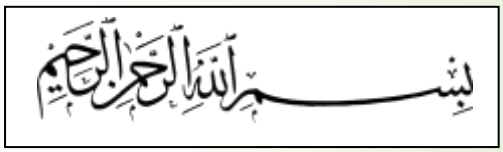
Oct 08

My LOGO



۴۹ پروژه الکترونیکی؛

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۲	آمپلیفایر ۲۵ وات صوتی	۱۹	شبیه ساز الکتروتراپی	۳۶	منبع دی سی قابل تنظیم
۳	فرکانس متر دقیق	۲۰	فلش لامپ ۲۲۰ ولت	۳۴	تولیدکننده زنگ تلفن
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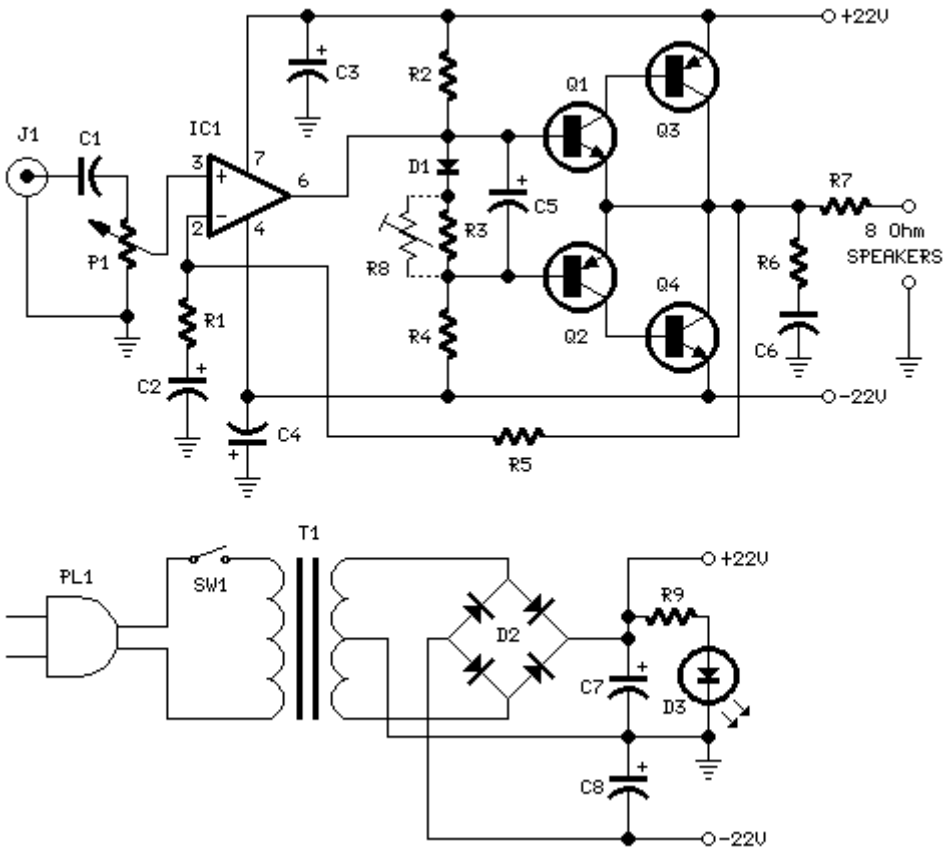
18W Audio Amplifier

High Quality very simple unit
No need for a preamplifier

Circuit diagram:



Amplifier parts:

```
P1_____________22K  Log.Potentiometer (Dual-gang for stereo)

R1_____________1K  1/4W Resistor
R2_____________4K7 1/4W Resistor
R3____________100R  1/4W Resistor
R4_____________4K7 1/4W Resistor
R5_____________82K  1/4W Resistor
R6_____________10R  1/2W Resistor
R7_____________R22  4W Resistor (wirewound)
```

```
R8_______________1K  1/2W Trimmer Cermet (optional)

C1_____________470nF  63V Polyester Capacitor
C2,C5__________100µF   3V Tantalum bead Capacitors
C3,C4__________470µF  25V Electrolytic Capacitors
C6_____________100nF  63V Polyester Capacitor

D1___________1N4148  75V 150mA Diode

IC1________TLE2141C  Low noise,high voltage,high slew-rate Op-amp

Q1_____________BC182  50V 100mA NPN Transistor
Q2_____________BC212  50V 100mA PNP Transistor
Q3___________TIP42A  60V 6A    PNP Transistor
Q4___________TIP41A  60V 6A    NPN Transistor

J1_______________RCA  audio input socket
```

Power supply parts:

```
R9_______________2K2 1/4W Resistor

C7,C8________4700µF 25V Electrolytic Capacitors

D2_____________100V 4A Diode bridge
D3_____________5mm. Red LED

T1_____________220V Primary, 15 + 15V Secondary 50VA Mains transformer

PL1____________Male Mains plug

SW1____________SPST Mains switch
```

Notes:

- Can be directly connected to CD players, tuners and tape recorders.
- Don't exceed 23 + 23V supply.
- Q3 and Q4 must be mounted on heatsink.
- D1 must be in thermal contact with Q1.
- Quiescent current (best measured with an Avo-meter in series with Q3 Emitter) is not critical.
- Adjust R3 to read a current between 20 to 30 mA with no input signal.
- To facilitate current setting add R8 (optional).
- A correct grounding is very important to eliminate hum and ground loops. Connect in the same point the ground sides of J1, P1, C2, C3 &C4. Connect C6 at the output ground.
- Then connect separately the input and output grounds at the power supply ground.

Technical data:

Output power: 18 Watt RMS @ 8 Ohm (1KHz sinewave)

Sensitivity: 150mV input for 18W output

Frequency response: 30Hz to 20KHz -1dB

Total harmonic distortion @ 1KHz: 0.1W 0.02% 1W 0.01% 5W 0.01% 10W 0.03%
Total harmonic distortion @10KHz: 0.1W 0.04% 1W 0.05% 5W 0.06% 10W 0.15%

Unconditionally stable on capacitive loads

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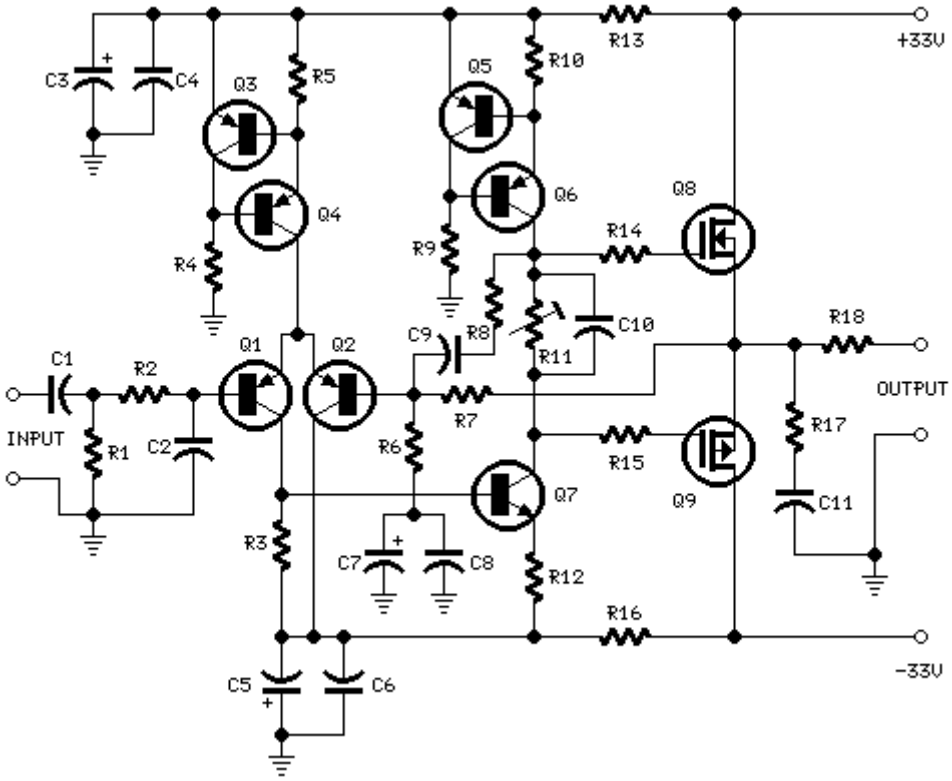
25 Watt MosFet Audio Amplifier

High Quality simple unit
No need for a preamplifier

Circuit diagram:



Parts:

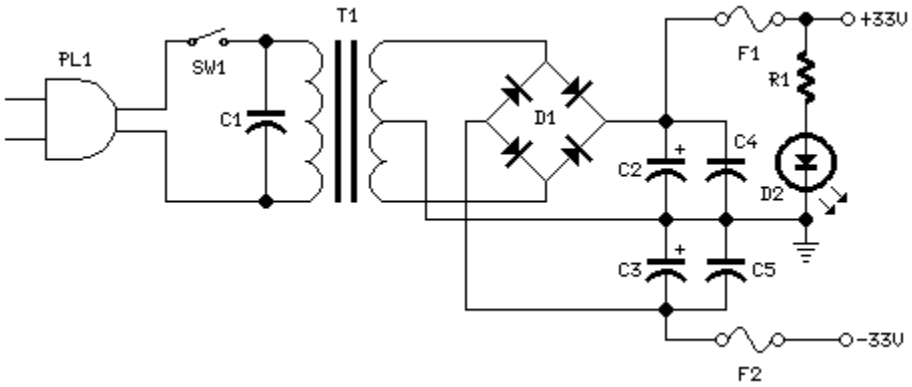
R1,R4	47K	1/4W Resistors
R2	4K7	1/4W Resistor
R3	1K5	1/4W Resistor
R5	390R	1/4W Resistor
R6	470R	1/4W Resistor
R7	33K	1/4W Resistor
R8	150K	1/4W Resistor
R9	15K	1/4W Resistor
R10	27R	1/4W Resistor
R11	500R	1/2W Trimmer Cermet
R12,R13,R16	10R	1/4W Resistors
R14,R15	220R	1/4W Resistors

R17_____8R2 2W Resistor
R18_____R22 4W Resistor (wirewound)

C1_____470nF 63V Polyester Capacitor
C2_____330pF 63V Polystyrene Capacitor
C3,C5_____470µF 63V Electrolytic Capacitors
C4,C6,C8,C11_100nF 63V Polyester Capacitors
C7_____100µF 25V Electrolytic Capacitor
C9_____10pF 63V Polystyrene Capacitor
C10_____1µF 63V Polyester Capacitor

Q1-Q5_____BC560C 45V 100mA Low noise High gain PNP Transistors
Q6_____BD140 80V 1.5A PNP Transistor
Q7_____BD139 80V 1.5A NPN Transistor
Q8_____IRF532 100V 12A N-Channel Hexfet Transistor
Q9_____IRF9532 100V 10A P-Channel Hexfet Transistor

Power supply circuit diagram:



Parts:

R1_____3K3 1/2W Resistor

C1_____10nF 1000V Polyester Capacitor
C2,C3_____4700µF 50V Electrolytic Capacitors
C4,C5_____100nF 63V Polyester Capacitors

D1_____200V 8A Diode bridge
D2_____5mm. Red LED

F1,F2_____3.15A Fuses with sockets

T1_____220V Primary, 25 + 25V Secondary 120VA Mains transformer

PL1_____Male Mains plug

SW1_____SPST Mains switch

Notes:

- Can be directly connected to CD players, tuners and tape recorders. Simply add a 10K Log potentiometer (dual gang for stereo) and a switch to cope with the various sources you need.
- Q6 & Q7 must have a small U-shaped heatsink.
- Q8 & Q9 must be mounted on heatsink.
- Adjust R11 to set quiescent current at 100mA (best measured with an Avo-meter in series with Q8 Drain) with no input signal.
- A correct grounding is very important to eliminate hum and ground loops. Connect in the same point the ground sides of R1, R4, R9, C3 to C8. Connect C11 at output ground. Then connect separately the input and output grounds at power supply ground.

Technical data:

Output power: well in excess of 25Watt RMS @ 8 Ohm (1KHz sinewave)

Sensitivity: 200mV input for 25W output

Frequency response: 30Hz to 20KHz -1dB

Total harmonic distortion @ 1KHz: 0.1W 0.014% 1W 0.006% 10W 0.006% 20W 0.007% 25W

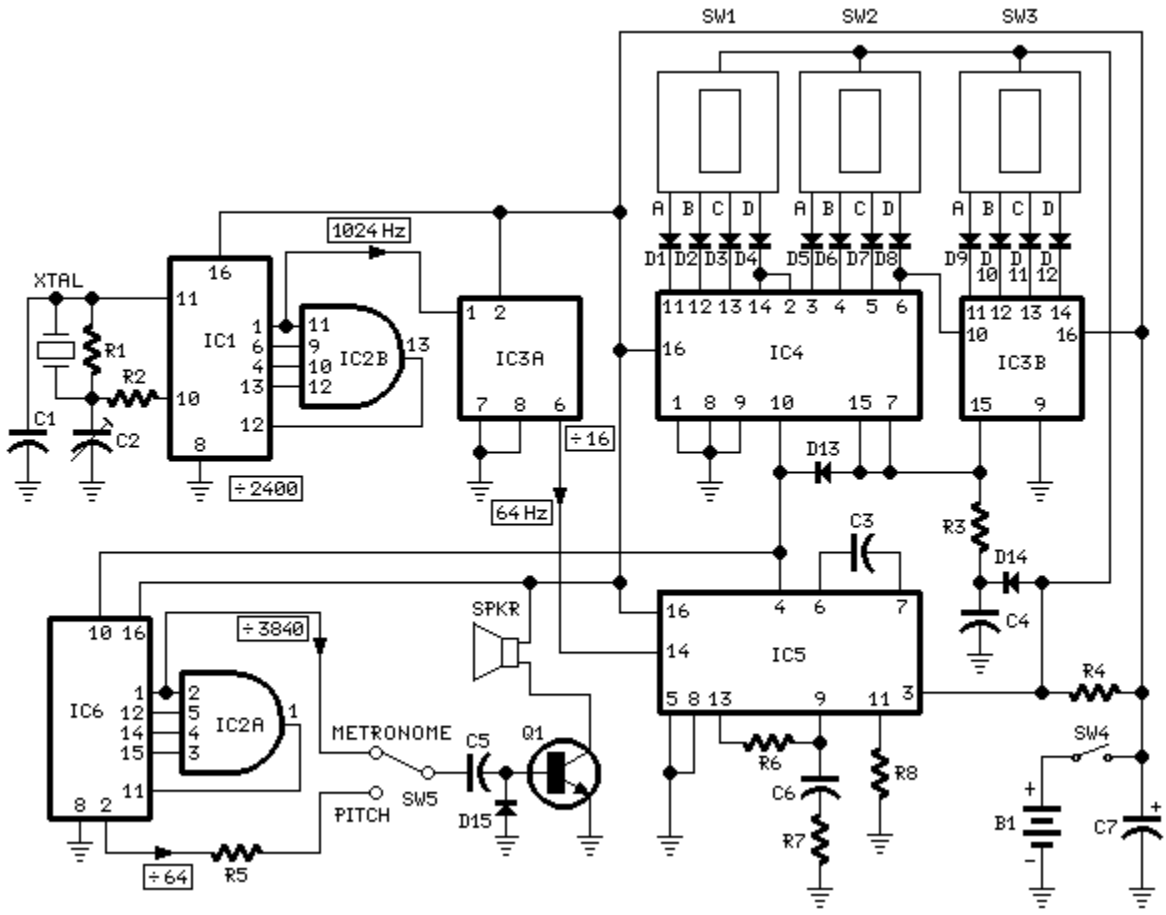
Total harmonic distortion @10KHz: 0.1W 0.024% 1W 0.016% 10W 0.02% 20W 0.045% 25W

Unconditionally stable on capacitive loads

Precision Metronome and Pitch ge

Precision Frequency generator 1 to 999 Hz
Precision Metronome 1 to 999 beats per minute

Circuit diagram:



Parts:

```
R1_________1M  1/4W Resistor
R2_________22K  1/4W Resistor
R3_________6K8 1/4W Resistor
R4_________4K7 1/4W Resistor
R5_________47K  1/4W Resistor
R6________100K  1/4W Resistor
R7_________39K  1/4W Resistor
R8_________12K  1/4W Resistor
```

```
C1_________47pF  63V Ceramic Capacitor
C2_______2-22pF  63V Ceramic Trimmer
C3_________470pF  63V Ceramic Capacitor
C4_________10pF  63V Ceramic Capacitor
C5_________100nF  63V Polyester Capacitor
C6_________220nF  63V Polyester Capacitor
C7_________22µF  25V Electrolytic Capacitor

D1-D15___1N4148  75V 150mA Diodes

IC1________4060  14 stage ripple counter and oscillator IC
IC2________4082  Dual 4 input AND gate IC
IC3________4520  Dual binary up-counter IC
IC4________4518  Dual BCD up-counter IC
IC5________4046  Micropower Phase-locked Loop IC
IC6________4040  12 stage ripple counter IC

Q1________BC337  45V 800mA NPN Transistor

XTAL______2.4576 MHz Miniature Quartz crystal

SW1__________BCD Miniature Thumbswheel Switch (units)
SW2__________BCD Miniature Thumbswheel Switch (tens)
SW3__________BCD Miniature Thumbswheel Switch (hundreds)
SW4_________SPST Slider Switch (On-off)
SW5_________SPDT Slider Switch (Metronome-Pitch)

SPKR_______8 Ohm, 50 mm. Loudspeaker

B1_________9V PP3 Battery

Clip for 9V PP3 Battery
```

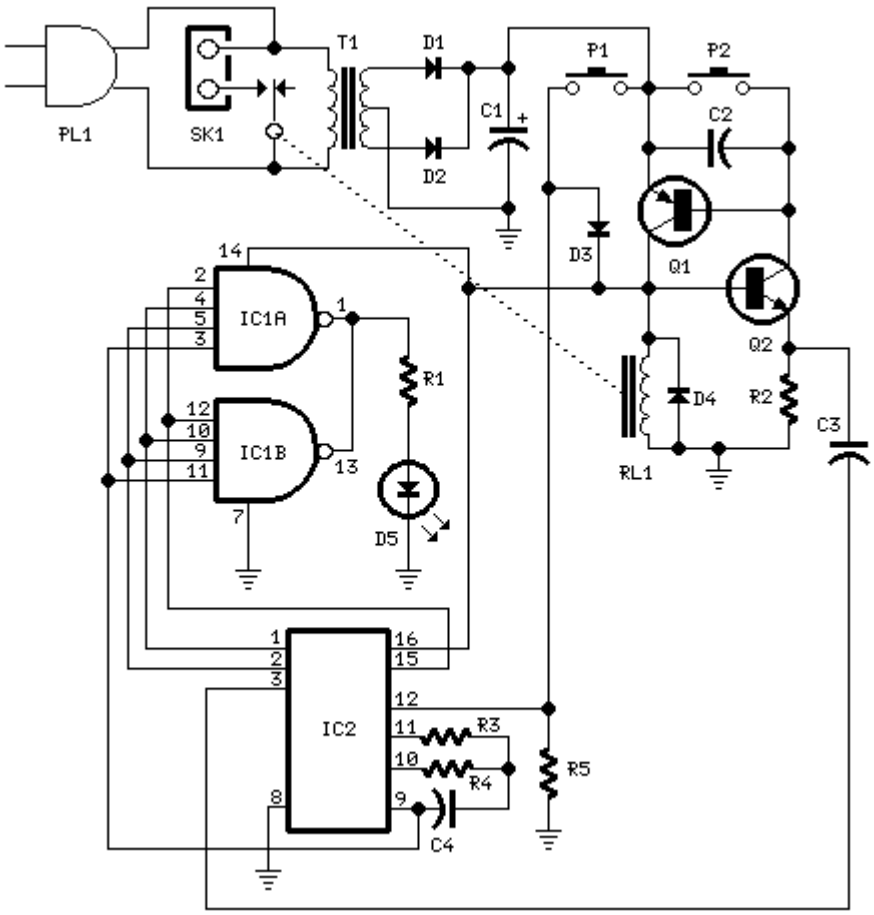
Circuit operation:

CMos IC1 and IC2B quad AND gate form a 2.4576 MHz crystal oscillator plus a 2400 times divider. IC3A provides further division by 16, obtaining a 64 Hz stable frequency square wave. This frequency is multiplied by operation of Phase Locked Loop IC5, double decade divider IC4 and IC3B 4 bit binary divider, by the number set by three miniature BCD thumbswheel switches SW1, SW2 and SW3: units, tens and hundreds respectively.
Connecting, by means of SW5, Q1 base to pin 2 of IC6, we obtain after a 64 times division, the same frequency set by thumbswheel switches with quartz precision, and no need for a scale indicator.
Volume regulation of the pitch generator is obtained trimming resistor R5. In the same manner, with SW5 set to metronome, the small speaker reproduces the frequency set by thumbswheel switches but divided by 3840, thus obtaining beats per minute ratio.

Bedside Lamp Timer

30 minutes operation
Blinking LED signals 6 last minutes before turn-off

Circuit diagram:



Parts:

```
R1________1K    1/4W Resistor
R2________4K7   1/4W Resistor
R3_______10M    1/4W Resistor
R4________1M    1/4W Resistor
R5_______10K    1/4W Resistor

C1_______470µF  25V Electrolytic Capacitor
```

```
C2-C4____100nF  63V Polyester Capacitors

D1-D4____1N4002 100V 1A Diodes
D5_______5mm. Red LED

IC1______4012  Dual 4 input NAND gate IC
IC2______4060  14 stage ripple counter and oscillator IC

Q1_______BC328  25V 800mA PNP Transistor
Q2_______BC238  25V 100mA NPN Transistor

P1,P2____SPST Pushbuttons

T1_______220V Primary, 9 + 9V Secondary 1VA Mains transformer

RL1______10.5V 470 Ohm Relay with SPDT 2A 220V switch

PL1______Male Mains plug

SK1______Female Mains socket
```

Device purpose:

The purpose of this circuit is that of power a lamp or other apparatus for a given time (30 minutes in this case), and then to turn it off. It's useful when reading at bed by night, turning off the bedside lamp automatically in case the reader falls asleep... After turn-on by P1 pushbutton, an LED lights for c25 minutes, but 6 minutes before the turn-off, start blinking for two minutes, then stop blinking for other two minutes and finally blinks for other two minutes, thus signaling that the on-time is ending. If the user want to prolong the reading, can earn another half-hour of light by pushing on P1. Turning-off the lamp at user's ease is obtained pushing on P2.

Circuit operation:

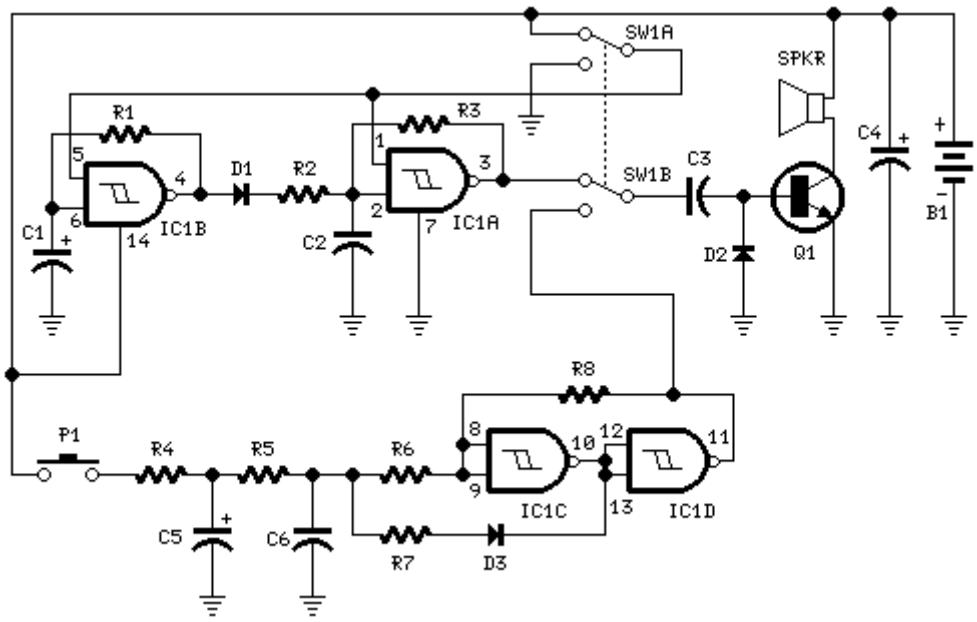
Q1 and Q2 forms an ALL-ON ALL-OFF circuit that in the off state draw no significant current. P1 starts the circuit, the relay is turned on and the two ICs are powered. The lamp is powered by the relay switch, and IC2 is reset with a positive voltage at pin 12. IC2 start oscillating at a frequency settled by R4 and C4. With the values shown pin 3 goes high after c30 minutes, turning off the circuit via C3. During the c6 minutes preceding turn-off, the LED does a blinking action by connections of IC1 to pins 1,2 & 15 of IC2. Blinking frequency is provided by IC2 oscillator at pin 9. The two gates of IC1 are in parallel to source an higher current. If needed, a piezo sounder can be connected at pins 1 & 14 of IC1. Changing IC2 brand name, varies the oscillation frequency. In particular Motorola's ICs run faster. Obviously, time can be varied changing C4 and R4 values.

This circuit was awarded with publication in ELECTRONICS WORLD "Circuit Ideas", October 1999 issue, page 819.

