



JCM Electronic Services Vulcan 1 Construction Guide

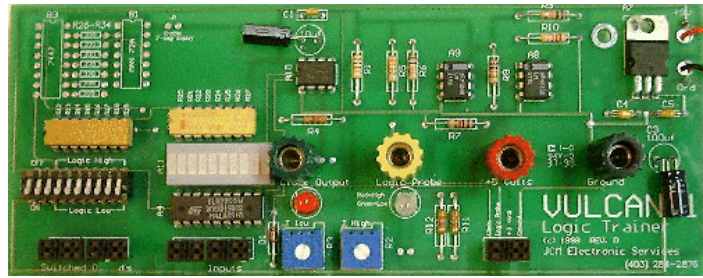
Vulcan 1 Construction Guide:

ASSEMBLY NOTES

Caution:

Building an electronic project is enjoyable, but please resist the temptation to hurry ahead and omit instruction steps. Please be sure that you:

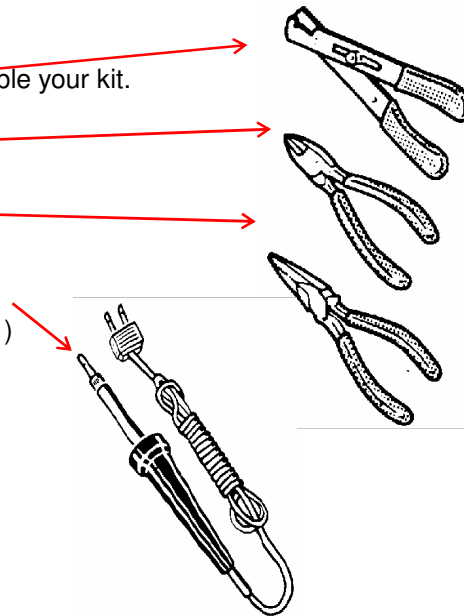
- Read all instructions carefully.
- Read the entire step before you perform each operation.
- Be careful when handling hot soldering iron. Tip temperature may approach 700° F.
- Make certain that you wear appropriate **safety glasses** at all times and work in a well **ventilated area**.
- When cutting wires, make sure that the cut end is directed away from anyone.
- **Wash your hands** after you have handled solder. Solder has a high lead content.



Tools

You will need these tools to assemble your kit.

- Wire Strippers
- Diagonal Cutters
- Long Nose Pliers
- Soldering Iron (25 to 40 Watts)



Please follow all instructions carefully, and be very careful that you **use safety glasses** at all times when building your kit! Be careful when handling your soldering iron... the tip is very hot!

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Soldering

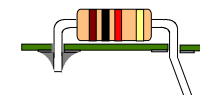
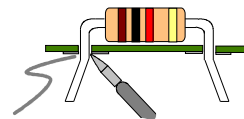
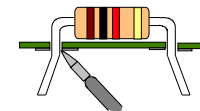
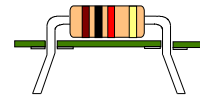
Soldering is the most important operation you will perform while constructing this kit. A good solder connection will ensure a solid electrical connection between the part and the circuit board. A bad solder joint can prevent an otherwise well assembled kit from functioning properly.

It is simple to make a good solder connection if you follow a **few simple rules**:

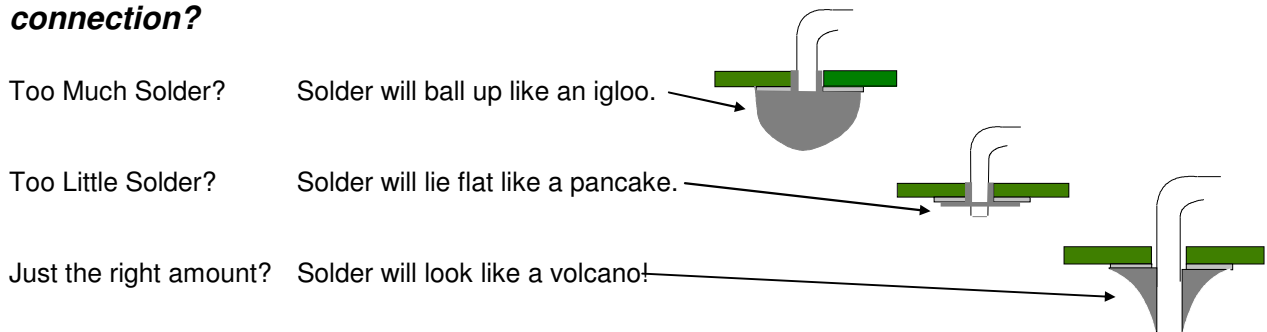
1. Use the right type of soldering iron. A 25 to 40 Watt pencil type iron intended for electronic work with a 1/8" pointed tip works best. Use a rosin-core solder on diameter approximately .081 mm and a 60/40 lead/tin ratio.
2. Keep the soldering tip clean by wiping it frequently on a wet sponge or cloth: then apply solder to the tip to give the entire tip a *wet* look. (Tinning the tip) When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and re-tinned.

