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U V W X Y Z

How to Use the Index

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A

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Alarm Circuits

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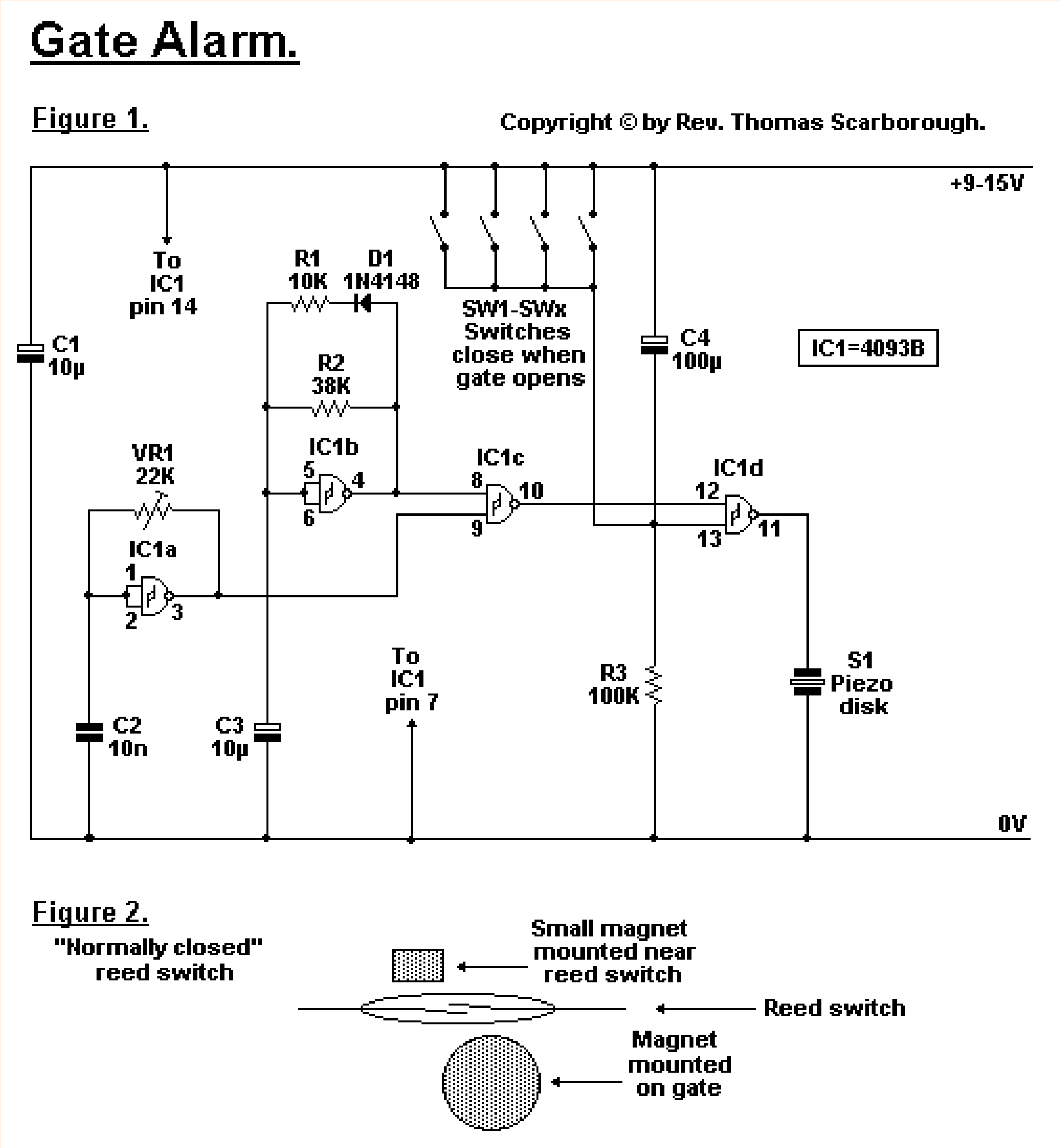
Gate Alarm.



By Rev. Thomas Scarborough

Cape Town

E-mail scarboro@iafrica.com

Figure 1 represents a cheap and simple Gate Alarm, that is intended to run off a small universal AC-DC power supply.

IC1a is a fast oscillator, and IC1b a slow oscillator, which are combined through IC1c to emit a high pip-pip-pip warning sound when a gate (or window, etc.) is opened. The circuit is intended not so much to sound like a siren or warning device, but rather to give the impression: "You have been noticed." R1 and D1 may be omitted, and the value of R2 perhaps reduced, to make the Gate Alarm sound more like a warning device. VR1 adjusts the frequency of the sound emitted.

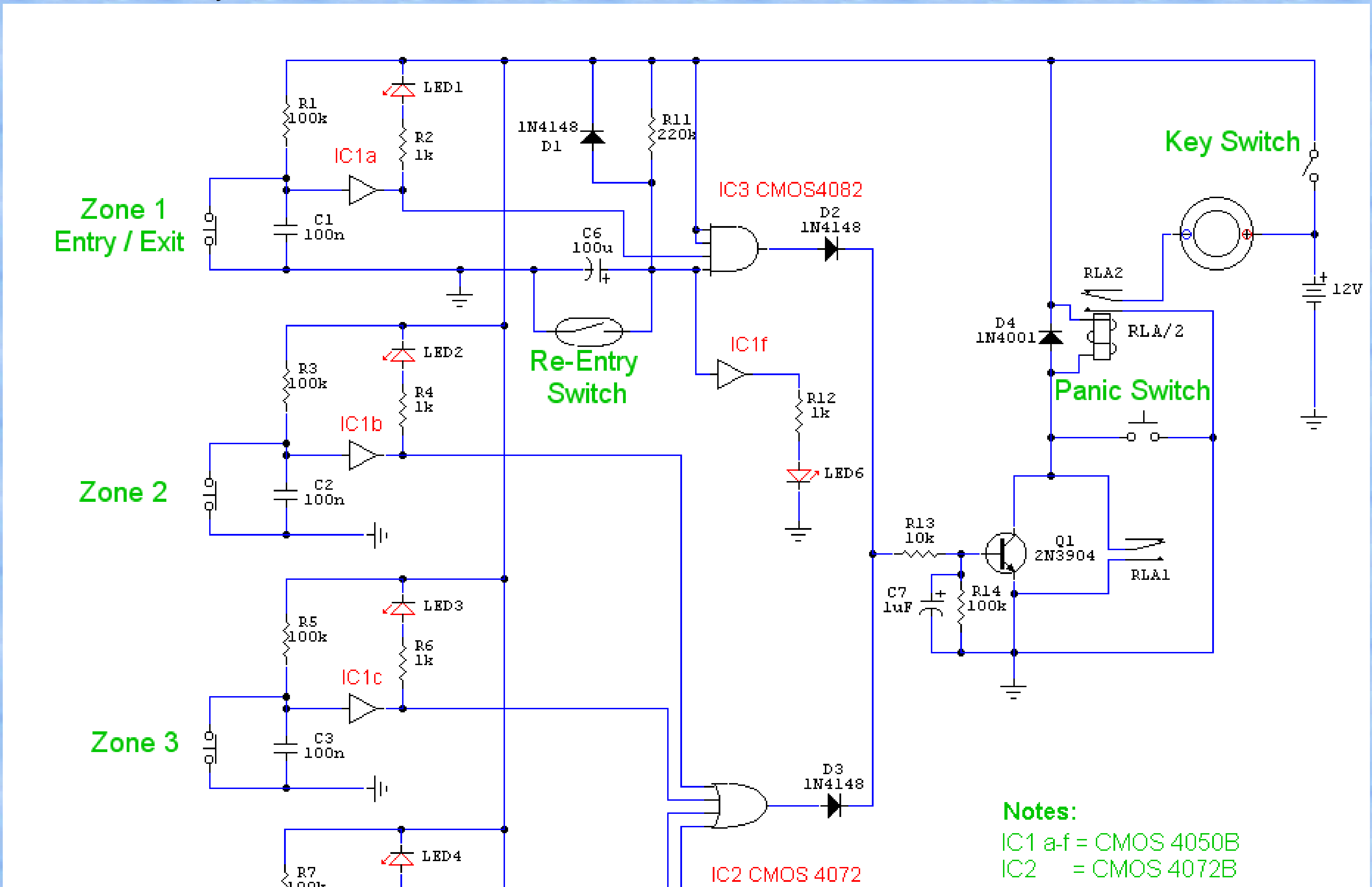
IC1d is a timer which causes the Gate Alarm to emit some 20 to 30 further pips after the gate has been closed again, before it falls silent, as if to say: "I'm more clever than a simple on-off device." Piezo disk S1 may be replaced with a LED if desired, the LED being wired in series with a 1K resistor.

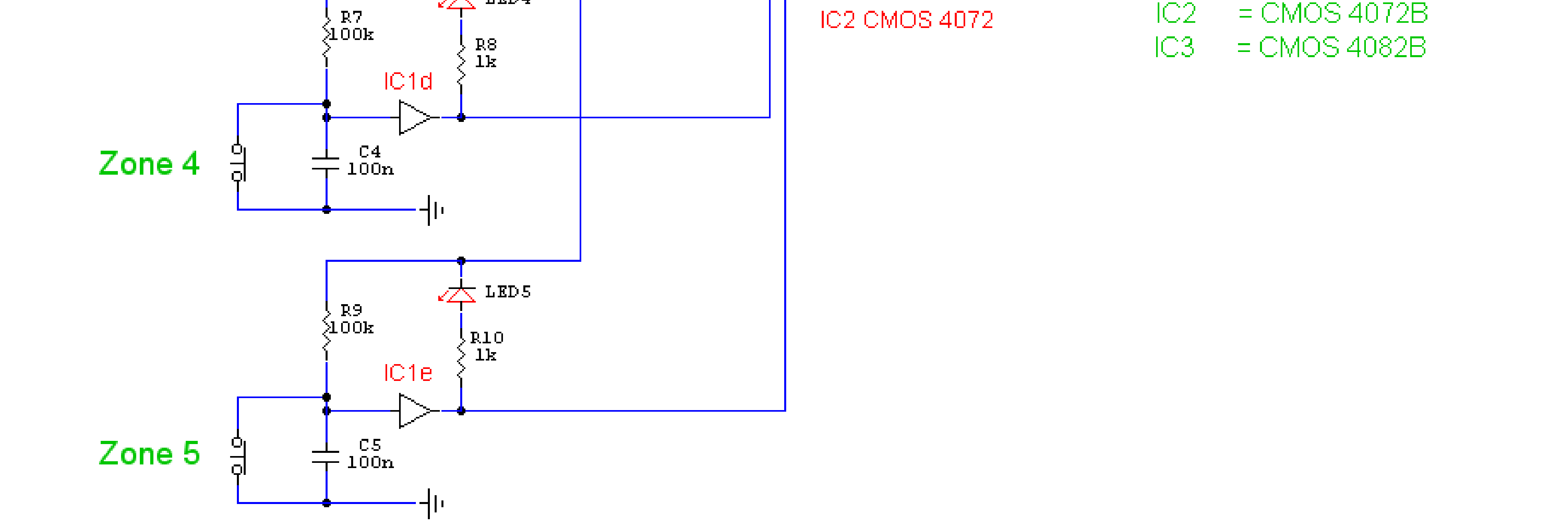
Figure 2 shows how an ordinary reed switch may be converted to close (a "normally closed" switch) when the gate is opened. A continuity tester makes the work easy. Note that many reed switches are delicate, and therefore wires which are soldered to the reed switch should not be flexed at all near the switch. Other types of switches, such as microswitches, may also be used.

Return to Alarm & Security Circuits

5 Zone Alarm System

Description
This is a complete alarm system with 5 independent zones suitable for a small office or home environment. It uses just 3 CMOS IC's and features a timed entry / exit zone, 4 immediate zones and a panic button. There are indicators for each zone a "system armed" indicator. The schematic is as follows:





Circuit Notes:

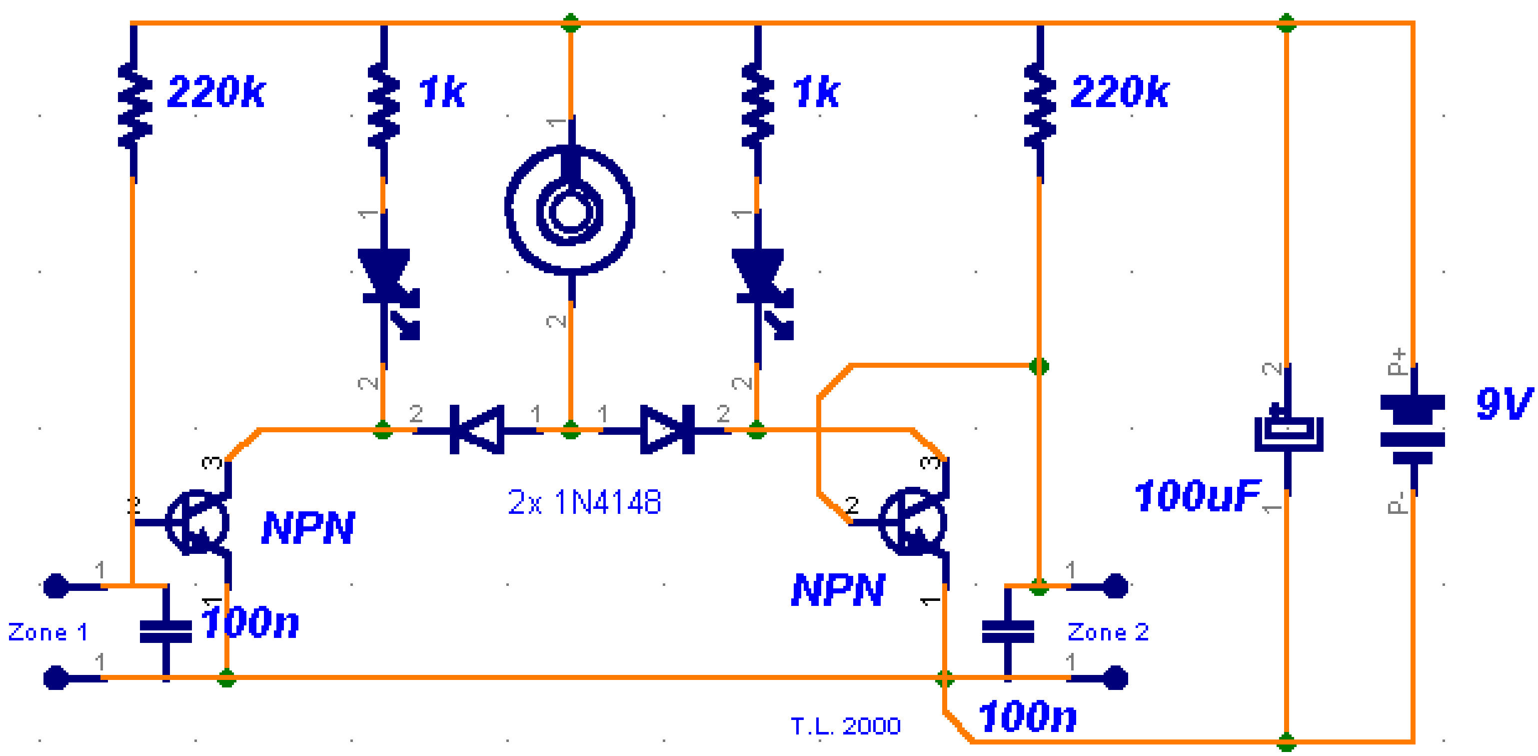
Each zone uses a normally closed contact. These can be micro switches or standard alarm contacts (usually reed switches). Zone 1 is a timed zone which must be used as the entry and exit point of the building. Zones 2 - 5 are immediate zones, which will trigger the alarm with no delay. Some RF immunity is provided for long wiring runs by the input capacitors, C1-C5. C7 and R14 also form a transient suppresser. The key switch acts as the Set/Unset and Reset switch. For good security this should be the metal type with a key. At switch on, C6 will charge via R11, this acts as the exit delay and is set to around 30 seconds. This can be altered by varying either C6 or R11. Once the timing period has elapsed, LED6 will light, meaning the system is armed. LED6 may be mounted externally (at the bell box for example) and provides visual indication that the system has set. Once set any contact that opens will trigger the alarm, including Zone 1. To prevent triggering the alarm on entry to the building, the concealed re-entry switch must be operated. This will discharge C6 and start the entry timer. The re-entry switch could be a concealed reed switch, located anywhere in a door frame, but invisible to the eye. The panic switch, when pressed, will trigger the alarm when set. Relay contacts RLA1 provide the latch, RLA2 operate the siren or buzzer.

Return to Alarm Circuits

Miniature Loop Alarm

By Tomaz Lazar - Ljubljana, Slovenia

A few months ago, I decided to build a compact, yet effective alarm. My demands were:- simple construction, reliable operation, very small power consumption, and, most of all, small size. I started with CMOS logic gates, but was soon forced to abandon the concept after a few unsuccessful (and far too complicated) attempts. Then I suddenly realized that a simple transistor switch might do the job and I was right.



As you can clearly see from the schematics, the circuit is utterly primitive and consists of two identical transistor switches. Each has its own alarm LED and they're coupled to a neat 82dB buzzer. The two 1N4148 diodes are used to prevent a signal from one sensor from triggering both LEDs. The sensors used are either wire loops or normally closed reed switches or even a combination of both. You could, for example, tie a wire loop to your suitcase and place a reed switch to the door of your hotel room.

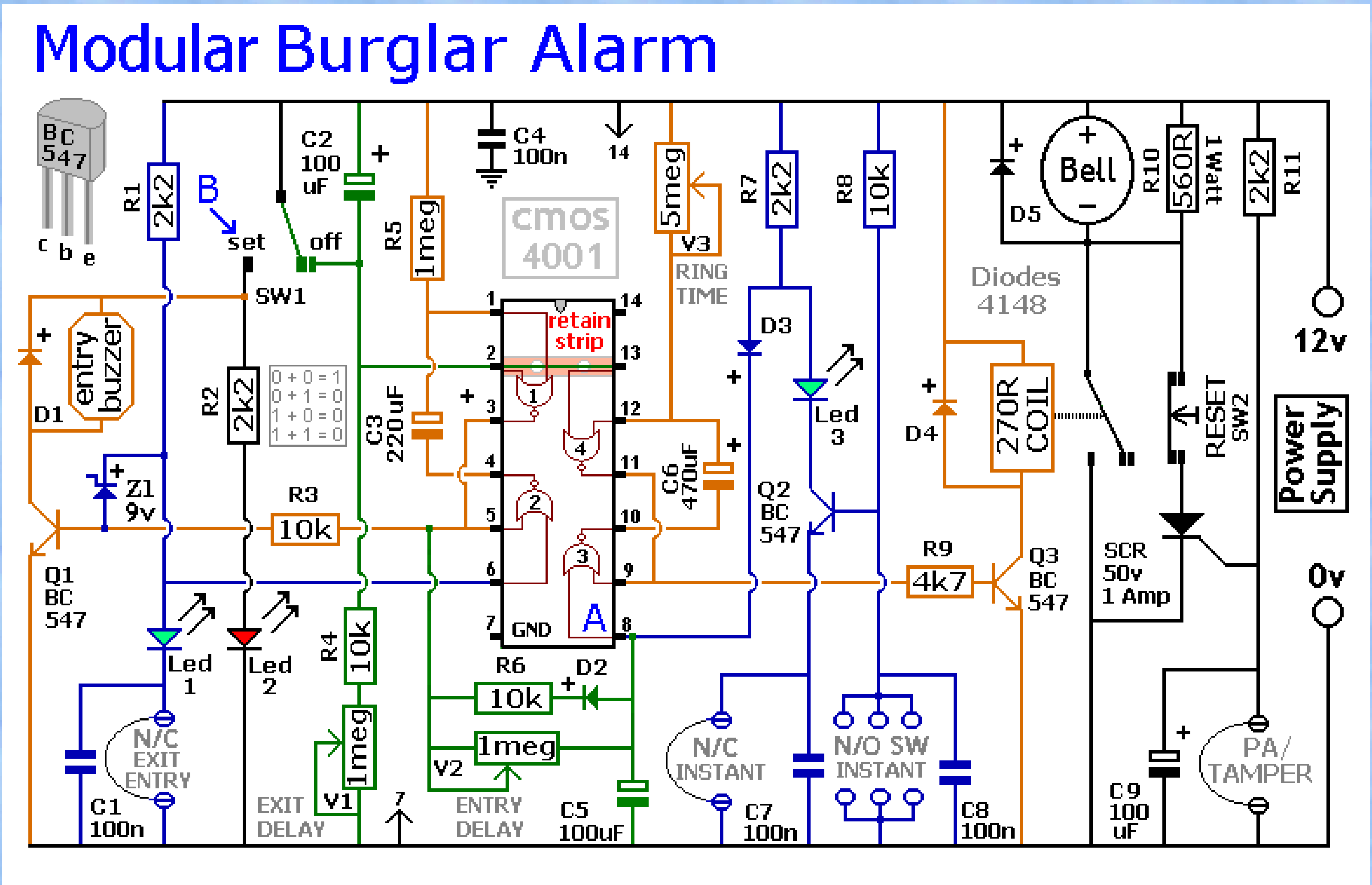
Since this little alarm is intended to be kept in arms reach at all times, there aren't any provisions for automatic shutdown after a certain period of time. The buzzer will sound until you turn the whole circuit off or connect the wire loop back to the jumpers. The same goes for the two LEDs, each indicating its own zone.

Construction is not critical and there aren't any traps for the novice. The two 100n capacitors aren't really necessary, I just included them to make sure that there is no noise interference coming from the long wire loops. For transistors, you can use any NPN general-purpose audio amplifiers/switches (BC 107/108/109, BC 237/238, 2N2222, 2N3904...). Assemble the circuit on perf board. Together with the buzzer and a 9V battery, it should easily fit in a pocket-sized plastic box smaller than a pack of cigarettes. A fresh battery should suffice for weeks of continuous operation.

Return to Alarm Circuits

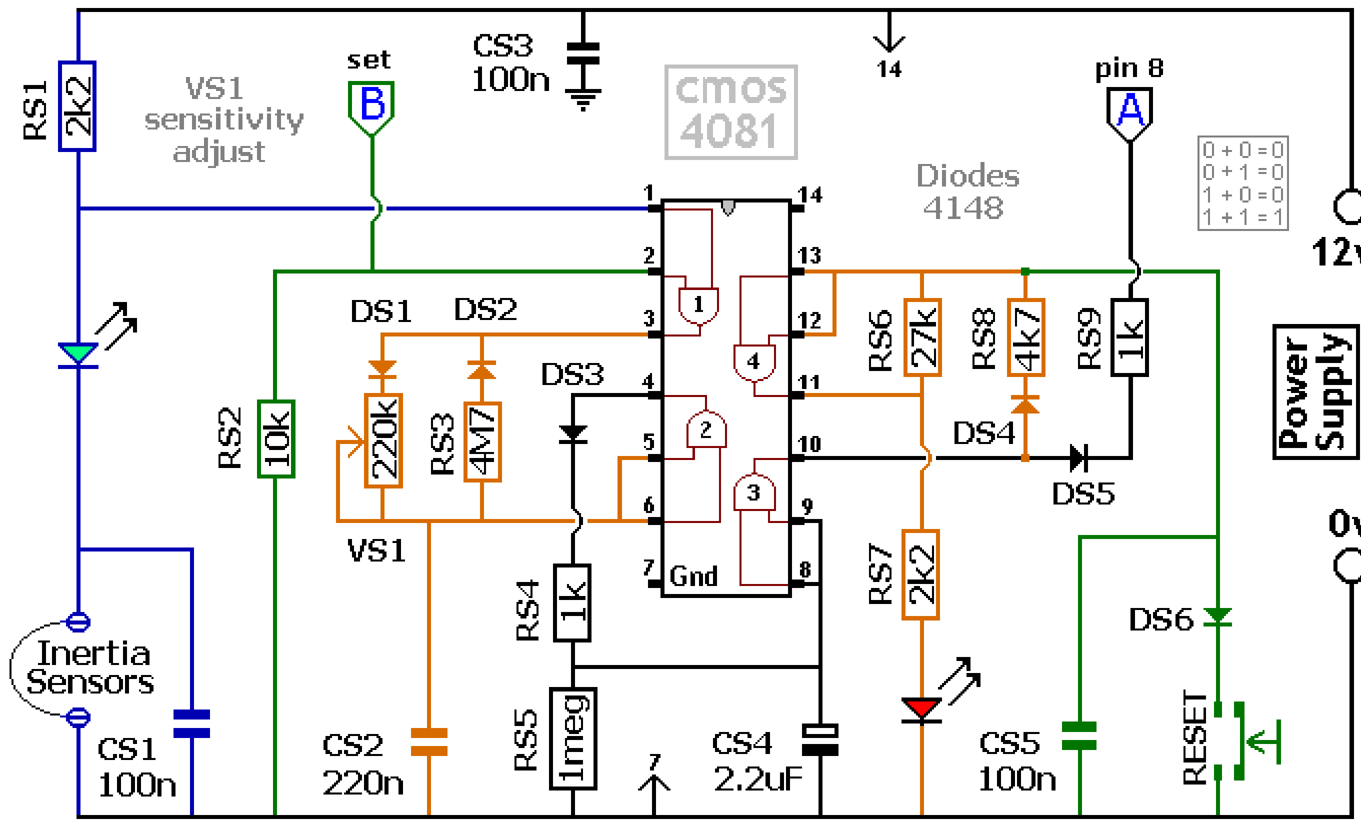
Modular Burglar Alarm

RON J   Email: ronj@gofree.indigo.ie

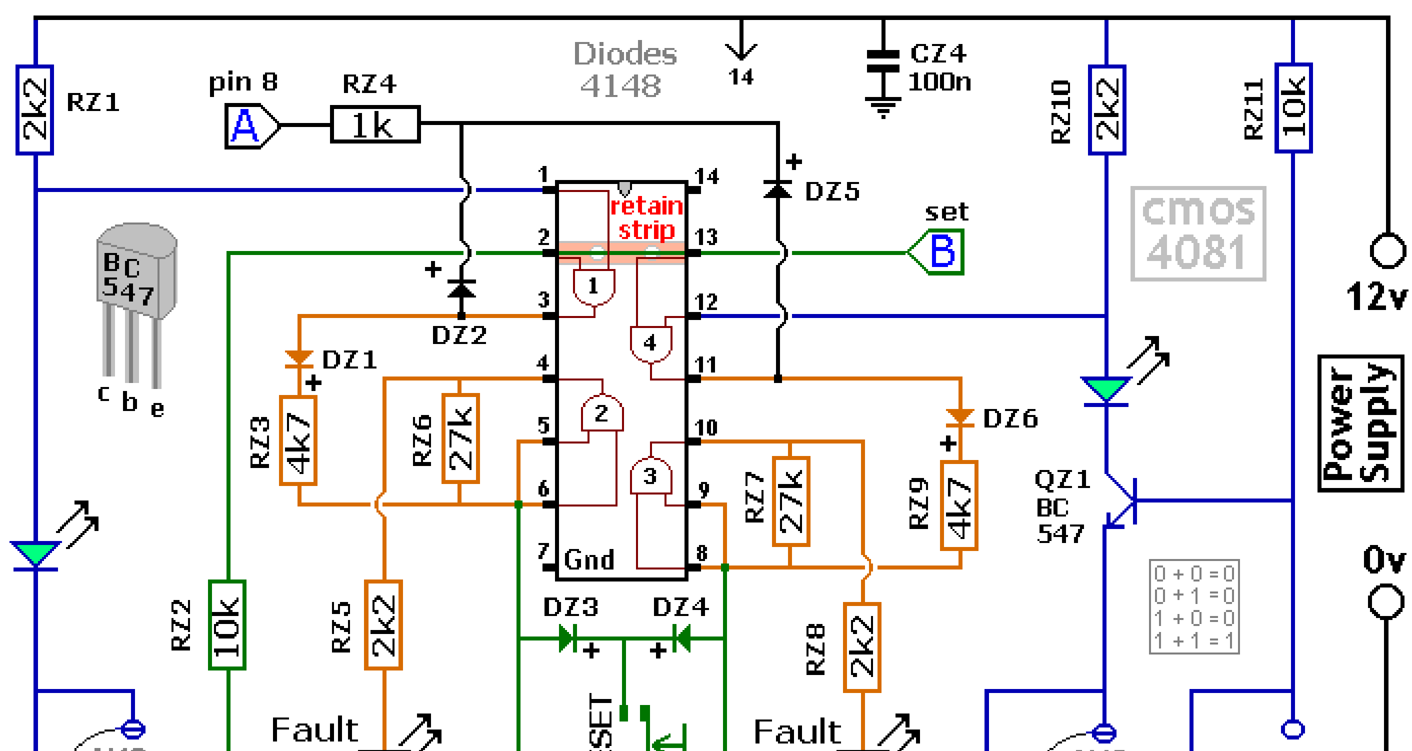


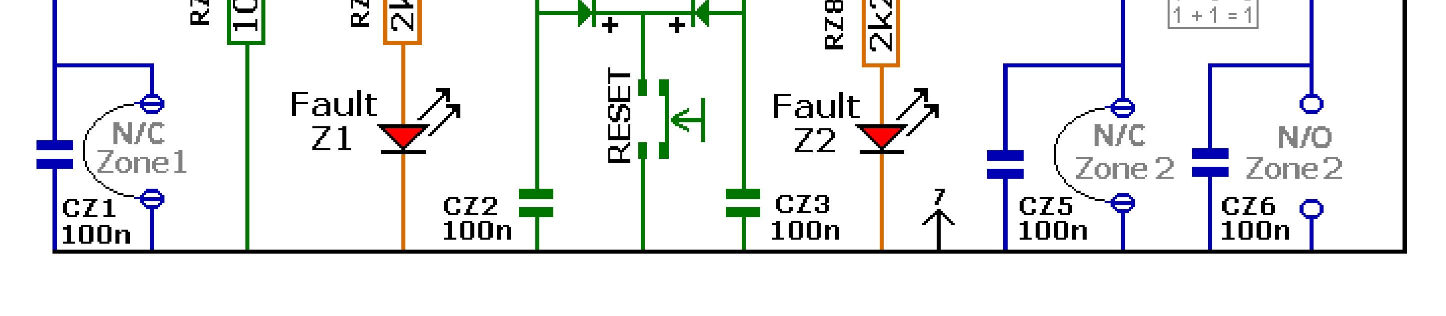
This circuit features automatic Exit and Entry delays and a timed Bell Cut-off. It has provision for both normally-closed and normally-open contacts, and a 24-hour Personal Attack/Tamper zone. It is connected permanently to the 12-volt supply and its operation is "enabled" by opening SW1. By using the expansion modules, you can add as many zones as you require; some or all of which may be the inertia (shock) sensor type. All the green LEDs should be lighting before you open SW1. You then have up to about a minute to leave the building. As you do so, the Buzzer will sound. It should stop sounding when you shut the door behind you. This indicates that the Exit/Entry loop has been successfully restored within the time allowed. When you re-enter the building you have up to about a minute to move SW1 to the off position. If SW1 is not switched off in time, the relay will energise and sound the main bell. It will ring for up to about 40 minutes. But it can be turned off at any time by SW1. The "Instant" zone has no Entry Delay. If you don't want to use N/O switches, leave out R8, C8 and Q2; and fit a link between Led 3 and C7. The 24 Hour PA/Tamper protection is provided by the SCR/Thyristor. If any of the switches in the N/C loop is opened, R11 will trigger the SCR and the bell will ring. In this case the bell has no time limit. Once the loop is closed again, the SCR may be reset by pressing SW2 and temporarily interrupting the current flow. The basic circuit will be satisfactory in many situations. However, it's much easier to find a fault when the alarm is divided into zones and the control panel can remember which zone has caused the activation. The expansion modules are designed to do this. Although they will work with the existing instant zone, they are intended to replace it. When a zone is activated, its red LED will light and remain lit until the reset button is pressed. All the modules can share a single reset button. The Stripboard layout of the prototype is available.

Inertia Sensor Module



Two Zone Module





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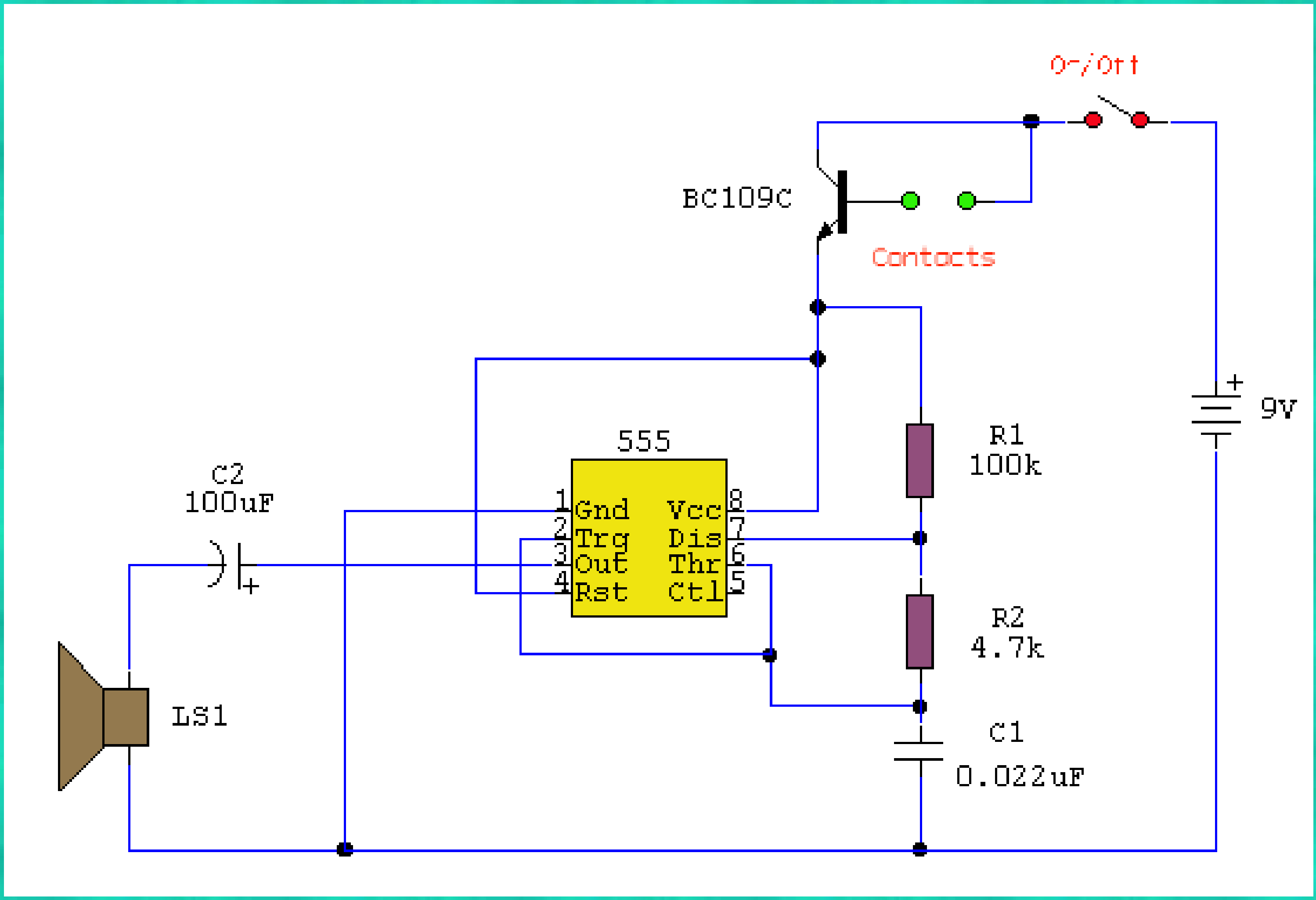
Water Activated Alarm



Submitted by Tom Email: XxTomxx14@aol.com

The circuit uses a 555 timer wired as an astable oscillator and powered by the emitter current of the BC109C. Under dry conditions, the transistor will have no bias current and be fully off. However as the probes get wet the transistor will conduct and sounding the alarm.

An On/Off switch is provided and remember to use a non-reactive metal for the probe contacts. Gold or silver plated contacts from an old relay may be used, however a cheap alternative is to wire alternate copper strips from a piece of veroboard. These will eventually oxidize over but as very little current is flowing in the base circuit, the higher impedance caused by oxidization is not important. No base resistor is necessary as the transistor is in emitter follower, current limit being the impedance at the emitter (the oscillator circuit).

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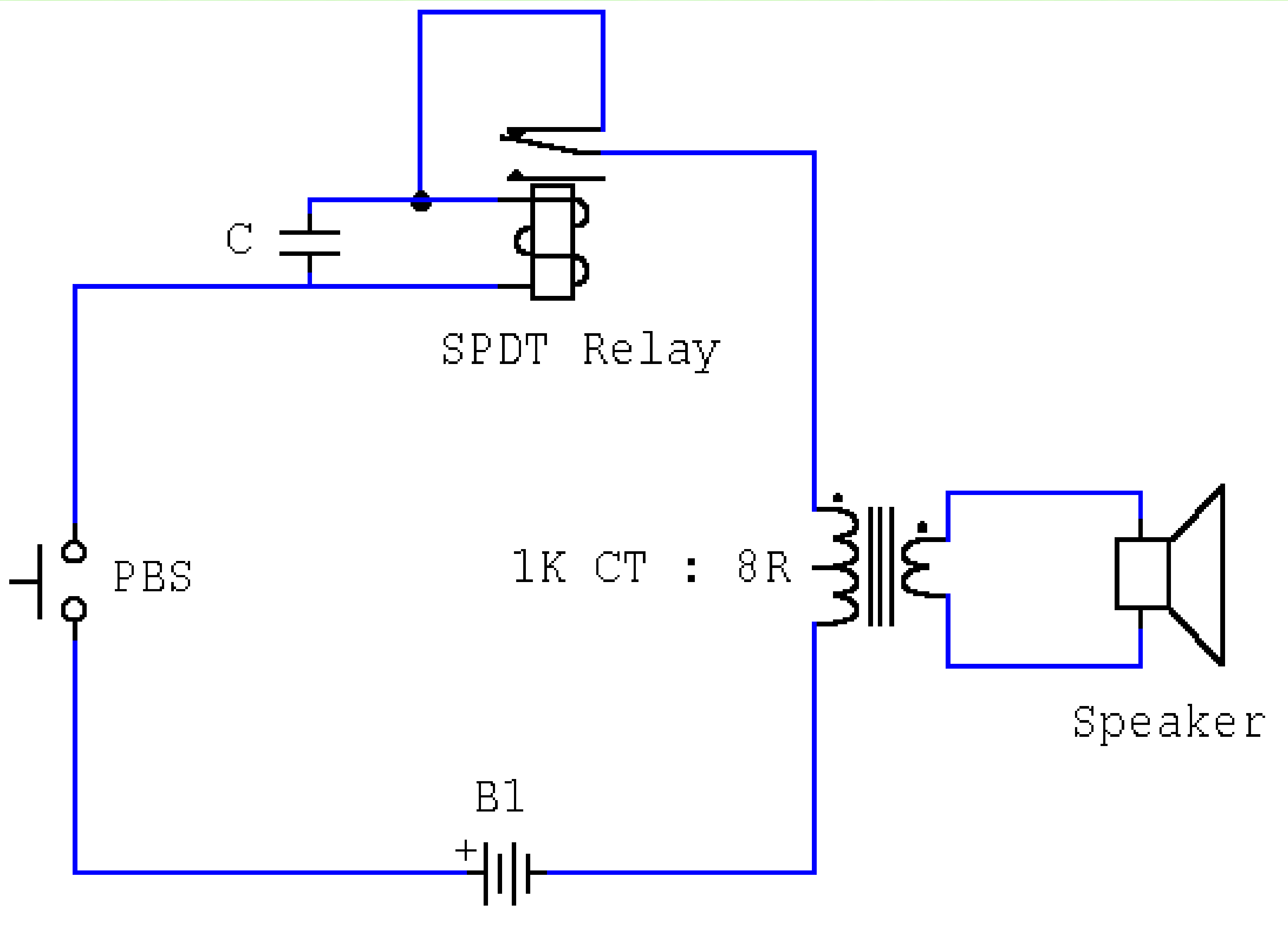
Novel Buzzer



Designed by Tom.

This novel buzzer circuit uses a relay in series with a small audio transformer and speaker. When the switch is pressed, the relay will operate via the transformer primary and closed relay contact. As soon as the relay operates the normally closed contact will open, removing power from the relay, the contacts close and the sequence repeats, all very quickly...so fast that the pulse of current causes fluctuations in the transformer primary, and hence secondary. The speakers tone is thus proportional to relay operating frequency. The capacitor C can be used to "tune" the note. The nominal value is 0.001uF, increasing capacitance lowers the buzzers tone.

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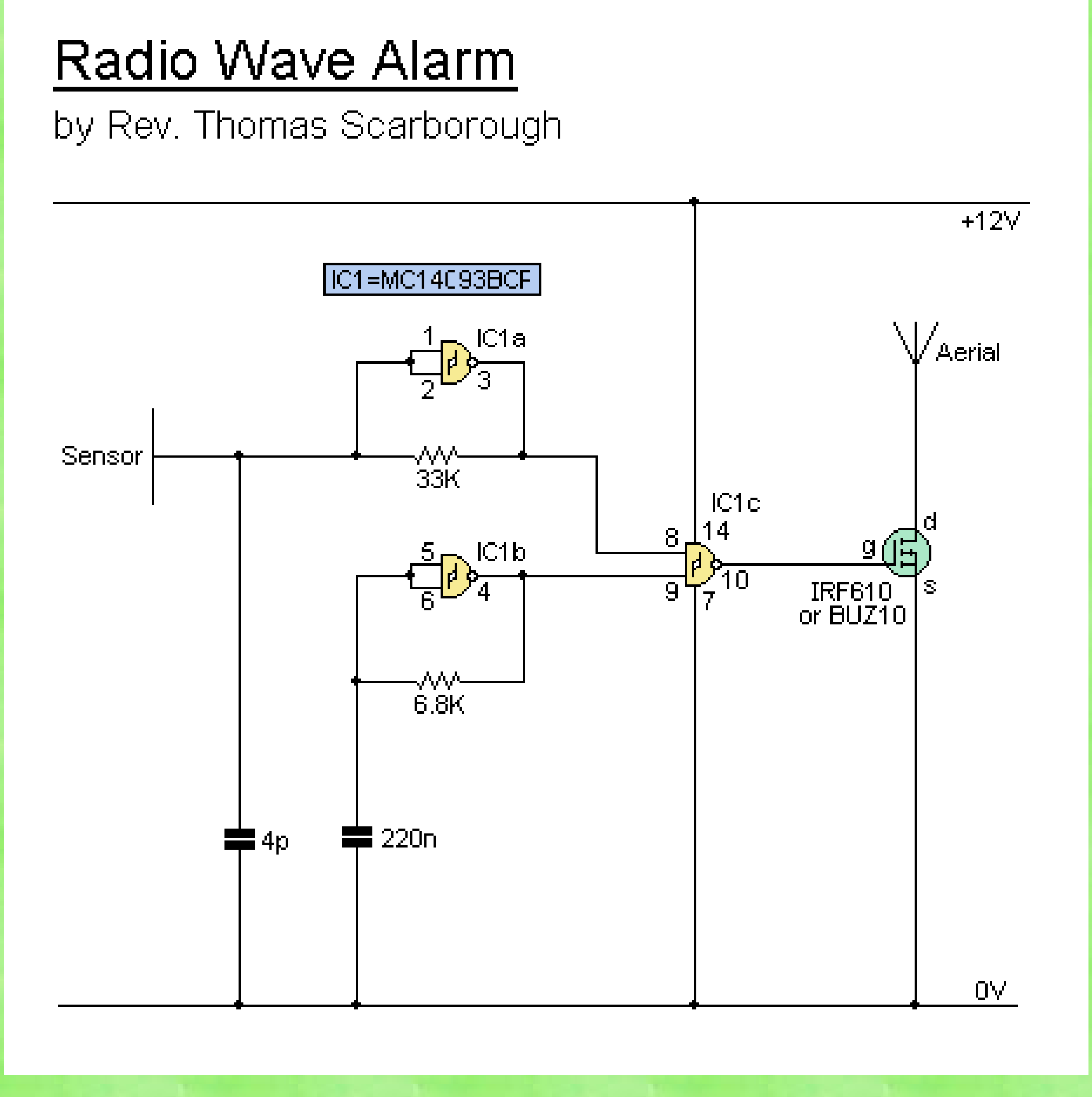
Radio Wave Alarm

by Rev. Thomas Scarborough - scarboro@iafrica.com

This simple circuit is sure to have the police beating a path to your door - however, it has the added advantage of alerting you to their presence even before their footsteps fall on the doormat.



The circuit transmits on Medium Wave (this is the small problem with the police). IC1a, together with a sensor (try a 20cm x 20cm sheet of tin foil) oscillates at just over 1MHz. This is modulated by an audio frequency (a continuous beep) produced by IC1b. When a hand or a foot approaches the sensor, the frequency of the transmitter (IC1a) drops appreciably.

Suppose now that the circuit transmits at 1MHz. Suppose also that your radio is tuned to a frequency just below this. The 1MHz transmission will therefore not be heard by the radio. But bring a hand or a foot near to the sensor, and the transmitter's frequency will drop, and a beep will be heard from the radio.

Attach the antenna to a multiplug adapter that is plugged into the mains, and you will find that the Medium Wave transmission radiates from every wire in your house. Now place a suitably tuned Medium Wave radio near some wires or a plug point in your house, and an early-warning system is set up.

Instead of using the sheet of tin foil as the sensor, you could use a doorknob, or burglar bars. Or you could use a pushbutton and series resistor (wired in series with the 33K resistor - the pushbutton would short it out) to decrease the frequency of IC1a, so activating the system by means of a pushbutton switch. In this case, the radio would be tuned to a frequency just below that of the transmitter.

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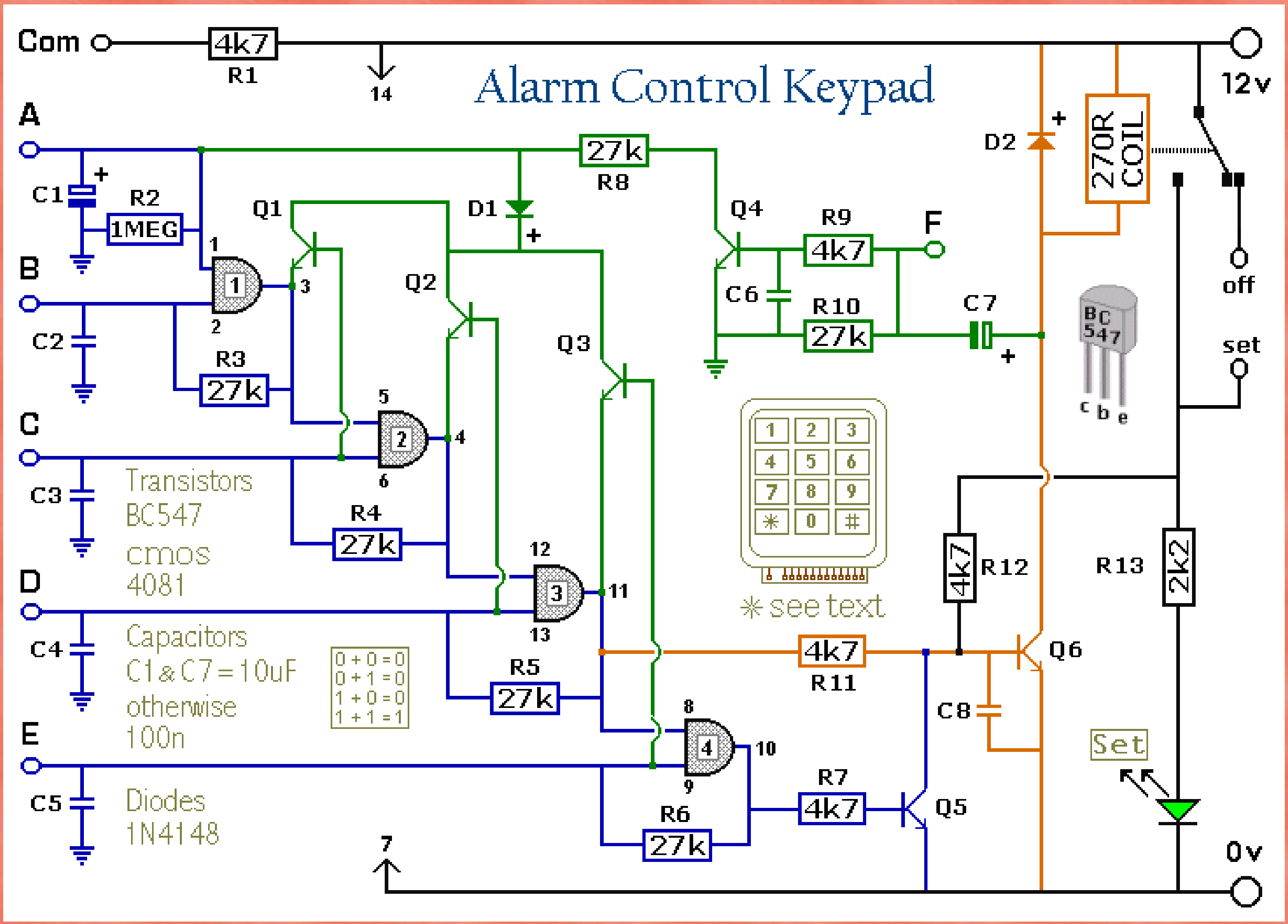
Enhanced 5 Digit Alarm Keypad

Circuit : Ron J
Email:ronj@gofree.indigo.ie

Description:
This is an enhanced 5 digit keypad which may be used with the Modular Alarm System.

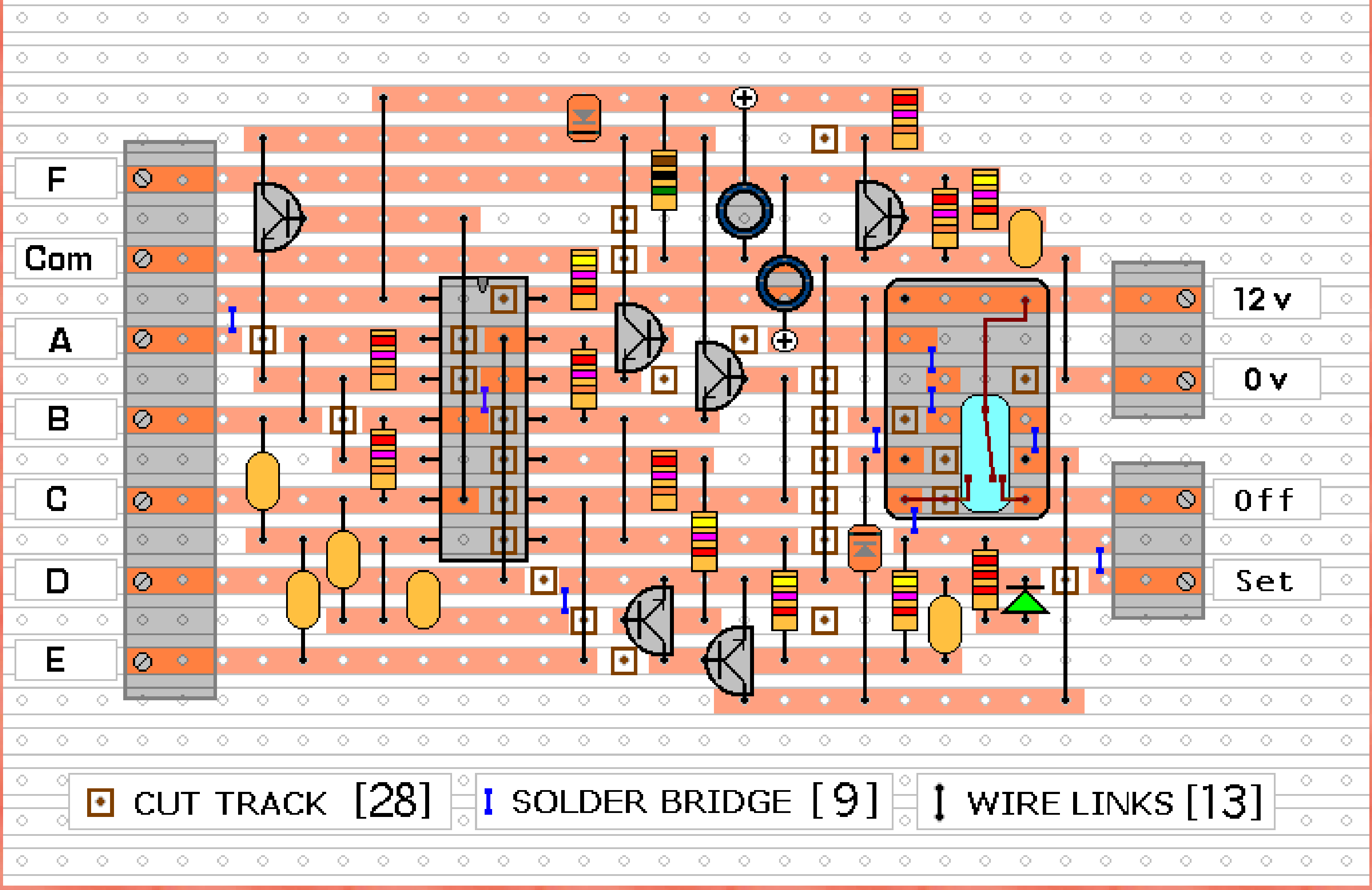


Notes:
This switch will suit the Modular Burglar Alarm circuit. However, it also has other applications. The Keypad must be the kind with a common terminal and a separate connection for each key. On a 12-key pad, look for 13 terminals. The matrix type with 7 terminals will NOT do. Choose the five keys you want as your code, and connect them to 'A, B, C, D & E'. Wire the common to R1 and all the remaining keys to 'F'. Because your choice can include the non-numeric symbols, almost 100 000 different codes are available. The Alarm is set using the first four of your five chosen keys. When 'A, B, C & D' are pressed in

the right order and within the time set by C1 and R2 (about 10 seconds), current through R11 switches Q6 on. The relay energizes, and then holds itself on by providing base current for Q6 through R12. The 12-volt output switches from the "off " to the "set " terminal, and the LED lights. To switch the Alarm off again it is necessary to press A, B, C, D & E in the right order. The IC is a quad 2-input AND gate, a Cmos 4081. These gates only produce a high output when both inputs are high. Pressing 'A' takes pin 1 high for a period of time set by C1 and R2. This 'enables' gate 1, so that when 'B' is pressed, the output at pin 3 will go high. This output does two jobs. It locks itself high using R3 and it enables gate 2 by taking pin 5 high. The remaining gates operate in the same way, each locking itself on through a resistor and enabling its successor. If the correct code is entered within the time allowed, pin 10 will switch Q5 on and so connect the base of Q6 to ground. This causes Q6 to switch off and the relay to drop out. Any keys not wired to 'A, B, C, D or E ' are connected to the base of Q4 by R9. Whenever one of these 'wrong' keys is pressed, Q4 takes pin 1 low. This removes the 'enable' from gate 1, and the code entry process fails. If C, D or E is pressed out of sequence, Q1, Q2 or Q3 will also take pin 1 low, with the same result. You can change the code by altering the keypad connections. If you make a mistake entering the code, just start again. If you need a more secure code you can use a bigger keypad with more 'wrong' keys wired to 'F'. A 16-key pad gives over half a million different codes. All components are shown lying flat on the board; but some are actually mounted upright. The links are bare copper wires on the component side. Two of the links must be fitted before the IC.

Veroboard Layout

ALARM CONTROL KEYPAD

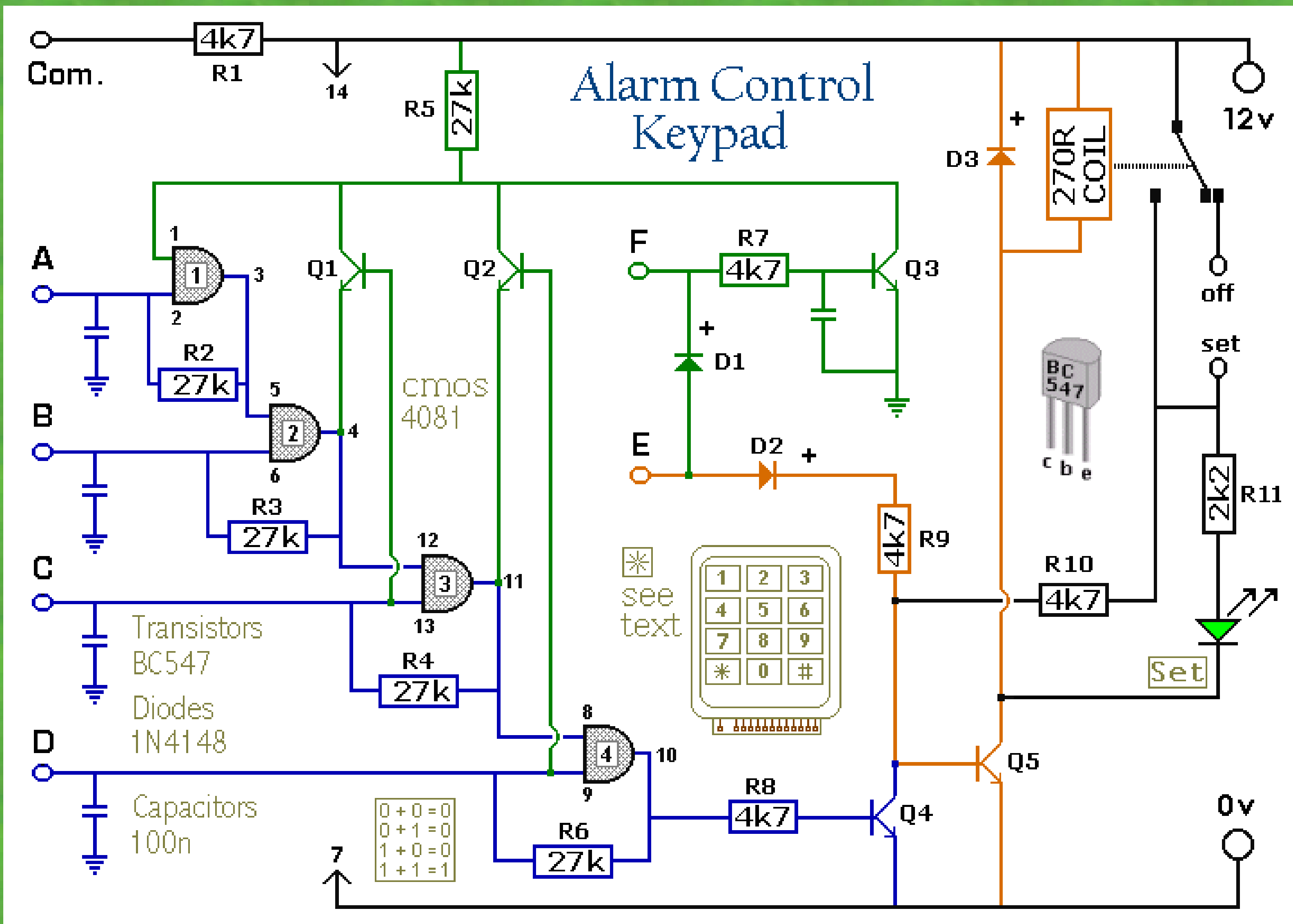


Return to Alarm Circuits

Enhanced 4 Digit Alarm Keypad

Circuit : Ron J
Email:ronj@gofree.indigo.ie

Description:
This is an enhanced 5 digit keypad which may be used with the Modular Alarm System.



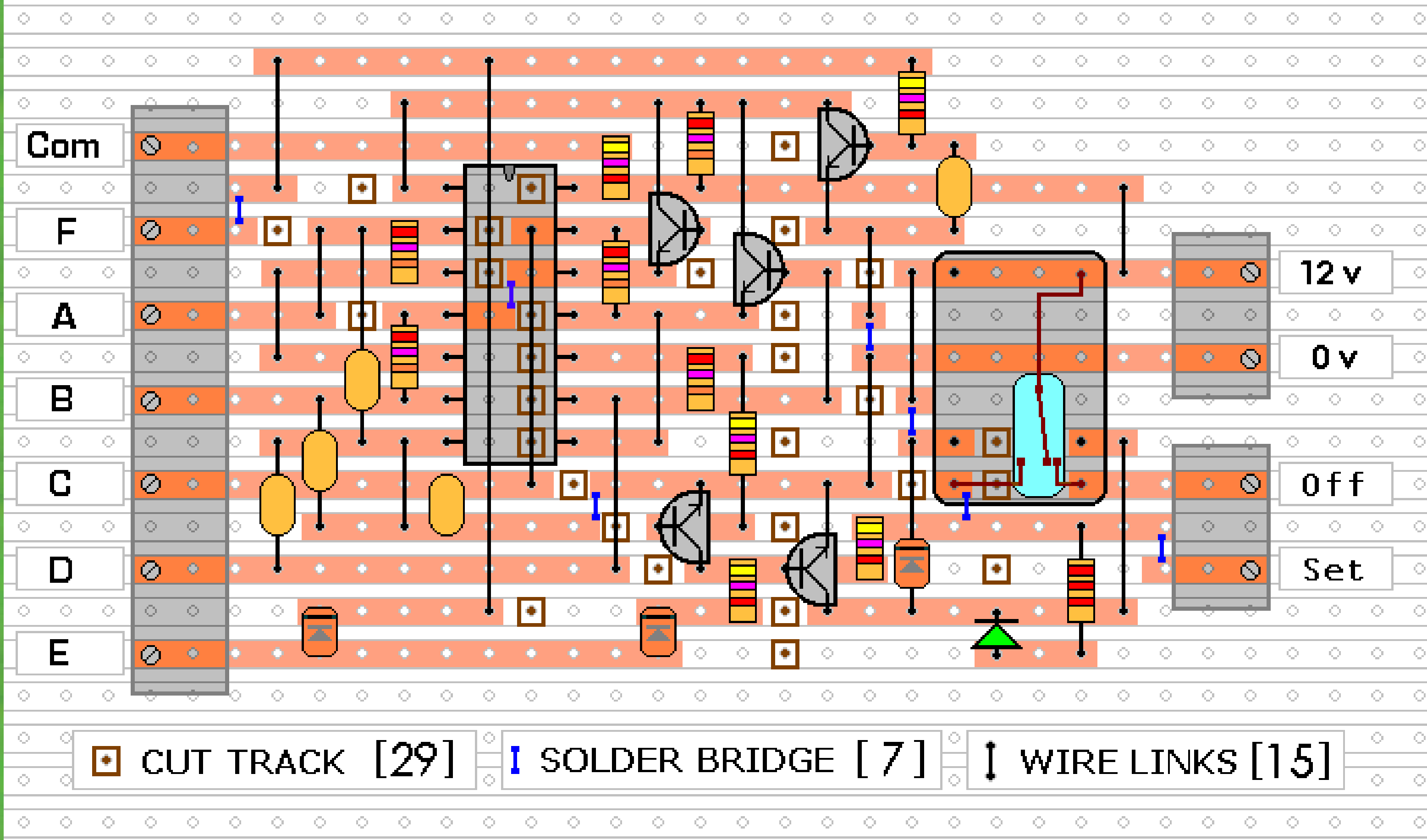
Notes:
The Keypad must be the kind with a common terminal and a separate connection for each key. On a 12-key pad, look for 13 terminals. The matrix type with 7 terminals will NOT do. The Alarm is set by pressing a single key. Choose the key you want to use and wire it to 'E'. Choose the four keys you want to use to switch the alarm off, and connect them to 'A B C & D'. Your code can include the non-numeric symbols. With a 12-key pad, over 10 000 different codes are available. Wire the common to R1 and all the remaining keys to 'F'.

When 'E' is pressed, current through D2 and R9 switches Q5 on. The relay energises, and then holds itself on by providing base current for Q5 through R10. The 12-volt output is switched from the "off " to the "set " terminal, and the LED lights. To switch the Alarm off again it is necessary to press A, B, C & D in the right order. The IC is a quad 2-input AND gate, a Cmos 4081. These gates only produce a high output when both inputs are high. Pin 1 is held high by R5. This 'enables' gate 1, so that when 'A' is pressed, the output at pin 3 will go high. This output does two jobs. It locks itself high using R2 and it enables gate 2 by taking pin 5 high. The remaining gates operate in the same way, each locking itself on through a resistor and enabling its successor. If the correct code is entered, pin 10 will switch Q4 on and so connect the base of Q5 to ground. This causes Q5 to switch off and the relay to drop out. Any keys not wired to 'A B C D or E' are connected to the base of Q3 by R7. Whenever one of these 'wrong' keys is pressed, Q3 takes pin 1 low. This removes the 'enable' from gate 1, and the code entry process fails. If 'C' or 'D' is pressed out of sequence, Q1 or Q2 will also take pin 1 low, with the same result. You can change the code by altering the keypad connections. If you need a more secure code use a bigger keypad with more 'wrong' keys wired to 'F'. A 16-key pad gives over 40 000 different codes. All components are shown lying flat on the board; but some are actually mounted upright. The links are bare copper wires on the component side. Two of the links must be fitted before the IC.

Veroboard Layout

ALARM CONTROL KEYPAD

Component Side



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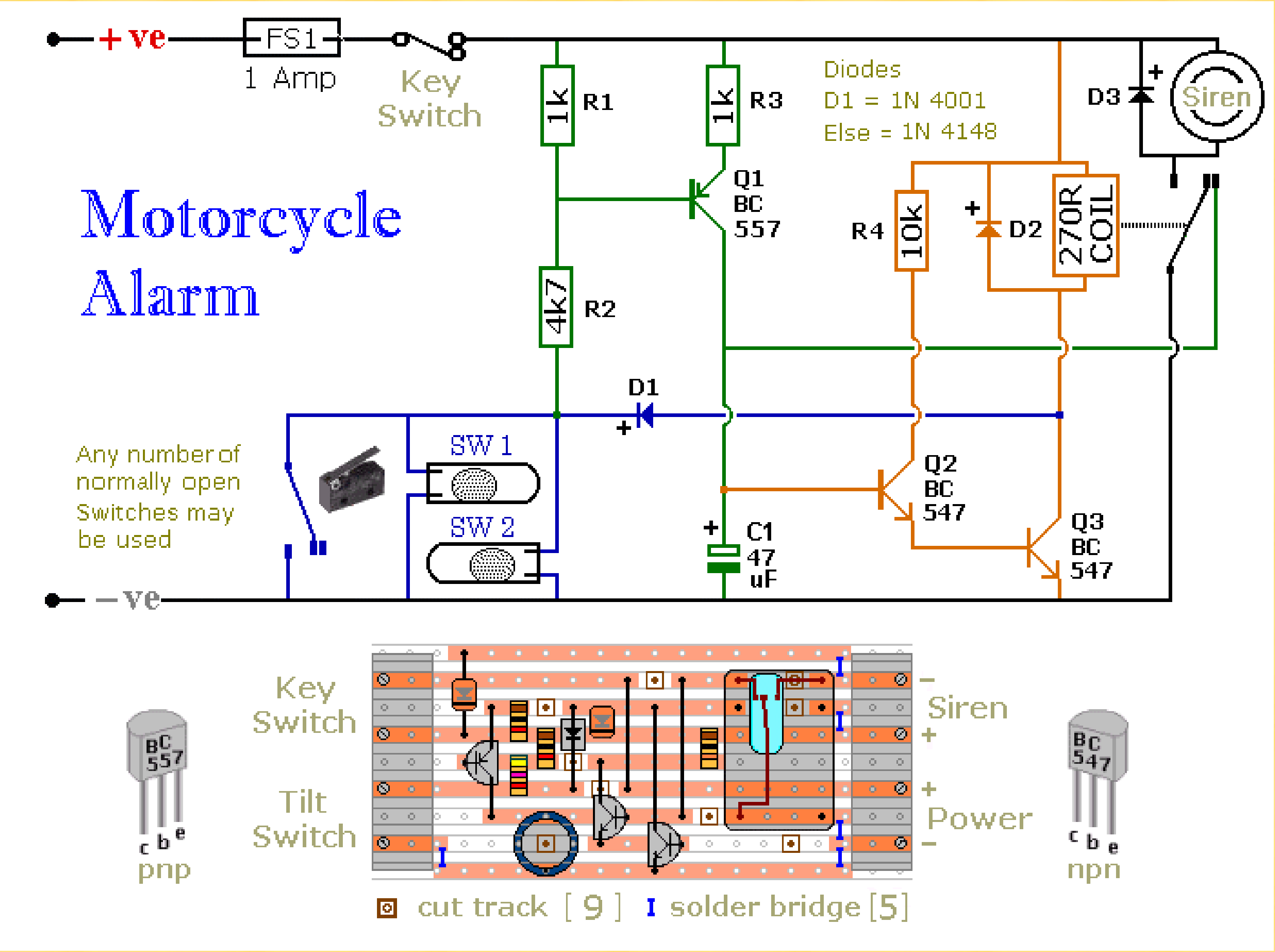
Motorcycle Alarm

Circuit : Ron J
Email: ronj@gofree.indigo.ie



Notes:
Any number of normally open switches may be used. Fit the mercury switches so that they close when the steering is moved or when the bike is lifted off its side-stand or pushed forward off its centre-stand. Use micro-switches to protect removable panels and the lids of panniers etc. While at least one switch remains closed, the siren will sound. About two minutes after the switches have been opened again, the alarm will reset. How long it takes to switch off depends on the characteristics of the actual components used. But, up to a point, you can adjust the time to suit your requirements by changing the value of C1.

The circuit board and switches must be protected from the elements. Dampness or condensation will cause malfunction. Without its terminal blocks, the board is small. Ideally, you should try to find a siren with enough spare space inside to accommodate it. Fit a 1-amp in-line fuse close to the power source. This protects the wiring. Instead of using a key-switch you can use a hidden switch; or you could use the normally closed contacts of a small relay. Wire the relay coil so that it is energized while the ignition is on. Then every time you turn the ignition off, the alarm will set itself.

When it's not sounding, the circuit uses virtually no current. This should make it useful in other circumstances. For example, powered by dry batteries and with the relay and siren voltages to suit, it could be fitted inside a computer or anything else that's in danger of being picked up and carried away. The low standby current and automatic reset means that for this sort of application an external on/off switch may not be necessary.

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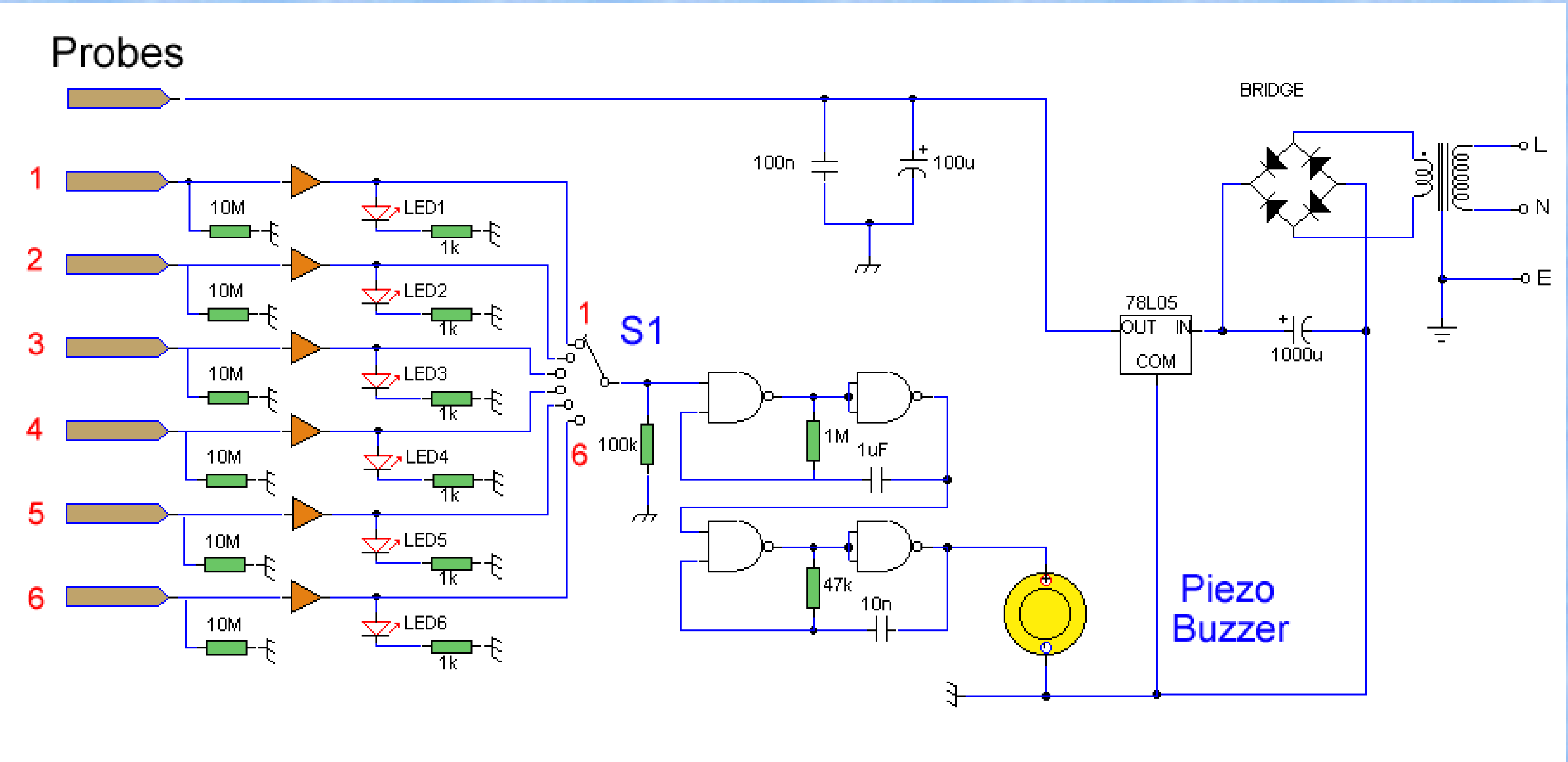
Water Level Alarm

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description:
A circuit that offers visual indication of fluid level in a vessel, with a switchable audible alarm. Example uses would be to monitor the level of water in a bath or cold storage tank.



The conductance of fluids:
Conductance is the reciprocal of resistance. The conductance of fluids vary with temperature, volume and

separation distance of the measurement probes. Tap water has a conductance of about 50 uS / cm measured at 25 ° C. This is 20k/cm at 25 ° C. See this site for more details about the conductance of fluids.

Notes:

This circuit will trigger with any fluid with a resistance under 900K between the maximum separation distance of the probes. Let me explain further. The circuit uses a 4050B CMOS hex buffer working on a 5 volt supply. All gates are biased off by the 10M resistors connected between ground and buffer input. The "common" probe the topmost probe above probe 1 in the diagram above is connected to the positive 5 volt supply. If probe 1 is spaced 1 cm away from the common probe and tap water at 25 ° C is detected between the probes (a resistance of 20k) then the top gate is activated and the LED 1 will light. Similarly if probe 2 at 2 cm distance from the common probe detects water, LED 2 will light and so on. Switch 1 is used to select which output from the hex buffer will trigger the audible oscillator made from the gates of a CMOS 4011B IC.

Placement of Probes:

As 7 wires are needed for the probe I reccommend the use of 8 way computer ribbon cable. The first two wires may be doubled and act as the common probe wire. Each subsequent wire may be cut to required length, if required a couple of millimetres of insulation may be stripped back, though the open "cut off" wire end should be sufficient to act as the probe. The fluid and distance between probe 6 and the common probe wire must be less than 900k. This is because any voltage below 0.5 Volt is detected by the CMOS IC as logic 0. A quick potential check using a 900k resistance and the divider formed with the 10M resistor at the input proves this point:

$$5 \times (0.9 / (0.9+10) = 0.41 \text{ Volt.}$$

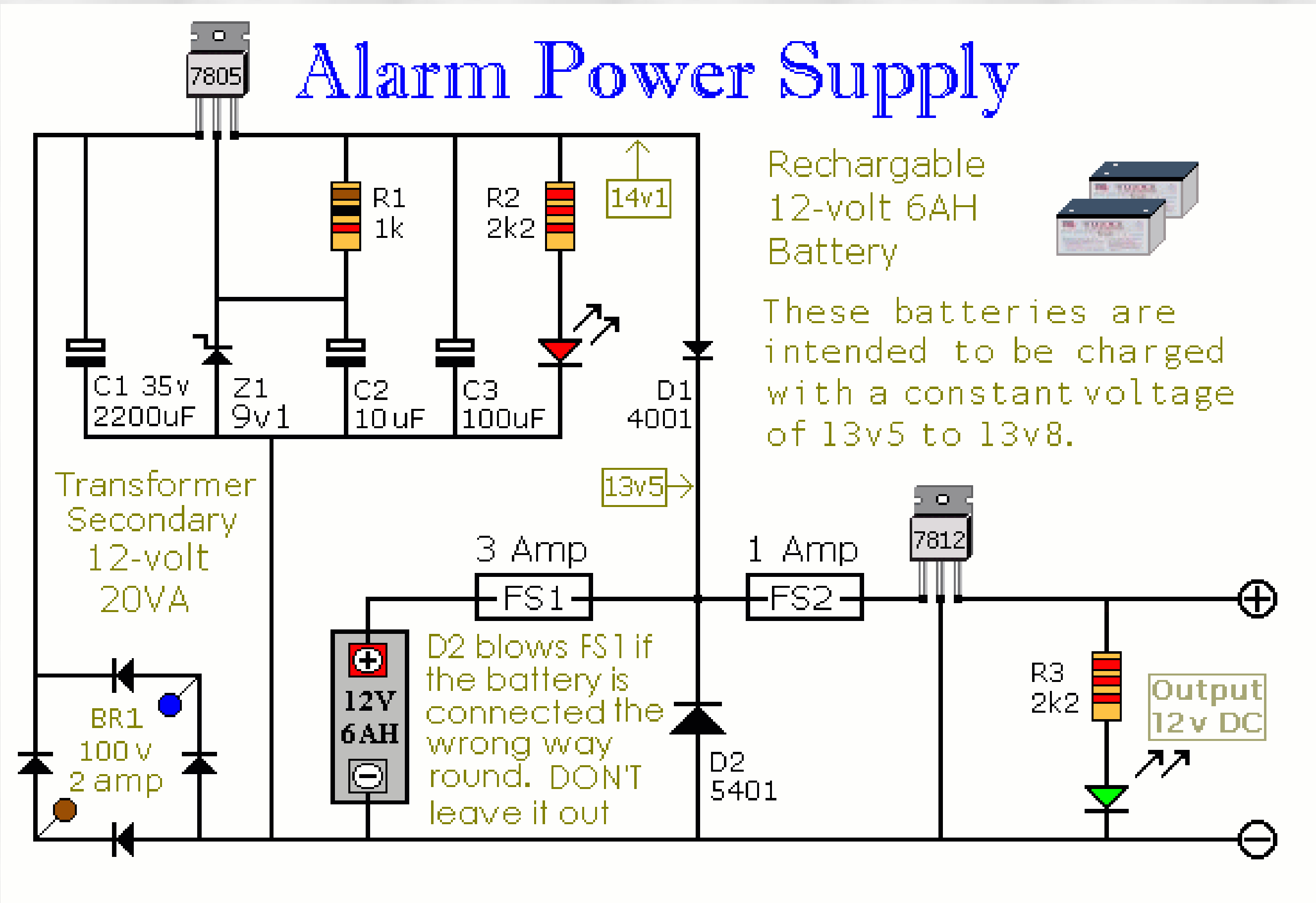
As this voltage is below 0.5 volt it is interpreted as a logic 0 and the LED will light. If measuring tap water at 25 ° C then the distance between top probe and common may be up to 45 cm apart. For other temperatures and fluids, it is advisable to use an ohmmeter first. When placing the probes the common probe must be the lowest placed probe, as the water level rises, it will first pass probe 1, then 2 and finally probe 6.

Return to Alarm Circuits

Alarm Power Supply

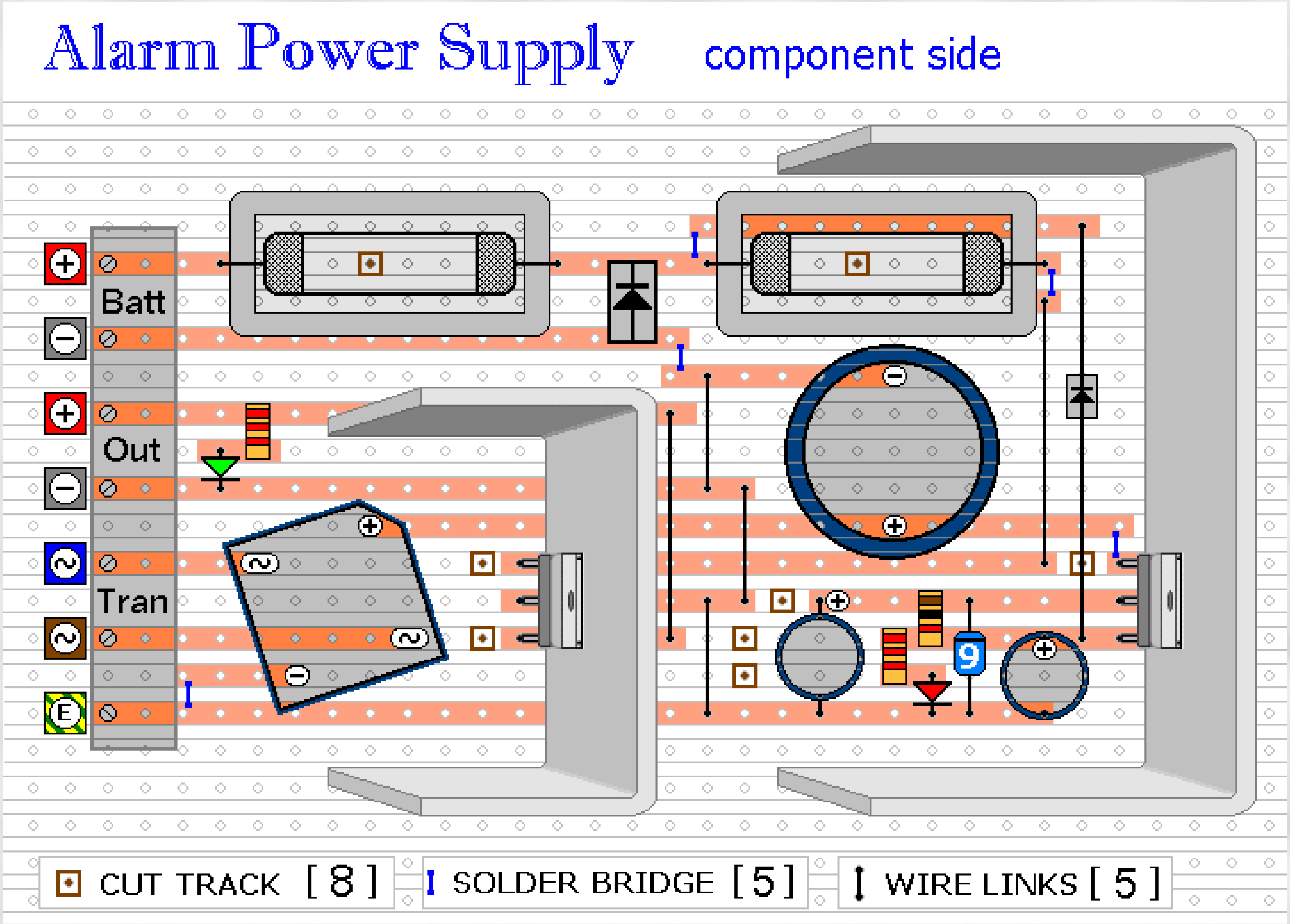
Circuit :Ron J
Email: anc@mitedu.freeserve.co.uk

Description:
A 12 Volt power suppiled designed for Ron's Modular Burglar Alarm. However, being a popular supply voltage this circuit will have many other uses as well.



Notes:
This Power Supply is suitable for the Modular Burglar Alarm. However, it has other applications. It is designed to provide an output of 12-volts, with a current of up to 1-amp. In the event of mains failure, the back-up battery takes over automatically. When the mains is restored, the battery recharges. Use a genuine alarm type back-up battery. They are maintenance-free, and their terminals can be held at 13v8 for many years, with no ill effects. A smaller or larger capacity battery may be used, without circuit modification. Use the 2-amp version of the 7805. It needs the larger heatsink because it has to dissipate a lot of energy, especially when called upon to recharge a flat battery. This heatsink is at 9v1, and must NOT be connected to ground. The 7812 never has to dissipate more than 2-watts, so its heatsink can be smaller.Many of the components, which are shown lying flat

on the board, are actually mounted upright. The links are bare copper wire on the component side. The heatsinks are folded strips of aluminium, about 2mm thick. Use a well-insulated panel mounted fuse holder for the mains supply to the transformer, and fit it with a 1-amp fuse.



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Power Circuits

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5. Fuse Blown Indicator
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7. Dual Regulated Power Supply
8. Boosting Regulator Current
9. Logic PSU with Over Voltage Protection
10. Nicad Battery Charger
11. PIC Nicad Battery Charger External link to Peter Hayles Site
12. Variable Power Supply
13. Transformerless Power Supply by Ron J
14. Universal DC-DC Convertor
15. Variable Regulator Output by Ron J
16. LM317 Regulator Circuit by Matthew Hewson

17. Basic UPS

18. Over Voltage Protection for LM317

19. Alarm PSU by Ron J

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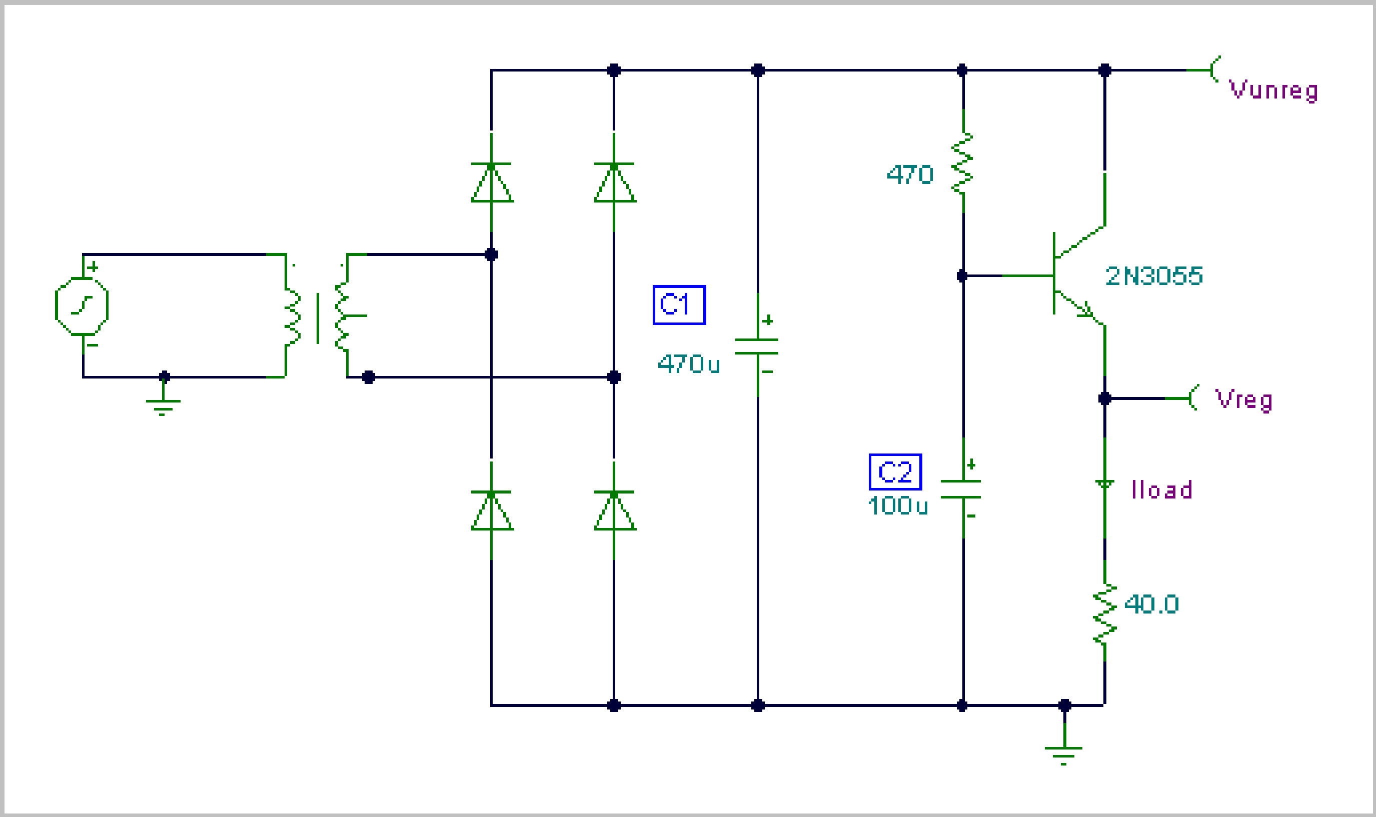
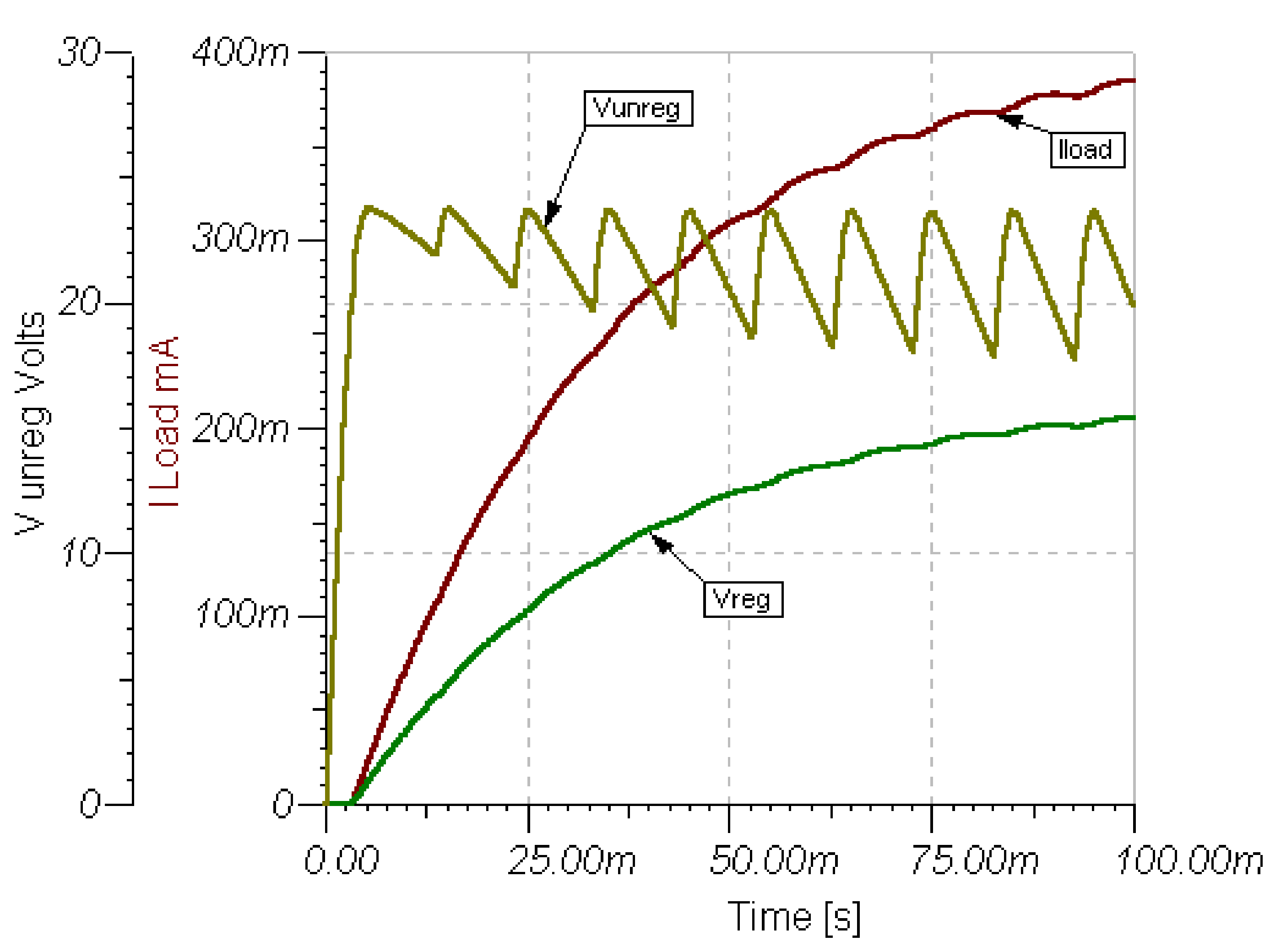
Rectification using a Gyrator Circuit



Notes:
To avoid excess ripple output on a power supply feeding a heavy load, usually a large value capacitor is
chosen following the rectifier. In this circuit, C1 is only a 470uF capacitor. The gyrator principle uses the
effect that the value of input capacitance at the base of a transitor is effectively multiplied by the current
gain of the transistor. Here C2 which is 100u appears at the ouput (Vreg) to be 100 x current gain of
the 2N3055 power transistor. If you assume a dc current gain of 50, then the smoothing across the
supply, would be as though you had chosen a 5000uF capacitor. The graph below shows the output
voltage and current through the load :-



The load draws nearly 400mA. With the output directly from the rectifier there is about 5v pk-pk ripple
in the output.   Using the output at the emitter of the transistor things are much better. The circuit will
take a few hundred milliseconds for the output voltage to stabilize and reach maximum value. The
advantages are that a smaller, less costly reservoir capacitor can be used with this circuit to give a
high quality smoothed supply.

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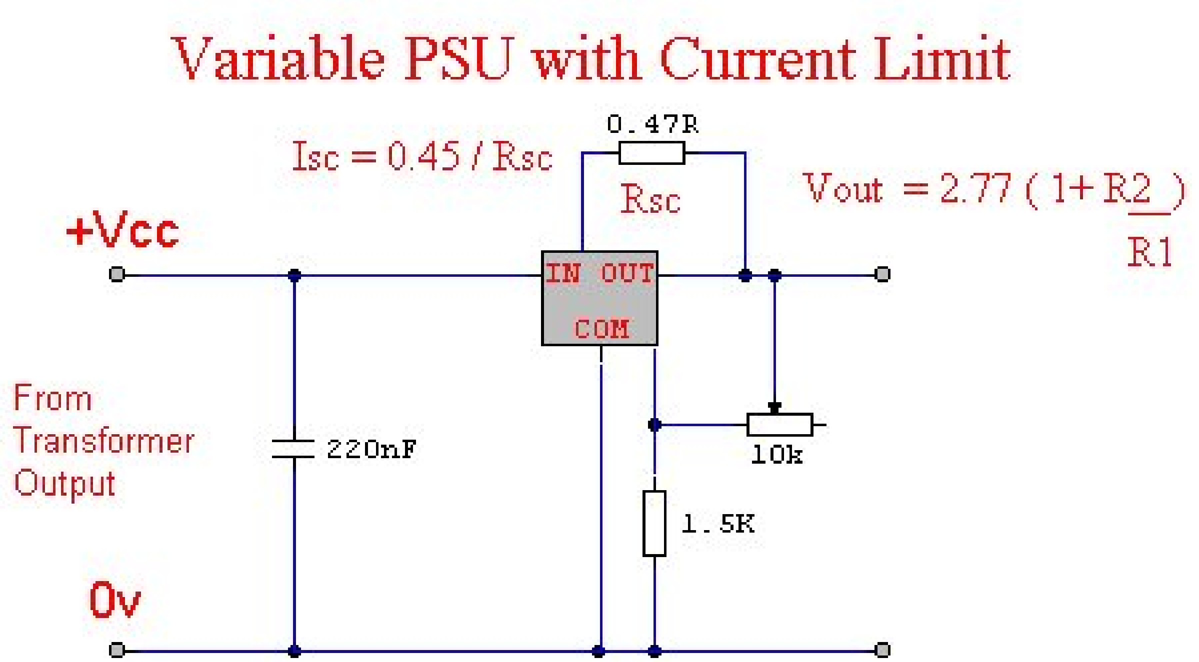
L200 Regulator Circuit



Notes:

It is very easy to build a power supply with one single IC, the L200. In addition, the L200 offers a variable
current limit of up to 2amp, as well as voltage regulation. In the above diagram the output voltage can
be calculated where R1 is the 1.5k resistor, and R2 the variable 10k resistor. To make a variable curent
limit , you need to alter the value of the 0.47 ohm resistor.

