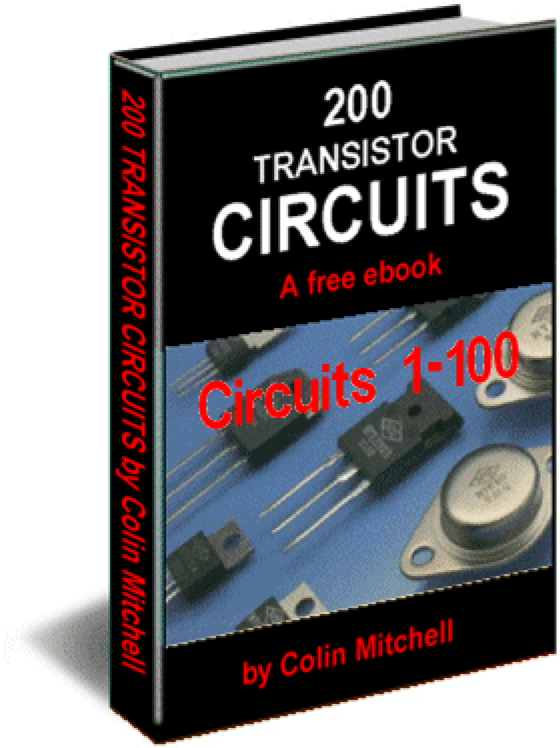

Go to: 101 - 200 Circuits
Go to: 100 IC Circuits

Talking Electronics

See TALKING ELECTRONICS WEBSITE

email Colin Mitchell: talking@tpg.com.au

INTRODUCTION

This e-book contains 100 transistor circuits. The second part of this e-book will contain a further 100 circuits.
Most of them can be made with components from your "junk box" and hopefully you can put them together in less than an hour.
The idea of this book is to get you into the fun of putting things together and there's nothing more rewarding than seeing something work.
It's amazing what you can do with a few transistors and some connecting components. And this is the place to start.
Most of the circuits are "stand-alone" and produce a result with as little as 5 components.
We have even provided a simple way to produce your own speaker transformer by winding turns on a piece of ferrite rod. Many components can be obtained from transistor radios, toys and other pieces of discarded equipment you will find all over the place.
To save space we have not provided lengthy explanations of how the circuits work. This has already been covered in TALKING ELECTRONICS Basic Electronics Course, and can be obtained on a CD for $10.00 (posted to anywhere in the world) See Talking Electronics website for more details: http://www.talkingelectronics.com
Transistor data is at the bottom of this page and a transistor tester circuit is also provided. There are lots of categories and I am sure many of the circuits will be new to you, because some of them have been designed recently by me.
Basically there are two types of transistor: PNP and NPN.
All you have to do is identify the leads of an unknown device and you can build almost anything.
You have a choice of building a circuit "in the air," or using an experimenter board (solderless breadboard) or a matrix board or even a homemade printed circuit board. The choice is up to you but the idea is to keep the cost to a minimum - so don't buy anything expensive.
If you take parts from old equipment it will be best to solder them together "in the air" (as they will not be suitable for placing on a solderless breadboard as the leads will be bent and very short).
This way they can be re-used again and again.
No matter what you do, I know you will be keen to hear some of the "noisy" circuits in operation.
Before you start, the home-made **Speaker Transformer** project and Transistor Tester are the first things you should look at.
If you are starting in electronics, see the **World's Simplest Circuit.** It shows how a transistor works and three transistors in the **6 Million Gain** project will detect microscopic levels of static electricity! You can look through the Index but the names of the projects don't give you a full description of what they do. You need to look at everything. And I am sure you will.

KIT OF PARTS

Talking Electronics supplies a kit of parts that can be used to build the majority of the circuits in this book.
The kit costs $15.00 plus postage.

In many cases, a resistor or capacitor not in the kit, can be created by putting

two resistors or capacitors in series or parallel or the next higher or lower value can be used.
Don't think transistor technology is obsolete. Many complex circuits have one or more transistors to act as buffers, amplifiers or to connect one block to another. It is absolutely essential to understand this area of electronics if you want to carry out design-work or build a simple circuit to carry out a task.

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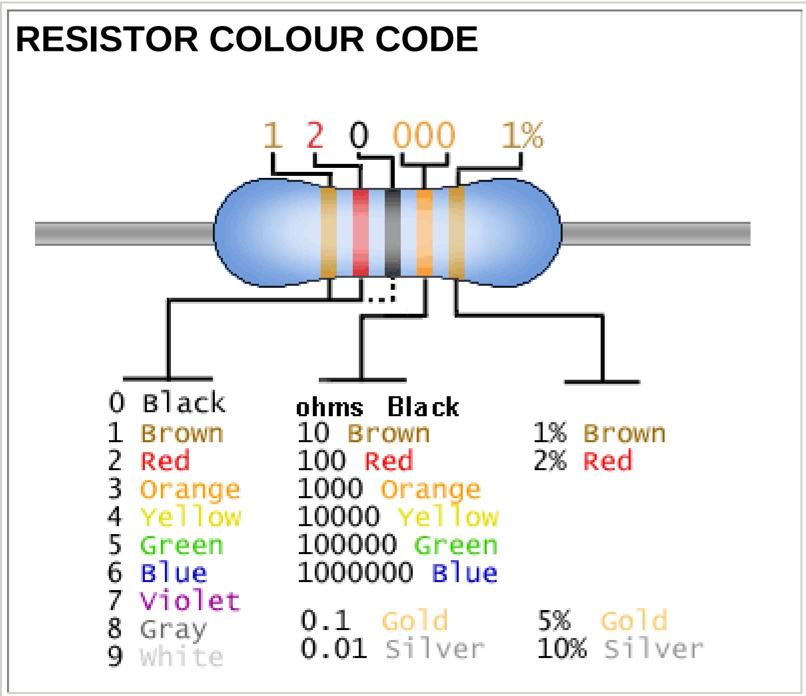
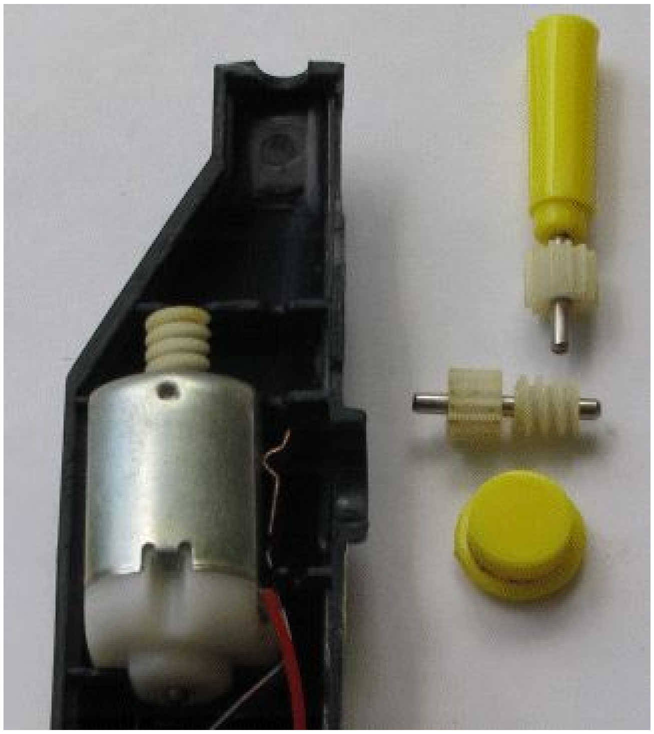
circuits in red are in [101-200 Circuits]



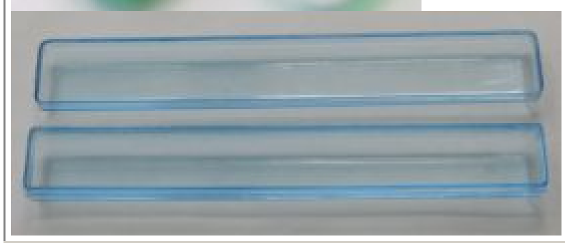
See [resistors from 0.22ohm to 22M] in full colour at bottom of this page and another [resistor table]



A two-worm reduction gearbox producing a reduction of 12:1 and 12:1 = 144:1 The gears are in the correct positions to produce the reduction.

BOXES FOR PROJECTS

One of the most difficult things to find is a box for a project. Look in your local "junk" shop, $2.00 shop, fishing shop, and toy shop. And in the medical section, for handy boxes. It's surprising where you will find an ideal box.
The photo shows a suitable box for a Logic Probe or other design. It is a toothbrush box. The egg shaped box holds "Tic Tac" mouth sweeteners and the two worm reduction twists a "Chuppa Chub." It cost less than $4.00 and the equivalent reduction in a hobby shop costs up to $16.00!



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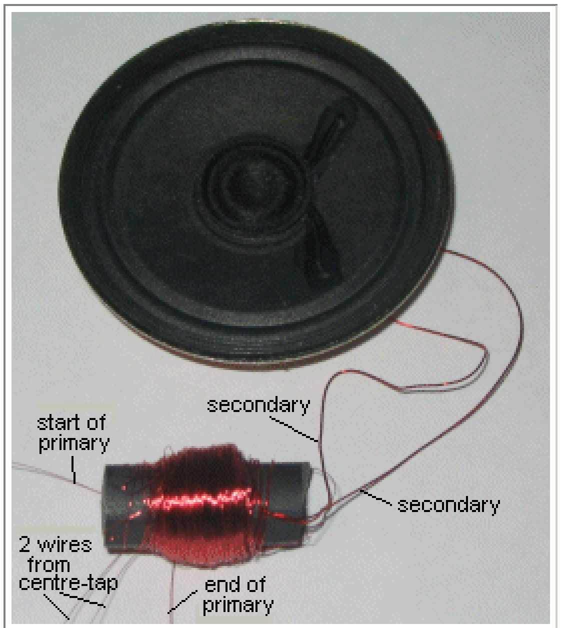

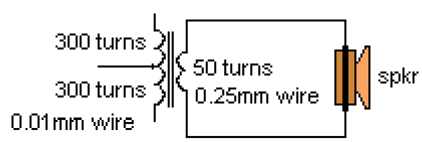

HOME MADE SPEAKER TRANSFORMER

The **speaker transformer** is made by winding 50 turns of 0.25mm wire on a small length of 10mm dia ferrite rod.
The size and length of the rod does not matter - it is just the number of turns that makes the transformer work. This is called the secondary winding.
The primary winding is made by winding 300 turns of 0.01mm wire (this is very fine wire) over the secondary and ending with a loop of wire we call the centre tap.
Wind another 300 turns and this completes the transformer.
It does not matter which end of the secondary is connected to the top of the speaker.
It does not matter which end of the primary is connected to the collector of the transistor in the circuits in this book.

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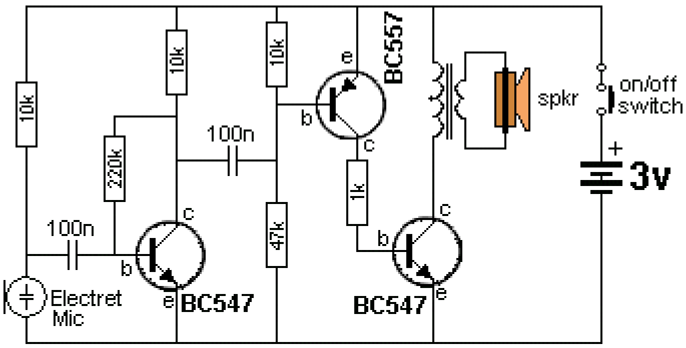

SUPER EAR

This circuit is a very sensitive 3-transistor amplifier using a speaker transformer. This can be wound on a short length of ferrite rod as show above or 150 turns on a 10mH choke. The biasing of the middle transistor is set for 3v supply. The second and third transistors are not turned on during idle conditions and the quiescent current is just 5mA. The project is ideal for listening to conversations or TV etc in another room with long leads connecting the microphone to the amplifier.

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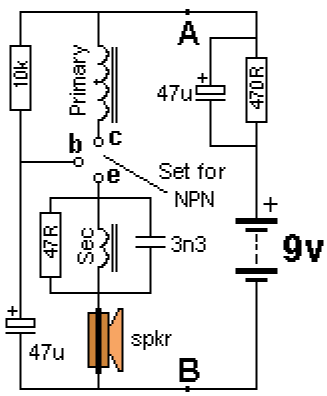

TRANSISTOR TESTER-1

CIRCUIT

The 10mH choke with 150 turns for the secondary

TRANSISTOR TESTER - 1

Transistor Tester - 1 project will test all types of transistors including Darlington and power. The circuit is set to test NPN types. To test PNP types, connect the 9v battery around the other way at points A and B.
The transformer in the photo is a 10mH choke with 150 turns of 0.01mm wire wound over the 10mH winding. The two original pins (with the red and black leads) go to the primary winding and the fine wires are called the Sec.
Connect the transformer either way in the circuit and if it does not work, reverse either the primary or secondary (but not both).
Almost any transformer will work and any speaker will be suitable.
If you use the speaker transformer described in the **Home Made Speaker Transformer** article, use one-side of the primary.

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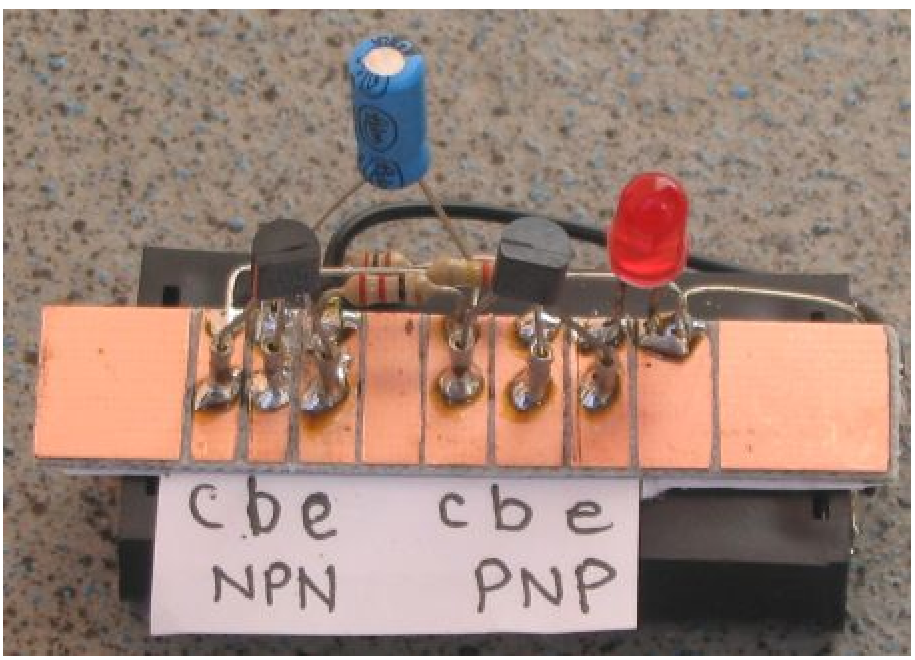
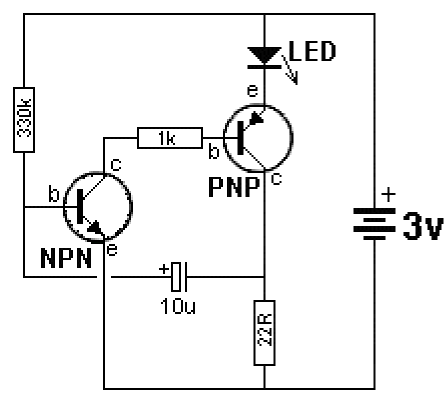


TRANSISTOR TESTER - 2

Here is another transistor tester.



This is basically a high gain amplifier with feedback that causes the LED to flash at a rate determined by the 10u and 330k resistor.
Remove one of the transistors and insert the unknown transistor. When it is NPN with the pins as shown in the photo, the LED will flash. To turn the unit off, remove one of the transistors.

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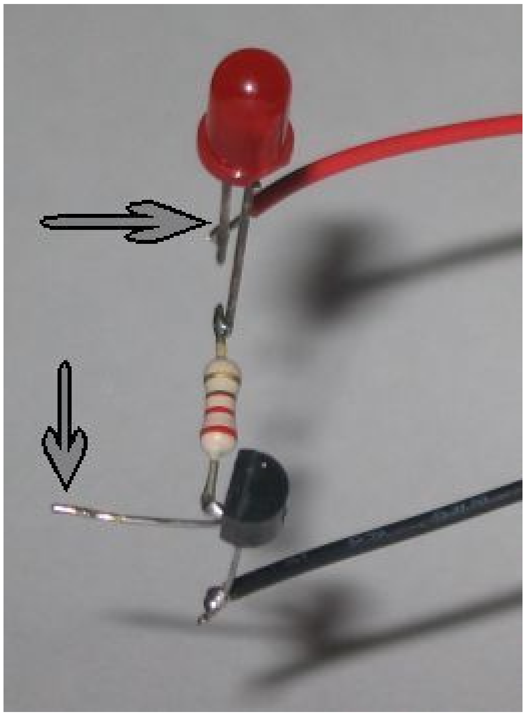
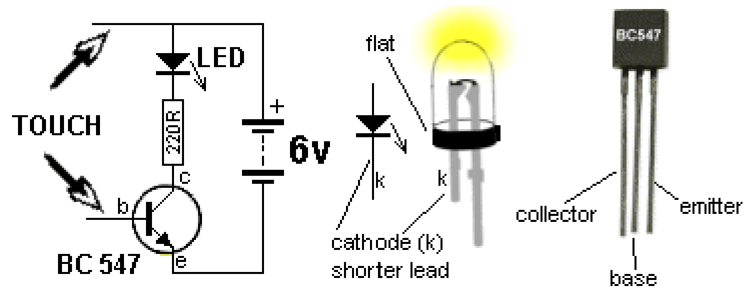


WORLDS SIMPLEST CIRCUIT

This is the simplest circuit you can get. Any NPN transistor can be used.



Connect the LED, 220 ohm resistor and transistor as shown in the photo.
Touch the top point with two fingers of one hand and the lower point with
fingers of the other hand and squeeze.
The LED will turn on brighter when you squeeze harder.

Your body has resistance and when a voltage is present, current will flow though your body (fingers). The transistor is amplifying the current through your fingers about 200 times and this is enough to illuminate the LED.

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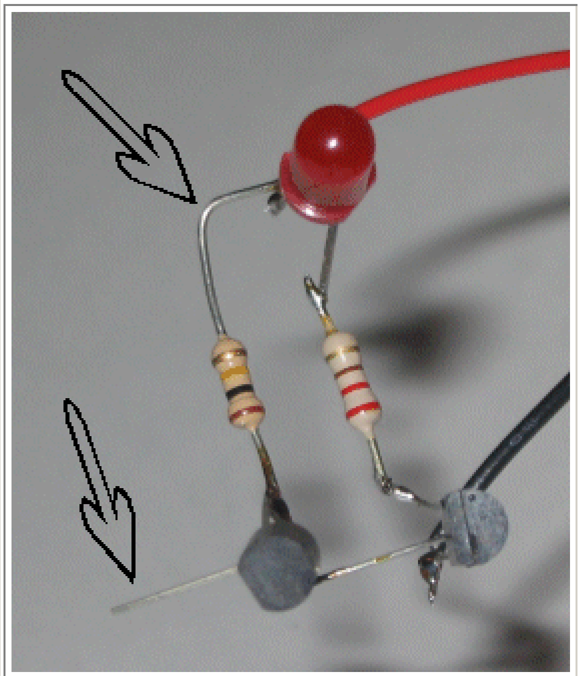
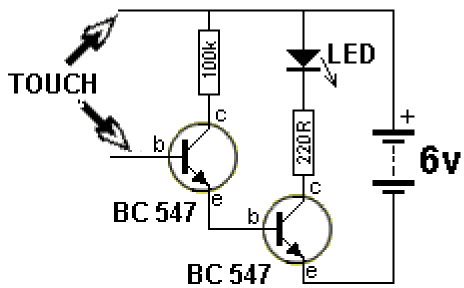


SECOND SIMPLEST CIRCUIT



This the second simplest circuit in the world. A second transistor has been added in place of your fingers. This transistor has a gain of about 200 and when you touch the points shown on the diagram, the LED will illuminate with the slightest touch. The transistor has amplified the current (through your fingers) about 200 times.

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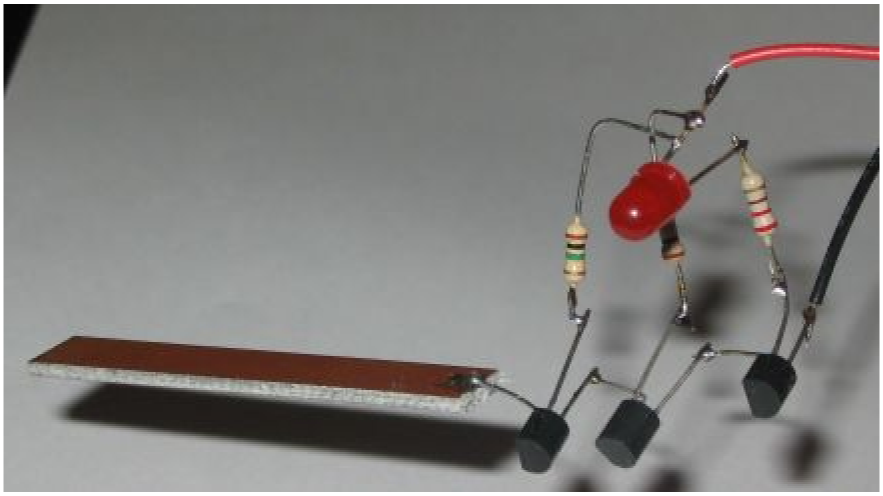
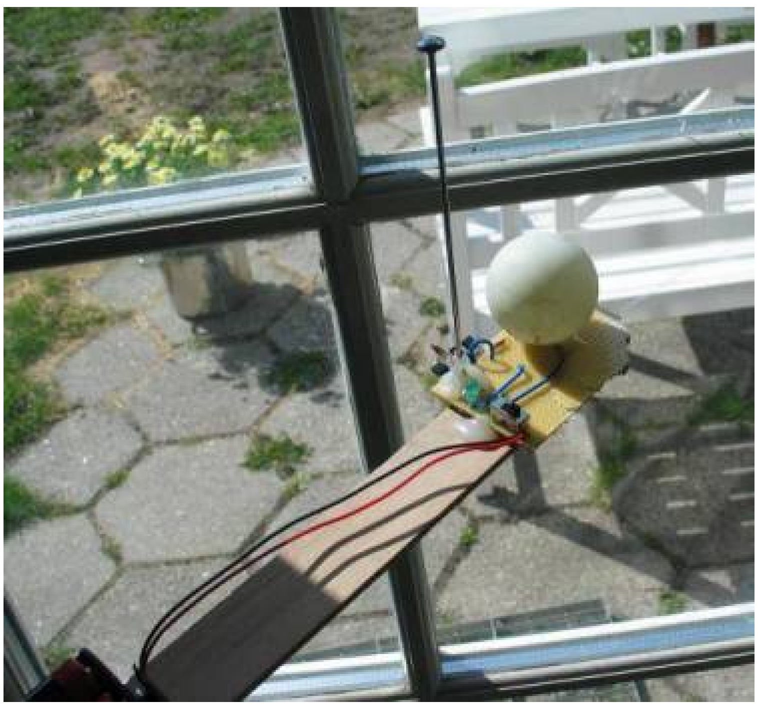
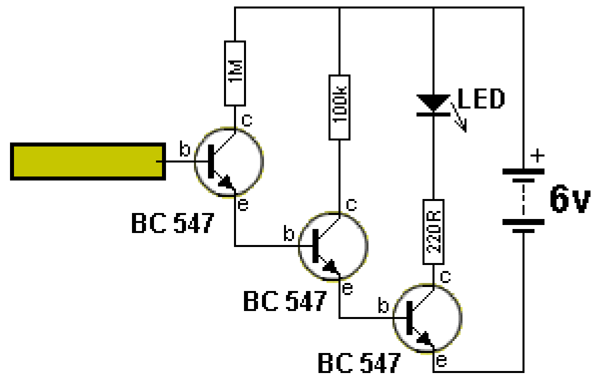




6 MILLION GAIN!

This circuit is so sensitive it will detect "mains hum
Simply move it across any wall and it will detect wh
the mains cable is located. It has a gain of about 2(
200 x 200 = 6,000,000 and will also detect static
electricity and the presence of your hand without a
direct contact. You will be amazed what it detects!
There is static electricity EVERYWHERE! The inpu
this circuit is classified as very high impedance.



Here is a photo of the circuit, produced by a
constructor, where he claimed he detected "ghosts

http://letsmakerobots.com/node/12034
http://letsmakerobots.com/node/18933

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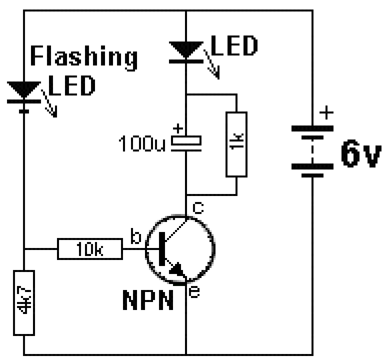
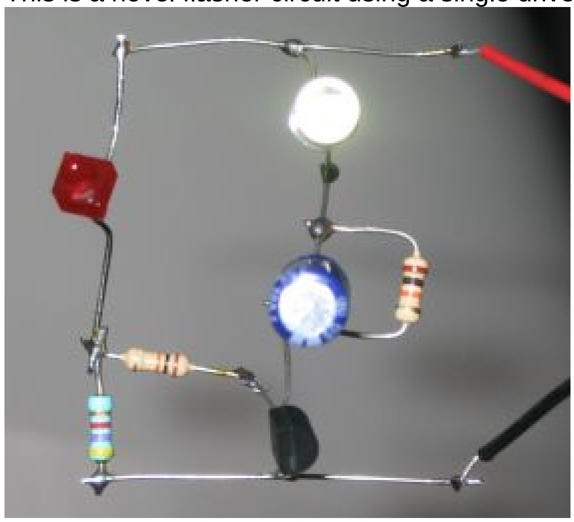


The circuit uses a flashing LED to flash a super-bright 20,000mcd white LED

LED FLASHER WITH ONE TRANSISTOR!

This is a novel flasher circuit using a single driver transistor that takes its flash-



rate from a flashing LED. The flasher in the photo is 3mm. An ordinary LED will not work.
The flash rate cannot be altered by the brightness of the high-bright white LED can be adjusted by altering the 1k resistor across the 100u electrolytic to 4k7 or 10k.
The 1k resistor discharges the 100u so that when the transistor turns on, the charging current into the 100u illuminates the white LED.
If a 10k discharge resistor is used, the 100u is not fully discharged and the LED does not flash as bright.
All the parts in the photo are in the same places as in the circuit diagram to make it easy to see how the parts are connected.

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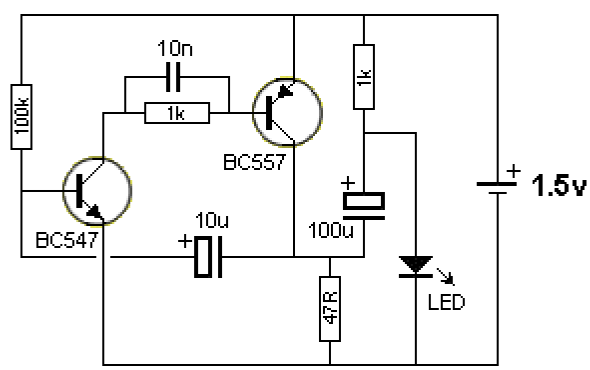

1.5v LED FLASHER

1.5v LED FLASHER

This will flash a LED, using a single 1.5v cell. It will even flash a white LED even though this type of LED needs about 3.2v to 3.6v for operation.
The circuit takes about 2mA but produces a very bright flash.

