50 555 CIRCUITS
A free ebook

by Colin Mitchell

50 555 CIRCUITS by Colin Mitchell

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 Go to: **1 - 100 Transistor Circuits**
 Go to: **101 - 200 Transistor Circuits**
 Go to: **100 IC Circuits**

For more data on the 555, see these pages:

555-Page 1   **for CD users:**   **555-Page 1**
555-Page 2   **555-Page 2**
555-Page 3   **555-Page 3**
555-Test   **555-Test**

To learn about the development and history of the 555, go to these links:
http://semiconductormuseum.com/Museum_Index.htm - a general discussion about the development of the transistor
http://semiconductormuseum.com/Transistors/LectureHall/Camenzind/Camenzind_Index.htm - history of the 555 - Page1
http://www.semiconductormuseum.com/Transistors/LectureHall/Camenzind/Camenzind_Page2.htm - history of the 555 - Page2
http://www.semiconductormuseum.com/Transistors/LectureHall/Camenzind/Camenzind_Page3.htm - history of the 555 - Page3
http://www.semiconductormuseum.com/Transistors/LectureHall/Camenzind/Camenzind_Page4.htm - history of the 555 - Page4
http://www.semiconductormuseum.com/Transistors/LectureHall/Camenzind/Camenzind_Page5.htm - history of the 555 - Page5
http://www.semiconductormuseum.com/Transistors/LectureHall/Camenzind/Camenzind_Page6.htm - history of the 555 - Page6
http://www.semiconductormuseum.com/Transistors/LectureHall/Camenzind/Camenzind_Page7.htm - history of the 555 - Page7
http://www.semiconductormuseum.com/Transistors/LectureHall/Camenzind/Camenzind_Page8.htm - history of the 555 - Page8
http://www.semiconductormuseum.com/Transistors/LectureHall/Camenzind/Camenzind_Page9.htm - history of the 555 - Page9
http://www.semiconductormuseum.com/Transistors/LectureHall/Camenzind/Camenzind_Page10.htm - history of the 555 - Page10

For a list of every electronic symbol, see: Circuit Symbols.

For more articles and projects for the hobbyist: **see TALKING ELECTRONICS WEBSITE**

Talking Electronics

This set of 555 projects has increased to the largest on the web, with many circuits designed by me as a request from readers. The whole site has been copied by many other sites without any reference or acknowledgement to me. But you can see the circuits are mine by the way they have been drawn and none of the other sites keep updating with the latest additions.
Over one million readers have viewed this article and many have saved it as .pdf
This is the only site that teaches you how to learn and remember how a 555 works and this is very important when you want to design a new circuit.   The secret is: you can hold the 555 with the output LOW by putting a high on pin 6, but when pin 2 goes LOW, the output goes HIGH. Pin 2 dominates over pin 6.

CONTENTS

You will find many of these circuits "talked-about" and produced on bread-board (with videos) on:
http://www.555-timer-circuits.com and:
http://www.555-timer-circuits.com/forum

WHAT IS THE 555?

The 555 is an 8-pin chip that can be turned into lots of different things (building blocks).

The circuit inside the 555 is just an amplifier with 2 inputs and an output.
The parts you add to the chip determine the final result (effect).
In most cases you add a capacitor and resistor to produce a circuit known as a TIME
DELAY CIRCUIT and the chip has a detection-pin and an amplifier (also called a power
amplifier) to produce an output.
It is not just a "timer," "delay" or "oscillator" but is capable of being converted into these and
maybe 100 other circuits.   Just call it the "555"
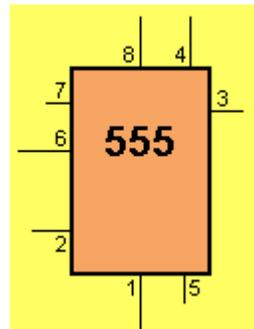
THE 555 IC
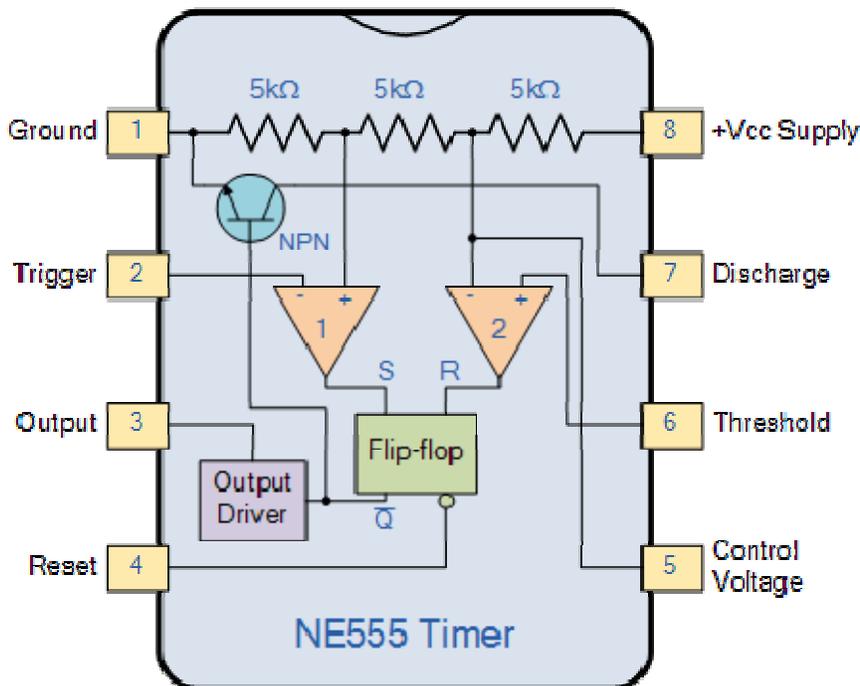
image from: Electronics Tutorials
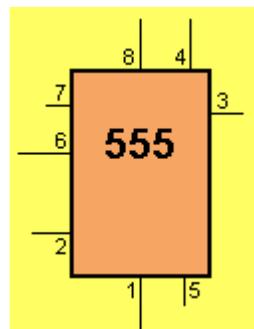
THE 555 IC

The 555 HOW IT WORKS

To understand how the 555 works, you need to know how to connect pins 2 and 6.
This is covered **HERE**
Here is what you need to know:
Do not leave pins 2 and 6 un-connected. . . . .the output of the 555 will be HIGH and
sometimes it will be LOW.
Pins 2 and 6 are HIGH IMPEDANCE and can pick up static electricity and sometimes turn
the 555 on or off.

Here are the 4 possibilities for pins 2 and 6:

Pin 2	Pin 6		
Pin 2 LOW	Pin 6 LOW	Pin 3 HIGH	Pin 2 controls the 555. Pin 6 has NO effect.
Pin 2 LOW	Pin 6 HIGH	Pin 3 HIGH	Pin 2 controls the 555. Pin 6 has NO effect.
Pin 2 HIGH	Pin 6 LOW	Pin 3 LOW	Pin 2 controls the 555.(the 555 does not turn on)
Pin 2 HIGH	Pin 6 HIGH	Pin 3 LOW	Pin 2 controls the 555. (the 555 does not turn on)
Connect pin 2 and 6 together. Take both HIGH . . . .. Pin 3 LOW (**toggle Mode**)			
Connect pin 2 and 6 together. Take both LOW . . . .. Pin 3 HIGH (**toggle Mode**)			

Toggle Mode is also called INVERTER MODE . . . The output is opposite to the input.
The 555 takes 10mA ALL THE TIME . . . even when the output is LOW

INTRODUCTION
This e-book covers the 555.
The 555 is everywhere and it is one of the cheapest and most-rugged chips on the market.
It comes as a TTL 555 and will operate from 4v to about 16-18v. (but don't use less than 5.5v) It costs from 10 cents (eBay) to $1.20 depending on the quantity and distributor.
The circuitry inside the chip takes about 10mA - **even when the output is not driving a load**. This means it is **not suitable** for battery operation if the chip is to be powered ALL THE TIME.
The 555 is also available as a CMOS chip (ICM7555 or ICL7555 or TLC555) and will operate from 2v to 18v and takes 60uA when the circuitry inside the chip is powered. The "7555" costs from 60 cents (eBay) to $2.00. But the output driving capability is a lot less than the TTL 555.
We call the TTL version "555" and the CMOS version "7555."   This is called **ELECTRONICS JARGON**.
The 555 comes as a single timer in an 8-pin package or a dual timer (556) in a 14 pin package.
The 7555 comes as a single timer in an 8-pin package or a dual timer (7556) in a 14 pin package.

The 555 and 7555 are called TIMERS or Timer Chips. They contain about 28 transistors and the only extra components you need are called TIMING COMPONENTS. This is an external resistor and capacitor. When a capacitor is connected to a voltage, it takes a period of time to charge. If a resistor is placed in series with the capacitor, the timing will increase.
The chip detects the rising and falling voltage on the capacitor. When the voltage on the capacitor is 2/3 of the supply the output goes LOW and when the voltage falls to 1/3, the output goes HIGH.
We can also do other things with the chip such as "freezing" or halting its operation, or allowing it to produce a single HIGH-LOW on the output pin. This is called a "ONE-SHOT" or MONOSTABLE OPERATION - but it still takes 10mA while "sitting around".
When the chip produces an output frequency above 1 cycle per second, (1Hz), the circuit is called an OSCILLATOR and below one cycle per second, it is called a TIMER.
But the chip should not be called a "**555 Timer**," as it has so many applications. That's why we call it a "**555**." (triple 5)
Another thing you have to be aware of is the voltage on output pin 3. It is about 1-2v LESS THAN rail voltage and does not go to 0v (about 0.7v for 10mA- output - and up to 1900mV for 200mA sinking current). For instance, to get an output swing of 10v you will need a 12.6v supply. In "electronic terms" the 555 has very poor sinking and sourcing capabilities.
One way to understand how the chip operates is to remember that pin 7 goes LOW when pin 3 (the output pin) goes LOW. When pin 3 goes HIGH, pin 7 goes "open circuit" (it does not go HIGH - it goes HIGH IMPEDANCE).
When pin 4 is taken LOW, (it needs to be as low as 0.5v) the chip stops operating, but it still takes 10mA.

For photos of nearly every electronic component, see this website:

You can also search the web for videos showing the 555 in action.
Here are a few:
Making A 555 LED Flasher – Video Tutorial
Three 555 LED Flasher
555 Timer Flasher
Fading LED with 555 timer

Each website has lots more videos and you can see exactly how the circuits work. But there is nothing like building the circuit and that's why you need to re-enforce your knowledge by ACTUAL CONSTRUCTION.

Learning Electronics is like building a model with Lego bricks. Each "topic" or "subject" or "area" must be covered fully and perfectly, just like a Lego brick is perfect and fits with interference-fit to the next block. When you complete this eBook, you can safely say you will have mastered the 555 - one more "building block" under your belt and in the process you learn about DC motors, Stepper motors, servos, 4017 chips, LEDs and lots of other things. Any one of these can take you off in a completely different direction. So, lets start . . .

Colin Mitchell
TALKING ELECTRONICS.
talking@tpg.com.au

To save space (and get everything on a single page) we have not provided lengthy explanations of how any of 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 (http://www.talkingelectronics.com) for more details on the 555 by clicking on the following four pages: **555-Page 1** **555-Page 2** **555-Page 3** **555-Test**
Many of the circuits have been designed by Colin Mitchell: **Music Box**, **Reaction Timer Game**, **Traffic Lights**, **TV Remote Control Jammer**, **3x3x3 Cube**, while others are freely available on the web. But this eBook has brought everything together and covers just about every novel 555 circuit. If you think you know everything about the 555, take the **555-Test** and you will be surprised!

SI NOTATION

All the schematics in this eBook have components that are labelled using the System International (SI) notation system. The SI system is an easy way to show values without the need for a decimal point. Sometimes the decimal point is difficult to see and the SI system overcomes this problem and offers a clear advantage.
Resistor values are in ohms (R), and the multipliers are: k for kilo, M for Mega. Capacitance is measured in farads (F) and the sub-multiples are u for micro, n for nano, and p for pico.
Inductors are measured in Henrys (H) and the sub-multiples are mH for milliHenry and uH for microHenry.
A 10 ohm resistor would be written as 10R and a 0.001u capacitor as 1n.
The markings on components are written slightly differently to the way they are shown on a circuit diagram (such as 100p on a circuit and 101 on the capacitor or 10 on a capacitor and 10p on a diagram) and you will have to look on the internet under **Basic Electronics** to learn about these differences.

Here's a 555 built from transistors by Eric Schlaepfer in honor of Hans Camenzined, who invented the 555:
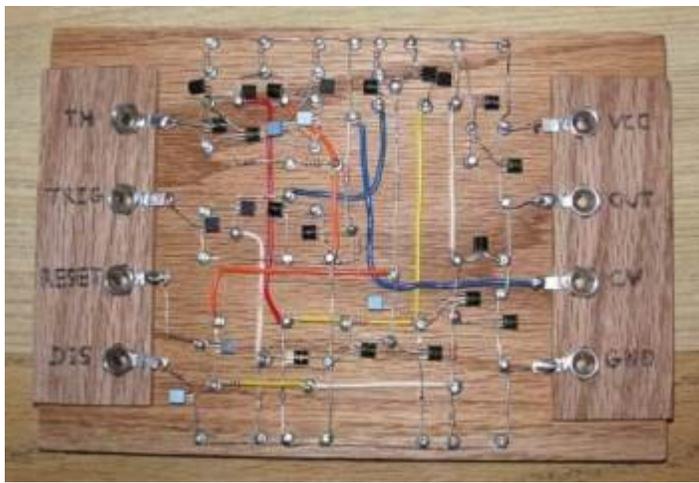
You can build your own 555 from this Instructable:
http://www.instructables.com/id/Build-Your-Own-555-Timer/

Or buy a kit for $35 from Evil Mad Scientist:
http://shop.evilmadscientist.com/productsmenu/tinykitlist/652

This kit is ideal for a school science project.
Here is the circuit and assembly instructions.

WARNING!!

Before making any 555 project, remember the chip takes about 10mA **ALL THE TIME** and cannot be turned off.
The output (the "driving power") of a 555 is about 200mA while the CMOS versions are only about 50mA.
The chip is not really suited for doorbells and circuits as the 10mA will rapidly drain the battery.
The 555 does not like 5v supply.   Use 6v supply (minimum) when designing a circuit and then see if it works on 5v.   This is a REAL TRAP !!!!!

THE 555 IS RUBBISH
This headline is just to grab your attention.
There is one more problem with the 555. It is not suited to deliver a current above 100mA on a 12v supply.
WHY?
This has never been covered before.
If you put a 555 on 12v and create a square-wave output (50:50) with a load of 100R, the output voltage will be 10v and the current will be 100mA when the output is HIGH and 0mA when the output is LOW. This means the average current through the load is 50mA. But the current taken by the circuit will be more than 50mA. Where does the extra current
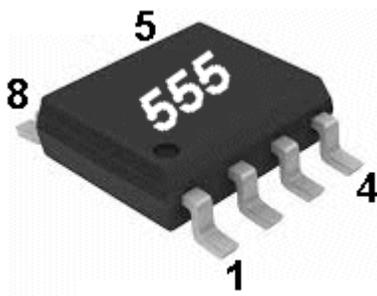
go ????
It goes into the circuitry of the 555 and heats up the chip. When the load is 50R, the current will be 200mA and 0mA with an average of 100mA. But the current from the supply will heat up the chip so hot that you cannot hold it.
Everyone thinks it is the loss of 2v due to the output switching HIGH and LOW, but that would only account for about 400mW. The chip is actually dissipating up to 1200mW and that's why it will burn your finger.
The 555 was initially developed as a TIMER. It provides time-delays up to about 30 minutes.
During a timing interval it might be able to deliver 200mA to a load but when it is used as an oscillator, the transistors inside the chip consume about 50% of the current and cause the chip to heat up.
NOW YOU KNOW.

SURFACE MOUNT 555

The 555 is also available in SURFACE MOUNT packages.

There are 5 different sizes and you will need to find out the "foot-print" before making a Printed Circuit board.
All the features of the surface mount version are the same as the through-hole version, but you must remember the output does not "go to rail" or 0v. When the current through the output pin is less than 10mA, the output will go as low as 250mV. But when the current increases to 100mA to 200mA, the output will not go lower than 2.5v.
When the output is HIGH and trying to deliver 200mA, it will be

 2.5v lower than the supply voltage. That's why you need to make a prototype circuit first and check the output voltage as well as the heating of the chip. Max current is 200mA.

NEW! FROM TALKING ELECTRONICS

A new range of 555 chips have been designed by Talking Electronics to carry out tasks that normally need 2 or more chips.
These chips are designated: TE 555-1, TE555-2 and the first project to use the TE 555-1 is **STEPPER MOTOR CONTROLLER TE555-1**.
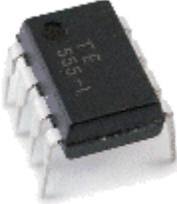
It's a revolutionary concept. Instead of using an old 8-pin TTL 555 chip, you can use a new TE555-1,2,3 8-pin chip and save board space as well as components. These new chips require considerably less external componentry and the possibilities are endless.
Depending on the circuit, they can have a number of timing and frequency outputs as well as a "power-down" feature that consumes almost no current when the circuit is not operating. See the first project in this series: **STEPPER MOTOR CONTROLLER TE555-1**.
See also: **Stepper Motor Controller** project

See also TE 555-2   TE555-3   TE 555-4   TE555-5

555 TIMER CALCULATOR
A program to work out the values for a 555 in Astable or Monostable mode is available from Andy Clarkson's website:
 http://555-timer-circuits.uk/
   555-Timer.zip (987KB). Name a folder: "555 Timer." Unzip and run "555 Timer setup.exe"

Setup will produce a desktop icon. Click on icon for program. Set the voltage for the 555 then use the Astable or Monostable tabs to design your circuit. Read the Help screen to understand the operation of: "Hold Output" and "smallest."
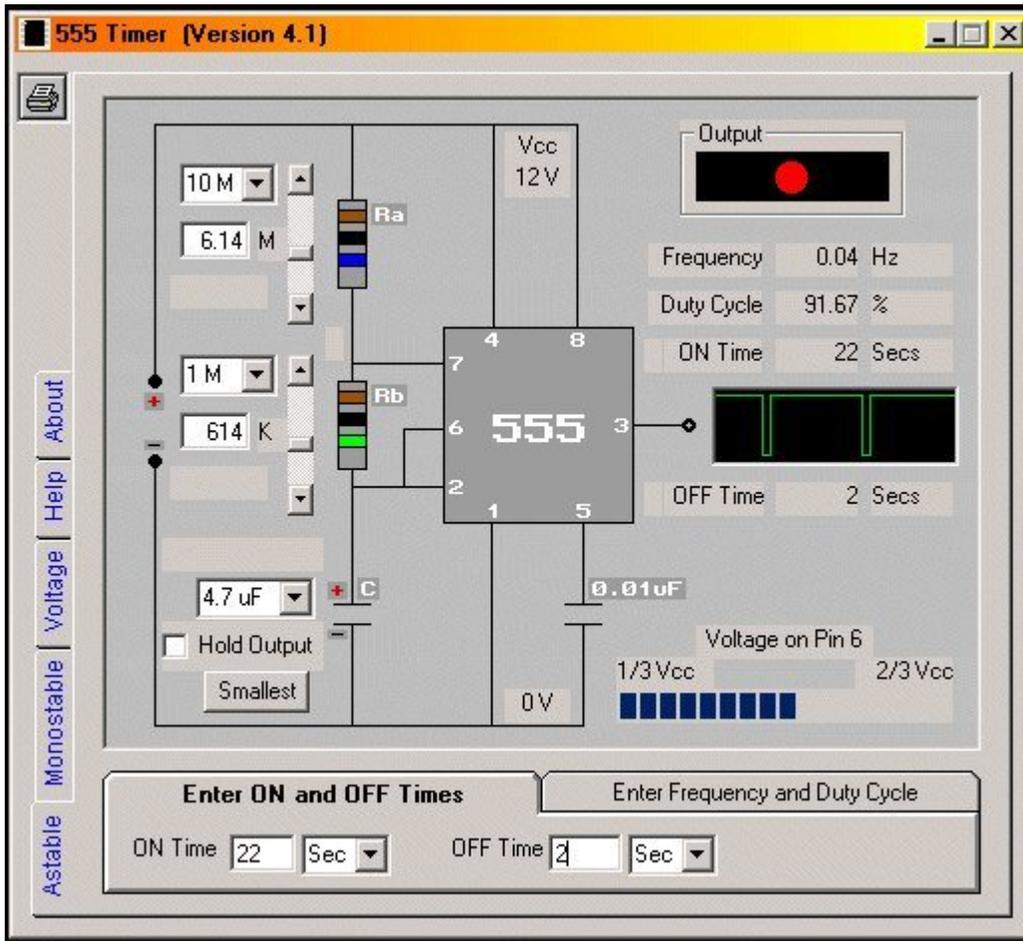
Here is another 555 calculator by Jeff:

555 Timer Calculator
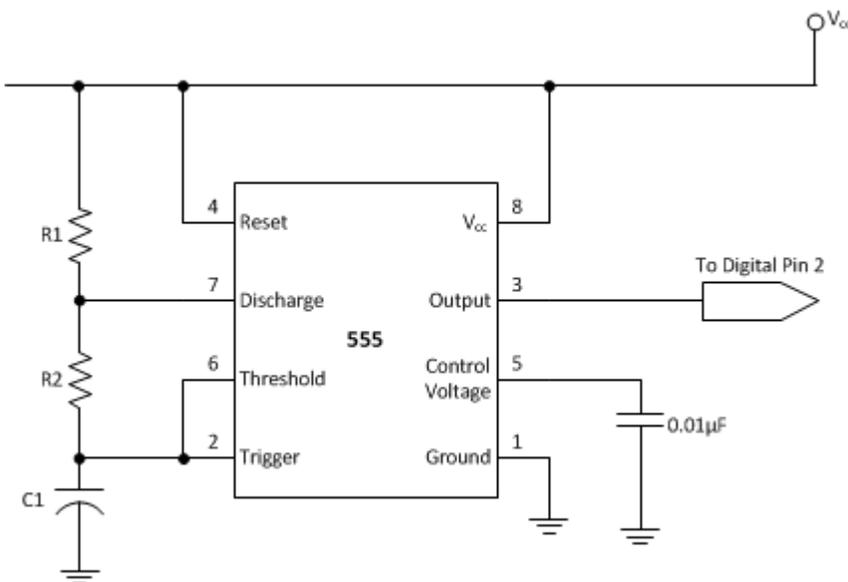
This calculator will provide a number of component values for the delay you want or the frequency.
You can specify "10ms" or "4.5kHz" in the text fields.

How often do you want the timer to produce an output?	[_____]	seconds
What frequency do you want the timer to operate at?	[_____]	Hertz

7555 CMOS CALCULATOR   see 7555

The 555 comes in a low-power CMOS version. The drive-current from pin 3 is less than the TTL "555."
At 5v, a 7555 will deliver 2mA and sink only 8mA
At 12v a 7555 will deliver 10mA and sink 50mA
At 15v a 7555 will deliver 100mA and sink 100mA
Use the following 7555 calculator to find the OUTPUT FREQUENCY in Astable mode or OUTPUT TIME in Monostable mode:
7555 CMOS Calculator

Here's a 555 made with 22 transistors by Malcolm Faed. See his video.

See his Electric Vehicle website.

How are your powers of observation?
Can you find the LED:
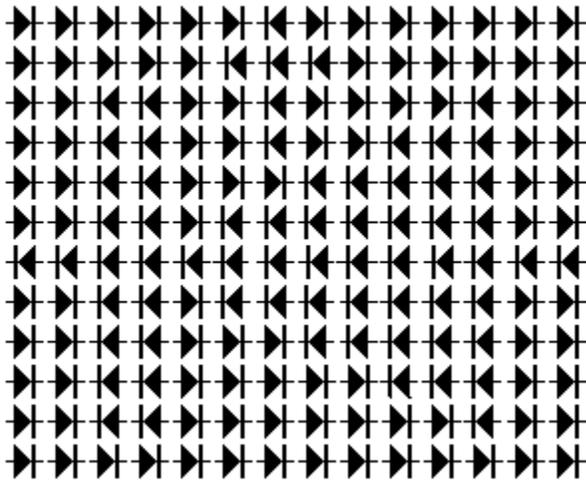
THE POWER SUPPLY
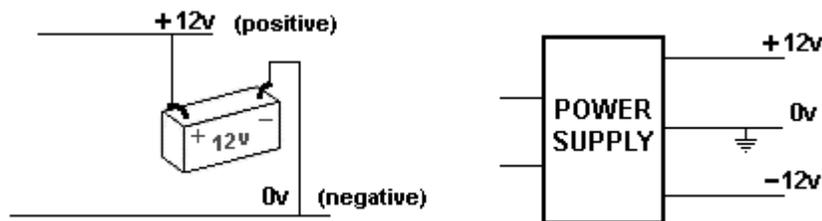
Sometimes you will see a circuit as shown in the **first diagram** with 12v or +12v on the top rail and 0v or a negative sign or the word "negative" on the bottom rail. In **this**

case the word negative means earth or "chassis of a car" and we commonly refer to this as "negative earth" or "negative chassis."
In the **second diagram**, the output from a power supply has a positive 12 volts and a negative 12v with the 0v rail in the middle. In **this case** the negative 12v rail is twelve volts BELOW the earth rail and that's why we call it the NEGATIVE RAIL.
This means that when you hear "Negative Rail," you need to work out if it means the negative terminal of a battery (as in the first case - meaning 0v or earth) or if the voltage is below zero volts (as in the second case).

CD of Talking Electronics website

A CD of the whole website is available for $10.00 posted to anywhere in the world. The CD comes with a small bag of electronic components including surface-mount items.

Log in to your PayPal account and send a payment to: talking@tpg.com.au for $10.00 AUD

Or email Colin Mitchell:
talking@tpg.com.au for details on sending for the CD plus other kits etc.

SQUARE WAVE OSCILLATOR KIT

A Square Wave Oscillator Kit is available from Talking Electronics for under $10.00. See full details of circuit below.
   (This link will send an email to Colin Mitchell and you will be advised of costs and how to send money via Paypal or credit card.)
 Or email Colin Mitchell: talking@tpg.com.au

555 KIT

A kit of components to make many of the circuits described in this eBook is available for $10.00 plus $7.00 post.
Or email Colin Mitchell: talking@tpg.com.au

The kit contains the following components:
(plus **extra** 30 resistors and 10 capacitors for experimenting), plus:

2 - 220R
2 - 1k

2 - 4k7
2 - 10k
2 - 33k
2- 100k
2 - 1M
1 - 10k mini pot
1 - 100k mini pot

2 - 10n
BUY NOW 2 - 100n
1 - 10u electrolytic
1- 100u electrolytic

2 - 1N4148 signal diodes
2 - BC547 transistors
1 - BC557 transistor
1 - 555 timer chip
1 - 8 pin IC socket
1 - red LED
1 - green LED
1 - orange LED
1 - mini 8R speaker
1 - mini piezo
1 - LDR (Light Dependent Resistor)
1 - 10mH inductor
1 - push button
1 - tactile push button
1 - **Experimenter Board** (will take 8, 14 and 16 pin chips)
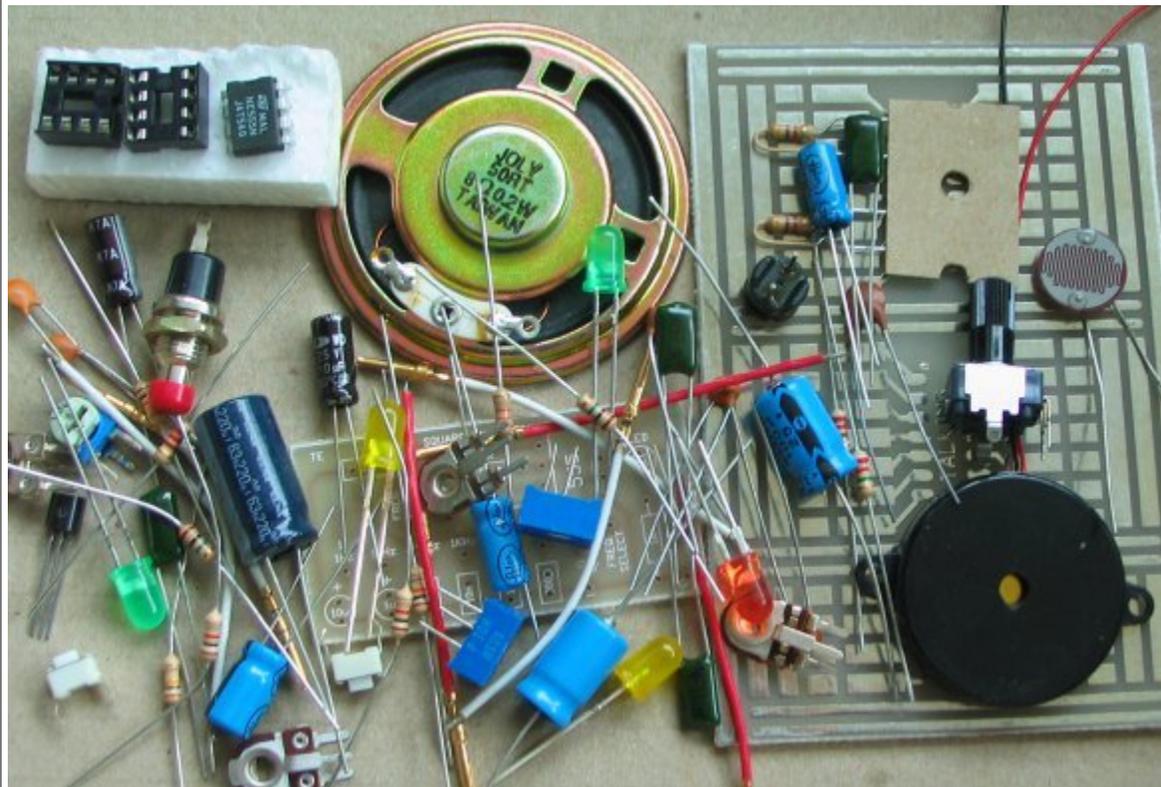
Components for 555 Kit

There are more components than you think.
All kits contain more components than on the list.
555 Kit: $10.00 plus $7.00 postage

You can also get a breadboard and 30 jumper leads for $5.00 so you can plug the parts into the board and re-use them for another circuit:
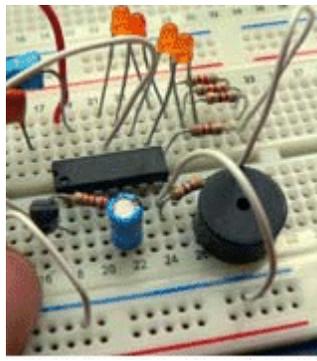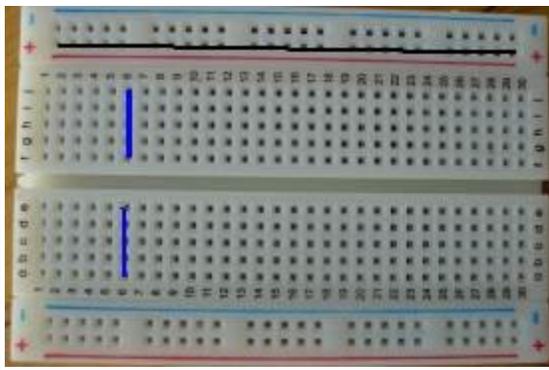
The photo shows a number of components fitted to the breadboard.
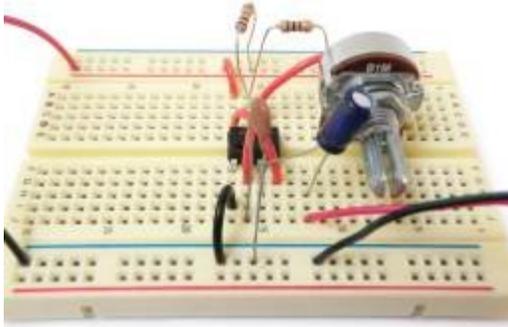
This is the breadboard you get.   **These are the 30 jumper leads that come with the breadboard**

Here is a project from Franz Bachler, using a 555 and 4017 to drive 4 orange LEDs. He has used the bread-board to make a very neat project. The only problem is: he has cut the leads of the components and some of them will only fit between three holes. This may be a problem when you make the next project.

Email: Colin Mitchell to get the breadboard for $5.00 with the TRANSISTOR KIT or 555 KIT (see above).

You can make this project with MAKE A 555+4017 DISPLAY. The kit has 3 different displays that plug into the main board to get a range of different effects.
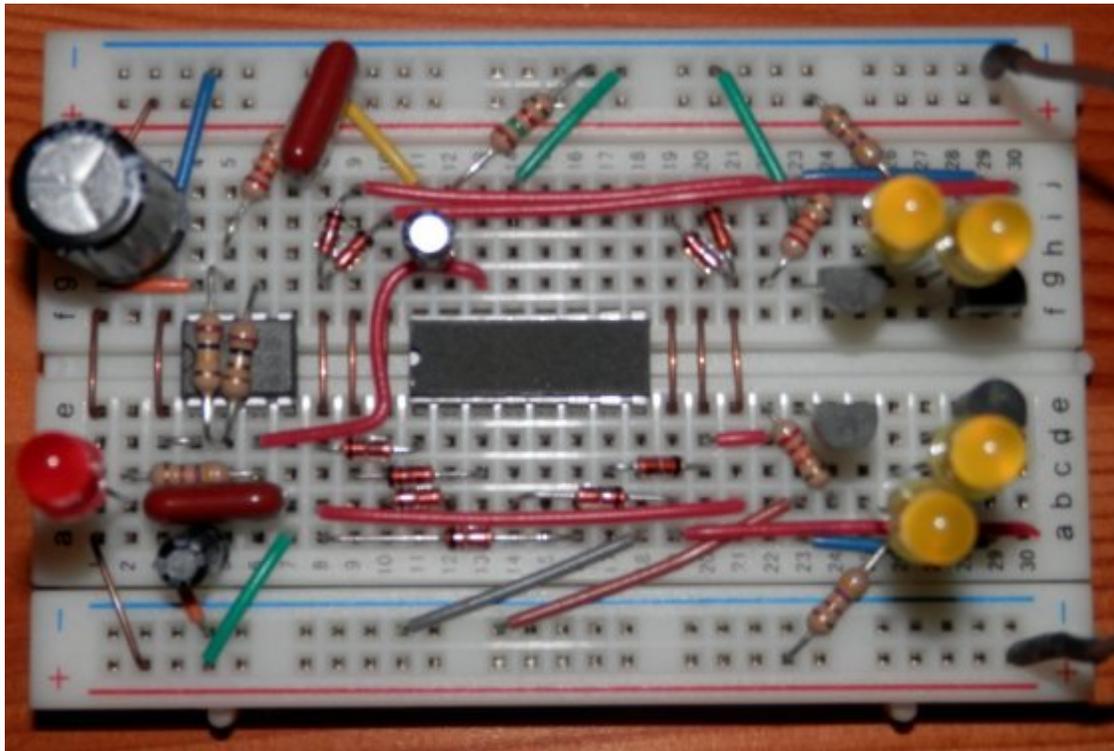
This is what you can do with the breadboard.

MAKE ANY 555 PROJECT

3 Printed circuit boards: MAKE ANY 555 PROJECT are available for $10.00 post free to ANYWHERE IN THE WORLD !!!.
email Colin Mitchell: talking@tpg.com.au
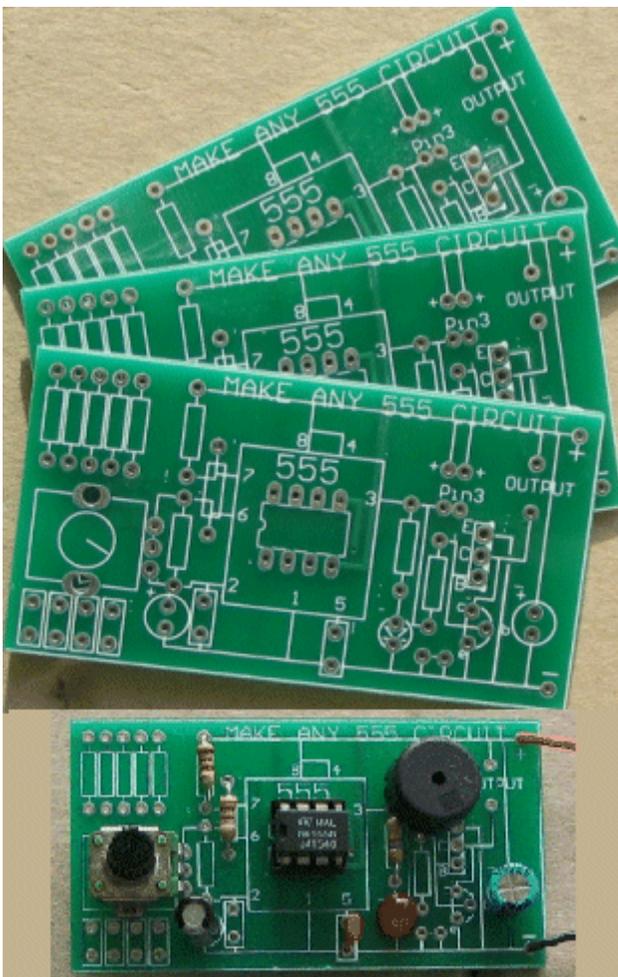
A set of components for **MAKE ANY 555 PROJECT** is just $5.00 extra
See Guitar Tuner Project
and Automatic Garden LED Strip Project

NEW !

5 Different boards are now available for $10.00 USD posted.
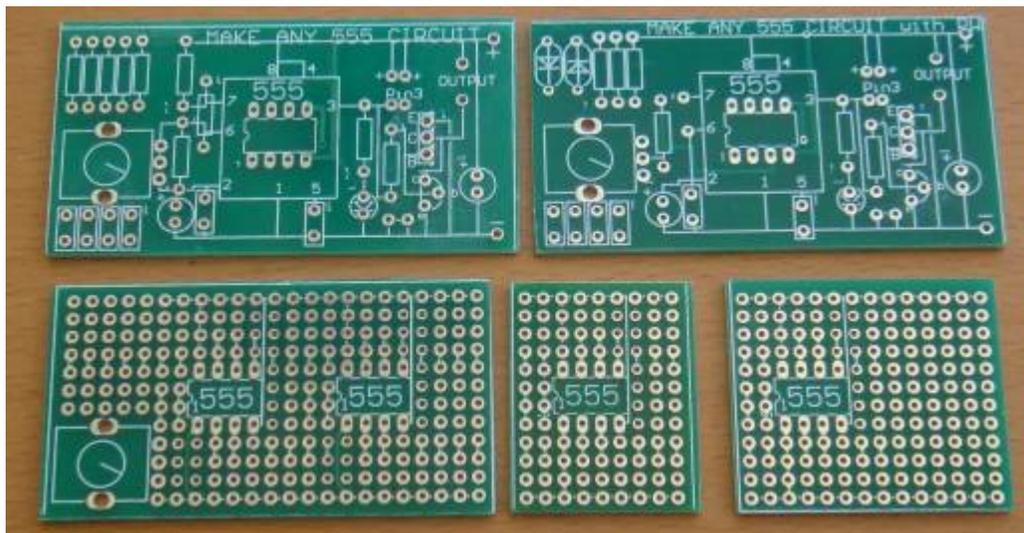
Please log into your paypal account and send a payment to talking@tpg.com.au for $10.00   USD

 And send your name and address and I will send the item(s). Let me know that you want the 5 different 555 boards for $10.00 posted.

Colin

The parts include:
2 - 220R
2 - 1k
2 - 4k7
2 - 10k
2 - 33k
2 - 47k
2- 100k
2 - 1M
1 - 10k mini pot
1 - 100k mini pot
2 - 10n
2 - 100n
1 - 10u electrolytic
2- 100u electrolytic
1 - 1N4148 signal diodes
3 - BC547 transistors
3 - 555 timer chips
3 - 8 pin IC sockets
1 - red LED
1 - green LED
1 - orange LED
3 - mini piezos
1 - LDR (Light Dependent Resistor)
3 - slim tactile push buttons
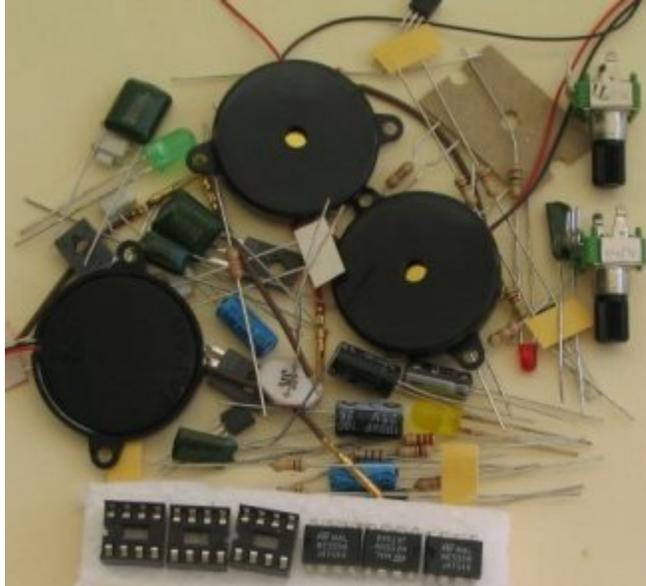
These parts will help you build many of the 555 circuits presented below.

Kit: $5.00   [VALUE: $6.50]
3 x Make any 555 Project PC boards $10.00 plus $5.00 components: $15.00 (post FREE)

MAKE A 555+4017 DISPLAY $4.50

Make you own RUNNING LED DISPLAY with this 555+4017 PC board. It comes with 3 display boards that plug into the main board to produce an expanding or compressing effect, as well as a 6-LED KITT SCANNER.   email Colin Mitchell: talking@tpg.com.au
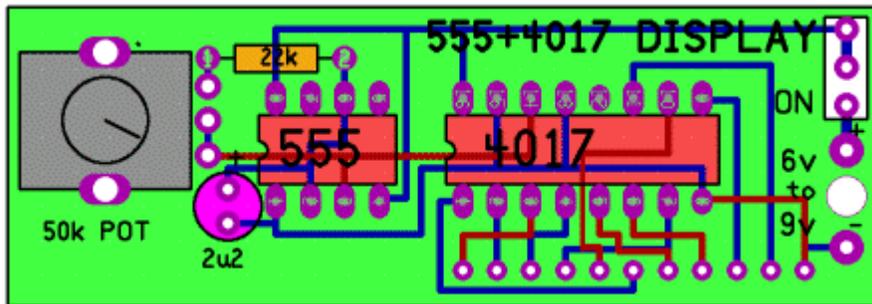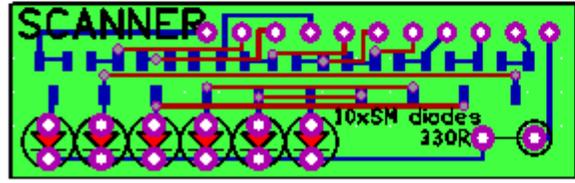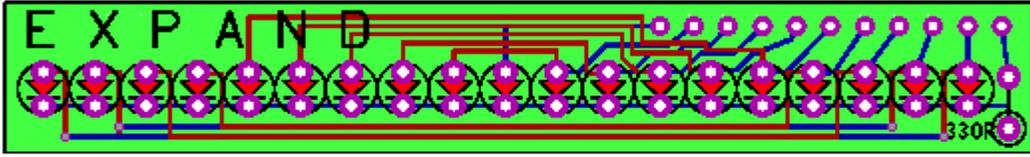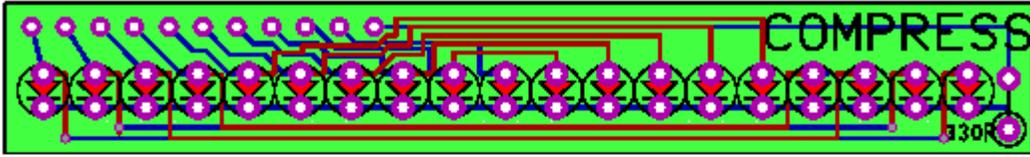
The Scanner - called Kitt Scanner
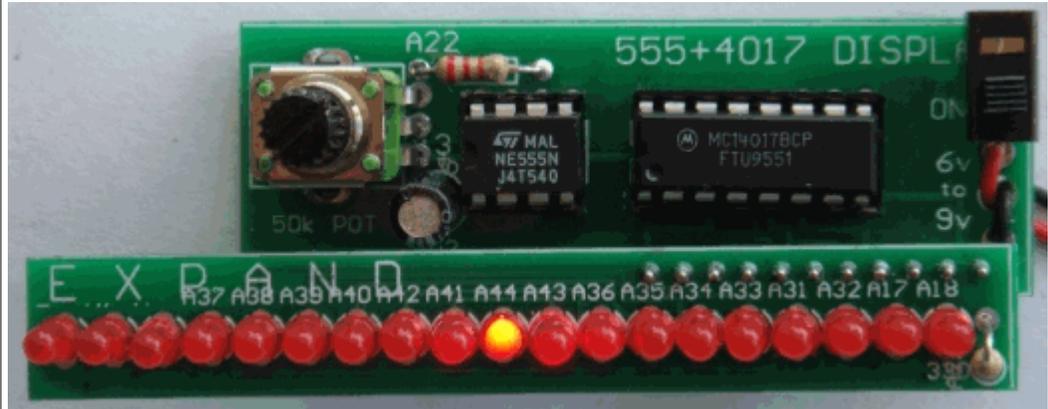
555 EXPAND

You also get COMPRESS - all instantly interchangeable

A set of components for this project is just $7.50 extra. This includes 44 LEDs, 20 surface mount diodes, 50k pot, 2u2, 22k, 555, 4017, IC sockets, 11 machine pins, 33 double-ended pins, slide switch, and battery snap.

Make 555+4017 Project (with 3 display boards) $4.50
Set of components: $7.50
plus $4.00 postage.

We have everything for the hobbyist and engineer to build a 555 circuit on a Printed Circuit Board. This is the latest edition to the range:

555 MATRIX BOARD $1.50each
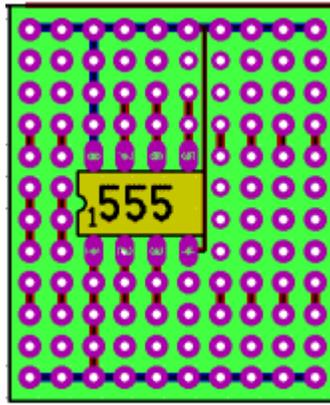
555 MATRIX BOARD

The 555 IC is already "wired up" and some of the lands are connected to make fitting components easy. The overlay on the board shows you the wiring.
Get the set of components above for $5.00 extra and you will be able to make 3 different projects.

MORSE KEYER

METAL DETECTOR

HEE HAW SIREN

MOSQUITO REPELLENT

POLICE SIREN

MAKE ANY 555 CIRCUIT

Pin3   OUTPUT
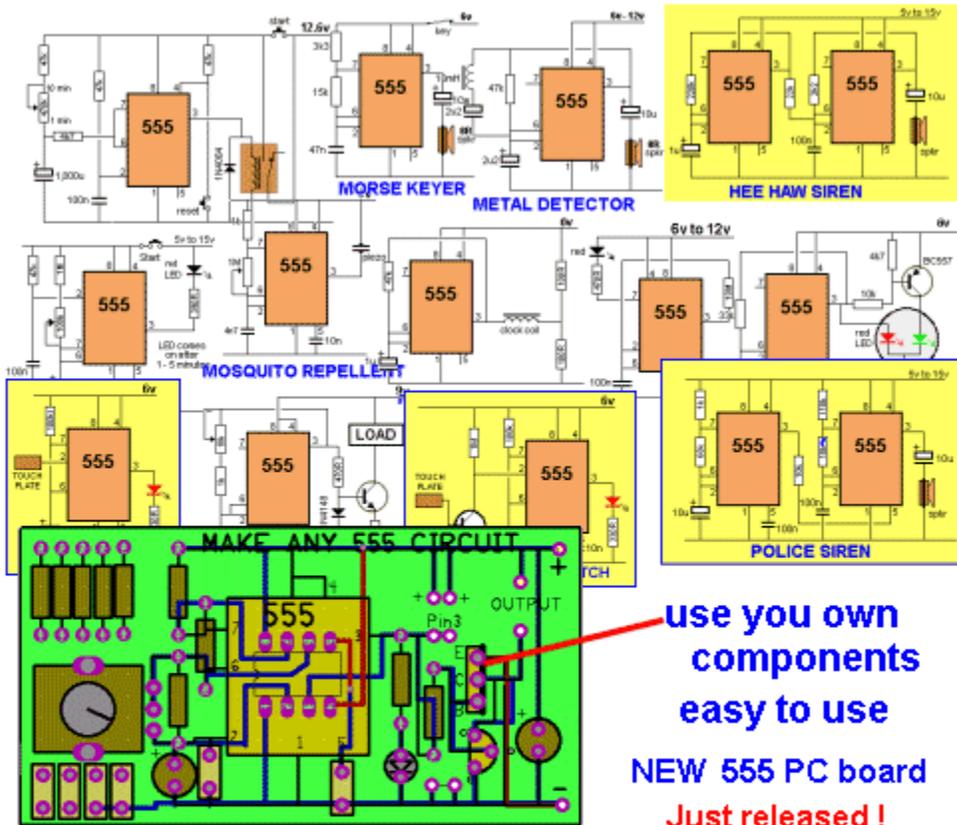
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components
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NEW 555 PC board
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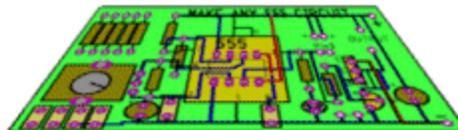
LONG DELAY TIMER

The 555 does not produce times longer than about 60 minutes and a new chip on the market produces times up to 1,000 hours. It is called C005. Here is the prototype where we tested the chip:
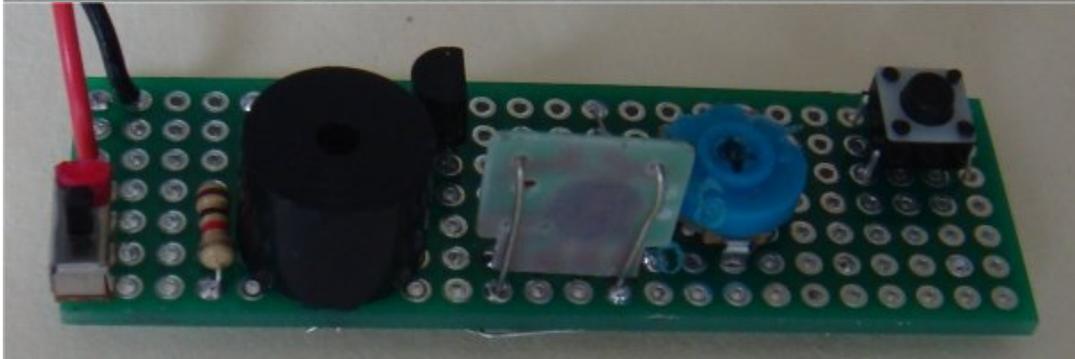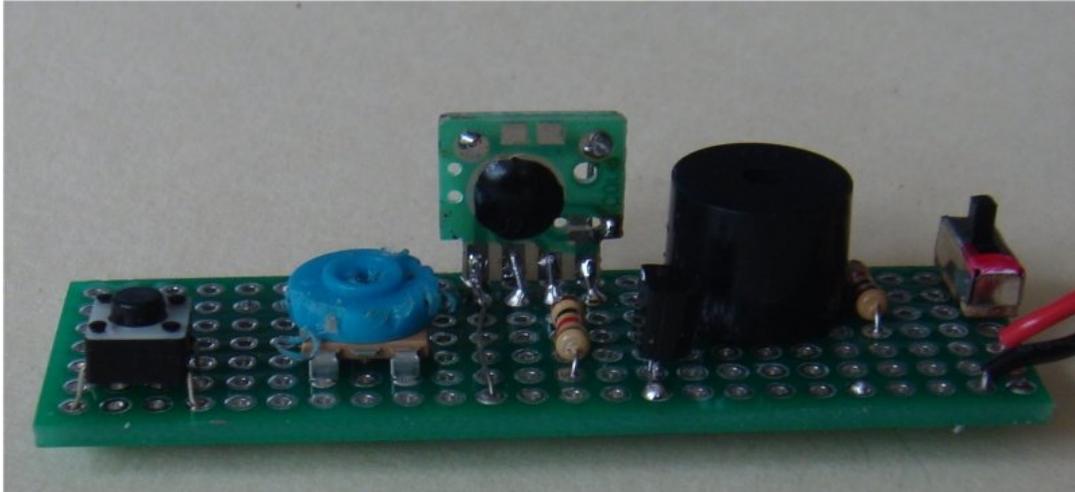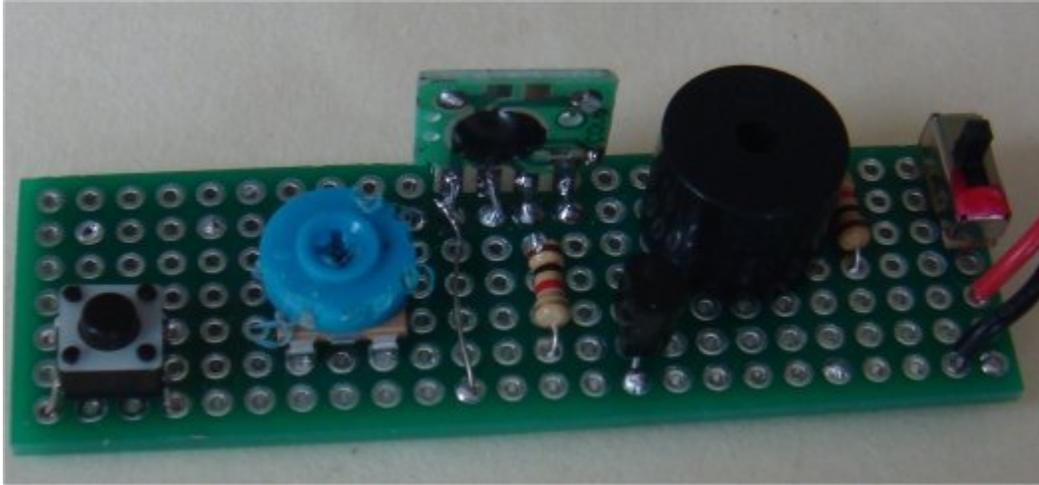
Back of the timer module showing the two wires for the pot.
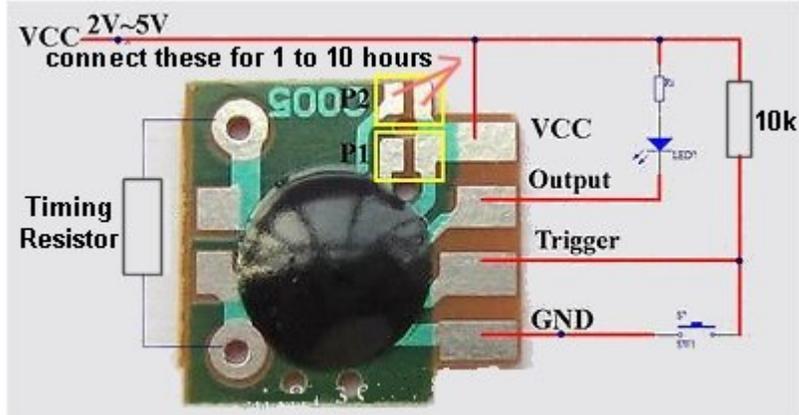
Connect the two top pads to produce 1 to 10 hours

A kit is available for $8.00 (plus postage) **and comes with all components and a printed circuit board with all parts clearly shown on the overlay.**
The pot is marked with 1 to 10 hours and this will be ideal for most applications. The tactile button starts the timing and the buzzer sounds when the time is up. Two output pins are also provided on the PC board to connect to other devices to turn them ON.
The output of the board turns ON a device such as a relay, after say 5 hours, and the contacts on the relay will turn the device OFF. The buzzer on the board will let you know the 5 hours is up.
The project is connected to 3 x AA cells (4.5v) (in a battery box)
Consumption when timing: 100uA
Output: pull-up 3mA   pull-down 30mA
Connecting the pads at P1   and also the pads at P2 increases the delay by 8 times, making the timing up to 80 hours. (but don't let P1 pads touch P2 pads). Changing the pot to 20M creates 1,000 hours.
 email Colin Mitchell: **talking@tpg.com.au** for payment for the kit via paypal.

