darTZeel

NHB-108 model one Version B

User Manual

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darTZeel NHB-108 model one
Version B

User Manual

1. Introduction

Congratulations for purchasing a darTZeel NHB-108 model one.
Our machines are designed and hand built for *very* long lasting use and musical pleasure.

The darTZeel NHB-108 model one is a highly unusual power amplifier, and requires special care. We strongly recommend you read this manual in its entirety, in order not to miss *any* reason for enjoying your machine at its very best!

When opening the crate, you certainly noticed the three separate information sheets. They are of primary importance and you must read them *without fail* before continuing.

These documents are:

- The warning notice, printed in red.
- The "3-step-to-go" commissioning leaflet, printed in blue.
- The packing/unpacking notice, printed in green

While humor is truly part of our philosophy, please keep in mind that all our warnings *must* be taken into account, for the sake of your own safety.
If you carefully follow all the instructions herein, you will be rewarded by very long, joyful listening sessions, for years and years to come.

Please carefully keep all documentation and packing material in a safe place, especially the crate, in case you have to move house one day.

2. Brief description

The darTZeel NHB-108 model one is the pinnacle of more than 16 years of research & development, with the first goal in mind being sound reproduction, nothing but sound reproduction.

Every basic element of the darTZeel NHB-108 model one was chosen for its high intrinsic sound qualities. No compromise about the cost price was even contemplated.

The result is what you can see, touch and hear… right now.

One of the secrets of the darTZeel NHB-108 model one can be found in two words:

Passion and Love… The passion for sound, of course, and love of music, needless to say…

As for the rest, we just put in few electronics, a wee bit of mechanics, and an awful lot of working hours.

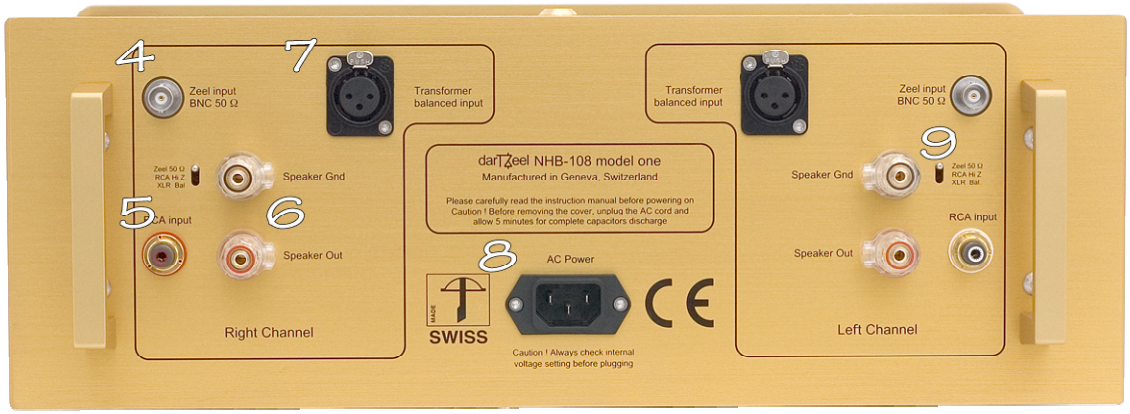
If you want to know more about the technical side of the darTZeel NHB-108 model one, we invite you to read the dedicated section at the end of this manual, in which you should find much of interest.

3. The NHB-108 in details

3.1. FRONT PANEL

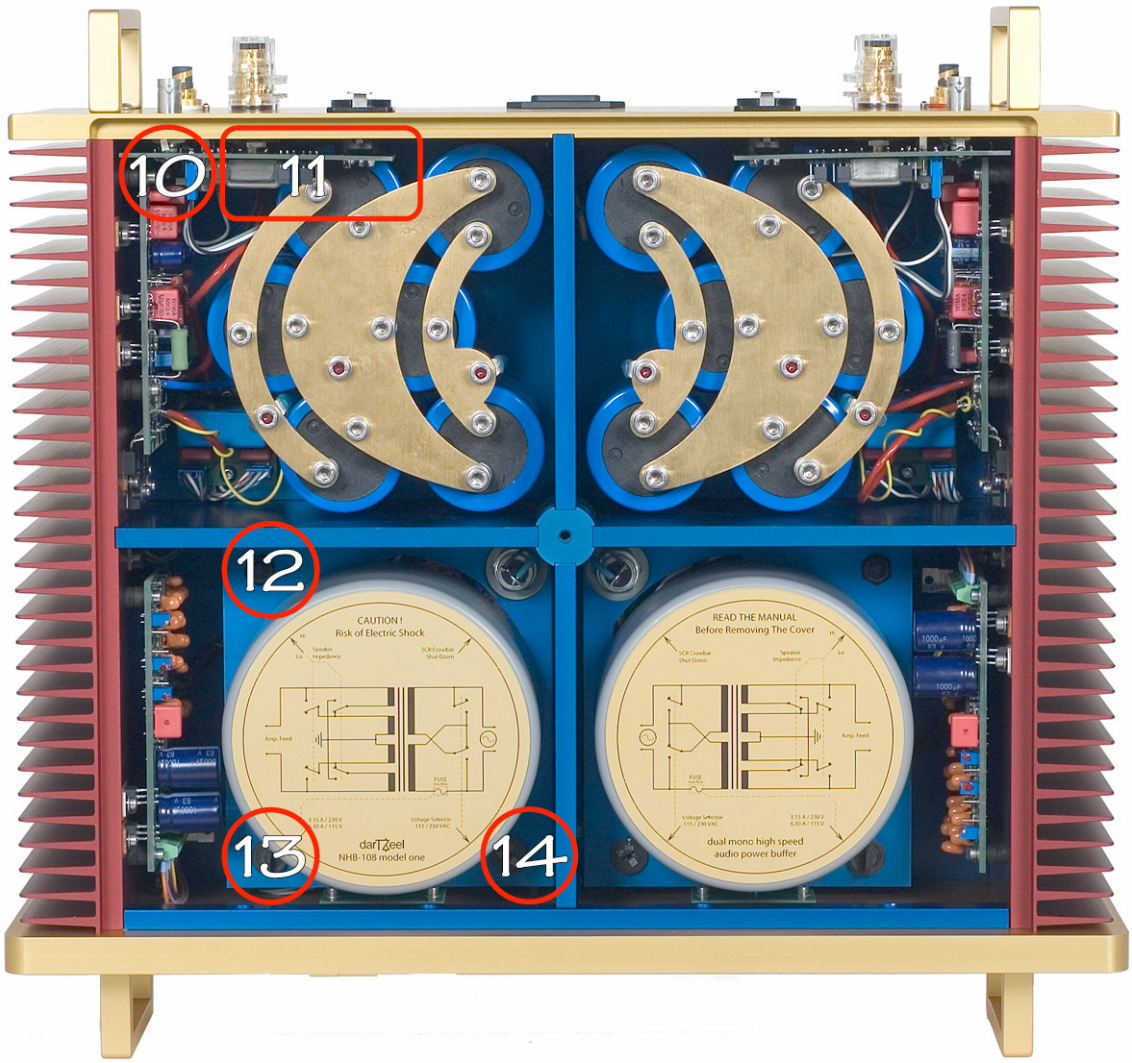
1. **Identification Plate**
2. **The Eyes**
3. **The Power Nose**

3.2. REAR PANEL



4. **50Ω BNC Zeel Inputs**
5. **RCA Inputs**
6. **Speakers Terminals**
7. **XLR Inputs**
8. **IEC Power Socket**
9. **Input Impedance Selector**

3.3. TOP VIEW



10. **DC Offset Trimmer**
11. **Jumpers**
12. **Speaker Impedance Switch**
13. **Fuse Holder**
14. **Operating Voltage Selector**

4. Who am I?

Your darTZeel NHB-108 model one bears, on its front panel, its **Identification Plate (1)**. On this 24k gold plated brass plate are engraved your name, and the serial number. Do not unscrew the plate since it is the identity card of your machine!

The serial number can be read as follows:

TZ-XY1081.dcbZ

X = Century of making
Y = Batch number
dcb = Identity in the batch number
Z = Version (**A** or **B**)

Example:

The sample bearing the serial number

TZ-UC1081.001B

Is the first machine of the third batch, made in the 21st century, and of version **B**. This numbering is thus valid until the end of the 26th century.

From the second batch, we chose to manufacture only the darTZeel NHB-108s in version **B**. Actually this version even offers some slight improvement over the version **A**. If you want to know how the version **A** differs, please visit our website at www.darTZeel.com, where you can download the previous manuals.

It is vital to bear in mind all the following notes and remarks concerning the use of your darTZeel NHB-108 model one.

Thank you.

5. Connecting and setup

5.1. Important prior notice

In order to protect the loudspeakers, your darTZeel NHB-108 model one features a special monitoring circuit. If any abnormal situation is detected, this circuit will intentionally melt the power fuse(s). This behaviour is not be interpreted as a failure. The NHB-108 has been designed to behave this way, in line with our philosophy of not spoiling the sound by adding any protection circuit in the signal path. If you want to know more about this specific circuit, also called Crowbar, please refer to the technical section, in chapter **T6**.

5.2. Location

Before making the first connection, you should think carefully about the location where you are going to put your gear. If you planned to fit your darTZeel NHB-108 model one into furniture, please bear in mind that you must allow at least one inch of free space all around the unit, for proper cooling.

If you do not respect this, the darTZeel NHB-108 model one may stop playing if it becomes too hot.

The heat sinks shutdown point is at around 70°C, and the power supply starts up again when the temperature has dropped to 55 °C.
Please also note that permanent excessive temperature will reduce the life span of your machine. Read the technical section at the end of this manual if you want to learn more about this topic.

Anyway, if possible, always leave enough space around your darTZeel NHB-108 model one, allowing you to gain easy access to it when making connections.

5.3. Speaker impedance

The darTZeel NHB-108 model one can drive virtually any loudspeaker, provided its nominal impedance is between 1.5 and 8 ohms. Above 8 ohms, maximum available power output will be slightly reduced, but without any sound quality loss.

Nominal standardized impedance can vary by ± 20%, and can thus reach the following critical minimum values:

6.4Ω in the case of 8Ω speakers
3.2Ω in the case of 4Ω speakers
1.6Ω in the case of 2Ω speakers

If your loudspeakers are between 3Ω and 8Ω, which is nearly always the case, you can directly hook them to the **Speaker Terminals (6)**.

Black terminal (upper) = Ground.
Red terminal (lower) = Live signal.

If your loudspeakers impedance is less than this, or if you want to parallel 2 pairs of 4Ω speakers, you must go to chapter **6.3. "User parameters"** before you consider going further.
If you do not respect the above, you may encounter some blown fuses when playing music at loud levels.

CAUTION: You must connect your loudspeakers to the **Speaker Terminals (6)** before powering ON the darTZeel NHB-108 model one!

5.4. Choice of the input

Only one input can be used at a time. All inputs are paralleled, so you cannot select them separately.

If you do not own a darTZeel NHB-18NS preamplifier yet, we suggest you use either **RCA (5)** or **XLR (7)** inputs, with the **Input Impedance Selector (9)** switched on "RCA Hi Z" (mid position, physically speaking), or "XLR Bal". (lower position), respectively.

The XLR inputs are truly balanced on the version **B**, through floating transformers:
Pin 1 = Ground
Pin 2 = Hot leg
Pin 3 = Cold leg.

If you have already paid us the honour of purchasing a darTZeel NHB-18NS preamplifier, we strongly recommend using the **50Ω BNC** Zeel **Inputs (4)**, with the **Input Impedance Selector (9)** switched on "Zeel 50Ω"(upper position, physically speaking).
The Zeel input is definitely the one that will bring you the purest sound ever achievable. Read the technical section at the end of this manual if you want to know more about this topic.

5.5. Powering ON

Please do not forget that the darTZeel NHB-108 must have loudspeakers connected before you power ON.

Your machine has already been factory set in order to adapt to your mains supply, as confirmed by the 3-Step-To-Go commissioning leaflet. In case of doubt, please contact us.

Connect the supplied power cable into the **IEC socket (8)** and plug the other end into the mains wall outlet.

You can then power ON the darTZeel NHB-108 model one by pushing the **Power Nose (3)** button.

If a source is already connected, you should immediately hear the music.
When powering the amplifier OFF by pressing the **Power Nose (3)** button, you can still hear the music for 10 to 30 seconds before the level goes down dramatically and stabilizes. This behavior is perfectly normal, and it is not a failure at all. If you need more details about this, please refer to the technical section.

6. Using the darTZeel

6.1 Power cycle

The darTZeel NHB-108 model one has been designed to deliver more than 90% of its magical sound at cold start.

