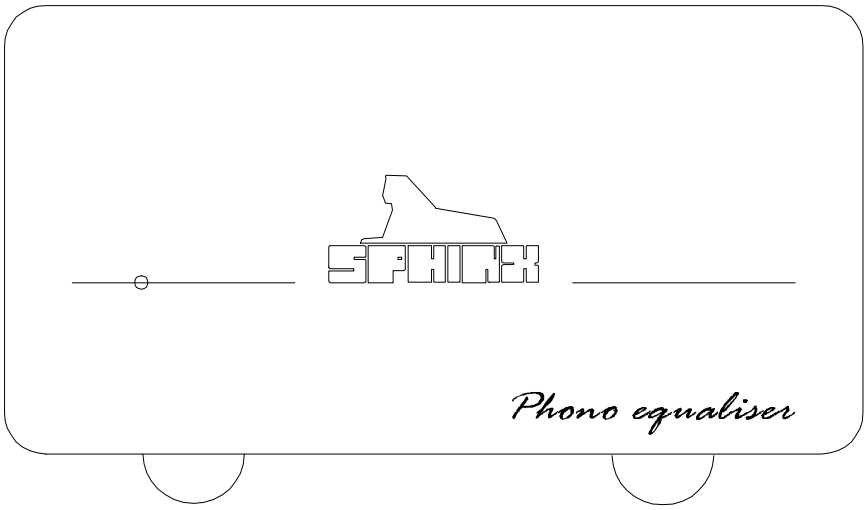
SERVICE MANUAL

PHONO EQUALISER



The Sphinx *Phono equaliser* design

This service manual will help you to optimally service and repair the Sphinx *Phono equaliser*.

The *Phono equaliser* active MM and MC phono pre-preamplifier is the first to obtain the extremely high audio quality standards of the Sphinx product line. The design has therefor been only been finalised after numerous intensive comparative listening sessions. It is based on a radically new amplifier design using special complementary FETs in a single housing (the same that are used for the Project Eight preamplifier). This is guarantees ultra-low noise and an incomparable transient response. It offers numerous user adjustable settings for MM and MC (Gain, Impedance, etc.). This enables you to fine-tune the *Phono equaliser* to almost any cartridge on the market.

It is however not confined to the regular MM and MC cartridges but in addition offers special settings for the use of 78-rpm records!
One of which is a specially designed filter: this ensures the correct playback correction curve. And thus prevents the usual annoying increased surface noise of the records when played via 'normal' phono preamps. It restores the actual sound quality of the records.

To obtain the maximum quality from this *Phono equaliser* it is necessary to use it with top quality audio components, preferably with other Sphinx components.
The *Phono equaliser* may be used with components from the Sphinx Project Series, the Myth Series and even with non-Sphinx products.

1. UNPACKING

Before leaving the factory every *Phono equaliser* is subjected to stringent and extensive technical and exterior quality inspection.
This ensures you will enjoy many years of high quality audio performance from a perfect-looking product.

After unpacking your *Phono equaliser* we therefore recommend you carefully check it for any transport damage.
In case of damage: please contact your Sphinx dealer immediately and retain all packing materials for possible proof of damage and possible claims.

Even if the component is in perfect condition you should still keep the packing materials. If you need to transport your *Phono equaliser* at a later time it will be best protected by the original packing materials.

2. CONTACTING THE MANUFACTURER

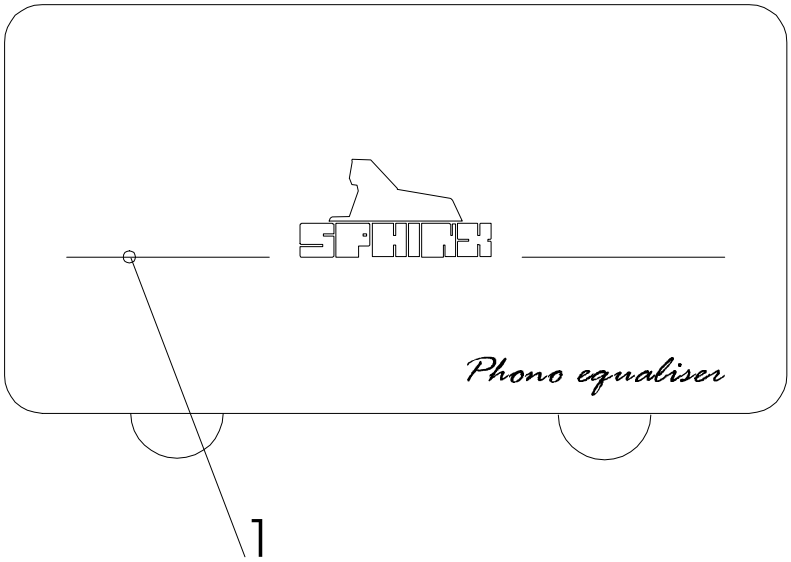
In case of any problem not covered in this manual or if you have other questions you may contact the **Sphinx International Service Department** in The Netherlands (local time: GMT +1h) during office hours at the following numbers:

Telephone	(+31) 35 602 0302
Fax	(+31) 35 602 2806
E-mail	audionl@euronet.nl

It is always very helpful and efficient if you have all relevant information about the specific product and the problem ready.