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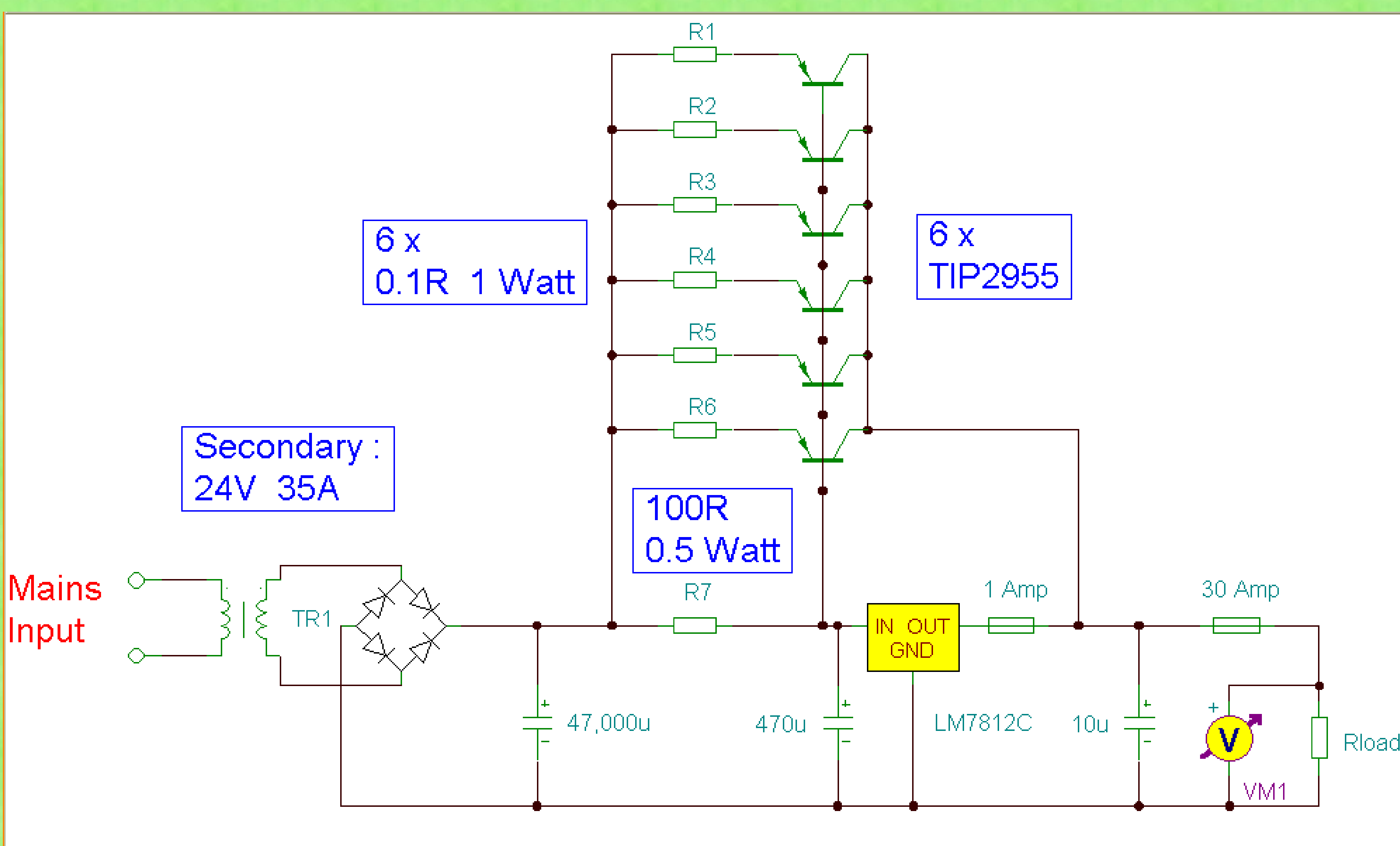
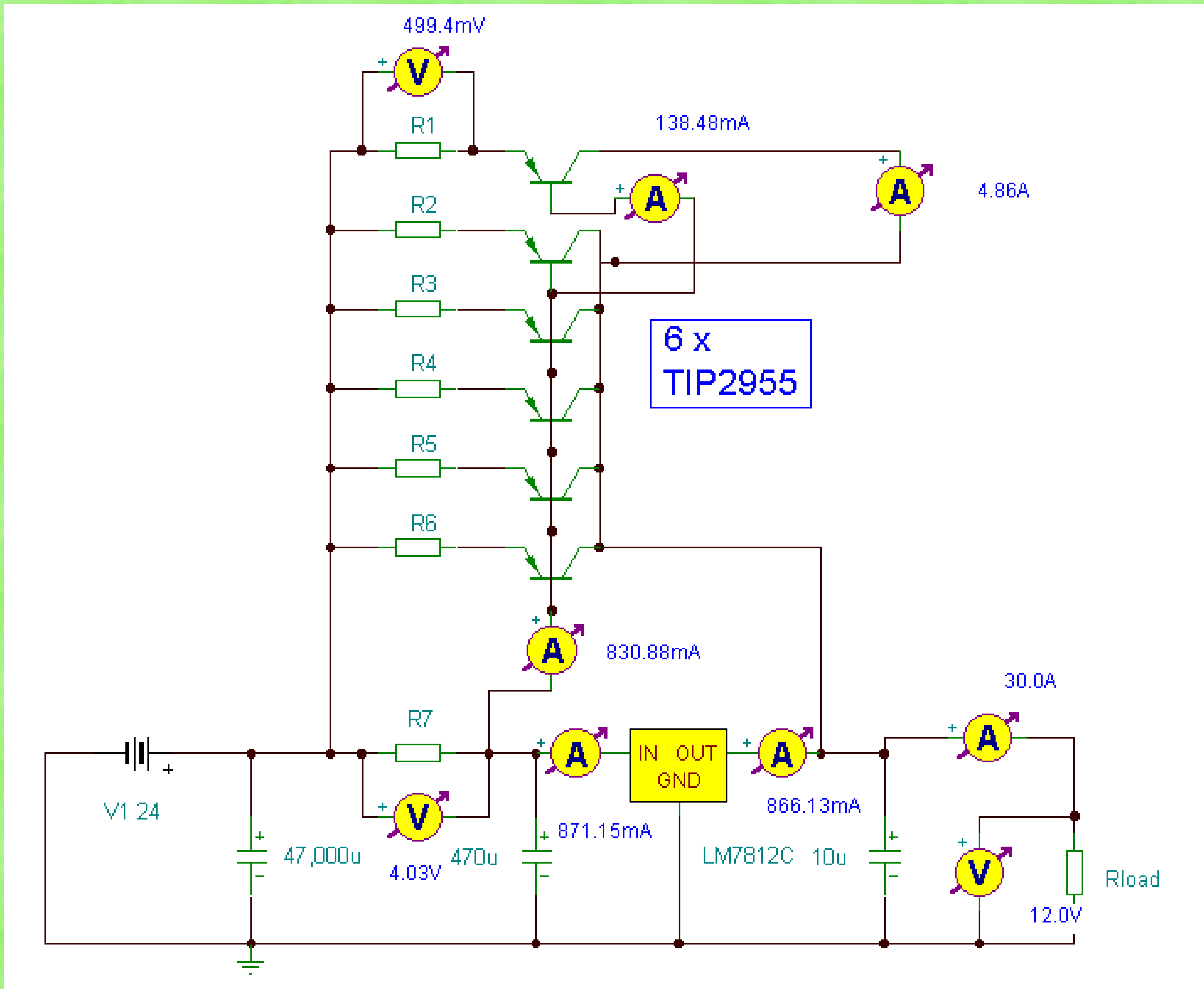
12 Volt 30 Amp PSU

Using a single 7812 IC voltage regulator and multiple outboard pass transistors, this power supply can deliver output load currents of up to 30 amps. The design is shown below:



Notes:

The input transformer is likely to be the most expensive part of the entire project. As an alternative, a couple of 12 Volt car batteries could be used. The input voltage to the regulator must be at least several volts higher than the output voltage (12V) so that the regulator can maintain its output. If a transformer is used, then the rectifier diodes must be capable of passing a very high peak forward current, typically 100amps or more. The 7812 IC will only pass 1 amp or less of the output current, the remainder being supplied by the outboard pass transistors. As the circuit is designed to handle loads of up to 30 amps, then six TIP2955 are wired in parallel to meet this demand. The dissipation in each power transistor is one sixth of the total load, but adequate heat sinking is still required. Maximum load current will generate maximum dissipation, so a very large heat sink is required. In considering a heat sink, it may be a good idea to look for either a fan or water cooled heat sink. In the event that the power transistors should fail, then the regulator would have to supply full load current and would fail with catastrophic results. A 1 amp fuse in the regulators output prevents a safeguard. The 400mohm load is for test purposes only and should not be included in the final circuit. A simulated performance is shown below:



Calculations:

This circuit is a fine example of Kirchoff's current and voltage laws. To summarise, the sum of the currents entering a junction, must equal the current leaving the junction, and the voltages around a loop must equal zero. For example, in the diagram above, the input voltage is 24 volts. 4 volts is dropped across R7 and 20 volts across the regulator input, 24 -4 -20 =0. At the output :- the total load current is 30 amps, the regulator supplies 0.866 A and the 6 transistors 4.855 Amp each , 30 = 6 * 4.855 + 0.866. Each power transistor contributes around 4.86 A to the load. The base current is about 138 mA per transistor. A DC current gain of 35 at a collector current of 6 amp is required. This is well within the limits of the TIP2955. Resistors R1 to R6 are included for stability and prevent current swamping as the manufacturing tolerances of dc current gain will be different for each transistor. Resistor R7 is 100 ohms and develops 4 Volts with maximun load. Power dissipation is hence (4^2)/200 or about 160 mW. I recommend using a 0.5 Watt resistor for R7. The input current to the regulator is fed via the emitter resistor and base emitter junctions of the power transistors. Once again using Kirchoff's current laws, the 871 mA regulator input current is derived from the base chain and the 40.3 mA flowing through the 100 Ohm resistor. 871.18 = 40.3 + 830. 88. The current from the regulator itself cannot be greater than the input current. As can be seen the regulator only draws about 5 mA and should run cold.

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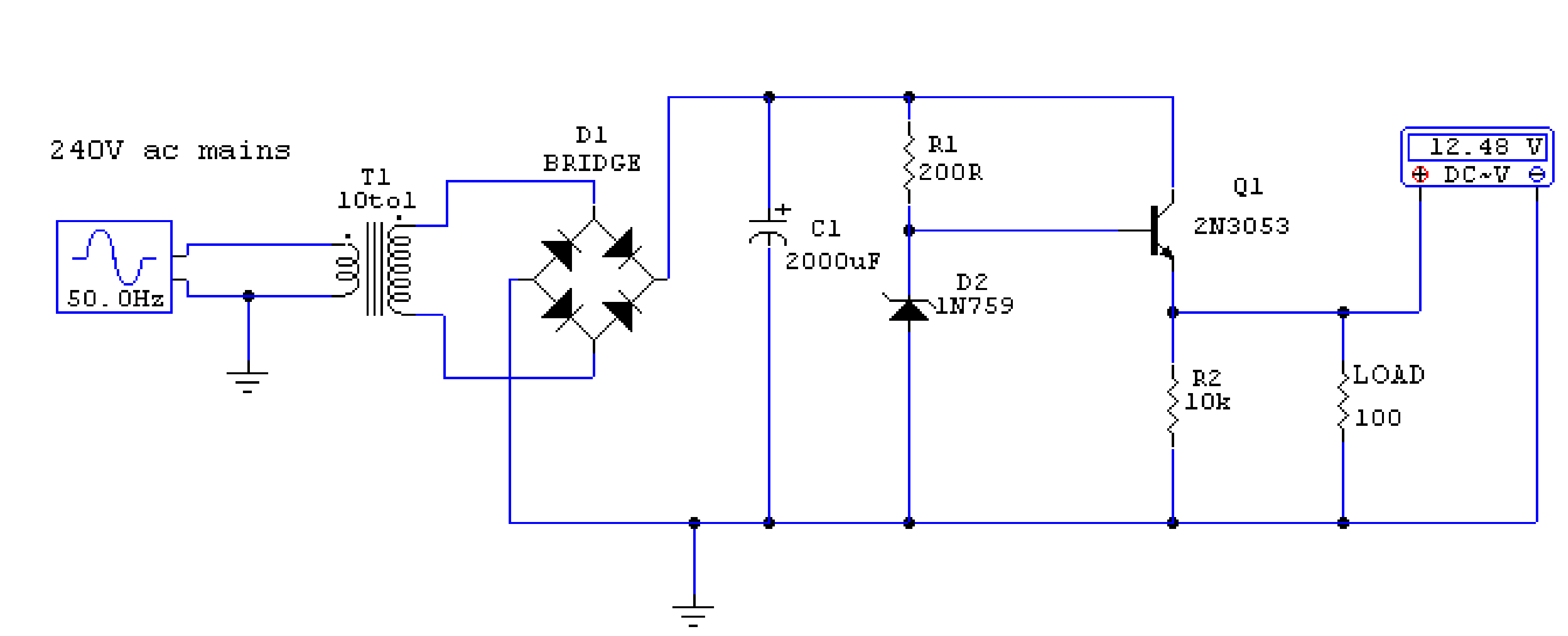
Regulated 12 Volt Supply

Circuit : Mick Devine
Email: mick_devine@yahoo.com

Description
A basic regulated 12 Volt power supply



Notes:
This circuit above uses a 13 volt zener diode, D2 which provides the voltage regulation. Aprroximately 0.7 Volts are dropped across the transistors b-e junction, leaving a higher current 12.3 Volt output supply. This circuit can supply loads of up to 500 mA. This circuit is also known as an amplified zener circuit.

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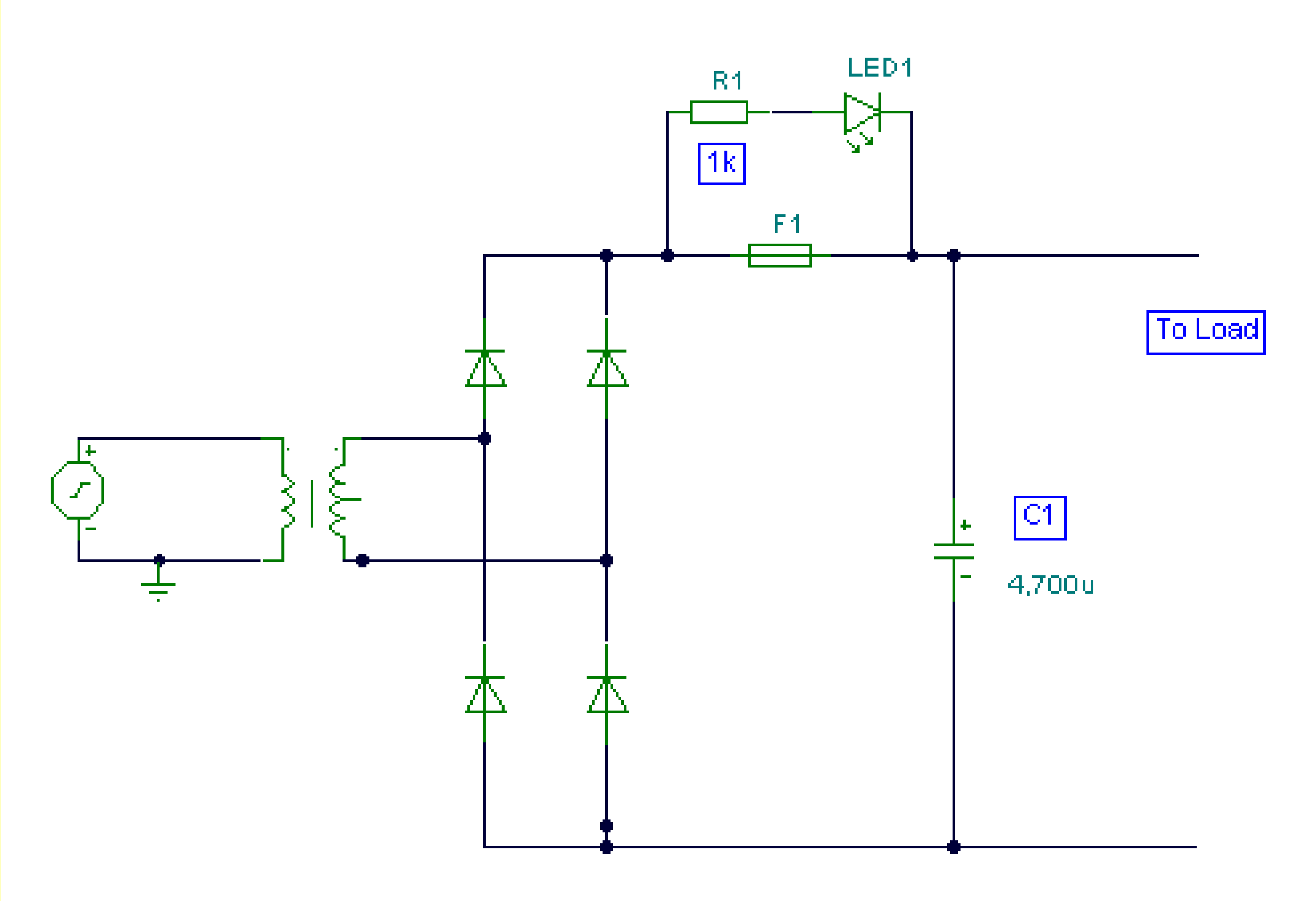
Fuse Monitor / Alarm

It came to me in a flash. A simple way to see if a fuse has blown without removing it from its holder.
Its not often you can design a circuit using just two components, but with just one resistor and an
LED this circuit provides visual indication of when a fuse has blown.



LED 1 is normally not lit, being "short - circuited " by the fuse, F1. Should the inevitable "big-bang"
happen in your workshop then LED1 will illuminate and led you know all about it! Note that the
LED will only light under fault conditions, i.e. a short circuit or shunt on the load. In this case the
supply current is reduced to a safe level by R1.

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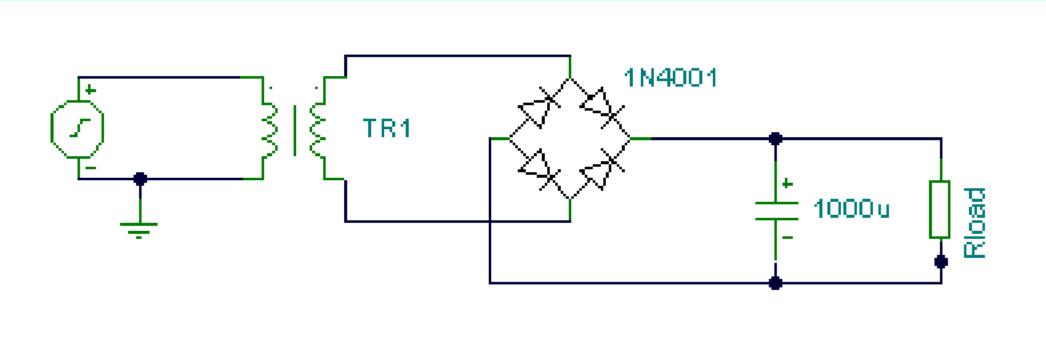
Unregulated Power Supply

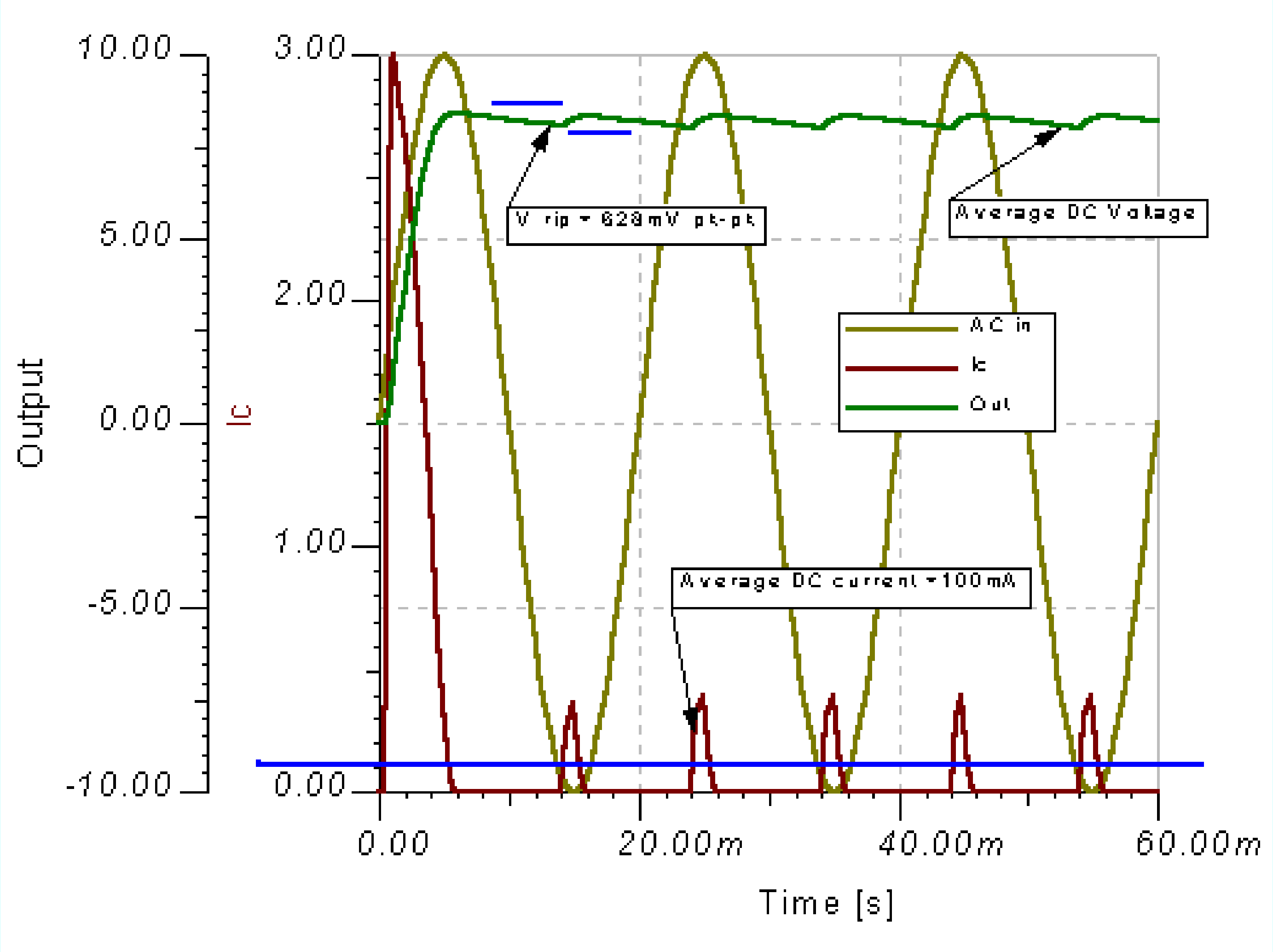
A basic full wave rectified power supply is shown below. The transformer is chosen according to the desired load. For example, if the load requires 12V at 1amp current, then a 12V, 1 amp rated transformer would do. However, when designing power supplies or most electronic circuits, you should always plan for a worst case scenario. With this in mind, for a load current of 1 amp a wise choice would be a transformer with a secondary current rating of 1.5 amp or even 2 amps. Allowing for a load of 50% higher than the needed value is a good rule of thumb. The primary winding is always matched to the value of the local electricity supply.



Notes:
An approximate formula for determining the amount of ripple on an unregulated supply is:

$$Vrip = Iload * 0.007 / C$$

where I load is the DC current measured through the load in amps and C is the value of the capacitor in uF.The diagram below shows an example with a load current of 0.1 amp and a smoothing capacitor value of 1000uF.



The calculated value of ripple is (0.1 * 0.007) / 1000e-6 = 0.7 volts or 700mV. The value of peak-peak ripple measured from the graph is 628mV. Therefor, the equation is a good rule of thumb guide for choosing the correct value for a smoothing capacitor in a power supply.

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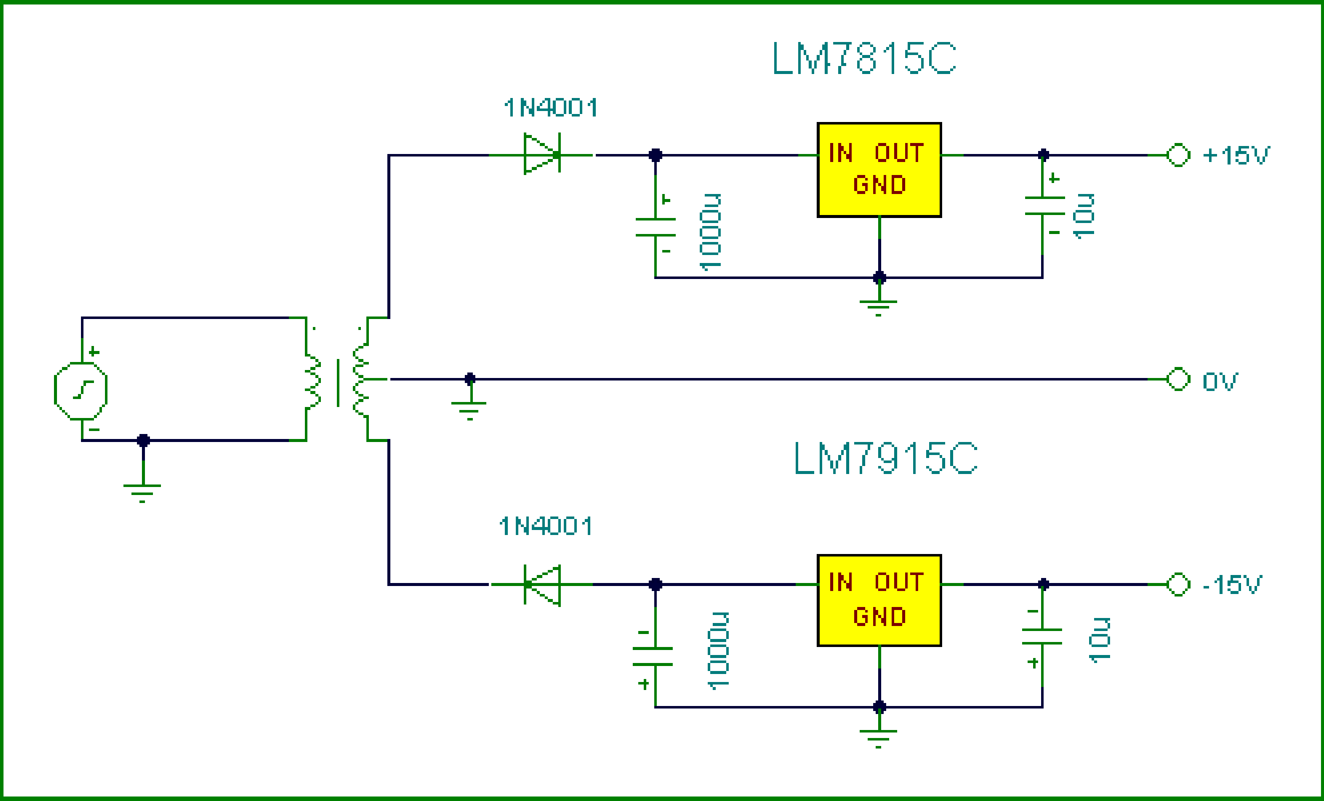
Dual Regulated Power Supply



Notes:
In this circuit, the 7815 regulatates the positive supply, and the 7915 regulates the negative supply. The transformer should have a primary rating of 240/220 volts for europe, or 120 volts for North America. The centre tapped secondary coil should be rated about 18 volts at 1 amp or higher, allowing for losses in the regulator. An application for this type of circuit would be for a small regulated bench power supply.

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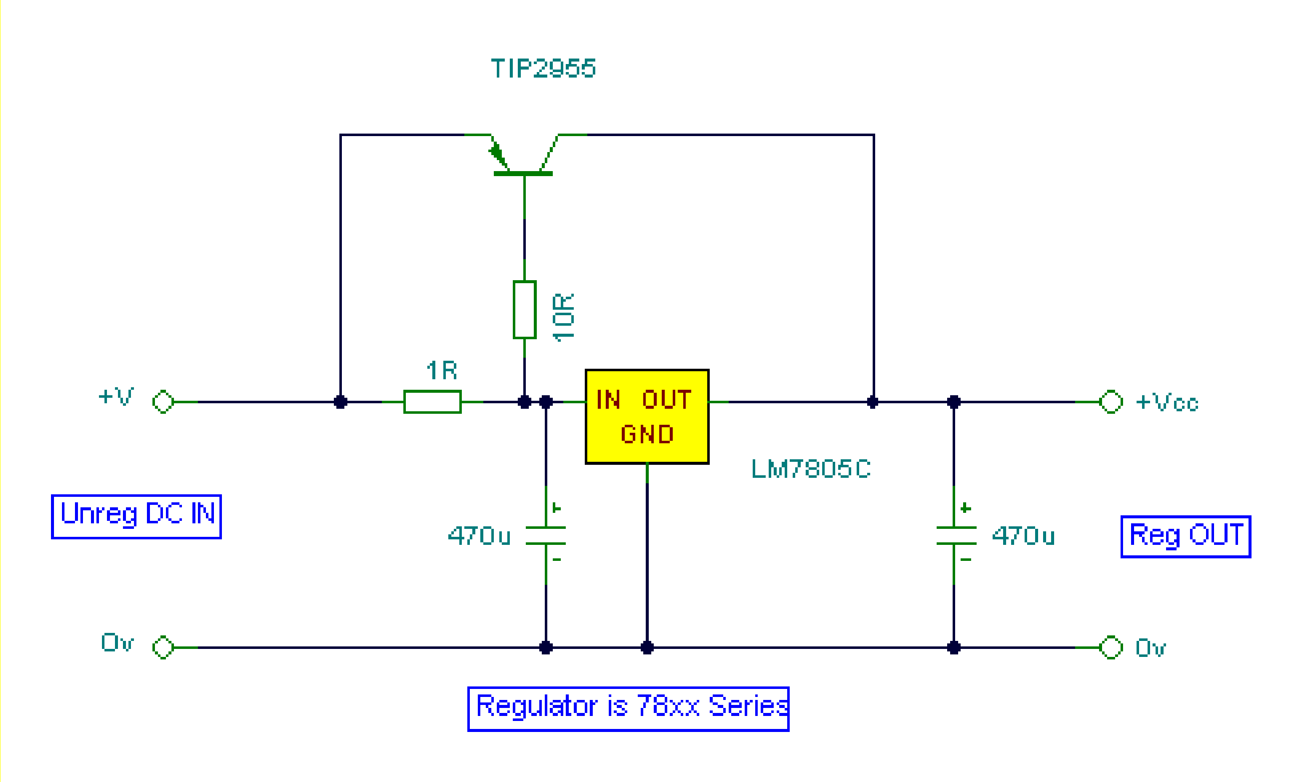
Increasing Regulator Current



Notes:
Although the 78xx series of voltage regulators are available with different current outputs, you can boost
the available current output with this circuit. A power transistor is used to supply extra current to the load
the regulator, maintaining a constant voltage. Currents up to 650mA will flow through the regulator, above
this value and the power transistor will start to conduct, supplying the extra current to the load. This should
be on an adequate heat sink as it is likely to get rather hot. Suppose you use a 12v regulator, 7812. The
input voltage should be a few volts higher to allow for voltage drops. Assume 20 volts. Lets also assume
that the load will draw 5amps. The power dissipation in the transistor will be Vce * Ic or (20-12)*8=40watt.
It may keep you warm in the Winter, but you will need a large heatsink with good thermal dissipation.

If you want to increase the output current with a negative regulator, such as the 79xx series, then the circuit
is similar, but an NPN type power transistor is used instead.

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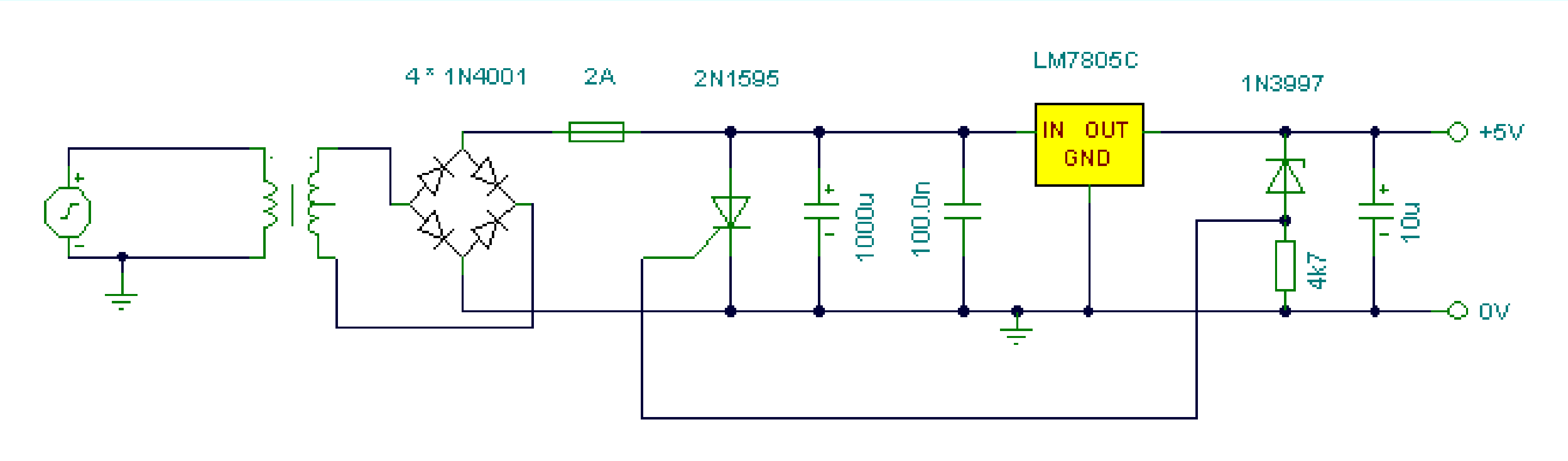
Logic PSU with Over Voltage Protection

The 5 volt regulated power supply for TTL and 74LS series integrated circuits, has to be very tolerant. These IC's are easily damaged from over voltage. A fuse will only blow when its current rating is exceeded, but with this circuit the fuse will blow when the voltage exceeds a set amount.

Fast Protection

An ordinary so called "quick blow" fuse takes several milliseconds to go open circuit, in a fraction of this time several logic IC's can be destroyed. This system uses the crowbar method, where a thyristor will short circuit the supply and cause the fuse to blow. This will take place in a few microseconds or less, and so offers much
greater protection than an ordinary fuse.



Notes:

I have not specified a transformer as power supplies differ from country to country.However, the dc input to the regulator needs to be a few volts higher than the regulator voltage. In the case of a 5v regulator, I would use a secondary voltage of 8-10volts ac.
The zener diode is a 5V6 type and is normally off. In the event of the output voltage rising to 5.6 volts or higher, the zener conducts, the small positive voltage across the resistor turns on the thyristor and short circuits the supply, causing the fuse to blow. Within the first few microseconds, the short circuit reduces the output voltage before the fuse will blow, safeguarding the precious logic IC's.
By choosing a different regulator and zener diode, you can build an over voltag trip at any value.
I have a simulated transient graph of this over voltage protection circuit in the Design section.

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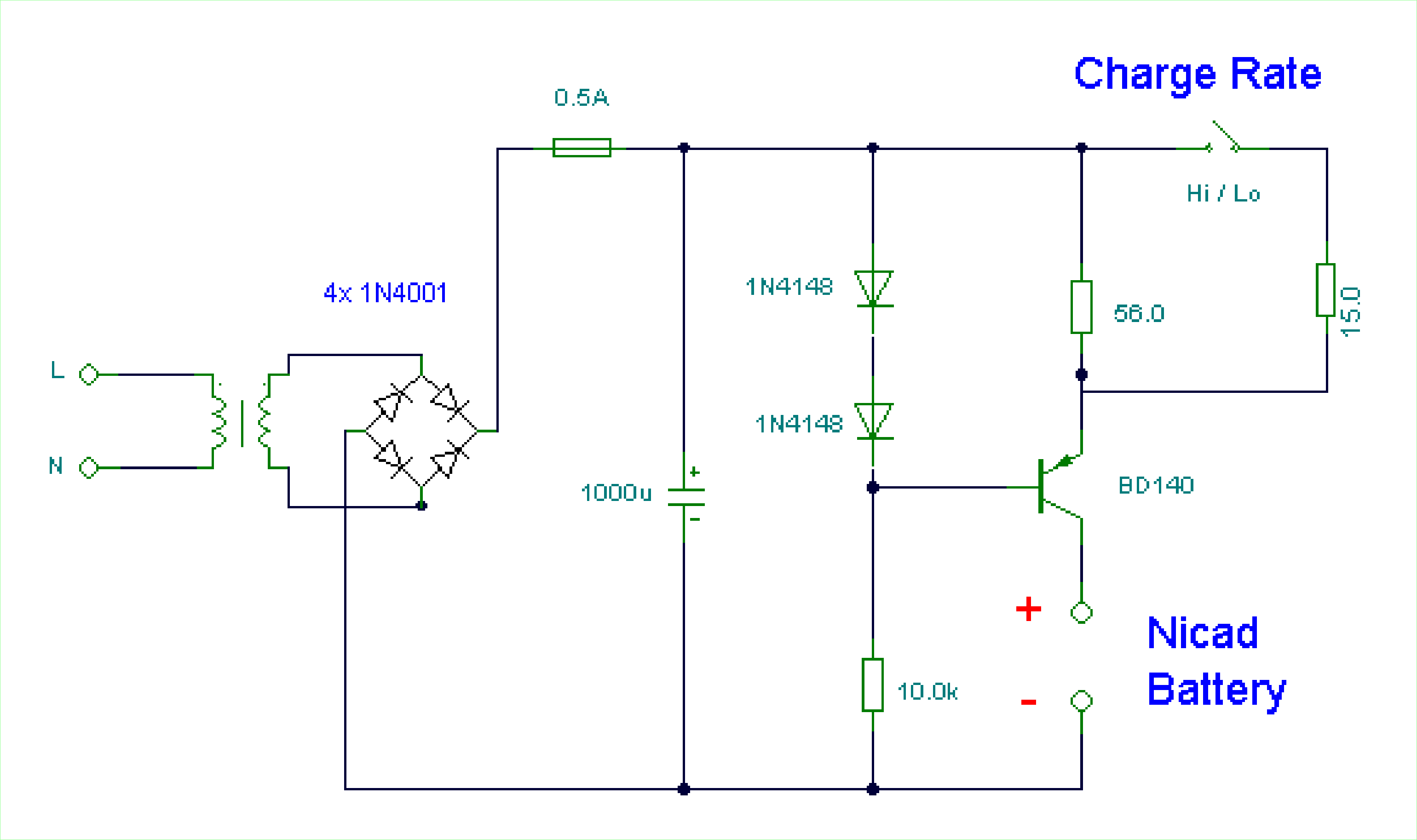
Nicad Battery Charger



Notes:
This simple charger uses a single transistor as a constant current source. The voltage across
the pair of 1N4148 diodes biases the base of the BD140 medium power transistor. The base-
emitter voltage of the transistor and the forward voltage drop across the diodes are relatively stable. The charging current is approximately 15mA or 45mA with the switch closed. This
suits most 1.5V and 9V rechargeable batteries.
The transformer should have a secondary rating of 12V ac at 0.5amp, the primary should be
220/240volts for Europe or 120volts ac for North America.

WARNING: Take care with this circuit. Use a voltmeter to observe correct

polarity. Nicads
can explode if short circuited or connected with the wrong polarity.

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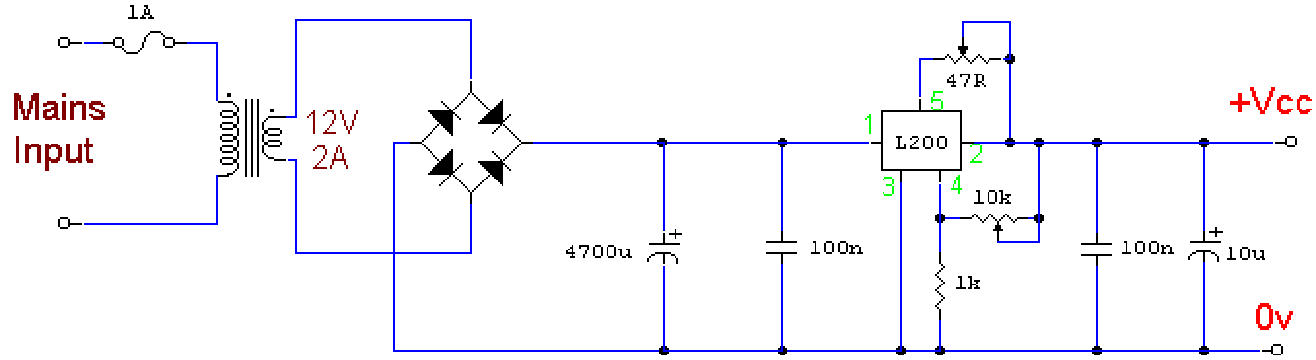
Variable Power Supply



Notes:
Using the versatile L200 voltage regulator, this power supply has independent voltage and current limits. The mains transformer has a 12volt, 2 amp rated secondary, the primary winding should equal the electricity supply in your country, which is 240V here in the UK. The 10k control is adjusts voltage output from about 3 to 15 volts, and the 47 ohm control is the current limit. This is 10mA minimum and 2 amp maximum. Reaching the current limit will reduce the output voltage to zero. Voltage and current regulation equations can be found at this page.

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Transformerless Power Supply

Web-masters Note:

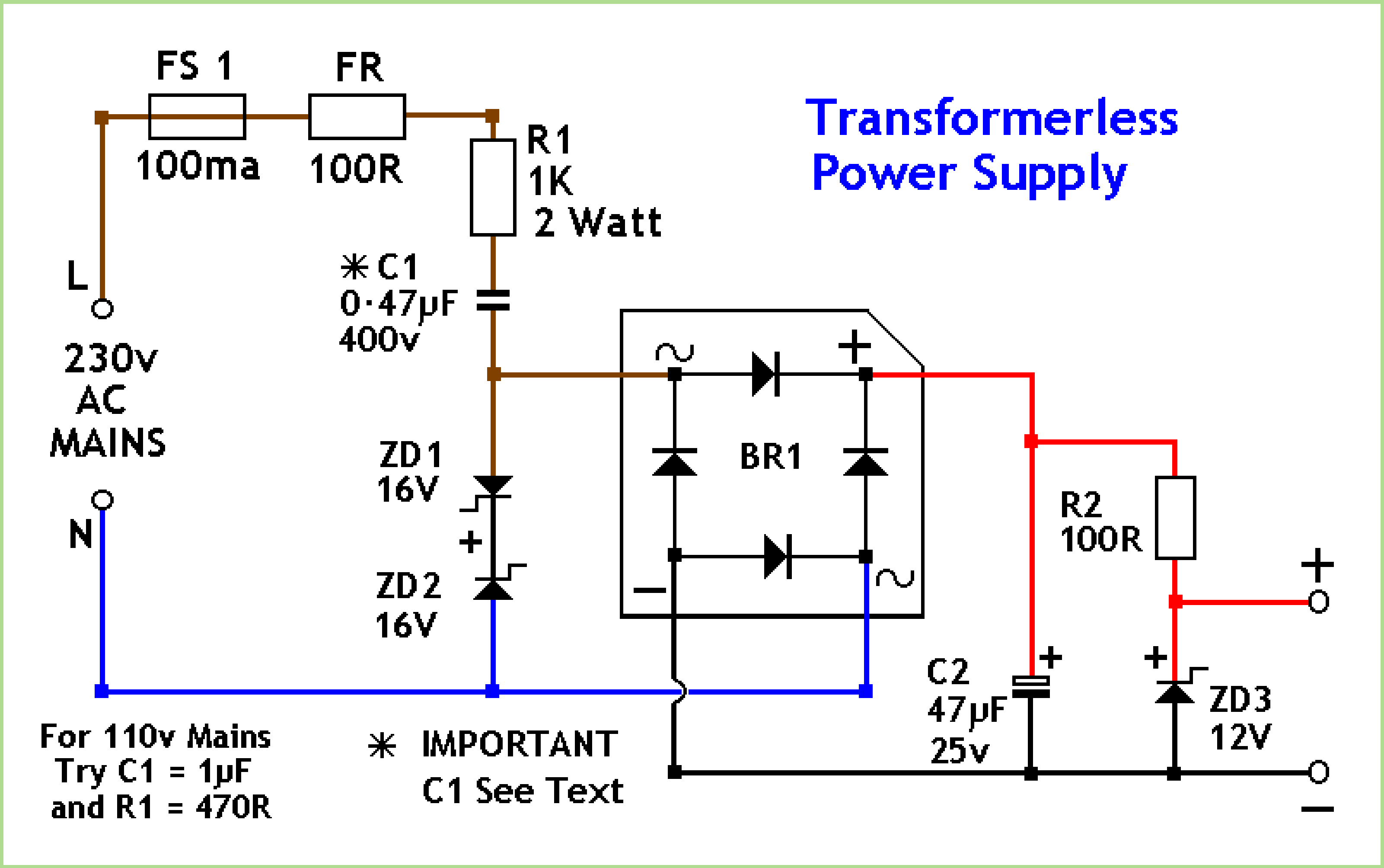
I have had several requests for a power supply project without using a power supply. This can save the expense of buying a transformer, but presents potentially lethal voltages at the output terminals. Under no circumstances should a beginner attempt to build such a project. Please also read the Disclaimer on this site.

Important Notice:

Electric Shock Hazard. In the UK,the neutral wire is connected to earth at the power station. If you touch the "Live" wire, then depending on how well earthed you are, you form a conductive path between Live and Neutral. DO NOT TOUCH the output of this power supply. Whilst the output of this circuit sits innocently at 12V with respect to (wrt) the other terminal, it is also 12V above earth potential. Should a component fail then either terminal will become a potential shock hazard.

Below is a project by Ron J, please heed the caution above and Ron's design notes.

MAINS ELECTRICITY IS VERY DANGEROUS.



If you are not experienced in dealing with it, then leave this project alone.Although Mains equipment can itself consume a lot of current, the circuits we build to control it, usually only require a few milliamps. Yet the low voltage power supply is frequently the largest part of the construction and a sizeable portion of the cost.
This circuit will supply up to about 20ma at 12 volts. It uses capacitive reactance instead of resistance; and it doesn't generate very much heat.The circuit draws about 30ma AC. Always use a fuse and/or a fusible resistor to be on the safe side. The values given are only a guide. There should be more than enough power available for timers, light operated switches, temperature controllers etc, provided that you use an optical isolator as your circuit's output device. (E.g. MOC 3010/3020) If a relay is unavoidable, use one with a mains voltage coil and switch the coil using the optical isolator.C1 should be of the 'suppressor type'; made to be connected directly across the incoming Mains Supply. They are generally covered with the logos of several different Safety Standards Authorities. If you need more current, use a larger value capacitor; or put two in parallel; but be careful of what you are doing to the Watts. The low voltage 'AC' is supplied by ZD1 and ZD2. The bridge rectifier can be any of the small 'Round', 'In-line', or 'DIL' types; or you could use four separate diodes. If you want to, you can replace R2 and ZD3 with a 78 Series regulator. The full sized ones will work; but if space is tight, there are some small 100ma versions available in TO 92 type cases. They look like a BC 547. It is also worth noting that many small circuits will work with an unregulated supply. You can, of course, alter any or all of the Zenner diodes in order to produce a different output voltage. As for the mains voltage, the suggestion regarding the 110v version is just that, a suggestion. I haven't built it, so be prepared to experiment a little.

RON J   Email: ronj@gofree.indigo.ie

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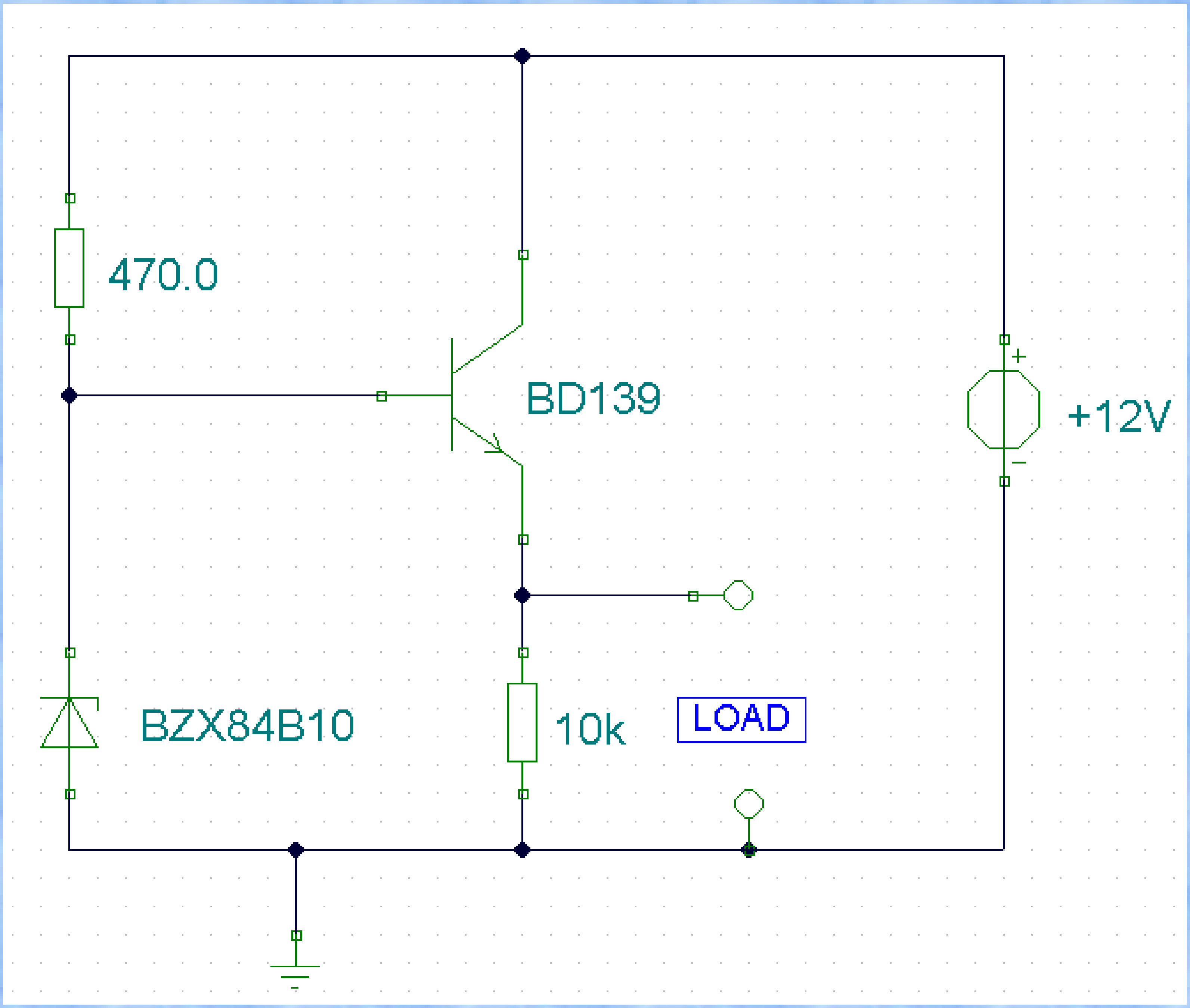
Universal DC-DC Convertor

Design : anc
Email: anc

Descriptipn:
This circuit will generate a smaller DC output voltage from a larger DC input voltage.It is quick and simple to make and by changing the value of the zener diode, the circuit can be universally adapted to provide other output voltages.The circuit and all diagrams represent a DC convertor with 12V battery input and 9Volt DC output.

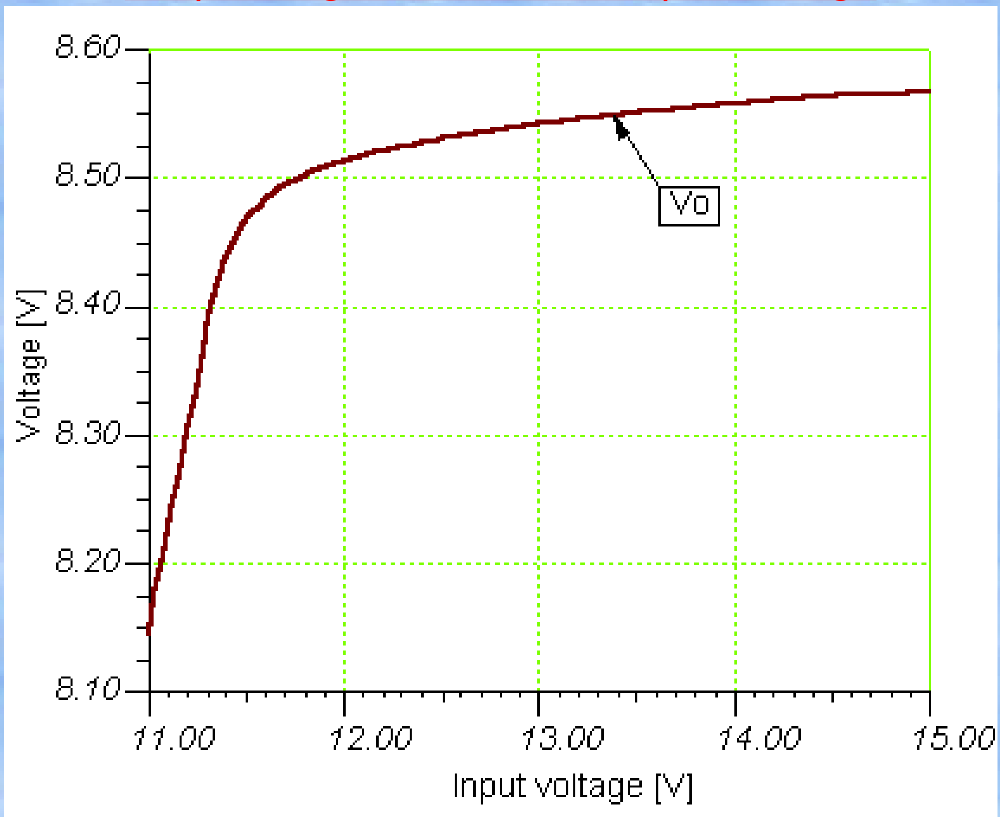


The output voltage is equal to the zener diode voltage less 0.7 volts, or :-

$V_o = V_z - 0.7$ where V_z is the value of the zener diode.

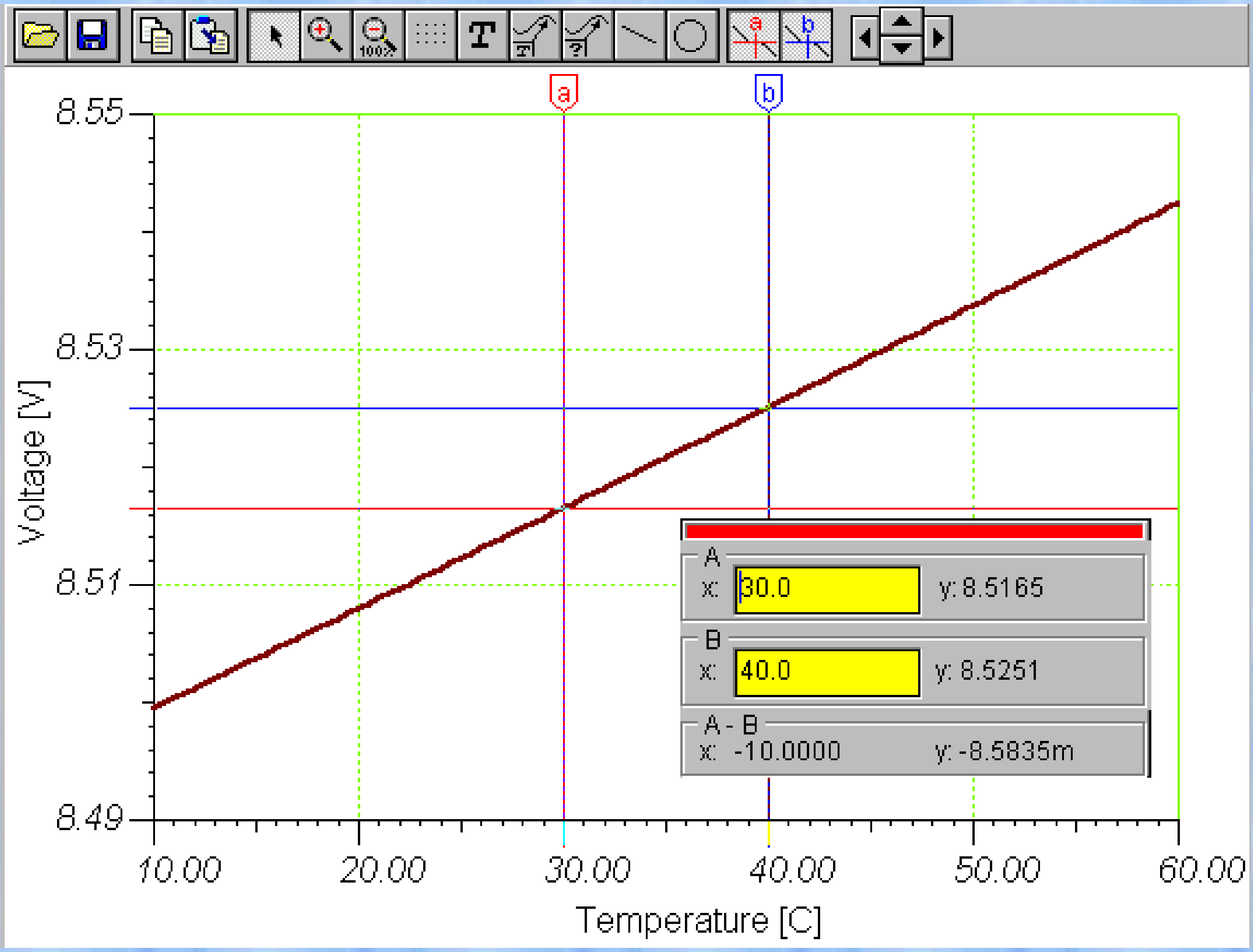
With the 10V zener diode as shown in the diagram the output voltage is about 9.3 Volts DC. The supply voltage used must always be at least a few volts higher than the zener voltage. In this example I have used a 12 Volt DC battery to provide the regulated 9 Volt DC output.

Output Regulation Versus Input Voltage



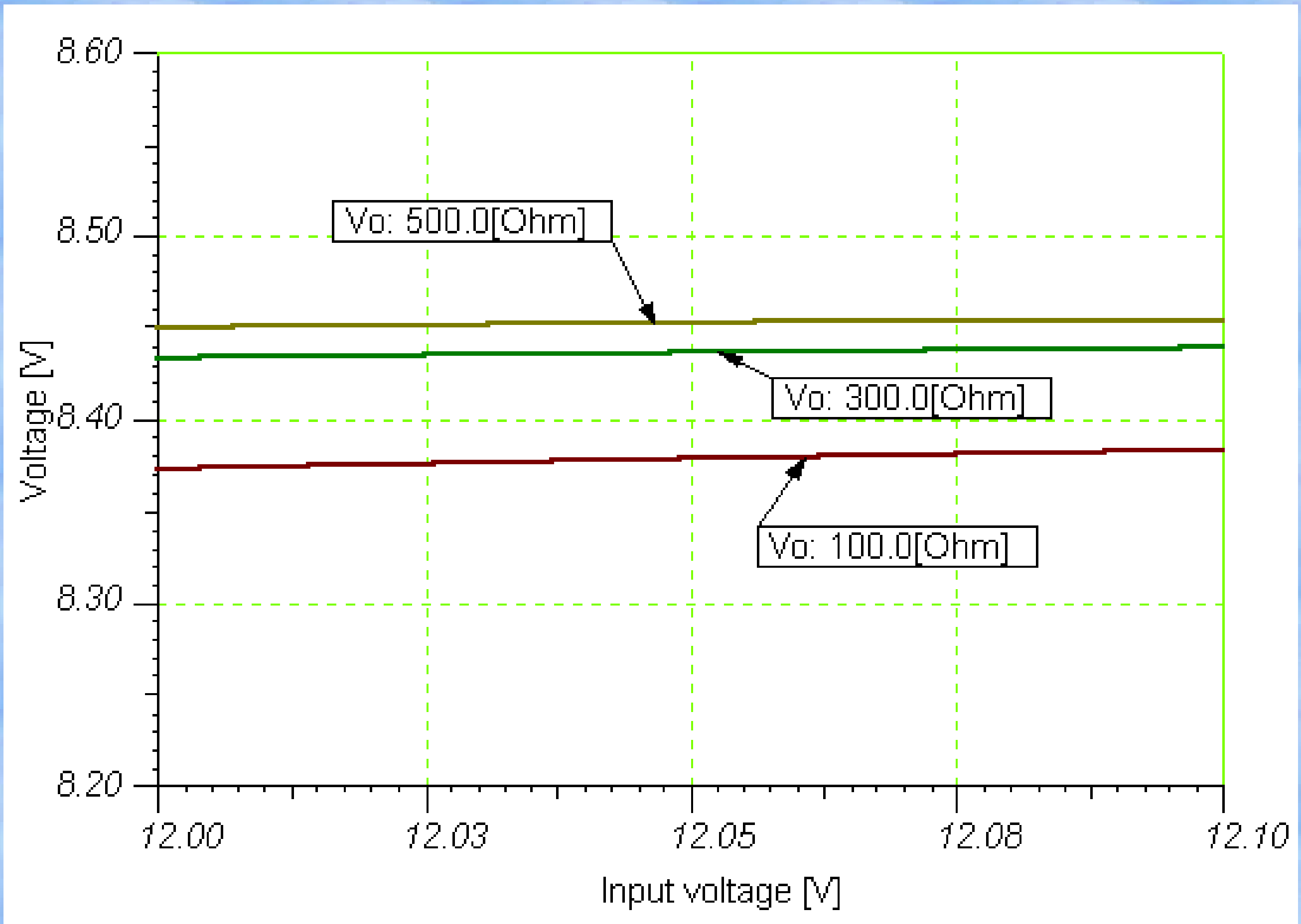
The above graph shows how the output is affected by input voltage variations. This was produced with a load current of 100mA and using a 10 volt rated zener diode. Note that the circuit falls sharply out of regulation when the input voltage falls to 11.5 volt, hence the requirement for an adequate supply voltage.

Temperature Stability



Temperature stability is very good as the above graph shows. The output voltage changes by 8.5mV for every 10 degree rise in temperature. This is less than 1 mV / degree.

Output Voltage versus Load Current



Power Dissipation

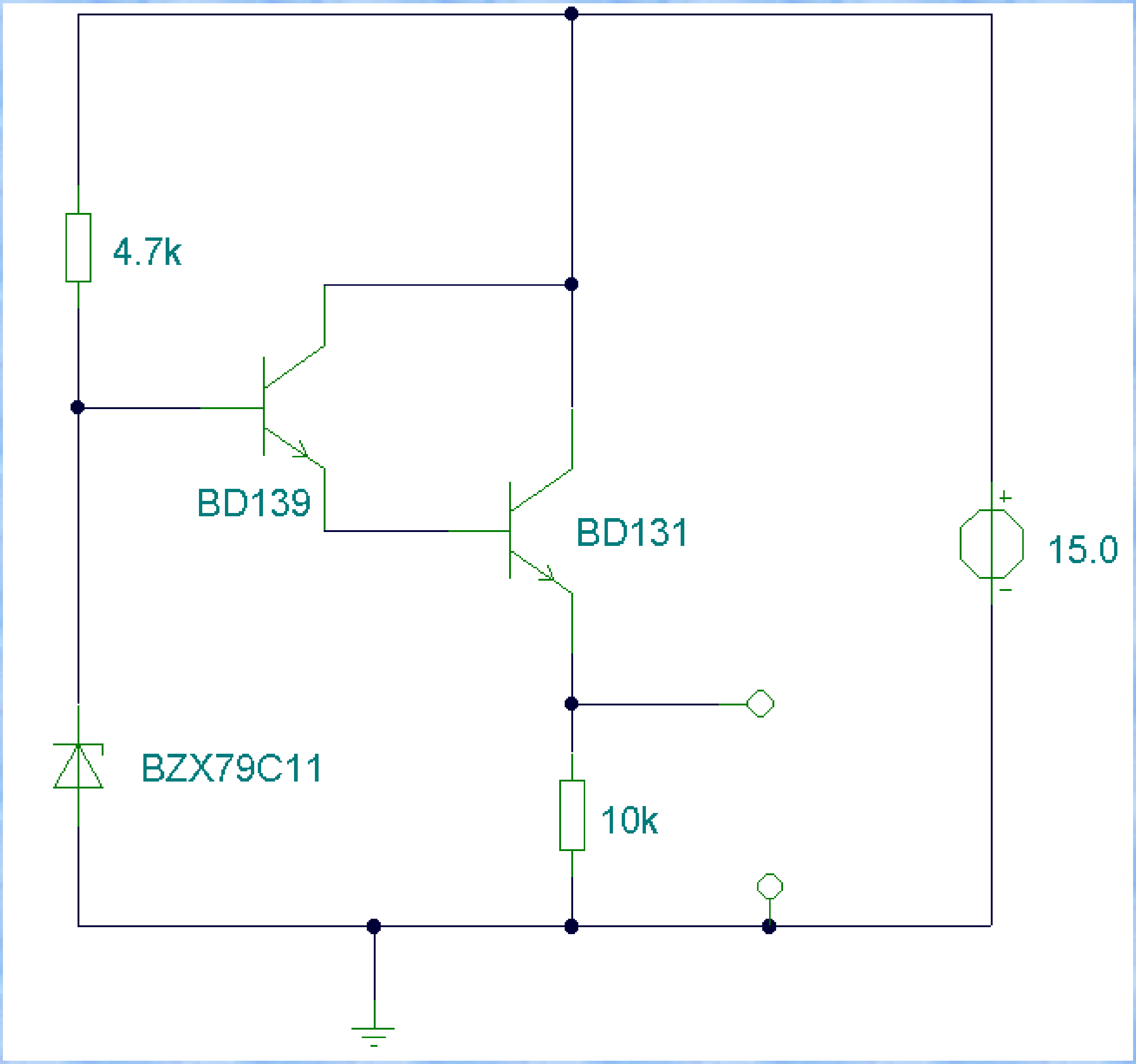
With a DC-DC convertor, the most important consideration is power dissipation in the output device. Power dissipation is the product of the transistors emitter current and collector-emitter voltage. With this circuit the maximum power dissipation of the BD139 or maximum collector current cannot be exceeded, otherwise the transistor will be destroyed.

Example:

With a 12 Volt supply and a 9 Volt, 100 mA load the dissipation is as follows. Using a 10 volt zener the output voltage will be about 9.3 volts DC therefore:

$$V_{CE} * I_C = (12 - 9.3) * 100 \text{ mA} = 2.7 \text{ Watts}$$

This is well within the maximum limits of power dissipation and collector current, which for the BD139 are 8 watts and 1 amp respectively. If higher load currents are required then the following circuit may be used.



Output dissipation is calculated in the same way, the BD131 has a maximum power dissipation of 15 watts and collector current of 3 amps. The output voltage is approximately 1.4 volts less than the zener diode voltage and supply voltage must be higher than the input voltage by at least 3 volts.

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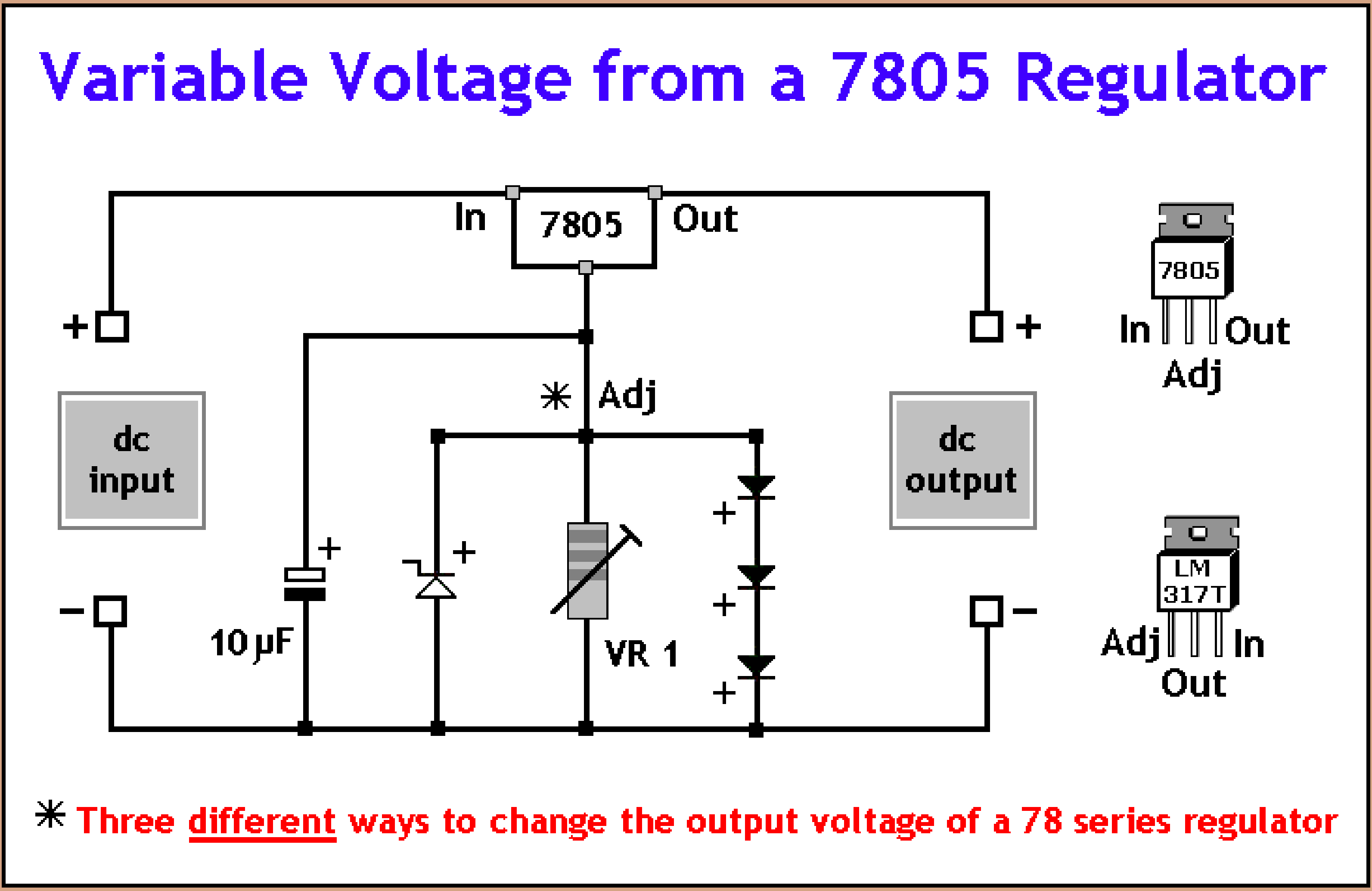
Variable Voltage Regulation



Circuit by Ron J
Text by ANC

Notes:
As Ron suggests, controlling the output voltage from a regulator can be made variable in three ways:-
1. Using a fixed reference zener diode to increase the output by the value of the zener
2. A variable resistor for variable output, note that a voltage less than the nominal regulator is not possible
3. A chain of diode such as 1N4001, this increases the output by +0.7 V for every diode used.

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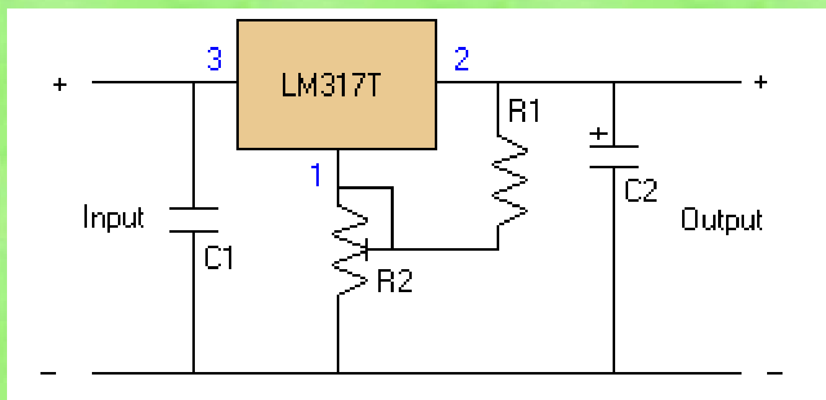
LM317 Regulator Circuit

Submitted by: Matthew Hewson

I constructed this voltage regulator to power my two way mobile radio from the car cigarette lighter circuit. It has many other uses and the voltage can easily be adjusted by the use of a potentiometer. The voltage regulator is an LM317T, and should accept up to about 14 volts without problems. It can handle up to 1 amp, but you WILL need a heatsink on the voltage regulator.



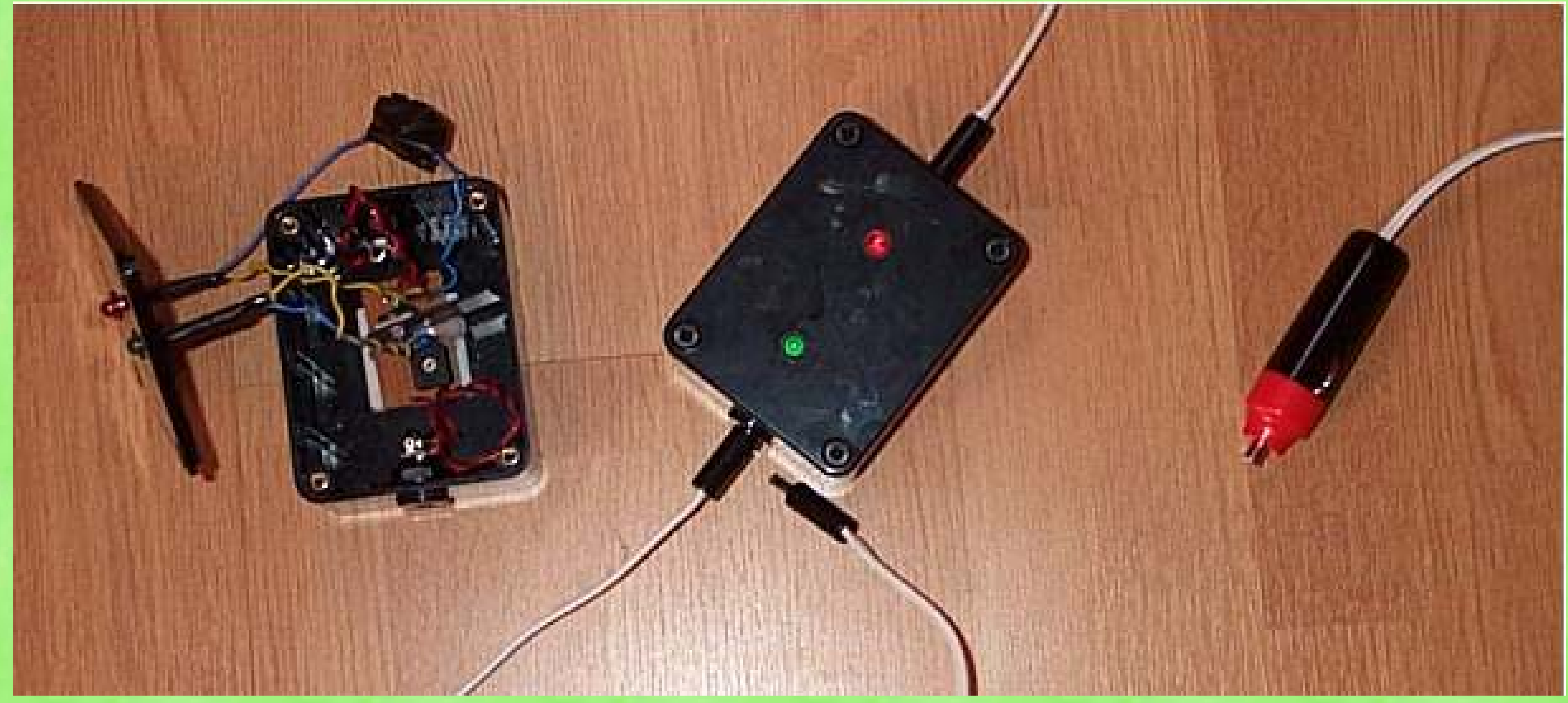
The components are:

R1: 270R
R2: 2K Cermet or carbon preset potentiometer
C1: 100nF
C2: 1uF tantalum
LM317T Voltage regulator
Heatsink
PCB board

I also added DC power jacks for input and output on my voltage regulator, a green power LED, and a red over-voltage LED. The over voltage LED uses a zener diode to switch on the LED at a certain preset voltage, this can be varied depending on the voltage of the zener diode, I used a 6.2v zener diode. If you plan to vary the voltage for the different items you power, don't bother adding this feature. If you only plan to use items that run on one voltage, this is a very useful feature and will save plugging in and damaging your valuable (or not so valuable) equipment. You can even add a relay to switch off the power if the over voltage LED turns on, but bear in mind it will have to work from the voltage of the zener diode right up to the input voltage. I couldn't add a relay because I couldn't find any that operated from 6.2-13.8 volts. Anyway, the schematic is shown above, the over voltage and power LED are not included in them because it is assumed that anybody who makes this will understand how to use a zener diode:

This is what the final product should look like inside:

This is an outside view of the finished voltage regulator:



Here is what my voltage regulator is intended to power:

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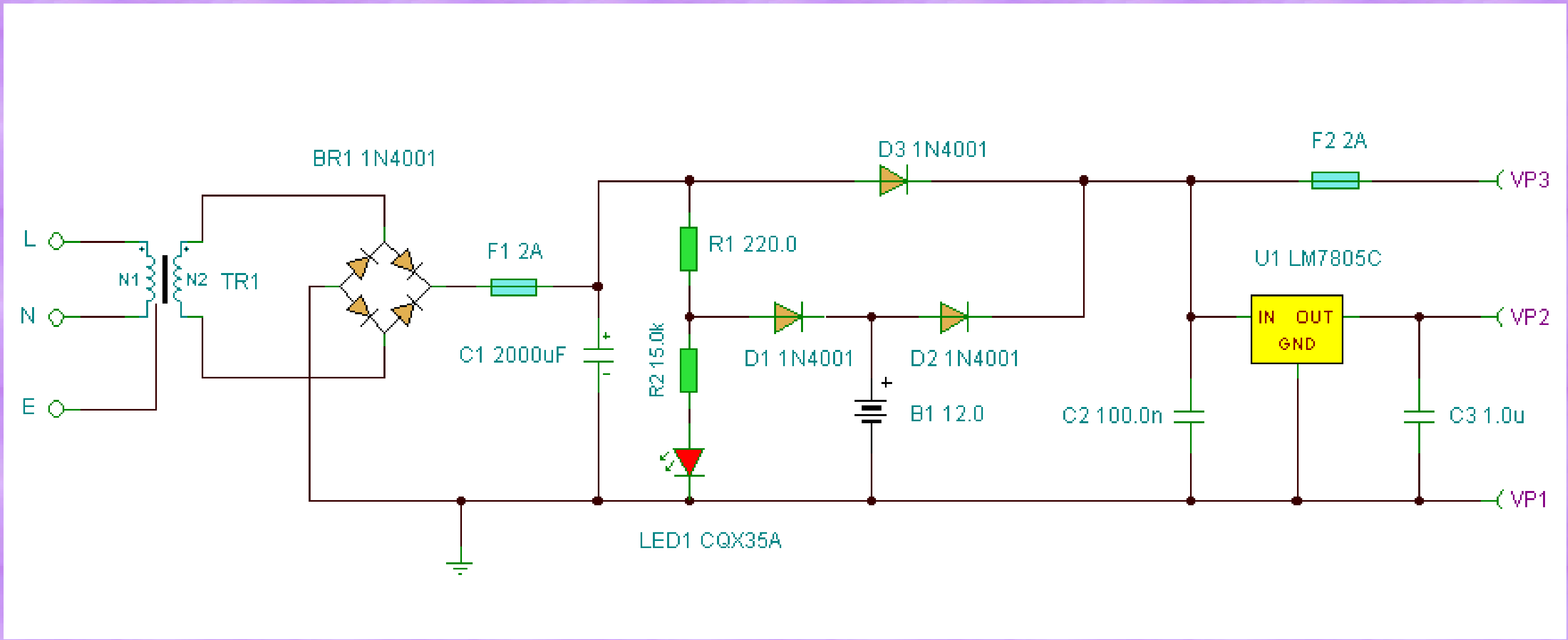
Basic UPS Power Supply

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description

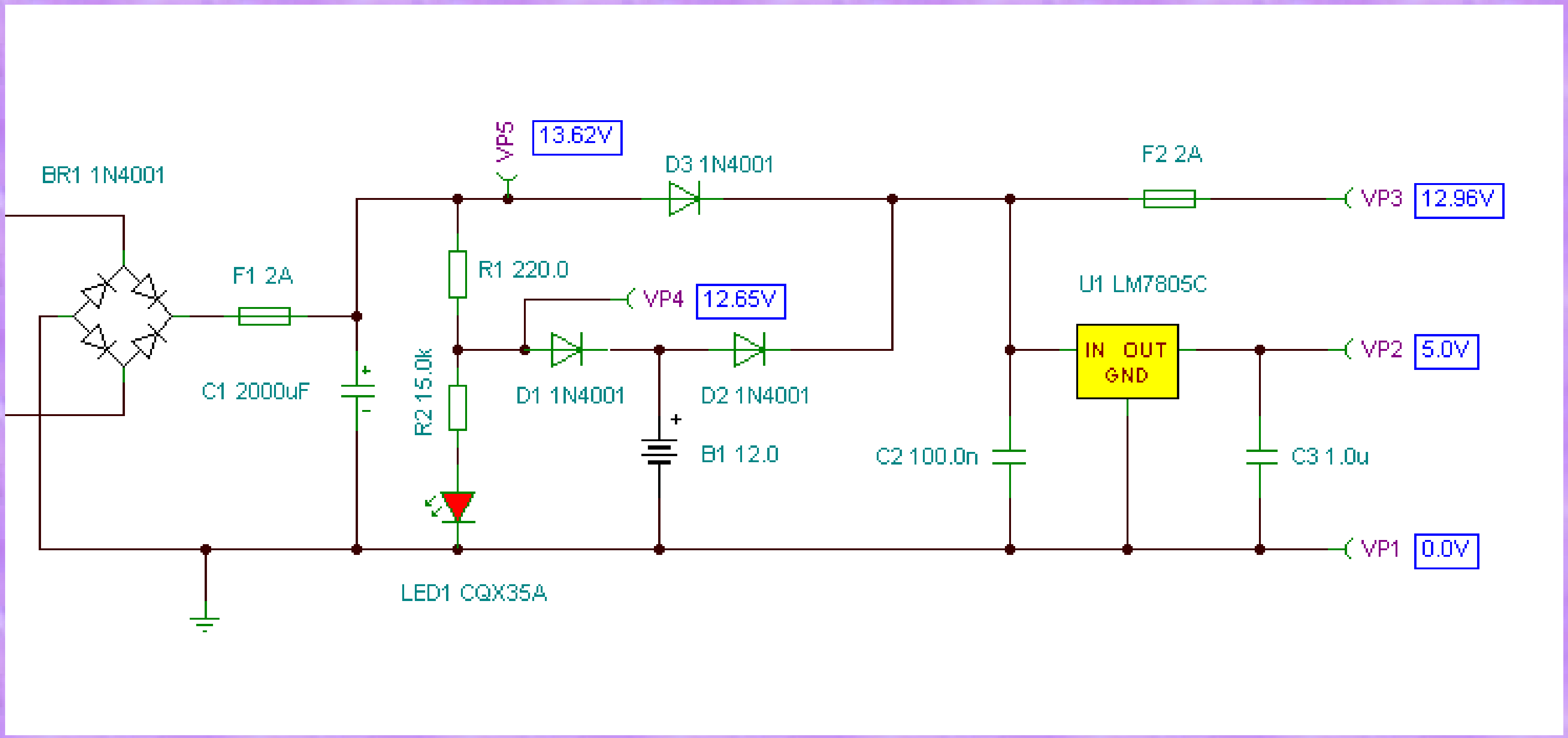
This circuit is a simple form of the commercial UPS, the circuit provides a constant regulated 5 Volt output and an unregulated 12 Volt supply. In the event of electrical supply line failure the battery takes over, with no spikes on the regulated supply.



Notes:

This circuit can be adapted for other regulated and unregulated voltages by using different regulators and batteries. For a 15 Volt regulated supply use two 12 Volt batteries in series and a 7815 regulator. There is a lot of flexibility in this circuit.

TR1 has a primary matched to the local electrical supply which is 240 Volts in the UK. The secondary winding should be rated at least 12 Volts at 2 amp, but can be higher, for example 15 Volts. FS1 is a slow blow type and protects against short circuits on the output, or indeed a faulty cell in a rechargeable battery. LED 1 will light ONLY when the electricity supply is present, with a power failure the LED will go out and output voltage is maintained by the battery. The circuit below simulates a working circuit with mains power applied:

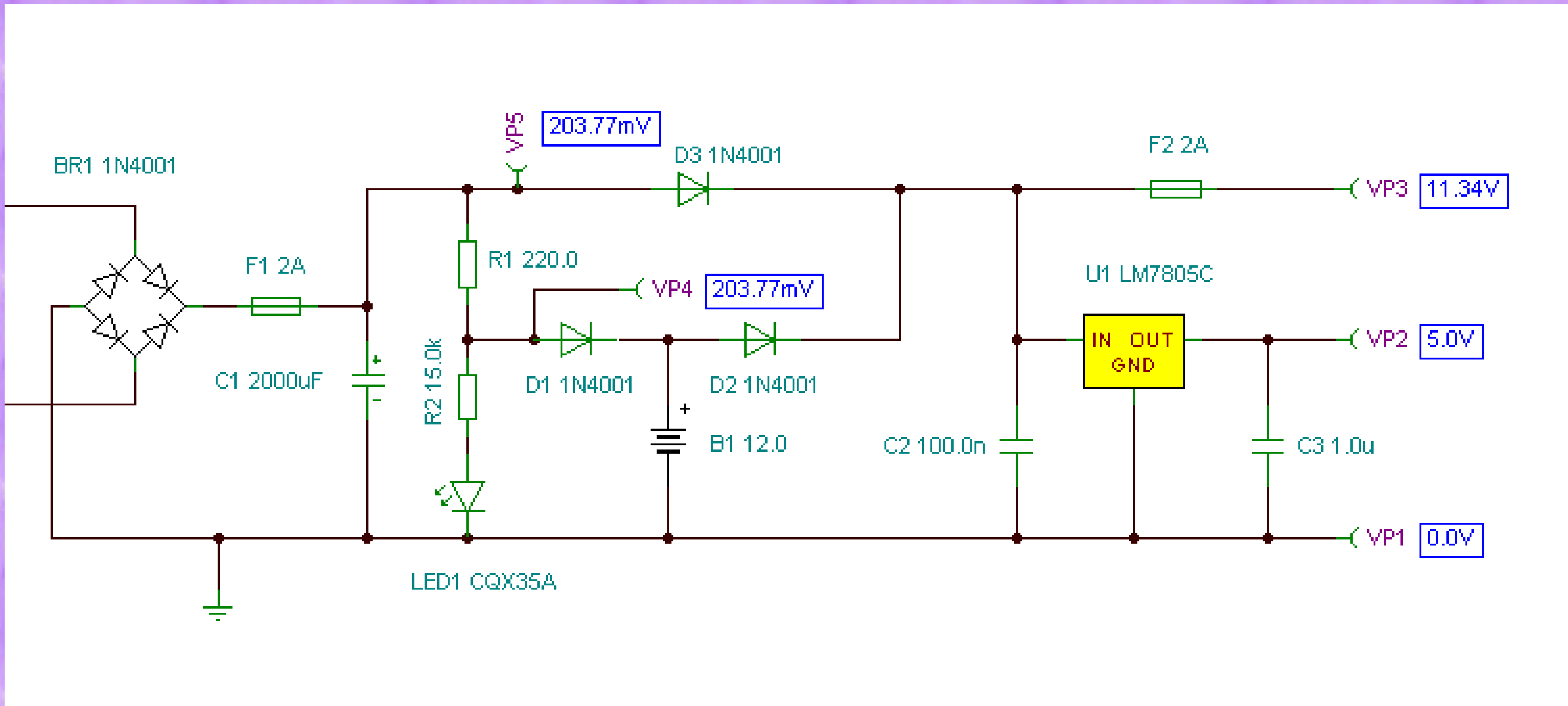


Between terminals VP1 and VP3 the nominal unregulated supply is available and a 5 Volt regulated supply between VP1 and VP2. Resistor R1 and D1 are the charging path for battery B1. D1 and D3 prevent LED1 being illuminated under power fail conditions. The battery is designed to be trickle charged, charging current defined as :-

(VP5 - 0.6) / R1

where VP5 is the unregulated DC power supply voltage.

D2 must be included in the circuit, without D2 the battery would charge from the full supply voltage without current limit, which would cause damage and overheating of some rechargeable batteries. An electrical power outage is simulated below:



Note that in all cases the 5 Volt regulated supply is maintained constantly, whilst the unregulated supply will vary a few volts.

Standby Capacity

The ability to maintain the regulated supply with no electrical supply depends on the load taken from the UPS and also the Ampere hour capacity of the battery. If you were using a 7A/h 12 Volt battery and load from the 5 Volt regulator was 0.5 Amp (and no load from the unregulated supply) then the regulated supply would be maintained for around 14 hours. Greater A/h capacity batteries would provide a longer standby time, and vice versa.

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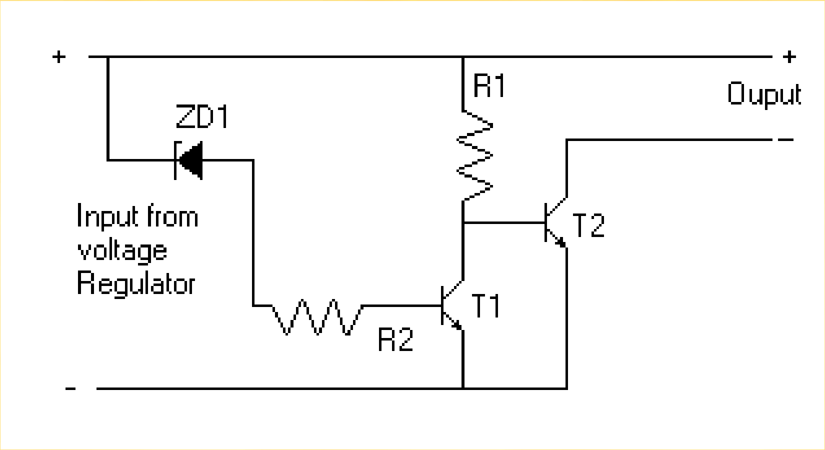
Overvoltage Protection for the LM317

Circuit : Adam
Email: electronicplanetuk@hotmail.com

Description:
This is an add-on Over Voltage Circuit for the LM317 Regulator Circuit submitted by Matthew Hewson. The original circuit may be viewed here.

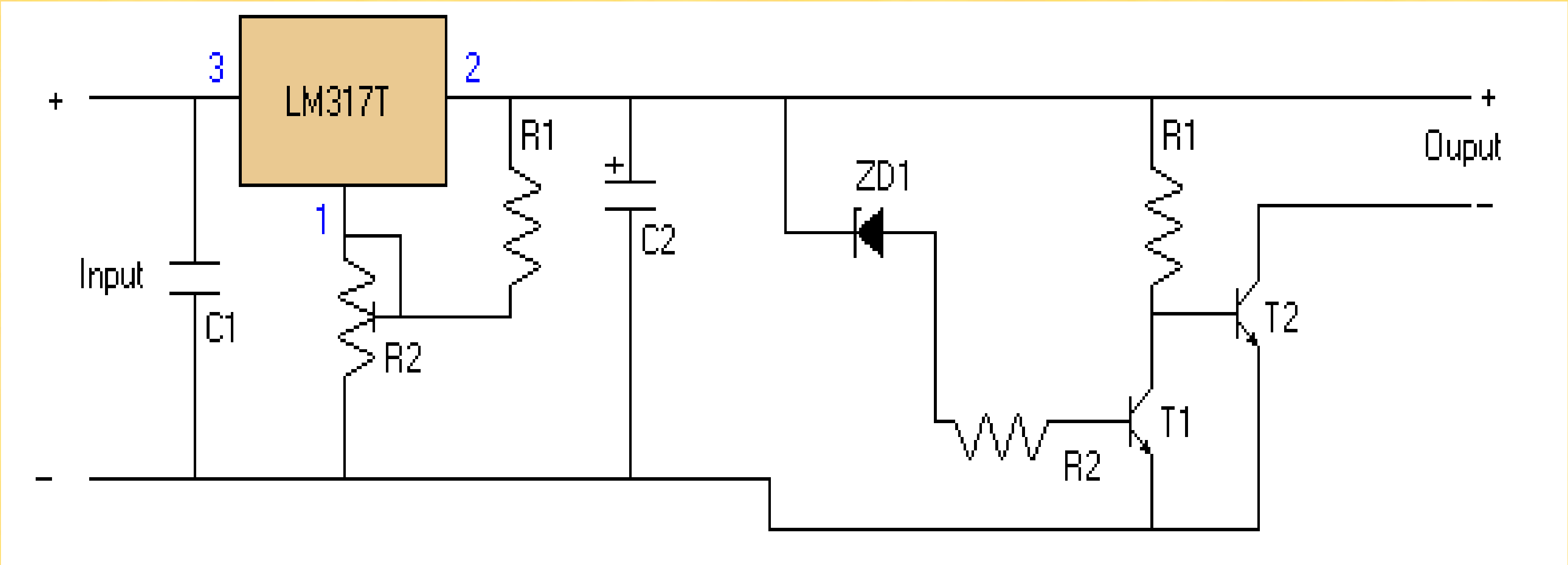


Notes:
It is a voltage regulator that allows a 6v portable supply to be derived from the 12v car battery. You can add a 6.2V zener diode and a LED to warn you when the input supply is overvoltage. If you could find a relay that would operate from 6.2v right up to 12v that you could connect in such a way that if over voltage occurred, then the relay would automatically switch off the output preventing damage to any connected equipment.
Such a relay would be quite difficult to find, so I designed this, it is a simple two transistor circuit which will switch off the output should the voltage raise above 6.2v (this can be changed by selecting a different value of zener diode).

