Audio Circuit Denmark

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LYNX

Power Amplifier
Main PCB v2.1 and v2.2

Quick Assembly Guide v.1.2

16.11.2003

Contents

1. Introductions and Specifications

Introduction
This project had only one goal. To create a rock-solid and powerful sonic Power Amplifier like those used in recording studios. However, if you are fond of the deceased mighty and "muscular" power amps from Phase Linear, SAE, GAS and Dynaco etc. you may be intrigued by this project as the result is very close to those.

Components
Components shown in the schematics are only suggestions. The circuit has shown good characteristics and have produced a clear sound, when build with low cost components. So with this circuit you have the possibility to either build a low cost dynamic Power Amplifier or a Studio Class Power Amplifier.

Technical Specifications:
With the use of a heavy Power Supply combined with a large Capacitor Bank, the LYNX Power Amplifier are able to deliver loud and clear sound, and have shown capable of handling loads down to 1 Ohms without any instability.

Specifications rated at +/- 55 Volt DC Supply Voltage with 2x22.000 uF capacitor bank:

Output Power:	150 Watts pr. Channel into 8 Ohms 275 Watts pr. Channel into 4 Ohms 400 Watts pr. Channel into 2 Ohms
Frequency response:	DC to 300 kHz
Signal-to-Noise Ratio:	Better than 110 dB (20 Hz to 20 kHz
Harmonic Distortion THD:	Less than 0.001% from 20 to 450 Hz raising to less than 0.05% at 20 kHz
Damping Factor:	Greater than 700 from DC to 400 Hz

The amplifier can run with supply voltages from +/-35 to +/-70 Volts DC without changing any resistor values.

2. Circuit Description and Schematics

Circuit Description
The input signal from a Pre-Amp or a Volume Control is applied to the Inverting Input (Pin 2) of the U101 Opamp through a low-pass filter (R102 and C101), while the feedback signal (determent by R120 and R121) is applied to the Non-Inverting Input (Pin 3) of the U101 Opamp.

U101 makes the first low Voltage Gain, and provide low output impedance to the Voltage Amplifier stage Q101 and Q103 (Positive Voltage Amplification) and Q102 and Q104 (Negative Voltage Amplification).

The signal is then feed to the Current Gain Stages, which are build-up as “Three Deep Darlington” (TDD) circuits, each consisting of one Pre-Driver (Q106 and Q107), one High Power Driver (Q110 and Q111) and the Output Transistors (Q112 to Q119).

The Bias circuit consists of Q105, C104 (decoupling), R113, R115 and a Potentiometer R114, which allows the Bias to be adjusted.

The +/-15V DC Supply to U101 are provided by R122, ZD101 and C105 (Positive Supply) and R123, ZD102 and C106 (Negative Supply).

A Current Limiting Circuit (R124 to R127, C109 and C110, D103 to D108 and Q108 to Q109) is fitted to protect the output stage from delivering high currents above safety level. The use of C105 and C106 allows high current peaks (dynamic peaks) on the output without limiting the output current. Only if the current flow continues above "safety level" the capacitors are charged and Q108/Q109 limits the output current by lowering the signal to the Pre-Drivers.

If you are afraid of DC-Voltages on the input (from the outputs of your other equipment) you can add a 47uF/10V NP-capacitor to the input in series with R101.

On the last page you see the full schematics for the LYNX Power Amplifier.

3. Component List

LYNX Power Amplifier main PCB v.2.1 and v2.2 (updated 16.11.2003)

Item	Description	Mfr./Type	Alternatives	Notes
R101, R105, R105, R120	10K, 0.25W			1%
R102	1M8, 0.25W			1%
R103, R104	820R, 0.25W			1%
R107, R108	1K, 0.25W			1%
R109, R110	3.3K, 0.25W			1%
R111, R112	330R, 1W			Non-Inductive
R113	1K8, 0.25W			1-5%
R115	220R, 0.25W			1-5%
R116, R117	180R, 1W			Non-Inductive
R118, R119	4R7, 2W			Non-Inductive
R121	390R, 0.25W			1-5%
R122, R123	2K7, 2W			Non-Inductive
R124, R125, R126, R127	100R, 0.25W			1-5%
R114	4K7 potentiometer	Cermet, Bourns	Equivalent	10-24 turns
C101, C104	100pF	WIMA FKP 2	Equivalent	
C102, C103	33pF	WIMA FKP 2	Equivalent	
C105, C106	22uF, 50V			Non-Polarity
C107, C108	0.1uF	VISHAY MKP 1837	Equivalent	
C109	100pF	WIMA FKP 2	Equivalent	
U101	OPA627		OPA27	Low DC-Offset opamp
Q101, Q108	MPSA42	Philips	Equivalent	
Q102, Q109	MPSA92	Philips	Equivalent	
Q103, Q107	MJE350	Fairchild	Equivalent	
Q104, Q105, Q106	MJE340	Fairchild	Equivalent	
Q110	MJE15032	Motorola	Equivalent	
Q111	MJE15033	Motorola	Equivalent	
D103, D104, D105, D106, D107, D108	1N4148		Equivalent	
ZD101, ZD102	15V Zener, 1W			

