CROCODILE CLIPS

INSTALLATION

The demonstration Crocodile Clips software includes a number of circuits from this publication. To use these circuits (as well as a number of other examples) you must install the software to your computer hard-disk. To install the software (Windows or Mac versions) follow the instructions below. An Acorn version is not planned.

WINDOWS 3.1, 3.11

System Requirements:

386 processor or greater
2 MB RAM
0.7 MB of free hard-disk space

1. Insert the Crocodile Clips 'demo disk' into the floppy disk drive.
2. Choose **'Run'** from the **'File'** menu in the Program Manager.
3. Type **a:\setup** in the Run dialog box. (*If your floppy disk is known as drive 'b' type* b:\setup)
4. Click on **OK** in the Run dialog box.
5. Follow the instructions displayed on the screen, answering OK to the two message boxes that appear.

WINDOWS '95

System Requirements:

486 processor or greater
4 MB RAM
0.7 MB of free hard-disk space

1. Insert the Crocodile Clips 'demo disk' into the floppy disk drive.
2. If the taskbar is not visible press the 'Windows' key on the keyboard.
3. Click on the **Start** button and choose **'Run'**
4. Type **a:\setup** in the Run dialog box. (*If your floppy disk is known as drive 'b' type* b:\setup)
5. Click on **OK** in the Run dialog box.
6. Follow the instructions displayed on the screen, answering OK to the two message boxes that appear.

MAC

System Requirements:

68020/68030/68040 processor or
Power Macintosh
System 7.0 or later
4MB RAM (needs virtual memory on if less than 8M)
6.2MB of free hard-disk space

1. Insert the Crocodile Clips 'demo disk for Mac' into the floppy disk drive.
2. An icon labelled 'Disk1' will appear on the Macintosh desktop. If you can't see this icon you may have to resize or close other applications. It is a recommended that on machines with less than 8MB of RAM, you close other applications before installing Crocodile Clips.
3. Double click on the 'Disk1' Icon. A window will appear in the foreground, containing an Icon called 'Crocodile Clips Installer'.
4. Double click the Icon called 'Crocodile Clips Installer'.
5. Follow the instructions displayed on you screen.

DEMONSTRATION SOFTWARE

There are over 60 examples to try with the demonstration software, including a number of example circuits from this publication. You can also draw your own circuits using up to three symbols - see 'Computer Simulation'. You cannot print, save or copy any circuit. These restrictions DO NOT apply to the full version.

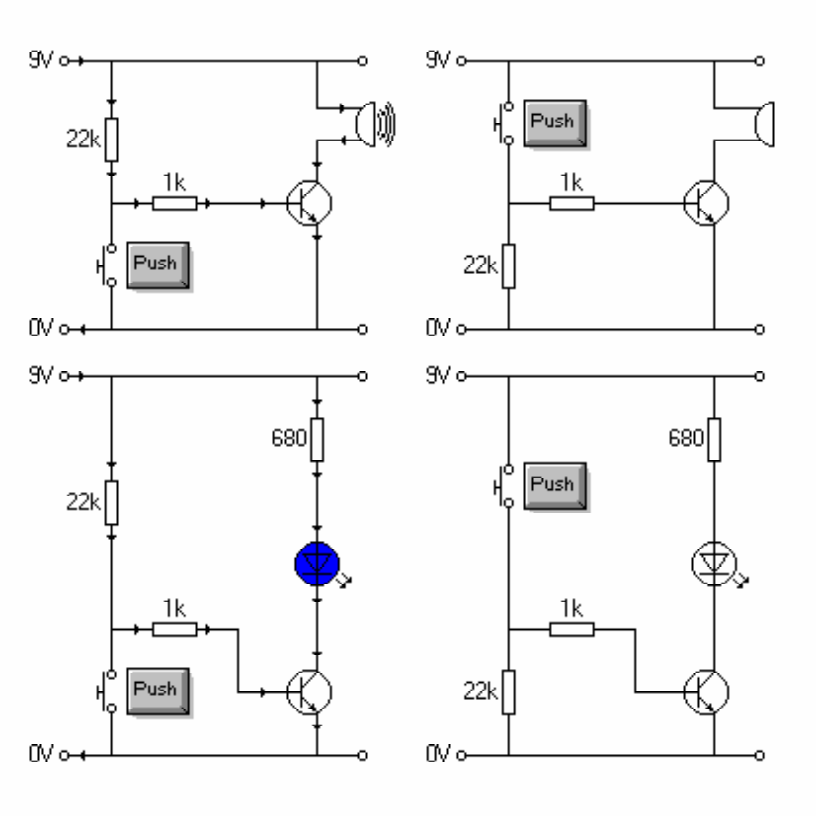
The six examples taken from this publication are:

tep001.ckt -	Moisture sensor circuits (uses switch to simulate sensor).
tep002.ckt -	Two thyristor switching circuits.
tep003.ckt -	555 Time delay circuit
tep004.ckt -	Light sensor circuit.
tep005.ckt -	Potential divider investigations.
tep006.ckt -	Bipolar transistor investigation.

