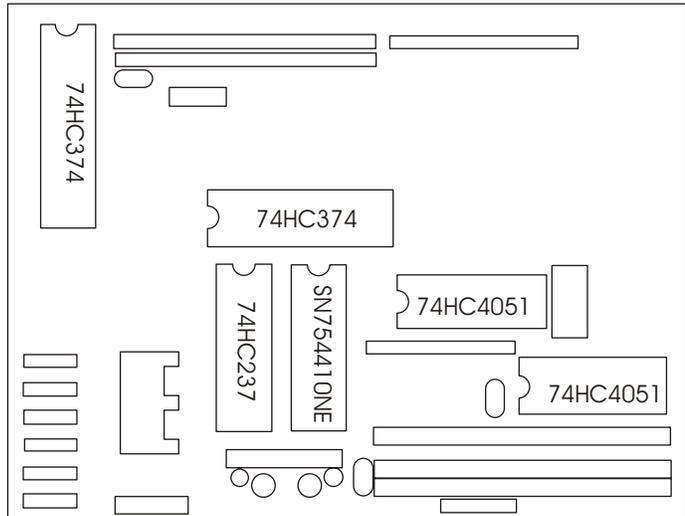
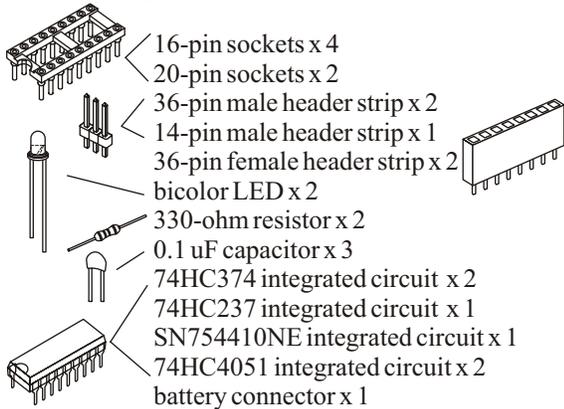


# 6.270 Expansion Board Assembly Instructions

## Overview

The Handy Board comes preassembled, but 6.270 also uses a custom expansion board that gives you more sensor ports, two additional motor ports, servo control, and digital outputs you must use for controlling the IR beacon. The expansion board also allows 6.270 to use the Handy Board with high-capacity batteries as the motor supply. You must both assemble the expansion board and modify the main Handy Board printed circuit board (PCB) to make it compatible with the expansion board. A completed expansion board is shown on the last page.

First, assemble the expansion board. Make sure you know how to solder, and that you've already built the battery charger to get some practice. While the board may look complicated, we will not be populating all of the board. The outline below shows all the components you must install. Before you begin, make sure you have all of them (description followed by quantity in kit):

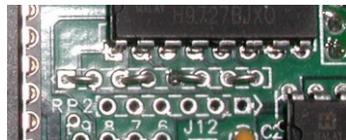
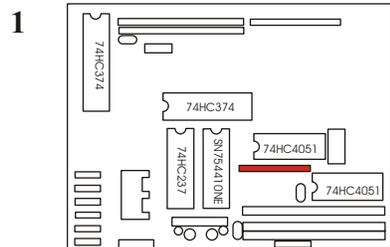


You will also need a short length (3" or so) of solid wire, which you should be able to find around lab.

Once your expansion board is assembled, you can make the necessary modifications to the Handy Board. **Do not plug the battery into the expansion board or turn on the Handy Board before you have made the necessary modifications!**

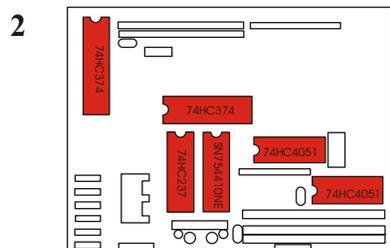
## Assembly

Most components belong on the top side of the PCB, which has white silkscreen drawings on it. This means you insert the component on that side, and solder on the side that has no drawings. However, there are a few connectors, which connect to the main Handy Board PCB, that you will have to insert on the bottom side and solder on the silkscreen side.