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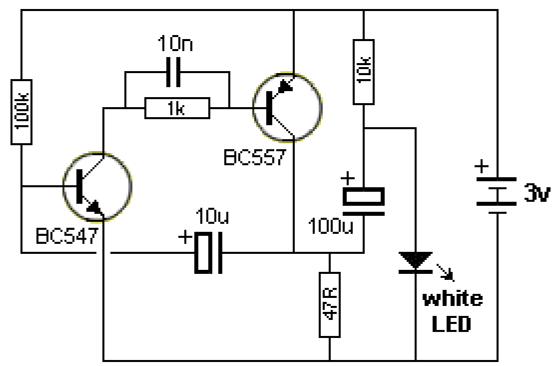

3v WHITE LED FLASHER

3v WHITE LED FLASHER

This will flash a white LED, on 3v supply and produce **a very bright flash.** The circuit produces a voltage higher than 5v if the LED is not in circuit but the LED limits the voltage to its characteristic voltage of 3.2v to 3.6v. The circuit takes about 2mA an is actually a voltage-multiplier arrangement.

Note the 10k in series with the LED charges the 100u. It does not illuminate the LED because the 100u is charging and the voltage across it is always less than 3v. When the two transistors conduct, the collector of the BC557 rises to rail voltage and pulls the 100u HIGH. The negative of the 100u effectively sits on top of the positive rail and the positive of the electro is about 2v higher than this. All the energy in the electro is pumped into the LED to produce a very bright flash.

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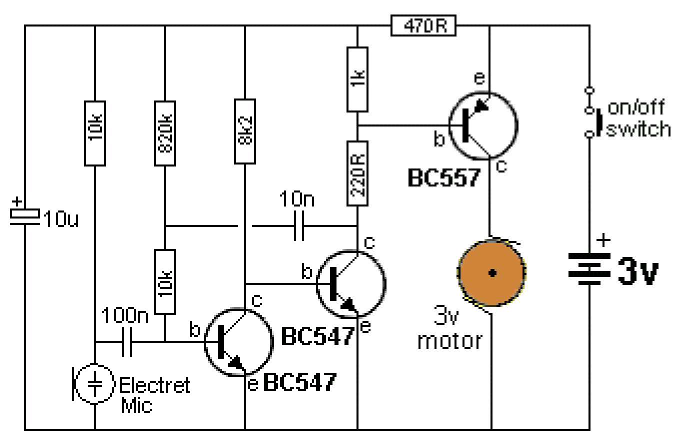

DANCING FLOWER

This circuit was taken from a dancing flower.

A motor at the base of the flower had a shaft up the stem and when the microphone detected music, the bent shaft made the flower wiggle and move.

The circuit will respond to a whistle, music or noise.

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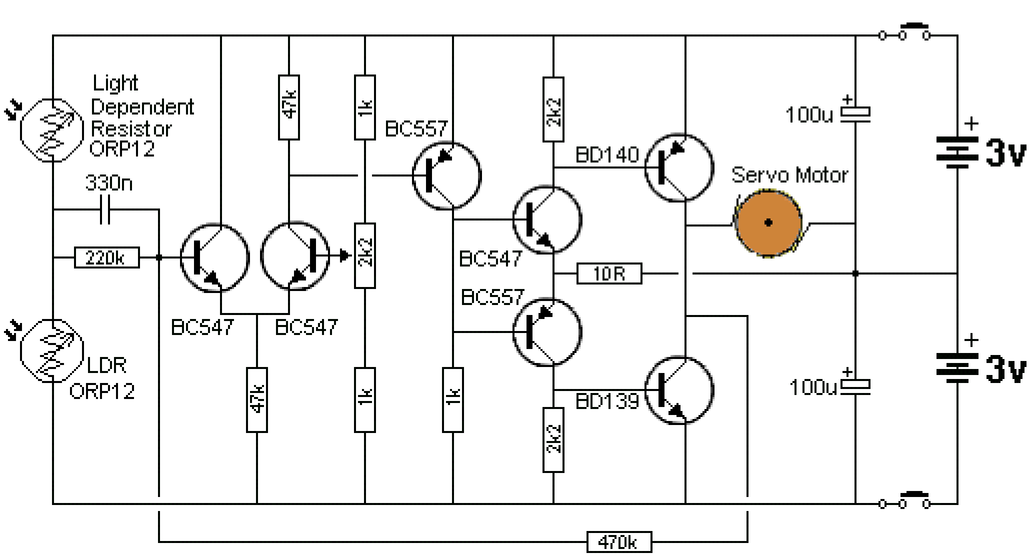

WHITE LINE FOLLOWER

This circuit can be used for a toy car to follow a white line. The motor is either a 3v type with gearing to steer the car or a rotary actuator or a servo motor. When equal light is detected by the photo resistors the voltage on the base of the first transistor will be mid rail and the circuit is adjusted via the 2k2 pot so the motor does not receive any voltage. When one of the LDR's receives more (or less) light, the motor is activated. And the same thing happens when the other LDR receives less or more light.

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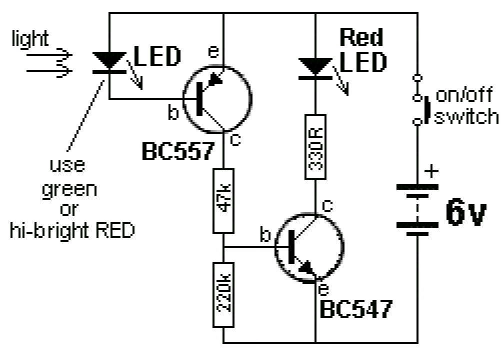

LED DETECTS LIGHT

All LEDs give off light of a particular colour but some LEDs are also able to detect light. Obviously they are not as good as a device that has been specially made to detect light; such as solar cell, photocell, photo resistor, light dependent resistor, photo transistor, photo diode and other photo sensitive devices.

A green LED will detect light and a high-bright red LED will respond about 100 times better than a green LED, but the LED in this position in the circuit is classified as very high impedance and it requires a considerable amount of amplification to turn the detection into a worthwhile current-source.

All other LEDs respond very poorly and are not worth trying.

The accompanying circuit amplifies the output of the LED and enables it to be used for a number of applications.

The LED only responds when the light enters the end of the LED and this makes it ideal for solar trackers and any time there is a large difference between the dark and light conditions. It will not detect the light in a room unless the lamp is very close.

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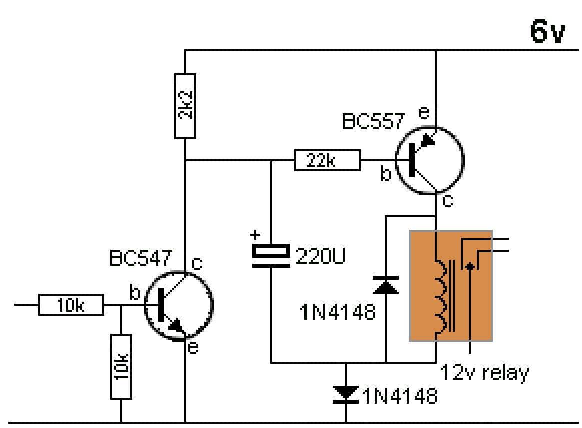

12v RELAY ON 6V SUPPLY

This circuit allows a 12v relay to operate on a 6v or 9v supply. Most 12v relays need about 12v to "pull-in" but will "hold" on about 6v. The 220u charges via the 2k2 and bottom diode. When an input above 1.5v is applied to the input of the circuit, both transistors are turned ON and the 5v across the electrolytic causes the negative end of the electro to go below the 0v rail by about 4.5v and this puts about 10v across the relay.

Alternatively you can rewind a 12v relay by removing about half the turns.

Join up what is left to the terminals. Replace the turns you took off, by connecting them in parallel with the original half, making sure the turns go the same way around

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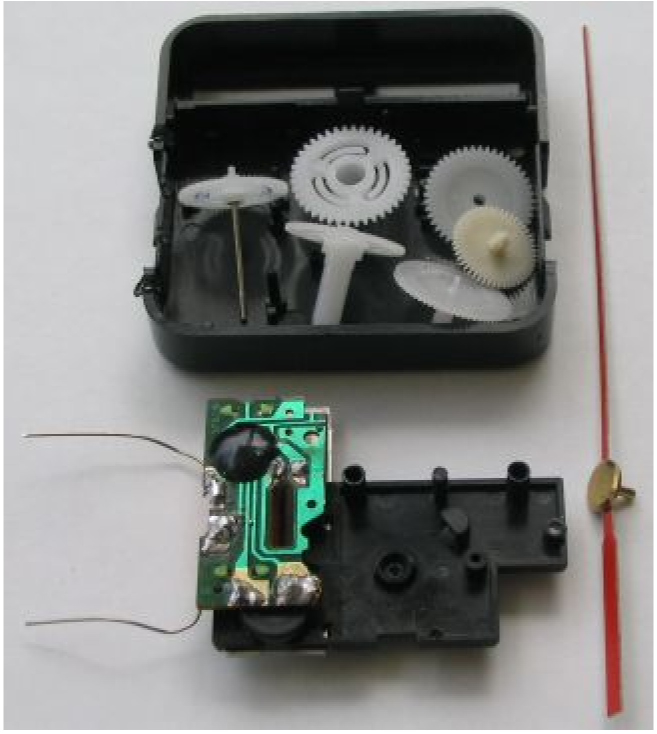
MAKE TIME FLY!

Connect this circuit to an old electronic clock mechanism and speed up the motor 100 times!
The "motor" is a simple "stepper-motor" that performs a half-rotation each time the electromagnet is energised. It normally takes 2 seconds for one revolution. But our circuit is connected directly to the winding and the frequency can be adjusted via the pot.
Take the mechanism apart, remove the 32kHz crystal and cut one track to the electromagnet. Connect the circuit below via wires and re-assemble the clock.
As you adjust the pot, the "seconds hand" will move clockwise or anticlockwise and you can watch the hours "fly by" or make "time go backwards."
The multivibrator section needs strong buffering to drive the 2,800 ohm inductive winding of the motor and that's why push-pull outputs have been used. The flip-flop circuit cannot drive the highly inductive load directly (it upsets the waveform enormously).
From a 6v supply, the motor only gets about 4v due to the voltage drops across the transistors. Consumption is about 5mA.

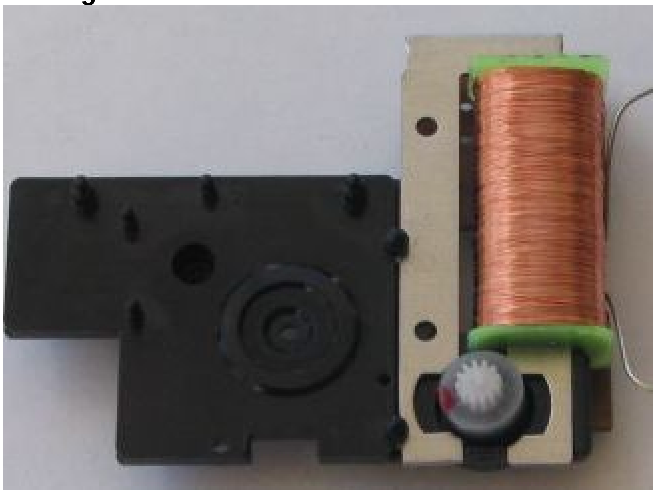


The crystal removed and a "cut track" to the coil. The 6 gears must be re-fitted for the hands to work.

HOW THE MOTOR WORKS

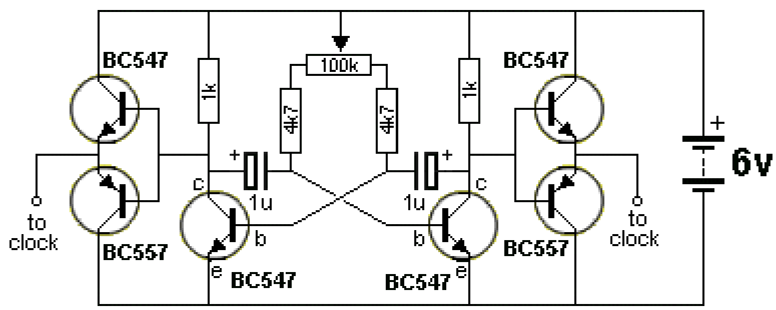
The rotor is a magnet with the north pole shown with the red mark and the south pole opposite.
The electromagnet actually produces poles. A strong North near the end of the electromagnet, and a weak North at the bottom. A strong South at the top left and weak South at bottom left. The rotor rests with its poles being attracted to the 4 pole-pieces equally.

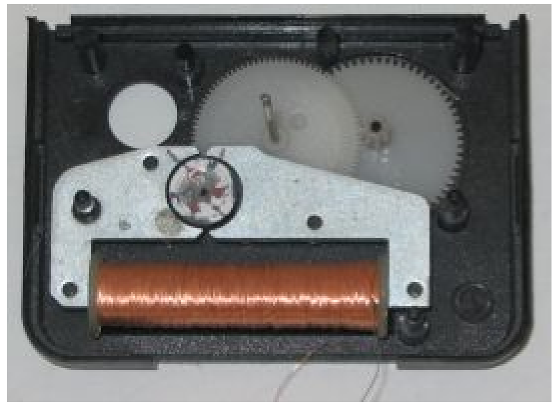
Voltage must be applied to the electromagnet around the correct way so that repulsion occurs. Since the rotor is sitting equally between the North poles, for example, it will see a strong pushing force from the pole near the electromagnet and this is how the motor direction is determined. A reversal of voltage will revolve the rotor in the same direction as before. The design of the motor is much more complex than you think!!



A close-up of the clock motor

Another clock motor is shown below. Note the pole faces spiral closer to the rotor to make it revolve in one direction. What a clever design!!





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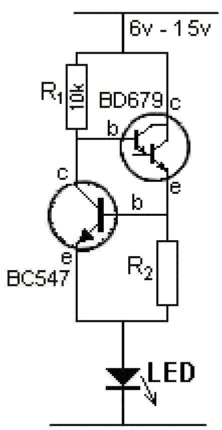

CONSTANT CURRENT SOURCE

This circuit provides a constant current to the LED. The LED can be replaced by any other component and the current through it will depend on the value of R2. Suppose R2 is 560R. When 1mA flows through R2, 0.56v will develop across this resistor and begin to turn on the BC547. This will rob the base of BD 679 with turn-on voltage and the transistor turns off slightly. If the supply voltage increases, this will try to increase the current through the circuit. If the current tries to increase, the voltage across R2 increases and the BD 679 turns off more and the additional voltage appears across the BD 679.
If R2 is 56R, the current through the circuit will be 10mA. If R2 is 5R6, the current through the circuit will be 100mA - although you cannot pass 100mA through a LED without damaging it.

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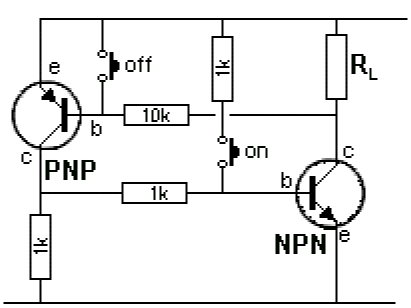

ON - OFF VIA MOMENTARY PUSH-BUTTONS

This circuit will supply current to the load R_L. The maximum current will depend on the second transistor. The circuit is turned on via the "ON" push button and this action puts a current through the load and thus a voltage develops across the load. This voltage is passed to the PNP transistor and it turns ON. The collector of the PNP keeps the power transistor ON.
To turn the circuit OFF, the "OFF" button is pressed momentarily. The 1k between base and emitter of the power transistor prevents the base floating or receiving any slight current from the PNP transistor that would keep the circuit latched ON.
The circuit was originally designed by a Professor of Engineering at Penn State University. It had 4 mistakes. So much for testing a circuit!!!! It has been corrected in the circuit on the left.

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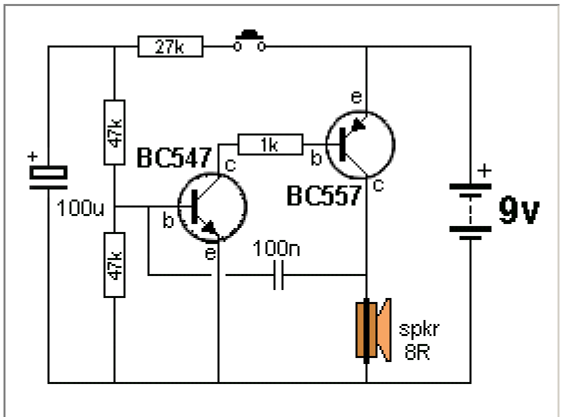

SIREN

This circuit produces a wailing or siren sound that gradually increases and decreases in frequency as the 100u charges and discharges when the push-button is pressed and released. In other words, the circuit is not automatic. You need to press the button and release it to produce the up/down sound.

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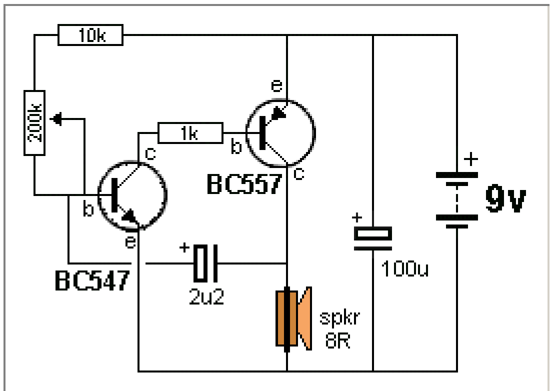

TICKING BOMB

This circuit produces a sound similar to a loud clicking clock. The frequency of the tick is adjusted by the 220k pot.
The circuit starts by charging the 2u2 and when 0.65v is on the base of the NPN transistor, it starts to turn on. This turns on the BC 557 and the voltage on the collector rises. This pushes the small charge on the 2u2 into the base of the BC547 to turn it on more.
This continues when the negative end of the 2u2 is above 0.65v and now the electro starts to charge in the opposite direction until both transistors are fully turned on. The BC 547 receives less current into the base and it starts to turn off. Both transistors turn off very quickly and the cycle starts again.

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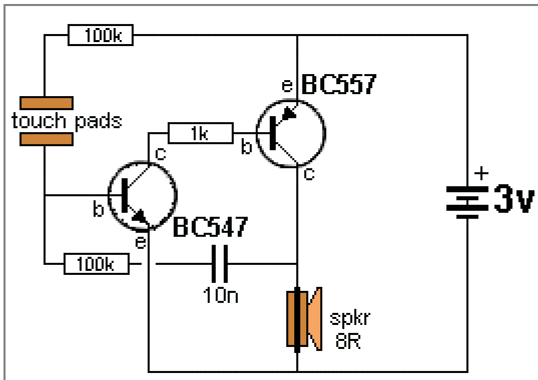

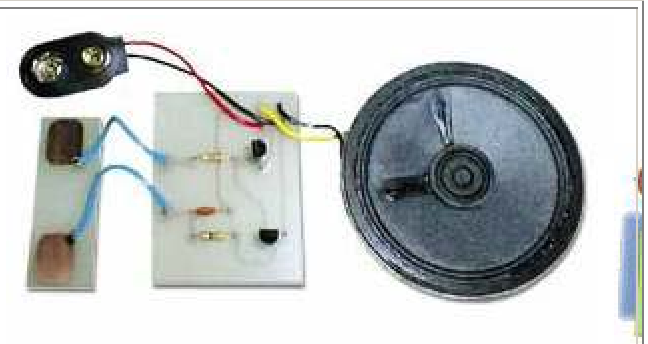

LIE DETECTOR

This circuit detects the resistance between your fingers to produce an oscillation. The detection-points will detect resistances as high as 300k and as the resistance decreases, the frequency increases.
Separate the two touch pads and attach them to the back of each hand. As the subject feels nervous, he will sweat and change the frequency of the circuit.
The photos show the circuit built on PC boards with separate touch pads.

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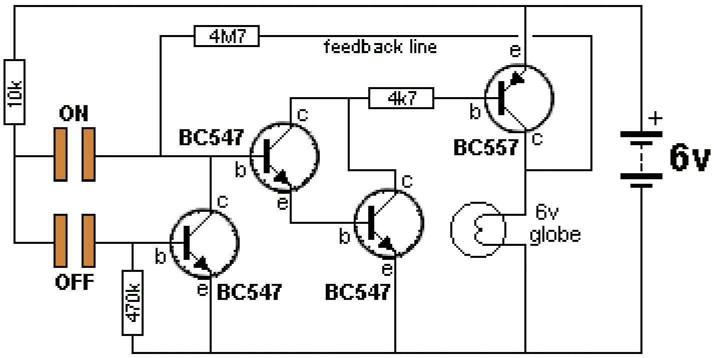

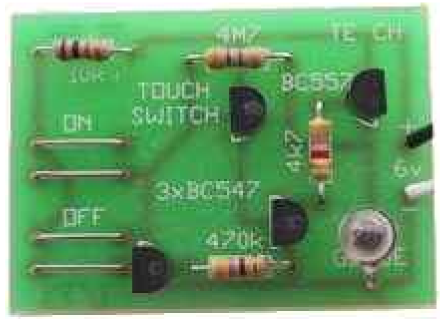

TOUCH SWITCH

This circuit detects the skin resistance of a finger to deliver a very small current to the super-alpha pair of transistors to turn the circuit ON. The output of the "super transistor" turns on the BC 557 transistor. The voltage on the top of the globe is passed to the front of the circuit via the 4M7 to take the place of your finger and the circuit remains ON.
To turn the circuit OFF, a finger on the OFF pads will activate the first transistor and this will rob the "super transistor" of voltage and the circuit will turn OFF.

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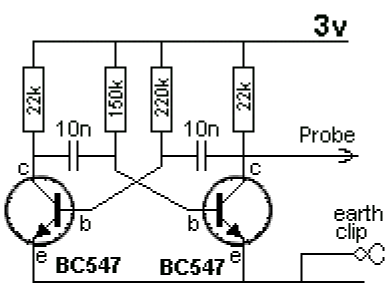

SIGNAL INJECTOR

This circuit is rich in harmonics and is ideal for testing amplifier circuits. To find a fault in an amplifier, connect the earth clip to the 0v rail and move through each stage, starting at the speaker. An increase in volume should be heard at each preceding stage.
This Injects will also go through the IF stages of radios and FM sound sections in TV's.

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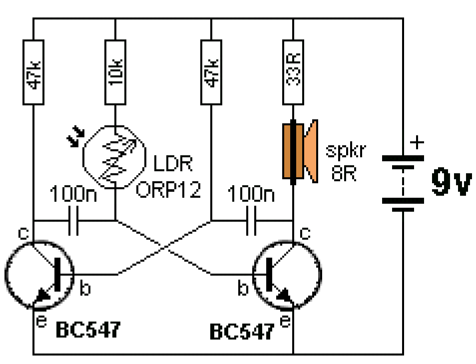

LIGHT ALARM - 1

This circuit operates when the Light Dependent Resistor receives light. When no light falls on the LDR, its resistance is high and the transistor driving the speaker is not turned on.
When light falls on the LDR its resistance decreases and the collector of the second transistor falls. This turns off the first transistor slightly via the second 100n and the first 100n puts an additional spike into the base of the second transistor. This continues until the second transistor is turned on as hard as it can go. The first 100n is now nearly charged and it cannot keep the second transistor turned on. The second transistor starts to turn off and both transistors swap conditions to produce the second half of the cycle.

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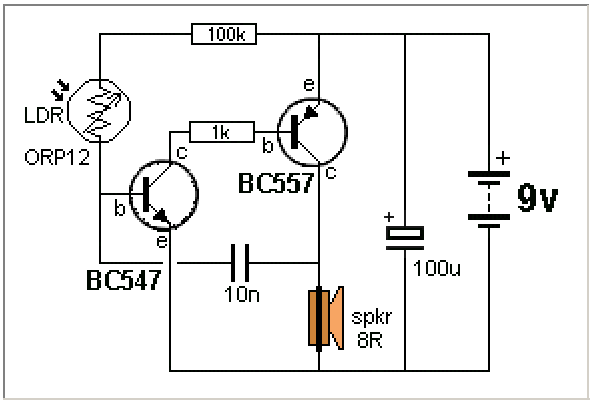

LIGHT ALARM - 2

This circuit is similar to Light Alarm -1 but produces a louder output due to the speaker being connected directly to the circuit.
The circuit is basically a high-gain amplifier that is turned on initially by the LDR and then the 10n keeps the circuit turning on until it can turn on no more.
The circuit then starts to turn off and eventually turns off completely. The current through the LDR starts the cycle again.

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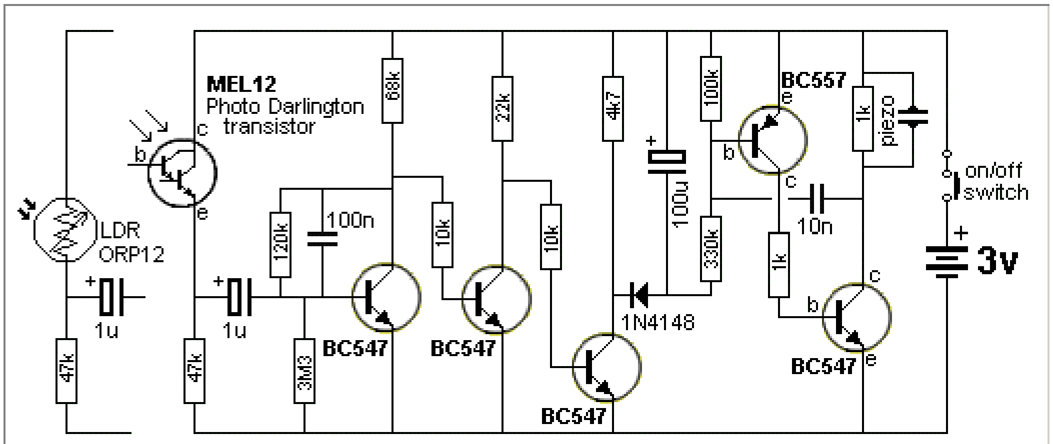

LIGHT ALARM - 3 (MOVEMENT DETECTOR)

This circuit is very sensitive and can be placed in a room to detect the movement of a person up to 2 metres from the unit.
The circuit is basically a high-gain amplifier (made up of the first three transistors) that is turned on by the LDR or photo Darlington transistor. The third transistor charges the 100u via a diode and this delivers turn-on voltage for the oscillator. The LDR has equal sensitivity to the photo transistor in this circuit.

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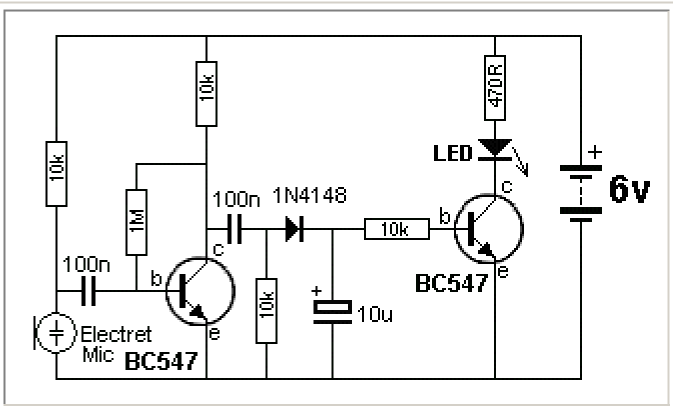

SOUND TRIGGERED LED

This circuit turns on a LED when the microphone detects a loud sound.
The "charge-pump" section consists of the 100n, 10k, signal diode and 10u electrolytic. A signal on the collector of the first transistor is passed to the 10u via the diode and this turns on the second transistor, to illuminate the LED.

