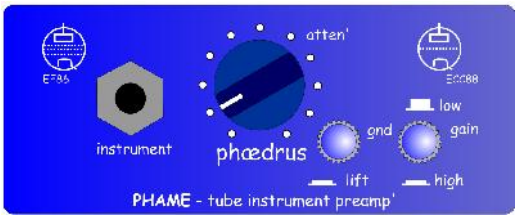
User Manual for

phædrus

phædrus-audio.com

PHAB - tube microphone preamp'

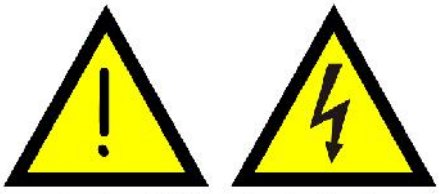


PHAME - tube instrument preamp'

&

PHI - tube DI box

This manual is also available as a pdf download, Go to: www.phaedrus-audio.com



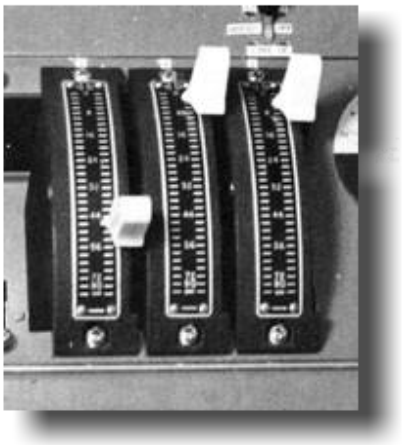
RISK OF ELECTRIC SHOCK
DO NOT OPEN!

Preface – About Phædrus Audio

Phædrus Audio was formed to design, manufacture and sell high-quality products for the professional and semi-professional audio market. Phædrus Audio's founders remain inspired by the music and the recording practices of the fifties and sixties, and are motivated to re-establish the values of the great audio-technology legends of the past with their ideals of transparency, hand-built quality, and serviceability. Using modern manufacturing techniques and the benefits of modern component technology, Phædrus Audio's aim is to reproduce the quality and character of classic equipment but in a modern, highly reliable, and cost-effective way.

Chapter 1 - Background

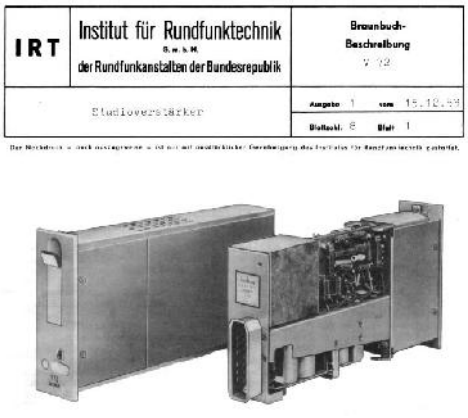
The Phædrus Audio PHAB, PHAME and PHI products came about because two, recording musicians wanted to own a "classic" console from the nineteen-sixties. Ideally a famous all valve (vacuum tube) mixer used to record The Beatles.



But those desks make a collection of hen's teeth look positively prosaic - as well as cheap! So, we set about researching with the idea of producing a replica console.

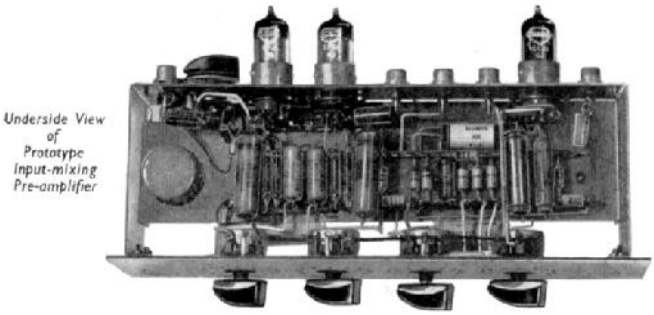
In order to do this, first it was necessary to have a design for the amplifier modules around which the mixers of this vintage are organised.

In the famous Beatles mixers, these amplifiers were either the German manufactured V72(S) amplifiers or the, very rare, EMI built, Type 47 amplifiers.



V72 and Type 47 modular amplifiers

Ironically, despite the fact that many more V72 amplifiers exist than do Type 47s, the EF804 valves which the German amplifiers use are no longer in current production and are becoming very expensive: whereas the EF86 and ECC88 (E88CC) valves employed in the British amplifiers remain in production and are widely available. So, a new amplifier, designed from the common source of Mullard's reference audio designs, and thereby sharing a common heritage with the Type 47 amplifiers, was developed. We called this amplifier the Phaedrus "PHILHARMONIC" (literally*, music loving*). This PHILHARMONIC amplifier forms the heart of the Phædrus Audio LONDON Mark II console. The PHILHARMONIC amplifier circuit is described in detail below in section *Circuit descriptions*.

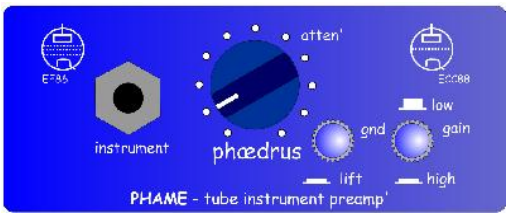


Mullard published many reference designs which were used by EMI in developing the Type 47 amplifiers. Phædrus Audio went back to these same references to develop the PHAB, PHAME and PHI products.

The prototype London Console (Mark II)

PHAB

The Phædrus Audio PHAB microphone preamplifier is essentially the front-end of a single-channel of the LONDON console, in which PHILHARMONIC modular-amplifier is combined with a rotary attenuator, switchable pad, high-pass filter and gain-switching circuitry similar to that employed in the famous sixties consoles.



PHAB microphone preamp' and PHAME instrument preamp'

PHAME

The Phædrus Audio PHAME is a development of the PHAB in which the very high input impedance of the input pentode valve is exploited to provide a very high quality instrumental preamplifier.

PHI

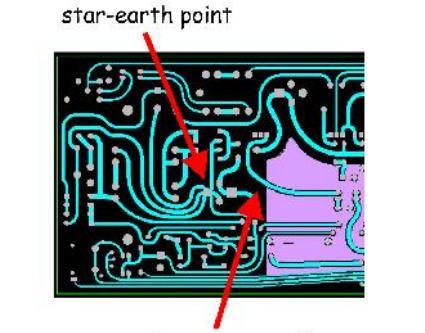
The Phædrus Audio PHI DI-Box is a product designed for a wide range of applications; from live use to the recording studio. Partnered with the PHAB it provides a solution for almost any instrumental or vocal preamp' application.

PHI DI-Box

Construction - or star earths (grounds) and curly tracks

Given their vintage, the V72 amplifiers and the TYPE 47 amplifiers were built on a metal chassis, with the components hardwired onto tag-strips. Although Phædrus Audio equipment uses printed circuit boards to ensure consistent performance and reliability, the equipment follows "classic" practices such as star earths and "natural contour" tracking, just like hook-up wire.

Every Phædrus Audio PHAB, PHAME and PHI product is hand assembled and individually tested. A test pro-forma is provided with every unit. Phædrus Audio offer comprehensive service for products both inside and outside of their warranty period.



natural-contour tracking:
with curved corners and shortest-paths

Chapter 2 - Warranty and Service

Please register your purchase with Phaedrus Audio at www.phaedrus-audio/registration.htm . This will simplify service & repair should you need this service. Your name will be placed on our mailing list (unless otherwise requested) for future updates and new product announcements.

