

VLC (Very Low Cost) Prop Controller

I've been looking round for a while at the various prop controllers. As far as I can see, one of the best ones for the job is the Prop-1 from EFX-TEK. All of their controllers are excellent and the company is very helpful.

HOWEVER, being a bit of a hacker I also wanted to come up with a low cost adaptable controller (or controllers) just for my own satisfaction. After wandering around numerous websites, I decided to base the controller on the excellent Picaxe series of chips from Rev-Ed in the UK. As luck would have it I was due to be in the UK for 3 weeks (I live in Australia) so I was able to order these on-line and pick them up in the UK.

Rev-Ed produce a number of chips all of which are suitable for Prop control. However, I wanted to challenge myself to see just how cheaply I could build something so I decided to base the controllers on the Picaxe 08M and 14M chips. Please bear in mind that the EFX-TEK products are very well thought out, built and documented and this article is written as much for my satisfaction as anything else and NOT meant to detract from their product.

VLC Controllers Mark 1 and Mark 2

The Mark 1 controller is based on the Picaxe 08M chip and Axe021 Proto Board. This is not an ideal controller as I couldn't quite get the combination of features I wanted with it (3 Servo, Analogue Input and Slave Output). This was due to internal limitations in the 08M chip. However, you can buy the combined kit of chip and board for less than US\$6 and a complete controller costs less than US\$10 making it very inexpensive. There will be 2 or 3 'flavours' of these controllers for different functions.

The Mark 2 controller will be based on a custom designed circuit board and be capable of using Picaxe 08M, 14M and 20X2 chips and offering servo and medium current outputs and analogue and digital inputs.

Very Low Cost (VLC) Prop Controllers Mark 1

A starter kit that includes the Axe021 self assembly board, chip, USB cable and battery box works out at US\$26 excluding postage – a fair amount less than the Prop-1 Starter kit BUT once you have one Picaxe starter kit then for the next and subsequent controllers you just buy an 08M chip and Axe021 board at a cost of less than \$5! (plus a battery box) Since the download cable and software can be used with any Picaxe solution, I'll base all costings for the projects below on the 08m/board combination.

Please note that in the picture, a serial connection is shown – I've actually priced for the USB version. If you have a spare 3.5mm jack and RS232 connector you can solder your own serial cable and save buying a starter kit.

The 08M/Board combo comes as a kit of parts and needs to be soldered up. This took me about 10-15 minutes as the component count is very low. The components include an IC socket which is handy as it allows is to plug in 08Ms with differing programs to perform different tasks (if you want to). The battery box is not included but the power connector terminates in a PP9 style connection (Note do NOT connect a PP9 battery – you will damage the chip).

VLC Servo Prop Controller

The first project was to create a board that would control standard RC servos. The board in this tutorial is capable of controlling up to 3 servos (actually 4 if you change a jumper).

3 servos can control the movement on 3 axis skull for example. A second board could control 2 axis eyes and jaw movement with the slave output being used for lighting the eyes if required.

I wanted the board to be as adaptable as possible but I decided to hardwire all the inputs and outputs. Because servos can be very (electrically) noisy, I wanted the board to take split power supplies – one for the board and inputs and another for the servos. In practice I have run servos off the same battery supply as the Picaxe itself without a problem (so far) but this is with the servos at no-load.

Step 1

Basic Parts: Axe021 Proto Board

Picaxe 08M chip

20 Pin SIL Header Strip

4 x 330 Ohm $\frac{1}{4}$ or $\frac{1}{8}$ watt resistors

1 x 10K Ohm pull-down resistor

Insulated hookup wire (I use rainbow spectra strip split into individual colours but almost anything will do)

2 x 4.5V battery box with PP9 connector (Picaxe Power)

PP9 connector wired to a 3 pin header wired as per the diagram

Testing:

