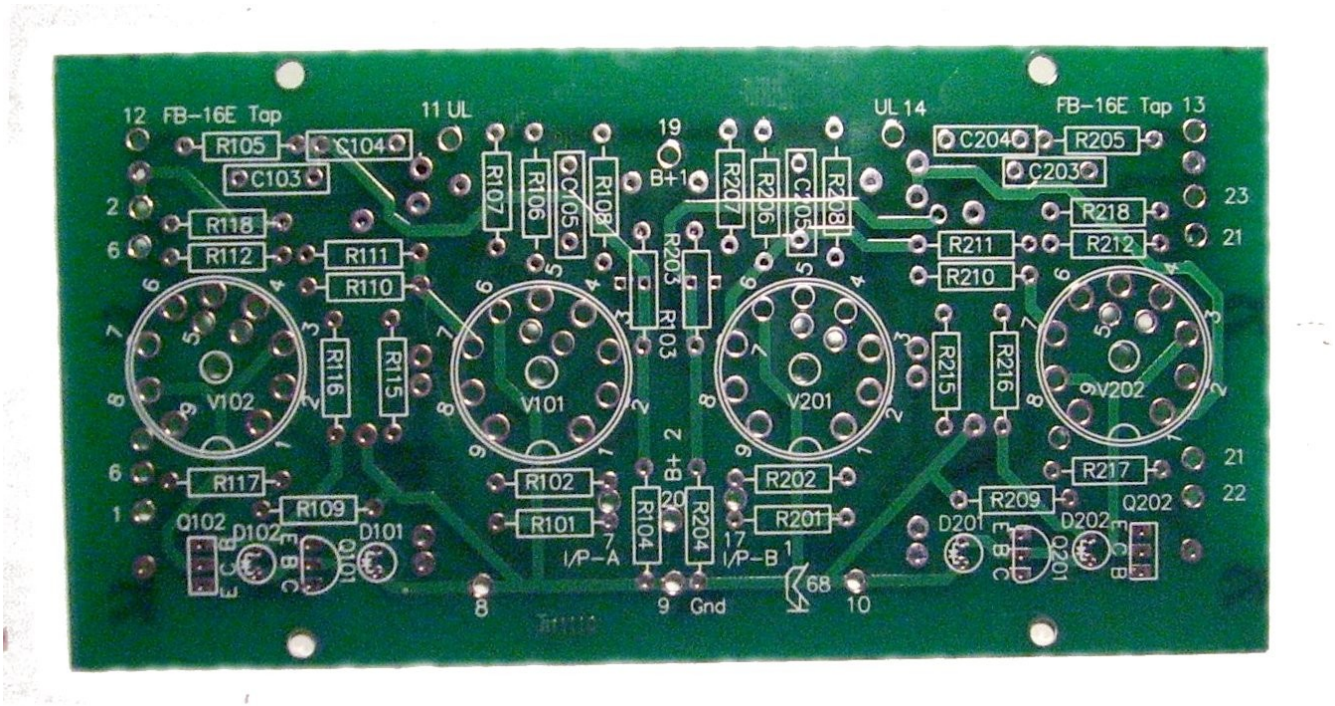
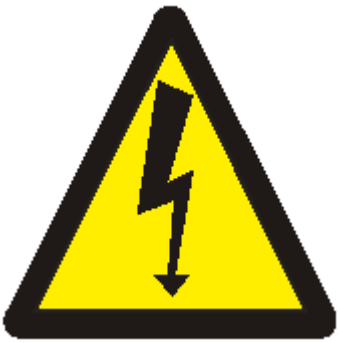
DynaMull Driver Board
for the
Dynaco® ST-70



Classic Valve Design

Classic Valve Design assumes no responsibility for circuit or user damage from the use or misuse of these boards or any other product. We simply provide these on an AS-IS basis with workmanship quality as the only thing guaranteed at this time.

This product is designed for and use around **LETHAL VOLTAGES**. We assume the user has a reasonably competent grasp of line operated electronics at the time of sale.



