Bill and Will's Synth
Jürgen Haible
Triple Chorus - "Solina" Emulator
Construction

December 2007 -

In September of 2007 (on the 20th), Jürgen Haible posted a message on the MOTM list server announcing his J.H. String Ensemble / Triple Chorus - "Solina"(TM) ulator. Now those same

recordings we intend to do in the winter of 2008 for which we want the "Tau Pipe Phaser" will also require a chorus effect. Having been working on the Tau Pipe, we immediately expressed interest.

True to character, Jürgen offered us tireless generosity in answering our questions and for letting us post some of the images he created here on our page. Our interest in doing so is to document his work and provide an idiot's guide to building his marvelous gadget. We hope we succeed.

Please note: **This circuit REQUIRES three now rare TDA1022 ICs**, but as of Jan, 2008 they can still be gotten at vintageplanet.nl for around 8 euros a piece.

Table of Contents

This page has become really long, so here's a table of contents that we hope will make it easier to traverse:

Set up / Testing

Use notes

Background

Jürgen's site describes the effect:

"The lush Sound of the Solina (TM) Ensemble is created by 3 BBD delay lines that are modulated in a unique way: There are two 3-phase modulation generators, one running at slow speed ("Chorus"), and one running at high speed ("Vibrato").

"We'll focus on one of the modulation generators first, 'Chorus': the slow one. '3-Phase' means that the modulation generator has 3 outputs, each of which's phase is roughly 120 deg apart from the previous output. Let's call them '0 deg', '120 deg,' and '240 deg' - it's easy to see that, with 360 deg describing a full circle, the three modulation outputs a modulation generator are equally distributed around a circle. They are routed to the CV inputs of the 3 BBD's clock VCOs. Modulation of a BBD line causes a pitch shift similar to the Doppler effect of a moving sound source, so with the 3 BBD lines modulated by the 3-phase control signals, a sonic image of 3 sound sources that are moving along the same circle, with equal distance to one another along the outline of the circle, is created.

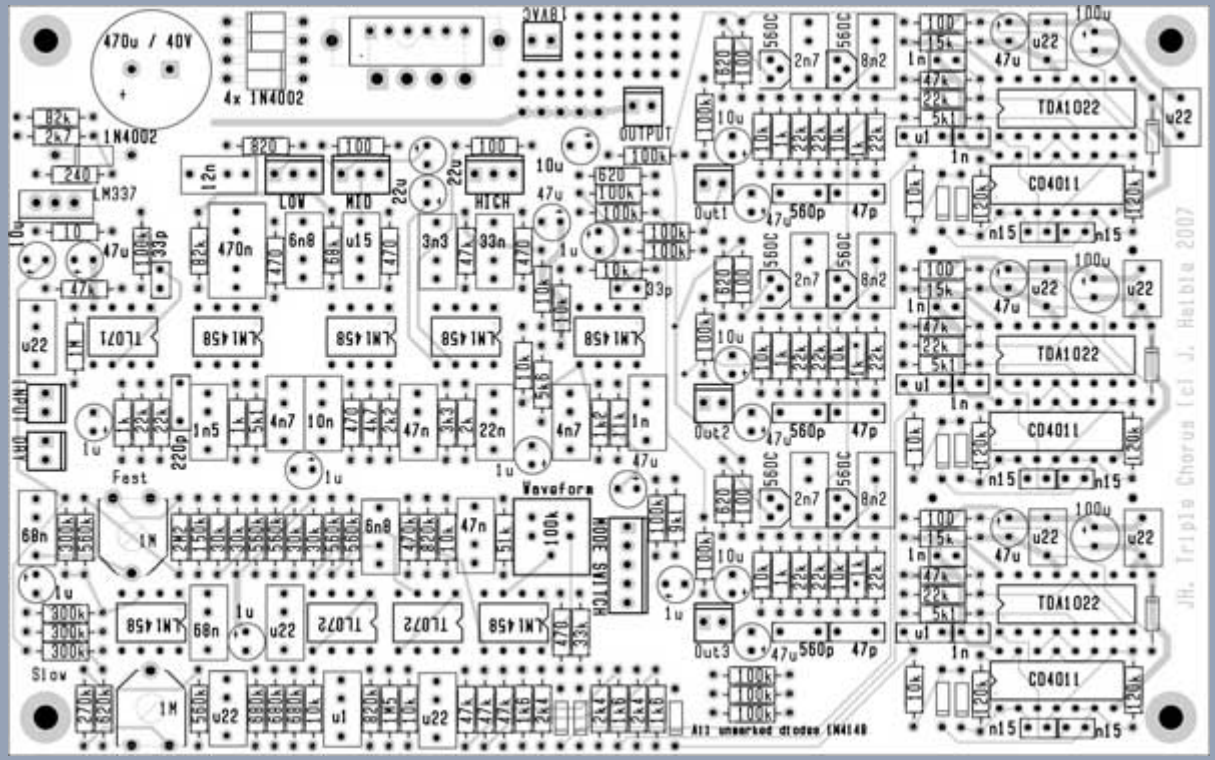
"Actually, each BBD clock VCO is controlled not by a single modulation generator, but by a combination of the slow and the fast generator.

> BBD1 sees a CV that is combined from the Chorus generator's "0 deg" output and the Vibrato generator's "0 deg" output.
>
> BBD2 sees Chorus "120 deg" and Vibrato "120 deg".
>
> BBD3 sees Chorus "240deg" and Vibrato "240 deg".

"This method creates the famous 'Solina' sound, which was so successful that it has been emulated by other manufacturers. Of these, I have studied two very closely: The Crumar

Performer, and the Dr. Boehm Phasing Rotor 78. I've also taken a look at the Korg Polysix's Ensemble mode."

Learn more...



Jürgen's PC board diagram - you can click on the image to download a higher resolution image.

But Jürgen's posting doesn't fully describe the details of the different configurations possible. Here are the different options:

Recapitulation of Construction/Feature Options

1. Power Supply Options

    Option 1 - On-board power supply.

Option 2 - MOTM-style dual power supply.

2. Connection/Control Options

A. Basic Connection/Controls (common to all options)

Equalizer Knob- High
Equalizer Knob- Mid
Equalizer Knob- Low
Effect Active/Bypass Switch
Modulation on/off Switch
Output Jack

B. Input Control

Option 1 - Minimal Version - this involves one jack.
Option 2 - Basic Version - this involves one jack and a POT

C. Mode Switching

Option 1 - 3 Position Rotary Switch
Option 2 - Two Toggle Switches - Roll-off Switch & Equalization On/Off Switch

D. Wave Shape Adjustment

Option 1 - On pcb
Option 2 - On panel

E. Extra Outputs

Dry Output
Individual Outputs 1, 2, & 3

F. Mixed Output - Mix Knob and a Mixed Output jack

Option Details

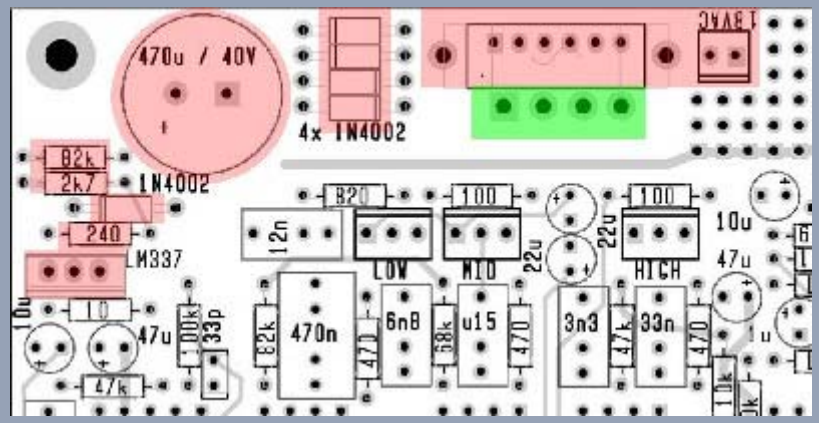
1. Power Supply

Option 1

On-board power supply - per Jürgen, "It contains a power supply (less transformer and primary fuse). You only have to connect 18V AC from a transformer."

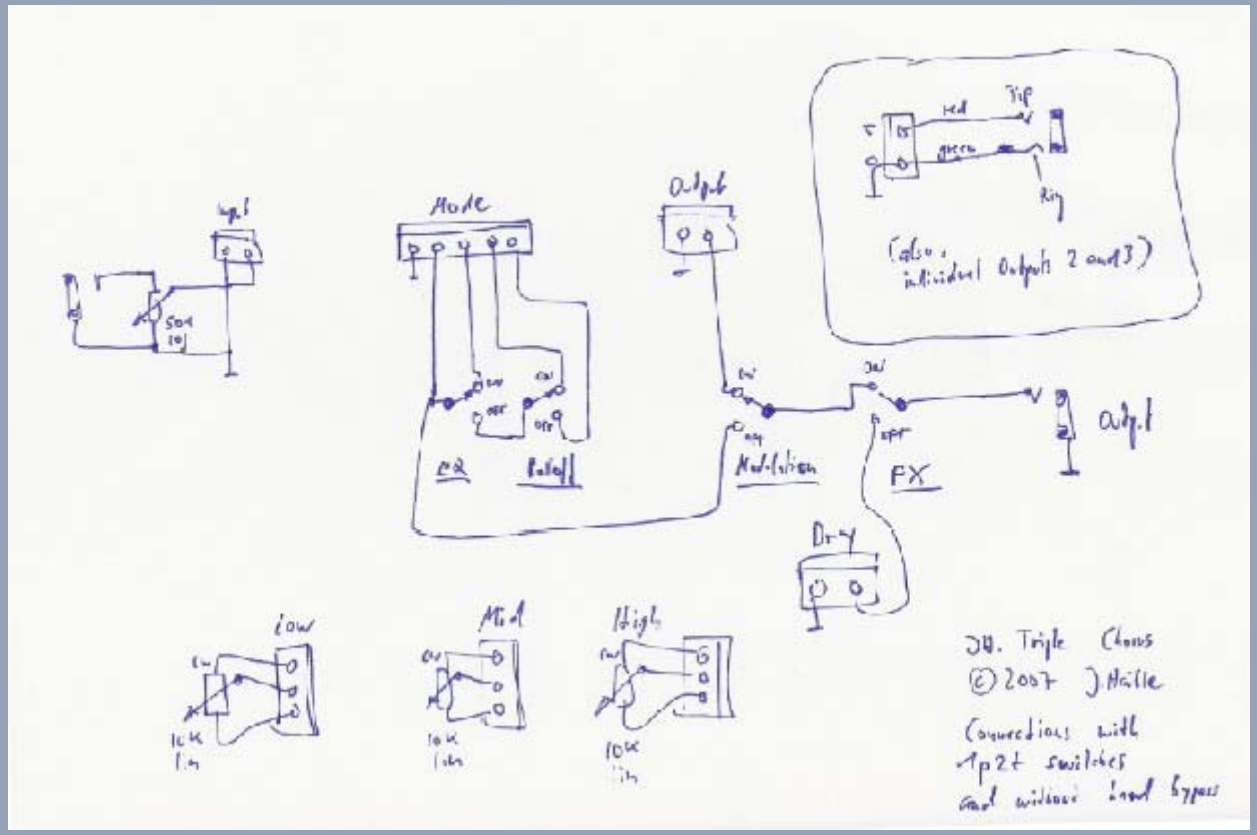
Option 2

MOTM-style dual power supply - per Jürgen, "I've also included the footprints of MOTM and .COM power connectors, if you want to run the board directly from 15V, without a transformer of its own. I've placed the footprint for the connectors beneath the (secondary) fuse, because you never need both at the same time. When connecting to 15V DC, you must omit a lot of the power supply components, too... By the way: The whole circuit only needs the -15V part of the MOTM and .COM system; the +15V pins of the connectors are unconnected. The audio signals are centered to 0V nevertheless, of course, due to AC coupling of inputs and outputs."



