This is the Revision C verion of the BS2Hub8 RoboBrick. The status of this project is that it has been replaced by the revision D version.

BS2Hub8 Robobrick (Revision C)

Table of Contents

This document is also available as a PDF document.

1. Introduction

The BS2Hub8 RoboBrick is a master RoboBrick that can control up to 8 slave RoboBricks. It is controlled by a Basic Stamp 2® from Parallax. It has two terminals that can be connect to a battery between 6 and 9 volts. It has an on board 5 volt voltage regulator to provide power to the slave RoboBricks. The is a connector that can be connected to a DB9 connector and used to communicate with a controlling PC via RS−232 voltage levels.

2. Programming

We may eventually put a few examples of programming the BS2Hub8 RoboBrick here. Basically, it is programmed using the Parallax Basic for the Basic Stamp 2.

```
' Even numbered pins inputs and odd number pins are outputs.
' (Remember for the BS2, 1=output and 0=input.)
dirs = $aaaa

' Set all outputs to high:
high 1
high 3
high 5
high 7
high 9
high 11
high 13
high 15

' To copy a Switch8−B (on N2) to LED10−B (on N1):
switches var byte
loop:
    ' Send command 0 (Read switches) to Switch8−B:
    serout 11, 396, [0]
    ' Receive the switch readings from Switch8−B:
    serin 10, 396, [switches]
    ' Send switch values to LED10−B:
    serout 9, 396, [switches]
```

```
goto loop
```

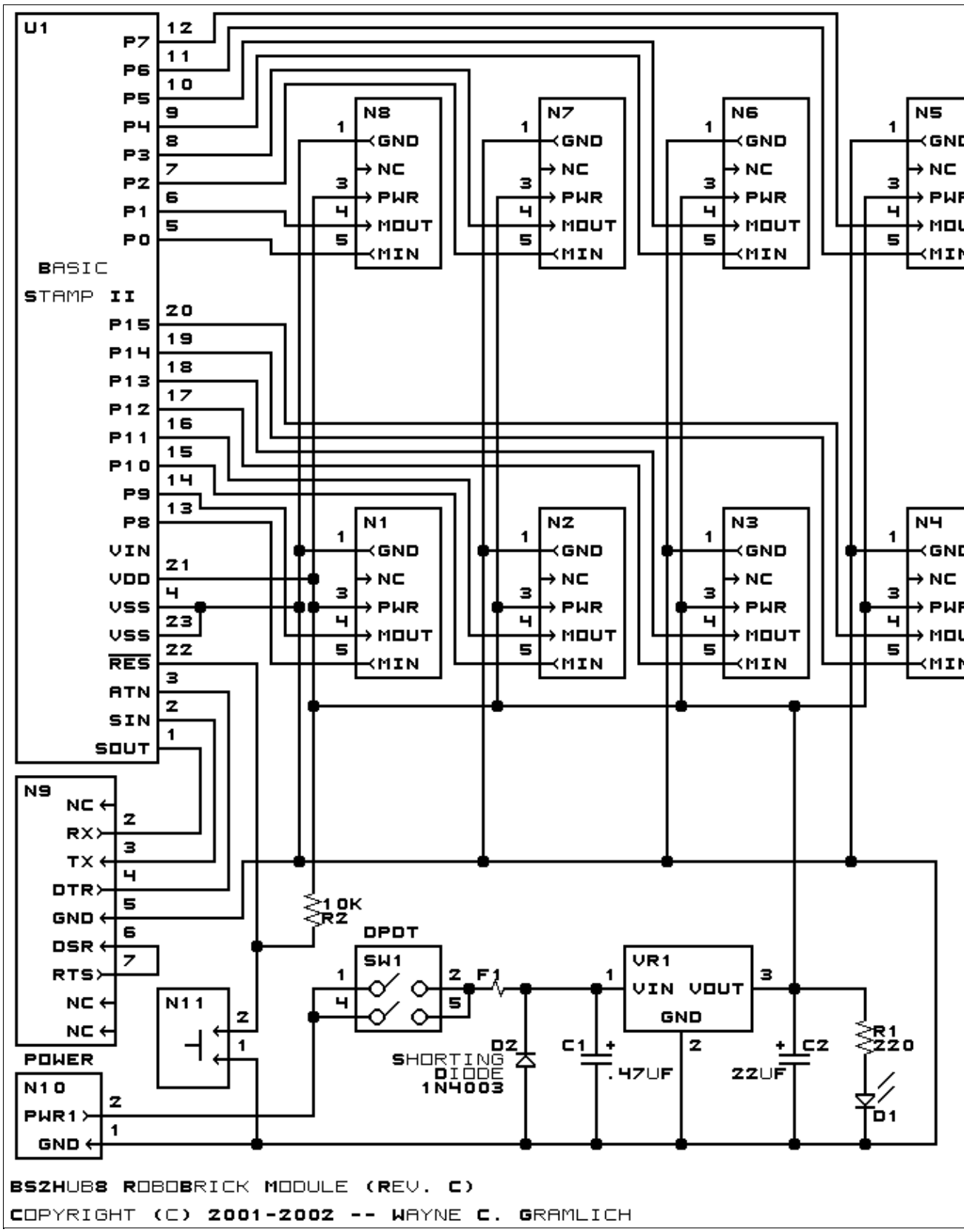
Connector	Input	Output
N1 (Top)	P8	P9
N2	P10	P11
N3	P12	P13
N4	P14	P15
N5	P6	P7
N6	P4	P5
N7	P2	P3
N8 (Bottom)	P0	P1

3. Hardware

The hardware consists of a circuit schematic and a printed circuit board.

3.1 Circuit Schematic

The schematic for the BS2Hub8 RoboBrick is shown below:



The parts list kept in a separate file −− bs2hub8.ptl.

3.2 Printed Circuit Board

The printed circuit board files are listed below:

bs2hub8_back.png
: The solder side layer.

bs2hub8_front.png
: The component side layer.

bs2hub8_artwork.png
: The artwork layer.

bs2hub8.gbl
: The RS−274X "Gerber" back (solder side) layer.

bs2hub8.gtl
: The RS−274X "Gerber" top (component side) layer.

bs2hub8.gal
: The RS−274X "Gerber" artwork layer.

bs2hub8.gml
: The RS−274X "Gerber" mask layer.

bs2hub8.drl
: The "Excellon" NC drill file.

bs2hub8.tol
: The "Excellon" tool rack file.

3.2 Construction Instructions

The construction instructions are kept in a separate file document to be a little more printer friendly.

4. Software

There is no software for the BS2Hub8 RoboBrick yet.

5. Issues

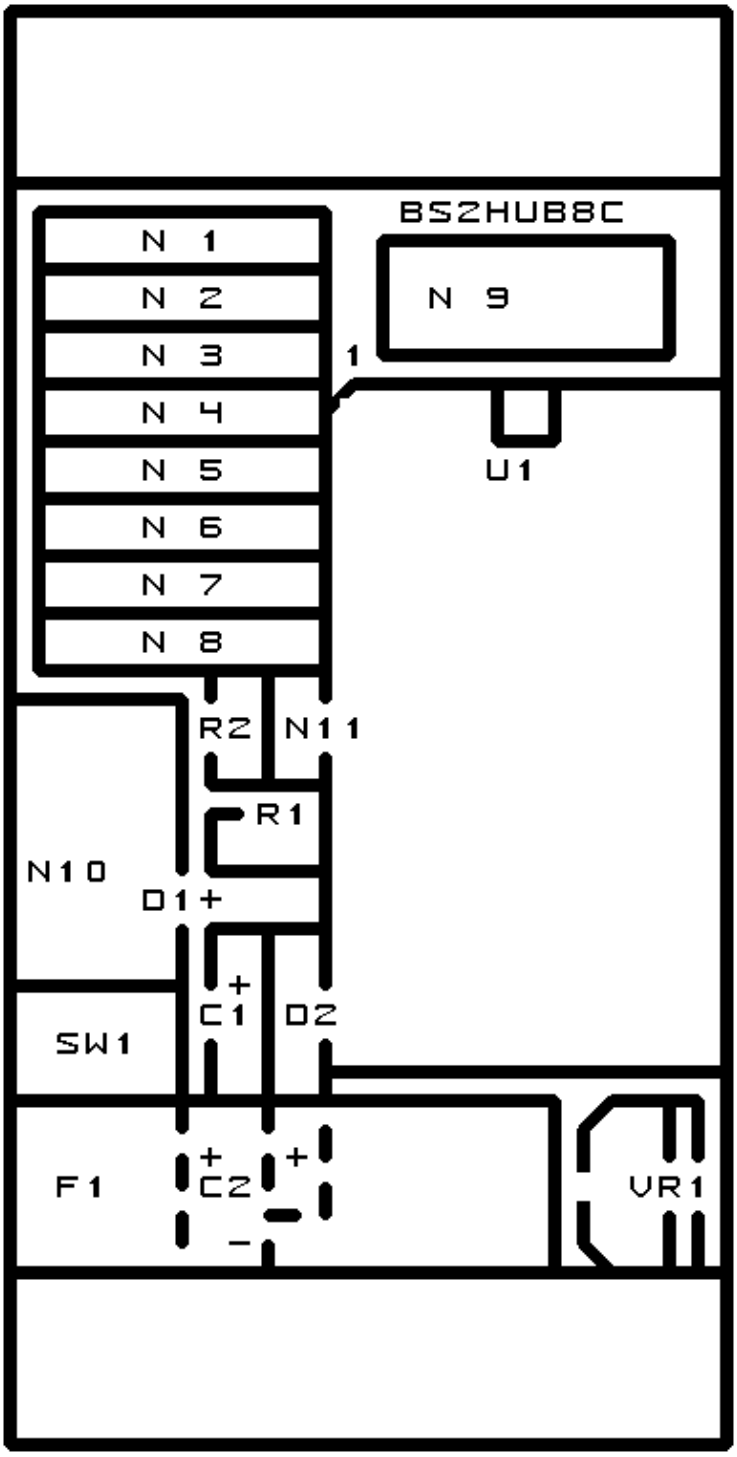
The following fabrication issues have come up:

- The fuse clip holes are still too small (size 3) and should be enlarged to size 4.
- The artwork for the 22uF capacitor is backwards.
- The artwork for the shorting diode is be backwards.

