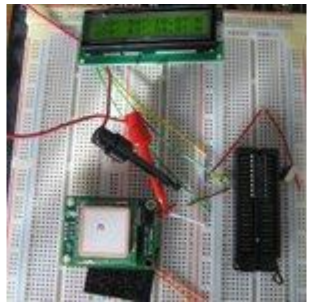
GPS RECEIVER



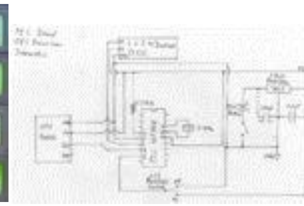
If you have never been to the MAKE Magazine website you should really check it out. They have tons of project ideas on their site and more are posted every day on their project blog. In July I saw an article regarding a project that took a GPS module, a simple LCD display, a Basic Stamp to interface the two together, and created a GPS receiver. The receiver displays your coordinates in degrees, minutes, and seconds.

I was intrigued because for such a complex sounding project it appeared very straightforward and relatively inexpensive. Upon further digging I discovered that this project used a Basic Stamp 2 chip for a processor, along with a Basic Stamp Development Board and software; these together cost around $200, not including the cost for the LCD Display and GPS module (another $100).Then I remembered that the Basic Stamp is actually based off of and very similar to the PIC series of microcontrollers that I had previously worked with in college.

After looking at the code provided on the project page, I decided that with a little effort I could convert it for use with a PIC (I used a PIC16F84A, but others can be used, they cost $6).

To program the chip I used the programmer I had from college. Built from a kit, it is USB compatible and has a ZIF socket so you don't wear out the PIC's pins pulling it in and out of the socket while troubleshooting your projects. It is not the cheapest programmer available at $85. Many other programmers are available for much less money, or you can build your own. The last item necessary is a BASIC compiler for the PIC. While the Basic Stamp is also programmed using the BASIC computer language (hence the name), the PIC uses a slightly different version called PicBasic. The compiler I used is called PicBasic Pro ($250) which I had from college (there is a cheaper version called PicBasic Compiler for $100); I also found another compiler which offers a free demo. For me, since I already have all of the pieces I need for PIC development it was much cheaper ($6 vs $200) to use a PIC instead of a Basic Stamp. The casual hobbyist should decide which route they want to take since the Stamp ($200 to get started) offers a more user friendly path, while the PIC ($150-$300 to get started depending on programmer and compiler) offers more customization and more processing power.

It took me most of an afternoon to refresh my memory and convert the code from PBASIC to PicBasic. The photo above shows my version of a homebrew GPS receiver using a PIC as I prototyped it on my breadboard. The GPS module has an LED that flashes to show it is acquiring satellite signals (at least 3 are needed for valid GPS data) and is solid once enough connections have been made. Since I plan on putting this project in some sort of handheld enclosure, the LED will no longer be visible. To get around this I added some code which makes use of one of the built-in features of the GPS module. This feature will report back how many satellites have made connections with the module, when this value is below 3 the LCD displays the text "Searching for satellites...". When the value is above 3 the LCD displays the GPS location data. Overall this project was a lot of fun and a great refresher for me regarding PICs. In part 2 I'll talk about how I powered this project off of batteries, integrated it into an enclosure, and provide my final schematic and parts list.

I previously prototyped my own GPS receiver. Since then I modified a small plastic enclosure to hold the LCD, GPS module and circuit board holding the PIC microcontroller and power circuit. I also added code (see link below) that checks for the state of a switch to determine if you wish to have the LCD's backlight on or off. I decided to add this feature after measuring the current draw of the receiver as a whole. With the backlight on, the receiver draws an average of 165mA; with the backlight off, the receiver draws an average of 125mA (that's about a 25% savings). Since the receiver runs off of a single 9 volt battery (alkaline - 600mAh typically), that power savings is equivalent to as much as 72 minutes of additional time the unit will now be able to run. With a lithium 9 volt (1200mAh - typically) it could add another 2 hours and 24 minutes.

The picture on the right shows the receiver as completed; I will be the first to say that it is not the most professional looking, but it works. The switch on the right is for power and the other switch is for the backlight. The center picture shows the 4 possible LCD states: searching with backlight off, searching with backlight on, receiving GPS data with backlight off, and receiving GPS data with backlight on. The last picture is the schematic for the receiver unit.

I did some research and here are some constants that show how useful this unit can be for many different functions.

- 1 Degree = 60 Nautical Miles (69 Miles)
- 1 Minute = 1 Nautical Mile (1.15 Miles)
- 1 Second = 101.2 Feet
- 0.1 Seconds = 10 Feet

With these relationships and some basic geometry, I can determine distances and directions to and from GPS way points.

This was a really satisfying project to do. With just a handful of parts and a couple of modules I have a fully functional and now portable GPS receiver.

- Final GPS PicBasic Code

As you can see in the photo,  I got a new frontpanel for my GPS and replaced the two slide switches with push-on-off switches. The left button is for power and the right turns the LCD's backlight on and off.

Since the backlight toggle is performed via a digital input on the PIC I had to modify the circuit slightly by adding a 1M ohm pull-down resistor to the digital input which the pushbutton wires to. This is required because in the previous version the single pole double throw slide switch would either connect the digital input to +5V or ground; since the circuit now uses a single pole single throw pushbutton it cannot perform this same functionality. Therefore, the pull-down resistor grounds the digital input when the switch is not on and then when the switch is turned on its resistance is so high that it is effectively an insulator to ground in comparison to the straight +5V from the power supply circuit.