Damn Good 300B

Design Documentation

Contents

Revision History

DG300B R1.0 Design Documentation

Revision	Date	Notes
0.1	21 SEP 2015	Document created.
0.2	21 SEP 2016	Updated top level hook-up diagram.
0.3	18 OCT 2016	Updated power transformer wiring colours.

DG300B Driver Board

Revision	Date	Notes
1.0	09 DEC 2012	First production layout.

DG300B Power Supply Board

Revision	Date	Notes
2.0	09 DEC 2012	First production layout.
2.01	13 JAN 2013	BOM change, no layout changes. Ferrite bead on Q1.
2.1	08 JUL 2016	RL1 changed to G5NB due to obsolescence.

Disclaimer

The DG300B project involves high voltages - LETHAL VOLTAGES. If you are not comfortable with or qualified to deal with these potentially deadly voltages, please do not attempt to build this project.

The DG300B is a circuit intended for Do-It-Yourself (DIY) assembly and use. While the circuit has been thoroughly tested and found to work exceptionally well, mistakes in assembly do happen. By populating the circuit board, the builder assumes all responsibility for the performance of the assembled board and assumes all risk associated with the assembly and use of this circuit.

DG300B Board Set

The Damn Good 300B Amplifier Board Set consists of the following Neurochrome circuit boards:

1 × DG300B Driver Board

1 × DG300B Power Supply Board

1 × 21st Century Maida Regulator Board

3 × Universal Filament Regulator Board

This document covers the DG300B Driver Board and DG300B Power Supply Board, as well as combining the complete set into a functional amplifier. The 21st Century Maida Regulator and Universal Filament Regulator are described in their respective design documents.

Specifications

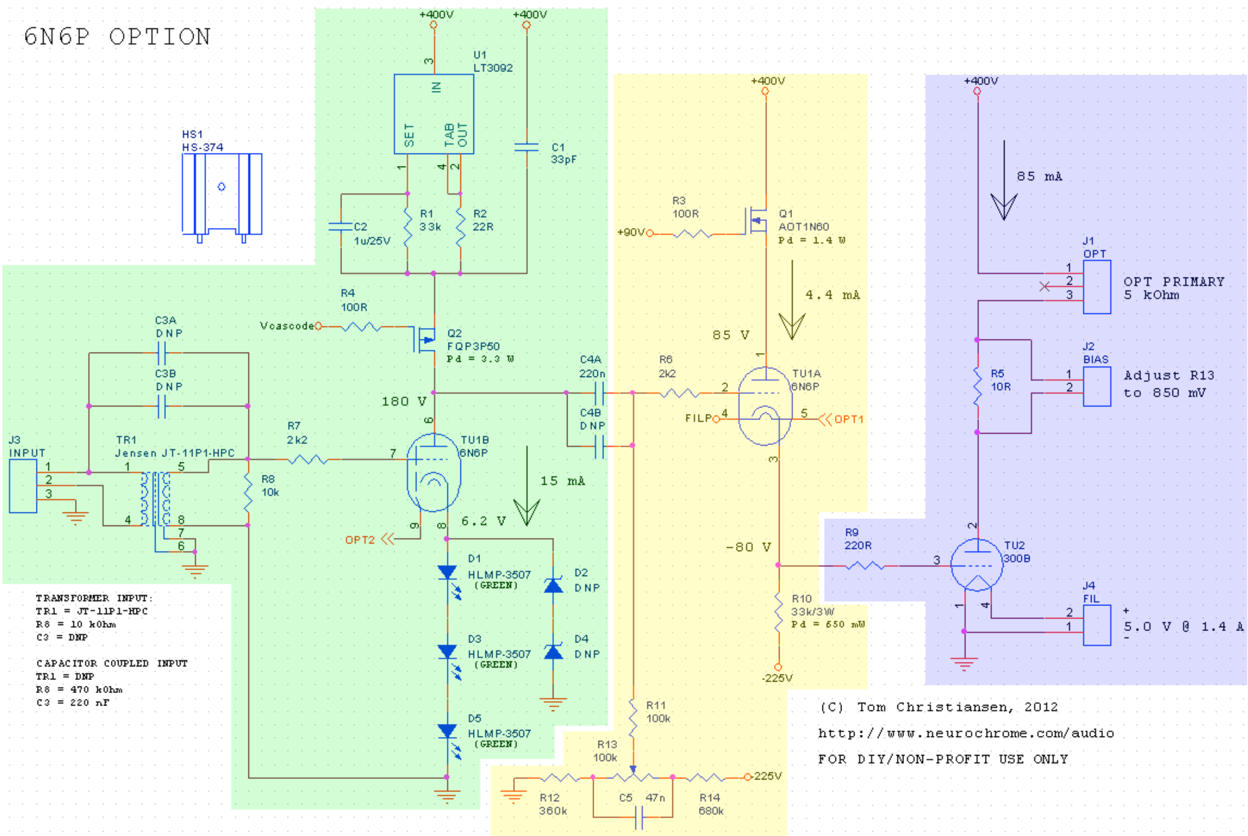
The specifications for the DG300B Amplifier using JJ 300B output tubes, JJ E88CC driver tubes, and Electra-Print output transformers are shown below.

Parameter	Value	Notes
Output Power	10 W	@ 3 % THD, 50 Hz
Gain	7. 3 dB	
Input Voltage for 1 W output	1.24 V RMS	
Input Sensitivity	3.90 V RMS	
THD+N @ 1 W, 1 kHz	0.25%	
THD+N @ 10 W, 1 kHz	1.5%	
THD+N @ 10 W, 50 Hz	3.0%	
Bandwidth	36 kHz	-3 dB, ref. 1 kHz @ 1 W

Due to the relatively low gain of the DG300B, some builders may wish to use a preamp with a bit of gain. The Neurochrome THAT Driver circuit, configured for a gain of 15 - 20 dB, is ideally suited for this application.

Circuit Description

The schematic for one channel of the DG300B is shown below with the major circuit blocks highlighted. For the complete schematics, please see the appendix.



Input Transformer and Gain Stage (green)

The Jensen JT-11P1-HPC input transformer and R8 form the input to the amplifier. Using an input transformer offers several advantages. First off, the input can be configured for fully differential, or balanced, signalling. This type of signalling is largely immune to electromagnetic interference injected on the input wires. The differential input also effectively removes any input side ground loop from the signal path, thus, eliminating hum and buzz if a differential source is used. The input transformer is a relatively expensive component ($70 each at the time of writing) and some builders may wish to forego the advantages to lower the build cost. To satisfy these builders, the input can be configured as a regular capacitor-coupled input by populating C3. The relevant component changes are tabulated below.

Input Type	TR1, TR2	C3, C8	R8, R22
Differential (Transformer)	Jensen JT-11P1-HPC	DNP	10 kΩ
Single-Ended (Capacitor-Coupled)	DNP	220 nF	470 kΩ

DNP = Do Not Populate.

The footprint for C3 allows for the use of a general purpose polypropylene capacitor (C3B) or a larger boutique capacitor (C3A), hence satisfying the needs of various builders and build budgets.

The input tube, TU1B, operates as a grounded cathode gain stage with a constant current source (CCS) anode load. The input tube is biased by a string of LEDs. This arrangement of LED biasing and CCS load provides by far the lowest THD of any tube stage. The end result is that the majority of the THD of the DG300B comes from the 300B and output transformer, really making the legendary 300B shine.

The CCS is an LT3092 IC. Resistors R1 and R2 set the CCS current. C1 and C2 are needed to ensure stability for the CCS IC. The IC can handle up to 40 V, which is quite respectable, but not enough for this application. Therefore, Q2 is introduced as a cascode. This offers two advantages: It prevents the LT3092 from experiencing over-voltage and it greatly increases the output impedance of the CCS. A CCS with high output impedance is closer to an ideal CCS and will further improve the performance of the grounded cathode gain stage.

The gain of the grounded cathode stage depends on the choice of driver tube. The total amplifier gain for the four recommended driver tubes are tabulated below.

Tube Type	DG300B Gain	Input Sensitivity @ 1 W	Input Sensitivity
JJ ECC99, 6N6P	3.8 dB	1.83 V	5.84 V
12BH7A	1.3 dB	2.44 V	7.80 V
ECC88-family	7.3 dB	1.24 V	3.90 V

Driver Stage and Bias Adjustment (yellow)

The gain stage is capacitively coupled to the driver stage by capacitor C4. As is the case with C3, C4 offers the ability to use a general purpose capacitor (C4B) or a larger boutique component (C4A).

The driver tube, TU1A, is configured as a cathode follower. This circuit has a voltage gain of slightly less than unity, but offers high output current drive capability. This is necessary to drive the input capacitance of the 300B output tube. The anode of the driver tube connects to a cascode (Q1). This arrangement limits the total voltage swing available at the output of the cathode follower. This ensures that the 300B is never driven to large positive gate voltages, which increases the life expectancy of the 300B tube under overdrive conditions. The use of a cascode also lowers the amount of power dissipated in TU1A as the total dissipated power is shared between the cascode and the vacuum tube. This makes it possible to use a small-signal driver tube with high gm, resulting in a high-performance cathode follower.

The voltage divider formed by R12, R13, and R14 provide the bias adjustment for the 300B output tube. C5 is included to minimize the thermal noise contribution of the bias circuit.

Output Stage (blue)

TU2 is the 300B output tube. It operates as a grounded cathode with a 5 kΩ plate load provided by the output transformer. A small current-sense resistor, R5, is in series with the anode to provide a convenient test point for the quiescent current of the 300B.

The output transformer is connected at J1. J2 provides the quiescent current test points. J4 connects to the filament supply for the 300B.

Power Supplies

The supply voltages and connections on the 300B Driver Board are tabulated below.

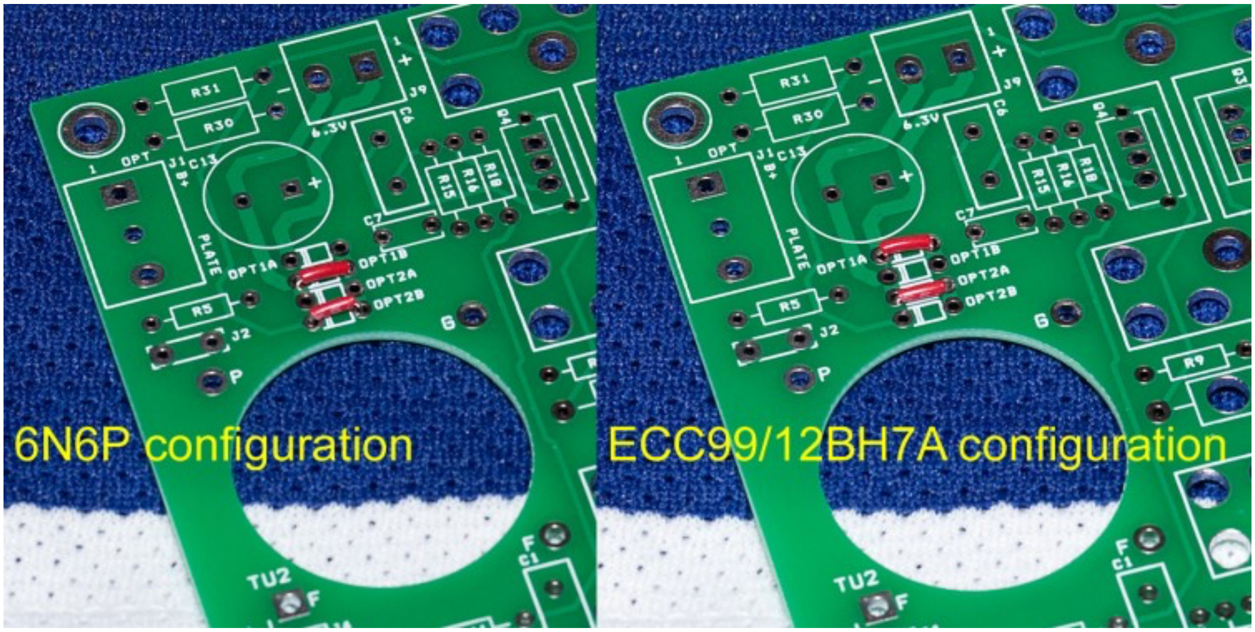
Connector - Pin	Voltage	Description
J4 - 1	0 V	GND, filament supply for 300B (TU2)
J4 - 2	+5 V	Filament supply for 300B (TU2)
J8 - 1	0 V	GND, filament supply for 300B (TU4)
J8 - 2	+5 V	Filament supply for 300B (TU4)
J9 - 1	See below	Heater supply for driver tubes (TU1, TU3)
J9 - 2	See below	Heater supply for driver tubes (TU1, TU3)
J10 - 1	+400 V	B+ Supply
J10 - 2	N/A	No connection (key)
J10 - 3	0 V	GND
J10 - 4	-225 V	Bias supply

To prevent breakdown of the heater-cathode interface in the driver tubes, the heater supply of the driver tube (J9) is floated at approximately -100 V. The positive output of the heater supply connects to J9 - 1 and the negative to J9 - 2. The voltage of the heater supply is 6.3 V, regardless of the chosen driver tube. Note that the PCB jumper options need to be set according to the chosen tube and that the heater current does depend on the chosen tube. The heater currents and jumper options for the various supported tubes are tabulated below.

Tube Type	Heater Current, Total	Jumper Options Used	Heater Connection
JJ ECC99	1.6 A	OPT1A, OPT2A	Parallel, pins 4,5,9
12BH7A	1.2 A	OPT1A, OPT2A	Parallel, pins 4,5,9
6N6P	1.5 A	OPT1B, OPT2B	Single, pin 9 shield
ECC88-family	730 mA	OPT1B, OPT2B	Single, pin 9 shield

The ECC88-family includes E88CC, ECC88, PCC88, 6922, 6DJ8, and 6N23P.

The wire link options are shown below.



If “tube rolling” is expected, I suggest using the 6.3 V, 1.2 - 2.5 A version of the Universal Filament Regulator. This regulator will perform well even with the relatively light load of the ECC88 heater, even though it is optimized for the higher load currents. Note, however, that “tube rolling” will require additional changes to the circuit, including changes to the biasing of the input tube. See the bill-of-materials for the various options to determine the full scope of these changes.