In this diagram, the elements omitted for the MOTM style 15V power supply are shaded red, the MTA header for the 15V power is shaded green

2. Connections and Controls



A. Basic Connection/Controls (common to all options)

Equalizer Knob - High

10k linear POT - to "HIGH" on PCB

Equalizer Knob - Mid

10k linear POT - to "MID" on PCB

Equalizer Knob - Low

10k linear POT - to "LOW" on PCB

Effect Active/Bypass Switch

SPDT switch (per above diagram) from Output Jack Tip - ON to Modulation On/Off

Switch, OFF to "Dry" on PCB

Modulation on/off Switch

SPDT switch (per above diagram) from Effect Active/Bypass switch (ON position) - ON to "Out" on PCB, OFF to "Mode Switch" on PCB position 1

Output Jack

Switchcraft 112A Jack to "Out" on PCB

B. Input Control

Option 1 - Minimal Version

Switchcraft 112A Input Jack to "Input" on PCB

Option 2 - Basic Version

Switchcraft 112A Input Jack to 50K log POT to "Input" on PCB

C. Mode Switching

Option 1 - 3 Position Rotary Switch

Switch center to Mode Header Position 2

16kHz Roll Off

3 Position Switch to Mode Header Position 4

"Solina" 12kHz Roll Off

3 Position Switch to Mode Header Position 3

"Performer EQ

3 Position Switch to Mode Header Position 2

Option 2 - Two Toggle Switches

Equalization On/Off Switch

SPDT switch (per above diagram) from "Mode Switch" on PCB position 1 - ON to position 2, OFF to Roll-off Switch

Roll-off Switch

SPDT switch (per above diagram) from EQ switch OFF - ON to "Mode Switch" on PCB position 3, OFF to "Mode Switch" on PCB position 4

D. Wave Shape Control

Option 1 - 100k trimmer on PCB

Option 2 - 100k "SHAPE" POT on Panel

E. Extra Outputs

Dry Output -

Switchcraft 112A Dry Out Jack to "Dry" (Output) on PCB

Individual Outputs

three Switchcraft 112B (TRS) jacks to "Out 1," "Out 2," and "Out 3" on PCB

F. Mixed Output

Version 1 -

Switchcraft 112A MIX OUT jack to 10k lin "Mix" POT to DRY and OUT on PCB

Version 2 -

Switchcraft 112A MIX OUT jack to buffer daughter-board - either MUUB2 or Ken Stone Tiny Buffer from Bridechamber to 10k lin "Mix" POT to DRY and OUT on PCB

Parts

Will and I have developed a parts-list / bill-of-materials in the form of an XL spreadsheet. Jürgen has been very patient and helpful answering our many pesky questions. As of today, 26 January 2008, it's not entirely complete because it doesn't really address parts that may be needed for the implementation of buffer / inverters for the "DRY" and "MIX" outs. WE're not even really sure how we're going to handle these features yet.

In the BOM, the left-most column is the "part." The parts we've ordered have a green

background. These parts we have a high (but not perfect) level of confidence that we've specified correctly - we caught a mistake or two in part numbers / prices as we were ordering. please double-check us and let us know of mistakes you find.

Click here to see Jürgen's Bill of Materials.

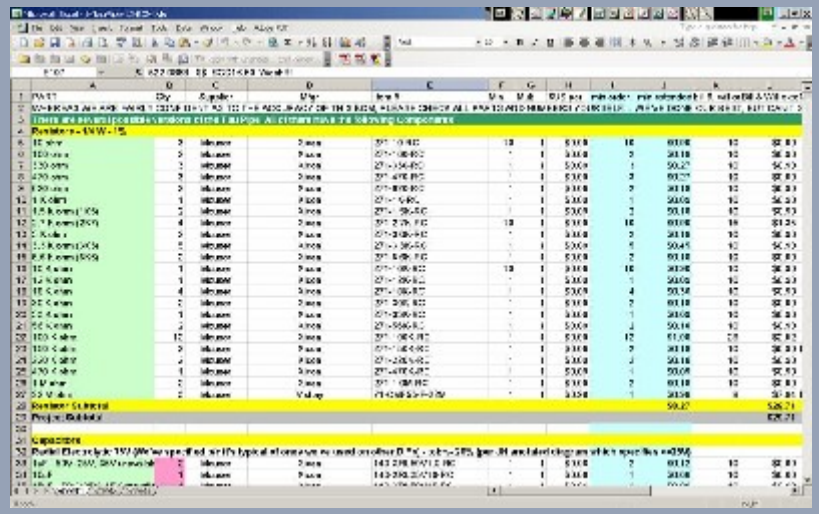
Corrections to BOM:

None yet -

Notes:

None yet -

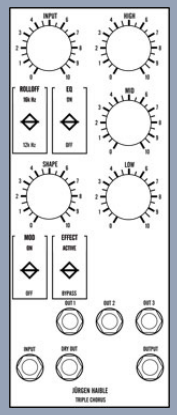
Click here to download the spreadsheet (apx. 350K).



Panel

With the help of Jürgen and in collaboration with and with input from Mike (mrmike of clickbang) and Scott Deyo (Bridechamber.com), Will and I developed the Panel design at the top of the page. If you click on that drawing, you can see a bigger version.

The evolution of the design isn't really worth exploring. The design went back and forth between us and Jürgen several times - each time he was clarifying how the features should be interpreted.



Will and I then developed the following rack-mount panel design for my stage equipment guitar-rack. Thanks again to Mike for his suggestions.

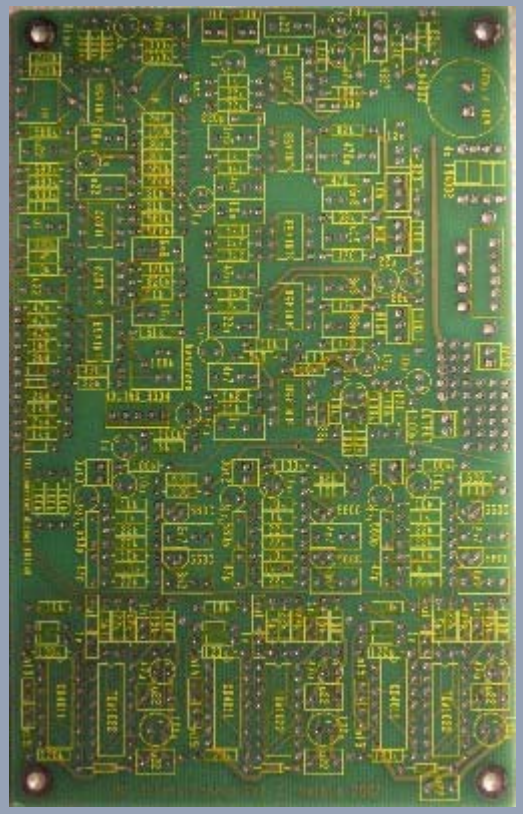
But then, in September of aught 8, as we finally approached building the module, we took a closer look at Jürgen's schematics. His schematic shows a 3 position rotary swithc used for Mode switching. So we re-visited our panel design adding the rotary switch and Will's Mixed Output idea.

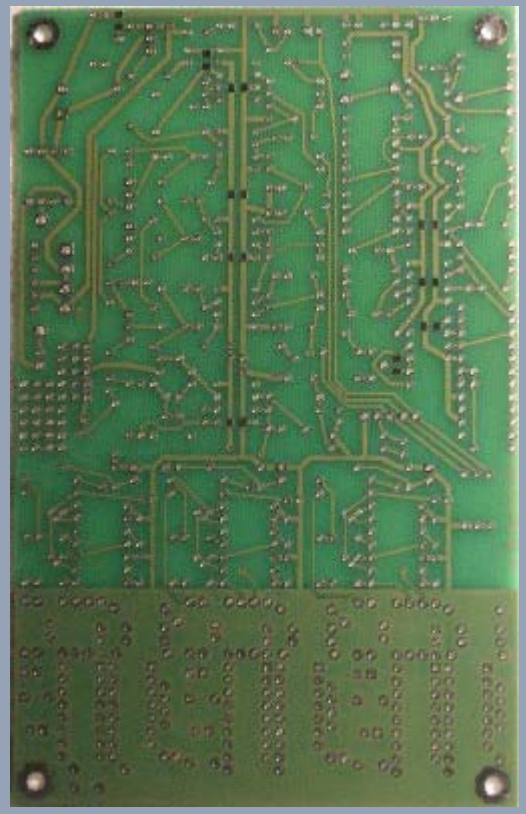
Scott Deyo developed his panel based, in part, on our rotary-switch design. We got one of his panels:

November 2008

PCB

Here's what the PCB looks like...





PCB front and back (click on image for larger one)

March 2009 -

Construction Phase 1

All the stuff in Phase 1 gets soldered using "Organic" Solder. At every break in the action, we wash the board off to get rid of the flux.

Resistors

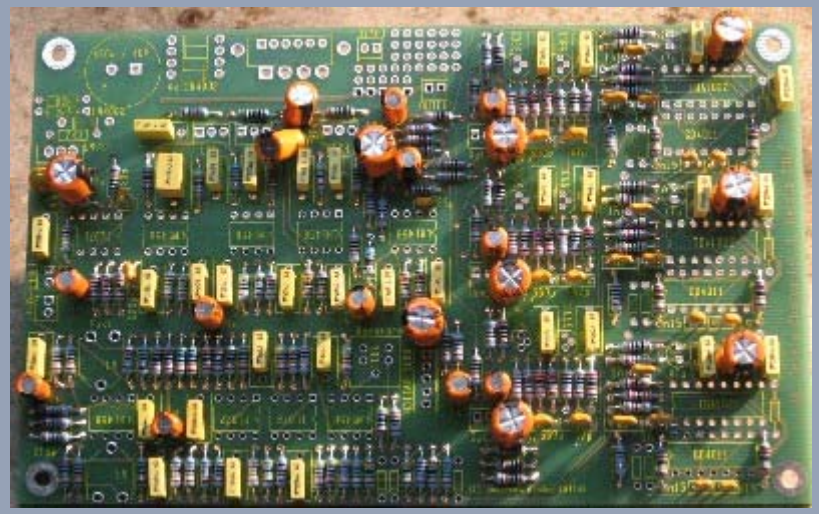
The PCB is very dense. It took us 6 hours in two sessions (washing inbetween) just to do the resistors.