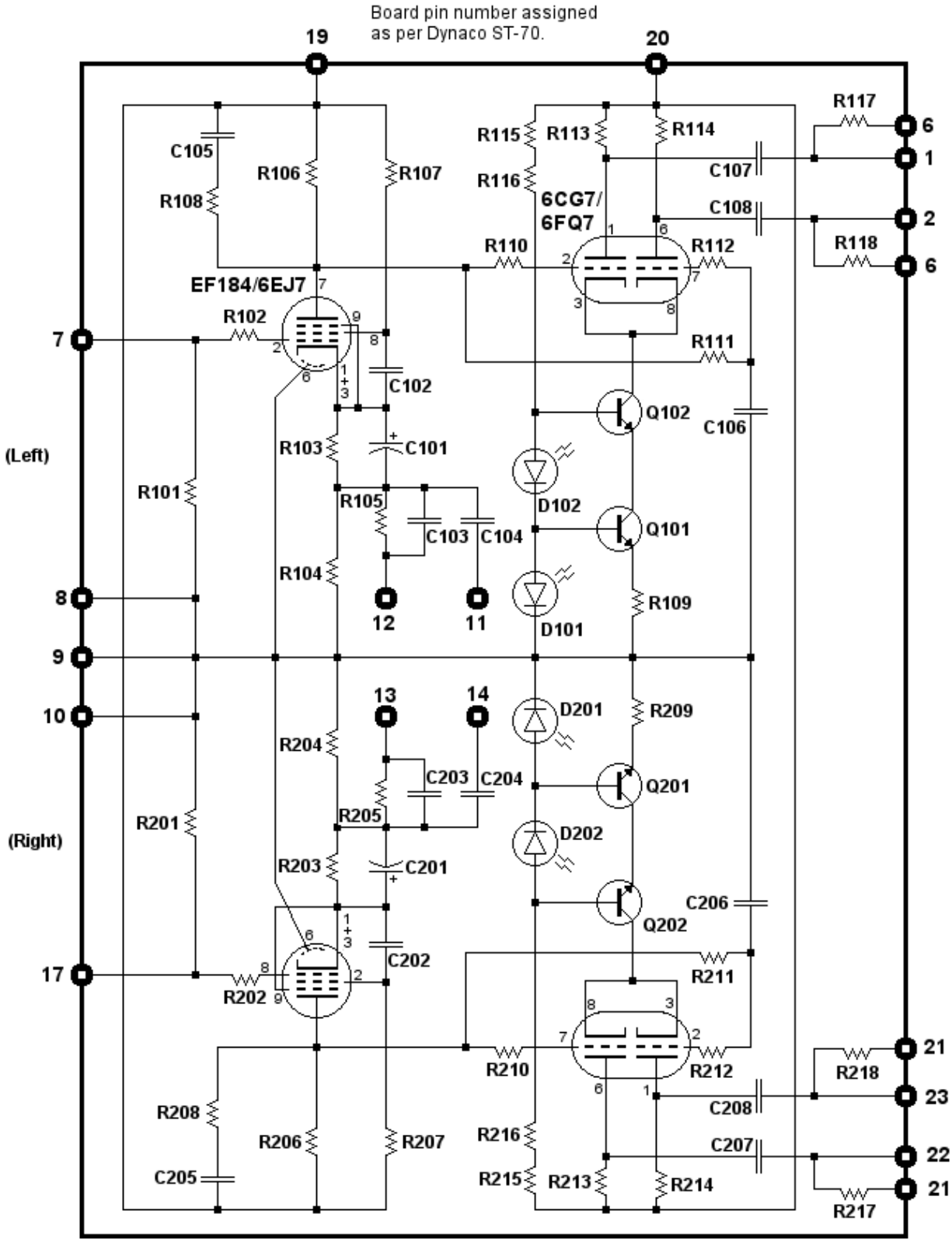
The DynaMull driver board is a Classic Valve Design adaption of the Mullard 5-20 circuit for the Dynaco ST-70 with some modernization.

Two main differences are the choice of input tube and the Constant Current Source (CCS) in the tail of the phase inverter.

Why the EF184/6EJ7? It is a fantastic tube with clean sonics, low noise (brand dependent) and a lot of transconductance.... significantly more than the EF86. It is also cheaper and easier to find.

The CCS in the tail of the 6FQ/CG7 is a "no brainer" - superior performance AC and DC. A time-tested cascode design that we and others have used successfully for years. Proximity to the 6FQ/CG7 keeps temperature nearly constant for minimal temperature coefficient drift.

We have attempted to keep to the classic design overall, as it already is one great sounding circuit.


