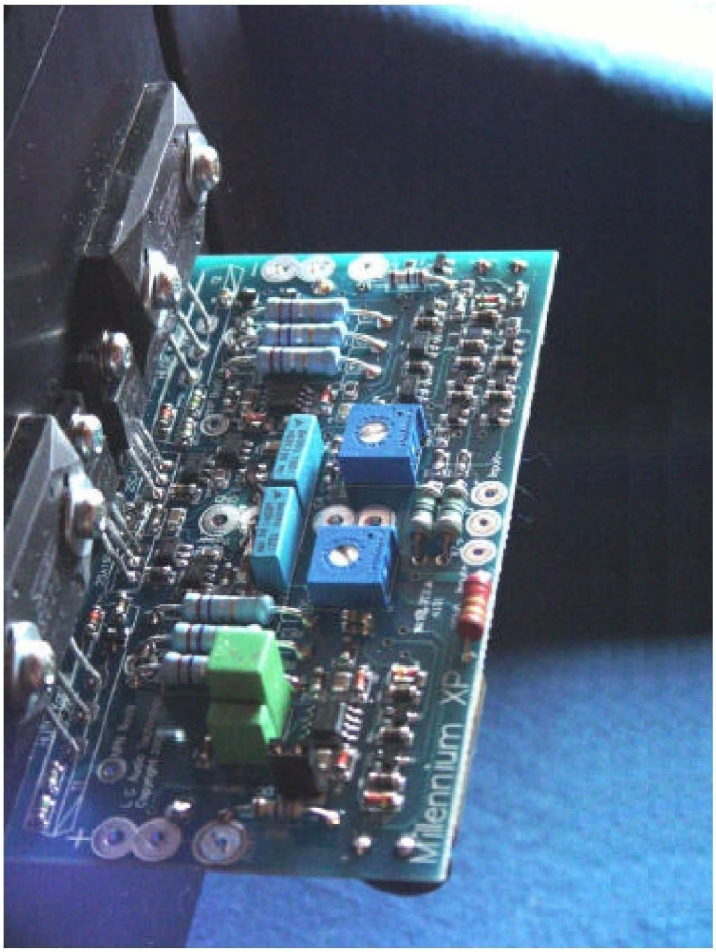
Millenium XP & The End mk. 3.1
discontinued by L C Audio Technology

The End mk.3.1 &

Millennium XP

Audio Amplifier



Construction book

for "The End Millenium". The construction book can be used for "The End mk. 3.1"

Millenium XP / "The End mk. 3.1" can be built up with power from 99 to 250 watts into 8 ohms. If this is not enough, a balanced version is realized with powers up to 1000 Watts.
Millenium XP / "The End mk. 3.1" drive in Class A / B, and is constructed entirely without the usual feedback loop (100% non-feedback).
Because of the simple circuits, and the use of ultra linear semiconductors and glass-substrate resistors, the output from this power stage are in class with the best amplifiers on the market, regardless of price.
Treble and midrange reproduced with unprecedented detail and homogeneity, while the bass is fast and has unusually good control and raw power.

L C Audio Technology ©

Contents:

Millenium XP & The End mk. 3.1
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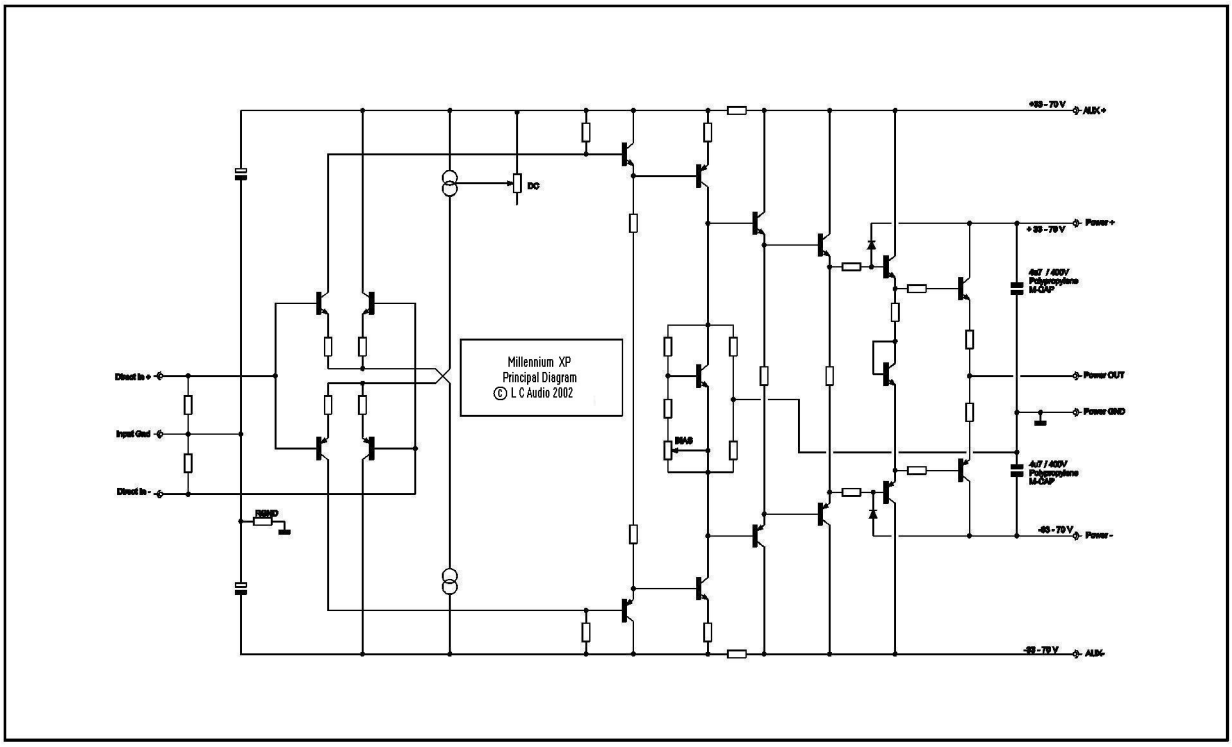
Principle behind **Millennium XP.**



The principle schematic shows how simple the basic circuit of Millennium really are. There are no usual feedback loop, (100% non-feedback), there are no capacitors or other audio detrimental components in the signal path. The frequency range are from DC to 500,000 Hz linearly, so everything from the deepest bass to the all fastest transients are reproduced with ease of this amplifier.

Add to that an effective short circuit protection that does not interfere with the signal path, but only monitors if the amplifier is approaching overload. If this happens, closes the amplifier down the volume for 3 seconds, then the amplifier again try to activate the output stage. Is there still overload, closes the amplifier just down again, and so the amplifier can actually bear to stand for days without damage.

Thanks to the new design, which in many ways is a breakthrough in modern audio technology, we have managed to produce an amplifier that sets new limits on free-flowing musical, but at the same time correct and precise reproduction. Listening to The End Millennium is a feeling of purity and freshness. One senses all music material contains of pulse and nerve, but also details and space around the musicians.

The speakers are due to the non-feedback technique allowed to draw all the power it takes, not only to start the membranes, but also to stop them at the right time. At the same time, the price kept down to a level where everyone can participate, mainly because you build your own amplifier together as a kit.

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100% NON - FEEDBACK = 100% Musicality

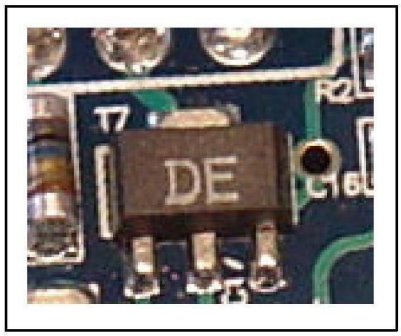
The warm-almost tube-like - sound is primarily due to the amplifier which do not contains the usual feedback loop. This principle is called non-feedback, and are used in a number of very expensive, in particular American amplifiers.

In an ordinary amplifier with negative feedback you use the a circuit with high gain (typically 100,000 times) and a high distortion. Then you reduce the measurable distortion, by comparing what comes out of your amp with what you send in and correct accordingly. However, one can not correct the error before it has occurred, and then it is actually too late.