Service

If you experience a problem with a Phædrus Audio Ltd. product, contact:

support@phaedrus-audio.com
TELEPHONE: +44 207 193 4609
Skype ID: phaedrusaudio

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 Ltd.'s support service. Be sure to write RMA number on outside of shipping box and to include your name, address, phone number, a copy of original sales invoice and a detailed description of the problem. Phædrus Audio Ltd. 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 Ltd. 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 Ltd.'s Limited Warranty

This limited warranty is valid only if you purchased the product from Phædrus Audio Ltd. of from a Phædrus Audio authorized dealer in the country of purchase: a list of authorized dealers can be found on Phædrus Audio website www.phaedrus-audio.com, or by contacting sales@phaedrus-audio.com. Phædrus Audio Ltd. 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. Valves (vacuum tubes) are excluded from the one-year warranty, but are warranted for 90 days from day of purchase. This warranty does not extend to any Phædrus Audio Ltd. 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 Ltd.; 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 Ltd. 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 Ltd., or authorized retail dealer) and is not transferable to anyone who may subsequently purchase the product. No other person (retail dealer, etc.) shall be entitled to give any warranty promise on behalf of Phædrus Audio Ltd. Phædrus Audio Ltd. makes no other warranties, expressed or implied, of merchantability, fitness for a particular purpose or otherwise. Phædrus Audio Ltd. liability is limited to repair or replacement by Phædrus Audio Ltd., at its sole discretion and, in no event, will Phædrus Audio Ltd. 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 Ltd. has been advised of the possibilities of such damages.

Shipping Charges

For any hardware defects experienced by the customer while the product is under warranty, Phædrus Audio Ltd. will incur the shipping cost to the customer and the customer is responsible for the shipping costs to Phædrus Audio Ltd's designated after-sales service office. For defective products that are out of warranty the customer is responsible for all shipping costs to and from Phædrus Audio Ltd's designated after-sales service office.

Extended warranty and out-of-warranty services

Various services are available from Phædrus Audio Ltd. These include repair services for equipment once the warranty period has expired, and the ability to extend the warranty period. These are:

PHAB-REP - Repair of a defective PHAB preamp', charged at a flat-rate
PHAME-REP - Repair of a defective PHAME preamp', charged at a flat-rate
PHI-REP - Repair of a defective PHI DI box, charged at a flat-rate

PHAB-MISEAJOUR - Mise à jour for PHAB preamp'*
PHAME-MISEAJOUR - Mise à jour for PHAME preamp'*
PHI-MISEAJOUR - Mise à jour for PHI DI box*
PHAE-EXTWARR - Extends standard warranty (see above) by a further year**

* A mise à jour service includes a complete inspection, re-valve (re-tube) and the implementation of any engineering updates as well as a re-test to performance specification.
** If extended warranty is ordered after the initial warranty has expired then the intervening period is charged without exception.

Please contact your dealer or Phædrus Audio Ltd. for current prices.

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

Chapter 3 - Safety

General

Before using any piece of equipment manufactured by Phædrus Audio Ltd., 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 the operating instructions.

Selection of PSU

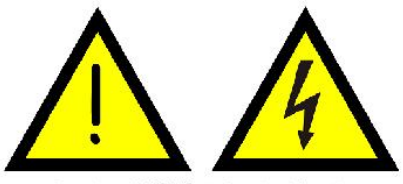
Suitable PSUs for the Phædrus Audio Ltd. PHAB and PHAME preamplifiers and the PHI DI-Box are available as line items from Phædrus Audio.
They are:

PHAE-PSU(110) - 110V mains plugtop PSU: plug is North American type.
PHAE-PSU(220Euro) - 220V mains plugtop PSU; plug is European type
PHAE-PSU(220UK) - 220V mains plugtop PSU; plug is 3 pin 13 AMP, British type

A 12V AC supply is required for the Phædrus Audio PHAB, PHAME and PHI units. A direct current (DC) supply is NOT suitable and will damage the unit. If a supply is sourced elsewhere than from Phædrus Audio, it must have the following specifications:

- 12V AC, 12 Watt supply or greater (> or = 1000mA supply current)
- Must be suitable for connection to the appropriate mains voltage
- Must be Class-II, double-insulated
- Must have 30% regulation or better
- Must contain one-shot thermal fuses, resettable fuses, or Polyswitches for over-current protection.

UK and Euro units should comply with **EN 60950-1** and **CE** requirements and **only PSUs with UL and CSA** approvals should be provided on North American units. Units supplied to other countries should be verified to comply with the relevant standards which obtain in those territories.



User Access & Servicing

Phædrus Audio equipment employs thermionic valve (vacuum-tube) technology and employs hazardous voltages for the high-tension supplies. THE USER SHOULD NOT ATTEMPT TO SERVICE THE UNIT. ALL SERVICING

SHOULD BE REFERRED TO QUALIFIED SERVICE PERSONNEL OR FACTORY ONLY.
The PHAB and PHAME preamplifiers and the PHI DI-Box should NEVER be connected to the external power supply or in any other way energised when the case is opened and/or the circuit board is accessible.

PHI – Exposed valve (vacuum tube) safety

The Phædrus Audio PHI DI-Box has an exposed 12AU7 (ECC82) valve (tube). In order to ensure safety, the HT supply is automatically collapsed to below 1 volt if the valve (tube) is removed from the socket or if the tube fails to function. In all circumstances, even if the glass envelope of the valve (tube) were smashed, the exposed voltages ensure touch-current is limited to a safe value. Keep this product away from babies, children and pets. DISCONNECT THE EXTERNAL PSU AND ALL OTHER CONNECTED EQUIPMENT WHEN REPLACING THE VALVE (TUBE).

Ground (earth) issues

Phædrus Audio Ltd.'s PHAB, PHAME and PHI products are all powered by external (12V AC) power supplies which should be double insulated, class-II types (see above). It should therefore be appreciated that,

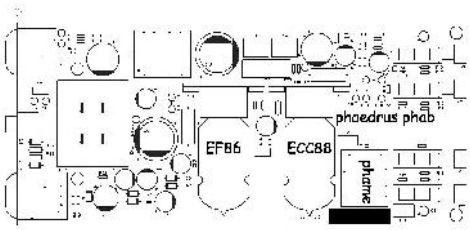
A CONNECTION TO EITHER THE PHAB, the PHAME of the PHI product CAN NEVER BE RELIED UPON PROVIDE A PROTECTIVE OR SAFETY EARTH (GROUND). This advice obtains IRRESPECTIVE OF THE SETTINGS OF ANY "EARTH OR GROUND LIFT" SWITCHES.

General Safety Instructions

- Do not operate Phædrus Audio equipment near any source of water or in excessively moist environments.
- Keep your Phædrus Audio equipment away from babies, children and pets.
- Do not let objects do not fall, or liquids be spilled, into the enclosure.
- Situate the Phædrus Audio equipment away from heat sources or other equipment that produce heat.
- Ensure Phædrus Audio equipment has adequate ventilation. Improper ventilation will cause overheating, and can damage the equipment.
- When cleaning Phædrus Audio 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 Phædrus Audio equipment.
- Phædrus Audio equipment should be serviced by qualified service personnel or returned to Phædrus Audio Ltd. 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 4 - About Valves (Vacuum Tubes)

Valve (tube) types



The Phædrus Audio PHAB and PHAME preamplifiers employ an EF86 pentode input valve (tube) and an ECC88, or E88CC, valve (tube) as the output device. Positions for the valves are very clearly marked on the PCB silkscreen as indicated in the illustration. The valves (tubes) that are installed in Phædrus Audio's products during assembly are selected to give the best possible performance. We offer versions of all products with NOS (rather than current production) valves. But these must be chosen carefully, and be pre-screened. Replacing the supplied valves (tubes) with different, collectible, or "high-end" valves (tubes) types may not affect any improvement and might cause deterioration of performance.