Capacitors

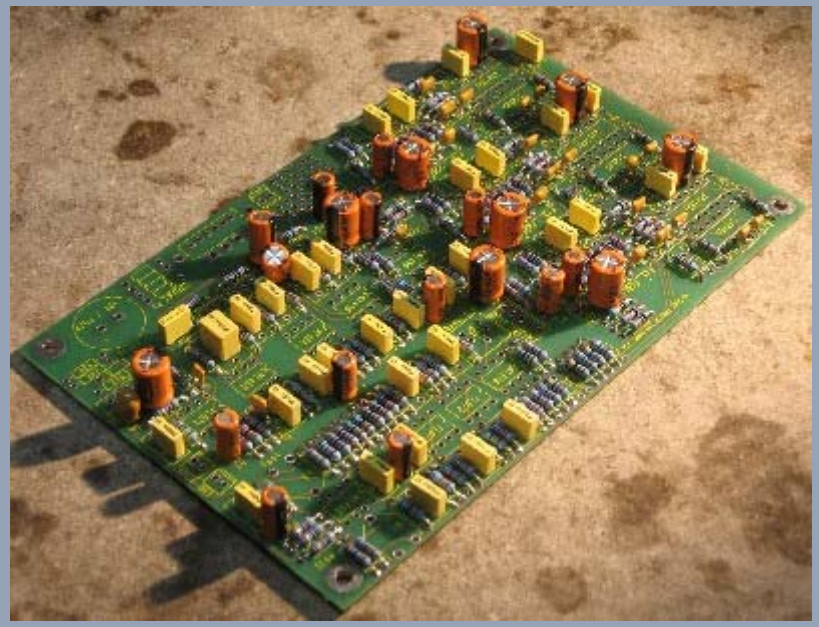
Box Caps

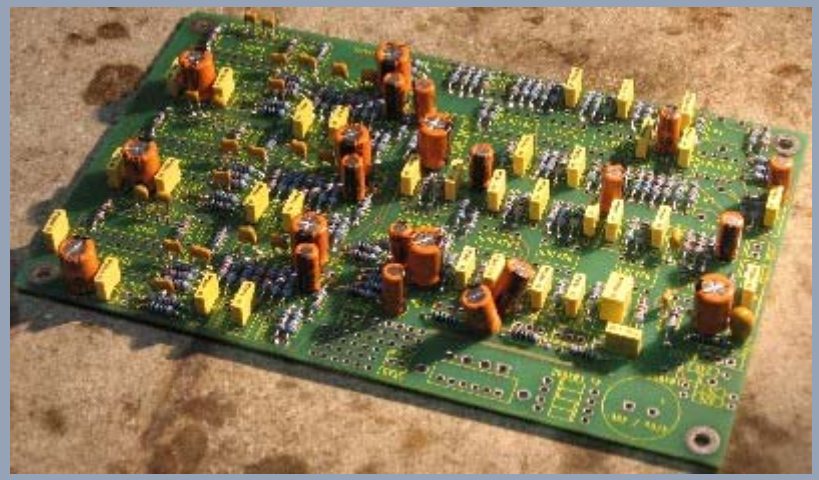
Ceramic Caps

Electrolytic Caps



The electrolytic caps we got are the right value, but some of them are too big around to fit neatly. But it'll be OK. We missed three of the 47µF caps - and we got to the later.





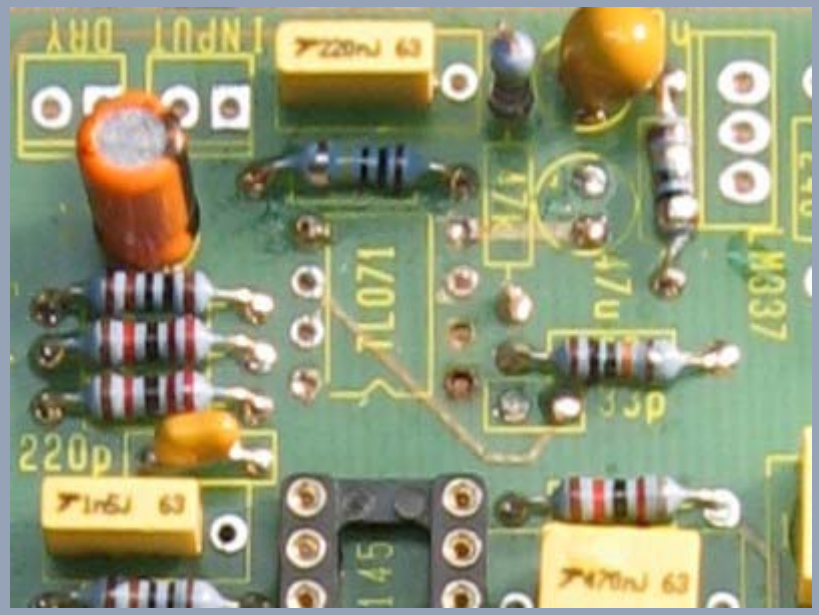
Here's what it looks like (we left off three 47µ electrolytics that we caught as of finishing the IC sockets)

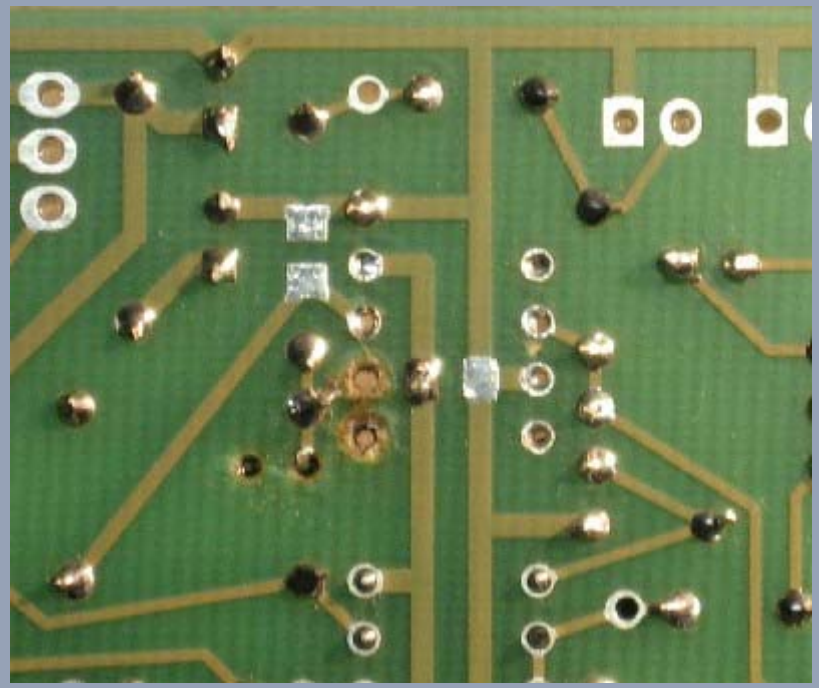
We decided to come back and do the dinky SMT caps after the IC sockets...

IC Sockets

So we started in on the IC sockets - when tragedy struck! (duzz duzz duzz) Somehow, as I was soldering in the socket for the TL071 - up there by the tantalum cap - one of the pins got stuck and it wouldn't sit all the way down. And I tried to fiddle with it and it only made it worse. And I tried to un-solder it and the pliers slipped and damaged the 33p cap and as I struggled, the 47K resistor and further destroyed two solder pads and a trace. <groan!>

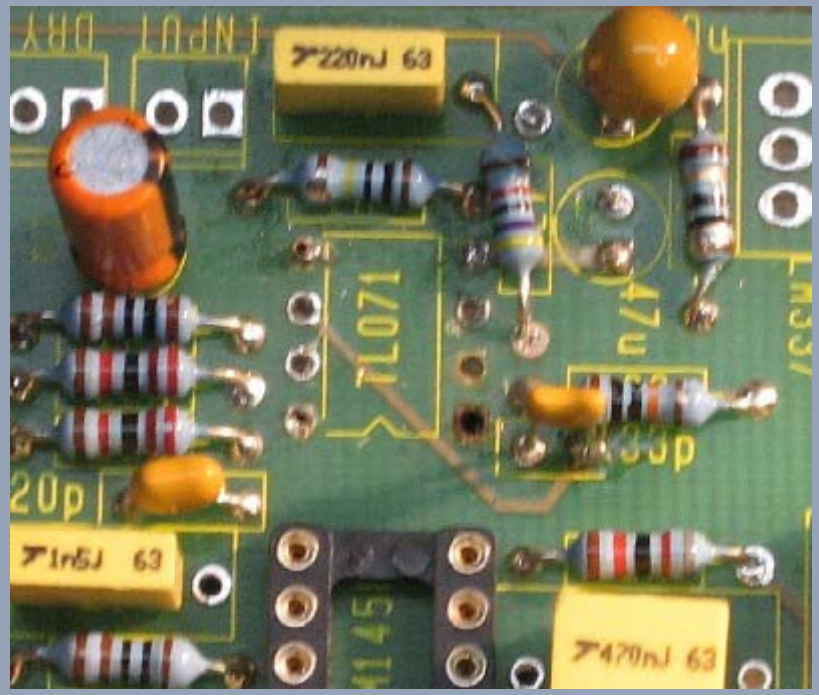
I cut away the broken parts - -



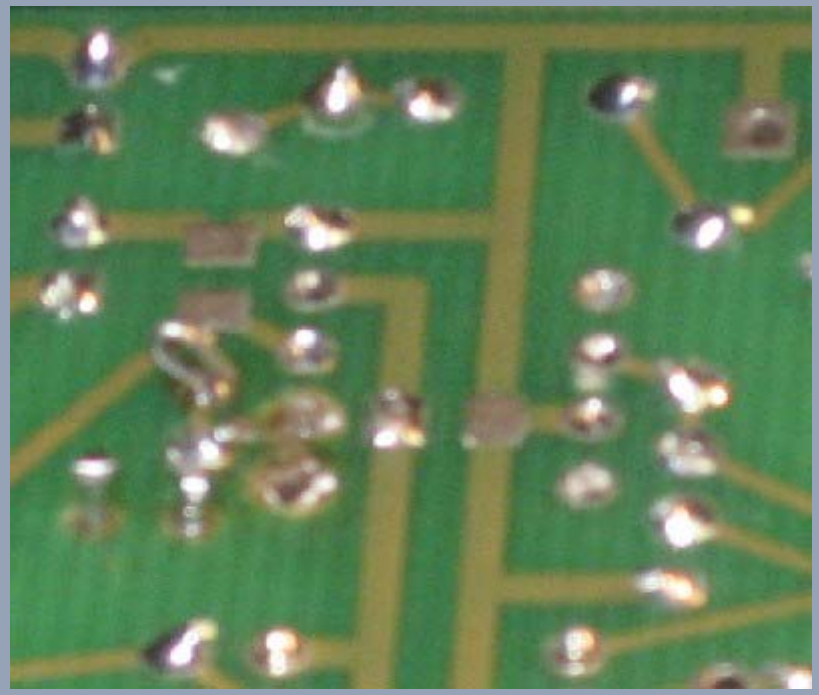


We decided to mount the TL071 down in that little bread-board area by the OUTPUT point. We'll run jumpers down to it as required.