After 5 minutes, you are very close to the best the machine can offer. The increasing quality you may hear as time goes by will be mostly the reflection of your growing musical pleasure…
No need then to leave your machine powered ON all the time, except of course if you like paying bigger electricity bills…

If your present preamplifier produces some clicks and/or bumps when powering on/off, we suggest you observe the following sequence:

Powering ON: first the Preamp, then the darTZeel NHB-108 model one.
Powering OFF: first the darTZeel NHB-108 model one, then the preamplifier.

If this procedure is not respected, you may encounter some blown fuses due to Crowbar triggering.
If you still hear some thumping at powering OFF, you will have to wait around 10 seconds before switching the preamplifier OFF. This noise, however, will be inconsequential and harmless.

6.2. darTZeel's Eyes

The 2 giant orange LEDs, called **Eyes (2)** for obvious reasons, are fully featured function indicators. Five different illumination states, for each individual channel, are described hereunder:

1) Eyes shut (light off). This is of course the status when the darTZeel NHB-108 model one is either powered off or not plugged in. If one Eye only is shut, it means that there is a power fault or a blown fuse in the channel in question. In the latter case, please go to chapter **7.1."Fuse(s) replacement"**.

2) Idle state. 45 to 55 seconds after powering ON, and with no input signal, the Eyes go into this barely illuminated state.

3) Signal presence. When an input signal, corresponding to over 10 mW at 8Ω is detected, the Eyes illuminate fully. You are in "musical cruise mode". When the input signal disappears for more than 45 to 55 seconds, the Eyes go back to idle state. While listening at very low levels, Eyes could toggle between states 2 and 3; this is normal behaviour.

4) Clipping. When approaching maximum output power, the corresponding Eye flashes brightly for about half a second, and then goes back to the "musical cruise mode".

5) Blinking. Please refer to chapter **8.2.2. "Blinking Eyes"**.

6.3. User parameters

The darTZeel NHB-108 model one must be correctly set, accordingly to the loudspeakers' nominal impedance. Your machine is already factory set for speakers having nominal impedance from 3Ω to 8Ω, as is usually the case.

If your loudspeakers' nominal impedance is between 1.5Ω and 2.5Ω, or if you connect two paralleled 4Ω speakers, you must adapt your NHB-108 to that load. If you want to know more about this special mode, please refer to the technical section.

The procedure for the adaptation of the output impedance is described hereunder:

Power the machine OFF.

!!! UNPLUG THE AC CORD FROM THE WALL, and please wait for 5 minutes !!!

Disconnect all links you may have installed by removing all cables from **inputs (4)**, **(5)** or **(7)**, and from **Speakers Terminals (6)**. Unscrew the single central cover screw, and remove the smoked glass using the supplied suction grips, as shown in fig.1 Gently wet them in order to get firm vacuum. Please be very careful when removing the cover, since it is real tempered glass, not Plexiglas[tm].

Fig.1 – Suction grips

The speaker's impedance switch is located at the upper left of the transformer (upper right for the right channel),

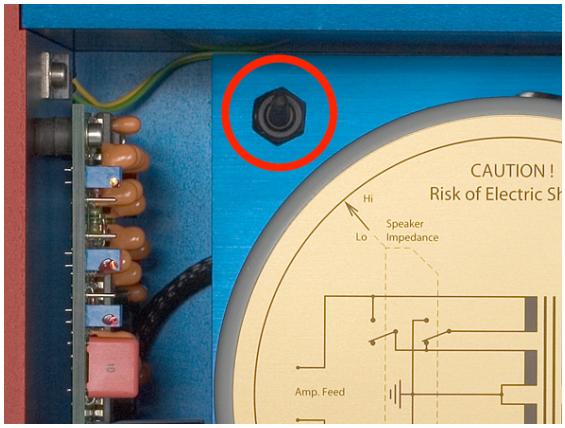


Fig.2 – Speaker's impedance switch

as shown in Fig.2
When the switch is pointing towards the front plate, you are in **Lo** mode, suitable for 1.5Ω to 2.5Ω speakers. In this mode, you can also parallel 2 pairs of 4Ω speakers.

By flicking the switch towards the rear panel direction, you set the **Hi**, default mode, for speakers of 3Ω or more. This is the most often used configuration.

The darTZeel NHB-108 model one being a true dual mono design, you can also use it to biamplify hybrid loudspeakers (having different technology and impedance drivers, i.e. an 8Ω woofer and a 2Ω tweeter) by switching one channel to **Hi** and the other one to **Lo**, respectively.
Please bear in mind that in this case, you will need *two* NHB-108 model one, one for each loudspeaker.

Once you have chosen your configuration, you can carefully put the glass cover back, and screw it on again as follows:
Freely hand screw until you feel the thread-end resistance. Then use the supplied screwdriver and turn an extra 1/8 turn approximately. The screw must be sufficiently tightened to prevent the possibility of the glass rotating around the screw axis.

Then reconnect all the wires and cables, paying special attention to the loudspeaker cables. They must be hooked to the **Speaker Terminals (6)** before powering the amplifier ON.

Now just sit back and relax, and immerse yourself in pure musical pleasure!

6.4. Jumper settings

Before making any change in the jumper settings, power off the amplifier, REMOVE the AC cord, and wait for 5 minutes before removing the glass cover.

On the inside rear panel (see chapter **3.3. "Top View"**, no. 11), where the input circuit boards are located, you will see 3 jumpers per channel:

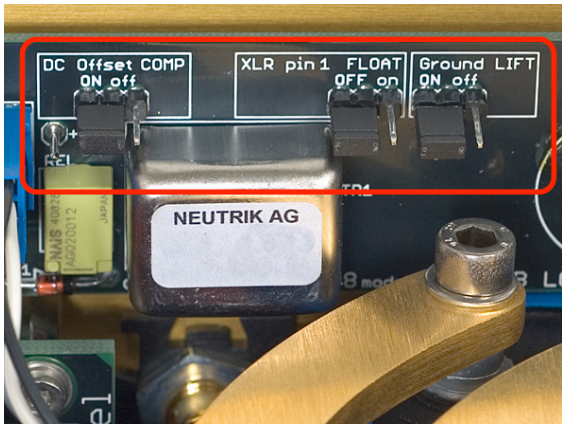


Fig.3 – Jumpers

2 jumpers are labeled **Ground LIFT** and **XLR pin 1 FLOAT**. They can be changed over in the event of a hum problem when an **XLR** input is used, depending on the circuit design of the associated preamplifier. In a lesser extend, these jumpers may also affect **RCA** inputs. Their factory default position is the most commonly used in order to obtain best results.

The third jumper, labeled **DC Offset COMP** is the most important one since it *does* affect the sound of the amplifier.

This jumper is set to **ON** at the factory, preventing any problem of DC offset due to AC voltage variation or too great an ambient temperature change.
If your AC mains voltage is stable, and your listening room is at standard temperature, we recommend removing the compensation by putting the jumper to **off**.

In doing so, you will fully benefit from the very philosophy of the NHB-108 model one, which is to refuse any compensation or global negative feedback which could impair the sound. Most users have reported to us that this setting has the best sound. Depending on your own audio system, this result may vary, however, so experiment for yourself.

7. Maintenance

7.1. Fuse(s) replacement

The following procedure concerns the left channel. For the right channel, the procedure is the same but that the fuse is in a mirror image configuration.

If one – or both – fuse(s) has/have blown, first try to determine the cause.
The Crowbar circuit installed in the darTZeel NHB-108 model one causes fuses to melt when an abnormal situation is detected. This is normal behaviour.
For more information about this topic, please refer to the technical section, chapter **T6**.
If a newly replaced fuse immediately melts when you power on your NHB-108 model one, even though your speakers are correctly connected to the **Speakers Terminals (6)**, unplug the AC mains and contact us directly:

troubles@dartzeel.com

Hereunder is the procedure:

In order to change a fuse, power off your NHB-108 model one by pressing the **Power Nose (3)** button.

!!! UNPLUG THE AC CORD FROM MAINS, and wait for 5 minutes !!!

Remove all the input and output connections.

Remove the single central screw located on the top smoked glass cover. Take the two supplied suction grips, slightly wet them in order to provide strong vacuum, and firmly apply them on the cover glass, as indicated in Fig.1

Please be careful when removing the top cover, since it is of real glass, not Plexiglas™.

Put the amplifier on a carpeted surface, and gently (but firmly, as it is a heavy, 30kg electronic creature) pivot it vertically onto its front handles. Use a protective cloth as indicated in fig.4 in order to avoid scratching the inside aluminum parts

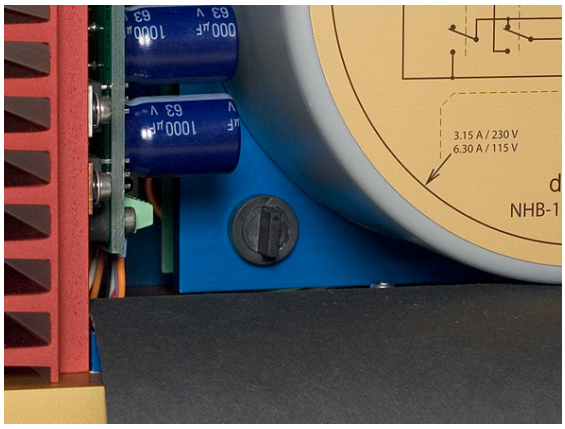


Fig.4 – Soft cloth

while using the supplied long nosed pliers (fig. 5),

Fig.5 – Supplied tools

gently turn the fuse holder, as shown in fig.6, 180° counter clockwise,

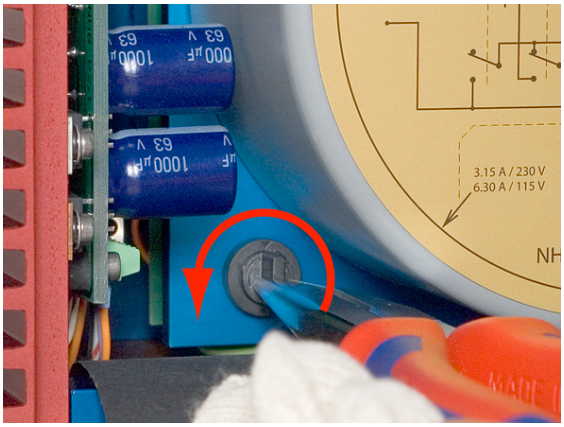


Fig.6

and pull it off, as shown in fig. 7

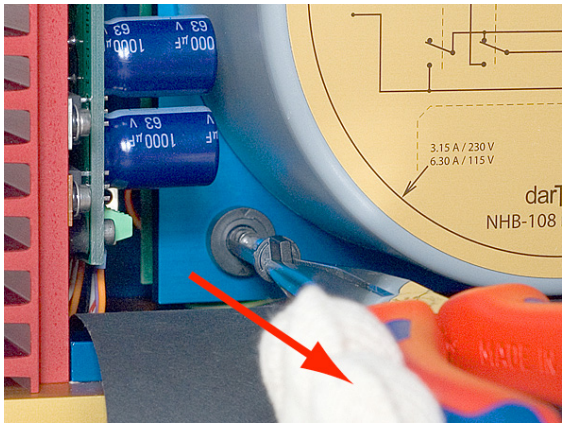


Fig. 7

Then turn again 180° counter clockwise and let the fuse fall onto the inner side of the front panel, as shown in fig. 8

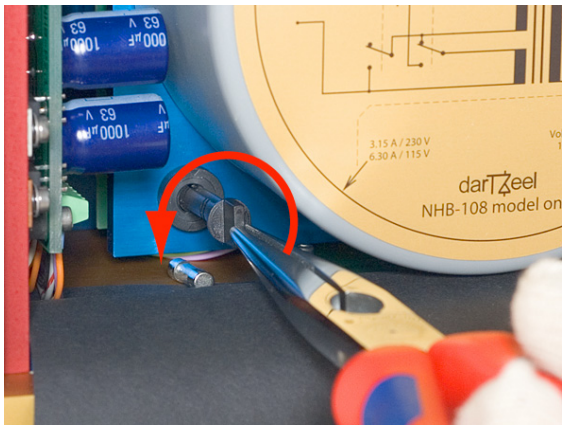


Fig. 8

Pick up the fuse with pliers and check that the glass envelope is dark or black, indicating a blown fuse. Remove it and simply install a new fuse in the holder. Once the new fuse is inserted, push back the fuse holder and turn it 180° clockwise until you feel a slight click.
You're back in business!

Fuse ratings are:
110-125vAC: 6.3 amps T type.
220-240vAC: 3.15 amps T type.

T type means "Temporized". Do NOT use the so-called "slo-blo" type, especially the kind with coil-wounded filament. The filament in the fuse glass envelope must be seen as a thin STRAIGHT wire.

