



VF14M Product Manual

Electronic replacement for Telefunken VF14M tube in
Neumann U47 & U48 microphones

Manufactured by Phædrus Audio . UK

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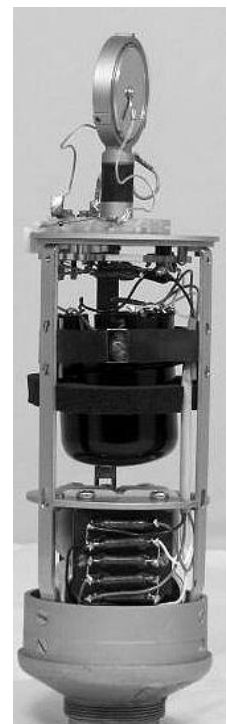
Chapter 1 - The Neumann U47 and U48 microphones and the VF14 tube



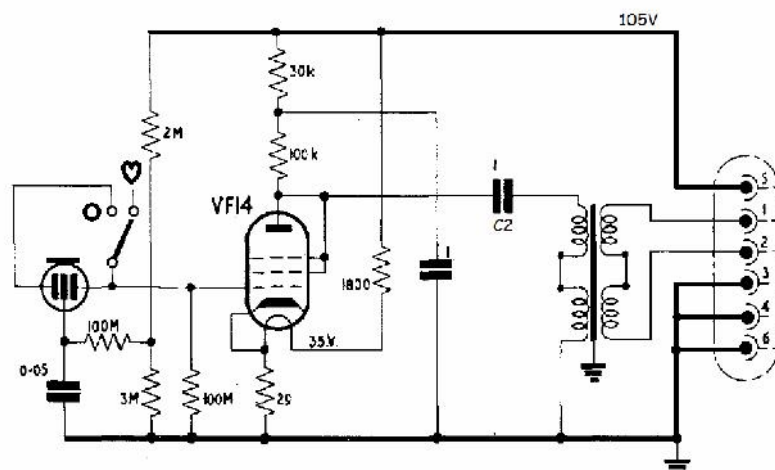
The U47 microphone was developed by the German company Neumann and was launched in 1947. It is common to see Neumann, Telefunken and Siemens "versions" of the U47 because Neumann OEM'ed the microphone to Telefunken and Siemens who stuck on their own badges, but all U47s were manufactured by Neumann.

The U47 is deservedly a legendary microphone. Ella Fitzgerald and Billie Holiday both recorded using the U47. Sinatra refused to record without his "Tele" (Telefunken U47), and the microphone was the first choice for the early Beatles records; both for vocals and guitar.

The U47 is a switchable omni'/cardioid microphone with a high sensitivity of 25mV/Pa (in cardioid configuration). The microphone's internals are illustrated left and right and the circuit diagram is given below. Note that the polar pattern is switchable by means of selecting the signal from one or both the diaphragms either side of the common back plate - the latter forming the other, common, energised electrode.



The back plate is held at a constant tension of about 55V and the charge is held steady by feeding this through a very large resistance. The impedance-converter uses a VF14M tube which acts as a voltage amplifier circuit and drives the output transformer which loses most of the voltage gain of the tube, but translates the output impedance to 50 or 200 ohms to drive the long microphone cable. Note that there is only one supply (105V at 40mA) which is used for the HT and for the heater supply for the tube (specified to be the unusually high 55V, but under-run in this application at about 35V). The heater supply is simply dropped by the 1800Ω resistor which dissipates about 2.6 watts in the process!



U48

The U48 microphone is identical to the U47 in every way, except for the selection of directional characteristics; the U48 offering the choice of cardioid and figure-of-eight instead of the U47's choice of cardioid and omni-directional. Although this seems quite a radical change, in fact the modification to bring this about is relatively simple.

