

Propeller Robot Controller ver. 2.00

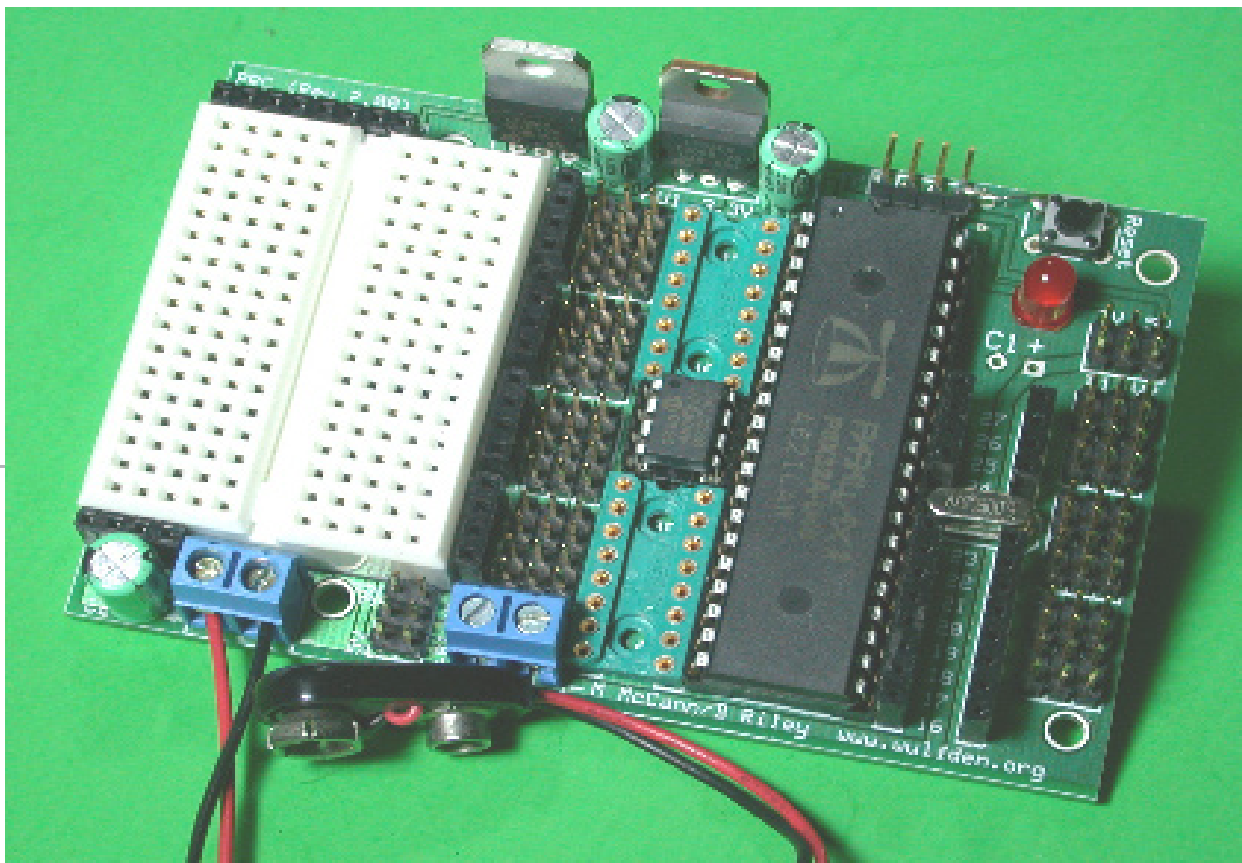
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Preliminary 2/16/2007

includes PRC-I/O



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The Most Up-to-date Documentation is available at:
<<http://www.wulfden.org/PRC>>

Builder's Notes

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1 Overview

Genesis

The Propeller Robot Controller (PRC) was created by Mark McCann of Kansas, City, MO To satisfy the need for a integrated controller board that could handle upwards from a dozen servos simultaneously. He got together with Brian Riley of Underhill Center, Vermont. In collaboration they produced the PRC REv 1.02 and sold over 100 of t he boards.