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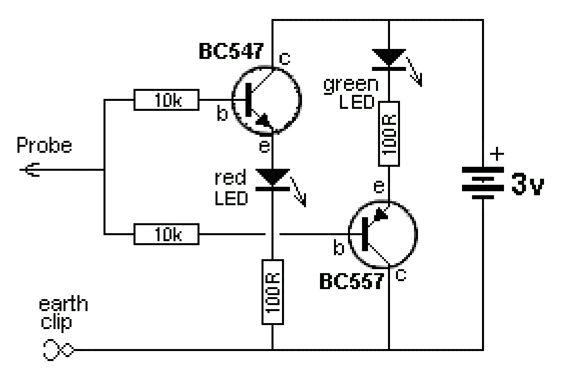

SIMPLE LOGIC PROBE

This circuit consumes no current when the probe is not touching any circuitry. The reason is the voltage across the green LED, the base-emitter junction of the BC557, plus the voltage across the red LED and base-emitter junction of the BC547 is approx: 2.1v + 0.6v + 1.7v + 0.6v = 5v and this is greater than the supply voltage.
When the circuit detects a LOW, the BC557 is turned on and the green LED illuminates. When a HIGH (above 2.3v) is detected, the red LED is illuminated.

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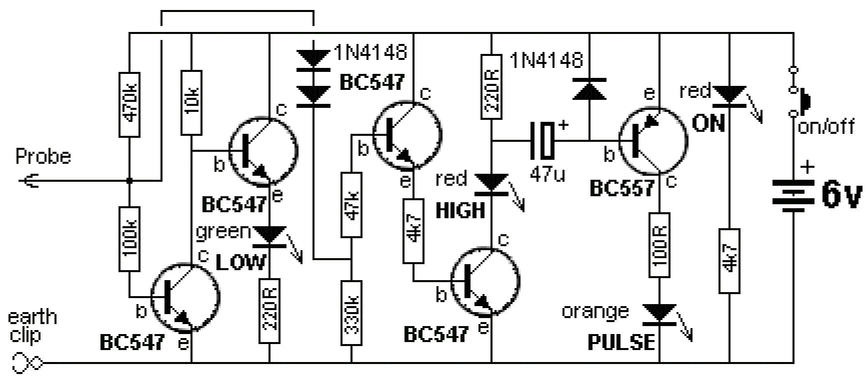

LOGIC PROBE with PULSE

This circuit has the advantage of providing a PULSE LED to show when a logic level is HIGH and pulsing at the same time. It can be built for less than $5.00 on a piece of matrix board or on a small strip of copper clad board if you are using surface mount components. The probe will detect a HIGH at 3v and thus the project can be used for 3v, 5v and CMOS circuits.

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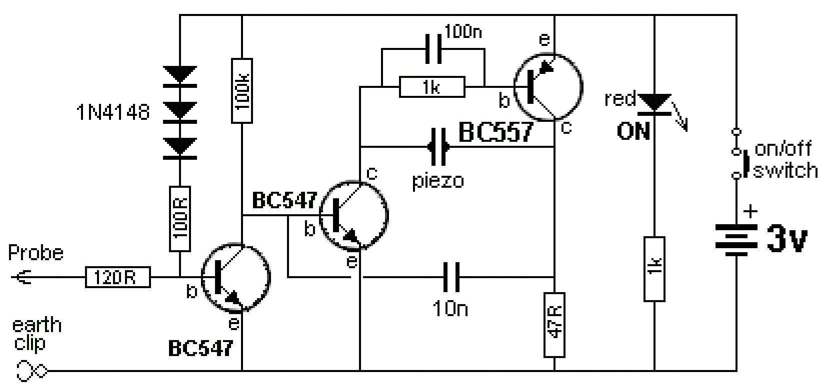

CONTINUITY TESTER

This circuit has the advantage of providing a beep when a short-circuit is detected but does not detect the small voltage drop across a diode. This is ideal when testing logic circuits as it is quick and you can listen for the beep while concentrating on the probe. Using a multimeter is much slower.

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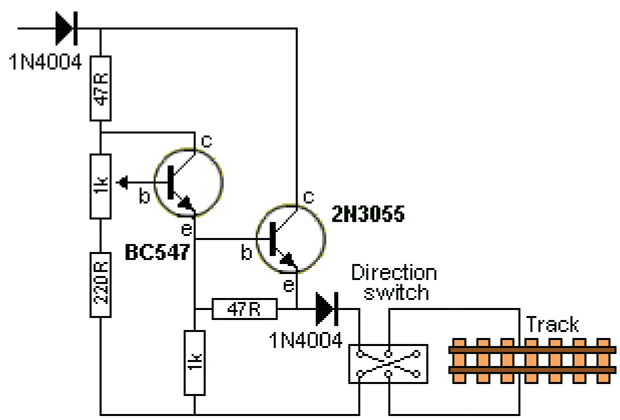

TRAIN THROTTLE

This circuit is for model train enthusiasts. By adding this circuit to your speed controller box, you will be able to simulate a train starting slowly from rest.
Remove the wire-wound rheostat and replace it with a 1k pot. This controls the base of the BC547 and the 2N3055 output is controlled by the BC547. The diodes protect the transistors from reverse polarity from the input and spikes from the rails.

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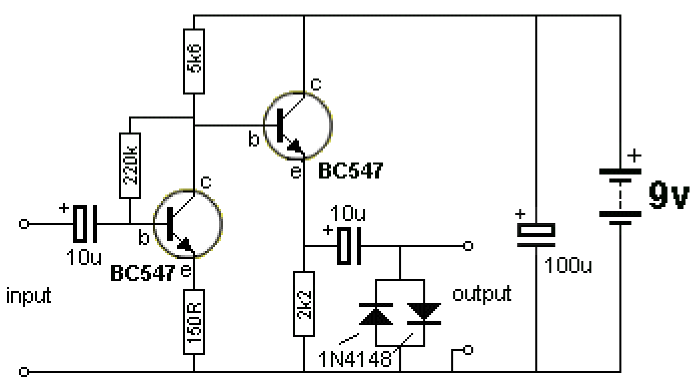

GUITAR FUZZ

The output of a guitar is connected to the input of the Fuzz circuit. The output of this circuit is connected to the input of your amplifier.
With the guitar at full volume, this circuit is overdriven and distorts. The distorted signal is then clipped by the diodes and your power amp amplifies the Fuzz effect.

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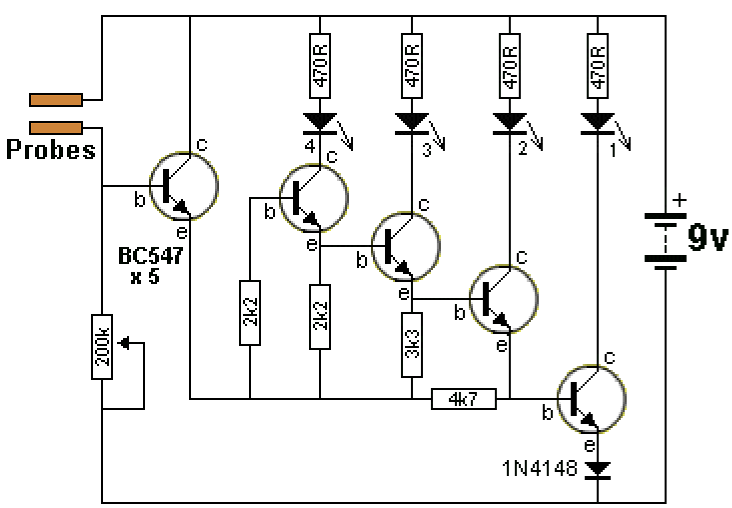

STRENGTH TESTER

This is a simple "staircase" circuit in which the LEDs come on as the resistance between the probes decreases.
When the voltage on the base of the first transistor sees 0.6v + 0.6v + 0.6v = 1.8v, LED1 comes on. LEDs 1&2 will come on when the voltage rises a further 0.6v. The amount of pressure needed on the probes to produce a result, depends on the setting of the 200k pot.

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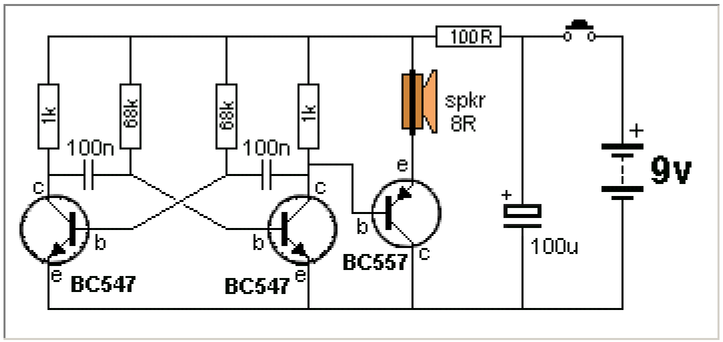

FOG HORN

When the push-button is pressed, the 100u will take time to charge and this will provide the rising pitch and volume. When the push-button is released, the level and pitch will die away. This is the characteristic sound of a ship's fog horn.

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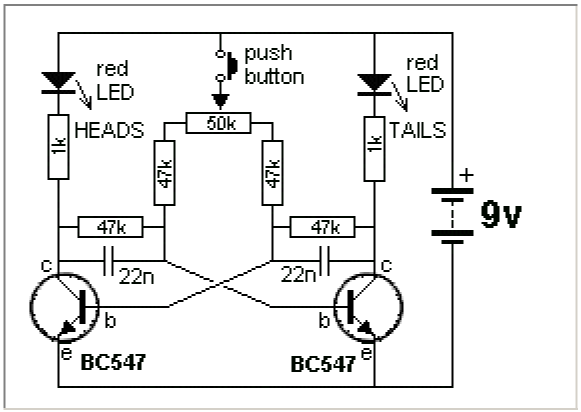

HEADS OR TAILS

When the push-button is pressed, the circuit will oscillate at a high rate and both LEDs will illuminate. When the push button is released, one of the LEDs will remain illuminated. The 50k is designed to equalise the slightly different values on each half of the circuit and prevent a "bias."

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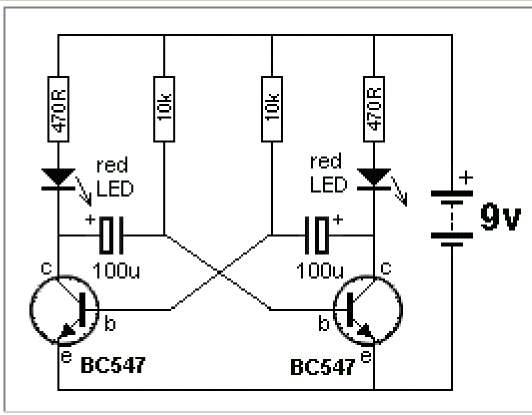

ROBOT MAN

This multivibrator circuit will flash the Robot Man's eyes as shown in the photo. The kit of components is available from Talking Electronics for $8.50 plus postage. Send an email to find out the cost of postage: talking@tpg.com.au

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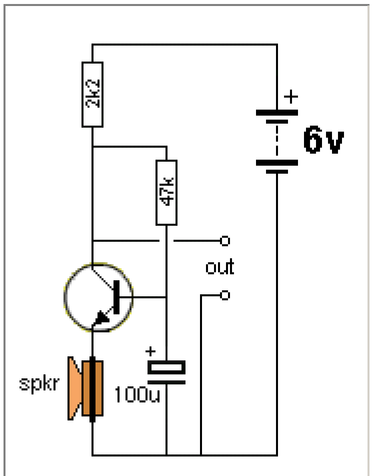

DYNAMIC MICROPHONE AMPLIFIER

This circuit takes the place of an electret microphone. It turns an ordinary mini speaker into a very sensitive microphone.
Any NPN transistors such as BC 547 can be used. The circuit will work from 3v to 9v. It is a common-base amplifier and accepts the low impedance of the speaker to produce a gain of more than 100.

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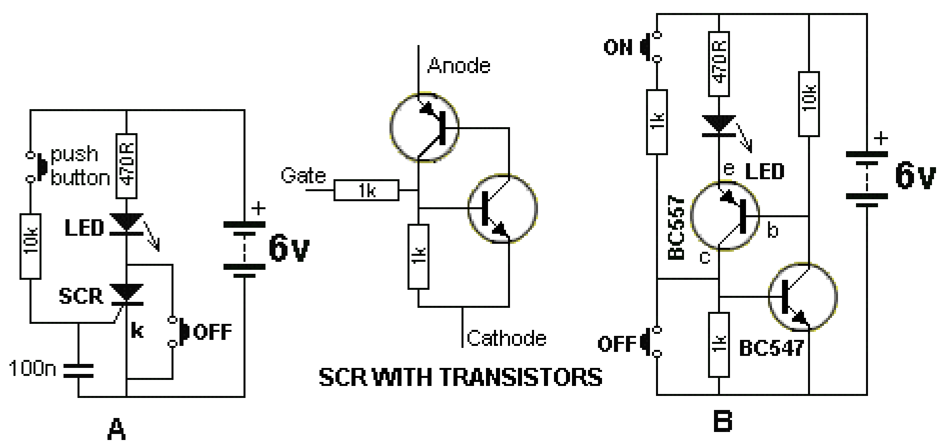

SCR WITH TRANSISTORS

The SCR in circuit A produces a 'LATCH.' When the button is pressed, the LED remains illuminated.
The SCR can be replaced with two transistors as shown in circuit B.
To turn off circuit A, the current through the SCR is reduced to zero by the action of the OFF button. In circuit B the OFF button removes the voltage on the base of the BC547. The OFF button could be placed across the two transistors and the circuit will turn off.

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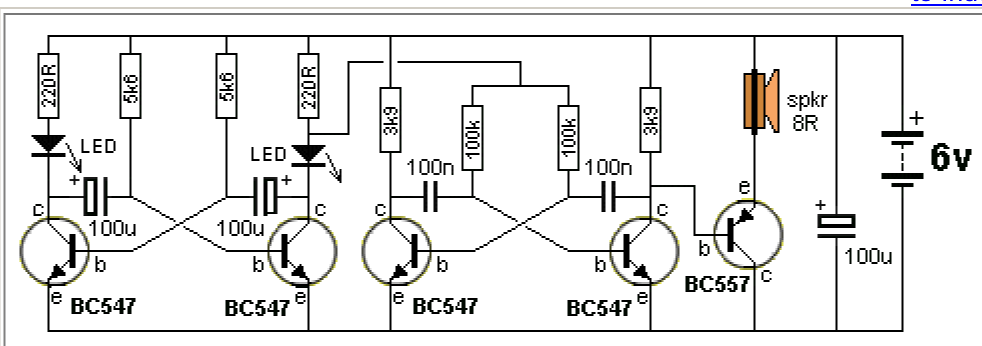

HEE HAW SIREN

The circuit consists of two multivibrators. The first multi-vibrator operates at a low frequency and this provides the speed of the change from Hee to Haw. It modifies the voltage to the tone multivibrator, by firstly allowing full voltage to appear at the bottom of the 220R and then a slightly lower voltage when the LED is illuminated.

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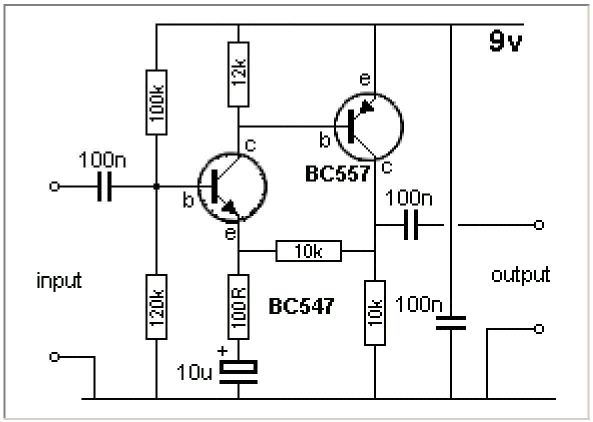

MICROPHONE PRE-AMPLIFIER

This circuit consists of two directly coupled transistors operating as common-emitter amplifiers.
The ratio of the 10k resistor to the 100R sets the gain of the circuit at 100.

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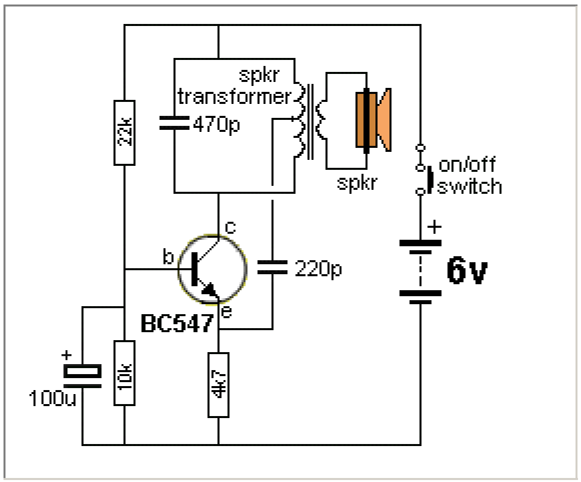

HARTLEY OSCILLATOR

The Hartley Oscillator is characterised by an LC circuit in its collector. The base of the transistor is held steady and a small amount of signal is taken from a tapping on the inductor and fed to the emitter to keep the transistor in oscillation.
The transformer can be any speaker transformer with centre-tapped primary.
The frequency is adjusted by changing the 470p.

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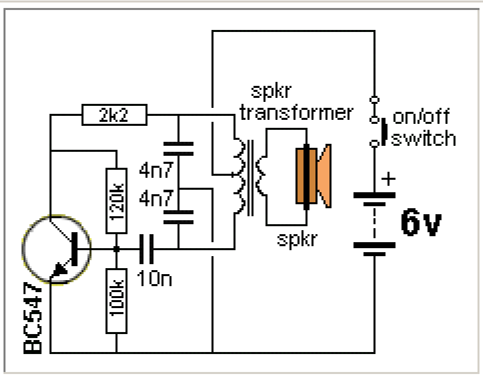

COLPITTS OSCILLATOR

The Colpitts Oscillator is characterised by tapping the mid-point of the capacitive side of the oscillator section. The inductor can be the primary side of a speaker transformer. The feedback comes via the inductor.

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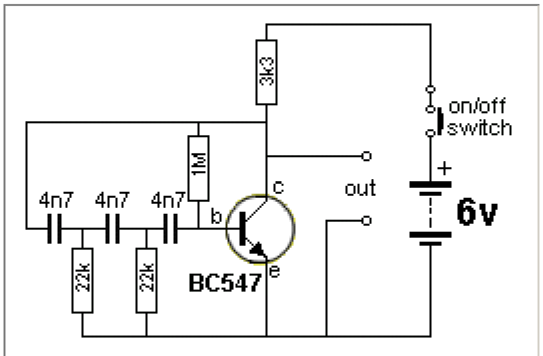

PHASESHIFT OSCILLATOR

The Phaseshift Oscillator is characterised by 3 high-pass filters, creating a 180° phase shift. The output is a sinewave. Take care not to load the output - this will prevent reliable start-up and may stop the circuit from oscillating. Reduced the 3k3 load resistor if the load prevents the circuit oscillating. See Phase Shift Oscillator in section section of 200 Transistor Circuits for a better design.

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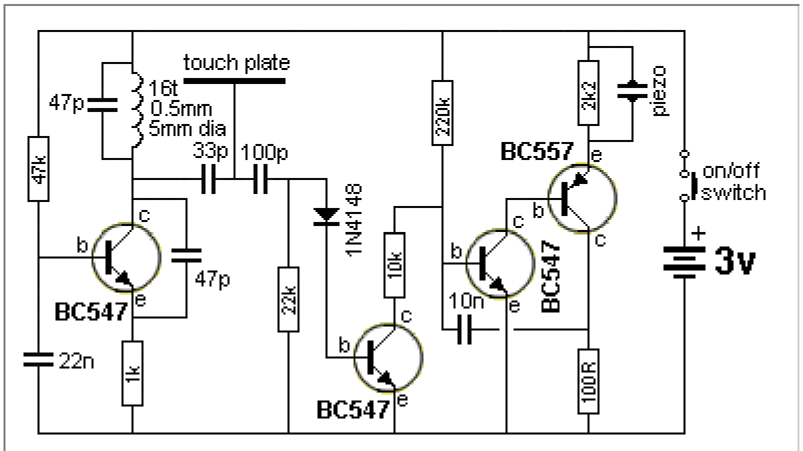

DOOR-KNOB ALARM

This circuit can be used to detect when someone touches the handle of a door. A loop of bare wire is connected to the point "touch plate" and the project is hung on the door-knob.
Anyone touching the metal door-knob will kill the pulses going to the second transistor and it will turn off. This will activate the "high-gain" amplifier/oscillator.
The circuit will also work as a "Touch Plate" as it does not rely on main hum, as many other circuits do.

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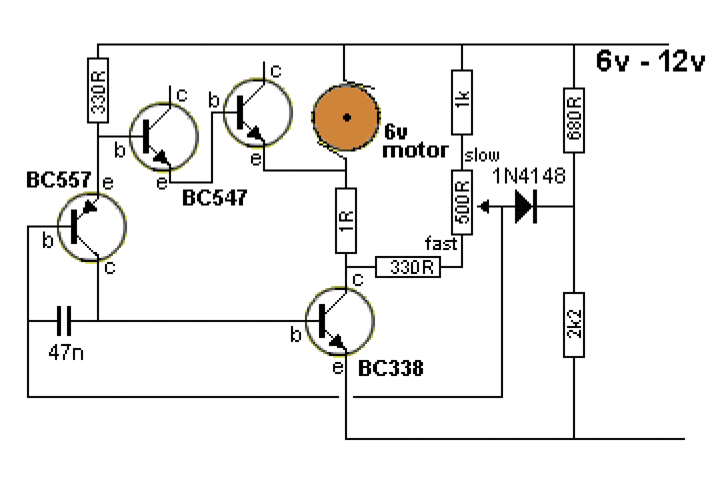

MOTOR SPEED CONTROLLER

Most simple motor speed controllers simply reduce the voltage to a motor by introducing a series resistance. This reduces the motor's torque and if the motor is stopped, it will not start again.
This circuit detects the pulses of noise produced by the motor to turn the circuit off slightly. If the motor becomes loaded, the amplitude of the pulses decreases and the circuit turns on more to deliver a higher current.

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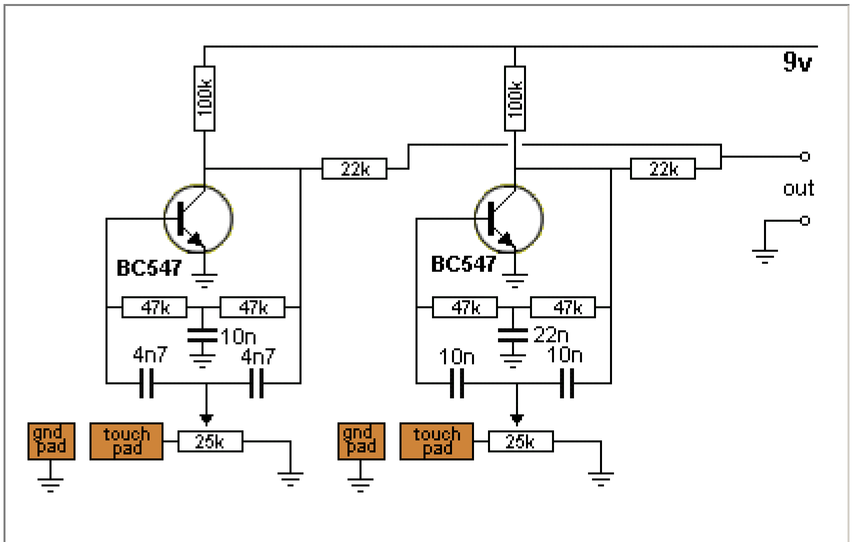

ELECTRONIC DRUMS

The circuit consists of two "twin-T" oscillators set to a point below oscillation. Touching a Touch Pad will set the circuit into oscillation. Different effects are produced by touching the pads in different ways and a whole range of effects are available. The two 25k pots are adjusted to a point just before oscillation. A "drum roll" can be produced by shifting a finger rapidly across adjacent ground and drum pads.

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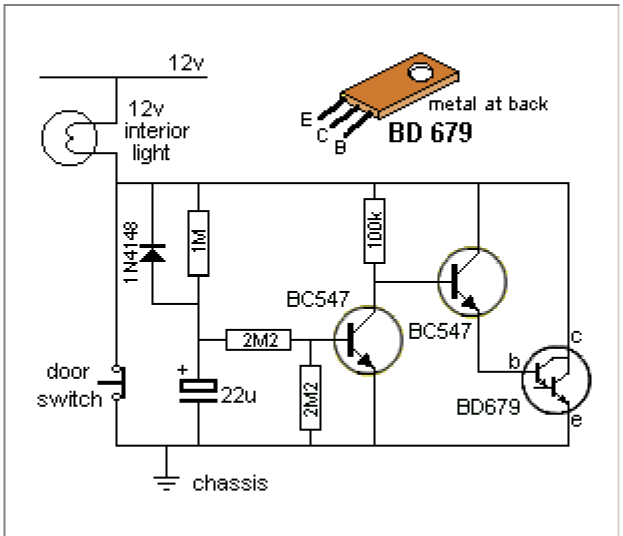

LIGHT EXTENDER

This circuit is a Courtesy Light Extender for cars. It extends the "ON" time when a door is closed in a car, so the passenger can see where he/she is sitting.

When the door switch is opened, the light normally goes off immediately, but the circuit takes over and allows current to flow because the 22u is not charged and the first BC 547 transistor is not turned ON. This turns on the second BC547 via the 100k and the BD679 is also turned on to illuminate the interior light.

The 22u gradually charges via the 1M and the first BC547 turns on, robbing the second BC547 of "turn-on" voltage and it starts to turn off the BD679.

The 1N4148 discharges the 22u when the door is opened.

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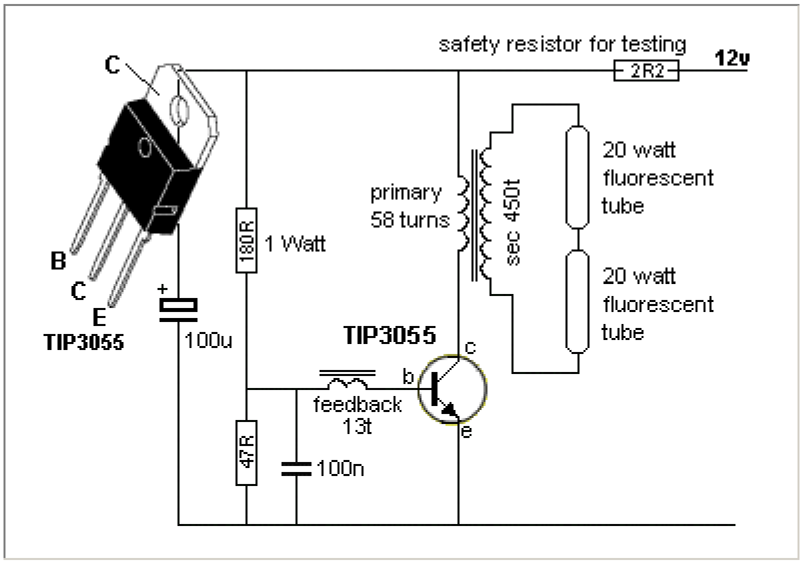

20 WATT FLUORO INVERTER

This circuit will drive a 40 watt fluoro or two 20-watt tubes in series.
The transformer is wound on a ferrite rod 10mm dia and 8cm long.
The wire diameters are not critical but our prototype used 0.61mm wire for the primary and 0.28mm wire for the secondary and feedback winding.
Do not remove the tube when the circuit is operating as the spikes produced by the transformer will damage the transistor.
The circuit will take approx 1.5amp on 12v, making it more efficient than running the tubes from the mains. A normal fluoro takes 20 watts for the tube and about 15 watts for the ballast.