Board pin number assigned
as per Dynaco ST-70.
19
20
(Left)
(Right)
7
8
9
10
17
12
11
13
14
6
1
2
6
21
23
22
21
C105
R108
R106
R107
R115
R116
R113
R114
C107
C108
R117
R118
6CG7/
6FQ7
R110
R112
EF184/6EJ7
R102
R111
C102
Q102
C106
R103
C101
R101
D102
R105
C103
C104
Q101
R104
D101
R109
D201
R209
R204
C203
C204
Q201
R205
R201
D202
R203
C201
C206
Q202
C202
R211
R202
R210
R212
R218
C208
R208
R206
R207
R216
C207
C205
R215
R213
R214
R217

Parts List

Resistors:

R101, 111, R201, 211: 1Meg, ½W
R102, R202: 10K, ½W
R103, 104, 110, 112, R203, 204, 210, 212: 1K, ½W
R105, R205: 18K, ½W
R106, R206: 82K, 1W
R107, 115, 116, 117, 118, R207, 215, 216, 217, 218: 220K, ½W
R108, R208: 62K, ½W
R109, R209: 180 ohms, ½W
R113, 114, R213, 214: 47K, 1W

Capacitors:

C101, C201: 22uF, 16V electrolytic. Audio type preferred (Nichicon KZ, Elna SILMIC, etc)
C102, 106, 107, 108, C202, 206, 207, 208: 220n, 630V polypropylene film
C103, C203: 33p silver mica, polycarbonate, or "linear" ceramic
C104, C204: 22p, 1KV silver mica, polycarbonate, or "linear" ceramic
C105, C205: 82p, 500V silver mica, polycarbonate, or "linear" ceramic

Semiconductors:

D101, 102, D201, D202: generic 3mm red LED
Q101, Q201: 2N3904
Q102, Q202: MJE340

Tubes:

V101, V201: 6EJ7/EF184
V102, V202: 6CG7/6FQ7

Hardware:

2 x Heat sinks for MJE340
2 x Insulator kits for the MJE340 (if heat sinks are accessible, it can save you from a shock)
4 x 9-pin noval PCB mount tube/valve sockets

Assembly

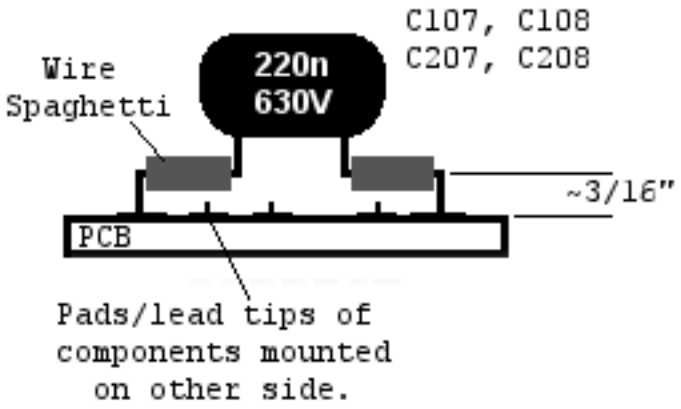
Assembling the PCB is fairly straightforward and needs no adjustments or alignment when complete.

Numbering of the off-board connections is the same as the original ST-70 board for simplicity. The only difference is the grid bias resistors for the EL-34's are each brought out to their own pad should you wish to use our ST-70 power supply board (or your own circuit) for balancing of the power tube bias (instructions for such provided on the ST-70 power supply board documentation). Should you use the original ST-70 bias circuit, which only provides bias for left and right channels, tie the two pads labeled "21" together, as well as the pads labeled "6" together and run a wire to their respective bias. Image for this shown later.

Due to the density of the board, certain components must be installed before others. Here is the procedure (components mounted on the top side of the board unless noted):

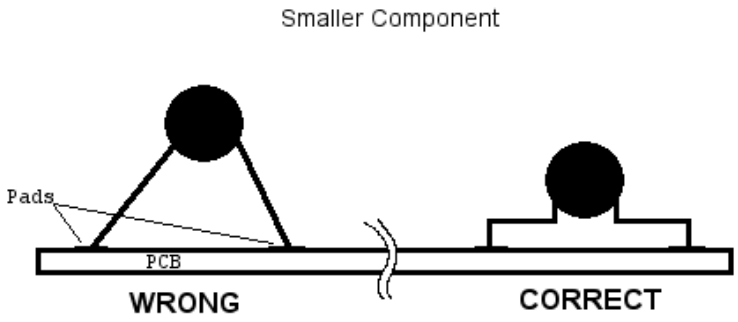
- Install C101 and C201 on bottom side of the board
- Install R103 and R203
- Install R115, R116 and R215, R216
- Install R110, R111 and R210, R211
- Install C105 and C205
- Install C103, C104 and C203, C204
- Install R105 and R205
- Install D101, D102 and D201, D202
- Attach heat sinks and insulators (if used) on Q102 and Q202
- Install Q101, Q201 and Q102, Q202
- Install R113, R114 and R213, R214 on bottom side of the board
- Install remaining top-of-board components.
- Install remaining bottom-of-board capacitors
- Install sockets

