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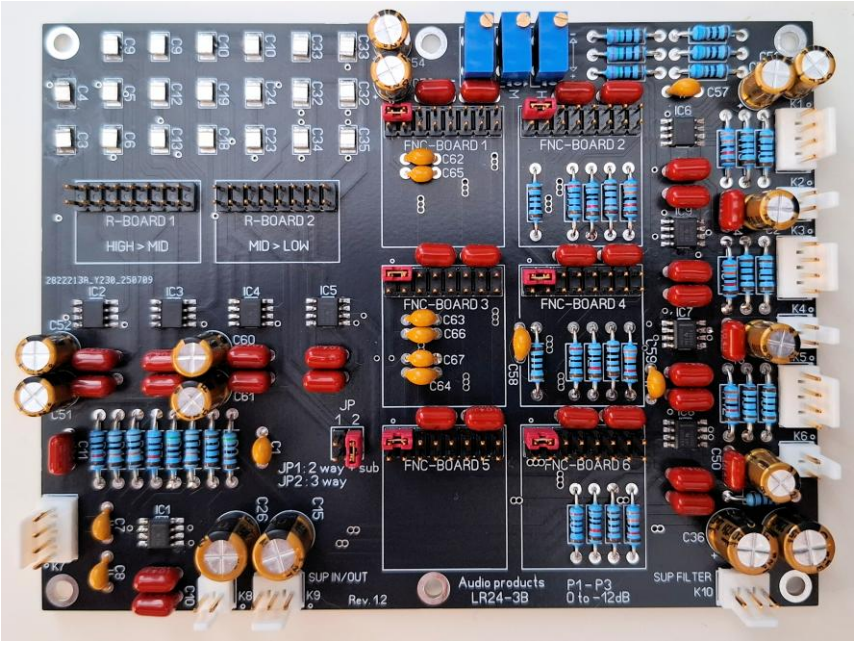
LR24-3B

Pure analog 24dB per octave 3 way active crossover filter with Linkwitz Riley topology



LR24-3C picture

Beschijving

- OPA1602 or OPA1612 SoudPlus OpAmps
- Mono design
- Balanced and unbalanced outputs
- Separate power supply for filter and I/O
- Configurable as 3 way or 2 way with subwoofer
- High End circuit and PCB design with groundplane
- Space for two option boards per channel
- Pluggable boards for setting crossover points
- Polypropylene filter condensators 22nF 2%
- Nichicon audio grade condensatoren

Introduction

The LR24-3B is a mono 3/2 way active 24dB per octave crossover filter with Linkwitz Riley topology. The circuit is designed as a mono module for maximum flexibility. The power supply of the inputs and outputs are carried out separately from the filter circuit.

The circuit is inspired by the designs of Siegfried Linkwitz† as can be found on the web site https://www.linkwitzlab.com/filters.htm