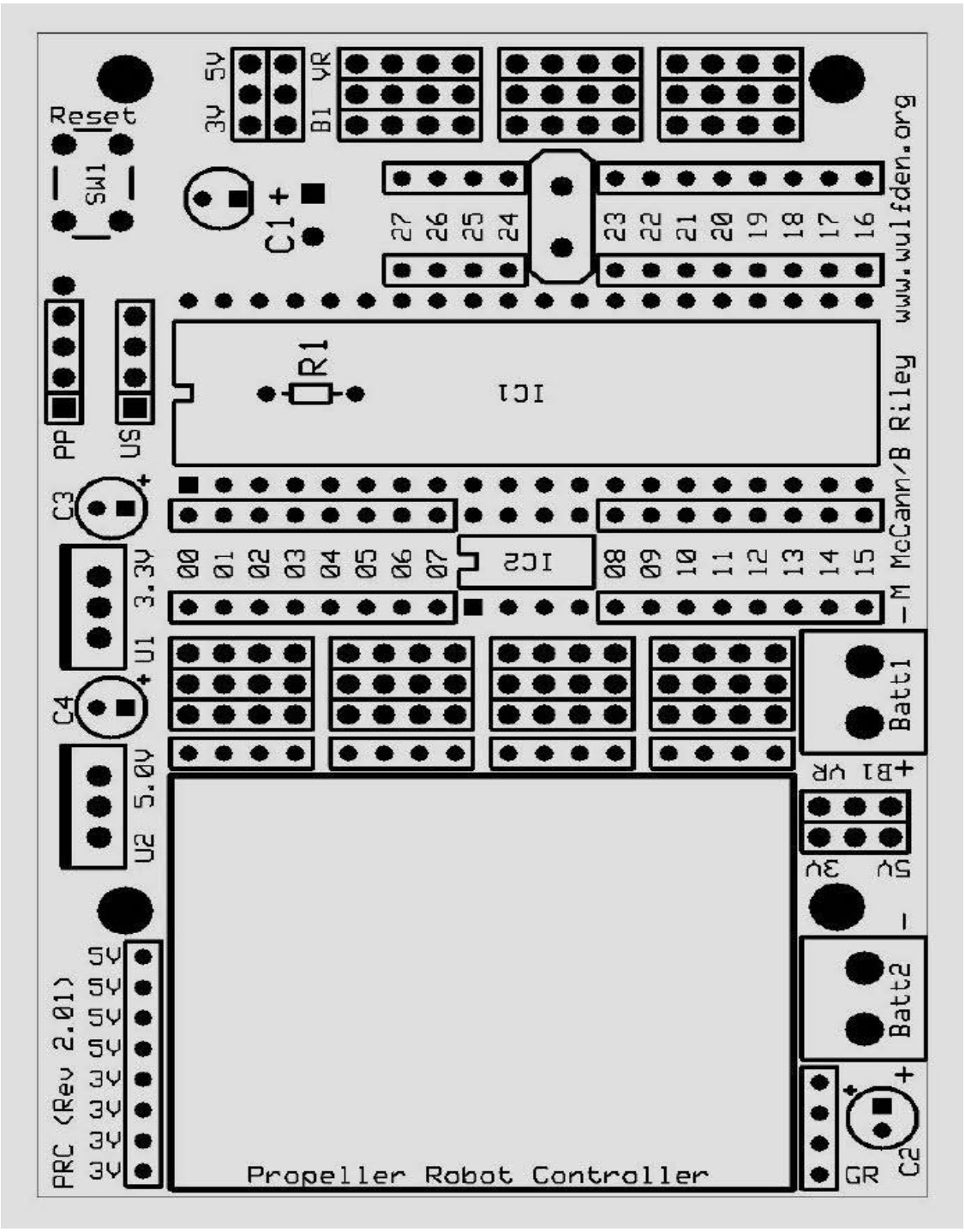
Brian Riley took the Rev 1.02 version and produced an updated board labelled Rev 2.00. The new board added provisions to handle the new Parallax Propeller Plug for programming, changed some physical alignments of the power jumper selections, and beefed up some of the power busses.

While that was going on Brian also created a design for a setof I/O board that would attach to existing PRC connectors and provide for use of keyboard, mouse, composite video, VGA, etc.

With the I/O boards in mind, the reset button and power LED were rearranged.

