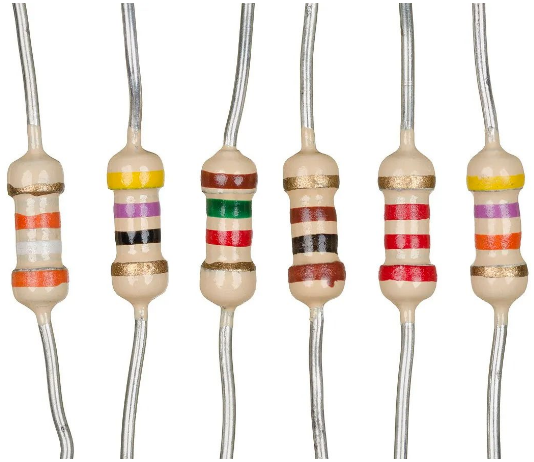
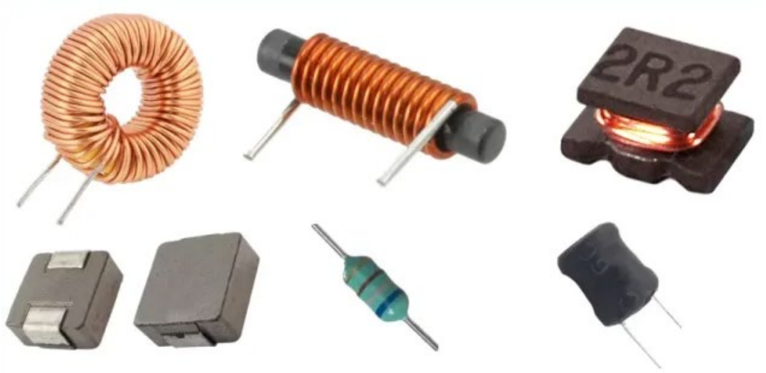
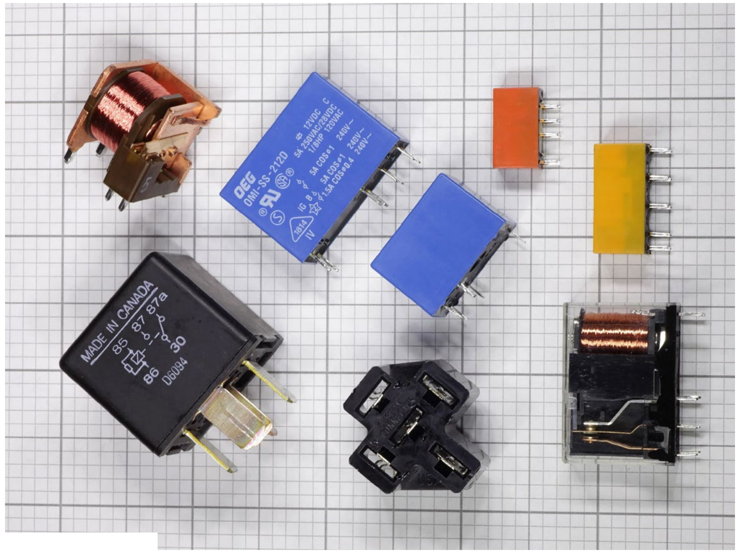
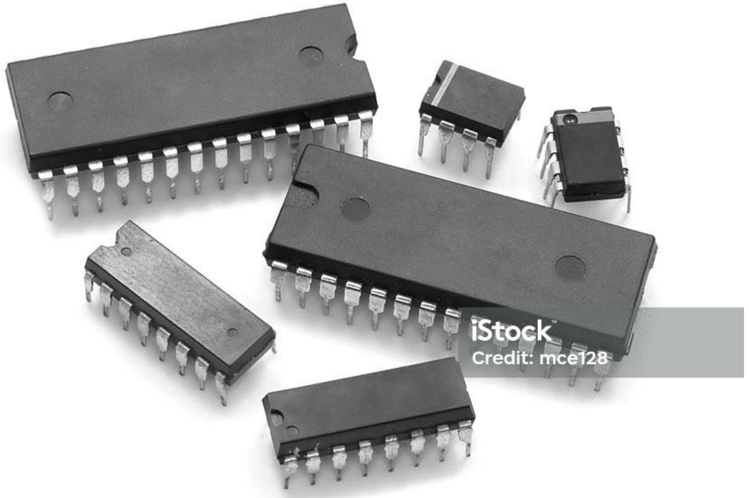
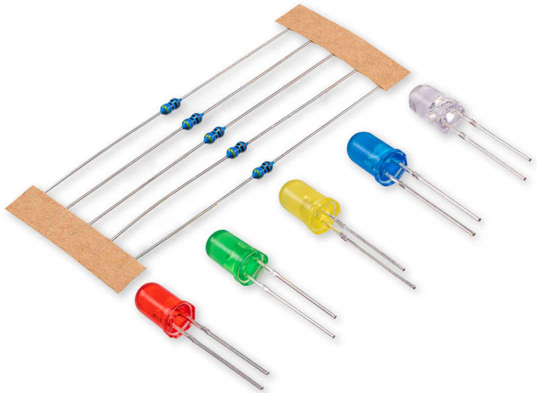
Electronic components



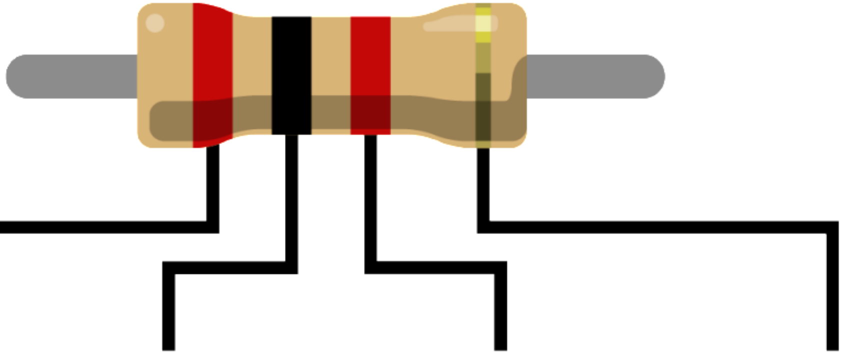








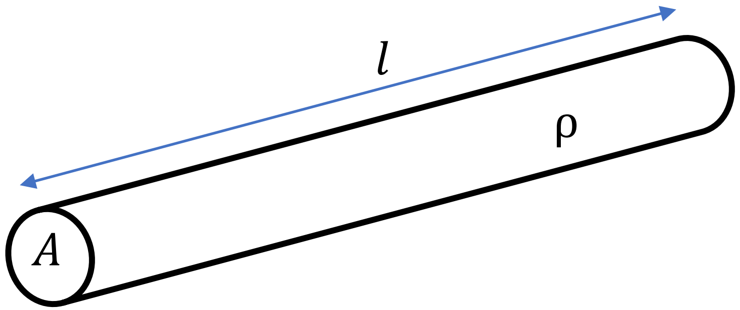
Resistors

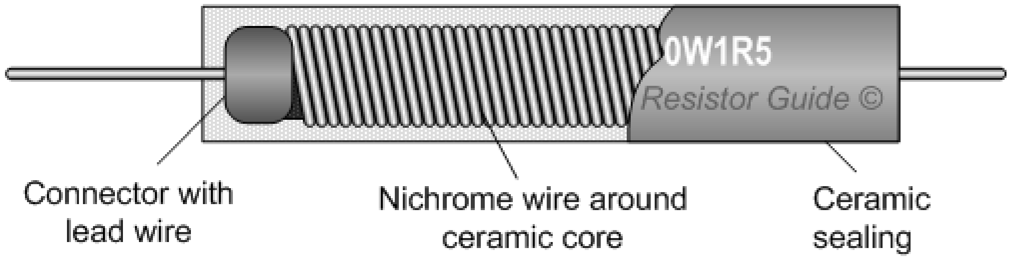


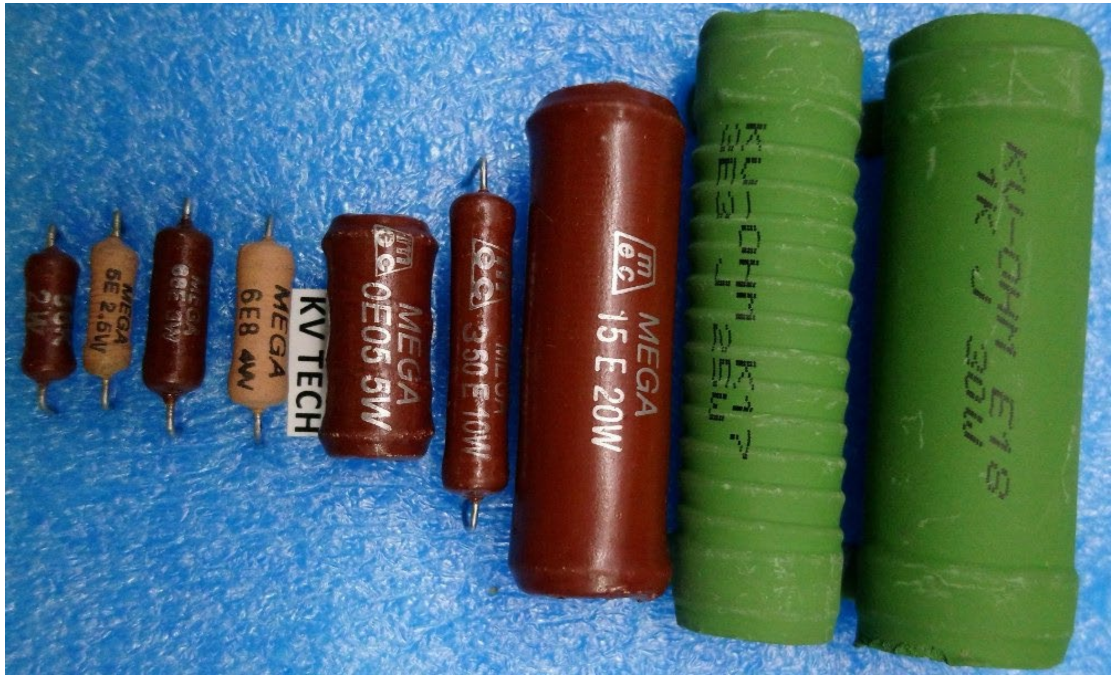
1st digit	2nd digit	Multiplier	Tolerance
0	0	x 1	
1	1	x 10	±1%
2	2	x 100	±2%
3	3	x 1K	
4	4	X 10K	
5	5	x 100K	
6	6	x 1M	
7	7		
8	8	x 0.1	±5%
9	9	x 0.01	±10%

