NovaMod

SH-101 Modification Instructions
Version 2.0

The Lab

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Overview

The NovaMod is a collection of simple “do it yourself” modifications for the Roland SH-101 synthesizer. These modifications allow the SH-101 to create more sounds as well as interface better with external devices.

The complete NovaMod is a some what difficult modification for a beginner to do however one can easily choose to do only the easier parts of the NovaMod initially and continue with the difficult parts at a later date.
It is strongly recommended that the person doing the NovaMod is:
- capable of completely disassembling and reassembling an SH-101 synthesizer
- familiar with electronic components and concepts
- has experience with soldering/de-soldering components; cutting circuit boards; cutting traces...etc

The Lab does not take responsibility for damage done to synths while attempting the NovaMod however, The Lab will do it's best via email support, to answer any questions regarding a NovaMod.

Although the last sentences sounds pessimistic, the NovaMod is certainly a satisfying modification and well worth the effort.

History:
The NovaMod has been in existence since 1995. During the first two years, The Lab had been doing private modifications for friends with much positive feedback. This inspiration lead to sharing the mod by posting sketchy notes on the Internet. It was a simple Word 6 document with spartan details, lots of typos and a few mistakes (oops!). Surprisingly, many people successfully used the document to complete their own NovaMods. Following even more positive feedback, a better html based step-by-step instruction with drawings, photos and scans of the schematics was created an put on line. This document seemed to be very popular but the medium proved too awkward to maintain. This present document is the replacement and is most likely the final format.

As with each revision, new features have been added. The NovaMod gas grown from 5 mods to over 15!

Good luck with your NovaMod!
Philip Pilgrim

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Features

FM of VCF (amount and source selection)
Amazing and aggressive new sounds are now added through this feature. Six FM sources are available.

Pulse Width Mod source selection
Now you can choose a pulse width source. It is independent from the LFO's waveform setting. OSC sources are included

External Audio In
The ability to route a signal into the audio path is now provided. Don't forget feedback loops using headphone out! Routing of external audio to frequency modulate VCO is also implemented. An envelope follower is also included.

Envelope #2 (AR type)
A discrete ARP Odyssey AR envelope can be used to drive the VCA. This free's the ADSR for complex VCF modulations. The AR envelope also re-triggers.

Pulse width to near 0%
Pulse width effects are now made more extreme and powerful

External LFO Clock input
Syncing the Arpeggiator and LFO to external drum modules and sequencers is now possible. As well, interesting feedback loops can be created. Even triggers by 1V or less audio signals.

External VCF CV input
Just plug in a foot pedal or a CV from a midi converter and your SH-101 will be even more expressive.

LFO rate scalar (lo, normal, high)
Ever hear a bell sound out of a 101? Try this on Hi! Want a really slow sweep...you got it too!

VCO mod source selector (LFO or Env.2)
Simply an auto pitchbend-like feature when Env2 is used.

Manual accent button and amount
An Accent button is added for manual increase of volume. A pot controls amount. Lots of fun live.

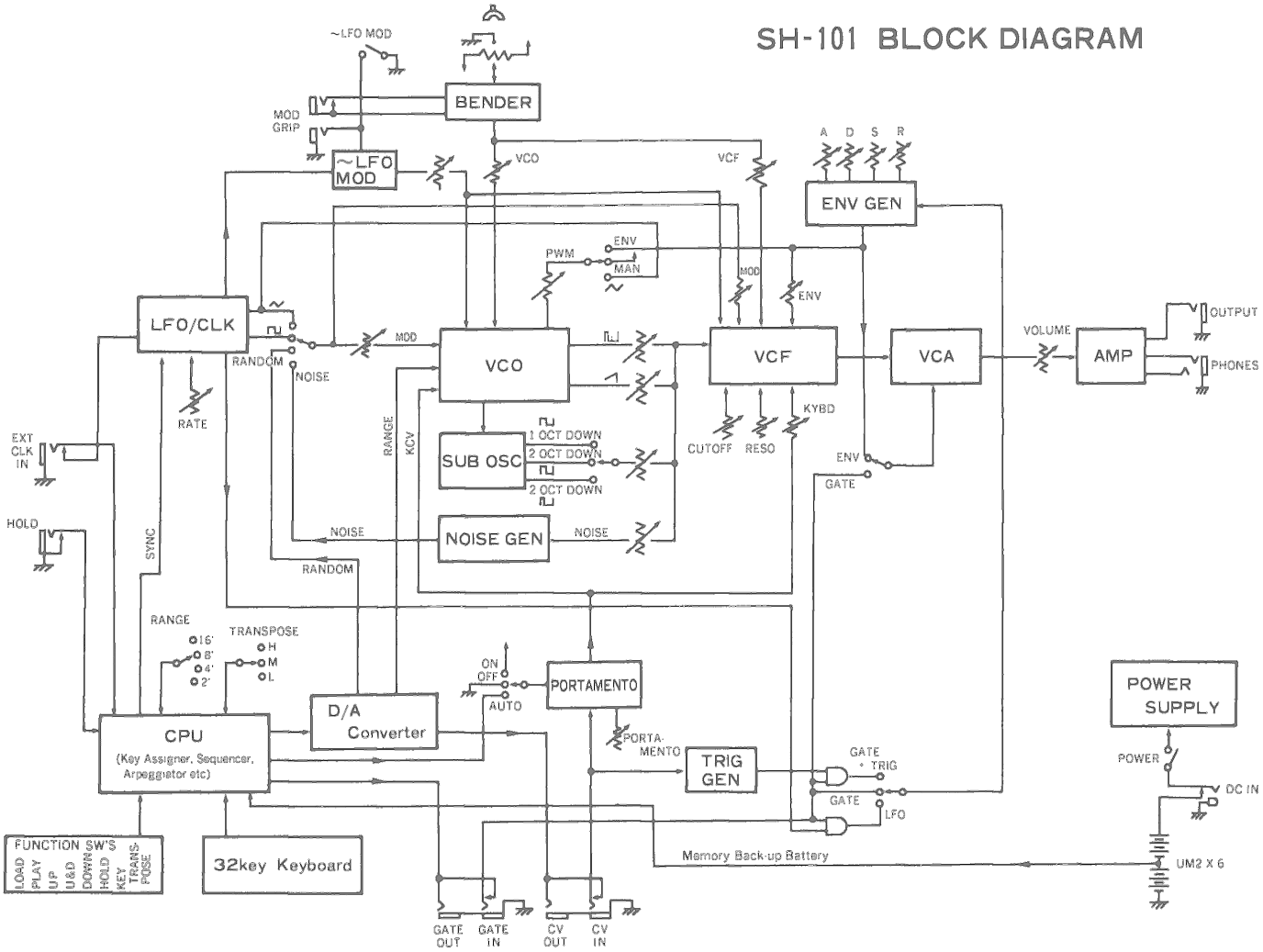
1/4" CV/Gate input/outputs
Aren't we all tired of those miniphono plugs? They should only exist on walkmans.

1/4" portamento control
Now you can use your computer sequencer and a MIDI to CV converter to create complex sequences with slides. Like a 303 but far more powerful sonically and musically.

1/4" accent control
Now you can use your computer sequencer and a MIDI to CV converter to create complex sequences with accent. Like a 303 but far more powerful sonically and musically.

Overdrive
Overdrive the VCA...borrowed from 22Hz's MC-202 mods! Results in a nice saturated sound.

Resonance Boost
With this, you now can peel paint off walls! Watch your ears!



Parts List:

Part	Value	Quantity
Capacitor (electrolytic Non-Pol)	0.01uF	1
Capacitor (electrolytic Pol)	3.3uF 20V	1
Capacitor (electrolytic Pol)	0.47uF 50V	1
Capacitor (electrolytic)	4.7uF 16V	1
Circuit Board		1
Colour Coded wire 6’		1
Decals		1
Diode	1N4148	3
Pot Rotary	100K Linear	3
Pot Rotary	1M Audio	2
Resistor	100k 1/2watt	3
Resistor	51k 1/2watt	1
Resistor	150k 1/2watt	1
Resistor	220R 1/2watt	2
Resistor	680R 1/2watt	3
Resistor	1k 1/2watt	2
Resistor	15k 1/2watt	1
Resistor	47k 1/2watt	2
Switch (N/C momentary)		1
Switch (toggle) SPDT		3
Switch Rotary (2pole,6 position)		2
Switch SPDT (on-off-on)		1
Nylon Hardware		2
Transistor NPN	2N5172	2
Transistor PNP	2N4126	3
Knobs	blue	8
1/4” Chassis Jack (with DPDT switch)		1
1/4” Chassis Jack mono		6
1/4” Chassis Jack mono (closed circuit)		2
+5v relay		2

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Recommended Tools:

1. scissors
2. tape (scotch tape and electrical tape)
3. awl (or sharp pointy object for pressing drill points into plastic chassis)
4. drill press
5. metal file
5. drill bits 6mm, 8mm, 9mm, 10mm, 13mm
4. soldering iron
5. de-solder tool
6. edge cutters
7. wire strippers
8. ruler (metric)
9. needle nose pliers
10. vice
11. hack saw
12. Grinder
13. Xacto knife
14. permanent marker black
15. glue in aerosol can
16. glue or epoxy ("Goop" brand recommended)
17. multimeter

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Terminology:

Lug: solder connection point on a switch or pot

Clockwise/Counter Clockwise: with respect to switches and rotary pots, the clockwise (cw) position is referenced from an operators position who is turning the control. Full Clockwise (cw) rotation is typically "10" or "Max". Counter Clockwise (ccw) is typically "0" or "Min"

Synth Body: plastic chassis of the SH-101

Wire Colours:

green -	grn
black-	blk
yellow-	yel
gray-	gry
red-	red
blue-	blu
orange-	org
brown-	brn
white-	wht
purple-	pur

A (red/wht) wire is a white wire with red rings. Read as “red on white”.

Component Side: the side of a circuit board which holds the components (resistors, ICs, capacitors ..etc.).

Solder Side: the side of a circuit board with the solder and leads/legs of the components. (usually green)

Solder Mask: the green protective coating over the traces on the solder side of a circuit board

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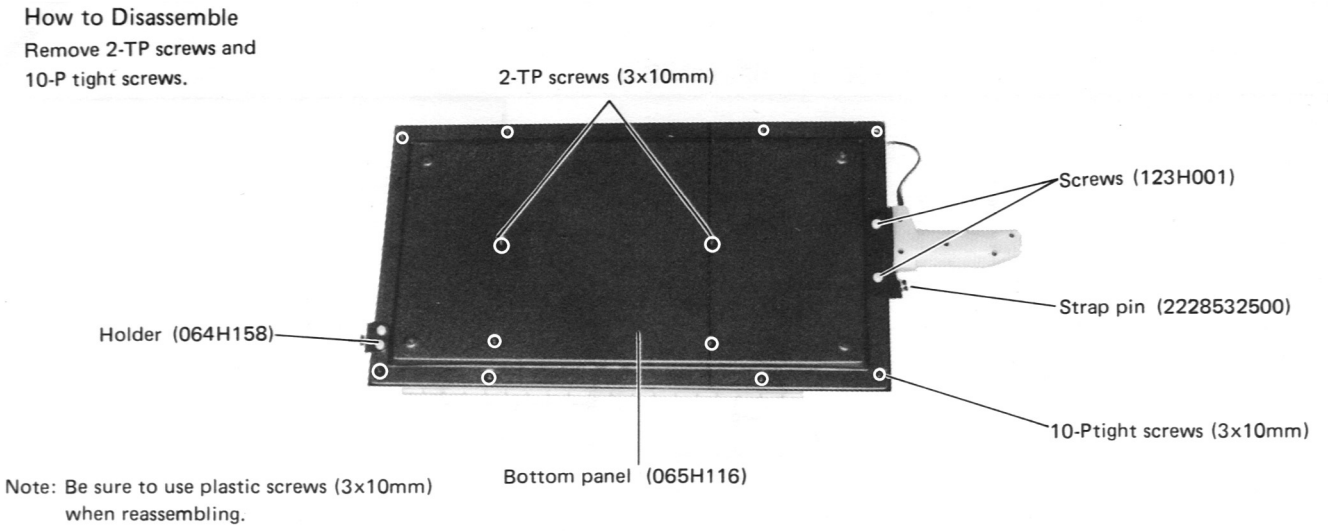
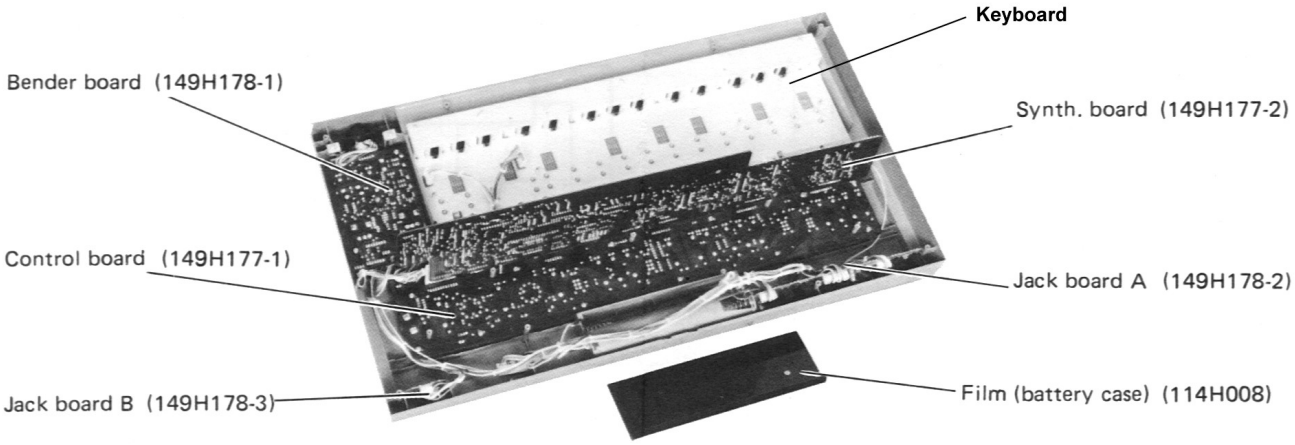
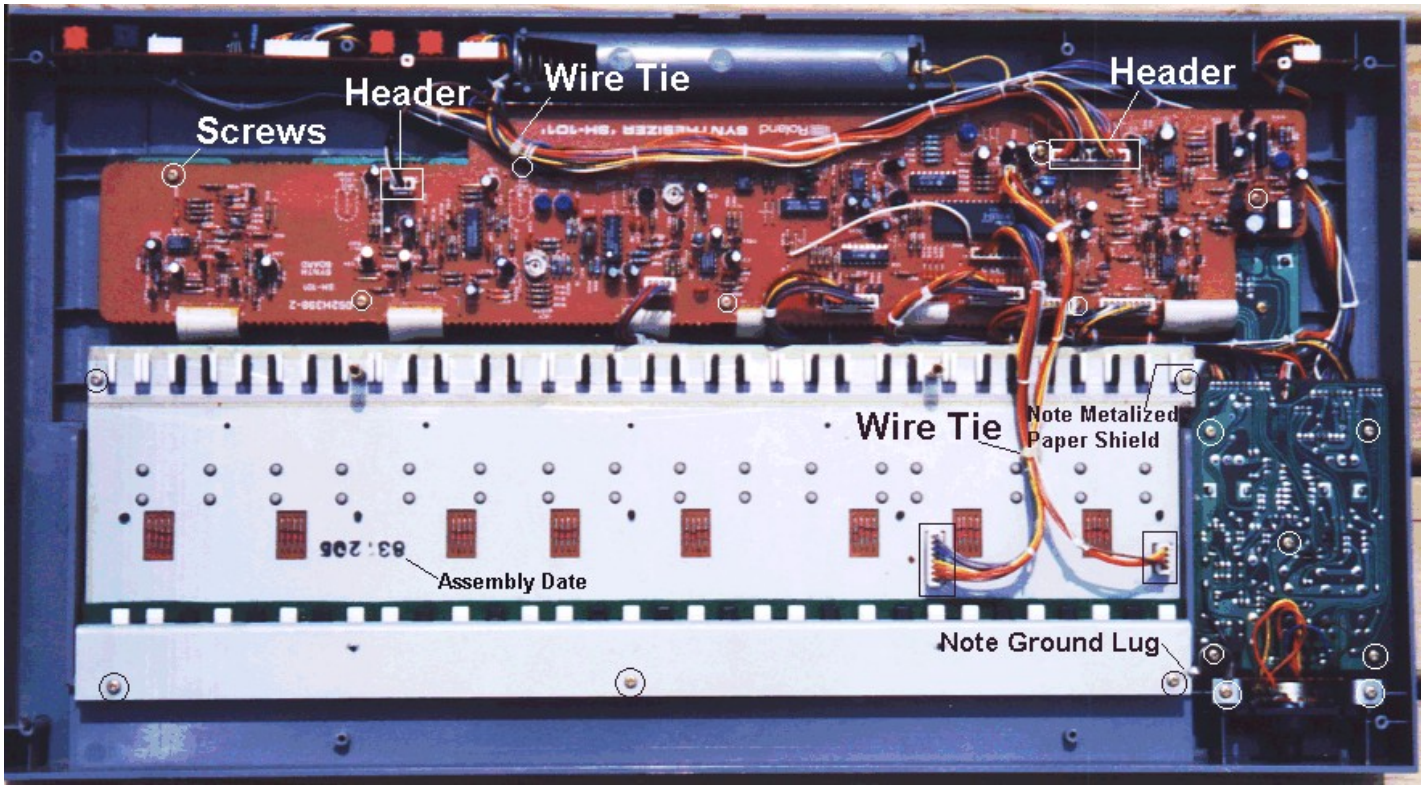
1. Remove all slider caps and rotary knobs.

Slider Colour	Quantity	Location
Green	5	LFO/CLK Rate, Pulse, Saw, Sub, Noise
Yellow	4	PW Mod Src switch, Sub Osc Oct switch, VCA mode switch, Env Trigger switch
Orange	14	All other sliders

2. Remove bottom panel. (10 black screws and 2 black machine screws)



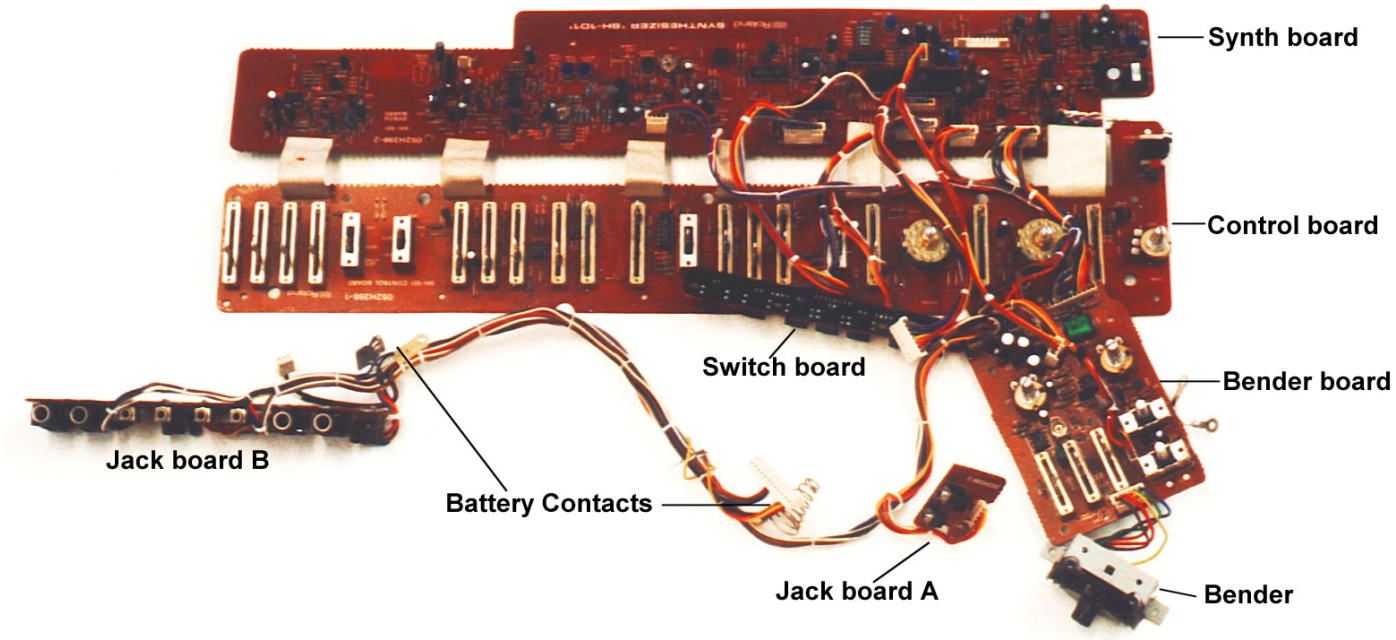




3. Clip wire tie holding two wire harnesses to keyboard.
4. Clip wire tie holding main wire harness to synth board.
5. Disconnect two header connectors on keyboard board (4pin and 8pin).
6. Disconnect two header connectors on synth board (one near C55 (3pin) , the other (12pin) near C12).
7. Remove 7 screws that hold synth board in place.
8. Remove 5 screws that hold bender board in place. (note Gnd lug connecting bender and keyboard)
9. Remove 2 screws that hold pitch bender in place.
10. Remove 5 screws holding keyboard in place. (note metalized cardboard shield from arp switch board)
11. Lift up and remove keyboard. (grasp brass stand offs)
12. Flip up synth board from battery compartment side to expose the control board.
13. Remove plastic battery drip protective film.
14. Remove 13 screws that hold the control board in place.
15. Pull battery contacts from their slots with needle nose pliers
16. Remove two jack boards.(note later SH-101's have a metal plate)
17. Gently lift up bender board, pitch bender, control board, and jack boards to allow access to the switch board.
18. Remove 4 screws to switch board.