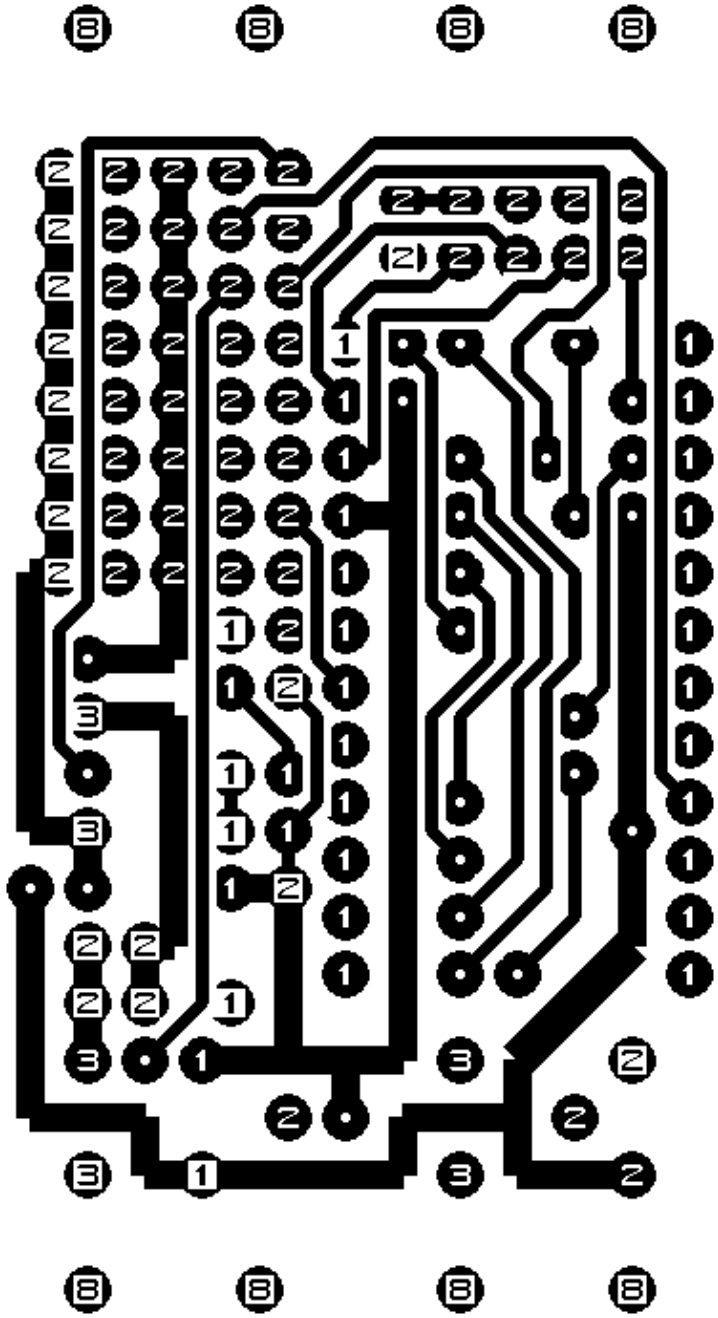
A. Appendix A: Parts List

```
# Parts list for BS2Hub8 RoboBrick (Rev. C)
#
C1: Capacitor470nF − .47uF Tantalum Capacitor [Jameco: 33531]
C2: Capacitor22uF − 22uF Tantalum Capacitor [Jameco: 94094]
D1: LEDGreen − Small Green LED [Jameco: 34606]
D2: 1N5400 − 3 Amp 50 PIV Silicon Diode [Jameco: 77075]
F1: Fuse5x20mmSide.BS2Hub8B − 5 x 20 mm Fuse Holder Clips [Jameco: 119280]
# F2 is the fuse that plugs into F1; it is not really a second
# fuse on the PCB.
F2: Fuse5x20mm1A − 250V 1A 5x20mm fuse [Jameco: 103907]
# Can substitute 4 2x5 Male headers for 8 1x5 male headers [Jameco: 153699]
N1−8: Header1x5.RBMaster − 1x5 Male Header [5/40 Jameco: 160881]
N9: Header2x5.DB9 − 2x5 Male Header [10/80 Jameco: 117196]
N10: TerminalStrip2.BS2Hub8 − 2 Junction Terminal Strip [Jameco: 189675]
N11: Header1x2.BS2Hub8 − 1x2 Male Header [2/40 Jameco: 160881]
# N12 is the Socket for U1; it is not listed on the PCB.
N12: Socket24DIP − 24−pin DIP socket (.6" wide) [Jameco: 39351]
R1: Resistor220.Vertical − 220 Ohm 1/4 Watt Resistor [Jameco: 30470]
R2: Resistor10K.Vertical − 10K Ohm 1/4 Watt Resistor [Jameco: 29911]
R3−4: Resistor220K.Vertical − 220K Ohm 1/4 Watt Resistor [Jameco: 30525]
SW1: SwitchSmallDPST − Small DPDT Power Switch [Jameco: 161816]
U1: BasicStamp2 − Basic Stamp II [Jameco: 130892]
VR1: LM2940CG−5 − 5 Volt Low Dropout Voltage Regulator [Jameco: 107182]
```

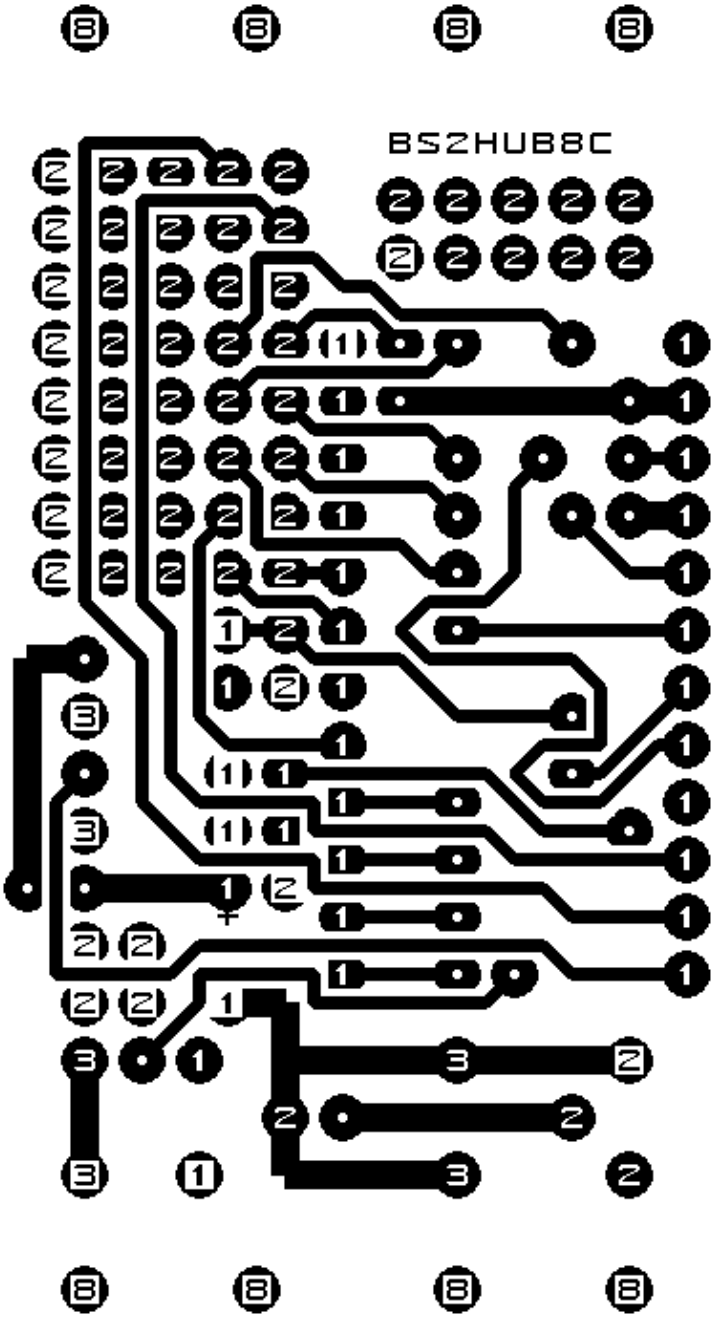
B. Appendix B: Artwork Layer



C. Appendix C: Back (Solder Side) Layer



D. Appendix D: Front (Component Side) Layer



E. Appendix E: Construction Instructions

The instruction steps for building the BS2Hub8 (Rev. C) RoboBrick are listed below:

1. Orient the board vertically with N1 in the upper left corner. [step1.jpg]
2. Take a 2×5 male header and install it at N9. When installing, start by soldering only one pin. Then turn the board upside down and verify that the connector is properly seated. If not, re−heat the pin you initially soldered and re−seat the connector. When you are satisfied that the connector is properly seated, turn the board back over again and solder the remaining 9 pins. [step2.jpg]
3. Take another 2×5 male header and orient it horizontally. Using some diagonal cutters, snip off 2 pins corresponding to pins 3 and 4 in the diagram below:

1	X	5	7	9
2	X	4	6	8

   Pins 3 and 4 are in the positions marked `X'. Using the same procedure as in the previous instruction, install the 2×5 header at position N1 and N2. The snipped of pins must be on the left side. Again, solder one pin first, verify seating, and solder the remaining nine pins. [step3.jpg]
4. Using the same procedure as the preceding instruction, install 3 more 2×5 headers at positions N3&N4, N5&N6, and N7&N8 respectively. Again, be sure to snip off the two pins prior to soldering one pin, verify seating, and solder the remaining pins. [step4.jpg]
5. Take the 24−pin IC socket and orient it so that the notch is pointing up. Frequently, the IC sockets are not very well marked as to which pin is pin 1. If the socket gets installed upside down, no real harm is done, since the socket is symmetrical. As with the male headers, solder 1 pin first, verify seating, and solder the remaining 23 pins. In the picture, the notch is highlighted with some white ink. [step5.jpg]
6. Take a 1×2 male header and install it at position N11. There may be a little interference between N11 and the IC socket. If so, sand, file, or scrap off a little on the edge of N11 until it fits in without tipping over any. Again, solder 1 pin, verify seating, and solder the remaining pin. [step6.jpg]
7. Find the 10K Ohm resistor. It has a color code of Brown−Black−Orange. Frequently, orange is followed by a Gold or Silver band. This is resistor R2 and it is going to be installed vertically. With the Brown band on top, bend the lead 180 degrees until it is pointing down. (Resistors are symmetrical, so no harm is done if you have the gold band on top.) Insert the lead coming out the bottom (i.e. near the gold band) into the bottom hole of R2; the remaining lead goes into the bottom. Turn the board over, spread the leads a little to keep the resistor from falling out, and solder one lead. Turn the board front−side up, and verify the resistor is sitting straight up. If not, re−heat the lead you soldered to re−seat the resistor. When you are happy with the resistor position, solder the remaining lead. Finally, using diagonal cutters, snip the two leads close to the board. [step7.jpg]
8. Find the 220 Ohm resistor. It has a color code of Red−Red−Brown, typically with either a gold or silver band at the end. Using the same technique as in the previous instruction, bend the lead over 180 degrees, and insert the bottom (gold/silver) side into the left hole of R1; the other bent lead goes into the right hole of R1. Spread the leads, solder one lead, verify seating, solder the remaining lead, and snip off the excess leads close to the board. [step8.jpg]
9. Take the small green LED and orient it so that the long lead is on your left. The long lead is the positive lead and the slightly shorter lead is the negative one. LED's are not symmetrical; if you put them in backwards, they will not operator properly. Insert the LED into area marked `D1+' with the long in the hole closest to the `+'. The negative lead goes into the hole on the right. As before, turn the board over, spread the leads, solder one, verify seating, solder the remaining lead, and snip off excess leads. [step9.jpg]
10. Take the remaining diode and orient it so that the end with the circular band painted around it is pointing up. This is diode D2. The end with the band is negative and the other end is positive. Diodes

are not symmetric, if it is installed backwards, the board will not work properly. Bend both leads down by 90 degrees. Align the leads so that they go through the two holes of D2. Insert the positive lead into the top hole and the negative lead into the bottom hole. Turn the board over, spread the leads, solder one lead, verify seating, solder the other lead, and snip the excess leads off. [step10.jpg]