HOW A 555 WORKS
To design a 555 circuit you must know how a 555 IC works. Here is an explanation:

How the 555 Oscillates
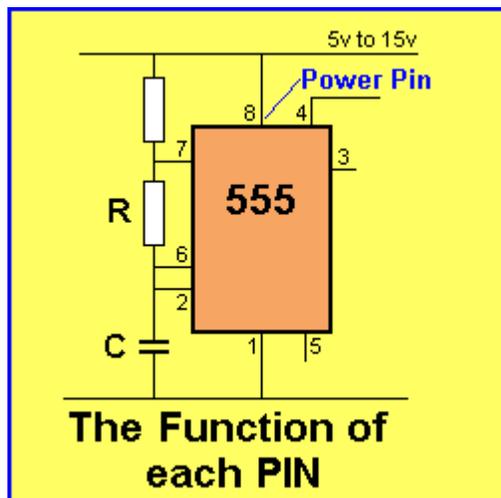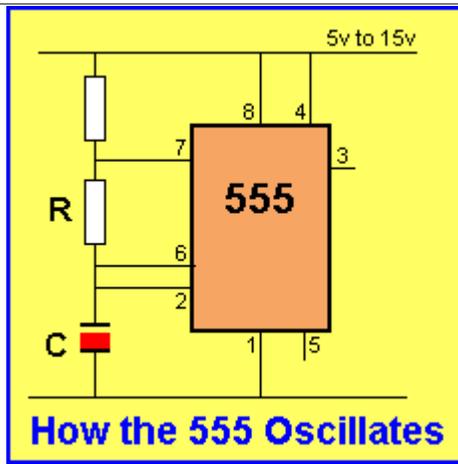
The capacitor charges between 33% and 66% of tail voltage. When the capacitor is 66%, pin 6 detects the voltage and makes pin 7 go LOW. The capacitor discharges to 33% and pin 2 detects the voltage and makes pin go HIGH (actually pin7 goes OPEN) and the capacitor charges to 66% to repeat the cycle.

LET'S START:
1. Connect the 555:
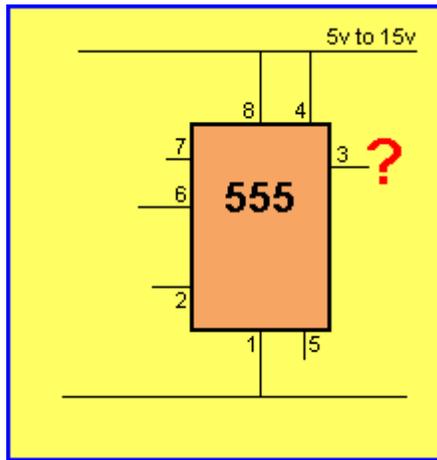
UNKNOWN STATE

We start with pins 2 and 6 NOT CONNECTED. This is called the UNKNOWN STATE because the chip is not getting any information and the output is UNKNOWN.
The inputs are called "FLOATING."   Inputs must NEVER be "FLOATING."

2. Connect Pins 2 and 6:
We start by connecting pins 2 and 6 as shown and then connect the power:
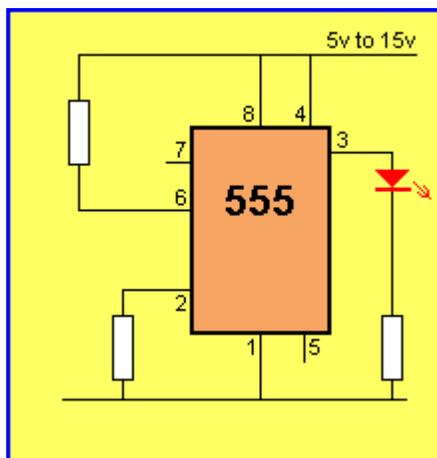
Read the notes to understand this.

This is also called the UNKNOWN STATE because Pin 2 detects a LOW to make the output HIGH and pin 6 detects a HIGH to make the output LOW.
The output will be HIGH or LOW depending on which pin is detected first.
The output is controlled by a BUILDING BLOCK called a FLIP FLOP or TOGGLE or SWITCH or BI-STABLE LATCH. It will remain "locked" or in a stable state and it will take a voltage of about 33% or more of rail voltage to change the state via pins 2 or 6.
In most cases the output will "flip over" to the state with the output LOW. If you delay pin 2 by 1uS, the output will go HIGH, indicating pin 2 is now detected to make the output HIGH.

3. Toggle (or change) the output:
The output can be changed by using pin 2 or 6.
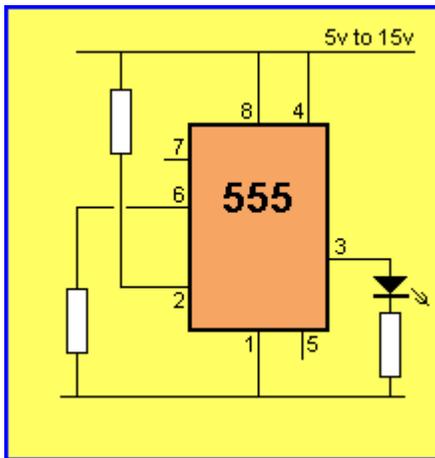
Pin 2 and Pin 6 change output

The output changes immediately, the animation is a "slow-down."

4. The output:
If we make pin 2 LOW and Pin 6 HIGH, both pins are trying to change the output of the chip and pin 2 WINS !!!   The output is HIGH !!
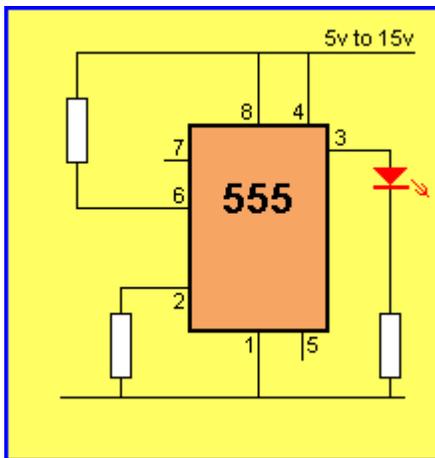
Pin 2 WINS !!

4a. The RESET PIN
Pin 4 is the reset pin. When it is taken to the positive power rail, the chip "works." When it is taken to 0v rail, the chip "freezes" and pin 3 instantly goes LOW, (even if it is halfway through a timing cycle). But the current taken by the chip remains at 10mA and you cannot use this pin to "turn off the current taken by the chip."
If pin is unconnected, it will allow the chip to operate as the internal circuitry puts a "High" (950mV) on the pin.

But the Reset Pin is more complex.

When nothing is connected to pin 4, it has a voltage of about 950mV on it and it will deliver about 350uA. This is due to the circuitry inside the chip.
It must be taken below 500mV to turn the chip off.
A 2k7 resistor connected to pin 4 will turn the chip off.
A 3k3 resistor connected to pin 4 will **NOT** turn the chip off.
This means pin 4 is generating a voltage (and current) and we can use this feature to turn the chip OFF via a Light Dependent Resistor (LDR).
If we connect an LDR to pin 4, it will require a very bright light to reduce the resistance of the LDR to less than 3k3.
By adding a 10k to the circuit, we help the LDR produce a combined resistance less than 3k3 and the circuit will work in a normal lounge-room or bedroom. When the LDR sees illumination from a room-light, it will turn the chip off.
You can try values as low at 4k7 to make the chip MORE sensitive.
In the following circuit, both pin 2 and pin 6 activate the chip to make the output HIGH and LOW "at the same time" but Pin 2 has control over pin 6 and pin 2 makes pin 3 (the output pin) HIGH.

CHIP TURNS ON WHEN DARK
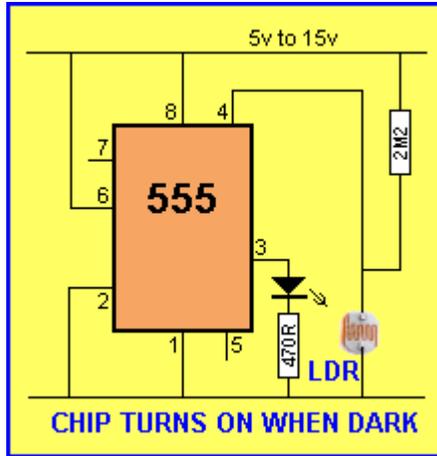
5. The Schmitt Trigger:
Pin 2 detects 33% of rail voltage and pin 6 detects 66%. This gives a gap of 33% between the two. This gap is called the HYSTERESIS GAP.
Here is a circuit to show how the gap works:

The Hysteresis Gap
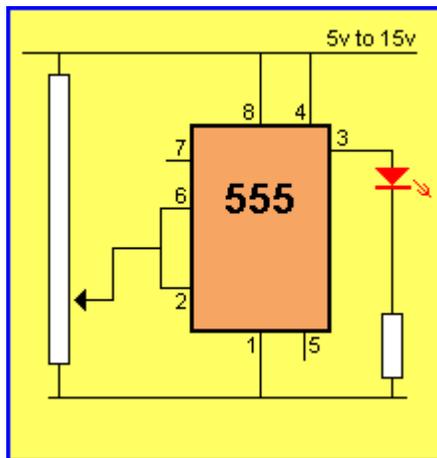
The 555 is wired as a SCHMITT TRIGGER. A Schmitt Trigger has a gap between HIGH and LOW input so the signal has to rise and fall a large percentage of rail voltage to make the output change. This means noise on the input will not alter the output as noise has a small amplitude. This type of circuit "cleans up" noisy inputs.
This circuit is also called AN **INVERTER**, A **BUFFER** and AN **AMPLIFIER**

5a. The Schmitt Trigger:
Here is a circuit with the 555 wired as a Schmitt Trigger. It is an oscillator with a square-wave output and operates by detecting 33% and 66% of rail voltage on the capacitor to

change the state of the output.
The first diagram shows the rectangular 555 and the second diagram shows it as a triangular shape which is the same shape for a 74c14 (40106) Hex Schmitt Trigger.
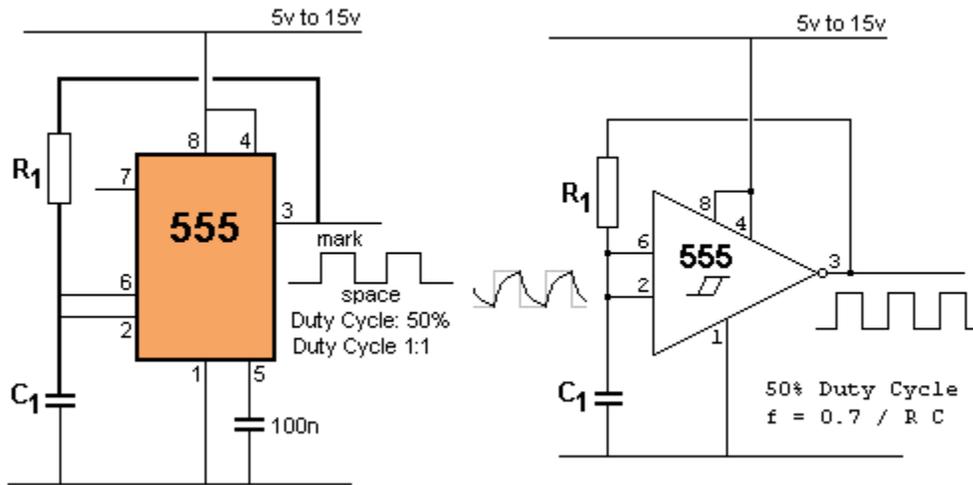
6. One-Shot or Switch Debouncer:
The 555 can take the noisy pulses from a switch and produce a single CLEAN pulse.
The circuit is also called **PULSE EXTENDER**.

Switch Debouncer
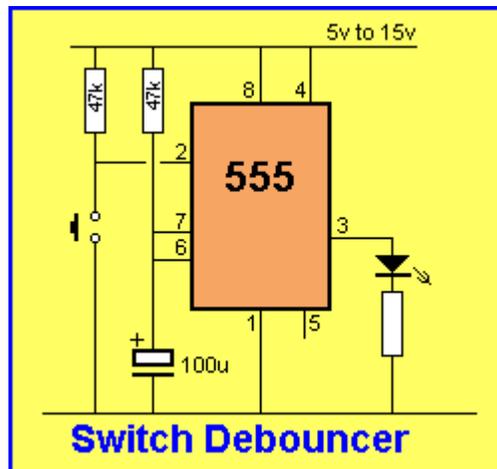
7. The 555 as a Delay (Timer):
The 555 can be used as a timer up to 10 minutes. This circuit is also called a DELAY.
To start timing, the START button is pressed briefly and the output of the chip goes LOW. At the expiration of 10 minutes, the output goes HIGH and the red LED illuminates.
A simple application may be for a cooking operation in a shop.
If a product needs to be cooked or heated etc, the button can be pressed and the LED illuminates when the time has expired.

10 MINUTE TIMER
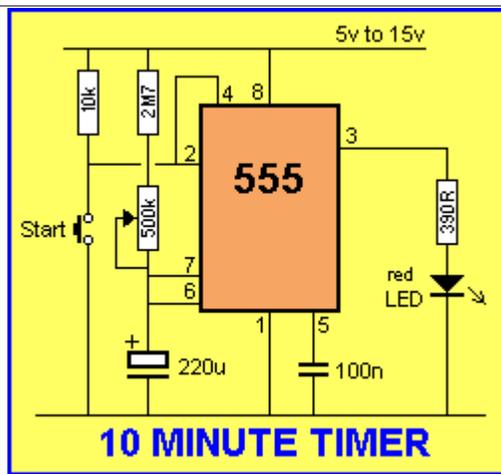
When calculating the time-duration for the circuit above, the capacitor charges from 0v to 2/3 rail voltage.

The timed period:

$$T = 1.1 \times R_t \times C_t \text{ seconds}$$

where:
  R_t in Ohms
  C_t in Farads

In this circuit we can see pin 2 is taken LOW when the power is applied and quickly goes HIGH. Pin 2 has control over pin 6 as explained in **THE 555 PINS** below.
The action of Pin 2 going LOW "activates the 555" and makes pin 3 HIGH. This only applies because pin 6 is LOW.
Because pin 2 goes HIGH after 0.1secs, it has done its job of turning ON the 555 and now we wait for pin 6 to go HIGH to turn the chip OFF. If pin 2 remained LOW, the chip would NEVER turn OFF.

555 TIMER
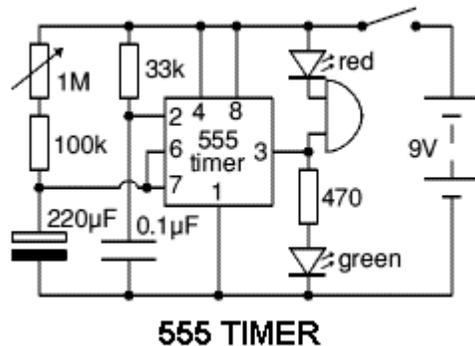
8. LONG Duration Timer:

The 555 can be used as a timer up to 10 minutes, but the accuracy of this duration is not reliable and will vary enormously according to the temperature of the day and the leakage of the electrolytic. If you make the time too long, the output may never go HIGH. Reliability stops at about 1 minute, so to get a long duration we connect the 555 to a chip called a "divider-chip" or "counter-chip."
They are called **divider chips** because they are designed to take a high frequency and reduce it to a lower frequency by using a number of flip flops.
A flip-flop has the ability to divide a signal by 2. In other words, the output oscillates at half the input frequency.
If you connect a chain (or train) of flip flops, the signal gets divided by 2, 4, 8, 16, 32, 64, 128 etc.
Thus 1 minute will turn into 2 minutes . . . 128 minutes.
This type of chip is called a BINARY DIVIDER CHIP.
You can also connect a 555 to a divide-by-10 counter (CD4017) to get 2 minutes, 3, 4, 5, 6, 7, 8, 9, 10.
If your timing is 61 seconds, the 10 minutes will be 10 minutes and 10 seconds.

Here are 2 **LONG DURATION** TIMING CIRCUITS:

LONG DURATION TIMER - 1
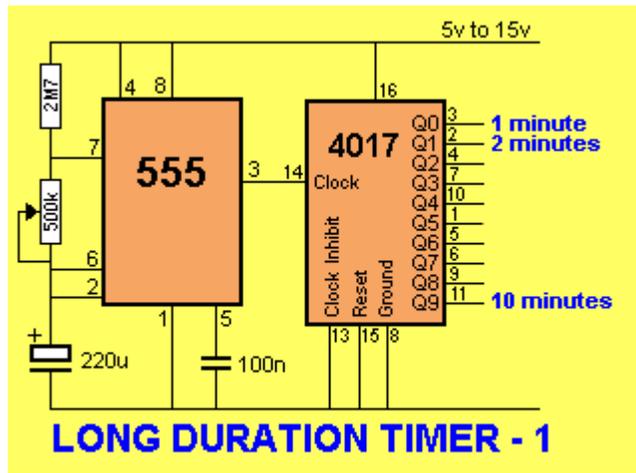
LONG DURATION TIMER -1 will produce a HIGH on pin 3 after 1 minute. Or pin 11 after 10 minutes. The timer start when the power is applied, providing the 220u is fully discharged. If not, the 1st minute will not be accurate. The timer will keep cycling.

CD 4024 LONG Duration Timer:

LONG DURATION TIMER - 2
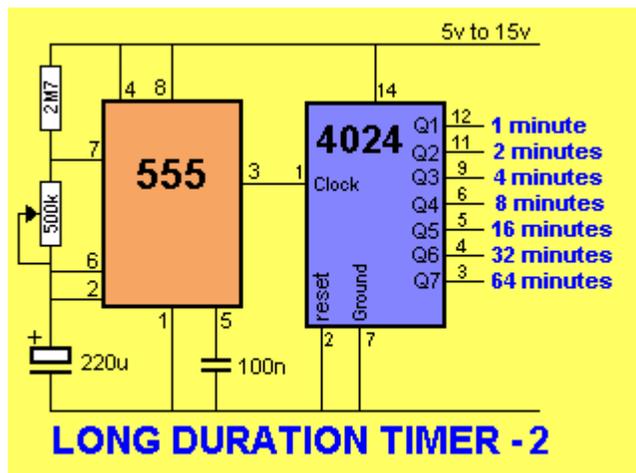
You have to test the circuit to see if the counter-chip advances on the HIGH or LOW of the 555 and the actual timing for each pin may be different to the circuit above. The circuit is just a sample of how to connect the two chips.

The circuits above will CYCLE. In other words, the outputs will "start all over again" after the longest time-interval has occurred.
To FREEZE the output and make it stay HIGH, you need the following modification:

LONG DURATION TIMER - 1 with STOP

LONG DURATION TIMER - 2 with STOP
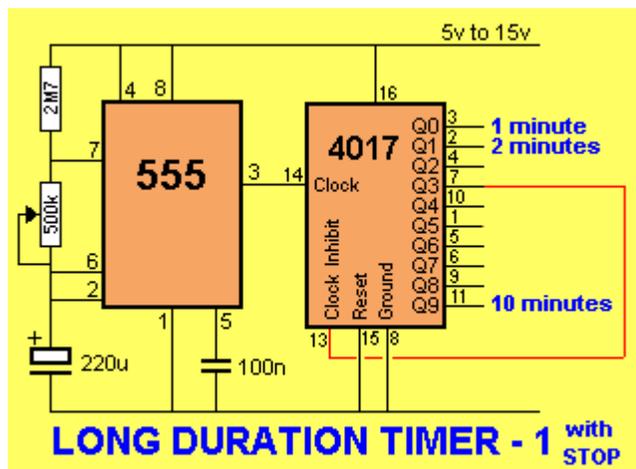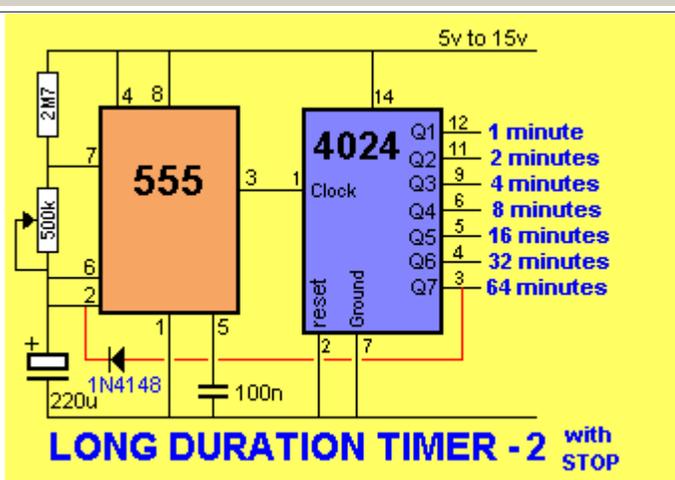
9. Delay before turn-on:
Pin 3 comes on LOW and goes HIGH after a few seconds:

Delay before turn-ON
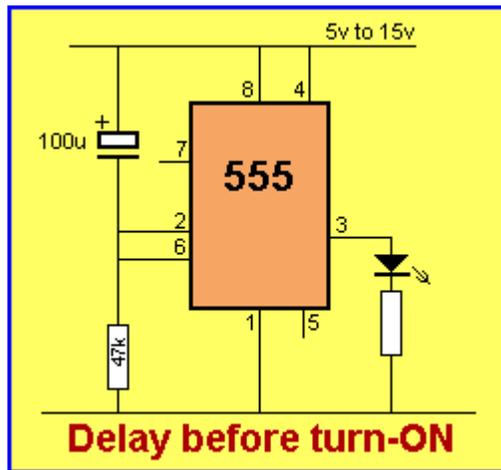
In other words, Pin 2 "turns the chip ON" when it sees a LOW

10. Delay before turn-off:
Pin 3 comes on HIGH and goes LOW after a few seconds:

Delay before turn-OFF
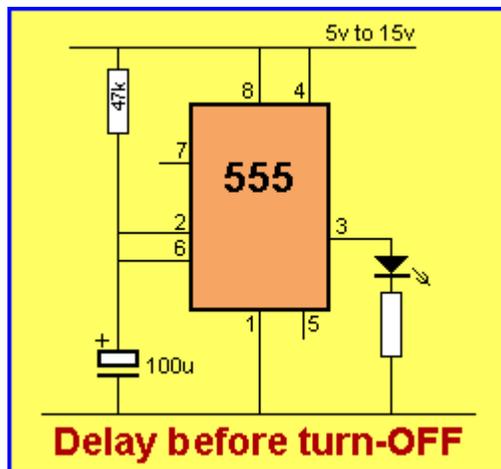
In other words, Pin 6 "turns the chip OFF" when it sees a HIGH

Don't forget, the chip takes 10mA **ALL THE TIME** because it is connected to the supply. **These two circuits show how pins 2 and 6 control the chip.**

11. HIGH for 3 seconds every 60 seconds
Here's a very simple circuit to create a HIGH for 3 seconds and a LOW for 60 seconds:

3 sec HIGH 60 sec LOW
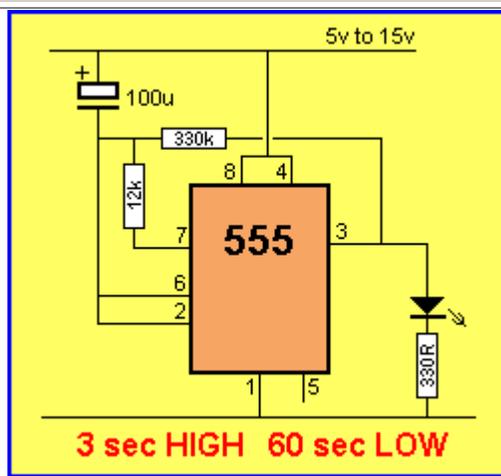
12. Level Shifter

This circuit produces a maximum 5.6v on the output and minus 0.7v when the output is LOW. The electro on the output charges to about 8v when the output is HIGH and when it goes low, this 8v would produce a negative 8v on the output, but when the output goes below 0.7v, the zener turns into an ordinary diode and conducts to discharge the electro. This guarantees 0v on the output as pin 3 of the 555 does not go to 0v and sometimes the device being driven by pin 3 does not fully turn off due to this.

LEVEL SHIFTER
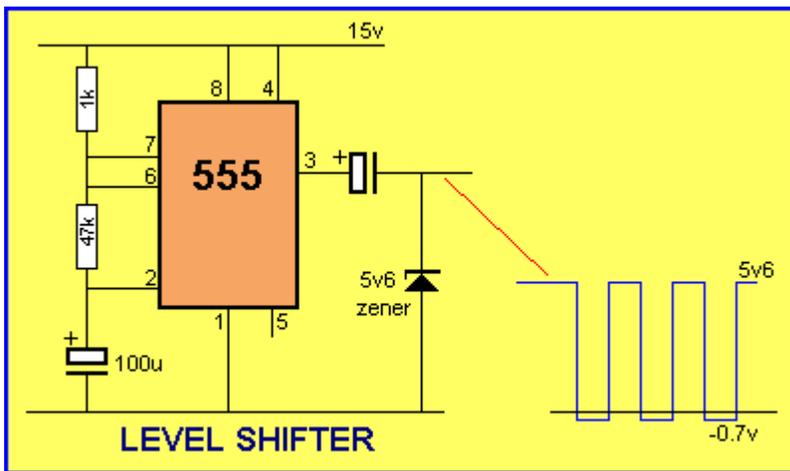
13. PIN 3 - THE OUTPUT PIN

The output of the 555 does not rise to rail voltage or fall to 0v.
The actual value of the HIGH and LOW will depend on the supply voltage and the load on the output. The output can be as much as 2v less than rail voltage and up to 1v above the 0v rail.
Because of the it can fail to turn OFF an NPN transistor connected to the output and it will fail to turn OFF a PNP transistor.

14. FIRST CYCLE

The first cycle of a 555 is twice as long as all the other cycles because the timing capacitor has to charge from 0v to 2/3supply. All the other cycles require the capacitor to charge from 1/3 supply voltage to 2/3.
The following circuit charges the capacitor quickly when the project is turned ON:
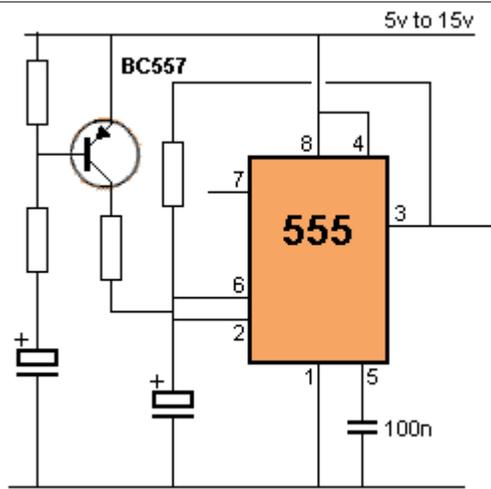
HOW THE 555 WORKS
Remember this . . .
Always draw a 555 with the pins as shown in the diagram.
Pin 3 is output. It pulls HIGH (200mA max).   It pulls LOW (200mA max).
Pin 7 is IN PHASE with pin 3. But it only pulls LOW (100mA max). When it is HIGH it is open-circuit - "high-impedance." Pin 7 can be connected to Pin 3 to get 300mA LOW.
Make Pin 2 HIGH. Now Pin 6 detects 66% of rail voltage to make Pin 3 LOW.
If Pins 2 and Pin 6 are connected, chip goes LOW when both pins go HIGH and chip goes HIGH when pins are LOW.
Make Pin 2 LOW. Chip stays HIGH.   Pin 6 has NO effect.
Pin 4 is RESET. Must go to 0.8v to reset the chip.
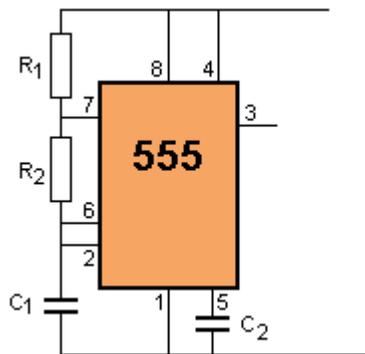
THE 555 PINS
Here is the identification for each pin:
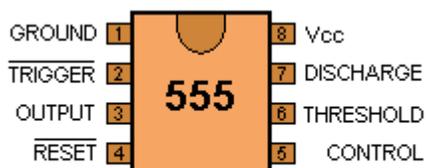
555 PINOUT
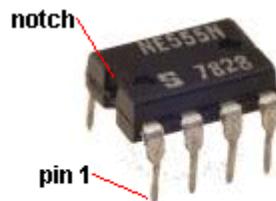
When drawing a circuit diagram, always draw the 555 as a building block, as shown below with the pins in the following locations. This will help you instantly recognise the function of each pin:

5v to 15v

Power Pin
+v turns chip ON
0v turns chip OFF

Discharge pin

8 4

7

555 3

output

detects 2/3 V

6

2

detects 1/3 V

1 5

connect to 0v via 100n

Ground pin

100n
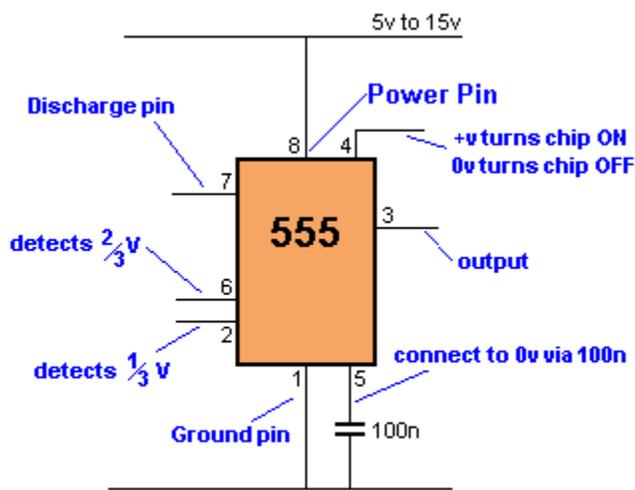
The Function of each PIN

Pin 1 GROUND. Connects to the 0v rail.

Pin 2 TRIGGER. Detects 1/3 of rail voltage to make output HIGH. Pin 2 has control over pin 6. If pin 2 is LOW, and pin 6 LOW, output goes and stays HIGH. If pin 6 HIGH, and pin 2 goes LOW, output goes LOW while pin 2 LOW. This pin has a very high impedance (about 10M) and will trigger with about 1uA.

Pin 3 OUTPUT. (Pins 3 and 7 are "in phase.") Goes HIGH (about 2v less than rail) and LOW (about 0.5v above 0v rail) and will deliver up to 200mA.

Pin 4 RESET. Maybe internally connected HIGH via 100k in some chips, but NOT others!!. Must be taken below 0.8v to reset the chip.

Pin 5 CONTROL. A voltage applied to this pin will vary the timing of the RC network (quite considerably).

Pin 6 THRESHOLD. Detects 2/3 of rail voltage to make output LOW only if pin 2 is HIGH. This pin has a very high impedance (about 10M) and will trigger with about 1uA.

Pin 7 DISCHARGE. Goes LOW when pin 6 detects 2/3 rail voltage but pin 2 must be HIGH. If pin 2 is HIGH, pin 6 can be HIGH or LOW and pin 7 remains LOW. Goes OPEN (HIGH) and stays HIGH when pin 2 detects 1/3 rail voltage (even as a LOW pulse) when pin 6 is LOW. (Pins 7 and 3 are "in phase.") Pin 7 is equal to pin 3 but pin 7 does not go high - it goes OPEN. But it goes LOW and will sink about 200mA. You can connect pin 7 to pin 3 to get a slightly better SINK capability from the chip.

Pin 8 SUPPLY. Connects to the positive rail.
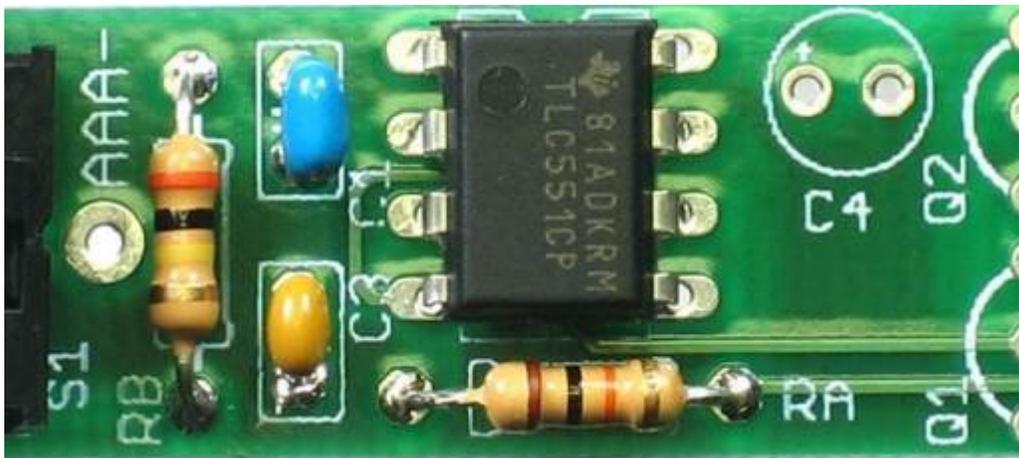
555 in a circuit - note the circle on the chip to identify pin 1
This is sometimes called a "push-out-pin" (hole) to push the chip out of the cavity when it is being moulded and sometimes it has no importance. But in this case it represents pin 1.

SHOOT-THROUGH:

The 555 (the TTL version, such as NE555, SE555) has a problem that both the output transistors turn ON when the output changes from HIGH to LOW or LOW to HIGH. This only occurs for a very short period of time (about 2 nanoseconds) and is called **SHOOT THROUGH**. This is when a high current flows through a circuit during a part of a cycle. It flows through the

collector-emitter junction of transistors Q22 and Q24.

This type of problem may damage a component and it may also put a "blip" (glitch, spike) on the rail voltage.

Since this is generally a very high current, if you have a small filter capacitor (electrolytic) on the rail, the **shoot-through** will take a large amount of energy from the capacitor and extend the width of the time when the voltage is low. The capacitor will take an extra amount of time to recover. This spike may now be wide enough for the rest of the circuit to detect the glitch and create a problem.

That's why you need a large-value electrolytic (100u) across the 555 and try to avoid using it with counting-chips and microcontrollers.
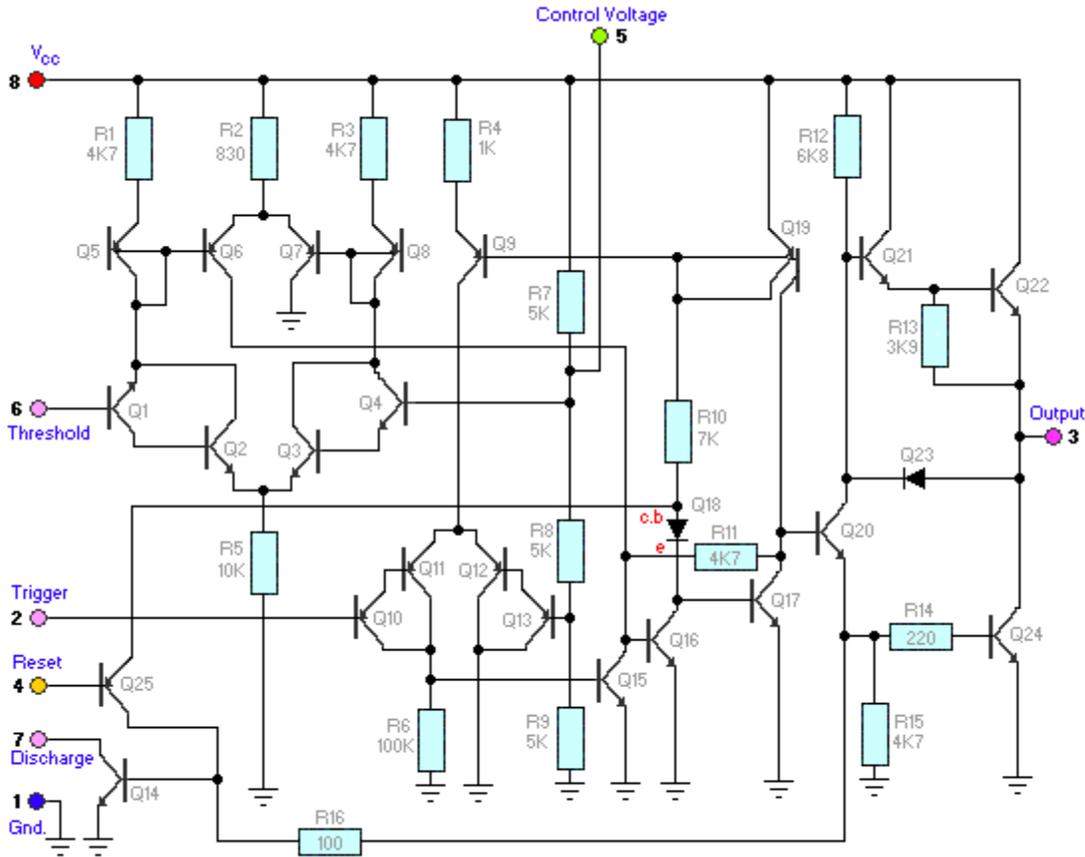
555 Schematic

The schematic of the 555 shows the two output transistors can be active when Q20 turns ON and starts to turn on Q24, while Q22 is still turned ON via Q21 and R12. This problem does not affect the operation of the 55, but may affect sensitive IC's in the same project.

THE SIMPLEST 555 OSCILLATOR

The simplest 555 oscillator takes output pin 3 to capacitor C1 via resistor R1.

When the circuit is turned on, C1 is uncharged and output pin 3 is HIGH. C1 charges via R1 and when Pin 6 detects 2/3 rail voltage, output pin 3 goes LOW. R1 now discharges capacitor C1 and when pin 2 detects 1/3 rail voltage, output pin 3 goes HIGH to repeat the cycle.

The amount of time when the output is HIGH is called the MARK and the time when the output is LOW is called the SPACE.

In the diagram, the mark is the same length as the space and this is called 1:1 or 50%:50%.

If a resistor and capacitor (or electrolytic) is placed on the output, the result is very similar to a sinewave.

SIMPLEST 555 OSCILLATOR

mark

space
Duty Cycle: 50%
Duty Cycle 1:1

SINEWAVE OUTPUT

Sinewave output

SINEWAVE OUTPUT

Sinewave output

produces a positive and negative waveform
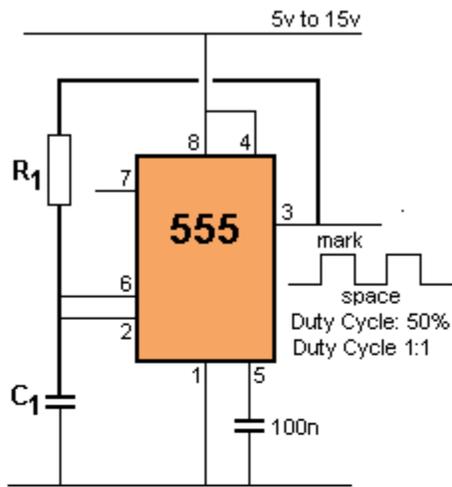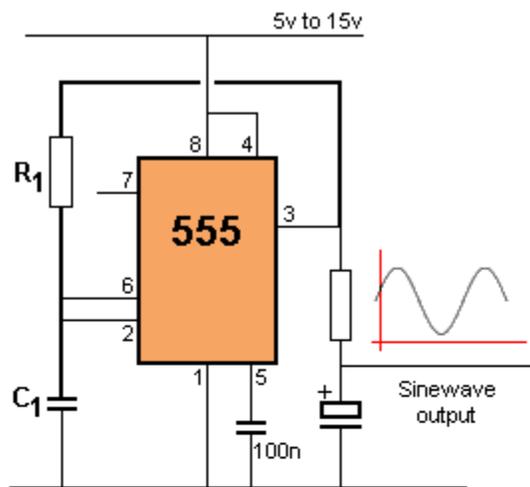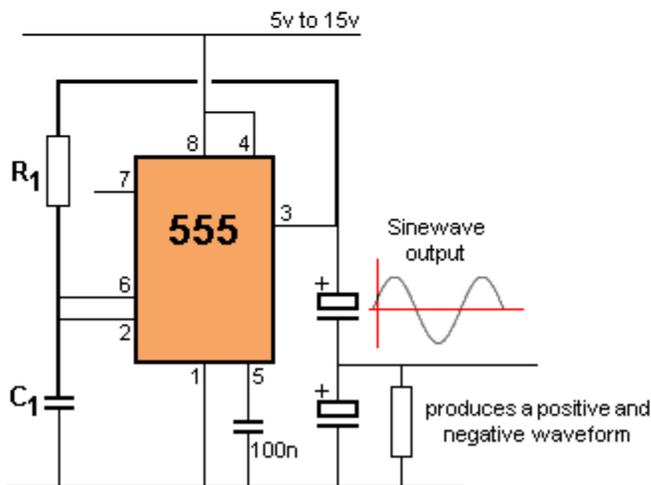
C1 to POSITIVE RAIL

C_1 can be connected to the positive rail. This is not normal practice, however it does work.
The output frequency changes when the capacitor is changed from the negative rail to the positive rail. Theoretically the frequency should not change, but it does, and that's why you have to check everything. The frequency of operation in this arrangement is different to connecting the components via pin7 because pin3 does not go to full rail voltage or 0v. This means all the output frequencies are lower than those in the "555 Frequency Calculator."
The table shows the frequency for the capacitor connected to the 0v rail and 12v rail:

C_1 to 0v rail			C_1 to 12v rail		
1k	1n	505kHz	1k	1n	255kHz
1k	10n	115kHz	1k	10n	130kHz
1k	100n	23kHz	1k	100n	16kHz
10k	1n	112kHz	10k	1n	128kHz
10k	10n	27kHz	10k	10n	16kHz
10k	100n	3700Hz	10k	100n	1600Hz

CHANGING THE MARK-SPACE RATIO

This ratio can be altered by adding a diode and resistor as shown in the following diagrams. In the first diagram, the 555 comes ON ("fires-up") with pin 3 low and pin 2 immediately detects this low and makes pin 3 HIGH. The 10n is quickly charged via the diode and 4k7 and this is why the MARK is "short." When the capacitor is 2/3Vcc, pin 6 detects a HIGH and the output of the 555 goes LOW. The 10n is discharged via the 33k and this creates the long-duration SPACE (LOW). The second diagram creates a long-duration HIGH:
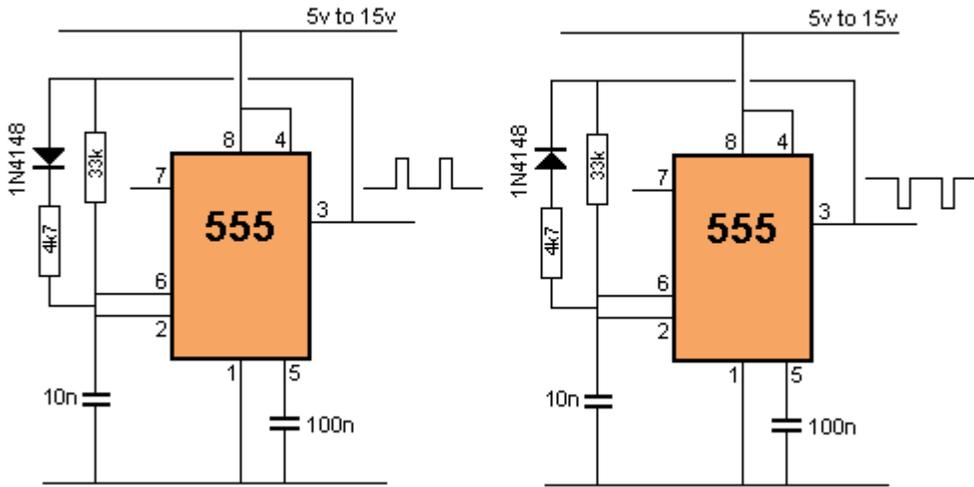
THE THREE BASIC 555 OSCILLATORS

The 3 basic 555 oscillators are shown in these circuits.
The basic points to remember are these:
Pin 7 goes LOW when pin 3 goes LOW.
Pin 6 detects a HIGH
Pin 2 detects a LOW
Pin 3 can be used instead of the supply-rail to deliver a HIGH and instead of pin 7 to deliver a LOW to the timing section made up of pins 2&6 and "C" and a timing resistor.

THE 3 BASIC 555 OSCILLATORS

6v to 18v

1k

8 4
7 555 3
6
2
C
1 5

6v to 18v

1k

8 4
7 555 3
6
2
C
1 5

6v to 18v

8 4
7 555 3
6
2
C
1 5
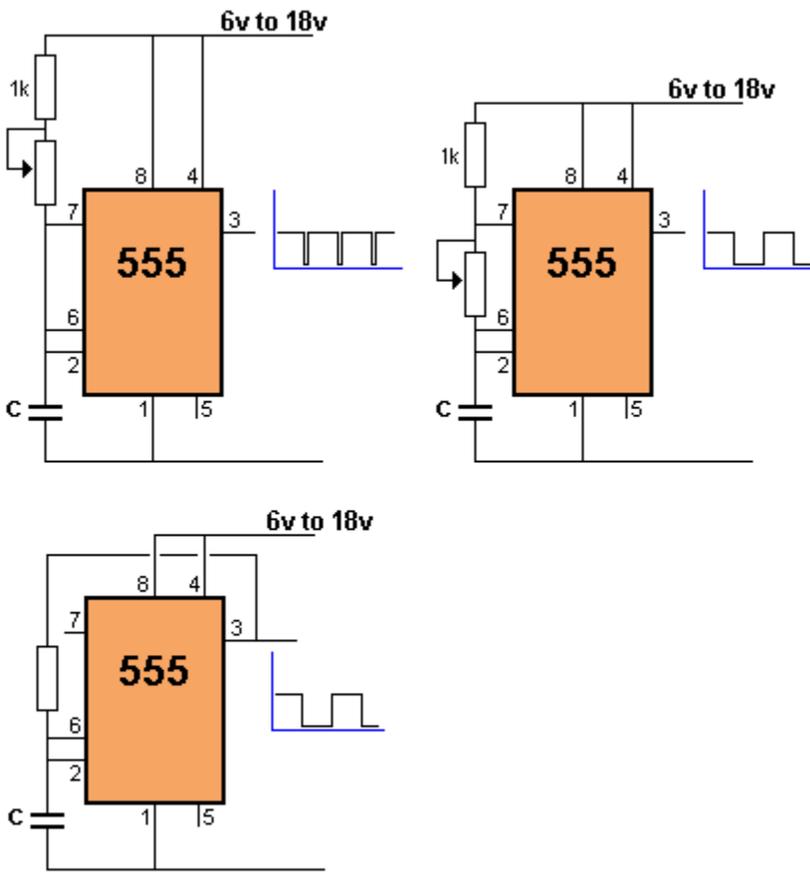
THE 3 BASIC 555 OSCILLATORS

HOW TO REMEMBER THE PINS:

Connects to Rail Voltage

Goes LOW (with pin 3)

Detects 2/3 rail voltage

connects to 0v

detects 1/3 rail voltage
makes ouput pin 3 HIGH
Has control over pin 6

OUTPUT goes HIGH - LOW

Connect this pin to RAIL

Connect to 0v via 10n

5v to 15v

8 4
7 3
555
6
2
1 5
10n
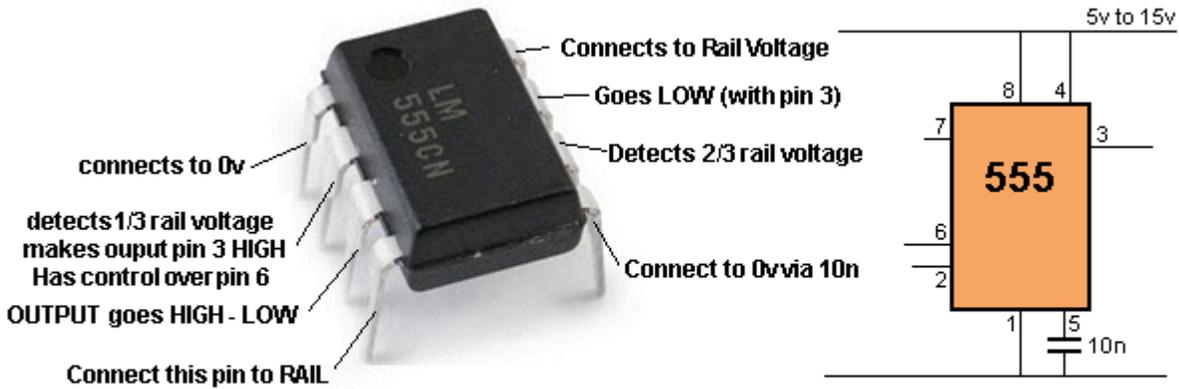
THE 555 PINS AND THEIR FUNCTION

THE FASTEST 555 OSCILLATOR

The highest frequency for a 555 can be obtained by connecting the output to pins 2 and 6. This arrangement takes about 5mA and produces an output as shown. The max frequency will depend on the supply voltage, the manufacturer, and the actual type of 555 chip.
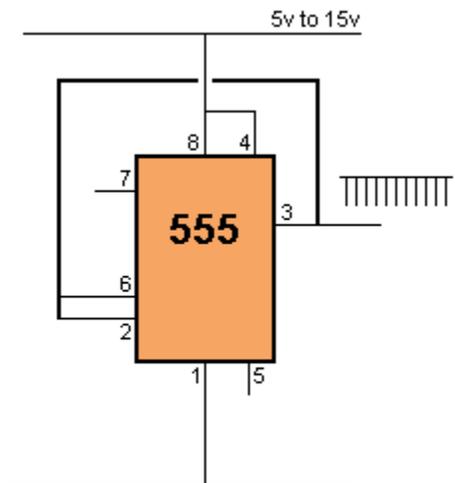
FASTEST 555 OSCILLATOR

View the output on a CRO. Our 555 "Test Chip" produced a frequency of 300kHz at 5v and also at 12v. (CMOS versions will operate at a higher frequency.) Note the very short LOW TIME.