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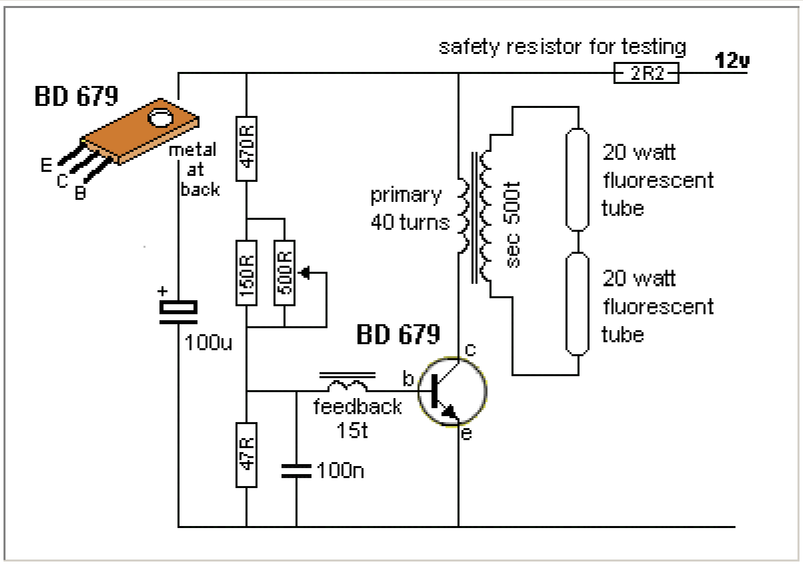

6 to 12 WATT FLUORO INVERTER

This circuit will drive a 40 watt fluoro or two 20-watt tubes in series but with less brightness than the circuit above and it will take less current.
2 x 20 watt tubes = 900mA to 1.2A and 1 x 20 watt tube 450mA to 900mA depending on pot setting.
The transformer is wound on a ferrite rod 10mm dia and 8cm long. The wire diameter is fairly critical and our prototype used 0.28mm wire for all the windings.
Do not remove the tube when the circuit is operating as the spikes produced by the transformer will damage the transistor. The pot will adjust the brightness and vary the current consumption. Adjust the pot and select the base-bias resistor to get the same current as our prototype. Heat-sink must be greater than 40sq cm. Use heat-sink compound.

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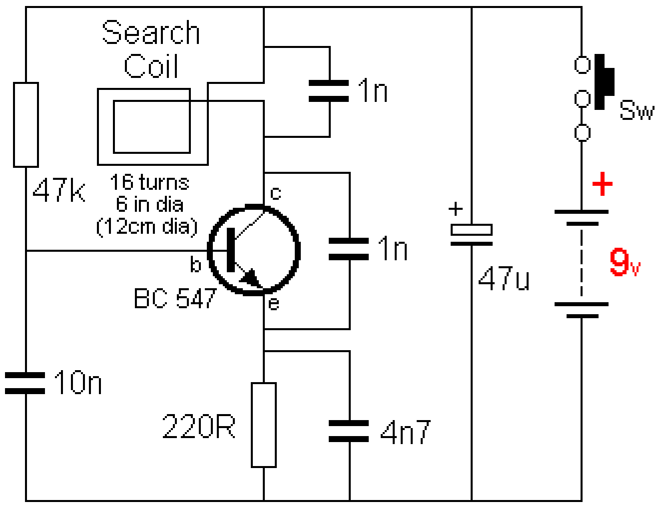
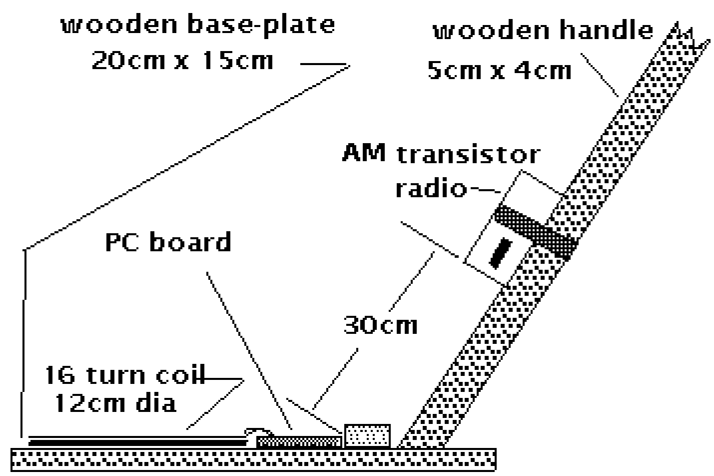
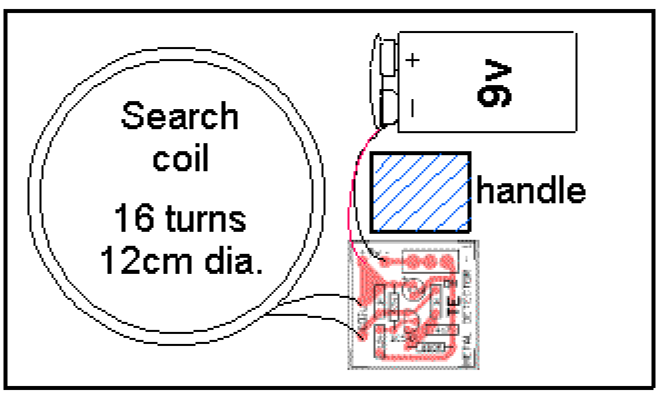




THE LAYOUT OF THE DETECTOR



The Layout of Metal Detector -1

GOLD DETECTOR

This very simple circuit will detect gold or metal or coins at a distance of approx 20cm - depending on the size of the object.
The circuit oscillates at approx 140kHz and a harmonic of this frequency is detected by an AM radio.
Simply tune the radio until a squeal is detected.
When the search coil is placed near a metal object, the frequency of the circuit will change and this will be heard from the speaker.
The layout of the circuit is shown and the placement of the radio.

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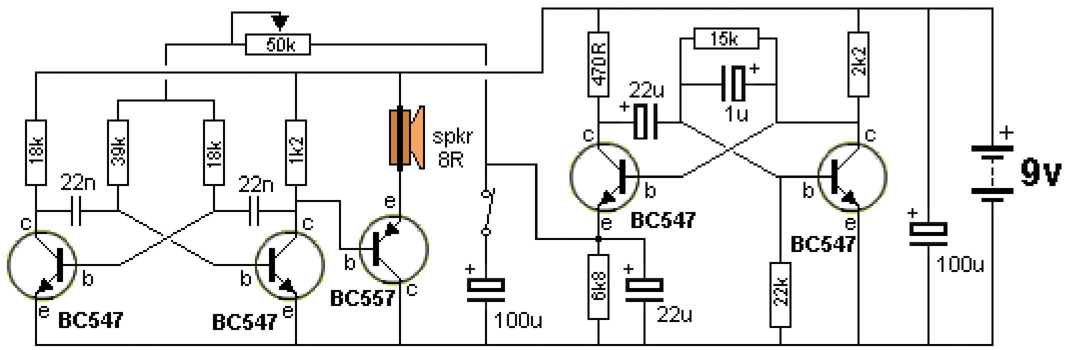

PHASER GUN

This is a very effective circuit. The sound is amazing. You have to build it to appreciate the range of effects it produces. The 50k pot provides the frequency of the sound while the switch provides fast or slow speed.

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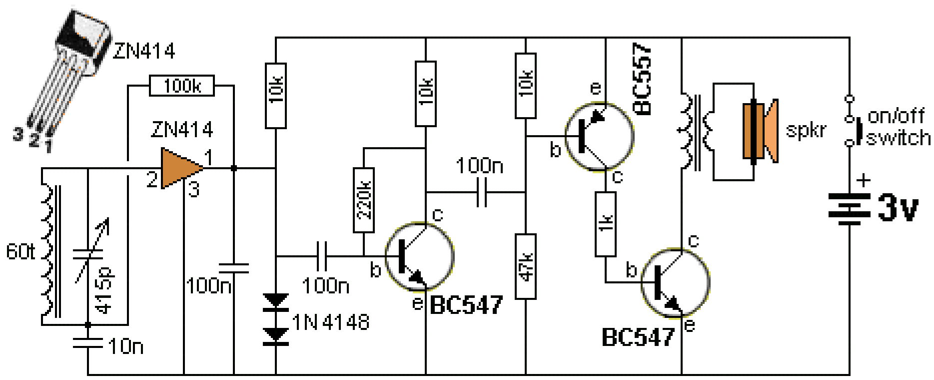

IC RADIO

This circuit contains an IC but it looks like a 3-leaded transistor and that's why we have included it here.

The IC is called a "Radio in a Chip" and it contains 10 transistors to produce a TRF (tuned Radio Frequency) front end for our project.

The 3-transistor amplifier is taken from our SUPER EAR project with the electret microphone removed.

The two 1N 4148 diodes produce a constant voltage of 1.3v for the chip as it is designed for a maximum of 1.5v.

The "antenna coil" is 60t of 0.25mm wire wound on a 10mm ferrite rod. The tuning capacitor can be any value up to 450p.

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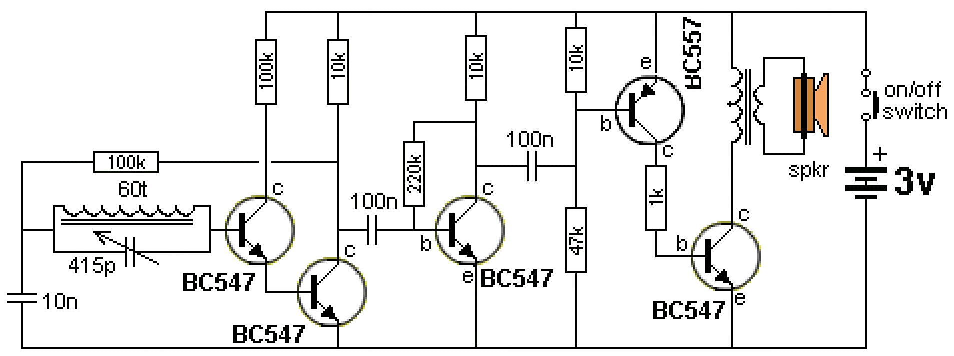

5-TRANSISTOR RADIO

If you are not able to get the ZN414 IC, this circuit uses two transistors to take the place of the chip.

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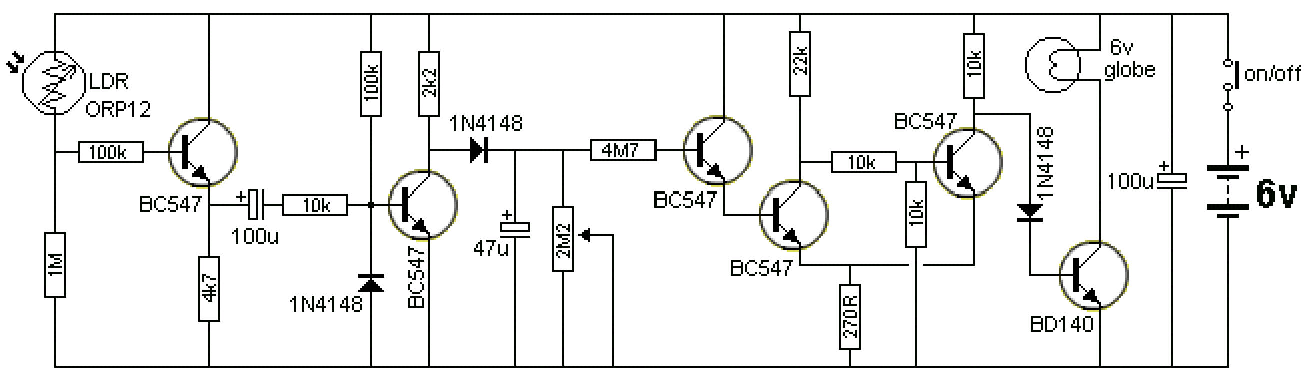

AUTOMATIC LIGHT

This circuit automatically turns on a light when illumination is removed from the LDR. It remains ON for the delay period set by the 2M2 pot.

The important feature of this circuit is the building blocks it contains - a delay circuit and Schmitt Trigger. These can be used when designing other circuits.

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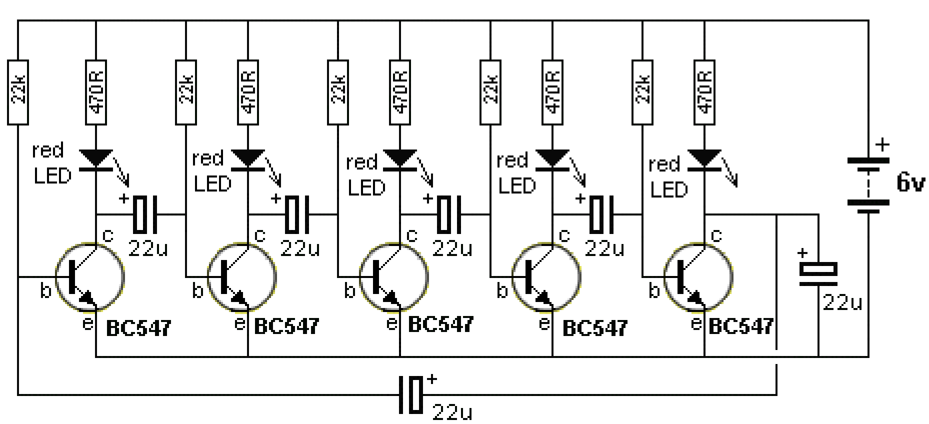

5-LED CHASER

The LEDs in this circuit produce a chasing pattern similar the running LEDs

display in video shops.
All transistors will try to come on at the same time when the power is applied, but some will be faster due to their internal characteristics and some will get a different turn-on current due to the exact value of the 22u electrolytics. The last 22u will delay the voltage-rise to the base of the first transistor and make the circuit start reliably.
The circuit can be extended to any number of odd stages.

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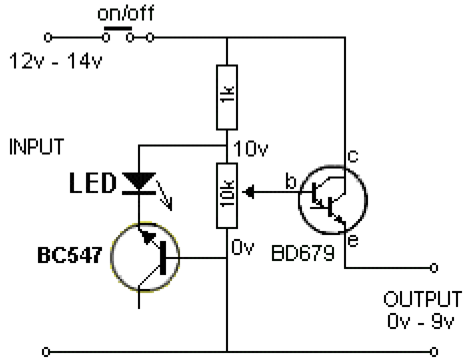
BENCH POWER SUPPLY



This power supply can be built in less than an hour on a piece of copper-laminate. The board acts as a heat-sink and the other components can be mounted as shown in the photo, by cutting strips to suit their placement.
The components are connected with enamelled wire and the transistor is bolted to the board to keep it cool.
The Bench Power Supply was designed to use old "C," "D" and lantern batteries, that's why there are no diodes or electrolytics. Collect all your old batteries and cells and connect them together to get at least 12v -14v.
The output of this power supply is regulated by a 10v zener made up of the characteristic zener voltage of 8.2v between the base-emitter leads of a BC547 transistor (in reverse bias) and approx 1.7v across a red LED. The circuit will deliver 0v - 9v at 500mA (depending on the life left in the cells your are using). The 10k pot adjusts the output voltage and the LED indicates the circuit is ON. It's a very good circuit to get the last of the energy from old cells.

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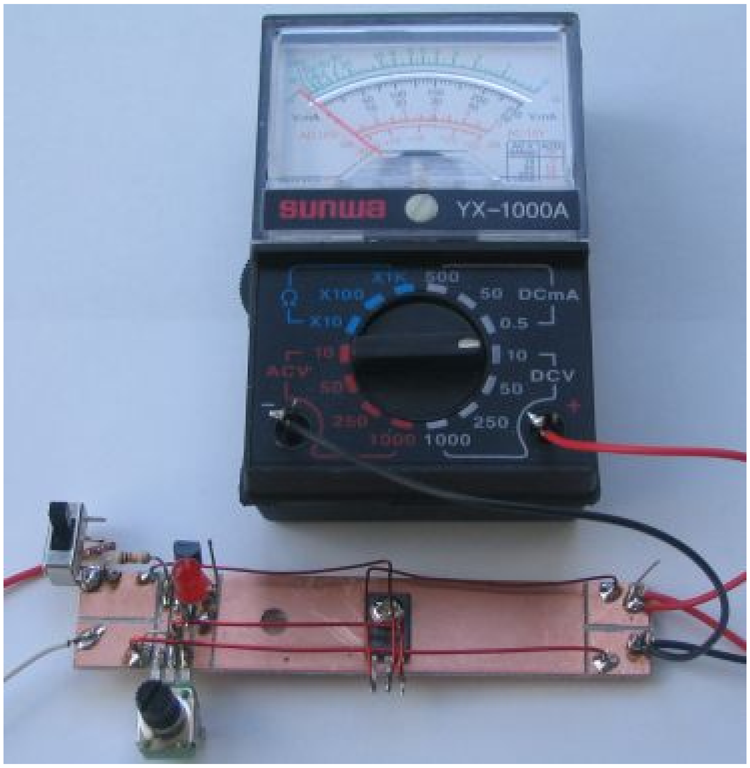
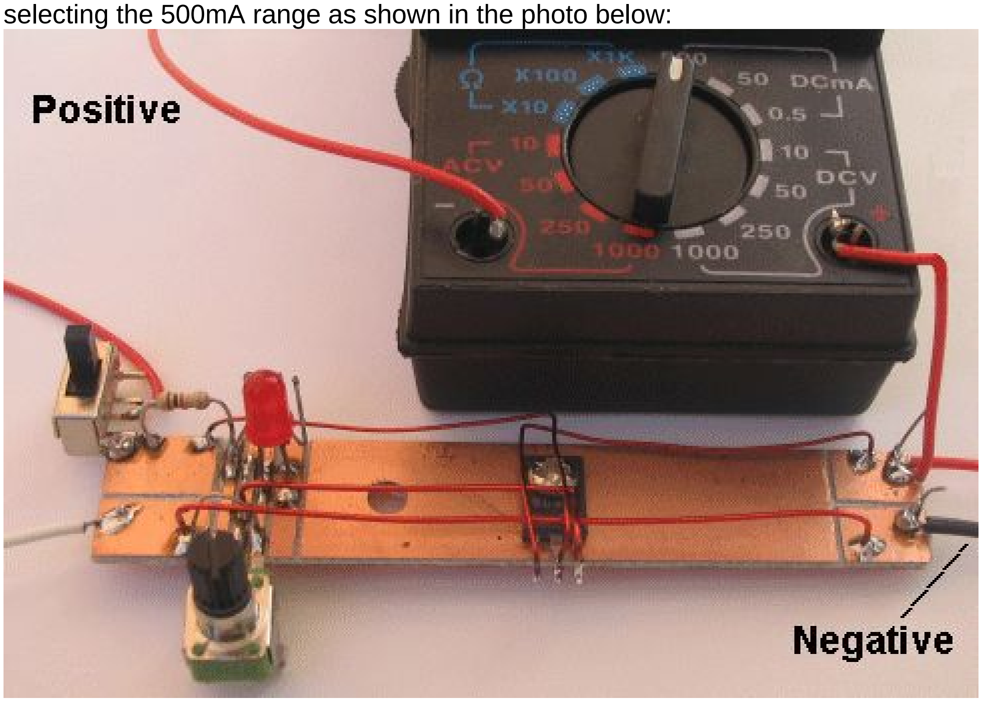
ADDING A VOLT-METER TO THE BENCH POWER SUPPLY



A voltmeter can be added to the Bench Power Supply by using a very low cost multimeter. For less than $10.00 you can get a mini multimeter with 14 ranges, including a 10v range. The multimeter can **also** be used to monitor current by removing the negative lead and making a new RED lead, fitting it to the "—" of the multimeter and selecting the 500mA range as shown in the photo below:



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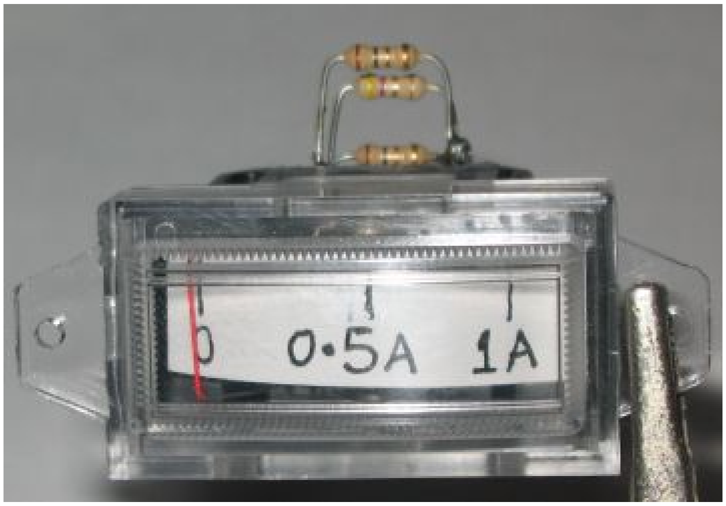
MAKING 0-1Amp meter for the BENCH POWER SUPPLY



The item in the photo is called a "Movement." A movement is a moving coil with a pointer and no resistors connected to the leads.
Any Movement can be converted to an ammeter without any mathematics.
Simply solder two 1R resistors (in parallel) across the terminals of any movement and connect it in series with an ammeter on the output of the Bench Power Supply. The second ammeter provides a reference so you can calibrate the movement. Connect a globe and increase the voltage.
At 500mA, if the pointer is "up scale" (reading too high) add a trim-resistor. In our case it was 4R7.
The three shunt resistors can be clearly seen in the photo. Two 1R and the trim resistor is 4R7.
You can get a movement from an old multimeter or they are available in electronics shops as a separate item. The sensitivity does not matter. It can be 20uA or 50uA FSD or any sensitivity.

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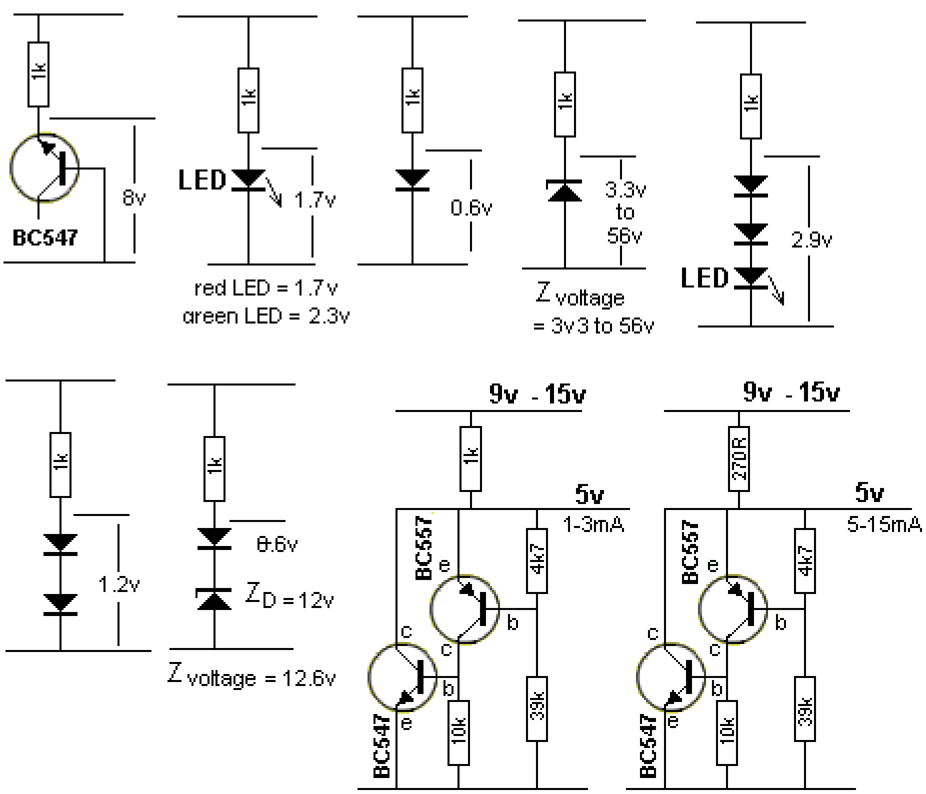
MAKING A ZENER DIODE

Sometimes a zener diode of the required voltage is not available. Here are a number of components that produce a characteristic voltage across them. Since they all have different voltages, they can be placed in series to produce the voltage you need. A reference voltage as low as 0.65v is available and you need at least 1 to 3mA through the device(s) to put them in a state of conduction (breakdown).



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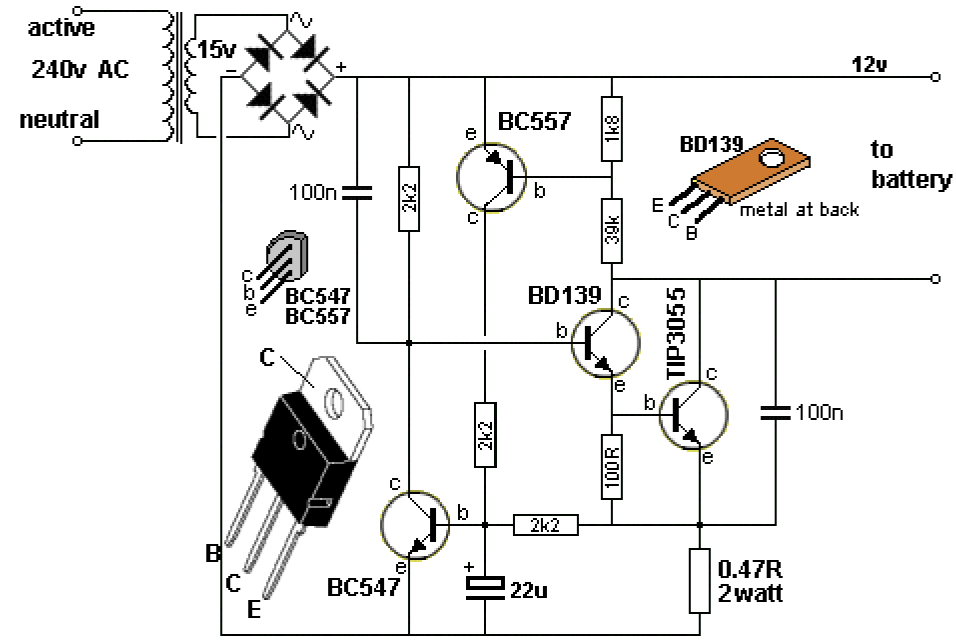
12v TRICKLE CHARGER



The 12v Trickle Charger circuit uses a TIP3055 power transistor to limit the current to the battery by turning off when the battery voltage reaches approx 14v or if the current rises above 2 amp. The signal to turn off this transistor comes from two other transistors - the BC557 and BC 547.
Firstly, the circuit turns on fully via the BD139 and TIP3055. The BC557 and BC 547 do not come into operation at the moment. The current through the 0.47R creates a voltage across it to charge the 22u and this puts a voltage between the base and emitter of the BC547. The transistors turn on slightly and remove some of the turn-on voltage to the BD139 and this turns off the TIP3055 slightly.
This is how the 2 amp max is created.
As the battery voltage rises, the voltage divider made up of the 1k8 and 39k creates a 0.65v between base and emitter of the BC557 and it starts to turn on at approx 14v. This turns on the BC 547 and it robs the BD136 of "turn-on" voltage and the TIP3055 is nearly fully turned off.
All battery chargers in Australia must be earthed. The negative of the output is taken to the earth pin.