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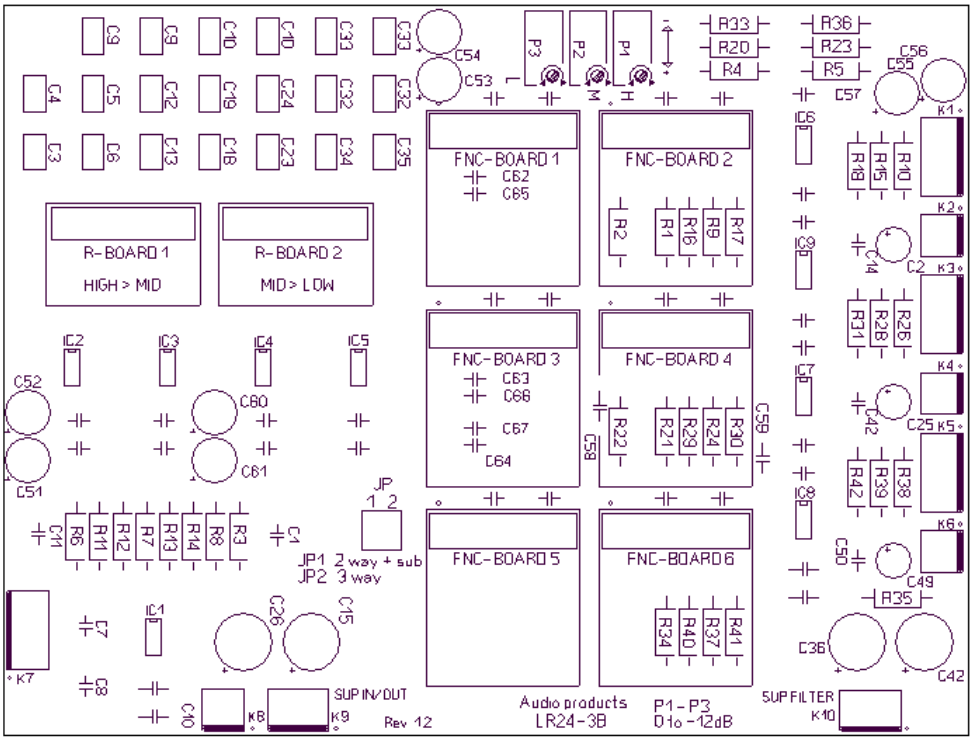
Beschrijving en aansluiten



The circuit has gold-plated headers for all connections and also for the resistor board headers as well as the function board headers. Connection materials and/or tools for making cables can be ordered separately via our website.

There are separate power supply connections for in- and output and for the filter circuit. Although a single power supply can be used for this, it is recommended to use two separate power supplies.

For the balanced cabling, unshielded wire can be used with the hot and cold wires twisted. The unbalanced connection is connected with shielded cable or single wire when they can be kept very short.

On the circuit board there is a plug-in jumper that can be configured as a 3-way filter or two-way with sub. In the latter case, the entire bass goes to the middle connection, K3 and K4, and the bass for the sub to K5 and K6.

The function board connectors are all equipped with gold-plated jumpers that must be removed when a function board is plugged in. As a result, the audio signal runs from pin 1/2 to pin 3/4 via the function board.

If a double function board is used, for example a Linkwitz transform that has the width of two function boards, the jumpers of both function boards must be removed. There is also the possibility to use two function boards in series for each output, such as an all-pass and a notch filter in series.

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Some notes and warnings for use

- Never change modules with the power supply switched on
- Always turn on the power supply of the filter before switching on the power amplifiers.
- Always turn off the power amplifiers before turning off the filter.
- If you are not sure if this will always happen in this order, connect a capacitor of about 22uF in series with the tweeter and the power amplifier, this way you protect the tweeter against switch-on plops that can damage the tweeter.

The PWRSW-01 power controller developed by us provides the correct switching on and off of the power amplifiers by means of a 12V trigger. The power amplifier is then switched on and off two by two. The power amplifiers must of course be equipped with this function.

Determining the cross-over points for the speaker drivers

Which cross-over points you choose depends on a large number of factors.

In the first place, of course, the speaker drivers used. The filter must be adjusted to the specifications of these drivers. In addition, the speaker cabinet and your specific wishes play an important role. There is hardly a standard formula for this because every situation is different.

By changing resistor modules, you can easily experiment with different tipping points.
Please note, always switch off the power supply before changing the modules.

2 way with sub woofer or 3 way filter

With jumpers 1 and 2 you can choose to use the filter as a conventional 3-way filter creating 3 frequency bands. By setting the jumper to JP2 you configure a 3-way filter.

If you want to use the filter as a 2-way + sub woofer, choose JP1. You then have two frequency bands, one for high and one for low, the low end is then connected to the middle connection, and a sub woofer output to the low output.