One-IC two-tones Siren

Double tone Police sound
Single tone old ambulance sound

Circuit diagram:



Parts:

```
R1,R3___470K   1/4W Resistors
R2_____680K   1/4W Resistor
R4_____82K   1/4W Resistor
R5_____330K   1/4W Resistor
R6_____10K   1/4W Resistor
R7_____33K   1/4W Resistor
R8_____3M3  1/4W Resistor

C1,C5____10µF  25V Electrolytic Capacitors
C2,C6____10nF  63V Polyester Capacitors
C3_____100nF  63V Polyester Capacitor
C4_____100µF  25V Electrolytic Capacitor

D1-D3___1N4148  75V 150mA Diodes

IC1____4093   Quad 2 input Schmitt NAND Gate IC

Q1_____BC337   45V 800mA NPN Transistor
```

```
P1______SPST Pushbutton

SW1_____DPDT Switch

SPKR____8 Ohm Loudspeaker

B1______6V Battery (4 AA 1.5V Cells in series)
```

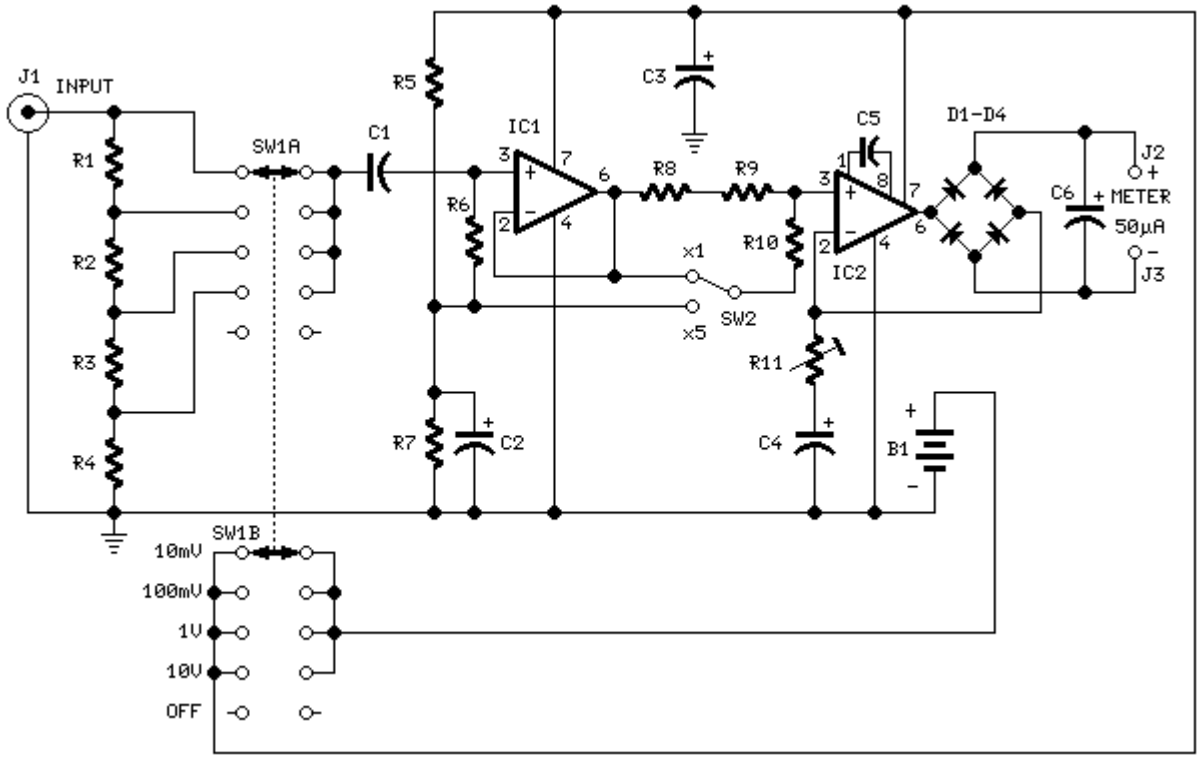
Circuit operation:

This circuit is intended for children fun, and is suitable to be installed on bicycles, battery powered cars and motorcycles, but also in models and other games. With SW1 positioned as shown in the circuit diagram it reproduces the typical dual tone sound of Police or Fire-brigade cars, by the oscillation of IC1A and IC1B gates. With SW1 in the other position, the old siren sound increasing in frequency and then slowly decreasing is reproduced, by pushing on P1 that starts oscillation in IC1C and IC1D. The loudspeaker, driven by Q1, should be of reasonable dimensions and well encased, in order to obtain a more realistic and louder output. Tone and period of the sound oscillations can be varied changing the values of C1, C2, C5, C6 and/or associated resistors. There is no power switch: leave SW1 in the low position (old-type siren) and the circuit consumption will be negligible.

Precision Audio Millivoltmeter

Measures 10mV to 50Volt RMS in eight ranges
Simply connect to your Avo-meter set @ 50µA range

Circuit diagram:



Parts:

```
R1_____909K    1/2Watt 1% Metal Oxide Resistor
R2_____90K9    1/2Watt 1% Metal Oxide Resistor
R3_____9K09    1/2Watt 1% Metal Oxide Resistor
R4_____1K01    1/2Watt 1% Metal Oxide Resistor
R5_____100K    1/4W Resistor
R6_____2M2     1/4W Resistor
R7_____82K     1/4W Resistor
R8_____12K     1/4W Resistor
R9_____1K2     1/4W Resistor
R10____3K3     1/4W Resistor
R11____200R    1/2W Trimmer Cermet

C1_____330nF   63V Polyester Capacitor
```

```
C2,C3__100µF   25V Electrolytic Capacitor
C4_____220µF   25V Electrolytic Capacitor
C5______33pF   63V Polystyrene Capacitor
C6_______2µ2   63V Electrolytic Capacitor

D1-D4___1N4148 75V 150mA Diodes

IC1_____CA3140 Op-amp
IC2_____CA3130 Op-amp

SW1_____2 poles 5 ways rotary switch
SW2_____SPDT switch

J1______RCA audio input socket
J2,J3___4mm. output sockets

B1______9V PP3 Battery

Clip for PP3 Battery
```

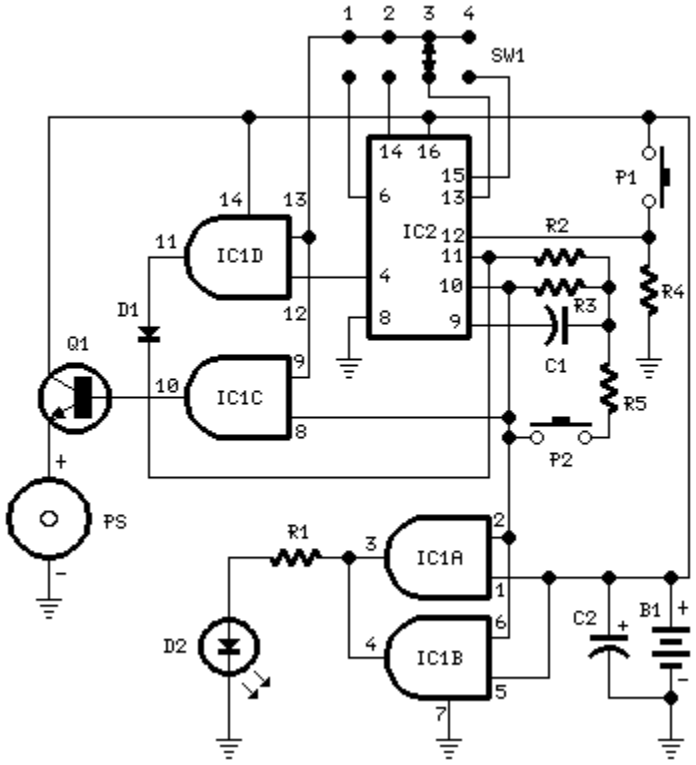
Notes:

- Connect J2 and J3 to an Avo-meter set @ 50µA range
- Switching SW2 the four input ranges can be multiplied by 5
- Total fsd ranges are: 10mV, 50mV, 100mV, 500mV, 1V, 5V, 10V, 50V
- Set R11 to read 1V in the 1V range, with a sinewave input of 1V @ 1KHz
- Compare the reading with that of another known precision Millivoltmeter or with an oscilloscope
- The oscilloscope reading must be a sinewave of 2.828V peak to peak amplitude
- Frequency response is flat in the 20Hz-20KHz range
- If you have difficulties in finding resistor values for R1, R2, R3 & R4, you can use the following trick:
  R1 = 10M + 1M in parallel
  R2 = 1M + 100K in parallel
  R3 = 100K + 10K in parallel
  R4 = 1K2 + 6K8 in parallel
  All resistors 1% tolerance

Timed Beeper

Beeps 7.5 seconds after a preset time
Adjustable time settings: 15 sec. 30 sec. 1 min. 2 min. & others

Circuit diagram:



Parts:

```
R1_____220R   1/4W Resistor
R2_____10M    1/4W Resistor
R3_____1M     1/4W Resistor
R4_____10K    1/4W Resistor
R5_____47K    1/4W Resistor

C1_____100nF  63V Polyester Capacitor
C2_____22µF   25V Electrolytic Capacitor

D1_____1N4148  75V 150mA Diode
D2_____3mm.   Red LED

IC1____4081   Quad 2 input AND Gate IC
```

```
IC2_____4060   14 stage ripple counter and oscillator IC

Q1______BC337  45V 800mA NPN Transistor

P1______SPST Pushbutton (Start)
P2______SPST Pushbutton (Reset)

SW1_____4 ways Switch (See notes)

PS______Piezo sounder (incorporating 3KHz oscillator)

B1______3V Battery (2 AA 1.5V Cells in series)
```

Device purpose:

This circuit is intended for alerting purposes after a certain time is elapsed. It is suitable for table games requiring a fixed time to answer a question, or to move a piece etc. In this view it's a modern substitute for the old sandglass. Useful also for time control when children are brushing teeth (at least two minutes!), or in the kitchen, and so on.

Circuit operation:

Pushing P1 resets IC2 that start oscillating at a frequency fixed by R3 & C1. With values shown, this frequency is approx. 4Hz. The LED D2, driven by IC1A & B, flashing at the same oscillator frequency, signals proper circuit operation. SW1 selects the appropriate pin of IC2 thus adjusting timing duration:

- Position 1 = 15 seconds
- Position 2 = 30 seconds
- Position 3 = 1 minute
- Position 4 = 2 minutes

When the selected pin of IC2 goes high, IC1C drives Q1 and the piezo sounder beeps intermittently at the same frequency of the LED. After approx. 7.5 seconds pin 4 of IC2 goes high and IC1D stops the oscillator through D1. If you want to stop counting in advance, push P2.

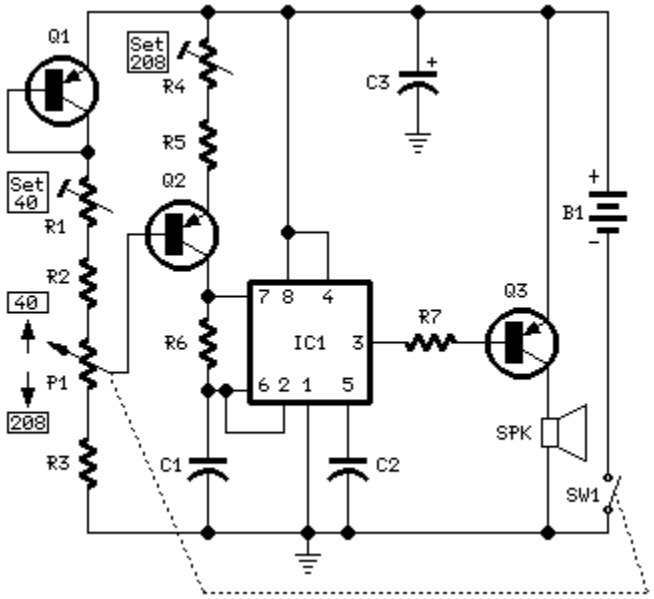
Notes:

- SW1 can be any type of switch with the desired number of ways. If you want a single fixed timing duration, omit the switch and connect pins 9 & 13 of IC1 to the suitable pin of IC2.
- The circuit's reset is not immediate. Pushing P2 forces IC2 to oscillate very fast, but it takes some seconds to terminate the counting, especially if higher timer's duration is chosen and the pushbutton is operated when the circuit has just started. In order to speed the reset, try lowering the value of R5, but pay attention: too low a value can stop oscillation.
- Frequency operation varies with different brand names for IC2. E.g. Motorola's ICs run faster, therefore changing of C1 and/or R3 values may be necessary.
- You can also use pins 1, 2, 3 of IC2 to obtain timings of 8, 16 and 32 minutes respectively.
- An on-off switch is not provided because in the off state the circuit draws no significant current.

Mini Metronome

Linear scale Small size
40 to 208 beats per minute

Circuit diagram:



Parts:

```
P1______100K   Linear Potentiometer

R1_______10K   1/2W Trimmer Cermet
R2_______10K   1/4W Resistor
R3______330K   1/4W Resistor
R4_______50K   1/2W Trimmer Cermet
R5______100K   1/4W Resistor
R6,R7_____1K   1/4W Resistor

C1_______1µF    63V Polyester Capacitor
C2_______10nF   63V Polyester Capacitor
C3_______47µF   25V Electrolytic Capacitor

IC1_____NE555   General purpose timer IC

Q1,Q2___BC560   45V 100mA Low noise High gain PNP Transistors
Q3_____ZTX753   100V 2A PNP Transistor
```

```
SW1_____SPST Switch (Ganged with P1)

SPK_____8 Ohm 40mm. Loudspeaker

B1_____12V Battery (MN21, GP23A or VR22 type)
```

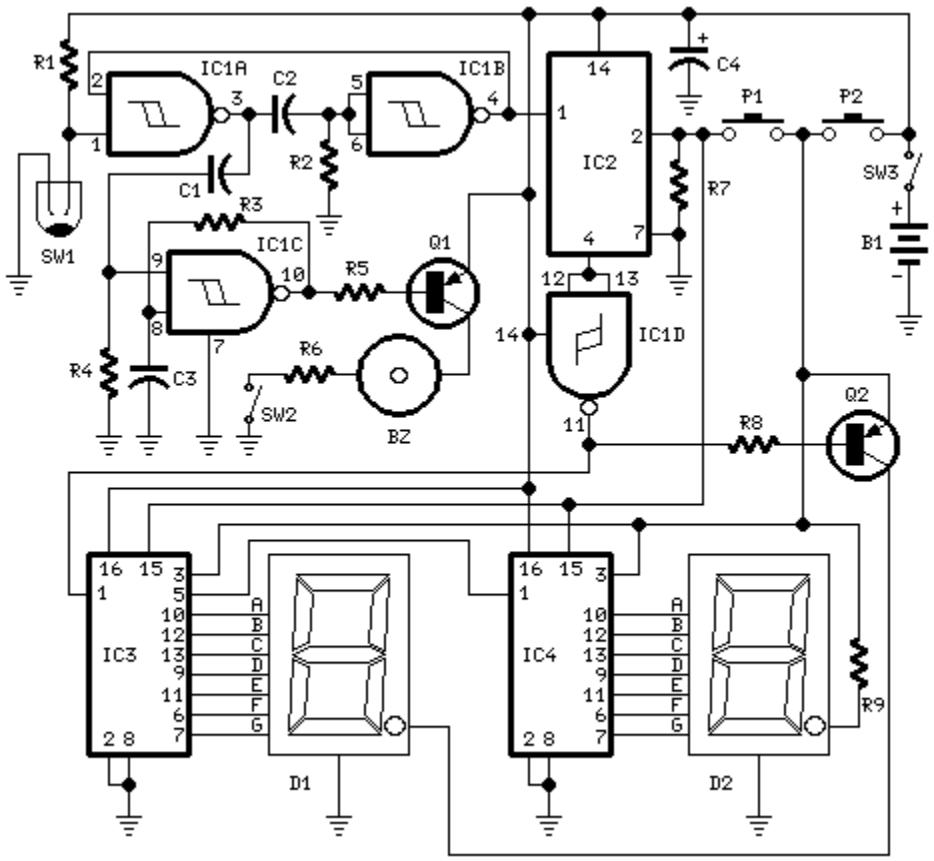
Notes:

- Q1 & Q2 provide linear frequency operation of IC1 following P1 resistance variation.
- Q3 was added in order to obtain a louder click, similar to clockwork metronomes.
- 12V micro battery was used to obtain more output power and more compactness.
- Rotate P1 fully towards R2, then set R1 to obtain 40 beats per minute (compare with another metronome).
- Rotate P1 fully towards R3, then set R4 to obtain 208 beats per minute.
- Finally mark the entire scale with the usual metronome steps as following:
  40 - 42 - 44 - 46 - 48 - 50 - 52 - 54 - 58 - 60 - 63 - 66 - 69 - 72 - 76 - 80 - 84 - 88 - 92 - 96 - 100 - 104 - 108 - 112 - 116 - 120 - 126 - 132 - 138 - 144 - 152 - 160 - 168 - 176 - 184 - 192 - 200 - 208.

Digital Step-Km Counter

Max. range: 9.950 meters with two digits
Slip it in pants' pocket for walking and jogging

Circuit diagram:



Parts:

```
R1,R3____22K   1/4W Resistor
R2_______2M2   1/4W Resistor
R4_______1M    1/4W Resistor
R5,R7,R8__4K7  1/4W Resistor
R6_______47R   1/4W Resistor
R9_______1K    1/4W Resistor

C1_______47nF   63V Polyester Capacitor
C2______100nF   63V Polyester Capacitor
C3_______10nF   63V Polyester Capacitor
```

```
C4_______10µF   25V Electrolytic Capacitor

D1_______Common-cathode 7-segment LED mini-display (Hundreds meters)
D2_______Common-cathode 7-segment LED mini-display (Kilometers)

IC1______4093   Quad 2 input Schmitt NAND Gate IC
IC2______4024   7 stage ripple counter IC
IC3,IC4__4026   Decade counter with decoded 7-segment display outputs IC

Q1,Q2___BC327   45V 800mA PNP Transistors

P1_______SPST Pushbutton (Reset)
P2_______SPST Pushbutton (Display)

SW1______SPST Mercury Switch, called also Tilt Switch
SW2______SPST Slider Switch (Sound on-off)
SW3______SPST Slider Switch (Power on-off)

BZ_______Piezo sounder

B1_______3V Battery (2 AA 1.5V Cells in series)
```

Device purpose:

This circuit measures the distance covered during a walk. Hardware is located in a small box slipped in pants' pocket and the display is conceived in the following manner: the leftmost display D2 (the most significant digit) shows 0 to 9 Km. and its dot is always on to separate Km. from hm. The rightmost display D1 (the least significant digit) shows hundreds meters and its dot lights after every 50 meters of walking. A beeper (excludable), signals each count unit, which occurs every two steps. A normal step is calculated to span approx. 78 centimeters, thus the LED signaling 50 meters lights after 64 steps or 32 mercury switch's operations, the display indicates 100 meters after 128 steps and so on. For low battery consumption the display lights only on request, pushing P2. Accidental reset of the counters is avoided because to reset the circuit both pushbuttons must be operated together. Obviously this is **not** a precision meter, but its approximation's degree was found good for this kind of device. In any case, the most critical thing to do is placement and sloping degree of the mercury switch inside the box.

Circuit operation:

IC1A & IC1B form a monostable multivibrator providing some degree of freedom from excessive bouncing of the mercury switch. Therefore a clean square pulse enters IC2 that divide by 64. Q2 lights the dot of D1 every 32 pulses counted by IC2. IC3 & IC4 divide by 10 each and drive the displays. P1 resets the counters and P2 enables the displays. IC1C generates an audio frequency square wave that is enabled for a short time at each monostable count. Q1 drives the piezo sounder and SW2 let you disable the beep.

Notes:

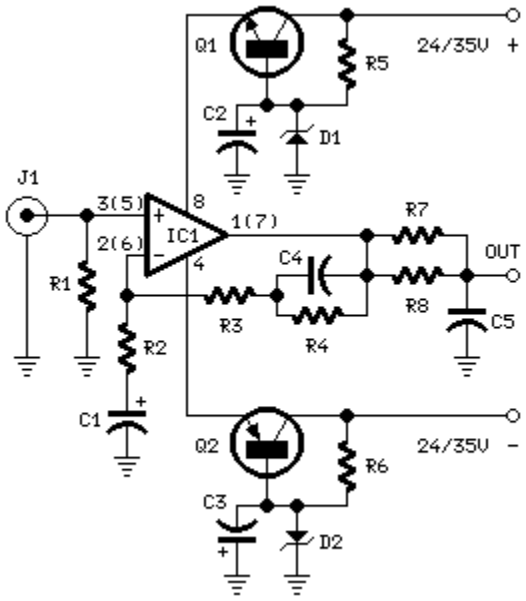
- Experiment with placement and sloping degree of mercury switch inside the box: this is very critical.

- Try to obtain a pulse every two walking steps. Listening to the beeper is extremely useful at this setting's stage.
- Trim R6 value to change beeper sound power.
- Push P1 **and** P2 to reset.
- This circuit is primarily intended for walking purposes. For jogging, further great care must be used with mercury switch placement to avoid undesired counts.
- Current consumption with display disabled is negligible, therefore SW3 can be omitted.

Phono Preamplifier

Simple circuitry suitable for moving-magnet cartridges
Passive high-frequency equalization

Circuit diagram:



Parts:

```
R1_________47K   1/4W Resistor
R2________100R   1/4W Resistor
R3_________6K8   1/4W Resistor
R4_________68K   1/4W Resistor
R5,R6______2K7   1/4W Resistor
R7_________2K2   1/4W Resistor
R8_________39K   1/4W Resistor

C1-C3_____100µF  25V Electrolytic Capacitors
C4,C5_____47nF   63V Polyester Capacitors 5% tolerance

D1,D2__BZX79C18  18V 500mW Zener Diodes

IC1_______LM833  Low noise Dual Op-amp

Q1________BC337  45V 800mA NPN Transistor
Q2________BC327  45V 800mA PNP Transistor
```

```
J1__________RCA  audio input socket
```

Comments:

In recent years, following CD's introduction, vinyl recordings are almost disappeared. Nevertheless, a phono preamplifier is still useful for listening old vinyl discs from a well preserved collection. This simple but efficient circuit devised for cheap moving-magnet cartridges, can be used in connection with both audio power amplifiers shown in preceding pages, featuring low noise, good RIAA frequency response curve, low distortion and good high frequency transients behaviour due to passive equalization in the 1 to 20KHz range. Transistors and associated components provide ± 18V supply to the op-amp, improving headroom and maximum output voltage.

Notes:

- R2, R3, R4, R7, R8, C4 & C5 should be low tolerance types.
- Schematic shows left channel and power supply.
- For stereo operation R1, R2, R3, R4, R7, R8; J1; C1, C4 & C5 must be doubled.
- Numbers in parentheses show IC1 right channel pin connections.