Wire wound resistors

$$R = \frac{\rho\, l}{A}$$

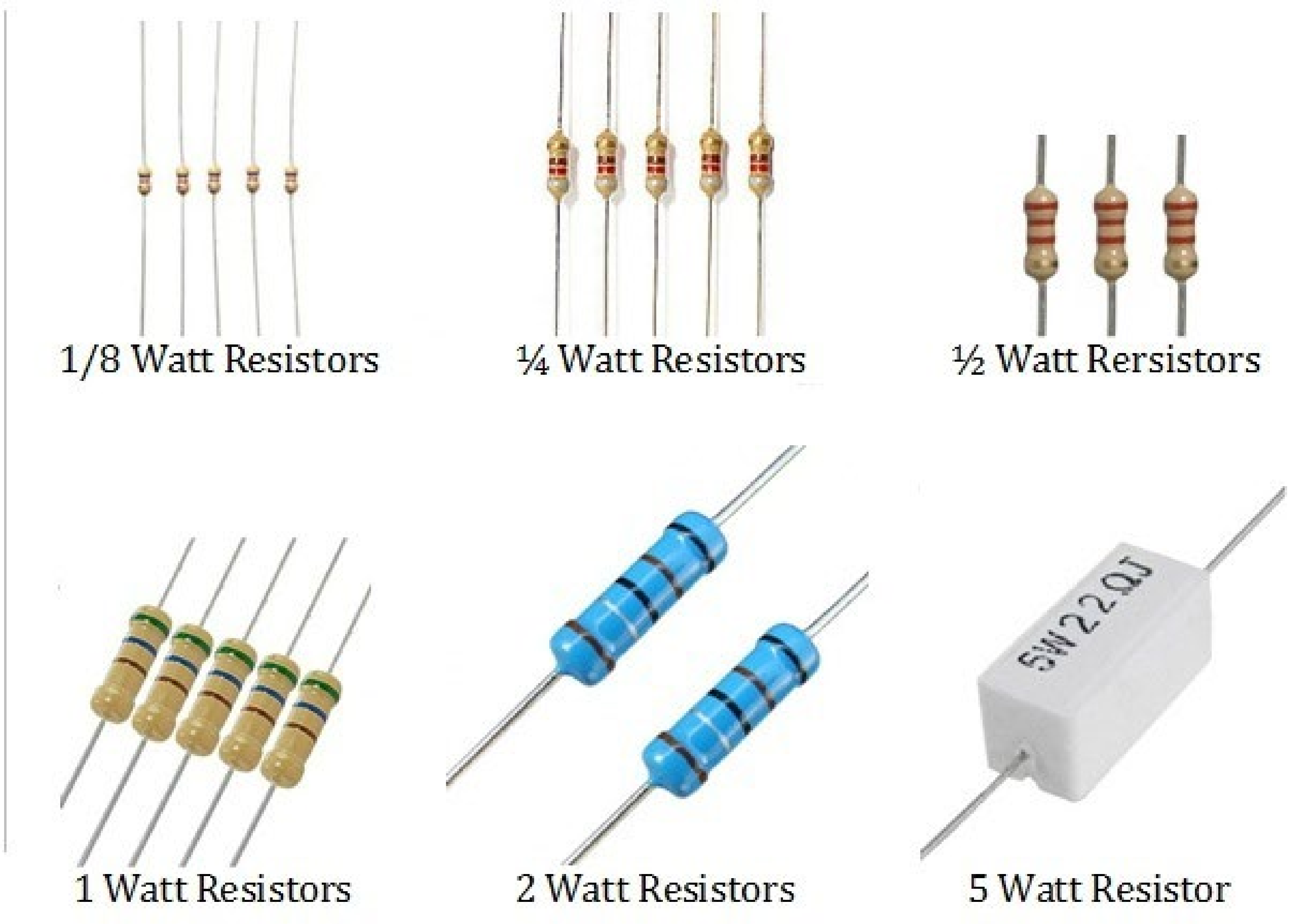


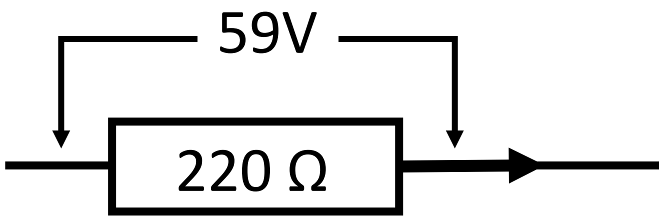


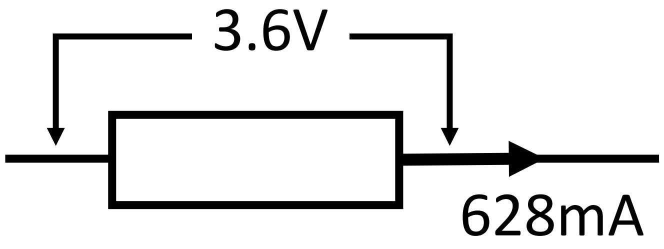


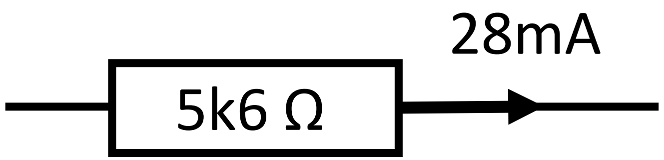
What is the resistance of 2 x 100m 2.5mm^2 cable.

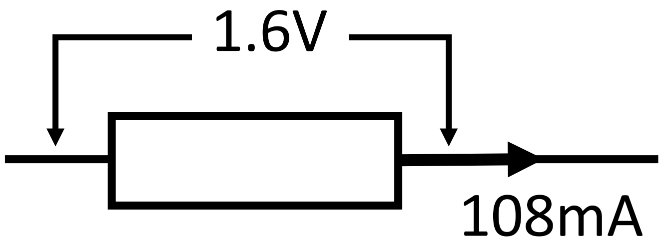
$R_{cu} = 1.724 \times 10^{-8}$

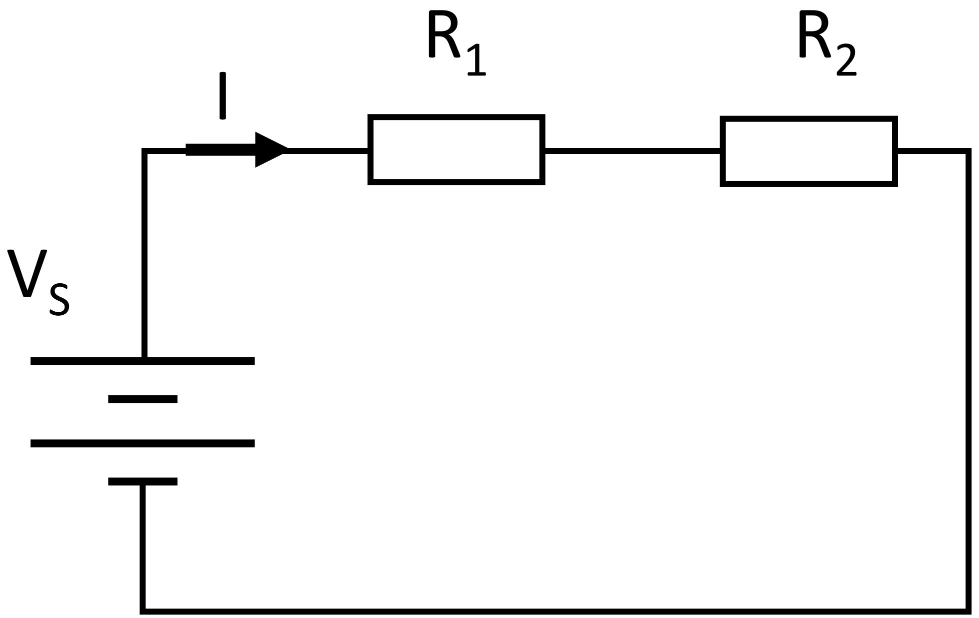

1/8 Watt Resistors
¼ Watt Resistors
½ Watt Rersistors
1 Watt Resistors
2 Watt Resistors
5W 22ΩJ
5 Watt Resistor


59V
220 Ω


3.6V
628mA


28mA
5k6 Ω


1.6V
108mA



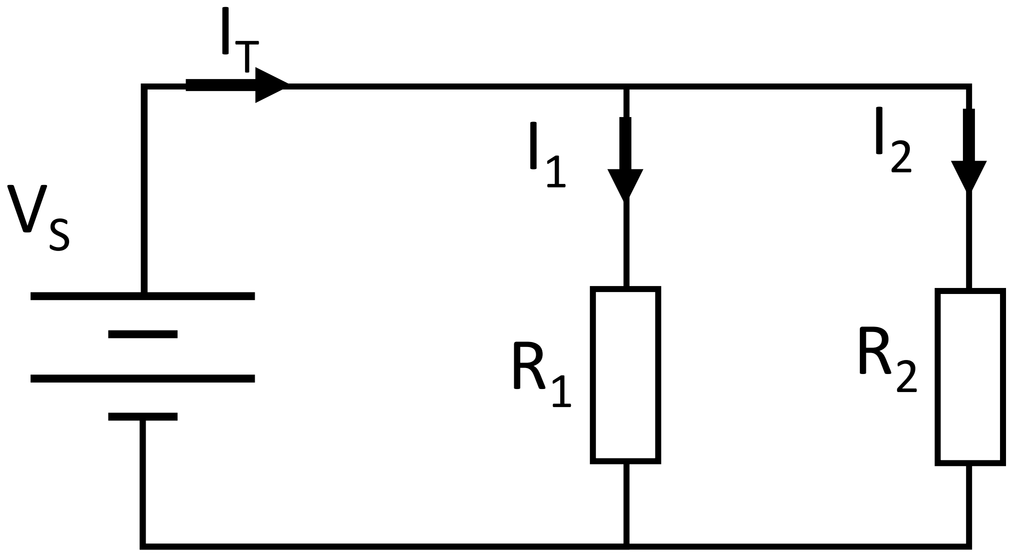
$$R_T = R_1 + R_2$$

$$I = \frac{V_S}{R_T}$$

$$V_1 = IR_1 \qquad V_2 = IR_2$$

$$V_T = V_1 + V_2$$

$$P_1 = IV_1 \qquad P_2 = IV_2$$



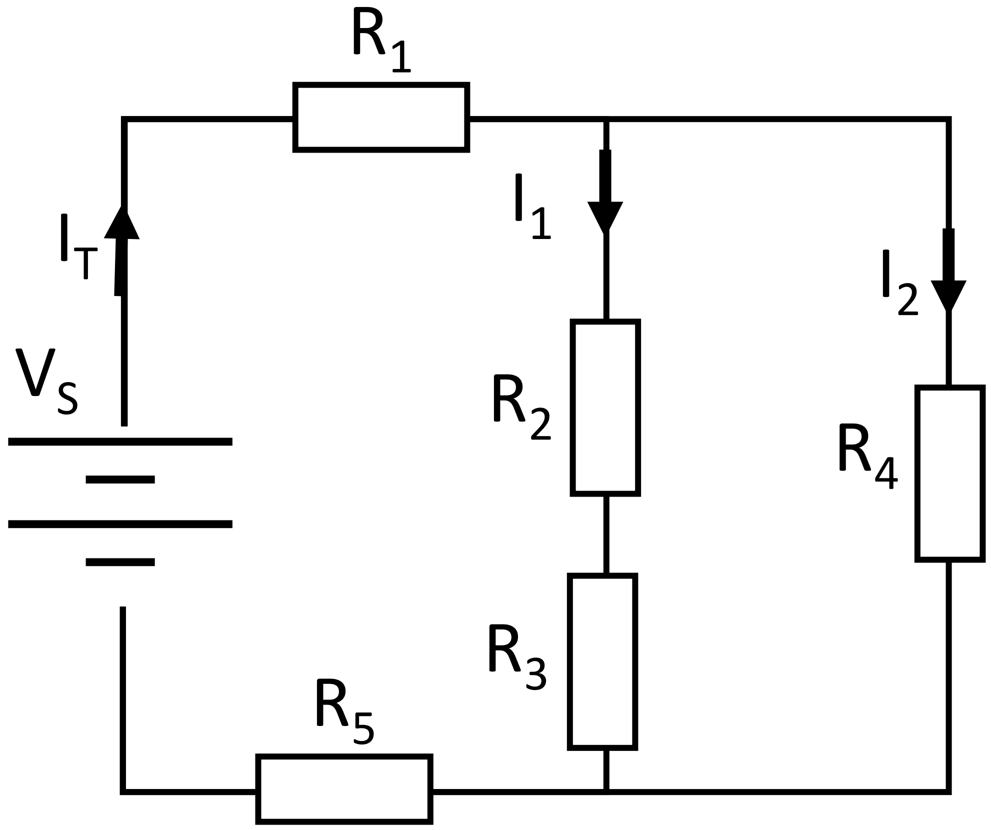
$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$I_T = \frac{V_S}{R_T}$$