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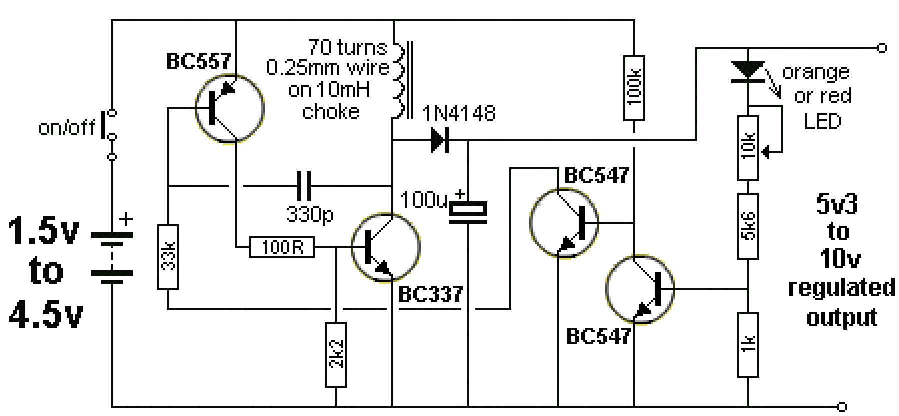
1.5v to 10v INVERTER



This very clever circuit will convert 1.5v to 10v to take the place of those expensive 9v

batteries and also provide a 5v supply for a microcontroller project.
But the clever part is the voltage regulating section. It reduces the current to less than 8mA when no current is being drawn from the output. With a 470R load and 10v, the output current is 20mA and the voltage drop is less than 10mV. The pot will adjust the output voltage from 5.3v to 10v.

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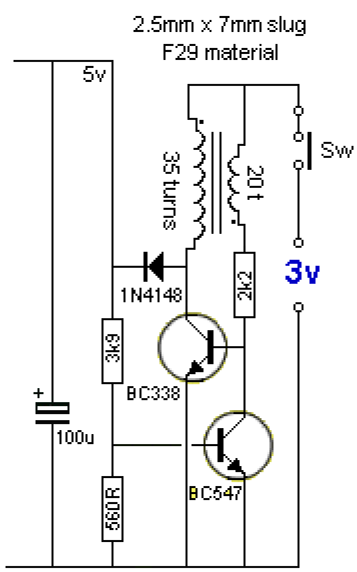

5v REGULATED SUPPLY FROM 3V

This circuit will produce a 5v regulated output from 2 cells (3v). The output current is limited to 50mA but will be ideal for many microcontroller circuits. The output voltage is set to 5v by the 3k9 and 560R resistors, making up a voltage divider network.

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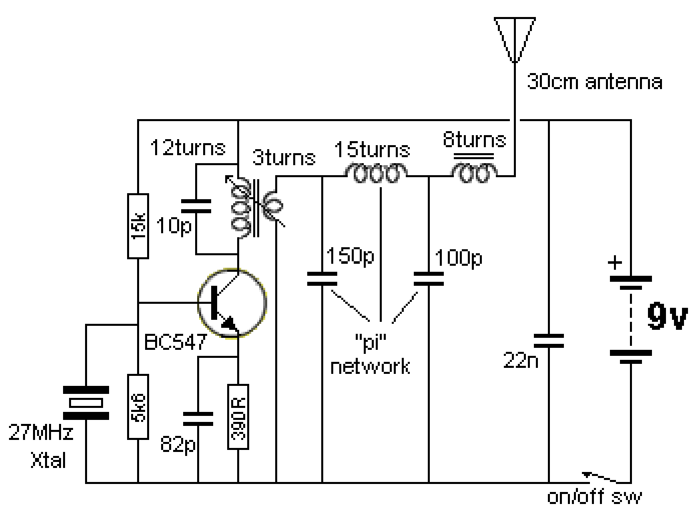

27MHz TRANSMITTER

The transmitter is a very simple crystal oscillator. The heart of the circuit is the tuned circuit consisting of the primary of the transformer and a 10p capacitor. The frequency is adjusted by a ferrite slug in the centre of the coil until it is exactly the same as the crystal. The transistor is configured as a common emitter amplifier. It has a 390R on the emitter for biasing purposes and prevents a high current passing through the transistor as the resistance of the transformer is very low.
The "pi" network matches the antenna to the output of the circuit. See full description in 27MHz Links article.

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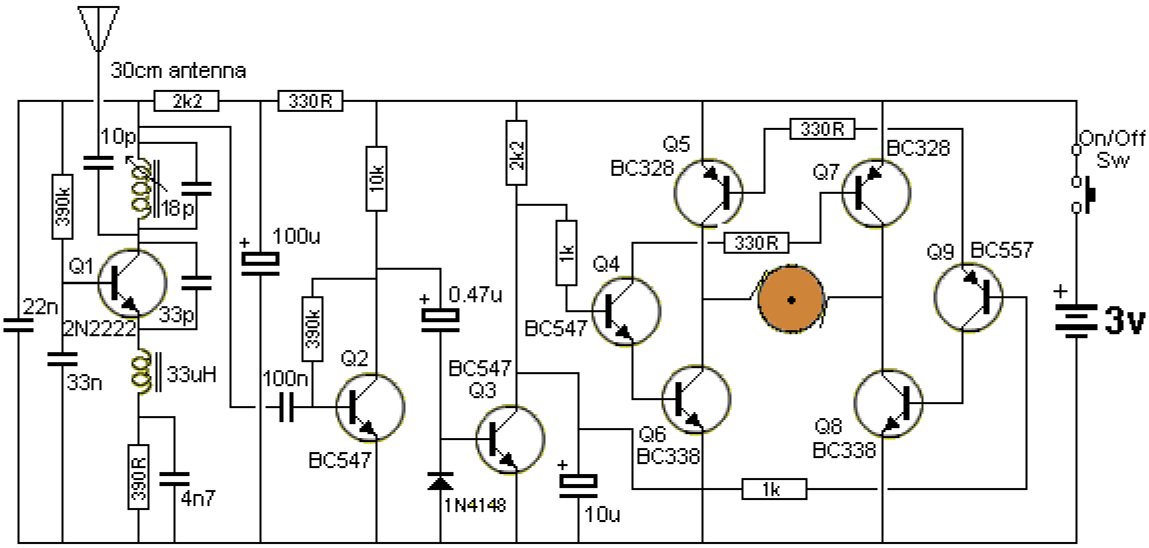

27MHz RECEIVER

The 27MHz receiver is really a transmitter. It's a very weak transmitter and delivers a low level signal to the surroundings via the antenna. When another signal (from the transmitter) comes in contact with the transmission from the receiver it creates an interference pattern that reflects down the antenna and into the first stage of the receiver.
The receiver is a super-regenerative design. It is self-oscillating (or already oscillating) and makes it very sensitive to nearby signals. See full description in 27MHz Links article.

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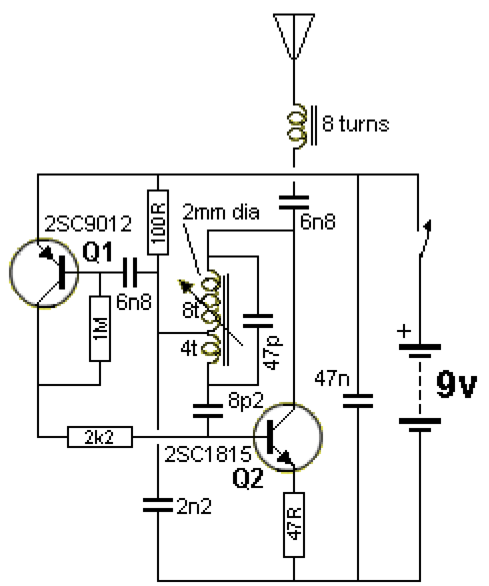

27MHz TRANSMITTER WITHOUT A CRYSTAL

A 27MHz transmitter without a crystal. When a circuit does not have a crystal, the oscillator is said to be "voltage dependent" or "voltage controlled" and when the supply voltage drops, the frequency changes.
If the frequency drifts too much, the receiver will not pick up the signal. For this reason, a simple circuit as shown is not recommended. We have only included it as a concept to show how the 27MHz frequency is generated. It produces a tone and this is detected by a receiver.

See full description in 27MHz Links article.

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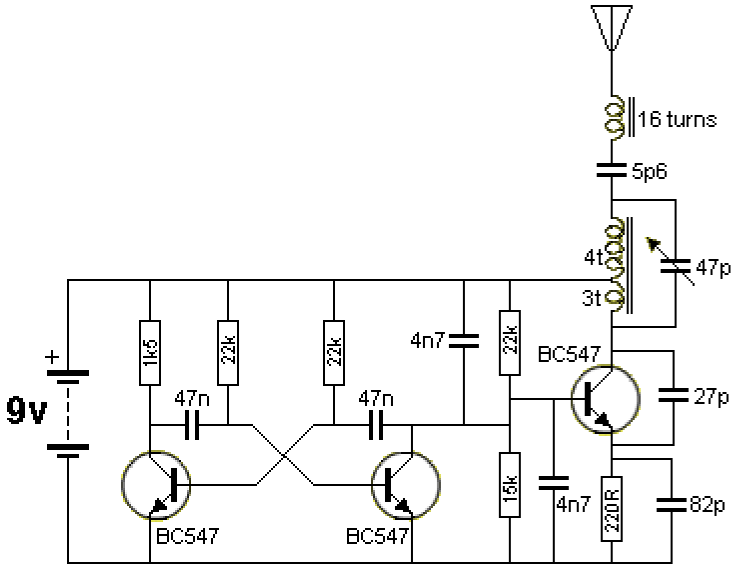

27MHz TRANSMITTER WITH SQUARE-WAVE OSCILLATOR

The circuit consists of two blocks. Block 1is a multivibrator and this has an equal mark/space ratio to turn the RF stage on and off. Block 2 is an RF oscillator. The feedback to keep the stage operating is provided by the 27p capacitor. The frequency-producing items are the coil (made up of the full 7 turns) and the 47p air trimmer. These two items are called a parallel tuned circuit. They are also called a TANK CIRCUIT as they store energy just like a TANK of water and pass it to the antenna. The frequency of the circuit is adjusted by the 47p air trimmer. See full description in 27MHz Links article.

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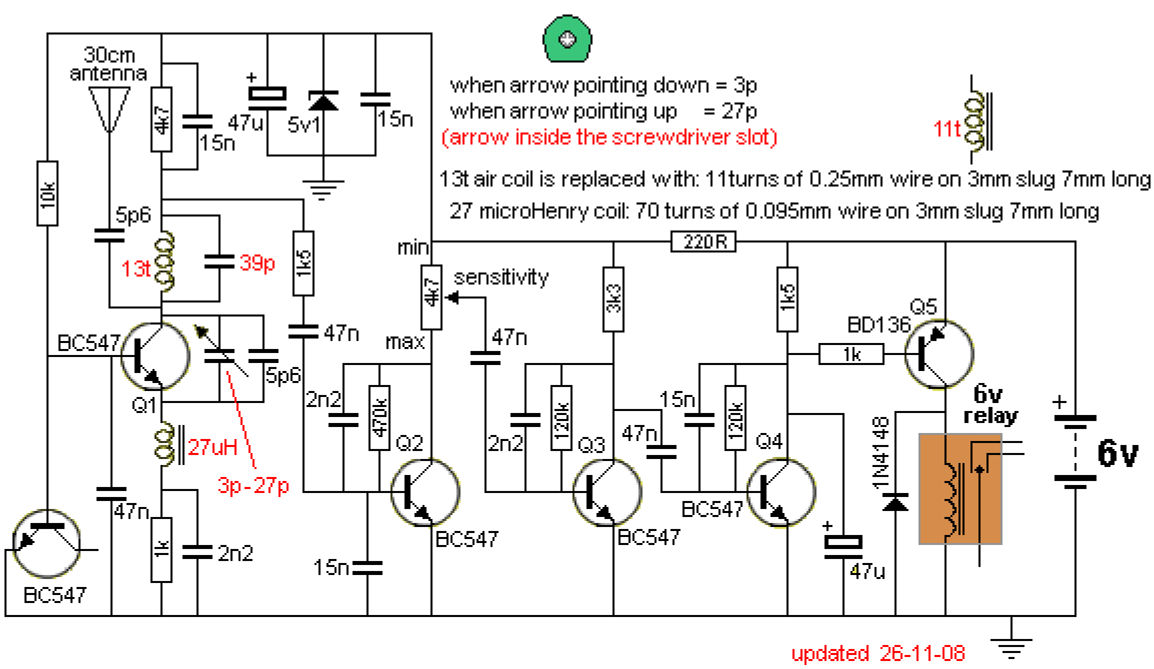

27MHz RECEIVER-2

This circuit matches with the 27MHz Transmitter with Square-wave Oscillator. See full description on Talking Electronics website: 27MHz Links article.

The receiver frequency is fixed. The transmitter is adjusted to suit the receiver. The 3-27p trimmer is

adjusted for maximum gain (10p trimmer and 5p6 in our case) and this is a critical adjustment.
The base-emitter junction of the first BC547 sets 0.7v (as it is heavily turned on by the 10k) on the base of the oscillator Q1, and this is fixed. Q1 is very lightly turned on (due to the emitter resistor), and this makes it very sensitive when it is oscillating. Any 27MHz signal from the surroundings will upset the oscillator and any tone in the signal will be passed to the stages for amplification. The coil is 13 turns. It can be replaced with 11 turns of 0.25mm wire on 3mm dia slug 7mm long. Although the original Russian product worked very well, our prototype did not have very good sensitivity. The circuit was very difficult to set-up.
Note: When making the 27uH inductor and checking its value on an inductance meter; if the meter does not read low values accurately, put two inductors in series. Measure the first inductor, say 100uH. The two inductors in series will be 127uH as inductors combine just like resistors in series! The result is the addition of the individual values.

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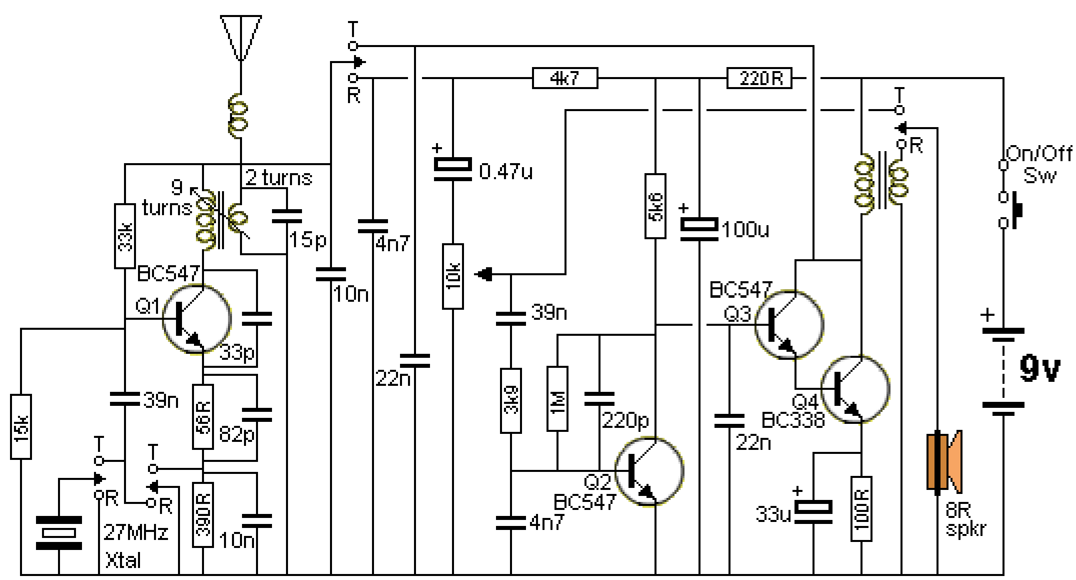

WALKIE TALKIE

Nearly all the components in the 4-transistor circuit are used for both transmitting and receiving. This makes it a very economical design. The frequency-generating stage only needs the crystal to be removed and it becomes a receiver. Next is a three transistor directly coupled audio amplifier with very high gain. The first transistor is a pre-amplifier and the next two are wired as a super-alpha pair, commonly called a Darlington pair to drive the speaker transformer. See full description in 27MHz Links article.

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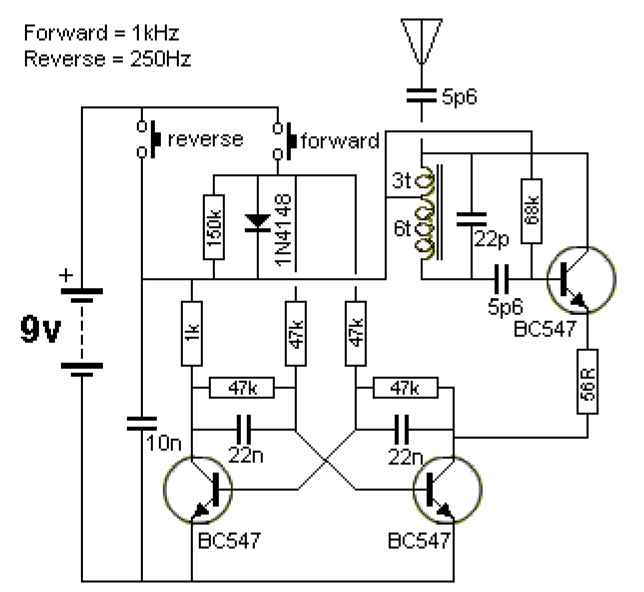

27MHz TRANSMITTER - 2 CHANNEL

This circuit does not use a crystal but has a clever feature of using the two push buttons to turn the circuit on when it is required to transmit.
The frequency of the multivibrator is determined by the value of resistance on the base of each transistor. The multivibrator is driven directly from the supply with the forward button and via a 150k for the reverse frequency.
The receiver requires a 1kHz tone for forward and 250Hz for reverse.

See full description in 27MHz Links article.

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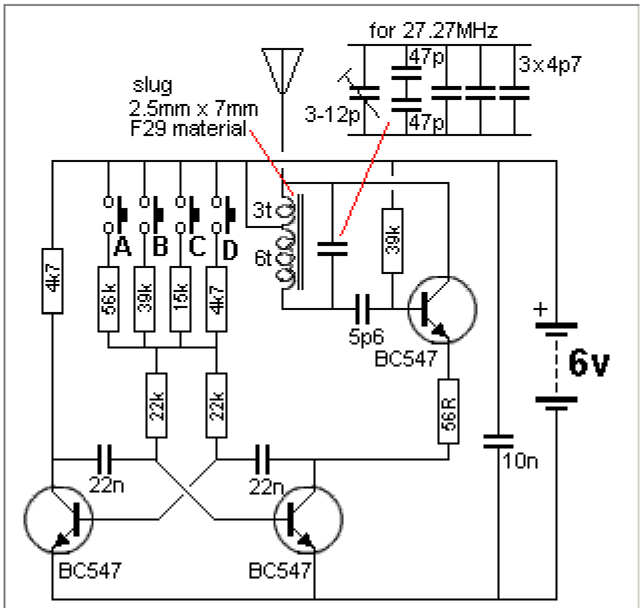

27MHz TRANSMITTER - 4 CHANNEL

This circuit uses the same number of components as the 2-Channel circuit above but has 4 channels.
The frequency of the multivibrator is determined by the value of resistance on the base of each transistor.
A 4 channel receiver has been designed by talking Electronics using a PIC12F628 micro to detect the different frequencies.

See P4 of:
2 Digit Up/Down Counter (see left index on Talking Electronics website).
2 Digit Up/Down Counter has the receiver section.

A = 500Hz B = 550Hz C = 660Hz D = 1kHz

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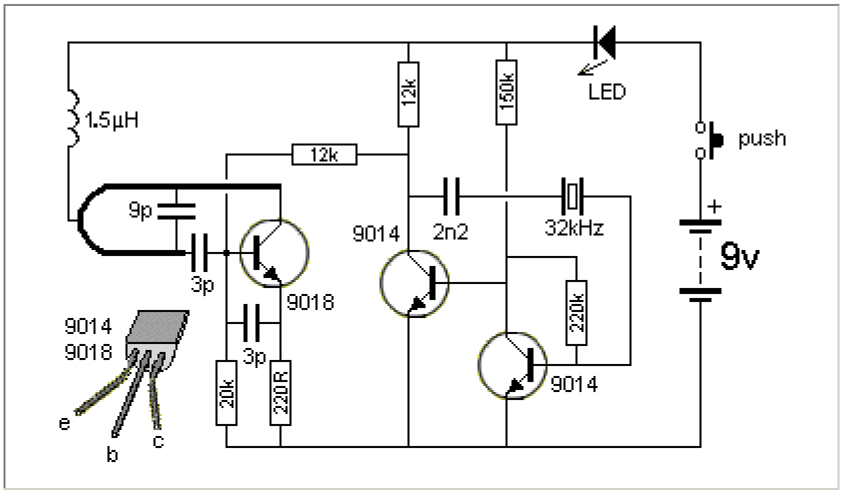

303MHz TRANSMITTER
The transmitter circuit is made up of two building blocks - the 303MHz RF oscillator and the 32kHz crystal controlled oscillator to generate a tone so the receiver does not false-trigger.
The 303MHz oscillator consists of a self-oscillating circuit made up of the coil on the PC board and a 9p (9 puff) capacitor.

See full description in Wireless Doorbell article.

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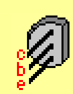
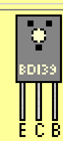
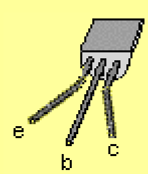
Type:		Gain:	Vbe	Vce	Current	Case
2SC1815	NPN	100	1v	50v	150mA	
2SC3279	NPN	140 to 600 @0.5A	0.75v	10v	2amp	
BC337 BC338	NPN	60 @300mA	0.7v	45v 25v	800mA	
BC547 BC548 BC549	NPN	70 @100mA	0.7v	45v 30v 30v	100mA	
BC557	PNP			45v	100mA	
BD139	NPN	70-100 @150mA	0.5v	80v	1.5A	
BD140	PNP	70-100 @150mA	0.5v	80v	1.5A	
2SCxxx						
8050	NPN			10v	1.5A	
8550	PNP			10v	1.5A	
9012	PNP				500mA	
9013	NPN		1v	20v	500mA	
9014	NPN				100mA	
9015	PNP				100mA	
9018	NPN	700MHz		15v	50mA	

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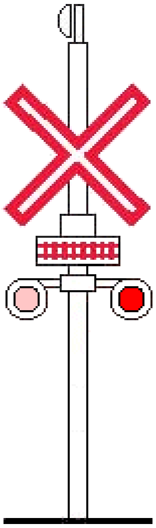

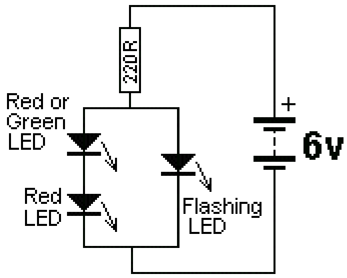

BOOM GATE LIGHTS

This simple circuit will produce flashing lights for your model railway crossing. It uses one flashing LED and one normal red LED, with a green LED hidden in the background. It can be used somewhere else on your layout but it is needed to produce a voltage drop so the two red LEDs will flash. You cannot get a simpler circuit.

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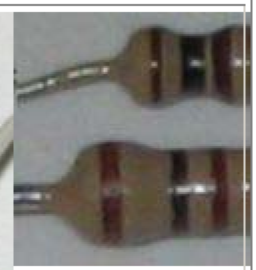
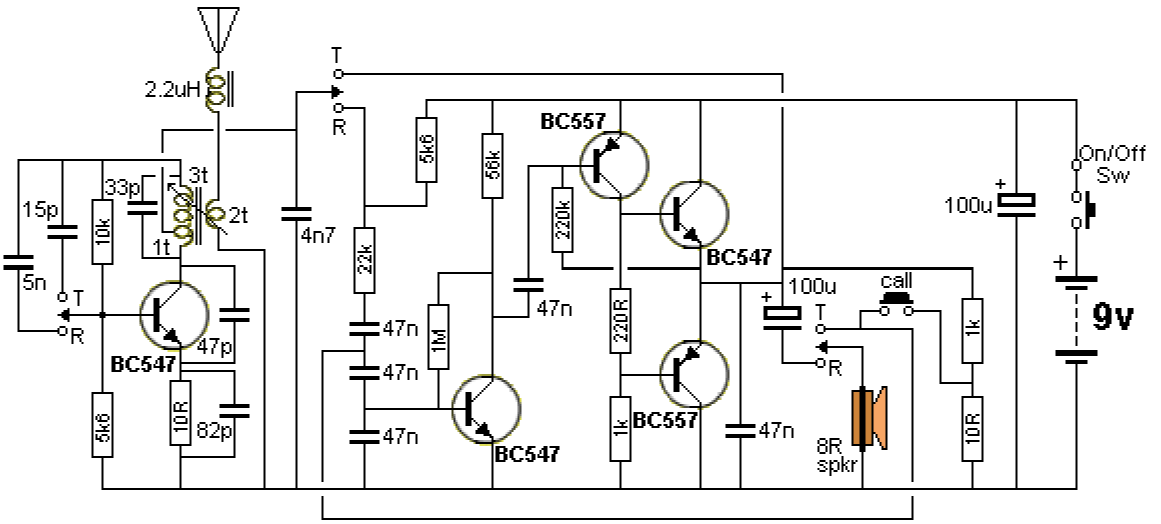


The 1/10th watt resistors used in this circuit, compared with 0.25watt resistors.



5 TRANSISTOR WALKIE TALKIE - 1

This walkie talkie circuit does not have a crystal or speaker transformer, with the board measuring just 3cm x 4cm and using 1/10th watt resistors, it is one of the smallest units on the market, for just $9.50 to $12.00. The wires in the photo go to the battery, speaker, call-switch and antenna. The most difficult component in the circuit to duplicate is the oscillator coil. See the photo for the size and shape. The coil dia is 5mm and uses 0.25mm wire. The actual full-turn or half turn on the coil is also important. Almost all 5 transistor walkie talkies use this circuit or slight variations. See the article: [27MHz Transmitters] for theory on how these transmitters work - it is fascinating.

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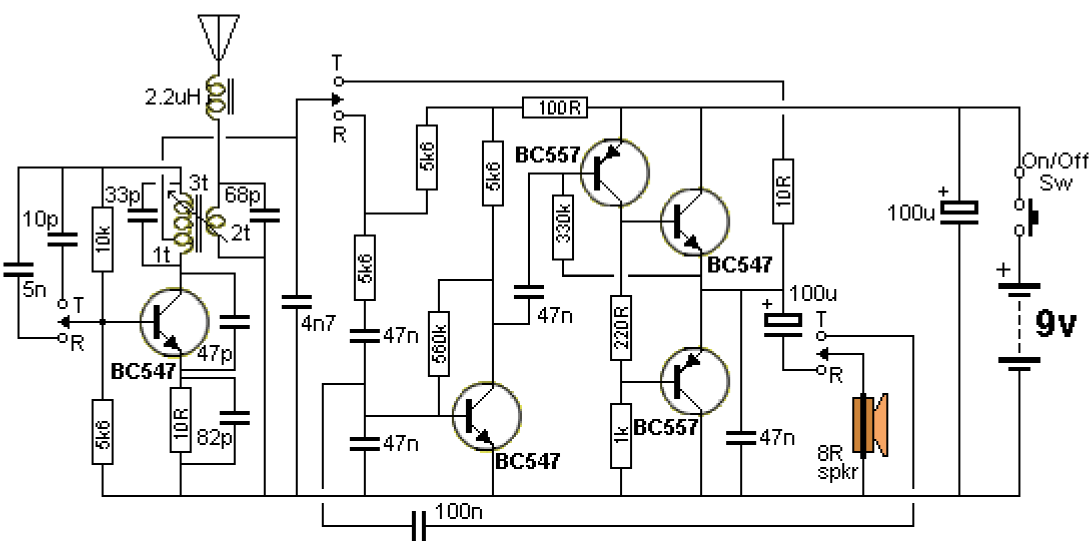

5 TRANSISTOR WALKIE TALKIE - 2

Here is another walkie talkie circuit, using slightly different values for some of the components. See the article: [27MHz Transmitters] for theory on how these transmitters work.