11. Find the two terminal blue terminal block and orient it so that the wires will enter the block from the left. Insert the terminal block into the holes for N10. Turn the board over while carefully holding the terminal block in place. Solder one lead, verify seating, and solder the remaining lead. [step11.jpg, step12.jpg]
12. Using a fine point pen carefully mark the top terminal with a `+' and the bottom terminal with a `−'. Some people will take a red magic marker and mark the top most lead as red as a way of remembering that the positive battery lead (usually colored red) goes into the top terminal and the negative battery lead (usually colored black) goes into the bottom terminal. [step13.jpg]
13. Find the .47µF tantalum capacitor. This is capacitor C1. Orient the capacitor so that the lead marked with a `+' is on the top and the lead marked with a `−' is on the bottom. Like diodes, tantalum capacitors are not symmetrical, if they are installed backwards, they will not work properly. Insert the positive lead into the top hole (i.e. the next to the `+' sign) and the other lead into the bottom hole. Turn the board over, spread the leads, solder one lead, verify seating, solder the other lead, and snip the excess leads off. [step14.jpg]
14. Find the 22µF tantalum capacitor. This is capacitor C2. This capacitor is going to be oriented on its side rather than vertically. The reason for this is because the fuse will be resting on top of the C2. As in the previous instruction, find the `+' and `−' leads and orient the capacitor with the `+' on top. Now bend the capacitor over on its side by 90 degrees. Now the capacitor is pointing to the right and leads are pointing straight down towards the board. Put the `+' lead into the hole labeled `+' and the `−' lead into the hole labeled `−'. You know the drill, turn the board over, spread the leads, solder one lead, verify seating, solder the other lead, and snip off the excess leads. [step15.jpg]
15. Find the little switch SW1. While the switch is symmetrical, we need to snip off two leads on one end in order for it to fit in the 4 available holes. Turn the switch over and snip off two leads as indicated by `X's below:

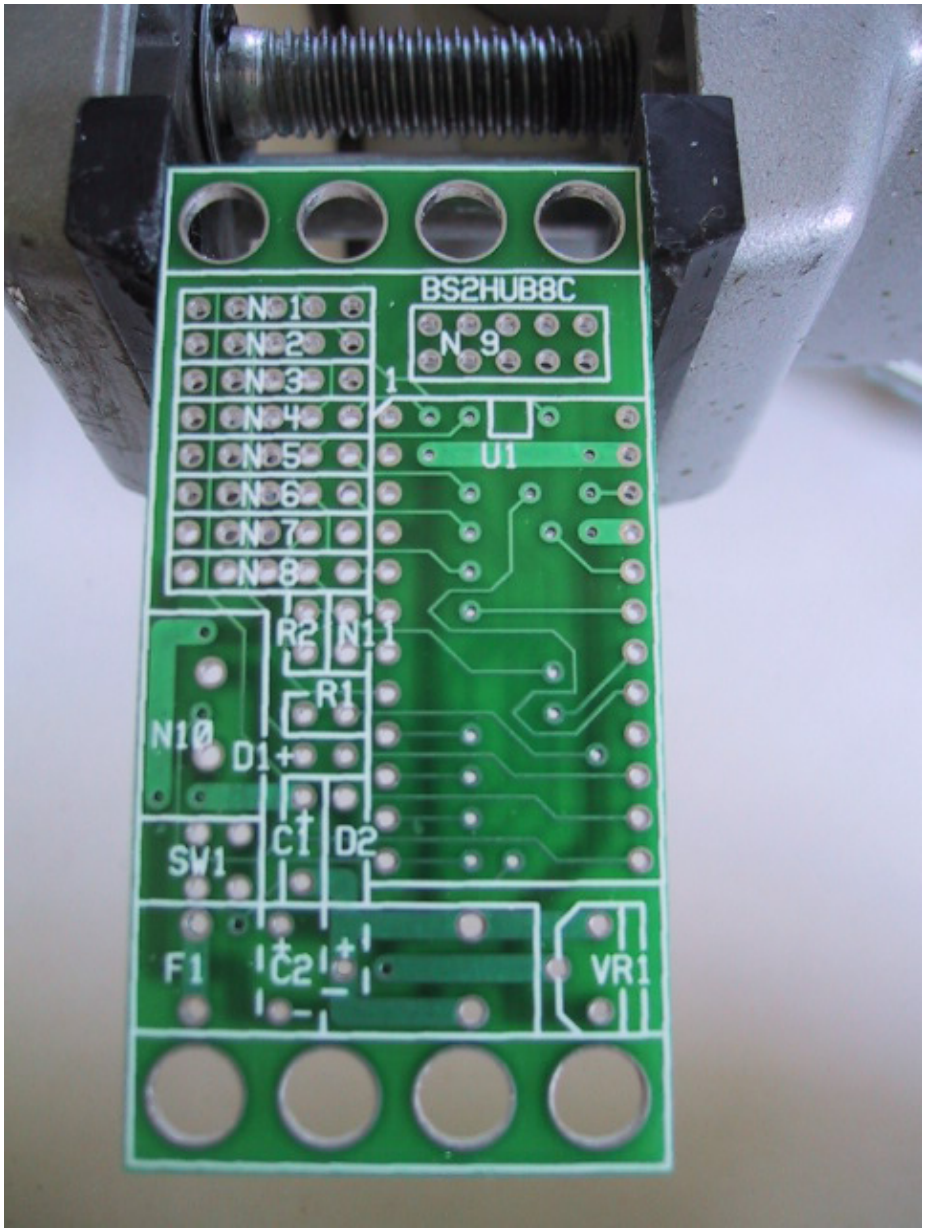
X	O	O
X	O	O

    Now flip the switch over so that the 4 remaining leads are on the right and insert it into the 4 holes labeled SW1. While holding the switch in place with your hand, carefully turn the board over, and solder in 1 lead. As usual, verify seating prior to soldering in the remaining 5 leads. [step16.jpg]
16. It is possible to install the fuse clips backwards. To prevent this, please find both fuse clips and snap them onto the fuse. While the fuse is 20mm long, the spacing for the fuse clip is closer to 25mm long. Place the whole fuse and fuse clip assembly into the 4 holes labeled F1 on the board. There will be some additional space between the fuse ends and the fuse clip edges; this is OK. Remember the fuse goes over capacitor C2, so it might be necessary to push C2 down a little to get everything to fit. Again, while holding the fuse assembly in one hand, turn the board over and solder in one lead of each fuse clip. To prevent burns, it is a good idea to hold the assembly by the glass fuse rather than the metal clips. After seating has been verified, solder the the fuse clips all the way in. [step17.jpg]
17. Take the LM2940 voltage regulator and orient it so that the lettering is facing you. The LM2940 is component VR1. Bend the middle lead a little towards you and the two outer leads a little away from you. Now rotate VR1 90 degrees clockwise around its vertical axis of symmetry. Insert VR1 into the three holes labeled VR1. Turn the board over, spread the leads a little, solder one lead, verify seating, solder the remaining leads, and snip off any excess leads. [step18.jpg, step19.jpg]
18. Find the heat sink and orient it such that the fins are pointing to the left with the hole on top. Using the screw and nut, attach the heat sink to VR1, such that VR1 is enclosed by the heat sink. [{Missing

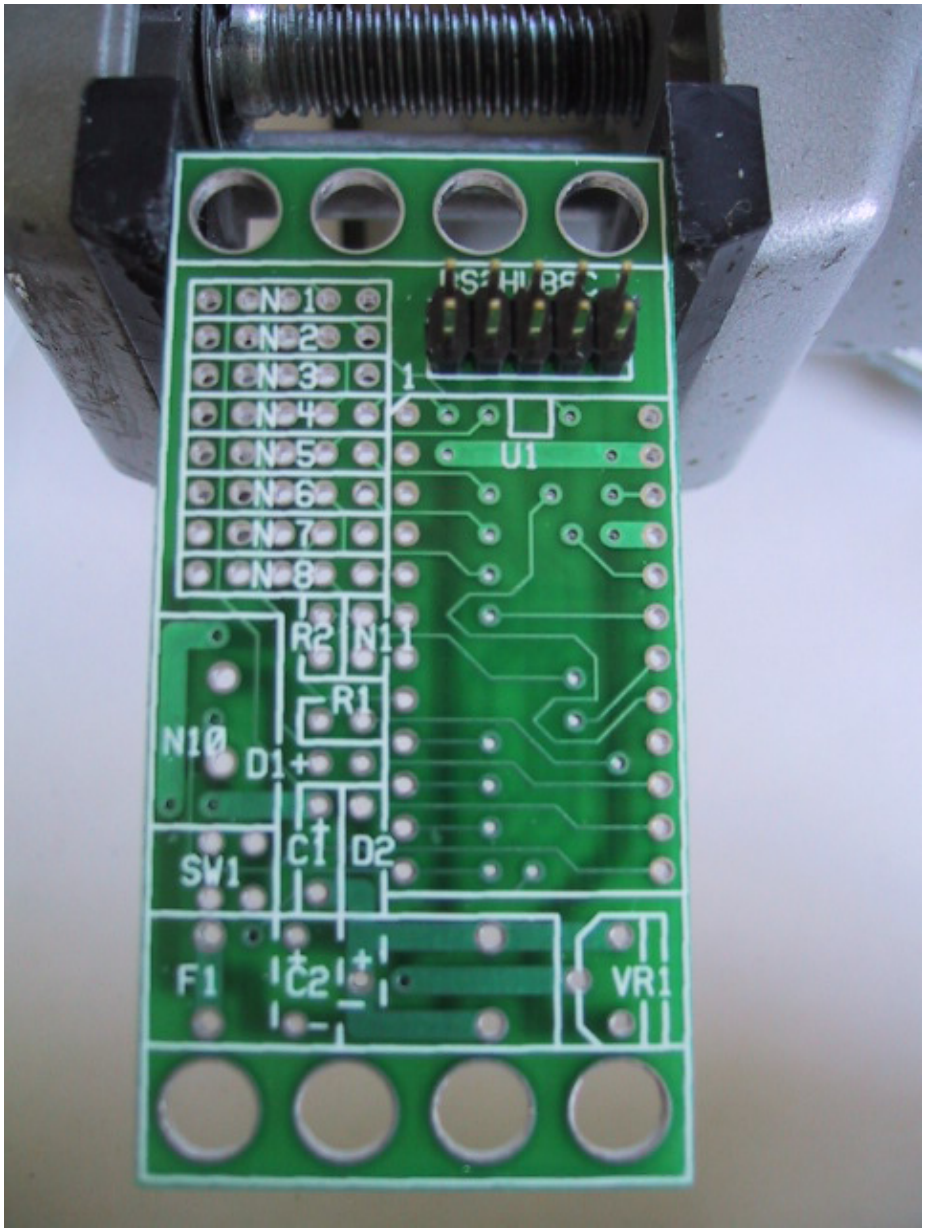
picture with heat sink.}]

The assembly of the BS2Hub8 (Rev. C) RoboBrick is complete.