INSIDE THE 555
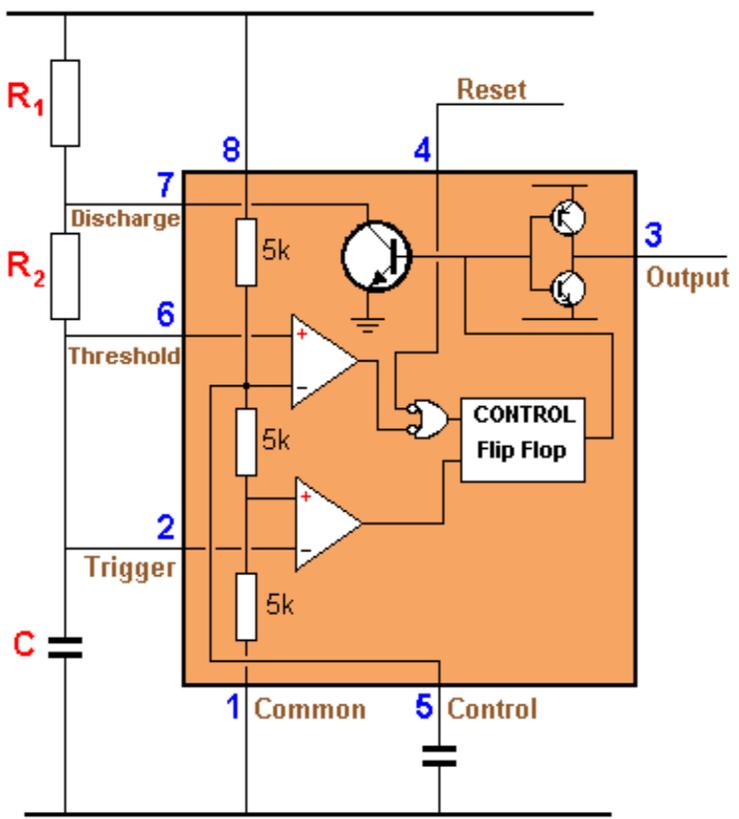
INSIDE THE 555 CHIP

17-3-2014

Note: Pin 7 is "in phase" with output Pin 3 (both are low at the same time).
Pin 7 "shorts" to 0v via a transistor. It is pulled HIGH via R1.
Maximum supply voltage 16v - 18v
Current consumption approx 10mA
Output Current sink @5v = 5 - 50mA   @15v = 50mA
Output Current source @5v = 100mA   @15v = 200mA
Maximum operating frequency 300kHz - 500kHz

Faults with Chip:
Consumes about 10mA when sitting in circuit
Output voltage can be up to 2.5v **less than rail voltage**
Output can be **0.5v to 1.5v above ground**

Sources up to 200mA
Some chips sink only 50mA, some will sink 200mA

A NE555 was tested at 1kHz, 12.75v rail and 39R load.
The Results:
Output voltage 0.5v low, 11.5v high at output current of 180mA
The "test chip" performance was excellent.

HOW TO USE THE 555

There are many ways to use the 555. They can be used in hundreds of different circuits to do all sorts of clever things. They can also be used as three different types of oscillators:

(a) Astable Multivibrator - constantly oscillates

For frequencies above 1 cycle per second, it is called an oscillator (multivibrator or square wave oscillator).
For frequencies below 1 cycle per second it is called a TIMER or DELAY.

(b) Monostable - changes state only once per trigger pulse - also called a ONE SHOT
(c) Voltage Controlled Oscillator - called a VCO.

THE ASTABLE (or FREE RUNNING) MULTIVIBRATOR

ASTABLE 555
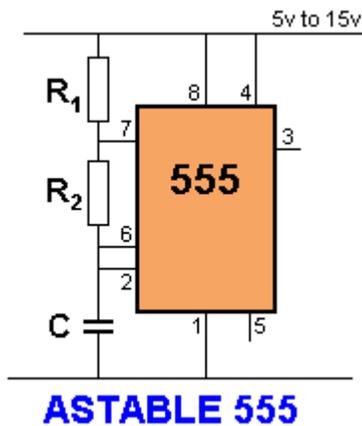
The capacitor C charges via R1 and R2 and when the voltage on the capacitor reaches 2/3 of the supply, pin 6 detects this and pin 7 connects to 0v. The capacitor discharges through R2 until its voltage is 1/3 of the supply and pin 2 detects this and turns off pin 7 to repeat the cycle.
The top resistor is included to prevent pin 7 being damaged as it shorts to 0v when pin 6 detects 2/3 rail voltage. Its resistance is small compared to R2 and does not come into the timing of the oscillator.

The following graph applies to the Astable circuit:

FREE RUNNING FREQUENCY (Hz)
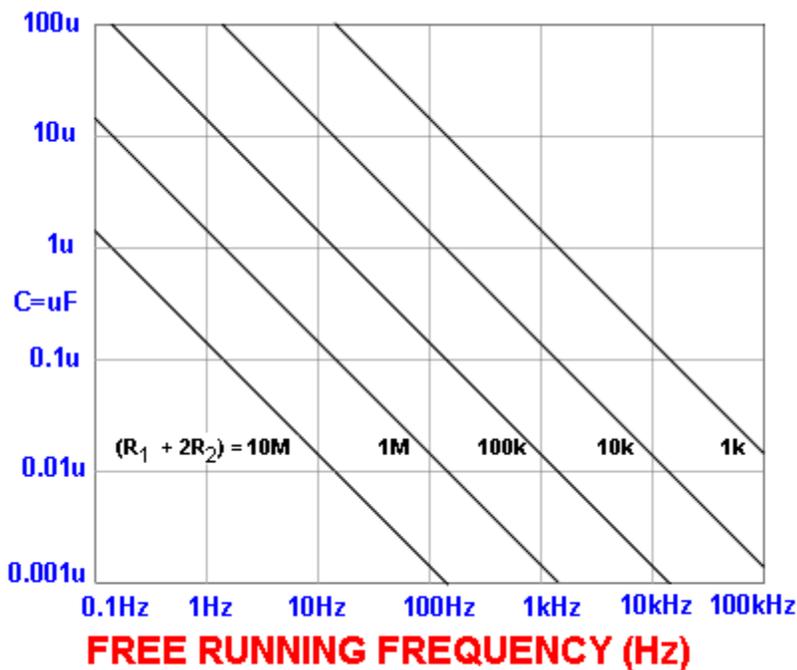
Using the graph:
Suppose R1 = 1k, R2 = 10k and C = 0.1u (100n).
Using the formula on the graph, the total resistance = 1 + 10 + 10 = 21k
The scales on the graph are logarithmic so that 21k is approximately near the "1" on the 10k. Draw a line parallel to the lines on the graph and where it crosses the 0.1u line, is the answer. The result is approx 900Hz.

Suppose R1 = 10k, R2 = 100k and C = 1u
Using the formula on the graph, the total resistance = 10 + 100 + 100 = 210k
The scales on the graph are logarithmic so that 210k is approximately near the first "0" on the 100k. Draw a line parallel to the lines on the graph and where it crosses the 1u line, is the answer. The result is approx 9Hz.

The frequency of an astable circuit can also be worked out from the following formula:

$$\text{frequency} = \frac{1.4}{(R_1 + 2R_2) \times C}$$

555 astable frequencies		
C	$R_1 = 1k$ $R_2 = 6k8$	$R_1 = 10k$ $R_2 = 68k$	$R_1 = 100k$ $R_2 = 680k$
0.001μ	100kHz	10kHz	1kHz
0.01μ	10kHz	1kHz	100Hz
0.1μ	1kHz	100Hz	10Hz
1μ	100Hz	10Hz	1Hz
10μ	10Hz	1Hz	0.1Hz

0.001μ = 1n
0.01μ = 10n
0.1μ   = 100n

HIGH FREQUENCY OSCILLATORS
360kHz is the absolute maximum as the 555 starts to malfunction with irregular bursts of pulses above this frequency. To improve the performance of the oscillator, a 270R and 1n can be added as shown in the second circuit:
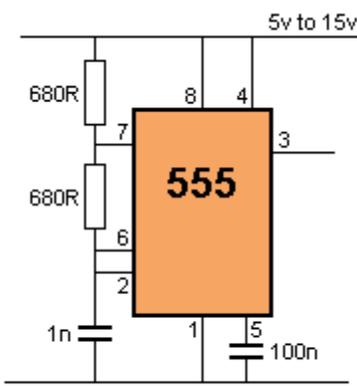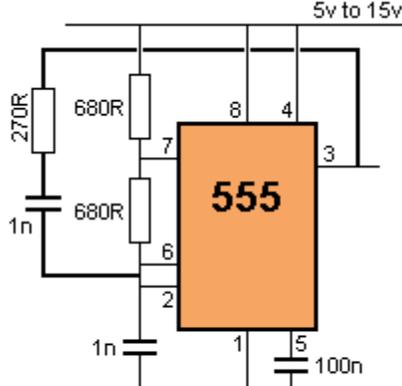
360kHz   **360kHz - mods**

LOW FREQUENCY OSCILLATORS - called TIMERS

LOW FREQUENCY 555
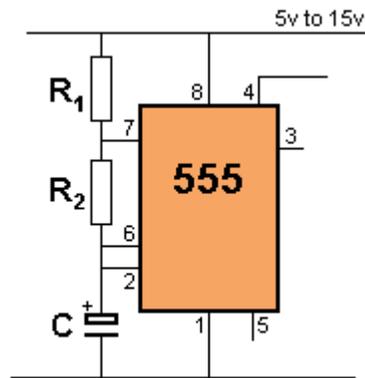
If the capacitor is replaced with an electrolytic, the frequency of oscillation will reduce. When the frequency is less than 1Hz, the oscillator circuit is called a timer or "delay circuit." The 555 will produce delays as long as 30 minutes but with long delays, the timing is not accurate.

C	$R_1 = 100k$ $R_2 = 100k$	$R_1 = 470k$ $R_2 = 470k$	$R_1 = 1M$ $R_2 = 1M$
10μ	2.2sec	10sec	22sec
100μ	22sec	100sec	220sec
470μ	100sec	500sec	1000sec

555 Delay Times:

The following circuits show a 1-5 minute timer and 10 minute timer:

1 - 5 min TIMER

10 MINUTE TIMER

(Circuit diagram: 555 timer with 5v to 15v supply, resistors 10k, 2M7, 500k, 220u capacitor, 100n capacitor, 330R resistor, red LED, Start switch. Pins labeled 4, 8, 2, 3, 7, 6, 1, 5.)
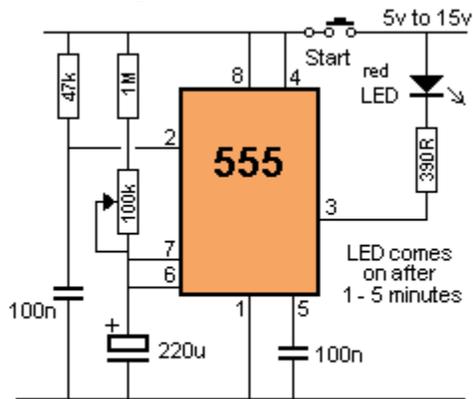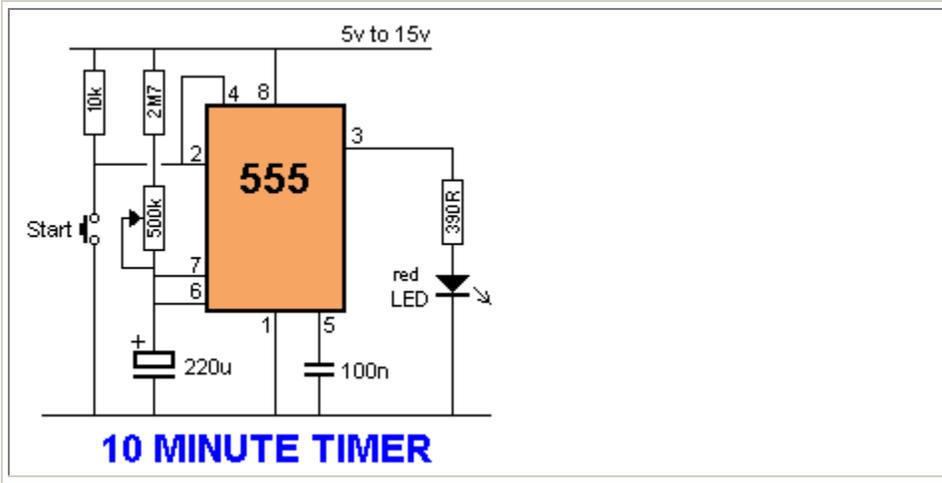
CMOS 555

A low power version of the 555 is available from many manufacturers and basically it is a CMOS version of the TTL 555 device.

The CMOS 555 has the same pinouts as the TTL version and can be fitted into the same 8 pin socket but if the circuit needs more current than can be supplied by the CMOS version, it will not produce the same results.

It is the low current capability of the CMOS version that will be the major reason why you cannot directly replace the TTL version with the CMOS version.

It will operate from 1v (only some manufacturers) to 15v and will work up to 3MHz in astable mode.

Current consumption @5v is about 250uA (1/4mA)

But the major thing to remember is the output current capability.

At 2v, the chip will only deliver 0.25mA and sink only 1mA.

At 5v, the chip will deliver 2mA and sink only 8mA

At 12v the chip will deliver 10mA and sink 50mA

At 15v the chip will deliver 100mA and sink 100mA

(Circuit diagram: CMOS 555 with 2v to 15v supply, resistors 470R, 220R, capacitors 220p, 1n. Pins labeled 8, 4, 7, 3, 6, 2, 1, 5.)

CMOS 555
MAXIMUM FREQUENCY
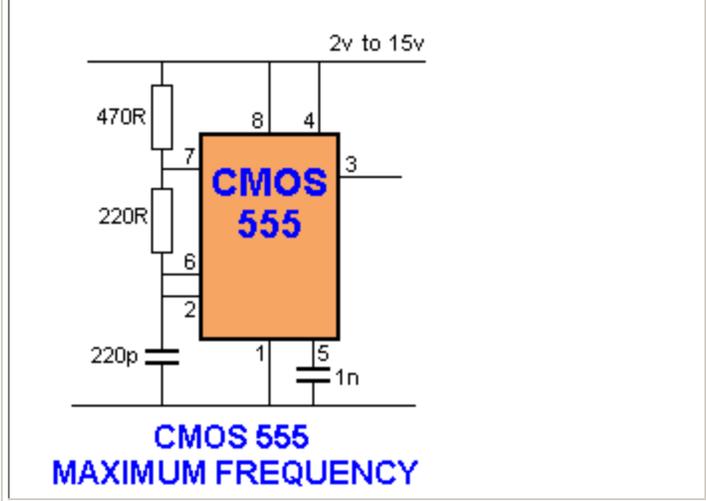
SQUARE WAVE OSCILLATOR KIT:

A mini trim and 10k resistor can be used in place of the 68k to create a variable frequency. Put a link in the 100k holes if a trim-pot is not used
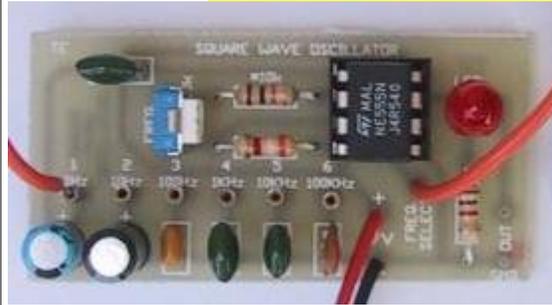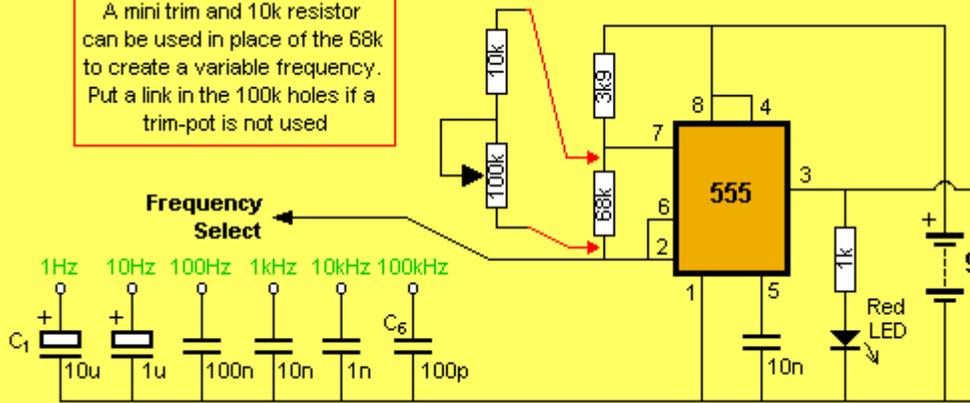
A square wave oscillator kit can be purchased from Talking Electronics for approx $10.00
See website: **Square Wave Oscillator**
It has adjustable (and settable) frequencies from 1Hz to 100kHz and is an ideal piece of Test Equipment.
   (This link will send an email to Colin Mitchell and you will be advised of costs and how to send money via Paypal or credit card.)

Bi-stable or "Latch" or "2-state" 555

The bi-stable 555 has two steady states. SET turns ON the LED and RESET turns the LED off. The 555 comes on in reset mode as Pin2 does not see a LOW to SET the 555.
See also: **Divide By Two**
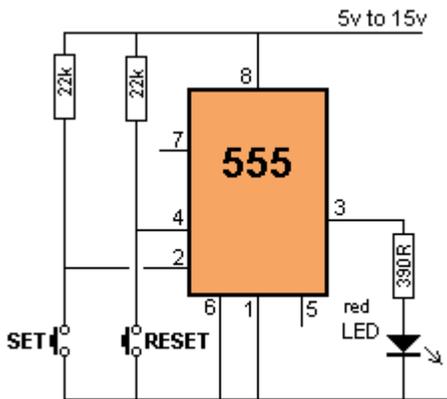
BI-STABLE 555

Monostable or "One Shot" or Pulse Extender

When the circuit is turned on, the output is LOW and a brief negative pulse on pin 2 will make the output go HIGH for a period of time determined by the value of R and C. If pin 2 is low for longer than this period, the output will remain HIGH while pin 2 is LOW and immediately go LOW when pin 2 goes HIGH.

CIRCUIT OPERATION
When the circuit is turned on, the capacitor is uncharged. Pin 6 sees a LOW and pin 2 sees a HIGH.
Remember: Pin 2 must be LOW to make the output HIGH.
Pin 6 must be HIGH to make the output LOW.
Neither pin is "controlling the chip" at start-up.

SET OR RESET?

**The 555 contains a FLIP-FLOP and the output can be either HIGH or LOW if the voltage on pins 2 and 6 are not at the correct levels.
If pin 6 is HIGH and pin 2 is LOW - the output will be HIGH - pin 2 is sending a "set" message
If pin 6 is HIGH and pin 2 is HIGH - the output will be LOW - pin 6 is sending a "reset" message
If pin 6 is LOW and pin 2 is LOW - the output will be HIGH - pin 2 is sending a "set" message
If pin 6 is LOW and pin 2 is HIGH - the output will be HIGH or LOW - because no pin is sending a "set" or "reset" message.**

When pin 2 see a LOW pulse, the chip goes to SET mode and the output goes HIGH. Pin 7 goes OPEN and capacitor C charges via R. When pin 6 sees 2/3 rail voltage, the chip goes to RESET mode with pin 3 and 7 LOW. The capacitor instantly discharges via pin 7 and the circuit waits for a negative pulse on pin 2.
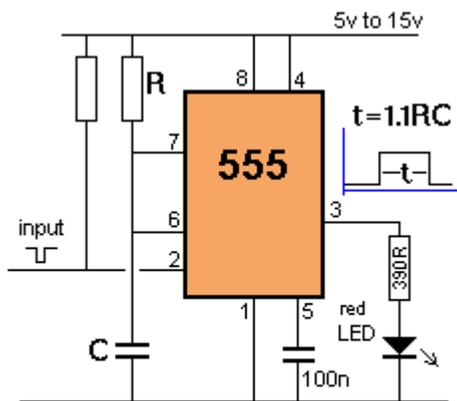
**MONOSTABLE
OR
"ONE-SHOT"**

Re-triggerable 555

In the previous circuit, the output is LOW until pin 2 sees a brief LOW. The output goes HIGH and remains HIGH until pin 6 sees a HIGH via the charging of the capacitor. In other words the 555 extends the pulse according to the value of **R** and **C.**
The following diagrams show the output when the switch is pressed immediately, at half-time at the end of time and after the time has expired:
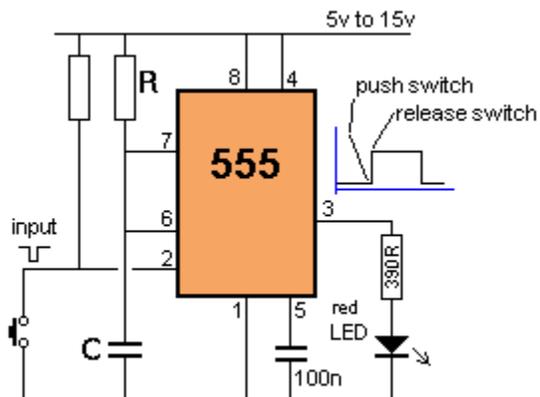
The switch is pushed and released quickly in the circuit above. Note the HIGH time for the output.
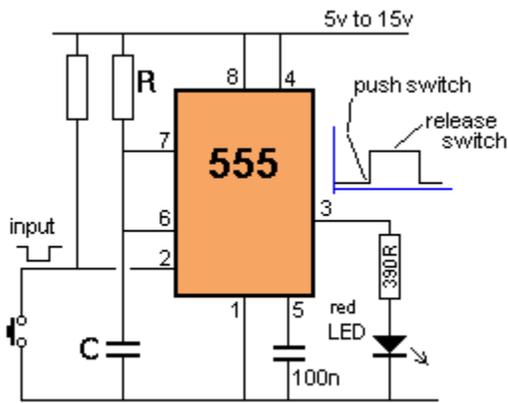
The switch is pushed and released slowly in the circuit above. Note the HIGH time for the output is the same as before.
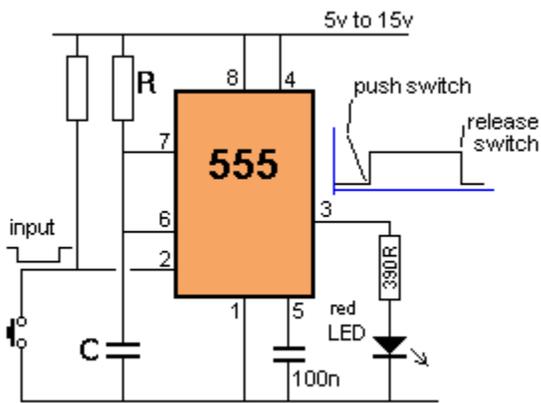
The switch is pushed and released just when the time is expiring. Note the HIGH time for the output is the same as before. The switch does not extend (re-trigger) the 555.

To re-trigger the 555, the **capacitor** must be discharged. To do this we add a diode as shown so the capacitor discharges each time the switch is pressed:
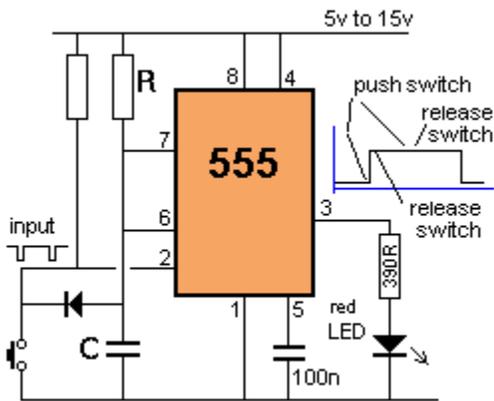
Re-triggering the 555

THE 555 AS A VOLTAGE CONTROLLED OSCILLATOR (VCO)

By adjusting the voltage on pin 5, (the CONTROL pin) the frequency of the oscillator can be adjusted quite considerably. See **Police Siren** for an

application.
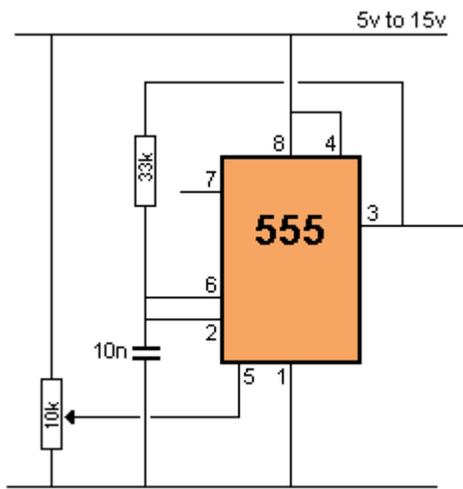
THE 555 AS A RAMP GENERATOR

When a capacitor is charged via a constant current, the waveform across it is a ramp.
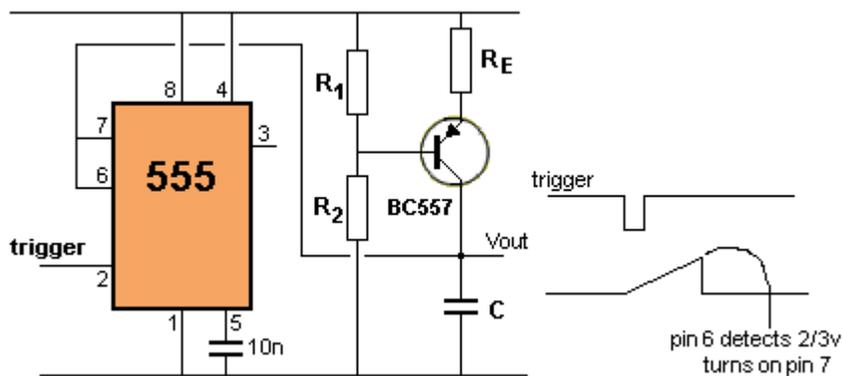
FREQUENCY DIVIDER

A 555 can be used to divide a frequency by almost any division.
It works this way:
A 555 is set-up to produce the required output frequency.
Pin 2 is then taken to the input frequency and this turns the 555 into a Monostable Multivibrator.
The circuit will detect a LOW on pin 2 to start the timing cycle and pin 3 will go HIGH. The 555 will not respond to any more pulses on pin 2 until pin 6 detects a HIGH via the charging of the capacitor. The value of C and the 1M pot need to be adjusted to produce the desired results.
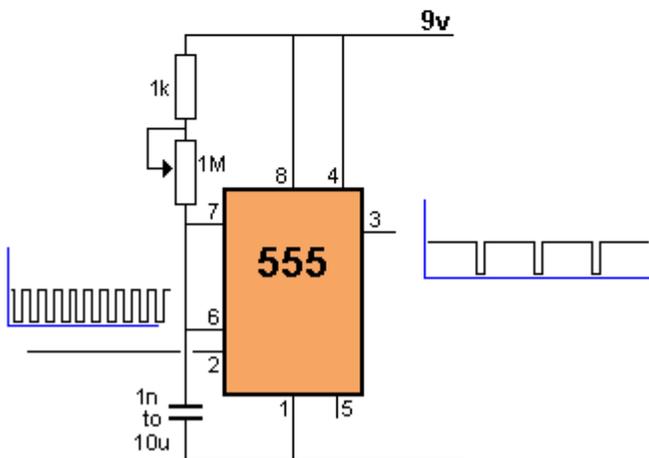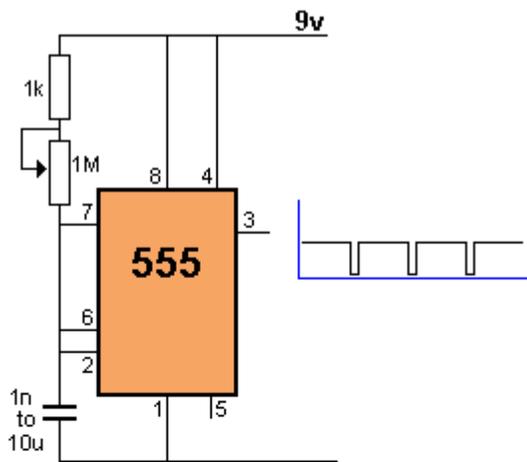
FREQUENCY DIVIDER

DIVIDE BY 2

A 555 can be used to divide-by-2
When pins 2 and 6 are connected, they detect 1/3 and 2/3 of rail voltage.
When the detected voltage is below 1/3, the output goes HIGH and when the voltage is above 2/3, the output goes LOW.
The push switch detects the output voltage and after a short period of time the electrolytic will charge or discharge and it will be HIGH or LOW.
If the switch is pressed for a short period of time, the output will change. If the switch is kept pressed, the output will oscillate at a low frequency.

This circuit can also be used as a Push-ON Push-OFF.
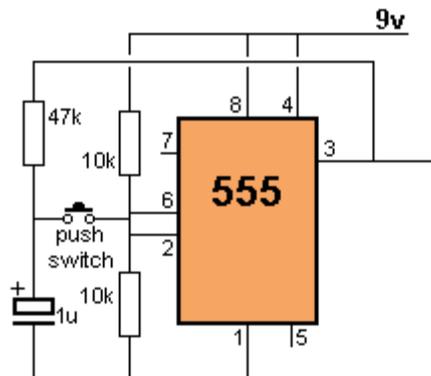
LOGIC PROBE

A 555 can be used to make a very simple LOGIC PROBE. It connects to the circuit you are testing via a red and black alligator clip and pins 2 and 6 detect 1/3 and 2/3 of the voltage on the chip.
Pins 2 and 6 provide a high impedance input and the red and green LEDs indicate HIGH and LOW.
The only problem is one of the LEDs will be illuminated when the probe is not touching anything and that's why this circuit is not a really GENUINE Logic Probe. But it will do in an emergency or if you want to build something quickly to test a project.
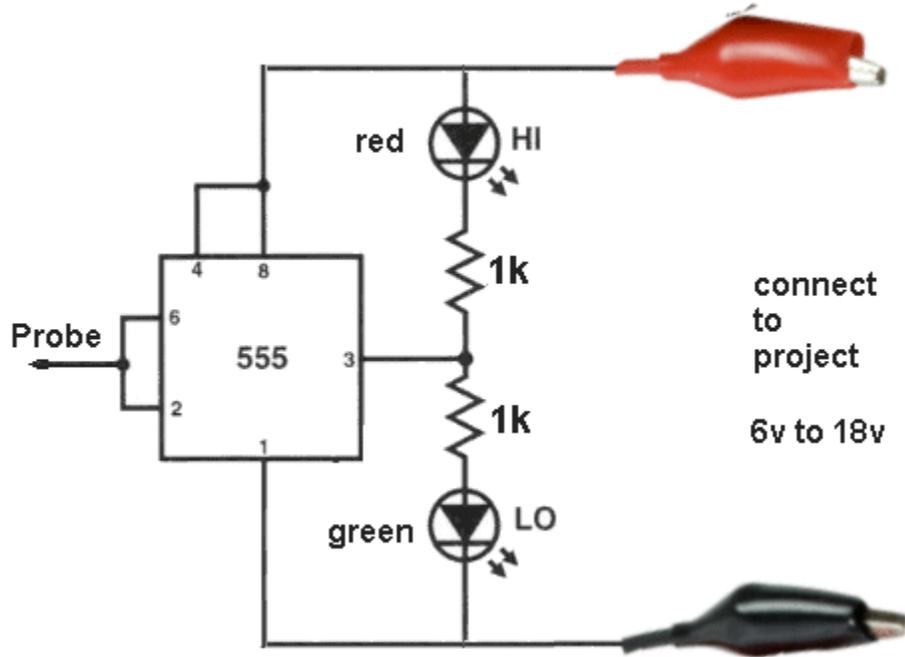
LM386 LED FLASHER

If you don't have a 555, you can use an LM386 IC to flash a LED. This will show how an LM386 chip works and and how to use chips for purposes other than their normal intent.
An LM386 IC is an 8-pin 250mW power amplifier with a differential input, similar to an op-amp.
Here is the internal circuit:
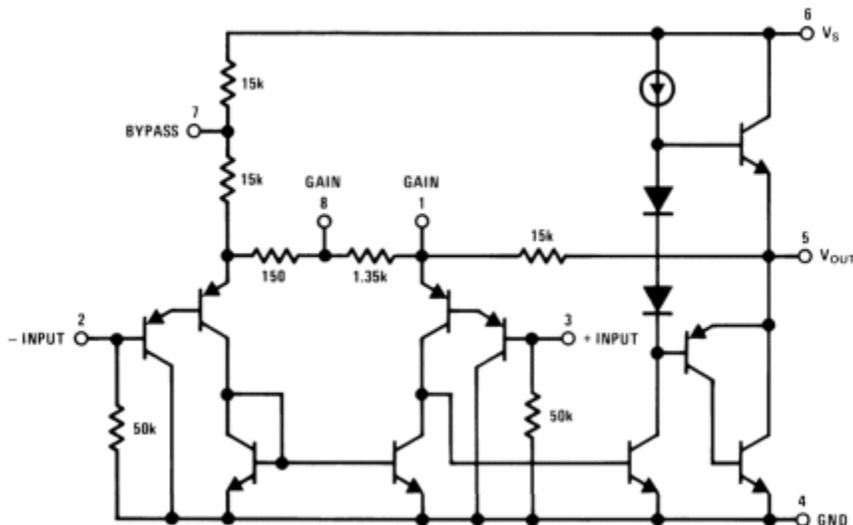
Normally pin 3 has zero volts on it, but the 100k puts about 35% of rail voltage on the pin.
This means pin 3 has an input impedance of about 300k.
The actual voltage does not matter, as long as it is slightly higher than

zero volts, so pin 2 can have an effect when it goes lower than pin 3.
When the circuit is turned on, the 100u is uncharged and zero volts is applied to pin 2.
This means pin 2 is lower than pin 3 and the output goes HIGH to illuminate the LED.
The 100u charges via the 10k and after a short period of time the voltage on pin 2 is higher than pin 3 and it makes the output go LOW. The LED turns OFF and the 100u starts to discharge via the 10k to repeat the cycle.
The chips has a gain of 20, but this is not enough for this circuit to flash a LED. By joining pins 1 and 8, the gain is increased to 200 or more and the circuit works successfully.
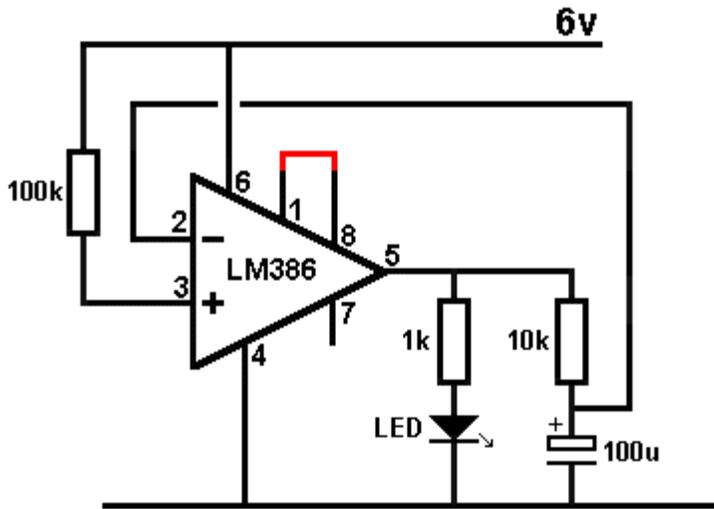
LED FLASHER USING LM386 IC

"No-No's"

Here are some mistakes to avoid:
1. Pin 7 gets connected to the 0v rail via a transistor inside the chip during part of the operation of the 555. If the pot is turned to very low resistance in the following circuit, a high current will flow through the pot and it will be damaged:
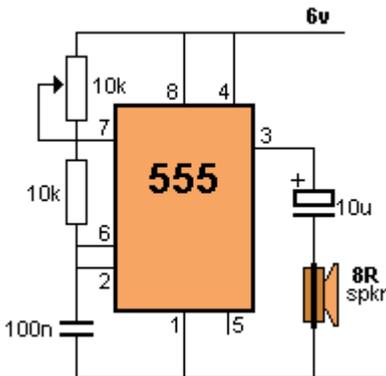
2. The impedance of the 100u electrolytic will allow a very high current to flow and the chip will get very hot.   Use 10u maximum when using 8R speaker. (The temp of the chip will depend on the frequency of the circuit.)
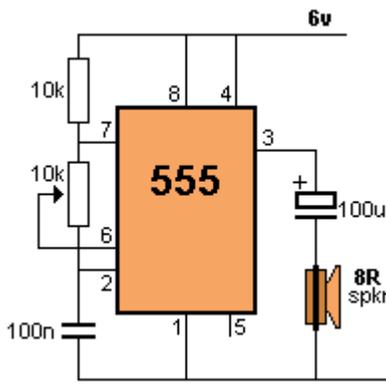
3. The reset pin (pin 4) is internally tied HIGH via approx 100k but it should not be left floating as stray pulses may reset the chip.
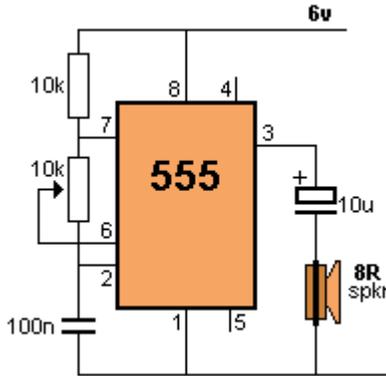
4. Do not draw 555 circuits as shown in the following diagram. Keep to a standard layout so the circuit is easy to follow.
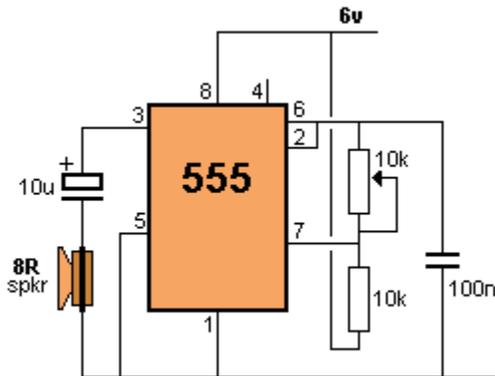
5. Here's an example from the web. It takes a lot of time to work out what the circuit is doing:
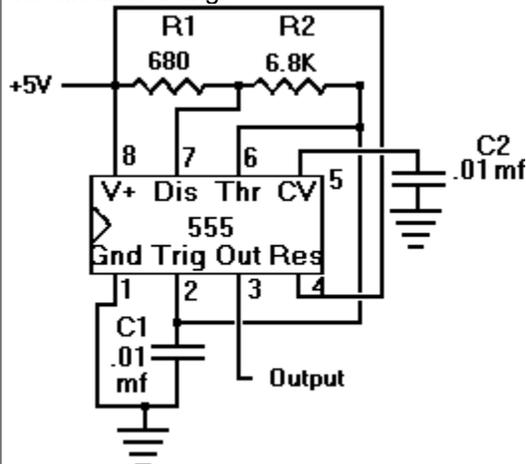
The aim it to lay-out a circuit so that it shows instantly what is happening. That's why everything must be in recognised locations.

Here is the corrected circuit: From this diagram it is obvious the circuit is

an oscillator (and not a one-shot etc).

5v

R1 680R, 555 pins 8, 4, 7, 3, R2 6k8, 6, 2, C1 10n, 1, 5 C2 10n
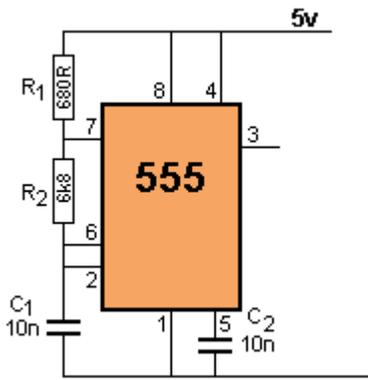
6. Don't use high value electrolytics and high resistances to produce long delays. The 555 is very unreliable with timing values above 5-10 minutes. The reason is simple. The charging current for the electrolytic is between 1 - 3 microamp in the following diagram (when the electro is beginning to charge) and drops to less than 1 microamp when the electro is nearly charged.
If the leakage of the electro is 1 microamp, it will never fully charge and the 555 will never "time-out."

5v to 15v

Start
red LED
390R
47k, 4M7, 100k, 555, 100n, 470u, 100n

15 min TIMER
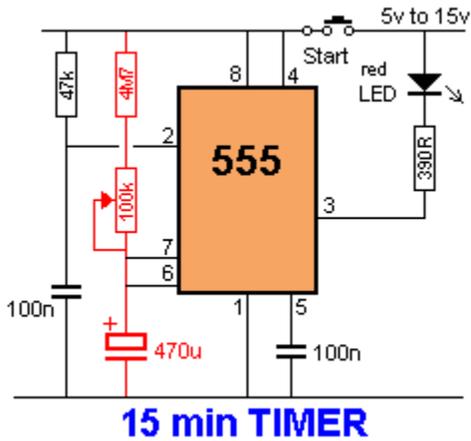
7. Do not connect a PNP to the output of a 555 as shown in the following diagram. Pin 3 does not rise high enough to turn the transistor OFF and the current taken by the circuit will be excessive. Use an NPN driver.

6v

10k, 555, BC557, 470R, 8R spkr, 470R, 8R spkr, 10k, 6, 2, 100n

PNP Driver   NPN Driver
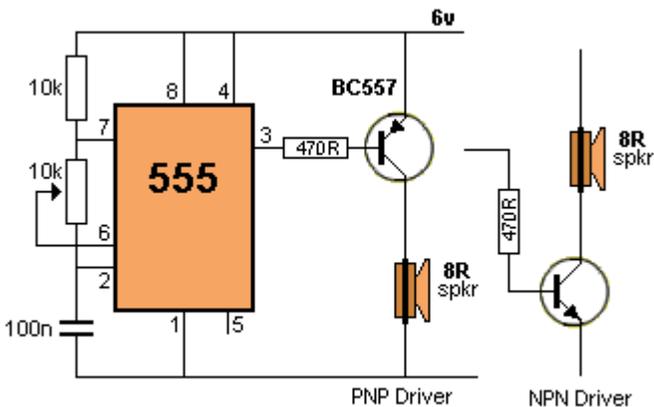
8. Do not connect pin 7 directly to the capacitor. Pin 7 connects to the 0v rail during part of a cycle and this will discharge the capacitor very quickly and produce a very brief "low" on the output.
This may upset the clocking of a chip (such as a CD4017).
Use a resistor of at least 1k to increase the width of the LOW.
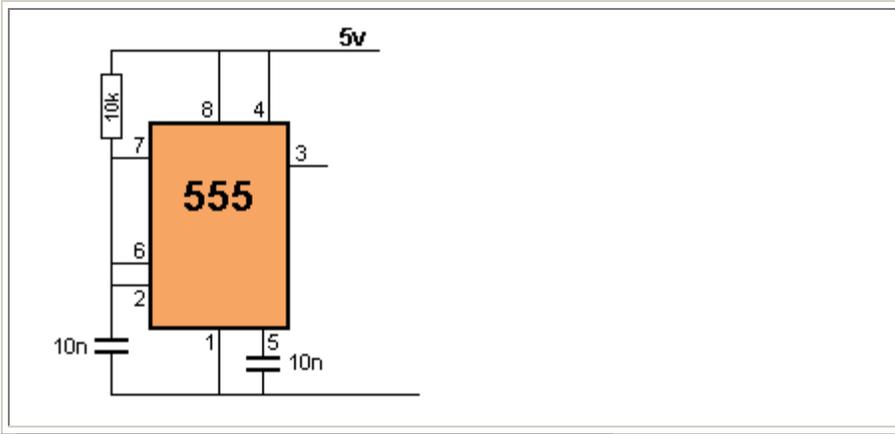
555's

Here is a list of 555's from different manufacturers plus the range of low voltage, low current 555's. The normal 555 is called a TTL or Transistor-Transistor-Logic chip and it consumes about 10mA when "sitting and doing nothing." It will work from 4v to 18v.

A low current version is available from the list below, (called a CMOS version) and consumes about 10uA to 100uA. Some of these chips work from 1.5v to 15v (ZSCT1555 = 9v max) but they can sink and source only about 100mA (less than 30mA at 2v).

The 555 is the cheapest and the others cost about double.

The normal 555 oscillates up to 300kHz. A CMOS version can oscillate to 3MHz.

You need to know the limitations as well as the advantages of these chips before substituting them for the normal 555:

Manufacturer	Model	Remark
Custom Silicon Solutions	CSS555/CSS555C	CMOS from 1.2V, IDD < 5uA
ECG Philips	ECG955M	
Exar	XR-555	
Fairchild Semiconductor	NE555/KA555	
Harris	HA555	
IK Semicon	ILC555	CMOS from 2V
Intersil	SE555/NE555/ICM7555	
Lithic Systems	LC555	
Maxim	ICM7555	CMOS from 2V
Motorola	MC1455/MC1555	
National Semiconductor	LM1455/LM555/LM555C	
National Semiconductor	LMC555	CMOS from 1.5V
NTE Sylvania	NTE955M	
Raytheon	RM555/RC555	
RCA	CA555/CA555C	
STMicroelectronics	NE555N/ K3T647	
Talking Electronics	TE555-1, -2, -3, -4	email **Talking Electronics** $2.50 ea
Texas Instruments	SN52555/SN72555; TLC555	CMOS from 2V
Zetex	ZSCT1555	down to 0.9V (9v max)

REPLACING A 556 WITH TWO 555's

Here is a handy reference to replace a 556 dual timer with two 555's:
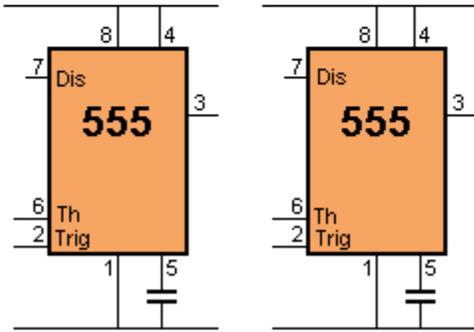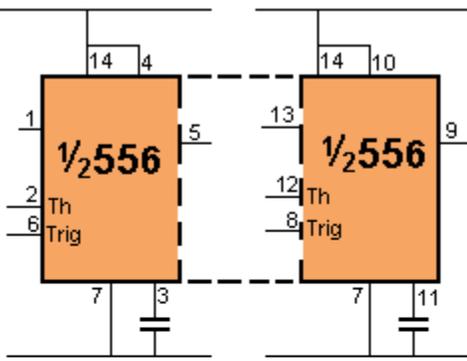
The table shows the pin numbering for each timer:

	555	556 - Timer 1	556 - Timer 2
Ground (–)	1	7	7
Trigger	2	6	8
Output	3	5	9
Reset	4	4	10
Control	5	3	11
Threshold	6	2	12
Discharge	7	1	13
Vcc (+)	8	14	14

REPLACING A 558 WITH FOUR 555's

This is an obsolete chip. No-one stocks it.
The LM558 only has 100mA output current (the LM555 has up to 200mA).
The output only goes LOW. In other words, the output only SINKS.

I suggest only using 555's in all projects. You can easily remember the pin numbering on a 555 and this makes servicing and testing and fault-finding easy. A circuit using a "558" (NE55, LM558) can be converted to using 4 x LM555's by referring to the following image:

OUTPUT A Pin 3 on 555	1	OUTPUT STAGE
TIMING A Pin 6 on 555 and then pin 7 !!	2	
TRIGGER A Pin 2 on 555	3	COMP
CONTROL VOLTAGE Pin 5 on 555	4	LM558
Vcc Pin 8 on 555	5	R1
TRIGGER B Pin 2 on 555	6	COMP
TIMING B Pin 6 on 555 and then pin 7 !!	7	
OUTPUT B Pin 3 on 555	8	OUTPUT STAGE
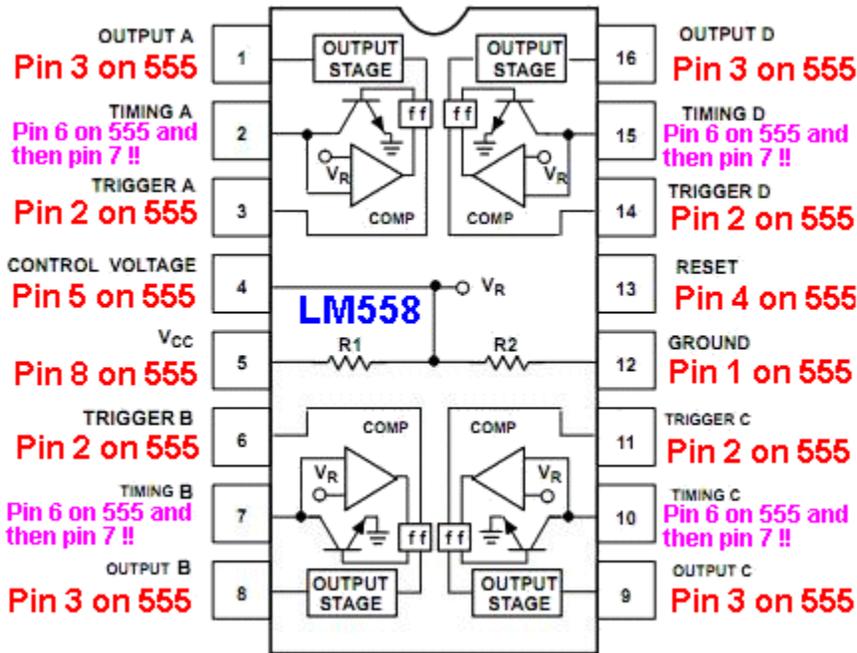
The NE558 is a very messy chip and it seems the pin that is equivalent to pin 6, changes to pin 7 to discharge the capacitor when 66% of rail voltage is reached.

SUBSTITUTING A 555 - part 1

Although a 555 is a wonderful chip, it may not be the best choice for some applications.
You may require an oscillator frequency higher than 1MHz, or a very low quiescent current. You may also need 4 or more 555's to get the timing and delays you require. Here are some circuits to help you substitute a 555.