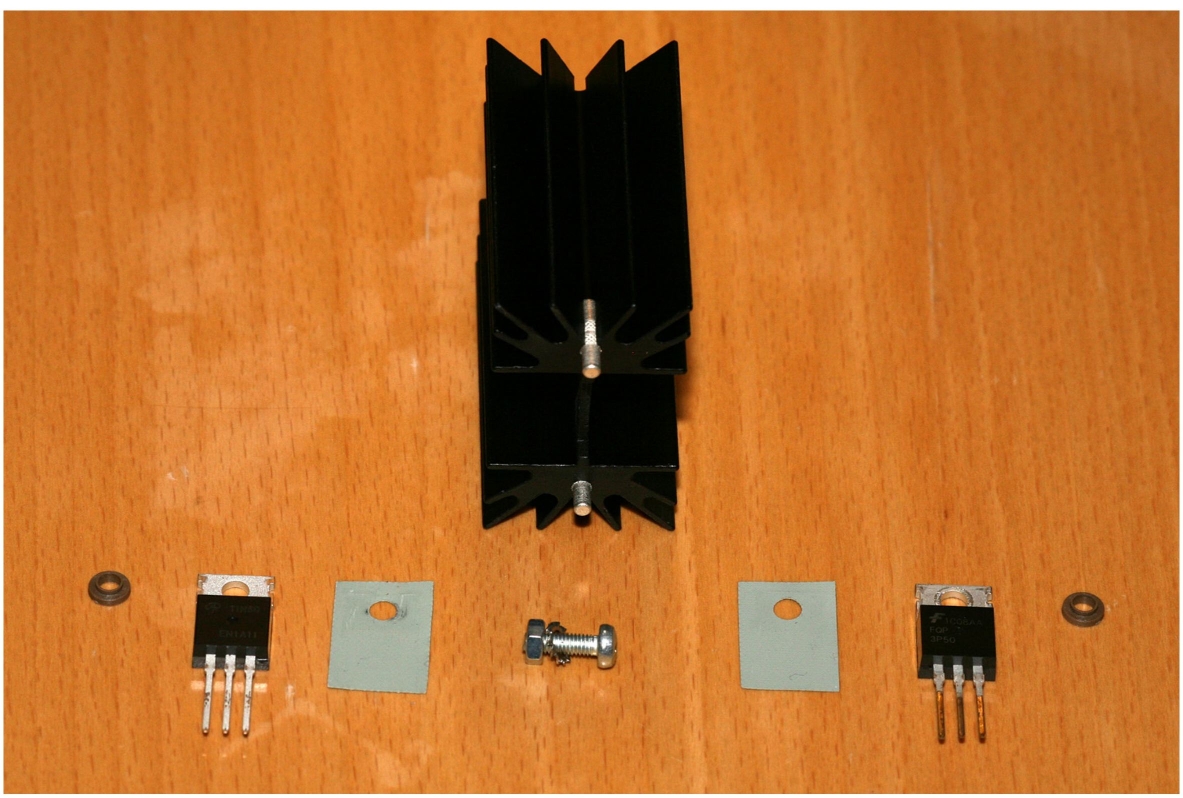
Tweaking

A significant portion of the DIY community enjoys tweaking circuits. Tube circuits are certainly inviting to various tweaks and modifications. In case of the DG300B, the main candidate for tweaking is the input stage. In addition to LED biasing, PCB footprints are provided for zener biasing. These can be used for resistive biasing as well. If zener or resistive biasing is used, it is recommended to bypass the zener or resistor with a good quality audio capacitor. This capacitor may be fitted on the footprints intended for the LEDs.

Assembly, DG300B Driver Board

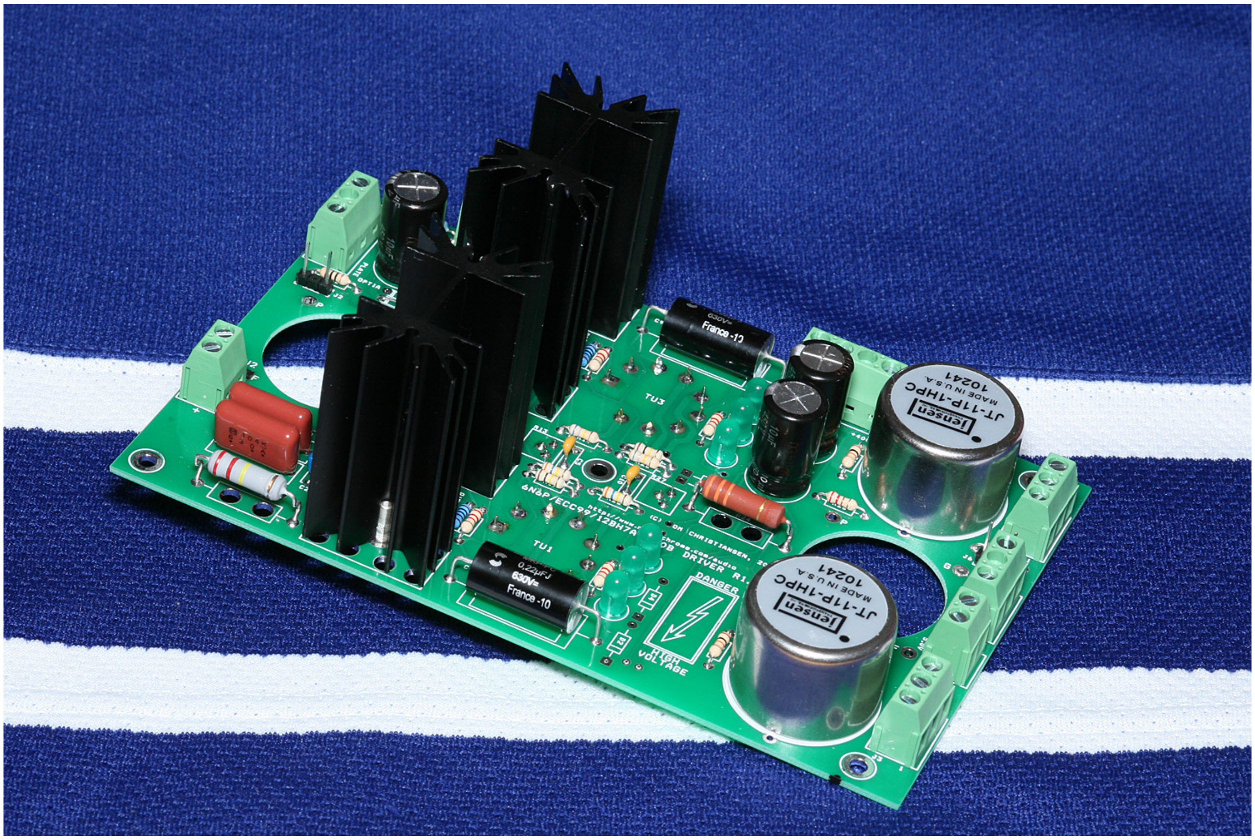
The easiest way to populate the DG300B driver board is to work from the smaller components to the larger. I suggest the following sequence:

1. Wire link options: OPT1, OPT2.
2. ICs: U1, U2.
3. 1/4 W resistors: R1 — R9, R11, R12, R14 — R23, R25, R26, R28.
4. 1/2 W resistors: R30, R31.
5. 2-3 W resistors: R10, R24, R29.
6. Potentiometers: R13, R27. Note that the potentiometers may be mounted on either side of the board for ease of access in the assembled amplifier.
7. LEDs: D1, D3, D5, D6, D8, D10.
8. Capacitors: C1 — C15.
9. Terminal blocks: J1, J3 — J5, J7 — J10.
10. Bias test point headers: J2, J6.
11. Tube sockets for TU1, TU3.
12. Cascode devices: Q1 — Q4. Note that the devices need to be electrically isolated from their respective heat sinks. The necessary mounting hardware is shown below.



13. Input transformers: TR1, TR2.
14. Verify all solder joints and ensure that the board is clean of wire clippings and excess flux.

A populated DG300B Driver Board is shown below.



Output Transformers

There are many options for output transformers. Select output transformers that meet the following specifications.

Parameter	Value
Output Power	Min. 15 W
Primary Impedance	5 kΩ
Primary Current	Min. 100 mA
Secondary Impedance	Match the impedance of your speakers.

If you're price conscious, Edcor (www.edcorusa.com) CXSE25-4-5K (5 kΩ : 4 Ω) or CXSE25-8-5K (5 kΩ : 8 Ω) is probably your best option. The James (http://jianshin.myweb.hinet.net) JS-6113HS looks like it would be a good fit as well. Both the Edcor and the James transformer will set you back about $80/each.

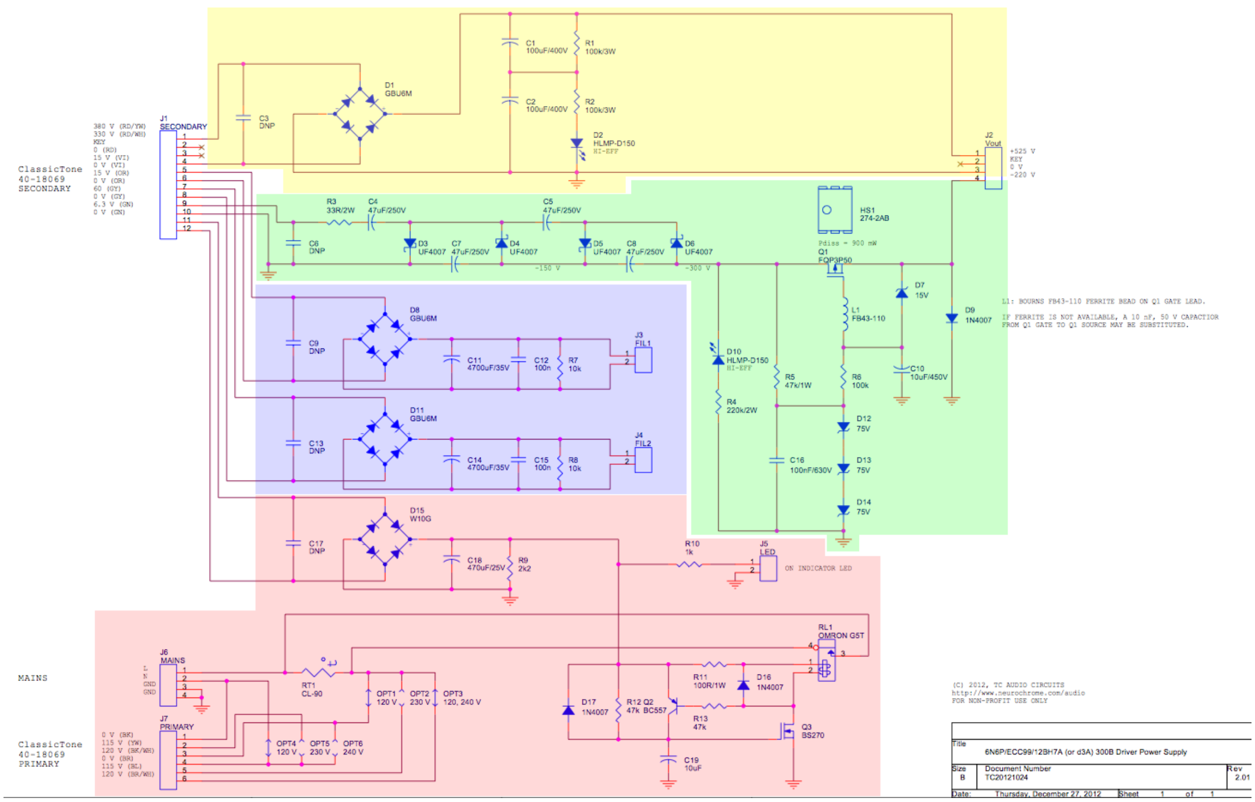
Doubling the price lands you in Lundahl (www.lundahl.se) territory. The LL1623/120mA appears to be a good candidate, though with 5.6 kΩ primary impedance, the max output power will be ever so slightly lower.

In the $250 category, you'll find Electra-Print (www.electra-print.com). When dealing with Electra-Print, it is important to be concise and to-the-point. The output transformers shown in the amp on the front page are specified as "15 W, 100 mA, 5 kΩ primary, 4 Ω and 8 Ω secondary, copper for 300B". A less expensive option is to use an OPT with a single secondary. A 6 Ω secondary will work reasonably well with both 4 Ω and 8 Ω speakers, but it is a compromise.

Personally, I find the Edcor CXSE25-series to be absolutely incredible good value for the money. The Electra-Print transformers do clean up the sound a bit, but are also three times as expensive. I have no personal experience with the James or Lundahl transformers.

Power Supply Board

The schematic for the power supply board is shown below. A larger view is available in the appendix.



The power supply is comprised of four parts: B+ supply (yellow), bias supply (green), filament supplies (blue), and a soft-start circuit with options for selecting the appropriate mains voltage (red).

The filament supplies are fairly standard fare; rectifier and reservoir capacitor.

The B+ supply is slightly more sophisticated with two reservoir capacitors in series to accommodate the full rectified voltage. The two balancing resistors act as bleeders as well to ensure that the capacitors get fully discharged when the power is turned off. An LED is in series with the bleeders/balancing resistors to provide a visual indication of applied power. Note, however, that it is possible to have lethal voltages present in the circuit even if the LED is extinguished. Therefore, always measure the voltages across the reservoir caps (or at the supply connectors) to ensure that the capacitors have been fully discharged before working on the circuit.

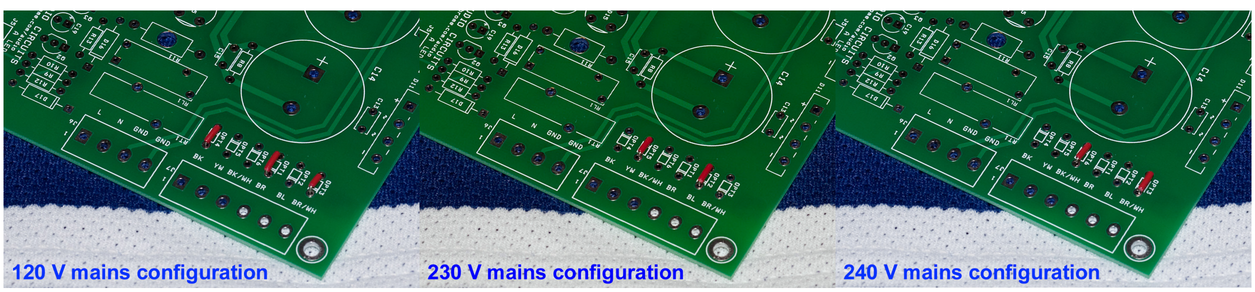
The bias supply is the most complicated part of the supply circuit. It is comprised of an inverting voltage quadrupler (C4, C5, C7, C8, D3-6) with a resistor (R3) in series to limit the peak current drawn by the quadrupler. The input to the circuit is 60 V RMS and the output is roughly -300 V DC. This voltage is regulated by a simple zener regulator with a source follower output, providing the negative bias voltage needed for the DG300B.

