The Compleat Tagger

Being a collection of hintf and modificationf for tag compatible weaponry

Containing therein many diuerse circuitf and ideaf for the wife.

More compleat than ever yet published.

CONCERNING THE HOBBY OF TAGGING
and the playing thereof.

Reminifant of Izaak Walton at hif beft - Henry Colt.

THE COMPLEAT TAGGER

This booklet has been put together in order to collate the many advances that have been made in the world of tagging and so make them accessable to all members of the hobby.

Many of the modifications in this booklet require some electronics skill, but don't let that put you off! This comes from someone who was totally ignorant of this subject before entering the hobby. The electronic circuits included here are not difficult to make, requiring some basic equipment, patience and care. Many good books exist on the subject of electronics construction for beginners, I suggest that you read one of them before embarking on these projects if you have had no previous experience of electronics.

There are modifications in this booklet for most of the types of Lazer Tag compatible weaponry about and also some idea's for the sensors as well.

Most groups agree that if you are going to improve any standard weapon, then this should be done in conjunction with building a larger body, having a loud sound system and bright muzzle flash. There is also a current trend which adds enjoyment for all, of putting magazine counters in machine gun type weapons. These counters disable the gun for a variable period of time, once its "magazine" has been emptied. The length of disable time depends on the size of the magazine.

All this may seem a momentous amount of work for a beginner to the hobby to undertake, and so it is. However all of the groups I play with are quite understanding to anyone who is using a gun that has not been finished, ie only has some of the above properties. The most important thing to do is to start with a strong large body, that will leave you with ample room to fit in any additional circuits or battery packs that you may require in the future and when I say big, think **BIG!!** Good access to the insides is also very important and should be thought about well in advance.

What you use to make the body is up to you, I have seen wood, plastic tubing, electronics hobby boxes, toy guns, milliput and A.B.S plastic sheeting all put to good use. Surface detail is a problem and the sooner someone produces manufactured bodies we can use the better. Remember that if you are going to use a long range lens system with the gun, you will need to anticipate the size of the lens in the gun design. Most people build the gun around the lens.

I just have to say thank you to all of the many people from various clubs who have worked to obtain this information, all the proceeds from this booklets sale will go into improving the quality of the hobbies fanzine, "FIREFIGHT".

Finally, although I have made every effort to ensure that the information in this booklet is correct, I cannot guarantee it and so any modifications to your equipment are made at your own risk. Well thats all I have to say so the rest is up to you, good luck and if you get any problems I am always quite accessable to phone calls.

Mark Arnold (0203 341501)

CONTENTS

GUNS

There are many different types of compatible commercially available (but not very available) guns on the market. There are also a few homemade gun circuits included in this booklet. What follows is a brief description of each of the commercial weapons, all of which come in a set complete with a sensor.

Lazer Tags

These are the guns that really started the hobby, although not made any more, they were produced by Worlds of Wonder and originally sold at very expensive prices. The project seems to have flopped, but Lazer Tag sets can still be found very cheaply on market traders stores in some parts of the country (expect to pay up to £30 for a set).

The gun is a black plastic futuristic pistol, that fires a single shot every second over a range of about 70 metres. Claims have been made of much greater distances but these should be taken with a bucket of salt. The addition of a small telescopic sight onto the top of the integral sight, greatly improves the guns accuracy.

G.I Joes

These guns were also made by Worlds of Wonder, they are made of green plastic in the shape of a pistol. Again these fire a single shot every second but there unmodified range is only about 20 metres. Again these guns can be found on market stalls and in small shops, expect to pay between £5 and £20. These guns are very versatile and a bargain.

Quickshots/Sureshots

These pistols are made of black or grey plastic and come complete with a sight that slides into the top. They can still be found in a variety of places and have a range of about 20m unmodified. Expect to pay between £15 and £25 pounds for a set. Not a bad little gun, which emits a smear of light when it is fired, rather than a single shot.

Neutronic 7000

I have only ever seen one of these grey plastic pistols which cost about seven pounds. It is similar to the quickshot but less well made. Unfortunately it has to be turned on before use and has a continuous flashing L.E.D when it is on.

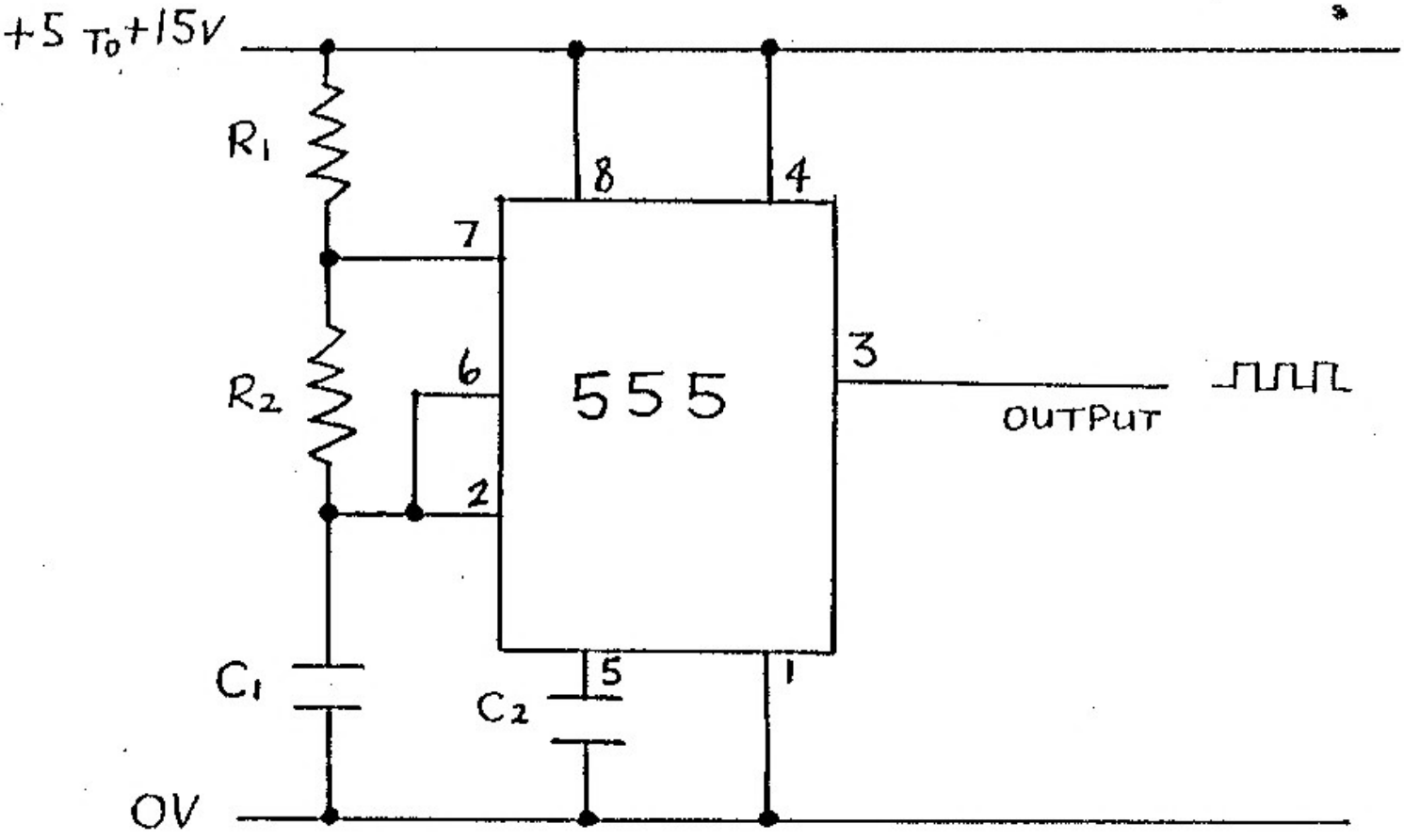
Infra-red Rays Gun

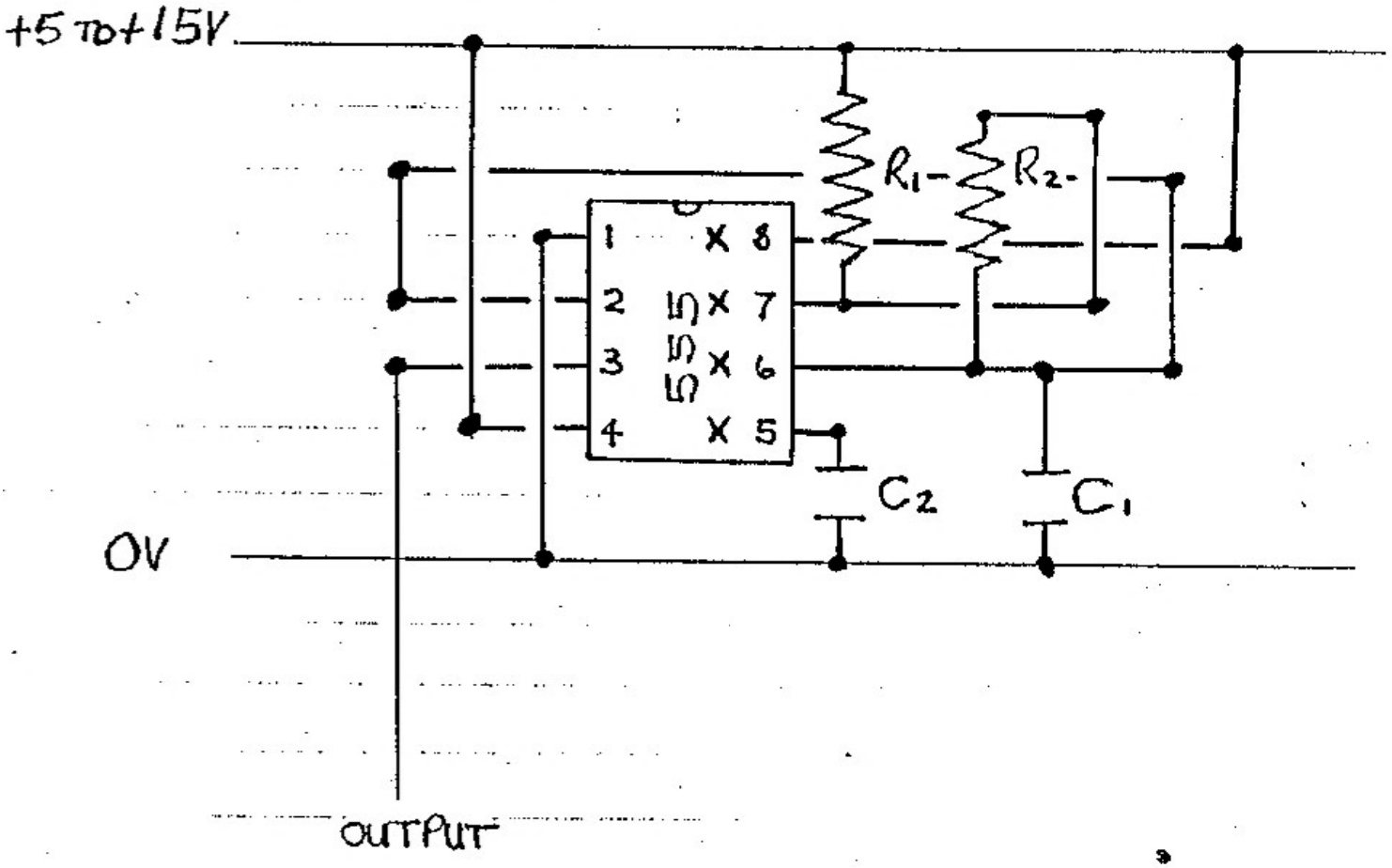
These quaintly titled guns are an eastern import and look like a machine gun. They have a very loud gunfire and repeat automatically when fired. Unfortunatley they are not very robust and have a limited range of about 15-20 metres. However they can be purchased from Jon Blau of Dark Star for about £30.