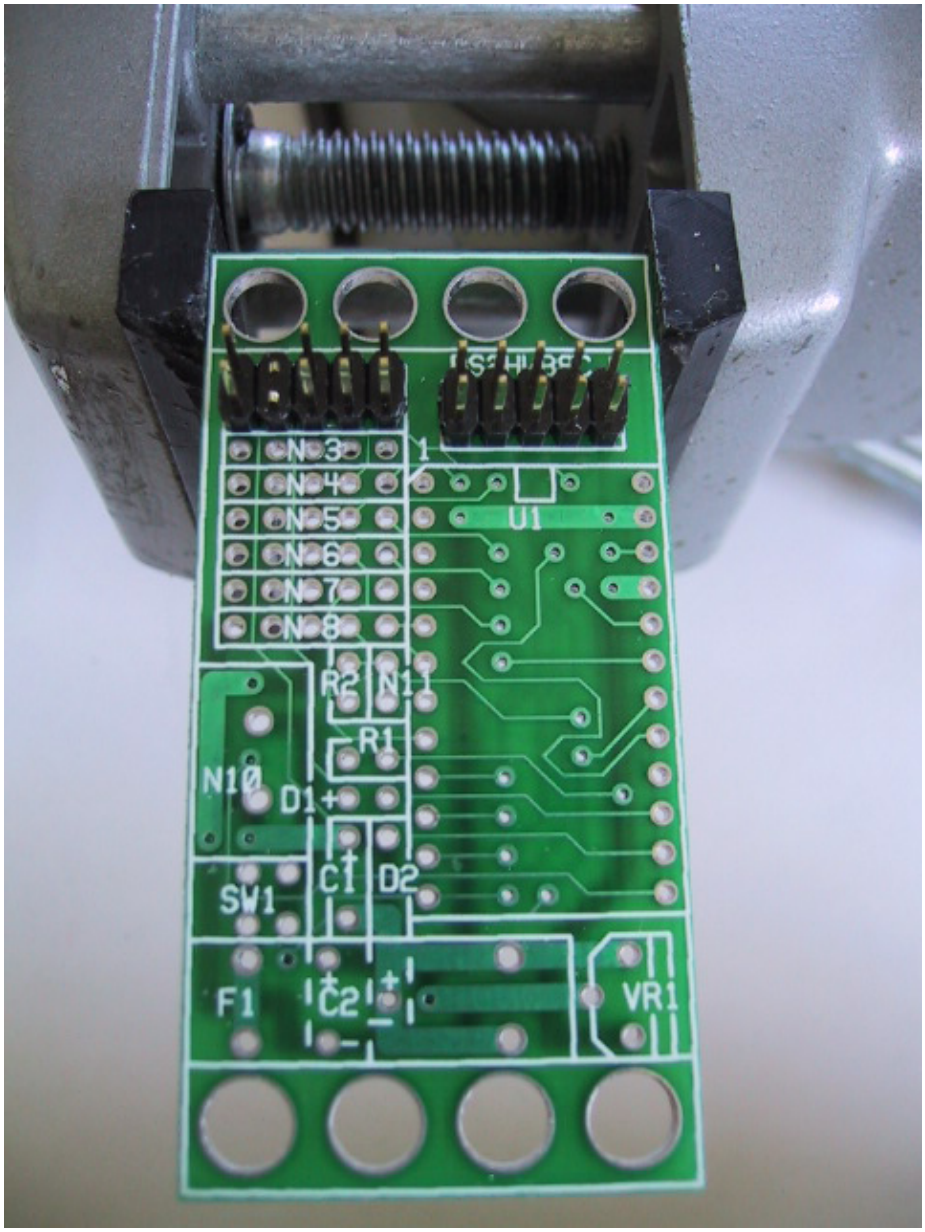
Step 1


BS2HUB8C
N1
N2
N3
N4
N5
N6
N7
N8
N9
1
U1
R2
N11
R1
N10
D1
C1
D2
SW1
F1
C2
VR1

Step 2



Step 3



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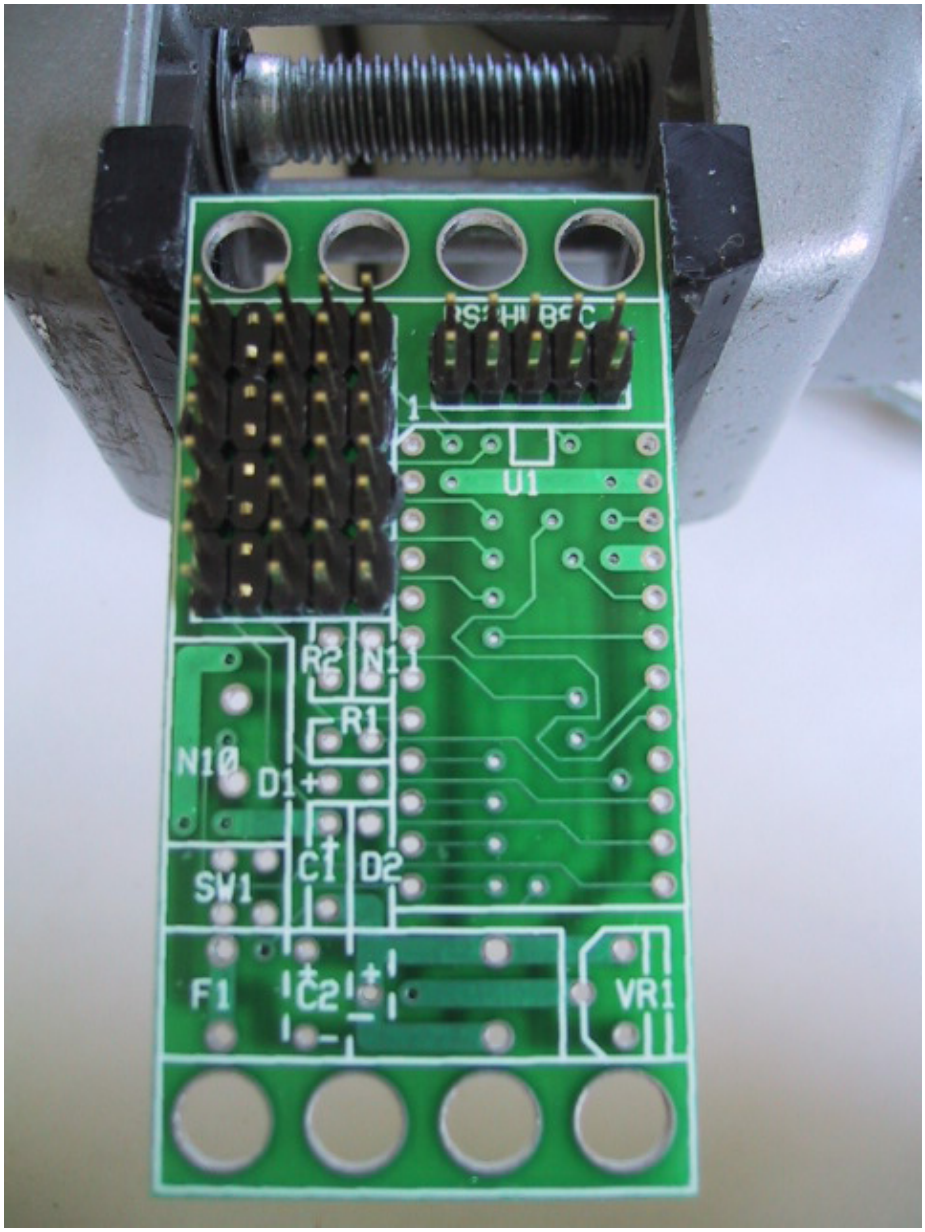
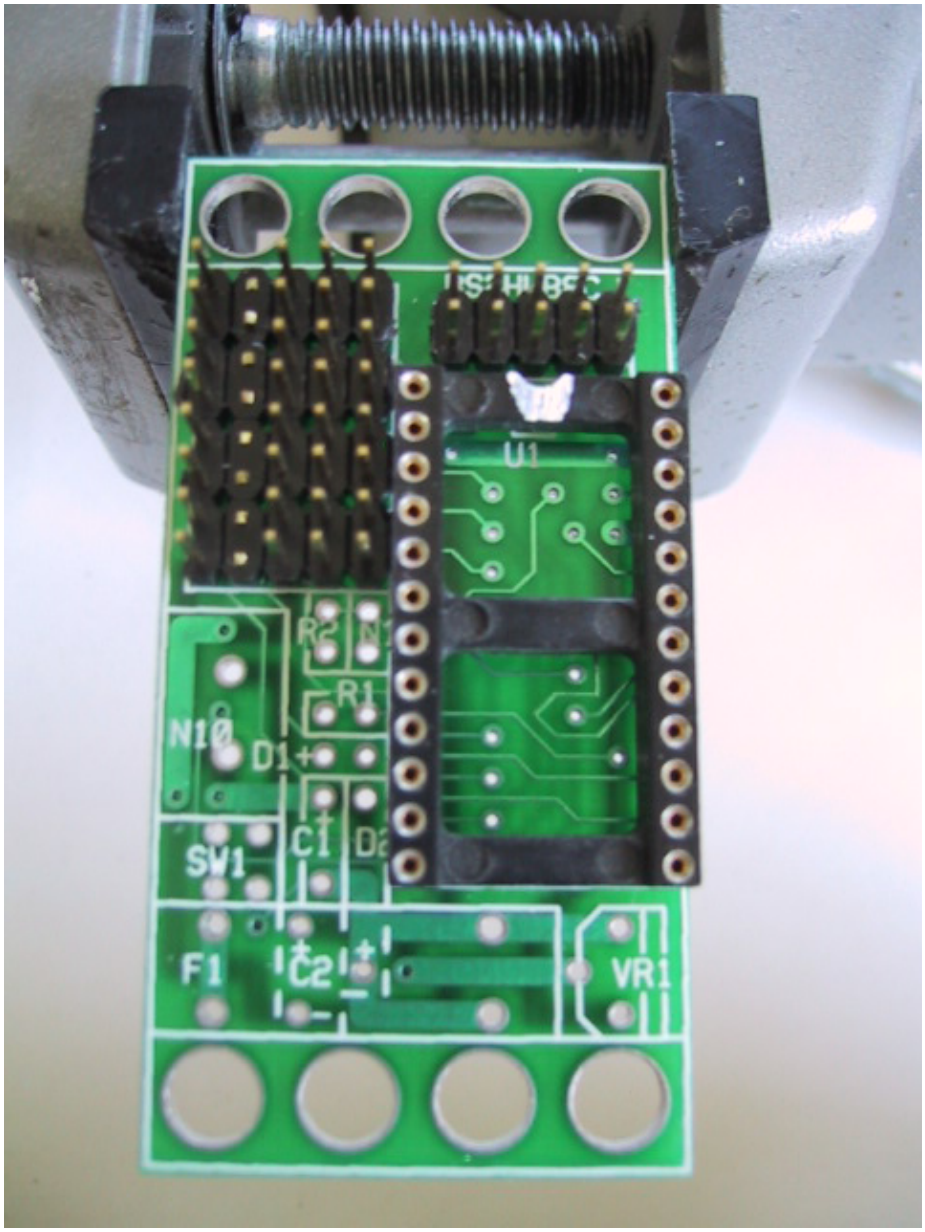