How to Solder

- Install the component on the board, flaring the leads on bottom side slightly (so the part does not fall out when the board is flipped!) Flip the board upside down.
- Touch the freshly tinned solder to the point where the component wire meets the board. Hold for 1 second!
- Touch the solder to the opposite side of the component wire/board junction and allow solder to melt and surround pad entirely.
- Remove solder and soldering iron by dragging iron up the component wire.
- Clip off excess component wire



How do you know when you made a good connection?



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Component Identification

Resistors will be described by their colour-code, a sequence of colored bands which identify their resistance's. The colour lines are read from left to right with the gold or silver band being the right-most band.

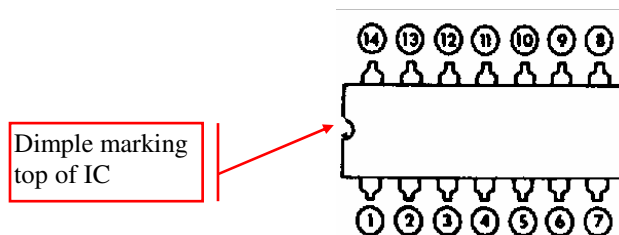
- The first two bands identify the first two digits of the resistance value.
- The third band is the number of zero's (or multiplier)
- The fourth band indicates the tolerance of the resistor and is typically gold (5%) or silver (10%)



Colour	1 st Band	2 nd Band	3 rd Band
Black	0	0	No Multiplier
Brown	1	1	0
Red	2	2	00
Orange	3	3	000 (K)
Yellow	4	4	0,000
Green	5	5	00,000
Blue	6	6	000,000 (M)
Violet	7	7	0,000,000
Gray	8	8	00,000,000
White	9	9	000,000,000

Example: Brown, Black, Red, Gold = 1 0 00 (5%) = 1000 ohms (1K)

Integrated Circuits will be called out by their part number, found printed on the top of their case. Pin numbers of the integrated circuits always start (1) with the top left pin and number counter-clockwise around the chip. The top of the chip is always identified with a dimple or notch.



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Capacitors will be called out by their capacitance value in uF (microfarads) or pF (picofarads) and type: monolithic or electrolytic. The larger electrolytic capacitors will have their values printed on them and have the negative lead marked with a large white arrow. The small Monolithic capacitors will be labeled as 103 (1×10^3 pF) or 102 (1×10^2 pF) and have no polarity.