MACHINE GUNS

The first modification most people wish to make to their shop bought weapon, is to convert it from a single shot weapon into a machine gun. At the heart of such a modification is an electronic circuit built around something called a 555 timer integrated circuit (I.C or chip). This I.C is a very versatile and common one and can be found in any electronics shop at a variety of prices (50p - £1.00). Now the same I.C can come in a variety of different logic types e.g T.T.L and C.M.O.S, you dont have to know what this means, but I suggest that you ask for a T.T.L 555 unless you know what you are doing with electronic components, as C.M.O.S ones can be damaged very easily!

Below is a circuit diagram showing you how to build the circuit you require, you can see you will need a few other electronic components. When you come to build this you will do so on something called stripboard, this is a piece of non-conductive board with holes in it and strips of copper on one side. The components are soldered to the copper strips to make connections between them. The strips also have to be cut in some places to break connections. The diagram below has to be rearranged to fit it on stripboard and this has been done for you in the next diagram, the crosses indicate where the strips have been cut. The rearrangement is not difficult so long as you are logical. You will have to do it for yourself in subsequent circuits.





Now this circuit is a very useful one, when a battery is placed across the two power rails (0V and +5 to 15V), the circuit produces a square wave output from its pin number 3. In other words it turns on and off repetitively. The speed of its on/off cycle depends upon the values of the other components in the circuit. Increasing the values of C_1, R_1 and R_2 will cause the oscilation to slow and vice versa.

For a nice fast machine gun rate I recommend the following values

R_1	1 meg Ohm
R_2	47 kilo Ohm
C_1	0.1 micro Farad
C_2	0.1 micro Farad

Remember in construction that some capacitors have a polarity and you must place them in the circuit the right way around. To check the operation of the circuit, try placing a light emitting diode across pin 3 and 0V. If it does not flash then try it with the L.E.D the other way around. If it still does not flash then check your circuit!

Now depending on what type of gun you are using, the method of connecting this circuit will vary.

LAZER TAG

With the gun open, disconnect the wire that is attatched to the bottom trigger contact and reconnect it to the output from pin 3.. Connect the positive power rail of the circuit to this bottom contact and the negative power rail to any handy negative source eg the negative side of the battery, or the negative side of the big capacitor in the gun handle.

All that remains to do is CAREFULLY desolder the 1 micro Farad capacitor on the lazer tag board (labelled C8) and replace it with a 0.1 micro Faradcapacitor. It may be better to cut the original capacitors legs and then resolder to those rather than desoldering it. With any luck it should now work.

G.I JOE

The method of doing this is very similar to that above. One side of the trigger is positive, the other side becomes positive when the trigger is pressed. Disconnect the wire from this side (labelled E4) and reattatch it to the output from pin 3. Connect the positive power rail of the circuit to the vacated trigger contact. Again find a convenient negative source to attatch the negative power rail to.

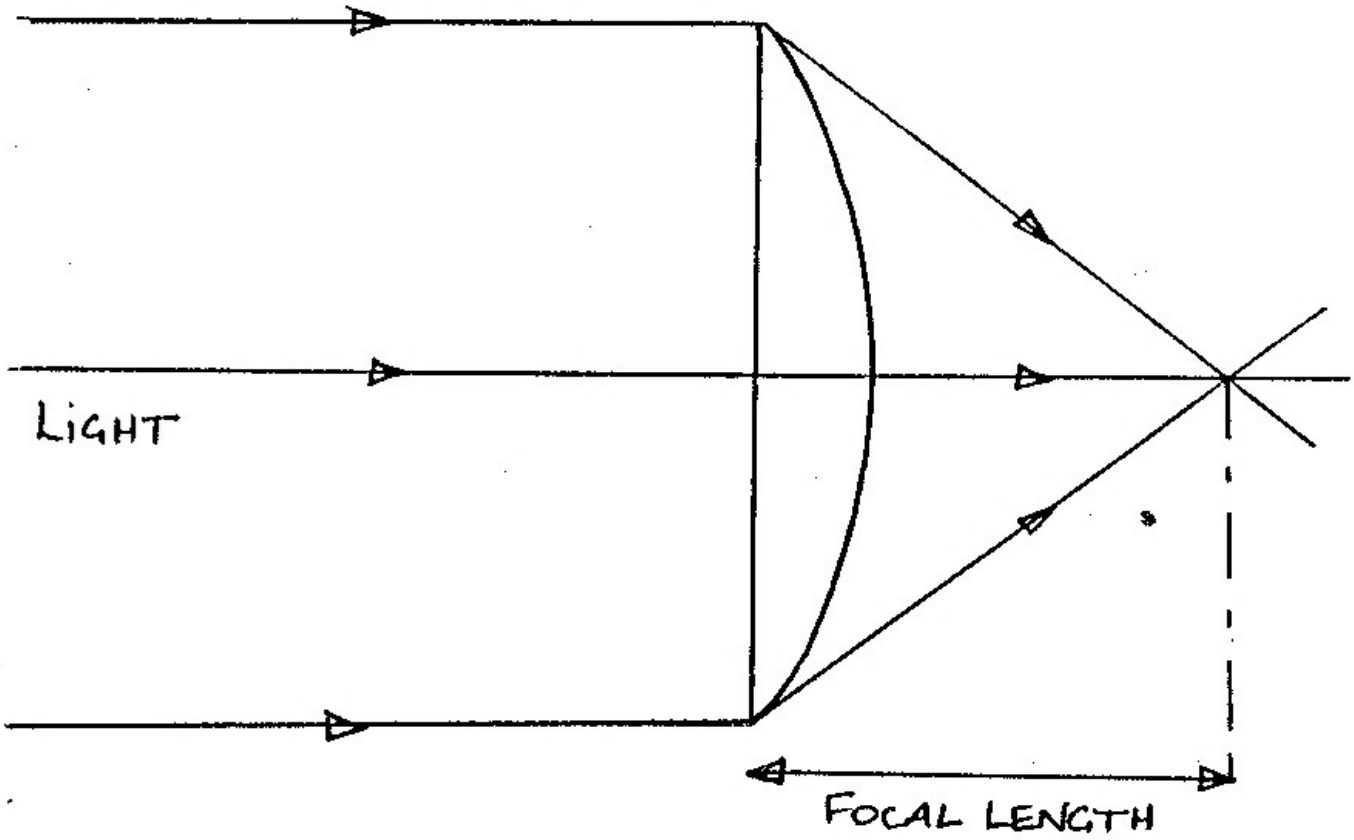
Find the capacitor labelled C1 (47 micro Farad) on the G.I JOE board and replace it with a 0.1 micro Farad capcitor.

INCREASING RANGE

The right type of lens can improve the range of any shop bought gun dramatically. The correct lens to use is a convergent or convex one, these can be obtained very cheaply by buying a magnifying glass and using its lens.

The effect of these lenses is to bend light towards a point. If the input light is diverging (as in the case of an L.E.D) then the output light can be made parallel and this is the arrangement required to obtain long ranges.

Lenses have a distance associated with them called the focal length, this is the distance from the lens at which parallel light entering it is focussed to a point, see the illustration below.

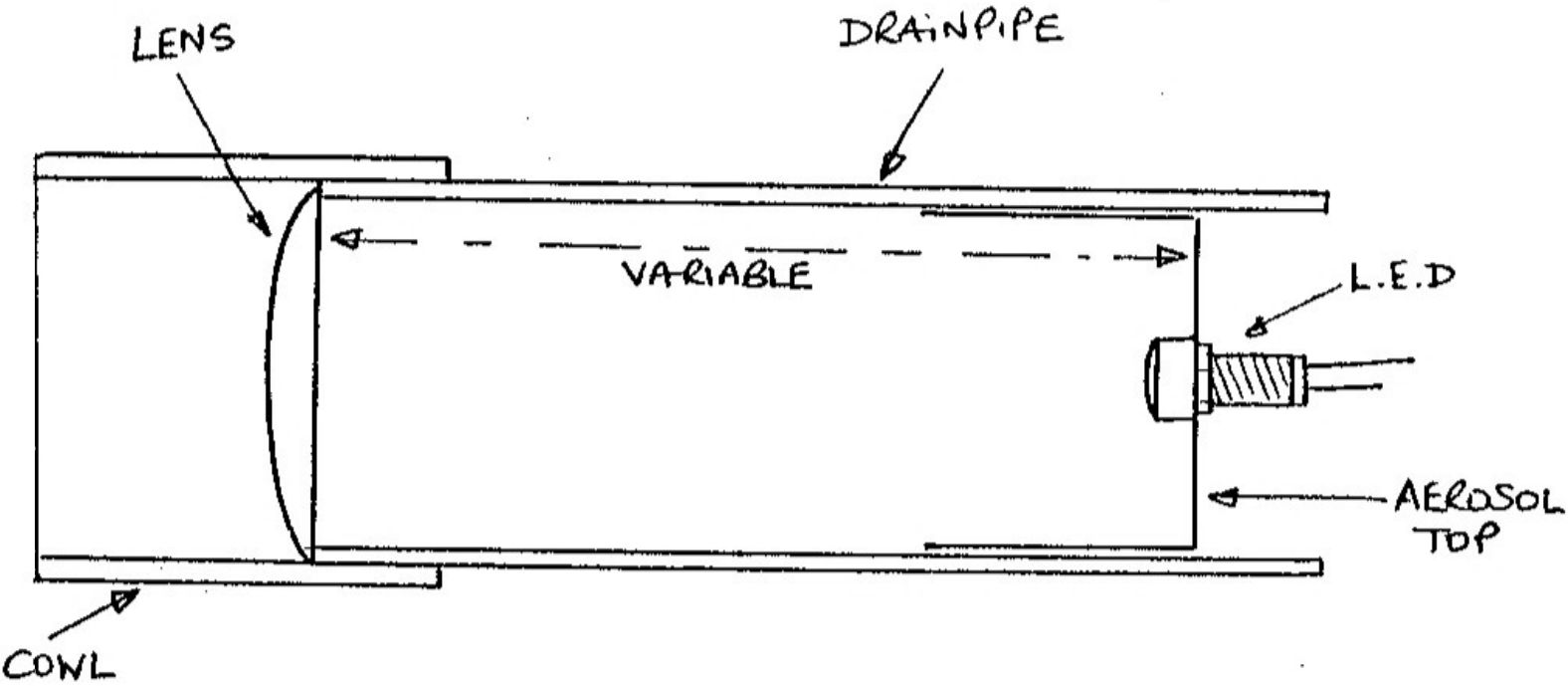


The approximate focal length of a lens can be found by holding it in front of a window with a piece of paper behind it. Move the paper closer and further from the lens until a sharp image of the outside world is obtained on the paper. The distance between the paper and the lens is the focal length.