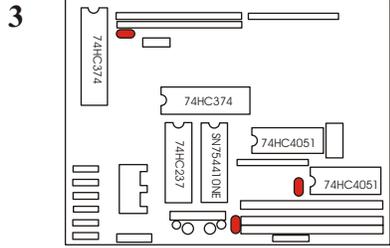


are bad, find the online version on the handouts page, or find someone who has already done this step.)

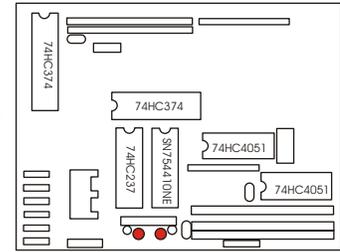
Begin by shorting out consecutive pairs of contacts on RP1 with small pieces of bare wire. This will require 4 separate small pieces of wire, and 8 solder connections. Your result should look like the picture to the left. (If the copies of these instructions



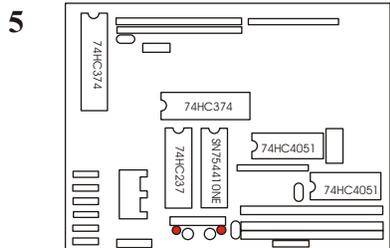
Next, solder in the six sockets in the indicated locations. Make sure to align the notches in the sockets with the notches in the PCB drawings!



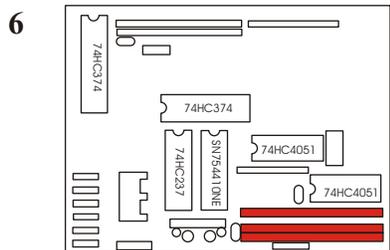
3 Solder in the three 0.1 uF capacitors. They are not polarized, so either lead can go into either hole.



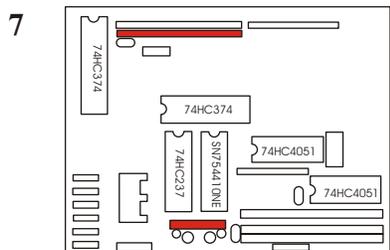
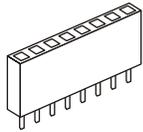
4 Put the two bi-color LEDs in the spaces marked MTR4 and MTR5. The longer lead should go into the hole with the square pad.



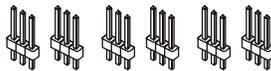
5 Bend the 330-ohm resistors into inverted “U” shapes as shown to the left, and solder into the locations labeled R5 and R6.



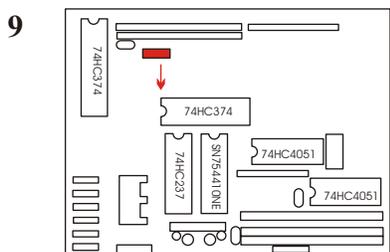
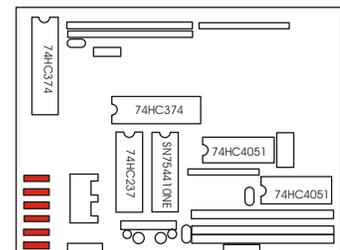
6 Carefully cut three 16-unit-long sections of **female** header, preferably using a small saw blade. Solder them into positions J5 and J8 (ANLG BANK 1 and 2). Make sure the setup of these is similar to that of the Handy Board. You will be plugging your sensors into these pins, so you must make sure that the sockets are parallel and perpendicular to the PCB. It might help to plug in male header in two locations (towards the ends) to keep things square as you solder.



