

The Propeller Cookbook

Propeller Protoboard Experimenter Designs
For the Beginner V1.4

Release Oct 9, 2007

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Many projects in this book require .spin objects to make them work.
These objects are located at <http://obex.parallax.com>

Was this document useful?
This author accept donations to his coffee fund at paypal: jeffledger@gmail.com

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WARNING: Designs in this book involve soldering electronics components, and experimenting with low voltage electricity. It is possible to sustain minor injury, or damage electronics easily. This author is not responsible for fried electronics or injury to your dog as a result of your anger. You may proceed at your own risk.

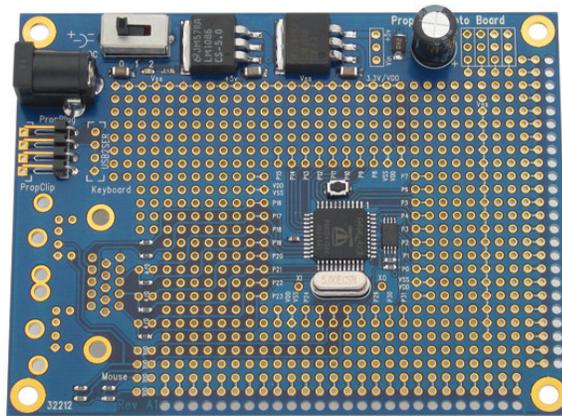
INTRODUCTION:

This book (in electronic form) is intended to be a getting started guide to the Parallax Propeller chip, specifically, the Protoboard product. You should have a basic understanding of electronics, as well as reasonable soldering skills. I'll assume that you've assembled some very basic projects in the past.

This author does not consider himself an expert on the Propeller, or electronics for that matter. Most of what I've learned, I've picked up from others, failed experiments, and bad electronics designs that hit the trash before too many people saw them. This book will share some of the successes I've had with Propeller, hopefully in a fashion that will allow the reader to duplicate it readily.

There's no feeling of accomplishment like that of making something yourself, and seeing it work. The Propeller offers a lot of cool stuff for those "instant gratification" types among you.

Now that I've introduced myself a little, let me introduce you to the guest of our little discussion, the Parallax Protoboard, a bargain for \$20. All of the requirements for power are already in place, waiting for you to connect a 6v-9v DC power supply to the unit, turn on the switch and start playing. The only real requirement is a connection for programming, which I recommend the investment in the Propplug from Parallax.



This text is all about upgrading the Propeller, so one of the first upgrades I'd recommend is purchase of the Protoboard Accessory kit from Parallax. This will provide you with VGA video out, as well as PS2 mouse and keyboard within a few minutes of soldering. I'll talk about a good method of installing this without losing design flexibility later on in this guide, so you may want to get that part on order, and read further before installing it.

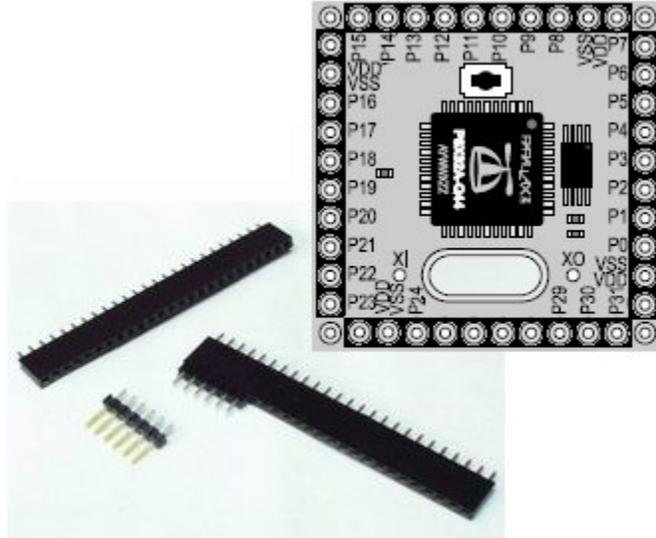
ADDING THE ABILITY TO EXPERIMENT

One of the first items I add to all my Protoboards, are 'Female Pin Headers'

These are an inexpensive way get your Propeller spinning in a variety of experiments, as you can quickly add/remove wires, or even small circuit boards. I purchased these from Sparkfun Electronics

Notice the Vdd/Vss connection at the end of each row? These are power and ground connections. I highly recommend pin headers for those positions as well.

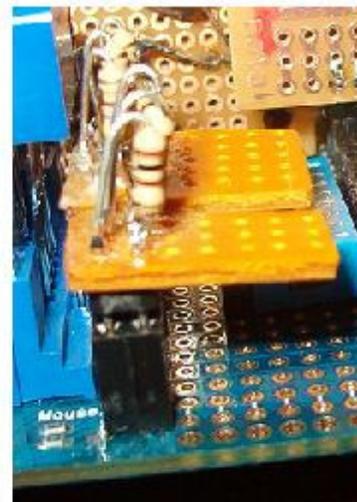
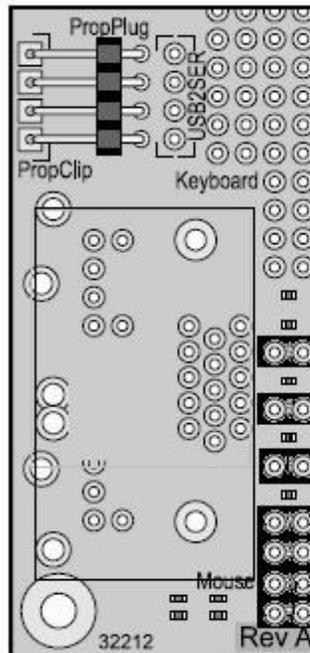
Vdd = +3v
Vss = Ground



ADDING VGA, PS2 MOUSE AND KEYBOARD

As mentioned early on, one of the easiest upgrades for the Protoboard is the addition of VGA header, PS2 mouse & keyboard connections. Parallax sells everything you need as the Protoboard Accessory kit.

I've made one big adjustment to the design of this upgrade. Giving the resistors the ability to be removed at will, freeing up all of the I/O pins for other projects. This is an important feature if you are going to build the reversible video card for compatibility with the "Hydra" product. (The Hydra used the same pins for composite video as are now used with the mouse & keyboard.) I built these in two removable sets, one for keyboard/mouse, the other for the VGA header.



