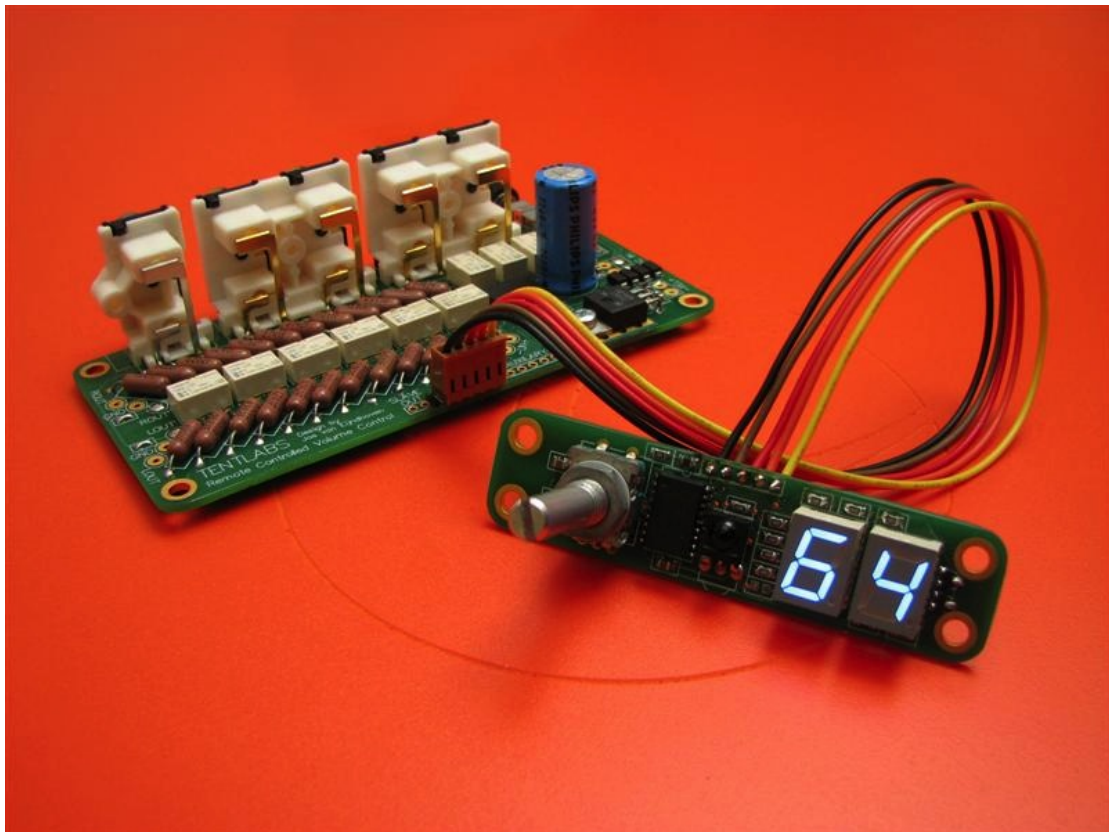


DRAFT  
Tentlabs Application Note AN.07\_V3  
Volume Control



## **Introduction**

This Note applies to the Tentlabs Volume Control module V3. It shows how to connect the module as:

- Stand alone control
- Volume control in existing equipment

An FAQ is added to help trouble shooting, and the specifications are listed for reference.

## **Purpose**

The Tentlabs volume control serves as a master volume control. It can replace existing controls or can be used in newly built equipment.

## ***Electrical safety***

Within electronic equipment, during building and surely when finished, AC mains voltages and high DC voltages exist. Care should be taken as long as the cabinet is not closed and the equipment has been connected to the mains. The user remains responsible for his own and others' safety and damage of the equipment. Following the instructions however will avoid hazard and electrical shock.

## ***Liability***

Tentlabs accepts no liability at all from any potential damage or injury that may occur when assembling, connecting or using the negative bias supply or any of its sub parts and assemblies.

## ***Warranty***

The warranty on the Tentlabs module is 5 years, assumed they are applied and used according the instructions in this Application Note.

## **Introduction**

64 steps of attenuation are achieved with 6 Omron G6K relays, controlling 12 Dale RN6 resistors in parallel configuration in the analogue domain. This is a fundamental difference compared to other attenuators, which usually have more contacts or resistors in their signal way.

