Kit 49. ULTRASONIC MOVEMENT DETECTOR II

This is our second ultrasonic movement detector circuit. It also uses a crystal locked circuit to get maximum performance from the ultrasonic transmitter. However, the detection circuit is different. We think it is more sensitive.

ASSEMBLY INSTRUCTIONS

Check all the components against the parts list. It is generally easier to solder in the lowest height components first - the resistors and diodes. Make sure to get the diodes in the correct way. The black circle or band on the diodes must match the bar of the diode symbol on the overlay. There are a lot of resistors. Use the resistor color code printed on the back of the header card to work out each value.

The 40 kHz crystal can be inserted either way. Holes have been provided to secure its case to the PCB. Use one of the leads cut from the resistors. You can also quickly solder the wire to the case of the crystal.

The ultrasonic transmitter has a T suffix on the number stampedunderneath it. The receiver has an R suffix. Each may be soldered either way around on the pads under the PCB. Make sure to get them both pointing straight out at 90^{o} from the PCB.

CALIBRATION

Battery operation is not recommended for this detector. As the battery potential decreases the sensitivity will change. This is partcuarly so if the unit is triggered often (as in detecting a door opening.) It is better to use a power supply. Use 9V to 12V DC. You could go to a maximum of 15V but you may have to replace the 78L05 by a 7805.

Immediately after you connect the power let the unit stand for at least 20 seconds so whole circuit will settle down electrically. The schematic shows that the setting of the trimpot value is critical to the operation of the detector. We provide a 1M trimpot. Set it to about 400K by eye. We have found that below about 300K the detector is too sensitive and will self-trigger. Trial and error will show the best setting for your particular requirement.

Note that this circuit is very sensitive. Even air moving (hot air rising, wind blowing) will trigger it when the trimpot is set near the most sensitive position. That is why we say to set it for your particular need.

CIRCUIT DESCRIPTION

The transmitter sends out a steady ultrasonic tone at 40kHz. At this frequency the wavelength is about 6 mm.

Any reflected sound is detected by ultrasonic receiver. The signal is then amplified by IC1:A and IC1:B. IC1:A is self-biasing via C2 & R5. The time constant of the first amplifier is set to let the 40kHz signal through. Between the first & second amplifier there is a negative peak detector (diode D1 & R8) which follows the envelope of the 40kHz signal. If there is no movement the envelope is just a straight line. The time constant of IC1:B is much slower so that it will follow this envelope. All the amplifiers are AC coupled to prevent DC bias problems.

Then the signal is fed through a window detector IC1:C which detects both positive and negative pulses. When there is no movement the potential at pin 7 sits at half the supply potential and neither D2 or D3 can conduct. The potential at pin 8 is low. If the signal rises D3 conducts causing the output to go high. If the signal falls then D2 conducts which also causes the output to go high. Thus the name window detector circuit because it detects potentials which move both below and above a given range.

A low pass filter screens out unwanted spurious signals, then an amp IC1:D set up as a monostable flip flop converts any signal that gets through the filter into a substantial pulse to turn on the BC639. This turns on the LED and provides a Signal Out to drive a separate relay or any other device you may wish to signal to. The time constant of the monostable flip-flop is about half a second and is set by C8 & R10. D4 is used to separate the charge & discharge time constants. It lets the circuit switch on immediately movement is detected but allows about a 1/2 second delay for the reset.

WHAT TO DO IF IT DOES NOT WORK

Poor soldering is the most likely reason. Check all solder joints carefully under a good light. Next check that all components are in their correct position on the PCB. Thirdly, follow the track with a voltmeter to check the potential differences at various parts of the circuit.

Other items to check; are the IC's in the correct way. Check no IC pins are bent up. Are the diodes, transistors and the electrolytic capacitor in the correct way. Did you mix up the 78L05 with the BC639? Check the values of the resistors.

COMPONENTS

Resistors: carbon film, 5%		
47R	R17	1
1K brown black red	R6 R20	2
2K2 red red red	R4	1
10K brown black orange	R13 R16 R19	3
100K brown black yellow	R1 R2 R15	3
150K brown green yellow	R22	1
220K red red yellow	R5	1
1M Brown black green	R8 R9 R10 R14	4
1M2 brown red green	R12 R11	2
10M brown black blue	R3 R7 R18 R21	4
Trimpot 1M		1
Capacitors:		
100nF monoblock (104)	C1 C10	2
100pF monoblock (101)	C5	1
10nF (103) ceramic	C2 C6 C7	3
33pF ceramic	C11 C12	2
100 uF electrolytic	C9	1
470 nF (474) monoblock	C3 C4 C8	3
Diode 1N4002/4	D5	1

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Diode 1N4148	D1 2 3 4	4
9V battery snap		1
40kHz crystal		1
78L05 voltage regulator		1
14049 hex buffer IC	IC2	1
BC639		1
LM324 IC	IC1	1
14 pin IC socket		1
16 pin IC socket		1
40kHz Ultrasonic Tx/Rx pair	400ST/R160	1
LED		1
Kit 49 PCB		1
Documentation		

INFORMATION

The manufacturers specifications (pdf format) for the ultrasonic transducers see under Kit 20 or Kit 49 at

http://kitsrus.com/kits.html

The data sheet for the LM324 & 4049 is available at

www.nsc.com