Another problem is the modulation that occurs when editing a ramp signal up through a nonlinear amplifier stage. Modulation means sonically that details disappear from signal, and musical parameters such as perspective, depth, etc. disappear from the signal. You can hear the modulation. If you have a power amplifier with multiple parallel output transistors, then you have probably discovered that the sound character changes completely depending on whether you turn up or down.

In Millennium is used a different technique, which does not have these disadvantages. Non feedback! Here is no comparison of input and output, and therefore one must in construction ensure, to completely avoid if non-linearities and distortion occurs. You can not remove it later. This requires a more advanced design than conventional amplifiers, and moreover, you can only use ultra-linear and low noise components, if you want to achieve perfect sound quality.

The result is all worth it! Pure uncomplicated and musical reproduction with lots of dynamics and life. Despite the high requirements for linearity and freedom from distortion, the Millennium a very simple design with short signal path. The signal passes through a minimum of components, all of which are of the highest possible quality: SANKEN ring-emitter output transistors, ultra-fast drivers from Sanyo (Japan), linear and fast Z-transistors and small signal transistors also from ROHM and Motorola. In addition super stable resistors (some based on a special glass substrate) from Beyschlag and ECEL polypropylene capacitors. These are components of such high quality that you will not find elsewhere in ready madeamplifiers, and certainly not in Millennium's price level ..



Z transistor is a bipolar transistor structure in the same way as a MOSFET.
The result is a very linear, fast and ultra-low noise transistor with excellent sound characteristics.

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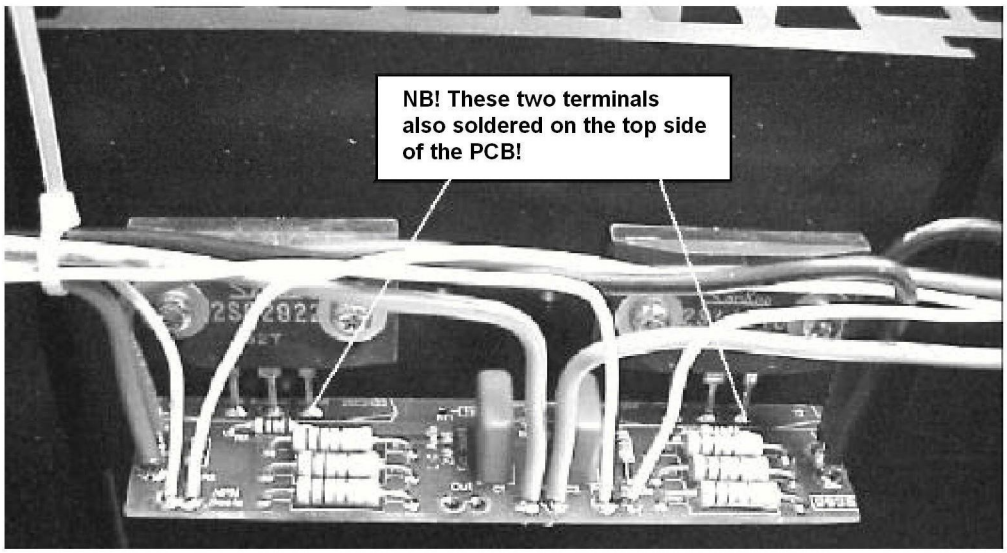
High Power.

Millennium is designed to run with a transformer of 2 X 33 V, and deliver 120 watts into 8 Ohms. By replacing a few components, and put some extra output transistors on can be easily raise output to either 180 or 250 watts into 8 ohms. This is done by connection of ext. boards, with extra output stage, to the main board .. The ext. PCB contains besides the output transistors of a few decoupling capacitors, which stops anv self oscillation. and non-inductive emitter resistors. as those on the main board. By using ext. PCBs the Millennium also get to pull very low impedances - down to 1 ohm, with powers up to 800 watts.

We recommend because of the non-feedback technique - not to put more outputs in parallel, at least if the amplifier are to reproduce treble and midrange.

This is due to a number of parallel transistors, because of their (minimal) differences in silicon chip allows small amounts of modulation distortion in high orders of the root. For example. If it represents a 100 Hz tone, there will occur side- tones of 900, 1100 and 1300 Hz regions. So very audible and annoying distortion.

At high powers (180 Watt and above) we strongly recommend that you use The End main circuit board for tweeter / midrange, and one or more extention boards (extra output transistors mounted on a PCB with accessory components) to a separate bass output. That way you get both the purity of midrange / treble and plenty of punch in bass.
Up to 250 watts per channel into 8 ohms can be realized directly with one The End print and two ext. modules. It requires that the speaker has the possibility to be bi-wired.



Ext, board with an extra set of outputs. You can connect up to 3 ext. boards per main circuit board. The output from ext. board's wired through a separate speaker terminals for the bass.
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New generation of Denmark's most bought Audio construction.

Have you been audio diy constructor for some years, you've probably already familiar with one or more of our amplifiers. The forerunner of the Millennium XP, namely The End Millennium and The End 3.1 together are built In more than 6000 copies, making it one of the DIY audio greatest successes ever.

In XP version is carried out optimization of the following Circuits:

NEWS The driver transistors are switched to a more linear type with improved sound characteristics.

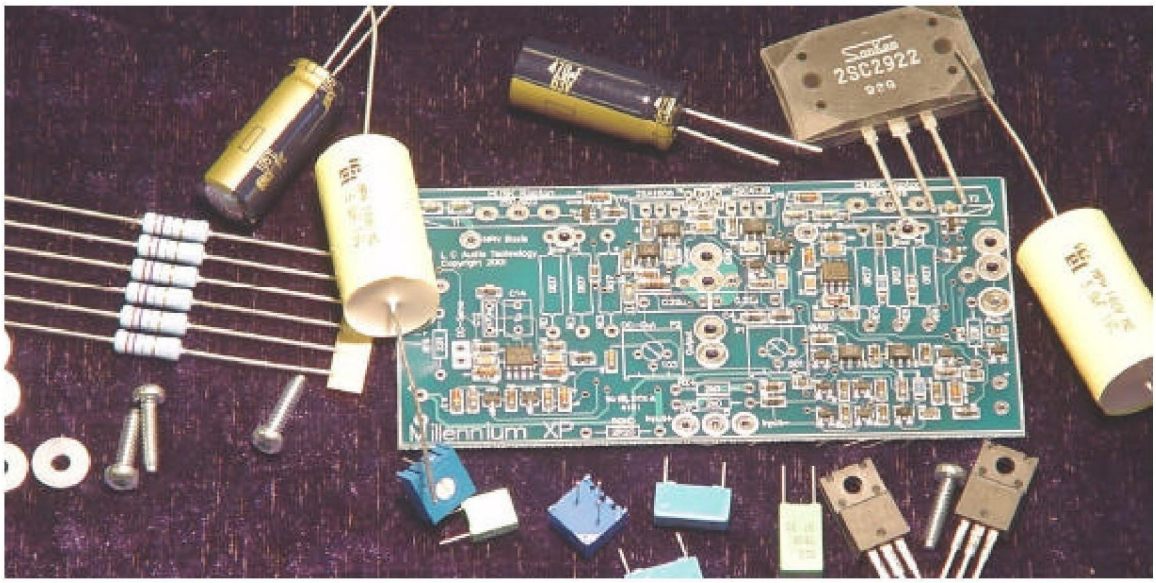
NEWS Small Signal transistors is changed to a new type with high hfe

NEWS The special Z-transistors, which stands for the gain, here is also introduced a new type that has less than 3 pF capacity Ccbo.

NEWS Included polypropylene replaced by a better double foil.

NEWS All PCB's audio connections are made in soft-curve technique that improves the resolution in the midrange / tweeter.