The lens to use for your weapon, should have a focal length of between 10 and 20 cms. It is not possible to be precise about this as it will vary with the type of infra-red LED you are using.

When setting up the lens and LED, make sure that both are straight and that the LED is mounted at the centre of the lens a distance equal to the focal length from it. To get the best results it is necessary to field test the unit, trying different focal lengths until the best results are obtained.

We find that the mounting of the lens and the LED are best done with a piece of drainpipe, a suitable aerosol lid can be used to mount the LED and slide it back and forth inside the drainpipe to alter the focal length (see diagram below)



The type of LED,s we find best are panel mounted lensed ones from Farnell Electronic Supplies, order No CQW13L. The lens can be of any size diameter but between 5 and 10 cms would seem to be the maximum sensible to fit on the front of a weapon. Theoretically the larger the diameter the better.

Ranges of well in excess of 200 metres are achievable using this method. It is probably better to cowl the lens as shown above, this protects it from damage and also stops the beam from spreading sideways too much, which will make you unpopular with the people you play with.

Lazer Tag

A short note about Lazer tags is appropriate here, the emitters used in these guns do not work well with glass lenses. It is better to change them for a different type.

LOUDER GUNFIRE

It is only fair that the person you are firing at should be able to hear you at the same time as he hears his sensor go off. With the increased ranges now available this requires separate circuits to produce and amplify gunfire.

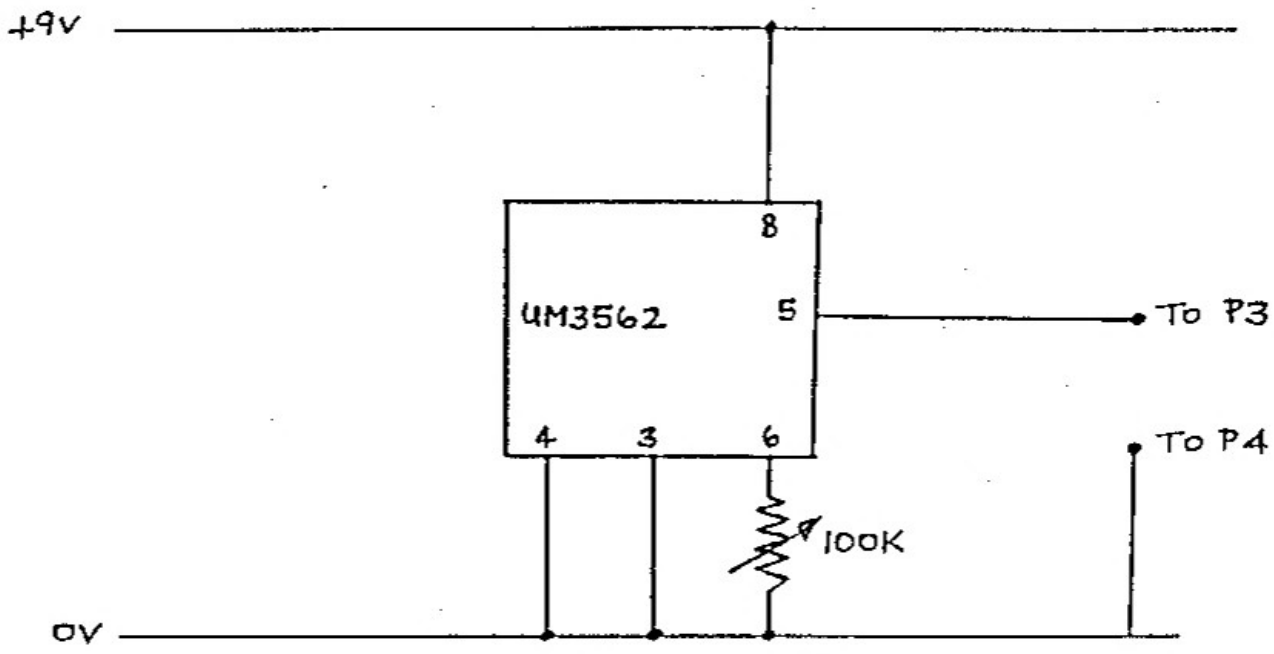
This system is built around a sound generator I.C and project amplifier kit that can both be bought from Maplins. The total cost will be well under a tenner. The noise made is that of a machine gun although 2 different sounds can be produced by altering where pin 2 on the sound generator chip is connected. A single rifle shot is produced if it is taken to the +9V rail and a single phaser blast if connected to the 0V rail.

The parts list is as follows:

Part	Maplin Order No
Three gun sound generator	UL24B
1 W Power amplifier module	LP16S
100 K variable resistor	
1.5 W 3.5" speaker 8 Ohm	YT25
Stripboard	
Wire	
9V battery pack	

Construction

Complete the power amplifier kit as per the instructions given with it. Construct the simple circuit shown below using the three gun sound generator and the variable resistor.



Connect the wires shown in the circuit to the connections on the power amplifier kit labelled P3 and P4. Connect the speaker to the connections P8 and

P9. Now take two wires from the positive side of the battery pack and connect one to the positive rail of the circuit above, and the other to connection P1 on the amplifier. Similarly take two wires from the negative side of the battery pack and connect them to the 0V rail and P2 respectively.

To switch the gun on and off, the power is connected and disconnected. The loundness of the gun can be varied using the variable resistor on the amplifier kit. The rate of fire can be varied using the variable resistor in the sound generator circuit.

The sound is louder if you use a 9V battery pack rather than a single 9V PP3 battery.

AMMO COUNTER

A very nice addition to make to a machine gun type weapon is to add an ammo counter. This circuit will count the number of shots fired and then disable the gun for a variable amount of time when all of the shots in a "magazine" have been fired. The time of disable is dependent upon the size of the magazine, a delay of 3/4's of a second for each 10 shots is the generally used standard. This gives a delay of 7.5 seconds for a 100 round magazine.

The use of ammo counters greatly increases the fun of a game, nothing is so frustrating as running out of ammo at a critical time, it also allows scenarios with limited amounts of ammunition (al a Aliens) to be run. Thirdly it gives players who have not modified their basic weapons, a chance in games against others who have.

The counter described below is the bog standard minimalist one, it has no display except a flashing L.E.D to denote that the gun is disabled. It is set to count to a magazine of 90 although this can be made less by moving one of the wires as described later.

The counter may be given a simple L.E.D display by connecting one or two bar graph displays to the outputs of I.C's 3 and 4. To do this is simple but will require further information about the 4017 I.C's. A digital display can also be connected to this circuit but this is more complicated and requires the removal of I.C's 3 and 4 and their replacement with several other chips.

To understand what is happening in the circuit read the following:

1] IC1 is a 555 chip set to give a short "on" period when the trigger is pressed. Its purpose is to stop trigger bounce which would cause false shot counts. The 100K variable resistor may be altered to change the length of time of the "on" period, the practical effect of this is to change the amount of shots fired when the trigger is pressed momentarily. This burst fire mode is quite useful, I recommend that it is adjusted to give a burst of 1 to 3 shots.

The other purpose of this circuit is to operate a sound system, the "to sound" output becomes positive in time with the chip and this can be used for this purpose.

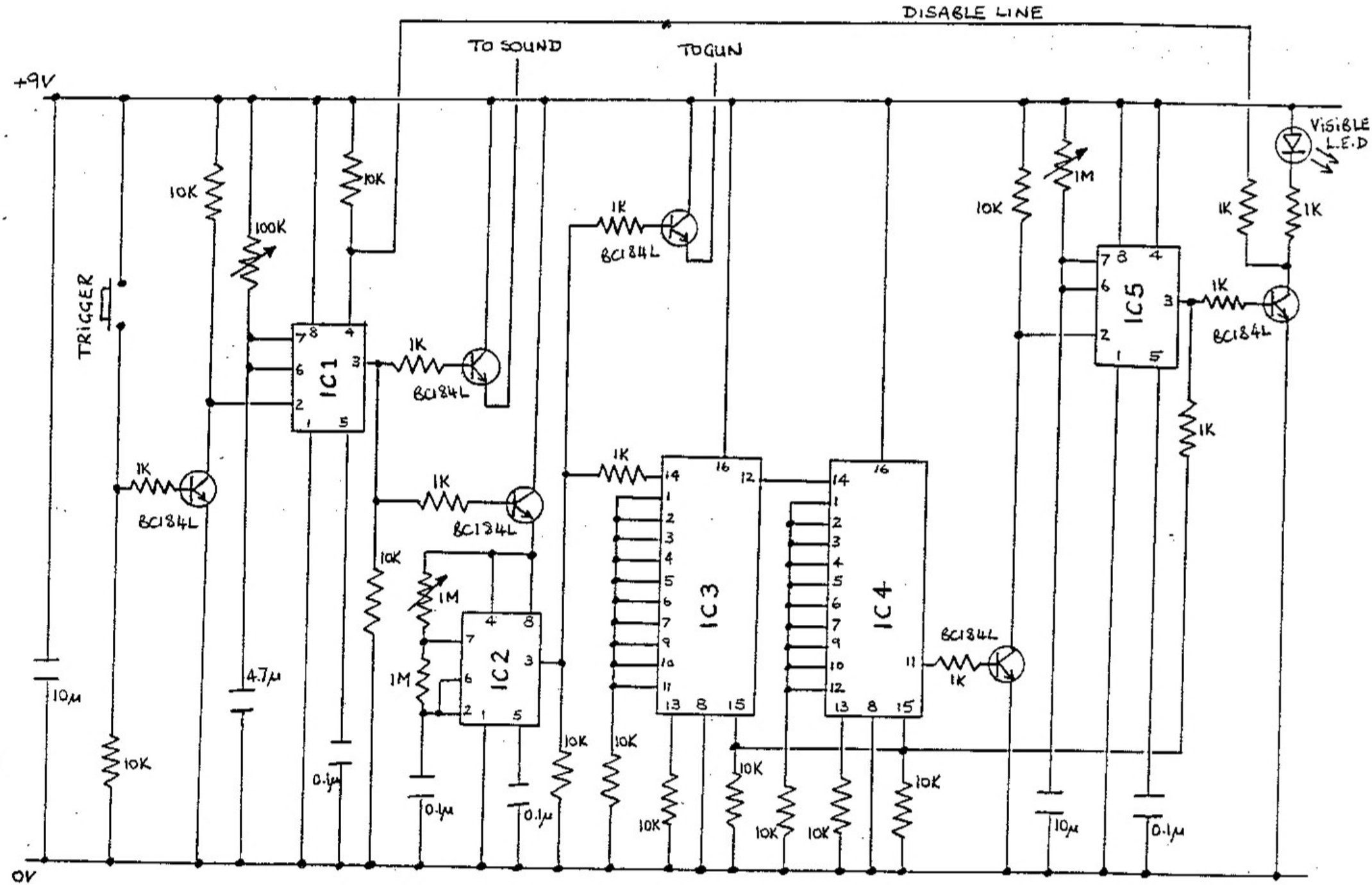
2] IC2 is another 555 chip that is set up to turn on and off continually. However it only does this when IC1 is on, so you can see now how the burst fire mode works. These on and off cycles can be used to fire the gun, the "to gun" output becomes positive and negative in time with the chip and this can be used activate the gun as described in the MACHINE GUNS article on page 1.