19. Carefully remove all components from SH-101's plastic chassis:

Make notes of locations of parts so that re-assembly will be trouble free.



Note two rubber dust covers on Bender boars switches. Soaking in water will soften.

NovaMod Step 2

The Lab SH-101 Synthesizer Modifications Rev 2.0 **26/06/15**
Mechanical Repair and Cleaning

Since your SH-101 is apart, now is the best time to repair any mechanical problems and clean it.

Mechanical Repairs:
1. Bent Slider Shafts:
   a. Using needle nose pliers, grasp shaft as close to slider body.
   b. Gently straighten shaft by applying pressure to it's tip with a finger or pliers.

2. Non- Functioning Controls (switches, pots ..etc.):
   a. Inspect and repair any cracked solder joints.

b. If solder joints are ok then you should order the replacement control from your nearest Roland Service Center. Before ordering a linear slider, you may wish to attempt repairing it yourself. Simply de-solder it and carefully take it apart. Be sure to note the orientation of the body, shaft, leaf springs, wipers, Teflon anti-stick bushing and phenol board with tracks. The common problem with SH-101 sliders is poor contact between the wiper and tracks. This is often the result of a blow to the shaft which bends the wiper and leaf spring. To repair simply reshape the leaf spring and wipers with a gentle force. You should also clean the slider components with isopropyl alcohol. A small amount of silicon gel (the kind recommended for pots can be applied sparingly to improve slider action. Use a multimeter to verify repair's success before re-installing.

3. Broken Keys:
If the pieces of the damaged key are still in the synth or have been saved, simply remove the rest of the key, glue it, then re-install. If this is not possible, order new keys from your nearest Roland Service Center.

4. Battery Acid Damage:
a. Clean as much acid/crust off the circuit boards.
b. Scrub the area with baking soda and water.
c. Rinse with isopropyl alcohol.
d. Allow to dry.
e. De-solder and replace any damaged components.
f. Use wires to jumper around damaged traces.

Cleaning:

1. Bath plastic body, knobs and slider caps in a sink full of warm soapy water.
2. Use a tooth brush to remove dirt from the grooves of the slider caps and from the knob indicators as well as from the module dividing grooves in the synth body.
3. Rinse the above components with water and dry.
4. Use a dry tooth brush to remove any dirt from the sliders, pots, switches on the control board.
5. Wipe keys with a clean cloth and a cleaner. (I like to use "tough and tender" melaleuca cleaner)

NovaMod Step 3

The Lab SH-101 Synthesizer Modifications Rev 2.0 **26/06/15**
Drilling Body and Trimming Plastic

Do not attempt to drill a SH-101 with any of the circuit boards installed!

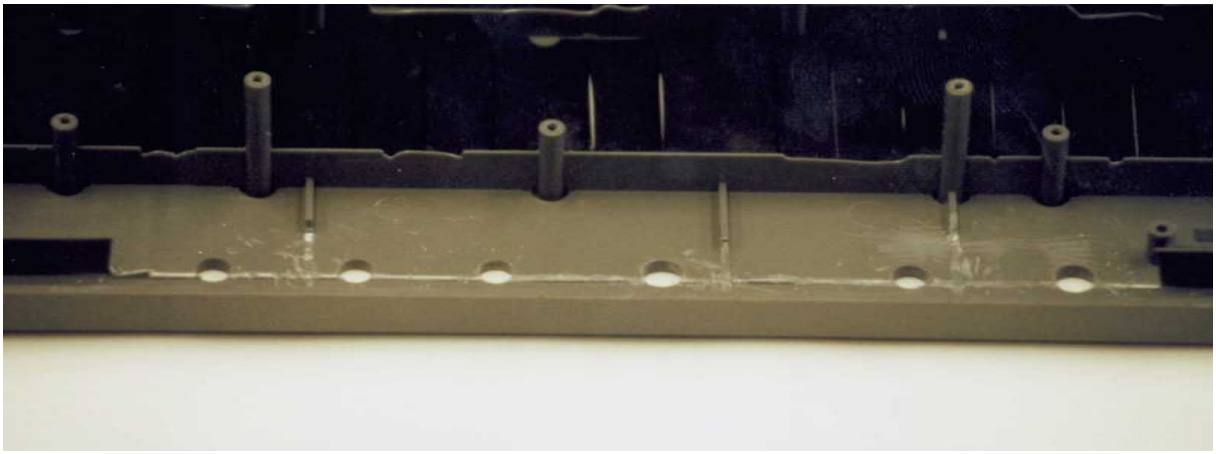
1. With scissors, carefully cut out paper drill templates and tape to main body.

Please pay close attention to alignment and orientation otherwise decals may not fit properly

2. Use awl or sharp object to indent plastic in main body at drill centers.
3. Remove paper template
4. Drill Holes (diameters are on paper drill templates). For better accuracy drill 3mm pilot holes first.

Don't forget to drill out the c.v. and gate in/out jacks if you plan to use 1/4" jacks.

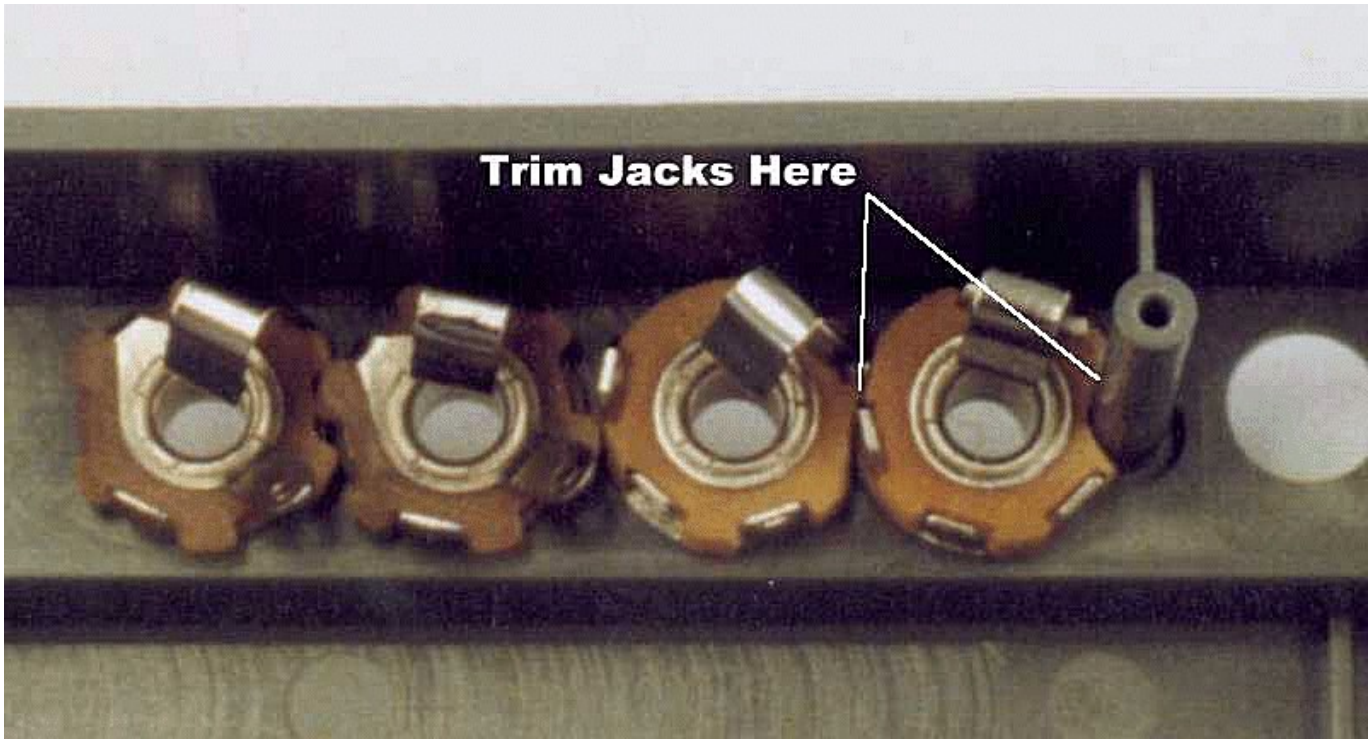
5. Cut away plastic structural bracing in the vicinity of the new pots and switches to be mounted under the Source Mixer, VCF, and VCA sections (Drill Template 1). Use a sharp Xacto knife to score the plastic, then carefully bend it until breaking. Take care not to force the plastic; damage to the top surface may result.

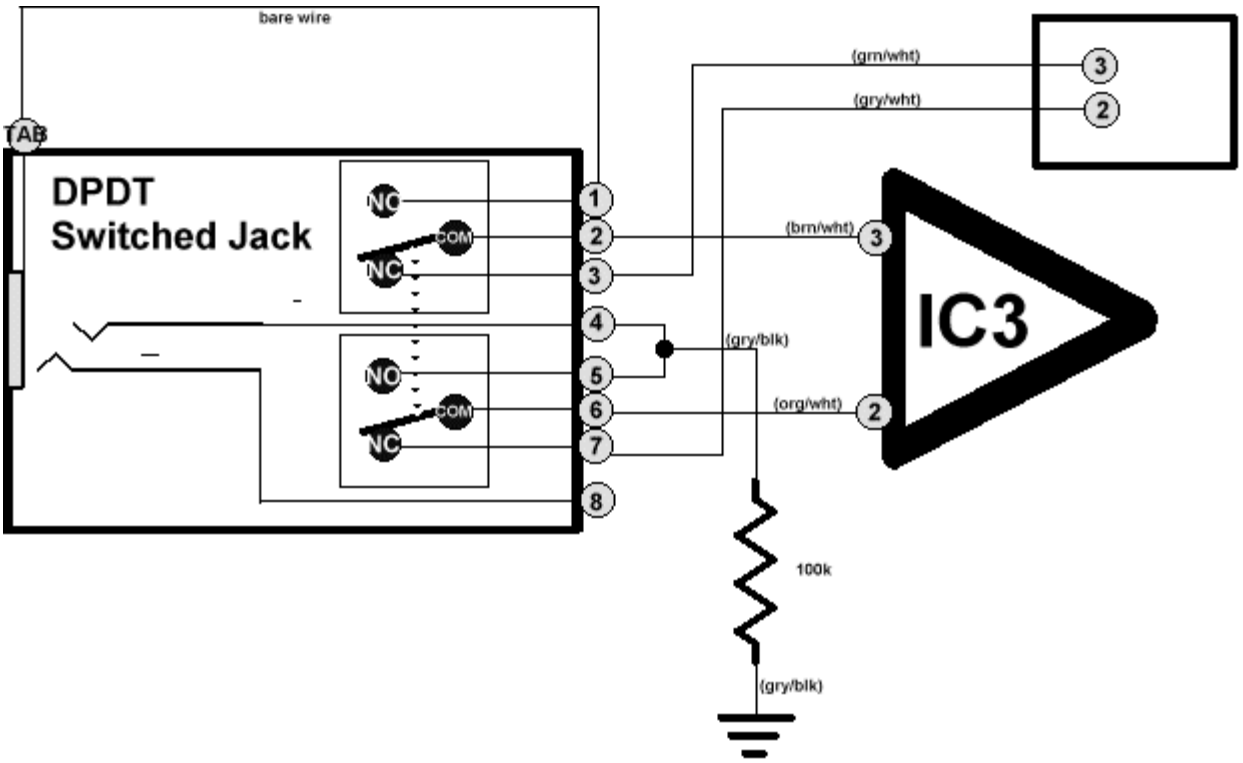


now.

1/4" jacks for CV/Gate mod will be mounted in step 18. At this point just ensure that the holes are large enough to fit the jacks in.

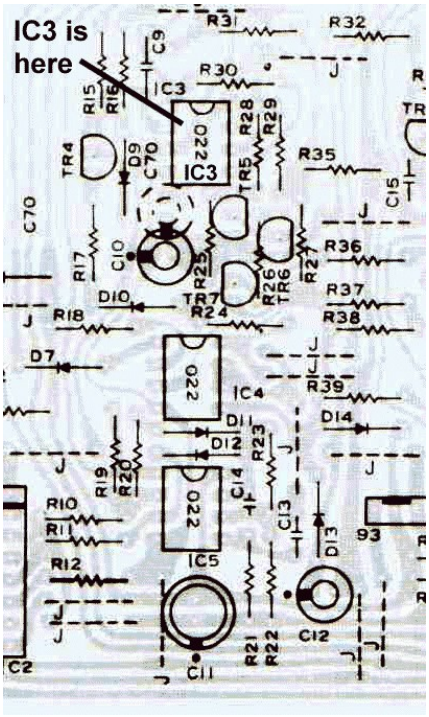
2. Test fit 1/4" jacks in synth body. C.V./gate ins are the 2 conductor shorting type while C.V./gate outs are regular 1/4" jacks. Tip contacts go to back of synth.
3. Carefully grind or file the C.V. in jack to allow clearance for the adjacent gate in jack as well as the plastic post. Grinding of other jacks may be required.





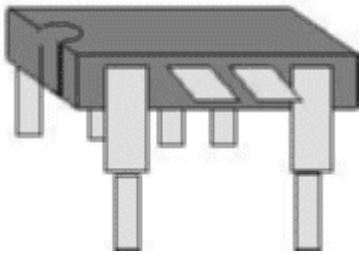
Part1 (IC3 rework)

1. On Synth board, de-solder op-amp IC3.

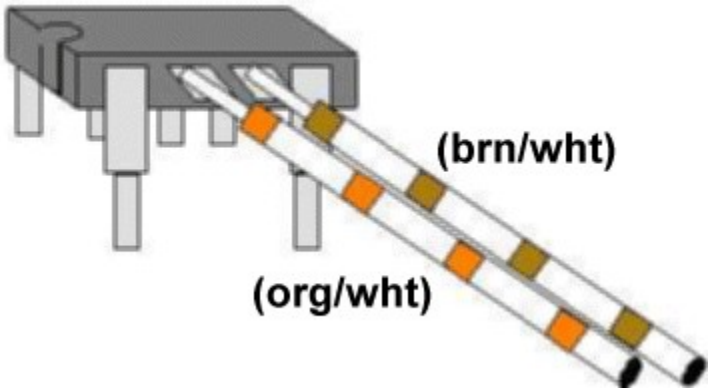


Wire Color	Destination	Length
gray on white	Pad 2 (on Synth board)	18cm
green on white	Pad 3 (on Synth board)	18cm
orange on white	Pin 2 (on IC3)	18cm
brown on white	Pin 3 (on IC3)	18cm

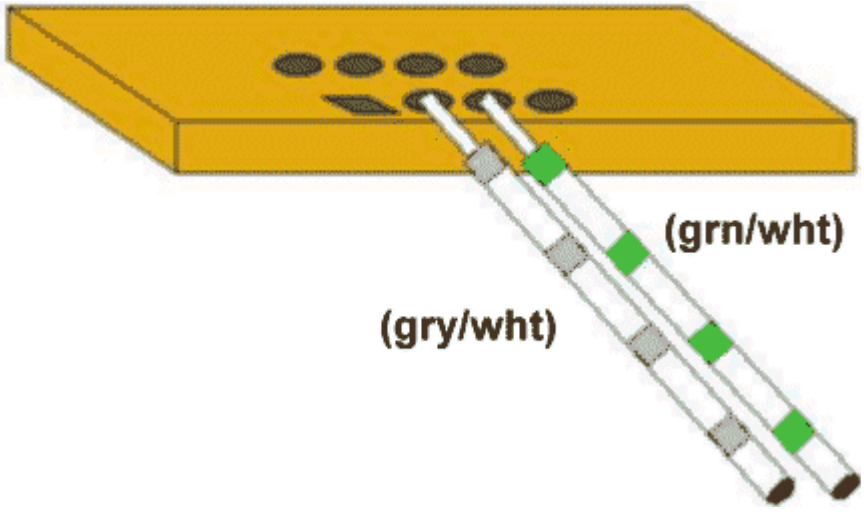
2. Carefully lift pins 2 and 3 up 90°



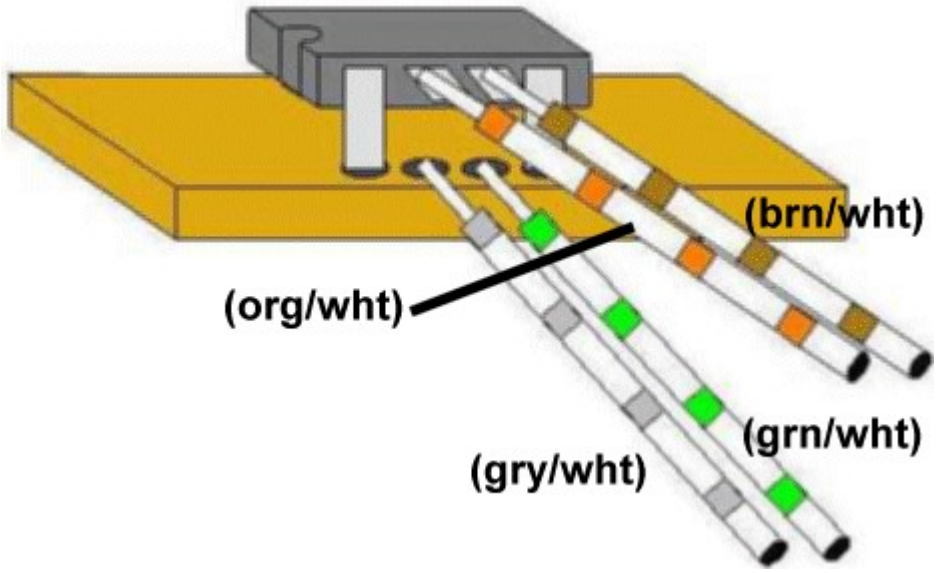
3. Twist two wires (brown on white and orange on white) together to make a piece 18cm. Strip ends ½ cm.
4. Twist two wires (green on white and gray on white) together to make a piece 18cm. Strip ends ½ cm.
5. Solder wires in 3.above to IC3

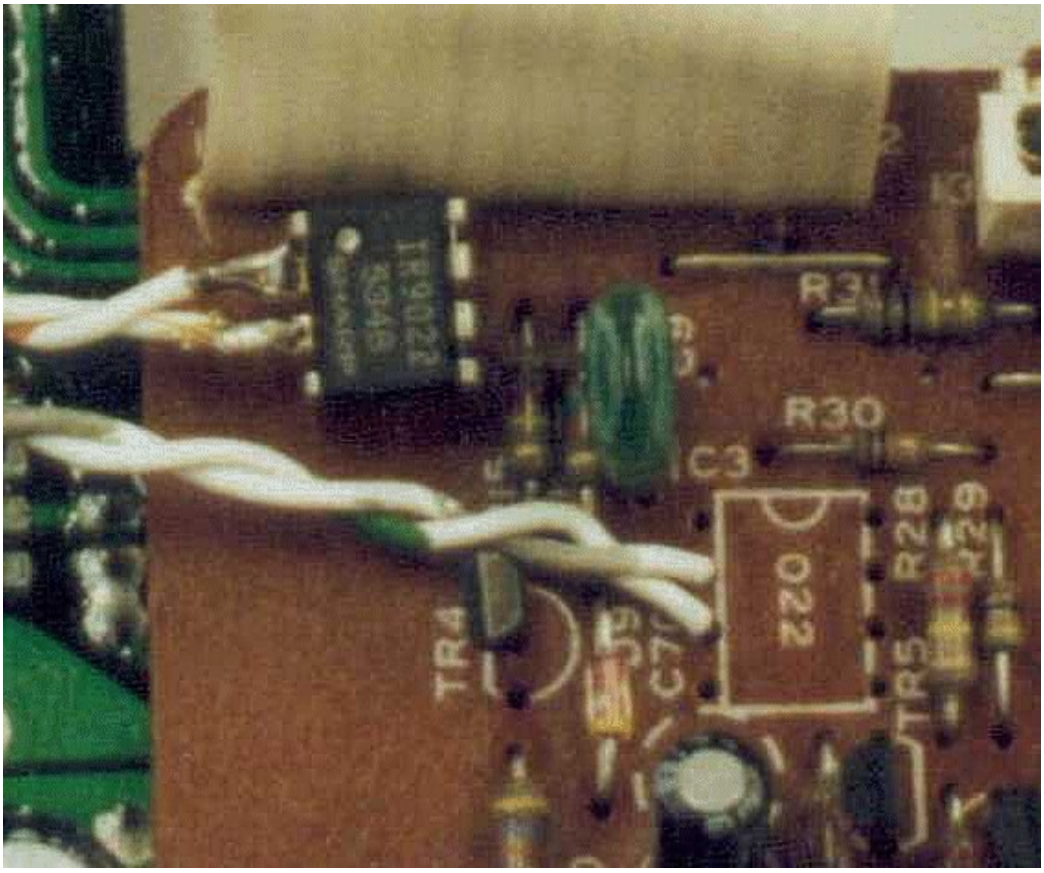


6. Solder wires in 4 above to solder pads of IC3 (push gray/white and green/white wires through from component side).



7. Re-install IC3 and re-solder. Ensure that pins 2 and 3 do not contact any pads or components or wires....etc.
8. Twist all four wires together (take care not to stress any solder joints)





