Size: 142.5 x 210 mm Cover Back panel

anko

Size: 142.5 x 210 mm Cover front panel

anko

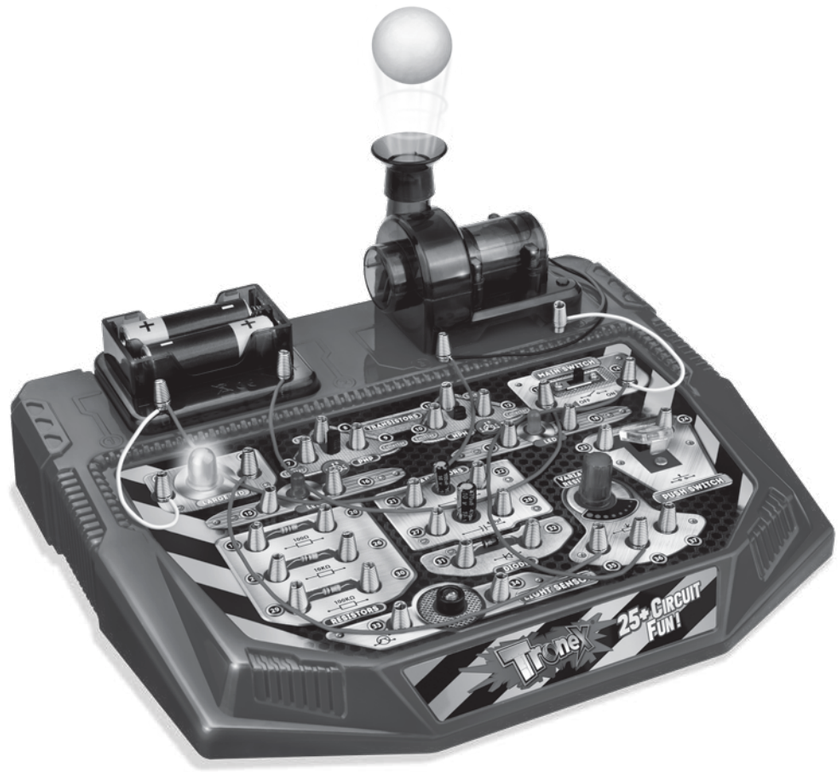
25+ Circuit Fun

PHYSICS

› includes over 25+ multi-functional experiments
› create light control, LED light, floating ball and much more

8+ years

STEM
SCIENCE
TECHNOLOGY
ENGINEERING
MATHS



⚠ WARNING:
CHOKING HAZARD - SMALL PARTS.
NOT FOR CHILDREN UNDER 3 YRS.

⚠ WARNING:
CHOKING HAZARD - TOY CONTAINS A SMALL BALL. NOT FOR CHILDREN UNDER 3 YRS.

⚠ WARNING:
NOT SUITABLE FOR CHILDREN UNDER 3 YEARS AS FOAM PIECES MAY BREAK OFF AND CAUSE A CHOKING HAZARD.

WARNING: CONTAIN LEADS WITH FUNCTIONAL SHARP POINT.

WARNING: FOR SAFETY REASONS, REMOVE ALL TAGS, LABELS AND PLASTIC FASTENERS BEFORE GIVING THIS TOY TO YOUR CHILD.

WARNING: HAIR ENTANGLEMENT MAY RESULT IF THE CHILD'S HEAD IS TOO CLOSE TO THE MOTORISED UNIT OF THIS TOY. ADULT SUPERVISION AND ASSISTANCE IS REQUIRED.