THE REVERSABLE VIDEO CARD:

This may be the simplest video card design you've ever seen. In fact, I'm sure of it. This particular video card will give you compatibility with both the Demo board, and the Hydra

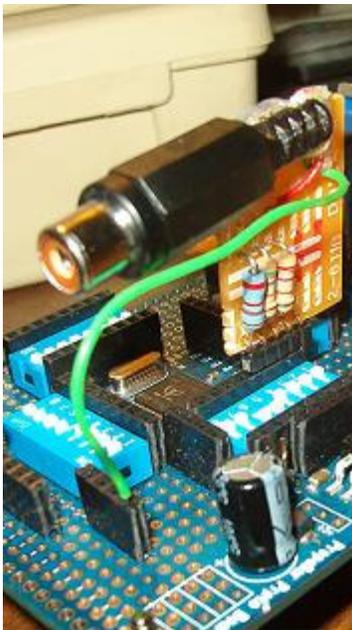
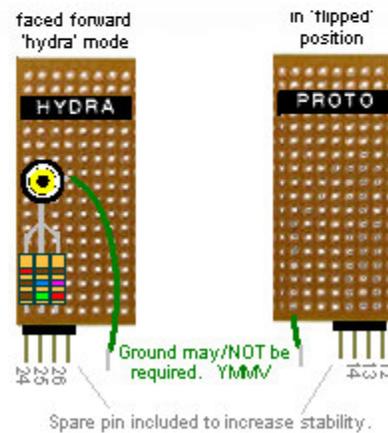
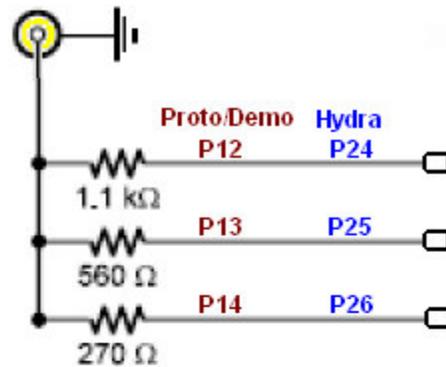
Note the pins used by Demo & popular Protoboard designs, and the Hydra to the right.

Simply unplug, and flip the board around to become compatible with either board design.

You will need to be able to remove the resistors from the mouse/keyboard connections. (as listed in the last page) Unplug them to prevent interference when using pins 24-26 for video.

Ingredients:

- 1 Female RCA jack
- 1 1.1k resistor
- 1 560ohm resistor
- 1 270ohm resistor
- 1 4pin male header
- 1 small piece of perfboard.



Thanks to the Propeller's ability to broadcast video, I've discovered that I don't need the ground wire. (YMMV "Your Mileage May Vary") You will want to do a little experimentation with your own setup.

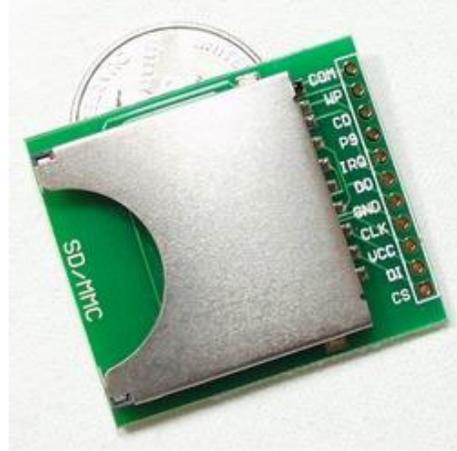
Also, If you insert a short piece of wire into the RCA jack, you should be able to pickup the signal on a television a short distance away.

Left: Author's own reversible video card.

STORAGE: ADDING AN SD SLOT

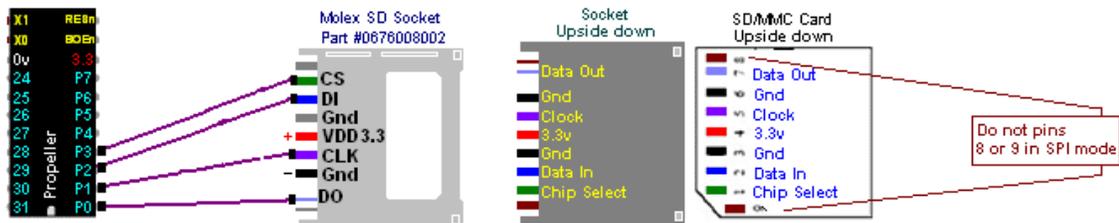
This is the upgrade that is a *must* for any Propeller experimenter. Virtually unlimited storage, (as far as the Propeller is concerned) in a small package.

There are two popular ways to go about this upgrade. Sparkfun Electronics sells the “SD Breakout Board” for about \$15. Its connections are well mapped and easy to solder to. They also carry the socket itself for around \$4. I’ve personally used both the Breakout board, as well as a couple free sample sockets from Molex with success.



You will need four connections from the Propeller to the SD socket, as well as +3v, and Ground. Many designs call for pull-down resistors to be used, which I’ve forgone without problems. ymmv.

(SD breakout from Sparkfun)



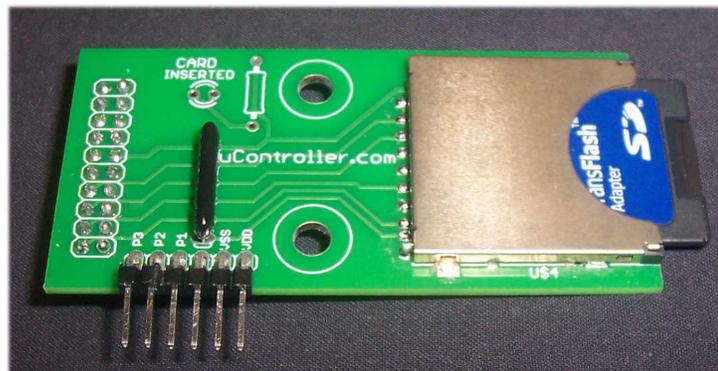
(Example connection using the Molex SD Socket)

The typical connection of the SD to the Propeller uses pins P0-P3. This creates some possible compatibility issues with Hydra, but by creating a removable board, much like the reversible video card, this can be overcome quickly.

