



PHAEDRUS
phaedrus-audio.com

User Manual for

GROOVE SLEUTH

NON-EQUALISING

PHONO PREAMPLIFIERS

(for needle-drop* recordings with Stereo Sauce Software)



* A *needle-drop* is a term which means a version of a music album that has been transferred from a vinyl record to digital audio medium. Needle-drops are also sometimes called *vinyl rips*.

Version 4.0 (May 2016)



These hardware products are manufactured by Phædrus Audio in the UK under licence from Pspatial Audio.

Chapter 1 - Introduction

Computers are so much of our daily lives, yet they have been slow to integrate with the highest quality home audio systems. Often computer audio seems to mean little more than playing mp3 files via the internal audio interface, connected to the hi-fi by a mini jack plug. Yet modern computers and digital signal processing offer huge potential to widen the enjoyment of music recordings of the very highest quality. Ironically enough as they sit at such opposite ends of the recording history timeline, never more so than in the replay of gramophone (or phonograph) records.



Phædrus Audio's **Groove Sleuth** preamplifiers are designed to be used in conjunction with Pspatial Audio's **Stereo Sauce** (Phonograph or Audiophile) app which runs under OS X on the Apple Mac. **Stereo Sauce** has a wide feature set but it devotes a large part of its functionality to software equalisation and decoding of analogue records.

This isn't just technology for technology's sake. There are real, audible reasons for doing this: phase-linear warp and rumble filtering is only possible in the digital domain and reveals a bottom octave with unprecedented clarity and realism. The accuracy of RIAA equalisation and perfect channel balance ensures an uncoloured sound with superb stereo sound staging. And the flexibility in recording characteristics will bring to life LPs you thought mediocre. Moreover, **Stereo Sauce** also includes software decoders for *QS* and *SQ* quadraphonic and *Ambisonic* LPs; thereby bringing life to forgotten, analogue, multichannel gems.

For **Stereo Sauce** to process needle-drop captures and equalise them, it needs recorded files of the "raw" signal, direct from the groove, unfettered by analogue equalisation. And that is where **Groove Sleuth** preamplifiers come in. Each model is a phono preamplifier of the very highest quality but *without* equalisation, so that the signal fed to the computer is the closest version of the signal direct from the groove, but at a suitable amplitude for digitisation. The **Groove Sleuth** preamplifiers have various options to augment this basic task to aid with monitoring and to ease integrating these units into a high-quality audio system. These are described in the pages that follow.

Chapter 2 - Safety

General

Before using any piece of equipment manufactured by Phædrus Audio, be sure carefully to read the applicable items of these operating instructions and the safety suggestions. Keep them for future reference. Follow the warnings indicated on the unit, as well as in these operating instructions.

THE USER SHOULD NOT ATTEMPT TO SERVICE THE UNIT. ALL SERVICING SHOULD BE REFERRED TO QUALIFIED SERVICE PERSONNEL OR FACTORY ONLY.

Phædrus Audio products should NEVER be connected to the external power supply or in any other way energised when the case is opened and/or the circuit boards are accessible.

General Safety Instructions

- Do not operate this equipment near any source of water or in excessively moist environments.
- Keep this equipment away from babies, children and pets.
- Do not let objects do not fall, or liquids be spilled, onto the enclosure.
- Situate this equipment away from heat sources or other equipment that produce heat.
- Ensure this equipment has adequate ventilation. Improper ventilation will cause overheating, and can damage the equipment.
- When cleaning this equipment, remove all connections to the unit; including power and gently wipe with a clean lint-free cloth; if necessary, gently moistened with lukewarm or distilled water. Use a dry lint-free cloth to remove any remaining moisture. NEVER use aerosol sprays, solvents, or abrasives on this equipment.
- This equipment should be serviced by qualified service personnel or returned to Phædrus Audio when: an object (or objects) have fallen into the enclosure; or liquid has fallen into, or been spilled into the unit; or the unit has been exposed to rain or high humidity; or the unit does not operate normally or exhibits a marked change in performance; or the unit has been dropped, or the enclosure has been damaged.

Chapter 3 - Gramophone record equalisation in software

The signal recorded onto a gramophone (phonograph) record is pre-equalised, whereby the bass is drastically attenuated and the treble boosted during the cutting of the master disc lacquer. If this isn't done, the large groove modulations due to the musical bass frequencies can cause the cutter to break through to an earlier rotation of the spiral groove during recording; an effect called *over-cutting*. Replay processing is therefore required to present a complimentary characteristic to restore the original audio balance. The electronic amplifier which corrects for the equalisation applied during recording is today universally called an *RIAA preamplifier*. The design of good, accurate RIAA equalisation has taxed the ingenuity of audio hardware engineers for sixty years.