Technical data:

Sensitivity @ 1KHz: 2.5mV RMS input for 200mV RMS output

Max. input voltage @ 1KHz: 120mV RMS
Max. input voltage @ 10KHz: 141mV RMS
Max. input voltage @ 20KHz: 127mV RMS

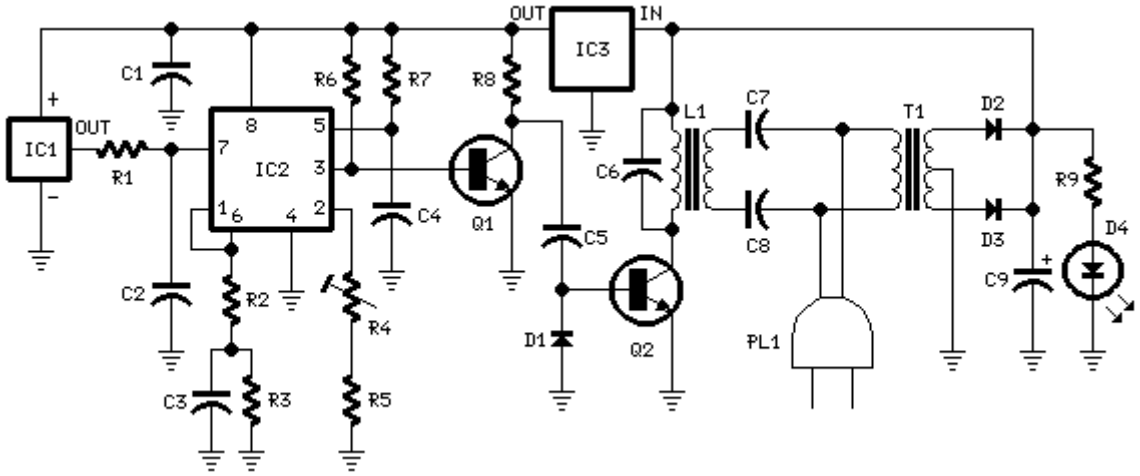
Frequency response @ 1V RMS output: 100Hz to 20KHz ± 0.5dB; -0.75dB @ 30Hz

Total harmonic distortion @ 1KHz and 6V RMS output: 0.006%
Total harmonic distortion @10KHz and 1V RMS output: 0.02%

Digital Remote Thermometer

Remote sensor sends data via mains supply
Temperature range: 00.0 to 99.9 °C

Transmitter circuit diagram:



Transmitter parts:

```
R1,R3_________100K   1/4W Resistors
R2____________47R    1/4W Resistor
R4____________5K     1/2W Trimmer Cermet
R5____________12K    1/4W Resistor
R6____________10K    1/4W Resistor
R7____________6K8    1/4W Resistor
R8,R9_________1K     1/4W Resistors

C1____________220nF   63V Polyester Capacitor
C2____________10nF    63V Polyester Capacitor
C3____________1µF     63V Polyester Capacitor
C4,C6_________1nF     63V Polyester Capacitors
C5____________2n2     63V Polyester Capacitor
C7,C8_________47nF   400V Polyester Capacitors
C9____________1000µF   25V Electrolytic Capacitor

D1____________1N4148   75V 150mA Diode
D2,D3_________1N4002  100V 1A Diodes
D4____________5mm. Red LED

IC1___________LM35   Linear temperature sensor IC
IC2___________LM331  Voltage-frequency converter IC
```

IC3_____78L06 6V 100mA Voltage regulator IC

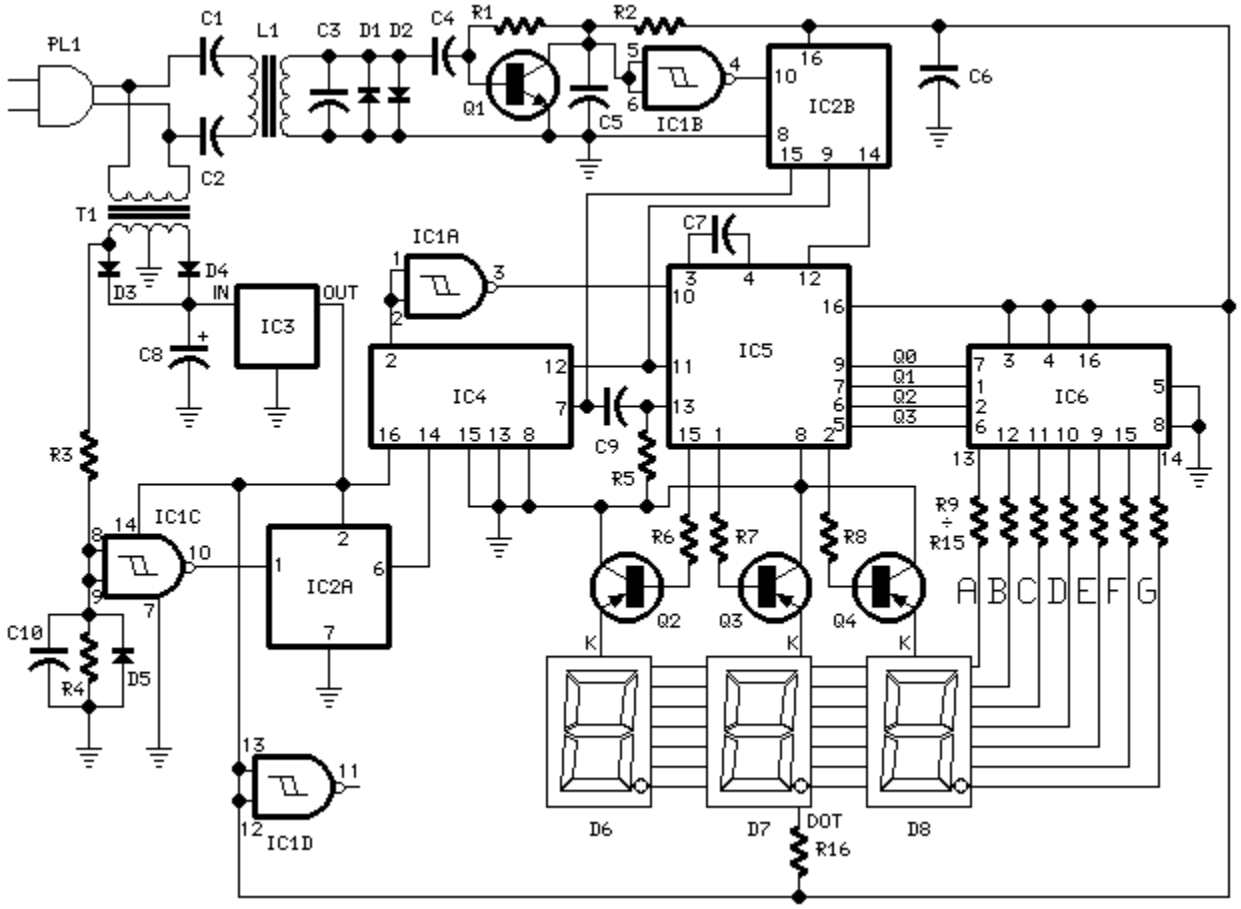
Q1_____BC238 25V 100mA NPN Transistor
Q2_____BD139 80V 1.5A NPN Transistor

L1_____Primary (Connected to Q2 Collector): 100 turns
Secondary: 10 turns
Wire diameter: 0.02mm. enameled
Plastic former with ferrite core. Outer diameter: 4mm.

T1_____220V Primary, 12+12V Secondary 3VA Mains transformer

PL1_____Male Mains plug & cable

Receiver circuit diagram:



Receiver Parts:

R1_____100K 1/4W Resistor
R2_____1K 1/4W Resistor

```
R3,R4,R6-R8__12K   1/4W Resistors
R5___________47K   1/4W Resistor
R9-R15______470R   1/4W Resistors
R16_________680R   1/4W Resistor

C1,C2________47nF 400V Polyester Capacitors
C3,C7_________1nF  63V Polyester Capacitors
C4___________10nF  63V Polyester Capacitor
C5,C6,C10____220nF  63V Polyester Capacitors
C8__________1000µF  25V Electrolytic Capacitor
C9___________100pF  63V Ceramic Capacitor

D1,D2,D5____1N4148  75V 150mA Diodes
D4,D4_______1N4002 100V 1A Diodes
D6-D8_______Common-cathode 7-segment LED mini-displays

IC1__________4093   Quad 2 input Schmitt NAND Gate IC
IC2__________4518   Dual BCD Up-Counter IC
IC3__________78L12  12V 100mA Voltage regulator IC
IC4__________4017   Decade Counter with 10 decoded outputs IC
IC5__________4553   Three-digit BCD Counter IC
IC6__________4511   BCD-to-7-Segment Latch/Decoder/Driver IC

Q1___________BC239C 25V 100mA NPN Transistor
Q2-Q4________BC327  45V 800mA PNP Transistors

L1___________Primary (Connected to C1 & C2): 10 turns
             Secondary: 100 turns
             Wire diameter: 0.02mm. enameled
             Plastic former with ferrite core. Outer diameter: 4mm.

T1___________220V Primary, 12+12V Secondary 3VA Mains transformer

PL1__________Male Mains plug & cable
```

Device purpose:

This circuit is intended for precision centigrade temperature measurement, with a transmitter section converting to frequency the sensor's output voltage proportional to the measured temperature. The output frequency bursts are conveyed into the mains supply cables.
The receiver section counts the bursts coming from mains supply and shows the counting on three 7-segment LED displays. The least significant digit displays tenths of degree and then a 00.0 to 99.9 °C range is obtained.
Transmitter-receiver distance can reach hundred meters, provided both units are connected to the mains supply within the control of the same light-meter.

Transmitter circuit operation:

IC1 is a precision centigrade temperature sensor with a linear output of 10mV/°C driving IC2, a voltage-frequency converter. At its output pin (3), an input of 10mV is converted to 100Hz frequency pulses. Thus, for example, a temperature of 20°C is converted by IC1 to 200mV and then by IC2 to 2KHz. Q1

is the driver of the power output transistor Q2, coupled to the mains supply by L1 and C7,C8.

Receiver circuit operation:

The frequency pulses coming from mains supply and safely insulated by C1,C2 & L1 are amplified by Q1; diodes D1,D2 limiting peaks at its input. Pulses are filtered by C5, squared by IC1B, divided by 10 in IC2B and sent for the final count at the clock input of IC5.
IC4 is the time-base generator: it provides reset pulses for IC1B and IC5 and enables latches and gate-time of IC5 at 1Hz frequency. It is driven by a 5Hz square wave obtained from 50Hz mains frequency picked-up from T1 secondary, squared by IC1C and divided by 10 in IC2A.
IC5 drives the displays' cathodes via Q2,Q3 & Q4 at a multiplexing rate frequency fixed by C7. It drives also the 3 displays' paralleled anodes via the BCD-to-7 segment decoder IC6.
Summing up, input pulses from mains supply at, say, 2KHz frequency, are divided by 10 and displayed as 20.0°C.

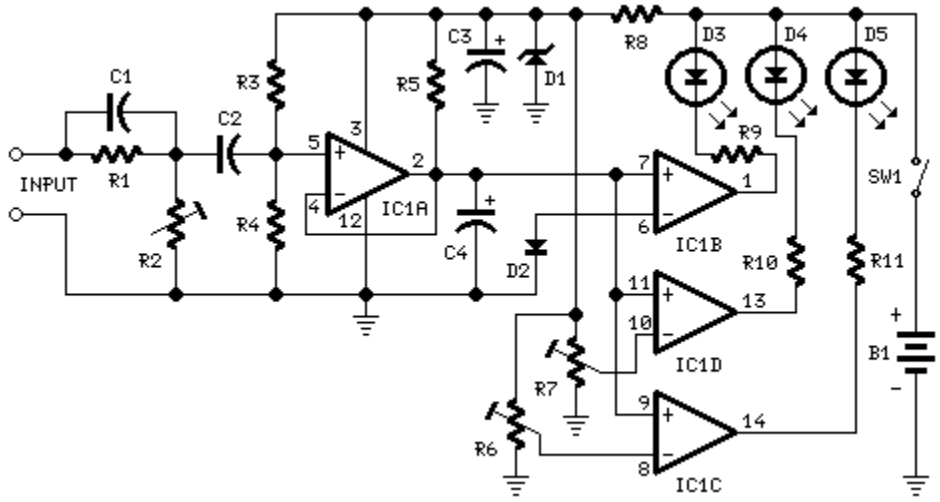
Notes:

- D6 is the Most Significant Digit and D8 is the Least Significant Digit.
- R16 is connected to the Dot anode of D7 to permanently light the decimal point.
- Set the ferrite cores of both inductors for maximum output (best measured with an oscilloscope, but not critical).
- Set trimmer R4 in the transmitter to obtain a frequency of 5KHz at pin 3 of IC2 with an input of 0.5Vcc at pin 7 (a digital frequency meter is required).
- More simple setup: place a thermometer close to IC1 sensor, then set R4 to obtain the same reading of the thermometer in the receiver's display.
- Keep the sensor (IC1) well away from heating sources (e.g. Mains Transformer T1).
- Linearity is very good.
- **Warning!** The circuits are connected to 220Vac mains, then some parts in the circuit boards are subjected to **lethal potential!**. Avoid touching the circuits when plugged and enclose them in plastic boxes.

Three-Level Audio Power Indicator

Battery-operated 3 LED display
Simply connect it to loudspeaker output

Circuit diagram:



Parts:

```
R1__________100K   1/4W Resistor
R2__________50K    1/2W Trimmer Cermet
R3__________330K   1/4W Resistor
R4__________1M2    1/4W Resistor
R5__________470K   1/4W Resistor
R6,R7_______500K   1/2W Trimmers Cermet
R8__________1K5    1/4W Resistor
R9-R11______470R   1/4W Resistors

C1__________47pF   63V Ceramic Capacitor
C2__________100nF  63V Polyester Capacitor
C3__________47µF   25V Electrolytic Capacitor
C4__________1µF    25V Electrolytic Capacitor

D1______BZX79C5V1 5.1V 500mW Zener Diode
D2_________1N4148  75V 150mA Diode
D3-D5_______3mm.   Yellow LEDs
```

```
IC1_________LM339  Quad Voltage Comparator IC

SW1_________SPST  Slider Switch

B1_____________9V  PP3

Clip for 9V PP3 Battery
```

Circuit operation:

This circuit is intended to indicate the power output level of any audio amplifier. It is simple, portable, and displays three power levels that can be set to any desired value. For a standard HiFi stereo power amplifier like the 25W one described in these pages, the power output values suggested are as followings:

- D5 illuminates at 2W
- D4 illuminates at 12.5W
- D3 illuminates at 24.5W

The above values were chosen for easy setup, but other settings are possible.
IC1A is the input buffer, feeding 3 voltage comparators and LEDs drivers by means of a variable dc voltage obtained by R5 and C4 smoothing action. In order to achieve setting stability, the supply of IC1 and trimmers R6 & R7 is reduced and clamped to 5.1V by Zener diode D1.

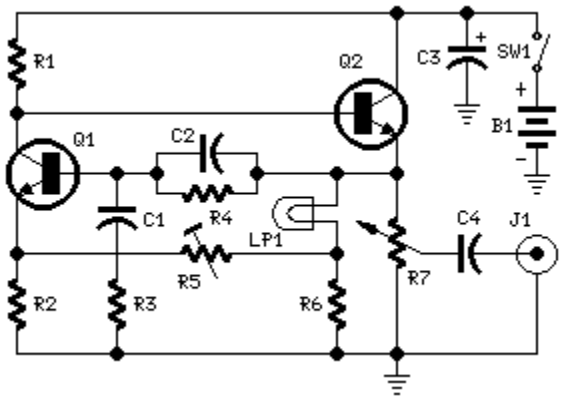
Notes:

- The simplest way to connect this circuit to the amplifier output is to use a twisted pair cable terminated with two insulated crocodile clips.
- Setup is best accomplished with an oscilloscope or an audio millivoltmeter like the one described in these pages.
- A 1KHz sine wave generator with variable output is also required (see a suitable circuit in this website also).
- Connect the generator to the amplifier input and the Audio Power Indicator to the output of the amplifier, in parallel with the oscilloscope probe or the audio millivoltmeter input.
- When using high power outputs disconnect the loudspeakers to avoid Tweeters damage and connect in their place an 8 Ohm 20-30 Watt wirewound resistor.
- Remember that VRMS output is equal to output Peak-to-Peak Voltage divided by 2.828.
- RMS power output in Watts is equal to $VRMS^2$ divided by speaker impedance (usually 8 or 4 Ohms).
- Example: set the output of the 1KHz sinewave generator to read 14V on the audio millivoltmeter (24.5W 8 Ohms). Set R2 until D3 illuminates, and be sure that D3 turns-off when diminishing a little the generator's output.
- Do the same with R7 for D4 and R6 for D5. The readings of the audio millivoltmeter must be 10V (12.5W 8 Ohms) and 4V (2W 8 Ohms) respectively.

1KHz Sinewave Generator

Simple circuitry, low distortion, battery operated Variable, low impedance output up to 1V RMS

Circuit diagram:



Parts:

```
R1_____________5K6  1/4W Resistor
R2_____________1K8  1/4W Resistor
R3,R4_________15K   1/4W Resistors
R5___________500R   1/2W Trimmer Cermet
R6___________330R   1/4W Resistor
R7___________470R   Linear Potentiometer

C1,C2_________10nF  63V Polyester Capacitors
C3___________100µF  25V Electrolytic Capacitor
C4___________470nF  63V Polyester Capacitor

Q1,Q2________BC238  25V 100mA NPN Transistors

LP1____________12V  40mA Lamp (See Notes)

J1___________Phono chassis Socket

SW1__________SPST  Slider Switch

B1_____________9V  PP3

Clip for 9V PP3 Battery
```

Circuit description:

This circuit generates a good 1KHz sinewave using the inverted Wien bridge configuration (C1-R3 & C2-R4). Features a variable output, low distortion and low output impedance in order to obtain good overload capability. A small filament lamp ensures a stable long term output amplitude waveform. Useful to test the Audio Millivoltmeter, Audio Power Meter and other audio circuits published in this site.

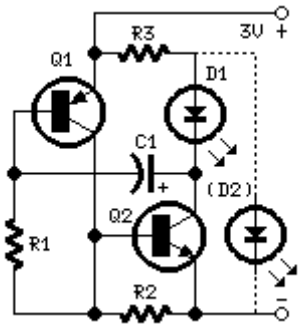
Notes:

- The lamp must be a low current type (12V 40-50mA or 6V 50mA) in order to obtain good long term stability and low distortion.
- Distortion @ 1V RMS output is 0.15% with a 12V 40mA lamp, raising to 0.5% with a 12V 100mA one.
- Using a lamp differing from specifications may require a change in R6 value to 220 or 150 Ohms to ensure proper circuit's oscillation.
- Set R5 to read 1V RMS on an Audio Millivoltmeter connected to the output with R7 fully clockwise, or to view a sinewave of 2.828V Peak-to-Peak on the oscilloscope.
- With C1,C2 = 100nF the frequency generated is 100Hz and with C1,C2 = 1nF frequency is 10KHz but R5 is needing adjustment.
- High gain transistors preferred for better performance.

LED or Lamp Flasher

Minimum parts counting
Designed for 3V battery operation

Circuit diagram:



Parts:

```
R1_______33K  1/4W Resistor
R2,R3____47R  1/4W Resistors

C1_______10µF  25V Electrolytic Capacitor

D1,(D2)__LED(s) (Any type and color)

Q1_____BC560   45V 100mA PNP Transistor
Q2_____BC337   45V 800mA NPN Transistor
```

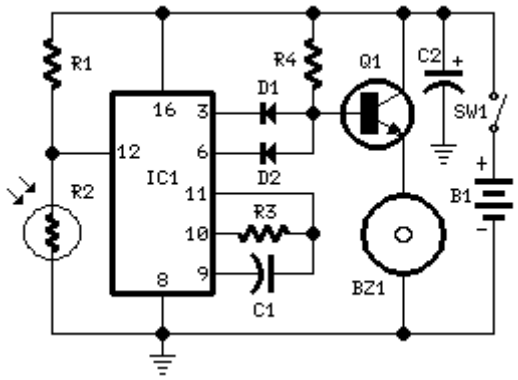
Notes:

- Power supply can vary from 2 to 4.5V.
- Add D2 to obtain two LED alternate blinking.
- D1's on-time is shorter than off-time. The opposite regarding D2.
- You can also use D2 only, shorting D1.
- Don't change resistors' values.
- Flashing frequency can be varied changing C1 value from 2.2µF to 100µF and higher.
- This circuit is very efficient when driving a 3.2V lamp. In this case omit the LEDs and R3, connecting the lamp at Q2's collector and to positive supply, further reducing parts counting.

Fridge door Alarm

Beeps if you leave open the door over 20 seconds
3V battery operation, simple circuitry

Circuit diagram:



Parts:

```
R1_____________10K   1/4W Resistor
R2_____________Photo resistor (any type)
R3,R4_________100K   1/4W Resistors

C1_____________10nF  63V Polyester Capacitor
C2_____________100µF  25V Electrolytic Capacitor

D1,D2_______1N4148  75V 150mA Diodes

IC1____________4060  14 stage ripple counter and oscillator IC

Q1_____________BC337  45V 800mA NPN Transistor

BZ1____________Piezo sounder (incorporating 3KHz oscillator)

SW1____________Miniature SPST slide Switch

B1_____________3V Battery (2 AA 1.5V Cells in series)
```

Circuit operation:

This circuit, enclosed in a small box, is placed in the fridge near the lamp (if any) or the opening. With the door closed the interior of the fridge is in the dark, the photo resistor R2 has a high resistance (>200K) thus clamping IC1 by holding pin 12 high. When a beam of light enters from the opening, or the fridge lamp lights, the photo resistor lowers its resistance (<2K), pin 12 goes low, IC1 starts counting and, after a preset delay (20 seconds in this case) the piezo sounder beeps for 20 sec. then stops for the same lapse of time and the cycle repeats until the fridge door closes. D2 connected to pin 6 of IC1 makes the piezo sounder beeping 3 times per second.

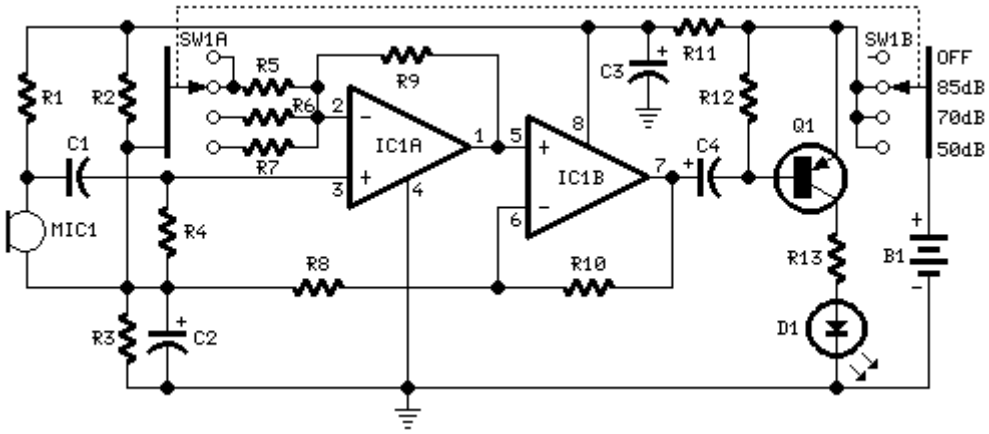
Notes:

- Connecting D1 to pin 2 of IC1 halves the delay time.
- Delay time can be varied changing C1 and/or R3 values.
- Any photo resistor type should work well.
- Current drawing is insignificant, so SW1 can be eliminated.
- Place the circuit near the lamp and take it away when defrosting, to avoid circuit damage due to excessive moisture.
- Don't place it in the freezer.

Room Noise Detector

One LED monitors three levels: 50, 70 & 85 dB
Useful to detect too noisy environments

Circuit diagram:



Parts:

```
R1_____________10K   1/4W Resistor
R2,R3__________22K   1/4W Resistors
R4_____________100K  1/4W Resistor
R5,R9,R10______56K   1/4W Resistors
R6_____________5K6   1/4W Resistor
R7_____________560R  1/4W Resistor
R8_____________2K2   1/4W Resistor
R11____________1K    1/4W Resistor
R12____________33K   1/4W Resistor
R13____________330R  1/4W Resistor

C1_____________100nF  63V Polyester Capacitor
C2_____________10µF   25V Electrolytic Capacitor
C3_____________470µF  25V Electrolytic Capacitor
C4_____________47µF   25V Electrolytic Capacitor

D1_____________5mm. Red LED

IC1____________LM358  Low Power Dual Op-amp

Q1_____________BC327  45V 800mA PNP Transistor

MIC1___________Miniature electret microphone
```

SW1_____2 poles 4 ways rotary switch

B1_____9V PP3 Battery

Clip for PP3 Battery

Device purpose:

This circuit is intended to signal through a flashing LED, the exceeding of a fixed threshold in room noise, chosen from three fixed levels, namely 50, 70 & 85 dB. Two Op-amps provide the necessary circuit gain for sounds picked-up by a miniature electret microphone to drive a LED. With SW1 in the first position the circuit is off. Second, third and fourth positions power the circuit and set the input sensitivity threshold to 85, 70 & 50 dB respectively.
Current drawing is <1mA with LED off and 12-15mA when the LED is steady on.

Use:

- Place the small box containing the circuit in the room you intend to measure ambient noise.
- The 50 dB setting is provided to monitor the noise in the bedroom at night. If the LED is steady on, or flashes bright often, then your bedroom is inadequate and too noisy for sleep.
- The 70 dB setting is for living-rooms. If this level is often exceeded during the day, your apartment is rather uncomfortable.
- If noise level is constantly over 85 dB, 8 hours a day, then you live in a dangerous environment.

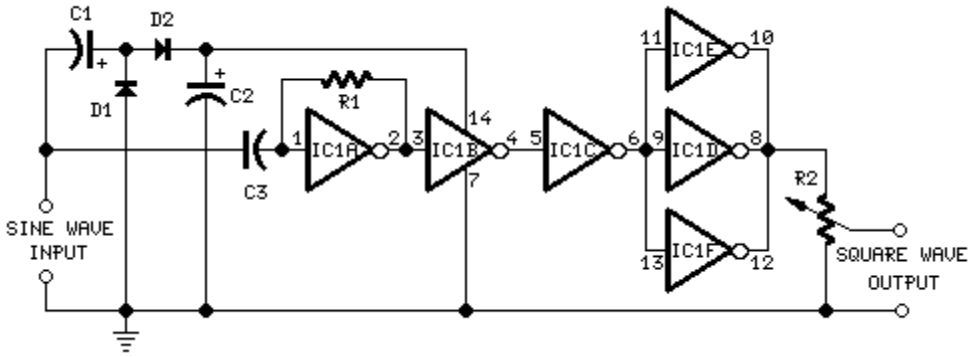
dB	Example of sound sources
20	Quiet garden, electric-clock ticking, drizzling rain
30	Blast of wind, whisper @ 1 m.
40	Countryside areas, quiet apartment, wrinkling paper @ 1 m.
50	Residential areas, quiet streets, fridges, conversation @ 1 m.
55	Offices, air-conditioners
60	Alarm-clocks, radio & TV sets at normal volume
64	Washing machines, quiet typewriters
67	Hair-dryers, crowded restaurants
69	Dish-washers, floor-polishers
70	Loud conversation, noisy street, radio & TV sets at high volume
72	Vacuum cleaners
78	Telephone ring, mechanical workshop
80	Passing trucks, noisy hall or plant, shuffling @ 1 m.

90	Passing train, pneumatic hammer, car hooter @ 1 m.
95	Mega "disco", circular saw
100	Motorcycle without silencer

Self-powered Sine to Square wave Converter

Converts sine to square waves without a power-source
Useful as a test instrument for audio purposes

Circuit diagram:



Parts:

```
R1_____________1M   1/4W Resistor
R2_____________100K   Linear Potentiometer

C1,C2_________100µF  25V Electrolytic Capacitors
C3_____________10nF  63V Polyester Capacitor

D1,D2_______1N4148  75V 150mA Diodes

IC1____________4069  Hex Inverter IC
```

Device purpose:

This circuit is intended to provide good square waves converting a sine wave picked-up from an existing generator. Its major feature consists in the fact that no power-source is needed: thus it can be simply connected between a sine wave generator and the device under test.
The input sine wave feeds a voltage doubler formed by C1, C2, D1 & D2 that powers the IC. IC1A

amplifies the input sine wave, other inverters included in IC1 squaring the signal and delivering an output square wave of equal mark/space ratio and good rise and fall times through the entire 20Hz-20KHz range.

