

ME 3210: Mechatronics
Signal Conditioning Circuit for IR Sensors
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This manual and the circuit described have been brought to you by Adam Blankespoor, Roy Merrill, and the number 47.

The Problem:

The lighting conditions in the Union are much different than the conditions found in the Mech lab. The Union has a DC inferred source (the sunlight coming through the windows) and 60 Hz inferred source (the incandescent lights). These extra sources of IR light have posed problems for devices in previous years. Since this year's competition depends on the device's ability to accurately locate a desired IR source, the circuit described below has been designed to address the problem.

Solution Description:

The lights that will be used in the competition will be flashing at 700 Hz. This frequency is much greater than the frequency of the two noise sources mentioned above. The advantage of a flashing light is the fact that it can be distinguished from the noise. The disadvantage is that a circuit needs to be built and without the circuit your robot will go towards the sun. Each IR sensor will need to be placed in the circuit shown in Figure 1.

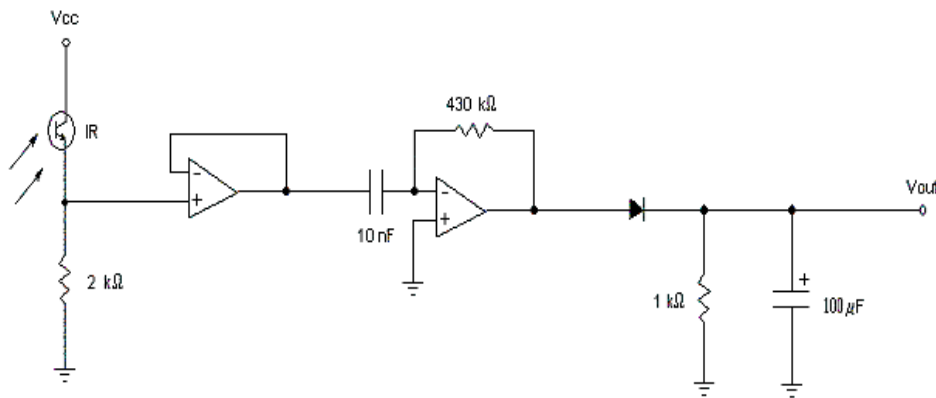


Figure 1: IR circuit, schematic

The rest of this manual gives step-by-step instructions to make the circuit for five IR sensors. Notice from Figure 1, that each sensor uses two op-amps, so five sensors will need a total of three LM324 chips.

Circuit Construction:

List of components for 5 IR sensors

- 1 breadboard
- 5 2 kohm resistors
- 5 10 nF capacitors
- 5 430 kohm resistors
- 5 1N4004 diodes
- 5 1 kohm resistors
- 5 100 μ F capacitors
- 3 LM324 op-amp chip
- 5 IR sensors
- 6 Molex header and housing
- 1 15 inch length of heat shrink tubing
- 1 4 pin header
- 1 5 pin header
- 1 15 inch length of ribbon cable with 5 leads
- 1 6 inch length of red wire
- 1 6 inch length of black wire