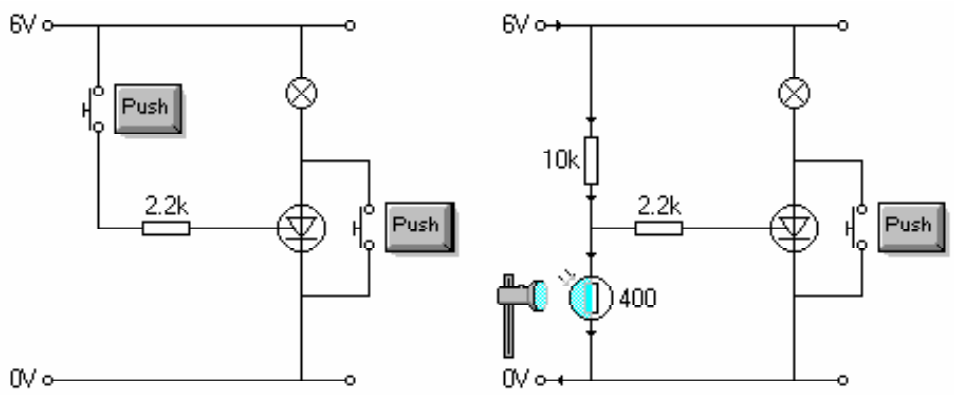
For further details on ordering the full version of the software please contact Crocodile Clips directly (the software is not available from TEP and cannot be purchased via the TEP voucher scheme).

Address:	Crocodile Clips, 11 Randolph Place, Edinburgh, EH3 7TA
Tel:	0131 2261511
Fax	0131 2261522
Email:	sales@crocodile-clips.com
Internet:	http://www.crocodile-clips.com/education/