The 74c14 IC contains 6 Schmitt Trigger gates and each gate can be used to replace a 555 in SOME circuits. The voltage for a 74c14 is 3v to 15v. Maximum output current per gate is 15mA. Max frequency of operation: 2MHz - 5MHz. Quiescent current is 1uA if all inputs are 0v or rail voltage.
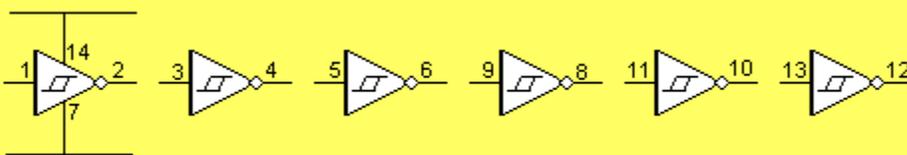
Fig: 8 The six Schmitt Trigger Gates for a 74c14 IC

10 MINUTE TIMER

THE 555 OSCILLATOR AND ITS EQUIVALENT SCHMITT
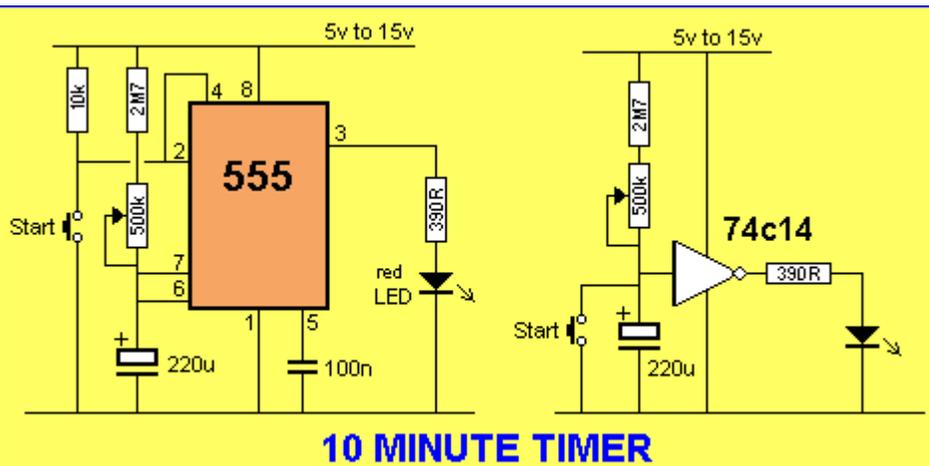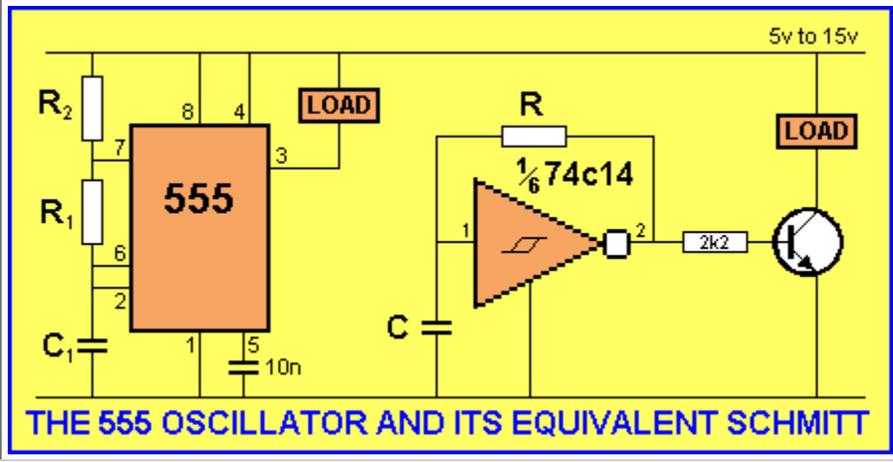
SUBSTITUTING A 555 - part 2

If you need a special function or special effect, it may take 2, 3 or more 555's to do the job. The 74c14 has 6 gates and can create 6 "building blocks."
Here are some circuits to show its versatility:

2 MINUTE TIMER

The relay is energized for a short time, 2 minutes after the push-button is pressed. The push-button produces a brief LOW on pin 1, no matter how long it is pushed and this produces a pulse of constant length via the three components between pin 2 and 3. This pulse is long enough to fully discharge the 100u timing electrolytic on pin 5. The 100k and electrolytic between pins 6 and 9 are designed to produce a brief pulse to energize the relay.

Produces a short pulse after 2 minutes
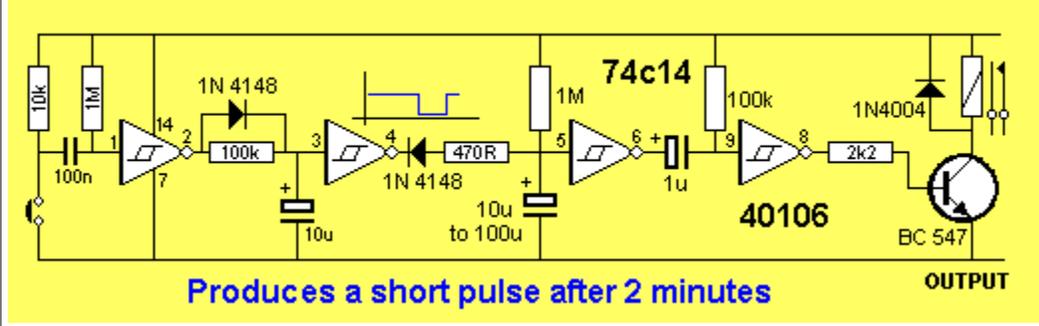
OUTPUT AFTER 2 MINUTES

Here is another very similar circuit. Use either the active HIGH or Active LOW switch and if the Active LOW switch is used, do not connect the parts or gate between pins 1 and 2 to the rest of the circuit.
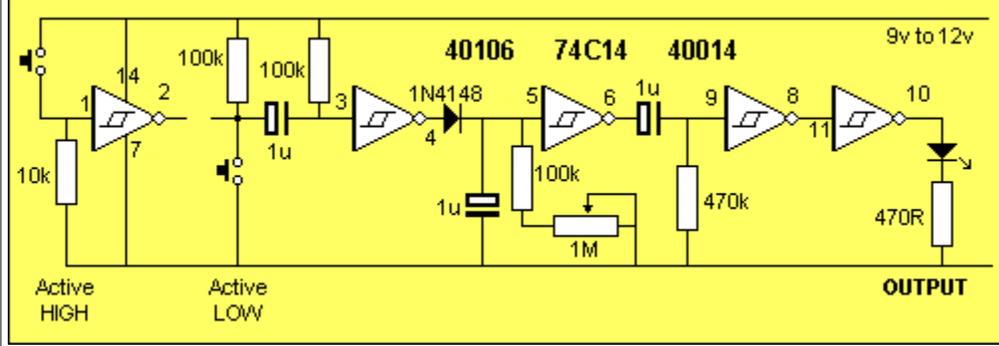
PULSER

The 74c14 can be used for lots of different circuits. In the following design, the output produces 3mS pulses every second. The circuit is adjustable to a wide range of requirements.

Produces (3mS wide) pulses per sec

TRIGGER TIMER

The next design interfaces a "Normally Open" and "Normally Closed" switch to a delay circuit.

The feedback diode from the output prevents the inputs re-triggering the timer (during the delay period) so that a device such as a motor, globe or voice chip can be activated for a set period of time.

TRIGGER TIMER

BUILDING THE CIRCUITS

The fastest way to put a circuit together is on BREADBOARD. The cheapest and best bread-board has power-rails and sets of "tie-points" or "holes" as shown in this photo:

Connect the components with hook-up wire (called jumpers) by stripping the ends to expose the wire at both ends. Or you can use 0.5mm tinned copper wire (make sure the jumpers do not touch each other).

Do not cut the leads of the components as you may want long leads on another project.

Neatness is not important. The important thing is to build as many circuits as possible as each one will help you understand how the 555 works and how the external circuitry modifies the signal to produce the resulting effect. There is a point-to-learn in every circuit.

POWERING A PROJECT

The safest way to power a project is with a battery. Use 4 x AA cells in a holder or a 9v battery if you only want to use the project for a short period of time.

If you want to use a 555 project for a long period of time you will need a "power supply." The safest power supply is a Plug Pack (wall-wort, wall wart, wall cube, power brick, plug-in adapter, adapter block, domestic mains adapter, power adapter, or AC adapter). The adapter shown in the diagram has a switchable output voltage: 3v, 6v, 7.5v, 9v, 12v) DC and is rated at 500mA. The black lead is negative and the other lead with a white stripe (or a grey lead with a black stripe) is the positive lead.

This is the safest way to power a project as the insulation (isolation) from the mains is provided inside the adapter and there is no possibility of getting a shock.

The rating "500mA" is the maximum the Plug Pack will deliver and if your circuit takes just 50mA, this is the current that will be supplied. Some pluck packs are rated at 300mA or 1A and some have a fixed output voltage. All these plug packs will be suitable.

Some Plug Packs are marked "12vAC." This type of plug pack is not suitable for these circuits as it does not have a set of diodes and electrolytic to convert the AC to DC. All the circuits in this eBook require DC.

TRAFFIC LIGHTS

PROJECTS

TOY ORGAN

This circuit produces a tone according to the button being pressed. Only 1 button can be pressed at a time, that's why it is called a monophonic organ. You can change the 1k resistors to produce a more-accurate scale.

TOY ORGAN

TICKING BOMB

This circuit sound just like a ticking bomb.

This project can be constructed on our **MAKE ANY 555 PROJECT** printed circuit board.

TICKING BOMB

METAL DETECTOR

This circuit detects metal and also magnets. When a magnet is brought close to the 10mH choke, the output frequency changes. The photo shows the circuit made by a reader:
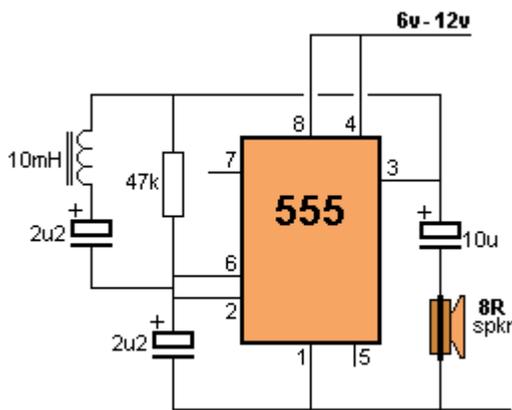
METAL DETECTOR
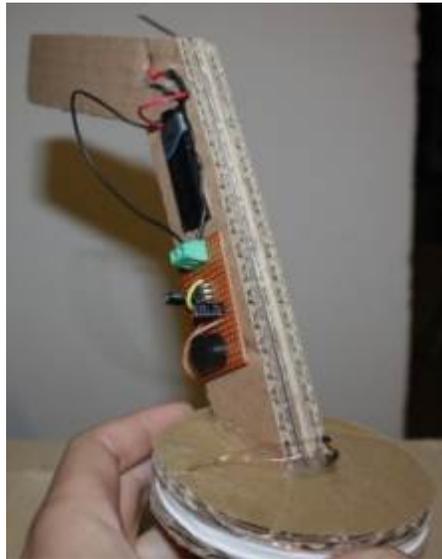
GUITAR TUNER

This circuit is designed to produce a tone of 440Hz.
To do this: Set the potentiometer to about half a turn with a small screw driver. Used an electronic keyboard and select the square wave tone, then turn on the Guitar Tuner circuit. Hold the A4 key down on the keyboard and use the screwdriver to turn the potentiometer until the frequencies match.
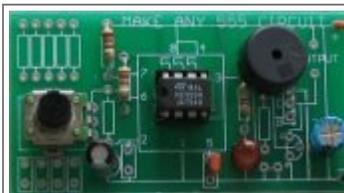
This project can be constructed on our **MAKE ANY 555 PROJECT** printed circuit board.
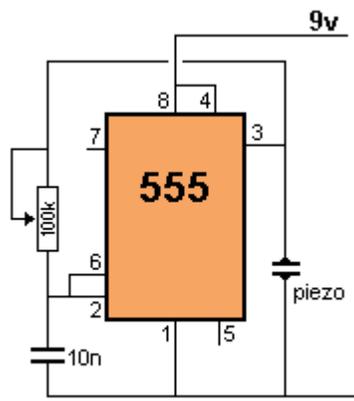
GUITAR TUNER
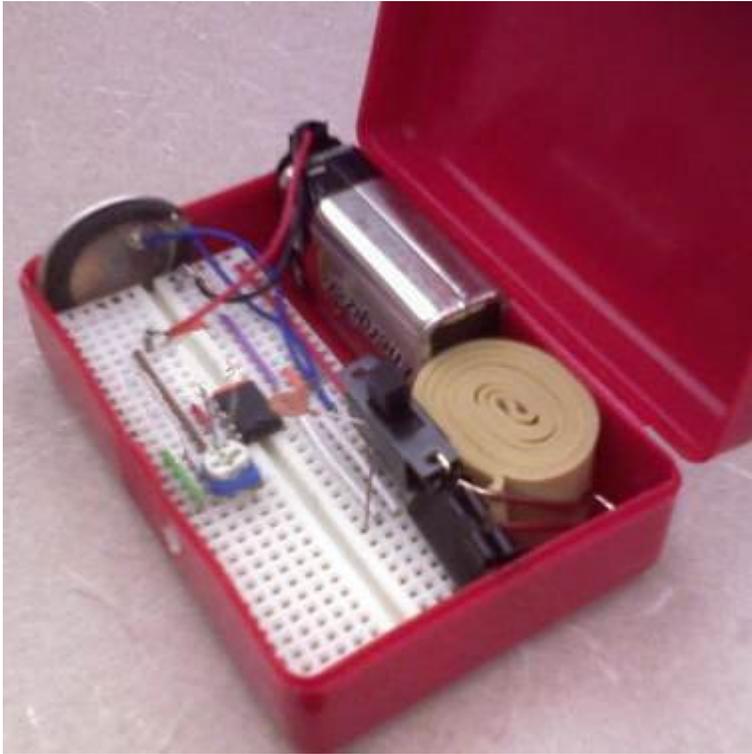
UNEVEN CLICKS

This circuit produces two clicks then a short space before two more clicks etc. Changing the voltage on pin, 5 via the diode, adjusts the timing of the chip.

UNEVEN CLICKS

6v

47k
555
1N4148
10u
8R spkr

UNEVEN CLICKS
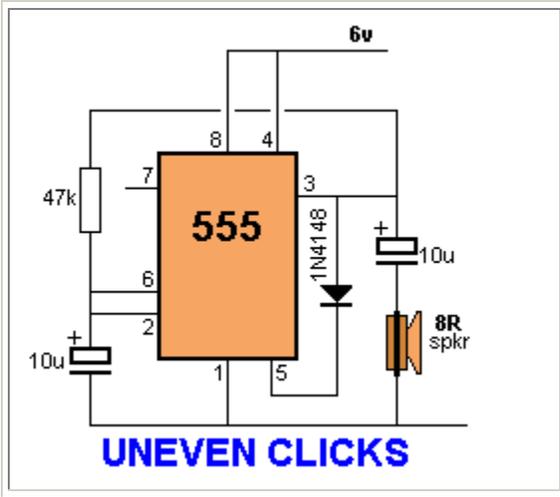
FLASHING RAILROAD LIGHTS

This circuit flashes two red LEDs for a model railway crossing.

6v - 12v

red LED
220R to 470R

47k
555

220R to 470R
red LED

10u

FLASHING LIGHTS
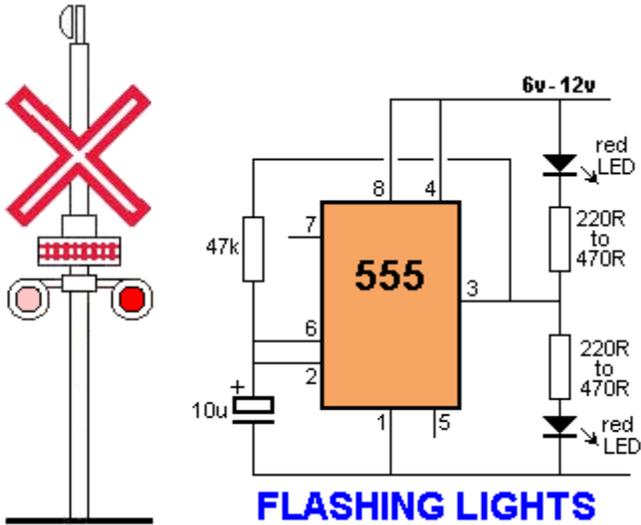
SCREAMER

This circuit will produce an ear-piercing scream, depending on the amount of light being detected by the Light Dependent Resistor.

6v

Light Dependent Resistor ORP12

1k
555
10u
8R spkr

100n

SCREAMER
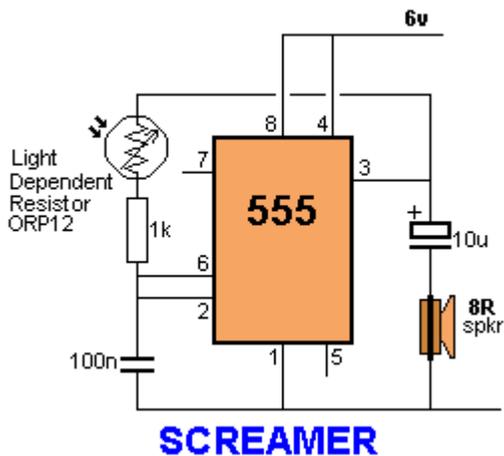
This project can be constructed on our **MAKE ANY 555 PROJECT** printed circuit board.

LASER RAY

This circuit produces a weird "Laser Ray" sound and flashes a white LED at approx 5Hz:
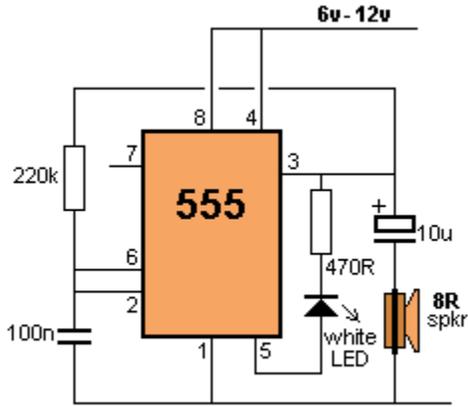
LASER RAY

Here is a video of the sound. It sounds much better with a large speaker.

LED DIMMER

This circuit will adjust the brightness of one or more LEDs from 5% to 95%.
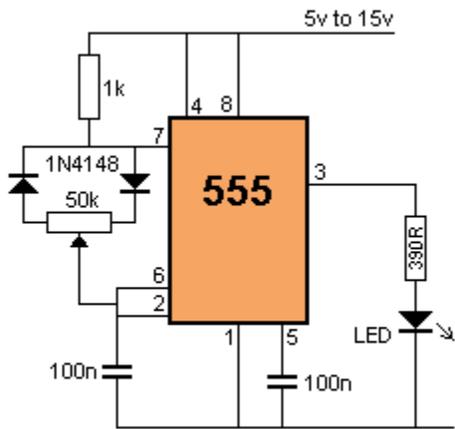
LED DIMMER

rev A

MOTOR PWM

See also: **PWM Controller**

The speed of a motor can be adjusted by this circuit, from 5% to 95%.

MOTOR PWM

rev A
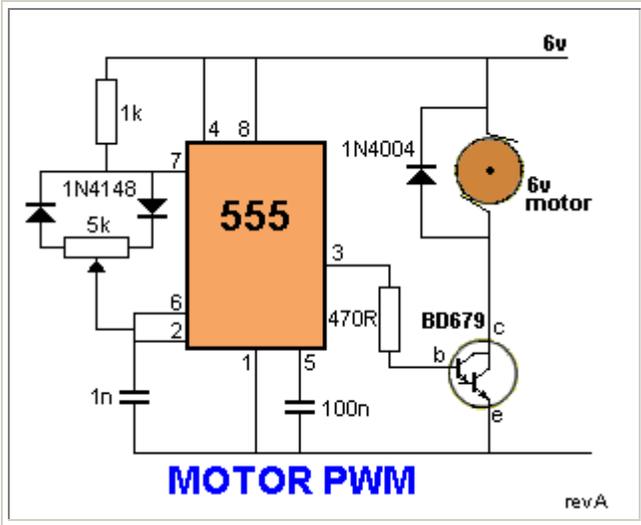
Throttle - simple

The speed of a motor can be adjusted by this circuit, from 5% to 95%. The circuit uses a FET and no heatsink is needed. This circuit is available from Talking Electronics as a fully assembled module. Click HERE for details.

THROTTLE PWM - Simple
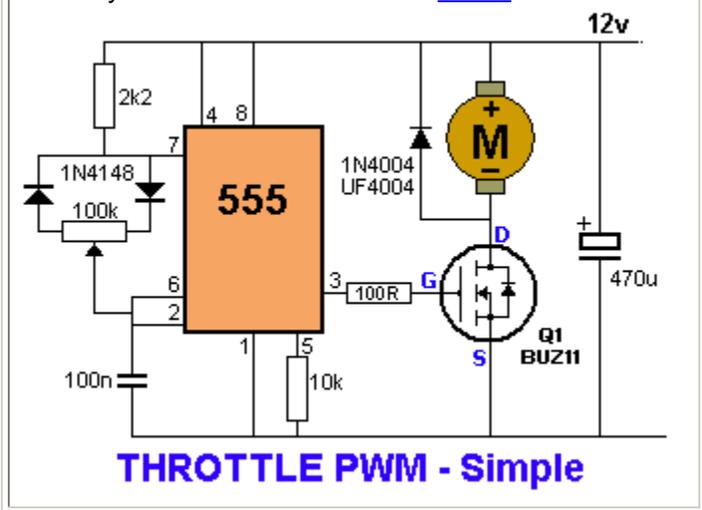
Throttle - with Current Limiting

The maximum current the circuit will deliver is controlled by the second pot. When it is rotated fully clockwise the current is limited to 1.4Amps. When it is turn anticlockwise the current is limited to 100mA. This allows you to drive large or small locos and also allows you test your track for short-circuits at turn-outs etc.

It is designed for those who have a 12v @ 10Amp supply. If a short-circuit occurs with the type of supply, the throttle module will be damaged. With current limiting, the current will be limited to 1.4Amp and even though it will stress the power diodes, they will not be destroyed.

This circuit is available from Talking Electronics as a fully assembled module. Click HERE for details
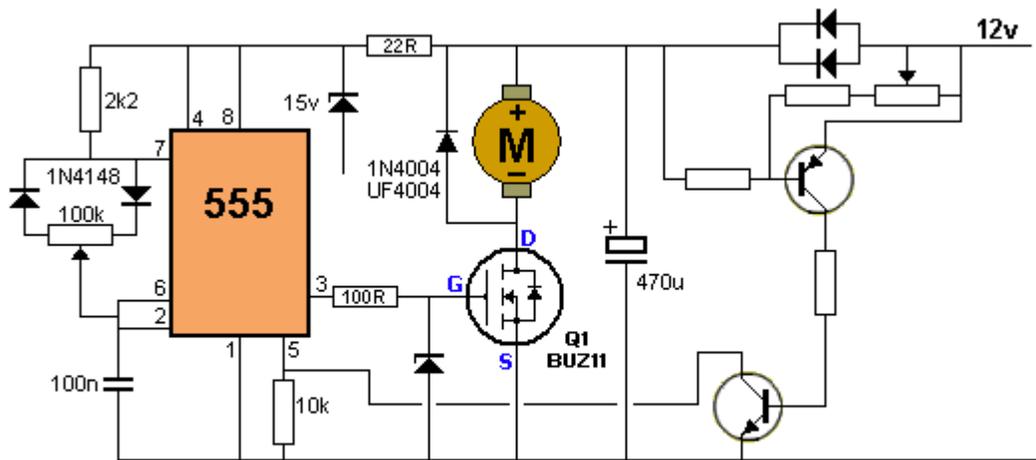
MOTOR PWM with CURRENT LIMITING

The current-limiting circuit controls the mark-space ratio of the 555 by shifting the setting created by the 100k pot and the charging and discharging of the 100n capacitor via the two signal diodes.

The current across the two supply diodes is monitored by the PNP transistor and they have a voltage of about 0.7v across them when passing current. This voltage will turn on any PNP transistor so we create a voltage divider to the base with a pot. The resistor in series with the pot sets the maximum current for the circuit as the pot allows the circuit to increase the current to infinity when it has its smallest value. So we create the lowest value with a series resistor.

As the pot is increased in value, the maximum current reduces to less than 100mA, because the PNP transistor can be turned on at a lower current through the diodes and now we have our two extremes.

As the PNP transistor turns ON, it turns on the NPN transistor and this is causes the voltage on pin 5 to reduce and change the mark-space ratio.

This is the first time such a feature of the 555 has been used and shows the versatility of this chip. This is a proprietary circuit from Talking Electronics and the important component values have been omitted from the diagram as the module is available **fully built and tested**.

Using pin 5
30 Billion 555 IC's have been used and almost no-one has discussed the use of pin 5. It controls when the two amplifiers come into operation.

The inputs of the two amplifiers are connected to pin 2 and pin 6. These amplifiers are called OPERATIONAL AMPLIFIERS and have two inputs and one output. It is the difference in voltage on each of the input lines of each op-amp that makes them change state. These amplifiers have what we call a VERY HIGH INPUT IMPEDANCE. This means a very weak signal will be detected. As long as the signal has a very good amplitude, (voltage) it will be detected. That's because the op-amps are internally connected in such a way that they only respond to a large amplitude. The op-amp circuitry will respond to a very small change in voltage but the 555 IC has different internal circuitry set by three resistors so that when pin 2 goes below 30% of the voltage supplied to the chip, it will change state and when it goes higher than 30% NOTHING HAPPENS. It only works when going below 30%

When the voltage is above 70%, on pin 6, the chip will change to the opposite state and when the voltage goes LOW on pin 6, nothing happens.

The chip need both pin 2 and 6 to be connected to the input voltage for it to change states.

This is how output pin 3 changes from HIGH to LOW. It sees voltage-levels on pins 2 and 6.

But we can change these trigger-values (they are called levels, extremes, you can even call them digital values, trigger points, trigger values, inputs or control voltages) by adjusting the voltage on pin 5.

Pin 5 controls these "trigger voltages" by shifting them up and down. It controls the point at which pins 2 and 6 activate the chip.

And that's what we do in the circuit above.

Pin 5 normally has about 70% of the value of the supply on it and by reducing this voltage to almost zero, we can create a very big change in the frequency of operation

of the 555 when it is wired as an oscillator.

I am not going into any technical details as you can build your own circuit and see the changes.

All I will say is pin 5 is classified as a low-impedance input as it has some 5k resistors connected to it and it will appear to have a resistance of much less than 2k, with a voltage of about 60% of rail voltage.

You can supply a voltage to this pin up to rail voltage or take pin to 0v without damage.

PWM

See also: **PWM Controller**

The output of these circuits can be adjusted from 5% to 95%.
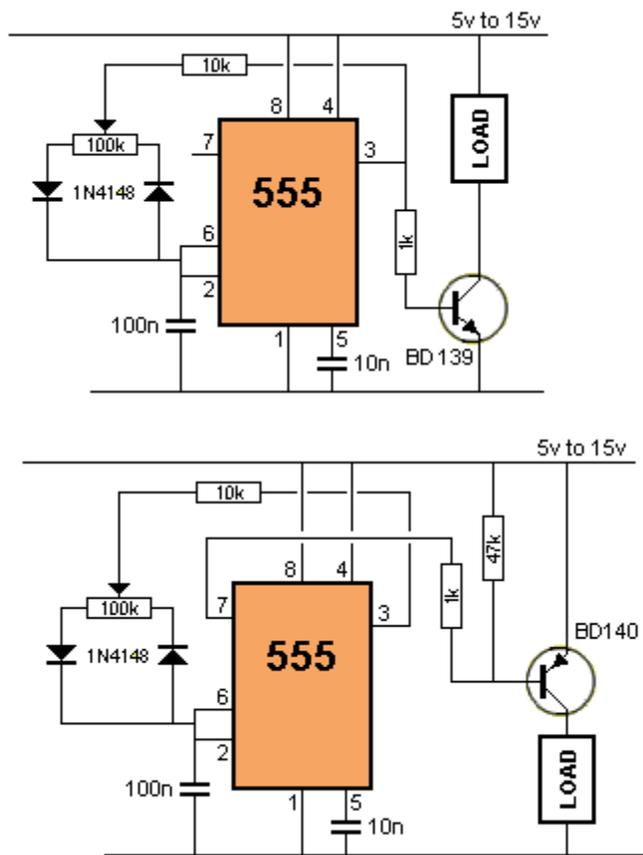
PWM via pin 5

The ratio of the HIGH time to the LOW time can be adjusted by changing the voltage on Pin 5. This is called PULSE-WIDTH adjustment or PULSE-WIDTH -MODULATION.

It does not give the wide range of the circuits above, but is handy for some applications.
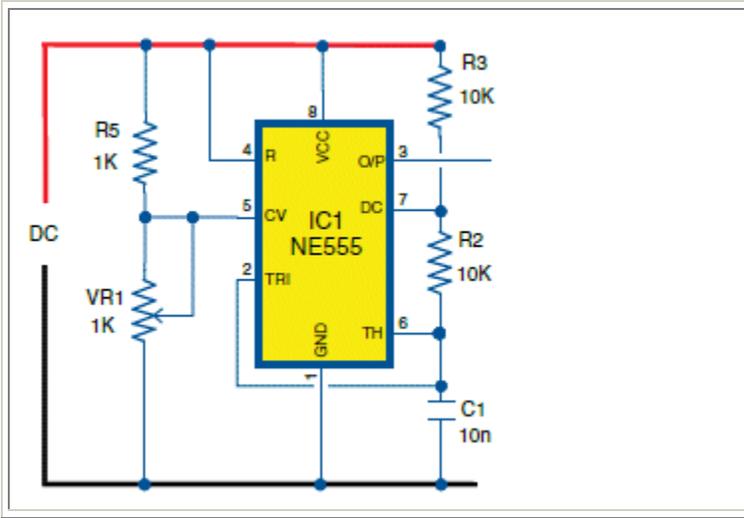
VOLTAGE DOUBLER

A voltage higher than the supply can be created by a "Charge-Pump" circuit created with a 555, diodes and capacitors as shown in the following circuit. The output will deliver about 50mA
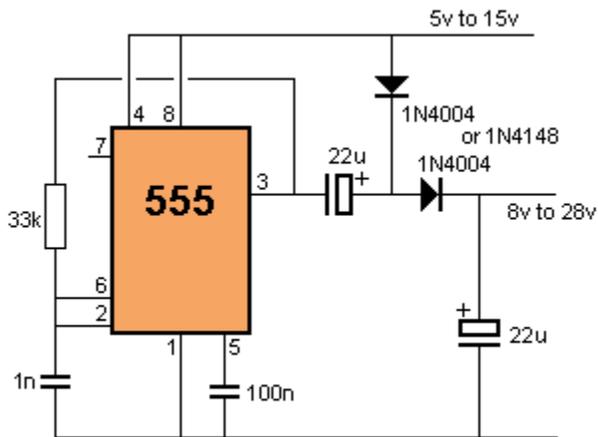
VOLTAGE DOUBLER

VOLTAGE TRIPLER and QUADRIPLER!

A voltage of about 3 times the supply (minus about 5v) can be created by the following circuit. The output will deliver about 50mA. Pin 3 goes LOW to about 0.5v and HIGH to about 11v.
When pin 3 goes LOW, capacitor "a" charges via diode "a" to about 11v.
When pin 3 goes HIGH, capacitor "a" has about 11v across it, plus the voltage on pin 3. The 22v on the positive lead of capacitor "a" passes through diode "b" to charge capacitor "b" with 21v - 12v = 9v. This produces a voltage of 21v on the anode of diode "c." When pin 3 goes LOW, both capacitors "a" and "c" will charge via diodes "a" and "c" with capacitor "a" being charged via diode "a" and capacitor "c" charged via diode "c." When pin 3 goes HIGH, the 9v across capacitor "c" will be added to the 22v to charge capacitor "d" to 31v.

VOLTAGE TRIPLER

1N4148

21v **c**   **d**   **31v**

1N4148
a   22v   **b**

22u
c

22u
d

12v

22u
b

22u
a

4 8

7

555

3

33k

6

2

1 5

1n

26-04-2016

VOLTAGE QUADRIPLER

1N4148
41v

31v

1N4148

21v

22u

1N4148

22v

22u

22u

22u

22u

12v

22u

4 8

7

555

3

33k

6

2

1 5

1n
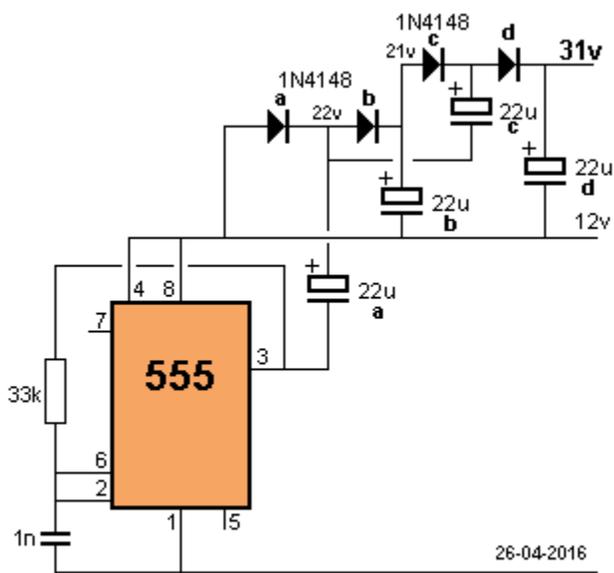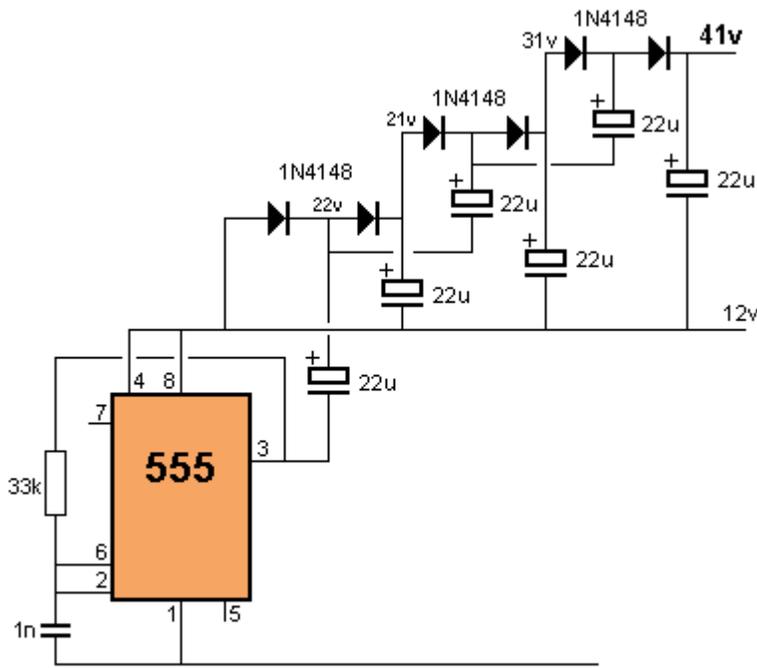
INCREASING OUTPUT PUSH-PULL CURRENT

Some 555's do not swing rail-to-rail when 200mA is being delivered and the chip gets very hot when trying to deliver 200mA.
The solution is to add a push-pull output. The following arrangement has been chosen as it swings almost rail-to-rail but two faults need to be addressed.
Both transistors turn on during the brief interval when pin 3 is travelling from high to low or low to high.
This means the two transistors will put a "short" across the power rail. The addition of the 4R4 will allow a high current to flow but the transistors will not be damaged. In addition, green LEDs on the base of each transistor reduces the time when both transistors are ON.
The animation shows how the transistors are turned on and off and deliver a high current to the load. The animation shows how NPN and PNP transistors follow an input signal in a push -pull arrangement using

positive and negative supply rails. This is not the same as our circuit however the basic effect applies. The output is inverse of pin3 but pin3 only needs to deliver 10-50 milliamp and the transistors can deliver 1 amp or more to the load. This allows the 555 to be kept cool.
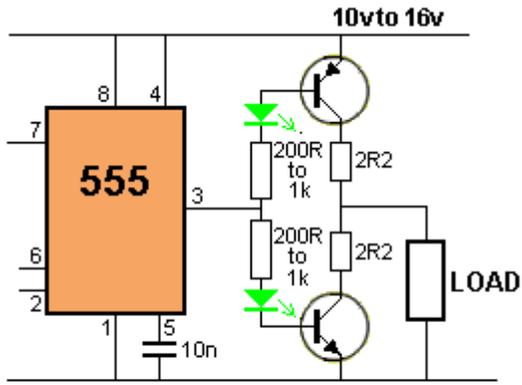
INCREASING PUSH-PULL OUTPUT CURRENT
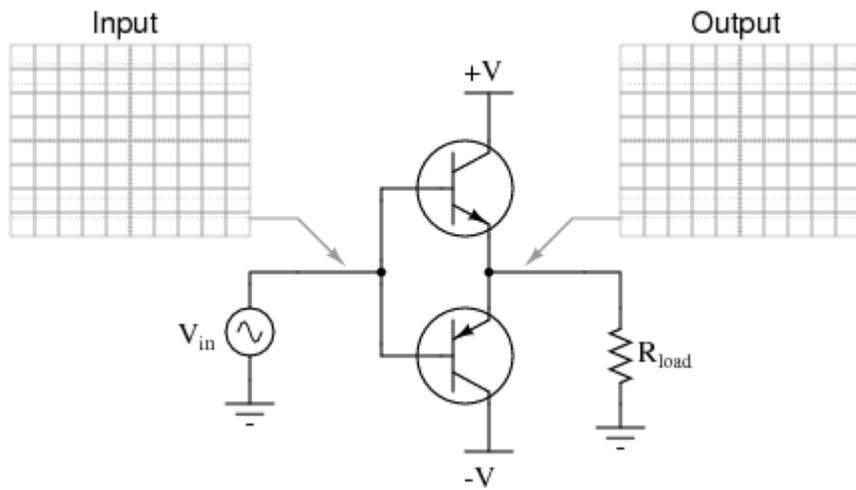
NEGATIVE VOLTAGE

A negative supply can be produced by a "Charge-Pump" circuit created with a 555, diodes and capacitors as shown in the following circuit. The output will deliver about 50mA.
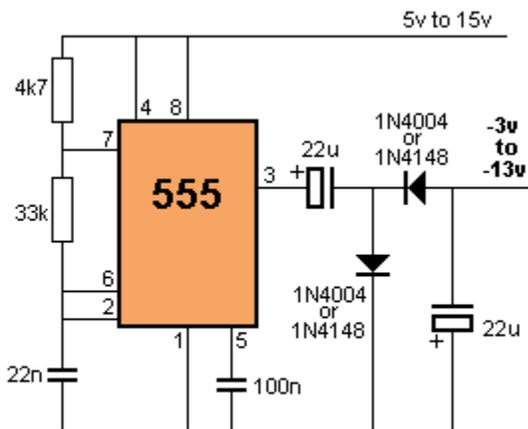
NEGATIVE VOLTAGE

STUN GUN - Voltage Multiplier

This circuit produces a very high voltage and care must be used to prevent getting a nasty shock. The transformer can produce over 1,000v and the 8-stage multiplier can produce up to 20,000v

STUN GUN
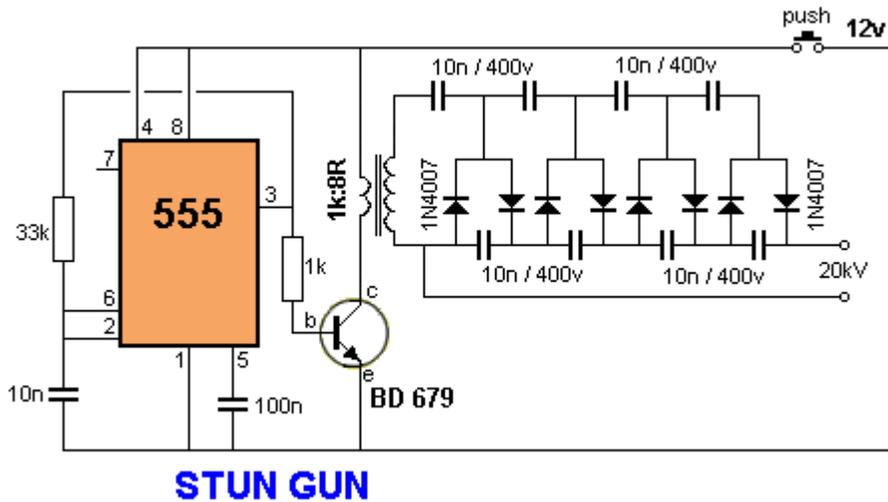
12v to 240v INVERTER

This circuit will produce 240v at 50Hz. The wattage will depend on the driver transistors and transformer.

12v TO 240v INVERTER
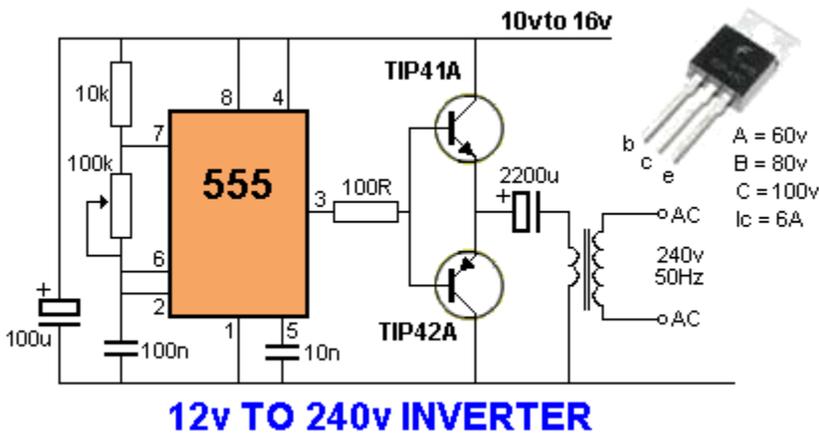
170v SUPPLY FOR NIXIE TUBES

This circuit produces approx 170v for Nixie tubes and other neon tubes. It is a switch-mode boost circuit.

170v POWER SUPPLY
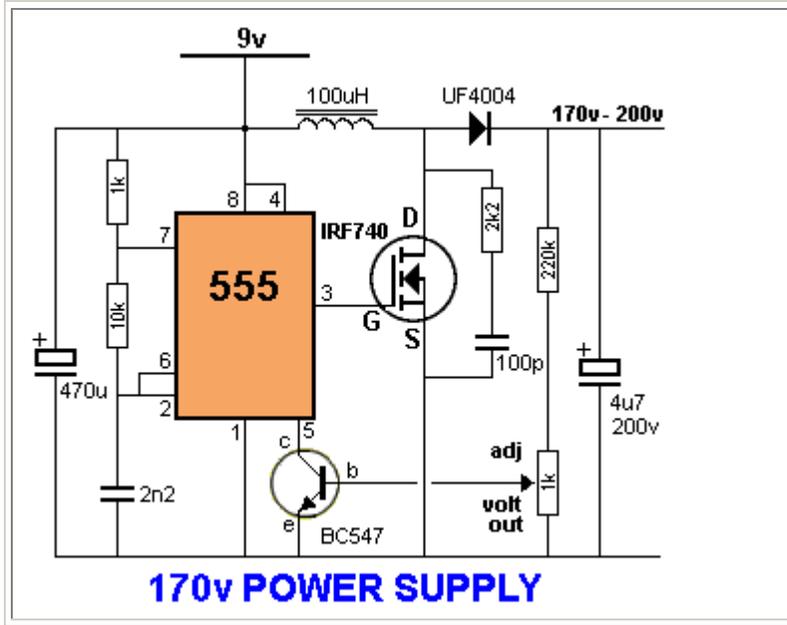
12v DC to 12v DC BATTERY CHARGER (and 19v see below)

You cannot charge a 12v battery from a 12v battery. The battery being charged creates a "floating charge" or "floating voltage" that is higher than the charging voltage and the charging stops.
The following circuit produces a voltage higher than 12v via a CHARGE PUMP arrangement in which the energy in an electrolytic is fed to a battery to charge it.
The circuit produces about 900mA "charge current" and the diodes and transistors must be fitted with heat sinks. The LEDs are designed to prevent the two output transistors turning ON at the same time. The lower output transistor does not start to turn on until the voltage is above 5v and the top transistor does not turn on until the voltage drops 4v from the positive rail. This means both transistors will be turned on ONLY when the voltage passes a mid-point-gap of 4v. In our circuit, this time is very short and and the transition is so fast that no current (short-circuit current) flows via the two output transistors (as per our test).
The electrolytic charges to about 10v via the lower transistor and top diode. The top BD679 then pulls the negative of the 2200u electrolytic towards the 12v6 rail and the positive is higher than 12v6 by a theoretical 10v, (about 9v in our case) however we need the ENERGY IN THE ELECTROLYTIC and in our circuit it is capable of delivering a current of about 900mA. This energy is passed to the battery via the lower diode. Most batteries should not be charged faster than the "14-hour-rate." This basically means a flat battery will be charged in 14 hours. To do this, divide the AHr capacity by 14 to get the charge-rate. For example, a 17AHr battery should be charged at 1.2A or less. For lower-capacity batteries, the 2200u can be reduced to 1,000u. Charging is about 80% efficient. In other words, delivering 120% of the AHr capacity of a battery is needed to fully charge it.
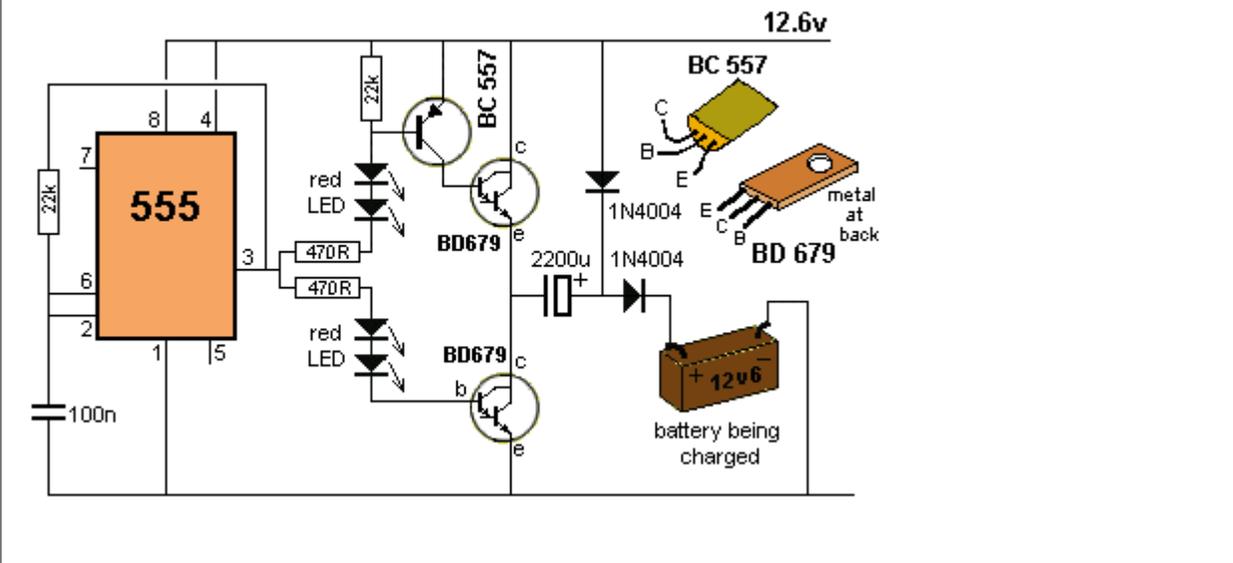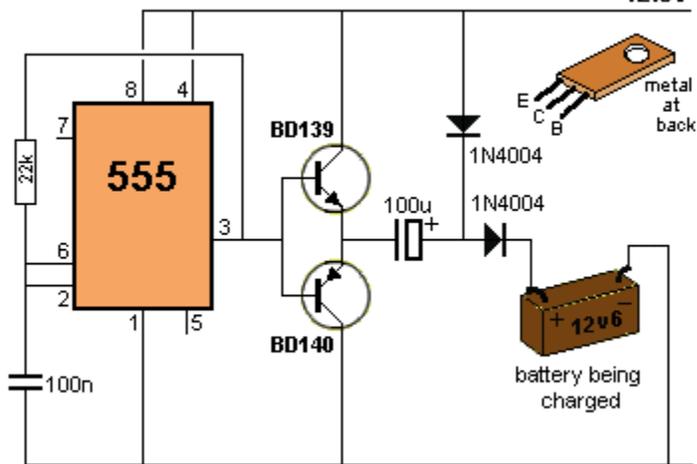
This circuit will deliver about 150mA

12v DC to 19v DC

This circuit can also be used to charge some of the older-style laptops that need a 19v supply. Remove the 12v battery from the circuit above and connect the cathode of the lower 1N4004 to the input of the laptop.

3.7v DC to 5v DC

This circuit will produce about 5v from a 3.7v Li-Ion cell:
A 555 will not work on 3.7v - 0.7v = 3v   You may be lucky to get it to "pump up" the output to get 5v and this will activate the 555. BUT some chips will not work.   The 7555 IC may work on 3.0v - but I would not guarantee anything.
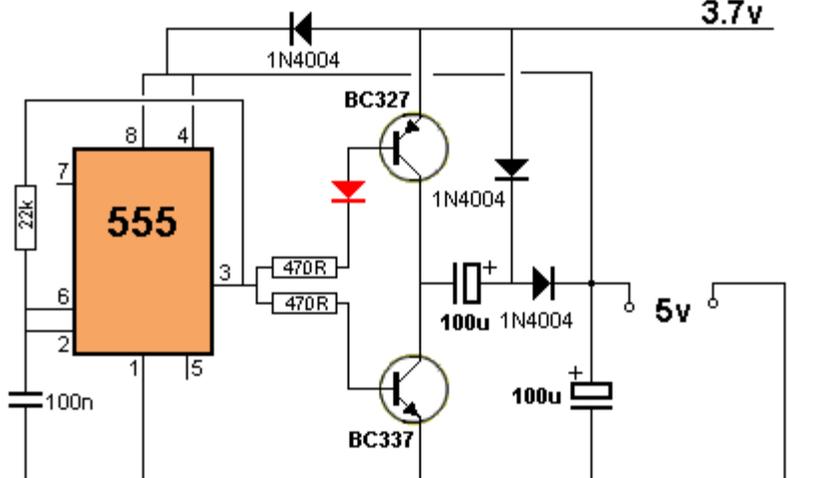
5v DC to 7v DC

This circuit will produce about 7v from a 5v USB port or 5v cell-phone charger to trickle charge a 6v battery.
The voltage of the battery will rise to about 7v when charging (called the "floating charge") and that's why you need to "jack-up" the voltage from the USB port to charge the battery. The circuit is limited to about 45mA with a 22u electrolytic and a battery can take up to a week to charge.
Circuit design by: budiyantosamuel90@gmail.com
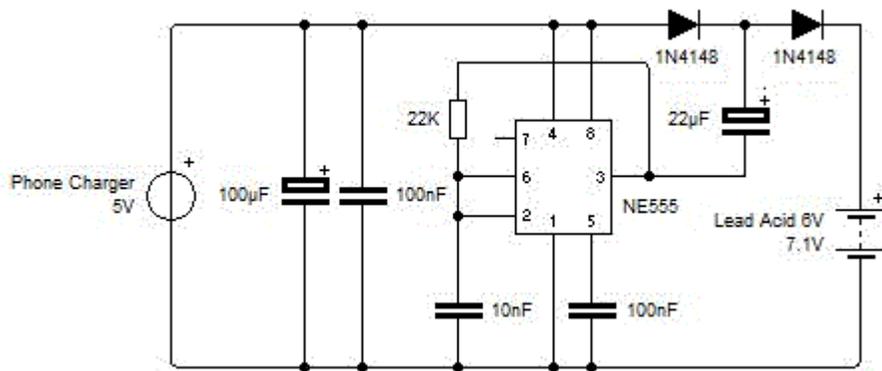
This circuit will deliver about 45mA

555 AMPLIFIER

The 555 can be used as an amplifier. It operates very similar to pulse-width modulation. The component values cause the 555 to oscillate at approx 66kHz and the speaker does not respond to this high frequency. Instead it responds to the average CD value of the modulated output and demonstrates the concept of pulse-width modulation. The chip gets very hot and is only for brief demonstrations.
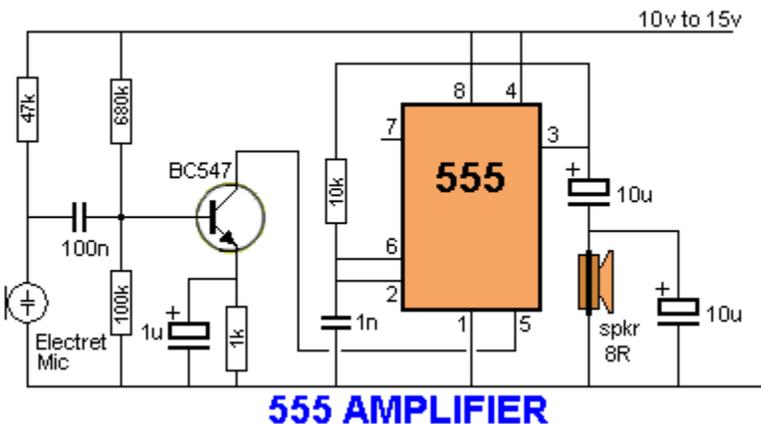
555 AMPLIFIER

LIGHT DETECTOR

This circuit detects light falling on the Photo-cell (Light Dependent Resistor) to turn on the 555 and create a tone that is delivered to the speaker. Pin 4 must be held below 0.7v to turn the 555 off. Any voltage above 0.7v will activate the circuit. The adjustable sensitivity control is needed to set the level at which the circuit is activated. When the sensitivity pot is turned so that it has the lowest resistance (as shown in red), a large amount of light must be detected by the LDR for its resistance to be low. This produces a voltage-divider made up of the LDR and 4k7 resistor. As the resistance of the LDR decreases, the voltage across the 4k7 increases and the circuit is activated.

When the sensitivity control is taken to the 0v rail, its resistance increases and this effectively adds resistance to the 4k7. The lower-part of the voltage-divider now has a larger resistance and this is in series with the LDR. Less light is needed on the LDR for it to raise the voltage on pin 4 to turn the 555 on.