If you are looking to cheat a little at this point, Brian at uController.com has created a ready-made SD board which will plug into our Protoboard design. If you’ve added the recommended female pin headers from the first chapter, you will be able to plug this little board in and take off. His \$12.99 price includes a little solder work for you, but the board arrives with the SD socket all ready attached.

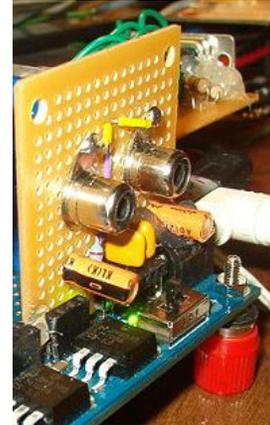
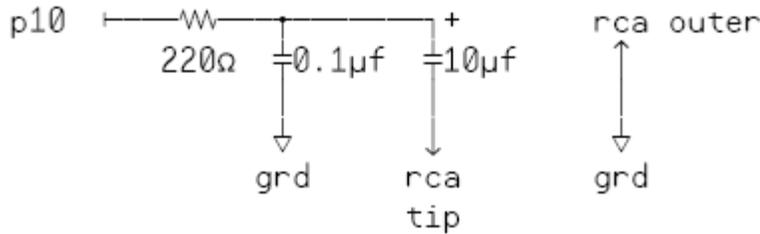
Notice the Vdd/Vss P0-P3 connections in the picture to the right?

[Source: uController.com]



MAKING NOISE: ADDING AUDIO

Ready to make a little noise? Propeller audio is quick and easy with just a few parts. The schematic for single channel audio looks like this:



Ingredients:

- 1 220ohm resistor
- 1 0.1uf ceramic cap
- 1 10uf electrolytic cap
- 1 Female RCA plug

There are several programs which take advantage of both P10 and P11 to generate stereo sound. Simply duplicate the design. (and double the parts list)

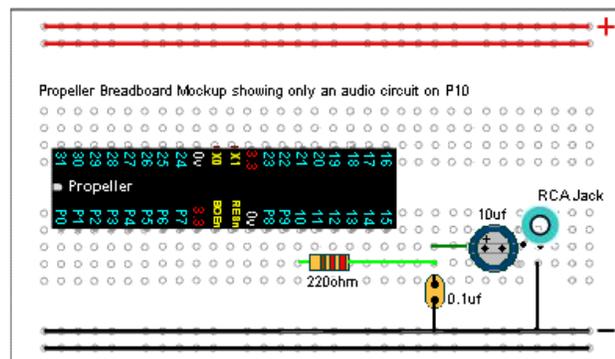
I've also added a couple switches that allow me to select between P11 and P7. The Hydra uses P7 for single channel audio output.

Recently, it was discovered by Rich on Propeller Forums that he could generate sound with a connection from P10 to a 220ohm resistor to the center of the RCA jack, skipping all the caps. The consensus was to keep the resistor for safety sake, but by all means, if all you have is a few parts... Don't forget the ground connection. Again.. ymmv.

[Want a ready-to-assemble kit for audio and video? Read ahead to pages 14-15.](#)

How is your schematic reading?

This text was written with the idea of introducing very simple add-ons, increasing the complexity as we go along. Compare the breadboard mockup with the schematic above.



FAT FINGERS: ADDING A SECOND RESET SWITCH

This is a Propeller Cookbook entry from Xander. (a.k.a. Mightor) The reset switch that sits in the middle of the Protoboard has two issues. First, once you load the board up with wires and plug-in boards, it can become buried beneath your project. Second, if you have fat fingers, (like the author) the thing can be a little intimidating to press as I'm reluctant to touch other more static sensitive parts nearby. Mightor's solution of a second switch is a great idea.

Most of us are using the 4 Prop plug lines that extend off the board near the power connector, leaving the USB2SER untouched. An 'N/O' (normally open) switch across pins 1 and 4 of the USB2SER connector provides a quick secondary reset switch.

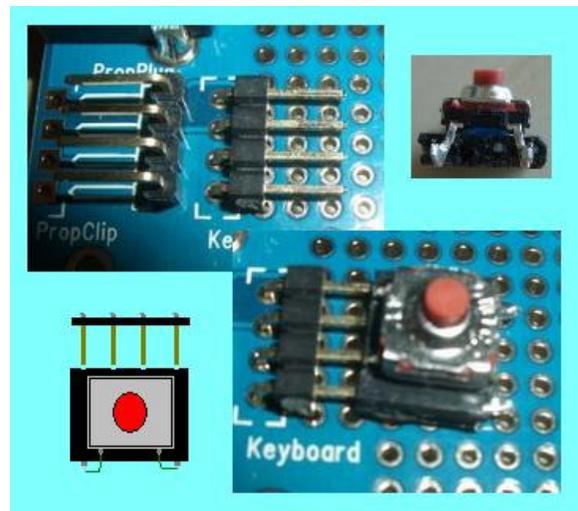
Ingredients for Mightor's solution:

- 1 4 pin male header
- 1 4 pin female header
- 1 small 'n/o' contact switch

Two important notes:

First of all, the PropPlug and the USB2SER lines are wired different.

Second, you will want to extract the Two center pins from the female header to prevent possible short circuits.
(see pic in upper right corner)



Recycling Tip:

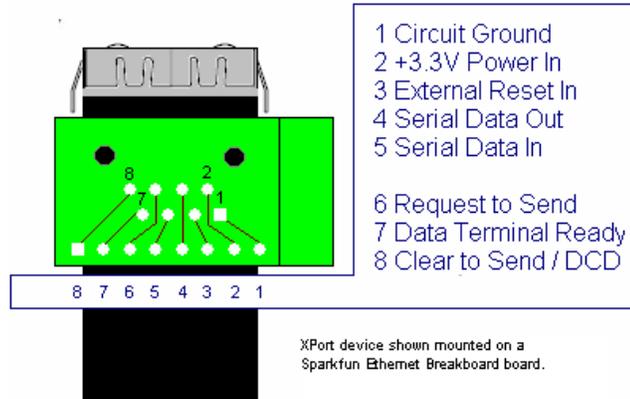


I'm a PC repair technician by day. My own version of this reset switch was to pull the reset switch and 4pin speaker connector from an old computer case. With a little patient modification, replace the 2pin connector on the reset switch with the 4pin connector from the speaker, and voila! Instant Protoboard compatible reset that you can now place anywhere.