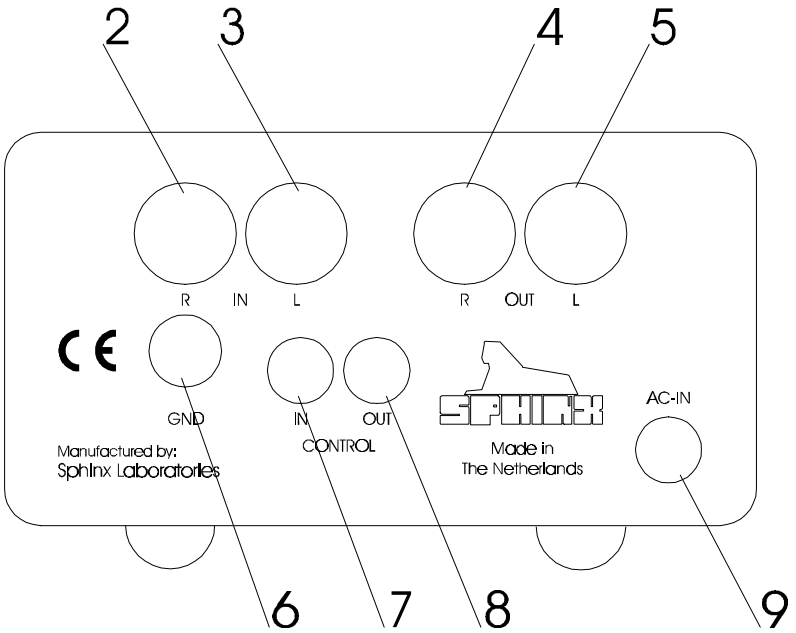
3. THE PHONO EQUALISER AT A GLANCE

Front panel



1. **LED:**
   in green
   (for Myth Series: not illuminated)
   Standby red

Rear panel



2. **R IN**: Connect to this input the *right* (red) output cable from the turntable.
3. **L IN:** Connect to this input the *left* (white or black) output cable from the turntable.
4. **R OUT:** Connect this output to the *right* input of the (pre-) amplifier
5. **L OUT:** Connect this output to the *left* input of the (pre-) amplifier.
6. **GND:** Connect here the separate ground wire from the turntable.
   Also connect here the ground wire from the (pre) amplifier (if applicable).
7. **Control IN:** Connect here the optical cable from another Sphinx component's Control Out (usually the preamplifier).
8. **Control OUT**: Connect here the optical cable that goes to another Sphinx component's Control In.
9. **AC IN**: Connect the mains cable to a mains power outlet (100 - 240 VAC).
10. **Manufacturer's label:** (at housing underside) This shows important data for the component, such as serial number and mains power voltage.

4. INSTALLATION AND CONNECTIONS

Installation

The *Phono equaliser* will not become very hot, so placement is not critical, although you should not place it on top of or near other heat-radiating equipment (such as power amps) or in direct sunlight.
If you use it in a closed cabinet or on a bookshelf, please ensure unrestricted ventilation around the component.
To prevent any possible interference keep power supply cables away from all audio cables.

Note: The mains power transformer of the *Phono equaliser* is mounted at the front side.

Position the *Phono equaliser* as close to the turntable as possible while keeping the cables as short as possible.
Always connect the separate ground wire from the turntable to the GND terminal (6).

If all these conditions are met, the *Phono equaliser* will perform to the extremely high standards it is designed for.

Connecting the mains cable

Before you connect the cable please check whether the mains voltage indicated on the manufacturer's label on the rear panel is the same as your local mains voltage.
If not: please contact your dealer and do not connect the component to the mains.

The *Phono equaliser* does not have a dedicated on/off switch. After you have connected it to the mains power it will always be active while the default setting is ON..
This way the electronic circuits will be kept at optimum working temperature so you can enjoy maximum audio quality immediately after switching on. Additionally it significantly increases the life span of the component.
Via the Control IN input (7) however it may be remotely switched to Standby by another Sphinx component.

Connect the mains cable after you have connected all other components in the system, have double-checked all connections and after the *Phono equaliser* has been matched to the cartridge in use (see Chapter 5).

Audio connections

Before you start connecting equipment it is always wise to check whether all the mains power cables of all components are disconnected from the mains outlets! This will prevent any damage to the loudspeakers and amplifiers caused by incorrect wiring or settings.
Make sure you connect L and R properly. Most cinch cables use Red for the Right channel and White or Black for Left.
The cinch connectors on the rear panel of the *Phono equaliser* have a red centre for the right channel and a white one for the left channel.

When making the connections please refer to the descriptions for parts 2. to 10. on page 5.

Connecting the pre-amp

Connect the R OUT (4) and L OUT (5) to the LINE- or AUX inputs of the pre-amp, using normal cinch cable (but of top quality!).
Connect the separate ground wire (if supplied) from the pre-amp to the GND terminal (6).

Connecting the turntable

Connect the (in most cases fixed) audio cable from the turntable to the R IN (2) and L IN (3).
Connect the separate ground wire from the turntable to the GND terminal.

Connecting the optical cables

Connect the CONTROL OUT of a Sphinx pre-amp to the CONTROL IN (7) of the *Phono equaliser*. It will then switch to Standby mode as soon as the pre-amp is set to Standby.
Connect the *Phono equaliser*'s CONTROL OUT (8) to the CONTROL IN of another Sphinx component. It will then automatically switch to Standby as soon as the *Phono equaliser* is selected to Standby.

Ensure proper connection of the optical cables, otherwise the Standby LED on the front panel may remain off, even though the Standby mode is activated.

If the CONTROL IN is not used and the *Phono equaliser* is placed in strong direct sunlight, the Standby mode may self-activate.
In that case you should place the supplied dummy connector in the CONTROL IN jack.

5. CHANGING THE SETTINGS

The *Phono equaliser* may be used with a wide range of cartridges, including the 78 rpm types. Before you can use the *Phono equaliser* it should therefore be matched to your specific cartridge and application.