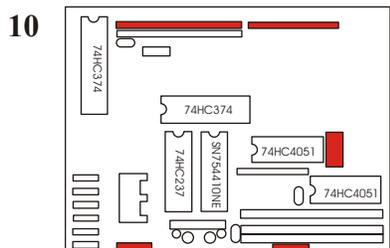
7 Cut a 14-pin section of **female** header and put it in location J1: it is your LCD connector. Use a remaining 6-pin section of female header as your motor connector in location J23 and J24. Keep them perpendicular to the PCB.



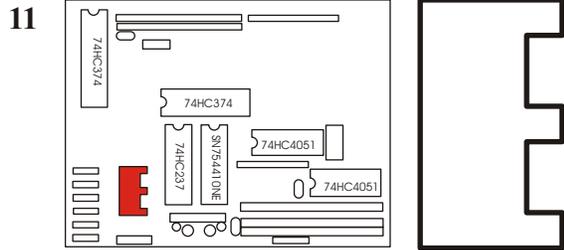
8 Snap off six 3-pin pieces of **male** header and solder them to the six servo outputs. Make sure the short end is going through the PCB and that the long end and plastic stick up and out. Try to keep them perpendicular to the PCB.



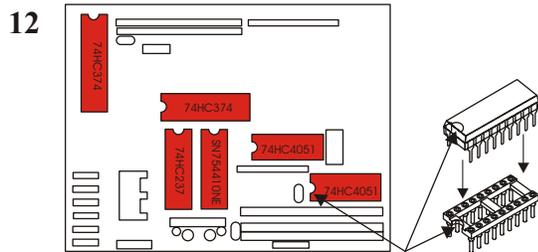
9 Use one more 3-pin piece of **male** header for the digital outputs, labeled d0-d2. Since these are located under the LCD screen, you will have to gently bend them to nearly a right angle with a pair of pliers (so that the pins are almost parallel to the plane of the PCB, with the tips pointing toward U4, as indicated by the arrow in the diagram).



Snap off **male** header for locations J4 (on the bottom right of the board--you can't see the label), J2, J3, J6, and J19. **These are the connectors to the main board, and they must therefore be installed on the bottom side!** In other words, the long end and the plastic holding the pins together should be on the bottom side of the board. Try to get the pins as perpendicular to the board as possible. It might help to plug the header pins into the Handy Board first, and then to place the expansion board PCB over the pins. This will guarantee that you will be able to plug one into the other. (You will have to remove the LCD from the Handy Board; carefully pull it out, and keep it safe until you plug it back in.)



Solder in the battery connector into the spot labeled J7. Look at the shape of the connector, and make sure it matches the outline on the board, magnified to the left. **Make sure you orient it correctly!**



Carefully plug each of the ICs into its corresponding socket. The part numbers are printed on the board. The large board drawing on the first page of these instructions also has the IC locations labeled. Also, make sure the notched end of the IC matches up with the notches in the drawings.

### Cutting Your Handy Board PCB Power Trace (If on Assignment 2, skip to "Final Step!")

Unless you are very sure of yourself, check with the staff or with other teams before you perform this important step.

You must cut the large power trace on the top surface of the Handy Board PCB. This will disconnect the internal NiCd batteries and allow the motors to be powered off of the more capacious Hawker batteries. The trace is in the lower-left corner of the PCB, directly under the words, "THE HANDY BOARD". Use a sharp knife or razor blade, and make sure to completely sever this trace. Make sure that you do not cut any other traces, and that you do not cut all the way through the board. Avoid cutting yourself or your teammates: blood won't help the Handy Board run better. See <http://handyboard.com/6270/hawkers.html> for a picture of this operation (just step 1).

### Final Step!

Plug your expansion board into the Handy Board, and plug the LCD into its position at J1. That should be it! If you have any questions, have a staff member check it over for you before you plug it in or turn anything on.

Here is a bad picture of an assembled expansion board. The ribbon cable is connected to the IR beacon, and the LEDs and some sockets are missing. Note the cut in the main Handy Board PCB.