Components are as follows:
ZD1 =3D 6.2v Zener diode (you can change this to any value, the circuit will switch off the output if the input voltage raises above the value of the zener diode)

R1 = 1K Resistor (this can be of any power rating, it carries very little power)
R2 = 1K Resistor (this can be of any power rating, it carries very little power)
T1 = Low power NPN Transistor (BC108 or BC547 will do fine)
T2 = NPN transistor transistor capable of switching the equipment you are running (BFY51 or BC140 can switch 1 Amp, which is the maximum the voltage regulator circuit can handle)

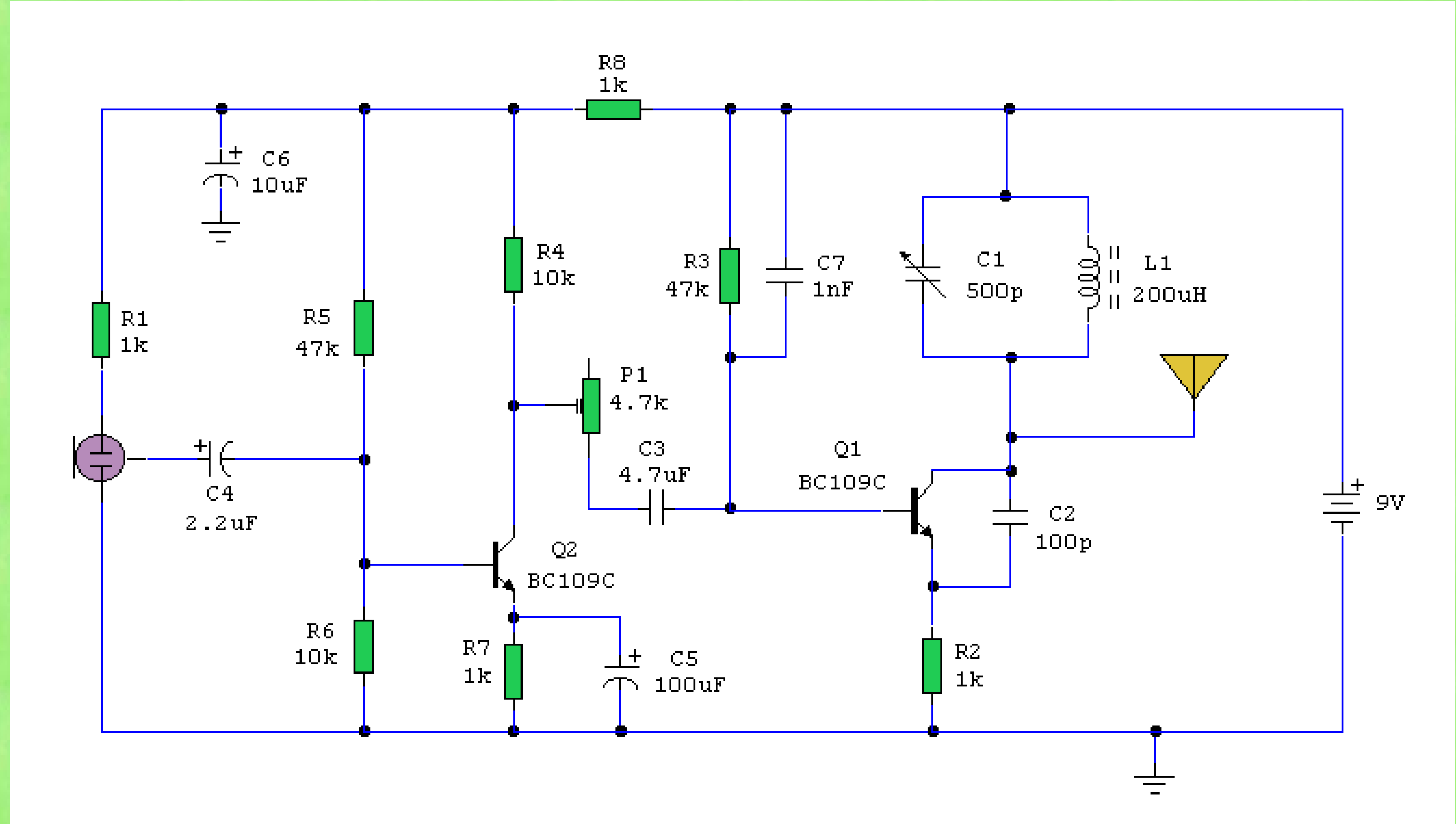
It is advisable to test this circuit with a voltmeter, slowly increasing the voltage on the regulator circuit and make sure that this circuit switches off the output when the value of the zener diode is reached, before plugging in your expensive equipment. This circuit is intended to be used with the voltage regulator posted by Matthew Hewson, my overvolatge add-on circuit is shown with the original below:-



Double check the polarity, It is very easy to blow up components in the eqipment that you are powering if you reverse the polarity. Also, if you want to increase the power output of the voltage regulator circuit above 1 Amp then connect several LM317's in parallel, be sure to make sure that transistor T2 on this circuit is of a high enough rating if you do this.
If you have any problems with this circuit, you can email me at:
electronicplanetuk@hotmail.com
or have a look for updates on my http://www.electronics.vze.com/
Adam

Return to Power Supply Circuits

AM Transmitter



Notes:
Please read the disclaimer on this site before making any transmitter circuit. It is illegal to operate a radio transmitter without a license in most countries. This ircuit is deliberately limited in power output but will provide amplitude modulation (AM) of voice over the medium wave band.
The circuit is in two halfs, an audio amplifier and an RF oscillator. The oscillator is built around Q1 and associated components. The tank circuit L1 and VC1 is tunable from about 500kHz to 1600KHz. These components can be used from an old MW radio, if available. Q1 needs regenerative feedback to oscillate and this is achieved by connecting the base and collector of Q1 to opposite ends of the tank circuit. The 1nF capacitor C7, couples signals from the base to the top of L1, and C2, 100pF ensures that the oscillation is passed from collector, to the emitter, and via the internal base emitter resistance of the transistor, back to the base again. Resistor R2 has an important role in this circuit. It ensures that the oscillation will not be shunted to ground via the very low internal emitter resistance, r_e of Q1, and also increases the input impedance so that the modulation signal will not be shunted. Oscillation frequency is adjusted with VC1.
Q2 is wired as a common emitter amplifier, C5 decoupling the emitter resistor and realising full gain of this stage. The microphone is an electret condenser mic and the amount of AM modulation is adjusted with the 4.7k preset resistor P1.
An antenna is not needed, but 30cm of wire may be used at the collector to increase transmitter range.

Return to RF Circuits

RF Circuits

1. AM Receiver
2. MW Preamplifier by David Sayles
3. Q- Multiplying Loop Antenna (David Sayles)
4. 4 Band Double Tuned Preselector (David Sayles)
5. ZN414 Portable AM Receiver
6. SW Receiver using the ZN414
7. 2 Transistor FM Transmitter
8. FM Transmitter by David Sayles
9. FSM Field Strength Meter
10. Simple Field Strength Meter
11. 4 Transistor Transmitter by Paul K Sherby
12. FM Transmitter with Opamp by Kamram Ahmed
13. UHF TV Preamplifier
14. ATL3 Loop Antenna by Graham Maynard
15. Surveillance Transmitter Detector
16. AM Transmitter

17. 6 x 6 Antenna Loop by Graham Maynard

18. 2 Transistor Transmitter by Rob van der Weijden

19. MPF102 FM Receiver by Patrick Cambre

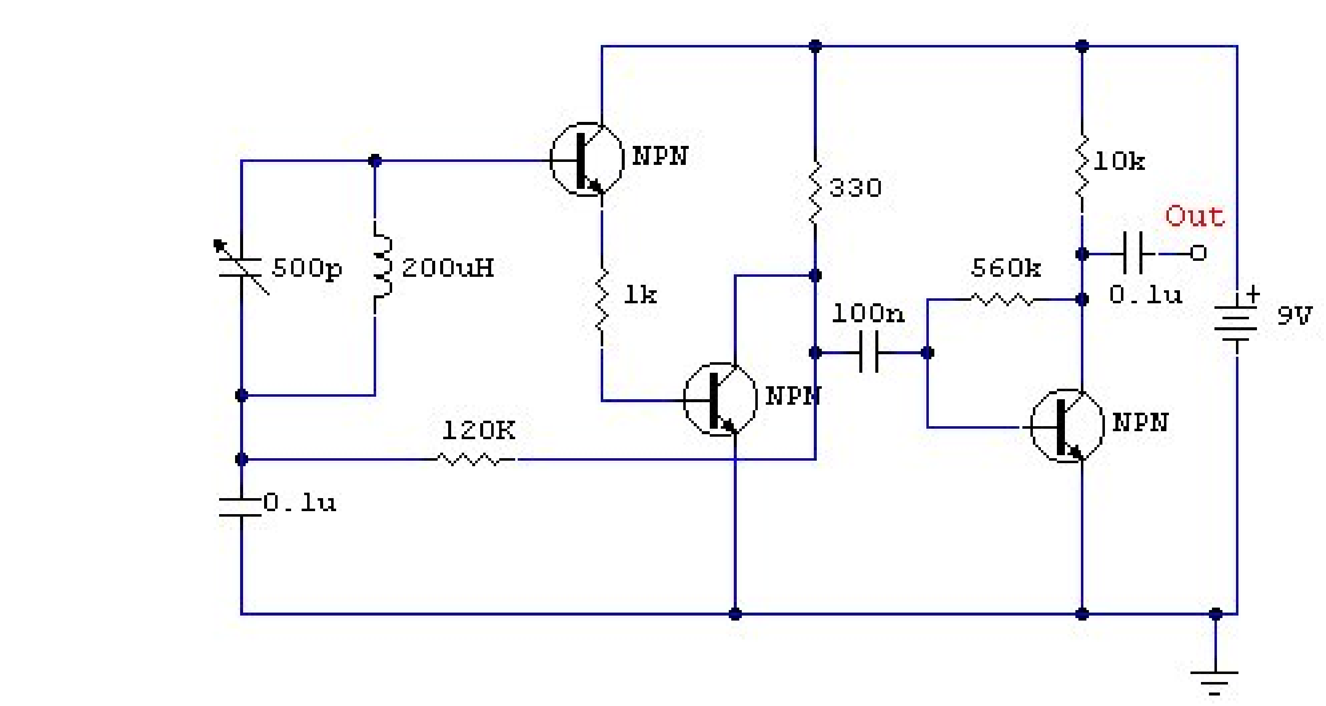
20. SW RF Pre-Amplifieramplifier

Return to Schematics

AM Receiver

Description:

This is a compact three transistor, regenerative receiver with fixed feedback. It is similar in principle to the ZN414 radio IC which is now no longer available. The design is simple and sensitivity and selectivity of the receiver are good.



Notes:

All general purpose transistors should work in this circuit, I used three BC109C transistors in my prototype.The tuned circuit is designed for medium wave. I used a ferrite rod and tuning capacitor from an old radio which tuned from approximately 550 - 1600kHz. Q1 and Q2 form a compund transistor pair featuring high gain and very high input impedance. This is necessary so as not to unduly load the tank circuit.

The 120k resistor provides regenerative feedback,between Q2 output and the tank circuit input and its value affects the overall performance of the whole circuit. Too much feedback and the circuit will become unstable producing a "howling sound". Insufficient feedback and the receiver becomes "deaf". If the circuit oscillates,then R1's value may be decreased; try 68k. If there is a lack of sensitivity, then try increasing R1 to around 150k. R1 could also be replaced by a fixed resisor say 33k and a preset resistor of 100k. This will give adjustment of sensitivity and selectivity of the receiver.

Transistor Q3 has a dual purpose; it performs demodulation of the RF carrier whilst at the same time, amplifying the audio signal. Audio level varies on the strength of the received station but I had typically 10-40 mV. This will directly drive high impedance headphones or can be fed into a suitable amplifier.

Construction:

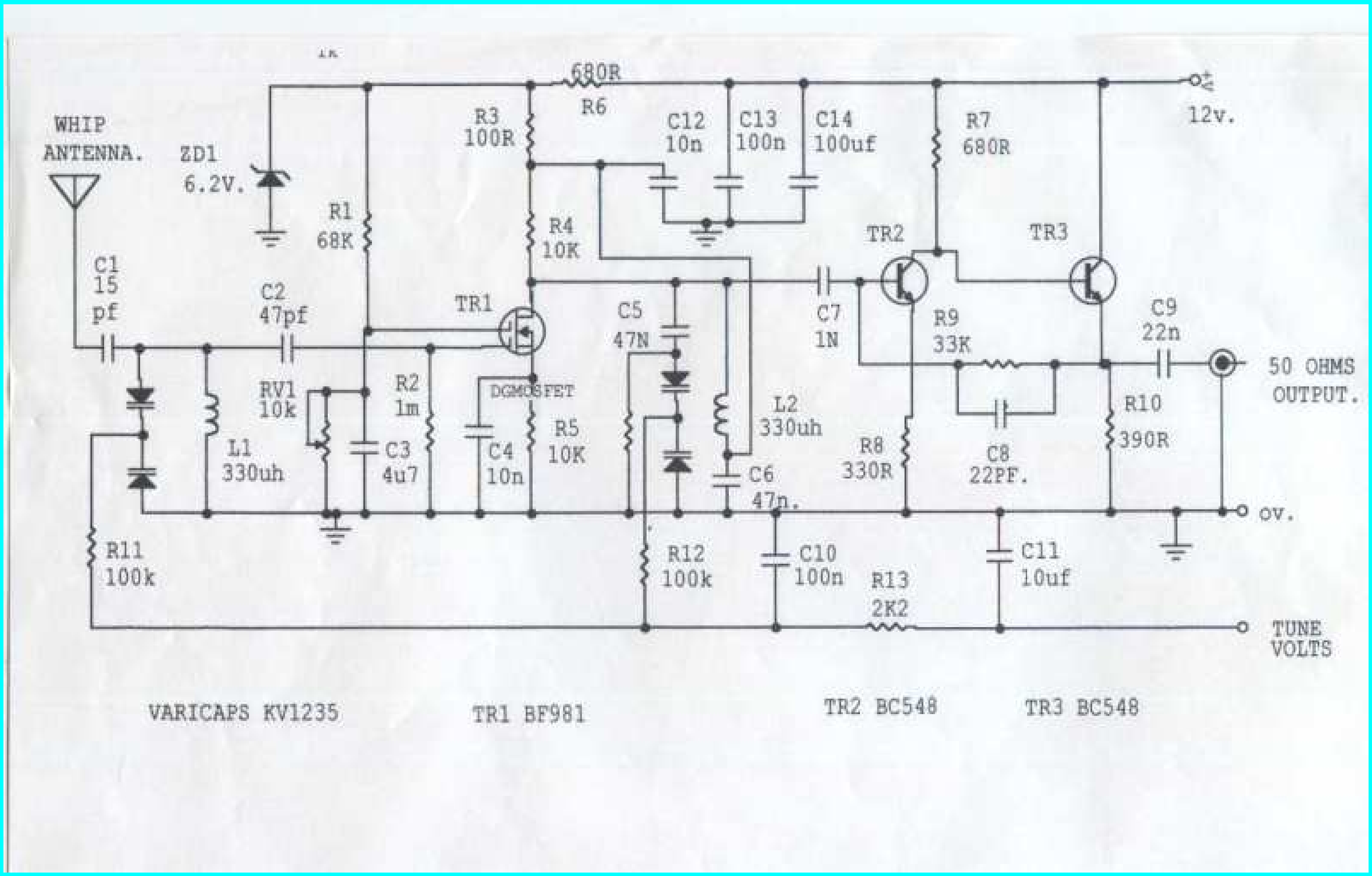
All connections should be short, a veroboard or tagstrip layout are suitable. The tuning capacitor has fixed and moving plates. The moving plates should be connected to the "cold" end of the tank circuit, this is the base of Q1, and the fixed plates to the "hot end" of the coil, the juction of R1 and C1. If connections on the capacitor are reversed, then moving your hand near the capacitor will cause unwanted stability and oscillation.

Finally here are some voltagee checks from my breadboard prototype.This should help in determining a working circuit:-
All measurements made with a fresh 9volt battery and three BC109C transistors with respect to the battery negative terminal.

Q1 (b) 1.31V
Q2 (b) 0.71V
Q2 (c) 1.34V
Q3 (b) 0.62V
Q3 (c) 3.87V

Return to RF Schematics

Medium Wave Preamp



Notes

This circuit was kindly submitted by David Sayles. The tuning voltage is variable from 1 to 12 volts and is designed to cover the medium waveband from about 550Khz to 1650Khz. Davids email address radio_david@yahoo.com

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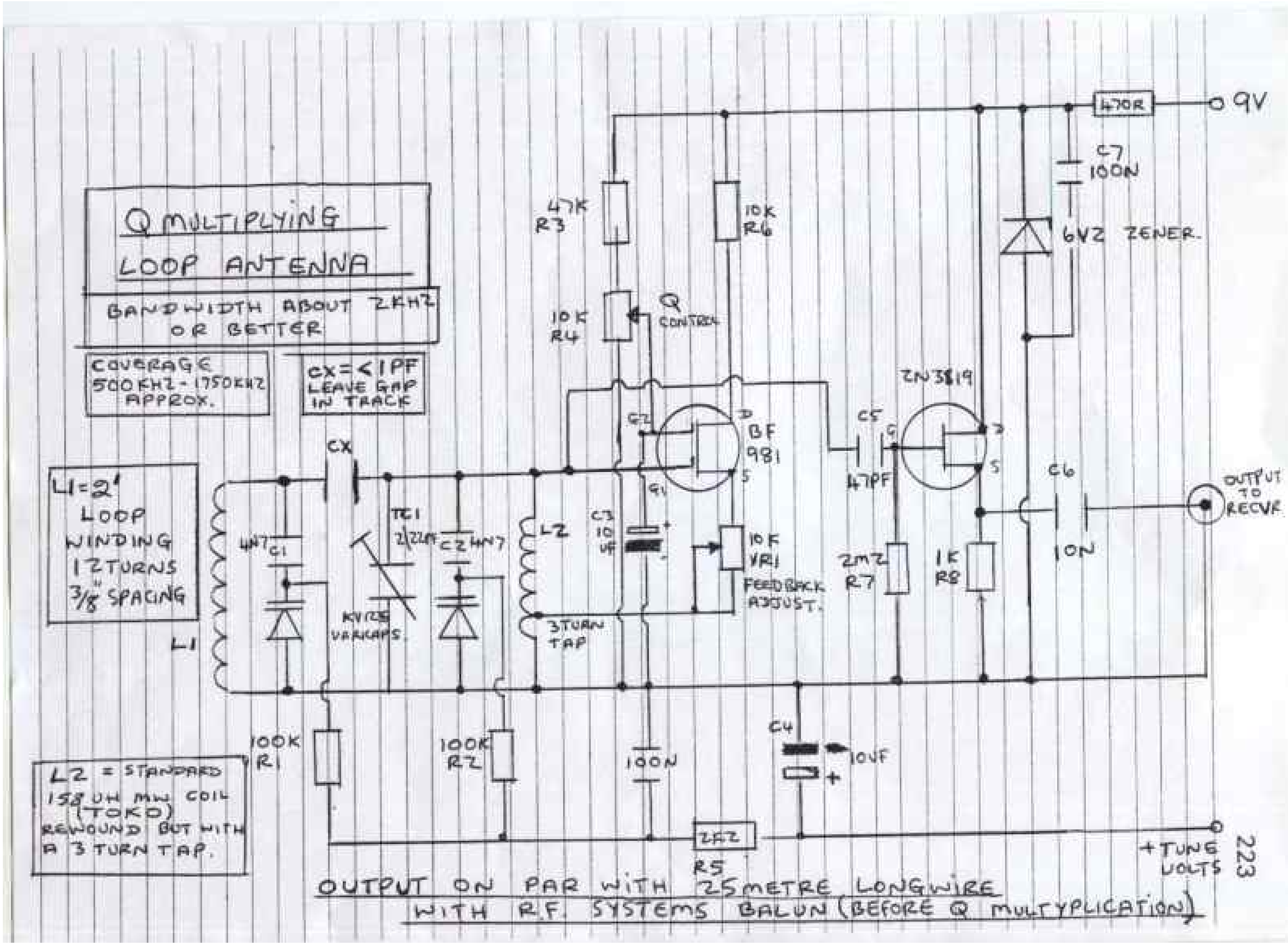
Q - Multiplying Loop Antenna



Notes

Also from David Sayles this circuit is designed to be used in conjunction with the standard 4 foot square loop used in MW for long distance reception. David's email is radio_david@yahoo.com

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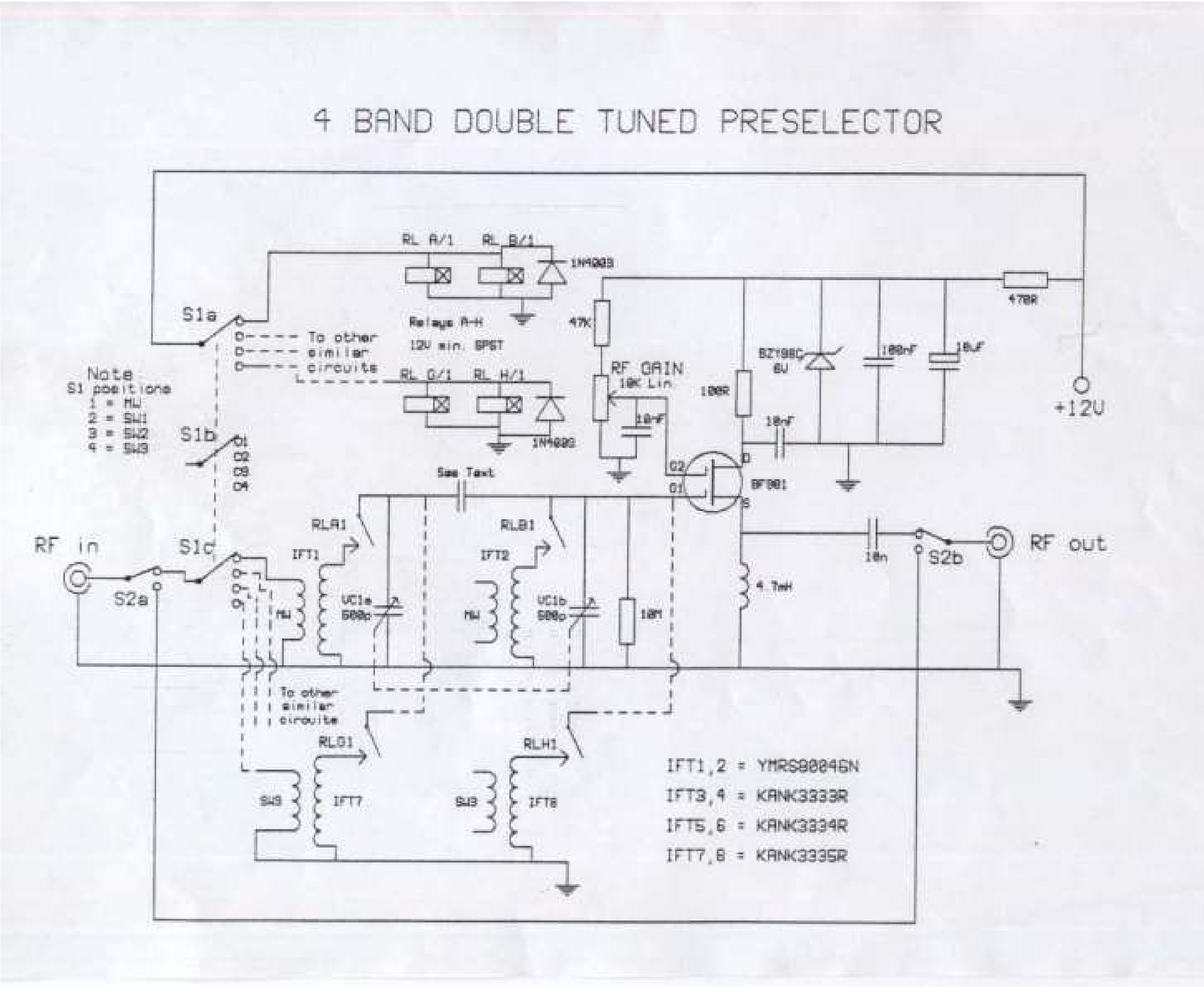
4 Band Double-Tuned Preselector



Notes:

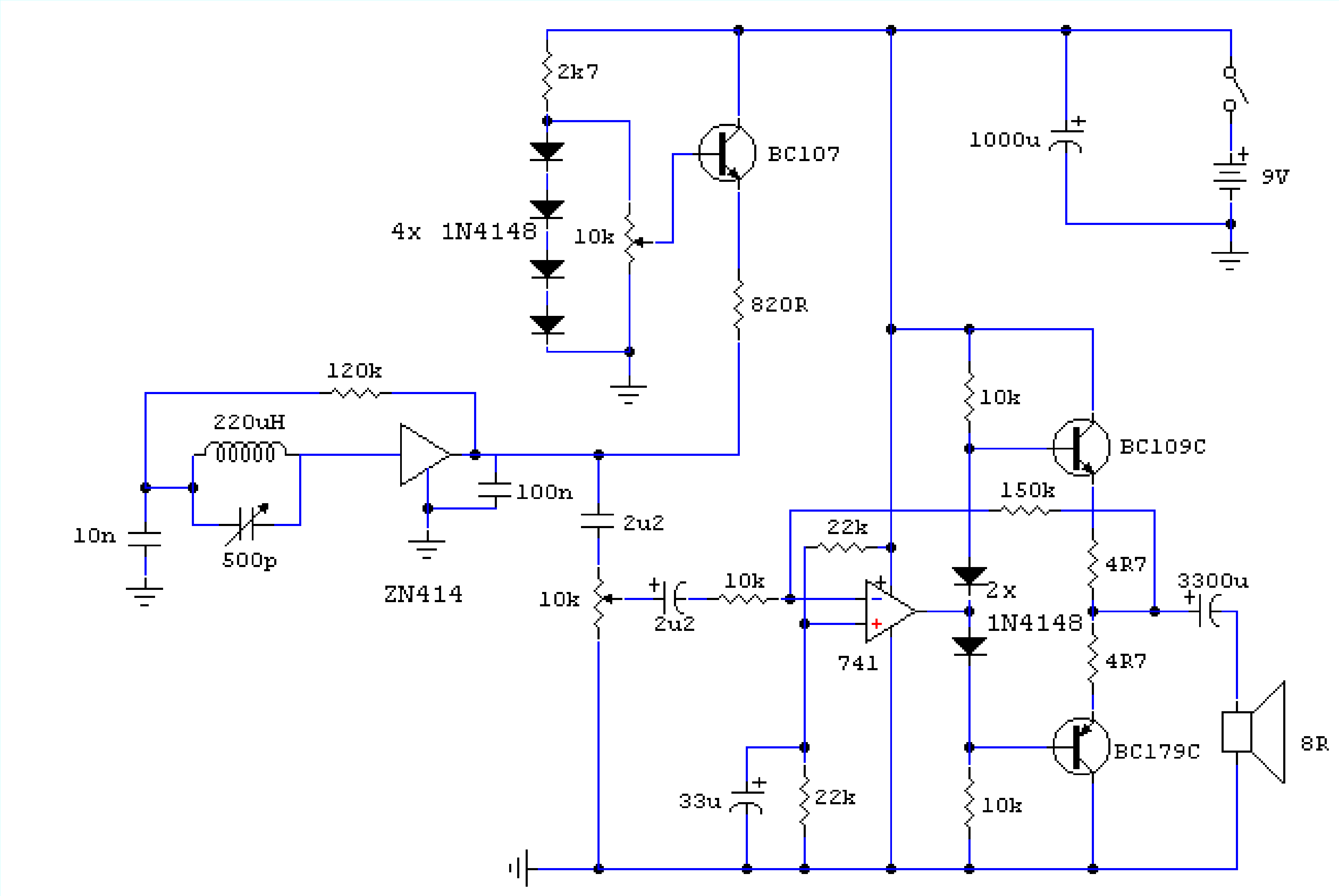
Once again, this is a project designed by David Sayles. The input can be from a longwire or a loop antenna. The unit covers MW and Sw to 30MHz. Click here for a picture of David's MW loop. Click here to view a finished picture of this project. (Courtesy of David Dayles.)

Back to RF Circuits

ZN414 Portable AM Receiver

Notes:
Designed around the popular ZN414 ic this receiver covers the AM band from 550 - 1600 KHz with the values
shown. For Longwave the coil needs to be changed. Use one from an old MW radio to save time. The ZN414
is a tuned radio frequency designed and incorporates several RF stages and an AM detector. It is easily overloaded and the operating voltage is critical to achieve good results.

The BC107 acts as a voltage follower, the four 1N4148 diodes providing a stable 2.4V supply. With the
10k pot , which acts as a selectivity control, and the b-e voltage drop of the BC107, the operating voltage for
the ZN414 is variable from 0 to 1.8volts DC. If you live in an area that is permeated with strong radio signals,
then the voltage will need to be decreased. I found optimum performance with a supply of around 1.2 volts.



The audio amplifier is built around an inverting 741 op-amp. Extra current boost is provided using the BC109 / BC179 complementary transistor pair. The voltage gain of the complete audio amplifier is around 15. The audio output of the complete receiver is really quite good and free from distortion. I may provide some sound samples later. Click here to see a picture of my prototype. I used a small wooden enclosure and the complete tuning assembley from an old radio.

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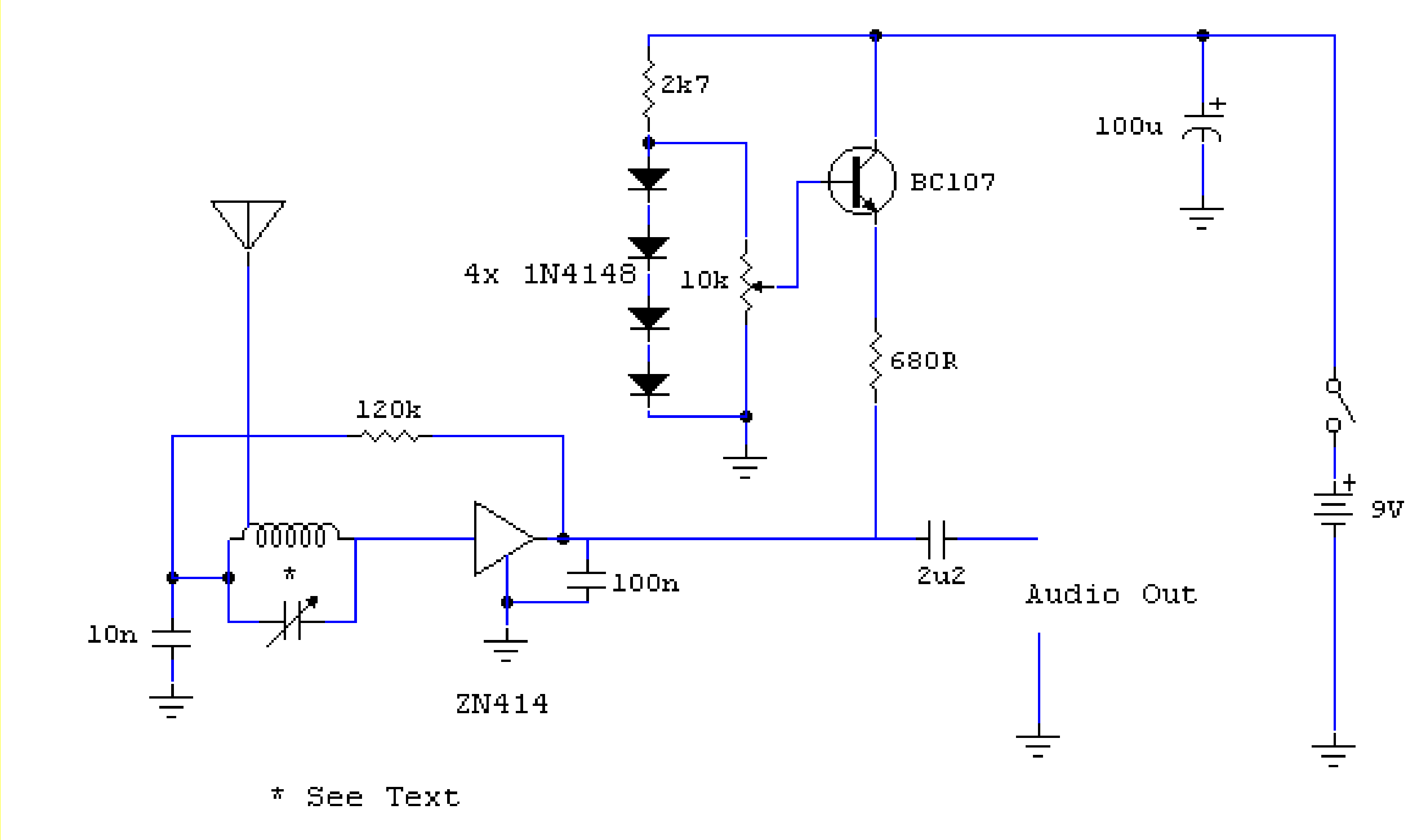
Short Wave Receiver Using the ZN414



Notes:
The original data sheet for the ZN414 states that the maximum working frequency is around 4 MHz. That may be
true, but SW broadcasts are so powerful that this receiver will work well with signals up to around 6 or 7 mhz.
The 10k resistor controls the operating voltage for the ic which is critical for good performance.

The tuned circuit consists of a variable capacitor and fixed air spaced coil. For the inductor, I wound 10 -20 turns
of wire on an empty tube of around 1.5 inches diameter. The turns were spaced so that the overall length was
around 3 inches. The variable capacitor tuned 0 - 300 pF but there is plenty of scope for experiment here. One
final point, you will need an external antenna to receive broadcasts. I have an outside wire that is about 7 meters
long and this was quite effective. The antenna can be connected at either end of the coil or via a series capacitor
value between 10pF and 100 pF.

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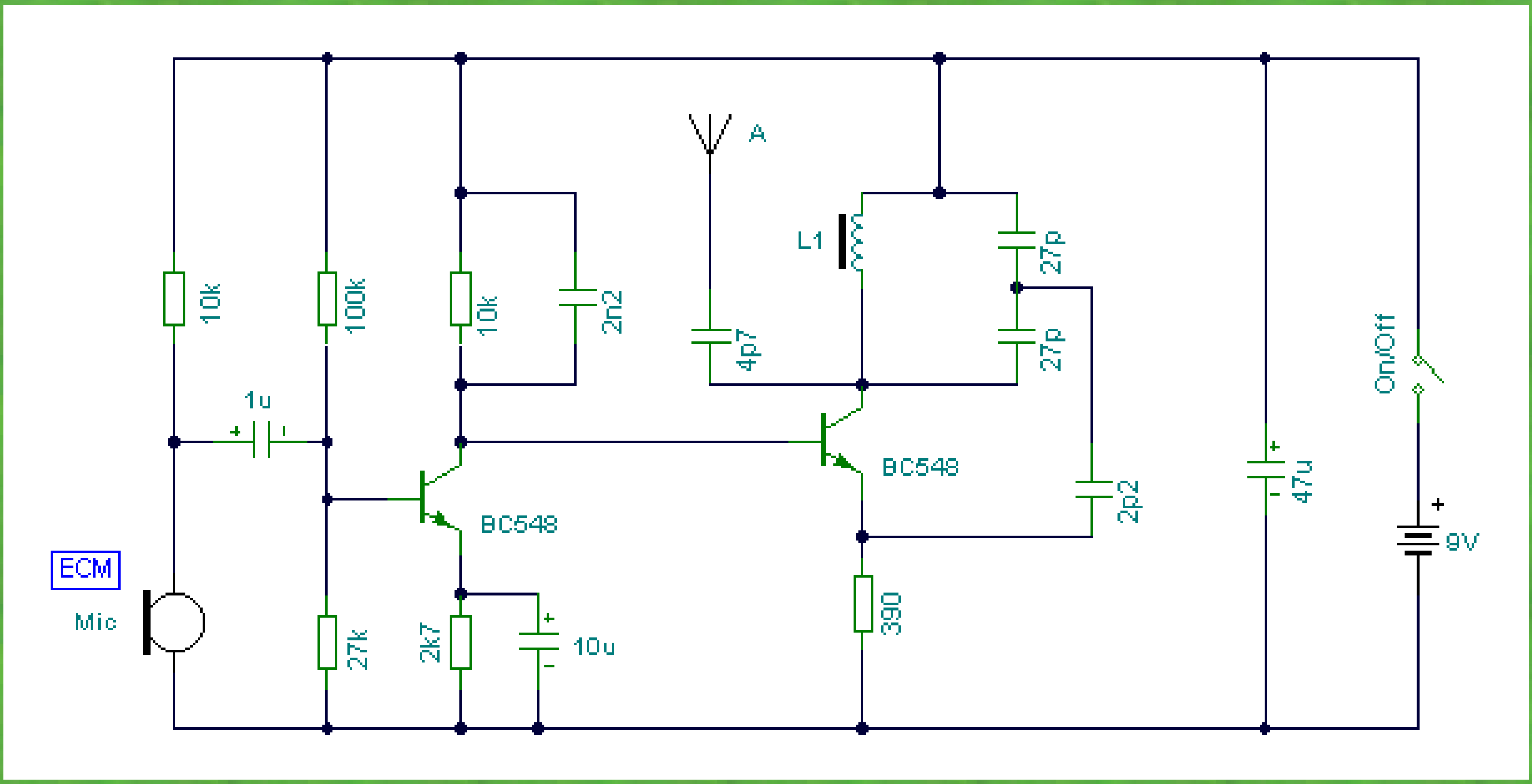
2 Transistor FM Voice Transmitter

Warning:
Take care with transmitter circuits. It is illegal in most countries to operate radio transmitters without a license. Although only low power this circuit may be tuned to operate over the range 87-108MHz with a range of 20 or 30 metres.



Notes:
I have used a pair of BC548 transistors in this circuit. Although not strictly RF transistors, they still give good results. I have used an ECM Mic insert from Maplin Electronics, order code FS43W. It is a two terminal ECM, but ordinary dynamic mic inserts can also be used, simply omit the front 10k resistor. The coil L1 was again from Maplin, part no. UF68Y and consists of 7 turns on a quarter inch plastic former with a tuning slug. The tuning slug is adjusted to tune the transmitter. Actual range on my prototype tuned from 70MHz to around 120MHz. The aerial is a few inches of wire. Lengths of wire greater than 2 feet may damp oscillations and not allow the circuit to

work. Although RF circuits are best constructed on a PCB, you can get away with veroboard, keep all leads short, and break tracks at appropriate points.

One final point, don't hold the circuit in your hand and try to speak. Body capacitance is equivalent to a 200pF capacitor shunted to earth, damping all oscillations. I have had some first hand experience of this problem. The frequency of oscillation can be found from the theory section,and an example now appears in the Circuit Analysis section.

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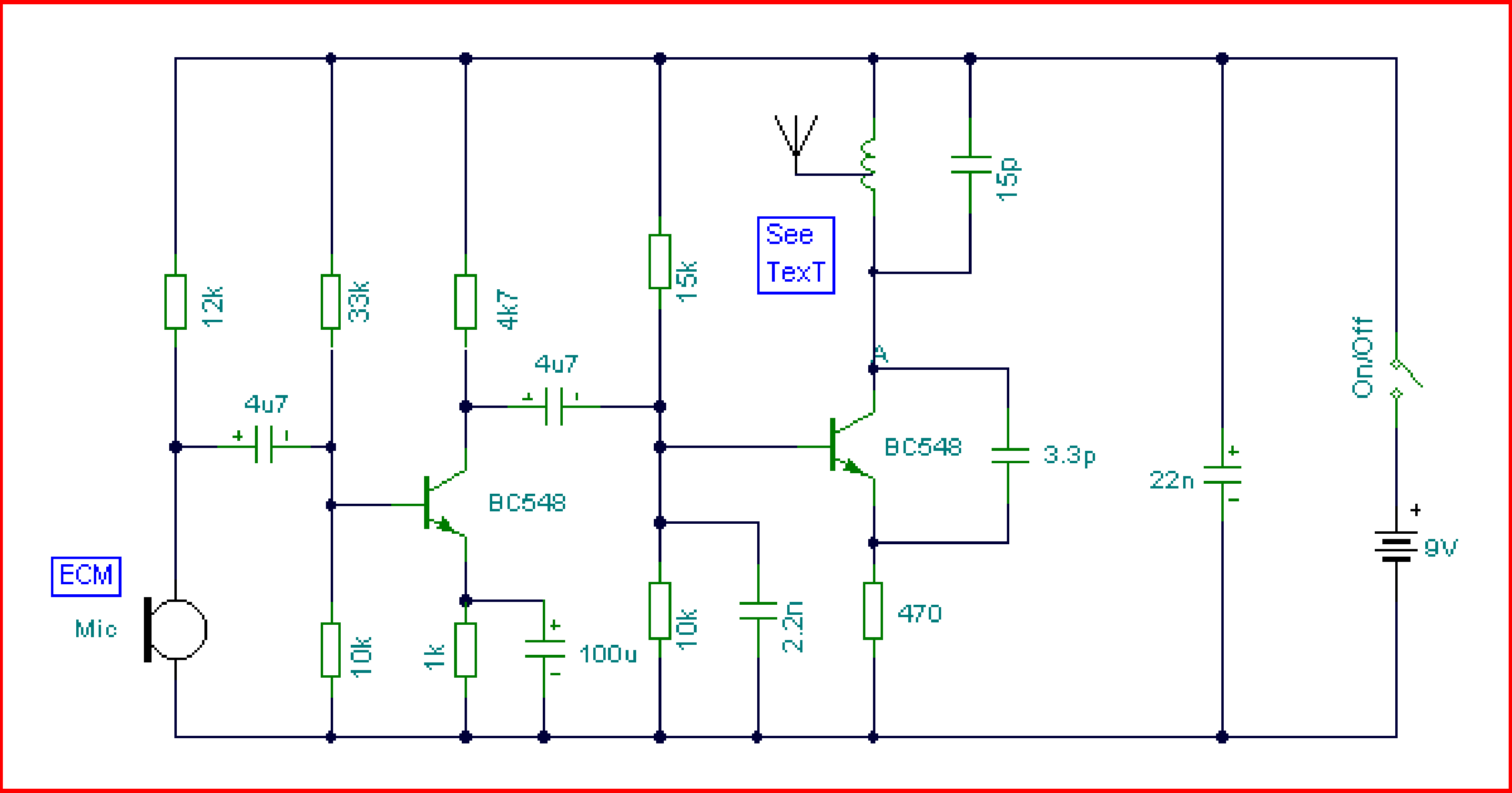
FM Transmitter Bug



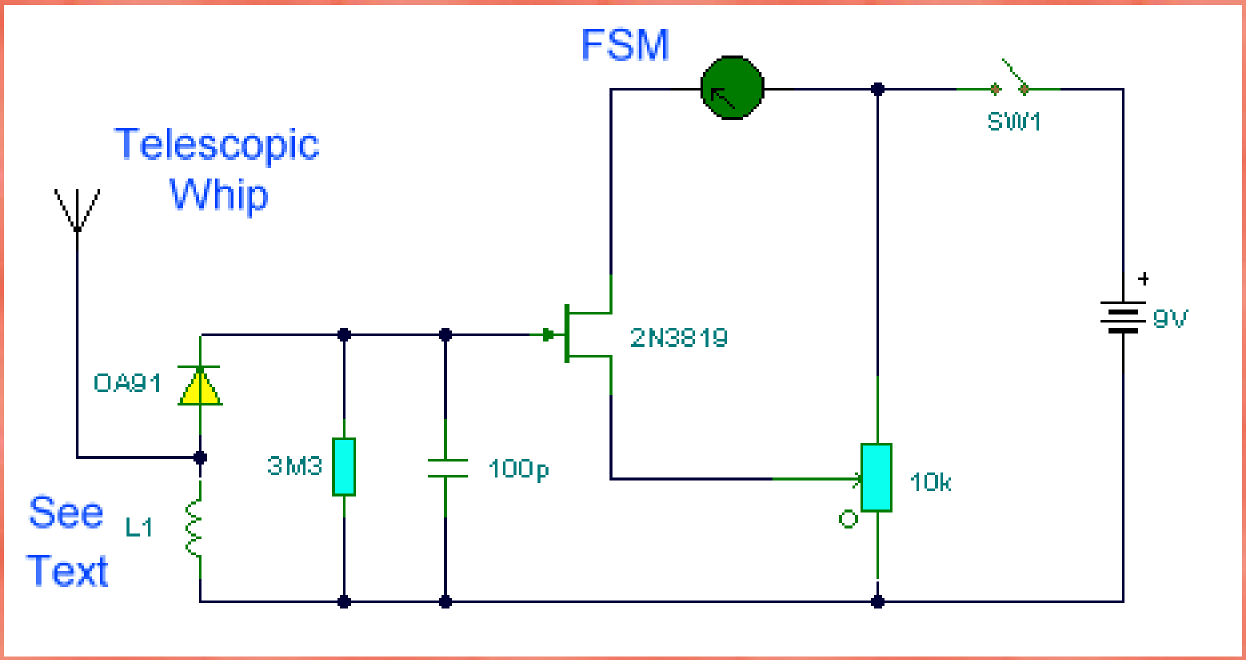
Application Notes:
This small transmitter uses a hartley type oscillator. Normally the capacitor in the tank circuit would connect at the base of the transistor, but at VHF the base emitter capacitance of the transistor acts as a short circuit, so in effect, it still is. The coil is four turns of 18swg wire wound around a quarter inch former. The aerial tap is about one and a half turns from the supply end. Audio sensitivity is very good when used with an ECM type microphone insert. David's email : radio_david@yahoo.com

Back to RF Circuits

Field Strength Meter

Descripton

This is a wide band signal strength meter circuit which responds to small changes in RF energy, designed to be used for the VHF spectrum and will respond to AM or FM modulation or just a plain carrier wave.



Notes:

This circuit measures radio field strength by converting the signal to DC and amplifying it. This field strength meter was designed for VHF frequencies in the range 80 -110 MHz.The inductor L1 is 4 to 6 turns of 20swg wire air spaced wound on a quarter inch former or similar. Alternatively an inductor of value 0.15 - 0.35uH will suffice. Sensitivity is not as good as I would have liked, but a small 9 volt battery transmitter will deflect the meters needle from a distance of up to two feet from the FSM. Higher power transmitters give higher signal strength readings and of course from much further away.The meter used was a signal meter with FSD of 250uA. Lower FSD meters will offer greater sensitivity.

The FET used in this circuit is a general purpose 2N3819. A small telescopic whip antenna is used for signal pickup. The 10k preset resistor is used to adjust bias of the FET circuit; with no transmitter present the meter reading is zero, adjust preset if not. The RF signal, whether modulated or just a plain carrier, is rectified and converted to DC by the diode,capacitor and 3.3M resistor. This small DC voltage just enough to upset the bias of the circuit and hence cause a deflection of the meter.

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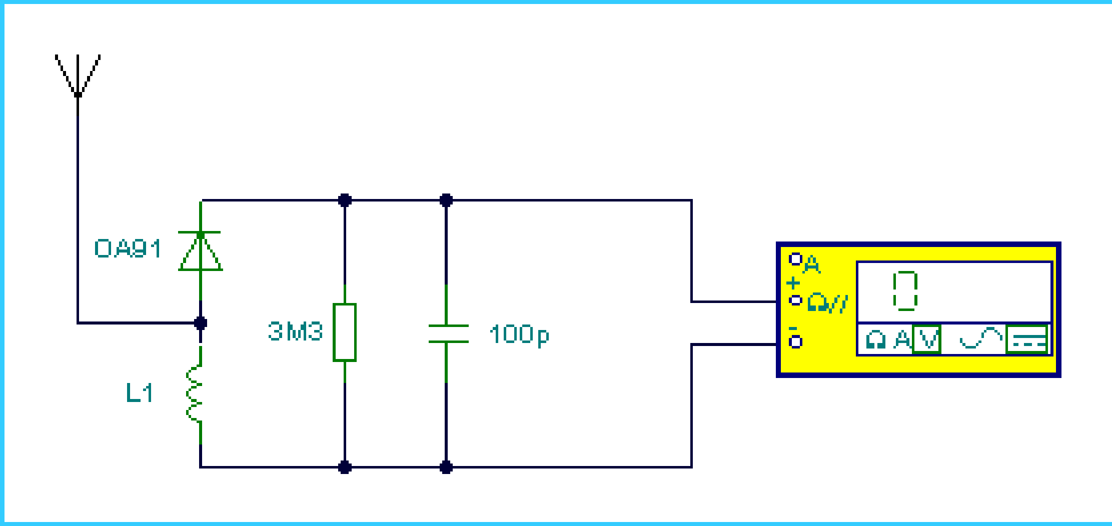
Simple Field Strength Meter



Notes:

This Field Strength Meter is simple and also quite sensitive. It uses an ordinary digital voltmeter
to measure signal strength. The VM should be set to the lowest dc volts range for maximum sensitivity. This is normally 200mV DC for most meters.

I have tried this at VHF and was quite pleased with the results. L1 was 7 turns on a quarter
inch former with ferrite slug. This covered the UK FM band. A digital multimeter, as opposed
to an analogue signal meter has several advantages in this circuit.

First, the impedance of a digital meter is very high, around 10M / volt on most meters. This
does not shunt the tank circuit unduly.
Second, as opposed to an analogue meter, very small differences in signal strength can
be observed more easily on the digital meter.
Thirdly, used with a digital meter, the FSM will have better linearity, responding well to both

weak and stronger signals, a cheap analogue meter may not respond too well to very weak changes in signal strength.

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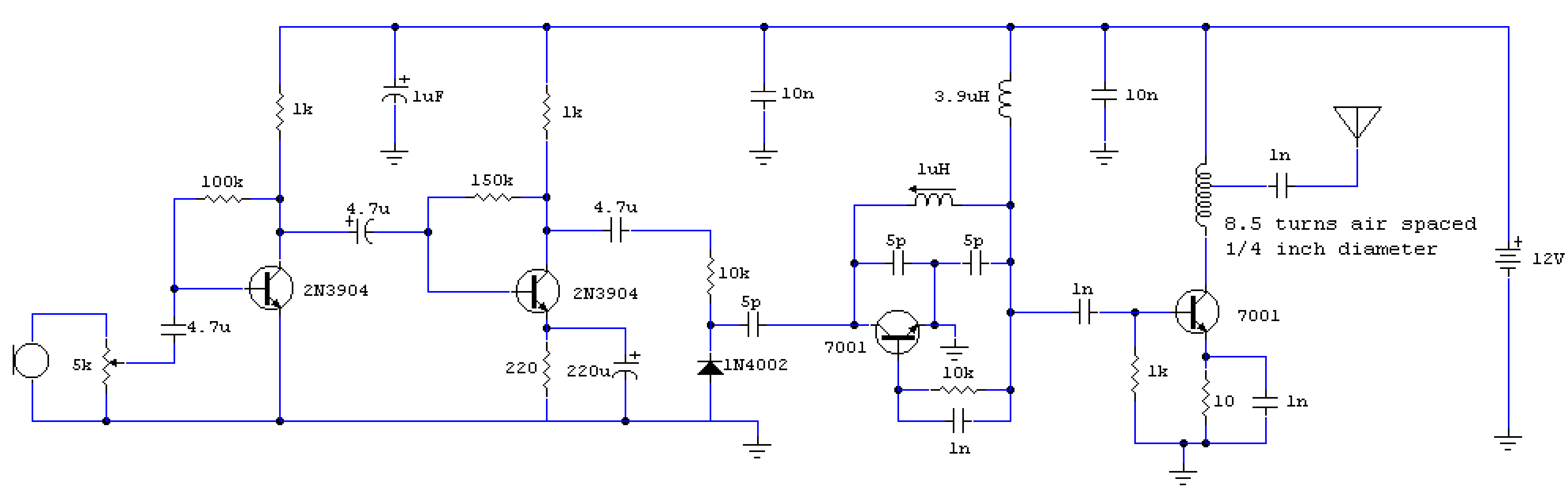
4 Transistor Transmitter



Circuit Notes:
This circuit provides an FM modulated signal with an output power of around 500mW. The input Mic preamp is built around a couple of 2N3904 transistors, audio gain limited by the 5k preset. The oscillator is a colpitts stage, frequency of oscillation governed by the tank circuit made from two 5pF capacitors and the inductor. (Click here for Colpitt Oscillator Resonant Frequency Equation.) Frequency is around 100Mhz with values shown.

Audio modulation is fed into the tank circuit via the 5p capacitor, the 10k resistor and 1N4002 controlling the amount of modulation. The oscillator output is fed into the 3.9uH inductor which will have a high impedance at RF frequencies.

The output stage operates as a class D amplifier , no direct bias is applied but the RF signal developed across the 3.9uH inductor is sufficient to drive this stage. The emitter resistor and 1k base resistor prevent instability and thermal runaway in this stage.

Paul K. Sherby
Belleville,
Michigan.
USA
Website:- http://www.geocities.com/Eureka/Park/5323

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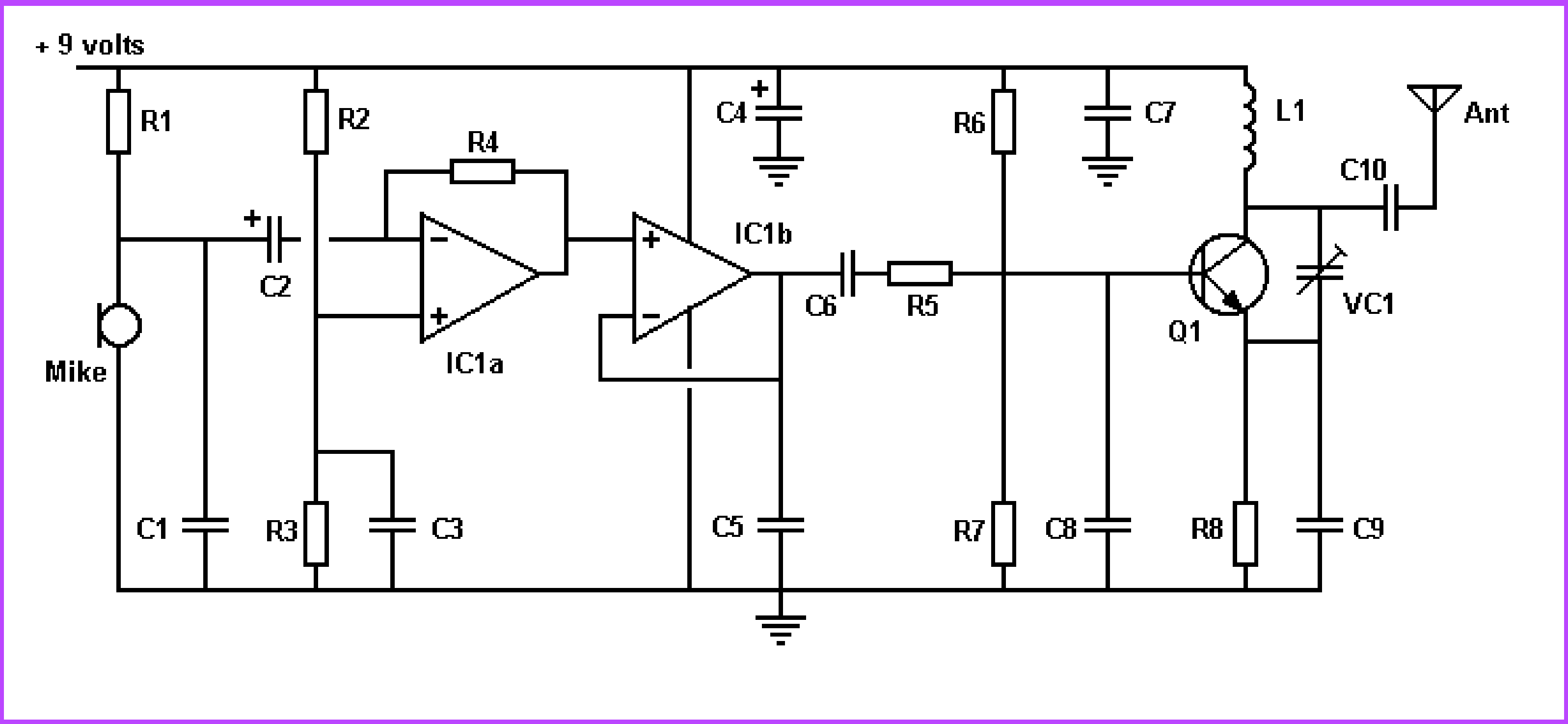
FM Transmitter Circuit

By Kamran Ahmed - UK



Parts List:

```
R1 4K7          R4 150K      R7 3K9 (2K7)

R2 4K7          R5 220R      R8 120R (82R)

R3 4K7          R6 4K7

All resistors except R8 are at least 0.25W rated. R8 is at least
0.5W rated
(the 0.6W metal film M-series from Maplin can be used for R1-R8).

C1 1n           C4 22uF          C7 10n          C10 1n

C2 4u7          C5 1n            C8 1n

C3 1n           C6 10n           C9 33pF

VC1 5-60pF           IC1 LM358          Q1 ZTX108
```

Notes:
L1 is 0.112uH (this tunes to the middle of the FM band, 98 MHz, with VC1 at its centre value of 33pF). L1 is 5 turns of 22 swg enamelled copper wire close-wound on a 5mm (3/16")

diameter former. Alternatively, you can have a fixed 33pF cap instead of VC1 and have L1 as an adjustable molded coil (eg UF64U from Maplin). VC1 will give you a tuning range of 85 - 125 MHz, and a possible choice is the Philips type polypropylene film trimmer (Maplin code WL72P). Two sets of oscillator bias resistors are given, the ones in the brackets give about 20% more RF power. Mike is our favourite Omnidirectional sub-mini electret (Maplin code FS43W). Ant is a (lambda / 4) whip monopole (eg 76 cms of 22 swg copper wire). Q1 is configured as a Clapp oscillator. Frequency modulation results from the audio voltage changing the transistor's base-emitter capacitance.

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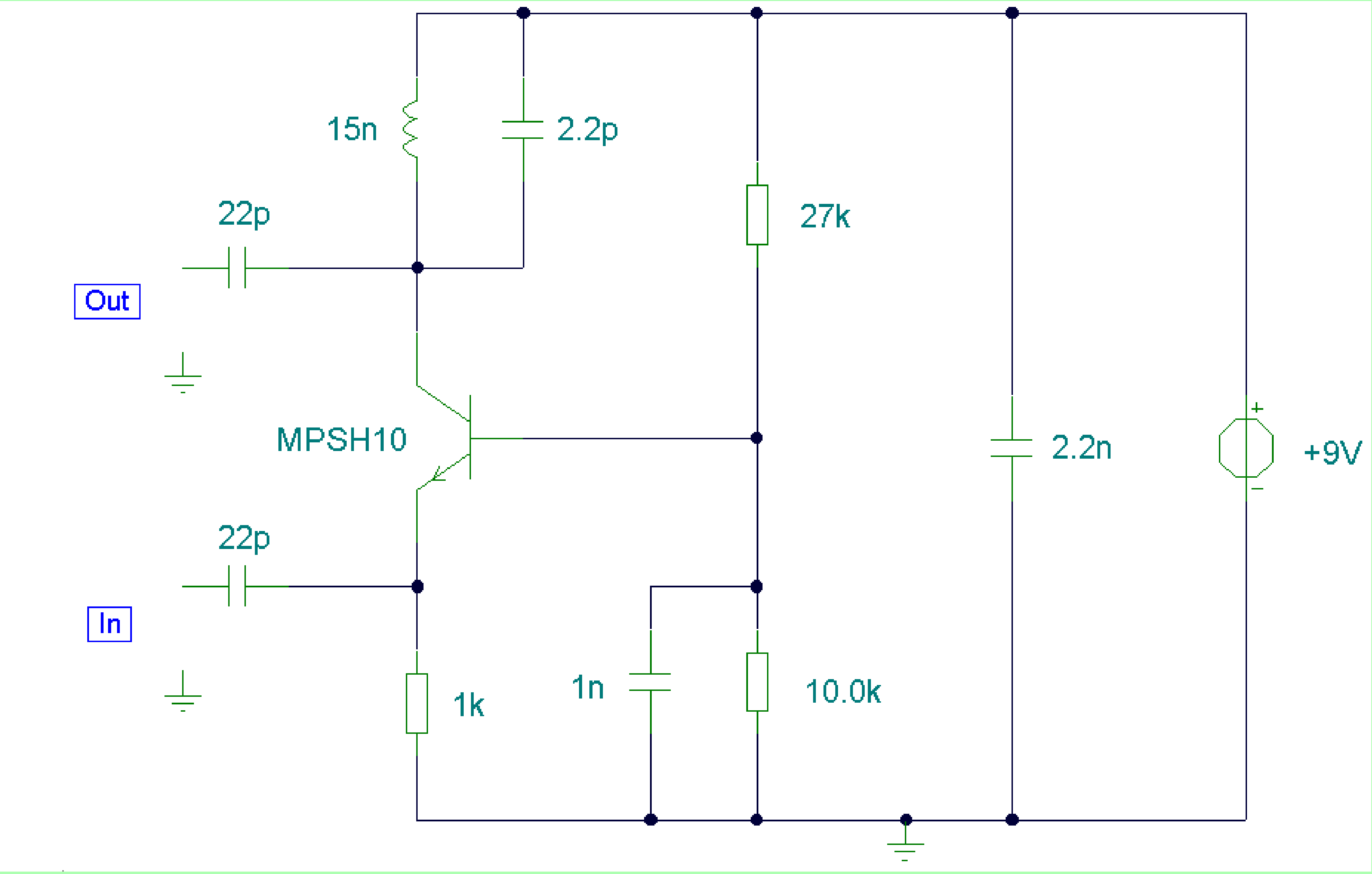
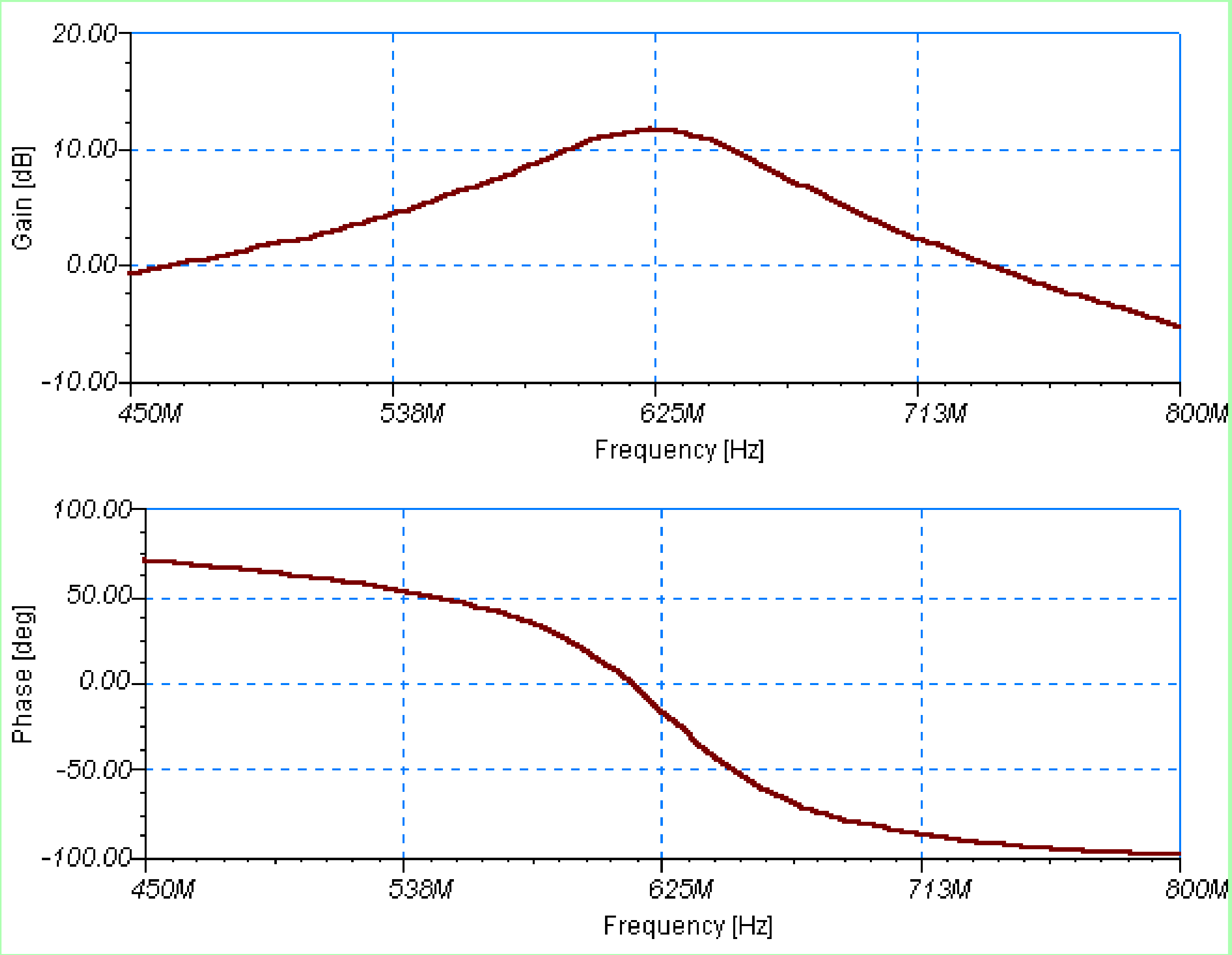
UHF Preamplifier

This circuit is designed to work at UHF frequencies in the range 450-800MHz. It has a gain of around 10dB and is suitable for boosting weak TV signals. The circuit is shown below:-



The MPSH10 transistor used is available from Maplin Electronics order code CR01B. Alternatives that may be used instead are BF180 and BCY90. The tuned circuit comprising the 15nH inductor and 2.2pF capacitor resonate in the centre of the UHF band. The 2.2pF capacitor may be exchanged for a 4.7pF or a trimmer capacitor of 2-6pF to improve results. The approximate frequency response is shown below. N.B. This is a simulated response using the TINA program produced by using a swept 20uV input swept over the frequency range 400-800MHz. Output was measured into a 1k source and the frequency generator has a 75ohm impedance.



Construction

The coil is half a turn of 18-20 SWG copper wire bent around a half inch drill bit. This ensures a low Q and therefore broad tuning. High frequency work requires special construction techniques to avoid instability (unwanted oscillations) caused by feedback from output to input. Veroboard is not suitable for this project as the capacitance between tracks is around 0.2pF. A better approach is to use tag-strip or a PCB. The circuitry should be enclosed in a metal case and a screen made between input and output. As the transistor is used in common base mode,its low input impedance is a good match for 50-75 ohm coax cable, whilst at the same time providing full voltage gain to the upper frequency limit of the device. The 15nH inductor load, having almost a short circuit impedance at DC, has an impedance of 56ohms at 600MHz. This inductance and 2.2pF capacitor form a tank circuit at the transistors collector, providing maximum gain at resonance. Note however that the voltage gain will be reduced under load, when the circuit is connected to the input of a TV set or a very long piece of coaxial cable for example. Hence the simulated Tina plot.

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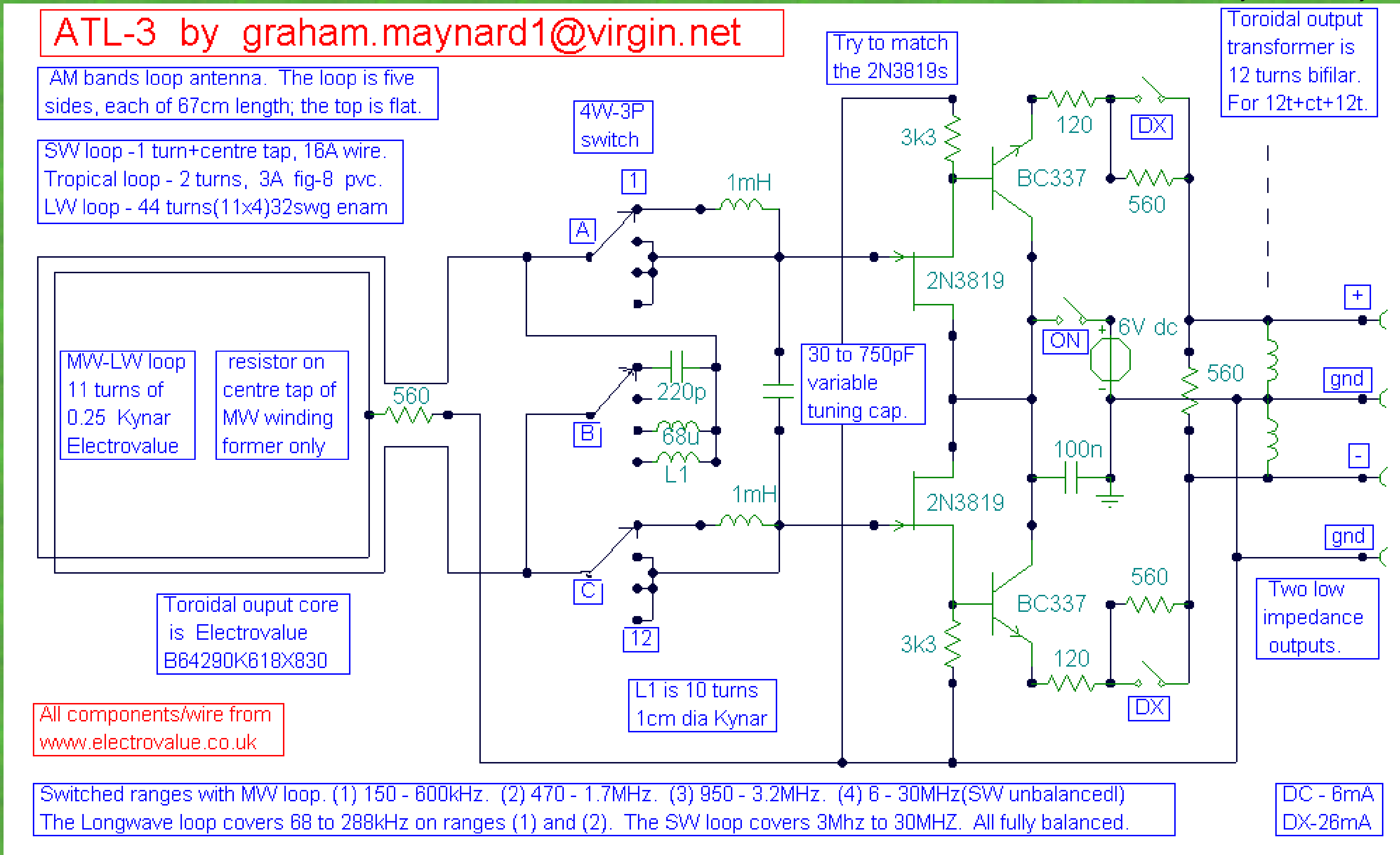
The ATL-3 Loop Antenna

by Graham Maynard



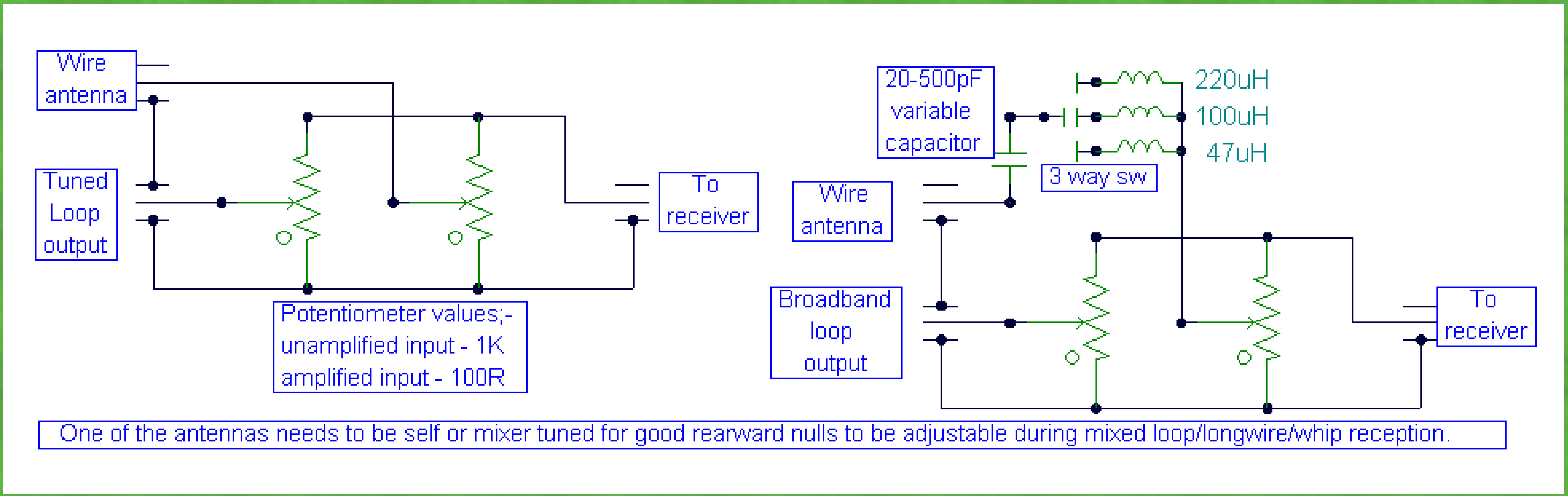
This antenna is the result of long term development and user feedback.

All ATL-3 loop windings are centre tapped and balanced w.r.t. their amplifier/receiver chassis ground, and therefore electric field interference pick up tends to self cancel. Magnetic noise fields,e.g. televisions and the electric meter box, or electromagnetically radiated interferences, may be minimised by loop rotation. Where the received noise does not degrade wanted station reception, an indoor active loop can be very rewarding.

Tuned winding antennas always have a potential 6dB greater signal sensitivity, and provide a better signal to noise ratio than equally sized broadband designs; thus a much larger broadband loop area becomes necessary to better the performance of the standard 40 inch frame loop with d.m.a., or an ATL-3. Note that the switched ATL-3 amplifier circuit will work just as well from 150kHz to 3MHz with a seven turn 40" MW box loop, by simply extending a ground connection to a centre tap at the middle of the winding. 40" loop construction details are already available from MWC reprints.

ATL-3 loop windings are in the shape of a five 65cms. (26inches) sided spiral with flat top, so that they won't bash your radio when you rotate them. Winding turns are 2mm. spaced for the 11 turn MW loop,with the centre tap 5t. in from the outside edge; the excellent 44 turn LW winding is comprised of 4 turns per eleven 2mm. spaced slots. Loop corner formers can be made from sections of unclad 0.1 inch matrix board from Electrovalue, with the turns fixed in place with varnish or paint after winding, but before use.

Do try combining your loop signal with the signal from an outdoor wire or active whip antenna. Whatever your loop gain, it can be doubled in one direction in line with the loop, with deep nulling in the opposite direction......just what UK Dxers need to counter strong night-time EU skywaves. The controls do not need to be complicated, see the circuit drawings below.



The Medium Wave Circle can be found by clicking here.

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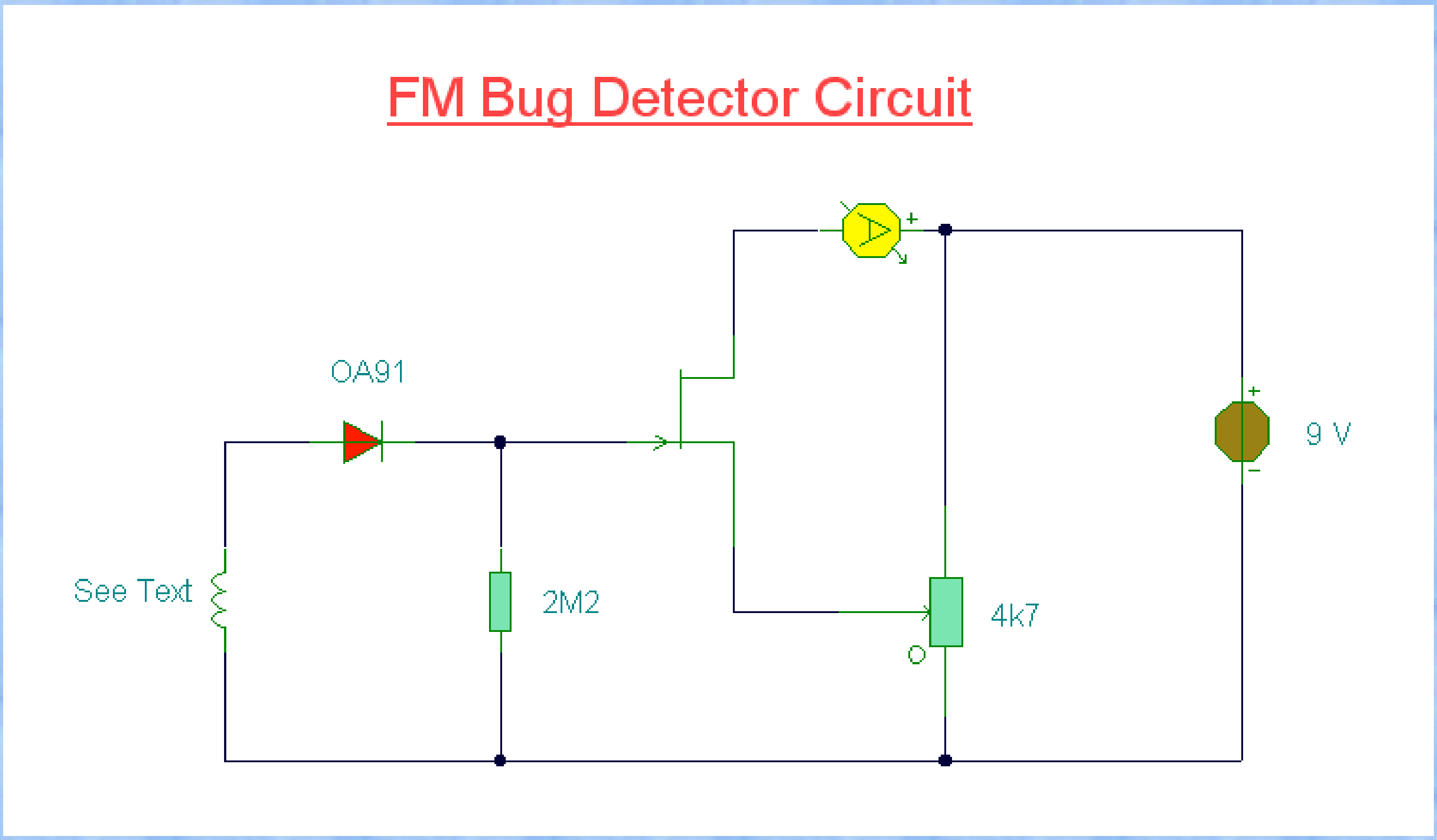
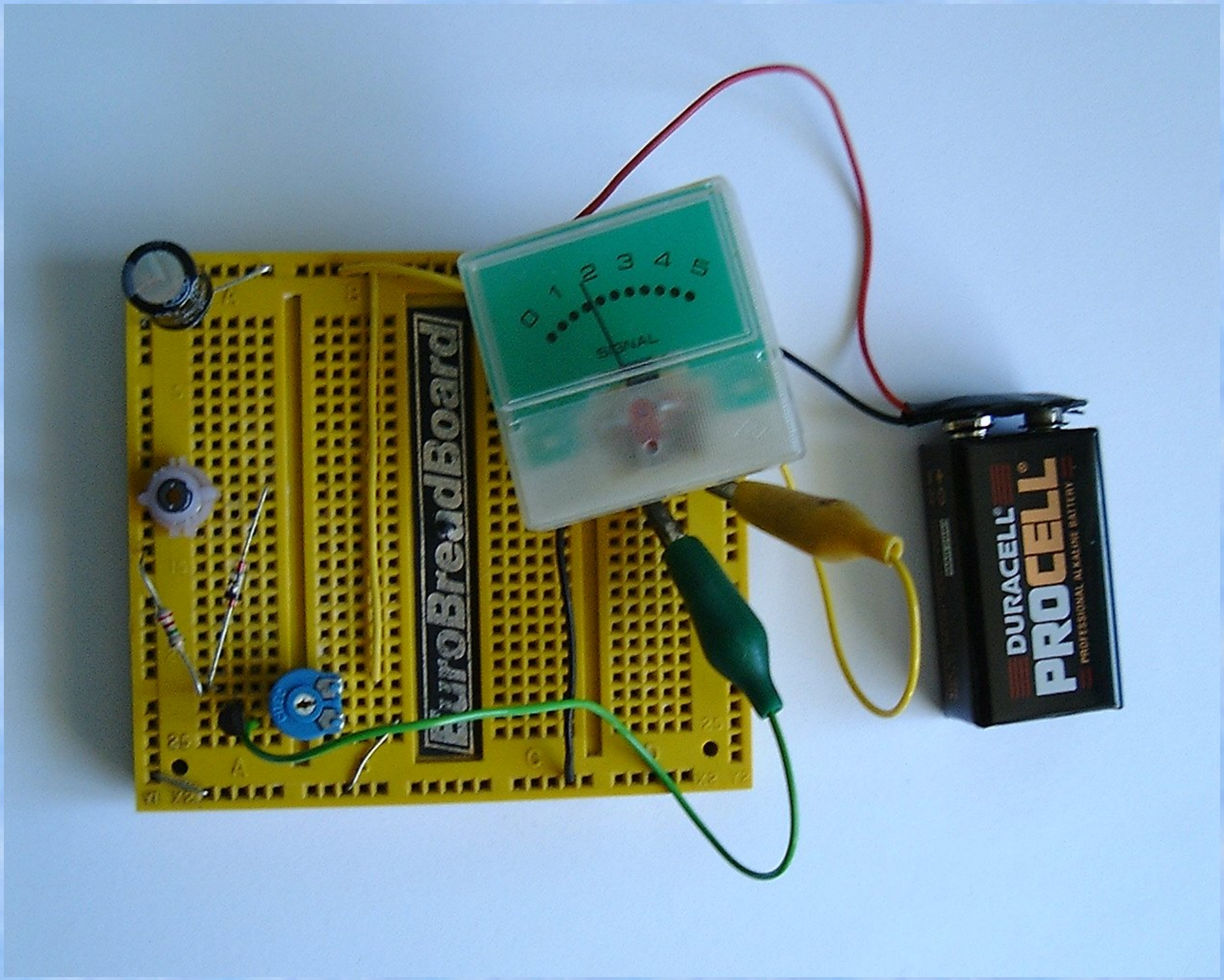
Surveillance Transmitter Detector



Notes:
My site contains a few low power transmitters of one type or another, but until now no receiver. This circuit can be used to "sweep" an area or room and will indicate if a surveillance device is operative. The problem in making a suitable a detector is to get its sensitivity just right, Too much sensitivity and it will respond to radio broadcasts, too little, and nothing will be heard.

This project has few components, can be made on veroboard and powered from a 9 volt battery for portability. My prototype shown below worked OK on a Eurobreadboard.



Circuit operation is simple. The inductor is a moulded RF coil, value of 0.389uH and is available from Maplin Electronics, order code UF68Y. (See my links page for component suppliers.) The coil has a very high Q factor of about 170 and is untuned or broadband. With a test oscillator this circuit responded to frequencies from 70 MHz to 150 MHz, most of the FM bugs are designed to work in the commercial receiver range of 87 - 108 MHz. The RF signal picked up the coil, and incidentally this unit will respond to AM or FM modulation or just a plain carrier wave, is rectified by the OA91 diode. This small DC voltage is enough to upset the bias of the FET, and give an indication on the meter. The FET may by MPF102 or 2N3819, the meter shown in the picture is again from Maplin Electronics, order code LB80B and has a 250 uA full scale deflection. Meters with an FSD of 50 or 100 uA may be used for higher sensitivity.

In use the preset is adjusted for a zero reading on the meter. The detector is then carried around a room, a small battery transmitter will deflect the meter from a few feet away.

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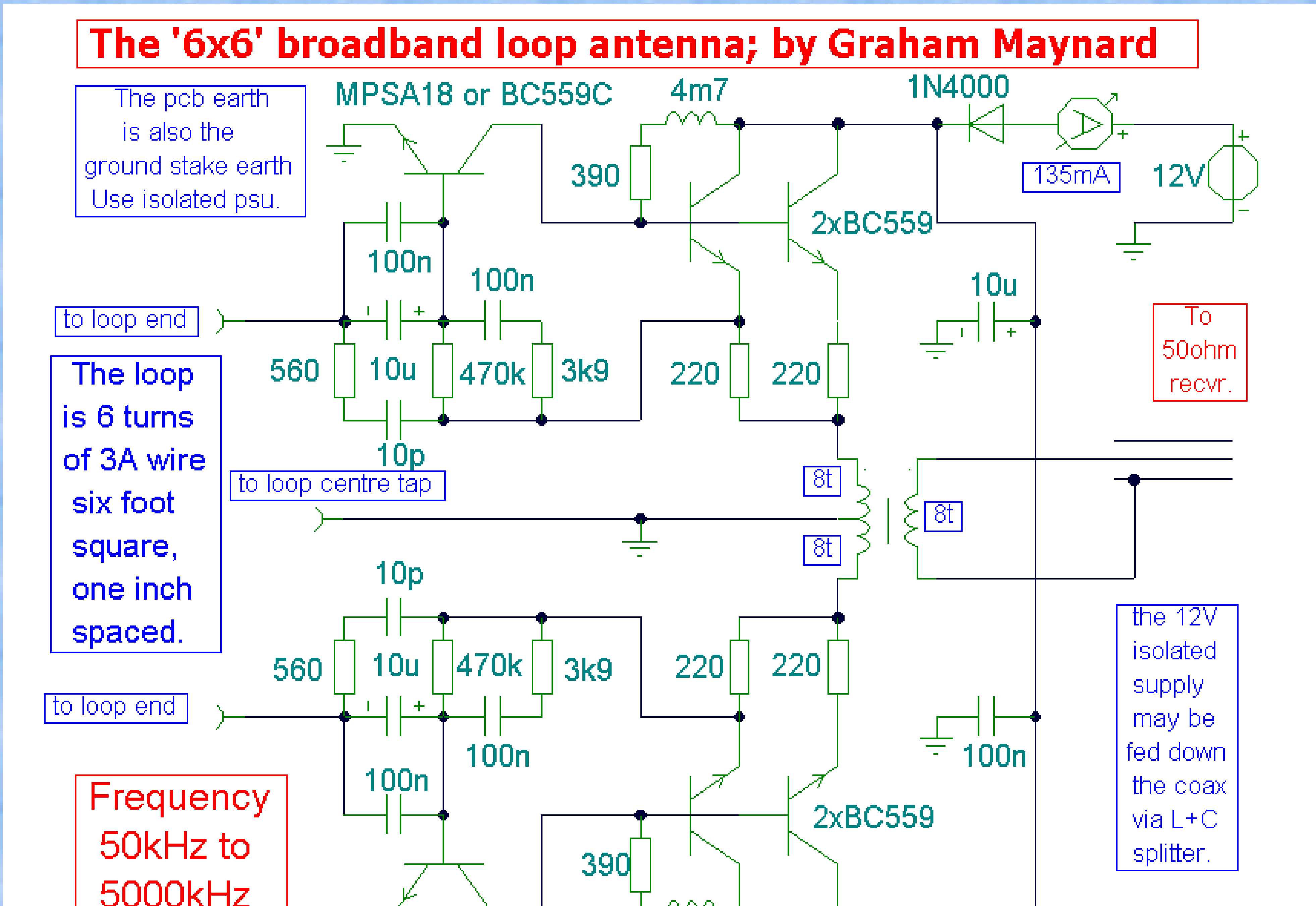
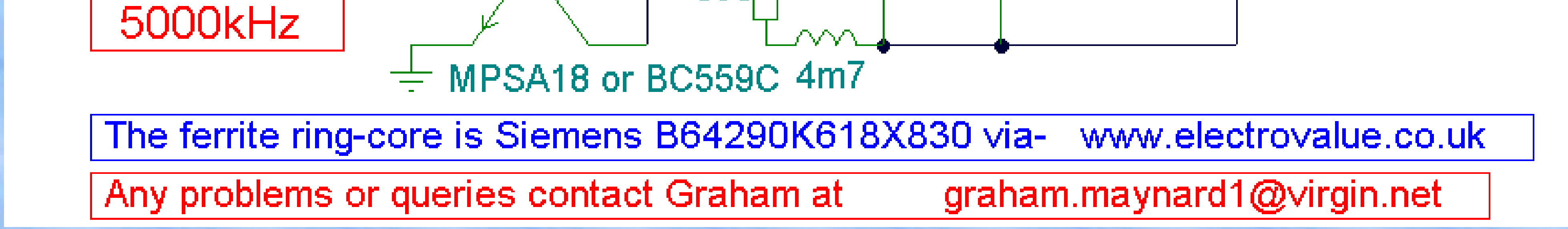
6 x 6 Loop Antenna

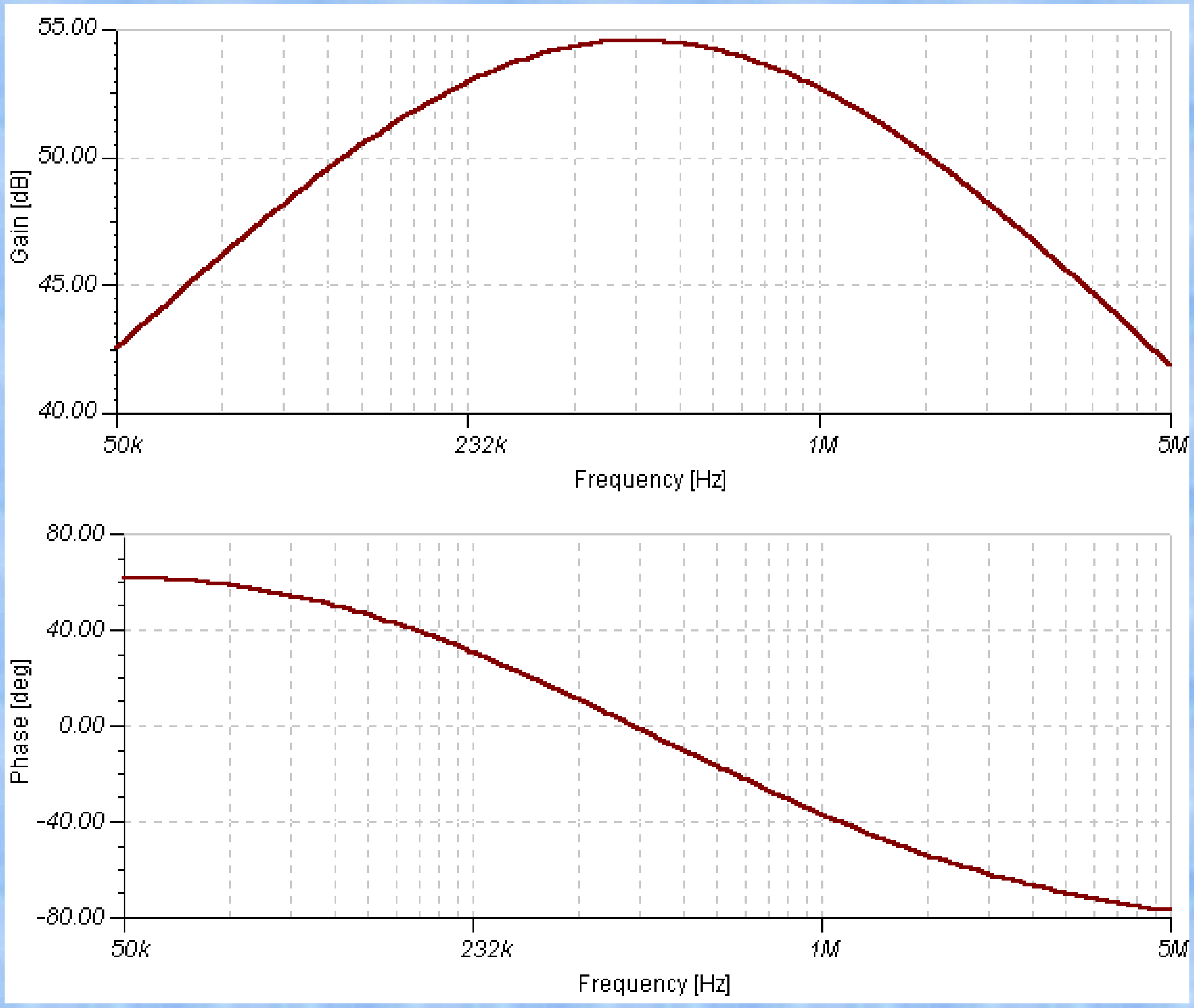
Circuit: Graham Maynard
Text: Graham Maynard and Andy Collinson





Notes:
This new loop antenna by Graham Maynard is his best design yet and I am proud to be the first to present his work. It uses one, six foot square, six turn loop, and is aperiodic in nature, covering the frequency range 50KHz - 5000KHz.

The loop is of a size that can be mounted inconspicuously against a garden fence away from household interferences. This new '6x6' design uses the centre tapped loop winding as an input phase splitter. This ensures low distortion push-pull operation. The amplifier also has a low impedance shunt input which maximises gain. These aspects give it a better signal to noise ratio than with a single ended or high impedance amplifier. The amplifier provides a useful gain of 42 - 54dB over its frequency range, see the Bode Plot below. Please note, that the Bode plot is derived for the amplifier circuit ONLY, it is not possible to simulate the characteristics of a six foot square loop.



The first MPSA18 transistor on each loop operates in common emitter, the collector being directly coupled to a double emitter follower pair. The circuit has self DC biasing, the emitter of the first BC559 being coupled to the base of the MPSA18 transistor. The network of resistors and capacitors around the base of each MPSA18 transistor tailors the amplifier response to the specified limits. The double emitter follower pair evenly distributes the Class A heat dissipation, and direct feedback in the bias chain, counters temperature drift effects. The output from each amplifier half is fed via a 2:1 tri-filar wound push-pull output transformer, with the output winding sandwiched between each primary half. There is equal but opposite current flow and therefore maximum linearity. The output is isolated, which minimizes earth loop noise injection, either via receiver earth leakage or loop amplifier psu earth leakage.

To power the amplifier a separate twin flex may be used (speaker wire) , though it is possible to use a mains PSU via the coax itself. Graham's recommended mains psu is the UNI550R from Electrovalue (£8+p/p)

In Use:

The overall phase response is reasonably flat throughout any band, thus any cardioid or other developed reception patterns can remain directionally stable over a decent frequency range, which might be useful for trans-oceanic MW reception. It is intended that the centre-tap be made at the mid point along the bottom six foot antenna span, and this may be grounded with an earth stake. Sometimes reception on some bands can be made quieter by grounding this centre tap. You should to try the '6x6' with and without the ground on your favourite band.

Construction:

To ensure stability, the component layout should follow the above circuit layout, with all signal ground connections being kept as short and thick as possible in the centre of the pcb. This is of course a sensitive DXing antenna, thus it might be overloaded if used too close to a local broadcast transmitter. You can null powerful signals by setting the loop up at right angles to their source, i.e. when the loop's winding axis is in line with the interference.