In addition there are two special filters that may be selected.
Note: The 'rumble' filter (12 dB/octave@10 Hz) can not be deselected.
And you can even select the working mode of the LED on the front panel: Project Series or Myth Series!

In order to select the correct settings you'll need the following data:

a. The type of audio system:
   Sphinx Project or Myth Series
   R*e. the cartridge*:
b. The output sensitivity
c. The output capacitance
d. The type: MM or MC and
   the output impedance
   And finally:
e. The type of records: normal or 78 rpm.

These data you may find in the manuals and/or technical specifications of the equipment.
Write these (preferably with a pencil) into the last column of the following table.
The *Phono equaliser's* default values are marked in the first column:

Setting	Default	Your data
a.	LED: Project Series	
b.	High Gain (250-750 µV)	
c.	47 pF	
d.	MC cartridge 200 ohm	
e.	RIAA	
f.	78 rpm filter OFF	

This simplifies the procedure while showing exactly the default value(s) differing from your data and thus which setting(s) need to be changed!

A. Default values match your data and system
You do not have to change anything, may skip this chapter, go straight to Chapter 6 and start using the *Phono equaliser*.

B. Some values are different
In that case you may have to change one or more settings. You should use the following procedures to ensure correct results.

You may refer to the sticker inside the cover showing the settings for each DIP-switch.

Which setting should be changed is wholly dependent on the default values that differ from your data.
Note: If you have to change more values, the order in which you adjust settings a – f is not important.

ATTENTION: Before starting the procedures always first disconnect the mains cable from the power outlet!

Removing the cover

Carefully (to prevent any scratching of the surface) remove the small Phillips screws on the left-hand side and on the right-hand side.
Remove the cover and store it in a safe place. However, make sure that you are able to read the sticker on the inside when necessary.

You'll see the mains transformer and the circuit board with the components and switches.

The Phono settings are changed by means of the small switches in the four red 'switch blocks' (showing the text ON).
The LED setting is changed with the small shorting plug (positioned closest to the 8-pin power supply connector at the front of the housing).

a. LED: Project or Myth Series standard

When using the *Phono equaliser* with the Sphinx Myth Series you are able to give the LED (1.) the same functionality as that on the Myth Series (when the equipment is 'on' the LED is 'off').
- Remove the red shorting plug.
- You will see two free pins.
- Replace the plug so it covers *both* pins.
- Ready!

If there are no other settings to be changed you may continue with "Replace the cover". Otherwise select one of the following settings.

b. Input sensitivity (Gain)

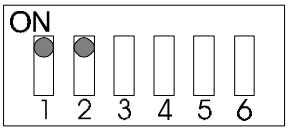
It is important to match the input sensitivity of the *Phono equaliser* to the output value of the cartridge in use. Only this will ensure the maximum S/N ratio and will prevent distortion.

The Gain has three settings:
- **High:** for cartridges with an output signal between 250 µV and 750 µV.
- **Mid:** for cartridges with an output signal between 750 µV and 1,5 mV.
- **Low:** for cartridges with an output signal between 1,5 mV and 15 mV.

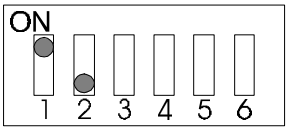
The Gain is set with switches 1 and 2 of the large red 'switch blocks' (one for each channel).

Using the value of your cartridge (as marked in the table), move the switches to the correct value according to one of the following pictures.

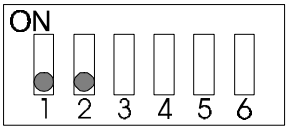
HIGH (standard)



MID



LOW



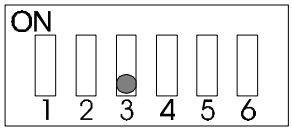
c. Input capacity (MM)

This setting is specifically for MM cartridges. The standard value is 47-pF, but some cartridges need a value of 147-pF for optimum results.

Note: This setting has no influence on the MC settings.

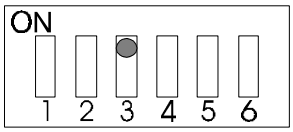
The standard value is 'LOW' (47-pF).

Capacity low (standard)



You select the HIGH value by moving switch 3 to the upper (ON) position.

Capacity High



d. Cartridge type / Input impedance

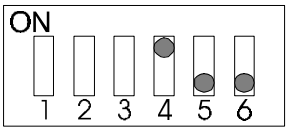
For each cartridge type you need to set the correct input impedance.
You may find the value for your cartridge in its manual under the technical specifications.

The impedance is set with switches 4, 5 and 6.

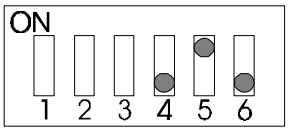
If your MC cartridge needs an impedance other then 200 ohm you may select:
- 100 ohm or
- 50 ohm.

For a MM cartridge however you can only select:
- 51 kohm.

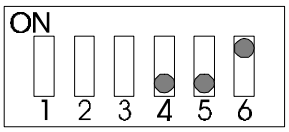
200 Ohm (standard)



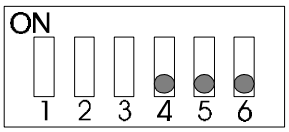
100 Ohm



50 Ohm (MC)



51 kOhm (MM)



e. RIAA or 78 rpm

The standard replay correction is RIAA, this is also suitable for many 78 rpm records. The *Phono equaliser* can be switched to a special 78 rpm curve needed by certain records (see also Chapter-7. “The 78 rpm modes”).
This is set with switches 1 and 2 on the small red ‘blocks’.
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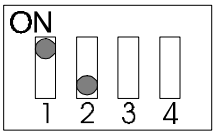
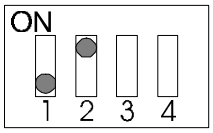
RIAA (standard)



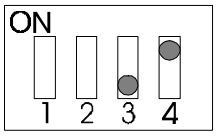
78 RPM



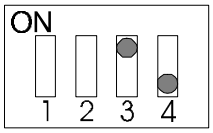
f. 78 rpm filter

To ensure proper 78 rpm replay quality with modern audio systems, it is necessary to use a special low-pass filter. Otherwise the frequencies above 4 kHz will become too emphasised. After selecting this filter the replay quality will be more according to the ‘old’ standards.