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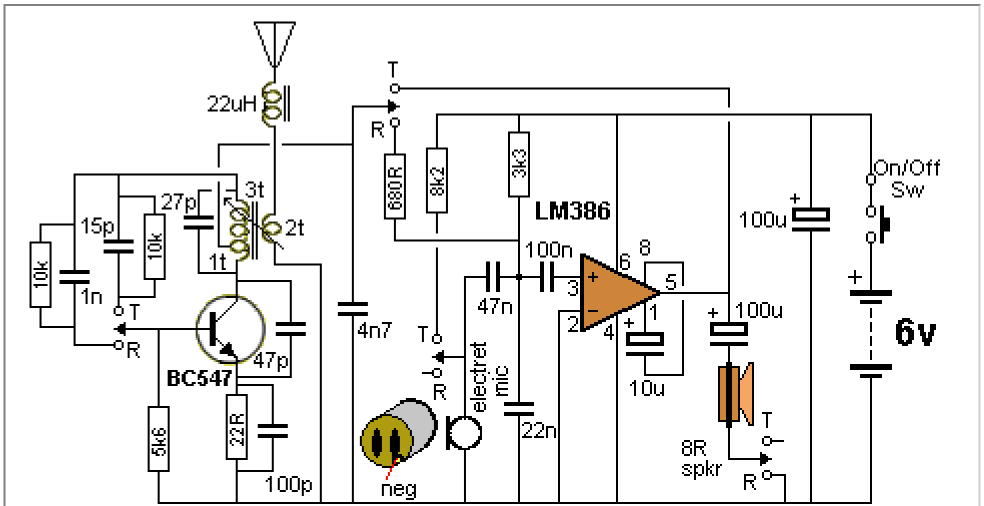

WALKIE TALKIE with LM386

Here is a more up-to-date version of the walkie talkie, using an LM 386 amplifier IC to take the place of 4 transistors.

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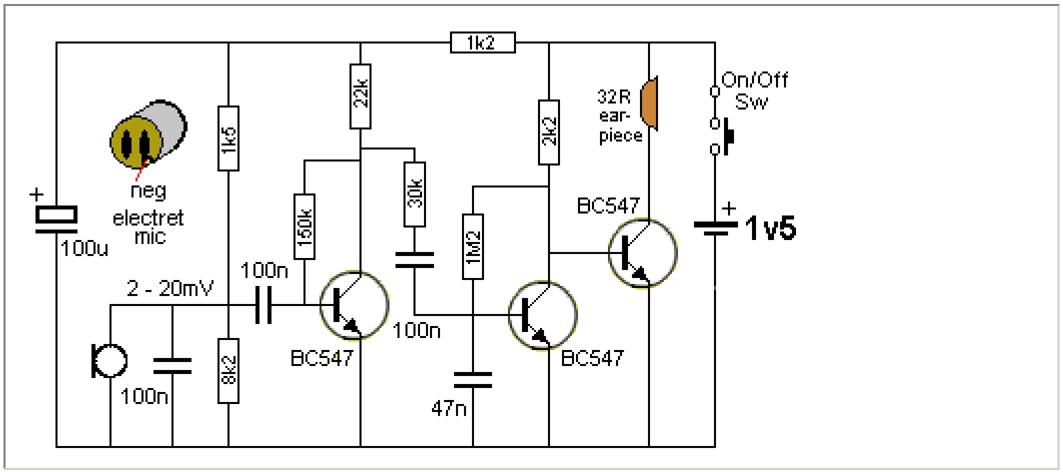

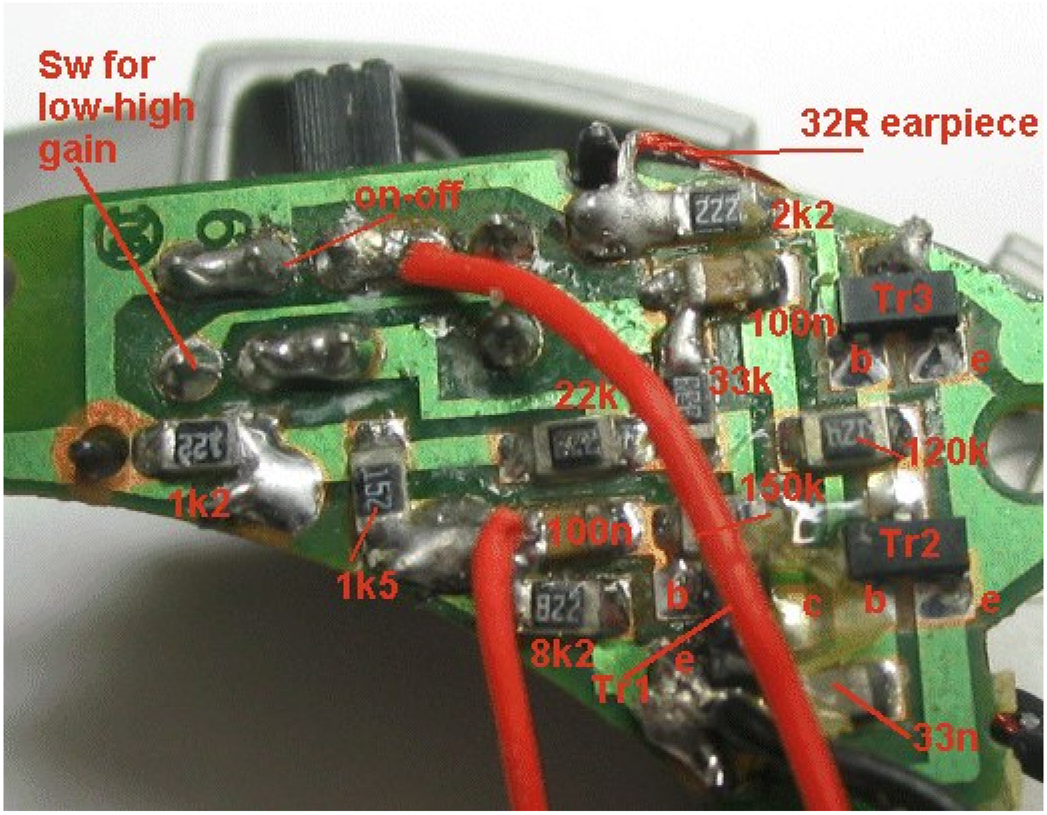

SPY AMPLIFIER
This simple circuit will detect very faint sounds and deliver them to a 32 ohm earpiece. The circuit is designed for 1.5v operation and is available from $2.00 shops for less than $5.00 The photo shows the surface-mount components used in its construction.

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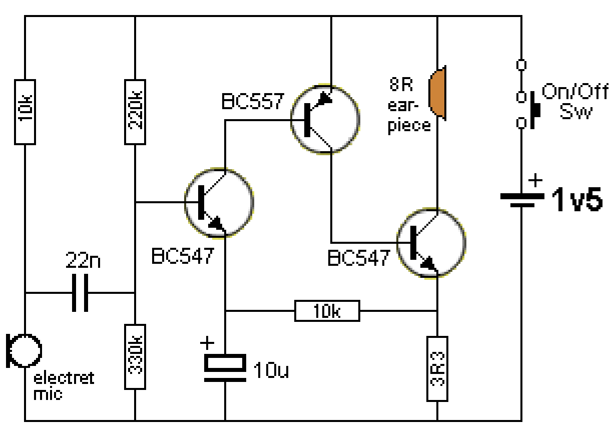

HEARING AID 1.5v SUPPLY
This simple circuit will detect very faint sounds and deliver them to an 8 ohm earpiece. The circuit is designed for 1.5v operation.

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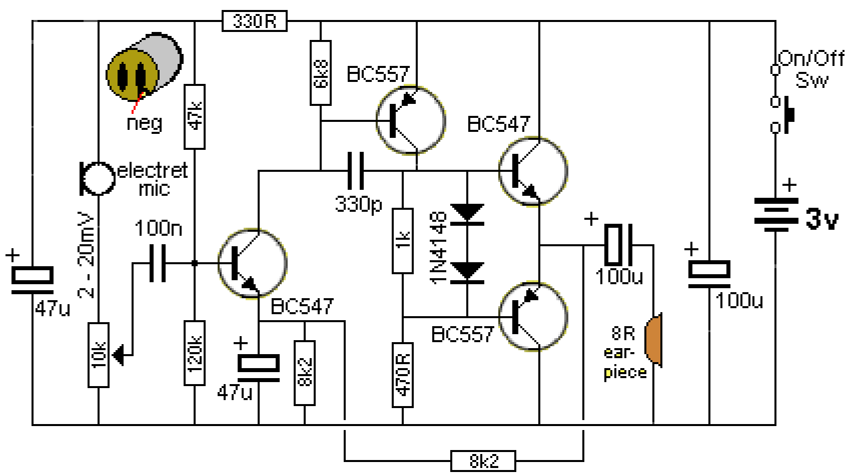

HEARING AID with PUSH PULL OUTPUT

This circuit will detect very faint sounds and deliver them to an 8 ohm earpiece. It is designed for 3v operation.

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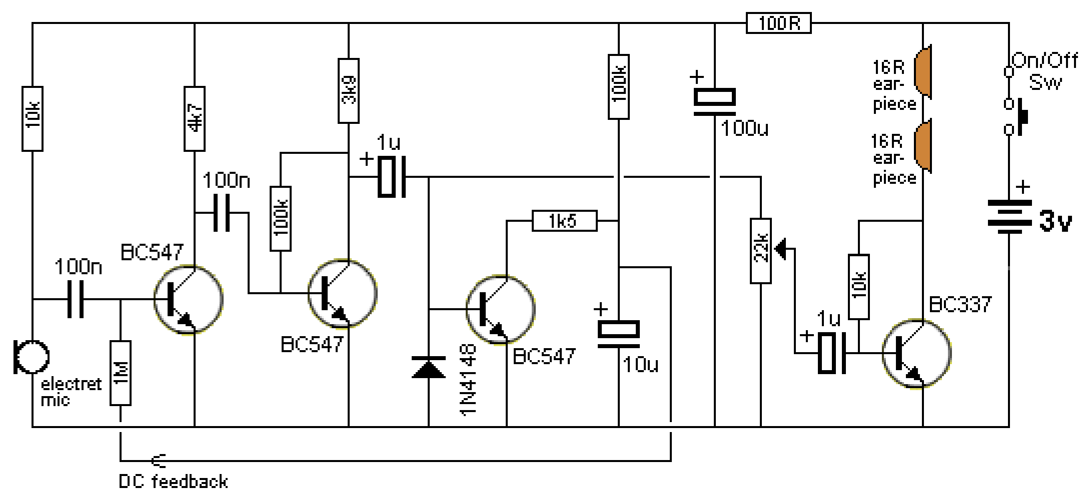

HEARING AID with CONSTANT VOLUME

This is a very handy circuit as it provides constant volume. It is designed for 3v operation.

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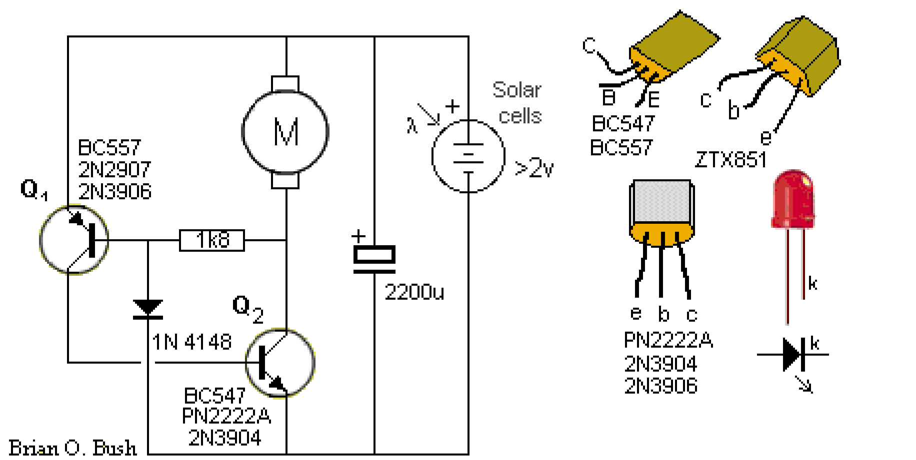

SOLAR ENGINE

This circuit is called Type-1 SE. Low current from a solar cell is stored in a large capacitor and when a preset voltage-level is reached, the energy from the capacitor is released to a motor.
For full details on how the circuit works and how to modify it, see:
http://www.talkingelectronics.com/projects/Robots/Page2.html

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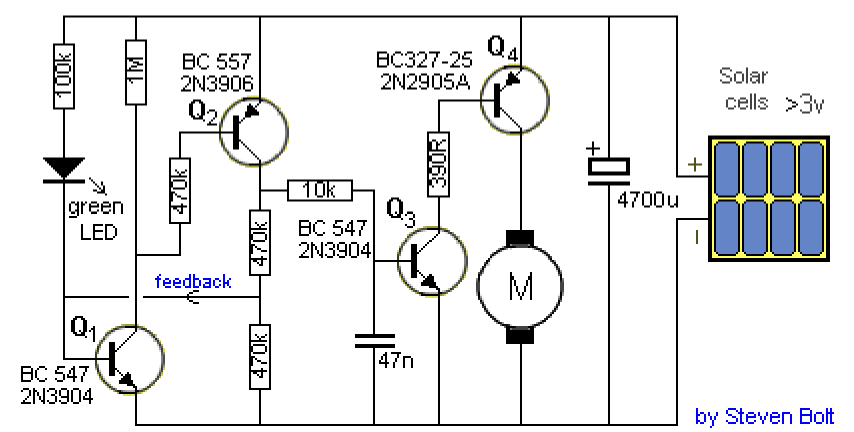

SUN EATER-I

An improved design over Solar Engine circuit above. It has a clever 2-transistor self-latching arrangement to keep the circuit **ON** until the voltage drops to 1.5v. The circuit turns on at 2.8v. This gives the motor more energy from the electrolytic at each "pulse." For full details on how the circuit works and how to modify it, see:
http://www.talkingelectronics.com/projects/Robots/Page2.html

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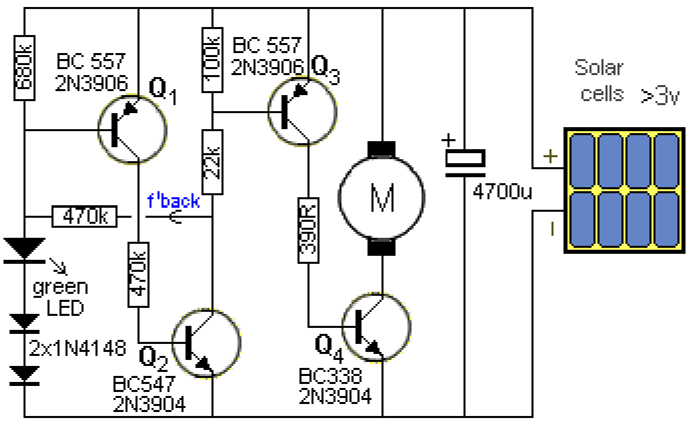

SUN EATER-1A

This circuit is an improvement on the **Sun Eater I** shown above. It works exactly the same except the slight re-arrangement of the components allows an NPN power transistor to be used. One less resistor is needed and one less capacitor but two extra diodes have been added to increase the upper turn-on voltage.
For full details on how the circuit works and how to modify it, see:
http://www.talkingelectronics.com/projects/Robots/Page2.html

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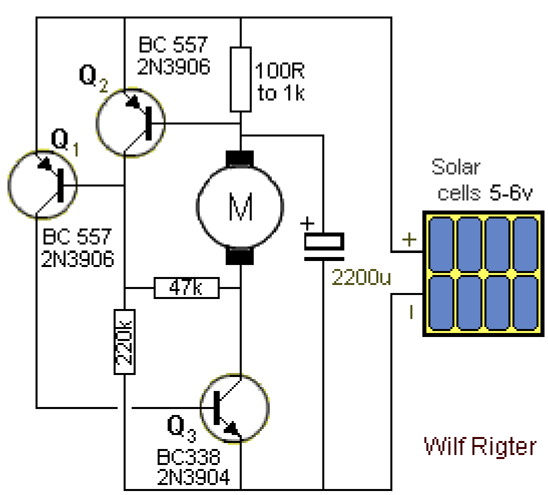

SOLAR ENGINE Type-3

Type-3 circuits are **current controlled** or current-triggered. This is another very clever way of detecting when the electrolytic has reached its maximum charge.
At the beginning of the charge-cycle for an electrolytic, the charging current is a maximum. As the electrolytic becomes charged, the current drops.
In the type-3 circuit, the charging current passes through a 100R resistor and creates a voltage drop. This voltage is detected by a transistor (Q2) and the transistor is turned ON.
This action robs transistor (Q1) from turn-on voltage and the rest of the circuit is not activated. As the

charging current drops, Q2 is gradually turned off and Q1 becomes turned on via the 220k resistor on the base.
This turns on Q3 and the motor is activated. The voltage across the storage electrolytic drops and the current through the 100R rises and turns the circuit off. The electrolytic begins to charge again and the cycle repeats. For full details on how the circuit works and how to modify it, see:
http://www.talkingelectronics.com/projects/Robots/Page2.html

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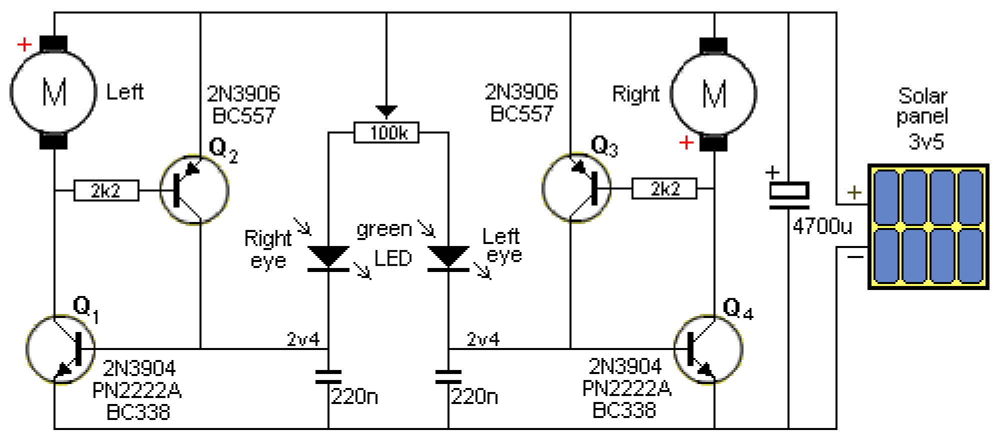

SOLAR PHOTOVORE

The green LEDs cause the Solar Engine on the opposite side to fire and the **Solar Photovore** turns toward the light source. The motors are two pager "vibe" motors with the weights removed. The 100k pot on the "head" balances the two Solar Engines. If you cannot get the circuit to work with green LEDs, use photo-transistors. For full details on how the circuit works and how to modify it, see:
http://www.talkingelectronics.com/projects/Robots/Page4.html

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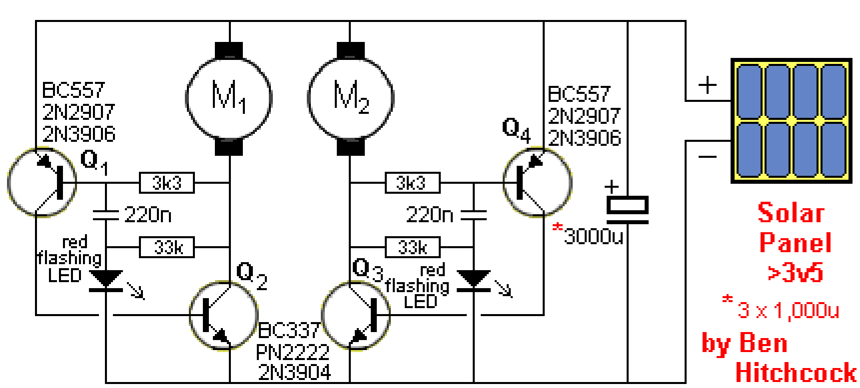

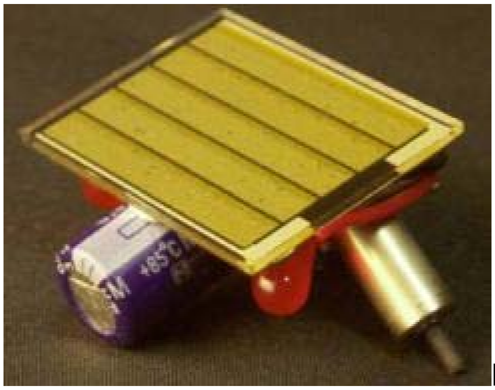

FRED Photopopper (Flashing LED)

It is a Photopopper using low-cost components. It uses two red or green flashing LEDs to turn the circuit **on** when the voltage across the electrolytic has reached about 2.7v. The flashing LEDs change characteristics according to the level of the surrounding light and this turns the circuit into phototropic.
For full details on how the circuit works and how to modify it, see:
http://www.talkingelectronics.com/projects/Robots/Page6.html

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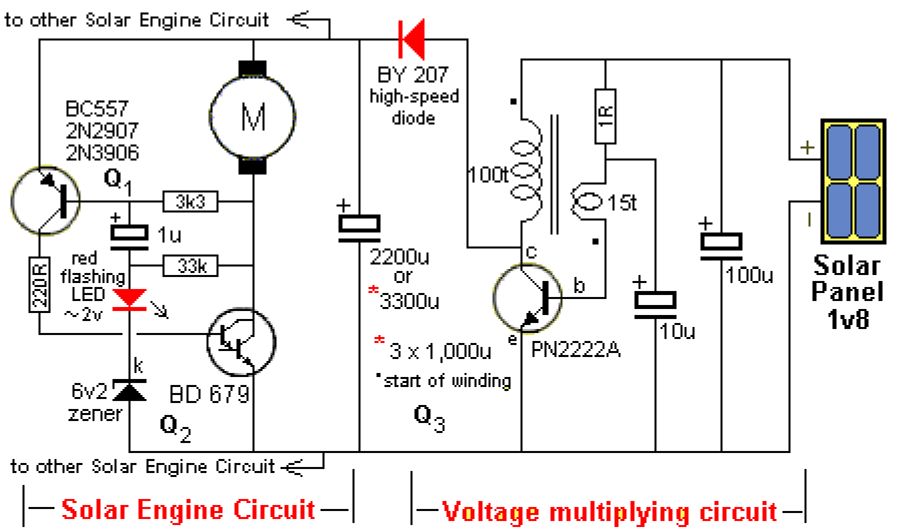

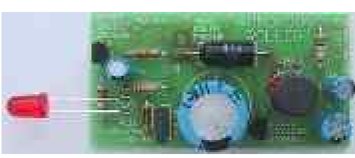

ROBO ROLLER

The circuit consists of two building blocks. The Photopopper circuit and a voltage multiplying (or voltage increasing) circuit from a **Solar Charger** project.
For full details on how the circuit works and how to modify it, see:
http://www.talkingelectronics.com/projects/Robots/Page7.html

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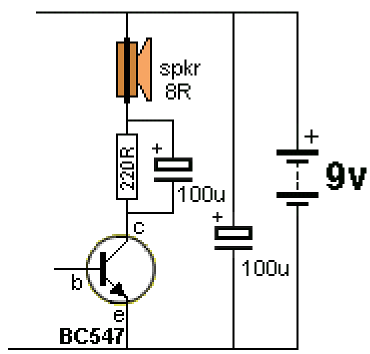

SIGNAL BY-PASS

This circuit allows a class-A amplifier to drive a low impedance speaker and has a low quiescent current. The 220R in series with the speaker limits the "wasted" current to about 20mA max as the transistor is generally biased at mid-voltage. However the transistor will be almost directly driving the speaker when a signal is being processed and the only limitation is the ability of the 220R to discharge the 100u during each cycle.
The circuit is called a signal by-pass as the signal by-passes the 220R and drives the speaker directly (via the 100u).

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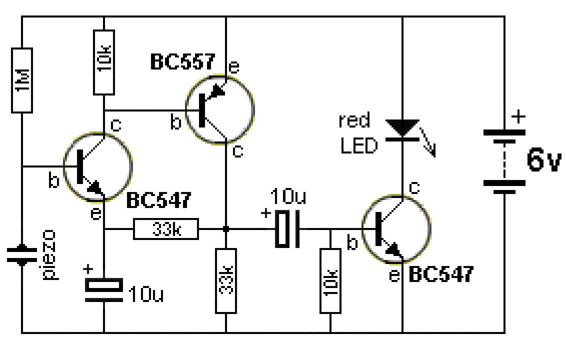

SOUND-TO-LIGHT

The LED illuminates when the piezo diaphragm detects sound.
Some piezo diaphragms are very sensitive and produce 100mV when whistling at 50cm. Others produce 1mV. You must test them with a CRO.
The sensitivity of the diaphragm will determine the sensitivity of the circuit.

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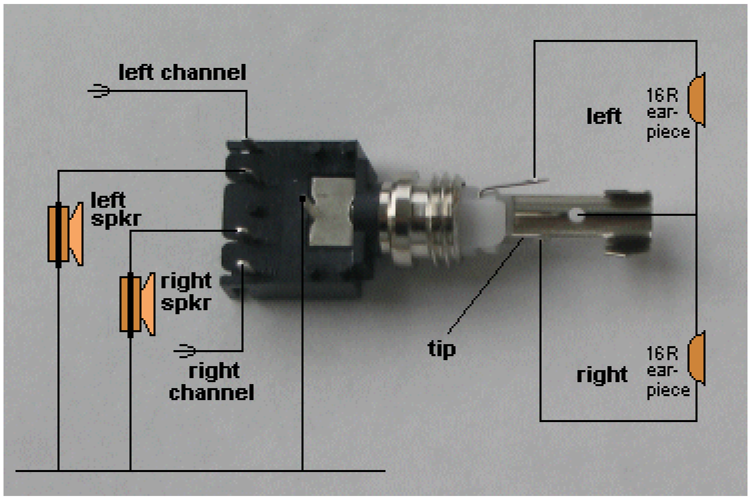
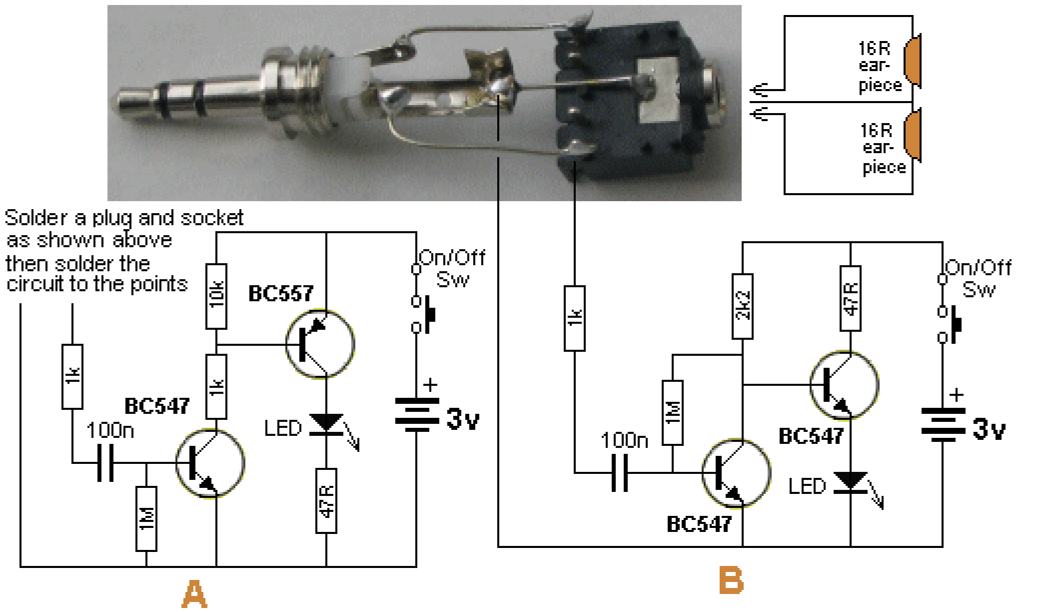


Above: **A 3.5mm switched stereo plug and socket wiring.**



MUSIC-TO-COLOUR

The LED illuminates when the circuit detects a high amplitude waveform. It can be connected to a "Walkman" or mini radio with earphones. A second channel can be connected to produce a stereo effect. Circuit A consumes less current as the LED is off when no audio is detected. Circuit B pulses the LED brighter when audio is detected.