Step 5



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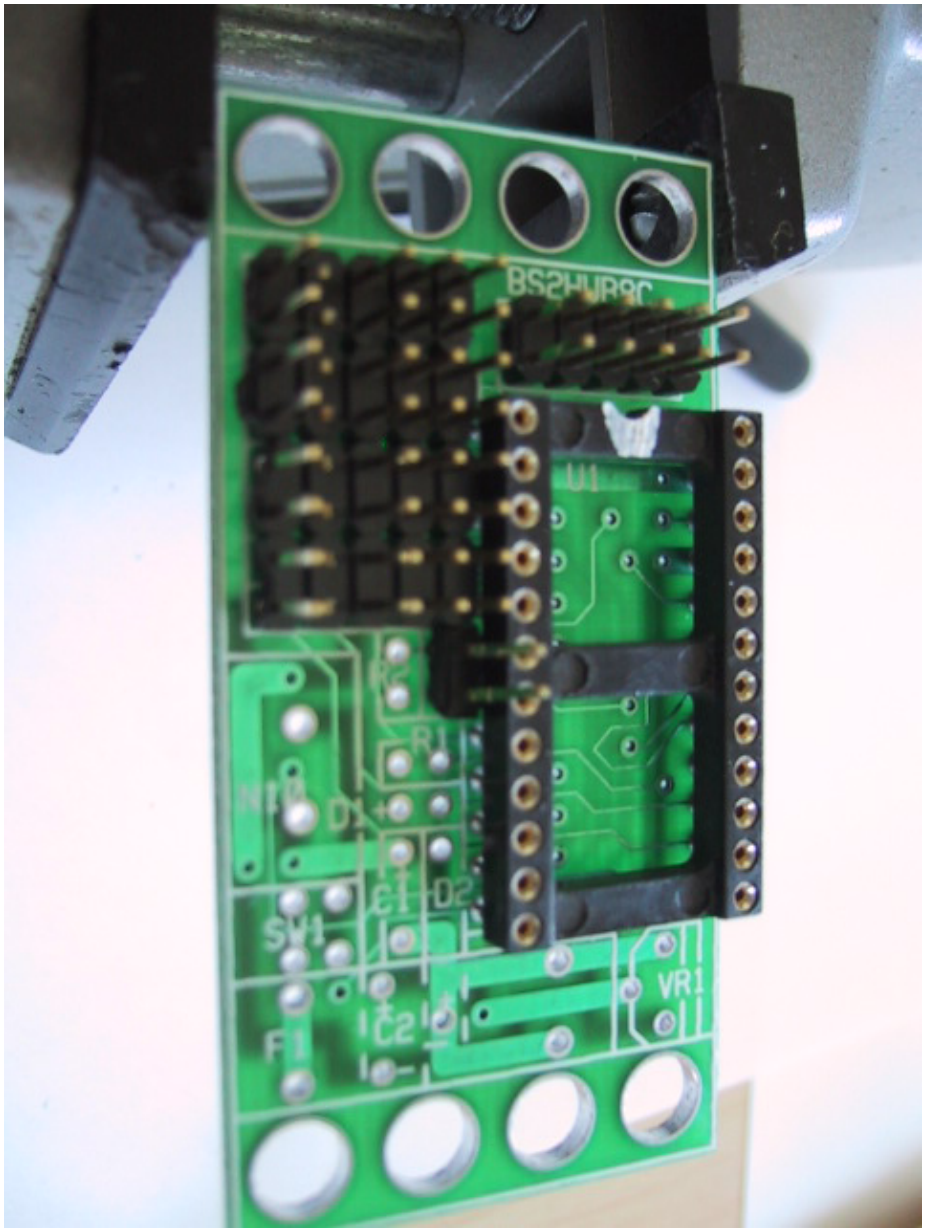

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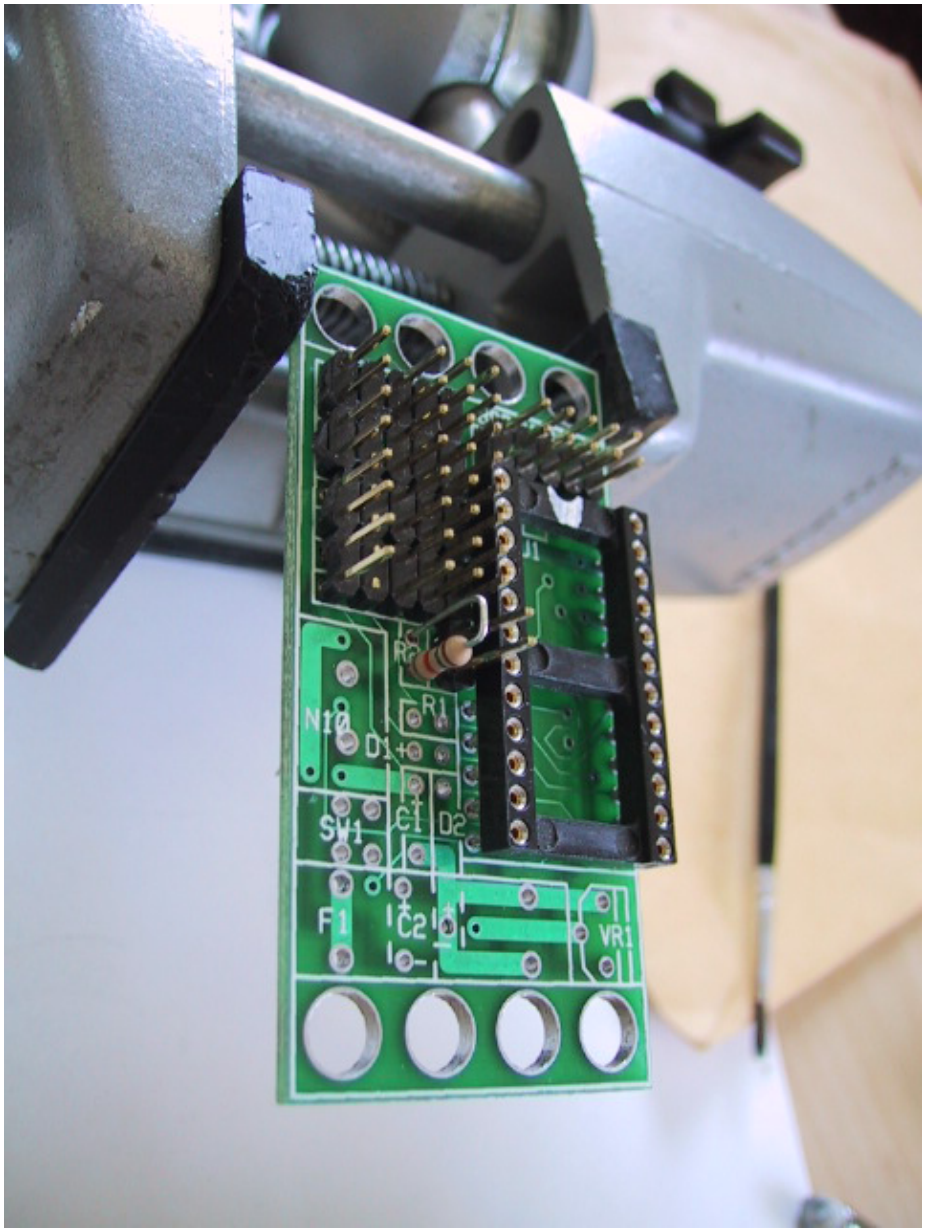
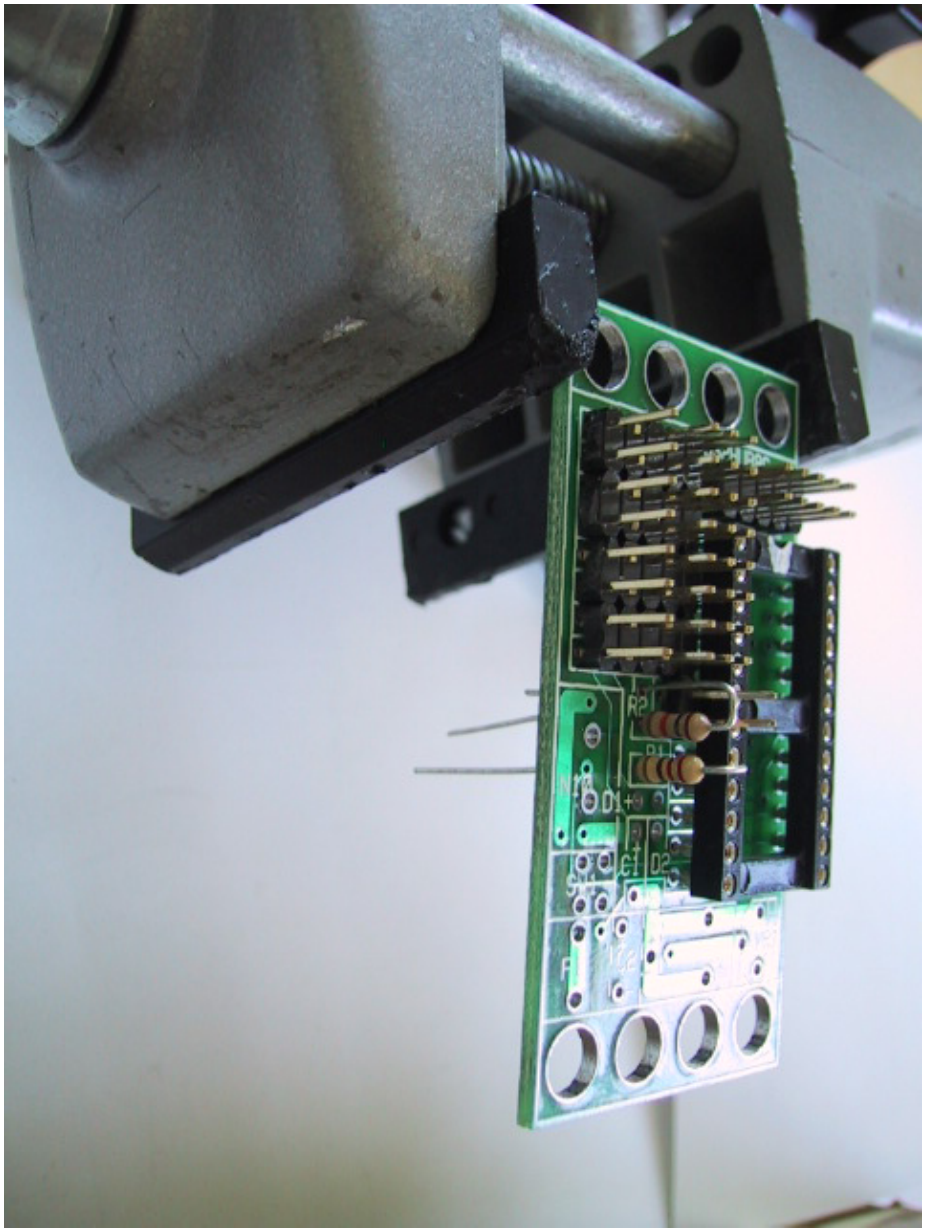


Step 8



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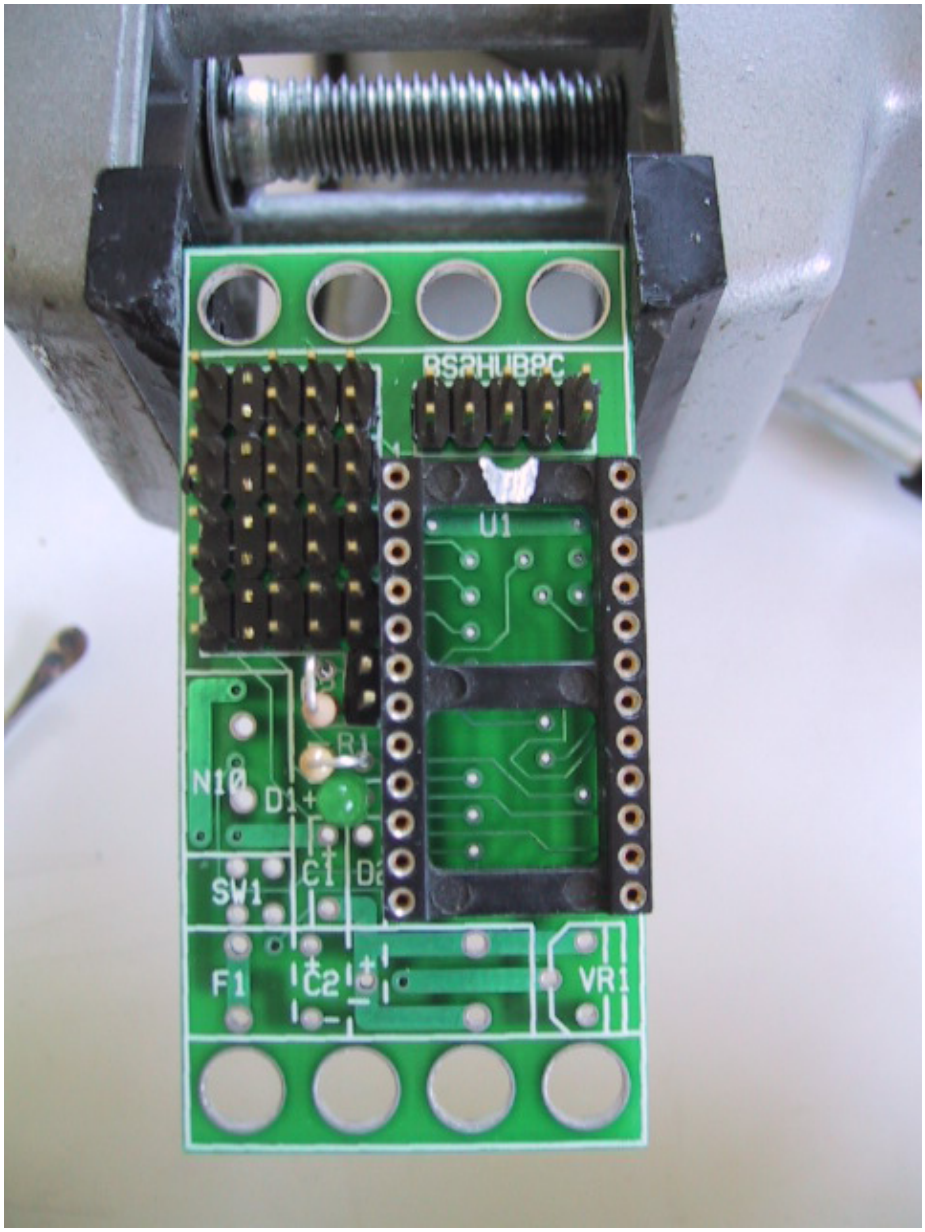