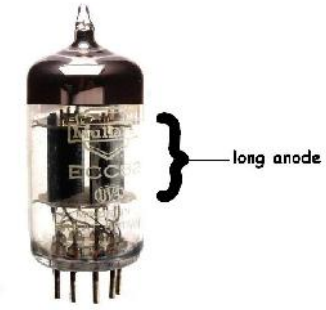
EF86

The EF86 is a low noise pentode, originally manufactured by many different factories and branded by Philips, Mullard, Telefunken, Valvo, and GEC, TESLA and Siemens/RFT. Many NOS valves are still available. Equivalents include the CV2901 (the UK service designation for the EF86) and the CV4085; a special quality version for military use. The EF86 tube is still being produced in Russia and in the Slovak Republic under JJ Electronics brand name (formerly Tesla). Chinese close equivalents are also still being manufactured.

ECC88

The ECC88 is a frame-grid, sharp cut-off, twin (dual) triode with an internal, separating screen. The valve was originally designed for service in the front ends of VHF radio receivers. The ECC88 (E88CC) tube type is equivalent to the North American 6DJ8 tubes and the (rare) military branded CV2492. The transposition of the figures from ECC88 to E88CC was Mullard's way of denoting a special quality build and is equivalent to the US 6922. Russian 6N1P tubes and the Chinese 6N1 tube are NOT equivalent. **NEVER install a 6N1(P) in the Phædrus Audio PHAB or PHAME product**. The ECC88 valve is sill being manufactured in China and in the Slovak Republic under JJ Electronics brand name (formerly Tesla).

12AU7 or ECC82



The 12AU7 is a popular, miniature 9-pin medium-gain dual triode valve (tube) and is used in many instrument and hi-fi amplifiers. Both triodes are used, in cascade, in the Phædrus Audio PHI product. The 12AU7 is also known in Europe under its Mullard-Philips tube designation ECC82. This tube is widely available both new and NOS and a number of special quality equivalents are available. Current production of 12AU7 takes place in Russia, Slovakia, and China. Phædrus Audio selects and recommends the long anode (plate) version of the ECC82 (ECC802S) or 12AU7 valve for application in the PHI DI-Box.

Valve (tube) lifetime

You should replace the valves in the tubes in the Phædrus Audio products only when you start to notice changes in the sound quality. If the gain of the preamplifier decreases noticeably, then this is certainly evidence of the onset of valve (vacuum tube) failure. Before this, the tone may become "dull" and transients may be become "blunted".

That said, the lifetime of a valve (tube) is largely determined by the lifetime of its cathode emission and the small-signal valves (tubes) used in the PHAB, PHAME and PHI use oxide cathodes, which can provide adequate cathode emission for 100,000 hours or more. That's over eleven year's continuous use. So do not replace valves (tubes) just because they have seen a few years service.

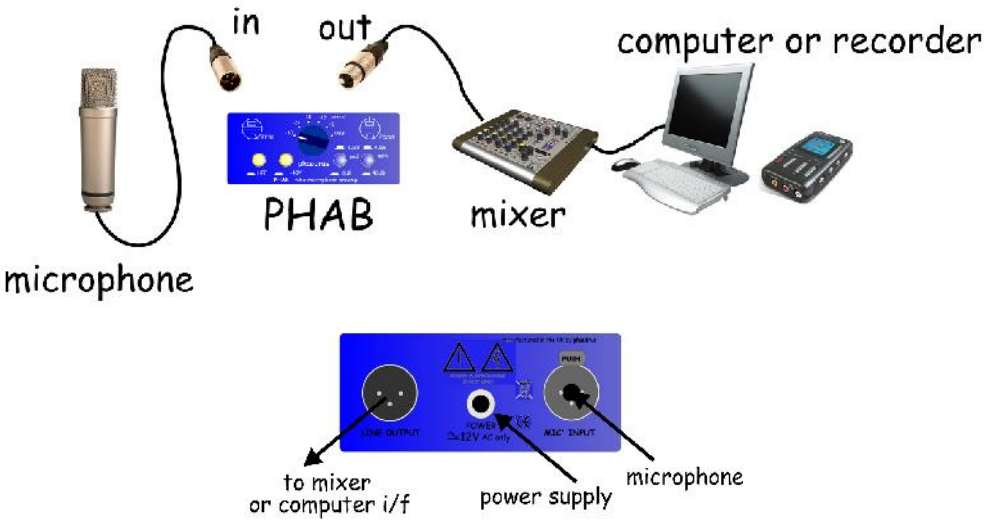
Phædrus Audio Ltd. can provide suitable valves (tubes) as spares which, after a burn-in period, are screened for best performance in your Phædrus Audio product. These are available as line items:

PHAE-12AU7 – Selected 12AU7/ECC82 type valve
PHAE-ECC88 - Selected ECC88 type valve
PHAE-EF86 - Selected EF86 type valve

Please contact your dealer or Phædrus Audio Ltd. for current prices.

Chapter 5 - Instructions for use

Phædrus Audio's PHAB, PHAME and PHI products employ valves (vacuum tubes) as the ONLY ACTIVE DEVICES in the audio path. Valves (vacuum tubes) and their associated circuitry need time to reach an electronic equilibrium before they will operate at optimal specifications. Please therefore allow these products to warm up for, at least, 5 to 10 minutes before using them in your signal chain. To prolong the life of your valves (tubes), it is recommended that you turn off these units when not in use.

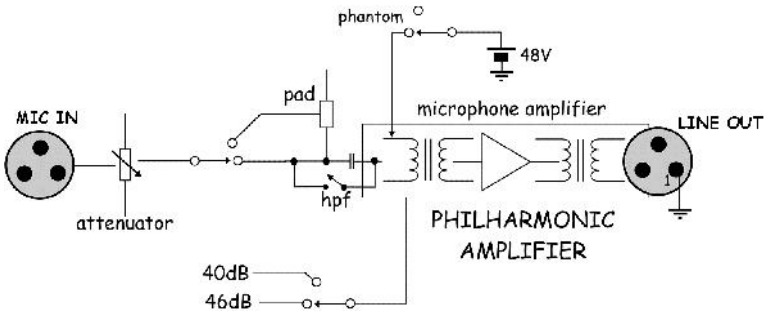


Typical connection set-up for the PHAB

PHAB

Application and connections

Mixer and computer interface manufacturers operate in a very competitive environment. Even a small mixer must (by definition) contain 8, 16 or perhaps 32 microphone amplifiers. Similarly, a computer interface designer has to "shoe-horn" a microphone amplifier into a box with a host of other features and a noisy, semi-digital environment. Unsurprisingly, these amplifiers are designed on a careful budget and contain some compromises. Hence, the use of a few dedicated, stand-alone microphone preamplifiers, solely designed with sound-quality in mind, can transform the quality of your recorded signals. That is the aim of the Phædrus Audio PHAB tube microphone preamplifier: to offer just such a no compromise microphone amplifier in a product which incorporates the standards and qualities adopted in classic recording gear. A block diagram of the PHAB is given below. The unit is connected as shown in the accompanying diagrams.