**Electrolytic
Capacitor**

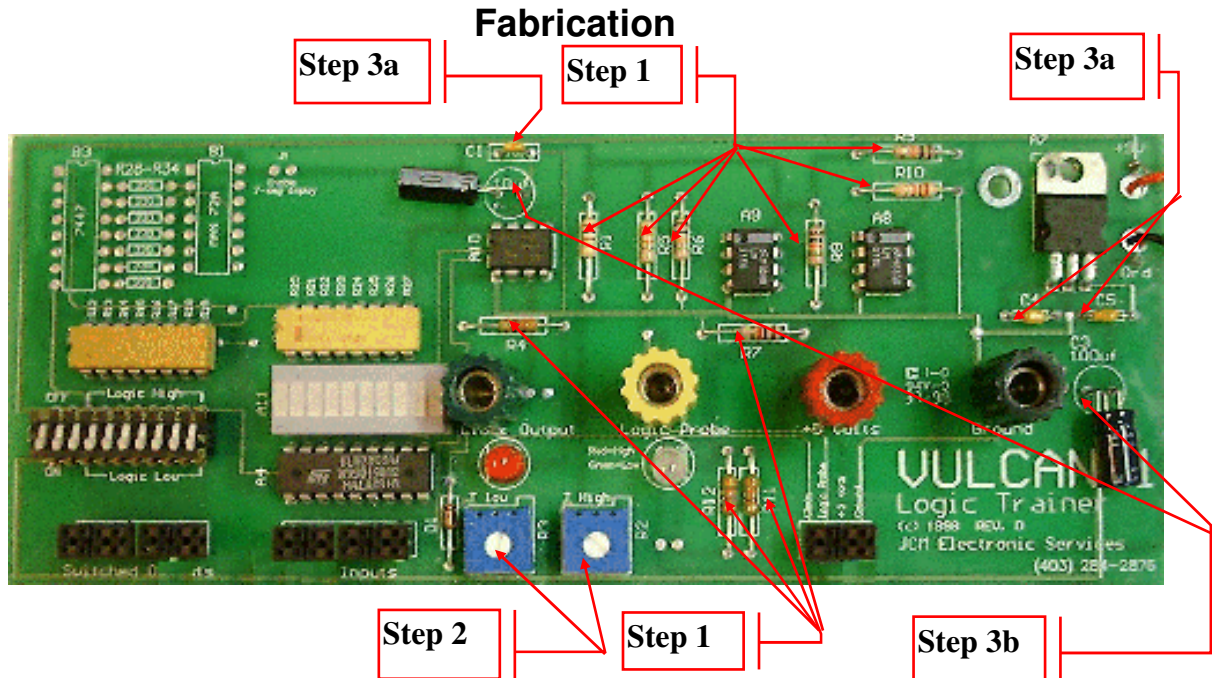


**Monolithic
Capacitor**

Parts list for Vulcan 1 Digital Logic Trainer

Part Designator	Item And Full Description	Component Label
A1, A2	four 2x4 straight female headers	None
A3	10 position dip switch	None
A4	uln2803a (Darlington Driver Pack)	ULN2803A
A5	4700 Resistor Pack (DIP 16 isolated)	472G
A6	330 Resistor Pack (DIP 16 isolated)	331G
A7	MC 7805 Voltage Regulator	7805A
A8, A9	311 TC Op Amp	LM 311N
A10	555 Timer (MC 1455)	555
A11	10 Segment Bar LED (Red or Green)	None
A12	BI Leds (Two Colour LED appears white)	None
A13	Red LED	None
C1, C4	.01 Ceramic	103
C2	10 uF Electrolytic ($\geq 10v$)	10 uF
C3	100 uF Electrolytic cap ($\geq 10v$)	100 uF
C5	0.1 uF Ceramic	104
R1	100 Ohm 1/4 Watt	Brown Black Brown Gold
R4, R11, R12	330 Ohm 1/4 Watt	Orange Orange Brown Gold
R5	33K Ohm 1/4 Watt	Orange Orange Orange Gold
R6, R9	10K Ohm 1/4 Watt	Brown Black Orange Gold
R7, R8	1K Ohm 1/4 Watt	Brown Black Red Gold
R10	2.2K Ohm 1/4 Watt	Red Red Red Gold
R2, R3	50K Potentiometer	
D1	1N914 diode	None
	9V Battery Clip	

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Step 1: Install all resistors...

Neatly bend the leads of the 10 resistors and place them in the correct location on the circuit board. You may wish to spread the leads slightly apart on the back side of the board to prevent the resistors from falling out when the board is turned over for soldering.

Designator	Resistor	Colour Code
R1	100 Ohm (5%)	Brown Black Brown Gold
R4, R11, R12	330 Ohm (5%)	Orange Orange Brown Gold
R5	33,000 Ohm (5%)	Orange Orange Orange Gold
R6, R9	10,000 Ohm (5%)	Brown Black Orange Gold
R7, R8	1,000 Ohm (5%)	Brown Black Red Gold
R10	2,200 Ohm (5%)	Red Red Red Gold

Invert the board and solder all resistors in. Use sidecutters to clip off leads as close to the board as possible.