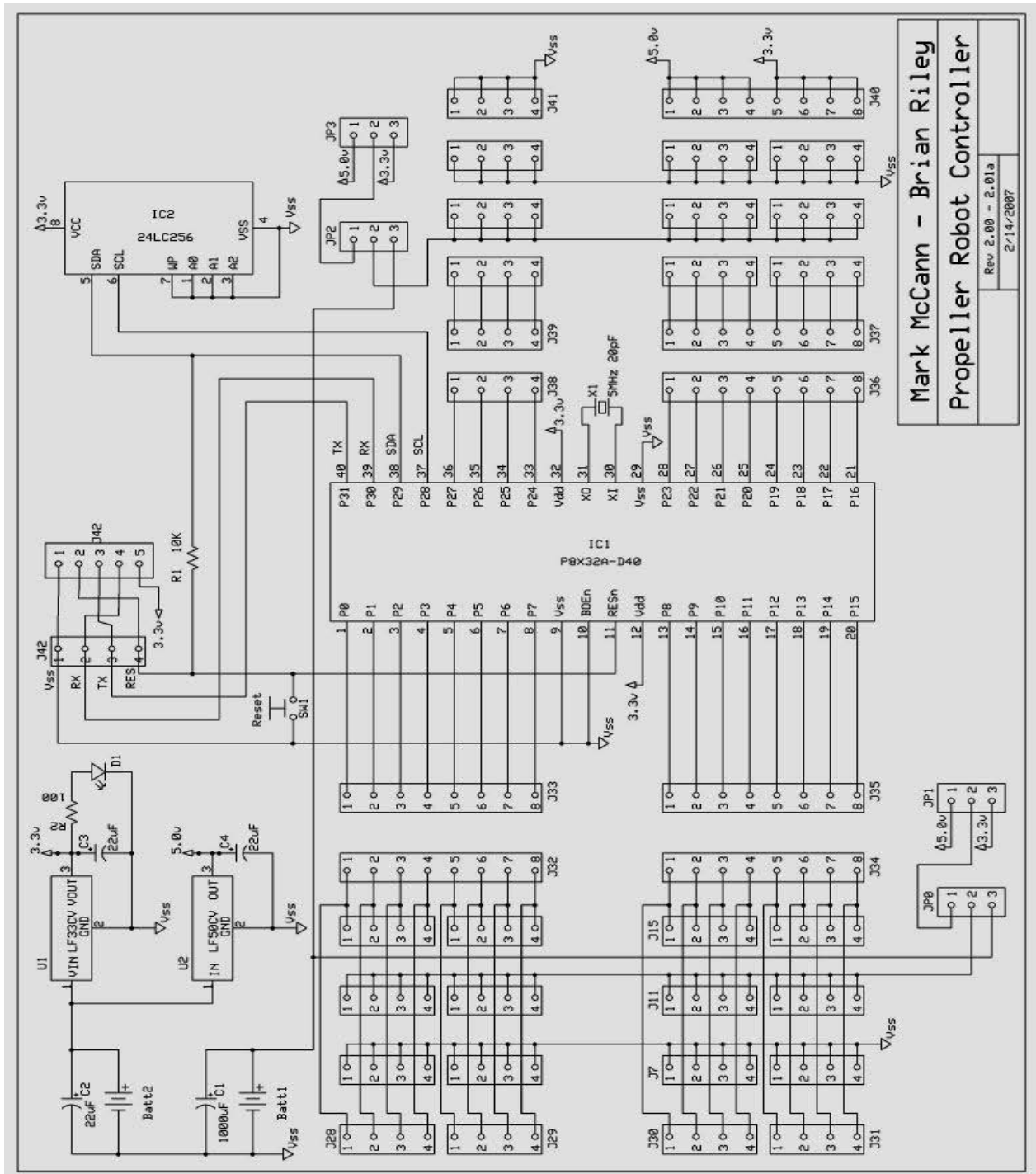
2 Hardware

Parts Layout



2 Hardware

Schematic



2 Hardware

PRC mainboard - Parts List

R1	10 Kohm - 1/8 watt resistor
D1	Red LED w/built-in 330 ohm series resistor
IC1	P8X32A-D40 (40-pin DIP) chip
IC2	24LC256 serial EEPROM
C1	1000 uF 16V electrolytic capacitor
C2,C3,C4	22 uF 50 V electrolytic capacitor
SW1	N.O. pushbutton switch (DigiKey P8006S-ND)
J0-J27	1x3 pin headers installed as 14 - 2x3 (see text)
J28-J31	4 - 1x4 socket headers
J32-J37	6 - 1x8 socket headers (see text)
J38-J39	2 - 1x4 socket headers
J40	1x8 socket header
J41	1x4 socket header
J42	1x4 (1x5) right angle pin header (see text)
JP0-JP3	4 - 1x3 pin headers installed as 2 - 2x3
BT1, BT2	Buchanan Euroblock 2 pos power connector
X1	5.00 MHz Crystal, low profile (Mouser 520-HCU500-20X)
U1	3.3 volt regulator (Mouser 511-LF33C V)
U2	5 volt regulator (Mouser 511-LF50CV)
n/a	push on jumpers (4)
n/a	1 - 8 pin and 1 - 40 pin DIP sockets

Notes

J0-J27 - these are the three pin servo connectors. One pin each for GND, +V, and Signal. For ease of construction as well as physical strength they are installed in *pairs* as 2x3 pin header units instead of 1x3's.

J32-J37 - 4 of the 1x8 can be replaced by 2 16 position machined pin DIP sockets that can as easily take resistor wires as Dip resistor packs.

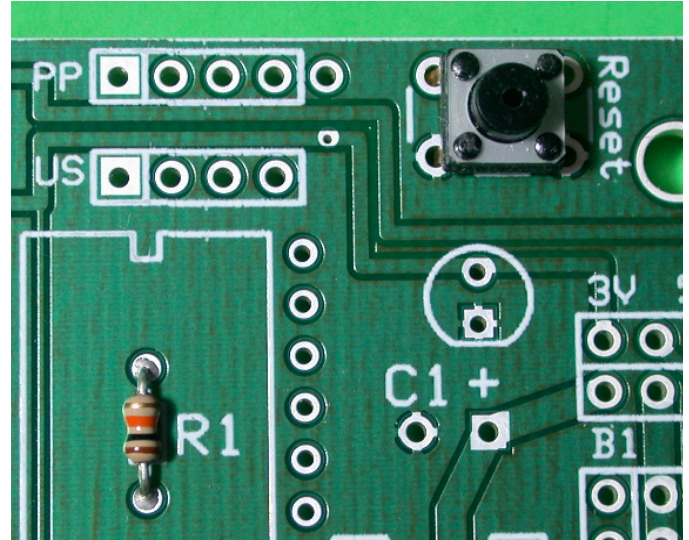
J42 - If you are using the USB2SER to program your Propeller, the 4 pin J42 goes into the 4 holes labelled "US." If you are using the newer Parallax Propeller Plug, J42 goes into the left 4 holes adjacent to the "PP." If you have home brewed a transistor based programming interface that needs power, make J42 a 1x5 pin header and use all five holes. The odd (5th) hole on the right has +3.3 vdc.