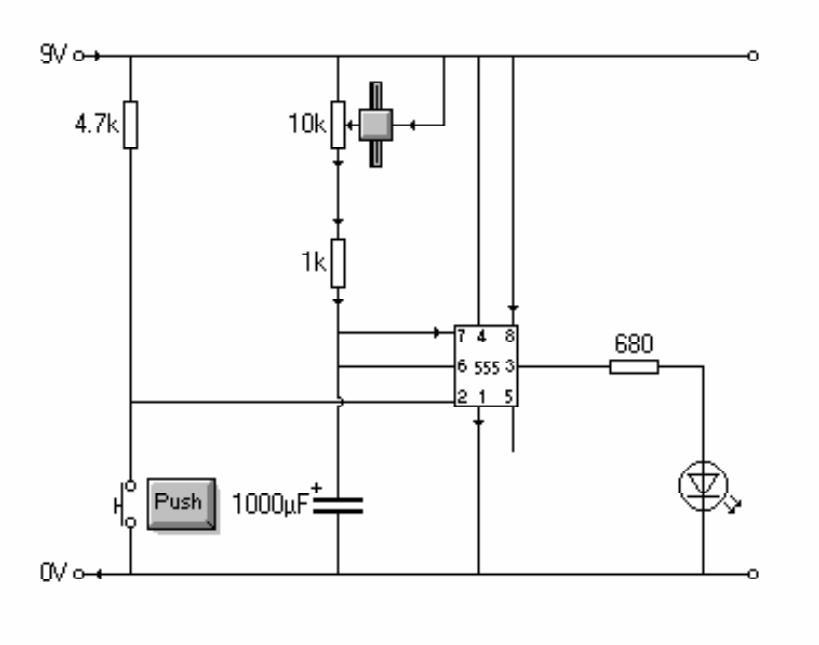
TEP001: MOISTURE SENSOR CIRCUITS



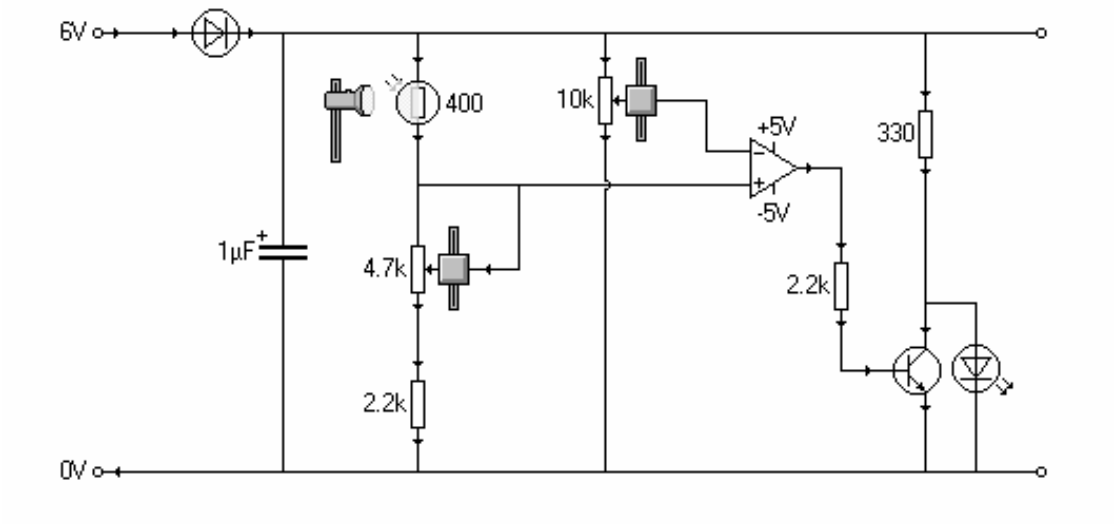
TEP002: THYRISTOR CIRCUITS



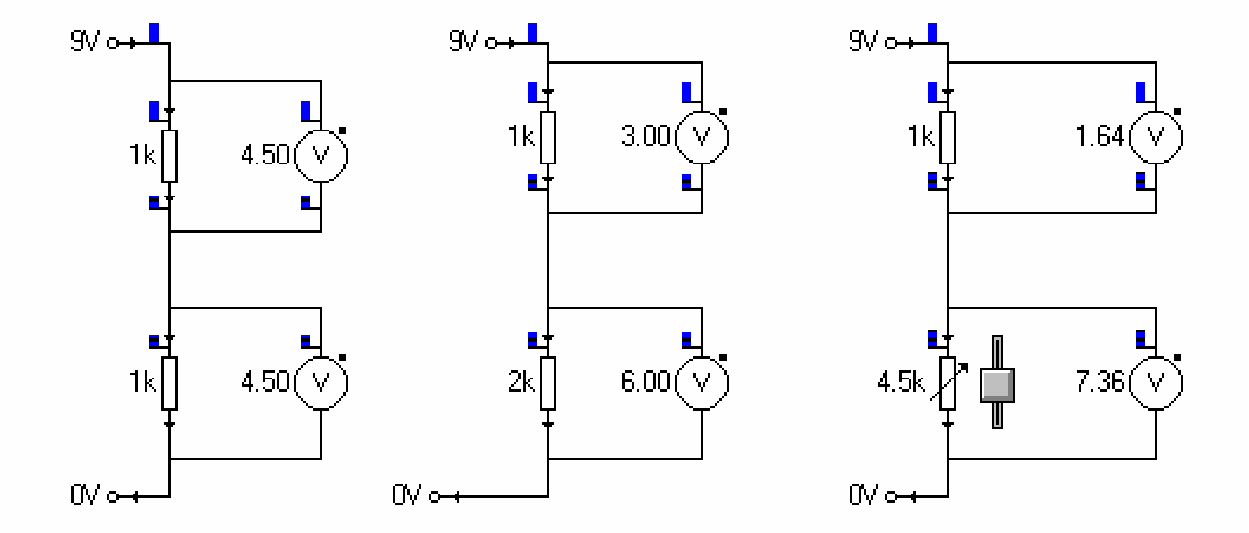
TEP003: 555 TIME DELAY CIRCUIT



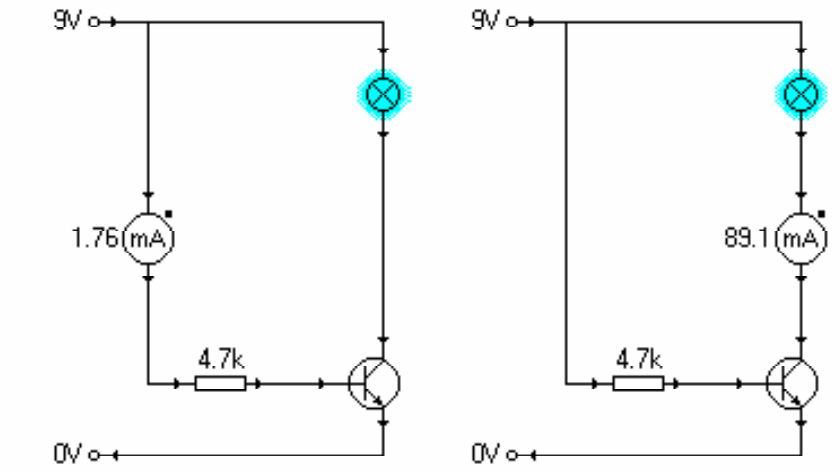
TEP004: LIGHT SENSOR CIRCUIT



TEP005: POTENTIAL DIVIDER

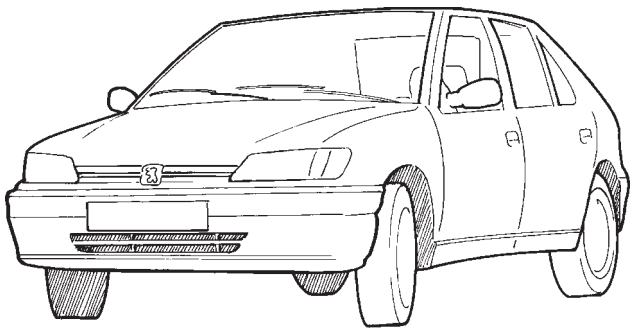


TEP006: BIPOLAR TRANSISTOR



COMPUTER SIMULATION

Computer Simulation is used in many industries to model real-life situations. Car manufacturers use simulation to find the most aerodynamic vehicle shape, engineers test bridge designs to see if the proposed construction materials are strong enough, and clothing designers can 'try out' various colour and pattern combinations.



