

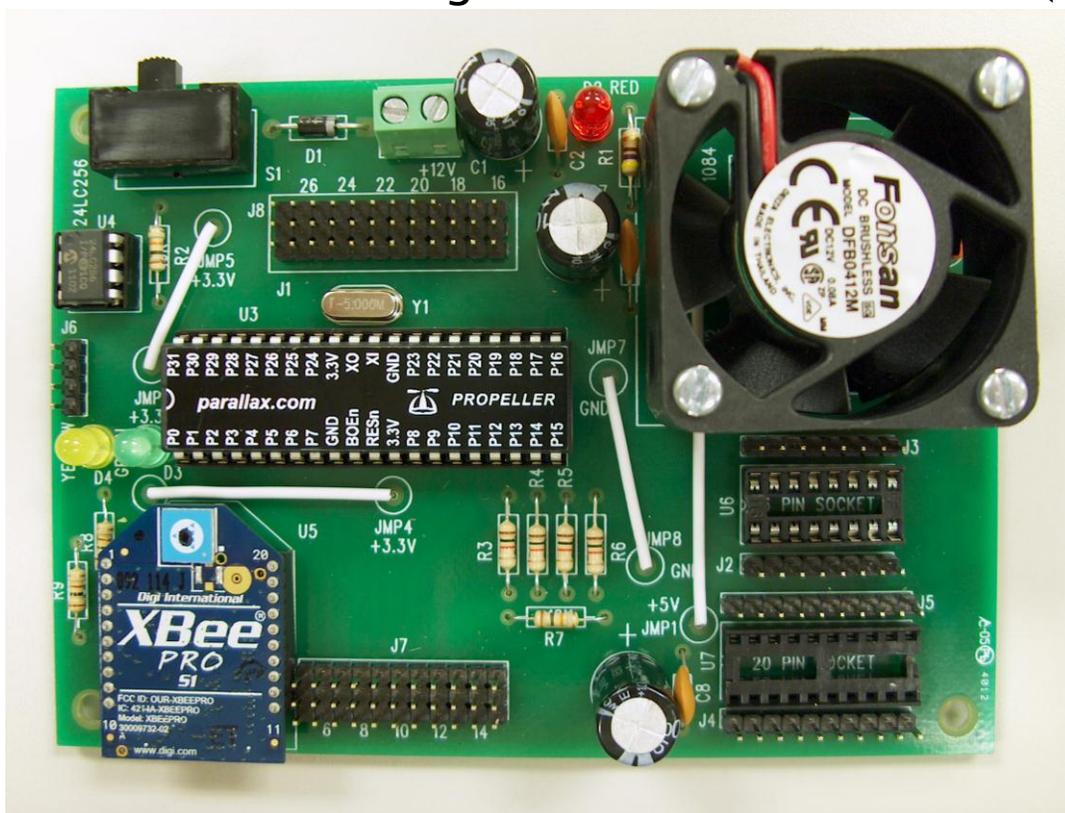
STEM Robotics Challenge Robot Control Board (RCB) Plan Sheet

This plan sheet should be used to construct the RCB for the STEM Robotics Challenge. Please follow the instructions carefully. The steps of construction are numbered. In order to prevent mistakes in assembly, please follow the instructions in the order they are provided.

Tools and materials you will need to build the RCB:

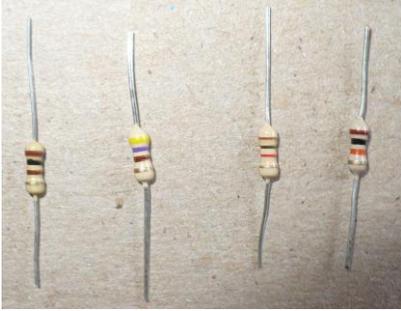
1. Soldering Iron
2. Solder
3. Soldering iron stand
4. Solder sponge
5. #1 Flat head screwdriver
6. # 1 Phillips screwdriver
7. 4 - 1" (4/40) machine screws
8. 4 - ½" (4/40) Machine screws
9. 4 - Fiber standoffs (4/40) thread
10. 12" length of # 22 gauge solid wire
11. Wire cutters
12. Wire strippers
13. Needle-nose pliers

