Circuits for the Hobbyist

For your electronics hobby entertainment; ENJOY!

It is assumed that you have AT LEAST the equivalent of a Basic Electronics certificate for the electronics projects listed on this page. Other projects require more advanced electronics. A lot of these circuits assume the latter so I will no longer answer the tons of emails in regards to that. If you wish to learn more about electronics there is enough of that available on the internet.

NEW! **Circuits' Message Board** Ask your questions here. Someone may answer them.

Circuits

- Alternating On-Off Control
- Audio Pre-Amplifier #1
- Automatic 9-Volt Nicad Battery Charger
- Basic IC MonoStable Multivibrator
- Basic RF Oscillator #1
- Basic LM3909 Led Flasher
- Battery Monitor for 12V Lead-Acid
- Battery Tester for 1.5 & 9V
- Bench Top Powersupply, 0-30V/0-10A, Part 1
- Bench Top Powersupply, 0-30V/0-10A, Part 2
- Bench Top Powersupply, 0-30V/0-10A, Part 3
- Birdie Doorbell Ringer
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- Car Converter for 12V to 9V
- Car NiCad Charger
- DC Motor Reversing Circuit
- DC Motor Control Circuit
- Gel Cell Charger, I - Off-line
- Gel Cell Charger, II
- Clock Generator
- Christmas Lights Tester
- Continuity Tester, Low-Voltage
- Continuity Tester, Smart
- Continuity Tester, Latching NEW
- ScanMate Your (Radio) scanner buddy! Error-Fix! 6-20-2002
- Simplest R/C Circuit
- Simplest RF Transmitter
- Simple Transistor Audio PreAmplifier
- Single IC Audio Preamplifier
- Solar Cell NiCad Charger UPDATED 7-24-2002
- Solid State Relay
- Third Brake Light Pulser
- Toroids, RF/EMI Cores
- Touch Activated Alarm System
- Two-Tone Trainhorn
- Universal Flasher Circuit
- Variable Power Supply, 1 - 30V @ 1.5A
- Wailing Alarm
- Water-level Sensing and Control
- Waterpump Safety Guard for Fish-pond
- Weller WLC100 Electronic Soldering Station NEW
- Xmas Lights Tester
- Zap Adapter
- 1.5V Tracking Transmitter
- 4-Transistor Tracking Transmitter

- Cut Phone Line Detector
- Dark/Light Activated Relay
- Electronic Dazer UPDATED 6-13-2002
- Fluid-Level Detector
- High Voltage circuits Interesting HV devices
- Lantern Flasher/Dimmer
- Led Flasher, 2 transistor
- Leds Flasher, alternately
- LED Pilot Light (AC or DC)
- Light Sensor With Hysteresis
- Logic Probe with pulse
- Logic Probe with pulse, CMOS
- Micro-Spy with FETs
- Micro-Spy with USW
- Micro-Spy with TTL
- Miniature FM Transmitter #1
- Miniature FM Transmitter #2
- Miniature FM Transmitter #3
- Mini-Drill variable Powersupply
- Missing Pulse Detector (Basic)
- Morse Code Practice Keyer, I
- Morse Code Practice Keyer, II
- Motor Accu Lader (Dutch)
- Motorcycle Battery Charger Error-Fix!
- No-Hassle Third Brake Light
- 9 to 9 pin (Female) Nullmodem Cable
- Practical Intercom NEW
- Pulse Width modulator NEW UPDATED 8-07-2002
- RF Transmitter, light sensing
- RJ45 Cable Tester
- Radio Shack Special
- 9-V Stabilized Powersupply
- 30-Meter QRP Transmitter for Morse Code
- 555 Timer IC Tester UPDATED 5-30-2002
- 555 Go No/Go Tester More advanced
- 741-Light Sensor

Tutorials

- 555 Timer/Oscillator
- 741 Op-Amp
- Capacitors UPDATED 6-28-2002
- Electronic Template
- MosFet Test
- Piezo Education/Tutorial
- PLL - Almost done!
- Resistor Color Code Tutorial
- SCR Tester UPDATED
- Triac Test UPDATED
- UJT Test
- Coils
- Integrated Circuits
- Make Your Own Shunts
- Relays, Relay Drivers, Solid-State

"Green" means on-line, "Red" means off-line

Bookmark this valuable page with *'Ctrl-D'*.

Info/Data

- Circuits Archive - Older circuits. Most are working, some are not. Could be still useful.
- Radio Shack Partnumbers - Most common order numbers for my circuits
- Tandy Corporation - European/Australian counterpart of Radio Shack
- TUP/TUN/DUS/DUG European transistor replacement system
- Tomi Engdahls' Page - Solid electronics projects!
- Jan Freak's Page in the Netherlands - Well thought out information. Dutch language only
- Bowden's Hobby Circuits - Collection of circuits, for everyone.
- Circuit Exchange International - Andy's website. Good selection of excellent circuits
- Electronic Tutorials - Collection of electronics tutorials.
- Dolbowent.Com - Electronic Surplus and Engineering Support.
- Jordan's Electronics Page - Lots of good circuits here also.
- LED Webpage. White Led's everywhere - Malcom's site in the UK.
- Guelph Amateur Radio Club - GARC--Official Homepage NEW
- PA3BWK's Ultimate Morse Code Website - Wilko Hollemans site in the Netherlands
- Larry's Robotics & Electronics Page - Many good circuits
- ElectronicsZone - Naveen's Website
- Spark Museum - John D. Jenkins amazing collection of antique wireless & scientific instruments NEW

DISCLAIMER: I take no responsibility whatsoever for the use and/or implementation thereof, or the misuse leading to damage to equipment, property, or life, caused by the above circuits. Check with local, provincial and federal laws before operating some of these devices. You may also check your life insurance and/or the fact if they cover death by electrocution if you intend to play with Micro-wave ovens and other lethal HV devices. Safety is a primary concern when working with high power circuits or con/inverters. Play it safe!

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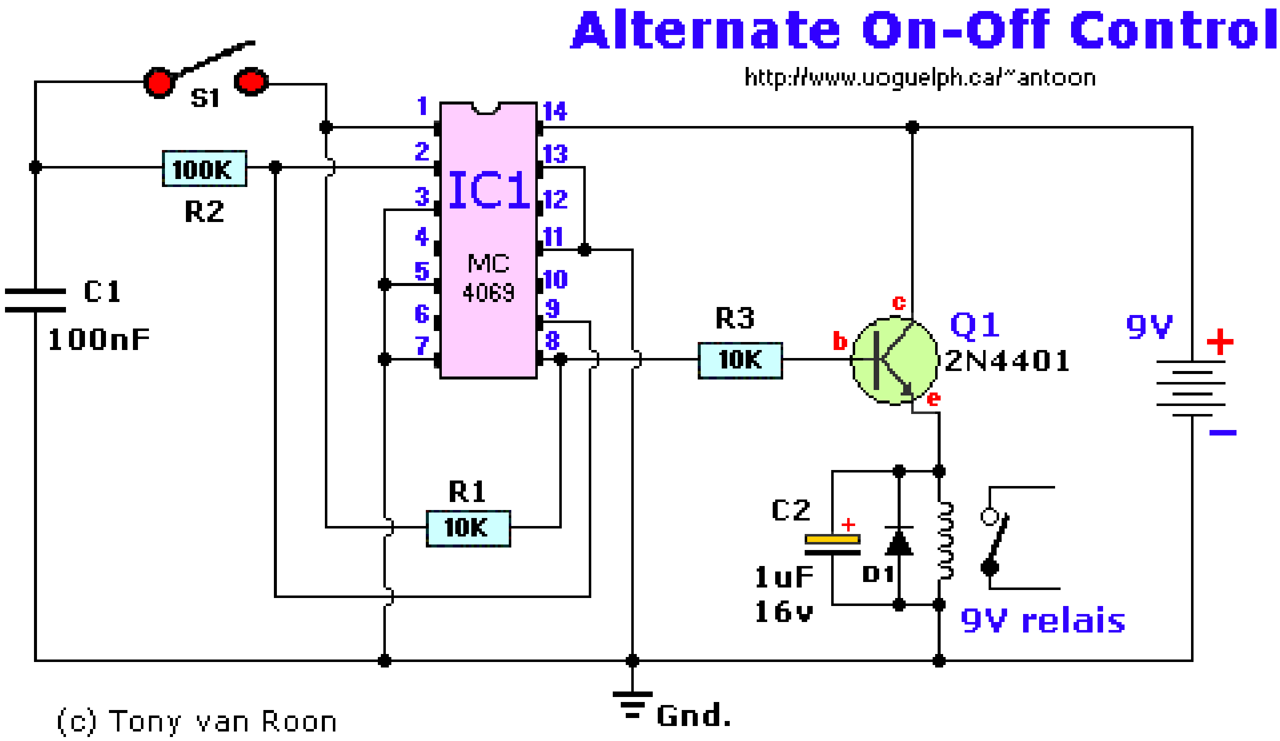
Last Updated: August 7, 2002

Alternating ON-OFF Control

by Tony van Roon

Use this circuit instead of a standard on-off switch. Switching is very gentle. Connect unused input pins to an appropriate logic level. Unused output pins *MUST* be left open!. First 'push' switches ON, another 'push' switches OFF. You can use 1/4 watt resistors if they are metal-film type. Any proper substitute will work for Q1, including the european TUN's. For C2, if you find the relay acts not fast enough, leave it out or change to a ceramic cap between 10 and 100nF.



Parts List

All resistors are 1/2 Watt and 5% tolerance.

R1 = 10K

R2 = 100K

R3 = 10K

C1 = 0.1µF, Ceramic

C2 = 1µF/16V, Electrolytic

D1= 1N4001

Q1 = 2N4401 (ECG123AP, NTE123AP, etc.)

IC1 = 4069, CMOS, Hex Inverter (14069), or equivalent

S1 = Momentary on-switch

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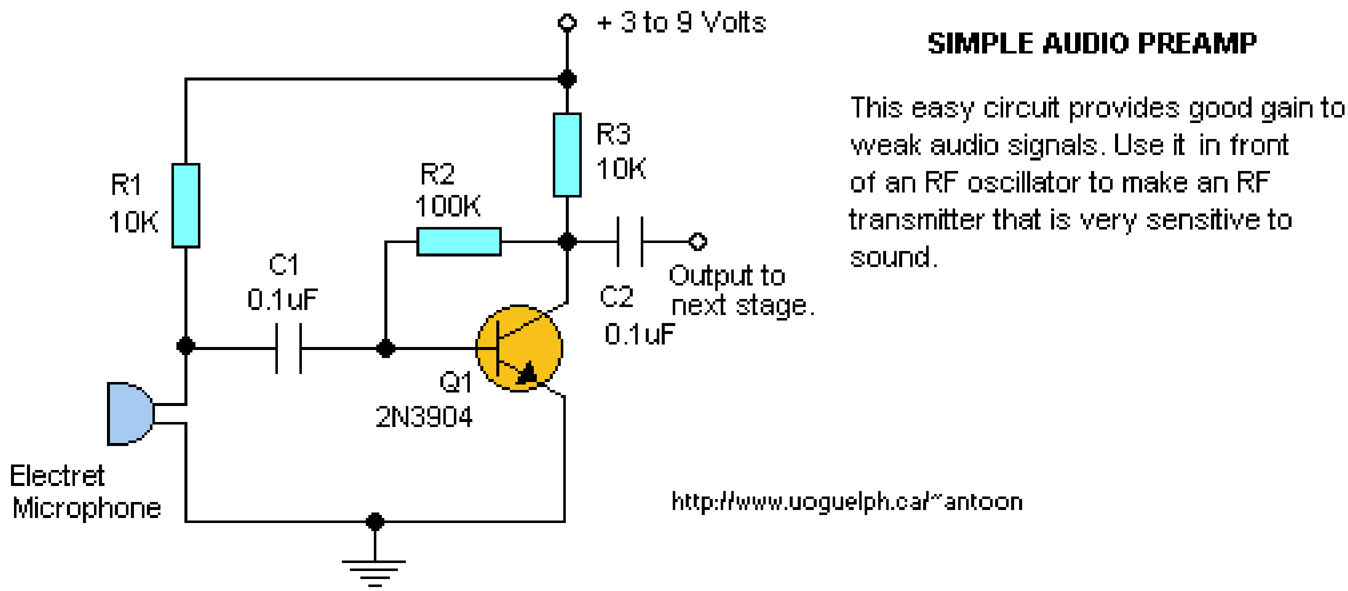
Audio Pre-Amplifier



Additional Notes
(N/A)

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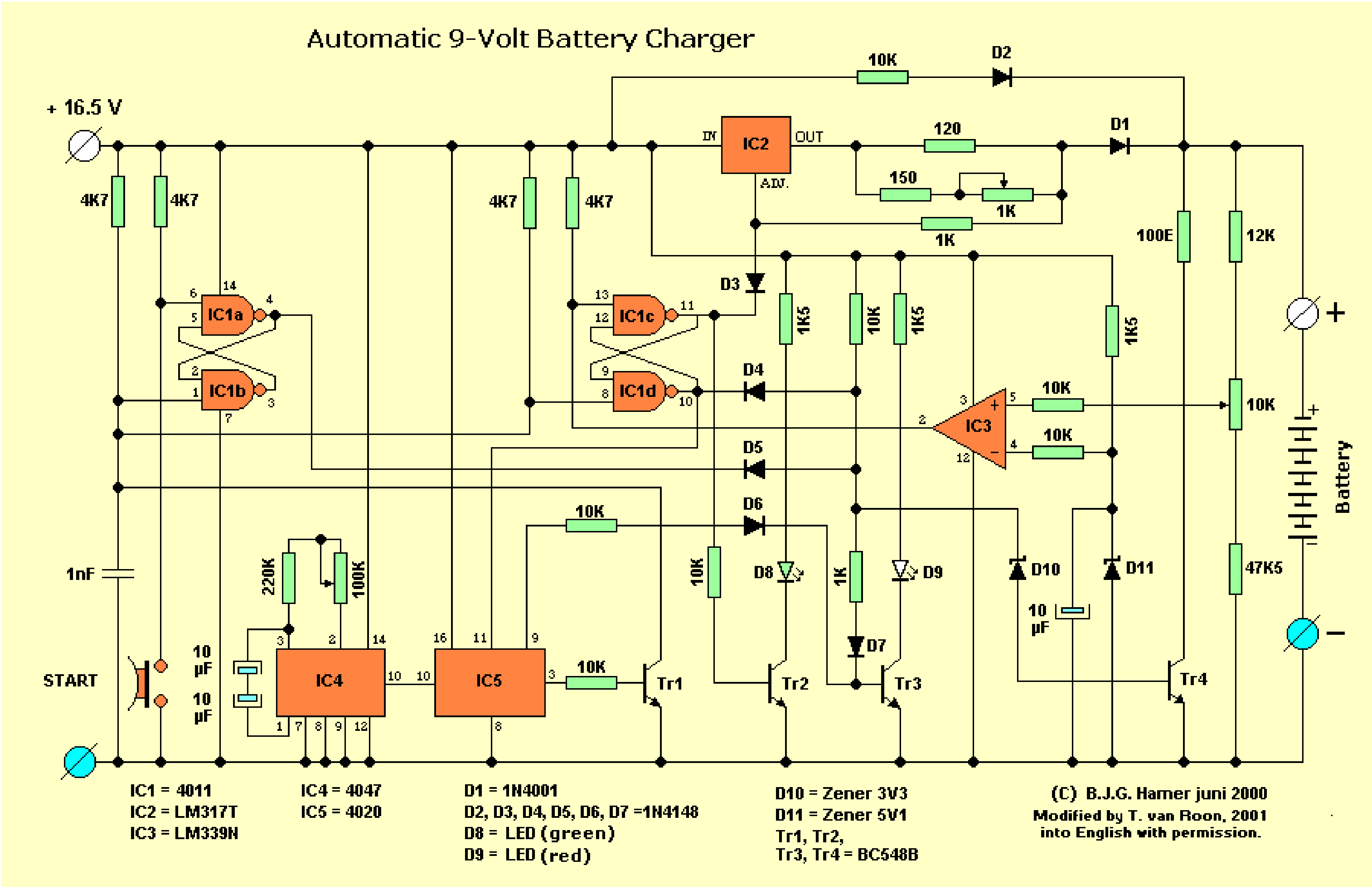

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Good care given to your NiCad batteries will ensure a long life. However, they do need to be handled and charged with special care.

It is therefore important to first discharge the NiCad to 1 Volt per cell, ensure that the battery is discharged, and then start the charge cycle. Manufacturers recommend a charge current of 1/10th the capacity for a duration of about 15 hours uninterrupted.

In reality, we learn some hard lessons when we forget to switch the charger off after the 15 hours and find that one or more cells inside the battery no longer accept a charge. That is the very reason that the circuit above is fully automated.
The only thing to do is connect the battery and press the 'Start' button. When the discharge cycle is finished the circuit switches over to charge for 15 hours. After the 15 hours the circuits maintains a trickle charge to keep the battery 'topped-up'.

Before I go into the schematic details I like to explain some of the component descriptions in the schematic. Jan Hamer lives in the Netherlands and so the circuit details are based on european standards.
120E, 150E, etc. The '**E**' just stands for Ohms so 120 ohm, 150 ohm. The original circuit specified the HEF type of cmos IC's which are not readily available in most of Canada. So just get any other type of CMOS chip like the MC4011, MC4020, MC4047 from Motorola. Any other type will do fine too. The BC548B is replaceble by a NTE123AP (NOTE: make sure it is the 'AP' type, the regular NTE123A is a total different transistor), ECG123AP, and the 2N3904 will work also. Watch for the correct pin locations since the BCE may be reversed with this european type. The LM317T is a TO-220 type and replaceble with a ECG956 or NTE956. The LM339N can be replaced with a ECG834 or NTE834

Although this circuit looks quite impressive and maybe a bit difficult it is certainly not difficult to understand. The circuit needs to be hooked-up to a DC supply voltage of between 16.5 and max 17.5 volt, otherwise the CMOS IC's will go defective. Because I didn't feel like to design a seperate powersupply for this circuit I connected it to my fully adjustable bench top powersupply.
First we connect a 'to-be-charged' 9-volt nicad battery to the appropriate connections. Then hook it up to the powersupply. Upon connection the 1nF capacitor starts up the two RS Flip-Flops formed by IC1a, IC1b, IC1c, IC1d, and pulls pins 3 and 10 'high' and pins 4 and 11 'low'. The clock pulses are created by the free-running multivibrator IC4. IC4's frequency is determined by the 10uF capacitors, the 220K resistor and the 100K trimpot. The clock runs continuesly but the counter behind, IC5, is not counting yet because pin 11 (the master-reset) is kept high. When the 'START' button is pressed, output pin 4 from IC1a goes high and biases TR4, which is made visible by the Red LED (D9) which remains lit. The NiCad is now being discharged via this transistor and the 100 ohm resistor.
The 10K trimpot (at the right of the diagram) is adjusted in such a way that when the battery voltage dips below 7 volt, the output of IC3 goes LOW and the output pin 11 of IC1a HIGH. At hte same time the output pin 10 of IC1d goes LOW, and the red LED turns off.
Because output pin 11 went HIGH the green LED (D8) lights up and at the same time the voltage level rises causing the battery to be charged. The charge-current is determined by the 120 ohm, 150 ohm, and the trimpot of 1K, at the right side of IC2. Actually we could have used one resistor, but the output voltage of different brands for IC2 may differ, by about 1.25 volt.
Because the charging current is devided by value of the resistors, with the trimpot the current can be adjusted to the correct value of your own 9-volt NiCad. (In my case, the battery is a 140 mA type, so the charge current should be adjusted for 14 mA (c/0.1).
At the same time the LOW of output pin 10 from IC1d starts the counter of the clock. On pin 9 of IC5 appear pulses which light up the red LED. This is implemented for two reasons, the clock-frequency can, with the 100K trimpot, be adjusted to the correct value; the red LED has to come ON for 6.59 seconds and for the same duration going OFF and except for that fact the green LED, who indicates the charge current, can be checked if the total charge-time is correct.
When the counter has reached 8192 pulses (x 6.59 = 53985.28 sec = 14.99 hours) the output pin 3 of IC5 goes high again, transistor Tr1 activates and resets the two flip-flops to the start position.
The charging process stops and goes over to trickle charge via the 10K resistor and the D2 diode and keeps the battery topped-up.
The adjustments of the project are really very simple and nothing to worry about. Turn the walker of the 10K pot in the direction of the 12K resistor, ground connection point of 10K resistor/diode D2, like the adjustment pin of IC2, apply a voltage of 7-volt to the battery connection terminals, switch the power ON and slowly turn the pot backward until the greeen LED starts to light up. Switch OFF the power and take away the connections you made to make the adjustment.
Insert an amp-meter between the battery and the output connection and again switch the power ON. The battery will, in case it is not completely empty, totally discharged (to a safe level) and as soon as the 7 volt margin is reached goes over to the charge cycle. The charge current is at this time adjusted via the 1K trimpot (which is connected in series with the 150 Ohm resistor and in parallel with the 120 ohm resistor) accurately to the desired value.
Addendum: It is strongly recommended to include small 100nF ceramic capacitors over the powersupply lines feeding EACH CMOS IC to keep possible interference to a negliable value.

If you have improved upon or know ways to improve it, Jan Hamer will appreciate your feedback. Klick on his name at the top of this page or contact him via his website specified below. Thanks!

Please visit Jan Hamer's website in the Netherlands!

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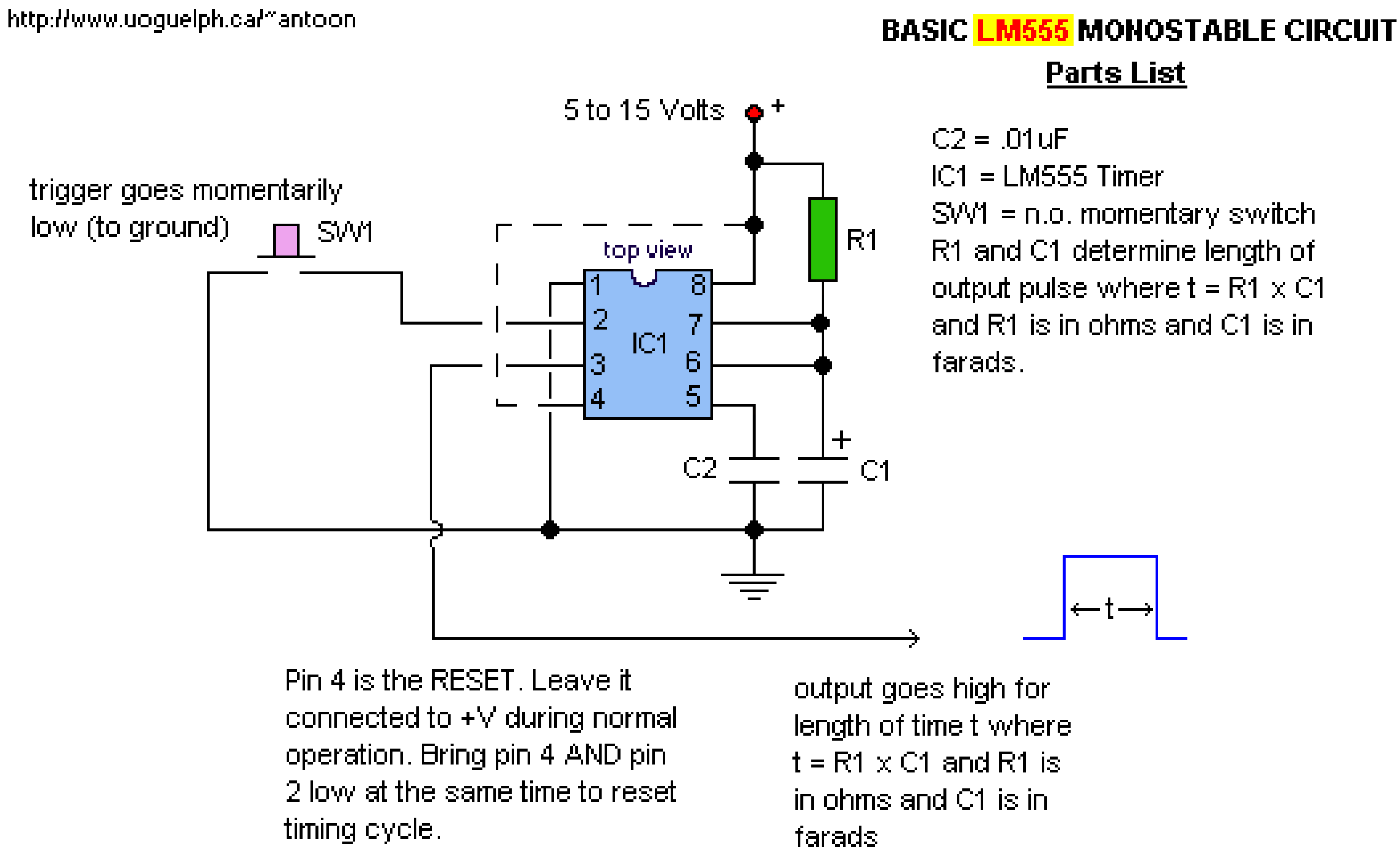
Basic IC MonoStable Multivibrator

by Tony van Roon



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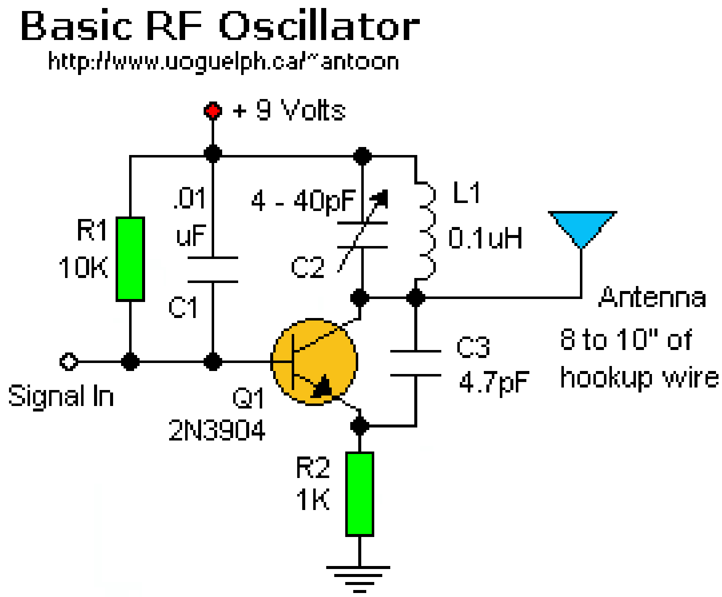

This basic circuit is easy to build and the components are not critical. Most of them can be found in your junk parts box. The L1 antenna coil can be made by close winding 8 to 10 turns of 22 gauge insulated hookup wire around a 1/4 inch form such as a pencil. You can experiment with the size of the coil and the number of turns to see how it affects the frequency and signal output of the oscillator. You should be able to pick up its signal with a standard FM radio receiver. The "Signal in" should be coupled by a disc capacitor of about 0.1uF to the stage in front of it.

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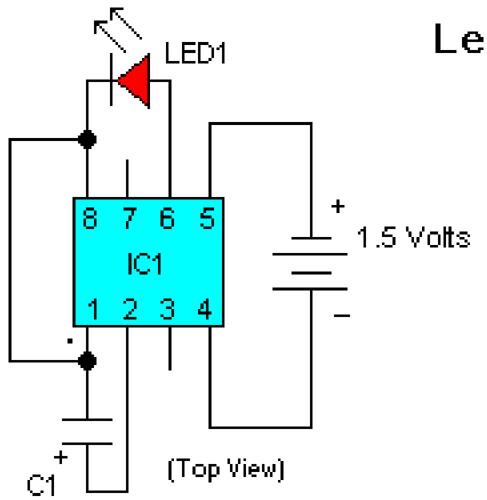

Led Flasher with the LM3909 IC

http://www.uoguelph.ca/~antoon

PARTS LIST

C1 = 100uF electrolytic capacitor
IC1 = LM3909 led flasher IC
LED1 = Red LED
Battery = 1.5 Volt AAA

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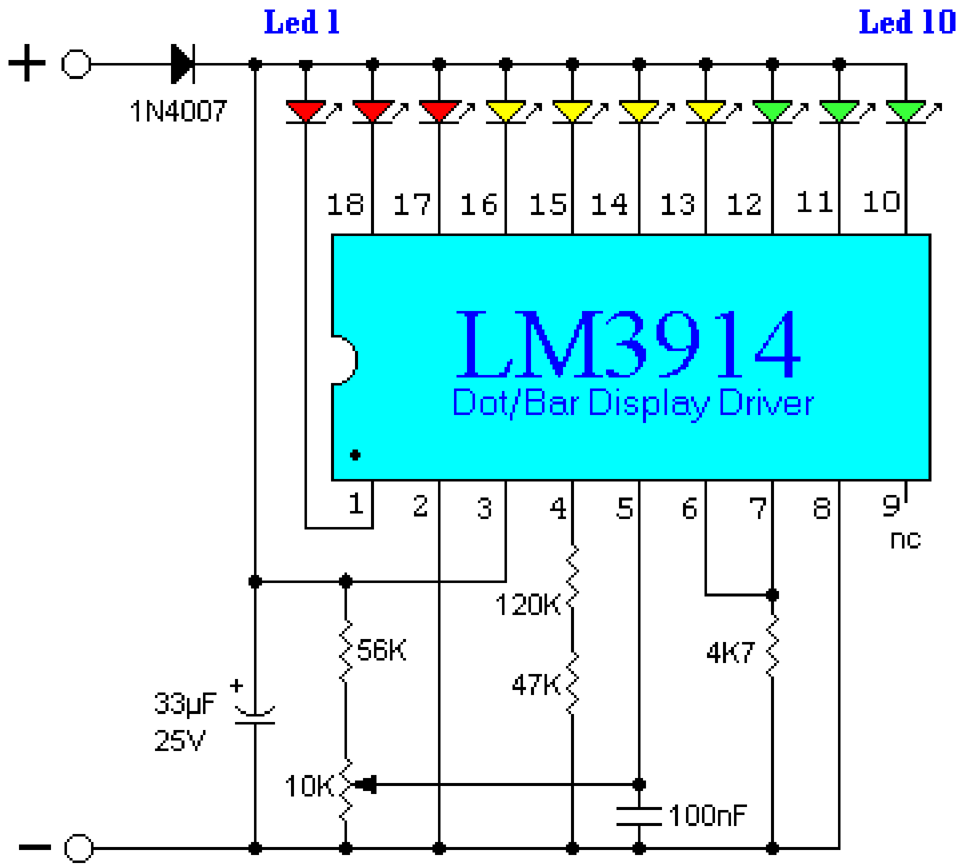
12 V Lead-Acid Monitor



(C) 2001 Jan Hamer (NL)

Posted with permission of Jan Hamer

This simple circuit makes it posible to monitor the charging process to a higher level.
Final adjustsments are simple and the only thing needed is a digital voltmeter for the necessary accuracy. Connect an input voltage of 12.65 volt between the positive and negative poles and adjust the 10K trimmer potentiometer until Led 10 lights up. Lower the voltage and in sequence all other Led's will light up. Check that Led 1 lights up at approximately 11.89 volts.

At 12.65 volt and higher the battery is fully charged, and at 11.89 is considered 'empty'.
The green Led's indicate that the battery capacity is more than 50%, the yellow Led's indicate a capacity of 30% - 50% and the red Led's less that 30%. This circuit, with the components shown, uses less than 10mA.
Ofcourse you can adapt this circuit to your own needs by making small modifications. The circuits above is set for 'DOT' mode, meaning only one Led at a time will be lit. If you wish to use the 'BAR' mode, then connect pin 9 to ground, but obviously with increased current consumption.
The LED brightness can be adjusted up- or down by choosing a different value for the 4K7 resistor

connected at pin 6/7
You can also change the to monitoring voltage level. For example, let's say you wanted to change to 10 - 13 volt, you connect 13volt to the input (+ and -) and adjust the 10K potentiometer until Led 10 lights up. Change temporarily the resistors at pin 4 with a 200 Kilo-ohm potentiometer and reconnect a voltage from 10 Volt to the input. Now, re-adjust the 200K potentiometer until Led 1 lights up. When you are satisfied with the adjustment, feel free to exchange the 200K potentiometer with resistors again.(after measuring the resistance from the pot, obviously).
The diode 1N4007 was included to protect the circuit from a wrong polarity connection.
It is however strongly recommended to connect the monitor directly to the battery, in principle a connection to the cigarrette lighter would suffice but for reasons unknown at this time the voltage at that point is 0.2 volt lower than the voltage measured directly on the battery. Could be some residual resistance caused by ignition switch and path through the fuse?

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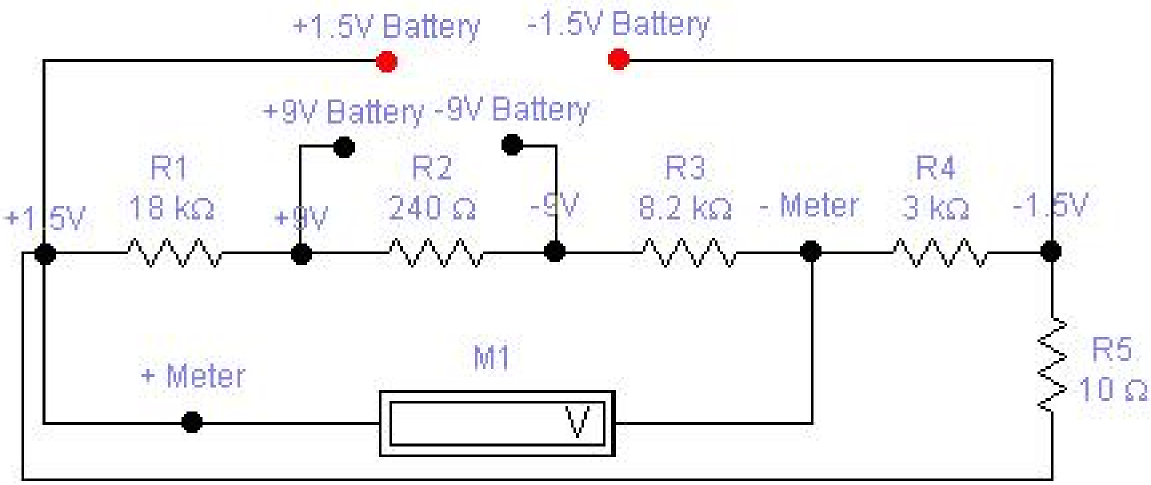
Battery Tester for 1.5 and 9V

by Matthew B.



Parts List:

R1 = 18K
R2 = 240 Ohm
R3 = 8.2K
R4 = 3K
R5 = 10 Ohm
M1 = Panel Meter (Anyone will work)

Design Considerations:

You may have experiment with the values of R3 and R4 to get an accurate reading from the meter. Every meter is different, so a little bit of playing with the resistor values is required.

Try using a variable resistor in place of R3 & R4 to get a value of resistance that works.

If you have questions or suggestions please contact Matthew B.

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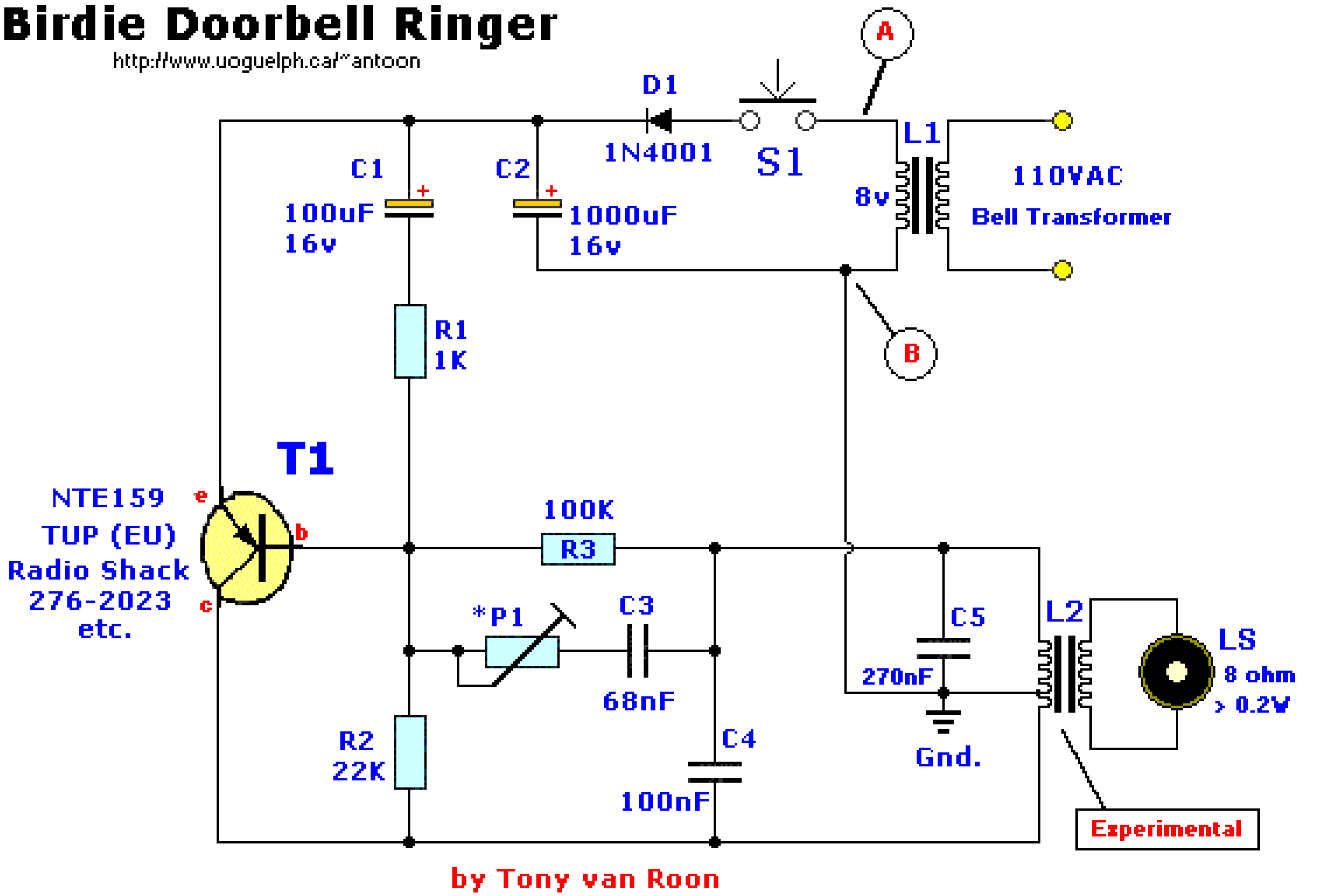

Notes

P1 is of experimental value. Start with 220 Ohms or so and modify to suit your needs. The transistor is a general purpose kind and is not critical, almost any pnp type will work. L1 is a bell-transformer which is usually already present in the house. If you wish, you could use a battery instead of the bell transformer. Just hookup a 9-volt battery to points 'A' and 'B' (A=+) the diode (D1) is to protect the circuit from accidental polarity reversal and is optional, but required for use with the bell transformer.
T1 is a General Purpose PNP transistor and probably anything will work. L2 comes out of an old am transistor radio. They look like miniature transformers and are usually colored red or green. You have to fiddle with different transformers as the sound can vary depending on the value. The loudspeaker is a 8 Ohm type and must be larger than 200milli-Watt. I used a 2Watt type, but anything over 0.2W will do. It really sounds like a bird and when you release the doorbell button the sound slowly fades away. I have used this circuit in my house for over 20 years and even build the "Birdie" for others. Although an old circuit, the experimentation and the final results still give a punch. Remember to Have fun!

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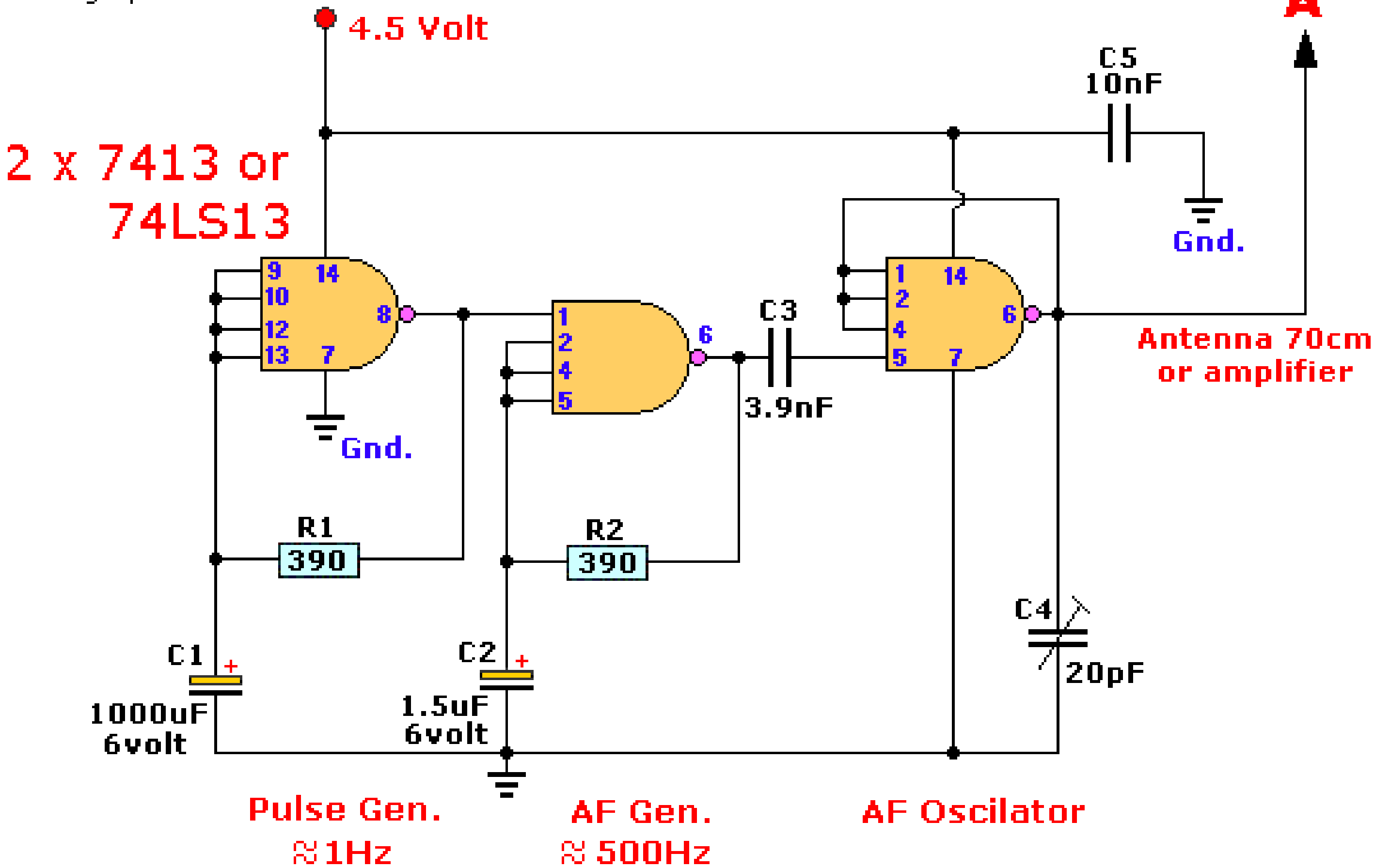
Bug Detector with Beep

by Tony van Roon

http://www.uoguelph.ca/~antoon



Parts List

R1 = 390 ohm, 5%
R2 = 390 ohm, 5%
C1 = 1000uF, 6V
C2 = 1.5uF, 6V
C3 = 3.9nF
C4 = 20pF, trimmer
C5 = 10nF (0.01uF)
IC = SN7413 or SN74LS13 (2)

Please note: This circuit is not open for discussion. Although working perfectly, it was experimental. I will answer no emails in regards to this circuit.