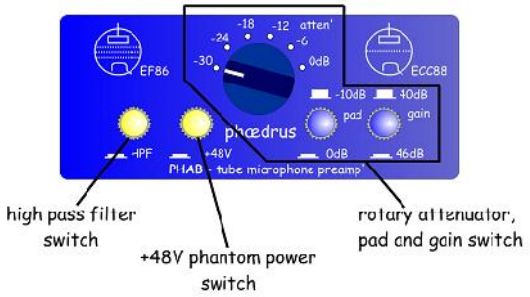


Architecture of the PHAB preamp'

Controls

Input rotary attenuator, Pad and Gain switch

The PHAB microphone preamplifier operates with a constant-gain amplifier and attenuates the signal reaching the amplifier for level control. This is NOT common with modern equipment; in which the gain is adjusted by modifications to the feedback network. Yet this approach was completely standard in the 1950s and 1960s.



The Phædrus Audio PHAB tube preamplifier is built around a modular amplifier with a fixed gain of +40dB (with a switch available to raise this to approximately +46dB). This amplifier is preceded by a rotary, switched attenuator control, offering attenuation of 0 to -30dB in steps of 6dB. A further pad (operated by a front panel switch) is available, to increase the attenuation to -40dB; thereby matching the gain of the modular amplifier and reducing the overall unit gain of the equipment to unity. These controls (the input attenuator, pad and the gain switch) are used to set the overall preamplification level of the unit and feed a suitable electrical level to your downstream equipment. (see *Operating level* section for more information).

Normal operation should be to operate WITHOUT the -10dB pad engaged and with the preamplifier gain set to 40dB. Only operate the pad switch when the signal from the microphone is too great for attenuation via the rotary attenuator control: and only operate the +46dB gain switch when the signal from the microphone is too low, even when the rotary attenuator is set to 0dB.

HPF (*rumble filter*)

By virtue of its very high quality input and output transformers and its minimalist, wideband, valve circuitry, the pass-band of the Phædrus Audio PHAB preamplifier is extended in both the bass and extra-high frequency ranges. Due to this, unwanted, very low frequencies, due to traffic or air-conditioning "rumble" may be picked up by the microphones and amplified. The high-pass filter (HPF) filters out these frequencies and prevents them from either, intermodulating with the wanted signals with in the microphone preamp' itself, or, being fed to downstream equipment. This filter section is engaged by depressing the HPF switch.

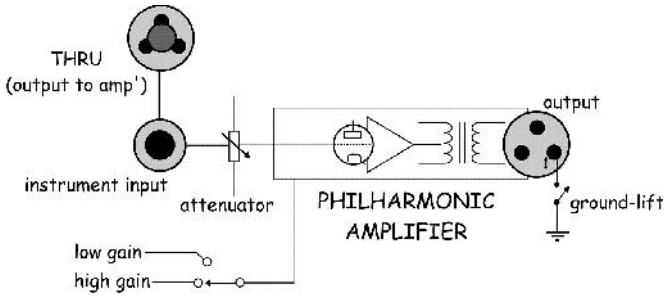
+48V "Phantom" supply

An internal phantom supply is provided to power the microphone connected to the input. This supply is engaged by depressing the "+48V" switch on the front panel of the unit. Although this supply is designed to "ramp-up" slowly, it is NEVER a good idea to switch phantom power onto a microphone on a channel with an open fader because it can create "pops and bangs" which can damage electronic equipment, speakers and fray nerves! Always mute any following circuit before switching on the phantom (+48V) supply. To avoid loud transients, always make sure phantom power is off when connecting or disconnecting microphones.This supply is designed to support the hungriest of microphones.

NOTE: Some microphones may be damaged by having phantom-power applied to them: ribbon microphones are especially delicate in this regard. ALWAYS check what type of microphone is connected, and that it is suitable for phantom-powering BEFORE operating the front-panel switch.

PHAME

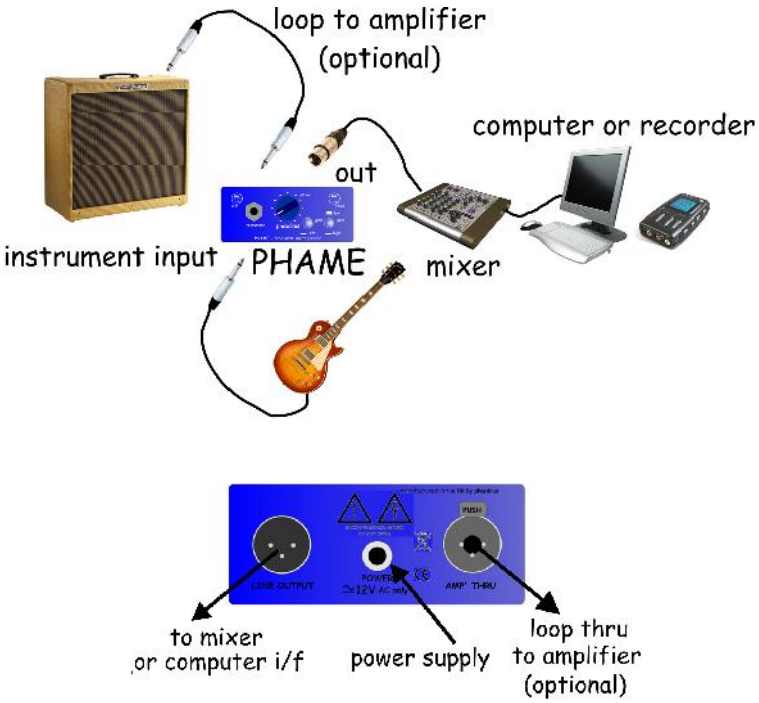
Application and connections



Architecture of the PHAME preamp'

The unit is connected as shown in the accompanying diagrams.

Direct injection (DI) provides a clean way of applying instruments to your mixer or computer interface. This is especially interesting today, now that there are so many plug-in effects and amplifier emulations which run as software on the computer host. All that is required, when working this way, is to get a natural signal into the computer's analogue to digital conversion circuits. The software will then "take it from there".

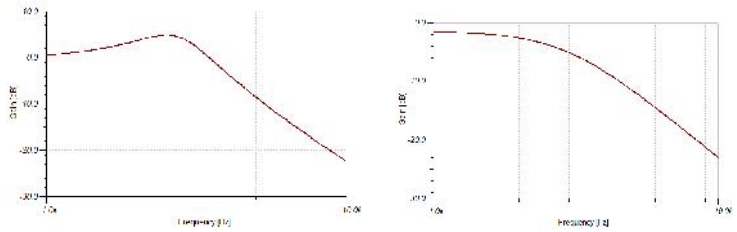


How to connect the PHAME preamp'

But if only things were that simple! The problem is that a normal passive DI-box, or a solid-state input stage can rarely offer the benefits of a valve preamplifier. (See *Voicing and the valve (tube) amplifier* box.)

Voicing and the valve (tube) amplifier

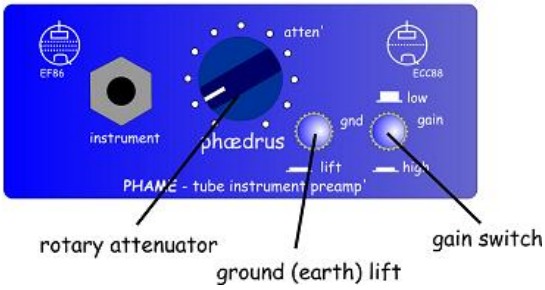
Guitar pickups are made by winding about 8000 turns of wire on a former or bobbin which surrounds several permanent magnets. The resistance of the wire is relatively low, but the inductance is high and the device therefore has a rising output impedance. The guitar connects to the amplifier by means of a coaxial cable with the inner, signal wire surrounded by the earthy "screen". The construction of this type of cable is not a million miles away from the construction of a capacitor and, unsurprisingly, the coaxial cable displays a significant capacitance at audio frequencies. When the inductive pickup is connected via a capacitive cable, a resonant circuit is formed and we can model this and confirm that this creates a musically-significant resonant-circuit well within the audio band. (Left trace below.)