WARNING: BATTERIES ARE TO BE INSERTED WITH THE CORRECT POLARITY. DO NOT MIX DIFFERENT TYPES OF BATTERIES OR NEW AND USED BATTERIES. NON-RECHARGEABLE BATTERIES ARE NOT TO BE RECHARGED. RECHARGEABLE BATTERIES ARE ONLY TO BE CHARGED UNDER ADULT SUPERVISION. RECHARGEABLE BATTERIES ARE TO BE REMOVED FROM THE TOY BEFORE BEING CHARGED. THE SUPPLY TERMINALS ARE NOT TO BE SHORT-CIRCUITED. REMOVE BATTERIES FROM THE TOY WHEN NOT IN USE FOR EXTENDED TIME OR WHEN BATTERIES BECOME EXHAUSTED. BATTERY INSTALLATION BY AN ADULT IS REQUIRED. DISPOSE OF BATTERIES RESPONSIBLY. DO NOT DISPOSE OF IN FIRE.

PRODUCT MAY VARY SLIGHTLY FROM IMAGES SHOWN.
PLEASE KEEP THE INSTRUCTION MANUAL FOR FUTURE REFERENCE.
READ THE INSTRUCTION MANUAL BEFORE USE.

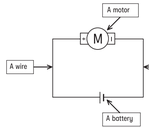
2 X AA

REQUIRES 2 X 1.5V AA BATTERIES (NOT INCLUDED).

Size : 142.5 x 210 mm

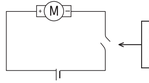
BASIC CONCEPTS

How to read a circuit diagram?



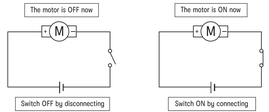
The **battery** is a source of electricity. It contains chemicals which will undergo chemical reaction to produce electricity when a circuit is connected. The **wire** is a conductor that conducts electricity. Connecting a wire is like providing a path that allows electricity to flow though. The motor is a device that produces rotary motion when electricity is provided. As an analogy, the battery is like a pump that pumps water through the piles (wires). When a circuit is connected, electricity can flow through it. The electricity flowing is called a **current**. A current is the flow of electric charges. The amount of a current is the amount of electric charge flowing in the wire in a second. Another common term we often heard about electricity is the **voltage**. Voltage is referring to the electric energy per unit charge. It is the electric energy of each unit amount of electric charge carries.

Open circuit and close circuit



This is an open circuit. The wires are not connected and electricity cannot flow through the circuit.
When it is connected, then it is completed and is called a closed circuit. Electricity can flow through it.

A **switch** is a simple mechanism that makes the circuit open or close.



BASIC CIRCUIT SYMBOLS

Component	Circuit symbol	Explanation
Wire		A wire is like a path that allows electric current to flow through. It has very low resistance which is close to zero.

Size : 142.5 x 210 mm

Battery		Each symbol represents a battery.
On/off switch		The main switch.
Push switch		Press it to make the metal plates come into contact. Currents can then through them and thus the path is connected.
Resistor		Resistor is a unit that process resistance. It is like an obstacle that reduces the flow of currents in a circuit.
Variable resistor		A resistor which resistance can be changed by adjusting it manually.
Diode		Allows current to flow in one direction only. Current in the reverse direction cannot pass through it. The symbol is like the direction of an arrow that indicates the direction of the current allowed.
LED		Light Emitting Diode. It is like a diode that allows currents to flow in one direction only. Additionally it will emit light when currents pass though it.
Motor	M	A device that produce rotational motion when electricity is applied.
Capacitor		A component that can store a small amount of electrical charge temporary. The symbol resembles its basic internal structure that two conductive plates are separated by a non-conductive region.
Capacitor (polarized)	or	Capacitor but with different polarities. The positive side can only store positive charge while the opposite side can only hold negative charge.
Light Sensor		There are different types of light sensors. The one used here is a phototransistor. When light falls on it, it is like a switch has connected and so current is allowed to pass through it.
Transistor (PNP)		The transistor is a semi-conductor material device that has three terminals. It can act as a switch or signal amplifier. The transistor is the key active component in practically all modern electronics. Besides being an individual component, they can be found integrated in logic gates, IC and Center Processing Unit (CPU) of a computer. CPUs nowadays contain billions of transistors integrated inside!
Transistor (NPN)		