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12Volt to 9Volt DC Converter

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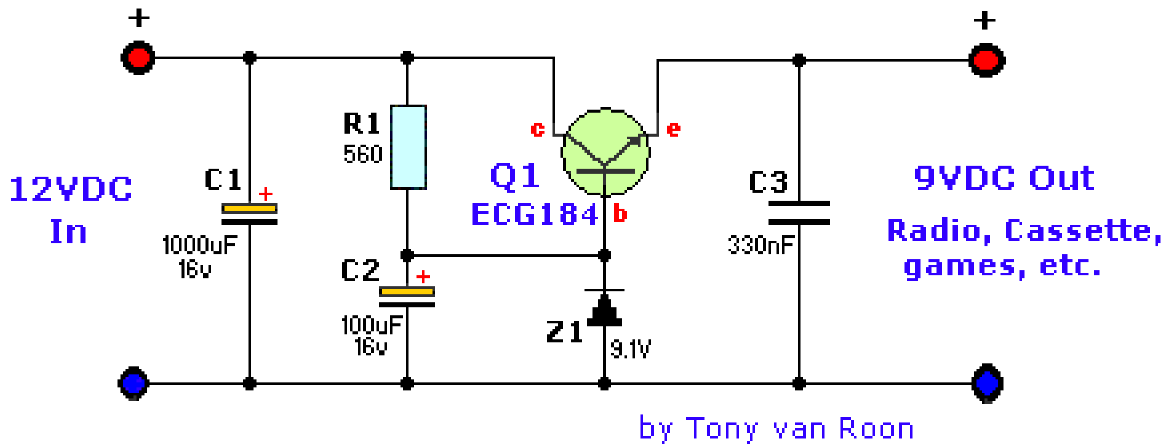

Parts List:

R1 = 560 ohm
C1 = 1000µF/16V, Electrolytic
C2 = 100µF/16V, Electrolytic
C3 = 330nF, Ceramic
Z1 = 9.1V, 0.4watt zener
Q1 = ECG184, NTE184

Notes:

To get a more precise output voltage, replace zener diode Z1 with 10V and R1 with a 1Kilo ohm potentiometer. A Coolrib for Q1 is optional. Simple circuit to power your 9 volt cassette recorder and other stuff.

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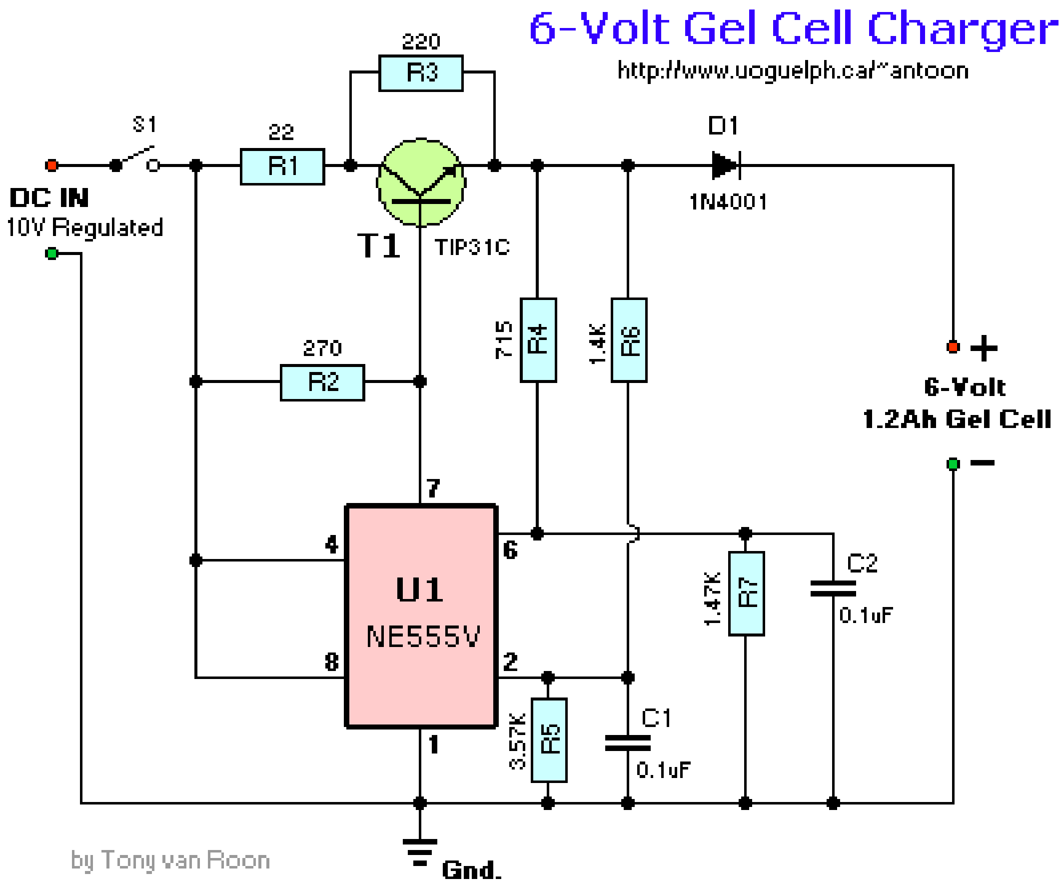

Parts List:

Resistors are carbon, 1/4 watt, 5% tolerance, unless otherwise indicated.

R1 = 22 ohm, 1W
R2 = 270 ohm
R3 = 220 ohm
***R4 = 715 ohm, 1%**
***R5 = 3.57K, 1%**
***R6 = 1.40K, 1%**
***R7 = 1.47K, 1%**

C1 = 0.1µF, ceramic
C2 = 0.1µF, ceramic
D1 = 1N4001
T1 = TIP31A, B, C (or equivalent)
U1 = NE555V (or equivalent)
S1 = Toggle switch, ON-OFF

Description:

This circuit needs a regulated 10V-DC front end capable of supplying 2 Amps. Starts the charge cycle at 240mA and at full charge switches automatically to a float condition (trickle charge) of 12mA.
The capacitors are the ceramic 50V (or better) type. Switching transistor T1 is an NPN, Si-Power Output/SW, with a TO-220 case and can be replaced with a suitable substitute like the NTE291, ECG291, etc.
Timer/Oscillator U1 is a 8-pin NE555V and can be replaced with a NTE955M or ECG955M.
Resistors R4, R5, R6, and R7 are 1% metal film types. They may not be available at your local Radio Shack/Tandy store and have to be ordered in. Try Electro-Sonic or Newark Electronics supply stores.

NOTE: For 6-volt, 1.2Ah Gel Cell type batteries only!

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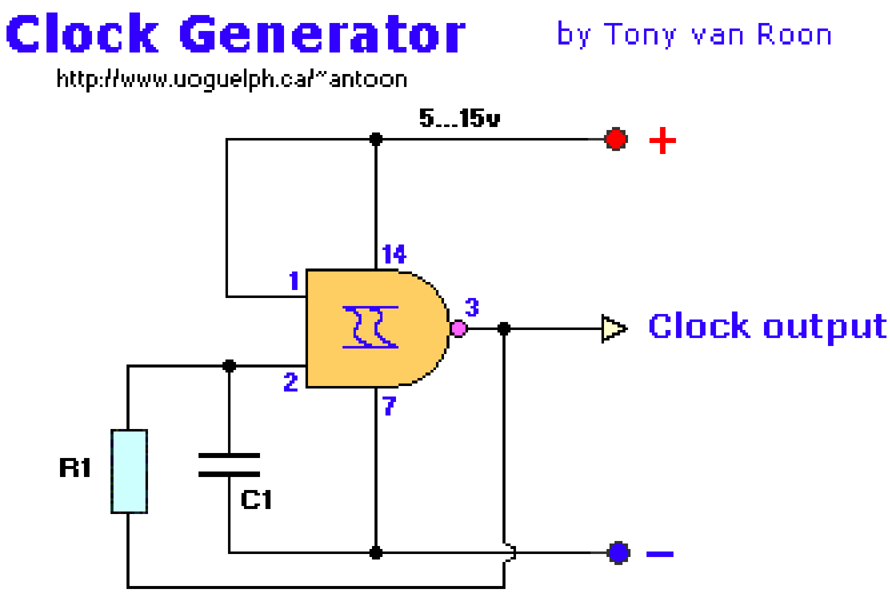

o - Excellent clock generator to drive 4017 type cmos circuits.
o - R1 = 10K to 10M, C1 = 100pF to 47uF.
o - Fo is ±1Kz when R1=100K and C1=10nF.
o - Input voltage can be from 5 to 15V.

Please note: I will answer no email in regards to this circuit.

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Chrismas Lights Tester

© by Jan Hamer

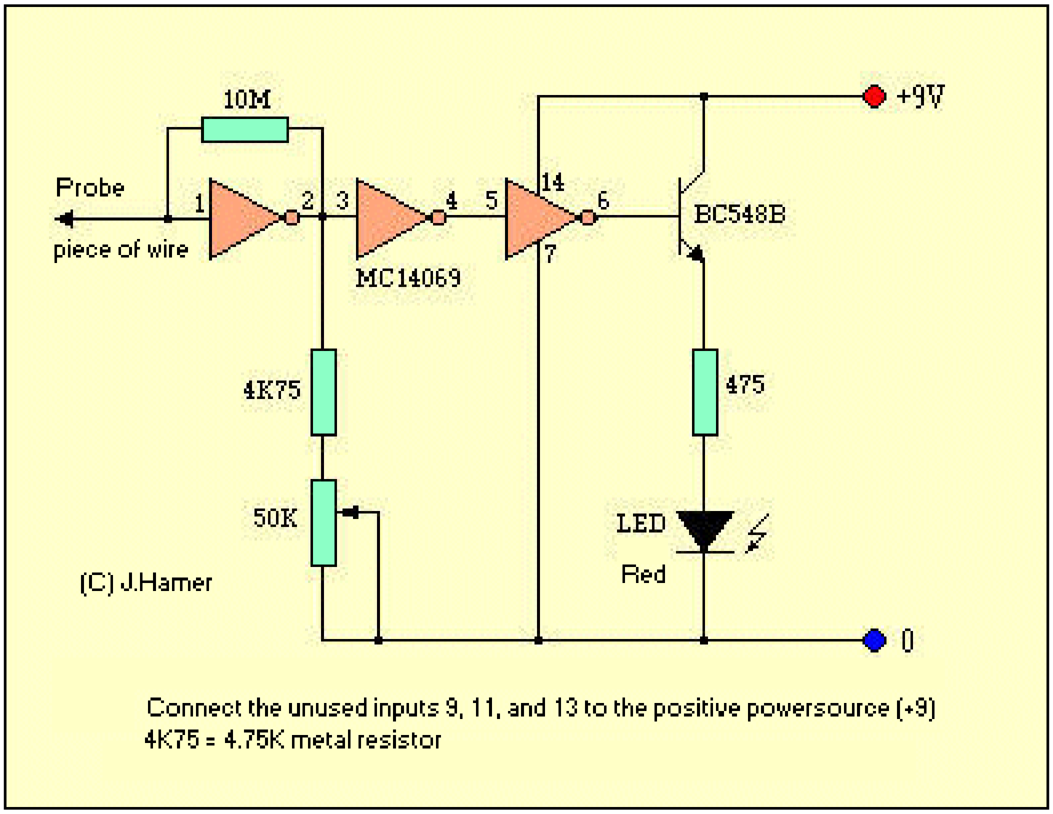
Like every year arround the same time, I hurried to get my Christmas tree all set up and the first thing we do when the tree is 'standing' we like to hang the lights in the tree. Okay, better first test them before putting all 50 of them in the tree. Yep! Working beautifully. I started a carefully planned organization of the lights so they would be evenly devided over the branches. Now the second string of lights, tested, yep working. In the tree with them. Putting the plugs into the receptacle and... oh no-- one series of them are on in full glory, all the others are out. Annoyed I tried to 'fix them' by trying to push each bulb further into their sockets. Still no go.

It was a crime trying to pull all the bulbs out of their sockets to measure them for continuity. Funny enough, and against the law of nature, it was not even the last bulb in the string of 50 which was defective, but number 41.
I put a new bulb in it, and yes here we go, they all light up beautifully. Alright! Happy again I again hung them in the tree. Finally the big moment arrived, as soon as I plugged them in they would shine in all their glory. Right? Oh no! The second I plugged in my lights only the first series of bulbs lighted up, same as before. All my work for nothing. Sigh...

In the mean time is was already way past midnight and so I decided for my next attempt to wait till next morning. Irritated and very annoyed I went to bed. However, I was so irritated that I could not sleep immediately and so was thinking of a smart way to get to the defective bulb the easy way. All over sudden I got it; if the bulb was not lit, there was no current draw either and up to the defective bulb I would measure the 115V AC (phase). Now I knew the solution I almost fell asleep satisfied right away.

The next day I had to get some groceries in I noticed new xmas lights for a small price. $5.95 for a string of 100 lights, and with a CSA and UL sticker. Wow, I thought for that kind of money I might as well forget the repair and buy a new set. So I did. Coming home I plugged the new lights into the receptacle and yes, all 100 were doing fine.

Happy again with the new lights I again hung them in to the Christmas tree, not suspecting that this could be another rotten day. After fiddling with the lights to get them all neatly organized in the tree the moments had arrived to plug them in and awe at the fascinating beauty of those little lights. Yes? NO! Not again. Isn't this to explode out of your skin! Angry I was looking for a solution, but there was none. I finally decided to put a circuit together on pieace of experimenters board from Radio Shack.



The heart of this little "CIRCUIT" is established by a hex inverter IC, the MC14069.
By positive feedback to the input, the first inverter acts as an analogue amplifier, which amplification can be adjusted a bit via the 50K trimpotentiometer.

To get the correct polarity on the basis of the transistor a second and third stage inverter have been added the same way. The others I put to the positive input voltage of the 9-volt battery.
When you touch a voltage carrying wire, with the antenna connected to pin 1 of the MC14069, the led will light up. The antenna is just a sturdy small piece of wire.

Armed to the teeth with this little tester I re-investigated the cords. At the first try I ofcourse picked the wrong wire; the neutral (0). The moment I tried it on the other wire (phase) the led came on right away. I followed the cord from bulb to bulb sliding the piece of antenna wire over the cord until I hit the broken xmas bulb and the led went out. Aha! Finally got the bloody little sucker! The broken bulb showed voltage on one site of the wire (led on) and none at the other end of the bulb (led off). This little tester can also be used for other AC applications, like checking for broken wires behind the wall and stuff.

If you have questions about this circuit, please direct them to Jan Hamer or visit his website in the Netherlands (if you can read Dutch).

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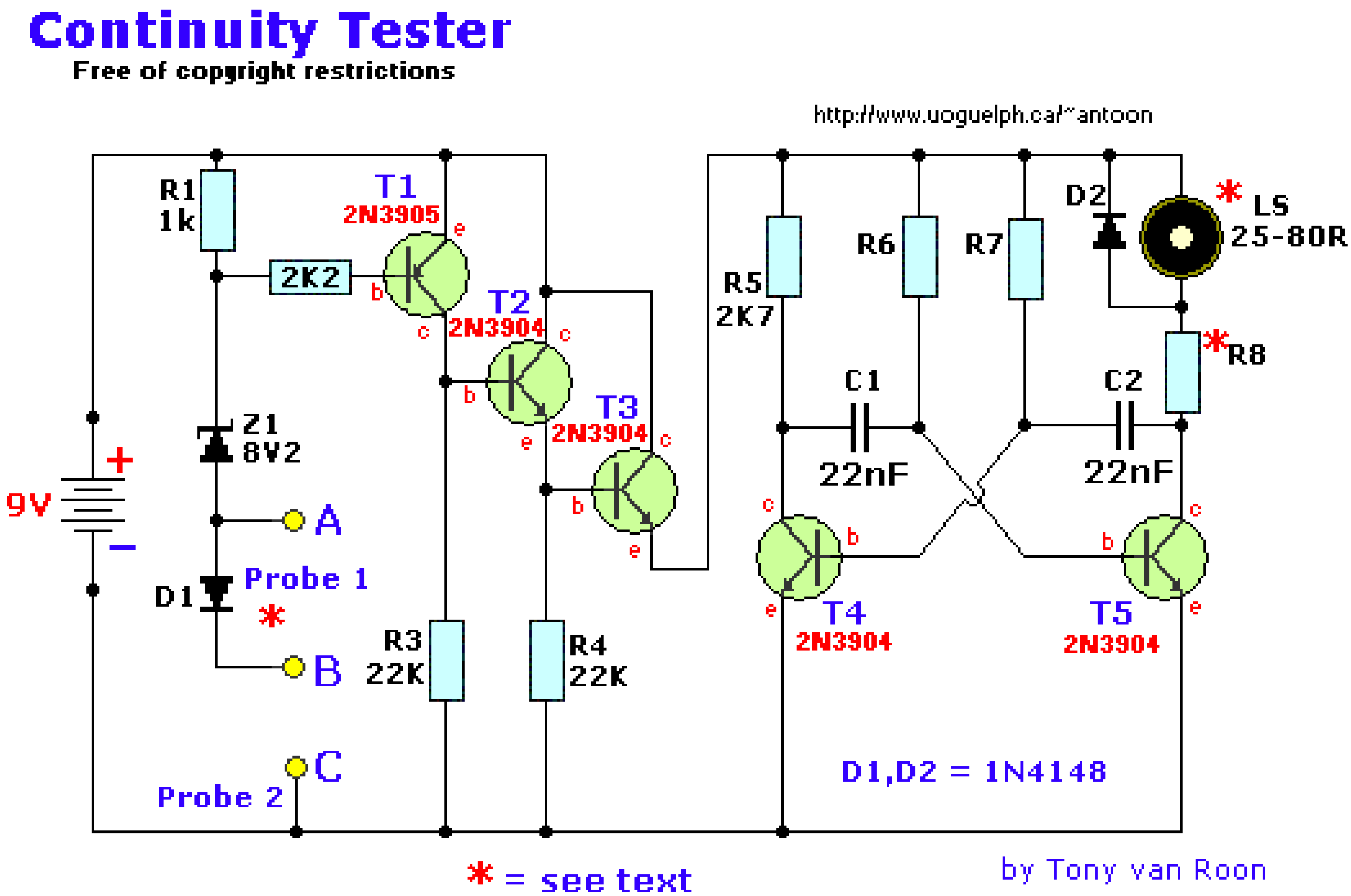


Parts List:

R1 = 1K	D1,D2 = 1N4148
R2 = 2K2	Z1 = 8V2, 1/4 watt
R3,R4 = 22K	T1 = 2N3905 (PNP)
R5 = 2K7	T2,3,4,5 = 2N3904 (NPN)
R6,R7 = 56K	9volt Alkaline battery
R8 = *See text	suitable loudspeaker
C1,C2 = 22nF	housing & probes

An on-off switch is not necessary. D1 is used when the battery is brand-new and giving over the nominal 9 volt, T1, T2 and T3 acting as the switch for supplying power to the multivibrator.

Design Considerations:

Several simple circuits were tried -- a lamp, battery and probes still demanded the attention of the eyes; replacing the lamp with a buzzer was more successful but needed some three to four volts and gave no indication of a series semiconductor junction if the polarity was correct while the current flow was large enough to damage the more delicate devices within the circuit under test. An extension of the principle to

operate an astable (multivibrator) type of oscillator gave good audibility but would operate from zero through to several thousands of ohms and so was too general an indication.
A set of specifications was becoming apparent; (1) probe current to be small; (2) probe voltage to be as low as possible, preferable less than 0.3V to avoid seeing germanium or silicon junctions as a continuous circuit; (3) no on/off switch to be used.
The above circuit was the result and several have been designed and are earning their keep for both "heavy" electricians and electronic technicians.

How it works:

Starting with a 9 volt supply, when the probes are shortcircuited there is a 8.2 volt drop accross the zener diode Z1 leaving a maximum of 0.8 volt across R1. Aplication of Ohms' Law shows that a maximum current of 0.8/1,000 = 0.8 mA lows via the probes and this satisfies the first design requirement of low probe current.

T1 is a silicon type and the base-emitter voltage will need to be about 0.5 to 0.6 volt to forward-bias the junction and initiate collector current. With a maximum of 0.8 volt availabe across R1 it is seen that if a semiconductor junction or resistor is included in the outside circuit under test and drops only 0.3 volt then there will be 0.5 volt remaining across R1, barely enough to bias T1 into conduction.

Assuming that the probes are joined by nearly zero resistance, the pd across R1 is 0.7 - 0.8 volt and T1 turns on, its collector voltage rising positively to give nearly 9 volt across R3. T2 is an emitter follower and its emitter thus rises to about 8.3 volt and this base voltage on T3 (a series regulator circuit or another emitter-follower if you prefer it) results in some 7.7 volt being placed across the T4 - T5 oscillator circuit. All the transistors are silicon types and unless the probes are joined, the only leakage current flows from the battery thus avoiding the need for an On-Off switch. When not in use, the battery in the tester should have a life in excess of a year. My own unit lasted for more than 2 years with one Alkaline battery.

Descriptive Notes:

The output from the speaker is not loud but is more than adequate for the purpose. I used a small transistor radio loudspeaker with an impedance of 25 - 80 Ohms. The resistance should be brought up to 300 ohms by adding series resistor R8. Example, if your speaker is 58 ohms, then R8 = 242 ohms.

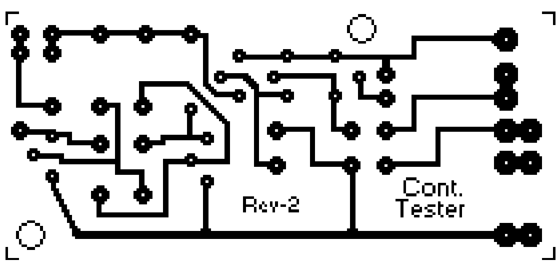
An experiment worth doing is to select the value of either C1 or C2 to produce a frequency oscillation that coinsides with the mechanical resonant frequency of the particular loudspeaker in use. Having choosen the right value, which probably lies in the range of 10n - 100n, the tone will be louder and more earpiercing. A "freewheel" diode D2 is connected across the transducer since fast switching action of the oscillator circuit can produce a surprisingly high back e.m.f. across the coil and these high voltages might otherwise lead to transistor damage or breakdown.

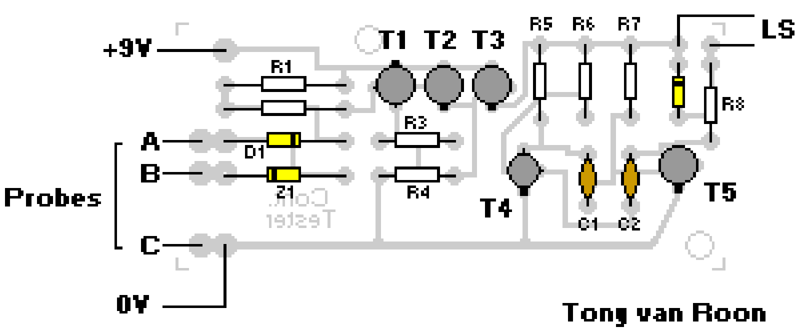
Zener diodes do not provide an absolutely constant volt-drop regardless of current; at the 0.8 mA design current an 8.2 volt diode will quite possibly give only about 8.0 volt drop since test current for zener selection and marking is typically 5 mA or more. A further possible source of error is the battery; the one suggested, nominally provides 9V but a brandnew one may be as much as 9.2 - 9.6V until slightly run-down and this "surplus" voltage, combined with an "under-voltage" zener volt-drop will leave considerably more than the forecast voltage available at the probes. A silicon diode D1 is therefore connected in series with the zener to decrease the probe voltage by a further 0.6 volt or so.

During your final testing and before boxing your circuit, the most suitable connection, A or B, is selected for the positive probe wire. The aim is to have the circuit oscillating with short circuited probes but to stop oscillation with the least amount of resistance or the inclusion of a diode (try both ways) between the probes.

No sensitivity control is fitted because I don't think it is worthwhile nor necessary and would spoil the simplicity of the circuit.

There is no easy way to proof the unit against connection to the supply. Be ***careful*** if checking AC line wiring and switch off first. In a similar way, if checking electronic apparatus for unwanted bridging between tracks, for instance or a suspected crack in a PCB (Printed Circuit Board) track switch off power first also. **DISCHARGE ALL LARGE CAPACITORS.** Good luck!





The pcb pattern above is shown full-size at 73mm x 33mm (2-7/8" x 1-1/4")

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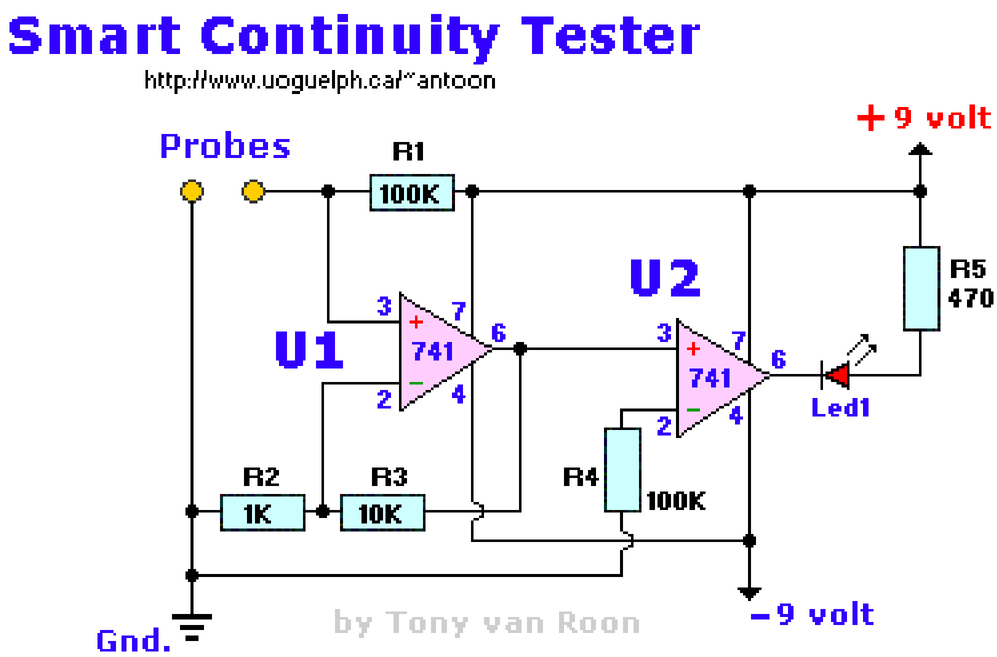


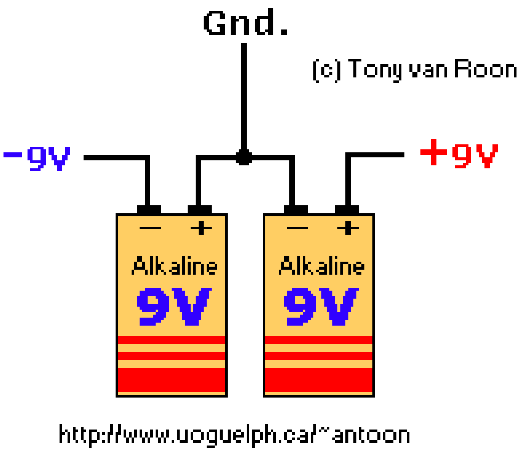
Parts List:

R1 = 100K
R2 = 10K
R3 = 1K
R4 = 100K
R5 = 500 ohm

Led1 = High Brightnes LED, RED, 5mm
IC1 = LM741, OpAmp
9 volt Alkaline battery, case, probes

How it works:

Occasionally you need a continuity test between two points in an electronic circuit. Unfortunately, most continuity testers are prone to "lie". They don't do that deliberately, but if they see a small resistance, they *still* tell you that you have continuity. They just don't know any better.
This unit is different. If you have continuity it will tell you so. And if you're reading even a low resistance through a component, the unit will tell you that as well.
The unit uses two 741 op-amps. It offers a short-circuit test current of less than 200uA. It detects resistance values of less than 10 ohms. Nicest of all, it will not break down a PN junction. The device has come in handy in my own shop for debugging electronic circuits.
In building this circuit, use good electronic practice, mounting the 741's in suitable ic sockets on perf-board. While there's nothing critical here, keep the work neat, and leads nice and short. When you're done, mount the unit in a small plastic box. A small dab of silicon rubber adhesive keeps the 9-volt battery in place at the bottom of the case, and will last a long time.



Just in case you're just starting out in electronics, here is how to get the -9, +9, and Ground connections.

A small hole with a grommet keeps the leads (probes) together. Another hole with a grommet holds the LED in place on top of the box where it is plainly visible. This makes a nice one-evening project. Enjoy!

Caution:

There is no easy way to proof the unit against connection to the supply. Please, please be ***careful*** if checking AC line wiring and switch off first. In a similar way, if checking electronic apparatus for unwanted bridging between tracks, for instance or a suspected crack in a PCB (Printed Circuit Board) track switch off power first also. Always practice good safety and ***think-before-you-do!***

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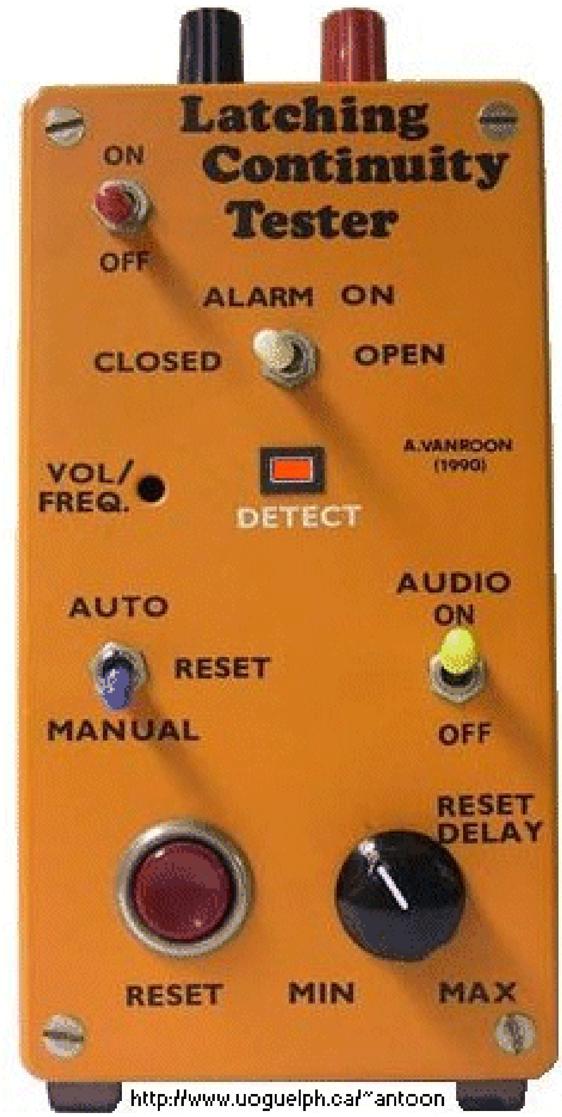
Continuity Tester, Latching

By Tony van Roon

"This Latching Continuity Tester can help you locate those difficult-to-find intermittent short and opens that other testers always seem to miss. It has been part of my workbench for many years and performs superb. I have solved many intermittend problem with this highly flexible unit."



A continuity tester is a must on every service bench for testing cables, pcboards, switches, motors, plugs, jacks, relays, and many other kinds of components. But there are times when a simple continuity test doesn't tell the whole story. For example, vibration-induced problems in automobile wiring can be extremely difficult to detect because a short or open is not maintained long enough for a non-latching tester to respond.
This latching continuity tester detects intermittent (and steady state) opens and shorts. The tester will detect and latch on an intermittent condition with a duration of less than a millisecond. In addition, it provides both visual and (defeatable) audio indicators, uses only one inexpensive and easy-to-find IC, and can be built from all new parts for about $35, or less if you have a well-stocked junkbox.

Circuit Elements:

The heart of the circuit is a 4093 quad two-input NAND Schmitt trigger, one gate of which is shown in Fig. 1-a. The gate functions as shown in Fig. 1-b. Nothing happens until the *enable* input goes high. When that happens, the output responds to the input as follows.

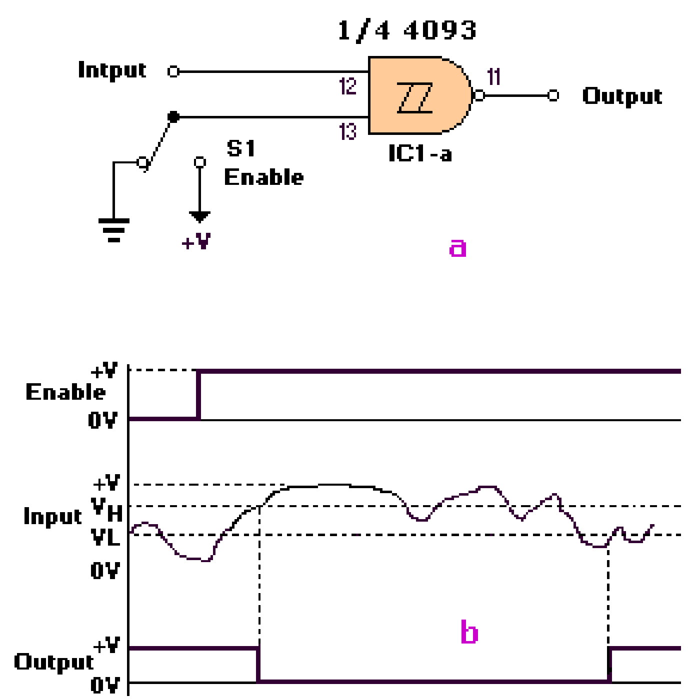


Fig. 1 -- A Schmitt Trigger (a) is insensitive to input signals between V_H and V_L (b). The output changes state only when the enable input is high.

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As long as the input voltage stays between V_H and V_L, the output stays high. But when the input goes above V_H, the output goes low. The output will not go high again until the input goes below V_L. That characteristic is what gives the Schmitt trigger its ability to "square-up" a slowly changing input signal. The Schmitt trigger is ideally suited for our application because it is not dependent on edge triggering, and because both slow and fast signals trigger it when either threshold is exceeded.

We use two gates of the 4093 as a combination detector and latch. The gates are cross connected to form an SR (*S*et-*R*eset) flip-flop. When pin 12 goes low, pin 11 will go high. That high may be used to enable an LED or other indicator. Switch S1 is used to select whether the tester will provide ouput when it detects an open or a short. In the ***OPEN*** position, pin 12 is held low, so the output of the gate is normally high. When the test leads are connected across a short, pin 12 is pulled high, so the output drops low. The circuit works in the converse manner when S1 is in the ***CLOSED*** position.

As shown in Fig. 2-a, we use another Schmitt trigger to build a gated astable oscillator. A gated astable oscillator produces output as long as the ***GATE*** input is high. Fig. 2-b shows the waveforms that are present at various points in the circuit. When the pin-8 input goes high, pin 10 goes low, and C1 starts discharging through R1. When V_C falls below V_L, the output of the gate goes high, so C1 starts charging through R1. When V_C exceeds V_H, the output again drops low. Oscillation continues in that way as long as the gate input remains high. The frequency of oscillation is given by a fairly complex equation that can be simplified, for purposes of approximation, as F = 1 / R1C1.

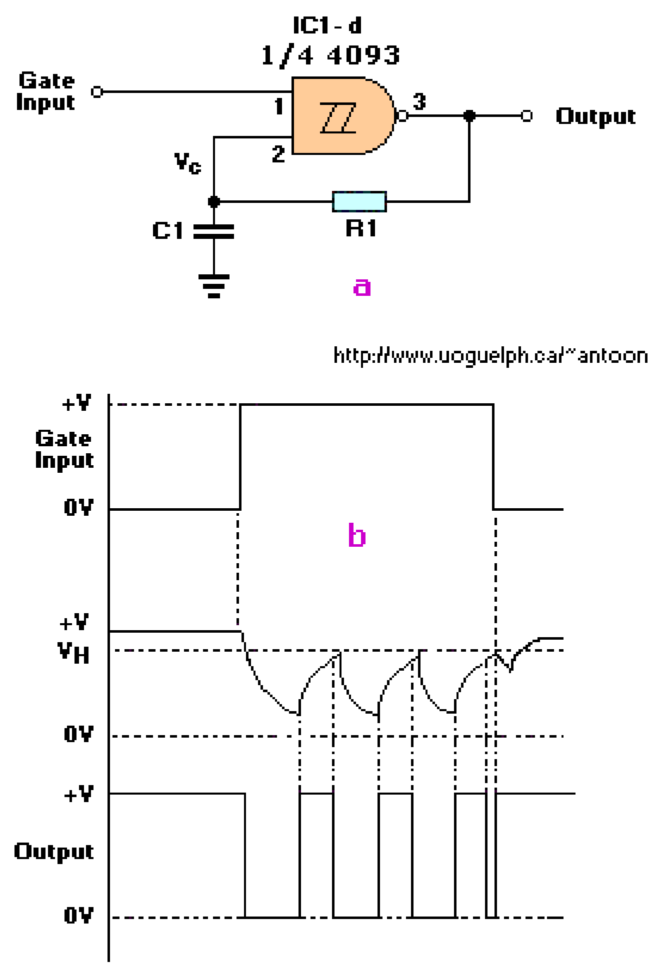
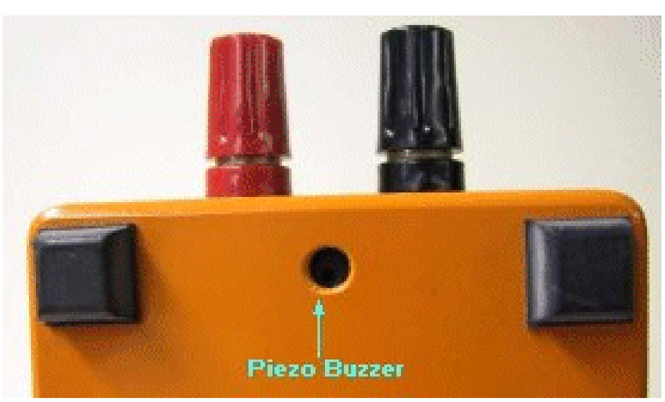


Fig. 2 -- An Astable Oscillator (a) may be built from a single gate, a resistor and a capacitor. The circuit oscillates at a frequency of about 1/R1C1 whenever th gate input is high (b).

Putting it all together:

The complete circuit is shown in Fig. 3. In that circuit, IC1-a and IC1-b funtion as the flip-flop/detector. The output of IC1-a is routed through S4, ***AUDIO***. When that switch is closed, IC1-d is enabled and an audio tone will be output by BZ1. The frequency of that tone can vary from 1000Hz to well above the audio range (100KHz), according to the setting of R4. In addition, R4 varies frequency and volume simultaneously, so you can set it for the combination that pleases you best.

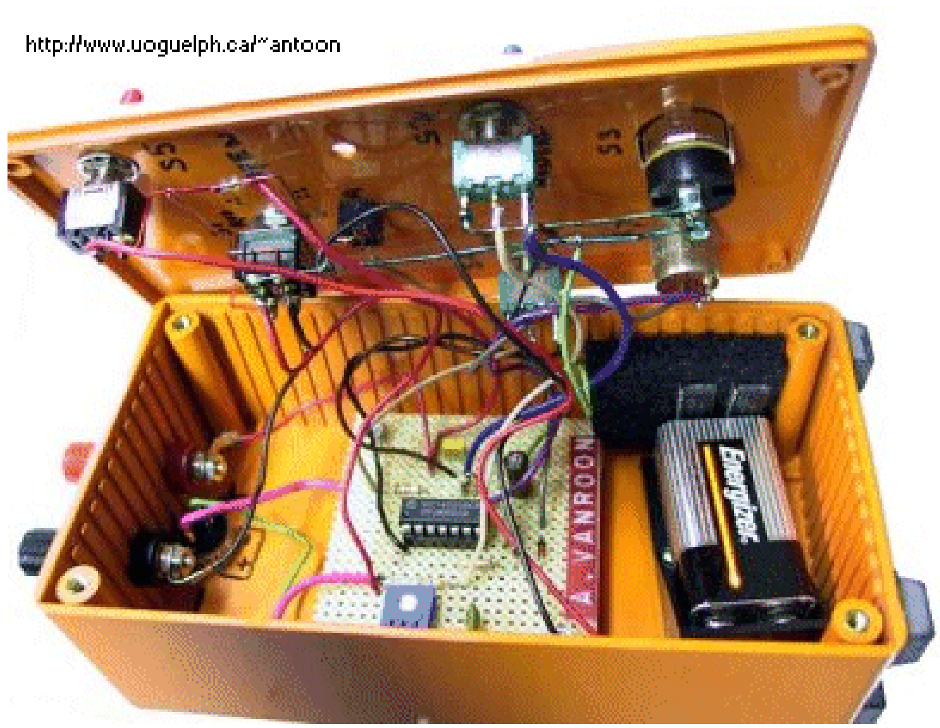
Originally we used a PM (Permanent Magnet) speaker. When the detector has not been tripped, the full power-supply voltage is across the buzzer, but no current is drawn. The reason is that the piezo element is like a capacitor and does not conduct DC current. When the circuit is oscillating, the buzzer consumes a current of only about 0.5 milli-amp. The output of the flip-flop/detector circuit also drives IC1-c. If S2 is in the ***AUTO*** position, the output of IC1-c will automatically reset the flip-flop after a period of two to six seconds, depending on the position of R7. If S2 is in the ***MANUAL*** position, the LED will remain lit (and the buzzer will continue buzzing, if S4 is on) until manual ***RESET*** switch S3 is pressed



Construction:

Picture at the left shows the tester from the back. The hole is for the piezo buzzer. The circuit may be built on a piece of perfboard or Vero-board, or on a PCB. The PCB is designed to take board-mounted switches, which makes a neat package and eliminates a rat's nest. (see prototype picture below).

Referring to Fig. 4, mount and solder the components in this order: diodes, fixed resistors, IC-sockets, capacitors, variable resistors, and then the pcb mounted switches. The regular ones will work too it just means more wire. Mount the buzzer and the LED last as described below. Trimmer potentiometer R7 is manufactured by Piher (903 Feehanville Drive, Mount Prospect, IL 60056); it has a shaft that extends through the panel. If the Piher pot is unavailable, an alternate is available from Digi-Key (701 Brooks Ave, South, P.O. Box 677, Thief River Falls, MN 56701). The disadvantage of the alternate is that it has no shaft, so it must be adjusted using a miniature screwdriver.



The circuit board is held approximately 1/2-inch from the cover by the shafts of the switches. The LED and the buzzer should be inserted in the appropriate holes in the pcb now. Then install the top cover, and adjust the height of the LED so that it protrudes through the top cover. Then solder its leads. Attach the buzzer to the top cover, using silicone rubber adhesive (RTV or double side foam tape.

We mounted a pair of banana jacks on the top of our prototype's case, but you could solder the wires directly to the appropriate points on the circuit board, tie strain reliefs in the wires, and then solder alligator clips to the ends of the wires. However, a set of good leads are really not all that expensive and it does give the tester more flexible usage as you have the opportunity to use a variety of different leads to suit your purpose.

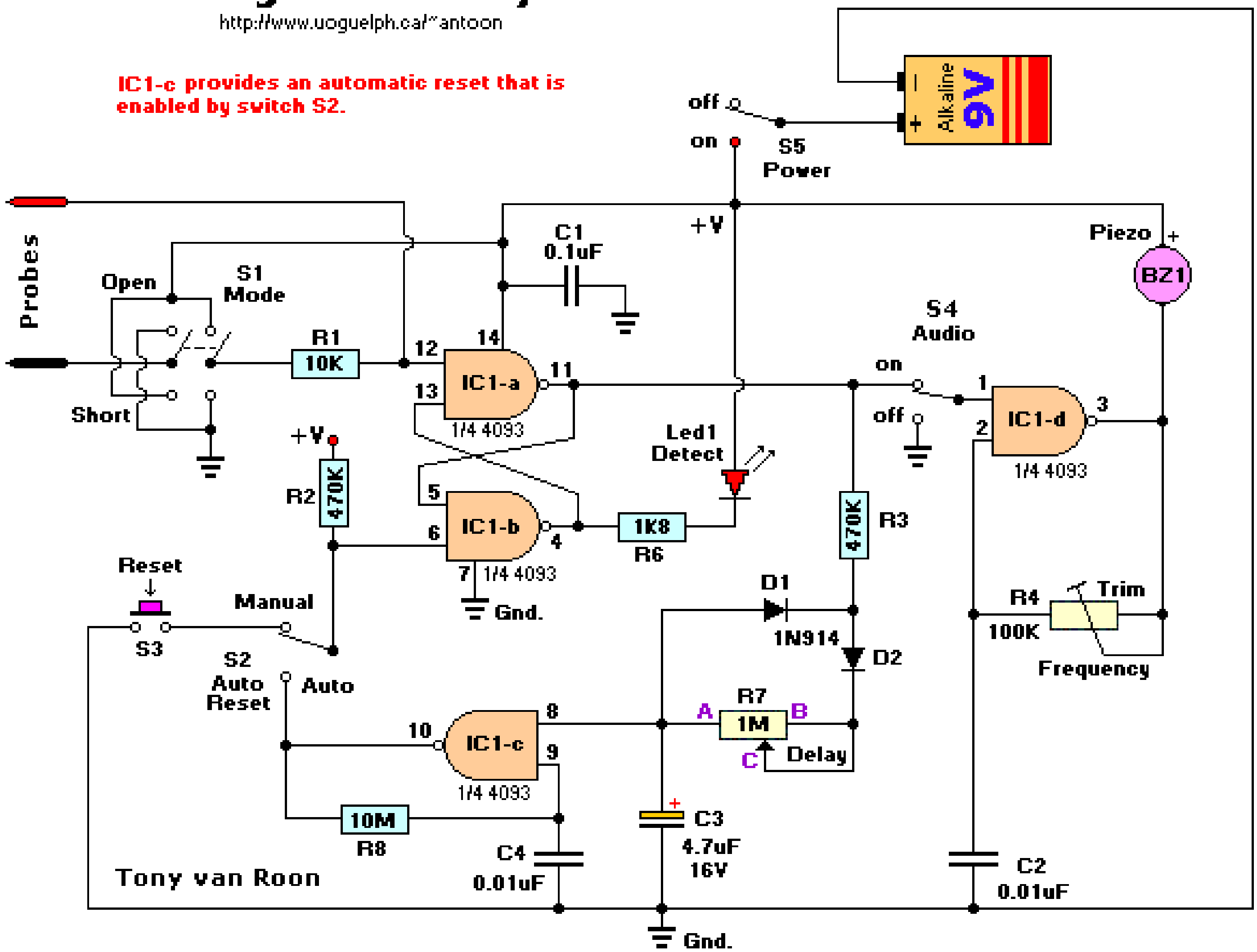
The nine-volt battery is secured to the side of the case with a clip or use a holder. Your completed pcb should appear as in Fig. 5.