Mains Voltage Selection

The power supply board contains six option jumpers (OPT1 — OPT6) for selecting the mains voltage. They are to be populated according to the information in the table below.

Mains Voltage	Options Populated
120 V	OPT1, OPT3, OPT4
230 V	OPT2, OPT5
240 V	OPT3, OPT6

These configurations are illustrated below.



120 V mains configuration 230 V mains configuration 240 V mains configuration

Soft Start

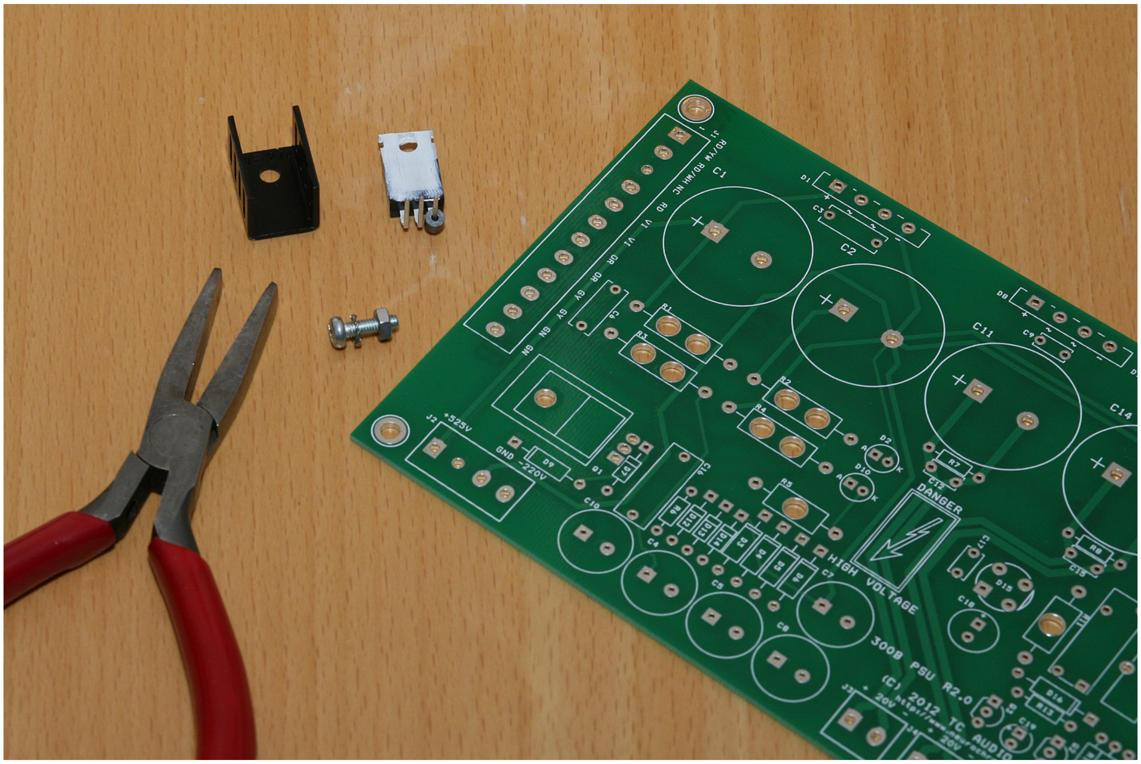
A soft-start is provided by NTC resistor RT1. This resistance of this resistor is about 90 ohm at room temperature. Hence, on turn-on, the current in the transformer primary is limited to roughly 1.3 A with 120 V mains (2.5 A for 230 V mains). Relay, RL1, shorts out the NTC resistor after the roughly 0.5 second time delay set by R12, C19, Q3, and associated components. After the delay, RT1 is shorted by RL1. This allows RT1 to cool off, thereby, ensuring that the soft-start circuit re-activates in the event of a momentary loss of mains power.

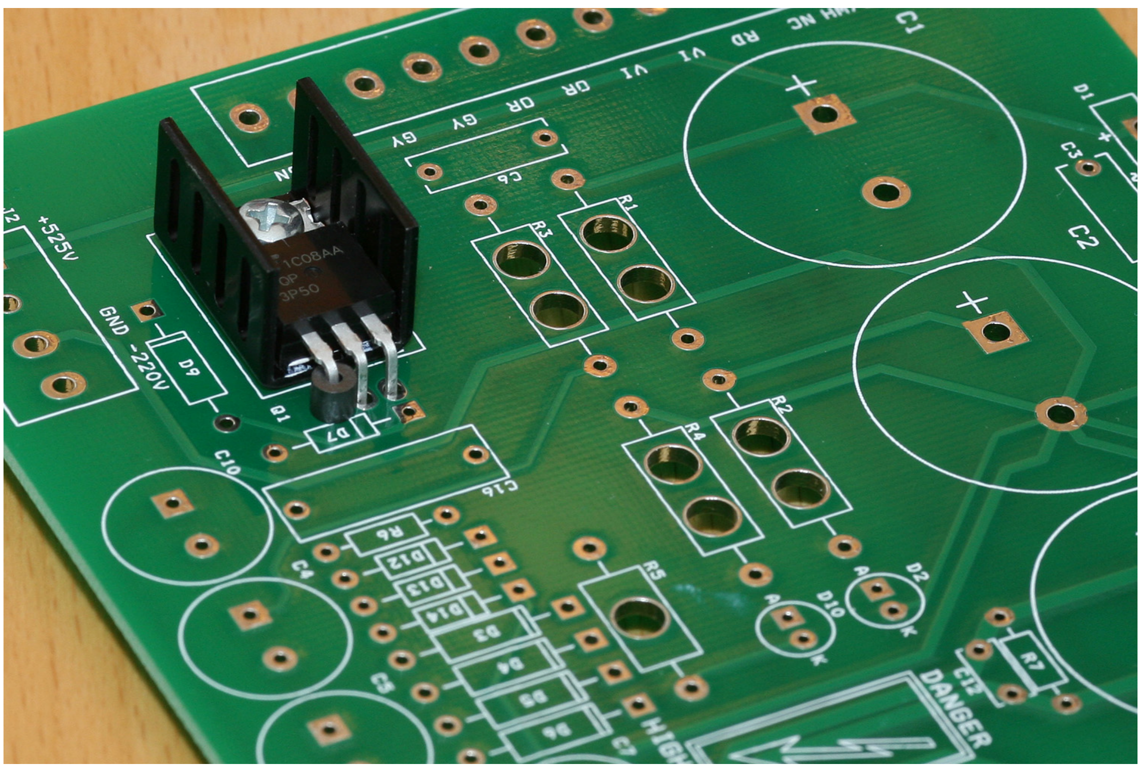
Assembly, Power Supply Board

As with the driver board, the supply board is assembled "low to high". I suggest the following assembly sequence:

1. Mains voltage selector options: OPT1 — OPT6.
2. 1/4 W resistors: R6 — R10, R12, R13.
3. Diodes and zeners: D3 — D7, D9, D12 — D14, D16, D17.
4. Transistors: Q2, Q3.
5. Small bridge rectifier: D15.
6. LEDs: D2, D10.
7. Power resistors: R1 — R5, R11.
8. Snubber capacitors (if desired): C3, C6, C9, C13, C17.
9. Voltage quadrupler capacitors: C4, C5, C7, C8, C10. Note that the square pad marks the anode or positive terminal of the capacitor.
10. Remaining smaller capacitors: C12, C15, C16, C18, C19.
11. Larger electrolytic capacitors: C1, C2, C11, C14.
12. Terminal blocks: J1 — J7.
13. Relay: RL1.
14. Thermistor: RT1.
15. Transistor Q1 (see images below):
    1. Apply a thin coat of thermal grease to the back side of Q1.
    2. Drape ferrite bead, L1, over the gate lead (pin 1) of Q1.
    3. Attach Q1, L1, and the heat sink to the PCB using an M3 x 12 (or #4 x 1/2") machine screw, nut, and lock washer.

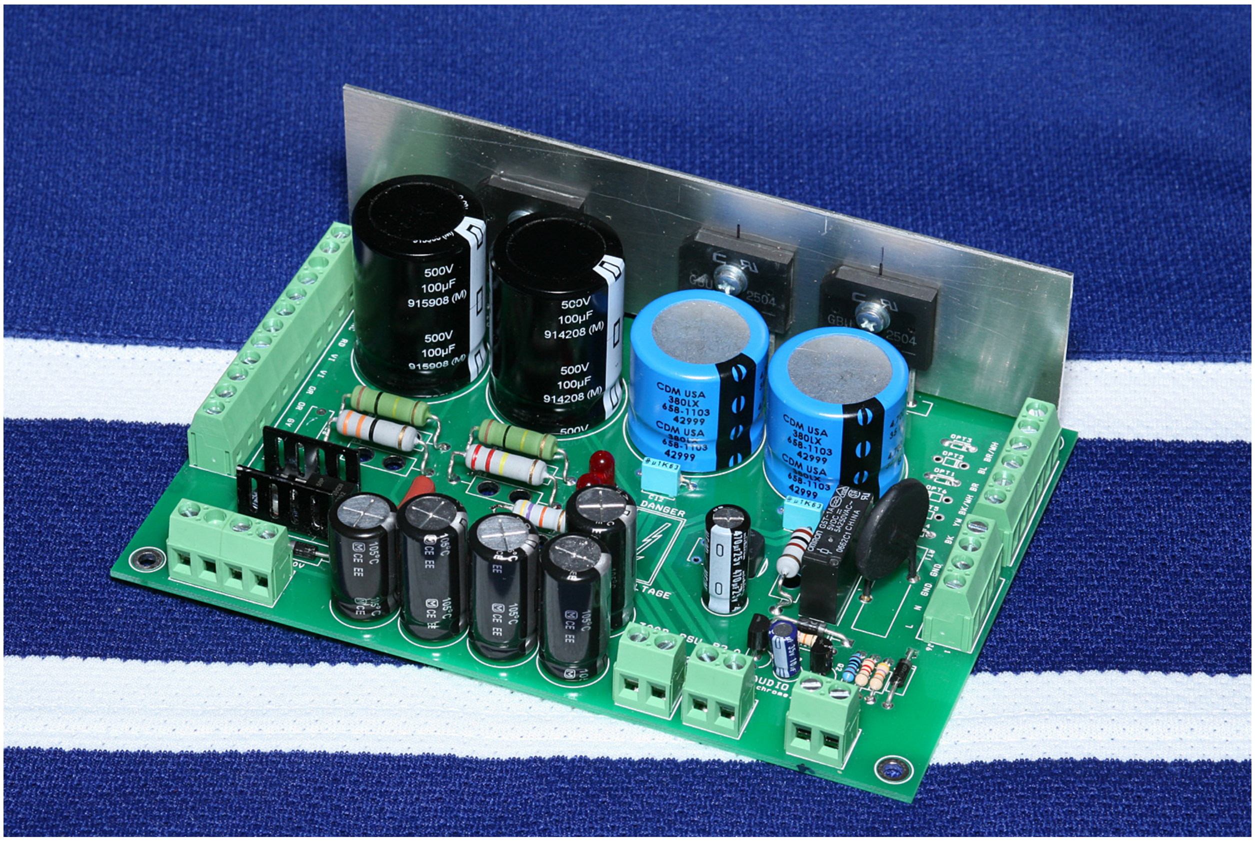
4. If a ferrite bead is not available, a 10 nF NP0 ceramic capacitor mounted from the gate to the source (pin 1 to pin 3) of Q1 may be used instead.





16. Diode bridges: D1, D8, D11. Please observe the polarity on these devices, in particular D1. These devices should ideally be fitted with a small heat sink. A sheet of 1.6 mm (1/16”) aluminum 40 × 150 mm (1.5 × 6 inches) is adequate. Another option would be to attach them to the (metal) chassis.

A fully populated 300B Power Supply Board is shown below.



Testing the Power Supply

I strongly recommend testing the power supply before connecting it to the amplifier board. The following test procedure is suggested.

1. Connect the Classic Tone 40-18069 to the supply board following the wiring diagram in the appendix. Do note that Classic Tone changed the colours of the wires for the 15 V secondaries starting in late 2014. Schematics for both colour combinations are shown in the appendix.
2. Gradually apply the mains voltage to the supply board using a variac. Continuously monitor the B+ output voltage (J2 - 1) as the mains voltage is increased. The B+ voltage should gradually increase and reach about 525 V once the full mains voltage has been applied. Along the way, RL1 should engage with an audible click.
    1. If a variac is not available, the use of a "light bulb tester" (25 W incandescent light bulb in series with the LIVE mains wire) is recommended. If the bulbs lights up brightly, there is an error in the circuit.
3. Once it has been established that there are no major wiring errors or component errors in the circuit, apply the full mains voltage.
4. Measure the B+ voltage from J2 - 1 to J2 - 3. Should be approx. 525 V.
5. Measure the bias voltage from J2 - 4 to J2 - 3. Should be approx. -225 V.
6. The voltages at J3 and J4 should be roughly 20 V.
7. If an LED is connected at J5, it should be illuminated.
8. The relay RL1 should engage with an audible click within a few seconds of turning the mains voltage on and disengage with a click immediately when the mains voltage is turned off.
9. Turn off the mains voltage and wait until all capacitors have discharged to below 5 V before continuing.

Bringing it Together

With the Power Supply Board, 21st Century Maida Regulator, Universal Filament Regulators, and DG300B Driver Board completed, it's time to bring everything together. It is recommended to do this following the steps below, rather than in one Big Bang test.

1. Connect the Power Supply Board, 21st Century Maida Regulator, Universal Filament Regulators, and DG300B Driver Board as shown in the wiring diagram in the appendix.
2. Leave the tubes out of the driver board for now.
3. Turn the two bias pots (R13, R27) all the way counter-clockwise.
4. Power up the circuit.
5. Connect a voltmeter across the two larger diameter pins in one of the 300B sockets.
6. The voltage should gradually rise and reach 5.0 V within 5-10 seconds of power-up.
7. If the voltmeter shows -5.0 V, reverse the leads to the voltmeter.
8. Note the connection of the (-) probe to the voltmeter, as this will be the ground reference for the remaining measurements.
9. Measure the voltages at the two smaller diameter pins in the 300B socket. One of them, pin 2, should measure +400 V. The other, pin 3, should measure approx. -225 V.
10. Repeat steps 5 - 9 for the other 300B socket.
11. On the two 9-pin sockets, measure the following voltages:
    1. Pin 1: Approx. 85 - 90 V.
    2. Pin 2: Approx. -100 V. This voltage should change within the range of -70 V to -100 V when the bias pot is turned. Leave the bias pot in the position that gives the largest negative voltage on pin 2. This is the minimum bias current position and should be fully counter-clockwise on the pot.
    3. Pin 3: Approx. -225 V.
    4. Pin 6: Approx. the full B+ voltage (so about 400 V).
    5. Pin 7: 0 V.
    6. Measure the heater voltage following the table below.