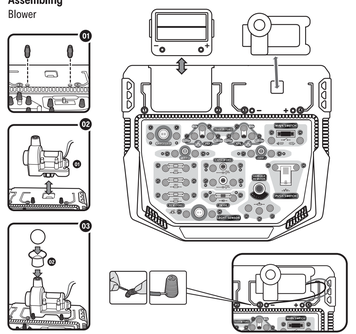
Size : 142.5 x 210 mm

COMPONENTS IN THIS KIT

Description	Quantity
Circuit Board Unit	1pc
Connecting wire	10cm x 12pcs, 20cm x 8pcs
Instruction Manual	1pc
Blower	1pc
Blow-nozzle	1pc
Foam ball	1pc
Spring	2pcs

Assembling

Blower



Size : 142.5 x 210 mm

25+ EXPERIMENTS

1. Blower (Floating ball)
2. Simple LED circuit
3. Two LEDs in parallel connection
4. Three LEDs in parallel connection
5. Blower (Floating ball) and LED with separate switches
6. Basic circuit operation of LEDs
7. Demonstration of resistance and current
8. Demonstration of the variable resistor
9. Demonstration of the function of the capacitor
10. Diode and capacitor discharge
11. "AND Gate" circuit for LED
12. "OR Gate" circuit for LED
13. "NOT Gate" circuit for LED (with floating ball for extra excitement)
14. "NAND Gate" circuit for LED (with floating ball for extra excitement)
15. "NOR Gate" circuit for LED (with floating ball for extra excitement)
16. A simple demonstration of the light sensor
17. A simple demonstration of a function of the PNP transistor
18. A simple demonstration of a function of the NPN transistor
19. Delayed lighting up LED
20. Delayed extinguishing LED
21. Light control blower (Light type)
22. Light control blower (Dark type)
23. Alternating LED and blower
24. Speed adjustable blower
25. Connection indicator
26. Manual control stop-and-resume blower

WARNING

Adult supervision and assistance is required.
This unit is only for use by children aged 8 years and older.
Not suitable for children under age 3 years old due to small part(s) and component(s) - CHOKING HAZARD.
Read and follow all instructions in the manual before use.
This toy contains small parts and functional sharp points on components. Keep away from children under age 3 years.
2 x AA size batteries are required (not included)
Please retain the information and this manual for future reference.
Instructions for parents are included and have to be observed.
Hair entanglement may result if the child's head is too close to the motorized unit of this toy.
This toy contains functional sharp points on component leads and wires, requiring care when handling.

CAUTION !

Before setting up any experiment, please double check and make sure all wiring connections you have made are correct before inserting the batteries and switching on the unit, as failure may result in damage to components or circuit board unit. When experiment is finished, make sure the batteries are disconnected and switch off the unit before you clear away the wires. Do not apply any components or parts to the experiment other than those provided with this kit. Do not lock the motor or other moving parts. It may cause overheating. The toy is not to be connected to more than recommended number of power supplies.

BATTERY INFORMATION

Use 2 x AA size batteries (not included)
For best performance, always use fresh batteries and remove batteries when not in use
Batteries must be inserted with the correct polarity
Non-rechargeable batteries are not to be recharged
Re-chargeable batteries are only to be charged under adult supervision
Re-chargeable batteries are to be removed from the toy before being charged
Different types of batteries or new and used batteries are not to be mixed.
Exhausted batteries are to be removed from the toy
The supply terminals are not to be short-circuited
Only batteries of the same or equivalent types are to be used
Do not dispose of the batteries in fire
Do not mix old and new batteries
Do not mix alkaline, carbon zinc and re-chargeable batteries

WIRING SEQUENCE AND CONNECTION

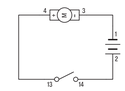
Ensure all wires are correctly connected to the numbered spring terminals of the main circuit board unit as stated wiring sequence of each experiment.
Bend the spring terminal over and insert the exposed shiny conductor part of wire into spring terminal. Make sure the wire is securely connected to spring terminal.
For example if the wiring sequence is 4-33, 1-10-32-35, 2-12, then first connect a wire between spring terminal 4 and 33; next connect a wire between spring terminal 1 and 10, and then a wire between spring terminal 10 and 32, a wire between spring terminal 32 and 35, and finally connect a wire between spring terminal 2 and 12. This is an example to demonstrate wiring connections only, not an exact circuit connection in the experiment.
If the circuit does not work, check the wire and spring terminal connection to see whether it is probably not well connected or the insulated plastic part of a wire is inserted to spring terminal.