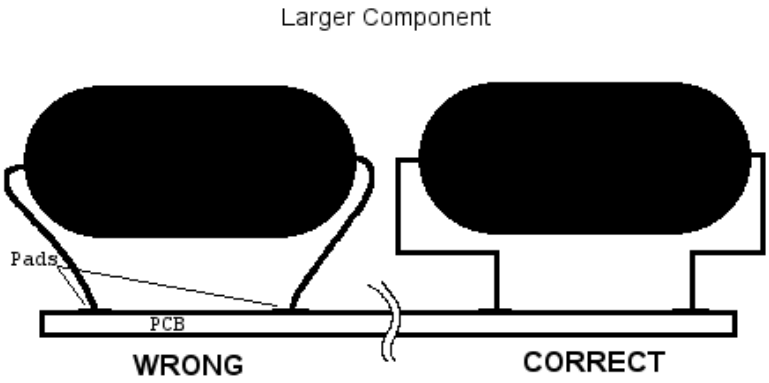
C107, C108 and C207, C208 require "spaghetti" on parts of their leads to keep from shorting out on some components, if you have used small pin-spaced capacitors (we used Panasonic ECW, which are small). Suggestion is shown below.



The wire "spaghetti" can be a piece of insulation stripped off a wire with 600V rating, actual radio-TV spaghetti, or even 1/16" walled polyurethane pneumatic tubing available from a commercial supply house (the volts/mil breakdown of polyurethane is very high - just don't use it on components that'll get hotter than ~70C.).

While we are on the subject of smaller or larger pad spacing components (often capacitors), there is a right and wrong way of mounting them for reliability.





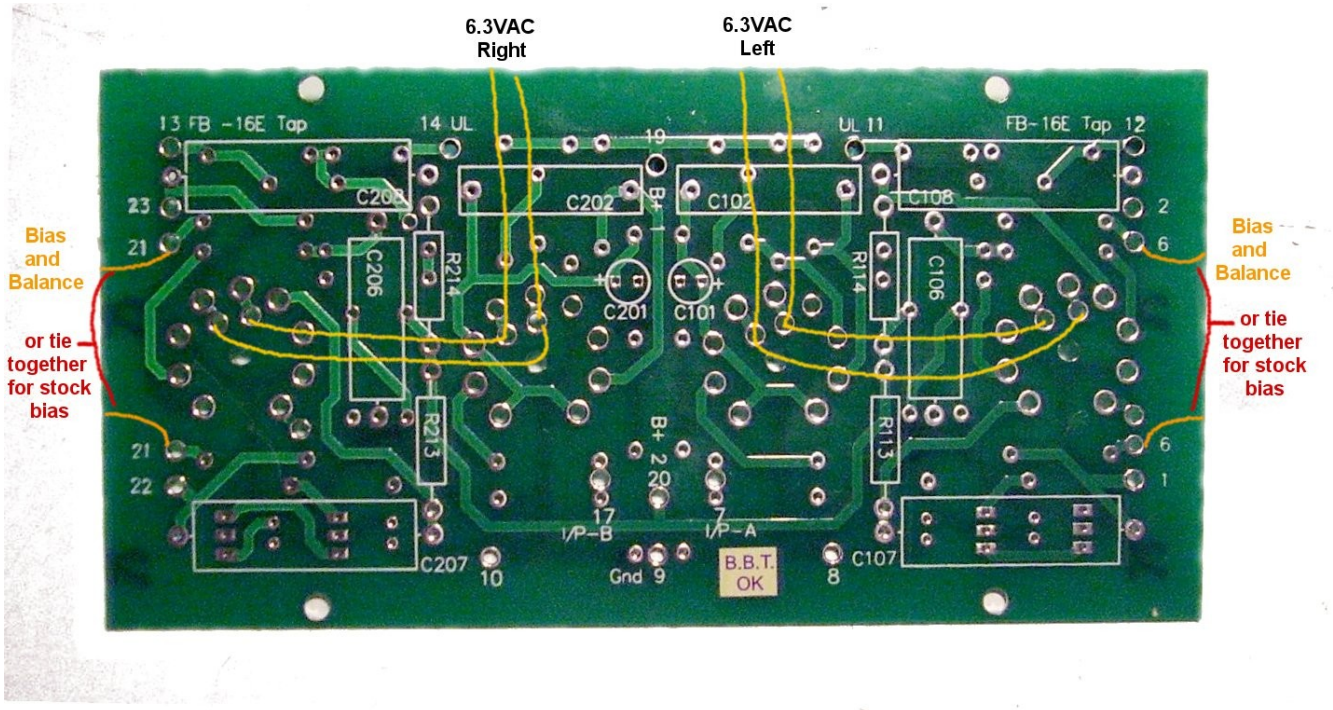
Wiring

Now that your board has the components mounted, you need to prepare the filament wiring.

