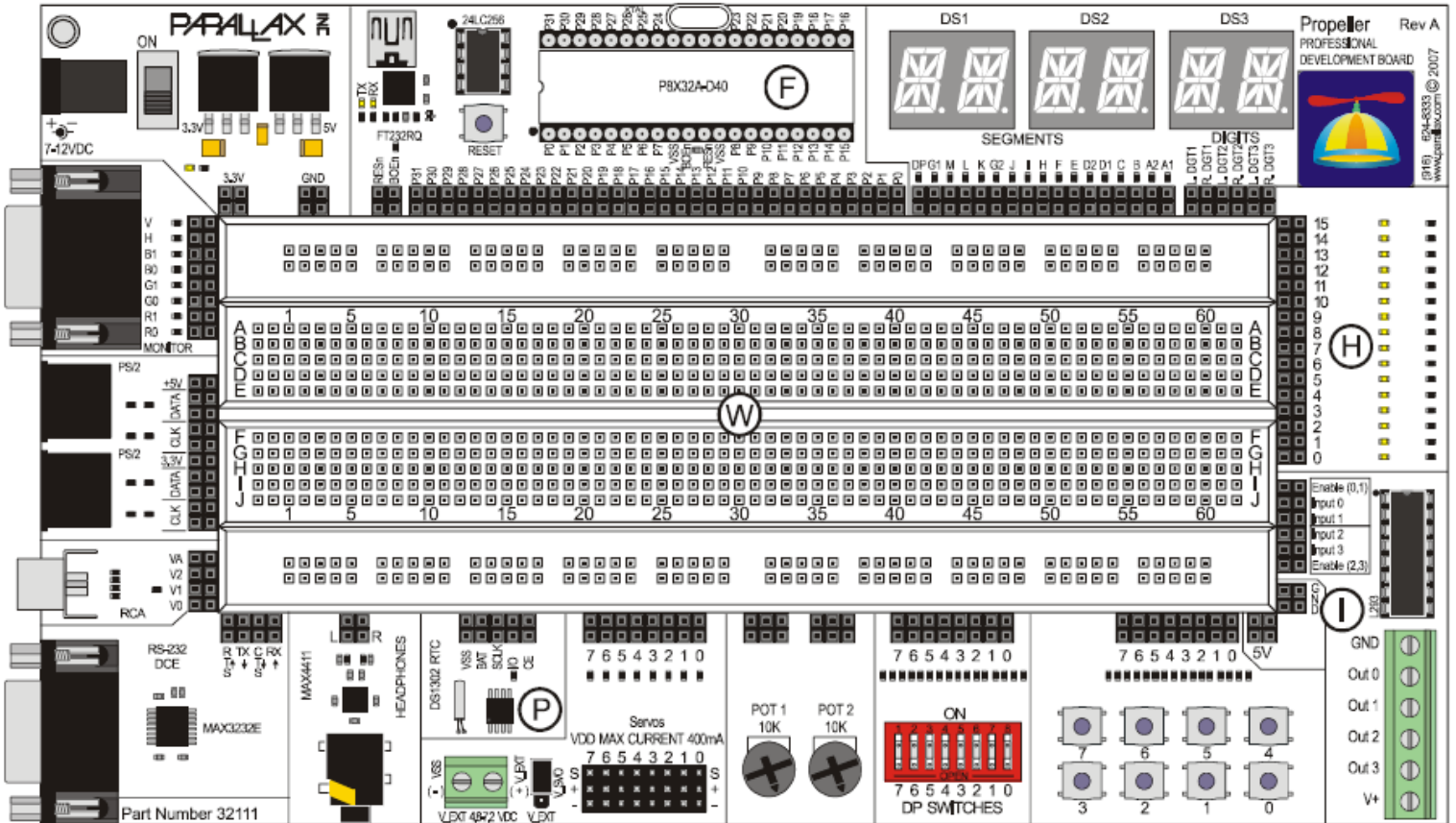


The PPDB

Parallax's Propeller Professional Development Board



By
Jorge Joaquin Pareja

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About This Article

This article is written for all the Propeller Professional Development Board (throughout the remainder of the book this will be referred to as the PPDB) users out there in the world that do not necessarily have one of the other propeller platforms available.

Many of the projects on OBEX and Parallax's Forums are made for use on a specific platform and not the PPDB, this manual will guide you to mimic those platforms and projects using the PPDB. Some of the platforms will require additional components that are not available on the PPDB.

About the Author

The author of this article, Jorge Joaquin Pareja, is an electronics and programming hobbyist, making projects and programs mainly for personal enjoyment. When I see that a project or program can be useful to someone other than myself, I release it either in binary or source form.

My website, <http://WhatsAvailable.org> came about during a non public beta test of what is now <http://www.OfficeLive.com> that is intended for Small Business's wishing to maintain an online presence free of charge. This service is available thanks to Microsoft. In return for the testing, Microsoft gave me that website free of charge for life, including domain registration, So thank you Microsoft and the developers of OfficeLive.com.

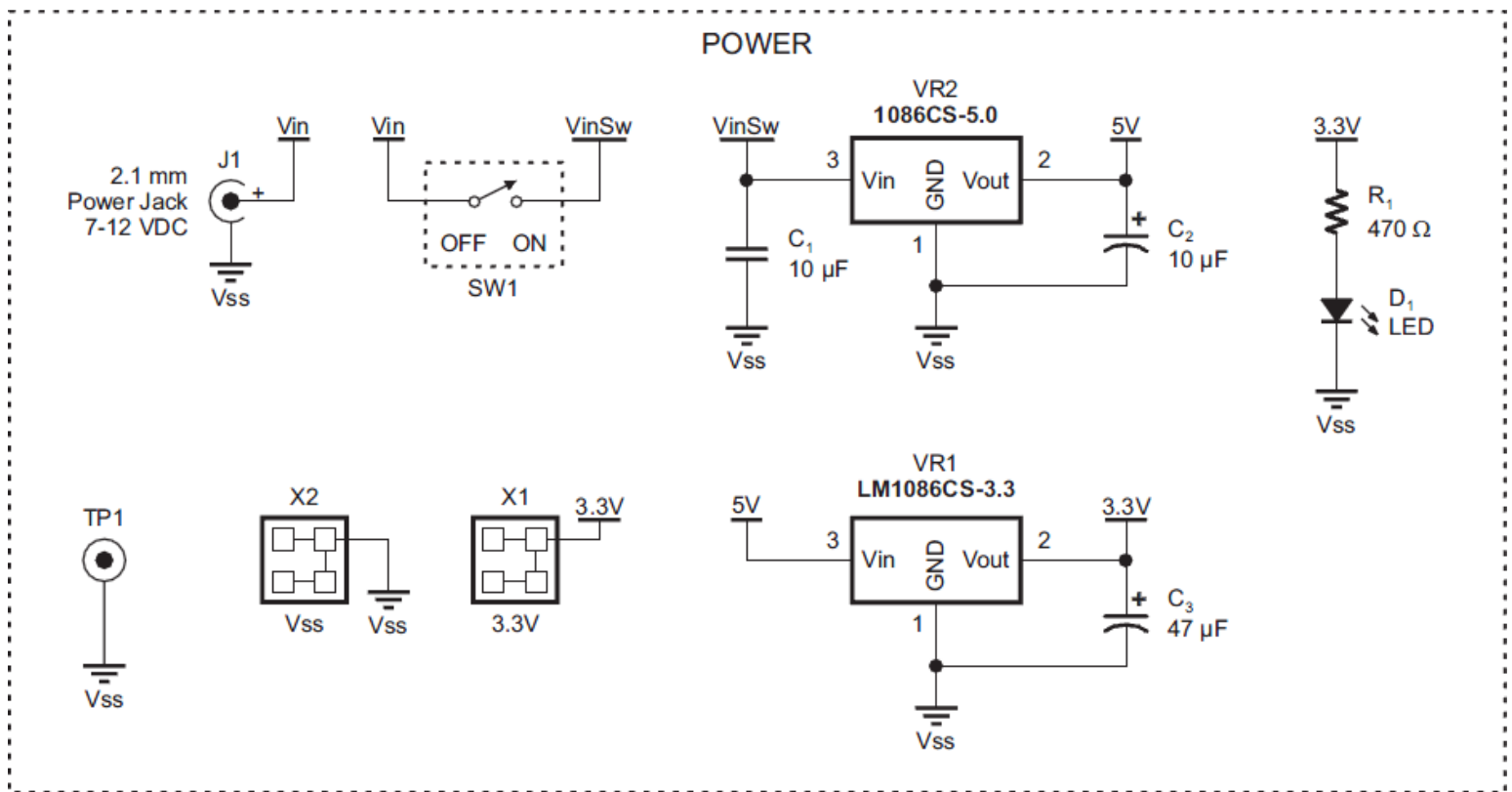
The PPDB

During the past two years I have used the Propeller, I have not found many projects made specifically for the PPDB. Most are for platforms like the Demo Board, Proto Board, and Gadget Gangsters Propeller Platform to name a few. Several of the various platforms schematics are released under OSHW, Open Source Hardware.

“Open source hardware is hardware whose design is made publicly available so that anyone can study, modify, distribute, make, and sell the design or hardware based on that design.” This gives us a lot of freedom to Mimic a specific platform on the PPDB so we can learn how other Propeller based platforms work. The PPDB can mimic most of them with little or no additional components.

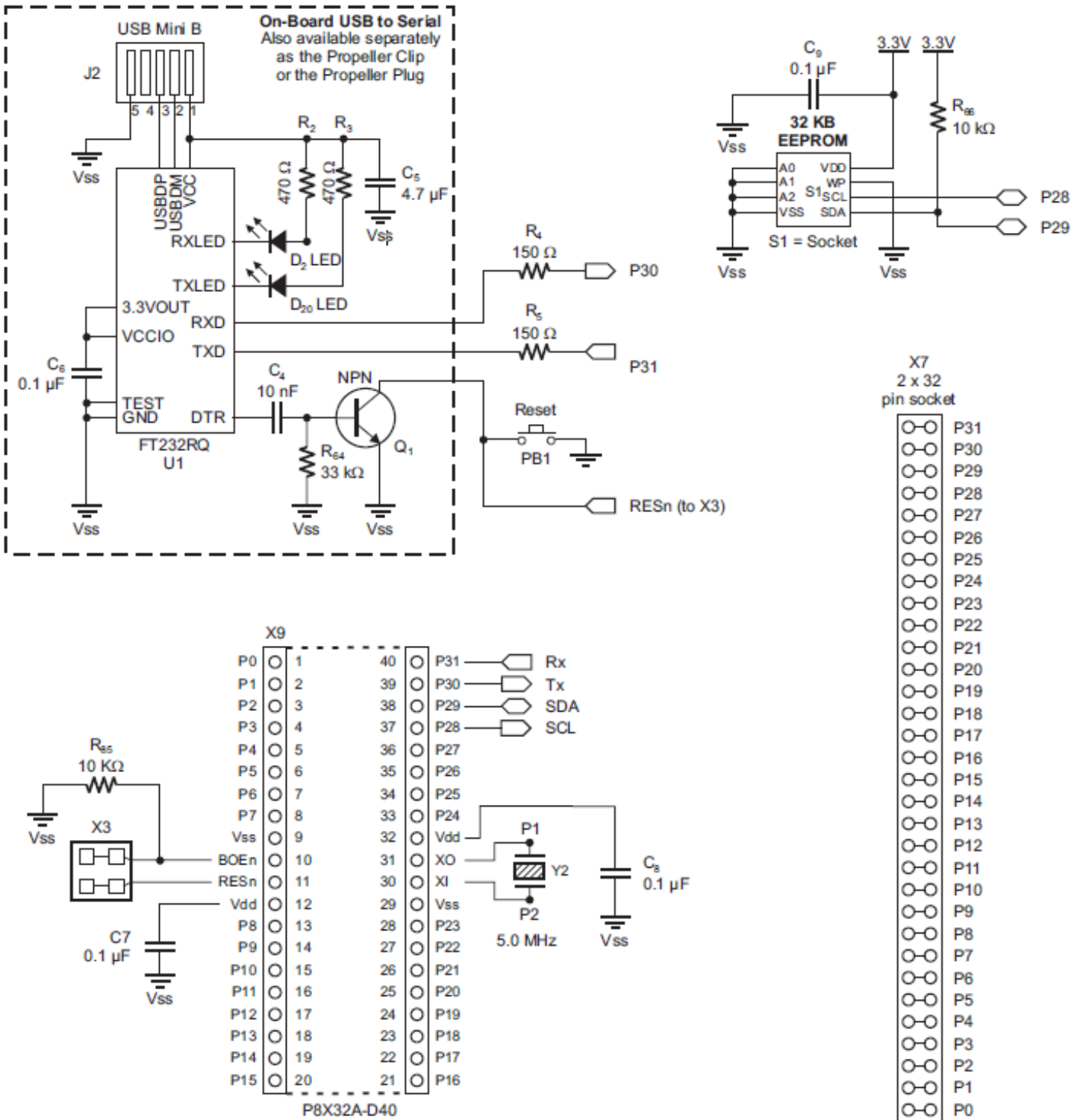
In some cases (mostly with the Buttons, LEDs, Switches, and 16 Segment Display) the PPDB will need some additional components. This is due to whether or not the components used on specific platforms and projects are pulled high or low. In the case of the push buttons, the buttons are wired on the PPDB internally to +3.3v pulling them high until they are pressed, which causes them to go low.