4 Servo extension cables

LED – any colour

10K pot – any type

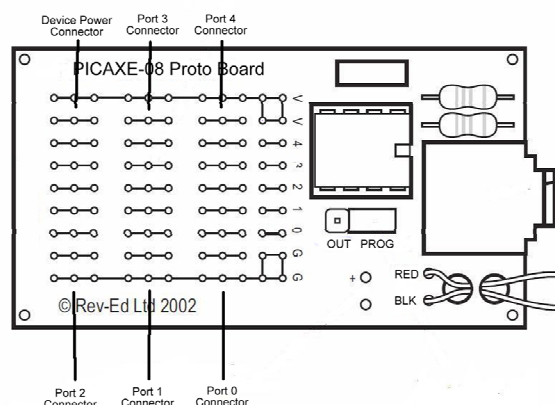
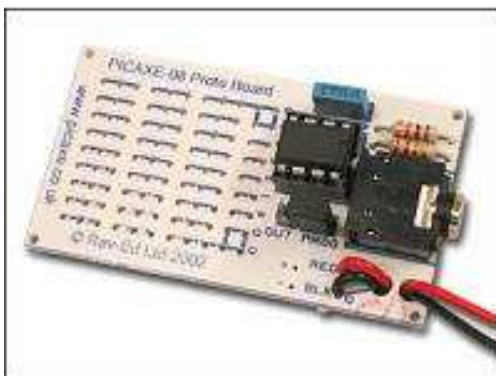
Push switch

Heat shrink tubing – Black, Red and other colour.

Buy an Axe021 proto board and 08M picaxe chip. Assemble the board according to the instructions that come with it. It should end up like the one below. Keep the wire ends of the resistors that you cut off as these will be used later as links on the board.

I actually buy more boards than 08M chips just in case of foul ups. Because I wanted to use a few of these boards I soldered up 3 of them in a mini production line.

Connector Descriptions

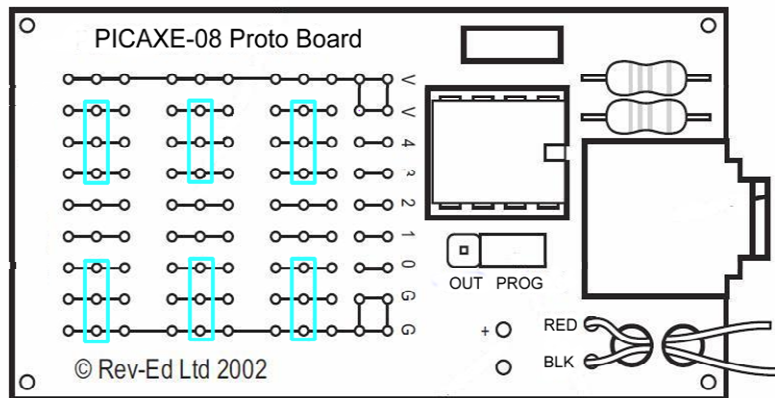


Assembly of the VLC Mark 1 – Servo version.

Take the 28 pin SIL header strip and break it into sections of 3 pins. You can either break it with your fingers or cut it with a fine bladed wire cutters.

Using the diagram below, solder the 6 off 3 pin SIL headers into place.