Each socket has unnumbered pads for filament connections. The 6FQ/CG7 tubes also have a pad on pin 9. The pad on pin 9 of the 6FQ/CG7 tubes can have jumpers to ground. Some brands of 6FQ/CG7 tubes have a shield between the sections that is to be grounded. Other brands have no shield and the pin floats free internally. Better to ground this pad than let it float (we didn't do this on the PCB because some experimenters like adding a small negative voltage here).

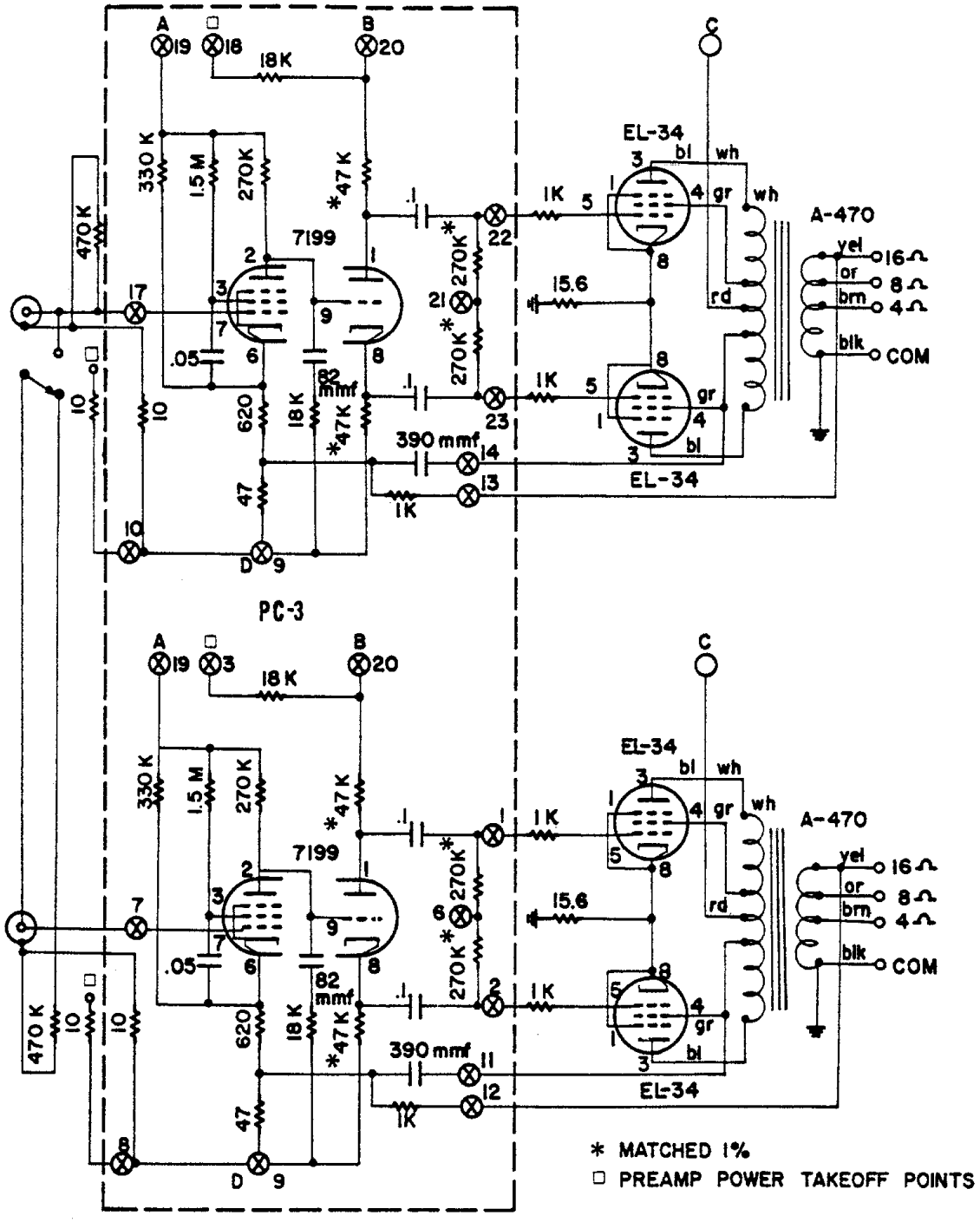
The heater pads (pins 4 and 5) of the left 6FQ/CG7 and 6EJ7 need to be tied together with a twisted pair of wire (to reduce hum). Same for the right. Each will go to their respective power supply leads on the ST-70 power supply.