$$I_1 = \frac{V_S}{R_1} \qquad I_2 = \frac{V_S}{R_2}$$

$$P_1 = I_1 V_S \qquad P_2 = I_2 V_S$$

$$I_T = I_1 + I_2$$


R1
I1
IT
I2
VS
R2
R4
R3
R5

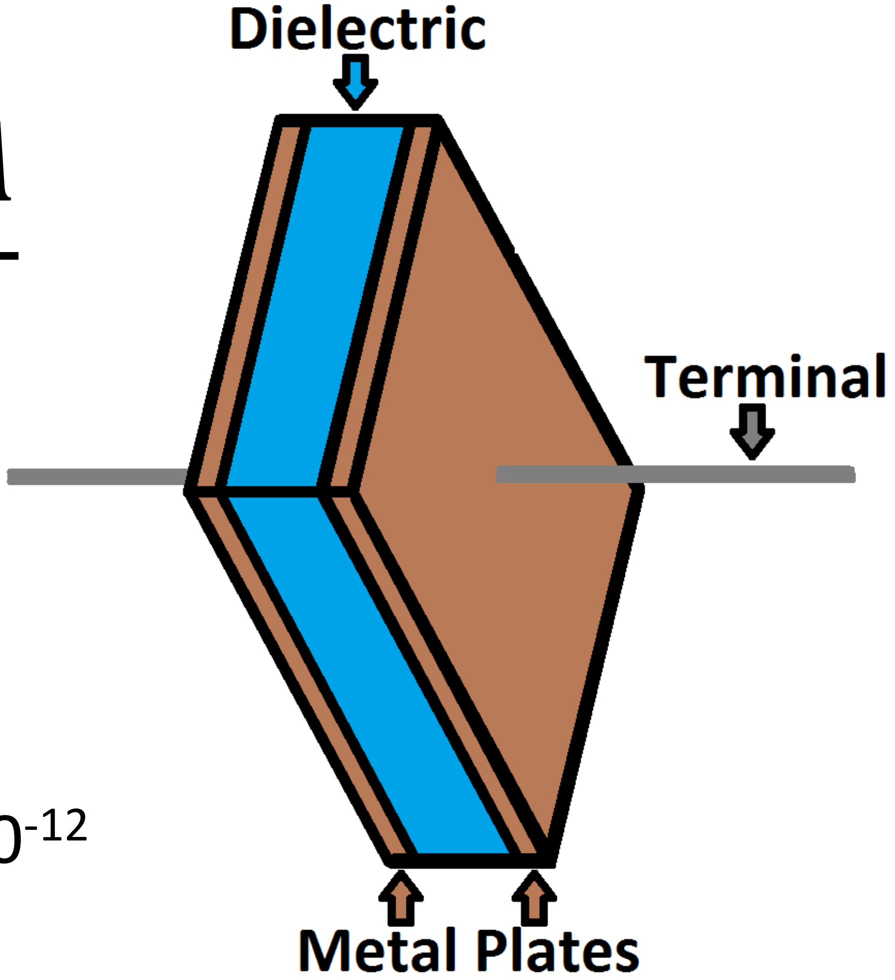
Capacitors

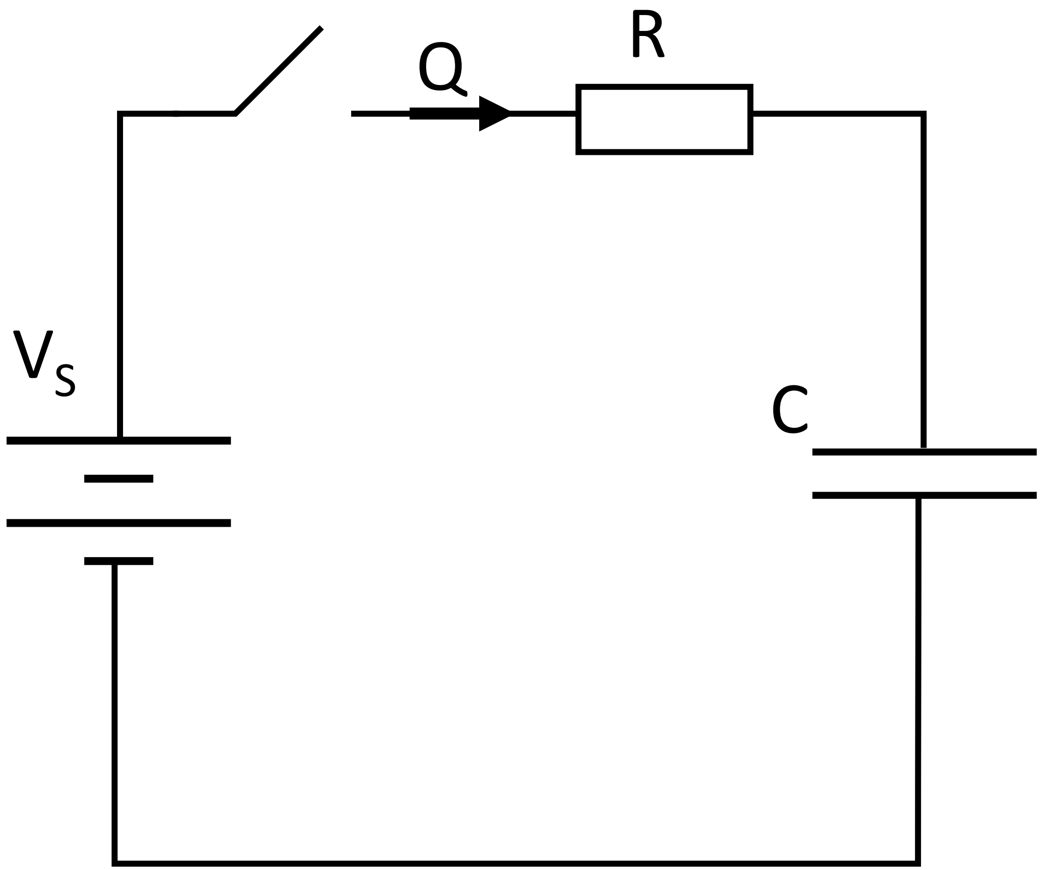

nichicon
4700μF 35V
100μF 16V
SPRAGUE
VITAMIN Q
T.M.REG.U.S.PAT.OFF.
CAPACITOR
22 - 400 D.C.
35 V 470μF
189-505-5
193-10 8216
4.7μF 35V
103K
500V
561
10
7
151
15
22μF 35V

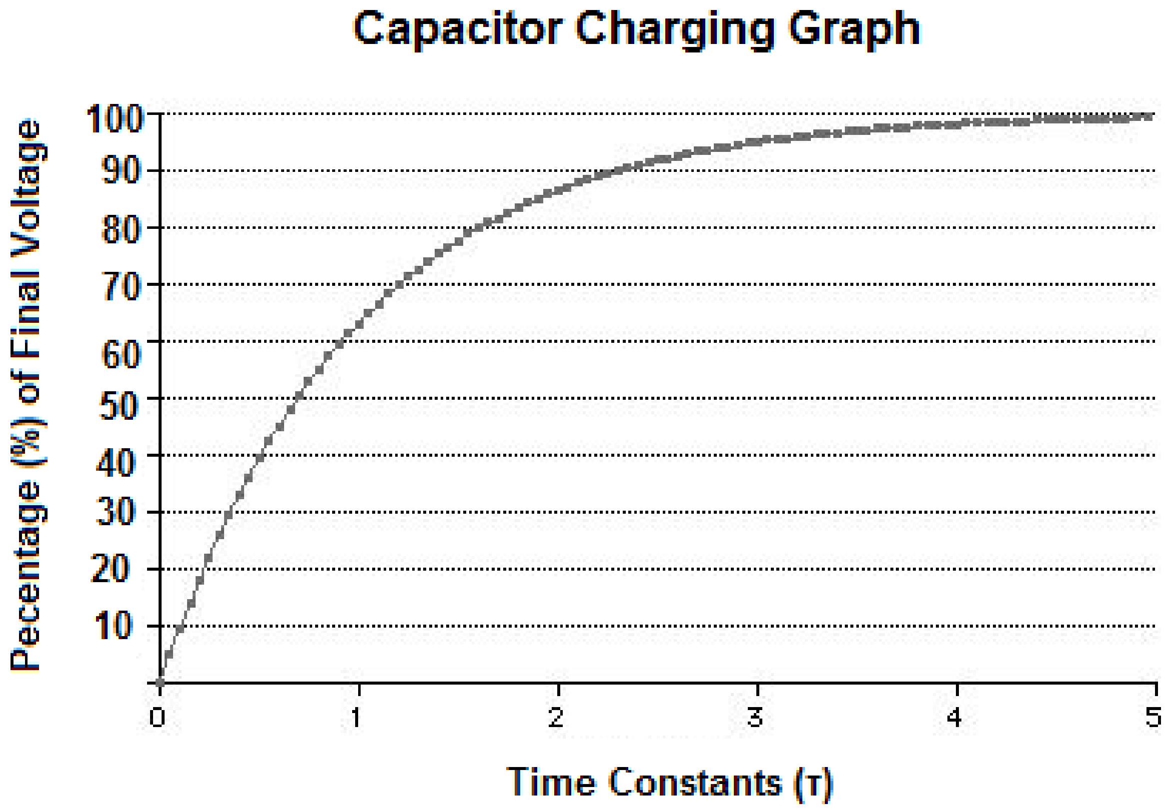
Capacitor Type	Dielectric	Relative permittivity
Ceramic Class 1	Paraelectric (titanium dioxide)	12-90
Ceramic Class 2	Ferroelectric (barium titanate)	200-14,000
Film	Polypropylene (PP)	2.2
Film	Polyethylene terephthalate (PET)	3.3
Film	Polyphenylene sulfide (PPS)	3.0
Film	Polyethylene naphthalate (PEN)	3.0
Film	Polytetrafluoroethylene (PTFE)	2.0
Paper	Waxed paper	3.5-6.0
Aluminum electrolytic	Aluminum oxide	9.6
Tantalum electrolytic	Tantalum pentoxide	26
Niobium electrolytic	Niobium pentoxide	42
Glass	Glass	3.7-10
Mica	Mica	5-8

$$C = \frac{\varepsilon_0 \varepsilon_r A}{d}$$

$\varepsilon_0 = 8.85 \times 10^{-12}$




Q
R
V_S
C


Capacitor Charging Graph
Pecentage (%) of Final Voltage
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
Time Constants (τ)

$$E = \frac{CV^2}{2}$$

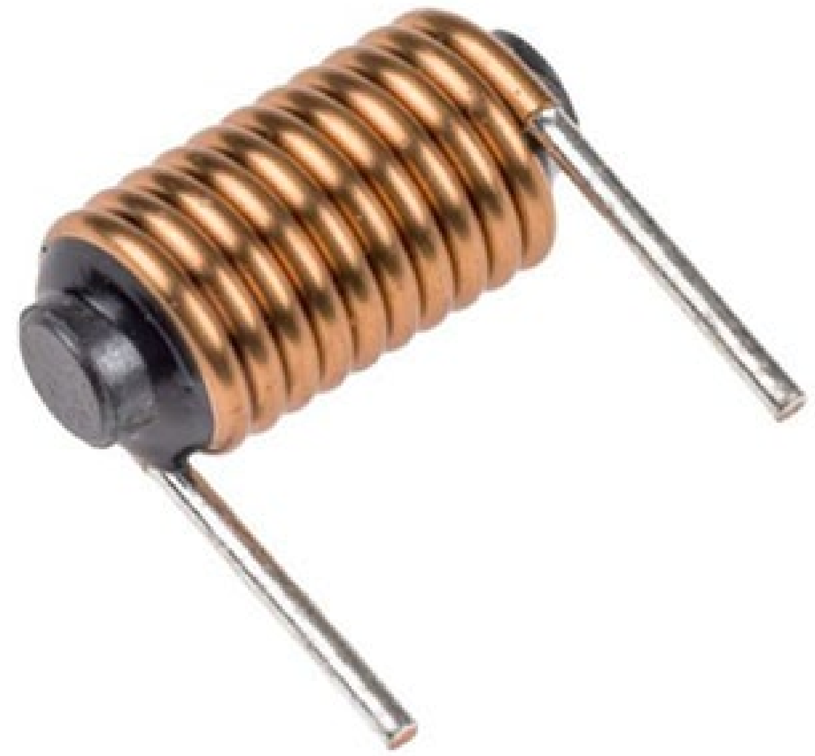
So how much energy could this capacitor have?

Inductors

$$L = \frac{N^2 \mu_0 \mu_r A}{l}$$

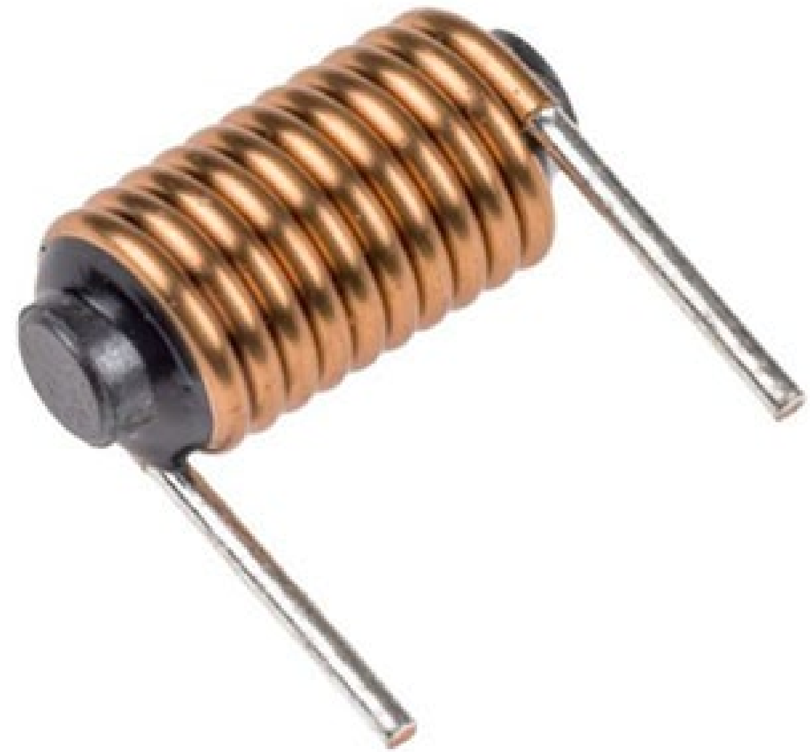
$\mu_0 = 4\pi \times 10^{-7}$

Material	μ_r
Vacuum	1
Air	1.00000037
Copper	0.999994
Aluminum	1.000022
Carbon steel	100
Iron (99.8% pure)	5000
Permalloy	100000