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Setting attenuation on the outputs

Loudspeaker drivers almost always have a different sensitivity SPL expressed in dB (2.83V/1m). Bass speakers have a lower SPL, so they are less sensitive, than mid-range speakers and mid-range speakers have a lower SPL than tweeters. Tweeters in particular will sound louder than midrange and woofers at the same signal strength.

Each output of the filter is equipped with an attenuation circuit that is adjustable from 0dB to -12dB attenuation to compensate for this. Adjusting this attenuation is preferably done with a measurement microphone and an audio analysis application on the PC where the measured values are used to get the reproduction characteristic as flat as possible at the place where the loudspeaker is used.

With P1 to P3, high, mid and low can then be adjusted to the right level. The attenuators have a logarithmic behavior, which makes adjustment with the right measuring equipment relatively easy.

Manual setup (this can be a tricky, sometimes almost impossible)

If you want to do the settings manually and by ear, we recommend that you start with the bass output. Use a mono signal, never stereo, especially when you want to adjust two filters at the same time, this makes setting up easier.

Turn P1 and P2 fully counterclockwise until it clicks. The regulators have 25 turns/revolutions so keep this in mind. On mid and high you have set a attenuation of -12dB.

Turn P3 all the way clockwise, clockwise, until you hear a click. Now turn P3 back 3 to 4 turns, counterclockwise. This creates enough 'space' to be able to make corrections to the bass later.

Now slowly turn P2 clockwise, clockwise, to bring the midrange in the playback to the desired strength.

Now do the same with P1 for the treble.

Adjusting the filter by ear requires very good hearing and infinite patience.

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Setting with an Oscilloscope

Theoretically, the difference in signal strength that must be set per output can be calculated and then adjusted with an oscilloscope. The desired signal strength can be calculated with 10^ (dB/10) where dB is the difference in SPL between the drivers.

For this you use a signal generator with pink noise with a signal strength of about 2.5V or a frequency sweep of 5Hz to 20kHz with an amplitude of 2.5 volts peak/peak.

For example, if the woofer has an SPL of 86dB, the midrange an SPL of 87dB and the tweeter an SPL of 89dB, the difference values to be calculated are 1dB for mid to the woofer and 3dB for high to the woofer.

Measure the peak/peak value on the low output with the scope.

Now calculate with 1/(10^(1/10)) the desired reduction in signal strength for the midrange output.
1/1.2589 = 0.7943 times the peak/peak value on the woofer output.

Now calculate with 1/(10^(3/10)) the desired reduction in signal strength for the tweeter output.
1/1.995 = 0.50 times the peak/peak value on the woofer output.

So if you have 2.5V peak/peak on the woofer output, you adjust the middle output to 2.5 x 0.7943 = 1.986 volts peak/peak and the tweeter to 2.5 x 0.5 = 1.25 volts peak/peak.

It is possible to do the adjustment with a multimeter with True RMS measurement setting, you can then simply measure the output voltage. Make sure that the meter measures True RMS on the entire audio frequency range. This True RMS measurement can only be found on more expensive universal meters.

Please note that these are theoretical values and the actual SPL values of the drivers may differ from the specifications. In particular, new drivers that have not yet been played in can show a clear deviation.

In addition, the acoustics of the room where you use the speakers also have an important influence. Adjusting with a measuring microphone and PC application is the absolute preference.

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Connectors (pin 1 is indicated by a white dot on the circuit board)

K1 : High Out – Balanced
1. Ground
2. Hot
3. Cold
4. Plug

K2: High Out – Unbalanced
1. Ground
2. Hot

K3: Mid Out – Balanced
1. Ground
2. Hot
3. Cold
4. Plug

K4: Mid Out – Unbalanced
1. Ground
2. Hot

K5: Low Out – Balanced
1. Ground
2. Hot
3. Cold
4. Plug

K6: Low Out – Unbalanced
1. Ground
2. Hot

K7: In Balanced
1. Ground
2. Hot
3. Cold
4. Plug

K8 : Audio detection out for PWRSW-01
1. Ground
2. Hot

K9: Power supply for inputs and outputs
1. +
2. Ground
3. –

K10: Power supply for filter
1. +
2. Ground
3. –

FNC boards
1. In for FNC board
2. In for FNC board
3. Out from FNC board
4. Out from FNC board
5. +
6. +
7. +
8. +
9. Ground
10. Ground
11. Ground
12. Ground
13. –
14. –
15. –
16. –

