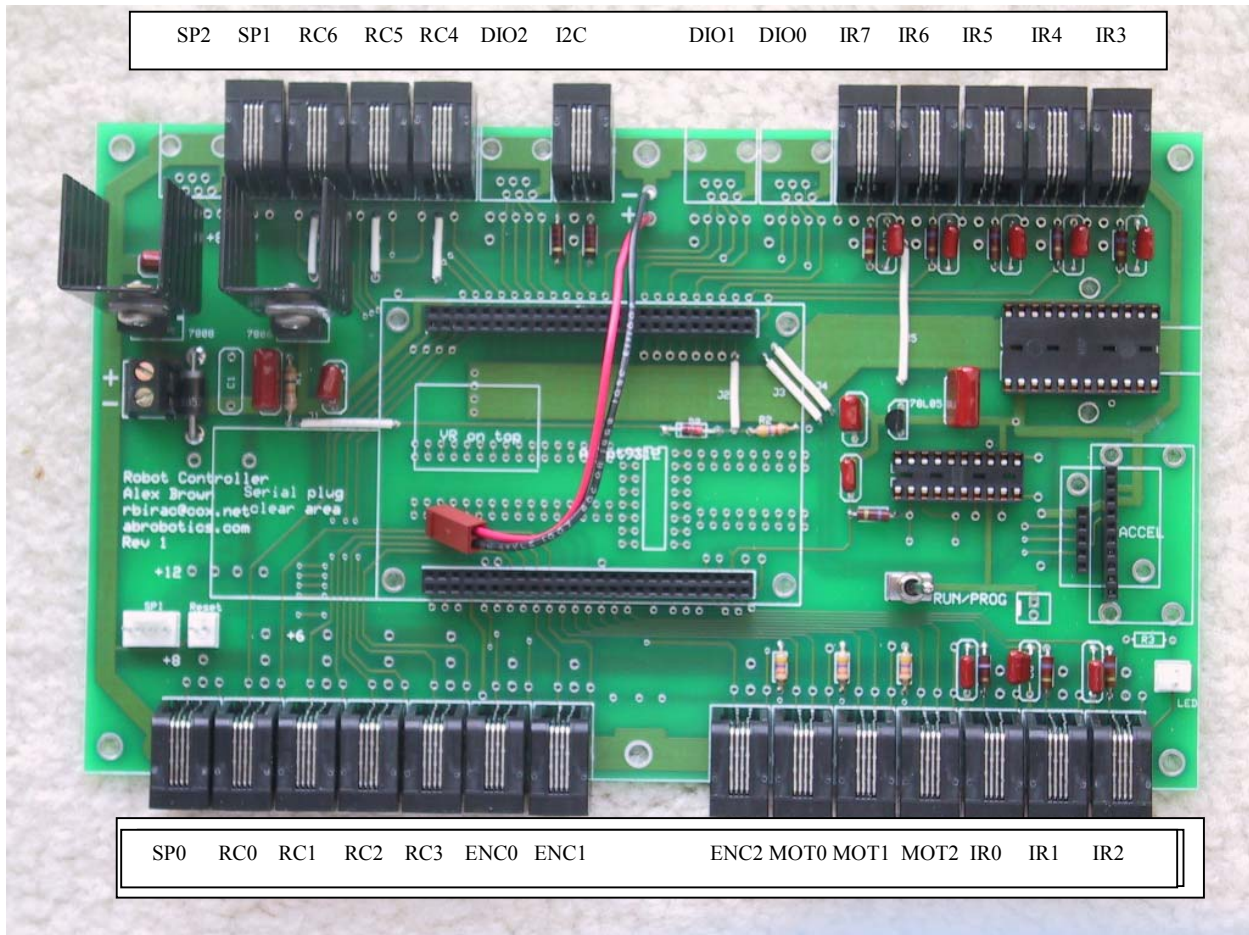


# Microcontroller board Assembly

Rev 3A 12/05/09

Following are suggested assembly and testing instructions for the Leaf microcontroller board Revision 1 thru 3. Questions and comments to Alex Brown [rbirac@cox.net](mailto:rbirac@cox.net) abrobotics.com , leafproject.org

Note: all the pictures are of the Rev 1 board which is almost identical to all revision levels. The only addition for rev 2 is provisions for a 4 pin header to permit easy selection of the RC motor drive mode. For rev 3, a new header strip is incorporated to accommodate an alternate rate gyro module; and the wire jumpers to select between sonar and RC servo on ports RC0-RC7 have been change to 3 pin headers and jumpers. These changes will be covered below.