Pspatial Audio believe that, after 60 years, hardware RIAA equalisation has just about reached the end of the developmental road and that equalisation is nowadays better performed in software for the following reasons:

REASON 1: Greatly increased digital resolution

Stereo Sauce has internal processing in software which uses double-precision floating-point math. CD audio represents the audio signal with a dynamic range of 96dB, smaller than the capacity of the human hearing system, which has a dynamic range of about 120dB. The very best analogue circuits can just about match this dynamic range. But, by contrast, double precision floating-point math is a binary format which has a precision of 53 bits or 320dB. That's a dynamic range which is ten billion (10^{10}) times greater than the hearing system.

REASON 2: Filter accuracy and stability and perfect left-right channel matching

Even the very best electronic components can only be manufactured with a certain degree of accuracy which is rarely better than 1%. Physical components are also subject to ageing such that they go "off value". Digital processing ensures perfect channel balance and frequency response for ever, which guarantees an uncoloured sound with superb stereo sound staging. (See Appendix 4 for details of the unique implementation of the equalisation in **Stereo Sauce**.)

REASON 3: Better warp and rumble handling - with phase-linear filtering in software

In a perfect world, all gramophone records would be perfectly flat, there would exist no inevitable resonance of the arm-mass and the stylus mounting compliance and the mechanical vibrations from the driving motor would be entirely eliminated. But LPs do not exist in a perfect world so, when warp or rumble (as these imperfections are named) are present, they are better eliminated. The technique always employed to remove these effects is high-pass filtering and that is the approach taken in **Stereo Sauce** too: a slightly under-damped fourth-order filter may be employed as a *rumble filter* so that the response falls sharply below the audio passband. However, very differently, the rumble filter is a phase-linear, non-causal design which means there is *no phase distortion introduced*. Phase distortion is inevitable, real and audible in causal, filters and can never be eliminated in analogue designs¹. But it is entirely eliminated in software processing. The result is a bottom octave which will sound like you've never heard it before.

REASON 4: Flexibility of equalisation characteristics - to cope with records not equalised with RIAA curve



Conventional wisdom has it that, by the mid-fifties in a *belle époque* of international cooperation, most American labels and most major European labels had adopted the new RIAA standard and had brought to an end a very chaotic situation which had existed since the dawn of electric recording in which the record companies all specified different equalisation for their discs. However, the truth is that many labels were much slower to adopt the RIAA curve and disc recording characteristics were not effectively standardised until the late 1960s, or possibly even later. It is therefore a great boon to the vinyl enthusiast to have flexible equalisation characteristics. But such flexibility, combined with perfect mathematical precision is very complicated and expensive to implement in hardware.

In providing digital equalisation as part of **Stereo Sauce**, Pspatial Audio wished to offer a comprehensive range of these non-RIAA equalisation options for gramophone disc collectors whilst avoiding a complex and over technical user-interface. So, **Stereo Sauce** features seven equalisation options which are simply selected in the main process menu (left). Pspatial Audio's *Equalisation Guide* is reproduced in the Appendices of this manual. This table indicates the best EQ setting to select according to the record label and date.

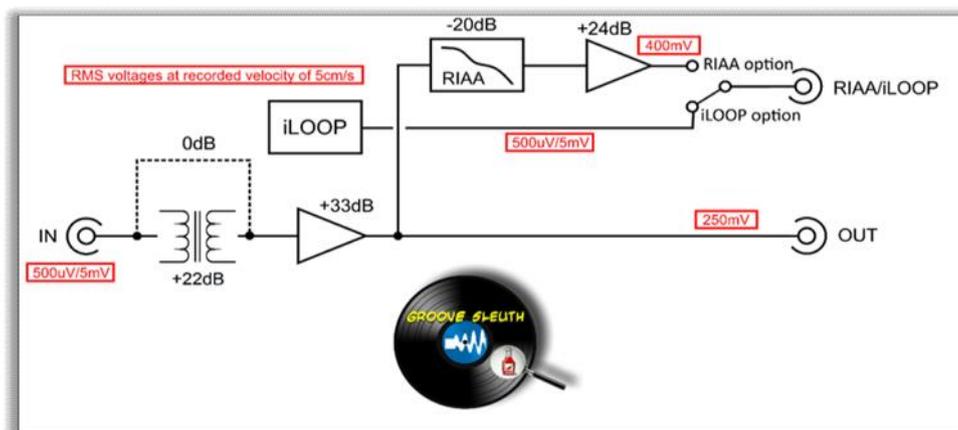
¹ Or indeed even in real-time digital designs unless a great deal of delay can be tolerated.