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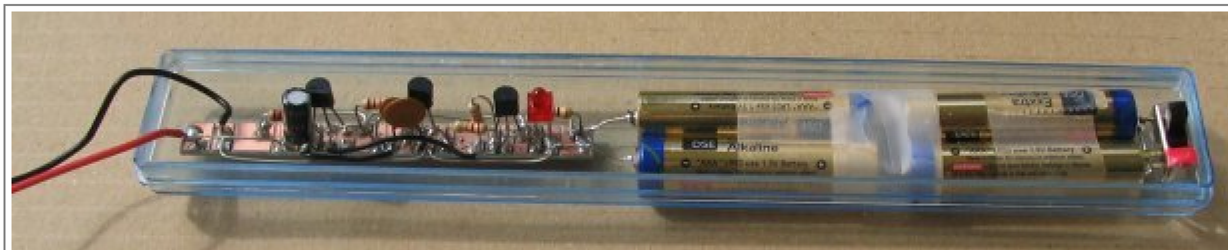
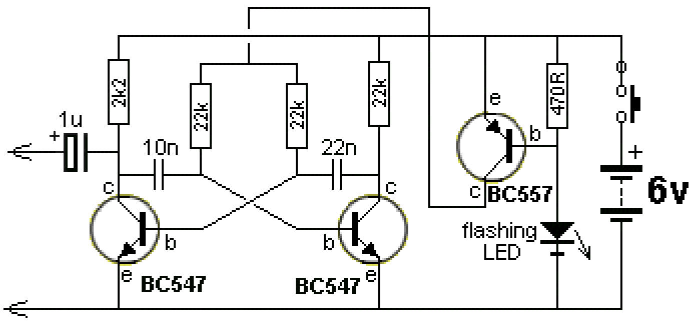
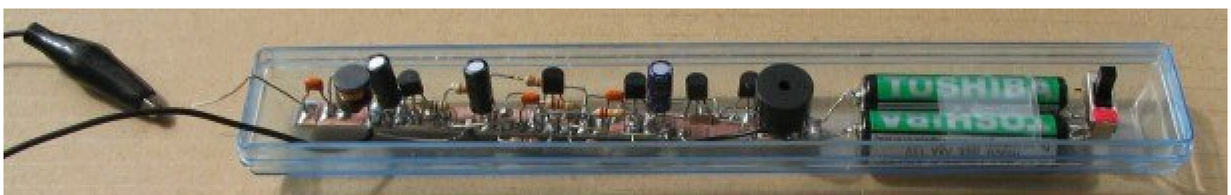


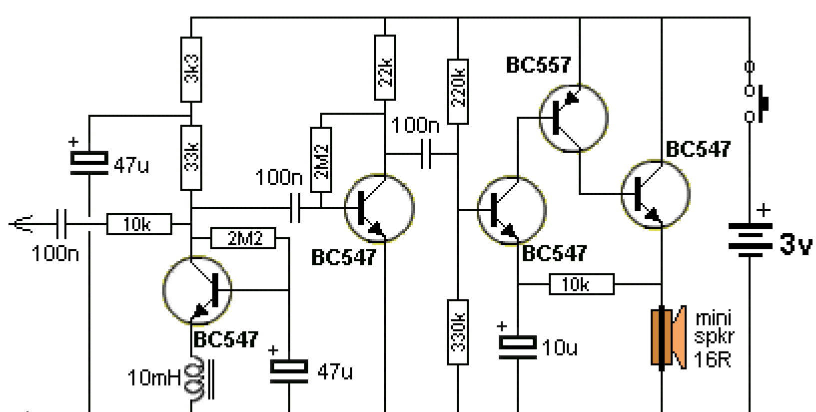
This is the professional unit

The transmitter is built on a small length of PC board, cut into lands with a file. The photo clearly shows how all the components are mounted and how the board is fitted into a toothbrush holder. The flashing LED shows the unit is ON and serves to control the beep-beep-beep of the circuit.



TRANSMITTER CIRCUIT





RECEIVER CIRCUIT

The receiver circuit is a high-gain amplifier and produces constant background noise so the slightest magnetic field can be detected.
The 10mH choke can be any value but the largest number of turns on the core is best.
The mini speaker can be a 16R earpiece but these are not as loud as a mini speaker.
Quiescent current is 50mA so the on-off switch can be a push-button.

CABLE TRACER

Why pay $100 for a cable tracer when you can build one for less than $10.00! This type of tracer is used by telephone technicians, electricians and anyone laying, replacing or wiring anything, using long cables, such as intercoms, television or security.
Our cable tracer consists of two units. One unit has a multivibrator with an output of 4v p-p at approx 5kHz. This is called the transmitter. The other unit is a very sensitive amplifier with capacitive input for detecting the tone from the transmitter and a magnetic pickup for detecting magnetic lines of force from power cables carrying 240v. This is called the receiver. The circuit also has an inductive loop, made up of a length of wire, to pick up stray signals from power cables, so if one detector does not detect the signal, the other will. Our circuit is nothing like that in the professional unit shown above.

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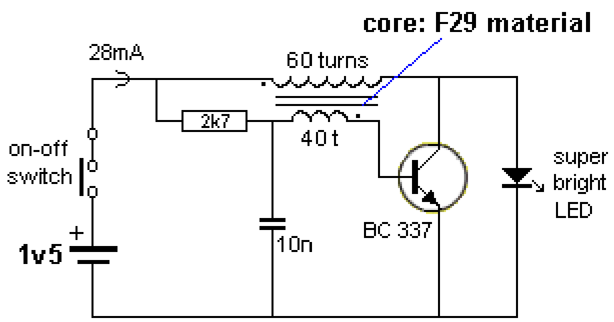

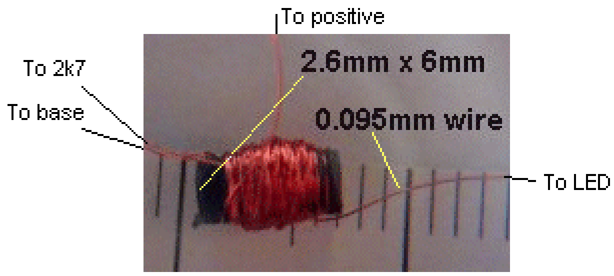

Transformer Details

LED TORCH with 1.5v SUPPLY

This simple circuit will illuminate a super-bright white LED to full brightness with 28mA from a 1.5v cell. The LED is 20,000mcd (20cd @ 15° viewing angle) and has an output of approx 1lumen.
The transformer is wound on a small ferrite slug 2.6mm dia and 6mm long. It is made from F29 ferrite material as the circuit operates at a high frequency (100kHz to 500kHz).
The efficiency of the circuit revolves around the fact that a LED will produce a very high output when delivered pulses, but the overall current will be less than a steady DC current.
BC 337 has a collector-emitter voltage of 45v. (BC338 has 25v collector-emitter voltage rating.) The voltage across the transistor is no more than 4v as the LED absorbs the spikes.
Do not remove the LED as the spikes from the transformer will damage the transistor.
The circuit will drive 1 or 2 while LEDs in series.

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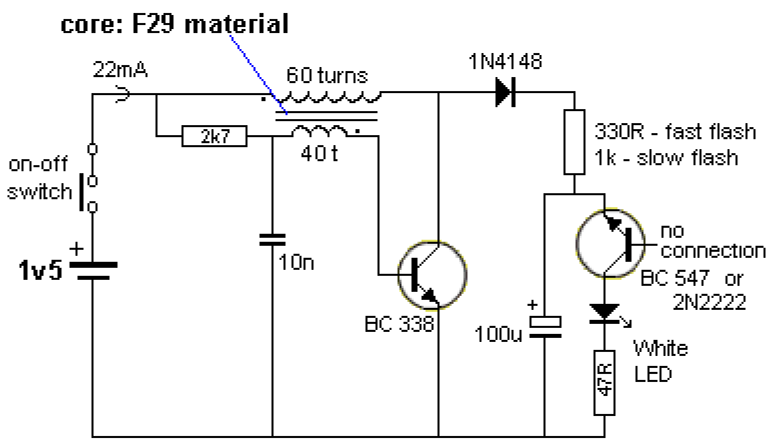

WHITE LED FLASHER

This circuit will flash a super-bright white LED from a 1.5v cell.
The transformer is wound on a small ferrite slug 2.6mm dia and 6mm long as shown in a project above.
The circuit uses the zener characteristic of the reverse-base-emitter junction of a BC 547 to pass current and flash the LED.

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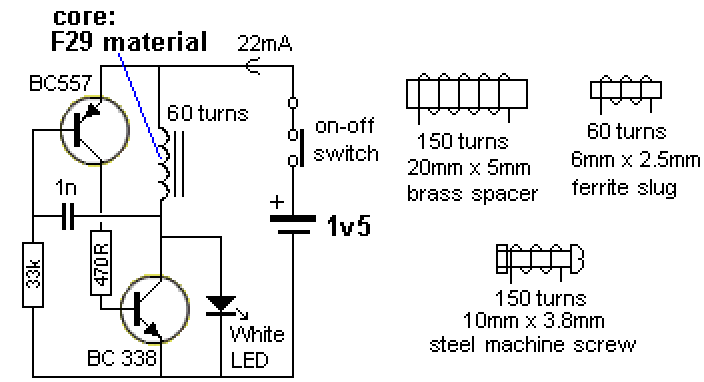
1v5 WHITE LED



DRIVER WHITE LED DRIVER

This circuit will drive a super-bright white LED from a 1.5v cell.
The 60 turn inductor is wound on a small ferrite slug 2.6mm dia and 6mm long with 0.25mm wire.
The main difference between this circuit and the two circuits above is the use of a single winding and the feedback to produce oscillation comes from a 1n capacitor driving a high gain amplifier made up of two transistors.
The feedback is actually positive feedback via the 1n and this turns on the two transistors more and more until finally they are fully turned on and no more feedback signal is passed though the 1n. At this point they start to turn off and the signal through the 1n turns them off more and more until they are fully turned off.
The 33k turns on the BC557 to start the cycle again.

If you do not have a ferrite slug, the inductor can be
machine screw 10mm long and about 3-4mm dia. Wi
of 0.25mm wire. Or you can use a brass ferrule 20mm
5mm. Wind 150 turns.

RESULTS for the same brightness:
Slug: 21mA
Brass Spacer: 18mA
Machine screw: 14mA
Isn't this a SURPRISE!

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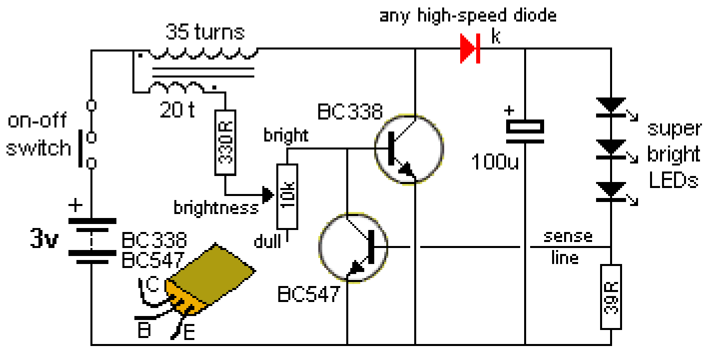

LED TORCH with ADJUSTABLE BRIGHTNESS

This circuit will drive up to 3 high-bright white LEDs from a 3v supply. The circuit has a pot to adjust the brightness to provide optimum brightness for the current you wish to draw from the battery.
The transformer is wound on a ferrite slug 2.6mm dia and 6mm long as shown in the LED Torch with 1.5v Supply project.
This circuit is a "Boost Converter" meaning the supply is less than the voltage of the LEDs. If the supply is greater than the voltage across the LEDs, they will be damaged.

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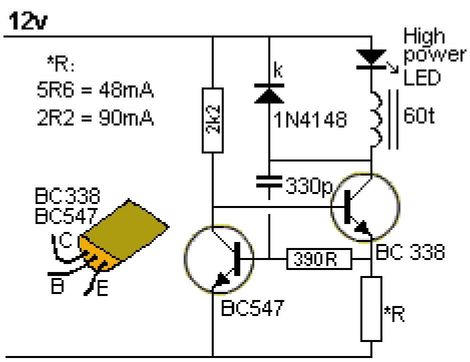

Inductor: 60 turns on 10mm ferrite rod, 15mm long.

BUCK CONVERTER for HIGH-POWER LED 48mA to 90mA

This circuit is a "Buck Converter" meaning the supply is greater than the voltage of the LED. It will drive 1 high-power white LED from a 12v supply and is capable of delivering 48mA when R = 5R6 or 90mA when R = 2R2.
The LED is much brighter when using this circuit, compared with a series resistor delivering the same current.
But changing R from 5R6 to 2R2 does not double the brightness. It only increases it a small amount.
The inductor consists of 60 turns of 0.25mm wire, on a 15mm length of ferrite rod, 10mm diameter.   Frequency of operation: approx 1MHz.
The circuit is not designed to drive one 20mA LED.
This circuit draws the maximum for a BC 338.

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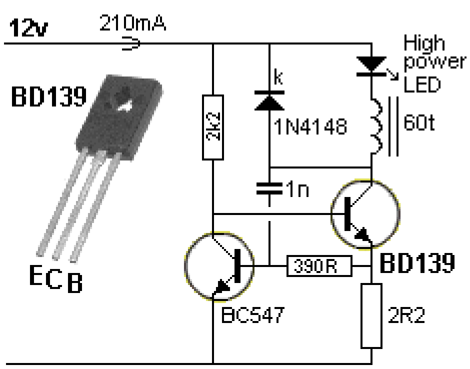

BUCK CONVERTER for HIGH-POWER LED 210mA

This circuit will drive 1 high-power white LED from a 12v supply and is capable of delivering 210mA.
The driver transistor is BD 139 and the details of the inductor are shown above.
The voltage across the LED is approx 3.3v - 3.5v
The driver transistor will need a small heatsink.
The 2R2 can be increased if a lower drive-current is required.

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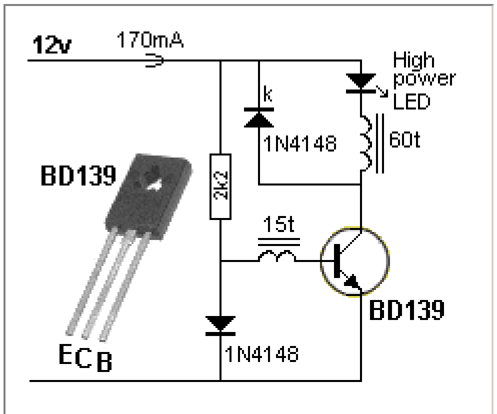

BUCK CONVERTER for HIGH-POWER LED 170mA

This circuit is slightly simpler than above but it does not have the feature of being able to adjust the drive-current.
The inductor is the same as the photo above but has a feedback winding of 15 turns.
Connect the circuit via a 220R resistor and if the LED does not illuminate, reverse the feedback winding.
The driver transistor will need a small heatsink.

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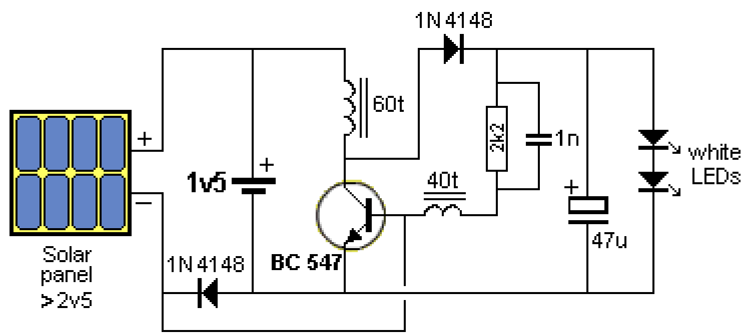

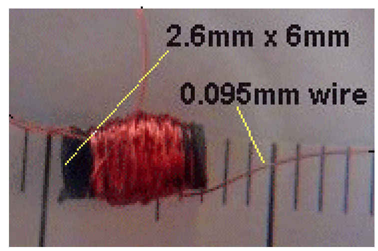

Transformer Details
core: F29 material

AUTOMATIC GARDEN LIGHT

This circuit automatically turns on and illuminates the LEDs when the solar panel does not detect any light. It switches off when the solar panel produces more than 1v and charges the battery when the panel produces more than 1.5v + 0.6v = 2.1v

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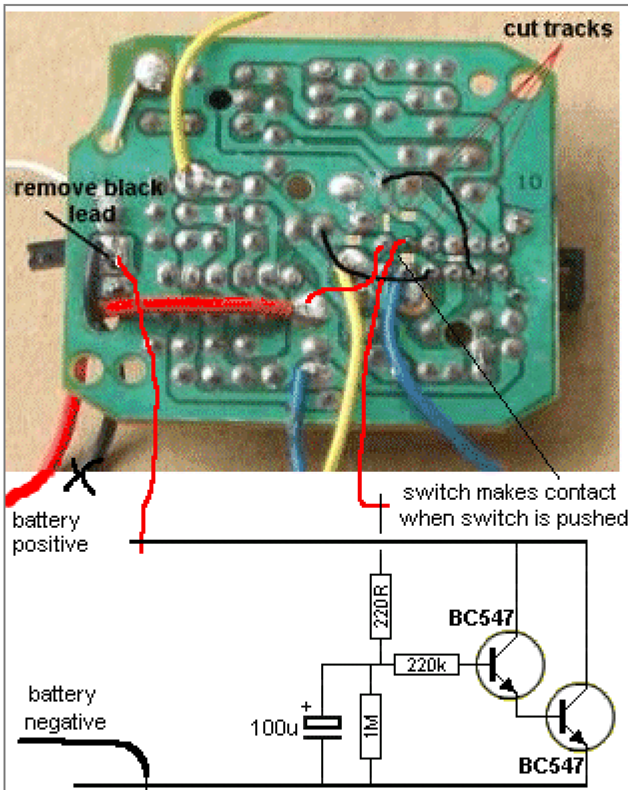


27MHz DOOR PHONE

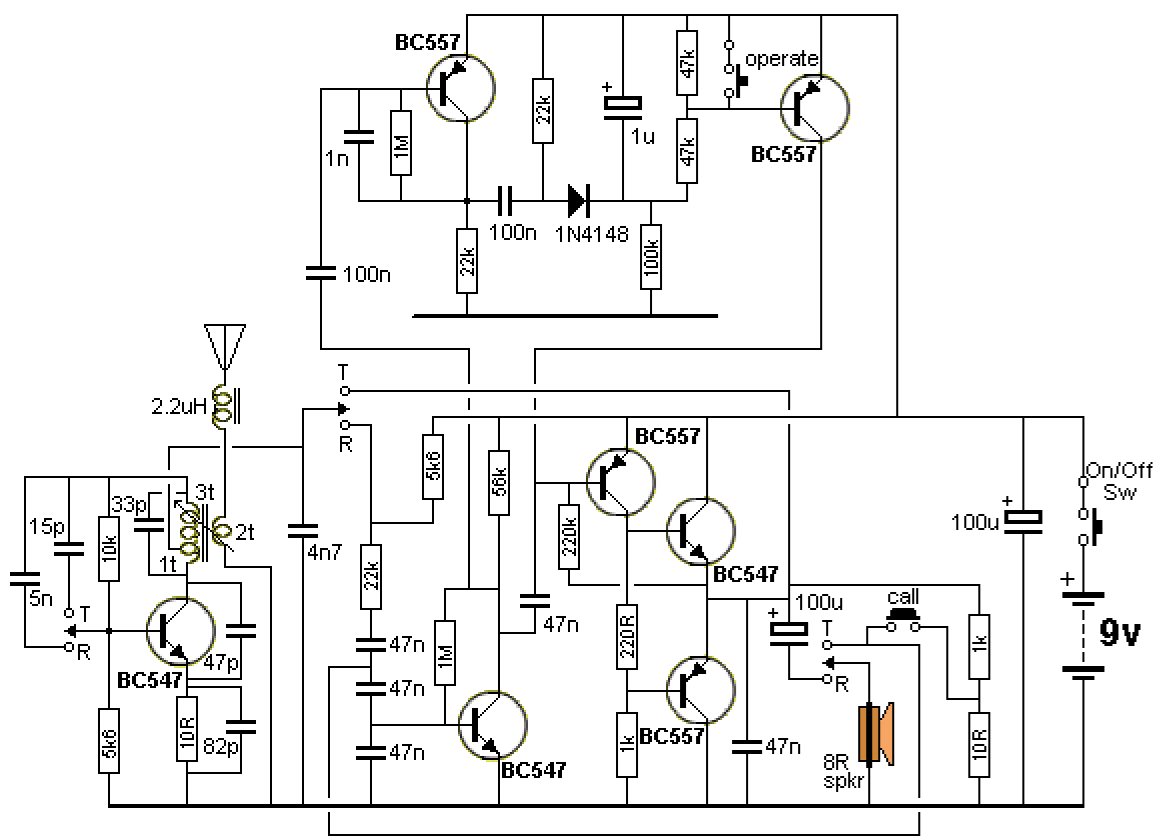
This circuit turns a walkie talkie into a handy wireless door phone. It saves wiring and the receiver can be taken with you upstairs or outside, without loosing a call from a visitor.
A 5-Transistor walkie talkie can be used (see circuit above) and the modifications made to the transmitter and receiver are shown below:

THE TRANSMITTER

Only three sections of the transmit/ receive switch are used in the walkie talkie circuit and our modification uses the fourth section. Cut the tracks to the lands of the unused section so it can be used for our circuit.
There are a number of different printed circuit boards on the market, all using the same circuit and some will be physically different to that shown in the photo. But one of the sections of the switch will be unused.
Build the 2-transistor delay circuit and connect it to the walkie talkie board as shown. When the "push-to-talk" switch is pressed, the PC board will be activated as the delay circuit effectively connects the negative lead of the battery to the negative rail of the board for about 30 seconds.
The 100u gradually discharges via the 1M after the "press-to-talk" switch is released and the two transistors turn off and the current drops to less than 1 micro-amp - that's why the power switch can be left on. .
The transmitter walkie talkie is placed at the front door and the power switch is turned on. To call, push the "push-to-talk" switch and the "CALL" button at the same time for about 5 seconds. The circuit will activate and when the "push-to-talk" switch is released, the circuit will produce background noise for about 30 seconds and you will hear when call is answered.
The "push-to-talk" switch is then used to talk to the other end and this will activate the circuit for a further 30 seconds. If the walkie talkie does not have a "CALL" switch, 3 components can be added to provide feedback, as shown in the circuit below, to produce a tone.

THE RECEIVER

The receiver circuit needs modification and a 2-transistor circuit is added. This circuit detects the tone and activates the 3-transistor direct-coupled amplifier so that the speaker produces a tone.
The receiver circuit is switched on and the 2-transistor circuit we connect to the PC board effectively turns on the 3-transistor amplifier so that the quiescent current drops from 10mA to about 2-3mA. It also mutes the speaker as the amplifier is not activated. The circuit remains on all the time so it will be able to detect a "CALL." When a tone is picked up by the first two transistors in the walkie talkie, it is passed to the first transistor in our "add-on" section and this transistor produces a signal with sufficient amplitude to remove the charge on the 1u electrolytic. This switches off the second transistor and this allows the 3-transistor amplifier to pass the tone to the speaker. The operator then slides a switch called "OPERATE" to ON (down) and this turns on the 3-transistor amplifier. Pressing the "push-to-talk" switch (labelled T/R) allows a conversation with the person at the door. Slide the "OPERATE" switch up when finished.



The receiver walkie talkie with the 2-transistor "add-on"

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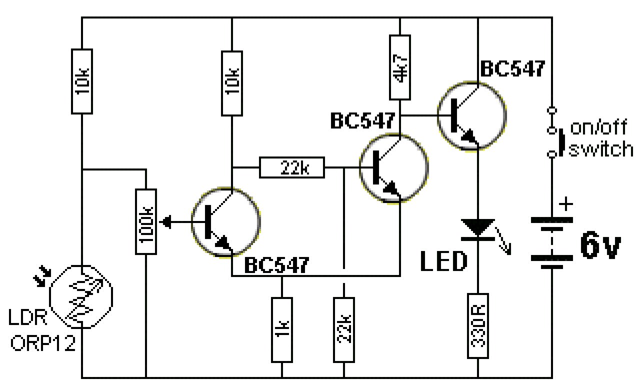

SCHMITT TRIGGER

A Schmitt Trigger is any circuit that has a fast change-over from one state to the other. In our case we have used 2 transistors to produce this effect and the third is an emitter-follower buffer.
The circuit will drive a LED or relay and the purpose is to turn the LED ON quickly at a particular level of illumination and OFF at a higher level. The gap between ON and OFF is called the HYSTERESIS GAP.

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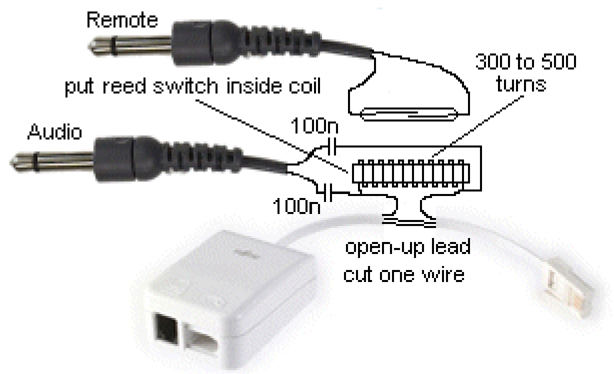

PHONE TAPE - 1

This simple circuit will allow you to tape-record a conversation from a phone line.
It must be placed between the plug on the wall and the phone.
The easiest way is to cut an extension lead. Wind 300-500 turns of 0.095mm wire on a plastic straw and place the reed switch inside. Start with 300 turns and see if the reed switch activates, Keep adding turns until the switch is reliable.
Fit two 100n capacitors to the ends of the winding for the audio. Plug the Audio into "Mic" on tape recorder. Plug the remote into "remote" on the tape recorder and push "record." The tape recorder will turn on when the phone is lifted and record the conversation.

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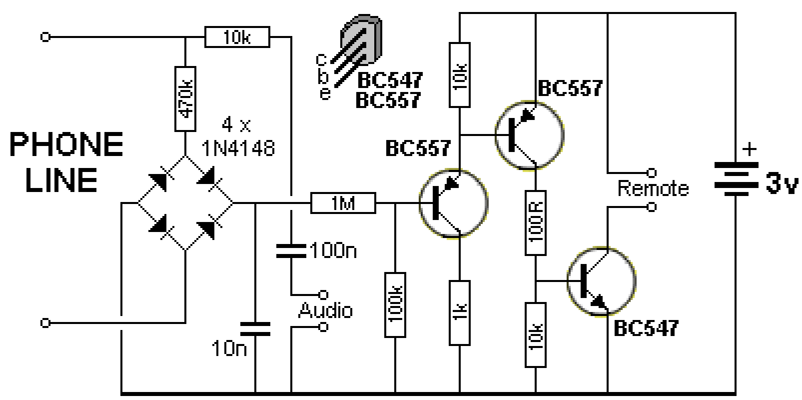

PHONE TAPE - 2

The circuit is turned off when the phone line is 45v as the voltage divider made up of the 470k, 1M and 100k puts 3.5v on the base of the first BC557 transistor. If you are not able to get to cut the lead to the phone, the circuit above will record a conversation from an extension lead. The remote plug must be wired around the correct way for the motor to operate.