Usage Hints:

Set S1 for *short* or *open* depending on the condition to be tested. Then connect the test leads across the circuit to be tested. If an intermittent condition is detected, the LED will illuminate, and the buzzer will sound (if S4 is on). If you don't remove the test leads (assuming if S2 is set for *AUTO Reset*, the LED will flash (very fast)and audio will warble at a rate determined by the reset circuit.

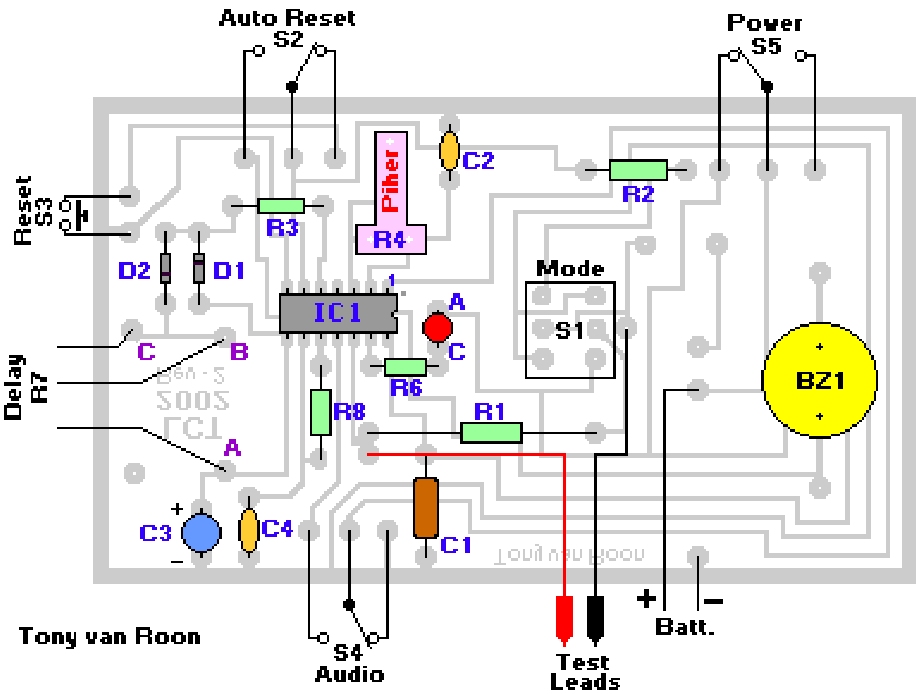
It is very important that the test leads make a positive connection with the circuit to be tested. In fact, clips should be used instead of test leads. There are good test leads available for about $15 which are hardened stainless-steel and have sharpened points which were my personal choice. This detector is so sensitive that, when it is initially connected across a long length of parallel wires or traces, it may latch due to capacitance between the wires. As a matter of fact, it happens with my model all the time. Just press the reset switch S3 when that occurs.

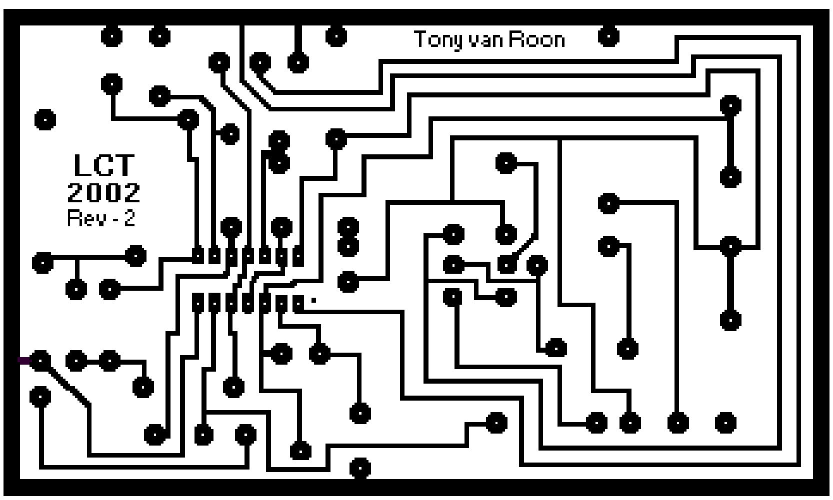
Latching Continuity Tester

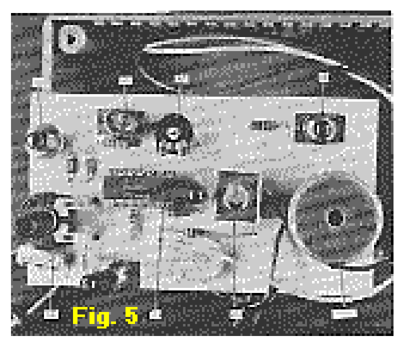


Parts List

```
   R1 = 10K                         IC1 = 4093B Quad Nand Schmitt Trigger
(NTE4093B/ECG4093B)
R2,R3 = 470K                      D1,D1 = 1N914 or 1N4148 (NTE519/ECG519)
   R4 = 100K Trim-pot              LED1 = Red, 5mm, High Brightness
   R5 = Not used                    BZ1 = Piezzo Buzzer
   R6 = 1.8K (1800 ohm)              S1 = DPDT, miniature toggle, pcb mount
   R7 = 1M Potmeter (Lin)      S2,S4,S5 = SPDT, miniature toggle, pcb mount
   R8 = 10M                          S3 = SPST, momentary push, normally open
   C1 = 0.1µF, ceramic     Additionally: IC socket, plastic case (4.75" x 2.5"
1.5"),banana jacks,
C2,C4 = 0.01µF ceramic                   wire, solder, battery clip, couple cold
beers.
   C3 = 4.7µF, 16V, Elec.
```







The assembled pcboard reveals the low parts-count and easy assembly of the continuity tester

I fully support this project. Most parts can be obtained via your local Radio Shack or Tandy store. I will answer all questions but via the message forum only. ***Tony's Message Forum*** can be accessed via the main page, gadgets, or circuits page. I'm fine-tuning this project at this time. There are a couple of extra holes on the pcb; ignore them. When you're done soldering everything up check your wiring before connecting the battery. Especially if you use non-pcb switches (which is okay) it is very easy to make a wiring error. Good luck and have fun building this most versatile project.

For Radio Shack part numbers click on this RS data sheet.

Copyright and Credits:

The original project is copyright © by Eldon L. Knight (1986). Document updates & modifications, all diagrams, PCB/Layout by Tony van Roon. Photography by Yves Savoret.

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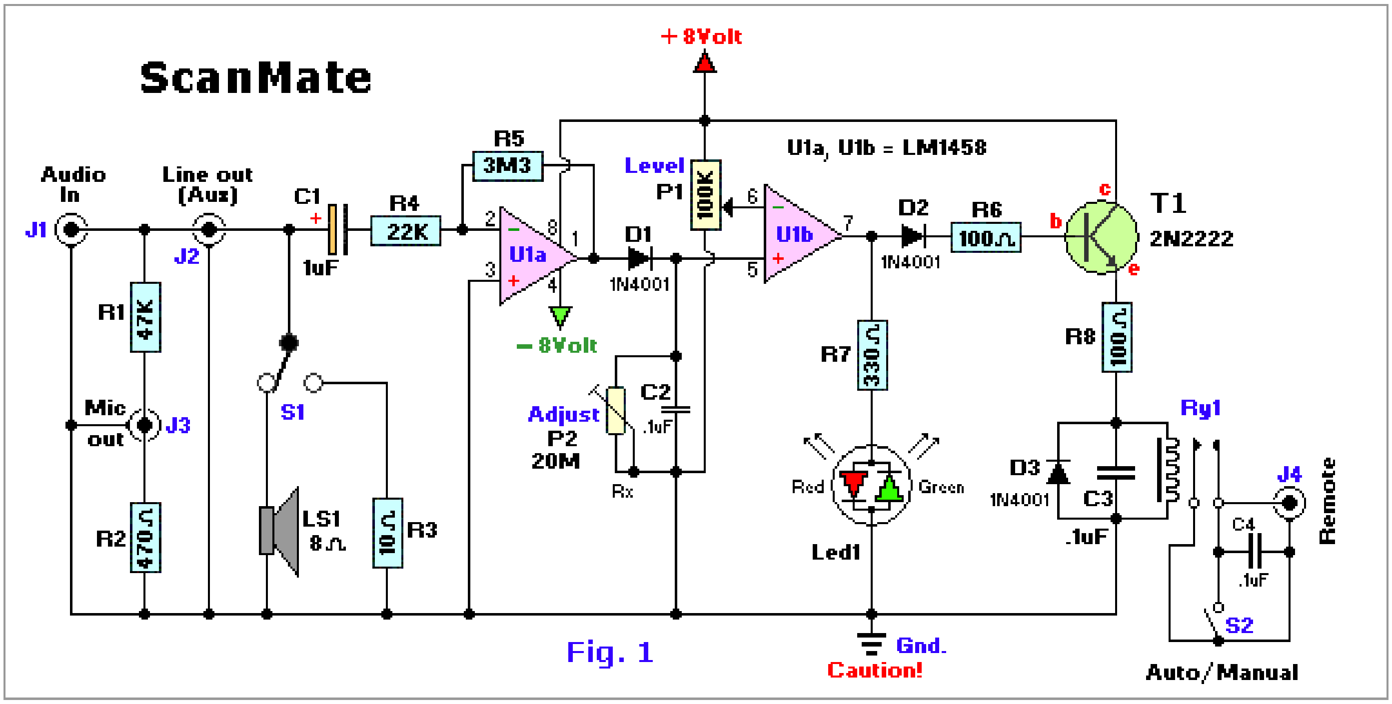


Fig. 1

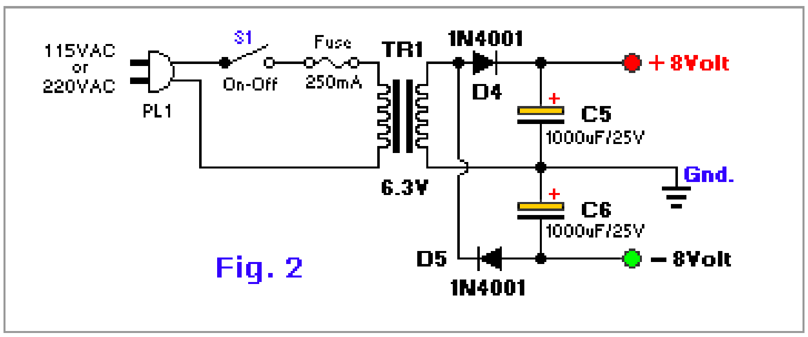


Fig. 2

by Tony van Roon
http://www.uoguelph.ca/~antoon

Parts List:

R1 = 47K	C1 = 1uF/16V	S1 = on-on, SPDT Switch
R2 = 470 ohm	C2,C3,C4 = 0.1uF	S2 = on-off, SPST Switch
R3 = 10 ohm	C5,C6 = 1000uF/25V	S3 = on-off, SPST Switch (115VAC)
R4 = 22K	D1,D2,D3,D4 = 1N4001	Ry1 = Reed Relay, 5V-1A
R5 = 3M3	T1 = 2N2222	TR1 = Transformer, 12.6V CT, PC-Mount
R6 = 100 ohm	U1 = LM1458	Socket for U1 (8-pin)
R7 = 330 ohm	LS1 = Speaker, 8-ohm	>>**Radio Shack**<< or Tandy part #'s
R8 = 100 ohm	J1,J2,J3 = Jacks, 3mm*	
P1 = 100K, Lin	J4 = Jack, 2mm*	Note: 3M3 (R5) same as 3.3M
P2 = 20M 10-turn (Rx) optional	LED1 = Bicolor LED*	

Error fixed: 6-20-2002. *The electrolytic capacitor, C6, was drawn up-side-down and had polarity reversed. Corrected.*

Intro:

What exactly is 'ScanMate'? Read on. It never seems to fail. You wake up in the morning, turn on the radio news, and there it is: A major fire across town, a drug bust in the local park, police chases, or an airliner forced to make an emergency landing along the highway. Such events always seem to happen just after you have turned off your scanner and gone to bed, or left the

house.
Some of the hottest action to come over the airwaves for months, and you missed it....that is, until *ScanMate!* With ScanMate connected between your scanner and a tape recorder (via the recorder's microphone or auxilliary input and its remote start jack), you will never have to worry about missing any of the action again.
ScanMate is similar to several of the available commercial units, but offers greater flexibility. The ScanMate unit has a 'level' control that allows it to be used successfully with any type of scanner--portable or base unit--regardless of its output-amplifier configuration. It also provides control over the length of time the recorder continues to run after the transmission ceases. Also included in the circuit is a switch that allows you to select either automatic or manual operation.
When ScanMate is set to the auto-mode, the recorder's motor operates only during transmissions. In the manual-mode, the motor is activated whenever any of the recorder's functions (play, rewind, etc.) is selected. That allows all the interconnection cables to remain in place when you decide to rewind and listed to the tape. A speaker in/out switch is provided to allow monitoring (via the circuit's build-in speaker) while recording. In addition, ScanMate provides both microphone and line-level outputs, so that even the least-sophisticated recorders can be used.

How It Works:

Figure 1 is the schematic diagram of the ScanMate circuit. Audio coming from the scanner's earphone or speaker jack is fed to the circuit via J1. Jack J2, which is wired parallel with jack J1, provides a line-level output for input to the recorder via its auxiliary input jack. The signal is also fed through a voltage divider, consisting of resistors R1 and R2, which attenuate the signal for the mic-out jack J3.
Switch S1 is used to switch speaker LS1 in and out of the circuit. In the 'out' position, a 10-ohm resistor, R3, is switched into the circuit in place of the speaker's 8-ohm impedance, providing a fairly constant lead for the scanner's output. Capacitor C1 blocks any DC voltage that might be present. The signal is then fed to the inverting input of U1a (1/2 of a LM1458 dual op-amp), the gain of which is set to about 150 by the R4/R5 combination. The output of U1a at pin 1 is rectified by diode D1. The peak voltage is fed across C2 to the non-inverting input of U1b, which is configured as a voltage comparator. When the voltage at pin 5 is higher than that set by P1 (the level/sensitivity control) at pin 6, the output of U1b swings to near the positive supply rail, lighting the green half of LED1, a bi-color Light Emitting Diode.
Resistor R7 limits the current to LED1. The high at U1b's output (pin 7) also turns on T1 which, in turn, activates a reed relay, Ry1, causing its contacts to close. The contacts of the relay act as the tape-recorder's motor on/off switch. When the voltage at pin 5 of U1b is lower than that at pin 6, its output swings close to the negative supply rail, illuminating the red half of LED1, and at the same time turning off T1 and Ry1, as wel as the tape recorder's motor.
The discharge rate of C2, combined with the setting of P1, determines the time the recorder runs after the last transmission. With an LM1458 Op-Amp, and its relatively low input impedance a C2 value of 0.1uF provides an ideal discharge rate. However, if a high input impedance op-amp is used, such as one with JFET inputs, C2's value should be increased to around 5uF (4.7uF is ok) and the value of P2 should be adjusted to near 10-megohms. Some experimentation with the setting of P2 -- which value should be between 5 and 30 megohms -- may be necessary to achieve optimum performance. I only used the adjustable potmeter (P2) to find the optimum setting and then measured that resistance and replaced the pot with an apropriate value of a resistor (Rx). Works.
Diode D3 and capacitor C3 are used to shunt any harmful spikes produced by the relay's coil away from T1. Switch S2 is the 'Manual/Auto' select switch. When S2 is closed, it acts like the closed contacts of the relay, turning on the tape-recorder motor.
The circuit is powered from a dual 8-volt power supply, (see Fig. 2) consisting of a handful inexpensive components. The AC line voltage is fed through S3 (the on/off switch) and a Fuse of 0.25 Amp (250mA) to power transformer TR1, which reduces the 117V line to 6.3 volts. That voltage is then full-wave rectified by D4 and D5, and filtered by electrolytic capacitors C4 and C5, to provide a suitable power source for the circuit.

Construction:

There is nothing critical about the circuit's layout, and its okay to use perfboard, but using the printed circuit board pattern shown in Fig. 3 helps to simplify matters. Jacks J1 to J4 should be of whatever type matches the inputs to your scanner and tape recorder. In my case, the mic/aux/audio jacks are the standard 3mm and the remote jack 2mm in the ScanMate prototype.
Fig. 4 is the parts-placement diagram for ScanMate's printed circuit board. Note that several components for the circuit are mounted off-board on the front and rear panel of the project enclosure. After positioning the off-board components, run short lengths of hookup wire from the appropriate points on the board to those components.

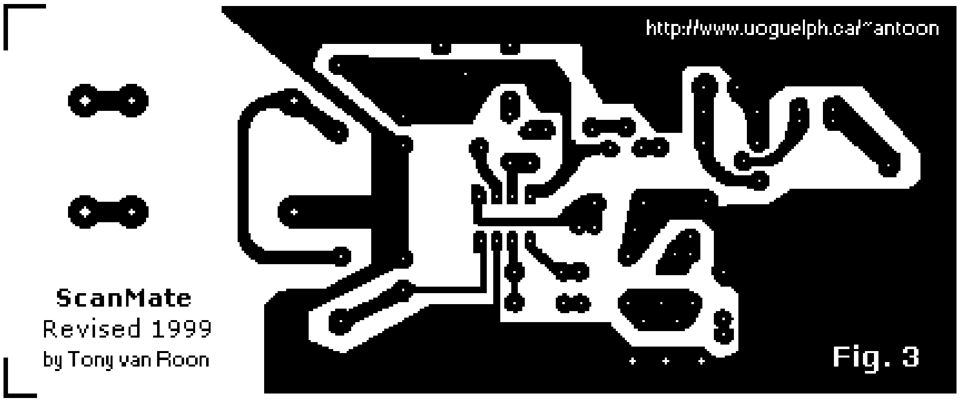


Fig. 3

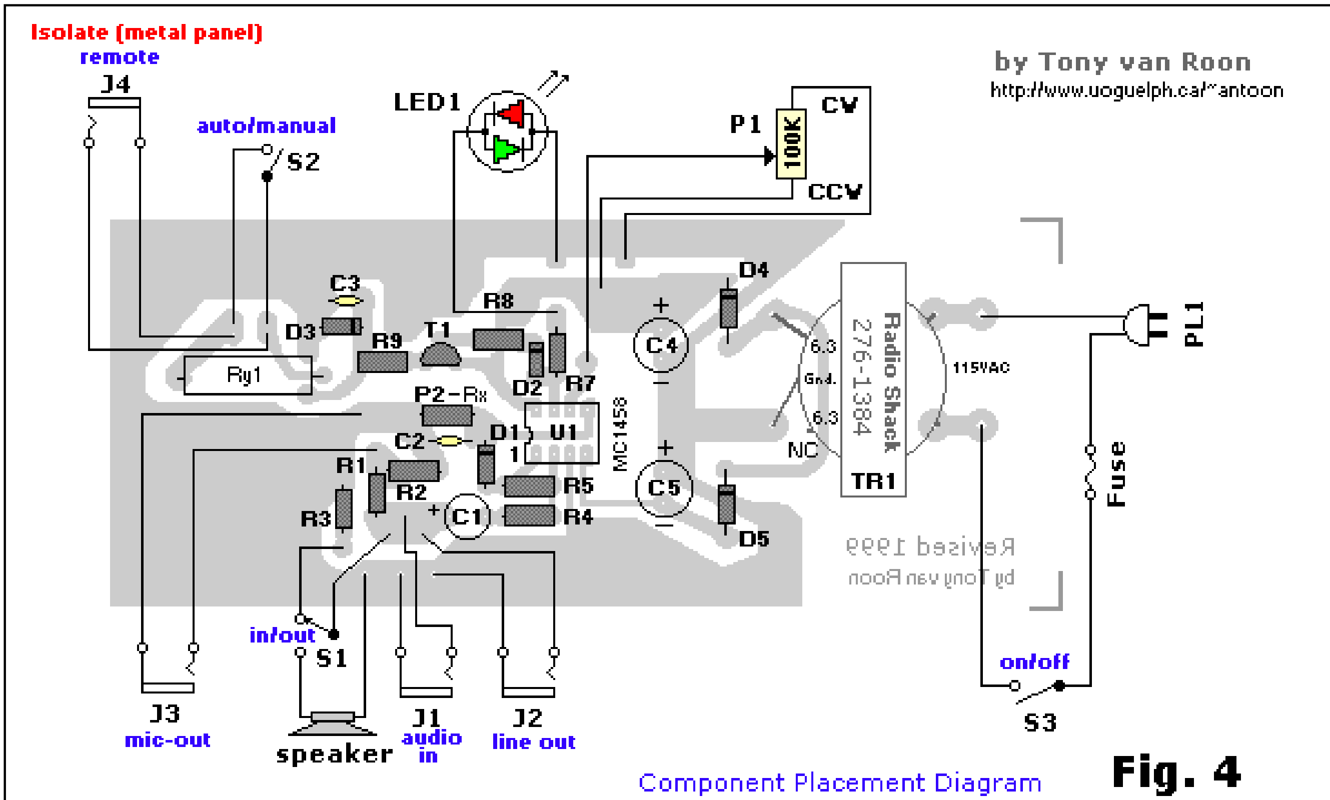


Fig. 4

Components not shown on the printed circuit board are mounted on the front and rear panel of the enclosure.

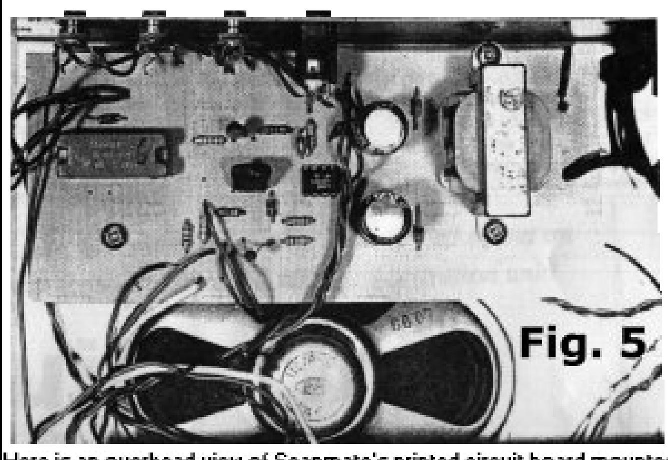
Turning to the bi-colored LED used in the circuit; if a similar unit cannot be found, the two-color unit can be replace by two discrete LED's. Of course, it will be necessary to supply an appropriate dropping resistor for each unit; or if you decide to hook them up back-to-back (duplicating the unit's schematic symbol), you may have to play with the value of the dropping resistor.
I used a Radio Shack 12.6 volt, center-tapped (ct) transformer in the power-supply of his prototype. I was unable to obtain the 300mA version so saddled for the 500mA type which meant modifying the PCB a bit since the transformer is larger in size. The output of the transformer is taken from its center tap, thereby providing 6.3 volts AC for the rectifer circuit. If you have difficulty in locating a similar unit, you might consider using a 12-volt transformer (with sufficient current rating), along with a 7808 and a 7908 (positive and negative, respectively), 8-volt, three terminal regulators. If you choose to go that route, be sure not to overlook the filter capacitors.
I have not experimented with an DC-type adapter but don't see why that should not work. If you have a 8 or 9 volt DC adapter of at least 300mA or better, try it. Saves the cost of the powersupply parts + powercord in Fig. 2.

As for the enclosure itself, there are a couple of things to watch for should you decide to use a metal cabinet to house the project (as in my case). A lot of tape recorders with positive grounds or other unusual circuitry react violently to haning either side of their remote start switches grounded. To prevent that problem, the remote start jack (J4) should be covered with heatshrink, or whatever, to keep the contacts completely isolated from ScanMate's other circuitry. You will most likely

hear tremendous 'hum' if the remote jack is improperly isolated from the metal panel. (if, ofcourse, you use a case with metal front and rear panels). You may have noticed that, unlike the other jacks, the remote jack is not connected directly to ground.

TR1 is a pc-mountable 12.6volt/300mA Center Tapped transformer. I purchased mine at Radio Shack: #276-1385. Some modifications were required to the PCB-layout to make the transformer fit nicely. Just in case you don't have a lot of experience with electronics and you're wondering why the schematic shows 6.3V and the parts list 12.6V. The transformer is a so-called 'center-tapped' model wich means 6.3V - 0 - 6.3V. Either side of the '0' provides 6.3V. The '0' is the center-tap (Gnd.), or CT for short. We only use one side of the transformer with the center tap. CAUTION: Because of the +8 and -8 volts, the above circuit ONLY uses the ground coming from the center-tap of TR1!
In addition, because the circuit derives power from a 117-volt AC outlet, make certain that the board is mounted in its enclosure on standoffs to prevent the board from coming in contact with the cabinet.
Making a neat cutout for speakers is always a problem, if you're not handy with mechanical equipment, but can be easily solved by putting the opening at the bottom of the cabinet, where imperfections won't be noticed. I solved the problem by drilling 3 millimeter holes in a half star pattern. Looks really good. Anyone can drill a couple of holes right?
Check my **Radio Shack** data sheet for partnumbers; makes things easier when you visit the Radio Shack/Tandy store.

Just in case you have any problems finding some of the parts: You can replace the 2N2222 for a NTE123A (not AP), a 2N2219, BC107, or a TUN type as specified in Elektuur (Elektor), or try something else (if it works it works right?). By the way, a 2N2222 is the same as the MPS2222A type from Radio Shack. If you can't find the LM or MC1458, use the NTE778A, or the 276-038 model from Tandy/Radio Shack; they are all pin-for-pin compatible as far as I know. The 1N4001 diodes can be substituted with a NTE116 or the #276-1101 model from Radio Shack. A 1N4002 or 1N4003 model will work just fine also, they just have a higher PIV. Transformer TR1 is available from Radio Shack as the #273-1384 6.3v/300mA. Use what's available in your area.



Here is an overhead view of Scanmate's printed circuit board mounted into its casing. Note that the spekaer is mounted at the bottom of the of the case with the pcb hovering above it on standoffs.

ScanMate viewed from the back. The fuse as well as the Remote, input, Mic-output, Line-out and Audio input jacks are located on the rear panel of the enclosure. All connections to and from the ScanMate's unit are through those jacks.

Fig. 6

Using The ScanMate:

After connecting ScanMate, a scanner, and a tape recorder together, flip the speaker switch (S1) to the 'on' position and turn the 'level/sensitivity' potentiometer (P1) fully counter-clock-wise. Next, find a busy channel on the scanner and put the tape unit into the record mode. LED1 should be red, meaning the tape is stopped. Slowly turn the P1 potentiometer clockwise until the bi-colored led turns green. At that point, your tape recorder should be running, recording everything coming over the scanner.

Now switch to a silent channel and check how long it takes for ScanMate to shut off the recorder. If the delay isn't right, turning the 'Level' potentiometer clockwise (up to a certain extend), will increase the time before shut-off, turning it counterclockwise shortens the delay. Again, keep in mind that the level of delay is limited by the values of P1 and C2.

Copyright and Credits:

The original project was written by Tim Goebel under the name "Auto Scan". Reproduced from Popular Electronics, August 1989, by permission of Gernsback Publishing, Inc., 1996. Revised, updated, and modified. All diagrams, Printed-Circuit Board and Layout redrawn by Tony van Roon.

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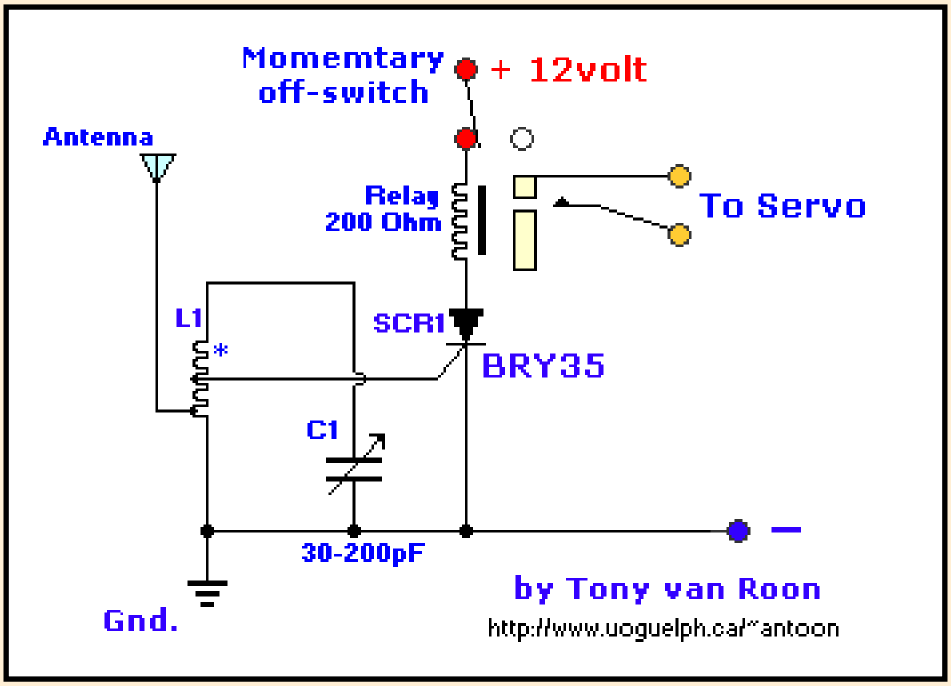
Simplest R/C Circuit

by Tony van Roon



A simple and effective receiver for actuating garage doors, starter motors, alarms, warning systems and numerous other possibillities. The SCR, which has a very low trigger current of 30 uA is typical -- it requires an input power of only 30 uW to activate the relay. A high Q tuned antenna circuit assures rejection of spurious signals. A whip or wire antenna is adequate up to 100 feet from a low power transistor transmitter. A momentary-off switch resets the circuit.

The circuit specifies a *whip* or *wire* antenna which just means a solid piece of wire 6-12 inches long (15-30cm). The antenna coil is experimental but you can start with 10 to 12 turns of #22 (0.7mm) magnet wire, and 5/16" (8mm) coil diameter. Antenna wire is soldered at 1/2 turn of the coil and the gate of the BRY35 is soldered about halfway the coil. This circuit will transmit up to 100-feet with the above specifications @ 30uA.

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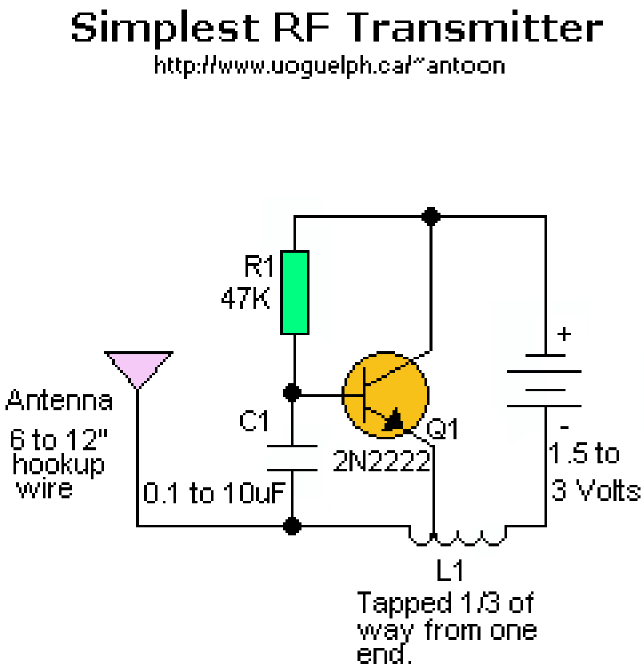

This is probably the simplest radio transmitter that you will find anywhere. It has a total of five parts and can be constructed into a very small space. It is great for science fair projects or other science related projects where short range transmission is useful. It runs on 1.5 to 3 volts, with small hearing aid batteries or lithium "coin" cells being ideal. A thermistor or photoresistor can be inserted in series with R1 to have a varying output frequency dependent on the input. The frequency can also be changed by changing the value of C1. A 2N2222 transistor is recommended, but you can try other types also. Performance tends to vary from type to type as well as from transistor to transistor. L1 is 20 to 30 turns of thin magnet wire (24 to 32 ga.) close wound around a 1/8 to 1/4" diameter non-conductive form. The coil is tapped 1/3 of the way from one end and the tap connected to the emitter of Q1. Experiment with all of the values in this circuit. Nothing is critical, but performance can be varied considerably.

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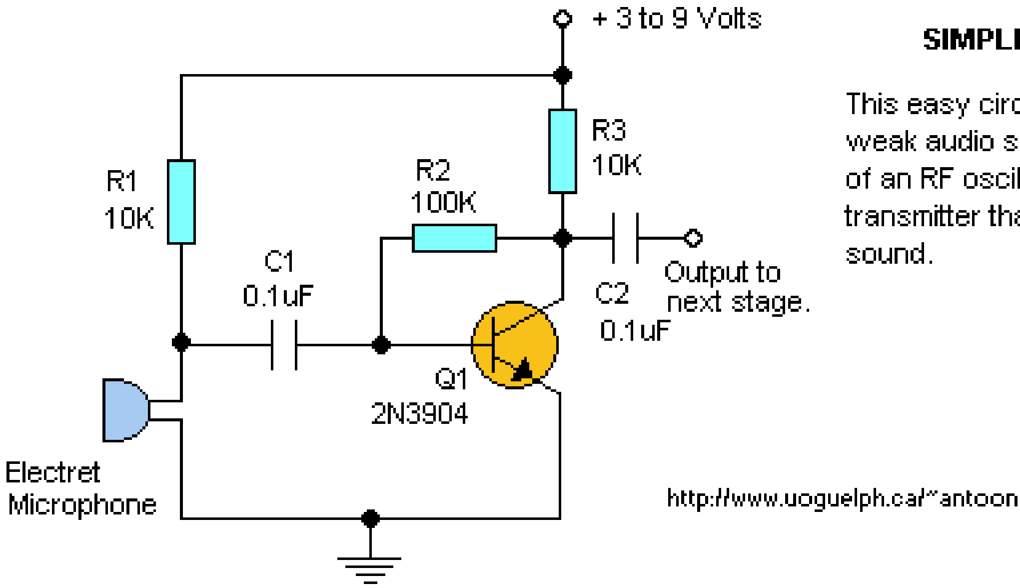

SIMPLE AUDIO PREAMP

This easy circuit provides good gain to weak audio signals. Use it in front of an RF oscillator to make an RF transmitter that is very sensitive to sound.

Additional Notes
None of the parts are critical. Use whatever you have. Again, note that the microphone is an "electret" type.

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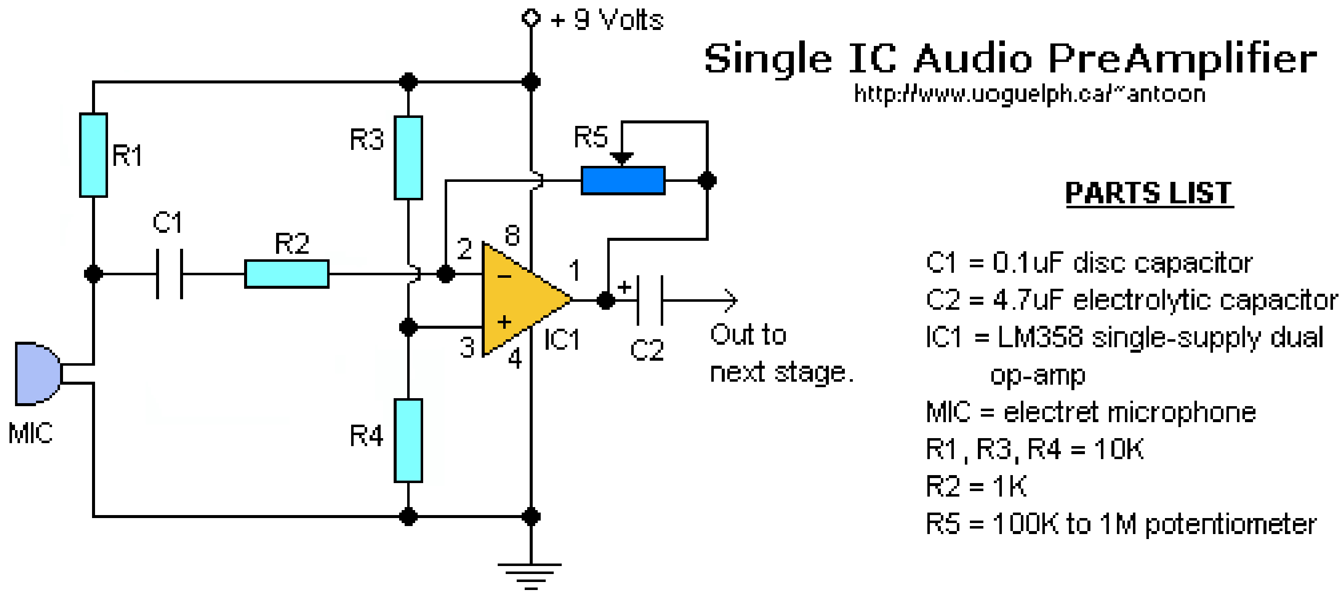
Single IC Audio Preamplifier

by Tony van Roon



[Additional Notes]
Parts are non-critical components and available from most Radio Shack stores.

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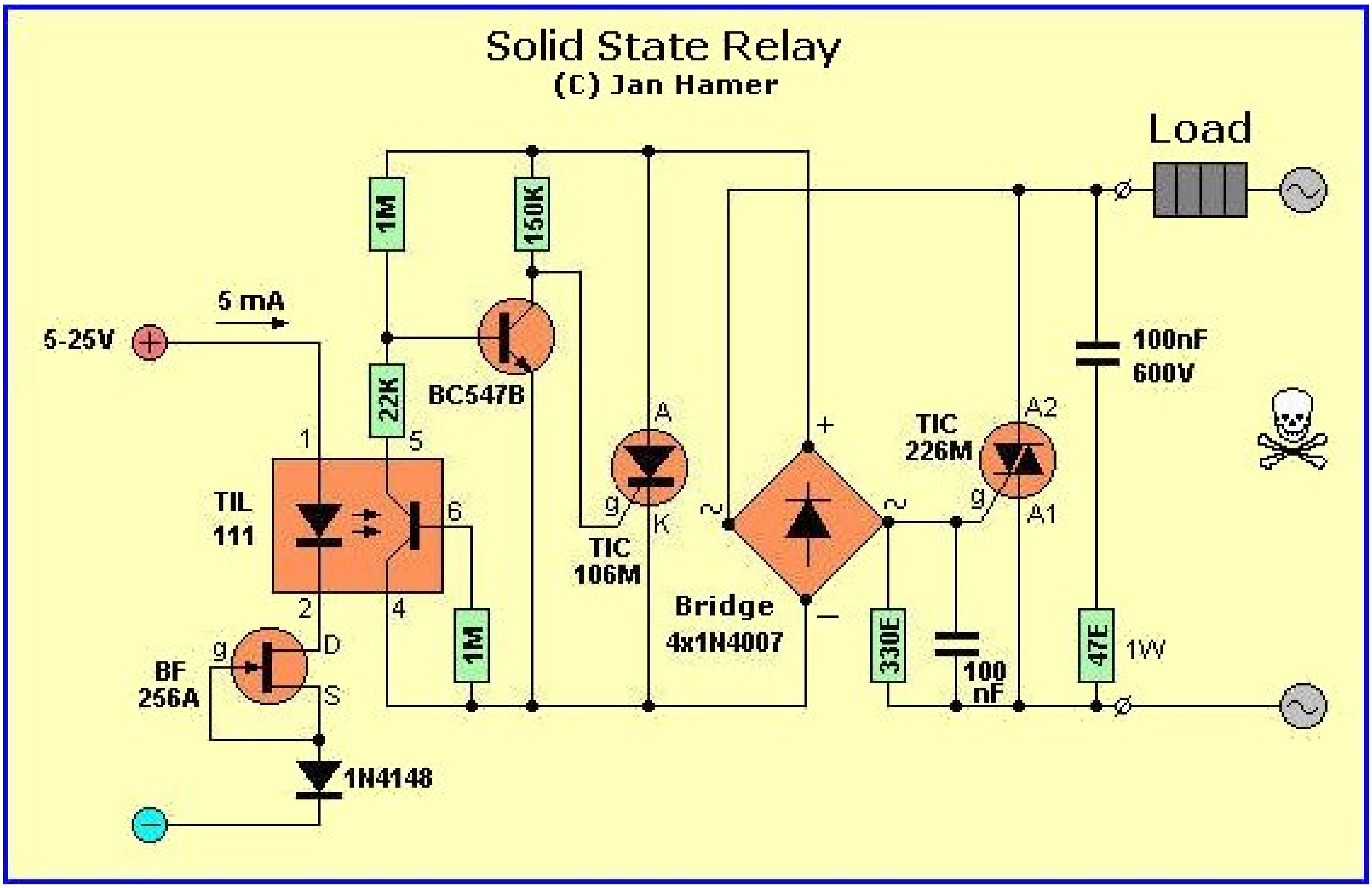
Solid State Relais

by Jan Hamer

Solid State Relays are available almost everywhere these days, however they remain very expensive. Therefore, your efforts to build one yourself pays off. Especially since it only needs a handful components and the circuitry is simple and straightforward.



A Solid State Relay is actually not a relay at all. There is no 'relay' present, just the electronics which does the switching. It works the same way as a relay; you can use a low voltage to switch a higher voltage or better. This *'relay'* is positioned in between one of the 115/220V AC wires although it is common practice to leave the neutral wire the way it is and switch the phase or hot wire. See diagram for 'LOAD'.

As long as thereis no dc voltage present (left side of circuit diagram), the phototransistor within the TIL111 blocks and so no current is present. To make sure of that the base of the TIL111 is fed to the emitter (e) via an 1M resistor. This method prevents the base of transistor BC547B going low and thus remains biased 'on'. The collector is thus also low, and consequently the gate (g) of the

TIC106M thyristor, which remains in the 'off' state. Through the 4-diode bridge rectifier circuit there is no current, except for the miniscule basis and collector current of the BC547B which is not enough over the 330 ohm resistor to switch on the TIC226M Triac. The current through the 'Load' is thus very very small.

With a certain input voltage, say 5 volt, the diode inside the TIL111 lights up and activates the phototransistor. The voltage drop over the 1Meg ohm resistor in series with the 22K resistor increases to a certain set point that it will block the BC547B transistor. The collector current at that moment will follow that of the AC voltage to a certain value which will activate the Thyristor. This creates a sufficient large voltage drop over the 330 ohm resistor to switch the Triac 'on'. The voltage over the Triac at that moment is only a couple volts so that the practically the whole 115/220 AC voltage is over the 'Load'.