This resonant mechanism is one of the principal voicings for the electric guitarist. Three factors affect the resonant circuit: the inductance of the pickup; the capacitance of the cable; and the input impedance of the amplifier: essentially the greater the capacitance and the greater the inductance, the lower the formant frequency. This is why expensive "Custom Wound" pickups and Humbuckers (which have more turns and therefore greater inductance) sound considerably more "chunky" or "fatter" than standard pick-ups. It's the major reason why cables really do sound different; fatter cables (because of their lower capacitance) "singing" better than cheap, thin cables.

The effect of the amplifier input resistance is to damp the resonant circuit. Valve preamplifiers do not do this because of the common value of 1MΩ for the bias resistor of the first valve. Solid state circuits on the other hand – due to their higher bias currents and lower circuit impedances – can have a major damping effect on the input signal, destroying so much of the character imparted by the resonant circuit (see right-hand trace above). In short, the formant frequency is absolutely crushed and the character of the voice destroyed. Amongst many other reasons, this, so many solid-state guitar preamplifier designs fail to have the "spring" and "life" of a good valve amplifier: the precious signal is choked before it reaches (literally and metaphorically) first base!

Controls



Input attenuator

The input attenuator is a good quality, high-value potentiometer; just like the volume control on an amp'. Set this control so as to drive the appropriate level to the downstream equipment; see *Operating Levels* section.

Gain select (low/ high)

The gain select switch should normally be set to the low position. In the high position it is possible to overdrive the tube preamplifier circuitry from a guitar. This setting is for low output instruments and/ or creative effects only.

Ground (earth) lift

Hums and buzzes are the bane of an audio engineer's life. Unfortunately, it is the nature of a high-impedance, unbalanced instruments like an electric guitar to be highly susceptible to the AC electromagnetic fields thrown off by all mains-powered equipment. Often all that is required to solve the problem and reduce the hum (and/or buzz) to a manageable level is to orient the instrument differently so that the pickups no longer intercept so much changing flux. But sometimes hums and buzzes prove to be particularly stubborn and intractable, regardless of the guitarist's pirouetting! When this happens, it is usually because of a ground-loop (or earth-loop). A ground-loop forms when an unbalanced, audio signal flows in a circuit in which the signal-return (usually the cable braid), provides a current path which is in parallel with the installation earth. This is a problem because "all

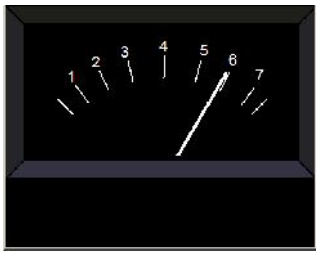
earths are not equal". That's to say, the installation earth will be carrying certain leakage currents. These currents set up a potential across the installation wiring which drives a circulating current in the braid of the audio cable. The result is a “hum” voltage superimposed upon the audio signal.

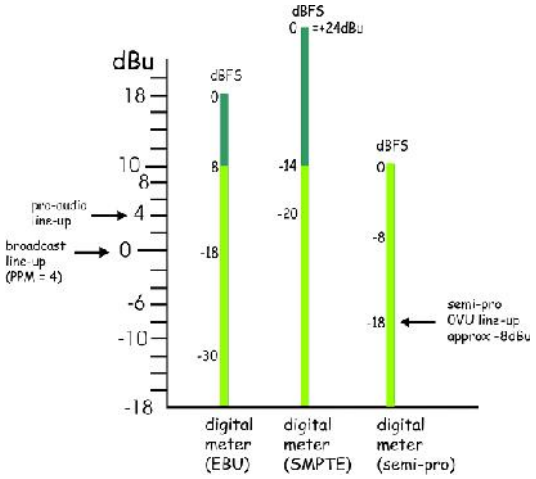
The adoption of balanced signals, and especially audio transformers should ensure that ground-loops (or earth-loops) should NEVER occur. Certainly the Phædrus Audio PHAME, by being both double-insulated and incorporating an earth-free, transformer-balanced output stage can never create a ground-loop in a correctly wired studio. However, connection to an earthed (or grounded) guitar amplifier can cause a circulating current should pin 1 of the output XLR be earthed (grounded) elsewhere in the installation.

This is the role of the GROUND-LIFT switch. It interrupts the connection of pin 1 of the output XLR to the chassis of the PHAME and to the sleeve and screen of the guitar wiring. Adjust the position of this switch to eliminate any ground-loop “hums”.

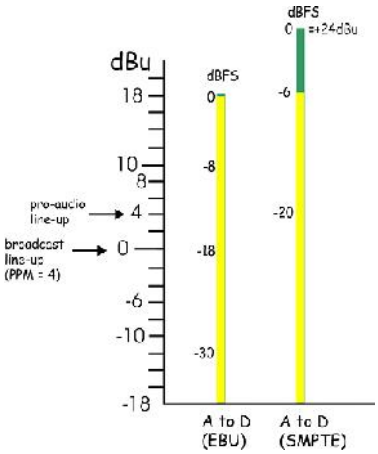
Please note, as explained in the Chapter 4, that, because the Phædrus Audio products are double-insulated, they CAN NEVER BE RELIED UPON PROVIDE A PROTECTIVE OR SAFETY EARTH (GROUND). This advice obtains IRRESPECTIVE OF THE SETTINGS OF ANY "EARTH OR GROUND LIFT" SWITCHES.

Operating levels





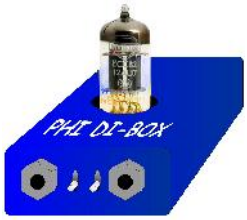
Because of the vintage of the PHAB and PHAME preamplifier designs and their origin in German manufactured broadcast television and radio equipment, the envisaged operating level for this equipment is slightly lower than modern recording industry standards. When feeding downstream equipment, the output level should be set to a nominal 0dBu (0.775V RMS). This means that if monitoring the output on a standard VU instrument, the input attenuator should be set so that the output level reads around -4VU, with occasional peaks to 0VU on programme. On a digital meter, this is equivalent to signal peaks reading +6dB above recording industry standard +4dBu alignment level. This is equivalent to +10dBu (or -8dBFS on equipment aligned to EBU EBU R64-1992 standard and -14dBFS on equipment aligned to SMPTE RP155 as illustrated). On a broadcast standard PPM, peaks should be set to read 6 on the BBC scale, or +8 on the European EBU scale. Output level is sufficient easily to modulate semi-pro' equipment (mixers, DAT, solid-state recorders and many sound cards) to 0dBFS.



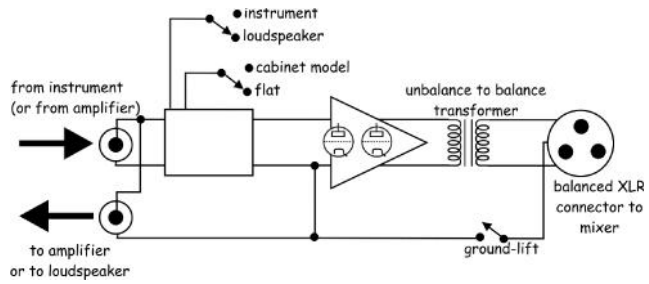
That said, the headroom on the PHAB and PHAME is considerable, and no noticeable distortion is evident when operating the equipment at standard recording industry levels of +4dBu=0VU, or even higher. There thus considerable scope for experimentation with over driving this vintage circuitry to explore its character in gradual overload. For example, peaks may be allowed to reach +18dB above alignment level without clipping. The Phædrus Audio PHAB and the PHAME preamplifiers may thus be used directly to feed modern A to D conversion equipment aligned to EBU or SMPTE standards following the recommendations illustrated (right).