The image below shows this, as well as the bias connection we talked about earlier.



Note for Advanced Builders: You can use a pair of 3EJ7 for the input tubes and wire their heaters in series. Tie the now 6V string to either channel.

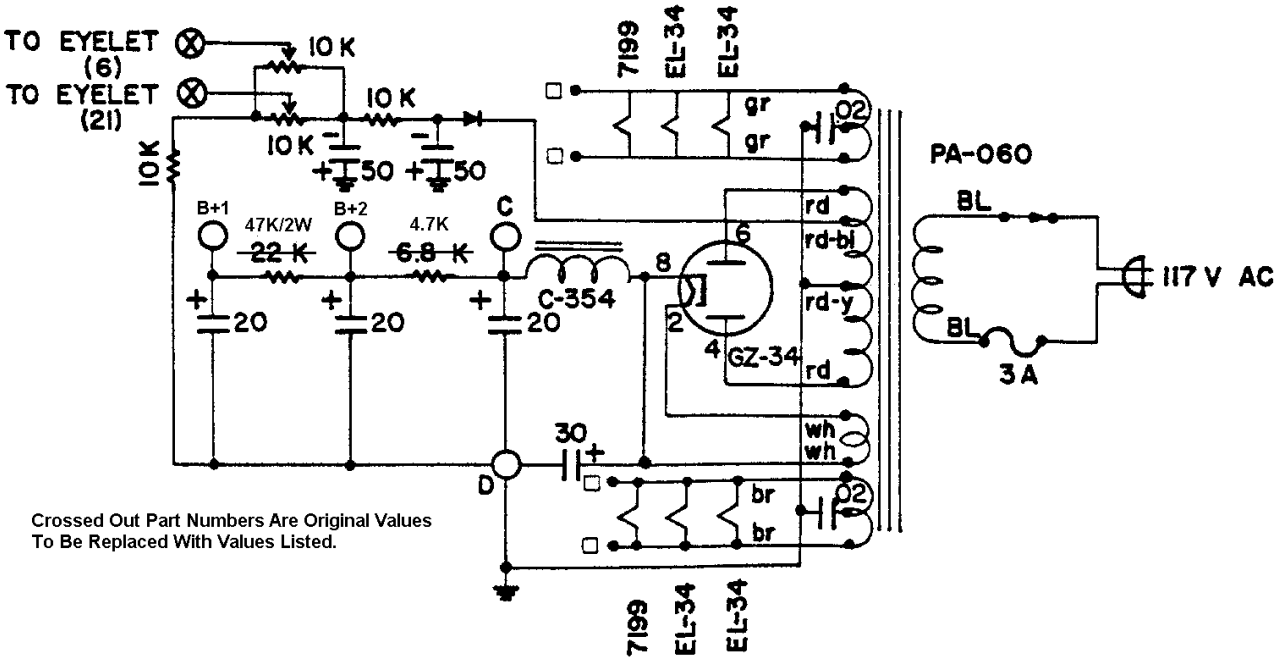
To aid builders with the pad-number-to-wire arrangement, here is the original Dynaco ST-70 schematic:



Pad numbers "3" and "18" are not used on this board and the 18K/2W resistor may be added externally to the preamp power sockets, if desired.

Pad number "19" is labeled "B+1" on the DynaMull board and pad number "20" is labeled "B+2".

The power supply of the original ST-70 requires two resistor changes:



If you are using our ST-70 power supply board, use the components shown, 47K, 2W and 4.7K for R9 and R10 on that board, respectively.

If you have a different B+ off point "C" than the stock Dynaco due to the use of solid state rectification or a different power transformer, please adjust the 4.7K resistor so the B+2 is in the area of 415V to 420V.

Using Different Output Transformers

Often more advanced builders will change the output transformers on their ST-70. We here at Classic Valve Design use a set of output transformers (OPT's) from a MK-III, because we need the extra capability to swap in various power tubes from 6L6GC to 6550 without blowing anything up. Other ST-70 aficionado's like custom transformers, or even a certain brand.