Chapter 4 - Groove Sleuth Preamplifiers

The signal from a gramophone pickup is too small to apply to the line input of most sound-cards or audio interfaces. What is required is a dedicated phono preamplifier to bring the small signal from the cartridge up to a healthy level for input to the computer sound-card. Many phono preamplifiers exist at all price levels from a host of manufacturers. But, the vast majority of the phono preamplifiers apply RIAA equalisation in the hardware of the unit and that is not what is required here. We need a preamplifier which provides gain and impedance conversion, without applying the equalisation. These are unfortunately very rare, especially models which guarantee extremely low-noise, exemplary headroom, excellent linearity, and an accurate and extended frequency-response. It is to fill this need that the **Groove Sleuth** preamplifiers were developed.

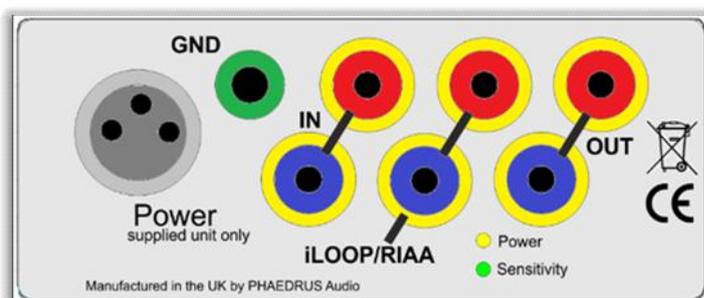
The Groove Sleuth range

Please refer to this block diagram of the **Groove Sleuth- 1** preamplifiers in the following description.



The larger **Groove Sleuth-1** preamplifiers are available in three base configurations: **GS-1-high**, **GS-1-low** and **GS-1-active**. The **GS-1-high** version is suitable for high-output moving-coil (HMC) and moving-magnet (MM) cartridges, and the **GS-1-low** version suits low-output moving-coil (MC) cartridges. The **GS-1-active** is suitable for **PHAEDRUS PHLUX** active moving-magnet cartridges. (See Chapter 5 for more information about **PHLUX** active cartridges.)

Each base unit is equipped with a high-quality looping path called **iLOOP**, and the **GS-1** preamplifiers have an option for RIAA equalisation. The miniature, lower-cost **GS-MINI** preamplifier is suitable for HMC and MM cartridges only and does not have an RIAA option. However, the **GS-MINI** does support **PHAEDRUS PHLUX** active phono cartridges.



In the base options, the unit simply presents the cartridge with the correct impedance at the IN phonos and amplifies the signal. The output is presented on the phonos marked OUTPUT on the rear of the **Groove Sleuth** unit.

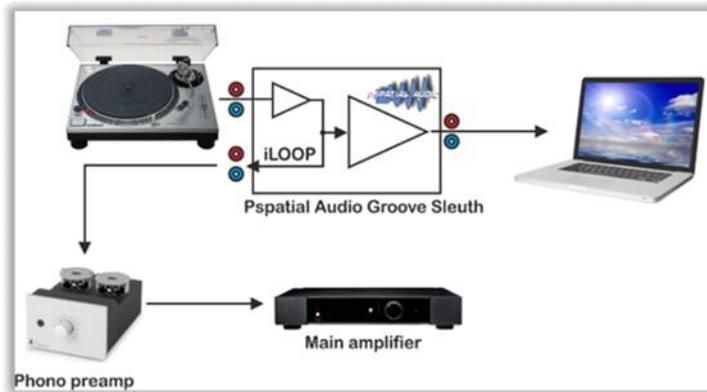
The gain of this preamplifier is a little lower than the typical mid-band gain of an RIAA preamplifier because, without RIAA equalisation, the crest-factor of the signal is somewhat greater than

with a typical music signal (by about 4dB). The signal amplification is designed for the lowest possible distortion and noise-floor; a discrete transistor stage with multiple, paralleled transistors being necessary for the latter. This amplified signal is sent to an external audio interface for digitisation and subsequent recording equalisation in **Stereo Sauce**.

Transformers

The **GS-1-low** (MC) **Groove Sleuth** preamplifier includes a step-up transformer stage. Transformers are heavy and expensive, but they sound great! And they do offer the lowest possible noise-floor. The transformers selected for the **Groove Sleuth** preamplifier are of the highest quality: they possess high primary inductance, very low leakage and are fully mu-metal screened.

Signal loop (iLOOP)



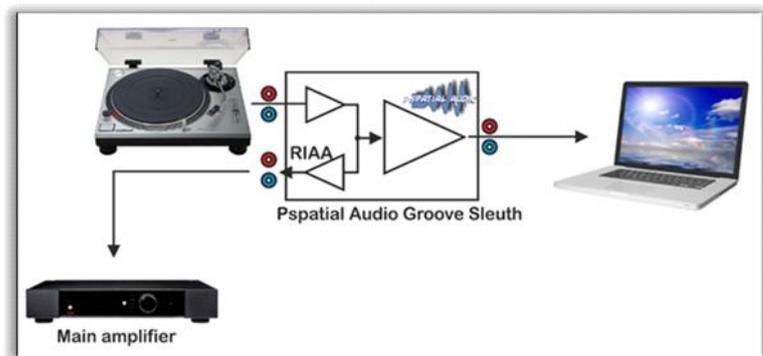
All **Groove Sleuth** preamplifiers feature the **iLOOP**; a wide-bandwidth, low-noise and distortion buffered loop-through. This is especially convenient for enthusiasts who already have an excellent LP replay solution but who want to introduce computer audio into their system. This is because the **Groove Sleuth** integrates transparently into a pre-existing setup and provides new functionality without upsetting what's there already.