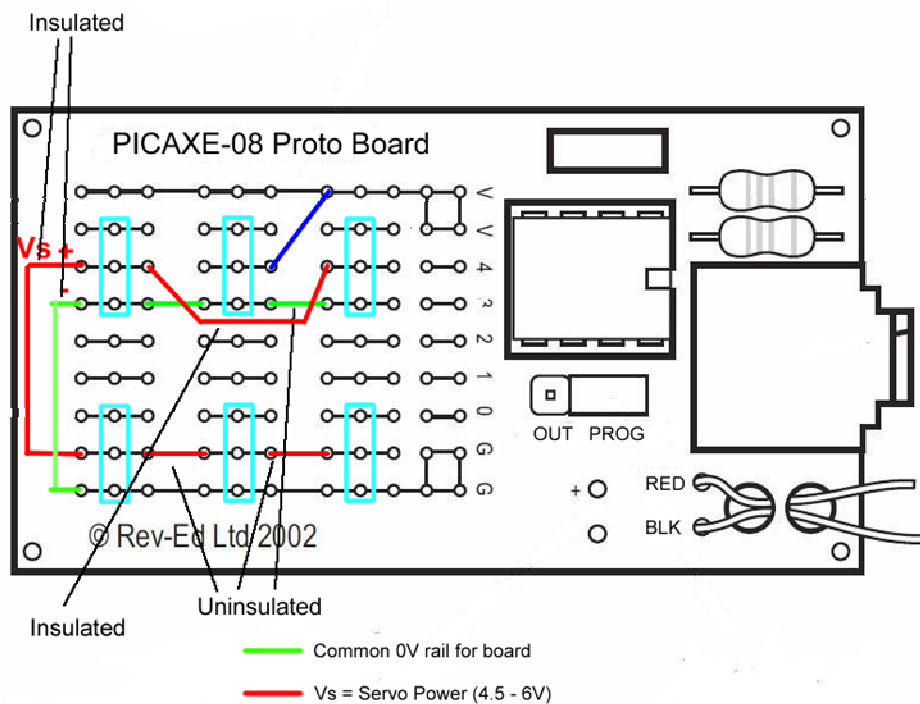
1. Solder in the 3 Pin Headers



6 off
3 pin headers

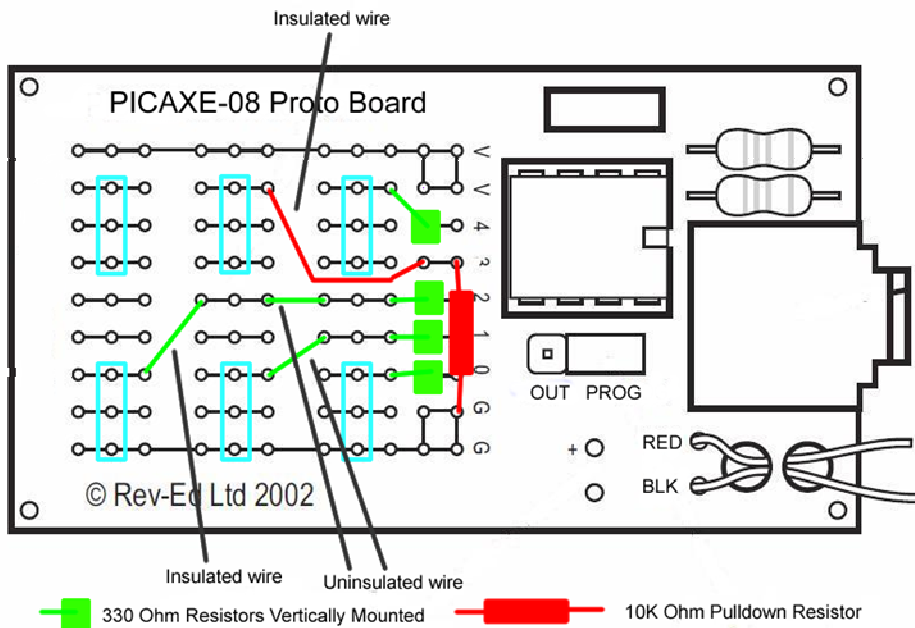
Using the bare wire remaining from the resistors, link the remaining pads as show.

2. Solder in the power lines



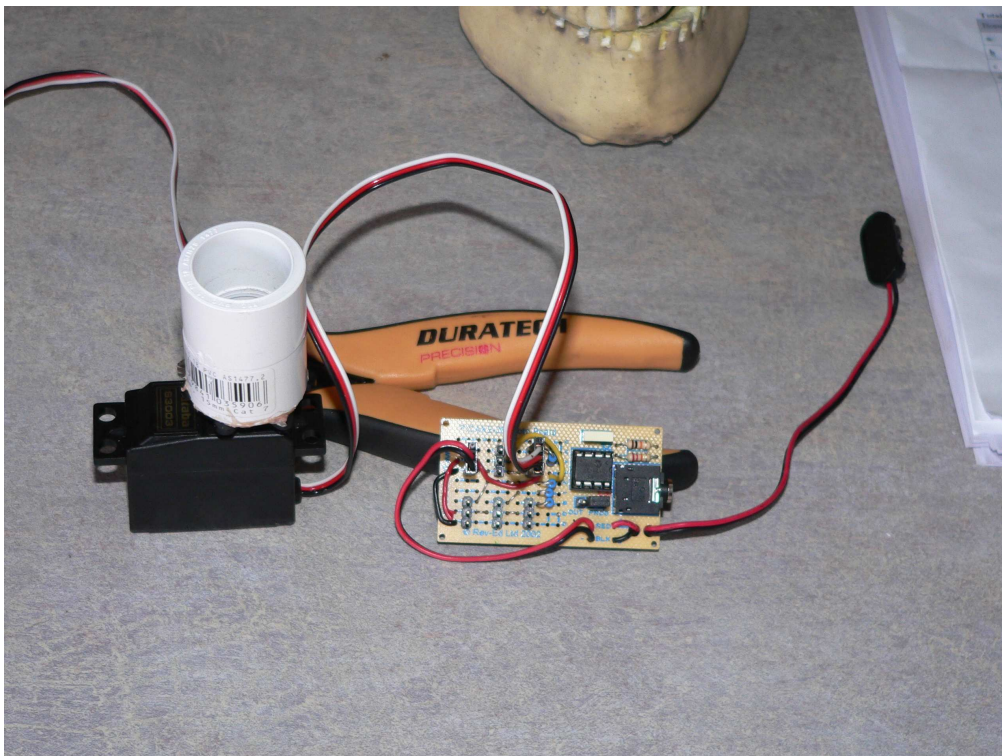
Now solder in the resistors and other wires as shown

3. Solder in the data wiring



These steps can be done in any order you find convenient.