Output Stage (not on PCB)

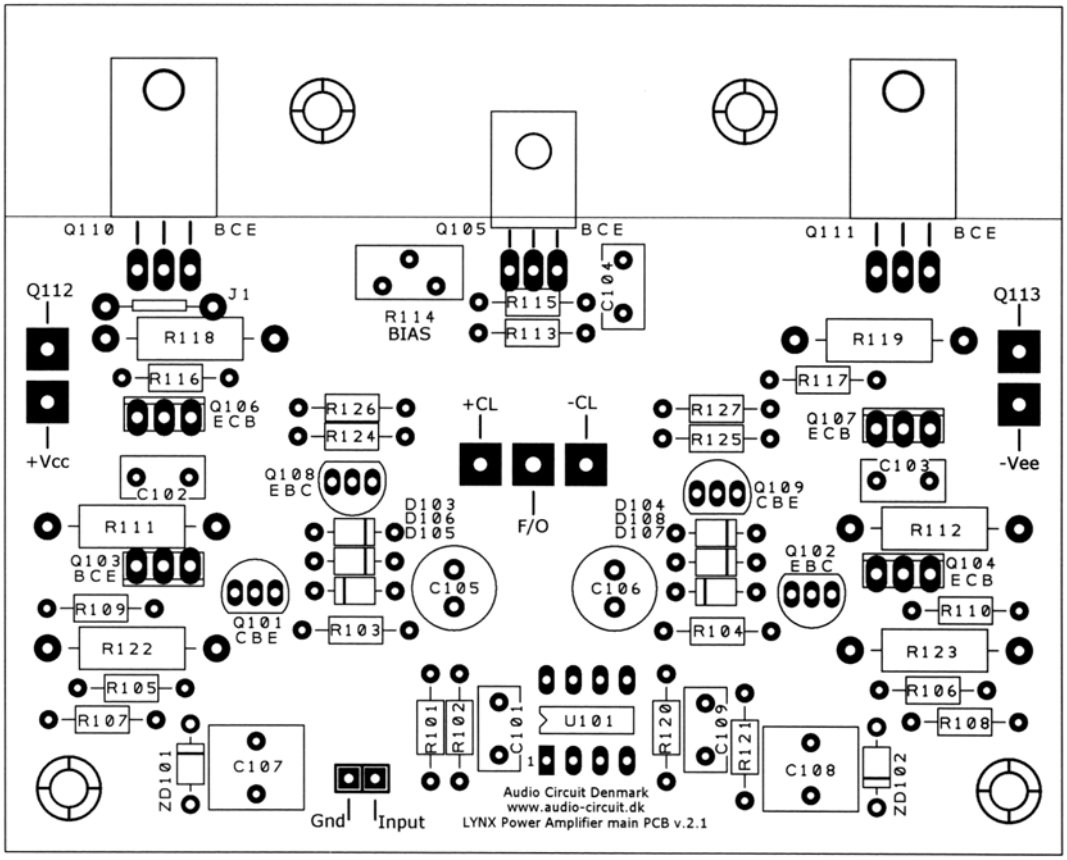
Item	Description	Mfr./Type	Alternatives	Notes
R131, R132, R133, R134, R135, R137, R138, R139	0,33R, 5W		0,22R, 5W	Non-Inductive
R139	2R7, 5W			Non-Inductive
R140	10R, 5W			Non-Inductive
C110	0.1uF	VISHAY MKP 1837	Equivalent	
L101	2uH			20A rating
Q112, Q113, Q114, Q115	MJL21194		Equivalent	On main heatsink
Q116, Q117, Q118, Q119	MJL21193		Equivalent	On main heatsink
D109, D110	1N5059		Equivalent	