Never use improper fuse ratings. Very great fire risk!

Now you can restore the amplifier back to its horizontal position and put the glass cover on, as described in chapter **6.3. "User parameters"**.

Connect again all your cables, without omitting the loudspeakers, and power ON your NHB-108 model one.
Now you are ready to enjoy some more good music, compensating all that tiring physical effort you have just put in…

Although the above procedure could seem rather long and complicated, you will see that it is a simpler task to perform than to explain.
Anyhow, if you carefully respect all advice and warnings, you should never encounter such problems of blown fuse(s).

7.2. DC voltage drift

Every single NHB-108 model one is lovingly checked, tested and listened to before leaving our workshop.
Output DC voltage drift normally does not need any further adjustment, provided you use your amplifier in a room temperature ranging from 59°F to 95°F (15°C to 35°C).
Furthermore, the version **B** now features a built-in DC compensation circuit. In order to fully benefit from total lack of any overall negative feedback, you can disable this circuit.
Please refer to chapter **6.4. "Jumper settings"**.

If one – or both – Eye begins to blink, even though your loudspeakers are properly connected, a readjustment is recommended.

This tuning procedure is described at the very end of the technical section.

7.3. Cleaning and upkeep

The darTZeel NHB-108 model one has not only been designed for providing you intense moments of musical pleasure; it is also designed to withstand the rigors of time, especially if you take proper care.

This is undoubtedly one of the few, if not the only, amplifier to be virtually dust-proof. The whole case performs heat exchange, while the two lateral heat sinks regulate and maintain the correct temperature. This design avoids the need for any vent slot.

The only visible traces you will see in the long-term will be located on the inner side of the smoked glass, and will be due to some natural evaporation of some plastic packaged components.

We suggest that you remove the cover glass once a year, and use a soft cloth to gently wipe the glass with an appropriate cleaning solution. Your NHB-108 model one will then keep its "like-new" aspect for decades, and as time goes by, the less you will need to perform this operation.

As for the external parts of your equipment, a soft cloth or even a dust brush will be completely adequate.
In case of fingerprints, a gentle rub with a cloth soaked in isopropyl alcohol will be more appropriate.

Just bear in mind, however, that the simplest things are, more often than not, the most efficient.
We personally found that a spot of soap on a wet soft cloth is the best method most of the time. Try for yourself!

As you have certainly guessed, we confirm that it is strongly recommended to never use acid to clean your gear. Acid is very corrosive and could react with the anodized coating. Furthermore, acid is *very* corrosive for the skin, too…

If you follow these few elementary rules, you will be assured of having a very nice looking machine for decades to come.

8. Some advice and tips

8.1. What not to do

Our advice and recommendations have been voluntary placed close to the end of this owner's manual. This does not mean that they are of only minor importance - quite the contrary.
We just thought that the following points are not directly involved in the everyday use of your amplifier.
However, the completely new concept of the NHB-108 model one calls for certain precautions.

These few but important warnings are the following:

1) Never, ever attempt to short circuit the **Speaker Terminals (6)**.

   Repetitive shorts could lead to permanent damage to the corresponding output stage.

   When bi or tri cabling, be especially careful when connecting the cables. If you inadvertently cross the polarity of one run regarding the other(s), you will make a perfect short circuit. This can easily destroy the corresponding output stage!

   The warranty will be partially or totally void in the event of non-compliance with the above !

2) Do not power ON the darTZeel NHB-108 model one when no loudspeaker is hooked to the **Speaker Terminals (6).**
   In such a case the internal fuses could be blown by the Crowbar circuit, especially if the DC compensation offset has been disabled.

3) Before connecting or disconnecting the audio cables to/from the **RCA (5)** or **XLR (7)** inputs, always flip, when possible, the **Input Impedance Selector (9)** onto "Zeel 50Ω" position. You will thus avoid any of the resulting parasitic clicks and bumps.

8.2. Troubleshooting

While setting up your NHB-108 model one, it is possible that you may not obtain the desired results. Hereunder we list the most frequent problems you are likely to encounter. If the problem cannot be solved, please do not hesitate to contact us directly at:

troubles@dartzeel.com

8.2.1. Eyes Closed

The eyes are closed – I beg your pardon, extinguished - while the **Power Nose (3)** button is ON. Please check that the AC power cord is correctly connected at both ends, and that the mains AC voltage is present. Just test with a table lamp. If AC is present, it means that both primary fuses have melted. Please go to point **7.1. "Fuse(s) replacement"**.

One Eye only is not lit. This means that you have to change the corresponding channel fuse.

8.2.2. Blinking Eyes

Blinking Eyes indicate that the output DC offset value has exceeded the permitted limit. If such an event occurs, please read the following:

A) Eyes blink at cold power ON. If your listening room is at a temperature below 65°F (18°C), this could be considered as normal, provided that this behaviour disappears in the following 3 to 5 minutes.

   In a room at a temperature above 65°F (18°C), blinking eyes indicate that your NHB-108 model one could do with some tuning. However, if this behaviour ceases after 3 to 5 minutes, and especially if you can put up with it, no adjustment is mandatory.

B) Eyes blink after several hours, when the machine is hot, or even *very* hot. If your room temperature is above 90°F (32°C), this can be considered as normal behaviour, and normally the eyes should stop blinking as soon as the ambient temperature returns to "human being" levels.

   Please also check that your darTZeel NHB-108 model one is properly ventilated, as indicated in chapter **5.2. "Location"** and that you are not using it at quasi-permanent power clipping levels with 3Ω loads.

   If the ambient temperature is under 90°F (32°C) but the Eyes blink, your machine needs some tuning.

To cut a long explanation short, NHB-108's eyes should not blink in ambient temperature ranges from 65°F to 90°F (18°C to 32°C). If they do, the amplifier needs some adjustment.

In all cases it is important to know the working environment in which you will use your darTZeel NHB-108 model one.
If you live at the South Pole or on the Equator, a slightly different setting could be necessary, especially when the DC compensation offset is **off**.

If you need to know more about this topic, can you guess what? Yes, read the technical section…

8.2.3. Amplifier ON, no sound

Please check first the Eyes' illumination state, as described in point **6.2. "darTZeel's Eyes"**.

A) Idle state. No signal is present at the input of your NHB-108 model one. Be sure that the source (SACD, CD, Tuner or whatever) is correctly selected and connected to the preamplifier feeding your machine.
   Please also verify that the **Input Impedance Selector (9)** of each channel is *not* at the upper position ("Zeel 50Ω") when you are not using a darTZeel NHB-18NS preamplifier.

B) Signal presence. The input source is correctly connected and routed, but the loudspeakers are not hooked to the **Speakers Terminals (6)!** We remind you that this is totally forbidden. Okay, no trouble for this time. You are lucky enough that the Crowbar circuit did not melt one fuse or two…

C) No sound when using XLR inputs. Please check that the **Input Impedance Selector (9)** of each channel is at the lower position ("XLR Bal.").

8.2.4. Warped sound

You are using the **RCA input (4)**, but the **Input Impedance Selector (9)** of one or both channels is in the upper position ("Zeel 50Ω").
Your present preamplifier not being a darTZeel (this will change one day), its outputs cannot drive 50Ω loads.
So please switch the **Input Impedance Selector (9)** to "RCA Hi Z" mode (mid position).

8.2.4. Sensitive fuses

Fuses have the bad tendency to melt much too often. Why, then, not replace them by a higher value rating?
Please **never, ever** do such a thing!
Improper fuse ratings could produce a **fire!** Please carefully read the technical section at the end of this

manual in order to better know how the Crowbar circuit works.

Fuses can blow if the nominal impedance of your speakers is less than 3 Ω and your NHB-108 model one has not been set up to drive such a load.
Please refer to chapters **6.3. "User parameters"** and **5.1 "Important prior notice"**. Then again check your fuses if you are in doubt, by taking a look at point **7.1. "Fuse(s) replacement"**. Be sure that you are using fuses of correct rating and type.

8.2.5. Sound too quiet

A) darTZeel's Eyes are quasi-permanently in the clipping state, as described in chapter **6.2 "darTZeel's Eyes"**, point 4.

   Your speakers are particularly inefficient! Please choose loudspeakers of more than 84 dB/w/m …

   Alternatively, maybe your room is very big, and that even with your old 1200 watts per channel powerhouse amp, there was only just enough volume?

   In such a situation, please do not hesitate to consult us. We will try to help you find a solution.

B) The volume setting of your preamplifier is close to maximum.

   This can occur if you use either a passive or a low gain preamplifier.

8.2.7. Melting Fuse(s) at power ON

The NHB-108 model one features a Crowbar inhibiting circuit working at power ON. During the first 20 milliseconds, no Crowbar operation will occur, avoiding blown fuse(s) if bumps greater than 2 volts are detected.

However, if you power your machine ON again, immediately after having powered it OFF, it is possible that it will eventually trigger the Crowbar circuit, and lead to melted fuse(s). In such a case, you will have to change the blown fuse(s) as described in chapter **7.1. "Fuse(s) replacement"**.
In order to avoid this situation, we recommend that you wait around 3 seconds before powering your NHB-108 model one ON again, when switched OFF.

8.2.8. RAS (Regular And Satisfactory)

In such a situation, we sadly deplore having no real cure.

We suggest you display your most charming smile, relax in your armchair, and enjoy listening to your favorite tunes.

Symptoms should disappear by themselves within a few days. If everything continues OK, please invite some friends!

9. Conditions of warranty

9.1. Breakdowns or faulty parts

The darTZeel NHB-108 model one is guaranteed for one full year, parts and labor, against any breakdowns or component failure, as is the tradition in Switzerland for such equipment.

As we see it, any warranty longer than 1 year is the obvious sign of inferior quality and design, indicating that a failure could arise anytime.

Any component either will fail within days or will last "forever" (several decades in practice).
This is the reason why all our machines are thoroughly broken in before being lovingly packed and sent to you.

We are still fully aware that no component is always flawless, and that a problem could arise anytime after the warranty period.

In such a case, we will carefully examine every situation, with the aim of reducing the likely repair costs to minimum levels. You can always trust us for customer care, as you already trusted us when purchasing your NHB-108 model one.

9.2. Conditions of use

darTZeel Audio SA company disclaims any responsibility in case of damage or injury directly or indirectly due to any misuse, incorrect manipulation, or simply the non-observance of red warnings, and/or advice formulated in this entire manual, including the technical section.

Any non-authorized intervention *on* or *in* the darTZeel NHB-108 model one, or any failure due to one of the situations described above, or any similar situation, will render the warranty void.

10. Assistance

If you need *any* commercial or technical information about the darTZeel NHB-108 model one, or if you have any difficulties or enquiries, please feel completely free to contact us by email at

moreinfo@dartzeel.com

You can of course write us at the following address:

darTZeel Audio SA
21A, route de la Galaise
CH-1228 Plan-les-Ouates
Geneva/Switzerland

We also invite you to visit our website at

www.dartzeel.com

We wish you countless hours of musical delight with your NHB-108 model one and do hope that you will have no further need to read this manual except for the pleasure…

Musically yours,

Hervé Delétraz

11. Technical data

darTZeel NHB-108 model one, version B

Nominal output power	:	100 watts RMS @ 8 (Hi) and 2 (Lo) ohms. 160 watts RMS @ 4 (Hi) ohms.
Gain	:	26 dB @ 8 ohms.
Input impedances	:	RCA: > 30 kohms, 5 Hz to 100 kHz. BNC: 50 ±1 ohm, 1 Hz to 1 MHz. XLR: > 15 kohms bet. Pin 1 and 2. > 15 kohms bet. Pin 1 and 3.
Output impedance	: <	0.33 ohms, from 20 Hz to 20 kHz (measured under 8 ohms).
Frequency response	:	1 Hz to 1 MHz, +0, -6 dB (depends on measurement method). 10 Hz to 100 kHz, +0, -0.5 dB (depends on measurement method). 20 Hz to 50 kHz, ±0.5 dB (XLR inputs).
Rise time	: <	0.8 µs. (depends on measurement method).
Slew rate	: >	88 V/µs, peak-peak.
DC voltage output drift	:	DC comp Off : < ± 590 mV max. DC comp ON : < ± 50 mV max.
Total Harmonic Distortion (THD)	: <	1 % from 7 Hz to 77 kHz
Temporal Distortion	:	None, at any level and load, as specified above.
Crosstalk	: <	-90 dB from 20Hz to 20kHz.
Signal to noise ratio	: >	112 dB (A) @ nominal power.
Consumption	:	150 watts @ idle, 900 watts @ maximum output power.
Size in mm	:	440 x 335 x 170 (WxDxH). Total deep with handles: 415 mm.
Net weight	:	30 kg.

darTZeel NHB-108 model one amplifiers are made to last forever by

darTZeel Audio SA in Geneva, Switzerland.

darTZeel Audio SA
21A, route de la Galaise
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Genève Suisse

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darTZeel NHB-108 model one

Technical Section

T1. Introduction

Thank you for studying this technical section devoted to true audiophiles, demonstrating proof of your interest in the darTZeel NHB-108 model one.