The Triac is protected via the 100nF capacitor and the 47 ohm resistor, the 100nF capacitor over the 330 ohm resistor is to prevent unwanted biasing of the Triac created by small spikes. To create the posibility to switch this circuit with different voltages, a FET BF256A has been added. This FET acts like a current-source by means of connecting the source (s) with the gate (g). What this means is that this FET determines the current through the TIL111, no matter what voltage is put on the input (within certain tolerances ofcourse). The diode 1N4148 is to protect the circuit in case of polarity reversal.
(Tony: The TIL111 is a so called 'optoisolator' with an NPN output and can be replaced with a NTE3042)

A good point of a circuit like this is the seperation of the DC and AC voltages, so this circuit could be used in a variety of applications, up to approximately 1.5 KiloWatt, if you mount the Triac on a large cooling-rib.
The 'M' indicator noted on the Triac means it is a 600volt type, a 'D' stands for 400volt. So make sure you go for the M type.
(Tony: The NTE replacements for this circuit are 600volt types which is more than sufficient for our 110/115VAC.) **Also, if you decide to make a pcb for this circuit, to create sufficient space between the AC lines and don't make these AC tracks too narrow.**

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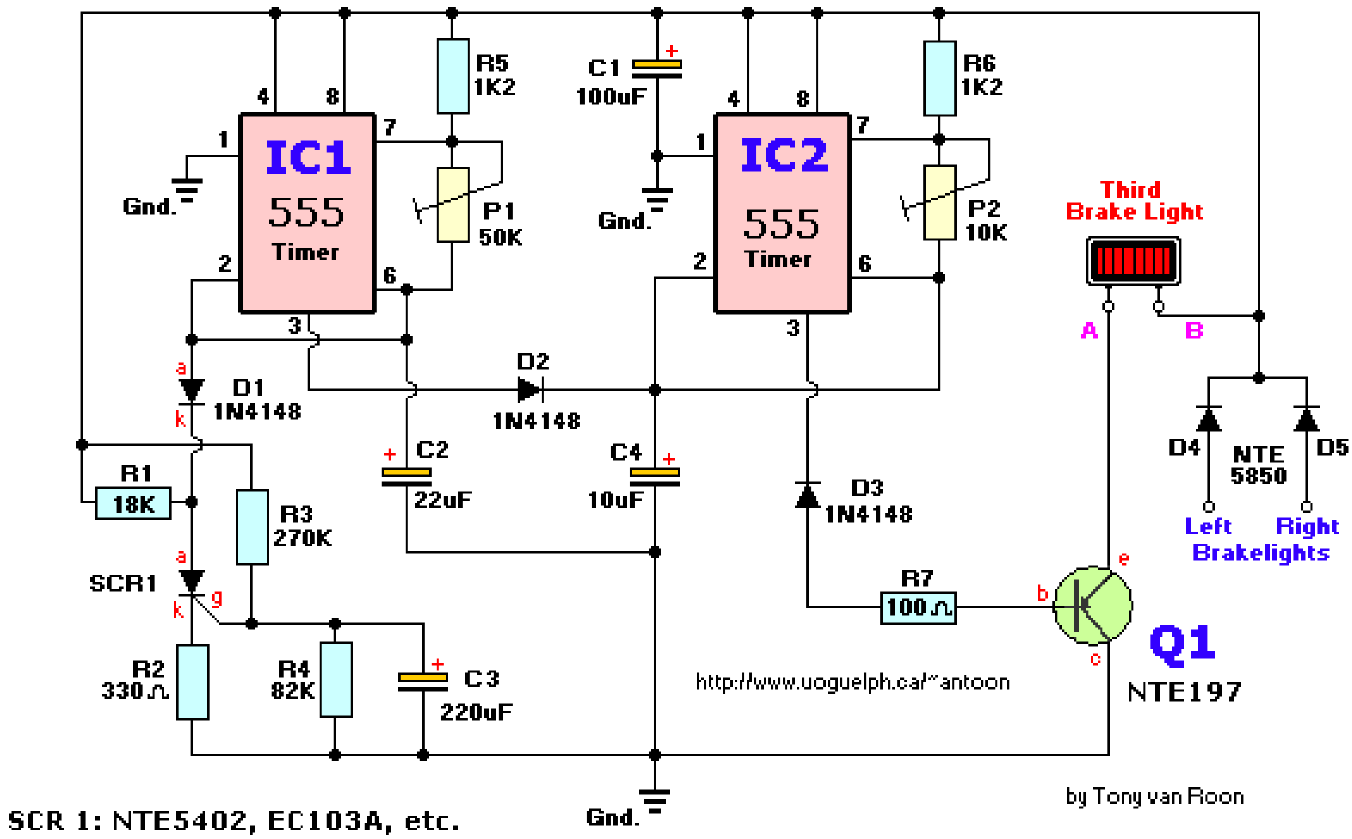
Pulsing Third Brake Light



Caution: I'm checking into the legalities of this particular circuit at this time. Any type of flashing light on the **main** brakelights is prohibited and illegal in *most* states of the U.S.A. I'm verifying for the same here in Canada. In the mean time, use this circuit at your own risk and be aware that the possibility exists to be stopped by law enforcement if you implement this circuit in your vehicle.

Use in my motorcycle: Several years ago these flashers were introduced in the automotive industry as part of the third brake light (and were flashing contineously) but got abandoned sometime later because of the 'strobe' effect (some of them kept flashing contineously) it has on some people. However, there is a major difference between this flasher and the ones from the automotive industry and others. This flasher gives 3 or 4 flashes, at reduced intensity, and then goes solid. They do not have the 'strobe' effect in any way or form, in my opinion. My main concern, when driving my motorcycle, is to be seen early enough. Seems to work.

Parts List

Semiconductors:

```
 IC1,IC2 = 555 Timer, RS #276-1723
    SCR1 = NTE/ECG5402, RS #276-1067, EC103A, MCR104, etc.
      Q1 = NTE/ECG197, SK3083, TIP125, or equivalent
D1,D2,D3 = 1N4148, 1N914, NTE/ECG519, RS #276-1122
   D4,D5 = 1N5400, NTE/ECG5850, RS #276-1141, or equivalent
```

Resistors:

```
      R1 = 18K (Brown-Gray-Orange)
      R2 = 330 ohm (Orange-Orange-Brown) (RS #271-1315)
```

```
      R3 = 270K (Red-Violet-Yellow)
      R4 = 82K (Gray-Red-Orange)
   R5,R6 = 1K2 (Brown-Red-Red) (1200 ohm)
      R8 = 100 ohm (Brown-Black-Brown) (RS# 271-1311)
      P1 = 50K, 10-turn
      P2 = 10K, 10-turn
```

Capacitors:

```
      C1 = 100µF/16V (RS# 272-1016)
      C2 = 22µF/16V  (RS# 272-1014)
      C3 = 220µF/16V (RS# 272-1017)
      C4 = 10µF/16V  (RS# 272-1013)
```

Q1 is a PNP Silicon Audio Power Out/Medium Power Switch Transistor, 7A, with a TO-220 case. As long as you have a transistor which is close it will work fine. The SCR is a 100vrm, 0.8A, sensitive gate with a TO-92 case. Diodes D1, D2 and D3 are standard small signal diodes. Power diodes D4 and D5 are the 6A, 50prv types, cathode case. The 60vrm type will work as well. I used for IC1 & IC2 the LM555 type. P1 controls the 'on' and pulse-duration, P2 controls the pulse-timing.

Applying the Brakes: When you first press the brakes, this circuit will turn on your 3rd brake light via the main brake lights. After about a second a series of short pulses occur. The number of pulses can range from approximately 1 to 10, depending on the setting of P1/P2 and when the brake pedal was applied last. After the pulses have been applied the third brake light assumes normal operation. The prototype was set for five flashes which seemed more than enough. Two days later I re-adjusted the trimmer potentiometers for 4 flashes. Looks pretty cool!

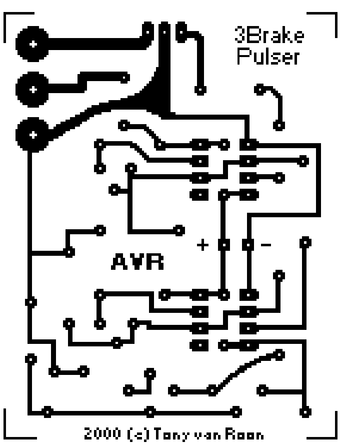
Circuit Description: The schematic consists of two 555 timer/oscillators in a dual timer configuration both setup in astable mode. When power is applied via the brake pedal, the brake light driver Q1 is switched on via the low-output pin 3 of IC2, and timer IC1 begins its timing cycle. With the output on pin 3 going high, inhibiting IC2's pin 2 (trigger) via D2, charge current begins to move through R3, R4 and C2.
When IC1's output goes low, the inhibiting bias on pin 2 of IC2 is removed and IC2 begins to oscillate, pulsing the third brake light via the emitter of Q1, at the rate determined by P2, R6, and C4. That oscillation continues until the gate-threshold voltage of SCR1 is reached, causing it to fire and pull IC1's trigger (pin 2) low. With its trigger low, IC1's ouput is forced high, disabling IC2's trigger. With triggering disabled, IC2's output switches to a low state, which makes Q1 conduct turning on the 3rd Brake Light until the brakes are released. Obviously, removing the power from the circuit at any time will reset the **S**ilicon **C**ontrolled **R**ectifier SCR1, but the RC network consisting of R4 and C2 will not discharge immediately and will trigger SCR1 earlier. So, frequent brake use means fewer flashes or no flashes at all. But I think that's okay. You already have the attention from the driver behind you when you used your brakes seconds before that.
The collector/emitter voltage drop accross Q1 together with the loss over the series fed diodes D4/D5, will reduce the maximum available light output, but if your car's electrical system is functioning normally in the 13 - 14volt range, these losses are not noticeable.

Building Tips: You can easily build this circuit on perfboard or on one of RS/Tandy's experimentors boards (#276-150), or use the associated printed circuit board listed here.
Keep in mind that Q1 will draw most likely 2 or 3 amps and mounting this device on a heat sink is highly recommended. Verify that the scr is the 'sensitive gate' type. In incandecent bulbs, there is a time lag between the introduction of current and peak brightness. The lag is quite noticeable in an automotive bulb, so the duration of a squarewave driving such a bulb should be set long enough to permit full illumination. For that reason, and because lamps and car electrical systems vary, adjustment via P1 and P2 is necessary to provide the most effective pulse

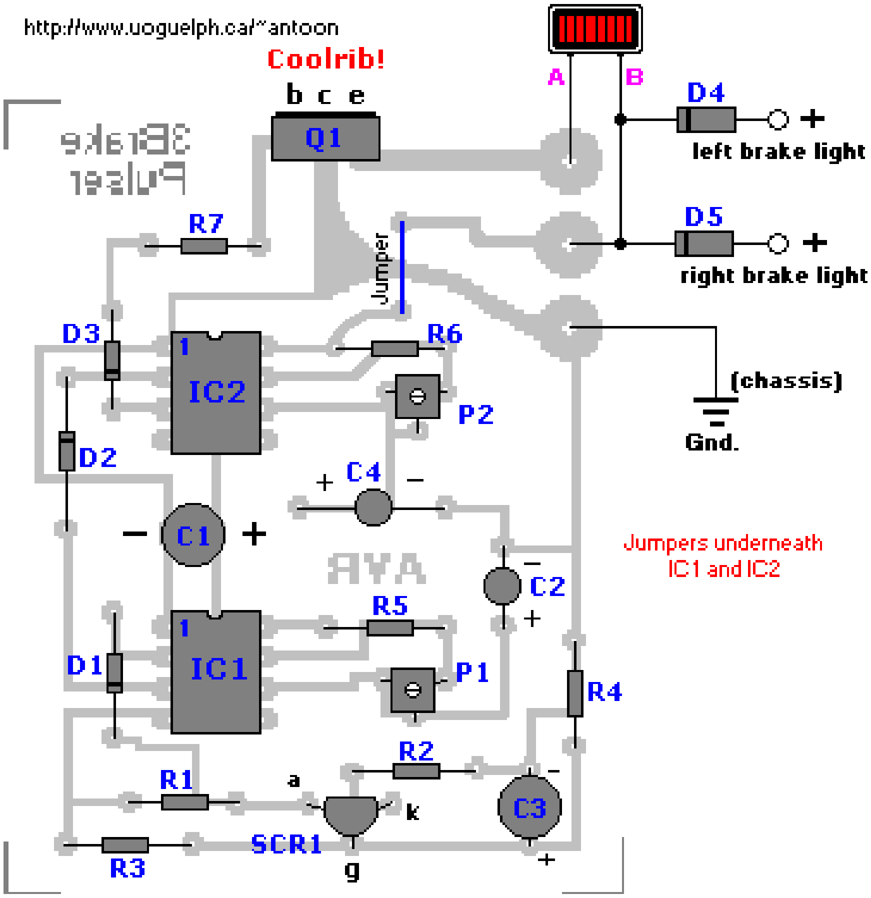
timing for your particular vehicle.
The reason that the third light is connected to both brake lights is to eliminate the possibility of a very confusing display when you use your turn signal with the brakes applied.
The cathode of D4 and D5 are tied together and go to point 'B' of the third brake light in the component layout diagram. Point 'A' goes to the other leg of the third brake light. Most if not all third brake lights in Canada & USA have two wires, the metal ones also have a ground wire which obviously goes to ground. I don't know the wiring scheme for Australian and European third brake lights.
Don't forget the three jumpers on the pcb; two jumpers underneath IC1/IC2 between pin 4/8 and the one near Q1/R6.
If you use a metal case, don't forget to insulate the D4/D5 diodes. (For motorcycle you can eliminate D5).

Some 90's cars, like my 1992 Mercury Sable, have two bulbs inside the third brake light, each bulb is hooked up seperately to the left and right brake light for reasons only Ford knows. Click here for a possible 2-bulb hookup. It shows how I modified mine to get it working; and that was easier than I expected. Current draw with the two bulbs was measured at 1.85Amps (1850mA). Even with double the current none of the circuit components were getting hot. I had to re-adjust the two pots to make it flash since the bench testing was done with one bulb.

Bench Testing: I tested different semiconductors like the 1N5401/1N5404, NTE153, and 4A type powerdiodes for D4/D5. All worked very well. As expected, Q1 is getting *very* hot. Current draw was measured between 680 - 735mA with a regular automotive 'headlight' bulb, extra heavy duty to make sure the circuit was safe. I tested several other power transistors including some darlingtons like the TIP125 and the TIP147. I eventually settled for the TIP125 myself because I had it available but any thing with 5A or more will do fine.
The actual third brake bulb is a lot smaller. Adjusting the trimpots (P1/P2) may take a bit of patience but really fine-tunes the circuit well. The only drawback of this circuit is the discharge lag coming from the electrolytic capacitor C2 and the R4 resistor. Especially if the brakes are used often or at short intervals the third brake light will not flash or maybe flash once or twice. Again, this is because the R-C combo does not have enough time to discharge in between braking. It takes about 12 seconds to discharge C2.



The pcb measures 2 x 2.5 inch (5 x 6.4cm or 170 x 200 pixels) at 2 colors and is shown smaller when you print these pages. If you need a direct, full size copy of the pcb I suggest to load the gif file into a program like Paint Shop Pro or one of the many gif viewers available. This pcb was modified by Bert Vogel and eliminates the jumpers. Click Here Good stuff; thanks Bert.



PCB Component Lay-out
(c) Tony van Roon

The layout is enlarged a bit for a better component view. Note that Q1 is drawn soldered on the pcb but if you have a metal case you can put it anywhere on the metal case (as a coolrib) and use havy duty wiring between Q1 and the PCB.

CORRECTION: SCR1's anode/kathode were shown reversed (fixed: 2-26-2000).

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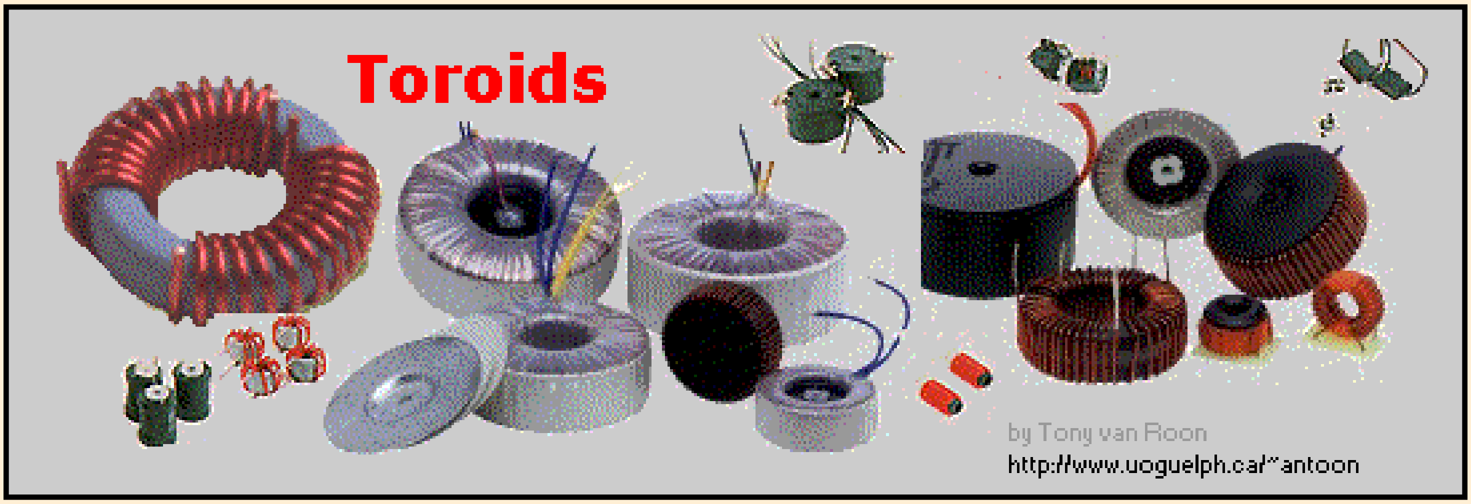


by Tony van Roon

Toroids & RF-chokes, come in different shapes and sizes, like in donut, tube, and stick models, and are used on a large scale in a variety of electronic equipment. Toroids can be of different materials, like Ferrite or Iron. The most common application today is filtering. If you check your cable at the back of your computer monitor you will find one, or even two, on the cable going to your computer. They are also used in Power Supplies, Radio, Ham Radio, Scanners, Transmitters, Transformers, and Electro-Magnet applications.
Here is an excellent link to provide more 'Amidon' information: **Bytemark Inc.**

Below I have made up 4 tables with the most common-size toroids. I hope they can be of some assistance to you. The 'µ' stands for the permeability factor of the core.

Red E Cores: 500Khz - 30Mhz (u=10)

Core	OD	ID	H (in inches)
T12-2	0.125	0.06	0.05
T25-2	0.25	0.12	0.09
T37-2	0.37	0.21	0.12
T50-2	0.50	0.30	0.19
T68-2	0.68	0.37	0.19
T80-2	0.80	0.50	0.25
T94-2	0.94	0.56	0.31
T200-2	2.00	1.25	0.55

Black W Cores: 30Mhz - 200Mhz (u=7)

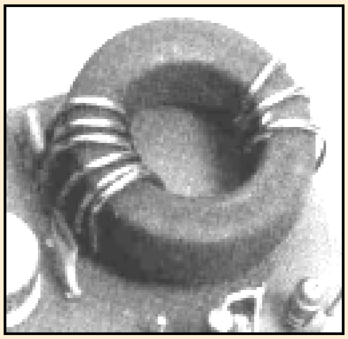
Core	OD	ID	H (in inches)
T12-10	0.125	0.06	0.05
T25-10	0.25	0.12	0.09
T37-10	0.37	0.21	0.12
T50-10	0.50	0.30	0.19

Yellow SF Cores: 10Mhz - 90Mhz (u=8)

Core	OD	ID	H (in inches)
T12-6	0.125	0.06	0.05
T26-6	0.25	0.12	0.09
T50-6	0.50	0.30	0.19
T68-6	0.68	0.37	0.19
T80-6	0.80	0.50	0.25
T94-6	0.94	0.56	0.31

Ferrite Toroids (Amidon)

Core	OD	ID	H (in inches)
FT-23	0.230	0.120	0.060
FT-37	0.375	0.187	0.125
FT-50	0.500	0.281	0.188
FT-82	0.825	0.520	0.250
FT-114	1.142	0.750	0.295



The photograph at left shows a Toroid Red 'E'Iron core and is used in a CW-transmitter (morse-code) application in the 30-meter band.

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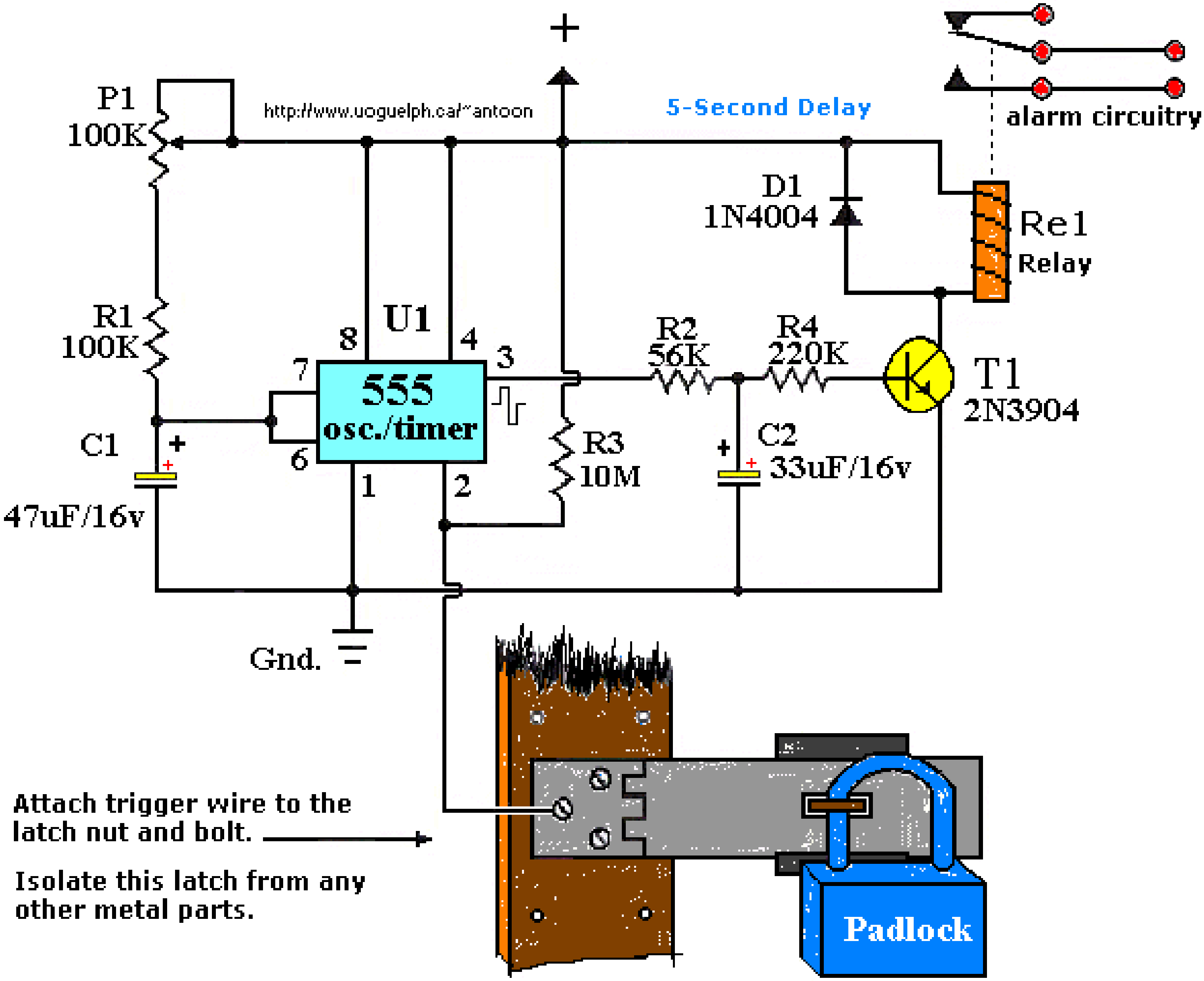
Touch Activated Alarm System

by Tony van Roon



Parts List

R1 = 100K	D1 = 1N4004	U1 = 555 Timer*
R2 = 56K	C1 = 47µF/16V**	
R3 = 10M	C2 = 33µF/16V**	
R4 = 220K	T1 = 2N3904, or equivalent	
P1 = 100K	Re1 = Relay***	

Additional Notes

Not much to tell here as the circuit speaks for itself. *The 555 can be a LM, NE, or MC(cmos) type, they are all pin-compatible. ****C1/C2's** working voltage should be increased to 25V if you decide to go with a 12V power source. Rule of thumb: the working voltage of capacitors are at least double the supplied voltage, in other words, if the powersource is 9Volt, your capacitor(s) is at least 18V. Transistor T1 can be any approximate substitute. *** Use any suitable relay for your project and if you're not tight on space, use any size. I've build this particular circuit to prevent students from fiddling with the security cameras in computer labs at the University I am employed. I made sure the metal casing was not grounded. But as the schematic shows you can basically hook it up to any type of metal surface. I used a 12-vdc power source. Use any suitable relay to handle your requirements. A 'RESET' switch (**N**ormally **C**losed) can be added between the positive and the 'arrow-with-the-+'. The trigger (touch) wire is connected to pin 2 of the 555 and will trigger the relay, using your body resistance, when touched. It is obvious that the 'touching' part has to be clean and makes good contact with the trigger wire. This particular circuit may not be suitable for all applications. Just in case you wonder why pin 5 is not listed in the schematic diagram; it is not really needed. In certain noisy conditions a small ceramic capacitor is placed between pin 5 and ground. It does no harm to add one or leave it out.

***NOTE:* For those of you who did not notice, there is an approximate 5-second delay build-in before activation of the relay to avoid false triggering, or a 'would-be' thief, etc.**

AGAIN, make sure the latch is not touching anything 'ground' or the circuit just keeps resetting itself and so will not work. My shed has wooden doors so works fine. If you can not get yours to work, check the trigger input, verify there is some sort of signal coming from output pin 3 play with the value of R3. If you are interested in a short tutorial about the 555 Timer/Oscillator IC or find yourself having some problems understanding some of the pin functions, please check here: **555 Tutorial**

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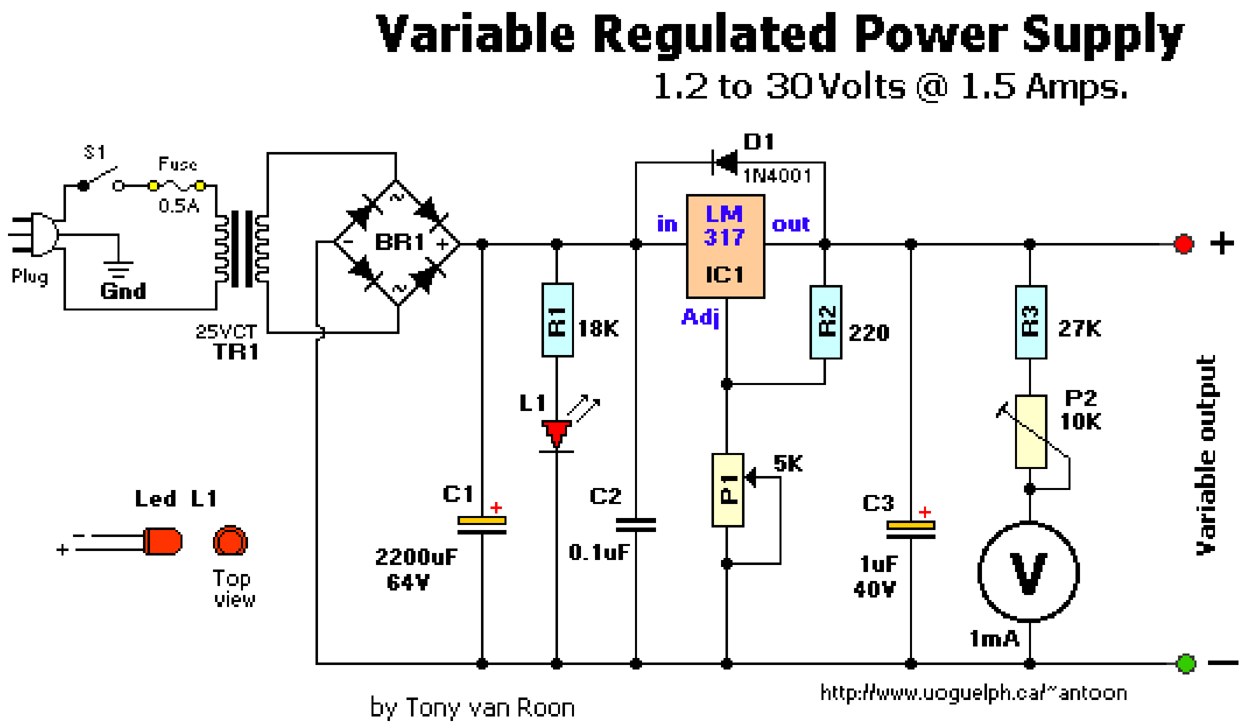
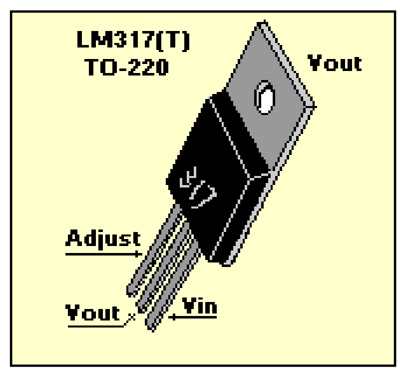


Parts List

BR1 = Bridge Rectifier, 100V - 3A	C1 = 2200 µF, 63V
IC1 = LM317, adjustable regulator	C2 = 0.1 µF
V = Meter, 30V, Ri = 85 ohm	C3 = 1µF, 40V
TR1 = Transformer, 25V, 2A	Plug = 3-wire plug & cord
R1 = 18K, 5%	S1 = On-Off toggle switch
R2 = 220 ohm, 5%	D1 = 1N4001
R3 = 27K, 5%	Fuse = 110V, 500mA, slow-blow
P1 = 5K, potentiometer	FuseHolder, wire, solder, case, knob for P1
P2 = 10K, 10-turn trim-pot	Red & Black Banana Jacks



Some Notes: This is a simple, but low-ripple powersupply, and an excellent project if you're starting out in electronics. It will suit your needs for most of your bench testing and prototype applications. The output is adjustable from 1.2 volts to about 30 volts. Maximum current is about 1.5 amps which is also sufficient for most of your tinkering. It is relatively easy to build and can be pretty cheap if you have some or all the required parts. A printed circuit board is not included and I'm not planning on adding one since the whole thing can easily be build on perferated or vero board. Or buy one of Radio Shack/Tandy's experimentors boards (#276-150). Suit yourself. The meter and the transformer are the money suckers, but if you can scrounge them up from somewhere it will reduce the cost significantly. BR1 is a full-wave bridge rectifier. The two '~' denotes 'AC' and are connected to the 25vac output coming from the transformer. IC1 is a 3-pin, TO-220 model. Be sure to put a cooling rib on IC1, at it's max 1.5 A current it quickly becomes very hot...
All the parts can be obtained from your local Radio Shack or Tandy store. The physical size of the power supply case depends largely on the size of the meter & transformer. But almost anything will do. Go wild.

Circuit Description: The 110V-AC coming from the powercord is fed to the transformer TR1 via the on-off switch and the 500mA fuse. The 30vac output (approximately) from the transformer is presented to the BR1, the bridge-rectifier, and here rectified from AC (Alternating Current) to DC (Direct Current). If you don't want to spend the money for a

Bridge Rectifier, you can easily use four general purpose 1N4004 diodes. The pulsating DC output is filtered via the 2200µF capacitor (to make it more manageable for the regulator) and fed to 'IN'-put of the adjustable LM317 regulator (IC1). The output of this regulator is your adjustable voltage of 1.2 to 30volts varied via the 'Adj' pin and the 5K potmeter P1. The large value of C1 makes for a good, low ripple output voltage.
Why exactly 1.2V and not 0-volt? Very basic, the job of the regulator is two-fold; first, it compares the output voltage to an internal reference and controls the output voltage so that it remains constant, and second, it provides a method for adjusting the output voltage to the level you want by using a potentriometer. Internally the regulator uses a zener diode to provide a fixed reference voltage of 1.2 volt across the external resistor R2. (This resistor is usually around 240 ohms, but 220 ohms will work fine without any problems). Because of this the voltage at the output can never decrease below 1.2 volts, but as the potentiometer (P1) increases in resistance the voltage accross it, due to current from the regulator plus current from R2, its voltage increases. This increases the output voltage.
D1 is a general purpose 1N4001 diode, used as a feedback blocker. It steers any current that might be coming from the device under power around the regulator to prevent the regulator from being damaged. Such reverse currents usually occur when devices are powered down.
The 'ON' Led will be lit via the 18K resistor R1. The current through the led will be between 12 - 20mA @ 2V depending on the type and color Led you are using. C2 is a 0.1µF (100nF) decoupler capacitor to filter out the transient noise which can be induced into the supply by stray magnetic fields. Under normal conditions this capacitor is only required if the regulator is far away from the filter cap, but I added it anyway. C3 improves transient response. This means that while the regulator may perform perfectly at DC and at low frequencies, (regulating the voltage regardless of the load current), at higher frequencies it may be less effective. Adding this 1 µF capacitor should improve the response at those frequencies.
R3 and the trimmer pot (P2) alows you to 'zero' your meter to a set voltage. The meter is a 30Volt type with an internal resistance of 85 ohms. I you have or obtained a meter with a different Ri (internal resistance) you will have to adjust R3 to keep the current of meter to 1mA. Just another note in regards this meter, use the reading as a guideline. The reading may or may not be off by about 0.75volts at full scale, meaning if your meter indicates 30 volts it may be in reality almost 31 volts or 29 volts. If you need a more precies voltage, then use your multimeter.

Construction: Because of the few components you can use a small case but use whatever you have available.
I used a power cord from a computer and cut the computer end off. All computer power cords are three-prong. The ground wire, which is connected to the middle pin of the power plug is connected to the chassis. The color of the ground-wire is either green or green/yellow. It is there for your protection if the 110vac accidentally comes in contact with the supply housing (case). BE CAREFUL always to disconnect the powerplug when you working inside the chassis. If you choose to use an in-line, or clip-type fuseholder be sure to isolate it with heat shrink or something to minimize accidental touching.
I use perf-board (or Vero board) as a circuit board. This stuff is widely available and comes relatively cheap. It is either made of some sort of fiber material or Phenolic or Bakelite pcb. They all work great. Some Phenolic boards come with copper tracks already on them which will make soldering the project together easier.
I mounted the LM317(T) regulator on a heatsink. If you use a metal/aluminum case you can mount it right to the metal case, insulated with the mica insulator and the nylon washer around the mounting screw. Note that the metal tab of the LM317 is connected internally to the 'Output' pin. So it has to be insulated when mounting directly to the case. Use heat sink compound (comes in transparent or white color) on the metal tab and mica insulator to maximize proper heat transfer between LM317 and case/ or heatsink.

Drill the holes for the banana jacks, on/off switch, and LED and make the cut-out for the meter. It is best to mount everything in such a way that you are able to trouble-shoot your circuit board with ease if needed. One more note about the on-off switch S1, this switch has 110VAC power to it. After soldering, insulate the bare spots with a bit of silicon gel. Works great and prevents electrical shock through accidental touching.

If all is well, and you are finished assembling and soldering everything, check all connections. Check capacitors C1 & C3 for proper polarity (especially for C1, polarity reversal may cause explosion). Hookup a multimeter to the power supply output jacks. Set the meter for DC volts. Switch on S1 (led will light, no smoke or sparks?) and watch the meter movement. Adjust the potentiometer until it reads on your multimeter 15Volts. Adjust trimpot P2 until the meter also reads 15volts. When done, note any discrepancies between your multimeter and the power supply meter at full scale (max output). Maybe there is none, maybe there is a little, but you will be aware of it. Good luck and have fun building!

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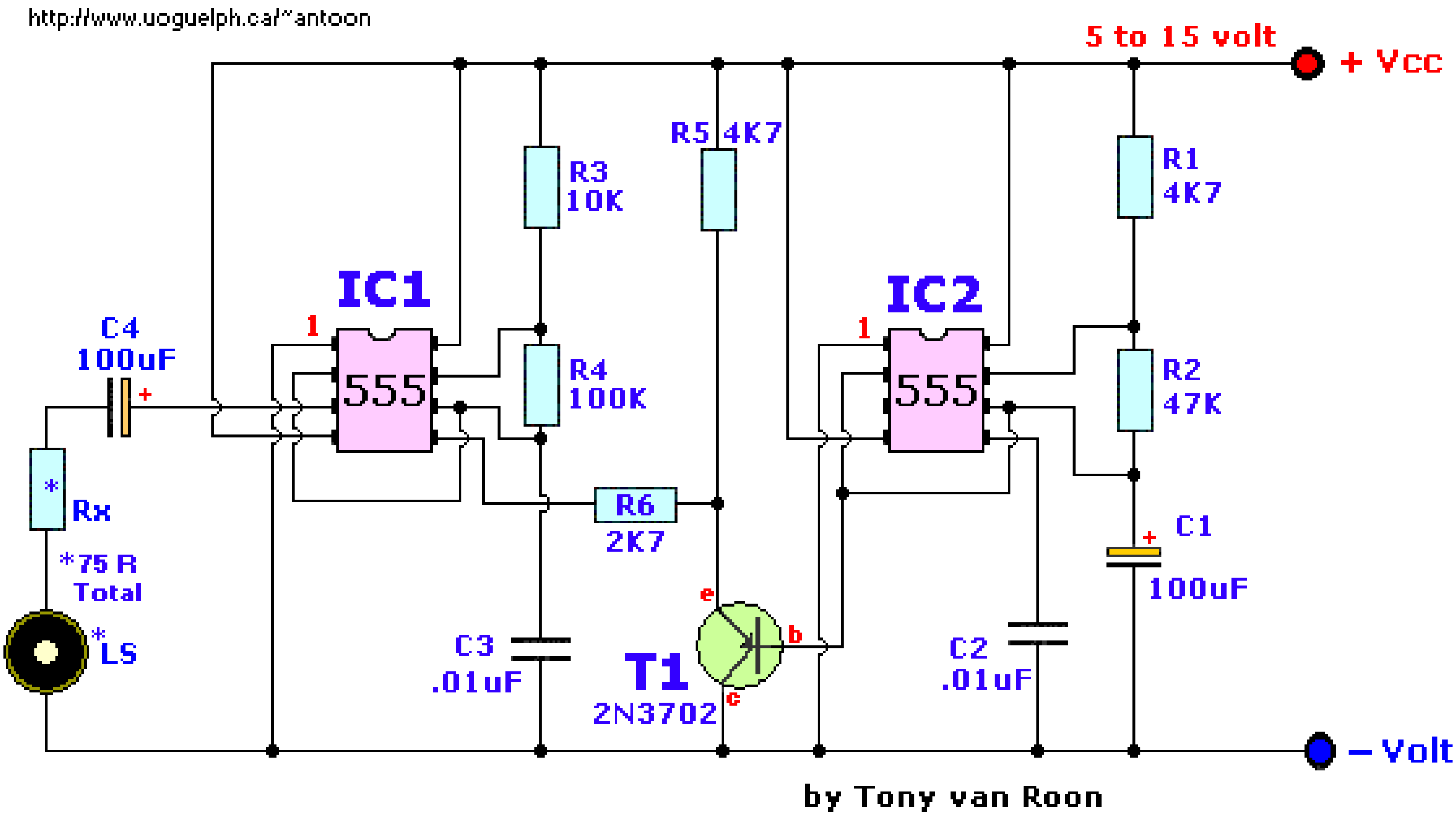
Wailing Alarm Siren

by Tony van Roon



Parts List:

```
R1,R5 = 4.7K       C1,C4 = 100uF/25V, electrolytic
   R2 = 47K        C2,C3 = 0.01uF (10nF), ceramic
   R3 = 10K           T1 = 2N3702 (NTE159, TUP, etc.)
   R4 = 100K     IC1,IC2 = LM/NE555, MC1455P, etc
   Rx = *Notes        LS = Loudspeaker. *Notes
```

Notes:

This circuit provides a warbling sound to any alarm circuit. IC2 is wired as a low frequency astable with a cycle period of about 6 seconds. The slowly varying ramp waveform at C1 is fed to pnp emitter follower T1, and is then used to frequency modulate alarm generator IC1 via R6. IC1 has a natural center frequency of about 800Hz. Circuit action is such that the alarm output signal starts at a low frequency, rises for 3 seconds to a high frequency, then falls over 3 seconds to a low frequency again, and so on.
*The Loudspeaker LS and the resistor marked "Rx" should be together 75 ohms. If you have a standard 8-ohm speaker then Rx is 67 ohms. The nearest value is 68 ohms. So for a 8 ohm loudspeaker Rx is 68 ohms. For a 4 ohm loudspeaker Rx is 71 ohms, for a 25 ohm loudspeaker Rx is 50 ohms, etc, etc.

BUT, the Rx value is not very critical. It is just there as some sort of volume control. Experiment with it. C2 and C3 are 0.01uF (10nF) and a simple ceramic type will do the job. I tested the circuit at 9, 12, and 15 volt. My choice would be 9volt alkaline for battery operation or 12volt for use with a small powersupply. Output pin 3 of IC2 is NOT connected; just in case you are wondering... :-) In my prototype I used LM555 timers.

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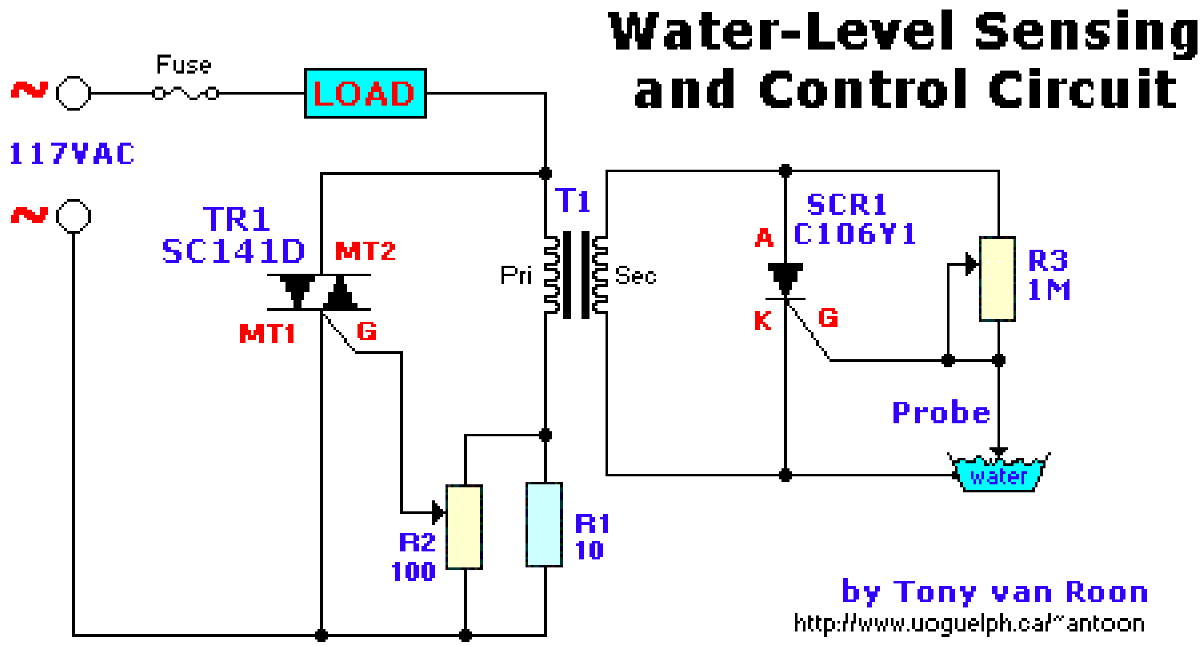

Parts List

R1 = 10 ohm, 10 watt, wirewound
R2 = 100 ohm, potentiometer, wirewound
R3 = 1 Mega-ohm potentiometer
T1 = Transformer, 12.6volt, 1.2amp (min)
SCR1 = Silicon Controlled Rectifier, C106Y1, NTE5452, or equivalent
TR1 = TRIAC, SC141D, NTE5608, or equiv., rated 6 to 10 amp at 200 to 400 volt. Case TO-220
Fuse = Slow-blow, 2 amp.

This is a simple but reliable circuit for your sump-pump, aquarium, boat, or whatever, but water only. Please be careful when working with 115Volt line voltage! Take every precaution to avoid electrical shock. Unplug the power before making changes or touching resistor R1. Murphy's Law applies to all of us!

This circuit is NOT suitable for use with flamable liquids!!!