In its final form, the circuit will look something like the circuit in Figure 2

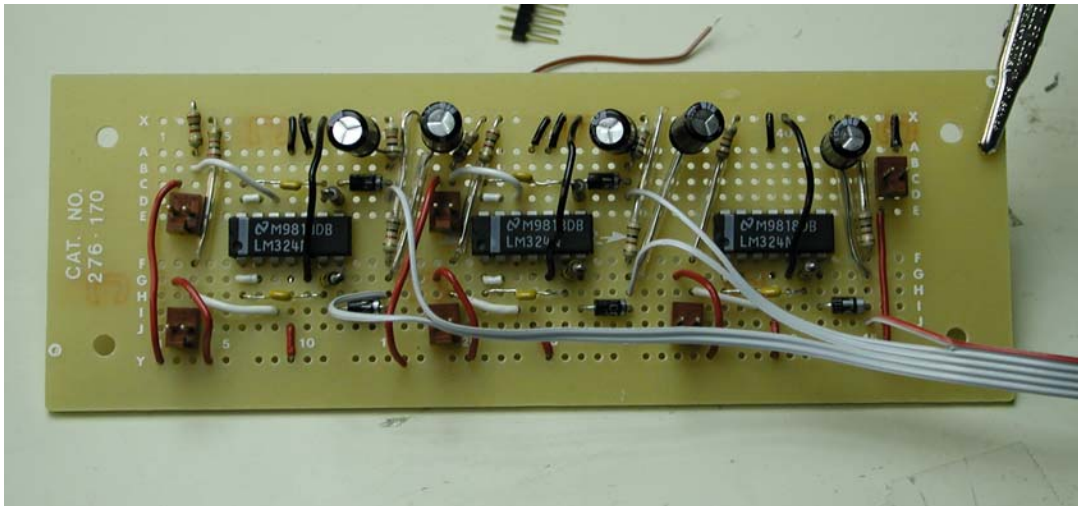


Figure 2: Final Circuit

- As shown in Figure 3, the three chips should be evenly spaced on the board. The pins 1 and 14 were placed in column 6, 21, and 36 for the three chips.
- Figure 3 also shows the power supply for the circuit in the upper right corner. Notice the leads extending from the Molex header to the bottom and top rows that establish the positive and negative buses.
- The chips are powered with the red and black wires extending from the positive and negative buses to pins 4 and 7 respectively. The feedback was placed on the op-amp used as a buffer with the small white wires.
- Once all of these components were in place, the board was turned over and each lead was soldered.

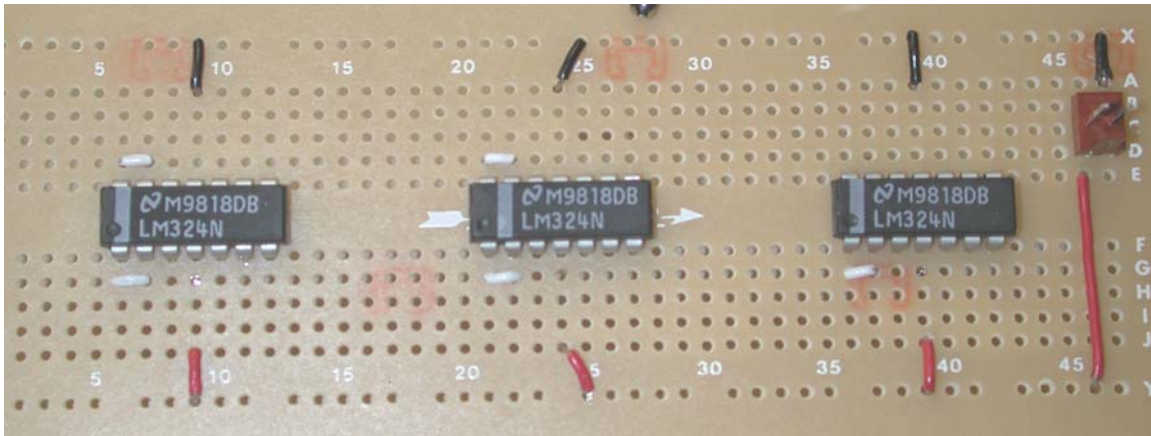


Figure 3: Chip placement, power buses, and buffer feedback

- Figure 4 shows the 10 nF capacitors installed from pin 1 to 6 and pin 14 to 9.
- Also shown is the feedback resistor installed from pin 6 to 7 and pin 8 to 9.
- Again, flip the board over and solder the components in place

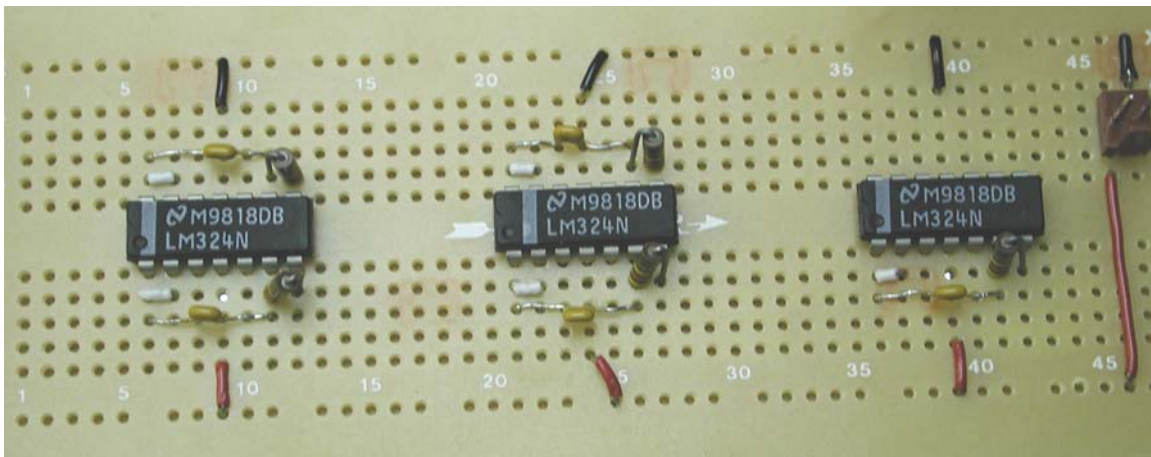


Figure 4: Capacitors and resistors

- Figure 5 shows the placement of the five diodes. Make sure the banded side of the diode is not connected to pin 7 or 8 of the chips.
- The ground connections for pins 5 and 10 were also added
- Flip and solder