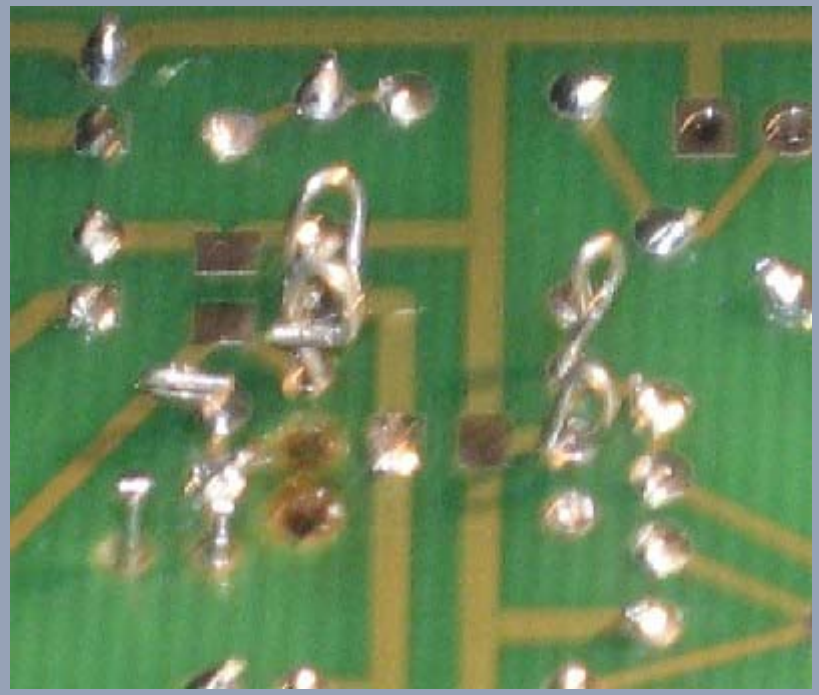
But first to repair the damage...



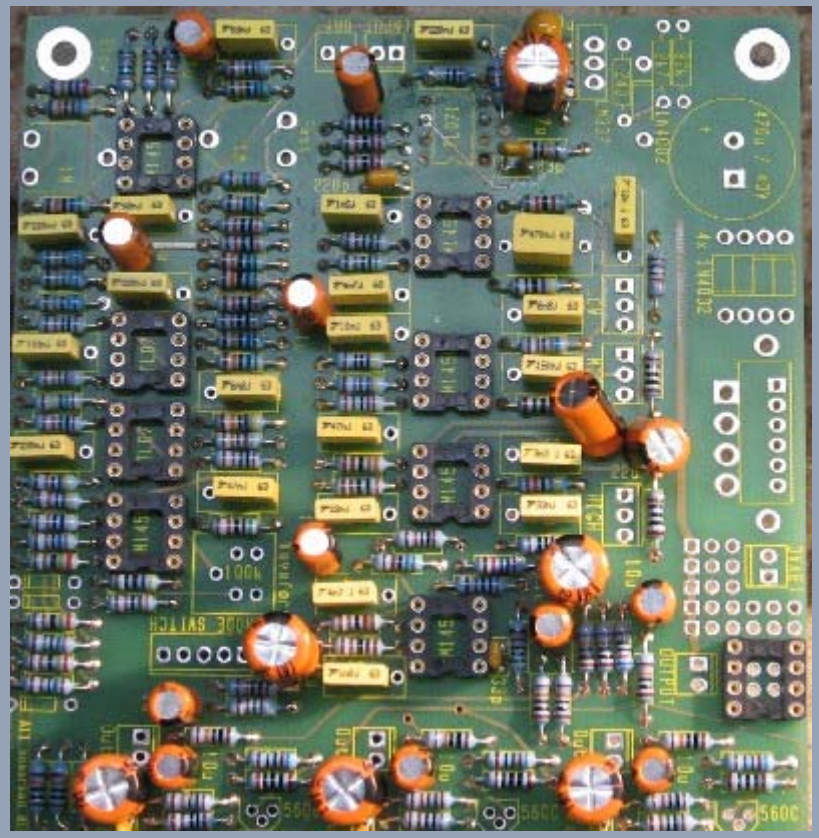
We replaced the 33p cap and the 47K resistor. It was easier to thread one of its leads through the hole by the box cap - it goes to the same place.



And the other end of that resistor lead - we made this little loop on the underside of the PCB... we'll use that loop to solder the jumper to.

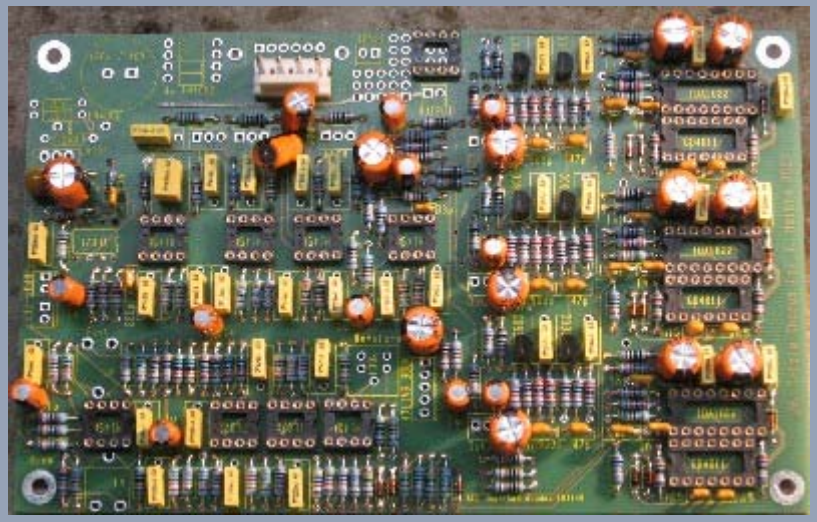


We used bits of scrap resistor lead to make other solder points for the other four jumpers (only five of the eight IC pins are used).



We replaced the 47µ cap and soldered in the socket down by the OUTPUT point <groan>. We'll run the jumpers as part of Phase 2 Construction.

Now to finish the IC sockets.



IC sockets and the diodes and transistors

Snack - Pot Roast

the ingredients:

meat (beef - chuck-roast 3-1/2lbs... we're working our way up to elk)
small yellow onions
carrots
little red potatoes
red wine
black pepper
bay leaf
thyme
celery salt


put olive oil in the pot and brown the meat


chop onion, place in pot with roasted garlic

add thyme and bay leaves

and a half-cup or so of red wine... we had this wonderful Alicante in the fridge - kind of expensive - but now a little old for drinking <G> - a real luxury for cooking

It goes into the oven at 275° for 3 hours!

we chop the carrots and potatoes... and after 3 hours, add them to the pot. Back into the oven for another 1-1/2 hours

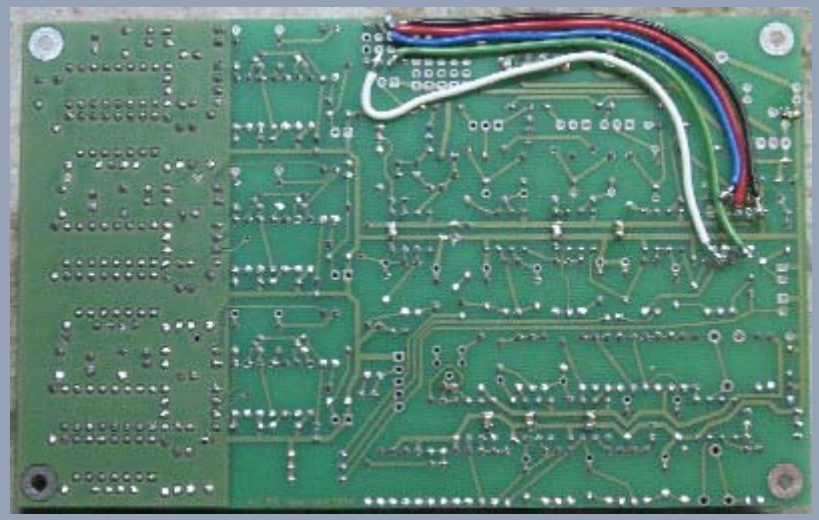
Construction Phase 2

All the stuff in Phase 2 gets soldered using "No-Clean" Solder and the PCB doesn't get washed

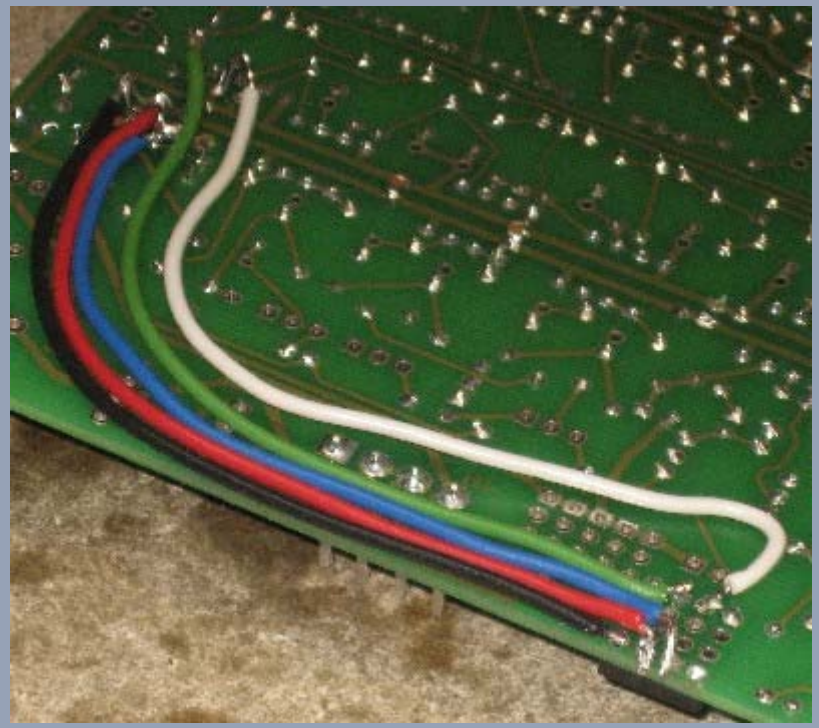
off from here on.