STEM Robotics Challenge “Robot Control Board” (RCB)



Robot Control Board" (RCB) Component Identification

¼ Watt Resistors



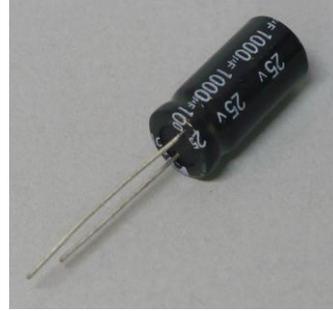
.1 uF Disc Cap



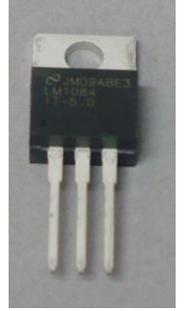
10uF Tant. Cap



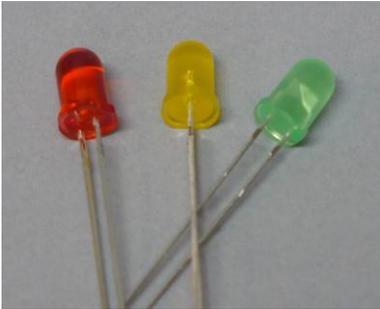
1000uF Electrolytic Cap



LM 1084 5v Regulator



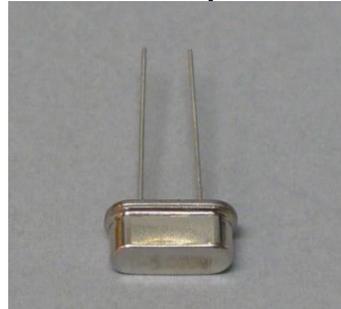
Red, Yellow and Green LED's



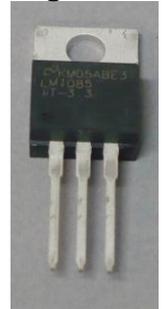
2 Pin Power Terminal



5 Mhz Crystal



LM 1085 3.3 v Regulator



Heat Sink



Fiber Standoff



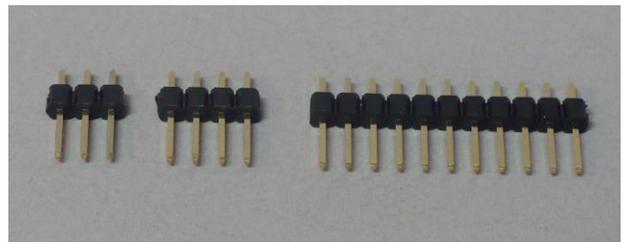
Slide Switch



1n 4004 Diode

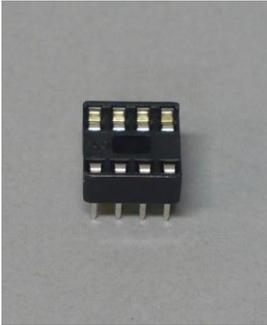


Header Pins

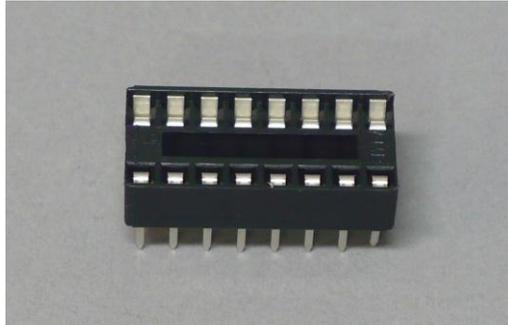


Robot Control Board" (RCB) Component Identification

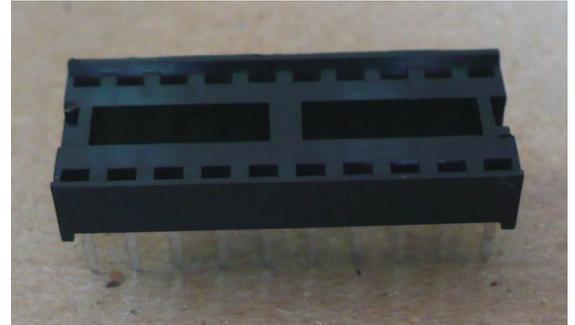
8 Pin
DIP Socket



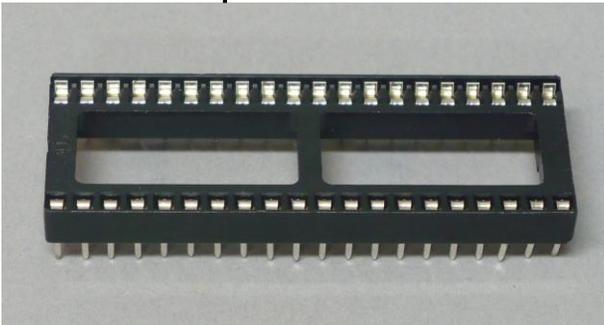
16 Pin
DIP Socket



20 Pin
DIP Socket



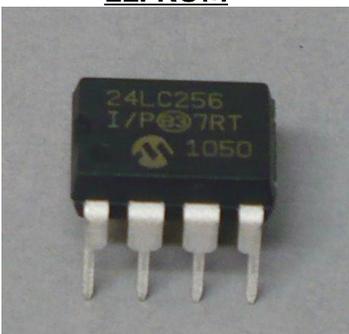
40 Pin
Dip Socket



Propeller Microcontroller Chip



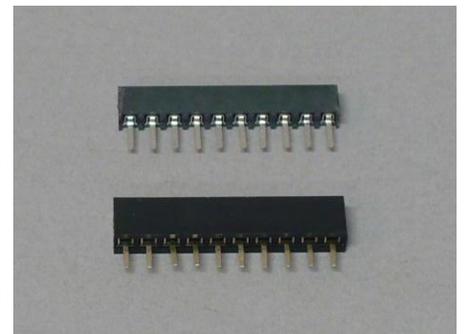
24LC256
EEPROM



ULN 2803A
Darlington Driver

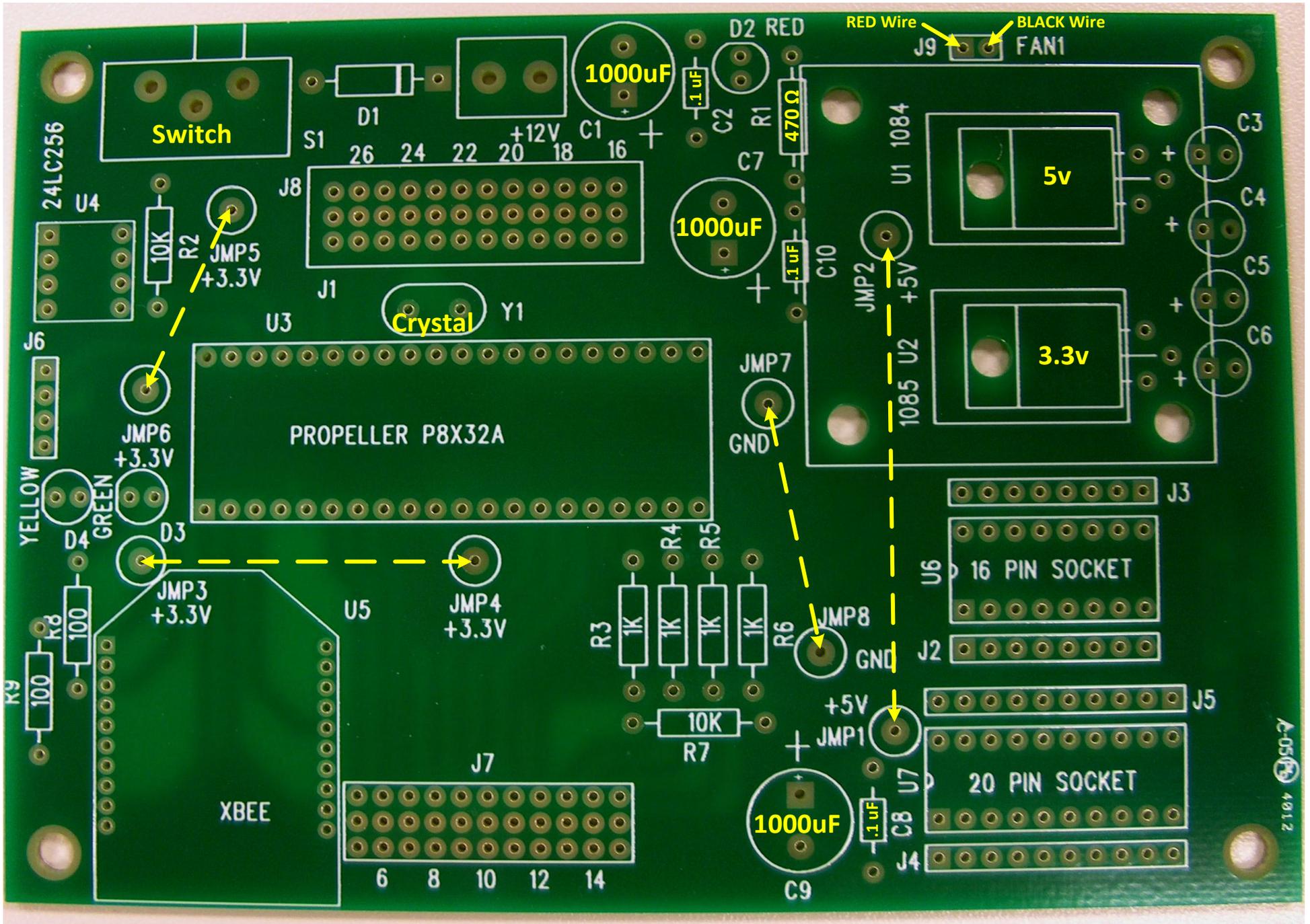


XBEE Socket



RCB Assembly Diagram

TOP EDGE OF BOARD



Robot Control Board” (RCB) Assembly Instructions

1. Install the four 1K Resistors (R3 – R6). (Brown, Black, Red, Gold) Place the brown stripe toward the top of the board and install each resistor flat to the board.