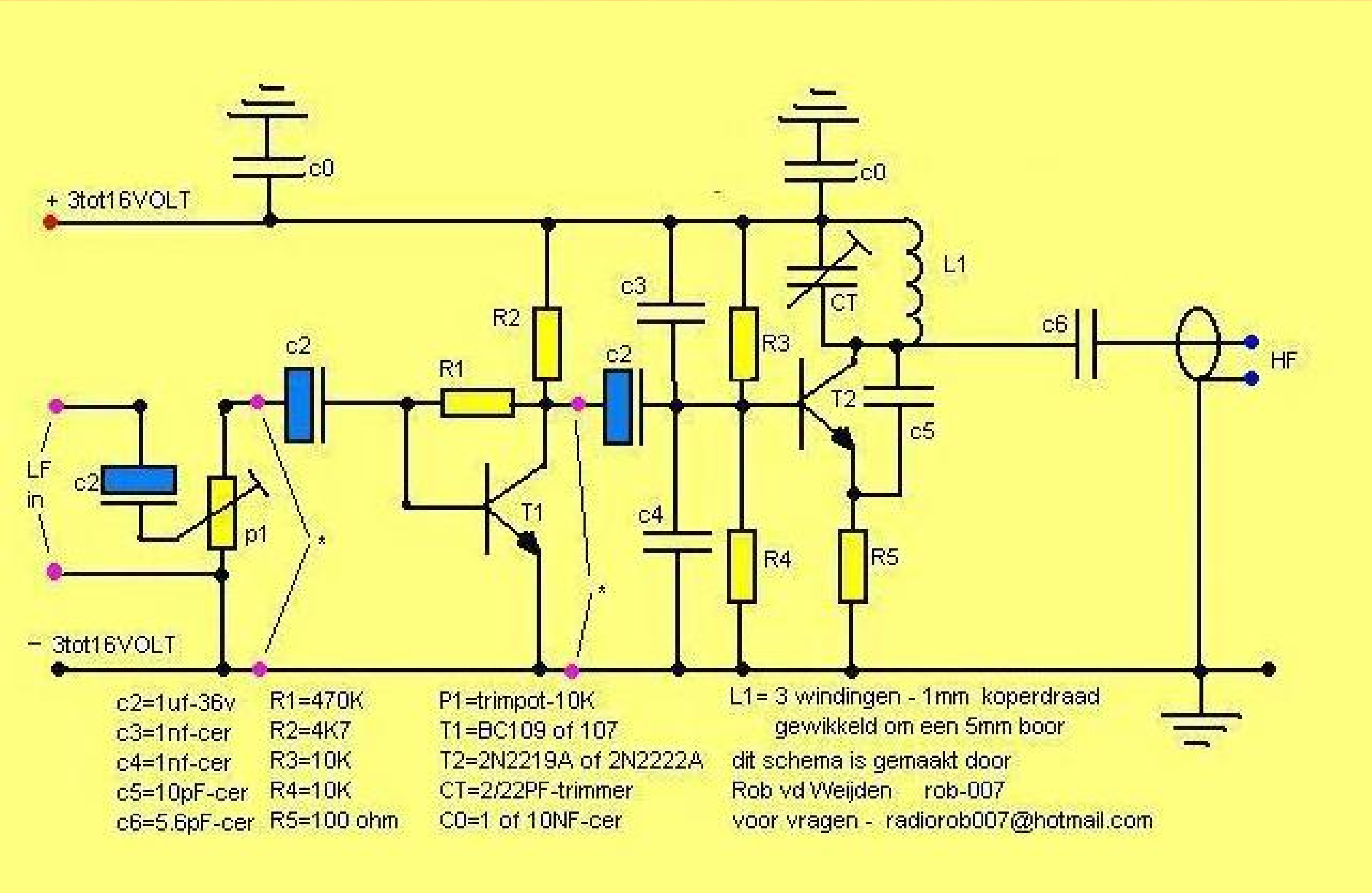
Please let Graham know if you construct this antenna, he is interested in hearing of everyone's results.

Return to RF Circuits

2 Transistor Transmitter

Circuit : Rob van der Weijden
Email: radiorob007@hotmail.com Dutch only please!
Notes: Andy Collinson

Description:
A compact 2 transistor transmitter for use at VHF frequencies.



Notes:
Transistor T1 works as an audio preamplifier, gain is fixed at approximately R2/R1 or 100 times. The audio input is applied at the points LF in (on the diagram). P1 works as gain control. After amplification this audio signal now modulates the transmitter built around T2. Frequency is tunable using the trimmer CT and L1 is made using 3 turns of 1mm copper wire wound on a 5mm slug. The modulated signal passes via C6 to the antenna. A dipole can be made

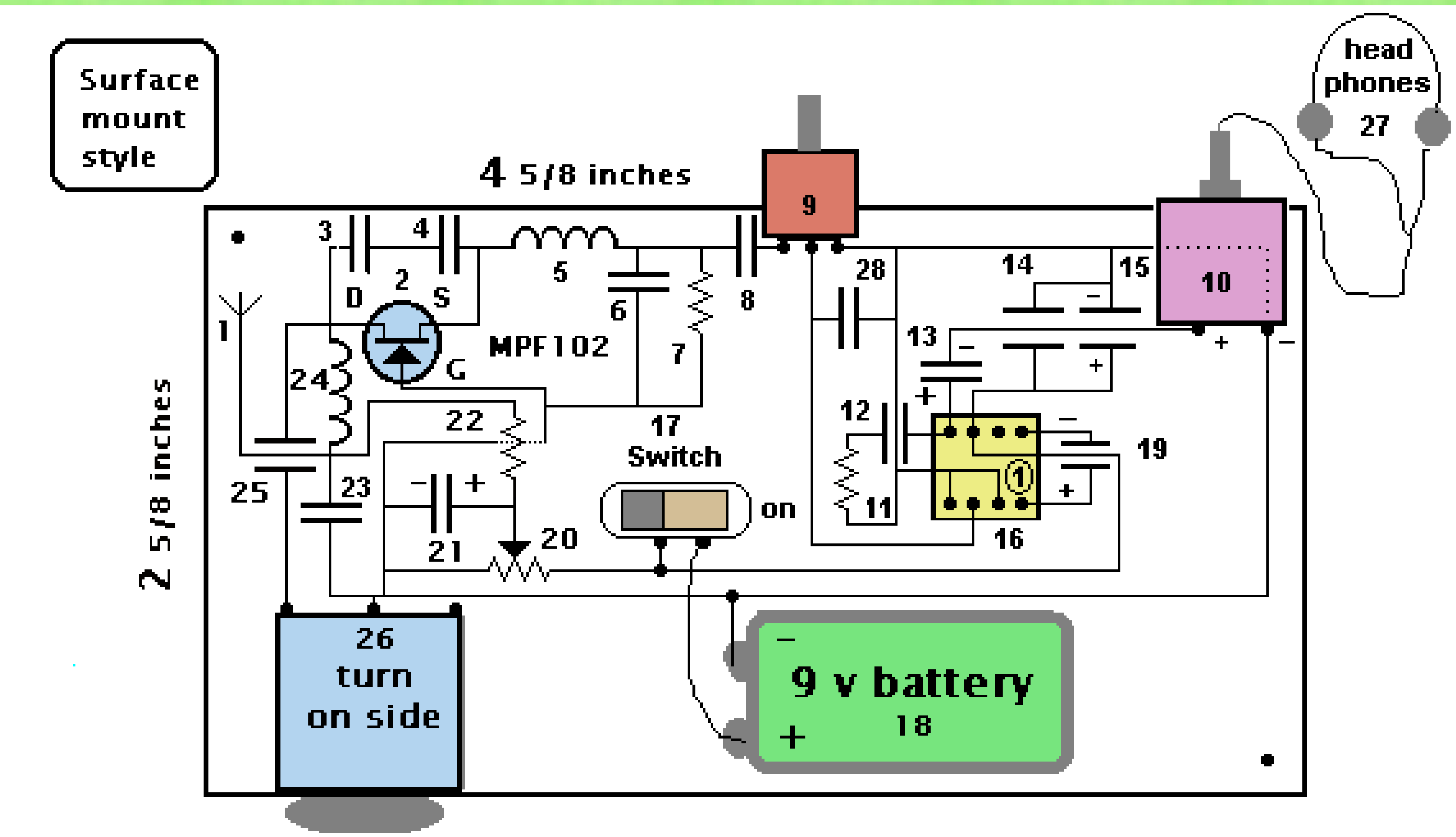
using 2 lengths of 65cm copper pipe. A DC power supply in the range 3 to 16 volts is required.

Return to RF Circuits

FM Receiver

Circuit :Patrick Cambre
Email: braincambre500@yahoo.com

Description:
An FM regenereative receiver using a single FET and one audio amplifier IC.



Component placement and values

1. Antenna - 12 inches of 18 guage wire
2. MPF102 N-Channel FET or 2N3819 N-Channel FET
3. 5.6pF disk capacitor
4. 5.6pF disk capacitor
5. 20 wraps of 24 guage bare enameled wire using a 5/16 round pencil as wooden form. Wraps must be tightly wound.
6. .0047 disk capacitor

17. On/Off Switch.
18. 9-volt DC Battery
19. 10uF capacitor (Observe Polarity)
20. 4.7K Potentiometer
21. 33uF/25v capacitor (Observe Polarity)
22. 1K ohm resistor
23. .001 disk capacitor
24. Using a 5/6 inch standard size bolt, wrap 8 to 10 turns with

enameled wire using a 5/16 round pencil as wooden form. Wraps must be tightly wound.

6. .0047 disk capacitor
7. 10K ohm resistor
8. .1 disk capacitor
9. 5k or 10k pot device
10. Head phone jack
11. 10 ohm resistor
12. .047 disk capacitor
13. 220uF/25v capacitor (observe polarity)
14. .047 disk capacitor
15. 100uF/25v capacitor (observe pol-arity)
16. LM386 audio amp IC. Pin #1 is highlighted in yellow. The chip is positioned up-sidedown and underneath the PCB.

22. 1K ohm resistor
23. .001 disk capacitor
24. Using a 5/6 inch standard size bolt, wrap 8 to 10 turns with bare 22 guage wire, then back wire out of bolt. Stretch or compress to adjust for full range with the variable capacitor.
25. 10pF disk capacitor
26. 15-140 variable capacitor; can be found in a small tunable AM/FM portable radio
27. Any pair of head phones.
28. .01 disk capacitor

NOTE: This is a single (not double) sided PCB. The bottom side has no copper. Also, all components are mounted standing up.

SUGGESTIONS:

* THE COIL THAT HAS THE EIGHT TO TEN TURNS SHOULD BE TAPPED OFF; STARTING FROM THE BOTTOM END OF THE PICTURE. IF THIS IS THE FIRST TIME YOU ARE MAKING THIS PROJECT; I SUGGEST YOU DO NOT USE A TAP (AS SHOWN IN THE PICTURE). AFTER YOU GET IF WORKING, YOU CAN THEN START EXPERIMENTING WITH THE TAP, STARTING FROMTHE BOTTOM UP. OF COURSE, TAPPING HIGHER AND HIGHER DOES PROMOTE EXCELLENT SOUND QUALITY, BUT THE OSCILLATING TANK WOULD BE MORE AND MORE ON THE VERGE OF STOPPING.

* ALSO, THE REGENERATIVE CONTROL (GAIN), WHICH IS THE 4.7K POTENTIOMETER, SHOULD BE TURNED ALL THE WAY TO THE RIGHT WHEN TURNING THE UNIT ON FOR THE FIRST TIME. AFTER YOU HAVE RECEIVED FM STATIONS, YOU CAN NOW ADJUST FOR MORE GAIN.

* IF YOU DO NOT HAVE A TYPICAL RADIO AM/FM VARIABLE CAPACITOR, YOU CAN PUT A FIXED CAPACITOR IN ITS PLACE, AND ADJUST THE FREQUENCY BY SQUEEZING OR STRETCHING THE COIL. I WOULD ASSUME THE FIX CAPACITOR IS IN THE NEIBORHOOD OF 10- TO 25 PF'S.

* I HAVE ALSO USED A 2N3819 JFET, AND IT WORKED ALSO. ALTHOUGH, I DID NOT EXPERIMENT MUCH WITH THIS TRANSISTOR BEING IN THE CIRCUITRY. I EXPERIMENTING A LOT WITH THE MPF102 IN THE CIRCUITRY SHOWN ABOVE.

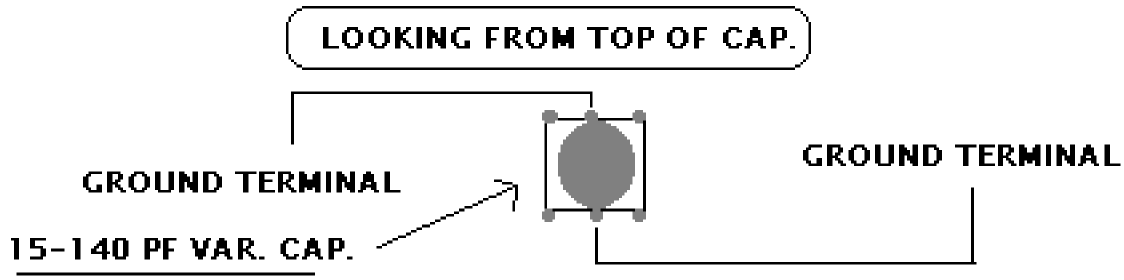
* THE GATE CIRCUITRY FROM THE MPF102 GOES IN BETWEEN THE TWO CONNECTIONS POINTS OF # 22.

* THE GROUND CIRCUITRY FROM THE VOLUME CONTROL, GOES UNDER NEATH THE AUDIO JACK (SEE DIAGRAM ABOVE).

* IF YOU DO HAVE A 15-140 VARIABLE CAPACITOR (THE ONES THAT COMES WITH A TYPICAL PORTABLE AM/FM RADIO), THE GROUND CONNECTION OF THE VARIABLE CAPACITOR MUST GO TO GROUND ON THE CIRCUITRY BOARD. AND OF COURSE,THE OTHER TERMINAL FROM THE VARIABLE CAPACITOR GOES TO THE 10 PF CAP

* IF YOU DO HAVE A 15-140 VARIABLE CAPACITOR (THE ONES THAT COMES WITH A TYPICAL PORTABLE AM/FM RADIO), THE GROUND CONNECTION OF THE VARIABLE CAPACITOR MUST GO TO GROUND ON THE CIRCUITRY BOARD. AND OF COURSE,THE OTHER TERMINAL FROM THE VARIABLE CAPACITOR GOES TO THE 10 PF CAP.

THE GROUND ON THE VARIABLE CAPACITOR IS ALWAYS THE 'CENTER' TERMINAL.

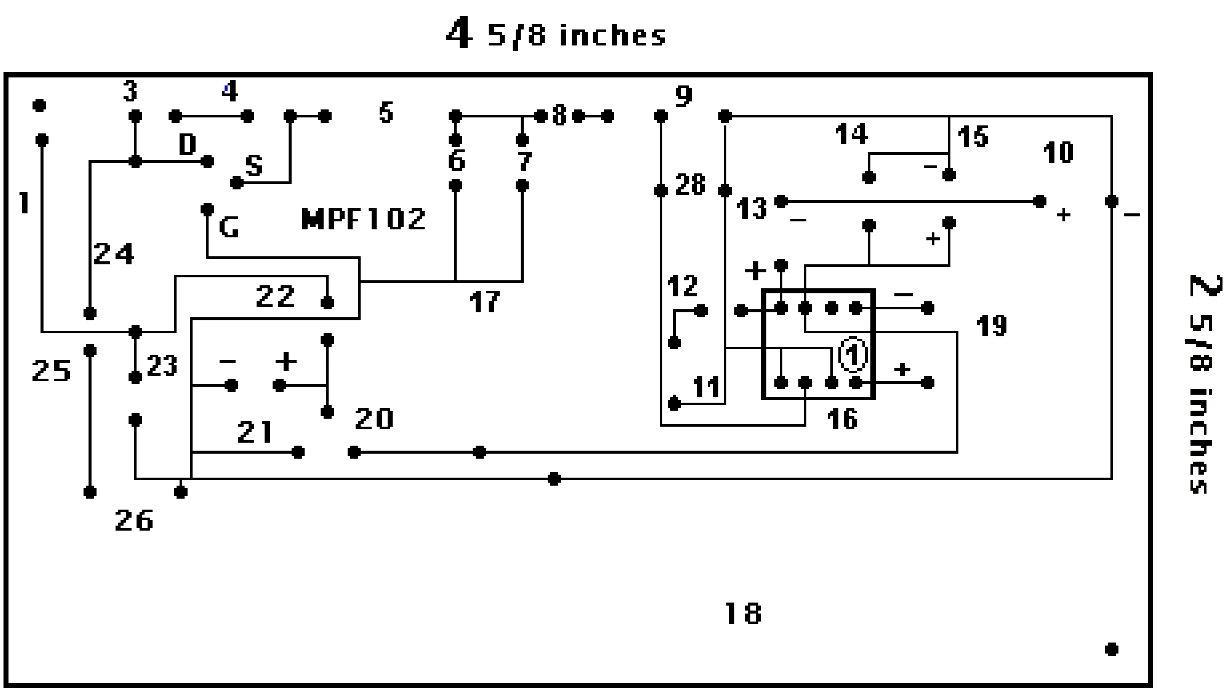


If for some reason you might need clarification or assistance in making this project, please don't hesitate to e-mail me at... braincambre500@yahoo.com

...your friend, Patrick

FM Receiver (MPF102)

All components are standing up on top of PCB. There is no copper on bottom side. There are no drilled holes, except for the LM386.



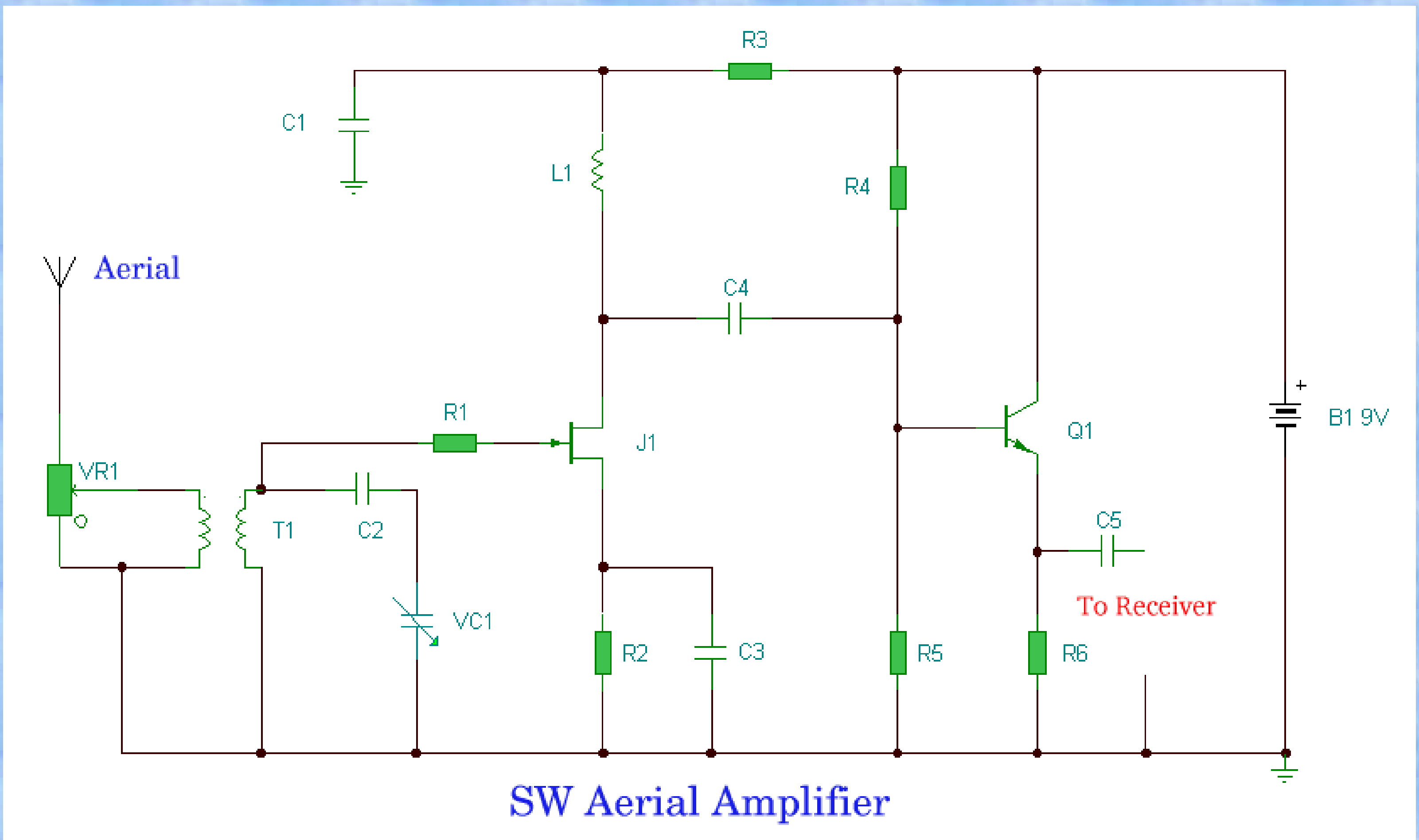
PCB CIRCUITRY LAYOUT

Return to RF Circuits

SW RF Pre-Amplifier

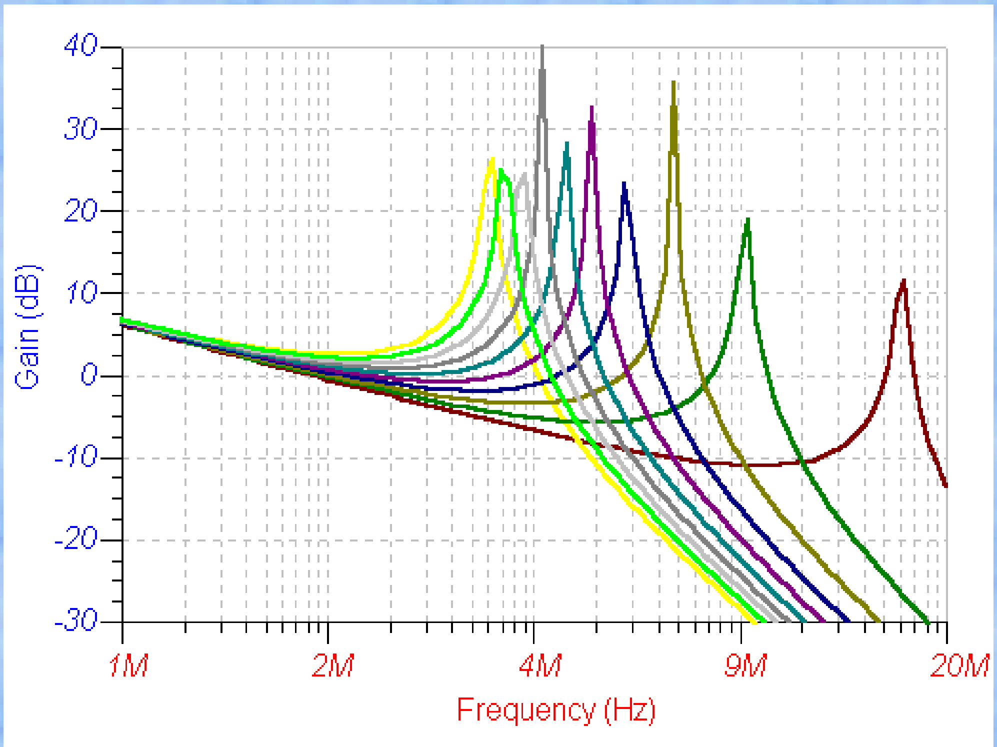
Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description:
A radio frequency amplifier to boost SW reception. Frequency range approximately 5 to 20 MHz.



Notes:
The problem with amplifying weak radio signals is that you also amplify the noise. What you can receive depends on how much background noise is present, whether it be man made interference or static. In this design the RF signal is first met by a resistive attenuator, this is necessary as strong signals could otherwise overload your receiver. The transformer T1 is would on a 1 inch diameter ferrite loop. The primary (antenna side) is 2 turns of 22 swg wire. The secondary is 4 turns of 22 swg wire. The 4 turns are spaced to occupy roughly half the coils circumference. The approximate inductance of the secondary is 20uH. To cover 5 to 20 Mhz a capacitor tuning from around 3pF to 200pF is required. A standard capacitor of 400 or 500pF (full mesh) can be used by including a series capacitor, C2 in the above Capacitors. Capacitors in series behave the same as resistors in parallel. The smallest capacitance is just less than the smallest capacitor in series and highest value also less than the highest capacitance. With a 220pF capacitor for C2 and a 500pF variable capacitor (that tunes down to 5pF) the effective capacitance tunes 143pF to about 4.8pF. This is roughly correct and not critical as the gain of the FET will amplify frequencies outside the tuned circuit range. The 2N3819 FET operates in common source. The series base resistor R1 is included to even out the response, the internal gate source impedance is

thus increased by R1 at higher frequencies. The drain circuit includes a 2.5mH choke. A 4.7mH can also be used. As the Q factor of these coils are high, a series resistor R3 is introduced to flatten the response. The frequency response is shown below calculated at 10% increments of VC1:



The output impedance from the FET is high, so is buffered by the BC108C in emitter follower mode. Current drain is around 3mA from a 9 Volt battery. As with any RF circuit, the circuit is sensitive to noise and interference. A metal or aluminum box would be a good choice for this project. However, on my trusty breadboard, this circuit preformed well, and weak signals were boosted well.

Parts List:

R1	100k
R2	1k
R3	330
R4	47k
R5	68k
R6	4.7k
VR1	4.7k
C1	100n
C2	220p
C3	100n
C4	1n
C5	10n
VC1	500pF
L1	2.5m
J1	2N3819
Q1	BC108B

Return to RF Circuits

Audio Circuits

1. 2 Watt Amplifier A low distortion amplifier using discrete components.
2. ECM Mic Preamplifier A high quality preamp for electret mic inserts
3. Tone Controls
4. Stereo Line Driver
5. TDA2030 8 Watt amplifier
6. Audio Notch Filter For audio frequencies 100Hz - 10KHz
7. 6 Input Mixer 3 Mic inputs, 3 Line Inputs
8. Hi-Fi Pramplifier by Graham Maynard
9. Peak Reading Audio Level Meter
10. Doorphone Intercom by Laurier Gendron & myself
11. Computer Microphone by Lazar Pancic
12. 100 Watt Amp Circuit External Link to John Tirone's Site
13. 3 Band Equaliser
14. Voice-Over Circuit
15. Quadraphonic Amplifier
16. 15 Watt Amplifier by Sergio Garcia

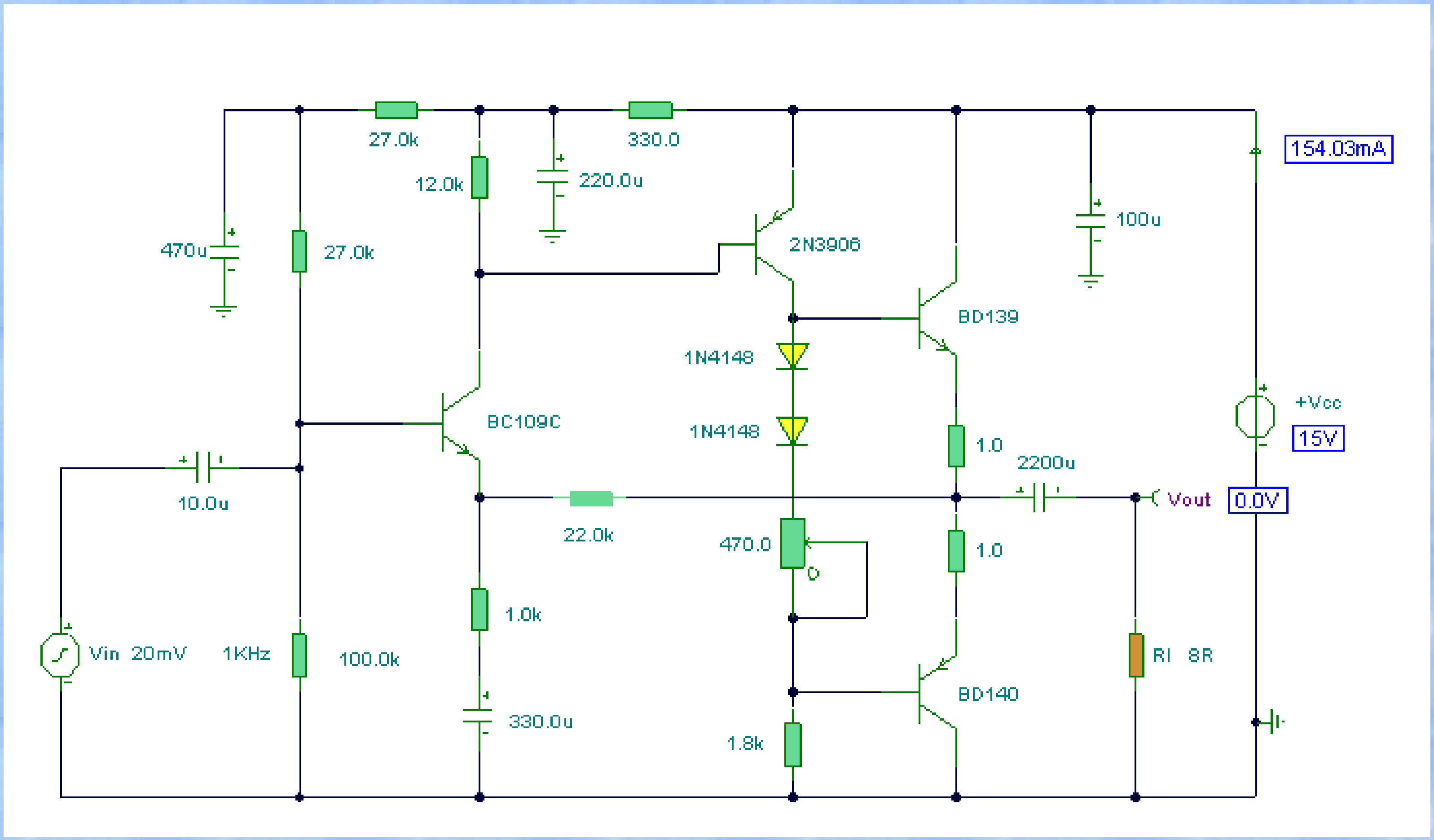
17. Audio VU Meter by Matthew Hewson

18. Soft switching Amplifier with Tone Controls

18. Audio Level Meter

Return to Schematics

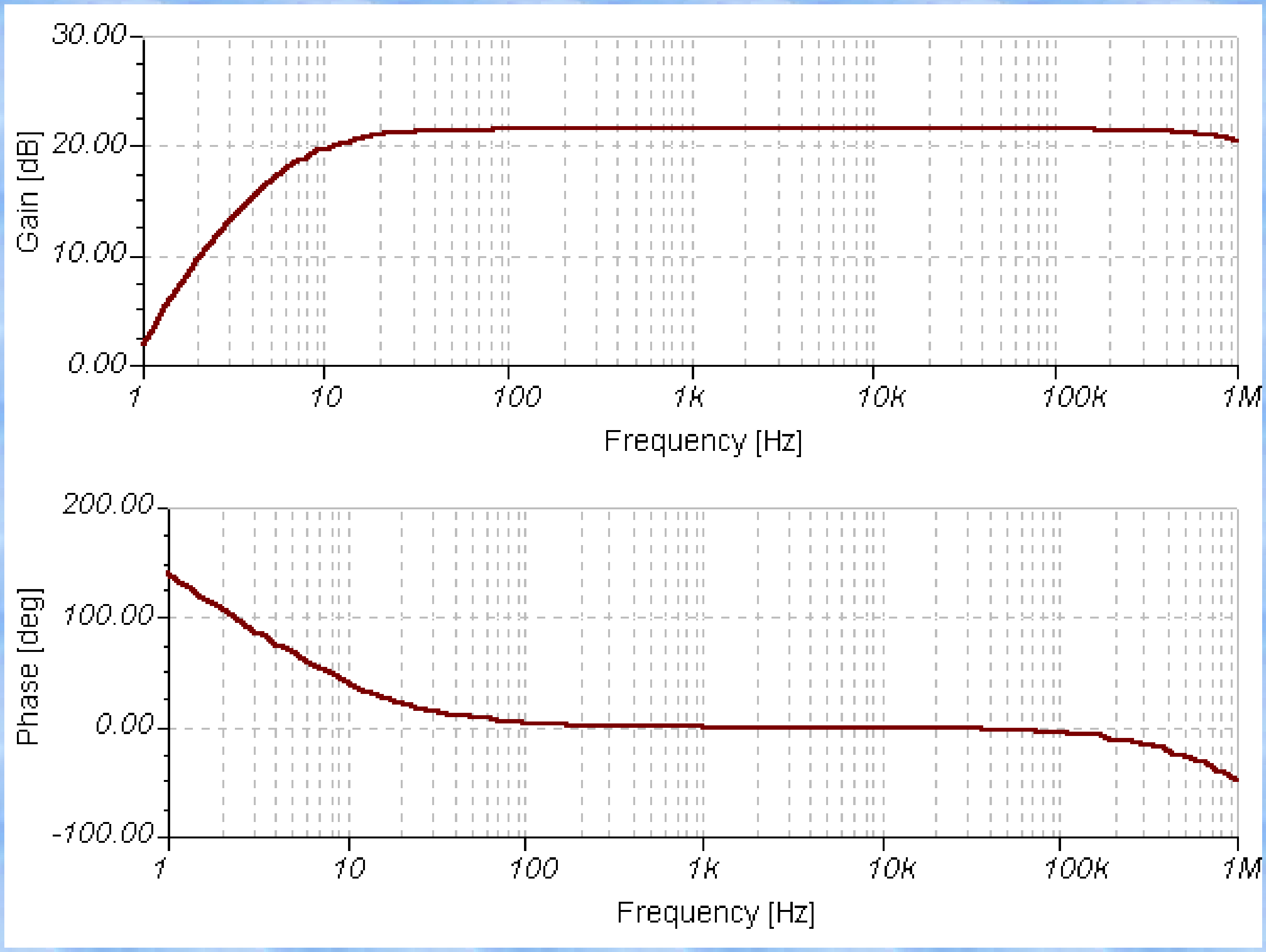
2 Watt Audio Amplifier



Notes:
This was one of the earliest circuits that I ever designed and built, in Spring 1982. At that time I had only an analogue meter and a calculator to work with. Although far from perfect, this amplifier does have a wide frequency response, low distortion, and is capable of driving an 8 ohm speaker to output levels of around 5 watts with slightly higher distortion. Any power supply in the range 12 to 18 Volts DC may be used.

Circuit Description

The amplifier operates in Class AB mode; the single 470R preset resistor controls the quiescent current flowing through the BD139/140 complimentary output transistors. Adjustment here, is a trade-off between low distortion and low quiescent current. Typically, under quiescent conditions, standby current may be 15 mA rising to 150 mA with a 50 mV input signal. A simulated frequency response is shown below:



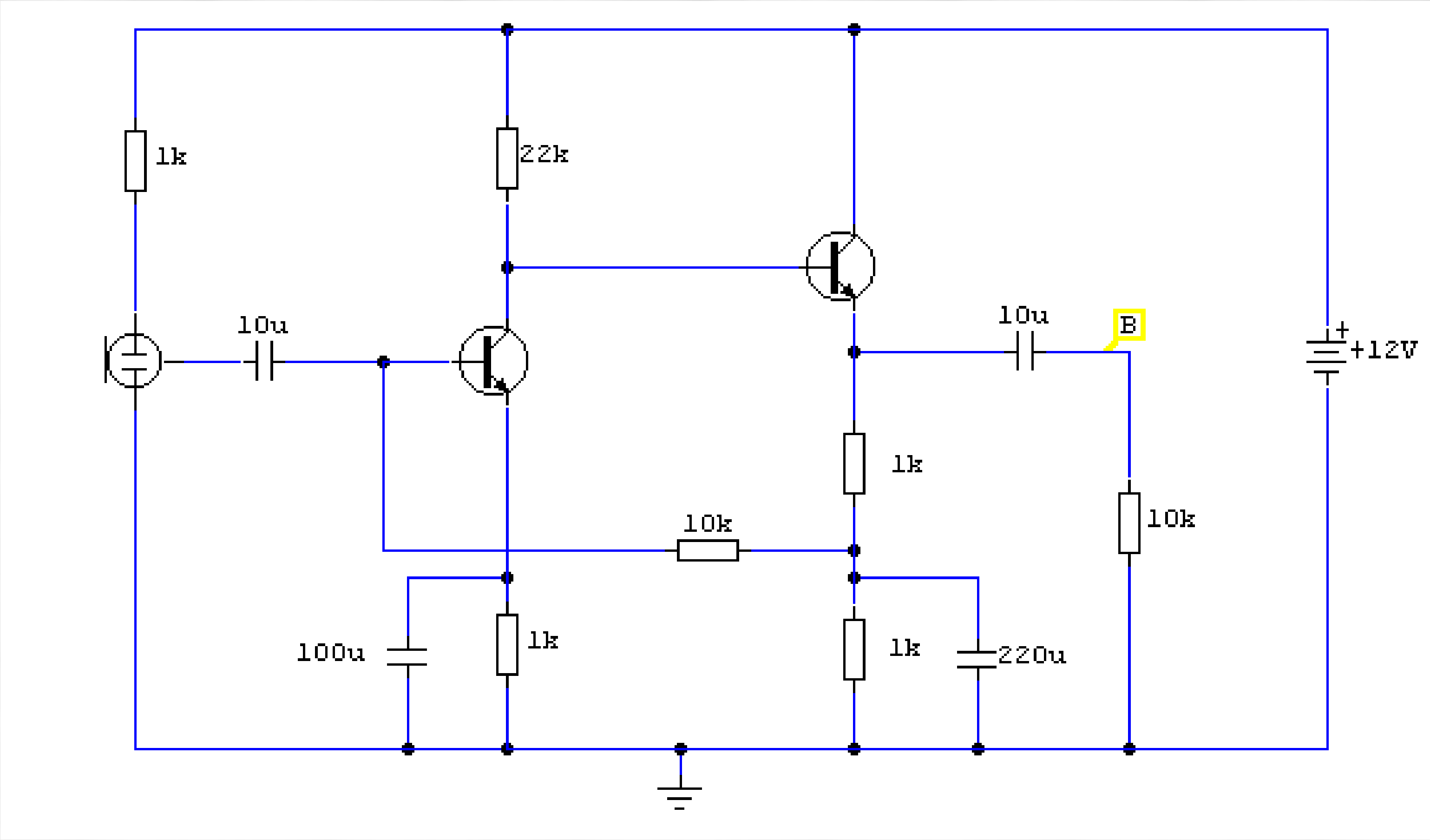
The circuit is DC biased so that the emitters of the BD139 and BD140 are at approximately half supply voltage, to allow for a maximum output voltage swing. All four transistors are direct coupled which ensures:-
(i) A good low frequency response
(ii) Temperature and bias change stability.

The BC109C and 2N3906 operate in common emitter. This alone will provide a very high open loop gain. The output BD139/140 pair operate in emitter follower, meeting the requirements to drive low impedance speakers. Overall gain is provided by the ratio of the 22k and 1k resistor. A heat sink on the BD139/140 pair is recommended but not essential, though the transistors will run "hot" to the touch.

Original March 1999
Last Revision 13-8-01 by ANC

Return to Audio Schematics

ECM Mic Preamplifier

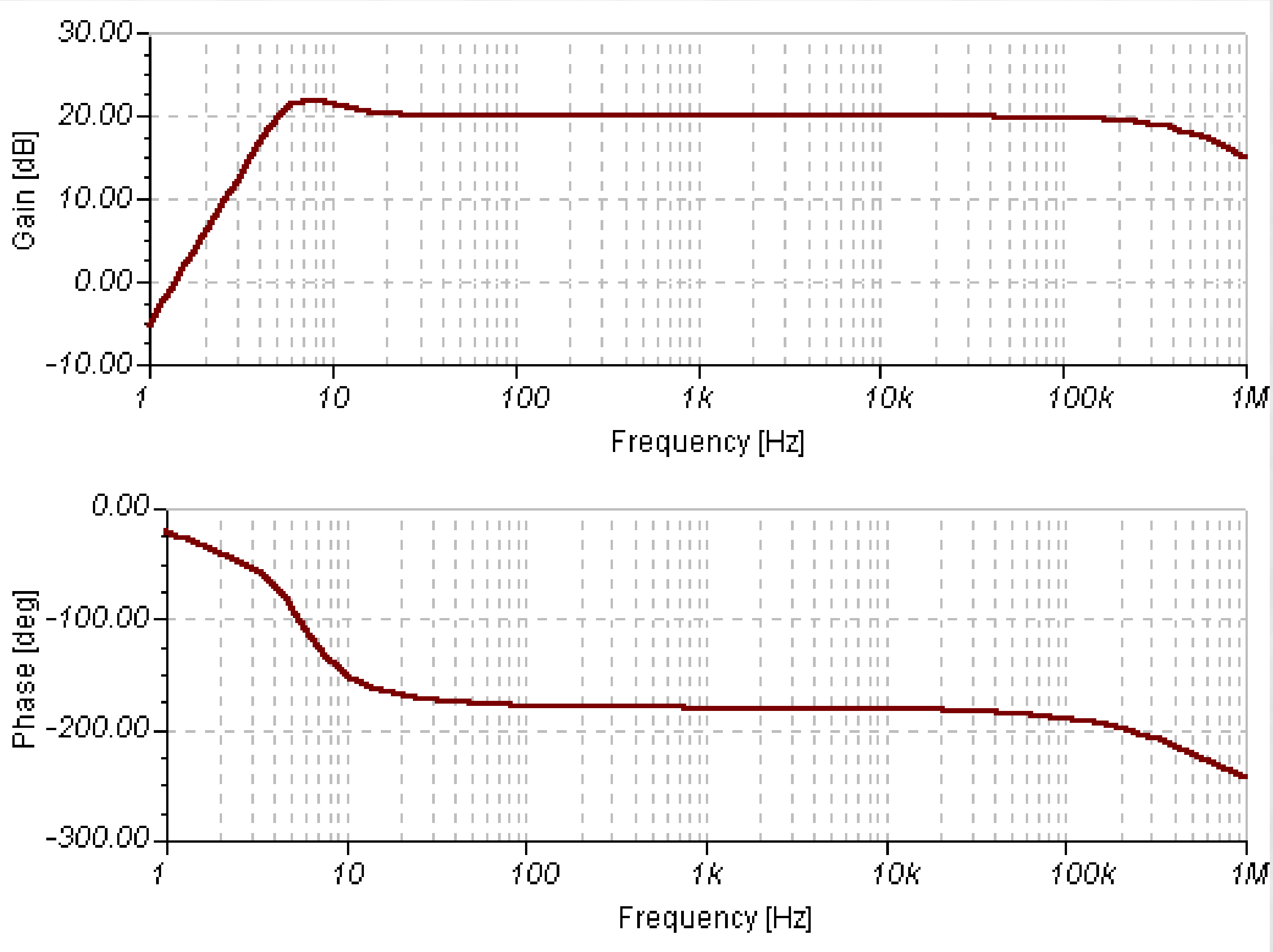


Notes:

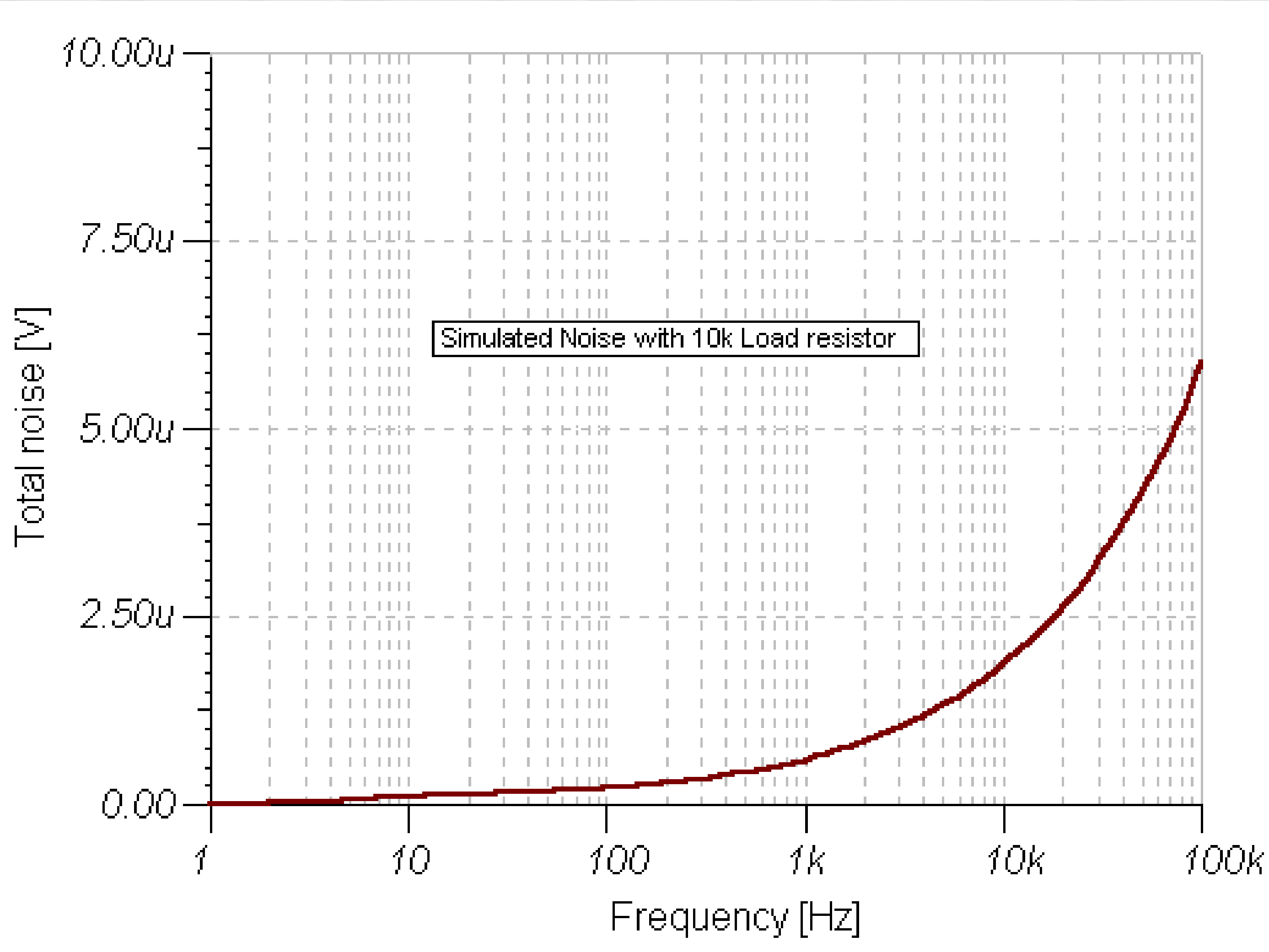
Both transistors are low noise types. In the original circuit, I used BC650C which is an ultra low noise device. These transistors are now hard to find but BC109C are a good replacement. The circuit is very device tolerant and will set its quiescent point at roughly half the supply voltage at the emitter of the last transistor.

The electret condenser microphone (ECM) contains a very sensitive microphone element and an internal FET preamp, a power supply in the range 2 to 10 volts DC is therefore necessary. Suitable ECM's may be obtained from Maplin Electronics. The 1k resistor limits the current to the mic. The output impedance is very low and well suited to driving cables over distances up to 50 meters. Screened cable therefore is not necessary.

The frequency response measured across a 10k load resistor is plotted below:



The noise response of the amplifier measured across the 10k load is shown below. Please note that this plot was made with the mic insert replaced by a signal generator.



This preamplifier has excellent dynamic range and can cope with anything from a whisper to a loud shout, however care should be taken to make sure that the auxiliary equipment i.e. amplifier or tape deck does not overload.

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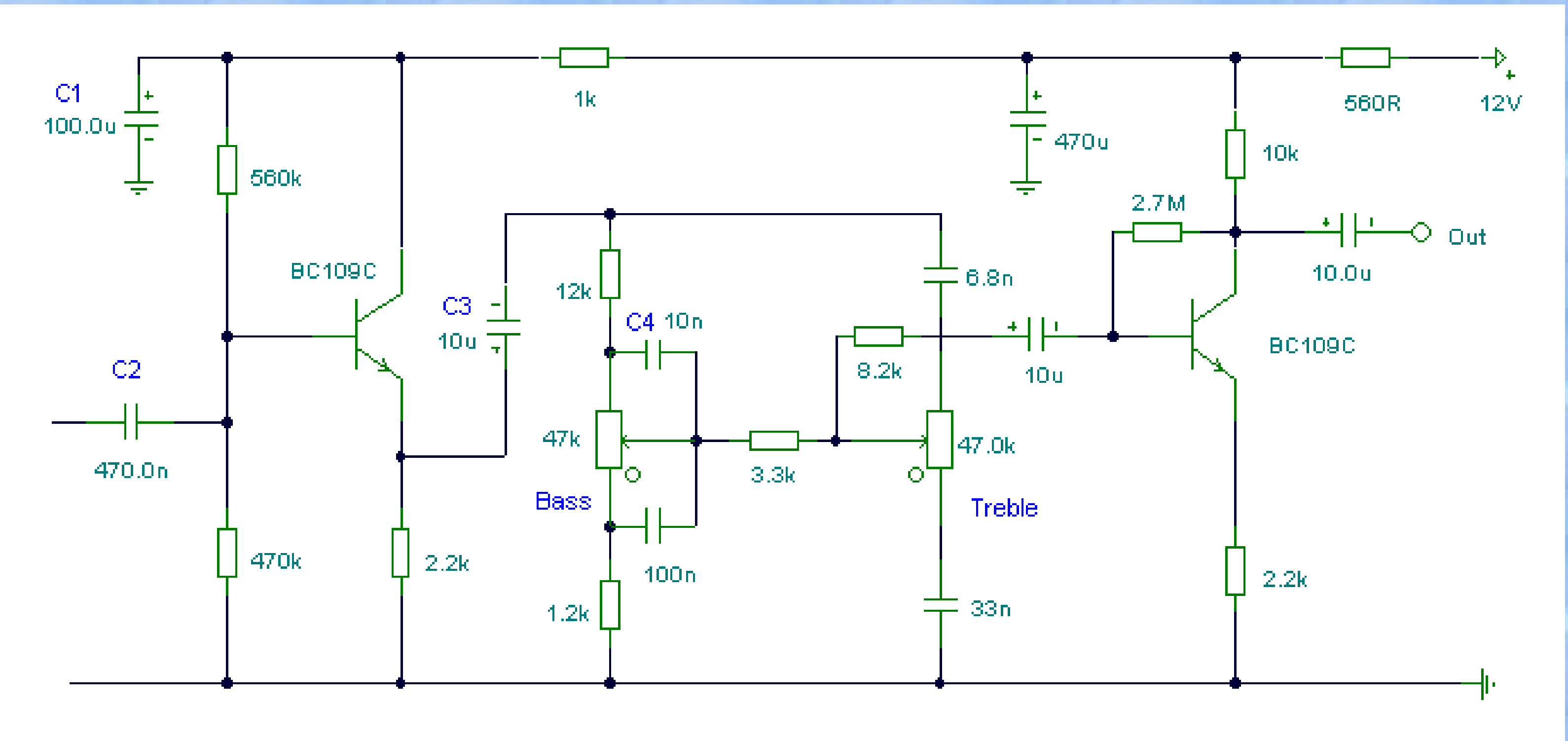
Tone Control Circuit



Notes:
Based on the classic Baxendall tone control circuit, this provides a maximum cut and boost of around 10dB at 10K and 50Hz. As the controls are passive, the last transistor provides a slight boost. The output is designed to feed an amplifier with input impedance of 10k to 250k.

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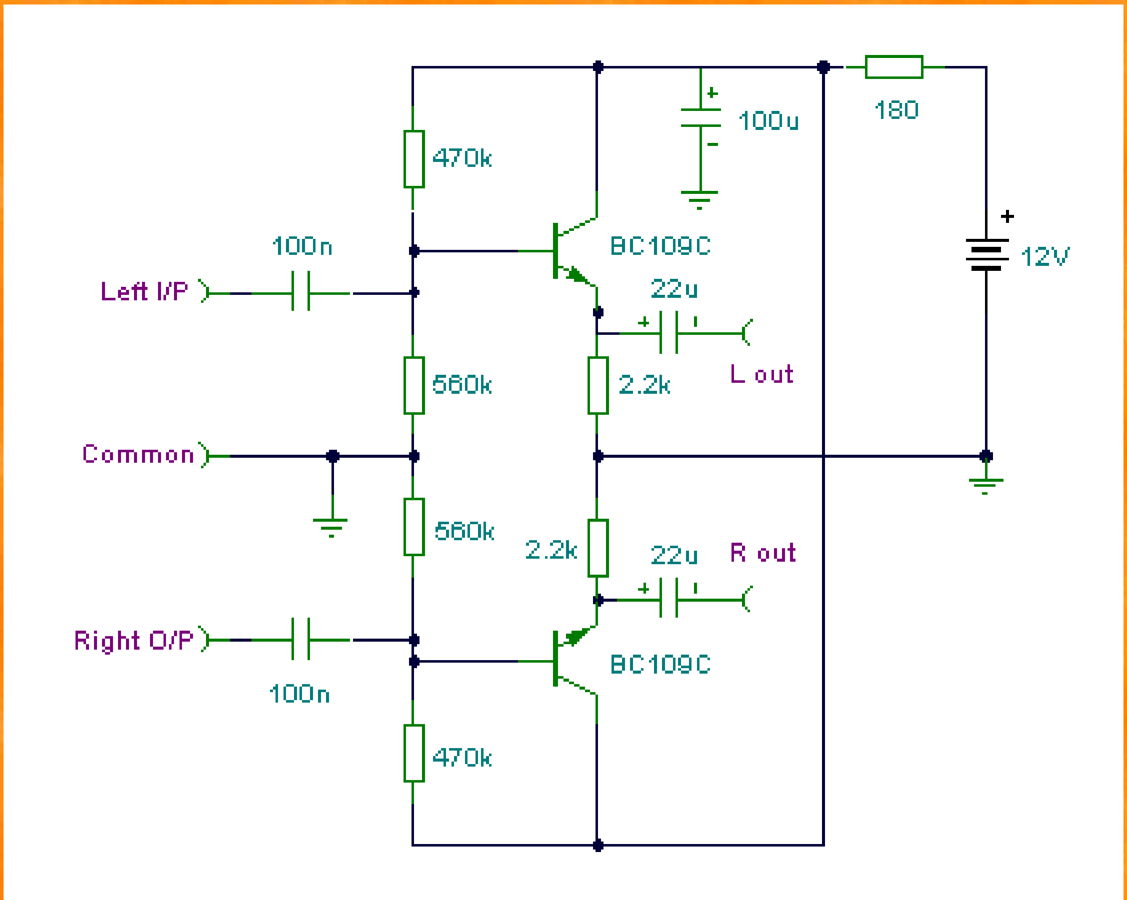
Audio Line Driver



Notes:
This preamplifier has a low output impedance, and is designed to drive long cables, allowing you to listen to a remote music source without having to buy expensive screened cables. The very low output impedance of around 16 ohms at 1KHz, makes it possible to use ordinary bell wire,loudspeaker or alarm cable for connection. The preamplifier must be placed near the remote music source, for example a CD player. The cable is then run to a remote location where you want to listen. The output of this preamp has a gain of slightly less than one, so an external amplifier must be used to drive loudspeakers.

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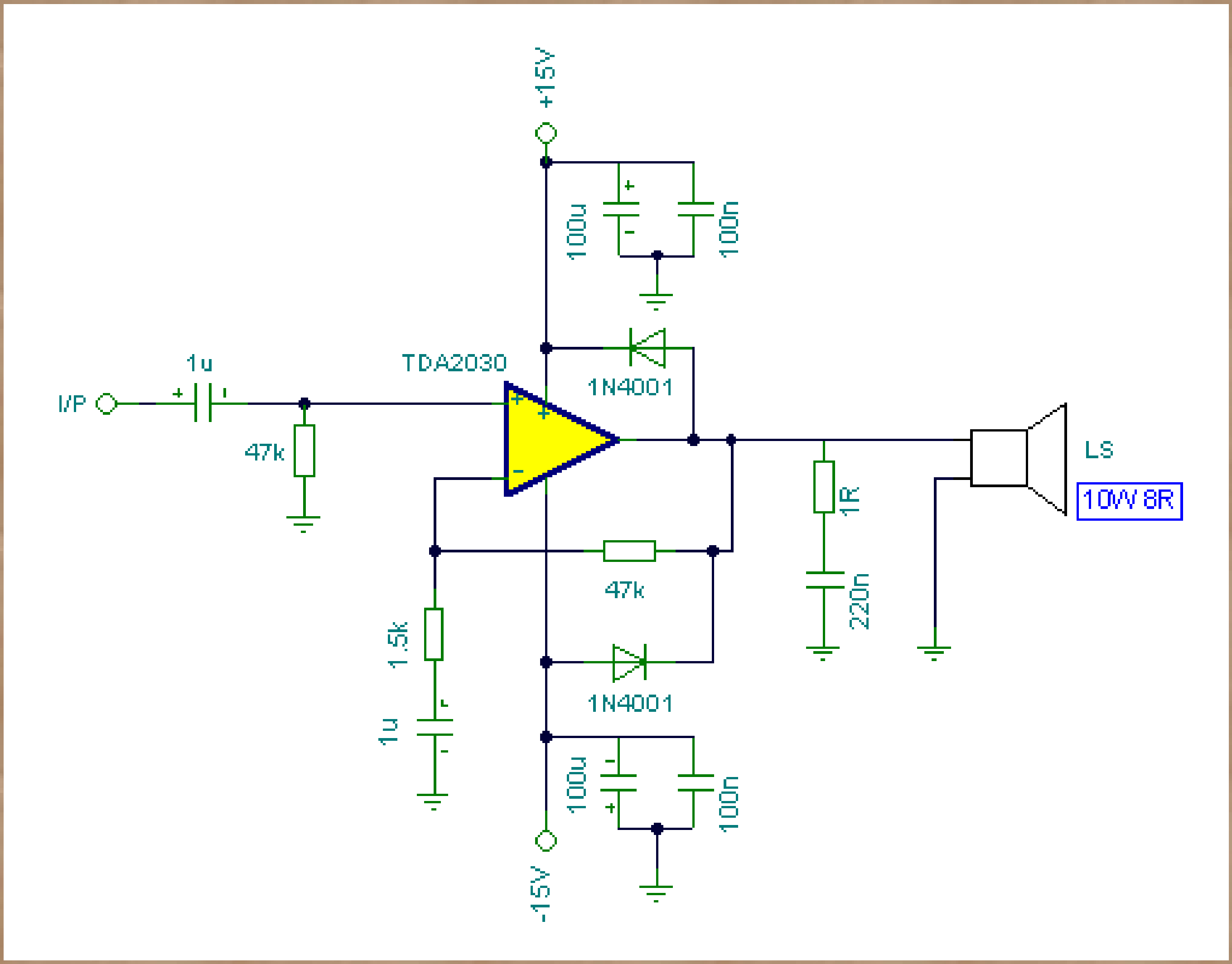
8 Watt Amplifier



Notes:
Although the TDA2030 can deliver 20 watts of output power, I deliberately reduced the output power to about 8 watts to supply 10 watt speakers. Input sensitivity is 200mV. Higher input levels naturally will give greater output, but no distortion should be heard. The gain is set by the 47k and 1.5k resistors. The TDA2030 IC is affordable and makes a good replacement amplifier for low to medium audio power systems. Incidentally, it is speaker efficiency that determines how "loud" your music is. Speaker efficiency or sound pressure level (SPL) is usually quoted in dB/meter. A speaker with an SPL of 97dB/m will sound louder than a speaker with an SPL of 95dB/m.

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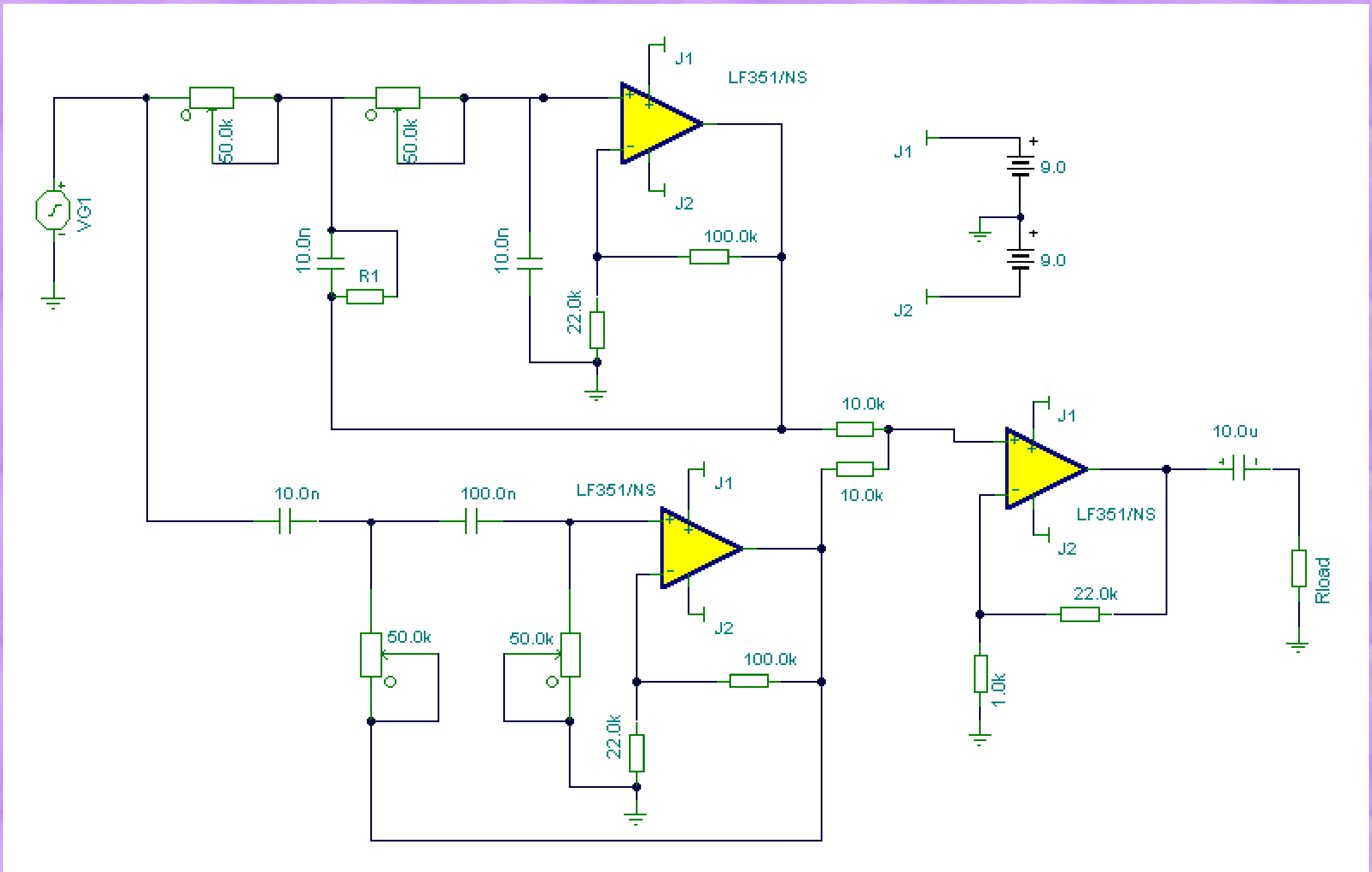
Audio Notch Filter



Notes
At first glance this circuit looks fairly complex, but when broken down,can be divided into high pass and low pass filter sections followed by a summing amplifier with a gain of around 20 times. Supply rail voltage is +/- 9V DC. The controls may also be adjusted for use as a band stop (notch) filter or band pass filter.

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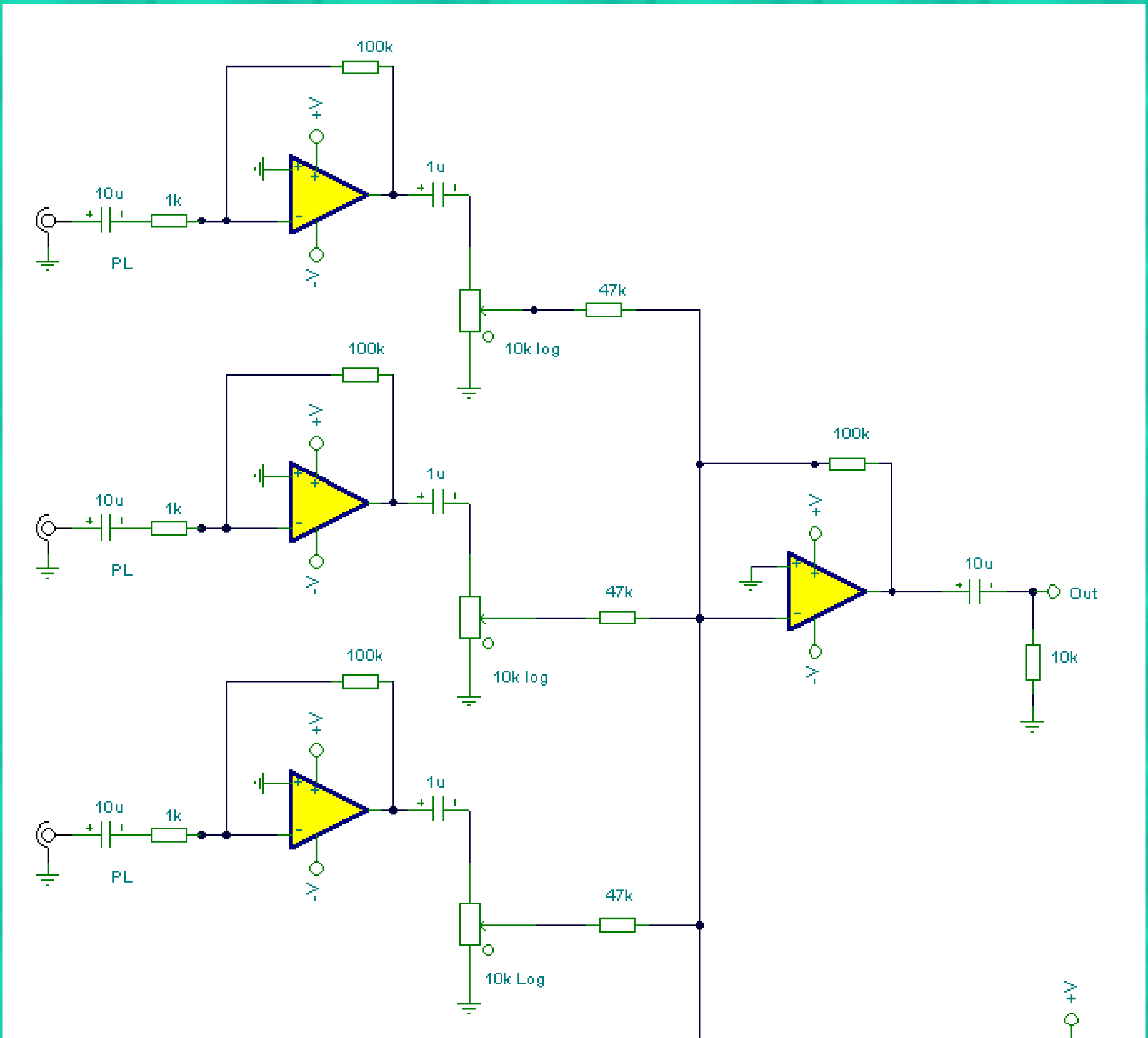
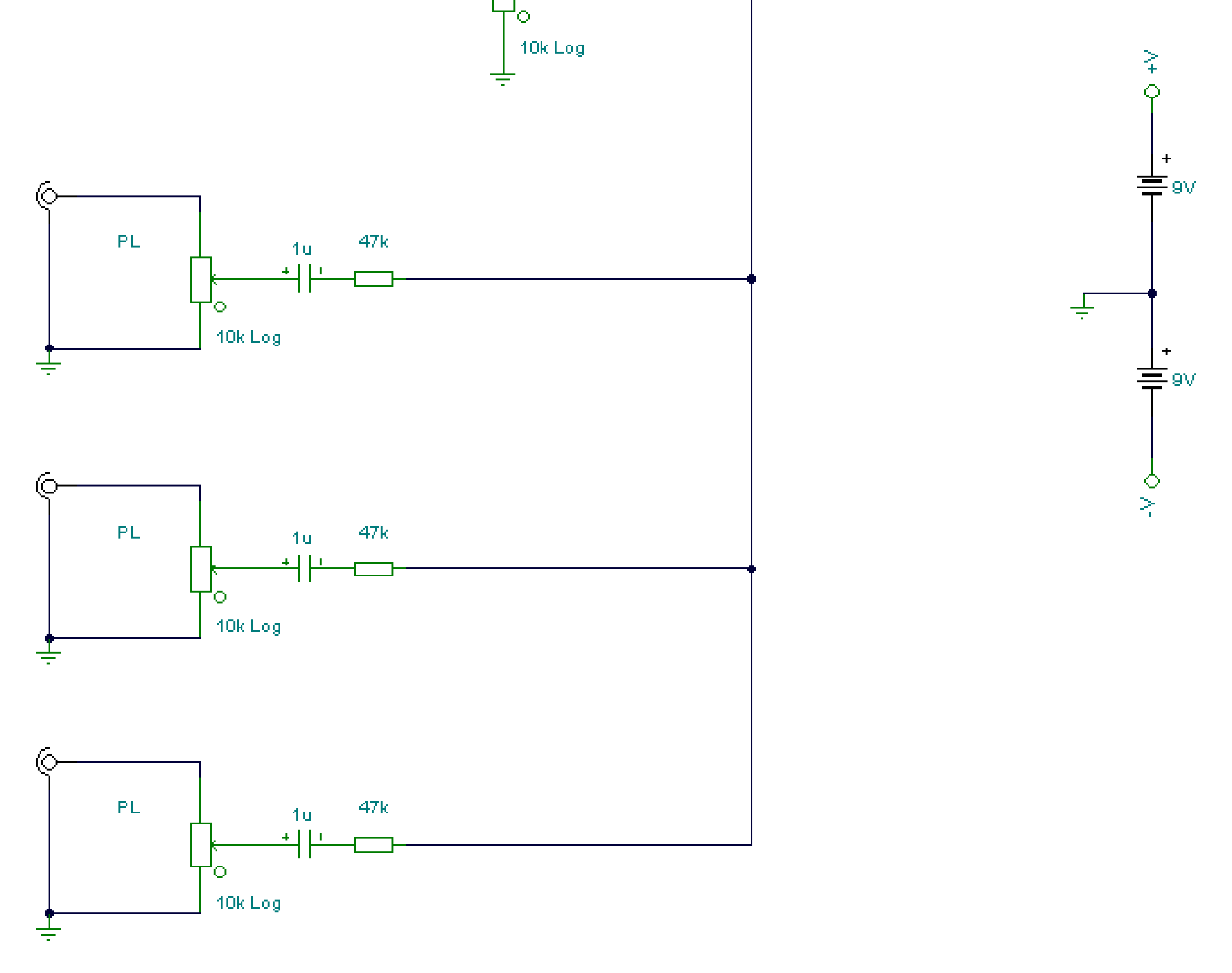
6 Input Mixer

Notes:
The mixer circuit below has 3 line inputs and 3 mic inputs. The mic inputs are suitable for low impedance 200-1000R dynamic microphones. An ECM or condenser mic can also be used, but must have bias applied via a series resistor. As with any mixer circuit, a slight loss is always introduced. The final summing amplifier has a gain of 2 or 6dB to overcome this. The Input line level should be around 200mV RMS. The mic inputs are amplified about 100 times or by 40dB, the total gain with the mixer is 46dB. The mic input is designed for microphones with outputs of about 2mV RMS at 1 meter. Most microphones meet this standard.





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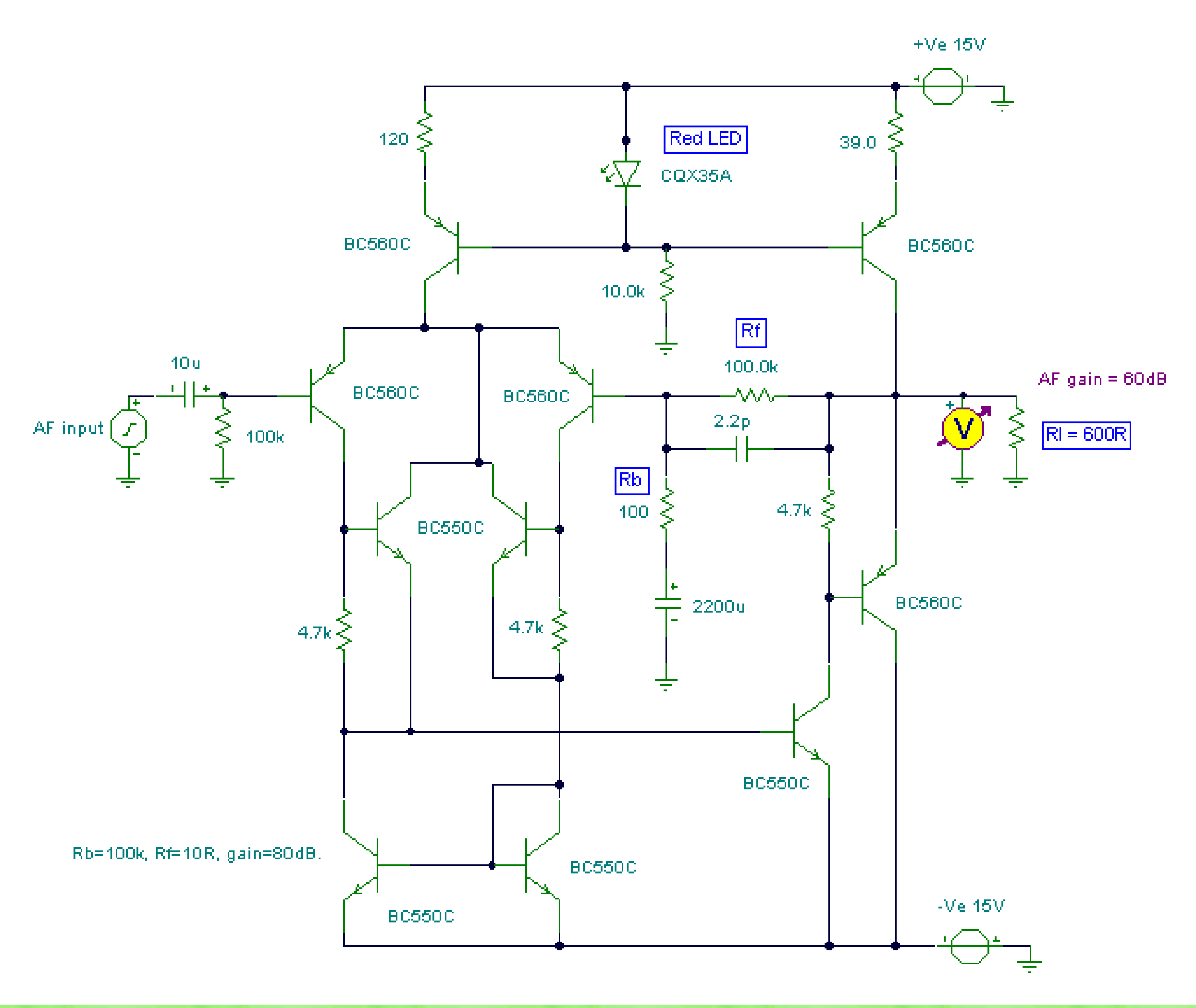
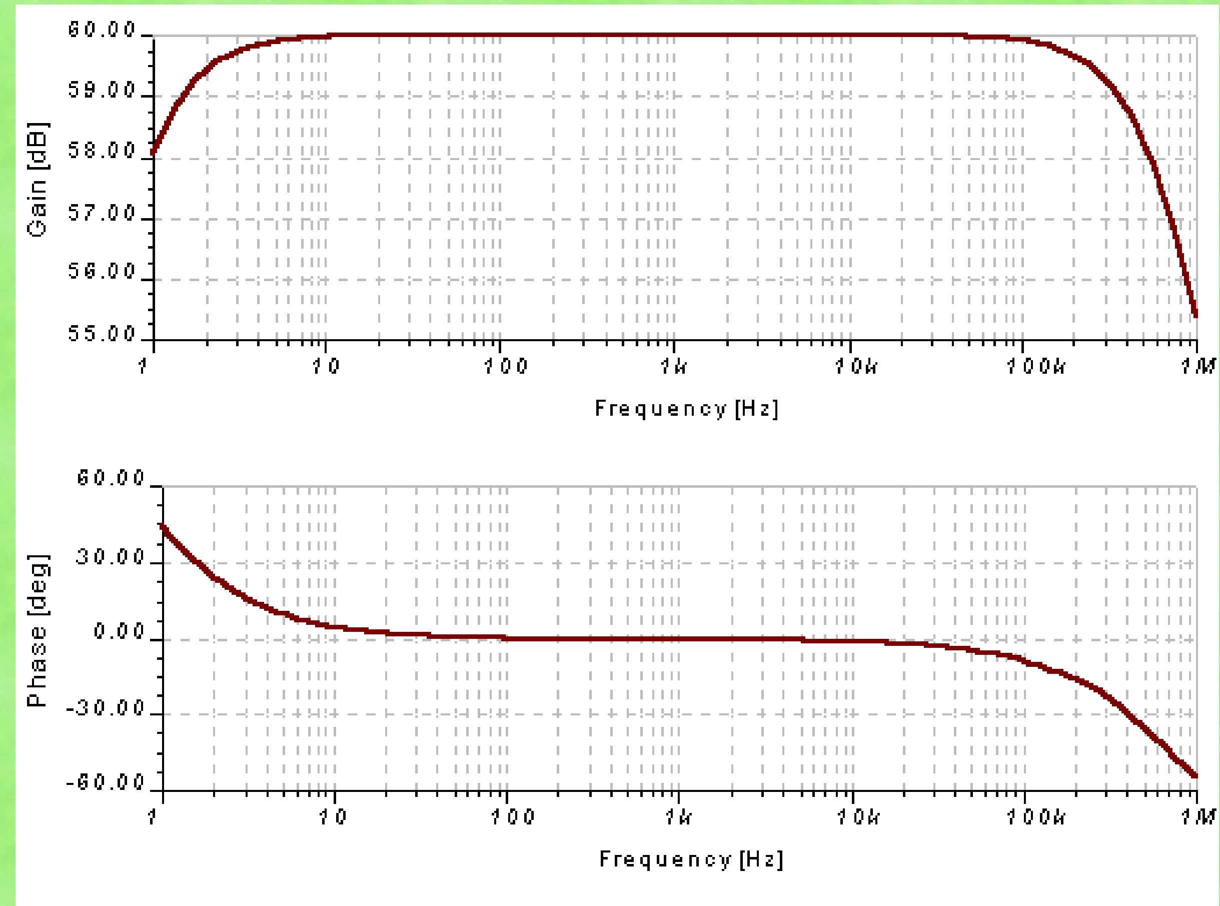
Hi-Fi Preamplifier

Design: Graham Maynard
Email graham.maynard1@virgin.net

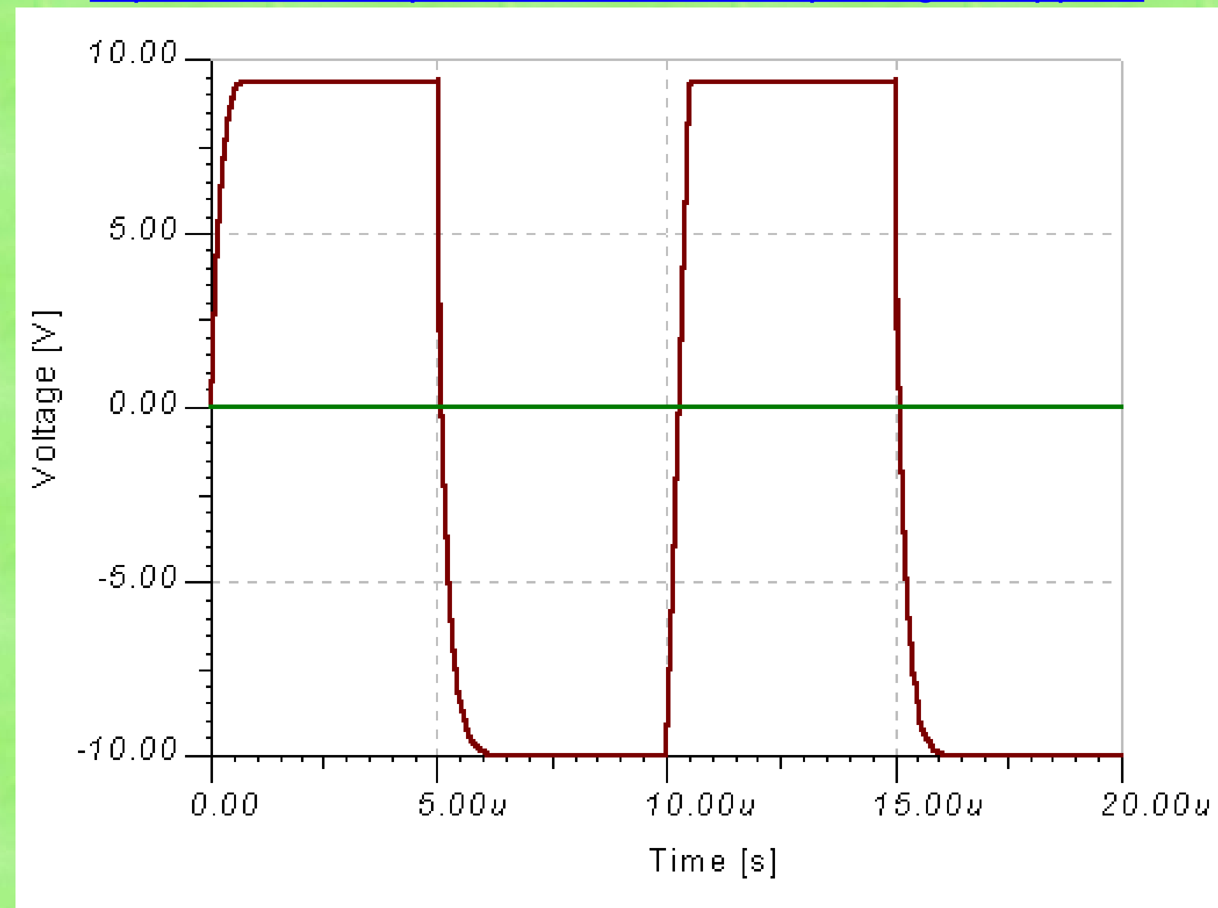
Notes:
This circuit was submitted by Graham Maynard from Newtownabbey, Northern Ireland. It has an exceptionally fast high frequency response, as demonstrated by applying an 100kHz squarewave to the input. All graphs were produced using Tina Pro.



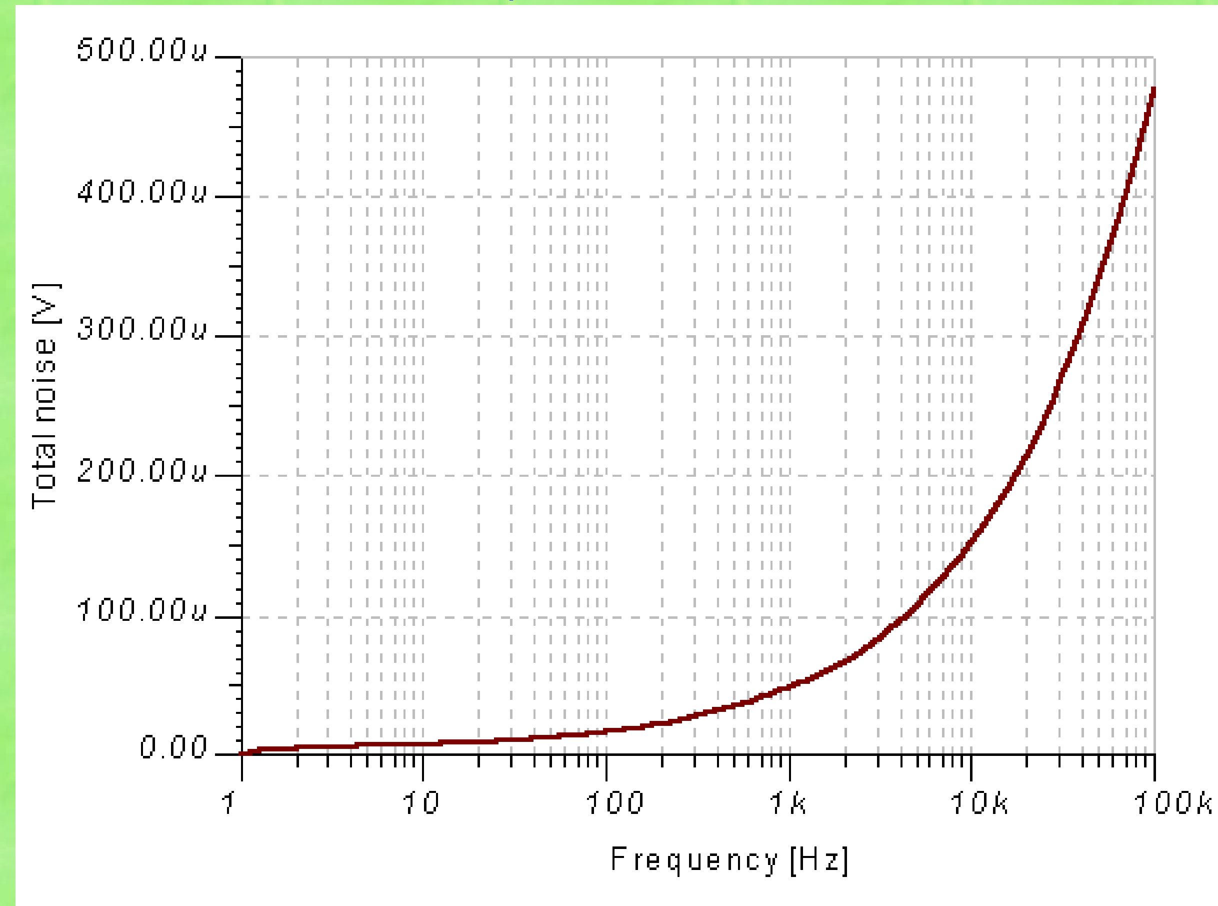
The Preamp's Bode Response



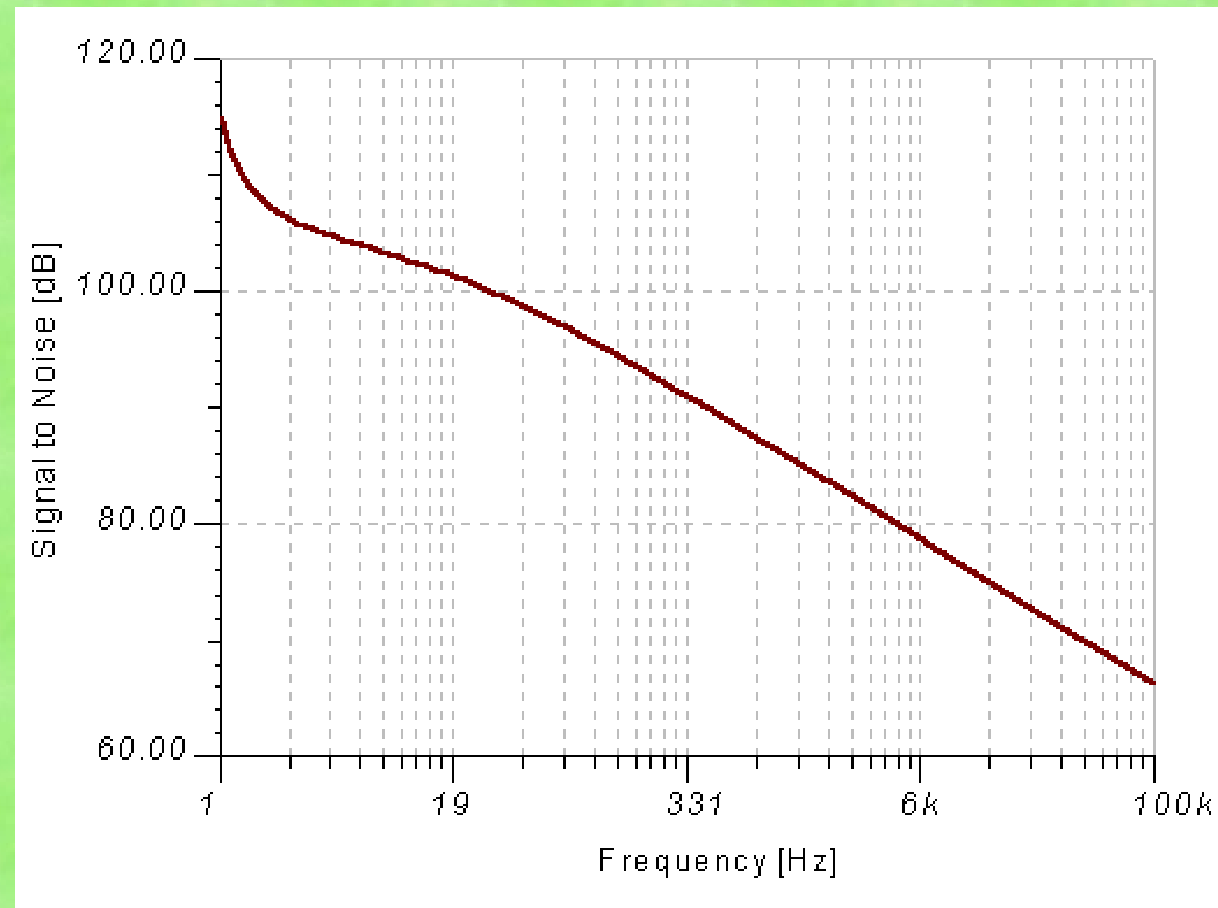
Squarewave Response with 100kHz Input Signal Applied



[Total Noise at Output Measured with 600R Load]



[Signal to Noise Ratio at Output]



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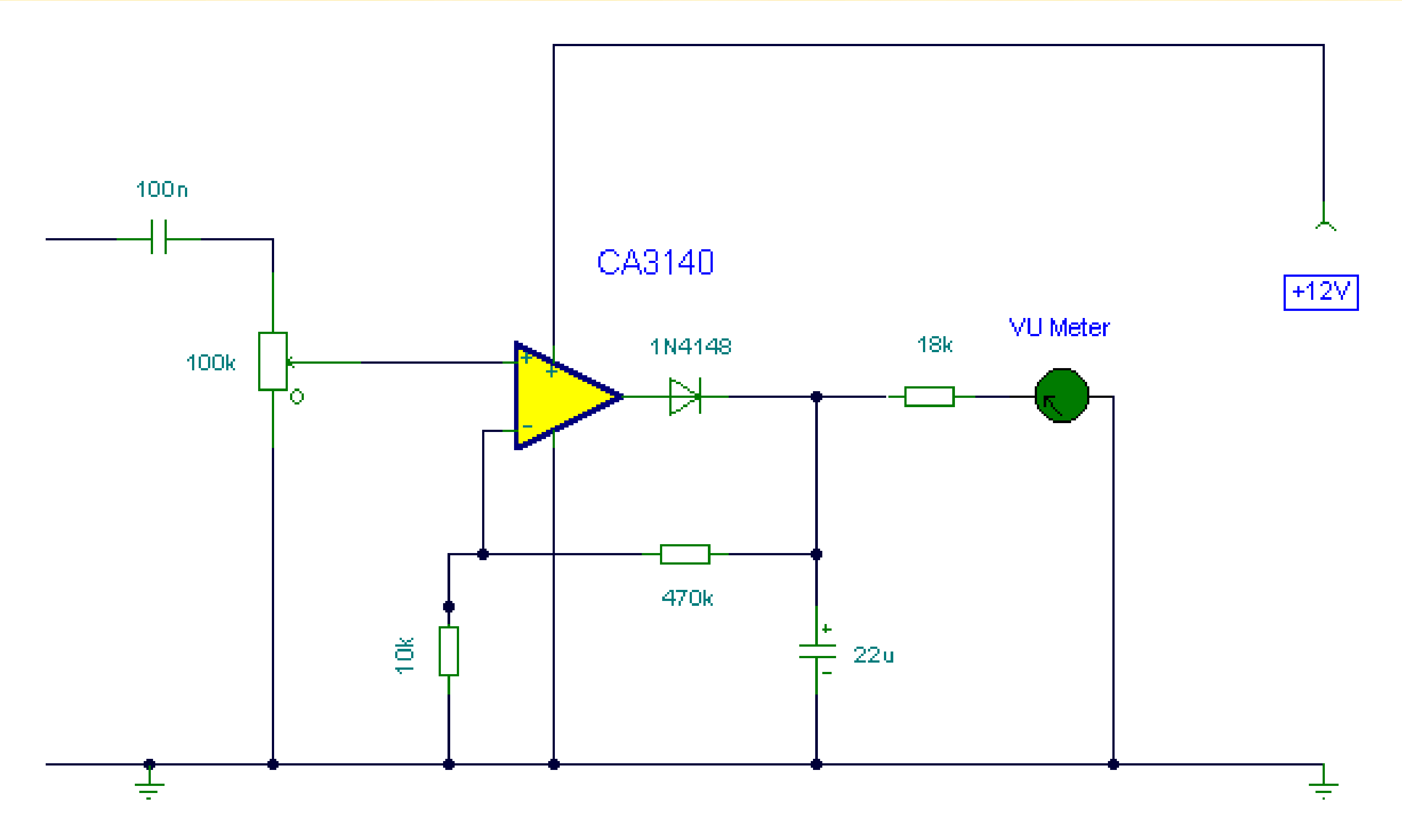
Peak Reading Audio Level Meter



Important Note: This circuit will only work with a MOSFET opamp !

Application Notes:
Using minimum component count; this simple circuit will indicate peak audio response on an analogue meter, similar to a tape recorders meter. The circuit uses an opamp as a non inverting amplifier, but with one addition - a diode in the feedback loop. The circuit has a fast response time and slow decay time to indicate peak readings. The 1N4148 diode provides half wave rectification of the input signal, the dc output being smoothed by the 22u capacitor. the capacitor will charge to the peak value of the input waveform, and then discharge via the meter and 18k resistor. I used a meter with a FSD of 150uA, but any meter with a FSD in the range 50-250uA may be used. The discharge time is around a quarter of a second. Increase the 22uF cap for a longer discharge time, or omit altogether to make an instantaneous reading level meter.

This circuit will only work with a MOSFET type opamp, bipolar types i.e. 741 and J-FET opamps such as LF351 will not work in this circuit.

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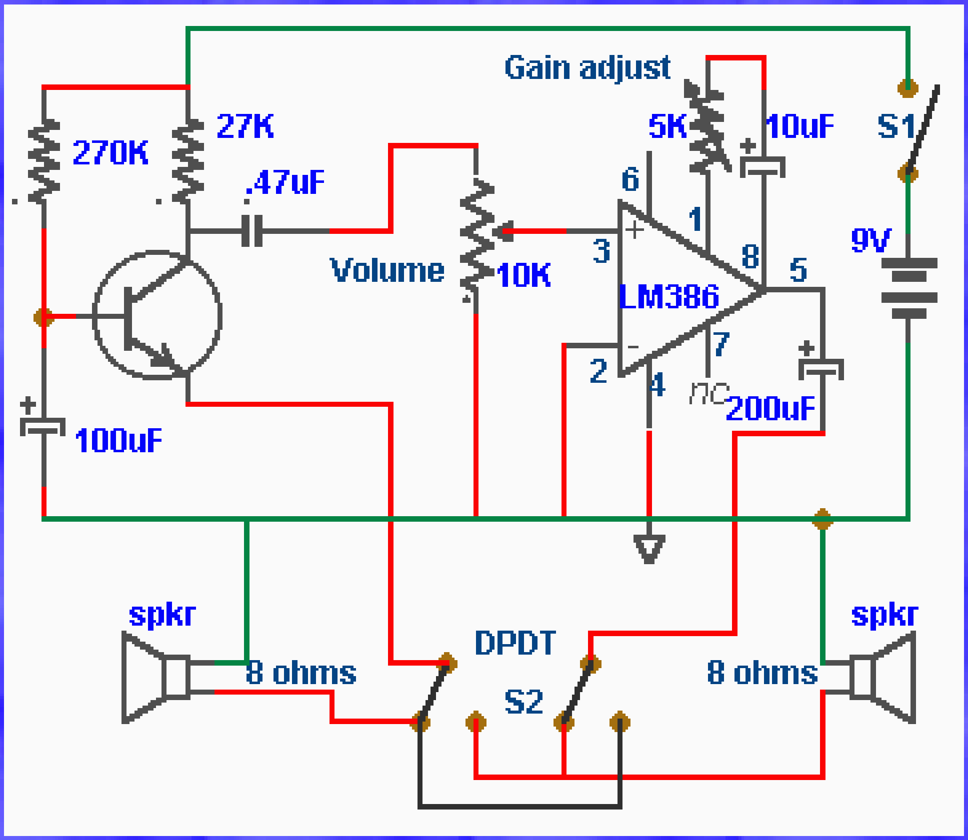
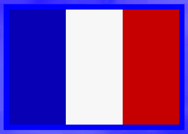
Doorphone Intercom





Notes:

For the first time, this circuit was designed by two authors, Mr Laurier Gendron of Burnaby in British Columbia, Canada, and myself. Please make sure you visit Laurier's web site, Handy Dandy Little Circuits. This page is also available in French by clicking on the flag.