3 Construction Guide and Hints

Programming Connector Selection

*** **NOTE** *** in the Rev 2.00 there is a flaw in the RESET circuit that requires one or two simple fixes. Read this section, then read the ERRATA section before implementing and soldering in the programming connectors

- 1.) J42 is the 4 or 5 pin right angle header to be used as the programming connector. It will go in one of two sets of holes, either "US" or "PP"
- 2.) Locate the section of PCB shown to the right. if you plan to program the Propeller using the Parallax Propeller Plug, you will insert a 4 position right angle pin header into the four holes enclosed in a white rectangle adjacent to the legend "PP."
- 3.) If you plan to use the older USB2SER device you will insert a 4 position right angle pin header into the four holes adjacent to the legend "US."
- 4.) If you have fabricated your own interface from discrete components and it requires 3.3 volt power, you will insert a 5 position right angle pin header at position marked "PP."



Programming Connector Pin Assignments

US-Pin	PP-Pin	J42 - Description
1	1	Ground
4	2	RX
3	3	TX
2	4	RESET
nc	5	+ 3.3 vdc

*** Some Cautions ***

- 1.) The DIP sockets supplied for the Prop chip and the EEPROM have bent legs that do a good job of gripping the board when inserted, making it easy to flip over and solder. They do occasionally catch on the hole and when you push them in, the pin pushed the socket wiper up and out of the plastic frame. **Before** you solder the sockets down look and make sure all the socket pins are flush down with the plastic body of the socket.
2. There are extensive ground planes on this board. They help keep it electrically quiet. The downside of this coupled with the board being RoHS compliant (lead-free) is that soldering to them is more difficult. The extra area wicks heat away from the solder joint. The Rev 2.00 boards had a thorough going over and 95% of the ground plane connections were changed to a *thermal type* pad. Now, when soldering you still will need a slightly hotter

iron (750-775F) than normal (700F) for these joints, but it will be a lot easier than the Rev 1.02.

- 3.) It may be a good idea to inert a sliver of thin cardboard under the crystal before soldering it in to keep it up slightly off the board.
- 4.) It may be a good idea to mount heat sinks on the voltage regulators, particularly the 5 volt, if you are going to be running a lot of peripheral devices. The ST LF50CV is only rated slightly over half an amp. Even in light circumstances definitely heat sink them if you use a 12volt supply.

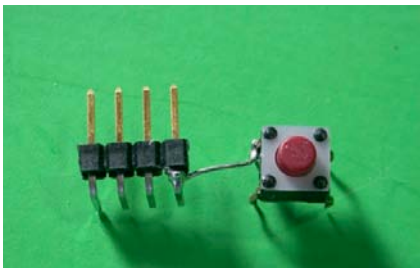
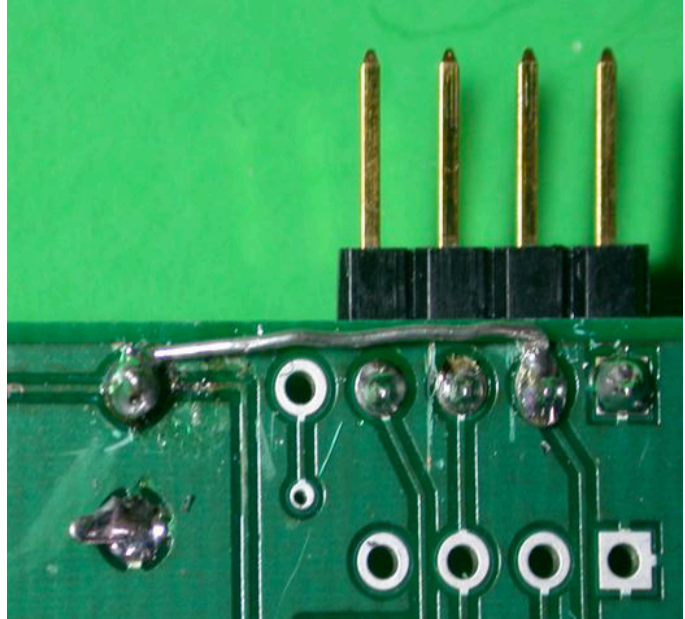
*** * * E R R A T A * * ***

In general, if you made none of these corrections ...