Tube Type	Voltmeter Connection	Expected Voltage
ECC99, 12BH7A	Pin 4 (+); Pin 9 (-)	6.3 V ±150 mV
	Pin 5 (+); Pin 9 (-)	6.3 V ±150 mV
6N6P, ECC88-family	Pin 4 (+); Pin 5 (-)	6.3 V ±150 mV
	Pin 9 (+); GND (-)	0 V

12. Power down and wait for the supply capacitors to fully discharge before proceeding.
13. Plug in the two 9-pin driver tubes, TU1 and TU3, and power up the amp.
14. As the driver tubes start to conduct, the LEDs should start to illuminate.
15. Once the driver tubes have warmed up, measure the voltage on pin 3 of the two 300B sockets. This voltage should measure approx. -105 V and should be adjustable by turning the bias pot. Leave the pot turned all the way counter-clockwise for minimum 300B bias.
16. The voltage on pin 6 of the driver tubes (accessible on C4, C9) should measure somewhere around 200 V. There will be considerable variation between the tube types and some tube-to-tube variation as well, so expect a voltage in the range of 150 - 250 V, with most tubes falling in the 180 - 220 V range.
17. Power down and wait for the supply capacitors to fully discharge before proceeding.
18. Plug in the 300B tubes.
19. Connect an 8 Ω dummy load (power resistor) across each pair of speaker terminals.
20. Connect a voltmeter across test point J2 and another across J6. If only one voltmeter is available, I suggest proceeding one channel at a time.
21. Turn on the power and wait for the tubes to start conducting. As the 300B tubes start to conduct, the voltage indicated on the voltmeters will rise. 10 mV on the voltmeter corresponds to 1 mA of anode/plate current for the 300B. If the voltage indicated on any of the voltmeters exceeds 1.0 V for more than a few seconds, power down and trouble-shoot.
22. Adjust the 300B bias gradually, using the bias pots, to 850 mV measured on J2 and J6. This corresponds to a anode/plate current of 85 mA.

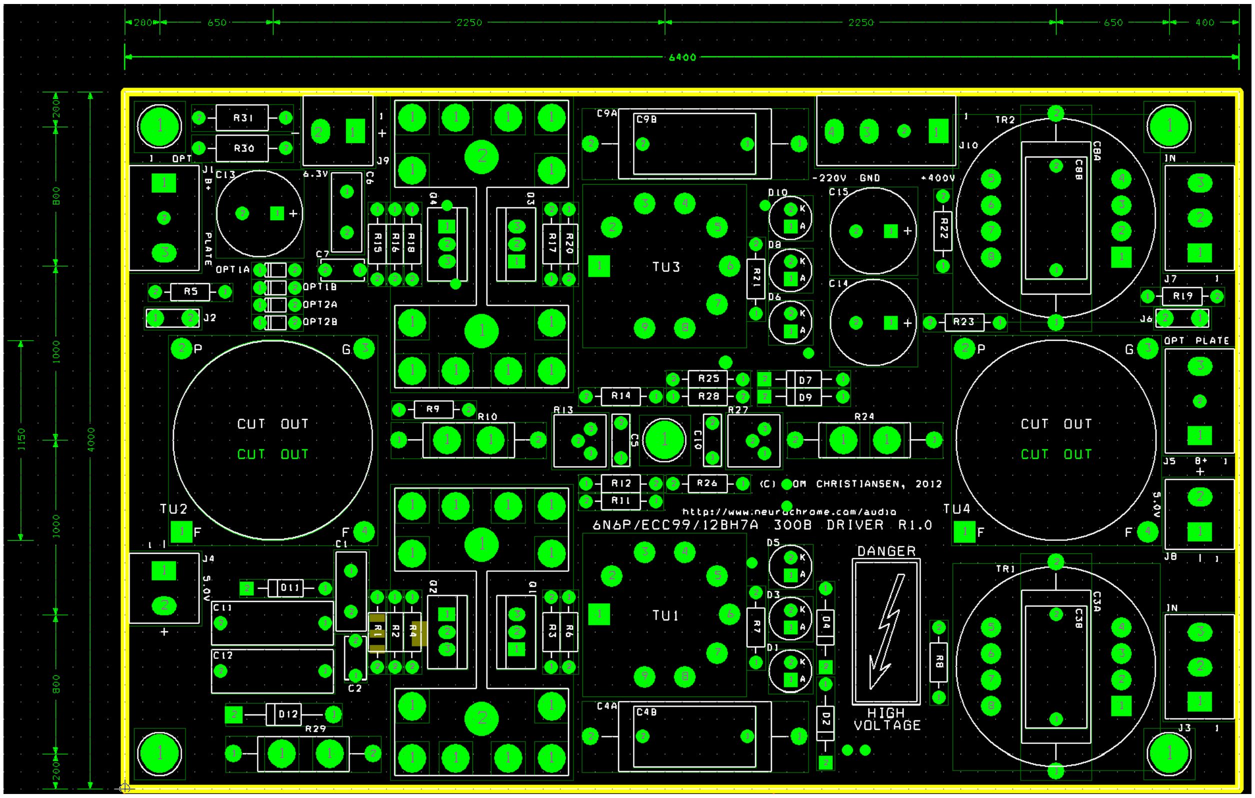
23. Expect the 300B bias point to drift significant during the first hour of use. Monitor the bias every few minutes and adjust as necessary.
24. During the next couple of hours of use, monitor the bias every 15-30 minutes until the tubes have fully stabilized. A well-stabilized tube will show a bias current of 85 mA ±5 mA (850 mV ±50 mV) after about 10 - 15 minutes of warm-up and will be within this range after 60 minutes of use.
25. Power off the amp. Connect speakers and signal source, power back up, and enjoy the music.
26. Check the bias periodically. I suggest measuring the bias after three months of use and once a year after that.

It is recommended that the bias test points remain internal connections, however, some builders bring out the bias test points to a chassis-mounted connector for ease of access. If you choose to do so, please make sure the connector can handle 400 V as the bias points float at the full B+ voltage. Also make sure the user cannot make contact with the bias points for the same reason. Many of the MILSPEC connectors by Amphenol can handle the voltage and can be equipped with a grounded metal cap for safety when the connector is not in use.

Appendix

A-1: Mechanical Dimensions, Driver Board

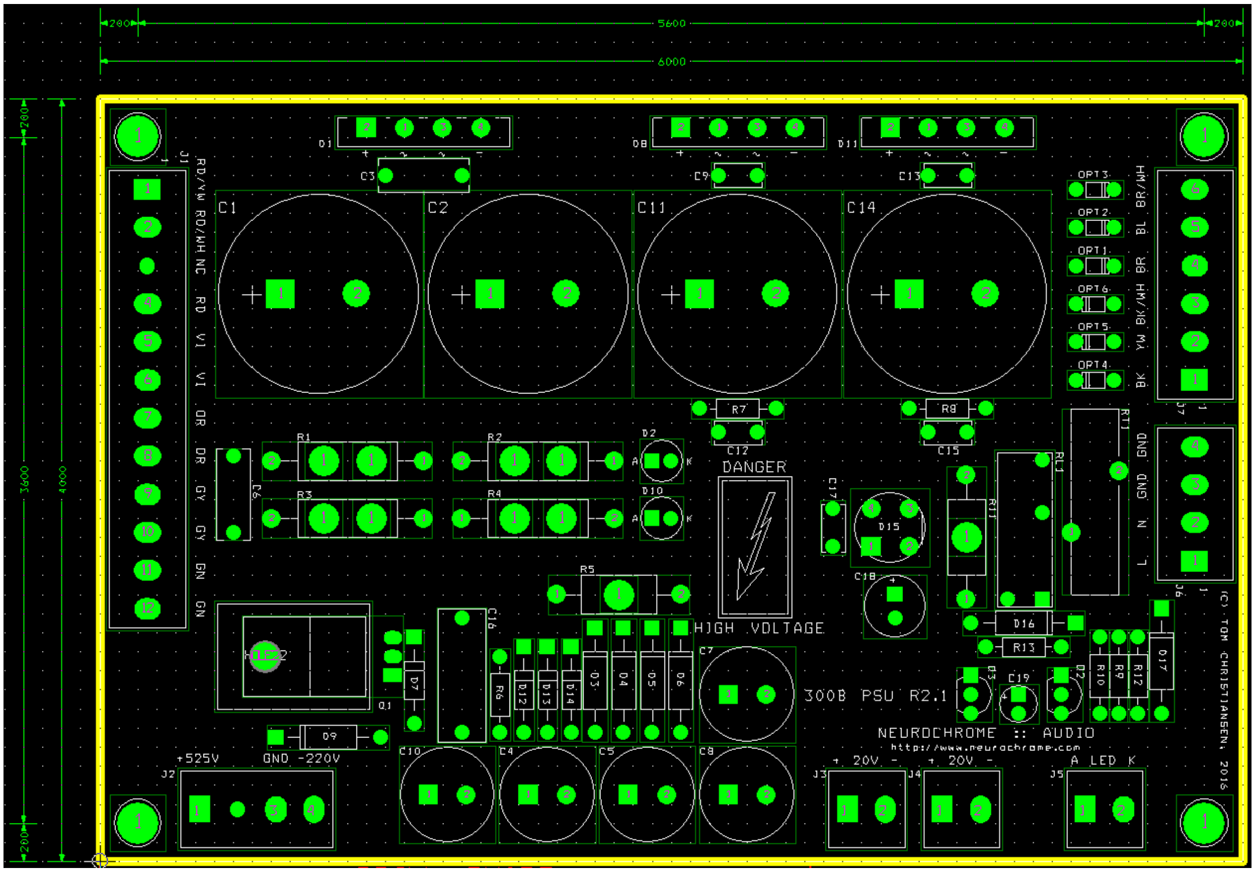
The dimensions of the DG300B board are shown below. The dimensions are in mil. 1 mil = 0.001 inches. The board measures 6.400 x 4.000 inches. The five mounting holes are 0.130” in diameter and are intended for use with M3 or #4 machine screws. These holes are arranged symmetrically around the tube sockets.



The board is intended for mounting below the top deck of the amplifier chassis. Using 12 mm (or 0.5 “) standoffs allows sufficient clearance for the 9-pin tube sockets. The cut-outs allow for the pins of the 300B sockets, mounted to the top plate, to poke through.

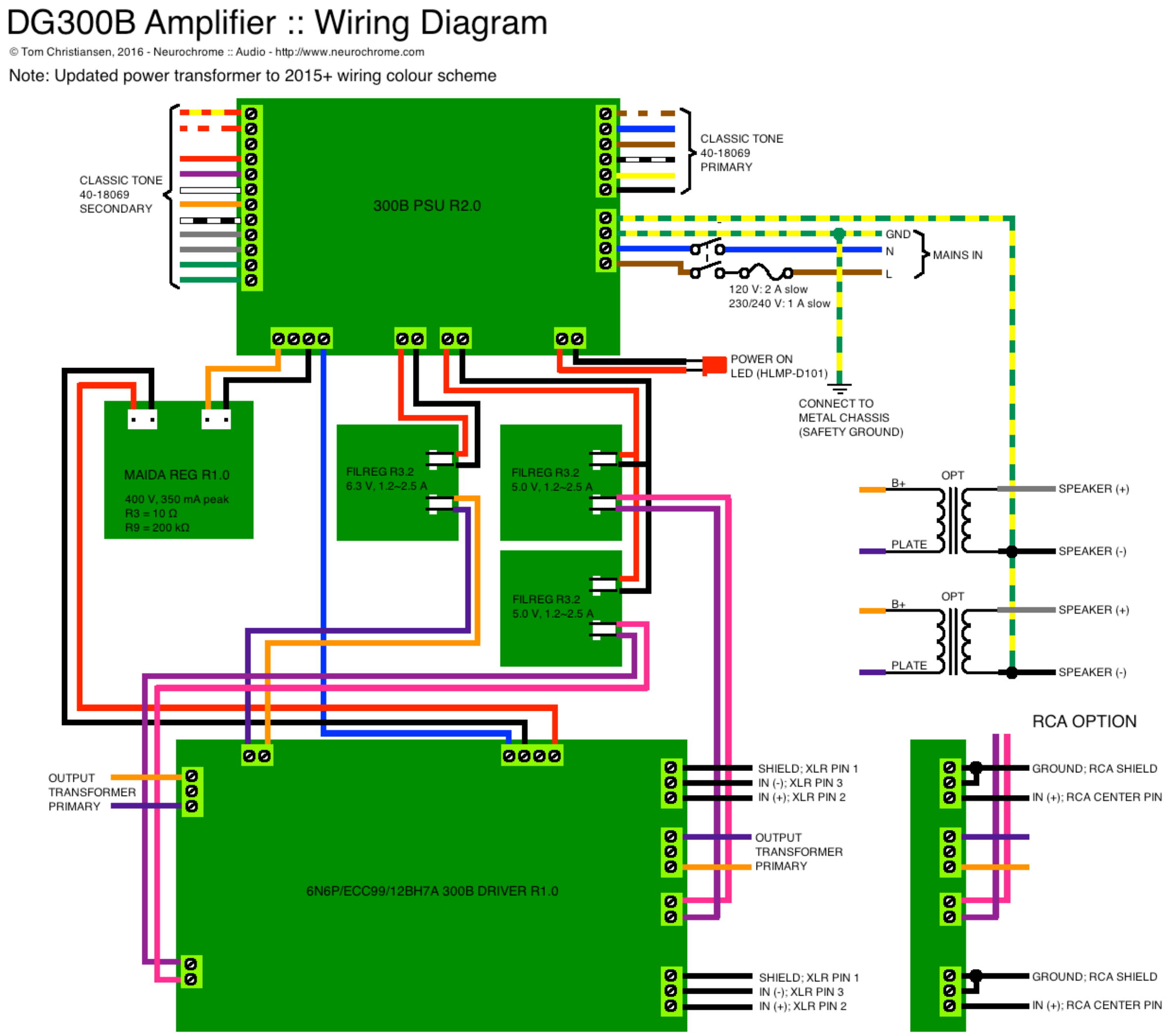
A-2: Mechanical Dimensions, Power Supply Board

The mechanical dimensions for the power supply board are shown below. The board measures 6.000 x 4.000 inches. The four mounting holes are 0.130” in diameter and are intended for use with M3 or #4 machine screws. The mounting holes are located 0.200 inches from the board edge.