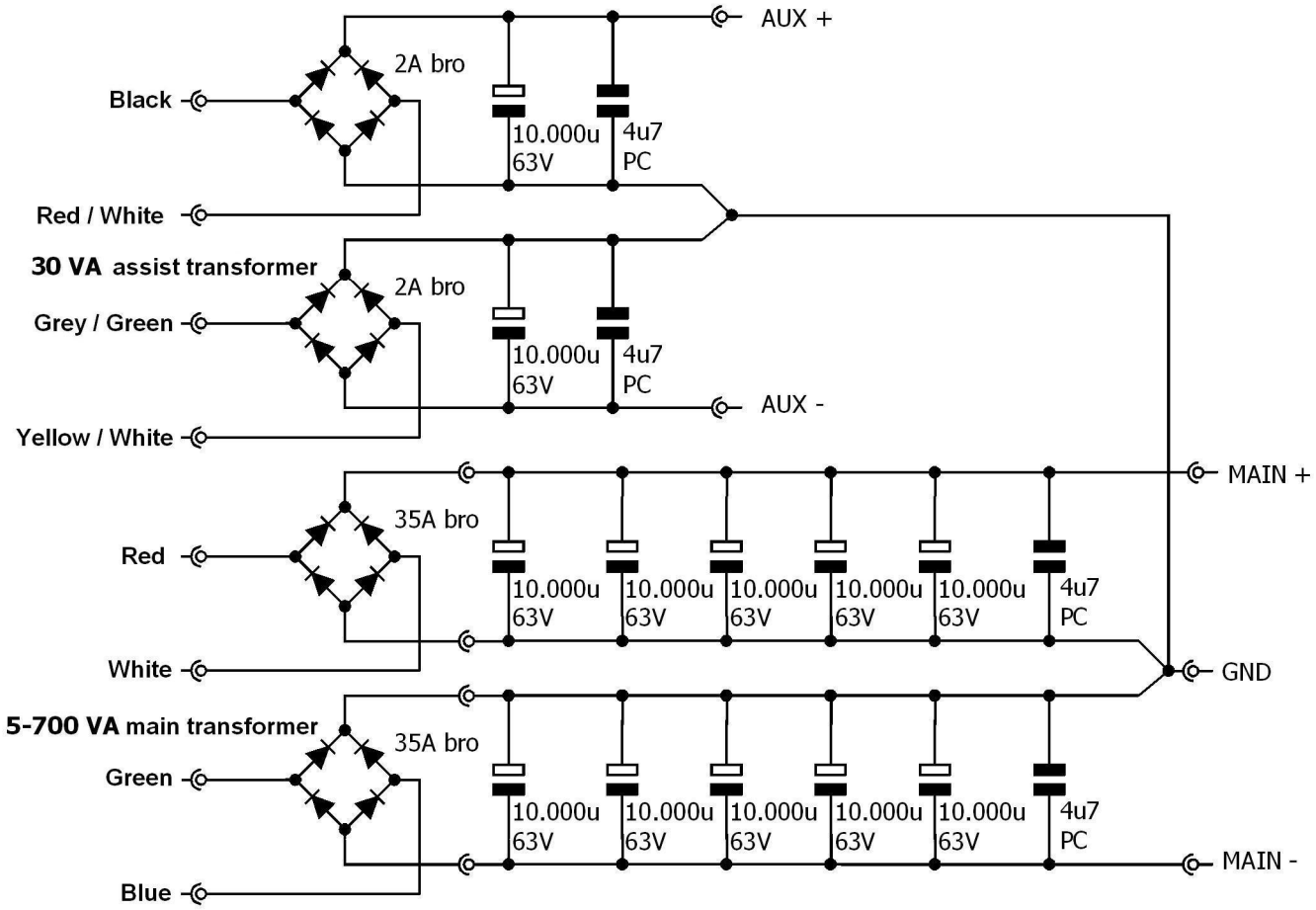
In addition, on the main board, which is approx. 15% less than The End version 3.1, built-in optional DC servo (one point 2nd order) and short circuit protection.
A new bias system where all steps are designed for a supply voltage of + / - 80V ensures continuous operation with + / - 63V (200 W output power into 8 ohms) is 100% safe. In bridged configurations can impact on more than 800 Watts into 8 Ohms / 1600 Watts into 4 Ohms realized without additional circuitry than Millenium XP, and the necessary ext. boards.



Power supply.

The power supply is essential for the sound quality!
When it comes to designing the perfect power source for Millennium, is the most immediately appealing solution, using a battery of huge RIFA or Sprague electrolytes with coils between, so you could avoid direct parallel connection. Unfortunately, such a power supply cost a fortune and take up so much space that the amplifier looks more like a deep freeze than a hifi equipment.

In order to achieve a good result sonically, with a more realistic power supply we have added a proud work to develop a power pack consisting of several small electrolytes. We have for The Millennium chosen some domestically-produced low-impedance electrolytes from Chemi-Con (ex Sprague). There is a separate power supply for the operating steps, which makes it possible to avoid large current draw of the main supply, not to disturb the sensitive amplifier stages. In fact, only the output transistorstage are connected to the main supply. Capacity is a total of 100,000 uF / 63V on the mains, and 20,000 uF for AUX supply and driver stages. (Total 120,000 uF)