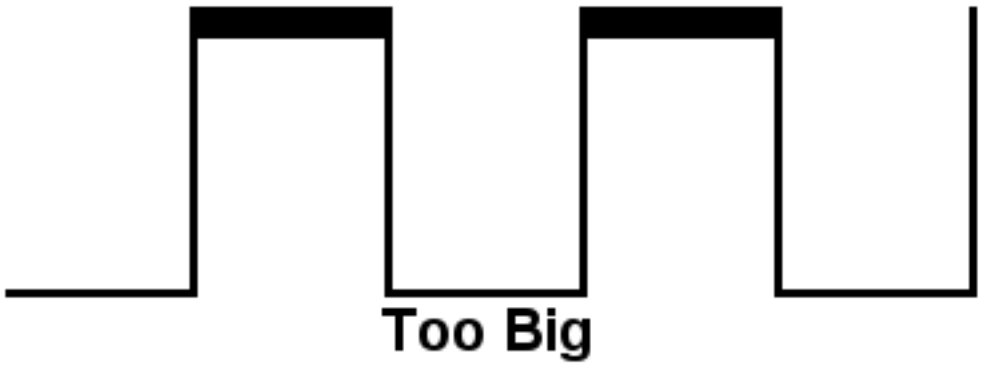
Different OPT's have different characteristics and the value of C104 and C204 is very sensitive to these changes.

What that capacitor basically does is add a little bit of high frequency corrective feedback to dampen oscillation - a neutralizing capacitor.

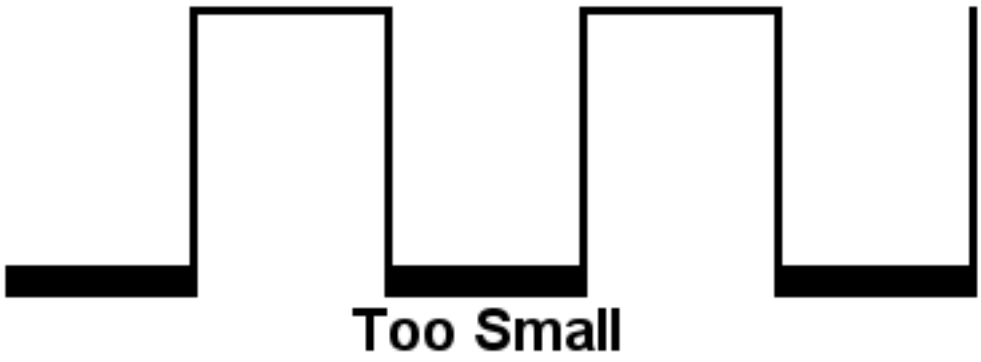
If it is not there, RF oscillations are almost certain. If it is too big or small, really strange things can happen.

If you are swapping output transformers, you will most likely have an oscilloscope and function generator on your bench to make the following tests if C104 and C204 are correct for your OPT's.

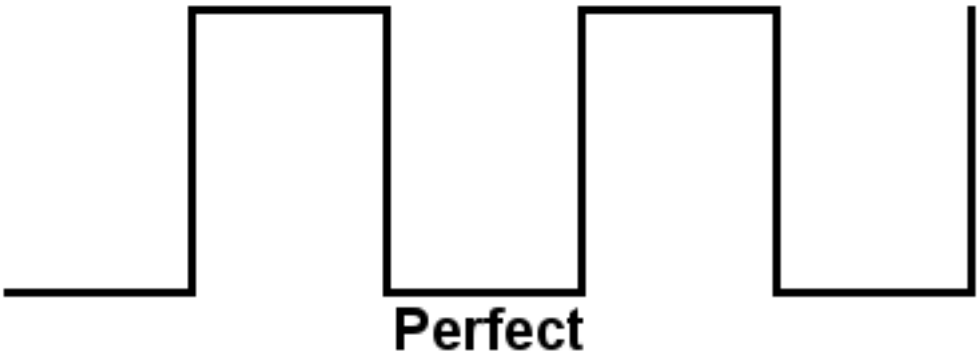
- Set up your amplifier with an 8 ohm resistive dummy load on the speaker terminals.
- Connect an oscilloscope to the output of one channel.
- Connect a function generator to the input of the same channel.
- Set the function generator to 1KHz square wave.
- Adjust the square wave input so as to not saturate the amplifier.
- Allow amp to warm up ten minutes and view the square wave output.
- View the waveform at various levels.
- The waveform will tell you the adjustment, if required, to the value of C104 and C204.