Step 2: Install the two potentiometers

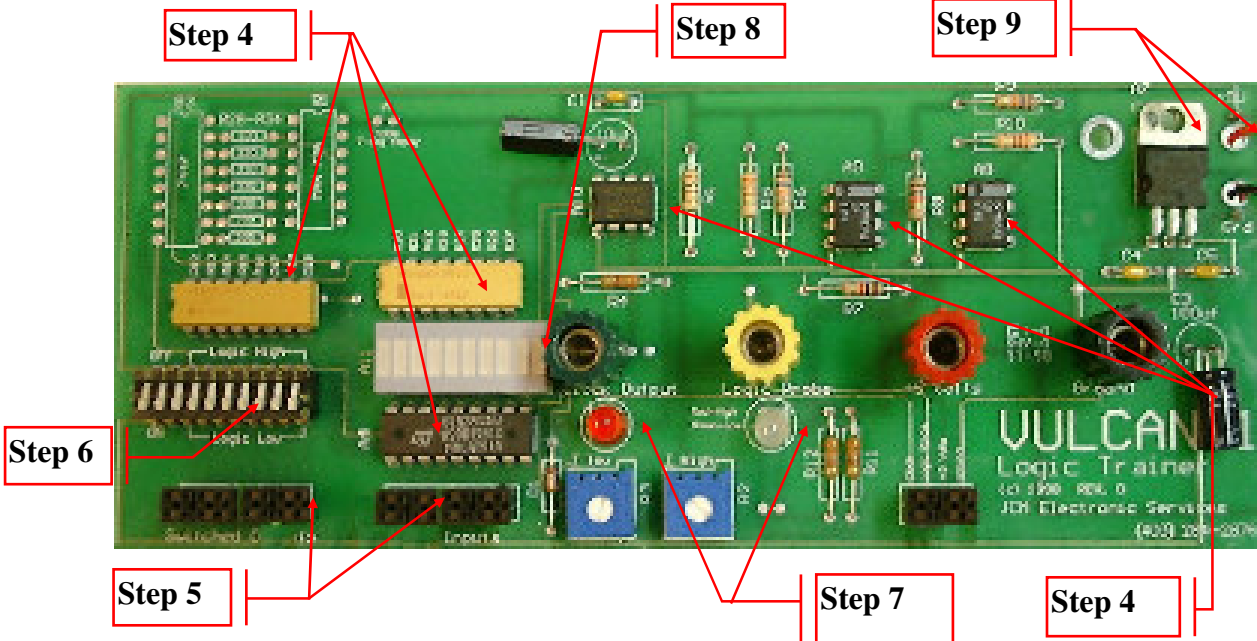
Insert the two potentiometers (50K ohm) into the squares indicated R2 and R3. Invert the board and solder.

Step 3: Install all capacitors

Step 3a: Install Monolythic capacitors C1 (103), C4 (104), and C5 (103). These parts are not polarity sensitive. Invert board, solder, and cut excess leads as close the board as possible.

Step 3b: Install electrolytic capacitors C2 and C3. **These components are polarity sensitive. Negative lead is clearly marked on the capacitor.** . Invert board, solder, and cut excess leads as close the board as possible.

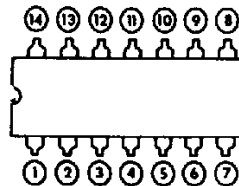
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Step 4: Install the DIP Packages

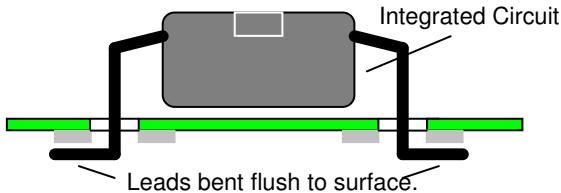
Caution: Polarity Sensitive Components! Make sure that dimple on top of IC packages aligns with dimple marked on boards white silk-screen.

Dimple marking top of IC



Carefully insert the IC's (Integrated Circuits) into the correct location on the board.

When you install the integrated circuits on the printed circuit board (PCB), fold the pins flush with the solder side of the board before soldering. (This will allow a tighter fit when the VULCAN mounts on the GSP board).



You will notice that several numbers appear on each integrated circuit package. Many of these numbers are only production date codes and manufacturer logos. For instance, A9 is a 311 type op-amp, but the package may show LM (Linear device) 93A34 (Made 1993, 34th work week) and

'ti' (Texas Instrument made this part) in addition to the desired 311 part number. A sharp eye should find the numbers shown in the Component Label column of the parts list (Table 1).