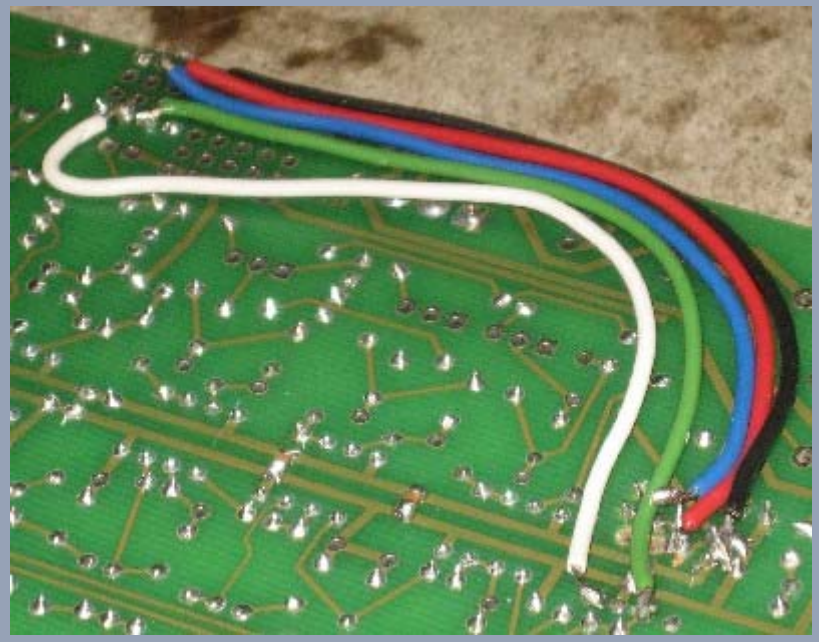
SMT caps / TL071 fix jumpers

OK - now, - you won't have to do put in the jumpers because you will not have destroyed the TL071 socket (if you're even using sockets at all)...



but you can see the SMT caps

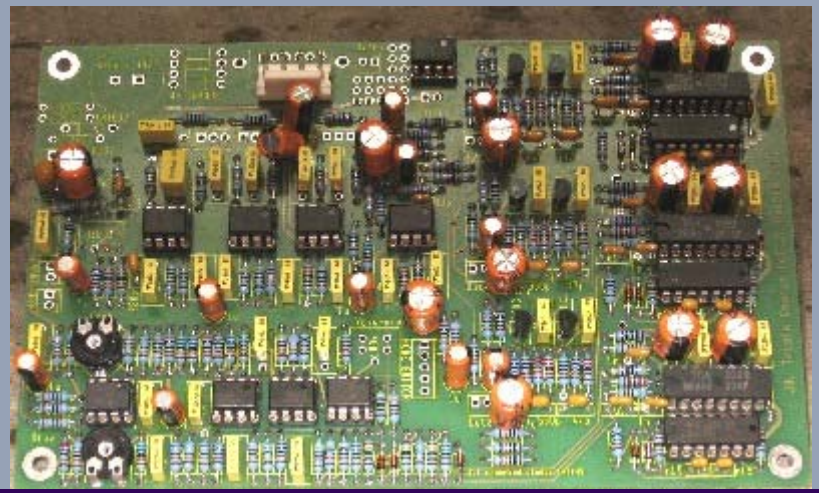




so here are the jumpers

ICs and Trimmers

We put the ICs in their sockets and soldered in the two 1M trimmers



Mounting Bracket

A three-pot "Stooge" style panel from Bridechamber just barely fit the Triple-Chorus PCB. We drilled special holes - the bottom left was pretty sloppy - but it worked anyway.

Test Mount

We did an elaborate test-mounting of the PCB, Mounting Bracket, Panel Mounted Pots and Rotary Switch, and the Panel so we could determine the various wire-lengths required for soldering into the PCB.

we screwed the PCB to the mounting bracket and soldered chicklets onto the three 10K lin "EQ" pots that will secure the bracket to the panel.

Here's how we figured out the 10K lin "EQ" pots would fit

There are two more panel-mounted pots - 100K lin for SHAPE and 50K log for INPUT

But then there's the matter of the MODE rotary switch - and we took a little time to figure this out...

See - the switch has 12 positions but we only want to use three.

the switch comes with all you see here (batteries not included <G>)
switch, "tool" (this is the thing that adjusts how many of the 12 positions gets used), ring (this, we figured out, pushes against the "tool" to hold it in place, lock-washer, flat washer, nut

OK - it's hard to see, but by putting the "tool" here, you get three positions... fiddle around with it a bit - you'll find it.

so that black vinyl ring goes over the "tool" (sorry the pic is out of focus) then the switch gets mounted into the panel

Right - so here they are screwed into the panel...

now we can figure out the wiring...

PCB Wiring

Here's how we figured the wires should be:

HIGH pot (10K lin) - twisted triple wire 7in.

MID pot (10K lin) - twisted triple wire 8-1/2in.

LOW pot (10K lin) - twisted triple wire 10in.

INPUT to INPUT pot - coax 8-1/2in.

MODE switch - twisted quadruple wire 6in.

WAVEFORM (SHAPE) to OUT 3 jack - twisted triple wire 7in.

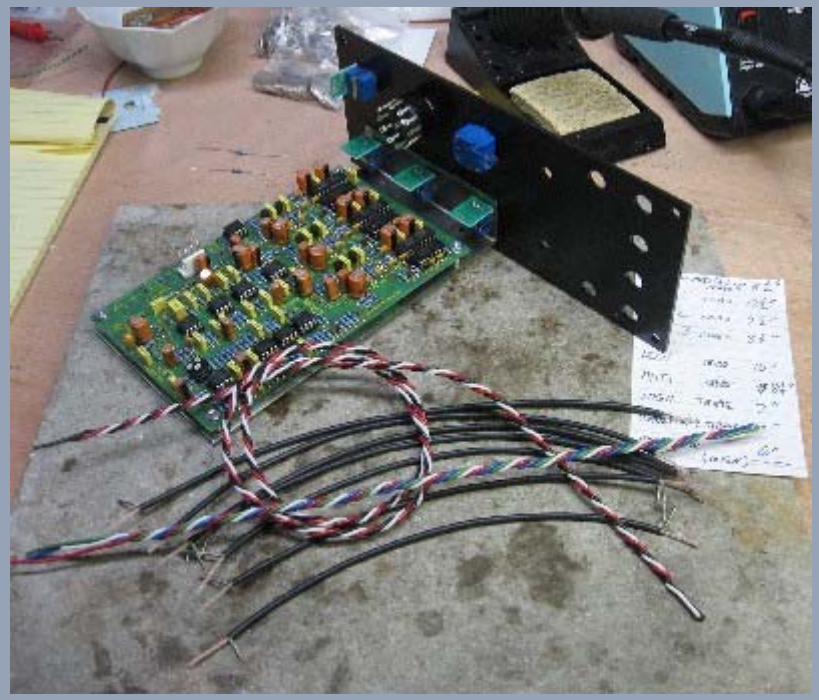
OUT (on PCB) to MOD switch - coax 8-1/2in.

DRY OUT (on PCB) to DRY OUT jack - coax 10in.

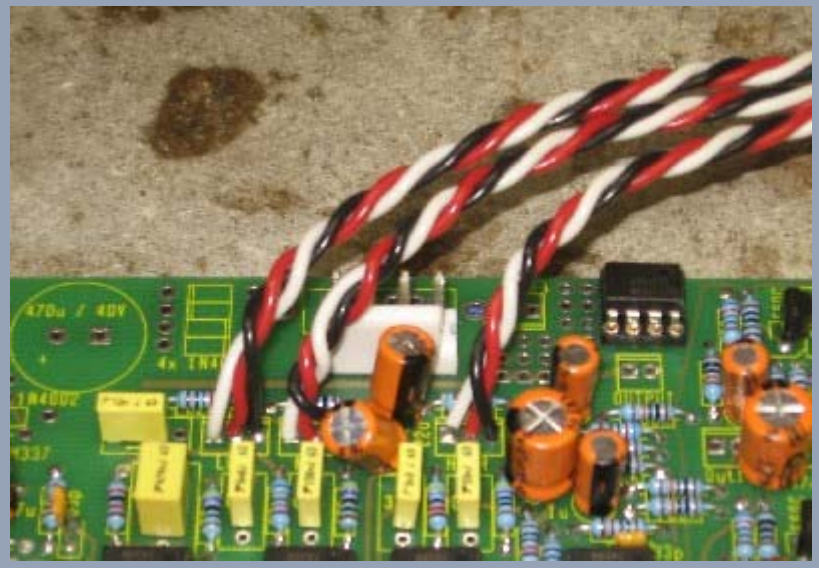
OUT 1 (on PCB) to OUT 1 jack - coax 10-1/2in.

OUT 2 (on PCB) to OUT 2 jack - coax 9-1/2in.

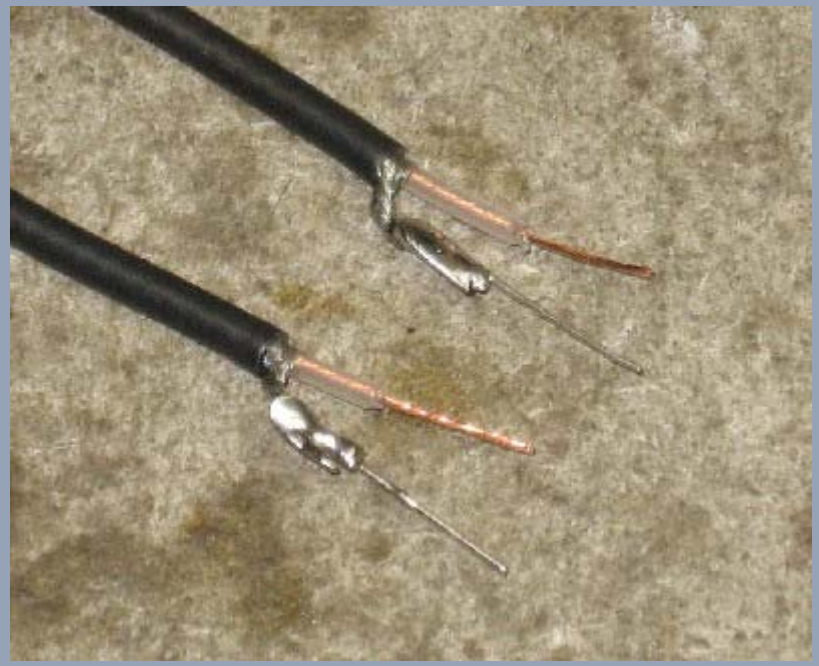
OUT 3 (on PCB) to OUT 3 jack - coax 8-1/2in.