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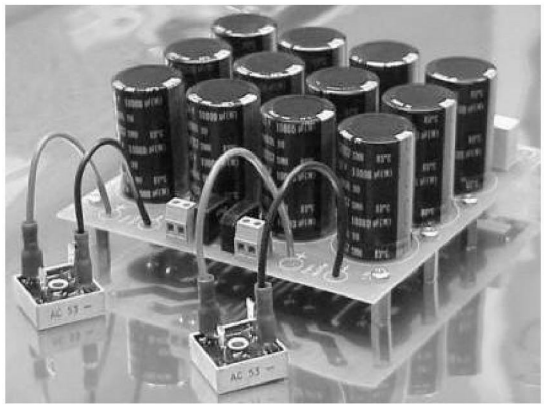
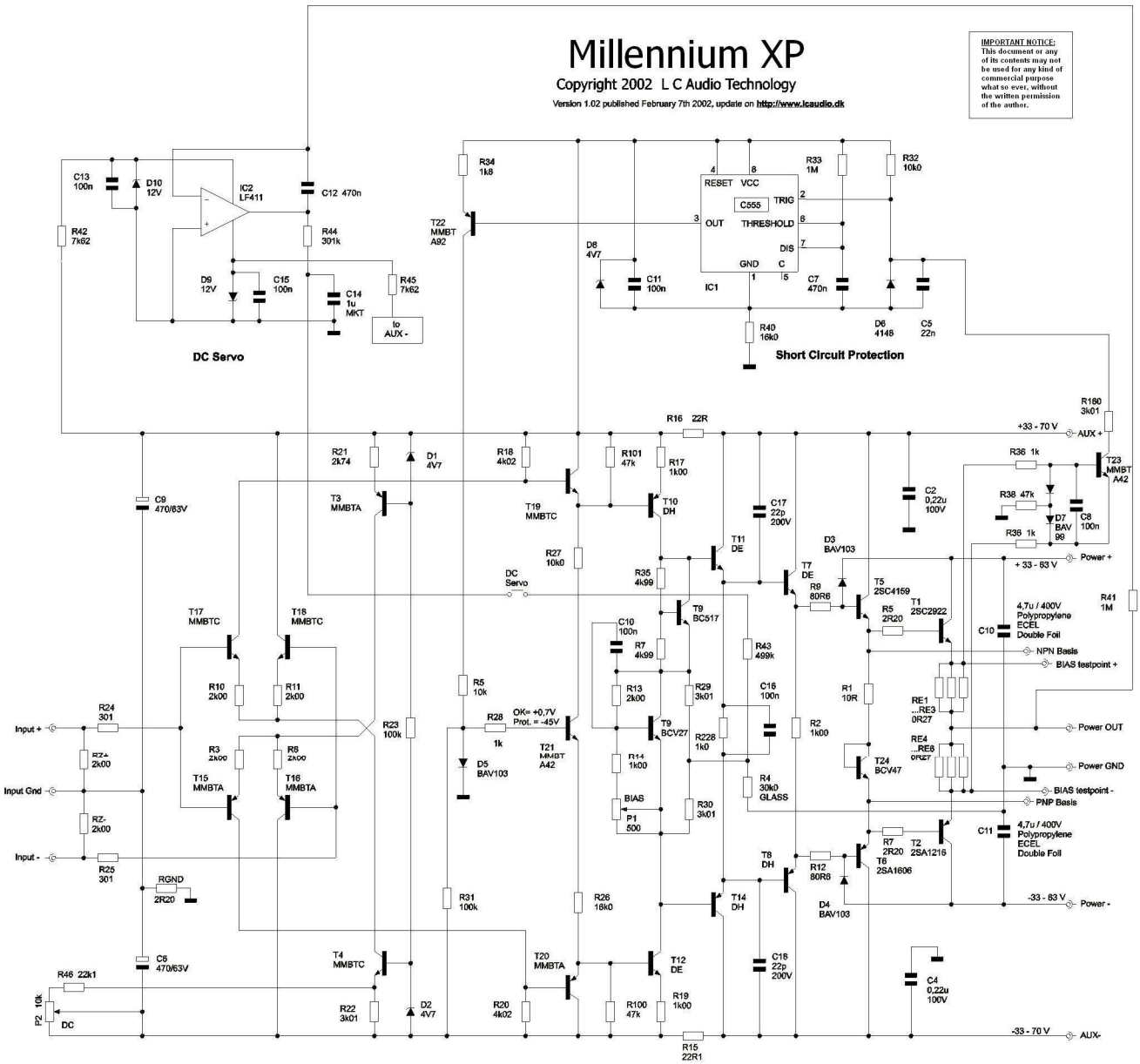
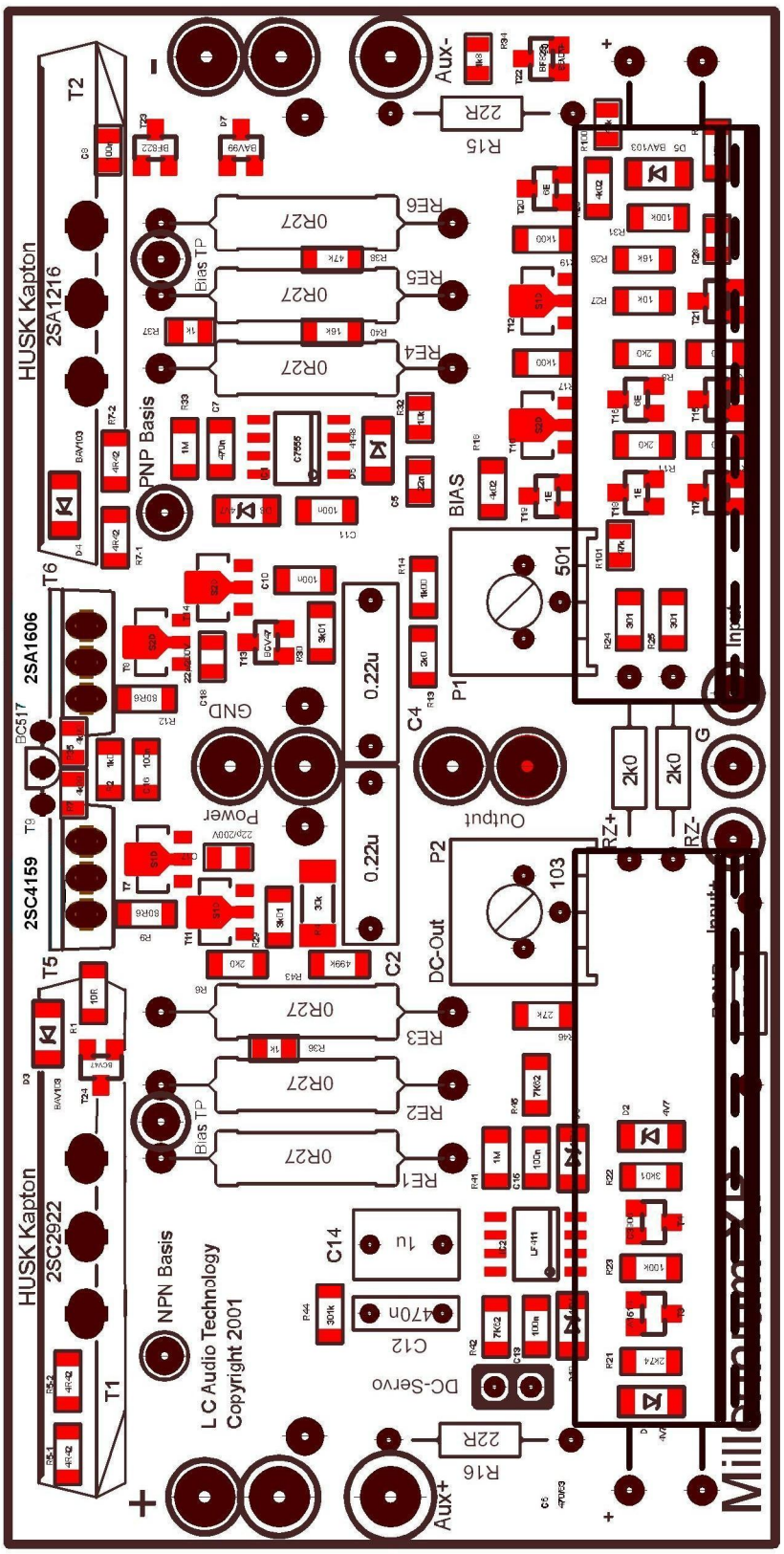
The power supply unit consists of 120,000 U.S. microfarad, giving Millennium far more muscle strength and power surplus than other amplifiers in this price range.



Complete Schematic.





PCB Drawing

Ps! Not 1:1

Size: 107 X 54 mm.

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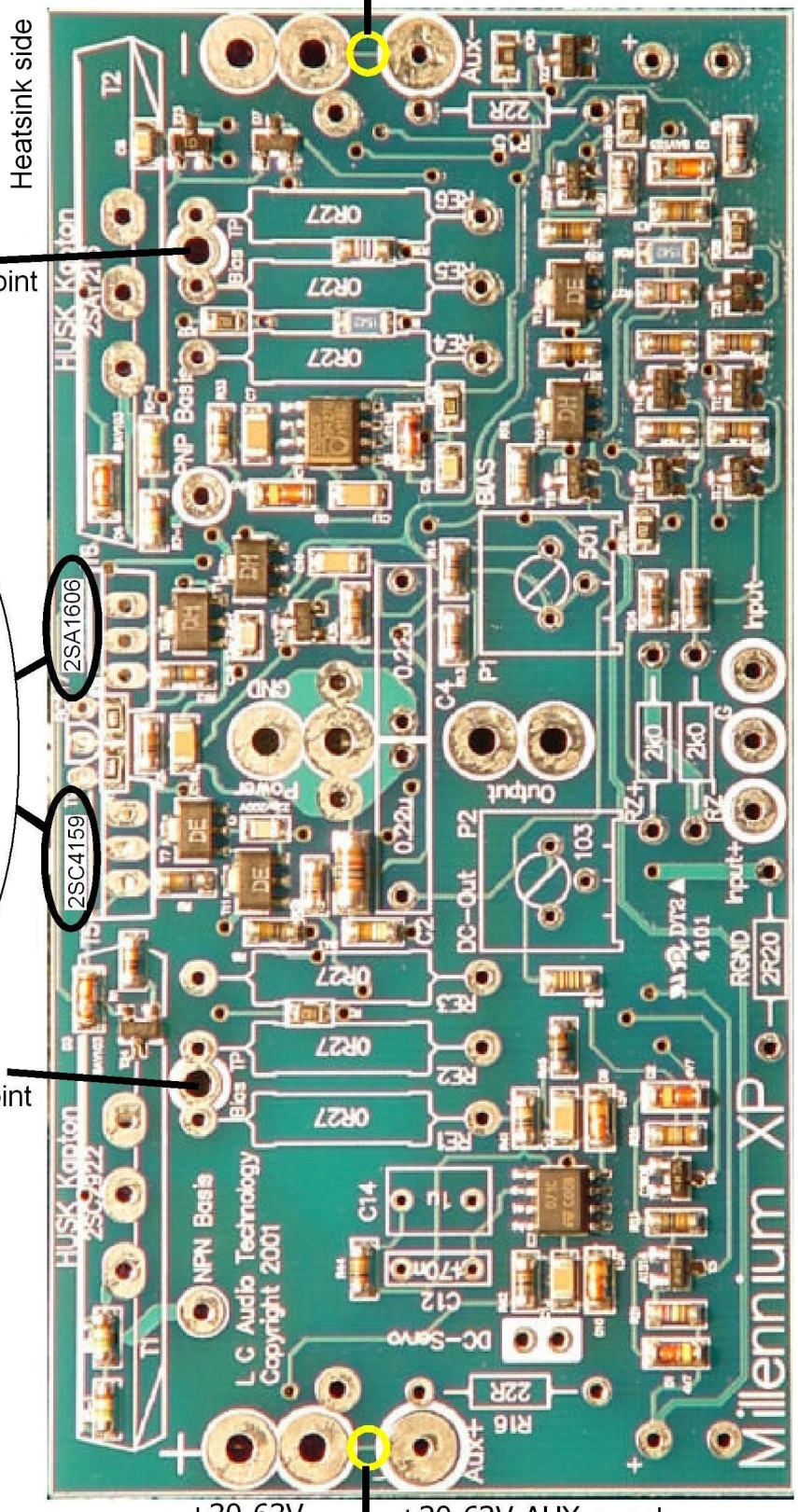
This print path must be broken if using AUX supply