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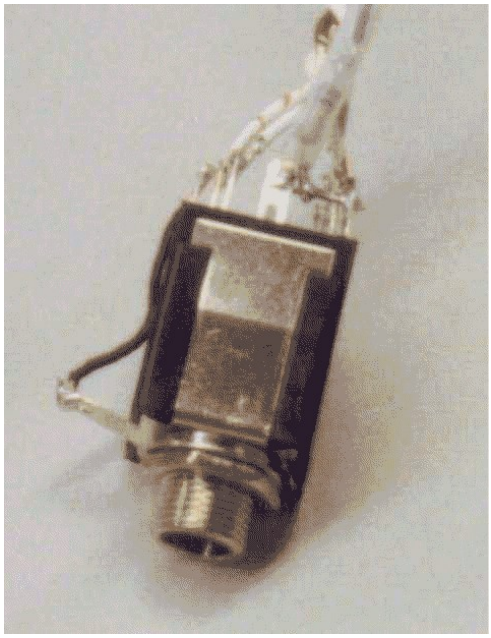
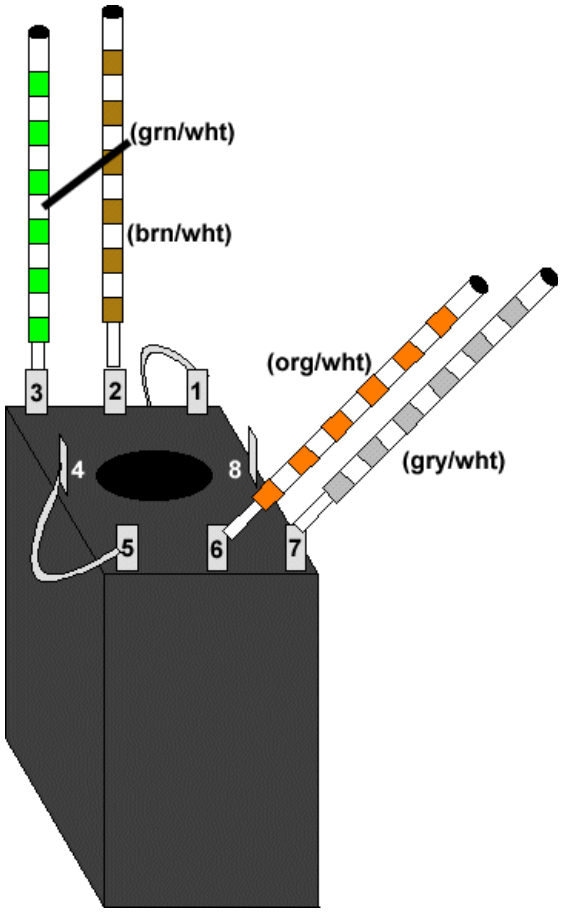
Part2 (1/4" Jack with DPDT switch work)

9. Connect pin 5 on 1/4" jack with DPDT switch to pin 4 on same jack (see figure below).
10. Connect sleeve of jack to pin 1 of jack.(see figure below .note: sleeve not visible)
11. Connect wires to 1/4" jack with DPDT switch as shown in Interconnect Table below:

Interconnect Table

Wire Color	Destination
brown on White	Pin 2 on jack
green on White	Pin 3 on jack
orange on White	Pin 6 on jack
gray on White	Pin 7 on jack
No connect	Pin 8

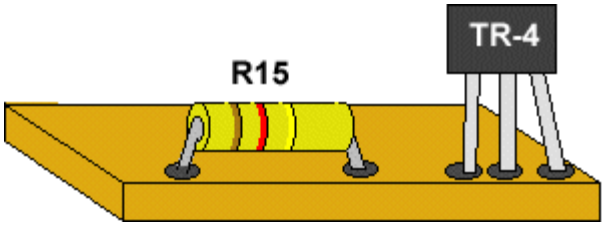




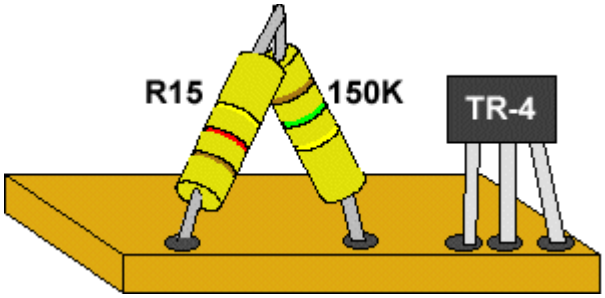
NovaMod Step 6

The Lab SH-101 Synthesizer Modifications Rev 2.0 **26/06/15**
LFO Rate Scalar (preparation)

1. De-solder and lift R15 (on side connected to TR-4) on synth board.



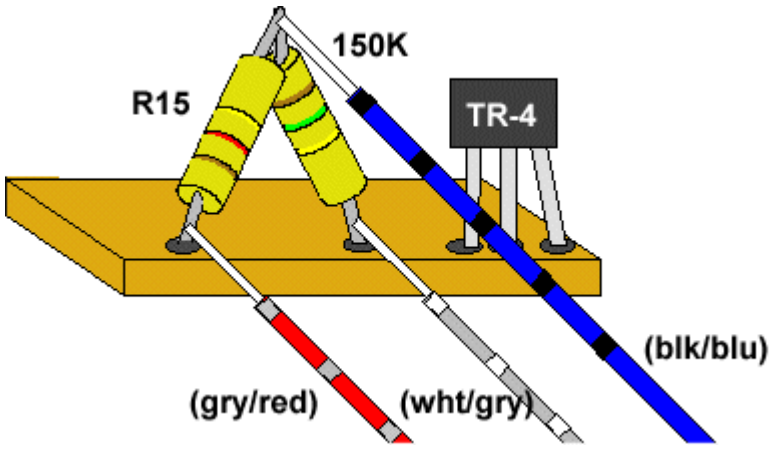
2. Solder 150K resistor in series with R15. (150K colour code is brown green yellow).

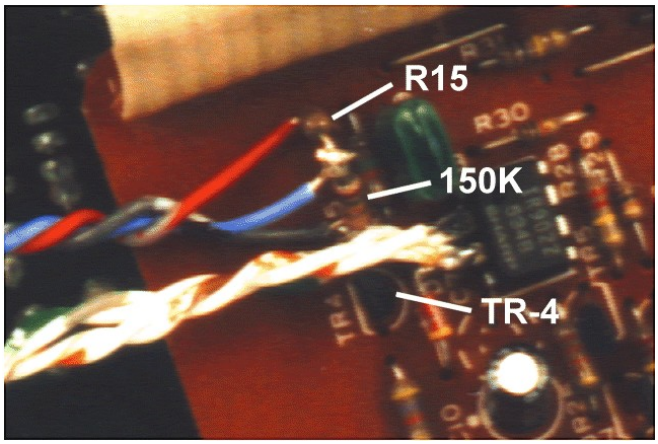


3. Twist three wires (white on gray, gray on red, black on blue) together to make a piece 21cm. Strip ends 1/2cm.

Keep three wires on component side of board

4. Solder white on gray to junction of TR-4 and 150K resistor.
5. Solder gray on red wire to unmodified side of R15 resistor.
6. Solder black on blue to junction of R15 and 150K resistor.





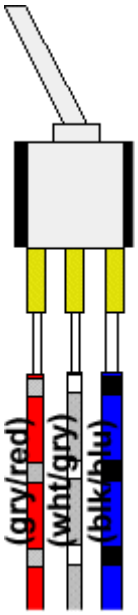
NovaMod Step 6

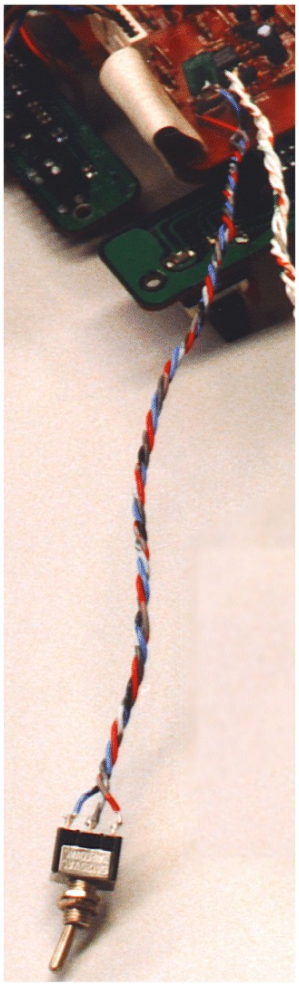
The Lab SH-101 Synthesizer Modifications Rev 2.0 **26/06/15**
LFO Rate Scalar (preparation)

7. Connect wires to SPDT (center off) switch as follows:

Interconnect Table:

Wire Colour	Destination	Length
gray on red	side lug of switch	21cm
white on gray	center lug of switch	21cm
black on blue	other side lug of switch	21cm

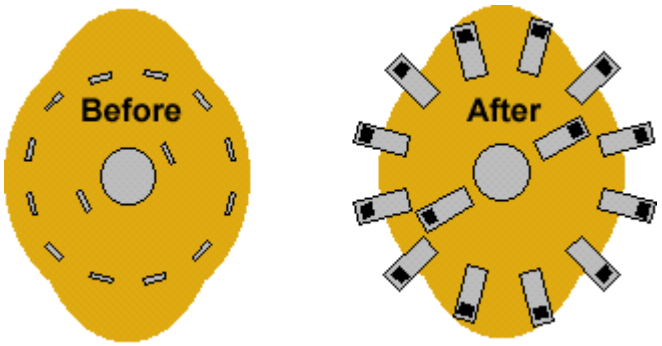




NovaMod Step 7

The Lab SH-101 Synthesizer Modifications Rev 2.0 **26/06/15**
FM of VCF (preparation)

1. Carefully flatten connection points on 6 position rotary switch.



2. Connect six 20 cm wires (black on brown, red on orange, white on green, white on blue, blue on yellow, black on blue) to 6 position rotary switch. Refer to wiring interconnect below.

   ⓘ **Only half of the rotary switch is used.**

3. Connect one 6cm wire (blue on red) to output pole of switch

Switch Position	Waveform	Colour	Length
1	Pulse	black on brown	20cm
2	Ramp	red on orange	20cm
3	-1Oct	white on green	20cm
4	-2Oct Sqr	white on blue	20cm
5	-2 Oct. pulse	blue on yellow	20cm
6	Osc Noise	black on blue	20cm
Common	Output	blue on red	6cm

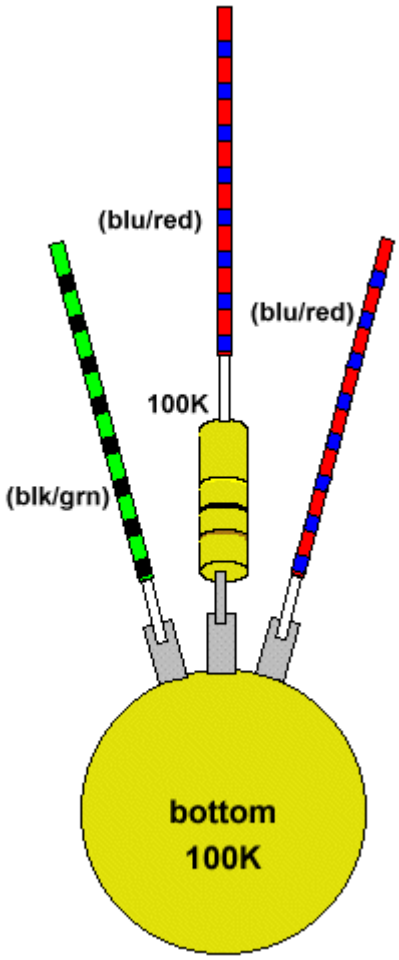
ⓘ **Pay careful attention to wire colors, rotation...etc. Mistakes here will result in decal mismatch problems.**

NovaMod Step 7

The Lab SH-101 Synthesizer Modifications Rev 2.0 **26/06/15**
FM of VCF (preparation)

4. Connect 10cm wire (blue on red) to 100k resistor (100k colour code is Brown Black Yellow).
5. Connect other side of 100k resistor to center lug on rotary pot.

6. Connect output of 6 position switch (blue on red) to full clockwise lug on 100k rotary pot.
7. Connect 12 cm ground wire (black on green) from full counter clockwise lug on 100k pot.



Bottom View of 100K Rotary Pot

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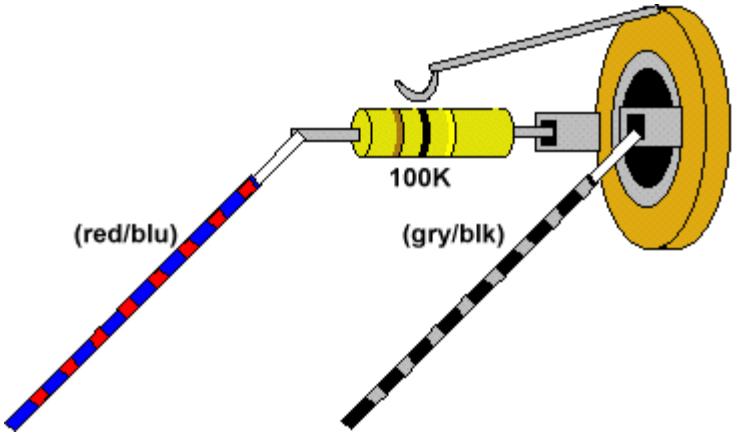
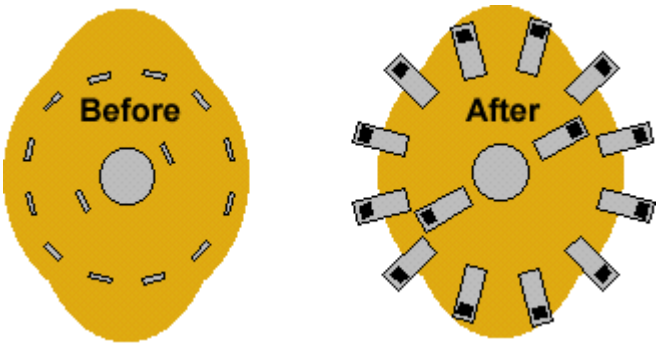
1. Connect 100k resistor (100K colour code is brown black yellow) to tip of 1/4" mono jack.
2. Connect 30cm wire (red on blue) to 100k resistor.
3. Connect 30cm wire (gray on black) to sleeve of 1/4" mono jack.
4. Twist both 30cm wires together.



Verify which solder tabs of the jack are tip and sleeve before soldering.

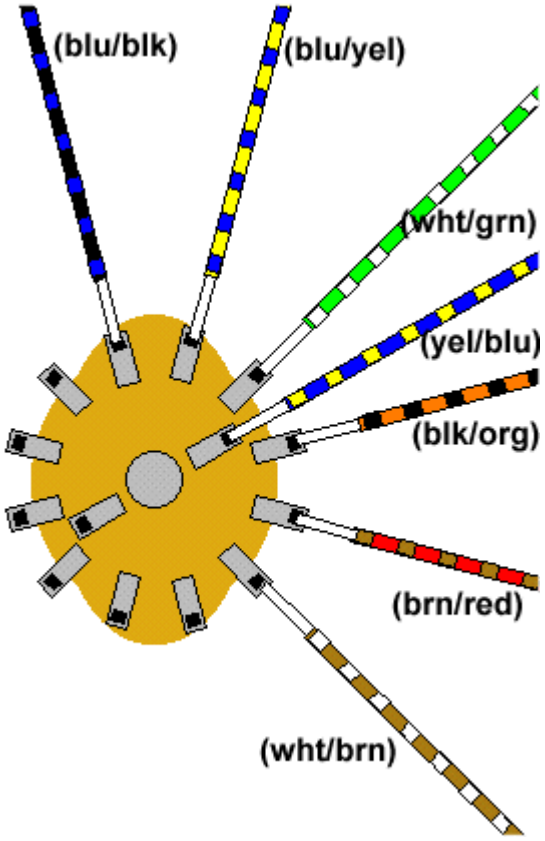
1. Carefully flatten connection points on 6 position rotary switch.

ⓘ Only half of the rotary switch is used.



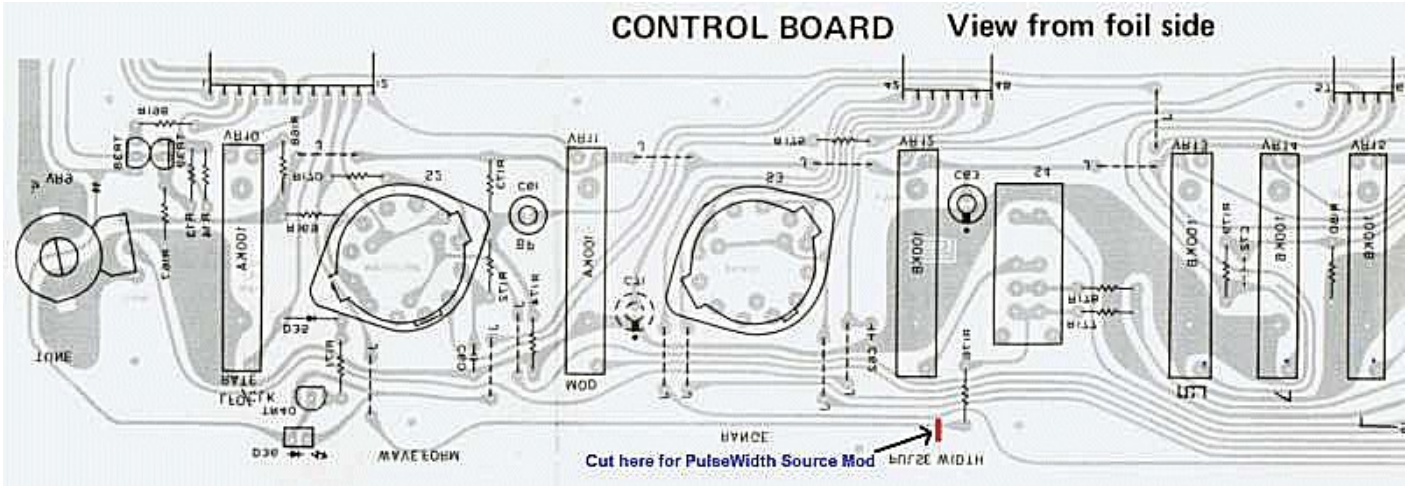
2. Connect six wires (white on brown, brown on red, black on orange, white on green, blue on yellow, blue on black) to 6 position rotary switch.