In this doorphone circuit,an 8 ohm speaker is used both as a microphone and also an output device. The BC109C stage amplifies in common base mode, giving good voltage gain , whilst providing a low impedance input to match the speaker. Self DC bias is used allowing for variations in transistor current gain. An LM386 is used in non-inverting mode as a power amplifier to boost voltage gain and drive the 8 ohm speaker. The 10k potentiometer acts as the volume control, and overall gain may be adjusted using the 5k preset. The double pole double throw switch, reverses the loudspeaker positions, so that one is used to talk and the other to listen. Manually operating the switch (from inside the house) allows two way communication.

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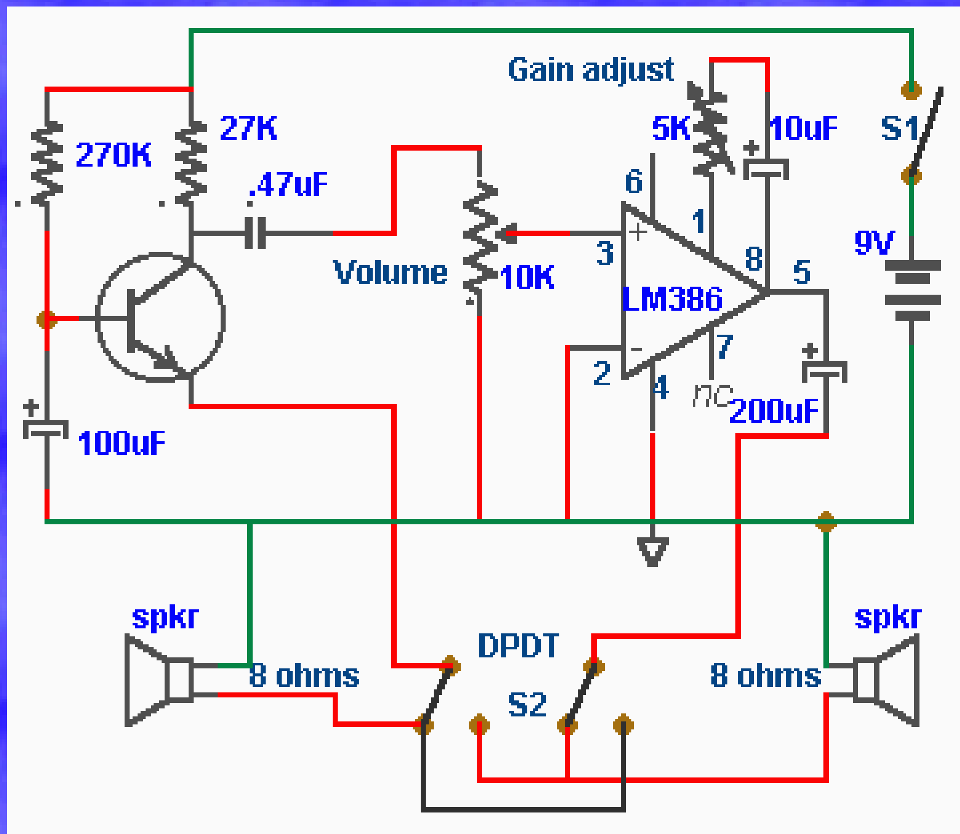
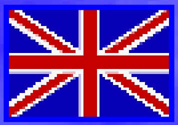
Doorphone Intercom





Dans notre circuit de doorphone, un haut-parleur de 8 ohms est utilisé comme microphone et appareil de sortie. L'étape de BC109C amplifie en mode de base commune, donnant le bon gain de tension, tout en en même temps appariant la basse impédance d'entrée du haut-parleur. La polarisation d'individu est tenue compte a utiliser de petites variations de gain du dispositif.
Un LM386 est employé pour amplifier le gain de tension et pour piloter un haut-parleur de 8 ohms. Le potentiomètre 10k agit en tant que commande de volume, et le gain global peut être ajusté en utilisant le 5k a pré-établi. Un double commutateur de jet de double de poteau est utilisé pour permettre l'entretien et pourécouter, (à l'extrémité de maison).

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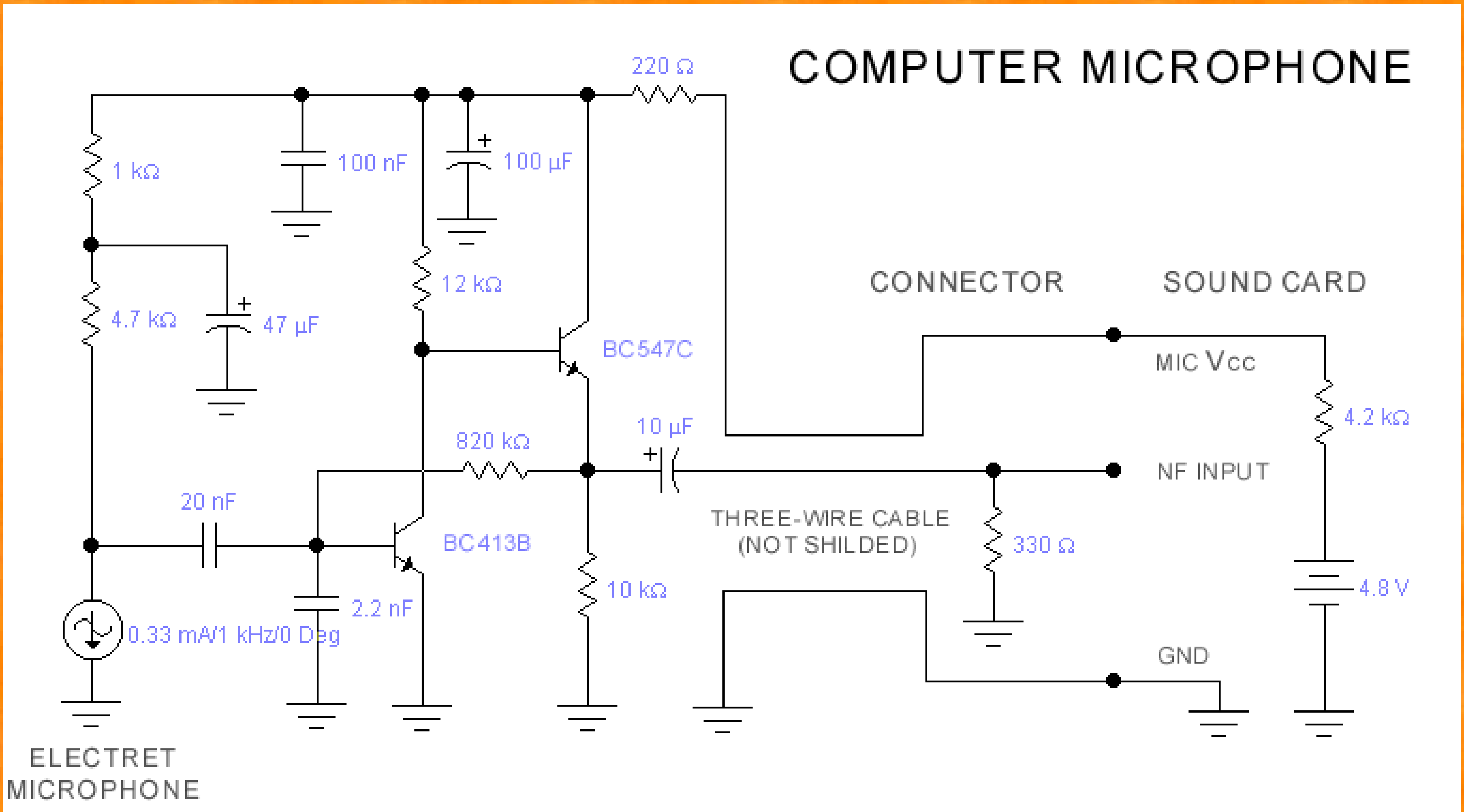
Computer Microphone



Notes:

This circuit was submitted by Lazar Pancic from Yugoslavia. The sound card for a PC generally has a microphone input, speaker output and sometimes line inputs and outputs. The mic input is designed for dynamic microphones only in impedance range of 200 to 600 ohms. Lazar has adapted the sound card to use a common electret microphone using this circuit. He has made a composite amplifier using two transistors. The BC413B operates in common emitter to give a slight boost to the mic signal. This is followed by an emitter follower stage using the BC547C. This is necessary as the mic and circuit and battery will be some distance from the sound card, the low output impedance of the circuit and screened cable ensuring a clean signal with minimum noise pickup.

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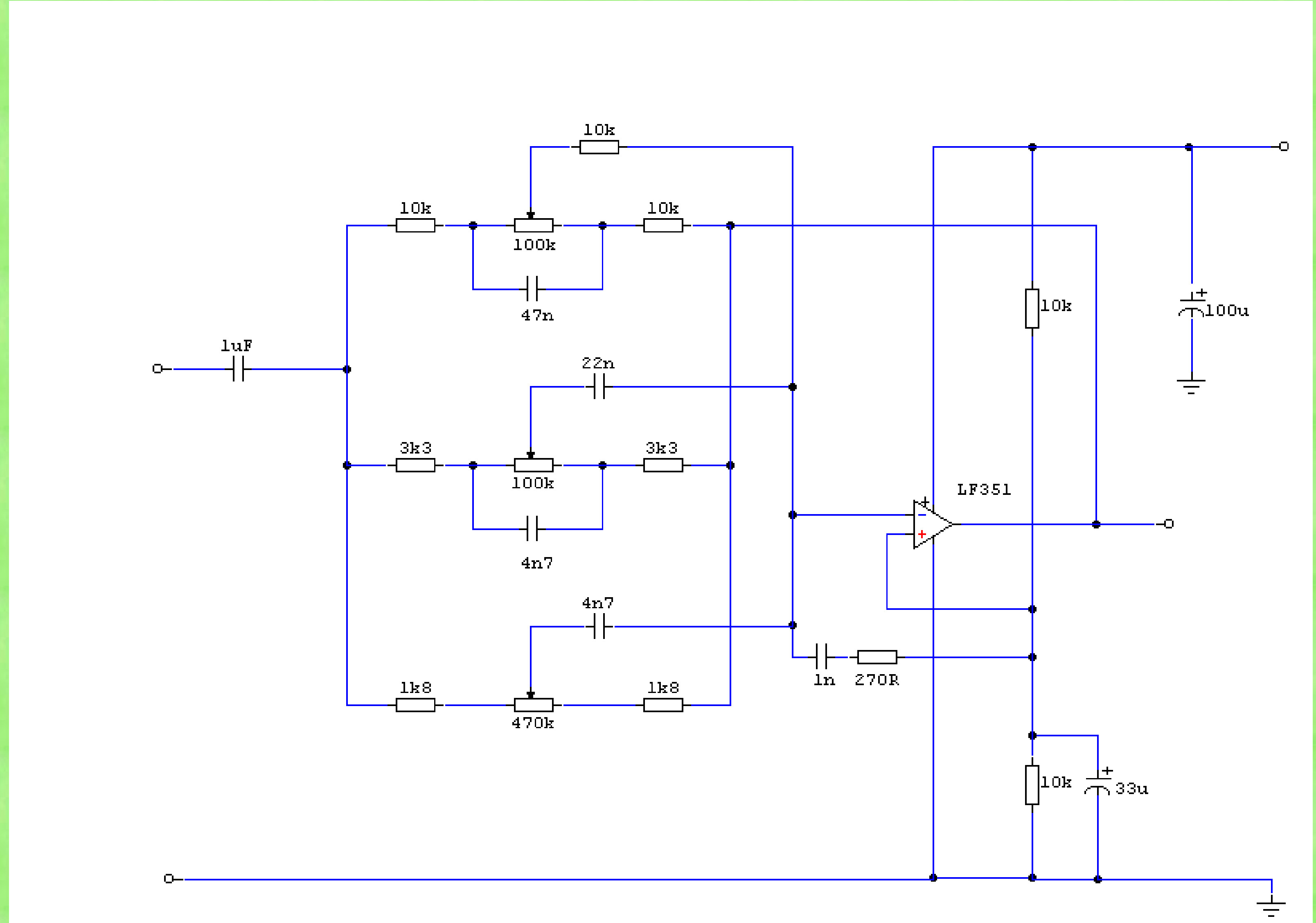
3 Band graphic equalizer



Notes
Using a single op-amp this easy to make equalizer offers three ranges, low frequency,mid frequency,and high. With component values shown there is approximately +/-20dB of boost or cut at frequencies of 50Hz, 1kHz and 10kHz. Supply voltage may be anything from 6 to 30 Volts. Maximum boost 20dB is only realized with maximum supply voltage.

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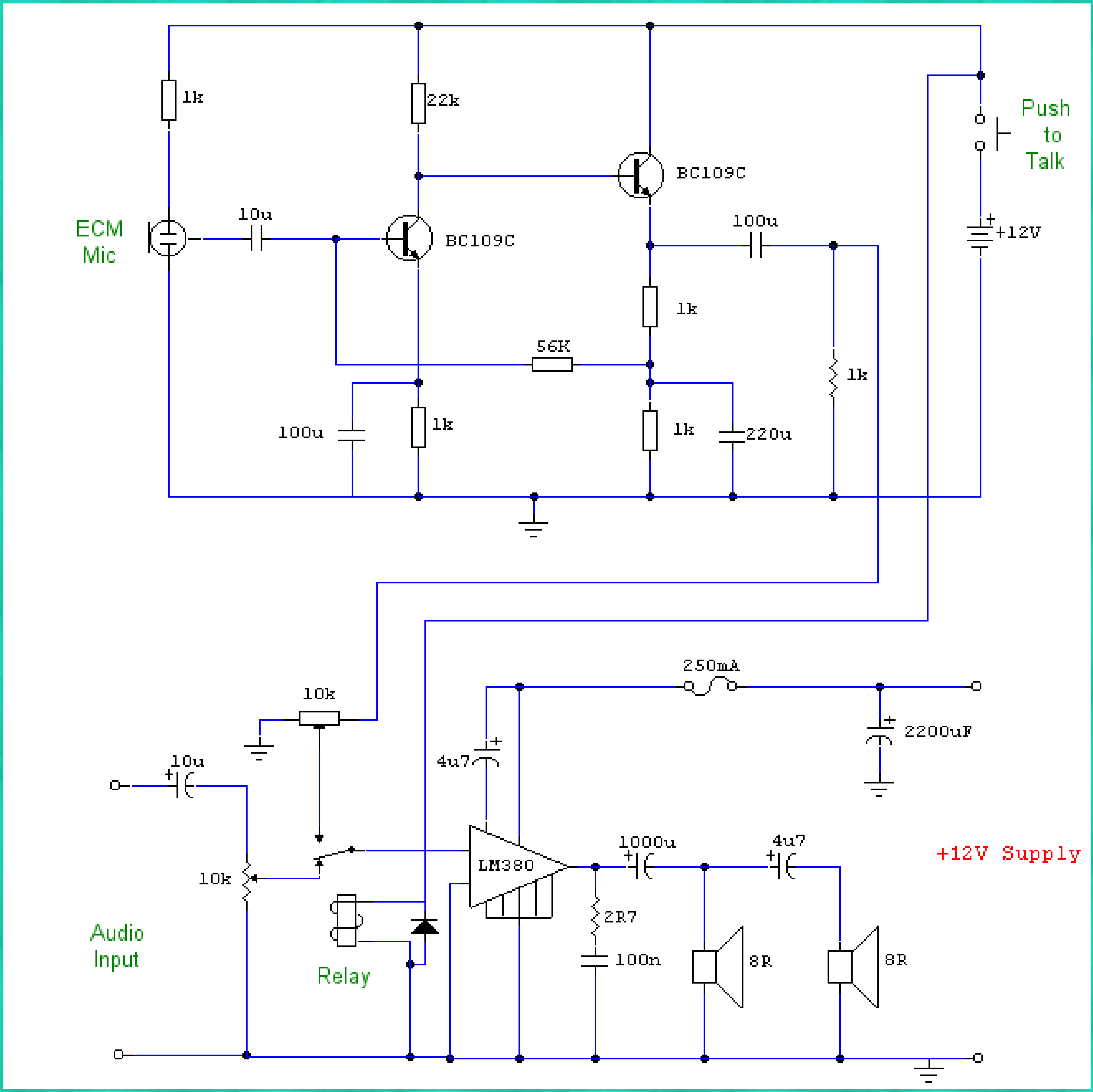
Voice-Over Circuit



Application Notes:

In its simplest form, a voice-over unit is just a microphone and change-over switch feeding an amplifier, the output from the microphone having priority over the amplifiers audio signal when the "push-to-talk" switch is pressed. In this circuit, a preamplifier immediately follows the microphone and is designed to be used some distance away from the main amplifier. The changeover switch is nothing more than a relay with a single changeover contact. For completion, an amplifier based on the LM380 is shown. Three wires are needed to connect the remote microphone unit to the amplifier and switching unit.

Circuit Notes:

With reference to the above schematic, the two BC109C transistors are used to make a microphone preamplifier. The left hand BC109C operates in common emitter mode, the right hand emitter follower. The combination form a high gain, low output impedance amplifier, capable of driving a long audio cable. Screened cable is not required as the output impedance from the microphone pre-amp is very low, and will be immune to mains hum and background noise. The input is shown as a three wire Electret Condenser Microphone though two wire ECM's may also be used. The output of the pre-amp is via a 100uF capacitor and 1k resistor. The 1k resistor here plays an important role, eliminating the dc component of the audio output. (See also eliminating the DC "thump" also on this web site.) A cable of three or more wires is wired to the remote amplifier. The amplifier shown here is based on the National Semiconductor LM380. The input signal is passed via the normally closed contact of a changeover relay, the 10k potentiometer being the volume control for the audio input source. The 10k preset at the normally open contact allows volume control of the voice input, note that this signal has by-passed the normal volume control. At the remote end, when the push-to-talk switch is pressed, the relay will operate and the "voice" signal will be heard in the speaker. There will be no "thump" or "thud" on voice-over as direct current has been eliminated as already mentioned. A suitable application for this circuit would be for use in a remote location such as a workshop or shed.

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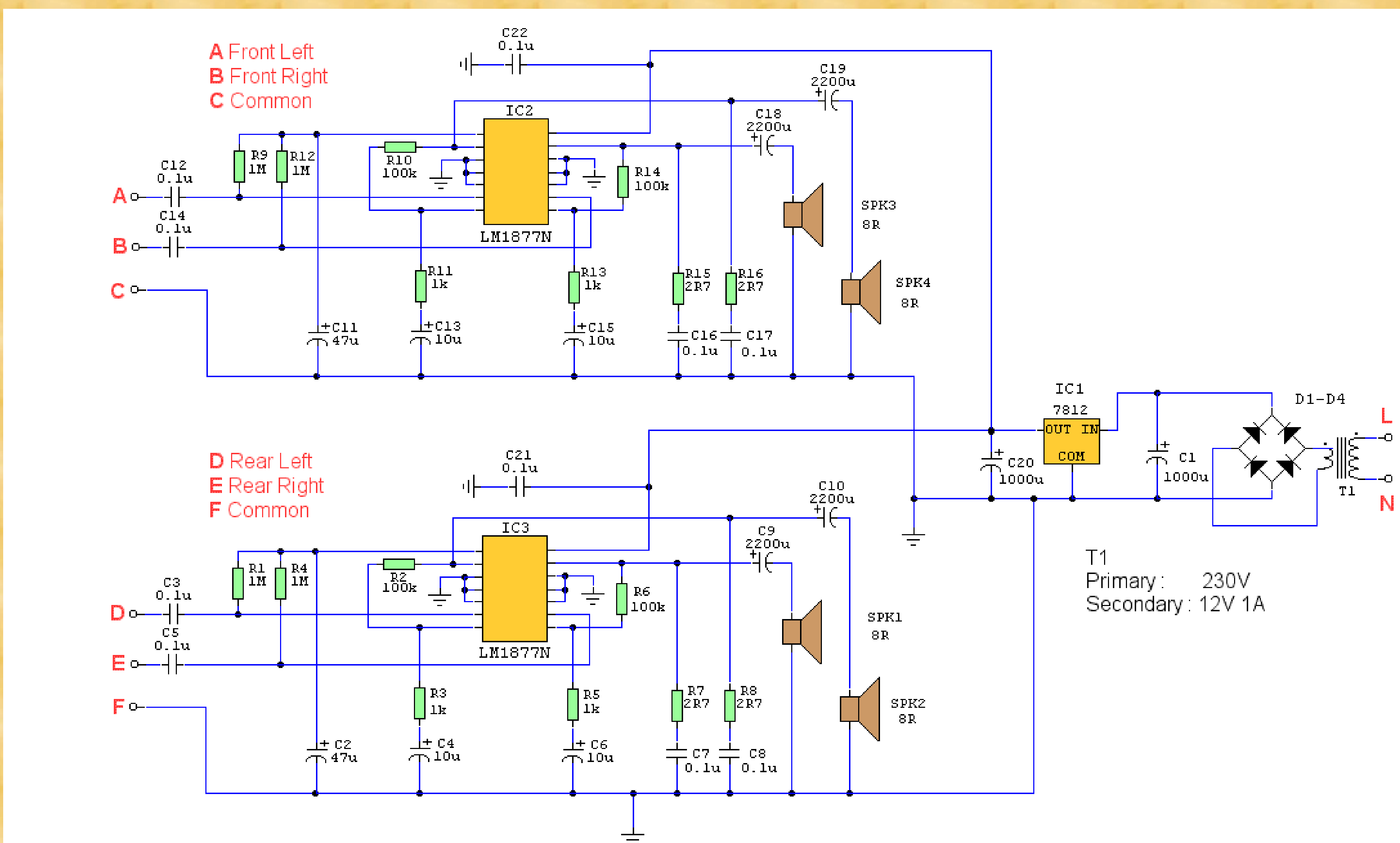
Quadraphonic Amplifier

Description:
This is a four channel amplifier ideally suited for use with quadraphonic equipment such as a Sound Blaster Live card. There is no volume control,audio levels being directly controlled from the sound card itself.



Parts List:
D1-D4: 1N4001 (4)
C1,C20: 1000u CAP (2)

C2,C11: 47u CAP (2)
C3,C5,C7,C8,C12,C14,C16,C17,C21,C22: 0.1u CAP (10)
C4,C6,C13,C15: 10u CAP (4)
C9,C10,C18,C19: 2200u CAP (4)
R1,R4,R9,R12: 1M RESISTOR (4)
R2,R6,R10,R14: 100k RESISTOR (4)
R3,R5,R11,R13: 1k RESISTOR (4)
R7,R8,R15,R16: 2R7 RESISTOR (4)
IC1: 7812 (1)
IC2,IC3: LM1778N (2)
SPK1,SPK2,SPK3,SPK4: 8R 2 Watt speakers (4)

Notes:
Construction is straight forward and is suitable for Verobaord. Overall gain is controlled by the ratio R14/R13 and R6/R5. Used with small hifi speakers the volume was too loud for my room so I reduced R14 and R6 to 33k. The zobel network formed by R7,C7,R8,C8,R15,C16,R16,C17 prevents instability which can happen with long speaker wires. The input impedance is high, 1M and if very long input cables are present could pick up noise. Screened cable should be used, in my case I used 10k resistors between points A & C, B & C, D & F, E & F. This provides a DC path to ground and higher noise immunity. If instability does occur, then you will notice sound distortion and the LM1877N will become hot to touch.

Connections:
The back of a sound blaster live card has colour coded 3.5mm stereo jacks. The image below shows a close up of the rear of my Sound Blaster Live card. As well as colour coding, each connector has an appropriate marking, for easy connectivity.

The normal output connector is green and the rear speaker connector is black. Creative provide utilities and sound mixer for use with Windows. Under Linux the utility Gamix can be used, which allows independent volume control for all channels.

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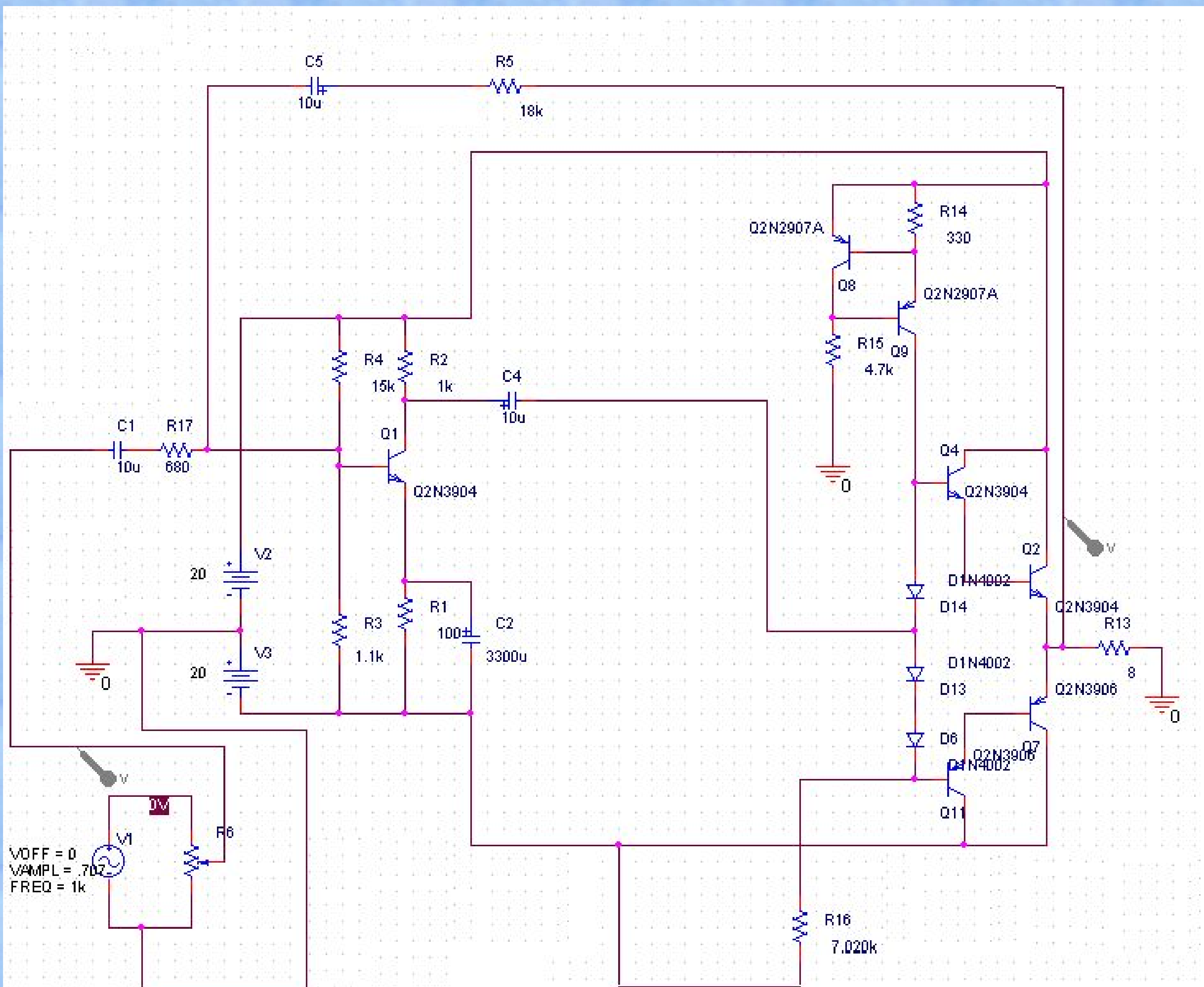
15 Watt Amplifier

Circuit : Sergio García de Alba Garcin from Guadalajara, Mexico
Email: turboman80@hotmail.com

Description:
A 15 watt amplifier made using discrete components. Sergio designed this circuit for his Electronics Level II course.



Notes:
This amplifier uses a dual 20 Volt power supply and delivers 15 watts RMS into an 8 ohm load. Q1 operates in common emitter, the input signal being passed to the bias chain

consisting of Q8, Q9, D6, D13 and D14. Q8 and Q9 provide a constant current through the bias chain to minimize distortion, the output stage formed by a discrete darlington pair (Q2,Q4) and (Q7,Q11). The last two transistors are power Transitors, specifically the 2N3055 and MJ2955. The 7.02K resistor, R16 was made using a series combination of a 4.7K, 680 Ohms, and two 820 Ohms. The 1.1K resistor, R3 was made using a 100 Ohms and a 1K resistor. You can use this circuit with any walkman or CD player since it is designed to take a standard 500mv RMS signal.

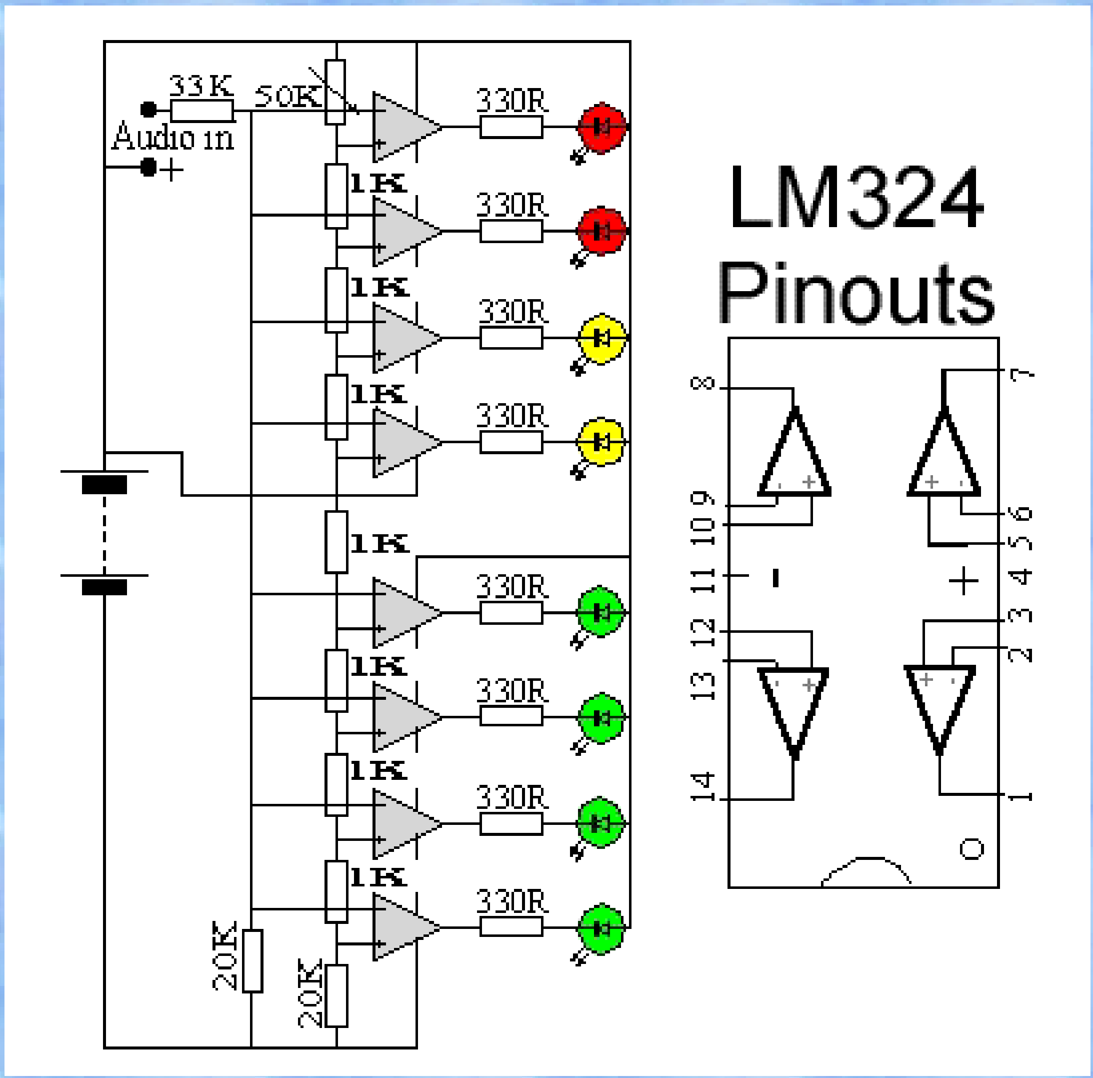
Sergio García de Alba Garcin
Guadalajara, Mexico

Return to Audio Circuits

Audio VU Meter

Circuit : Matthew Hewson
Email: Matthew.Hewson@btinternet.com

Description:
This circuit uses two quad op-amps to form an eight LED audio level meter. The op-amp used in this particular circuit is the LM324. It is a popular IC and should be available from many parts stores.



Notes:
The 1K resistors in the circuit are essential so that the LED's turn on at different audio levels. There is no reason why you can't change these resistors, although anything above 5K may cause some of the LED's to never switch on. This circuit is easily expandable with more op-amps, and

is not limited to use with the LM324. Pretty much any op-amp will work as long as you look up the pinouts and make sure everything is properly connected.

The 33K resistor on the schematic is to keep the signal input to the circuit at a low level. It is unlikely you will find a 33K resistor, so the closest you can get should do. The value of this resistor may need to be changed, so it is best you breadboard this circuit before actually constructing it on PCB. The circuit in it's current form will accept line level inputs from sources such as the aux out on a Hi-Fi, all though could be easily modified to accept speaker inputs.

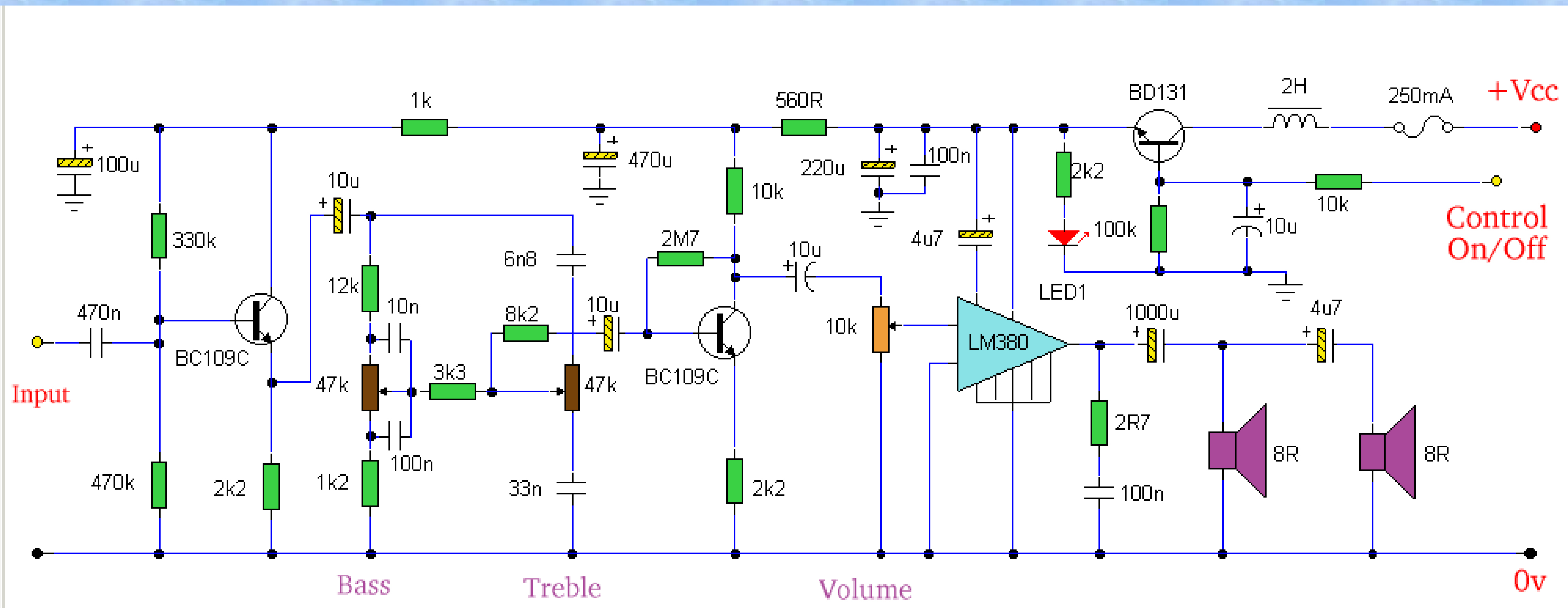
The audio + is connected to the main positive rail, while the audio - is used for signal input. The 50k pot can be used to vary the sensitivity of the circuit.

Return to Audio Circuits

Amp with Tone Controls & Soft Switching

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description:
Built around an LM380, this amplifier includes tone controls and electronic "soft switching". The soft switching circuitry ensures power is built up gradually eliminating the dc thump.



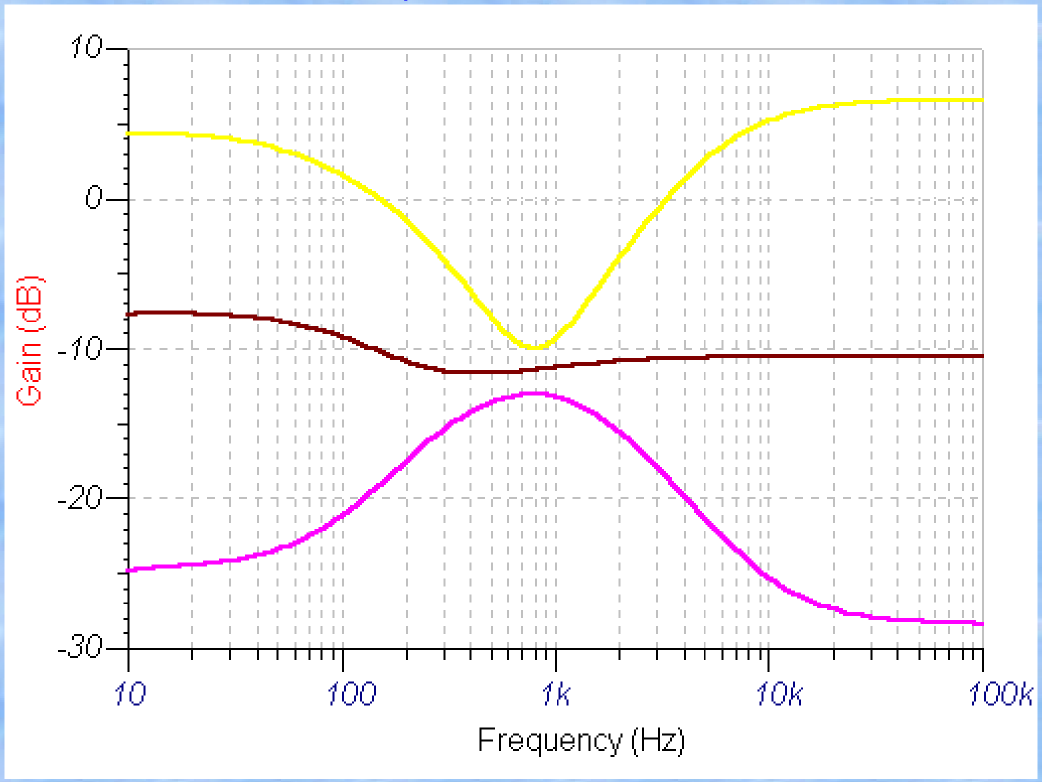
Notes:
The soft switching is enabled by a BD131 transistor wired as a switch in emitter follower configuration. The collector is wired to a permanent supply voltage, the 2H series inductor serves only to filter out power supply hum. This inductor is not too important and may be omitted if the DC supply is adequately smoothed. The control voltage is applied to the BD131 base terminal, the 10u capacitor and 10k resistor having a dual purpose:-
i) a gradual charge of the 10u capacitor ensures that the transistor will switch linearly from 0 volts to full supply, and
ii) serves as a hum filter ensuring a very smooth dc supply to the amplifier and tone controls.
LED1 will light when the amplifier is on. The control voltage should ideally be 0 volts when the amplifier is off and full supply voltage when on. The LM380 is shown driving two 8 ohm loupspeakers, the load is therefore 4 ohms. The 4u7 capacitor acts

as a crude crossover, lower frequencies are impeded and so this loudspeaker may be a "tweeter" type.

Tone Controls:

The input of this is amplifier is via a tone control based on the baxendall design. The first BC109C serves as a buffer, offering a high input impedance. The output signal fed via a 10u capacitors reaches the tone control network. This passive network of resistors and capacitors attenuates high and low frequencies. The bass control is centered on 100Hz and treble control 10kHz. The second BC109C amplifies the losses from the tone control, overall the tone control provides roughly +6dB boost and -20dB cut. See the bode plot below:

Bode response of Tone Controls:



The traces show maximum lift, maximum cut and the response with tone controls in the centre position. There may be difficulty in obtaining BC109C transistors, but BC108C transistors will make an ideal replacement.

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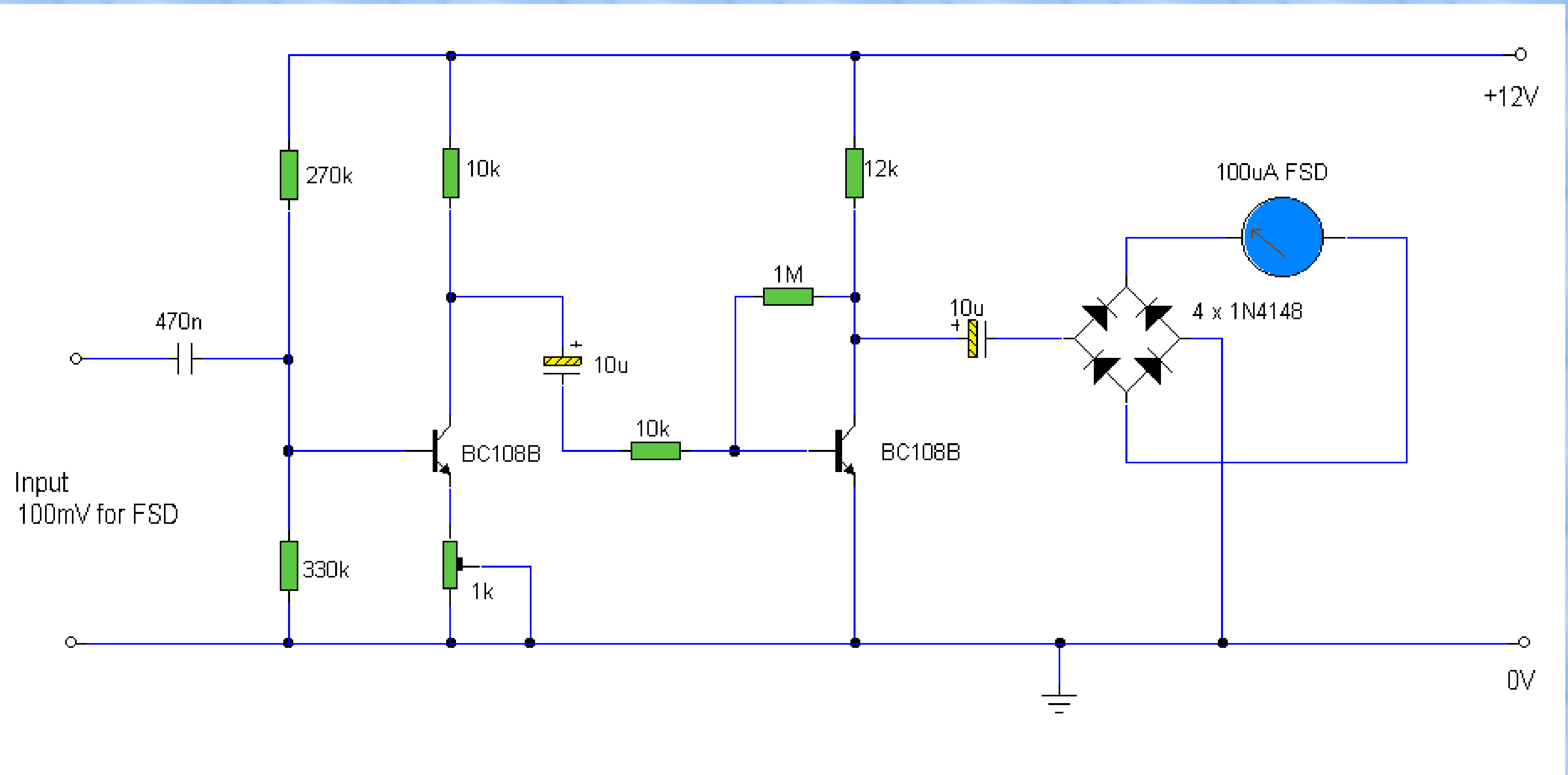
Audio Level Meter

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description:
Audio levels can be monitored using a small panel meter with this circuit built from discrete components.



Notes:
The circuit has a flat frequency response from about 20Hz to well over 50Khz. Input sensitivity is 100mV for a full scale deflection on a 100uA meter. Built on two common emitter amplifiers, the first stage has a preset resistor which

may be adjusted for a FSD. The last stage is biased to operate at roughly half the supply voltage for maximum ac voltage swing. Audio frequencies are passed through the 10u dc blocking capacitor and the full wave bridge rectifier converts the signal to a varying dc voltage. Note that the meter reading is instantaneous and will not provide a "peak" reading. A peak reading audio level meter is also available on this site click this link.

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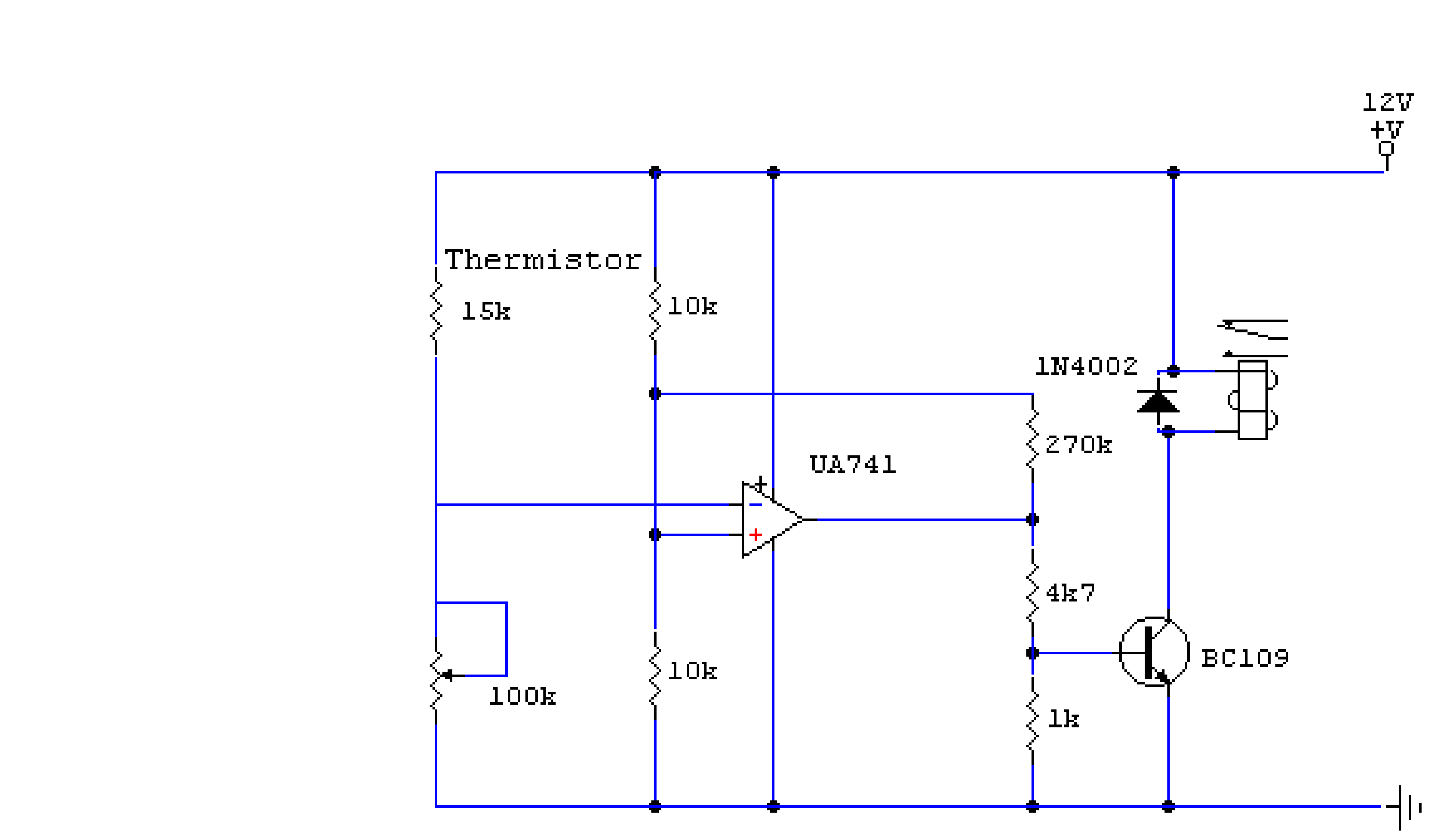
Frost Alarm



Notes:
The thermistor used has a resistance of 15k at 25 degrees and 45k at 0 degrees celsius. A suitable bead
type thermistor is found in the Maplin catalogue. The 100k pot allows this circuit to trigger over a wide range
of temperatures. A slight amount of hysteresis is provided by inclusion of the 270k resistor. This prevents
relay chatter when temperature is near the switching threshold of this circuit.

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Switching Circuits

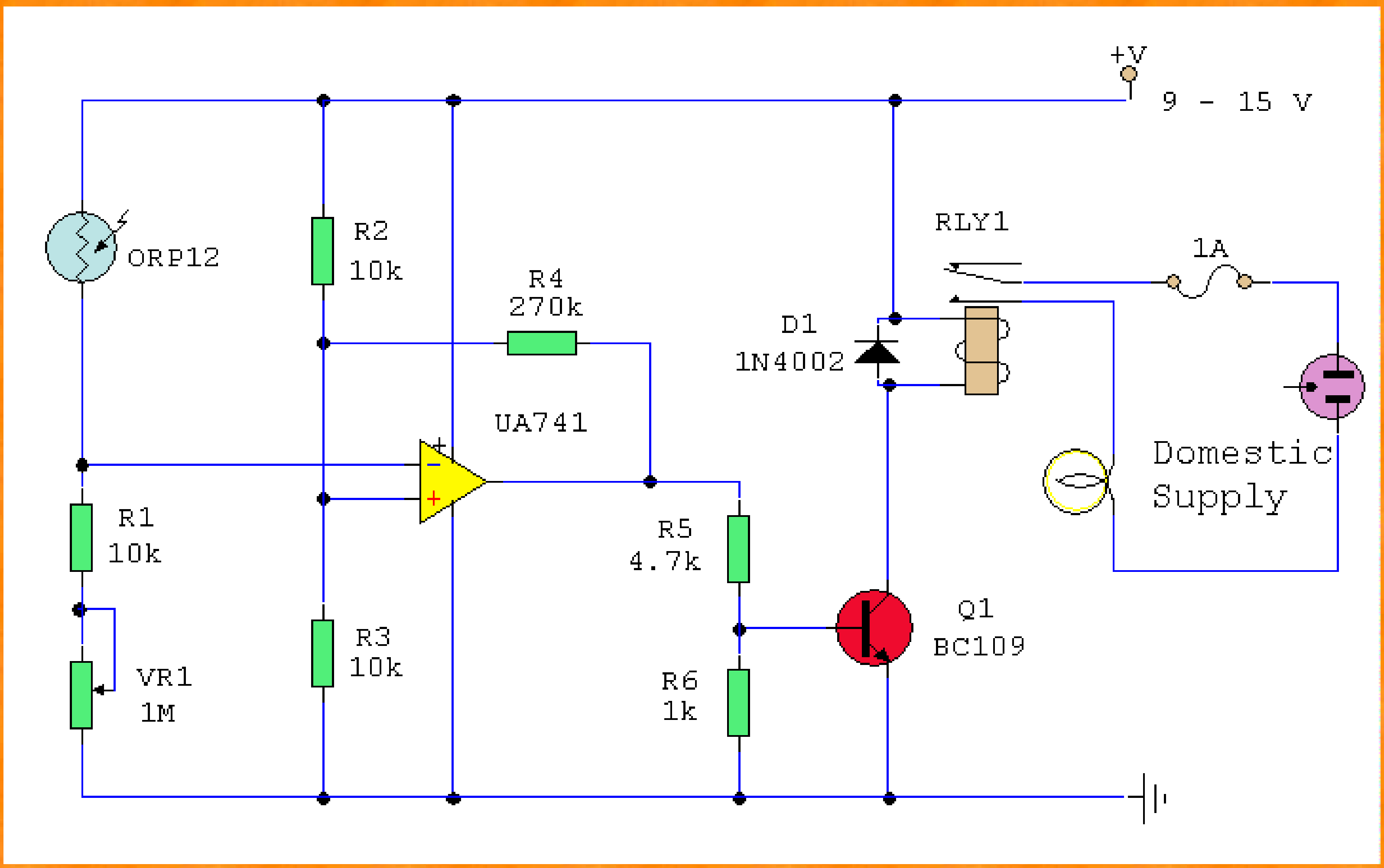
1. Frost Alarm or Cold Activated Switch
2. Dark Activated Switch or Porch Light Switch
3. Electronic Keypad by Ron J
4. Light Detector Circuit by Mick Devine
5. DC Push Button Motor Control Circuit
6. Push Button Switch Debouncer
7. Remote Doorbell Indicator
8. Doorbell with Counter
9. Digital Combination Lock
10. Electronic Night Light
11. Sound Operated Switch
12. Voltage Comparator Switch
13. DC Motor Reversing Circuit
14. Water Activated Relay by Marin Lukas

Return to Schematics

Dark Activated Switch

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description:
This circuit will activate a relay when light falls to a preset level. Light level can be adjusted with VR1 and the relay contacts may be used to operate an external light or buzzer.



Notes:
The light sensor used is the ORP12 photocell. In bright light the resistance of the ORP12 can be as low as 80 ohm and at 50lux (darkness) the resistance increases to over 1 Mohm. The 1M control should provide a wide range for light intensities, if not its value may be increased. The op-amp senses the voltage difference between pins 2 and 3. The control VR1 is adjusted so that the relay is off, the output of the op-amp will be around 2 Volts. When light falls, the resistance of the photocell increases and the difference in input voltage is amplified by the op-amp, the output will swing towards full supply and drive the transistor and relay. The 270k resistor provides a small amount of hysteresis, so that the circuit switches on and off with slightly different light levels. This eliminates relay chatter.

Take great care if you decide to wire the relay to activate a mains lamp. Make sure the relay contacts provide adequate isolation and have ample rating for the load.

Parts List:
ORP12 Photocell (1)
RLY1: 12VSPDT (1)
U1: UA741 (1)
Q1: BC109 NPN (1)
D1: 1N4002 DIODE (1)
F1: 1A (1)
VR1: 1M RESISTOR (1)
ORP12: 500K RESISTOR (1)
R1,R3,R2: 10k RESISTOR (3)
R5: 4.7k RESISTOR (1)
R6: 1k RESISTOR (1)
R4: 270k RESISTOR (1)

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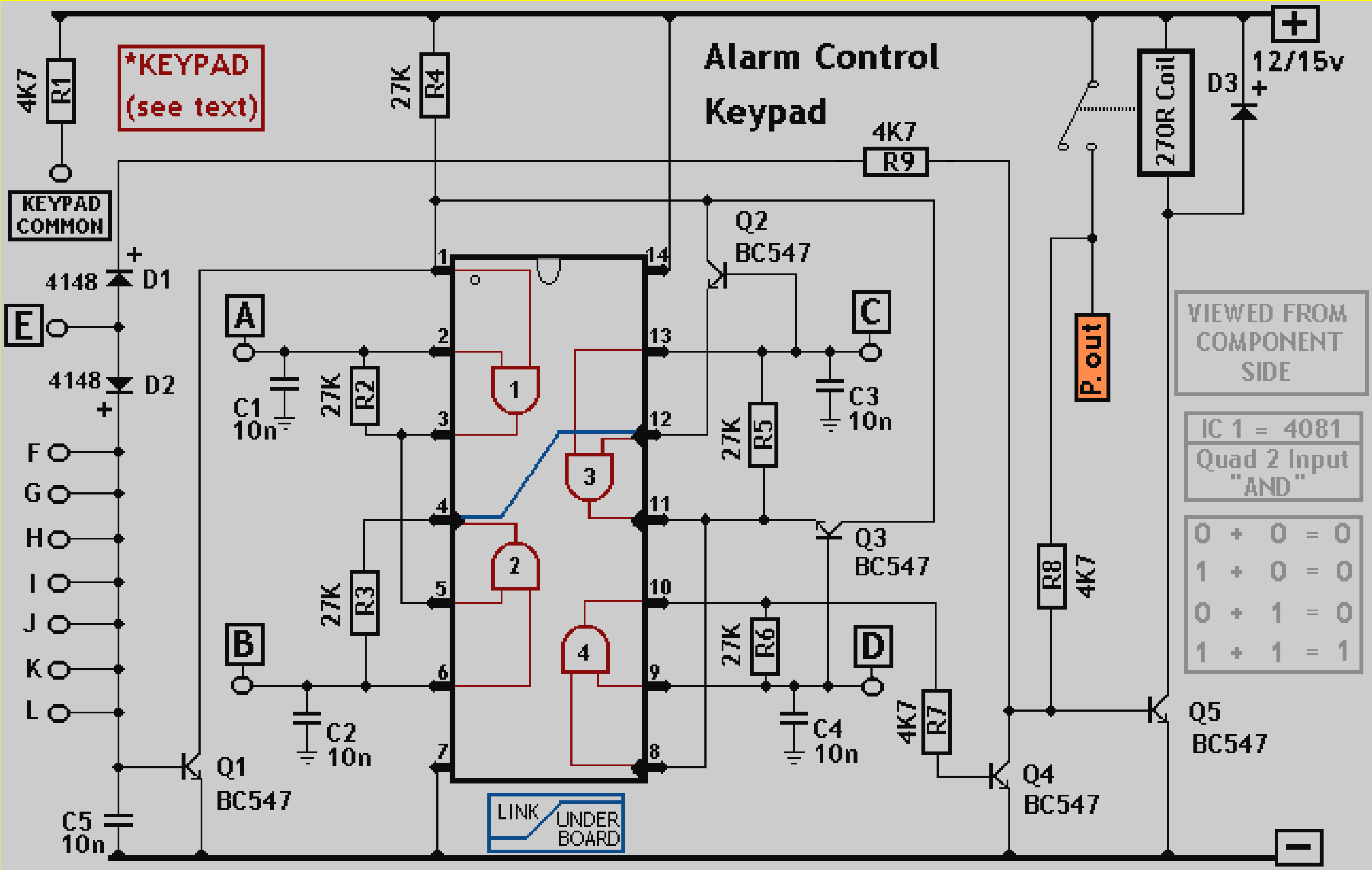
Electronic Keypad



The IC is a quad 2 input "AND" gate, a CMOS 4081. These gates only produce a HIGH output, when BOTH the inputs are HIGH. When the key wired to 'E' is pressed, current through R1 and D1 switchs Q5 on.The relay energises; and Q5 is 'latched on' by R8. Thus, the Alarm is set by pressing a single key,say one of the two non-numeric symbols.

The alarm will switch off when the 4 keys connected to "A,B,C,D" are pushed in the right order.The circuit works because each gate 'Stands' upon its predecessor.If any key other than the correct key is pushed, then gate 1 is knocked out of the stack, and the code entry fails. Pin 1 is held high by R4. This 'Enables' gate 1; and when button 'A' is pressed, the output at pin 3 will go high. This output does two jobs.It locks itself 'ON' through R2 and it 'Enables' gate 2, by taking pin 5, high. Now, if 'B' is pressed, the output of gate 2, at pin 4 will go high. This output does two jobs. It locks itself 'ON' through R3 and it 'Enables' gate 3 by taking pin 12 high.

Now, if 'C' is pressed, the output of gate 3 will lock itself 'ON' through R5 and, by taking pin 8 high, 'Enable' gate 4. Pressing 'D' causes gate 4 to do the same thing; only this time its output, at pin 10, turns Q4 'ON'. This takes the base of Q5 to ground, switching it off and letting the relay drop out. This switches the alarm off.

Any keys not connected to 'A B C D E' are wired to the base of Q1. Whenever 'E' or one of these other keys is pressed, pin 1 is taken low and the circuit is reset. In addition, if 'C' or 'D' is pressed out of sequence, then Q2 or Q3 will take pin 1 low and the circuit will reset. Thus nothing happens until 'A' is pressed.Then if any key other than 'B' is pressed, the circuit will reset.
Similarly, after 'B', if any key other than 'C' is pressed,the circuit will reset. The same reasoning also applies to 'D'.
The Keypad needs to be the kind with a common terminal and a separate connection to each key. On a 12 key pad, look for 13 terminals. The matrix type with 7 terminals will NOT do. Wire the common to R1 and your chosen code to 'A B C D'. Wire 'E' to the key you want to use to switch the alarm on. All the rest go to the base of Q1.

The diagram should give you a rough guide to the layout of the components, if you are using a stripboard. The code you choose can include the non-numeric symbols.In fact, you do not have to use a numeric keypad at all,or you could make your own keypad.
I haven't calculated the number of combinations of codes available, but it should be in excess of 10 000 with a 12 key pad; and, after all, any potential intruder will be ignorant of the circuit's limitations. Of Course, if you must have a more secure code, I can think of no reason why you shouldn't add another 4081 and continue the process of enabling subsequent gates. Or you could simply use a bigger keypad with more "WRONG" keys.
Any small audio transistors should do. The 27k resistors could be replaced with values up to 100k. And the only requirements for the 4k7 resistors is that they protect the junctions while providing enough current to turn the transistors fully on.
Capacitors (C1 C2 C3 C4 C5) are there to slow response time and overcome any contact bounce. They are probably unnecessary.

RON J   Email: ronj@gofree.indigo.ie

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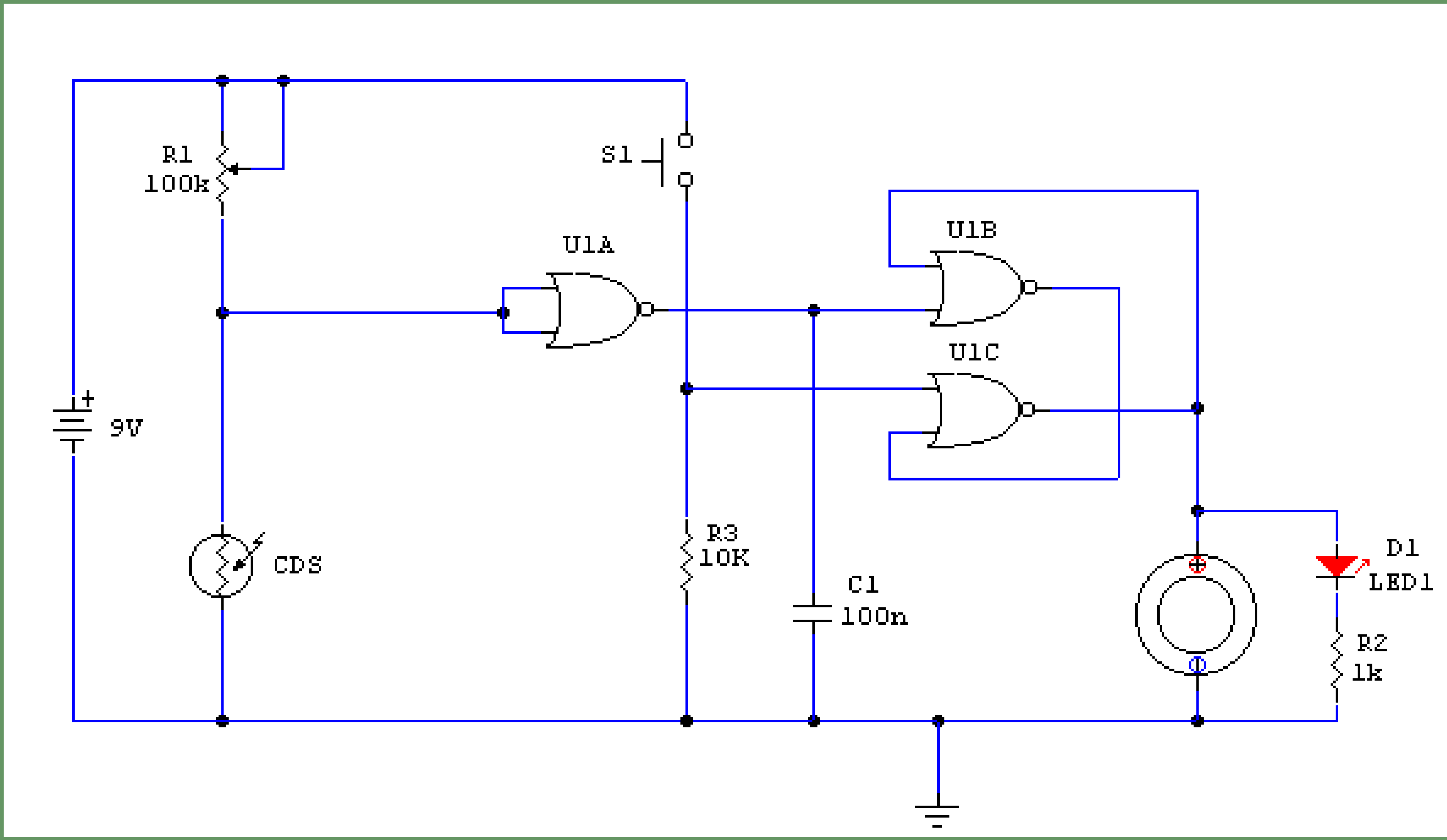
Light Detector Circuit



Kindly submitted by Mick Devine from the UK

Notes:
Variable resistor R1 adjusts the light threshold at which the circuit triggers. R1's value is chosen to match the photocells resistance at darkness. The circuit uses a CMOS 4001 IC. Gate U1a acts as the trigger, U1b and c form a latch. S1 resets the circuit. The output device may be a low power piezo buzzer.

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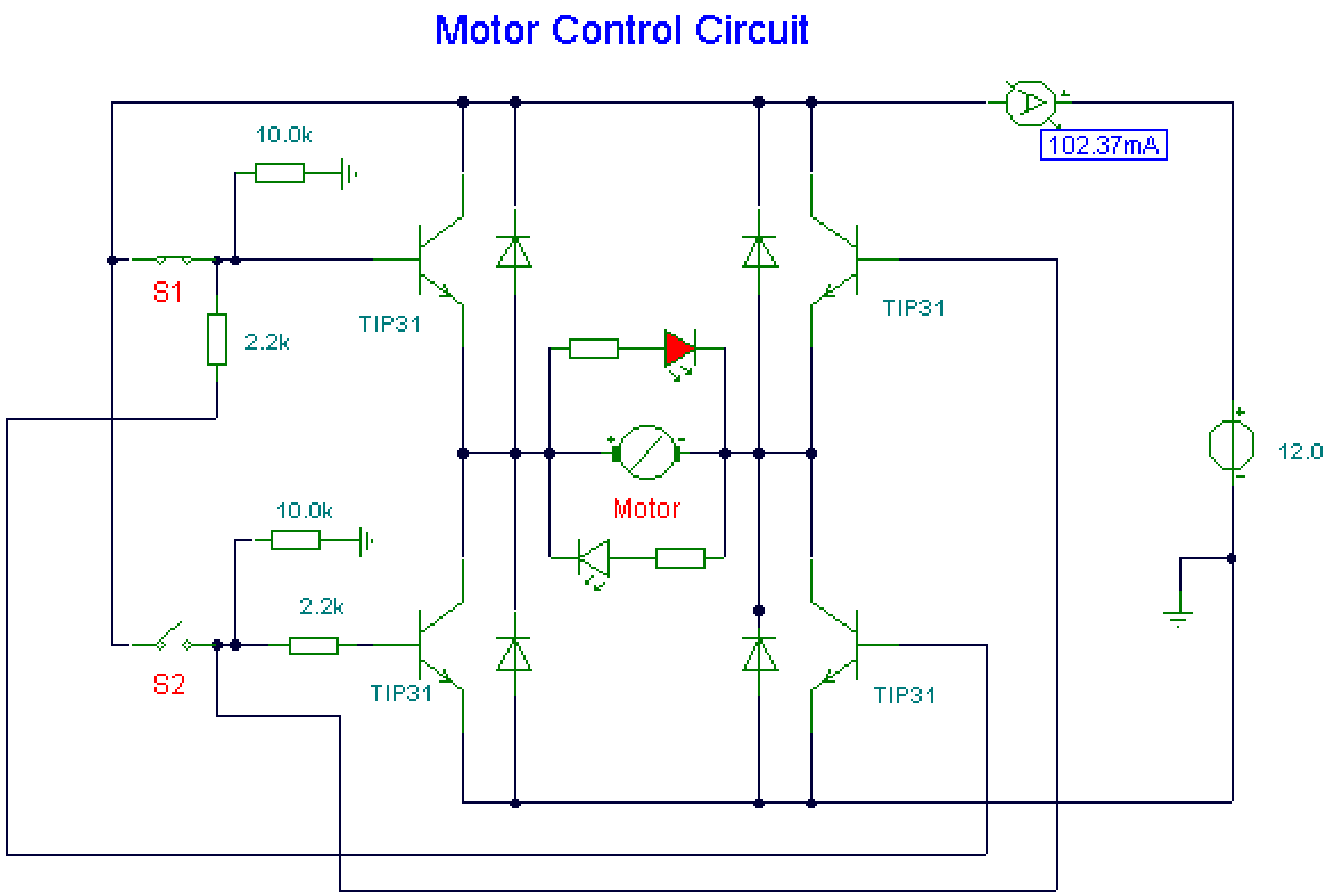
DC Motor Control Circuit



Notes:

Here, S1 and S2 are normally open , push to close, press button switches. The diodes can be red or green and are there only to indicate direction. You may need to alter the TIP31 transistors depending on the motor being used. Remember, running under load draws more current. This circuit was built to operate a small motor used for opening and closing a pair of curtains. As an advantage over automatic closing and opening systems, you have control of how much, or how little light to let into a room. The four diodes surriunding the motor, are back EMF diodes. They are chosen to suit the motor. For a 12V motor drawing 1amp under load, I use 1N4001 diodes.

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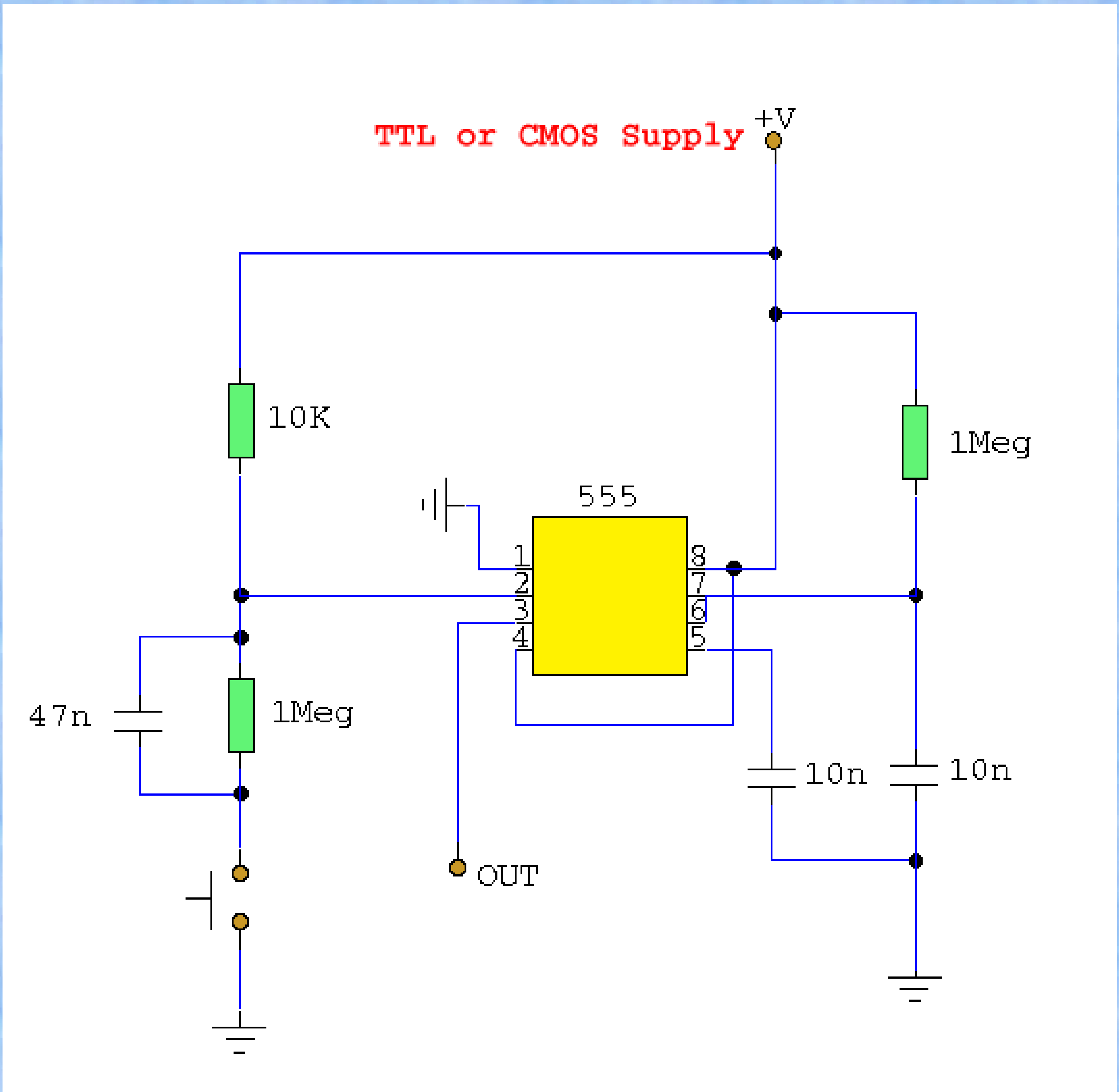
PBS Switch Debouncing Circuit

Design :Andy Collinson
Email: anc

Description:
This circuit will remove the transient spikes and contact bounces from a non-latching push button switch.



Notes:
I do not claim originality here for a 555 monostable circuit, but in this application, it finds use as a good switch debouncer. There are many circuits for SPDT debouncing, but not many for a normally open, push-to-make press button switch (PBS). The 555 monostable gives an output pulse of around 20 msec with component values shown. The 555 circuit can be re-triggered if the input is held low longer than the output pulse. To prevent this happening, I have included a further timing circuit comprised of the 1Meg resistor and 47n capacitor. Normally, the 47n capacitor is discharged via the 1 Meg resistor. When the switch is pressed the capacitor quickly charges and provides a brief negative pulse to the 555 input. When the capacitor is fully charged, the potential across the voltage divider formed by the 10k and 1Meg resistors is insufficient to retrigger the monostable. Releasing the switch quickly discharges the capacitor. The output of a 555 monstable is suitable for connecting to TTL and CMOS logic circuits.

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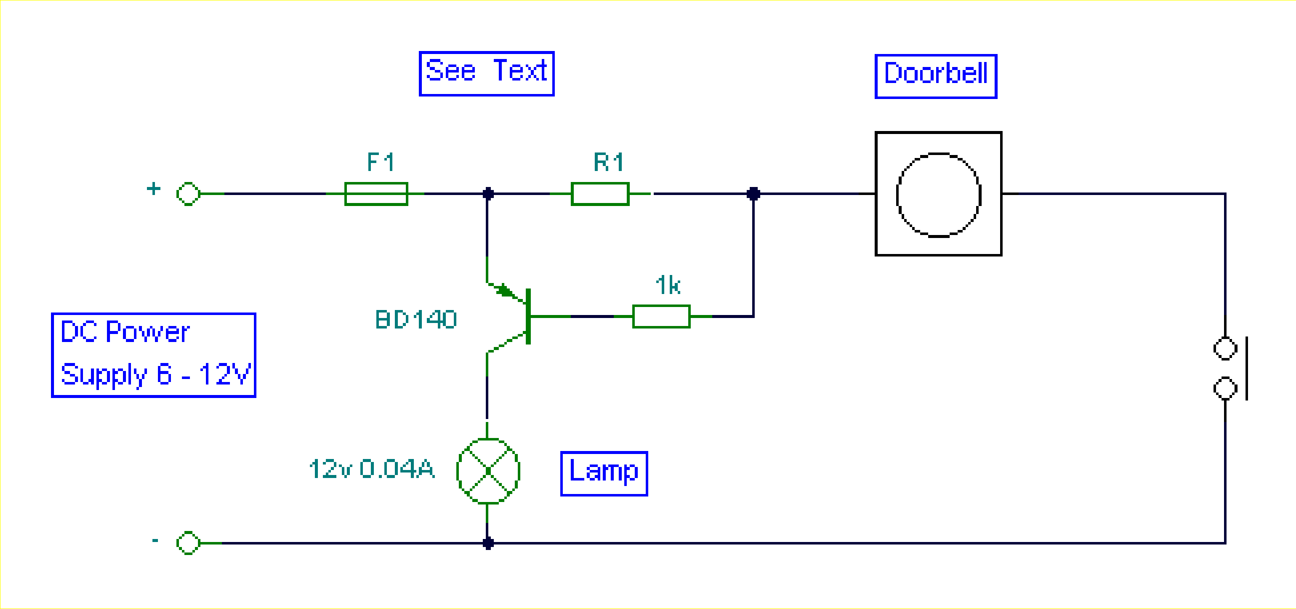
Remote Doorbell Warning Switch



Important Note:
This circuit should only be used with the solenoid type chime doorbells, the electronic type that play tunes
will not work here.

Notes:
The hardest part for this circuit was the title. It is quite easy to miss the sound of a doorbell if you are watching
TV , this circuit gets round the problem by providing a visual indication, i.e. a lamp. As an alternative, a LED
could also be used. You could just parallel a lamp across the doorbell, but this would mean extra drain from
the doorbell batteries or transformer.
Using a series resistor R1 actually reduces current flow , and if run from batteries, will give them a longer
life. The value of R1 is chosen so that about 0.6 to 0.7 volts is dropped across it, and the doorbell should
still ring. I used a combination of a 22 ohm resistor in parallel with a 50 ohm. The doorbell still rang and
circuit operated correctly. I used to have an electromechanical counter that registered each time when
someone pressed the switch....in fact, I remember a time when I had more "hits" at my doorbell then at my
web site=:)

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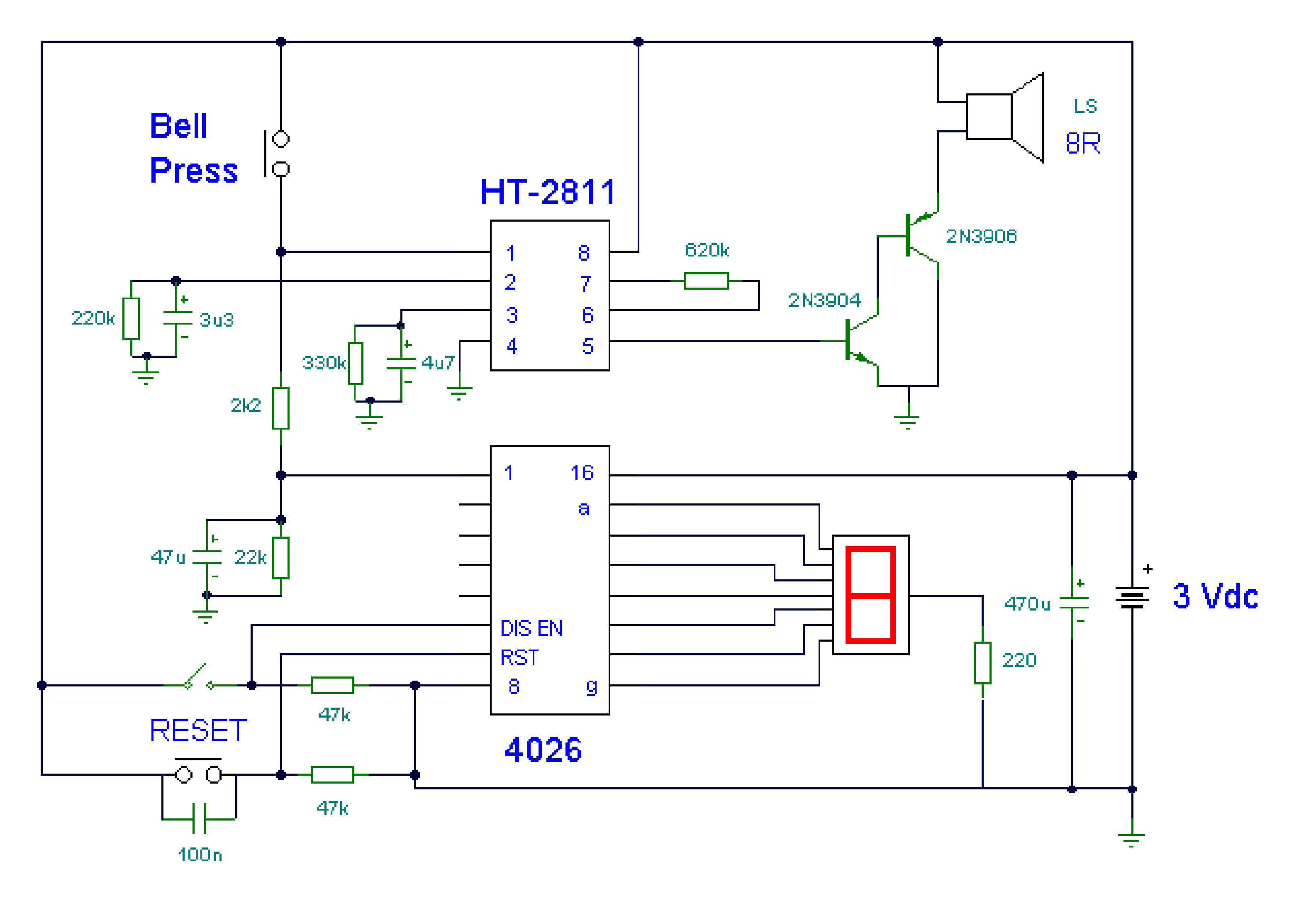
Electronic Doorbell with Counter

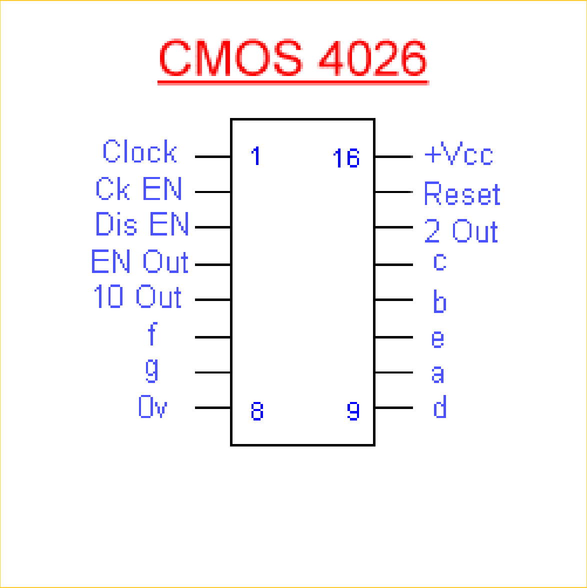
This circuit makes use of a synthesized sound chip from Holtek, the HT-2811. This reproduces
the electronic sound equivalent of the "ding-dong" type chiming doorbells. I have also made use
of the CMOS 4026 counter display driver IC which will keep track of your visitors.



Application Notes:

The Holtek HT-2811 is available from Maplin electronics in the UK, order code BH69A. The
operating voltage must remain within 2.4 to 3.3Vdc. Standby current is minimal, as is the rest
of the circuit. The reset switch returns the count to zero, the 7 segment display is a common
cathode type. To save power consumption the display can be enabled or disabled with a

switch as shown in the above diagram. The count will still be held in memory. The IC pin out
for the 4026 is shown in pin order below:



The count can be expanded for up to 99 visits by cascading two CMOS 4026 IC's. All that is
required is to wire pin 5 (10 out) to the clock input , pin 1 of the next IC.

The envelope of the chime is set by the 220k, 330k, 3u3 and 4u7 resistors and capacitors.
These values are the manufactures default values, but may be adjusted to alter the length
and delay of the chime.

The combination of the 2k2, 22k and 47u resistor capacitor network has a double function.
It provides a debouncing circuit for the bell press and at the same time has a sufficiently
long time constant. This ensures that anyone rapidly pressing the doorbell switch, only
advances the count once. The 47u capacitor can be increased in value, if needed.

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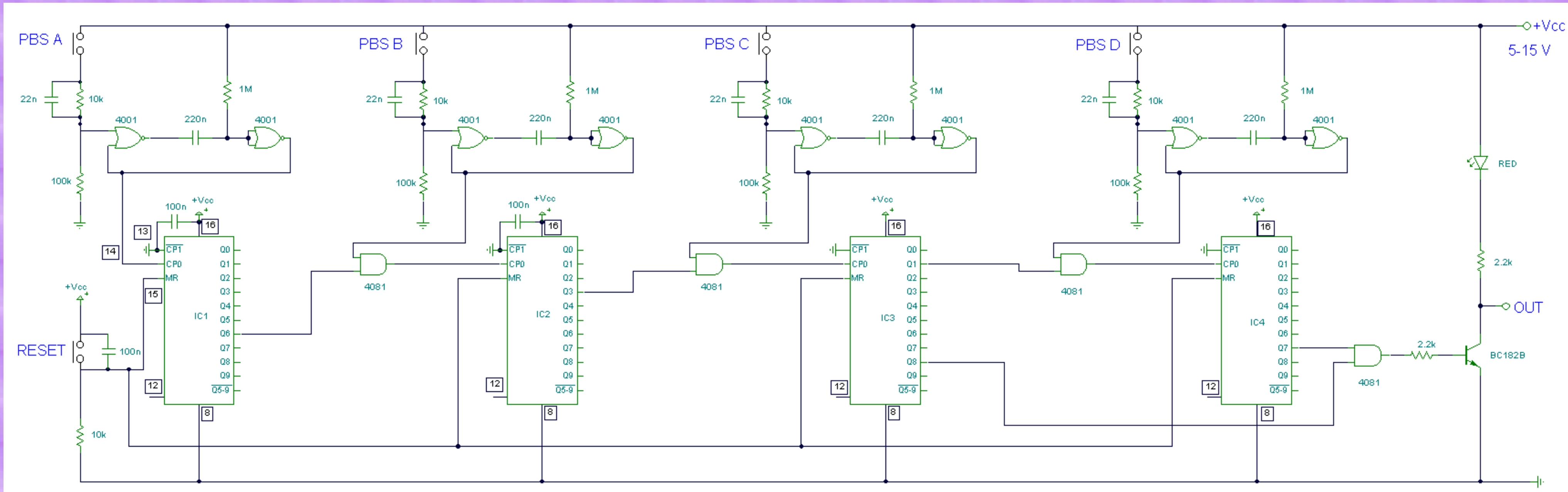
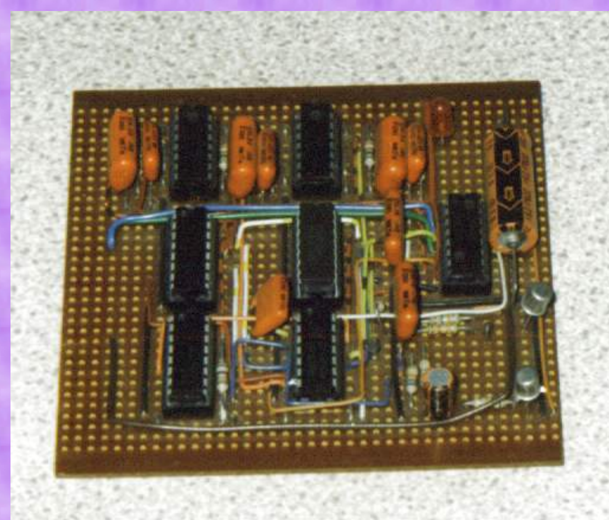
Digital Combination Lock



IC1-4 are CMOS4017

Notes:

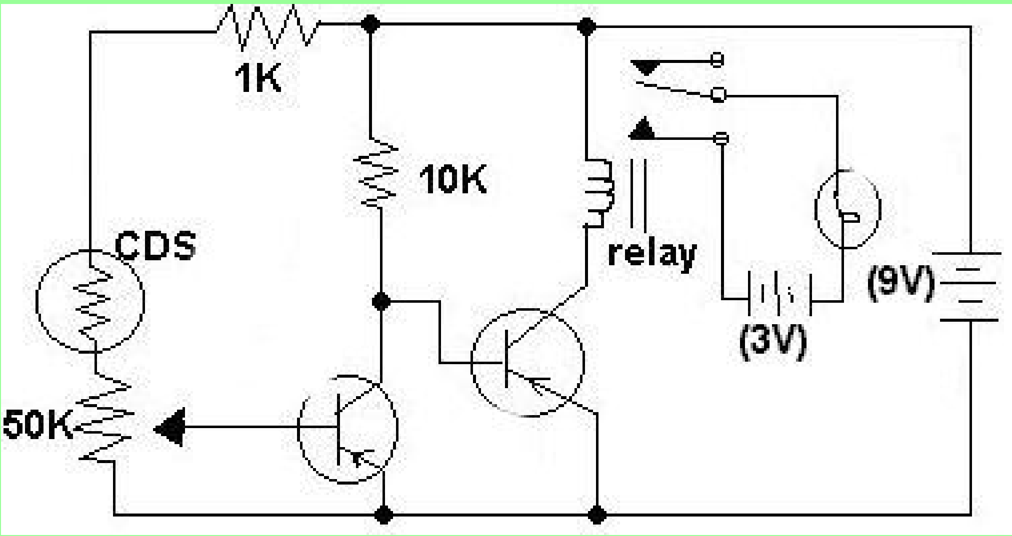
The circuit above above makes use of the CMOS 4017 decade counter IC. Each depression of a switch steps the output through 0 - 9. By coupling the output via an AND gate to the next IC, a predefined code has to be input to create the output. Each PBS switch is debounced by two gates of a CMOS4001 quad 2-input NOR gate. This ensures a clean pulse to the input of each CMOS 4017 counter. Only when the correct number of presses at PBS A will allow PBS B to become active. This is similar for PBS C and PBS D. At IC4, PBS D must be pressed 7 times. Then PBS C is again pressed 7 times, stepping from output 1 to output 8. The AND gate formed around CMOS4081 then goes high, lighting the LED. The Reset switch can be pressed at any time. Power on reset is provided by the 100n capacitor near the reset switch. Below is a picture of one that I made about 15 years ago:



Unfortunately, this board was part of a much larger project containing multiple power supplies. One day whilst working on another circuit , I slipped with a wire and splashed 24volts DC onto this board. There was a small spark, and puff of smoke before all this chips were cooked! If anyone does consider building such a circuit, then my advice would be to stop and look in your local electronic parts catalogue. There are now dedicated combination lock IC's with combinations many times greater than this circuit. Incidentally the number of combinations offered here is 10 x 10 x 10 x 10 x 9 = 90,000. Check out Dean White's Electronic Gadgets, on the Electronic Sites Alliance web ring, he also has a combination lock circuit.

Return to Switching Circuits

Electronic Night Light



Notes:
This circuit was submitted by Adam from Canada who is still at school. I have provided the
text. The two transistors are used as a direct coupled switch, Adam used 2SC711 but any
general purpose transistor will do e.g. 2N3904, BC109C.

The CDS photocell, type ORP12 is normally illuminated, therefore its resistance is low. The
50k control, the 1k resistor and the photocell form a potential divider which biases the first
transistor. This transistor is on, its collector being held low, turns the last transistor and
hence lamp and relay off.

In darkness, the resistance of the photocell becomes high and the first transistor switches

off. The base voltage for the second transistor goes high, switching this transistor on and
illuminating the lamp.

Although Adam used a secondary supply of 3V , you could use any voltage and any lamp
here. Make sure the relay contacts can handle the load. If using a large relay, it is preferable
to wire a 1N4001 in reverse polarity across the coil. This will prevent the back EMF of
the relay from damaging the transistors.

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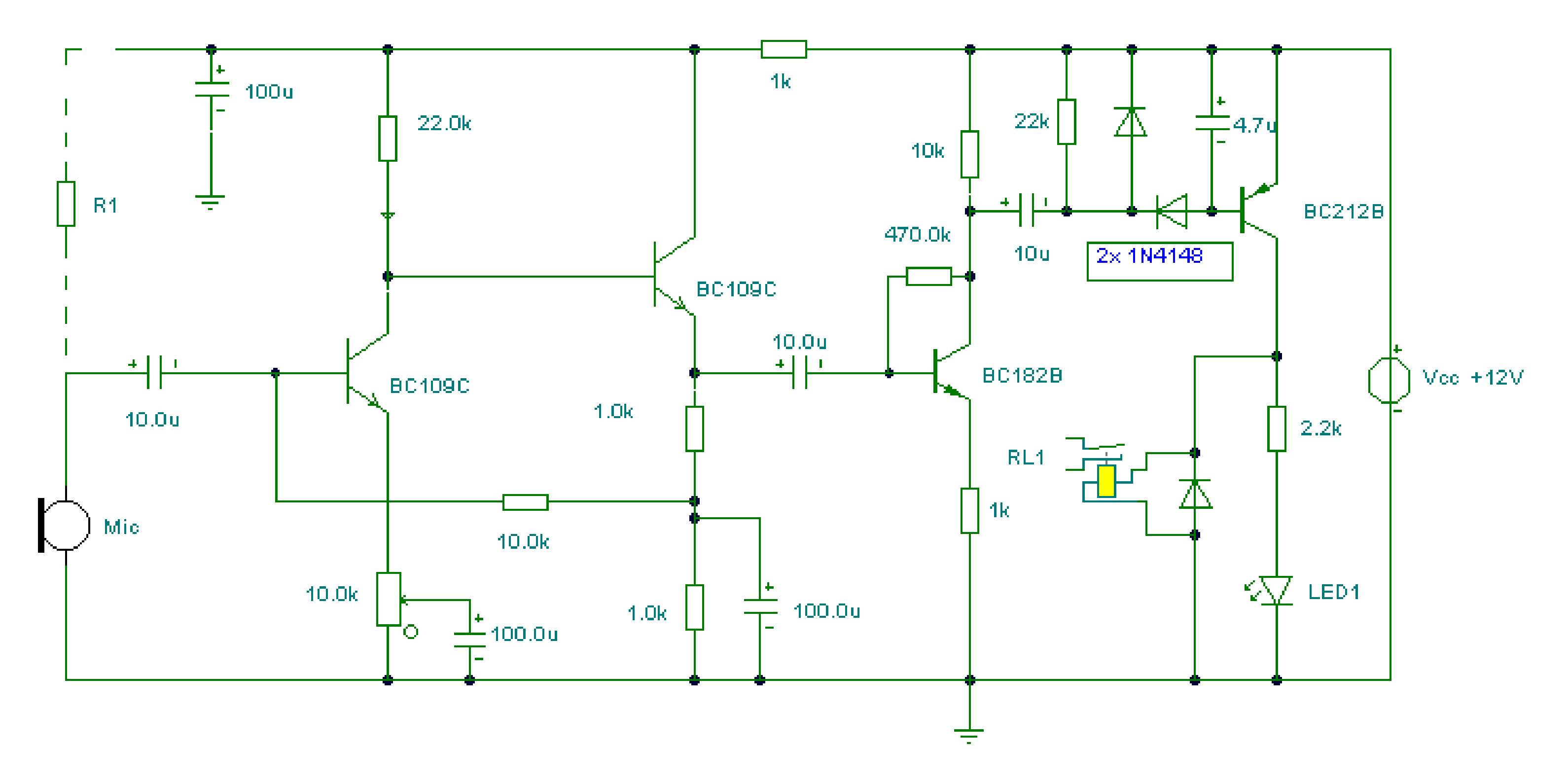
Sound Operated Switch



Notes:
This sensitive sound operated switch can be used with a dynamic microphone insert as above,
or be used with an electret (ECM) microphone. If an ECM is used then R1 (shown dotted) will need to be included. A suitable value would be between 2.2k and 10kohms.