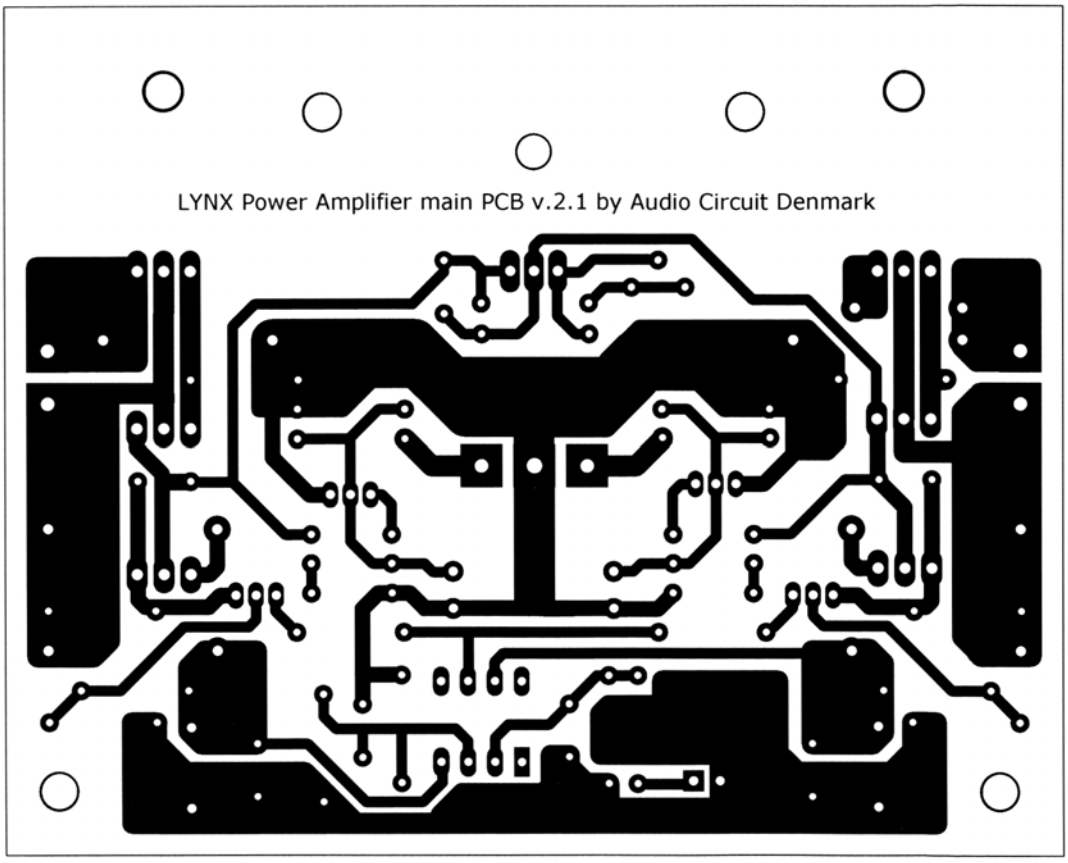
Misc. (Power Supply and external connectors not included)

One L-shaped Aluminium Profile 20 x 20 mm (0.79” x 0.79”), L: 100 mm (3.94”), thickness: 3 mm (0.1”) or more.
Two large heatsinks for output transistors (C/W 1 at 100 W for normal use)
Suitable isolation pads for Q105, Q106, Q107, Q110, Q111 and Q112 to Q119 and heat-conducting paste.
TO-220 heatsinks for Q106 and Q107, e.g. K25-004 from Austerlitz (C/W 15 at 4.0 W).
Terminal Blocks for easy wiring and suitable wires etc.
Various suitable screws, bolts, washers, nuts and insulation bushes for secure attachment of PCB and transistors.

4. PCB-Layout and Silk Screen

The LYNX main PCB v.2.1 Silk Screen and PCB-Layout
Original board size: 100 x 80 mm (app. 3.94" x 3.15") = one half of a Euro-Board.