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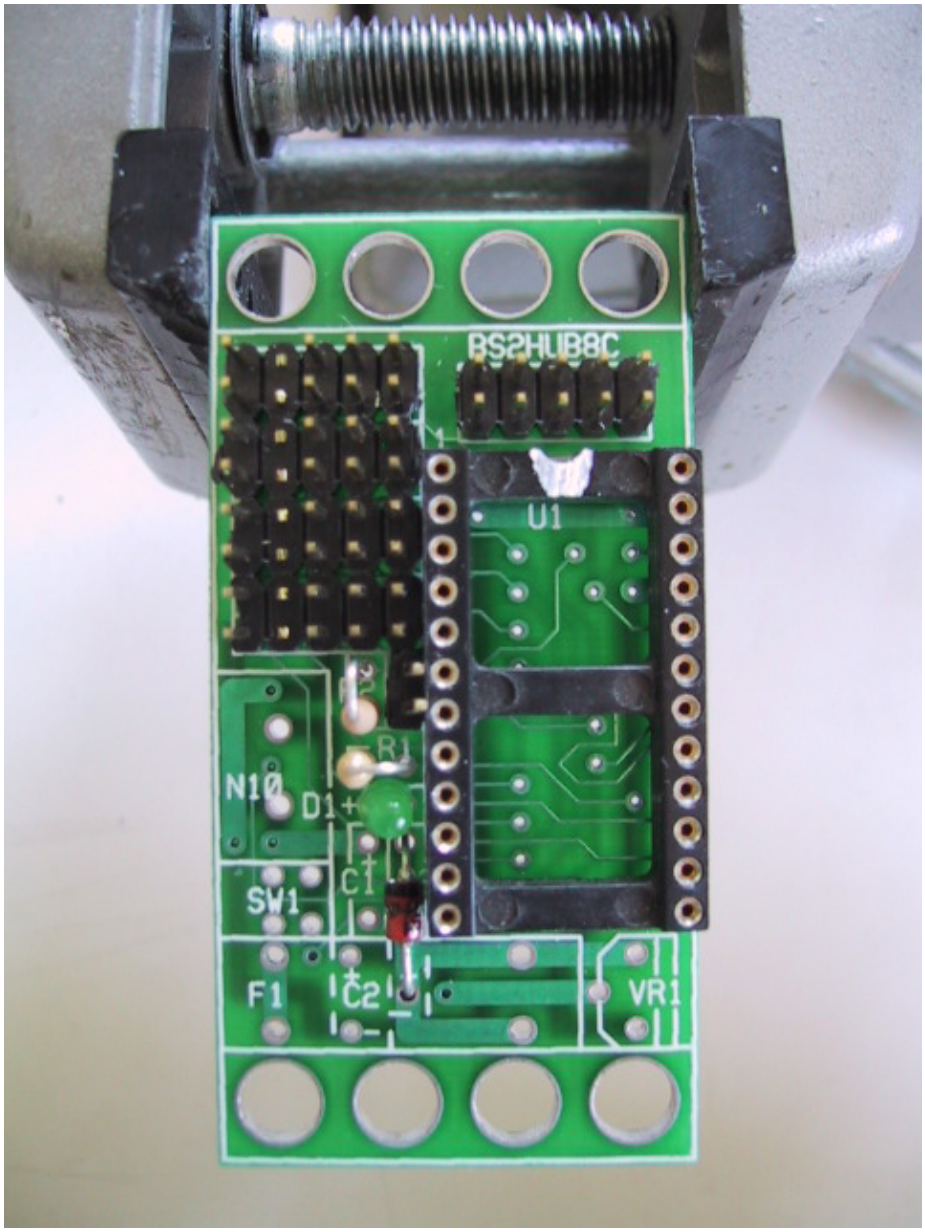

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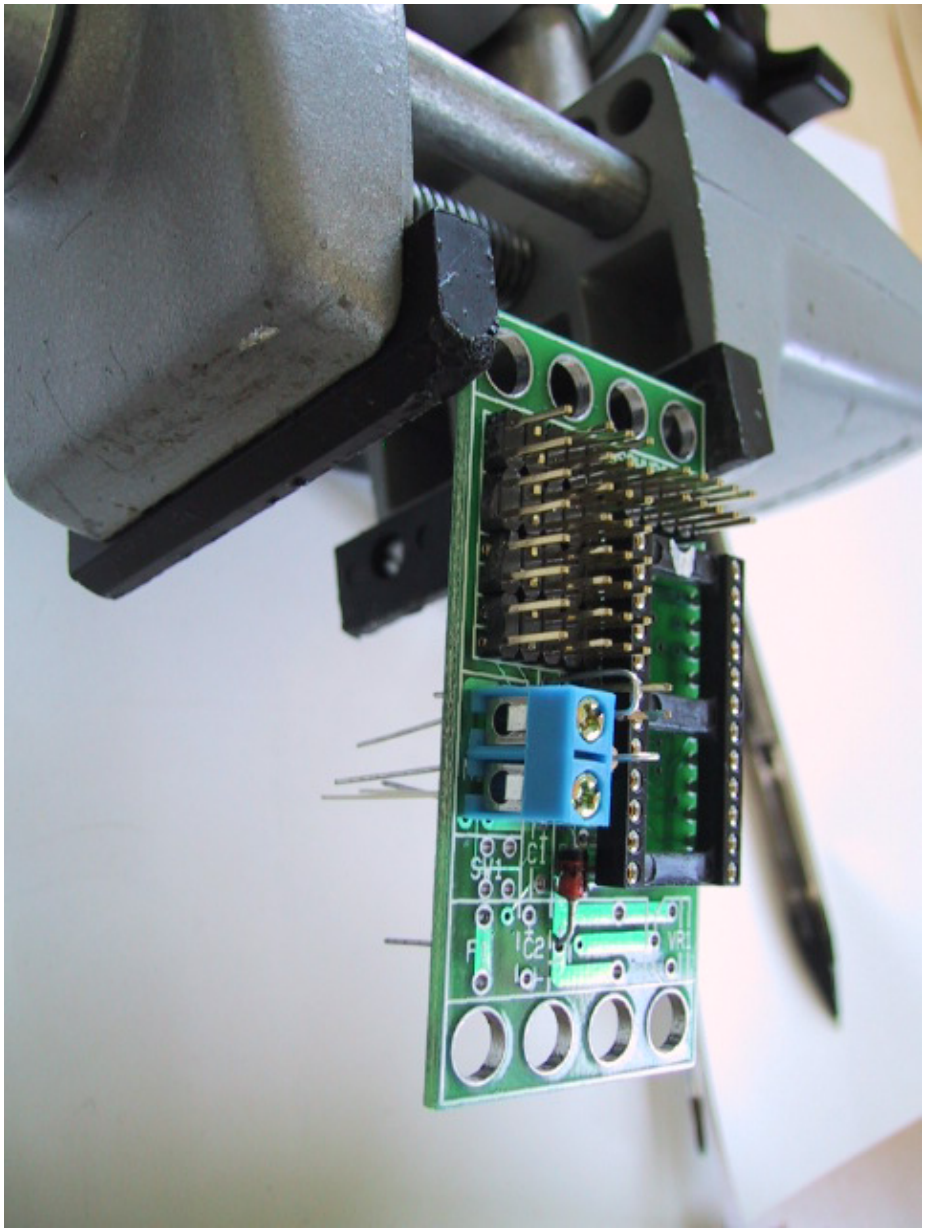
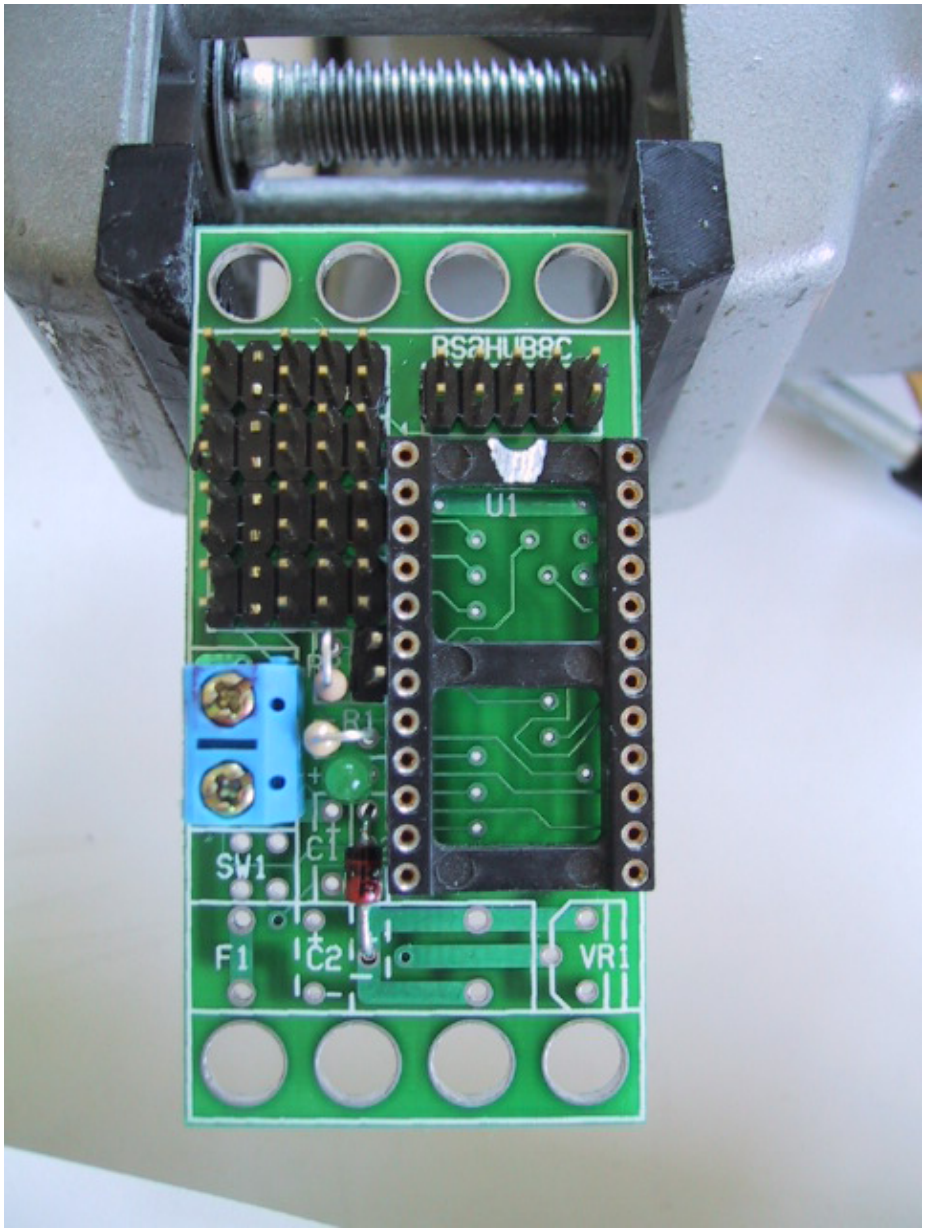