Notes:

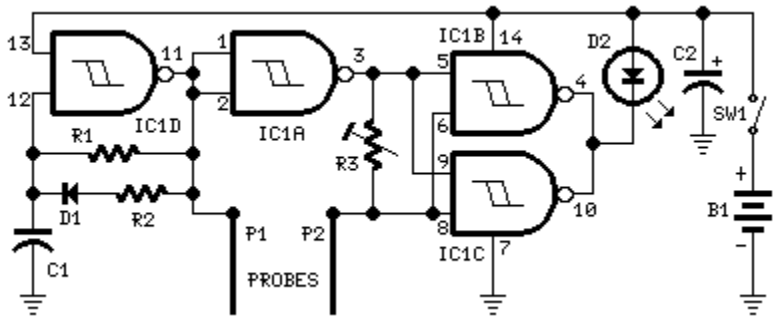
- Best performances are obtained with an input sine wave amplitude from 1V RMS onwards.
- Output square wave amplitude is proportional to input amplitude.
- Minimum sine wave input amplitude needed for good performance: 750mV RMS.
- Output square wave amplitude with 1V RMS input: 3V peak to peak, with R2 set at max.
- Minimum output square wave amplitude: 2V peak to peak, with R2 set at max.
- Substituting the two silicon diodes with germanium types (e.g. AA118, AA119), the minimum input threshold can be lowered.

This circuit won £50 and was published on ELECTRONICS WORLD "Circuit Ideas", February 2000 issue, page 135.

Plants Watering Watcher

Varying brightness LED signals the necessity to water a plant
Very low consumption, 3V powered circuit

Circuit diagram:



Parts:

```
R1_____________470K   1/4W Resistor
R2_____________3K3  1/4W Resistor
R3_____________100K   1/2W Trimmer Cermet

C1_____________1nF  63V Polyester Capacitor
C2_____________47µF  25V Electrolytic Capacitor

D1_____________1N4148  75V 150mA Diode
D2_____________5mm. Red LED

IC1____________4093  Quad 2 input Schmitt NAND Gate IC

P1,P2_________Probes  (See text)

SW1____________SPST  Slider Switch

B1_____________3V  Battery (2 AA 1.5V Cells in series)
```

Device purpose:

This circuit is intended to signal when a plant is needing water. A LED illuminates at maximum

brightness when the ground in the flower-pot is too dry: it dims gradually as the water's content in the pot grows, turning off when the optimum moisture's level is reached. This condition is obtained trimming R3.

Circuit operation:

IC1D forms a square wave oscillator with approx. 10/90 mark-space ratio. It feeds the output probe P1 and its signal, inverted by IC1A is compared with that picked-up by P2 in the NAND gates IC1B & IC1C in parallel, driving the LED. When a low resistance exists between the probes, due to an high water's content in the flower-pot, the LED is off, turning gradually on as the resistance between the probes increases.

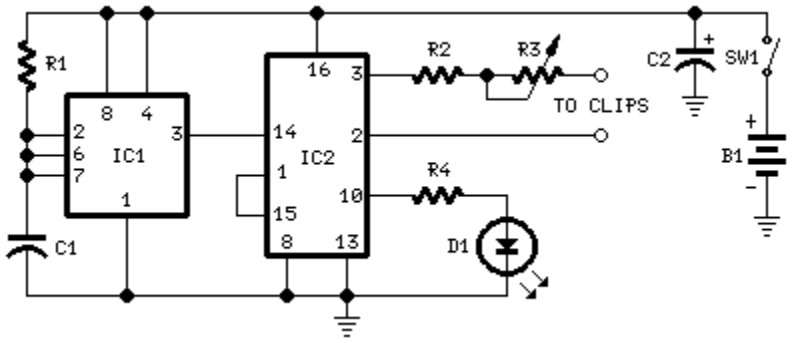
Notes:

- A square wave is used to avoid probes' oxidization.
- Probes can be long nails, carbon rods obtained from disassembled exhausted 1.5V batteries, or even a couple of screwdrivers.
- The probes must be driven in the pot's ground a few inches apart.
- Due to 3V supply, the LED needs not a limiting resistor.
- Power consumption: LED off = 50µA; LED full on = 1mA.
- To switch-off the circuit, you can short the probes. In this case SW1 can be omitted.
- Using an high-efficiency LED, brightness variations are better emphasized. In this case a limiting resistor could be necessary.

Cranial Electrotherapy Stimulator

Current generated flows through clips placed on the earlobes
Output current adjustable from 80 to 600 microAmperes

Circuit diagram:



Parts:

```
R1_____________1M5  1/4W Resistor
R2_____________15K  1/4W Resistor
R3_____________100K  Linear Potentiometer
R4_____________2K2  1/4W Resistor

C1_____________330nF  63V Polyester Capacitor
C2_____________100µF  25V Electrolytic Capacitor

D1_____________3mm. Red LED

IC1____________7555  or TS555CN CMos Timer IC
IC2____________4017  Decade counter with 10 decoded outputs IC

SW1____________SPST  Slider Switch

B1_____________9V  PP3 Battery

Clip for PP3 Battery

Two Earclips with wires (see notes)
```

Device purpose:

Owing to the recent launching in Europe of Cranial Electrotherapy Stimulation (CES) portable sets, we have been "Electronically Stimulated" in designing a similar circuit for the sake of Hobbyists. CES is the most popular technique for electrically boosting brain power, and has long been prescribed by doctors, mainly in the USA, for therapeutic reasons, including the treatment of anxiety, depression, insomnia, and chemical dependency. CES units generate an adjustable current (80 to 600 microAmperes) that flows through clips placed on the earlobes. The waveform of this device is a 400 milliseconds positive pulse followed by a negative one of the same duration, then a pause of 1.2 seconds. The main frequency is 0.5 Hz, i.e. a double pulse every 2 seconds. Some people report that this kind of minute specialized electrical impulses contributes to achieve a relaxed state that leaves the mind alert.

Obviously we can't claim or prove any therapeutic effectiveness for this device, but if you are interested in trying it, the circuit is so cheap and so simple to build that an attempt can be made with quite no harm.

Circuit operation:

IC1 forms a narrow pulse, 2.5Hz oscillator feeding IC2. This chip generates the various timings for the output pulses. Output is taken at pins 2 & 3 to easily obtain negative going pulses also. Current output is limited to 600µA by R2 and can be regulated from 80 to 600µA by means of R3. The LED flashes every 2 seconds signaling proper operation and can also be used for setting purposes. It can be omitted together with R4, greatly increasing battery life.

Notes:

- In order to obtain a more precise frequency setting take R1=1M2 and add a 500K trimmer in series with it.
- In this case use a frequency meter to read 2.5Hz at pin 3 of IC1, or an oscilloscope to read 400msec pulses at pins 2, 3 or 10, adjusting the added trimmer.
- A simpler setting can be made adjusting the trimmer to count exactly a LED flash every 2 seconds.
- Earclips can be made with little plastic clips and cementing the end of the wire in a position suited to make good contact with earlobes.
- Ultra-simple earclips can be made using a thin copper foil with rounded corners 4 cm. long and 1.5 cm. wide, soldering the wire end in the center, and then folding the foil in two parts holding the earlobes.
- To ensure a better current transfer, this kind of devices usually has felt pads moistened with a conducting solution interposed between clips and skin.
- Commercial sets have frequently a built-in timer. Timing sessions last generally 20 minutes to 1 hour. For this purpose you can use the Timed Beeper the Bedside Lamp Timer or the Jogging Timer circuits available on this Website, adjusting the timing components to suit your needs.

Disclaimer: we can't claim or prove any therapeutic effectiveness for this device.

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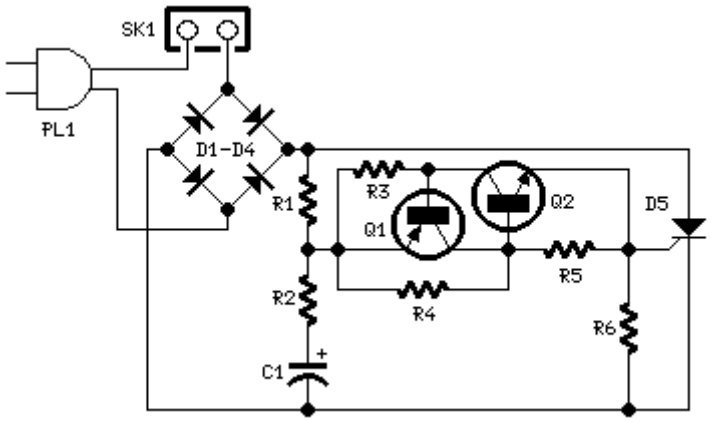
220 Volts Flashing Lamps

Especially designed for Christmas tree lamps
Replaces old thermally-activated switches

Circuit diagram:



Parts:

```
R1_____________100K   1/4W Resistor
R2,R5___________1K    1/4W Resistors
R3,R6_________470R    1/4W Resistors
R4_____________12K    1/4W Resistor

C1____________1000µF  25V Electrolytic Capacitor

D1-D4________1N4007   1000V 1A Diodes
D5____________P0102D  400V 800mA SCR

Q1____________BC327   45V 800mA PNP Transistor
Q2____________BC337   45V 800mA NPN Transistor

PL1___________Male Mains plug

SK1___________Female Mains socket
```

Device purpose:

This circuit is intended as a reliable replacement to thermally-activated switches used for Christmas tree lamp-flashing. The device formed by Q1, Q2 and related resistors triggers the SCR. Timing is provided by R1,R2 & C1. To change flashing frequency don't modify R1 and R2 values: set C1 value from 100 to 2200µF instead.
Best performances are obtained with C1=470 or 1000µF and R4=12K or 10K. Due to low consumption of normal 10 or 20 lamp series-loops intended for Christmas trees (60mA @ 220V typical for a 20 lamp series-loop), very small and cheap SCR devices can be used, e.g. C106D1 (400V 3.2A) or TICP106D (400V 2A), this last and the suggested P0102D devices having TO92 case.

Important Note:

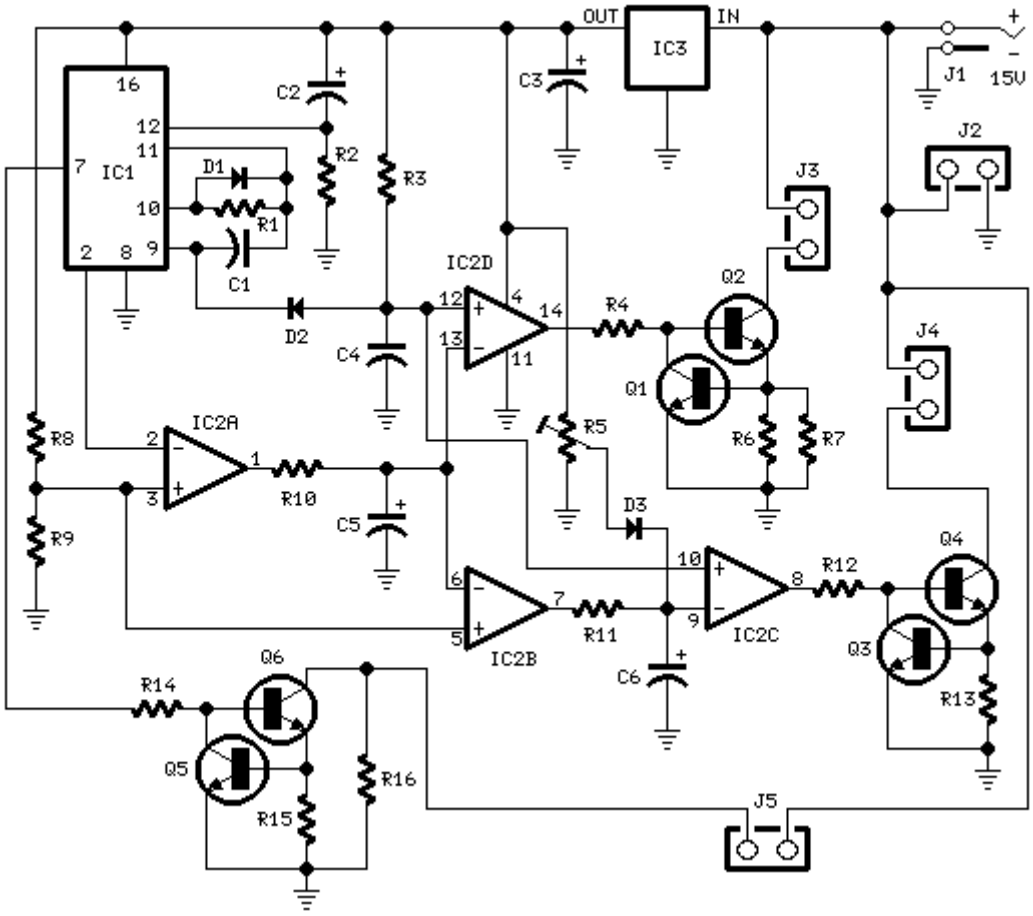
For proper operation it's absolutely necessary to employ high Gate-sensitive SCRs.
If you are unable to find these devices you can use Triacs instead. In this case the circuit operates also with relatively powerful devices. A recommended Triac type is the ubiquitous TIC206M (600V 4A) but many others can work.
Note that in spite of the Triac, diode bridge D1-D4 is in any case necessary.

This circuit was awarded with publication in ELECTRONICS WORLD "Circuit Ideas", June 2000 issue, page 458.

Automated Crib Lights

Low supply (12V) for children safety
Fully protected outputs

Circuit diagram:



Parts:

```
R1_____________150K  1/4W Resistor
R2,R9,R14______22K   1/4W Resistors
R3,R11_________220K  1/4W Resistors
R4,R12_________10K   1/4W Resistors
R5_____________100K  1/2W Trimmer Cermet
R6,R7,R13,R15__1R    1/4W Resistors
R8_____________33K   1/4W Resistor
R10____________270K  1/4W Resistor
```

```
R16_____________47R  1/4W Resistor

C1,C4_________100nF  63V Polyester Capacitors
C2,C6___________10µF  25V Electrolytic Capacitors
C3,C5_________100µF  25V Electrolytic Capacitors

D1-D3________1N4148  75V 150mA Diodes

IC1_____________4060  14 stage ripple counter and oscillator IC
IC2_____________LM324  Low power Quad Op-Amp IC
IC3_____________78L12  12V 100mA Voltage regulator IC

Q1,Q3,Q5_____BC238  25V 100mA NPN Transistors
Q2,Q4,Q6_____BD681  100V 4A NPN Darlington Transistors

J1_____________Miniature input socket,
               suited for commercial plug-in variable voltage power supplies
J2-J5_________Two ways output sockets
```

Device purpose:

This circuit is intended to drive the various lamps decorating the crib prepared during Christmas season at many homes, especially for children delight, in order to obtain realistic light-effects.

Features:

- Alternating day and night with lamps gradually dimming from full-on to full-off and the opposite.
- Slow turn on of model-houses interior as night approaches, and slow turn off as sun rises, with presettable intensity, thus imitating candles' light for a more realistic effect.
- Flickering ever-running circuit driving lamps for fires, firesides, lanterns effects etc.
- Total cycle duration: 2 minutes. Day duration: 1 minute, 15 seconds. Night duration: 45 seconds. (All values are approximate).

Load requirements:

- Input J1 is connected to a commercial wall plug-in power supply transformer with variable output settled to 12-15V, and a required minimum output capability of 600mA @ 12V. Using a good number of lamps the output capability must reach approx. 1.5A.
- Output J2 is connected to a permanently-on 12V 1W blue lamp(s) for night effect.
- Output J3 is connected to several 12V 2.2W lamps in parallel for sunlight effect. Max. output current: 1.2A (i.e. 6-7 lamps).
- Output J4 is connected to several 12V 1W or 1/2W micro-lamps in parallel for house-interiors lights. Max. output current: 600mA (i.e. 7-8 1W lamps, doubling in number if 1/2W).
- Output J5 is connected to one or several 12V 1W or 1/2W micro-lamps in parallel for fires, firesides, lanterns effects etc. Max. output current: 600mA (lamps number same as above).
- All outputs are current limited, and short-proof for a reasonable lapse of time.

Circuit operation:

IC1 oscillates at a frequency calculated to obtain a pin 2 level change approx. every minute. IC2A is then enabled to slowly charge and discharge C5 through R10 during a 2 minutes period. IC1 pin 9 drives D2, R3 & C4, generating a sawtooth for IC2C & IC2D comparators. IC2D comparing the voltage at pin 13 with the sawtooth, generates a squarewave with variable mark-space ratio driving the output darlington Q2 for daylight lamps. IC2B changes its output at a threshold voltage settled by R8 & R9, activating IC2C & Q4 that act like IC2D & Q2 driving model-houses lamps as evening approaches and turning them off at dawn. R11 & C6 provide slow turn on and off and R5 sets the basic brightness of these lamps. IC1 pin 7 drives the output darlington Q6 for flickering fires lamps and R16 prevents them to turn off completely for a more realistic effect. Q1-Q3 and associated Base resistors provide current limiting.

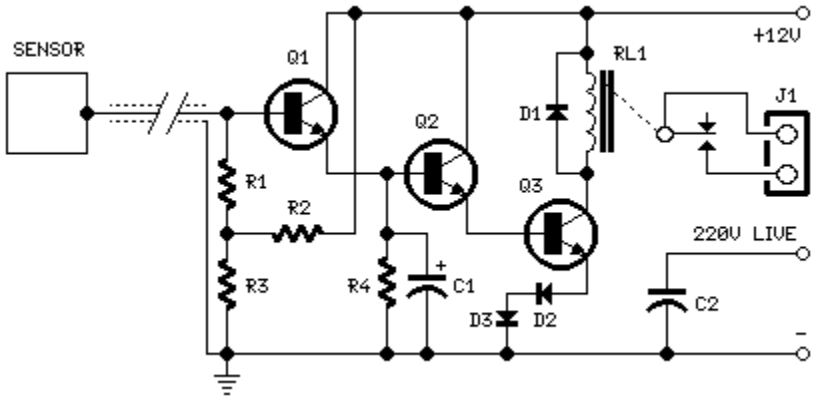
Notes:

- Total period length can be varied changing C1 and/or R1 values.
- Day-night ratio can be varied changing R10 value slightly.
- Threshold voltage of turn on and off of model-houses lights can be varied changing slightly R8 and/or R9 values.
- Turn on and off speed of model-houses lights can be varied changing R11 value.
- Current limiting can be varied changing Q2,Q4 & Q6 Emitter resistors.
- Heatsinks for Q2, Q4 & Q6 are needed if current limits are increased.
- Be aware that Motorola's 4060 oscillators run faster than others.

Capacitive Sensor

Special design for shop-windows animation
Useful for many types of touch controls

Circuit diagram:



Parts:

R1,R2_____1M 1/4W Resistors
R3,R4____47K 1/4W Resistors

C1_______10µF 25V Electrolytic Capacitor
C2_______470pF 630V Ceramic or Polyester Capacitor

D1-D3____1N4002 100V 1A Diodes

Q1-Q3_____BC337 45V 800mA NPN Transistors

RL1_______Relay with SPDT 2A @ 220V switch
Coil Voltage 12V. Coil resistance 200-300 Ohm

J1________Two ways output socket

Sensor____Aluminium or copper thin sheet with the dimensions of a post-card,
glued at the rear of the same (approx. 15x10.5 cm.)

Thin screened cable

Circuit description:

The purpose of this circuit is to animate shop-windows by means of a capacitive sensor placed behind a post-card-like banner. The card is placed against the glass inside the shop-window, and the visitor can activate the relay placing his hand on the card, from the outside. Especially suited for toy-shops, the circuit can activate model trains, small electric racing cars, lights etc. Further applications are left at user's imagination. Adopt it to increase the impact of your shop-window on next Christmas season!

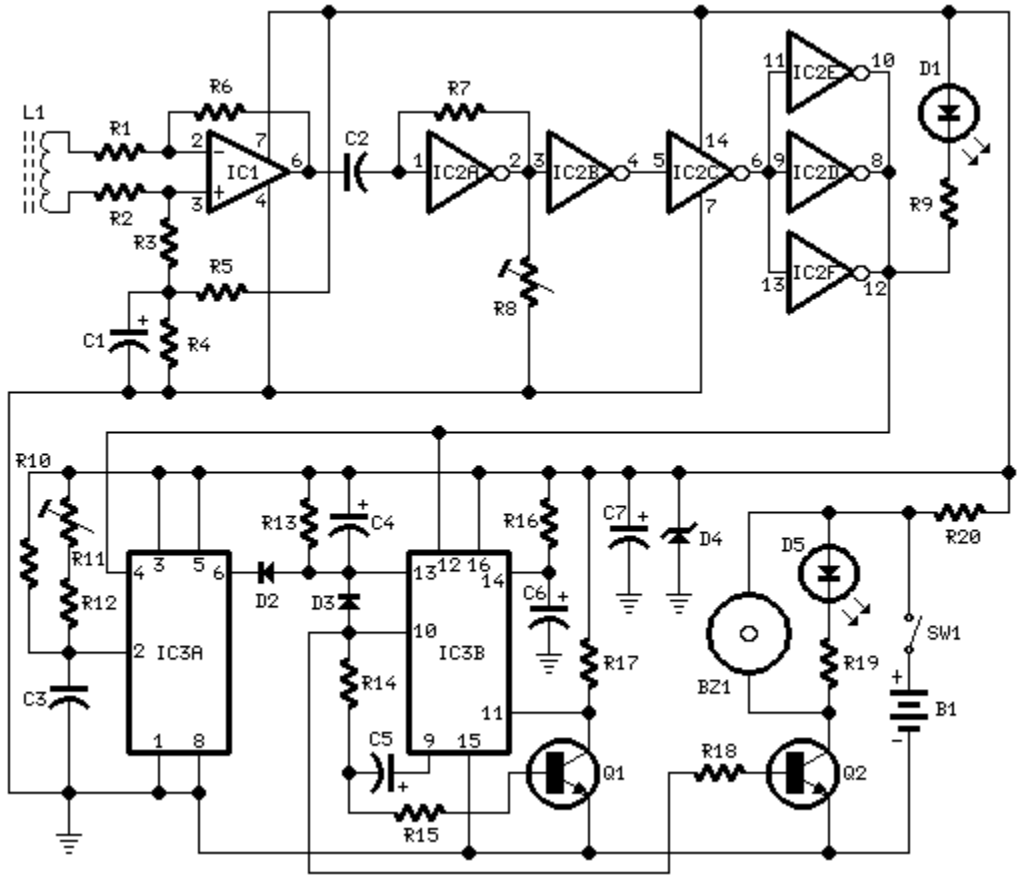
Q1, Q2 & Q3 form a high impedance super-Darlington that drives the relay, amplifying the 50Hz alternate mains-supply frequency induced in the sensor by the human body. C1 & D2, D3 ensure a clean relay's switching. Power supply can be any commercial wall plug-in transformer with rectifier and smoothing capacitor, capable of supplying the voltage and current necessary to power the relay you intend to use.

Note: For proper operation, circuit ground must be connected via a small value, high voltage-rating capacitor to one side of the mains supply socket. The "Live" side is the right one.

Speed-limit Alert

Wireless portable unit
Adaptable with most internal combustion engine vehicles

Circuit diagram:



Parts:

R1,R2,R19	1K	1/4W Resistors
R3-R6,R13,R17	100K	1/4W Resistors
R7,R15	1M	1/4W Resistors
R8	50K	1/2W Trimmer Cermet
R9	470R	1/4W Resistor
R10	470K	1/4W Resistor
R11	100K	1/2W Trimmer Cermet (see notes)
R12	220K	1/4W Resistor (see notes)
R14,R16	68K	1/4W Resistors

```
R18_____________22K   1/4W Resistor
R20_____________150R   1/4W Resistor (see notes)

C1,C7___________100µF  25V Electrolytic Capacitors
C2,C3___________330nF  63V Polyester Capacitors
C4-C6_____________4µ7  25V Electrolytic Capacitors

D1,D5_____Red LEDs  3 or 5mm.
D2,D3_________1N4148  75V 150mA Diodes
D4_________BZX79C7V5  7.5V 500mW Zener Diode

IC1___________CA3140  or TL061 Op-amp IC
IC2_____________4069  Hex Inverter IC
IC3_____________4098  or 4528 Dual Monostable Multivibrator IC

Q1,Q2___________BC238  25V 100mA NPN Transistors

L1_____________10mH  miniature Inductor (see notes)

BZ1_____________Piezo sounder (incorporating 3KHz oscillator)

SW1_____________SPST  Slider Switch

B1_________________9V  PP3 Battery (see notes)

Clip for PP3 Battery
```

Device purpose:

This circuit has been designed to alert the vehicle driver that he has reached the maximum fixed speed limit (i.e. in a motorway). It eliminates the necessity of looking at the tachometer and to be distracted from driving.
There is a strict relation between engine's RPM and vehicle speed, so this device controls RPM, starting to beep and flashing a LED once per second, when maximum fixed speed is reached.
Its outstanding feature lies in the fact that no connection is required from circuit to engine.