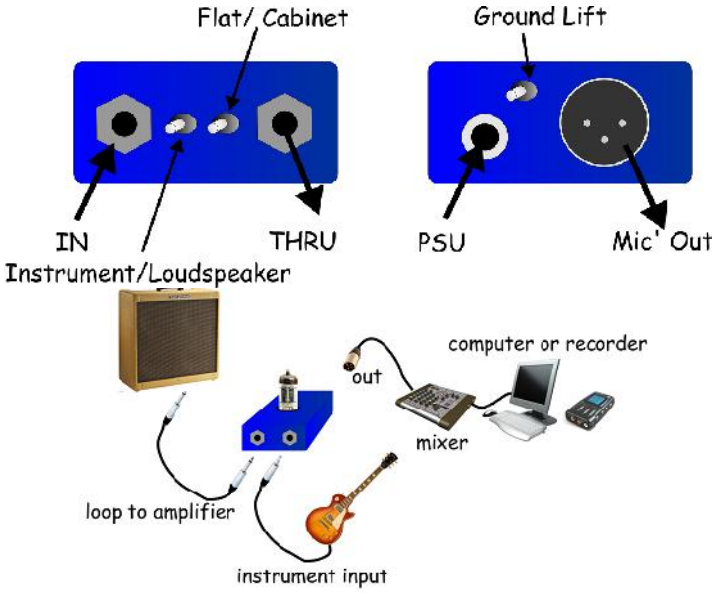
PHI

Application and connections

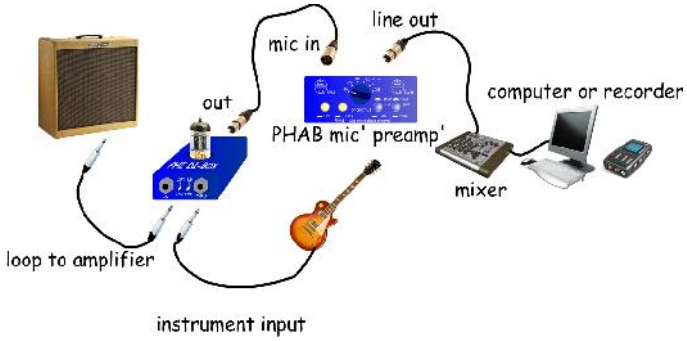


Simple DI units utilise a transformer to balance the unbalanced signal and feed it to the microphone input of your mixer or microphone preamplifier. This technique provides a reasonably high-impedance as presented to the instrument; typically a few tens of thousands of ohms. Adequate for a keyboard, for example: at a push, sufficient for a bass guitar. But the tone of an electric guitar is completely destroyed, unless it drives an impedance hundreds of times greater than can ever be provided by a transformer. The only answer is to present the instrument with the very high input impedance, such as it "sees" when plugged into a valve amp' (see *Voicing and the valve amplifier* section above). This is the role of the Phædrus Audio PHI DI-Box. The dual valve (tube) stage acts as an impedance-converter, presenting the instrument input with an impedance of approximately 1MΩ. The output of the unit then feeds the microphone input of your mixer, computer interface, or your PHAB preamplifier.





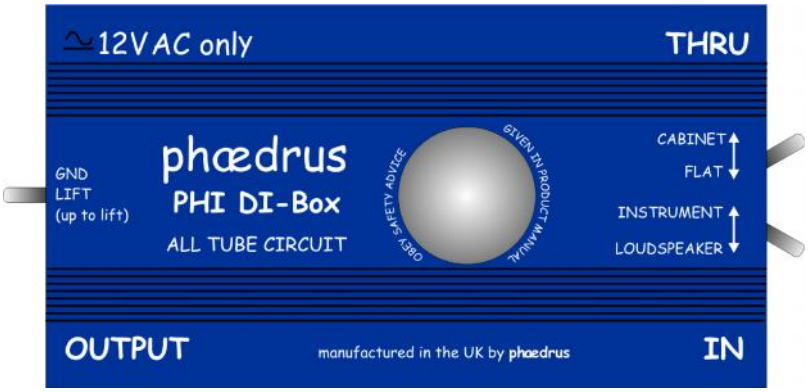
The Phædrus Audio PHI DI-Box is connected as shown in the diagrams above. Ensure that the "LOUDSPEAKER/INSTRUMENT" switch is in the "INSTRUMENT" position. However, note that feeding the output of the PHI into the studio console will negate some of the benefits of the PHI's unique character. Use a premium-quality microphone preamplifier (such as Phædrus Audio's PHAB) for the very best results as shown below.



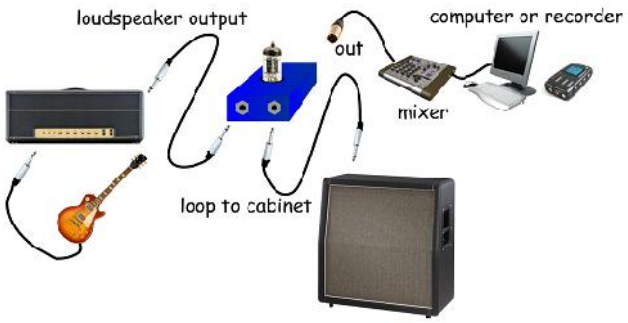
Controls

Instrument/ Loudspeaker switch – *LOUDSPEAKER MODE*

As a general rule, guitar and bass guitar and certain electric pianos and organs rely on the distortions in their amplifiers and loudspeaker-cabinets for the character of their sound. Ideally of course, these instruments need to be captured with microphones, rather than applying a line-level signal to the mixer. However, this is not always possible for a host of reasons including: unacceptable "spill" from other sources; feedback problems; room resonance issues; cabinet "buzz", inadequate microphone response and so on.

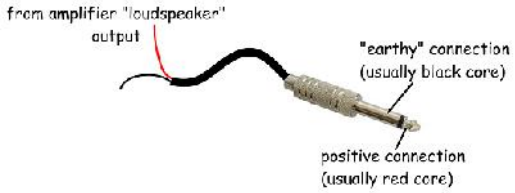


In this situation, it is useful to be able to DI, not the output from the instrument, but the signal which drives the loudspeaker. This signal is not modified by the cabinet, but it does have - at least - the character of the amplifier, its tonal modifications and distortion characteristics, imprinted upon it. The Phædrus Audio PHI is able to provide this functionality. However, this loudspeaker signal is of a very much larger amplitude than this signal which leaves the instrument - it has been *amplified* after all! It is therefore necessary to attenuate this signal before presenting to the DI circuitry and this is exactly what is done when the "LOUDSPEAKER/INSTRUMENT" switch is moved to the "LOUDSPEAKER" position. The attenuation is -32dB.



YOU MUST SELECT THE “LOUDSPEAKER” POSITION OF THE LOUDSPEAKER/INSTRUMENT SWITCH WHEN CONNECTING THE Phædrus Audio PHI TO THE LOUDSPEAKER CIRCUIT OF AN AMPLIFIER. NOT SO DOING WILL DAMAGE YOUR Phædrus Audio PHI. FURTHERMORE YOU MUST OBSERVE THE WARNING GIVEN BELOW, AS FAILURE TO DO THIS COULD DAMAMGE YOUR AMPLIFIER.