First of all, please do not think for a minute that we consider audiophiles differently from music lovers. We know perfectly well that audiophiles love music too, and we are very happy with this.
It is however true that music lovers are generally less inclined to enjoy the technical and performance side of the music, hence the existence of the *Music lover's manual*.

In the light of what follows, you will better understand why our technical choices during the design of the NHB-108 model one led to what one could call a truly exceptional machine.

We trust that you will derive great pleasure from reading this manual, and that we succeed in communicating some of the burning passion that has been boiling inside us for more than 30 years.

Enjoy your reading!

T2. Genesis of NHB-108

The NHB ("**N**ever **H**eard **B**efore") project began in summer 1984.
Crazy about audio since childhood, we gradually developed the idea of designing a power amplifier.

Even though the original NHB-108 model one is the fruit of a single man, the moral, financial and professional support from family and friends over all these years has played a huge part in this endeavor.

At the time it was only a dream, and we are grateful to every gal and pal who has been involved in it and contributed to its achievement.

In the '70s and '80s, here in Europe, Japanese electronics were queens and kings of the market. Very rare, and above all virtually unknown, was the real high-end audio gear coming from USA or elsewhere. The finish was already very good, but the sound quality did not come up to scratch, simply because it was not one of the original design goals! Only a few companies were able to offer real breakthrough products. Not all of them are still in business, Alas!

The more the years passed, the more our desire for designing a new machine became tangible. In mid spring 1984, we produced a first digital power amplifier in a school lab, as a diploma project.
Paradoxically, the innovation here was not the fact that the amp was digital, but that no feedback whatsoever was used. The output stage was totally open-loop.

The sonic result was so astounding that we immediately started the NHB project, although its code name did not come until later.

The initial idea was to design a new very powerful digital amplifier, totally open loop if possible, with the purest sound reproduction we could attain, without any other consideration, especially the price factor.

The main problem at the time was that the technology did not yet offer the monochip solution, so we had to build the circuit entirely in hybrid technology, using mainly discrete devices. The odd thing is that even in this early 21st century, we have still not surpassed the speed of those old circuits.

Another problem then arose. Our circuits were much more complex than a single modern IC, and of course they were not very reliable either. We especially encountered several performance consistency problems from sample to sample, and we gave up for a time. Some years later, new ICs allowed further investigation, and we built several prototypes. We quickly noted, however, that digital had some limits when pushed hard.

We used a sample frequency of 500 kHz at the time, corresponding to a theoretical bandwidth close to 250 kHz, far higher than all competitors, even in the analog domain. But – alas – even with such a high sample frequency, the actual measured bandwidth was strongly dependant on the loudspeaker impedance.

Another problem, jitter, already well known in labs at the time, was difficult to cure, to say the least. The signal to noise ratio was just above our minimum criterion.

Since pure sound was the only goal, then noise, if at acceptable level, could have been tolerated by us. On the other hand, interdependence between load impedance and frequency response was not our cup of tea. Not by a long chalk.

End of the digital trip.

It is interesting to note that several manufacturers offer digital amplifiers, with greater or lesser success. The theoretical limits remain the same, even if better managed than in the '80s. Analog fortunately does not have to cope with such limitations.

After several months of deep thinking, circuit designing, and circle squaring attempts, the project was revived (in 1990) on brand new bases. The gear would be fully analog, moderately powerful, and as close as possible, philosophically speaking, to the signal treatment used in its digital ancestor.

Two new prototypes were built on the basis of existing designs; even though heavily modified to suit our tastes, they produced unexciting results. Then we asked ourselves what is the point of producing nice looking gear if the sonics bring nothing new under the sun?

In 1992, we decided to develop a revolutionary design from scratch. This ultimate quest (for ultimate sound) lasted over 5 years, with more disappointment than joy. But the fun was always here.

Countless schematics were studied, scrutinized and hooked together until we obtained, in mid 1995, what we could call the first theoretical design corresponding to our aims.

From 1995 to 1999, on that first elementary circuit basis, dozens of different versions were simulated, some of them being built and listened to.
By 11 November 1999 the definitive circuit was built and assembled. This was the very first darTZeel machine, the NHB-108 model zero.
The results, sonically speaking, were outstandingly better than expected. It seems that this design was the right one. So much so that most of our test listeners said that this product *must* be put into production, even on a very small scale.

The darTZeel NHB-108 model one was born.

T3. Criteria

Your NHB-108 model one is not an ordinary machine and this is no doubt one of the reasons why you purchased it.

The entire concept is based on just three criteria:

- Simplicity
- Purity
- Reliability

These words can often be deceptive. Easy to pronounce, conjuring up elegance and fascination, they nevertheless constitute very tough technical challenges, since their respective meanings are not at all easy to reconcile.

Nothing is eternal. As for the NHB-108 model one, not enough time has yet elapsed for us to assert such a claim.

What we do assert is that *everything* has been taken into account so that you can benefit from your machine for a long time. *A very long time*.

You will discover that more often than not, simplicity means long lasting. Sometimes, it also means purity, whether of sound or of form.

Welcome to darTZeel.

T4. Structural aspects

It would be all too easy to compare the darTZeel NHB-108 model one and wristwatches, both being made in Switzerland. There are no springs, cogwheels, or hands in a NHB-108 model one. Here, everything is a tad… bigger.

T4.1. The case modules

The case of your machine is exclusively machined from AW-5754-ALMG3 alloy aluminum, offering a remarkably even surface and hardness.

Every item is CNC machined from the billet in order to ensure a very high density and outstanding rigidity, thus considerably lowering all unwanted resonances.

The elements are finished in the three hard anodized darTZeel colors, namely **Electric Blue**, **Blazing Red**, and **Gleaming Yellow**. This unique finish gives to the NHB-108 model one its inimitable appearance.

The three main elementary modules are the mother plate, the transformer platforms and the heat sinks. They are tightly assembled together with non-magnetic, stainless steel screws.

Each basic module is first carefully hand assembled, and individually tested. Only then is it dated and signed before being fitted.
If you dismantle your darTZeel NHB-108 model one, you will see that modules are not assembled in a hurry. Some of them are installed with several weeks elapsing between construction and assembling.

In line with this non-stress approach, we take all the time necessary to achieve the best job we can. If our tests show that a component is out of specification – this can sometimes occur *after* its assembling – the entire module is dismantled, checked, and reassembled before being tested a second time.

The NHB-108 model one housing features a 20mm thick false bottom machined from the billet, and a

5mm thick bottom plate, in the form of a sandwich. All cables and wires are routed in this sandwich, minimizing the influence of electromagnetic fields.
Furthermore, such an arrangement is of extreme rigidity ensuring exceptionally good mechanical coupling between the mother plate and heat sinks modules.

T4.2. Divide to conquer

The inside of the NHB-108 model one is divided into four distinct volumes. The left and right channels are insulated from each other, as are their respective power supplies. This unprecedented construction allows extremely low crosstalk behavior across the whole audio frequency range. You are either true dual mono, or you are not. The darTZeel NHB-108 model one definitely is.

The two front compartments are devoted to the power supplies, and are themselves divided into a two-storey structure. The Crowbar elements and the soft start circuitry are located on the lower level, while the suspended toroidal transformers are fixed on the 6mm thick, upper decks.

We insist on the fact that in the final assembly process, all parts are precisely aligned by means of cotter pins, like in Swiss precision clockwork movements, before being tightly screwed together. This additional precaution adds still more rigidity, and the entire case then behaves as a single block. As a free bonus, the case is thus virtually dust proof.

T4.3. Eliminating vibrations

The fastening of the power supply transformers was carefully thought out as regards noise reduction and trouble-free life. A specially developed suspension ensures that even in case of failure, the transformers will not fall off.

So, in 40 or 50 years, when the rubber absorbers have become – perhaps – worn out, they will withstand their last trip to the factory for their replacement.
The same is true for the silentblocs used for suspending the lighter audio and monitoring circuits.

These various suspensions, tuned on different resonance frequencies, are coupled quite tightly to the chassis, absorbing especially the medium and high frequencies, most important in terms of sound reproduction accuracy.

And while on this subject, have you ever heard an amplifier *singing*? This can occur when the transistors of the final stages and/or the power transformers are not properly decoupled.
They start to vibrate at the excitation signal frequency – in this case the music – this vibration interfering with the *electrical* origin of the signal. You can hear it if the amp is hooked to a dummy load, since in normal use, loudspeakers fortunately mask this disconcerting internal "singing".
No such mechanical singing on the NHB-108 model one! The electric signal is transmitted stage to stage, from input to output, free from any mechanical disturbance, internal or external.

The NHB-108 model one stands on 3 pads incorporating rubber inserts. Oddly enough, *very few* manufacturers rely on 3 legs instead of four.
Weighing around 30kg, the darTZeel needs to have a good stable base. Those three pads are evenly located around the horizontal center of gravity of the amplifier, ensuring excellent stability on virtually any surface.

The absorbing rubber pads dampen the lower frequencies, thus forming the ideal complement to the suspensions described earlier. In the case where you would want to use 2, 3, or even 4 stacked darTZeel NHB-108 model one units, we can make on special request pads of different diameter to maintain the very same vibrational absorption behaviour. These pads are easy to install and can be purchased separately.

T4.4. Everything is transparent

The NHB-108 model one cover is made of 8mm thick tempered, bronze-smoked glass. It harmonizes magnificently with the colours of the housing, and gives an inimitable touch.

The glass is held by a single, central 24k gold plated screw, and rests on a dedicated, cut-out rubber seal, giving to NHB-108 its dust proof quality. Your machine will therefore remain as new for years to come.
The reason why we did not choose a metal cover is not so obvious as it might appear. It is true that to look through the glass of the darTZeel NHB-108 model one is a pleasure for the eyes. Look at those 24k gold plated, 5mm thick pure copper Moon-crescent shaped bar busses, and tell us frankly what you feel…

There are also a couple of technical advantages that glass has over metal.
Its crystalline, inert structure, combined with the rubber foam seal, functions as an internal noise killer.
And contrary to metal, glass is totally transparent to magnetic fields, thus avoiding the inherent magnetic loop that metal would induce over the power supply transformers. Last but not least, the internal housing is much less polluted by magnetic ghosts.

T4.5. TIO, Totally Identified Object

It is however the final touch that makes this darTZeel machine, now installed in your listening room, *your* darTZeel NHB-108 model one:

We refer to the identification plate, fully described in the first part of this manual.

Made from 24k gold plated brass, it is a unique handmade piece, just like the machine on to which it is affixed.

Your name is engraved in gold letters, thus amalgamating the destiny of the darTZeel NHB-108 model one with your future unforgettable musical moments.

We proudly congratulate you!

T5. The audio electronics

Simplicity.

The whole NHB-108 model one electronic concept could come down to this single word.
Simplicity does not mean simple, however.

Purity

Total cancellation or absence of harmonic distortion does not mean "purity", alas.
You certainly know that most musical instruments are very rich, harmonically speaking. Thanks to these harmonics, we can distinguish between a saxophone and a flute.
Did you know, though, that the level of these natural harmonics can easily reach 20 to 40% of the fundamental note, depending on the instrument played? But do we say that an *instrument* distorts?

T5.1. What is distortion?

In the audio world, any signal change is called "distortion". Many different kinds of distortion exist, but we mostly speak about "**T**otal **H**armonic **D**istortion", or THD. THD is so well known that we more than often forget that other ones do exist.

Negative Feed-Back, NFB, is a smart electronic trick used for diminishing or even eliminating all type of distortions, and can be roughly described as follows:

At the amplifier input we put a signal having an inverse deformation from the one it naturally produces at its output. So, the new output signal will be "purified" since the 2 inverse deformations will cancel each other.

This is what the theory says.

Now let us see what actually happens in practice. We will discuss only the best-known distortions, given that their behaviour is simpler to explain.

T5.1.1. Keeping in harmony

Let us take an amplifier especially designed to produce exactly 1% of THD. Then let us feed it with a recorded musical instrument. We shall suppose that this instrument is moderately rich harmonically, say around 20%.

Now, let's be a bit optimistic and suppose that the speakers we will use are truly perfect, without a single trace of any distortion.

Well, now, let us try figure the THD we will have at the output of the amplifier. We could be tempted to say "21%, since 20 plus 1 makes 21, no?"
Okay… So then, which "golden ears" could notice the THD difference between 20 and 21%? Who could swear that the amplifier does add distortion?