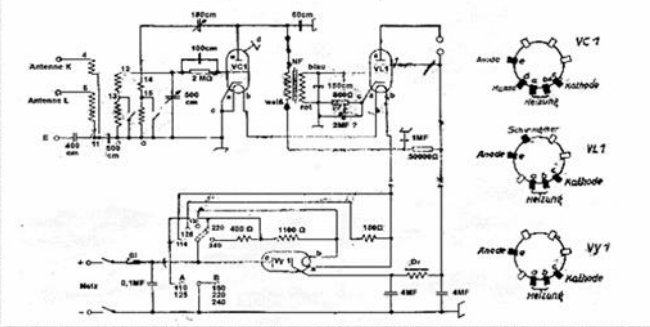
Why did Neumann chose this unusual tube?

2-Röhren Allstrom-Empfänger

mit den neuen 55-Volt-Röhren

(Entspricht dem VE 301 GW)

Einfacher, übersichtlicher Aufbau; verblüffend gute Empfangsergebnisse bei denkbar geringstem Stromverbrauch.



After the Second World War, the collateral damage to German infrastructure was so severe that no nationwide electricity supply existed. Instead, many temporary and provisional mains electricity supplies were contrived; both AC and DC. As part of post-war reconstruction, there existed a market for cheap radio sets which could operate on all these various supplies – an unusual requirement because the sets running on DC supplies couldn't use

transformers. To satisfy this demand, German tube manufacturers developed tubes with a high filament voltage which could be run directly from the mains supply.

Since two-tube radio-sets were the most common and 110V AC and DC were the most common supplies (a contemporary design is shown above), the voltage chosen for the filaments was 55V, so that the two devices could be wired across the radio-set HT supply in series. The article declares, "Two tube universal voltage receiver with the new 55 volt tubes Simple, clear circuit; amazingly good reception and low power consumption."

One such tube, widely used in radios of the period, was the VF14, a 55V heater version of the ubiquitous EF14 which was pretty much the *volks-pentode* of the German war machine, finding applications in everything from field radios to the *Vergeltungswaffen Zwei* or V2 rocket!



The VF14 tube used in the impedance converter of the U47

The new German broadcast stations after the war had the same issue as civilians. Faced with a DC (110V) mains supply, *Berliner Rundfunk* (Radio Berlin) asked Georg Neumann to supply them microphones which could be used without a power supply: run directly from the mains. Neumann solved this in exactly the same way as the radio designers had, and opted to use the VF14.

Strait is the gate, and narrow is the way

But the requirements for the tube in the head amplifier in a broadcast microphone and in the RF front-end of a cheap radio are very different. And, whilst the pedestrian VF14 tube worked consistently in the latter, only a few examples worked in the former. Neumann's solution was to set up an arrangement with tube manufacturer Telefunken so that when they took delivery of a batch of VF14 tubes, they selected suitable samples on the basis of: low grid-current (which affects low-frequency response by effectively reducing the input impedance of the amplifier); low-noise; and low microphony and the rejects were returned to the tube manufacturer. *At least, two-thirds of the tubes off the production-line were rejected for inadequate performance in the U47 and U48 microphones.* Those that passed the Neumann test procedure were marked with an "M" on the side of the steel can (for *Microphon*).

The maths

In retrospect, Neumann's selection of the VF14 tube was an unfortunate choice for the active device in the impedance converter because only about twenty-seven thousand of these tubes were ever made before production was halted 1954¹. The maths speaks for itself. We know that Neumann produced about 6000 U47s and about 800 U48 microphones. That's about 7000 examples and, given the two to one rejection ratio, that means their tube consumption was about 21,000 of the 27,000 or so available VF14 tubes.

This left only about 2000 suitable tubes ($6000 \times \frac{1}{3}$) for the rest of all time. Not even enough units to allow for re-tubing the microphones once in their lifetime! In fact, even by the late nineteen-fifties, Neumann could not get hold of reliable quantities of the VF14 for production, maintenance and repair and the situation was so serious that, by 1960, a major German broadcast customer refused further to invest in Neumann equipment unless the company demonstrated that it had a solution to keeping their substantial investment in U47s in service.