iLOOP always outputs the phono signal at high-output HMC (or MM) signal levels. In fact, if a moving-coil cartridge is used (with the GS-1-

low) and the **iLOOP** output is fed to a moving-magnet input, the **Groove Sleuth** will function as a first-rate, wide-bandwidth, low-noise MC preamplifier.

RIAA

In the case of the **GS-1** preamplifiers, a high-quality RIAA stage (GS-RIAA) may be included so that the "loop" signal is RIAA equalised and emerges at line level on the phonos marked iLOOP/RIAA. The RIAA filter is a high-precision, passive network. This is followed by slightly more make-up gain (+24dB) than the mid-band loss in the RIAA network because the signal now has the crest-factor of the original music signal. (The RIAA option is not available in the GS-MINI.)



Warm up

The **Groove Sleuth** preamplifiers are designed so that the analogue sections remain energised all the time since this is consistent with the best audio practice. By means of an advanced power-supply design, this condition is achieved whilst remaining compatible with European Eco-Consumption directives. If the unit is unplugged or the power is removed or interrupted, the analogue circuitry is held in a muted state for about 5 seconds until the various bias voltages are stabilised. Therefore do not be alarmed if the unit does not produce an audio output immediately after connecting power.



**GROOVE SLEUTH
OUTPUT PHONOS**

Connecting the Groove Sleuth to your sound card

The **Groove Sleuth** is connected to your sound-card's line inputs (as shown above). Levels should be set on the interface in the normal way and you will find that the **Groove Sleuth** delivers audio at a sufficiently high level for all commercial sound-cards, both internal and external.

Chapter 5 – The Groove Sleuth MINI

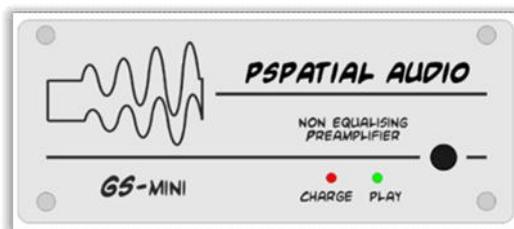


mains power-supply cannot influence the audio quality. The **GS-MINI** may be thus used with a low-cost plug-top power supply without any compromise in audio excellence. The **GS-MINI** has about 24 hours operational charge, but we recommend battery play be limited to approximately 10 hours. For parties, or very long listening sessions, the unit may be kept in charge mode when listening with only a minute loss of quality.

The **Groove Sleuth-MINI** optionally supports PHAEDRUS Audio's **PHLUX** active phono cartridge as described in the next chapter.

The **Groove Sleuth-MINI** is a cost-effective non-equalising preamplifier for audiophiles on a budget. Just like its big brothers, the **GS-MINI** provides **iLOOP** and a computer output. The only limitation is that it is for HMC and MM cartridges only, and it does not support a RIAA equalisation option.

Whilst the **GS-MINI** may be operated with the **RESOLVE** power-supply (as described in a later chapter), it incorporates a rechargeable battery and a front panel switch which permits total disconnection of the PSU. By this means, the unit runs solely on low-noise, low-impedance battery power and the



Chapter 5 – Phaedrus Audio P H L U X - Active Phono Cartridge



The Phaedrus Audio **PHLUX** active phono cartridge is a new development in phono cartridge technology in which a moving-magnet motor system is buffered by a miniature amplifier thereby securing the performance of a moving-coil cartridge with the superior tracking and general convenience of the moving-magnet type. Using a combination of the **PHLUX** cartridge, the **GS-MINI** and Pspatial Audio's **Stereo Sauce** software, absolutely first-rate needle-drops may be obtained with mid-price equipment. More information is available from www.phaedrus-audio.com/PHLUX.htm

The power to the **PHLUX** active cartridge is supplied via the signal cable: rather as phantom power is delivered to modern microphones. In this way, the **PHLUX** may be fitted to any standard turntable without any rewiring. All that is required is that the phono preamplifier supplies the appropriate current and voltage to the turntable leads. This circuitry is provided within the **GS-1-active** and optionally provided inside the **GS-MINI** by the moving of two links on the PCB (one for left and one for right). The position of the links is illustrated in the photograph below.