The two BC109C transitors form an audio preamp, the gain of which is controlled by the 10k preset. The output is further amplified by a BC182B transistor. To prevent instability the preamp is decoupled with a 100u capacitor and 1k resistor. The audio voltage at the collector of the BC182B is rectified by the two 1N4148 diodes and 4.7u capacitor. This dc voltage will directly drive the BC212B transistor and operate the relay and LED.

It should be noted that this circuit does not "latch". The relay and LED operate momentarily in response to audio peaks.

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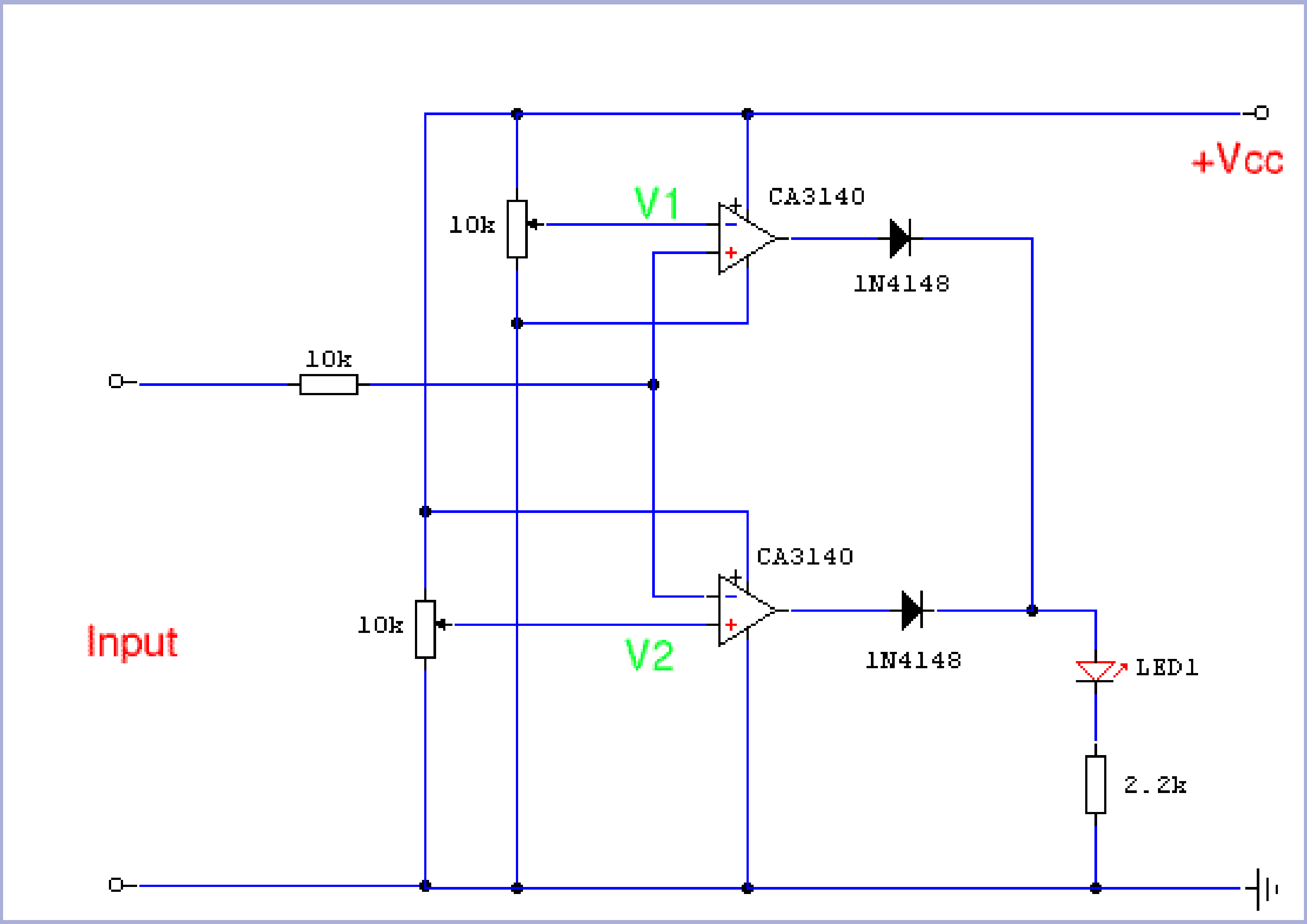
Voltage Comparator Switch



Notes:
This circuit will provide an indication whenever the input voltage differs from two defined limits, V1 and V2. The supply voltage, Vcc must be higher than the highest input voltage by at least 2 volts. One application here is to monitor a 12V car battery. V1 could be set to 14V and V2 to 11V thus giving an indication of over charge or a weak battery.

The op-amps used here are MOSFET CA3140. They are used to advantage as they have very little output offset voltage and can switch down to near 0volts. If any other op-amp is used such as LF351 or CA741 then it will be necessary to have an offset null control. This is just a 10k preset contacted between pins 1 and 5, the wiper connected to the negative supply rail or op-amp pin 4. With this circuit either op-amp will light the LED if the input voltage goes out of limits, the two 1N4148 diodes forming an "AND"-gate at the output. The input voltage to be monitored is fed via a series 10k resistor to inputs of both op-amps. If the input voltage is greater than the limit set by V1 then the CA3140 will swing its output to almost the full supply voltage and light the LED. Similarly, if the input voltage is less than the limit defined by V2 then this op-amp will swing towards Vcc and light the LED.

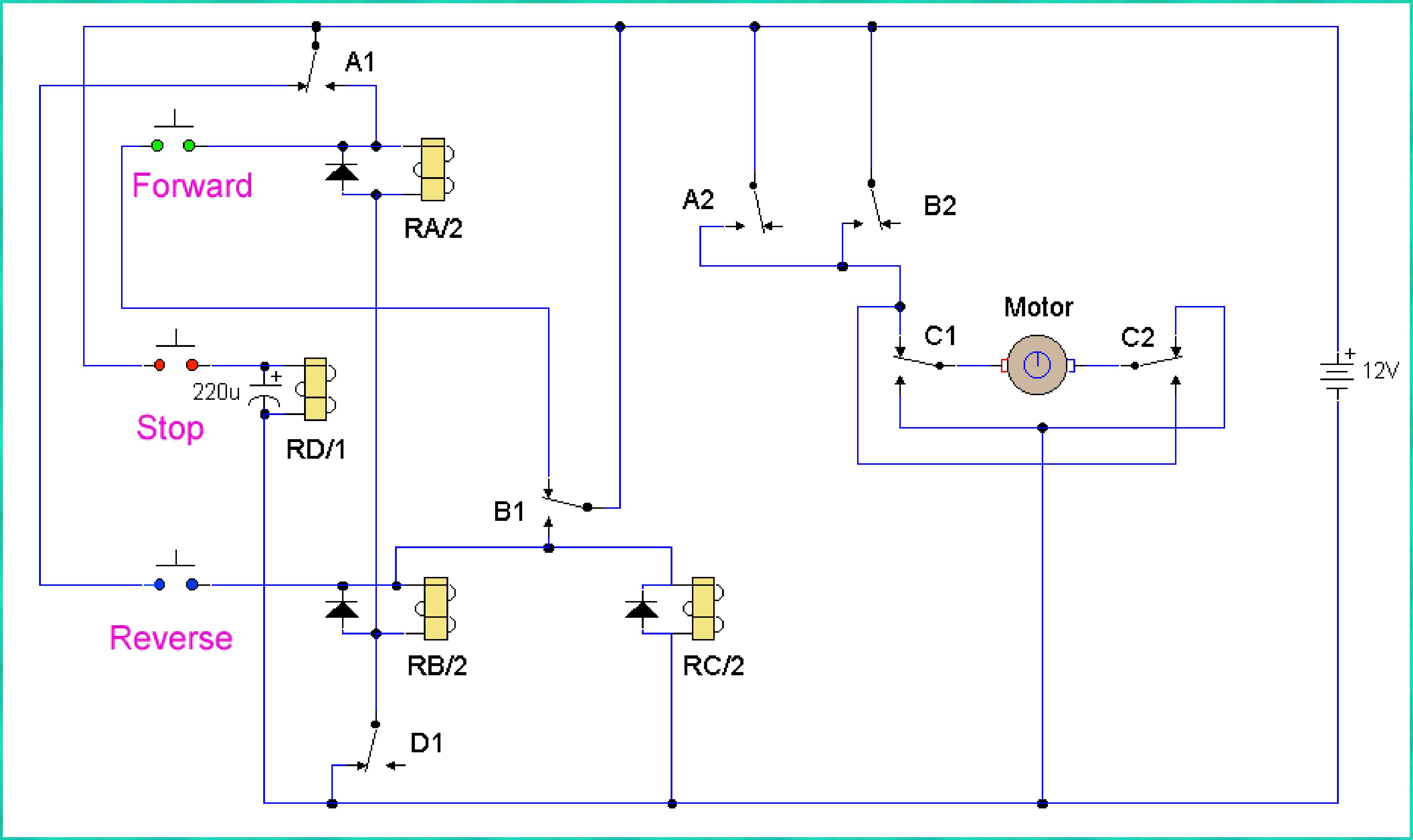
Return to Switching Circuits

DC Motor Reversing Circuit

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description:

A DC motor reversing circuit using non latching push button switches. Relays control forward, stop and reverse action, and the motor cannot be switched from forward to reverse unless the stop switch is pressed first.



Notes:

Except for the back emf diodes across the relay coils this circuit is identical in function to the example shown on the relay contact labeling guide in the practical section. At first glance this may look over-complicated, but this is simply because three non-latching push button switches are used. When the forward button is pressed and released the motor will run continuously in one direction. The Stop button must be used before pressing the reverse button. The reverse button will cause the motor to run continuously in the opposite direction, or until the stop button is used. Putting a motor straight into reverse would be quite dangerous, because when running a motor develops a back emf voltage which would add to current flow in the opposite direction and probably cause arcing of the relay contacts. This circuit has a built-in safeguard against that condition.

Circuit Operation:

Assume that the motor is not running and that all relays are unenergized. When the forward button is pressed, a positive battery is applied via the NC contacts of B1 to the coil of relay RA/2. This will operate as the return path is via the NC contacts of D1. Relay RA/2 will operate. Contacts A1 maintain power to the relay even though the forward button is released. Contacts A2 apply power to the motor which will now run continuously in one direction. If now the reverse button is pressed, nothing happens because the positive supply for the switch is fed via the NC contact A1, which is now open because Relay RA/2 is energized. To Stop the motor the Stop switch is pressed, Relay D operates and its contact D1 breaks the power to relays A and B, (only Relay A is operated at the moment). If the reverse switch is now pressed and released. Relay B operates via NC contact A1 and NC contact D1. Contact B1 closes and maintains power so that the relay is now latched, even when the reverse switch is opened. Relay RC/2 will also be energized and latched. Contact B2 applies power to the motor but as contacts C1 and C2 have changed position, the motor will now run continuously in the opposite direction. Pressing the forward button has no effect as power to this switch is broken via the now open NC contact B1. If the stop button is now pressed. Relay D energizes, its contact D1 breaks power to relay B, which in turn breaks power to relay C via the NO contact of B1 and of course the motor will stop. All very easy. The capacitor across relay D is there to make sure that relay D will operate at least longer than the time relays A,B and C take to release.

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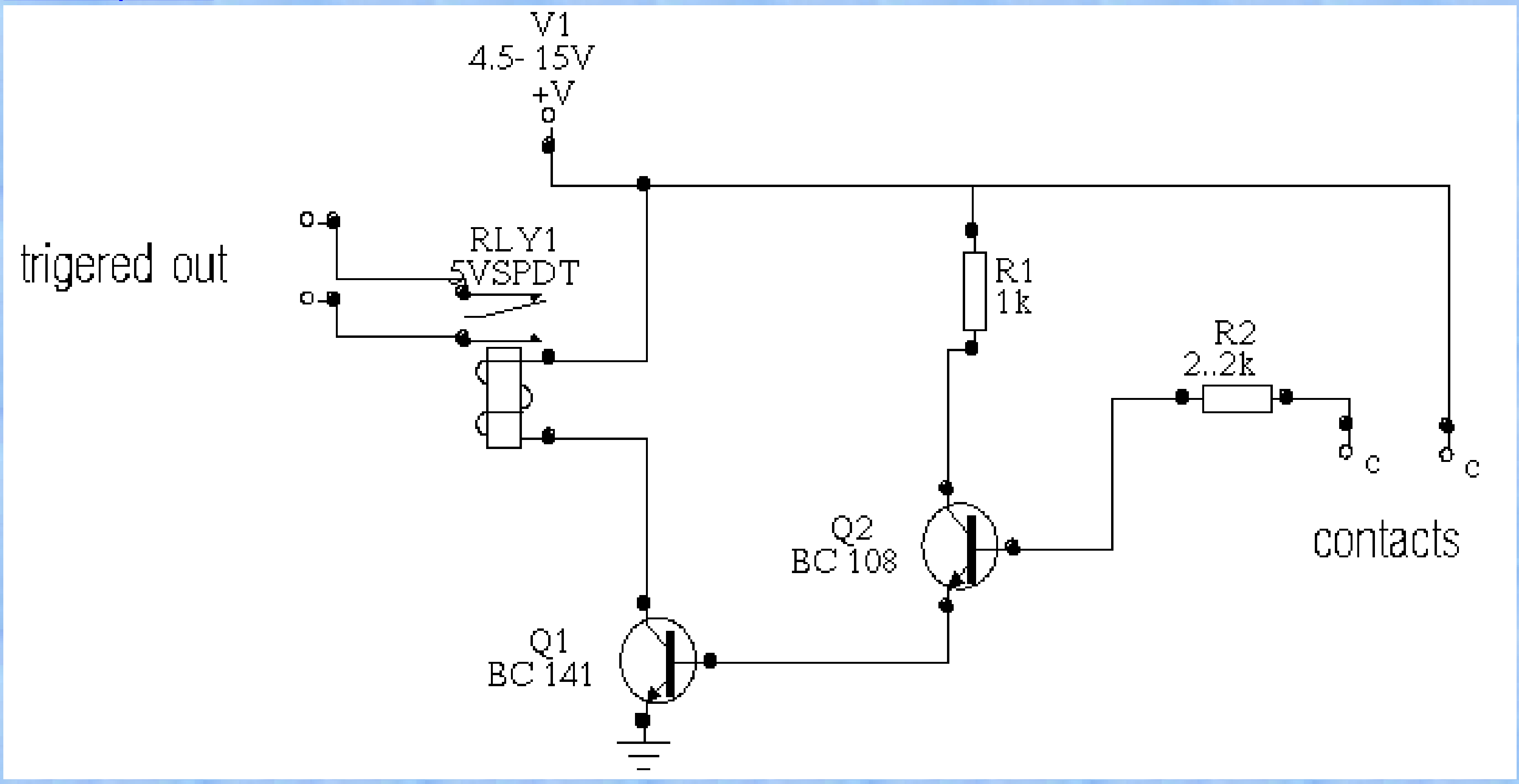
Water Activated Relay

Circuit : Marin Lukas, Croatia
Email:marinlukas@hotmail.com

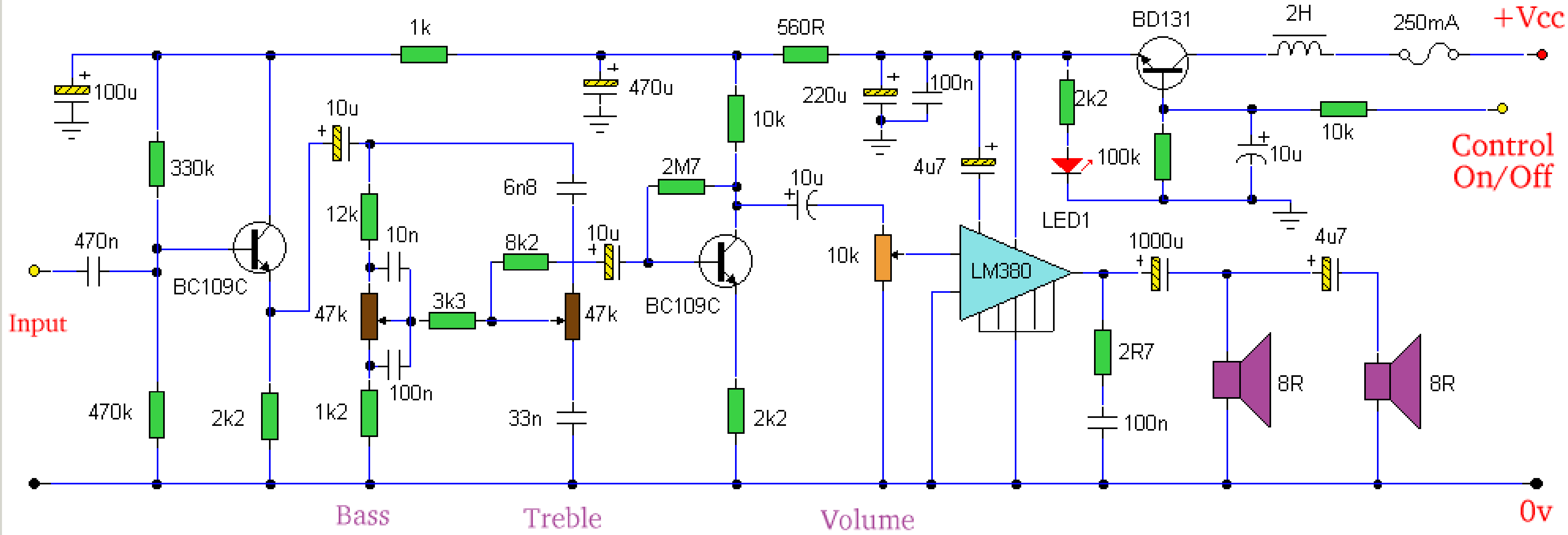
Description:



Notes (English follows) :
Ovaj sklop je projektiran da ukljuci relej kada se na knotaktima pojavi voda.Tranzistor T1 moze biti zamijenjen s 2N2222A.Tranzistor T2 mora biti BC108. Na kolektor tranistora T1 osim releja mogu biti spojeni signal injektor, LE dioda, zarulja i ostali signalizacijski elementi.

In his circuit Marin has used two transistors wired as a high gain compound pair. Transistor T1 may be a 2N2222A and T2 a BC108. The current gain will be the product of each transistors beta, which will be a minimum of 140 x 110 or 15400. The power supply used can be any voltage from 4.5 to 15 volts, a typical 5 volt relay may require 60 mA to operate, in which case any fluid which passes a minimum current of 4 uA will activate the relay. This is easily achieved with tap or rain water.

Return to Switching Circuits



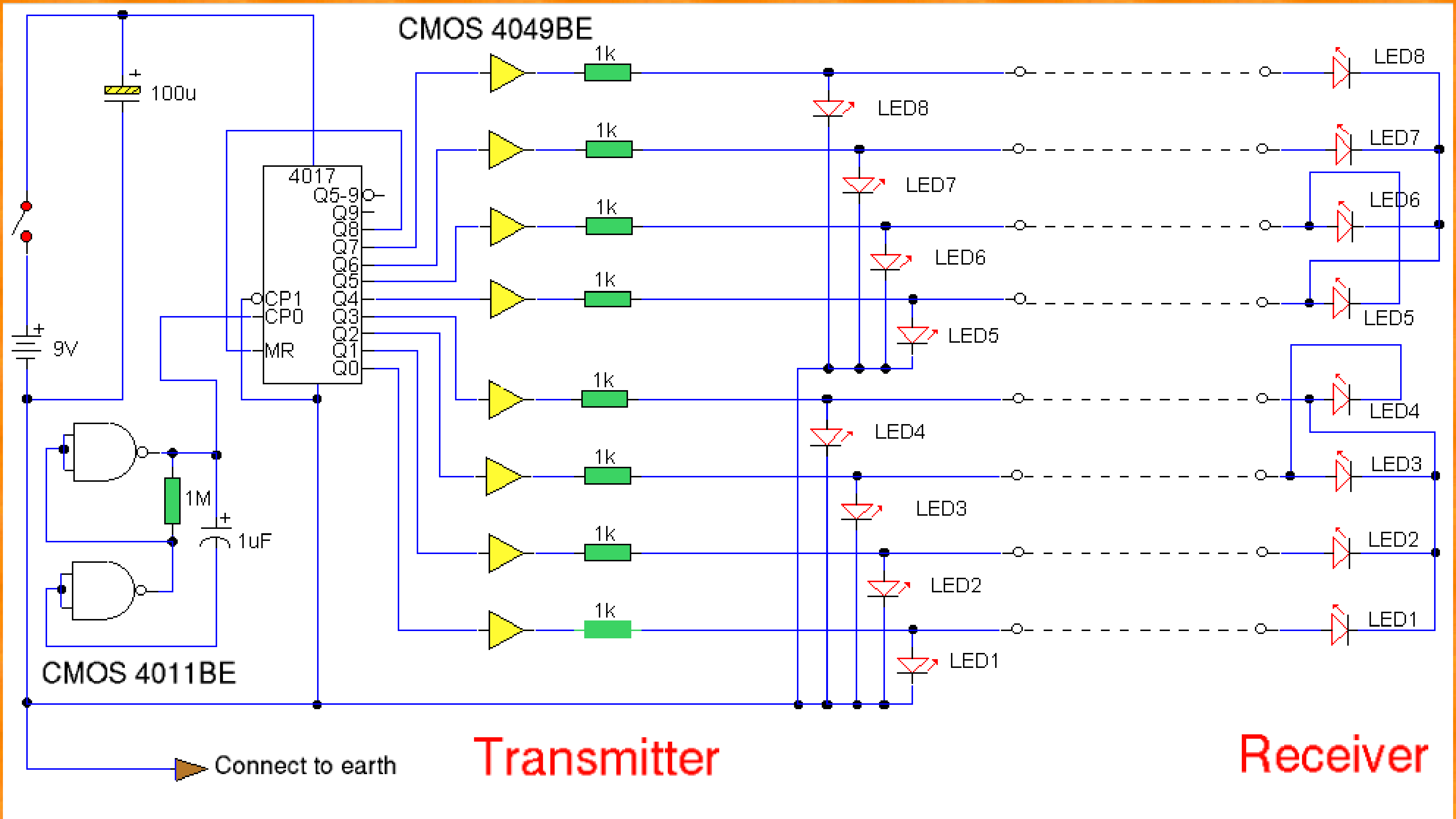
+Vcc
250mA
2H
BD131
1k
560R
100u
470u
220u
100n
2k2
10k
Control
On/Off
330k
10u
6n8
2M7
10k
4u7
100k
10u
LED1
470n
12k
10n
8k2
10u
10k
LM380
1000u
4u7
Input
BC109C
47k
3k3
47k
BC109C
2R7
8R
8R
470k
2k2
1k2
100n
33n
2k2
100n
Bass
Treble
Volume
0v

Multi Wire Cable Tester

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description:
A multi wire cable tester with a separate LED for each wire. Will show open circuits, short circuits, reversals, earth faults, continuity and all with four IC's. Designed initially for my intercom, but can be used with alarm wiring, CAT 5 cables and more.

Full circuit can be viewed with resolution of 1024x768



Circuit Notes:

Please note that for clarity this circuit has been drawn without showing power supplies to the CMOS 4011 and CMOS 4050 IC's. The positive battery terminal connects to Pin 14 of each IC and negative to Pin 7. The CMOS 4017 uses Pin 16 and Pin 8 respectively. Note also that as the CMOS 4050 is only a hex buffer, you need 8 gates so two 4050's are required, the unused inputs are connected to ground (battery negative terminal).

Circuit Description:

The circuit comprises transmitter and receiver, the cable under test linking the two. The transmitter is nothing more than a "LED chaser" the 4011 IC is wired as astable and clocks a 4017 decade counter divider. The 4017 is arranged so that on the 9th pulse, the count is reset. Each LED will light sequentially from LED 1 to LED 8 then back to LED 1 etc. As the 4017 has limited driving capabilities, then each output is buffered by a 4050. This provides sufficient current boost for long cables and the transmitter and receiver LED's. The receiver is simply 8 LED's with a common wire...read on.

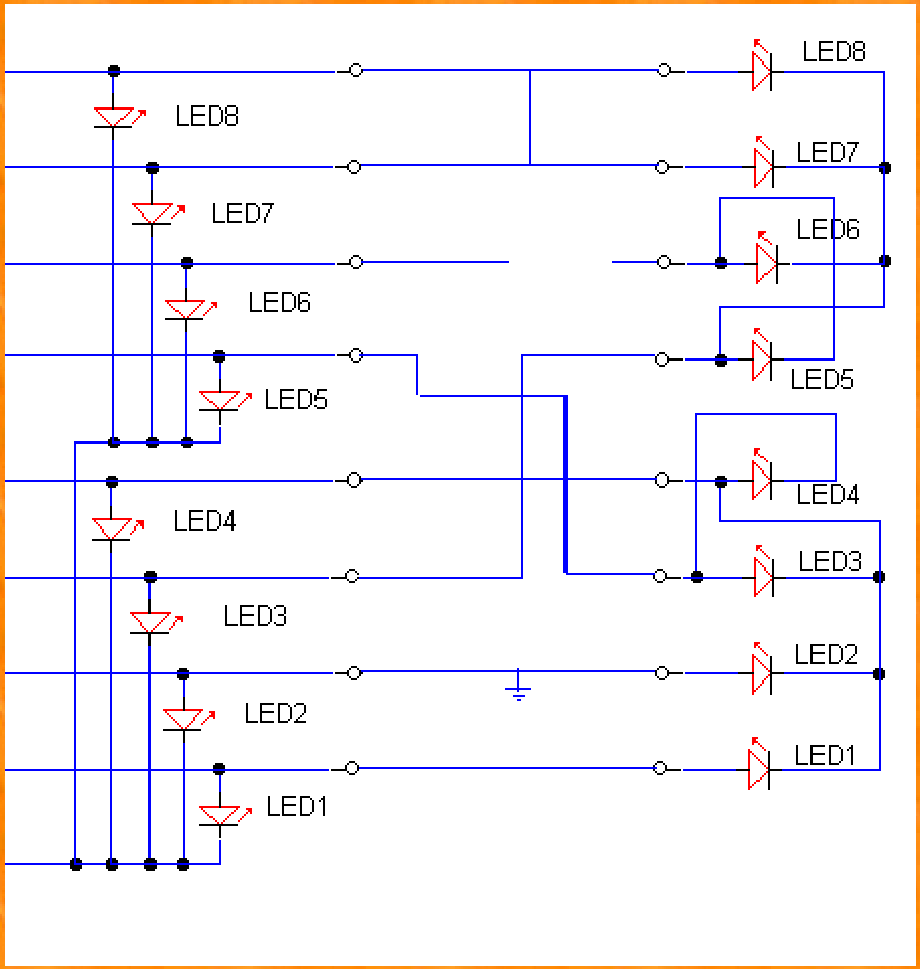
7 Led's 8 Wires:

Not a mistype. The problem with testing each wire individually is that if you had 7 individually addressable LED's, then you would need an eight return or common wire. In the case of testing 8 wires you would need a ninth wire. You could use a domestic earth but its not really practical, and also if the cable was shorting to earth anyway it would be no good anyway. The solution had me thinking for a while, but since this is a logic circuit, there are only two conditions, logic high or zero. As the 4017 outputs are either high or low, any output can provide a common return path for a LED. So LED's 1 - 3 use the 4th output of the 4017, which will be zero, and the 4th LED is wired with reverse polarity. On the 4th pulse, output 4 is high, output 3 is low and so the LED will light. If the common return wire is open circuit then LEDs 1-4 will not light. A similar situation occurs with outputs 5 to 8. The common wire in can be taken from any output terminal from the 4017, but the same rule would still apply. The ability to test all wires quickly outweighs this small disadvantage. If a cable of just 4 or 6 wires is tested then it must use the wires with LED's numbered 1 to 4 or 1 to 6, which is why the LED's are numbered that way.

Testing:

With a good cable and all wires connected then LED 1 will light at both cable ends, followed in sequence by LED 2 ,3, 4 etc to LED 8, the sequence then repeating. If a 4 wire cable is used, it must be connected to use the common return wire as described in the preceeding paragraph. The sequence would be LED 1,2,3,4 repeating with a delay as the 4 unused outputs are stepped through.
To check for earth contact faults, the probe labeled "to earth connection" would be physically connected to a local earth. A wire that is earthing will dim or extinguish the LED's at both ends of the cable. An LED not lighting at the receiver, indicates a broken or open circuit. If two wires are short circuit, example 3 and 4 then at the receiver the sequence would be 1, 2, 34,

43, 5, 6, 7, 8. A reversal would be indicated by an out of pattern sequence of LED's. Here's an example, the probe is connected to an earth at the transmitter, the cable is very faulty, wire 1 is OK, 2 is earthing, 3 and 5 are reversed 4 is OK, 6 is open circuit and 7 and 8 are short circuit. See below.



[Test Result]

```
The transmitter pattern would be as below:
The receiver pattern would be as below:
            1 ON
1 ON
            2 OFF or Faint
2 OFF or faint
```

```
            3 ON
3 (would show LED 5)
            4 ON
4 ON
            5 ON
5 (would show LED 3)
            6 ON
6 OFF
            7 ON
7 (would show 7 & 8)
            8 ON
8 (would show 7 & 8)
```

The LED sequence of course is stepped through, as you know the transmitter "pattern" it is easy to tell the state of the cable by viewing the receiver pattern. The earth condition will only show up if the contact to earth is less than 1000 ohms, a better but more time consuming method foe earth faults is to use a meter on the Megaohms range.

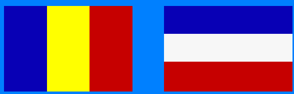
Return to Testgear

Testgear Circuits

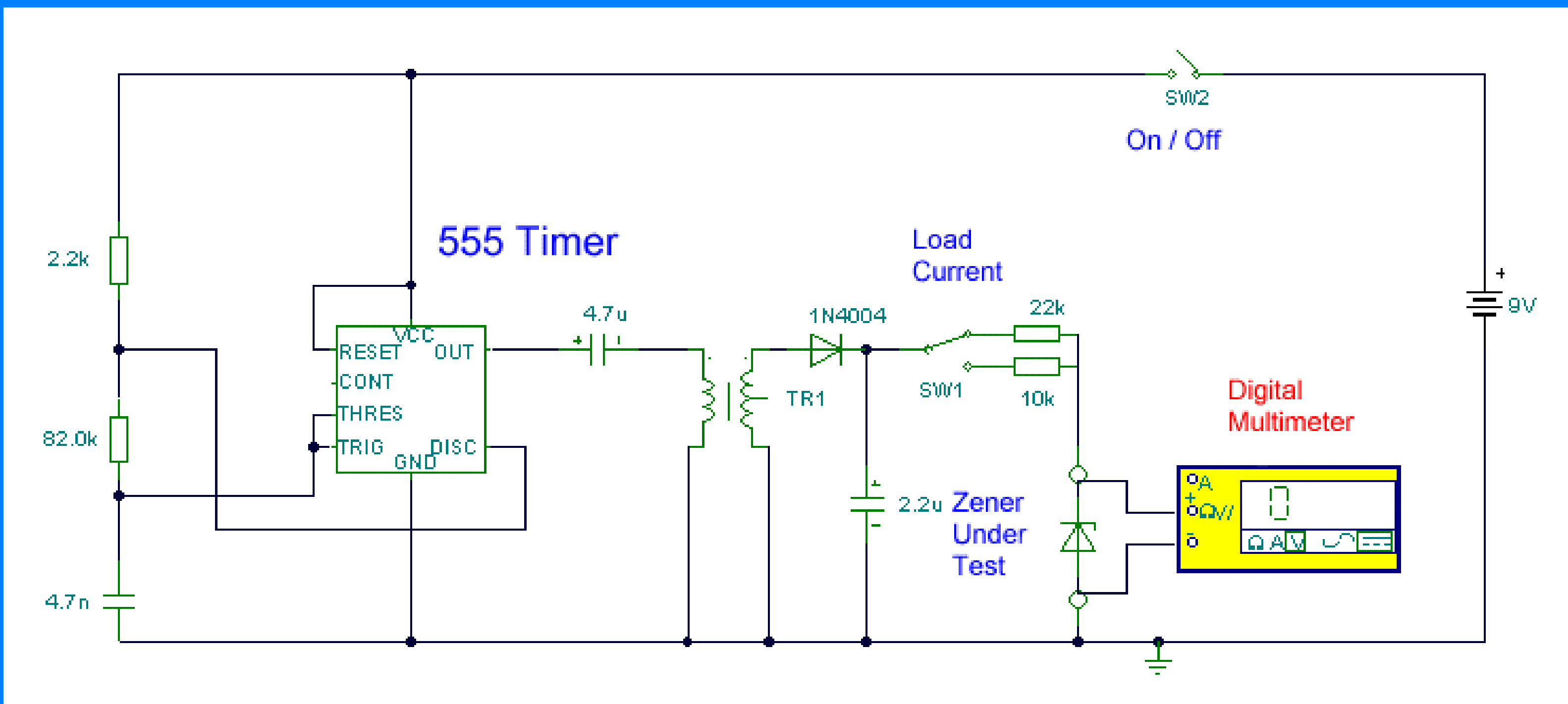
1. Zener Diode Tester
2. Infra Red Remote Control Tester
3. Electromagnetic Field Probe with Meter
4. Simple Square Wave Oscillator
5. Logic Probe
6. Function Generator
7. MilliGauss Meter by Rev Tomas Scarborough
8. Multi Wire Cable Tester
9. Connection Tester
10. Sine Wave Generator

Return to Schematics

Zener Diode Tester



I have teamed up with Magazine Mikro Elektronica for this project. Please visit their site. I am very grateful to Aleksandar Dakic for the kind translation into Serbian and Romanian languages.



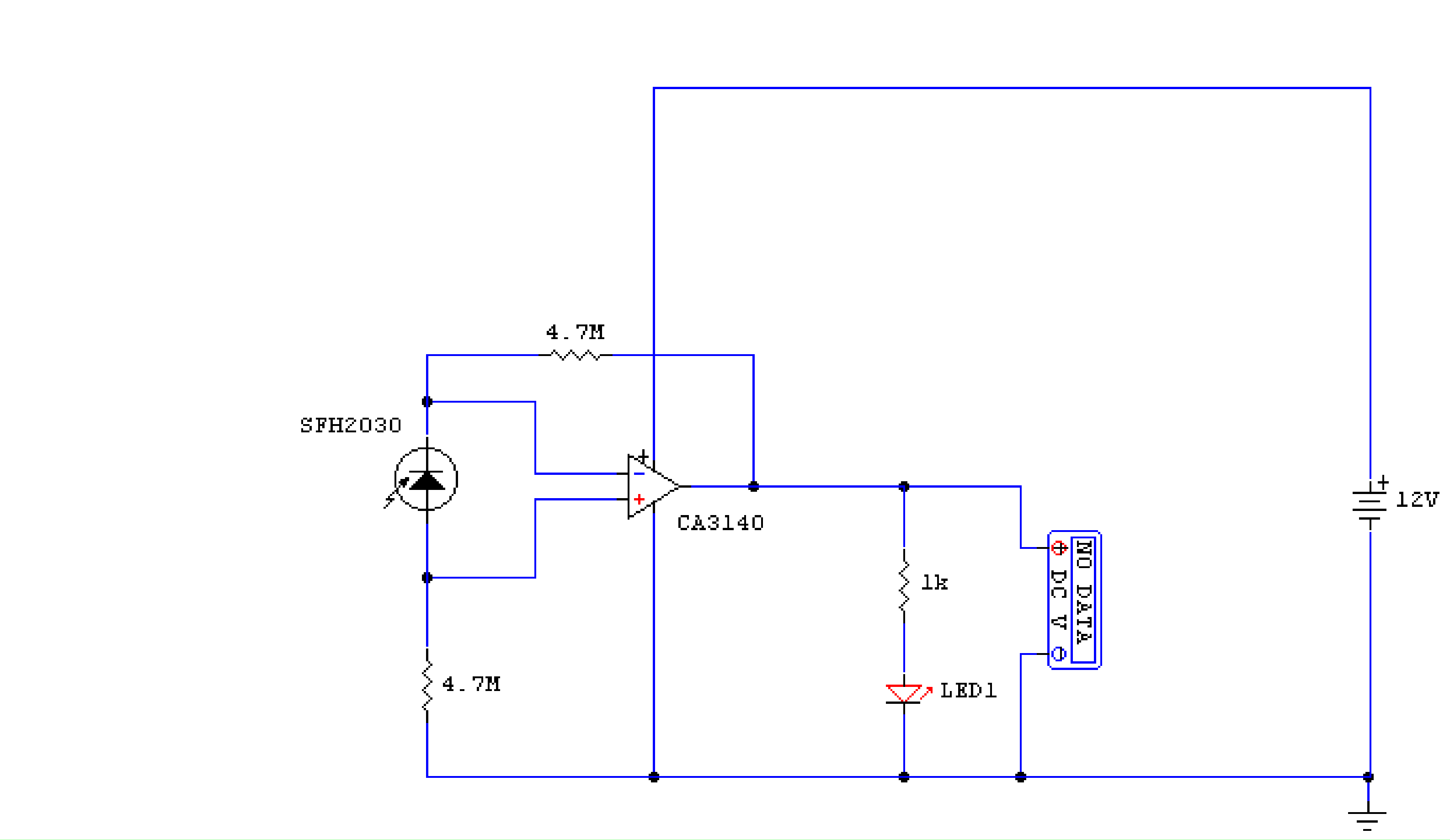
Notes:
Using a single 555 Timer IC and a small transformer to generate a high voltage, this circuit will test zener diodes of voltage ratings up to 50VDC. The 555 timer is used in the astable mode, the output at pin3 drives a small audio transformer such as the LT700. This has a primary impedance of 1K and a secondary impedance of 8 ohms. Used in reverse the unloaded ac voltage is around 120volts ac. This is rectified by the 1N4004 diode and smoothed by the 2.2u capacitor which MUST be rated at 150 VDC. The zener under test is measured with a multimeter set to DC volts as shown. The load current switch enables the zener to be tested at 1 or 2mA DC. The rectified DC load, but a good zener should maintain the reading on the volt meter.

Alexsander Dakic

Andy Collinson

Return to Test Gear

IR Remote Control Tester

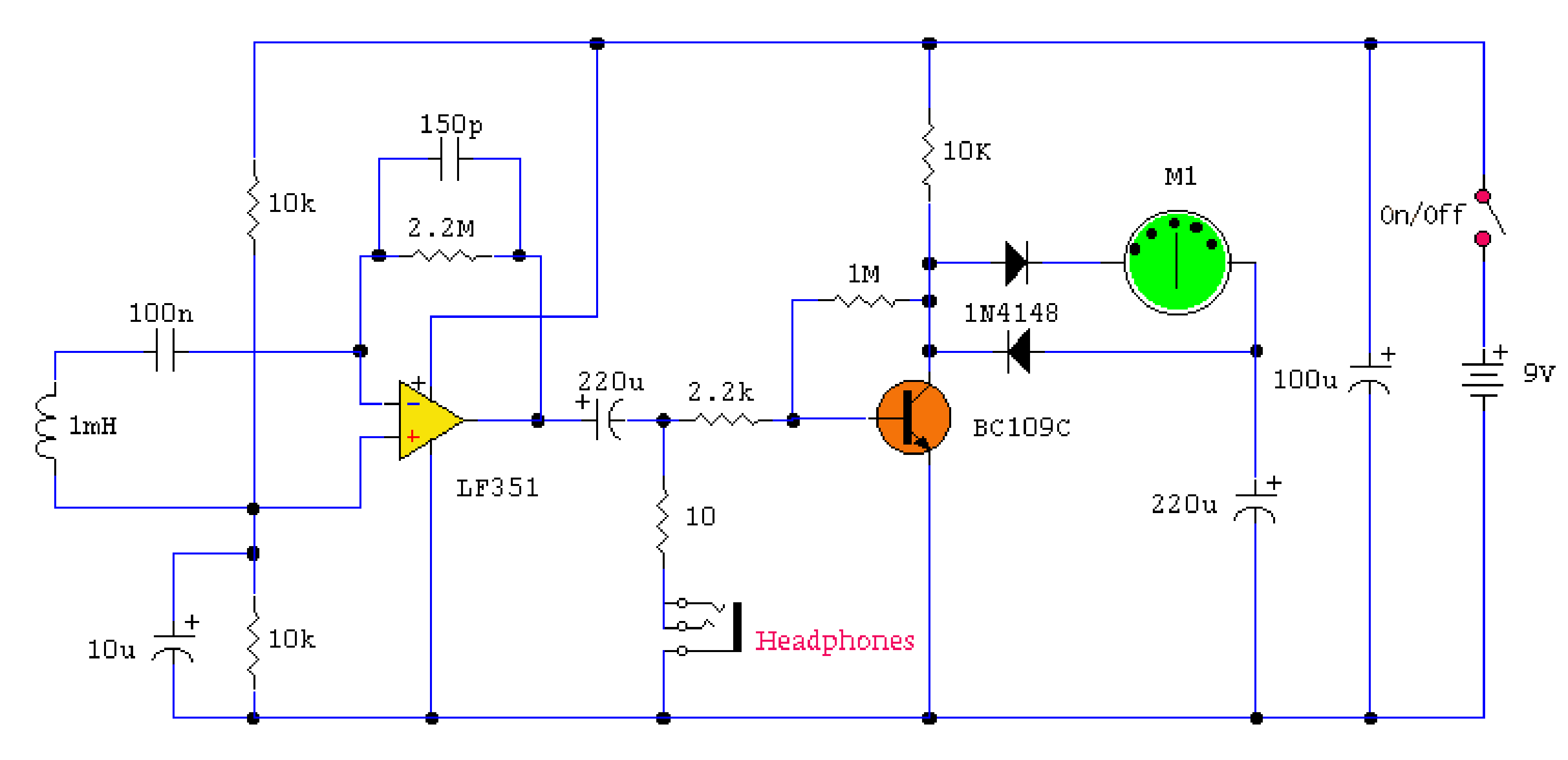


Notes:

As I was developing my IR Extender Circuit, I needed to find a way of measuring the relative intensities of different Infra red light sources. This circuit is the result of my research. I have used a photodiode, SFH2030 as an infra red sensor. A MOSFET opamp, CA3140 is used in the differential mode to amplify the pulses of current from the photodiode. LED1 is an ordinary coloured led which will light when IR radiation is being received. The output of the opamp, pin 6 may be connected to a multimeter set to read DC volts. Infra red remote control strengths can be compared by the meter reading, the higher the reading, the stronger the infra red light. I aimed different remote control at the sensor from about 1 meter away when comparing results. For every microamp of current through the photodiode, about 1 volt is produced at the output. A 741 or LF351 will not work in this circuit. Although I have used a 12 volt power supply, a 9 volt battery will also work here.

Return to Test Circuits

Electromagnetic Field Probe with Meter Output



Notes:
This tester is designed to locate stray electromagnetic (EM) fields. It will easily detect both audio and RF signals up to frequencies of around 100kHz. Note, however that this circuit is NOT a metal detector, but will detect metal wiring if it conducting ac current. Frequency response is from 50Hz to about 100kHz gain being rolled off by the 150p capacitor, the gain of the op-amp and input capacitance of the probe cable. Stereo headphones may be used to monitor audio frequencies at the socket, SK1.

Probe Construction:
I used a radial type inductor with 50cm of screened cable threaded through a pen tube. The cable may be used with a plug and socket if desired. My probe is shown below:

A layer of insulating tape or glue is used to secure the pen body to the inductor.

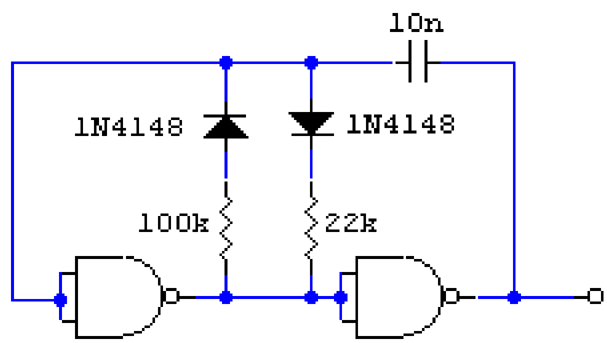
Meter Circuit:
The output signal from the op-amp is an ac voltage at the frequency of the electro-magnetic field. This voltage is further amplified by the BC109C transistor, before being full wave rectified and fed to the meter circuit. The meter is a small dc panel meter with a FSD of 250uA. Rectification takes place via the diodes, meter and capacitor.

Testing:
If you have access to an audio signal generator you can apply an audio signal to the windings of a small transformer. This will set up an electromagnetic field which will be easily detected by the probe. Without a signal generator, just place the probe near a power supply, mains wiring or other electrical device. There will be a deflection on the meter and sound in the headphones if the frequency is below 15KHz.

In Use:
Switch on, plug in headphones (optional) and move the probe around. Any electrical equipment should produce a hum and indicate on the meter.I remember once building a high gain preamp (for audio use). I made a power supply in the same enclosure. The preamp worked, but suffered from an awful mains hum. This was not directly from ripple on the power supply as it was regulated and well smoothed.What I had done was built the audio circuit on a small piece of veroboard, and placed it within a distance that was less than the diameter of the transformer. The transformers own electromagnetic field was responsible for the induced noise and hum. I should however note, that this was when I was new to electronics with very little practical experience. You can now buy toroidal transformers which have a much reduced hum field.

Return to Test Gear

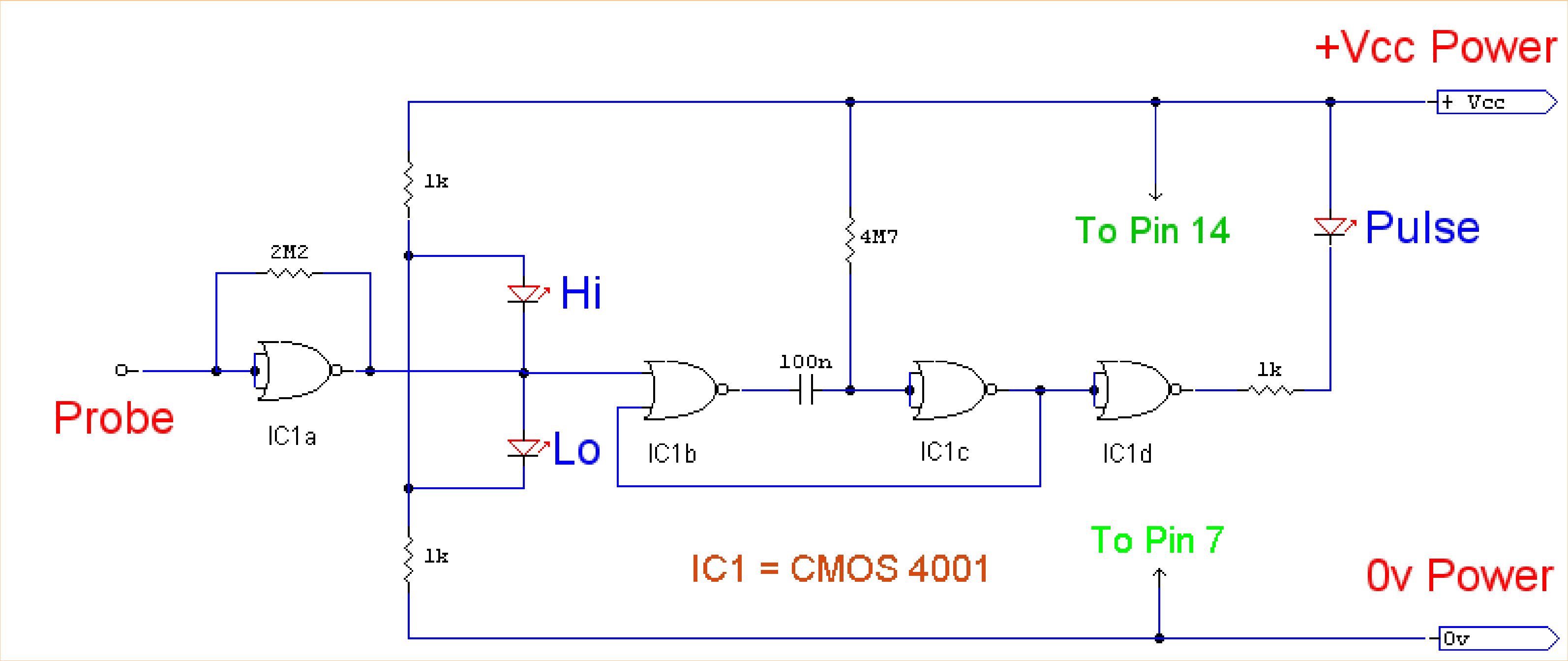
Sqaure Wave Oscillator



Notes:
Using two gates from a CMOS 4011 NAND chip, a simple aquarewave oscillator can br made. Alternatively a CMOS 4001 chip can also be used, or a TTL equivalent. In this circuit the mark space ratio can also be independantly controlled by varying the value of the resistors. The rise and fall times of the output pulses depend on the operating voltage of the IC and type of IC, but will be typically in
the order on tens of nanoseconds.

Return to Test Gear

Logic Probe

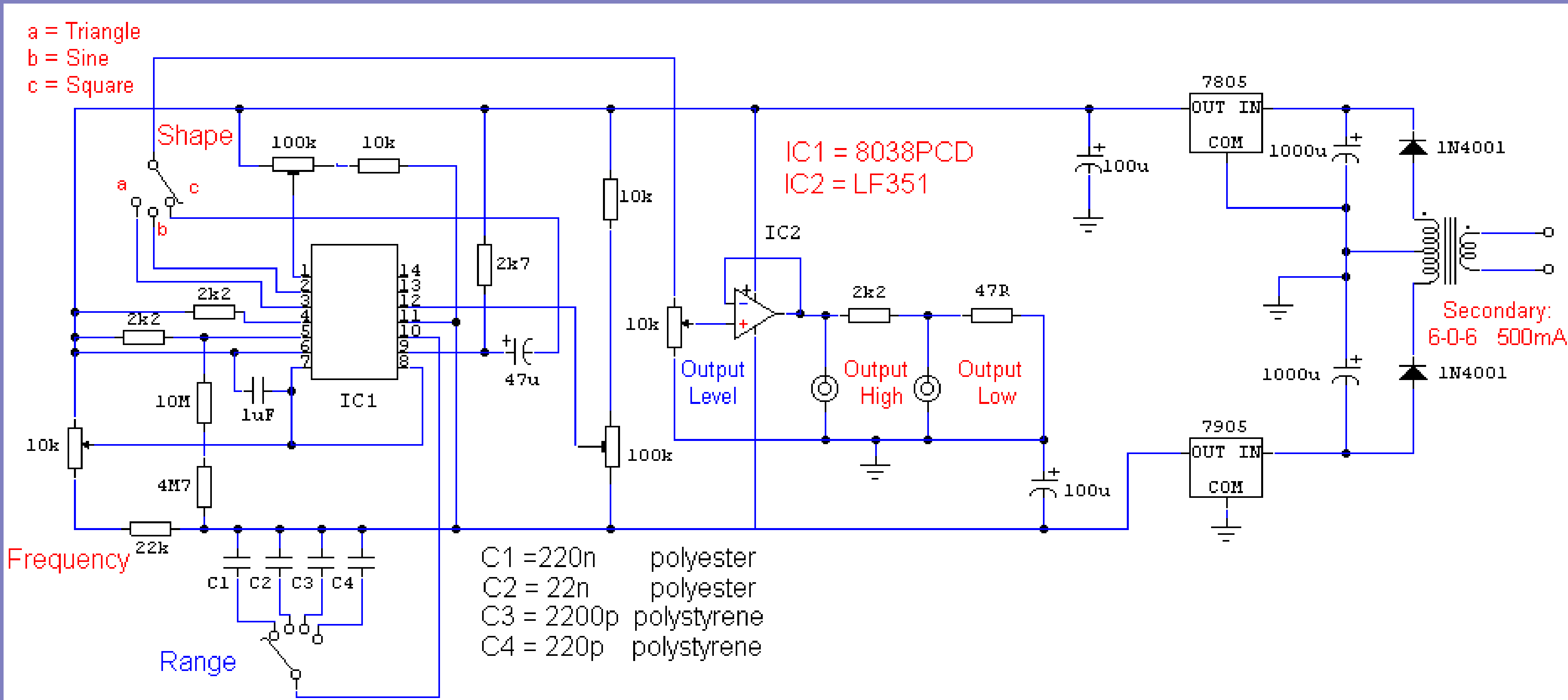


Notes:

This logic probe uses a single CMOS IC and shows three logic conditions, High, Low and Pulsing. In addition if the probe input is neither hi or low (the high impedance state of tri-output logic ic's) then no LED's will light. Power from the logic probe is taken from the logic circuit under test; using a CMOS IC enables logic circuits to be tested using voltages from 3 to 15 volts. IC1a is arranged as a buffer with a difference. Under no input, i.e. probe not connected to circuit the gate will oscillate due to feedback from the 2M2 resistor. Output voltage at IC1a is approximately half supply voltage. The Hi and Lo logic indicator LED's are also connected to a potential divider consisting of the two 1k resistors. Voltage at the junction is half supply voltage hence with no input , or high impedance no LED's will light. A Hi or Lo logic condition will cause IC1a to rest in a permanent state indicated by either the Hi or Lo LED illuminating. With a fast oscillator or clock signal both Hi and Lo LED's will light but will be quite dim. This is the reason for IC1b and IC1c. These two gates form a monostable oscillator, time constant determined by the 100n capacitor and 4M7 resistor. With a clock signal this is effectively slowed as the monostable is continually triggered and retriggered. IC1d acts as a buffer to drive the pulsing LED.

Return to Test Gear

Function Generator



Notes:

Built around a single 8038 waveform generator IC, this circuit produces sine, square or triangle waves from 20Hz to 200kHz in four switched ranges. There are both high and low level outputs which may be adjusted with the level control. This project makes a useful addition to any hobbyists workbench as well.

Allof the waveform generation is produced by IC1. This versatile IC even has a sweep input, but is not used in this circuit. The IC contains an internal squarewave oscillator, the frequency of which is controlled by timing capacitors C1 - C4 and the 10k potentiometer. The tolerance of the capacitors should be 10% or better for stability. The squarewave is differentiated to produce a triangular wave, which in turn is shaped to produce a sine wave. All this is done internally, with a minimum of external components. The purity of the sine wave is adjusted by the two 100k preset resistors.

The wave shape switch is a single pole 3 way rotary switch, the wiper arm selects the wave shape and is connected to a 10k potentiometer which controls the amplitude of all waveforms. IC2 is an LF351 op-amp wired as a standard direct coupled non-inverting buffer, providing isolation between the waveform generator, and also increasing output current. The 2.2k and 47 ohm resistors form the output attenuator. At the high output, the maximum amplitude is about 8V pk-pk with the square wave. The maximum for the triangle and sine waves is around 6V and 4V respectively. The low amplitude controls is useful for testing amplifiers, as amplitudes of 20mV and 50mV are easily achievable.

Setting Up:

The two 100k preset resistors adjust the purity of the sine wave. If adjusted correctly, then the distortion amounts to less than 1%. The output waveform ideally needs to be monitored with an oscilloscope, but most people reading this will not have access to one. There is however, an easy alternative:- Winscope. This piece of software uses your soundcard and turns your computer into an oscilloscope. It even has storage facility and a spectrum analyser, however it will only work up to around 20KHz or so. Needless to say, this is more than adequate for this circuit, as alignment on any range automatically aligns other ranges as well. Winscope is available at my download page click here. Winscope is freeware and designed by Konstantin Zeldovich. After downloading, read the manual supplied with winscope and make up a lead to your soundcard. My soundcard is a soundblaster with a stereo line input, i made up a lead with both left and right inputs connected together. Connect the lead to the high output of the function genereator, set the output level to high, shape to sine, and use the 1k to 10k range, (22nF capacitor). A waveform should be displayed, see the Figure 1 below:-

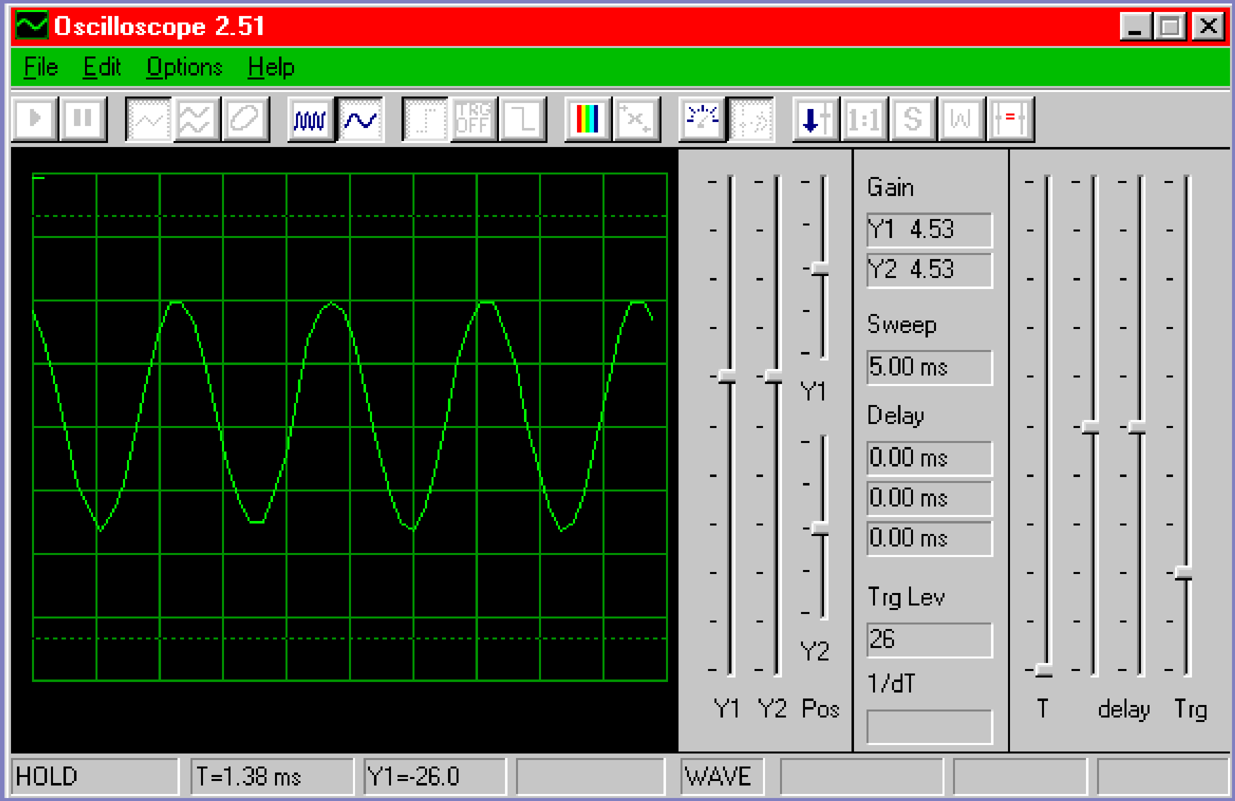
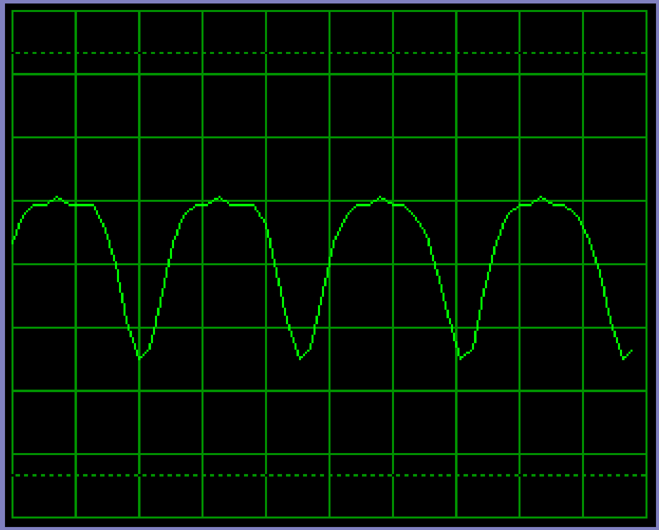


Figure 1.

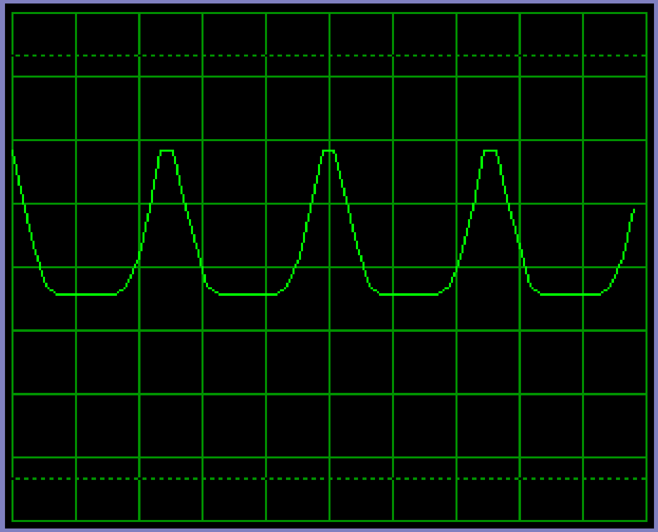
Here an undistorted sine wave is being displayed. The display on winscope may flicker, this is normal as it uses your soundcard to take samples of the input waveform. The "hold" button on winscope will display a steady waveform.

Alignment:

First adjust the 100k preset connected to Pin 1 of the 8038. An incorrect setting will look similar to the waveform below:-



Adjust the preset so that the top of the sine wave has a nicely rounded peak. Then adjust the other preset, again an incorrectly adjusted waveform is shown below:



The two presets work together, so adjusting one affects the other. A little is all that's needed. When your waveform is asjusted and looks similar to Figure 1 press the FFT button on winscope. This will preform a fast fourier transform and the displayed output will be a spectrogram of the input. For a pure sine wave, only one signal is present, the fundamental frequency, no harmonics will be present and so a spectrogram for a pure sine should contain a single spike, see Figure 2 below:-

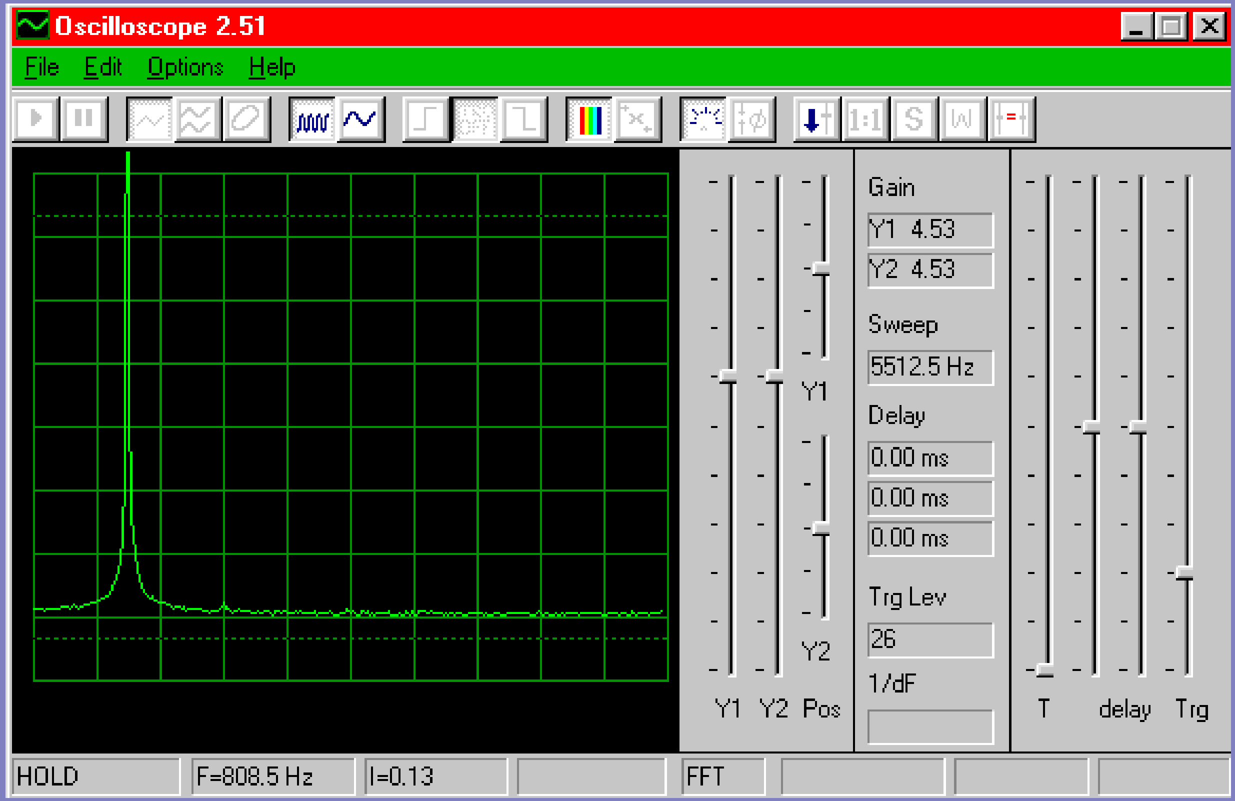
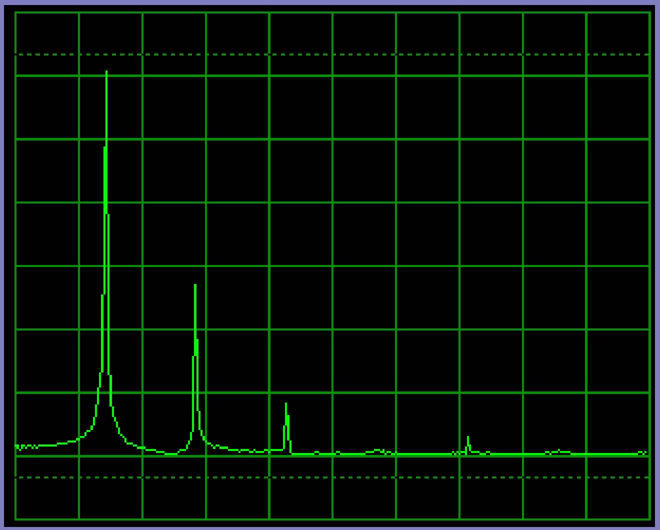
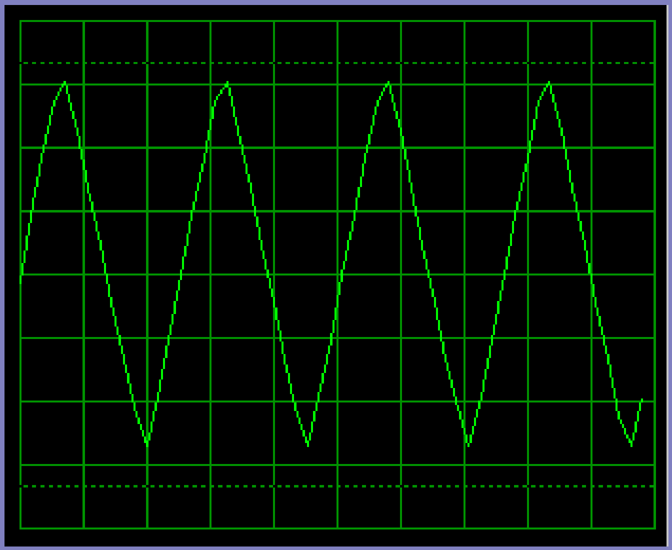


Figure 2.

A distorted sine wave will contain odd and even harmonics, and although the shape of the sine may look good, the spectrogram will reveal spikes at the hormonics, see below:-



Once alignment of the sine wave is complete, the other wave shapes will also be set up correctly. Below is a picture of the triangle waveform generated from my circuit:-



Finally the ICL8038PCD is available from Maplin Electronics order code YH38R.

Return to Test Gear

MILLIGAUSS METER.

Circuit : Rev. Thomas Scarborough
Email: scarboro@iafrica.com

Description:
The circuit of Fig.1 provides an easy yet reliable way to detect the intensity of a.c. (or e.l.f.) fields around the home or workplace. It is doubly effective because it does not merely detect the electromagnetic radiation emitted by electrical appliances, but the electromagnetic energy actually absorbed by the body.

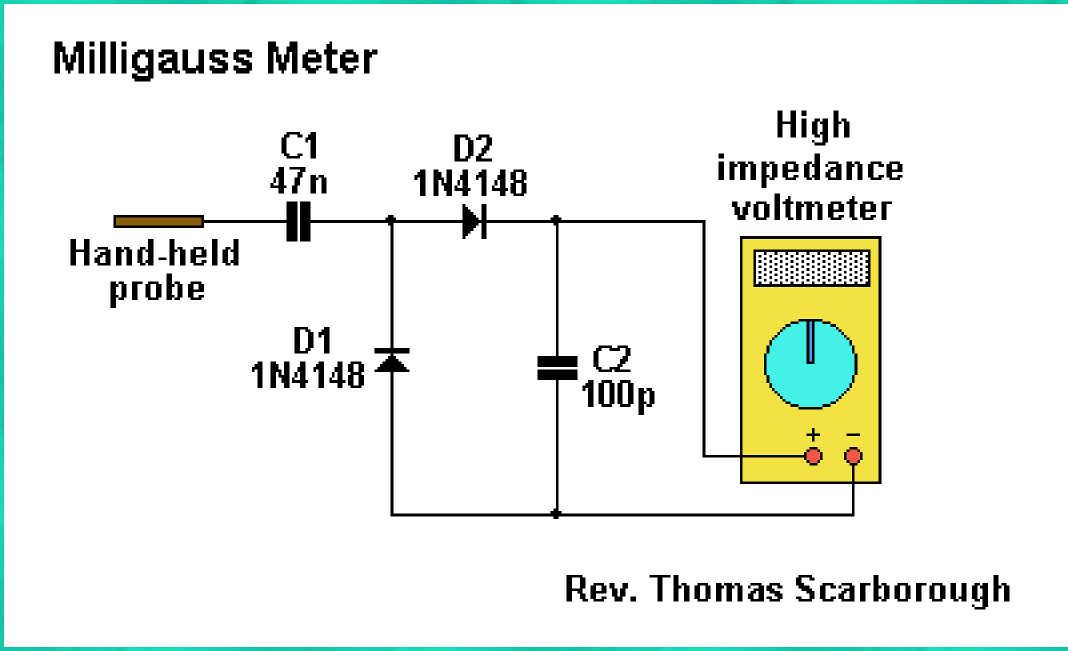


Fig. 1

The circuit in Fig.1 is a standard charge pump which is charged by the alternating eddy currents induced in the human body by a.c. fields. C1 charges virtually instantly, and is read by a digital (or high impedance) voltmeter.

To obtain a very rough translation from millivolts to milligauss (the unit of magnetic field strength), divide the millivolts reading by four. For example, 1000mV will yield 250 milligauss. A rough guide to the readings follows:

Up to 3 milligauss - Low electromagnetic radiation

25 milligauss - Significant electromagnetic radiation

100 milligauss - High electromagnetic radiation

250 milligauss - Maximum risk exposure

Detrimental effects have been reported at doses as low as 3 milligauss, and a series of studies since the 1970's has shown that sustained exposure to high e.l.f. doses heightens the risk of certain cancers and miscarriage.
Readings are taken while holding the probe in one hand. The closest proximity to the electromagnetic source does not necessarily give the highest reading, probably because the induced currents in the body remain localised at close proximity.

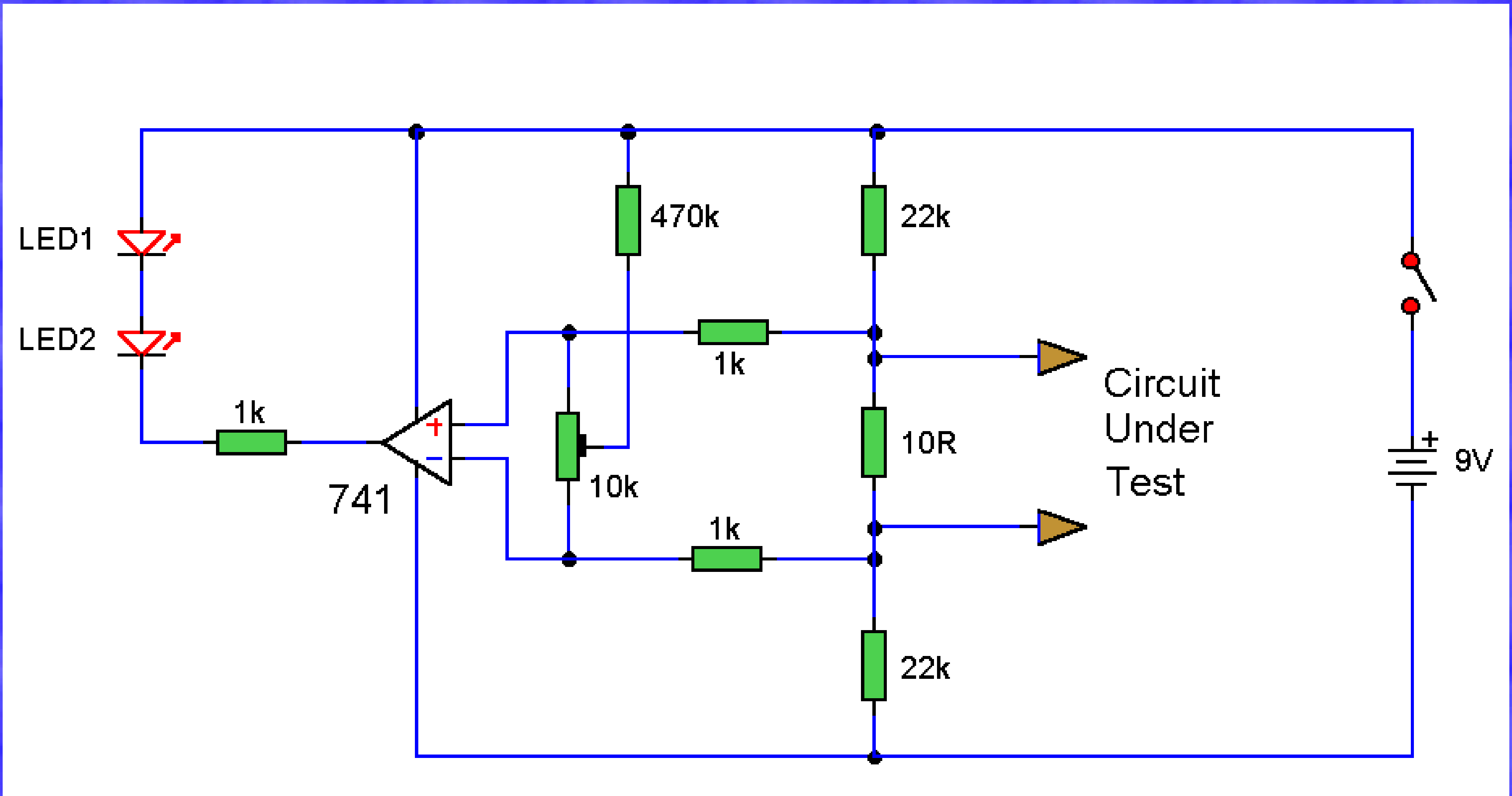
[Contact the author of this article at scarboro@iafrica.com].

Return to Testgear Circuits

Connection Tester

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description:
A low resistance (0.25 - 4 ohm) continuity tester for checking soldered joints and connections.



Notes:
This simple circuit uses a 741 op-amp in differential mode as a continuity tester. The voltage difference between the

non-inverting and inverting inputs is amplified by the full open loop gain of the op-amp. Ignore the 470k and the 10k control for the moment, and look at the input of the op-amp. If the resistors were perfectly matched, then the voltage difference would be zero and output zero. However the use of the 470k and 10k control allows a small potential difference to be applied across the op-amp inputs and upset the balance of the circuit. This is amplified causing the op-amp output to swing to full supply voltage and light the LED's.

Setting Up and Testing:

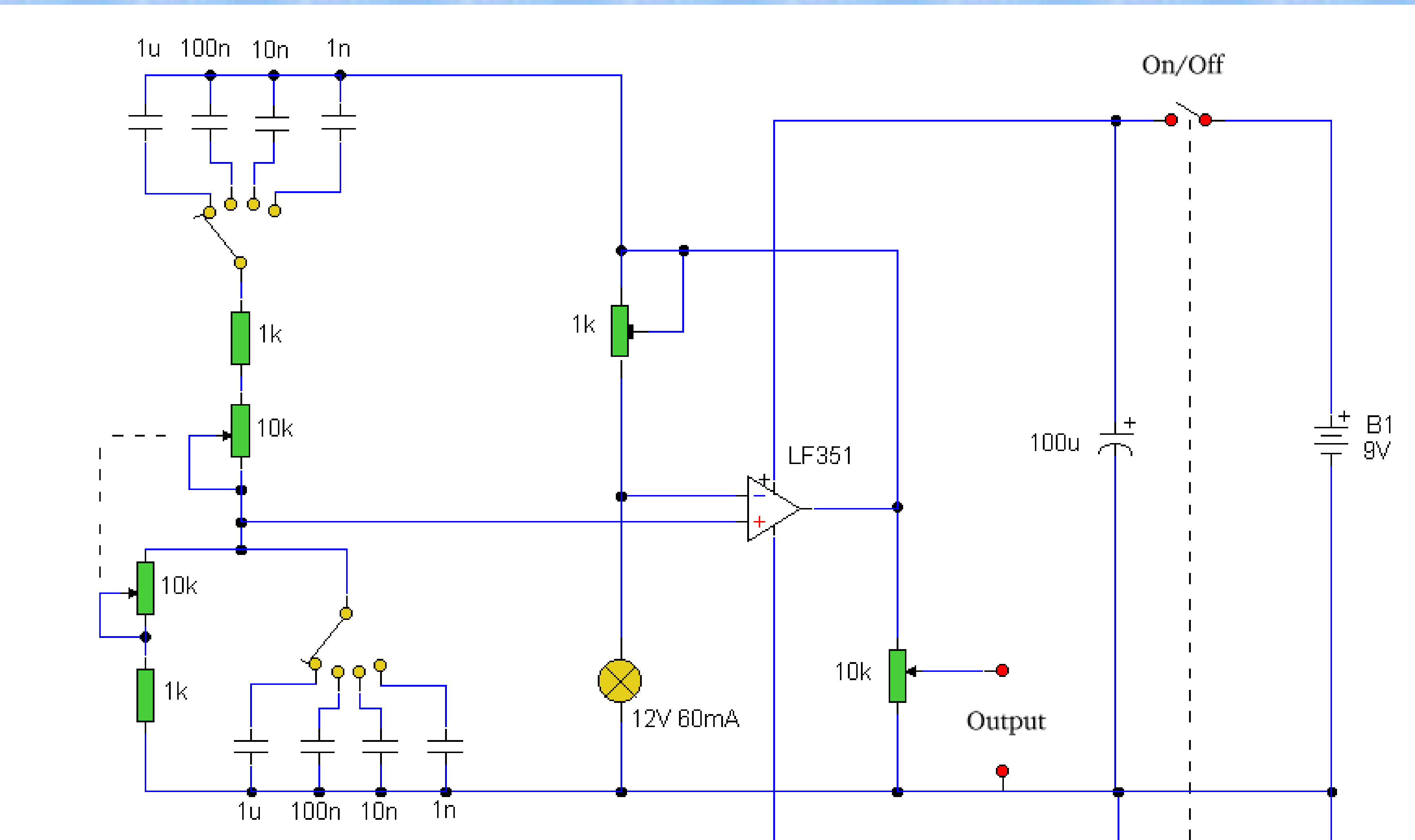
The probes should first be connected to a resistor of value between 0.22 ohm and 4ohm. The control is adjusted until the LED's just light with the resistance across the probes. The resistor should then be removed and probes short circuited, the LED's should go out. As the low resistance value is extremely low, it is important that the probes, (whether crocodile clips or needles etc) be kept clean, otherwise dirt can increase contact resistance and cause the circuit to mis-operate. The circuit should also work with a MOSFET type op-amp such as CA3130, CA3140, and JFET types, e.g. LF351. If the lED's will not extinguish then a 10k preset should be wired across the offset null terminals, pins 1 and 5, the wiper of the control being connected to the negative battery terminal.

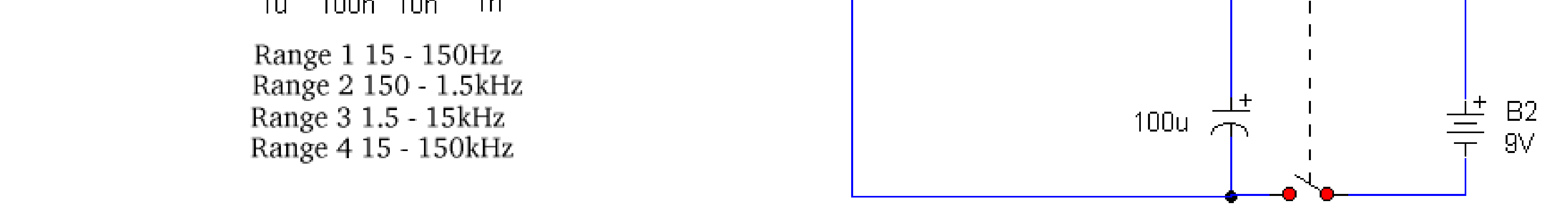
Return to Test Gear Circuits

Sine Wave Generator

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description:
A classic Wien Bridge oscillator using an Op-Amp covering a frequency range of 15 to 150kHz in four switched steps.





Notes:

Two conditions exist for a sinusoidal oscillator. Regenerative or positive feedback, and a gain greater than 29. Any good electronic text book will show the theory, and also some mathematics books as well. In this circuit the gain is provided by a FET type op-amp. I have used an LF351, which may be hard to obtain, but the TL071CN or TL081CN may be used and have a faster slewing rate than the LF351. The Maplin order codes are RA67X and RA70M respectively. The wien network is a parallel combination of resistor and capacitor, in series with a serial R-C network. Regenerative feedback is applied from the op-amp output, to the serail R-C input and continues. Stabilization is required to prevent the otherwise uncontrolled oscillation from building up and becoming unstable.

Stability and Distortion

There are two common methods of stabilizing a wien type oscillator. A thermistor with a NTC in the feedback loop or an incandescent lamp. The bulb used here is a 6V 60mA type Maplin code BT99H. A 12 Volt bulb rated 60mA or 40mA will also work. The feedback arrangement works as follows. As a bulb heats up its filament changes resistance. In this circuit, as the output voltage rises, the bulb heats up and its resistance will change. Forming a potential divider with the 1k preset, the feedback voltage at the inverting input to the op-amp is thus kept under control. The 1k preset is adjusted for minimum distortion. Note that split supplies are used and a ganged 10k potentiometer controls frequency with a 10:1 range.

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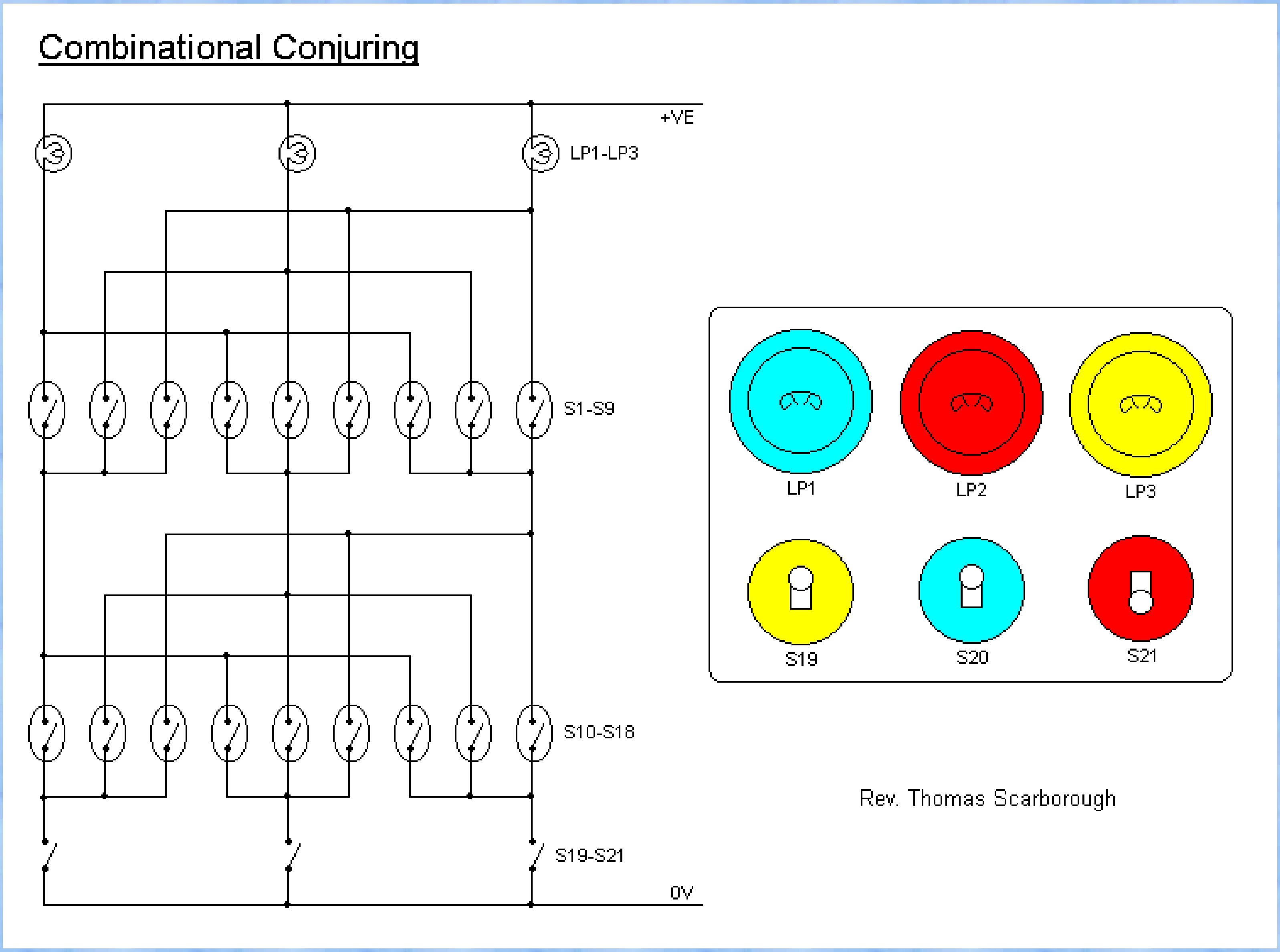
Combinational Conjuring Trick

Combinational Conjuring
Rev. Thomas Scarborough

E-mail scarboro@iafrica.com



The simple circuit of Fig.1 emulates a similar conjuring trick which sells for hundreds of Pounds. The trick seems to do the almost-impossible from an electronic point of view, let alone from the point of view of common sense.

It consists of a bank of three on-off switches (S19-S21), which have three switch covers, each of a different colour. These switch a bank of three lightbulbs (LP1-LP3), each of a different colour. The colours of the lightbulbs correspond with the colours of the switch covers.

Now comes the interesting part. The switch covers may be exchanged at will, but still they

switch the lightbulbs of corresponding colour. Similarly, the lightbulbs may be exchanged at will, but still they respond to the switches of corresponding colour. On the surface of it, there would seem to be 64 possible connections between switches and lighbulbs, and no possible way that the conjurer can manipulate them all.
However, add some sleight-of-hand, and things become a lot simpler. Each switch cover is symmetrical, in such a way that it looks the same whether facing N, E, or W. Further, each lightbulb is screwed into a circular base, which looks the same whether facing N, E, or W.

Let us consider just one of the switch covers (S19). Three reed switches (S10-S12) are positioned beneath the cover, at positions N, E, and W, and each of these activates a different lightbulb. Any one of the three reed switches may be closed by a single magnet positioned strategically under the switch cover. Depending on the orientation of the switch cover, therefore, the switch will activate any one of the three reed switches, and thus the selected lightbulb.

On discussing this with an accomplished magician, the author was told that this alone would be sufficient for the full effect described - reed switches S1-S9 may be omitted. Nevertheless, the lightbulbs may similarly be surrounded with three reed switches each, which are activated by the orientation of the circular base - a magnet being strategically positioned within it. These reed switches may thus reroute the power to the conjurer's selected lightbulb.

There is just one caveat from an electronic point of view. Carefully consider the voltage and power ratings of the reed switches and on-off switches, to match these with the chosen lightbulbs. Failing this, your trick may demonstrate how none of the switches will activate none of the lightbulbs.

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Miscellaneous Circuits

1. Conjuring Trick by Rev. Thomas Scarborough
2. Static Electricity / Negative Ion Detector
3. Perimeter Monitor
4. Lightening Detector by Charles Wenzel (External Link)
5. Temperature Monitor
6. Hot Water Tank Indicator
7. Electromagnetic Field Detector
8. Neon Desklamp by Rev. Thomas Scarborough
9. Magic Wand by Rev. Thomas Scarborough
10. Speaker Microphone Circuit
11. Magnetic Gun by Rev. Thomas Scarborough
12. Insect Repellant by Graham Maynard
13. LED Torch by Rev. Thomas Scarborough
14. Quiz Circuit
15. Ultrasonic Dog Whistle by Tomaz Lazar
16. Pot Plant Power by Rev. Thomas Scarborough

17. Combinational Conjuring Trick by Rev. Thomas Scarborough

18. Metal Detector

19. High Quality Intercom

20. Doorbell for the Deaf

Return to Schematics

E.S.P. Conjuring Trick.

By Rev. Thomas Scarborough.

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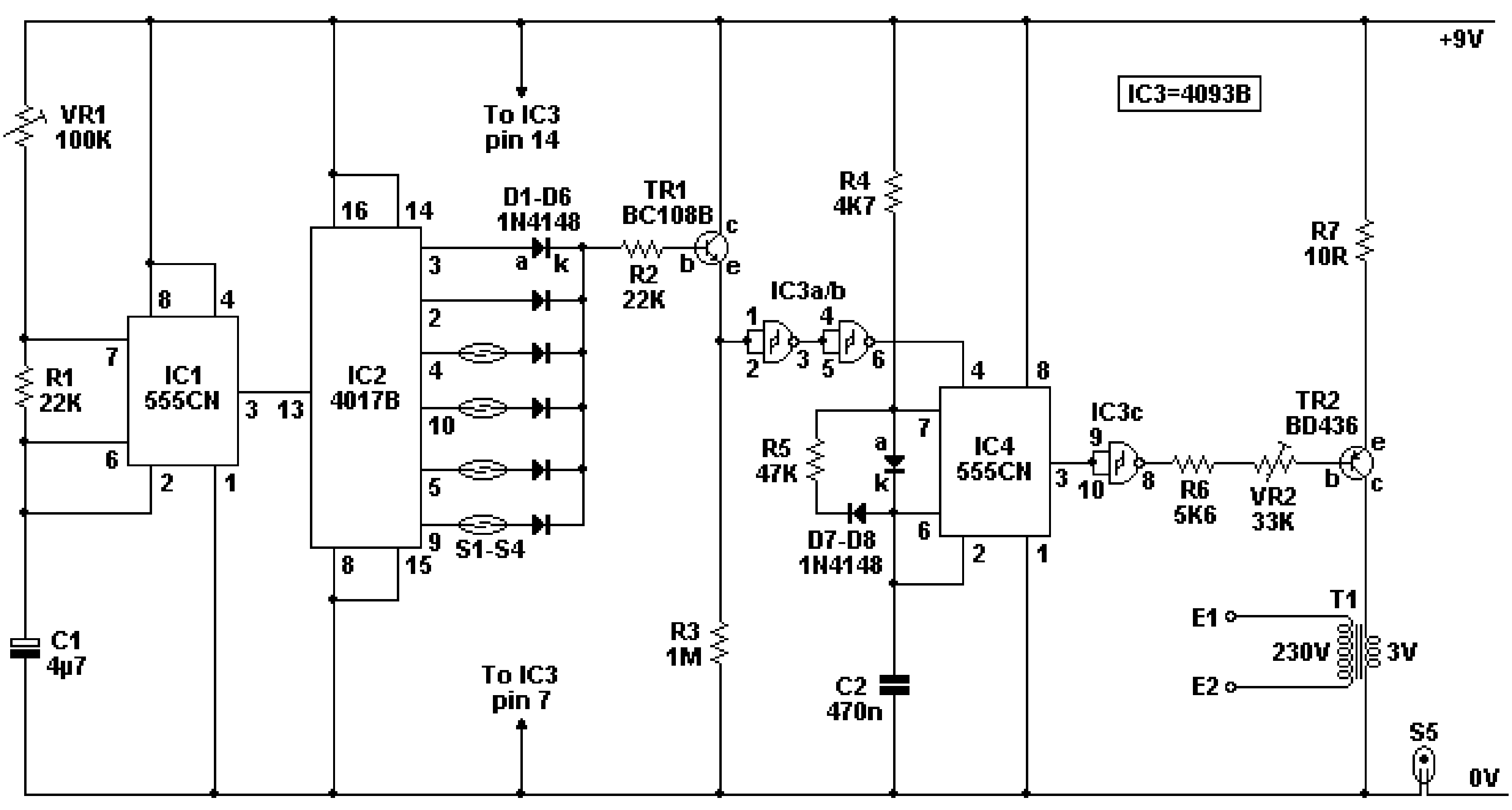
Figure 1.



A former President of the Magic Circle, three times awarded the International Award for Magic, commented when he saw this trick: "Absolutely incredible!"

It might be of interest to conjurers that it was a vaguely similar trick that gave rise to the idea. The trick, called the "Domino Box", was published in the Magic Circular in April 1991, and revealed the contents of a box by giving a parallel LED readout through smoky perspex. However, it used more than twice as many components, and the smoky perspex was open to some suspicion...

The elements of any good conjuring trick are a combination of simplicity on the one hand, and bafflement on the other - both of which are present in this trick.

The design uses tactile sense (or rather, neural sense) to reveal the contents of a box. The box contains 4 shapes, as in a child's shape sorter. The conjurer asks a person to secretly remove from the box any shape or shapes of his or her choosing, then to close the box, and to place a silk over it. The conjurer then rests a hand on the silk, and through "extra-sensory powers" reveals the contents of the box.