78 RPM Filter 'off' (standard)



78 RPM Filter 'on'



Replace the cover

After you have changed the settings we advice you to recheck whether each setting is correctly done. It is also very useful to make a note of all the changes you have made for future reference.
Then replace the cover and tighten the screws.
The *Phono equaliser* is now ready for use with your audio system.

6. OPERATION

After you have properly adjusted all settings you may start using the *Phono equaliser*.

Connect the mains cable to a mains outlet
The LED (1) will blink *red* for some time after which it changes to *green* (when the Myth setting is selected it will go *off*).

Switching on

The *Phono equaliser* per default is always switched on and can not be switched off.

This way the electronic circuits will be kept at optimum working temperature so you can enjoy maximum audio quality immediately after switching on. Additionally it significantly increases the life span of the component.

Standby

The *Phono equaliser* may be remotely switched to Standby by another Sphinx component if it is connected to the CONTROL IN (7) optical input.
The LED will switch to red.

Switching off

The only way to switch the *Phono equaliser* off completely is to unplug the mains cable.

7. THE 78 RPM MODES

When 'cutting' a record master for vinyl records the audio signal is sent (for technical reasons) through a special correction equaliser: this *in*creases the highs and *de*creases the lows. During replay of the record this correction curve is 'reversed' by the replay filter in a phono pre-amp.
The **RIAA** curve is an international standard curve for 33 and 45 rpm records. This attenuates the frequencies above 2120 Hz and amplifies those below 500 Hz (these points are also known as the 'corner frequencies' or f_c).
For 78 rpm records there have been a number of – incompatible – standards. Research by the Sphinx' designers showed however that the most commonly used standards were the **RCA** (2120 and 500 Hz) and **AES** (2500 and 500 Hz). These actually use the same curve as the RIAA, so *most* 78 rpm records can properly be played with the normal phono input.
An important (and differing) group was formed by EMI, Decca and Columbia with f_c-'s of 250, 200 and 300 Hz respectively.
That is why the *Phono equaliser* offers the special **78RPM** mode of 250 Hz (as described in **5e**). So you may also play all these specific 78 rpm records properly.

In the 78rpm era quality of the audio systems was much worse than today, especially lacking response above 4000 Hz. Due to this 'natural low-pass filter', record surface noise, etc. was undetectable.
When you replay these records via a modern audio system however, you will hear an annoying amount of surface noise and maybe even a 'thin' or 'scratchy' sound quality.
That is why the *Phono equaliser* offers the **78RPM FILTER** mode (as described in **5f**). This special filter is designed with the help of many listening tests. It ensures a usable high frequency replay quality with modern audio systems.

Note: A special problem are recordings using the following different standards: 'old' RCA, EMI or Decca. These did not incorporate any HF record correction!
Playback via a normal system will thus result in extremely attenuated highs. This is inherent to these recordings and not caused by the modern replay systems!

8. CARE AND MAINTENANCE

Clean the exterior with a soft, lint-free, anti-static cloth. Do not use force while wiping the surface. To remove difficult stains use a few drops of detergent on a moist cloth, sweep carefully and wipe dry afterwards.

If some scratching occurs, please consult your Sphinx dealer first. He can give you advice about possible solutions.

Do not use polishing or cleaning agents: they may damage the sensitive acrylic finish.

Do not use aerosol cleaning agents.
Most contain solvents, which might react with and damage the acrylic finish.

9. TECHNICAL SPECIFICATIONS

Bandwidth	0 – 111,000 Hz (+0/-3 dB)
Phase response error	<1°
Gain	High: 66 dB max. (2000x) Mid: 58 dB max. (800x) Low: 37 dB max. (70x)
THD+N (IHF-A)	<0.02% (2nd harm., 10 – 20,000 Hz)
IMD	<0.6%
S/N ratio (IHF-A)	>80 dB (>90 dB)
Channel separation	>95 dB
Slew Rate	> 24 V/µs
Inputs	2x cinch (WBT gold plated)
Level, nominal (for 1 V output)	0.13 V (-18 dBV)
Impedance	51 kohm 200 ohm 100 ohm 50 ohm (*selectable*)
Capacity	MM: 47 pF or 147 pF (*selectable*)
Outputs	2x cinch (WBT gold plated)
Level	1.1 V nominal 9.2 V max. (19.3 dBV) (1 – 100,000 Hz, THD <0.02%)
Impedance	<10 ohm
Rumble filter	12 dB/octave @ 10 Hz
Sphinx Control	1x optical IN, 1x optical OUT
Power supply	Internally, fully stabilised
Supply capacitance	16,280 µF total
Power transformer	O-core
Power consumption	10 W (7 W standby)
Housing	1,5 mm steel, with powder coating Chassis acoustically decoupled
Dimensions (h x b x d)	70 x 120 x 340 mm
Weight	3.5 kg

Measurements done while using the following settings: (@1 kHz, MC input, Gain High, Ri 100 ohm)

This unit conforms to the EMC interference regulations issued by the EU and to the CE standards.
This unit complies with safety regulation VDE 0860 and therefore with international safety regulation IEC 65.