The 1M variable resistor can be adjusted to alter the rate of fire, do not set it too high or you will empty your magazine very quickly.

3] IC3 and IC4 are the 4017 counter chips, one of them counts to ten and then carries one to the next chip. The original chip then counts to ten again and carries again. This continues until the second chip has counted to nine, 9 X 10 is 90, the number of shots in the magazine. When this number is reached IC5 is then activated.

4] IC5 is another 555 chip again set to give a single "on" period. The period of this one is the length of the gun disable and it can be altered by adjusting the 1M variable resistor. Set it to about 7 seconds for this magazine size. Its output also powers the flashing L.E.D to indicate that the magazine is empty.

Once the disable period finishes, the L.E.D stops flashing and the gun is ready to fire a new magazine.


DISABLE LINE
TO SOUND
TO GUN
+9V
0V
TRIGGER
10K
100K
10K
1K
BC184L
IC1
IC2
IC3
IC4
IC5
1M
4.7µ
10µ
0.1µ
VISIBLE L.E.D

Component List

Component	Maplin Order No
3 X 555 Timer IC	YH63T
2 X 4017 Decade Counter IC	UB99H
5 X BC184L Transistors	QB57M
1 X Flashing L.E.D	UK30H
1 X Microswitch (trigger)	FP43W
1 X 100K Variable Resistor	
2 X 1M Variable Resistor	
13 X 10K resistors	
9 X 1K resistors	
2 X 10 µF capacitors	
1 X 4.7 µF capacitor	
4 X 0.1 µF capacitors	

Changing the Magazine Size

This can be achieved by changing the pin of IC4 that supplies the transitor. This is currently pin 11, by swapping the connections between pin 11 and one of the other pins below, different magazine sizes can be produced. It is important that pin 11 is connected to 0V in the same way as the pin was that it is being exchanged for.

Pin Number	Magazine Size
1	50
2	10
4	20
5	60
6	70
7	30
9	80
10	40

Muzzle Flash

The muzzle flash on most commercial guns is either inadequate or non existent epecially so if the range of the weapon is to be increased. High brightness visible L.E.D's of 1 or 2 candela output are the easiest way to produce a bright flash when the gun is fired, without drawing a lot of current.

Replacing the infra-red L.E.D in a Farnell panel mounted emitter (see "Increasing Range") with one of these L.E.D's gives an excellent muzzle flash, visible in even daylight.

Alternatively using a bulb gives a bright white flash looks authentic, but has the disadvantage of requiring more current.

Lazer Tags

Dismantle the gun and cut the two wires that connect the board to the light bulb. Extend the wires from the board and connect them to the new L.E.D via a 1K resistor. Make sure that the L.E.D is connected the right way around and mount it on the front of the gun body you are using.

G.I Joes

Dismantle the gun and cut off the small red L.E.D that is mounted on the top of the gun. Reconnect the new L.E.D with extending wires to the old L.E.D's remaining legs, ensuring that the L.E.D is the correct way round. Mount the new L.E.D on the front of the gun body.

Quickshots

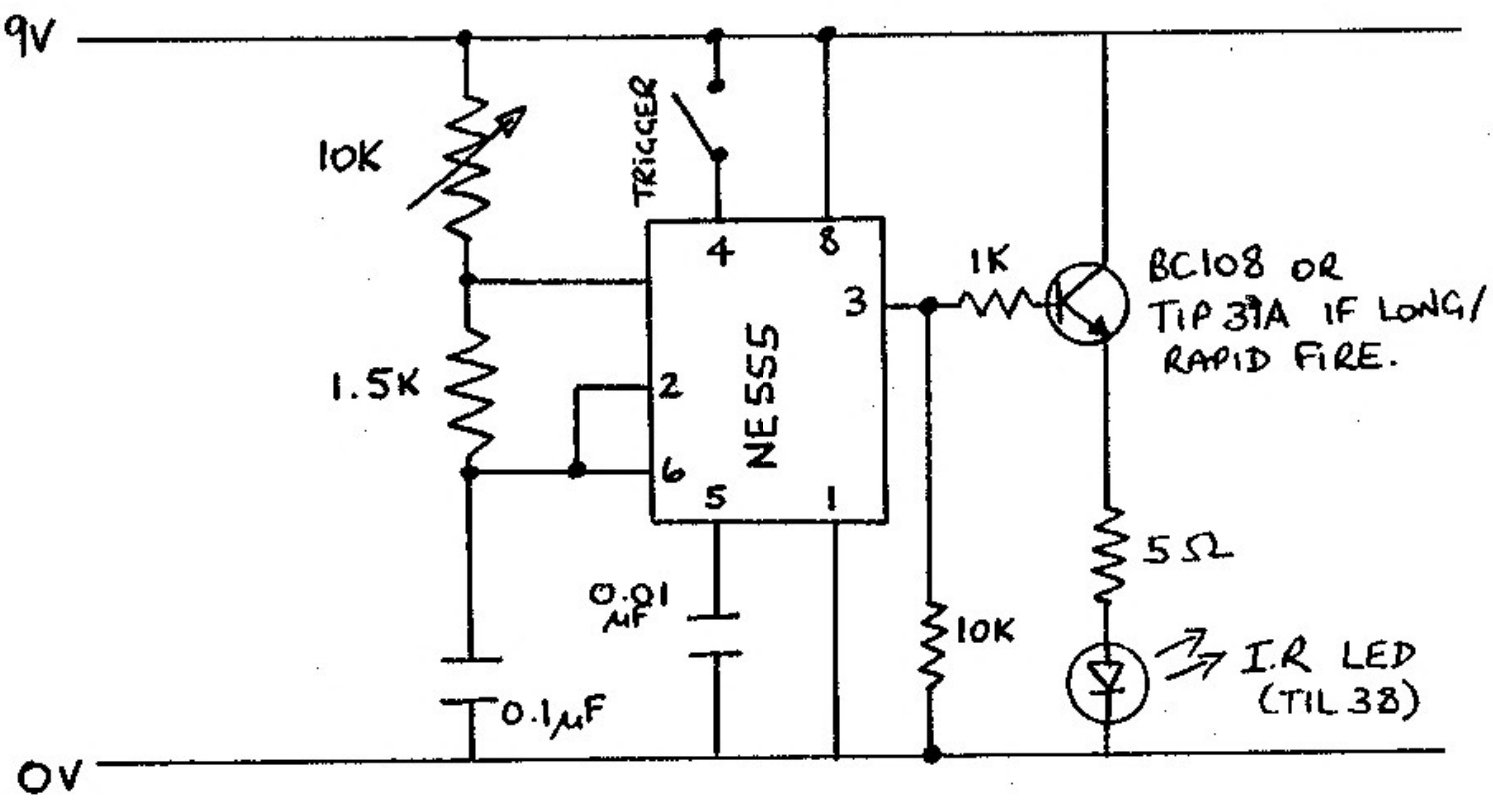
Open the gun up and locate the microswitch next to the trigger. The wire connected to it at the top is always positive. The wire connected below it becomes positive when the trigger is closed. Connect a wire to this connection and run it to a hyper bright L.E.D via a 470 Ohm resistor. Then take the other leg of the diode back to the negative terminal of the battery conections.

Drill a hole in the front plate of the gun below the barrel and poke the L.E.D though and glue it. The L.E.D should now light when the trigger is pulled.

Short Range Weapon

A very short range weapon suitable for mines, grenades and hand weapons can be made very simply by using a circuit similar to the one built in "Machine Guns". The range depends to a certain extent on how well the circuit has be "tuned" to the correct frequency but will not exceed several metres without a lens system.

The circuit below produces a square wave which drives an infra-red L.E.D via a transistor. The correct frequency to use is about 2 KHz and this can be accurately found by adjusting the variable resistor, with the circuit next to a live sensor. When the sensor is set off, gradually increase the distance between it and the circuit while fine tuning the resistor to get the maximum range.



Long Range Weapon

This circuit gives a much greater range than the previous one, and is suitable for use in guns. Using a lens system it can obtain ranges of over 180 metres.

When building the circuit use IC chip holders, and be careful not to touch the chips legs when installing them. The chips used are of CMOS logic technology and as such are very susceptable to damage from static electricity. It is best to follow accepted handling procedures when using these chips, which can be found in most electronics books.

Once built, the two variable resistors (VR1 and VR2), should be set to about their midpoints. VR1 should now be adjusted, sweep the resistor through its full range, with the circuit activated, noting when this sets off a sensor. Now move the resistor again and find the upper and lower limits of this range and position the resistor in the midpoint. If you own an oscilloscope then the signal on pin 4 of IC1 should have a frequency of about 2000 Hz.