The following diagrams are the full schematic layout of the PPDB, you will need to know this when working with projects not specifically built for the PPDB:



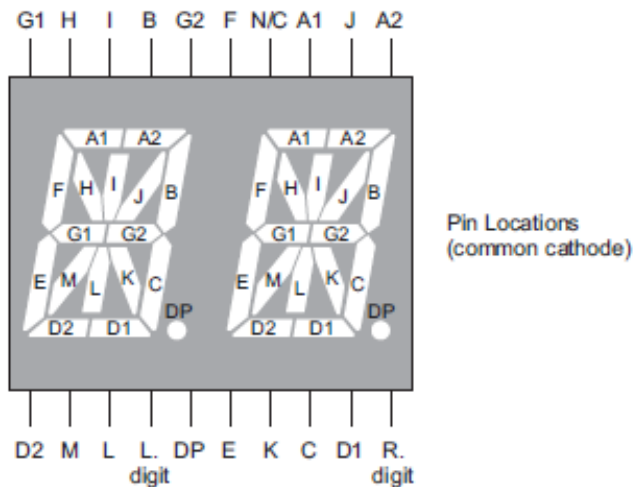
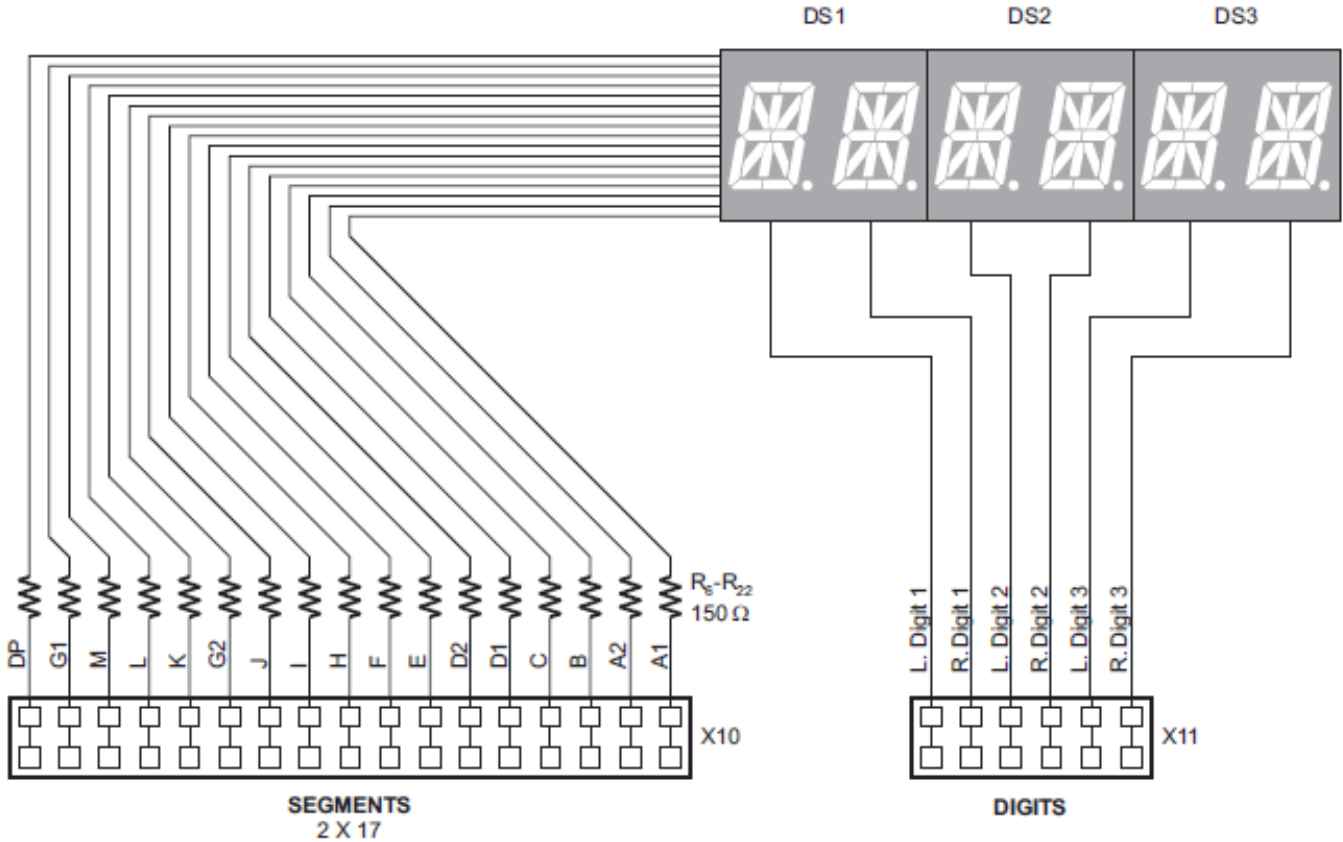
The PPDB power circuit takes from 7 to 12 Volts DC and converts it to 5 and 3.3 volts. The power bus is not internally connected on the Bread Board, you will need to make connections from X1 (3.3V), X5 (5V) and the grounds X2 (GND for 3.3v) and X4 (GND for 5V).

PROPELLER CIRCUIT

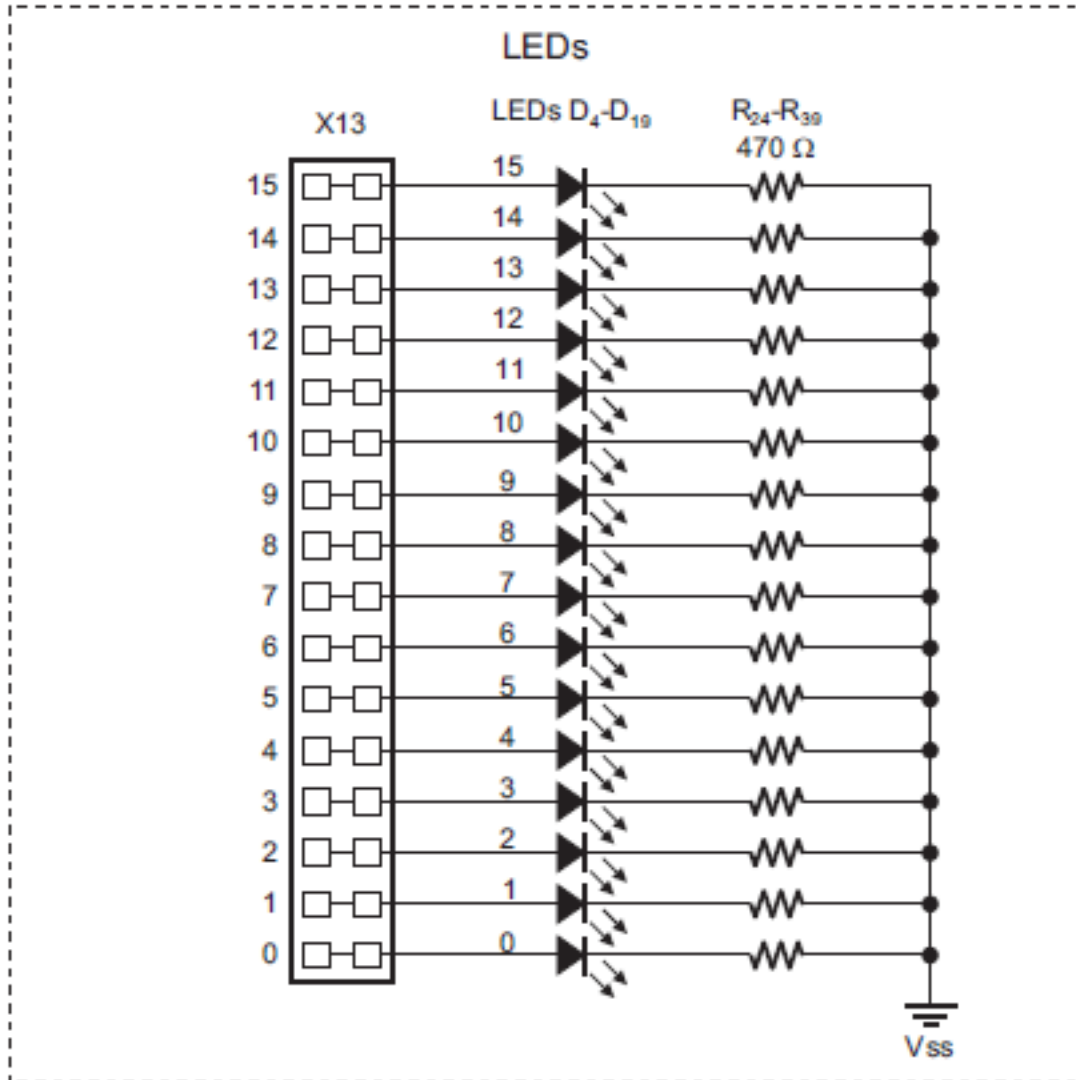


This is where we will be connecting all the components we wish to control, X7. Note that the PPDB already has the power line stability capacitors in place on the board. No need to add them.