The power to the **PHLUX** active cartridge is supplied via the signal cable: rather as phantom power is delivered to modern microphones. In this way, the **PHLUX** may be

For use with the **PHLUX** active phono cartridge, the links must be installed in the **ACTIVE** position. For all other types of cartridge, the links should be in the **MM** position. To access these links, remove all signal and power connections to the unit and undo the four rear panel screws at each corner of the unit. When these are removed, the whole assembly may be withdrawn rearwards from the case. Note that it is not necessary to remove the front panel.

The link selection is made by pulling upwards on the shunt and refitting it so that an alternative pair of pins is connected. By default, the shunts are fitted so that the right hand and middle pin are connected (when looking from the front as shown below). When fitting the shunt to supply power to the **PHLUX** active cartridge, push the shunt down onto the left and middle pins (as viewed from front) for **ACTIVE** mode. Do this for both channels.



Once the link positions have been changed, the assembly may be slid back into the housing on the lowest set of internal runners in the case. Be careful not to force the assembly so that the rear of the PCB sits flush with the back of the housing. If there is some resistance of this kind, it is almost certainly because one or both of the LEDs or the switch is fouling the front panel. If the assembly is slid into the correct slot, gentle wiggling should help the LEDs find the correct register with the holes in the faceplate.

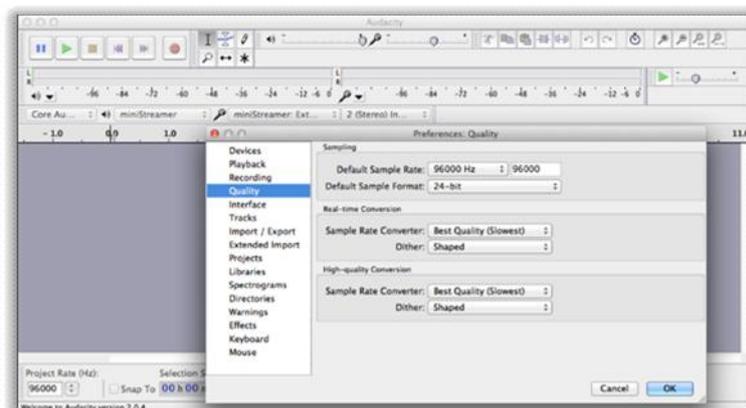
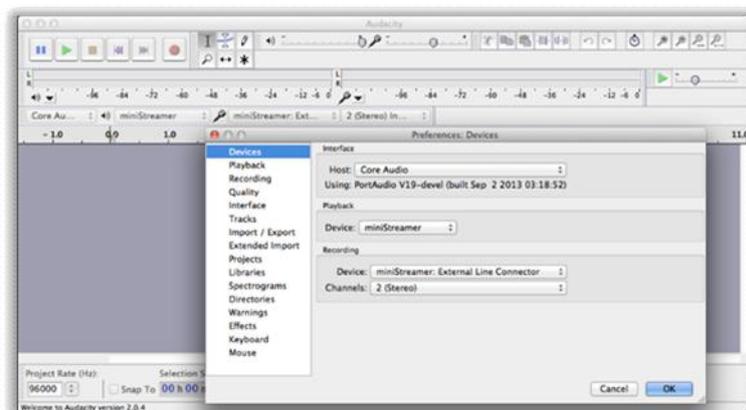
Finally refit the four screws and reconnect the unit.

Chapter 7 - Recording "Needle-drops"



To record a needle-drop, you will first need a program which records audio. Pspatial Audio can recommend *Audacity*, a free, easy-to-use, audio editor and recorder which runs on the Mac platform (and, in fact, on Windows and GNU/Linux too). *Audacity* is free software, developed by a group of volunteers and distributed under the GNU General Public License (GPL). *Audacity* features, not only the recording tools you need, but other tools which you can use to enhance your needle-drops like click and noise filtering and speed change. You can read about and download *Audacity* on their website (<http://audacity.sourceforge.net/>).

Setting parameters



You will also need to configure *Audacity* so that it matches the settings you have made in the **Audio MIDI Setup** utility. The selections are made in the **Preferences/Devices** and **Preferences/Quality** dialogues as illustrated above. You may also need to adjust buffer depths in the software (**Preferences/Recording**) for the higher sampling rates. We'd recommend you adjust the **Audio to buffer** parameter to **50 milliseconds** as a good starting point.