A Couple Notes

Triac TR1 enegizes a load which might control a valve, indicator light, audible alarm, relais, etc. The SC141D can be substituted with NTE5608, NTE5635, or Radio Shack 276-1001 model.
When the water-level is "low", the probe is out of the water and SCR1 is triggered "on". It conducts and imposes a heavy load on Transformer T1's secundary winding. That load is reflected back into the primary, gating TR1 on which energizes the load. The C106Y1 can be substituted with a NTE5452 or Radio Shack (or Tandy) 276-1352
T1 is 12.6V not 12V. Applications of the circuit are limited only by one's imagination.

The load may vary from a watervalve, a relay controlling a pump, etc. Lots of possibilities. Value of the (slow-blow) fuse may vary depending on your load. Select your probe carefully, keeping in mind the hardness and/or pH level of the water. In either case, on occasion it will be necessary to clean your probe from contaminants.

If your country's electrical supply is 220VAC change TR1 to a 400 - 600 volt type, potentiometer R2 to 220 - 500 ohms. If you find that 500 ohms is too coarse go with 220 ohm.
Experiment with the value for wire-wound resistor R1. It can be anywhere from 5 to 47 ohms. Start with 15 ohms or so and take it from there. Feel if it gets real hot (unplug the power first!). If so, increase the value.

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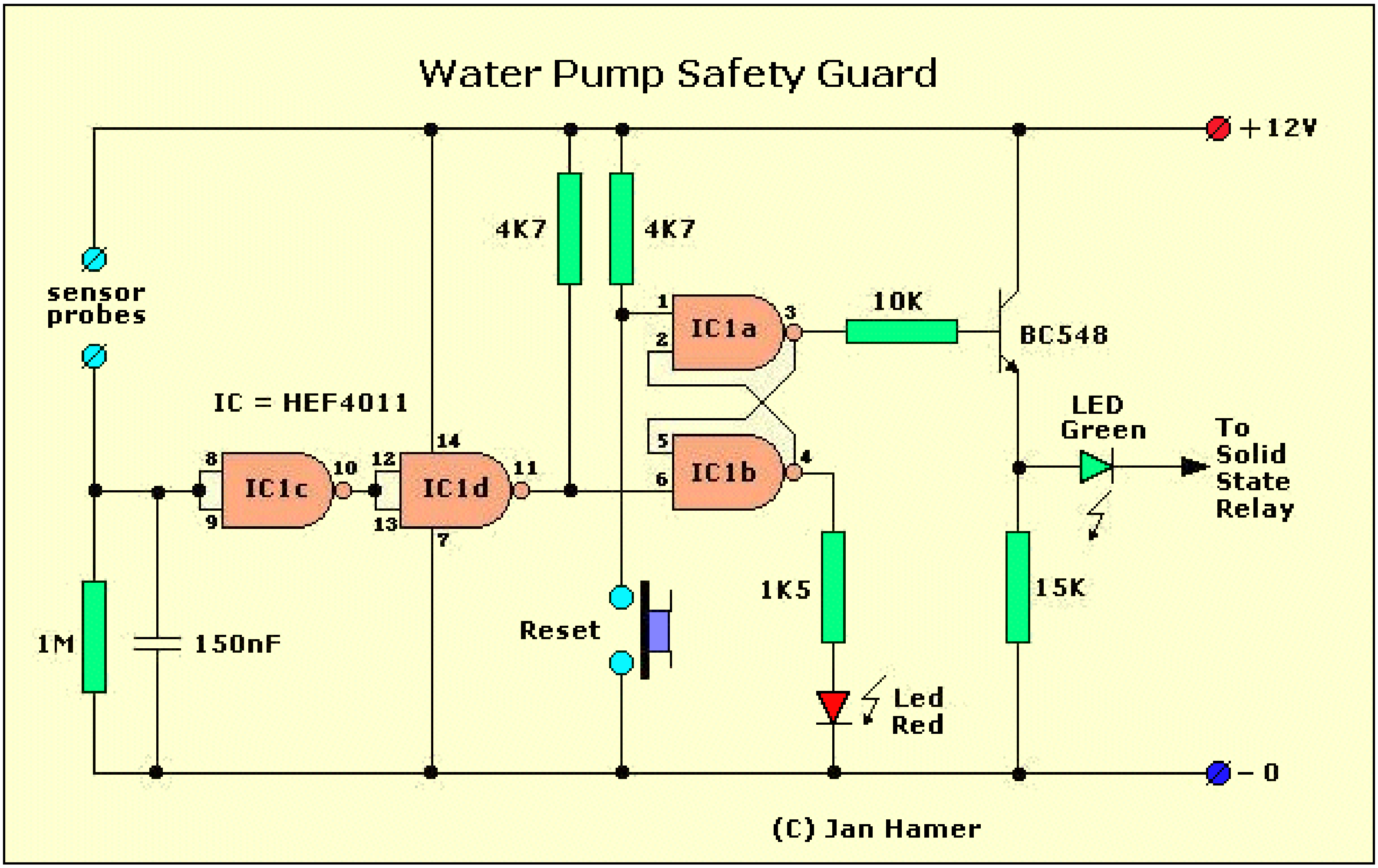
Waterpump Safety Guard for Fish-pond

© by Jan Hamer

The circuit below was developed to guard the fish pond. In this case to prevent that the pump sucks just air when the waterlevel get below the pump. When the waterfilters get saturated and dirty, the water level behind the filter gets to an unacceptable level. You can see this when the pump also produces airbubbles in the water.

Because you are not all day peeking if this is the case, I connected the pump via a Solid State Relais, which acts as a power switch mounted in one of the AC wires and is controlled by the circuitry below.



The sensor is fabricated using two sturdy solid *copperwires which are mounted approximately 1cm () apart in the water after the waterfilter. The conductivity of the water is sufficient to pull the input of the first IC (IC1c) high. The output of IC1d will then also be high. (* see note)

This output signals the R-S Flip-Flop formed by IC1a and IC1b.
Often the condition is correct when you power up, which is indicated by the green led. However, if the red led is lit, just press the Reset switch to put the circuit in the proper operational condition. The current flowing through the green led is also fed through the diode in the Solid State Relay, activating the relays and

the starting the pump.

If for some reason the water level is getting low and the copper wires no longer touch the water, the input of the first IC is pulled low and consequently also the ouput of the IC behind that. The R-S Flip-Flop flips to the other condition and the green led goes out and also the pump and the red led will be lit to indicate 'something' is wrong. In this case the waterlevel.

When you're ready after the filters have been cleaned, the only you have to do is press the Reset button to activate the pump again. This way unnecessary damage to the pump is prevented.

The copper wires will need regular cleaning to make sure they conduct.

If you have questions about this circuit, please direct them to Jan Hamer or visit his website in the Netherlands (if you can read Dutch).

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Weller WLC100 Electronic Soldering Station

WLC100 One day you switch on your soldering station. You flick the switch and the red light comes "ON", indication power is okay. Ten minutes later you get ready to solder and find the soldering pencil is not hot at all. What?! After the usual frustration period of confusion and bad words you decide to investigate and fix the problem. After all, you are a techie or technical inclined and you can fix anything.

Well, read on. I was in a similar situation and in for a 'quick-fix'; NOT! Not thinking of checking out the soldering pencil first (dumb,dumb,dumb) I started to take the one visible screw out from the bottom cover plate. The other two screws are hidden underneath the rubber feet at the left edge. As mentioned before, the circuit board is small. I pulled the knob off and unscrewed the nut holding the switch to the body. I marked the wiring on a piece of paper and took the pcb out all the way. We had brownouts and power-failures that afternoon so my first thought was a defective diac but after a quick test with the Huntron Tracker it proved to be good (see diagram below).
Okay, on to the Triac. The triac tester showed the triac capable of switching and holding its state. Also good. Finally it occured to me to check the soldering pencil itself. Yep. Darn thing was open. Murphy's Law at work again. Could have saved myself a lot of time by thinking first instead of taking the station apart impulsively. Oh well, one lesson learned.

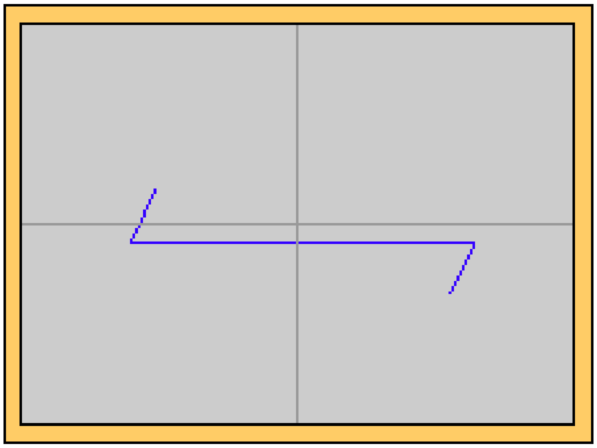
This station lasted about 6-years of 7-hour a-day use, so really fantastic. Unable to order replacement parts for this model I was forced to purchase a new station, not really expensive though, they are around $55.00 Canadian in my area so a good buy.

The WLC100 is a cheap and well build, temperature controlled, soldering station and works really well for most applications. Below I have drawn out the lay-out and pcb, and included a circuit diagram and parts list. The pcb measures about 1-7/8 by 1-inch. This document my help you in repairing your own station if the time comes.

Drawn by Tony van Roon (2002)

Parts List:

R1 = 15 Kilo-Ohm, brown-green-orange, 1/8 Watt, 5%
P1 = 220K potentiometer
C1 = 823K, 250V
D1,D2 = 1N4007
D3 = Diac, bilateral trigger type
Q1 = *Q4012LPH, Triac, 400V/25A, Manufacturered by Teccor



Notes:
The Diac I tested with an instrument called a "Huntron Tracker". It showed okay. Look at the picture at the left what a 'good' signature is for a diac.
Newer stations of the same model have now a receptacle at the left side, soldering iron plugs into here. Much easier to service this way.

***CAUTION:**The Triac has an Isolated tab, so if you need to substitute make sure to use the same type. Two replacements for the Q4012LPH are the Q4015L5 or the NTE6020.

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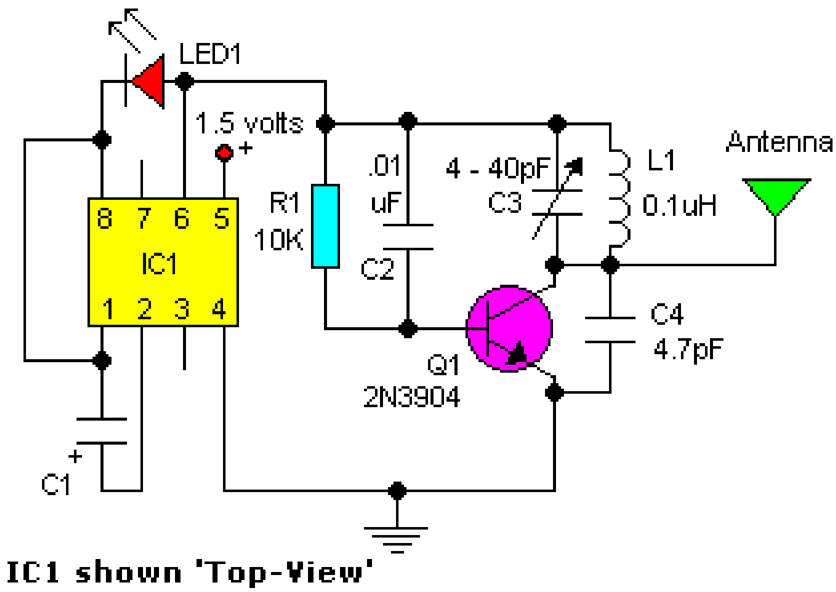
1.5 Volt Tracking Transmitter

http://www.uoguelph.ca/~antoon



Parts List

C1= 100 uF electrolytic capacitor
C2 = .01uF disc capacitor
C3 = 4 to 40 pF trimmer capacitor
C4 = 4.7 pF disc capacitor
L1 = 0.1 uH, 6 to 8 turns of 22 gauge hookup wire close wound around a 1/4" diameter non-conductive core, such as a pencil.
IC1 = LM3909 LED flasher
LED1 = red LED
Q1 = 2N3904 NPN silicon transistor
R1 = 10K
Antenna = 10 to 12 inches of hookup wire.

Additional Notes

o For stability, use a NPO types for C2 & C4.
o Resistance tolerance for R1 should be 1 or 2%.
o Frequency range is the usual 87-109Mhz on the FM dial.
o The coil is made from 22 ga 'hookup' wire, like the solid Bell phone wire. Leave the insulation on.
o The LED is the 'High Brightness' type for maximum illumination.

The current draw for this tracker is 3.7mA, so the 1.5V button cell will last awhile. What the heck am I suppose to hear you ask? When your circuit is working you should see the LED flash quite fast. Take your FM radio and search for the low-beat 'thumpe-thumpe-thumpe-etc' equal to the flash of the LED (probably around the 100Mhz). Found it? If that position is interferering with a radio station you can fine-tune it with the variable capacitor. If you like to have the tracker around the 88Mhz you can do that by spreading the windings from the home-made coil just a bit (1/2 a millimeter or so). Anyways, play with it and learn. It is a nice project. The 12-inch antenna can be anything, it is not really that critical. I used a piece of 22 gauge flexible wire. I haven't checked the range but will do that shortly. Have fun with it. -- Tony

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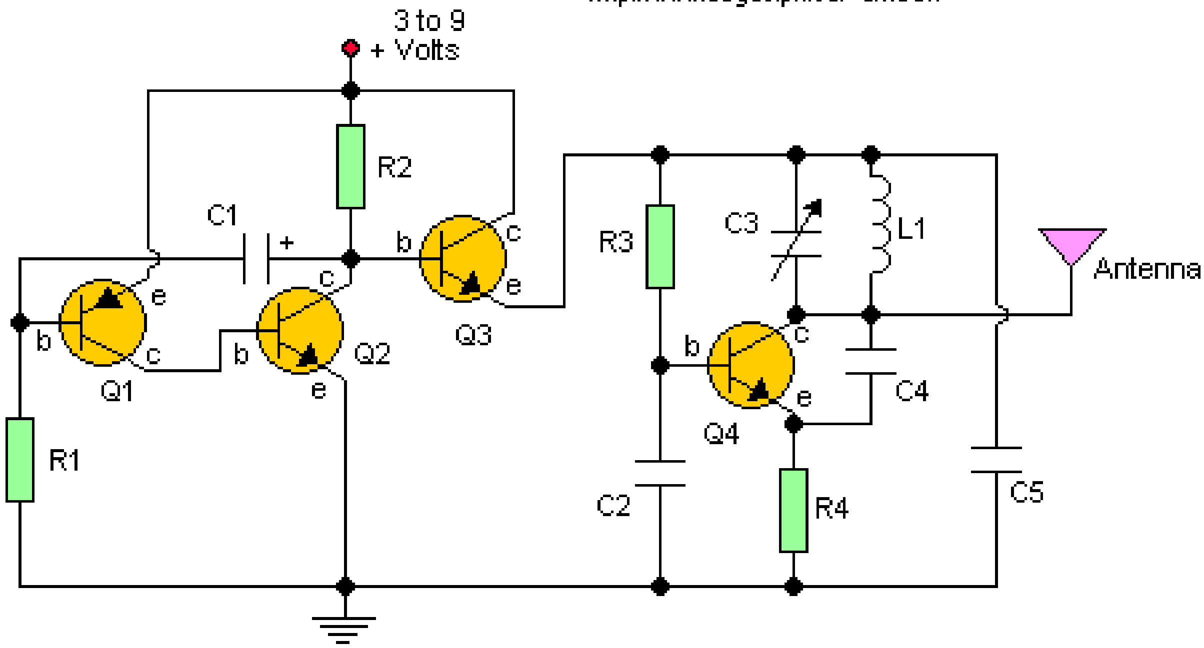
4-Transistor Tracking Transmitter

http://www.uoguelph.ca/~antoon



Parts List

C1 = 4.7 uF electrolytic cap
C2 = .001 uF disc cap
C3 = 10 to 40 pF trimmer cap
C4 = 4.7 pF disc cap
C5 = .001 uF disc cap

Q1 = 2N3906 PNP transistor
Q2, Q3, Q4 = 2N3904 NPN transistor
L1 = 4 to 5 turns of 22 ga. magnet wire close wound around 1/8" non-conductive core.

R1 = 100 K
R2 = 10 ohms
R3 = 47 K
R4 = 220 ohms
Antenna = 10 to 12" hookup wire.

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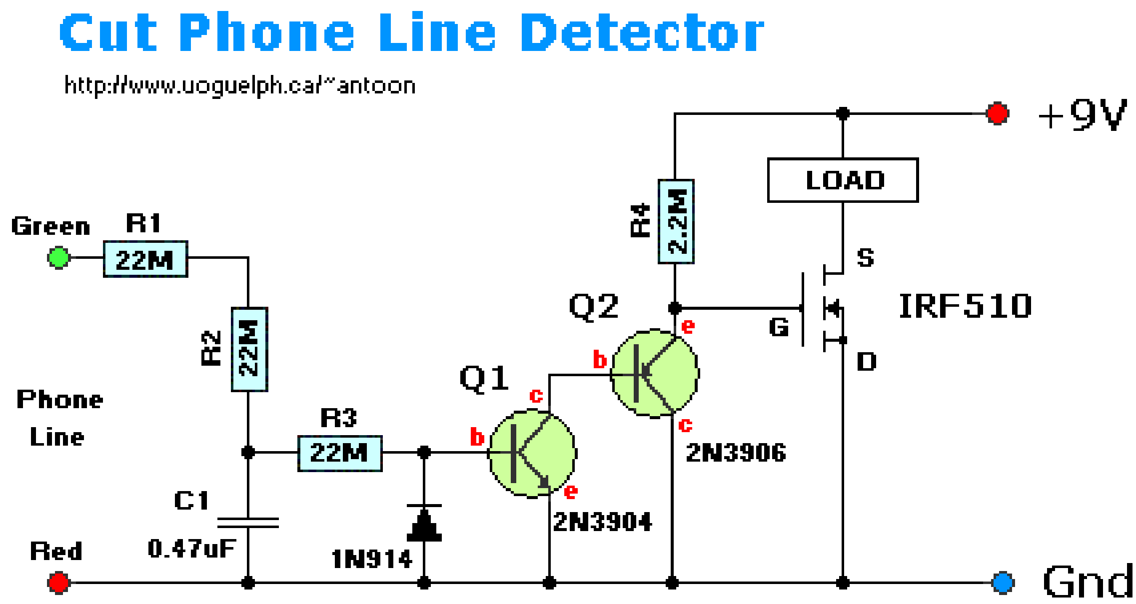

Parts List

```
R1,R2,R3 = 22M, Resistor
      R4 = 2.2M, Resistor
      C1 = 0.47uF, 250V, Mylar, Capacitor
      D1 = 1N914, NTE519, or other small signal diode
      Q1 = 2N3904, NTE123AP, Transistor
      Q2 = 2N3906, NTE159, Transistor
      Q3 = IRF510, NTE2382, Power MosFet
```

Description:

This circuit speaks for itself. When the phone line is okay, Q1 acts as a short with a very high ohms value via R1, R2, and R3 for a total of about 66 MegaOhm so very high. When the phone line is cut (open), it activates the MosFet (Q3) via transistor Q2 to drive the load. Substitutes are fine, none of the components are critical.

The 'LOAD' can be anything you like. A relay, motor, lamp, tape-recorder, stereo, security system, or whatever.
Keep in mind that Phone companies don't like to have anything 'directly' connected to their wires for obvious reasons, so use this circuit at your own risk. If you like to play it save use an Opto-Isolator or something...
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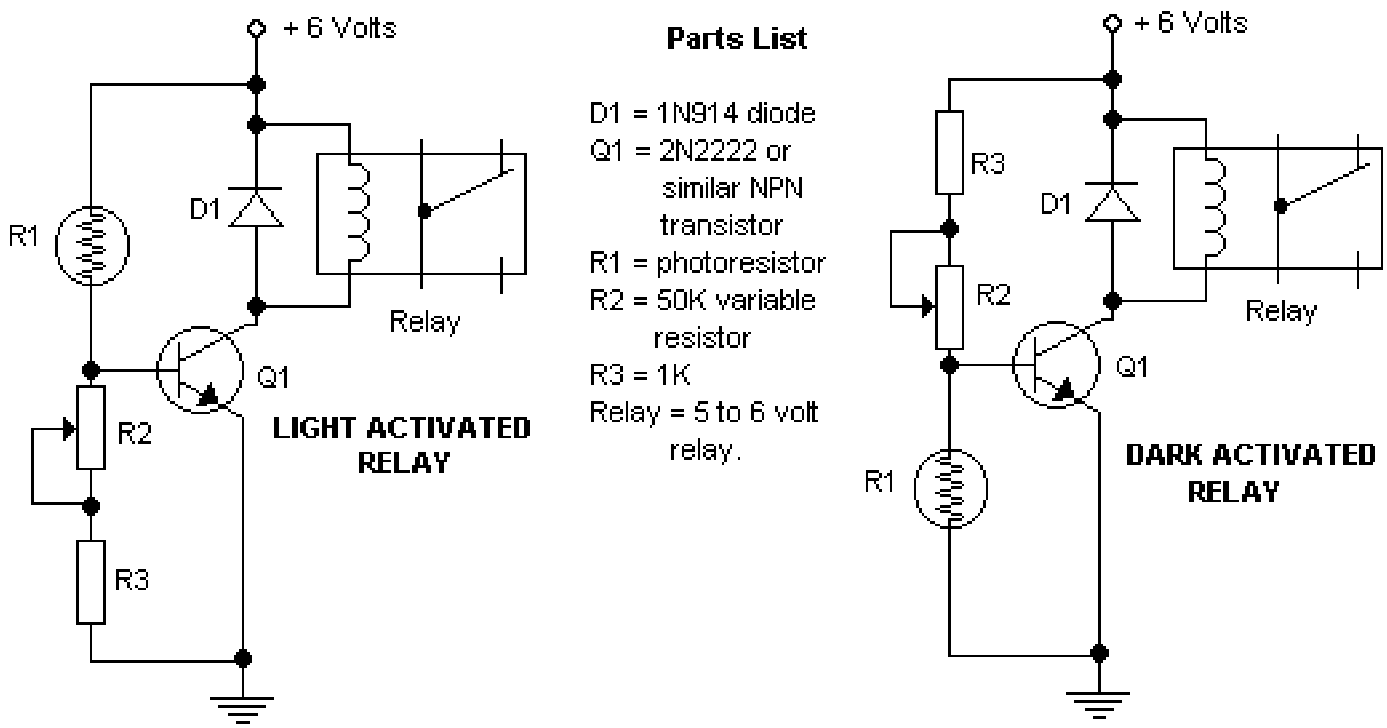
Dark/Light Activated Relay



Additional Notes

None of the parts are critical and easy available. The potmeter adjust the trigger 'on' level. The diode in the diagram shows to be 1N914. This is ok if you have a light-duty relay, also the 1N914 is a signal diode so actually does not qualify. Use a 1N4001 (or better) instead. A couple of substitutes for the 2N2222 transistor are: NTE123A, ECG123A, PN100, etc.

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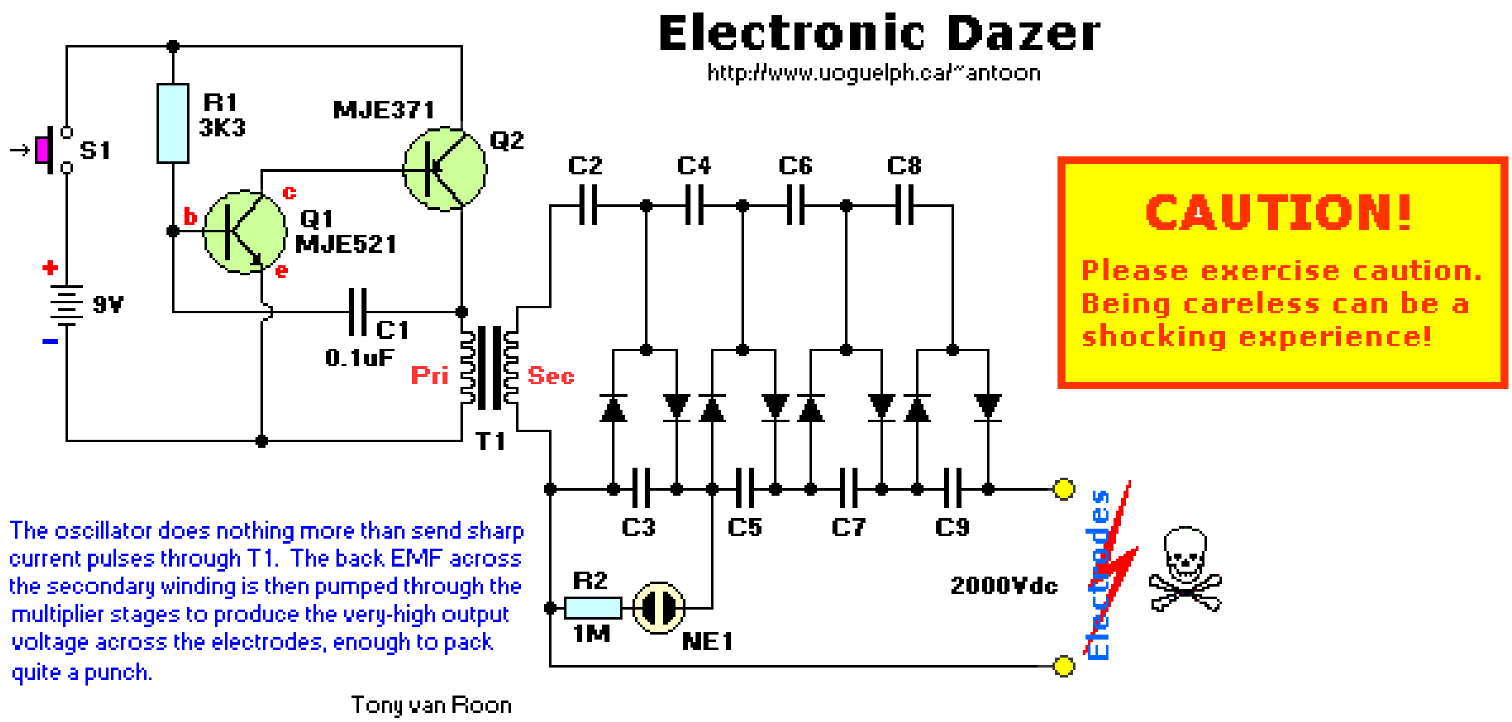
Electronic Dazer

By Rick Duker & Tony van Roon (circuit diagrams)

Never walk in fear with this one-evening project. It won't kill, but it is an effective way to say "Leave me alone!"



Parts List

```
    R1 = 3K3, 5%
    R2 = 1M, 5%
    C1 = 0.1µF, monolythic capacitor
C2-C9  = 0.01µF 400 volt polyester capacitors
 D1-D8 = 1N4007, 1KVolt diodes
   NE1 = Type NE-2 neon bulb
    Q1 = MJE521 NPN power transistor
    Q2 = MJE371 PNP power transistor
    T1 = 1200 to 8 ohm audio power transformer
    S1 = SPST momentary-contact, pushbutton switch
```

Additionally:

9-volt battery clip, 10 x 5 x 2.5cm plastic case, 7.5 x 4cm perfboard or pcboard, two 8/32 x 1-1/4 bolts and nuts for electrodes, adhesive for mounting NE-1, circuit board standoffs (optional), hookup wire, solder, etc.

Substitutes:
After several emails from readers I have found direct possible replacements for Q1/Q2. If I come across suitable others I will add them on a future occasion.
Q1, MJE521: The NTE184 or 2N5190 will work.
Q2, MJE371: The NTE185 or 2N5193 will work.
T1, 1200:8 ohm. Have not experimented with the 1000:8 type. Try it.

WARNING: THIS DEVICE IS NOT A TOY! We present it for EDUCATIONAL and EXPERIMENTAL purposes ONLY. The circuit develops about 2000 volts at a respectable amperage. It can cause you pain and even damage if you become careless and touch its output terminals. The unit can also damage property as well so use it wisely. You should NEVER use the device on another person! It may not be agains the law to possess such a device in your area, but if you use it on someone you may be deemed liable a a civil and/or criminal action suit. Don't just follow the golden rule after constructing the project, instead just don't do it unto anyone. Included in the article are a number of instructions on how to build, test, and operate the Dazer; all of them must be followed to the letter. **Do not deviate from the procedure.**

The *Electronic Dazer* is a modern, portable, personal-protection appliance. It generates hight potential energy to ward off vicious animals or other attackers. It is an aid to help exape from a potentially dangerous situation. the device develops about 2,000 volts. Higher voltages mabe be attained by adding aditional multiplier stages, but it should be noted that those stage will also increase the overal size of the unit.
The Dazer is very compact, being built into a small plastic case. It is powered by a single 9-volt battery, either NiCad or alkaline. (Editor's Note: the so-called 9-V NiCad actually provides only about 7.5V. Why? NiCad cells only give 1.25 per cell. 6 cells in a 9volt battery gives it 7.5V and so the Alkaline type would be a better choice).
The high voltage is applied to two electrodes which require only light contact to be effective. When touched with the Dazer, the victim will receive a stunning, but non-lethal jolt of electricity that will usually discourage any further encounters.
The electronic Dazer is apower supply which consists of a micro-size regenerative amplifier/oscillator coupled to an energy multiplier section. It should not be confused with a cheap induction-type cattle prods. The Dazer is more versatile than other high-voltage stun devices currently being sold. Those devices are basically high-voltage, AC generators which jam the nervous system. However, the Dazer may be used for heating and burning applications, or anywhere a high voltage DC supply is required.
*(**Tony's Note:** Don't confuse the Dazer with a Stun-Gun. The Dazer emits high voltage about 2000V **DC**, a Stun-Gun generates VERY High Voltage of around 15,000V **AC** pulses, and can cause personal injury or even death. Stun-Guns are considered banned illegal fire-arms, you risk criminal prosecution if law enforcement finds one in your possession.)*

How it Works:
Refering to the schematic diagram, the two power transistors Q1 and Q2, form a regenerative amplifier operating as a power oscillator. When Q1 turns on, Q2 turns on and that shorts the power supply across the primary of T1. That current pulse induces a high voltage in the secundary of T1. As C1 charges, Q1 turns on again and the cycle repeats itself. Therefore, a rapid series of DC pulses are generated and stepped up by T1 to approximately 300 volts at full battery charge. That voltage is rectified and increased by the voltage muliplier section which consists of C2 and C9, and D1 to D8. The final output is approximately 2000 volts. The neon

bulb NE1 is used as a charge indicator and indicates that the unit is charge and operating properly.

Check out fig. 1 at the right; these are standard voltage doublers found in many data books and others like the NTE or Electro Sonic catelogue. They can even be found on the internet. Just do a search on one of the major search engines like Yahoo or Google and search for 'voltage doubler' or 'HV'.

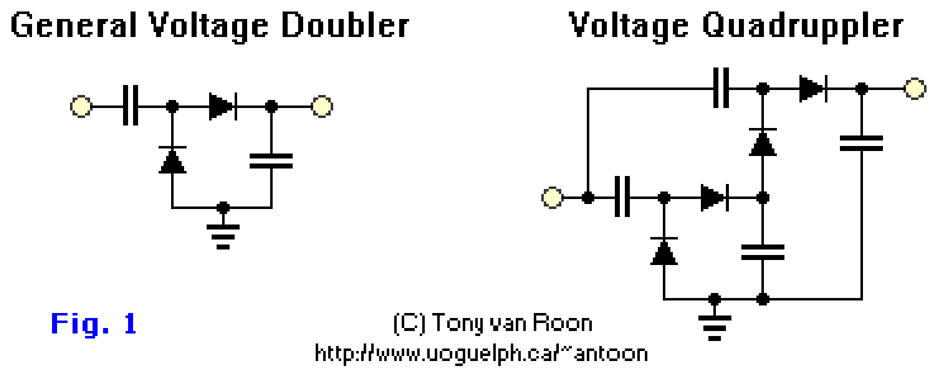


Fig. 1

Construction:

As with all projects start out by laying out and indentifying. If you do not wish to make a printed-circuit-board, then you may use perf board as long as you remember to keep the leads of all high-voltage components isolated. That is to prevent sparks from arcing across your board. A 4 x 7.5 cm of perfboard is suitable for that purpose.
The first components you should mount are the two transistors Q1, Q2, transformer T1, resistor R1, and neon bulb NE1. Solder them in place (for PCB construction) being sure that the transformer and transistors are hooked up correctly. Apply a small amount of adhesive to the base of NE1 to hold it securely in place.
Mount D1 to D8 and C2 to C9 on the board and make all solder connections. Note proper polarity of the diodes. The off-board components are next. Solder in leads for S1, and the output electrodes. Also solder in the battery clip for B1.
Build the enclosure from some nonconductive material such as ABS plastic. Drill holes for S1, NE1, and output electrodes. Be sure that the output electrodes are about a cm or greater apart. Connect the output wires tot the electrodes and insert them trhought holes from inside of the case. Thread on the retaining nuts and tighten them securely. Set the circuit board in the case and mount S1, securing with a nut. That completes the construction.

Testing:

Before inserting the battery and closing the case, a few test measurements should be made to ensure correct operation.
With the ground clip connected to battery (do NOT connect the complete clip to the battery ONLY the ground), connect a volt or multimeter between the positive clip and the positive terminal of the battery. Set the meter for current reading, and press S1. You should measure a current of approximately 300 to 500mA. NE1 should be glowing.
With a high voltage multimeter or VOM, you should measure about 2000 volts on the output terminals. Those measurements indicate proper circuit operation. Let the unit run for about one minute (keep pressing S1). Transistors Q1 and Q2 should be warm, but not hot to the touch (BE CAREFUL!). Insert the battery in the holder and close the case. That wraps up the Electronic Dazer.

Operation and Use:

CAUTION! Activate the unit by pressing S1. NE1 will light indicating the dazer is fully charged and ready to use. Notice also that only one pole of the neon light will glow, indicating DC voltage present. It is important to remember that the device holds a charge even after S1 is off. To discharge, (do not press S1) touch the electrodes to a metal object and note the healthy spark discharge.

The Electronic Dazer was designed as a self-defense weapon for use against vicious dogs or other attacking animals. The device is most effective when the electrodes contact an area of low resistance such as skin or flesh. Those include the snout or mouth since the resistance of those areas are much lower than areas of hair or of fur. The electrodes could be pointed to penetrate these areas better. The dazer generates great stopping power. One contact will give a powerfull jolt and should discourage any further attacks.

The device can burn and heat materials with low resistance. Those include flesh, moistened paper or wood, etc. That makes the unit potentially hazardous to humans. Remember, the dazer is *not* a toy but a quality electrical appliance and therefore must be treated accordingly. Use the utmost discretion with this device!

Another use for this device is as a high voltage DC power supply. It may be constructed as avariable power supply if output taps are taken from various stages of the voltage multiplier section. Remember, always disconnect the battery and fully discharge the capacitors before working with the circuitry.

Note that if you decide to 'Turbo-charge' your unit, you have to use diodes which can handle the voltage. This unit can easily be damaged (and stops working) by incorrect parts choice. So be careful and watch yourself.

Again, this project is for educational and/or laboratory purposes only and even so, it is your responsibility to check with local, provincial, and federal law enforcement in regards to the legality for having in possesion or the construction of this project. I take no responsibility, whatsoever, for the use and/or experimentation with this circuit and other lethal high voltage projects.

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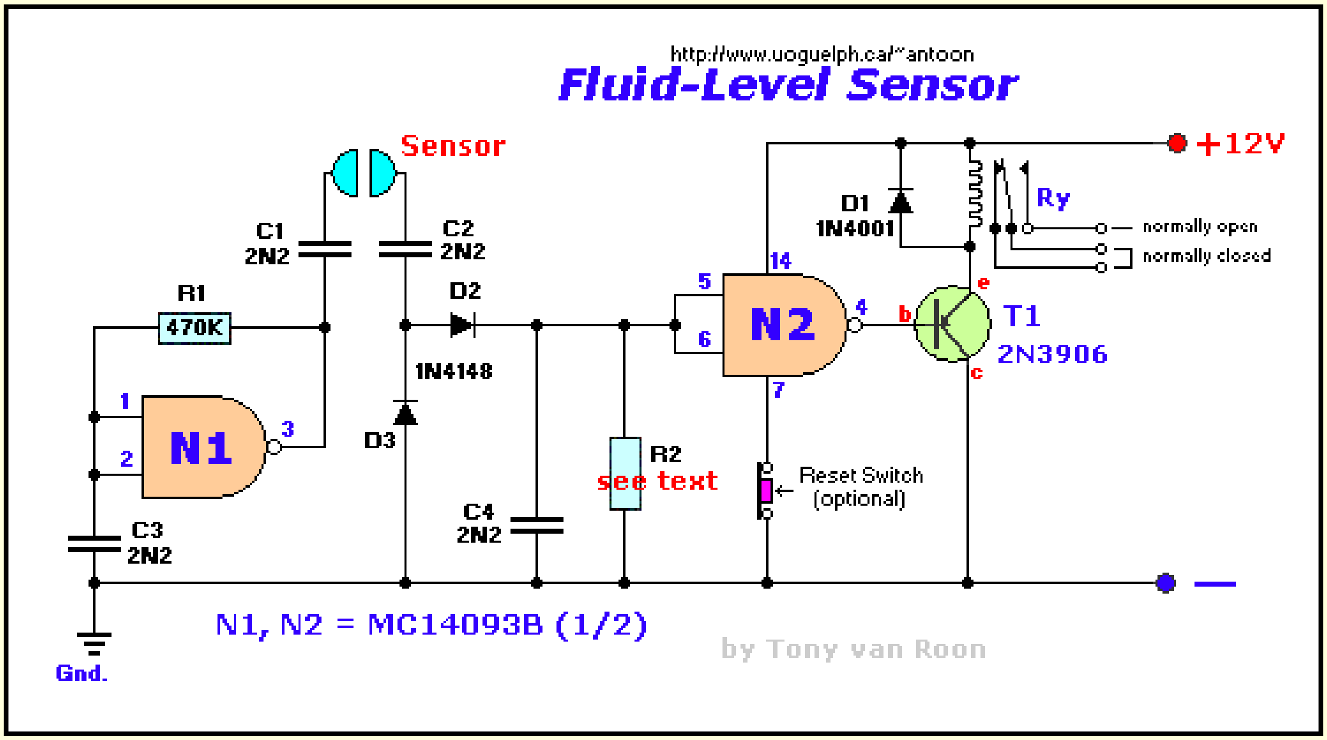

Parts List:

R1	= 470K	N1,N2	= MC14093B
R2	= 15M*	T1	= 2N3906 (these will work also: PN200, 2N4413) (NTE159, ECG159, BC557, BC157, TUP)
C1 - C4	= 2N2 (2.2nF)	Ry	= Relay (12V or matching supply voltage)
D1	= 1N4001	Sensor	= Stainless Steel probes, brass, chrome, etc.
D2,3	= 1N4148		

The above circuit uses an ac-sensing signal to eliminate electrolytic corrosion on the probes. The ac signal is rectified and used to drive Transistor T1 that drives the relay. The relay the 12-V type of your choice.
Transistor T1 can also be a TUP. Check out the **TUP/TUN** document for a large selection of European transistors and what this system is all about.
Diodes D2 and D3 are both small signal diodes (1N4148). Diode diode D3 (1N4001) eliminates transients and possible sparking over the relay coil. Do not use a signal diode for this but a rectifier diode like the 1N4001 or other types of the 1N400x series.
Resistor R2 controls the sensitivity. Also your choice. Select one between 10 and 22 Mega-ohm, or use a trim-pot.
The **MC14093B** is a mos p-channel quad 2-input NAND schmitt trigger. The supply voltage can be between 3.0 and 18Vdc. It is pin-for-pin compatible with the CD4093. The capacitors are standard ceramic types but try others if you have them available.

The unused inputs ***MUST*** be tied to an appropriate voltage level, either ground or +12V. In this case, tie input pins 8, 9, 12, and 13 to either ground or +12v. The unused outputs (10 & 11) ***MUST*** be left open. You can use them as spares when needed.
In regards to the sensor, use your imagination. Stainless steel would be preferred but try other materials too. Depending on what type of fluid you use it for you naturally would choose your type of sensor which would resist corrosion for that particular fluid. I often use chromed bicycle spokes with very good success.

The "RESET" switch in the circuit is optional. The relay can be replaced with anything you like; buzzer, lamps, other relays, etc. A small capacitor of about 10nF (nanoFarad = 0.01uF)

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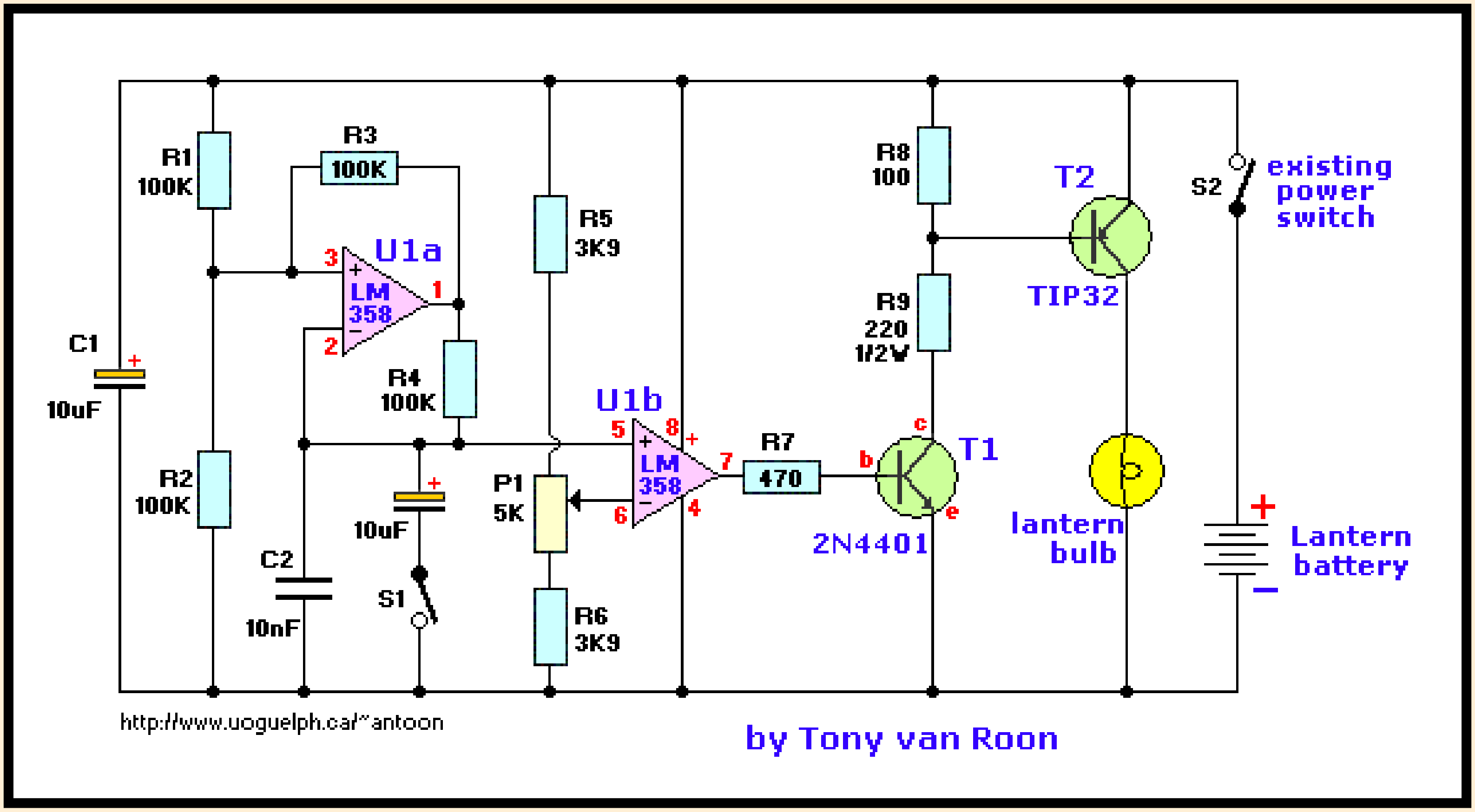
Lantern Dimmer/Flasher

by Tony van Roon



Parts List

R1 = 100K	C1,C3 = 10uF/16V
R2 = 100K	C2 = 0.01uF, ceramic
R3 = 100K	T1 = 2N4401
R4 = 100K	T2 = TIP32
R5 = 3K9	U1 = LM358
R6 = 3K9	L1 = Lantern Bulb
R7 = 470	S1 = On-Off Switch
R8 = 100	
R9 = 220, 1/2 watt	
P1 = 5K	

Additional Notes

ALL resistors are 1/4 watt, 5% tolerance, unless otherwise posted.
P1 is the dimmer potentiometer. S1 is an additional switch to activate the 'Flashing' mode. R9 has to be a half-watt type. T1 is a NPN audio amp transistor and can be substituted with a NTE123AP, the BC547, Elector's (Elektuur) TUN. T2 is a PNP power amp and can be substituted with a NTE197. Try others, they

also may work.