SIXTEEN SEGMENT DISPLAYS

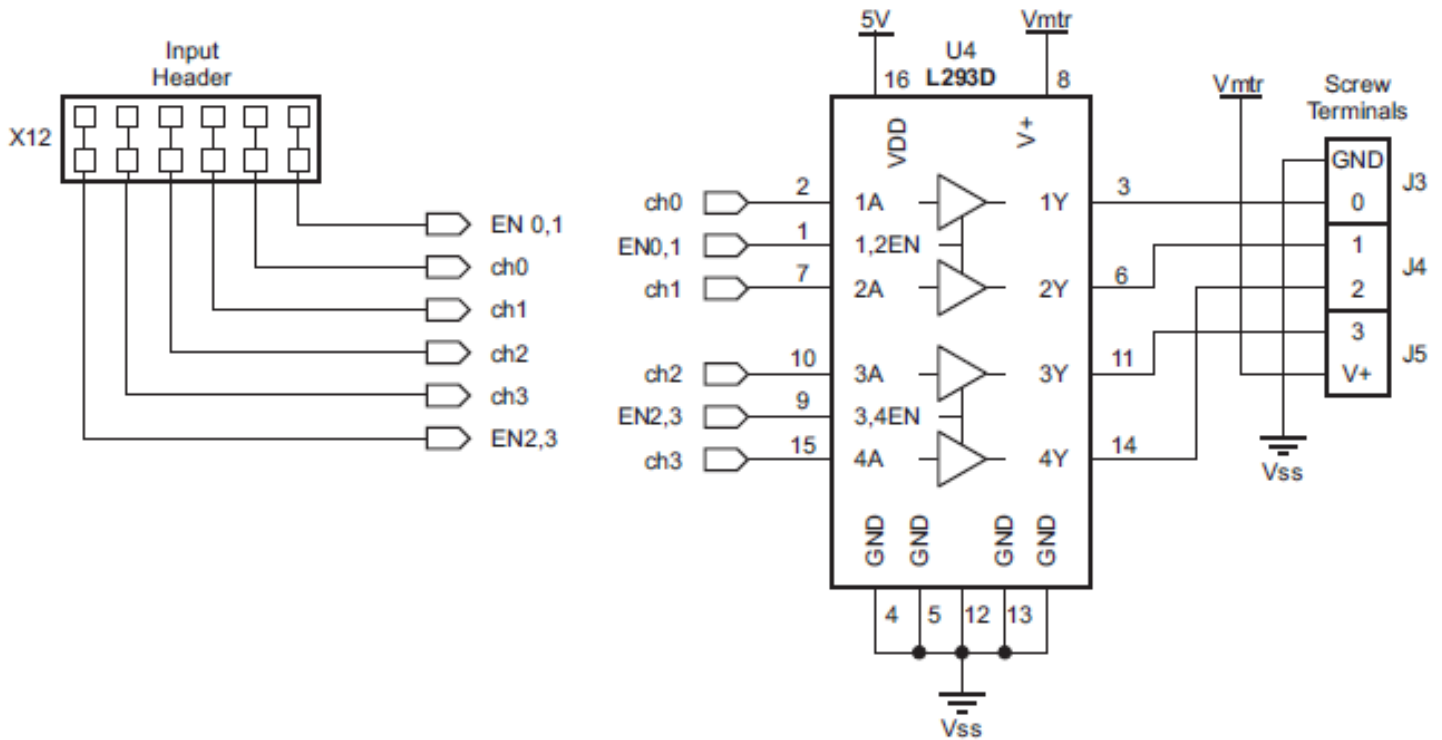


This display can come in useful if you do not want to use Parallax Serial Terminal to debug or view output. These are a High Brightness Common Cathode Blue Displays. The disadvantage is that this display uses 22 to 23 pins. I have managed to use two PCA9555 IC's which reduces the pin count used on the propeller to two. See my Blog at: <http://forums.parallax.com/blog.php?53890-Jorge-P>.

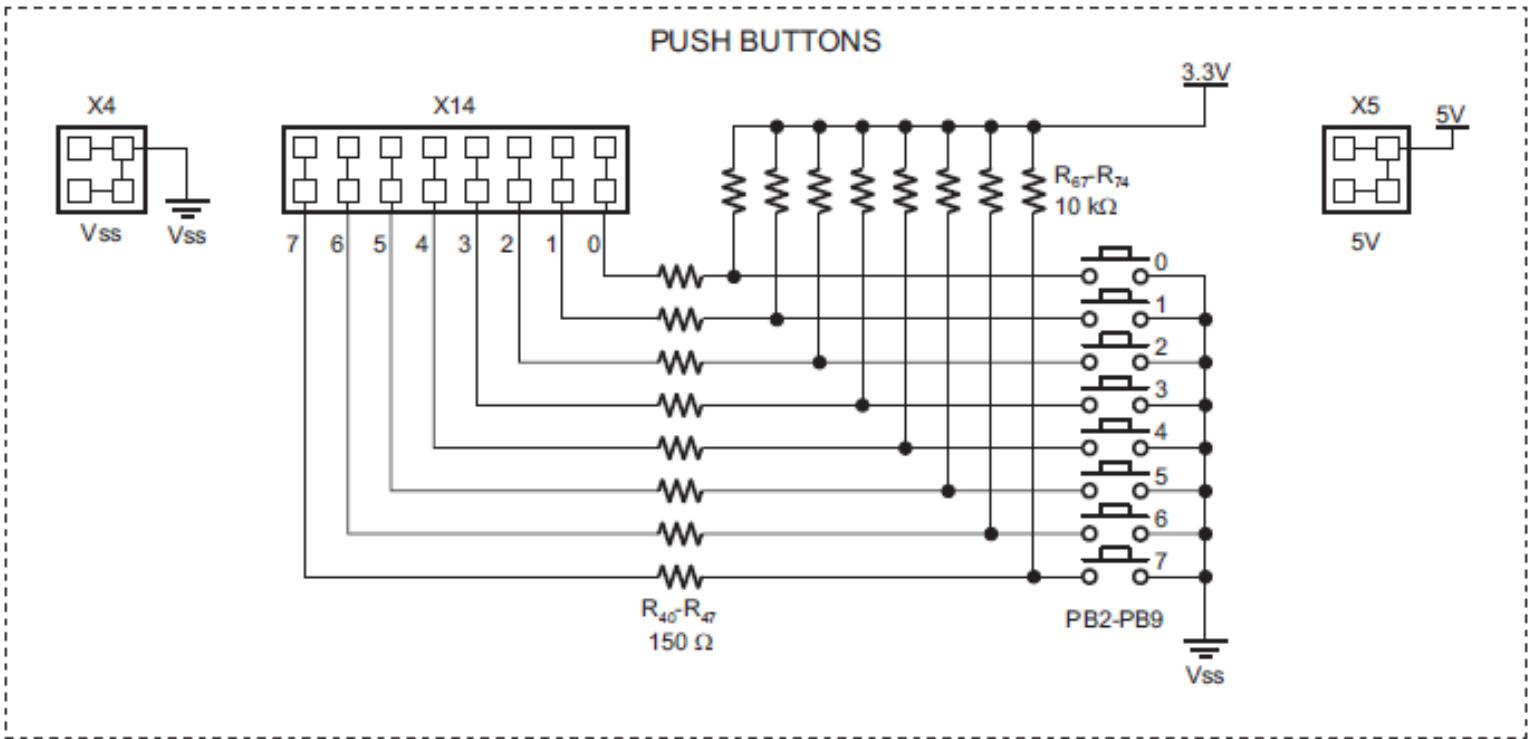


There are 16 LED's. These are fairly bright blue. There are several platforms that use LED's on the VGA port to visually represent the data. Make a note as to how they are grounded, some platforms will have the LED's reversed and pulled high. So pay attention to how they are wired when you are mimicking a platform or project. If the project has LED's pulled low, then you can use the PPDB's LED's. If not, you will need to either alter the code, or use additional resistors and LED's.