Step 12



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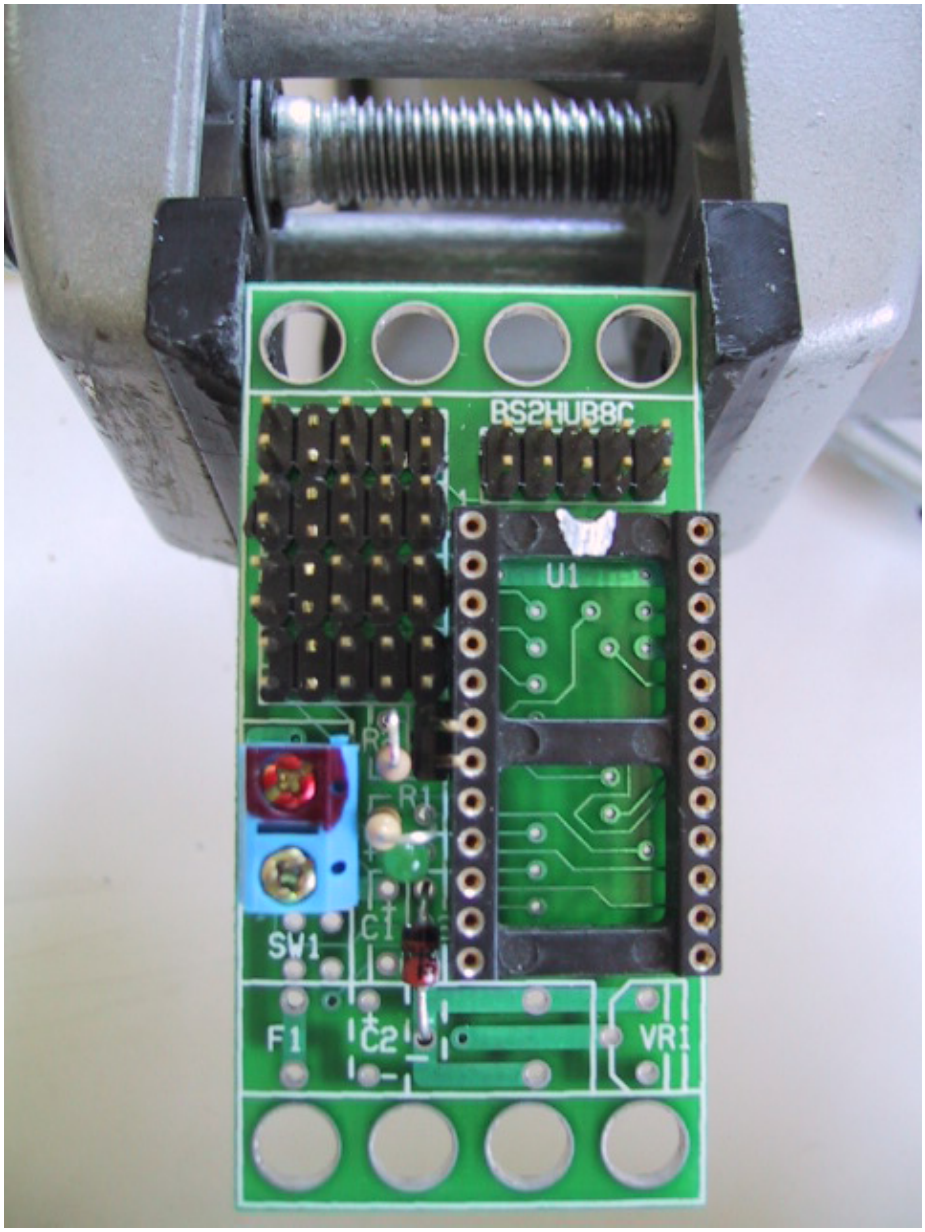

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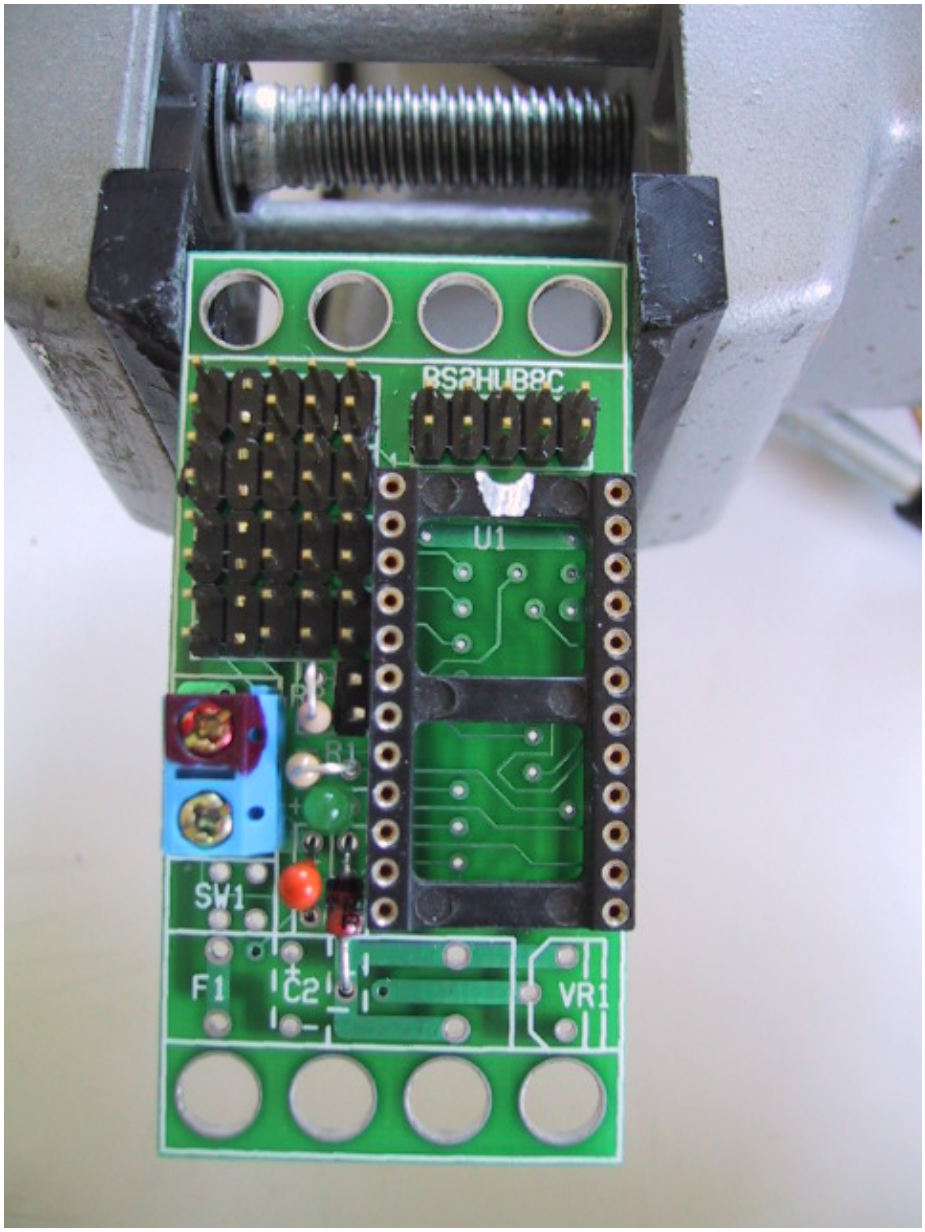