LIGHT DETECTOR

ANOTHER LIGHT DETECTOR

This is a very clever circuit because it detects when Pin 2 is less than 33% of rail voltage and then the voltage just has to rise above 33% for Pin2 to stop having any effect on the 555. Normally the input voltage has to rise above 66% but the "timing components" made up of the resistor on pin3 and the capacitor, resets the chip so that the change
in light intensity on the detector can be very small.
The Photo-transistor can be for visual light or Infra-red light and the 10k and 100n can be 10k to 100k and 100n to 1u.

LIGHT DETECTOR - 2

ooooooooooooooOOOOOOOOOOOOOOOoooooooo

MORE SENSITIVE 555

The circuit above makes the 555 more sensitive.
Normally the 555 detects a signal that is between 33% and 66% of rail voltage. This can be 2v to 4v and we know transistors can detect much smaller changes. The gap between the higher and lower value is called the HYSTERESIS GAP and is 35% for a 555.
When the voltage on pin 2 is above 35%, the chip is not turned ON and Pin 3 is LOW. This means the 100n capacitor is not charged. The 100k sensitivity pot is designed to put a little extra current through the photo-transistor so the voltage across the collector-emitter leads is slightly higher than 35% of rail voltage.
When light fall on the photo-transistor, it will allow more current to flow through the collector-emitter junction and the voltage across these leads decreases and the voltage on Pin 2 falls below 33% of rail voltage.
This is detected by Pi 2 and the 555 turns ON with pin 3 going HIGH to charge the 100n via the 10k resistor. When pin 6 detects a HIGH, the chip is put into RESET MODE, but it does not reset until the light has been removed from the photo-transistor and the voltage rises on

Pin2.
The circuit above can be adjusted so the Hysteresis Gap can be as small as 5% and if the time-delay of the 10k/100n is small, the 555 will respond instantly to the light received by the photo-transistor.
Remember: light makes Pin 3 go HIGH.

DARK DETECTOR

When the level of light on the photo-cell decreases, the 555 is activated. Photo-cells (Photo-resistors) have a wide range of specifications. Some cells go down to 100R in full sunlight while others only go down to 1k. Some have a HIGH resistance of between 1M and others are 10M in total darkness. For this circuit, the LOW resistance (the resistance in sunlight) is the critical value. More accurately, the value for a particular level of illumination, is the critical factor. The sensitivity pot adjusts the level at which the circuit turns on and allows almost any type of photo-cell to be used.
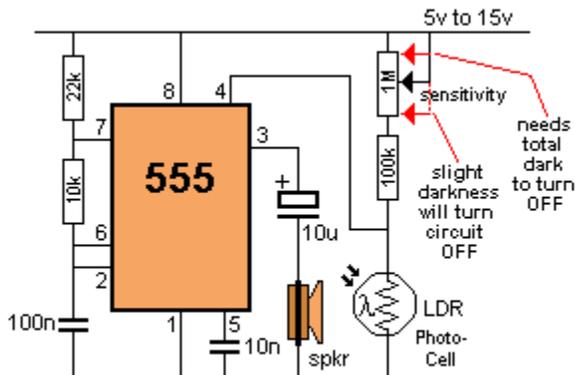
DARK DETECTOR

The next circuit turns on a relay for a short period of time when the LDR does not detect sufficient light:
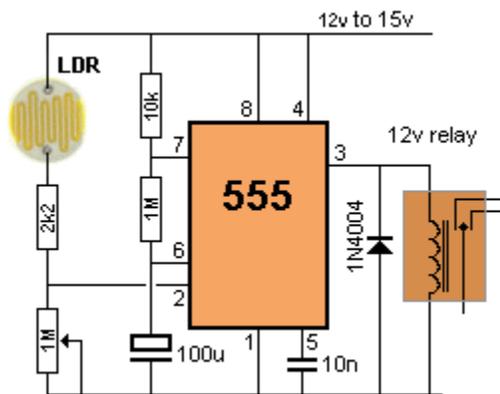
SHORT BEEP

This circuit produces a short beep when the input goes from HIGH to LOW. The input can stay LOW for any length of time but the output will always be a short beep.
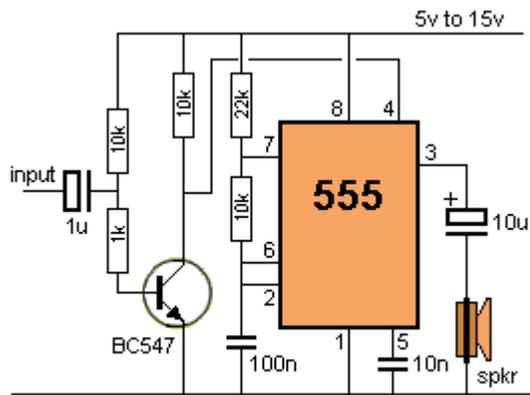
SHORT BEEP

This circuit produces a short beep when the input goes from LOW to HIGH. The length of the beep-tone depends on the value of the 1u electrolytic.
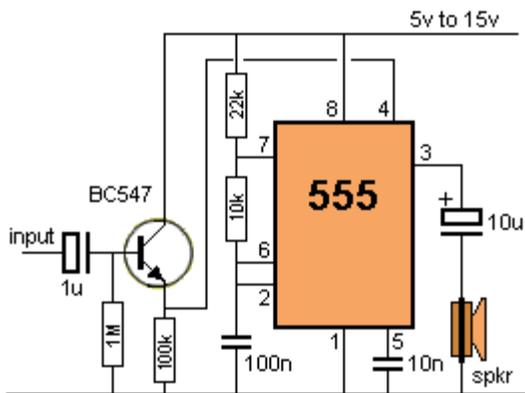
SHORT BEEP - a
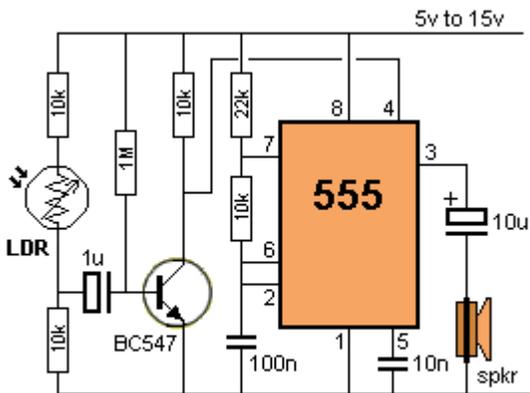
SHORT BEEP with LDR

This circuit produces a short beep when the LDR does not receive any illumination.
The length of the beep-tone depends on the value of the 1u and the 10k connected to it.

Don't forget:
The 555 still takes 10mA when it is "turned off" via pin 4.
Pin 4 merely stops the output changing state.

FLIP FLOP and MEMORY CELL

When output pin 3 is HIGH, the 220n charges through the 220k to 6v. When pin 3 is LOW, the 220n discharges through the 220k to 0v. Pressing the switch upsets the 3v created by the two 10k voltage dividers, triggering the flip flop inside the 555 and changing the state of the output from HIGH to LOW or *vice-versa.* The output of the 555 drives a transistor to turn a globe on and off.

The second circuit is a Memory cell and is the basis of the memory in a computer. The SET button turns on the globe and the RESET button turns the globe off.

It works like this: When the circuit is turned on, pin 6 does not see a high and pin 2 does not see a low, so the 555 starts in reset mode.

FLIP FLOP   **MEMORY CELL**
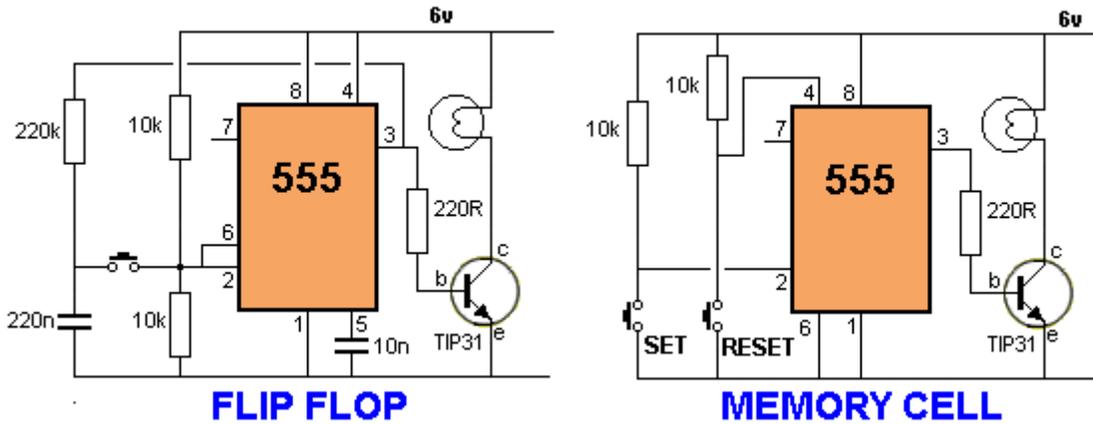
CAR TACHOMETER

A 555 is configured as a monostable or one shot in this project. The period of the 555 is determined by the 47k and the capacitor from pin 6 to ground (100n). Time "T" = 1.1 RC or 1.1 X 50,000 X 0.1 $^{X10^{-6}}$ = 0.0055 or 5.5 mS (milli-seconds).

The 555 receives trigger pulses from the distributor points. These are limited by the 1k and 5v zener diode. These are AC coupled to the trigger input through the 100n coupling capacitor. The 50mA meter receives pulses of current through the 200k pot to show a reading.

CAR TACHOMETER
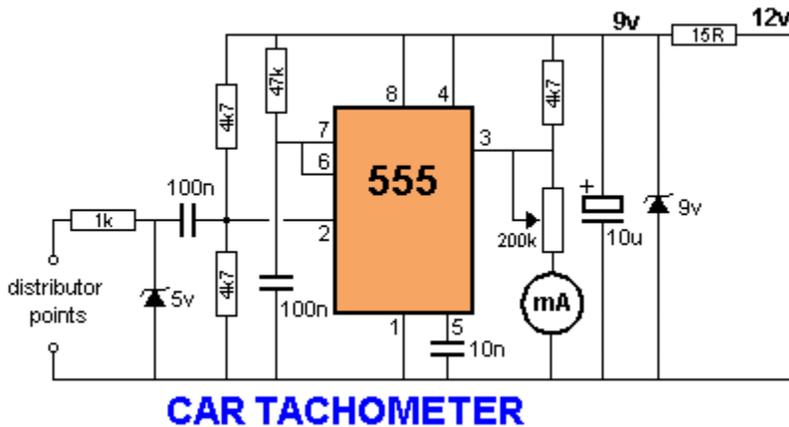
Integration of the current pulses produces a visible indication of the cars engine speed on the 0-1mA meter.

Supply is taken from the cars 12v system and for the 555 it is reduced to a regulated 9v by the 15 ohm resistor in conjunction with the 9v zener diode. Note: the 10u electrolytic must be placed physically as close as possible to supply pin 8.

FREQUENCY METER

This circuit will detect audio frequencies and display them on a meter (actually called a "movement"). Connect the circuit to the output of an amplifier. It is best to detect one frequency at a time.

9v

4k7 4k7

100n

audio amplifier 4k7

555

8 4
7
6
3
2
1 5

10k 10u

100n

10n

(mA) **0-1mA**
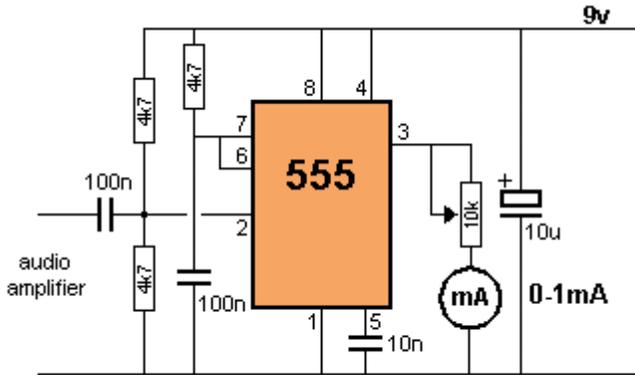
FREQUENCY METER

Integration of the audio frequency produces a visible indication on the 0-1mA meter.

SERVO TESTER

This circuit can be used to manually turn a servo clockwise and anti-clockwise. By pushing the forward or reverse button for a short period of time you can control the rotation of the servo. It will also test a servo. Here is a photo of a kit from **Cana Kit** for $10.00 plus postage (it is a slightly different circuit) and a motor and gearbox, commonly called a "servo." The output shaft has a disk or wheel containing holes. A linkage or push-rod is fitted to a hole and when the disk rotates, the shaft is pushed and pulled. The shaft only rotates about 180° to actuate flaps or ailerons etc.

27k to 33k **6v**

100k

3M3 1N4148

555

8 4
7
6
2
1 5

to SERVO:
o positive (red)
o negative (black)
o signal (yellow or white)

3

22n 10n
or 33n

SERVO CONTROLLER 21-1-2016

27k to 33k **6v**

FORWARD REVERSE 100k

3M3 1N4148

555

8 4
7
6
2
1 5

to SERVO:
o positive (red)
o negative (black)
o signal (yellow or white)

3

22n 10n
or 33n

SERVO TESTER 21-1-2016
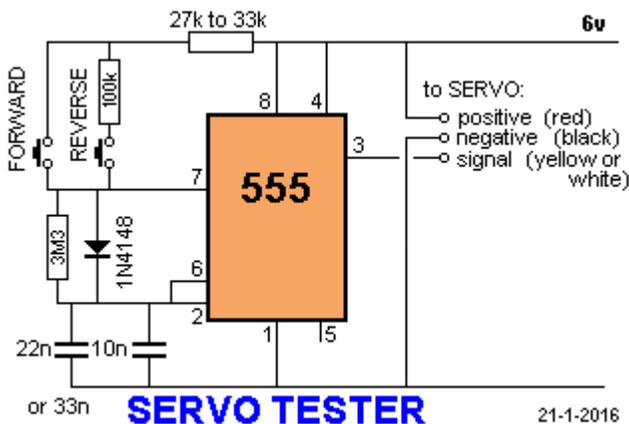
A pot can be used to control the position of the servo by using the following circuit. It

produces a positive pulse between about 0.9 milliseconds and 2.1 milliseconds. The off period between pulses is about 40 milliseconds. This can be shortened by reducing the value of the 3M3 resistor.

JOY STICK

This circuit will control a servo from a Joy Stick:
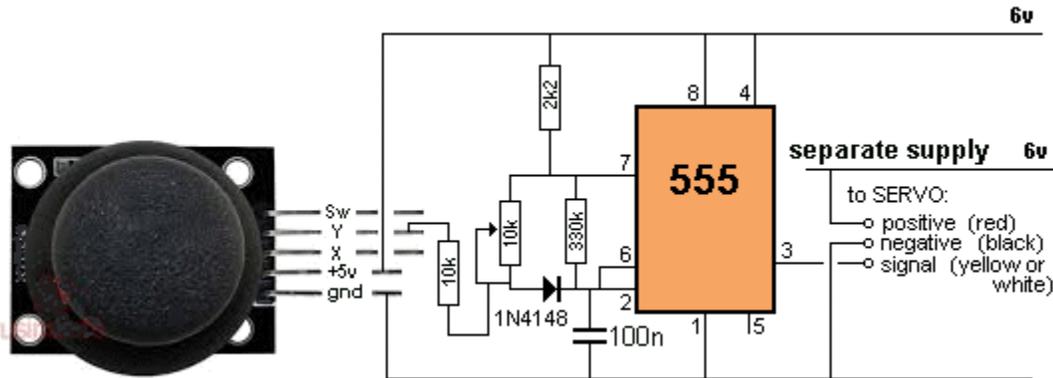
The supply for the servo must be separate from the 555 section because the 555 picks up noise from the servo and makes the motor vibrate all the time.
This circuit works in the "Y-direction." Build another circuit for the "X-direction."
Adjust the 10k pot for the centre of travel and use the Joy Stick to produce left and right action.
The **Joy Stick** comes in a set of **37 Sensors** for less than $20.00 on eBay and you can see all the sensors HERE.

USELESS MACHINE

Here is a fun project using a servo motor and a circuit similar to the SERVO TESTER project above. It is available on the INSTRUCTABLES website. Before you do anything, watch the video:
http://www.instructables.com/id/The-Most-Useless-Machine
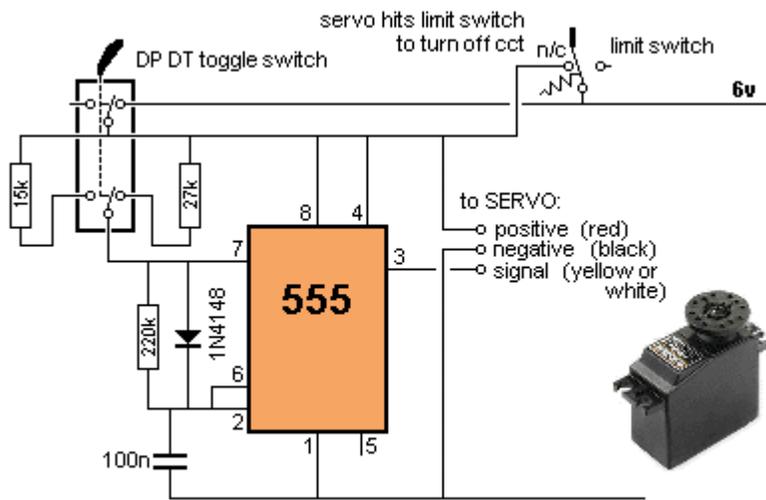
USELESS MACHINE

The Instructables website contains all the construction details. The circuit diagram shows the toggle switch is clicked towards the lid of the box and this starts the servo motor. The servo has an arm that comes out of the box and clicks the switch to the opposite position. This reverses the servo and the arm retreats into the box and hits the limit switch that turns the circuit off.

You may have to adjust the value of the 15k and 27k resistors and you will also see other videos on the Instructables website to help you with construction.

As the website says: "It's the most useless invention, but everyone wants one."

TRANSISTOR TESTER
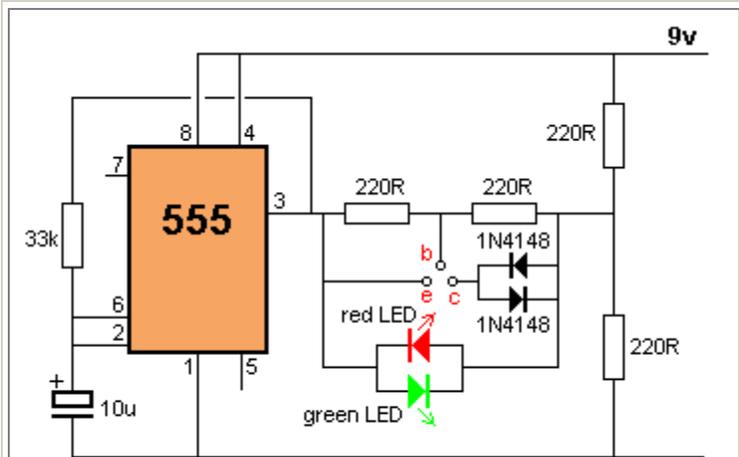
TRANSISTOR TESTER

The 555 operates at 2Hz. Output pin 3 drives the circuit with a positive then zero voltage. The other end of the circuit is connected to a voltage divider with the mid-point at approx 4.5v. This allows the red and green LEDs to alternately flash when no transistor is connected to the tester.
If a good transistor is connected, it will produce a short across the LED pair when the voltage is in one direction and only one LED will flash. If the transistor is open, both LED's will flash and if the transistor is shorted, neither LED will flash.

SWITCH DEBOUNCE

The output goes HIGH for 100mS when the switch is pressed.
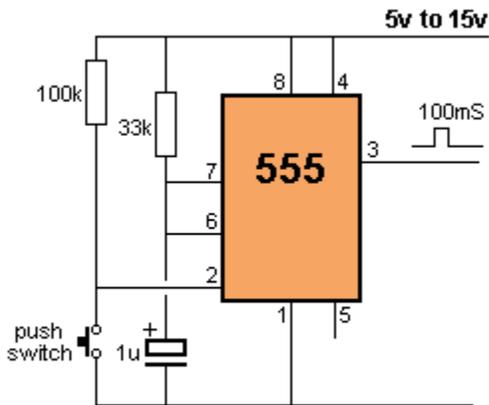
SWITCH DEBOUNCE

INCREASING OUTPUT CURRENT

The 555 will deliver 200mA to a load but the chip gets extremely hot (12v supply). The answer is to use a buffer transistor.
For 200mA, use a BC547 or equivalent.
For 500mA use a BC337 or equivalent
For 1A, use a TIP31 or equivalent.
For 3A - 5A use a BD679 or equivalent with heatsink
For 5A to 10A use TIP3055 with heatsink
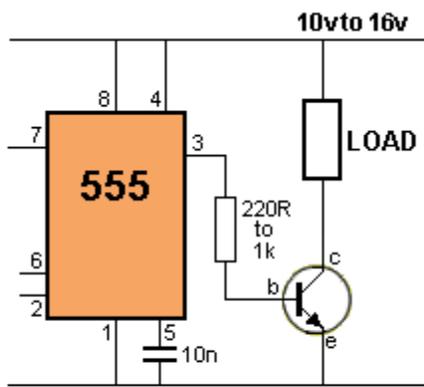
INCREASING OUTPUT CURRENT

IMPROVING THE SINKING OF A 555

The output of a 555 goes low to deliver current to a load connected as shown in the circuit below. But when the chip is sinking 200mA, pin 3 has about 1.9v on it. This means the chip does not provide full rail voltage to the load.
This can be improved by connecting pin 7 to pin 3. Pin 7 has a transistor that connects it to 0v rail at the same time when pin 3 is LOW. They can both be connected together to improve sinking capability. In this case the low will be 800mV for 200mA instead of 1900mV, an improvement of 1100mV. This will add 1v1 to the load and also make the chip run cooler.
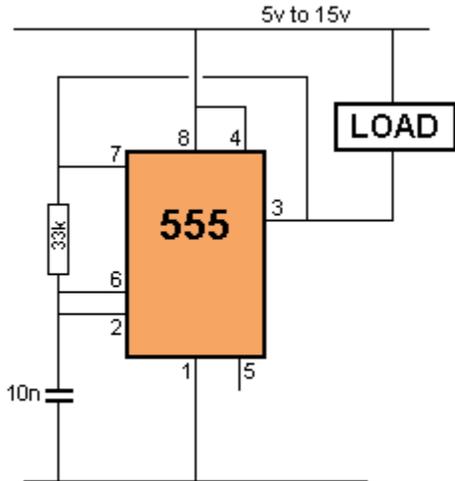
IMPROVING THE OUTPUT

CONSTANT CURRENT

The 555 will deliver 200mA to a load but this might be too much. You can add a dropper resistor (current limiting resistor) but the current will reduce as the supply voltage drops.

To provide a constant output current to a device such as an IR LED, the following circuit can be used. The current will be constant for any supply voltage but the best range will be 7v to 12v.
The current is determined according to the value of R. You can use this table:

R	Current
5R6	100mA
10R	60mA
22R	30mA
47R	15mA
100R	6mA

CONSTANT CURRENT
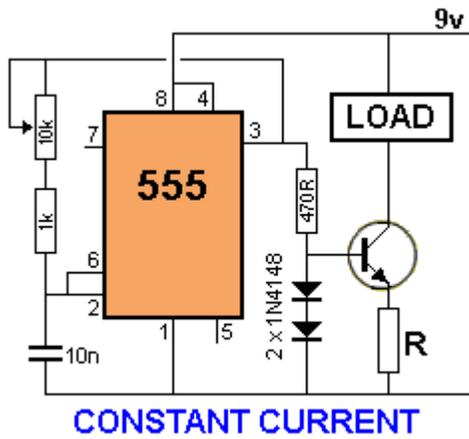
DRIVING A BI-COLOUR LED

Some 3-leaded LEDs produce red and green. This circuit alternately flashes a red/green bi-coloured LED:

DRIVING
A BI-COLOURED LED
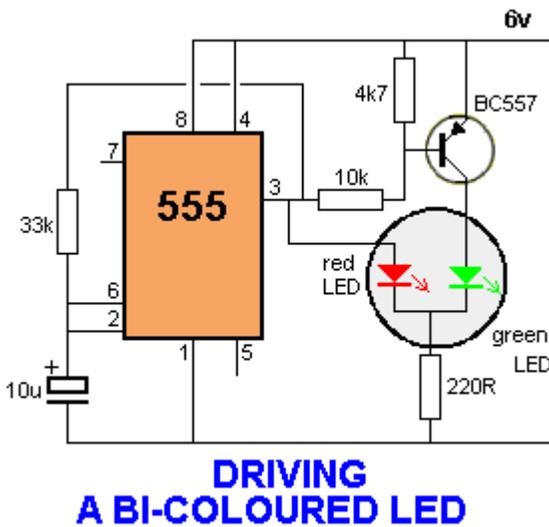
BI-POLAR LED DRIVER

Some 2-leaded LEDs produce red and green. These

are called Bi-polar LEDs. This circuit
alternately flashes a red/green bi-polar LED:

9v

red LED
green LED
33k
555
220R
220R
10u

BI-POLAR LED DRIVER
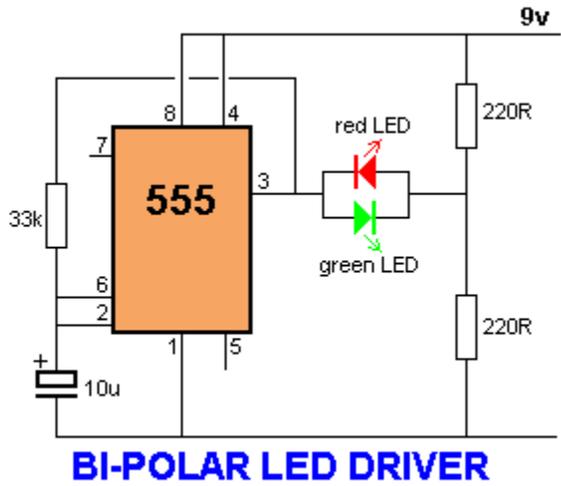
DRIVING A TRI-COLOUR LED

This circuit drives each colour slowly from dark to full brightness and each oscillator has a different frequency. This creates a total mixture of colours and allows the RGB LED to produce all its different colours. Some LEDs (diffused LEDs) work better than others. Change the 220k/22k etc for each oscillator to get a different mixing effect.
The output pin 3 goes HIGH immediately but the base is taken high slowly because the 100u takes time to charge via the 22k etc resistor). The transistor is an emitter-follower and it delivers more and more current through the 470R to increase the brightness. Then the process reverses.

DRIVING A TRI-COLOURED LED
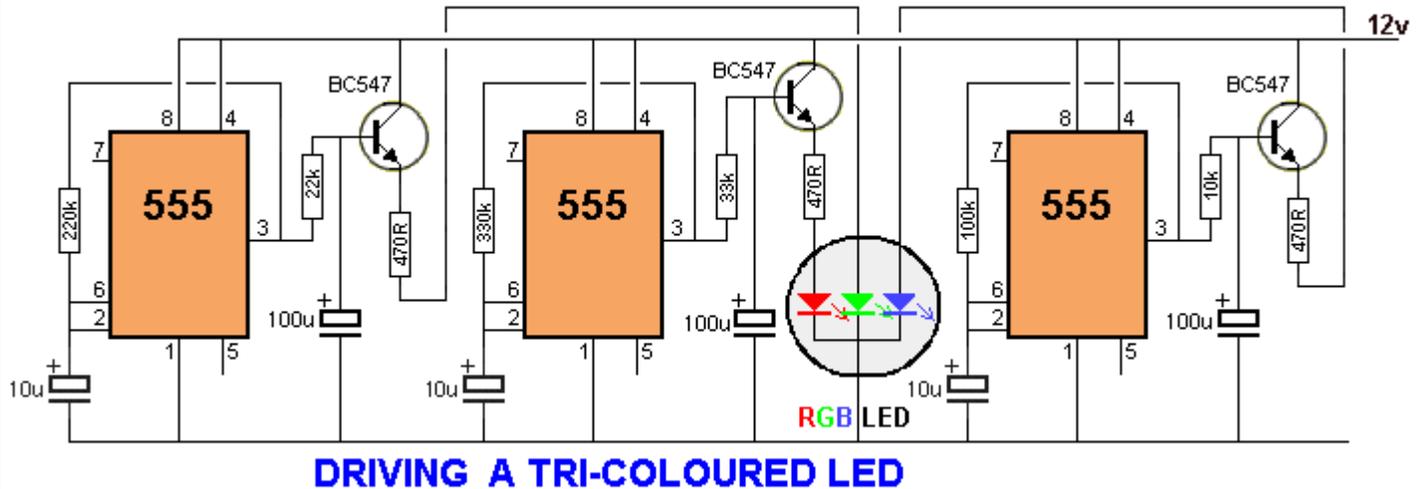
There are many different flickering and flashing LEDs on the market via eBay.
They contain a microscopic microcontroller chip and current limiting resistor. Many of them work on a voltage from 3v to 6v and you can hear the oscillator turning ON and OFF to produce the different effects by building the following circuit:

4.5v to 6v

470R
Piezo
diaphragm
RGB
Flashing
LED
BC547
2N2222
470R
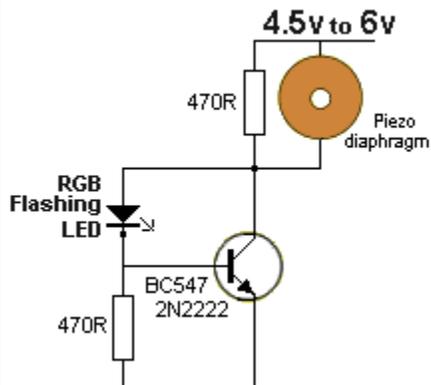
This means you have a choice. You can buy a 4-leaded RGB LED and activate the individual colours or buy a 2-leaded RGB LED and let the microcomputer inside the LED do all the flickering.

The circuit above will let you hear all the "ramping and oscillating" needed to produce the effects.

ZENER DIODE TESTER

This circuit will test zener diodes up to 56v. See Talking Electronics website, left index, 200 Transistor Circuits (circuits 1-100) and go to Zener Diode (making) to see how to make a zener diode and how to create a zener voltage from a combination of zeners.
Place the zener across the terminals in the circuit below and read the value across it with a multimeter set to 50v range.

ZENER DIODE TESTER
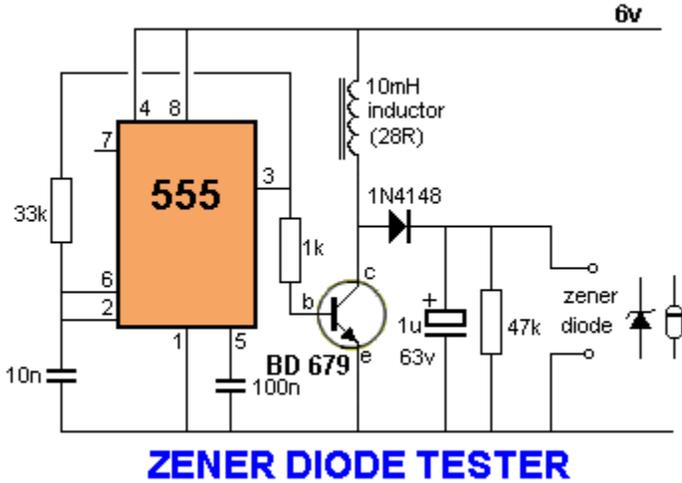
WAILING SIREN

By pressing the button, the wailing sound increases.
Releasing the button decreases the wailing.
The circuit automatically turns off after about 30 seconds.

WAILING SIREN
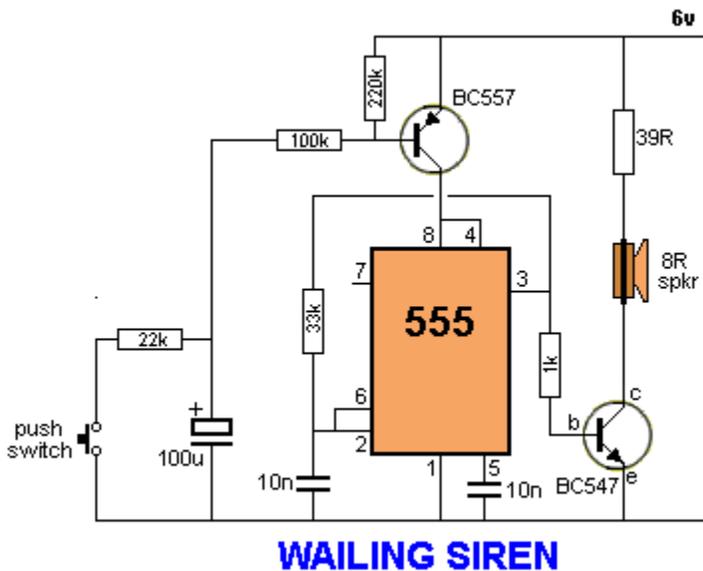
CONTINUITY TESTER

This circuit will detect low resistances and high resistances to produce a tone from the speaker.
It will detect up to 200k and the circuit automatically turns off when the probes are not used.

6v

BC557

10k

39R

8 4

7

33k

3

555

8R spkr

probes

6

1k

10n

2

1

5

c

b

e

10n BC547

CONTINUITY TESTER

MORSE KEYER

This circuit will help you master the art of keying Morse Code:

6v

key

3k3

8 4

7

3

555

15k

+

10u

6

8R spkr

2

1 5

47n

MORSE KEYER

Morse Code:

A .—   E .   I ..   M ——   Q ——.—   U ..—   Y —.——
B —...   F ..—.   J .———   N —.   R .—.   V ...—   Z ——..
C —.—.   G ——.   K —.—   O ———   S ...   W .——
D —..   H ....   L .—..   P .——.   T —   X —..—

International Phonetic Alphabet:

Alva	Echo	India	Mike	Quebec	Uniform	Yankee
Bravo	Foxtrot	Juliet	November	Romeo	Victor	Zulu
Charley	Golf	Kilo	Oscar	Sierra	Wiskey	
Delta	Hotel	Lima	Papa	Tango	Xray	

ACTIVE LOW TRIGGER

This circuit sits LOW and the output goes HIGH when the push-button is pressed. When the normally-closed push button is pressed, it opens and the uncharged 1u will be pulled to nearly 0v rail via the 10k and this will take pin 2 LOW to make output pin 3 HIGH for the duration determined by the 22u and 100k. If the push-switch stays open, the 1u will charge via the 100k and eventually the output of the 555 will go low.
But normally the switch must be pressed for a short period of time so that the timing components (100k and 22u) make the output go HIGH for a short period of time. This circuit is called an ACTIVE LOW TRIGGER
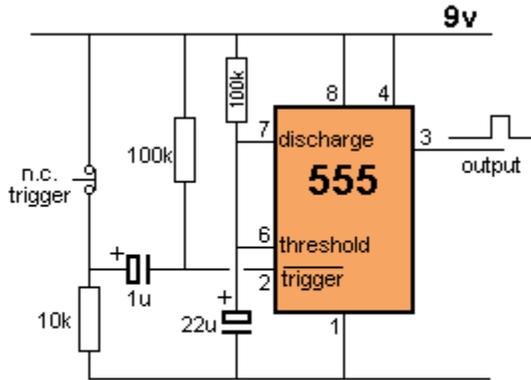
NORMALLY CLOSED TRIGGER
(also called ACTIVE LOW TRIGGER)

ACTIVE HIGH TRIGGER

This circuit produces a HIGH output via a HIGH trigger:
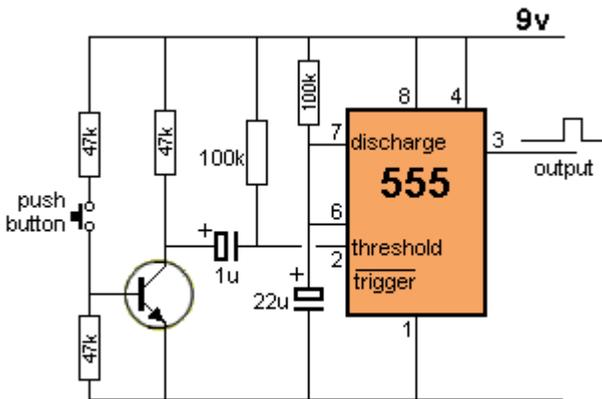
ACTIVE HIGH TRIGGER

MACHINE GUN

This circuit produces a sound very similar to a machine gun:
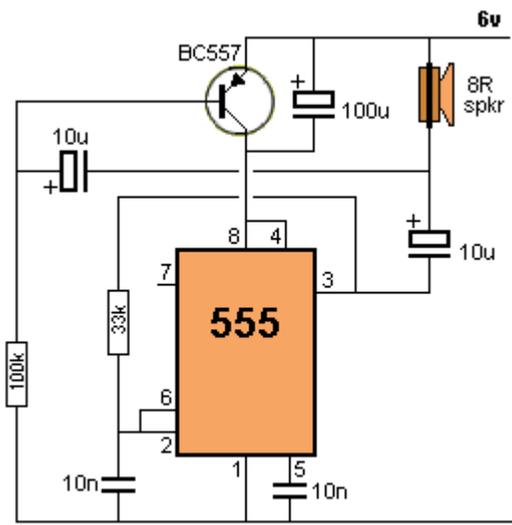
MACHINE GUN

LATCH

This circuit is a LATCH and remains ACTIVE when the push-button has been pressed for an INSTANT and released.
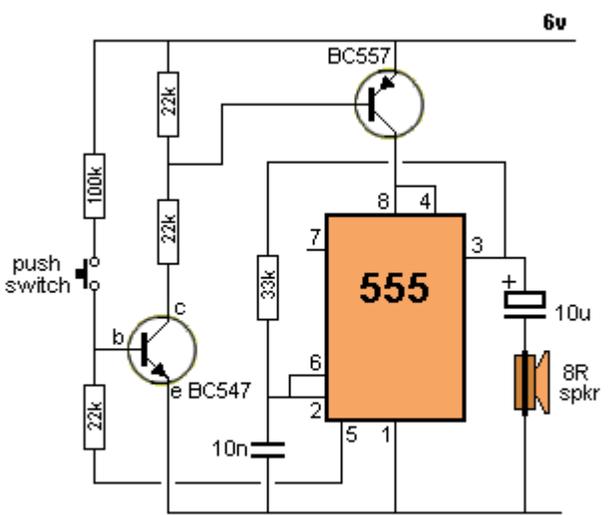
LATCH

TOGGLE 555

This circuit will toggle the output each time the switch is pressed. The action cannot be repeated until the 10u charges or discharges via the 100k.
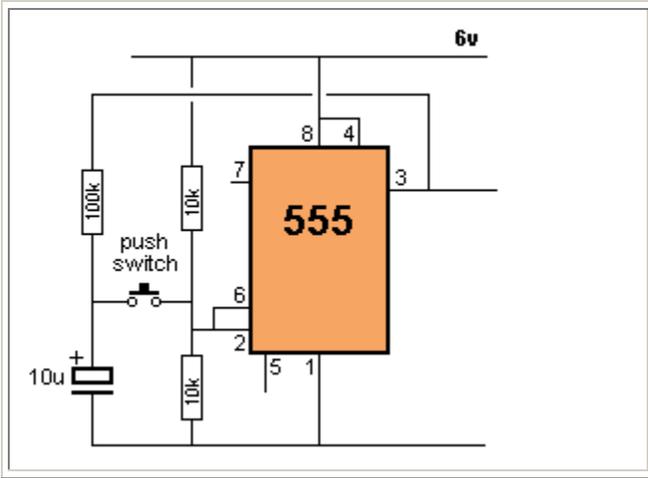
TOGGLE 555

Here is a circuit that toggles a 555.
The 555 has two op-amps and one input of each op-amp is connected to pin 2 and pin 6. The other input of each op-amp has a set of 5k resistors and these are internal and cannot be changed.
So, the end result is 2 inputs and these are high impedance inputs - meaning they will respond to a change in voltage from a very weak source. A very weal source is a voltage that has very little current-capability. And this means the input will respond to a voltage via a resistor of 100k or more because the input will not attenuate or lessen the value of voltage because it is very easily taken higher or lower.
Toggling a 555 is all to do with setting the voltage on the input(s) of the op-amps and working out how to create the correct voltage on each of the inputs so that one input takes the 555 LOW to turn it ON and the other input rises HIGH enough to turn it OFF.
When you reduce the voltage on pin 2 to less than 30% of rail voltage, the 555 is turned ON and the output goes LOW. When you take pin 6 higher than 70% of rail voltage, the 555 is turned OFF and the output goes HIGH. But you must increase the voltage on pin2 to a value above 30% of rail voltage so that pin 2 stops controlling the chip.
The easiest way to do this is to connect pin 2 and 6 together. That's what we have done.
The input(s) - pins 2 and 6 are classified as HIGH IMPEDANCE and the input lines must also be high impedance so that one input does not interfere with the other input.
All this is very difficult to achieve and that's why we need this discussion.

The most difficult component to understand in this circuit is the function of the 1u electrolytic. Because the input to the third 555 is high impedance, the value of the 1u can be very small as we are only requiring it to deliver a very short-duration pulse of more than 4v on the input. The 555 only needs 4v on the inputs to turn the chip off.
Secondly, the circuit will not change states until the 1u is charged because it is pulling the input "UP" with a large force while it is charging. We say it is a "strong force" because the 1u is connected to the output of the second 555 and then a diode. When the 1u is charging, this path has a low impedance. But when it is fully charged the path becomes high impedance and it has very little effect on holding the input rigid.
When the first 555 is turned ON, the output goes LOW and the 100k pulls the inputs of the third 555 low and because the first 555 is active for a period of time, the action of the 100k charges the 1u slightly and allows the input of the third 555 to go below 30% and turn it ON to illuminate the green LED.
The voltage on the input is quite complex but when the first 555 goes LOW, the output is 0.5v above the 0v rail and the inputs of the third 555 are initially at 3v and drop to 1.5v due to the current taken by the motor and the effect of the 100k going LOW.
This turns the third 555 ON and illuminates the green LED.
When the first 555 turns OFF, the output goes HIGH and this puts a higher voltage in the inputs of the third 555 (3v) but it is not enough to turn it off.
The third 555 is turned OFF by the second 555.
When pin 3 of the second 555 goes LOW it pushes the 1u towards the 0v rail and any voltage developed across the 1u is removed by the diode connected to the 0v rail and it is only left with about 1.5v.
When pin 3 of the second 555 goes HIGH it pulls the 1u up and puts about 4v on the input of

the third 555 to turn it OFF and illuminate the red LED. You cannot measure this voltage because it is of very short duration.

The 1u then starts to charge and after a very short time it has no effect on controlling the input of the third 555.

The other thing(s) that control the rate at which you can toggle the circuit is the discharging of the 22u electrolytics. They need to be discharged by the 50k pots so the 555's are ready to change state when a switch is pressed.

When all the circuit has been designed and is working correctly, you need to go though and check the need for each component. In this design I eliminated 3 components and changed the value of two.

The circuit even works down to 4.5v because the voltage on the inputs of the 555 are all a percentage of rail voltage.

POINT CONTROLLER-1
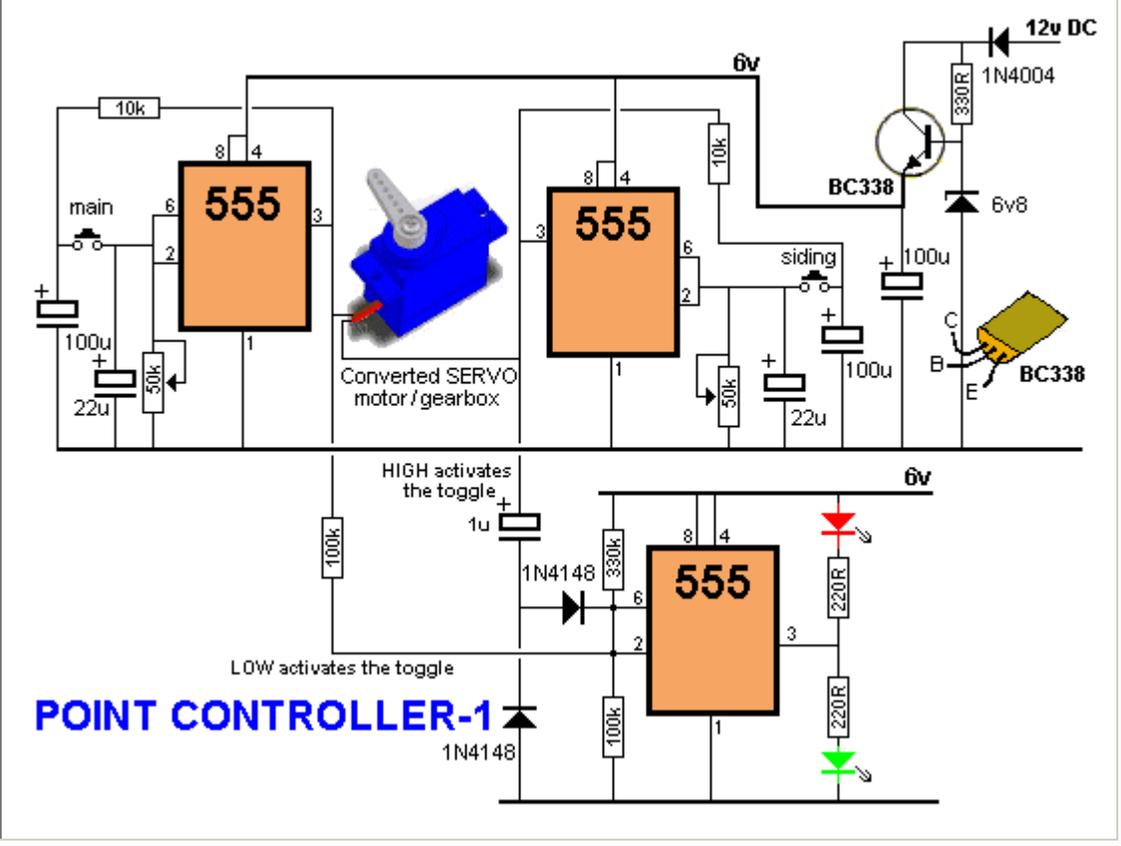
TAP ON TAP OFF

This circuit will toggle the output each time the piezo is tapped very hard. The action cannot be repeated until the 10u charges or discharges via the 100k (up to about 8 seconds).
The piezo must be good quality (available from Talking Electronics). Don't complain if your circuit does not work. The piezo must produce a high output.
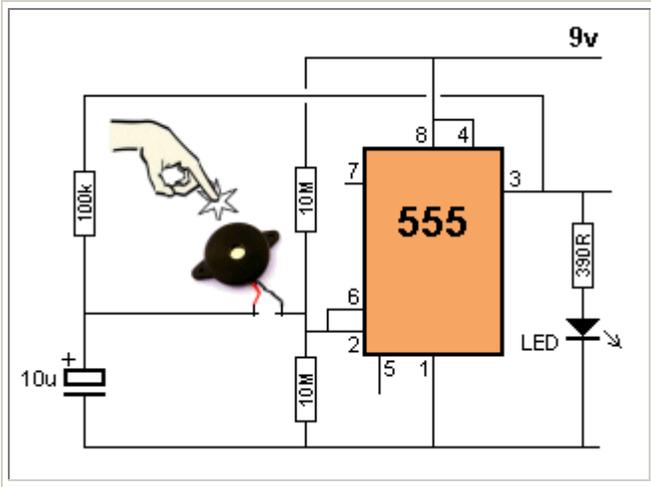
TAP ON TAP OFF-2

To increase the sensitivity of the piezo, a transistor can be added. It does not matter which way around the transistor is connected and the piezo can be connected to the collector and base. Try experimenting with the different arrangements and see if there is any improvement.
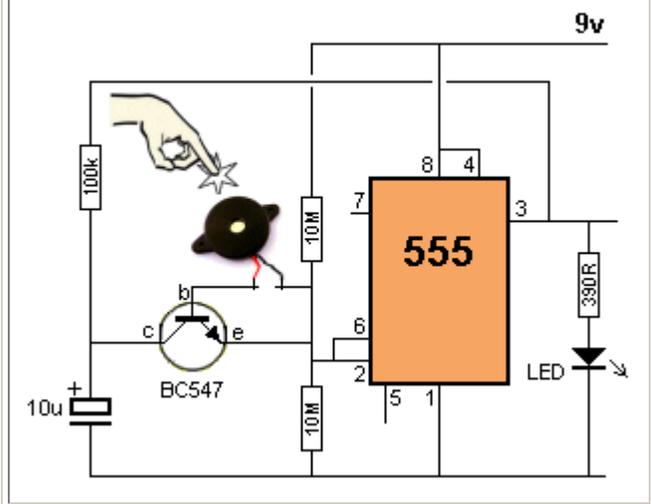
CLAP ON - OFF

At long-last we have a clap switch using a 555.
The output going HIGH and LOW provides two different voltages for the BC547 and also pins 2 and 6. The transistor simply provides a signal and this alters the voltage on pins 2 and 6.
Pin 3 will provide a lowish voltage on pin 2 and 6 and the transistor will simply lower this voltage to turn the 555 ON. When the 555 is ON, the voltage on pins 2 and 6 will be higher but not high enough to turn the 555 OFF. A clap will produce a waveform that increases the voltage on pins 2 and 6 and the 555 is turned OFF. The 100u slows down the change in voltage from the 555 so the clapping will be able to change the state of the chip. The circuit works on 6v to 9v.
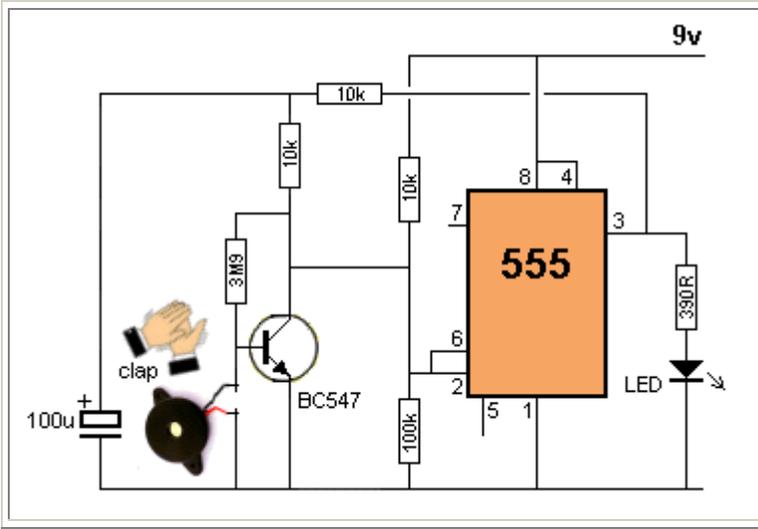
TOGGLE 555 - ON/OFF

This circuit will turn the output ON when a light shines on the LDR connected to pin 2 and OFF when a light shines on the LDR connected to pin 6.
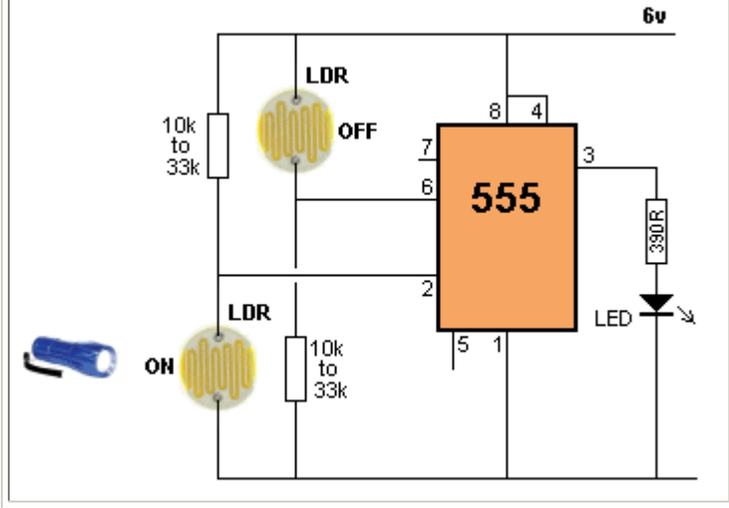
TOGGLE A RELAY

This circuit will toggle a relay each time the switch is pressed. The action cannot be repeated until the 10u charges or discharges via the 100k.

KNIGHT RIDER

In the **Knight Rider** circuit, the 555 is wired as an oscillator. It can be adjusted to give the desired speed for the display. The output of the 555 is directly connected to the input of a Johnson Counter (CD 4017). The input of the counter is called the CLOCK line.

The 10 outputs Q_0 to Q_9 become active, one at a time, on the rising edge of the waveform from the 555. Each output can deliver about 20mA but a LED should not be connected to the output without a current-limiting resistor (330R in the circuit above).