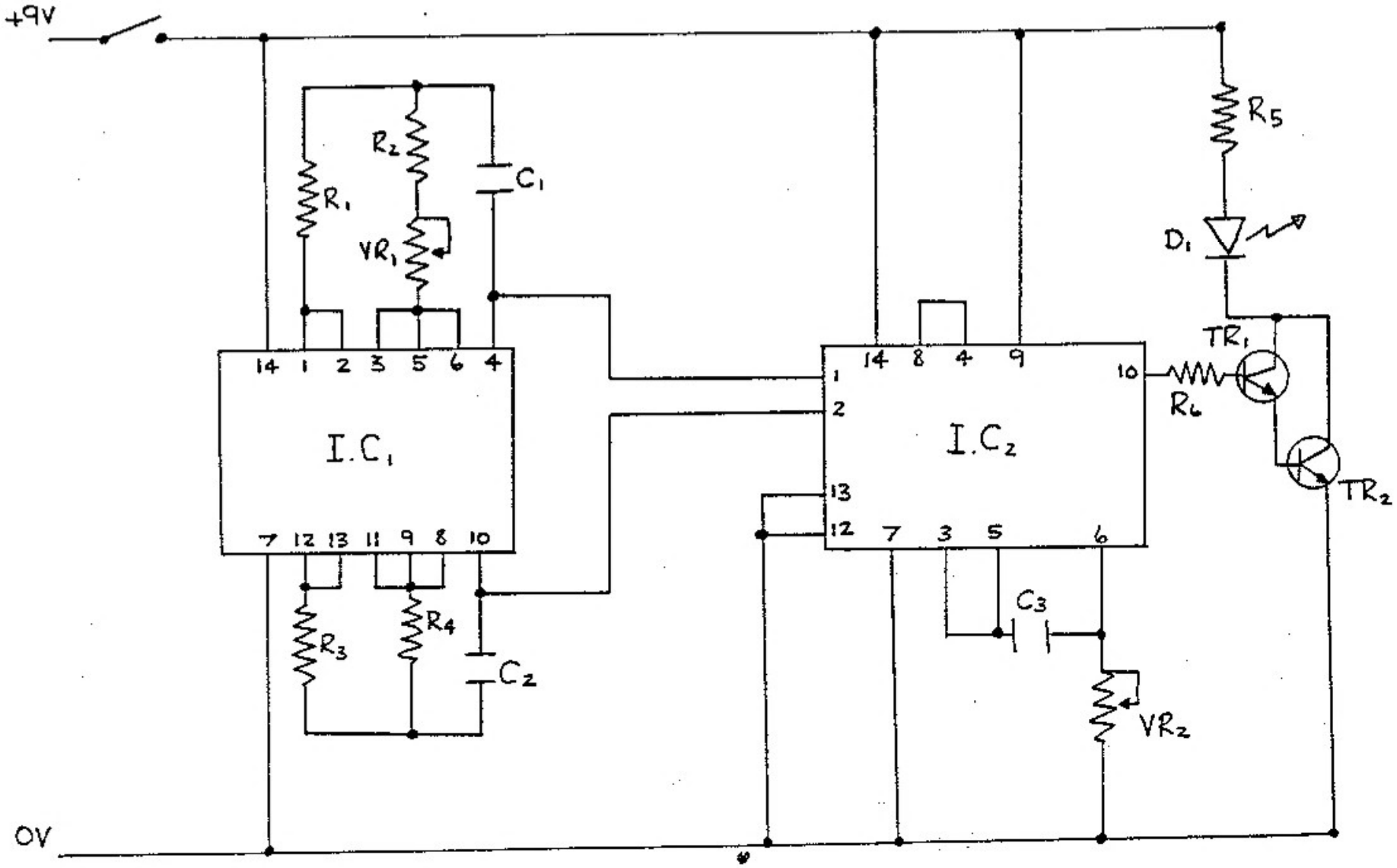
If the circuit does not hit no matter where VR1 is positioned, then first check that that there is a signal on pin 4 of IC1 (this can be done by connecting a high impedance speaker between pin 4 and 0V).

If there is no tone then there is a fault in the circuit, or the chip has been damaged. If there is a signal then this tone can be matched (by varying VR1) to the tone produced when a loudspeaker is connected across the emitter in a tag gun (It may be necessary to change the value of R2 as well).

Now that the circuit hits a sensor, set VR2 to about 1/4 of its maximum value and the circuit is now ready.

It may be necessary to retune VR1 when it is exposed to large temperature variations.

R1,R2,R3	=	22 K Ohms
R4	=	10 K Ohms
R5	=	1.5 Ohms
R6	=	47 Ohms
VR1,VR2	=	10 K Ohms variable
C1	=	22 n Farads
C2	=	1500 p Farads
C3	=	1000 p Farads
D1	=	TIL 38 Infra-red LED (or equivalent)
TR1	=	BC 337
TR2	=	TIP 122
IC1	=	Quad Nand CMOS 4011 BE
IC2	=	Quad And CMOS 4081 BE


+9V
R1
R2
VR1
C1
14 1 2 3 5 6 4
I.C1
7 12 13 11 9 8 10
R3
R4
C2
0V
14 8 4 9
1
2
13
12 7 3 5 6
I.C2
10
R6
R5
D1
TR1
TR2
C3
VR2

SENSORS

Each different type of commercial gun has its own sensor supplied with it. Lazer Tags have three different types of sensor. All seem to be compatible to a greater or lesser extent.

Lazer Tags

The sensor supplied with the gun is a starsensor. It will recieve hits from about the forward 170°. Another type of sensor that can be purchased is the Star Cap this recieves hits from the full 360° as does the last type, the Star Helmet. The Star Cap is a little small for adults and requires some cutting and alteration to fit. The Star Helmet fits adults but restricts hearing a lot and is also hot to wear.

For some reason the Star Sensors are the most sensitive, Star Caps next and Star Helmets least sensitive. All three types count up to six hits.

G.I Joes, Quickshots and Infra-red Rays Guns

The sensors supplied with all of the above only recieve hits from the forward 90° and so are not suitable to wear in games (unless special rules apply). They also only count 1 hit at a time.

The G.I Joe sensor is not able to detect more than the first hit from a rapid fire weapon until the fire is stopped and then started again. The Infra-red Rays gun sensor has to be adjusted by a small variable resistor inside before it will register hits from Lazer Tags, however doing so makes it insensitive to hits from its own gun (not ideal).

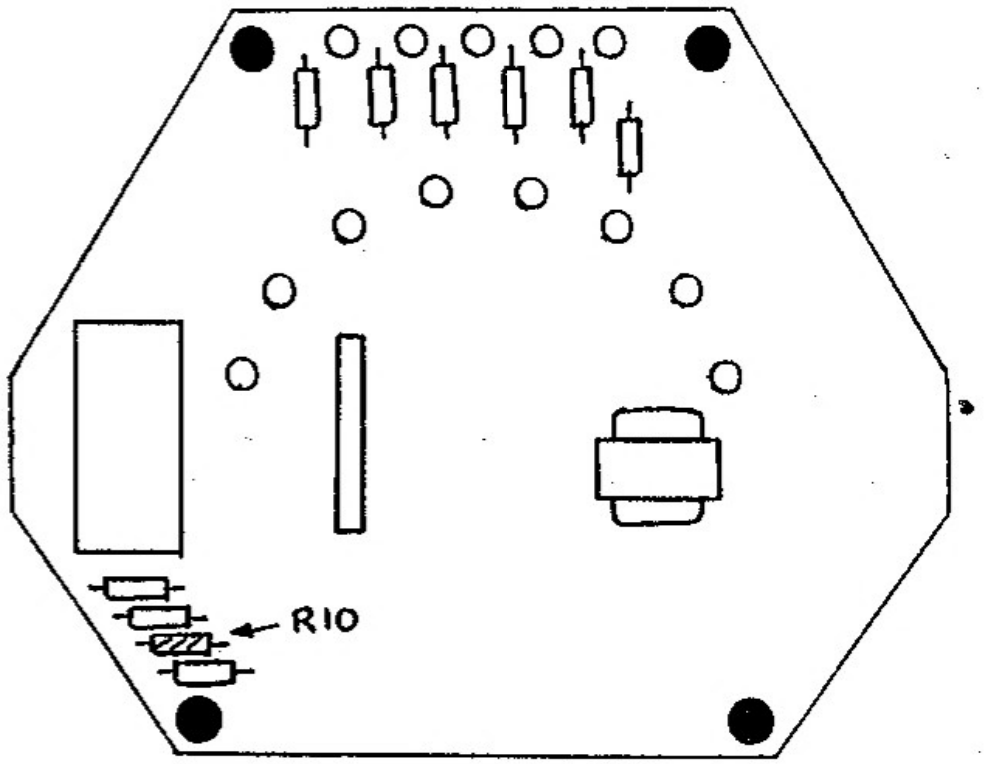
Bleeps Cure

The continual bleeping of the Lazer Tag sensors will give your position away and drive you crazy if you wear them long enough. Many is the time I have sat in the bath after a days tagging swearing that I can hear a sensor switched on.

The cure for this condition is to remove the bleeps before they remove your sanity, and to do this is a simple matter of cutting out a resistor.

Star Sensors

Remove the back of the sensor and gently pull out the circuit board. On the left hand side of the board from the front is a large chip with 4 resistors below it. Using wire cutters, remove the resistor labelled R10. This is the second one from the bottom. Now rebuild the sensor.



Star Caps

Disassemble the front of the starcap by removing the screws on its inside. Find the resistor labelled R7 which is on the opposite side of the board to the on/off switch and remove it. Reassemble.

Star Helmets

Disassemble the Starhelmet and find the resistor labelled R10. Remove it and reassemble.

NOTE: By removing the bleeps you make it less obvious when your battery is running out. Therefore regularly check your battery charge and use only new batteries.

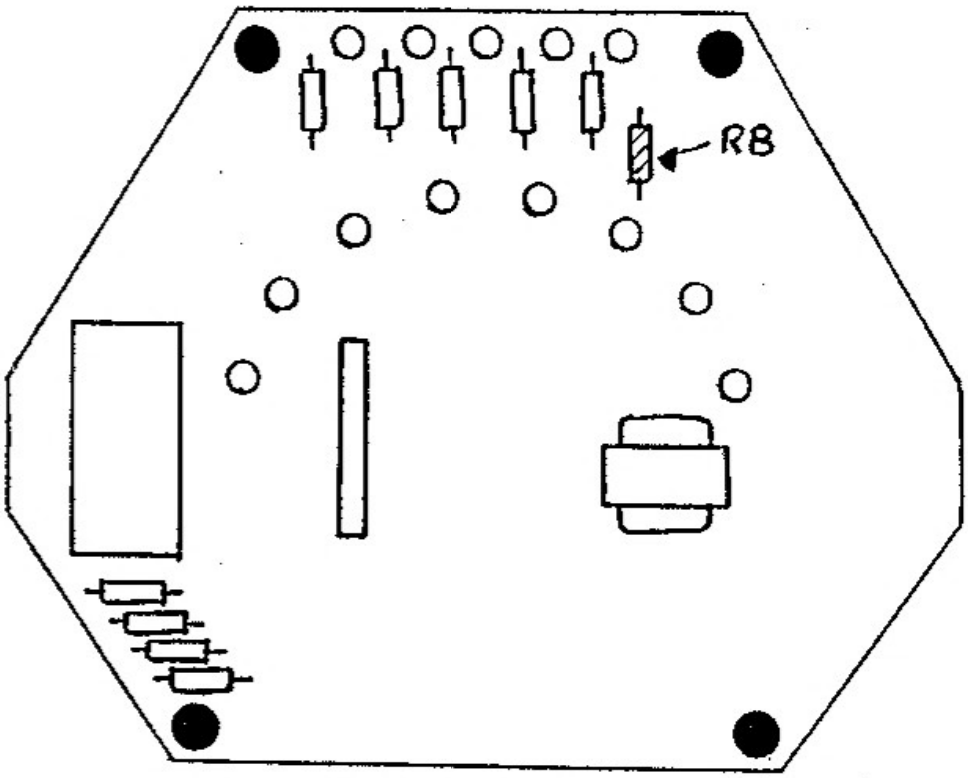
Removing Sensor Lights

The bouncing ball L.E.D's on the star sensor can be a bit of an annoyance during night games, as they are very difficult to obscure from the outside without covering the receptor of the sensor at the same time. There is a similar modification to the "Bleeps Cure" that can be performed to stop these lights, but since not all clubs allow this it is wise to use a switch rather than to permanently break the connection.