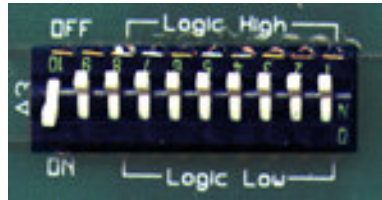
Step 5: Install the headers

Mount and solder the four 2x4 headers in locations A1 and A2. Two headers are required for each bank.

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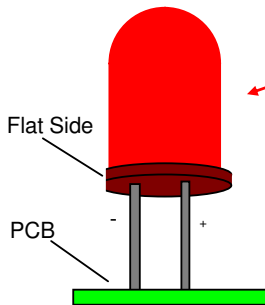
Step 6: Install the DIP switches

The 10 position DIP switches is installed as component "A3". It is **important** that the switches be installed **UPSIDE DOWN** (with switch 1 on the RIGHT!). Fold the leads flush to the board and solder.



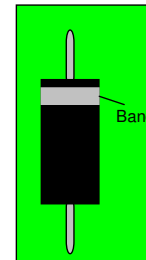
Mount switches upside-down!

Step 7: Install the LED's and diodes



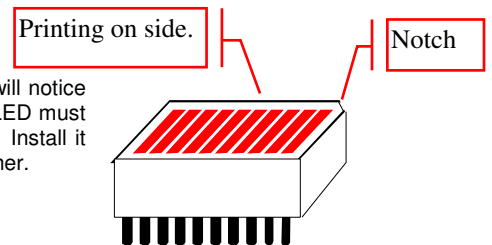
A12, the white Two-colour LED, and A13, the RED LED, are polarity sensitive so care must be taken when installing these. The negative side is the wire closest to the "flat side" of the plastic base of the LED. This flat side must be lined up with the white line on the boards silk-screen. (Left side for clock, right side for logic probe LED). After soldering, cut excess leads close to PCB.

The Diode (D1) is another **polarity sensitive** component. It must be installed with the band on the TOP side of the diode. Solder and cut excess wire.



Step 8: Install the BAR LED display

The polarity of the BAR LED is also important! If you study the package you will notice that one of the long sides has text printed on it, and the other doesn't. The BAR LED must be installed with the side with printing on it closest to the top of the circuit board. Install it backwards and they won't work! There is a small notch on the upper right hand corner.



Step 9: Install voltage regulator and connector

A7, the 5 Volt regulator, is prepared for placement by bending the three leads 90 degrees backwards at the point where the leads narrow. The component is then laid flush onto the circuit board (printing side up) and soldered into place.

The 9 volt battery clip is soldered as follows: Black wire to hole marked Grd and Red wire to hole marked +9V. You will find that some strain relief must be provided on these wires or they will quickly break off. A good way of providing strain-relief for these wires is to loop the wire through the large holes by the +9V and Grd solder pads before soldering them into the pads themselves.

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Testing the Vulcan 1

Before mounting your VULCAN 1 on the breadboard platform, you should first test out the operation of the circuit.

Voltage Regulator Test:

Attach a fresh 9 volt battery to the clip. Turn on the Vulcan trainer using the on/off switch on the left side of the Switched Output switches. The first sign of success will be a flashing red Clock Output LED. If you have a voltmeter available to you, check the voltage between the +5 Volts Pad and the Ground pad. It should register very close to +5.0 Volts.

Clock Output Test:

Adjust the potentiometers R3 and R2 and notice change in frequency / duty-cycle of the LED.

Logic Probe Test:

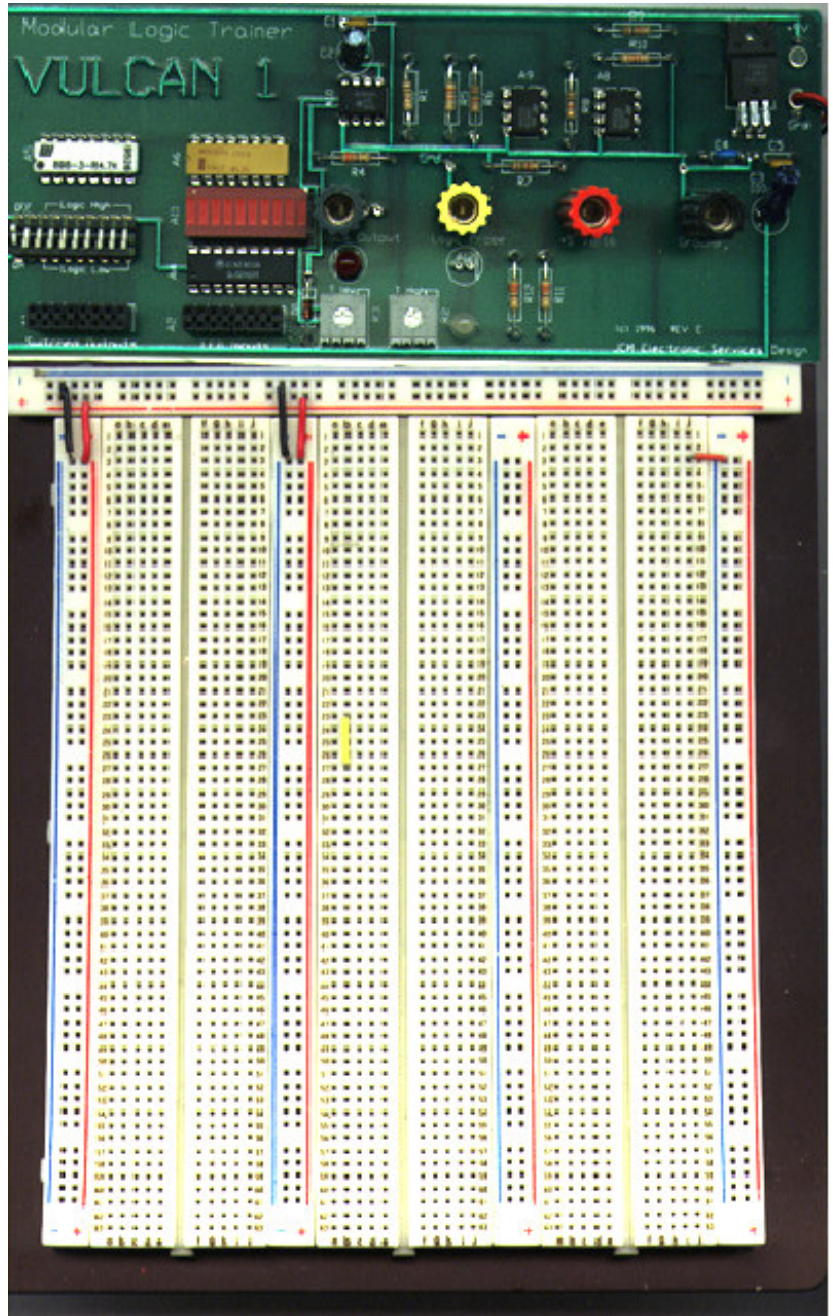
Run a wire between the Clock Output pad to the Logic Probe pad on the PCB. The white two-colour LED should flash green, then red. When the wire is removed, the two-colour led should be extinguished.

Switched Output Test:

Connect one end of the wire to the logic probe and insert the other end in the first switched output header. Move the associated switch up and down. With the switch in the down position, the logic probe should indicate Green (Logic Low). The switch in the up position should show a Red Light (Logic High). Repeat this test for each of the 8 switched outputs.

LED Input Test:

Connect one end of the test wire to the Clock Output pad. The other end should feed into the first LED input header hole. This connection should cause the first BAR LED to flash on and off in time to the Clock Output. Repeat this test for all 7 LED inputs.



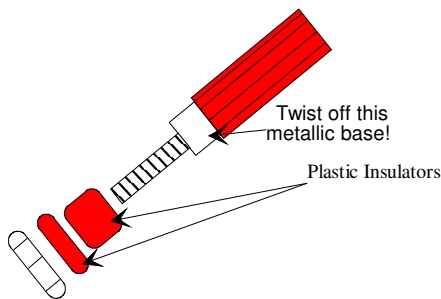
Vulcan mounted on optional GSP board

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Mounting the Vulcan on optional breadboard

The VULCAN 1 has been designed to mount firmly on the top of the GSP Model GB2-354 "Wishboard" which is available from Active Components distributors. (Active Component Part Number 70H07)