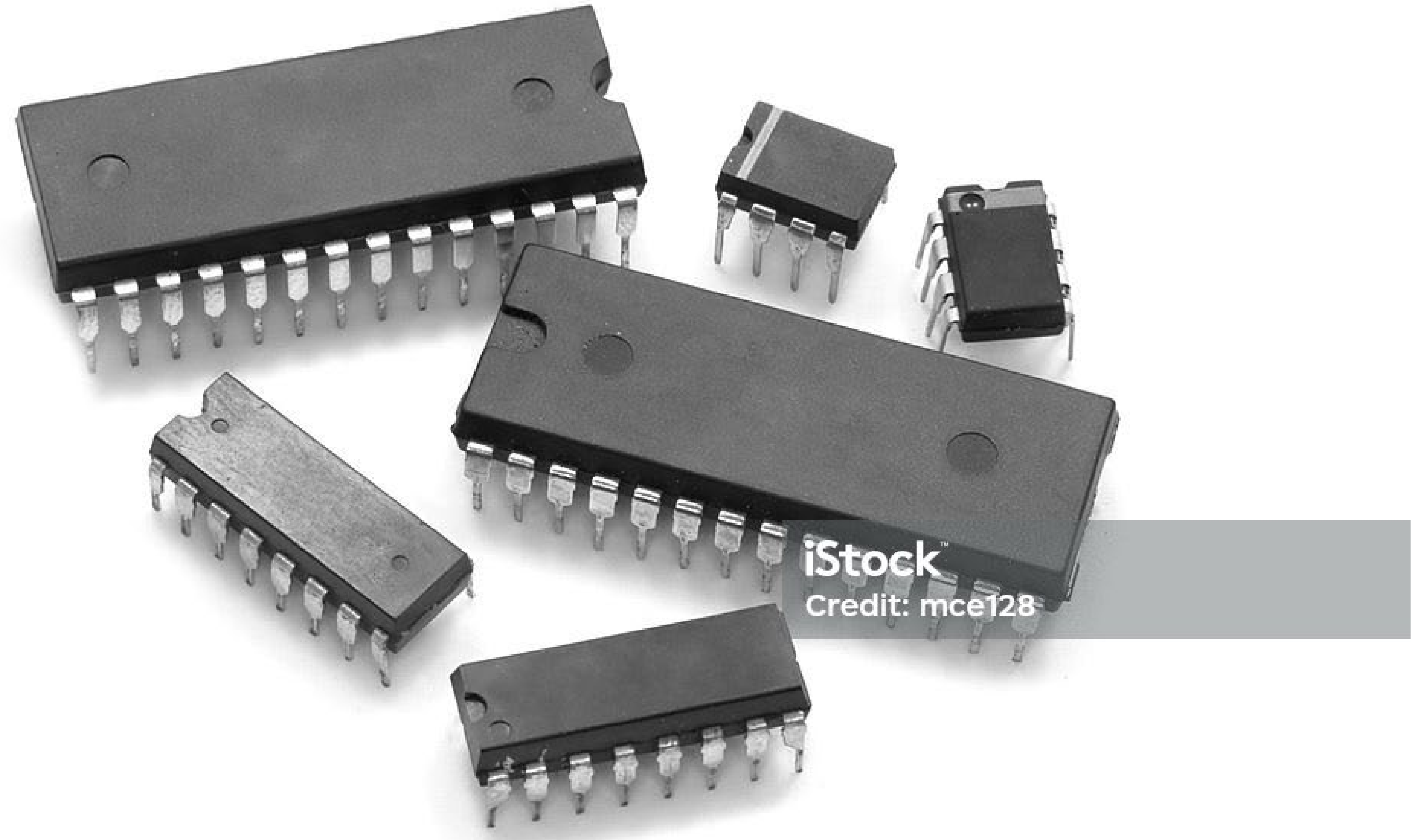


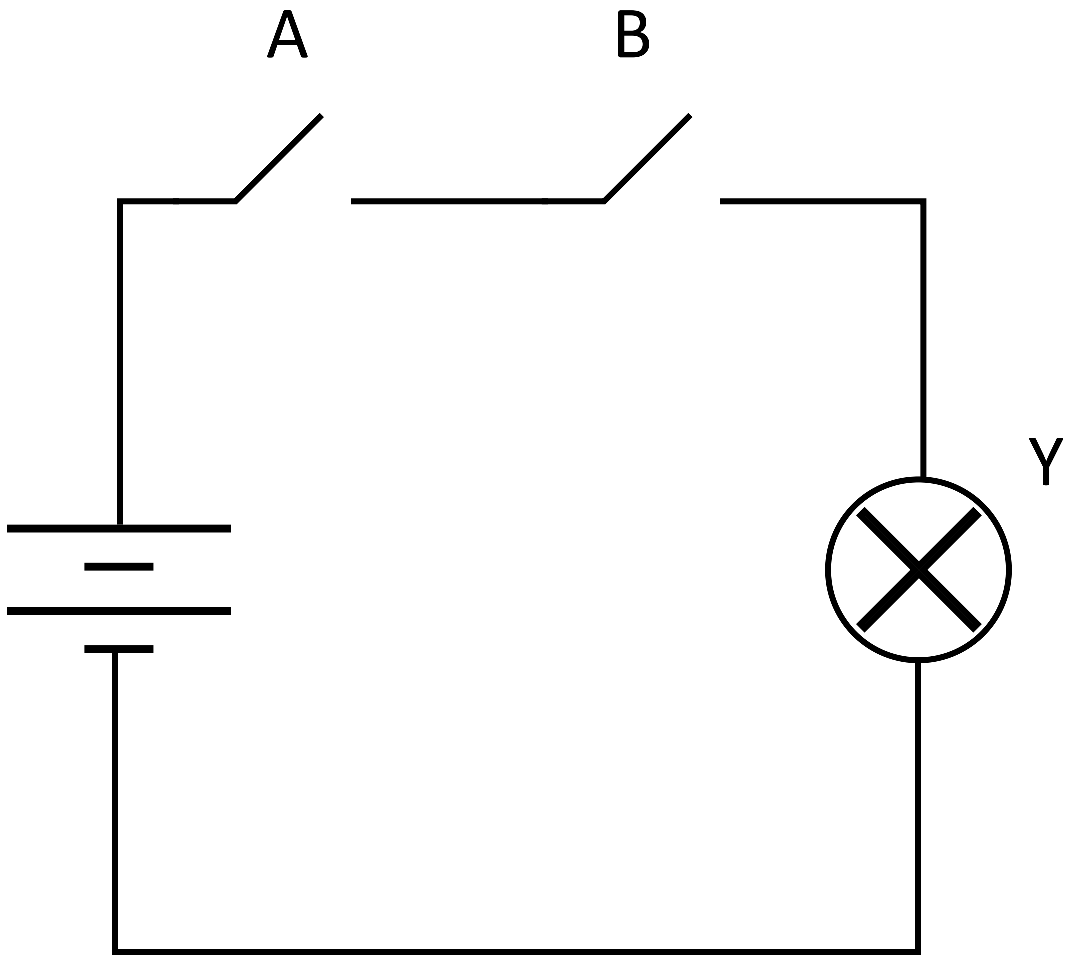
Inductors

$$E = \frac{LI^2}{2}$$



IC’s and Logic gates

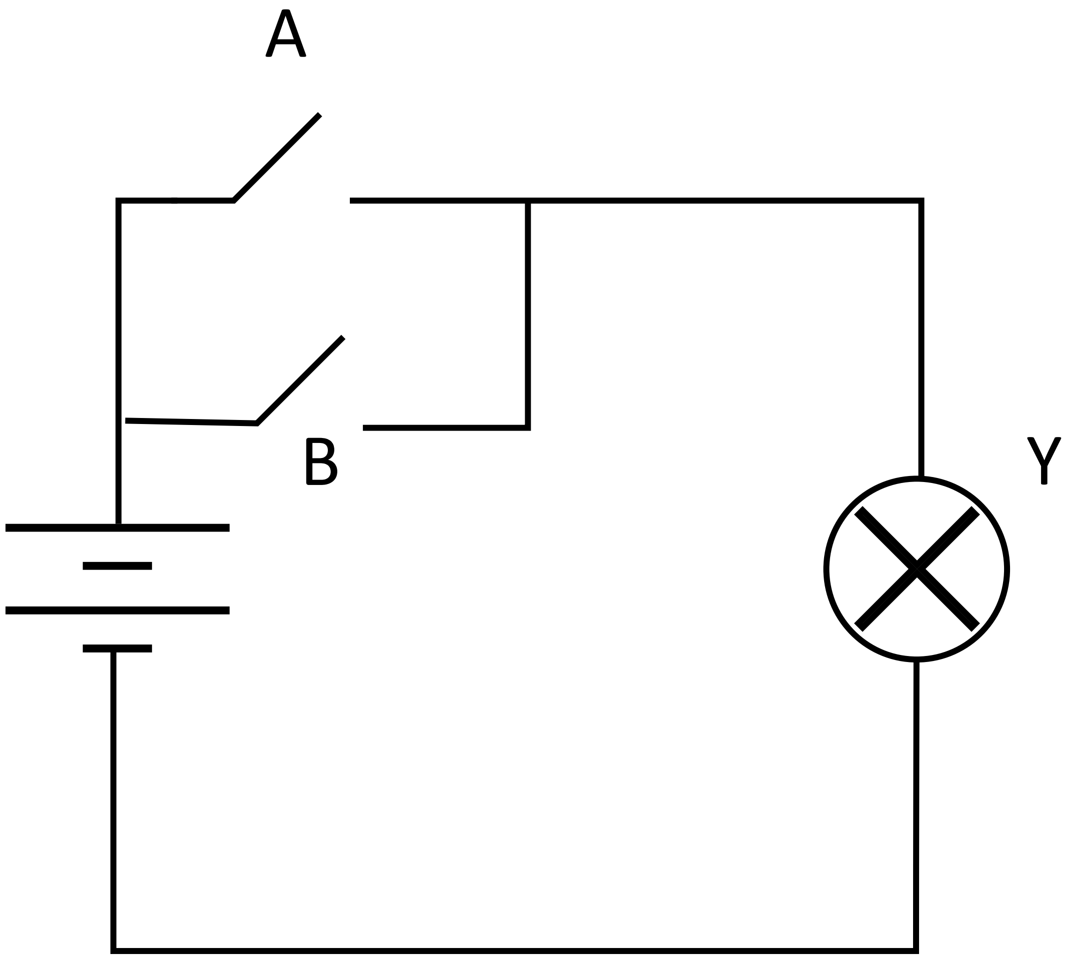




Logic

AND

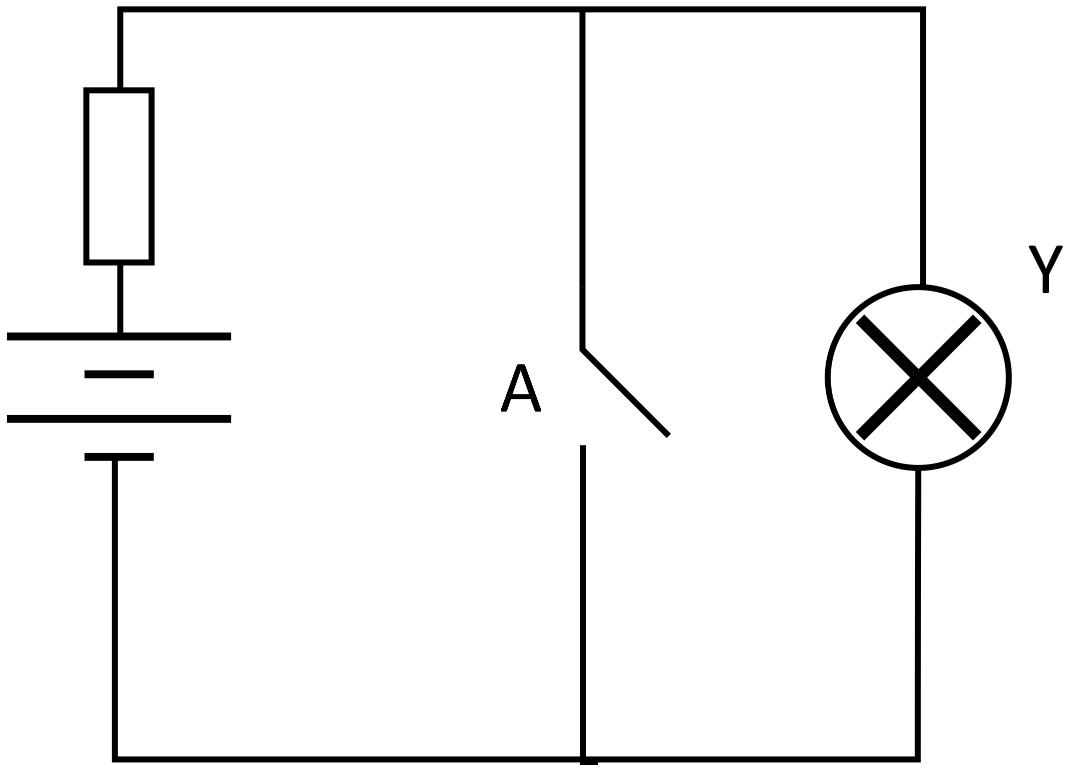
A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1