Nuvistor

Neumann's rather hurried solution employed a 13CW4 *Nuvistor* (a miniature, metal-encapsulated tube illustrated below) which fitted in a small board which could be plugged

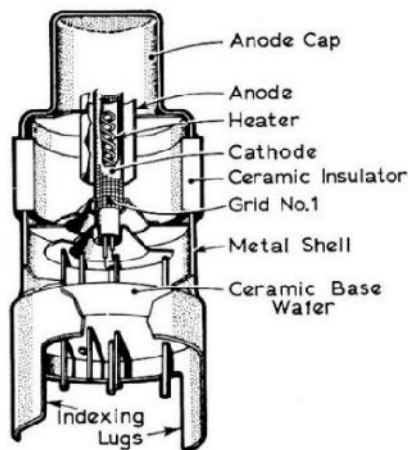
¹ In fact, no steel tubes were produced after March 1958 when the Telefunken factory in Berlin stopped the entire steel tube production line.



into the VF14 socket, a substitution which required a modification to the associated microphone power-supply. This modification has never gained favour with recording engineers as it does change the sound of the microphone , because Nuvistors are un-reliable and are themselves becoming scarce and expensive.

Appendix 1 includes details of the Neumann Nuvistor modification for those microphone owners who have Nuvistors fitted and whom might wish to return their microphones to the original specification and substitute a Phædrus Audio VF14M **Electronic Tube™**.

The end of the story



By the end of the fifties, the Neumann design team knew that the game was up. It was clear by then that no more VF14 tubes existed anywhere in the world which would measure sufficiently well to be used in their microphones and extensive research had revealed that no direct substitute tube existed. Their response was to re-design the associated circuitry, and particularly the output transformer, and release a new unit to replace the U47 and U48. This was the U67 microphone which was launched in 1960 which was able to work as an omni', a cardioid or as an eight.

The bare facts

So, the situation is rather bleak because we can summarise the above as the following:

- No more VF14M tubes will ever be found, Neumann exhausted these before 1960, and they also knew that no exact substitute tube exists for the VF14.
- Any VF14 tubes discovered today almost certainly saw the inside of the Neumann factory and were rejected because they were either: noisy, microphonic, or rolled-off the low-end frequency response unacceptably.

The next chapter describes the Phædrus Audio VF14M **Electronic Tube™** product which has been developed to keep these wonderful microphones in service as to provide active devices for the many clones and copies that exist of the original microphones.



Chapter 2 – Phædrus Audio VF14M Electronic Tube™

Product description



The Phædrus Audio VF14M Electronic Tube™

The VF14M is a static sensitive device: exercise reasonable precautions in handling.

DO NOT ATTEMPT TO TEST THE PHÆDRUS AUDIO VF14M IN A TUBE TESTER

The Phædrus Audio VF14M **Electronic Tube™** circuit replicates the circuit impedances, the transfer-function (gain and frequency response) and distortion characteristics of the real VF14s we've measured. In addition, all the voltages and currents in the microphone circuitry are maintained exactly as if a VF14M is in circuit. We've even made sure that the dissipation is exactly the same, so that the temperature within the tube will be as if a real VF14M was present.

The Phædrus Audio VF14M **Electronic Tube™** is thus a modelled design. It isn't original. It isn't even thermionic (it's solid state). But it does do exactly what an original VF14M does in terms of every parameter that we have been able to measure... including with our ears!

