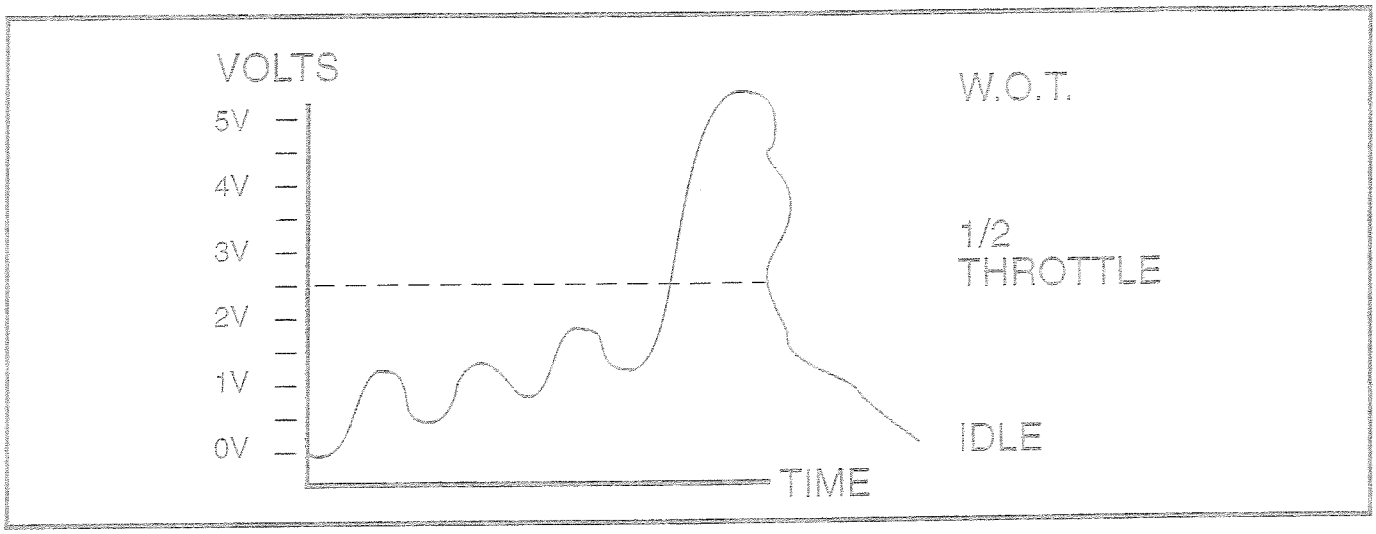
Extremely sensitive to electrostatic discharge

Many circuits combine both electrical and electronic components

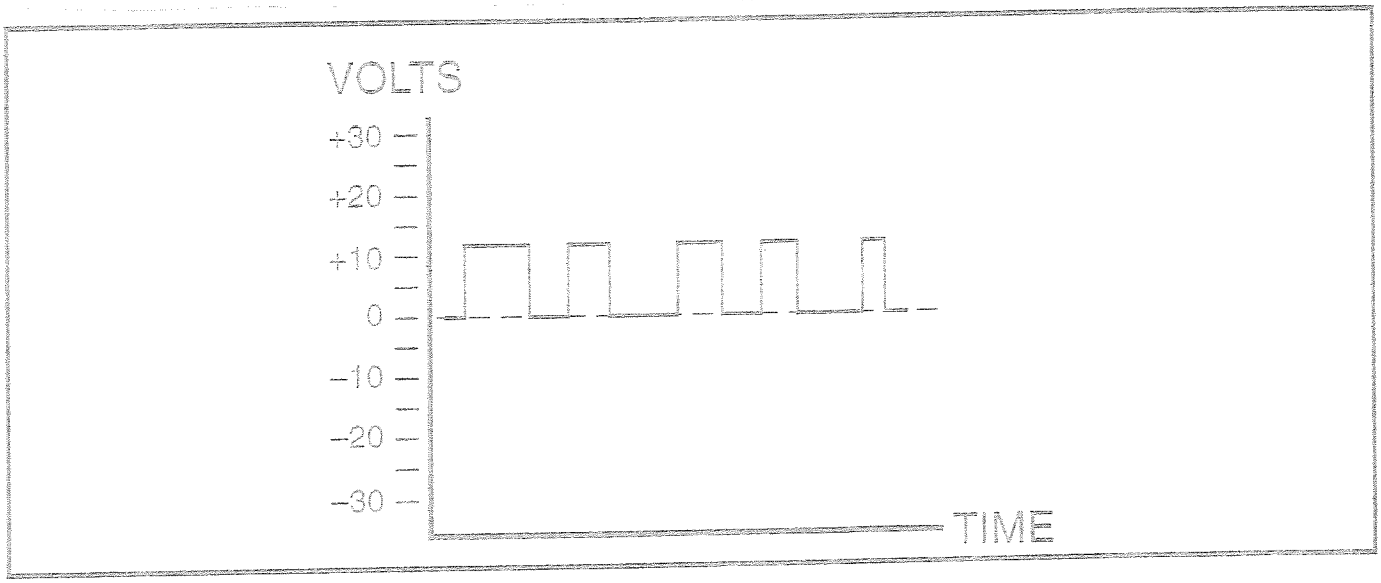

POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 6 30A
(8W-10-12)
6
FUSIBLE LINK
A11
10
DG
S100
A11
6
RD
A0
6
RD
A14
14
RD/DG
30
AUTOMATIC SHUT DOWN RELAY (IN PDC)
(8W-30-2)
87
BATTERY
A142
14
DG/OR
S128
(8W-10-12)
A142
14
DG/OR
GENERATOR
2
1
POWER DISTRIBUTION CENTER
(8W-10-2)
36
FUSE 26 15A
(8W-10-12)
37
K20
18
DG
K21
18
LB/RD
Z1
6
BK
ENGINE STARTER MOTOR
(8W-21-2)
3
C100
2
K20
18
DG
K21
18
LB/RD
F42
18
DG/LG
6
C103
S126
(8W-30-16)
K20
18
DG
K21
18
LB/RD
Z1
6
BK
G101
12
C3
10
C2
25
C3
G100
FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
POWERTRAIN CONTROL MODULE
(8W-30-2)
(8W-30-14)
(8W-30-16)

Types of signals

Analog: vary continuously from a minimum to a maximum value; represented by a continuous wavy line; some analog signals form a "sine wave".



Digital: vary from a minimum (usually zero) voltage to a maximum (five to twelve) volts; signal is either on or off; sometimes called a "square wave" signal; microprocessors require digital signal inputs.



Electrical and electronic malfunctions

1. Open circuit- electrically incomplete; no current flow
   a. Broken wire
   b. Defective (open) switch
   c. Open circuit protection device
   d. Defective (open) component (bulb, winding, module)
   e. Defective connection (including high resistance)
2. Short circuit- (short to voltage)- unwanted conductor to conductor (copper to copper) connection; current flow increases; component may overheat and/or burn out; fuse or breaker may open; other circuits may be affected
   a. Shorted windings in a coil or motor
   b. Shorted wires (in a harness?) due to defective insulation
   c. Shorted diode or transistor
3. Grounded circuit- (short to ground)- unwanted conductor to ground (metal) connection; current flow increases; component may overheat and/or burn out; fuse or breaker may open; other circuits may be affected
   a. Defective insulation on wires
   b. Physical location of exposed terminals
4. Excessive resistance- more than designed into circuit; current flow will be lower or negligible; circuit may function sluggishly or not at all
   a. Loose or dirty connections
   b. Undersized wires or broken strands of wire
   c. Rust or corrosion