2. Install the two 10K Resistors (R2, R7). (Brown, Black, Orange, Gold) Place the brown stripe to the left side on the lower resistor and toward the top on the upper resistor. Install resistors flat to the board.
3. Install the two 100 Ohm Resistors (R8 – R9). (Brown, Black, Brown, Gold) Place the brown stripe toward the top side of the board. Install resistors flat to the board.
4. Install the 470 Ohm Resistor (R1). (Yellow, Violet, Brown, Gold) Place the Yellow stripe toward the TOP side of the board. Install the resistor flat to the board.
5. Install the 1n4004 Diode (D1). Place the GREY stripe toward the RIGHT side of the board. Install the diode flat to the board.
6. Install the Yellow LED (D4). Push the LED into the board until it rests flat against the board. Be sure the FLAT SIDE (Negative Terminal) faces the LEFT SIDE of the board. Solder one leg, check the LED for position and then solder the other leg.
7. Install the Green LED (D3). Push the LED into the board until it rests flat against the board. Be sure the FLAT SIDE (Negative Terminal) faces the LEFT SIDE of the board. Solder one leg, check the LED for position and then solder the other leg.
8. Install the Red LED (D2). Push the LED into the board until it rests flat against the board. Be sure the FLAT SIDE (Negative Terminal) faces the TOP SIDE of the board. Solder one leg, check the LED for position and then solder the other leg.
9. Install the LM 1084 5 Volt regulator (U1). Bend the leads of the regulator with needle nose pliers as shown in figure 1. Locate the HEAT SINK that must be mounted UNDER the regulator. Locate the 4/40 X ½” Machine screw. Thread the screw into the front of the bolt cutters and cut the screw length to approximately ¼ “. Back the screw out of the bolt cutters with a flat head screwdriver. Locate the 4/40 nut. Push the 4/40 machine screw through the bottom of the board through the HEAT SINK and the 5v Regulator. Place the 4/40 nut on the end of the screw and tighten firmly. Next, solder the three terminals of the 5v Regulator.
10. Install the LM 1085 3.3 Volt regulator (U2). Bend the leads of the regulator with needle nose pliers as shown in figure 1. Locate the HEAT SINK that must be mounted UNDER the regulator. Locate the 4/40 X ½” Machine screw. Thread the screw into the front of the bolt cutters and cut the screw length to approximately ¼ “. Back the screw out of the bolt cutters with a flat head screwdriver. Locate the 4/40 nut. Push the 4/40 machine screw through the bottom of the board through the HEAT SINK and the 5v Regulator. Place the 4/40 nut on the end of the screw and tighten firmly. Next, solder the three terminals of the 3.3v Regulator.