In fact the distortion change is even less than this. THD, like most other non-correlated physical phenomena, does not increase in a linear fashion. The "total" THD is equal to the square root of the sum of the squared individual THDs.

A little equation is even better than a less-than-clear definition:

$$THD = \sqrt{(HD_1)^2 + (HD_2)^2 + ... + (HD_n)^2}$$

In our particular case, we only have 2 terms, so the equation becomes:

$$THD\ [\%] = 100\sqrt{\left(\frac{20}{100}\right)^2 + \left(\frac{1}{100}\right)^2} = 20.025\%$$

And now? *Who* could distinguish between a 20.000% harmonically rich musical instrument, and another one producing 20.025%? Not us for sure.
And the very next note, how rich is it? And the next one? Oh! The song has already finished? What sort of music was it?...

Even though in reality THD is a bit more complicated than this, we can still see that *a posteriori*, it does not have the importance that was attached to it for decades – quite the contrary.

If at darTZeel we could completely eliminate THD while maintaining our 3 main criteria, then maybe we would do so. Maybe. Just for the beauty of the gesture.

Some amplifiers available on the market claim extremely low THD figures, at the very limit of in-

strumentation measurement, assuming this result necessarily leads to outstanding sound purity. We take this with some caution, since it recalls for us the 70-80' Japanese philosophy, by which "performance" implies "quality". We have to be fair by acknowledging that such designs can be liked and even loved by audiophiles. The world is big enough for multi musical tastes.
The idea is very nice indeed, and we do admire such a philosophical approach, even if it is not ours: the problem is that those designs are highly sophisticated – too much for our ears – involving lots of added transistors, op amps, and higher than reasonable NFB, leading finally to altered sound structure.
These electronics can be considered as very pure and detailed for the first listening hours or days, but once noticed, their sonic signature becomes harder and harder to bear.

So if THD does not seem to be a determinant factor in the accuracy of the reproduced sound, we have to look elsewhere.

T5.1.2. Inter Modulation Distortion

Now, let us listen to two flute players. The flute is well known for its less rich than usual sound - harmonically speaking, of course! A kind of exception confirming the rule.
If each player produces a different, sustained note, what will we hear? One intermediary note, two distinct notes, or more than this?

In theory we should hear 2 distinctive notes. In theory only? Well yes, because in practice our hearing is not perfect. Truly wonderful indeed, but less than perfect.
Without entering into details, we can nevertheless say that in fact we will not only hear 2 distinctive sounds, but also combinations of those primary notes.

We beg musicians and music lovers to forgive us, but for a while we need to replace notes by frequencies. Not very musical, but much easier for the purposes of our explanation.
If the first flute plays a 1,000 Hz tone, and the second one a 2,500 Hz tone, we will not only hear those two discrete tones, but also the following combinations:

2,500-1,000=1,500 Hz, also called the beating frequency, and also the mirroring part, say 2,500+1,000=3,500 Hz. Fortunately, those combinations are of much less amplitude than the discrete notes themselves. But that's not all! We will also hear the *harmonics* of these combinations! So, frequencies of 1,500, 3,000, 4,500 Hz, but also 3,500, 7,000 and 10,500 Hz will be perceived. Once again, their level will be very low compared to the 2 initial notes played.

It seems hardly believable, but it is true… In practice, though, this is far less embarrassing than you might think at first glance. As said above, the relative level of those "ghosts" is much lower than the basic notes. The result will be heard as if the flutes had some *tremolo*, or vibrating behaviour, a very easily perceived phenomenon. And the combination's harmonics will add some "warming" factor, or on the contrary some "coldness" or "dryness" to the perceived sound, depending on how they will combine together.

So you can see that lMD is even less easy to understand and quantify than THD. And how can we appreciate IMD, can we hear it, at what level does it become a nuisance?

Well, the first thing we can admit is that it is not musical instruments that generate inter modulation effects, but our own hearing – brain included – that is the cause. Some acousticians say than our internal ear can "produce" inter modulation artefacts at levels between 25 to 40%! Of course the brain then does some necessary "correction".

However, this kind of "correction" cannot be compared with an electronic chain, say the microphone and analysis system. So, we feel very uncomfortable about advancing any IMD value from external origin for which our ear is sensitive. In practice it seems that IMD less than 2% (3 to 5% for THD) is considered as not disturbing, even not audible in a musical context, judging by the Single Ended Triode aficionados or by all the psycho acoustical experiments conducted over the past few decades.

By way of conclusion, it appears that IMD, while perhaps more disturbing than THD, remains practically harmless, provided the levels are not outrageously high.

Okay. Now bring on the next suspect…

T5.1.3. Temporal Distortion

In the 'seventies, the famous Matti Otala highlighted a new kind of distortion, not so easy to measure, but clearly audible, called **T**ransient **I**ntermodulation **D**istortion, TID (also called TIM, for **T**ransient **I**nter **M**odulation).

TID occurs when the negative feedback (NFB) loop is in a state of overflow, something that arises more often than you might think since the NFB correction always applies *after* the phenomenon to be corrected appears. During these very short instants, the amplifier can produce more than 100% THD and/or IMD.

At darTZeel, we prefer to call it **T**emporal **D**istortion, or TD, because this is obviously what it actu-

ally is. It is one of our favourite subjects for discussion, since it is here that we can find the key to the problem.

Since the CD came on the scene, lots of water has flowed under bridges. In the 'nineties, a big bug reared its ugly head on the "perfect sound for ever" road. Its name is "Jitter", and it is, more scientifically speaking, an "uncertainty of chronometer precision".
Jitter is nowadays well known, and well explains why temporal errors, even when small, lead to amplitude distortion. Effectively, a "0" or a "1" not arriving on time will be translated into output amplitude which will not be proportional to the input amplitude of the signal. We all know how jitter "sounds", when not cured.

Thanks to – or because of – this famous jitter, a truly digital calamity, we can better understand that temporal distortion will alter the precious and delicate analog, musical signal. In the analog world, though, TD is more subtle and more difficult to treat and cure.
In the darTZeel NHB-108 model one, everything has been done to preserve the temporal integrity of the music.

There are two principal means for reducing, or even eliminating, TD.

The first is to use several small but local NFB loops, instead of a bigger and slower, global NFB loop. This approach greatly improves signal transfer speed and propagation delay time.
The second is based on the principle that temporal error is equivalent to *phase shift*. So if one can enlarge the frequency response by a factor of ten (say 200 kHz), phase shift will be also greatly reduced.

Ideally, the best would be to apply both means described above. The only problem is that they contradict each other. High bandwidth generally requires higher global NFB, while low NFB leads to poorer frequency response.

Here is where the darTZeel NHB-108 model one comes in, the first very low NFB *and* high bandwidth power amplifier. No global NFB is used, and both 1st and 3rd stages are even open loop! So what about the frequency response? Everything is okay up to the Megahertz range (1,000,000 Hertz), say *fifty* times the audio range!

T5.2. What application field?

The electronic schematics of the darTZeel NHB-108 model one's audio circuit, as we will soon see, is astonishingly simple.

"It's because the NHB-108 has high THD and IMD values", would say our well-meaning detractors.

If you have read us from the beginning, you are now perfectly aware that harmonics are not directly responsible for the sonic signature of an amplifier.

The apparent simplicity of our audio circuit has been effectively made possible through our choice of semiconductors technology.

If the THD and IMD produced by the amplifier are kept low enough, say lower than the audibility threshold, then no further correction will be needed, and the audio circuit can remain simple.

At the start of this new century, 3 main technologies coexist in the construction of transistors, these being in chronological order:

- Bipolar, in the early 1950s.
- Field effect, in 1962.
- IGBT, a mix of the previous two, in the 'eighties.

At darTZeel, we strongly believe in new technologies. On the other hand, we readily admit that nothing can replace experience.

So, "our" winner is…

Bipolar technology!

T5.2.1. IGBTs

For your own information, we are ready to tell you an old secret. What does the word "transistor" mean?
It comes quite simply from the contraction of *transfer* and *resistor*.

IGBT stands for "Insulate Gate Bipolar Transistor". It behaves like a bipolar transistor at its output, while being driven like a FET at its input.

IGBTs are mostly used in power applications, like inverters, switching power supplies, heart defibrillators, and… for some audio power amplifiers.

We do not have any preconceived notion about the use, and more specifically, the sound of IGBTs. Results can vary with the samples used.
Their linearity is close to FETs, which is, alas, not enough for us.
IGBT technology is by far the youngest, and we lack time to fairly judge them as to their long-term sound quality, reliability and availability.

So for now, and maybe for still a little while, we will probably not use them directly in audio applications.

T5.2.2. FETs

FET stands for "Field Effect Transistor", of which there are two main categories. For small signals, they are called as is, FETs.
For power applications, their most common name is MOSFET, which stands for "Metal Oxide Silicon Field Effect Transistor". They behave similarly to FETs, but their internal structure may vary.

FETs are being used more and more, for several reasons, including the most obvious one:

It is commonly accepted that they perform very closely to vacuum tubes (or *electron tubes* or *valves*). Tube lovers generally like MOSFET amplifiers due to their similar behaviour.

Here, we are forced to say that we do not share this point of view. Not entirely, at any rate…

It is true that the sound of MOSFETs tends to be soft and warm, a bit like those found in tubes. But their electrical behaviour is not similar, simply because they are not made of similar materials.

The only true similarity is that MOSFETs – and FETs of course – are voltage driven, like tubes. Apart from that, they are in two different worlds, vacuum for tube, silicon for FETs.

Conduction in any type of transistor always acts in a solid, here the metallic silicon, hence their name of "solid-state" devices.
In a vacuum tube, electrons move in… a vacuum.

Coming back to FETs, what is their sound? For most designs, we would say that it is only a matter of taste. We are convinced that one can design a "standard", good sounding machine in the 3 technologies mentioned above, and even with the fourth - tubes - with virtually the same sound.
Obviously, if you like *music*, you definitely need a darTZeel NHB-108 model one.

Yet, and contrary to common belief, MOSFETs are less linear than bipolar transistors available today. MOSFETs often need more sophisticated added circuitry to make the best of their possibilities, and that means a longer and more complex signal path, and hence a reduced resolution.

MOSFETs are also slower, in absolute terms, than bipolars, and are much harder to drive in pulse mode.

Reproducing very fast transients requires a lot of instantaneous current drive, not easy for the power supply to properly feed, so temporal integrity could suffer.

T5.2.3. Bipolars

These have been in existence for more than fifty years. The industry knows them very well. Today's bipolars are better than ever. Ultra linear and extremely fast, they are perfectly suited for very high-end audio applications.

Their excellent linearity makes it possible to minimize the number of peripheral components, thus obtaining a straightforward signal path, with many less superfluous correction circuits.

In the NHB-108 model one, the audio signal travels through only 6 transistors, from input to output, maintaining low THD and IMD levels, and without using any global NFB, the output stage even operating in a totally open loop! The *slowest* transistors used have a bandwidth of more than 30 MHz, much higher than for a MOSFET. This extreme intrinsic speed allows a total phase respect across the whole audio range, without *any* static or dynamic deformation. In brief, no Temporal Distortion.

In terms of music, these breakthrough advantages bring you closer to the musicians. Now you can share the emotion of the violinist, the fire of the conductor or the sweetness of the flutist.

Words are however not enough to describe what a single bipolar transistor pair is capable of. The best is still to invite your friends home, making them understand, share and believe *your* ears.

T5.3. The circuit of darTZeel

T5.3.1. Criteria of choice

Simplicity.

The audio circuit of the NHB-108 model one uses only 14 transistors in all, including current sources.
Only three different bipolar transistor devices are used, all of the same brand.

Purity.

The version **B** of the darTZeel NHB-108 model one takes unprecedented care of the precious musical signal:

There is absolutely no connector, switch, fuse or relay (save for the XLR inputs) in the signal path. Even better, we did not use *any* of these devices except in the AC mains input.

By using one single pair of output devices, and by not limiting the output current, we are able to obtain unbeatable dynamic reproduction.

No output DC voltage drift compensation when this function is released – please refer to the first section of this manual – offering a truly breathtaking sound, from whispers to loud shouts.

Only a single, small, local symmetrical DC NFB, leading to extremely wide bandwidth, included in the very low frequencies, without addition of any multi polar phase shift.
The use of a very compact printed circuit board (PCB) reduces track lengths to the strict minimum.

Reliability.