The first 6 outputs of the chip are connected directly to the 6 LEDs and these "move" across the display. The next 4 outputs move the effect in the opposite direction and the cycle repeats. The animation above shows how the effect appears on the display.

Using six 3mm LEDs, the display can be placed in the front of a model car to give a very realistic effect. The same outputs can be taken to driver transistors to produce a larger version of the display.

  The **Knight Rider** circuit is available as a kit for less than $15.00 plus postage as **Kitt Scanner**.

Here is a simple Knight Rider circuit using resistors to drive the LEDs. This circuit consumes 22mA while only delivering 7mA to each LED. The outputs are "fighting" each other via the 100R resistors (except outputs Q0 and Q5).

KNIGHT RIDER CIRCUIT-2

FLASHING INDICATORS

This is a request from Daniel, one of our subscribers.
He needed to flash "turn indicators" using a 555 and a single 20 amp relay. Here is our suggestion. The timing resistor needs to be selected for the appropriate flash-rate.
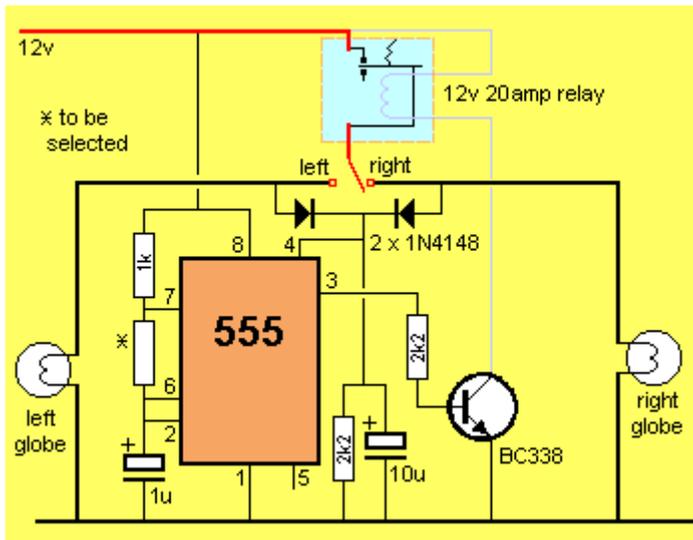
Flashing the "TURN INDICATORS"

TOUCH SWITCH and TOUCH ON-OFF

The **Touch Switch** circuit will detect stray voltages produced by mains voltages and electrostatic build-up in a room. In the first circuit, pin 2 must see a LOW for the circuit to activate. If sufficient static voltage is detected by the plate, the chip will change state. If not, you will need to touch the plate and the 0v rail. In the second circuit, two touch plates are provided and the resistance of your finger changes the voltage on pin 2 or 6 to toggle the 555.

TOUCH SWITCH

TOUCH ON-OFF
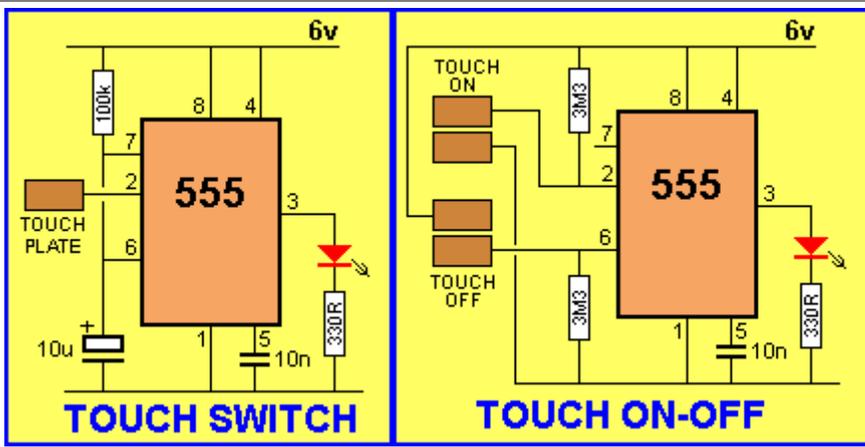
The circuit can be made 100 times more sensitive by adding a transistor to the front-end as shown in the diagram below:

SENSITIVE TOUCH SWITCH
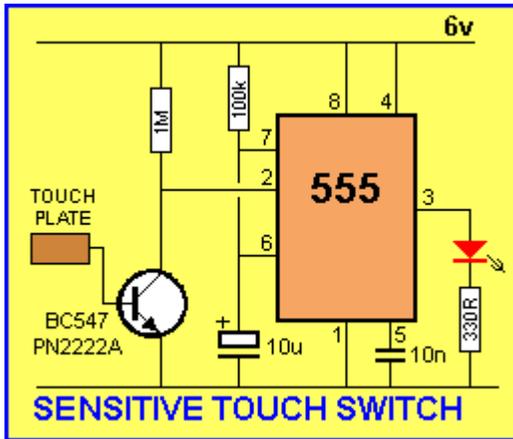
SIREN 100dB

This is a very loud siren and if two or more piezo's are located in a room, the burglar does not know where the sound is coming from.
A robber will not stay anywhere with an ear-piercing sound as he cannot hear if someone is approaching. It's the best deterrent you can get. The "F" contact on the piezo is "feedback" and is not needed in this circuit.
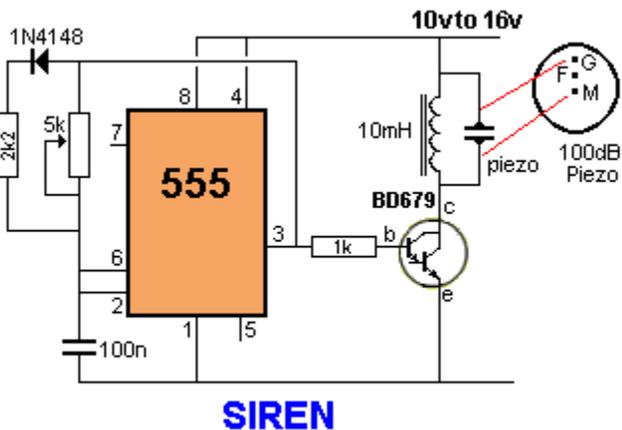
SIREN

POLICE SIREN

The **Police Siren** circuit uses two 555's to produce an up-down wailing sound. The first 555 is wired as a low-frequency oscillator to control the **VOLTAGE CONTROL** pin 5 of the second 555. The voltage shift on pin 5 causes the frequency of the second oscillator to rise and fall.
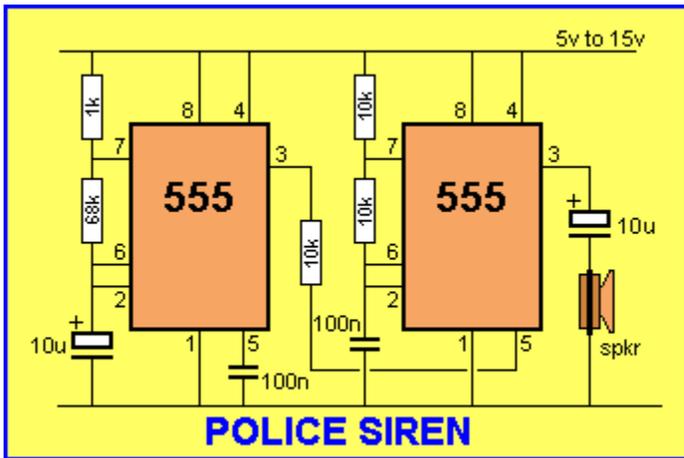
HEE HAW SIREN

Build the circuit and listen. Change the resistors and capacitors to get all sorts of different results.
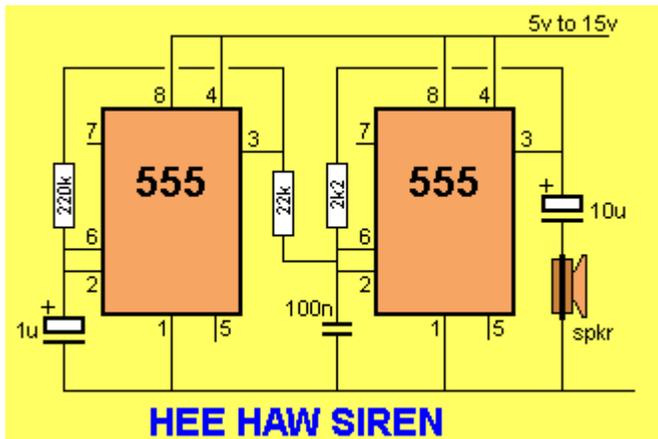
HEE HAW SIREN with one 555

The flashing LED is used to provide the timing and also to alter the 555 to produce two different tones.

555 PINOUT

GROUND	1	8	Vcc
TRIGGER	2	7	DISCHARGE
OUTPUT	3	6	THRESHOLD
RESET	4	5	CONTROL
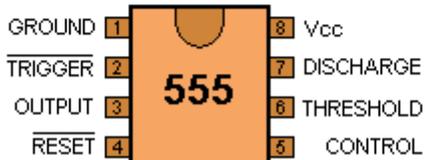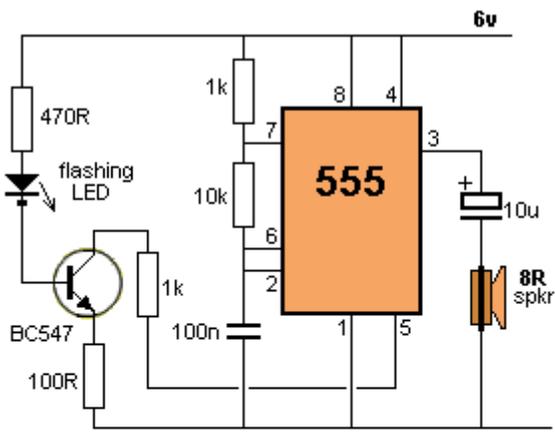
RAIN ALARM

This circuit consumes no current until moisture is detected on the rain plate.
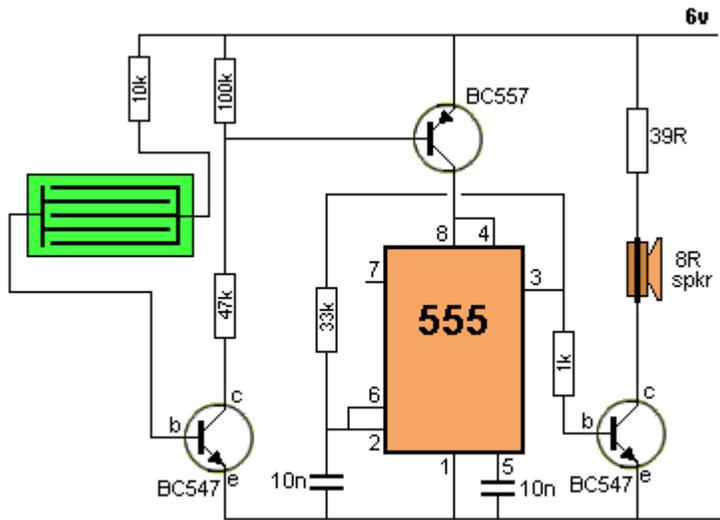
RAIN ALARM

PWM CONTROLLER

See also: **PWM**
This controller will deliver up to 30 amps and control the motor from 5% to 95%.

PWM CONTROLLER.
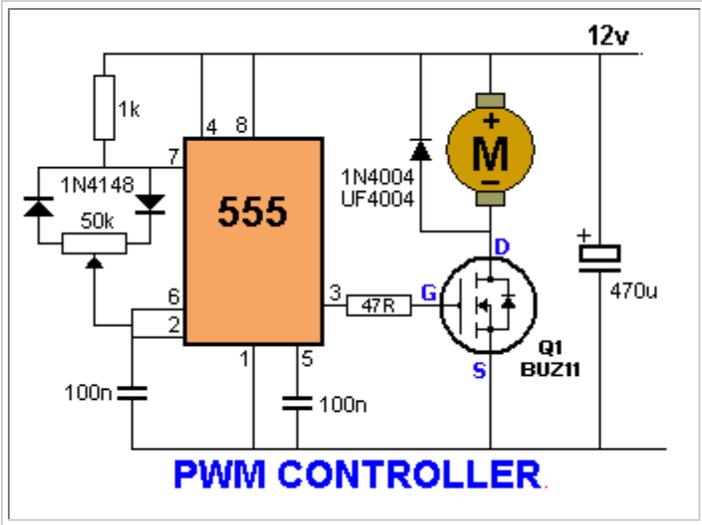
SOLAR TRACKER

For Solar Tracker circuits using the 555, go to Duane Johnson's website:
http://www.redrok.com/electron.htm
where he has developed a number of **Solar Trackers** on his enormous website. It will take you an hour to go through the whole site, so here is a starting point:
http://www.redrok.com/electron.htm#led555

HULDA CLARK ZAPPER

This is the circuit for Dr. Hulda Clark's Zapper, designed in 2003. The frequency is approximately 30kHz positive offset square wave. It has a red LED light that lights up when the unit is on. Perfect for regular zapping, extended zapping and other Hulda Clark related experiments.

This device is used to cure, treat and prevent any disease. It will cure anything. Simply hold the two probes (one in each hand) for 5-10 minutes then rest for 20 minutes, then repeat two more times. Do this each day and you will be cured. Here is the .pdf of her book: A Cure For All Diseases.   Website: http://clarktestimonials.com/ Hundreds of people have been cured of everything from herpes to AIDS.

On the other side of the coin is the claim that Dr Hulda Clark is a complete quack. Here is a website called: Quackwatch. The second diagram shows the two copper tubes and the circuit in a plastic box. I am still at a loss to see how any energy can transfer from this quack machine, through the skin (50k skin resistance and 9v supply) and zap a bug in your intestine. It's a bit like saying I will kill all the mice in a haystack by stabbing the stack with a needle.
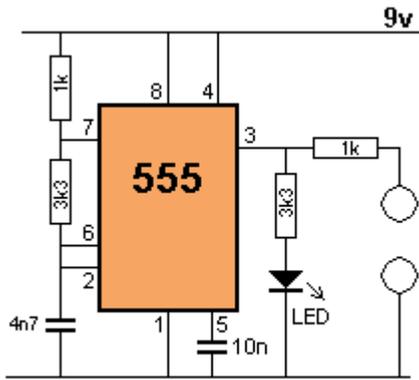
Dr CLARK'S ZAPPER
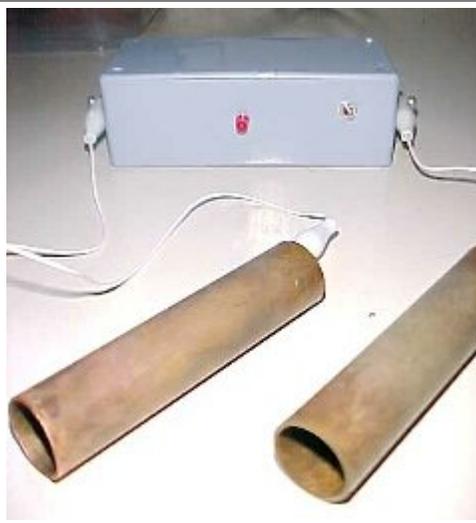
From: junaid.walker@gmail.comHulda
Hulda Clarke was persued by the FDA for false medical claims, and she escaped over the border into Mexico for a while. In her 70's she died of cancer, so obviously wasn't cured by her theories. In later life personal friends said she did admit that her frequencies 'didn't work', instead supporting that cures came about by "Blood electrolysis" (see https://www.electrobiotics.com/Blood-Electrification?chapter=10). They explain that this can be possible since this stimulates the immune system which in turn is capable of 'zapping bugs'.

TILT SWITCH

The output is LOW at start-up due to the capacitor on pin 4. When the mercury switch closes, the output goes HIGH and remains HIGH until the reset button is pressed. This circuit is called a LATCH. See Latch circuit and Memory Cell above.
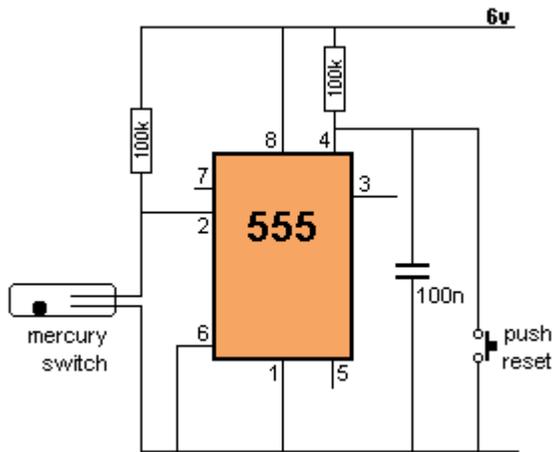
TILT SWITCH

MOSQUITO REPELLER

This circuit produces a tone above the human audible range and this is supposed to keep the mosquitoes away. You need a piezo diaphragm that will respond to 15kHz and these are very difficult to find.
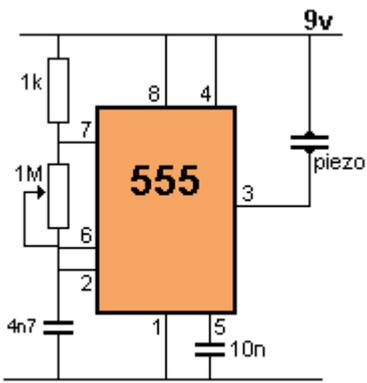
MOSQUITO REPELLENT

DRIVING A RELAY

The 555 will activate a relay. When pins 2 and 6 are connected as an input, the chip requires only about 1uA to activate the output. This is equivalent to a gain of about 200,000,000 (200 million) and represents about 4 stages of amplification via transistors.

In the first circuit, the output will be opposite to the input. The relay can be connected "high" or "low" as show in the second diagram. One point to note: The input must be higher than 2/3V for the output to be low and below 1/3V for the output to be high. This is called HYSTERESIS and prevents any noise on the input creating "relay chatter."

THE DIODE

The diode across the relay is very important. It prevents spikes entering the 555 via pin3 but it also has an effect on the way the chip works.

In an experiment that activated the relay at 5Hz, the frequency changed to 2Hz when the diode was added. Somehow the noise entering the chip had an effect on the frequency.

The diode also improved the output waveform, as you would expect.
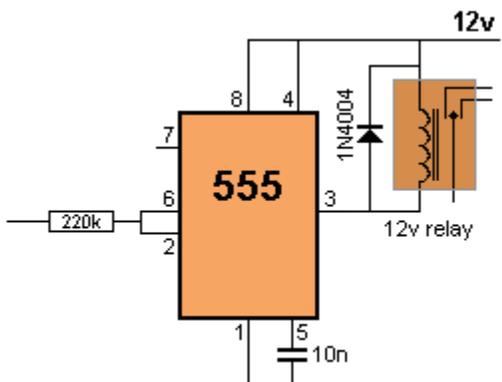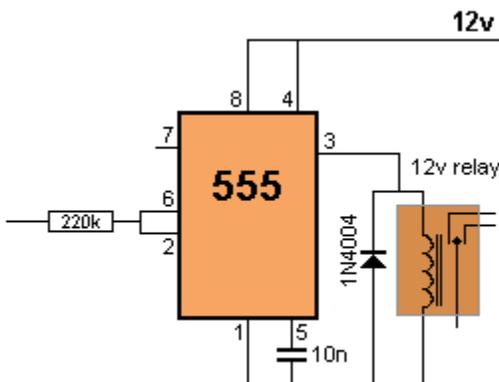
DRIVING A RELAY   **DRIVING A RELAY**

NEGATIVE LOGIC

An interesting point to remember.

In the first diagram above, the relay is connected so that it is active when the output is low. This is called NEGATIVE or NEGATIVE LOGIC. It has the same reasoning as **-5 - (-5) = 0.**

Or in English: "I am not NOT going."

When the input is low in the first diagram, the output is HIGH and the relay is OFF. The circuitry creates two reversals and makes it easy to see that when the input is LOW, the relay is OFF.

SCHMITT TRIGGER (Hysteresis)

also called AN INVERTER
also called A SCHMITT INVERTER

This circuit is the same as **Driving A Relay** circuit above. It is the same circuit with a different name.

We have also animated the circuit to show how the output goes high or low according to the input level. The animation shows a wide gap between the input levels when the time when the output goes HIGH or LOW and this gap is called the HYSTERESIS GAP.

This circuit is called a SCHMITT TRIGGER and it is used in many building-blocks (using a different chip - such as 74c14) to prevent false triggering.

It prevents false triggering because as the input rises, the output does not change until the input voltage is fairly high. If the input voltage falls, the output does not change until the input falls about 30%. This means small fluctuations (noise) on the input do not have any effect on the output. The output is the INVERSE of the input - in other words the 555 is a SCHMITT INVERTER. The second diagram shows a Schmitt Trigger building block.

DRIVING A RELAY
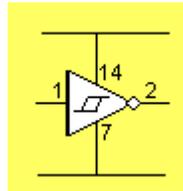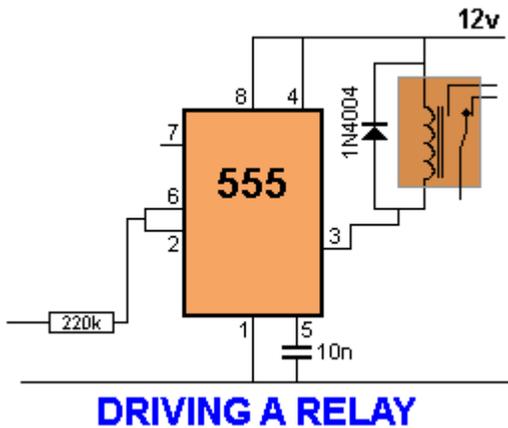
SCHMITT TRIGGER BUILDING BLOCK

THE 555 AS A SCHMITT TRIGGER

Here is another way to "see" a 555.

The 555 is drawn as a SCHMITT TRIGGER.

The 555 is actually a SCHMITT TRIGGER when pin 2 and 6 are connected together and pin 3 is take to the join of these pins.
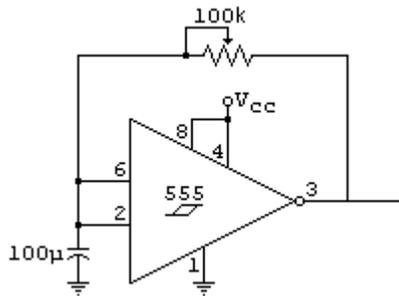
Pin 2 detects 33% of rail voltage on the electrolytic to turn the 555 ON and pin 6 detects 66% of rail voltage on the 100u to turn the 555 OFF.

The IC can also drive a LOAD with about 200mA and it can either source or sink the 200mA, so the chip is quite versatile.

MUSIC BOX

This circuit produces 10 different tones and by selecting suitable values to change the voltage on pin 5, the result can be quite pleasing. Note: the two unused outputs of the 4017 produce a tone equal to that produced by the 555 when pin 5 has no external

control voltage.

MUSIC BOX
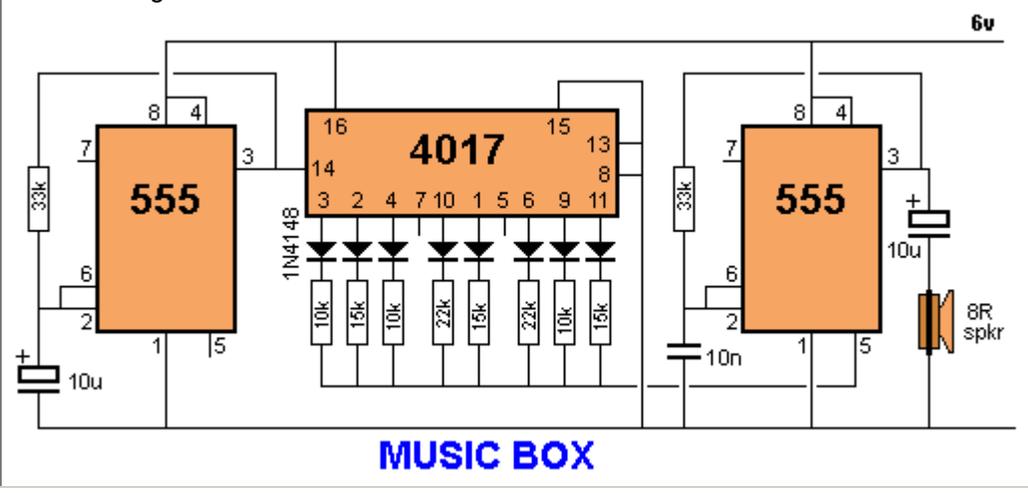
REACTION TIMER GAME

This is a game for two players.
Player 1 presses the **START** button. This resets the 4026 counter chip and starts the 555 oscillator.
The 555 produces 10 pulses per second and these are counted by the 4026 chip and displayed on the 7-Segment display.
The second player is required to press the **STOP** button. This freezes the display by activating the **Clock Inhibit** line of the 4026 (pin 2).
Two time-delay circuits are included. The first activates the 555 by charging a 10u electrolytic and at the same time delivering a (high) pulse to the 4026 chip to reset it. The second timer freezes the count on the display (by raising the voltage on pin 2) so it can be read.

REACTION TIMER
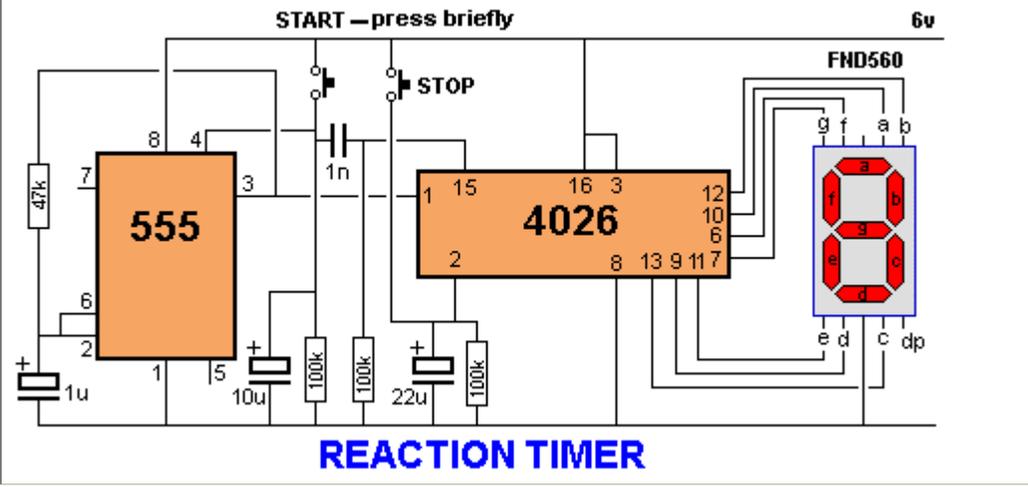
Prototype produced by Bruce Pierson
see: Bruce Pierson website for PCB layout

TRAFFIC LIGHTS

Here's a clever circuit using two 555's to produce a set of traffic lights for a model layout.

The animation shows the lighting sequence and this follows the Australian-standard. The red LED has an equal on-off period and when it is off, the first 555 delivers power to the second 555. This illuminates the Green LED and then the second 555 changes state to turn off the Green LED and turn on the Orange LED for a short period of time before the first 555 changes state to turn off the second 555 and turn on the red LED. A supply voltage of 9v to 12v is needed because the second 555 receives a supply of about 2v less than rail. This circuit also shows how to connect LEDs high and low to a 555 and also turn off the 555 by controlling the supply to pin 8. Connecting the LEDs high and low to pin 3 will not work and since pin 7 is in phase with pin 3, it can be used to advantage in this design.
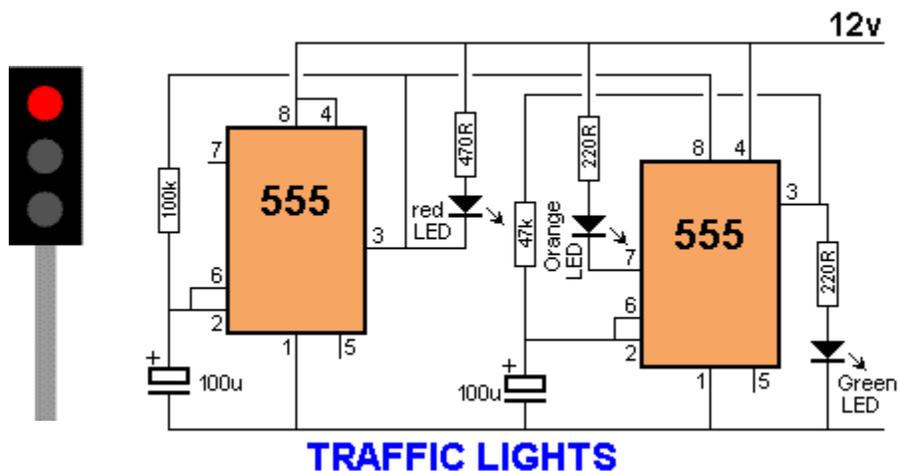
TRAFFIC LIGHTS

Here is a further description of how the circuit works:

Both 555's are wired as oscillators in astable mode and will oscillate ALL THE TIME when they are turned ON. But the second 555 is not turned on all the time!

The first 555 turns on and the 100u is not charged. This makes output pin 3 HIGH and the red LED is not illuminated. However the output feeds the second 555 and it turns on.

Output pin 3 of the second 555 turns on the green LED and the second 100u charges to 2/3 rail voltage and causes the 555 to change states. The green LED goes off and the orange LED turns on.

The second 100u starts to discharge, but the first 100u is charging via a 100k and after the orange LED has been on for a short period of time, the first 555 changes state and pin 3 goes LOW.

This turns on the red LED and turns off the second 555.
The first 100u starts to discharge via the 100k and eventually it changes state to start the cycle again.
The secret of the timing is the long cycle-time of the first 555 due to the 100k and the short cycle due to the 47k on the second 555.
One problem is the timing for the first time the circuit is turned ON is different to the continued operation, because the 100u's have to charge from 0v.
The sequence was not perfect with 100u + 100u so Paul Mathew changed the first 100u to 220u and the sequence was perfect.
You can change the 100k to 220k instead of changing the electrolytic.

4 WAY TRAFFIC LIGHTS

This circuit produces traffic lights for a "4-way" intersection. The seemingly complex wiring to illuminate the lights is shown to be very simple.
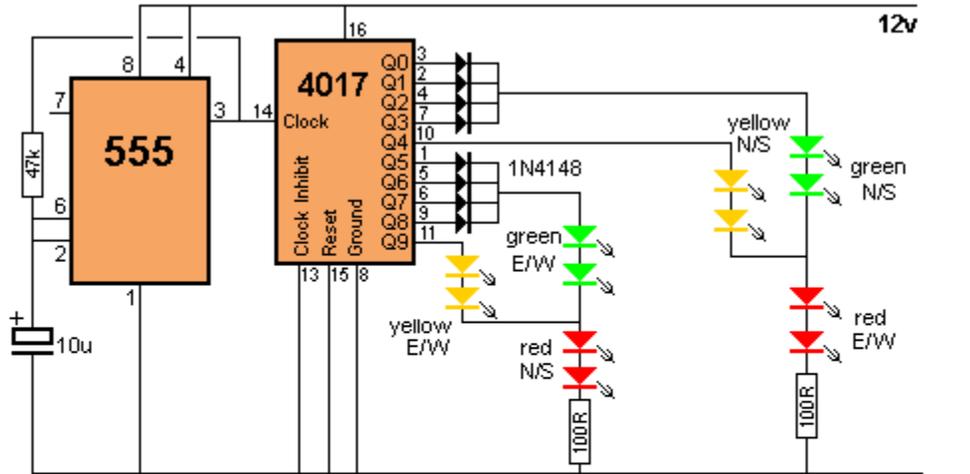
DRIVING MANY LEDS

The 555 is capable of sinking and sourcing up to 200mA, but it gets very hot when doing this on a 12v supply.
The following circuit shows the maximum number of white LEDs that can be realistically driven from a 555 and we have limited the total current to about 130mA as each LED is designed to pass about 17mA to 22mA maximum. A white LED drops a characteristic 3.2v to 3.6v and this means only 3 LEDs can be placed in series.
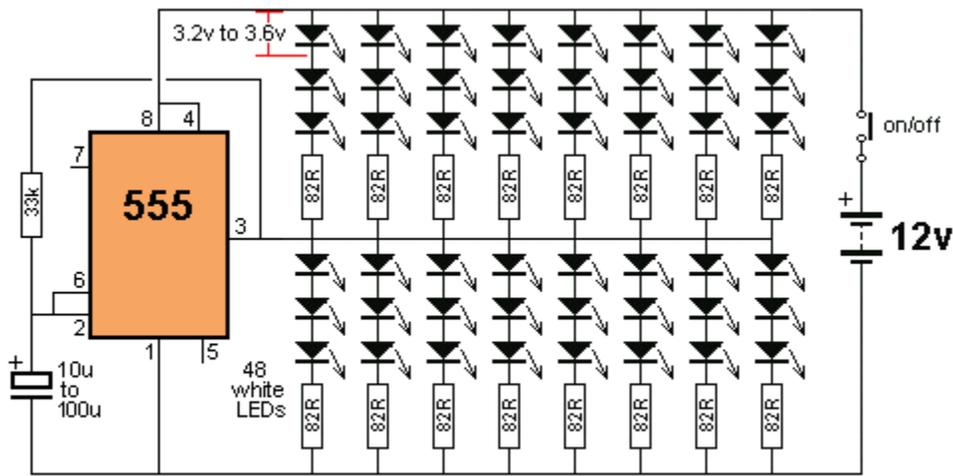
DRIVING WHITE LEDS (FLASHING)

TV REMOTE CONTROL JAMMER

This circuit confuses the infra-red receiver in a TV. It produces a constant signal that interferes with the signal from a remote control and prevents the TV detecting a channel-change or any other command. This allows you to watch your own program without anyone changing the channel !!   The circuit is adjusted to produce a 38kHz signal. The IR diode is called an Infra-red transmitting Diode or IR emitter diode to distinguish it from a receiving diode, called an IR receiver or IR receiving diode. (A **Photo diode** is a receiving diode). There are so many IR emitters that we cannot put a generic number on the circuit to represent the type of diode. Some types include: CY85G, LD271, CQY37N(45¢), INF3850, INF3880, INF3940 (30¢). The current through the IR LED is limited to 100mA by the inclusion of the two 1N4148 diodes, as these form a constant-current arrangement when combined with the transistor and 5R6 resistor.

Voltage typical: 1.4v
Current continuous: 100mA
Current Max: 1A
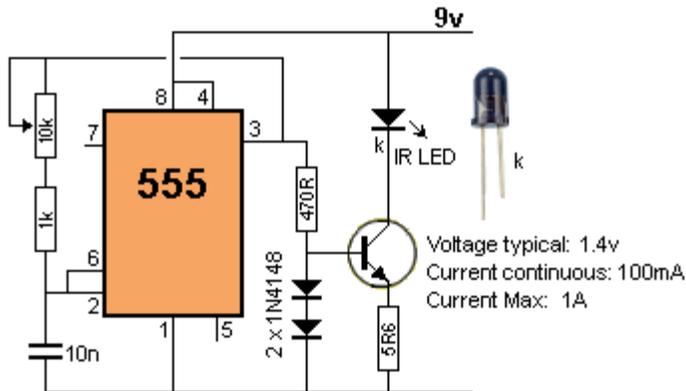
TV REMOTE JAMMER

3x3x3 CUBE

This circuit drives a 3x3x3 cube consisting of 27 white LEDs. The 4020 IC is a 14 stage binary counter and we have used 9 outputs. Each output drives 3 white LEDs in series and we have omitted a dropper resistor as the chip can only deliver a maximum of 15mA per output. The 4020 produces 512 different patterns before the sequence repeats and you have to build the project to see the effects it produces on the 3D cube.
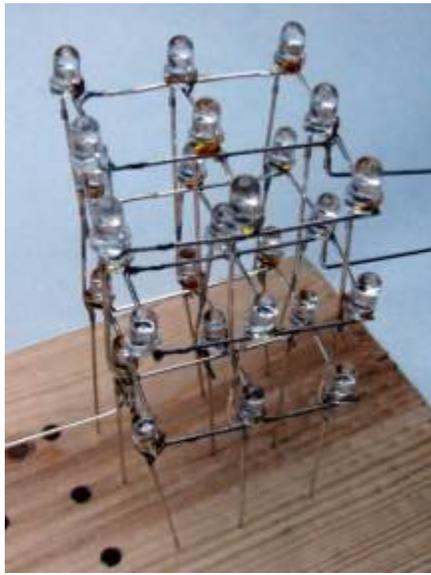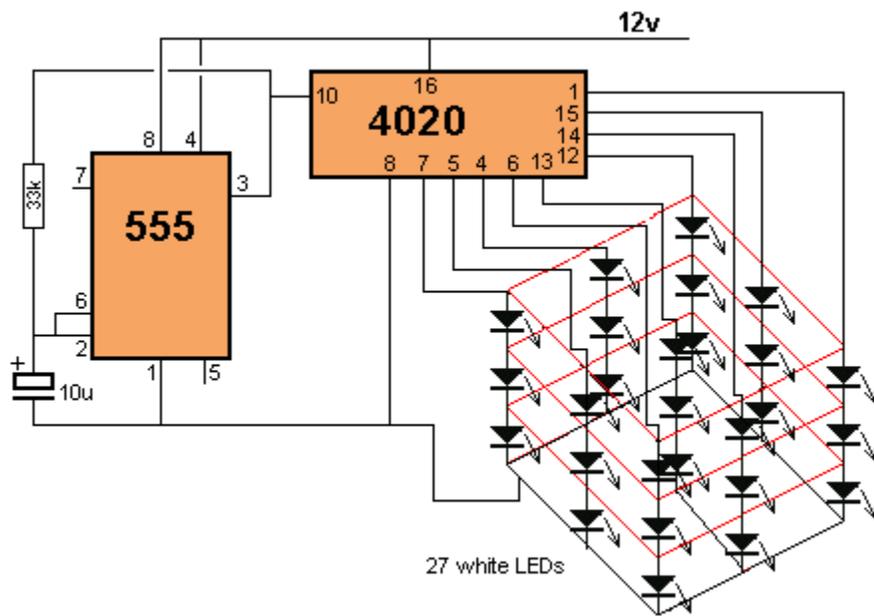
If you are having trouble understanding the circuit, here is a guide:
There are 9 strings of 3 LEDs.
Here is how to solder them together:
Connect 3 LEDs together and do this 9 times.
Now connect the cathode of the end of each string to all the other strings.
Now you have 9 strings of LEDs all connected together at the bottom.
Connect the top of each string to one of the pins: 7, 5, 4, 6, 13, 12, 14, 15, 1.
Now connect all the cathodes (they are already connected together) to pins 1 and 8 of the chips.
A 47R resistor can be connected to each of the outputs to limit the current if you are increasing the supply above 12v.

UP/DOWN FADING LED

These two circuits make a LED fade on and off. The first circuit charges a 100u and the transistor amplifies the current entering the 100u and delivers 100 times this value to the LED via the collector-emitter pins. The circuit needs 9v for operation since pin 2 of the 555 detects 2/3Vcc before changing the state of the output so we only have a maximum of 5.5v via a 220R resistor to illuminate the LED. The second circuit requires a very high value electrolytic to produce the same effect.
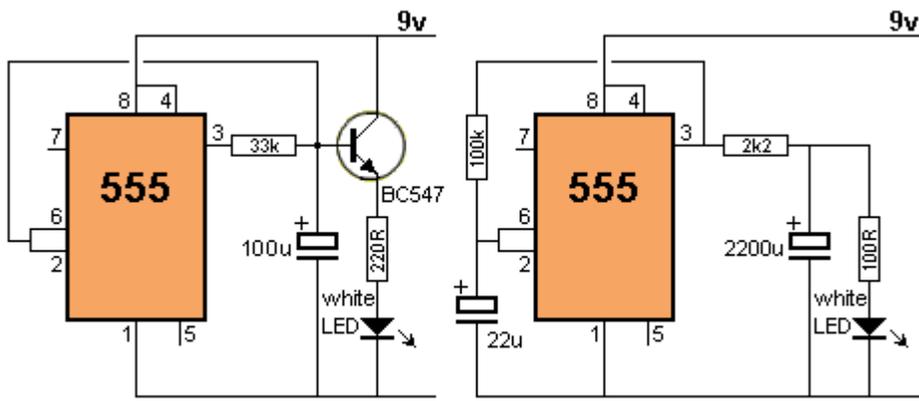
UP/ DOWN FADING LED

These circuits will really only support one LED. One constructor tried two LEDs and it did not work.
Here's the reason: The transistor amplifies the energy that the 100u is able to deliver on each cycle and this is only enough for one LED. Similarly, the 2,200u is only able to supply energy to one LED.
It works like this: The transistor detects the amount of current the LED wants at any part of the cycle (due to its illumination) and it takes about one-hundredth or one two-hundredth of this from the electrolytic. 99% of the current is delivered via the collector (via the supply rail). If two LEDs are connected, the electrolytic cannot supply the extra energy and the circuit may not work.
The energy in the 100u is supplied by the 33k and if you want it to deliver more energy, the 33k will have to be reduced.
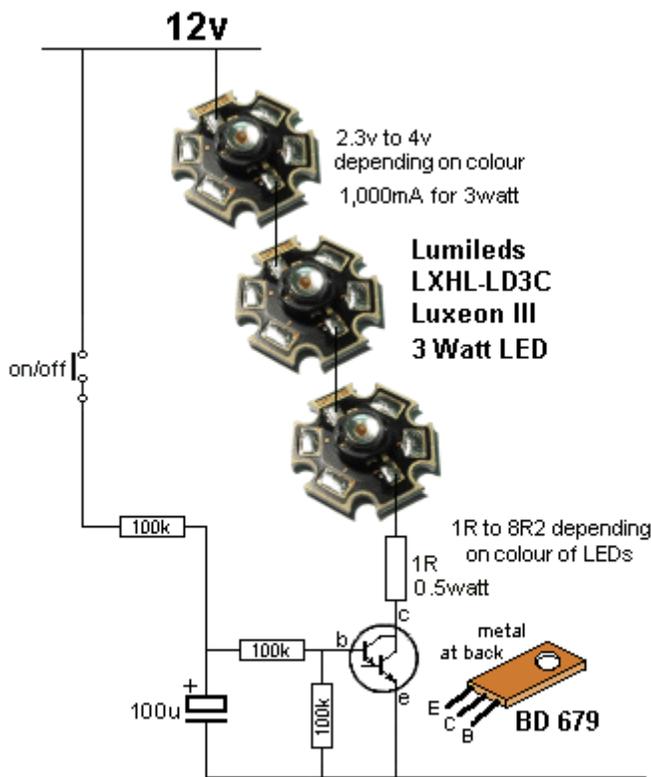
f you just want fade-ON and fade-OFF, this circuit is all you need:

FADE-ON FADE-OFF LED

You can also drive "rope lights."
These can be surface-mount LEDs or totally-sealed LEDs and generally have two wires connected to one end for the 12v supply.
Three LEDs are generally connected in series inside the "rope" with a dropper resistor and some "ropes" can be cut after each set of three LEDs as shown in the diagram below:
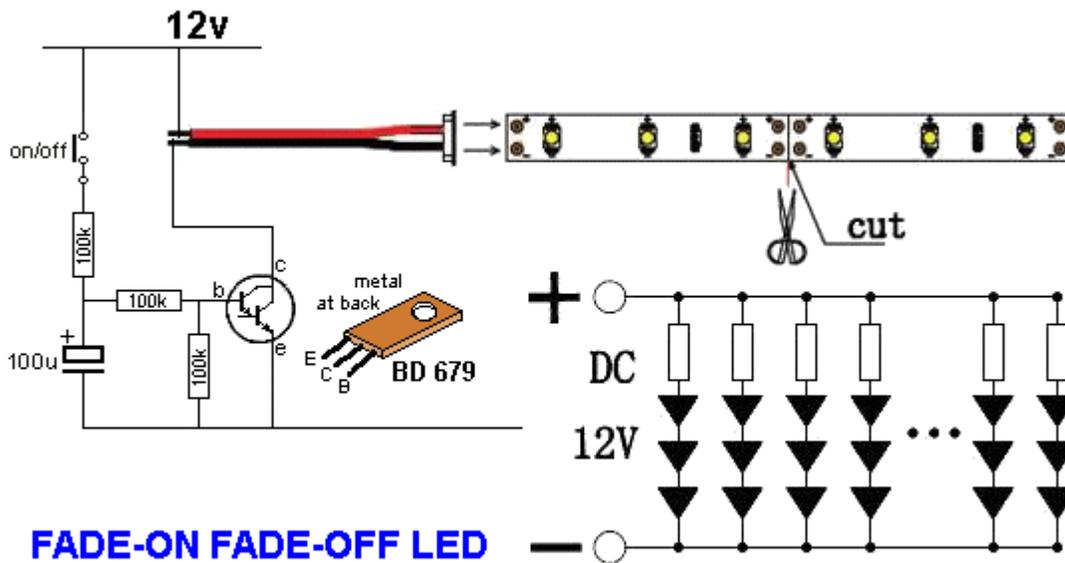
FADE-ON FADE-OFF LED

Each set of three LEDs draws about 20mA so a rope of 24 LEDs takes about 160mA. Adjust the first two 100k resistors and 100u to set the fade-IN and fade-OUT feature.

H-BRIDGE

This circuit drives a motor clockwise / anticlockwise via a 10k to 100k pot.
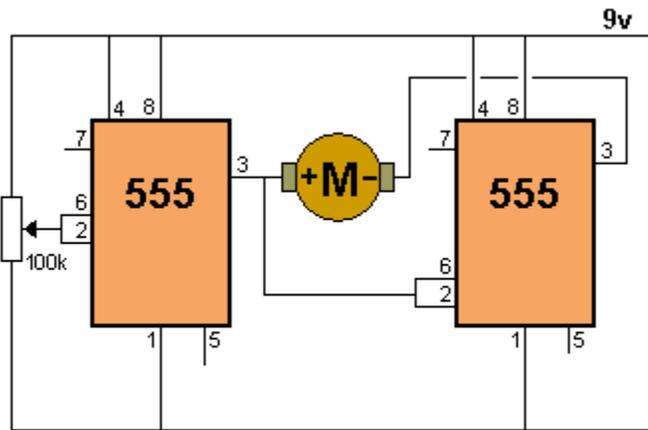
H-BRIDGE

H-BRIDGE WITH PWM

This circuit drives a motor clockwise / anticlockwise via a pot and reduces the speed to zero when the pot is in mid-position. The current is limited to 200mA and the voltage across the motor is less than 6v, but the circuit shows the principle of Pulse Width Modulation (providing powerful bursts of current to the motor to create a high or low RPM under load) and both forward / reverse RPM via the H-bridge arrangement.

H-BRIDGE WITH PWM
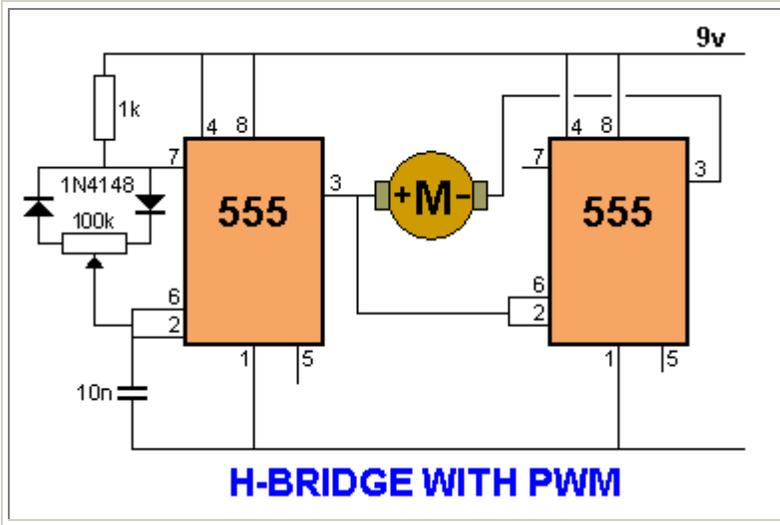
H-BRIDGE PUSH-PULL
DOG-BARK STOPPER

The two circuits above are also **H-Bridge Push-Pull** outputs, however the current is limited to 200mA or less. In this design the current can be 3 amps or more, depending on the supply voltage, the resistance of the load and the type of driver transistors. About 2v5 is lost between "c and e" due to the output of the 555 and the base-emitter voltage of the driver transistors. This circuit drives an ultrasonic transducer (speaker) at 20kHz to 40kHz to subdue dog barking.

If the unit is turned on by remote control every time the dog barks, the animal will soon learn to cease barking.

Look on eBay for Piezo Tweeter for about $3.00 plus $7.00 postage. The maximum frequency response will be about 30kHz.

H-BRIDGE PUSH-PULL
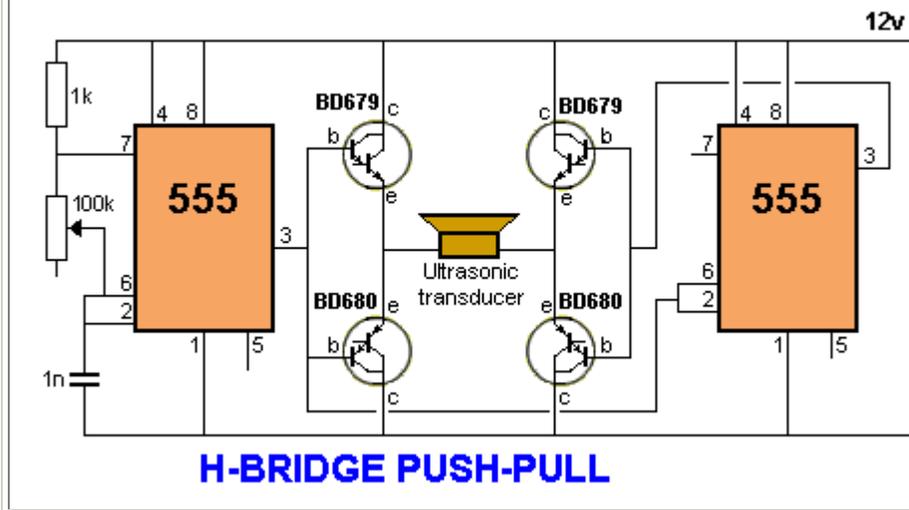
BIKE TURNING SIGNAL

This circuit can be used to indicate left and right turn on a motor-bike. Two identical circuits will be needed, one for left and one for right.

