2.00AJ / 16.00AJ Exploring Sea, Space, & Earth: Fundamentals of Engineering Design
Spring 2009

## 2.00AJ/16.00AJ Lab 3: Sensor Suite Assembly Instructions
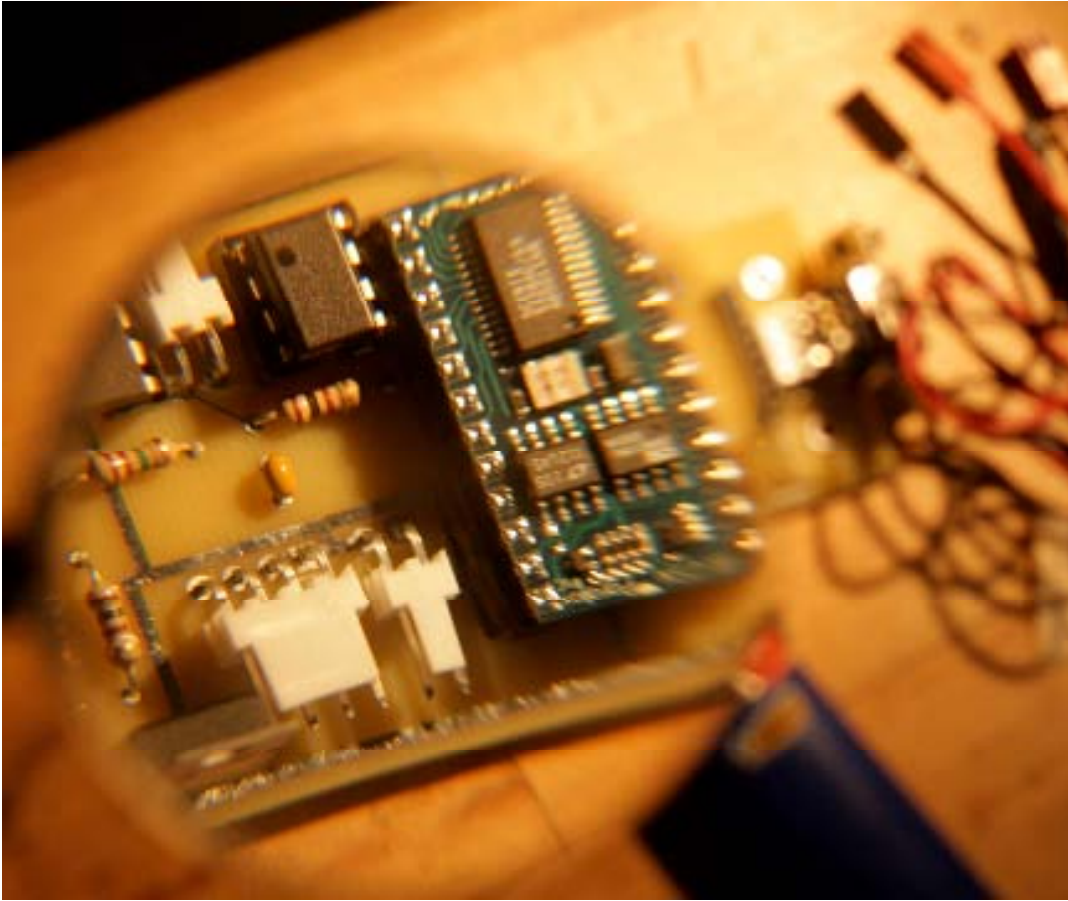


**Parts List:**

- 1 x Circuit Board
- 1 x Basic Stamp 2sx
- 1 x 9 Volt Battery
- 1 x DB9 Female Connector
- 1 x Parallax MMSD
- 1 x 9 Volt Battery Connector
- 1 x 330 Ohm Resistor
- 1 x 7805 5 Volt Voltage Regulator
- 1 x LED
- 1 x Female SIP Connector
- 1 x 0.22uf Capacitor
- 1 x 0.01uf Capacitor
- 1 x Right Angle 4 Pin Male Molex KK Connector
- 1 x Straight 2 Pin Male Molex KK Connector

- 1 x NE555N IC
- 1 x TLC0831CP IC
- 1 x UA741CN IC
- 1 x 24 Pin DIP Connector
- 2 x 1.1MOhm Resistors
- 3 x 8 Pin DIP Connector
- 3 x Right Angle 2 Pin Male Molex KK Connector
- 3 x 0.1uf Capacitors
- 4 x Female Molex KK Housings
- 8 x Molex KK Pins
- 1 x Temperature Probe
- 1 x Pressure Sensor
- 1 x Photocell
- 2 x Stainless Steel Screws