ALL THIS AND INTERNET TOO: XPORT & PROPNIC

One of the most expensive add-ons I've purchased for my Protoboard is the Xport from Lantronix. This \$100 device is essentially a UDS10/100 built into a single Ethernet connector. It interconnects between a serial connection (to the Propeller) and an Ethernet connection. Recently, Uncommon projects built something called yBox TV, which is a Propeller based device that connects between the Internet and your TV. There is source code to do everything from display time/weather to displaying images from the Internet on your Prop. yBox is simple to duplicate if you have an Xport handy.

Since I tend to breadboard projects like this one, I purchased an Ethernet breakout connector from Sparkfun. This board fits the Xport, allowing you to solder a male pin header for easy experimenter access. (Be aware of the possibility of shorting the top of the pin header against the Xport casing when building this project)

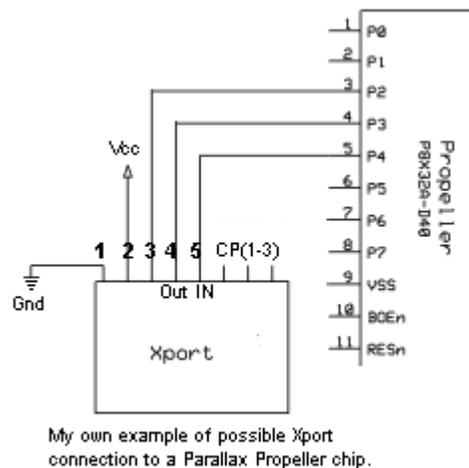


<http://www.yBox.com>

A few things to note: First of all, the Xport draws a lot of current, about 200ma. This is more than your entire Protoboard does with all the other add-ons I've mentioned. You may want to heatsink the voltage regulators on your Protoboard if you intend to use this long-term. Also, the documentation for Xport recommends that it be attached to an inch of copper. (on the perf board) The Sparkfun ethernet breakout isn't designed with extra copper, so a heatsink on the Xport might not be a bad idea either. In spite of a little heat, I had no problems with the unit being hooked up for a couple hours without issue.

Update: A New Propeller Ethernet Option

Recently, Brian at uController released PropNIC, an Ethernet card compatible with both a male pin header, as well as a SpinStudio connector. This card is very reasonably priced at \$34.99. It can be assembled in about an hour.



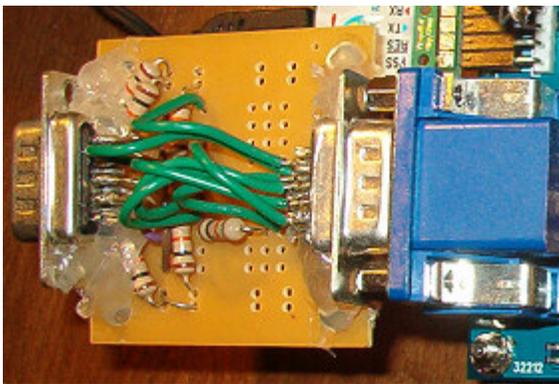
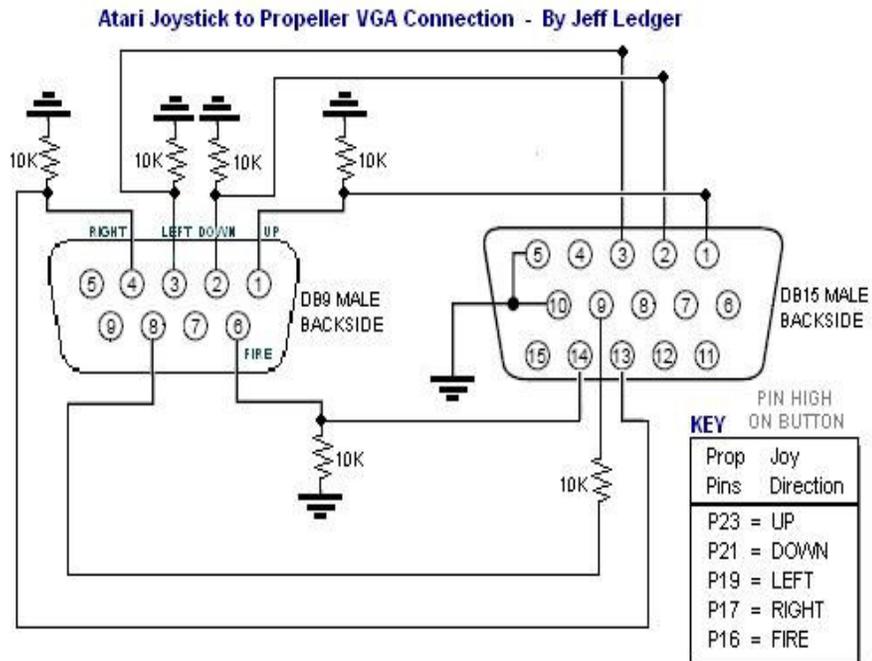
OH THE JOY: ADDING AN ATARI JOYSTICK

When I first started adding parts to my own Protoboard, I wanted to find solutions that could also be replicated by Demo board owners. The Demo board is very much like a completed Protoboard. It has VGA, mouse, keyboard, video, sound, and microphone out of the box. The catch is that only a limited number of I/O lines are made available to the user, as they are hardwired to everything else. I came up with a method of using the VGA connection as an input device for an Atari joystick.

Ingredients:

- 6 10k resistors
- 1 db9 male connector
- 1 db15 male connector
- 1 small perf board

Important Note: Do **not** skip the resistor on VGA pin 9. It operates to reduce 5v to 3v to the Propeller. The others are simple switch pull-downs.



Left: My VGA to Atari Joystick Adapter. (yes, I love hot glue...)

Did you know that Joysticks from the Atari, VIC20, Commodore 64/128, and Amiga are all wired the same? Now they can be used with your Protoboard! There is an object in the 'Object Exchange' that includes a gameport_drv as well as drop-in code to make many Hydra games compatible.