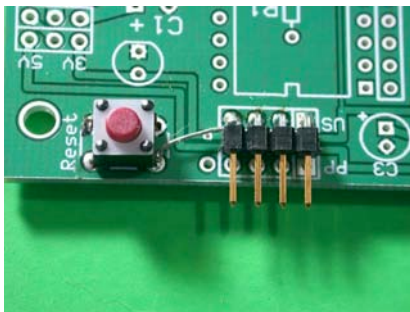
- if you set up for the Propeller Plug (PP), the board will work, but the reset button will be useless
- if you set up for the USB2SER (US), the Propeller Tool won't find the Propeller chip

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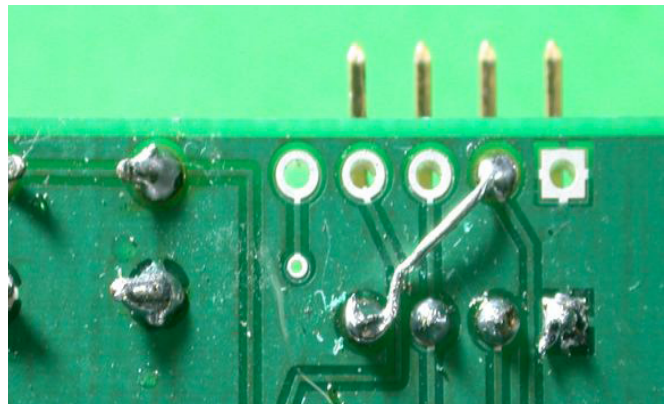
- 1.) If you are going to set the board up for the USB2SER skip over the next to step #3.
- 2.) If you are going to use the setup for the Propeller Plug you need to solder this jumper between Pin 2 of the PP and the reset button (see picture to the right). Hint ... insert the reset switch and bend 3 of the 4 pins down leaving the pin to which you will attach the jumper upright. Wrap the wire around the upright pin and then bend it over and solder it. You are done.
- 3.) For the USB2SER connector (marked "US") take the reset switch and the four pin right angle header and set them up as shown below.

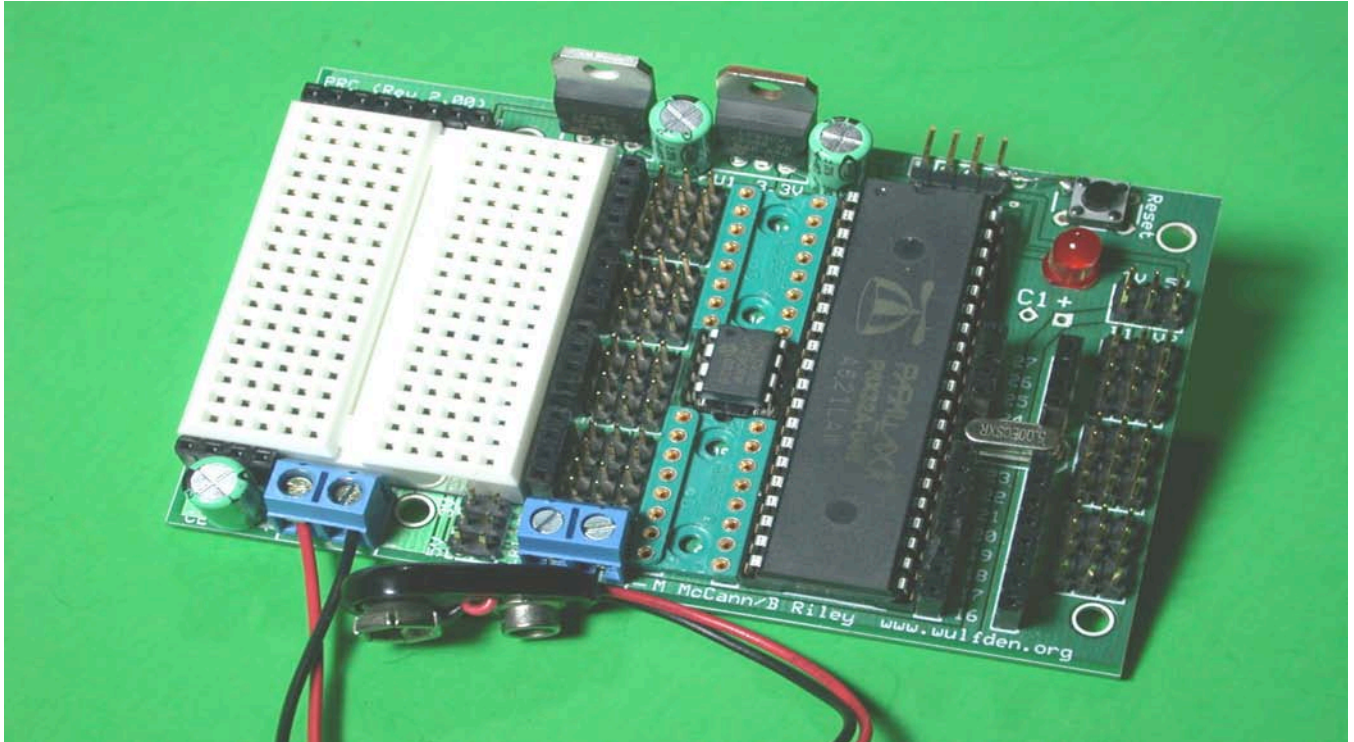


- 4.) Insert as shown and solder in place, do not solder US pin 4 yet!