Objective :
The overall aim for this electronic circuit kit is for you to get a better understanding of how connecting different wiring sequence will make different science experiments. Each experiment is targeted at different basic concept of electronics & electricity. Please make sure to read carefully and all wires are correctly connected in the indicated diagram in order to have each experiment work.

EXPERIMENT **1**

Blower (Floating ball)

Wiring Sequence **2-14, 13-4, 1-3**

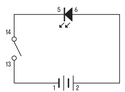


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch.
› The blower is on! Place the ball in mid-air to see it float!

EXPERIMENT **2**

Simple LED circuit

Wiring Sequence **2-5, 5-14, 13-1**

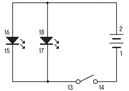


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch.
› The LED will light up as illumination.

EXPERIMENT **3**

Two LEDs in parallel connection

Wiring Sequence **2-18-16, 17-15-13, 14-1**

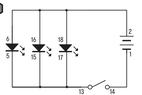


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch to see both LEDs light up.
› When you switch off the main switch, both LEDs will be turned off.

EXPERIMENT **4**

Three LEDs in parallel connection

Wiring Sequence **2-18-16-6, 5-15-17-13, 14-1**

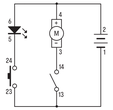


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch to see all LEDs light up.
› When you switch off the main switch, all LEDs will be turned off.

EXPERIMENT **5**

Blower (Floating ball) and LED with separate switches

Wiring Sequence **2-4-6, 5-24, 3-14, 13-23-1**

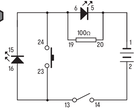


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch. The blower will blow.
› Press the push switch, the LED will light up.
› The blower and the LED are controlled by separate switches. Therefore they can be turned ON and OFF separately.

EXPERIMENT **6**

Basic circuit operation of LED

Wiring Sequence **2-14, 13-16-23, 24-19-15-6, 5-20-1**

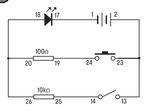


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch. You will see that the small LED will light up but the large LED will not.
› When you press the push switch, you will see the large LED will light up but the small LED will be turned off.

EXPERIMENT **7**

Demonstration of resistance and current

Wiring Sequence **2-23-13, 14-25, 24-19, 20-26-18, 17-1**

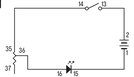


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch. The LED will light up dimly.
› Switch off the main switch to turn it off.
› Press the push switch. The LED will light up more brightly.
› Since the path of the main switch has a resistor of larger resistance, the current through this path will be less, and as a result the LED will be less bright. On the other hand, the path of the push switch has a resistor of smaller resistance, so the current through this path will be more, and the LED will be brighter.

EXPERIMENT **8**

Demonstration of the variable resistor

Wiring Sequence **2-13, 14-35, 36-16, 15-1**

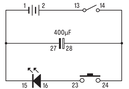


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch.
› By adjusting the variable resistor, the amount of currents in the circuit can be adjusted, and thus can alter the brightness of the LED.

EXPERIMENT **9**

Demonstration of the function of the capacitor

Wiring Sequence **2-13, 14-28-24, 23-16, 15-27-1**

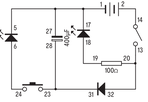


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch. It appears that nothing happens. Actually the capacitor is being charged.
› After 1 to 2 seconds, switch off the main switch. The capacitor is charged and is storing a small amount of electricity.
› Press the push switch. The electricity stored in the capacitor will be released immediately and the LED will light up for a brief moment!