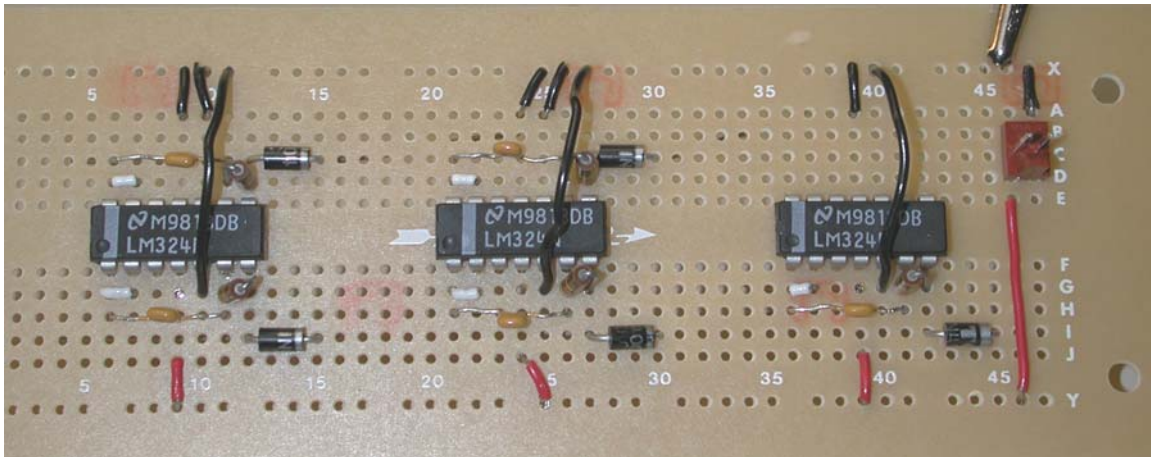


Figure 5: Diodes and grounding

- Figure 6 shows the installation of the 1 kohm resistors.
- The five 100 μ F capacitors were also installed.
- The location of the resistor and capacitor on the last chip are similar to that of the second chip (see Figure 7).
- A small amount of heat shrink was used to cover the bare leads on the resistors and capacitors

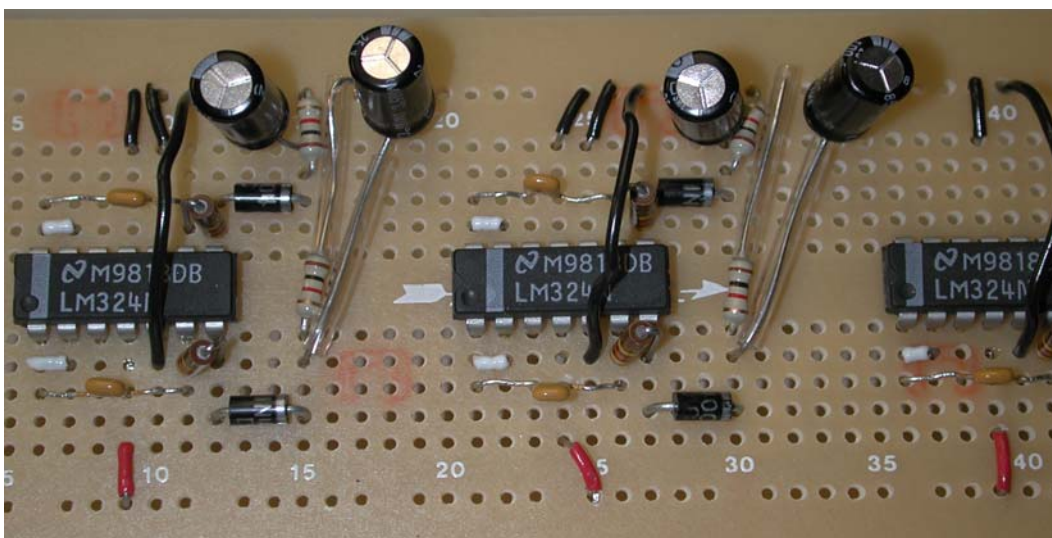


Figure 6: Resistors and capacitors

- Figure 7 shows where the Molex connectors are placed. These connectors will be used to input the IR sensor signal.
- Connected to the right pin of each connector is the 2 kohm resistor with a piece of heat shrink.
- The right pin of each connector is also wired to the positive input of the op-amp, pins 3 and pins 12, with a white wire.