Note that the four 6P6C modular jacks are missing in this picture. They were backordered at the time but are installed just like the others. Also the external RUN/PROG switch header is not installed.

## 1. Install all modular jacks.

First press their plastic tabs into the holes on the PC board. This takes quite a bit of force. Make sure the pins are in their holes first to make sure you don't bend them when the module pops into place. Make sure all the module jacks are aligned neatly. Solder all the pins.

**Note:** if you have a pcb holding tool, you may want to install all or some of the jacks later so that the board will fit in the tool.

## 2. Install jumpers J1 – J5 as shown in picture.

J1 – J5 are the jumpers other than the three in the upper left corner.  
(note: the Rev 3 board does not have the 3 jumpers in the upper left.)

## 3. Install optional jumpers for sonars and RC servo drives.

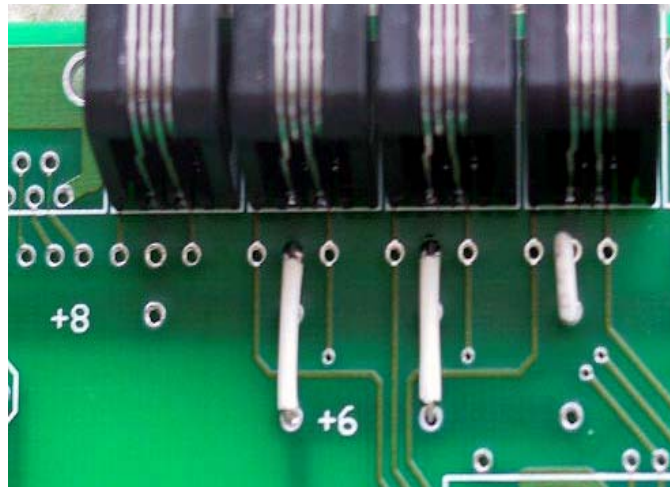
Module jacks RC0 – RC6 can be configured as sonar inputs or RC servo drivers. The current software configuration requires that sonars start at RC0 and work up; and RC servos start with RC6 and work down.

The difference is that sonars are provided with +8 vdc power and RC servos with +6. This is done with jumpers. The Rev 1 and 2 boards comes with RC0 – RC3 configured for sonar and RC4 – RC6 configured for RC servos.

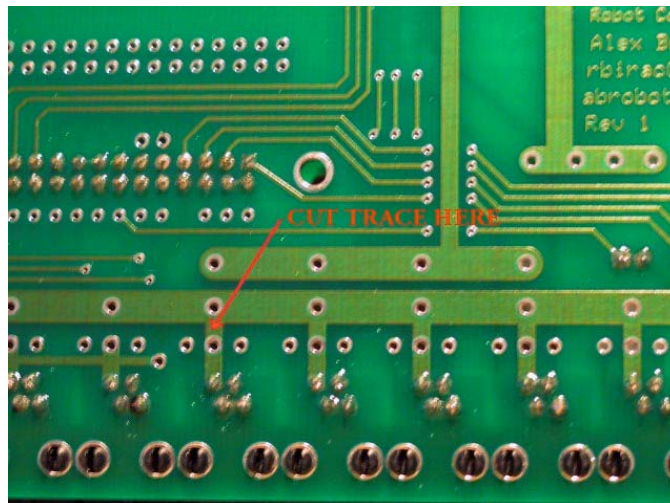
#### Rev 0 to 2 board instructions:

To assemble the board in “standard” configuration, the three jumpers in the picture which are located just below RC4 - RC6 must be installed. These go from the three holes just to the right of the “+6” marking to the three holes directly above in the center position immediately below the module jacks.

Alternately, if you want more or less sonars or RC servos: RC4 – RC6 can be converted to sonars by changing the jumpers so that they go to the holes to the right of the “+8” marking. See picture below.