**Step 1:**
Insert the resistors into the circuit board as depicted in image 1. Splay the resistor leads outwards once inserted to hold the component in place. Solder the leads on the back of the circuit board (image 2) and remove all excess material with a pair of wire nippers.
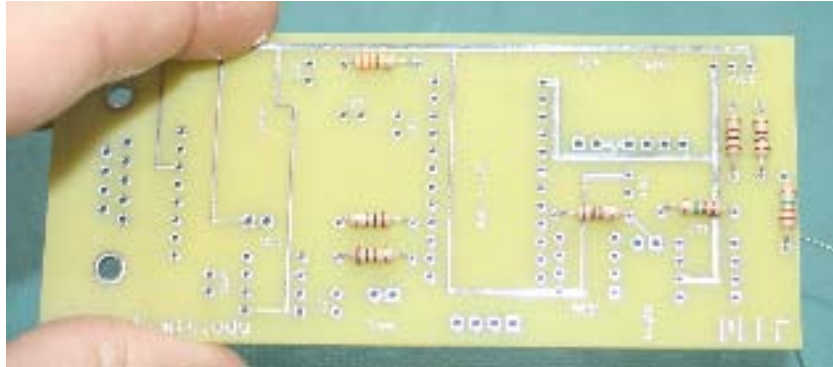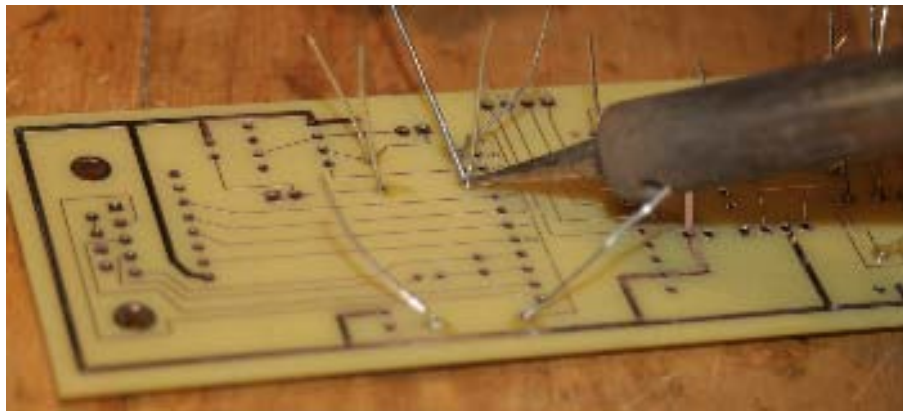

Image 1 – Resistors in Place


Image 2 – Soldering the Leads

**Step 2:**
Insert the capacitors into the board as shown in image 3. Note that the circuit board has the capacitor number printed above the mounting location for each component, and not all of the capacitors are the same.
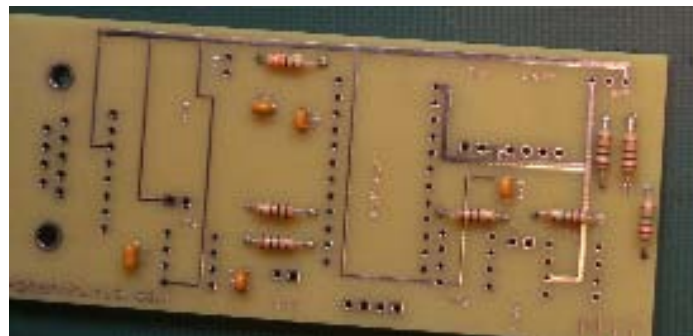

Image 3 – Capacitors in Place

**Step 3:**
Insert the LED into the circuit board with the positive lead (the longer side of the LED) in the hole marked with a square.  Attach and trim this component as in image 4.
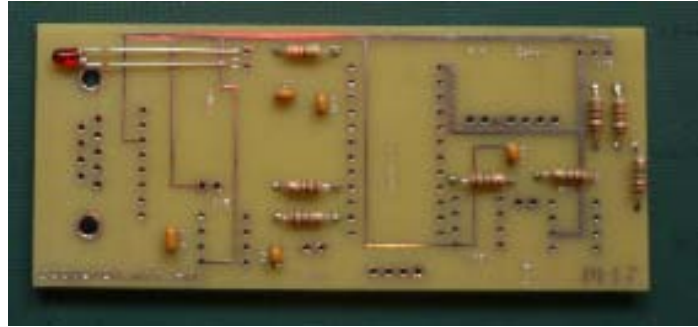

Image 4 – LED in Position

**Step 4:**
Insert and solder all of the DIP connectors in place.  Note that the 24 pin Dip has the notch pointed at the top of the circuit board, and the three 8 pin DIP connectors have the notch pointed towards the bottom.  This designates the orientation of the IC chips in future steps.  Make sure the component is flush with the board before soldering all of the leads.  It may work best to solder one lead, then put the component and board flat on the table and allow the weight of the assembly to press the component completely flush with the board and then solder the rest of the leads.
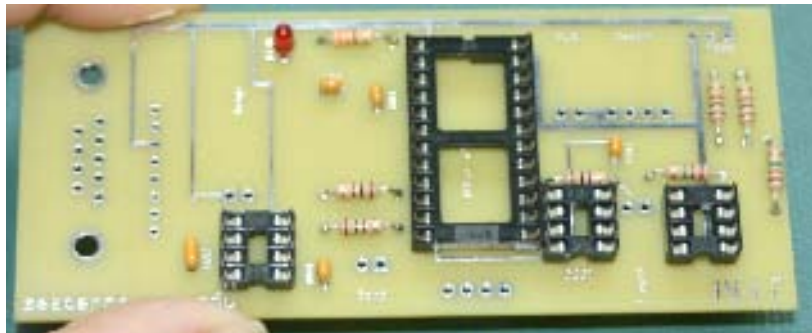

Image 5 – DIP Connectors in Place

**Step 6:**
Install the right angle Molex KK male connectors as show in image 6.  It is essential that these be soldered in place parallel to the board.  Failure to do this will result in the connectors for the sensor fitting incorrectly.