EXPERIMENT **10**

Diode and capacitor discharge

Wiring Sequence **2-14, 13-32-20, 19-18, 17-1-5-27, 28-31-23, 24-6**

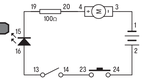


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch. The red LED will light up. Currents flowing via the diode will charge the capacitor at the same time.
› When you press the push switch, the yellow LED will light up. Release the push switch so that the yellow LED will turn off.
› Now switch off the main switch. The red LED will extinguish. If you press the push switch at this time, the yellow LED will light up for a brief moment due to the release of the stored electrical charge of the capacitor. However the red LED will not light up at all because the diode has blocked the current from the capacitor which is in an opposite direction.

EXPERIMENT **11**

"AND Gate" circuit for LED

Wiring Sequence **2-24, 23-14, 13-16, 15-19, 20-4, 3-1**



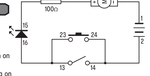
› Complete all wiring connections as indicated in the sequence.
› If you only switch on the main switch, or only press the push switch, the LED will not light up.
› If you switch on the main switch AND press the push switch together, then LED will light up.
› This is known as "AND Gate". Both switches have to be switched on in order to activate the LED.

A AND B = C		
A	B	C
0	0	0
1	0	0
0	1	0
1	1	1

EXPERIMENT **12**

"OR Gate" circuit for LED

Wiring Sequence **2-24-14, 13-23-16, 15-19, 20-4, 3-1**



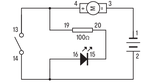
› Complete all wiring connections as indicated in the sequence.
› To light up the LED, you can either press the push switch OR switch on the main switch.
› This is known as "OR Gate". Switching on either switch OR switching on both switches will activate the LED.

A OR B = C		
A	B	C
0	0	0
1	0	1
0	1	1
1	1	1

EXPERIMENT **13**

"NOT Gate" circuit for LED (with floating ball for extra excitement)

Wiring Sequence **2-14-16, 15-20, 19-13-4, 3-1**



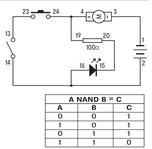
› Complete all wiring connections as indicated in the sequence.
› LED will automatically light up even though the main switch is off.
› When you switch on the main switch, LED will turn off.
› For the LED, this is known as "NOT Gate" - LED lights up when the switch is off; LED is off when switch is on.
› As an extra fun element, the blower will blow when the LED is off!

NOT A = B	
A	B
1	0
0	1

EXPERIMENT **14**

"NAND Gate" circuit for LED (with floating ball for extra excitement)

Wiring Sequence **2-14-16, 15-20, 13-23, 24-19-4, 3-1**



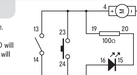
› Complete all wiring connections as indicated in the sequence.
› LED will automatically light up.
› LED will be turned off only when both push switch and main switch are switched on. This is called "NAND gate".
› "NAND gate" is the exact opposite of "AND gate".
› As an extra fun element, blower will blow when the LED is off!

A NAND B = C		
A	B	C
0	0	1
1	0	1
0	1	1
1	1	0

EXPERIMENT **15**

"NOR Gate" circuit for LED (with floating ball for extra excitement)

Wiring Sequence **2-24-14-16, 15-20, 19-23-13-4, 3-1**



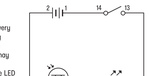
› Complete all wiring connections as indicated in the sequence.
› LED will automatically light up.
› When both the main switch and push switch are off, then LED will light up. When the main switch or push switch is/are on, LED will be off. This is known as "NOR Gate".
› "NOR Gate" is the exact opposite of "OR Gate".
› As an extra fun element, the blower will blow when the LED is off!