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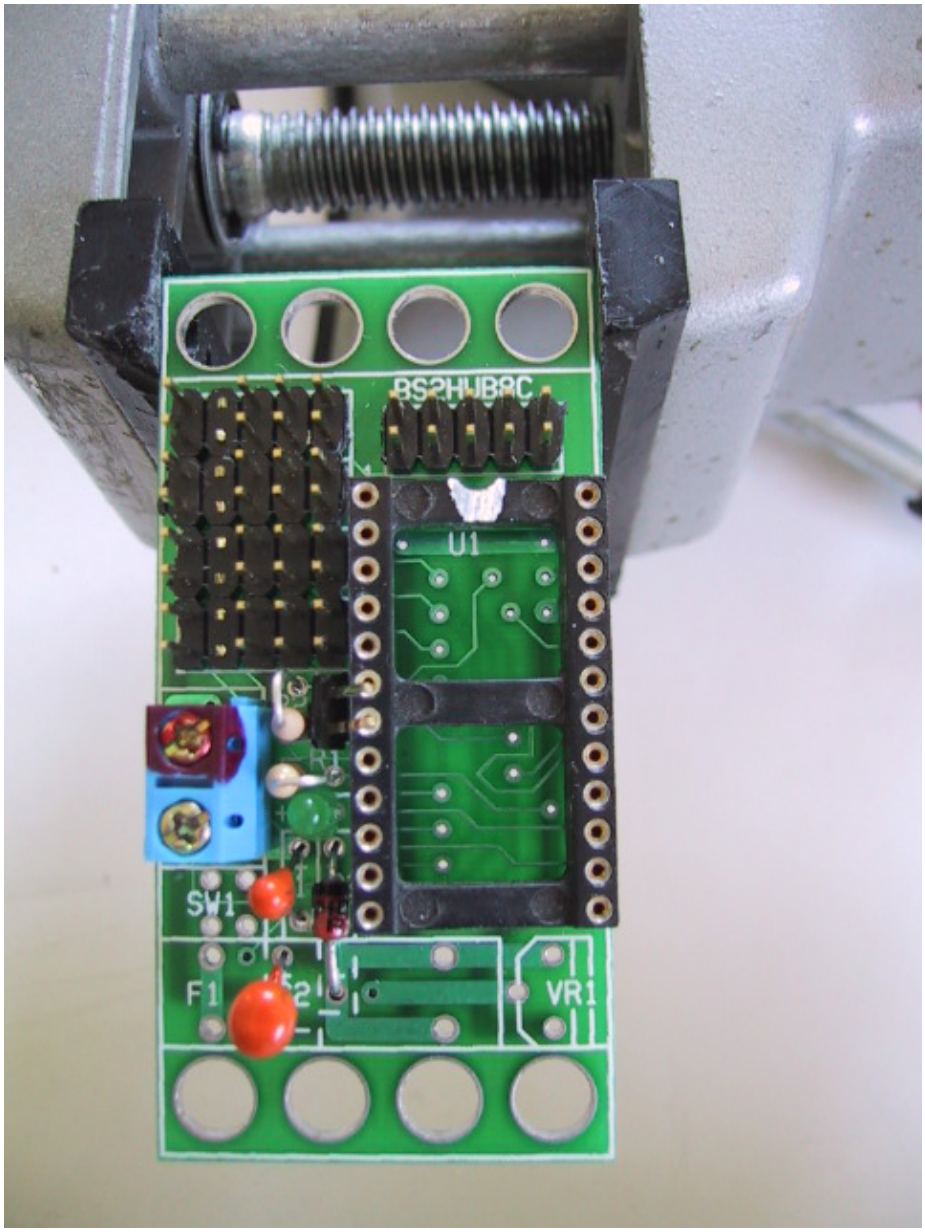
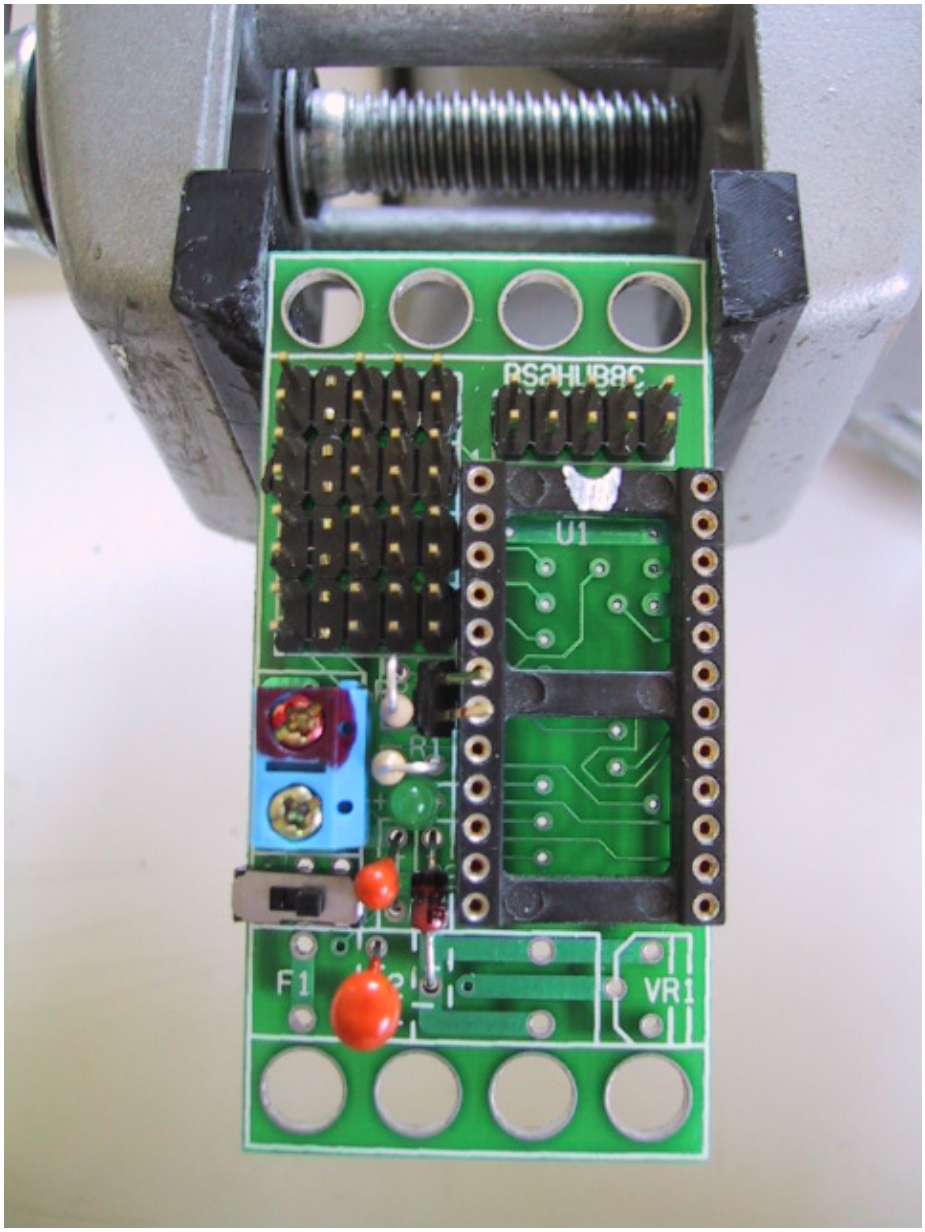
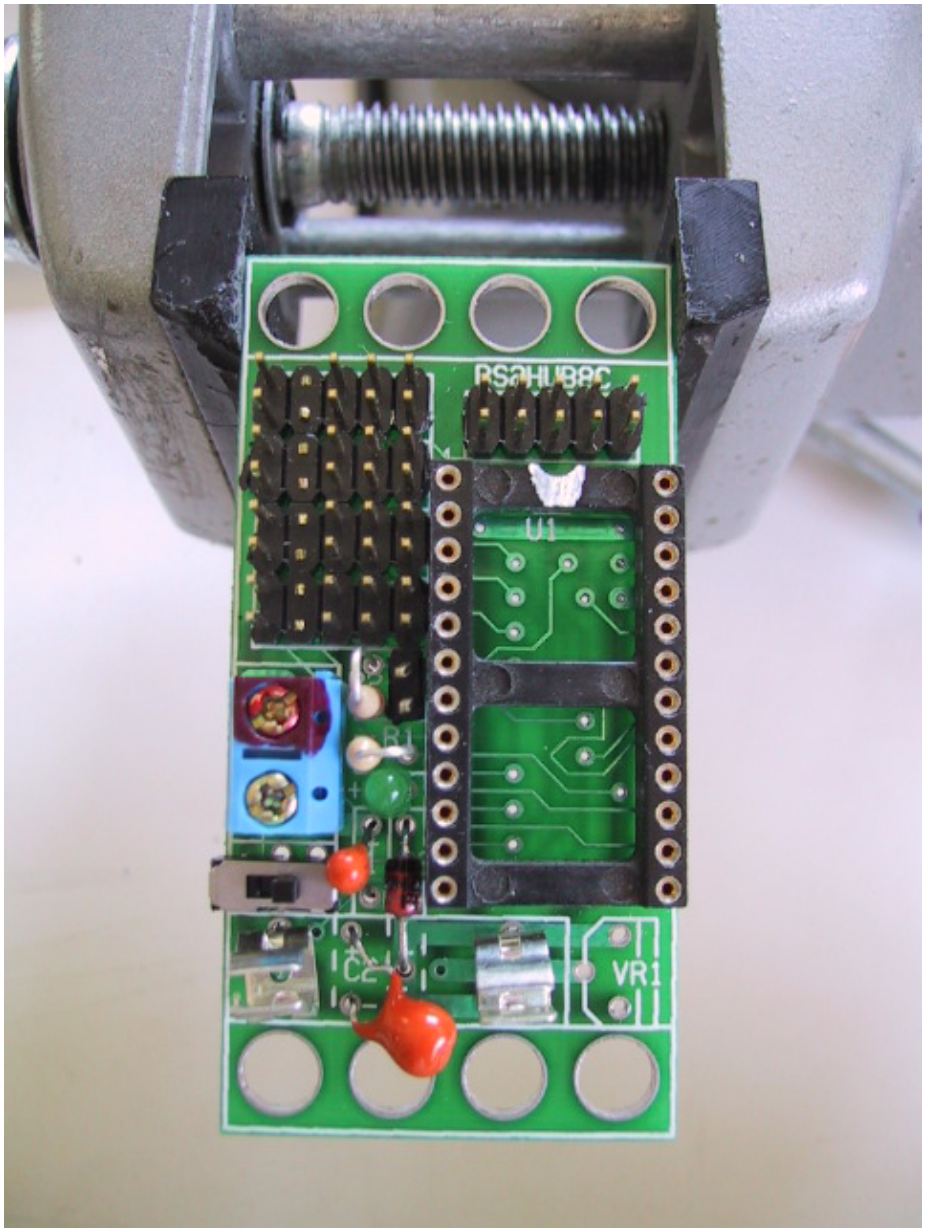


Step 16



Step 17



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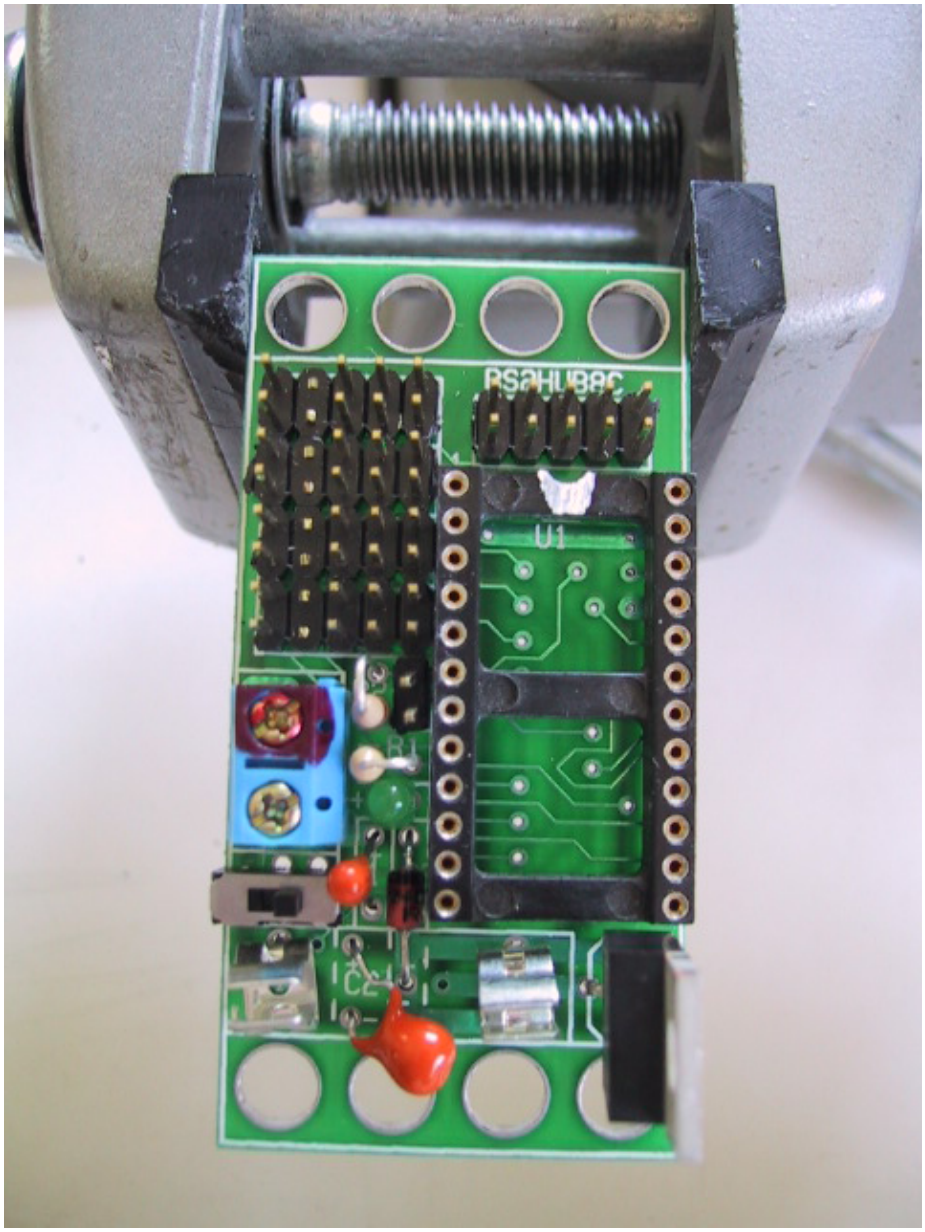

Step 19