

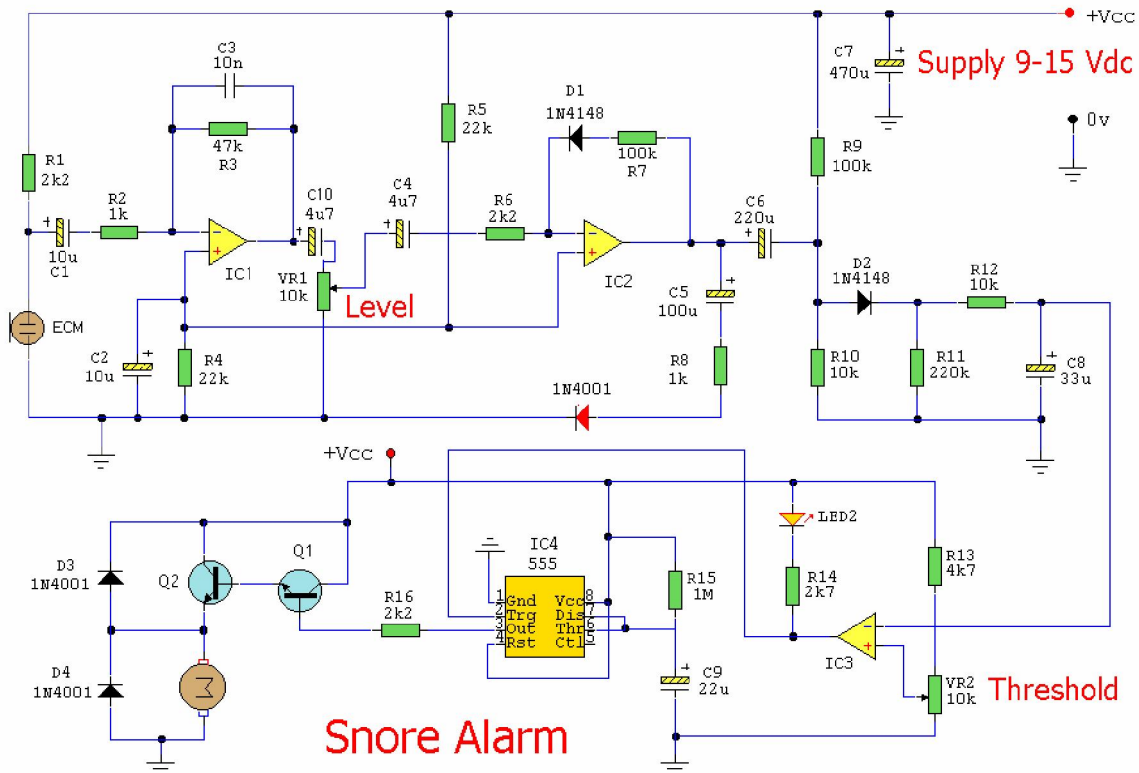
Snore Alarm

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Description:

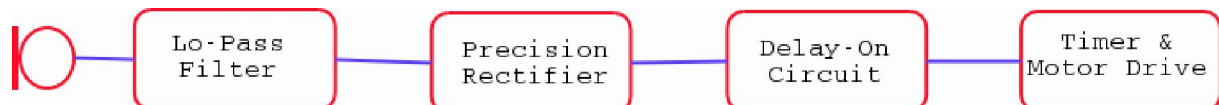
The idea behind this snore alarm, is just to rouse the snorer, not the entire household. To wake the sleeper, vibration is used, not an audible alert. The vibration is provided by a small motor housed in a small 35mm film case, which can be placed under the sleepers mattress or pillow. This circuit has a level control and peak display indicator, a variable trigger



threshold and trigger indication.

Notes:

This snore alarm is designed to trigger after a preset period, adjustable by VR2. It is designed not to activate with short noises, i.e. doors slamming, car horns etc, but instead wait for a set delay before triggering. A snore after all, is continuous for several seconds, and so the delay before triggering can be set by the threshold control. The loudness of the snore is controlled by setting VR1, so for loud snorers VR1 will be backed off and advanced for quiet snorers. Once activated, vibration is relied upon to gently wake the snorer. I suggest using a small dc motor in a 35mm film case connected by a 3.5mm jack plug to the



main unit. The circuit can be broken down into four parts, as shown in the block diagram below.

From left to right we have the input transducer, which is a small ecm microphone insert. A low pass filter and amplifier built around op-amp IC1, to filter out some high frequency

noises. The amplified sound is then converted to DC by a precision rectifier formed by op-amp IC2. The DC component is then filtered again and must be present for a few seconds to activate the delay circuit. The delay circuit uses op-amp IC3 as a level shifter and compares the charge on capacitor C8 to its reference input set by the threshold control, VR2. Once the threshold is reached, this triggers the timer and motor drive. The delay for the motor to run is fixed, but can be made variable by using a potentiometer for R15.