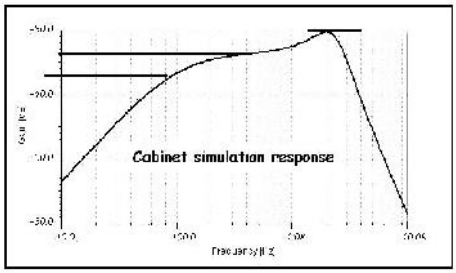
When the Phædrus Audio PHI is used in LOUDSPEAKER mode, it is important to observe the correct polarity of the signal fed from the amplifier to the PHI. To avoid short-circuiting the output of the amplifier, the earthy side of the loudspeaker signal MUST be connected to the sleeve of the input jack. In addition, as a precaution, ALWAYS operate with the Ground lift switch in the “LIFT” position when operating the PHI in this way.



Furthermore, the Phædrus Audio PHI is NOT a dummy load and a loudspeaker MUST be attached to the THRU output so as to provide the correct load for the power amplifier. Valve amplifiers especially may be damaged without the correct speaker-load connected.

Flat/ Cabinet switch

The problem with the signal from the amplifier is that it often contains many high frequencies which are not reproduced by instrumental loudspeaker cabinet. The result is a “fizzy”, over-bright signal; very different from that heard from the loudspeaker. The reason for this is that the loudspeaker and cabinet act together to form an asymmetrical band-pass filter; steeply attenuating the treble above about 4kHz, and gently rolling off the bass.



The signal from the amplifier may therefore be very greatly improved by the incorporation of an electrical filter which reproduces the electro acoustic band-pass of the loudspeaker cabinet. To this end, the Phædrus Audio PHI - DI unit, is enhanced by the inclusion within the unit of a loudspeaker-emulation filter which imprints the response of a typical, closed-back, guitar cab' onto the signal. The general response of this filter is illustrated above. Essentially the response falls away gently in the bass, peaks in the mid-treble and falls away rapidly above about 4kHz as shown in the figure.

Ground (earth) lift

A ground-loop (earth-loop) forms when an unbalanced, audio signal flows in a circuit in which the signal-return (usually the cable braid), provides a current path in parallel with the installation earth (ground). Small potentials in the installation earth (ground) wiring, drive a circulating current in the braid of the audio cable. The result is a “hum” voltage superimposed upon the audio signal.

The adoption of balanced signals, and especially audio transformers should ensure that ground-loops (or earth-loops) should NEVER occur. Certainly the Phædrus Audio PHI, by being both double-insulated and incorporating an earth-free, transformer-balanced output stage can never create a ground-loop in a correctly wired studio. However, connection to an earthed (or grounded) guitar amplifier can cause a circulating current should pin 1 of the output XLR be earthed (grounded) elsewhere in the installation.

This is the role of the GROUND-LIFT switch. It interrupts the connection of pin 1 of the output XLR to the chassis of the PHI and to the sleeve and screen of the guitar wiring. Adjust the position of this switch to eliminate any ground-loop “hums”.

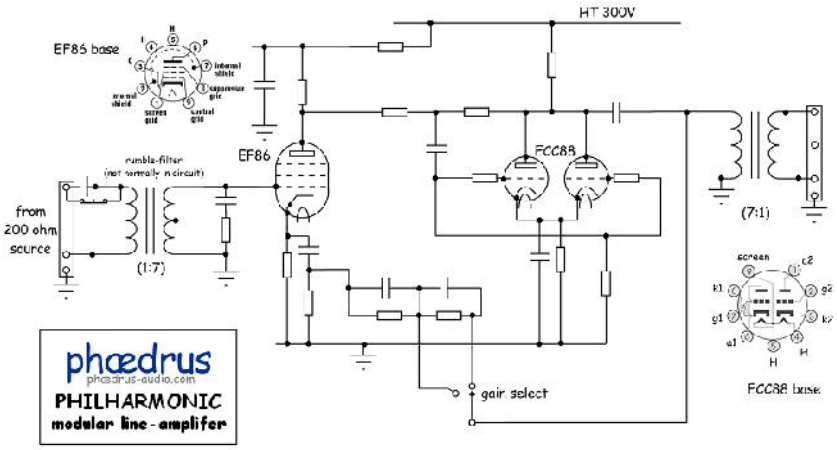
Please note, as explained in the Chapter 3, that, because the Phædrus Audio products are double-insulated, they CAN NEVER BE RELIED UPON PROVIDE A PROTECTIVE OR SAFETY EARTH (GROUND). This advice obtains IRRESPECTIVE OF THE SETTINGS OF ANY "EARTH OR GROUND LIFT" SWITCHES.

Chapter 6 - Circuit descriptions

PHAB & PHAME

The Phædrus Audio PHAB and the PHAME preamplifiers share roughly the same preamplifier circuit which is illustrated in general form below. The differences mainly lie in the input circuitry and attenuator controls. Both devices operate with a constant-gain amplifier and attenuate the signal reaching the amplifier for level control. In the case of the PHAB, the valve preamplifier has a fixed gain of +40dB (with a switch available to raise this to approximately +46dB). The amplifier is preceded by a switched attenuator control offering attenuation of 0 to -30dB in steps of 6dB. A further pad (operated by a front panel switch) is available, to increase the attenuation to -40dB; thereby matching the gain of the amplifier and reducing the overall unit gain to unity.

In the case of the Phædrus Audio PHAME, the preamplifier does not incorporate an input, balance-to-unbalance transformer. Instead the instrument feeds to grid of the EF86 pentode via a continuous attenuator (pot') to ensure a very high input impedance. This is vital to ensure the best tone from all electric instruments, and especially electric and bass guitars. The fixed gain of the amplifier is +24dB (30dB with the high-gain switch depressed).



The amplifier block is a two-stage design incorporating an EF86 low-noise pentode in the first stage and a paralleled ECC88 high mutual-conductance double-triode as the output stage. All the landmark amplifier designs from Mullard's application laboratories specified the EF86. In fact, Mullard described the EF86 as *a low noise pentode intended for use as a RC coupled AF voltage amplifiers; particularly in the early stages of high gain audio amplifiers, microphone preamplifiers and magnetic tape recorders*.

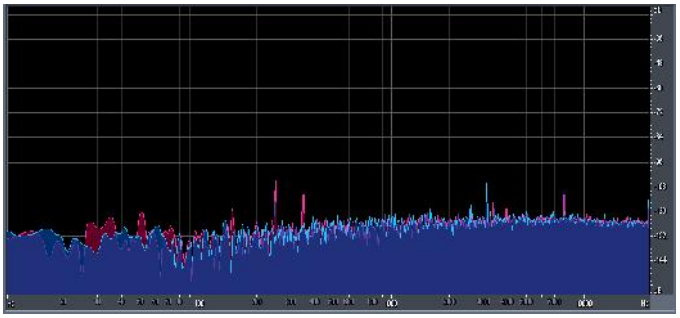
The output stage comprises a dual triode valve in which the two devices are wired in parallel. This paralleling of the two triodes has the beneficial effects of doubling the mutual conductance and halving the anode resistance. The latter characteristic is particularly valuable in ensuring a low impedance drive to the output transformer.