Installation

Whilst the Phædrus Audio VF14M **Electronic Tube™** will work in absolutely every U47/48 microphone and its copies and clones and is a total drop-in replacement for the Telefunken/

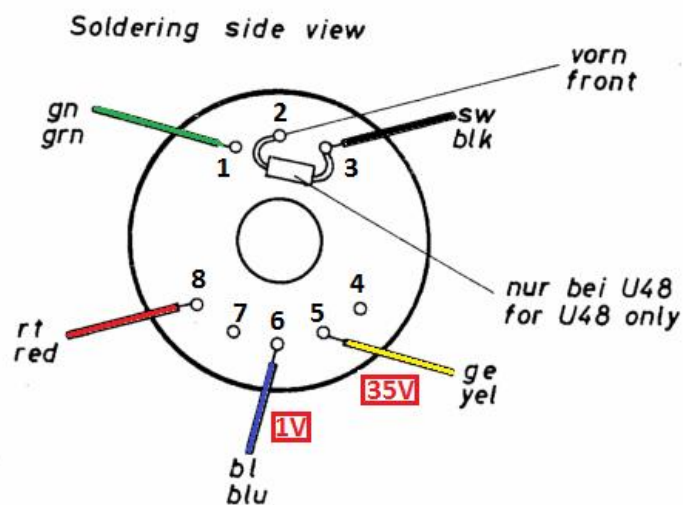


Neumann tube, the Phædrus Audio VF14M **Electronic Tube™** needs to have the heater volts applied in the correct polarity. Of course, a real tube doesn't care which "end" of the heater is positive. But, the solid state version does.

DO NOT FIT THE PHÆDRUS AUDIO VF14M UNTIL THIS CHECK HAS BEEN MADE

Heater polarity check

The requirement that the heater supply is connected in the correct polarity for the Phædrus Audio VF14M **Electronic Tube™** is easily checked. It may be determined visually or with a voltmeter.



The tube base of the VF14M in a U47 or U48 and the usual heater wiring arrangement

Open the microphone and look at the wiring to the tube base (as illustrated above). The important point to verify is that pin 5 (as numbered above) is the positive heater pin and that pin 6 is strapped to the cathode.

This may be determined visually. Check that pin 5 is connected to the dropper resistor in the base of the microphone case. The usual colour for the wire coming from the 1800Ω HT dropper resistor is yellow, but trace the wire and determine that it does issue from the power resistor.

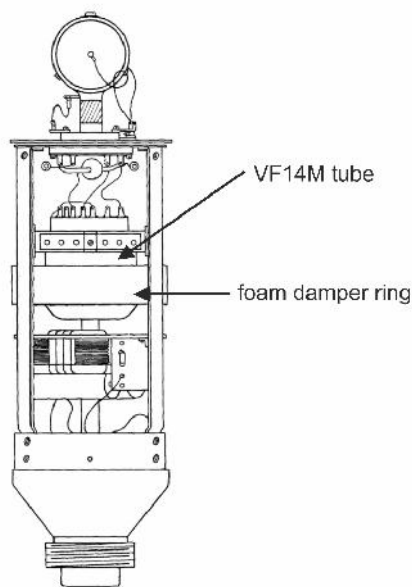
Even better, check this with a voltmeter with the microphone energised. Assuming the tube is still has its heater intact; you should measure close to 35V on pin 5 and about 1V on pin 6. If the tube heater is broken, you may well measure about 300V on the positive side of the heater.



Provided your inspection and tests determine that pin 5 is positive with respect to pin 6, then the Phædrus Audio VF14M Electronic Tube™ may be fitted with no modifications to the microphone. If your inspection and voltmeter reveal that pin 6 of the tube base is positive with respect to pin 5), then you have to rewire the microphone so that pin 5 is the positive end of the heater.

Fitting the Phædrus Audio VF14M Electronic Tube™

Always undertake work on a microphone in a clean, dry environment with clean, dry hands.

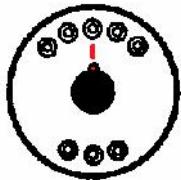


The U47 (and U48) microphone are opened by removing the three screws around the microphone head and removing it. The cylindrical sleeve of the microphone body may be slid off once the screw in the base has been removed. The internals of the microphone are as illustrated below. Be careful never to touch the capsule, or even to breathe or blow upon it directly.

Remove the VF14 by wiggling the tube gently and applying a gentle downward force. Be sure to support the tube base when removing the tube as the tube-base mounting is fragile. The foam damper ring which sits around the VF14 tube should be removed with the tube if there isn't room to remove it first.