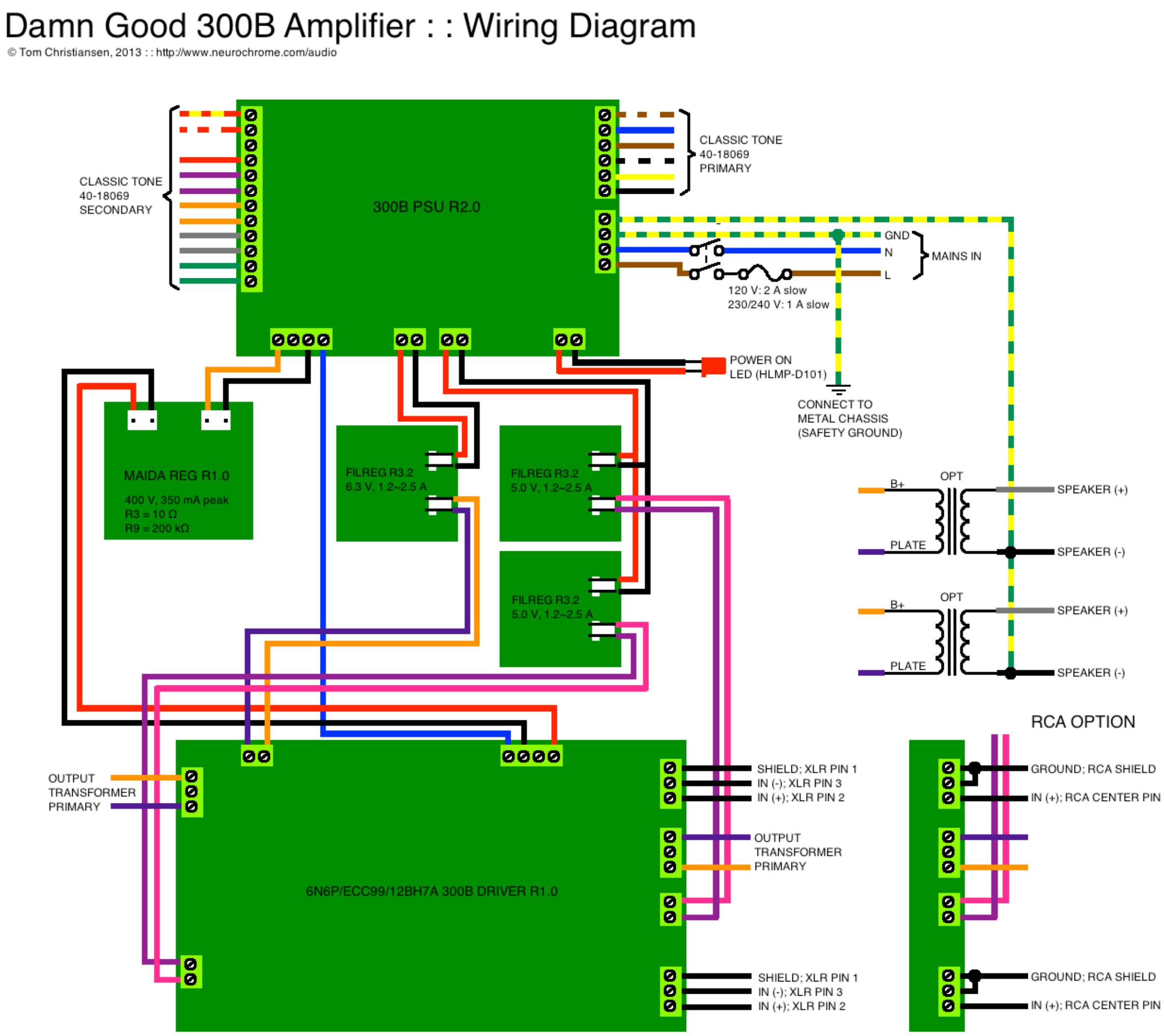


A-3: Wiring Diagram

The wiring diagram for the completed DG300B amp is shown below. Note that the wiring colours on the power transformer (Classic Tone 40-18069) reflect transformers manufacturers in 2015 and beyond. For the older transformer wire colours, please see the following page.



The wiring diagram for the completed DG300B amp using the older model of the Classic Tone 40-18069 power transformer is shown below. These are the connections to use if your Classic Tone 40-18069 power transformer was made in 2014 or earlier.



A-4: Additional Output Tube Options

The DG300B Driver Board has been optimized for use with a 300B tube. However, it could easily be used as a driver for other directly heated triode tubes as well. The table below shows the suggested component values for use with various DHTs. Except for the values for the 300B, these values are not tested and should be viewed as a good starting point for further experimentation. They were calculated from the operating points listed in the tube data sheets.

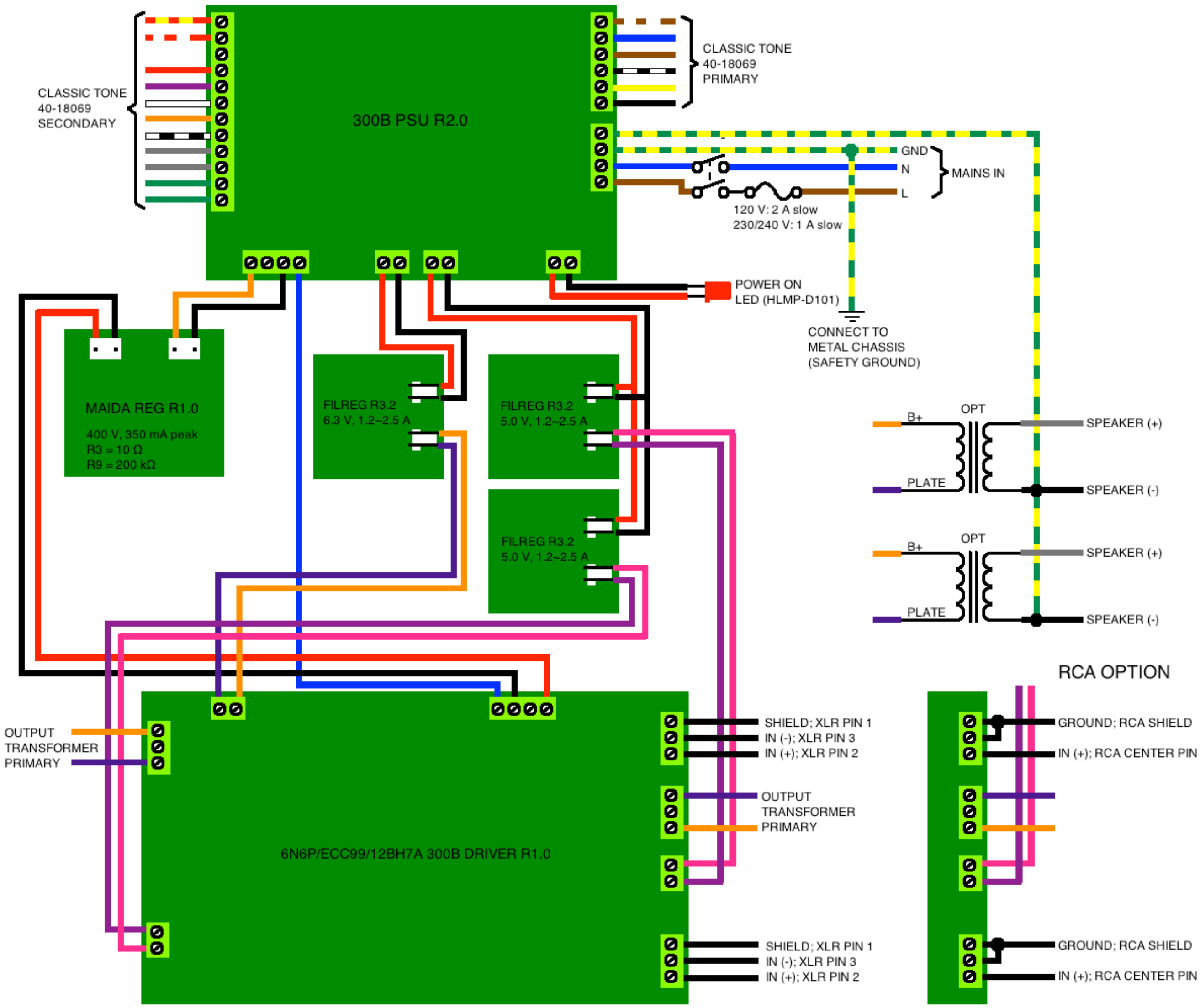
Output Tube	B+	Vgk @ idle	D1, D6	R10, R24	R12, R26	R14, R28
300B	400 V	-85 V	HLMP-3507	33 kΩ	360 kΩ	680 kΩ
2A3	250 V [1]	-45 V	SHORT	39 kΩ	270 kΩ	1.2 MΩ
45	275 V [1]	-56 V	SHORT	39 kΩ	300 kΩ	1.0 MΩ
801A	600 V [2]	-55 V	HLMP-3507	39 kΩ	300 kΩ	1.0 MΩ
211	1.25 kV [2]	-80 V	HLMP-3507	33 kΩ	330 kΩ	620 kΩ

[1]: The DG300B Driver Board is optimized for operation at 400 V with a 300B tube. Lowering the B+ voltage a bit – to, say 350 V – is no big deal. Operation at even lower voltages is likely to push the headroom on the CCS on the driver tube, TU1B. To gain a bit more headroom, D1 is replaced by a wire jumper (i.e. shorted out). This lowers the anode voltage on the driver tube and allows for full, undistorted signal swing even at the lower B+ voltages.

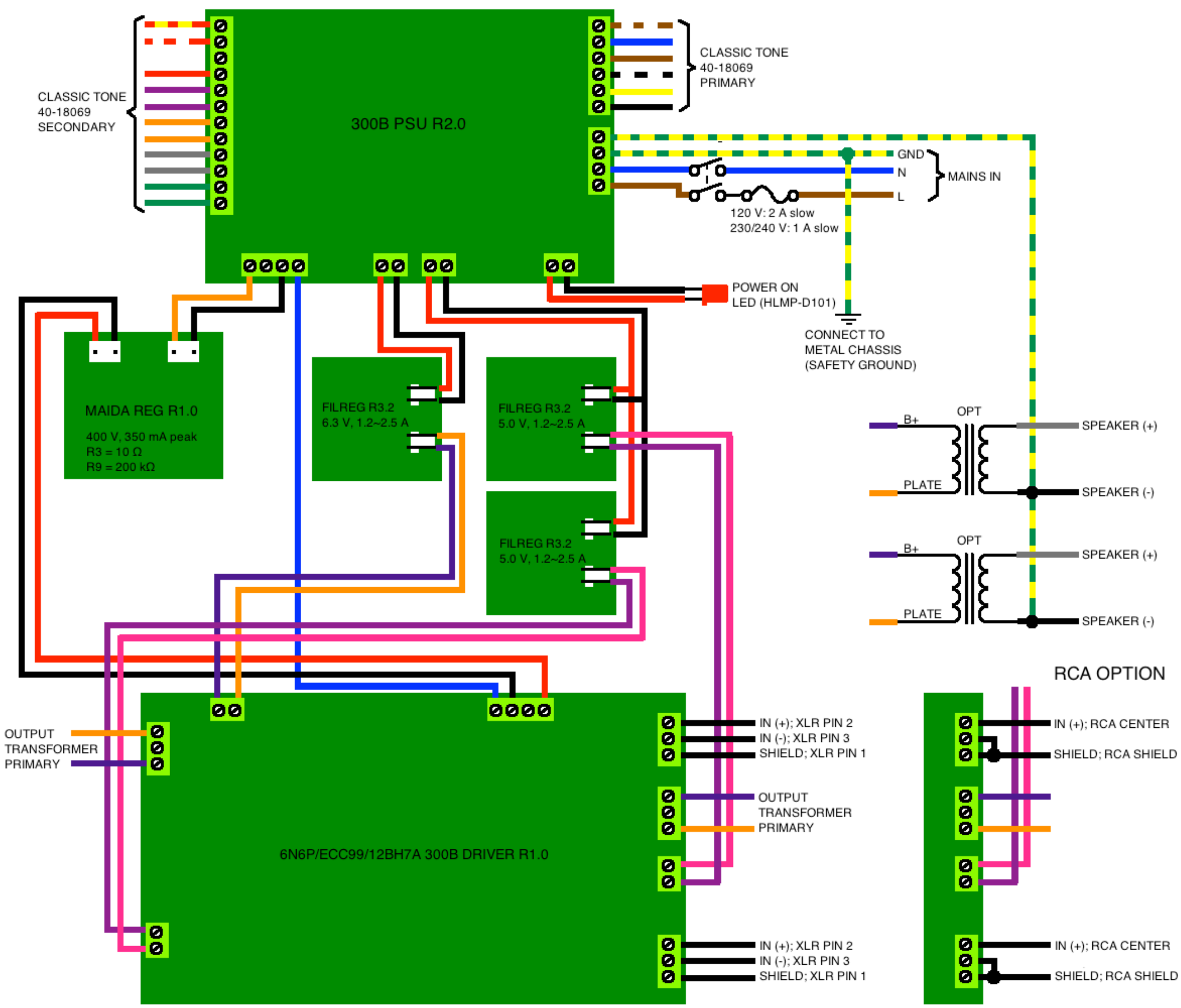
[2]: Note that the DG300B Driver Board will support B+ voltages up to 400 V. With a good voltage regulator, such as the 21st Century Maida Regulator, the B+ voltage may be increased to 425 V. Using higher B+ voltages for the output tube will necessitate a separate B+ supply for this driver circuit.