Too Big



Too Small

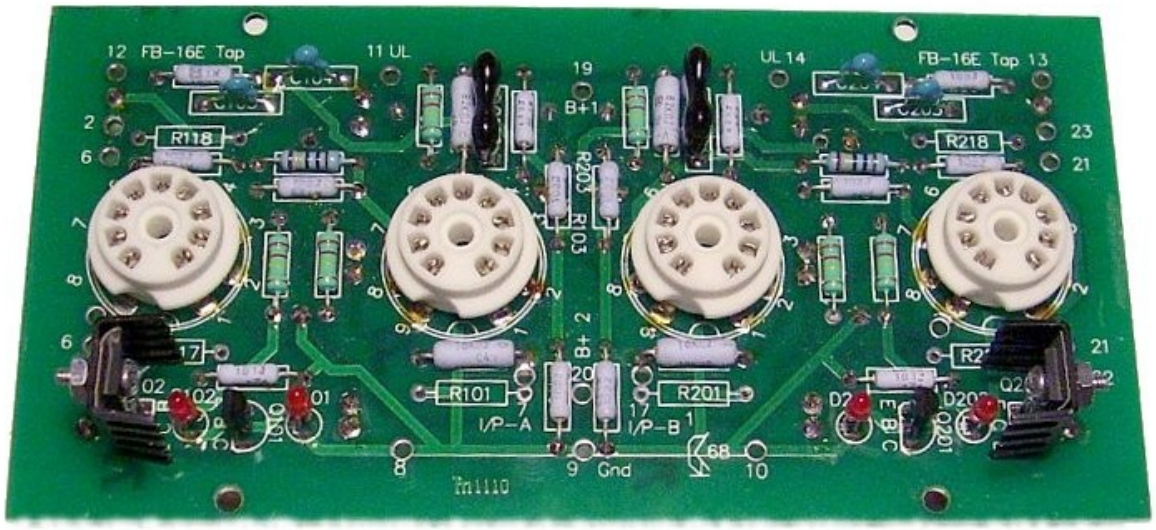


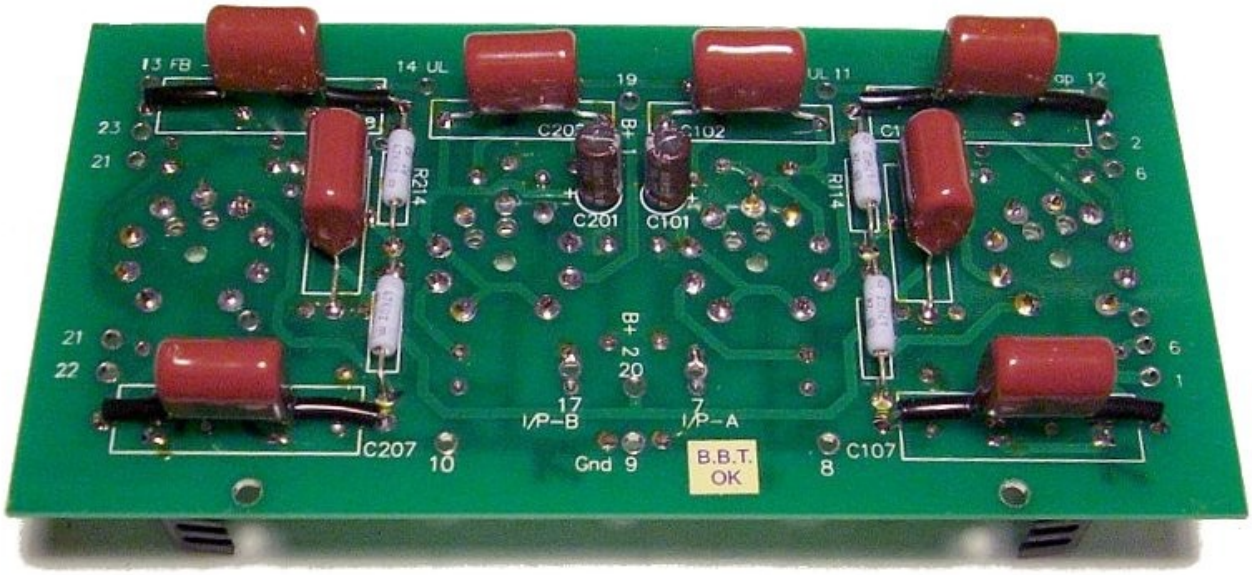
Perfect

Effect of C104 and C204 on the waveform

If you have leading-edge anomalies (ringing, large spike, etc.), this would indicate a value change for C103 and C203. Increase this value.

If you have a leaning leading edge or rounded corners, adjust C103 and C203 downward in value.





Author's completed boards. Missing components are due to them being permanent fixtures in the test bed amplifier.

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