The board should now look like this (shown with a servo attached). This is now complete and ready for basic testing. In the board below I soldered the red and black wires of a spare servo cable to the pads by the power in cable. This allows me to drive a single servo off the 4.5V battery pack just by plugging that cable into the servo power socket. This isn't recommended as some servos are electrically noisy and can interfere with the Picaxe and also servos can be power hungry and will drain the battery pack quite quickly. It does however make for easy testing.



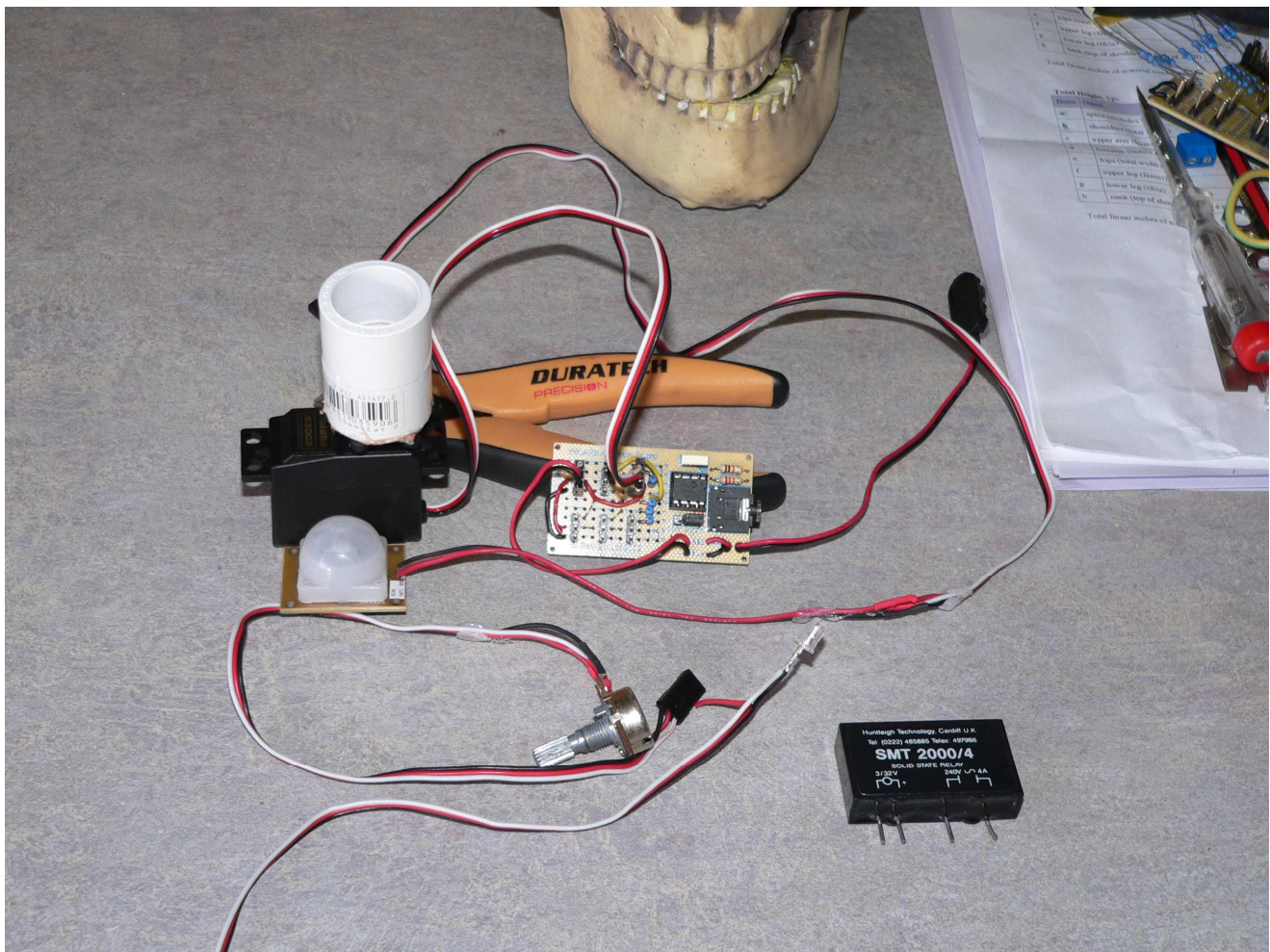
Assembly of the testing bits

While you have your soldering iron out, solder an LED to the end of a chopped off servo cable using black to shorter lead (cathode) and signal to the longer lead (anode). This is for testing the slave output (& can also be used for testing any outputs).

Also solder a 10K Ohm Potentiometer to another chopped off servo cable. Black to one side, red to the other and signal in the middle.

Also solder a push switch to another chopped off servo cable. Use Red and Signal to the N.O. (Normally Open) contacts.

Some of these are shown below – also in the picture is a PIR sensor I'll be using. The thing stuck on top of the servo is a PVC pipe connector – this board will be making a skull turn left and right randomly and the skull is mounted on a PVC pipe.



Basic Testing

Connect the processor power (the PP9 connector). Plug the comms cable in and run up the programming software.

Servo Port Testing

Input the following program and download it to the board.

```
BEGIN:  
SERVO 1,75  
SERVO 2,75  
SERVO 4,75  
PAUSE 500  
SERVO 1,115  
SERVO 2,175  
SERVO 4,225  
PAUSE 500  
GOTO BEGIN
```

If it fails to download, you may have a communications issue, refer to the Picaxe documentation to sort this out.

If the program has downloaded then testing can begin.

Plug in the servo battery source and then plug in a servo to Port 1 with the black wire towards the bottom of the board.

The servo should now start moving back and forth between 2 positions.

Move the servo to Port 2 and it should move but to a different position and then back to start and repeat.

Move the servo to port 4 and again it should move to a different position and then back to start and repeat.

This now proves that the 3 servo ports are working.

Slave Port Testing

Change the program to the following:

```
BEGIN:  
HIGH 0  
PAUSE 1000  