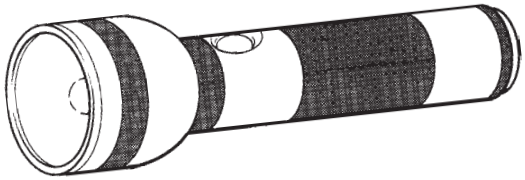
Generally computer simulation is cheaper than manually building a test rig as you do not have to buy and store all the materials required for the rig. It is normally quicker to 'build' a computer model than it is to build a physical structure, and so this time saving also reduces cost. Finally dangerous or hazardous events can also be simulated without exposing the designer to any risk.

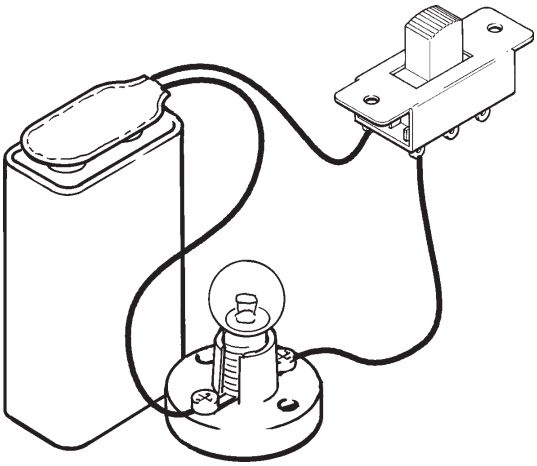
Electronic Engineers can use computer circuit simulation software such as Crocodile Clips to test their circuit designs. This can have a number of advantages over manually testing the circuits - consider the following situations:

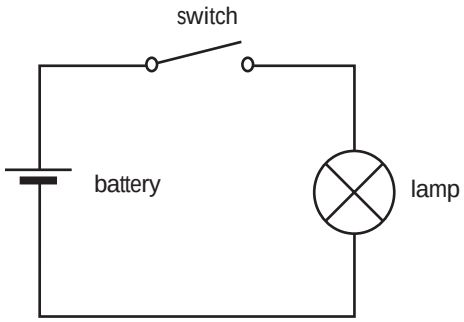
Situation	Computer Simulation	Manual Construction
You want to use a component you have not used before.	Select the component from the toolbar.	Order the component from supplier. Wait until the component arrives and then pay for it.
You want to 'try-out' different values of components.	Type in the new value.	Remove old component, find and/or buy new component and replace in correct position
You think you have accidentally damaged a component.	Look at the screen to see which component was damaged, and then correct the problem automatically identified by the computer	Test each component in turn to find which was damaged. Order new component and replace it when it arrives.
You have to design a dedicated 'integrated circuit' that will uses hundreds of components in one standard IC sized package.	Simulate the circuit using the basic components such as resistors and transistors.	Building the circuit using standard components would cost thousands of pounds for labour and chances of making a mistake are high
You want to carry out 'destructive' testing to find the limits of circuit operation.	When component is destroyed record values and replace with a 'new' component from the toolbar.	When component is destroyed record values and throw damaged component away. Order & pay for new component.

SIMULATING A SIMPLE ELECTRONIC CIRCUIT

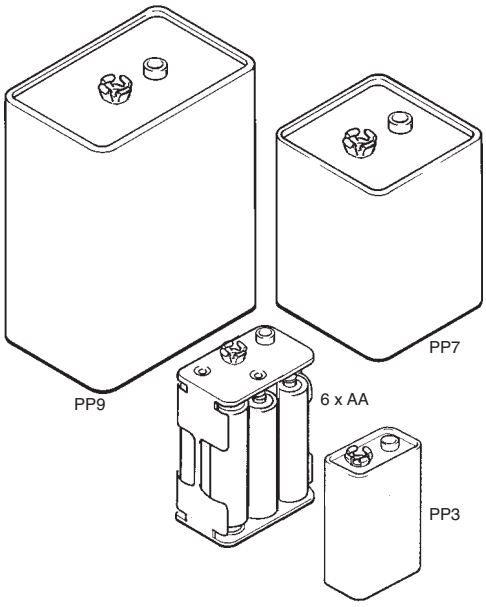
A torch consists of three main electronic components - the lamp ("bulb"), the battery and the switch. This circuit could be modelled manually by using a signal lamp, battery pack and slide switch.



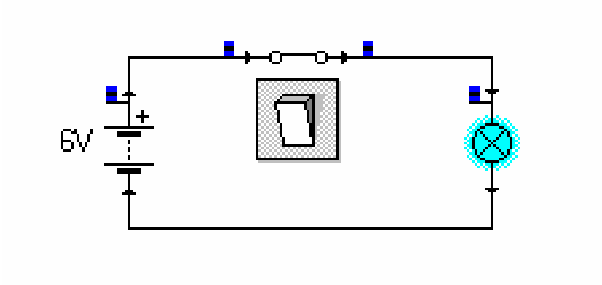




If you wanted to experiment to see the effect of different batteries on the bulb brightness you would need to collect together a number of different sized batteries. However, by using the Crocodile Clips software, you can simulate various different batteries by simply typing in their voltage values.