The lights on the star cap and star helmet are easily obscured with black insulating tape and so similar modifications are probabley not worthwhile.

Star Sensors

Again disassemble the sensor to expose to circuit board. Locate the resistor labelled R8 on the far right of the top. Cut one of its ends and solder two pieces of wire, one to each side of the cut metal. The two free ends of the wires can then be soldered to a switch which can be placed in a convenient place on the body.



Star Caps

The resistor required is R5.

Star Helmets

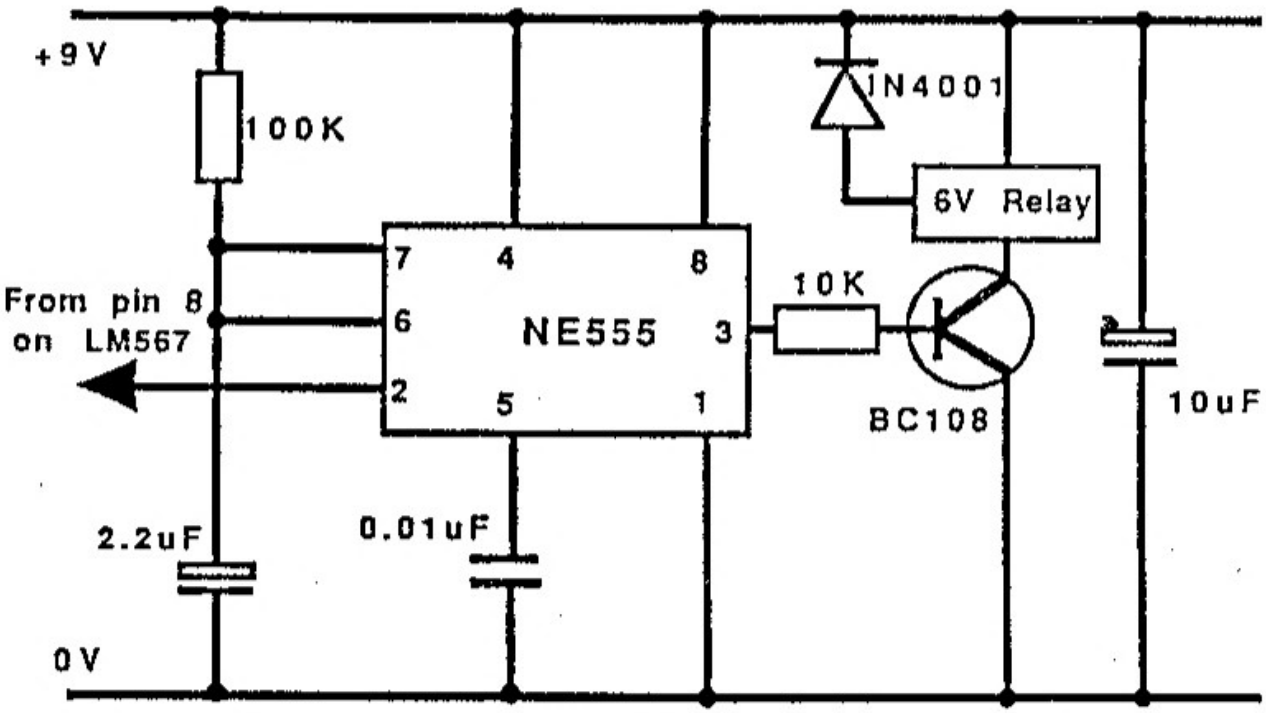
The resistor required is R6 in the compartment behind the L.E.D's.

G.I Joe Sensor Modification

The one shot sensor supplied with the G.I Joe gun can be put to good use by converting it to activate a relay when it is hit. This can be used to set off all manner of other circuits including guns and flash cubes.

Open the sensor and locate the I.C LM567. The circuit below should be built and connected to pin 8 on this chip. (pin 8 is the top right hand pin with the chip viewed the right way up ie with the spot or notch on the plastic casing at the top)

The length of time that the relay closes for can be altered by changing the 2.2 micro Farad capacitor in the circuit. Currently the time will be about 0.5 of a second, longer times are produced with bigger capacitor values.



Slaving Lazer Tag Star Sensors

Since Star Sensors can only recieve hits from the front, it is necessary to connect or slave two sensors together to obtain a 360° arc of sensitivity that all groups currently use with Star Caps and helmets.

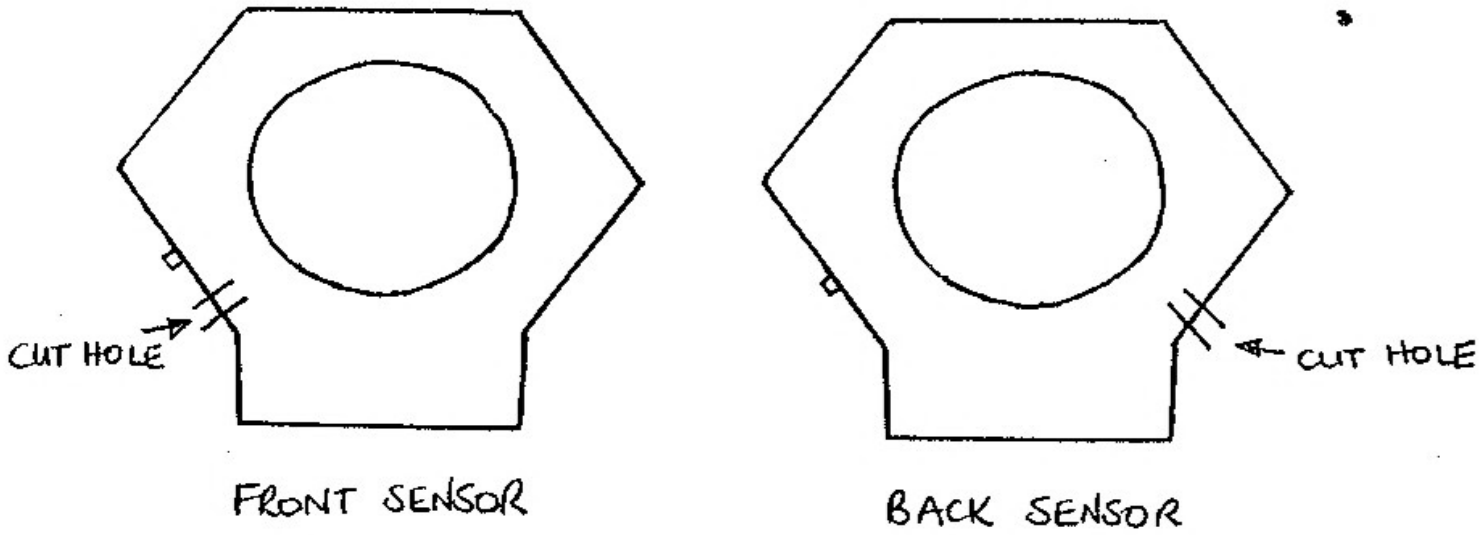
A method of doing this is as follows:

1] Open the sensors by removing the four screws on each at the back.

2] Cut some two core cable to the required length, that is the distance the sensors are to be apart plus about 15cm for allowing the wire to reach the outside of the sensors.

3] Locate the points TP8 and TP10 on the back of the sensor circuit boards. connect the ends of the wire to these points on each sensor with a soldering iron. Ensure that the same wire is connected to the same point at each end. Two colour wire is useful to ensure this. Use as little heat as necessary and apply a little new solder to each point as this will assist it to melt.

4] Cut two holes, one in each sensor body to enable the wire to exit. remember to cut the holes in opposite side so that the wire is on the same side when the sensors are placed back to back (as they will be worn). See the diagram below.



5] Bend the wire from the contacts down to the channel beside the battery compartment away from the hole that you have made. Then bend the wire back up the channel towards the hole, make a final 90° bend then pass the wire out. This arrangement traps the wire securely and prevents stress on the contact points.

6] Cut the wires to the speaker on the sensor that will become the rear one when worn.

7] Reassemble the sensors taking care not to trap the wires. On the sensor with the hole opposite the on/off switch, some plastic will have to be removed from the back of the sensor to allow the wire to exit.

Using the Sensors

To use the sensors perform the following routine:

1] Switch off both sensors.

2] Put batteries in both sensors.

3] Switch on the rear sensor. Its lights will flash and then it will recieve six hits automatically.

4] When this sensor has finished its flashing and "died", switch on the front sensor.

5] You are now ready to play.