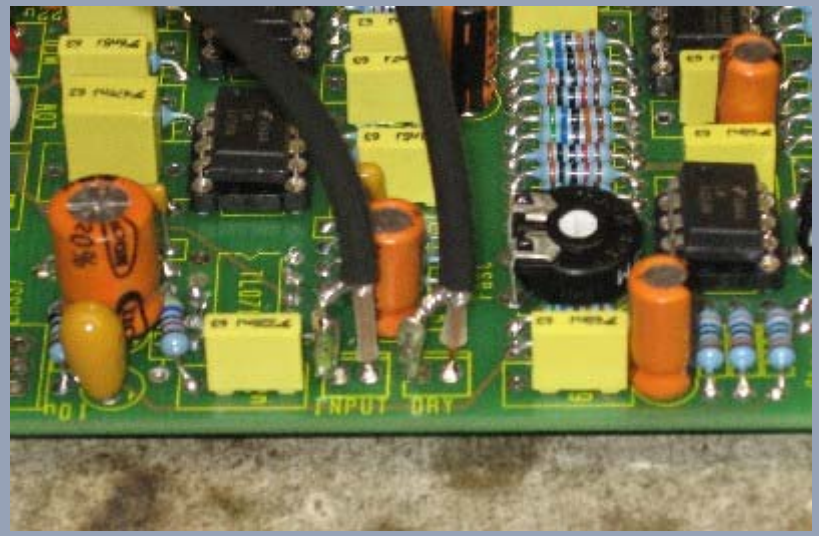
So we took things apart again so we could solder the wires into the PCB.



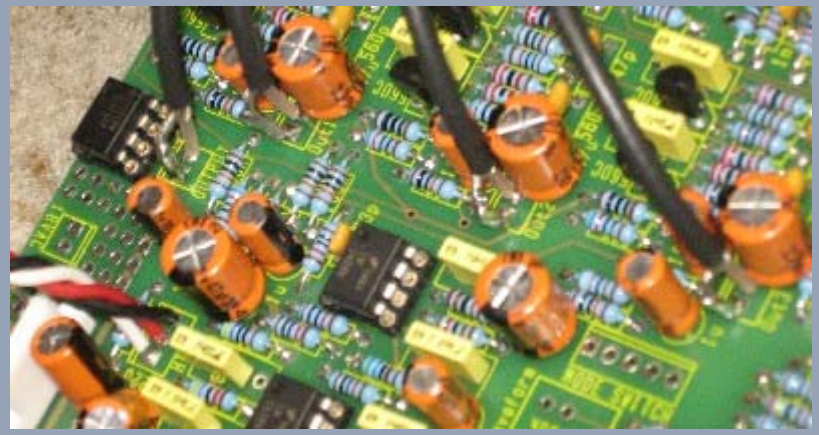
first the twisted triplets that go to the EQ points.



We soldered a bit of resistor lead onto the shield of the coax

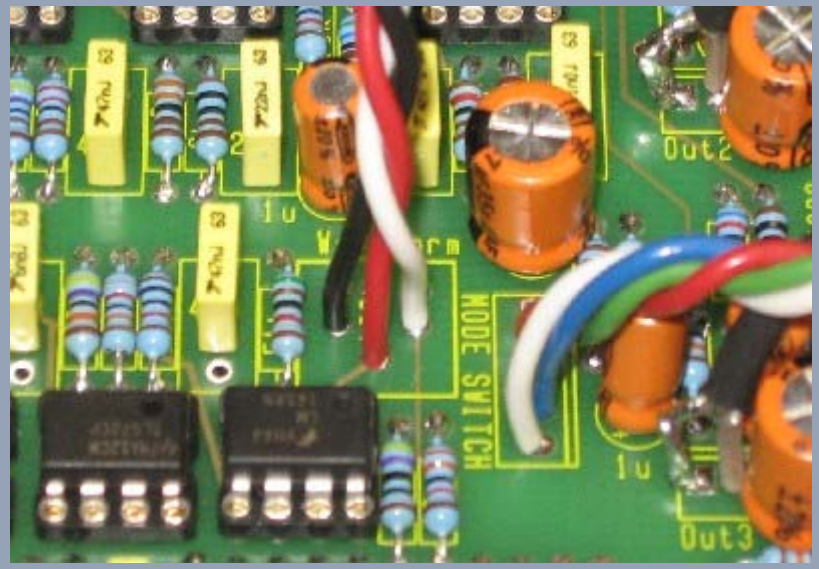


for the INPUT and DRY (output) points



same procedure for OUTPUT, Out1, Out2, and Out3 points

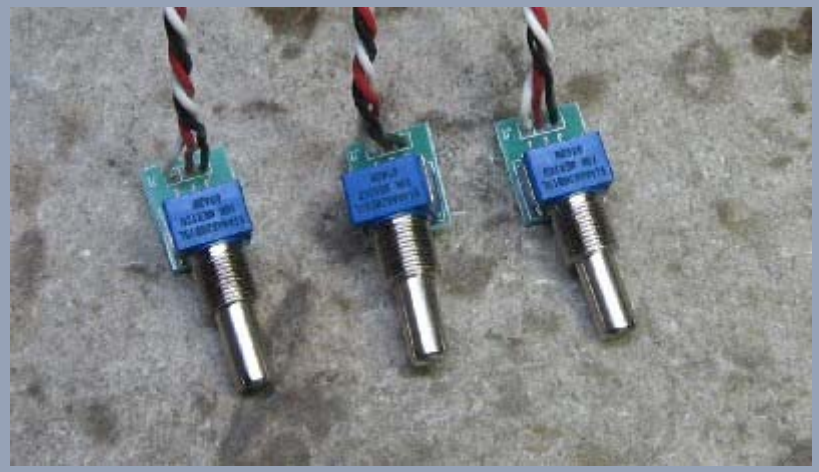
here's how we wired the MODE SWITCH points



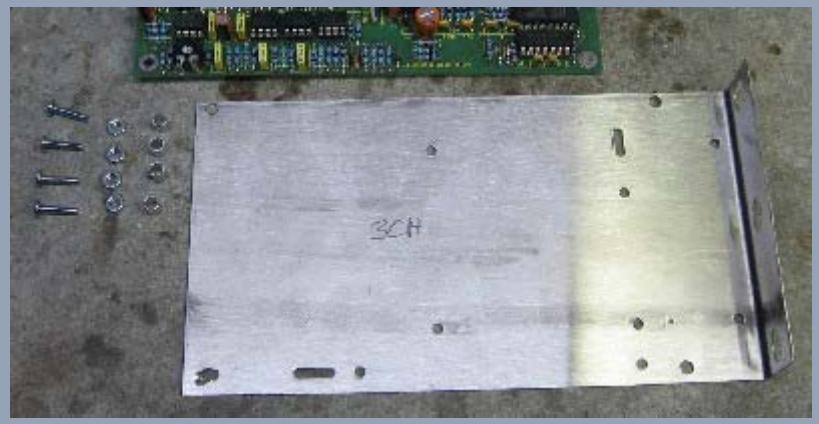
the "Waveform" (SHAPE) wires go here

Bracket mounting

First step - solder on the HIGH, MID, and LOW EQ 10K pots - then mount the PCB and bracket to the panel.



the EQ pots



the bracket ready for the PCB - those are 1/2" 4-40 screws with nuts and 1/4" spacers

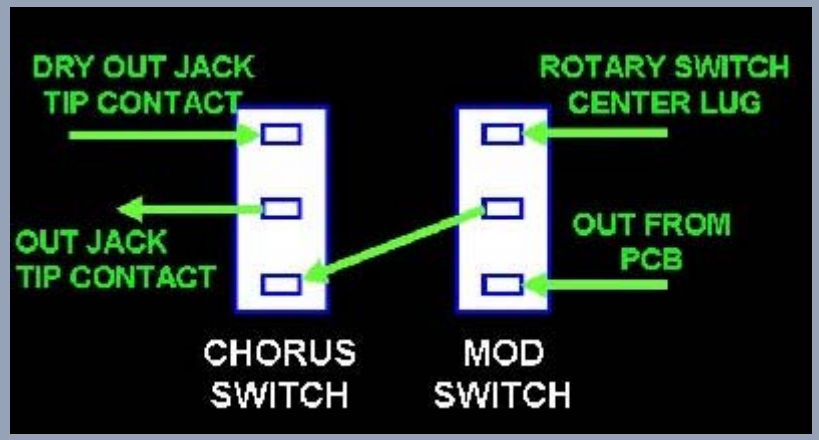
first the LOW EQ pot...

then the MID EQ pot...

and the HIGH EQ pot - we tightened them up to hold the mounting bracket on firmly

Bypass Switch

We want to finish the "Right Row" (that's the left one from the back) first because it's easier to build the module "up" lying on its side like this... so next in the bypass (or CHORUS) switch. First lets contamplate how the switches should be wired up:



here are the switch connections

So for the CHORUS (bypass) switch, we'll use three pieces of wire:

DRY OUT JACK TIP CONTACT (top lug) - 6in.

OUT JACK TIP CONTACT (middle lug) - 3in.

from MOD SWITCH (bottom lug) - 3 in.