RATHER PUSH BUTTONS? NES CONTROLLER FOR YOUR PROTOBOARD

Prefer buttons over a joystick? The NES controller is another great add-on that is fairly well documented, if you know where to look. Andre' LaMothe has written a great book, called "[Game Programming for the Propeller Powered Hydra.](#)" On the surface this book appears to be for another product, but the real power behind Hydra is the Propeller chip. The same chip you have on your Protoboard. This book/CD is worth the purchase to anyone working with any Propeller based product. Sneak peeks are offered on its information page on Parallax.com including the entirety of chapter 6 which talks all about the NES controller. (http://www.parallax.com/propeller/detail.asp?product_id=70360)

I recommend grabbing a copy of that .pdf from the website, and reading it a couple times. It is a wealth of information. I'll sum up the important bits for those who want to experiment with NES controllers on their Protoboard.

I managed to locate an Ebay vendor who carried NES repair parts for the purchase of a couple 'Controller Connector P1' ports pulled from a Nintendo System. An Ebay search for "Nes Repair Parts" should yield you what you need, otherwise prepare to cut off the end of the connector and use the following connections:



P3 → NES CLK 'clock'	Red
P4 → NES SH/LD 'latch'	Orange
P5 → NES A OUT 'data'	Yellow
3.3v → Power	White
Gnd → Ground	Brown



If you are patient enough to locate those controller ports, you will find that the color scheme is exactly the same.
(*I really miss 80's electronics design.*)

Important Note: I've verified (a least with the controllers I have) that the color code used by actual Nintendo controllers is accurate. Andre' warns that this may not be the case with other brands of compatible controllers. Crack them open and check first.



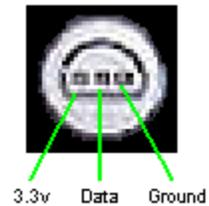
Anyone want to collaborate on some .spin code for the Nintendo Zapper?
(Btw, It uses pins 4 & 6)

CONTROLS DE'JOUR WITH 1 DATA LINE: THE N64 CONTROLLER



One of the finest, yet at present overlooked game controllers for the Propeller has got to be the Nintendo 64 controller. In exchange for 1 Propeller pin, you get 14 buttons, and an X/Y axis joystick controller. Add the required Vss/Vdd connections and you'll have more game controls than you'll ever use.

Unless you plan to snip the end off an N64 controller, obtaining the female receptacle is a good news, bad news situation. The bad news is that they are soldered to the main-board of the N64. The good news is that once you've broken the unit down to the PCB, there are two sets of connectors available. (Perhaps we should start a parts exchange.) It's likely that you'll only use a single connector, perhaps even just one side. As always Ebay is a great source for parts. (A.K.A. cheap Nintendo 64 pieces.)



Once you've extracted the two N64 controller ports, (two on each connector) you'll find the connection posts are a little too big to fit directly into standard perf-board holes. I had to bore the holes out a little with a small drill bit, so a piece of plain perforated breadboard will be perfect for this project.



There is mention of using a 10k resistor, but I had no problems simply connecting the 'data' pin directly to the Propeller. P4 is a good choice as it is the next remaining pin (*originally used for NES on the Hydra*) after the SD interface is attached.

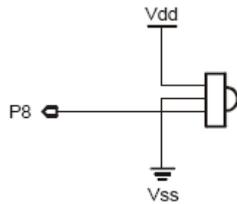
Now all we need is a new version of 'gamepad_drv_001' for the Nintendo 64 controller for rapid conversion of games created using the NES controller driver.

Trivia Break:

*Did you know they released a dance pad for the N64 in Japan?
Dance Dance Revolution*

PROPELLER VISION: ADDING AN IR SENSOR

An Infrared sensor is another one-pin-wonder. Combined with an inexpensive all-in-one remote for your local discount store, the Propeller becomes compatible with every couch potato.



Here are the ingredients:

- 1 Infrared Receiver (Parallax# 350-00017)
- 1 Cheap multi-brand programmable remote

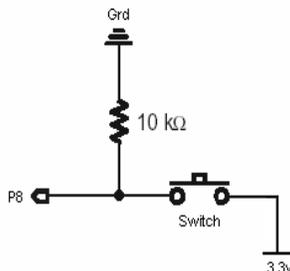


There is very good support for Sony compatible codes in the Object Exchange.

PUSHBUTTON DETECTION: ADDING A SIMPLE SWITCH

In an earlier article, we connected an Atari joystick to several connections on the Propeller via the VGA connector. In truth an Atari joystick is a set of five switches.

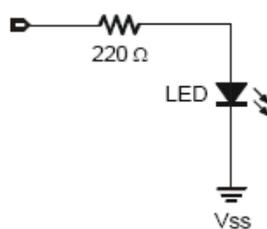
Here's a schematic for adding a single switch to a Prop-pin:



The 10k ohm resistor is acting as debounce, don't skip it as you *will* notice the difference.

LET THERE BE LIGHT: CONNECTING AN LED

While we are talking about some of the basics, it wouldn't be fair to skip the LED.

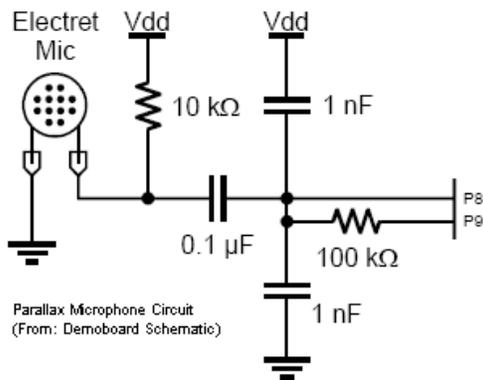


The 220k ohm resistor (or something close) prevents the LED from burning out due to over power. Don't skip it.

Have you figured out which end of the LED is negative? The shorter pin is the Cathode pin, which hooks to ground.

Memory Trick: Negative == Shorter Pin

CAN YOU HEAR ME NOW? ADD A MICROPHONE



Left: This is the schematic for the microphone as designed for the Parallax Demo board.