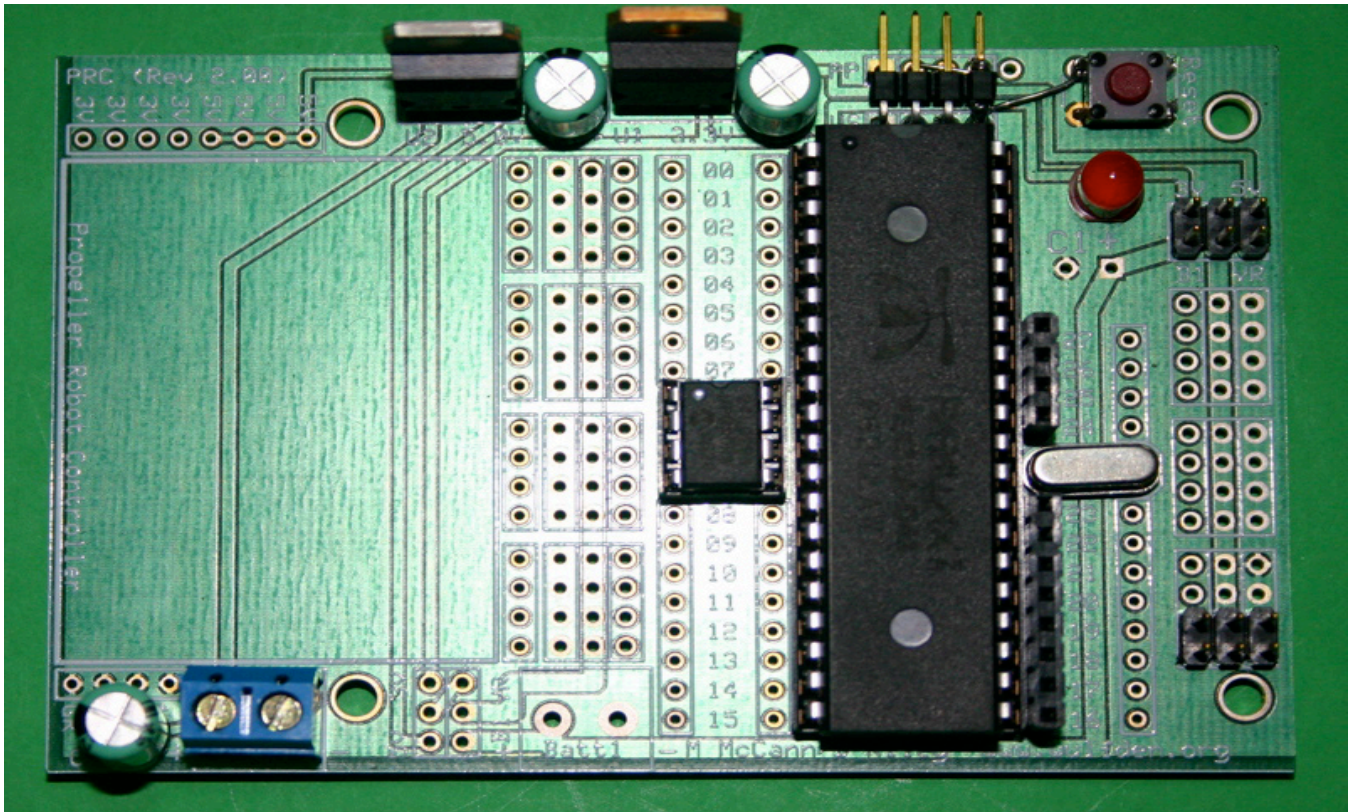
- 5.) Make a jumper from PP pin 2 to US pin 4 and solder both sides of board. You are done.





A fully populated PRC 2.00 Board shown above, except for C1 the 1000 uF capacitor, which will be bottom mounted. Use the silkscreen on top as a guide for getting the correct polarity for the electrolytic capacitor.