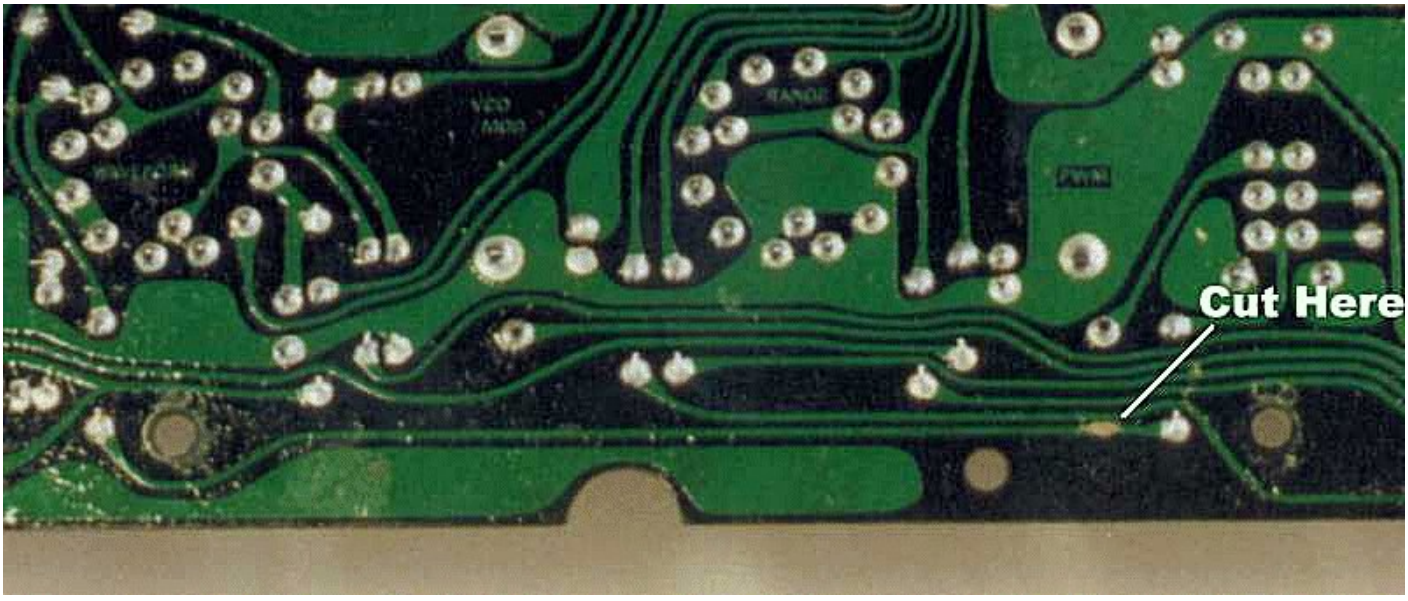
Switch Position	Waveform	Colour	Length
1	Tri LFO	white on brown	25cm
2	Sqr LFO	brown on red	25cm
3	Rnd LFO	black on orange	25cm
4	-1 Oct. Sub	white on green	11cm
5	-2 Oct. pulse	blue on yellow (twist together with White on Green)	11cm
6	LFO Noise	blue on black	25cm
Common	Output	yellow on blue	12cm



3. Connect one 12cm wire (yellow on blue) to output pole of switch.

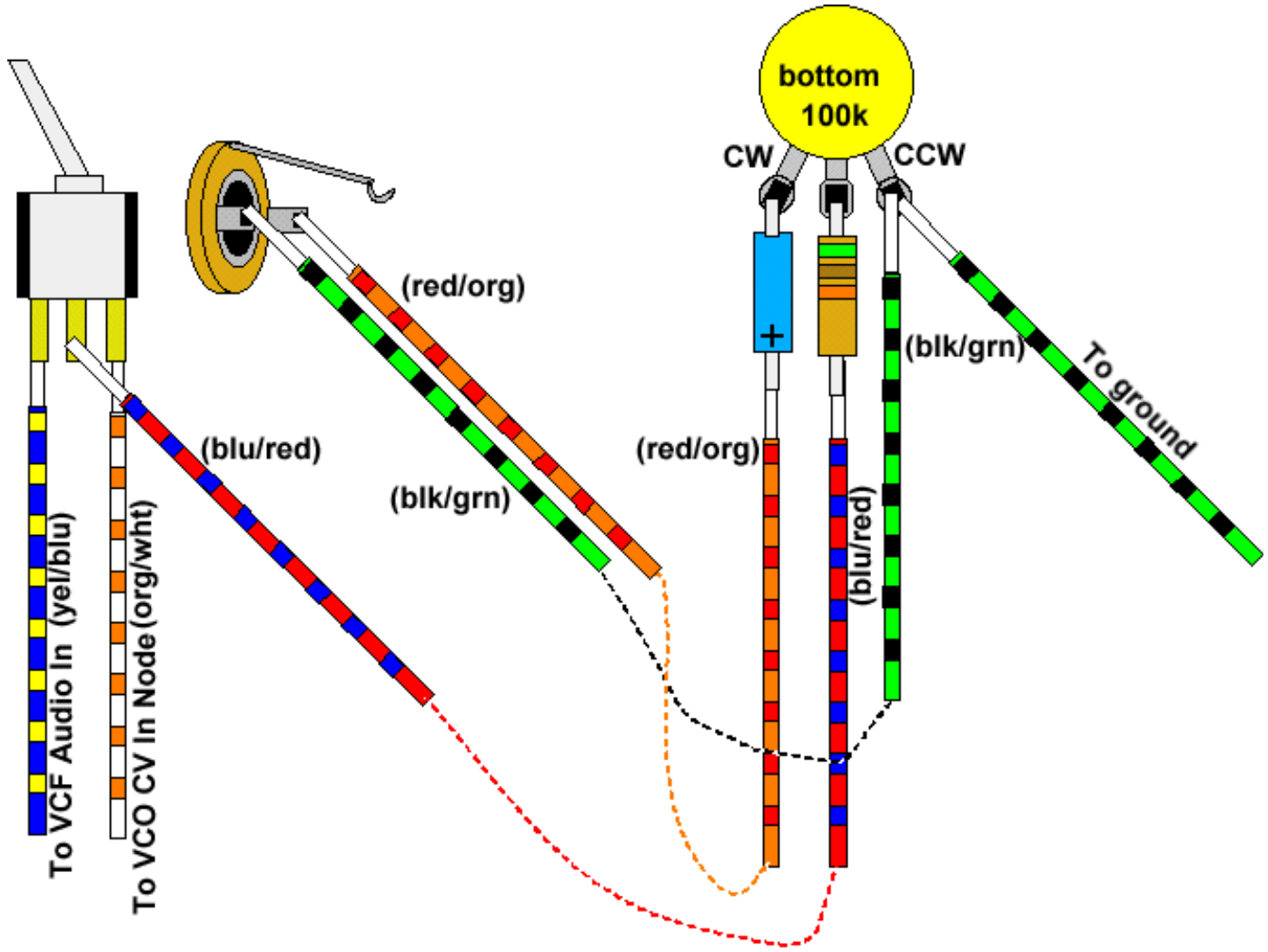
4. Cut trace on Control board between R176 and Jumper.





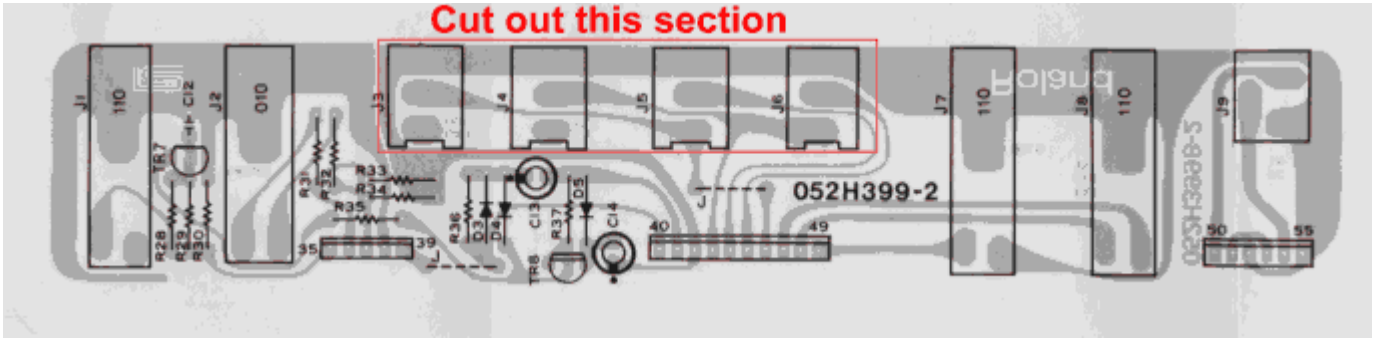
3. Connect 51k resistor (colour code is: green-brown-orange) to 35cm blue on red wire.
4. Connect to free side of 51k resistor to center lug of pot.
5. Connect a 25cm black on green wire and a 10cm black on green wire to counter clockwise lug of 100k pot.
6. Twist all 25cm and 35cm wires together.
7. Connect free end of 25cm red on orange wire to tip of 1/4" jack.
8. Connect free end of 25cm black on green to sleeve of 1/4" jack.
9. Connect free end of 35cm blue on red wire to center lug of SPDT switch.
10. Connect 35cm orange on white wire to one lug of SPDT switch.
11. Connect 35cm yellow on blue wire to other lug of SPDT switch.

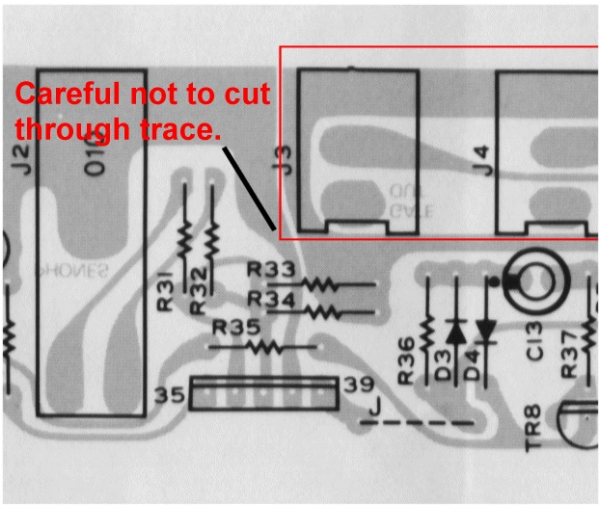
Wiring Diagram



1. De-solder four 1/8" c.v./gate in/out jacks.

2. Using a sharp utility knife, score a rectangle in jack board to match the area to be removed.



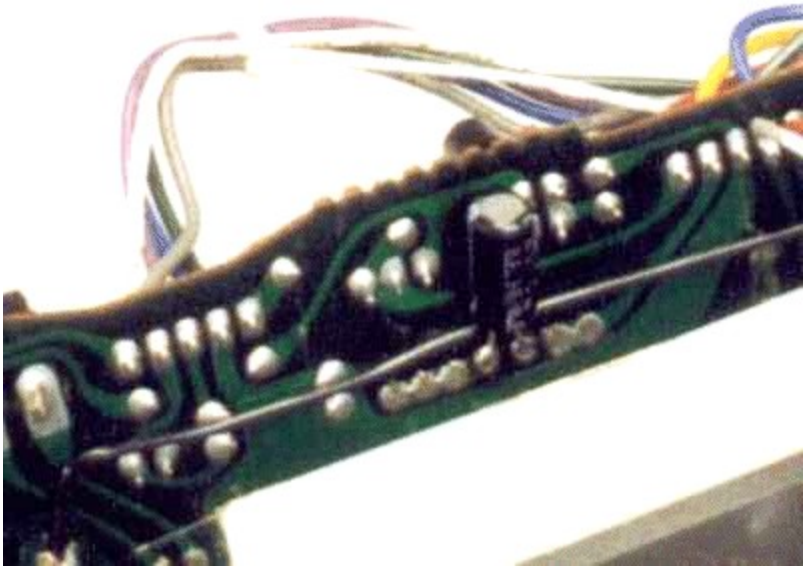


3. Using a hack saw, make the two short end cuts in jack board.
4. Using sharp knife, continue to score long horizontal cut until completely through circuit board.

ⓘ I know this is tedious however the circuit board, though brittle, does not break along score. Attempting to "score and crack" may destroy board.

5. De-solder capacitor C13 to allow clearance for an inserted jack. Re-install it on solder side of board.

ⓘ **Pay attention to polarity and ensure that an inserted 1/4" plug does not short the capacitors legs!**



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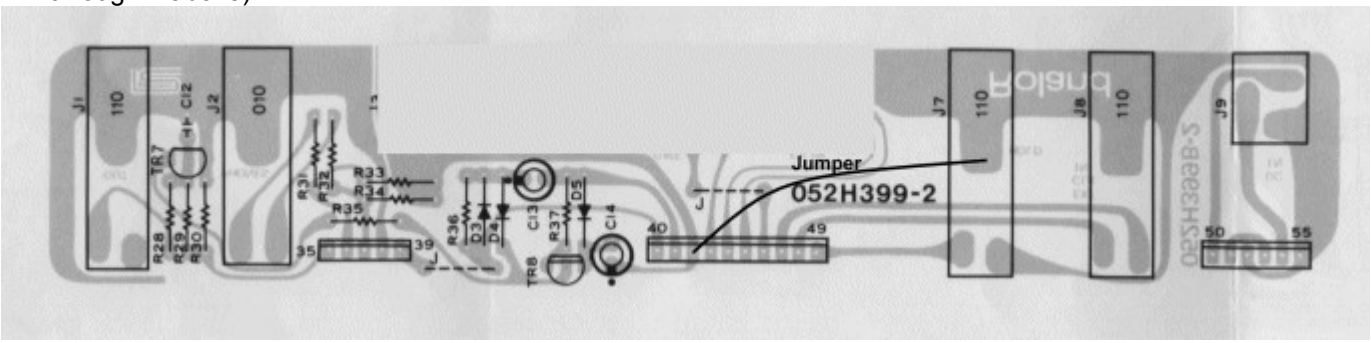
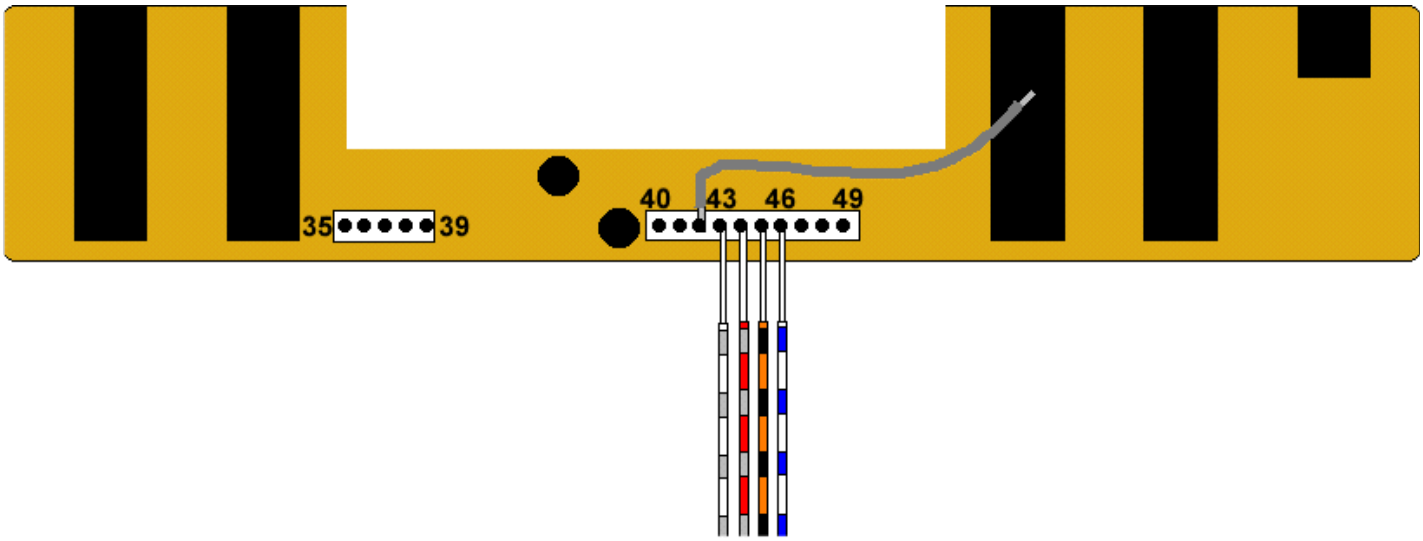
6. Solder a black on green jumper wire from large pin labeled "hold" on hold jack to pin 42 of the 9 pin connector. This re-makes the ground connection from the left side of the jack board to the right side. (The trace was cut in steps 1 through 4 above).



9. Solder 15cm wires to the pins of the 9 pin connector on the jack board as follows:

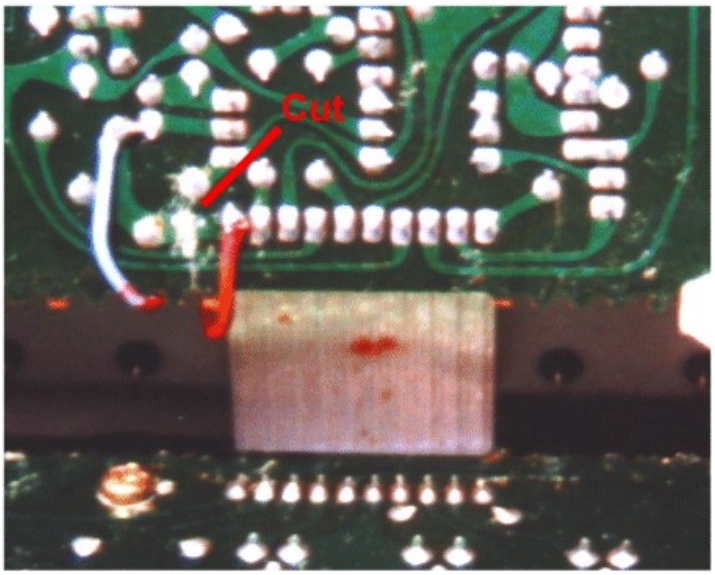
ⓘ **Do not connect to 1/4" jacks yet!**

Connector Pin	Wire Colour	Destination	Length
pin 43	gray on white	c.v. out tip	15cm
pin 44	gray on red	gate in tip	15cm
pin 45	black on orange	c.v. in tip	15cm
pin 46	blue on white	gate out tip	15cm
pin 42	black on green	“hold”	10cm

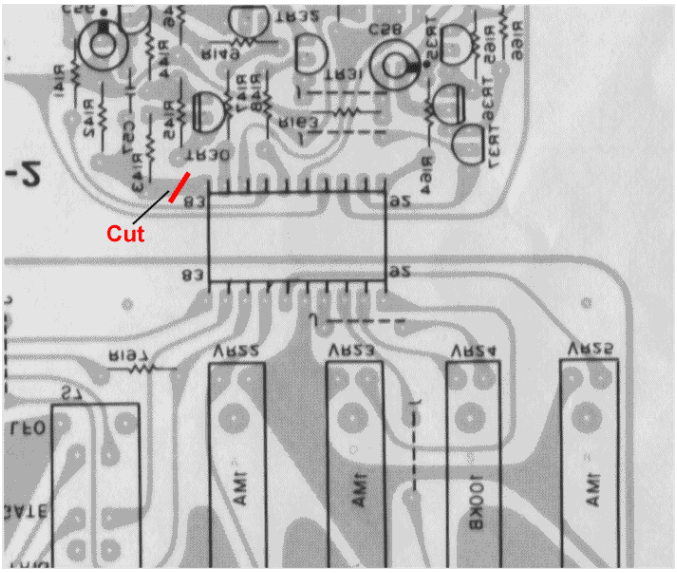


1. Cut trace to ribbon interconnect to control board at pin 83 on synth board.

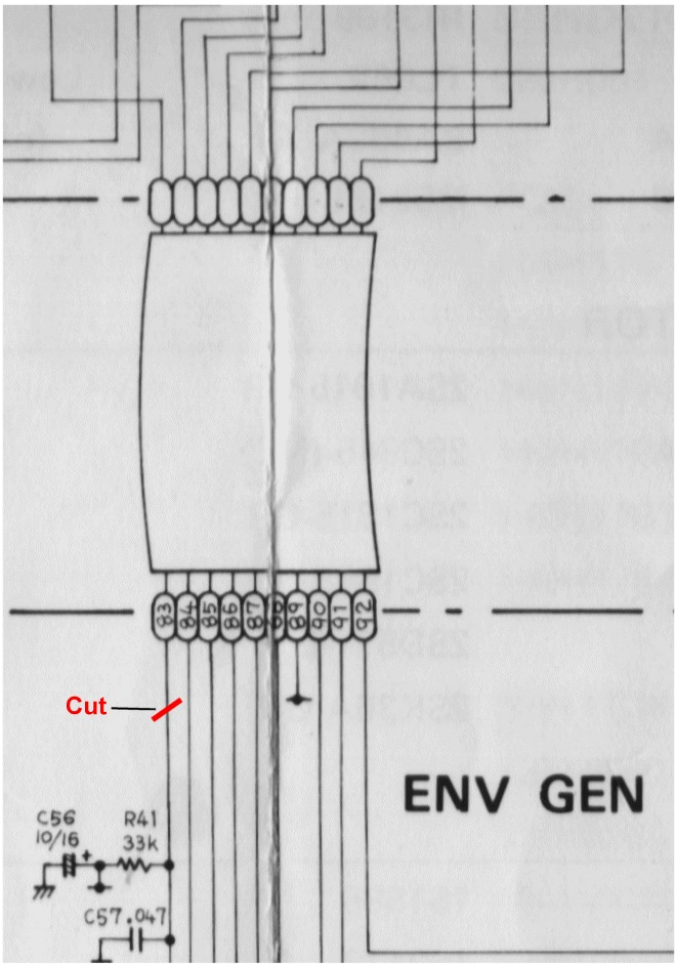
Photo:



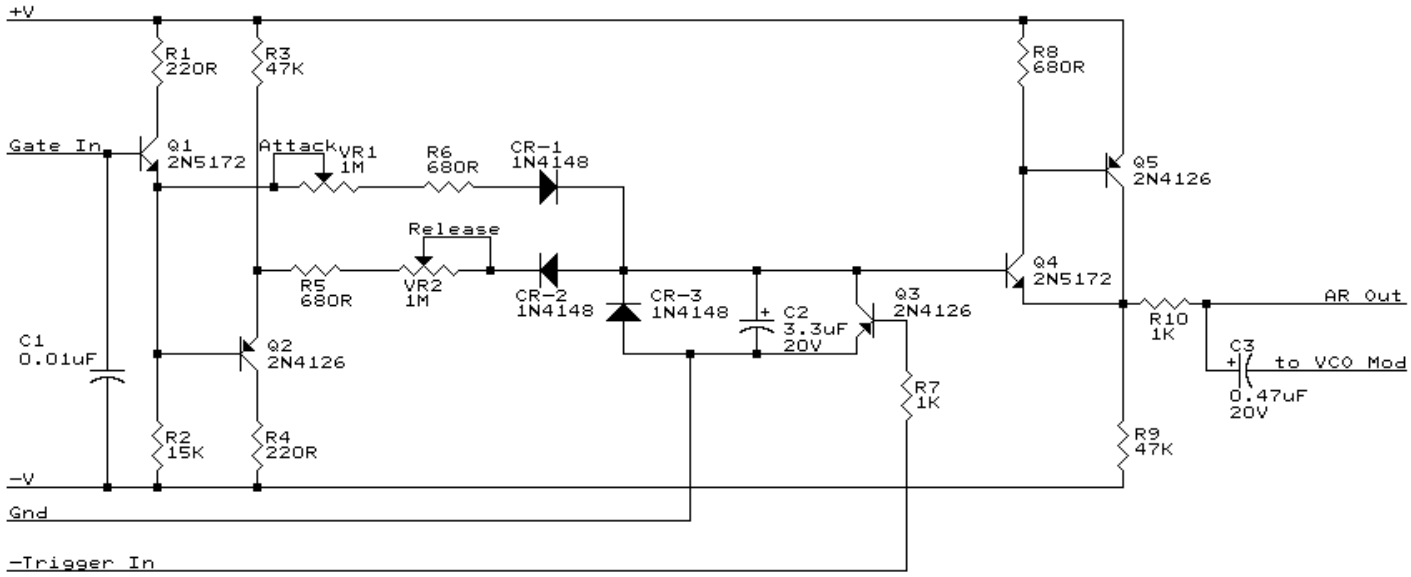
Artwork:



Schematic:



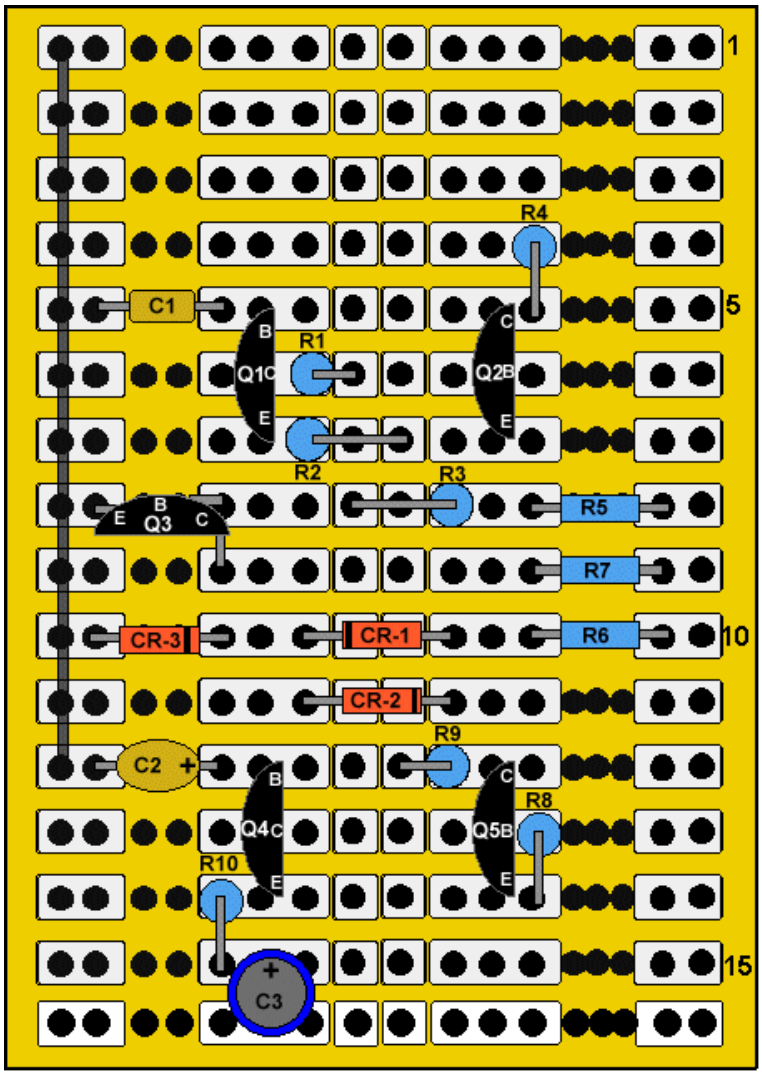
Schematic:

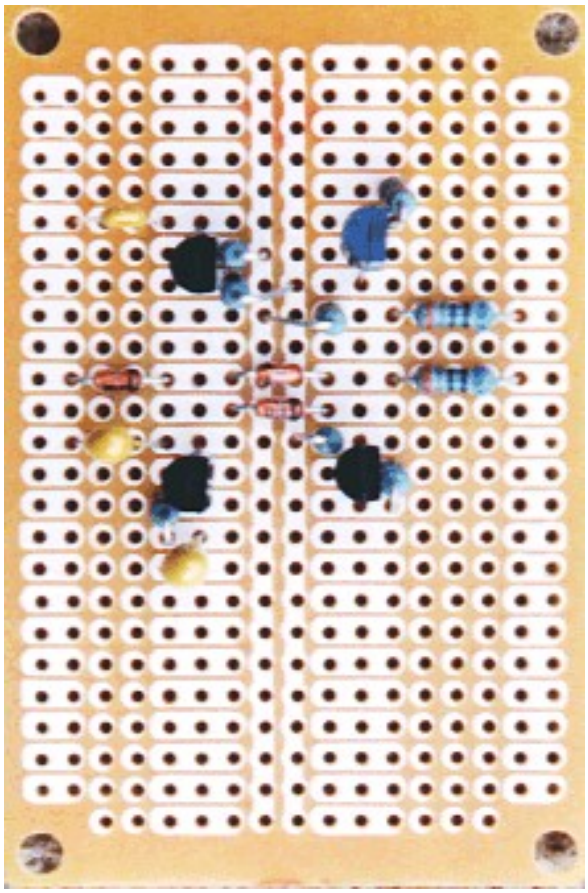


AR Envelope Part Reference:

✓	Designator	Part	Value
	R1	Resistor	220R 1/2watt (red red blk blk)
	R3 R9	Resistor	47k 1/2watt (yel pur blk red)
	R2	Resistor	15k 1/2watt (brn grn blk red)
	R4	Resistor	220R 1/2watt (red red blk blk)
	R5 R6 R8	Resistor	680R 1/2watt (blu gry blk blk)
	R7 R10	Resistor	1k 1/2watt (brn blk blk brn)
	C2	Capacitor (tant. Pol)	3.3uF 20V
	C1	Capacitor (Non-Pol)	0.01uF
	CR-1 CR-2 CR-3	Diode	1N4148
	Q1 Q4	Transistor NPN	2N5172
	Q2 Q3 Q5	Transistor PNP	2N4126
	VR-1 VR-2	Pot Rotary	1M linear
	C3*	Cap (electrolytic Pol)*	0.47uF 50V (required for step 25 AR to VCO mod)

*A .47uF tantalum capacitor may be substituted for C8.



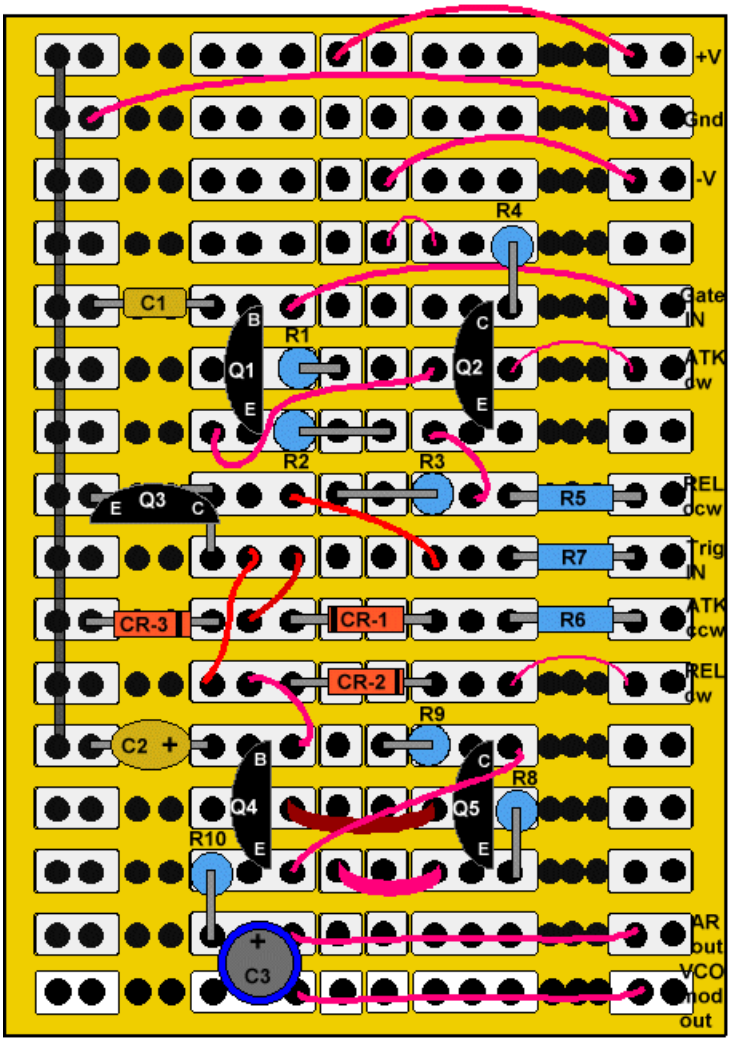


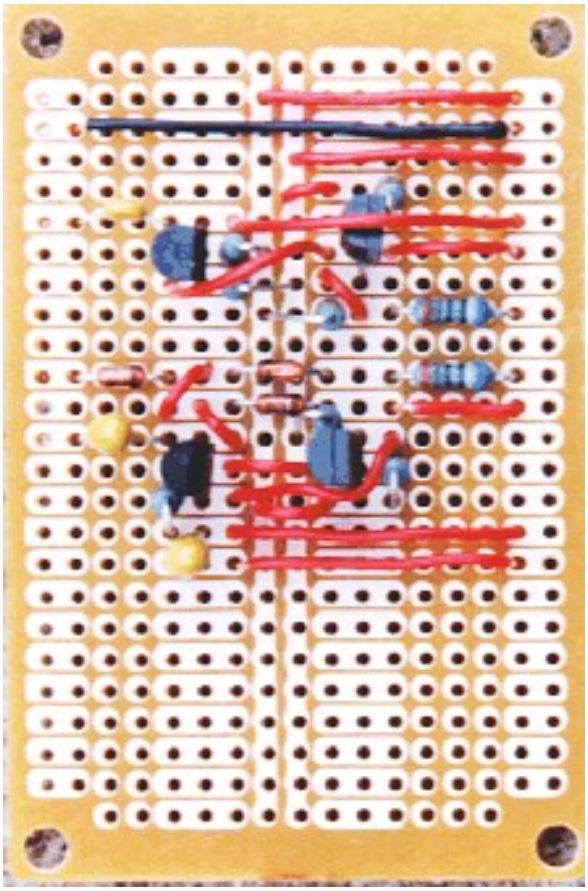
1. Populate protoboard with components as shown below.

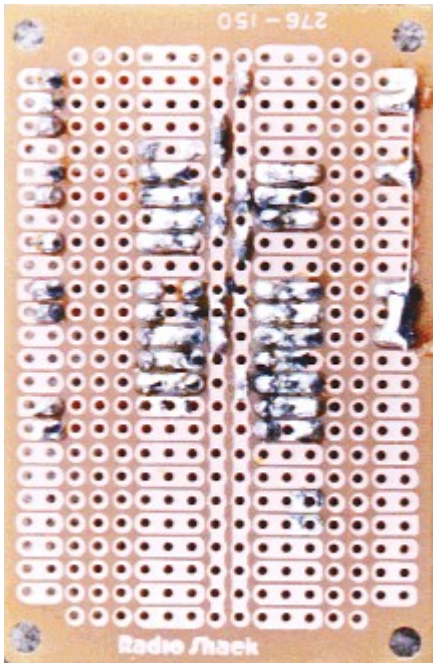
ⓘ **Please pay close attention to polarities of C2, C3, CR-1, 2, 3 and transistor orientation.**

ⓘ **Please note 2/3 hole number asymmetry of circuit board**.`1

2. Connect components as shown below (use orange on red wire): (note ground bus wire on underside of board)

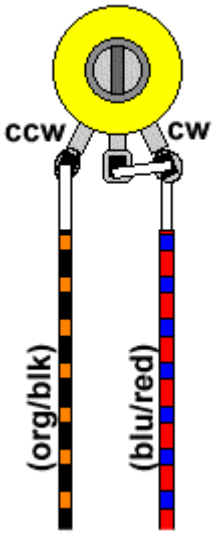






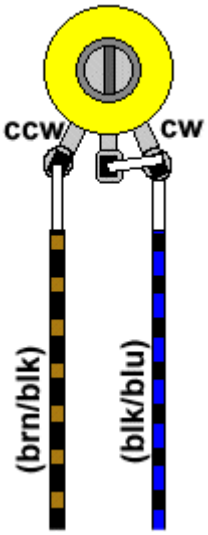
3. Twist together a 25cm blue on red wire with a 25cm orange on black wire.

4. Connect these to a 1M rotary pot.
   Blue on red connects to clockwise solder tab and center solder tab.
   Black on orange connects to the counter-clockwise solder tab.



Attack Pot Top View

5. Twist together a 25cm black on blue wire with a 25cm brown on black wire.
6. Connect these to a 1M rotary pot.
   Black on blue connects to clockwise solder tab and center solder tab.
   Brown on black connects to the counter-clockwise solder tab.



Decay Pot Top View

7. Twist together a 20cm black on green wire with a 20cm blue on yellow wire. and a 20cm black on orange wire.
8. Connect the wires in 3 to 7 above, plus a Gate In , Trigger In and an AR out wire to the protoboard as per the following table.

ⓘ Please refer to the drawing in 2 above to view the protoboard's connection points.

AR Envelope External Connect Wire Color code:

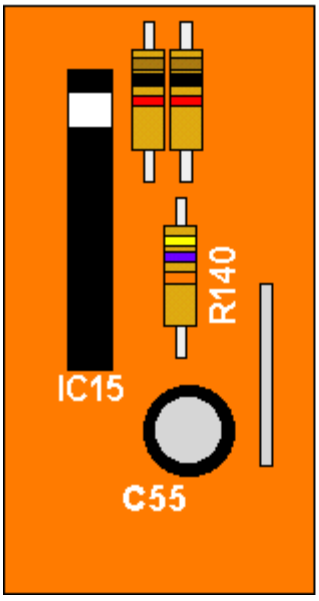
Signal	Wire Colour	Length
+15 V	black on orange	20cm
Gnd	black on green	20cm
-15 V	blue on yellow	20cm
Gate In	red on blue	10cm
AR Out	brown on red	10cm
Attack Pot CW (and center)	blue on red	25cm
Attack Pot CCW	orange on black	25cm
Release Pot CW (and center)	black on blue	25cm
Release Pot CCW	brown on black	25cm
Trigger In	blue on white	40cm

NovaMod Step 14

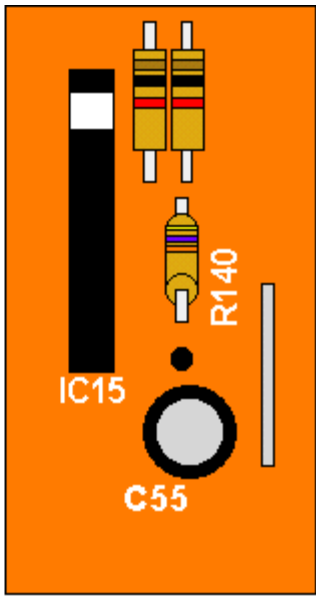
The Lab SH-101 Synthesizer Modifications Rev 2.0 **26/06/15**
Accent (preparation)

1. De-solder and lift leg of R140 on C55 side of resistor (on synth board).

Before:



After:



1. Cut trace on Control circuit board approx. 1/2 cm along hot side of VCO Mod slider.
2. Expose trace by scraping away green solder mask on side of cut not connected to the Mod slider.

Leave approximately 2cm of untouched trace between cut and exposed part to prevent trace from peeling when wires are connected.

Artwork:

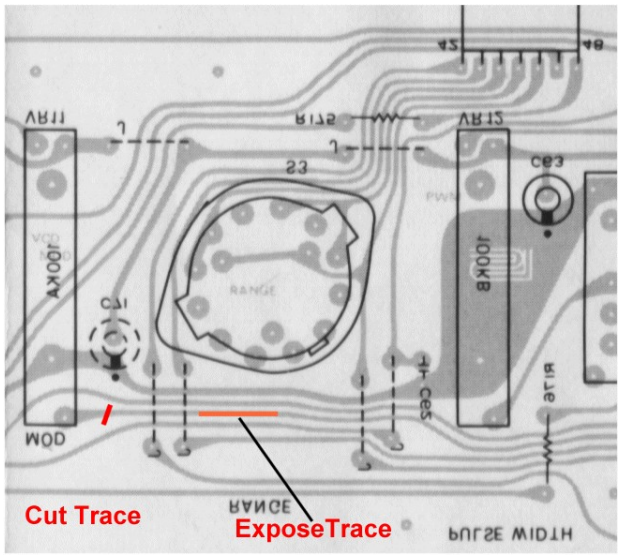
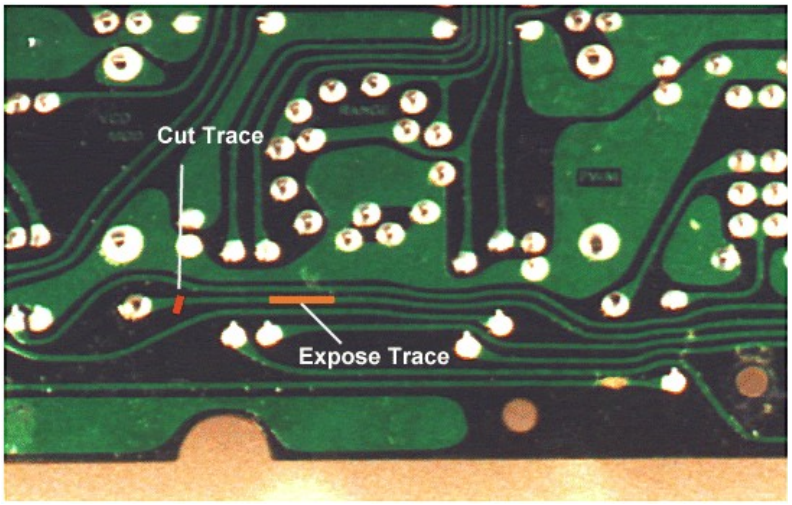
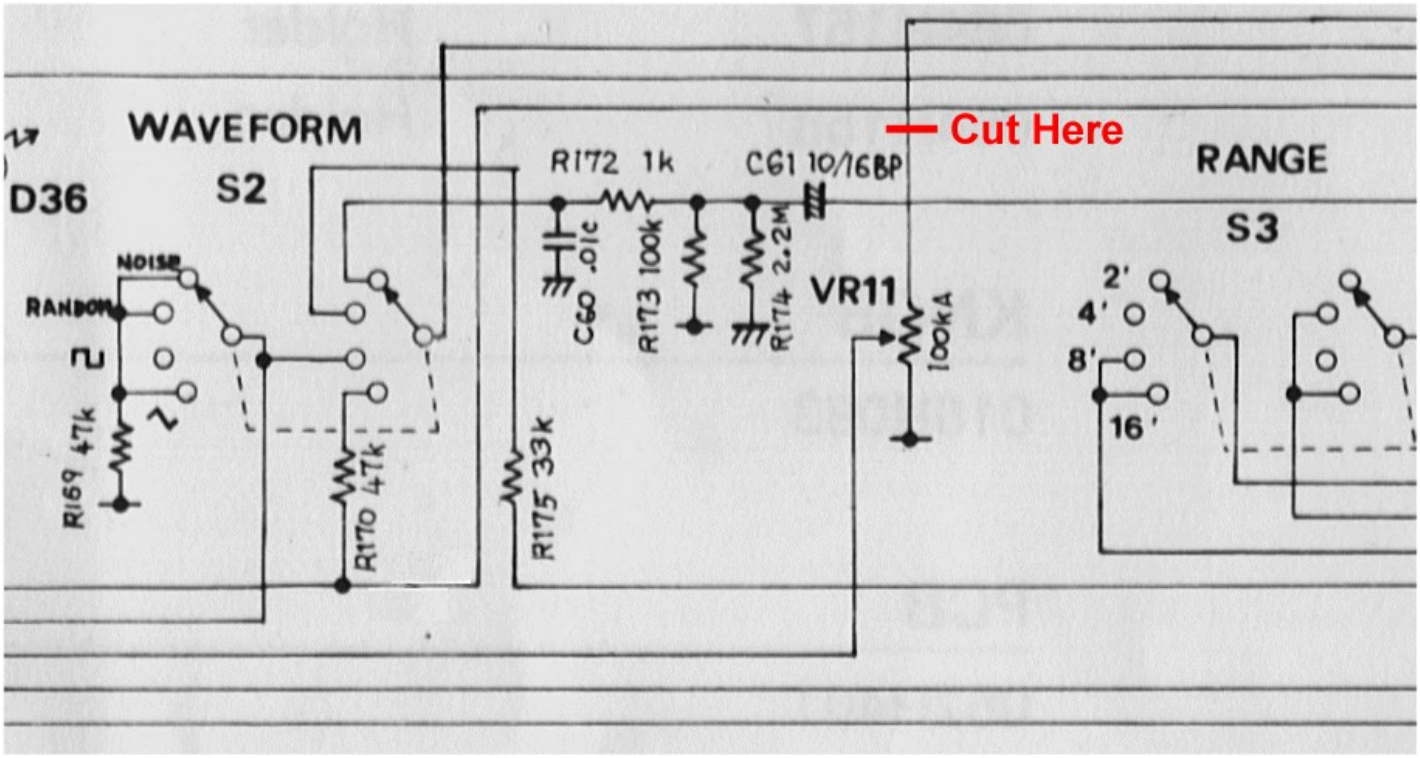


Photo:



Schematic:



NovaMod Step 15

The Lab SH-101 Synthesizer Modifications Rev 2.0 **26/06/15**
VCO Mod Source (preparation)

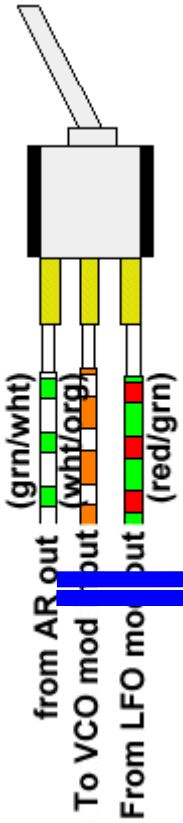
3. Cut a 15 cm piece of white on orange wire, a 15cm piece of red on green and a 40 cm of green on white wire.
4. Connect to SPDT switch as follows:

Wire Color	Destination	Length

green on white	side lug of switch	40cm
white on orange	center lug of switch	15cm
red on green	other side lug of switch	15cm

5 .Twist wires together for 12 cm.