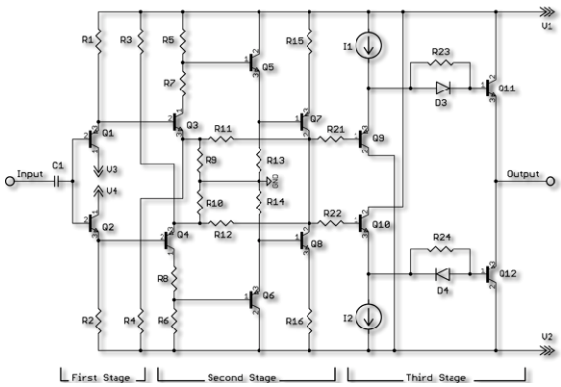
The NHB-108 model one does not use any "exotic" or "esoteric" component. Each element was chosen for its intrinsic sound qualities, its long-term availability, and for its long life. No compromise was conceded as to the build quality of any part or component. Some of them were tested for *15 years* in our lab before being selected.

T5.3.2. darTZeel schematics

For the most curious readers, we give hereunder the functional diagram of the darTZeel NHB-108 model one.
Connoisseurs will appreciate how simple it is, so different from the common belief of "bigger is better".

For once, we give the description in French, which is, after all, the very original text. A translation can be provided on special request.

This schematic is multi patent protected



Description du circuit:

3 étages, en technologie discrète, se décomposent ainsi :

1er étage, étage d'entrée. Cet étage, dépourvu de toute contre réaction, amplifie en courant le signal d'entrée, de telle sorte qu'il ne subisse aucune charge susceptible de le déformer. La simplicité apparente de ce premier étage (1 seul transistor par polarité) permet des vitesses de commutation très élevées, sans rotation de phase notable dans le spectre audio.

2ème étage, étage d'amplification, amplifie en tension le signal à la valeur nominale requise. Cet étage comporte 2 demi contre réactions locales, implantées de manière symétrique. Cette contre réaction symétrique s'effectue sur tout le spectre de fréquence, y compris le courant continu, afin d'apporter une réponse parfaite dans le grave.
La configuration de ce circuit permet une propagation de groupe homogène sur tout le spectre audio, grâce à la faible valeur de la contre réaction.

3ème étage, étage final de sortie, dépourvu de toute contre réaction. Cet étage amplifie en courant le signal issu de l'étage précédent, permettant ainsi d'alimenter un haut parleur. Le courant de repos des transistors de sortie est ici défini par une tension de jonction base-émetteur, et non par un courant de polarisation. Ce système élimine le besoin d'une régulation thermique. En effet, lorsque les valeurs initiales ont été fixées, tout échauffement des transistors de puissance entraîne également un échauffement des transistors drivers. La tension VBE chute aussi bien dans les drivers que dans les éléments de puissance, garantissant un équilibre thermique stable. Ce montage permet également des bandes passantes très étendues, sans déphasage important.

The above description is an extract of the original patent text, and is condensed to cover other applications, even in the non-audio field. To be added in the fly, the darTZeel NHB-18NS preamplifier circuit is directly derived from the NHB-108 model one schematics.
If you have any specific questions about this circuit, please do not hesitate to contact us at more-info@dartzeel.com

T5.3.3. Component layout

In analog, especially in audio, the layout of components is of paramount importance in the signature they can print onto the musical signal. A transformer too close to input circuits, or a power supply located too far from output devices, are just some examples among others. These parameters are difficult to cope with, particularly when cost considerations come into the picture.

The internal volume was exploited down to the last cubic centimetre. Output power devices are located less than 10 centimetres from the huge crescent-like bus bars. All the energy coming from the capacitor reservoir can then effortlessly flow to the output bipolar transistors.

Also, the Power Nose – please read the *Owner's manual* for more about the terminology we use – does not directly switch the AC mains, but drives static, semiconductor relays, by mean of a dedicated circuit powered by its own power transformer. This approach allows freedom from any electromagnetic disturbance from AC, and also to soft start the amplifier. The switch is also subject to less wear, since no spark can appear at its contacts, extending its lifespan close to one *million* ON-OFF operations.

We also placed inputs connectors directly on the input PCB, themselves very close to the entry audio PCB points, altering as little as possible the still unamplified incoming music.

Dozens of other small things have been thought about and implemented. We would need too much space to describe all of them; furthermore, such a description would be much too boring. Please believe us, we have done our best to look after the precious and delicate musical signal, leaving as little as possible to chance.

T5.4. Symmetrically balanced?

The following could seem contradictory sometimes. It is mainly due to the terms "balanced" and "symmetrical", or "unbalanced" and "single ended".
In French, these terms lead to even more confusion, since both "balanced" and "symmetrical" are translated by "symétrique".
So, you will not feel less comfortable than our French-speaking friends. Feel free to contact us at moreinfo@dartzeel.com if you need explanations in greater depth.

It is absolutely fascinating to note that some technical choices only serve fallacious sales arguments, and to our regret, audio is no exception to the rule…

Most high-end power amplifiers, especially flagship models, offer balanced inputs, described as being the very best, technically *and* sonically speaking. As often as not there's no option as regards balanced inputs: in fact there's nothing else!

For the darTZeel NHB-108 model one, our approach has been almost the opposite. To minimize the cost? Could you even believe that?

Maybe the time has come to refresh our memory to some extent…

T5.4.1. From the microphone…

A balanced line is in fact a transmission line without reference to ground. Imagine that instead of transmitting the signal between one wire and ground, we use *two* wires. A 3rd cable, earmarked for ground, is of course also present, even though not necessary for the signal right now.
This transmission mode finally leads to external noise and disturbance cancellation.

In pro audio engineering, balanced lines are *de rigueur* and massively used. Unbalanced links are very rare indeed! The reason is very easy to understand:

Microphones generate very tiny electric signals, and very long lengths of cable run from the studio to the mixing console. In these conditions, it is primordial for the signal to be free of any hum and/or noise.

Also, in concert performances, mixing consoles are generally located quite far from the stage, and balanced lines are welcome. A technical trick, using that 3rd, ground wire, also makes it possible to carry the phantom power supply feeding electrostatic microphones.

So now you have understood that balanced links are used especially in professional applications.

T5.4.2. To the loudspeakers…

Let us quit the studio and come back to the high-end, musical world.

Basing themselves on what they consider to be the real benchmark, audio companies equip their flagship machines with the balanced lines described above, using the well known XLR connectors.

Most of the time they offer "fully active balanced" topology from input to output, claiming that the sound will remain unaffected since it is immune to external disturbances.

Technically speaking, fully balanced topology is relatively easy to achieve. It suffices to double the entire electronics, in a mirroring fashion, assigning a new channel path for the inverted signal. Of course this simplicity has a price, in fact *double* the price. Finally, the balanced signal is amplified and routed to the loudspeakers.
Come to think of it, are loudspeakers balanced or not balanced? That is the question!

T5.4.3. And into the air…

Once in the air, the musical signal is travelling on its last trip before delicately tickling your eardrums.

How exactly does music propagate itself in the air? Music is a matter of vibration, and propagates in the shape of *waves*. Any wave, to be propagated, needs a medium. No medium, no wave, no sound. Just try playing trumpet on the Moon. Not an easy task, even if your name is Armstrong…

What about *radio* waves? What medium do they use, in the vacuum of inter-sidereal space? Well, write us, and we will send you the *Physicist manual*, as soon as we have got round to writing it…

As for *acoustical* waves, it is a much easier phenomenon to describe, and especially understand, since it is part of our daily life.

The medium can be water in the case of mermaids singing… er, sorry, when *whales* sing. Or when more human, technological things such as sonars, hydrophones and the like generate and detect acoustical waves.

The medium can also be *steel*. The hammer hitting the string, in a piano, generates a pulse which creates a propagating wave *in* the string, making it vibrate. Then this vibration will be eventually transmitted into the air.

Air: this is the ultimate medium where man-made music propagates. Music is spread in wave form, the latter being described by a physical law, called "wave propagation theory". We will not enter into the details, but mention just one crucial and essential point:

Acoustical waves do not *move* air.

When we read in some high-end magazine that such and such a flagship loudspeaker can blow out a candle while reproducing a trumpet or a saxophone, this is just metaphorical.

The sound is produced by the *vibration* of air molecules, step by step. Yes, you did read correctly. It is *vibration*, not *movement*.

If you know a friend who plays trumpet or saxophone, just put your hand on the bell and you will only feel vibration, not a single tiny puff of wind. By the way, you would never think about a piano being able to stir up air to produce wind, would you?

These vibrations have a purely single-ended behavior, since they are produced around a point of equilibrium, where vibrations are zero.

To cut a long story short, we can say that the whole acoustical chain is single-ended. The only moment when the acoustical signal could be balanced is when it travels into the electric wires. In the air, sound is unbalanced, asymmetric, single-ended, as you prefer.

Why then, this obsession to balance a naturally unbalanced signal? Is it not against nature?

Furthermore, where is the real advantage in running the loudspeaker in balanced mode? To our knowledge, there is *no* balanced crossover in the market! Has any manufacturer already told you that there is no such thing? Okay, now you've been told.

T5.4.4. Via the darTZeel

In the version **B** of the darTZeel NHB-108 model one, we have also installed balanced inputs. Did we do this just in order to be "with it"?

First, we want to stress that we use *floating* balanced inputs. This means that rather than doubling the whole electronics, as seen above, we use high quality input transformers. Of course the use of transformers is much more expensive, but the resulting performances are far superior.

Speaking of external disturbance immunity, transformers are much better than full active balanced topology. The common mode rejection (this is the name given to that kind of immunity) can be – wait for it – no less than *five thousand* times better when using transformers instead of full balanced circuits. Another, unbeatable, advantage is that they offer true electrical isolation – called *galvanic isolation* – between the line and the gear, providing outstanding safety in professional use. Last but not least is the fact that all the above-mentioned qualities are defined at the building stage, meaning that performances will not decrease over the years or even decades to come. This is not by any means the case in full active balanced versions.

In conclusion, we cannot resist insisting on the fact that a full active balanced solution utilizes twice the number of components, implying a more complex signal path, less reliability, and furthermore, especially in power amplifiers, an output impedance *twice as high* as with single-ended topology, and requires a higher output stage NFB to compensate.

Now that you have read these simple but demonstrative explanations, do the words "full active balanced" still mean "absolute superior sound" for you?

All this explains our choice for using, as a matter of course, transformers of the highest quality for our XLR inputs in the version **B**.

We said above that by very nature, music is part of a single-end world. More than 100 years ago, designers chose floating balanced lines – full balanced was not ready yet – for long distance links for the sole purpose of minimizing external disturbances.

Electric signals were therefore transmitted in a balanced way, the equipment working in single-ended mode.

The NHB-108 model one version **B** offers this very same possibility to professional users wanting to link their remote consoles to the NHB-108 model one, without having to use poor quality Balun-DI devices.

Despite what all our esteemed competitors might think, we nevertheless assert *and* corroborate that the one and only means of processing, amplifying and broadcasting a musical signal without altering it, even in the slightest, is simply to use the single-ended mode.

But only in a special way, though…

With short cables, say less than 10 meters, symmetrical - balanced - transmission does not have any justification but marketing. A given gear "singing" better in balanced mode only reveals poor design in some part of the circuit, which can be partially masked by internal disturbance cancellation.

Over longer lengths, external disturbances like hum, RFI and so forth take on a greater degree of importance.

The disturbances' intensity can be figured out by computing the RMS signal to noise ratio, in decibels.
A balanced, high quality, *floating* line can reach more than 120 dB of rejection, or -120dB relative to the signal, which represents one part per million, 1 ppm, a truly remarkable performance.
In full balanced mode, the result is far inferior, and in practice is barely better than -60dB, 0.1%. This may seem small, but just keep in mind that this implies component tolerances tighter than 0.5%, a truly demanding task. Professional consoles capable of such results are truly high-end by their 6+ figures price.

It is very important to point out that balanced lines, whatever they may be, are not impedance matched. *This means that even though they are fairly immune to external disturbances, they alter the musical signal proportionally to their length.*
Just ask a sound engineer if he is happy to use a cable 100 meters long when 10 meters are plenty enough.
Just ask him if high frequencies do not suffer from very great lengths, of the order of 100+ meters.

The 50Ω links used in the darTZeel NHB-108 model one, and described hereunder, behave differently…

T5.5. darT *to* Zeel 50Ω

The NHB-108 model one is equipped with 50Ω BNC connectors.
After a lot of research, we concluded that the *one and only* means for transmitting an electrical musical signal with no alteration or losses over a long distance is impedance matched lines, from end to end.

We have already mentioned that the darTZeel NHB-108 model one was thought up without any compromise in mind, especially regarding its cost price.
We confirm this once again, of course, but the purpose here is just to say we pursued this quest of sound purity simply because no other amplifier could bring us what we were looking for. So we designed the NHB-108 model one.

As for electric transmission lines, we didn't want to reinvent the already existing wheel. Perfect impedance-matched lines have been in use for almost a century. And so have coaxial cables.
Impedance matched links are utilized everywhere when high tech performance is needed. Radio applications, radar, microwaves, computers, and all such precision technologies use impedance-matched links. So why not audio?