R Board: see diagram

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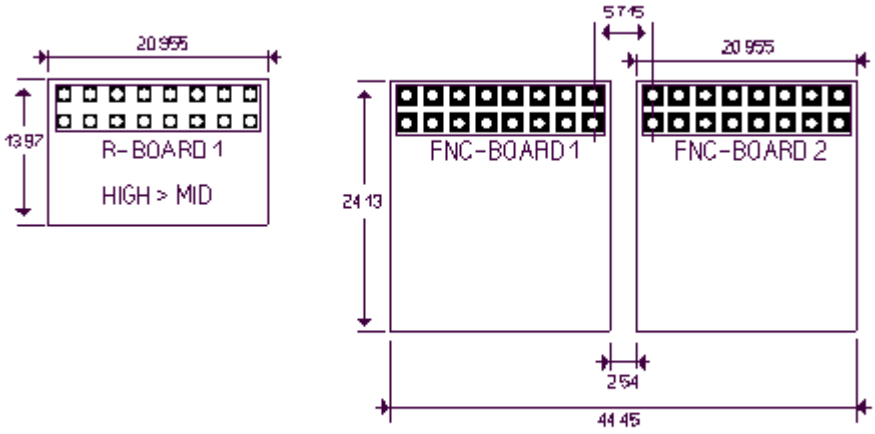
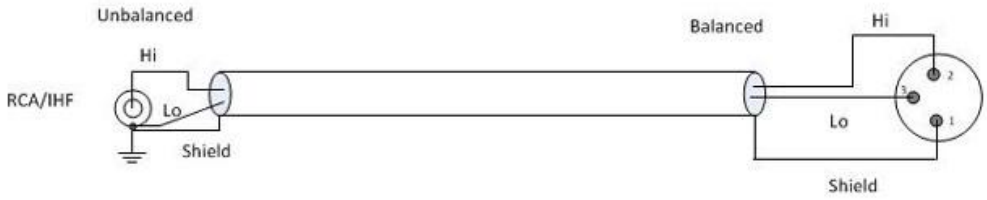
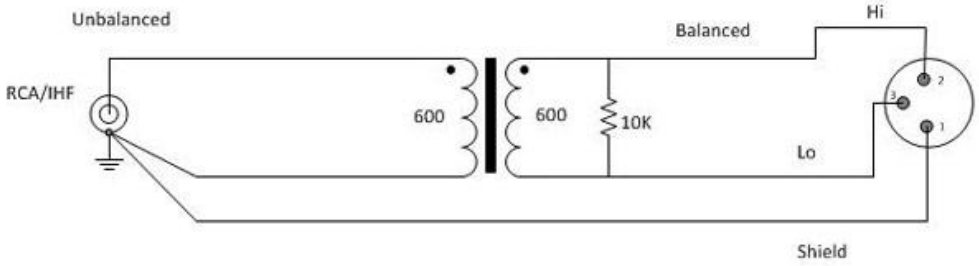


Dimensions of plug-in boards

Connect unbalanced cable to the balanced input of the circuit.
The circuits below can both be used, but figure 2 is preferred.