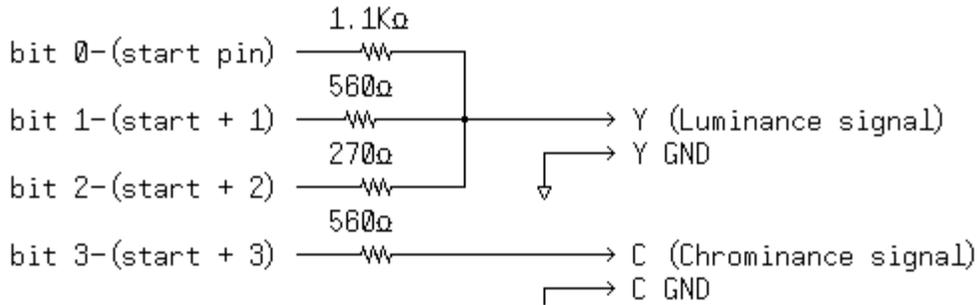
Ingredients:

- 1 10k ohm resistor
- 2 1nf capacitor
- 1 0.1uf capacitor
- 1 100k ohm resistor
- 1 Electret Mic

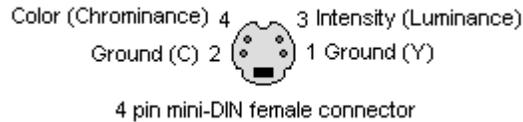
VIDEO REVISITED: ADDING S-VIDEO OUTPUT

Michael (A.K.A. RinksCustoms) has done some work on adding S-VIDEO out, including some .spin code at (<http://forums.parallax.com/forums/default.aspx?f=25&m=205283>)

Here's his schematic:



You'll want the plug configuration as well:



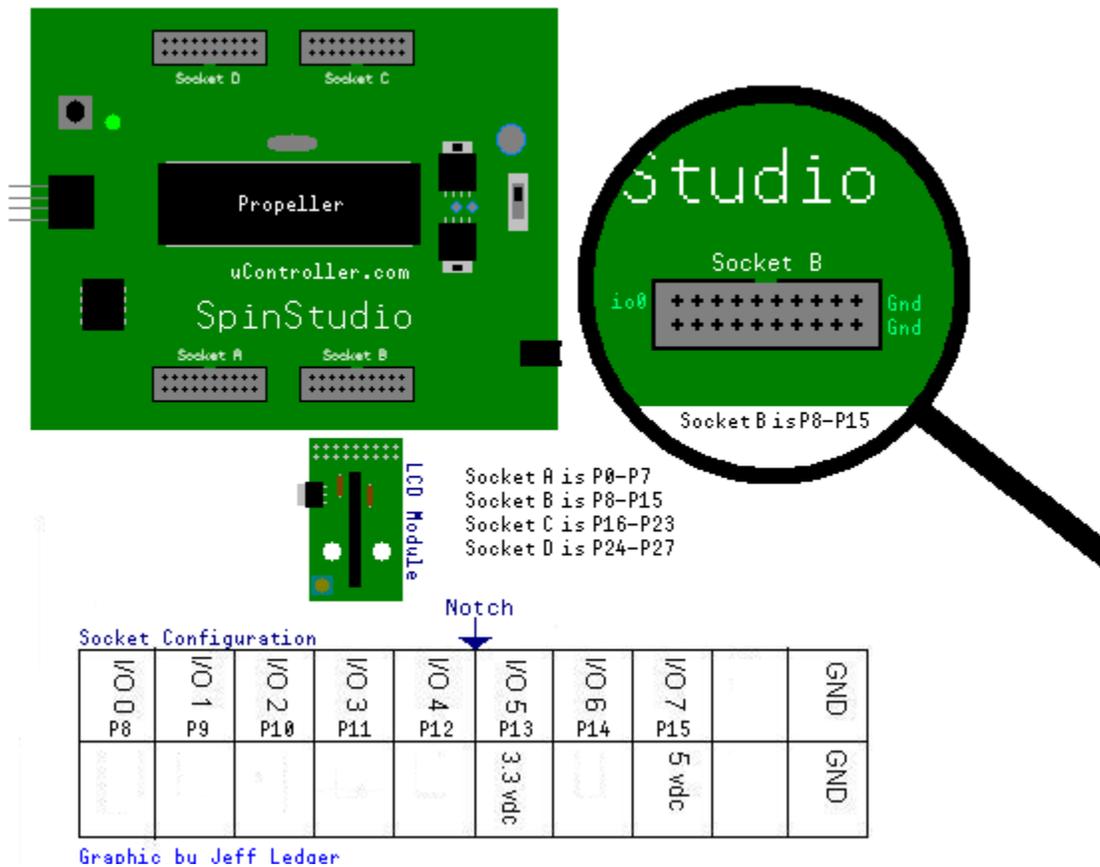
REINVENTING THE WHEEL: ADAPTING CARDS FROM SPINSTUDIO:

As mentioned earlier, Brian at uController.com has created a clever method of interfacing to the Propeller chip, called ‘SpinStudio’. His theory is that by creating the add-on cards as pluggable modules, nothing will be wasted when the next Propeller chip arrives. Simply plug the modules into a new board.

We have already looked at his adaptable SD card which fits both SpinStudio as well as the Protoboard pin configuration. This time we’ll take it a step further.

SpinStudio is broken into Sockets, A-D. Each socket has eight of the Propeller’s I/O pins, 3v and 5v, Ground, as well as access to few other nifty pins. As Protoboard owners, we’re interested in Socket B. By replicating Socket B, we have access to many of Brian’s other add-on cards: The Video/Audio board, the LCD module, the Servo module, and recently even an Ethernet Card!

Since a picture is worth a thousand words, so let’s take a closer look at Socket B.



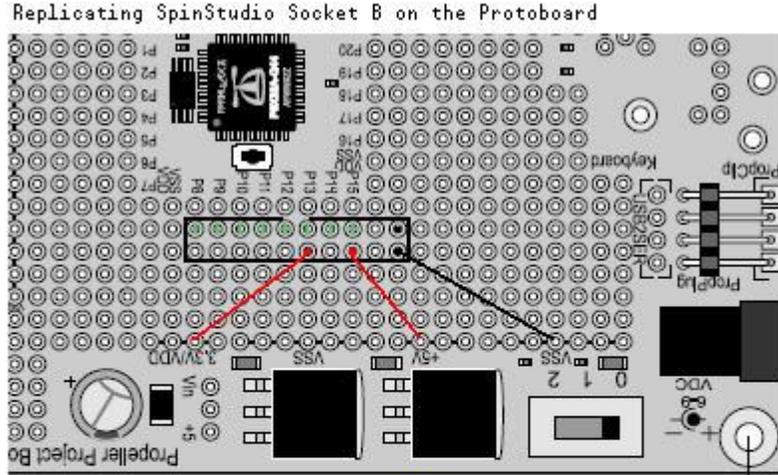
Note the ‘Notch’ under the words ‘Socket B’ on the SpinStudio board. Thanks Brian!