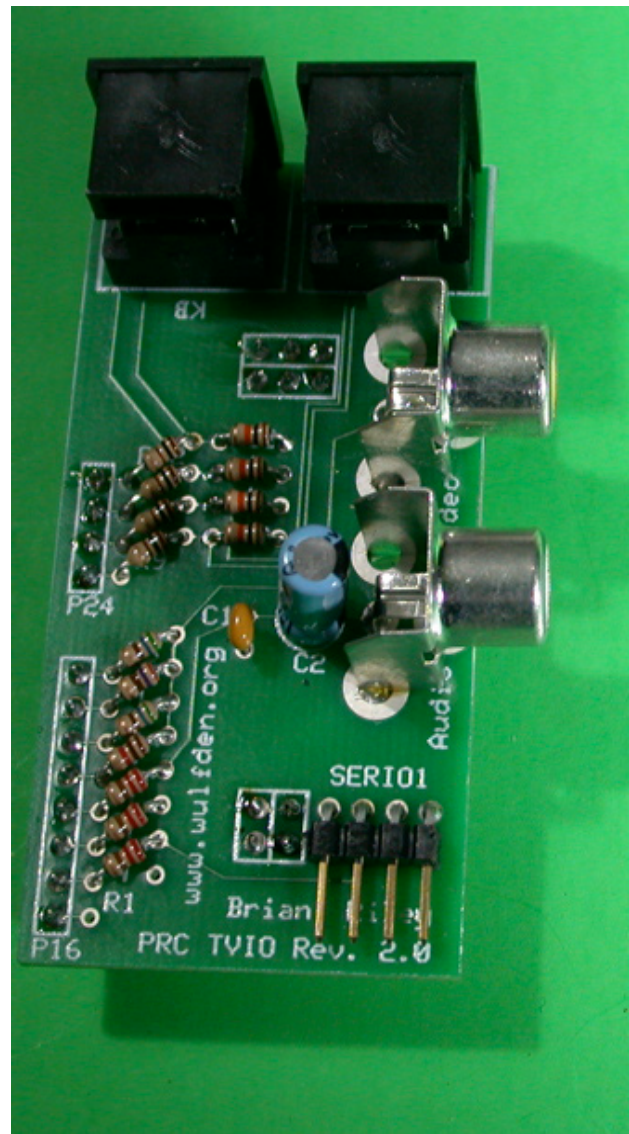
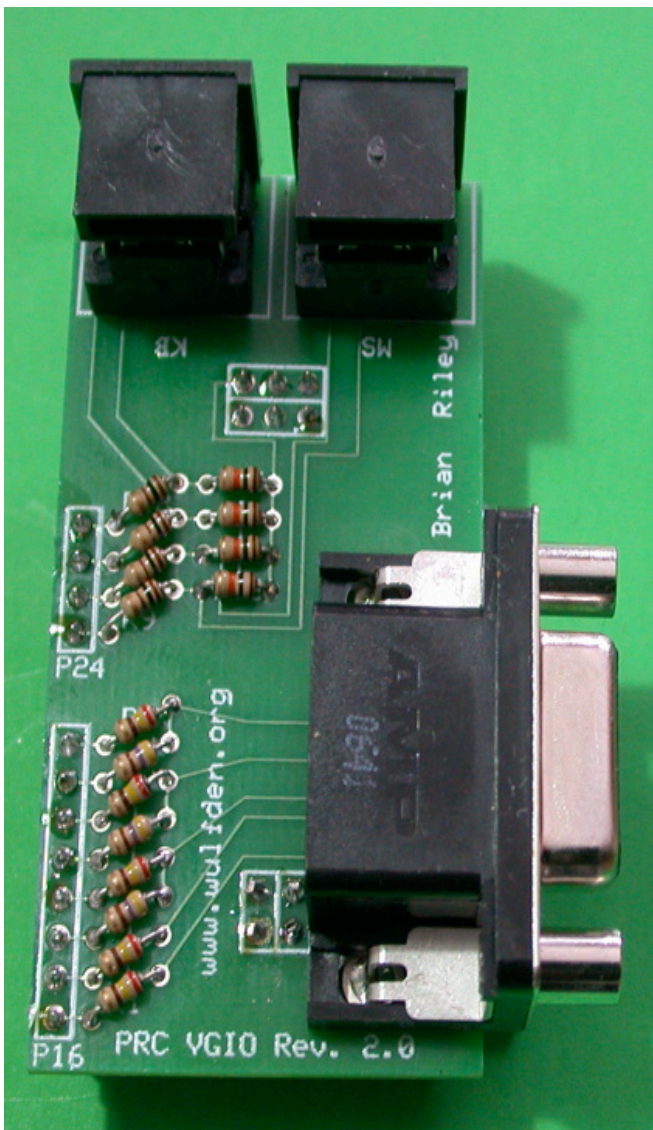
A minimally populated PRC 2.00 Board shown below. It is setup to use either of the PRC-I/O boards. All the power and CPU components (except C1 and BT1), J36, J38, the 2x3 for J16 and J17 and the 2x3 for JP2 and JP3. Remaining connectors and the breadboard on the left side are optional.

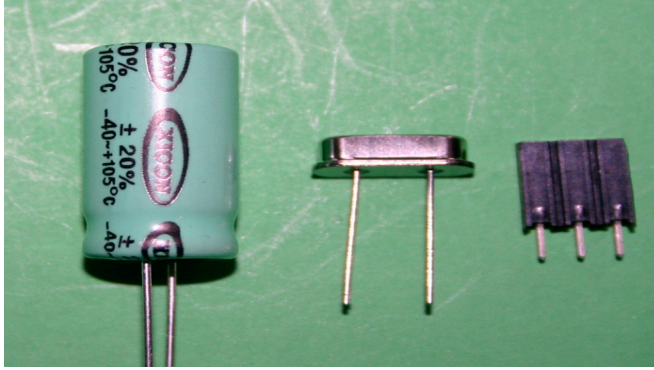


PRC-I/O Boards - Parts List

Component	PRC-VGIO	PRC-TVIO
R13-R16	10Kohms (brn-blk-org)	10 Kohms
R9-R12	100 ohms (brn-blk-brn)	100 ohms
R8	240 ohms (red-ylw-brn)	560 ohms (grn-blu-brn)
R7	470 ohms (ylw-prpl-brn)	270 ohms (red-prpl-brn)
R6	240 ohms	560 ohms
R5	470 ohms	1.1 Kohms (brn-brn-red)
R4	240 ohms	220 ohms (red-red-brn)
R3	470 ohms	220 ohms
R2	240 ohms	220 ohms
R1	240 ohms	220 ohms (optional)
C1	n/a	.1 uF
C2	n/a	10 uF

Port	PRC-VGIO
P26,P27	KeyBoard
P24,P25	Mouse
P16-P23	VGA
Port	PRC-TVIO
P26,P27	KeyBoard
P24,P25	Mouse
P20-P23	Composite Video
P19	Simple Audio
P17,P18	Serial Out/In
P16	unassigned