-30-63V

-30-63V AUX supply.



This print path must be broken if using AUX supply

photo of main board

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Parts list.

Transistors				
T1	2SC2922			
T2	2SA1216			
T5	2SC4159			
T6	2SA1606			
T9	BC517			
Capacitors				
C1	4u7 Polypropylen ECEL Double Foil			
C2	0,22u MKT 100V			
C3	4u7 Polypropylen ECEL Double Foil			
C4	0,22u MKT 100V			
C6	470u / 63V FC GoldCap			
C9	470u / 63V FC GoldCap			
C12	470n MKT			
C14	1uF MKT			
CZ	100n Polypropylen	(for Zobel network)		
Resistors		color codes:		
R15	16R Beyschlag	Brown	Blue Black	Gold
R16	16R Beyschlag	Brown	Blue Black	Gold
RGND	2R2 BC PRO1	Red Black	Gold	Gold
RZ+	2k20 Rohm	Red Red	Black	Brown Brown
RZ-	2k20 Rohm	Red Red	Black	Brown Brown
RE1-6	0R27 Beyschlag 1W	Red Violet	Silver	Gold
P1	500 Ohm Trimmer	mrk. '501'		
P2	10k Trimmer	mrk. '103'		
RZ	2R15 1W f. Zobel network	Red	Brown Green	Silver Brown
miscellaneous				
Mainboard				
2 kapton isolation				
6 screws 3X13 mm				
4 big washers				
2 Small washers				
Jumper for DC servo				
Silver solder				

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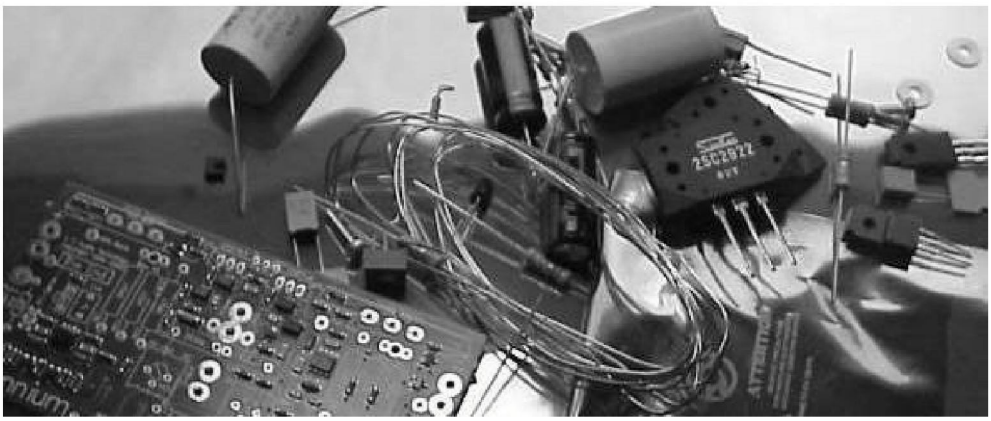
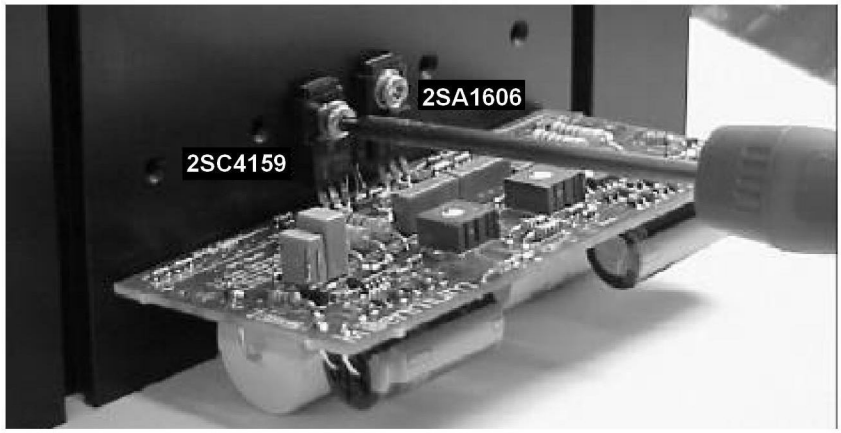
Construction guidelines.

It's fast and easy to assemble a Millennium!
Start by pouring all the components out on the table.



Attach the low components first, ie. resistors and jumper for DC servo. See color codes on the resistors in the parts list on the previous page. There may be some components that have changed compared to silkscreening, here is the parts list that apply.
Then continue with the higher capacitors, and T9. The flat side should face toward the edge of the PCB. Mount also trimmers Now, be careful not to swap them!
Then fasten the two 470 uF / 63V electrolytes on the back of the PCB (can also sit on the top, but it takes something of the overview of the wiring.) Remember to turn them properly, ie. with MINUS line to the edge of the PCB. (Applies to both electrolytes). Add them to PCB BEFORE you solder them on!
Now you can install two 4.7 uF axial polypropylene capacitors. (large ones!) They must also sit on the underside of the PCB, from plus to ground and from gnd to minus. There are large distinct islands for the purpose.
So the turn comes to the drivers 2SC4159 and 2SA1606 (be careful not to swap them!) IMPORTANT! There are mistakenly swapped texts in print.
BUT IT IS DIRECTED AT THE DRAWINGS
The drivers turned with the text inward toward the center of the PCB, and they are pressed fully into PCB prior to soldering. Check that they are not leaning to either side. After soldering screwed onto the heat sink with the short screws and small washers. You do not need thermal paste, mica washers, etc.