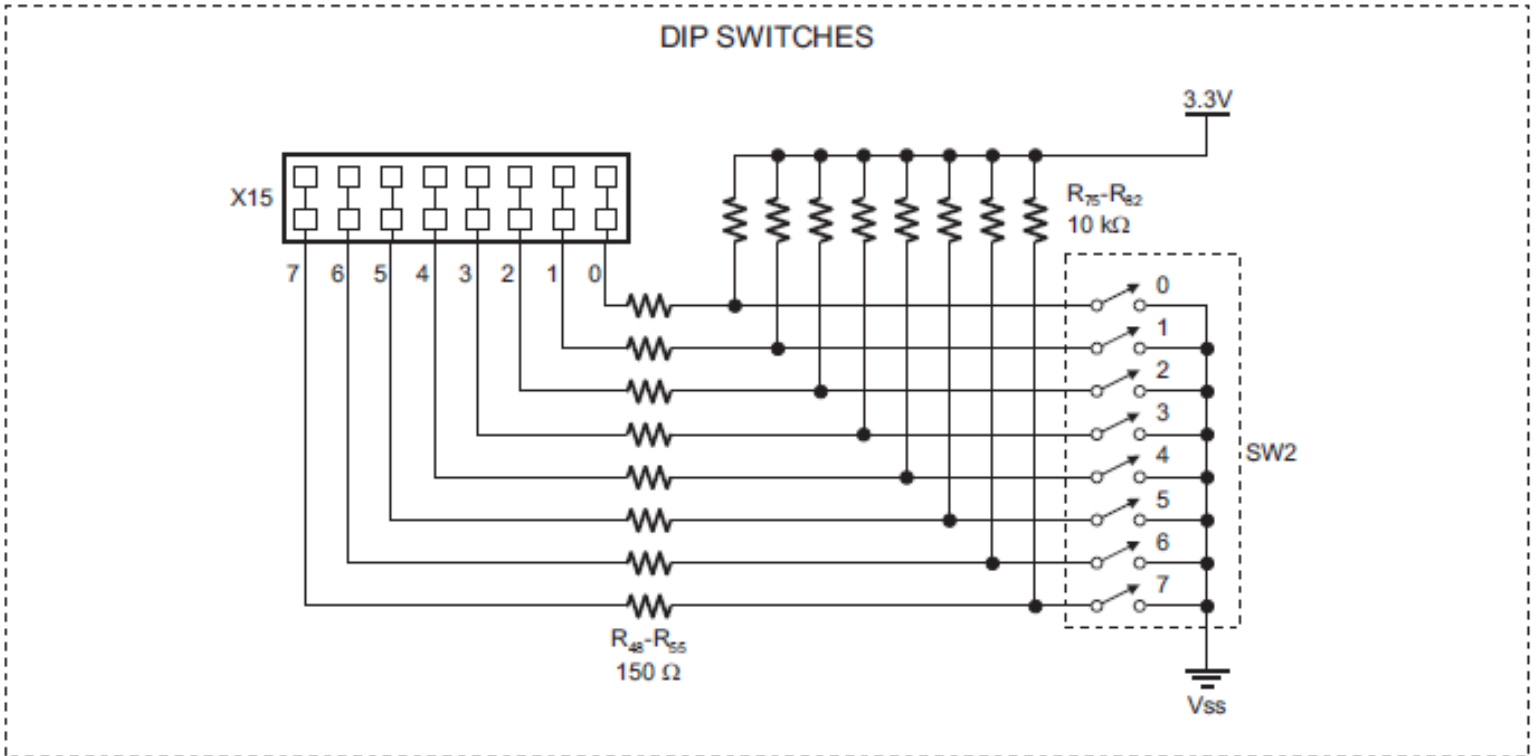
L293D 4-CH DRIVER



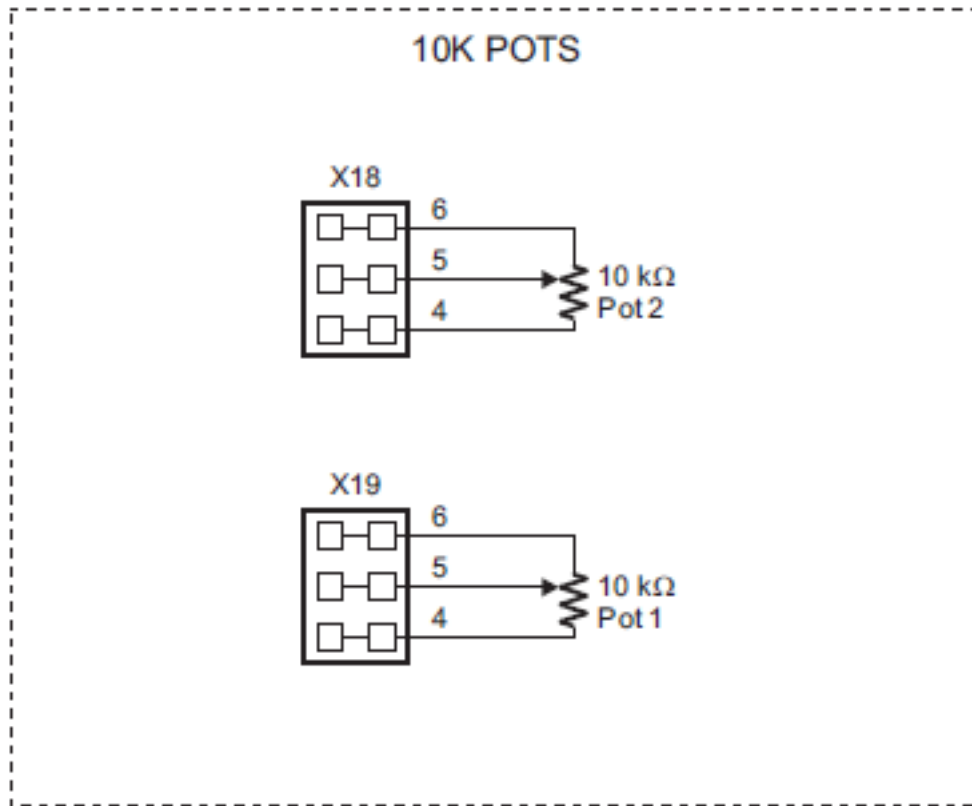
This driver is also called an H-Bridge used for driving motors. The L293D contains Diodes that are required by some schematics you will come across. There is another version of the L293 that does not have these Diodes built in so watch out for schematics using those. Luckily the chip is socketed on the PPDB so you can swap it out for the alternate L293 if you have one in your parts bin.



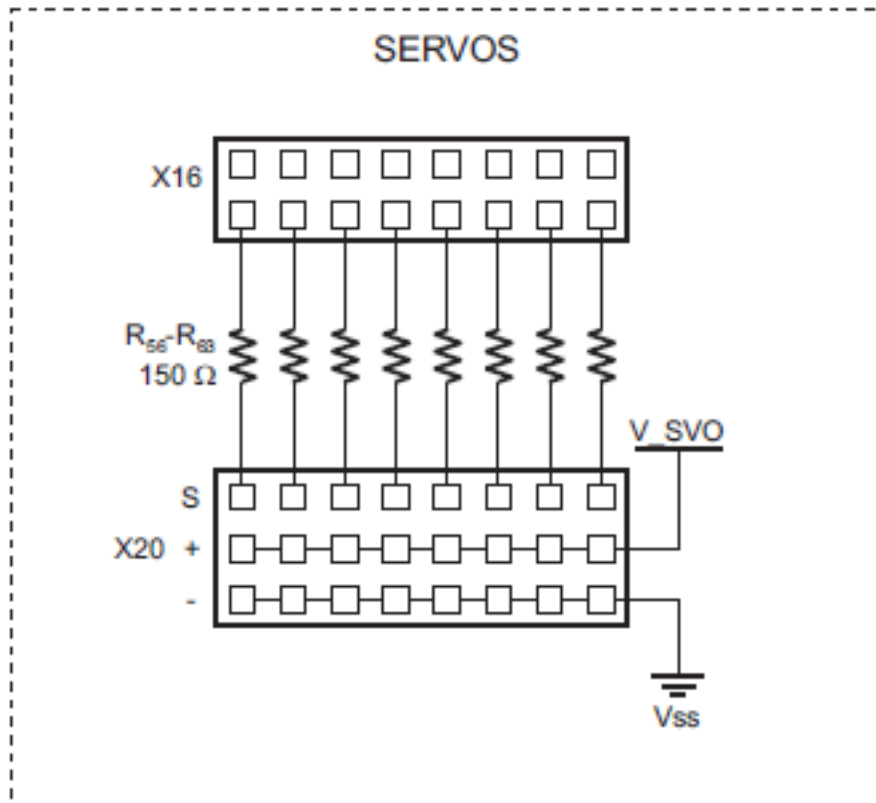
The push buttons are all pulled high when not pressed, when pressed they will be grounded, put in a low state. This confused me when working with some schematics using buttons where they should have been pulled low when not pressed.



As with the push buttons, the Dip-Switch is also pulled High by default, so pay attention to the platform or project you are mimicking.

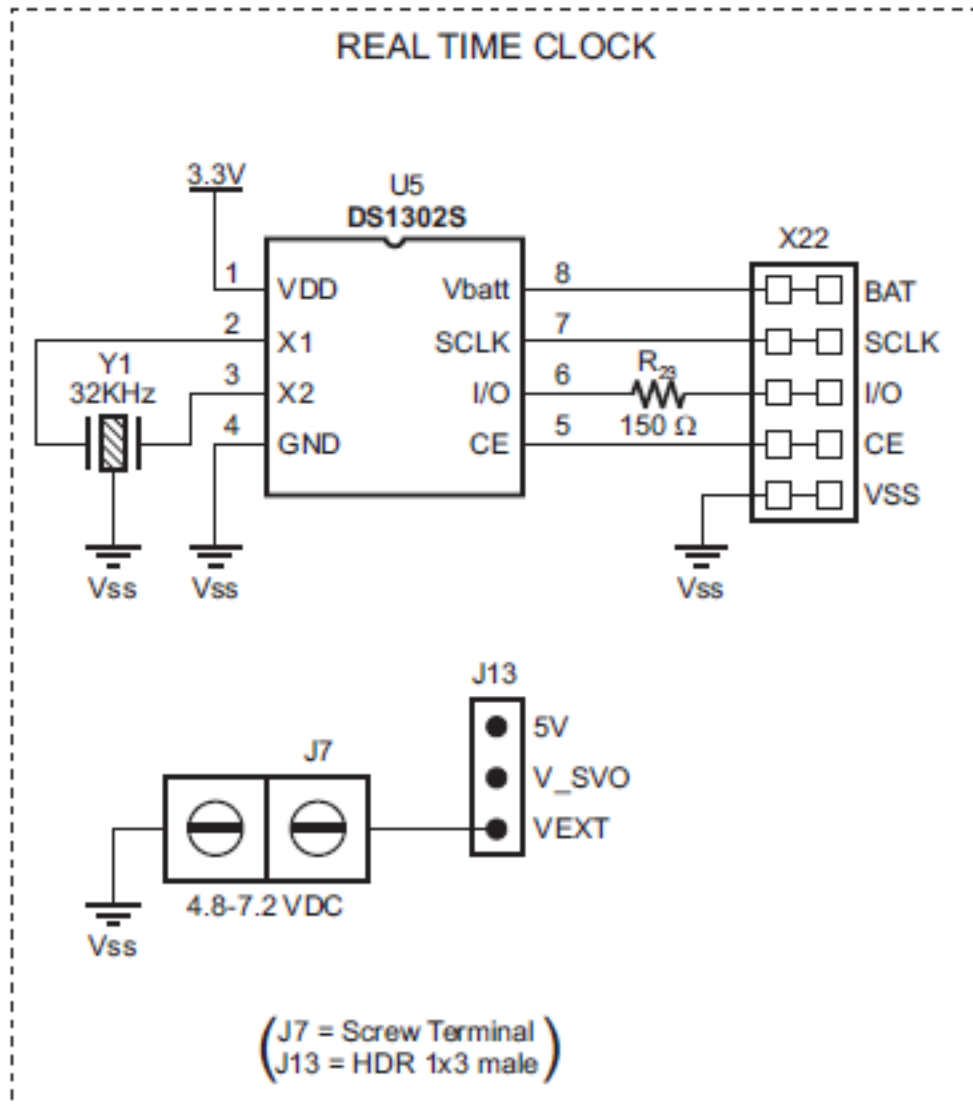


In case you didn't know, POTS are also called Variable Resistors. These are Thumb-Wheel pots as opposed to pots with a shaft protruding out. As you can see by the schematic, they are standard 10K pots.



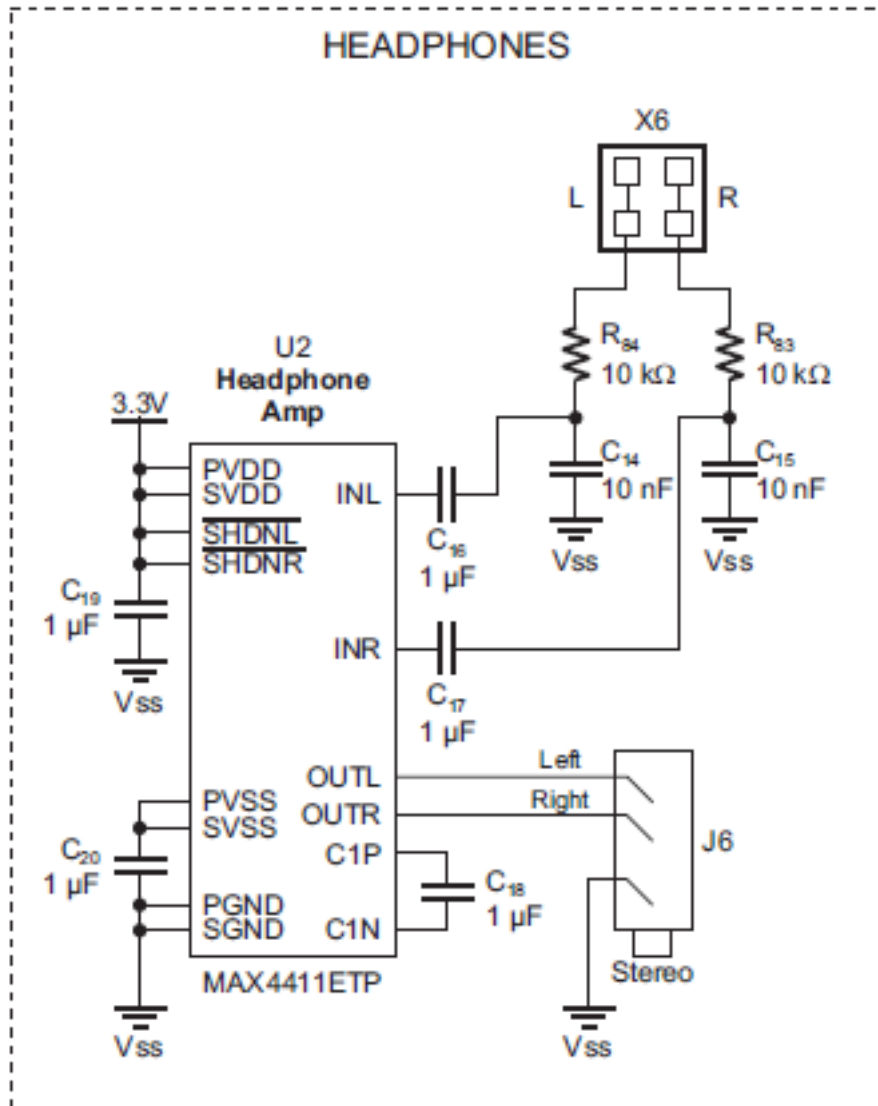
Servos are motors that can usually travel from 0 to 180 degrees of rotation, some will travel more and some will travel less. Continuous Rotation servos are commonly used for the drive wheels in wheeled robots. These ports can control up to 8 servos. The + voltage of X20 is 5V by default. If you plan to drive more than two or three servos at one time, use external power and alter Jumper J13.