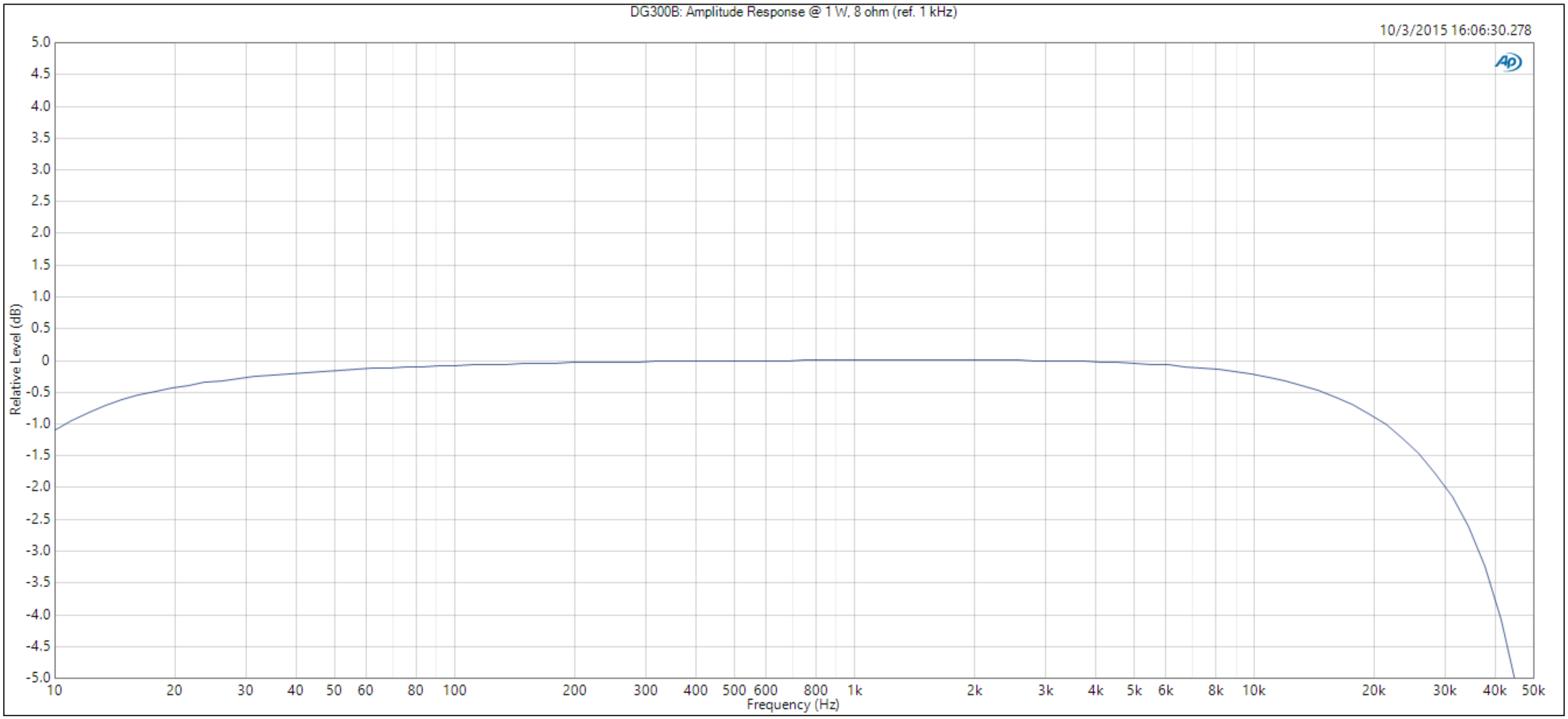
DG300B Amplifier :: Wiring Diagram

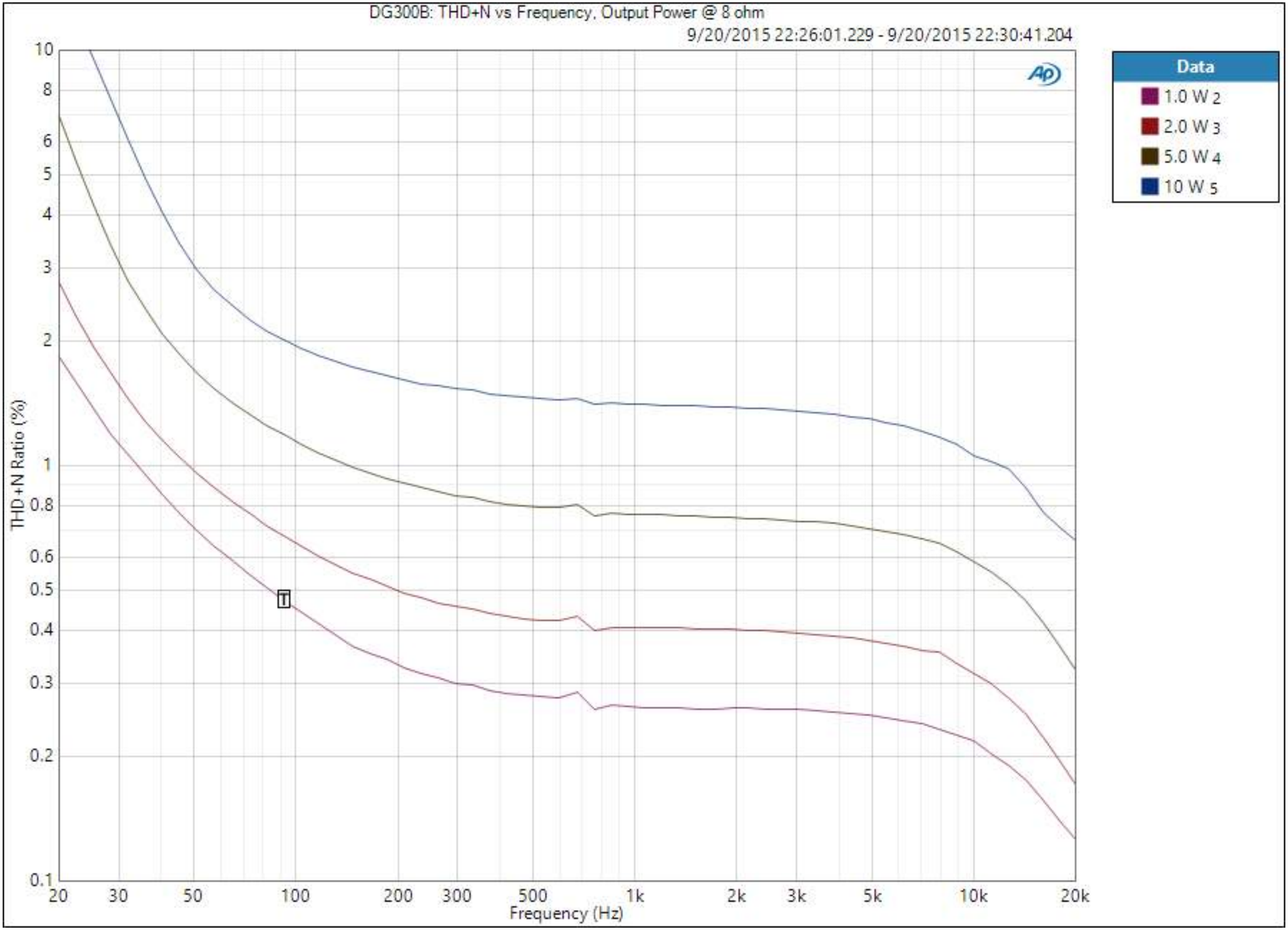
Note: Updated power transformer to 2015+ wiring colour scheme



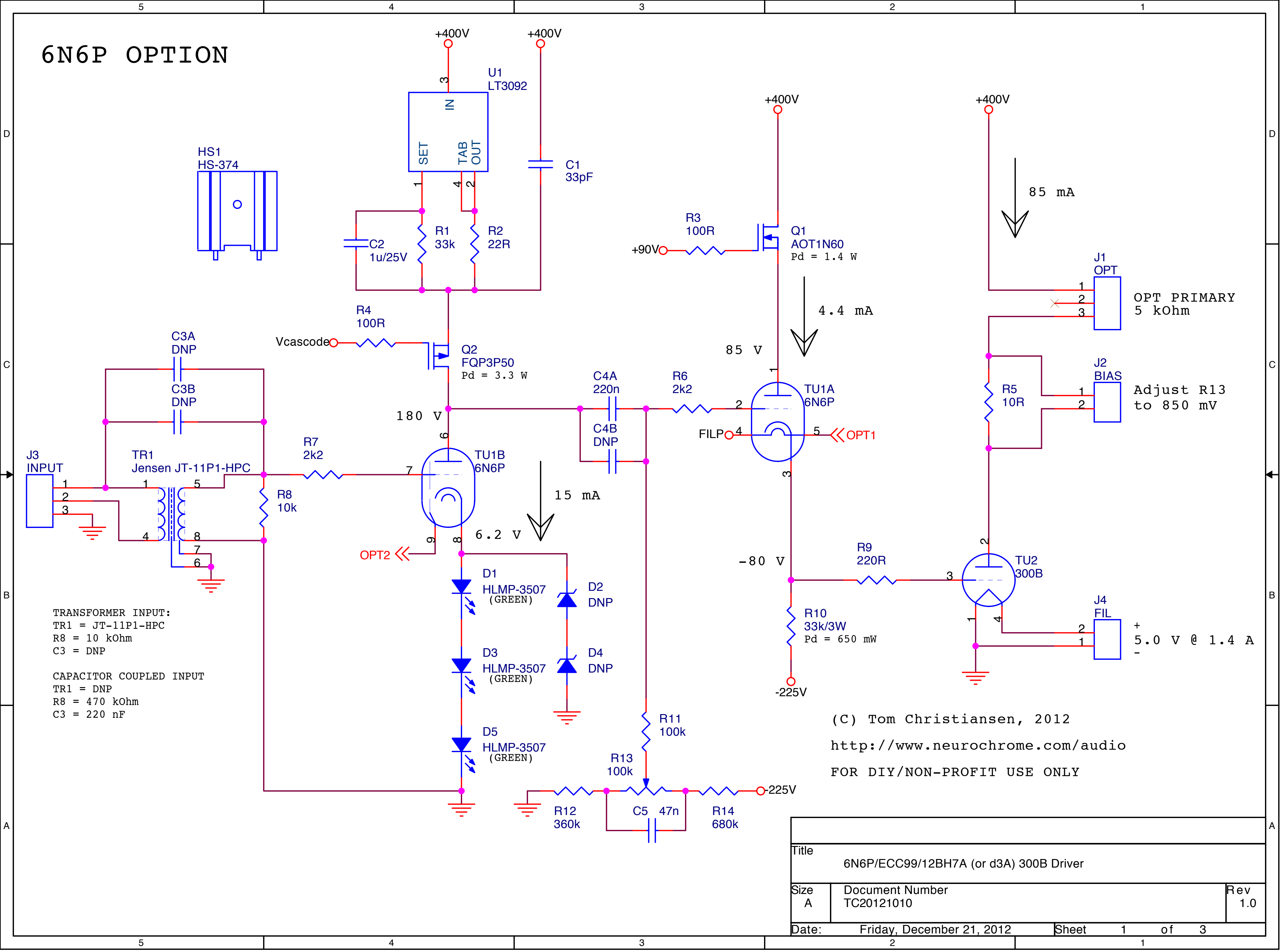
Damn Good 300B Amplifier : : Wiring Diagram