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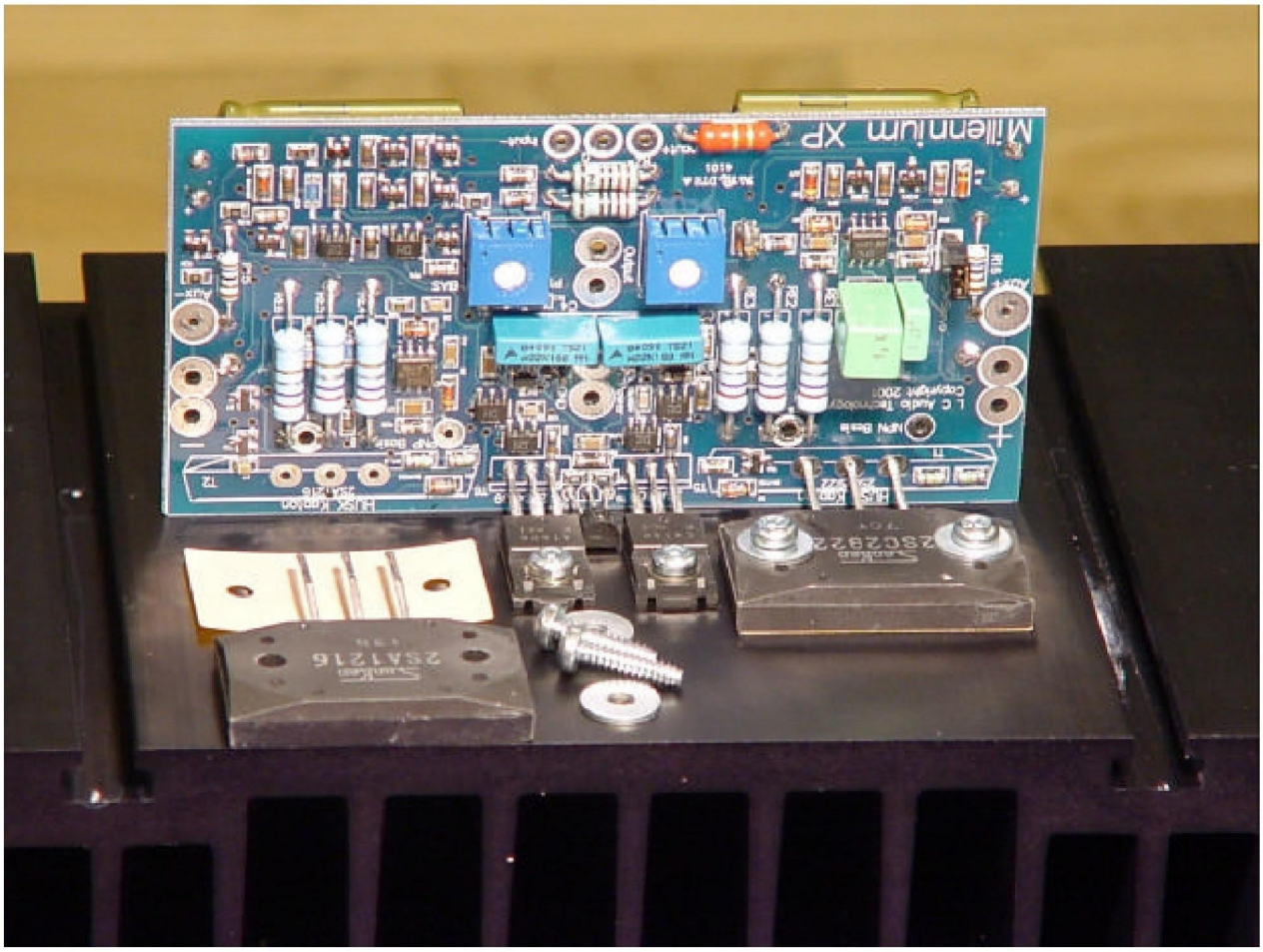
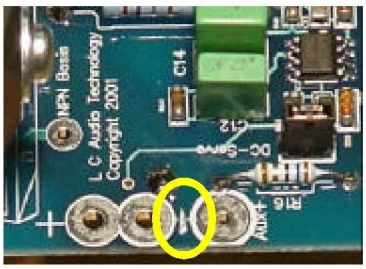


Place the heatsink down and position the Kapton washers (orange) where the outputs must be screwed on. You do not need thermal paste!
Attach the two output transistors (be careful not to mix them!) Metal side towards the heat sink. IMPORTANT! there must NOT be dirt, dust, metal chips, kapton cuttings, etc. between the output transistors and the heatsink.
Now tighten the output transistors firmly with the long screws and big washers. They must be tightened very securely, but without breaking the screws. Soldering the outputs solid.

Connect the input and output terminals as shown on the following pages.
If you use a power supply with separate driver stages (recommended), ie. our featured Super Power unit, you scratch the thin lanes between + and AUX + over with a pair of wire cutters. Equally at Minus.



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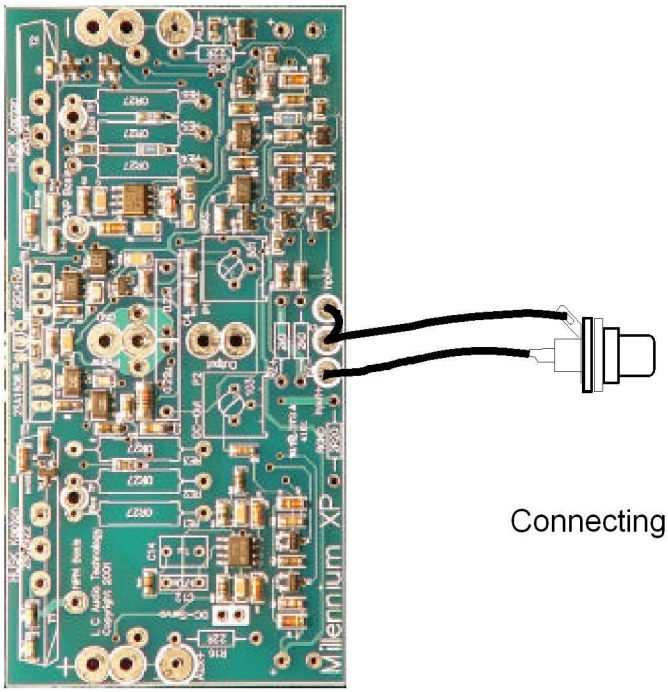
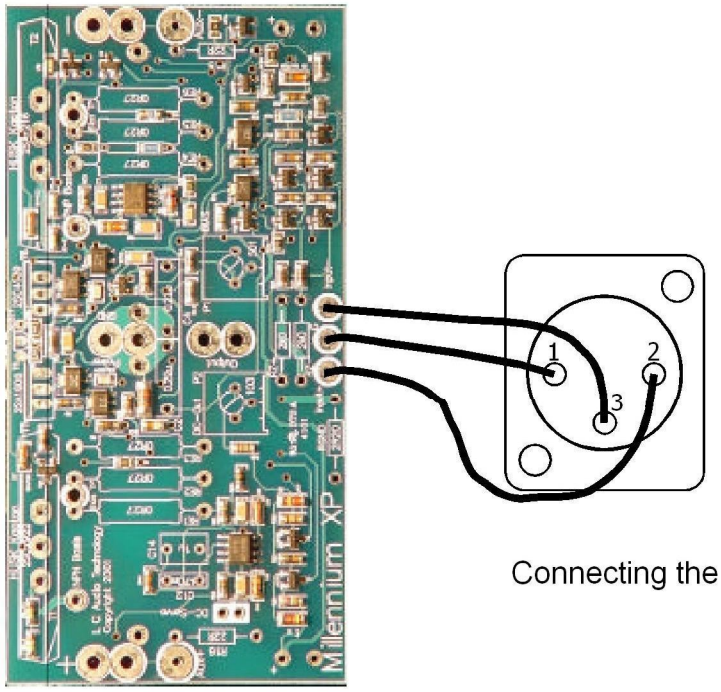
Connecting RCA inputs