The following schematic shows a 555 timer circuit driving five LEDs through BC547 transistors, powered by a 12v supply. Components include 4k7 resistors, 100u capacitors, 1N4148 diodes, 10k resistors, 330R and 390R resistors for the LEDs.
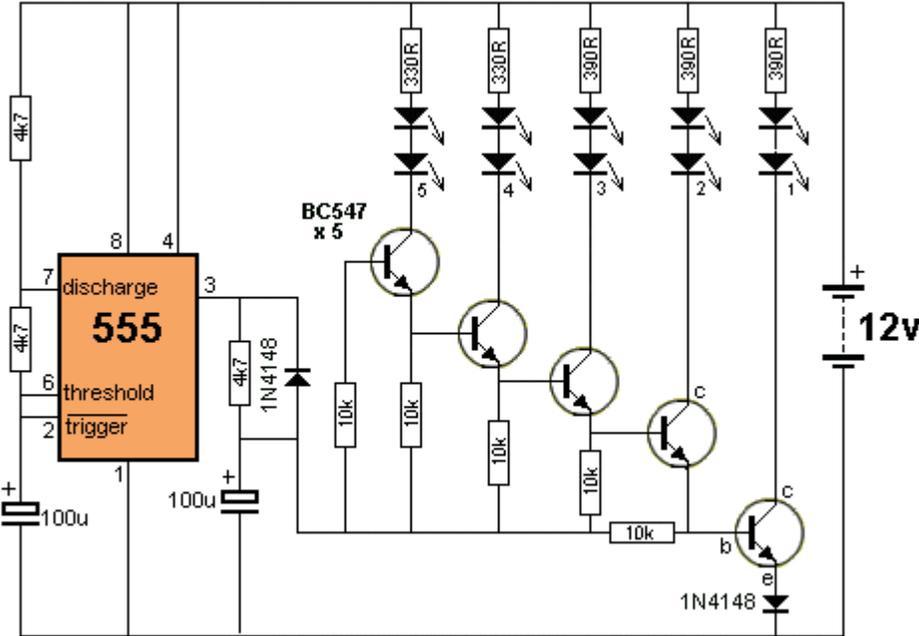
555 ON 24v

If you need to operate a 555 on 24v, you will need to reduce the voltage to less than 18v. The following circuits reduce the voltage to 12v:

30mA:

If the 555 circuit takes less than 30mA (the 555 takes 10mA) you can use a 400mW zener diode to drop the 24v supply to 12v for the 555. In other words, 12v is dropped across the zener.
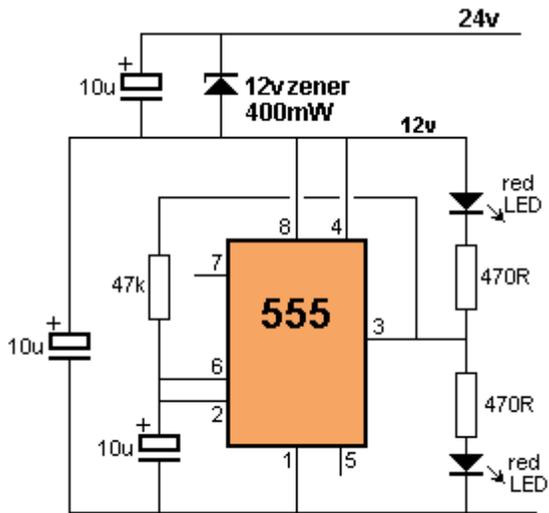
FLASHING LEDs

Up to 500mA:

The next circuit will allow up to 500mA. The transistor will need to be placed on a large heatsink. It is an emitter-follower-regulator transistor and can be used with a 400mW zener. The output voltage is 0.6v lower than the zener voltage.
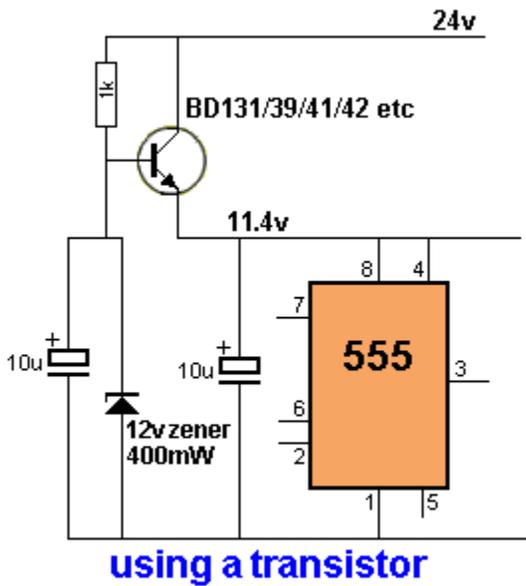
using a transistor

Up to 500mA with "Amplifier Zener"

A 400mW zener can be converted to a "Power Zener" by combining with a transistor as shown in the following circuit: 12.6v will be dropped across the rails. In other words, if the top rail is 24v, the bottom rail will be 11.4v.
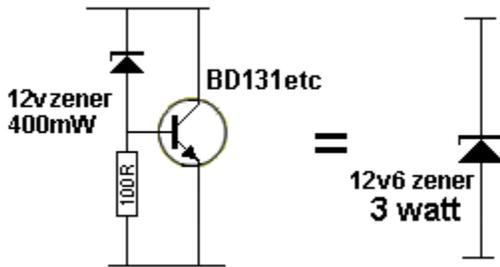
Up to 1A:

Using the next circuit will allow the 555 to take 200mA and the load to take 800mA. The 7812 will need to be placed on a large heatsink. The 7812 is called a 3-terminal VOLTAGE REGULATOR.

using a voltage regulator
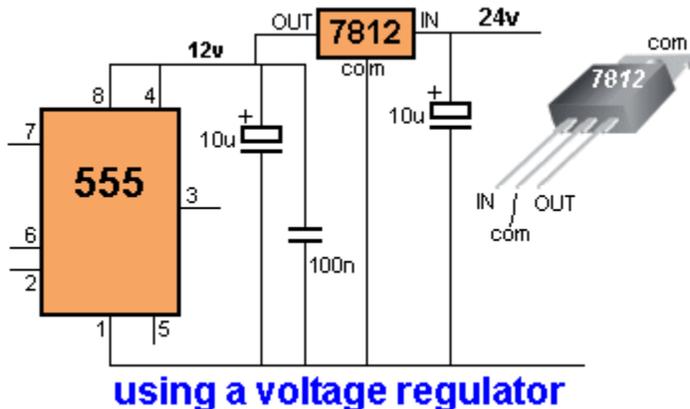
POLICE LIGHTS

These three circuits flash the left LEDs 3 times then the right LEDs 3 times, then repeats. The only difference is the choice of chips.
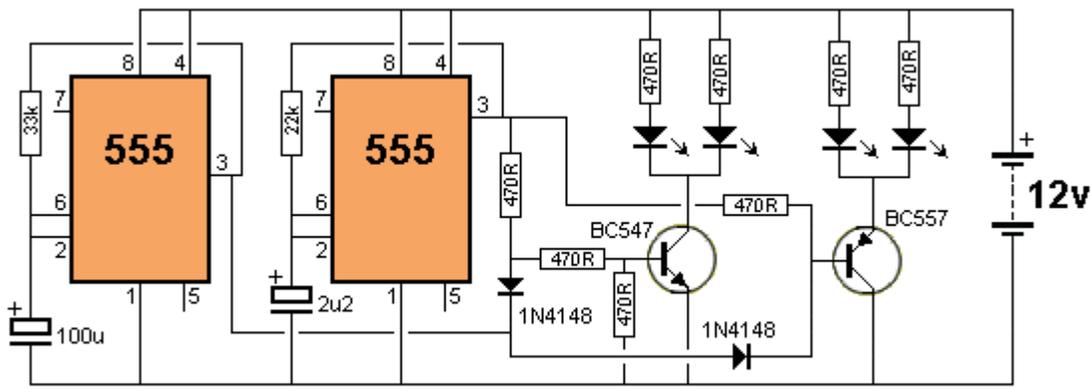
POLICE LIGHTS
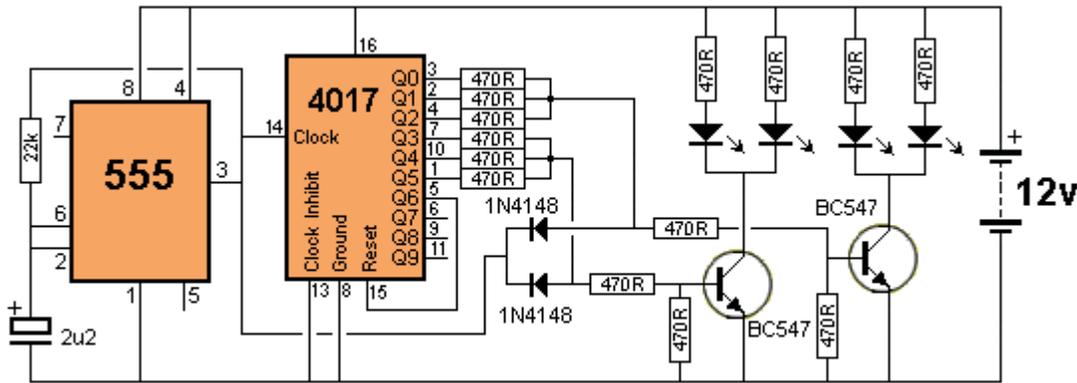
POLICE LIGHTS - 2
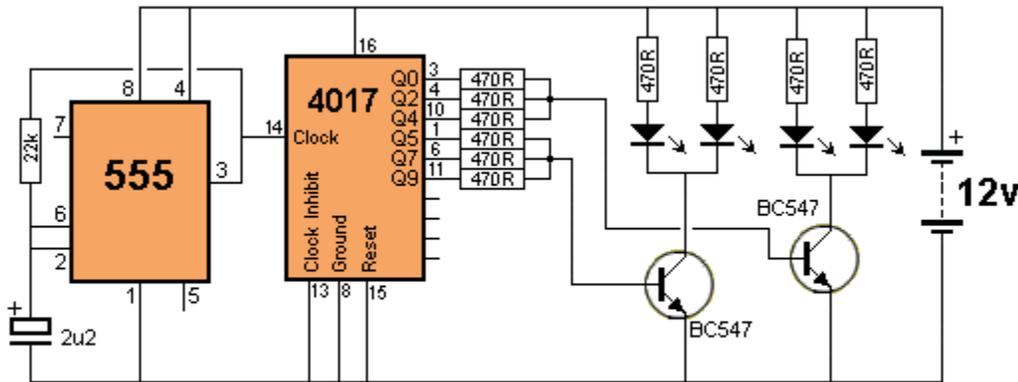
POLICE LIGHTS - 2a
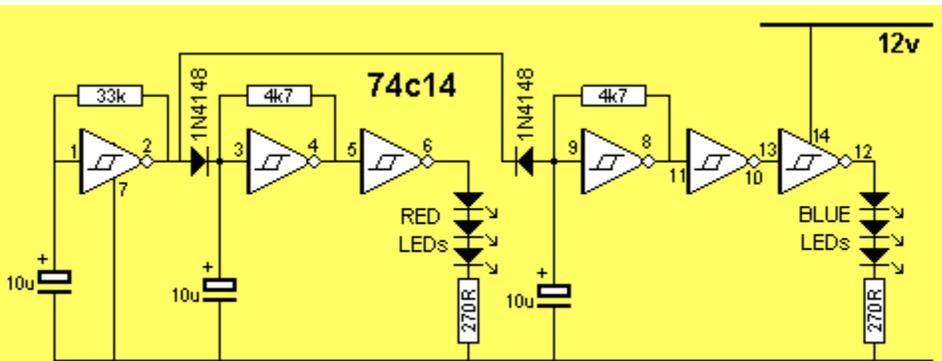
POLICE LIGHTS-3

LED DICE with Slow Down

This circuit produces a random number from 1 to 6 on LEDs that are similar to the pips on the side of a dice. When the two TOUCH WIRES are touched with a finger, the LEDs flash very quickly and when the finger is removed, they gradually slow down and come to a stop. **LED Dice with Slow Down kit** is

available from Talking Electronics.

LED DICE-3

This circuit creates a rotating LED that starts very fast when a finger touches the TOUCH WIRES. When the finger is removed, the rotation slows down and finally stops.
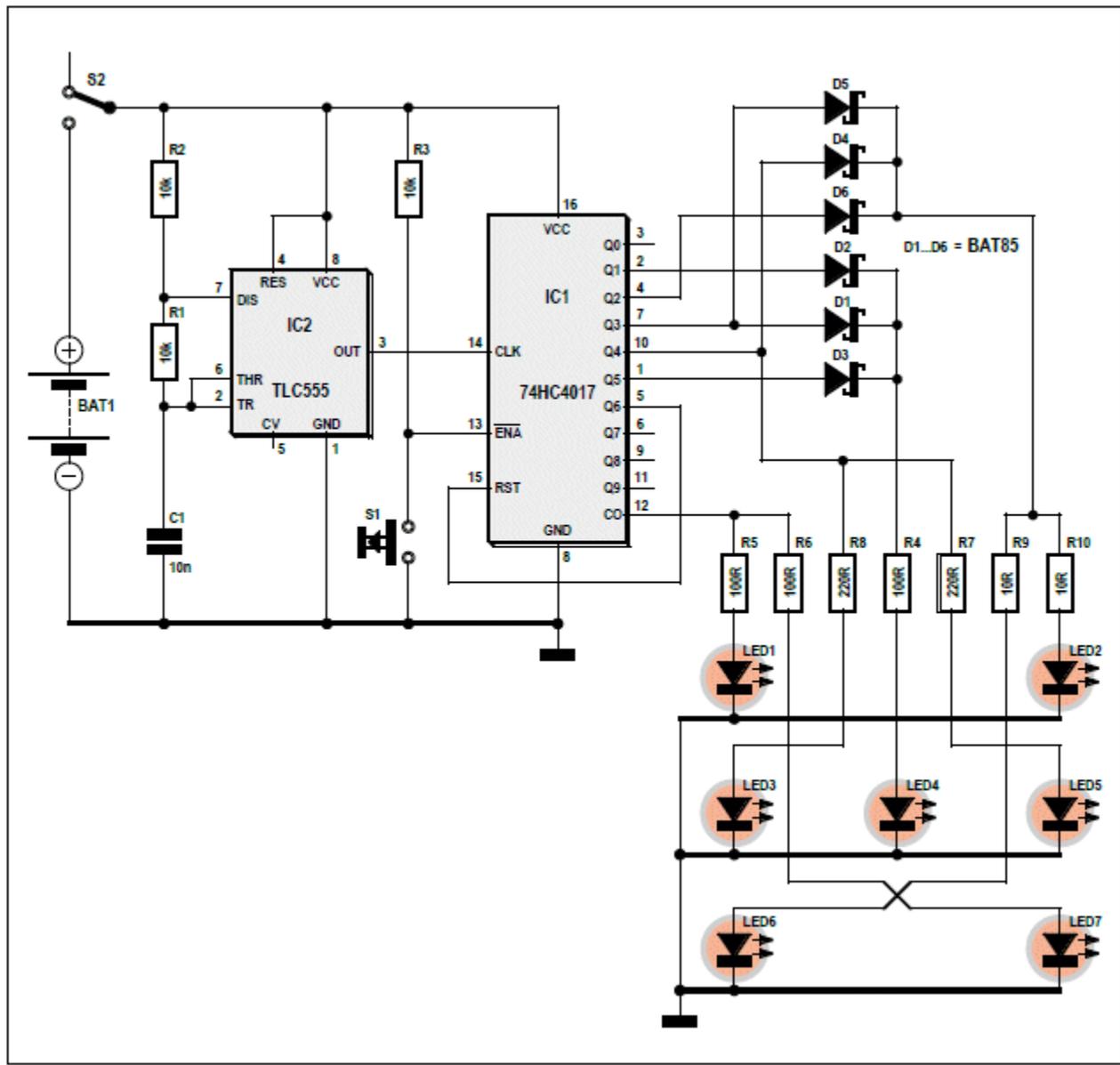
ROULETTE

This circuit creates a rotating LED that starts very fast when a finger touches the TOUCH WIRES. When the finger is removed, the rotation slows down and finally stops.
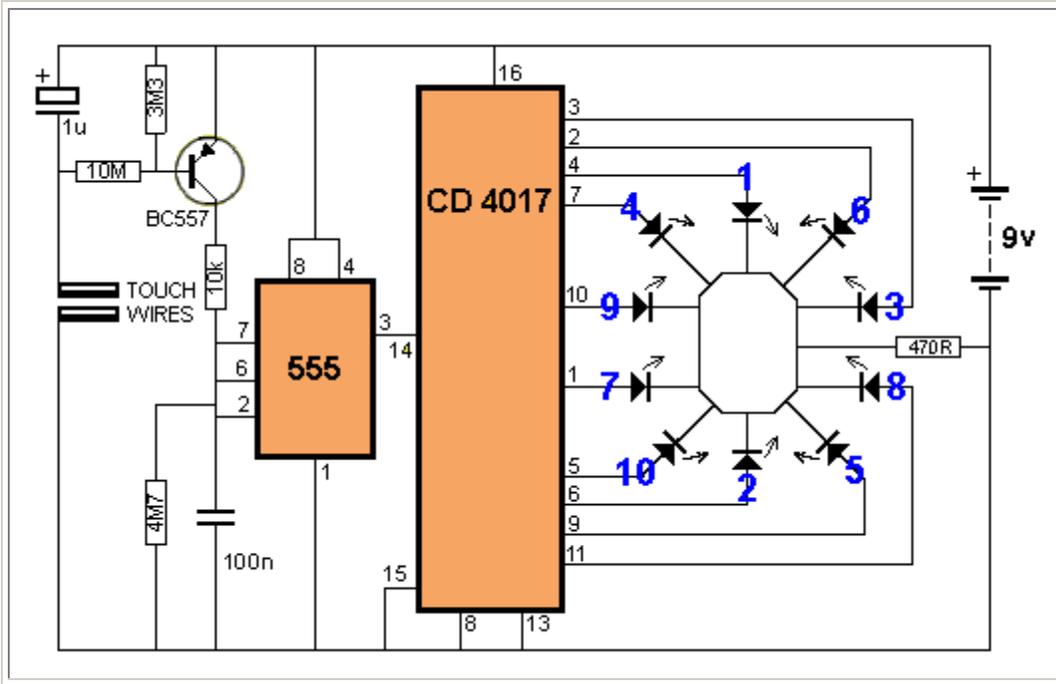
MODEL RAILWAY TIME

Here is a circuit that will convert any clock mechanism into Model Railway Time.
For those who enjoy model railways, the ultimate is to have a fast clock to match the scale of the layout. This circuit will appear to "make time fly" by turning the seconds hand once every 6 seconds. The timing can be adjusted by changing the 47k. The electronics in the clock is disconnected from the coil and the circuit drives the coil directly. The circuit takes a lot more current than the original clock (1,000 times more) but this is one way to do the job without a sophisticated chip.
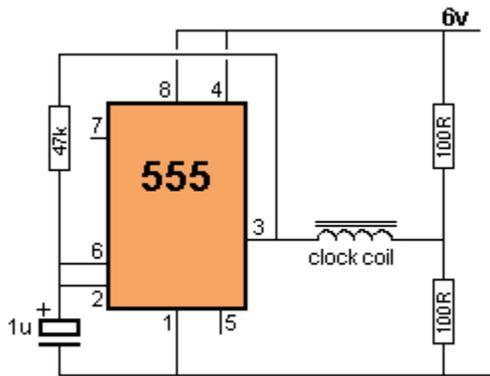
MODEL RAILWAY TIME
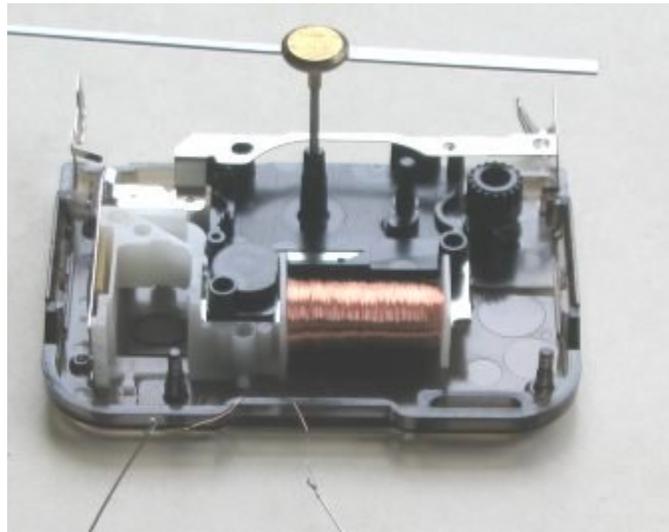
REVERSING A MOTOR-4 (see 1, 2, 3 in 200 Transistor Circuits)

In this example the power is applied via the start switch and the train moves to the away limit switch and stops. The 555 creates a delay of 1 minute and the train moves to the home limit and stops. Turn the power on-off to restart the action.
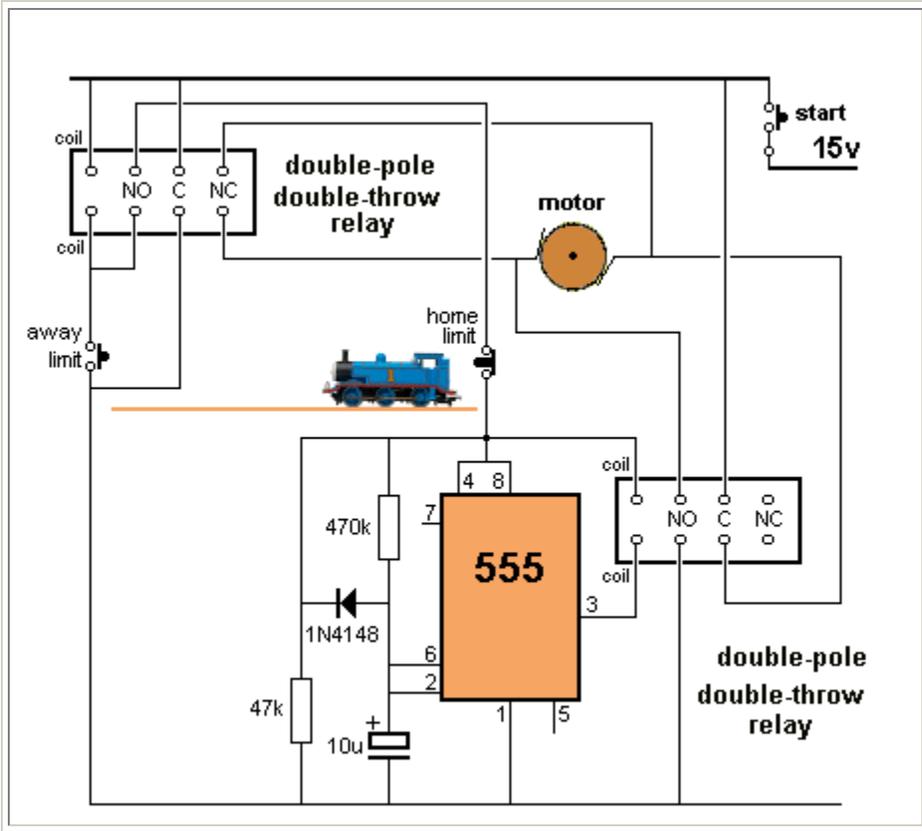
AUTOMATIC CURTAIN CLOSER

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk
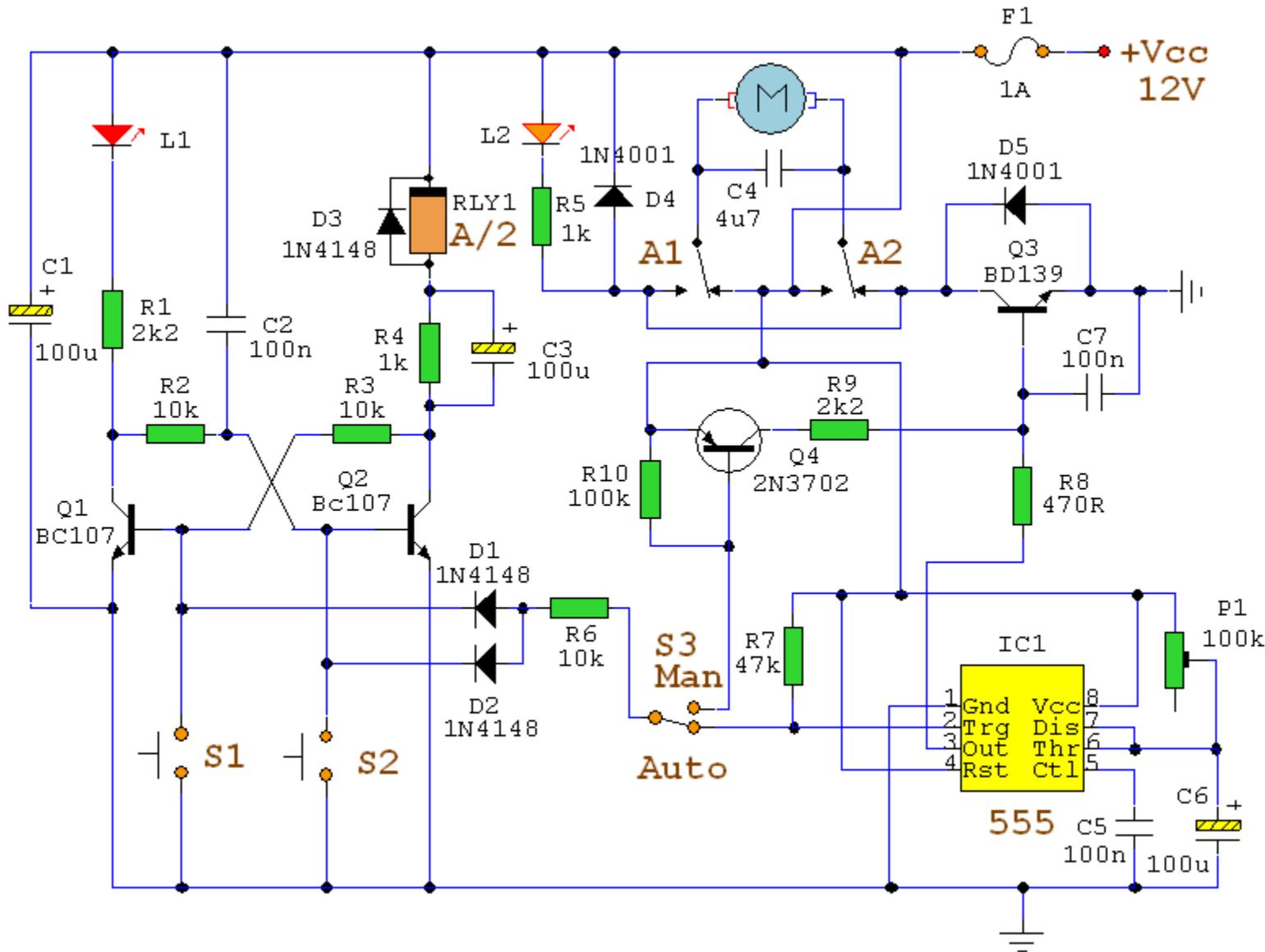
This circuit uses a mixture of transistors, an IC and a relay and is used to automatically open and close a pair of curtains. Using switch S3 also allows manual control, allowing curtains to be left only partially open or closed. The circuit controls a motor that is attached to a simple pulley mechanism, to move the curtains.

Automatic Operation
The circuit can be broken into three main parts; a bi-stable latch, a timer and a reversing circuit. Toggle switch S3 determines manual or automatic mode. The circuit as shown above is drawn in the automatic position and operation is as follows. The bi-stable is built around Q1 and Q2 and associated circuitry and controls relay A/2. S1 is used to open the curtains and S2 to close the curtains. At power on, a brief positive pulse is applied to the base of Q2 via C2. Q2 will be on, and activate relay A/2.
The network of C3 and R4 form a low current holding circuit for the relay. Relay A/2 is a 12V relay with a 500 ohm coil. It requires slightly less current to keep it energized than it does to operate it. Once the relay has operated, the current through the coil is reduced by R4, saving power consumption. When Q2 is off, C3 will be discharged, but when Q2 becomes active (either at switch-on or by pressing S1) capacitor C3 will charge very quickly via the relay coil. The initial charging current is sufficient to energize the relay and current flow through R4 sufficient to keep it energized.

STEPPER MOTOR CONTROLLER
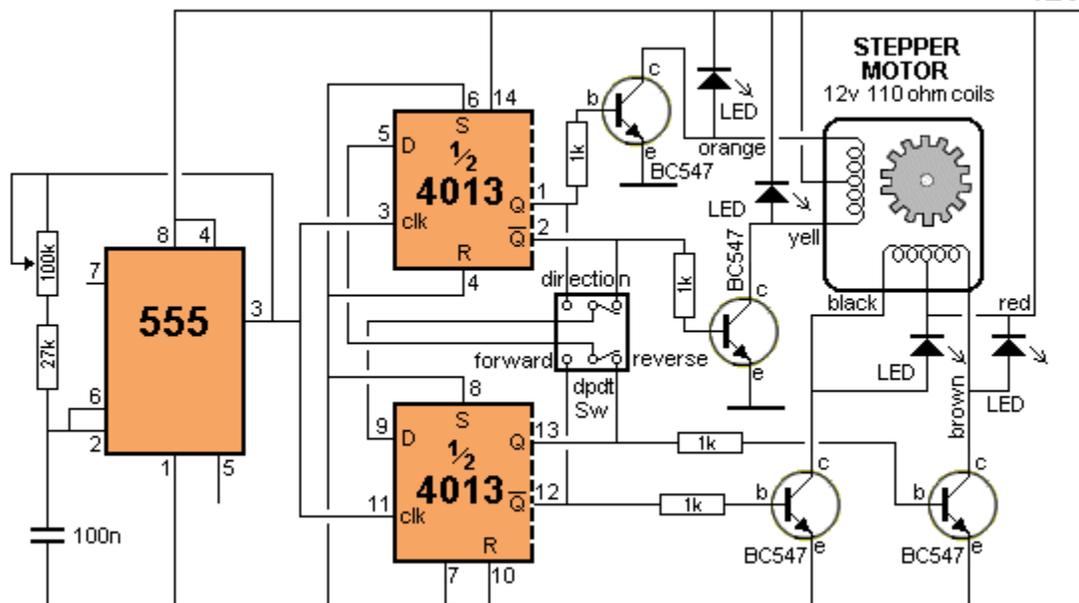
STEPPER MOTOR CONTROLLER

This circuit controls the speed of a stepper motor via the 100k pot. The direction of rotation is determined by the double-pole double-throw switch.

The stepper motor used in this circuit came from an old scanner. It had 5 wires: red-black-yellow-brown-orange. The LEDs illuminate via the back-emf of the coils and prevent the spikes entering the transistors. The LEDs will flicker to show the pulses being received by the stepper motor.

The 27k stop-resistor limits the upper-frequency of the 555 and prevents the circuit producing pulses that are too fast for the stepper motor.

If the colour coding is different on your stepper motor and it fails to work, you only need to reverse two connections thus:

A B C D
A B D C   (reverse the two end connections) and if this fails,
A D B C   (reverse the two middle connections)

This stepper motor costs less than $5.00 from BG Micro and has 6 wires as shown in the diagram above.

STEPPER MOTOR SPEED CONTROLLER
TE555-1
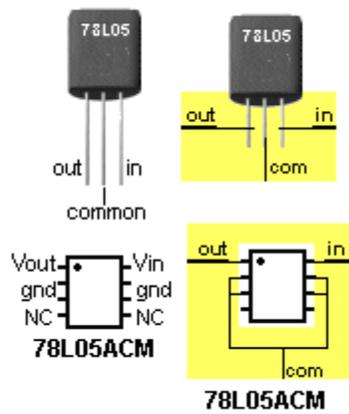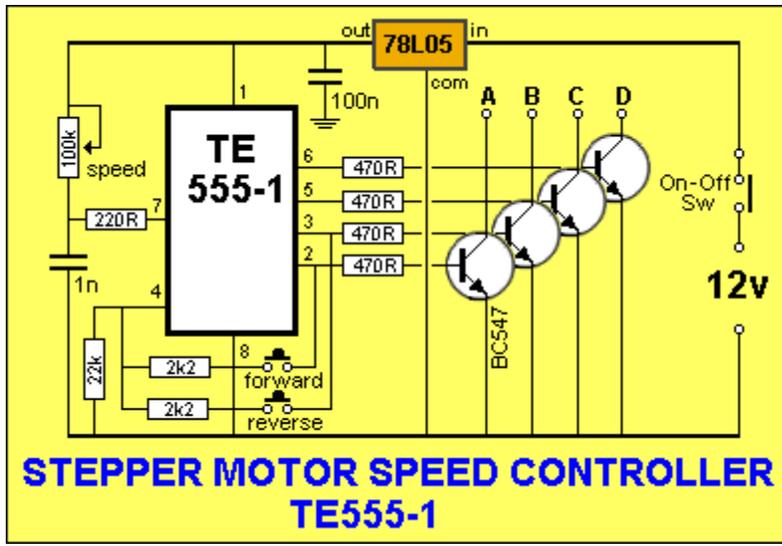
This circuit uses the latest **TE555-1** STEPPER MOTOR SPEED CONTROLLER chip from Talking Electronics. It is available for $2.50 and controls the speed of a stepper motor via the 100k pot. The direction of rotation is determined by the FORWARD and REVERSE switches and the motor does not take any current when a switch is not pressed.

ANIMATED DISPLAY CONTROLLER
TE555-2

TE 555-2

just $2.50

CLICK TO BUY

This circuit uses the latest **TE555-2** ANIMATED DISPLAY CONTROLLER chip from Talking Electronics. This 8-pin chip is available for $2.50 and produces 7 different animations on a 10 LED display. The animations are selected by the position of a 100k pot and when the animation is showing, the pot can be adjusted to increase the speed of the animation.
"Position 10" on the pot cycles through the 7 animations.

ANIMATED DISPLAY using TE555-2

5v

LEDS ON OTHER SIDE

0v

to pin 7 6   5   3   2   k
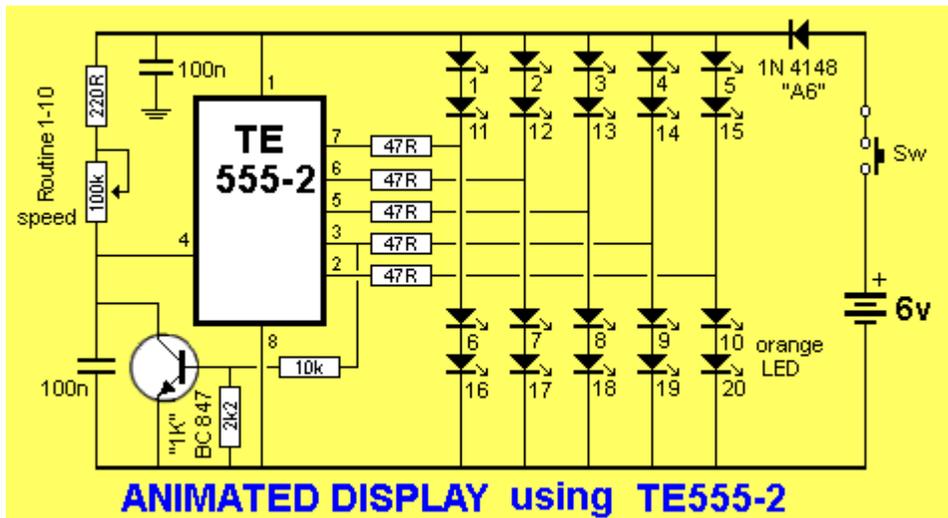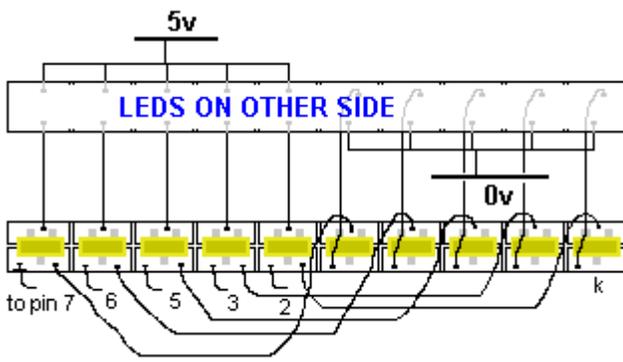
A kit of components (matrix board, PC board for LEDs, surface-mount resistors, capacitors, transistor, diode, switch, cells, battery holder, pot and 20 yellow LEDs with TE555-2 chip is available for $15.00 plus $5.00 postage. Click the link above and you will be sent an email with the costs. This is an ideal project you get you into surface-mount technology and you can add it to a model layout or build it into a Lego brick for a junior member.

Wiring the two ten-LED displays
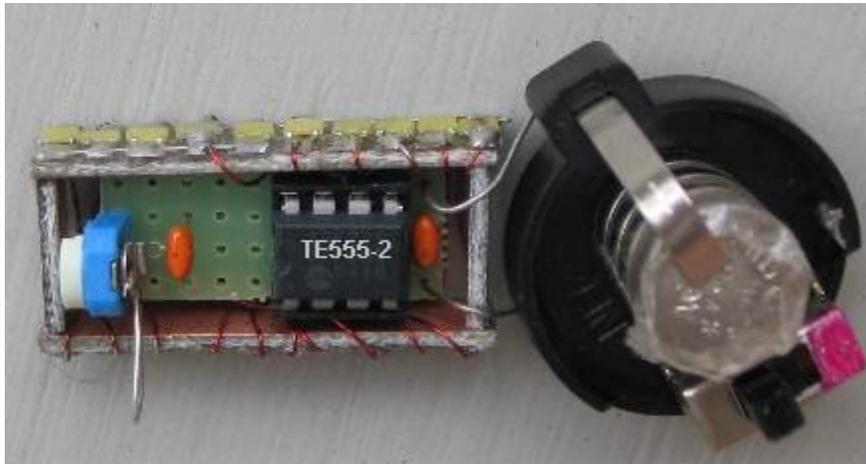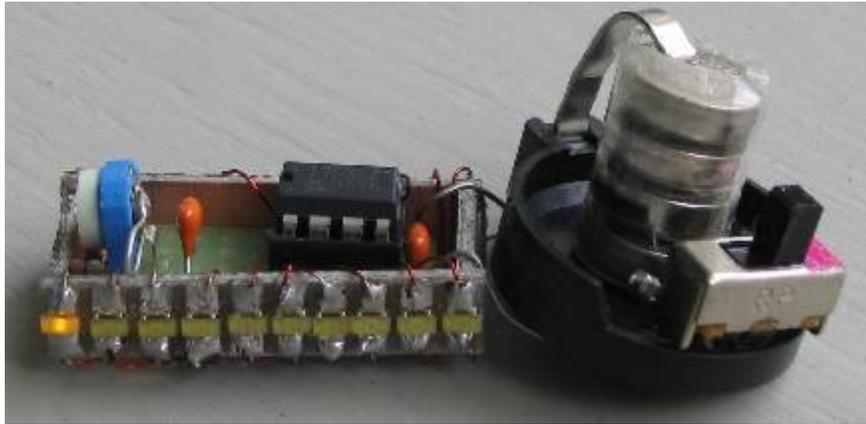
The project has two 10-LED displays. One on the front and one on the back

Two of the 7 animations
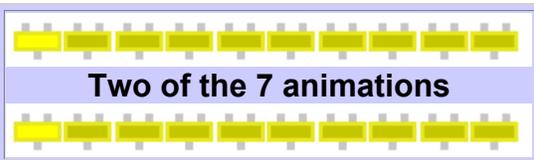
FOUR ALARMS SOUNDS TE555-3

This circuit uses the latest **TE555-3** **FOUR ALARM SOUNDS** chip from Talking Electronics. This 8-pin chip is available for $2.50 and produces 4 different alarm sounds. The chip can be used as a complete alarm system. All you need is a piezo diaphragm and the output will be enough for a single room. To create a very loud output you can add a buffer transistor and piezo speaker and the sounds will be deafening.
Just think of it. A complete alarm circuit for $2.50 plus a switch, battery and output piezo (such as a piezo tweeter). All the components are available from Talking Electronics and you just need to email Colin Mitchell: talking@tpg.com.au with your list of items.
The output is set to produce an alarm for 3 minutes then stops.

4 ALARM SOUNDS using TE 555-3
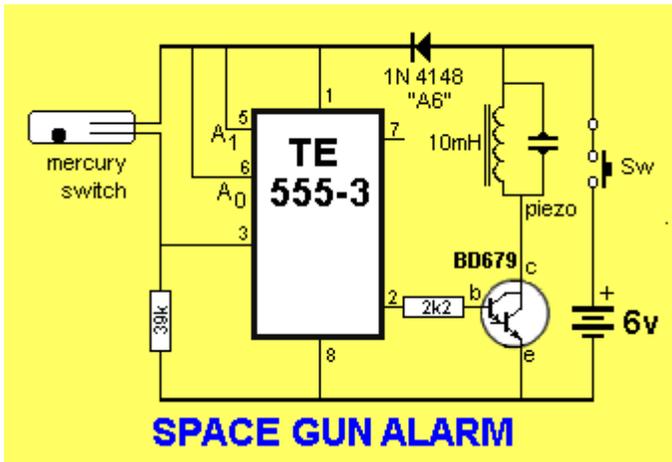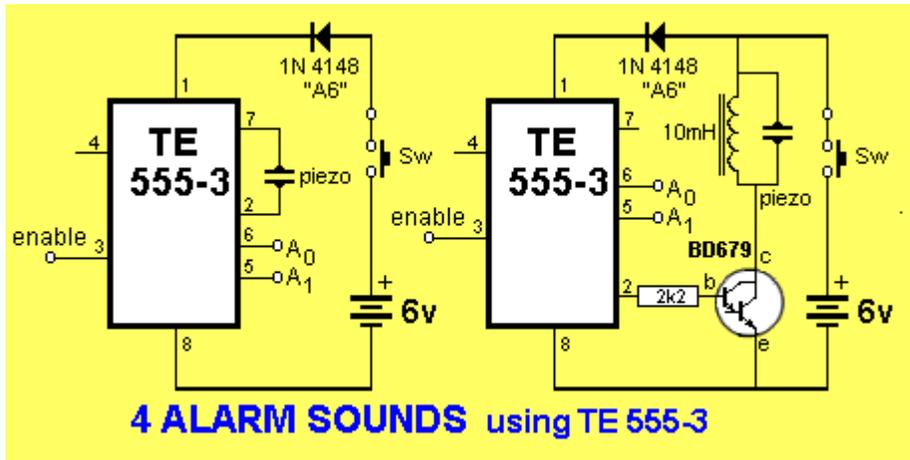
SPACE GUN ALARM
The chip set-up as an alarm

A1	A0	Alarm Output
0	0	Continuous 2.4kHz tone
0	1	Chirps
1	0	Siren
1	1	Space Gun

Control lines A0 and A1 are tied HIGH or LOW and when "enable" line is taken HIGH, the tone is emitted from pins 2 and 7 (in toggle mode). Pin 2 is LOW when the chip is at rest. To get a very loud output, pin 2 drives a Darlington transistor and piezo tweeter with a 10mH choke across the piezo to produce a waveform of nearly

100v. The circuit consumes 0.1mA when at rest.

DICE TE555-4

This circuit uses the latest TE555-4 **DICE** chip from Talking Electronics. This 8-pin chip is available for $2.50 and drives a 7-Segment display. The circuit can be assembled on proto-type board. For more help on the list of components, email Colin Mitchell: talking@tpg.com.au

DICE USING TE555-4
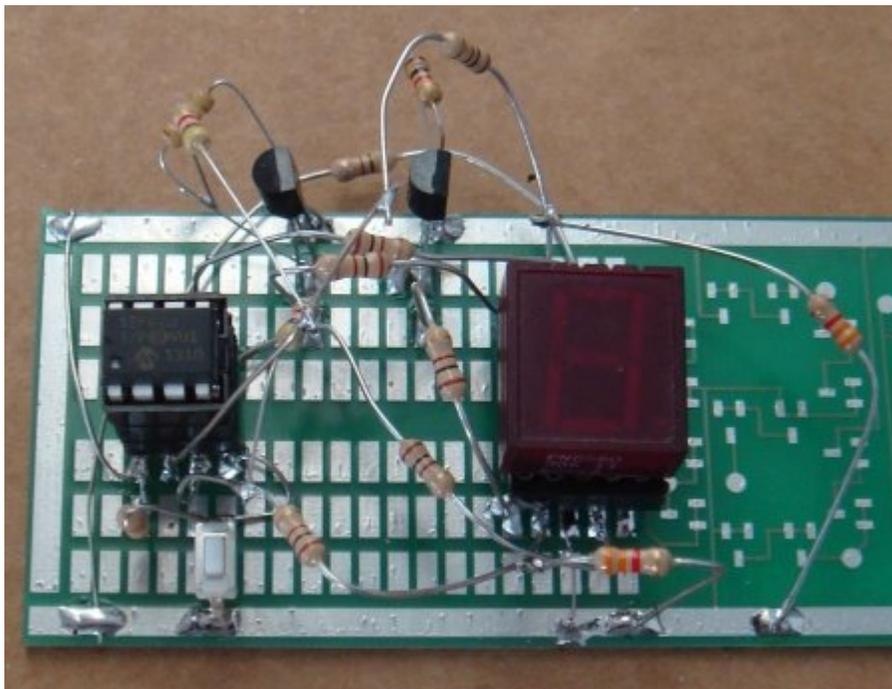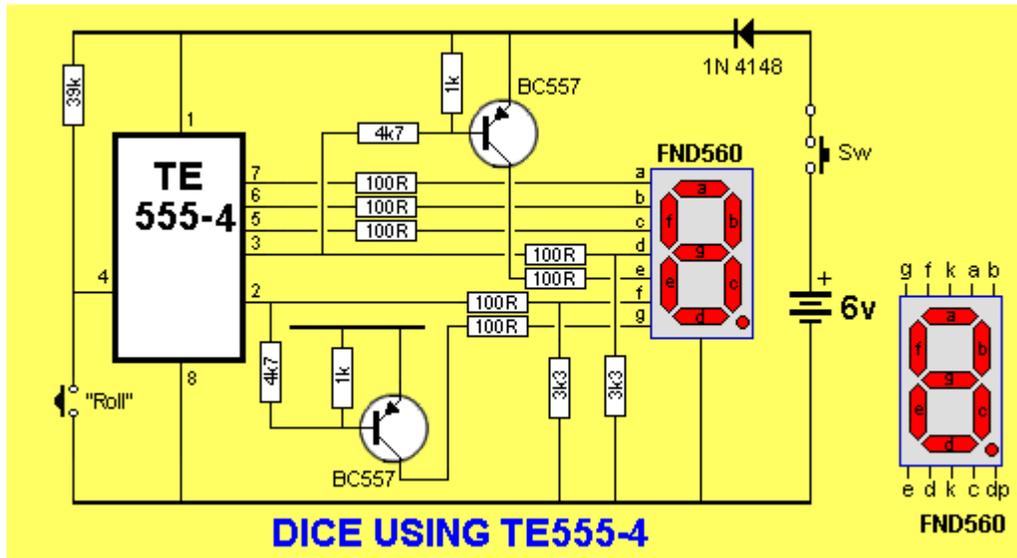
Here is the prototype.
It has been made very quickly on prototype board.

A kit of components is available from Talking Electronics

and a board shown above.
You will have to connect the parts yourself and
make a neater job . . .
Contact Colin for details.

This is how it works
The circuit relies on measuring your "**timing to push the button**" to get a random
number.
So, push the button and turn the circuit ON. (this generates the random number)
The letter "r" appears to say "ROLL."
Push the button and let it go.
The dice will roll.
The final value will stay illuminated for a few seconds and then "r" will appear for the next
roll.
The timing is so fast that even very fast pushes will get a different result.
So, you cannot cheat the system!!!!

LED FX TE555-5

TE 555-5
just $2.50
CLICK TO BUY
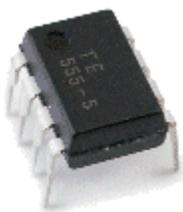
This circuit uses the latest **TE555-5** **LED FX** chip from Talking Electronics. This 8-pin chip is
available for $2.50 and drives 3 LEDs. The circuit can be assembled on matrix board.
The circuit produces 12 different sequences including flashing, chasing, police lights and
flicker.
It also has a feature where you can create your own sequence and it will show each time the
chip is turned on. The kit of components and matrix board can be purchased for $15.00 plus
postage. Email Colin Mitchell: talking@tpg.com.au   for more details.

LED FX
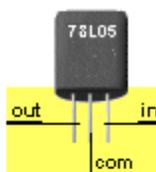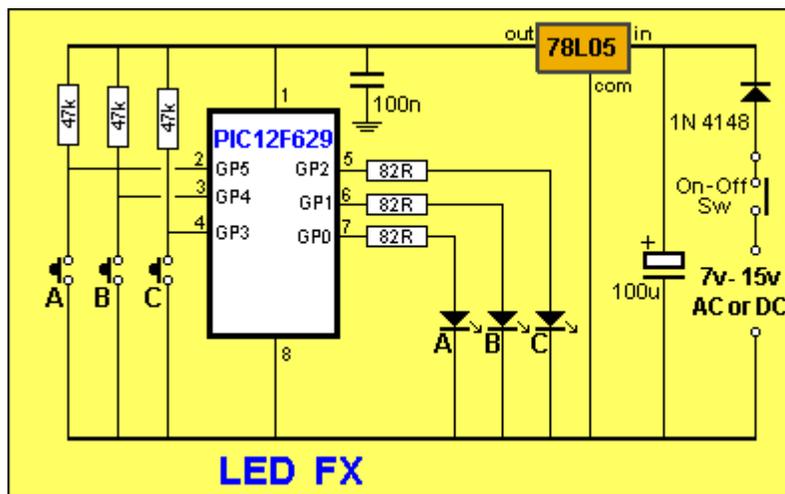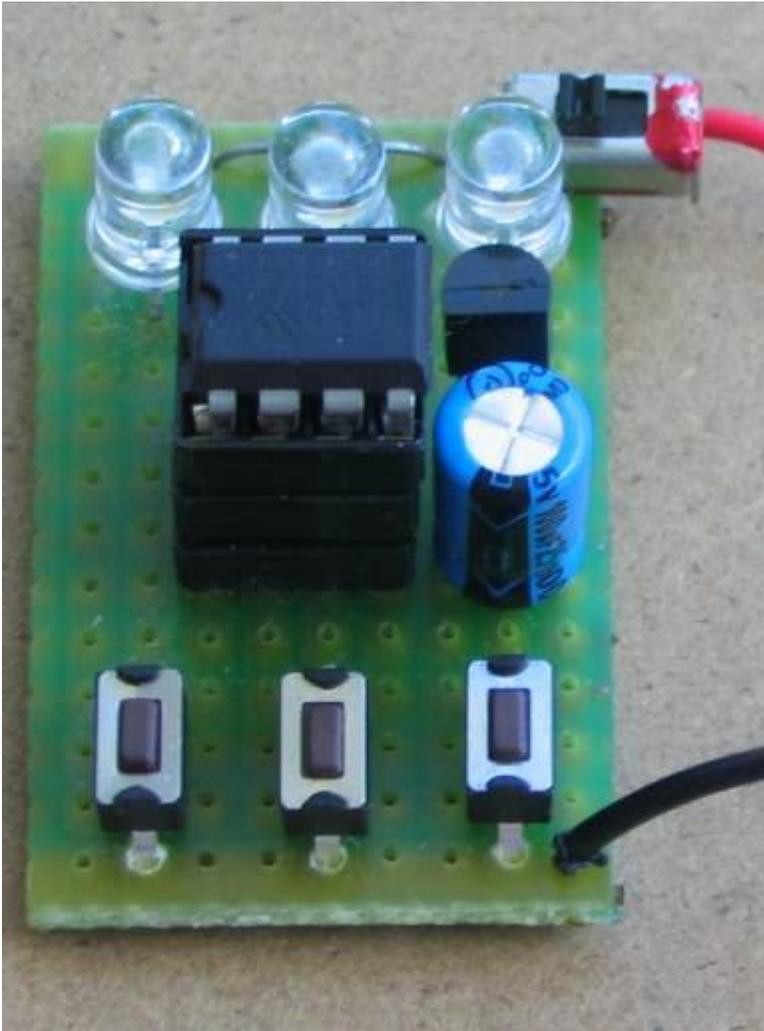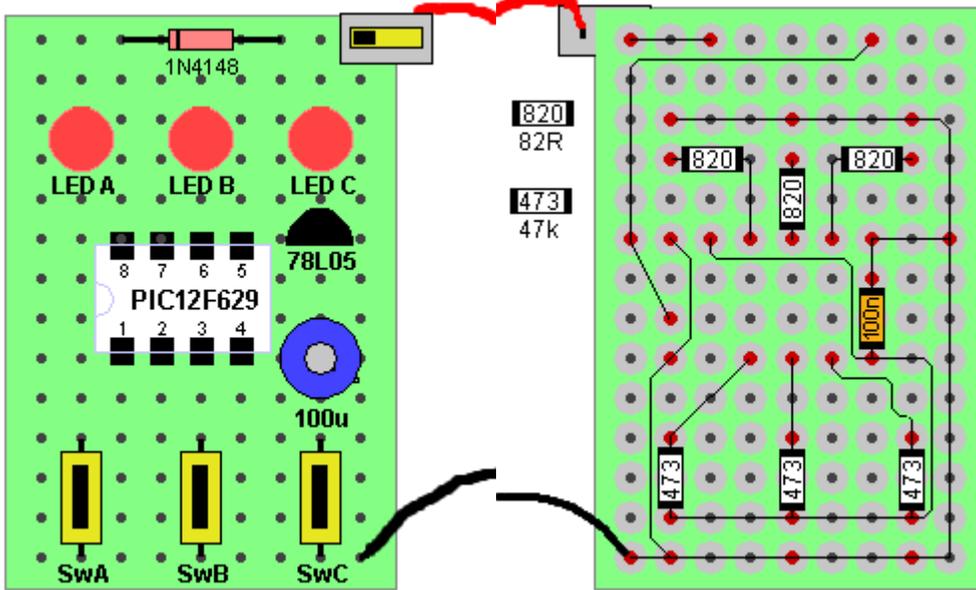
HOME ALARM-1

Here is a Home Alarm using 555 IC's.