Logic

OR

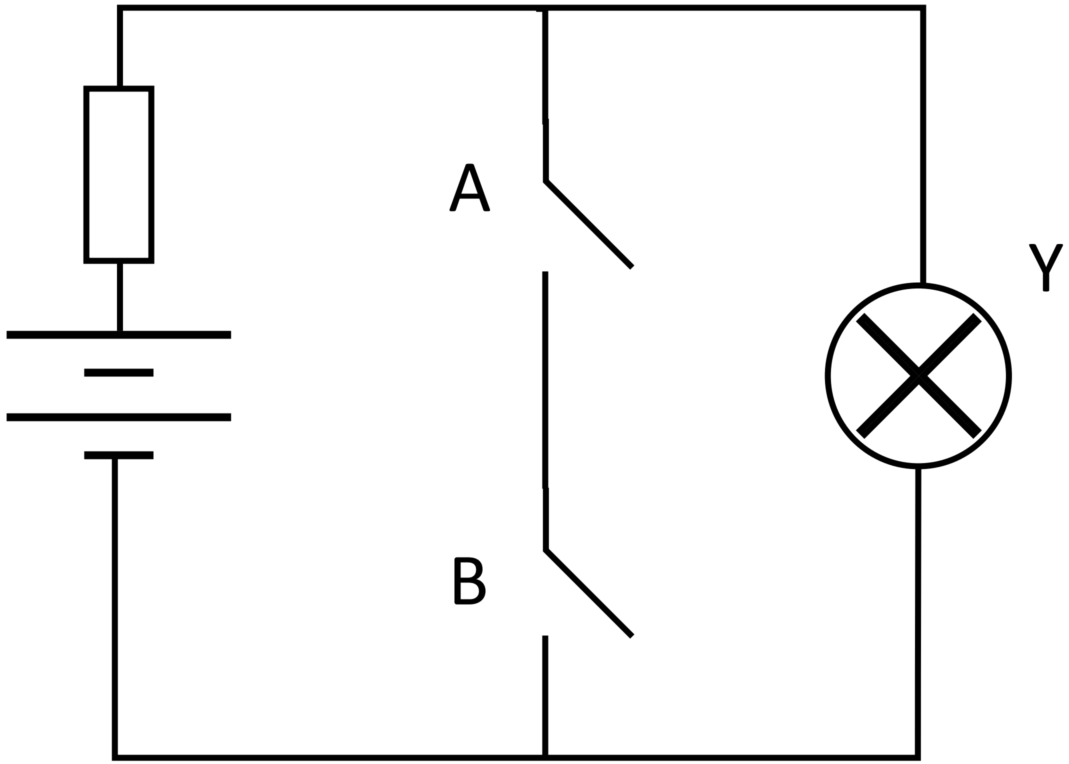
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1



Logic

NOT

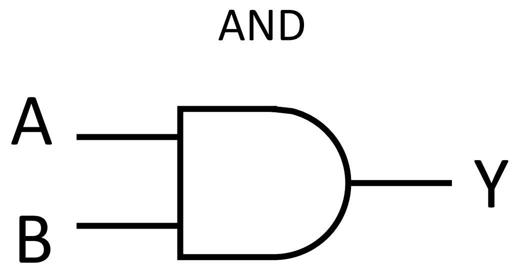
A	**Y**
0	1
1	0

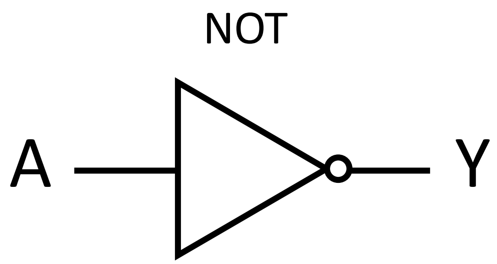


Logic

NAND

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

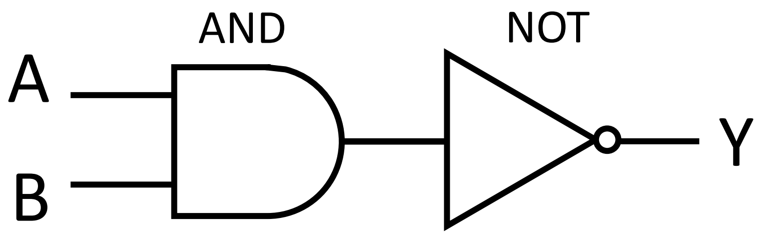


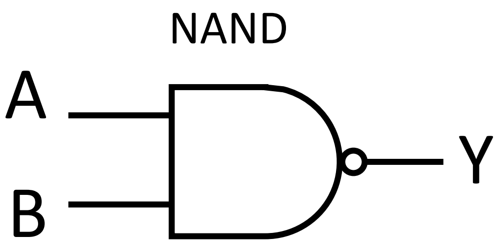


Logic

NAND

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0





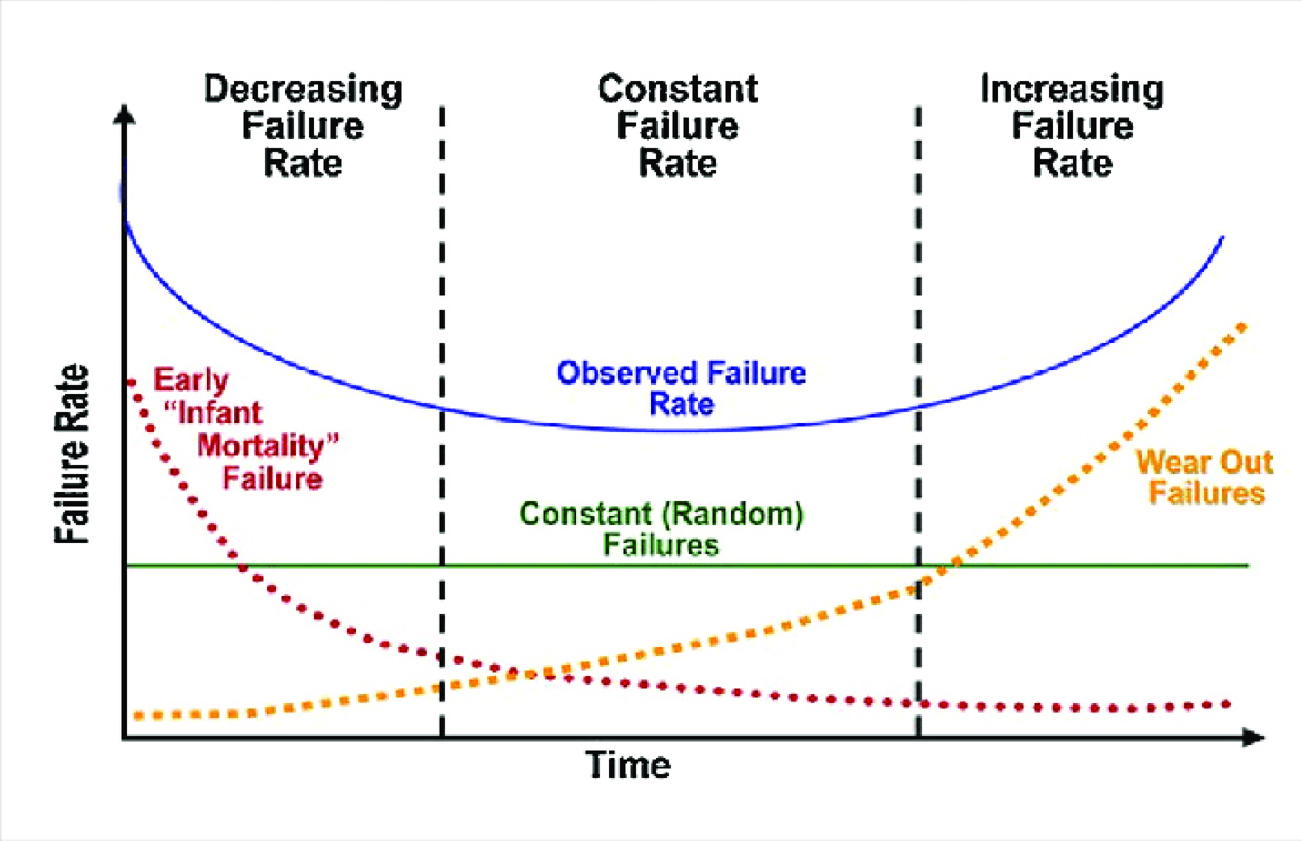
Faults in electronic equipment

Failures can be caused by;

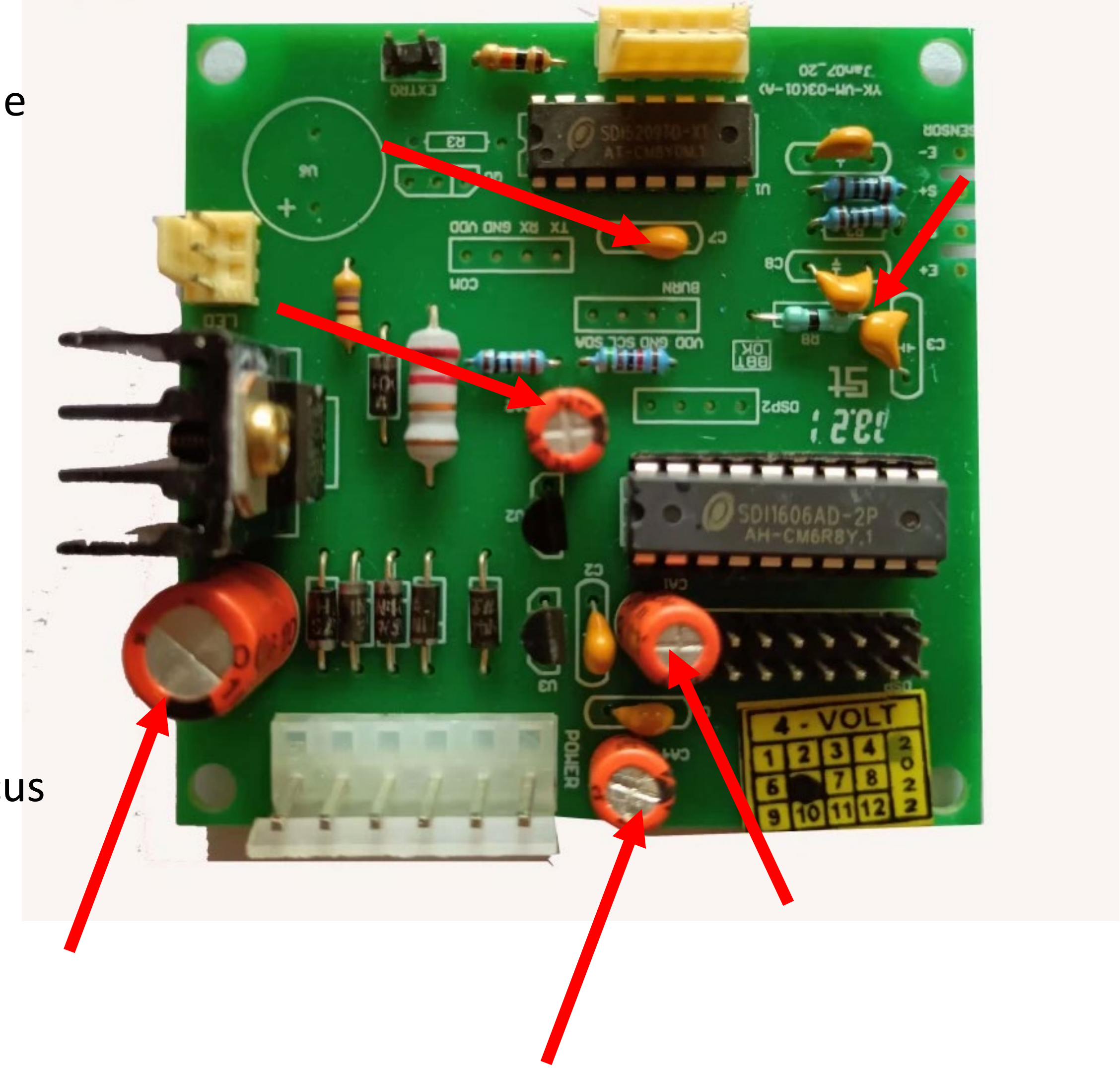
- excess temperature,
- excess current or voltage,
- ionizing radiation,
- mechanical shock, stress or impact, and many other causes.

In semiconductor devices, problems in the device package may cause failures due to;

- contamination,
- mechanical stress of the device, or
- open or short circuits or
- electrostatic discharge (ESD)



Capacitor Failure



Failures caused by capacitor damage are the highest among electronic devices, and damage to electrolytic capacitors is the most common.