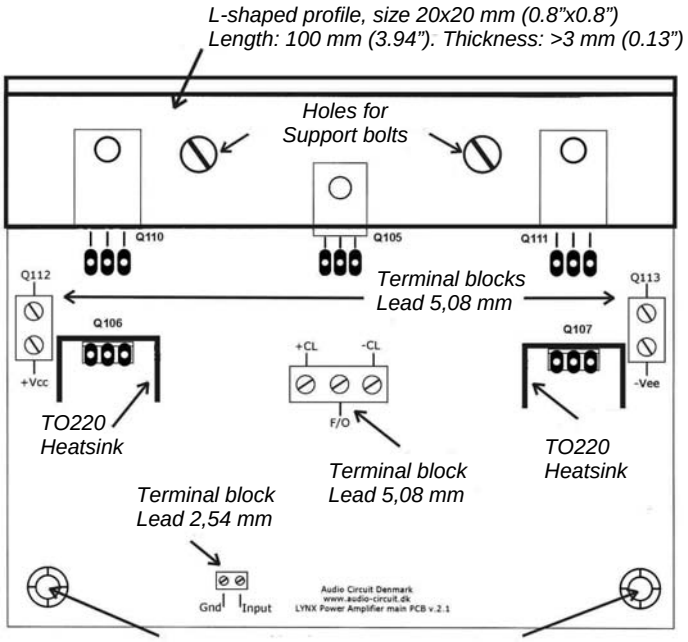


5. Hardware and Connecters

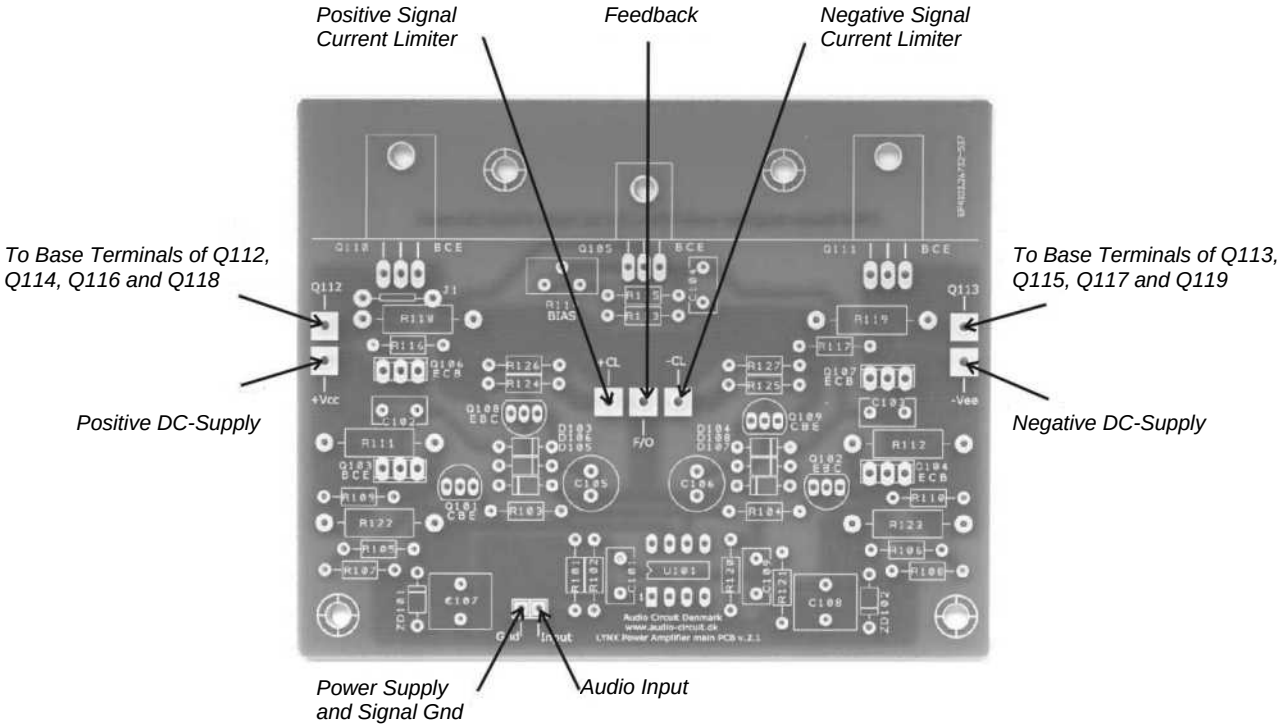
Main PCB v.2.1 fitted with L-Profile, TO-220 heatsinks and Terminal Blocks.