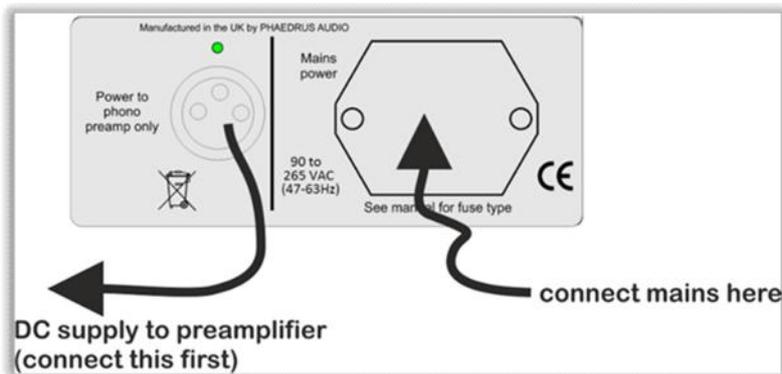
Recording levels

Set recording level so that peak music levels reach between -12dBFS and -6dBFS. Do not be tempted to over-record because this will cause distortion which **Stereo Sauce** cannot rectify. It is recommended that loudness processing is also applied during the **Stereo Sauce** software equalisation process. In this way you can be assured of the best dynamic range from your music and of good matching between needle-drops and other audio files (for example CD rips). There is no need to anticipate the effect of the RIAA filtering in **Stereo Sauce** because the software will automatically adjust the level of the input file for best resolution of the processed file.

Chapter 8 - The Groove Sleuth power supplies

All Phædrus Audio **Groove Sleuth** preamplifiers require a high-quality, external power-supply. There are two options of PSU to power the **Groove Sleuth** preamplifiers. The basic PSU is an external, high-quality, universal power-supply unit (**GS-PSU**). As an upgrade, the external power supply may be upgraded to the **GS-RESOLVE-PSU**. Housed in an identical chassis to the preamplifier, the **RESOLVE** power supply is of the very highest audio quality, but both supplies are manufactured with the highest audio-quality in mind and ensure that the power provided to the preamplifier is very low noise and very low impedance. All PSUs connect to the preamplifiers unit via a cable with screw-lock connectors.

Connecting the GS-RESOLVE-PSU and the preamplifier



The PSU and preamplifier should be connected BEFORE mains is applied to the PSU unit. It is not dangerous or harmful to the equipment, but it is better never to disconnect the preamplifier and PSU whilst this link is live.

Groove Sleuth preamplifiers are designed to be compatible with European Eco-Consumption directives. Consumption is less than 4 Watts in all

configurations and active. The unit is intended to remain energised all the time. The design is thereby compatible with the best audio practice of leaving the unit energised all the time whilst respecting the environment, and your electricity bill!

Voltage setting & Fuse replacement

The basic **Groove Sleuth** preamplifier PSU (**GS-PSU**) will adapt to a range of mains input voltages automatically. The range is: 90 - 265 VAC, 47 - 63 Hz. The **Groove Sleuth RESOLVE** PSU is a linear type supply and is internally set to be 110V ($\pm 10\%$) AC or 230V ($\pm 10\%$) AC. **The correct voltage type must be used according to the mains supply available.** If in doubt, consult your dealer or Phædrus Audio. The RESOLVE power supply should be fitted with a 5 x 20mm, 2 Amp, SLOWBLOW glass fuse.

Chapter 9 – Decoding Quadraphonic and Ambisonics discs

There were many interesting and important recordings made in Quadraphonic sound and versions of many classic recordings were mixed in Quad'. Many still only available as vinyl records, recording these LPs and decoding these recordings in software allows us to revisit, and indeed rediscover old friends.



Many beautiful and important recordings were made in Quadraphonic

Stereo Sauce allows decoding of SQ and QS Quadraphonic and Ambisonics recordings to multichannel audio files so that they can be played over a square of four loudspeakers (as was the intention in the 1970s) or over a modern 5.1 system. No special precautions need to be made in recording needle-drops of quadraphonic or Ambisonics discs. It is recommended that equalisation is applied to the needle-drop in **Stereo Sauce** before decoding.

Chapter 10 - Specifications

Size: GS-1: 112 × 50 × 225 mm (W-H-L): GS-MINI: 112 × 50 × 85 mm

Preamplifier Supply: DC input on screw locking connector, 85mA consumption at low-tension

Power: Groove Sleuth preamplifiers are designed to be compatible with European Eco-Consumption directives. Consumption is less than 4 Watts in all configurations and active. The unit is intended to remain energised all the time.

High-level input (GS-1-high) Preamplifier

Sensitivity: Nominal 5mV RMS (-44dBu) @ 5cm/s recorded velocity

Input load: 47kohms // 220pF

Gain (to computer output): 33dB (× 46)

Frequency response: ±0.1dB from 20Hz to 85 kHz

Distortion: 0.01% THD at maximum output level

Equivalent input noise (EIN): <500nV RMS (-124dBu), A-weighted. Input shorted.

Signal to noise (wrt nominal sensitivity and un-weighted): 80dB

Maximum input signal (prior to clipping): 60mV RMS

Headroom (wrt nominal sensitivity): 22dB

PHLUX (GS-1-active) Preamplifier

Sensitivity: Nominal 5mV RMS (-44dBu) @ 5cm/s recorded velocity

Input load: 150kohms

Gain (to computer output): 33dB (× 46)

Frequency response: ±0.1dB from 20Hz to 85 kHz

Distortion: 0.01% THD at maximum output level

Equivalent input noise (EIN): <500nV RMS (-124dBu), A-weighted.