Figuur 1



Figuur 2

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Schematic

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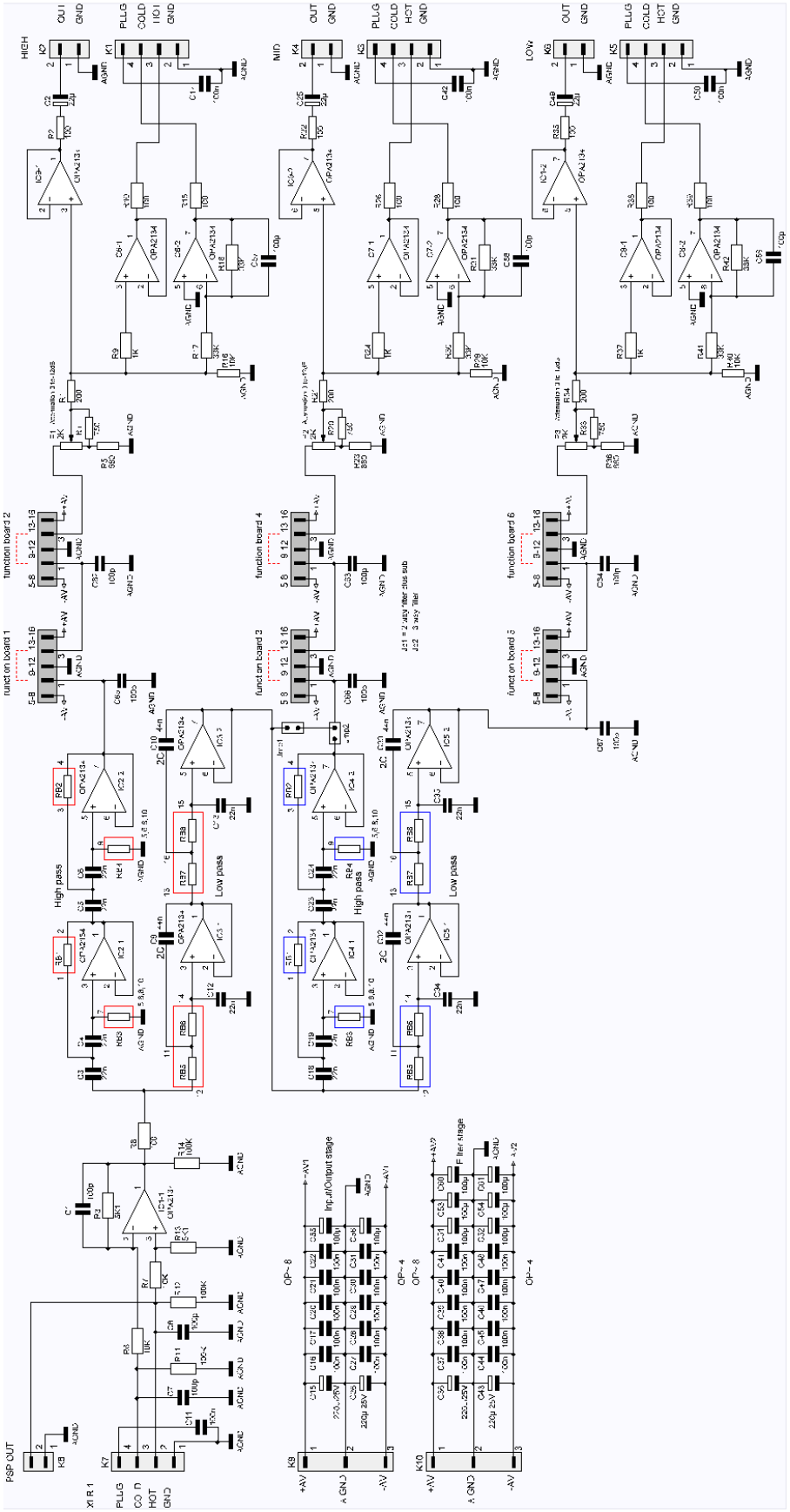

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Technical specifications

Power supply Vcc/Vss	±9 to ±15 VDC
Supply current	maximum ±200 mA depending on supply voltage
Frequency range	2Hz to 100.000Hz
Maximum attenuation on each channel	-12dB
Maximum input voltage Vin	90% from Vcc/Vss
Maximum output voltage Vout	90% from Vcc/Vss