Capacitor damage is manifested as: the capacity becomes smaller, the capacity is completely lost, the leakage, and the short circuit.

The life of a capacitor is directly related to the ambient temperature. **The higher the ambient temperature, the shorter the life of the capacitor.** This rule applies not only to electrolytic capacitors, but also to other capacitors.

Therefore, when looking for a faulty capacitor, you should focus on **checking the capacitors that are close to the heat source**, such as the capacitors next to the heat sink and high-power components.

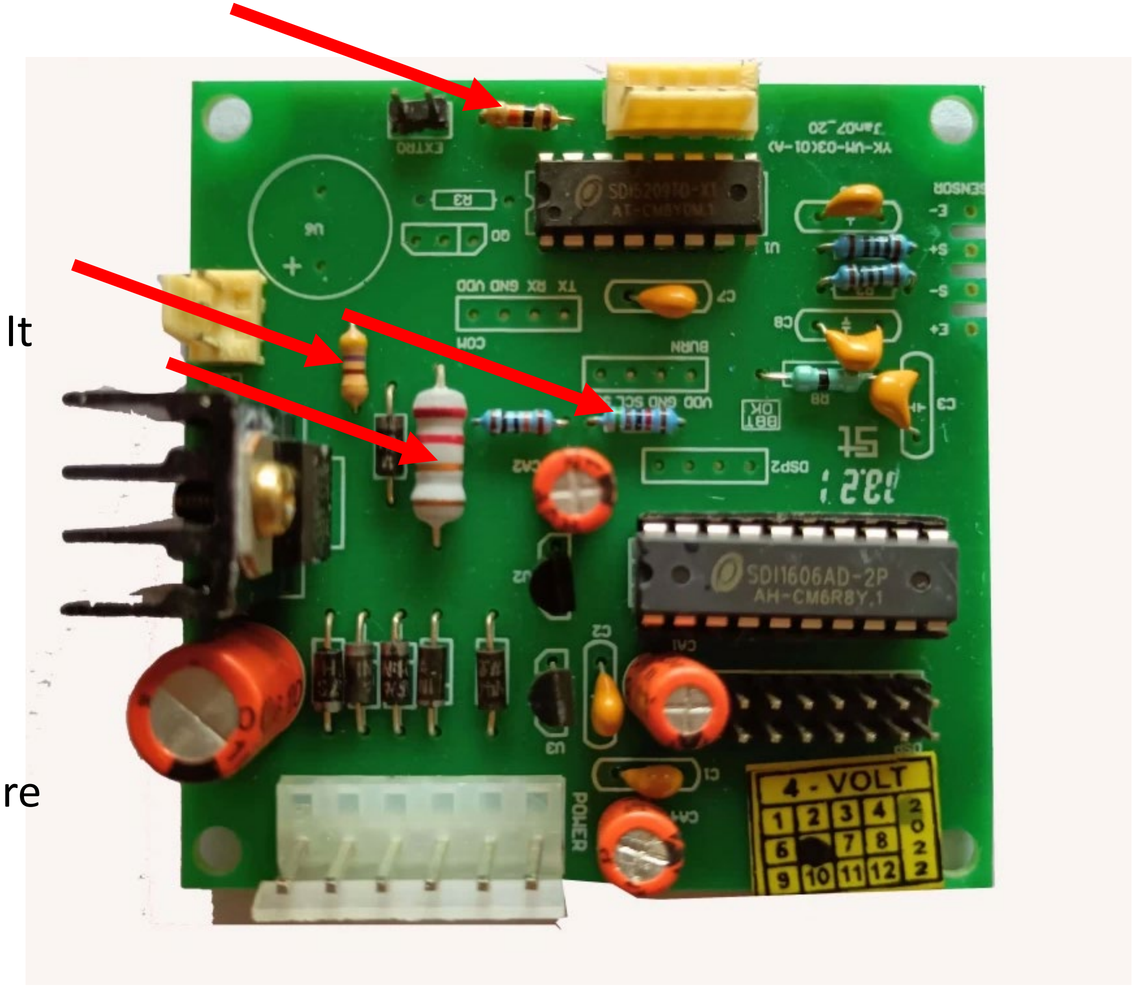
Using electronics in a cool, dry environment can prevent damage from excessive heat and humidity.

Resistor Failure

Resistance is the most numerous component in electrical equipment, but it is not the component with the highest damage rate.

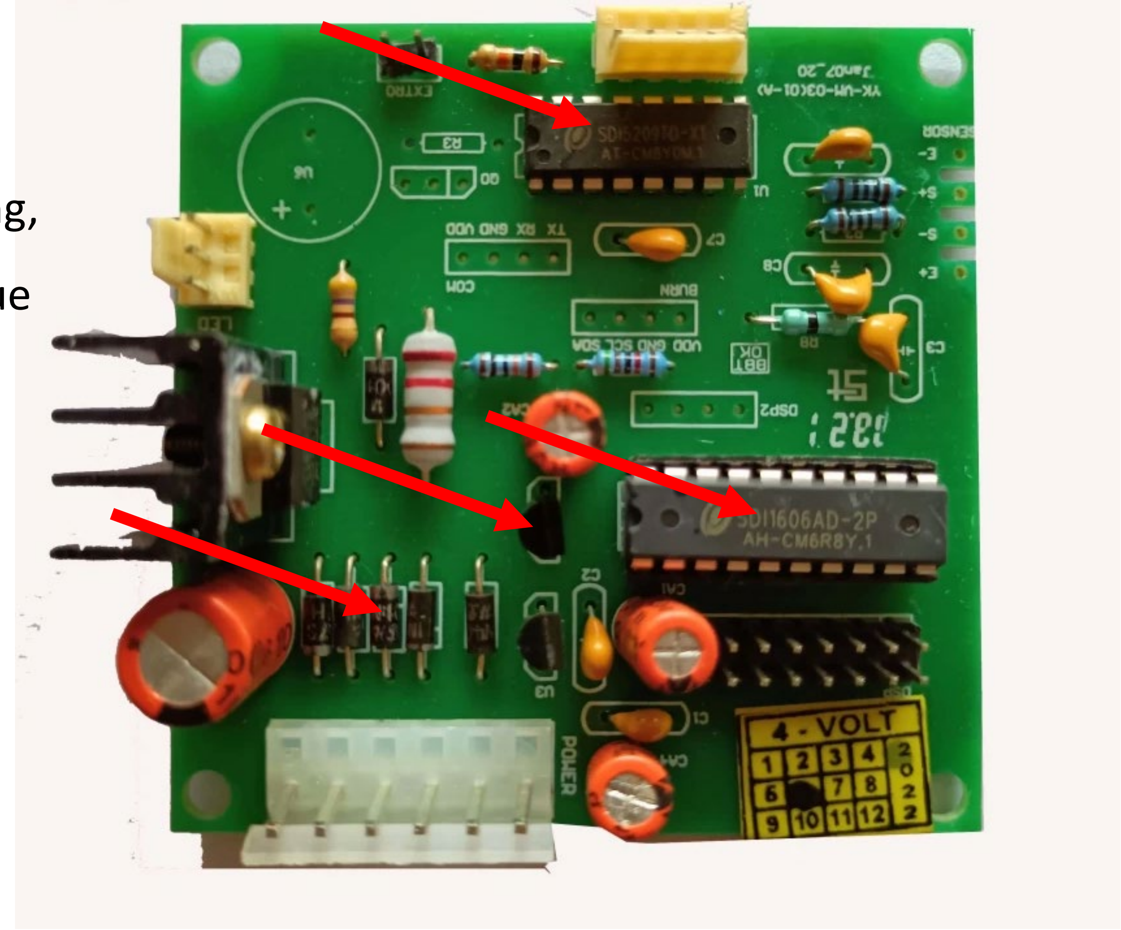
Open circuit is the most common type of resistance damage. It is rare that the resistance value becomes larger, and the resistance value becomes smaller.

According to the characteristics listed above, we can first observe whether the low-resistance resistors on the circuit board have burnt black marks, and then according to the characteristics that most of the resistors are open or the resistance becomes larger, and the high-resistance resistors are easily damaged.



Semiconductor Failure

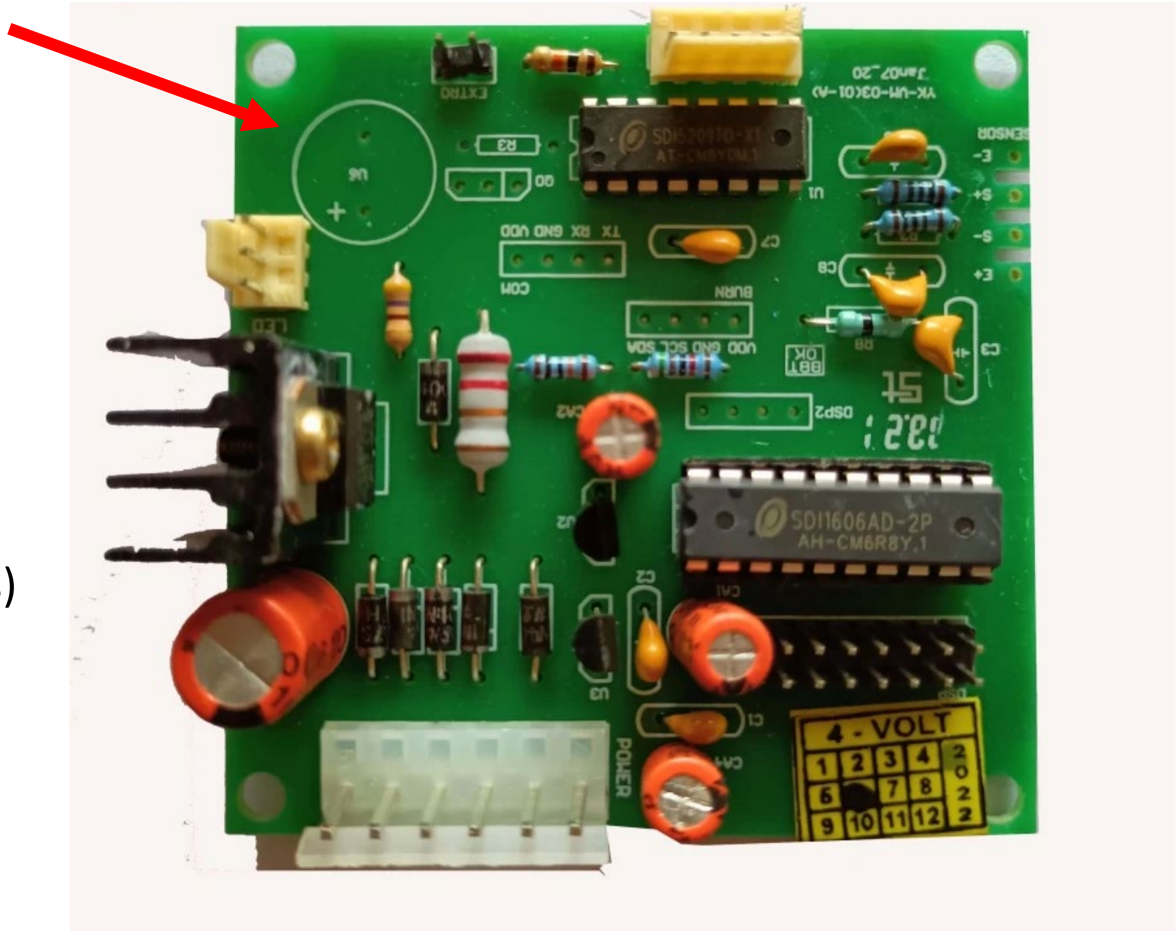
- Cracking of encapsulation due to thermal overstress
- Penetration of moisture, flux contaminants during soldering, washing of boards, storage under humid conditions, etc.due to seal integrity problems.
- Mechanical stress cracks due to differential thermal expansion of plastic encapsulant, metal leads, die.
- Design and fabrication faults, misalignment of layers, geometric Changes in threshold voltage/current characteristics with change of temperature.