BUILDING THE TORCH CIRCUIT

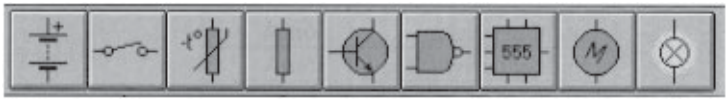


If you have not already installed the Crocodile Clips software, follow the instructions given in the installation section.

Start the software by clicking on the Crocodile Clips icon, and then click on OK when the 'About' screen appears.

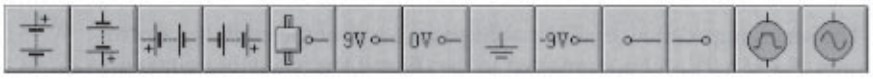
At the top of the Crocodile Clips window is the 'Main Toolbar' that consists of a number of electronic symbols. Each symbol leads to a 'Component Toolbar' that contains a number of associated symbols.

The Main Toolbar



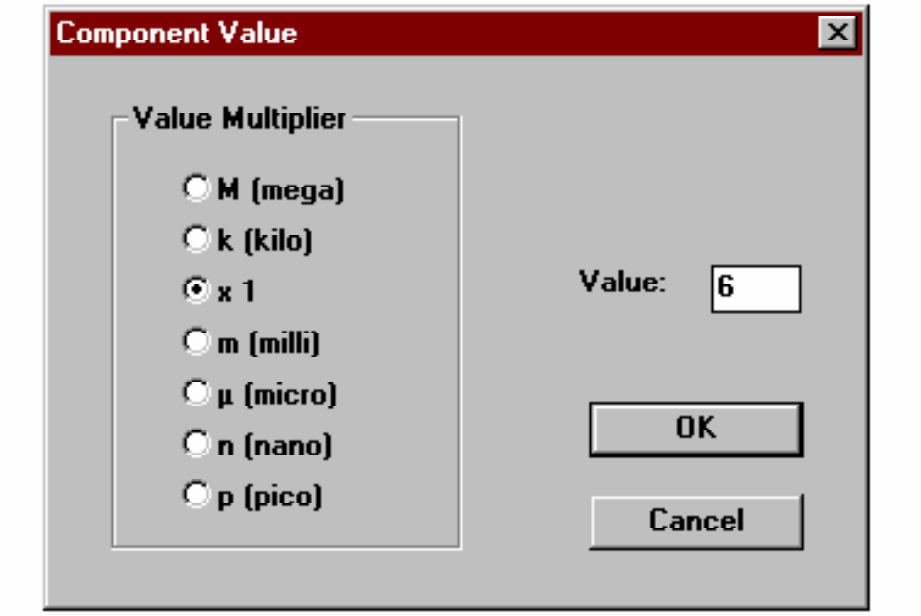
Click on the 'battery' symbol (next to the Crocodile) to move to the 'Power Supplies Toolbar'. The toolbar will now change to show all the available power supplies.

The Power Supply Toolbar



Move the mouse pointer over the first battery symbol (the first component on the toolbar) and 'click and drag' it on to the main screen. Then click on 'Close' to shut the Power Supply Toolbar and move back to the Main Toolbar.

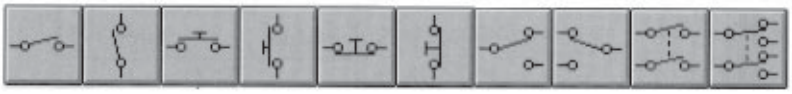
The battery will appear with a voltage of 9V. The original torch circuit used 4 AA sized batteries, which would give a total of 6V. To change the on-screen battery value click on the '9V' label next to the battery symbol. The 'Component Value' window will appear.



Change the value to '6' and then click on OK. (In this case you do not need to use a Value Multiplier, so leave it on the x1 setting. If you wish to know more about the different multipliers see the section on Electronic Units and Multipliers.) The battery will now show a value of 6V.

Now click on the 'Toggle Switch' symbol to move to the 'Switches Toolbar'. The toolbar will change to show all the available switches. Select the toggle switch (the first symbol on the toolbar) and drag it out on to the main screen. Click on Close to move back to the Main Toolbar.

Switches Toolbar



Finally click on the 'Signal Lamp' symbol to move to the 'Light Outputs Toolbar'.

Light Outputs Toolbar

Select the first signal lamp symbol and drag it onto the main screen. The screen should now show the battery, switch and lamp in roughly the positions shown in Figure A. If you need to move the symbols simply click and drag the symbol to the new position.