Robot Control Board” (RCB) Assembly Instructions

11. Install the four 10uF Tantalum Capacitors (C3 – C6). Look closely at the capacitors and find the side with the writing on it. You should see a + sign on the RIGHT LEG of the capacitor. The “+” sign means that the capacitor has a POLARITY. (A positive and negative terminal) Install each capacitor with the writing facing the TOP of the board and the “+” sign closest to the regulators. Push each capacitor fully into the holes and solder one leg. Turn the board back over and check the capacitor for position. Then solder the remaining leg. The capacitors should stand straight up and not lean one way or the other.

12. Install the three .1uF DISC capacitors (C2, C8, C10). These capacitors DO NOT have polarity and therefore do not have to be mounted a certain way. Insert the capacitors into the board until they stop. Do NOT FORCE them to the board. Solder one leg of each capacitor, check the position and then finish soldering. The capacitors should stand straight up when soldered properly.

13. Install the four JUMPER wires (JMP1 to JMP2, JMP3 to JMP4, JMP5 to JMP6, JMP7 to JMP8). Select any color of solid 22 gauge wire. Measure the distance between the holes where the jumper wire is to be installed. Add ½ inch to the length of the each wire that needs to be installed. Using wire strippers, strip ¼” of the insulation from each end of the wire. Bend the two stripped ends in a 90 degree angle and insert the wire into the proper holes. Solder one end, check the wire alignment to see that it is flat and straight, then solder the other end of the wire.

14. Install the header pins (J2, J3, J4, J5, J6, J7, J8) . Locate the header pin strips. You will need to use flat nose pliers to SNAP apart the header pins to the length required. See figure 2.

You will need the following;

- a. Three strips of 12
- b. Three strips of 11
- c. Two strips of 10
- d. Two strips of 8
- e. One strip of 4

Select any header pin area to begin. Select the correct strip to install and press the SHORT LEGS of the strip into the TOP of the circuit board. In the area where three header strips are required, place all three into the board. Place a piece of masking tape over the pins on the TOP side of the board and press the tape firmly to the board. See figure 3 This will hold the pins in place when you turn the board over to solder the pins. Pay close attention to be sure the pins are pressed all the way in and flat against the top of the circuit board. Solder one pin on each end of each strip into place. Turn the board over and be sure the pins are still mounted flat against the circuit board. Then, continue soldering all the pins on each header set. On areas where copper connects ALL the pins together, solder will travel down the copper. It is OK if these areas have solder that connects. However, on areas of copper that DO NOT connect, the solder may NOT bridge from 1 pin to another. Solder all pins carefully. If a pin becomes bridged to one that it is NOT supposed to connect to, use the de-soldering pump to remove the solder.

Robot Control Board” (RCB) Assembly Instructions

15. Install the “green” Two Pin Power Terminal (+12v). Press the terminal flat to the board with the holes which secure the wire toward the TOP of the board. Use a strip of masking tape to hold the Power terminal in place. Carefully turn the terminal over and solder into place. Be sure the terminal is mounted FLAT against the board. The side closest to the 1000uF Capacitor is the POSITIVE side. (It’s also marked on the same side with +12v)

16. Install the Slide Switch (S1). Insert the slide switch into the holes with the switch toward the TOP of the board. Use masking tape to secure the switch into place. Carefully turn the board over and solder the three terminals. Be sure the switch stays FLAT against the board.

17. Install the 8 PIN DIP socket (U4). Locate the socket and place the socket into the holes on the top of the circuit board. Use a strip of masking tape to hold the socket into place. Carefully turn the board over and solder the pins. Be sure to solder each pin separately. If copper connects pins together, it is OK if solder connects the two areas. Be sure the socket is mounted flat.