LOW 0  
GOTO BEGIN:
```

Connect the LED to Port 4 connector with the black lead towards the bottom of the board. Download the program. You should see the LED flash on and off at 1 second intervals.

This tests the slave out function.

Analogue Input Testing

Disconnect the LED and the Switch and plug a servo into Port 1. Plug the Pot into Port 4

Change the program code to look like this and download it.

The servo should reposition somewhere. Now if you turn the pot, the servo will move.

This finishes testing.

There you have it. For under US\$10 you have a nifty little prop controller.

ip Professional

PIR Activated Moving Head Halloween Prop

The first project I wanted to start was a PIR activated prop that randomly turned a lightweight skull via a servo. I wanted there to be a delay between the PIR activating and the head turning. I also wanted the VLC to generate a slave out signal once the head started moving (so that I could synchronize other things to happen).

I hacked a cheap battery powered PIR lamp to provide a logic level output using a voltage divider. The bulb in the lamp was a 6V unit and I needed a logic level out – 3V would be fine.

Here is the resistor arrangement:

I then took this input via a modified servo lead to Port 3 on the VLC controller. I plugged a servo into Port 1 and the LED into Port 4 to show that the slave output was activating.

I then downloaded the following code into the VLC.

```
BEGIN
For I = 1 to 60
Pause 1000
Next i
```

The second project I wanted to undertake was a simple on-off controller that could be used to control any mains powered device.

A quick trawl round eBay and I managed to source 10 solid state relays at a cost of US\$30 – individual cost of \$3. The relay inputs can be connected to the standard output of the 08M and do not need to be buffered. The relays are opto-isolated internally so are very safe to use. The relays I bought can handle 250V at up to 4A = 1000 Watts – more than enough for most lighting applications. I won't be running more than 200W through these but if I do approach the limit, I'll bond a heatsink onto the package.

I made up a mains power box using a spare PC power lead and a 2 port power socket. If you can find a distribution/power board with enough internal free space, you could build the solid state relay(s) into the board. Because I am quite safety conscious, I wired in a 4A fast blow fuse into the mains side of the power box.