Connecting RCA jack input



Connecting the XLR input

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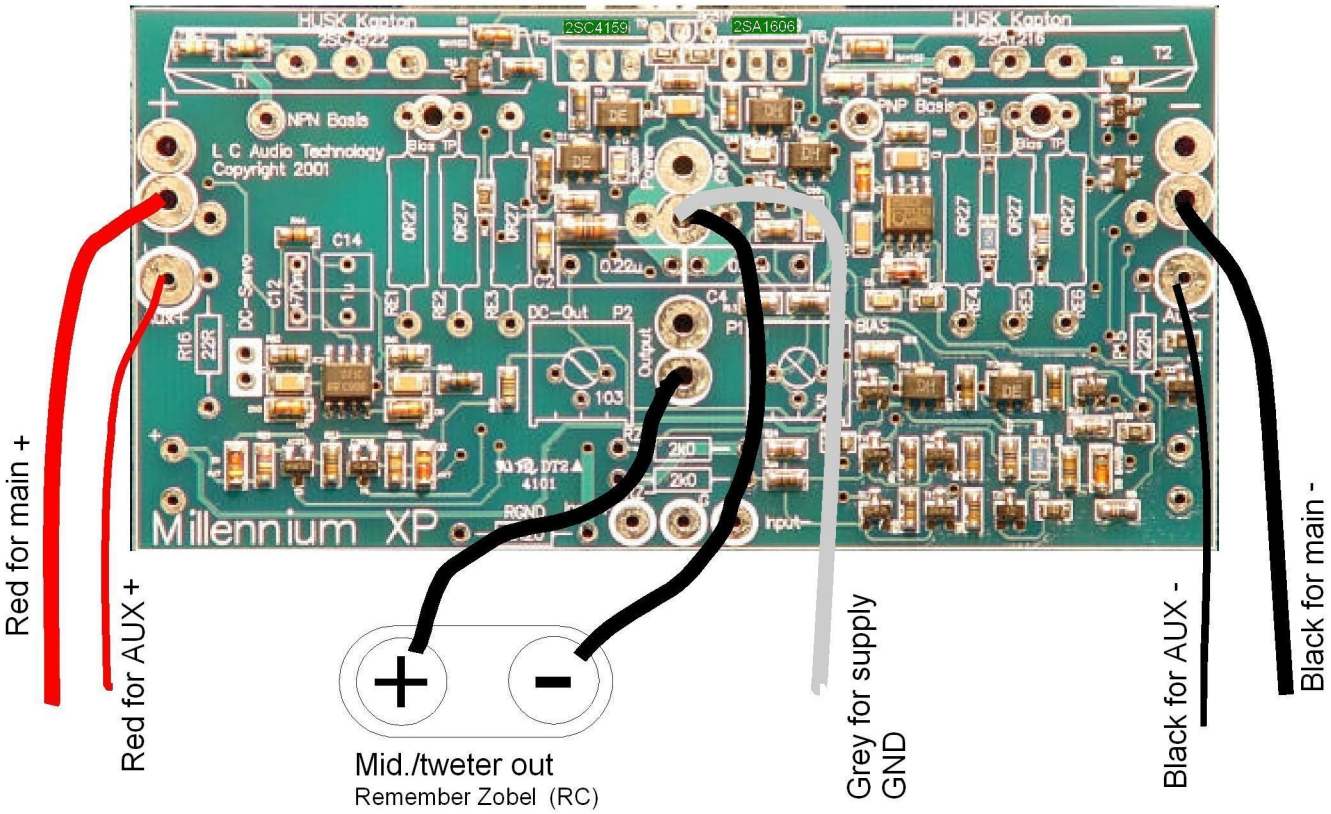
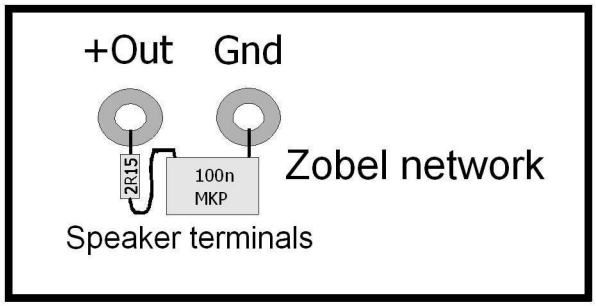
Connections to the power supply and output terminals.





it is recommended to use a zobel network as shown on all output terminals. The components included in the kit.

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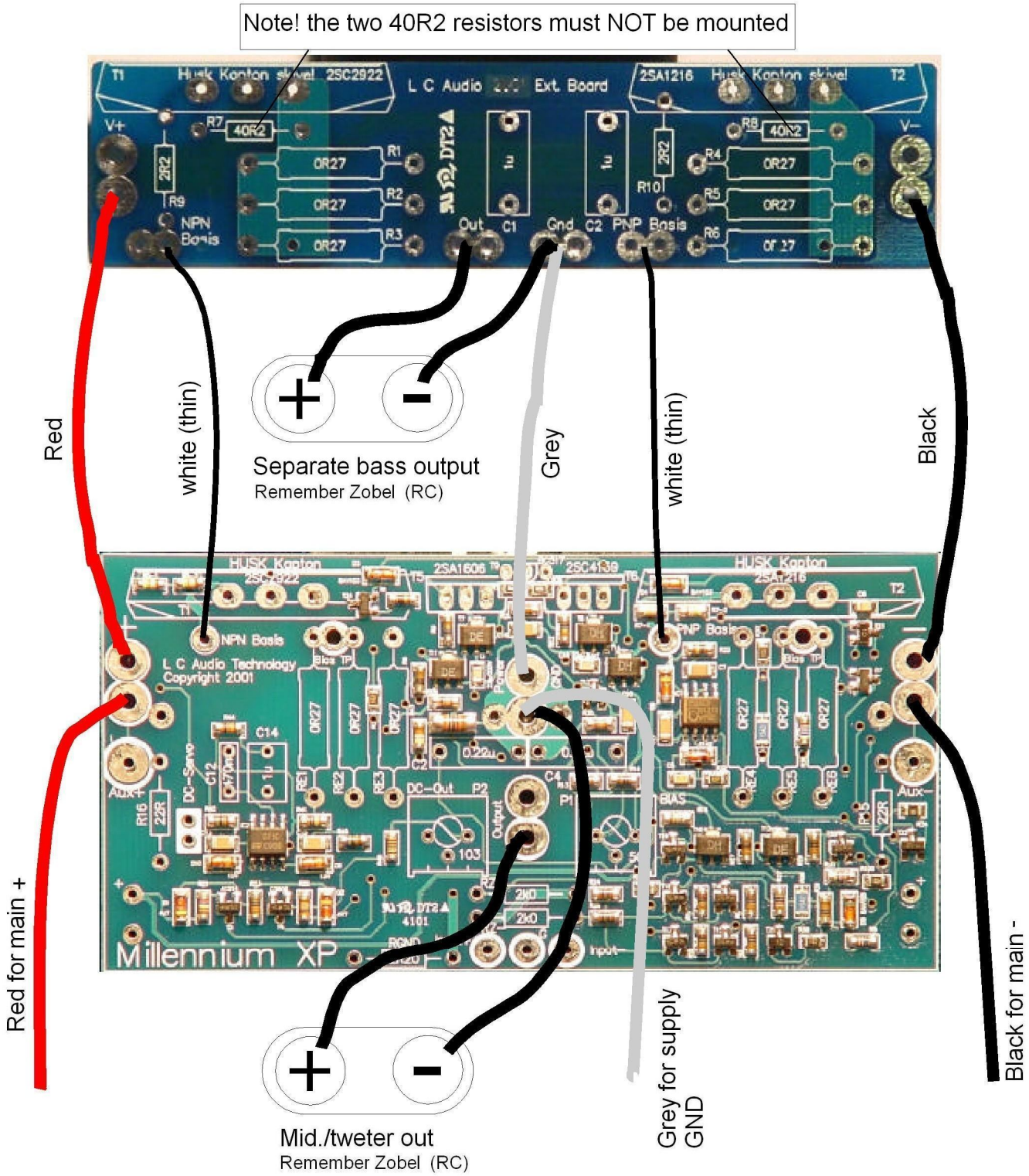
Connections between the main board and extension boards



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Adjustment.