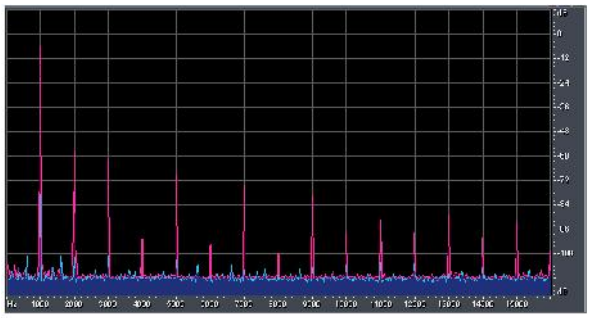
The output stage directly feeds the output step-down transformer. The output is balanced and earth free. A modest degree of negative feedback is taken from the anode of the output valve(s) to the cathode circuit of the input stage to stabilise gain, extend frequency-response and lower distortion. A change to this feedback network is employed to effect the gain switching (from 40dB to 46dB in the PHAB and from 24dB to 30dB in the PHAME), less feedback being applied to achieve higher gain.

In the case of the Phædrus Audio PHAB microphone preamplifier, the grid of the input pentode is driven from the input transformer. In the case of the PHAME, this transformer is not fitted.

Performance

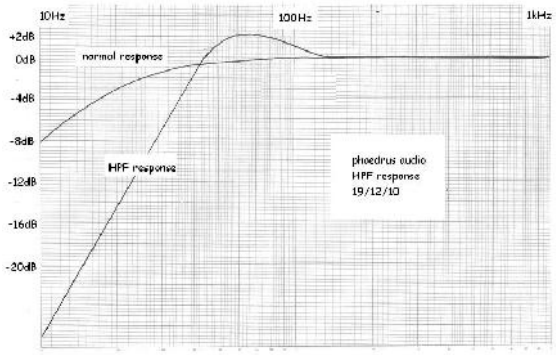
At recording industry line-up (0VV=+4dBu) the magnitude of all distortion components on a 1kHz sine wave input are less then -55dB below fundamental. This, and the A-weighted noise response relative to maximum output, is illustrated below.



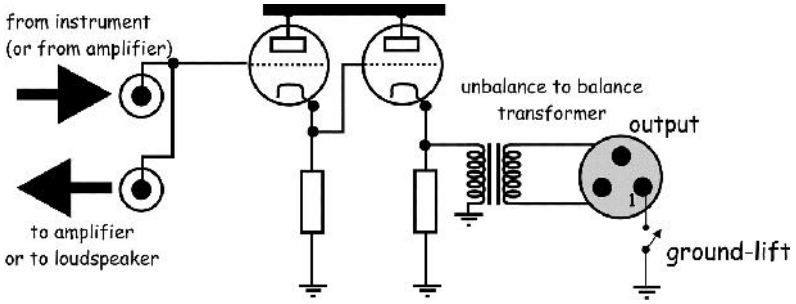


High Pass or Rumble filter (HPF)

The input stage in the PHAB is fed by a 1:7 transformer. When a capacitor is included in series with the transformer primary (it is usually short-circuited out of circuit), the capacitor forms a half-section filter with the primary inductance of the transformer primary; resulting in a sharp cut-off, high-pass filter. The response of the PHAB with and without the rumble filter is illustrated (right).



PHI circuit description

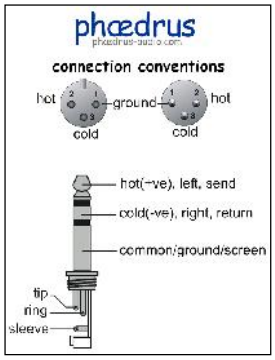


The system diagram for the Phædrus Audio PHI-DI Box is shown. In effect, before the signal from the instrument is applied to the transformer, it is buffered by a dual cathode-follower circuit. The first stage runs at very low current and is biased by a separately derived bias supply. This ensures a high and consistent input impedance. The second stage is DC-coupled to the first and runs in a higher quiescent current; consistent with having sufficient drive to overcome the excitation current in the transformer at low frequencies.

Loudspeaker input

In this configuration, it is necessary to attenuate the loudspeaker drive signal before presenting to the DI circuitry and this is exactly what is done when the "LOUDSPEAKER/INSTRUMENT" switch is moved to the "LOUDSPEAKER" position. The attenuation is -32dB. In the Phædrus Audio PHI - DI unit, this feature is enhanced by the inclusion within the unit of a loudspeaker-emulation filter. The general response of this filter was illustrated above. The LF roll-off is accomplished with a single-pole, RC response. The upper skirt of the passband is implemented by means of a single-terminated LC filter.

Specifications



Electrical connections

Input:

Unbalanced: 3 pin XLR Connector	Balanced: 3 pin XLR Connector
Pin 1 – Ground	Pin 1 – Ground
Pin 2 – (+) Signal	Pin 2 – (+) Signal
Pin 3 – Connect to Pin 1	Pin 3 – (-) Signal

Output:

Unbalanced: 3 pin XLR Connector	Balanced: 3 pin XLR Connector
Pin 1 – Ground	Pin 1 – Ground
Pin 2 – (+) Signal	Pin 2 – (+) Signal
Pin 3 – Connect to Pin 1	Pin 3 – (-) Signal

PHAB Specification

Circuit configuration: 3 valve (vacuum tube) design
Output: Balanced, transformer coupled
Maximum output level: +18dBu @ 1kHz
Input: Balanced, transformer coupled
Maximum input level: +8dBu (without PAD), +18dBu (with PAD) at 1kHz
Gain: +40dB (± 1dB) - normal setting, approximately +46dB - high setting
Attenuation: -30dB to 0dB in steps of 6dB; minus a further 10dB, by engaging PAD
Frequency response: 40Hz to 15kHz, ±1dB: 15Hz to 30kHz ±3dB
Distortion: <0.2%, 1kHz @ -4VU (0dBu), gain 40dB : <1%, 40Hz @ -4VU (0dBu), gain 40dB
Noise: <-120dB referred to input
Power supply: 12V AC
Power consumption: 8 Watts
Phantom Supply: +48V DC, up to 5mA

PHAME Specification

Circuit configuration: 3 valve (vacuum tube) design
Output: Balanced, transformer coupled
Maximum output level: +18dBu @ 1kHz
Input: Unbalanced, high-impedance
Maximum input level: Effectively infinite. Signals >2V RMS not recommended.
Gain: 24dB (± 1dB) – low-gain setting, 30dB – high-gain setting
Attenuation: Continuous. Max > -60dB
Frequency response: 40Hz to 15kHz, ±1dB: 15Hz to 30kHz ±3dB
Distortion: <0.2%, 1kHz @ -4VU (0dBu), gain 40dB: <1%, 40Hz @ -4VU (0dBu), gain 40dB
Noise: <-120dB referred to input
Power supply: 12V AC
Power consumption: 8 Watts

PHI Specification

Circuit configuration: 2 valve (vacuum tube) design
Output: Balanced, transformer coupled
Maximum output level: XX, just prior to waveform clipping @ 1kHz
Input: Unbalanced, high-impedance
Maximum input level (INSTRUMENT): 2V RMS
Maximum input level (LOUDSPEAKER): 100V RMS
Gain: -18dB
Power supply: 12V AC
Power consumption: 2 Watts

Phaedrus Audio Ltd. reserves the right to alter these specifications without notice.

Declaration of Conformity

The Manufacturer of the Products covered by this Declaration is

Phædrus Audio Ltd.
head office address

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:

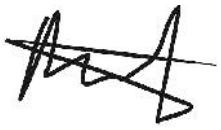
Phædrus Audio PHAB – microphone preamplifier; Phædrus Audio PHAME – instrument preamplifier; Phædrus Audio PHI – DI-Box.

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 2011.



Signed: **Richard Brice, Technical Director**
Date: January 2011