NOTE: You will see, in the next diagram, that you can use J13 to select an external power source if your servos take more than 5V to run. If you are using several servos, you should use the external power source, this will prevent excessive current running through the PPDBs power supply. If VR1 or VR2 become hot while using servos from the PPDBs internal power bus, you will know that you should use an external power supply not greater than 7.2 volts.

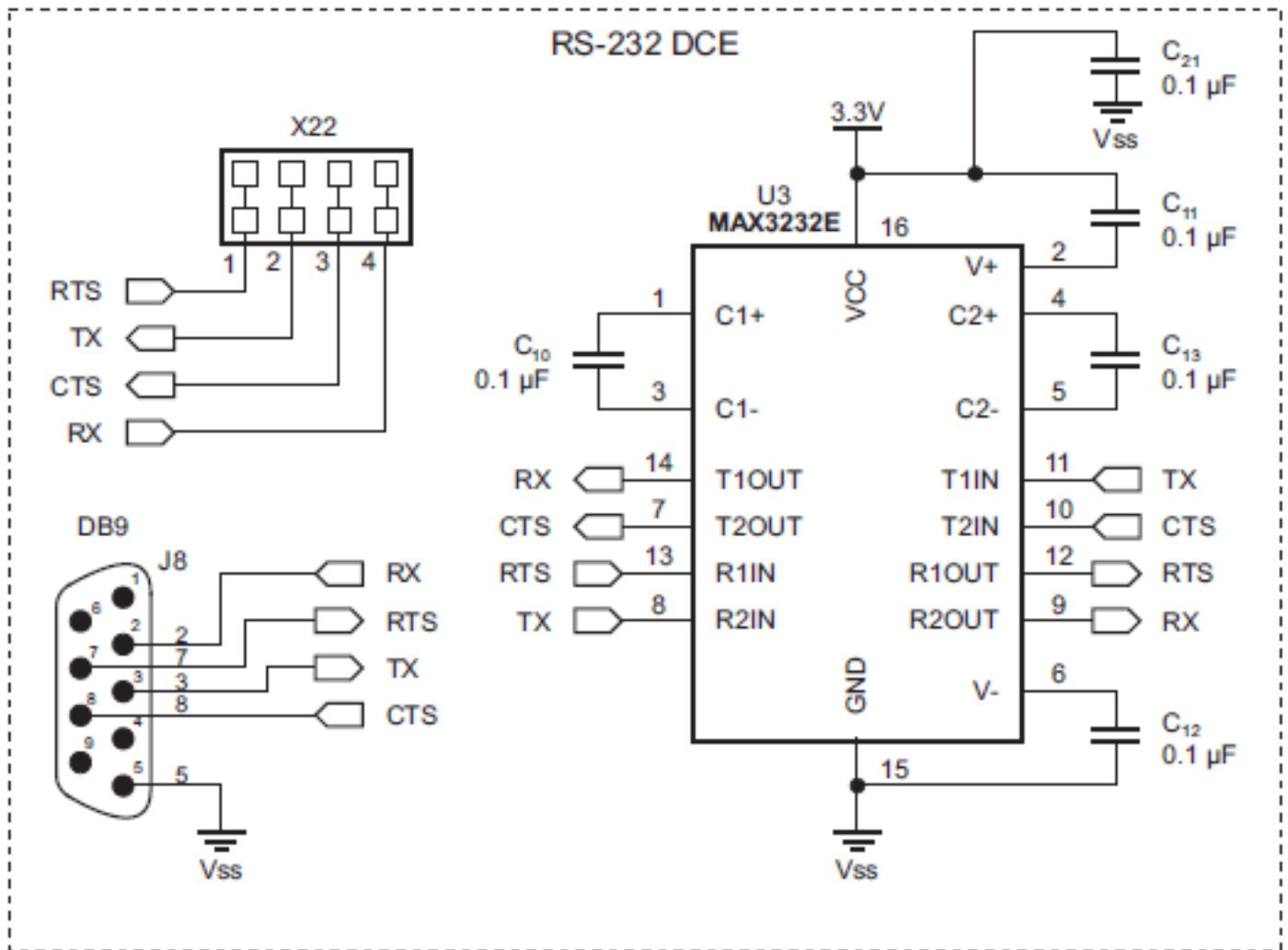


What time is It? This is an SPI bus DS1302 programmable time clock. Several projects I have come across use a DS1307 time clock, they are not compatible with each other even though they serve the same function. You can modify any project to make use of this IC. The DS1302 can be used as a calendar and has 32 bytes of eeprom storage.

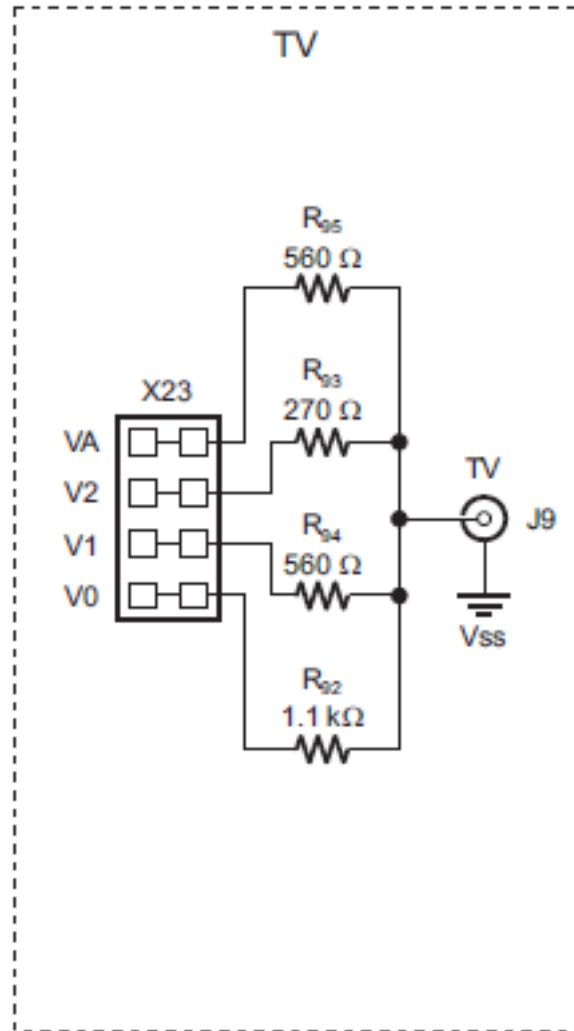
J7 is for external power to the Servo Port, previous schematic. Jumper J13 selects the on-board 5V supply or the external power connected to J7. J7 and J13 have nothing to do with the DS1302.



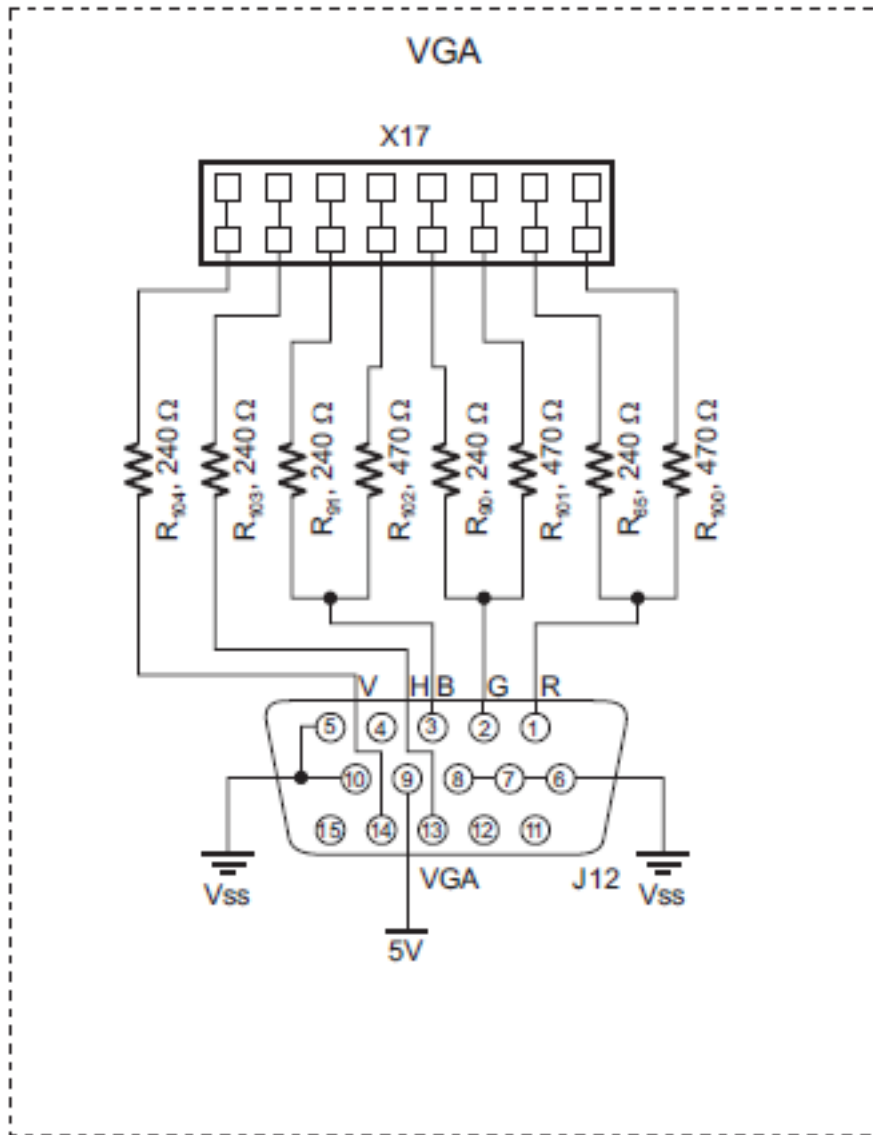
A stereo headphone port to make some noise with your projects. This is an amplifier so be sure to use some volume controls and turn the circuit on before placing headphones on your ears. You can use the two 10K pots for the left and right channel volume, they are the same value as the volume controls of most stereos.