Buzzer Board

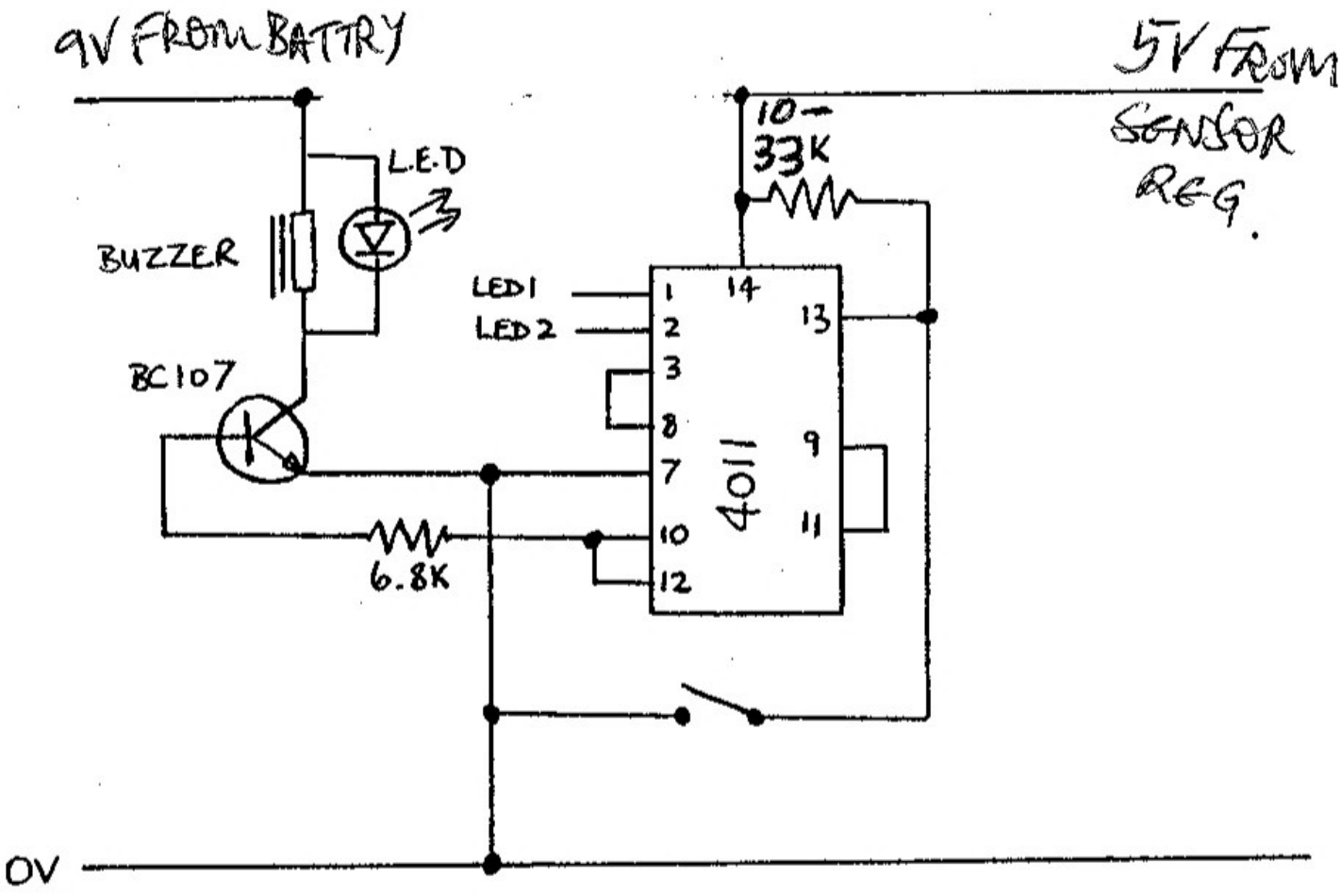
Sometimes in the middle of a crowded Firefight, it is difficult to know whether or not it is your sensor that has been set off. A modification that can be made to avoid this problem is the Buzzer Board. This circuit sounds a separate buzzer when all of your hits have been taken, which can be placed close to your ear.It also lights a bright L.E.D that can be positioned so that it can be seen.

The circuit is quite simple and depends upon the fact that when all your hits are lost, all of the L.E.D's at the front of the sensor flash together. By detecting the pulses at two of these L.E.D's, the buzzer can be made to sound only when pulses appear at both together.

Construct the circuit as indicated in the diagram. The wires LED1 and LED2 should be connected to one leg of the first green L.E.D and one leg of the last red L.E.D in the sensor, preferable the leg on the same side of each. The board needs to be powered from the same supply as the sensor, otherwise the circuit is unstable.

Components

BC 107 Transistor
12 V buzzer
Momentary pushbutton switch
Bright visible L.E.D
4011 Quad 2 input Nand gate
I.C holder for above
6.8 K Ohm resistor
1 K Ohm resistor



Power Supplies

All electronic circuits require power supplies to work, this is supplied by the use of batteries for our purposes. There are many different types of batteries but I shall simplify them into four catagories:

1] Alkaline
2] High Power
3] Standard
4] Rechargable

Alkaline

These are the most expensive normal battery per unit, however they work out to be the cheapest to use. Typically they have lifespans of 6-7 times that of a standard battery and are ideal for long continuous applications such as our sensors. Examples of these include Duracell, Ever Ready Gold Seal and other own label brands from supermarkets. These own label brands are usually a bit cheaper that the well known names and are not necessarily any worse as they are purchased from the same manufacturers. I can personally recommend the Asda type.

High Power

These batteries fall between the Standard and Alkaline batteries both in performance and type. If alkaline or rechargable batteries are outside your price range, I would recommend these. Ever Ready Silver Seal is an example of this type.

Standard

I cannot recommend these batteries unless you are really broke. I would certainly not buy them for a sensor unless the game was to last for less than two hours. Longer than this would require a change of battery which would cost you more than buying a single High Power or Alkaline battery to start with. An example of this type is.

Rechargable

These batteries have a bad press when used in sensors, but this is not necessarily the case. So long as the rules you are using allow it, you can change your battery to a fresh one every couple of hours depending on usage.

These are by far the cheapest batteries to run. Although expensive to buy initially (£6.00-£7.00), they can be recharged with the proper equipment (more expense!) and reused anything up to a thousand times.

The voltage supplied by these batteries is less than that supplied by their conventional counterparts being 1.2V compared to a 1.5V battery and about 7-8V compared to a 9V battery. All this means is that to get the same voltage you have to use more of these batteries in series.

I highly recommend the use of these batteries in guns, I leave the decision of sensors to the individual clubs. It is worth noting in these enviromental times that these are the greenest type to use. Batteries require a lot of energy to make and use some quite nasty materials in their construction, which are dumped when finished with.

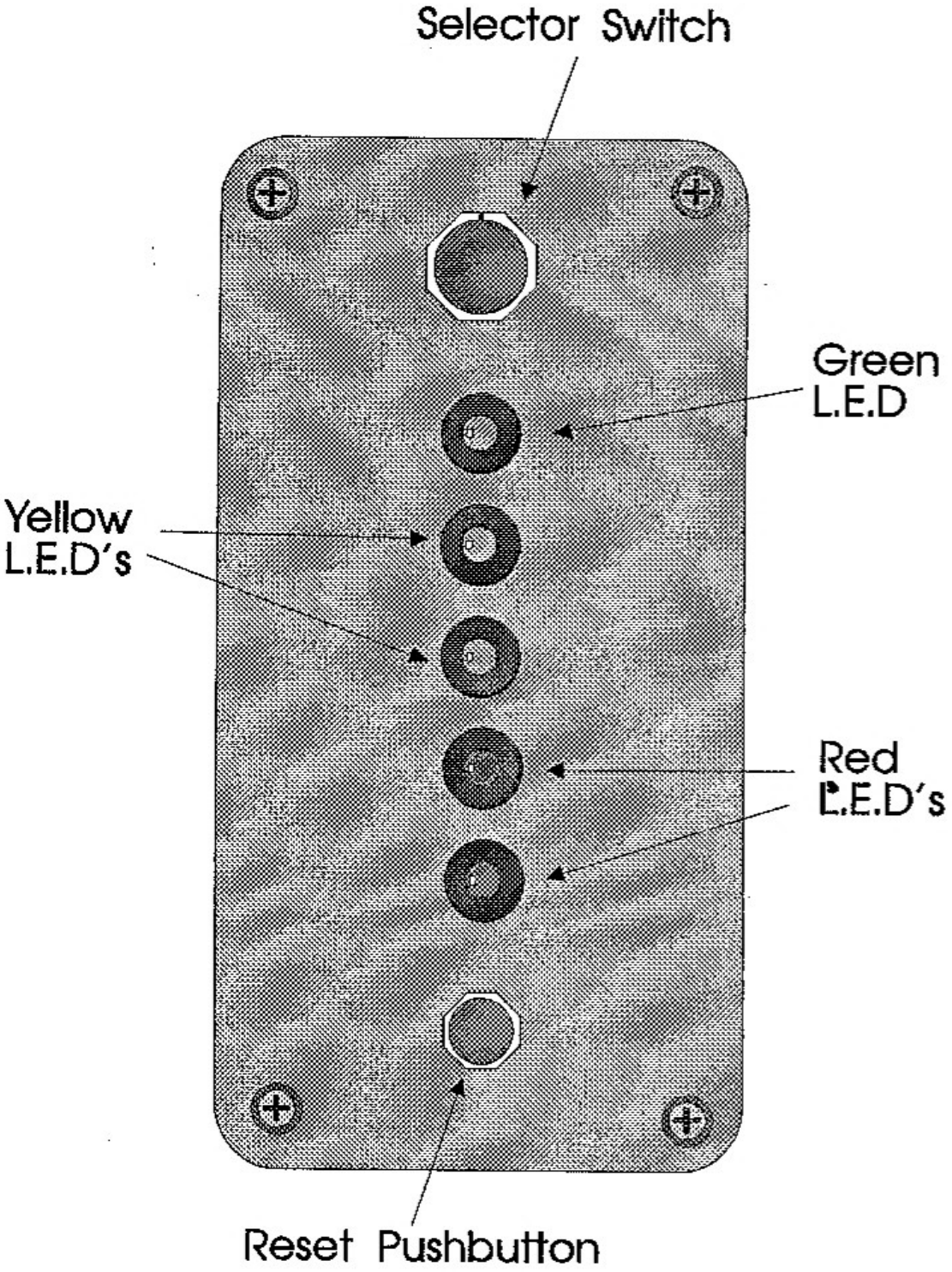
Single Batteries v Battery packs

A single 9V PP3 battery has the same voltage as six of the smaller batteries. However it will not be able to supply as much current to a circuit and will run out sooner. In almost all cases a guns performance can be improved by using a battery pack rather than a single PP3. It may also be possible to use more voltage than the gun was intended for but I take no responsibility whatever if you decide to try this trick, as you may damage it.

Connecting Power Packs

It is quite likely that when building your own guns you will choose to have separate power supplies to run the gun, sound system and possibly ammo counter. Unless you are using relays to completely isolate these circuits instead of transistors just to switch them on and off, you will need to connect the negative terminals of all the battery packs used together. This is to give all the power sources a reference level to compare themselves to, many circuits will not work unless this is done.

The C.I.A.B Medical Unit



This unit is an attempt to introduce an easily accessable, cheap and playable medical facility into club games. Several clubs have already agreed to use these units in interclub games so that medical rules are simplified and understood by all those attending.

The unit consists of a hand held box, with five coloured L.E.D's on its face. There are also two switches, a pushbutton type to reset the unit and a four position switch to turn the unit on and select the intensity of healing required.

On resetting, the unit lights the bottom red L.E.D and makes an audible buzz. Then in sequence the L.E.D's light and go out again from the bottom up, each with a similar buzz. Once the unit has completed its cycle of lights, the patient is said to be healed and may reset their sensor.