How it Works:

Sound is received by the microphone and amplified with IC1. An electret mic insert (ecm) was used in my prototype, but a dynamic mic insert of impedance 200 to 1k may also be used. If a dynamic mic is used, omit R1. IC1 functions as an active filter and reduces high frequency gain. At low frequencies gain is 47 times, starting to fall off above 1kHz. VR1 is the level control for this stage. Op-amp IC2 is a precision rectifier. It has a stage gain of $R7/R6$ to boost signal levels, the 1N4148 diode in the feedback loop now converts the audio signal into a positive half wave rectified signal. R4, R5 and C2 bias the non-inverting inputs of op-amps IC1 and IC2 to half the supply voltage. Peak signal levels pass through C5 and R8 to LED 1 which provides visual indication of peak levels. LED1 will not illuminate continuously but flash in response to peak sound. VR1 is adjusted so that LED1 flickers with each snore.

As a snore is an interrupted signal, the circuit must only trigger after someone begins to snore. If there was no delay, then the circuit would be set off by any background noise. Even though some degree of high frequency roll-off is employed in this snore alarm, all sounds consist of a fundamental frequency, plus a number of harmonics. Thus a car horn, or a car door opening in the middle of the night could set off the alarm, hence the need for an input delay.

The input delay is provided by C8 and R12. The half wave rectified signal from IC2 is now filtered again and used to slowly charge up C8, a 33u electrolytic capacitor. C8 will only charge when an input signal is present, i.e. by a loud noise such as a snore. With no input signal, C8 discharges through R12 and R11. The signal is further rectified by D2, R9 and R10 providing a slight forward bias to bring D2, a 1N4148 diode into conduction. This also precharges C8 with no signal to a few tenths of a volt. To provide the delay, op-amp IC3 is used as a variable level detector. VR2 now acts as a threshold control, so that the charge on C8 must equal the voltage at pin 3 of the op-amp, set by VR2. When this happens the circuit will trigger as indicated by LED2. Note that the output of IC3 is normally high, changing to low output on trigger.

If a capacitor is charged by a fixed DC current then its charge time can be calculated, however as the charging current to this circuit is not fixed, and provided by an intermittent noise source (a snore) then calculation becomes difficult. The easy option was experimentation, and with the values shown on the schematic, my prototype made on a breadboard provided between 2 and 10 seconds worth of delay.

Finally the trigger stage. The output from the delay circuit is normally high, changing momentarily to low on detection of a prolonged snore. This is of the correct polarity to trigger a 555 timer, IC4 configured as a monostable. The delay is set by R15 and C9 and calculated as $1.1 \times R15 \times C9$. This is 24.2 seconds with the values shown. R15 can be made variable if required, a 4M7 pot would provide an output for 114 seconds. The output from the 555 timer can supply loads up to 200mA, however Q1 and Q2 form a darlington emitter follower and can source up to 3 amps. As both transistors are fully on, all the power is

dissipated in the load and they do not require heatsinks.

Setting Up:

Before building the project some experimentation with the motor is required. I suggest using a small 9 or 12 Vdc electric motor and placing this in an empty 35mm film case. High torque and high power motors must not be used, and any running motor must not exceed 1 amp drawn from the power supply. The assembly then needs to be powered and placed under a pillow or mattress. If the vibration is too excessive then a resistor may be added in series with the motor. You need to measure the dc current with a multimeter with the motor running. This will vary depending on the power supply used and the motor. The 555 timer can source loads up to 200mA, so if the current drawn by the motor is less than this, then Q1, Q2 and R16 are not required. The vibration should not be enough to wake a sleeping person, hence the need for some experimentation.

VR1 is adjusted so that with a snore, LED1 will flicker. As LED1 functions as a peak detector, brief flashes are emitted. It is these brief pulses that slowly charge C8. The threshold control, VR2 is adjusted so that after a few seconds the circuit will trigger. A trigger condition is indicated by LED2. In the interval between a snore, the charge on C8 starts to decay, so short bursts of noise should not give a false alarm. One way to test this circuit is to lay down and make snoring sounds.

Parts List:

C2,C1: 10u (2)
C3: 10n CAP (1)
C4: 4u7 (1)
C5: 100u (1)
C6: 220u (1)
C7: 470u (1)
C8: 33u (1)
C9: 22u (1)
D1,D2: 1N4148 DIODE (2)
D3,D4: 1N4001 DIODE (2)
LED1 Red LED (1)
LED2 Red (or any colour)(1)
IC1,2,3: 741,TL071 or 1 quad opamp, i.e TL084 (3)
IC4: 555 (1)
Q1: 2N3053 (1)
Q2: BD131 or TIP31C (1)
R1,R6,R16: 2k2 RESISTOR (3)
R2,R8: 1k RESISTOR (2)
R3: 47k RESISTOR (1)
R5,R4: 22k RESISTOR (2)
R7,R9: 100k RESISTOR (2)
R10,R12: 10k RESISTOR (2)
R11: 220k RESISTOR (1)
R13: 4k7 RESISTOR (1)
R14: 2k7 RESISTOR (1)
R15: 1M RESISTOR (1)
VR1,VR2: 10k RESISTOR (2)