IMPORTANT NOTE!
Q105, Q106, Q107, Q110 and Q112 MUST be fitted with insulation pads and bushes to prevent any electric connection between the transistors and the L-Profile and heatsinks. Apply heat-conducting paste before attaching the transistors.

The PCB are to be thermal attached to main heatsink by the L-Shaped Profile using suitable bolts, washers and nut and heat-conducting paste!



Holes for support bracket if used in mobile equipment



6. PCB assembly and first test

Please read carefully before you start assembling the PCB!

- Check for correct board size and version (v2.1 and v2.2)
- Check carefully the PCB for broken or shorted tracks
- Check for missing, bad or misplaced drilled holes

L-Profile

Start by attaching the L-shaped pre-drilled Aluminium Profile to the PCB using the two fastening bolts.
Use suitable washers and nuts etc.

Carefully bend the pins and attach the three transistors Q105, Q110 and Q111 to the PCB and L-profile with suitable bolts, washers and nuts.
Use suitable isolation pads and bushes, and heat-conducting paste!

Components

Components should easily be soldered in if you use following order:

1. 0.25W resistors (all) according to the part list
   Always measure the resistance of each resistor before attaching it to the PCB!
2. Jumper J1 and the Bias potentiometer R114
3. Zeners ZD101 and ZD102 and all diodes D103 to D108
   Raise Zeners app. 5 mm from the PCB, as they can get warm
4. Opamp U101. Be careful to inset the opamp correctly.
   Note that pin 1 is marked on the silk screen and by a square pad on the PCB
5. Small transistors Q101, Q102, Q108 and Q109
6. Capacitors (all)
7. 1W and 2W resistors (all)
   Raise resistors app. 5-10 mm from the PCB as they can get warm
8. Large transistors Q103 and Q104, and Q106 and Q107 with fitted heatsinks
   Make sure that the heatsinks on Q106 and Q107 are not touching other components!
9. The terminal blocks (if used)

Check and double-check all solderings!!

Preparing the first test

Do the first test with no output stage connected!
In fact, if you replace each of the two driver emitter resistors R118 and R119 with 0.33 Ohms resistors, you have a complete small 40 W Power Amplifier.

Connect a regulated +/-40 to 70 Volt DC-Supply to the +Vcc and –Vee terminals of the PCB. Positive Supply to the +Vcc terminal and Negative Supply to the –Vee supply, using a 0.5 to 1A fuse in each supply line. Connect the Power Supply GND to both the GND and the Input terminal on the PCB, and your oscilloscope to the F/O terminal on the PCB.

First test

Switch on the Power Supply and observe the oscilloscope for any signs of oscillation on the F/O terminal. Also check that no component gets hotter, than you are still able to touch it. Verify that the Zener-stabilized supply to U101 are +/-15VDC.according to GND.

Measure the Bias Voltage across R118 and R119, and adjust the Bias trimmer R114 for app. 300 mV across each resistor.

Check that the DC-Voltage on the F/O terminal is below +/30mV. If DC-Voltage on the F/O terminal exceeds +/-30 mV, you may have to check all resistors values and check for faulty transistors etc. Please note that values above +/-30 mV can be normal, if you are using an Opamp (U101) with an internal DC-offset >1 mV, as this DC-offset is amplified 25 times!