NOTE: by placing the resistor and white wire on the right pin of the Molex header, you have established the polarity of the IR sensor. When wiring the Molex housing make sure the negative side of the IR sensor is connected to the resistor and wire you just installed (refer to Figure 1 for the circuit diagram).

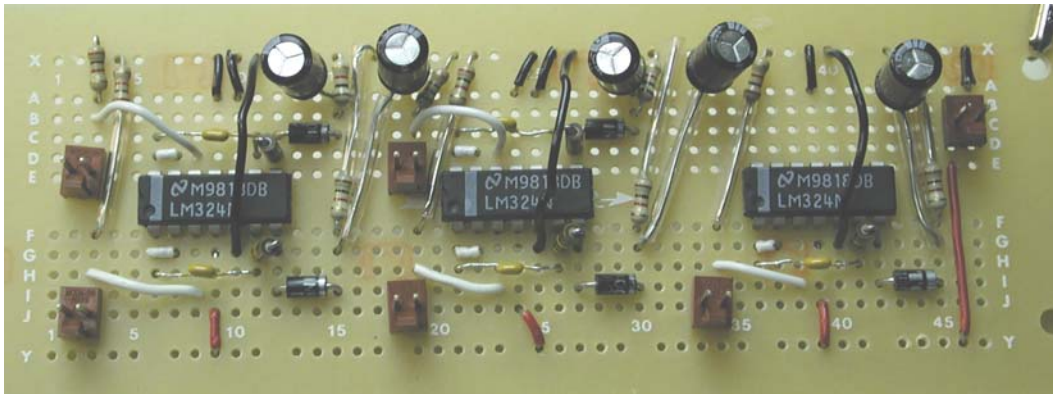


Figure 7: Molex headers, resistors, and signal input

- Figure 8 shows the final circuit. The red wires were installed on the left pin of the Molex header
- The ribbon cable was attached to the same column as the diode, resistor, and capacitor junction.

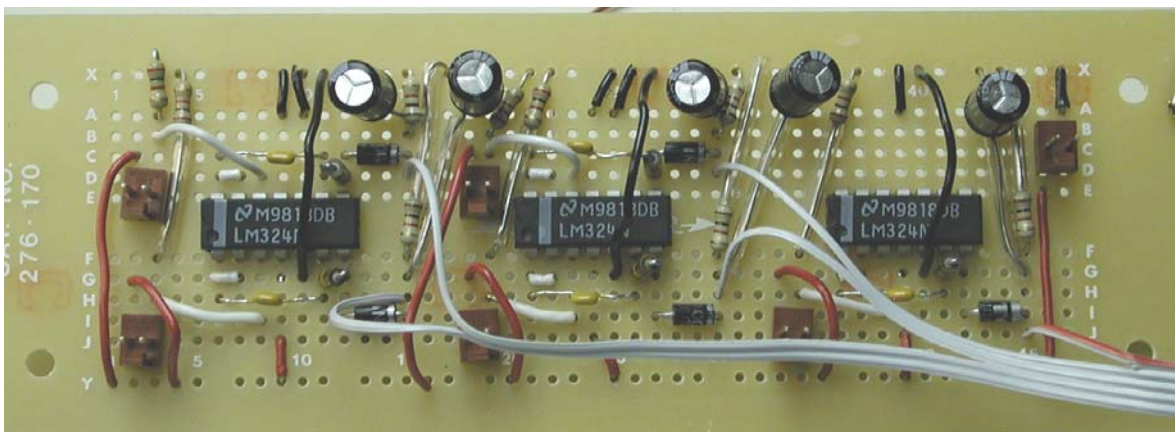


Figure 8: Positive supply and Handy Board input

Using the Circuit:

There are three types of connections that need to be made to use the circuit just constructed. The first connection is the power supply. The Molex connector in the upper right hand corner of the circuit needs to be connected to the power supply. Make sure that the left connector is positive and the right connector is negative when assembling the Molex housing. The power used for this circuit comes from the Handy Board battery power supply. This supply is available through the “power expansion header”. See the Handy Board manual on the class website.

The second connection is the connection to the IR sensors. As mentioned above, use the Molex housing and attach to the five headers on the board. Make sure the polarity of the sensor matches that used in wiring the circuit.

The final connection needed is the output of the circuit to the Handy Board. The ribbon cable connected to board has five leads that connect to the five desired analog inputs on the Handy Board. Use 5 pin header and some heat shrink to make a strong connection to the Handy Board.