ADAPTING CARDS FROM SPINSTUDIO: CONTINUED...

At first glance, replicating Socket B appears to be a lot of work, but let's compare Brian's layout with the actual Protoboard configuration.

The Protoboard duplicates its I/O pins, so we can leave space for a female pin header next to the cpu.

Notice all the I/O fall out just perfectly? You'll need to connect the 5v, 3v, and Gnd. Use a double row 20pin male pin header.



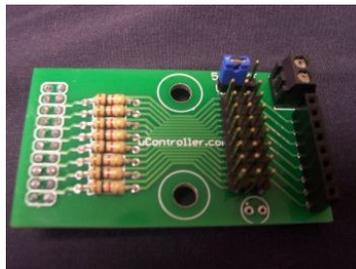
I've left out connections for SCL/SDA connections for now. We'll revisit some enhancements to this socket (add a few lines later.)

Socket Configuration								
I/O 0	I/O 1	I/O 2	I/O 3	I/O 4	I/O 5	I/O 6	I/O 7	GND
P8	P9	P10	P11	P12	P13	P14	P15	
					3.3 vdc		5 vdc	GND

So what did this get us? Look at these beauties you can get from uController.com that now work on your Protoboard! At \$11.99 a piece, your Protoboard will be top notch.



Two channel audio/video



Servo/IO board



LCD Module

These kits require assembly, but are perfect mini-projects for beginners.

(Special Note: The LCD Module will require an extra female pin header to be inserted between the Protoboard and the module to raise the LCD above the height of the Parallax VGA/PS2 Accessories kit. See uController.com for details.)

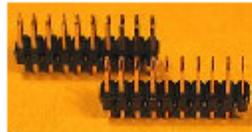
“I THINK I'M A CLONE NOW” - TURN PROTOBOARD INTO SPINSTUDIO:

At this point we've replicated SpinStudio socket B. Let's take it one step further and see what would happen if we include the other three sockets on an empty ProtoBoard.

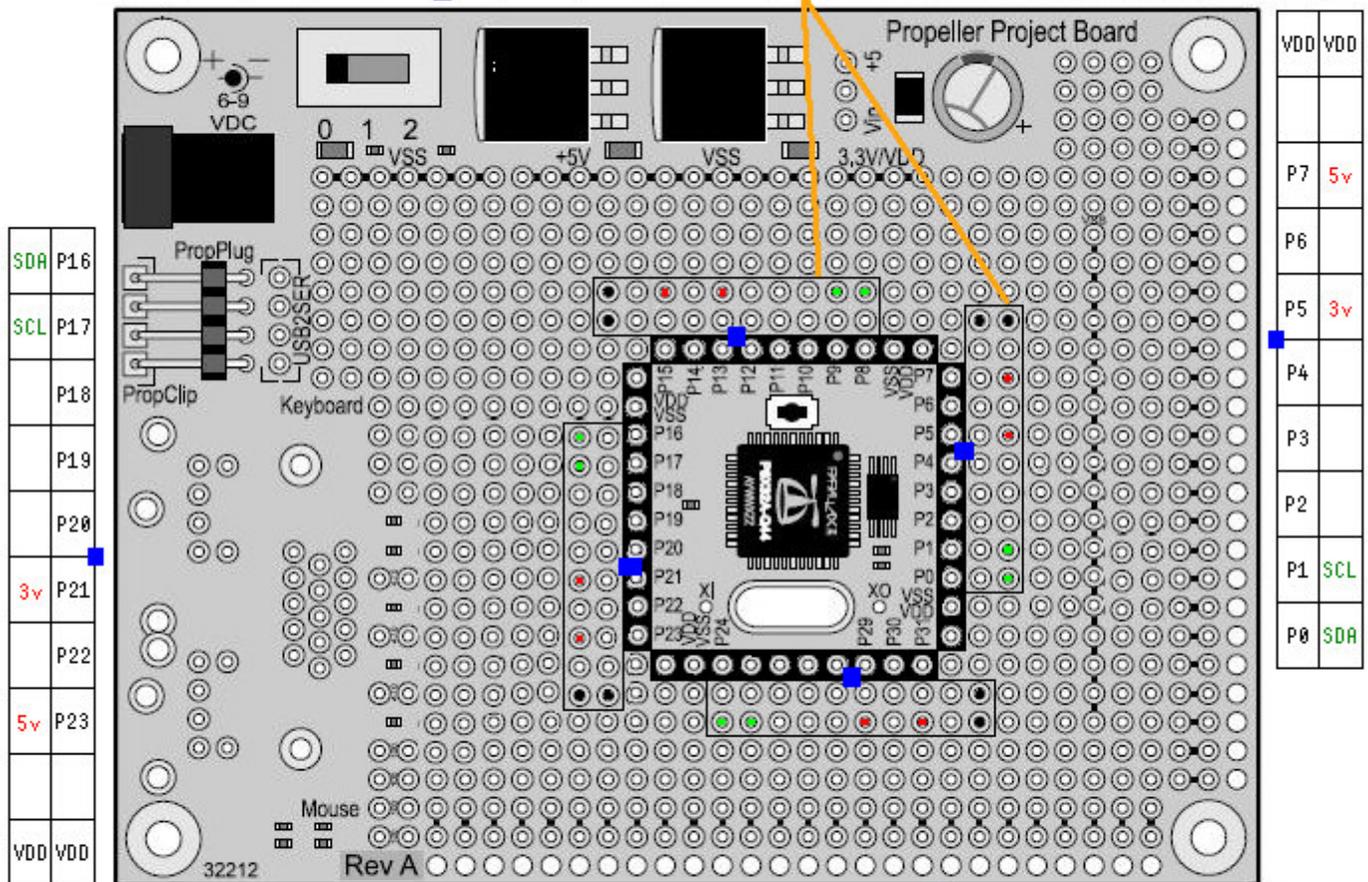
The next illustration includes both female pin headers next to the Propeller chip, as well as SpinStudio sockets A-D. All I/O pins line up perfectly, requiring only Vss/Vdd connections to be soldered. SCL & SDA pins are optional depending on which SpinStudio cards you are intending to use.