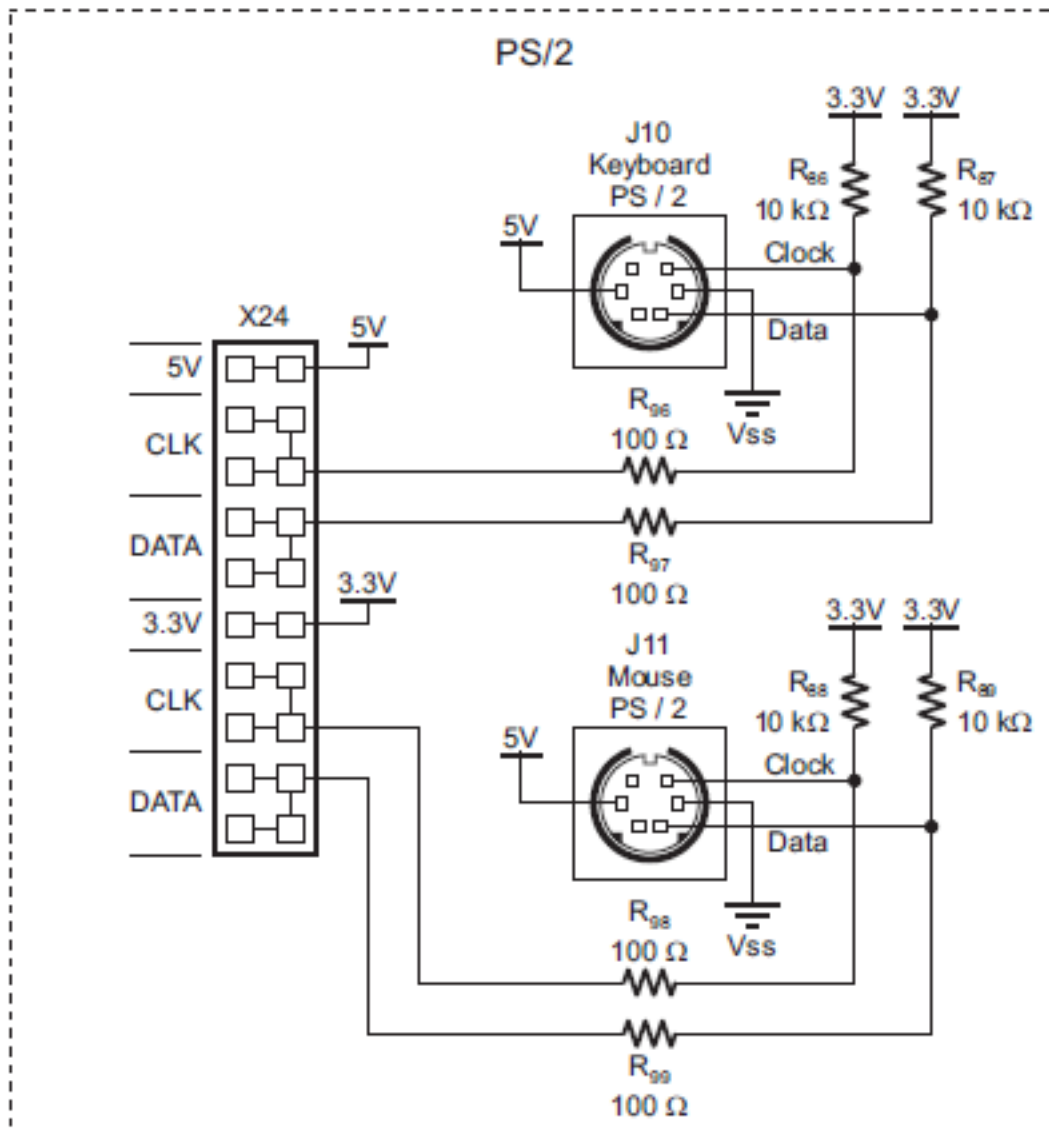
The RS-232 DCE is a Full Duplex serial port for communicating with external serial devices through the DB9 connector. You can connect TTL to X22 and connect it to a PC safely. For instance, most GPS modules can make use of this if they only output TTL level signals.



Several platforms use TV. This is a DAC to combine up to four signals required to view images on your Television set. This uses a standard RCA port for the connection. Most projects use only three pins of this port, the fourth pin (VA) is for the aural sub-carrier and not always used.



The VGA Graphics Port used on many platforms, pay attention to the schematics here as well as the platform or project schematics. Note the V, H, B, G and R signals in the diagram and the resistors they are connected to. This will help when wiring up a platform or project.



Keyboard and Mouse ports. These ports take standard PS2 keyboards and Mice, USB-to-PS2 connectors might work, but some have had problems with getting them to work correctly.

NOTE: The 5V and 3.3V power connections are NOT connected to the PPDB's power sources. You will need to make those connections.

What Platforms Can the PPDB mimic?

The PPDB has the components built in to mimic the following Platforms:

- The Propeller Demo Board
- The Propeller Proto Board
- The Propeller Education Kit (With some additional components required by the PEKit)
- The PropRPM (Propeller Rapid Prototyping Module) by ElMicro
- Gadget Gangsters Propeller Platform (with the addition of a MicroSD module)

If you plan on mimicking several different platforms frequently you should make some wiring harnesses for each platform using stranded wire. Solid wire will break after several uses, this can be troublesome especially when it breaks off in one of the PPDB's sockets or any breadboards sockets. You will want tinned 22 to 26 AWG Stranded wire. Most people use 22 gauge wire to lengthen the longevity of their breadboard sockets, higher gauges will stretch the socket pins over time. If you don't have pre-tinned stranded 22 gauge wire you can make it from any stranded 22 AWG wire you have, using a bit of solder.

When wiring any project, it is wise to use several wire colors. For instance, here are the colors I use most of the time and what I use them for.

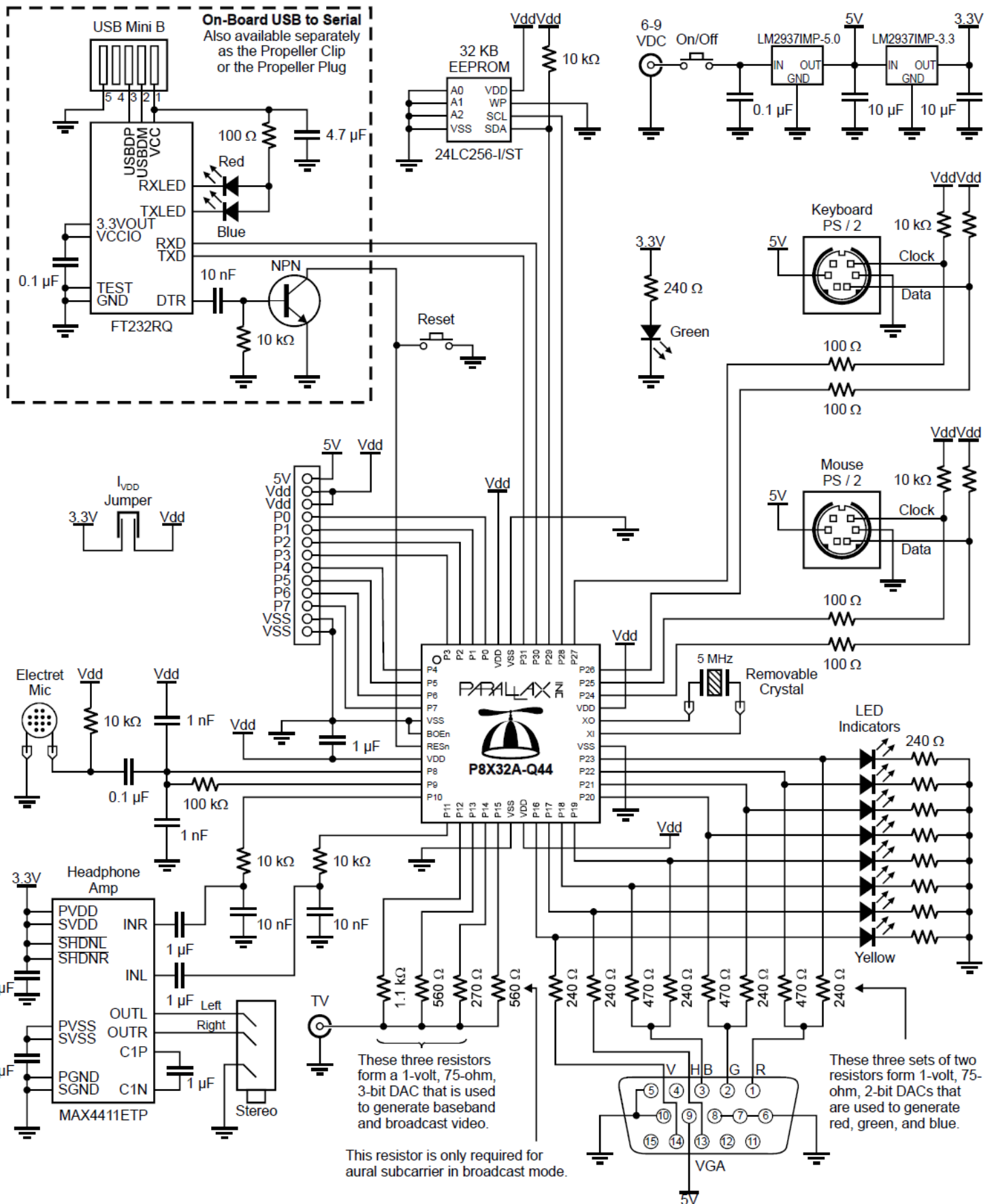
- Black – GND on the 3.3V supply
- Black with a White Stripe – GND on the 5V supply
- Red – +3.3V supply
- Light Red – +5V
- Blue – I2C Clock
- Light Blue – I2C Data
- Yellow – Incoming Data lines
- Light Yellow – Outgoing Data lines
- Dark Yellow – Bi-Directional Data lines

This helps when you need to trace a line on a board with several wires, you don't have to use my exact colors, but use several colors or you will have a mess if you have several connections.

The Propeller Demo Board



I have replicated several projects that use the Propeller Demo Board although I have never owned one. Demo Board projects can make use of that boards Electret Microphone, you will need one with the required components to successfully make those projects. The following schematic shows everything you need to complete any demo board project you come across:



On-Board USB to Serial
Also available separately as the Propeller Clip or the Propeller Plug

32 KB EEPROM
24LC256-I/ST

6-9 VDC On/Off
LM2937IMP-5.0
LM2937IMP-3.3

Keyboard PS/2
Clock
Data

Mouse PS/2
Clock
Data

PARALLAX
P8X32A-Q44

5 MHz
Removable Crystal

LED Indicators
240 Ω
Yellow

These three resistors form a 1-volt, 75-ohm, 3-bit DAC that is used to generate baseband and broadcast video.

These three sets of two resistors form 1-volt, 75-ohm, 2-bit DACs that are used to generate red, green, and blue.

This resistor is only required for aural subcarrier in broadcast mode.

VGA
5V

The PPDB has everything here with the exception of the Electret Microphone and the Expansion Port connector. You can purchase these directly from Parallax or from your favorite electronics component supplier or retailer. If you have a computer microphone that you do not use, you can use that since they are almost always electret microphones. You may want to get a mono headphone/microphone jack to use as well and use that as a microphone jack if you do not want to cut up the one for your PC. For the Expansion Port, we can just setup an area on the breadboard using 13 consecutive rows.