Circuit operation:

IC1 forms a differential amplifier for the electromagnetic pulses generated by the engine sparking-plugs, picked-up by sensor coil L1. IC2A further amplifies the pulses and IC2B to IC2F inverters provide clean pulse squaring. The monostable multivibrator IC3A is used as a frequency discriminator, its pin 6 going firmly high when speed limit (settled by R11) is reached. IC3B, the transistors and associate components provide timings for the signaling part, formed by LED D5 and piezo sounder BZ1. D3 introduces a small amount of hysteresis.

Notes:

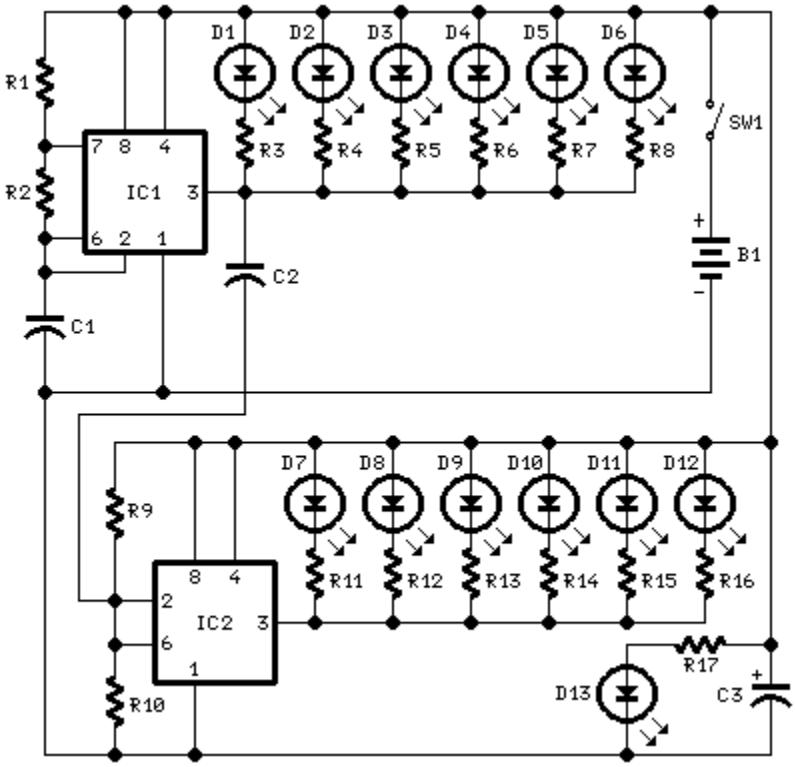
- D1 is necessary at set-up to monitor the sparking-plugs emission, thus permitting to find easily the best placement for the device on the dashboard or close to it. After the setting is done, D1 & R9 can be omitted or switched-off, with battery saving.

- During the preceding operation R8 must be adjusted for better results. The best setting of this trimmer is usually obtained when its value lies between 10 and 20K.
- You must do this first setting when the engine is on but the vehicle is stationary.
- The final simplest setting can be made with the help of a second person. Drive the vehicle and reach the speed needed. The helper must adjust the trimmer R11 until the device operates the beeper and D5. Reducing car's speed the beep must stop.
- L1 can be a 10mH small inductor usually sold in the form of a tiny rectangular plastic box. If you need an higher sensitivity you can build a special coil, winding 130 to 150 turns of 0.2 mm. enameled wire on a 5 cm. diameter former (e.g. a can). Extract the coil from the former and tape it with insulating tape making thus a stand-alone coil.
- Circuit's current drawing is approx. 10mA. If you intend to use the car's 12V battery, you can connect the device to the lighter socket. In this case R20 must be 330R.
- Depending on the engine's cylinders number, R11 can be unable to set the device properly. In some cases you must use R11=200K and R12=100K or less.
- If you need to set-up the device on the bench, a sine or square wave variable generator is required.
- To calculate the frequency relation to RPM in a four strokes engine you can use the following formula:
  Hz= (Number of cylinders * RPM) / 120.
  For a two strokes engine the formula is: Hz= (Number of cylinders * RPM) / 60.
  Thus, for a car with a four strokes engine and four cylinders the resulting frequency @ 3000 RPM is 100Hz.
- Temporarily disconnect C2 from IC1's pin 6. Connect the generator's output to C2 and Ground. Set the generator's frequency to i.e. 100Hz and regulate R11 until you hear the beeps and LED D5 flashes. Reducing the frequency to 99 or 98 Hz, beeping and flashing must stop.
- This circuit is not suited to Diesel engines.

Bicycle back Safety Light

Flashing 13 LED unit, 3V supply
Also suitable for jogger/walkers

Circuit diagram:



Parts:

```
R1_____________10K   1/4W Resistor
R2,R9,R10_____100K   1/4W Resistors
R3-R8,R11-R16__10R   1/4W Resistors
R17____________150R   1/4W Resistor

C1_____________1µF  63V Polyester Capacitor
C2_____________10nF  63V Polyester Capacitor
C3____________100µF  25V Electrolytic Capacitor

D1-D13_____Red LEDs  5mm. or bigger, high efficiency

IC1,IC2________7555  or TS555CN CMos Timer IC
```

```
SW1_____________SPST  Slider Switch

B1_______________3V  Battery (2 AA 1.5V Cells in series)
```

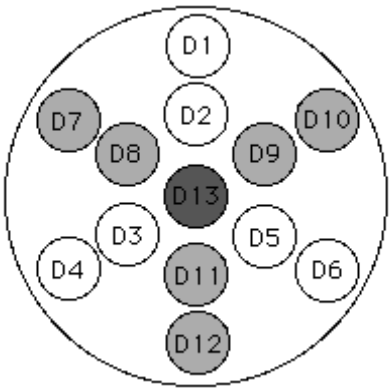
Device purpose:

This circuit has been designed to provide a clearly visible light, formed by 13 high efficiency flashing LEDs arranged in a pseudo-rotating order. Due to low voltage, low drain battery operation and small size, the device is suitable for mounting on bicycles as a back light, or to put on by jogger/walkers.

Circuit operation:

IC1 is a CMos version of the 555 IC wired as an astable multivibrator generating a 50% duty-cycle square wave at approx. 4Hz frequency. At 3V supply, 555 output (pin 3) sinking current operation is far better than sourcing, then LED D1-D6 are connected to positive supply. In order to obtain an alternate flashing operation, a second 555 IC is provided, acting as a trigger plus inverter and driving LEDs D7-D12. D13 is permanently on.
The LEDs are arranged in a two series display as shown below, with a center LED permanently on. This arrangement and the alternate flashing of the two series of LEDs provide a pseudo-rotating appearance.

LED arrangement:



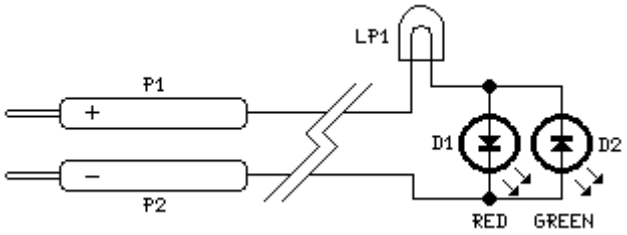
Notes:

- Flashing frequency can be varied changing C1 value.
- High efficiency LEDs are essential.

Ultra-simple Voltage Probe

Detects 1.8 to 220 Volts DC or AC
Minimum parts counting

Circuit diagram:



Parts:

```
D1________5 or 3mm. Red LED
D2________5 or 3mm. Green or Yellow LED

LP1_______220V  6W  Filament Lamp

P1________Red Probe
P2________Black Probe
```

Device purpose:

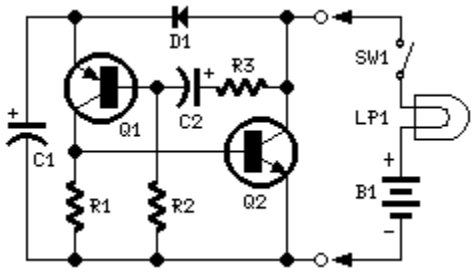
This circuit is not a novelty, but it proved so useful, simple and cheap that it's worth building.
When the positive (Red) probe is connected to a DC positive voltage and the Black probe to the negative, the Red LED illuminates.
Reversing polarities the Green LED illuminates.
Connecting the probes to an AC source both LEDs go on.
The lamp limits the LEDs current to 40mA @ 220V AC and its filament starts illuminating from approx. 30V, shining more brightly as voltage increases.
Therefore, due to the lamp's filament behaviour, any voltage in the 1.8 to 220 Volts range can be detected without changing component values.

Note: A two colors LED (Red and Green) can be used in place of D1 & D2.

Two-wire Lamp Flasher

Ideal to operate 3 to 24V DC existing on-circuit lamps
LED operation is also possible

Circuit diagram:



Parts:

```
R1_______________6K8  1/4W Resistor
R2_____________270K   1/4W Resistor
R3_____________22K    1/4W Resistor

C1_____________220µF   25V Electrolytic Capacitor
C2_____________10µF    25V Electrolytic Capacitor

D1___________1N4002  100V 1A Diode

Q1_____________BC557   45V 100mA PNP Transistor
Q2_____________BD139   80V 1.5A NPN Transistor

LP1____________Existing filament Lamp: any type in the range 3-24V 10W max.

SW1____________Existing On-Off switch

B1_____________Existing V DC source: any type in the range 3-24V
                       suited to the lamp adopted
```

Device purpose:

This circuit has been designed to provide that continuous light lamps already wired into a circuit, become flashing. Simply insert the circuit between existing lamp and negative supply.

Especially suited for car or panel pilot lights, this device can drive lamps up to 10W.

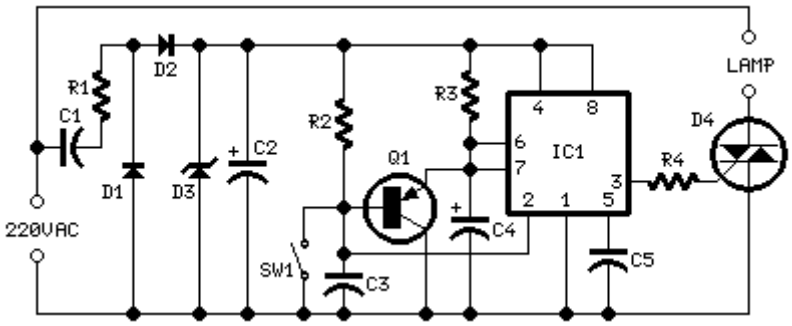
Notes:

- Break lamp(s) to negative supply connection(s), then insert the circuit between existing lamp(s) connection(s) and negative supply (respecting polarities!).
- C1 value can be varied from 100 to 1000µF or higher, in order to change flashing frequency.
- Although rather oversized, this circuit can also drive any LED, providing a suitable resistor is fitted in series with the light emitting device.
- The resistor should be in the range 47R to 2K2, depending on supply voltage.

Courtesy Light

15 seconds delayed switch-off
A good idea for bedroom lamps

Circuit diagram:



Parts:

```
R1_____________470R   1/2W Resistor
R2_____________100K   1/4W Resistor
R3_____________1M5  1/4W Resistor
R4_____________1K   1/4W Resistor

C1_____________330nF  400V Polyester Capacitor
C2_____________100µF   25V Electrolytic Capacitor
C3,C5__________10nF   63V Polyester or Ceramic Capacitors
C4_____________10µF   25V Electrolytic Capacitor

D1,D2_________1N4007 1000V 1A Diodes
D3___________BZX79C10   10V 500mW Zener Diode
D4___________TIC206M  600V 4A TRIAC

Q1_____________BC557   45V 100mA PNP Transistor

IC1____________7555 or TS555CN CMos Timer IC

SW1____________SPST Mains suited Switch
```

Device purpose:

This circuit is intended to let the user turn off a lamp by means of a switch placed far from bed, allowing him enough time to lie down before the lamp really switches off.
Obviously, users will be able to find different applications for this circuit in order to suit their needs.

Circuit operation:

Due to the low current drawing, the circuit can be supplied from 220Vac mains without a transformer. Supply voltage is reduced to 10Vdc by means of C1 reactance, a two diode rectifier cell D1 & D2 and Zener diode D3. IC1 is a CMos 555 timer wired as a monostable, providing 15 seconds on-time set by R3 & C4. When SW1 is closed, IC1 output (pin 3) is permanently on, driving Triac D4 which in turn feeds the lamp. Opening SW1 operates the monostable and, after 15 seconds, pin 3 of IC1 goes low switching off the lamp.

Notes:

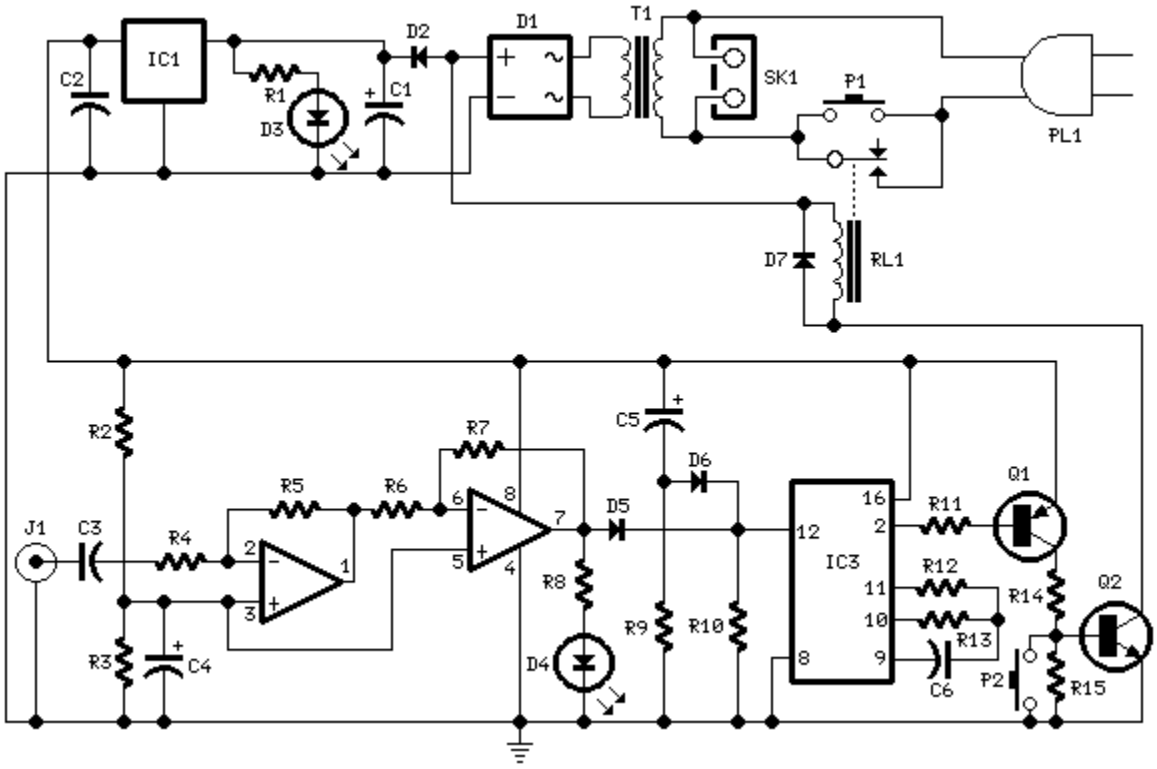
- The circuit is wired permanently to the mains supply but current drain is negligible.
- Due to transformerless design there is no heat generation.
- The delay time can be varied changing R3 and/or C4 values.
- Taking C4=10µF, R3 increases timing with approx. 100K per second ratio. I.e. R3=1M Time=10 seconds, R3=1M8 Time=18 seconds.
- Low Gate-current Triacs are recommended.
- Use a well insulated mains-type switch for SW1.
- **Warning!** The circuit is connected to 220Vac mains, then some parts in the circuit board are subjected to **lethal potential!**. Avoid touching the circuit when plugged and enclose it in a plastic box.

This circuit was awarded with publication in ELECTRONICS WORLD "Circuit Ideas", April 2001 issue, page 299.

Amplifier Timer

Turns-off your amplifier when idle for 15 minutes
Fed by amplifier tape-output

Circuit diagram:



Parts:

```
R1,R8_____________1K    1/4W Resistors
R2,R3_____________4K7   1/4W Resistors
R4_______________22K    1/4W Resistor
R5_______________4M7    1/4W Resistor
R6,R9_____________10K   1/4W Resistors
R7_______________1M5    1/4W Resistor
R10_____________100K    1/4W Resistor
R11_____________15K     1/4W Resistor
R12_____________10M     1/4W Resistor
R13_____________1M      1/4W Resistor
R14_____________8K2     1/4W Resistor
R15_____________1K8     1/4W Resistor
```

```
C1_____________470µF   25V Electrolytic Capacitor
C2,C3,C6_______100nF   63V Polyester Capacitors
C4,C5__________10µF    25V Electrolytic Capacitors

D1_____Diode bridge  100V 1A
D2,D7_________1N4002  100V 1A Diodes
D3___________Red LED  5mm.
D4________Yellow LED  5mm.
D5,D6_________1N4148  75V 150mA Diodes

IC1____________78L12  12V 100mA Voltage regulator IC
IC2____________LM358  Low Power Dual Op-amp
IC3_____________4060  14 stage ripple counter and oscillator IC

Q1_____________BC557  45V 100mA PNP Transistor
Q2_____________BC337  45V 800mA NPN Transistor

J1_______________RCA audio input socket

P1_______________SPST Mains suited Pushbutton
P2_______________SPST Pushbutton

T1_______________220V Primary, 12V Secondary 3VA Mains transformer

RL1____________10.5V 270 Ohm Relay with SPST 5A 220V switch

PL1_____________Male Mains plug

SK1___________Female Mains socket
```

Circuit operation:

This circuit turns-off an amplifier or any other device when a low level audio signal fed to its input is absent for 15 minutes at least.
Pushing P1 the device is switched-on feeding any appliance connected to SK1. Input audio signal is boosted and squared by IC2 A & B and monitored by LED D4. When D4 illuminates, albeit for a very short peak, IC3 is reset and restarts its counting. Pin 2 of IC3 remains at the low state, the two transistors are on and the relay operates. When, after a 15 minutes delay, no signal appeared at the input, IC3 ends its counting and pin 2 goes high. Q1 & Q2 stop conducting and the relay switches-off. The device is thus completely off as also are the appliances connected to SK1. C5 & R9 reset IC3 at power-on. P2 allows switch-off at any moment.

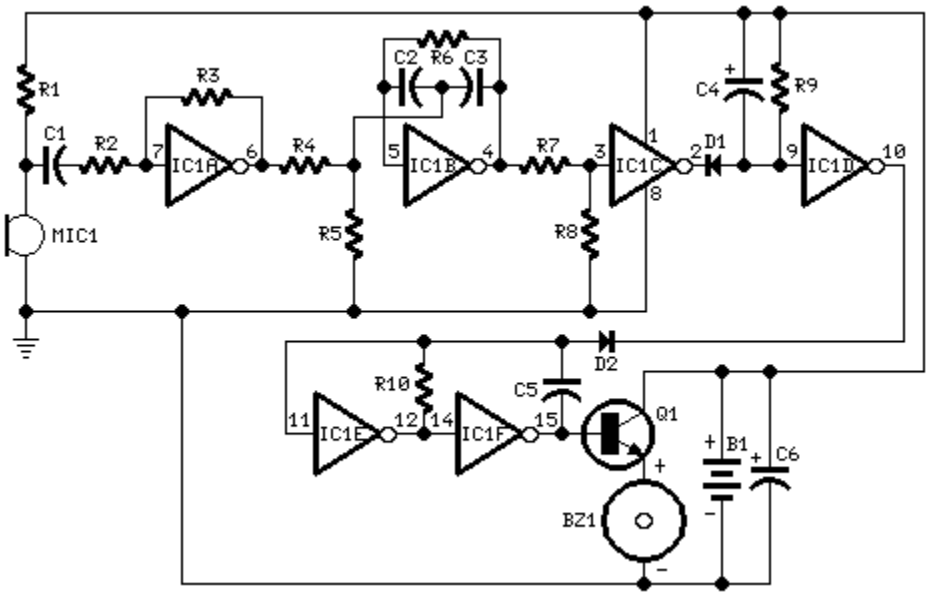
Notes:

- Simply connect left or right channel tape output of your amplifier to J1.
- You can employ two RCA input sockets wired in parallel to allow pick-up audio signals from both stereo channels.
- The delay time can be varied changing R13 and/or C6 values.
- Needing to operate a device not supplied by power mains, use a double pole relay switch, connecting the second pole switch in series with the device's supply.

Whistle Responder

Beeps when hears your whistle
A gadget suitable for key-holders, games etc.

Circuit diagram:



Parts:

R1	22K	1/4W Resistor
R2	10K	1/4W Resistor
R3	4M7	1/4W Resistor
R4,R8	100K	1/4W Resistors
R5	220R	1/4W Resistor
R6	330K	1/4W Resistor
R7	47K	1/4W Resistor
R9	2M2	1/4W Resistor
R10	1M5	1/4W Resistor
C1,C5	47nF	63V Polyester or Ceramic Capacitors
C2,C3	10nF	63V Polyester Capacitors
C4,C6	1µF	63V Electrolytic Capacitors
D1,D2	1N4148	75V 150mA Diodes
IC1	4049	Hex Inverter IC

```
Q1_____________BC337  45V 800mA NPN Transistor

MIC1_________Miniature electret microphone

BZ1__________Piezo sounder (incorporating 3KHz oscillator)

B1___________2.8 or 3V Battery (see notes)
```

Device purpose:

Some 15 years ago it was common to see small key-holders emitting an intermittent beep for a couple of seconds after its owner whistled. These devices contained a special purpose IC and therefore were not suited to home construction. The present circuit is designed around a general purpose hex-inverter CMos IC and, using miniature components and button clock-type batteries can be enclosed in a matchbox. It is primarily a gadget, but everyone will be able to find suitable applications.

Circuit operation:

This device beeps intermittently for approx. two seconds when a person in a range of about 10 meters emits a whistle.
The first two inverters contained in IC1 are used as audio amplifiers. IC1A amplifies consistently the signal picked-up by the small electret-microphone and IC1B acts as a band-pass filter, its frequency being centered at about 1.8KHz. The filter is required in order to select a specific frequency, the whistle's one, stopping other frequencies that would cause undesired beeper's operation. IC1C is wired as a Schmitt trigger, squaring the incoming audio signal. IC1D is a 2 second (approx.) monostable driving the astable formed by IC1E & IC1F. This oscillator generates a 3 to 5Hz square wave feeding Q1 and BZ1, thus providing intermittent beeper's operation.

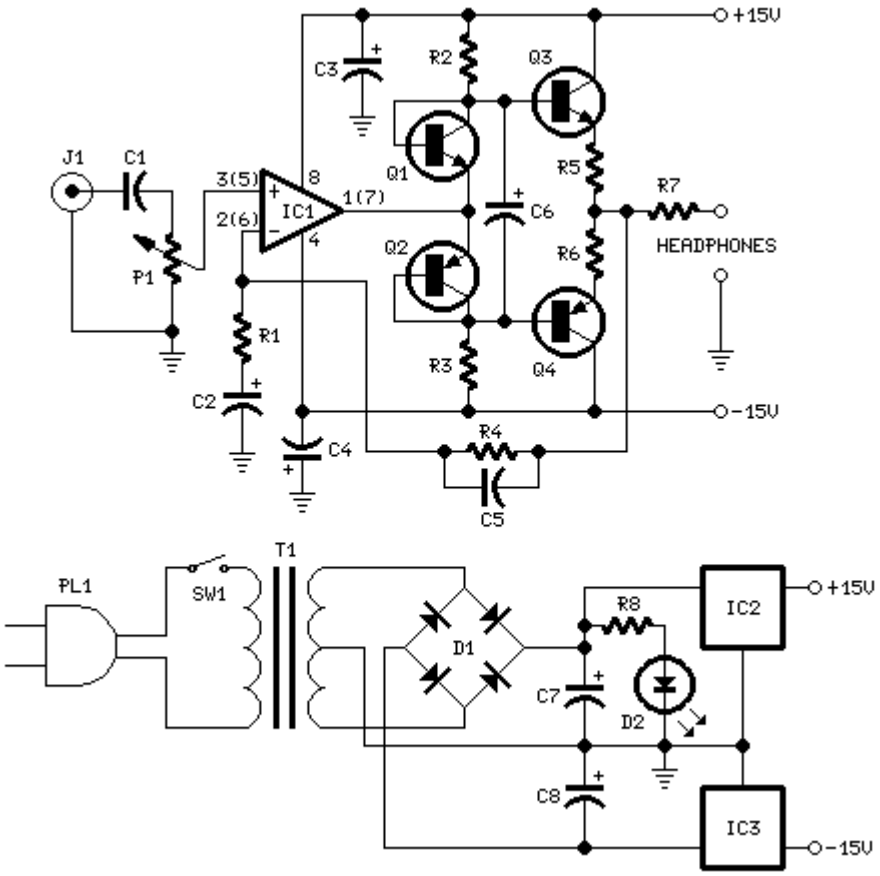
Notes:

- Power supply range: 2.6 to 3.6 Volts.
- Standing current: 150µA.
- Depending on dimensions of your box, you can choose from a wide variety of battery types:
- 2 x 1.5 V batteries type: AA, AAA, AAAA, button clock-type, photo-camera type & others.
- 2 x 1.4 V mercury batteries, button clock-type.
- 1 x 3 V or 1 x 3.6 V Lithium cells.