PCB Failure

Here are the most common causes of PCB failures:

- Defects
- Burnt components (a type of defect)
- Environmental factors like heat and humidity
- Warping/twisting
- Soldering issues (short/open ccts, lifting pads, dry joints)
- Human error
- Old age

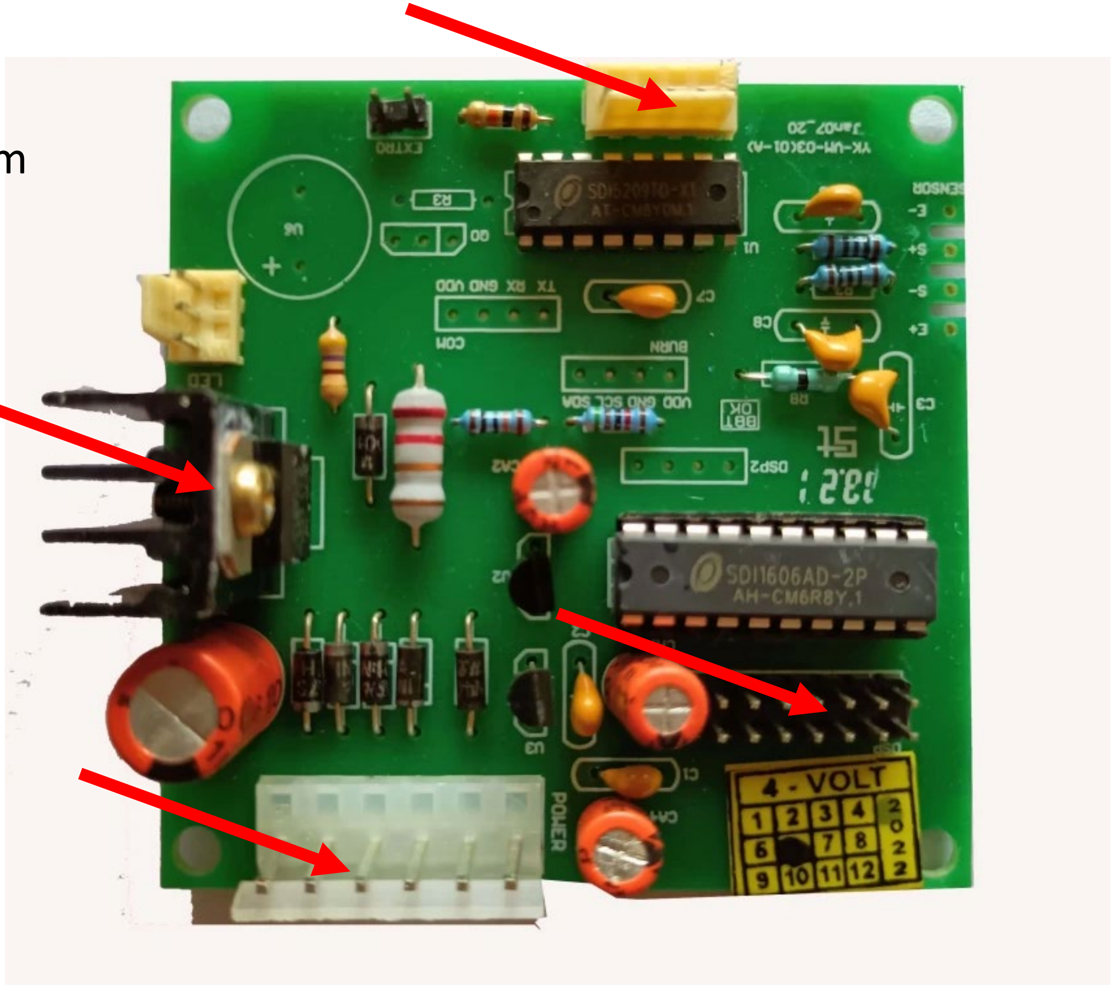


Other component failures

Terminals that get pressure as connectors are forced onto them

Heatsinks not properly bolted to the semiconductor and so does not allow heat to dissipate.

Relays that are constantly used and have carbonized contacts



Analyse Faults

There are techniques used to detect and analyze faults.

Visual inspection

The first step in fault detection is to visually inspect the circuit for any obvious signs of damage, wear, or improper connections. You should look for things like broken wires, loose or corroded terminals, burned or cracked components, solder bridges, or foreign objects. You should also check the polarity and orientation of components, such as diodes, transistors, or ICs.

Multimeter testing

The next step in fault detection is to use a multimeter to measure the voltage, current, or resistance of the circuit or its components. A multimeter is a handy tool that can help you verify the power supply, check the continuity of wires and traces, or find short circuits or open circuits.

Oscilloscope analysis

The third step in fault detection is to use an oscilloscope to observe the waveform of the signals in the circuit. An oscilloscope is a device that can display the voltage and time of a signal on a screen, allowing you to see its shape, frequency, amplitude, phase, or distortion. You can use an oscilloscope to compare the input and output signals of a circuit or a component, or to find noise, glitches, or anomalies in the signals.

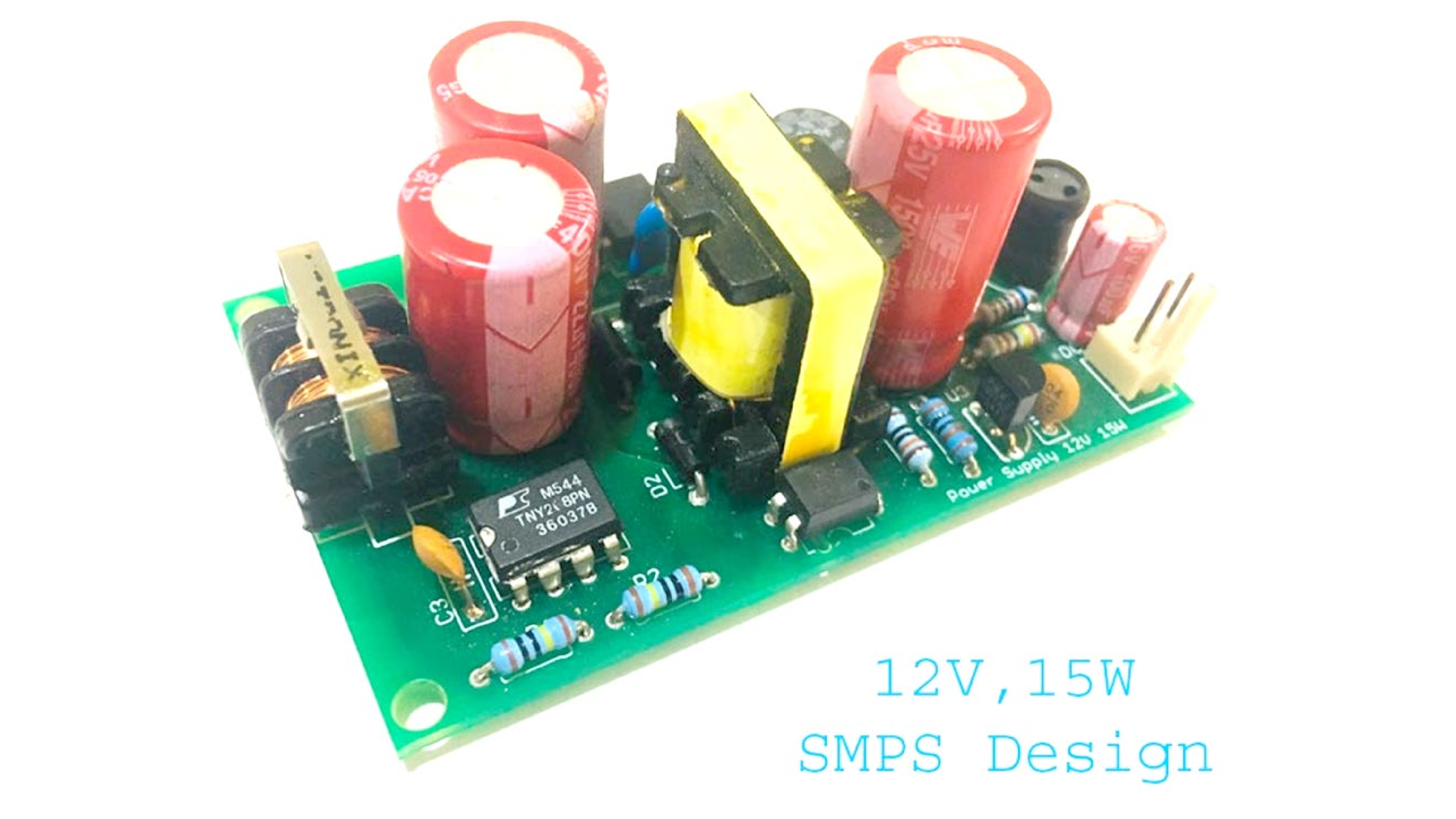
Logical troubleshooting

The final step in fault detection is to use logical troubleshooting to isolate and identify the cause of the fault.

Logical troubleshooting is a process of applying your knowledge of the circuit's function, design, and behavior to narrow down the possible sources of the fault.

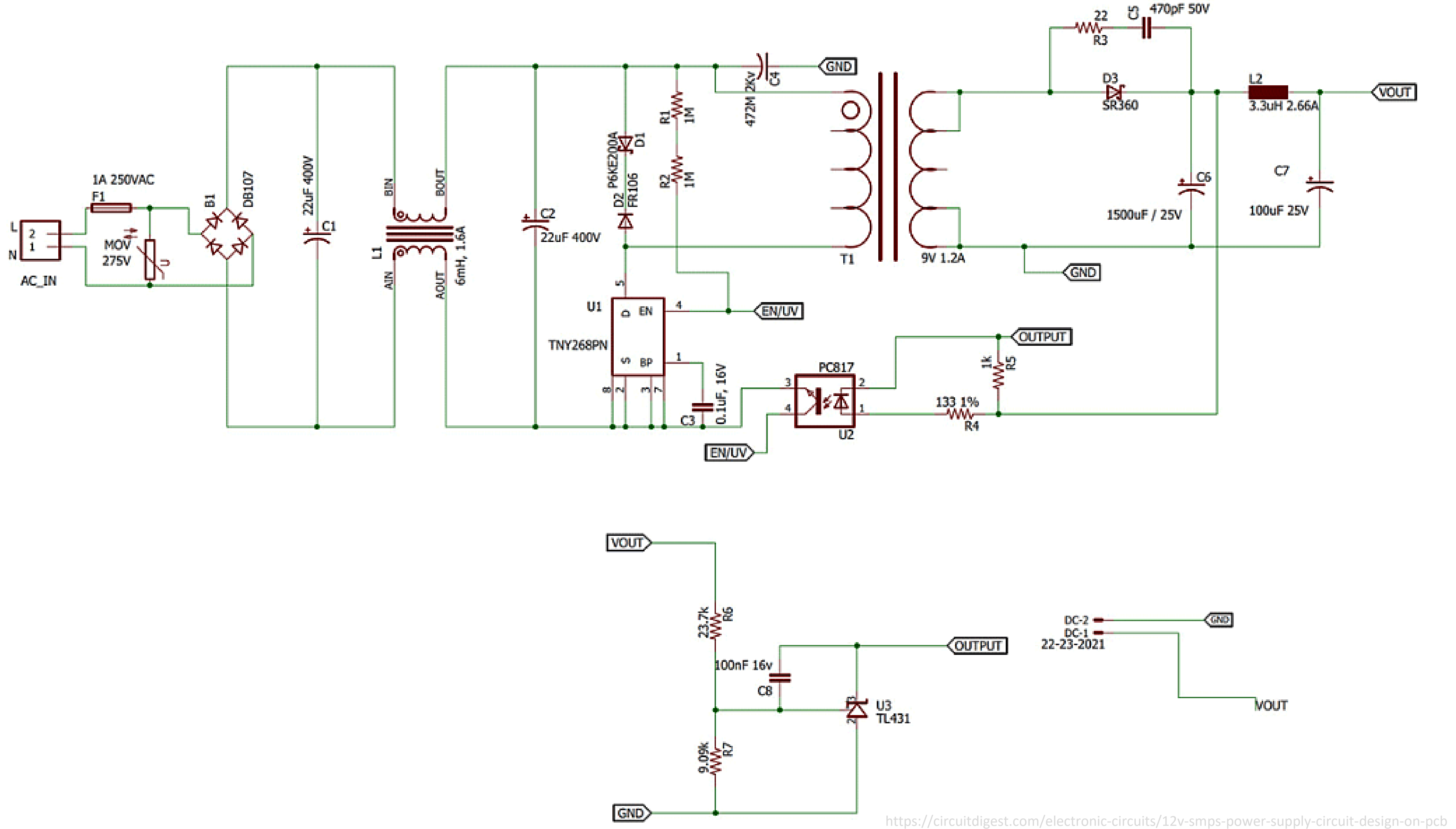
You can use a divide-and-conquer approach, where you split the circuit into smaller sections and test each one separately, or a hypothesis-and-test approach, where you formulate a possible explanation for the fault and verify it with experiments.

You can also use schematics, datasheets, or manuals to help you understand the circuit and its components.