Propeller ProtoBoard to SpinStudio Conversion by Jeff Ledger

VDD		5v		3v				SCL	SDA
VDD		P15	P14	P13	P12	P11	P10	P9	P8



Male pin headers are recommended as they will leave room for a female header next to the Propeller.



SDA	P16
SCL	P17
	P18
	P19
	P20
3v	P21
	P22
5v	P23
VDD	VDD

VDD	VDD
P7	5v
P6	
P5	3v
P4	
P3	
P2	
P1	SCL
P0	SDA

KEY

- = Notch
- SDA = P29
- SCL = P28

Image above shows placement of both male pin headers and female headers next to the cpu.

SDA/SCL may be optional depending on what SpinStudio cards you are planning to use.

P24	P25	P26	P27	P28	P29	P30	P31		VDD
SDA	SCL				3v		5v		VDD

In this configuration, all I/O pins line up correctly, requiring only Vdd & Vss

Note: You may want to skip the “Accessories Kit” from Parallax with this design.

“BATTLEZOWNED” - ADDING HYDRA-NET TO THE PROTOBOARD

Among the many cool features of the Hydra, it also has a type of simple communications interface for the purpose of connecting one Hydra to another. Recently, a game called BattlezOwned (A simple two player Battlezone clone) was designed to take advantage of this feature. Have you got a couple Propeller boards handy? Add Hydra-Net ports.

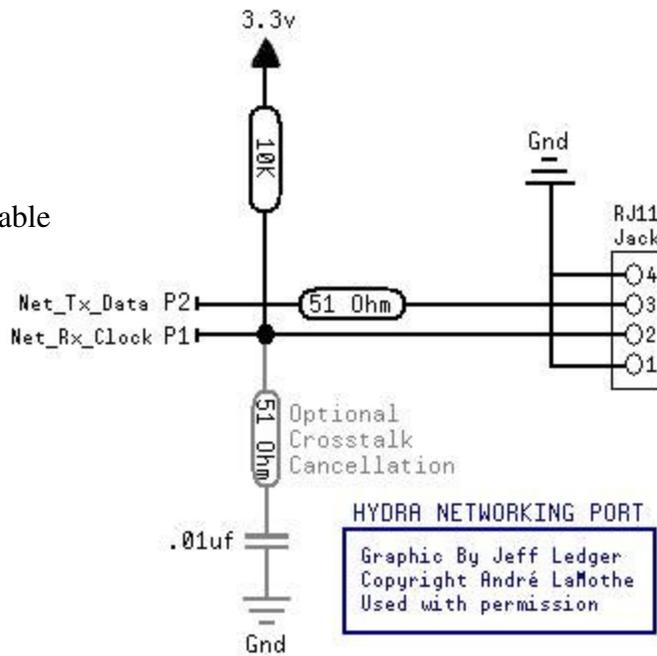
You will need an RJ11 Crossover Cable. (pins 2 & 3 cross)

Note: The “Crosstalk Cancellation” section is optional.
The Hydra used a simple switch/jumper to activate this circuit.

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Ingredients:

- 1 – 10K Resistor
- 2 – 51ohm resistors
- 1 - .01uf cap.
- 1 – RJ11 Jack
- 1 – RJ11 Crossover cable



The Propeller I/O Comparison Chart: *(used with permission)*
 Created by: George K. Herzog

<i>P in Number</i>	Propeller Proto Board – 5Mhz	Propeller Demo Board – 5Mhz	Hydra Gamer Board – 10Mhz	PropRPM Board – 5Mhz
P0	available	available	LED for Debug	available
P1	available	available	HYDRA Net	available
P2	available	available	HYDRA Net	available
P3	available	available	NES cntllr - CLK	available
P4	available	available	NES cntllr – SH/LD	available
P5	available	available	NES cntllr – A OUT	available
P6	available	available	NES cntllr – B OUT	available
P7	available	available	AUDIO Mono	available
P8	available	MIKE	MOUSE A	available
P9	available	MIKE	MOUSE A	available
P10	available	AUDIO stereo	MOUSE B	available
P11	available	AUDIO stereo	MOUSE B	available
P12	available	NTSC/PAL video	KEYBOARD A	NTSC/PAL video
P13	available	NTSC/PAL video	KEYBOARD A	NTSC/PAL video
P14	available	NTSC/PAL video	KEYBOARD B	NTSC/PAL video
P15	available	NTSC/PAL video	KEYBOARD B	NTSC/PAL video
P16	VGA video	VGA video	VGA video / Card I/O	LED 0
P17	VGA video	VGA video	VGA video / Card I/O	LED 1
P18	VGA video	VGA video	VGA video / Card I/O	LED 2
P19	VGA video	VGA video	VGA video / Card I/O	LED 3
P20	VGA video	VGA video	VGA video / Card I/O	LED 4
P21	VGA video	VGA video	VGA video / Card I/O	LED 5
P22	VGA video	VGA video	VGA video / Card I/O	LED 6
P23	VGA video	VGA video	VGA video / Card I/O	LED 7
P24	MOUSE	MOUSE	NTSC/PAL video	LED 8
P25	MOUSE	MOUSE	NTSC/PAL video	LED 9
P26	KEYBOARD	KEYBOARD	NTSC/PAL video	available
P27	KEYBOARD	KEYBOARD	NTSC/PAL video	available
P28 [system]	EEPROM clock	EEPROM clock	EEPROM clock	EEPROM clock
P29 [system]	EEPROM data	EEPROM data	EEPROM data	EEPROM data
P30 [system]	Primary Serial I/O Rx#	Primary Serial I/O Rx	Primary Serial I/O Rx	Primary Serial I/O Rx*
P31 [system]	Primary Serial I/O Tx#	Primary Serial I/O Tx	Primary Serial I/O Tx	Primary Serial I/O Tx*

General Note: Comparison with the Spin Stamp NOT provided. Power supplies vary in configuration.

Note #: Propeller Proto Board requires additional serial interface for SPIN programming. Access to all I/O pins, P0-P31.

Note *: PropRPM has an on-board RS-232 level shifter for programming and communications. Access to I/O pins P0-P27 and uses the 40pin DIP Propeller which can be easily replaced.