ready for mounting

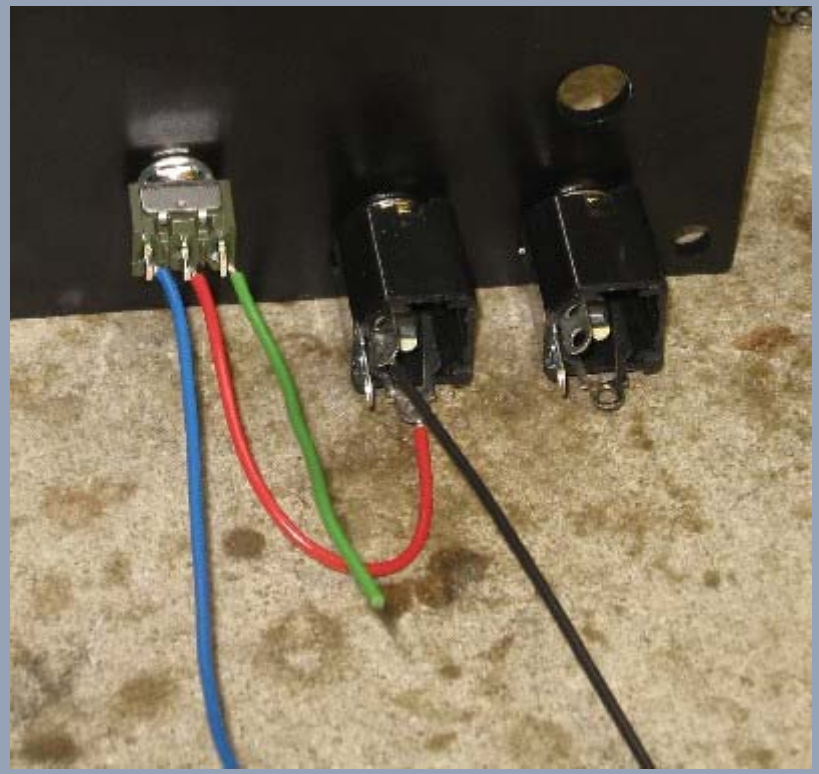
from the back

and the front

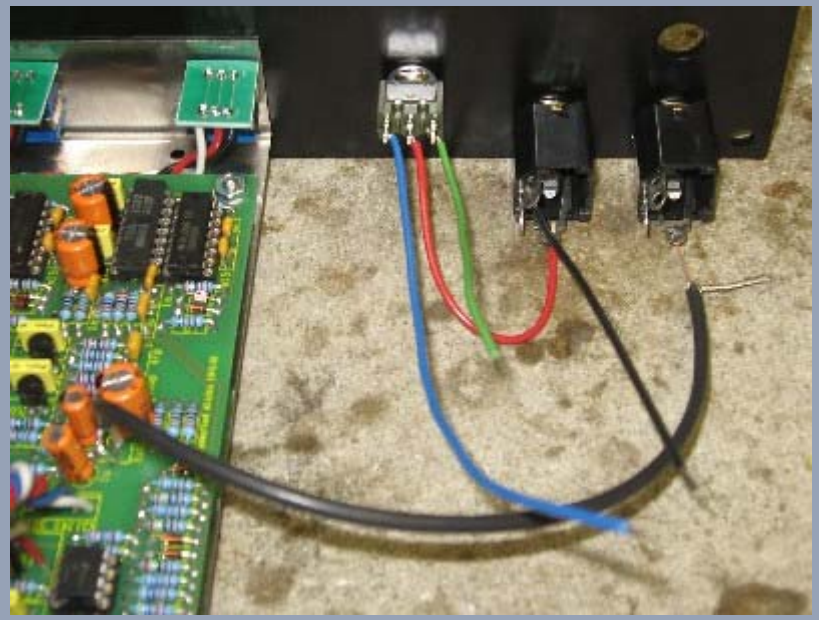
Output Jacks

We'll start on the output jacks

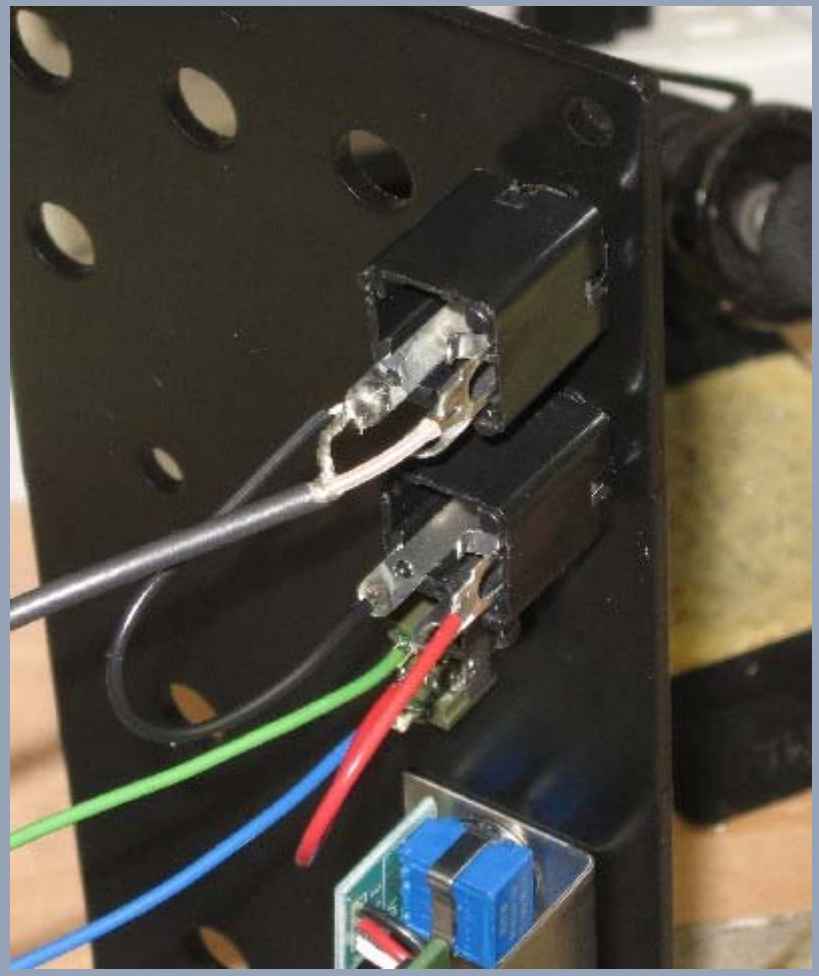
from the CHORUS (bypass) switch center lug to the MIXED OUT jack tip lug



a 3in. bit of wire for the MIXED OUT jack shank lug so we can take ground from the OUT 3 jack

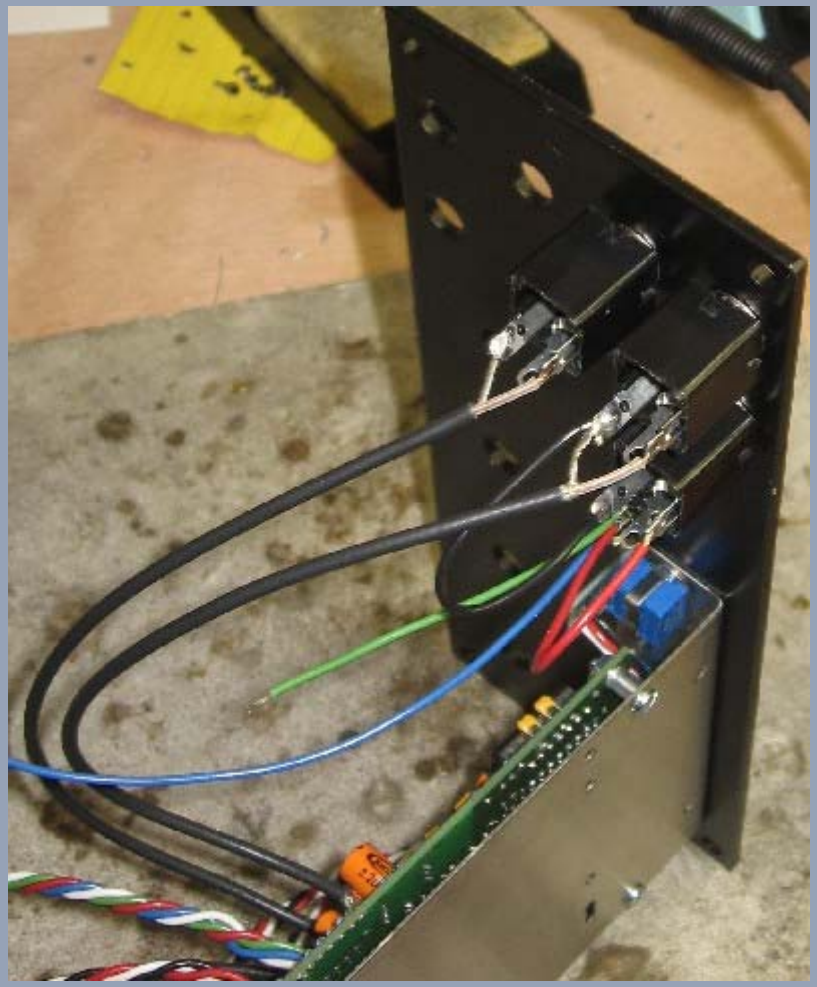


"Out 3" coax signal wire to the OUT 3 jack tip lug



so both the "Out 3" coax shield and the 3in. wire from the MIXED OUT jack shank lug solder to the OUT 3 jack shank lug

"Out 2" coax signal wire to the OUT 2 jack tip lug



"Out 2" coax shield to the OUT 2 jack shank lug

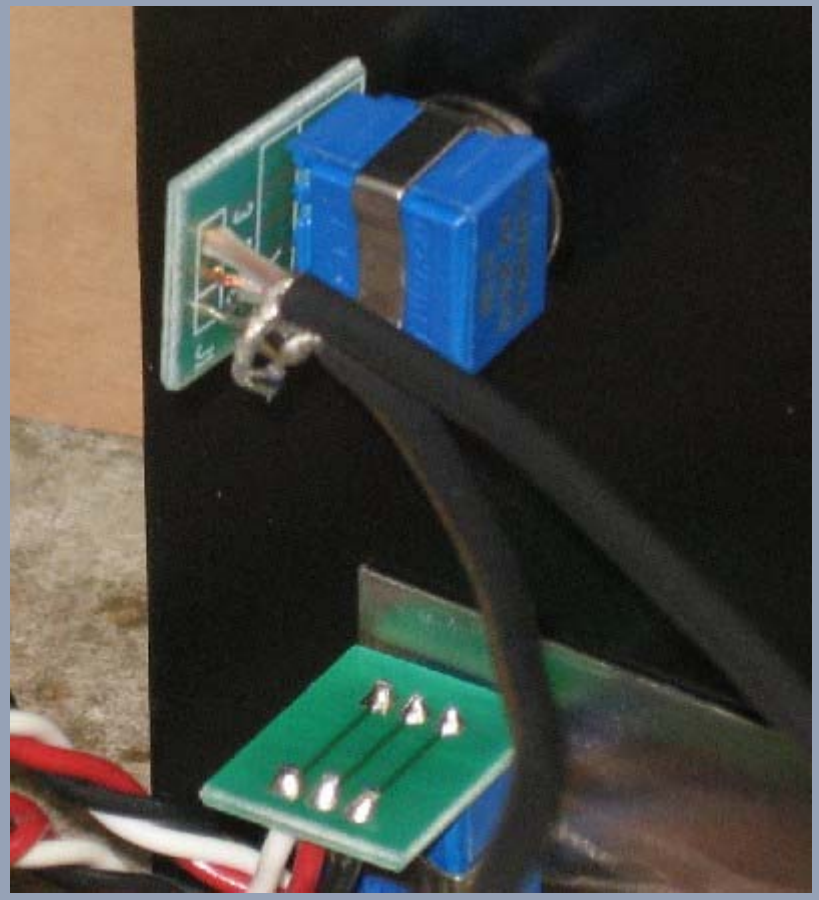
"Out 1" coax signal wire to the OUT 1 jack tip lug

"Out 1" coax shield to the OUT 1 jack shank lug

Input Pot

Now to start on the "Left Row" (that's the right one from the back).