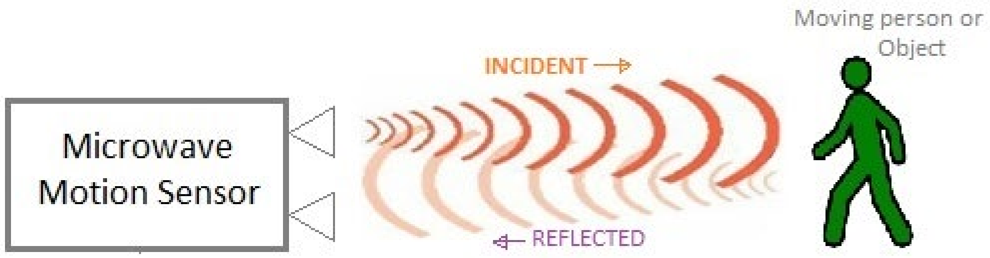
M544
36037B
D2
C3
Power Supply 12V 15W
12V,15W
SMPS Design

OFFICIAL



OFFICIAL

ALARM SYSTEM COMPONENTS
-Sensors



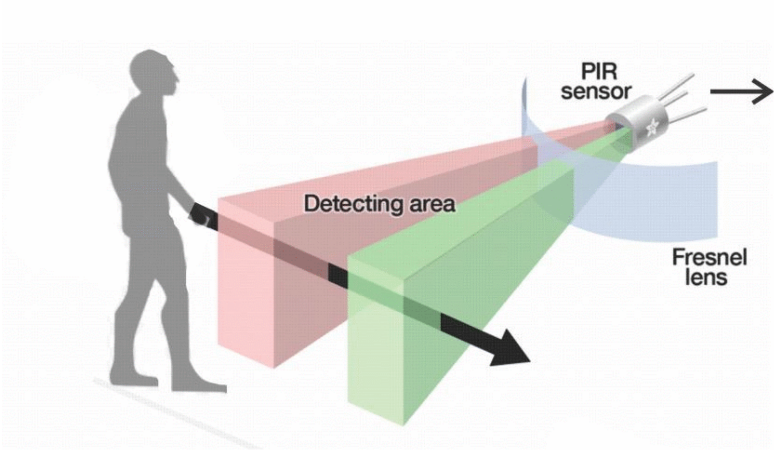
MICROWAVE

These motion detectors emit microwave signals and measure the time taken for the signal to be reflected back to the sensor, this is known as the echo time. The echo time is used to calculate the distances from all the stationary objects in the detection zone, to establish a baseline to work from.

A person moving into the detection zone causes a disruption in the microwave beam, changing the echo time and triggering the lights.

PIR

These sensors detect heat. They do this by measuring the ambient temperature of the room using several detection beams.



When a difference in temperature is detected by one of the beams, the sensor is activated, switching on the lights.

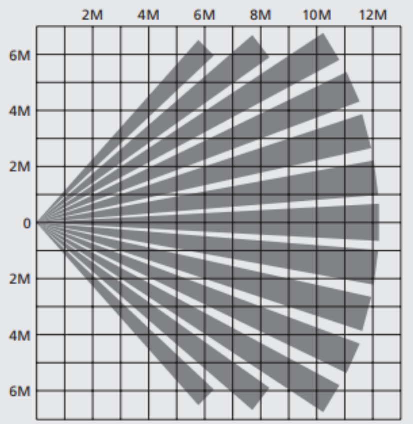
When all the beams sense the same temperature again, the lights will switch off.

ALARM SYSTEM COMPONENTS -PIR Sensors

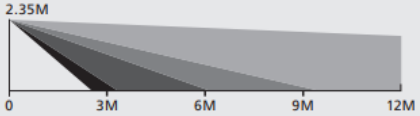
LOCATING THE MOTION DETECTORS

Your detectors have been preset to Normal Setting (fast) – covering a plan area of approximately 12 metres x 12 metres. If you have pets in the house while the alarm is on, refer to page 24 to set the detectors to a Pet Friendly Setting (slow). Pet coverage is approximately 10.5 metres x 10.5 metres.

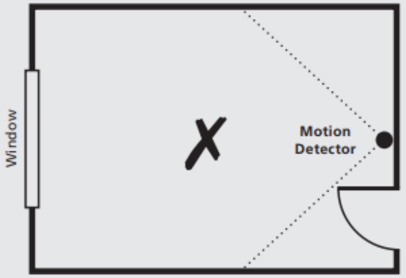
TOP VIEW *Fig. 2*



SIDE VIEW *Fig. 3*

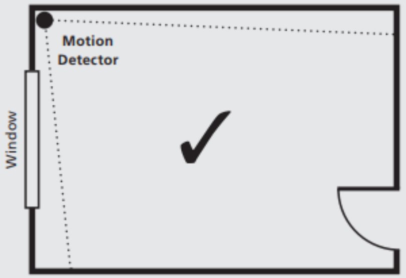


WRONG *Fig. 4*

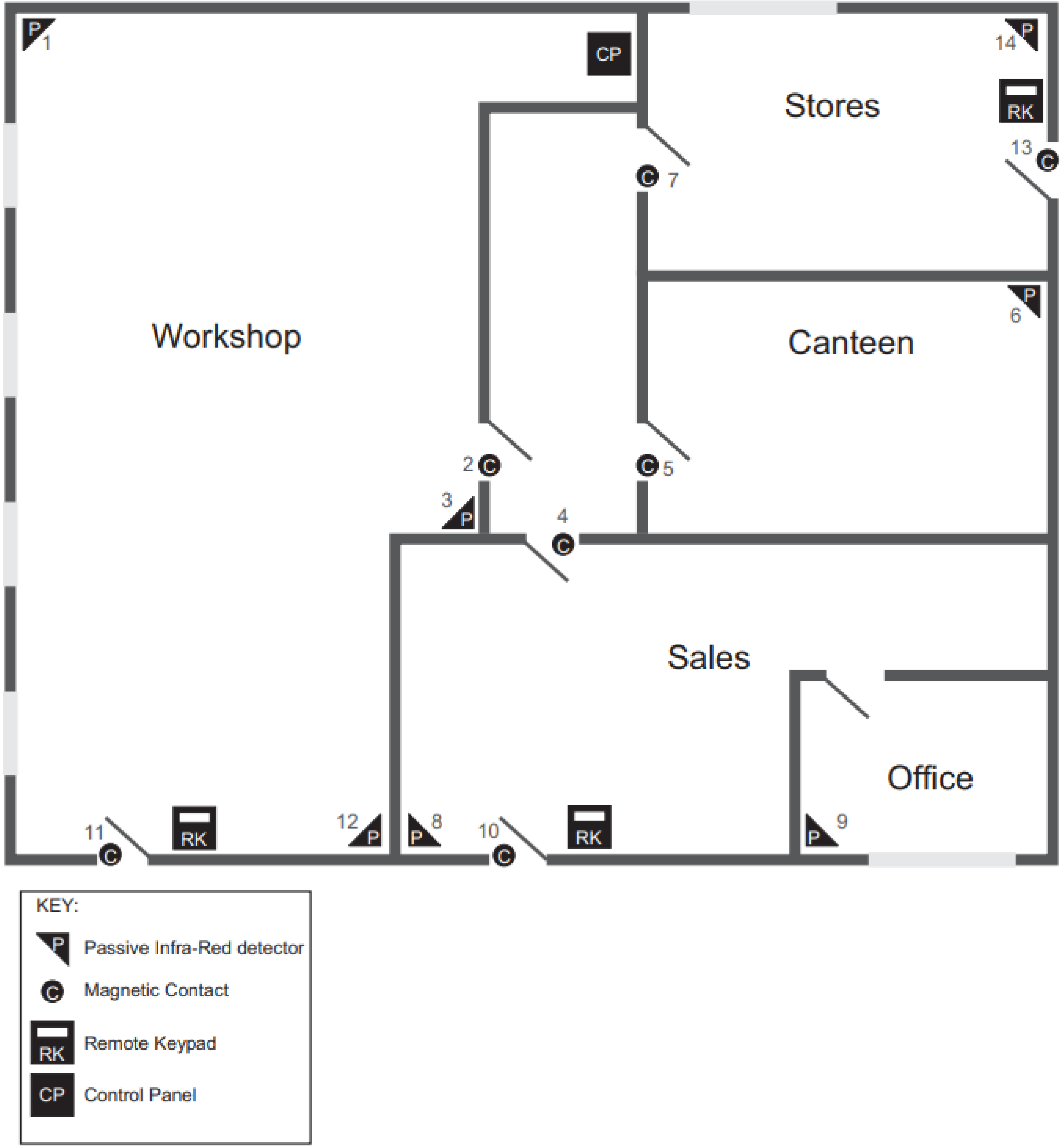


Do not locate detectors opposite windows and in middle of rooms. Reflective surfaces can cause false alarms.

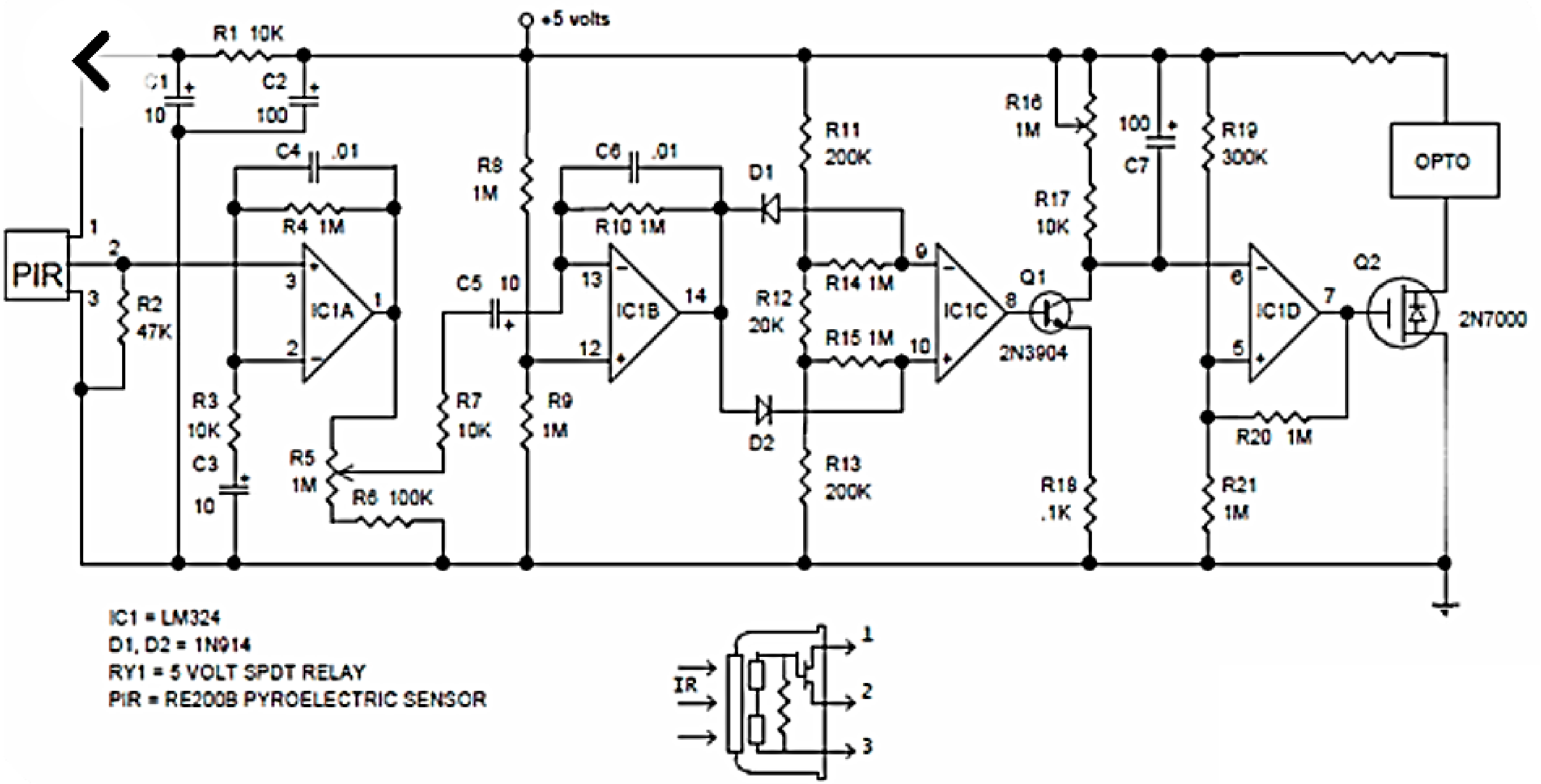
RIGHT *Fig. 5*



Locate detectors diagonally opposite doors and in corner of room.



PIR Sensors


+5 volts
R1 10K
C1 10
C2 100
C4 .01
R4 1M
PIR
R2 47K
IC1A
R3 10K
C3 10
R5 1M
R6 100K
C5 10
R7 10K
R8 1M
R9 1M
C6 .01
R10 1M
IC1B
D1
D2
R11 200K
R12 20K
R13 200K
R14 1M
R15 1M
IC1C
Q1
2N3904
R16 1M
R17 10K
R18 .1K
100
C7
R19 300K
IC1D
R20 1M
R21 1M
OPTO
Q2
2N7000
IC1 = LM324
D1, D2 = 1N914
RY1 = 5 VOLT SPDT RELAY
PIR = RE200B PYROELECTRIC SENSOR
IR