Headphone Amplifier

High Quality unit
No need for a preamplifier

Circuit diagram:



Amplifier parts:

```
P1_____________22K   Log.Potentiometer (Dual-gang for stereo)

R1_____________560R   1/4W Resistor
R2,R3__________10K   1/4W Resistors
R4_____________12K   1/4W Resistor
R5,R6__________2R2   1/4W Resistor
R7_____________22R   1/2W Resistor

C1_____________1µF    63V Polyester Capacitor
```

```
C2,C3,C4_____100µF   25V Electrolytic Capacitors
C5_____________22pF   63V Polystyrene or Ceramic Capacitor
C6_____________22µF   25V Electrolytic Capacitor

IC1____________LM833 or NE5532 Low noise Dual Op-amp

Q1,Q3__________BC337   45V 800mA NPN Transistors
Q2,Q4__________BC327   45V 800mA PNP Transistors

J1_____________RCA  audio input socket
```

Power supply parts:

```
R7_____________2K2  1/4W Resistor

C7,C8________2200µF   25V Electrolytic Capacitors

D1_____________100V 1A Diode bridge
D2_____________5mm. or 3mm. Red LED

IC2____________7815  15V 1A Positive voltage regulator IC
IC3____________7915  15V 1A Negative voltage regulator IC

T1_____________220V Primary, 15 + 15V Secondary 5VA Mains transformer

PL1____________Male Mains plug

SW1____________SPST Mains switch
```

Notes:

- Can be directly connected to CD players, tuners and tape recorders.
- Tested with several headphone models of different impedance: 32, 100, 245, 300, 600 & 2000 Ohms.
- Can drive old 8 Ohms impedance headphones, but these obsolete devices are not recommended.
- Schematic shows left channel and power supply.
- Numbers in parentheses show IC1 right channel pin connections.
- A correct grounding is very important to eliminate hum and ground loops. Connect in the same point the ground sides of J1, P1, C2, C3 & C4. Then connect separately the input and output grounds at the power supply ground.

Technical data:

Output voltage: Well above 5V RMS on all loads

Sensitivity: 250mV input for 5V RMS output

Frequency response: Flat from 30Hz to 20KHz

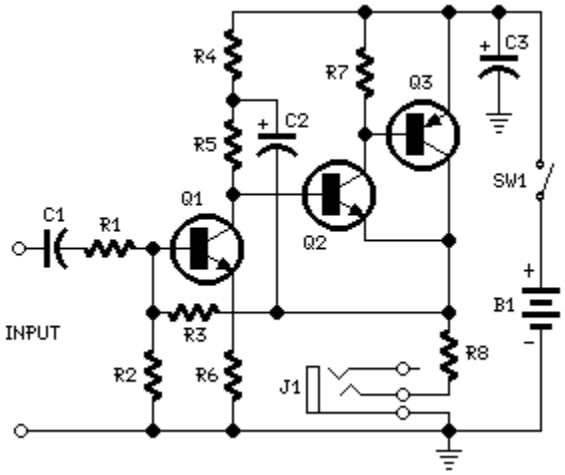
Total harmonic distortion @ 1KHz & 10KHz: Below 0.005% on 32 Ohms load and up to 4V RMS output (typical 0.003%)
Total harmonic distortion @ 1KHz & 10KHz: Below 0.005% on 100 to 2000 Ohms load and up to 5V RMS output (typical 0.003%)

Unconditionally stable on capacitive loads

Portable Headphone Amplifier

3V Battery powered
High Performance unit

Circuit diagram:



Parts:

R1_____10K 1/4W Resistor
R2_____100K 1/4W Resistor
R3_____68K 1/4W Resistor (see notes)
R4_____1K5 1/4W Resistor
R5_____3K3 1/4W Resistor
R6_____330R 1/4W Resistor
R7_____4K7 1/4W Resistor
R8_____2R2 1/4W Resistor

C1_____1µF 63V Polyester Capacitor
C2_____100µF 25V Electrolytic Capacitor
C3_____470µF 25V Electrolytic Capacitor

Q1_____BC239C 25V 100mA NPN High-gain Low-noise Transistor
Q2_____BC337 45V 800mA NPN Transistor
Q3_____BC327 45V 800mA PNP Transistor

J1_____Stereo 3mm. Jack socket

SW1_____SPST Switch

B1_____3V Battery (two 1.5V AA or C cells in series)

Notes:

- Can be directly connected to CD players, tuners and tape recorders.
- Tested with several headphone models of different impedance: 32, 100, 245, 300, 600 & 2000 Ohms.
- Schematic shows left channel only.
- B1, SW1, J1 & C3 are common to both channels.
- R3 value was calculated for headphone impedance up to 300 Ohms. Using 600 Ohms loads or higher, change R3 value to 100K.

Technical data:

Current drain: 35mA per channel with 32 Ohms impedance headphones. Much less with higher impedance loads

Output voltage: Above 2V peak-to-peak on all loads

Sensitivity: 90mV RMS input for 2V peak-to-peak output

Frequency response: Flat from 30Hz to 20KHz

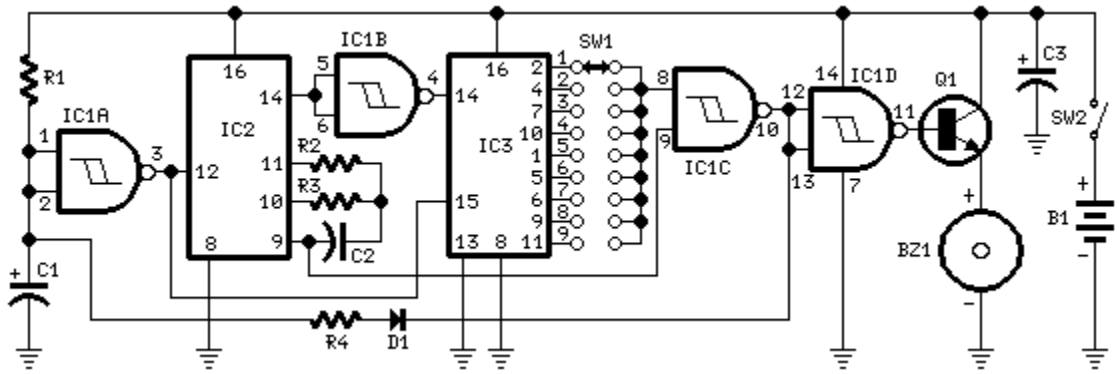
Total harmonic distortion @ 1KHz & 10KHz: Below 0.05% on 32 to 600 Ohms load and up to 1.5V peak-to-peak output. Below 0.1% at maximum output

Unconditionally stable on capacitive loads

Jogging Timer

3V Battery powered
Beeps after a fixed number of minutes

Circuit diagram:



Parts:

R1_____47K 1/4W Resistor
R2_____10M 1/4W Resistor
R3_____1M 1/4W Resistor
R4_____12K 1/4W Resistor (see notes)

C1,C3_____10µF 25V Electrolytic Capacitors
C2_____100nF 63V Polyester Capacitor

D1_____1N4148 75V 150mA Diode

IC1_____4093 Quad 2 input Schmitt NAND Gate IC
IC2_____4060 14 stage ripple counter and oscillator IC
IC3_____4017 Decade counter with 10 decoded outputs IC

Q1_____BC337 45V 800mA NPN Transistor

SW1_____1 pole 9 ways Rotary Switch (see notes)
SW2_____SPST Slider Switch

BZ1_____Piezo sounder (incorporating 3KHz oscillator)

B1_____3V Battery (two 1.5V AA or AAA cells in series etc.)

Device purpose:

This circuit was developed since a number of visitors of this website requested a timer capable of emitting a beep after one, two, three minutes and so on, for jogging purposes.
As shown in the Circuit diagram, SW1 is a 1 pole 9 ways Rotary Switch. Setting the switch in position 1, the Piezo sounder emits three short beeps every minute. In position 2 the same thing happens after 2 minutes, and so on, reaching a maximum interval of 9 minutes in position 9.

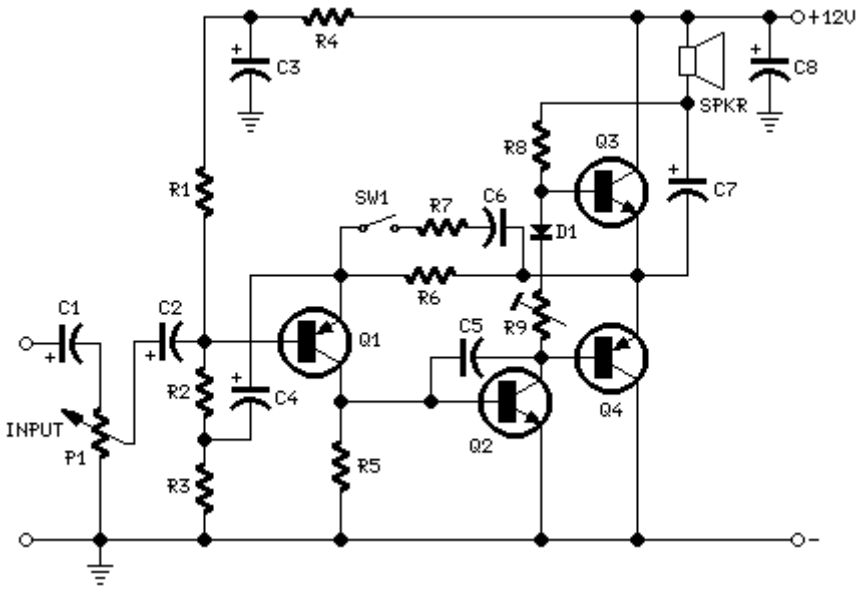
Notes:

- Needing only one time set, rotary switch can be replaced by an hard-wired link.
- A DIP-Switch can be used in place of the rotary type. Pay attention to use only a switch at a time, or the device could be damaged.
- Varying R4 from 10K to 15K you can obtain more or less than three short beeps after the preset time delay.
- To obtain a one-second beep only, after the preset time delay, disconnect pin 9 of IC1C from pin 9 of IC2 and connect it to pin 8 of IC1C.

Mini-box 2W Amplifier

Designed for self-powered 8, 4 & 2 Ohm loudspeakers
Bass-boost switch

Circuit diagram:



Parts:

P1	10K	Log.Potentiometer
R1,R2	33K	1/4W Resistors
R3	33R	1/4W Resistor
R4	15K	1/4W Resistor
R5,R6	1K	1/4W Resistors
R7	680R	1/4W Resistor
R8	120R	1/2W Resistor
R9	100R	1/2W Trimmer Cermet
C1,C2	10µF	63V Electrolytic Capacitors
C3	100µF	25V Electrolytic Capacitor
C4,C7	470µF	25V Electrolytic Capacitors
C5	47pF	63V Ceramic Capacitor
C6	220nF	63V Polyester Capacitor
C8	1000µF	25V Electrolytic Capacitor
D1	1N4148	75V 150mA Diode

```
Q1_____________BC560C  45V 100mA PNP Low noise High gain Transistor
Q2_____________BC337   45V 800mA NPN Transistor
Q3_____________TIP31A  60V 4A    NPN Transistor
Q4 _____________TIP32A  60V 4A    PNP Transistor

SW1_____________SPST switch

SPKR____________3-5 Watt Loudspeaker, 8, 4 or 2 Ohm impedance
```

Device purpose:

This amplifier was designed to be self-contained in a small loudspeaker box. It can be feed by Walkman, Mini-Disc and CD players, computers and similar devices having line or headphone output. Of course, in most cases you'll have to make two boxes to obtain stereo.
The circuit was deliberately designed using no ICs and in a rather old-fashioned manner in order to obtain good harmonic distortion behaviour and to avoid hard to find components. The amplifier(s) can be conveniently supplied by a 12V wall plug-in transformer. Closing SW1 a bass-boost is provided but, at the same time, volume control must be increased to compensate for power loss at higher frequencies.
In use, R9 should be carefully adjusted to provide minimal audible signal cross-over distortion consistent with minimal measured quiescent current consumption; a good compromise is to set the quiescent current at about 10-15 mA.
To measure this current, wire a DC current meter temporarily in series with the collector of Q3.

Technical data:

Output power: 1.5 Watt RMS @ 8 Ohm, 2.5 Watt @ 4 Ohm, 3.5 Watt @ 2 Ohm (1KHz sinewave)

Sensitivity: 100mV input for 1.5W output @ 8 Ohm

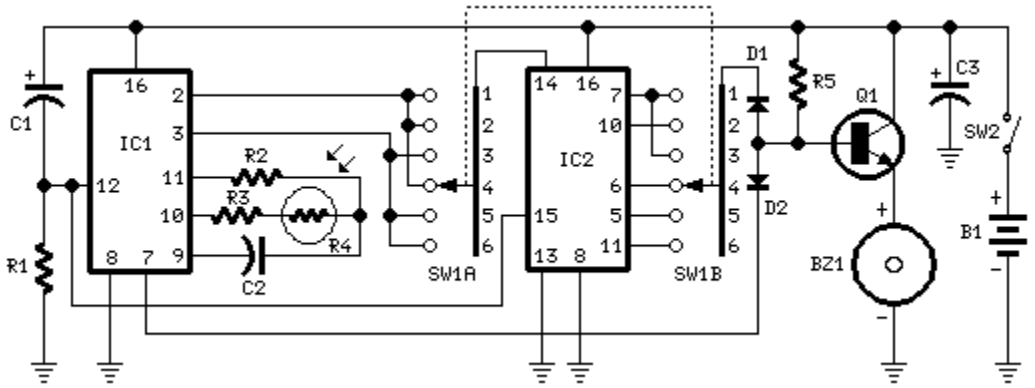
Frequency response: 30Hz to 20KHz -1dB

Total harmonic distortion @ 1KHz & 10KHz: Below 0.2% @ 8 Ohm 1W, below 0.3% @ 4 Ohm 2W, below 0.5% @ 2 Ohm 2W.

Tan Timer

Six timing positions suited to different skin types
Timing affected by sunlight intensity

Circuit diagram:



Parts:

```
R1_____________47K   1/4W Resistor
R2_____________1M    1/4W Resistor
R3,R5__________120K  1/4W Resistors
R4_____________Photo resistor (any type)

C1,C3__________10µF   25V Electrolytic Capacitors
C2_____________220nF  63V Polyester Capacitor

D1,D2_________1N4148  75V 150mA Diodes

IC1____________4060  14 stage ripple counter and oscillator IC
IC2____________4017  Decade counter with 10 decoded outputs IC

Q1_____________BC337  45V 800mA NPN Transistor

SW1____________2 poles 6 ways Rotary Switch (see notes)
SW2____________SPST  Slider Switch

BZ1____________Piezo sounder (incorporating 3KHz oscillator)

B1_____________3V Battery (two 1.5V AA or AAA cells in series etc.)
```

Device purpose:

This timer was deliberately designed for people wanting to get tanned but at the same time wishing to avoid an excessive exposure to sunlight.
A Rotary Switch sets the timer according to six classified Photo-types (see table).
A Photo resistor extends the preset time value according to sunlight brightness (see table).
When preset time ends, the beeper emits an intermittent signal and, to stop it, a complete switch-off of the circuit via SW2 is necessary.

Photo-type	Features	Exposure time
I & children	Light-eyed, red-haired, light complexion, freckly	20 to 33 minutes
II	Light-eyed, fair-haired, light complexion	28 to 47 minutes
III	Light or brown-eyed, fair or brown-haired, light or slightly dark complexion	40 to 67 minutes
IV	Dark-eyed, brown-haired, dark complexion	52 to 87 minutes
V	Dark-eyed, dark-haired, olive complexion	88 to 147 minutes
VI	The darkest of all	136 to 227 minutes
Note that pregnant women belong to Photo-type I		

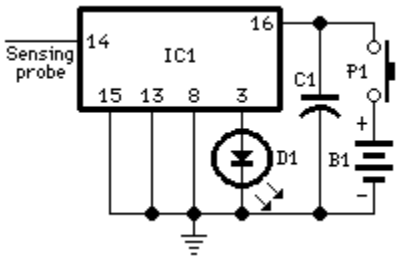
Notes:

- Needing only one time set suitable for your own skin type, the rotary switch can be replaced by hard-wired links.
- A DIP-Switch can be used in place of the rotary type. Pay attention to use only a switch at a time when the device is off, or the ICs could be damaged.

Live-line Detector

Detects the presence of a live mains conductor
Minimum parts counting

Circuit diagram:



Parts:

C1_____100nF 63V Polyester or Ceramic Capacitor

D1_____Red LED (any type)

IC1_____4017 Decade counter with 10 decoded outputs IC

P1_____SPST Pushbutton

B1_____3V Battery (two 1.5V AA or AAA cells in series etc.)

Sensing probe__3 to 15 cm. long, stiff insulated piece of wire

Circuit operation:

If the unit is brought close to a live conductor (insulated, and even buried in plaster) capacitive coupling between the live conductor and the probe clocks the counter, and causes the LED to flash 5 times per second, because the 4017 IC divides the mains 50Hz frequency by 10.
When remote from a live line, the unit stops counting, the LED resulting permanently off.

Notes:

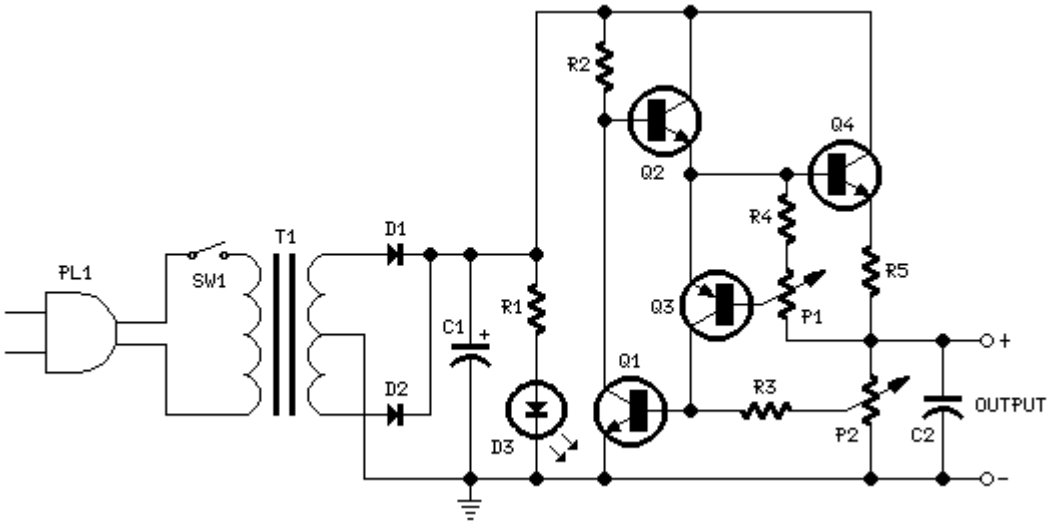
- Sensitivity can be varied using a more or less long sensing probe.

- Due to 3V operation, the LED's current limiting resistor can be omitted.

Variable DC Power Supply

Voltage range: 0.7 - 24V
Current limiting range: 50mA - 2A

Circuit diagram:



Parts:

```
P1_____________500R   Linear Potentiometer
P2_____________10K    Log. Potentiometer

R1,R2__________2K2  1/2W Resistors
R3_____________330R   1/4W Resistor
R4_____________150R   1/4W Resistor
R5_____________1R      5W Resistor

C1___________3300µF   35V Electrolytic Capacitor (see Notes)
C2_____________1µF    63V Polyester Capacitor

D1,D2________1N5402 200V 3A Diodes
D3_____________5mm. Red LED

Q1_____________BC182  50V 100mA NPN Transistor
Q2_____________BD139  80V 1.5A  NPN Transistor
Q3_____________BC212  50V 100mA PNP Transistor
Q4 ____________2N3055  60V 15A   NPN Transistor

T1_____________220V Primary, 36V Center-tapped Secondary 50VA Mains transformer (see
```

```
PL1_____________Male Mains plug

SW1_____________SPST Mains switch
```

Device purpose:

A Variable DC Power Supply is one of the most useful tools on the electronics hobbyist's workbench. This circuit is not an absolute novelty, but it's simple, reliable, "rugged" and short-proof, featuring variable voltage up to 24V and variable current limiting up to 2A. It's well suited to supply the circuits shown in this website. You can adapt it to your own requirements as explained in the notes below.

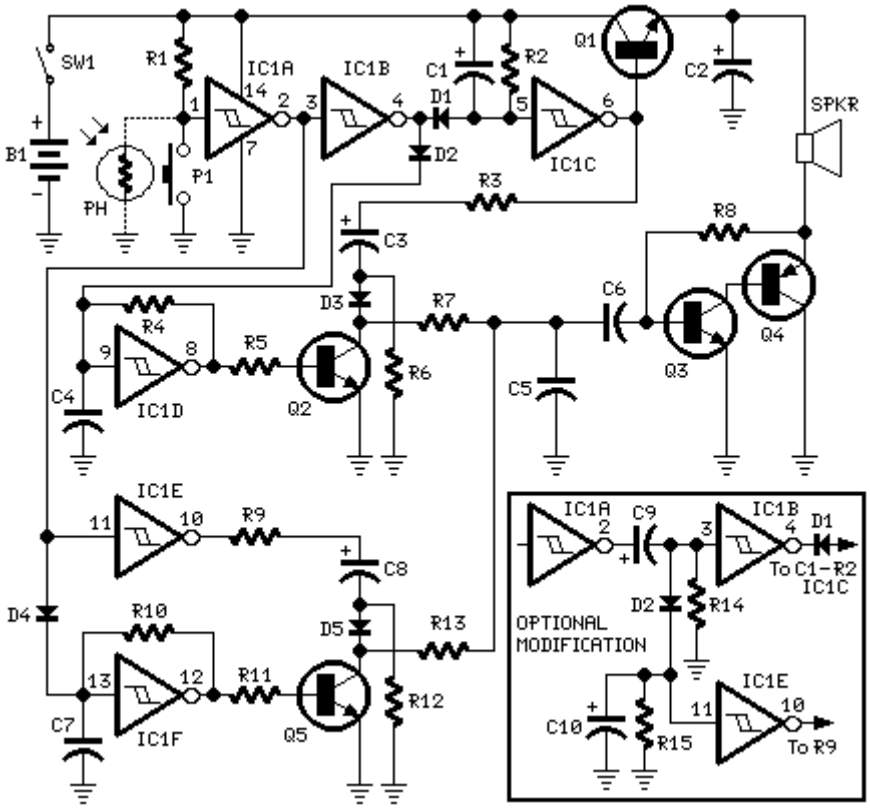
Notes:

- P1 sets the maximum output current you want to be delivered by the power supply at a given output voltage.
- P2 sets the output voltage and **must be** a **logarithmic** taper type, in order to obtain a more linear scale voltage indication.
- You can choose the Transformer on the grounds of maximum voltage and current output needed. Best choices are: 36, 40 or 48V center-tapped and 50, 75, 80 or 100VA.
- Capacitor C1 can be 2200 to 6800µF, 35 to 50V.
- Q4 must be mounted on a good heatsink in order to withstand sustained output short-circuit. In some cases the rear panel of the metal box in which you will enclose the circuit can do the job.
- The 2N3055 transistor (Q4) can be replaced with the slightly less powerful TIP3055 type.
- **Excellent quality-price ratio: enjoy!**

Bells ring Generator

Three circuit options
Can be synchronized to Christmas tree flashing lights

Circuit diagram:



Parts:

R1,R3,R7,R9,R13	10K	1/4W Resistors
R2	1M5	1/4W Resistor
R4	27K	1/4W Resistor
R5,R11	47K	1/4W Resistors
R6,R12	220K	1/4W Resistors
R8	2M2	1/4W Resistor
R10	33K	1/4W Resistor
C1	2µ2	25V Electrolytic Capacitor
C2	47µF	25V Electrolytic Capacitor
C3,C8	10µF	25V Electrolytic Capacitors
C4,C7	10nF	63V Polyester Capacitors

```
C5,C6__________100nF  63V Polyester Capacitors

D1-D5_________1N4148  75V 150mA Diodes

IC1__________MC14106 or 40106 Hex Schmitt Inverter IC

Q1_____________BC337  45V 800mA NPN Transistor
Q2,Q3,Q5_______BC238  25V 100mA NPN Transistors
Q4 _____________BC327  45V 800mA PNP Transistor

PH_____________Photo resistor (any type) (see Notes)

P1_____________SPST Pushbutton (see Notes)

SW1____________SPST Switch

SPKR___________8 Ohm Loudspeaker

B1_____________3V Battery (two 1.5V AA or AAA cells in series etc.)
```

Parts added to optional modification:

```
R14____________220K   1/4W Resistor
R15_____________1M   1/4W Resistor

C9_____________4µ7  25V Electrolytic Capacitor
C10____________1µF  25V Electrolytic Capacitor
```

Device purpose:

This circuit generates a dual-tone bells ringing similar to most door-bell units. It can be used in many applications other than door-bell. In the Notes below several options will be given in order to suit different needs.

Circuit operation:

The circuit as shown in the diagram generates a "Ding-tone" when P1 is pressed and a "Dong-tone" when P1 is released. IC1D is the first-tone frequency generator and IC1F generates the second-tone. Q2, Q5 and related components act as shape and decay controls of the two tones, trying to imitate as close as possible the bells sound. Their outputs are mixed (R7 & R13), filtered (C5) and boosted by a simple class-A audio amplifier (Q3 & Q4) in order to drive the loudspeaker. The amplifier is switched-on by Q1 when P1 is pressed, then is switched-off some seconds after P1 is released: this time-delay is fixed by C1 & R2. In this manner the circuit draws a negligible current when in stand-by mode.

Notes:

- To obtain a "Ding-Dong" operation when pushing on P1, no matter when it is released, you must

modify the circuit as shown in the frame placed at the low-right corner of the circuit diagram. D4 must be removed. C10 & R15 set the time-delay separating the first from the second tone.