Signal to noise (wrt nominal sensitivity and un-weighted): 80dB

Maximum input signal (prior to clipping): 60mV RMS

Headroom (wrt nominal sensitivity): 22dB

Low-level input (GS-1-low) Preamplifier

Front-end: Step-up transformer

Sensitivity: Nominal 500µV RMS (-64dBu) @ 5cm/s recorded velocity

Input load: 100ohms

Gain (to computer output): 55dB (× 593)

Frequency response: ±0.5dB from 20Hz to 20kHz

Distortion: 0.01% THD at maximum output level

Equivalent input noise (EIN): 75nV RMS (-140dBu), A-weighted. Input shorted.

Signal to noise (wrt nominal sensitivity and un-weighted): 76dB

Maximum input signal (prior to clipping): 5mV RMS

Headroom (wrt nominal sensitivity): 21dB

iLOOP (Intelligent Loop)

Function: Wideband, buffered loop-thru

Frequency response: ±0.1dB from 20Hz to 50 kHz

Output load: 47kohms (non-critical). Suitable for feeding any MM input

RIAA correction circuit option

Gain (to RIAA output): 37db/58dB (MM /MC); RIAA curve
RIAA response accuracy: ± 0.2 dB from 40Hz to 20kHz
IEC amendment: Not implemented; rumble roll-off performed in software
Neumann Pole or eRIAA: Not implemented ²

Groove Sleuth MINI (GS-MINI) Preamplifier

Sensitivity: Nominal 5mV RMS (-44dBu) @ 5cm/s recorded velocity
Input load: 47kohms (PHLUX Active cartridge support optional)
Gain (to computer output): 33dB ($\times 45$)
Frequency response: ± 0.1 dB from 20Hz to 50kHz
Distortion: 0.005% THD at maximum output level
Equivalent input noise (EIN): <500nV RMS (-124dBu), A-weighted. Input shorted.
Signal to noise (wrt nominal sensitivity and un-weighted): 80dB
Maximum input signal (prior to clipping at full charge): 75mV RMS
Maximum input signal (prior to clipping after 6 hours on battery): 60mV RMS
Headroom (wrt nominal sensitivity at full charge): 23dB
Headroom (wrt nominal sensitivity after 6 hours on battery): 20dB

Phædrus Audio reserves the right to change specifications without notice.

Chapter 11 - Warranty and service

Service

If you experience a problem with a Phædrus Audio product, contact support@phaedrus-audio.com. We will diagnose the problem remotely and advise you of the warranty status. If a repair or replacement is required, we will issue a Return Merchandise Authorization (RMA) number and tell you where to send the unit to be repaired. You MUST have an RMA number before you return the equipment to Phædrus Audio's support service. Phædrus Audio will not accept responsibility for loss or damage in shipping or for equipment returned without valid paperwork and/or a valid RMA number. Remember, warranty is void if product serial numbers have been removed or altered, or if the product has been damaged by abuse, accident or unauthorized modification and/or repair (see Phædrus Audio Limited Warranty for details). There are no user serviceable parts inside.

PLEASE RETAIN YOUR SALES RECEIPT. IT IS YOUR PROOF OF PURCHASE COVERING YOUR LIMITED WARRANTY. LIMITED WARRANTY IS VOID WITHOUT SUCH PROOF OF PURCHASE.

Phædrus Audio's Limited Warranty

This limited warranty is valid only if you purchased the product from Phædrus Audio or from a Phædrus Audio authorized dealer in the country of purchase. Phædrus Audio warrants that the equipment it manufactures shall be free from defects in material and workmanship for a period of one (1) year from the original date of purchase; unless a longer minimum warranty period is mandated by applicable local laws. If equipment fails due to such defects within this period, Phædrus Audio will, at its option, repair or provide a replacement for the defective part or product. This warranty does not extend to any Phædrus Audio product that has been damaged or rendered defective as a result of: accident, misuse, or abuse; or by the use of parts not manufactured or supplied by Phædrus Audio; or by unauthorized modification or attempted repair to the product; or by acts of God/Nature (accident, fire, flood, etc.) or any other condition that is beyond the control of Phædrus Audio. There are no user serviceable parts inside. This limited warranty is invalid if the factory-applied serial number has been altered or removed from the product. This limited warranty is extended exclusively to the original buyer (customer of Phædrus Audio, or authorized retail dealer) and is not transferable to anyone who may subsequently purchase the product. No other person or organisation shall be entitled to give any warranty promise on behalf of Phædrus Audio. Phædrus Audio makes no other warranties, expressed or implied, of merchantability, fitness for a particular purpose or otherwise. Phædrus Audio liability is limited to repair or replacement by Phædrus Audio, at its sole discretion and, in no event, will Phædrus Audio be liable for any direct, indirect, special, incremental or consequential damages resulting from any defect in the product, including lost profits, damage to property and, to the extent permitted by law, damage for personal injury, even if Phædrus Audio has been advised of the possibilities of such damages. For any hardware defects experienced by the customer while the product is under warranty, Phædrus Audio will incur the shipping cost to the customer and the customer is responsible for the shipping costs to Phædrus Audio designated after-sales service office.