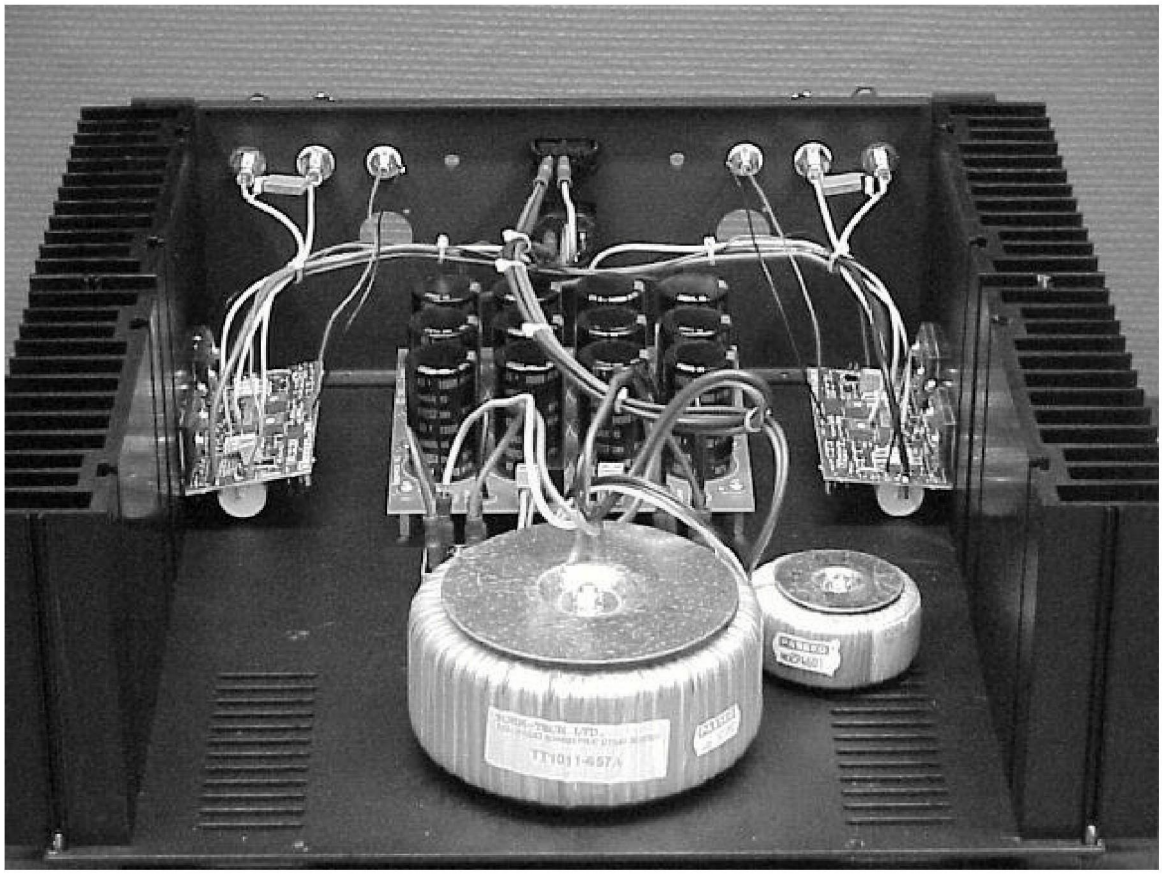
Measure with a multimeter between the two BIAS metrics, see page 10 if you can not find them.

Connect the power. Adjust BIAS trimmer to the meter shows 20 mV.

Move measuring stick end to the output terminals. (DC servos may not be activated).
Adjust DC Out trimmer to 0 mV. Fluctuations of + / - 50 mV is normal.
Check BIAS adjustment again after a few minutes.
Repeat this procedure for the second channel.

Speaker Cables.

Normal speaker cables can be used directly with Millennium, but do you use a high capacitive, low inductive cable, for example. Kimber TC8, Audio Quest Hyper Braided Wire or similar a fast amplifier as Millennium, (with gain up to several MHz) has a risk going in oscillation. To ensure against this problem, we recommend fitting Zobel network as described on page 15.



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Using DC servo.

Millennium has an integrated DC servo, which can be activated or deactivated according to your choice and conviction. If you are unsure whether you need to connect to DC servos or not, here are a few tips:

DC servos can in some sense affect bass reproduction, which would be more soft and rubbery when activated by a DC servo.
We have put a proud work in constructing DC servo so it does not affect the sound
at all. For example is the filter a 2.order servo , which the normal is only the first order.
Crack frequency is as low as 1/3 Hz, so the effect at 20 Hz is likely to be minimal.

Filter capacitors (C12 and C14) is of the plastic type with copper pins. Even if the sound had to pass through these capacitors, they would not affect significantly. But the sound do not have to pas! Only the filtered DC corrections passes through the filter capacitors. You need to use DC servo if you have electrostatic speakers, or other speakers with a transformer between the amplifier and speaker.
You do not need to use DC servo if you have normal dynamic speakers, they are namely usually indifferent to DC up to 200 mV.

Priser.

The End Millennium komplet byggesæt, 1 kanal
The End Millennium ext. komplet byggesæt
Ext. boards m. ekstra udgang (matched)
Køleplader til 1 kanal (4 st. til eet kabinet)
Supernetdel 120.000 uF / 63V inkl. broer
Supernet til 250W monoblok 60.000 uF / 80V inkl. broer
Trafo til 120W version 2 X 33V 500 VA
Trafo til 180W version 2 X 40V 700 VA
Trafo til 250W version 2 X 55V 700 VA
Hjælpetrafo til AUX forsyning 2 X 40V 30 VA
Kabinetkit, alle huller er udstanset, sort struktur lakering

Ekstra tilbehør:
Softstart, reducerer belastning ved opstart af store trafoer
DC filter til lysnet, forhindrer at trafoerne brummer mekanisk
Højttalerstik WBT 0780, sæt med 2 stk.
Phonobøsning 24k guld/ TEFLON sæt med 2 stk.

L.C. Audio site: http://www.lcaudio.com/

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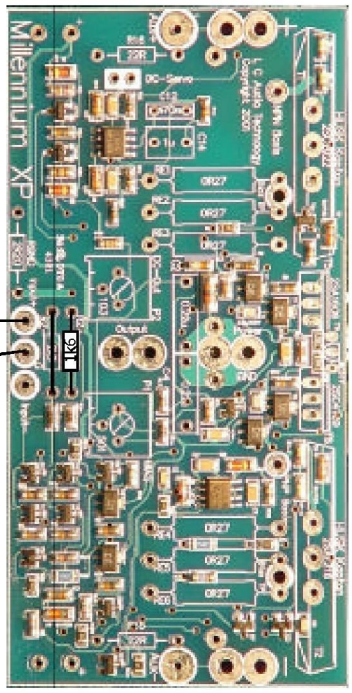
A complete Millennium amplifier costing from £ xxxxxx to around £ xxxxxx depending on power and connectivity. Contact LC Audio for guidance in choosing the right version from your speakers, listening and music types. You can also create an integrated Millennium, by adding a potentiometer and input selector. It is a compact and relatively cost effective solution to a complete amplifier, if you can do without remote control of the amplifier. But the sound is in top.

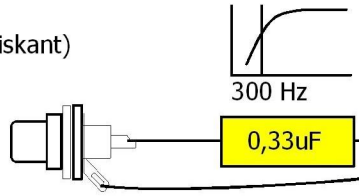
1.First Order active spectrum sharing with Millennium

With three relatively inexpensive components one can realize an active crossover to replace the speaker crossover. There are several advantages by sharing the signal before the amplifier. Firstly, improved audio quality, crossover components are less critical, and a much greater dynamic range. The same technique is used for this reason by any major live concert.



High pass (Mellemtone/diskant)

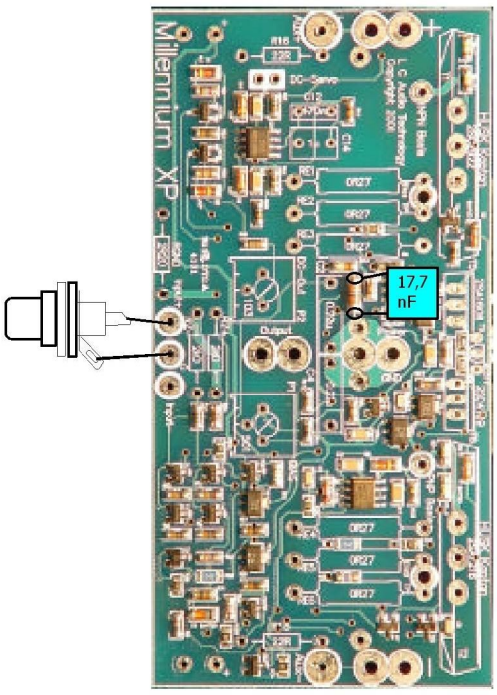
Rz+ = 1 / (2pi * f * C)



eks:
C = 0,33 uF
f = 300 Hz

Rz+ = 1 / (2*3,14 * 300 * 0,33 * 10-E6)

Rz+ = 1600 Ohm = 1k6



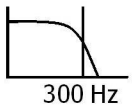
Low pass (Bas)

C = 1 / (2pi * f * R)

eks.
R = 30000 Ohm (Denne modstand er fast)
f = 300 Hz

C = 1 / (2*3,14 * 300 * 30000)

C = 0,0000001769 = 17,7 nF



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