A NOR B = C		
A	B	C
0	0	1
1	0	0
0	1	0
1	1	0

EXPERIMENT **16**

A simple demonstration of the light sensor

Wiring Sequence **2-34, 33-16, 15-13, 14-1**

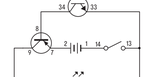


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch. You may notice that the LED lights up very dimly. This indicates only a very small amount of current is flowing through it. It depends on the intensity of light falling onto the light sensor. If you perform this experiment in a darker place, the LED may not light up at all.
› If you use a torch to shine on the light sensor, you can see that the LED light up brightly. This is because when there is more light, more current will be able to pass through the light sensor and light up the LED.

EXPERIMENT **17**

A simple demonstration of a function of the PNP transistor

Wiring Sequence **2-7, 9-16, 8-34, 33-15-13, 14-1**

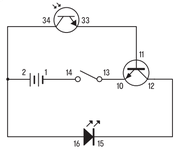


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch. This time, even with a small amount of light, the LED will light up brightly!
› It is because in this circuit, the PNP transistor is the real gateway to the LED, and the light sensor is only acting as a switch for opening the gateway! When the upper part of the circuit is not connected, no current is flowing through the "Emitter" to the "Base" of the transistor. So the gateway of the "Emitter" to the "Collector" is shut. When light falls on the light sensor, the upper circuit is connected; a very small amount of current passes through the "Emitter" to the "Base", and then the gateway of the "Emitter" to the "Collector" is opened! Electric current from the battery can then flow through the transistor to the LED, and therefore the LED will light up brightly! This circuit makes the light sensor to become a sensitive switch to detect light.

EXPERIMENT 18

A simple demonstration of a function of the NPN transistor

Wiring Sequence: **2-34-16, 15-12, 11-33, 10-13, 14-1**

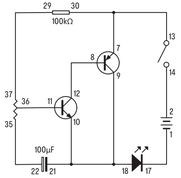


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch. Again, this time even with a small amount of light, the LED will light up brightly!
› This is pretty much the same as the case of the PNP transistor. It is just the polarities of the transistor that are reversed.

EXPERIMENT 19

Delayed lighting up LED

Wiring Sequence: **2-14, 13-7-30, 8-12, 29-37, 11-36, 35-22, 18-10-21-9, 17-1**

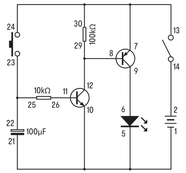


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch. Because of the capacitor, the LED will not light up immediately. The LED will light up after a while. NOTE: If the experiment does not work, you may need to "discharge" the capacitor first. To "discharge", connect any wire to 21-22 for a second. This way the electricity stored in the capacitor will be "discharged" and then the experiment can work again.

EXPERIMENT 20

Delayed extinguishing LED

Wiring Sequence: **2-14, 13-7-30-24, 23-22-25, 26-11, 12-29-8, 9-6, 5-10-21-1**

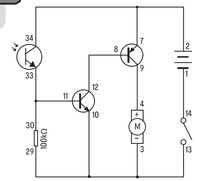


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch.
› By pressing the push switch, LED will light up.
› After you have released the push switch, just wait for some time and see. The LED will gradually extinguish.

EXPERIMENT 21

Light control blower (Light type)

Wiring Sequence: **2-7-34, 33-30-11, 12-8, 9-4, 3-10-29-13, 14-1**

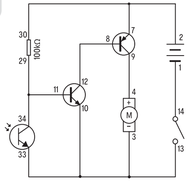


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch. The blower will blow.
› Cover the light sensor and the blower will become weaker or even stop operating. Uncover it to resume operation.

EXPERIMENT 22

Light control blower (Dark type)

Wiring Sequence: **2-7-30, 29-34-11, 12-8, 9-4, 3-10-33-13, 14-1**

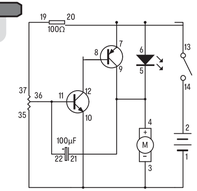


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch. Cover the light sensor and the blower will blow.
› Uncover the light sensor and the blower will become weaker or even stop operating.