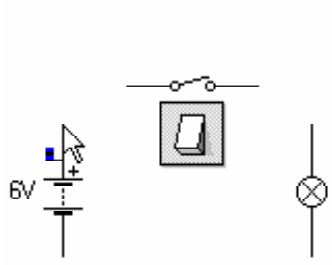


Figure A

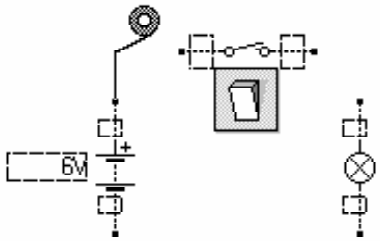


Figure B

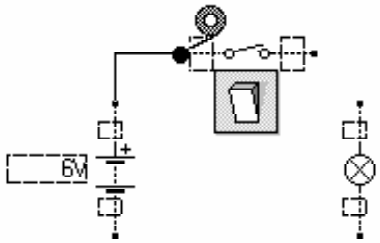


Figure C

WIRING THE CIRCUIT TOGETHER

reel of wire

connection

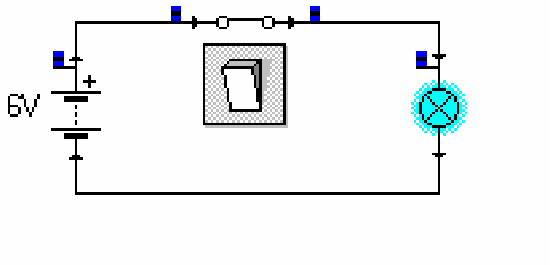
no-go

Now the components must be wired together. To do this click on the top lead of the battery symbol, so that the mouse pointer changes to the 'Reel-of-Wire'. Move the mouse away from the lead and a wire will be drawn. Wire segments can only be horizontal or vertical, so if you want to add a 'corner' click once with the mouse key.

Move the mouse pointer to the 'toggle switch' lead. When the mouse pointer turns to the 'Connection' symbol click the mouse key to make the connection (figure B). If the mouse pointer change to the 'No-Go' symbol you have probably tried to draw a wire over the top of a component, which is not allowed. Move the mouse pointer away from the component and try again.

Repeat for the other two wires so that the circuit is completed as in Figure C.

SIMULATING THE CIRCUIT



The circuit is now ready to be used. Click on the toggle switch control to switch on the circuit - the lamp will glow as current can now flow around the circuit (current is represented by small arrows which appear on the wires). You've probably also noticed the small red 'bar-graphs' at the component leads. These show the voltage at that particular point - the taller the bar-graph the greater the voltage.

Open the switch and change the battery voltage to 3V (remember that you click on the number to change the value). Why does the lamp now only glow dimly? Open the switch again and change the voltage to 12V - what happens to the lamp?

Open the switch and then drag the Crocodile over the lamp. Click when the Crocodile opens its mouth, and the reason the lamp exploded will be explained. Click on 'OK' to replace the component (remember to open the switch first or the lamp will instantly explode again!)

You may now like to experiment with other components - perhaps trying the buzzer or motor instead of the lamp. With the demonstration software you are only allowed to use three components at once (with the full version you can use as many components as you like). Therefore you will need to delete the lamp before you can add another component. To do this drag the Crocodile over the component, and, when the Crocodile opens its mouth, click on the mouse key so that the Crocodile eats the component!

Closed jaws pointer

Open jaws pointer

ELECTRONIC UNITS AND VALUE MULTIPLIERS

Electronic Units

Voltage	V	is measured in	volts	V
Current	I	is measured in	amps	A
Resistance	R	is measured in	ohms	Ω
Power	P	is measured in	watts	W
Capacitance	C	is measured in	farads	F
Inductance	L	is measured in	henrys	H

Ohms Law

voltage = current × resistance (V = I×R)

Power Relationship

power = voltage × current (P = V × I)

Value Multipliers

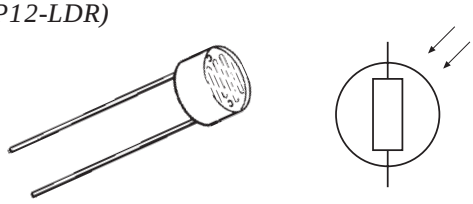
giga	G	1GW = 1 000 000 000 W
mega	M	1MΩ = 1 000 000 Ω
kilo	k	1kV = 1 000 V
milli	m	1mA = 0.001 A
micro	μ	1μH = 0.000 001 H
nano	n	1nF = 0.000 000 001 F
pico	p	1pF = 0.000 000 000 001 F

COMMON ELECTRONIC COMPONENTS

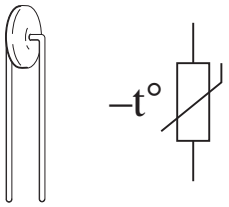
This section is designed to help those with little technical electronics knowledge decide on the correct component to order from an electronics supplier. After each 'common' component name is the 'technical' component name and/or reference number of the electronic device commonly used in schools. Note that this is not the only possible choice - as, for instance, there are over two hundred types of transistor! However the component named will be suitable for most educational projects.