To start, lets use an area of the PPDB's breadboard for the expansion port. Make the following connections:

- Connect +5V to Breadboard Row J, Column 1
- Connect +3.3V to Breadboard Row J, Column 2 & 3
- Connect P0 through P7 to Breadboard Row J, Column 4 through Column 11 respectively
- Connect VSS/GND to Breadboard Row J, Column 12 and Column 13

We will need to make the Microphone circuit on the breadboard and connect it to Pins:

- P8
- P9

Next is the Headphone Amplifier circuit, this is already on the PPDB so we will connect:

- P10 to R
- P11 to L

Likewise, the TV circuit and components are included on the PPDB so connect:

- P12 to V0
- P13 to V1
- P14 to V2
- p15 to VA

The Video and LED circuit is next. Looking at the LED's, we see that they are wired just like the PPDB's so we will use them. First lets connect the Video, make the following connections:

- P16 to V
- P17 to H
- P18 to B0
- P19 to B1
- P20 to G0
- P21 to G1
- P22 to R0
- P23 to R1

Now to continue the video circuit we need to connect the LEDs:

- P16 to LED0

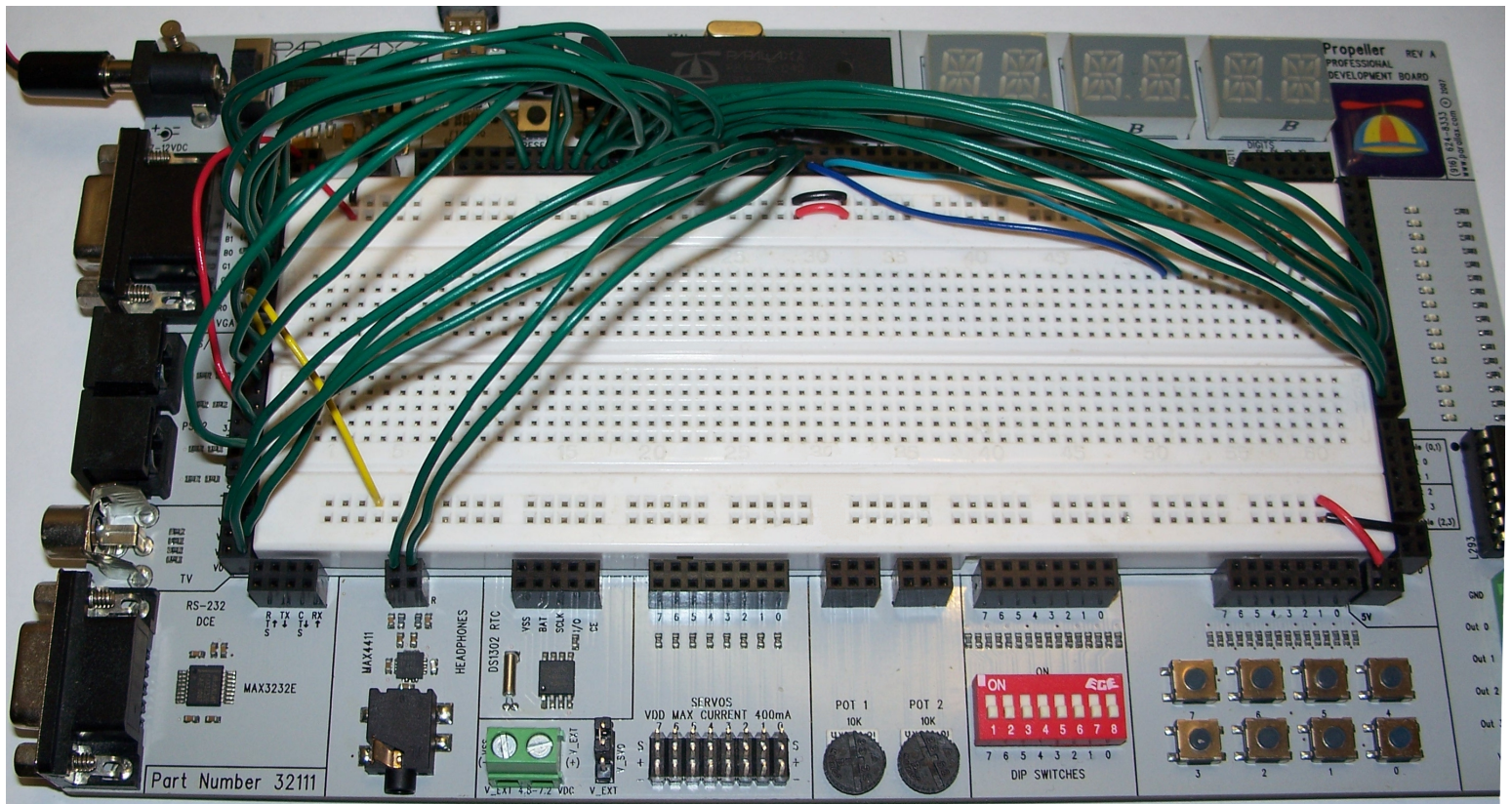
- P17 to LED1
- P18 to LED2
- P19 to LED3
- P20 to LED4
- P21 to LED5
- P22 to LED6
- P23 to LED7

The Mouse and the Keyboard are our last connections to complete the Demo Board:

- P24 to PS/2-A Data
- P25 to PS/2-A Clk
- P26 to PS/2-B Data
- P27 to PS/2-B Clk
- +3.3V to 3.3V
- +5V to 5V

We are now done with wiring up the Demo Board on the PPDB. You will still need to make connections and circuits for whatever the project calls for. Before doing that, you might want to take some measurements and route the wires to more convenient places to keep them out of the way. Also consider making a wiring harness to make rebuilding the connections a snap.

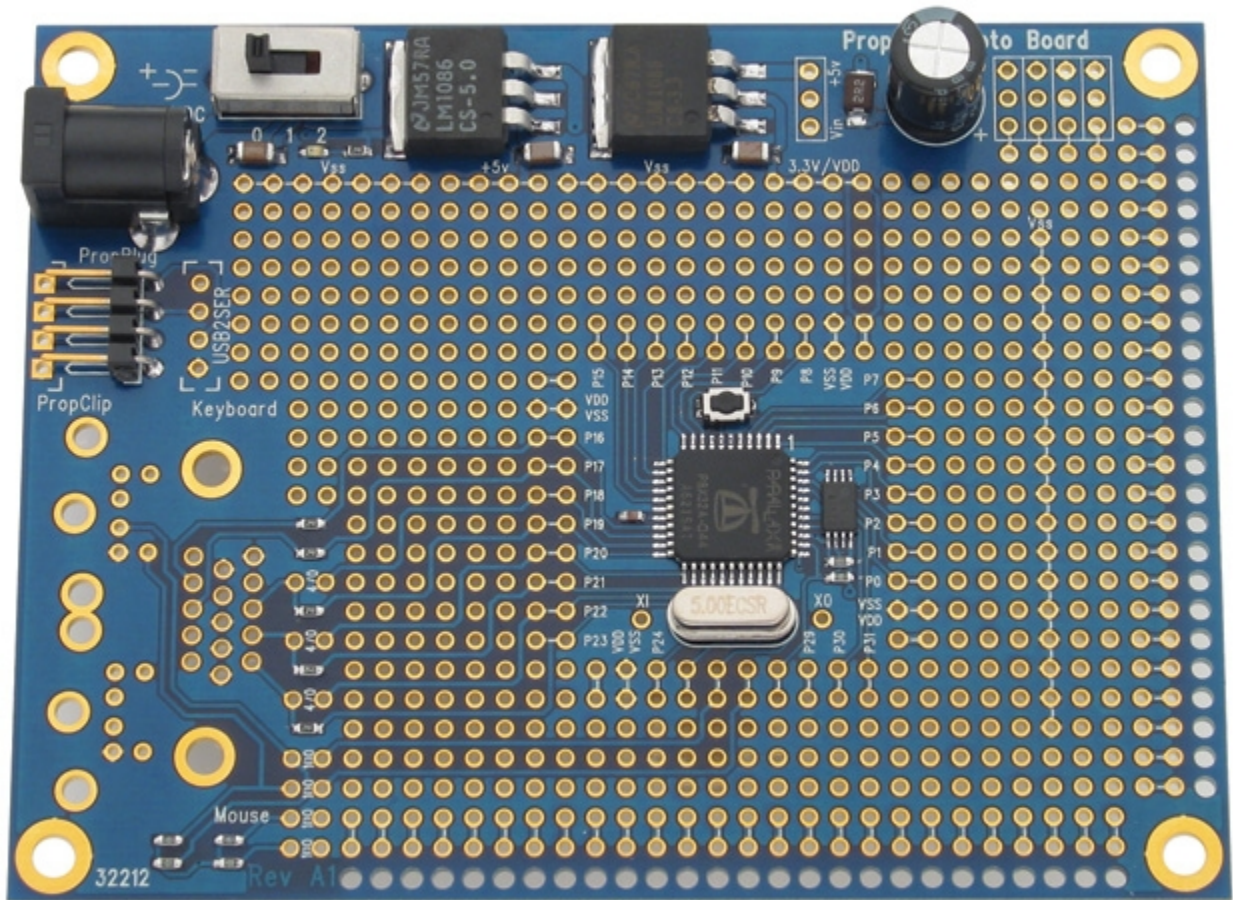
The following is my completed Demo Board on the PPDB:



Notice that I did not include the microphone circuit and I used all the same color wire. I did this intentionally to show how it would look. If I were to have a wiring error it would be difficult to trace. Also note how the wiring will be in the way of the breadboard, you will want to make your wires much longer and maybe use some header pins for the connections.

Once your wiring is complete, you can re-create any project that uses the Demo Board. The Parallax Forums have allot of great projects for the Demo Board.

The Propeller Proto Board



The Propeller Proto board is a fairly basic board, not much wiring for the main schematic. Each project will have different components placed on the prototyping area, so you will need to obtain those parts to complete them. Other than that, the PPDB has everything you need for the Proto Board.

The Propeller Education Kit



The PEKit is a great kit for learning how to use the Propeller micro-controller, the documentation is a valuable tool for this kit. You will need to obtain several of the parts for this platform, if you have the manual "Propeller Education Kit Labs: Fundamentals" turn to page 24 and page 25 of that manual. Everything on those pages is not required since the PPDB already contains the circuits these components are used for, with the exception of the USB A to Mini B cable, you will need to obtain one or one like it.

In the same manual, turn to Appendix C, page 224. From top to bottom I will go through what you will need and what you will not need for the PPDB.

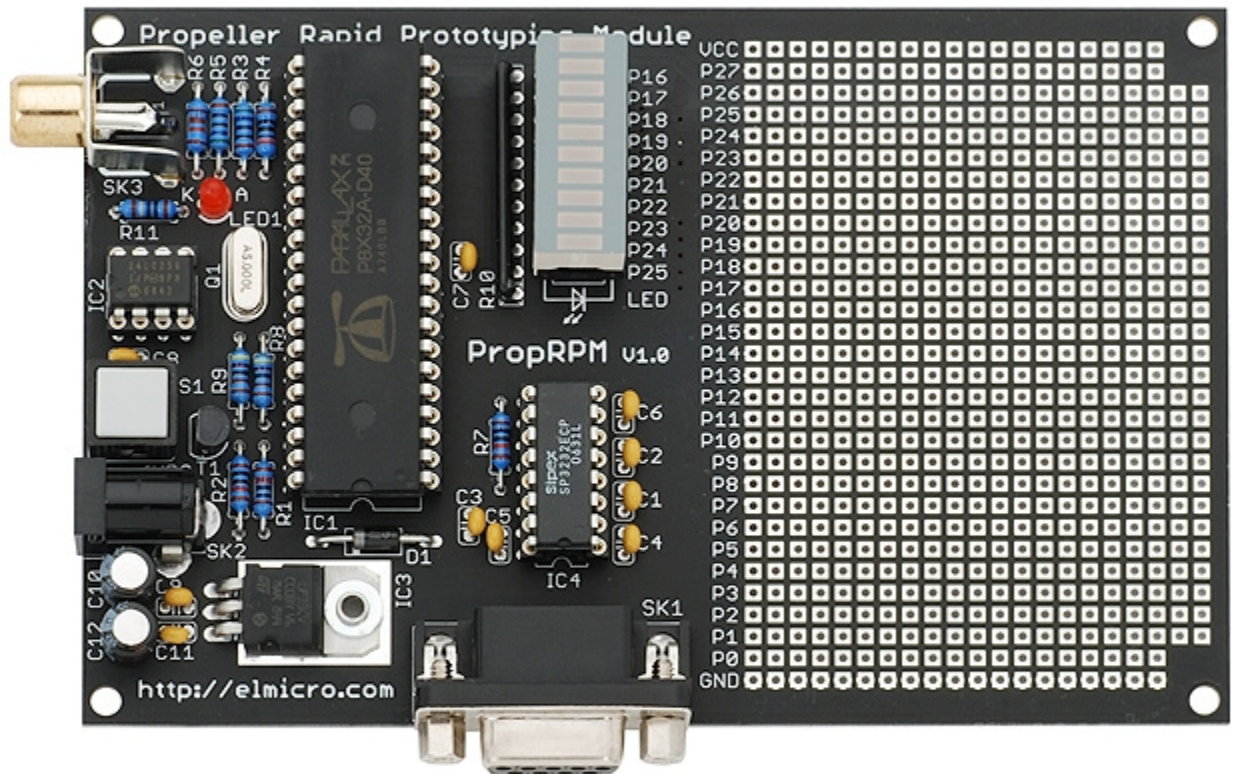
- **130-32305** has already been covered and these part are already on the PPDB.
- **130-32000** will need to be obtained, all parts will be needed to complete the manual including the LEDs as some projects require them to be wired solely to the propeller.
- **700-32305** will not be needed, it is just the breadboard, the PPDB already has one, however, you can never have too many breadboards.
- **32201** is not required, with the exception of the USB cable if you do not have it.
- **110-32305** is not required unless you do not have a storage bin for your components. You can use any storage box you like. Personally, I prefer fishing tackle boxes that have lots of small compartments and removable compartments, and you can get them fairly inexpensive from any sporting goods store.
- **122-32305** is at your discretion, although the manual is freely available online at www.Parallax.com in PDF form, I prefer hard-copies of manuals.
- **Table C-2: PE Project Parts Kit (#130-32000)** on page 224 will all be needed to complete the various projects. This is the same as the second part number above.