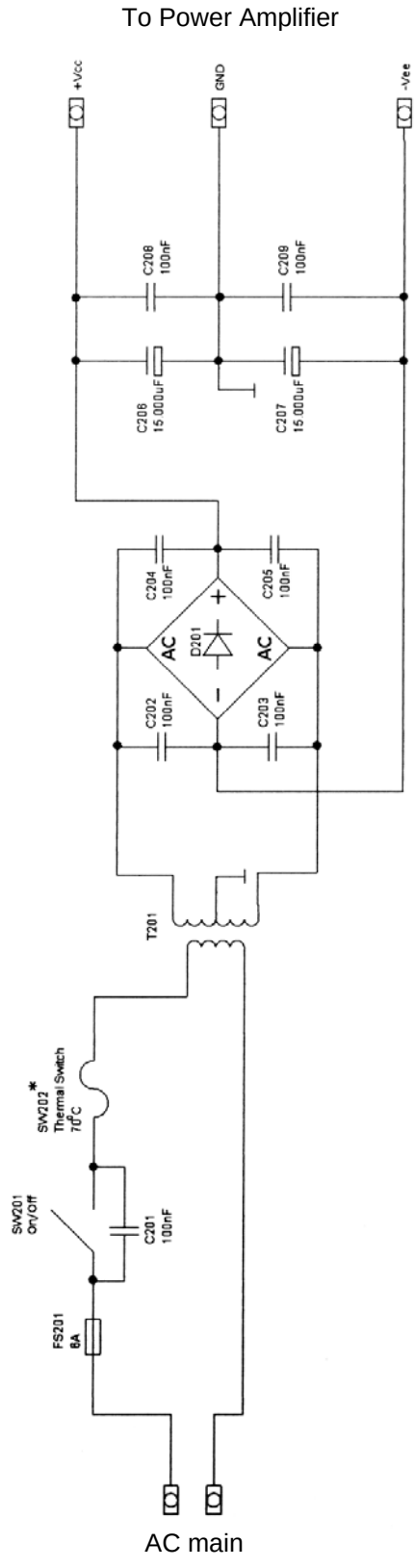
Apply a low level signal (e.g. 100 mV/1kHz sine wave) to the Input terminal and observe the F/O terminal. As the amplifier has a gain of app. 25, you should now see a clear 2.5V sine wave. If you observe any crossover distortion, then adjust the Bias trimmer R114 until distortion disappears.

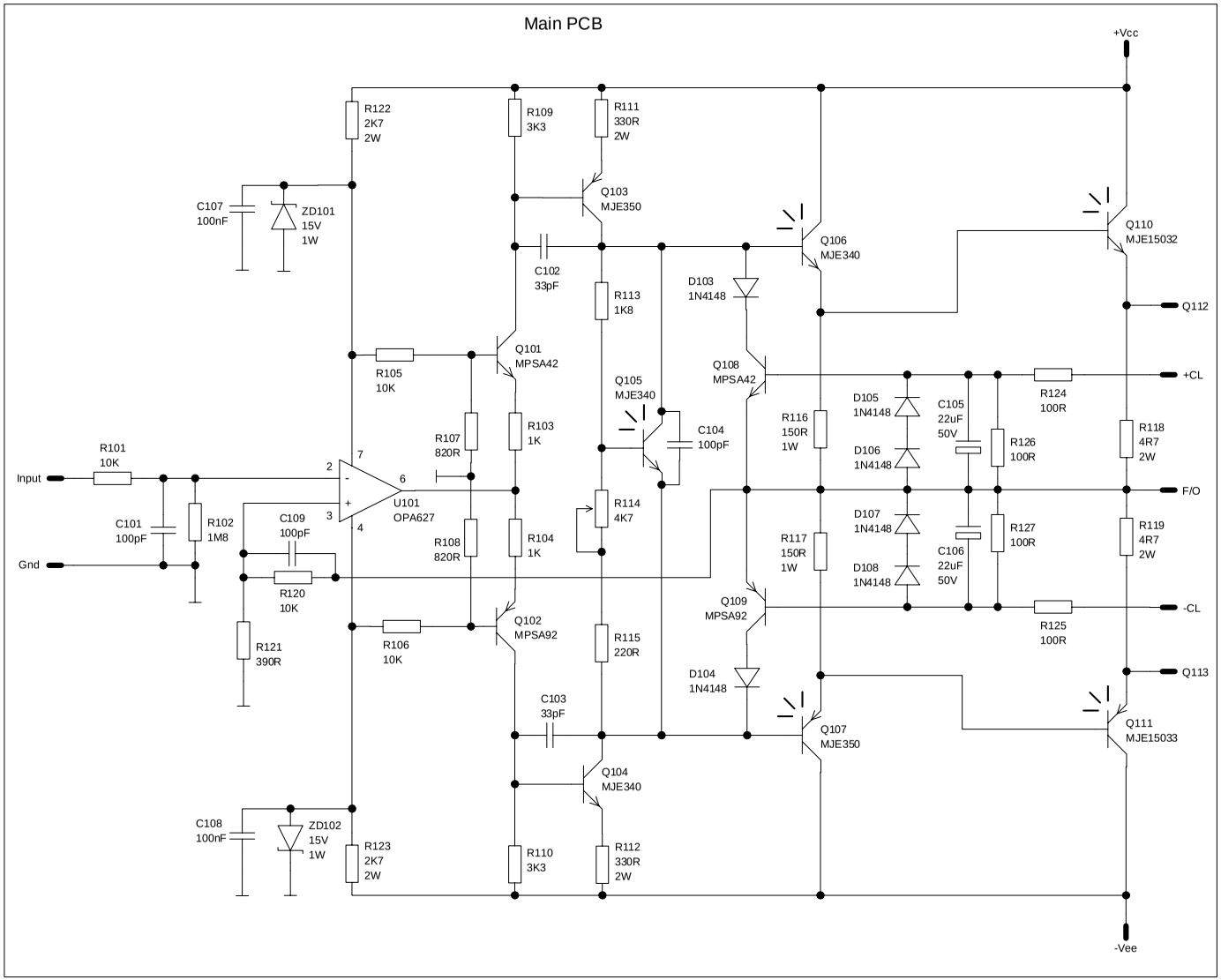
Slowly raise the Input Signal level until the amplifier clips, while checking for abnormal signal handling or oscillation on the F/O terminal.