**Step 7:**
Install the straight pin Molex KK Connector and the 8-pin SIP connector

**Step 8:**
Install the DB9 connector. Make sure that the solder joints here don't contact one another or neighboring wires.

**Step 9:**
This is a tight fit and will require trimming. Trim and install the voltage regulator so the flat part of the chip is facing the top of the board.


Image 6 – DB9, Molex, Voltage Regulator, and SIP installed

**Step 10:**
Take out the battery connector, thermocouple and 2 pair of wires, and attach the Molex crimp fittings to only one end of each wire (eight connections in total). Use the crimping tool, or a pair of small pliers. To install the wire, remove about 1/8th inch of sheathing from the end, place the stripped end of the wire in the connector so that one set of fold down flaps will cover the wire and sheathing, and the other set will cover only wire (image 7). Use pliers or the crimping tool to bend the flaps over and securely hold the two components together. Test the strength of this connection by trying to pull the components apart with medium force. If they hold, continue, if not, start over. Trim the excess material from the connector (image 8 & 9).


Image 7 – Wire in place


Image 8 - Trimming Crimped Wire


Image 9 – Final Connector

**Step 11:**
Take out four Molex housings and position them so the ramp is facing down, and the two slots are facing up and at the top of the housing (image 10).  Keep them arrange like this to follow the wire orientation instructions.



Image 10 – Housing Arrangement


**Step 12:**
For each of the following steps, the connector should fit easily in the housing, if not, trim more material and try to manipulate the crimped portions until it fits.  The flat side of the connector should face up when inserted into the housings in the position they were placed in step 11.  Note that there is a small raised flap on the flat side of the connector that will click in place in the slot in the back of the housing.
1. Thermocouple – Red Left, Black Right
2. Battery – Red Right, Black Left
3. Extra Wires – Any Orientation

**Step 13:**
Take one extra pair of wires and place 1 inch of heat shrink tubing on the wire.  Strip ½ inch from the wire and solder to the photocell leads (make sure the exposed lead will be covered by tubing).  Position the tubing so it covers the leads and rub the tip of the soldering iron back and forth until the tubing shrinks to size.

**Step 14:**
Take the next extra wire pair and strip 1 inch of material.  Wrap each wire around one stainless steel bolt.  This connection will be reinforced when the screws are installed in their housing.

**Step 15:**
Install the integrated circuits in the DIP housings ensuring that the notch, dent, or other pin 1 indication is positioned correctly (matching the notch in the DIP connector).  The 24 pin chip should have the notch facing the top, the other chips should face the bottom.  The numbers of the chip are indicated on the circuit board.

Image 11 – IC's installed

**Step 16:**
Install the MMSDL (Microcontroller Memory Stick Data Logger) and a memory stick.

**Step 17:**
Connect all of the sensors, a 9 volt battery, and the serial cable.

**Step 18:**
Connect the other end of the serial cable to a computer and execute the included program.

**Step 19:**
Verify that the system works.  The red LED should turn on after a minute, the LED on the MMSDL should blink red and green, then turn to blinking red, and the values on the screen should update as you alter the conditions of the sensors.
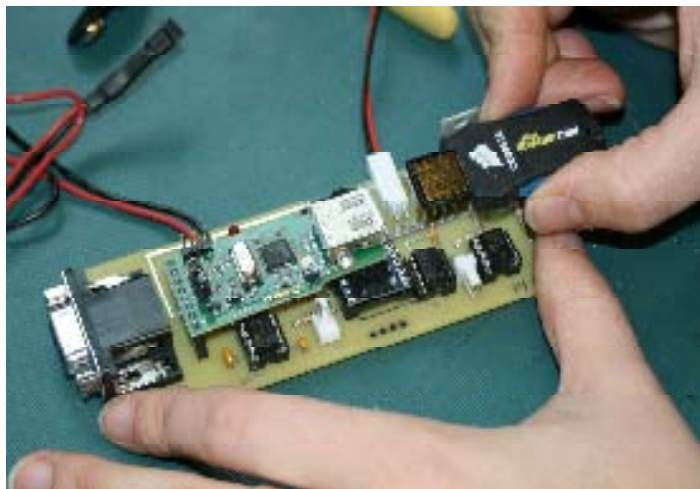
Image 12 – Completed Sensor