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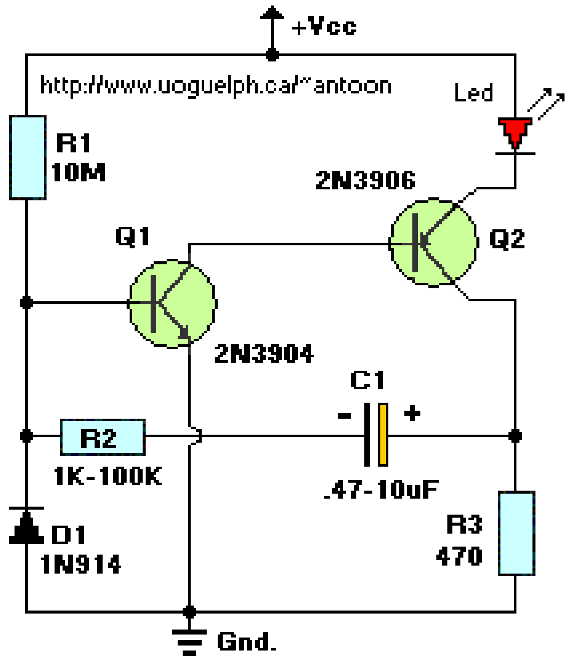
2-Transistor Led Flasher



Parts List
R1 = 10M, 5%
R2 = 1K - 100K, 5%
R3 = 470, 5%
C1 = 0.47µF - 10µF/25V
D1 = 1N914
Q1 = 2N3904
Q2 = 2N3906
Led = High Brightness Red LED

Volts	R1	R2	R3	C1	Approx. Flash Rate
12	10 Meg	22 K	470	0.47 uf	140 per minute
12	10 Meg	10 K	470	1.0 uF	60 per minute
9	6.8 Meg	1 K	390	6.8 uF	15 per minute
6	3.3 Meg	10 K	220	1.0 uF	80 per minute
3	1.5 Meg	10 K	51	1.0 uF	120 per minute
3	3.3 Meg	47 K	51	0.47 uF	140 per minute

This circuit will flash a bright or high-brightness red LED (5000+ mcd). Good for fake car alarm or other attention getting device. Component values are not critical, try anything else first from your junkbox. Obviously, the 470 ohm resistor (R3) determines the LED's brightness and limits the current flow to about 20mA. 390 ohm can also be used as a save value. If you decide to go with a green or yellow led, which draw more current, you may want to replace the 470 ohm with an appropriate value. Flash rate is determined by R2 and C1 and is approximately three time constants (3*R2*C1). R1 provides bias to Q1 which should be low enough not to saturate Q2 with the capacitor disconnected. If the circuit does not oscillate, R1 may be too low or R2 too high. D1 allows for highter duty cycle operation and limits the feedback at the base of Q1 to -0.7 volts. D1 may be ommited for low supply power like 6 - 9V and low duy cycle operation.

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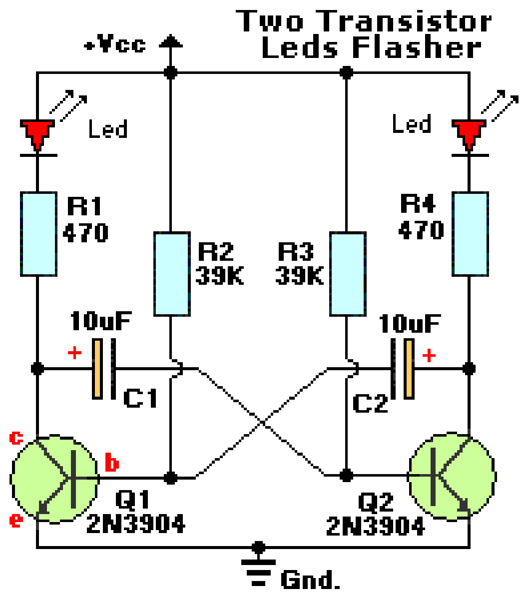

Parts List

R1,R4 = 470, 5%
R2,R3 = 39K, 5%
C1,C2 = 10µF/16V
Q1,Q2 = 2N3904
Led's = High Brightness, Red

Classic astable multivibrator using 2 transistors. Transistor is not critical. Try these: 2N4401, 2N2222, NTE123A, NTE123AP, NTE159, TUP/TUN and those in your junk box, you may find that most of them will work.
Obviously, the 470 ohm resistor determines the LED's brightness and limits the current flow to about 20mA. 390 ohm can also be used as a save value. If you decide to go with a green or yellow led, which draw more current, you may want to replace the 470 ohm with 270 or 330 ohm values. Flash rate is determined by the 39K resistors and the 10µF capacitors (determines the **'ON'** time). The two sides do not have to match. Different values for each side can give a nice effect for unique duty-cycles. Flashrate for above circuit is 1 cycle per second.

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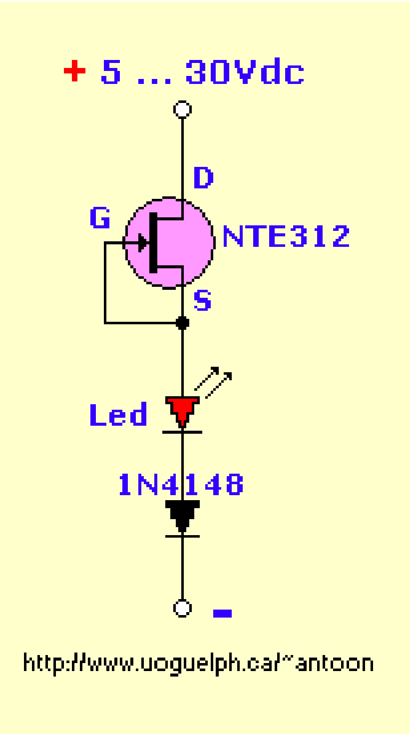
Led Pilot Light

by Tony van Roon



LED's are funny things. They only work at Vdc within specific tolerances, and normally connected with a current limiting resistor to the powersource. Instead of a resistor, you can use a FET (Field Effect Transistor) such as the ECG312, NTE312, try others. The ones mentioned I had available.
When the gate and the source are connected together, it behaves as a current regulator. In the circuit above the current is constant between 6 and 8 mA at 5 to 30Vdc.
If a diode is added (the 1N4148 is optional) this circuit is protected agains polarity reversal and can be connected to a AC source of 5 to 20 Vac.

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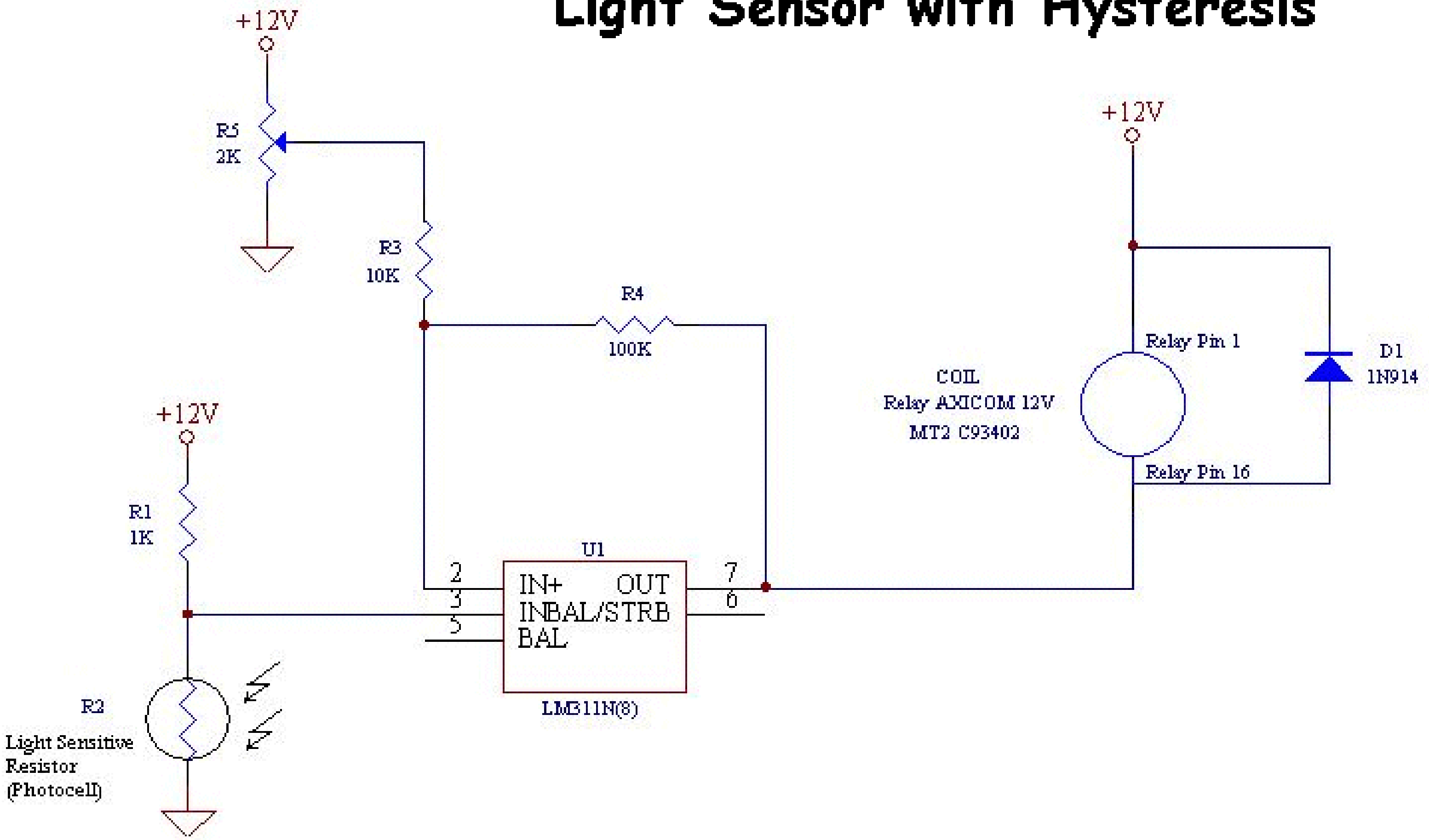
Light Sensor with Hysteresis



Posted with permission of Frank Rivard

It is quite a simple circuit but rather more effective than the one using the 741. It uses a simple comparator LM311 as the master piece. This comparator is powered from a +12V DC supply and does not require negative supply to work efficiently. The feedback given to the comparator provides some hysteresis and the potentiometer allows to adjust the sensitivity of the detector for darkness. I am quite sure you could inverse R1 and R2 positions to inverse the action of the detector but I haven't tried it !!!

The resistance of the light sensitive resistor is a trial and error game but I have been using values around 300 ohms under visible light and 3k under darkness... but as I repeat, you must try several types of photocell before it works correctly and you have enough span to adjust it correctly. It all depends what you have in your "junk" box !!!

The magic thing about this light sensor is that it does not trigger on and off at the same level of darkness (hence the purpose of hysteresis) and it makes it good for everyday uses. It will trigger from one state to the other when it is dark enough but will not trigger back and forth several times when you are on the edge of darkness. It requires a higher level of light to trigger back to the previous state.

So, if you use it to control outdoor lightings for example, it will produce a single clean trigger from on to off ... It will turn off one at dawn and will turn back on only once in the morning when light will be strong enough to energize the comparator. This is quite good because it avoids the relay to trigger several times under high currents...

If you have questions or design improvement upon the above circuit, please contact Frank Rivard

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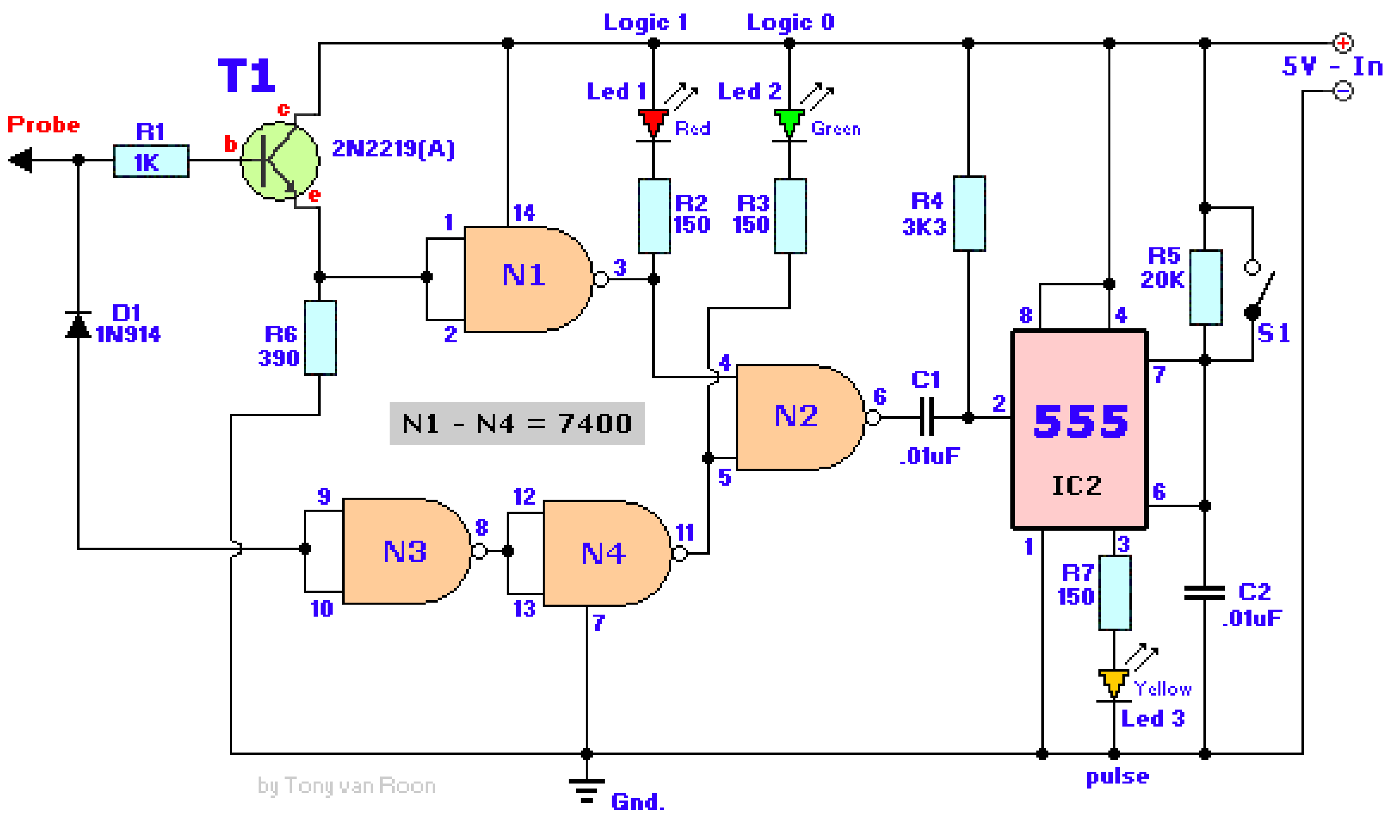
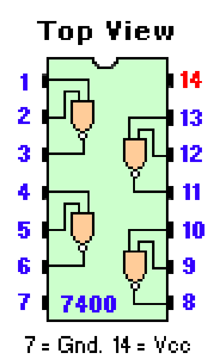
Logic Probe with Pulse

http://www.uoguelph.ca/~antoon



Parts List:



R1 = 1K	C1,C2 = 0.01uF (10 nanoFarad)
R2 = 150 ohm	T1 = 2N2219(A), NTE123, or TUN
R3 = 150 ohm	D1 = 1N914
R4 = 3K3	IC1 = 7400, quad 2-input NAND gate
R5 = 20K	IC2 = 555, timer/oscillator
R6 = 390 ohm	Led 1,2,3 = Red,Green, Yellow. Ultra bright, 3mm
R7 = 150 ohm	S1 = Switch, on-off

Error Fix: The position of the toggle switch (S1) was repositioned to before the 20K resistor R5. I have not tried this modification myself. Fix was suggested by Steve Main from Caspan Scripts who indicated that this was the only way the circuit would work as described below.

Description:

One of the most frustrating problems with experimenting is not be able to check the logic state of TTL or CMOS ic's without the use of a triggered oscilloscope. The schematic diagram above shows a simple and inexpensive way of building a 'Logic Probe' yourself. It will provide you with three visible indicators; "Logic 1" (+, red led), "Logic 0" (-, green led), and "Pulse" (yellow led).

The yellow or 'pulse' led comes on for approximately 200 mSec to indicate a pulse without regards to its width.

This feature enables one to observe a short-duration pulse that would otherwise not be seen on the logic 1 and 0 led's. A small switch (subminiature slide or momentary push) across the 20K resistor can be used to keep this "pulse" led on permanently after a pulse occurs.
In operation, for a logic 0 input signal, both the '0' led and the pulse led will come 'ON', but the 'pulse' led will go off after 200 mSec. The logic levels are detected via resistor R1 (1K), then amplified by T1 (NPN, Si-AF Preamplifier/Driver), and selected by the 7400 IC for what they are. Diode D1 is a small signal diode to protect the 7400 and the leds from excessive inverse voltages during capacitor discharge. The 7400 can also be a 'LS' type or whatever or any replacement.

For a logic '1' input, only the logic '1' led (red) will be 'ON'. With the switch closed, the circuit will indicate whether a negative-going or positive-going pulse has occurred. If the pulse is positive-going, both the '0' and 'pulse' led's will be on. If the pulse is negative-going, the '1' and 'pulse' led's will be on.

I have build mine into a short, but thick, magic-black marker. The probe-tip is made of a piece of piano wire. Have fun building it and make it part of your trouble-shooting equipment. Mine has been in operation since 1987!

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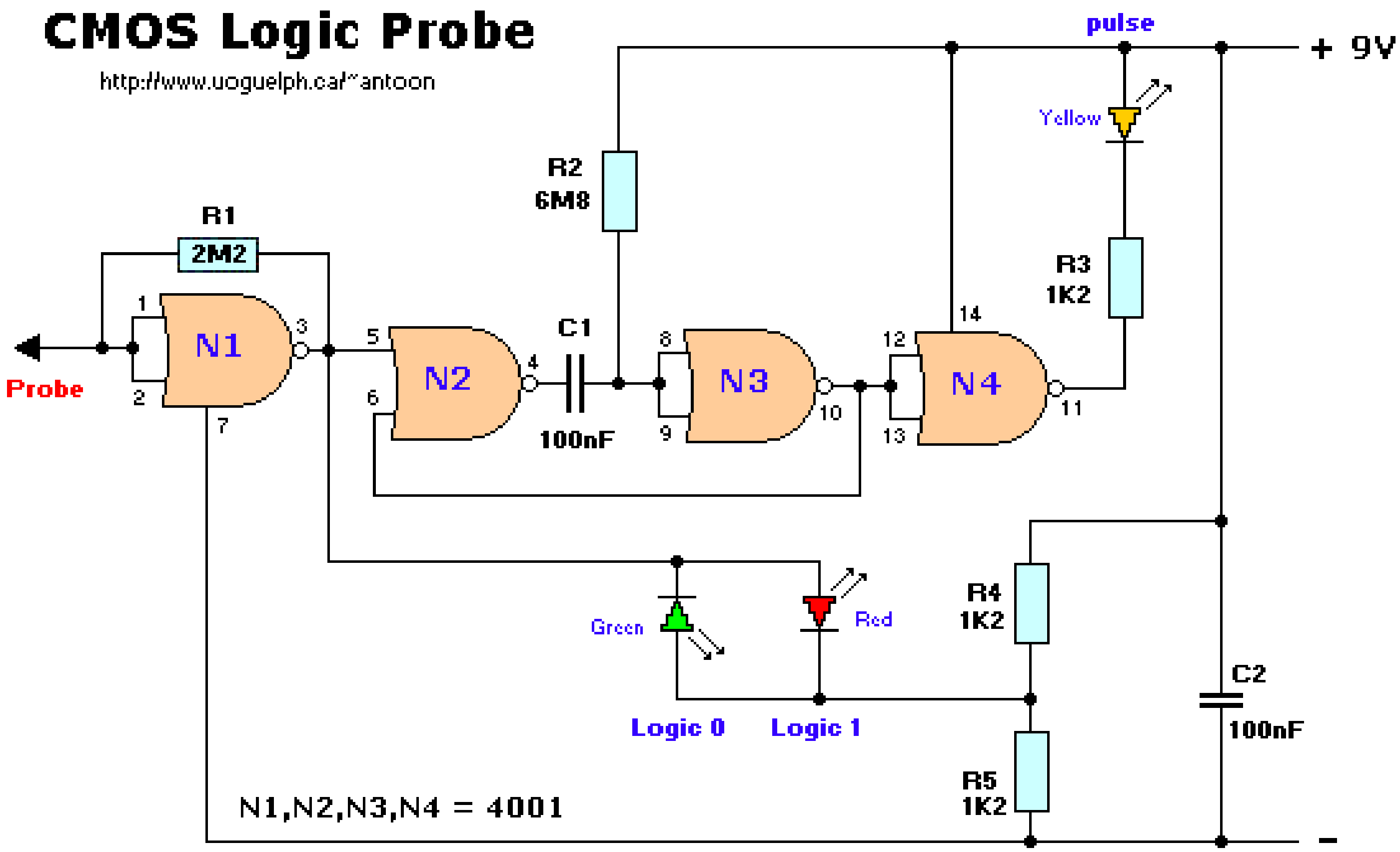

Parts List:

R1 = 2M2
R2 = 6M8
R3 = 1K2
R4 = 1K2
R5 = 1K2

C1,C2 = 0.1uF (100 nanoFarad)
IC = 4001 (CMOS)
Leds = D1-Red, D2-Green, D3-Yellow. Ultra bright, 3mm
(R2: 6.8M or two 3.3M)

Description:

A logic probe is a device which is used when testing digital circuits, and it shows the logic state at the selected test point. In common with most designs this one can indicate four input states, as follows:
1. Input high (logic 1)
2. Input low (logic 0)
3. Input pulsing (pulse)
4. Input floating

This circuit uses the four 2 input NOR gates contained within the 4001 CMOS IC, and is primarily intended for testing cmos circuits. The probe derives its power from the supply of the circuit being tested. The first gate, N1, has its inputs tied together so that it operates as an inverter, and it is biased by R1 so that roughly half the supply potential appears at its output. A similar voltage appears at the juntion of R4 and R5, and so no significant voltage will be developed across D1 and D2 which are connected between this junction and gate 1's output pin 3. Thus under quiescent conditions, or if the probe is connected to a floating test point, neither D1 or D2 will light up. If the input is taken to a high logic point, gate 1 output will go low and switch on D1(red), giving a logic 'high' indication. If the input is taken to a low test point, gate 1's output pin 3 will go high and light D2(green) to indicate a logic 'low'.

A pulsed input will contains both logic states, causing both Led's D1 and D2 to switch on alternately. However, if the duty cycle of the input signal is very high this may result in on indicator lighting up very vrightly while the other does not visibly glow at all . In order to give a more reliable indication of a pulsed input, gates N2 to N4 are connected as a buffered output monostable multivibrator. The purpose of this circuit is to produce an output pulse of predetermined length (about 1/2 a second in this case) whenever it receives a positive going input pulse.
The length of the input pulse has no significant effect on the output pulse. Led D3 is connected at the ouput of the monostable, and is switched on for about 1/2 a second whenever the monostable is triggered, regardless of how brief the triggering input pulse happens to be. Therefore, a pulsing input will be clearly visible by the yellow Led D3 switching on.
The various outputs will be: Floating input -- all Leds off. Logic 0 input -- D2 (green) switched on (D3 briefly flashes on). Logic 1 input -- D1 switched on. Pulsing input -- D3(yellow) switched on or pulsing in the case of a low frequency input signal (one or both of the other indicators will switch on, showing if one input state pre-dominates.
The finished project can easily be housed in a magic marker felt pen or something. The probe-tip is made of a piece of piano wire, but a bronze finishing nail is a good choice too. Solder the probe wire to the nail or pianowire and you are all set. Have fun building it and make it part of your trouble-shooting equipment.

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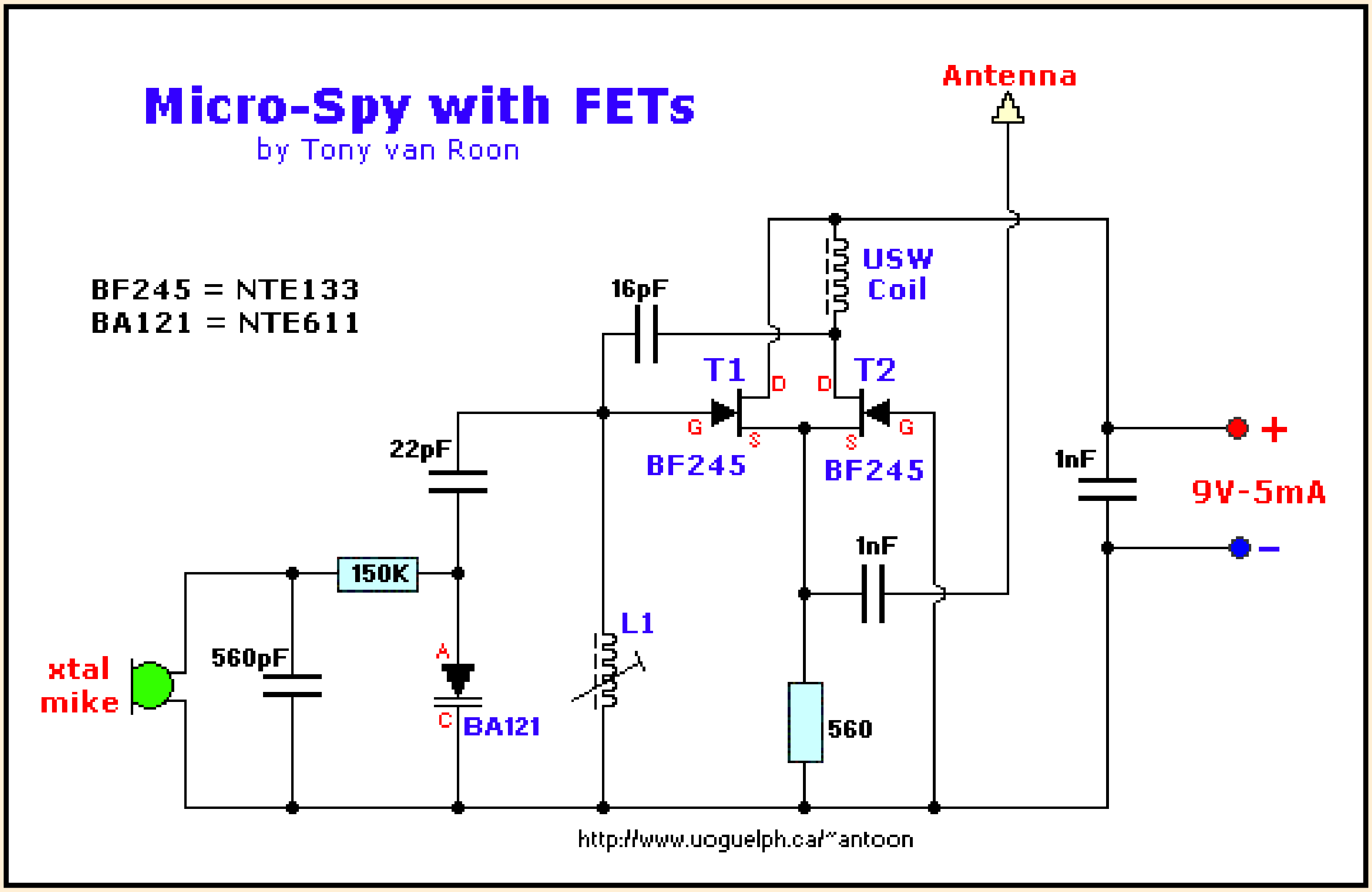

o T1 & T2 are BF245 N-channel FET's and can be replaced with a NTE133. The ECG312 could likely be used also. The varactor diode BA121 can be replaced with a ECG/NTE611. USW stands for 'Ultra-Short-Wave'.
o L1 = 7 turns of 0.8mm Silverwire on a 5mm round Ferrit-core (adjustable).
o This very stable oscillator has a frequency of approximately 100 Megaherz.
o Feedback via 16pF capacitor. No interference from antenna on resonance-loop.
o Distance is at *least* 300 meters!

Please note: This circuit is not open for discussion; do with it as you please (but no copyright violations). I will answer no emails in regards to this circuit.

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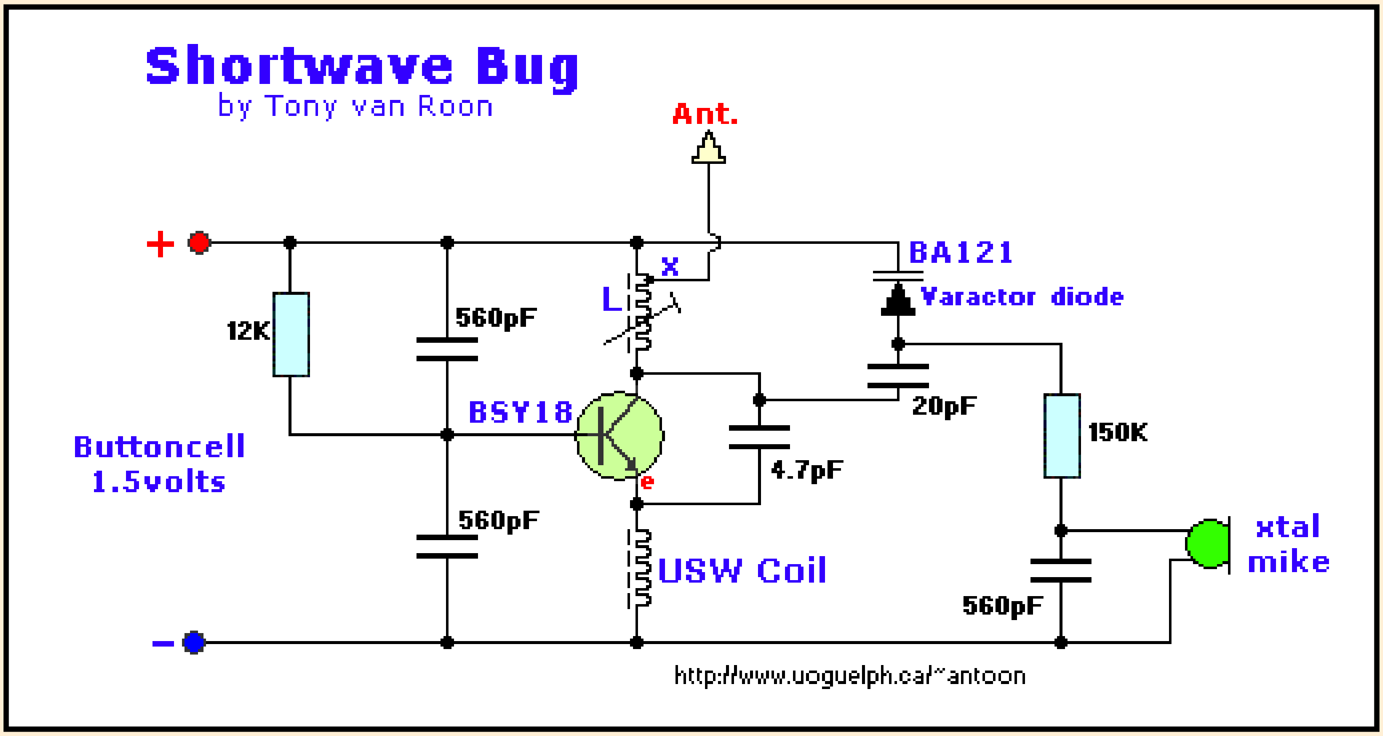

o BSY18 can be replaced with ECG123AP. BA121 can be replaced with ECG/NTE611 (10pF@4v). USW means 'Ultra-Short-Wave'.
o L1 = 7 turns of 0.8mm Silverwire(round) on a 5mm round adjustable Ferrit-core. Position 'X' = 0.5 ... 1 turn.
o This very stable oscillator has a frequency of approximately 100 Megaherz.
o Frequency determend by the Variac BA121 and 20pF capacitor. Feedback is thru 4.7pF capacitor.
o USW coil prevents HF signals (feedback) flow to ground.
o DC biased with the 12K resistor.
o Distance is from 100 to about 200 meters. Not bad for a little circuit like this!

Please note: This circuit is not open for discussion; do with it as you please (but no copyright violations). I will answer no emails in regards to this circuit.

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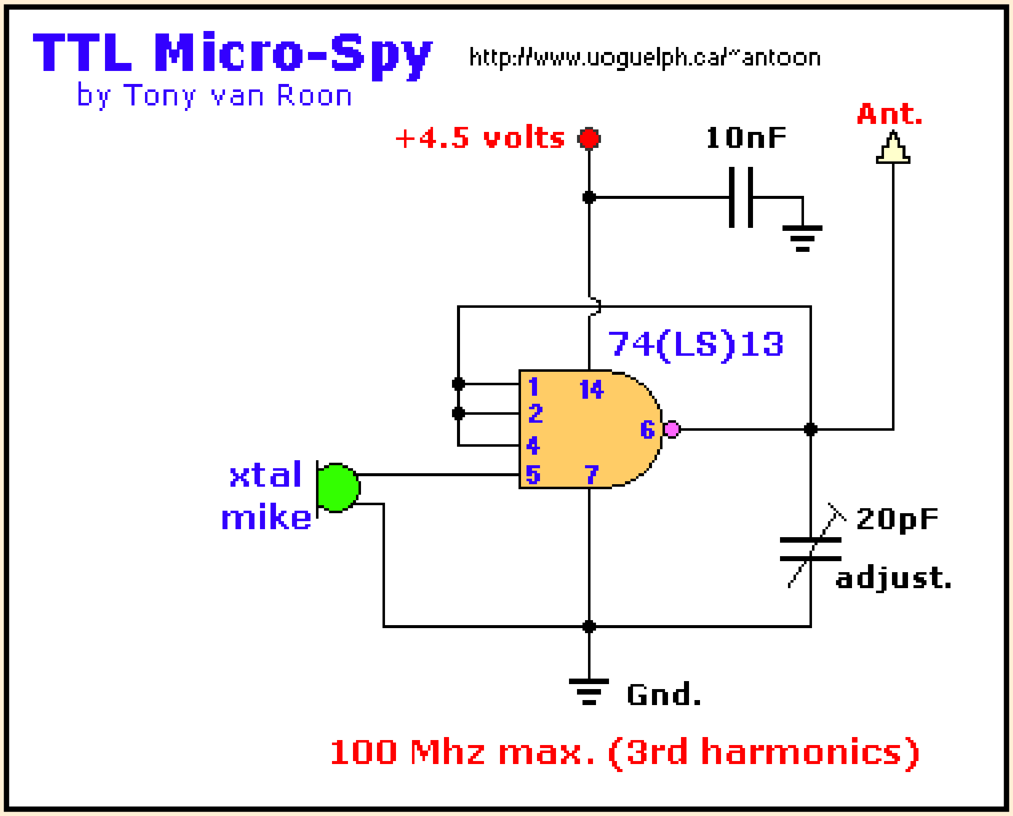

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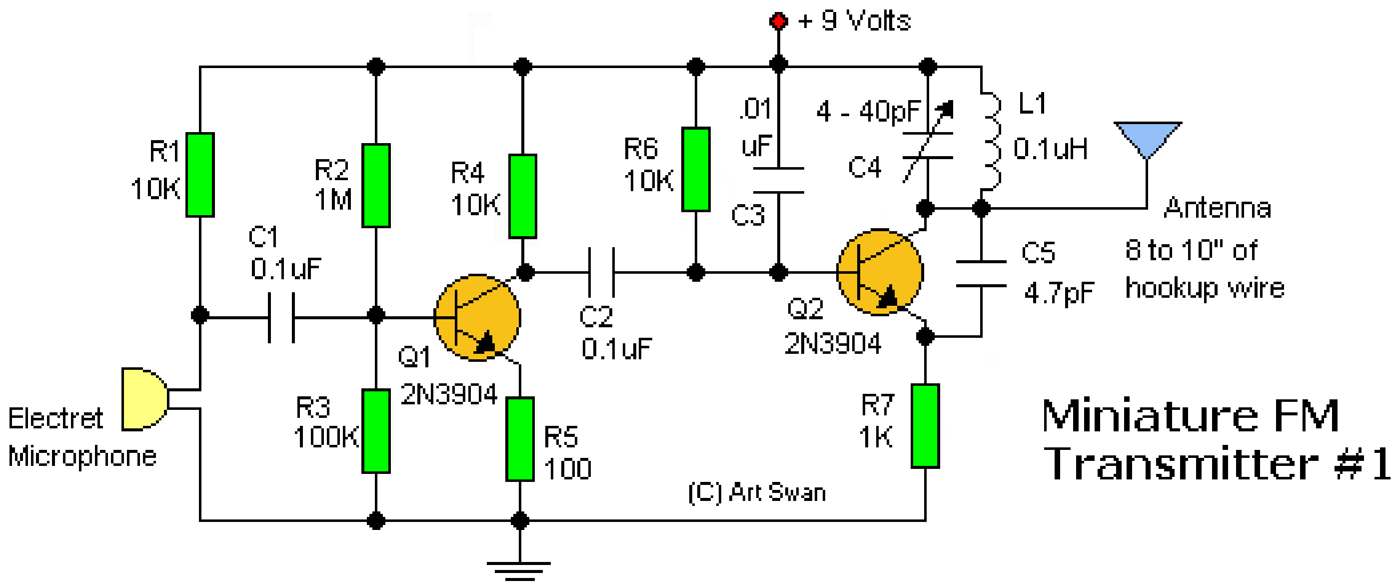

This miniature transmitter is easy to construct and it's transmissions can be picked up on any standard FM receiver. It has a range of up to 1/4 of a mile or more. It is great for room monitoring, baby listening, nature research, etc. L1 is 8 to 10 turns of 22 gauge hookup wire close wound around a non-conductive 1/4 inch diameter form, such as a pencil. C4 is a small, screw-adjustable, trimmer capacitor. Set your FM receiver for a clear, blank space in the lower end of the band. Then, with a non-conductive tool, adjust this capacitor for the clearest reception. A little experimenting and patience may be in order. Most of the parts values are not critical, so you can try adjusting them to see what happens.

Additional Notes

The default for the capacitors type is ceramic, preferably the npo 1% type or equivalent. But basically nothing critical here. Use any capacitor you have laying arround, but ***NO*** electrolytic or tantalum caps. Only if you intend to use this circuit outside the home you may want to select more temperature stable capacitors.

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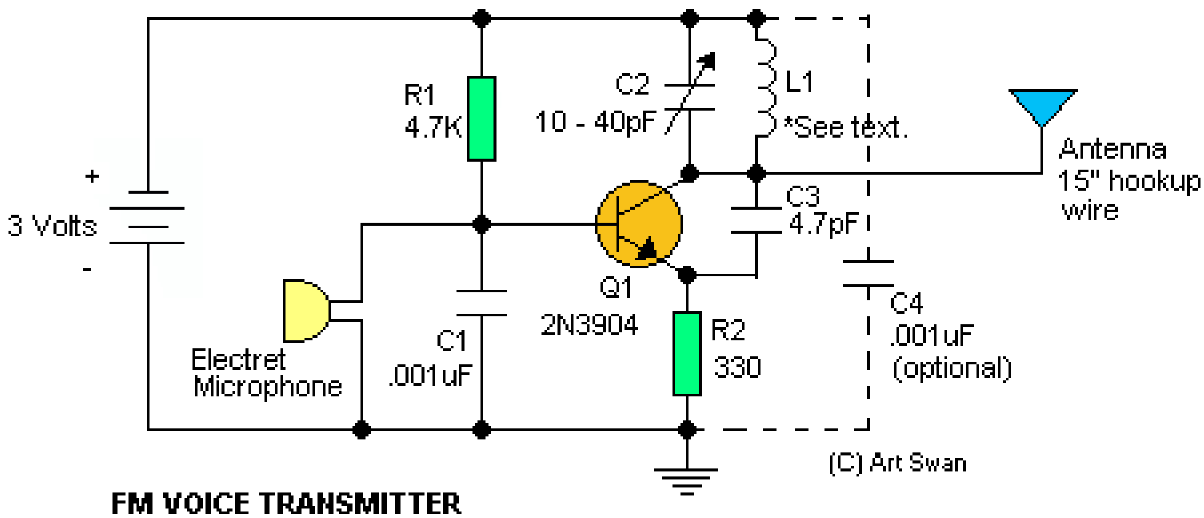
Miniature FM Transmitter #2



FM VOICE TRANSMITTER

This is another easy-to-build miniature FM transmitter that uses a minimum of parts. Construction is straightforward and non-critical. Although this design uses a 3 volt power source (such as a lithium coin cell), a 9 volt battery can be used, instead, by increasing the value of R1 to 15K and R2 to 1K. C4 is an optional RF bypass capacitor that may help improve performance and increase range. Experiment to find best results. L1 was made by stripping 22 ga. hookup wire of it's insulation, then wrapping it in the grooves of the screw threads of a 1/4 diameter bolt, and then back-screwing the bolt out of the resulting coil. 8 turns were made around the bolt. By wrapping the turns in the threads, a uniform seperation was made between the coil windings.

Additional Notes

The default for the capacitors type is ceramic, preferably the npo 1% type or equivalent. But basically nothing critical here. Use any capacitor you have laying arround, but **NO** electrolytic or tantalum caps. Only if you intend to use this circuit outside the home you may want to select more temperature stable capacitores.

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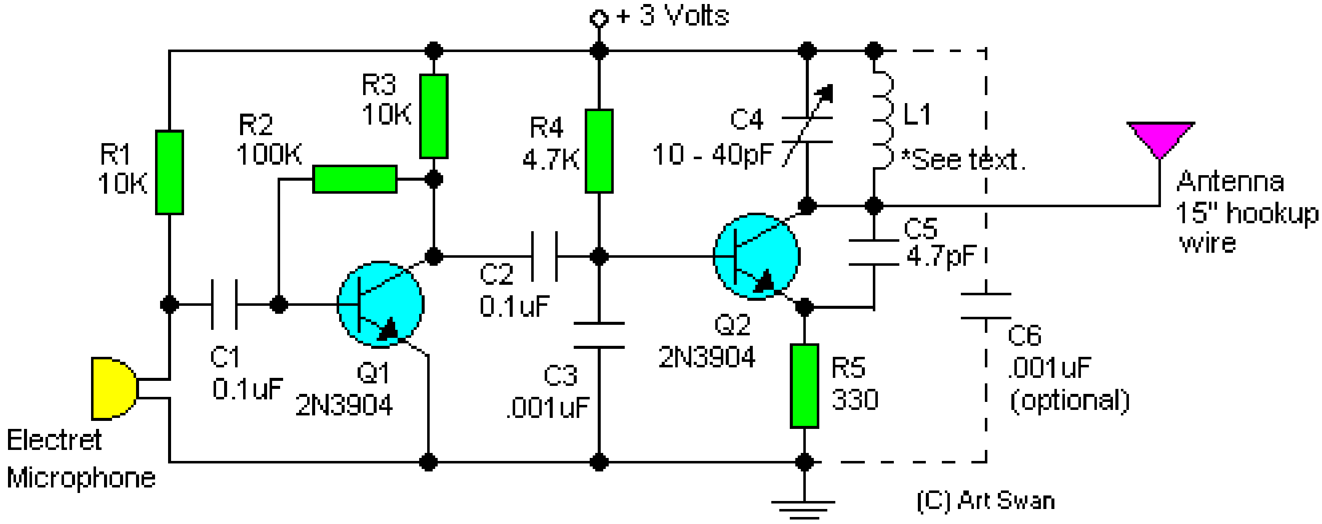
Sensitive FM Transmitter



* L1 = 0.1 Uh, 6 to 8 turns of 22 ga. hookup wire close wound around a 1/4 inch diameter non-conductive core such as a pencil.

Additional Notes

The default for the capacitors type is ceramic, preferably the npo 1% type or equivalent. But basically nothing critical here. Use any capacitor you have laying arround, but **NO** electrolytic or tantalum caps. Only if you intend to use this circuit outside the home you may want to select more temperature stable capacitores.