RC0 – RC3 can be similarly converted to RC servo. However, the connection to +8 vdc is done with a trace on the back of the PC board. That trace must be cut, see picture, and then a jumper placed to +6. The port can be changed back to sonar just by moving the jumper to the +8 position.



#### Rev 3 board instructions:

Each RC port will be seen to have a row of 3 circular soldering pads located just above the silkscreen name of the port. Solder a three pin IDC header strip into each of these. There is no longer a “default” configuration built into the board as described for earlier revisions above. You must apply an

IDC jumper for each RC port to attach it to +8 or +6 vdc as you desire. For + 8 vdc (sonars), place the jumper between the two pins closest to the associated modular phone jack. To select for an RC servo, place the jumper between the two pins farthest from the jack.

4. Install the battery monitor zener diode D2 and resistor R2 as shown in the picture.  
Be sure that the black band on the diode is oriented as shown on the silkscreen. The right leg of the resistor may not fit to the pad shown on the silkscreen and can be mounted to any one of the ground pads to the right. (see picture)
5. Install the two 50 pin headers for the Adapt9S12DP256 processor.  
These must be aligned accurately to ensure the processor board will fit. I suggest you solder each header in place at one pin on each end. Then insert the processor to ensure that the pins line up. If not, heat the soldered pins so the connectors can line up properly. Then solder the two pins at the ends of each header to ensure it remains aligned. Then removed the processor card and solder the rest of the pins.
6. Install the 20 and 24 pins dip sockets for the rate gyro and the USB adapter.  
If the socket has a specific orientation, pin 1 should be toward the lower left corner.  
**Rev 3 note:**  
You have a choice of using the 20 pin socket described above for the Analog Devices gyro evaluation board, or the 7 pin header strip for the Sparkfun Gyro Breakout board. You probably only want to install one option since no one has used the Sparkfun option and we don't know if it fits with both sockets installed.
7. Install the 10 pin header for the accelerometer.  
This is a good one to be sure it is mounted accurately also since it holds the accelerometer in position and will affect its final calibration..
8. Install the 4 and 2 pin headers for the SPI port, the external reset, the external Run/Program switch and the power LED
9. Install the (optional) external LED resistor R3.
10. Install the I2C pullup resistors R16 & R17.
9. Install resistors R5-R12 & R18 and capacitors C5-C12 & C15 for analog inputs.  
Eight of each are located behind the modular jacks for IR0 thru IR7. The remaining resistor and capacitor are near pin 1 of the rate gyro socket.
10. Install the three pullup resistors R13 - R15 for the motor brakes.  
These are located just behind the MOT0, 1, 2 module jacks.
11. Install the 78L05 voltage regulator and nearby capacitors C13 & C14. These are near pin 20 of the gyro socket.
12. Install the Program / Run switch.
14. Install the power input terminal block.
15. Install the power blocking diode right behind the power input terminal block.  
Be sure that the black band is aligned as shown in the silkscreen.
17. Install the resistor R1 just below the 7806 regulator.
18. Install capacitors C3 & C4 near the two power regulators.
19. Install capacitor C2 below the two power regulators.  
Note: C1 is provisions for any additional filtering that might be found necessary.
19. Install the heat sinks on the two power regulator chips (7808 and 7806).  
Use heat sink grease between the regulator chip and the heat sink.

20. Then solder the two regulators into place.

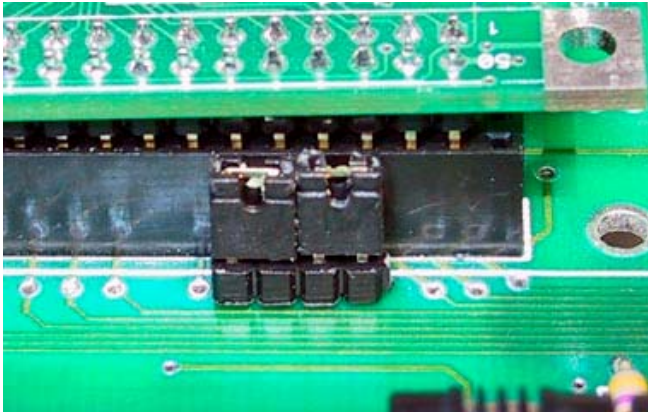
Make sure the heatsinks are a couple millimeters above the surface of the board. This is necessary since the heat sinks may short to some wires if they get pressed down to the board. It would be a good idea to put a piece of tape (or something) below the heat sinks to ensure they can not be pressed down to the board.