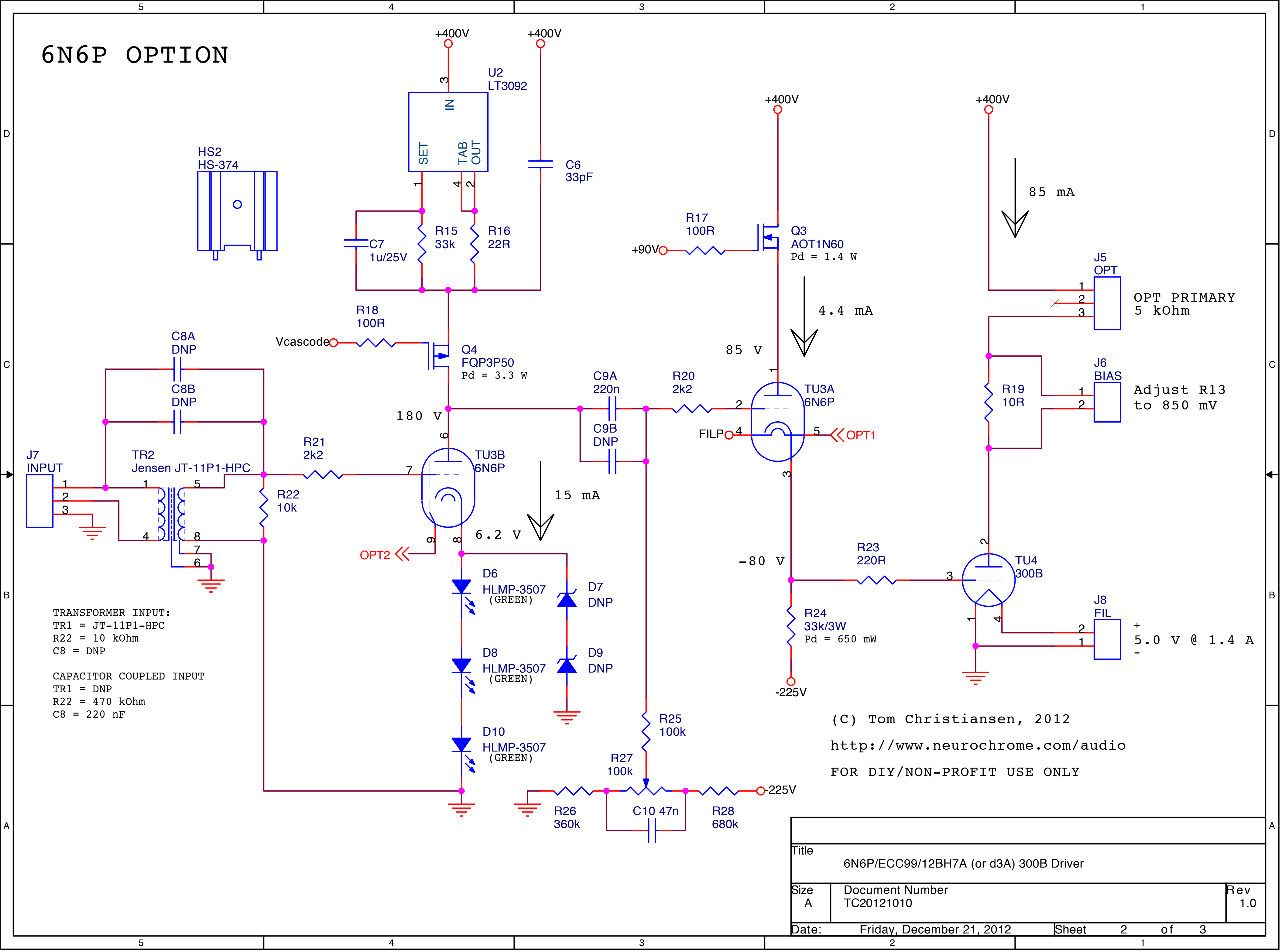


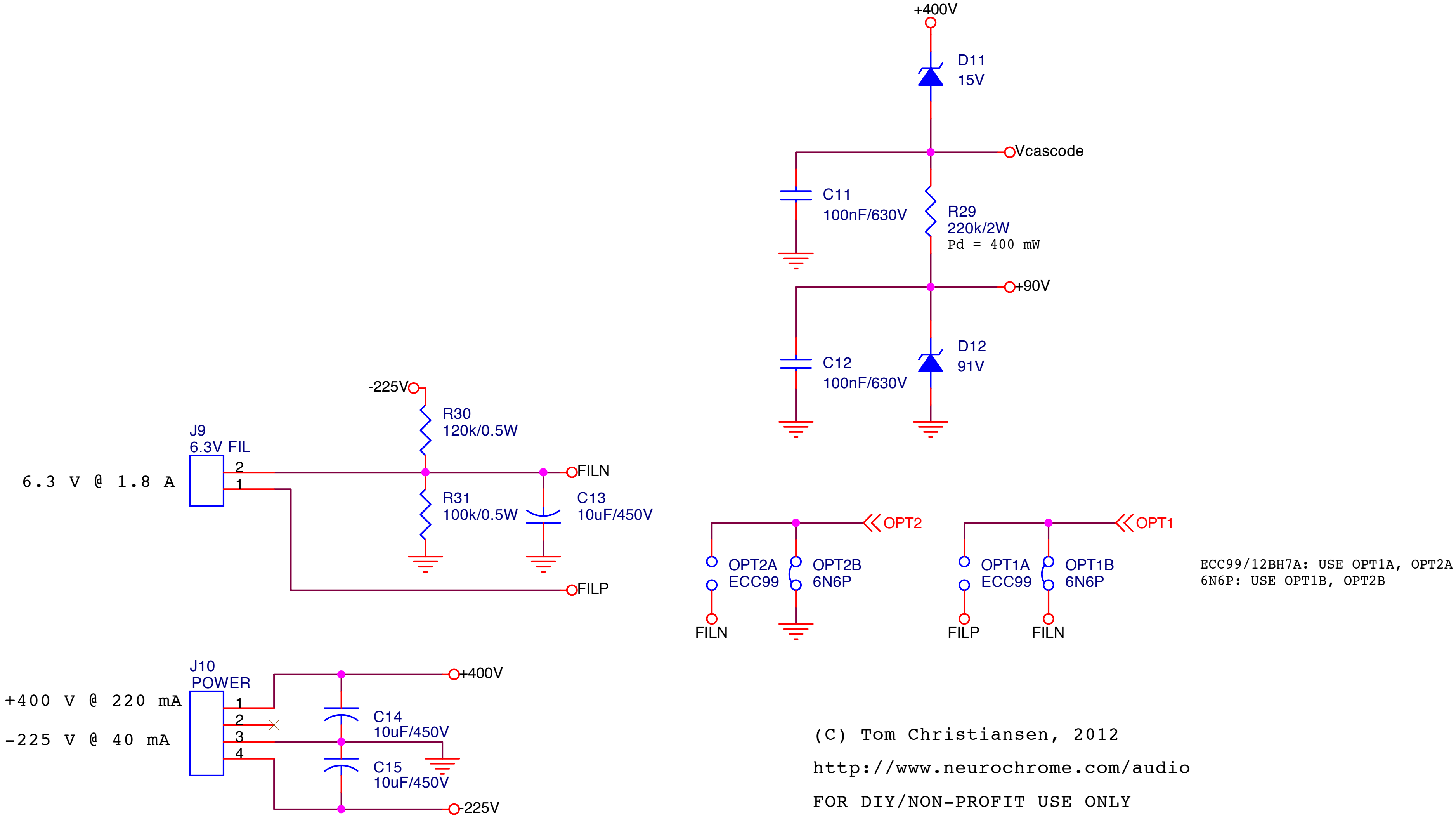

DG300B: Amplitude Response @ 1 W, 8 ohm (ref. 1 kHz)
10/3/2015 16:06:30.278
Relative Level (dB)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
10
20
30
40
50
60
80
100
200
300
400
500
600
800
1k
2k
3k
4k
5k
6k
8k
10k
20k
30k
40k
50k
Frequency (Hz)



DG300B: THD+N vs Frequency, Output Power @ 8 ohm
9/20/2015 22:26:01.229 - 9/20/2015 22:30:41.204
THD+N Ratio (%)
Frequency (Hz)
Data
1.0 W 2
2.0 W 3
5.0 W 4
10 W 5


6N6P OPTION
+400V
U1
LT3092
IN
SET
TAB
OUT
C1
33pF
HS1
HS-374
C2
1u/25V
R1
33k
R2
22R
R3
100R
+90V
Q1
AOT1N60
Pd = 1.4 W
85 mA
4.4 mA
J1
OPT
OPT PRIMARY
5 kOhm
R4
100R
Vcascode
Q2
FQP3P50
Pd = 3.3 W
C3A
DNP
C3B
DNP
85 V
180 V
C4A
220n
R6
2k2
TU1A
6N6P
FILP
OPT1
C4B
DNP
J2
BIAS
Adjust R13
to 850 mV
R5
10R
J3
INPUT
TR1
Jensen JT-11P1-HPC
R7
2k2
TU1B
6N6P
R8
10k
15 mA
6.2 V
OPT2
D1
HLMP-3507
(GREEN)
D2
DNP
D3
HLMP-3507
(GREEN)
D4
DNP
D5
HLMP-3507
(GREEN)
-80 V
R9
220R
TU2
300B
J4
FIL
R10
33k/3W
Pd = 650 mW
+
5.0 V @ 1.4 A
-
-225V
R11
100k
R13
100k
R12
360k
C5 47n
R14
680k
TRANSFORMER INPUT:
TR1 = JT-11P1-HPC
R8 = 10 kOhm
C3 = DNP
CAPACITOR COUPLED INPUT
TR1 = DNP
R8 = 470 kOhm
C3 = 220 nF
(C) Tom Christiansen, 2012
http://www.neurochrome.com/audio
FOR DIY/NON-PROFIT USE ONLY
Title
6N6P/ECC99/12BH7A (or d3A) 300B Driver
Size
A
Document Number
TC20121010
Rev
1.0
Date: Friday, December 21, 2012
Sheet 1 of 3


6N6P OPTION
+400V
+400V
U2
LT3092
IN
SET
TAB
OUT
C6
33pF
HS2
HS-374
C7
1u/25V
R15
33k
R16
22R
+400V
+400V
85 mA
R17
100R
+90V
Q3
AOT1N60
Pd = 1.4 W
4.4 mA
J5
OPT
OPT PRIMARY
5 kOhm
R18
100R
Vcascode
Q4
FQP3P50
Pd = 3.3 W
85 V
C8A
DNP
C8B
DNP
C9A
220n
R20
2k2
TU3A
6N6P
FILP
OPT1
J6
BIAS
Adjust R13
to 850 mV
R19
10R
180 V
C9B
DNP
J7
INPUT
TR2
Jensen JT-11P1-HPC
R21
2k2
TU3B
6N6P
R22
10k
15 mA
6.2 V
OPT2
-80 V
R23
220R
TU4
300B
D6
HLMP-3507
(GREEN)
D7
DNP
R24
33k/3W
Pd = 650 mW
J8
FIL
5.0 V @ 1.4 A
-225V
TRANSFORMER INPUT:
TR1 = JT-11P1-HPC
R22 = 10 kOhm
C8 = DNP
CAPACITOR COUPLED INPUT
TR1 = DNP
R22 = 470 kOhm
C8 = 220 nF
D8
HLMP-3507
(GREEN)
D9
DNP
D10
HLMP-3507
(GREEN)
R25
100k
R27
100k
-225V
R26
360k
C10 47n
R28
680k
(C) Tom Christiansen, 2012
http://www.neurochrome.com/audio
FOR DIY/NON-PROFIT USE ONLY
Title
6N6P/ECC99/12BH7A (or d3A) 300B Driver
Size
A
Document Number
TC20121010
Rev
1.0
Date: Friday, December 21, 2012
Sheet 2 of 3



Title	6N6P/ECC99/12BH7 (or d3A) 300B Driver		
Size A	Document Number TC20121010		Rev 1.0
Date:	Sunday, December 09, 2012	Sheet 3 of 3	

300B Amp - Driver Board Bill of Materials, 6N6P

300B_Driver_R1p0 BOM, 6N6P option

Item	Quantity	Reference	Part	Digikey P/N
1	2	C6,C1	33pF	338-1047-ND
2	2	C7,C2	1u/25V	445-8607-ND
3	2	C8A,C3A	DNP	Solen PPE022
4	4	C3B,C4B,C8B,C9B	DNP	EF6224-ND
5	2	C9A,C4A	220n	Solen PPE022
6	2	C10,C5	47n	445-5256-ND
7	2	C11,C12	100nF/630V	EF6104
8	3	C13,C14,C15	10uF/450V	P13671-ND
9	6	D1,D3,D5,D6,D8,D10	HLMP-3507	516-1333-ND
10	4	D2,D4,D7,D9	DNP	568-5806-1-ND
11	1	D11	15V	568-5018-1-ND
12	1	D12	91V	1N4763ACT-ND
13	2	HS2,HS1	HS-374	HS374-ND
14	2	J5,J1	OPT	609-3937-ND
15	2	J6,J2	BIAS	609-3464-ND
16	2	J7,J3	INPUT	609-3937-ND
17	2	J8,J4	FIL	609-3936-ND
18	1	J9	6.3V FIL	609-3936-ND
19	1	J10	POWER	2 x 609-3936-ND
20	2	OPT2A,OPT1A	DNP	N/A
21	2	OPT2B,OPT1B	6N6P	N/A
22	4	TU1,TU3	6N6P	N/A
23	2	Q3,Q1	AOT1N60	785-1184-5-ND
24	2	Q4,Q2	FQP3P50	FQP3P50-ND
25	4	Q1,Q2,Q3,Q4	TO-220 Thermal Pad	345-1000-ND
26	4	Q1,Q2,Q3,Q4	TO-220 Shoulder Washer	HS418-ND
27	2	Q1,Q2,Q3,Q4	M3x12 (#4x1/2) Machine Screw + Nut	
28	2	R15,R1	33k	33KQBK-ND
29	2	R16,R2	22R	22QBK-ND
30	4	R3,R4,R17,R18	100R	100QBK-ND
31	2	R19,R5	10R	10QBK-ND
32	4	R6,R7,R20,R21	2k2	2.2KQBK-ND
33	2	R22,R8	10k	10KQBK-ND
34	2	R23,R9	220R	220QBK-ND
35	2	R24,R10	33k/3W	P33KW-3BK-ND
36	2	R25,R11	100k	100KQBK-ND
37	2	R26,R12	360k	360KQBK-ND
38	2	R27,R13	100k	3362H-104LF-ND
39	2	R28,R14	680k	680KQBK-ND
40	1	R29	220k/2W	220KW-2
41	1	R30	120k/0.5W	120KH-ND
42	1	R31	100k/0.5W	100KH-ND
43	2	TR2,TR1	Jensen JT-11P1-HPC	N/A
44	2	TU4,TU2	300B	N/A
45	2	U2,U1	LT3092	LT3092EST#PBF-ND

DNP = Do Not Populate

300B Amp - Driver Board Bill of Materials, ECC99

300B_Driver_R1p0 BOM, ECC99 option

Item	Quantity	Reference	Part	Digikey P/N
1	2	C6,C1	33pF	338-1047-ND
2	2	C7,C2	1u/25V	445-8607-ND
3	2	C8A,C3A	DNP	Solen PPE022
4	4	C3B,C4B,C8B,C9B	DNP	EF6224-ND
5	2	C9A,C4A	220n	Solen PPE022
6	2	C10,C5	47n	445-5256-ND
7	2	C11,C12	100nF/630V	EF6104
8	3	C13,C14,C15	10uF/450V	P13671-ND
9	6	D1,D3,D5,D6,D8,D10	HLMP-3507	516-1333-ND
10	4	D2,D4,D7,D9	DNP	568-5806-1-ND
11	1	D11	15V	568-5018-1-ND
12	1	D12	91V	1N4763ACT-ND
13	2	HS2,HS1	HS-374	HS374-ND
14	2	J5,J1	OPT	609-3937-ND
15	2	J6,J2	BIAS	609-3464-ND
16	2	J7,J3	INPUT	609-3937-ND
17	2	J8,J4	FIL	609-3936-ND
18	1	J9	6.3V FIL	609-3936-ND
19	1	J10	POWER	2 x 609-3936-ND
20	2	OPT2A,OPT1A	ECC99	N/A
21	2	OPT2B,OPT1B	DNP	N/A
22	4	TU1,TU3	ECC99	N/A
23	2	Q3,Q1	AOT1N60	785-1184-5-ND
24	2	Q4,Q2	FQP3P50	FQP3P50-ND
25	4	Q1,Q2,Q3,Q4	TO-220 Thermal Pad	345-1000-ND
26	4	Q1,Q2,Q3,Q4	TO-220 Shoulder Washer	HS418-ND
27	2	Q1,Q2,Q3,Q4	M3x12 (#4x1/2) Machine Screw + Nut	
28	2	R15,R1	33k	33KQBK-ND
29	2	R16,R2	27R	27QBK-ND
30	4	R3,R4,R17,R18	100R	100QBK-ND
31	2	R19,R5	10R	10QBK-ND
32	4	R6,R7,R20,R21	2k2	2.2KQBK-ND
33	2	R22,R8	10k	10KQBK-ND
34	2	R23,R9	220R	220QBK-ND
35	2	R24,R10	33k/3W	P33KW-3BK-ND
36	2	R25,R11	100k	100KQBK-ND
37	2	R26,R12	360k	360KQBK-ND
38	2	R27,R13	100k	3362H-104LF-ND
39	2	R28,R14	680k	680KQBK-ND
40	1	R29	220k/2W	220KW-2
41	1	R30	120k/0.5W	120KH-ND
42	1	R31	100k/0.5W	100KH-ND
43	2	TR2,TR1	Jensen JT-11P1-HPC	N/A
44	2	TU4,TU2	300B	N/A
45	2	U2,U1	LT3092	LT3092EST#PBF-ND