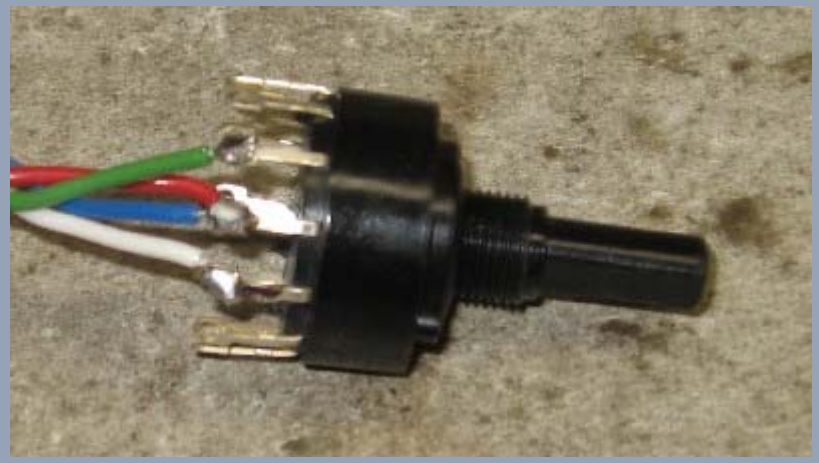
the two coax cables share a common ground



mounted in the panel

Rotary Switch

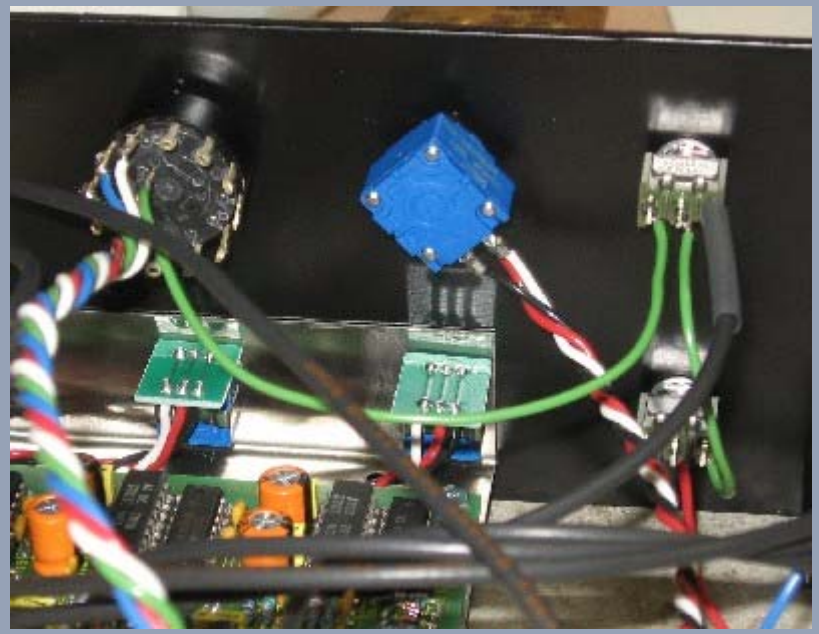
Here is the rotary switch. Using Granddad's ohm meter, we determined what lugs correspond to the different positions of the switch. We marked the left-most (LINEAR) one. We also trimmed off the no-turn pin because there's no hole for it in the panel. I suppose we could have drilled one... but we didn't.



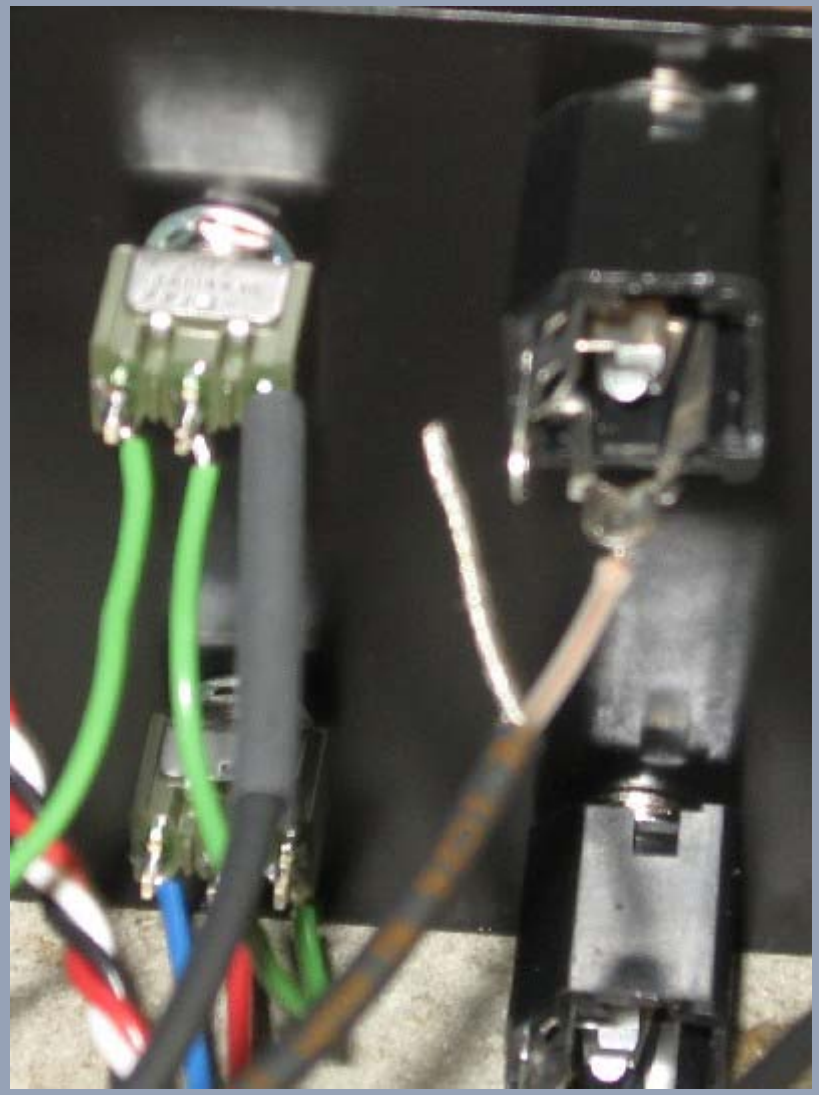
wired up

SHAPE pot and MOD swirch

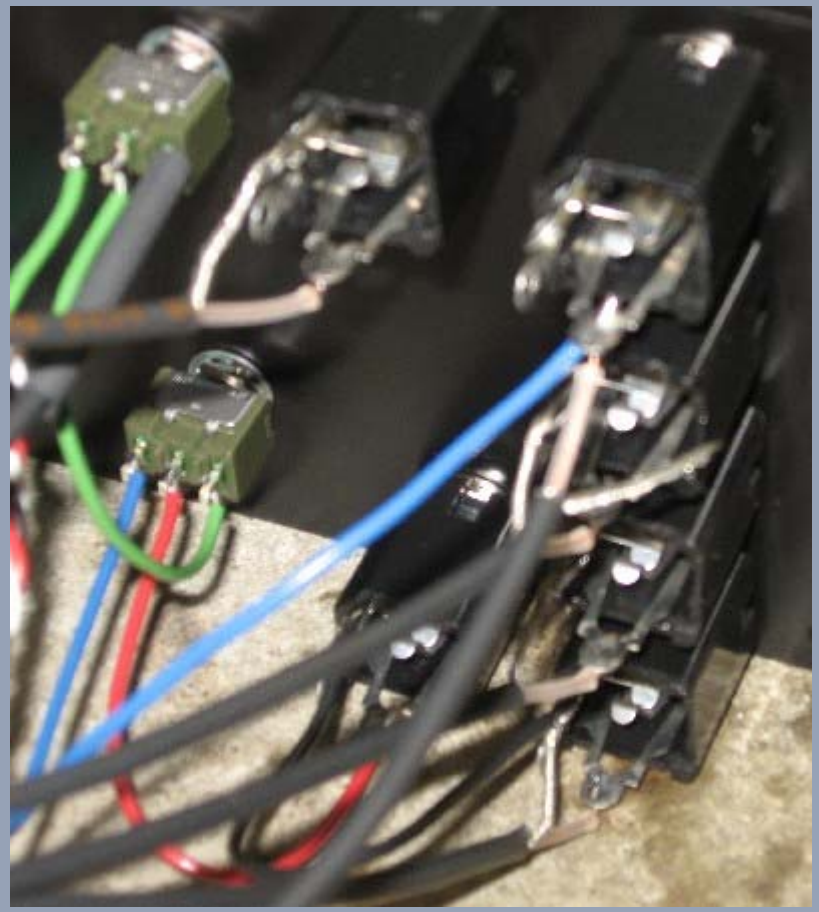
Here is the Rotary switch mounted in the panel and also the SHAPE pot with its connections. A wire (green) connects the center lug of the rotary switch to the top lug of the MOD switch. The green wire from the CHORUS (bypass) switch bottom lug goes to the MOD switch center lug. We trimmed back the shield of the OUT coax, slipped some heat-shrink onto coax, and soldered the signal wire to the MOD switch bottom lug.



The rest of the jacks



the coax to the INPUT pot to the INPUT jack tip lug



both the wire (blue) from the CHORUS (bypass) switch top lug and the DRY (out) coax signal wire go to the DRY OUT jack tip lug

DRY (out) shield to DRY OUT jack shank lug

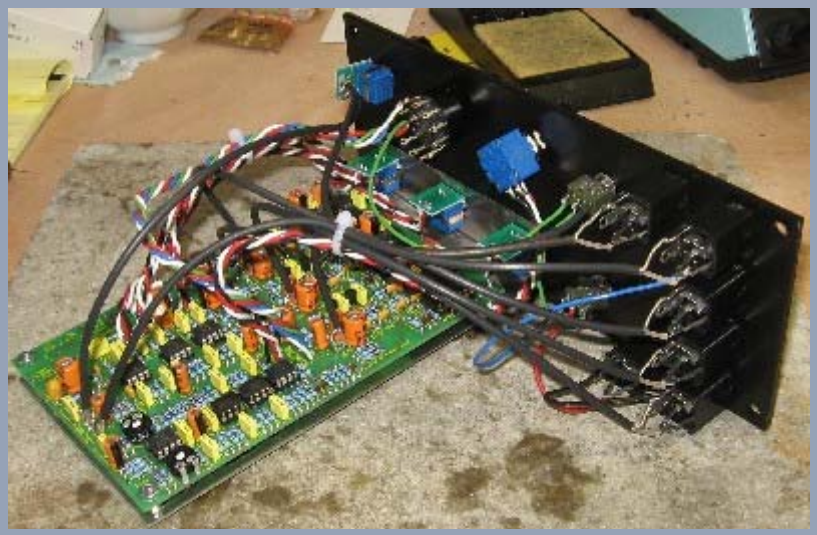
the heat shrink shrunken <G>

Knobs

ready for the knobs

Construction Done


INPUT
HIGH EQ
LINEAR
"SOLINA"
EQ
MID EQ
SHAPE
LOW EQ
MOD
ON
OFF
CHORUS
ACTIVE
BYPASS
INPUT
MIXED OUT
DRY OUT
OUT 1
OUT 2
OUT 3
JURGEN HAIBLE
TRIPLE CHORUS



Set up / Testing

Use Notes

Bill and Will's Synth Main Page
Send eMail to Dragonfly Alley

The fine Print:
Use this site at your own risk.
We are self-proclaimed idiots and any use of this site and any materials presented herein should be taken with a grain of Kosher salt. If the info is useful - more's the better.
Bill and Will