18. Install the 16 PIN DIP socket (U6). Locate the socket and place the socket into the holes on the top of the circuit board. Use a strip of masking tape to hold the socket into place. Carefully turn the board over and solder the pins. Be sure to solder each pin separately. If copper connects pins together, it is OK if solder connects the two areas. Be sure the socket is mounted flat.

19. Install the 20 PIN DIP socket (U7). Locate the socket and place the socket into the holes on the top of the circuit board. Use a strip of masking tape to hold the socket into place. Carefully turn the board over and solder the pins. Be sure to solder each pin separately. If copper connects pins together, it is OK if solder connects the two areas. Be sure the socket is mounted flat.

20. Install the 40 PIN DIP socket (U3). Locate the socket and place the socket into the holes on the top of the circuit board. Use a strip of masking tape to hold the socket into place. Carefully turn the board over and solder the pins. Be sure to solder each pin separately. If copper connects pins together, it is OK if solder connects the two areas. Be sure the socket is mounted flat.

21. Install the three 1000uF Electrolytic Capacitors (C1, C7, C9). These capacitors have a POLARITY and MUST be mounted properly. The top two capacitors have a negative terminal (striped side) that faces the TOP of the board. The capacitor that mounts at the bottom has a negative terminal (striped side) that faces the BOTTOM of the board. Be sure that the capacitors are mounted flat to the board.

22. Install the XBEE socket (U5). There are two xbee socket strips which must be installed. These pins are the most difficult to solder because the pins are closer than any other pins on the board. Place one socket strip in at a time. Use masking tape to secure the socket into place. Turn the board over carefully and solder one pin at each end. Turn the board back over to be sure that the socket is mounted flat. Continue soldering the remainder of the pins. Repeat the process for strip two. NONE of the pins can bridge on this socket. If you accidentally bridge two pins together, use the de-soldering tool to remove the solder.

Robot Control Board” (RCB) Assembly Instructions

23. Install the four fiber standoffs (Located around regulators) Locate the standoffs and set them aside. Locate four – 4/40 X ½” Machine screws. Use the bolt cutters to cut each machine screw length in half. To cut the screws, thread the machine screws into the front of the bolt cutter and cut the screw to length. Use a flat head screwdriver to back the screw out of the bolt cutter. Take each screw and push the screw through the copper side of the board. Thread the fiber standoff onto the machine screw. Repeat the process for each standoff. Secure the standoffs snugly to the board.

24. Install the 12 volt fan (J9). Locate the fan and locate four – 4/40 X 1” machine screws. Place the screws into the top of the fan (Sticker side) Place the fan on the board with the fan wires facing the top of the board. Using a flat head screwdriver, carefully start threading ALL FOUR machine screws into the standoffs. DO NOT secure each one of the screws all the way down UNTIL you have started threading all four. This will prevent alignment issues. Carefully snug each machine screw into place. Next, determine the length to trim the wires by lightly tugging the wires straight down toward the solder holes. Cut the wires about 1/8” past the bottom of the circuit board. Strip ¼” of the insulation off the end of the red and black wire. Carefully twist the exposed wires together tightly. Use solder to “tin” the wires so that they will stay together. Place the RED wire in the hole toward the LEFT side of the board. Push the wire all the way down so that the insulation touches the circuit board. Carefully solder the wire. Follow the same procedure and solder the BLACK wire. When complete, double check to be sure that there are NO SMALL WIRES sticking out from under the insulation. These wires could cause a short and DAMAGE the board.

25. Install the Crystal (Y1). The crystal has NO polarity. Place the crystal in the two holes and solder it in place (flat to the board). At this point your board should be ready for inspection by your instructor. Once the board is tested, it will be returned, ready for programming! Good Job!

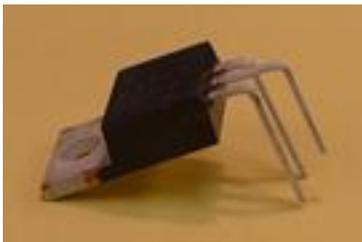


FIGURE 1



FIGURE 2



FIGURE 3