Note: These wires ted later in step 25.



NovaMod Step 17

Overdrive (preparation)

NovaMod Step 18

Decals (preparation)

1. Carefully cut out decals using shear, scissors or Xacto knife with ruler.
2. Carefully cut out center holes for pots and switches. Test fit with actual hardware.
3. Trace edges of decals with black permanent marker to hide the white color of the paper bonded inside laminate.

NovaMod Step 19

Decal Installation

1. Clean surface of SH-101 where decals will be placed.
2. In a well ventilated area, place decals on clean smooth piece of wax paper face down.
3. Spray aerosol glue onto the backs of the decals.
4. Carefully affix decals to SH-101's main body as per diagram below.
5. Allow 12 hours to dry

Clumps of glue can be removed easily at a later time. Do not worry about smudges on decals or synth body.

1. Install PW Source Switch. (leads away from keyboard)
2. Install Ext. Audio Pot (leads away from keyboard. Let switch and jack dangle.)
3. Install FM Source Switch (Leads away from keyboard.)
4. Install FM Amount Pot (Leads away from keyboard.)
5. Install ENV2 Attack Pot (Leads away from keyboard.)
6. Install ENV2 Release Pot (Leads away from keyboard)
7. Install Accent Amount pot and Accent switch.
8. Install CV/Gate in/out 1/4" jacks. Solder as follows:
- all sleeves daisy chained together
- CV in short to CV out tip
- gate in short to gate out tip
9. Mount VCO Mod SPDT switch (green on white nearest to keyboard) Bend leads towards keyboard to allow clearance of control board.
10. Carefully position control board and mount LFO scalar switch. (gray on red toward keyboard)
11. Fit switch board and screw into place.

Be sure to fit the metalized cardboard shield around switch board.

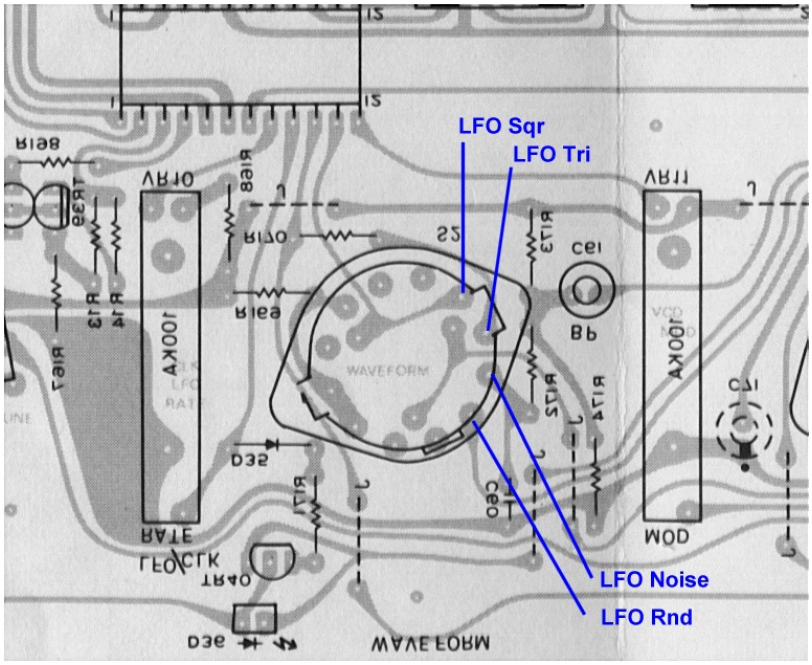
12. Fit control board and screw into place.
13. Route Ext. audio in jack and dest switch between synth board and control board and mount.
14. Mount bender unit and then bender board.
15. Mount jack board for hand grip
16. Mount battery terminals.
17. Rough fit CV/gate board.
18. Route all cables from PW/FM area between synth board and control board.
19. Connect CV/Gate 1/4" jacks as follow:
- sleeves daisy chained together are connected to ground on CV/Gate jack board.

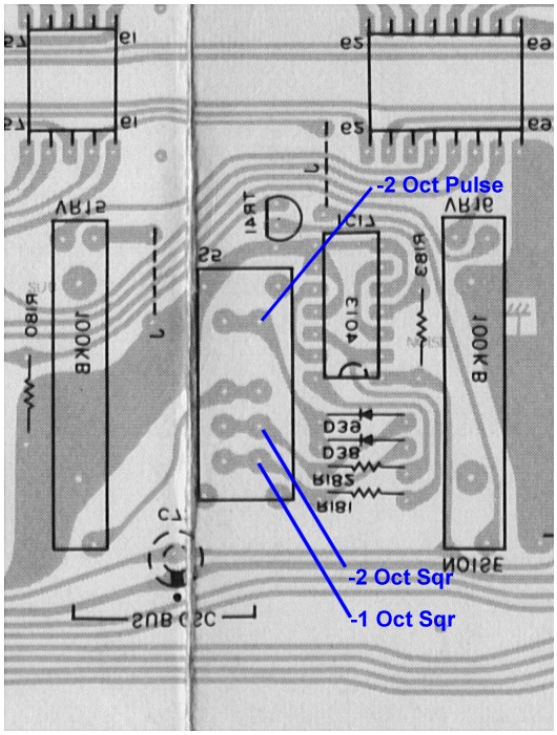
- CV in tip to pin 45 (black on orange)
- CV out tip to pin 43 (gray on white)
-gate in tip to pin 44 (gray on red)
-gate out tip to pin 46 (blue on white)

1. Connect the following from PW selector rotary switch to circuit board.

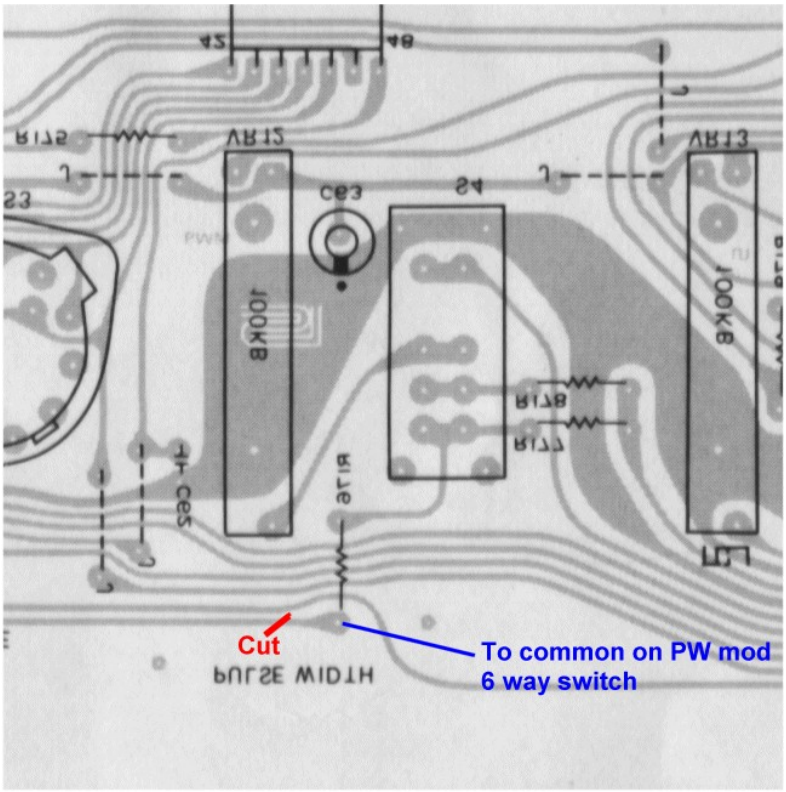
Switch Position	Waveform	Colour	Length	Destination
1	LFO Tri	white on brown	25cm	Switch 2 Control Board
2	LFO Sqr	brown on red	25cm	Switch 2 Control Board
3	LFO Rnd	black on orange	25cm	Switch 2 Control Board
4	-1 Oct. Sqr	white on green	11cm	Switch 5 Control Board
5	-2 Oct. pulse	blue on yellow (twist together with White on Green)	11cm	Switch 5 Control Board
6	LFO Noise	blue on black	25cm	Switch 2 Control Board
Common	Output	yellow on blue	12cm	R176 Control Board

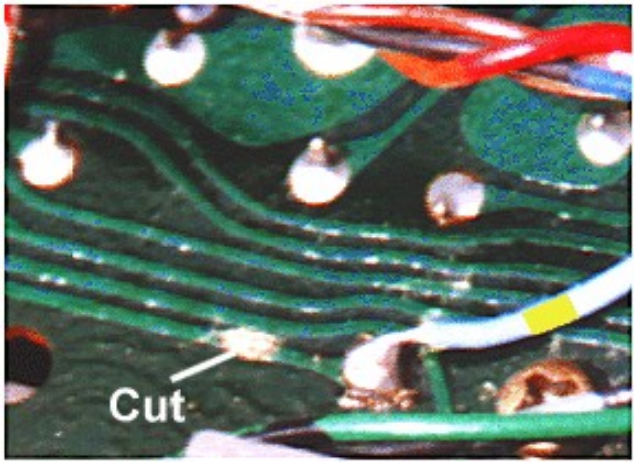
Interconnect (Art Work):





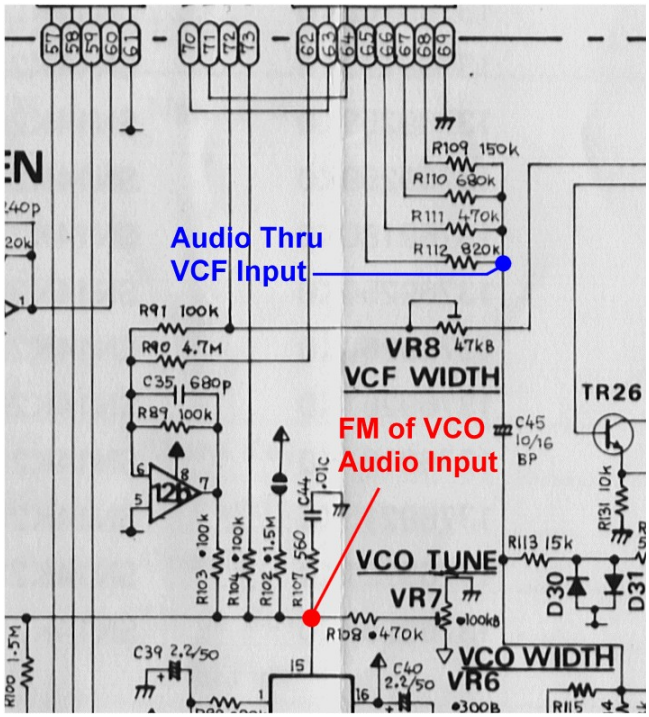
2. Connect Yellow on Blue wire from common on PW source rotary switch to R176 on Control Board.

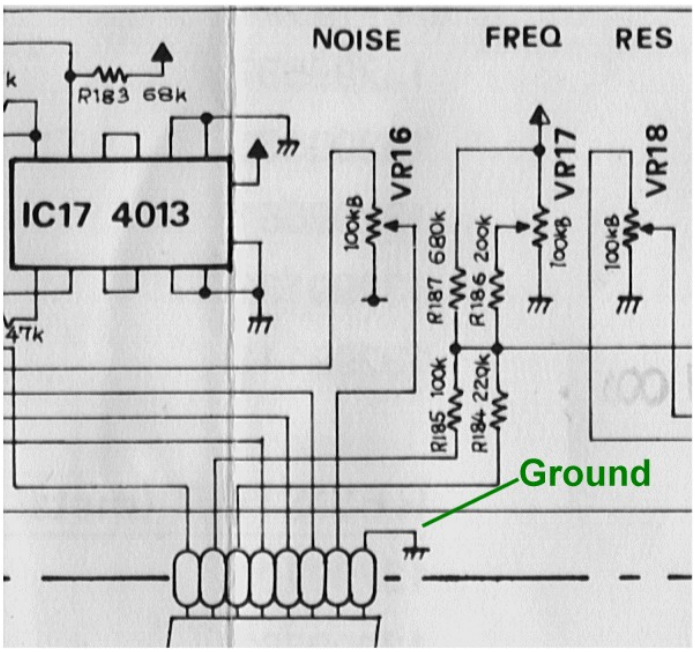




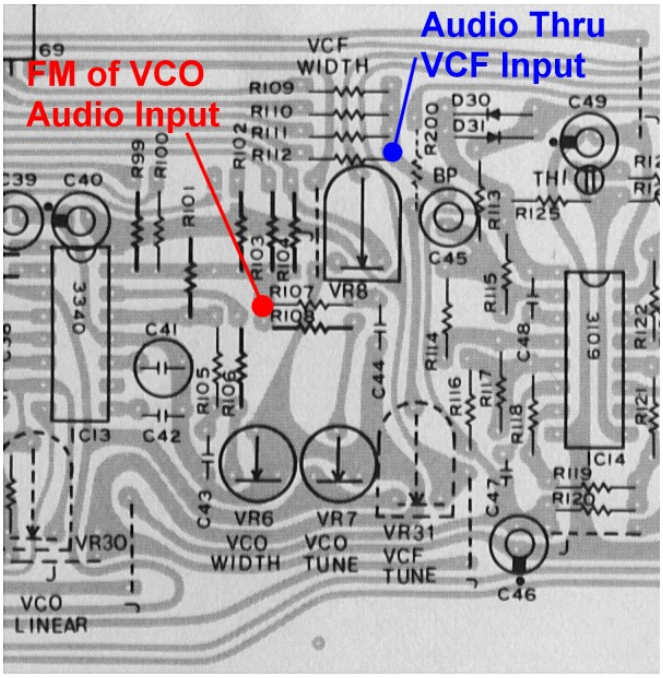
1. Mount SPDT switch in location with white on orange (VCO FM side) towards keyboard.
2. Connect white on orange wire to junction of R99,R100,R102,R103,R104,R107 and R108 on synth board.
3. Connect yellow on blue wire to junction of R109,110,111 and 112 on synth board.
4. Connect free end of 10cm green on black wire to ground on control board.

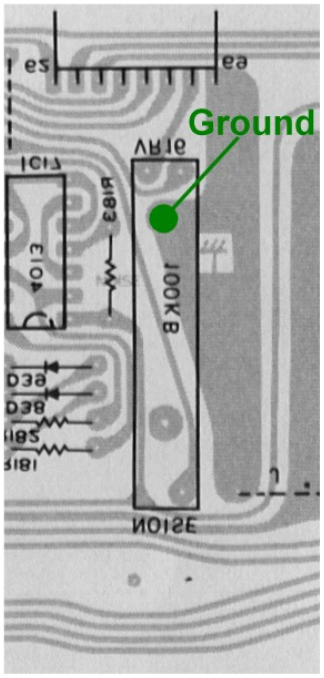
Connection Points (Schematic):



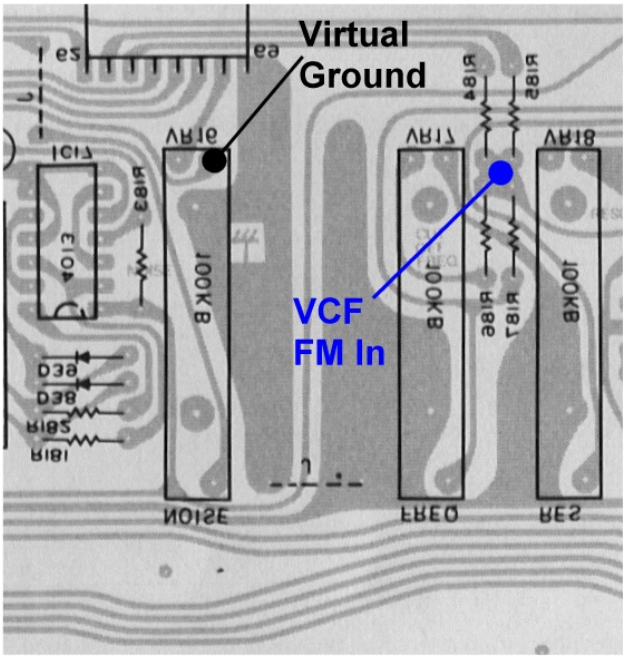


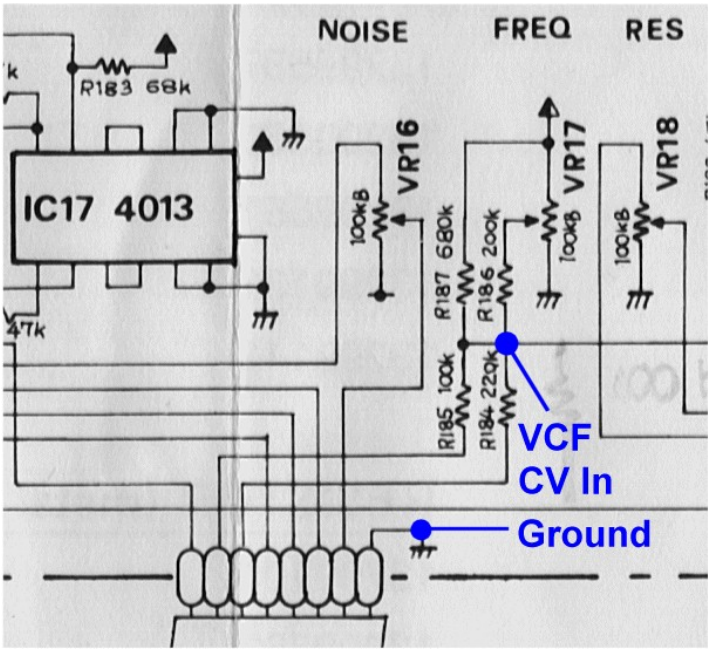
Connection Points (Art Work):





1. Connect 10cm blue on red wire from FM amount switch to junction of R184-187on Control board.
2. Connect gray on black ground to virtual ground on control board at low side of Noise slider.



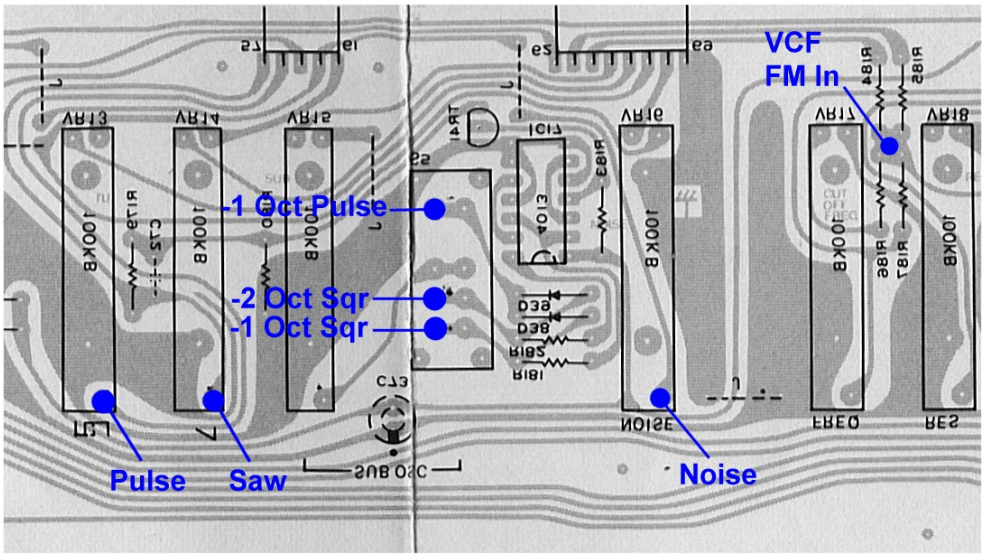


3. Connect wires as follows:

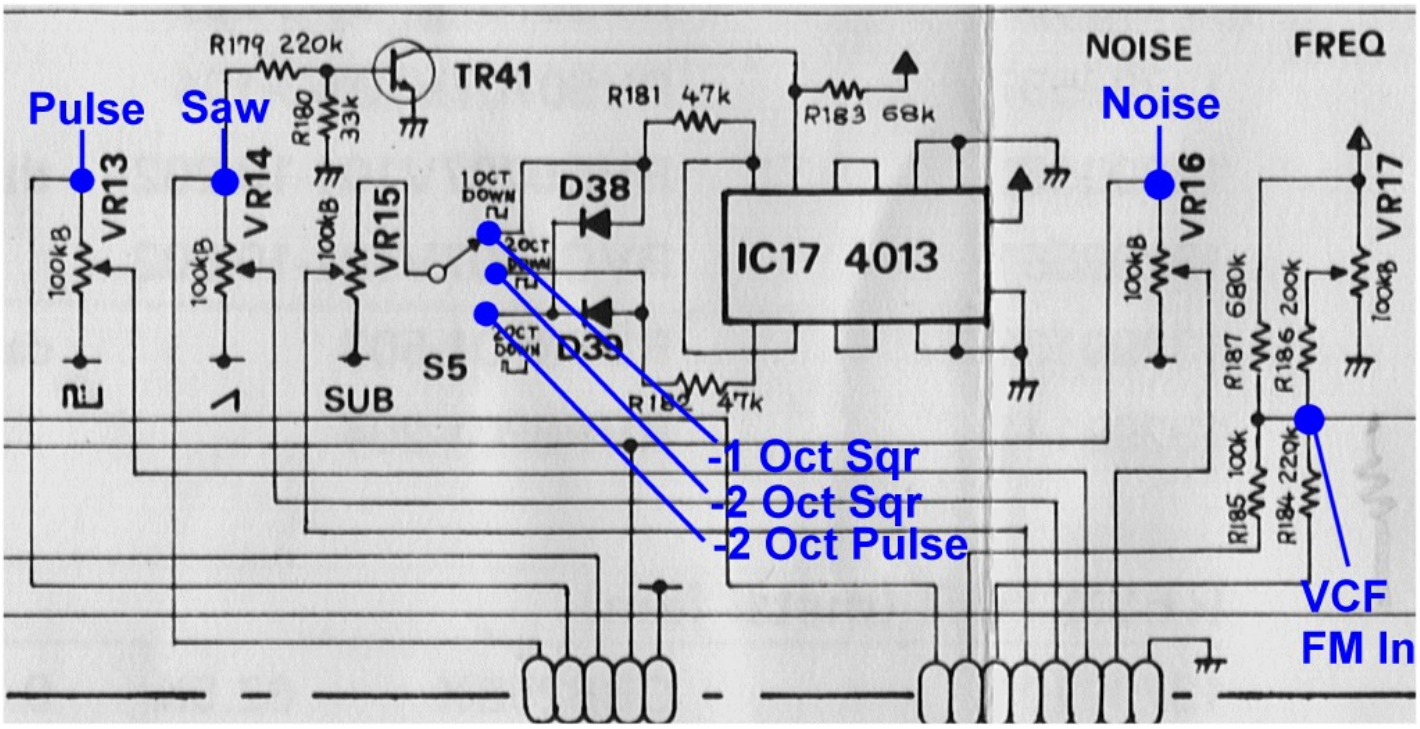
Interconnections:

Switch Position	Waveform	Colour	Length	Destination
1	Pulse	black on brown	20cm	VR13 hot pin (Control Board)
2	Ramp	red on orange	20cm	VR14 hot pin (Control Board)
3	-1Oct	white on green	20cm	S5 (Control Board)
4	-2Oct Sqr	white on blue	20cm	S5 (Control Board)
5	-2 Oct. pulse	blue on yellow	20cm	S5 (Control Board)
6	Osc Noise	black on blue	20cm	VR16 hot pin (Control Board)
Common	Output	blue on red	6cm	Junction of R184 to 187 (Control Board)

Connection Points (Art Work):

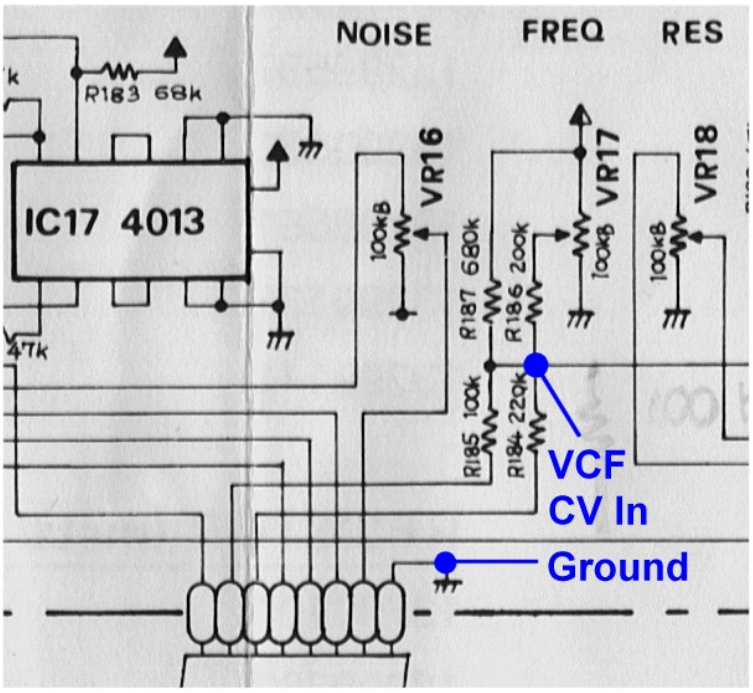


Connection Points (Schematic):

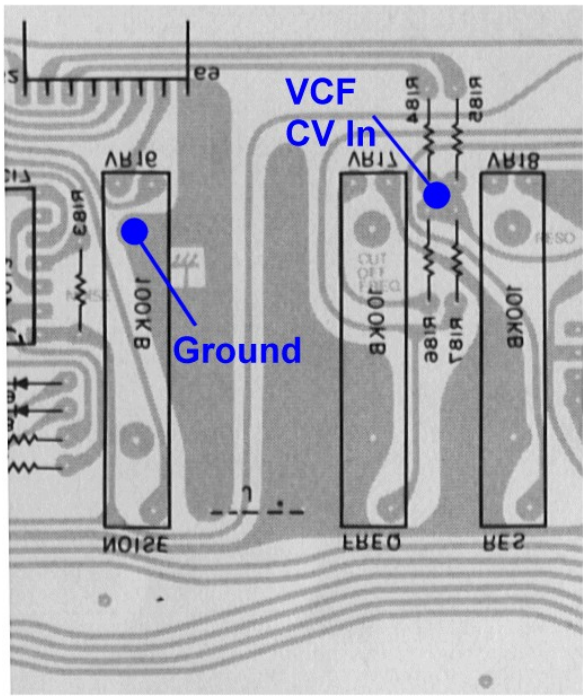


1. Connect black on green wire to Junction of R184-187 on Control board.
2. Connect Grey on black to Ground near noise source slider on Control board.

Connection Points (Schematic):

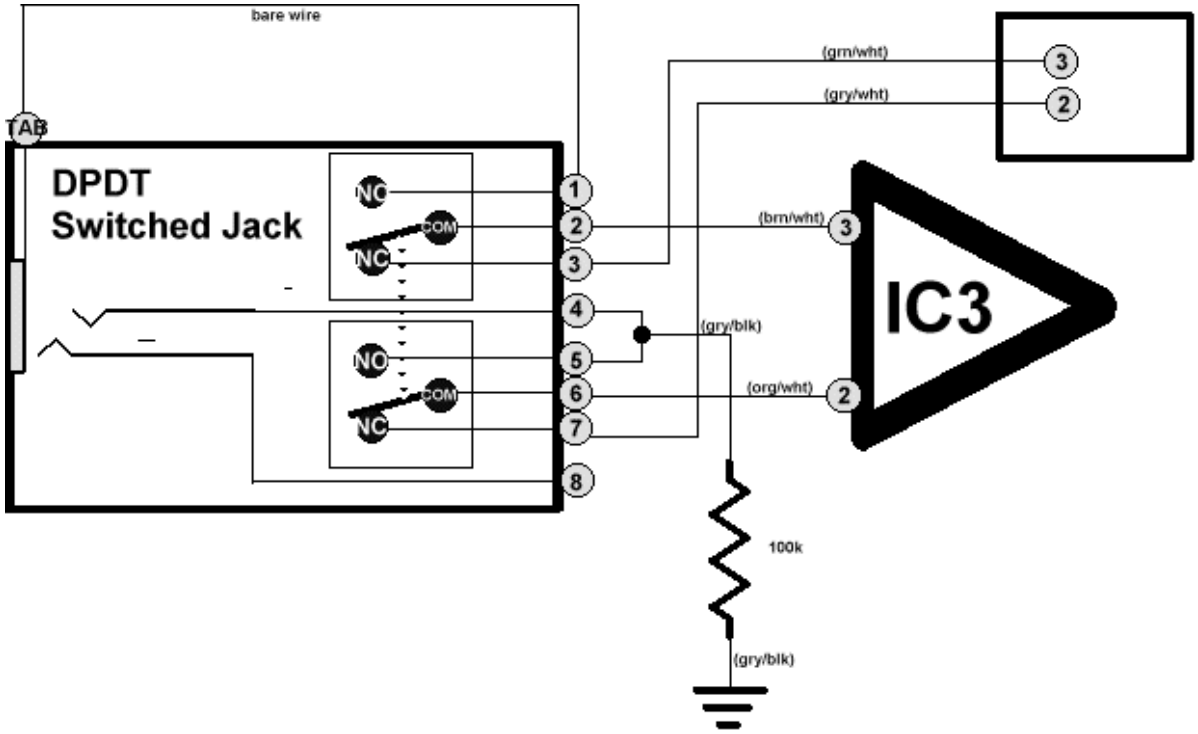


Connection Points (Art Work):

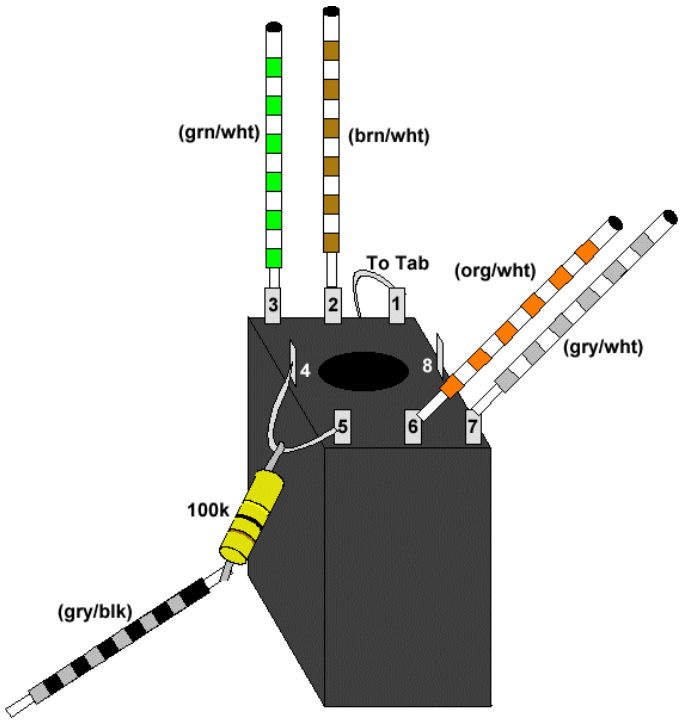


1. Mount 1/4" switched jack assembly on SH-101 main body.
2. Connect 100k resistor (colour code= brown black yellow) in series with 7cm piece of gray on black wire.
3. Connect 100k resistor to junction of pins 4 and 5 of 1/4" jack with DPDT switch.
4. Connect other end (gray on black wire) to sleeve connector on nearby 1/4" VCF in jack. (tied to Gnd)

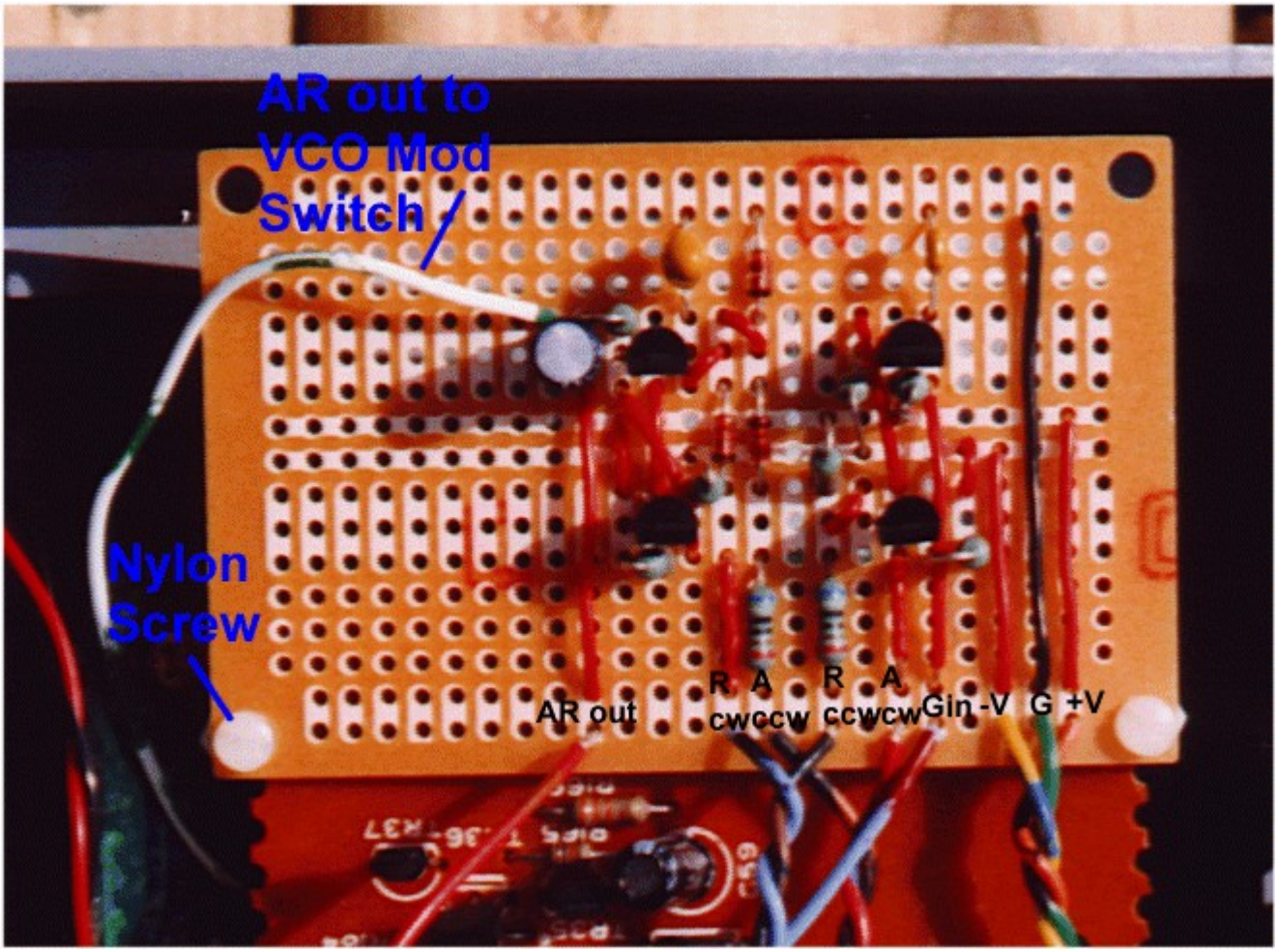
Schematic:



Physical Wiring:



1. Test fit AR unit to end of synth board.
2. Use an Xacto knife to enlarge two corrugations on synth board to allow screws to pass through.
3. Mount AR using two nylon screws and nuts.

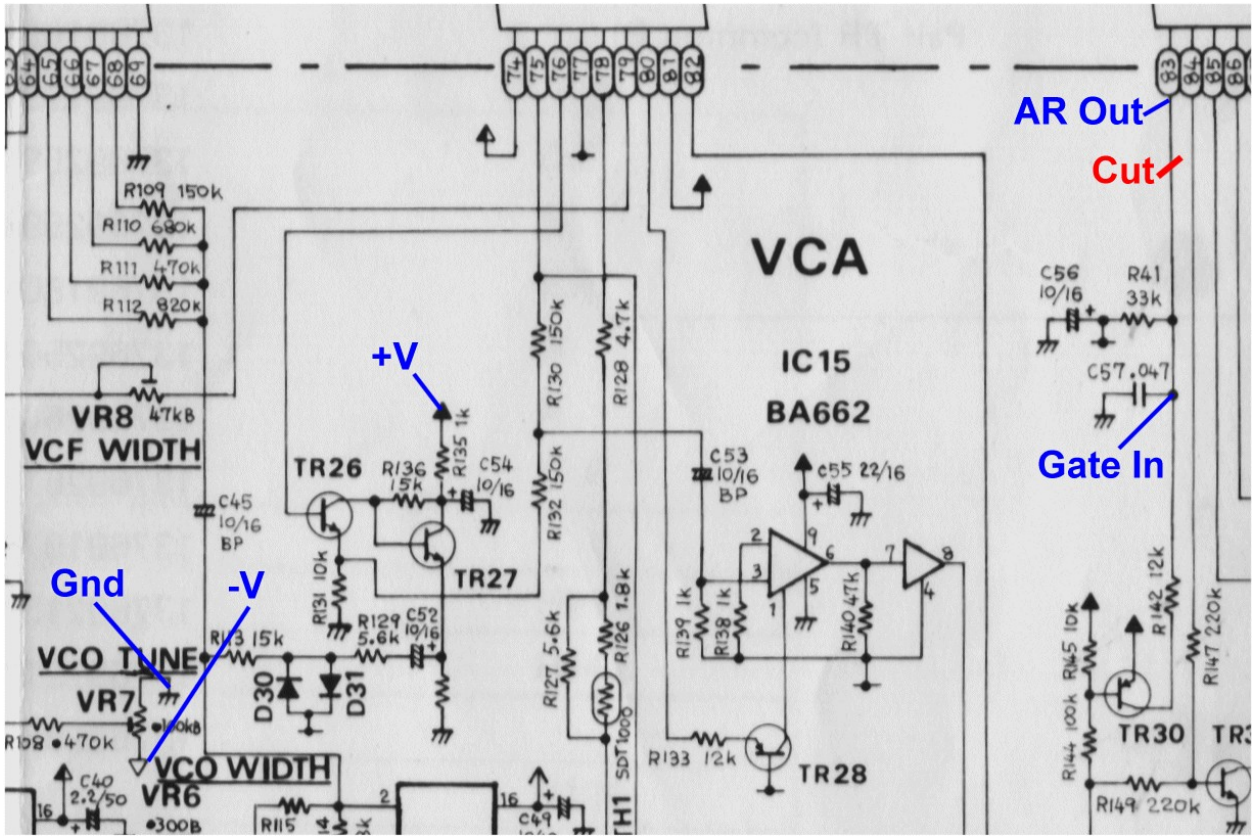


4. Attach wires from AR protoboard to -V, Gnd, +V, Gate In, AR Out points on Synth board:

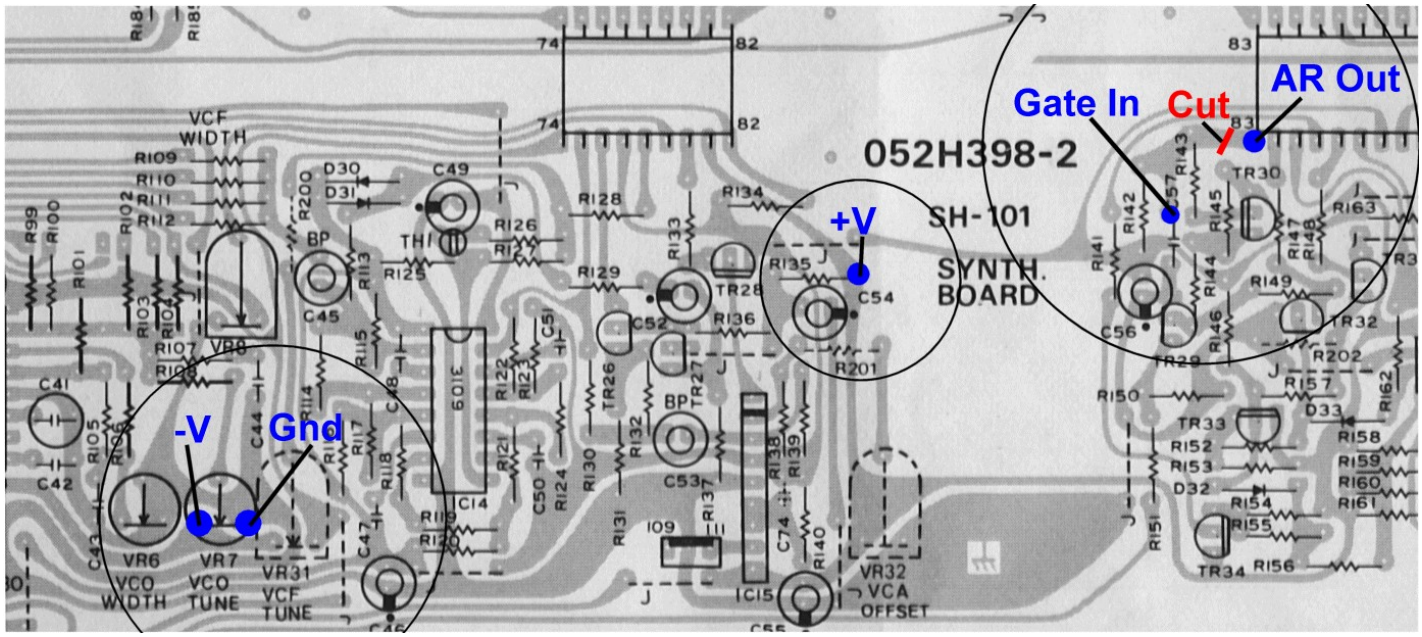
AR Envelope External Connect Wire Color code:

Signal	Wire Colour	Length	Destination
+V	black on orange	20cm	R135
Gnd	black on green	20cm	VR7 cw
-V	blue on yellow	20cm	VR7 ccw
Gate In	red on blue	10cm	C57 +
AR Out	brown on red	10cm	Pin 83
Attack Pot CW (and center)	blue on red	25cm	Attack Pot CW (and center)
Attack Pot CCW	orange on black	25cm	Attack Pot CCW
Release Pot CW (and center)	black on blue	25cm	Release Pot CW (and center)
Release Pot CCW	brown on black	25cm	Release Pot CCW
Trigger In	blue on white	40cm	R36