The great advantage of impedance matched-links is their virtual absence of losses, whatever their length.
For those of you who want to know everything about matching impedance in audio links, do not hesitate to contact us at moreinfo@dartzeel.com

Propagation time delay is preserved in DC up to several GHz in such lines, and no other link from any make can claim this, unless perfect impedance matching is achieved.

So the NHB-108 model one is fitted with such inputs, here called "Zeel 50Ω", while the darTZeel NHB-18NS preamplifier has "50Ω darT" outputs.

These inputs/outputs use 50Ω coaxial cables fitted on BNC connectors.

External disturbance immunity of a coaxial link depends on the cable itself. It can vary from -50dB to -100dB or more, the latter being greatly superior to the full active balanced mode, and all this, please bear in mind, *without any sonic alteration*.

You can use very affordable off the shelf RG58U cable, and will be very surprised by the result. Many shorter but much more expensive cables do not do better! And when there is a big length increase, there is no shadow of doubt, darT *to* Zeel 50Ω is simply unbeatable. Trying and hearing is just believing.

The optional coaxial cables delivered with the NHB-108 model one are furthermore of the high-end grade, silver plated pure copper, designed for hyper frequency applications. You will at last discover what resolution *really* means…
As stated above, one of the main advantages of darT *to* Zeel links is that you can locate the power amplifier as far as you want from the preamplifier. No more treble roll off, harsh or fuzzy. No more sluggish low end.
The theoretical length limit is… infinite! In practice, we recommend not to use lengths greater than 1 kilometre (we are *not* joking here, for once.)

This new way of linking is still in its infancy as regards audio, even if some of our esteemed competitors disagree. darTZeel will also offer in the near future, for professional applications, darT *to* Zeel *floating* balanced links.

Are you looking for darTZeel sound integrity in concerts and pro audio studios? You can have it just for the asking.

T6. Onboard safety

A power amplifier like the darTZeel NHB-108 model one cannot but offer the highest quality level when it comes to monitoring and protection.

Purity.

But we did not call this part of the NHB-108 model one the "protection circuit", by far preferring "supervision system", or "monitoring circuit", as you prefer. Indeed, this very sophisticated module is kept *totally* outside the signal path, electrically and physically, again so as not to disturb the delicate musical message.

Reliability.

The supervision system is based on a 100% analog design, making it independent from any problem or bug coming from a microprocessor.
The vital passive components have been selected for their extremely long life, greater than 40 years in continuous use. Your loudspeakers – and yourself – can rest on both ears, for quite a while.

T6.1. Crowbar circuit

You will have read this odd name several times in the first section, maybe without having a clue about what it really is.
This circuit has been well known for decades in industrial power electronics. By power electronics, we mean powers ranging from 50 to 200 *kilowatts*, like in on-line inverters used for mainframe computers or in hospital surgery "white" rooms.

On these powerful machines it is not always easy to suddenly cut off the power supply without causing electrical damage. Inductive loads can release huge energy transients which need to be properly directed.

Generally the best solution is to insert a fuse – rather a big one of its kind – between the supplies and the loads. In case of emergency, you only need to *short circuit* the power at the load terminals. But this is easier said than done: the sudden, huge current peak generated, well supported by the power inverter, immediately melts the fuse, shutting the load down. If the fuse is located at the input of the inverter, the *entire* supply system will be stopped.

It is such a circuit that we have installed in the NHB-108. When an anomaly or a faulty condition is detected, the Crowbar circuit, consisting mainly of a power thyristor, is activated.
The Crowbar shorts the power supply, melting – actually evaporating – the mains fuse of the channel concerned.

The principal advantage of such a Crowbar circuit is that it can be kept *totally* outside the audio signal path, thus completely avoiding any influence on the music.

Its caveat? The price. Thyristors like those we use in the NHB-108 model one can short peak currents of around 1,400 amperes. They cannot be considered as being "cheap" parts.

T6.1.1. Crowbar activation

In the first section of this manual we often mention that the Crowbar can be triggered, in cases where you have not followed the instructions for use.

To dissipate any remaining doubt from your mind, we would like to mention hereunder the faulty conditions which will trig the Crowbar:

- Using less than 3Ω nominal loudspeakers with dramatic impedance dips of less than 2 ohms, while the speaker's impedance selector is on **Hi** position.
- Short-circuit at speaker terminals.
- Output DC voltage drift greater than 2 volts at speaker terminals.
- Powering ON the darTZeel NHB-108 model one while speakers are not hooked to the speaker terminals.

T6.1.2. Crowbar cycle

For those who want to know better when and how the Crowbar acts, here are some further explanations…

When one of the following elements and/or signals, or a combination of them is detected, namely:

- An output DC voltage drift greater than 2 volts at speaker terminals;
- A permanent output current greater than 7 amperes, while the power supply impedance is on **Hi** *and* output voltage swing is no greater than 60 $Volts_{p-p}$;
- A permanent output current is greater than 14A;
- A peak, transient output current greater than 25A and longer than 25ms;

Then the power thyristor, paralleled with the total supply voltage, is trigged, i.e. put into conduction. The huge, abrupt short-circuit current peaks to around 350 amperes for 6.5 ms, completely releasing the filtering capacitors' storage energy, through an appropriate, custom designed choke absorber.

This sudden current rise at the transformer's secondary windings also implies a very high current at its primary windings, proportional to the inverse ratio of the primary to secondary voltages. This current is at least 20 times greater than the nominal value of

the fuses. The metal in the latter literally evaporates instantaneously against the glass envelope, as testified by the latter's black silver colour.

While you are replacing the melted fuse with a new one, the Crowbar circuit will have reset itself in the meantime, and will now be ready to work again, just in case. It is important to note, however, that if a newly replaced fuse is blown at power ON, you *must* follow the first section of this manual, that is to say unplug your darTZeel NHB-108 model one and contact us at troubles@dartzeel.com.

Never, ever, replace faulty fuses by values different than those originally indicated in the chapter 6.1.
RISK OF FIRE!

T6.2. Supervision system

T6.2.1. Current sensing

Most available amplifiers, if not *all*, use an output current limitation circuit, protecting the output stages against any possible overload.

This current limitation generally takes the form of one or more transistors that will shunt the incoming signal to ground when the current has reached a defined value. The current sensing is taken through one of the emitter resistors of the output stage.

Although very efficient, this type of protection is unfortunately located in the very heart of the amplifier, and cannot be kept apart from the signal path.

Other manufacturers, in order to avoid such an intrusive protection circuitry, just insert some fuses either in the rail supplies, or even worse, directly in series with the output speaker terminals. Of course this solution is by far the least expensive, but is sonically a true disaster. Any given fuse behaves as a non-linear resistor. Its resistance is substantial, and is thus not very compatible with high quality reproduction. Last but not least, fuses inserted in this way do not react quickly enough, leading to damaged components.

Purity.

As you might have guessed, in the NHB-108 model one we have used a somewhat different approach.

Rather than limiting the output current, we far prefer to measure in real time the *output power dissipation*. It is finally the output stage's temperature that defines its working range. An output device does not fail because the current is too high, but simply because the *temperature* caused by this current rises too much.

So, our monitoring circuit compares the instantaneous power dissipation with the value that the output stage can handle. There is no thermal inertia here, since we just measure the right thing at the right place. A premiere in the audio field, we can modestly say…

We then measure voltage *and* current passing *through* the output devices. Without adding any disturbance in the signal path? Yes, indeed.

As for measuring the voltage across the output devices, it can be done quite easily without altering the signal. Good news. For the current, however, it's quite another story.

Keeping in mind *not* to harm the audio signal, which is *music* after all, we use a special Hall effect electromagnetic sensor. The speaker wire goes through it, coupled magnetically.

This sophisticated current sensor has the enormous advantages of presenting an extremely light load, in the region of 10,000Ω (compared to the 8 ohms of a speaker), of *not interrupting* the signal path, and of being truly linear from 0 Hz to more than 150kHz, well above what is needed for music.
Its main drawback? The price, once again.

Simplicity.

To put it briefly, the monitoring circuit allows unlimited peak currents for the time necessary to produce any transient generated by instruments such as the piano or drums.

By using such a sophisticated supervision system, a *single output pair* bipolar device can safely manage the demanding task, ensuring the sonic purity laid down in the specifications.

T6.2.2. For *its* eyes only

The monitoring circuit not only takes extreme care of both your amplifier and loudspeakers. It can also anticipate.
The darTZeel NHB-108 model one's Eyes, better described in the first section are also controlled by the monitoring circuit.
Apart from their – we hope – aesthetic appeal, they warn you when limit conditions occur. With some experience, you will be able to use them as a thermometer. Sorry, this *is* a joke.

T7. Power supplies

T7.1. From mains to loudspeakers

More and more, audio manufacturers are insisting on the quality of the power supplies. They are quite right!
After all, the electric energy fed to your loudspeakers comes from the power supply and nowhere else.

The audio circuit itself is really just a sort of regulator for this energy.

The better the quality of the source energy, the easier the task of modulating it into sound waves.

This modulation is truly the audio signal you listen to. It is this same signal that will deliver the energy supply to your loudspeakers, which in turn will excite the air molecules to vibration, producing that magical feeling we audiophiles call "music".

In your darTZeel NHB-108 model one, the power supplies are not really standard ones. The amplifier is a *true* dual mono. We apologize about stressing the word "true", but much too often this description is abused.
The NHB-108 model one has 2 fully independent power supplies, one for each channel. The two channels are fully insulated, respective ground paths included, from each other. The crosstalk figure speaks for itself, at more than 90dB separation across the entire audio spectrum.

Toroidal transformers, each of 300VA, are wound on 450VA cores. Magnetic fields are thus reduced to the point that no core saturation can occur, ensuring clear power output under any dynamic conditions, without induced hysteresis distortion.
Cores are grain oriented, and primaries are electrostatically shielded from the secondaries, keeping RFI away. The entire units are impregnated in epoxy resin, eliminating possible winding vibration.
As seen above, the transformers are also suspended. Their residual mechanical noise is so low that even in *very* quiet listening rooms, you will not be disturbed anymore.

Immediately after the rectifier bridges, the DC sources are filtered by 6 paralleled, 22mF capacitors, which corresponds to 132,000 µF per channel, totalling a whopping storage energy of 230 joules per channel. Not so bad for a 100 watter…

The copper bus bars, CNC water-jet cut in 5mm-thick blocks, connect the filtering capacitors' leads together, creating as it were a low impedance power supply “on the spot”. The output transistors are located only a few centimetres away from the power supply: hence no problem in case of high current demand.

Our power supplies are filtered only, avoiding any dynamic limitation for which regulated supplies are often responsible. Fully regulated supplies have very low output impedance through high feedback regulation (NFB everywhere!). When huge dynamic changes arise, the NFB is in a state of overflow and the output impedance suddenly increases dramatically, causing dynamic compression. Does this remind you of something?

T7.2. Voltage or current?

For purity reasons invoked earlier, the output stages of darTZeel NHB-108 model one only have a single bipolar pair of output transistors.

The vast majority of amplifiers of over 50wpc use paralleled transistors, from 3 to 48(!) – or even more – pairs. The purpose of this parallelism is to obtain a greater output current, as required by low impedance loudspeakers.
This method is much cheaper than the solution used in the NHB-108*, power transistors being much less expensive than in the past.*
But parallelism has numerous drawbacks, as follows:

- *The need to match components for even heat spreading.*
- *The signal path is divided into multiple parallel paths, leading to TD (Temporal Distortion) by degradation of propagation time delay uniformity, each path not being of the very same length.*
- *Much longer mean path length, considerably increasing the output impedance, and hence the need for a greater NFB at output stage. This also induces TD.*
- *Much greater physical volume and area, limiting the high frequency response because of higher RFI sensitivity.*

And this list is unfortunately not exhaustive.

Without special precautions, the use of speakers with nominal impedance of 4Ω or less on a single output paired stage can cause excessive dissipated heat, outside the safe working range of the output devices.

We gave great thought to this and finally came up with a solution, allowing the use of 2Ω, or even 1.5Ω loudspeakers, if you can find some, without significant loss of power, yet with the same sonic quality attributes.

Power transformers have 4 identical secondary windings. Depending on whether they are connected in series or parallel, the result is a big voltage or a big current.

For loads between 3Ω and 8Ω, the current remains fairly low, around 7A RMS, corresponding to about 200 watts under 4Ω, but the voltage needed is relatively high, in the region of ±50 to ±60 volts for delivering a comfortable 130 watts under 8Ω.

Conversely, 200 watts under 1.5Ω need an RMS current of 11.5 amperes, but with only 17 volts RMS as an output voltage, allowing power supply rails of about ±25 to ±30 volts.