DNP = Do Not Populate   Change from 6N6P option

300B Amp - Driver Board Bill of Materials, 12BH7A

300B_Driver_R1p0 BOM, 12BH7A option

Item	Quantity	Reference	Part	Digikey P/N
1	2	C6,C1	33pF	338-1047-ND
2	2	C7,C2	1u/25V	445-8607-ND
3	2	C8A,C3A	DNP	Solen PPE022
4	4	C3B,C4B,C8B,C9B	DNP	EF6224-ND
5	2	C9A,C4A	220n	Solen PPE022
6	2	C10,C5	47n	445-5256-ND
7	2	C11,C12	100nF/630V	EF6104
8	3	C13,C14,C15	10uF/450V	P13671-ND
9	6	D1,D3,D5,D6,D8,D10	DNP	516-1333-ND
10	4	D2,D4,D7,D9	6V2	568-5806-1-ND
11	1	D11	15V	568-5018-1-ND
12	1	D12	91V	1N4763ACT-ND
13	2	HS2,HS1	HS-374	HS374-ND
14	2	J5,J1	OPT	609-3937-ND
15	2	J6,J2	BIAS	609-3464-ND
16	2	J7,J3	INPUT	609-3937-ND
17	2	J8,J4	FIL	609-3936-ND
18	1	J9	6.3V FIL	609-3936-ND
19	1	J10	POWER	2 x 609-3936-ND
20	2	OPT2A,OPT1A	12BH7A	N/A
21	2	OPT2B,OPT1B	DNP	N/A
22	4	TU1,TU3	12BH7A	N/A
23	2	Q3,Q1	AOT1N60	785-1184-5-ND
24	2	Q4,Q2	FQP3P50	FQP3P50-ND
25	4	Q1,Q2,Q3,Q4	TO-220 Thermal Pad	345-1000-ND
26	4	Q1,Q2,Q3,Q4	TO-220 Shoulder Washer	HS418-ND
27	2	Q1,Q2,Q3,Q4	M3x12 (#4x1/2) Machine Screw + Nut	
28	2	R15,R1	33k	33KQBK-ND
29	2	R16,R2	33R	33QBK-ND
30	4	R3,R4,R17,R18	100R	100QBK-ND
31	2	R19,R5	10R	10QBK-ND
32	4	R6,R7,R20,R21	2k2	2.2KQBK-ND
33	2	R22,R8	10k	10KQBK-ND
34	2	R23,R9	220R	220QBK-ND
35	2	R24,R10	33k/3W	P33KW-3BK-ND
36	2	R25,R11	100k	100KQBK-ND
37	2	R26,R12	360k	360KQBK-ND
38	2	R27,R13	100k	3362H-104LF-ND
39	2	R28,R14	680k	680KQBK-ND
40	1	R29	220k/2W	220KW-2
41	1	R30	120k/0.5W	120KH-ND
42	1	R31	100k/0.5W	100KH-ND
43	2	TR2,TR1	Jensen JT-11P1-HPC	N/A
44	2	TU4,TU2	300B	N/A
45	2	U2,U1	LT3092	LT3092EST#PBF-ND

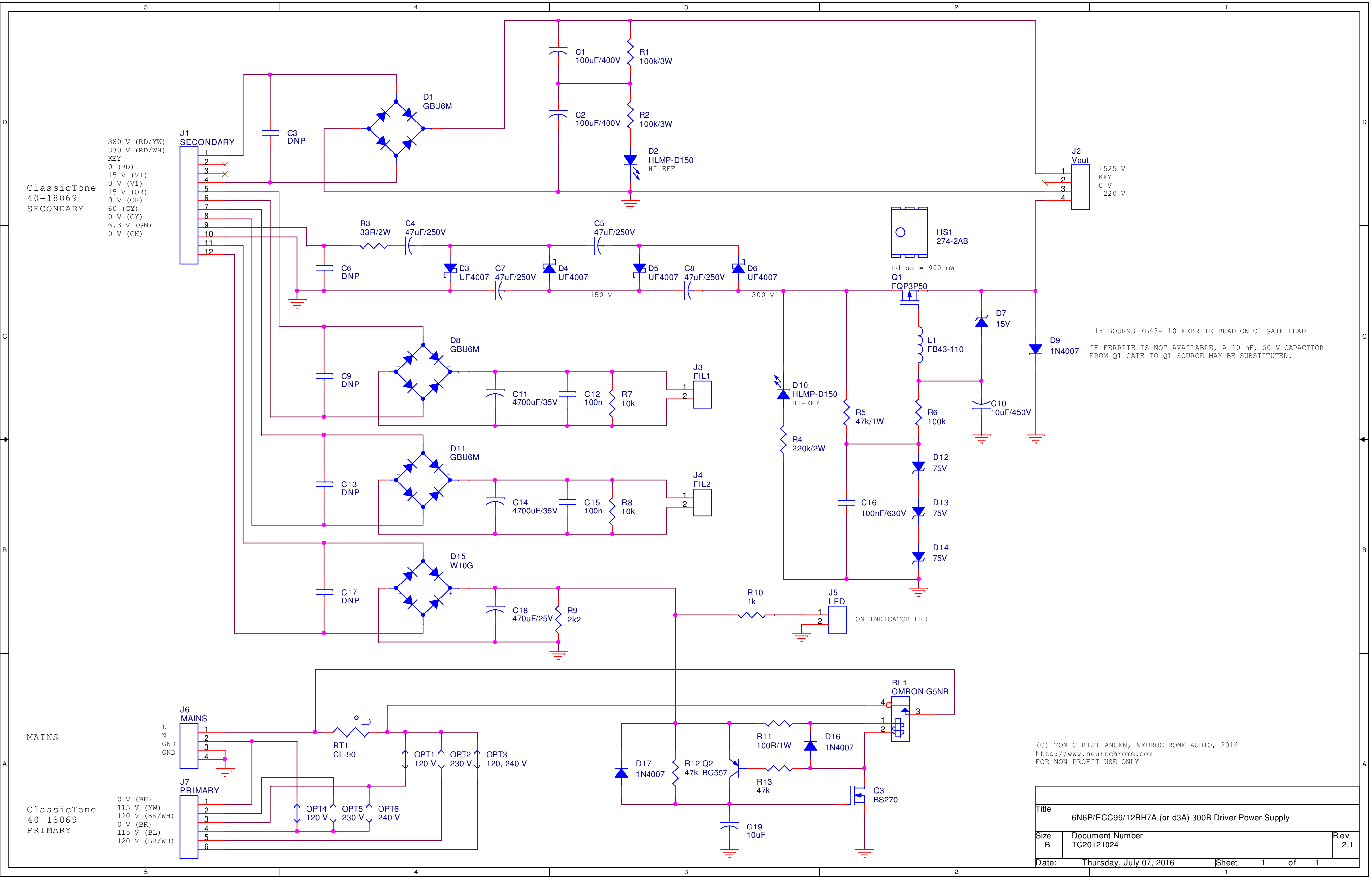
DNP = Do Not Populate   Change from 6N6P option

300B Amp - Driver Board Bill of Materials, E88CC

300B_Driver_R1p0 BOM, E88CC option

Item	Quantity	Reference	Part	Digikey P/N
1	2	C6,C1	33pF	338-1047-ND
2	2	C7,C2	1u/25V	445-8607-ND
3	2	C8A,C3A	DNP	Solen PPE022
4	4	C3B,C4B,C8B,C9B	DNP	EF6224-ND
5	2	C9A,C4A	220n	Solen PPE022
6	2	C10,C5	47n	445-5256-ND
7	2	C11,C12	100nF/630V	EF6104
8	3	C13,C14,C15	10uF/450V	P13671-ND
9	4	D1,D3,D6,D8	HLMP-3507	516-1333-ND
10	2	D5,D10	0 Ω (wire link)	N/A
11	4	D2,D4,D7,D9	DNP	568-5806-1-ND
12	1	D11	15V	568-5018-1-ND
13	1	D12	91V	1N4763ACT-ND
14	2	HS2,HS1	HS-374	HS374-ND
15	2	J5,J1	OPT	609-3937-ND
16	2	J6,J2	BIAS	609-3464-ND
17	2	J7,J3	INPUT	609-3937-ND
18	2	J8,J4	FIL	609-3936-ND
19	1	J9	6.3V FIL	609-3936-ND
20	1	J10	POWER	2 x 609-3936-ND
21	2	OPT2A,OPT1A	DNP	N/A
22	2	OPT2B,OPT1B	6N6P (and E88CC)	N/A
23	4	TU1,TU3	E88CC	N/A
24	2	Q3,Q1	AOT1N60	785-1184-5-ND
25	2	Q4,Q2	FQP3P50	FQP3P50-ND
26	4	Q1,Q2,Q3,Q4	TO-220 Thermal Pad	345-1000-ND
27	4	Q1,Q2,Q3,Q4	TO-220 Shoulder Washer	HS418-ND
28	2	Q1,Q2,Q3,Q4	M3x12 (#4x1/2) Machine Screw + Nut	
29	2	R15,R1	33k	33KQBK-ND
30	2	R16,R2	47R	47QBK-ND
31	4	R3,R4,R17,R18	100R	100QBK-ND
32	2	R19,R5	10R	10QBK-ND
33	4	R6,R7,R20,R21	2k2	2.2KQBK-ND
34	2	R22,R8	10k	10KQBK-ND
35	2	R23,R9	220R	220QBK-ND
36	2	R24,R10	33k/3W	P33KW-3BK-ND
37	2	R25,R11	100k	100KQBK-ND
38	2	R26,R12	360k	360KQBK-ND
39	2	R27,R13	100k	3362H-104LF-ND
40	2	R28,R14	680k	680KQBK-ND
41	1	R29	220k/2W	220KW-2
42	1	R30	120k/0.5W	120KH-ND
43	1	R31	100k/0.5W	100KH-ND
44	2	TR2,TR1	Jensen JT-11P1-HPC	N/A
45	2	TU4,TU2	300B	N/A
46	2	U2,U1	LT3092	LT3092EST#PBF-ND

DNP = Do Not Populate   Change from 6N6P option



ClassicTone 40-18069 SECONDARY
380 V (RD/YW)
330 V (RD/WH)
KEY
0 (RD)
15 V (VI)
0 V (VI)
15 V (OR)
0 V (OR)
60 (GY)
0 V (GY)
6.3 V (GN)
0 V (GN)
J1 SECONDARY
C3 DNP
D1 GBU6M
C1 100uF/400V
C2 100uF/400V
R1 100k/3W
R2 100k/3W
D2 HLMP-D150 HI-EFF
J2 Vout
+525 V
KEY
0 V
-220 V
R3 33R/2W
C4 47uF/250V
C5 47uF/250V
C6 DNP
D3 UF4007
C7 47uF/250V
D4 UF4007
D5 UF4007
C8 47uF/250V
D6 UF4007
-150 V
-300 V
HS1 274-2AB
Pdiss = 900 mW
Q1 FQP3P50
D7 15V
L1 FB43-110
D9 1N4007
L1: BOURNS FB43-110 FERRITE BEAD ON Q1 GATE LEAD.
IF FERRITE IS NOT AVAILABLE, A 10 nF, 50 V CAPACTIOR FROM Q1 GATE TO Q1 SOURCE MAY BE SUBSTITUTED.
D8 GBU6M
C9 DNP
C11 4700uF/35V
C12 100n
R7 10k
J3 FIL1
D10 HLMP-D150 HI-EFF
R4 220k/2W
R5 47k/1W
R6 100k
C10 10uF/450V
D11 GBU6M
C13 DNP
C14 4700uF/35V
C15 100n
R8 10k
J4 FIL2
D12 75V
C16 100nF/630V
D13 75V
D14 75V
D15 W10G
C17 DNP
C18 470uF/25V
R9 2k2
R10 1k
J5 LED
ON INDICATOR LED
MAINS
J6 MAINS
L
N
GND
GND
RT1 CL-90
OPT1 120 V
OPT2 230 V
OPT3 120, 240 V
RL1 OMRON G5NB
D17 1N4007
R12 47k
Q2 BC557
R11 100R/1W
D16 1N4007
R13 47k
Q3 BS270
C19 10uF
ClassicTone 40-18069 PRIMARY
J7 PRIMARY
0 V (BK)
115 V (YW)
120 V (BK/WH)
0 V (BR)
115 V (BL)
120 V (BR/WH)
OPT4 120 V
OPT5 230 V
OPT6 240 V
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FOR NON-PROFIT USE ONLY
Title
6N6P/ECC99/12BH7A (or d3A) 300B Driver Power Supply
Size B
Document Number TC20121024
Rev 2.1
Date: Thursday, July 07, 2016
Sheet 1 of 1

300B Amp - Power Supply Bill of Materials

300B_PSU_R2p1 BOM

Item	Quantity	Reference	Part	Digikey P/N
1	2	C1,C2	100uF/400V	338-1947-ND
2	2	C6,C3	DNP	EF6103-ND
3	4	C4,C5,C7,C8	47uF/250V	P13642-ND
4	3	C9,C13,C17	DNP	399-4326-ND
5	1	C10	10uF/450V	P13671-ND
6	2	C14,C11	4700uF/35V	338-2453-ND
7	2	C12,C15	100n	399-4329-ND
8	1	C16	100nF/630V	EF6104
9	1	C18	470uF/25V	493-1552-ND
10	1	C19	10uF	P15157-ND
11	3	D1,D8,D11	GBU6M	GBU6M-BPMS-ND
12	2	D10,D2	HLMP-D150	516-1323-ND
13	4	D3,D4,D5,D6	UF4007	UF4007-E3/54GICT-ND
14	1	D7	15V	1N5245BFSCT-ND
15	3	D9,D16,D17	1N4007	1N4007FSCT-ND
16	3	D12,D13,D14	75V	568-7943-1-ND
17	1	D15	W10G	W10G-E4/51GI-ND
18	1	HS1	274-2AB	345-1087-ND
19	1	J1	SECONDARY	6 x 609-3936-ND
20	1	J2	Vout	2 x 609-3936-ND
21	1	J3	FIL1	609-3936-ND
22	1	J4	FIL2	609-3936-ND
23	1	J5	LED	609-3936-ND
24	1	J6	MAINS	2 x 609-3936-ND
25	1	J7	PRIMARY	3 x 609-3936-ND
26	1	L1	FB43-110	M8702-ND
27	2	OPT4,OPT1	120 V	N/A
28	2	OPT5,OPT2	230 V	N/A
29	1	OPT3	120, 240 V	N/A
30	1	OPT6	240 V	N/A
31	1	Q1	FQP3P50	FQP3P50-ND
32	1	Q2	BC557	BC557BTACT-ND
33	1	Q3	BS270	BS270FS-ND
34	1	RL1	OMRON G5NB	Z2771-ND
35	1	RT1	CL-90	KC009L-ND
36	2	R1,R2	100k/3W	RSMF3JT100KCT-ND
37	1	R3	33R/2W	33W-2-ND
38	1	R4	220k/2W	220KW-2-ND
39	1	R5	47k/1W	47KW-1-ND
40	1	R6	100k	100KQBK-ND
41	2	R8,R7	10k	10KQBK-ND
42	1	R9	2k2	2.2KQBK-ND
43	1	R10	1k	1.0KQBK-ND
44	1	R11	100R/1W	100W-1-ND
45	2	R12,R13	47k	47KQBK-ND

DNP = Do Not Populate