Once all the components are obtained, we can build any of the PEKit projects.

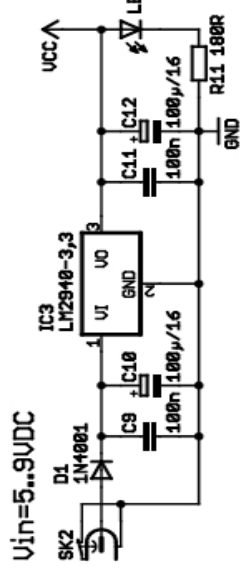
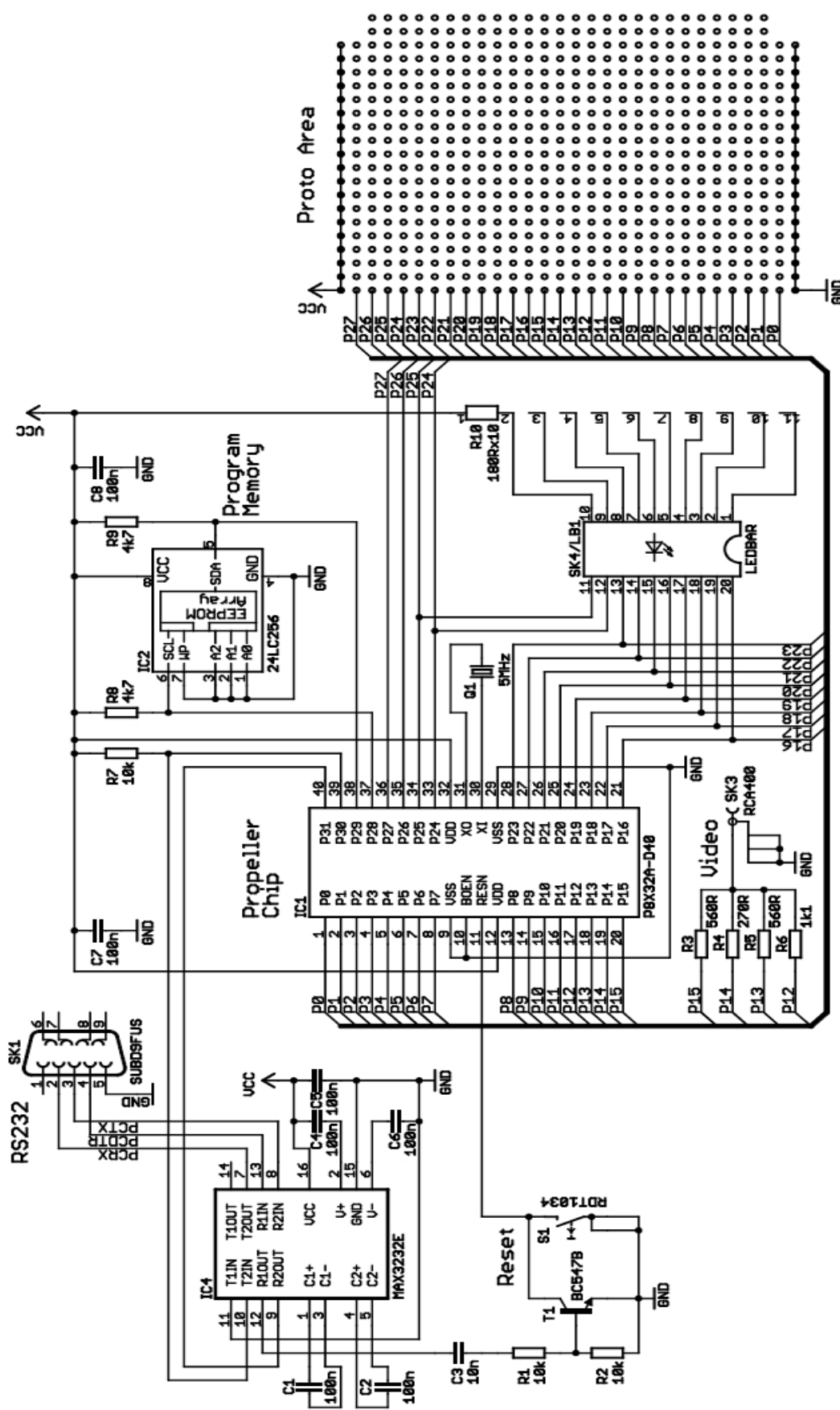
If you are new to the Propeller, go ahead and download the PEKit documentation from <http://www.parallax.com/go/pekit>, you will see that you do not need to build the power supply, reset, eeprom, or programming circuits. These are all built onto the PPDB.

Go through all of the projects, this will give you a better understanding of the Spin language.

The Propeller Rapid Prototyping Module



Also called the PropRPM, this can be easily built on the PPDB, the only connections you need to make are those to the Serial Port interface and the LEDs for the LED bar. You will however need the components that are added to any specific project built using the PropRPM. The PropRPM is by [EIMicro](http://elmicro.com), This site is available in English as well as German.



ProPRPM

<http://elmicro.com/proprpm.html>

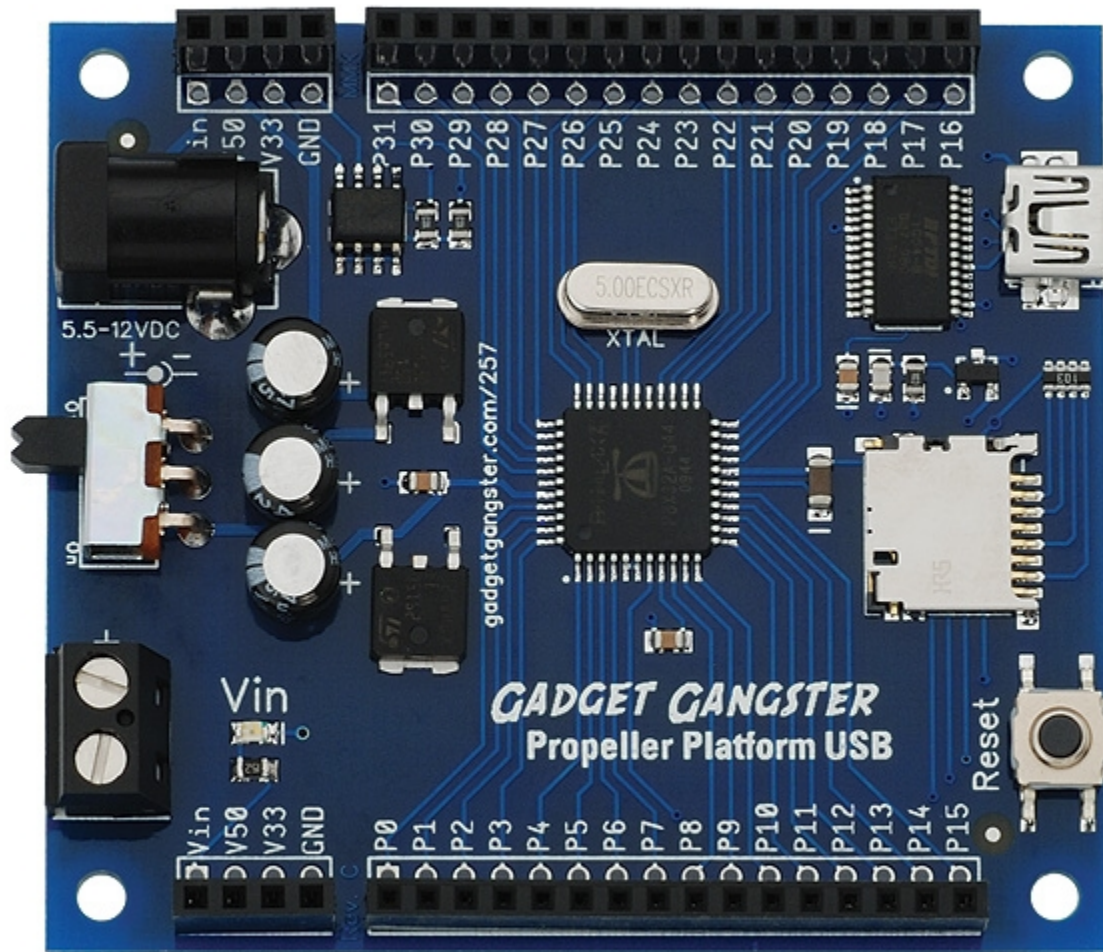
Design: Klaus Sander, Oliver Thamm
 (C)2007 by Elektronikladen | ELMICRO

Date: 26.02.2007 10:42:06 Sheet: 1/1

Propeller™ Rapid Prototyping Module

REV: 1.0

The Gadget Gangster Propeller Platform



The main key to mimicking this platform are the Memory, SD Card Adapter, and the physical width of the expansion port. The memory for this module is a AT24C512B which is a 64K byte memory. Luckily the PPDB has socketed memory so we can just replace the standard 32K byte eeprom for this one if you can find it as a PDIP. You will then need an SD Card or MicroSD Card adapter. The next part you will need is a blank prototyping board for this platform, this is because the PPDB's breadboard is not wide enough to duplicate the platforms IO connectors, although you can simply use jumper wires.

You can download the schematic from Gadget Gangsters website <http://www.GadgetGangster.com> or Parallax's site at <http://www.Parallax.com>.

Now What?

Now that you can mimic the most common Propeller platforms, you will need to find some projects. The following is a list of sites that have projects and tutorials for the Propeller.

Parallax

<http://www.Parallax.com>

<http://Forums.Parallax.com>

<http://www.ParallaxSemiconductor.com>

<http://OBEX.Parallax.com>

Gadget Gangster

<http://www.GadgetGangster.com>

<http://www.gadgetgangster.com/tutorials.html>

ElMicro

<http://www.elmicro.com>