By switching the secondary windings accordingly, the power transfer is optimized and the power transistors in the output stage remain within their safe working range.

So we can only use one single output transistor pair per channel. The signal path is shorter, uniform, and only passes though one silicon junction at a time.
Music is thus reproduced with unprecedented ease, purity and fidelity, simply impossible with more complex designs.

T7.3. Received idea

This chapter devoted to power supplies would not be complete without the following little addition, small in size but of great significance…

It is usually admitted in the audio world, particularly in the high-end manufacturers' community, that output current availability is of paramount importance, to the point where one praises machines capable of outputting dozens, or even hundreds, of amperes.
What nonsense!

Until the contrary is proven, as far as we know voltage and current are in a certain relationship, as clearly stated by Ohm's law:

$$V = R \bullet I \qquad I = \frac{V}{R} \qquad R = \frac{V}{I}$$

It is of course the same equation, just written in its 3 most usual forms.

Now, let us take an ideal amplifier, capable of delivering *exactly* 250 watts/8Ω, 500 watts/4Ω, 1000 watts/2Ω, and a whopping 2000 watts/1Ω.

The currents needed to deliver these abundant and generous powers are, respectively, of 5.6A, 11.2A, 22.4A and 44.8A.

Yes, we have to admit that the last figure is quite high… So, this amplifier can deliver roughly 45 amps under 1Ω.
Now say that you own speakers having an impedance of 6Ω, much easier to drive than 1Ω. How many amperes will this imposing amplifier deliver to your loudspeakers? 45 amperes with a big smile? Not at all!

Given Mr. Ohm's law, the amplifier will deliver at its best 333 watts, say 7.45A under 44.7volts.

So you can see that in the *real* world, you just need 7.5 amperes, not 45. Let us confess that for 333(!) watts, this is quite reasonable…

Do you now better understand why "Lots of Amperes" does not necessarily mean "Superb Bass"?

T8. The sound of darTZeel

It is always hard to define objectively what we perceive subjectively, isn't it? How to enjoy an excellent glass of wine, if not sharing it with friends?

We could say that the darTZeel NHB-108 model one offers an outstanding temporal linearity, allowing true three-dimensional re-creation.

We also could say that the bass is deeper than the Mariana Trench, with every nuance incredibly rendered.

We could add that voices are so sweet and timbres so accurate that you will turn your head, believing that someone has just entered the room.

We could even conclude that no cymbals can be better reproduced than through our machine.

Instead, we will just invite you to take a seat and listen to some good music…

After all, if you read this manual, you certainly already *own* a NHB-108 model one, and you know better than anyone what we are talking about. So why do we need to produce any further advertising? In fact, just for the fun of it. And music is fun too, isn't it?

T9. Reliability

T9.1. Quantified longevity

"How long does a darTZeel NHB-108 model one last? Before first failure?"

Well, let's us try to see a bit more clearly, and seek a better understanding of the different causes of failure…

Assuming that the first possible failure will be due to the weakest component, we could be tempted to install only the longest lasting components.

Is the first criterion, "Purity", compatible with "Reliability"? If a component lasts twice as long as another, but sounds twice as bad, what would be the lesser evil?

Before giving a firm answer, it is interesting to ask ourselves what are the most influential parameters affecting the life span of a given component. Several studies show that one key factor is *heat*.
This might seem obvious, and we have all experienced once in our life the consequence of leaving our beloved CDs – or cassettes for the most experienced of us – under our car's rear window on a hot summer's day…

What is far less known is the mathematical relationship between expected lifespan and high temperature exposure.

Many studies have shown that for each 5°C increase, lifespan is halved! Sorry about not converting into Fahrenheit - the law doesn't work out so easily. Sometimes the metric system is not so bad, especially when one wants to launch a probe to Mars… But that's another story.

Back to *our* story. If a component lifetime is given for 10 years at 20°C, it will only last *one day* if permanently exposed to 80°C! This very same component will last for *40 years* if ambient temperature is only 10°C…

This law does not take all parameters into account, but it is close enough to reality to rely on it when designing electronic circuits.

We see then that while it is very important to choose components designed to resist high temperatures, it is always preferable to stop the problem at source, by simply ensuring that components do not overheat.

In continuous round the clock domestic use – but is this still domestic use? – provided you respect the location advice mentioned in the first section of this manual, the NHB-108 model one stabilizes at around 50°C on its heat sinks. As bipolar transistors can work as high as 120°C, the margin is comfortable here.
The internal temperature, on the mother plate module, is around 40°C. At this crucial place are installed the very expensive filtering capacitors. Do not be worried too much: at 40°C, 24/24, their estimated span life is… 40 years.

Just imagine: a poorer design – we will not mention any name – subject to an internal temperature of 60°C would imply a change of capacitors every 2 and a half years!

Furthermore, in normal use, say if you sometime power OFF your machine, capacitors' life span can be easily doubled, or even quadrupled.

As soon as we realize that working temperature is the most long lasting factor, it becomes easier to choose components for their sonic attributes first.

Another factor, even less known but very interesting, is that of sustaining bias powering. A given component, being active or passive, lasts longer if some voltage, however low it is, remains applied to its terminals. For electrolytic capacitors, this small "polarizing" voltage even keeps their internal electrolyte in perfect chemical working condition, greatly reducing the "warming time" usually needed with other gear.
All these reasons led us to keep the darTZeel NHB-108 model one powered at around 2 volts (instead of 60), even when shut OFF, by pressing the Power Nose. Your amplifier is then always gently permanently energized, extending even further its life span, and attaining much more quickly the full performance the amplifier can deliver to your ears.

It is also the reason why you can still hear some music through the NHB-108 model one even when it is powered OFF. Incidentally, the fact that the amp can sing with such a low voltage demonstrates how simple the audio circuit really is…

In case you are worried about this, the power consumption of the "power OFF" mode is around 2 watts. It represents around $5.33 per year, assuming that a kilowatt/hour costs $0.33. This means $160 after 30 years. It is not too high a price to pay compared to changing the capacitors more frequently! Bear in mind that producing new capacitors pollutes more than keeping them energized… With all sonic benefits.

T9.2. Long term availability

T9.2.1. Spare parts

To own a darTZeel NHB-108 model one must not only give you musical pleasure.

You must also benefit from a first class customer service, whatever the problem encountered. Whether it is a failed component, or a broken heat sink due to an unfortunate accident – not dropped on your feet we hope – all parts need to be available, at anytime.

If, as we think, your machine only requires maintenance every 30 or 40 years, we will ensure that parts availability will last far beyond that.

We at darTZeel, always stock all "non perishable" components in sufficient quantity for – very – long term operation.

Semiconductors and passive components with no instable material inside are stocked, and will be available at any time, in brand new working condition.

As for electrolytic capacitors, however, their preservation is much more delicate when one tries to stock them for 30 or 40 years in brand new working condition, their life span being limited even when not in use.

Fortunately, we have chosen industrial models, of the highest quality, from one of the world's biggest and longest established manufacturers. We can bet that they will still be there in 100 years, and that they will continue to offer equally outstanding capacitors, or perhaps even better ones.

Furthermore darTZeel keeps permanently in touch with the industry, with the aim of anticipating any shortage or ending of production as regards every component entering into the building of the NHB-108 model one. In the worst case, "perishable" stock will be renewed accordingly in order to offer maximum availability at brand new specifications. Our wish is to be capable of offering you true and full customer service for many generations to come.

T10. The next darTZeel

Now that we are almost at the end of this manual, we do think that you have a better idea about our philosophy.

We just hope that we have not frightened you by our unusual way of thinking. After all, if you proudly own one of our machines, it is because you have trusted us. We just say: "You were right!"

Nevertheless, do not believe that we set such a high level for the darTZeel NHB-108 model one that no one could ever improve it.

Obviously we do not want nor even need to change our product line every year, or even every 5 years, but this does not mean that we will rest on our laurels.

The design of the NHB-108 model one incorporates the best that this beginning of the 21st century has to offer.
We sincerely think that at the time of going to press it is not possible to go much closer to the sonic truth than that which the darTZeel NHB-108 model one is already capable of providing.

As the years go by, technology will relentlessly improve. We will endeavour to determine to what extent we can go even further.

Each time we can make a leap forward, we will do so.

T11. Keeping an open door

Well, now we have reached the end of this technical section.

Is it too technical? Not audiophile enough? Please do not hesitate to tell us. We will be pleased to read your complaints, and we will take them into account for future manuals.

Any suggestion or criticism concerning the darTZeel NHB-108 model one, a particular manual, or any other point, can be emailed to:

moreinfo@dartzeel.com

We wish you very long and happy hours of music listening with the world's first "emotional amplifier".
One of our very first customers described the darTZeel NHB-108 model one in such a way. We have to admit that we fell in love with this description…

And now…

Music!

T12. Special adjustments

T12.1. Output DC voltage drift

When using the NHB-108 with the DC compensation offset **off**, Eyes could eventually blink, meaning that an output DC voltage greater than ±0.6 volt is present at the terminal speaker outputs. An adjustment is then necessary.

Caution! The procedure described below can present some risk, since the darTZeel NHB-108 model one must remain powered ON.
WE DECLINE ANY RESPONSIBILITY IN THE EVENT OF ELECTRIC SHOCK DUE TO INCORRECT MANIPULATION.

WARNING! ONLY A QUALIFIED PERSON OR A TECHNICIAN CAN SAFELY PERFORM THIS ADJUSTMENT.

The DC trimming potentiometers are located on the audio printed circuit boards attached to the rear of each heat sink, as shown in the figure below (left channel shown):

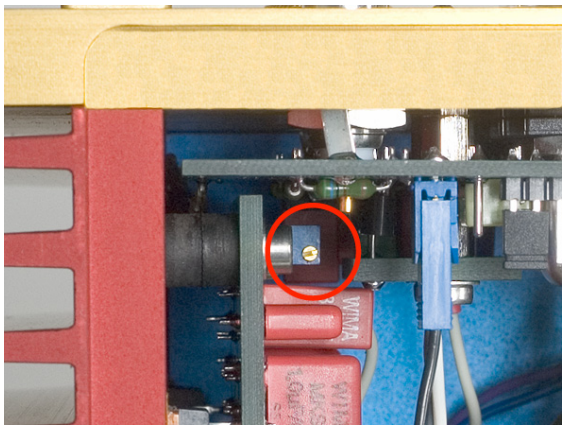


Fig.9 – DC Offset Trimmer

Before doing any task, it is important to ensure that:

- The "DC Offset Comp" jumper is set to **off**. Please refer to chapter **6.4** "**Jumper settings**".
- Ambient room temperature is between +15°C and +35°C.
- The NHB-108 model one is properly vented, as described in chapter **5.2.** "**Location**".
- The loudspeakers are connected to the speaker terminals!
- The darTZeel NHB-108 model one has been powered OFF for a minimum of 2 hours.

To make this adjustment, you need the following tools:

- A No. 5 flat blade screwdriver for removing the glass cover; this tool is supplied as standard with the NHB-108 model one.
- The 2 suction cups supplied with the NHB-108 model one. Please do not forget to slightly wet them, to get firm vacuum on the glass.
- A No. 0 flat blade screwdriver for adjusting the 12-turn trimmer; this tool is supplied as standard with the NHB-108 model one.
- A universal DMM (Digital Multi Meter), not supplied.

Procedure:

DO NOT FORGET THAT THE AMPLIFIER WILL BE POWERED ON!
NEVER TOUCH THE COPPER BUS BARS, WHICH ARE AT A POTENTIAL DIFFERENCE OF 115 VOLTS DC.
A SHORT CIRCUIT INDUCED BY THE SCREWDRIVER WILL PARTIALLY **EVAPORATE** THE BLADE BY INSTANTANEOUS MELTING OF THE METAL OF THE LATTER!

1) Power the amplifier ON. Connect the DMM to the speaker terminals. SLOWLY ADJUST THE DC TO ZERO VOLT, plus or minus 20 mV.
2) Let the amp gently warm for a couple of hours, then check the DC again. Adjust the trimmers in order to HALVE the value you just read. That's all!

Voltage values can be either positive or negative. When halving them, and if you got +300mV, set at +150mV. If you got -200mV, set at -100mV.

The measured output DC drift *does* fluctuate very slowly around the set value. This is a normal behaviour and cannot be interpreted as a failure.

If you intend to use the amplifier in areas where ambient temperature is subject to great changes, we recommend you put the "DC Offset Comp" jumper to **ON** (see chapter **6.4**. "**Jumper settings**").

T12.2. Monitoring circuit

The monitoring circuit, also called supervision system, has 3 trimmers intended for factory settings.
Any alteration of these trimmers will void the warranty.