Technical specifications may be changed by SPHINX without prior notice if technical developments make this necessary.

10. PROBLEMS AND SOLUTIONS

At the moment of writing the *Phono equaliser* has no known specific problems.
If in the future you encounter any problem(s) you may enter the info in this table. This table can then be used for future reference.

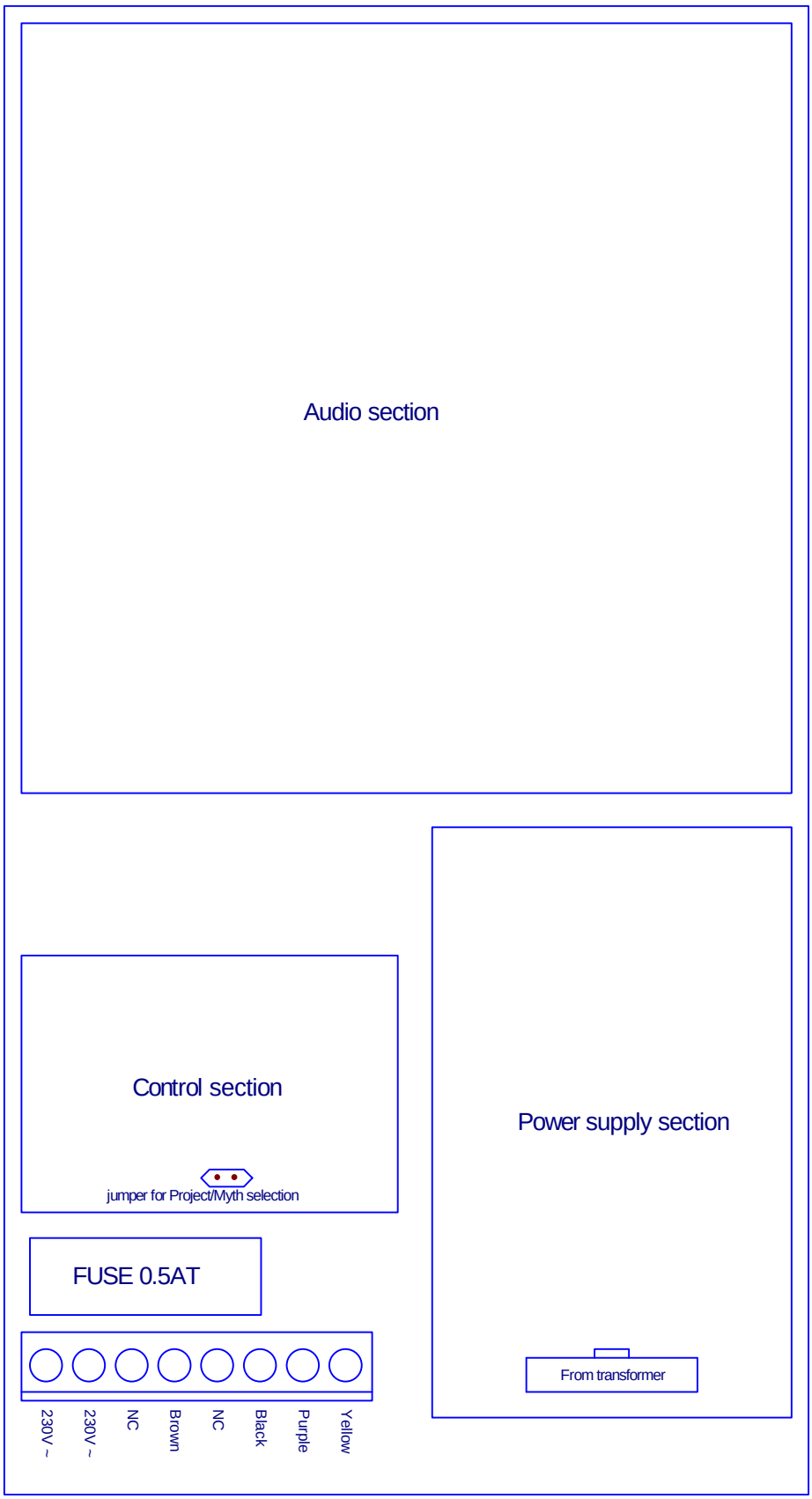
Please also send (by fax or e-mail) the specific information to the **Sphinx International Service Department** (see page 3): this info can then be added to the general database to aid others.