INPUT COMPONENTS

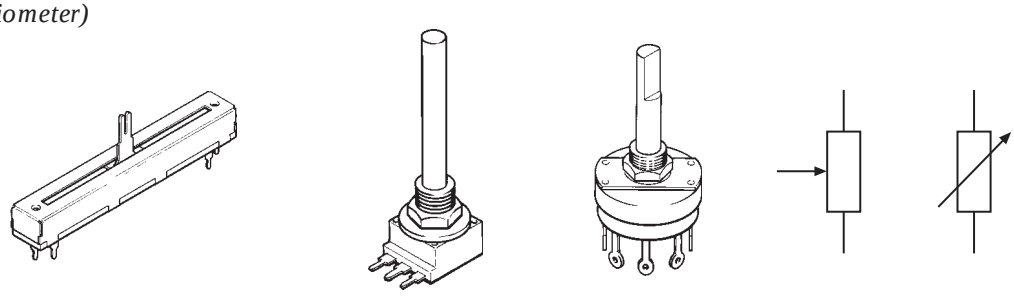
Light Dependent Resistor (LDR)
(ORP12-LDR)



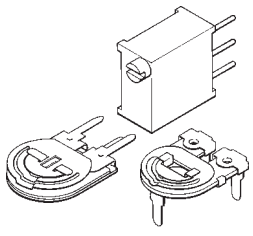
Thermistor
(NTC Mini-Disc Thermistor)

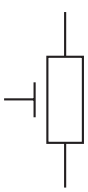


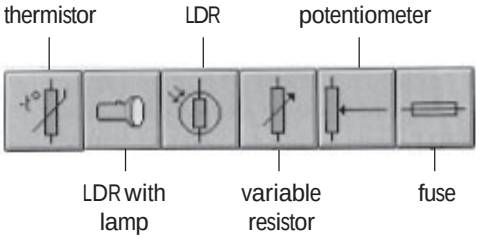
Variable Resistor, Potentiometer
(Potentiometer)



Preset Potentiometers
(Carbon presets)

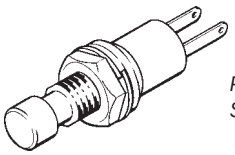






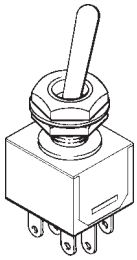
SWITCHES

Push-button
(Miniature push switches)

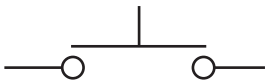


Push Button Switches

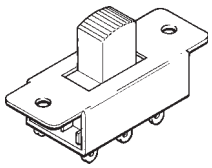
Toggle
(Miniature toggle switches)



Toggle Switches

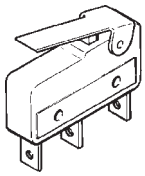


Slide switches
(Miniature toggle switches)



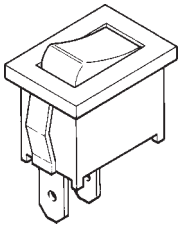
Slide Switches

Micro switches
(Miniature microswitches)



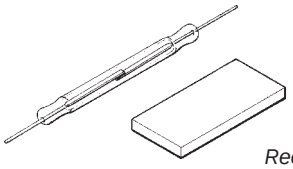
Micro Switches

Rocker switches
(Miniature rocker switches)



Rocker Switches

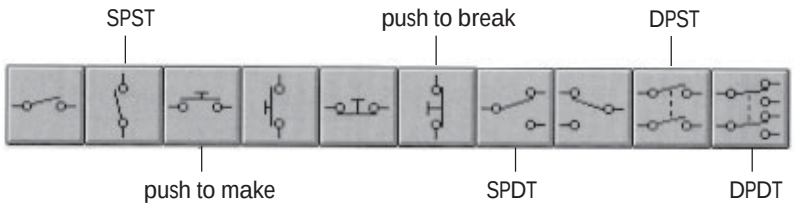
Reed switches
(Reed switch)



Reed Switches

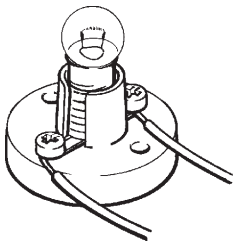
Tilt switch
(Tilt switch)

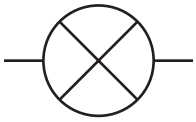
Vibration switch
(Vibration switch)



OUTPUT COMPONENTS

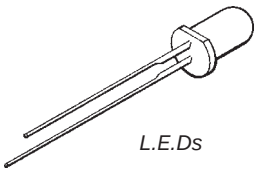
Signal Lamp
(MES (E10) lamps)



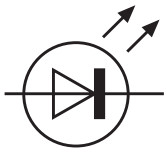


M.E.S. Bulbs and Holders

LED (Light Emitting Diodes)
(Standard 5mm LED)



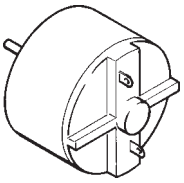
L.E.Ds



Motor
(Miniature DC Motors MM10 to 36)

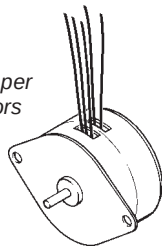
Solar Motor
(Solar DC motor)

Stepper Motor
(SM42 4-phase unipolar stepper)

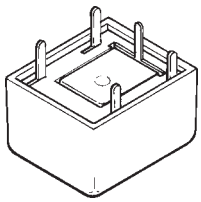


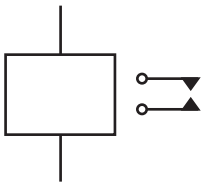
Solar Motors

Stepper Motors



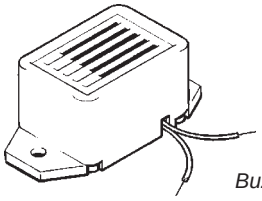
Relay
(Miniature 3A Relay, 6V coil)