The trick works as follows: each of the 4 shapes hides within it a magnet or magnets. The circuit sends a series of low-current high-voltage pulses to the surface of the box (by way of metal hinges, screws, or studs). When a shape is removed from its receptacle in the box, a reed switch (one of S1 to S4) under the receptacle opens, causing the pulse for that receptacle to drop out, so that one may identify which shapes are missing from inside the box. There is also a longer "marker" pulse (D1 and D2) so that one may identify the first shape in the sequence (the sequence repeats indefinitely). Figure 2 shows the pulses when all 4 shapes are inside the box:

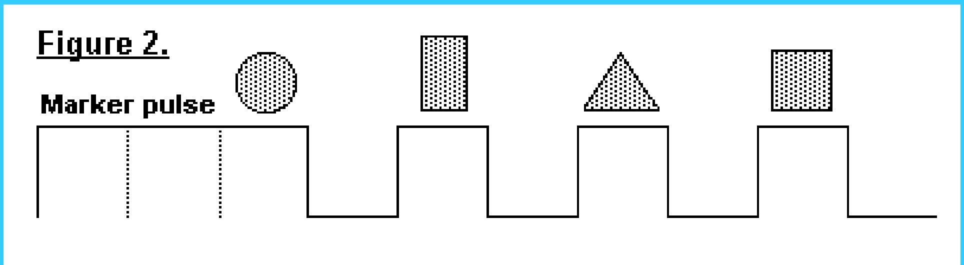


Figure 2.

Figure 3 shows the pulses when only the rectangular shape and the square shape are inside the box.

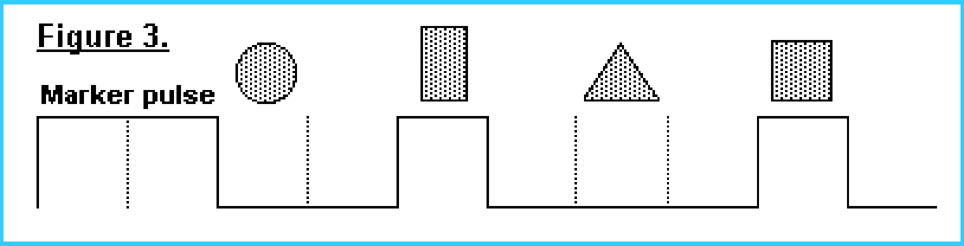


Figure 3.

The trickiest part of the trick is to learn whether the circle shape is missing or not, since its corresponding pulse is tacked on to the "marker" pulse.

Figure 4 shows how the magnet is positioned in the square shape, and the reed switch beneath it. An additional magnet may be positioned in the shape in case it is inserted into its receptacle upside down.

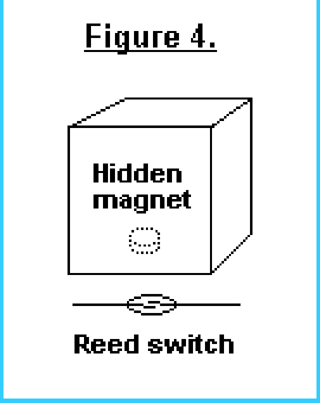


Figure 4.

The high-voltage pulses are imperceptible to a dry hand (eg. others handling the box), yet if the conjurer moistens a finger or fingers with the tongue, and touches the electrodes (hinges, etc.) through the silk, these pulses will be easily felt. The best result is obtained when separate fingers of the same hand touch the electrodes.

Though a high voltage is present, the circuit is safe, since the current flowing through the electrodes is very low. Especially if separate fingers of the same hand are used to detect the pulses, there should be no risk to life or health whatsoever. Nevertheless, **any persons using a pacemaker, or having any history of epilepsy, would be advised to avoid this circuit.**

Ideally, the shapes will follow the usual conjuring sequence as follows: 1 side (circle) - 2 sides (rectangle) - 3 sides (triangle) - 4 sides (square). Since no switch should be visible, a mercury switch (S5) was used to switch off the circuit when the box was laid on its side. The circuit ought to operate for 4 hours off a small PP3 9V battery.

IC1 is a slow astable multivibrator, which sequences IC2 through 6 pulses, the first 2 of which form the "marker" pulse. VR1 controls the speed of the pulses. S1 to S4 determine whether any of the pulses will drop out, by altering the potential at TR1 emitter. NAND Schmitt triggers IC3a and IC3b convert TR1's emitter potential to a logical high or low, which is used to switch IC4. IC4 is an astable multivibrator, wired to obtain a duty ratio of 10%. IC3c inverts the logic of IC4, while TR2 amplifies the output current from IC3c. Note that VR2 should initially be turned to 33K, then slowly turned back to obtain the desirable pulse strength across electrodes E1 and E2 - otherwise one may receive a small shock. A perceptible sensation is all one needs!

T1 is a 230V to 3V step-down transformer with its secondary (3V) coil in circuit. The primary coil serves as the electrodes. Note that the 555 IC's both have the CN suffix - they are a low power version of the 555, with slightly different characteristics (TS555CN).

One might wish to have a visual read-out of the pulses in order to practice the trick more easily. For this, a LED may be connected temporarily across the electrodes (observing the correct polarity). In fact a high-brightness LED could be mounted behind a pinhole in the box to offer alternative visual pulses to the conjurer instead of the "neural" pulses.

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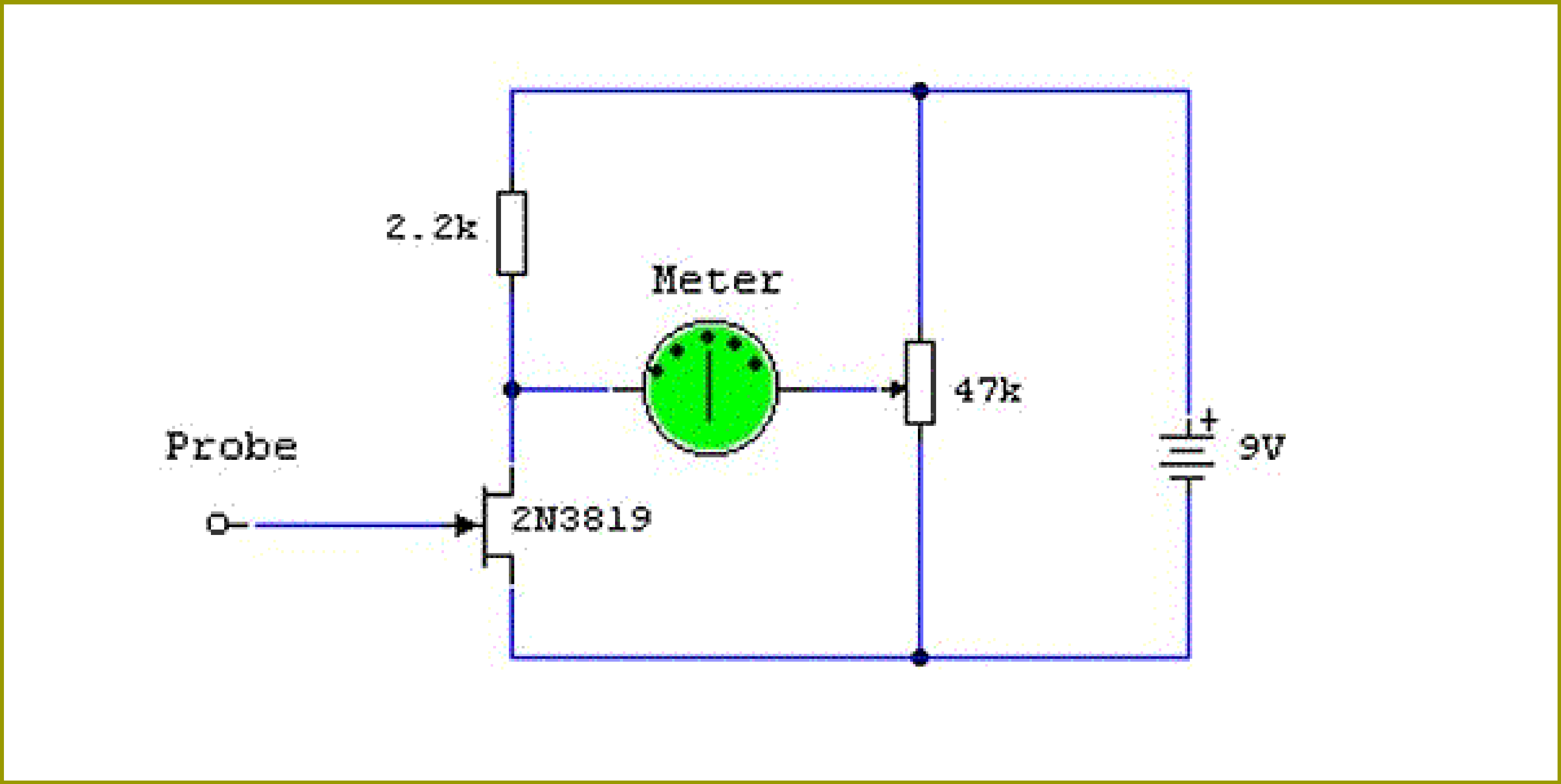
Static Electricity / Negative Ion Detector



Notes

This circuit relies upon the extra high input impedance of a FET, and also demonstrates
the gate terminals sensitivity to changes in voltage. The gate terminal here is left open circuit, connected only to the "probe" this being just a few inches of bare copper wire. With no fixed DC biasing, the gate terminal will respond to micro changes in voltage or "field strength". It is important not to make this circuit on veroboard or PCB material as this will reduce the effective gate impedance. Instead use an "open" construction technique soldering each component
together. The probe should not be touched directly and is best insulated in a plastic pen sleeve.

As static electricity can have either a positive or negative charge,

the meter used
should be a centre zero type. Full scale deflection can be 1mA or 250uA for greater sensitivity. Remove the meter and use a multimeter to measure the voltage between FET drain and the preset resistor. Adjust the preset for 0 volts and then replace the meter. This will avoid
"bending" the needle.

If placed in a room the meter will detect changes in static charge, positive charge
deflecting the needle one way and negative the other way. You can test the circuit by
placing the unit say 5 feet away from a TV set. When switched on, the meter needle should
jump to full scale deflection and then drop down again. If you have a room ioniser, its output
can be monitored by moving the probe in front of it. As the detector responds to changes in charge, you may need to move the detector around to see the effect, but it will prove the
output from such an ioniser.

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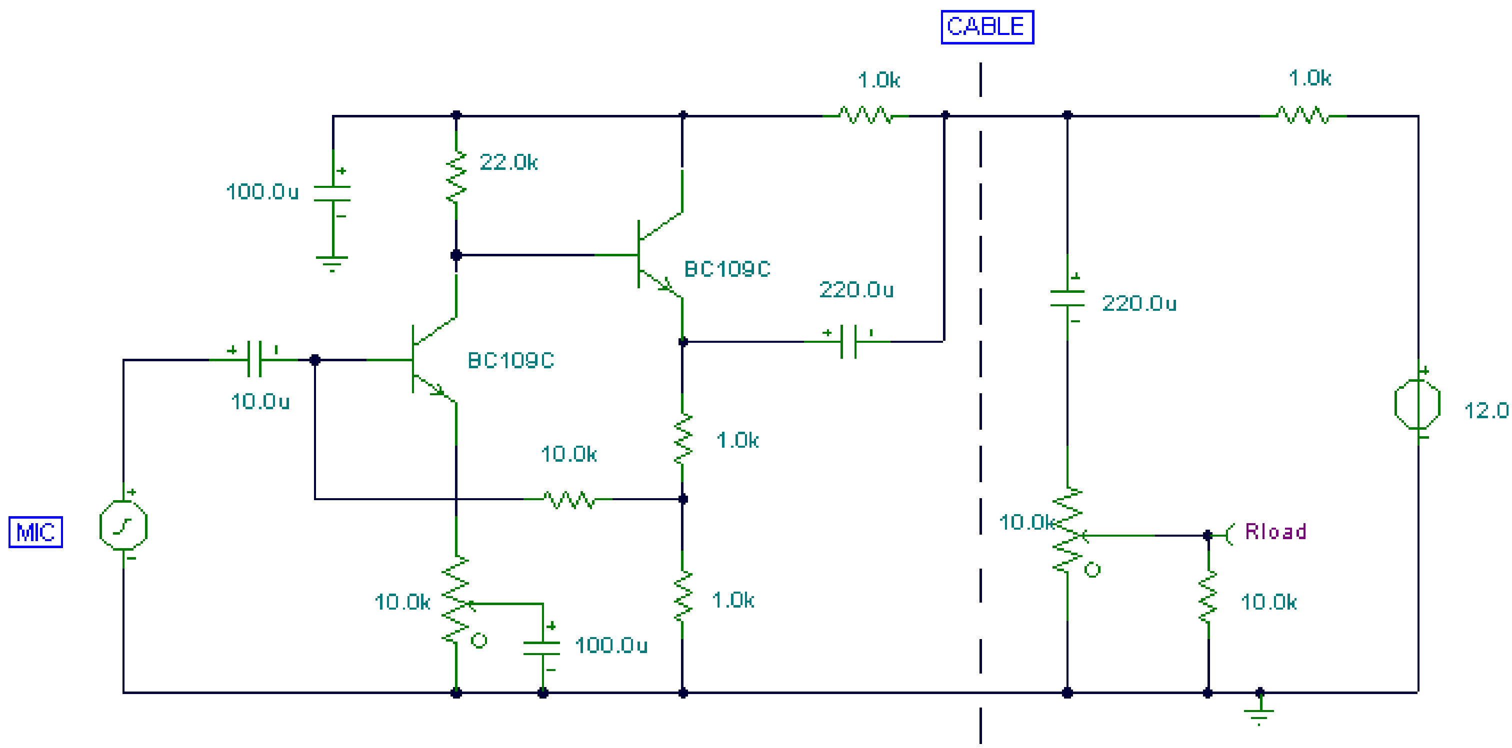
Audio Perimeter Monitor



Notes:
Using a single cable such as speaker wire or doorbell cable, this circuit can be remotely positioned, for example, at the bottom of a garden or garage, and used to detect all sound in that area. The cable can be buried in a hosepipe or duct and is concealed out of sight. The mic is an ordinary dynamic mic insert and should be housed in a waterproof enclosure with the rest of the circuit.

The mic output is amplified by the two transistors, the output is fed down the cable via the 220u capacitor. Here, it has a dual purpose of preventing the DC supply from upsetting the bias of the circuit, and also allowing the smaller ac audio output to pass down the line. At the power supply, the audio is recovered by the 10k preset and 220u capacitor. It is used to feed a small audio amplifier (such as the 2watt design) shown earlier on this site.

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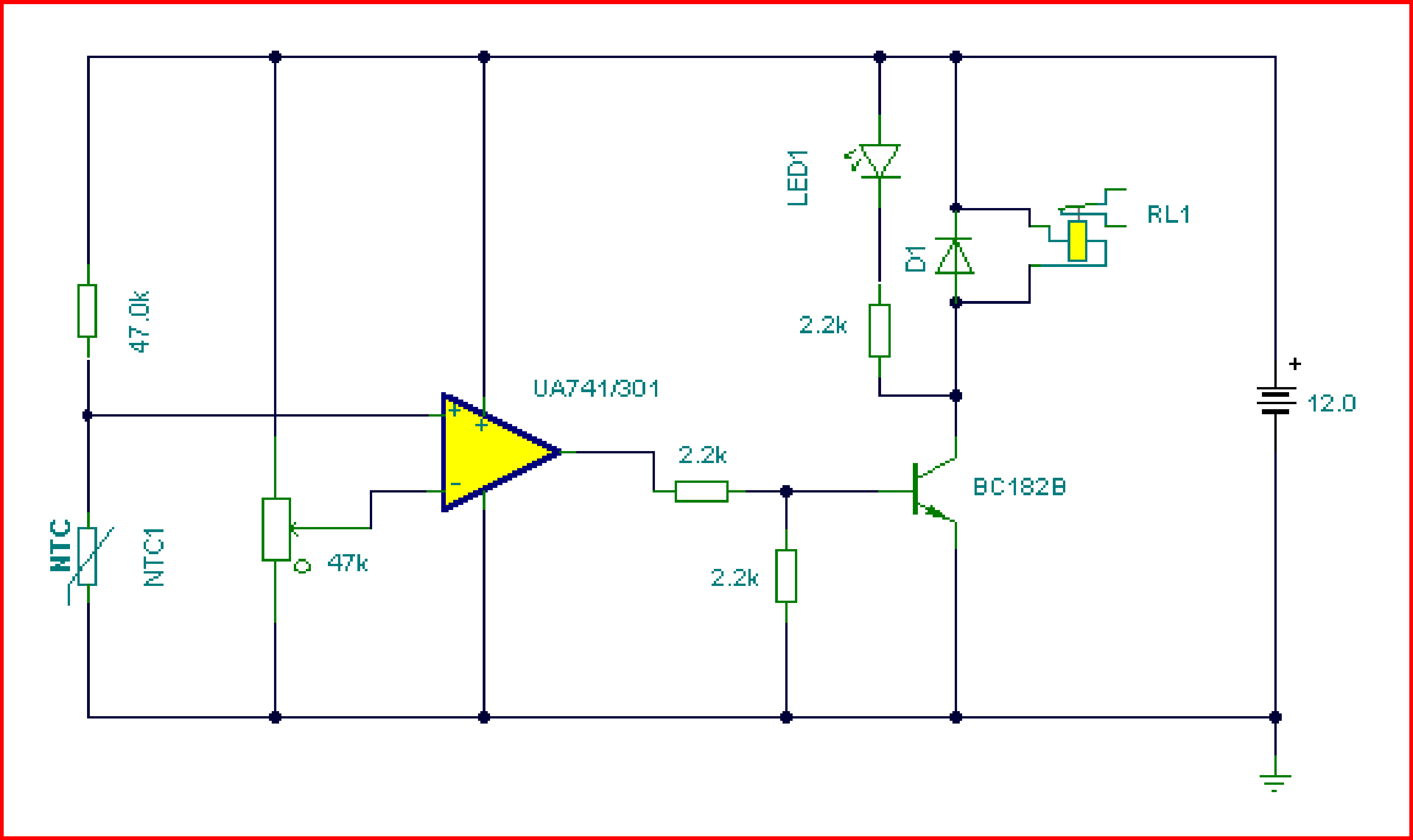
Temperature Monitor



Notes:
Using a thermistor in the position shown makes a heat activated sensor. A change in temperature will
alter the output of the opamp and energize the relay and light the LED. Swapping the position of the
thermistor and 47k resistor makes a cold or frost alarm.

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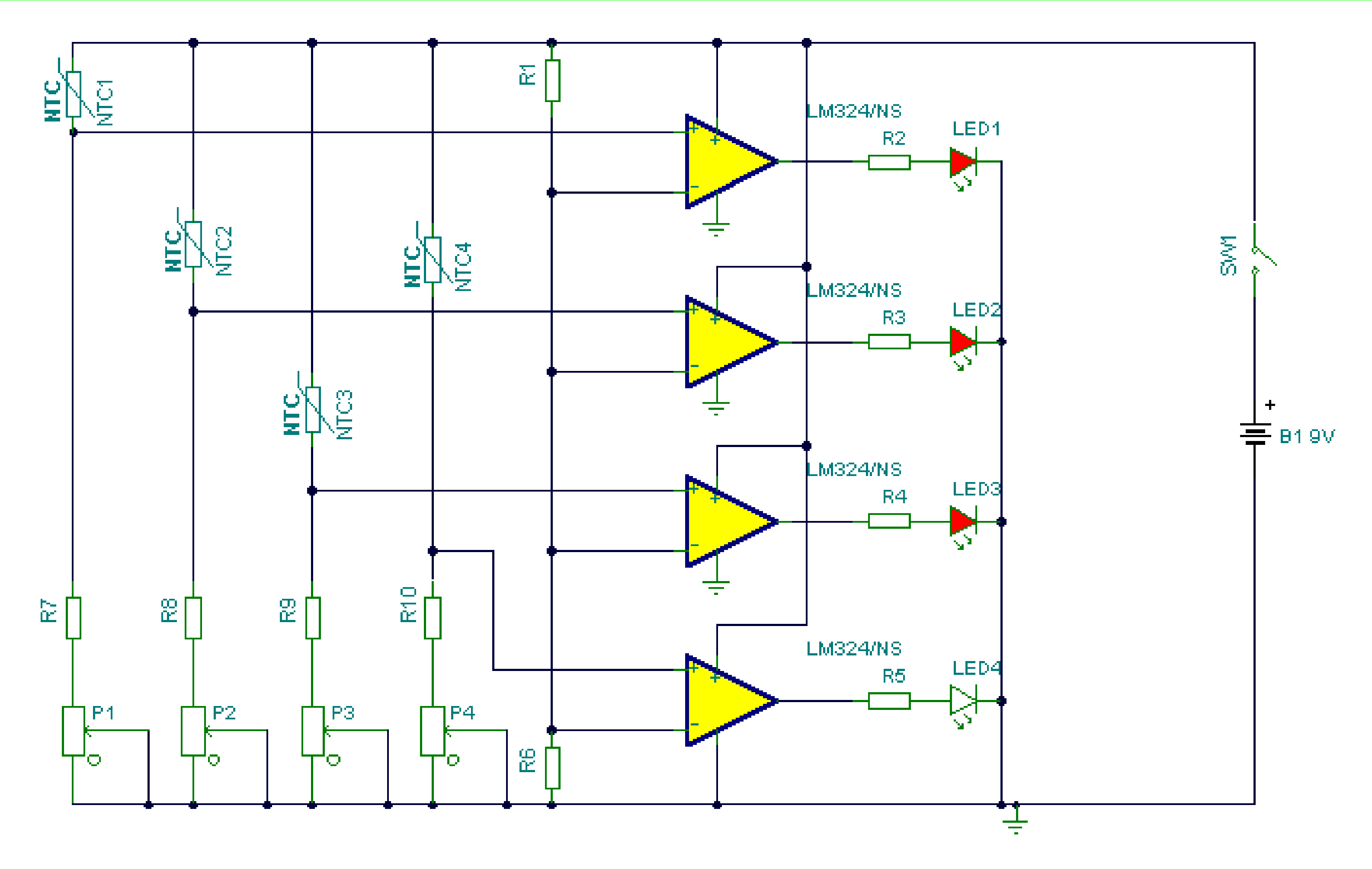
Hot Water Tank Indicator

Construction:

I used masking tape to stick the bead thermistors to the tank. Wires were soldered and insulated at the thermistors ends. A plastic box was used to house the circuit. Battery life will probably be 2 - 3 years depending on how often you use the push switch, SW1.



Notes:

Save fuel bills and the economy of the planet with this electronic circuit. SW1 is a press button switch which allows you to view the level of hot water in a hot water tank. Thermistors NTC1-4 should be spread evenly over the height of the tank. I placed NTC1 roughly 4 inches from the top of my tank and the others spaced accordingly.

Calibration:

With a full tank of hot water adjust P1-4 so that all LED's are lit. As hot water rises, the sensor at the bottom of the tank will be the maximum level of hot water. "Hot" can be translated as 50C to 80C the presets P1-4 allow adjustment of this range.

Parts:

I have used a quad version of the LM324 but any quad opamp can be used or even four single LM741's.
R2-R5 I used 330ohm ,but not critical.
NTC1-4 The thermistor resistance governs the value of R1 R6 and the presets. I used a thermistor from the Maplin catalogue. Cold resistance was around 300K, hot around 15k

R7-10 series resistance, to prevent a short circuit only needed if your thermistors resistance is several ohms
P1 - P4 I used 100k as this range corresponds to the resistance of the thermistor at the required water temp
R1 & R6 are equal and bias the supply voltage to half supply. I used R1=R6 = 100k

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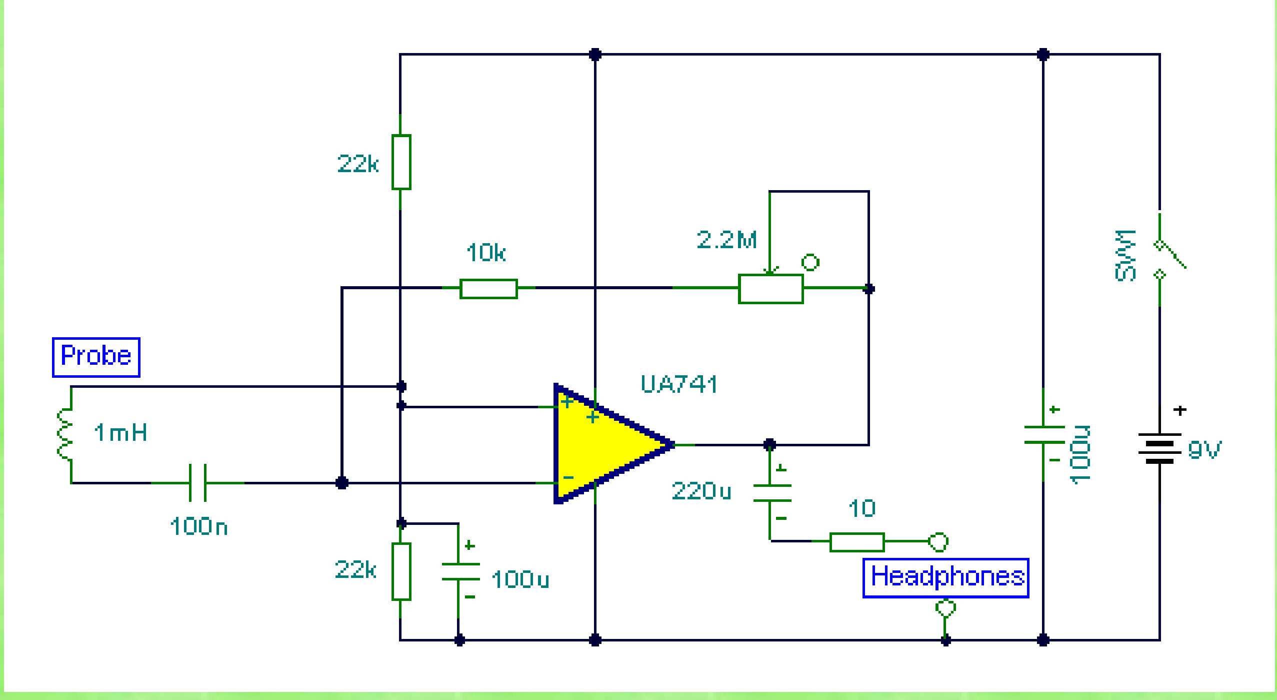
Electromagnetic Field Detector

This circuit is sensitive to low frequency electromagnetic radiation and will detect for example hidden wiring or the field that encompasses a transformer. Pickup is by a radial type inductor, used as a probe which responds well to low frequency changing magnetic and electric fields. Ordinary headphones are used to for detection. The field that surrounds a transformer is heard as a 50 or 60Hz buzz. The circuit is below:-



Notes:
I threaded a length of screened cable through an old pen tube and soldered the ends to a radial type can inductor. I used 1mH. The inductor fitted snugly into the pen tube. The opposite end of the cable connects to the input of the opamp. Any opamp should work here, possibly better results may be achieved with a low noise FET type such as the LF351. The 2M2 potentiometer acts as a gain control and the output is a pair of headphones. Stereo types can be used if they are wired as mono. I used an 8 ohm type, but the circuit should work equally well with higher impedance types. The probe (shown below) may be connected via screened cable and a 3.5mm stereo plug and socket.

Detection:

The sensitivity of this circuit is good. Mains wiring buried an inch in plaster can be detected with precision. A small load on the electric supply is all that is needed; a 20 watt desk lamp or similar will suffice. The hum field surrounding a transformer can be detected oat over 7 inches. Domestic appliances such as videos and alarm clocks all produce interference which can be heard with the probe. The electric field surrounding a loudspeaker or earpiece can also be heard. Try lifting a telephone and place the probe near the earpiece. A telephone pickup coil can be used in place of the inductor if desired. I will make an improved version of this circuit with a meter output later.

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Neon Desklamp.

By Rev. Thomas Scarborough.

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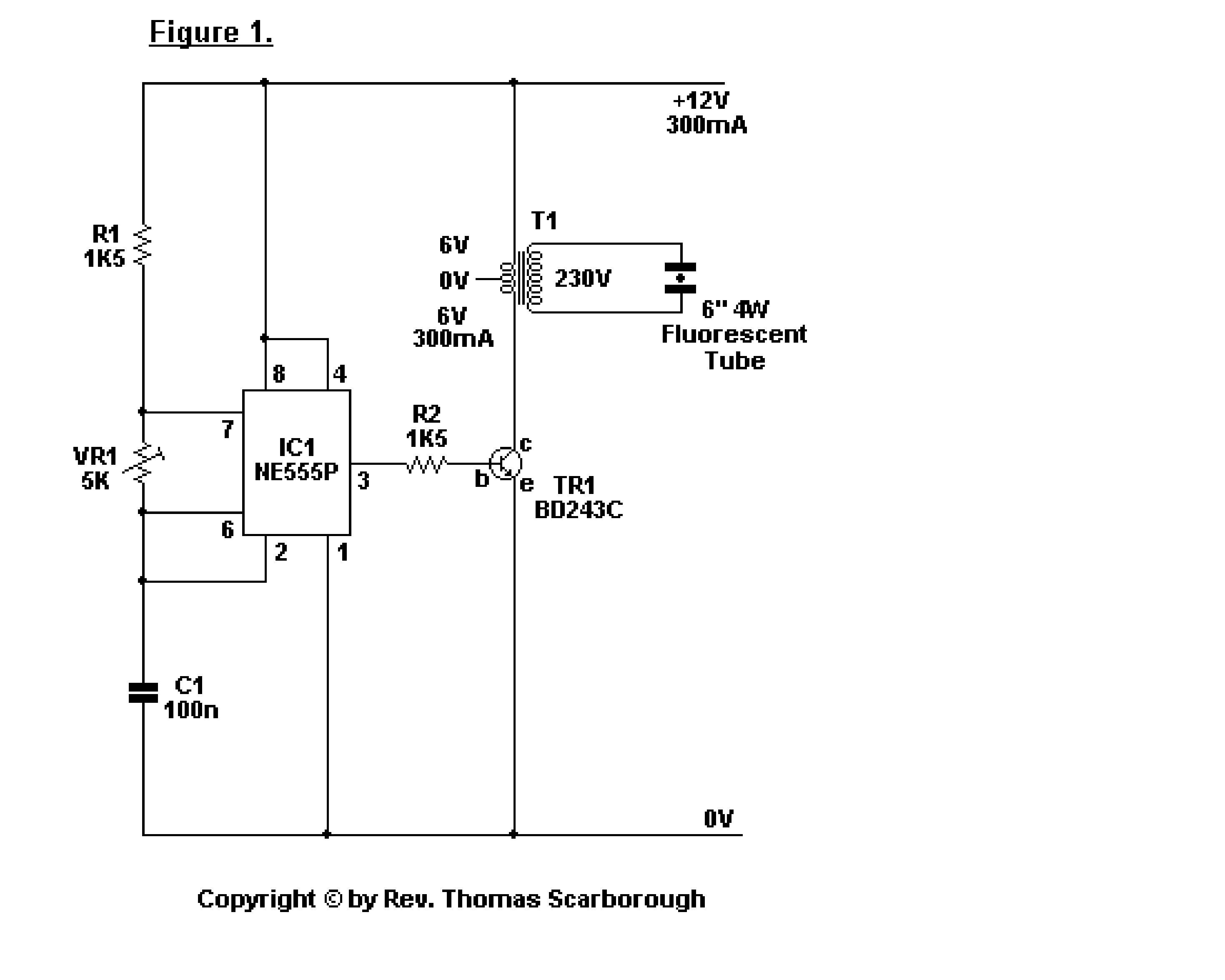

This circuit will power a 6 inch 4 Watt fluorescent tube off a 12 volt supply, consuming 300 mA. It may also be powered by a suitably rated universal AC/DC adapter. Advantages of the design are: good light, low power consumption, and readily available stock parts.

The circuit is based on IC1, which is a 555 timer IC in astable mode. IC1's current output is amplified by TR1, and the voltage at the collector is stepped up by T1, a mains to 6-

0-6 V transformer. Heat-sinks are advised for TR1 and T1.

Before applying power, VR1 should be advanced to a full 5 K. While power consumption is monitored with a multimeter, VR1 should be turned back slowly until power consumption rises to 300 mA maximum. The fluorescent tube should now shine brightly. Power consumption should not exceed 300 mA, or the circuit may be destroyed.

Should a universal AC/DC adapter be used at a later stage, constructors are advised to repeat the setup procedure with VR1, since the voltage of such adapters is unstable and may destroy the circuit.

Constructors should be aware that a high voltage is present at the transformer primary, which could deliver a nasty shock.

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Magic Wand Conjuring Trick.

By Rev. Thomas Scarborough
Cape Town,
South Africa.

The simple conjuring trick in Figure 1 is intended to provide some enjoyment for the beginner in electronics or conjuring, and should take only an hour or two to build.

Figure 1.

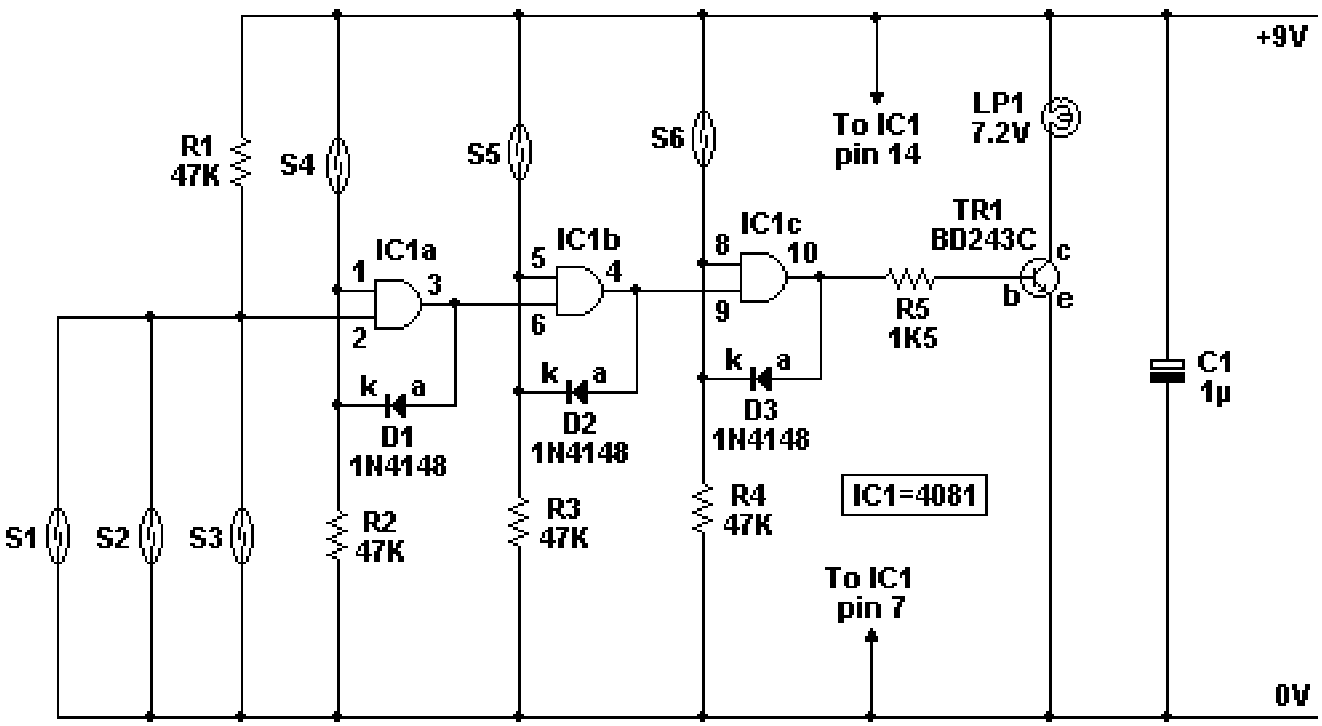
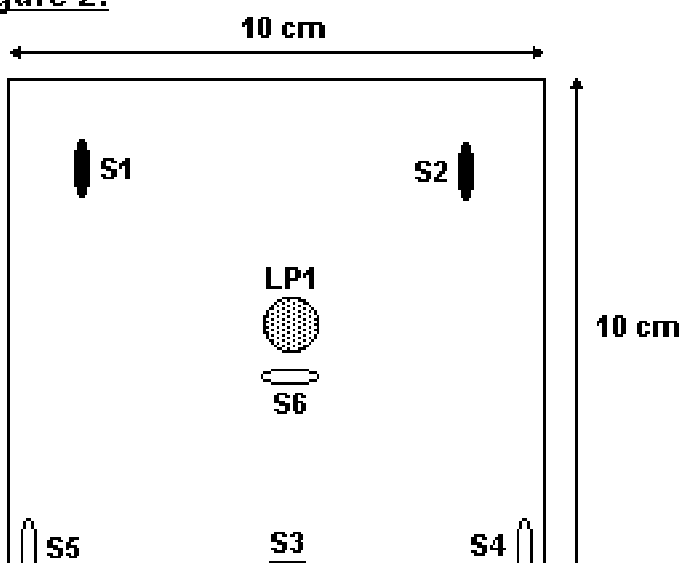
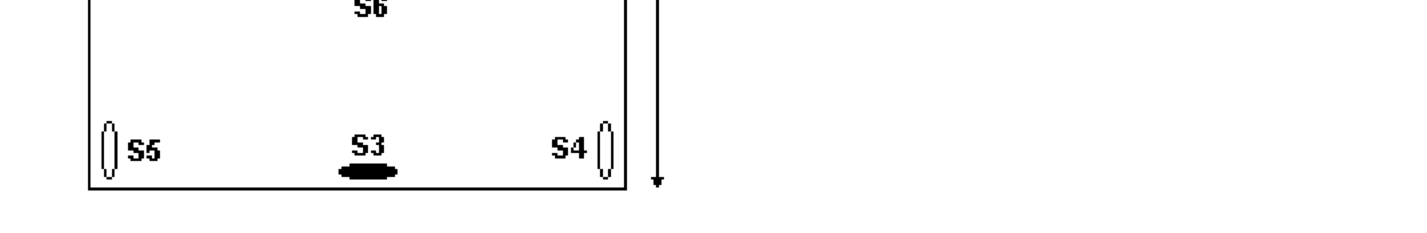


Figure 2.





The trick works as follows: a wand (with a magnet mounted in one end) must pass in a 1-2-3 sequence over reed switches S4 to S6 before the bulb LP1 will light. If the wand passes over reed switches S1, S2, or S3, the 1-2-3 sequence will be reset (that is, cancelled). Or, if the bulb is already burning, the activation of reed switches S1, S2, or S3 will extinguish it.

All the reed switches - S1 to S6 - are glued just beneath the surface of a 10 cm^2 box (Figure 2). A general purpose adhesive is suggested, so that the reed switches may later be moved if necessary. The bulb, LP1, is mounted in the centre of the box. A small PP3 9V battery may be used. The prototype box was built using balsa wood.

The wand may be waved back and forth in various motions over the box, on condition that it finally passes in the correct 1-2-3 sequence over S4 to S6 (at which point LP1 will light). This should thoroughly confuse any onlooker and make it virtually impossible for another person to repeat the correct motions with the same wand. The wand may also be lifted just high enough over reed switches S1 to S3 so as not to trigger them.

A 7.2V filament bulb, LP1, was used - instead of, say, a LED - so as not to give the trick an "electronic" appearance.

The operation of the circuit is fairly simple. Three AND logic gates of a 4081 CMOS IC are employed, with gates IC1a to IC1c being configured as a standard cascaded latch circuit. S1 to S3 serve as reset switches. The output at pin 10 will only switch to logic high when reed switches S4 to S6 are closed in sequence. Power transistor TR1 amplifies the output current to light bulb LP1.

Instead of a wand, a small neobdymium (super-strength) magnet may be stuck to one finger, and one's finger used in place of the wand.

In "stand-by" mode (with the bulb extinguished) the circuit will use very little current. Therefore a switch is not included in the circuit (of course, one may be added). The box may be opened and the battery simply clipped on or off.

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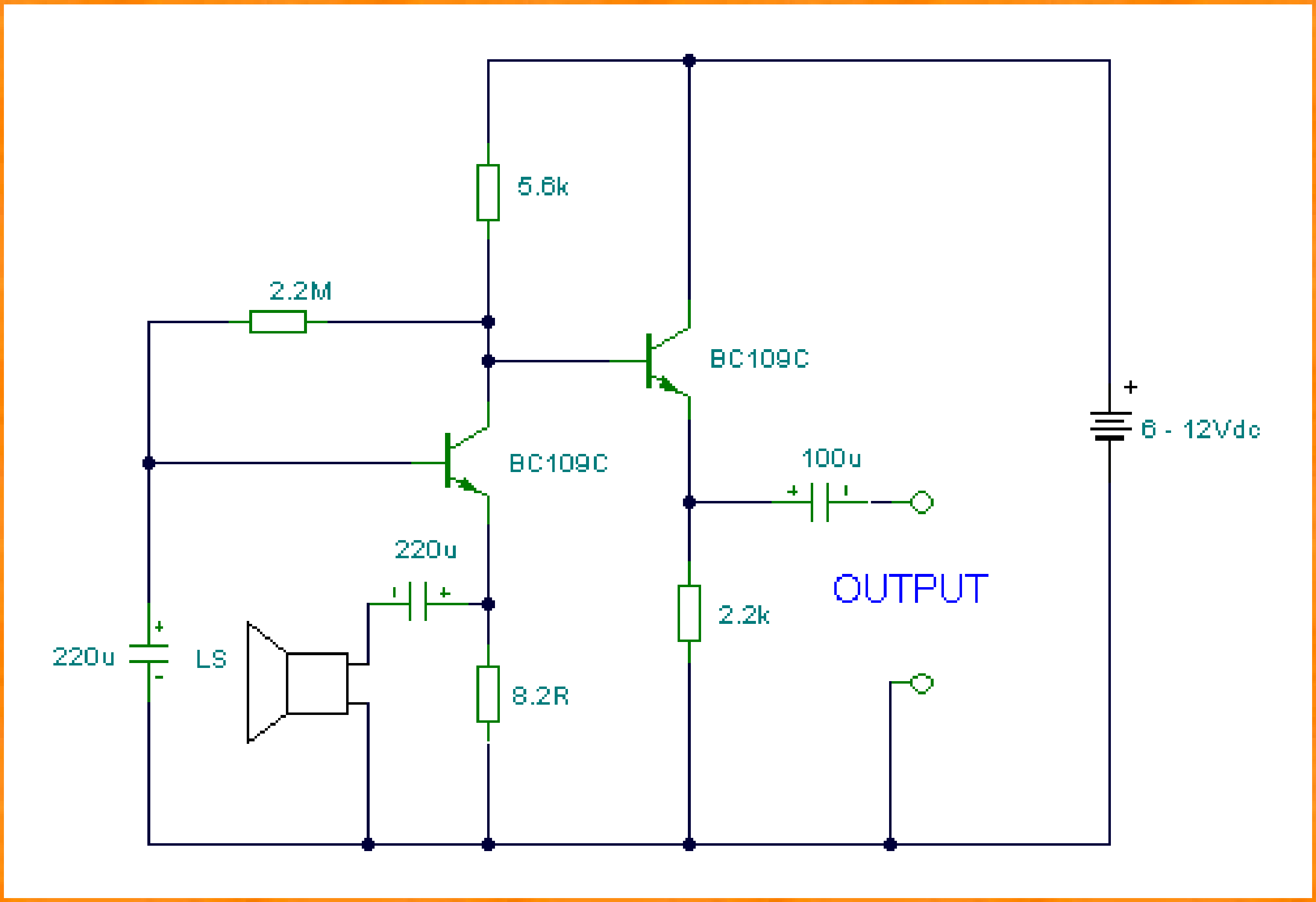
Speaker Microphone Circuit

Design : anc
Email: anc

Description:
This circuit takes an ordinary loudspeaker and allows it to be used in reverse, as a microphone.



Notes:
This circuits allows you to use a cheap loudspeaker as a microphone.Sound waves reaching the speaker cone cause fluctuations in the voice coil. The voice coil moving in the speakers magnetic field will produce a small electrical signal . The circuit is designed to be used with an operating voltage between 6 and 12 volts dc. The first transistor operates in common base mode. This has the advantage of matching the

low input impedance of the speaker to the common base stage, and secondly has a high voltage gain. The second stage is direct coupled and operates in emitter follower. Voltage gain is slightly less than unity, but output impedance is low, and will drive long cables.
Speech quality is not as good compared to an ordinary or ECM microphone, but quite acceptable results can be obtained. Speaker cones with diameters of 1 inch to 3 inches may be used. Speaker impedance may be 4 ohm to 64 ohm. The 8.2 ohm resistor value may be changed to match the actual speakers own impedance.

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Magnetic Gun.

Figure 1.

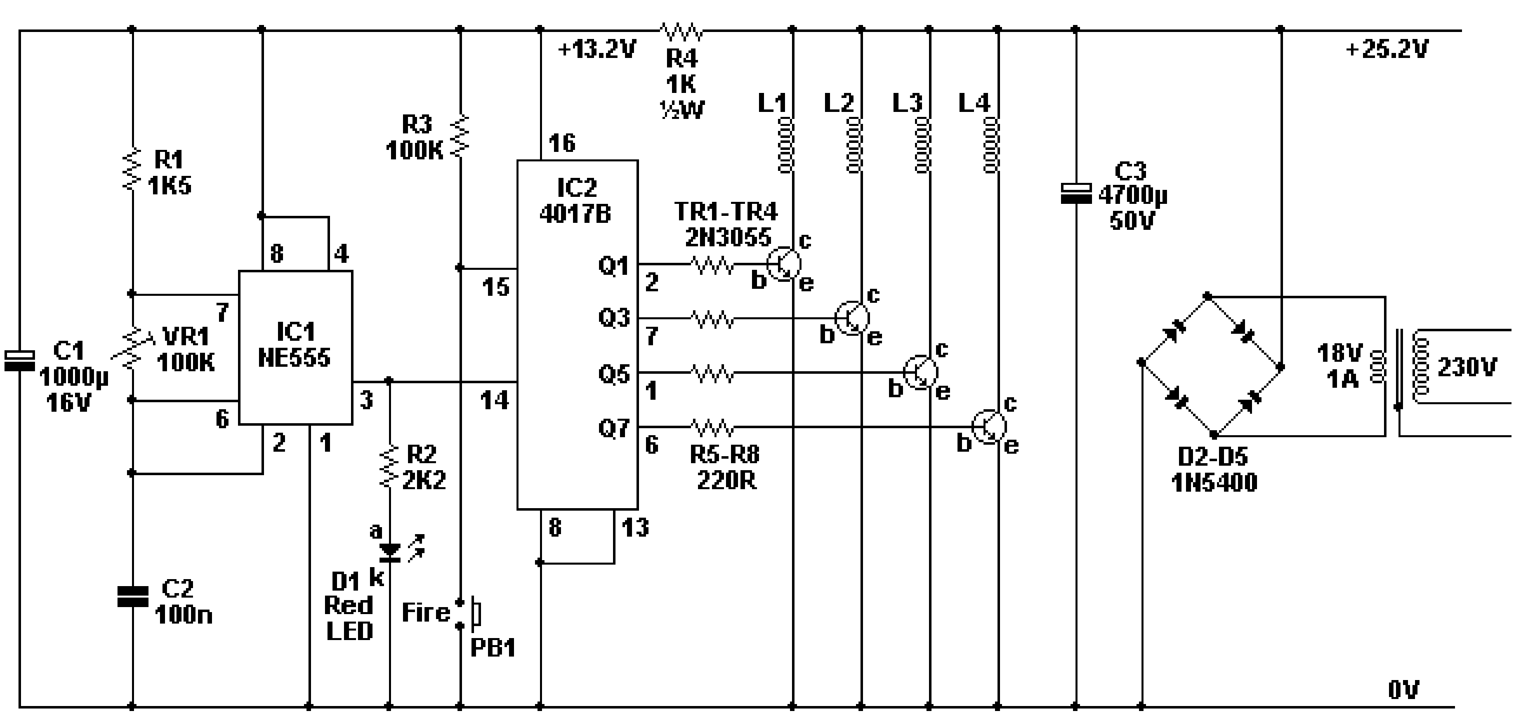
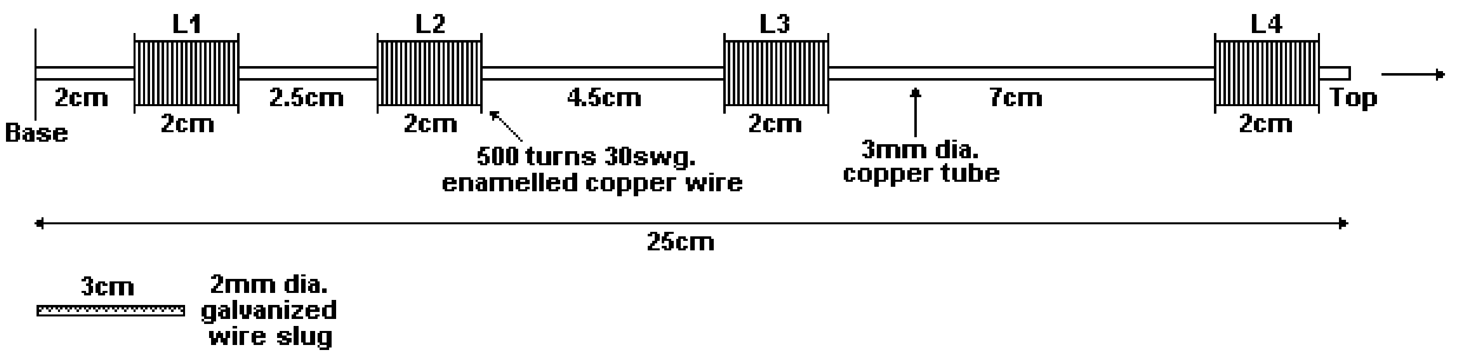


Figure 2. (Mount vertically).



By Rev. Thomas Scarborough.

Picured in Figure 1 is a miniature magnetic gun. When optimally tuned, it will propel a small slug about 1.5 metres high, or 2.5 metres horizontally.

IC1 is a 555 timer in astable mode, sending approx. 10 ms pulses to decade counter IC2. IC2 is continually reset through R3, until pin 15 is taken low through the "Fire" button. IC2 then sequences through outputs Q1 to Q7, to feed power transistors TR1 to TR4, which fire electromagnets L1 to L4 in rapid sequence.

Transformer T1 secondary is 18 volts 1 amp A.C. When rectified and smoothed, this provides 25.2 V D.C for electromagnets L1 to L4. Resistor R4 drops 12 V to obtain a supply voltage low enough for IC1 and IC2.

The electromagnets are wound on a 25 cm long, 3 mm dia. copper tube (available at hobby shops). Two "stops" may be cut from tin for each electromagnet, and 500 turns of approx. 30 swg. enamelled copper wire wound between them. The electromagnets should be wound on a base of reversed sellotape, so that one may slide them on the copper tube. The slug (or "bullet") is a 3 cm long piece of 2 mm dia. galvanized wire, which should slide loosely inside the copper tube.

Most crucial to the effectiveness of the gun are the setting of VR1 and the positions of electromagnets L1 to L4 on the copper tube (the values and measurements shown are merely a guide). Firstly, with L2 to L4 disconnected, VR1 should be tuned and L1 positioned for optimum effectiveness (place a wire inside the tube to feel how far the slug jumps with L1). Then L2 (now connected) should be positioned for optimum effectiveness (the slug will now exit the tube). Repeat with L3 and L4.

Electromagnets L2 to L4 were each found to substantially increase the range of the gun. In a forthcoming edition of EPE, the author will describe how readers may land a small projectile on Mars.

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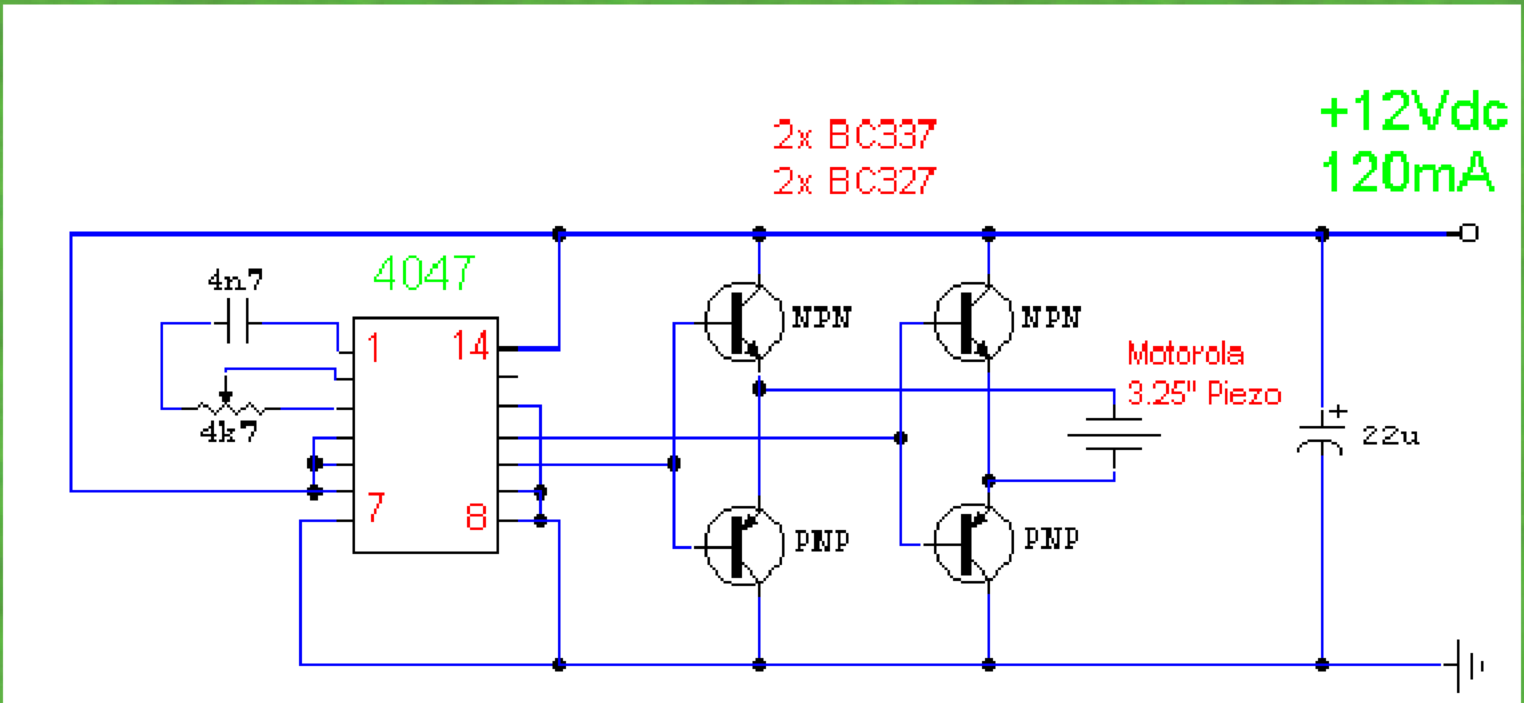
Insect Repellant

Circuit: Graham Maynard
Text: Andy Collinson



Notes:
Repell those repugnent insects from your Garden this Summer with this insect repellant circuit. Designed by Graham Maynard the circuitry consists of a phase locked loop (CMOS 4047) wired as a 22KHz oscillator. The output is amplified by a pair of complimentary output transistors and drives a Motorola 3.25 inch Piezo. Current drain is around 120mA so an external power supply is recommended.

The piezo used was a standard 85mm square Motorola Horn, Maplin part number WF09K or WF55K. These are rated +/-3dB to 28kHz.

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LED Torch.

Rev. Thomas Scarborough.

A common problem with small torches is the short life-span both of the batteries and the bulb. The average incandescent torch, for instance, consumes around 2 Watts. The LED Torch in Fig. 1 consumes just 24 mW, giving it more than 80 times longer service from 4 AA alkaline batteries (that is, up to one month's continuous service). Although the torch's light output is modest, it is nonetheless quite sufficient to illuminate a pathway for walking.

The LED Torch is based on a 7555 timer running in astable mode (do not use an ordinary 555). A white LED (Maplin order code NR73) produces 400 mcd light output, which, when focussed, can illuminate objects at 30 metres. Try Conrad Electronic for what appears to be a stronger white LED (order code 15 37 45-11).

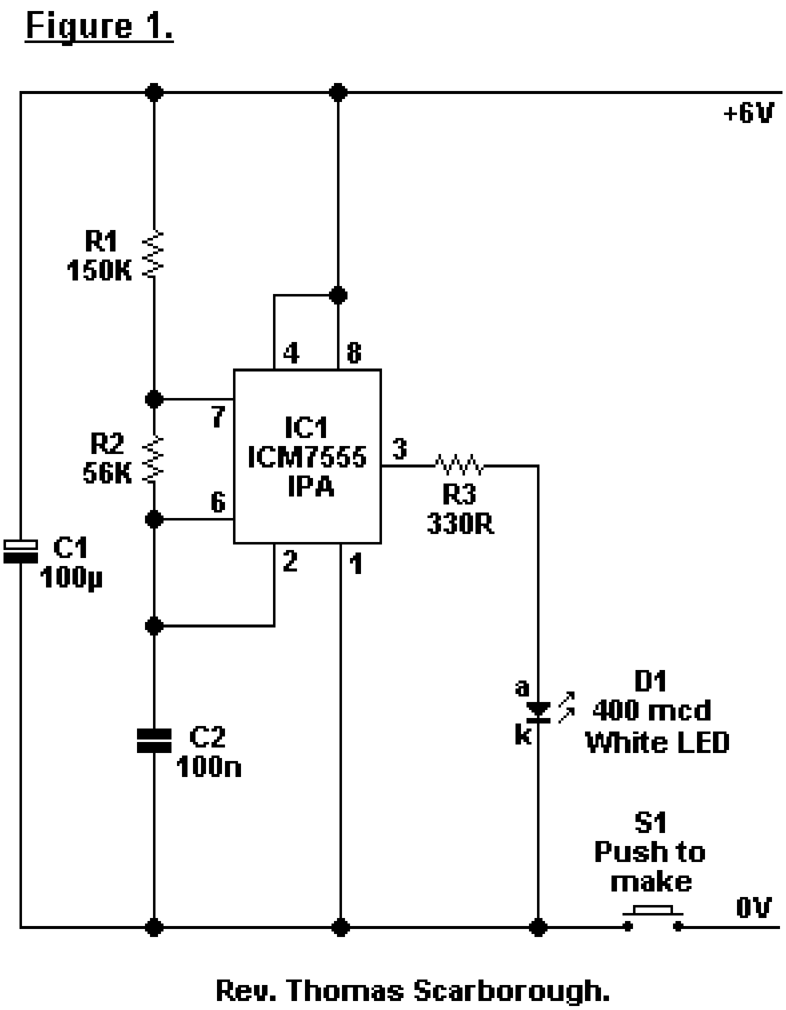
A convex lens with short focal length is placed in front of the LED to focus the beam. If banding occurs at the beam's perimeter, use another very short focal length lens directly in front of the LED to smooth the beam.

If a different supply voltage is preferred, the value of resistor R3 is modified as follows:

9V - 470 Ohm

12V - 560 Ohm

LED Torch.



See my "Wind-up Torch" feature article in the October 2000 edition of Everyday Practical Electronics for a completely battery-free go-everywhere torch.

E-mail scarboro@iafrica.com

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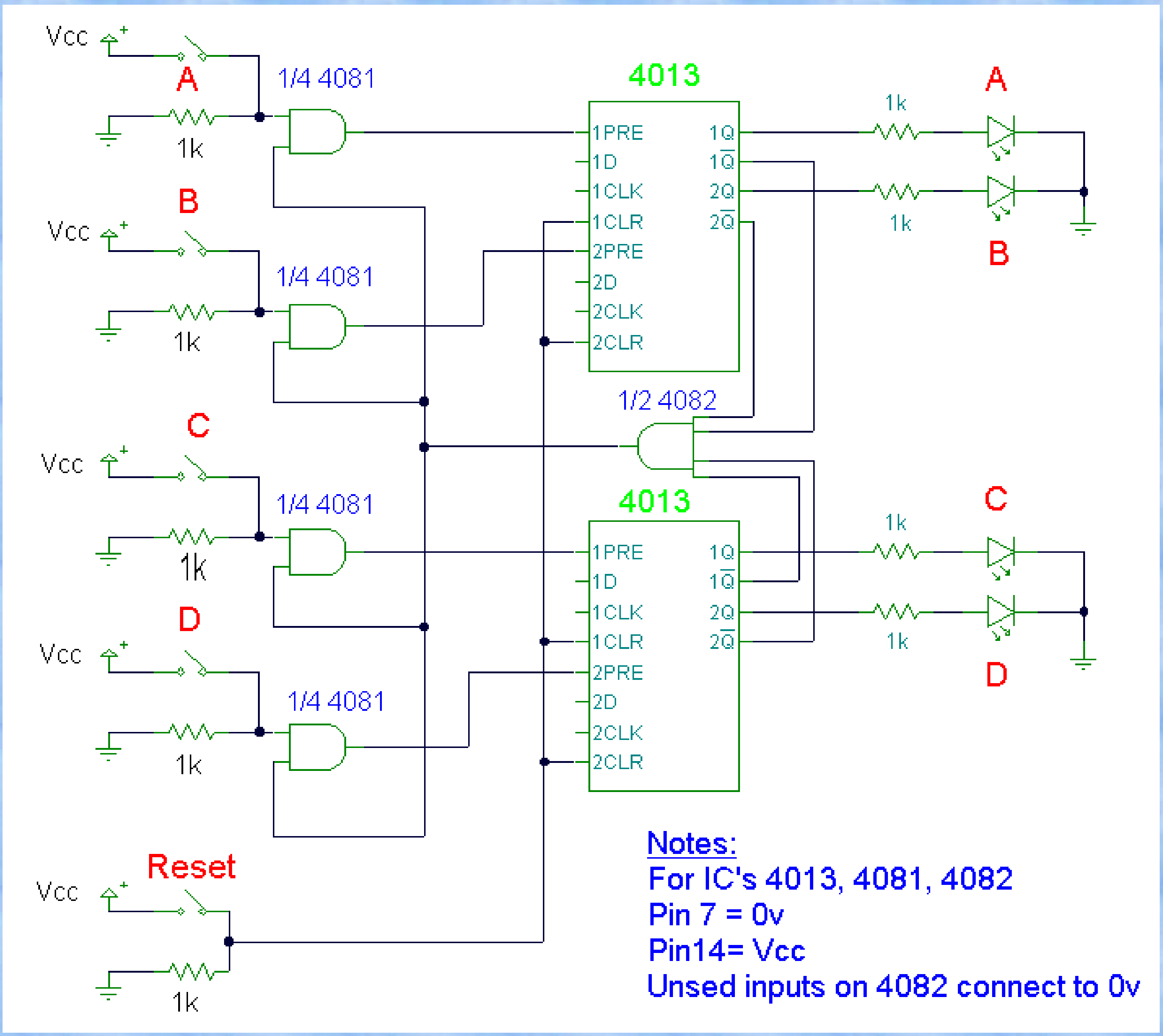
Quiz Circuit

Design : anc
Email: anc

I've had a few requests for a quiz circuit, so here is a 4 input design which can easily be modified. Maybe, I should write the application notes in the style of a game show host...



Notes:
This design uses four IC's and has four input circuits and four independent outputs and a single master reset switch. The outputs here are LED's but may be modified to drive

lamps or buzzers. Only one output LED can be lit at any time. The first person to press their input switch, A,B,C,D will light the corresponding output LED, disabling the other inputs.
The circuit uses all CMOS IC's part numbers shown on the diagram. The supply voltage may be anything between 3 and 15 volts. Alternatively, it may be built using equivalent TTL IC's and powered on 5 volts. The main component in this circuit is a bistable latch, here it is based on the dual 4013 D-type flip flop.

Circuit Operation:
Pressing the reset switch will clear all flip flops and extinguish any lit LED's. Under this condition the Q outputs will all be low (logic 0) and NOT Q outputs will be high (logic 1). All four NOT Q outputs are fed to a 4 input AND gate, the 4082 whose output will also be high. The output of the 4082 is wired to one input of each 2 input AND gate (4081). Switch inputs A,B,C,D are all non latching push button switches, the first person to press their switch will cause the corresponding AND gate (4081) to go high and trigger the preset input of the 4013 D-type flip flop. This will latch and light the appropriate LED. Also the triggered flip flop will have its NOT Q output, set at low, this changes the 4082 output to low and prevents any further triggering of the other flip flops. Switch contact de-bouncing is not required as the first press will latch one of the bistables. Pressing the reset switch, restores the circuit to its former state. I would recommend using heavy duty push button switches, as in use they are likely to be under some stress.

This circuit is available to download in the Circuit Maker section for anyone wishing to experiment further.

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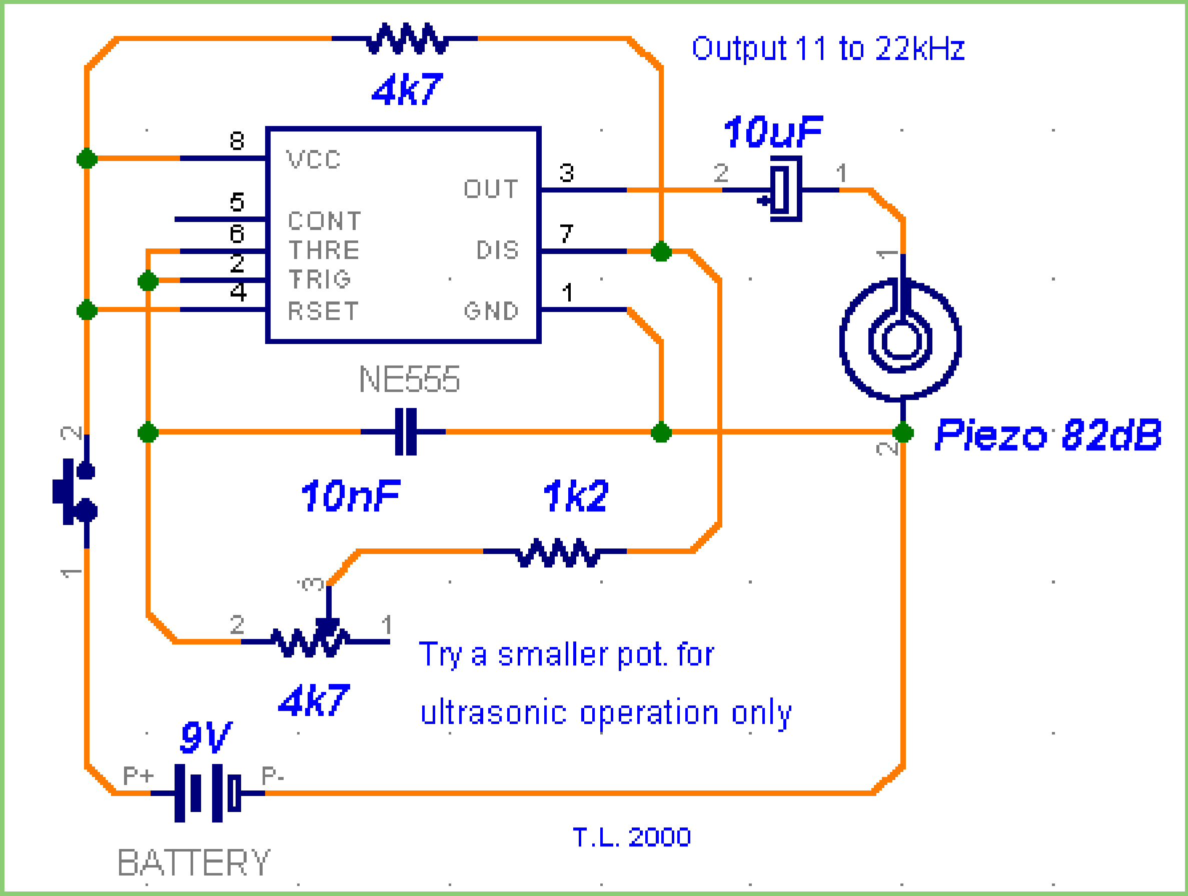
Ultrasonic Dog Whistle

By Tomaz Lazar - Ljubljana, Slovenia.

It's well known that many animals are particularly sensitive to high-frequency sounds that humans can't hear. Many commercial pest repellers based on this principle are available, most of them operating in the range of 30 to 50 kHz. My aim was, however, to design a slightly different and somewhat more powerful audio frequency/ultrasonic sound generator that could be used to train dogs. Just imagine the possibilities - you could make your pet think twice before barking again in the middle of the night or even subdue hostile dogs (and I guess burglars would love that!). From what I've read, dogs and other mammals of similar size behave much differently than insects. They tend to respond best to frequencies between 15 and 25 kHz and the older ones are less susceptible to higher tones. This means that an ordinary pest repeller won't work simply because dogs can't hear it. Therefore, I decided to construct a new circuit (based on the venerable 555, of course) with a variable pitch and a relatively loud 82 dB miniature piezo beeper. The circuit is very simple and can be easily assembled in half an hour. Most of the components are not really critical, but you should keep in mind that other values will probably change the operating frequency. Potentiometer determines the pitch: higher resistance means lower frequency. Since different dogs react to different frequencies, you'll probably have to experiment a bit to get the most out of this tiny circuit. The circuit is shown below:



Despite the simplicity of the circuit, there is one little thing. The 10nF (.01) capacitor is critical as it, too, determines the frequency. Most ceramic caps are highly unstable and 20% tolerance is not unusual at all. Higher capacitance means lower frequency and vice-versa. For proper alignment and adjustment, an oscilloscope would be necessary. Since I don't have one, I used Winscope. Although it's limited to only 22 kHz, that's just enough to see how this circuit works. There is no need to etch a PCB for this project, perf board will do. Test the circuit to see how it responds at different frequencies. A 4k7 potentiometer in conjunction with a 10nF (or slightly bigger) capacitor gives some 11 to 22kHz, which should do just fine. Install the circuit in a small plastic box and if you want to, you can add a LED pilot light. Power consumption is very small and a 9V battery should last a long time. Possible further experimentation: I'm working on an amplified version of the whistle to get a louder beep. All attempts so far haven't been successful as high frequency performance tends to drop dramatically with the 555. Perhaps I could use a frequency doubler circuit - I just don't know and I've run out of ideas. One other slightly more advanced project could be a simple "anti-bark" device with a sound-triggered (clap) switch that sets off the ultrasonic buzzer as soon as your dog starts to bark.

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POT-PLANT POWER.

by Rev.Thomas Scarborough.
Email: scarboro@iafrica.com

Following a hunch, the author discovered (or re-discovered?) that all plants carry an electric charge relative to the ground. This charge is more or less constant regardless of the size of the plant - a kind of "background voltage" in nature. This electric charge suffuses the entire plant, from its roots to its leaves and fruit. It was measured between a chrome-plated pin inserted into the plant (the positive terminal) and an iron spike driven into the ground (the negative terminal).

A number of explanations have been suggested in discussions:

- That the plant itself generates an electric charge to control its various functions.

- That the plant is picking up electromagnetic waves from power pylons or radio transmissions. Or

- That the pin and iron spike are generating a small voltage by means of electrolysis.

At any rate, the voltage present in plants may be harnessed to power a highly efficient circuit such as a "potato clock". This is done by wiring four or more plants in series. Garden plants, of course, share a common earth, and cannot therefore be wired in series. However, the author found that pot-plants can be wired in series, since each has a separate earth (see Fig.1).

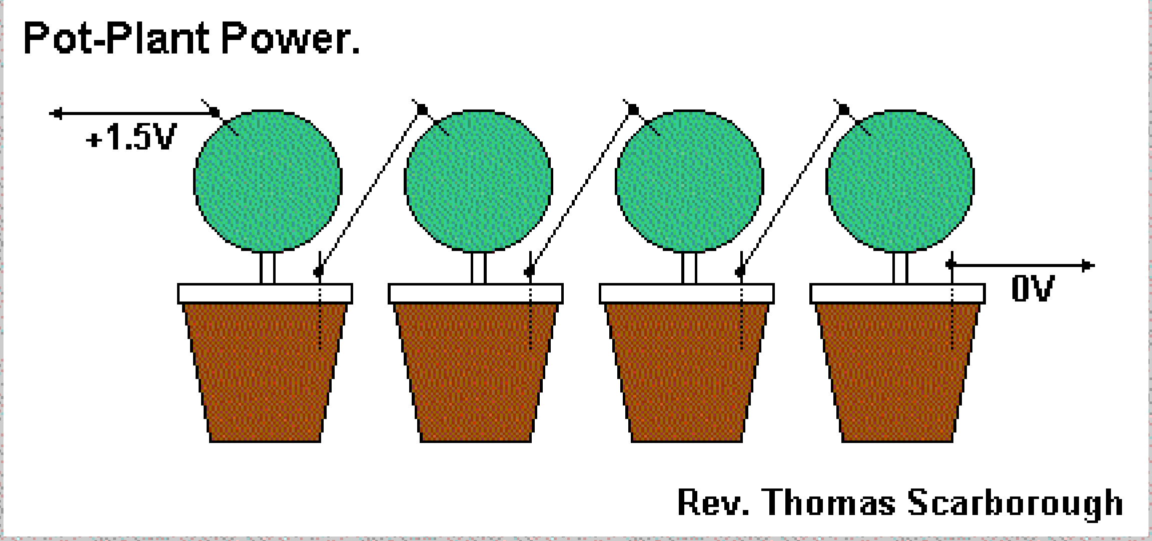

Fig.1

When electrical energy is tapped from a plant, the voltage in the plant drops about 20% within half a second, then settles at around 400mV, while current settles more slowly to one or two µA d.c. D.c. current may be increased by wiring together a few positive terminal pins across the same plant.

A curious feature noted by the author is that plants generated a variable a.c. waveform of a few kilohertz. This could also have a number of explanations. Do contact the author if you have any interesting experiments or new observations (see the e-mail address at the top of this article).

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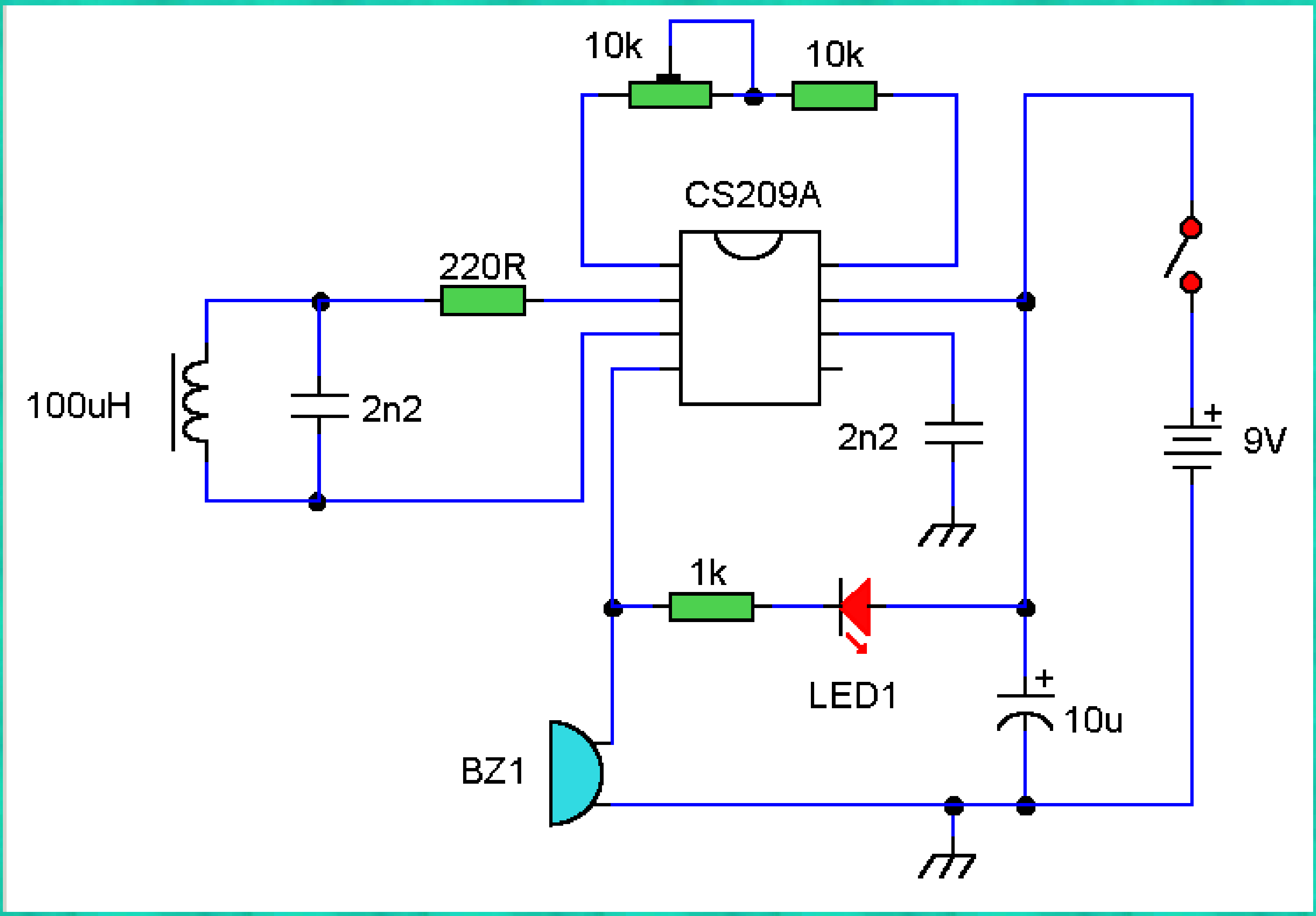
Metal Detector

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description:
A single chip metal detecor with a range of a few inches. This is useful for decting nails or screws in walls and floors, or for locating buried mains cable.



Notes:
The heart of the circuit is a single IC the CS209A made by Cherry Semiconductor. The detector, is a single 100uH choke. The IC has an integral oscillatorm the choke forms part of an external LC circuit, its inductance being altered by the proximity of metal objects. It is the change in oscillation that is amplified and demodulated. Led 1 will light and the buzzer will sound when the choke change sinductance. Set up is easy, VR1 is adjusted with the cjoke away from any metal source so that the LED lights and buzzer sounds. The control is backed off so that the LED goes out and buzzer stops. Now when the choke comes into contact with

any metal object that alters its inductance, LED 1 and the buzzer will activate.

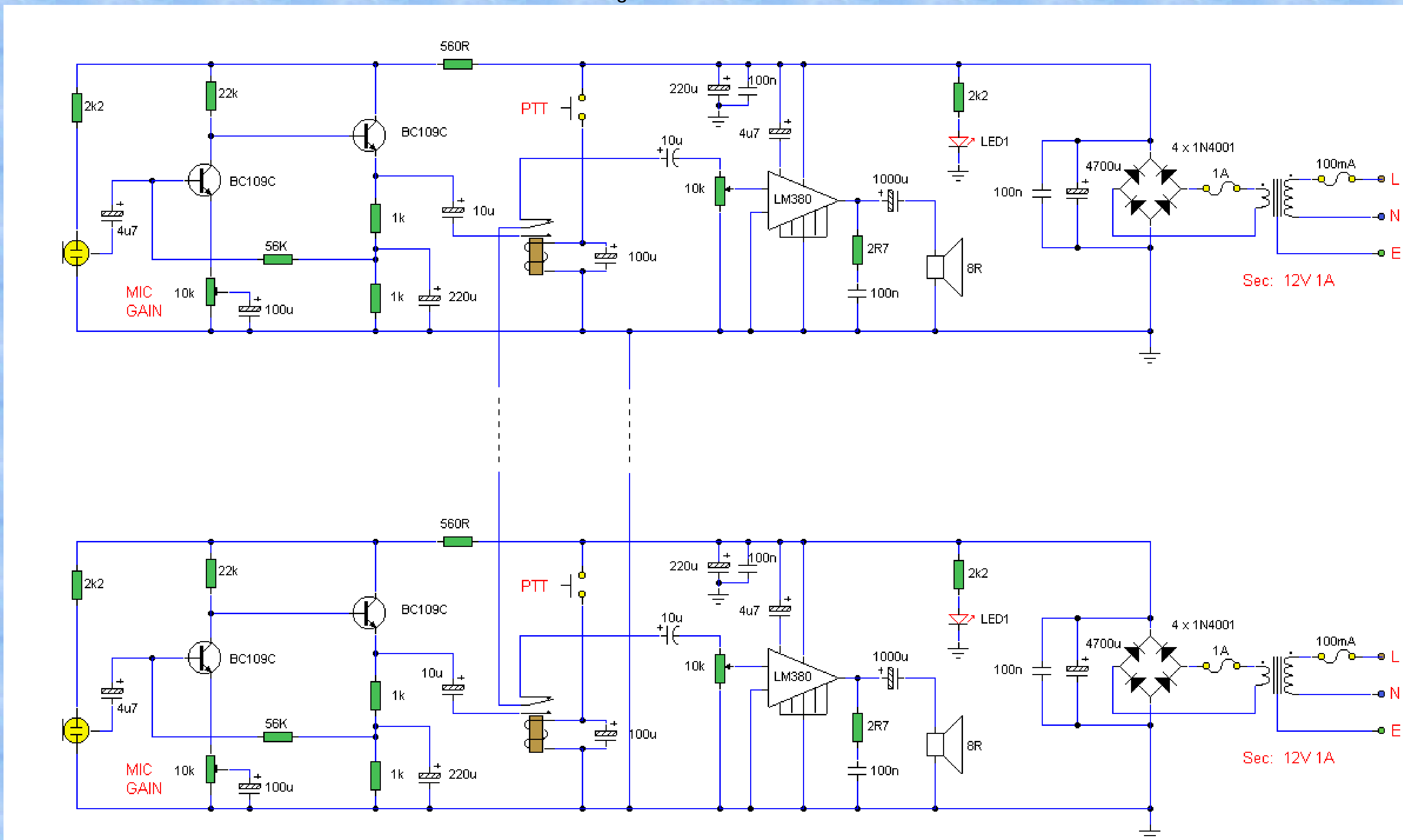
Return to Miscellaneous Circuits

High Quality Intercom

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description:
A very high quality intercom, which may also be used for room monitoring.

Full image resolution at 1600x1200



Click here to download a smaller 1024 x768 resolution schematic

Notes:

This circuit consists of two identical intercom units. Each unit contains a power supply, microphone preamplifier, audio amplifier and a Push To Talk (PTT) relay circuit. Only 2 wires are required to connect the units together. Due to the low output impedance of the mic preamp, screened cable is not necessary and ordinary 2 core speaker cable, or bell wire may be used.

The schematic can be broken into 34 parts, power supply, mic preamp, audio amplifierand PTT circuit. The power supply is designed to be left on all the time, which is why no on / off switch is provided. A standard 12 V RMS secondary transformer of 12VA will power the unit. Fuses are provided at the primary input and also secondary, before the rectifier. The 1 A fuse needs to be a slow blow type as it has to handle the peak rectifier current as the power supply electrolytics charge from zero volts.

The microphone amplifier is a 2 transistor direct coupled amplifier. BC108B transistors will work equally well in place of the BC109C transistors. The microphone used is a 3 terminal electret condenser microphone insert. These are popular and require a small current to operate. The preamp is shown in my audio circuit section as well, but has a very high gain and low distortion. The last transistor is biased to around half the supply voltage; this provides the maximum overload margin for loud signals or loud voices. The gain may be adjusted with the 10k preset. Sensitivity is very high, and a ticking clock can easily be heard from the distant loudspeaker.

The amplifier is based on the popular National Semiconductor LM380. A 50 mV input is all thats required to deliver 2W RMS into an 8 ohm loudspeaker. The choice of loudspeaker determines overall sound quality. A small loudspeaker may not produce a lot of bass, I used an old 8 inch radio loudspeaker. The 4.7u capacitor at pin 1 of the LM380 helps filter out any mains hum on the power supply. This can be increased to a 10u capacitor for better power supply rejection ratio.

The push to talk (PTT) circuit is very simple. A SPDT relay is used to switch between mic preamplifier output or loudspeaker input. The normally closed contact is set so that each intercom unit is "listening". The non latching push button switch must be held to talk. The 100u capacitor across the relay has two functions. It prevents the relays back emf from destroying the semiconductors, and also delays the release of the relay. This delay is deliberate, and prevents any last word from being "chopped" off.

Setting Up and Testing:

This circuit does not include a "call" button. This is simply because it is designed to be left on all the time, someone speaking from one unit will be heard in the other, and vice versa. Setup is simple, set to volume to a comfortable level, and adjust the mic preset while speaking with "normal volume" from one meter away. You do not need to be in close contact with the microphone, it will pick up a conversation from anywhere in a room. If the units are a long way away, there is a tendency for the cable to pick up hum, or radio interference. There are various defenses against this. One way is to use a twisted pair cable, each successive turn cancels the interference from the turn before. Another method is to use a small capacitor of say 100n between the common terminal of each relay and ground. This shunts high frequency signals to earth. Another method is to use a low value resistor of about 1k. This will shunt interference and hum, but will shunt the speech signal as well. However as the output impedance of each mic preamp is low, and the speech signals are also low, this will have little effect on speech but reduce interference to an acceptable level.

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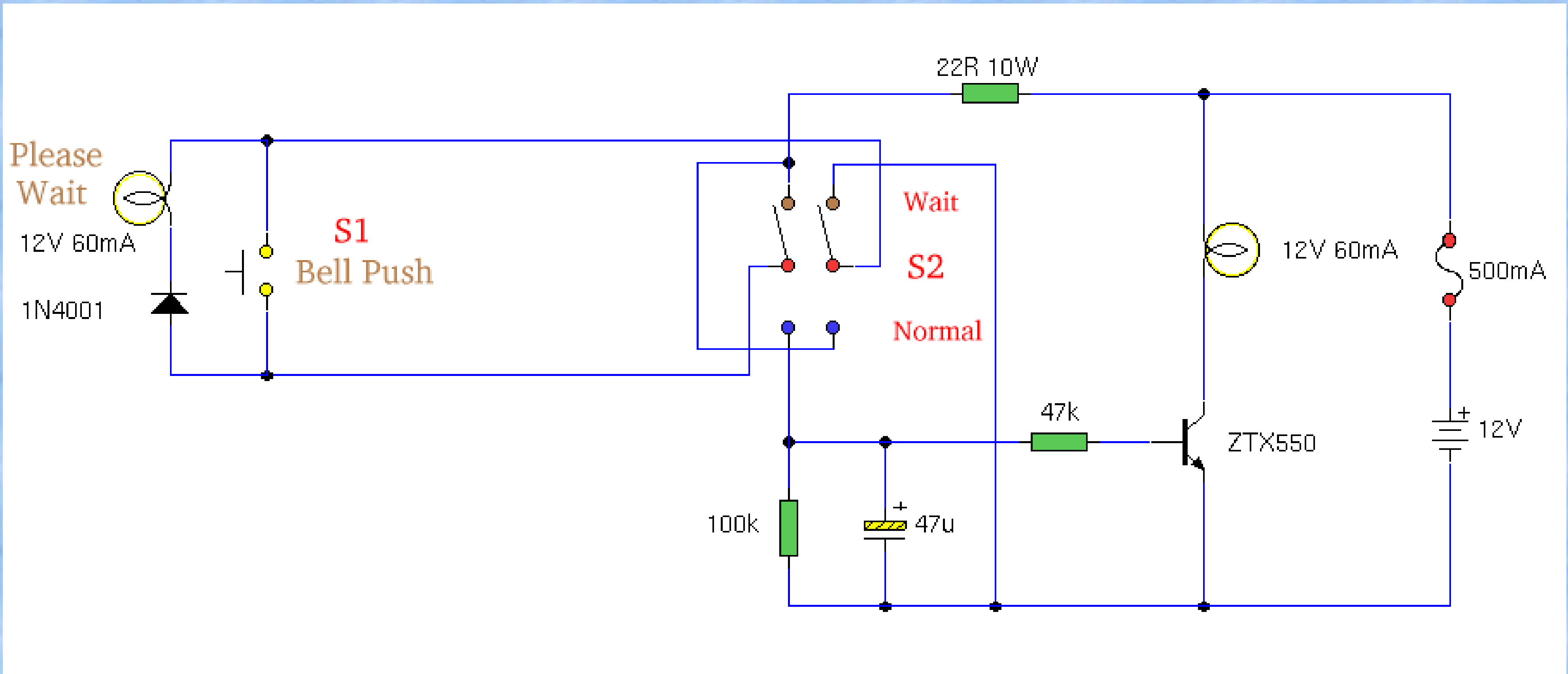
Doorbell for the Deaf

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description:

This circuit provides a delayed visual indication when a door bell switch is pressed. In addition, a DPDT switch can be moved from within the house which will light a lamp in the door bell switch. The lamp can illuminate the words "Please Wait" for anyone with walking difficulties.



Notes:

The circuit uses standard 2 wire doorbell cable or loudspeaker wire. In parallel with the doorbell switch, S1, is a 1N4001 diode and a 12 volt 60mA bulb. The bulb is optional, it may be useful for anyone who is slow to answer the door, all you need to do is flick a switch inside the house, and the bulb will illuminate a label saying Please Wait inside the doorbell switch or close to it. The double pole double throw switch sends the doorbell supply to the lamp, the 22 ohm resistor is there to reduce current flow, should the doorbell switch, S1 be pressed while the lamp is on. The resistor needs to be rated 10 watts, the 0.5 Amp fuse protects against short circuits.

When S2 is in the up position (shown as brown contacts), this will illuminate the remote doorbell lamp. When down, (blue contacts) this is the normal position and will illuminate the lamp inside the house. Switch S1 will then charge the 47u capacitor and operate the transistor which lights the lamp. As a door bell switch is only pressed momentarily, then the charge on the capacitor decays slowly, resulting in the lamp being left on for several seconds. If a longer period is needed then the capacitor may be increased in value.

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Control & Interfacing

1. Infra Red Remote Control Extender

2. Parallel PC Interface NB:- This is an external Link to the Schumari Technology site.

3. Multi Launcher for model rockets

4. Infra Red Remote Control Extender Mark 2 Version

5. Infra Red SWitch

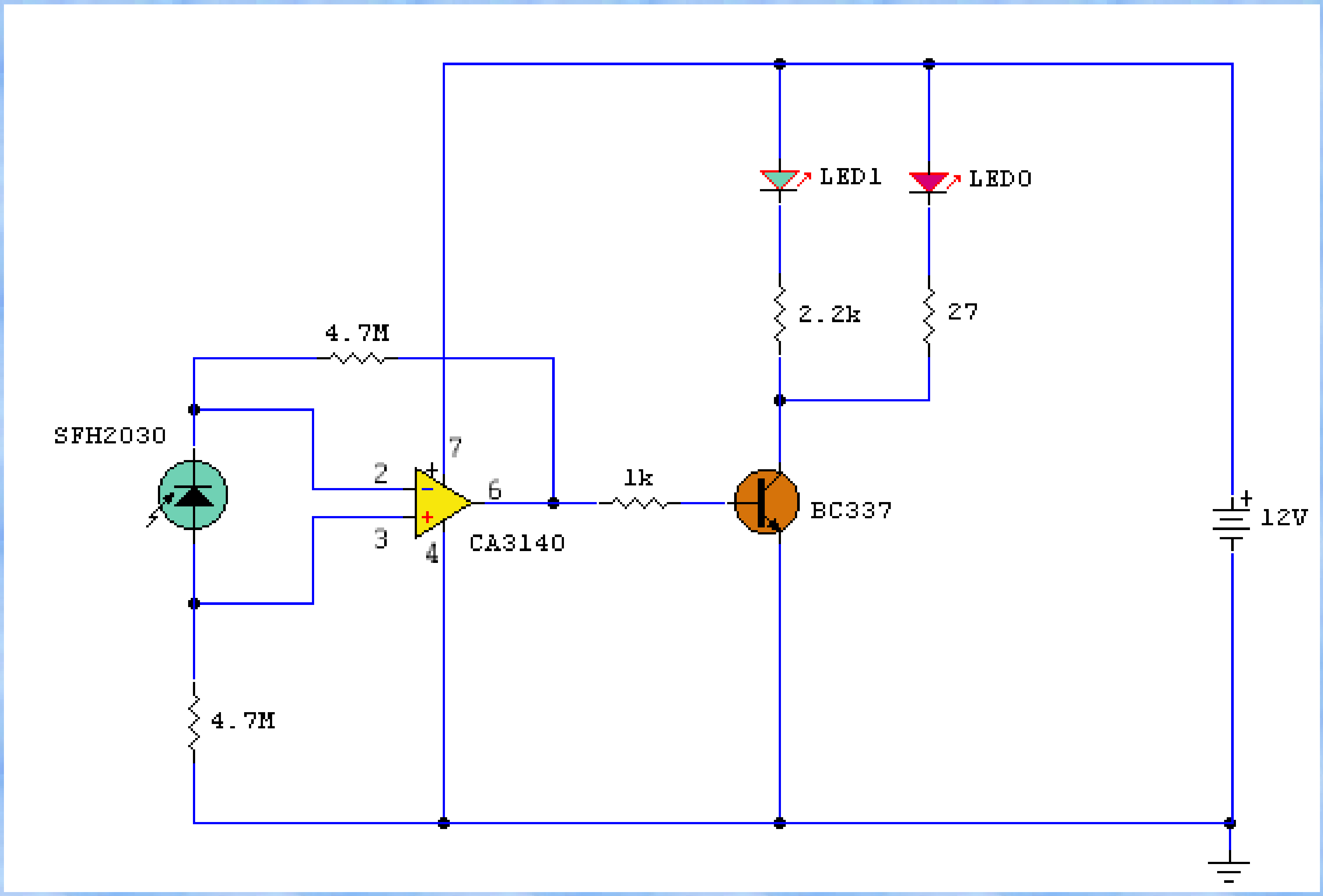
Return to Schematics

Infra Red Remote Control Extender

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description
This circuit is used to relay signals from an Infra Red remote control in one room to an IR controlled appliance in another room.

Forward
I have seen these devices advertised in magazines, they sell for around £40-£50 and use radio to transmit between receiver and transmitter. This version costs under £5 to make and uses a cable connection between receiver and transmitter. For example, if you have a bedroom TV set that is wired to the video or satellite in another room, then you can change channels on the remote satellite receiver using this circuit. The idea is that you take your remote control with you, aim at the IR remote control extender which is in the same room, and this will relay the IR signal and control the remote appliance for you. The circuit is displayed below:



Parts List:
1 SFH2030 Photodiode
1 TIL38 IR emitting diode
1 5mm Red LED
2 4.7M 1/4W resistors
1 1k 1/4W resistor
1 2.2k 1/4W resistor
1 27ohm 1/2W resistor
1 BC337 transistor
1 CA3140 MOSFET opamp
The LPC661 opamp Radio Shack # 900-6332 can be used as a substitute for the CA3140

Circuit Benefits
This circuit has an advantage over other similar designs in that there is

nothing to adjust or set-up. Also bellwire or speaker cable can be used to remotely site the IR emitting diode, since this design uses low output impedance and will not pick up noise. Some systems require coaxial cable which is expensive and bulky. The wireless variety of remote control extenders need two power supplies, here one is used and being radio are inevitably EM noise pollution. A visual indication of the unit receiving an Infra Red signal is provided by LED1. This is an ordinary coloured LED, I used orange but any colour will do. You will see LED1 flash at a rate of 4 - 40Hz when a remote control button is pressed. LED0 is an Infra Red Emitter Diode, this is remotely wired in the room with the appliance to be controlled. I used the type SFH487 which has a peak wavelength of 880nm. This is available in the UK from Maplin Electronics, order code CY88V. Most IR remote controls operate at slightly different wavelengths, between the range of 850 - 950nm. If you cannot obtain the SFH487 then any IR emitter diode that has an output in the above range should work.