- To obtain a one-tone-only generator, wire the circuit as in the optional modification, making the following changes:

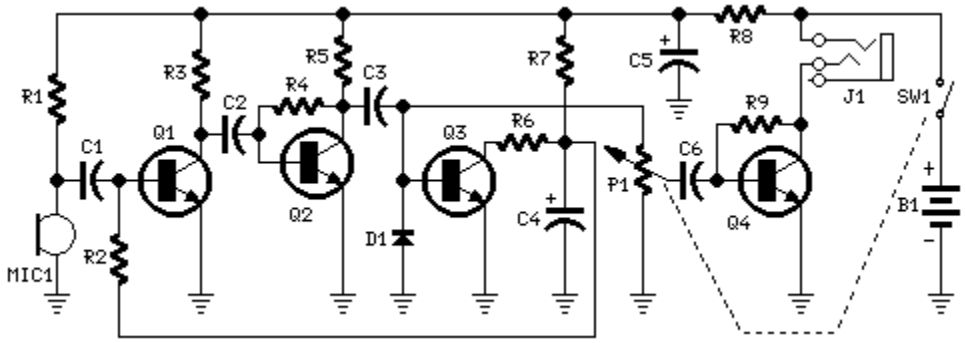
  C9 = 100nF 63V Polyester Capacitor.
  Omit R9 to R13 & R15; C7, C8 & C10; D2, D4, D5 & Q5.
  Connect to negative supply pins 11 & 13 of IC1 and left open pins 10 & 12.

- An amusing application of this circuit wired as in the original schematic, is to use a photo-resistor in place of P1, then placing the unit near the flashing lamps of your Christmas tree. A soft bell sound may be heard at switch-on and switch-off of the lamp chosen.
- To obtain higher output power you may substitute R8, Q3 & Q4 with an audio amplifier IC like the LM386 or LM380. In this case power supply must be raised to 6 - 12V but at the same time R4 & R10 should be changed to adjust bell-tone frequencies.
- Good tone frequencies are roughly 2000 and 1650Hz respectively.
- When in stand-by mode, current drawing of the circuit is 200µA @ 3V supply: therefore SW1 can be omitted.

Amplified Ear

Useful to listen in faint sounds
1.5V Battery operation

Circuit diagram:



Parts:

```
P1_____________22K   Log. Potentiometer (see Notes)

R1,R9__________10K   1/4W Resistors
R2_____________1M    1/4W Resistor
R3_____________4K7   1/4W Resistor
R4,R7__________100K  1/4W Resistor
R5_____________3K9   1/4W Resistor
R6_____________1K5   1/4W Resistor
R8_____________100R  1/4W Resistor

C1,C2__________100nF  63V Polyester or Ceramic Capacitors
C3,C6__________1µF    63V Polyester or Ceramic Capacitors
C4_____________10µF   25V Electrolytic Capacitor
C5_____________470µF  25V Electrolytic Capacitor

D1___________1N4148  75V 150mA Diode

Q1,Q2,Q3,_____BC547  45V 100mA NPN Transistors
Q4____________BC337  45V 800mA NPN Transistor

MIC1__________Miniature electret microphone

SW1____________SPST Switch (Ganged with P1)

J1_____________Stereo 3mm. Jack socket

B1_____________1.5V Battery (AA or AAA cell etc.)
```

Device purpose:

This circuit, connected with 32 Ohms impedance mini-earphones, can detect very remote sounds. Useful for theatre, cinema and lecture goers: every word will be clearly heard. You can also listen to your television set at a very low volume, avoiding to bother relatives and neighbours. Even if you have a faultless hearing, you may discover unexpected sounds using this device: a remote bird twittering will seem very close to you.

Circuit operation:

The heart of the circuit is a constant-volume control amplifier. All the signals picked-up by the microphone are amplified at a constant level of about 1 Volt peak to peak. In this manner very low amplitude audio signals are highly amplified and high amplitude ones are limited. This operation is accomplished by Q3, modifying the bias of Q1 (hence its AC gain) by means of R2.
A noteworthy feature of this circuit is 1.5V battery operation.
Typical current drawing: 7.5mA.

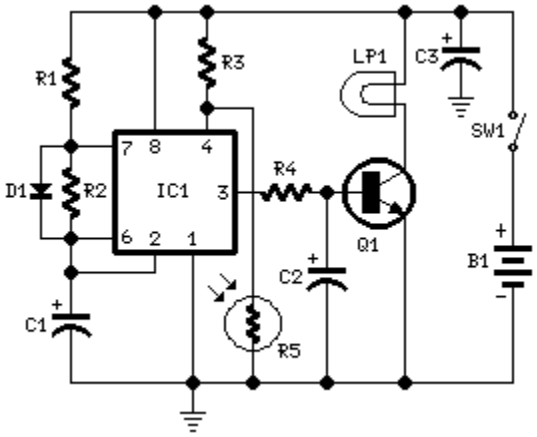
Notes:

- Due to the constant-volume control, some users may consider P1 volume control unnecessary. In most cases it can be omitted, connecting C6 to C3. In this case use a SPST slider or toggle switch as SW1.
- Note the stereo output Jack socket (J1) connections: only the two inner connections are used, leaving open the external one. In this manner the two earpieces are wired in series, allowing mono operation and optimum load impedance to Q4 (64 Ohms).
- Using suitable miniature components, this circuit can be enclosed in a very small box, provided by a clip and hanged on one's clothes or slipped in a pocket.

Nocturnal Animals Whisker

A low-rate flashing lamp drives away undesired visitors
Automatic on-off operation

Circuit diagram:



Parts:

R1_____100K 1/4W Resistor
R2_____2M2 1/4W Resistor
R3_____10K 1/4W Resistor (see Notes)
R4_____4K7 1/4W Resistor
R5_____Photo resistor (any type, see Notes)

C1,C2,C3_____47µF 25V Electrolytic Capacitors

D1_____1N4148 75V 150mA Diode

IC1_____7555 or TS555CN CMos Timer IC

Q1_____BD681 100V 4A NPN Darlington Transistor

LP1_____6V 3W Lamp (see Notes)

SW1_____SPST Switch

B1_____6V 1.2A Lead acid sealed rechargeable Battery (see Notes)

Device purpose:

This circuit proved very useful in keeping away from a terrace or a porch some bats and other nocturnal animals. You can use it for similar or different purposes. The lamp illuminates at a 4-5 seconds delay and stays off about one minute and 15 seconds. The photo resistor allows automatic switch-on of the circuit at dusk and switch-off at dawn. Supposing an eight hours operation per night, the lamp stays on for a total of about 30 minutes, allowing great current economy.

Circuit operation:

IC1 is wired as an astable multivibrator with on and off time-delays as explained before. R1 & C1 set the on time-delay, R2 & C1 set the off time-delay. As there is no critical parameter, you can set these delays at your wish. Q1 is the lamp driver and can feed rather big lamps. C2 prevents some brief instability when voltage at pin 4 of IC1 is very close to switching threshold.

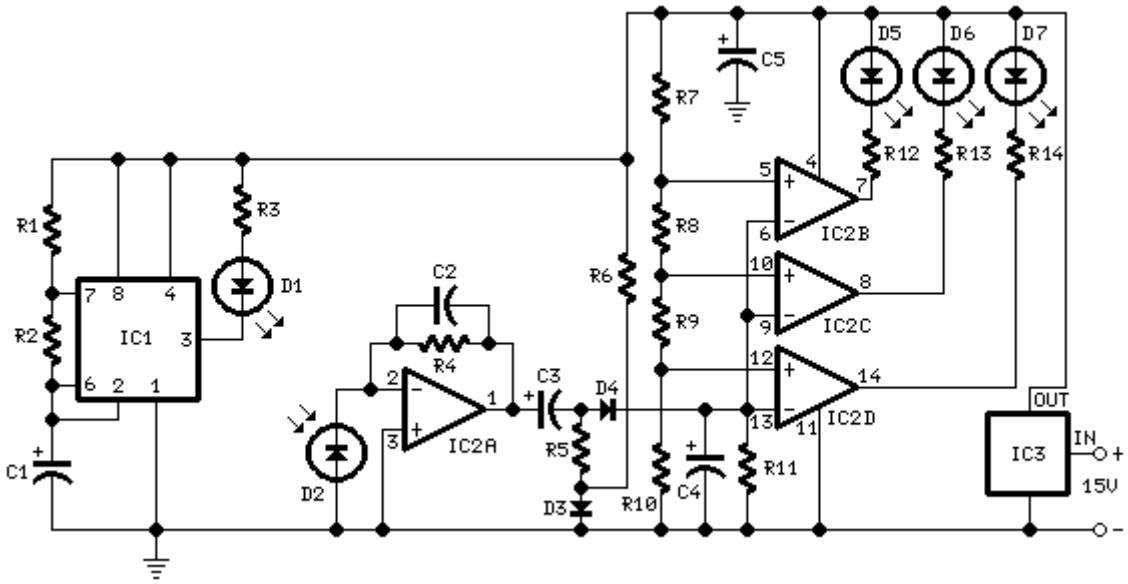
Notes:

- Mount the photo resistor's sensitive surface at an angle of 90 degrees or more compared with the lamp, in order to avoid light interaction.
- Owing to the photo resistor's type or to suit your own special needs, R3 can be varied to set the operating threshold.
- If you are not needing automatic on-off operation, omit R3 & R5 and connect pin 4 of IC1 to positive supply.
- The lamp can be any 6V type up to 10-12W, but a 3W one is a very good compromise.
- Batteries can be of the rechargeable type: lead acid sealed, NI-CD, NI-MH packages ranging from 3.6 to 12V, making sure that suitable lamps are provided.
- Using 1.2 Ampere-hour batteries, you should probably recharge them once a week or less.
- Obviously you can feed permanently the circuit by means of a suitable mains power supply.

Park-Aid

Three LEDs signal bumper-barrier distance
Infra-red operation, indoor use

Circuit diagram:



Parts:

```
R1_____________10K   1/4W Resistor
R2,R5,R6,R9_____1K   1/4W Resistors
R3_____________33R   1/4W Resistor
R4,R11_________1M    1/4W Resistors
R7_____________4K7   1/4W Resistor
R8_____________1K5   1/4W Resistor
R10,R12-R14_____1K   1/4W Resistors


C1,C4__________1µF   63V Electrolytic or Polyester Capacitors
C2_____________47pF  63V Ceramic Capacitor
C3,C5_________100µF  25V Electrolytic Capacitors

D1_____________Infra-red LED
D2_____________Infra-red Photo Diode (see Notes)
D3,D4________1N4148  75V 150mA Diodes
D5-7___________LEDs  (Any color and size)

IC1____________555   Timer IC
```

```
IC2_____________LM324  Low Power Quad Op-amp
IC3_____________7812  12V 1A Positive voltage regulator IC
```

Device purpose:

This circuit was designed as an aid in parking the car near the garage wall when backing up. LED D5 illuminates when bumper-wall distance is about 20 cm., D5+D6 illuminate at about 10 cm. and D5+D6+D7 at about 6 cm. In this manner you are alerted when approaching too close to the wall.
All distances mentioned before can vary, depending on infra-red transmitting and receiving LEDs used and are mostly affected by the color of the reflecting surface. Black surfaces lower greatly the device's sensitivity.
Obviously, you can use this circuit in other applications like liquids level detection, proximity devices etc.

Circuit operation:

IC1 forms an oscillator driving the infra-red LED by means of 0.8mSec. pulses at 120Hz frequency and about 300mA peak current. D1 & D2 are placed facing the car on the same line, a couple of centimeters apart, on a short breadboard strip fastened to the wall. D2 picks-up the infra-red beam generated by D1 and reflected by the surface placed in front of it. The signal is amplified by IC2A and peak detected by D4 & C4. Diode D3, with R5 & R6, compensate for the forward diode drop of D4. A DC voltage proportional to the distance of the reflecting object and D1 & D2 feeds the inverting inputs of three voltage comparators. These comparators switch on and off the LEDs, referring to voltages at their non-inverting inputs set by the voltage divider resistor chain R7-R10.

Notes:

- Power supply must be regulated (hence the use of IC3) for precise reference voltages. The circuit can be fed by a commercial wall plug-in power supply, having a DC output voltage in the range 12-24V.
- Current drawing: LEDs off 40mA; all LEDs on 60mA @ 12V DC supply.
- The infra-red Photo Diode D2, should be of the type incorporating an optical sunlight filter: these components appear in black plastic cases. Some of them resemble TO92 transistors: in this case, please note that the sensitive surface is the curved, **not** the flat one.
- Avoid sun or artificial light hitting directly D1 & D2.
- If your car has black bumpers, you can line-up the infra-red diodes with the (mostly white) license or number plate.
- It's wiser to place all the circuitry near the infra-red LEDs in a small box. The 3 signaling LEDs can be placed far from the main box at an height making them well visible by the car driver.
- The best setup is obtained bringing D2 nearer to D1 (without a reflecting object) until D5 illuminates; then moving it a bit until D5 is clearly off. Usually D1-D2 optimum distance lies in the range 1.5-3 cm.
- If you are needing a simpler circuit of this kind driving a LED or a relay, click Infra-red Level Detector

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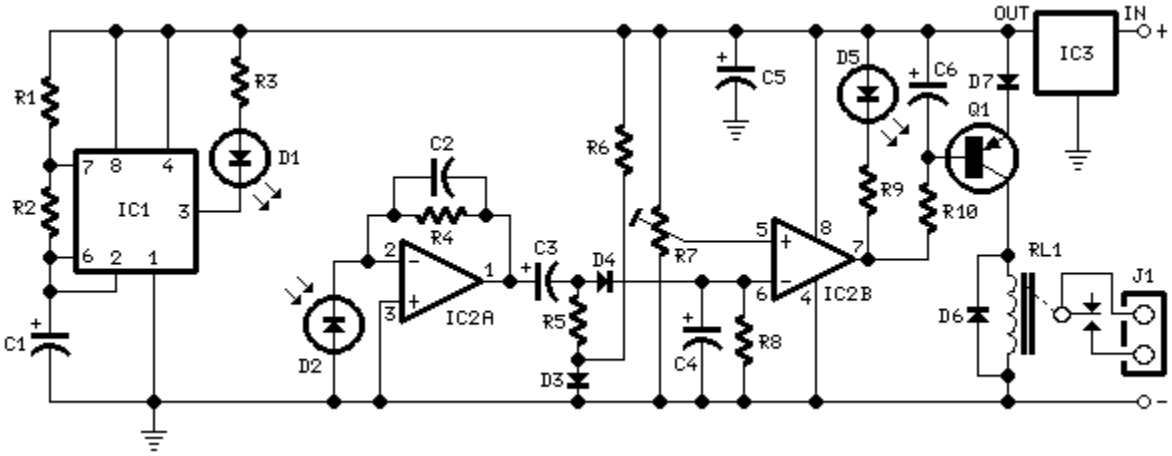
Infra-red Level Detector

Useful for liquids level detection and proximity devices
Up to 50 cm. range, optional relay operation

Circuit diagram:



Parts:

```
R1_____________10K   1/4W Resistor
R2,R5,R6,R9_____1K   1/4W Resistors
R3_____________33R   1/4W Resistor
R4,R8__________1M    1/4W Resistors
R7_____________10K   Trimmer Cermet
R10____________22K   1/4W Resistor


C1,C4__________1µF   63V Electrolytic or Polyester Capacitors
C2_____________47pF  63V Ceramic Capacitor
C3,C5,C6_____100µF   25V Electrolytic Capacitors

D1_____________Infra-red LED
D2_____________Infra-red Photo Diode (see Notes)
D3,D4________1N4148  75V 150mA Diode
D5_____________LED   (Any color and size)
D6,D7________1N4002  100V 1A Diodes

Q1___________BC327   45V 800mA PNP Transistor

IC1____________555   Timer IC
IC2___________LM358  Low Power Dual Op-amp
IC3____________7812  12V 1A Positive voltage regulator IC
```

```
RL1_____________Relay with SPDT 2A @ 220V switch
                Coil Voltage 12V. Coil resistance 200-300 Ohm

J1______________Two ways output socket
```

Device purpose:

This circuit is useful in liquids level or proximity detection. It operates detecting the distance from the target by reflection of an infra-red beam. It can safely detect the level of a liquid in a tank without any contact with the liquid itself. The device's range can be set from a couple of cm. to about 50 cm. by means of a trimmer.
Range can vary, depending on infra-red transmitting and receiving LEDs used and is mostly affected by the color of the reflecting surface. Black surfaces lower greatly the device's sensitivity.

Circuit operation:

IC1 forms an oscillator driving the infra-red LED by means of 0.8mSec. pulses at 120Hz frequency and about 300mA peak current. D1 & D2 are placed facing the target on the same line, a couple of centimeters apart, on a short breadboard strip. D2 picks-up the infra-red beam generated by D1 and reflected by the surface placed in front of it. The signal is amplified by IC2A and peak detected by D4 & C4. Diode D3, with R5 & R6, compensate for the forward diode drop of D4. A DC voltage proportional to the distance of the reflecting object and D1 & D2 feeds the inverting input of the voltage comparator IC2B. This comparator switches on and off the LED and the optional relay via Q1, comparing its input voltage to the reference voltage at its non-inverting input set by the Trimmer R7.

Notes:

- Power supply must be regulated (hence the use of IC3) for precise reference voltages. The circuit can be fed by a commercial wall plug-in power supply, having a DC output voltage in the range 12-24V.
- Current drawing: LED off 40mA; LED and Relay on 70mA @ 12V DC supply.
- R10, C6, Q1, D6, D7, RL1 and J1 can be omitted if relay operation is not required.
- The infra-red Photo Diode D2, should be of the type incorporating an optical sunlight filter: these components appear in black plastic cases. Some of them resemble TO92 transistors: in this case, please note that the sensitive surface is the curved, **not** the flat one.
- Avoid sun or artificial light hitting directly D1 & D2.
- Usually D1-D2 optimum distance lies in the range 1.5-3 cm.
- If you are needing a similar circuit driving 3 LEDs in sequence, also suitable as a parking aid, click here

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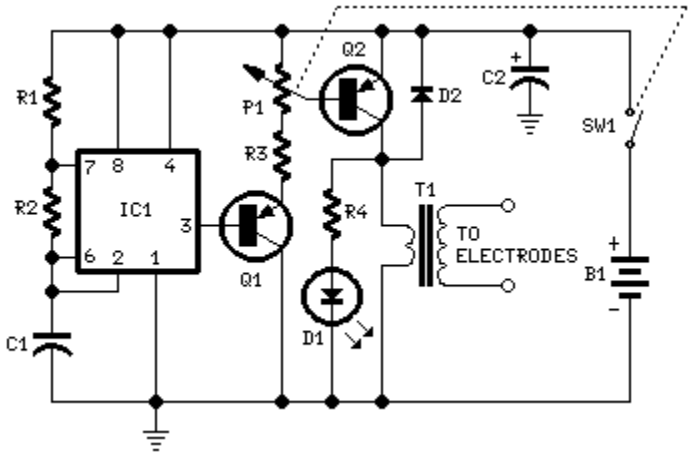
Muscular Bio-Stimulator

Particularly suitable for cellulitis treatment
3V battery supply, portable set

Circuit diagram:



Parts:

P1_____4K7 Linear Potentiometer

R1_____180K 1/4W Resistor
R2_____1K8 1/4W Resistor (see Notes)
R3_____2K2 1/4W Resistor
R4_____100R 1/4W Resistor

C1_____100nF 63V Polyester Capacitor
C2_____100µF 25V Electrolytic Capacitor

D1_____LED Red 5mm.
D2_____1N4007 1000V 1A Diode

Q1,Q2_____BC327 45V 800mA PNP Transistors

IC1_____7555 or TS555CN CMos Timer IC

T1_____220V Primary, 12V Secondary 1.2VA Mains transformer (see Notes)

SW1_____SPST Switch (Ganged with P1)

B1_____3V Battery (two 1.5V AA or AAA cells in series etc.)

Device purpose:

This is a small, portable set, designed for those aiming at look improvement. The Bio-Stimulator provides muscles' stimulation and invigoration but, mainly, it's an aid in removing cellulitis.
Tape the electrodes to the skin at both ends of the chosen muscle and rotate P1 knob slowly until a light itch sensation is perceived. Each session should last about 30 - 40 minutes.

Warning:

The use of this device is forbidden to Pace-Maker bearers and pregnant women.
Don't place the electrodes on cuts, wounds, injuries or varices.
Obviously we can't claim or prove any therapeutic effectiveness for this device.

Circuit operation:

IC1 generates 150µSec. pulses at about 80Hz frequency. Q1 acts as a buffer and Q2 inverts the pulses' polarity and drives the Transformer. Output pulses' amplitude is set by P1 and approximately displayed by LED D1 brightness. D2 protects Q2 against high voltage peaks generated by T1 inductance during switching.

Notes:

- T1 is a small mains transformer 220 to 12V @ 100 or 150mA. It must be reverse connected i.e.: the 12V secondary winding to Q2 Collector and ground, and the 220V primary winding to output electrodes.
- Output voltage is about 60V positive and 150V negative but output current is so small that there is no electric-shock danger.
- In any case P1 should be operated by the "patient", starting with the knob fully counter-clockwise, then rotating it **slowly** clockwise until the LED starts to illuminate. Stop rotating the knob when a light itch sensation is perceived.
- Best knob position is usually near the center of its range.
- In some cases a greater pulse duration can be more effective in cellulitis treatment. Try changing R2 to 5K6 or 10K maximum: stronger pulses will be easily perceived and the LED will shine more brightly.
- Electrodes can be obtained by small metal plates connected to the circuit's output via usual electric wire and can be taped to the skin. In some cases, moistening them with little water has proven useful.
- SW1 should be ganged to P1 to avoid abrupt voltage peaks on the "patient's" body at switch-on, but a stand alone SPST switch works quite well, provided you remember to set P1 knob fully counter-clockwise at switch-on.
- Current drawing of this circuit is about 1mA @ 3V DC.
- Some commercial sets have four, six or eight output electrodes. To obtain this you can retain the part of the circuit comprising IC1, R1, R2, C1, C2, SW1 and B1. Other parts in the diagram (i.e. P1, R3, R4, D1, D2, Q2 & T1) can be doubled, trebled or quadrupled. Added potentiometers and R3 series resistors must be wired in parallel and all connected from Emitter of Q1 to positive supply.

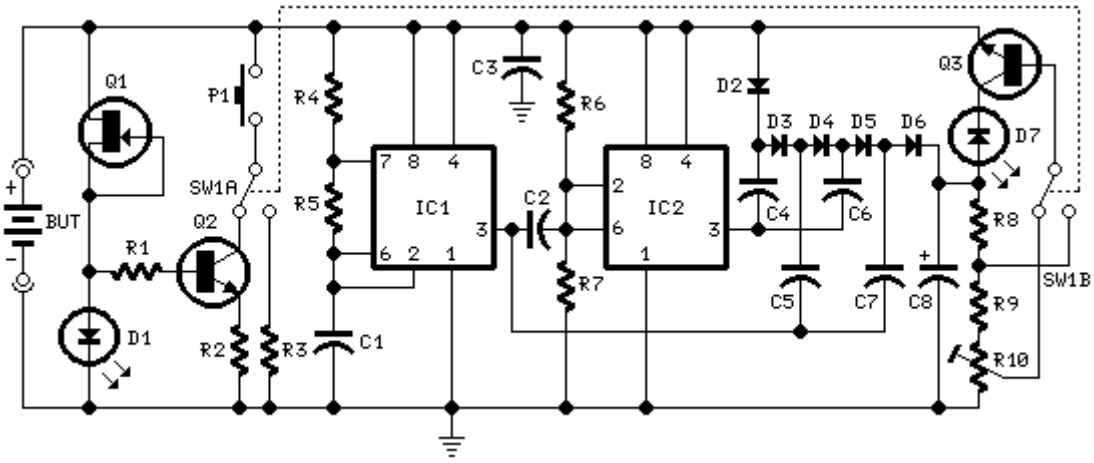
- Commercial sets have frequently a built-in 30 minutes timer. For this purpose you can use the Timed Beeper the Bedside Lamp Timer or the Jogging Timer circuits available in this Website, adjusting the timing components to suit your needs.

Disclaimer: we can't claim or prove any therapeutic effectiveness for this device.

Self-powered Fast Battery-Tester

Tests 1.5 to 15 Volt cells
Two-LED display, no power supply required

Circuit diagram:



Parts:

```
R1_______________2K2  1/4W Resistor
R2_______________3R3  1/4W Resistor
R3_______________10R  1/4W Resistor
R4_______________4K7  1/4W Resistor
R5_______________33K  1/4W Resistor
R6,R7____________100K  1/4W Resistors
R8_______________220K  1/4W Resistor
R9_______________330K  1/4W Resistor
R10______________500K  Trimmer Cermet

C1,C2____________10nF  63V Polyester Capacitors
C3-C7____________100nF  63V Polyester Capacitors
C8_______________220µF  35V Electrolytic Capacitor

D1,D7____________LEDs Red 5mm. (see Notes)
D2-D6_________1N4148  75V 150mA Diodes

Q1_____________2N3819  General purpose FET
Q2,Q3__________BC337  45V 800mA NPN Transistors

IC1,IC2_________7555 or TS555CN CMos Timer ICs

P1_______________SPST Pushbutton
```

SW1_____DPDT Switch

BUT_____Battery under test

Holder or clips to connect the Battery under test to the circuit

---

Device purpose:

This circuit runs a fast battery test without the need of power supply or expensive moving-coil voltmeters. It has two ranges: when SW1 is set as shown in the circuit diagram, the device can test 3V to 15V batteries. When SW1 is switched to the other position, only 1.5V cells can be tested.