PRC102 Adapter Kit

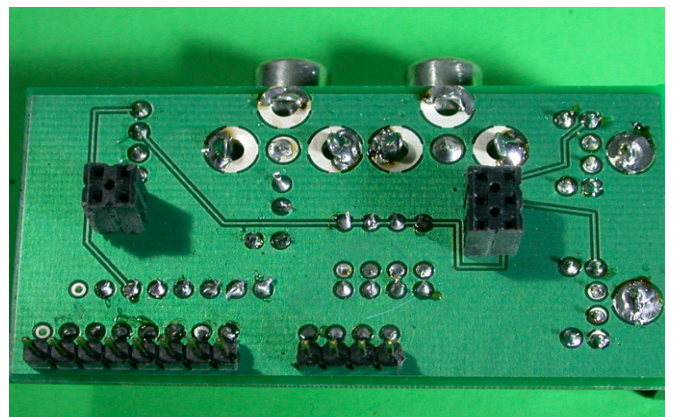
This kit consist of 3 type of componenets, a 1000 uF electrolytic capacitor, a 5 MHz low profile crystal, and 2 1x3 .100" spaced socket headers. This adaptation kit must be implemented in order to use the PRC-I/O boards with a Rev 1.02 PRC board.

The first two componenets are direct replacements for their counterparts on the PRC Rev 1.02 pcboard. This allows you a broader range of techniques in their removal since the original does not have to be recovered intact for re-use.

C1, the 1000 uF electrolytic cap is too tall and blocks the PRC-I/O boards. It must be removed and, if still desired to be used, inserted from the solder side of the board and bottom mounted. with longer leads and laid flat against the bottom of the board. A touch of hot-melt glue might be in rioder for added strength.

The original X1, the 5 MHZ crystal is in an HC-49/U which is also too tall. It is replaced with the same crystal value in an HC-49/US holder whihcis a much lower profile. It gets mounted back on the top component side.

The 1x3 socket headers are use on the PRC-I/O boards. Look at the picture to the right. Viewing the solder side of the PRC-I/O board (eithe one PRC-VGIO o PRC-TVIO) and holding it with the 12 pins (8 and 4) towards you, the 2x3 socket header on the right is to be replaced with the 1x3 socket header. The 1x3 goes into the right hand set of holes, leaving 3 holes empty. This substitution is made because the spacing of the two 1x3 pin headers for JP2 and JP3 on the PRC Rev 1.02 is not standard and the 2x3 will not mate to it. We are only using the 1st and 3rd pin of the set to the right anyway so this doesn't matter.



4 Programmer's Guide to the PRC

PRC-I/O Daughter Boards

The PRC-I/O boards were designed to emulate as close as possible, the Parallax Demo board with regards to Port Addressing.

PS2 Ports

The two PS2 Ports on each board are identical to each other and the Parallax Demo Board. That is to say, each port of each pair is identical to each other. except for addressing. On both the PRC-VGIO and the PRC-TVIO, one port is addressed via I/O pins P24 and P25 and the other via P26 and P27. Nominally, for sake of convenience, The P24/P25 is assigned to Mouse and P26/P27 is assigned to KeyBoard, they could easily be switched and the appropriate port numbers inserted as needed. When using the standard spin objects for the mouse and keyboard they would be invoked

```
mouse.start (24,25)
kb.start (26,27)
```

However there is no reason you could not switch the KB and mouse plugs and invoke

```
mouse.start (26,27)
kb.start (24,25)
```

VGA Port

The VGA port is also identical to the Parallax Demo board it uses eight (8) I/O pins P16 through P23. P16 is considered the *base pin*. the standard object for VGA would be invoked

```
vga.start (16)
```

Composite Video Port

This port does not conform to the Demo board, as it uses I/O pins in the 16-23 range. It uses four (4) I/O pins, starting at P20 through P23.

It is designated and invoked in one of two ways. The first, the most common, is the most difficult. Getting started it is best to take some working code and modify it. Look for a data table labeled *tvparams* the third long will be binary

DAT

```
tvparams    long    0    'status
            long    1    'enable
            long    %001_0101 ' Demo=001
            long    %010_0101 ' PRC=010
```

and specified as seven bits beginning with **001**. This would designate a composite video port beginning at P12. To shift it to P20, change the **001** to **010**, as shown in the code sample above. Note I leave both lines in place and comment out the one I don't want

The "tv_terminal" object however, uses the more conventional approach and would be invoked simply

```
tv_term.start (20)
```

Simple Audio Port

This is simply a standard series limiting resistor (220 ohms) and two capacitors to make a crude low pass filter on I/O pin P19. The output will be a bit weak, but readable. It is suggested the output be coupled to a high gain audio amplifier. It would be invoked, for example

```
voice.start (19)
```

Serial Port

The four pin right angle connector is configured to accept and Acroname Brainstem Serial Interface connector. The pins from left to right

Pin	Designation	I/O Pin
1	GND	
2	Serial Out	P18
3	+3.3vdc	
4	Serial In	P19