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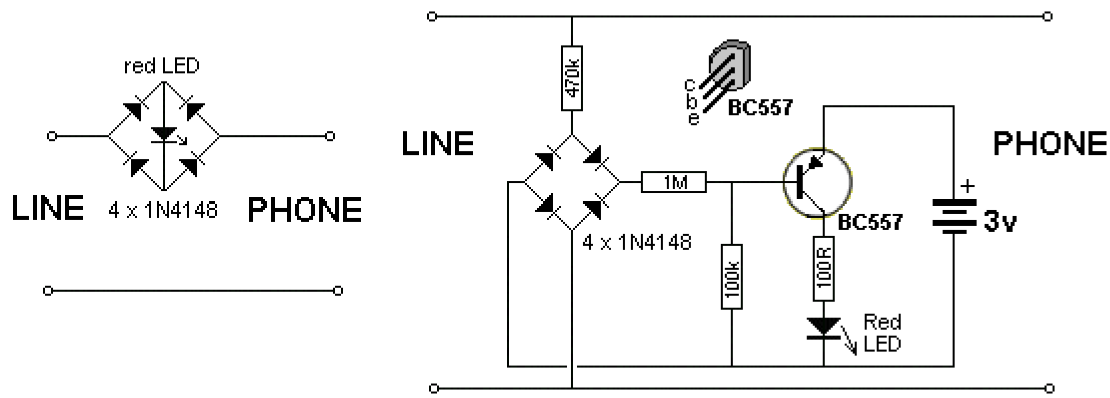

PHONE ALERT

Two circuits are available to show when a phone is being used. The first circuit must be placed between the socket on the wall and the phone - such as cutting into the lead and insert the bridge and diode.
But if you cannot cut the lead to the phone, you will have to add an extension cord and place the second circuit at the end of the line. You can also connect a phone at the end if needed.

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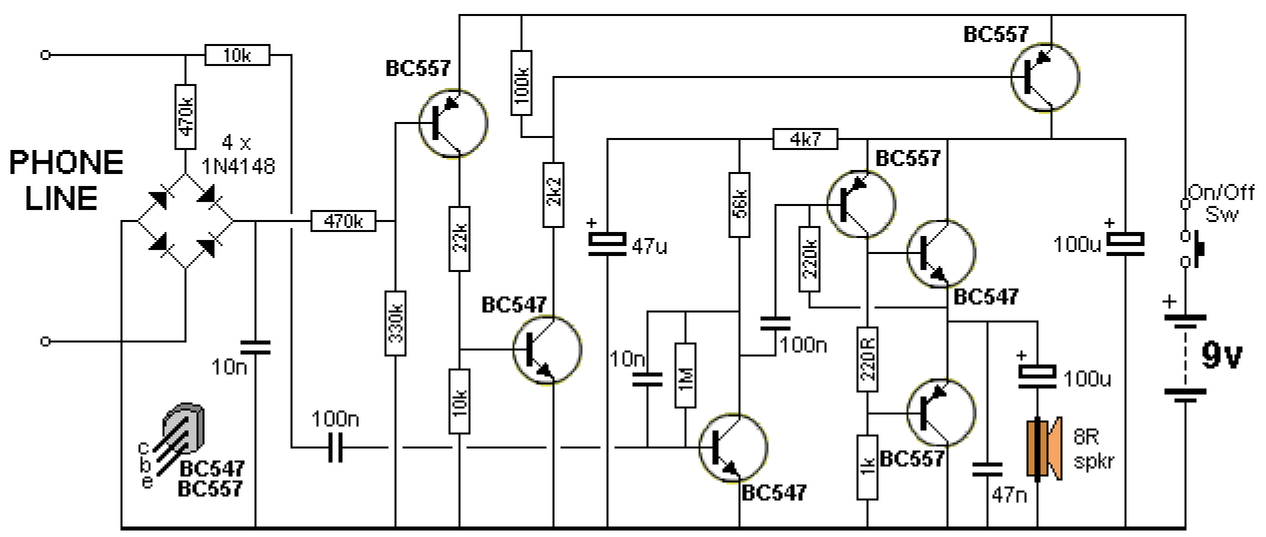

THE LISTENER

This circuit consists of a 4-transistor amplifier and a 3-transistor "switch" that detects when the phone line is in use, and turns on the amplifier. The voltage divider at the front end produces about 11v on the base of the first BC557 and this keeps the transistor off. Switch the unit off when removed from the phone line.

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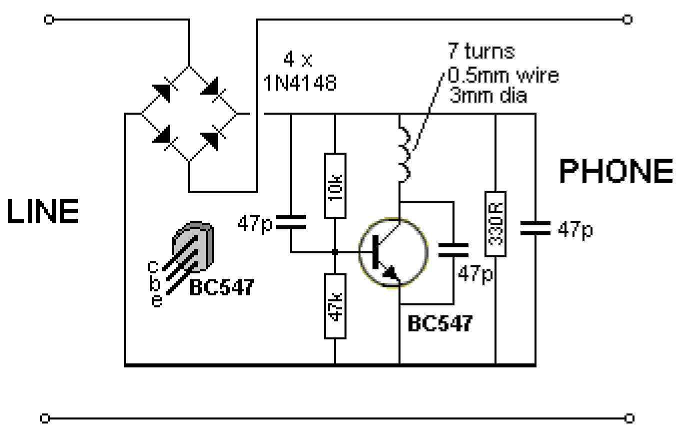

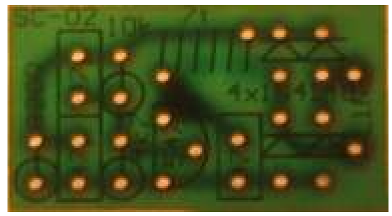

PHONE TRANSMITTER - 1

The circuit will transmit a phone conversation to an FM radio on the 88-108MHz band. It uses energy from the phone line to transmit about 100metres. It uses the phone wire as the antenna and is activated when the phone is picked up. The components are mounted on a small PC board and the lower photo clearly shows the track-work.

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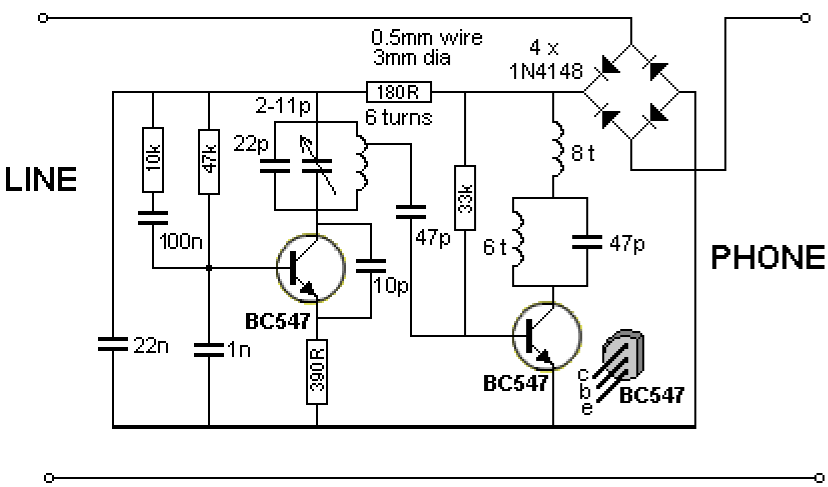

PHONE TRANSMITTER - 2

The circuit will transmit a phone conversation to an FM radio on the 88-108MHz band. It uses energy from the phone line to transmit about 200metres. It uses the phone wire as the antenna and is activated when the phone is picked up.

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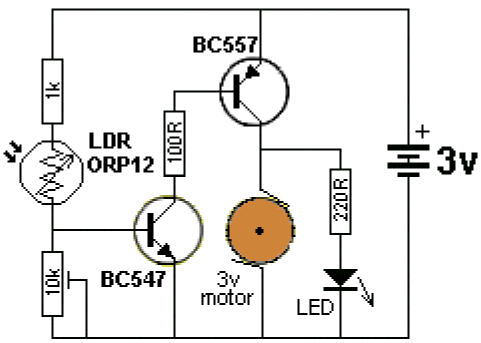


ROBOT-1

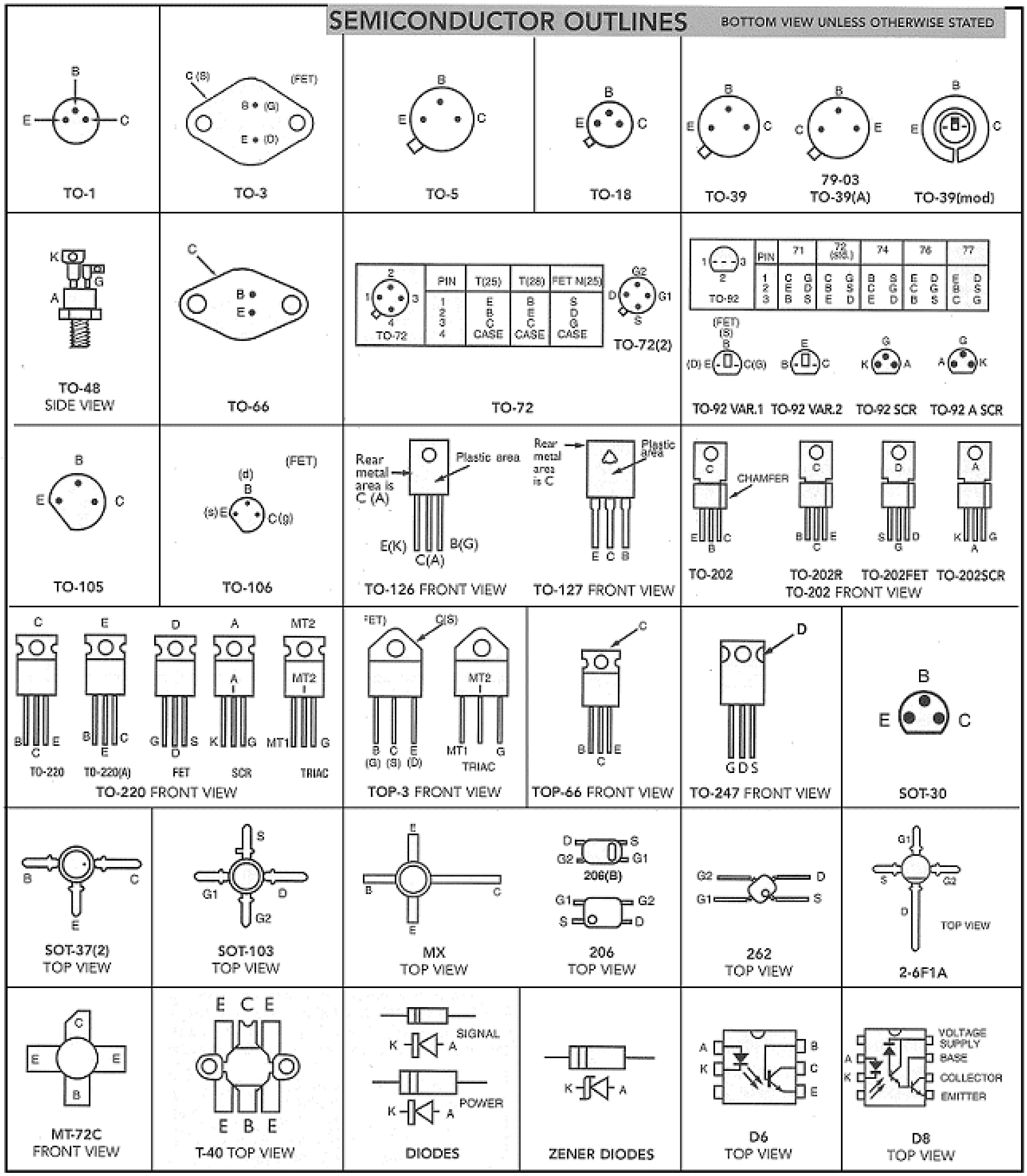
A simple robot can be made with 2 motors and two light-detecting circuits, (identical to the circuit above). The robot is attracted to light and when the light dependent resistor sees light its resistance decreases. This turns on the BC547 and also the BC557. The shaft of the motor has a rubber foot that contacts the ground and moves the robot. The two pots adjust the sensitivity of the LDRs. This kit is available from Velleman as kit number MK127.

BIPOLAR TRANSISTORS

Some small signal transistors may have a TO-92 case and a "PN" prefix. The electrical specifications are the same, only the case is changed.

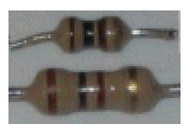
Type	CASE	V_{CE}	V_{CB}	I_C	V_{CEO}	@ I_C	h_{FE}	@ I_C	FT	@ I_C	P_{TOT}	USE	COMPARABLE TYPES
	Polarity	mA				mA		mA	MHz	mA	mW		
BC107	TO-18 NS	45	50	100	0.2	10	110-450	2	300	10	300	G.P S.S. amp.	BC207, BC147, BC182
BC108	TO-18 NS	20	30	100	0.2	10	110-800	2	300	10	300	G.P S.S. amp.	BC208, BC148, BC13
BC109	TO-18 NS	20	30	100	0.25	10	200-800	2	300	10	300	Low noise S.S. amp	BC209, BC149, BC184
BC109C	TO-18 NS	20	30	100	0.25	10	420-800	2	300	10	300	Low noise high gain	BC209C BC149C
BC177	TO-18 PS	45	50	100	0.3	10	75-260	2	150	10	300	G.P S.S. amp.	BC157, BC307, BC212
BC178	TO-18 PS	25	30	100	0.3	10	75-500	2	150	10	300	G.P S.S. amp.	BC158, BC308, BC213
BC179	TO-18 PS	20	25	100	0.3	10	125-500	2	150	10	300	G.P S.S. amp.	BC159, BC309, BC214
BC327	TO-92VAR1 PS	45	50	500	0.7	500	100-600	100	100	10	625	Output	2N3638
BC328	TO-92VAR1 PS	25	30	500	0.7	500	100-600	100	100	10	625	Output	BC327
BC337	TO-92VAR1 NS	45	50	500	0.7	500	100-600	100	100	10	625	Output	2N3642
BC338	TO-92VAR1 NS	25	30	500	0.7	500	100-600	100	100	10	625	Output	BC337
BC546	TO-92VAR1 NS	65	80	100	0.6	100	110-450	2	300	10	500	G.P S.S. amp.	
BC547	TO-92VAR1 NS	45	50	100	0.6	100	110-800	2	300	10	500	G.P S.S. amp.	BC107, BC207, BC147
BC548	TO-92VAR1 NS	30	30		0.6	100	110-800	2	300	10	500	G.P. S.S. amp.	BC108, BC208, BC148
BC549	TO-92VAR1 NS	30	30	100	0.6	100	200-800	2	300	10	500	Low noise S.S. amp.	BC109, BC209, BC149
BC549C	TO-92VAR1 NS	30	30	100	0.6	100	420-800	2	300	10	500	Low noise high gain	BC109C, BC149C
BC556	TO-92VAR1 PS	65	80	100	0.65	100	75-475	2	200	10	500	G.P. S.S. amp.	
BC557	TO-92VAR1 PS	45	50	100	0.65	100	75-800	2	200	10	500	G.P. S.S. amp.	BC157
BC558	TO-92VAR1 PS	30	30	100	0.65	100	75-800	2	200	10	500	G.P. S.S. amp.	BC158
BC559	TO-92VAR1 PS	30	30	100	0.65	100	125-800	2	200	10	500	G.P.S.S. amp.	BC159
BC639	TO-92(74) NS	80	100	1A	0.5	500	40-250	150	130		1W	Audio O/P	MU9610, TT801
BC640	TO-92(74) PS	80	100	1A	0.5	500	40-250	150	50		1W	Audio O/P	MU9660, TT800
BD139	TO-126 NS	80	10	1.5A	0.5	500	40-250	150	250	50	8W	G.P. O/P	40409
BD140	TO-126 PS	80	10	1.5A	0.5	500	40-250	150	75	50	8W	G.P. O/P	40410
BD262	TO-126 PS	60	60	4A	2.5	1.5A	750	1.5A	7	1.5A	36W	High gain Darl. O/P	BD266
BD263	TO-126 NS	60	80	4A	2.5	1.5A	750	1.5A	7	1.5A	36W	High gain Darl. O/P	BD267
BD266A	TO-220 PS	80	80	8A	2	3A	750	3A	7		60W	High gain Darl. O/P	
BD267A	TO-220 NS	80	10	8A	2	3A	750	3A	7		60W	High gain Darl. O/P	
BD681	TO-126 NS	100	10	4A	2.5	1 ,5A	750	1.5A	1		40W	Darlington O/P	BD263
BD682	TO-126 PS	100	100	4A	2.5	1.5A	750	1.5A	1		40W	Darlington O/P	BD262
BF173	TO-72(28) NS	25	40	25			40-100	7	550	5	230	T.V. I.F. amp.	
BF199	TO-92VAR2 NS	25	40	25			37	7	550		500	H.F. amp.	BF180
BF463	TO-202 PS	250	25	500			40-180	30	20		2W	H.V. med. power.	
BF469	TO-126 NS	250	25	50			50	25	60	10	1.8W	G.P high-V. amp.	
BF470	TO-126 PS	250	25	50			50	25	60	10	1.8W	G.P. high-V. amp.	
BFR90	SOT-37(2) NS	15	20	25			25-250	14	5GHz	14	180	Wideband amp..	
BFR91	SOT-37(2) NS	12	15	35	0.3	30	25-250	30	5GHz	30	180	Wideband amp.	
BFY90	TO-72(25) NS	15	30	25			25-125	2	1 GHz	2	200	Wideband amp.	
BUX80	TO-3 NS	400	80	10A	1.5	5A	30	1.2A	8		100W	Defl'n, high current	
MJ802	TO-3 NS	90	10	30A	0.8	7.5A	25-100	7.5A	2	1A	200W	High power output	
MJ2955	TO-3 PS	60	70	15A	1.1	4A	20-70	4A	2.5	500	115W	G.P. power	
MJ4502	TO-3 PS	90	10	30A	0.8	7.5A	25-100	7.5A	2	1A	200W	High power output	
MJ10012	TO-3 NS	400	60	10A	2	6A	100-2K	6A			175W	Power Darlington	
MJ15003	TO-3 NS	140	14	20A	1	5A	25-150	5A	2	500	250W	High power output	
MJ15004	TO-3 PS	140	140	20A	1	5A	25-150	5A	2	500	250W	High power output	
MJE340	TO-126 NS	300		500	0.75	100	30-240	50			20W	G.P. H.V. power	

Type	CASE	Polarity	V_{CE}	V_{CB}	I_C	V_{CEC}	@ I_C	h_{FE}	@ I_C	FT	@ I_C	P_{TOT}	USE	COMPARABLE TYPES
			mA				mA		mA	MHz	mA	mW		
MJE350T	TO-126	PS	300		500	0.77	100	30-240	50			20W	G.P. H.V. power	
MJE2955	TO-220	PS	60	70	10A	1.1	4A	20-100	4A	2	500	75W	G.P. power	TIP 2955
MJE3055T	TO-220	NS	60	70	10A	1.1	4A	20-100	4A	2	500	75W	G.P. power	TIP 3055
MPSA14	TO-92(72)	NS	30	30	500	1.5	100	20000	100	125	10	625	G.R Darlington	
MPSA65	TO-92(72)	PS	30	30	500	1.5	100	20000	100	100	10	625	G.P. Darlington	
MRF629	TO-39A	NS	16	36	400			20-200	100			5W	UHF power	
MRF660	TO-220A	NS	16	36	2.4A			20-160	250			25W	UHF power	
PN100	TO-92(72)	NS	35	60	500	0.5	100	60-240	150	350	50	600	G.P. amp/switch	PN2222, 2N3643
PN2907	TO-92(72)	PS	40	60	600	0.4	150	100-300	150	200	50	625	High S. switch	
PN200	TO-92(72)	PS	35	60	500	0.5	1 50	50-400	150	200	50	600	G.P. amp/switch	2N3638, BC214
TIP31B	TOP-66	NS	80	80	3A	1.2	3A	25	1A	3	500	40W	Power output	
TIP32B	TOP-66	PS	80	80	3A	1.2	3A	25	1A	3	500	40W	Power output	
TIP142	TOP-3	NS	100	100	10A	2	5A	>1000	5A			125W	Audio output	TIP140, TIP141
TIP147	TOP-3	PS	100	100	10A	2	5A	>1000	5A			125W	Audio output	TIP145, TIP146
TIP2955	TOP-3	PS	70	100	15A	1.1	4A	20	4A	3	500	90W	Power output	MJE2955
TIP3055	TOP-3	NS	70	100	15A	1.1	4A	20	4A	3	500	90W	Power output	MJE3055
2N2222A	TO-18	NS	40	75	800	1.6	500	00-300	150	300	20	500	High S. switch	
2N3019	TO-39	NS	80	140	1A	0.5	500	50-100	500	100	50	800	H.F. amp	
2N3053	TO-39	NS	40	60	700	1.4	150	50-250	150	100	50	2.86W	G.R switch	BD137
2N3054	TO-66	NS	60	90	4A	0.1	200	25-100	500	0.8	200	25W	Audio output	TIP31B
2N3055	TO-3	NS	60	70	15A	1.1	4A	20-70	4A	2.5	500	115W	G.P. power	BDY20
2N3563	TO-106	NS	15	30	50			0-200	8	600	8	200	RF-IF amp	BF173
2N3564	TO-106	NS	15	30	100	0.3	20	20-500	15	400	15	200	RF-IF amp	BF167
2N3565	TO-106	NS	25	30	50	0.35	1	150-600	1	400	1	200	Low level amp	BC108, BC208
2N3566	TO-105	NS	30	40	200	1	100	50-600	10	40	30	300	G.R amp & switch	BC183
2N3567	TO-105	NS	40	80	500	0.25	150	40-120	150	60	50	300	G.P. amp & switch	BC337
2N3568	TO-105	NS	60	80	500	0.25	150	40-120	150	60	50	300	G.P. amp & switch	
2N3569	TO-105	NS	40	80	500	0.25	150	00-300	150	60	50	300	G.P. amp & switch	
2N3638A	TO-105	PS	25	25	500	0.25	50	100	50	150	50	300	G.P. amp & switch	BC328
2N3641	TO-105	NS	30	60	500	0.22	150	40-120		250	50	350	G.P. amp & switch	BC337
2N3642	TO-105	NS	45	60	500	0.22	150	40-120		250	50	350	G.R amp & switch	BC337
2N3643	TO-105	NS	30	60	500	0.22	150	100-300	150	250	50	350	G.P. amp & switch	BC337
2N3644	TO-105	PS	45	45	500	1	300	100-300	150	200	20	300	G.P. amp & switch	BC327
2N3645	TO-105	PS	60	60	500	1	300	100-300	150	200	20	300	G.P. amp & switch	
2N3771	TO-3	NS	40	50	30A	2	15A	15-60	15A	0.2	1A	150W	Power output	
2N3866	TO-39	NS	30	55	400			0-200	50	500	50	1W	VHF amp	
2N3904	TO-92(72)	NS	40	60	200	0.2	10	00-300	10	300	10	310	Low level amp	BC167A, BF194
2N3905	TO-92(72)	PS	40	40	200	0.4	50	50-200	10	200	20	310	G.P. amp & switch	
2N3948	TO-39	NS	20	36	400			15	50	700	50	1W	VHF amp	
2N4030	TO-39	PS	60	60	1A	0.5	500	25	500	260	100	800	G.P. amp & switch	
2N4250	TO-106	PS	40	40	100	0.25	10	50-700	0.1	50		200	Low level amp	BC559
2N4258	TO-106	PS	12	12	50	0.5	50	30-120	10	700	10	200	Saturated switch	
2N4427	TO-39	NS	20	40	400	0.4	100	10-200	100	500	50	1W	VHF/UHF driver	2N3866
2N5401	TO-92(72)	PS	150	160	6000	0.5	50	60-250	10	100	10	625	H.V. switch	MPSL51
2N6557	TO-202	NS	250	250	500			>40	50	45		2W	H.V. med power	
2SC710	TO-92/76	NS	25	30	30			90		100		200	G.P, RF amp	BFS18
2SC1306	TOP-66	NS	65	65	3A			0-200	500	300		12W	H.F. output	2SC2166
2SC1307	TOP-66	NS	70	70	8A			0-150	2A	150		25W	H.F. output	2SC1969
2SC1674	TO-92(74)	NS	20	30	20	0.3	10	40-180	1	600	1	250	VHP amp	
2SC1969	TOP-66	NS	30	60	6A			0-180	10	150		20W	H.F output	2SC1307
2SC2166	TOP-66	NS	75	75	4A			5-180	100					
2SC2694	T-40	NS	17	35	20A			0-180	1A	800		140W	VHF output	MRF247
2SC3355	TO-92(74)	NS	12	20	100			0-300	20	6.5GHz	20	600	UHFSS	MRF573
2SC3358	MX	NS	12	20	100			0-300	20	7GHz	20	250	UHFSS	MRF573

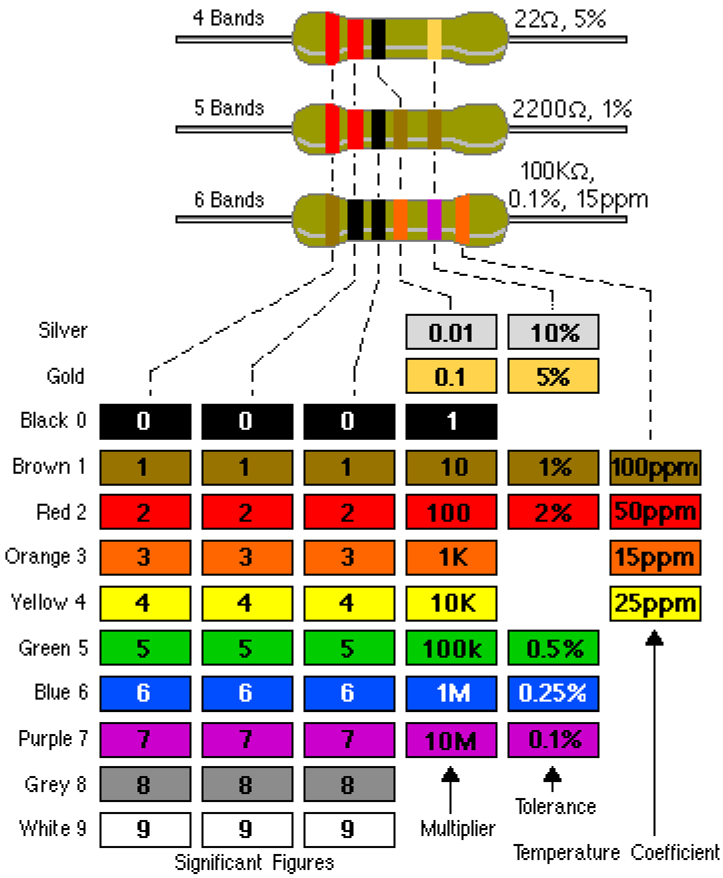


All the resistor colours:

1R0	10R	100R	1k0
1R2	12R	120R	1k2
1R5	15R	150R	1k5
1R8	18R	180R	1k8
2R2	22R	220R	2k2
2R7	27R	270R	2k7
3R3	33R	330R	3k3
3R9	39R	390R	3k9
4R7	47R	470R	4k7
5R6	56R	560R	5k6
6R8	68R	680R	6k8
8R2	82R	820R	8k2
10k	100k	1M0	10M
12k	120k	1M2	22M
15k	150k	1M5	
18k	180k	1M8	0R1
22k	220k	2M2	R22
27k	270k	2M7	0R0 zero ohm (link)
33k	330k	3M3	
39k	390k	3M9	
47k	470k	4M7	
56k	560k	5M6	
68k	680k	6M8	
82k	820k	8M2	



$^1/_{10}{}^{th}$ watt
and
0.25 watt



Resistor Color Code System

See **101-200 Circuits** for resistors in parallel and series and capacitors in parallel and series. You can make ANY VALUE by simply connecting resistors in parallel or series. And the same with capacitors.

20-7-2010