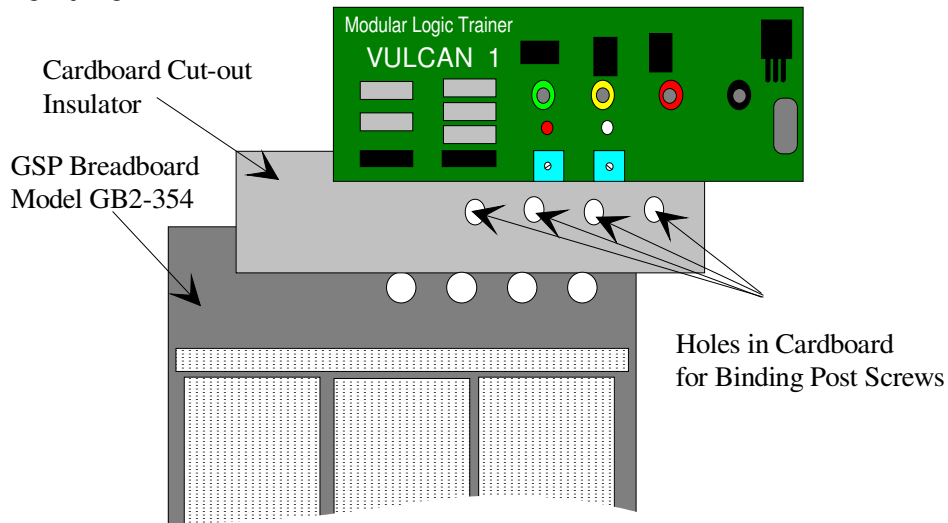
To install the VULCAN 1 on the GSP prototype board, it is important that an insulator separates the solder side of the printed circuit board from the conductive surface of the GSP chassis. We can fabricate this insulator by taking the cardboard backing from the GSP package (or any thin cardboard sheet) and cutting a rectangular area 2 inches by 6 inches.



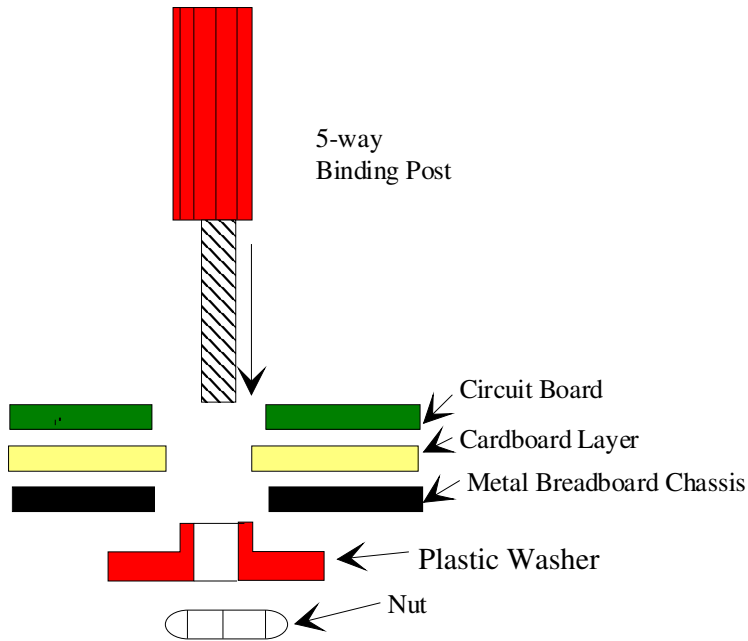
Now, if they are not already off, take off the four five-way binding posts from the top of the GSP board. Remove the nuts and the plastic washers from the binding posts as well as the small plastic base insulators. (These base covers *must* come off to ensure that our binding posts make good electrical connection with the pads on the printed circuit board, so don't forget

to remove them!) This base cover can be re-cycled by putting it upside down over the two LED's on the VULCAN1 board. They make ideal supports!

Find the cardboard insulator you cut out. You will have to add the four holes in the cardboard to allow the 5-way binding post screws to pass through. Try to make the holes as close to the diameter of the screws as possible. We have to make sure the screws don't touch the metal chassis of the breadboard, or your trainer won't work!



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The screw of the binding posts should pass through the circuit board, cardboard, and GSP board as shown on the left. The plastic washer **MUST** be placed on before the nut to ensure that the screw does not contact the metal breadboard chassis!

This completes the assembly and installation of your new VULCAN 1 modular logic trainer. I hope that you enjoy this useful product and that you have many hours of digital experimenting!

Should you have any problems with the product, please feel free to phone me at the following number, and I will be happy to assist you.

Craig Maynard
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