Warranty service conditions are subject to change without notice. For the latest warranty terms and conditions and additional information regarding Phædrus Audio limited warranty, please see complete details online at www.phaedrus-audio.com.

² The **Groove Sleuth** preamplifier's RIAA equalisation does not include the *Neumann pole* in the transfer-function of the equaliser. The truth is that the inclusion of a zero in the playback RIAA de-emphasis at 3.18 μ S compensates for *pole which never existed in the record equaliser* (see http://www.pspatialaudio.com/neumann_pole.htm)

Appendices

Appendix 1 - Model Codes

The model/order codes for **Groove Sleuth** preamplifiers are:

GS-1-high- High output moving-coil preamplifier (also moving magnet) with **iLOOP** signal loop but no RIAA. Baseband output suitable for feeding computer sound-card. Requires separate power supply unit.

GS-1-active- PHLUX active-MM cartridge preamplifier with **iLOOP** signal loop but no RIAA. Baseband output suitable for feeding computer sound-card. Requires separate power supply unit.

GS-1-low - Low output, moving-coil cartridge preamplifier with **iLOOP** signal loop but no RIAA. Baseband output suitable for feeding computer sound-card. Requires separate power supply unit.

GS-MINI – Cost-effective non-equalising preamplifier with **iLOOP** and support for Phaedrus Audio **PHLUX** active phono cartridge. Requires separate power supply unit.

GS-PSU - basic external, high-quality, universal power-supply unit for all **Groove Sleuth** models.

Options

GS-RIAA - RIAA option for **GS-1-high** and **GS-1 low** (Note that RIAA options replace **iLOOP**)

GS-RESOLVE-PSU-110V – Premier quality power supply for use with 110V ($\pm 10\%$) AC mains

GS-RESOLVE-PSU-220V – Premier quality power supply for use with 230V ($\pm 10\%$) AC mains

Appendix 2 - Spatial Audio Gramophone Equalisation Guide

The digital equalisation in Pspatial Audio's **Stereo Sauce** offers a useful range of these pre-RIAA equalisation options for gramophone disc collectors whilst avoiding a complex and over technical user-interface. Pspatial Audio's Equalisation Guide is given below. This is a straightforward guide as to which equalisations should be applied to which LPs.

Appendix 3 - Declaration of Conformity

The Manufacturer of the Products covered by this Declaration is

Phædrus Audio
Maidstone
Kent
UK

The directives covered by this declaration are:

89/336/EEC Electromagnetic Compatibility directive
73/23/EEC Low Voltage Equipment directive

The products covered by this declaration are:

Groove Sleuth non-equalising phono preamplifiers

The basis on which conformity is being declared: The manufacturer hereby declares that the products identified above comply with the protection requirements of the EMC directive and with the principal elements of the safety objectives of the Low Voltage Equipment directive, and that the following standards have been applied:

IEC INTERNATIONAL STANDARD 60065 - Audio, video and similar electronic apparatus – Safety requirements

The technical documentation required to demonstrate that the products meet the requirements of the Low Voltage Equipment directive has been compiled and is available for inspection by the relevant enforcement authorities. The CE mark was first applied in 2015.

Signed:



Richard Brice, Technical Director
Date: January 2015

Appendix 4 - Causal equalisation filters

Importantly, the correction curves applied in **Stereo Sauce** are *not* derived from FFT curve fitting. Such a technique results in generating a non-causal, linear-phase filter which does not correctly compensate for the phase distortion introduced by the pre-emphasis filter. Unfortunately, this is the technique employed in most of the software solutions commercially available. Not only does this technique result in frequency response anomalies (we've measured around 1dB errors), but - much more seriously - it destroys the linear phase response of the pre-emphasis + de-emphasis chain.



This is what happens to a $(\sin x)/x$ pulse (left) when it has been encoded with a standard RIAA encoded but decoded by an FFT filter (right). The amplitude of the frequency components is correctly recovered, but their phase is hugely distorted resulting in a distorted signal when viewed in the time-domain

Instead, in **Stereo Sauce**, the equalisation is performed in software with causal filters which are *exact mathematical analogies of real analogue filters*. The resulting overall phase-response being $\pm 2^\circ$ from 20Hz to 20kHz (RIAA, 96kHz sampling).