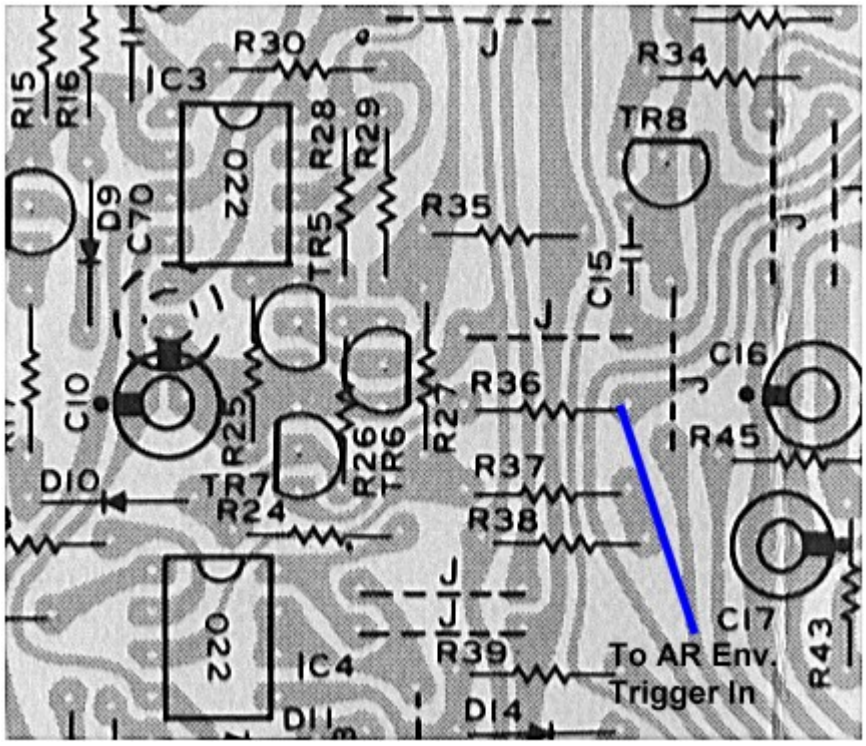
AR Envelope External Connect Points (Schematic):



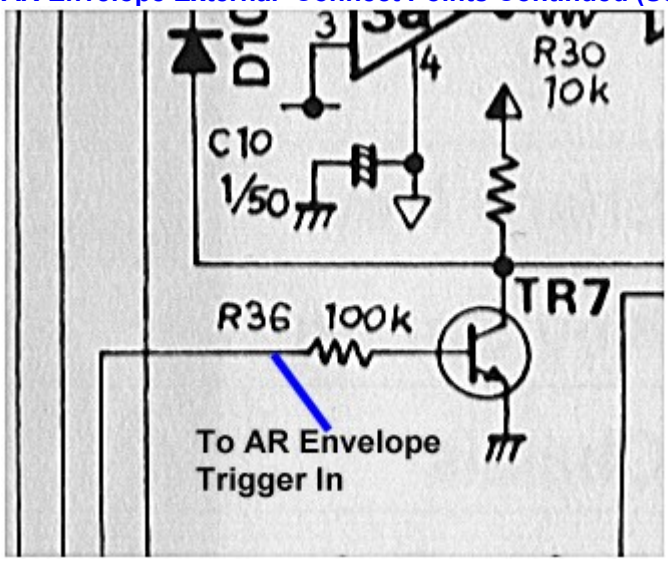
AR Envelope External Connect Points (Art Work):



AR Envelope External Connect Points Continued (Art Work):

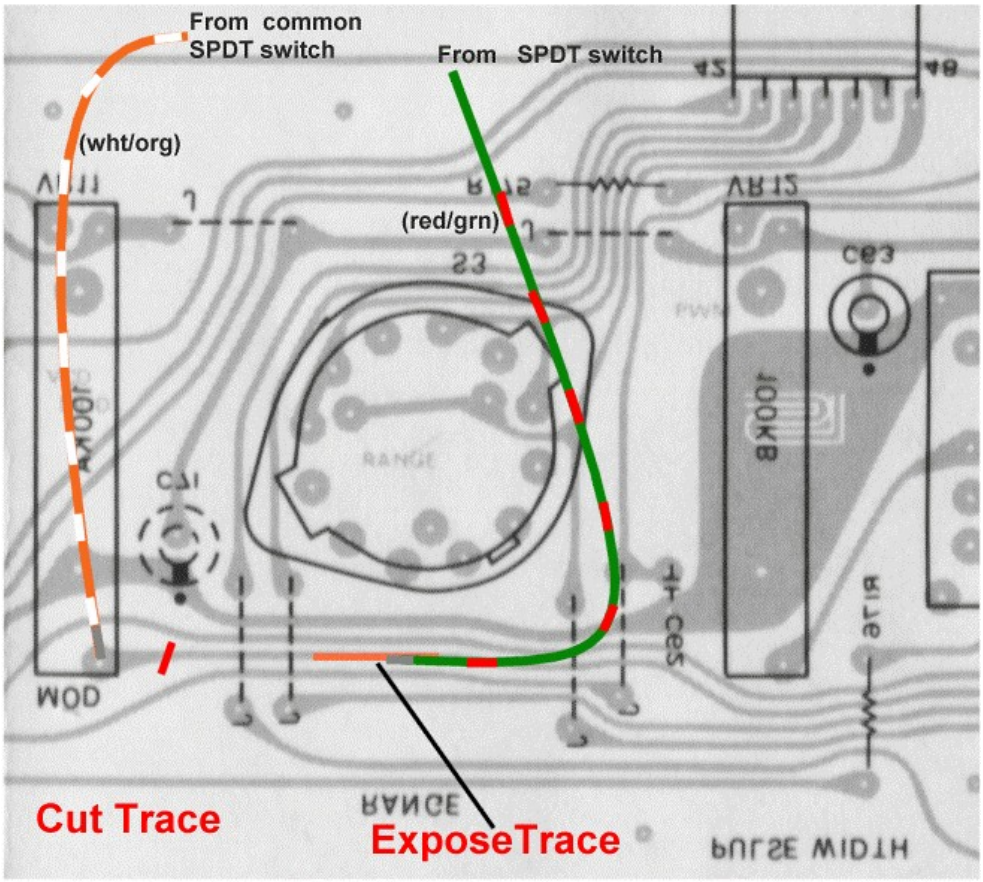


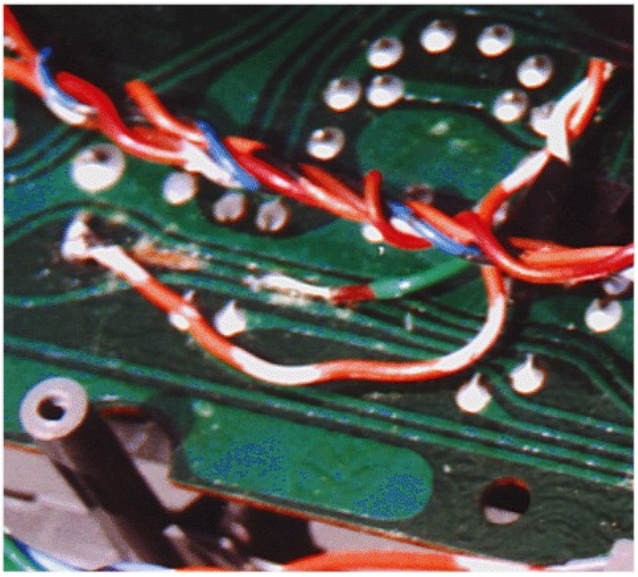
AR Envelope External Connect Points Continued (Schematic):



1. Solder white on orange wire from switch in step 15-4 to hot pin on Mod slider.
2. Solder red on green wire from switch in step 15-4 to exposed trace.
3. Route green on white wire from switch in step 15-4 to envelope area of circuit board

4. Connect green and white wire to AR circuit board's "VCO Mod Out" point (refer to step 13-2).





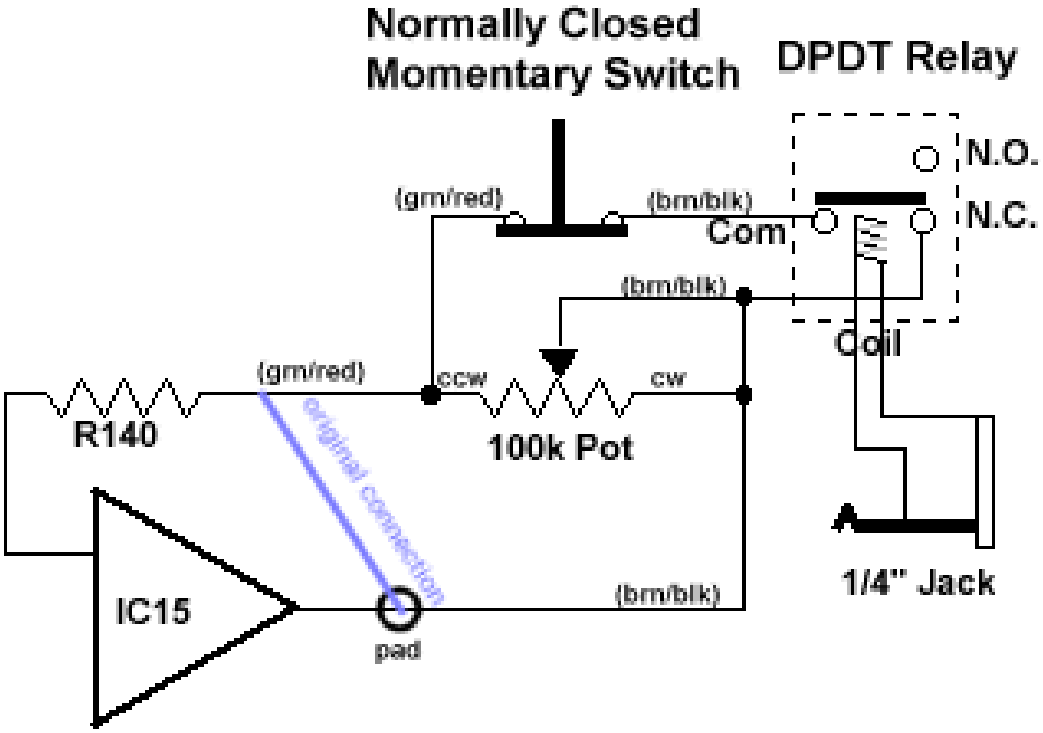
NovaMod Step 28

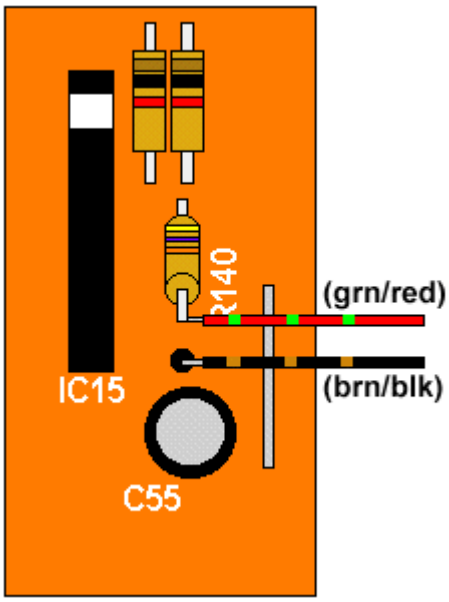
The Lab SH-101 Synthesizer Modifications Rev 2.0 **26/06/15**
Accent Installation

1. Connect red pushbutton normally closed switch to outside lugs of a 100k rotary pot with green on red and brown on black wires each 12cm (red on green to ccw lug, brown on black to cw lug).
2. Connect clockwise lug of pot to center lug of pot.

3. Connect brown on black wire (30cm) from clockwise lug of accent amount rotary pot to pad of R140.
4. Connect green on red wire (30cm) from counter clockwise lug of accent amount rotary pot to R140.

Interconnect (wiring/schematic):

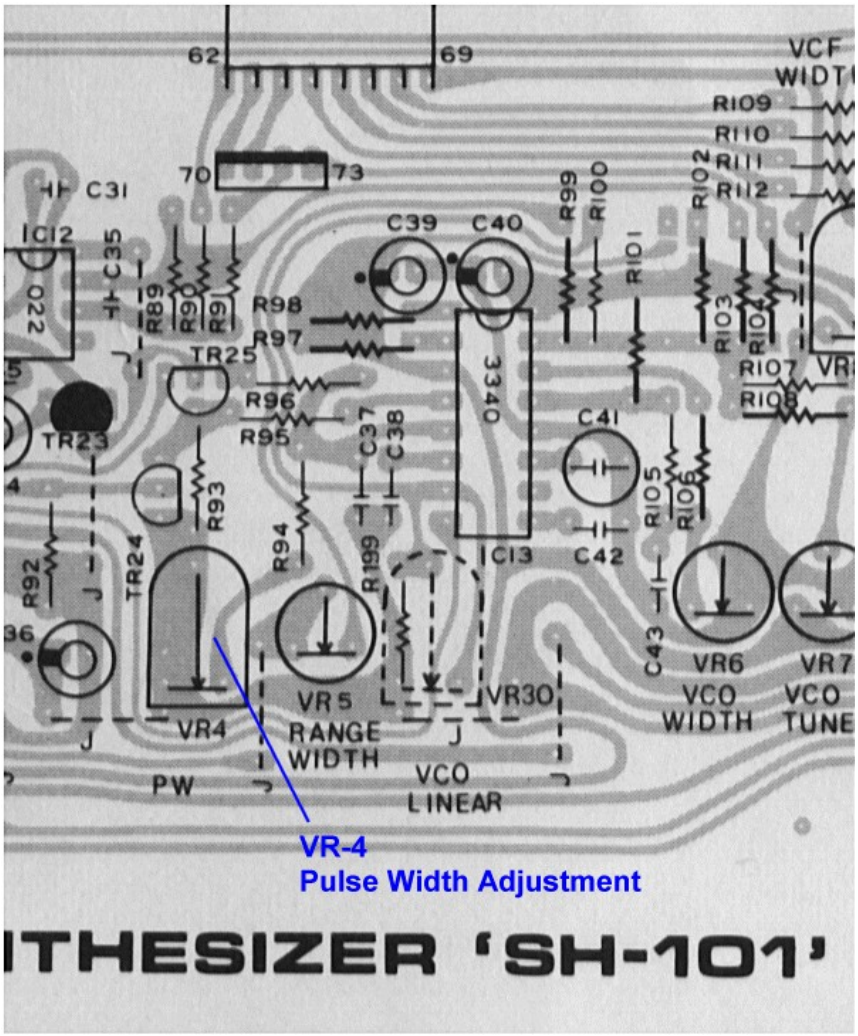




New! Connect brn/blk leads (common and Norm Closed) from 5V relay in series with momentary switch. Connect blue on white leads (coil) from 5V relay to ¼" accent in jack. Note polarity is not important. Mount Jack.

thelab@sprint.ca http://www.robotnik.com/the_lab
Made in Canada

1. Rotate VR-4 on synth board fully counter clockwise.



NovaMod Step 30

The Lab SH-101 Synthesizer Modifications Rev 2.0 **26/06/15**
External Portamento Installation

New! Connect brown on white leads (common and Norm Open) from 5V relay in across portamento switch S1 on bender board. Connect white on blue leads (coil) from 5V relay to ¼" portamento in jack. Note polarity is not important. Mount jack.

1. Install Keyboard.
   a. Test fit first to ensure the VCF FM Source, Amount, PW Source control contacts...etc do not short against keyboard's metal frame and springs.
   b. For safety, run two pieces of electrical tape over the VCF FM Source, Amount, PW Source control contacts...etc. to prevent shorts.
   c. Screw keyboard in place.

2. Fasten Synth Board.
   a. Carefully bend Synth board in place taking care not to stress wires.
   b. Double check for pinched wires or poorly soldered wires coming loose (especially those in NovaMod Steps 5 & 6

   c. Screw Synth Board in place.
3. Connect two cables to keyboard (unplugged in step 1-5)

4. Connect two cables to synthboard (unplugged in step 1-6)

5. Closely inspect wire routing, especially near jacks, and rearrange as required.

6. Insert 1/4" plugs in all new 1/4" jacks to test for ease of insertion. (See Step 30 Trouble Shooting for problems with insertion)

Trouble Shooting

1. No Power Up.
   a. Check the cuts made on the jack board for the CV/Gate 1/4" upgrade in Step 11 of the NovaMod.
      Compare the circuit board to the artwork and schematic in the SH-101 Service manual. Ensure that no +9Vdc or grounds have been cut.
      If they were cut, simply jumper around them.
   b. Check for wires which may have broken loose from flexing and stress while completing the NovaMod.
   c. Check for shorts caused by wires or debris on circuit boards.

2. No Sound.
   a. Ensure that the two cables to the keyboard (unplugged in Step 1-9) are re-connected.
   b. Ensure that the two cables to the synth board (unplugged in Step 1-4) are re-connected.

3. Difficulty in inserting 1/4" plugs.
   a. Ensure that objects on the Jack board (CV/Gate Jacks) do not interfere with plug insertion.
   b. Ensure that wire harnesses within the SH-101 do not interfere with plug insertion.
   c. Ensure that the back wall of the synth body does not prevent the tip of the 1/4" jack from moving when a plug is inserted.
      (bending the tip of the 1/4" jack away from center may assist or simply rotating the jack 45 degrees)

4. Text on decals does not match reality.
   a. Verify and correct wiring to the switch.

5. Noise floor and Hum is noticeable.
   a. Change the 9V dc "wall wart" power supply. I noticed that my Boss ACA-120 9V-200mA power supply causes noticeable hum from my SH-101 while my Boss PSA-120 9V-200mA is silent.
6. Glue on decals, edge of decals, synth body... etc.
   Using, thumb, rub glue continually in same direction . This will make a “gummy ball” which you can pick off.

Calibration Procedure:

This calibration is very easy to do. All that you need is a digital voltmeter capable of reading DC with an accuracy of 1mV. It is highly recommended to connect the voltmeter to a 1/8" plug. (best done by sacrificing a cable with 1/8" plug at one end and using alligator clips to connect the voltmeter). Use 1/4" plug if NOVA-MOD was done :) A guitar tuner or frequency counter is also needed.

1. Remove back panel of synth.

2. Adjust SH-101 front panel knobs as follows.
   Tune Pot in center position

   VCO Mod slider at 0
   Range at 8'

   Pulse width at 0
   Pulse waveform off
   Ramp waveform at Max.
   Sub-Osc waveform at 0
   Noise at 0

Freq. at Max.
Res. at 0
Env at 0
Mod at 0
Kybd at Max.

VCA at Gate

Portamento at Off
Transpose at M
Volume at 10
VCO/VCF/MOD bender assignments at 0

3. Connect voltmeter to CV output jack. Measure DC voltage

4. Power up SH-101 while holding LOAD and KEY TRANSPOSE buttons down. (These LEDS should stay lit)

5. Voltmeter will now read approx. 0.000V. Adjust VR-2 on Synth Board to achieve 0.000V.

6. Press PLAY button.

7. Voltmeter will now read approx. 2.750V. Adjust VR-1 on Synth Board to achieve 2.750V.

8. Press ARPEGGIO DOWN button.

9. Voltmeter will now read approx. 2.500V. Adjust VR-3 on Synth Board to achieve 2.500V

10. Repeat steps 5-9 until all measurements are within 1mV. (note, you can press the LOAD button to return to the state required for step 5 rather than re-powering.

11. De-power the Synth.

12. Re-power the synth and connect a guitar tuner or frequency counter to its output.

13. Alternate playing the lowest key (F3) and highest key (F5) while looking at the tuner/counter.

14. Adjust VR-6 until both notes are exactly 2 octaves apart. VR-6 adjusts the frequency spacing (width) between the two notes. It should be exactly 2 octaves however VR-6 can make it greater or less that this amount. If you have good ears, you may be able to adjust VR-6 without an instrument. (use keys G3 and G4 if you use a guitar tuner that reads only EADGBE notes) Note :you may have to adjust VR-7 slightly to retune. Unfortunately VR-6 adjusts the width AND the overall tuning. TIP: Play the lowest note and set it to reference point using VR-7 (i.e.
G3 for the guitar tuner) Next press the G4 key and note where it sounds. If it is too high, then adjust VR-6 so that the G4 note increases in pitch (YES INCREASES). Next, play G3 again and adjust VR-7 to re-center
the guitar tuner. Press G4 and see how close you have come. If G4 is too low then lower the pitch through VR-6. Repeat this until You get your octave spacing.

15. Press an A key and adjust VR7 until the guitar tuner is centered on A (221/442/884 on a counter).

16. Repeat 14 and 15 until happy or crazy. (Actually SH-101's are easy compared to Moogs!!!)

17. De-power the Synth

18. Re-power again holding the TRANSPOSE and LOAD keys.

19. Press the U&D button then press the UP button. Adjust VR-5 until the output is at the same pitch for each button.

20. De-power then re-power synth.

21. Adjust sliders so that:
    all waveforms and noise levels are 0.
    Res. is at Max.
    VCF Env and VCF Mod are 0
    Cutoff is approx. 8 (adjust so that a tone is hear from the self oscillation of the filter)

22. Alternately play two notes exactly 1 octave apart.

23. Adjust VR-8 until the two notes played sound 1 octave apart. Use a freq. counter or tuner or ear to measure.

24. Measure the DC voltage across the two test points on the Bender Board. (The test points are the wires accessed through the two holes drilled in the circuit board.) Adjust VR-3 on the bender board for a 0.000V dc reading.