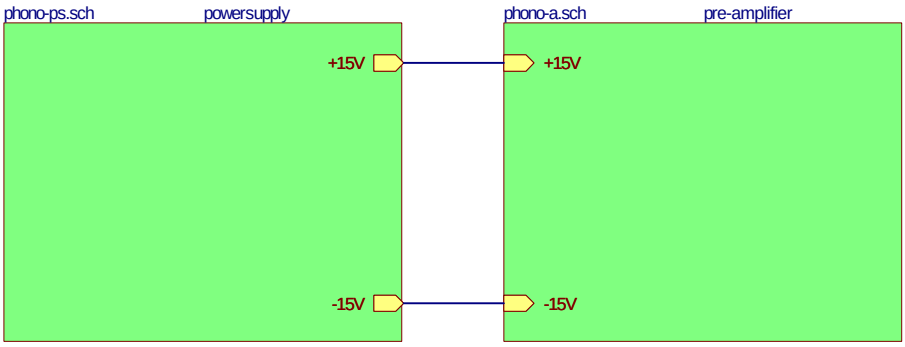
Problem	Cause	Solution	Refer to page…

11. DIAGRAMS AND PARTS LIST

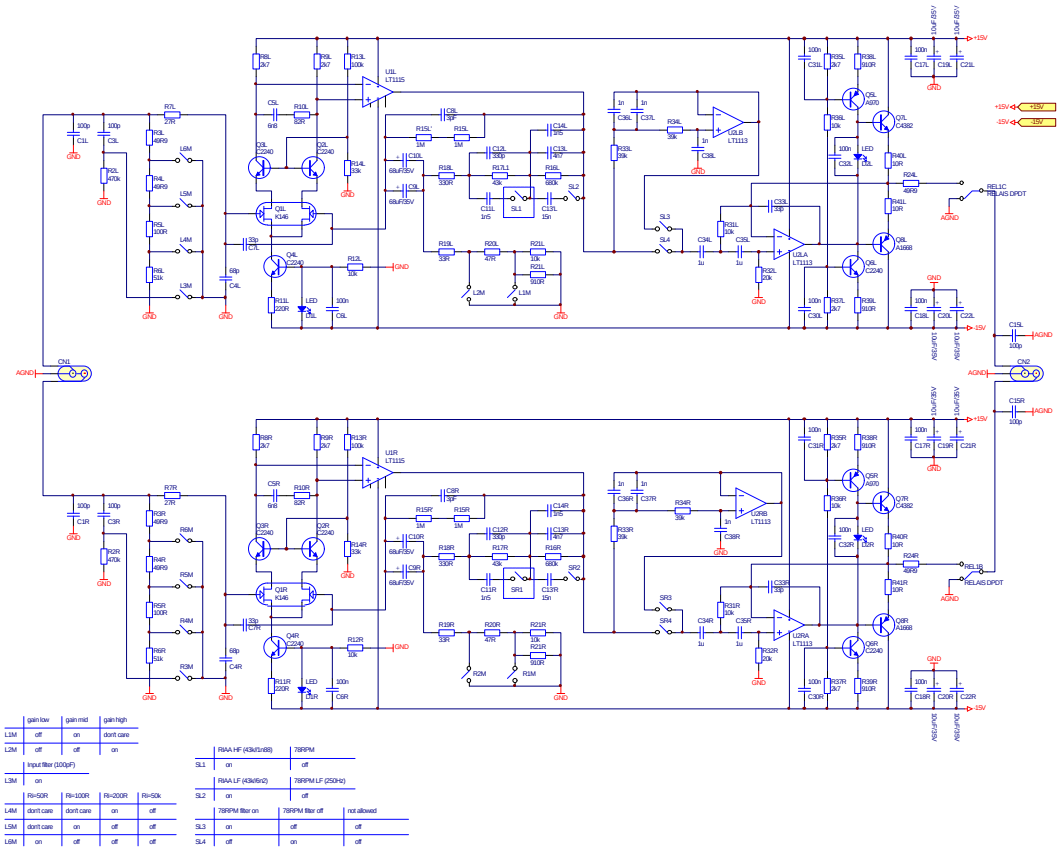
The next pages contain a complete set of schematic drawings including the associated parts list (if applicable).

Overview Components




phono-ps.sch
powersupply
+15V
-15V
phono-a.sch
pre-amplifier
+15V
-15V

Amplifier



	gain low	gain mid	gain high
L1M	off	on	don't care
L2M	off	off	on

	Input filter (100pF)
L3M	on

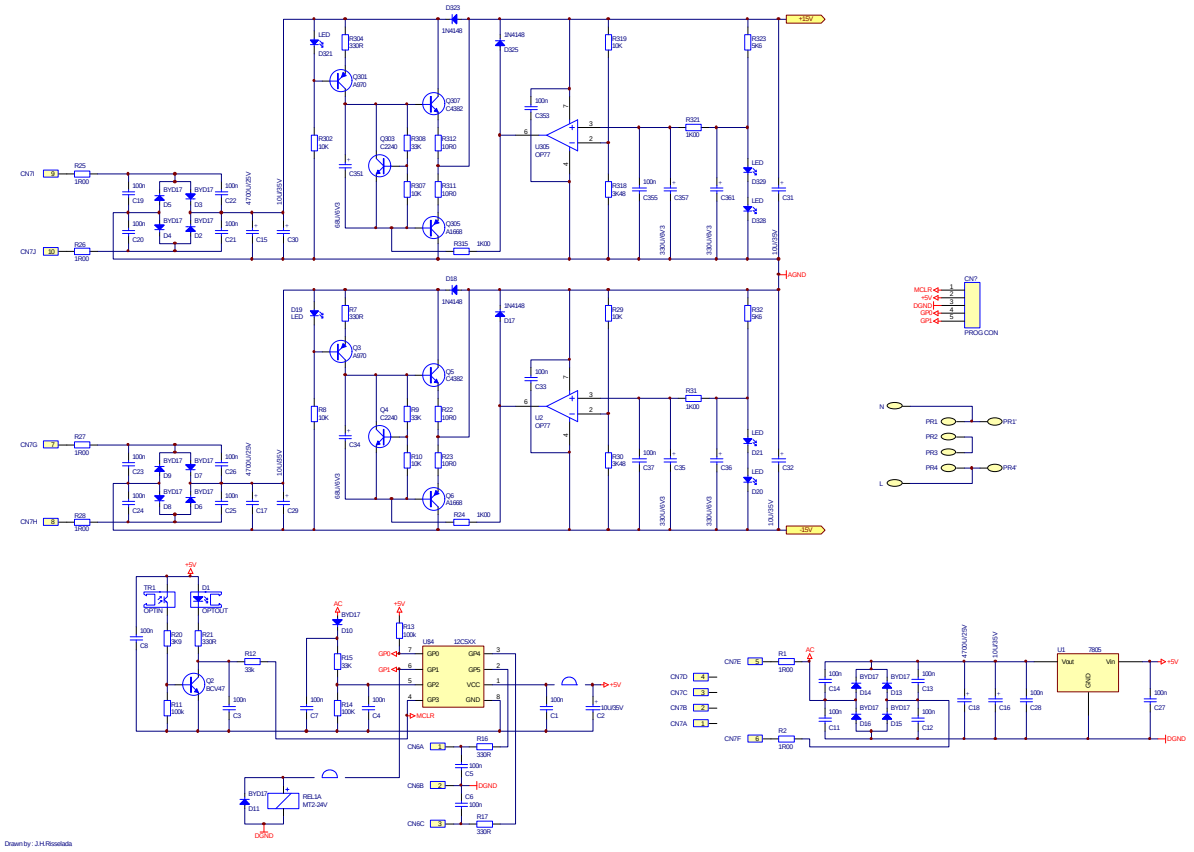
	Ri=50R	Ri=100R	Ri=200R	Ri=50k
L4M	don't care	don't care	on	off
L5M	don't care	on	off	off
L6M	on	off	off	off