The Phædrus Audio VF14M simply plugs into the German Y8A octal socket. Be careful to observe the correct orientation when plugging the tube in. The keyway will prevent the unit from being inserted in the wrong orientation.

Y8A



In the long-bodied version of the U47, the foam ring may be fitted after re-seating the tube in its socket. In the short-body type, and all U48s, the foam ring should be fitted prior to re-seating the tube in its socket. In the case of the Phædrus Audio VF14M, the foam ring should sit around the solid "top-deck". Do not fit the ring around the open lower deck as this will impede the cooling of the device by convection.



Chapter 4 - 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.

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.



Appendix 1 – The Neumann *Nuvistor* modifications

Conversion of Neumann U 47 and U 48 microphones
to nuvistor tubes

(nuvistor 13 CW 4 instead of tube VF 14)



U 47-960-02-01

In view of the fact that Telefunken quite some time ago discontinued manufacture of the VF 14 tube used in the U 47 and U 48 microphones, Neumann has devised a means of converting these microphones from the VF 14 tube to another tube. Due to the fact that no completely equivalent tube is available on today's market, the following changes have to be made:

1. Remove VF 14.
2. Remove the leads (red, blue, yellow, green, black) from the tube holder (at U 48 remove also 29- Ω -resistor.).
3. Remove the tube holder after unscrewing six screws in the three bars.
4. Two of the three plastic holders supplied have to be inserted into the screw holes.
5. Put the AR 47 upside down into these holders and fix it by inserting the third plastic holder. (The AR 47 side with three soldering points shows towards the front of the microphone.)
6. Resolder the leads according to the sketch below (at U 48 resolder also the 29- Ω -resistor).
7. Insert nuvistor 13 CW 4 into the socket.

The NG pwr supply must have a small change of wiring due to the greater heater current required by the nuvistor.

- a) Replace resistor R-2 (1 k Ω power resistor coming from + terminal of rectifier) by a solid wire connection between the first two electrolytic capacitors.
- b) Install this same R-2 in parallel with R-3 (an identical resistor next in the RC filter chain), thereby making its total resistance value 500 Ω .

After conversion, the U 47 / U 48 microphone will have an output level 2...3 dB lower than previously. Due to the very high output level of these microphones this is of no disadvantage.

Should you now have some microphones converted and others unconverted, the power supplies and microphones must be marked to prevent confusion.

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GEORG NEUMANN GMBH · ELECTROACOUSTIC · 1 BERLIN 61 (WEST)

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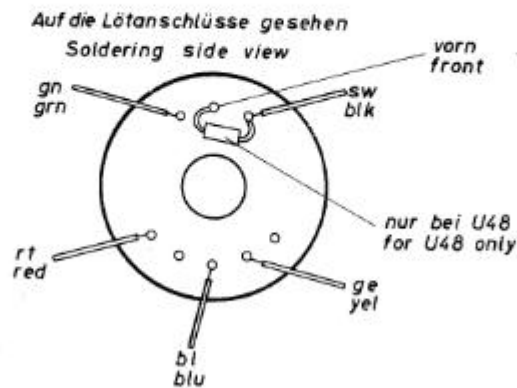
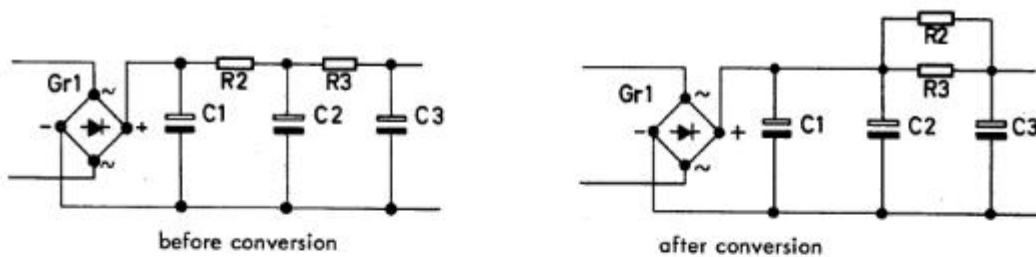