HOME ALARM-1

Amplifier   Rectifier   Sound Integrator   Follower   Inverter/Buffer

Labels in schematic: 2M2, 100k, +12v, 22uF, 120, 3140, 10uF, 1k, Delay, 150k, 100k, 220uF, 3140, 2k2, Q1 NPN, to siren (low to trigger), 12V, 1N4006, 100uF, 10k, 64 ohm spkr

12V — 555 — 470k — 220uF — 10nF — 12 s mono — 1k5 — 47k — NPN Q2 — Fast discharge — 120

12V — 1k — NC — NO — External Switches

12V — 100k — 555 — 100k — Q3 PNP — 220nF — 10M — 10nF — 220nF — 10k — 18k — Schmitt (Inverting) — External Switch logic

1k2 — NO Reset — 12V — 555 — 47k — 2M preset Reset Pause — 10nF — 470uF — Reset

---

BURGLAR ALARM 4-ZONE

This circuit uses a dedicated alarm chip from Talking Electronics (**TE555-BA4**). The chip costs $2.50 and contains a 4-zone Burglar Alarm circuit. All you need are the surrounding components to complete the project. These components are available as a kit for $20.00 including the dedicated chip and this makes it one of the cheapest kits on the market (postage for kit $6.50). Click **HERE** to order the chip or the kit.
The only additional parts you require are 4 reed switches. These can be purchased on eBay for $5.38 for a set of 5 Normally Open switches (post free).
Here is the link:
http://www.ebay.com/itm/5-Set-Door-Or-Window-Safety-Contact-Magnetic-Alarm-Reed-Switch-NO-with-Screws-/290746194636?pt=LH_DefaultDomain_0&hash=item43b1d2dacc

1. "Normally open" reed switch

Magnetic contact .... Magnetic contact

CURRENT OFF
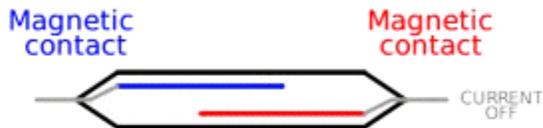
2. Switch closes when magnet is near

Magnetic contact .... Magnetic contact

N .... S
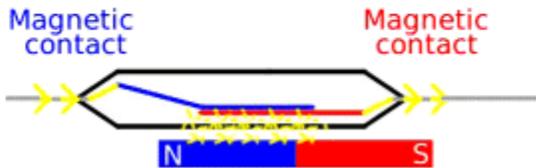
Build the circuit on a piece of matrix board (or the Circuit Board included in the kit) and connect the inputs to the screw terminals. 6 separate 2-screw terminals are provided in the kit to make it easy to wire-up the alarm. The alarm takes about 1mA when monitoring a house and about 100mA when activated.

The siren is only activated ONCE for 5 minutes when a break-in occurs as this is the maximum allowable time for a siren to wail in Australia.

If you want the alarm to constantly wail after a break-in, push button A when the alarm is turned on (and the exit beep is being produced). The constantly wailing LED will flash. Push the button again and the 5 minute LED will flash. The button toggles between the two features.

You can use reed switches for the input devices for doors and drawers. You can also trap the burglar by placing money under a clip and have a very thin length of tinned copper wire wound around two pins. When the money is removed, the wire is pulled off the pins. A single strand of wire can be obtained from a length of hook-up flex.

BURGLAR ALARM 4-ZONE
Button A toggles: 5 minute Wailing or Constant Wailing

6-1-2014

POWER SUPPLY
The alarm can be connected to a 12v gell cell with a rating of 1.2AHr and it can be automatically charged using our
Automatic Battery Charger in **101 Transistor Circuits.**
http://www.talkingelectronics.com/projects/200TrCcts/101-200TrCcts.html#84

HOW THE CIRCUIT WORKS
Any of the inputs can be used for the Entry/Exit.
It is connected to the door you will use to enter or exit the property. The alarm gives you 45 seconds to exit.
When you enter the property, the buzzer turns on as soon as you open the door and beeps for 45 seconds to allow you to turn off the alarm.
If the alarm is not turned off, the main piezo siren produces a soft tone for 30 seconds and then a piercing wailing sound.

This allows you to turn off the alarm before the loud wailing is produced and is one of the best features of the alarm as the worry of false-triggering an alarm prevents many householders setting their alarm.

Any unused inputs must be connected with a link so the alarm can be set.

When the circuit is turned ON, you have 45 seconds to exit the premises.

The chip then flashes either the 5-min LED or the Constant LED to indicate if the siren will wail for 5 minutes or constantly. You can change the setting by pressing the button. The circuit then beeps for 45 seconds to give you time to exit the property. It then monitors all 4 inputs.
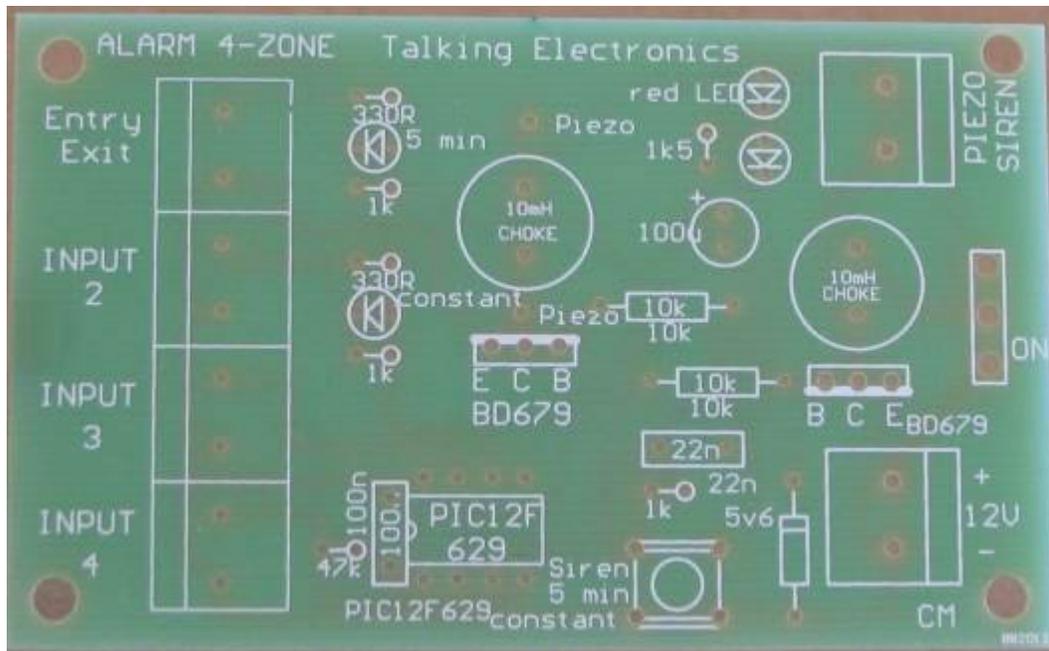
Alarm 4-Zone PCB

The main chip contains an internal oscillator to drive a piezo diaphragm and also a wailing oscillator for the Piezo Siren. The Piezo Siren is an 80dB piezo diaphragm driven by a

BD679 Darlington transistor with a 10mH choke to produce a high voltage for the diaphragm.
The chip operates on 5v and the rest of the circuit uses 12v. A very simple voltage-dropper consisting of 2 LEDs and 1k5 drops the 12v to 5v.

HEADLIGHT SELECTOR

This circuit was designed by a reader who needed to select between low and high beam by pressing a switch, then change back by pressing the switch again. The circuit always starts on low beam, regardless of the state when it was turned off.

HEAD LIGHT SELECTOR By: Kinarfi

1-10 MINUTE AUTO TURN OFF

This circuit provides an automatic turn-off feature after a time that can be set from 1 minute to 10 minutes by the 470k pot.

WATER LEVEL DETECTOR

This circuit can be used to automatically keep the header tank filled. It uses a double-pole relay. This is the transistor version of the circuit below.

+12V

LED

10k
2k2
2k2
1k

1N4148

RL1

2k2

BC547

BC547

BC547

BC547

2k2

METAL TANK

COPPER WIRES

WATER

Here is the circuit using a 555:
These are the facts you have to remember. In our circuit, Pins 2 and 6 detect a voltage when water is not touching the probes, due to the 100k resistors. When water touches the probes, neither pin "detects a voltage."

Don't worry about pin 2 detecting 1/3 of rail voltage and pin 6 detecting 2/3 of rail voltage. In our circuit the pins either detect a voltage or do not detect a voltage. Pin 2 detects a LOW and pin 6 detects a HIGH. Pin 2 does nothing when it detects a HIGH and pin 6 does nothing when it detects a LOW.

When the water is LOW, as shown in **fig 1**, both pins 2 and 6 are HIGH and the output of the 555 is LOW.

As the water rises, as shown in **fig 2**, Pin 6 goes low but nothing happens to pin 3 except the chip "has been prepared via the internal flip-flop" to change when pin 2 goes LOW. When the water reaches pin 2, as shown in **fig 3**, this pin "fails to see a HIGH," the output of the chip goes HIGH and the pump turns off.

As the water level goes down, as shown in **fig 4**, pin 2 sees a HIGH but this does not change the 555 as pin 2 only has an effect when it goes LOW.

When the water level goes down further, as shown in **fig 5**, pin 6 sees a HIGH and because pin 2 is not seeing a LOW, the chip will change states. The output goes LOW.

METAL TANK

COPPER WIRES

WATER

1	2	3	4	5
Pin3 LOW Pumping	Pin3 LOW Pumping	Pin3 HIGH Not Pumping	Pin3 HIGH Not Pumping	Pin3 LOW Pumping
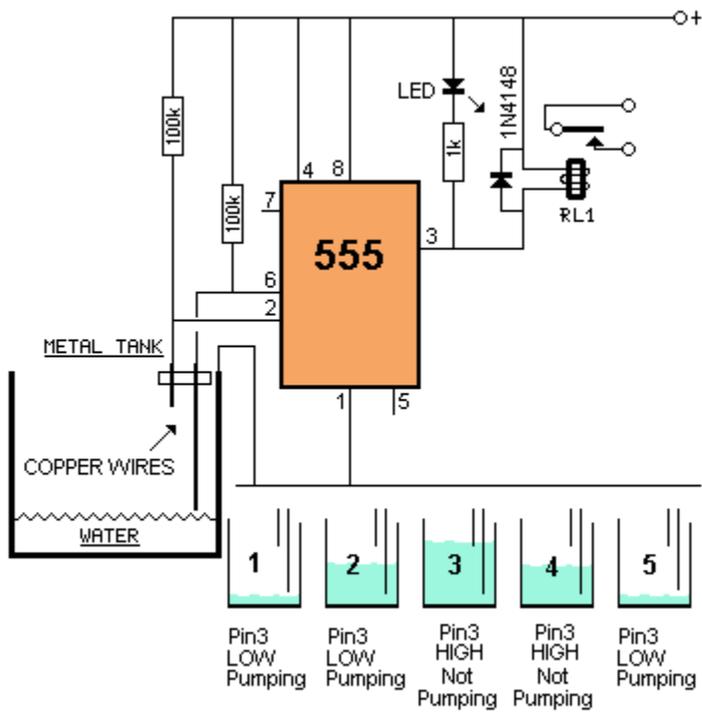
Here's the circuit used in a hydroponic garden, to grow tomatoes:
http://indoorhydroponicveggies.wordpress.com/#waterleveldetector

WARNING LIGHTS FLASHER

These two circuits flash two **5 watt to 21watt** car lamps. The first circuit uses BD679 Darlington transistors and the second circuit uses a 555.
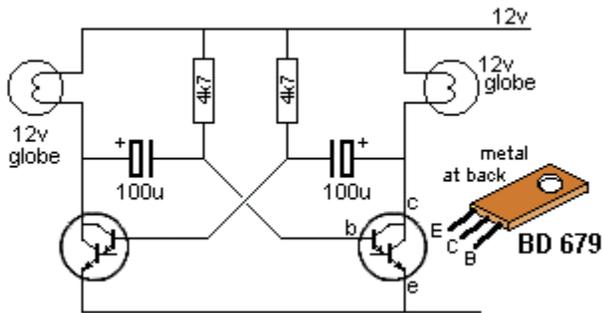
This 12v Warning Beacon is suitable for a car or truck break-down on the side of the road. The key to the operation of the circuit is the high gain of the Darlington transistors. The circuit must be kept "tight" (thick wires) to be sure it will oscillate.
A complete kits of parts and PC board costs $5.00 plus postage from: Talking Electronics. Email **HERE** for details.

The 555 circuit uses two diodes to connect the chip to the negative rail and this allows the components to be fitted between the "high side" of the lamps and the "power switch."

MISSING AUDIO DETECTOR

This circuit detects when audio is not received for about 4 seconds and turns on an alarm.

5 SECS DELAY THEN RELAY ON FOR 4 SECONDS

This circuit waits 5 seconds before turning on the relay for 4 seconds.

5 SEC ON - even if switch is kept pressed

This circuit illuminates a LED for 5 seconds - even if the switch is kept pressed.
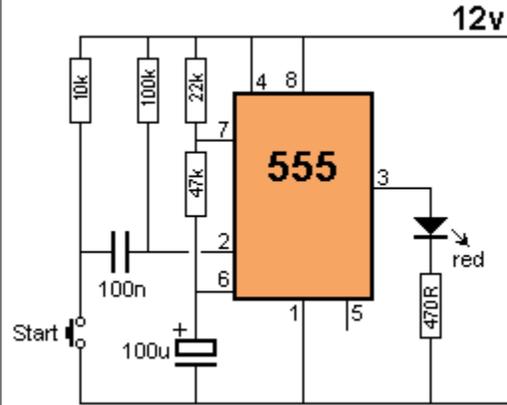
DELAY BEFORE TURNING ON

This circuit does not turn on for XX seconds after power is applied. Adjustable from 1 second to 2 minutes.
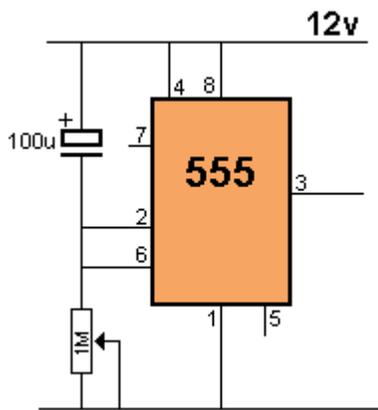
LOW CURRENT TIMER (delay)

The low-current version of the 555 is called 7555 (ICM7555CN), and is a CMOS direct-equivalent version of the TTL 555. It costs more but can be purchased on eBay for $12 (for 10 items incl postage). The normal standing current for a 555 is about 10mA. The standing current for a 7555 is about 0.3mA. This circuit will produce a delay of about 5mins. Change the 1M and/or 100u for different delays.

CROSSING LIGHTS

A magnet on the train activates the TRIGGER reed switch to turn on the amber LED for a time determined by the value of the first 10u and 47k.

When the first 555 IC turns off, the 100n is uncharged because both ends are at rail voltage and it pulses pin 2 of the middle 555 LOW. This activates the 555 and pin 3 goes HIGH. This pin supplies rail voltage to the third 555 and the two red LEDs are alternately flashed. When the train passes the CANCEL reed switch, pin 4 of the middle 555 is taken LOW and the red LEDs stop flashing.

See it in action: Movie   (4MB)

The circuit can also be constructed with a 40106 HEX Schmitt trigger IC (74C14). The 555 circuit consumes about 30mA when sitting and waiting. The 40106 circuit consumes less than 1mA.

Jim's Crossing Lights

This project operates crossing lights automatically, before the train enters the crossing and turns them off automatically. The flash-rate can be adjusted as well as the brightness of the lights and the overall length of time for the flashing. The full article is HERE.

LOCO STOP

This is another clever design.
Buy the module, fully built and tested for $15.00 usd plus $6.50 shipping.
Click **HERE** to order the module and 2-aspect signal.

LOCO STOP
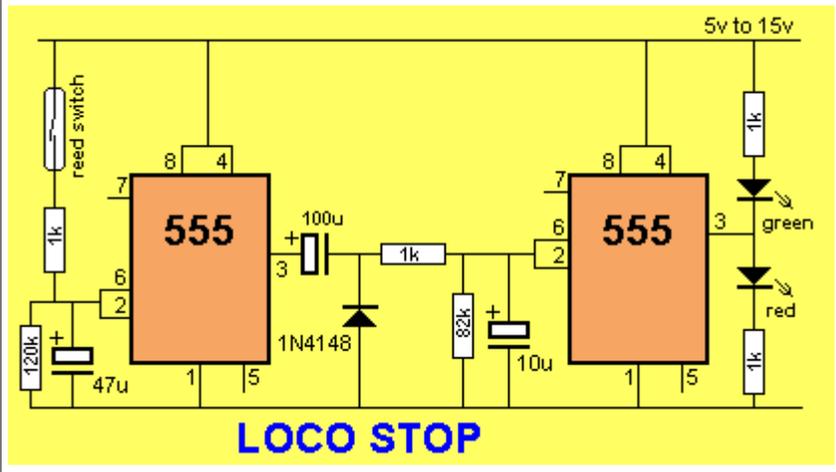
HOW THE CIRCUIT WORKS

The circuit is required to delay the trigger from the reed switch by about 7 seconds and then activate the second 555 to change the illumination of the red LED for 8 seconds to green and then red. In other words the pulse from the reed switch has to be extended as a HIGH to become a HIGH for 7 seconds. This is 7 seconds that the circuit does not appear to make any changes in the illumination of the LEDs.
The 1k resistor is designed to charge the 47u very quickly and the will take output pin 3 LOW for 7 seconds and the 100u will discharge very quickly via the 1N4148 diode. When the 7 seconds has elapsed the uncharged 100u will be taken

Connecting 2-aspect Signals
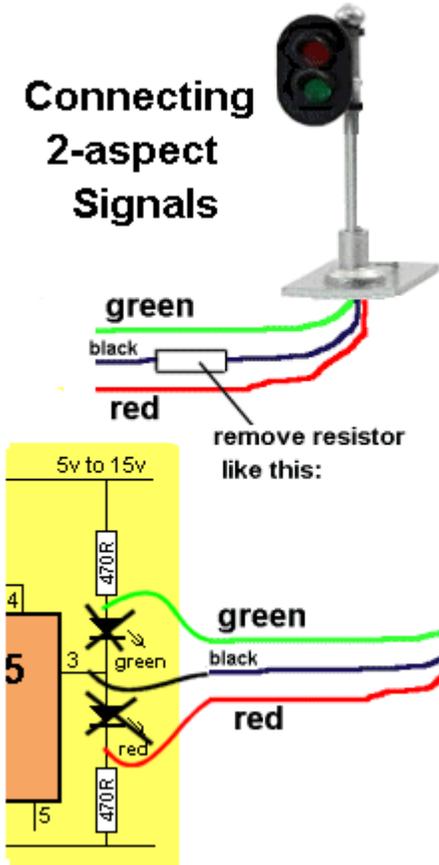
high and it will be just like a high is passed through the 1k and to pins 2 and 6 to change the condition of the second 555. The 100u will now start to charge via the 68k and eventually pins 2 and 6 will go low to change the outcome of the 555 and the red LED will be illuminated.

The 10u plays no part in the timing but the 1k and 10u form a very short delay to prevent a pulse from the first 555 flicking the red and green LEDs during part of the first 555 timing cycle. You can say this is one of the faults in the 555 that has to be fixed by adding these two components. The resistor values are obtained by experimentation. You cannot use any calculations as they do not form any normal part of the timing cycle of the 555. Just start with any value and change the value until to desired timing is achieved.

The circuit is used on a model railway layout to automatically control a 2-aspect signal to add to the features of driving around a layout.

The signal is normally red and when the loco activates the reed switch, the first 555 produces a timing of about 10 seconds so the loco has to stop and wait at the signal and when the time has expired, the second 555 is triggered and the green light shows for 10 seconds and then the red appears again.

All this has been done with 2 x 555 IC's.

The 2-aspect signal is not a normal signal but comes as a kit from Talking Electronics for $5.00 usd as the LEDs are connected differently to standard models.

green
black
red

remove resistor like this:

5v to 15v

green
black
red

For Chinese 2-Aspect signal you will need this circut:

LOCO STOP MkII
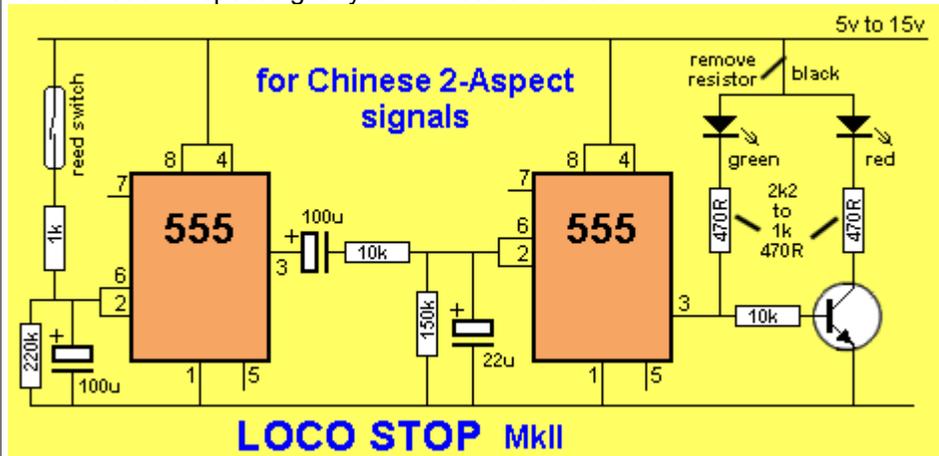
The 1k resistor in (on) the negative lead needs to be removed as the circuit has dropper resistors. The brightness is adjusted by selecting the appropriate dropper resistor.

DOORBELL for FRONT DOOR and BACK DOOR

This circuit produces two different sounds. One for the front door and one for the back door. The circuit takes NO CURRENT when not producing a sound and a 9v battery will last for many months.

PHASE CONTROL

The control circuit in **Figure 1a** allows you to manually adjust the power delivered to a load. By changing the setting of potentiometer R_3 you change the phase angle at which the thyristor (Q_3) fires (**Figure 1b**), thereby altering the load current's duty cycle. The adjustment range is about 0 to 180°. Q_3's off time is linear with R_3, but of course the resulting load power is not linear with R_3.


(a)

(b)

The full-wave diode bridge delivers pulsed-dc voltage to the load, making the circuit suitable for dc-control applications such as dimming. (The circuit can handle ac power if you substitute a triac for Q_3 and make slight modifications.)

IC_1 is a low-power—1 mW—timer configured as a monostable. Zener diode D_1 and filter capacitor C_1, activated by pulses from the voltage divider R_1/R_2, form a dc supply for the timer. Q_1 turns on and applies a negative-going trigger to the timer (pin 2) each time Q_1's base voltage approaches 0V. In response, the timer issues a positive pulse that turns on Q_2 and turns off Q_1, removing load power for

an interval equal to $1.1R_3C_2$. To increase the control resolution, you can lower the value of R_3, substitute a potentiometer with more turns, or add a fixed resistor in series with the potentiometer.

FREQUENCY SHIFT KEYING (FSK)

A digital signal can be converted to an analogue signal for transmission through the phone line. The signal consists of two different frequencies. One standard is 1270 for logic 1 (Mark) and 1070 for logic 0 (Space). The circuit below shows how to use a 555 to produce two different frequencies.
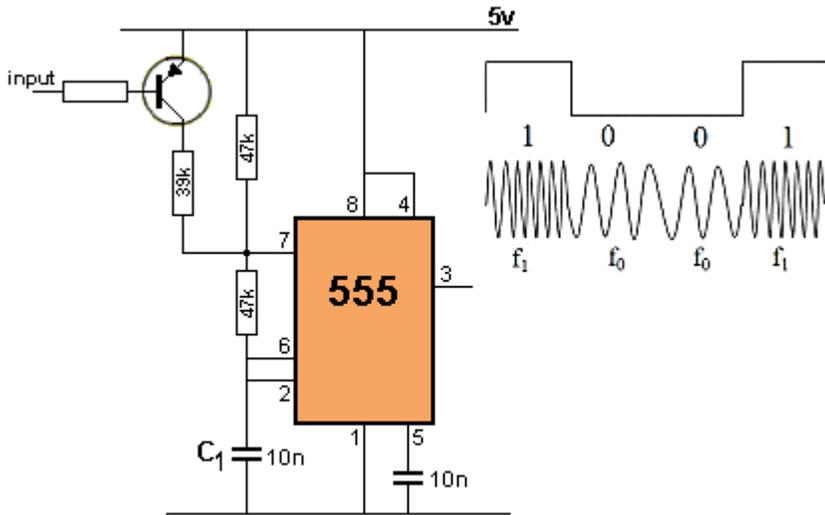

FREQUENCY SHIFT KEYING (FSK)

LED DICE
A SIMPLER CIRCUIT:

The circuit above can be simplified and output Pin 12 can be used to illuminate two of the LEDs as this line is HIGH for the times when Q0, Q1, Q2, Q3, and Q4 are HIGH and goes LOW when Q5 - Q9 is HIGH.

This means the 4017 starts with Q0 HIGH. But Q0 is not an output. This means that when Q0 is HIGH, "carry out" is HIGH and "2" will be displayed. The next clock cycle will produce "3" on the display when Q1 is HIGH, then "4" when Q2 is HIGH, "5" when Q3 is HIGH and "6" when Q4 is HIGH. When Q5 goes HIGH, it illuminates "1" on the display because "carry out" goes LOW.
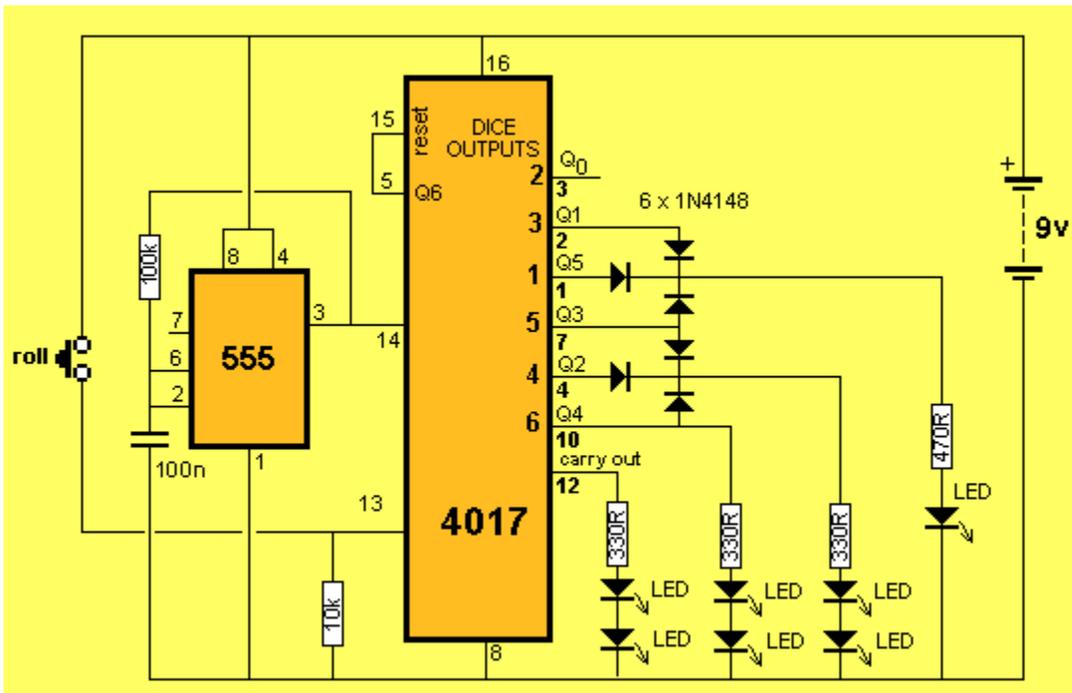
LED FLASHER

This circuit uses Pin 7 to turn on the LED and the capacitor is non-electrolytic to keep the circuit small.
Designed by Franz Bachler, this arrangement has never been presented before:
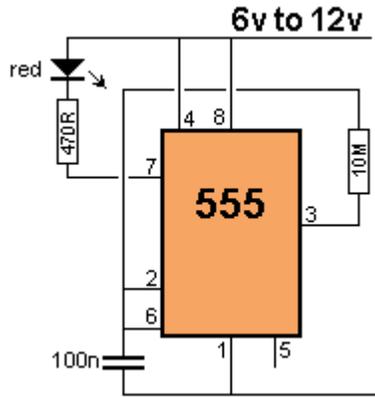
LED FLASHER with LDR

This circuit uses the fact that pin 6 needs to reach 2/3 rail voltage for the 555 to cycle. When light falls on the LDR, it produces a voltage-divider with the 22k to prevent pin 6 seeing 66% rail voltage and the LED stops flashing.
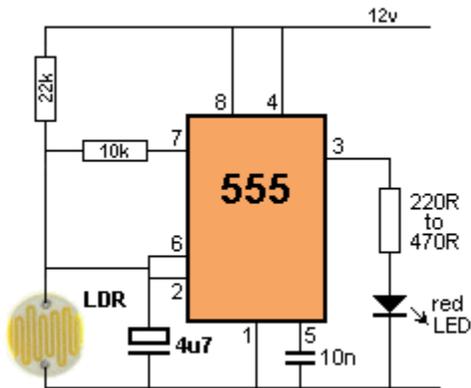

Automatic Garden LED Strip

This circuit uses two 5v switch-mode power supplies to create a 10v power supply.
You can do this with almost any two wall worts (plug packs) to get any desired voltage.
The circuit only turns on at night and the brightness of the LEDs can be controlled by the "dimming Control."
This project uses one of our "Make any 555 Project" PC boards. The two 5v @1 amp SMPS modules were connected to TWO 5 metre LED strips and the brightness turned down considerably as the whole driveway was illuminated and kept the neighbours up all night !!!! The estimated wattage was less than 5 watts for the 600 LEDs. The electricity cost is less than $5.00 per year to illuminate a dark driveway and make it safe for you and your visitors. Here is the .pdf of this project.

5v @ 1amp switch-mode power supply

Two 5v plug-packs can be connected to produce 10v supply.

Or use 12v plug pack.

LEDs come on at night

10v to 12v

dimming control

10k

8 4

1M

100k

7

100k

555

3

LDR
Photo-
Cell

1N4148

6

220R

2

100n

1 5

10n

BD 139

5v @ 1amp
switch-mode
power supply

MAKE ANY 555 CIRCUIT
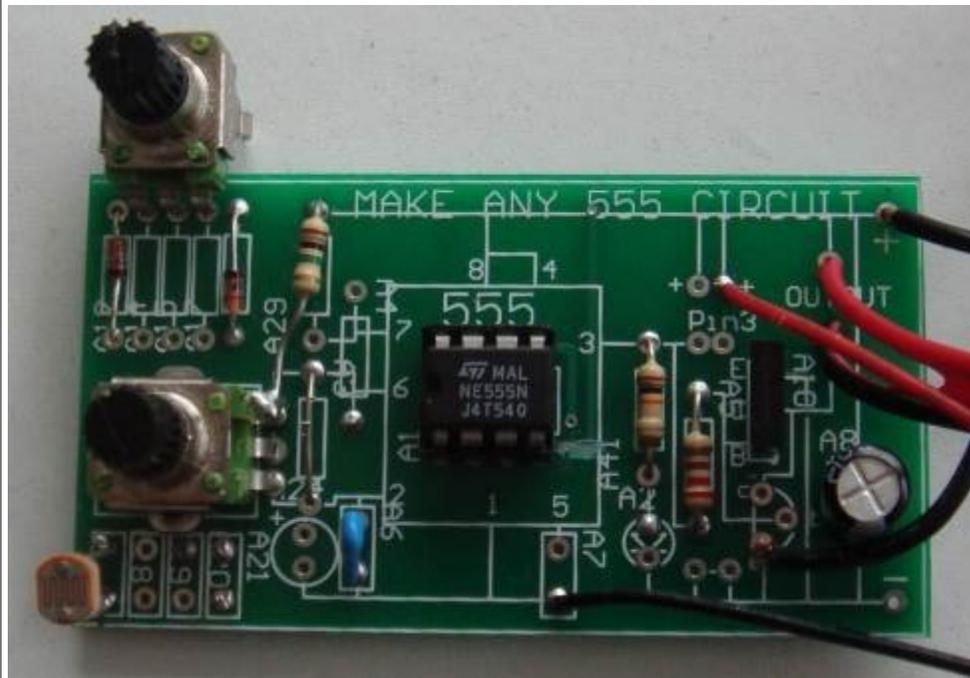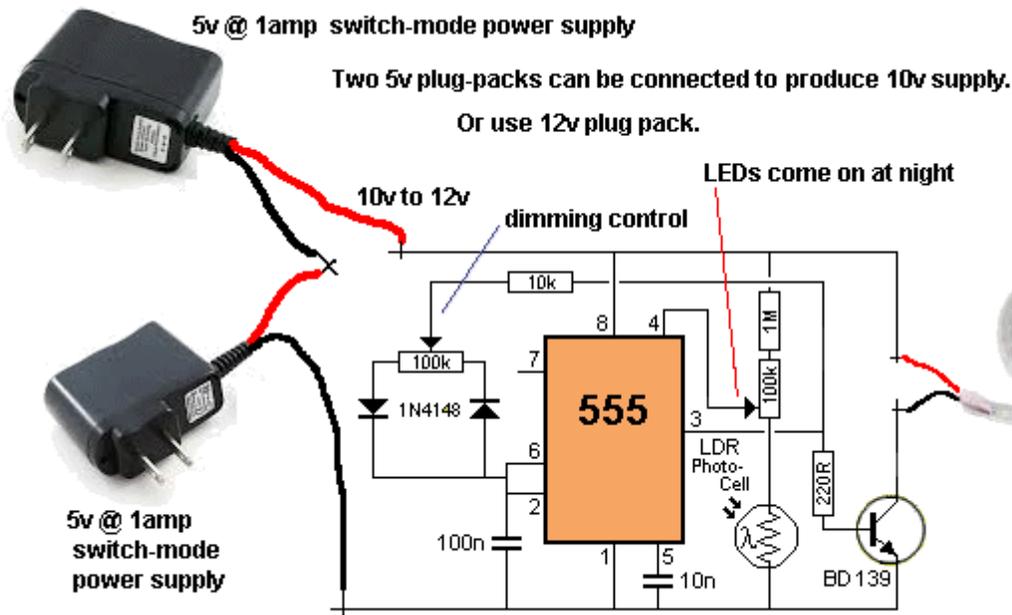
The **Make Any 555 Project** PC board allows you to create a beautiful project very easily and quickly.
90% of the circuit is already provided and all you have to do is cut a few tracks and add a few wires under the board and the project is complete.

The Universal 555
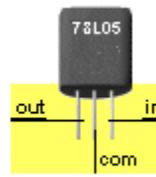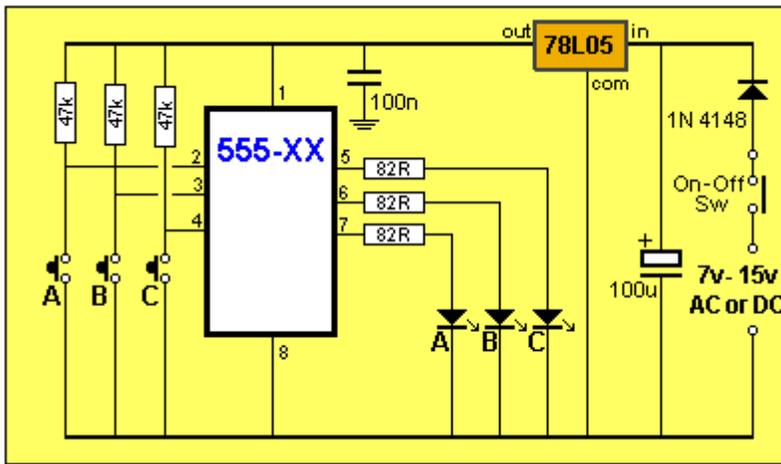
We have shown how hundreds of circuits can be made with the 555 but some requirements are too complex for this amazing chip.

Something as simple as:

I want to make a circuit that detects sensor 1 and within 1 sec it needs to detect sensor 2. If it does there is no problem but when detection of sensor 2 is more than 1 second I need to shut down the machine. It's for a project and I don't know which circuit I can use with the 555 timer.

This simple requirement will take a lot of circuitry using 555 chips and it is more complex than you think.

That's why they invented microcontrollers.

They simplify the requirement to a single chip and a few components.

The circuit above turns on LED A when SwA is pressed. But if SwB is pressed within 1 second, the LED is turned OFF. The output needs to go HIGH when SwA is pressed and a 1 second timer allows Sw B to turn OFF the output within 1 second.

This is a timer (or delay) plus gating requirement as well as a "latch" requirement the switches are only momentary pulses.

Personally I would not waste time with individual chips (gates) as at least 4 building blocks are needed. A program only requires 10 lines of code plus a sub-routine.

Simply look at SwA to turn ON the output and call a 100mS delay routine (10 times) while looking at SwB to turn OFF the output.

This is covered in **PIC Fx-1** project and you can contact Colin Mitchell for more details.

CHARGE CONTROLLER

This circuit prevents a battery being overcharged. When the battery is FULLY CHARGED, the energy from the solar panel is dumped into a LOAD. This load can be a 12v 100watt globe or a high-power resistor.

You only have to dump excess current if your solar panel is capable of fully charging the battery in less than 10 hours. If it takes 14 or more hours of sunlight to charge the battery, this is equal to 2 days of illumination and the battery will accept this low rate of charge and you possibly don't need this circuit.

A simple way of charging a battery without needing this circuit is to put a high wattage resistor and diode in series with the positive line of the solar panel and the battery.

The solar panel will then simply trickle charge the battery over a few days.
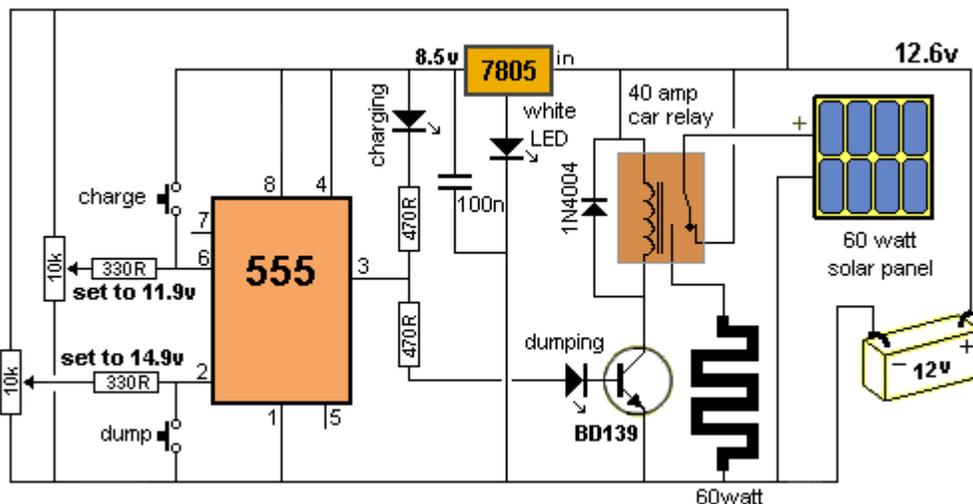
SETTING UP

Use a variable power supply.

You don't need the high wattage resistor or the battery or solar panel or the relay!.
Connect the variable power supply set to 11.9v. Adjust the top 10k pot to turn ON the charging LED.
Increase the voltage to 14.9v and adjust the lower 10k pot to make the dumping LED come on.
Now connect all the components as shown in the circuit and check the voltage levels once more before installing the project.
The white LED "jacks up" the 7805 to produce 8.5v output as the 555 does not like a voltage as low as 5v.
To manually "charge" or "dump" energy, simply press either button quickly and the 555 will toggle to the required state and perform the operation of charging or discharging.

If you don't have a variable power supply, here's what you do:
Get a small 12v battery and fit it to the circuit.
It will charge very quickly and you will be able to keep reading the voltage across the battery as it charges. Adjust the HIGH and LOW voltages (called "set points") as close as possible and watch the circuit cycle "up and down."
Each time you see it "cycle" you can fine-tune the exact voltages until you see it change at 11.9v and 14.9v.
In fact you can use **any** set of old "junk" rechargeable cells to perform this test as you are simply reading a high and low voltage and waiting for it to reach these values over a short period of time.

MOTOR OVER-RUN

The motor continues to operate about 2 seconds after the switch is opened, until the 10u drops below 33% of rail voltage, as is discharged via the 100k.
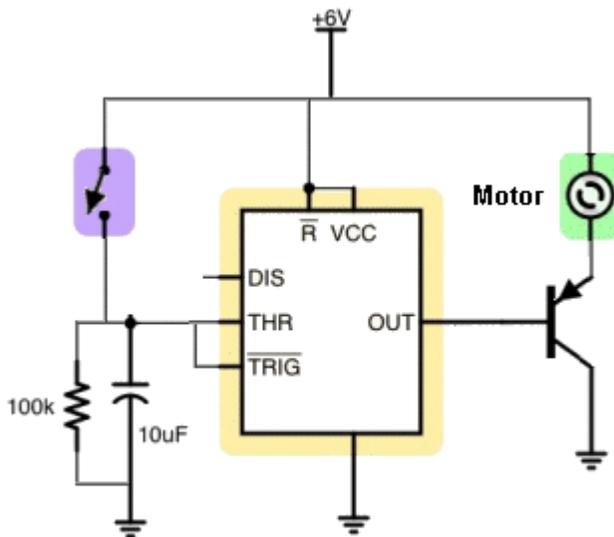

3-CHASE CHASER

555 chips are not very expensive and you can use them like "lollies" to create all sorts of effects.
This circuit produces a "chase effect" with 2 LEDs ON at any one time.
The advantage of this circuit is the HIGH POWER LEDs that can be connected to the output of the chips.
You cannot add any more stages as the circuit will not be self-starting.
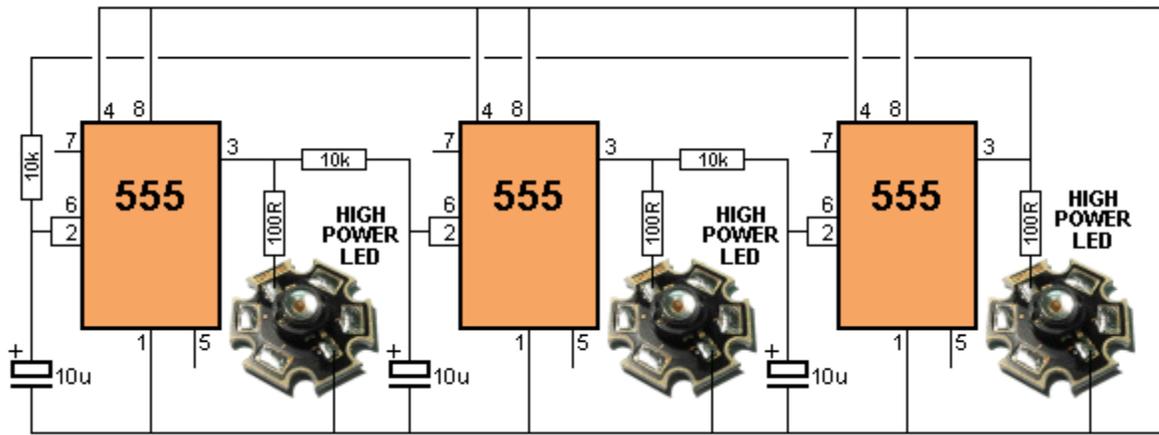
AIRCRAFT NAVIGATION BEACON
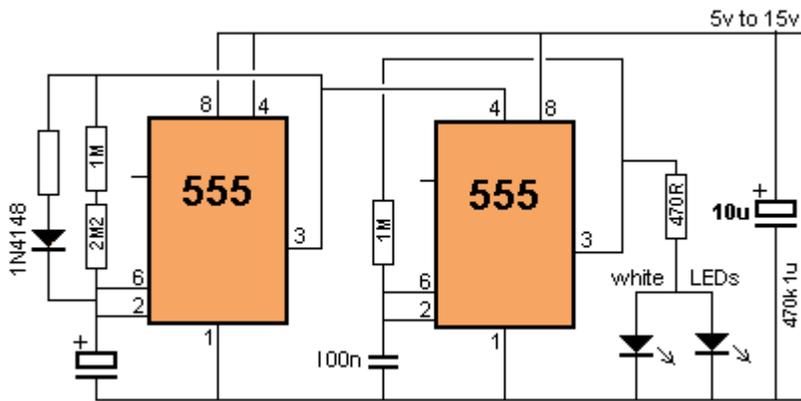
This project is available from Talking Electronics for $5.00 plus $4.00 post.
Buy A Kit It uses surface mount parts on a double-sided board 15mm x 15mm. Two very bright LEDs are mounted on the tips of the wings of your model aeroplane and the LEDs flash twice then delay 2 seconds before the next double flash.

FAULTS

Here are some circuits with faults. They come from projects on the web:

HEADLIGHT FLASHER

This circuit flashes headlights via a relay but the relay is only getting 9v4 due to the voltage-loss of the 555 and 0.6v of the transistor: The transistor should be common-emitter configuration.
In addition, the pot will be damaged if turned to zero ohms. A 1k should be placed in series with the pot (at pin7 end).
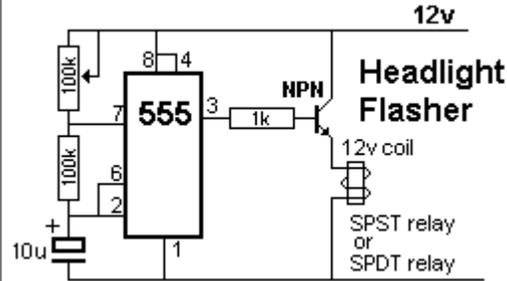
Here is a simpler circuit. It will need testing and adjusting to suit the relay you will be using:
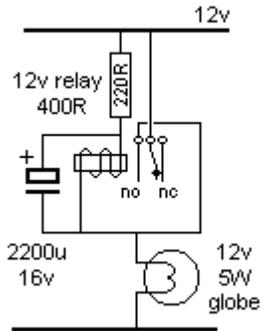
MISSING PULSE DETECTOR

This circuit is described on the web as a missing pulse detector. If the 1M pot is turned to zero ohms, it will be damaged when the transistor inside the 555 at pin 7 connects to 0v rail.

www.ECELab.com
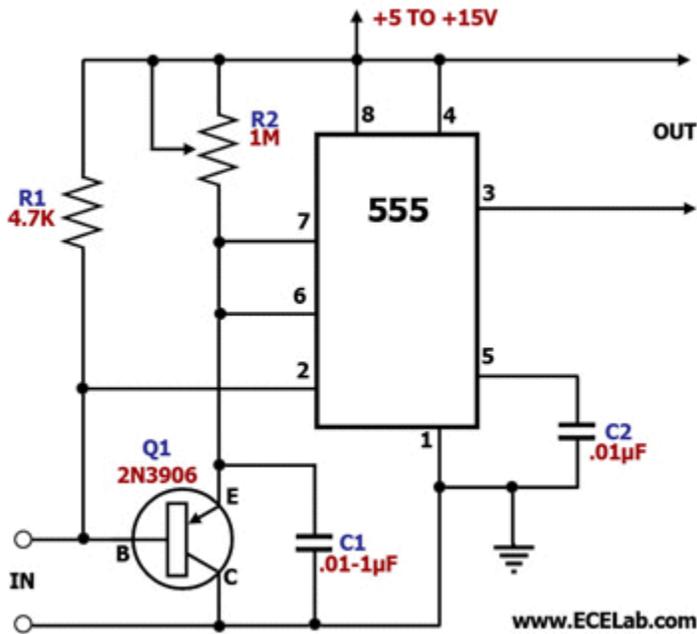
MERCURY SWITCH DETECTOR

This circuit is a LATCH CIRCUIT and it detects when the mercury switch is tilted. But it is consuming 10mA while it is

sitting around waiting for the mercury switch to make contact.
By replacing the 555 with two transistors, the circuit will
consume zero current when waiting for the switch to close.
Sometimes a 555 is not the ideal choice.
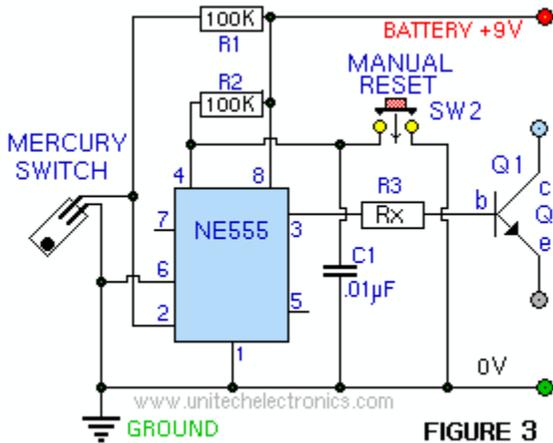
FIGURE 3
MERCURY TILT SWITCH DETECTION
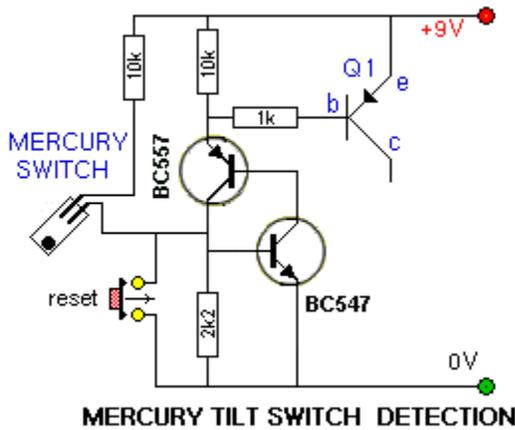
MERCURY TILT SWITCH DETECTION

What is the purpose of the 1k resistor?
Pin 6 is a high-impedance pin and 1k (or any value) will have no
effect.
(the same with pin 2). It is not needed.

The kit contains the following components:
(plus **extra** 30 resistors and 10 capacitors for
experimenting), plus:

2 - 220R
2 - 1k
2 - 4k7
2 - 10k
2 - 33k
2- 100k
2 - 1M
1 - 10k mini pot
1 - 100k mini pot
2 - 10n
2 - 100n
1 - 10u electrolytic
1- 100u electrolytic
2 - 1N4148 signal diodes
2 - BC547 transistors
1 - BC557 transistor
1 - 555 timer chip
1 - 8 pin IC socket
1 - red LED
1 - green LED
1 - orange LED
1 - mini 8R speaker
1 - mini piezo
1 - LDR (Light Dependent Resistor)
1 - 10mH inductor
1 - push button
4 - tactile push buttons
1 - **Experimenter Board** (will take 8, 14 and 16
pin chips)

THE FUTURE

This eBook has shown the enormous number of circuits
that can be produced with a 555.
However there is something we should point out.
The 555 has limitations and disadvantages.
It is not a chip you readily add to battery operated devices
as its current consumption is quite high at 10mA. (There is a whole
range of low-current equivalents.)
Secondly, the 555 is not a chip you add to a complex circuit as
there are many other chips that can perform the task of a
555 and you will have additional gates within the chip for other
sections of the circuit. The 74c14 is an example. It has 6 Schmitt trigger
gates and each gate can be wired as an oscillator or delay and the chip
takes less than 1mA.
Before designing a circuit around a 555, you should look at our
eBook: 100 IC Circuits. It has many "building Blocks" to help you design
your own circuits.

If 3rd band is gold, Divide by 10
If 3rd band is silver, Divide by 100
(to get 0.22ohms etc)

gold 5% 1R0
gold 5% 10R

ROW	SILVER	GOLD	BLACK	BROWN	RED	ORANGE	YELLOW	GREEN
1-	R10	1R0	10R	100R	1K0	10K	100K	1M0
2-	R11	1R1	11R	110R	1K1	11K	110K	1M1
3-	R12	1R2	12R	120R	1K2	12K	120K	1M2
4-	R13	1R3	13R	130R	1K3	13K	130K	1M3
5-	R15	1R5	15R	150R	1K5	15K	150K	1M5
6-	R16	1R6	16R	160R	1K6	16K	160K	1M6
7-	R18	1R8	18R	180R	1K8	18K	180K	1M8
8-	R20	2R0	20R	200R	2K0	20K	200K	2M0
9-	R22	2R2	22R	220R	2K2	22K	220K	2M2
10-	R24	2R4	24R	240R	2K4	24K	240K	2M4
11-	R27	2R7	27R	270R	2K7	27K	270K	2M7
12-	R30	3R0	30R	300R	3K0	30K	300K	3M0
13-	R33	3R3	33R	330R	3K3	33K	330K	3M3
14-	R36	3R6	36R	360R	3K6	36K	360K	3M6
15-	R39	3R9	39R	390R	3K9	39K	390K	3M9
16-	R43	4R3	43R	430R	4K3	43K	430K	4M3
17-	R47	4R7	47R	470R	4K7	47K	470K	4M7
18-	R51	5R1	51R	510R	5K1	51K	510K	5M1
19-	R56	5R6	56R	560R	5K6	56K	560K	5M6
20-	R62	6R2	62R	620R	6K2	62K	620K	6M2
21-	R68	6R8	68R	680R	6K8	68K	680K	6M8
22-	R75	7R5	75R	750R	7K5	75K	750K	7M5
23-	R82	8R2	82R	820R	8K2	82K	820K	8M2
24-	R91	9R1	91R	910R	9K1	91K	910K	9M1

10M
BLUE

COLOR CODES FOR THE WHOLE E12/E24 RANGE OF RESISTORS
The twelve odd rows - 1, 3, 5...- represent values available in the E12 range only, plus 10M