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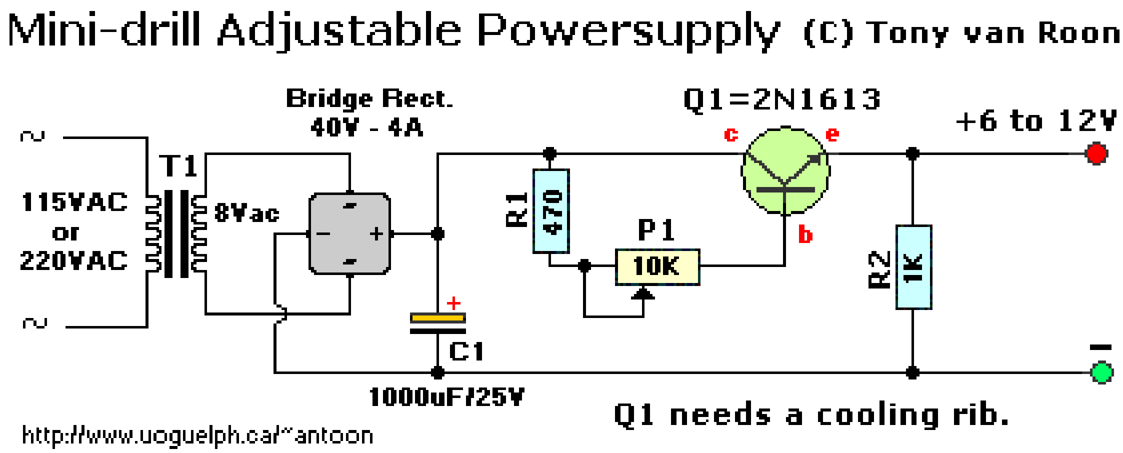

Parts List:

```
 T1 = 115/8 VAC transformer. Center Tap not needed.
 Q1 = 2N1613, NTE128, or substitute. (TO-39 case) On coolrib!
BR1 = 40V, 4A.  (Check max current of your mini-drill and add 2A)
 R1 = 470 ohm, 5%
 R2 = 1K, 5%
 P1 = potentiometer, 10K
 C1 = 1000uF, 25V
```

Notes:

C1 filters the noise and spikes off the ac. If you find the circuit output too noisy add another electrolytic capacitor over the output terminals. Value can be between 10 and 100uF/25V. The output voltage is variable with the 10K-potentiometer.

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Basic Missing Pulse Detector

by Tony van Roon -- http://www.uoguelph.ca/~antoon

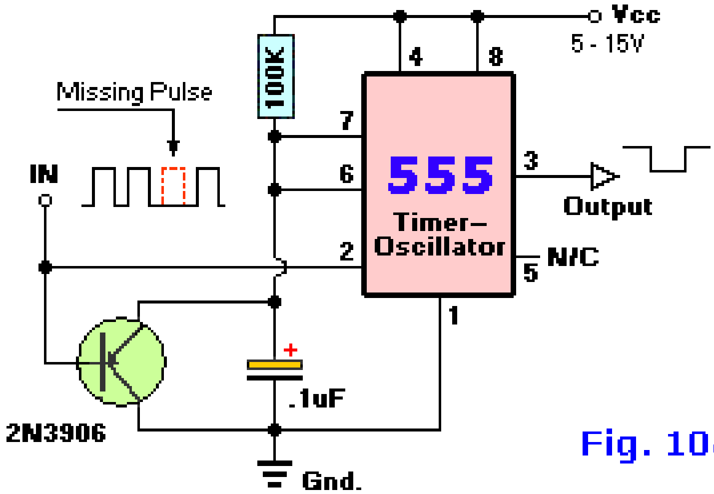

Fig. 10a

This circuit is a one-shot that is continually retriggered by incoming pulses. A missing pulse that prevents retriggering before a timing cycle is complete, causes pin 3 to go low until a new input pulse arrives. R1 & C1 control the response time. Use in alarms, continuity testers, beacons, R/C, etc.

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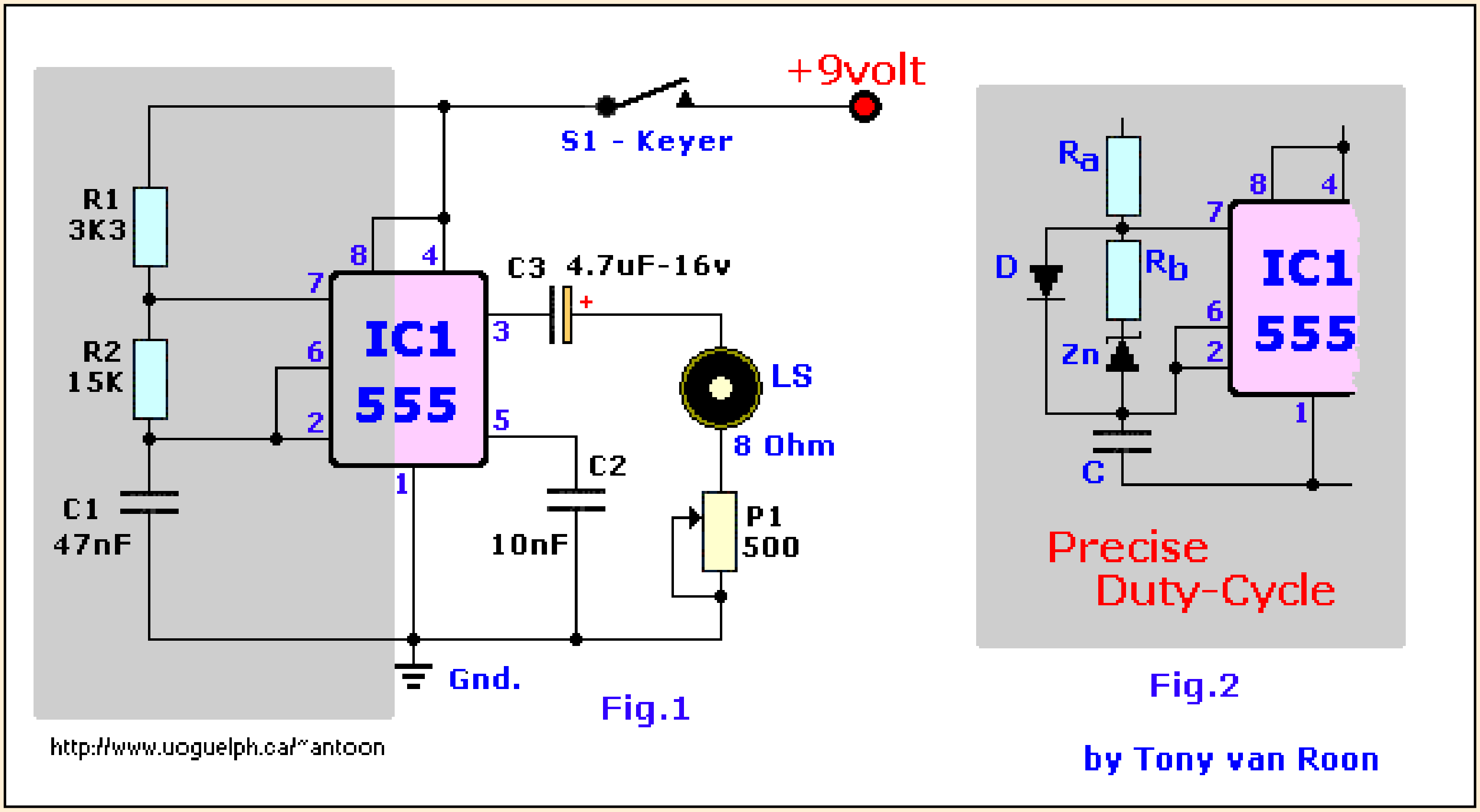
Morse Code Practice Oscillator

by Tony van Roon



Parts List

R1 = 3K3	IC1 = 555 Timer IC
R2 = 15K	S1 = Morse Keyer
P1 = 500 ohm	
C1 = 0.047uf (47nF)	
C2 = 0.01uF (10nF)	
C3 = 4.7uF/16v	

Additional Notes

The speaker (LS) can be any 8-ohm type up to 2-watts. C1 and C2 are ceramic capacitors. C3 is an electrolytic type.

IC1 is a CMOS MC1455P or equivalent. The cmos type consumes a lot less current when used with the 9-volt battery, but if you don't want to spent the money then the LM555, NE555, etc. are fine too and are pin-for-pin compatible with each other.

And obviously, S1 is your Morse-keyer. To get a more precise duty-cycle replace the components within the shaded gray area from Fig. 1 with the ones in Fig. 2. The diode can be 1N4148 or equivalent. The zenerdiode is between 5.2 and 5.8 volt. Ra and Rb are experimental to suit your personal taste. C is about the same.

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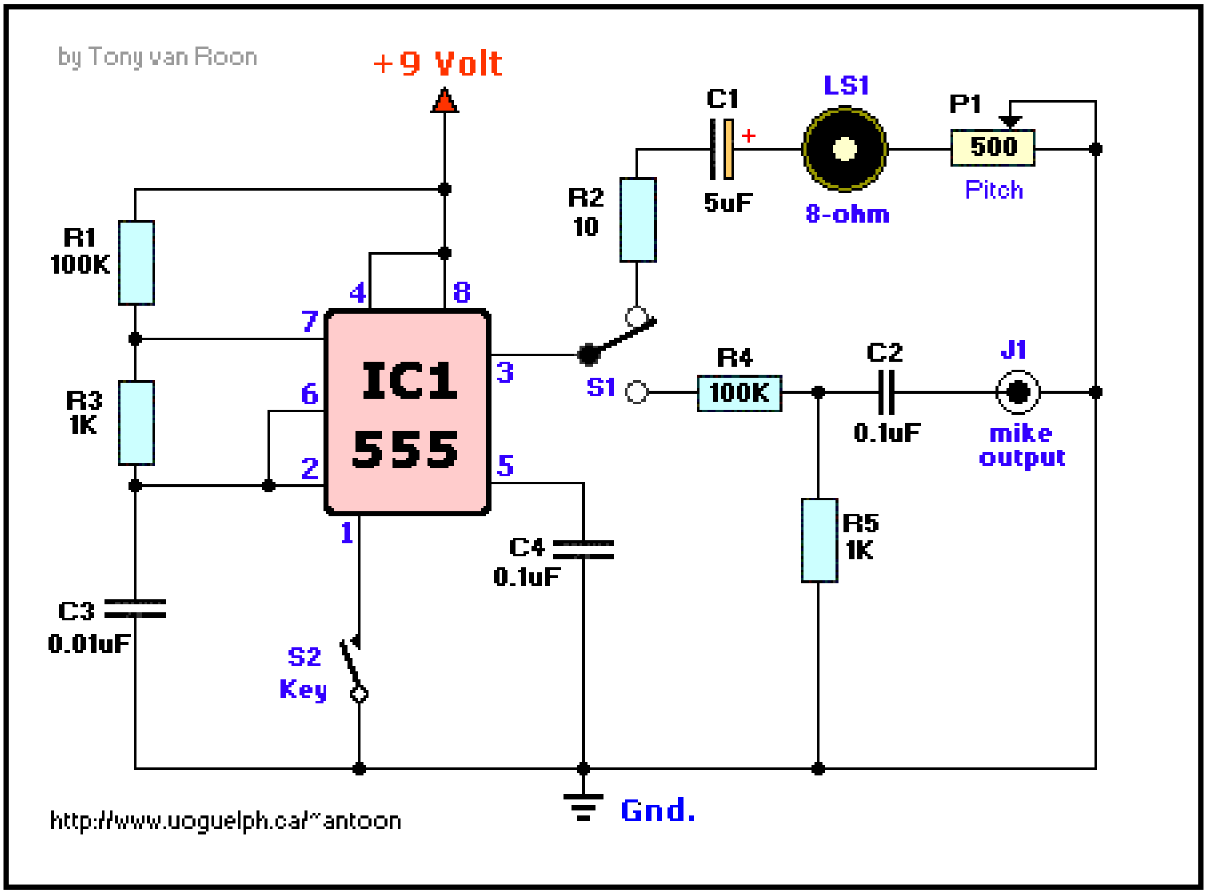
Morse Code Keyer (2)

by Tony van Roon



Parts List:

```
R1,R4 = 100K              IC1 = LM555
   R2 = 10 ohm             S1 = 3-pole, switch toggle, on-on
R3,R5 = 1K                 S2 = Morse keyer
   P1 = 500 ohm            J1 = Jack, mike-output
   C1 = 5uF/16V           LS1 = Loudspeaker, 8-ohm, up to 2 watts
C2,C4 = 0.1 uF          Batt1 = 9-Volt Alkaline battery
   C3 = 0.01uF
```

Description:

The speaker (LS1) can be any 8-ohm type up to 2-watts. Supply voltage for this circuit is up to 15 volts, but 12V is more desirable if you choose to go with a adapter. If possible, try to use a mylar or polyester kind of capacitor for C2.

IC1 is a CMOS MC1455P or equivalent, Timer/Oscillator. This type of cmos IC consumes a lot less current when used with the 9-volt battery, but if you don't want to spent the money then the LM555,

NE555, etc. are fine too and are pin-for-pin compatible with each other. The timing circuit is formed by R1, R3, and C3. Resistors R4 & R5 are a voltage devider to reduce the microphone output to a safe level. Potentiometer P1 can be used to control the 'Pitch'. Capacitor C5 is used as a bypass capacitor to clean up unwanted noise. C1 is specified as a 5uF electrolytic but a standard 4.7uF will work fine too.
S2 is your Morse-key or Paddle. S1 switches between your speaker and the microphone output jack (J1), which you can hookup to your stereo, amplifier, or cassette player. Match J1 with the jack you hook it up to.

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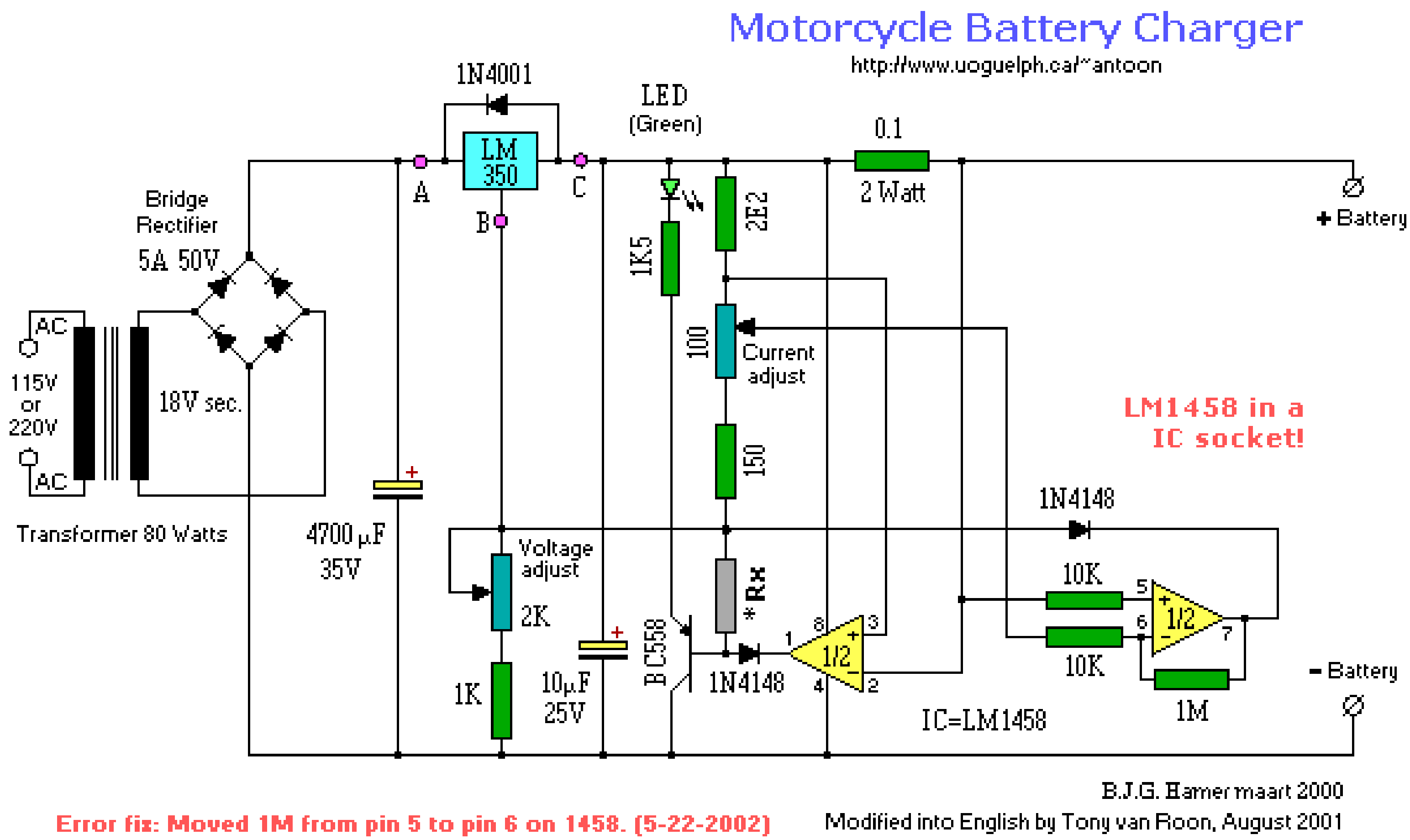

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ERROR FIX: The 1M resistor was connected to the wrong pin (5) on the second 1/2 of the 1458. Updated schematic correctly showing connection to pin 6. Apologies for any inconvenience.

This 3A charger was originally designed to work with small batteries like those used in motorcycles. In principle it can be used to charge car batteries also but will take a lot longer.
The charger below charges a battery with a constant current to 14.1 volt. When this level is reached, the current charge drops automatically to a safer level (13.6V) and keeps charging at this slower rate untill the LED lights up indicating a fully charged battery. This project looks very much alike with the Gel cell II charger elsewhere posted in the 'Circuits' section. The difference is the IC, namely a LM1458 instead of a LM301A. Nice job Jan!

Description:

The LM350 is an adjustable voltage regulator and keeps the voltage between points C and B at 1.25 Volt. By adding a 1K resistor between point B and gnd (-) you can, as it were, lift up the output voltage. To accurately control the output voltage we add to this resistor, in series, a 2K adjustable 10-turn potentiometer. As soon as a battery is connected a current flow occurs, controlled by the right halve of the LM1458. The current through the 0.1 ohm resistor causes a voltage drop. This drop is compared with the voltage on the walker of 100-ohm pot. The moment this drop is greater than the one adjusted with the potmeter will cause the output of the LM1458 IC to go low and a small current starts to flow thru the diode and this in effect will reduce the current through the series resistors 1K + 2Kpot. The current is hereby stabilized.

The point between C and B is devided by three resistors; 2.2 ohm, 100 ohm pot, and the 150 ohm. 2.2 ohm and the 100 ohm potmeter are connected to the non-inverting input (+) of the LM1458 IC. The inverting input (-) is connected to the 0.1 ohm wire-wound resistor in series with the output. As long as the voltage drop, caused by the current-flow over this resistor is greater than the voltage drop over the 2.2 ohm resistor the output of the LM1458 will stay high and in turn block the BC558 transistor. But as soon as the charge current falls below a specific value the 1458 will go low and turn on this transistor which wich activate the LED. At the same time a small current will flow thru the 'Rx' resistor, which will cause that the output voltage of the charger switches to 13.6 Volt. This is a very safe output voltage, and does not cause overcharging to the battery and remains fully charged (trickle).
Rx should be an experimental value determined below; a mathematically calculation is possible but the exact value is determined by the tolerances of your specific components.

The voltage regulator LM350 has to dissipate a lot of energy so make sure to mount it on a large cooling fin. (e.i. 3.3°C/Watt) Diode 1N4001 over the input/output is necessary to prevent damage to the regulator in case the input voltage gets interrupted.
The LM350 can be substituted with a NTE970, and the BC558B with a NTE159 if you wish.
The adjustments for this charger are really simple and the only thing needed is digital multimeter. The LM1458 should **NOT** be in the socket while doing the first adjustment. When no battery is connected there is no current flow thru the 0.1 ohm resistor and therefore pulling the output low. So no IC yet in the socket. Do **NOT** connect a battery also. I know that is obvious to most of us, but some people... :-)
Okay, here we go:
1. Connect the multimeter (set for Volt DC) to the '+' and '-' battery output and adjust with the 2k trimpot the output voltage to 14.1 Volt.

2. Switch the power off. Discharge the capacitors (short them out with a piece of wire).

3. Now insert the LM1458 IC carefully (check no pins are bend underneath the chip).

4. Switch the power back on and make the resistor marked **Rx** such a value that the output voltage reads 13.6 volt exactly.

5. Swith the multimeter to 'Amp-dc'. Turn the 100-ohm trimpot all the way CCW. Connect the 'to-be-charged-battery' (e.i. NOT a fully charged battery) and turn back the trimpot untill the current load is 0.1 X the battery capacity (max 3A). Example: A 16Amp battery adjusting to 1.6A. If you don't have an Amp meter on your multimeter you can use the 2-volt setting on your meter and connect it over the 0.1 ohm resistor. The current is volt devided by 0.1, so for 3A the meter should read 0.3 volt.

That's it. To get the Rx value you could also use a trimpot until you get the 13.6volt and then read the ohm's value of the trimpot and replace with a resistor. In my opinion this resistor should be a metalfilm type at 1 or 2% tolerance.

+-+-+-+-+-+-+-+-+-+-+

The Technical bits:

For those of you interested in how the value of essential components was calculated, read on. You may be

able to design your own charger for use with a different current or voltage (like 6-volt).
Calculations origin from the voltage between points C and B of the LM350 regulator. When a resistor is connected between these two points, enough current starts to flow that the voltage over this resistor measures 1.25 volt. In our case, the resistor total is 2.2 + 100 + 150 =252.2 ohm. Because we deal with very small currents the calculations are performed in milliamps and the calculations of resistance in Kilo-Ohms. Thus, the current thru this resistor is 1.25 / 0.2522 = 4.9564 mA. The same current also flows thru the 1K & 2K series resistors. We want the output voltage to be 14.1 volt, meaning the voltage drop over these series resistors must be 14.1 - 1.25 = 12.85 Volt.
The total resistance value thus must be 12.85 / 4.9564 = 2.5926 Ohms. To enable us to adjust it to this value, one of the resistors is chosen as a 10-turn trimpot (trimmer potentiometer). Together with the 1K in series (making it a total of 3K)we can adjust it to this correct value.
The **Rx** value is calculated this way; In this scenario we like to have a output voltage of 13.6 volt, in other words, the voltage on the connection point between the 1K/2Kpot should be 13.6 - 1.25 = 12.35 volt. This means that the current thru the 'voltage-divider' will be 12.35 / 2.5926 = 4.7635 mA and the leftover current should be 4.9564 - 4.7635 = 0.1929 mA thru Rx and also cause a voltage drop of 12.35 - 2.78 = 9.57 volt. Measuring this calculated value at the base of the BC558 transistor was 2.78 volt after the output of the LM1458 had become low. With the current of 0.1929 mA the result has become9.47 / 0.1929 = 49.611 Kilo-Ohm. A resistor of 47K would come close enough. Ofcourse you could also use a 50K trimpot to adjust the value even more accurately. The 1K5 (1500 Ohm) resistor in series with the LED is to limit the current thru the LED below 20 mA.

The only thing left is to calculate the value of the series resistor which determines the switch-over from charge to float condition. This occurs when the voltage drop over the 0.1 ohm (wire-wound) resistor at the positive leg smaller is than over the 2.2 ohm resistor. This value is 2.2 x 4.9564 = 10.9 mV. The resistance is 0.1 ohm, to get a voltage drop over this resistor of 10.9 mV is the current 10.9 x 0.1 = 109 mA. The second this charge current becomes lower then 109 mA, the LM1458 triggers over to the float condition.
The adjustment with the 100-ohm trimpot determines the maximum charge current. The voltage on the walker of this trimpot varies between 10.9 mV - 506.54 mV. The current is this way made adjustable between 0.1A - 5A, but we should not go that far because the LM350K can not handle anything over 3Amp. If we chose a trimpot with a value of 50 ohm, then on the other hand the 3A can not be obtained. So, careful adjustment is the remedy. Take your time!

With this information it is a simple task to calculate the dissipation values of the resistors. In other words, the product of the resistance multiplied with the current in square (I2xR).
The only resistor which gets it difficult is the 0.1 ohm, but then again, not by much 3 x 3 x 0.1 = 0.9 Watt. Rest us to calculate the power. For that we have add a couple of voltages. We have the input voltage of 14.1, the voltage drop over the resistor, 0.1 x 3 = 0.33 volt, and 3 volt minimum over the LM1458 for proper function, total 17.43 volt. The transformer provides 18V (effective). With ideal rectifying this should total 18 x 1.41 = 25.38 volt. There are however losses via the diodes and bridge rectifier so there is about 23.88 volt remaining. Not much tolerance to play with, on the other hand, too much causes energy loss in the form of heat anyway.
The voltage drop over the buffer capacitor may not be lower than 17.43 volt, meaning, the ripple voltage may reach about 23.88 - 17.43 = 6.45 volt. By double-fase rectifying is the ripple voltage equal to I/(2xfxC) whereby I is the discharge current, f is the supply frequentie and C is capacity of the buffer capacitor in Farad. Exchanging places this would give C = 3/(2x50x6.45) = 0.004651 Farad, or 4651 uF. A standard

value of 4700 uF with a minimum voltage value of about 35-40 Volt. The other capacitor is not very critical and is only there to kill small voltage spikes which could influence the operation of this charger otherwise.

The bridge rectifier gets a good workout also and it is therefore recommended to chose NOT a too light a unit. A 5A rectifier is often too small, better to take a 8 or 10A type. These are readily available everywhere.

Last but not least, the transformer. The buffer capacitor has approximately 25 volt accros. The current is 3A. This calculates to a power of 25 x 3 = 75 watt. This transformer has its own problems with powerloss (naturely occuring) and so a unit of about 80 watt is acceptable.
Never attempt to charge a 6 volt battery with a 12 volt charger; you are asking for trouble. Good luck all!

Please visit Jan Hamer's website in the Netherlands!

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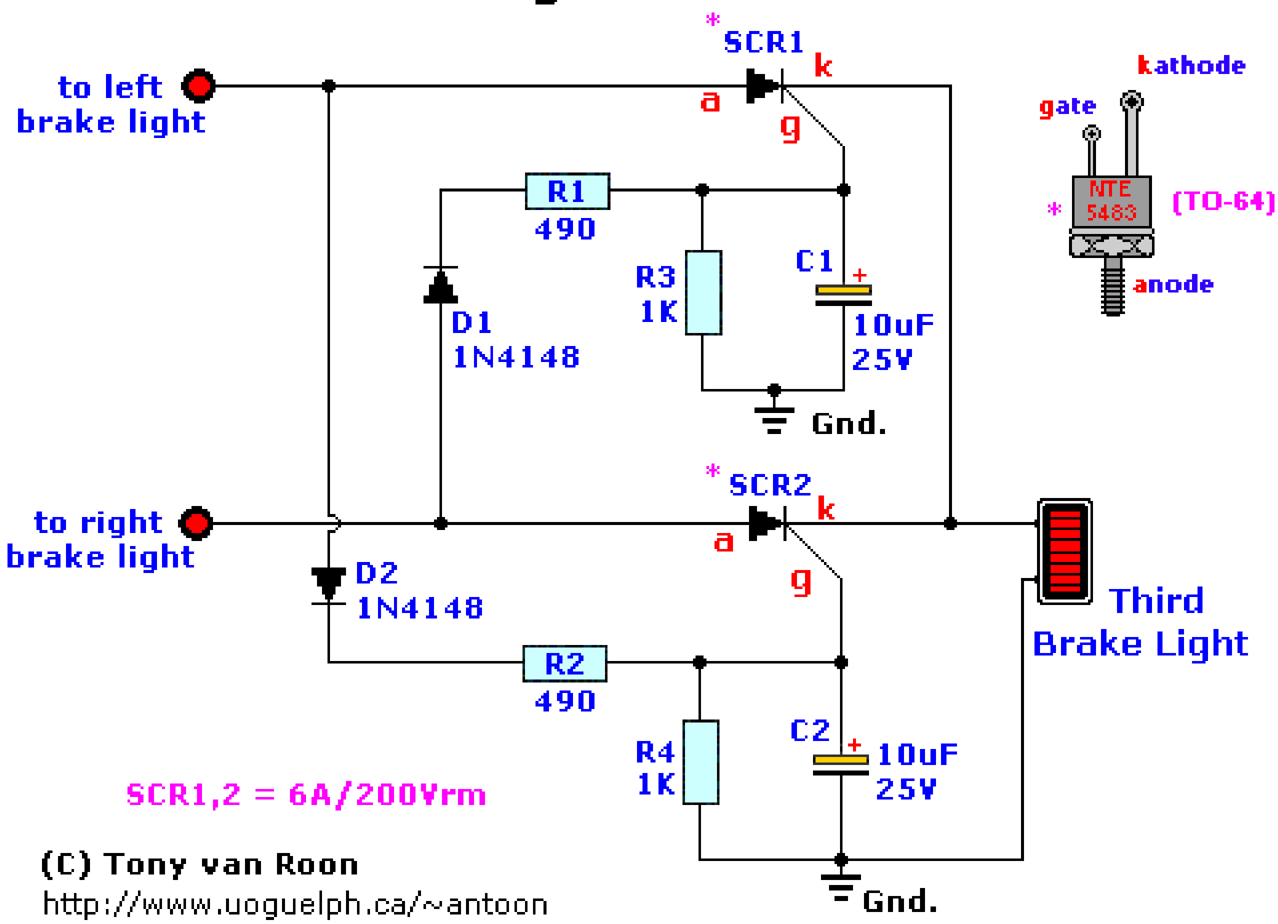
Third Brake Light



Additional Notes

What's so special about this circuit? Well, the first third-brake light I installed I had to pull a wire from the Third Brake Light all the way to the brake pedal switch and I thought it would be easier to pluck the signal of both brakelights via the trunk. Bench-test your circuit first and apply power to the circuit, with the brakelight connected, for at least a couple of minutes. If the two SCR's are getting hot (depending on the type of bulb in your 3rd brake light), mount coolribs on them. I used the NTE5483 which is a 8A, 200Vrm type.

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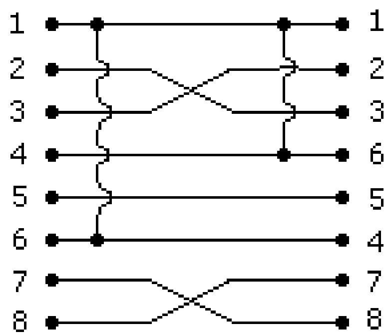
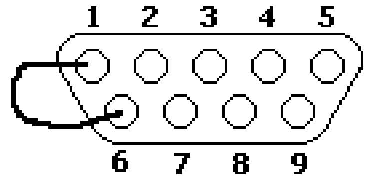
Nullmodem (9-9) Cable

9-pin to 9-pin female





Seen from the back
(solder side)

http://www.uoguelph.ca/~antoon

Signal Description

1	Carrier Detect	5	System Ground
2	Receive Data	6	Data Set Ready
3	Transmit Data	7	Request to Send
4	Data Terminal Ready	8	Clear to Send

Pins 6 & 1 are wired together to similute 'on-line' status. This Nullmodem configuration is also for gameply like Westwood's Command & Conquerer "Tiberian Sun".

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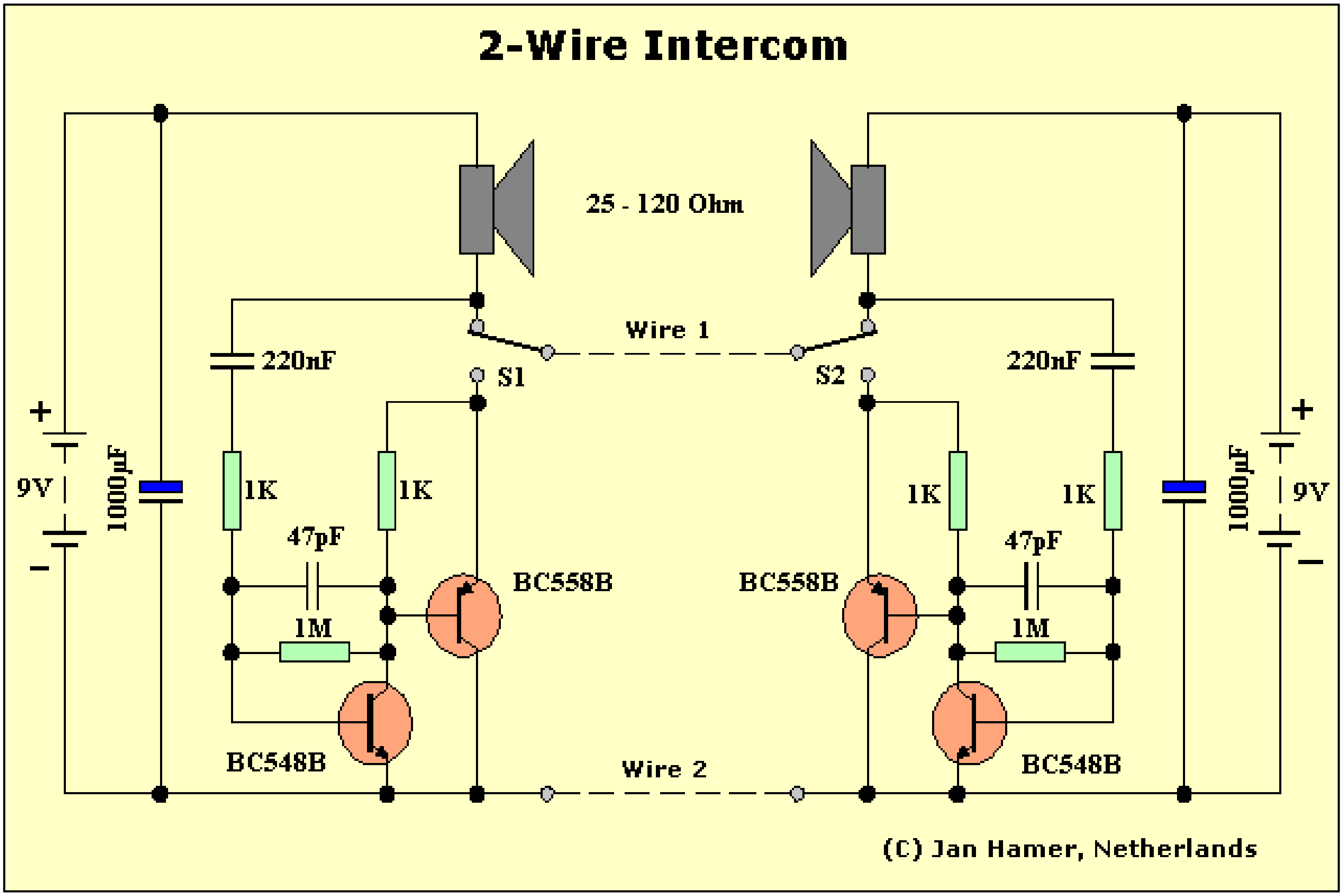
Practical Intercom

© by Jan Hamer

"Baby-monitors, baby-phones, or simply intercoms are for sale everywhere in a variety of models and colors. Some work on AC, others wireless or just via a little wire. We all have our preferences. Just in case you're looking for a VERY reliable Intercom, the circuit below will suit your needs."




```
Replacements: BC548B = NTE123AP, or TUN.
              BC558B = NTE159, or TUP.
               220nF = 0.22µF
              1000µF = 1000µF/25V, electrolytic
```

This Intercom is powered by two 9volt batteries and uses only current when the Intercom is used. Both units are connected via a two-wire little cable or simply two wires (dotted lines). The loud speakers act both as loudspeaker and as a microphone. When you press S1 and speak into the loudspeaker then this signal is amplified by the transistor stage and made audible in the right loudspeaker and vice-versa. An added benefit of this system is that when the switch is pressed it is quiet, not even annoying noise. This circuit has worked for me to my full satisfaction for many years now.

If you have questions about this circuit, please direct them to Jan Hamer or visit his website in the Netherlands (if you can read Dutch).

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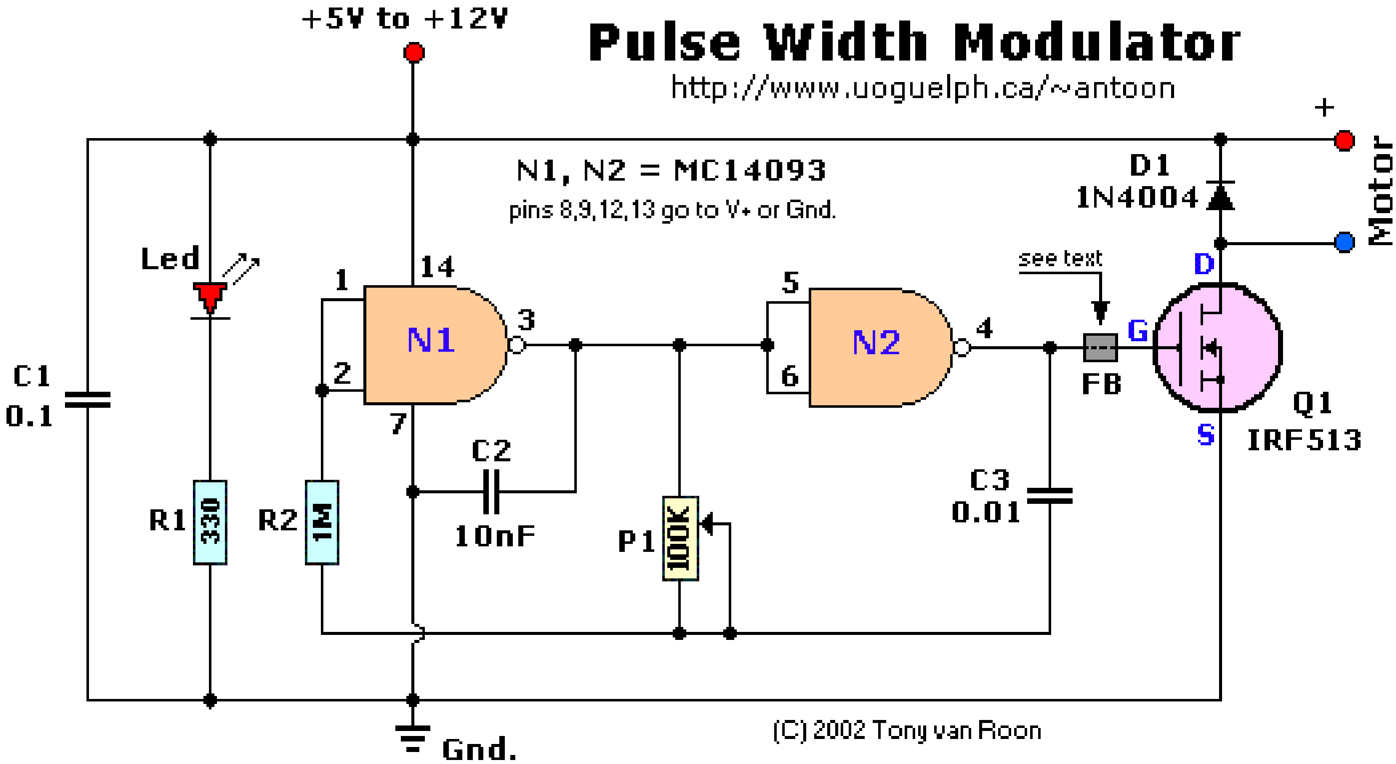

Parts List:
R1 = 330 ohm
R2 = 1MegaOhm
P1 = 100K potentiometer
C1 = 0.1µF, ceramic
C2 = 10nF, ceramic
C3 = 0.01µF, ceramic
D1 = 1N4004 (or faster schottky)
Led = Your choice
Q1 = IRF513, T-MOSFet
FB = Ferrite Bead (see text)
IC1 = MC14093, Quad 2-input NAND Schmitt Trigger

Couple Notes:
The IC used is a CMOS type MC14093, a quad 2-input NAND Schmitt trigger. If you wish, it can be directly interchanged with the CMOS MC14011 but this type is noisy.
The speed is adjustable from 0-max. Max rpm is 2/3 the supply voltage.
Supply voltage can be from 3 - 18volt, but I think around 12v works best for this application.
Input pins 8, 9, 12, and 13, need to be connected to Gnd. or 'V+'. Output pins 10 & 11 are left floating.
Maximum current draw, with the components shown, is approximately 220 mA max using a small type motor. Standby current at idle is about 88mA.

The way pulse modulation works is that it controls the motor by very short pulses. The longer the duration of the pulses the faster the motor turns. This method eliminates the excess heat associated with

more conventional setups.
Depending on the motor, Q1 may need a coolrib, and C2 modified to eliminate the 'jerk' at the end of P1's adjustment.
P1, the 100K potentiometer can be a multi-turn type if your needs are towards specific rpm's.
For Q1, the IRF513, I experimented with several other types such as the IRFZ42, IRF511, IRF513, and IRF620. They all seem to do the job, although I prefer the IRFZ42 type for its very low R_{ds}on
To minimize RFI (Radio Frequency Interference), put a **Ferrite Bead** on the gate of Q1, or if you can't obtain one, wind some 5 turns of thick magnet wire on a 10-ohm resistor (diameter approx. 1/4")
A schottky diode of proper specs may be required for some motors which require faster switching.

Here is some information in regards to the motor I used. Remember those full-height, black floppy drives from those old IBM pc's? That is exactly the motor I used. For those of you who remember that type, it was a belt drive model. The belt drove a little aluminum spindle. This motor is of excellent quality and made by the Buehler company in Kingston, USA.
A nice added feature is that those motors have a speed-sensor build-in and reads the rpm in AC volts. The yellow & green wires are the speed sensor and the red & blue wires are the positive/negative. It also has an extra aluminum shield around the motor-housing to keep rf interference to a minimum. Who wouldn't like a motor like that? If you can get your hands on them, take it!

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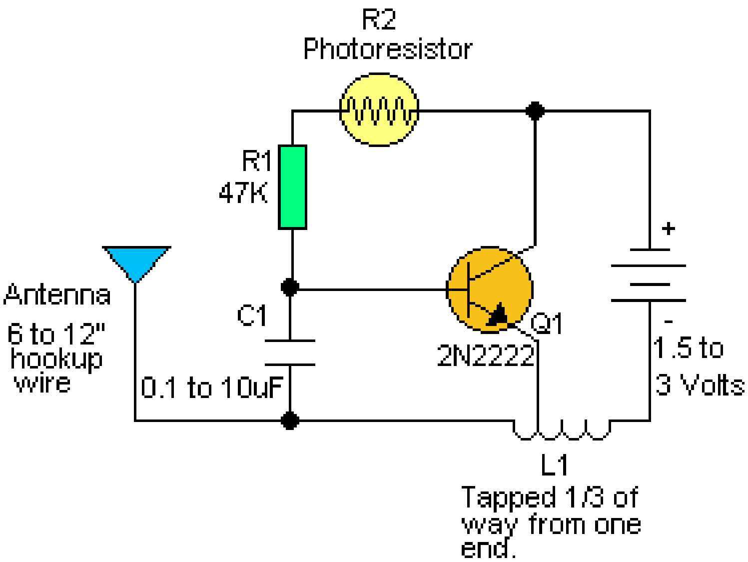
Light Sensing RF Transmitter

http://www.uoguelph.ca/~antoon



This transmitter is very similar to the Simplest RF Transmitter. The only difference being the photoresistor placed in series with R1. This could also be a thermistor or other variable resistance sensor. The frequency of the tone or "clicks" that is transmitted varies with the amount of light falling on the photo-resistor.

L1 is 20 to 30 turns of 24 to 32 ga. magnet wire close wound around a 1/8 to 1/4" diameter non-conductive form and tapped 1/3 of the way from one end. The tap is connected to the emitter of Q1.

The user should be able to pick up the signal from this transmitter on any regular FM or VHF receiver. By increasing the number of turns on L1, the RF frequency can be dropped down all the way into the AM broadcast band.