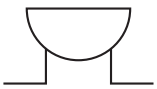




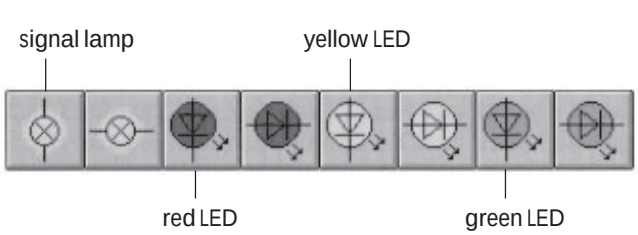
Relays (PCB mounting)

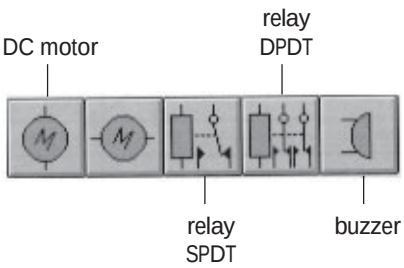
Buzzer
(Transistor Oscillator buzzer)





Buzzers

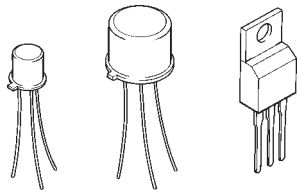




DISCRETE SEMICONDUCTOR COMPONENTS

Transistors
(Low Power - BC108, BC548)
(Medium Power - BFY51, 2N3904)
(High Power - TIP 31A)
(Darlington - BCX38B)

PNP Transistors
(Low Power - BC 178, BC558)
(Medium Power - 2N3906)
(High Power -TIP 32A)



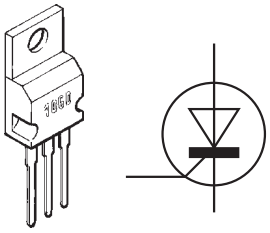
Transistors

pnp

npn

Field Effect Transistor
(IRF530 Power MOSFET)

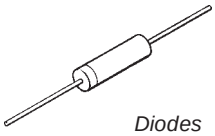
Thyristor
(Thyristor TIC106D)



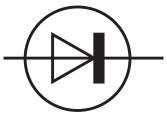
Diode
(IN4001 diode)

Signal Diode
(1N4148 diode)

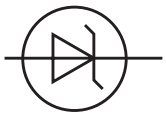
Zener Diodes
(BZX55 series zener diodes)



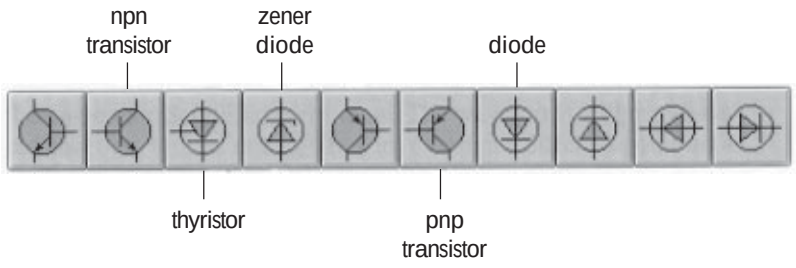
Diodes



General purpose diode

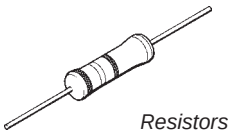


Zener diode

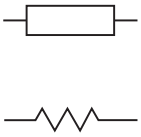


PASSIVE COMPONENTS

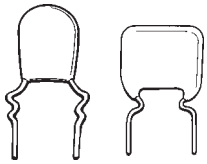
Resistors
(0.25 W Carbon Film Resistors)
(0.25 W Metal Film Resistors)

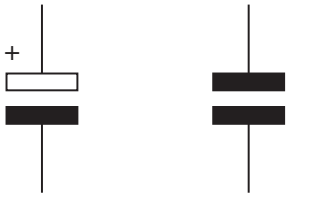


Resistors

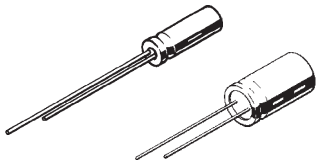


Non-polarised Capacitors
(Miniature polyester capacitors)
(Metallised polyester capacitors)

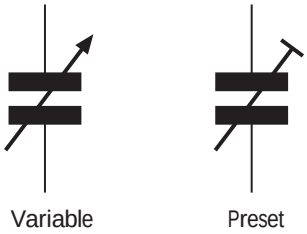




Polarised Capacitors
(Radial Electrolytic Capacitors, 16V)



Capacitors



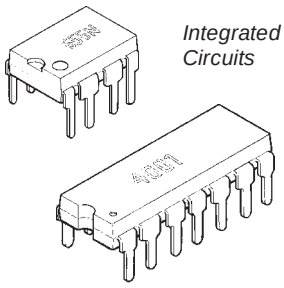
INTEGRATED CIRCUITS

555 Timer
(555 Timer)

741 Op-Amp
(741 Op-Amp)

324 Quad Op Amp
(324 Quad Op-Amp)

3909 LED Flasher
(3909 LED Flasher)



Integrated Circuits