21. Attach the processor board power connector (supplied with the processor) to the controller board.

With the processor installed (or at least roughly in position), attach the connector to the processor and measure how long the two wires should be to reach to the two holes in the controller board between the I2C connector and DIO 1. Cut them to length. Leave enough slack so that the connector can be easily removed from the processor board. Solder them into the controller board with the black wire connected to “-“ and the red wire “+”.

22. If you are going to use the RC mode of drive motor control, it is necessary to add 2 jumpers to the board just above and to the left of the MOT0 jack.

These can just be wire jumpers between the holes or a 4 pin header strip can be installed so that the board can be configured for either h-bridge or RC operation by adding or removing idc jumpers. The picture below shows the header strip installed with jumpers as provided on the Rev 2 board.



### **Soldering suggestions:**

Tape loose components in place before inverting the board to solder so that they don't move.

Align resistors and capacitors in the same direction (just esthetics).

Some components may not have leads which fit conveniently into the holes on the board. When necessary, bend the leads in closer or wider.

### **Inspection:**

Inspect all soldering to ensure no cold solder joints, The solder should look well bonded to both the pad and the pin. If in doubt, just reheat the joint &/or add a little more solder if needed.

Make sure that there are no shorts between adjacent solder paths.

If the flux residue on the board looks excessive (a little won't hurt), you can generally remove it by brushing with alcohol.

### **Preparation of USB adapter:**

Note: a quick glance at the ftdichip website indicates they have updated drivers from those noted below. Check the "Windows XP Installation Guide" at <http://ftdichip.com/Documents/InstallGuides.htm>. If anyone goes through this process, please let me know how it works and please provide revised instructions to replace those below.

The USB adapter card has a conflict with Windows XP. If you just hook up to an XP computer, it will install the wrong set of drivers. (see ftdichip.com website for more details)

FTDI has a resolution for this problem. Download their driver set DRP101504 and unzip it.

Hook up a USB cable between the PC/laptop and the USB adapter. (note: the adapter must be plugged into the circuit board to power up properly. Otherwise, see dlpdesign.com datasheet for info on which pins must be connected to get the adapter to work.

PC will recognize the USB adapter and automatically install the (wrong) driver. If you go to device manager, you will see the adapter under Ports as "USB Serial Port"

Run FTXPRCVR as supplied in the DRP101504 folder. This changes the identification of the adapter so that windows will not install the default driver.

Disconnect and reconnect the USB cable. XP should say new hardware found. When asked, install driver from DRP101504 folder.

### **Preparation of Adapt9S12DP256 card.**

On Adapt9S12 card, change the Mode Select jumpers so that they are on the LEFT two pins of the header (marked "1") rather than the right as it comes from the factory. This will enable the Run/Prog switch on the microcontroller board.

### **Preparation of accelerometer card.**

Each of the optional accelerometer cards has a resistor mounted which determines the period of the output pulses. Remove the existing resistor and install a 1.2M 1/4 watt resistor (if not already installed).

Also, Analog devices has changed its evaluation board and has the pins pointed up. The required orientation is with the component side up and the pins pointed down.

The annoying solution is to remove the existing header and reinstall it the other way around. This will probably involve removing the old header one pin at a time and putting in a new one. You'll want to cut the plastic strip between each pair of pins, then heat one pin's solder connection and pull the pin out. Then use a solder sucker or wire braid or something to remove solder from the holes, then solder the new strip in.

For those of you without spare header pins laying around, you can get a strip of 36 from Digikey.com as S1011-36-ND. You then just cut off the number of pins needed and you'll have spares for next time. But, who wants to pay shipping for one little part? Try your local electronics stores. Or, the accelerometer isn't used for anything yet; you can leave it out until you are making a bigger order.

So far, so good. Now go to the Microcontroller board testing procedure.