EXPERIMENT 23

Alternating LED and blower

Wiring Sequence: **2-14, 13-6-7-20, 5-4-9-21, 8-12, 11-36-22, 1-3-35-10, 19-37**

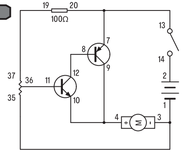


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch and try to adjust the variable resistor slowly.
› Both LED and blower will be activated alternately.
› The alternate frequency for both devices depends on the set value of the variable resistor.

EXPERIMENT 24

Speed adjustable blower

Wiring Sequence: **2-14, 13-7-20, 8-12, 19-37, 11-36, 35-3-1, 4-10-9**

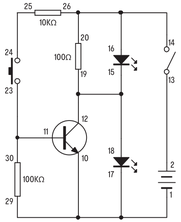


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch.
› By adjusting the variable resistor, you can adjust the blowing power of the blower.

EXPERIMENT 25

Connection indicator

Wiring Sequence: **2-13, 14-16-20-26, 25-24, 15-18-19-12, 23-11-30, 29-10-17-1**

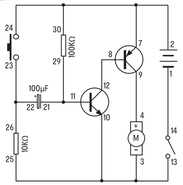


› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch. Red LED will light up but blue LED will not.
› Press the push switch. Blue LED will light up and red LED will extinguish.
› Release the push switch. Red LED will light up again and blue LED will extinguish.
› This principle can be used for indicating the break/connect of circuit: When the door, car-door or window is closed, it is just like the push switch is being pressed, and thus blue LED lights up while red LED does not. When the door, car-door or window is opened, this is just like the push switch is released and thus red LED lights up while blue LED goes off.

EXPERIMENT 26

Manual control stop-and-resume blower

Wiring Sequence: **2-7-30-24, 23-26-22, 21-29-11, 12-8, 9-4, 3-10-25-13, 14-1**



› Complete all wiring connections as indicated in the sequence.
› Switch on the main switch. After a while the blower will blow.
› Press the push switch, and the blowing speed will be changed for a while. Do not release the push switch and the speed will gradually back to the original blowing speed.
› And then release the push switch. The blower will stop for a while. After waiting for some time, the blower will resume operation again like it did at the beginning of the experiment!

GLOSSARY

Amplifier – An electronic circuit that amplifies the signal that is sent to it. The amplifying component can be a transistor, vacuum tube or appropriate magnetic device.

Battery – A source of energy. It contains chemicals which will undergo chemical reaction to produce electricity when a circuit is connected.

Capacitance – A measurement of the capacity of a capacitor for storing electric charge.

Capacitor – A device consists of two conductors that are separated by an insulator. It is designed for storing electrical charge or as a filter in the circuit.

Circuit – A system of interconnected components / devices such as power source, resistors, capacitors and transistors...etc.

Diode – A device which is used in electric circuitry to allow an electric current to flow in single direction and block it in the reverse direction.

IC (Integrated Circuit) – A small electronic device made of a semiconductor material and is used for a variety of devices, including microprocessors, electronic equipment and automobiles.

LED (Light Emitting Diode) – A diode emits light when current is passing through it.

Light Sensor – There are different types of light sensor. The one used here is a phototransistor. When light falls on it, it is like a switch connected and so current is allowed to pass through it.

Motor – A device that produce rotational motion when electricity is applied.

Resistance – A measurement of the degree to which an object opposes an electrical current through it.

Resistor – A device designed for possessing resistance.

Switch – A device for opening and closing power source to a circuit

Transistor – A device made of semiconductor material that can amplify a signal or open/close a circuit.

Truth Table – It is a mathematical table used to logically compute the values of logical explication and as a decision procedure.

Variable Resistor – A kind of resistor and a device of adjustable resistance in the electronic / electrical circuit.

Wire – A conductor that conducts electricity. Connecting a wire is like providing a path that allows electricity to flow though.

If at any time in the future you should need to dispose of this product please note that waste electrical products should not be disposed of with household waste. Please recycle where facilities exist. Check with your local authority or retailer for recycling advice. (Waste Electrical and Electronic Equipment Directive)

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