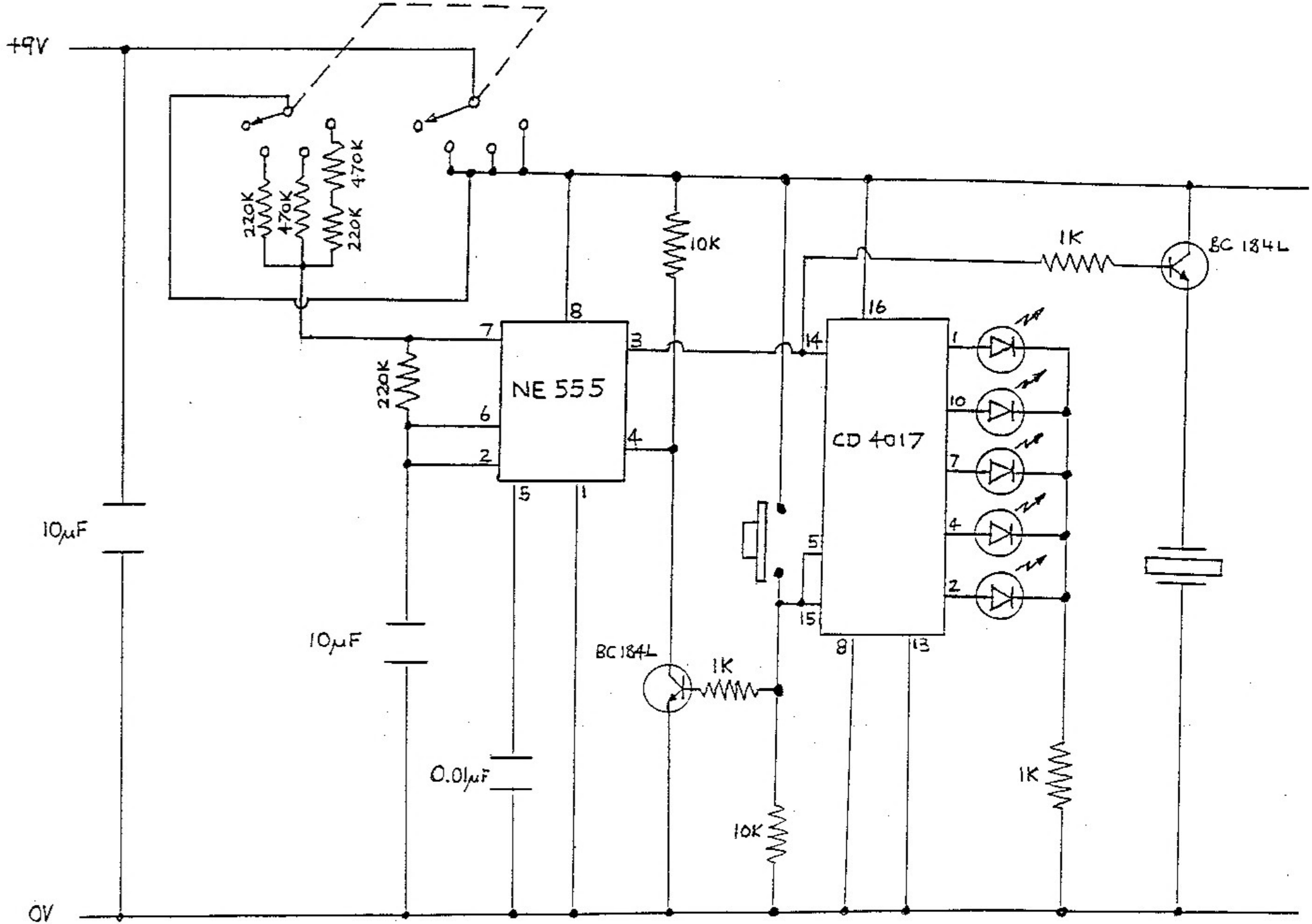
The first setting is used when the patient is on any green or yellow sensor light. The second setting is used when the patients red sensor light is lit. The final setting is used when the patient has been stunned (all hits taken).

The cycle times for the unit for each of the settings are 20 seconds, 40 seconds and 60 seconds respectively. To be used the unit should be placed on the patients chest and while in use no other actions should be taken be either the patient or the medic.

Components

Component	Maplin Order No
Stripboard	JP47B
Wire	BL00A
6V buzzer	FL39N
Rotary 4 way switch	FH44X
Knob	FE74R
Universal Project Box	YU53H
Push Button switch	FH59P
5 x LED Holders*	UK14Q
PP3 Battery Holder*	XX33L
PP3 Battery Clip	
555 Timer I.C	QH66W
4017 Decade Counter	
2 x BC184L Transistors	QB57M
2 x 10 microFarad capacitors	
1 x 0.1 microFarad capacitor	
3 x 1 K Ohm Resistors	
2 x 10 K Ohm Resistors	
3 x 220 K Ohm Resistors	
2 x 470 K Ohm Resistors	
2 x red L.E.D's	WL27E
2 x yellow L.E.D's	WL30H
1 x green L.E.D	WL28F

* Not essential


+9V
220K
470K
470K
220K
10K
1K
BC 184L
8
7
3
16
14
1
10
7
4
2
6
2
4
5
1
5
15
8
13
NE 555
CD 4017
220K
10µF
10µF
0.01µF
BC184L
1K
10K
1K
0V

Hide n Sneak Modification

These interesting little toys made by Worlds of Wonder are ultrasound emitters and detectors that allow you to locate the one with the other. A little annoyance with these is the method of turning on the emitter, it requires its top to be tapped by the detector until a lights turns on.

This has two distinct disadvantages:

1] You cannot carry the emitters in the same bag as the detector, as they stand a chance of being turned on by accident, wasting batteries.

2] You have to remember to turn on the emitter before leaving the detector with someone else.

A simple modification to rectify this is to open up the smaller emitter and locate the magnetic switch wrapped in foam at the top of it. Remove this switch and replace with one of your choice, mounting it on the emitter.

Hand Grenade/Mine Circuit

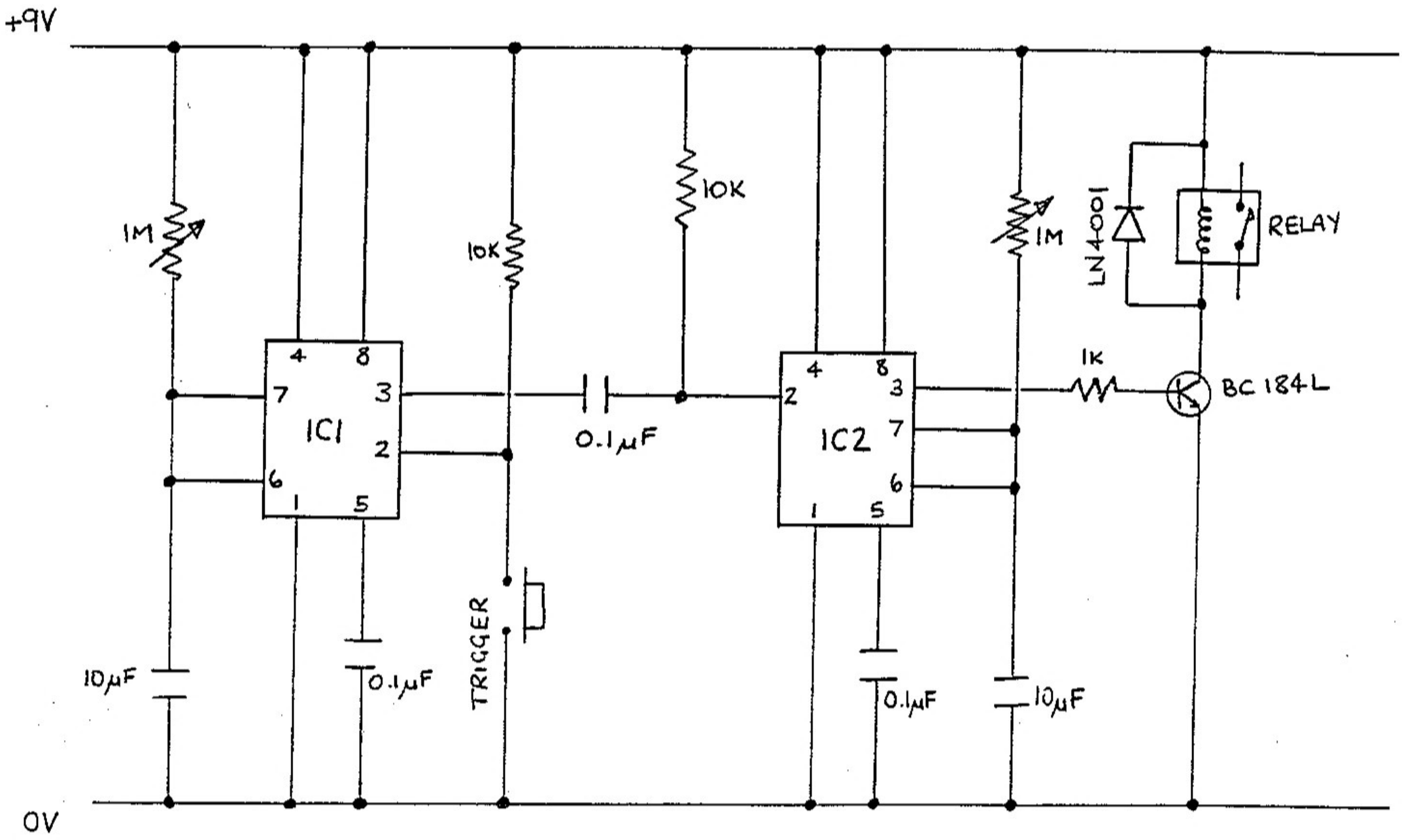
This is a very simple circuit but also a very useful one. It allows any circuit of the users choice to be activated for a preset period of time, after a preset delay. Thus it is ideal for triggering mines, hand grenades or any special effect such as a flash cube.

The initial trigger may be a simple pushbutton perhaps held open by a pin arrangement as in a hand grenade, or as complex as a passive infra red movement detector. The only condition is that the trigger is closed either permanently or momentarily.

IC1 is connected so that when the trigger is pressed, its output at pin 3 becomes positive for a period of time determined by the variable 1M Ohm resistor and the 10 micro Farad capacitor on the left of the circuit. The variable resistor can be altered to make this "on" period anything up to about 10 seconds. When this period finishes, the output at pin 3 drops to negative and it is this drop that triggers IC2 on its identical cycle. Again the length of this cycle can be altered using the second 1M Ohm variable resistor.

Triggering IC2 causes its output at pin 3 to become high. This causes the transistor to conduct and the relay to close. The relay contacts can be used as a switch to operate any other circuit.

Both IC1 and IC2 are NE555 chips or equivalent.


+9V
1M
10K
10K
1M
1N4001
RELAY
4
8
7
3
IC1
2
6
1
5
0.1μF
4
8
2
3
IC2
7
6
1
5
1K
BC 184L
10μF
0.1μF
TRIGGER
0.1μF
10μF
0V