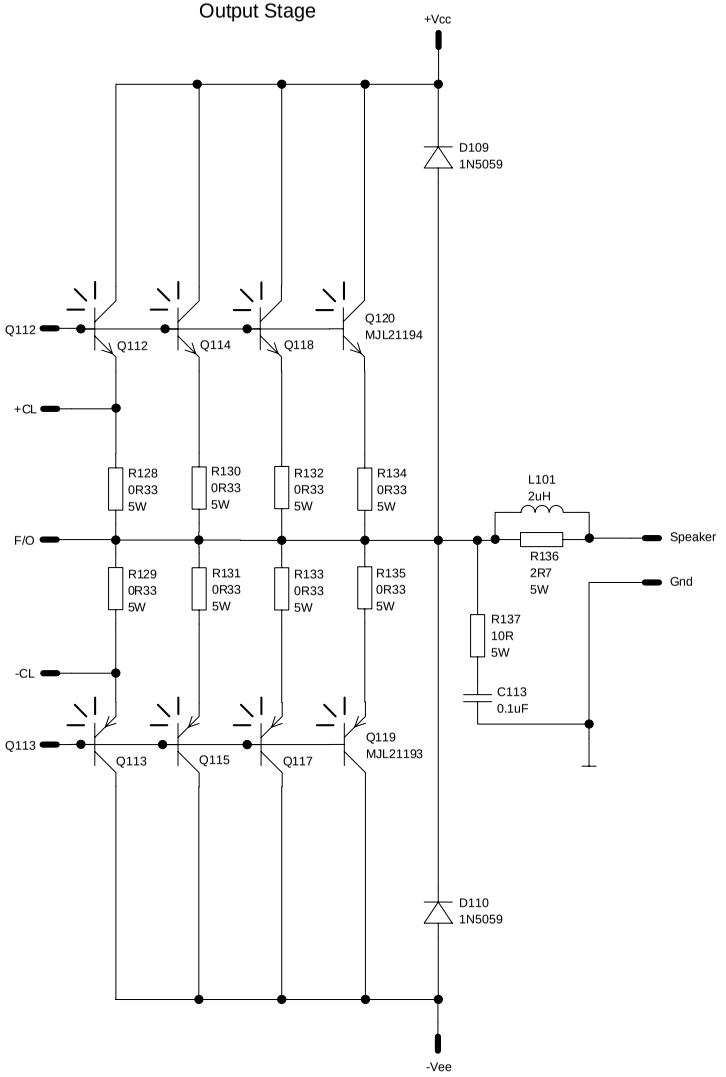
7. Power Supply

Recommended Specification

Rail Voltages:	+/-40 to 70 Volt DC with common ground
Transformer rating:	500 to 800 Watts per channel
Capacitor Bank:	2x15.000uF (minimum) with 2x100nF parallel







Schematic notes

Unless otherwise designated:
All resistors in Ohms, 1%, 0.25 Watt
Capacitors in uF, 100 Volt
Q106 and Q107 fitted with TO-220 heatsinks
Q105 and Q110 to Q119 placed on main heatsink
R139, R140, L101 and C131 are placed on Speaker Binding Posts

Date 18.06.2003	Date 08.09.2003	Date 11.11.2003	Ini JD	Project LYNX Power Amplifier	Client Public	Copyright Audio-Circuit Denmark www.audio-circuit.dk
Rev 2.1	Rev 3.0	Rev 3.1	Dept. R&D	Title LYNX Amplifier v2.2E	File name LYNX_v2-2_Overview	Drawing No / Sheet 1 of 1
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