Version 3.0 - January 2016

Should you desire complete interchangeability of converted and unconverted microphones, you may wish to do the following:

- a) Convert all your power supplies as described above.
- b) Install in those U 47 / U 48 microphones still equipped with the VF 14 tubes, a 1500 Ω 3 W resistor directly at the back of pin 5 (B+) terminal of the microphone base connector in series with the red lead.
- c) Remove this resistor at any time that you subsequently convert to the nuvistor adapter in these microphones.

NG power supply schematic:



Appendix 2 - Datasheet



TYPE: **VF14M**
Y8A OCTAL
AUDIO PENTODE

The Phædrus Audio VF14M is suitable for direct replacement of the VF14 (VF14M) in Neumann U47 and U48 microphones other derivative microphones originally specifying this device. See technical specification below. For more information and enquiries, [email sales@phaedrus-audio.com](mailto:sales@phaedrus-audio.com).

The Phædrus Audio VF14M is designed as a in replacement (Note 1) for the original Telefunken tube. No modifications to the microphone are necessary.

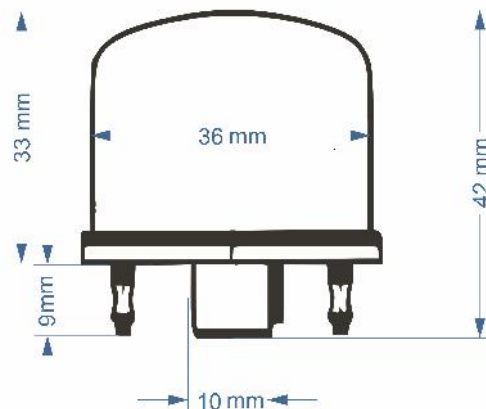
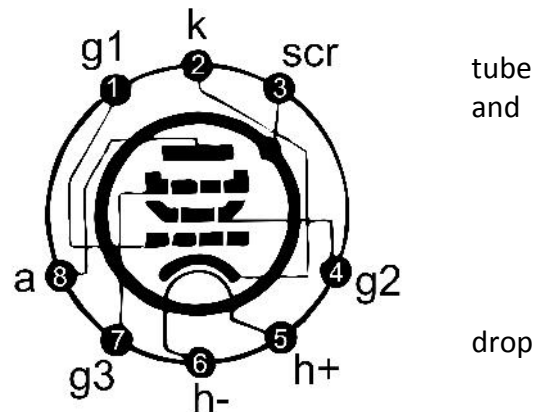
VF14M Electronic Tube™ Technical Specifications

Recommended operating conditions

- Heater voltage:** Underrun at 35V: fed by 1800Ω resistor from HT (*Note 1.*)
- Heater current:** 40mA
- HT Supply:** 90V (nominal top of R5)
- Anode load:** 100k
- Anode volts:** approx. 35V
- Grid voltage:** 0V
- Grid resistor:** 60 - 100MΩ
- Cathode circuit:** approx. 1V (derived across R3)

Notes:

- i.e. Polarity must be respected. Thus terminal h+ must be positive with respect to terminal h- .





TYPE: **VF14M**
Y8A OCTAL
AUDIO PENTODE

Warranty and service

If you experience a problem with a Phaedrus 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 Phaedrus Audio's support service. Phaedrus 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. There are no user serviceable parts inside.

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This limited warranty is extended exclusively to the original buyer (customer of Phaedrus 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 Phaedrus Audio.

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For any hardware defects experienced by the customer while the product is under warranty, Phaedrus Audio will incur the shipping cost to the customer and the customer is responsible for the shipping costs to Phaedrus 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 Phaedrus Audio's limited warranty, please see complete details online at www.phaedrus-audio.com.