About IR Remote Controls

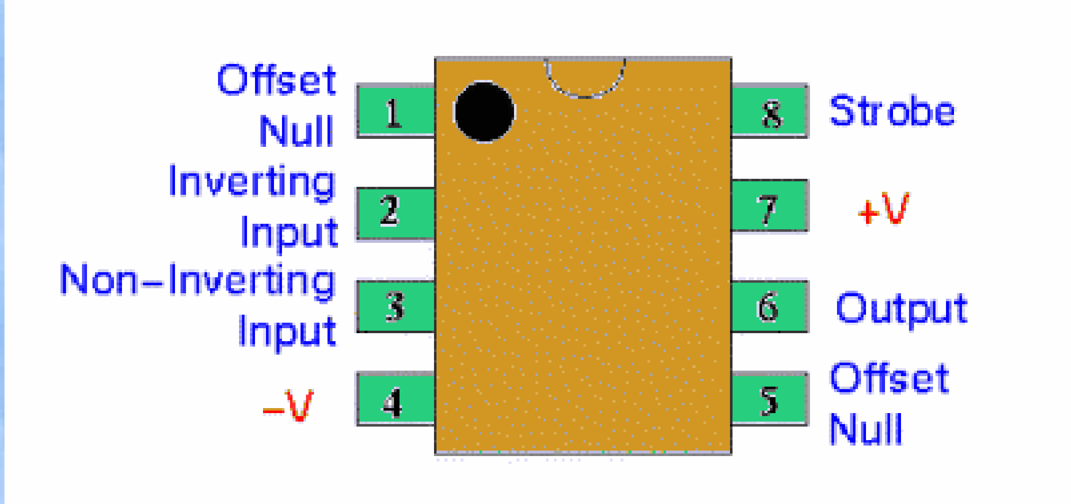
As previously stated IR remote controls use wavelengths between 850 - 950nm. At this short wavelength, the light is invisible to the human eye, but a domestic camcorder can actually view this portion of the electromagnetic spectrum. Viewed with a camcorder, an IR LED appears to change brightness. All remote controls use an encoded series of pulses, of which there are thousands of combinations. The light output intensity varies with each remote control, remotes working at 4.5V dc generally will provide a stronger light output than a 3V dc control. Also, as the photodiode in this project has a peak light response at 850nm, it will receive a stronger signal from controls operating closer to this wavelength. The photodiode will actually respond to IR wavelengths from 400nm to 1100nm, so all remote controls should be compatible.

Circuit Description

The receiver is built around a silicon photodiode, the SFH2030 available from Maplin, order code CY90X. This photodiode is very sensitive and will respond to a wide spectral range of IR frequencies. There is a small amount of infra red in direct sunlight, so make sure that the diode does not pick up direct sunlight. If this happens, LED1 will be constantly lit. There is a version of the SFH2030 that has a daylight filter built in, the SFH2030F order code CY91Y. A TIL100 will also give good results here. A photodiode produces minute pulses of current when exposed to infra red radiation. This current (around 1uA with the SFH2030 and a typical IR control used at a distance of 1 meter) is amplified by the CA3140 opamp. This is configured as a differential amplifier and will produce an output of about 1 volt per uA of input current. The photodiode, can be placed up to a meter or so away from the circuit. Screened cable is not necessary, as common mode signals (noise) will be rejected. It is essential to use a MOSFET input type here as there is zero output offset and negligible input offset current. A 741 or LF351 can not be used in this circuit. The output from the opamp is amplified by the BC337 operating in common emitter mode. As a MOSFET opamp IC is used, its quiescent voltage output is zero and this transistor and both LED's will not be lit. The 1k resistor makes sure that the BC337 will fully saturate and at the same time limits base current to a safe level. Operating an IR remote control and pointing at the photodiode (SFH2030) will cause both LED's to illuminate, you will only see the visable coloured LED (LED1) which will flicker. Remote controls use a system of pulse code modulation, so it is essential that the signal is not distorted by any significant amount. Direct coupling, and a high speed switching transistor avoid this problem.

Construction

No special PCB is required, I built my prototype on a small piece of Veroboard. The pinout for the CA3140 is shown below. Note that only the pins labeled in the schematic are used, pins 1, 5 and 8 are not used and left unconnected.



Alignment

There is nothing to set-up or adjust in this circuit. The only thing to watch is that the emitting diode is pointing at the controlled device (video, CD player, etc). I found that the beam was quite directional. Also make sure that there is a direct line of sight involved. It will not work if a 5 foot spider plant gets in the way, for example. I had a usable range at 5 meters, but possibly more distance may be possible. As a check, place a dc volt meter across the 27 ohm resistor. It should read 0 volts, but around 2 or 3 volts when a remote control is aimed at the photodiode.

Specifications of Prototype

Having made my prototype, I ran a few tests :-

Current consumption	2mA standby	60mA operating	(with 12V supply)
	2mA standby	85mA operating	(with 15V supply)
IR receiver range	< 1 meter		
IR transmitter range	> 5 meters		

It is difficult to measure the IR transmitter range as this is dependent upon a number of factors. The type of infra red control used and its proximity to the receiving photodiode, the voltage supply, the wavelength and efficiency of the IR emitter and the sensitivity of the controlled appliance all affect overall performance.

In Use

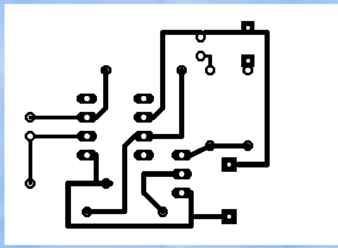
The reception range of the IR remote control to the photodiode depends on the strength of the remote control, but I had a working range of a meter or so, this needs bearing in mind when placing the circuit. Its also a good idea to wire LED1, the coloured LED near to the photodiode, that way, you know that the unit has received a signal. The IR emitter has a larger range, I had no problems at 5 meters but may possibly work further distances. The emitting diodes are quite directional, so make sure it is aimed directly at the appliance to be controlled. The IR emitting diode is small and can be placed out of sight. I drilled a small hole above the door frame. The emitter diode leads were insulated and pushed through this hole, leaving an inch or so to adjust the angle and position of the LED. From a distance, the clear plastic lens of the diode could not be seen.

Final Comments and Fault Finding

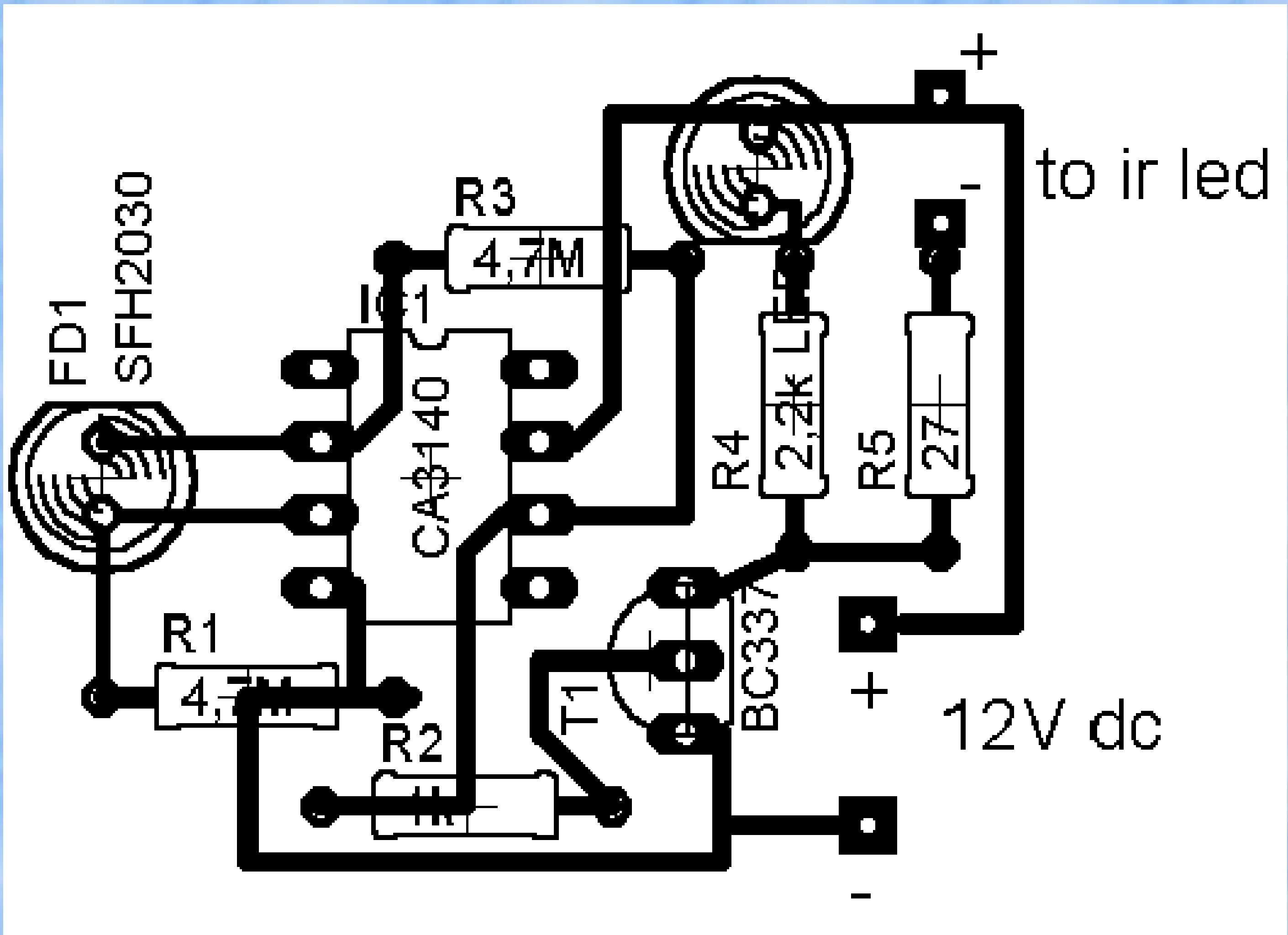
To date this has proved to be one of the most popular circuits on my site. Of all the email I receive about this circuit, most problems relate to the Infra Red photo diode. You must make sure that this is pointed away from sunlight, or use a type with daylight filter, otherwise LED1 will be constantly lit, and LED0 will be in operation also. This will draw excessive current and in some case overheat the BC337. The main problem is when using a different photo diode to the SFH2030. Any other photo diode LED should work, but you need to know its operating wavelength range beforehand. This will generally be described in the manufacturers data sheet or possibly described if you order from an electronic component catalogue. With these last two points in mind, you should be rewarded with a useful and working circuit.

PCB Template

This has been very kindly drafted by Domenico from Italy. First the copper side:



A magnified view from the component side is shown below:



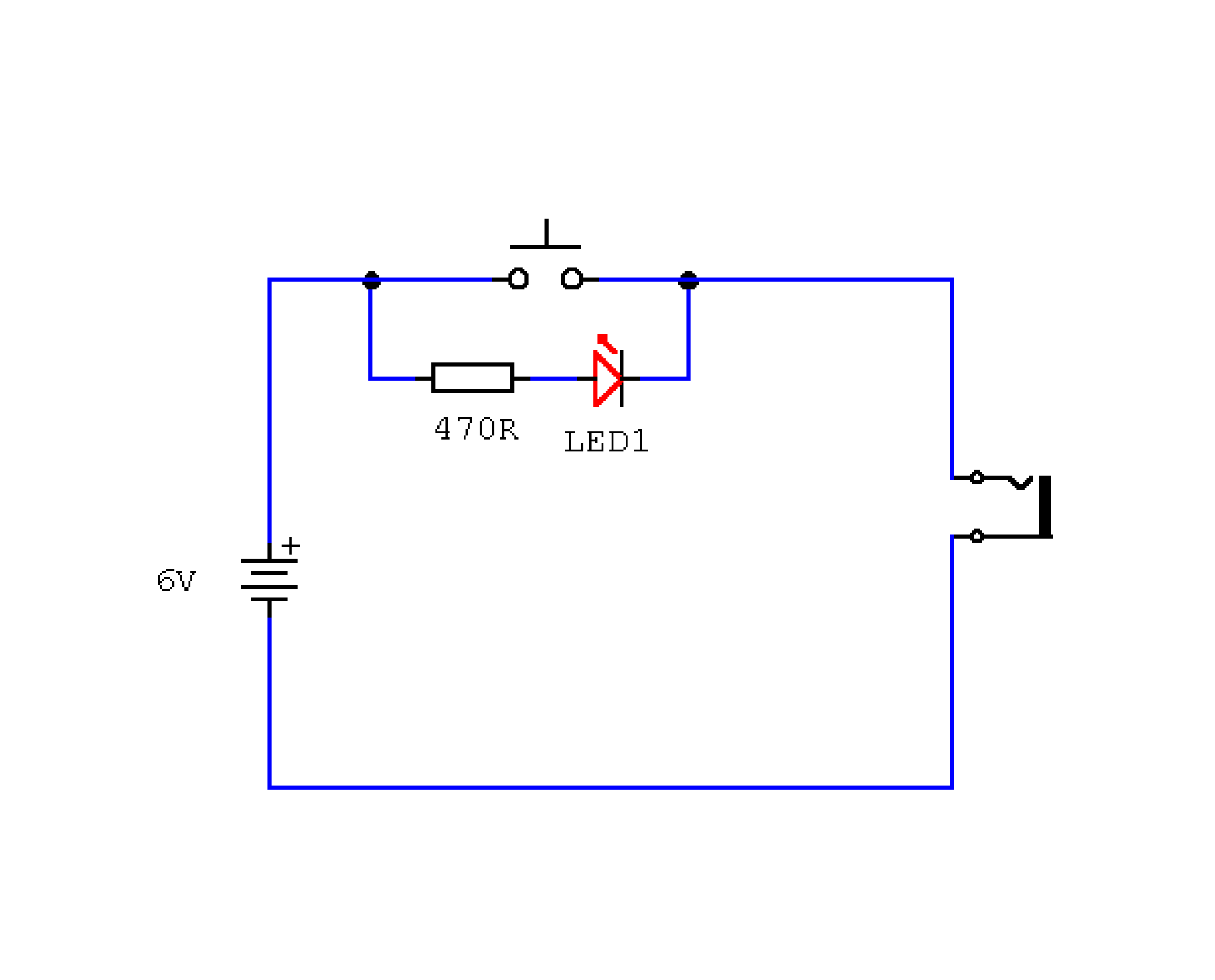
Last revision 11 Feb 2002

Return to Control and Interfacing

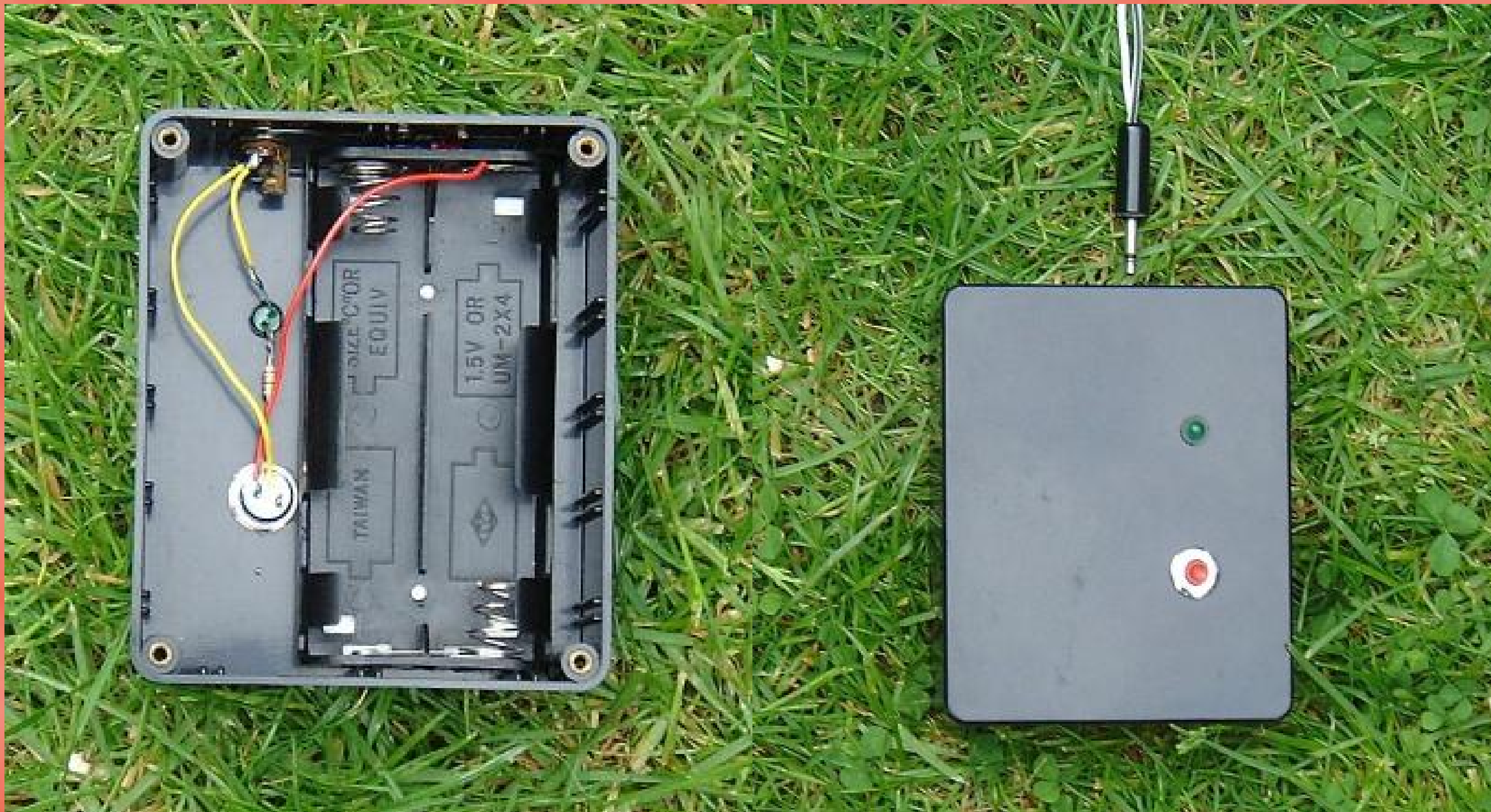
Multi Rocket Launcher

Description

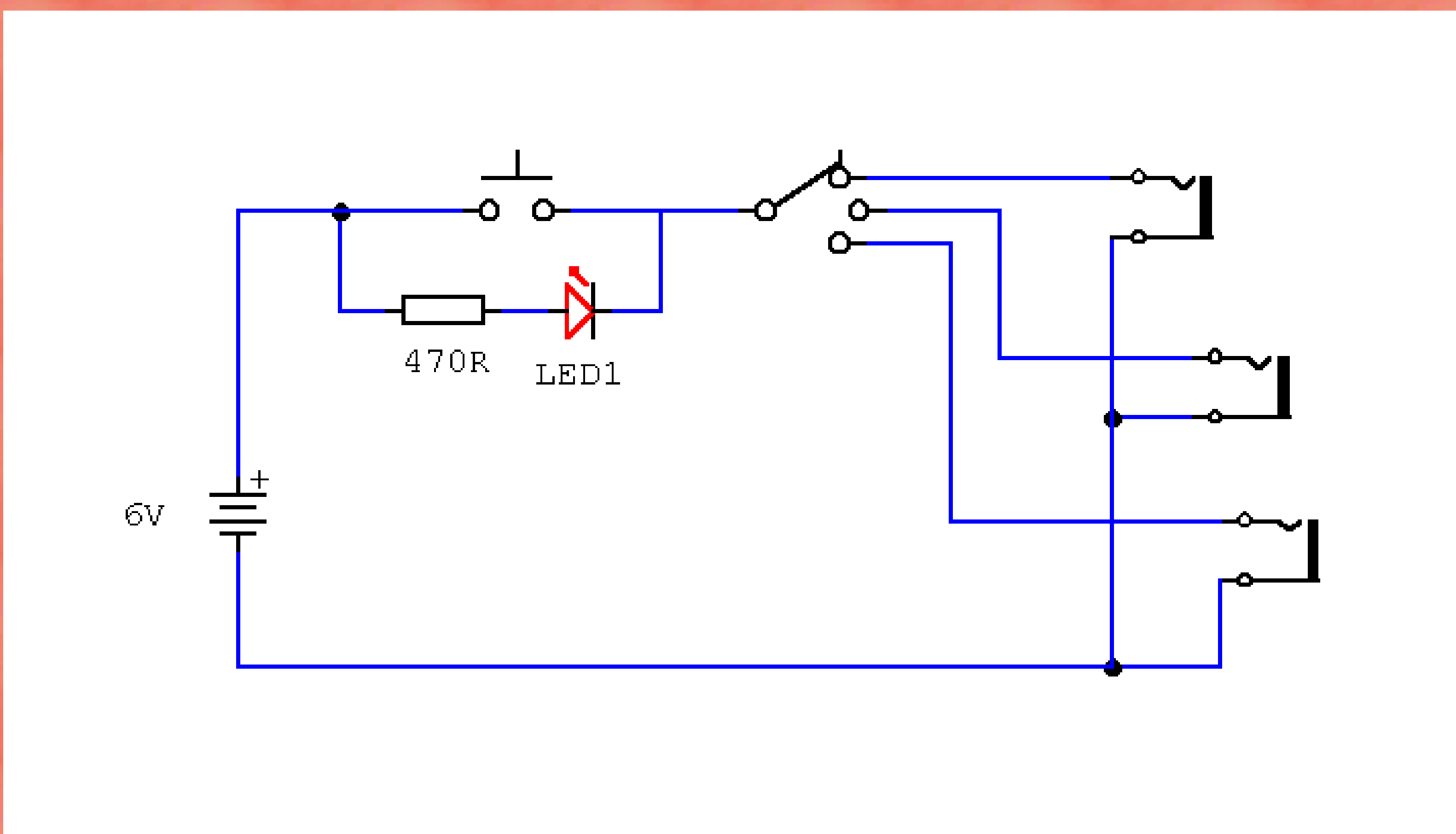
This launch controller can be used with low voltage battery igniters, which fire rocket engines in model rockets such as the Estes range. These circuits are electrical, only switches and contacts are involved. First the circuit for a single rocket:



The only thing to note here is that this controller uses "C" cells, providing more current than "AA" batteries and that the push button switch has contacts rated 1 amp or higher. The wire to the igniter is isolated via a 3.5 inch jack plug and socket. Connect the igniter, then plug in to control box and then press button, making sure you are the recommended distance away. Below is an internal and external picture of my controller:-



Ok, does anyone think my grass needs cutting? Moving on to the multi launch controller:-



Once again, nothing too complicated. The single pole rotary switch has contacts rated 1 amp so can easily handle the 400 mA of current that the igniter takes. Here three rockets can be launched by rotating the switch. The Green LED provides continuity between battery,igniter and wiring. This extinguishes as the launch switch is pressed. Once again, observe safety precautions.

Mission Critical:

Heres a story about my own Estes space shuttle, on its one and only mission. This is what happens when you're too eager to get a rocket flying and don't pay attention to balance. It was a late November afternoon in 1998 when I first launched the shuttle. Lift off was perfect, no wind, clear skies (doesn't sound at all like England), and the rocket motor was a C6-5. At launch, the rocket motor fired, though lift off acceleration was not as good as I expected, I blame too much paint and excess weight). As my rocket reached apogee, (estimated height about 100 meters) and acceleration became zero there was no immediate separation between the shuttle and main fuel tank. There was of course a delay of 5 seconds between the rocket engine blowing its ejection charge. Five seconds is a long time too wait, especially when the forces excerted of gravity take hold. At 9.8 meters/second, the rocket plunged towards earth losing at least half its height. Then, thankfully the ejection charge blew, separation was achieved the the main fuel tank with SRB's drifted slowly down to earth on its parachute. However all was not well with the shuttle. It was only after separation that I realized there was too much nose weight (hence a heavy lift up and not enough height). The shuttle did glide, but only at about 45 degrees downward, picking up speed until eventually it crash landed in some soft mud. Luckily it survived the impact, I cleaned it up but have not yet removed the nose cone to balance the shuttle. I like it as an ornament anyway.

My Rockets:

Click for a close up picture of my rockets, file size in brackets.

Estes Space Shuttle (71k)

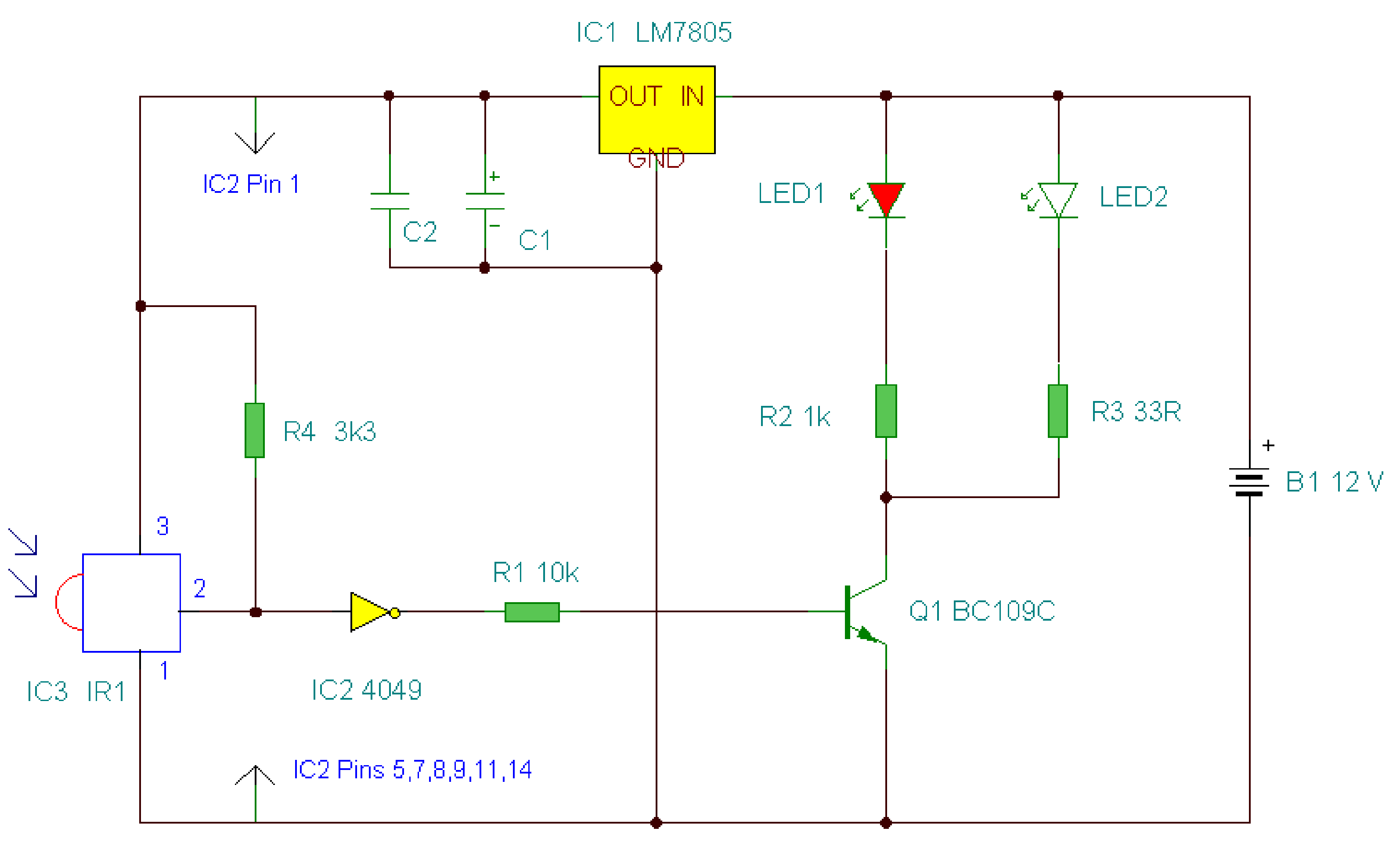
AMRAAM (78k)

Return to Control & Interfacing Circuits

IR Remote Control Extender Circuit (Mark 2)

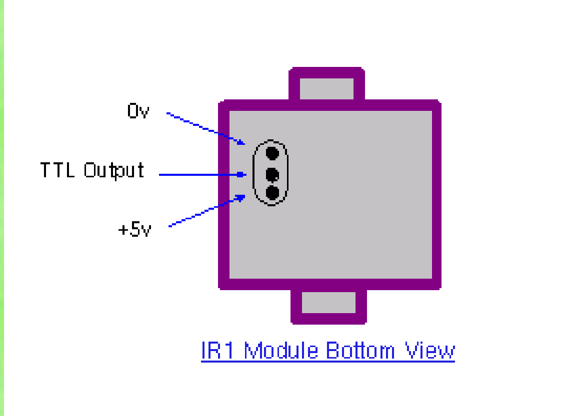
Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description:
This is an improved IR remote control extender circuit. It has high noise immunity, is resistant to direct sunlight and reflected light and has an increased range from remote control to the extender circuit of about 7 meters.



Notes:
The main difference between this version and the previous circuit, is that this design uses a commercially available Infra Red module. This module, part number IR1 is available from Harrison Electronics in the UK. The IR module contains a built in photo diode, amplifier circuit and buffer and has built in noise immunity. It operates on 5 Volt DC and has an output that can directly interface to TTL circuitry. It arrives in a small aluminium case, the connections viewed from underneath are shown below:

Infra Red Module, IR1 Pinout



How It works:

The IR1 module (IC3) operates on 5 Volt dc. This is provided by the 7805 voltage regulator, IC1. Under quiescent (no IR signal) conditions the voltage on the output pin is high, around 5 volts dc. This needs to be inverted and buffered to drive the IR photo emitter LED, LED2. The buffering is provided by one gate (pins 2 & 3) of a hex invertor the CMOS 4049, IC2. As the IR1 module can directly interface to TTL logic, a pull-up resistor, R4 is required to interface to CMOS IC's. This resistor ensures that the signal from a remote control will alternate between 0 and 5 volts. As TTL logic levels are slightly different from CMOS, the 3.3k resistor R4 is wired to the +5 volt supply line ensuring that the logic high signal will be 5 volts and not the TTL levels 3.3 volts. The resistor does not affect performance of the IR module, but DOES ensure that the module will correctly drive the CMOS buffer without instability.
The output from the 4049 pin 2 directly drives transistor Q1, the 10k resistor R1 limiting base current. LED1 is a RED LED, it will flicker to indicate when a signal from a remote control is received by the IR module. LED2 is a photo emitter LED. This will be driven at about 120 A when an IR remote signal is received. Incidentally all remote controls use pulse code modulation around 38 to 44KHz. Because this signal is modulated and therefore the LED's are turned on and off very quickly, the average DC current drain from the 12 volt power supply will only be around 40 mA DC.

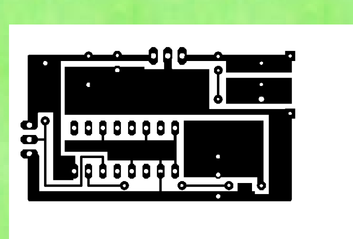
Parts List:

C1 100u 10V
C2 100n polyester
R1 10k
R2 1k
R3 33R 1W
R4 3k3
Q1 BC109C
IC1 LM7805
IC2 CMOS 4049B
IC3 IR1 module from Harrison Electronics
LED1 Red LED (or any visible colour)
LED2 TIL38 or part YH70M from Maplin Electronics
Pinouts for the IC's can be found on my IC pinout page, click here.

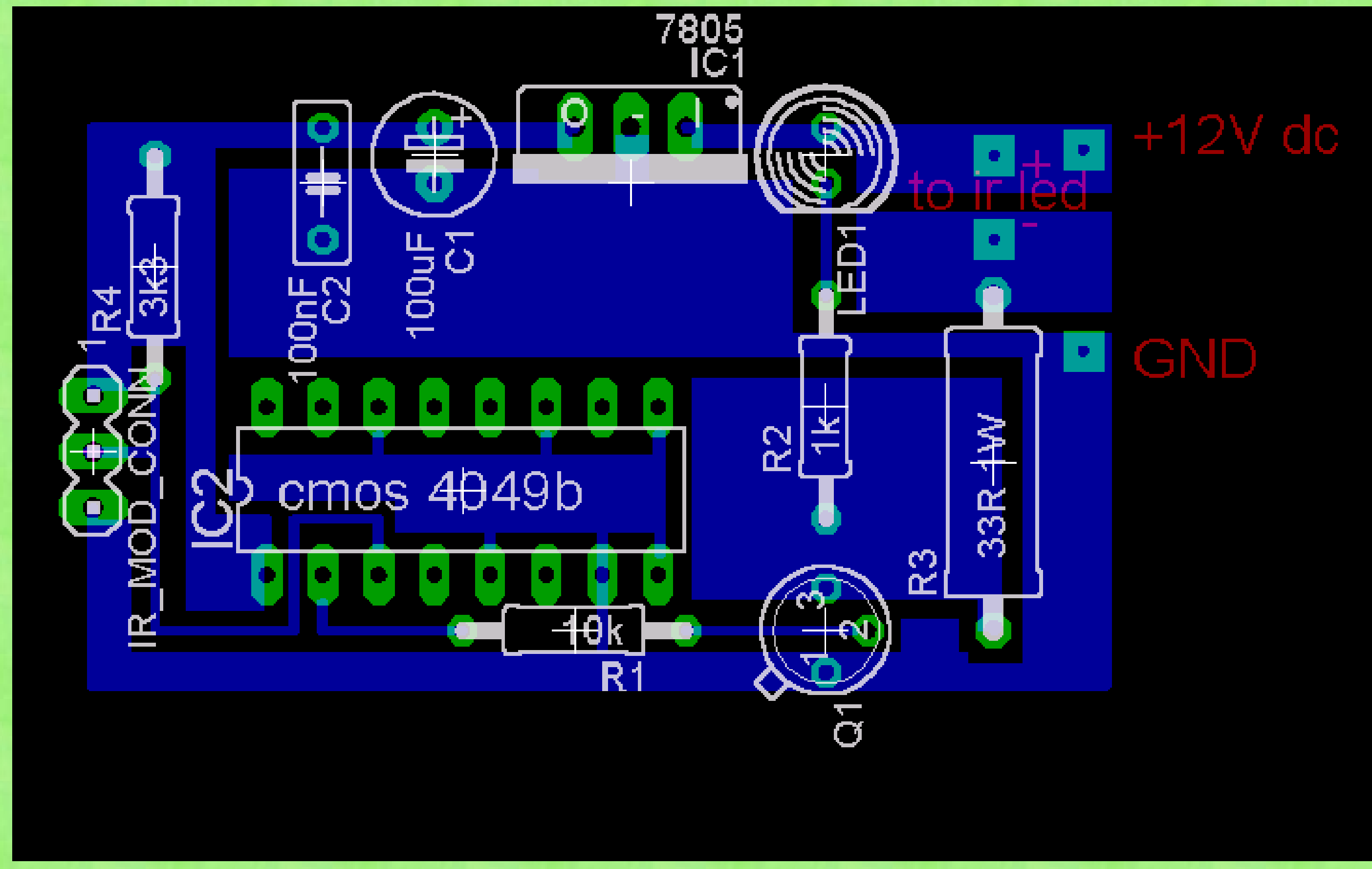
Testing:

This circuit should not present too many problems. If it does not work, arm yourself with a multimeter and perform these checks. Check the power supply for 12 Volt dc. Check the regulator output for 5 volt dc. Check the input of the IR module and also Pin 1 of the 4049 IC for 5 volts dc. With no remote control the output at pin 2 should be zero volts. Using a remote control pin 2 will read 5 volts and the Red LED will flicker. Measuring current in series with the 12 volt supply should read about 11mA quiescent, and about 40/50mA with an IR signal. If you still have problems measure the voltage between base and emitter of Q1. With no signal this should be zero volts, and rise to 0.6-0.7 volts dc with an IR signal. Any other problems, please email me, but please do the above tests first.

PCB Template:
Once again a PCB template has been kindly drafted for this project by Domenico.



A magnified view showing the component side is shown below:

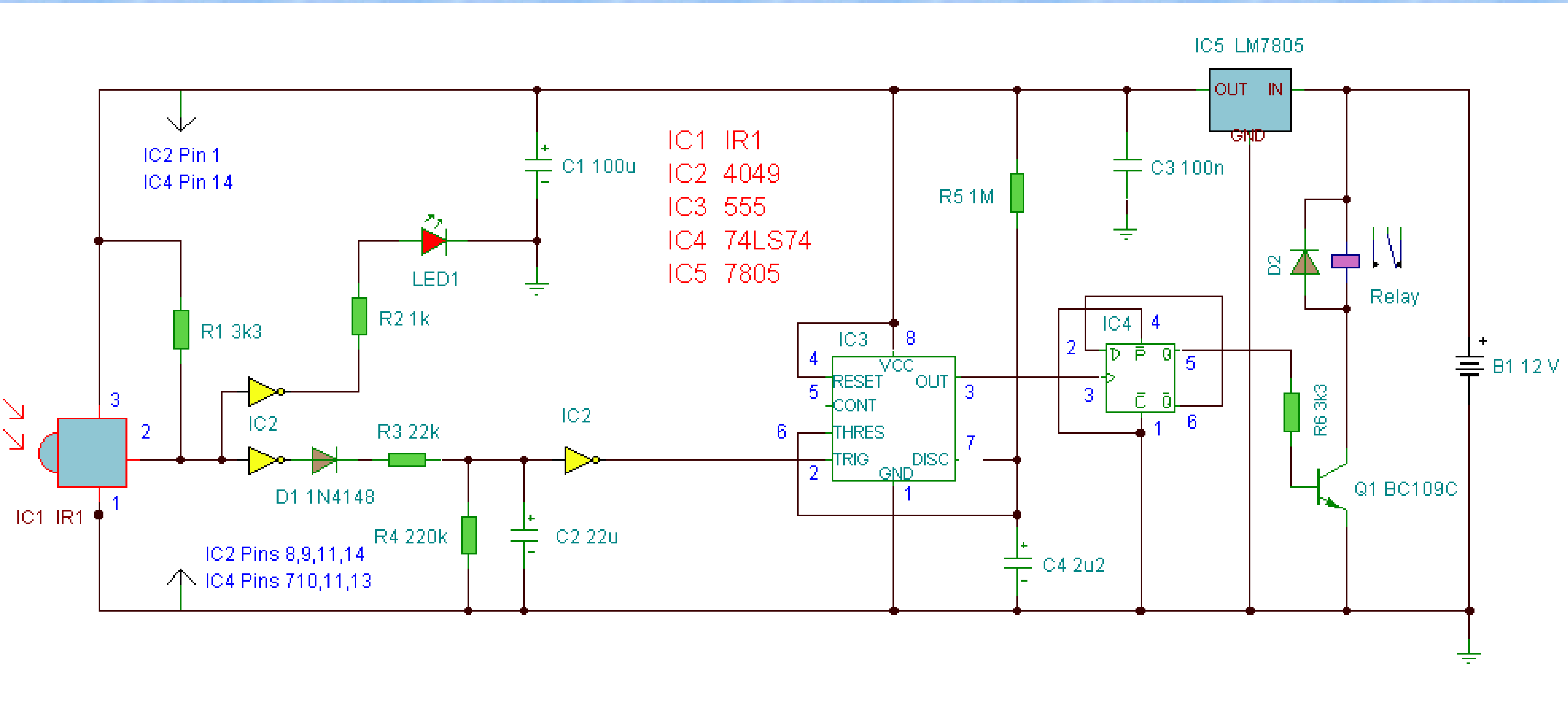


Return to Control & Interface Circuits

Infra Red Switch

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description:
This is a single channel (on / off) universal switch that may be used with any Infra Red remote control that uses wavelengths between 850-950nm.

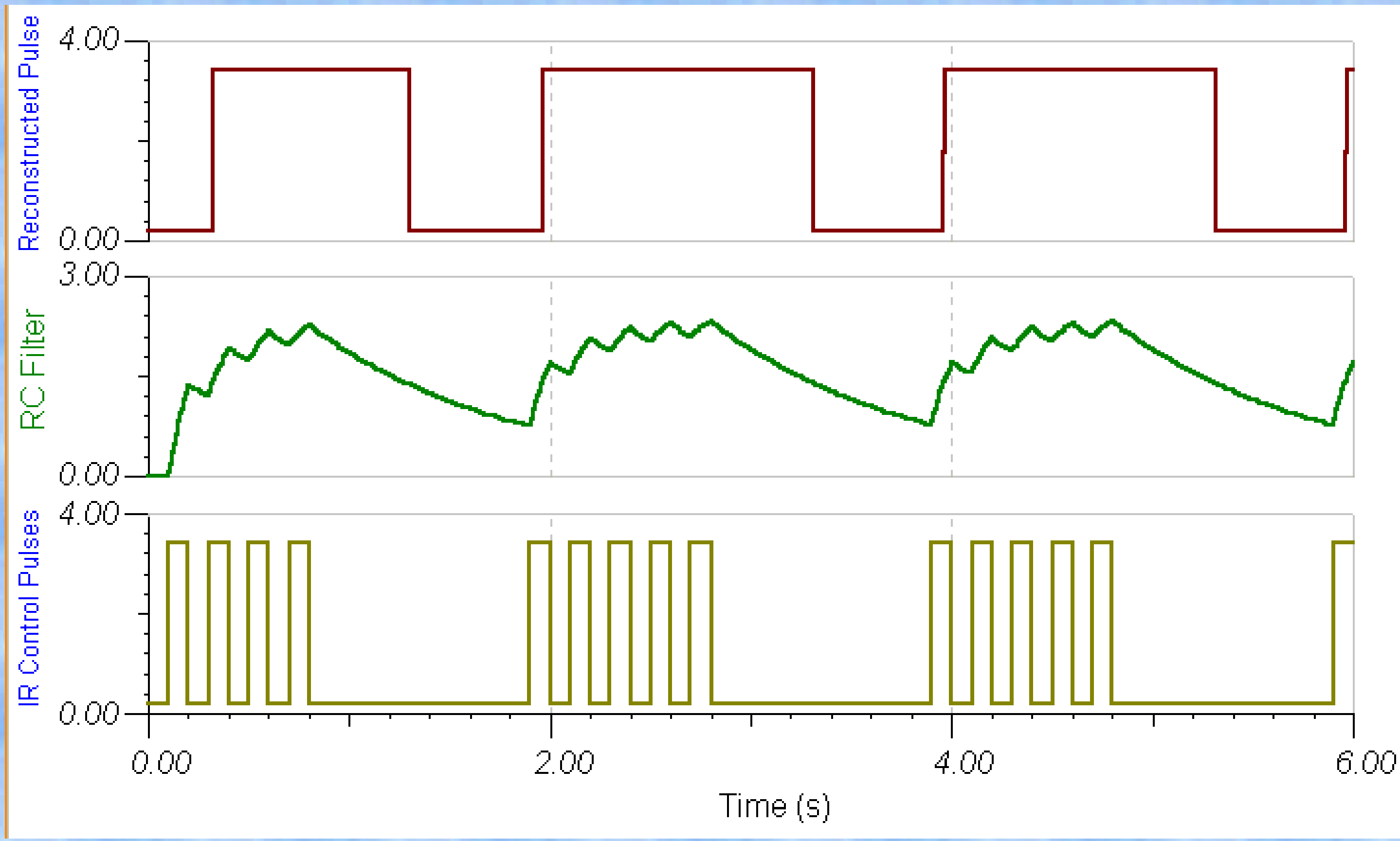


Notes:
Any "button" of any remote control may be used to work this universal switch. The button must be pressed for two seconds (determined by R3 and C2) before the relay will operate. Once operated the circuit will remain in this state (latched) until reset. To reset, any button is pressed and held for the delay.
For example, if you were watching TV, and your set was tuned to Channel 3, you could press and hold the TV remote

controls channel 3 button for two seconds. That way the TV viewing would not be affected and the relay would activate. You can connect anything to the relay, for example a lamp, but make sure that the relay contacts can handle the rated voltage and current.

Circuit Operation:

IC1 is an Infra Red module. IR modulated pulses are received and buffered by this IC. It has a standard TTL output, the output with no signal is logic 1. One gate of a CMOS inverter and drives Red LED1 as a visible switching aid. Another gate buffers the signal and applies it to the time constant circuit, comprising R3,C2,R4 and D1. C2 charges via R3, and discharges via R4, D1 prevents quick discharge via the low output impedance of the CMOS buffer.



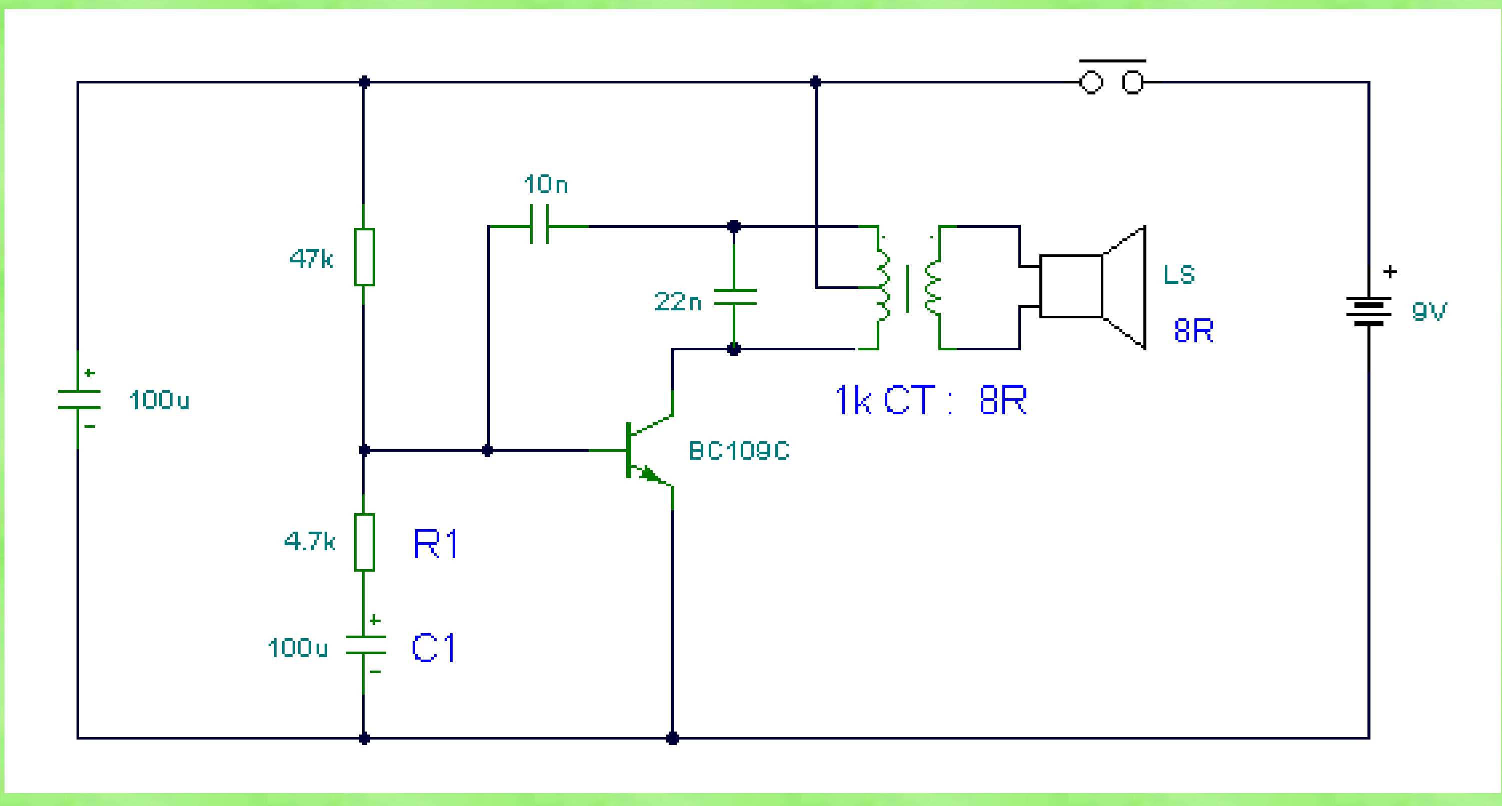
The pulses are further buffered and contain "jaggered edges" as shown above. These edges are produced by the modulated IR data, which has to be removed. This is achieved using IC3, a 555 timer wired as a monostable, pulse duration R5, C4. These cleanly reconstructs a single clean pulse to activate the bistable latch. A D type flip flop, IC4 is configured as a bistable. The input is applied to the clock pin, the inverted output fed back to the data input and clear and preset lines are tied to ground. For every pulse the relay will operate and latch, the next pulse will turn off the relay and so on. Note that quick turn on and off of the relay is not possible. The output pulse is set at about 1.5 seconds and input delay by R3, C2 set at two seconds.

Parts List:
R1 3k3
R2 1k
R3 22k
R4 220k
R5 1M
R6 3k3
B1 12 V
D1 1N4148
D2 1N4003
Q1 B109
LED1 CQX35A
IC1 IR1 available from Harrison Electronics
IC2 4049
IC3 CA555
IC4 SN74HCT74
IC5 LM7805
Relay 12 Volt coil with changeover contact
C1 100u
C2 22u
C3 100n
C4 2u2

Return to Interfacing Circuits

Electronic Canary

Feeling chirpy? Attract new friends with this modified hartley oscillator. You could also use it as a replacement doorbell.



Notes:

This circuit is a modified hartley oscillator with a couple of extra components included. The transformer is a small audio transformer, type LT700. The primary is center tapped with an impedance of 1Kohms at 1KHz . The secondary has an impedance of 8 ohms. The inclusion of R1 and C1 give this oscillator its characteristic "chirp". As the 100u capacitor charges via the 4.7K resistor, R1 the bias for the transistor is cut off. This causes the oscillation to stop, the capacitor discharges through the base emitter circuit of the transistor and oscillations start again. Altering these components alters the frequency of the chirp. The chirp is also voltage dependent. When the push button switch is operated the 100u capacitor is charged. When its released, the oscillation decays and the chirp becomes faster.

Sound Sample

Click here to listen. The download size is 164kb.

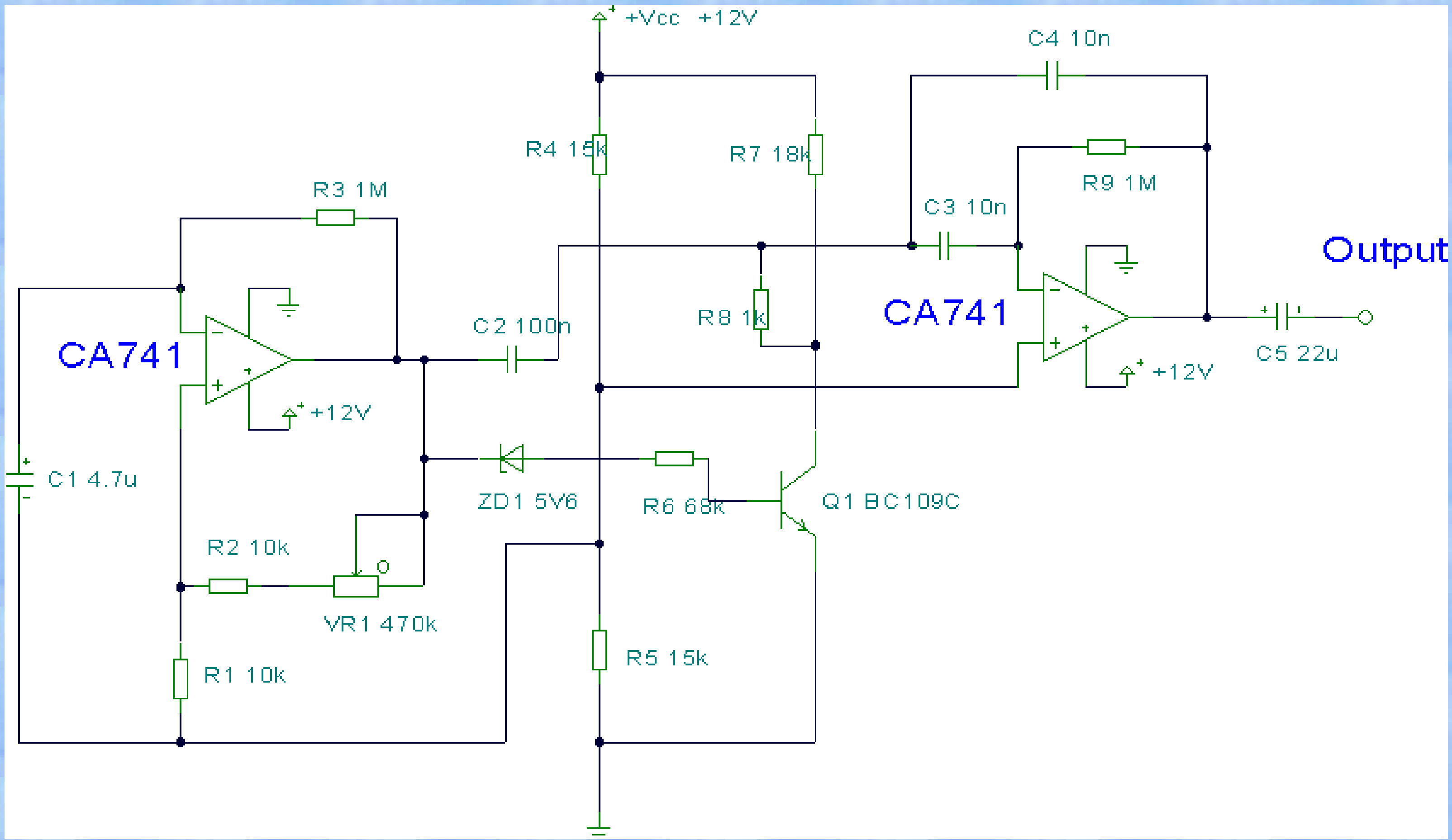
Return to Music & Special Effects

Music Circuits

1. Electronic Canary
2. Metronome Circuit
3. Sound Effects Generator
4. Sound Effects Generator 2
5. Electronic Siren

Return to Schematics

Metronome Circuit



Notes:

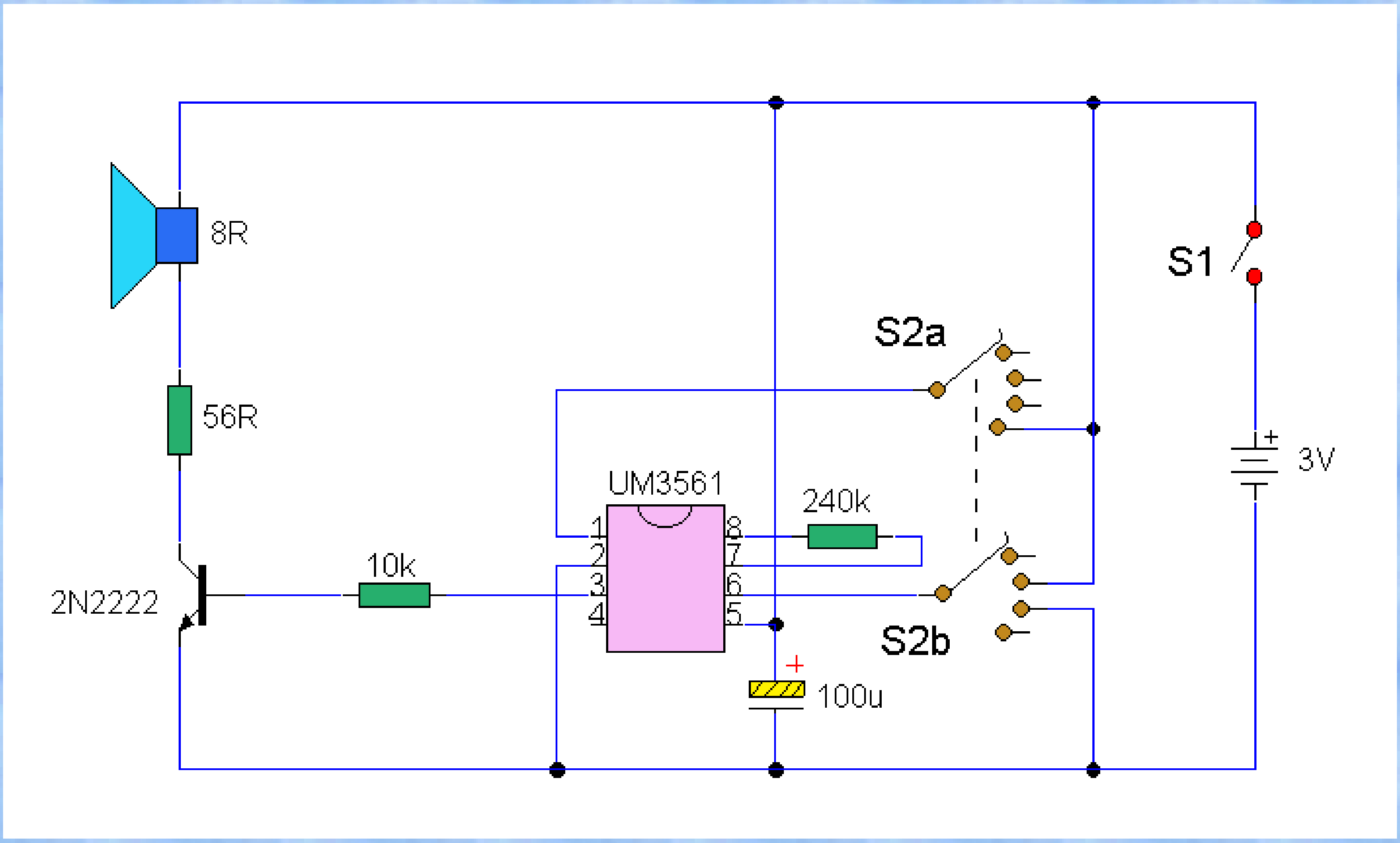
This circuit uses a couple of Op-amps to produce an interesting sound effect. The left hand CA741 is wired as a standard astable and produces the timing pulses, controlled by C1, R2 and VR1. The output is fed via C2 to the second op-amp and is also direct coupled via the zener ZD1 to Q1. The right hand CA741 is configured as an integrator, its purpose being to distort the output pulse from the first op-amp. This produces a ringing effect on the output pulse and gives the circuit a characteristic "tick" sound. The output pulse at the first op-amp will cause the zener and Q1 to conduct on every positive transition. The 1k resistor R8 then acts as a low impedance shunt at the input of the integrator and produces a characteristic "tock" effect. R8,R7,R9,C3 and C4 may all be adjusted to tailor the sound effect.

Return to Music and Special Effects

Sound Effects Generator

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description:
This circuit uses a UM3561 IC to produce four different sound effects.



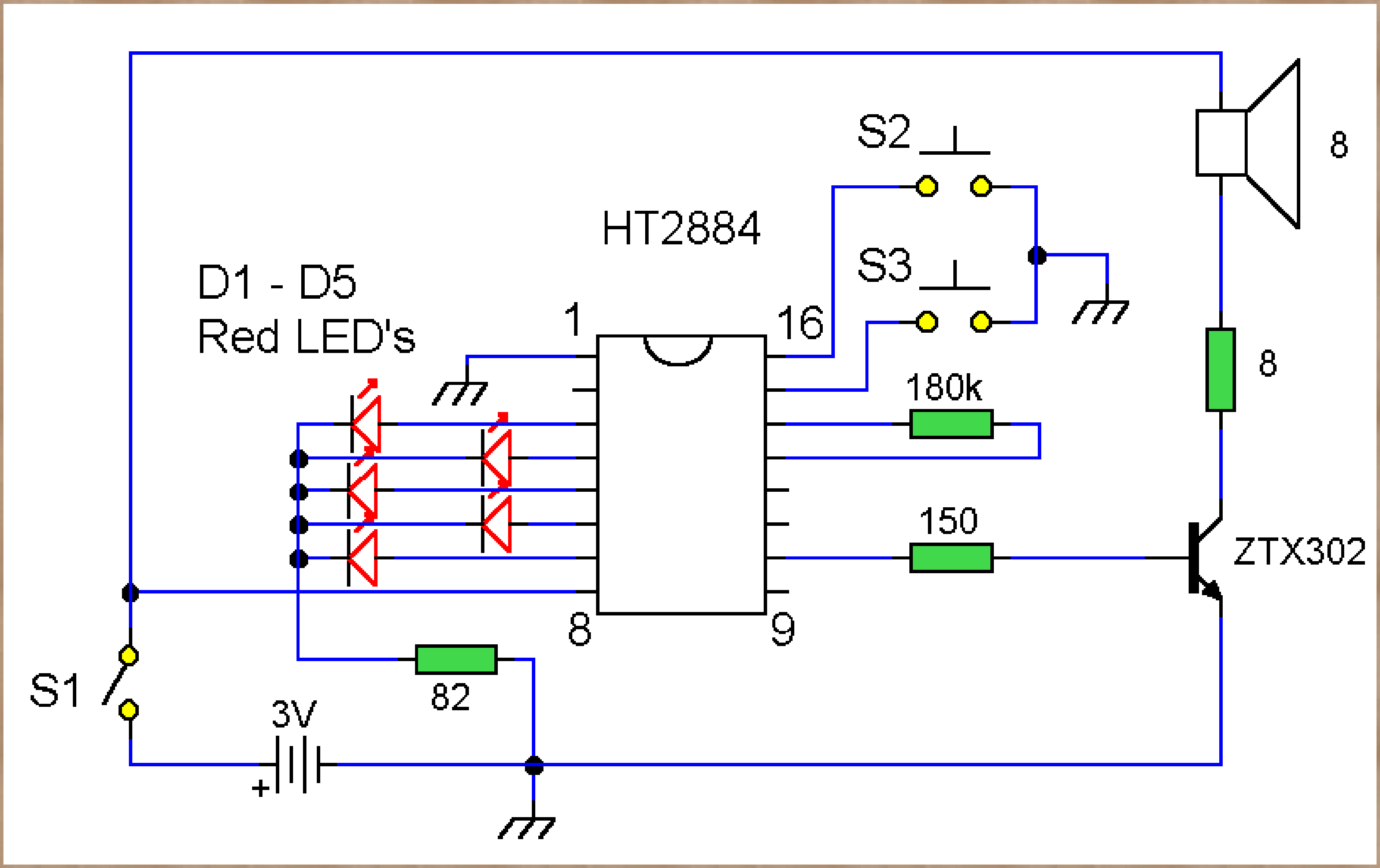
Notes:
Nothing too complicated here. The IC produces all the sound effects, the output at Pin 3 being amplified by the transistor. A 64 ohm loudspeaker can be substituted in place of the 56 ohm resistor and 8 ohm loudspeaker. The 2 pole 4 way switch controls the sound effects. Position 1 (as drawn) being a Police siren, position 2 is a fire engine sound, 3 is an ambulance and position 4 is a machine gun effect. The IC is manufactured by UMC and was available from Maplin electronics code UJ45Y. At the time of writing this has now been discontinued, but they have have limited stocks available.

Return to Music & Special Effects

Sound Effects Generator 2

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description:
This circuit uses the Holtek HT2884 IC to produce 8 different sound effects.



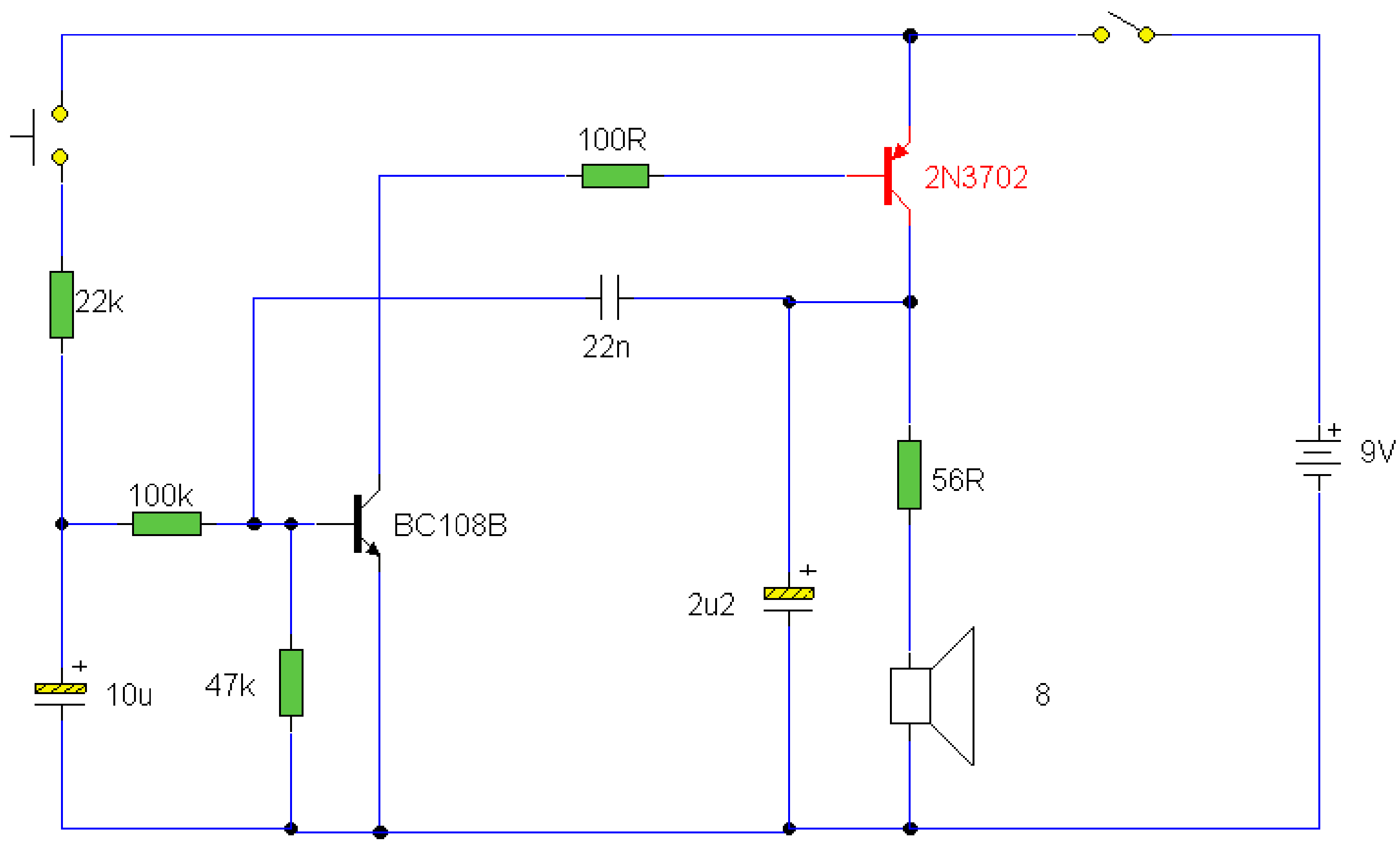
Notes:
All sound effects are generated internally by the HT2884 IC. Power is a 3 Volt battery, but the IC will work with any voltage between 2.5 and 5 Volts. Switch S1 is the on / off switch. The output at pin 10 is amplified and drives a small 8 ohm loudspeaker. Pressing S3 once will generate all the sounds, one after another. S2 can be used to produce a single sound effect, next depression gives the next sound effect. There are 2 lazer guns, 1 dual tone horn sound, 2 bomb sounds, 2 machine gun sounds and a rifle shot sound. Standby current is about 1 uA at 3 Volt, so battery life is very economical. The IC may be obtained from Maplin Electronics order code AZ52G.

Return to Music Circuits

Electronic Siren

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Description:
An electronic siren made from discrete components.

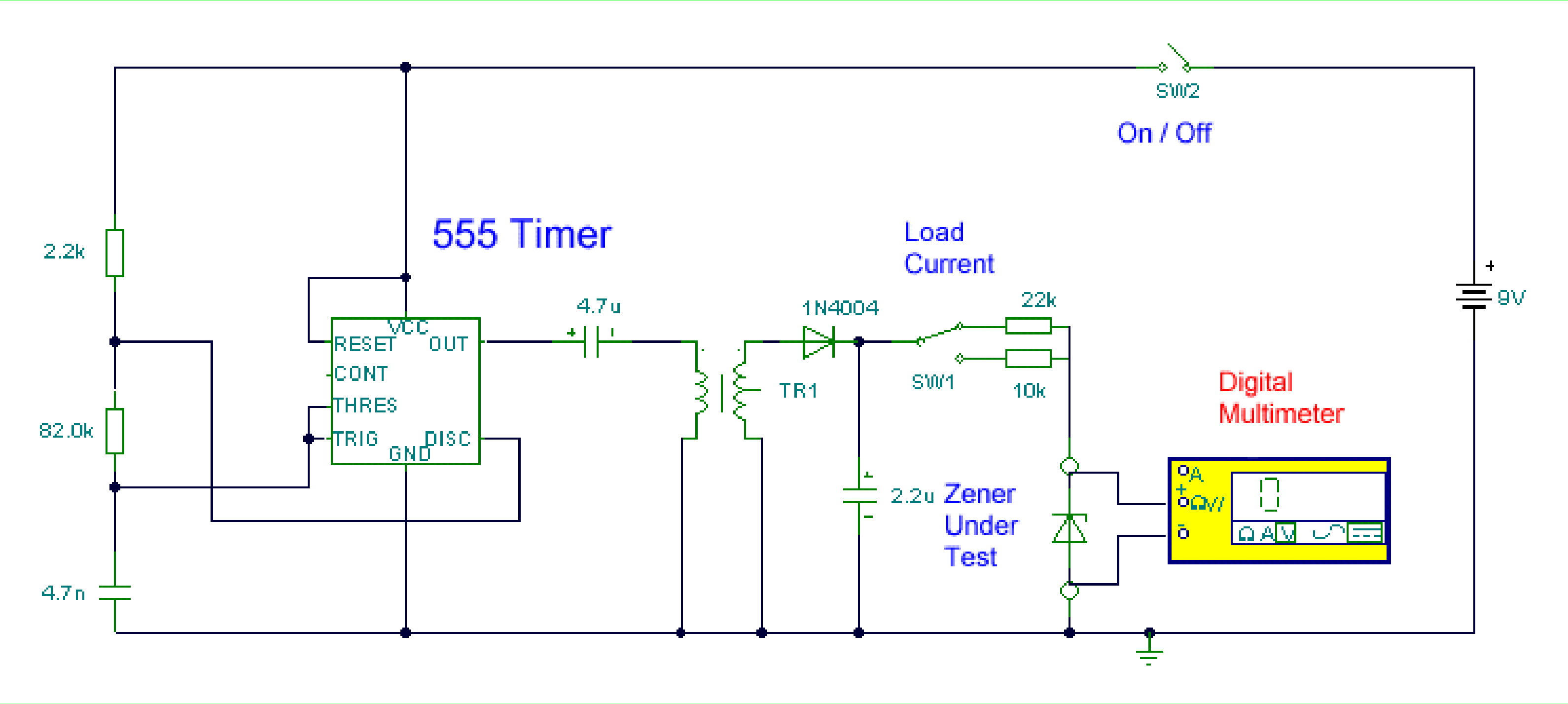


Notes:
The sound produced imitates the rise and fall of an American police siren. When first switched on the 10u capacitors is discharged and both transistors are off. When the push button switch is pressed to 10u capacitor will charge via the 22k resistor. This voltage is applied to the base of the BC108B which will turn on slowly. When the switch is released the capacitor will discharge via the 100k and 47k base resistors and the transistor will slowly turn off. The change in voltage alters the frequency of the siren. The oscillator action is more difficult to work out. As the BC108B transistor switches on its collector voltage falls and so the 2N3702 transistor is switched on. This happens very quickly (less than 1us). The 22n capacitor will charge very quickly as well. As this capacitor is connected between the collector of the 2N3702 and the base of the BC108B, it soon reaches almost full supply voltage. The charging current for the capacitor is then much reduced and the collector emitter voltage of the 2N3072 is therefore increased; the collector potential will fall. This change in voltage is passed

through the 22n capacitor to the base of the BC108B causing it to come out of saturation slightly. As this happens its collector voltage will rise and turn off the 2N3072 transistor more. This continues until both transistors are off. The 22n capacitor will then discharge via the 100k, 22k resistor, the closed push button switch, 9V battery, the speaker and 56 ohm resistor. The discharge time takes around 5-6msec. As soon as the 22n capacitor is discharged, the BC108B transistor will switch on again and the cycle repeats. The difference in voltage at the collector of the BC108B (caused by the charging 10u capacitor) causes the tone of the siren to change. As the 10u capacitor is charged, the tone of the siren will rise, and as it is discharged, it will fall. A 64 ohm loudspeaker may be used in place of the 8 ohm and 56 resistor, and the values of components may be altered to produce different sound effects.

Return to Music & Special Effects

Zener Diode Tester



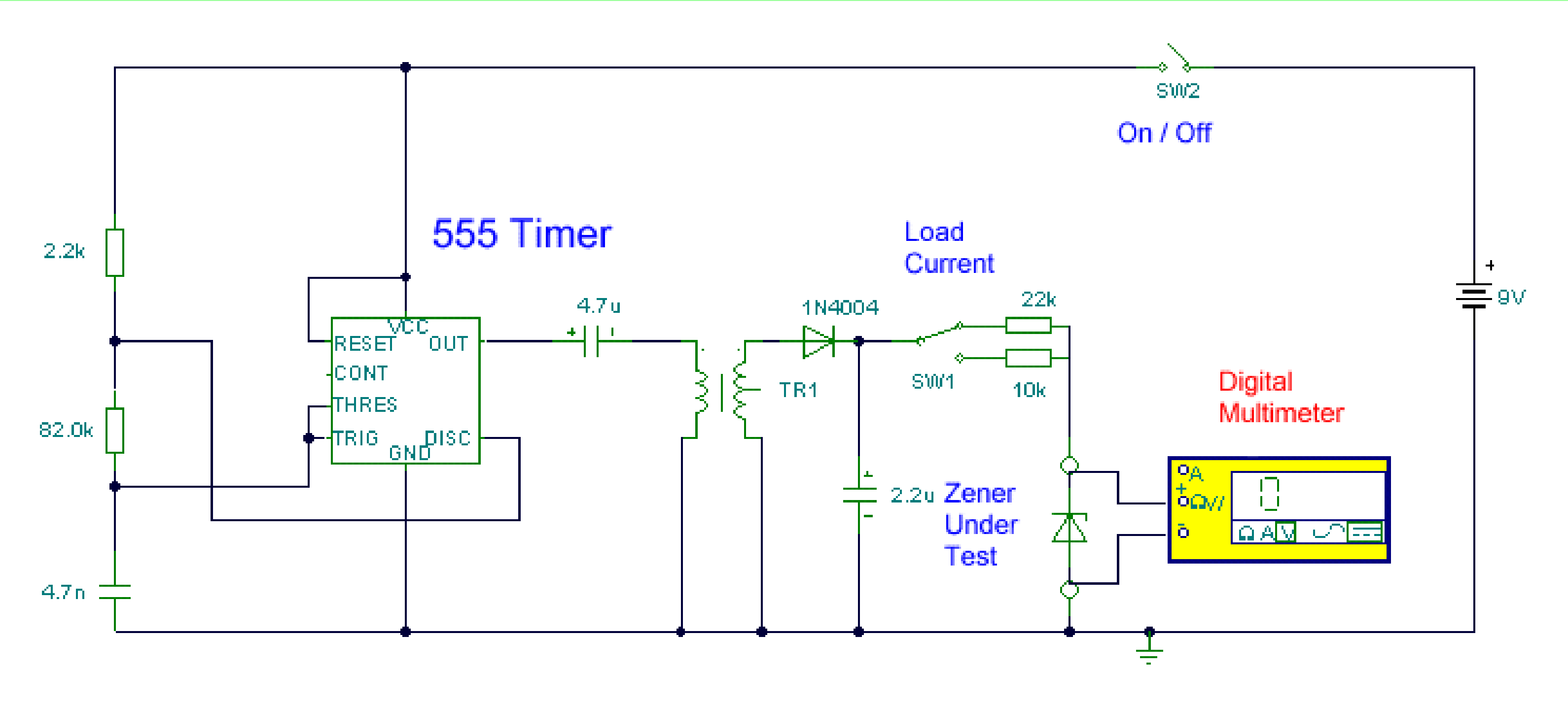
Întrebuin•înd un circuit timer 555 •i un mic transformator pentru a genera un voltaj mare, acest circuit face un test de diod• zener, de voltaj de m•rimea pîn• la 50VDC. Circuitul 555 timer este întrebuin•at în modul astabil, ie•irea este la pin3 •i porne•te un mic audio transformator ca de exemplu LT700. Impedansa primarului este 1K •i impedansa secundarului este 8 ohms. Întrebuin•at în reverse, ac voltajul neînc•rcat este de rîndul 120 vol•i ac. Aceasta se rectific• cu dioda 1N4004 •i se calc• mai departe cu un 2.2u capacitor care ESTE NECESAR s• fie de 150 VDC. Dioda zener se m•soar• cu un multimetru la care alegem m•surarea DC vol•i. Întrerup•torul de curentul de înc•rcare permite testul diodei zener la rîndul 1 ori 2mA DC. Voltajul rectifical DC v-a sc•dea sub înc•rcare, îns• o bun• diod• zener ar trebui s• re•in• m•rimea de pe voltmetru.

Alexsander Dakic

Andy Collinson

Return to Test Gear

Zener Diode Tester

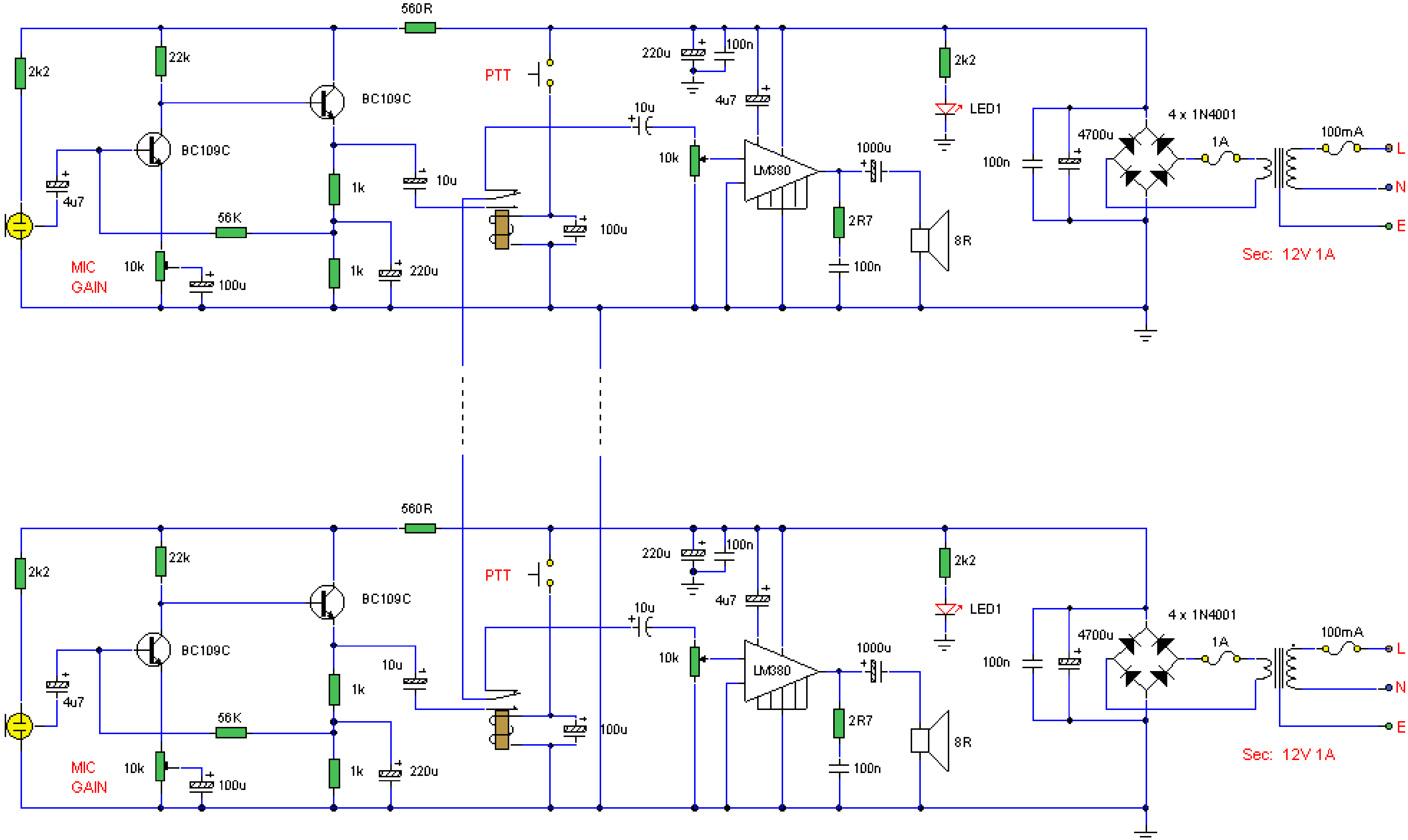


Koristeci 555 Tajmer IC i mali transformator da bi se generisao visok napon, ovo kolo moze da posluzi da testira zener diode ciji napon ne prelazi 50VDC. 555 tajmer se koristi u astabilnom modu. Na izlazni pin3 je povezan na mali audio transformator kao sto je LT700. Ovaj transformator ima impedancu primara od 1K , a sekundara od 8 ohma. Koristeci ga reverzno, ac napon na izlazu je oko 120V AC. Ovaj napon se ispravlja sa 1N4004 diodom i kondenzatorom od 2,2u koji mora biti dimenzionisan na 150 VDC. Zener diode koje se testiraju se mere unimerom kao sto je prikazano na slici. Prekidac omogucava da se testiraju zener diode na 1 ili 2mA DC. DC napon moze opasti, ali dobra dioda mora odrzati napon tako da se on moze ocitati na volt-metru.

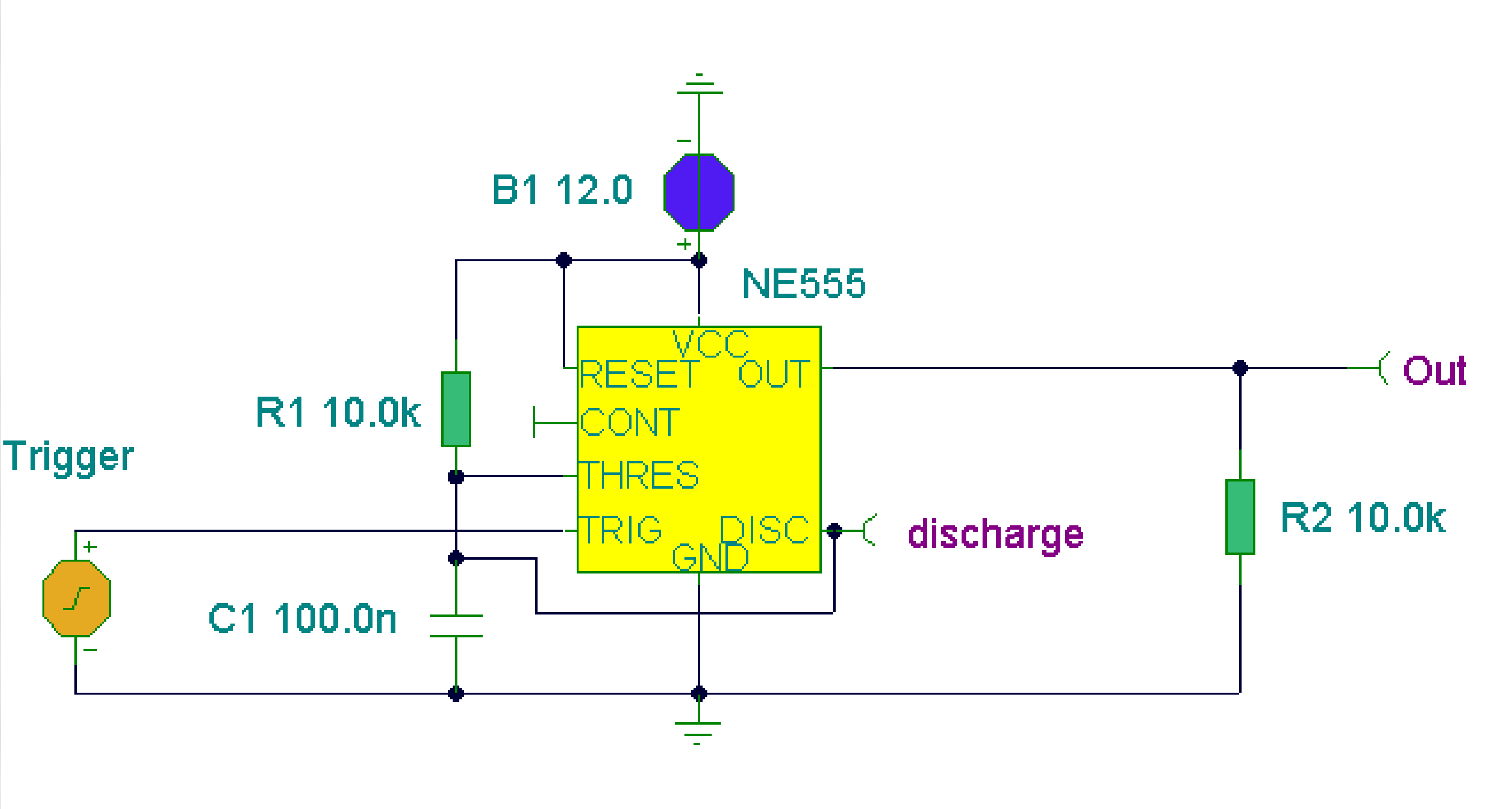
Alexsander Dakic

Andy Collinson

Return to Test Gear Circuits


560R
2k2
22k
BC109C
BC109C
4u7
56K
MIC
GAIN
10k
100u
1k
1k
10u
220u
PTT
100u
10u
220u
100n
4u7
10k
LM380
1000u
2R7
100n
8R
2k2
LED1
4 x 1N4001
4700u
100n
1A
100mA
L
N
E
Sec: 12V 1A
560R
2k2
22k
BC109C
BC109C
4u7
56K
MIC
GAIN
10k
100u
1k
1k
10u
220u
PTT
100u
10u
220u
100n
4u7
10k
LM380
1000u
2R7
100n
8R
2k2
LED1
4 x 1N4001
4700u
100n
1A
100mA
L
N
E
Sec: 12V 1A

NE555 Basic Monostable

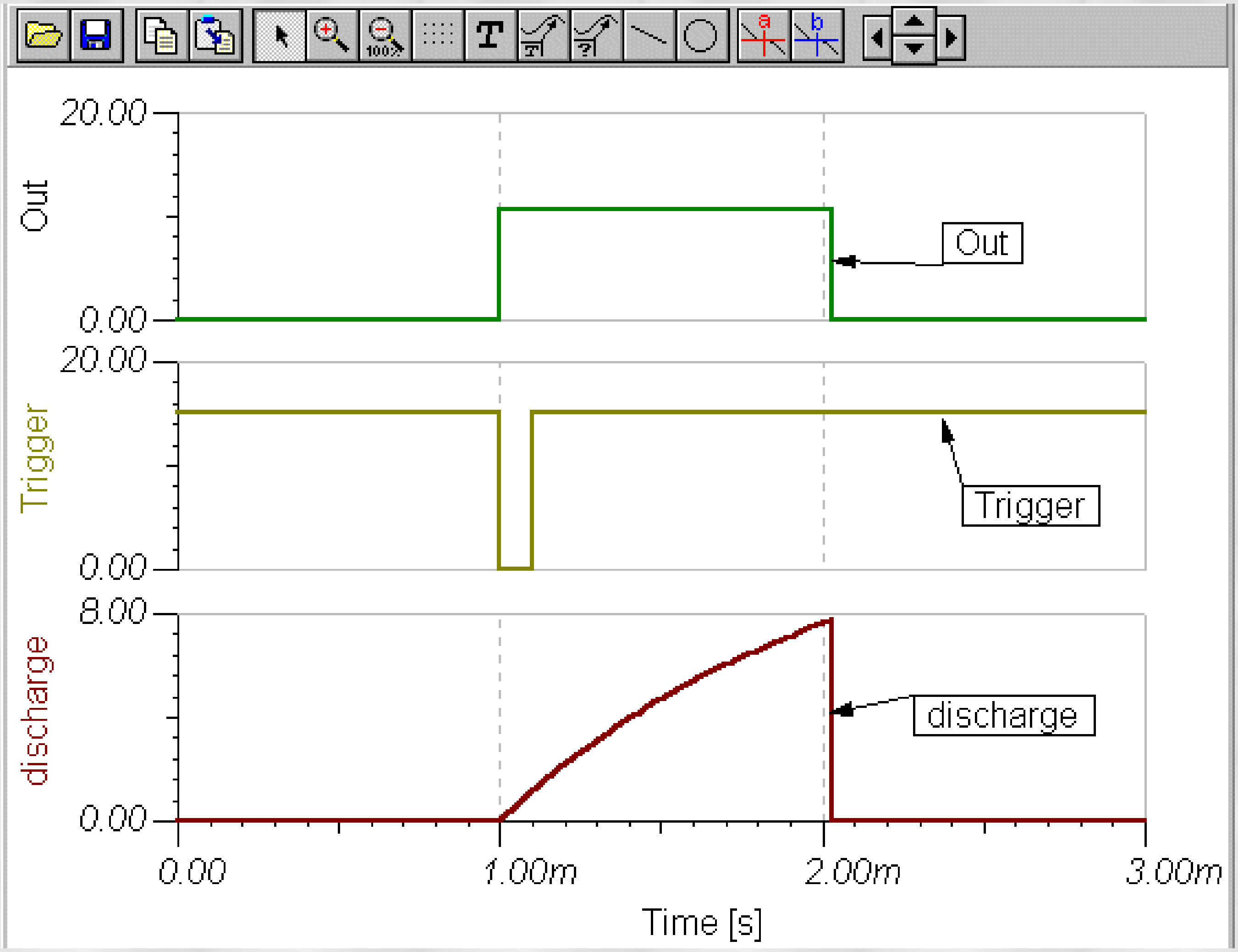


Notes:

Here the popular 555 timing IC, is wired as a monostable. The timing period is precise and equivalent to:-

$$1.1 \times R_1 \times C_1$$

With component values shown this works out at approximately 1.1msec.The output duration is independant of the input trigger pulse, and the output from the 555 is buffered and can directly interface to CMOS or TTL IC's, providing that the supply voltages match that of the logic family.



The timing diagram above shows the output pulse duration, the trigger input and the output at the discharge terminal of the IC.

Return to Timing Circuits

Timing Circuits

1. Basic 555 Monostable

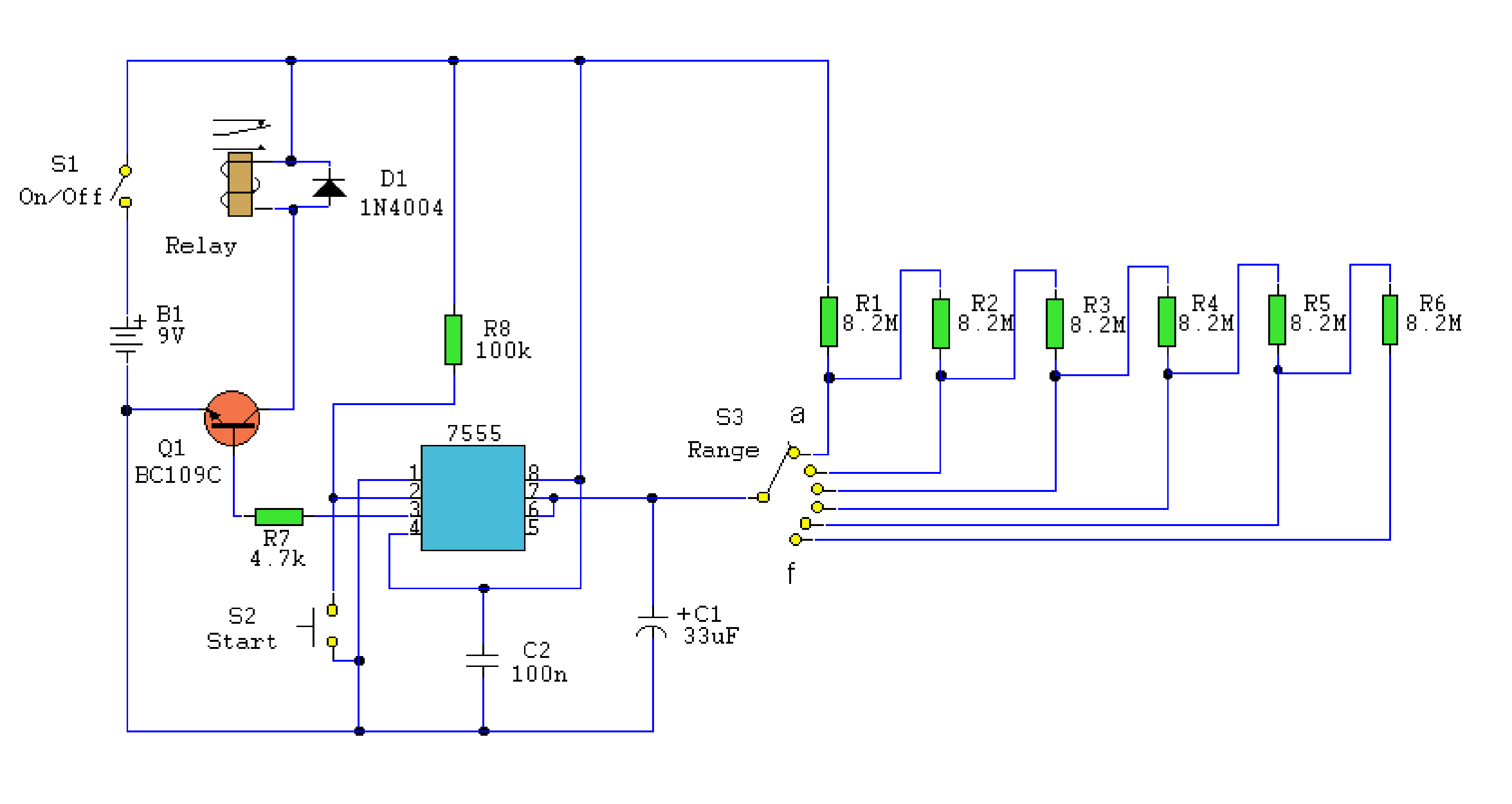
2. 5 to 30 Minute Timer

Return to Schematics

5 to 30 Minute Timer

Circuit : Andy Collinson
Email: anc@mitedu.freeserve.co.uk

Descriptipn:
A switched timer for intervals of 5 to 30 minutes incremented in 5 minute steps.



Notes:
Simple to build, simple to make, nothing too complicated here. However you must use the CMOS type 555 timer designated the 7555, a normal 555 timer will not work here due to the resistor values. Also a low leakage type capacitor must be used for C1, and I would strongly suggest a Tantalum Bead type. Switch 3 adds an extra resistor in series to the timing chain with each rotation, the timing period us defined as :-

$$\text{Timing} = 1.1\ C_1 \times R_1$$

Note that R_1 has a value of 8.2M with S3 at position "a" and 49.2M at position "f". This equates to just short of 300 seconds for each position of S3. C_1 and R_1 through R_6 may be changed for different timing periods. The output current from Pin 3 of the timer, is amplified by Q1 and used to drive a relay.

Parts List:
Relay 9 volt coil with c/o contact (1)
S1: On/Off (1)
S2: Start (1)

S3: Range (1)
IC1: 7555 (1)
B1: 9V (1)
C1: 33uF CAP (1)
Q1: BC109C NPN (1)
D1: 1N4004 DIODE (1)
C2: 100n CAP (1)
R6,R5,R4,R3,R2,R1: 8.2M RESISTOR (6)
R8: 100k RESISTOR (1)
R7: 4.7k RESISTOR (1)

Return to Timing Circuits