	RIAA HF (43k/1n68)	78RPM
SL1	on	off

	RIAA LF (43k/6n2)	78RPM LF (250Hz)
SL2	on	off

	78RPM filter on	78RPM filter off	not allowed
SL3	on	off	off
SL4	off	on	off

Power Supply and Control



Parts List

Designator	Part Type	Description
C1	100n	MKT capacitor
C10L	68uF/35V	Electrolytic capacitor
C10R	68uF/35V	Electrolytic capacitor
C11	100n	MKT capacitor
C11L	1n5	MKT capacitor
C11R	1n5	MKT capacitor
C12	100n	MKT capacitor
C12L	330p	MKT capacitor
C12R	330p	MKT capacitor
C13	100n	MKT capacitor
C13L	4n7	MKT capacitor
C13'L	15n	MKT capacitor
C13R	4n7	MKT capacitor
C13'R	15n	MKT capacitor
C14	100n	MKT capacitor
C14L	1n5	MKT capacitor
C14R	1n5	MKT capacitor
C15	4700U/25V	Electrolytic capacitor
C15L	100p	MKT capacitor
C15R	100p	MKT capacitor
C16	10U/35V	Electrolytic capacitor
C17	4700U/25V	Electrolytic capacitor
C17L	100n	MKT capacitor
C17R	100n	MKT capacitor
C18	4700U/25V	Electrolytic capacitor
C18L	100n	MKT capacitor
C18R	100n	MKT capacitor
C19	100n	100n MKT
C19L	10uF/35V	Electrolytic capacitor
C19R	10uF/35V	Electrolytic capacitor
C1L	100p	MKT capacitor
C1R	100p	MKT capacitor
C2	10U/35V	Electrolytic capacitor
C20	100n	MKT capacitor
C20L	10uF/35V	Electrolytic capacitor
C20R	10uF/35V	Electrolytic capacitor
C21	100n	MKT capacitor
C21L	10uF/35V	Electrolytic capacitor
C21R	10uF/35V	Electrolytic capacitor
C22	100n	MKT capacitor
C22L	10uF/35V	Electrolytic capacitor
C22R	10uF/35V	Electrolytic capacitor
C23	100n	MKT capacitor
C24	100n	MKT capacitor
C25	100n	MKT capacitor
C26	100n	MKT capacitor

Designator	Part Type	Description
C27	100n	MKT capacitor
C28	100n	MKT capacitor
C29	10U/35V	Electrolytic capacitor
C3	100n	MKT capacitor
C30	10U/35V	Electrolytic capacitor
C30L	100n	MKT capacitor
C30R	100n	MKT capacitor
C31	10U/35V	Electrolytic capacitor
C31L	100n	MKT capacitor
C31R	100n	MKT capacitor
C32	10U/35V	Electrolytic capacitor
C32L	100n	MKT capacitor
C32R	100n	MKT capacitor
C33	100n	MKT capacitor
C33L	33p	MKT capacitor
C33R	33p	MKT capacitor
C34	68U/6V3	Electrolytic capacitor
C34L	1u	MKT capacitor
C34R	1u	MKT capacitor
C35	330U/6V3	Electrolytic capacitor
C351	68U/6V3	Electrolytic capacitor
C353	100n	MKT capacitor
C355	100n	MKT capacitor
C357	330U/6V3	Electrolytic capacitor
C35L	1u	MKT capacitor
C35R	1u	MKT capacitor
C36	330U/6V3	Electrolytic capacitor
C361	330U/6V3	Electrolytic capacitor
C36L	1n	MKT capacitor
C36R	1n	MKT capacitor
C37	100n	MKT capacitor
C37L	1n	MKT capacitor
C37R	1n	MKT capacitor
C38L	1n	MKT capacitor
C38R	1n	MKT capacitor
C3L	100p	MKT capacitor
C3R	100p	MKT capacitor
C4	100n	MKT capacitor
C4L	68p	MKT capacitor
C4R	68p	MKT capacitor
C5	100n	MKT capacitor
C5L	6n8	MKT capacitor
C5R	6n8	MKT capacitor
C6	100n	MKT capacitor
C6L	100n	MKT capacitor
C6R	100n	MKT capacitor
C7	100n	MKT capacitor
C7L	33p	MKT capacitor
C7R	33p	MKT capacitor
C8	100n	MKT capacitor