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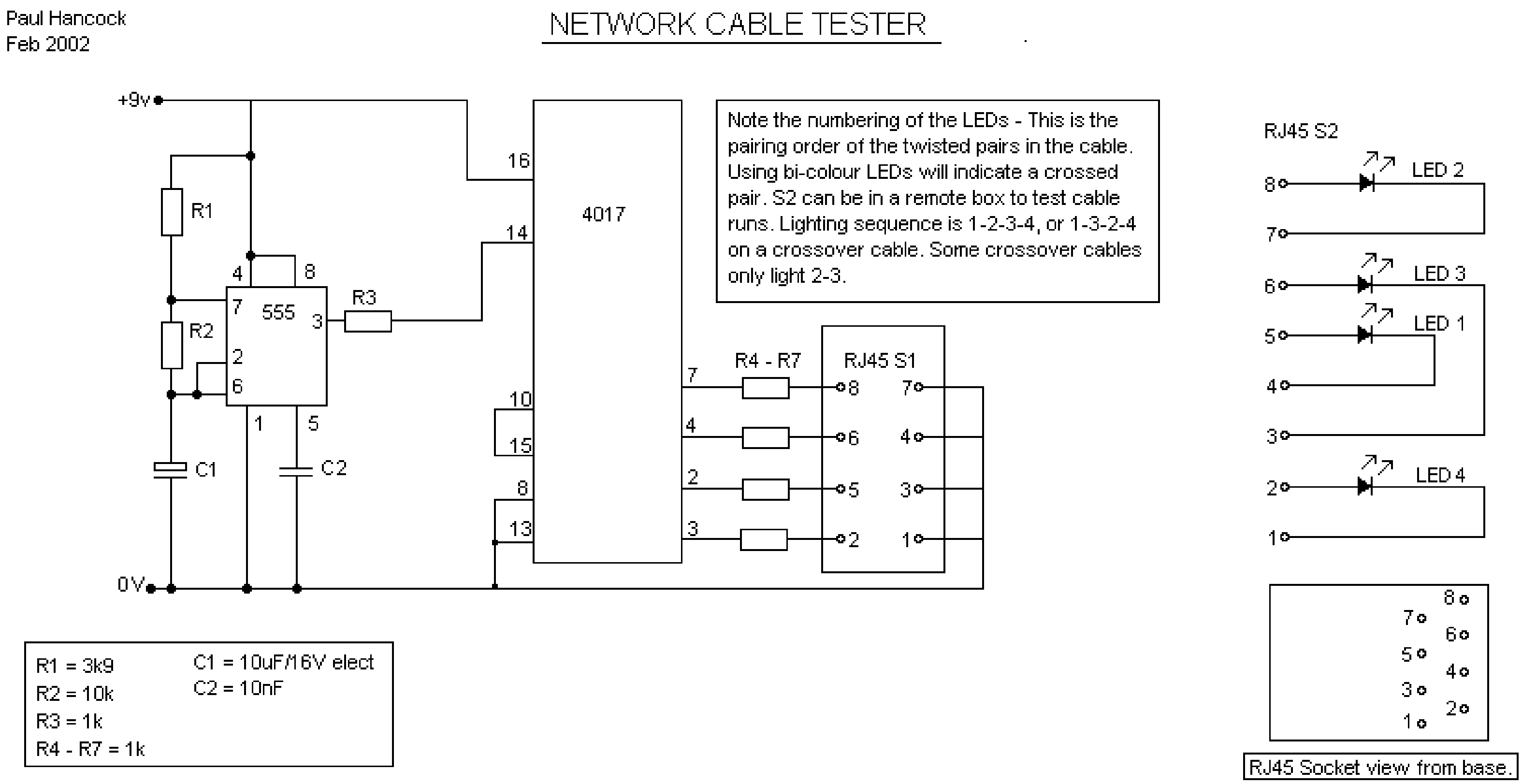
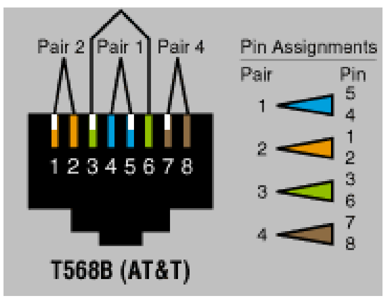
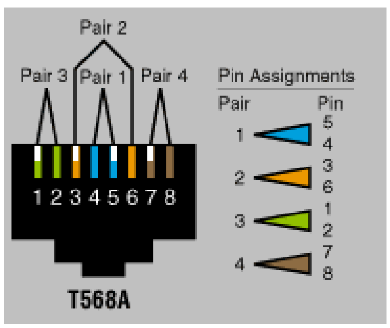
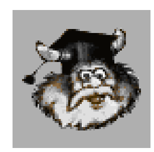
RJ45 Network Cable Tester

By Paul Hancock









Paul Hancock
Feb 2002

If you have any questions or are in need of other additional information in regards to the above circuit, please contact Paul Hancock here.

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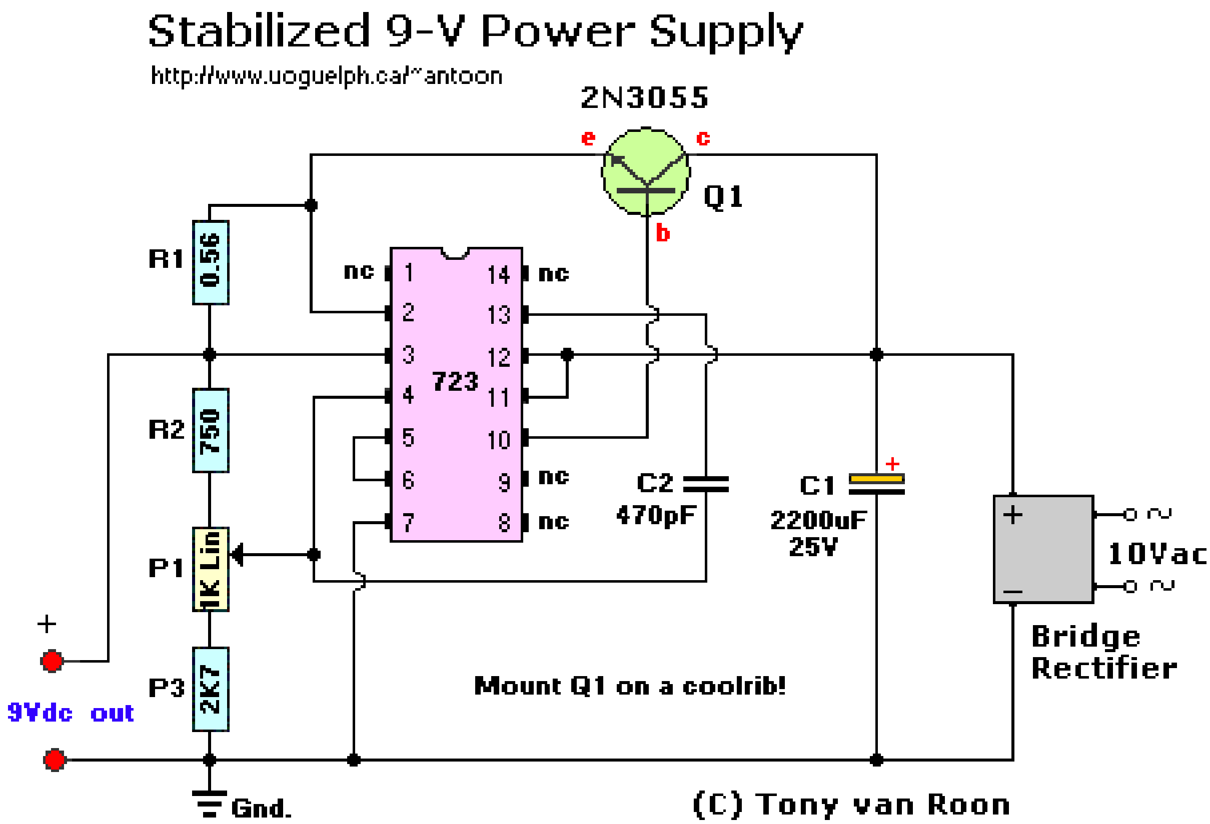

Parts List:

```
 T1 = 115/10 VAC transformer. Center Tap not needed.
IC1 = µA723, LM723, or equivalent.
 Q1 = 2N3055, NTE130, or substitute. (TO-3 case) Mount on a coolrib!
BR1 = 40V-5A
 R1 = 0.56 Ohm, 1 Watt, 5%
 R2 = 750 Ohm, 5%
 R3 = 2K7 (2700 ohm)
 P1 = potentiometer, 1K, Linear
 C1 = 2200uF, 25V
 C2 = 470pF
```

Notes:

C1 filters the noise and spikes off the ac. Adjust the circuit for 9 V output voltage with the P1 potentiometer.

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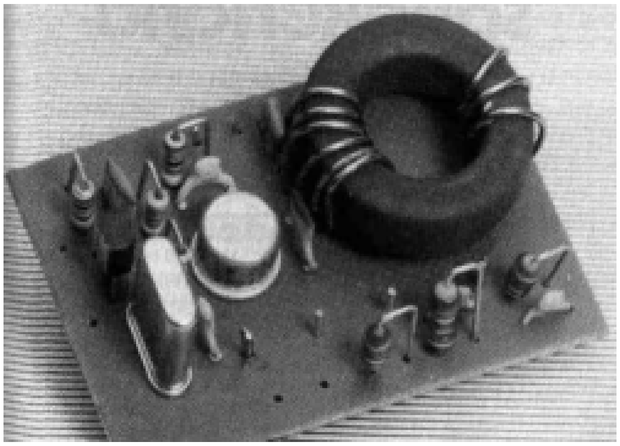
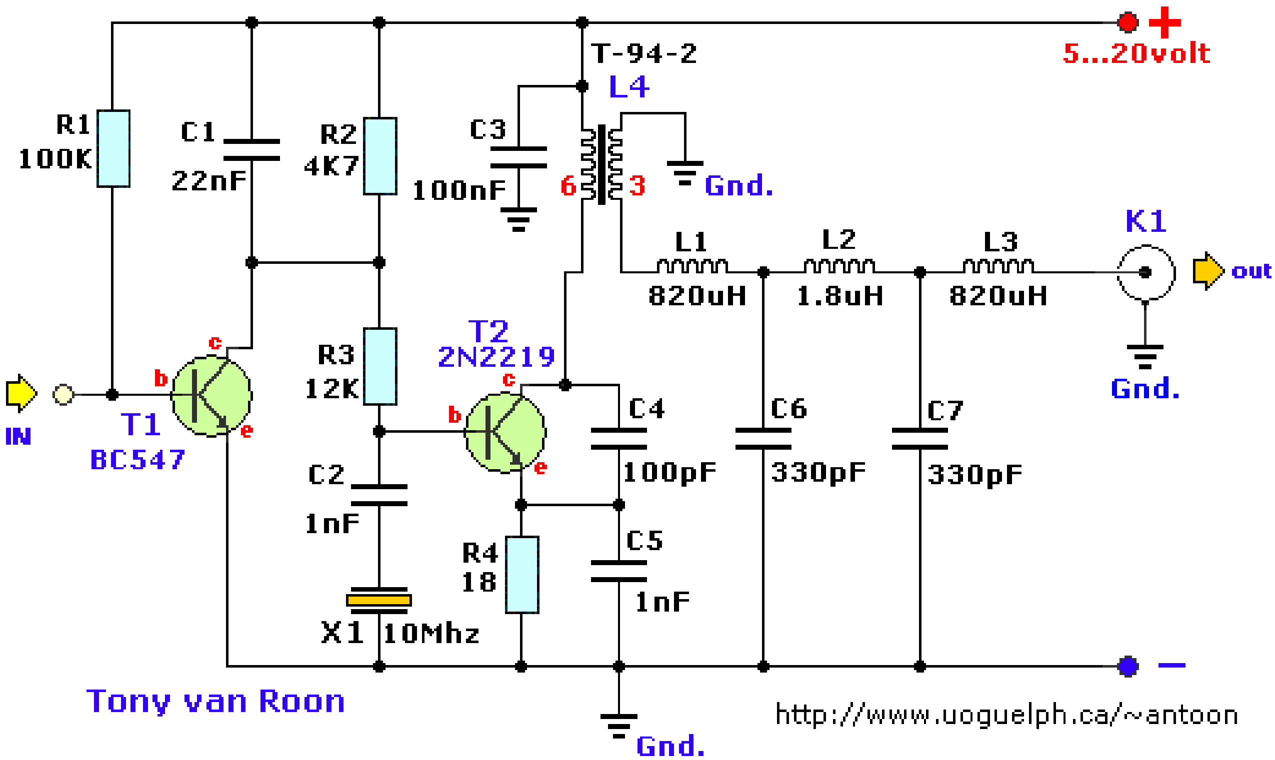
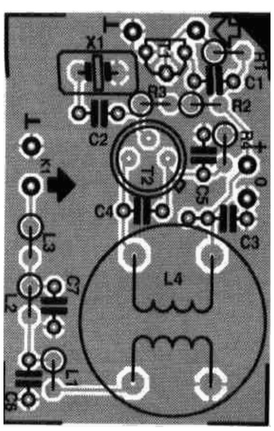


30-Meter QRP (CW)

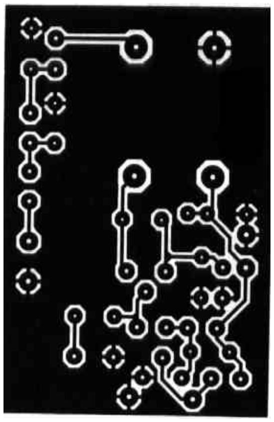
by P. Wyns, ON7WP (Belgium)

This transmitters' intended purpose is for morse-code only in the 30 meter band (10Mhz). It is a low-power QRP type and needs to be connected to your existing tranceiver. The harmonic rejections on the prototype were measured at 40dB on 20Mhz and 50dB on 30Mhz.





Component Layout.

 1-5/16" x 2" (34mm x 52mm) double-sided.

Parts List

R1 = 100K	C1 = 22nF	L1,L3 = 820nH	BNC connector
R2 = 4K7	C2,C5 = 1nF	L2 = 1.8µH	Coolrib for T2
R3 = 12K	C3 = 100nF	L4 = T-94-2 (Amidon)	Morse-key, single pole
R4 = 18 Ohm	C4 = 100pF	T1 = BC547	All-metal case
xtal = 10Mhz	C6,C7 = 330pF	T2 = 2N2219(A)	

Additional Notes

The transmitter is build as a Colpitts Oscillator with a strong 2N2219(A) transistor. HF-output of the oscillator is 100 to 500 mW, depending on the supply voltage of 5 to 20 Volts. The transmit frequency is stabilized with the 10Mhz crystal. A slight detuning is possible by putting a 150pF trimmer capacitor between C2 and the xtal. The oscillator signal is taken from the collector of T2 by induction and via a low-feedthrough filter and guided to the output. This particular filter is called "Chebychev" and uses standard E12 type values. The oscillator is keyed by T1, which biases as long as the morse-key is open and the base of T1 is at ground level. By keying the morse-key T1 is blocked and allows T2 to freely oscillate. For best results, use the double sided pcb as shown above. Coil L4 exists of Primary 6 turns and secundary 3 turns of 0.5mm magnet wire on a Amidon T-94-2 donut. Outside diameter is 24 mm and inside diameter is 14mm; the A(l) value is 84µH per 100 turns and permeability of 10. T2 needs a coolrib! The whole circuit needs to be mounted in an all-metal/aluminum case. If you're unable to obtain an all-metal case, then use a roll of self-sticking aluminum tape (available from your hardware store), just make sure that all individual pieces of aluminum-tape are conducting with each other. Works fine. Don't forget the coolrib on T2.

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555 Timer/Oscillator Tester

by Tony van Roon

Description 555 Tester:

The 555-tester above is basically a led flasher circuit but with the 555 removed. Imagen the output being a square-wave pulse with a high and low pulse, and is so indicated by the two leds, one 'Hi' and the other one 'Lo'. When you have a good 555 under test, the hi and lo leds are flashing steadily. If you have a defective 555 you may get both leds off, one or both on steady, or one or both on faintly. In all these case the 555 is defective. Oh yeah, just in case you are just starting out in electronics; do NOT insert a 555 (or take it out) with the power on. The flash-rate can be changed with different values for C1 and R2. Try it, its fun. At pin 5 there is a small ceramic 10nF capacitor. It is just there to filter out any noise and is optional. Experiment with leaving C2 out. C2 can be a value of 0.001 to 0.01µF, but the latter is the most common value. The datasheet for the 555 documention specifies to use a general purpose ceramic 0.01µF capacitor.

Read the **555 Timer/Oscillator Tutorial** for more information of the pin functions.

In regards to R3 and R4; depending on your Led type; start with 220 ohm and go up or down from 100 to 330 ohms, again, depending on your Led (e.i. regular, high, ultra bright, 2mm, 3mm, 5mm, etc.). The prototype was constructed with as few parts in mind as posible. In that regards you could save money by replacing the two leds with a bi-color (3 legs) one if you have a unit in your junkbox somewhere; it will then flash green/red. The second unit was smaller, but the third unit I build was so small it was about 2 x 1 x 1/2 inch and fitted nicely in my pocket.

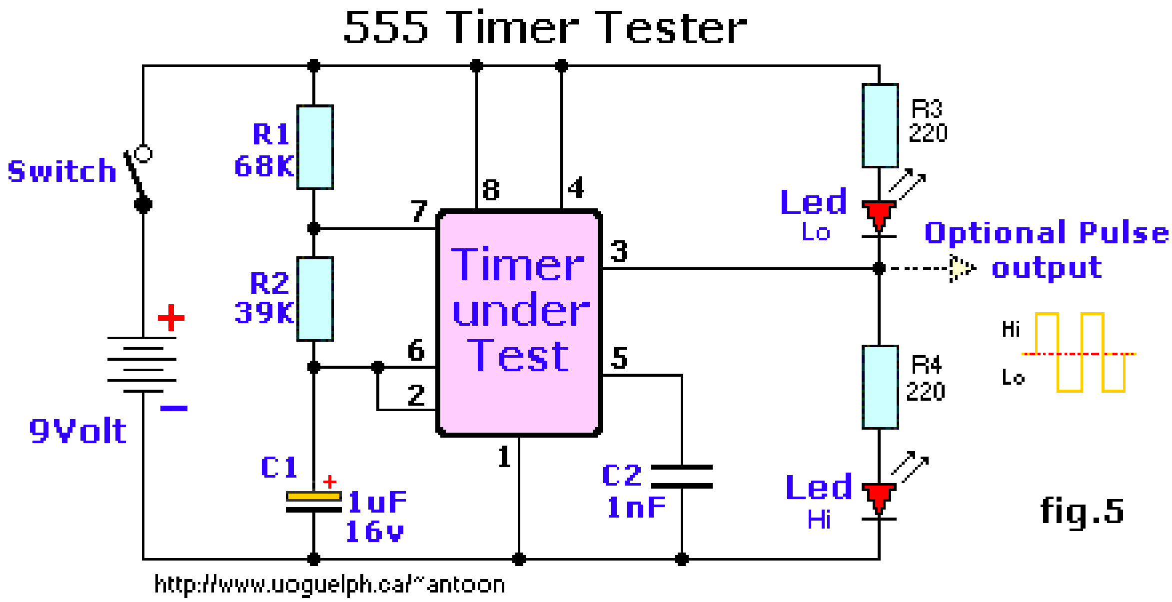

fig.5

Parts List:

R1 = 68K, 5%
R2 = 39K, 5%
R3 = 100 to 330 ohm depending on LED
R4 = Same as R3
C1 = 1µF, 16V
C2 = 0.01µF ceramic (see text)
Two led's, red or green.
8-pin dip socket
On-off switch or momentary 'push=on' switch
Solderless breadboard (if you wish) = Radio Shack #276-175

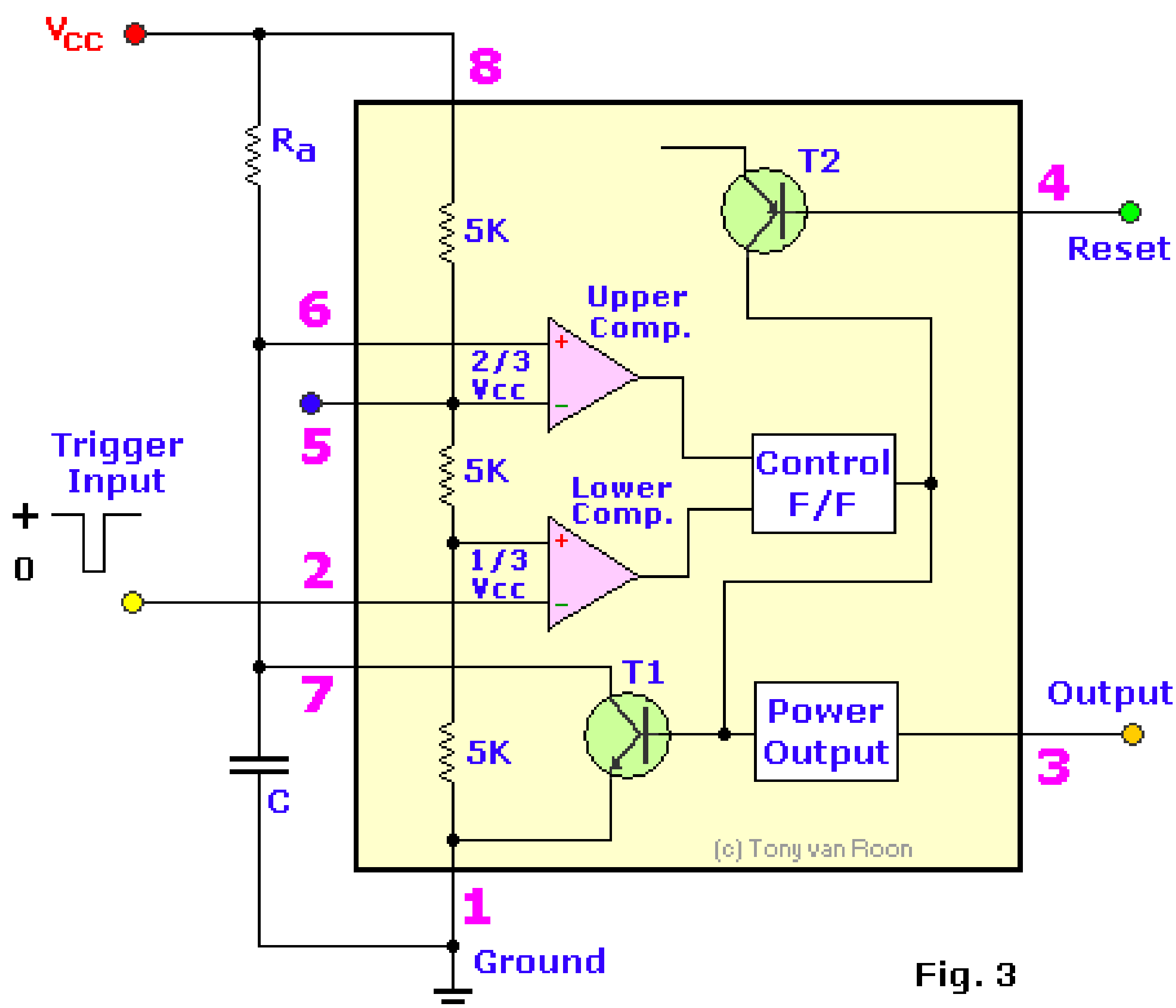

Fig. 3

Description 555 Timer/Oscillator:

Have a look at the block diagram above. To make the 555 work, a trigger pulse at pin 2 initially sets the 555's internal flip-flop 'on'. It does so by comparing the input pulse to 1/3 of the supply power to a second comparator. This turns off the transistor across the timing capacitor and allows the timing capacitor to start the charge cycle. The 555 stays 'on' until this timing cycle turns it 'off' again by resetting the control flip-flop.
The timing cycle can be made to start over again by applying a pulse to pin 4 (reset). This turns on the transistor that discharges the timing capacitor, and so delaying the charge from reaching 2/3 Vcc.
In some applications, the reset (pin 4) is connected to the trigger input (pin 2) so that each new input trigger signal restarts the timing cycle.
When the threshold at pin 2 drops, at the end of a timing cycle, that voltage drop can be used to start a new timing cycle right away by connecting pin 6 (threshold) to pin 2, the trigger input. This type of system is called an "astable, free running, oscillator" and is the most common one. If you look at a variety of diagrams where a 555 is used you notice that in most cases pins 2 and 6 are connected.
The 555's output circuit includes two high current transistors, each capable of handling at least 200mA. One transistor is connected between the output pin 3 and Vcc, and the other between pin 3 and ground. This way you can use the output pin 3 to either supply Vcc to your load (source) or provide a ground for your load (sink). If you have heard mentioning about 'sink' or 'source' this is exactly what it means. This tester will flash the led's alternately with good 555 under test, because both led's are driven from the single output pin 3 because of the way the 555 is designed. What an awsome chip!

If you wish to learn more about the 555 Timer/Oscillator, I invite you to read the 555 Timer/Oscillator tutorial.

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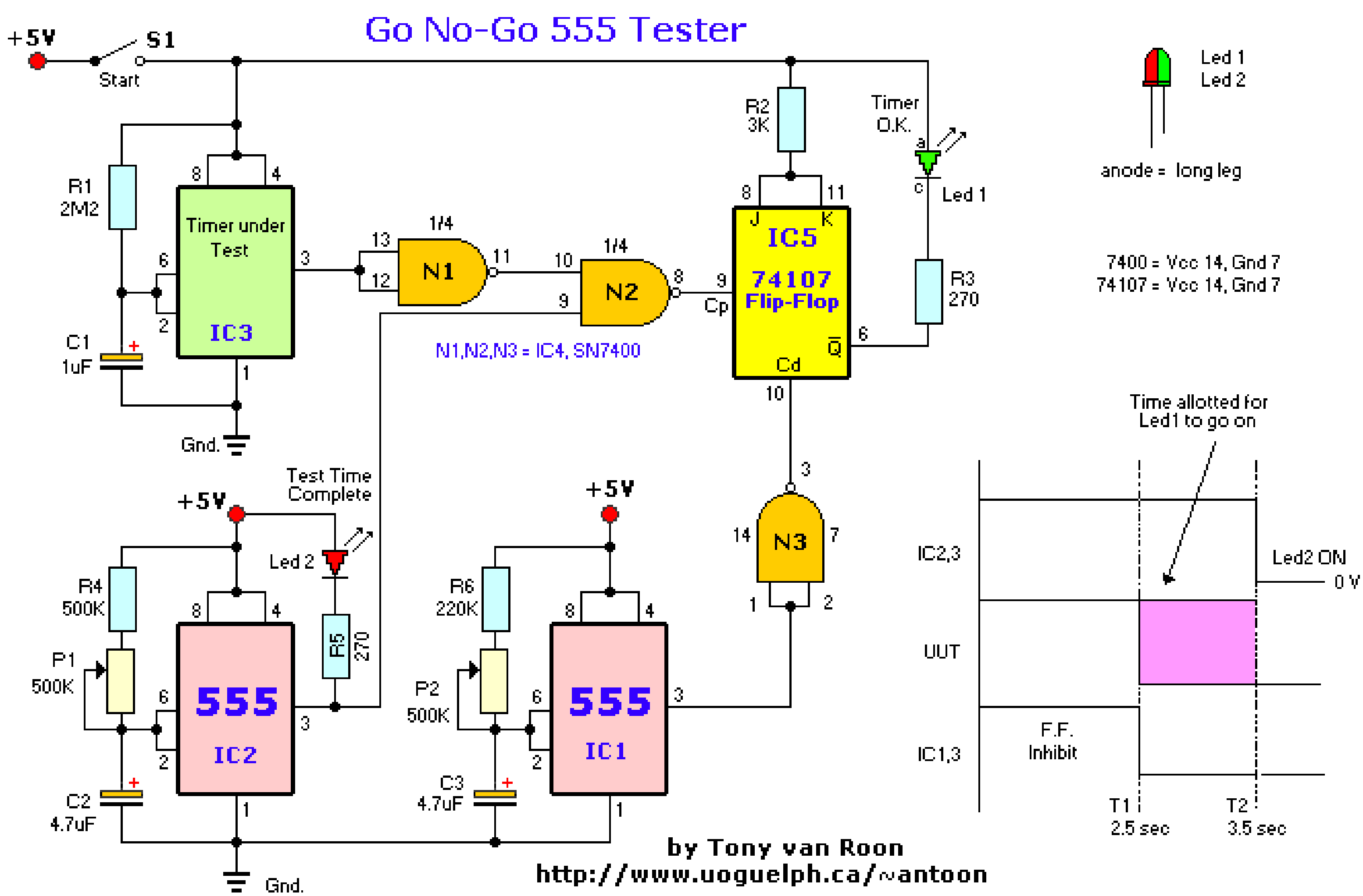

Parts List

R1 = 2M2 — IC1,IC2,IC3 = 555 Timer/Oscillator
R2 = 3K — IC4 = SN7400
R3,R5 = 270 ohm — IC5 = SN74107
R4 = 500K — Led1,Led2 = 5mm, Red/Green, high brightness
R6 = 220K — S1 = On-Off switch, push button
P1,P2 = 500K, Trimpots
C1 = 1µF, 10V
C2,C3 = 4µF, 10V

Description:

This is a more advanced unit with a precise timed testing procedure.

R1 (2M2) is same as 2.2 MegOhm.
The two timers determine the allowable accuracy for the timer IC under test. Potentiometers P1 and P2 permit ready adjustment for the desired range.
With power applied, all timers switch to the high state and begin their cycles. The output of IC1 inhibits the flip-flop for the interval T1. At T2, the output of IC2 goes low and inhibits any signal from the timer under test. The period between T1 and T2 is the time alloted for IC3, the timer under test, to complete its cycle and produce a low output. Only during this time can a high-to-low transition from IC3 trigger the Flip-Flop IC5 so that Led 1 (timer ok), which indicates a good IC, lights up. Led 2 lights up when the test is completed.

Although there can be a few milliseconds of contact bounce when S1 is first closed, thereby causing a delay in capacitor charging, the delay appears across all of the IC's. But since the ratio of delay times among all three timers is the same, the effect on test accuracy is nil.

How you get to the 5 volt supply power is up to you. Supply power should be between 4.5V (min) and 5.5 (max). Probably three 1.5V alkalines will total about 4.8V because they are never exactly 1.5 V but always between 1.56 and 1.59V or so, and will do the job until the voltage drops below 4.5V. A simple stabilized 5V power supply would be better choice, or use a 5 volt regulator with a 9 volt battery, works also. Do not forget to connect power to the 7400 and 74101 IC's (see circuit diagram). Standard procedure is that if they are not drawn, they are assumed. You can get the LS types (low schottky) which draw less current.
At this time I'm bench testing the cmos types.

Note: While bench testing I found that older timers like the µA555 and the MC1455, although good, were difficult to test. I tried extending the testing period (in seconds) by adjusting trimpot P2 and got an ok from led2 for the MC1455 but no such luck with the µA555. The LM555 and NE555 testing were excellent. I will test a couple more, including the cmos versions, and post my findings here. If I can find the time I will modify the power supply for use with a regular 9 volt battery instead of the bit ackward 5 volt supply...

Read the **555 Timer/Oscillator Tutorial** for more information of the pin functions.

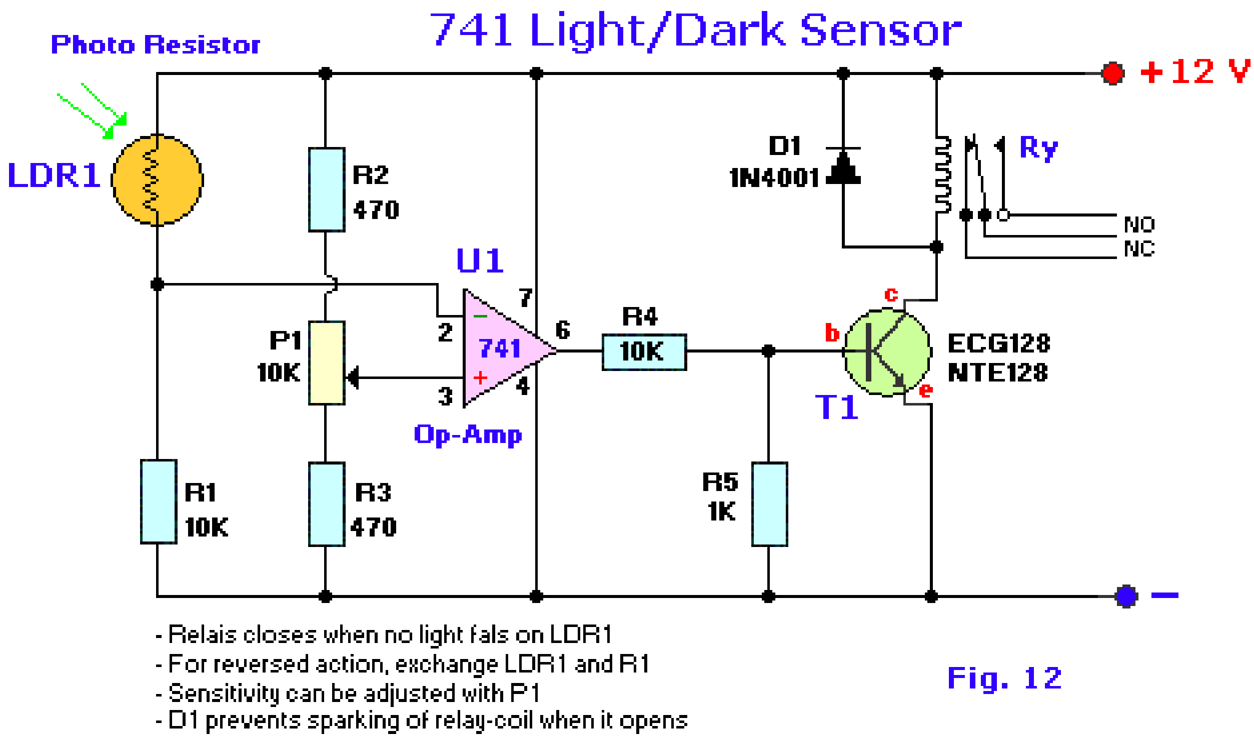

Fig. 12

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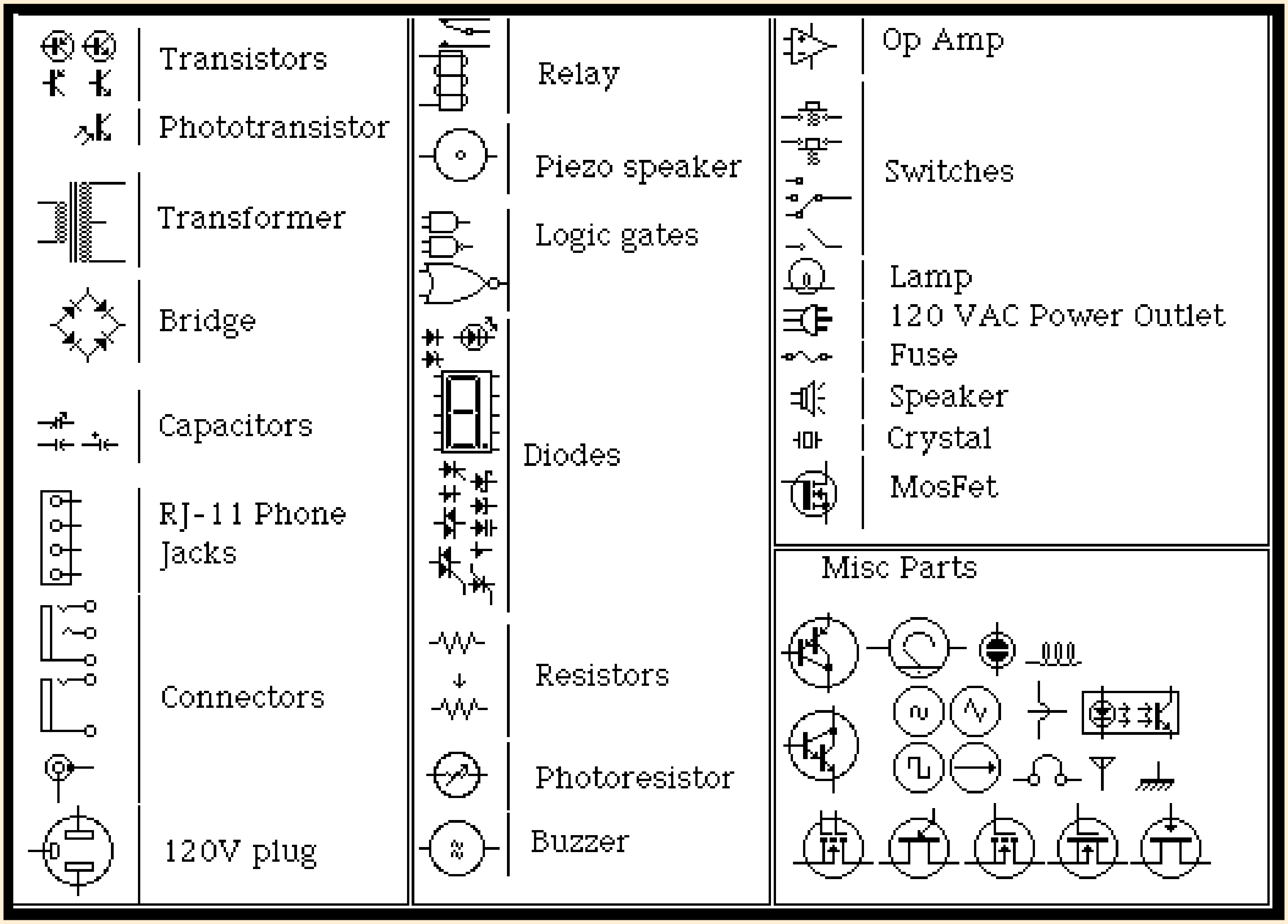
Electronic Component Template



Additional Notes
(N/A)

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Archived, older circuits

Some are working, others are not. That's why they are here, either non-working or obsolete. But they may still be of use either as example circuits or perhaps you can use snippets of the diagrams. Whatever. Use at your own risk. There is NO SUPPORT for any of these circuits.

Inverter - 12V-DC to 115V-AC. Problems with tantalum caps blowing or getting hot
Servo Tester #1 - Working. Not bad; I will revamp this one.
Servo Tester #4 - Working, but not to my satisfaction
Servo Tester #5 - Working, but not to my satisfaction

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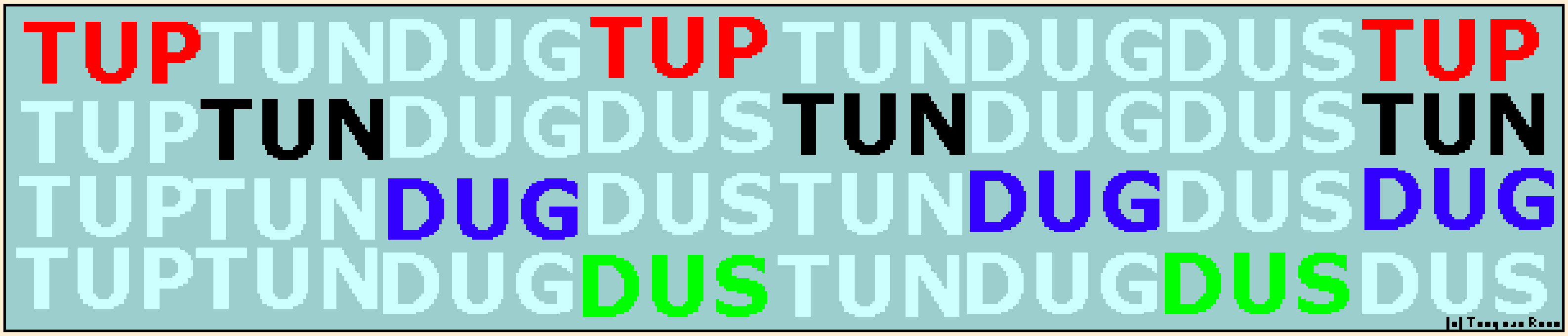

Circuits, as published and used by Elektor and the Dutch Elektuur, contain universal transistors and diodes to the abbreviations: TUP (Transistor Universal Pnp), TUN (Transistor Universal Npn), DUS (Diode Universal Silicon), and DUG (Diode Universal Germanium). Many transistors and diodes fit this way in these categories and makes component selection easier. Good system!

Table 1a. Transistors

	Type	U_{ceo} (max)	I_c (max)	h_{fe} (min)	P_{tot} (max)	f_T (min)
TUN	NPN	20Volt	0.1 Amp	100	0.1 Watt	100 Mhz
TUP	PNP	20Volt	0.1 Amp	100	0.1 Watt	100 Mhz

The minumum specifications have to be met, in Table 1a above, before you can call it a 'TUP' or a 'TUN'.

Table 1b. Diodes

	Type	U_R (max)	I_F (max)	I_R (max)	P_{tot} (max)	C_D (max)
DUS	Si	25 Volt	0.1 Amp	1 uAmp	0.25 Watt	5 pF
DUG	Ge	20 Volt	0.035 A	100 uAmp	0.25 Watt	10 pF

The minumum specifications have to be met, in Table 1b above, before you can call it a 'DUS' or a 'DUG'.

Table 2.		
TUN	(NPN)	
BC107	BC208	BC384
BC108	BC209	BC407
BC109	BC237	BC408
BC147	BC238	BC409
BC148	BC239	BC413
BC149	BC317	BC414
BC171	BC318	BC547
BC172	BC319	BC548
BC173	BC347	BC549
BC182	BC348	BC582
BC183	BC349	BC583
BC184	BC382	BC584
BC207	BC383	

Table 3.		
TUP	(PNP)	
BC157	BC253	BC416
BC158	BC261	BC417
BC159	BC262	BC418
BC177	BC263	BC419
BC178	BC307	BC512
BC179	BC308	BC513
BC204	BC309	BC514
BC205	BC320	BC557
BC206	BC321	BC558
BC212	BC322	BC559
BC213	BC350	
BC214	BC351	
BC251	BC352	
BC252	BC415	

In the above tables, Table 2 and Table 3, you can use several different transistor types for a TUP or a TUN. Obviously the tables are not complete. It would be almost impossible to list all available transistor types available today. From the above listed types are all A, B, or C types usable.

Table 4.		
DUS		DUG
BA127	BA318	OA85
BA217	BAX13	OA91
BA218	BAY61	OA95
BA221	1N914	AA116
BA222	1N4148	
BA317		

Several different types of diodes are suitable as a 'DUS' or 'DUG'.

Table 6.	NPN	PNP
	BC107 BC108 BC109	BC177 BC178 BC179
U_{ceo} (max)	45 V 20 V 20 V	45 V 25 V 20 V
U_{ebo} (max)	6 V 5 V 5 V	5 V 5 V 5 V
I_c (max)	100 mA 100 mA 100 mA	100 mA 100 mA 50 mA
P_{tot} (max)	300 mW 300 mW 300 mW	300 mW 300 mW 300 mW
f_T (min)	150 Mhz 150 Mhz 150 Mhz	130 Mhz 130 Mhz 130 Mhz
F (max)	10 dB 10 dB 4 dB	10 dB 10 dB 4 dB
(A), (B) or (C) added to transistor type: (A) = hfe 125 to 260 (B) = hfe 240 to 500 (C) = hfe 450 to 900		

The most important parameters of the BC107...BC109 and the BC177...BC179. These transistors have been choosen as an example of information.

Table 5. Row 1				Row 2				Row 3			
NPN	PNP	Case	Note	NPN	PNP	Case	Note	NPN	PNP	Case	Note
BC107 BC108 BC109	BC177 BC178 BC179			BC317 BC318 BC319	BC320 BC321 BC322		$I_{c\,max}$ = 150 mA	BC467 BC468 BC469			P_{max} = 220 mW
BC147 BC148 BC149	BC157 BC158 BC159		P_{max} = 250 mW	BC347 BC348 BC349	BC350 BC351 BC352			BC167 BC168 BC169	BC257 BC258 BC259		100/250: $I_{c\,max}$ = 50 mA
BC171 BC172 BC173	BC251 BC252 BC253		251....253 Noise Free	BC382 BC383 BC384				BC547 BC548 BC549	BC557 BC558 BC559		P_{max} = 500 mW
BC182 BC183 BC184	BC212 BC213 BC214		$I_{c\,max}$ = 150 mA	BC407 BC408 BC409	BC417 BC418 BC419		P_{max} = 250 mW	BC582 BC583 BC584	BC512 BC513 BC514		$I_{c\,max}$ = 200 mA
BC207 BC208 BC209	BC204 BC205 BC206			BC413 BC414	BC415 BC416		Noise Free		BC261 BC262 BC263		Noise Free
BC237 BC238 BC239	BC307 BC308 BC309			BC437 BC438 BC439			P_{max} = 220 mW	http://www.uoguelph.ca/~antoon			

The letter after the transistor indicates the hfe.

Example: BC107A, hfe = 125 ... 260
BC107B, hfe = 240 ... 500
BC107C, hfe = 450 ... 900

Substitutes within the BC series of transistors are also possible. In Table 6 you see that the transisors are grouped in three. Example, the BC107, BC147, BC317 and BC413 can be substituted with each other, but a BC548 may not be exchanged for a BC107. Why? The BC548 is the second of a group of three. Your choice would be a BC547(A,B, or C).

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