Testing 3V to 15V batteries:

- Switch SW1 as shown in the circuit diagram.
- Place the battery under test in a suitable holder or clip it to the circuit.
- Wait some seconds in order to let C8 reach its full charge.
- LED D1 illuminates at a constant intensity, independent of battery voltage.
- If D1 illuminates very weakly or is fully off the battery is unusable.
- If D1 has a good illumination, press P1 and keep an eye to LED D7. If D7 remains fully off, the battery is in a very good state.
- If D7 illuminates brightly for a few seconds, the battery is weak. This condition is confirmed by a noticeable weakening of D1 brightness.
- If D7 illuminates weakly for a few seconds but D1 maintain the same light intensity, the battery is still good but is not new.

Testing 1.5V batteries:

- Switch SW1 in the position opposite to that shown in the circuit diagram.
- Place the battery under test in a suitable holder or clip it to the circuit.
- Wait some seconds in order to let C8 reach its full charge.
- LED D1 illuminates very weakly only in presence of a new battery, otherwise is off.
- Press P1 and keep an eye to LED D7. If D7 remains fully off the battery can be in very good state.
- If D7 illuminates brightly for a few seconds, the battery is weak.
- If D7 illuminates weakly for a few seconds, the battery is still good but is not new.
- If you are suspecting a 1.5V cell to be completely discharged, a better test can be made wiring two 1.5V batteries in series, then running the 3V test.

Circuit operation:

FET Q1 provides a constant current generator biasing LED D1 and Q2 Base. In this manner D1 illuminates at a constant intensity, independent of battery voltage from 3 to 15V and Q2 (when P1 is closed) applies a constant current load of about 120mA to the battery. IC1 is a square wave generator oscillating at about 3KHz. IC2 acts as an inverter and drives, together with IC1 but in anti-phase, Diodes D2-D6 and Capacitors C4-C7, obtaining a voltage multiplication. C8 is charged by this raised voltage and R8-R10 form a voltage divider biasing the Base of Q3. When P1 is open, a very light load is ap

to the battery under test and Q3 Base is biased in order to maintain LED D7 in the off state.
Closing P1, a 120mA load is applied to the battery under test. If the battery is not fully charged, its output voltage starts reducing: when this voltage falls 0.6V below the battery nominal voltage, Q3 Emitter becomes more negative than the Base, transistor is hard biased and D7 illuminates. Obviously, this state of affairs lasts a few seconds: the time spent by C8 to reduce its initial voltage to the new one, proportional to the voltage of the loaded battery. If the battery under test is in a good charging state, its output voltage did not fall under a 120mA loading current, so LED D7 stays off.
When testing 1.5V batteries, the circuit formed by Q1, Q2, D1, R1 & R2 doesn't work well at this supply voltage, so a 150mA load current is applied to the BUT by means of the 10 Ohm resistor R3 after switching SW1A. Q3 bias is also changed via SW1B.

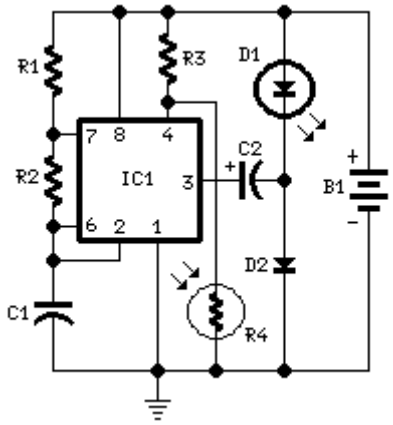
Notes:

- To set-up this circuit apply a 6 to 7.5V voltage source to the input and trim R10 until LED D7 is fully off (without pushing on P1).
- 1.5V test position needs no set-up.
- CMos 555 ICs must be used for IC1 & IC2 because they are the only cheap devices able to oscillate at 1.5V supply or less.

Battery-powered Night Lamp

Ultra-low current drawing
1.5V battery supply

Circuit diagram:



Parts:

```
R1,R2_____________1M    1/4W Resistors
R3_________________47K   1/4W Resistor (optional: see Notes)
R4_____________Photo resistor (any type, optional: see Notes)

C1_____________100nF  63V Polyester Capacitor
C2_____________220µF  25V Electrolytic Capacitor

D1_________________LED  Red 10mm. Ultra-bright (see Notes)
D2_____________1N5819  40V 1A Schottky-barrier Diode (see Notes)

IC1_____________7555 or TS555CN CMos Timer IC

B1_________________1.5V Battery (AA or AAA cell etc.)
```

Device purpose:

This circuit is usable as a Night Lamp when a wall mains socket is not available to plug-in an ever running small neon lamp device. In order to ensure minimum battery consumption, one 1.5V cell is

used, and a simple voltage doubler drives a pulsating ultra-bright LED: current drawing is less than 500µA.
An optional Photo resistor switches-off the circuit in daylight or when room lamps illuminate, allowing further current economy.
This device will run for about 3 months continuously on an ordinary AA sized cell or for around 6 months on an alkaline type cell but, adding the Photo resistor circuitry, running time will be doubled or, very likely, triplicated.

Circuit operation:

IC1 generates a square wave at about 4Hz frequency. C2 & D2 form a voltage doubler, necessary to raise the battery voltage to a peak value able to drive the LED.

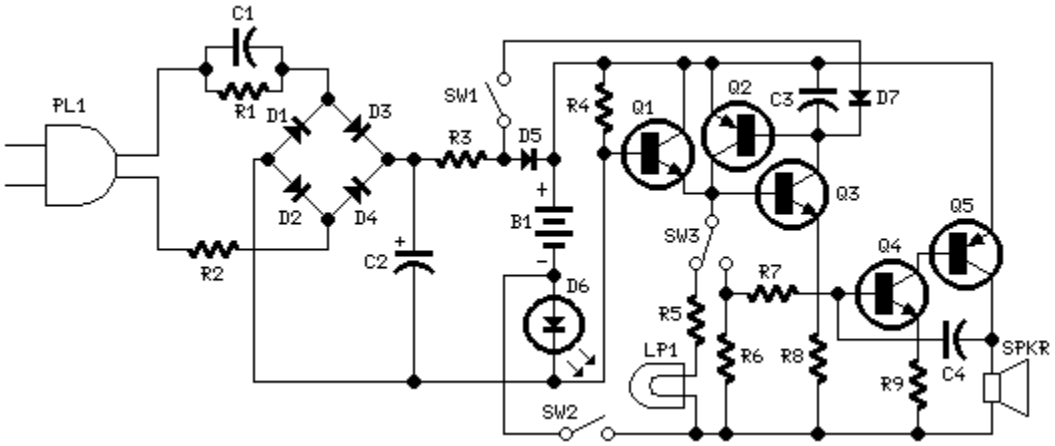
Notes:

- IC1 must be a CMos type: only these devices can safely operate at 1.5V supply or less.
- If you are not needing Photo resistor operation, omit R3 & R4 and connect pin 4 of IC1 to positive supply.
- Ordinary LEDs can be used, but light intensity will be poor.
- An ordinary 1N4148 type diode can be used instead of the 1N5819 Schottky-barrier type diode, but LED intensity will be reduced due to the higher voltage drop.
- Any Schottky-barrier type diode can be used in place of the 1N5819.

Emergency Light & Alarm

Powered by two AA NI-CD batteries
Four switchable options

Circuit diagram:



Parts:

```
R1_____________220K   1/4W Resistor
R2_____________470R   1/2W Resistor
R3_____________390R   1/4W Resistor
R4_____________1K5    1/4W Resistor
R5_____________1R     1/4W Resistor
R6_____________10K    1/4W Resistor
R7_____________330K   1/4W Resistor
R8_____________470R   1/4W Resistor
R9_____________100R   1/4W Resistor

C1_____________330nF  400V Polyester Capacitor
C2_____________10µF    63V Electrolytic Capacitor
C3_____________100nF   63V Polyester Capacitor
C4_____________10nF    63V Polyester Capacitor

D1-D5_________1N4007 1000V 1A Diodes
D6_____________LED  Green (any shape)
D7_____________1N4148   75V 150mA Diode

Q1,Q3,Q4_______BC547    45V 100mA NPN Transistors
Q2,Q5__________BC327    45V 800mA PNP Transistors

SW1,SW2_________SPST Switches
```

```
SW3_____________SPDT Switch

LP1_____________2.2V or 2.5V 250-300mA Torch Lamp

SPKR____________8 Ohm Loudspeaker

B1______________2.5V Battery (two AA NI-CD rechargeable cells wired in series)

PL1_____________Male Mains plug
```

Device purpose:

This circuit is permanently plugged into a mains socket and NI-CD batteries are trickle-charged. When a power outage occurs, the lamp automatically illuminates. Instead of illuminating a lamp, an alarm sounder can be chosen.
When power supply is restored, the lamp or the alarm is switched-off. A switch provides a "latch-up" function, in order to extend lamp or alarm operation even when power is restored.

Circuit operation:

Mains voltage is reduced to about 12V DC at C2's terminals, by means of the reactance of C1 and the diode bridge (D1-D4). Thus avoids the use of a mains transformer.
Trickle-charging current for the battery B1 is provided by the series resistor R3, D5 and the green LED D6 that also monitors the presence of mains supply and correct battery charging.
Q2 & Q3 form a self-latching pair that start operating when a power outage occurs. In this case, Q1 biasing becomes positive, so this transistor turns on the self latching pair.
If SW3 is set as shown in the circuit diagram, the lamp illuminates via SW2, which is normally closed; if set the other way, a square wave audio frequency generator formed by Q4, Q5 and related components is activated, driving the loudspeaker.
If SW1 is left open, when mains supply is restored the lamp or the alarm continue to operate. They can be disabled by opening the main on-off switch SW2.
If SW1 is closed, restoration of the mains supply terminates lamp or alarm operation, by applying a positive bias to the Base of Q2.

Notes:

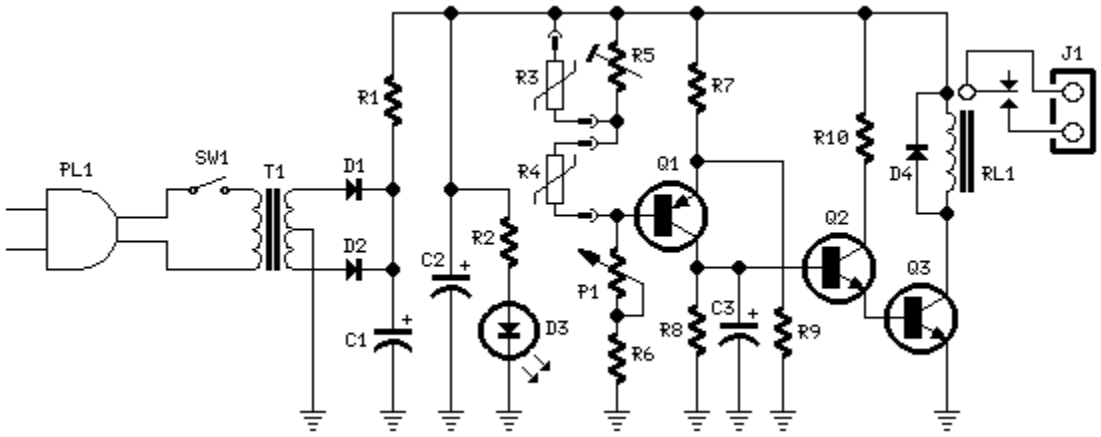
- Close SW2 **after** the circuit is plugged.
- **Warning!** The circuit is connected to 220Vac mains, then some parts in the circuit board are subjected to **lethal potential!**. Avoid touching the circuit when plugged and enclose it in a plastic box.

This circuit was awarded with publication in ELECTRONICS WORLD "Circuit Ideas", September 2001 issue, page 708.

Heating System Thermostat

Controlled by indoor and outdoor temperature
Simple, high reliability design

Circuit diagram:



Parts:

```
P1_______________1K    Linear Potentiometer

R1_______________10R   1/4W Resistor
R2_______________1K    1/4W Resistor
R3_______________3K3   @ 20°C n.t.c. Thermistor (see Notes)
R4_______________2K2   @ 20°C n.t.c. Thermistor (see Notes)
R5_______________10K   1/2W Trimmer Cermet
R6_______________3K3   1/4W Resistor
R7,R9____________4K7   1/4W Resistors
R8_____________470K    1/4W Resistor
R10____________10K     1/4W Resistor

C1,C2__________470µF    25V Electrolytic Capacitors
C3_______________1µF    63V Electrolytic Capacitor

D1,D2,D4_____1N4002   100V 1A Diodes
D3_______________LED   Red 3 or 5mm.

Q1_____________BC557    45V 100mA PNP Transistor
Q2_____________BC547    45V 100mA NPN Transistor
Q3_____________BC337    45V 800mA NPN Transistor

RL1____________Relay with SPDT 2A @ 220V switch
                Coil Voltage 12V. Coil resistance 200-300 Ohm
```

```
J1_____________Two ways output socket

SW1____________SPST Mains Switch

T1_____________220V Primary, 12 + 12V Secondary 3VA Mains transformer

PL1____________Male Mains plug & cable
```

Device purpose:

This circuit is intended to control a heating system or central heating plan, keeping constant indoor temperature in spite of wide range changes in the outdoor one. Two sensors are needed: one placed outdoors, in order to sense the external temperature; the other placed on the water-pipe returning from heating system circuit, short before its input to the boiler. The output from the Relay contact must be connected to the boiler's start-stop control input.
This circuit, though simple, has proven very reliable: in fact it was installed over 20 years ago at my parents' home. I know, it's a bit old: but it's still doing its job very well and without problems of any kind.

Circuit operation:

When Q1 Base to ground voltage is less than half voltage supply (set by R7 & R9), a voltage is generated across R8 and the driver transistors Q2 & Q3 switch-on the Relay. When Q1 Base to ground voltage is more than half voltage supply, caused when one of the n.t.c. Thermistors lowers its value due to an increase in temperature, no voltage appears across R8 and the Relay is off.
C3 allows a clean switching of the Relay.
P1 acts as main temperature control.

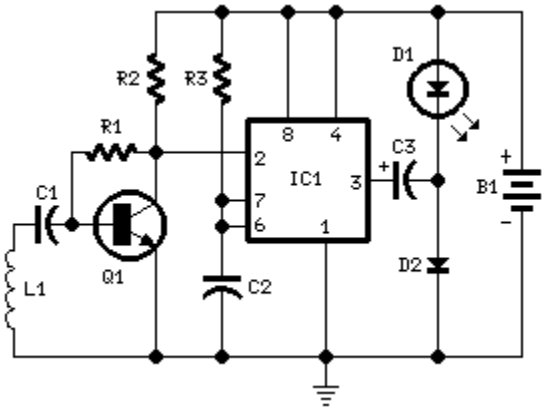
Notes:

- R3 is the outdoor sensor, R4 the indoor sensor.
- If you are unable to find a 3K3 Thermistor for R3 you can use a 4K7 value instead. The different value can be easily compensated by means of Trimmer R5.
- R5 allows to set the heating system for outdoor temperatures ranging from about +10°C downwards. The higher R5's resistance the hotter the heating system and vice versa.
- The existing boiler thermostat should be set to its maximum value and not bypassed: it is necessary for safety's sake.
- This circuit can be dispensed with its differential feature and converted into a simple precision thermostat omitting R3.

Cellular Phone calling Detector

Flashes a LED when detecting an incoming call
Powered by one 1.5V cell

Circuit diagram:



Parts:

```
R1_____________100K    1/4W Resistor
R2_____________3K9     1/4W Resistor
R3_____________1M      1/4W Resistor

C1,C2__________100nF    63V Polyester Capacitors
C3_____________220µF    25V Electrolytic Capacitor

D1_____________LED   Red 10mm. Ultra-bright (see Notes)
D2___________1N5819  40V 1A Schottky-barrier Diode (see Notes)

Q1_____________BC547    45V 100mA NPN Transistor

IC1____________7555 or TS555CN CMos Timer IC

L1_____________Sensor coil (see Notes)

B1_____________1.5V Battery (AA or AAA cell etc.)
```

Device purpose:

This circuit was designed to detect when a call is incoming in a cellular phone (even when the calling tone of the device is switched-off) by means of a flashing LED.
The device must be placed a few centimeters from the cellular phone, so its sensor coil L1 can detect the field emitted by the phone receiver during an incoming call.

Circuit operation:

The signal detected by the sensor coil is amplified by transistor Q1 and drives the monostable input pin of IC1. The IC's output voltage is doubled by C2 & D2 in order to drive the high-efficiency ultra-bright LED at a suitable peak-voltage.

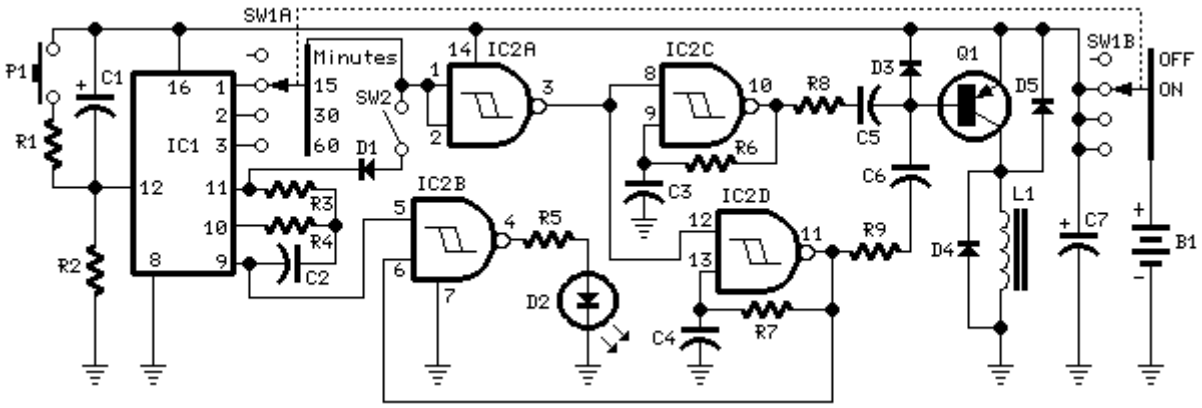
Notes:

- Stand-by current drawing is less than 200µA, therefore a power on/off switch is unnecessary.
- Sensitivity of this circuit depends on the sensor coil type.
- L1 can be made by winding 130 to 150 turns of 0.2 mm. enameled wire on a 5 cm. diameter former (e.g. a can). Remove the coil from the former and wind it with insulating tape, thus obtaining a stand-alone coil.
- A commercial 10mH miniature inductor, usually sold in the form of a tiny rectangular plastic box, can be used satisfactorily but with lower sensitivity.
- IC1 must be a CMos type: only these devices can safely operate at 1.5V supply or less.
- Any Schottky-barrier type diode can be used in place of the 1N5819: the BAT46 type is a very good choice.

Sleeping-Aid

Based on electromagnetic-field radiation
Place it under the pillow - Built-in timer

Circuit diagram:



Parts:

```
R1,R5___________1K    1/4W Resistors
R2______________10K   1/4W Resistor
R3,R6___________10M   1/4W Resistors
R4,R7___________2M2   1/4W Resistors
R8,R9___________4K7   1/4W Resistors

C1,C7___________47µF   25V Electrolytic Capacitors
C2______________100nF  63V Polyester Capacitor
C3,C4___________330nF  63V Polyester Capacitors
C5,C6___________15nF   63V Polyester Capacitors

D1,D3,D4,D5__1N4148   75V 150mA Diodes
D2______________LED   (any type) (see Notes)

IC1_____________4060  14 stage ripple counter and oscillator IC
IC2_____________4093  Quad 2 input Schmitt NAND Gate IC

Q1______________BC327   45V 800mA PNP Transistor

L1______________Radiator coil (see Notes)

P1______________SPST  Pushbutton

SW1_____________2 poles 4 ways rotary switch
```

SW2_____SPST Slider Switch

B1_____9V PP3 Battery

Clip for PP3 Battery

Features:

- Generates a natural electromagnetic-field
- Makes easier to fall asleep
- Induces a prolonged and sound sleep without drugs
- No side effects

Device purpose:

Many people experienced sleeping well in natural surroundings, into a tent or a wooden hut. This fact is due not only to the healthy atmosphere but also from our unconscious ability to perceive natural Earth's magnetic-fields.
The circuit generates this type of Geo-magnetic-fields and lets us perceive them: in this manner our brain is surrounded by an ideal environment for a sound sleep.
(N.B. Basic ideas for this circuit are coming from German papers).

Use:

- Select a timing option by means of the rotary switch SW1.
- Choose 15, 30 or 60 minutes operation.
- Select "Stop" or "Alternate" mode operation by means of SW2.
- With SW2 closed (Stop mode operation) the electromagnetic radiation stops after the pre-set time is elapsed.
- With SW2 opened (Alternate mode operation) the device operates for the pre-set time, then pauses for the same amount of time: this cycle repeats indefinitely.
- Place the unit under the pillow and sleep like a log.
- To reset a cycle press P1 pushbutton.

Circuit operation:

IC2C and IC2D generate two square waves at about 1.2 and 5 Hz respectively. These wave-forms are converted into 60µS pulses at the same frequencies by means of C5 & C6 and mixed at Q1's Base. This transistor drives the Radiator coil with a scalar series of pulses of 60µS length and 9V amplitude.
IC1, IC2A & IC2B form the timer section. C1 & R2 provide auto-reset of IC1 at switch-on. The internal oscillator of IC1 drives the 14 stage ripple counter and, after about 15 minutes, output pin 1 goes high. Pin 3 of IC2A goes low and stops IC2C & IC2D oscillation.
If SW2 is left open (Alternate mode operation), after 15 minutes pin 1 of IC1 goes low, pin 3 of IC2A goes high and oscillators are enabled again.
If SW2 is closed (Stop mode operation), the first time output pin 1 of IC1 goes high, the internal oscillator of the IC is disabled by means of D1. Therefore the circuit remains off until a reset pulse is applied to pin 12 by means of P1 or when the whole device is switched-off and then restarted.

The same thing occurs when SW1 is switched on 30 or 60 minutes positions, obviously changing time length.
IC2B drives pilot LED D2 which operates in the following three modes:

- flashes quickly and almost randomly when the Radiator coil is driven
- flashes somewhat slowly and regularly when the Radiator coil is pausing during the Alternate mode operation
- is off when the circuit auto-stops (Stop mode operation)

Notes:

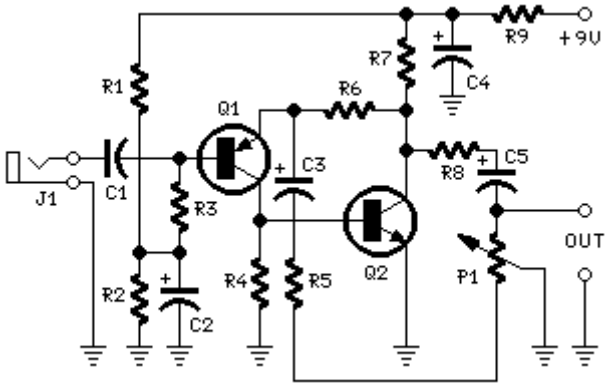
- L1 is obtained by winding randomly 600 turns of 0.2 mm. enameled wire on a 6 mm. diameter, 40 mm. long, steel bolt. Secure the winding with insulating tape.
- Mean current drawing is about 7mA, decreasing to less than 4mA during pauses when in Alternate mode operation.
- Battery life can be dramatically increased omitting LED D2 and its associated resistor R5.
- Use a plastic box to enclose the circuit: metal cases can severely limit electromagnetic radiation.

Disclaimer: we can't claim or prove any therapeutic effectiveness for this device.

Portable Microphone Preamplifier

High headroom input circuitry
9V Battery powered

Circuit diagram:



Parts:

```
P1_______________2K2  Linear Potentiometer

R1,R2,R3_______100K   1/4W Resistors
R4_______________8K2  1/4W Resistor
R5_______________68R  1/4W Resistor
R6_______________6K8  1/4W Resistor
R7,R8____________1K   1/4W Resistors
R9_____________150R   1/4W Resistor

C1_______________1µF   63V Polyester Capacitor
C2,C3,C4_______100µF   25V Electrolytic Capacitors
C5_____________22µF   25V Electrolytic Capacitor

Q1___________BC560C   45V 100mA Low noise High gain PNP Transistor
Q2___________BC550C   45V 100mA Low noise High gain NPN Transistor

J1_____________Jack socket (Mono 3 or 6 mm.)
```

Device purpose:

This circuit is mainly intended to provide common home stereo amplifiers with a microphone input. The battery supply is a good compromise: in this manner the input circuit is free from mains low frequency hum pick-up and connection to the amplifier is more simple, due to the absence of mains cable and power supply.
Using a stereo microphone the circuit must be doubled. In this case, two separate level controls are better than a dual-ganged stereo potentiometer.
Low current drawing (about 2mA) ensures a long battery life.

Circuit operation:

The circuit is based on a low noise, high gain two stage PNP and NPN transistor amplifier, using DC negative feedback through R6 to stabilize the working conditions quite precisely. Output level is attenuated by P1 but, at the same time, the stage gain is lowered due to the increased value of R5. This unusual connection of P1, helps in obtaining a high headroom input, allowing to cope with a wide range of input sources (0.2 to 200mV RMS for 1V RMS output).

Notes:

- Harmonic distortion is about 0.1% @ 1V RMS output (all frequencies).
- Maximum input voltage (level control cursor set at maximum) = 25mV RMS
- Maximum input voltage (level control cursor set at center position) = 200mV RMS
- Enclosing the circuit in a metal case is highly recommended.
- Simply connect the output of this device to the Aux input of your amplifier through screened cable and suitable connectors.