Designator	Part Type	Description
C8L	3pF	MKT capacitor
C8R	3pF	MKT capacitor
C9L	68uF/35V	Electrolytic capacitor
C9R	68uF/35V	Electrolytic capacitor
CN?	PROG CON	Connector
CN6	3PIN-M	Connector
CN7	10PIN-M	Connector
D1	OPTOUT	Optical output
D10	BYD17	Diode
D11	BYD17	Diode
D13	BYD17	Diode
D14	BYD17	Diode
D15	BYD17	Diode
D16	BYD17	Diode
D17	1N4148	Diode
D18	1N4148	Diode
D19	LED	LED red
D1L	LED	LED red
D1R	LED	LED red
D2	BYD17	Diode
D20	LED	LED red
D21	LED	LED red
D2L	LED	LED red
D2R	LED	LED red
D3	BYD17	Diode
D321	LED	LED red
D323	1N4148	Diode
D325	1N4148	Diode
D328	LED	LED red
D329	LED	LED red
D4	BYD17	Diode
D5	BYD17	Diode
D6	BYD17	Diode
D7	BYD17	Diode
D8	BYD17	Diode
D9	BYD17	Diode
Q1L	K146 or K240	DUAL N-JFET
Q1R	K146 or K240	DUAL N-JFET
Q2	BCV47	Transistor
Q2L	C2240	Transistor
Q2R	C2240	Transistor
Q3	A970	Transistor
Q301	A970	Transistor
Q303	C2240	Transistor
Q305	A1668	Transistor
Q307	C4382	Transistor
Q3L	C2240	Transistor

Designator	Part Type	Description
Q3R	C2240	Transistor
Q4	C2240	Transistor
Q4L	C2240	Transistor
Q4R	C2240	Transistor
Q5	C4382	Transistor
Q5L	A970	Transistor
Q5R	A970	Transistor
Q6	A1668	Transistor
Q6L	C2240	Transistor
Q6R	C2240	Transistor
Q7L	C4382	Transistor
Q7R	C4382	Transistor
Q8L	A1668	Transistor
Q8R	A1668	Transistor
R1	1R00	Resistor
R10	10K	Resistor
R10L	82R	Resistor
R10R	82R	Resistor
R11	100k	Resistor
R11L	220R	Resistor
R11R	220R	Resistor
R12	33k	Resistor
R12L	10k	Resistor
R12R	10k	Resistor
R13	100k	Resistor
R13L	100k	Resistor
R13R	100k	Resistor
R14	100K	Resistor
R14L	33k	Resistor
R14R	33k	Resistor
R15	33K	Resistor
R15L	1M	Resistor
R15L'	1M	Resistor
R15R	1M	Resistor
R15R'	1M	Resistor
R16	330R	Resistor
R16L	680k	Resistor
R16R	680k	Resistor
R17	330R	Resistor
R17L1	43k	Resistor
R17R	43k	Resistor
R18L	330R	Resistor
R18R	330R	Resistor
R19L	33R	Resistor
R19R	33R	Resistor
R2	1R00	Resistor
R20	3K9	Resistor
R20L	47R	Resistor
R20R	47R	Resistor

Designator	Part Type	Description
R21	330R	Resistor
R21L	10k	Resistor
R21L	910R	Resistor
R21R	10k	Resistor
R21R	910R	Resistor
R22	10R0	Resistor
R23	10R0	Resistor
R24	1K00	Resistor
R24L	49R9	Resistor
R24R	49R9	Resistor
R25	1R00	Resistor
R26	1R00	Resistor
R27	1R00	Resistor
R28	1R00	Resistor
R29	10K	Resistor
R2L	470k	Resistor
R2R	470k	Resistor
R30	3K48	Resistor
R302	10K	Resistor
R304	330R	Resistor
R307	10K	Resistor
R308	33K	Resistor
R31	1K00	Resistor
R311	10R0	Resistor
R312	10R0	Resistor
R315	1K00	Resistor
R318	3K48	Resistor
R319	10K	Resistor
R31L	10k	Resistor
R31R	10k	Resistor
R32	5K6	Resistor
R321	1K00	Resistor
R323	5K6	Resistor
R32L	20k	Resistor
R32R	20k	Resistor
R33L	39k	Resistor
R33R	39k	Resistor
R34L	39k	Resistor
R34R	39k	Resistor
R35L	2k7	Resistor
R35R	2k7	Resistor
R36L	10k	Resistor
R36R	10k	Resistor
R37L	2k7	Resistor
R37R	2k7	Resistor
R38L	910R	Resistor
R38R	910R	Resistor
R39L	910R	Resistor
R39R	910R	Resistor
R3L	49R9	Resistor

Designator	Part Type	Description
R3R	49R9	Resistor
R40L	10R	Resistor
R40R	10R	Resistor
R41L	10R	Resistor
R41R	10R	Resistor
R4L	49R9	Resistor
R4R	49R9	Resistor
R5L	100R	Resistor
R5R	100R	Resistor
R6L	51k	Resistor
R6R	51k	Resistor
R7	330R	Resistor
R7L	27R	Resistor
R7R	27R	Resistor
R8	10K	Resistor
R8L	2k7	Resistor
R8R	2k7	Resistor
R9	33K	Resistor
R9L	2k7	Resistor
R9R	2k7	Resistor
REL1	MT2-24V	Relay
TR1	OPTIN	Optical output
U$4	12C5XX	Microprocessor
U1	LM7805	Voltage regulator
U1L	LT1115	Opamp
U1R	LT1115	Opamp
U2	OP77	Opamp
U2L	LT1113	Opamp
U2R	LT1113	Opamp
U305	OP77	Opamp

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