A micro controller controls the relays. A second micro controller on the display section takes care of remote control and decoding, and communicates with the other micro to achieve correct volume and input settings. It also displays these settings.

Power supply consists of a low drop 5V regulator. On board rectifiers and decoupling capacitors assure proper functioning of the whole unit, being powered by either AC or DC. Additionally, a power on/off signal is present to directly drive an external relay, which in turn can switch a power amplifier, or fulfill other functions.

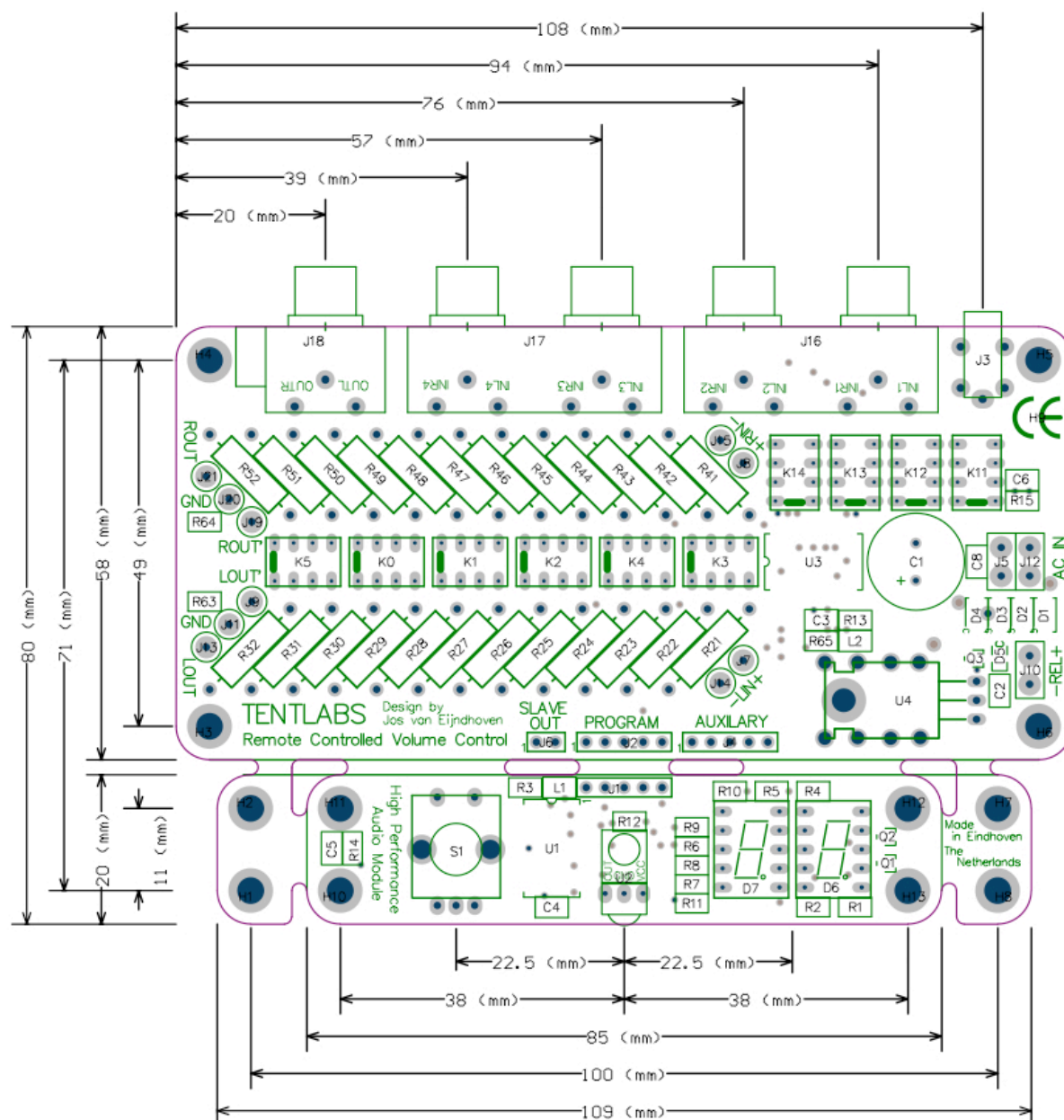
In power off mode, the controller of the volume control remains active, with a very low standby power.

## General Notes

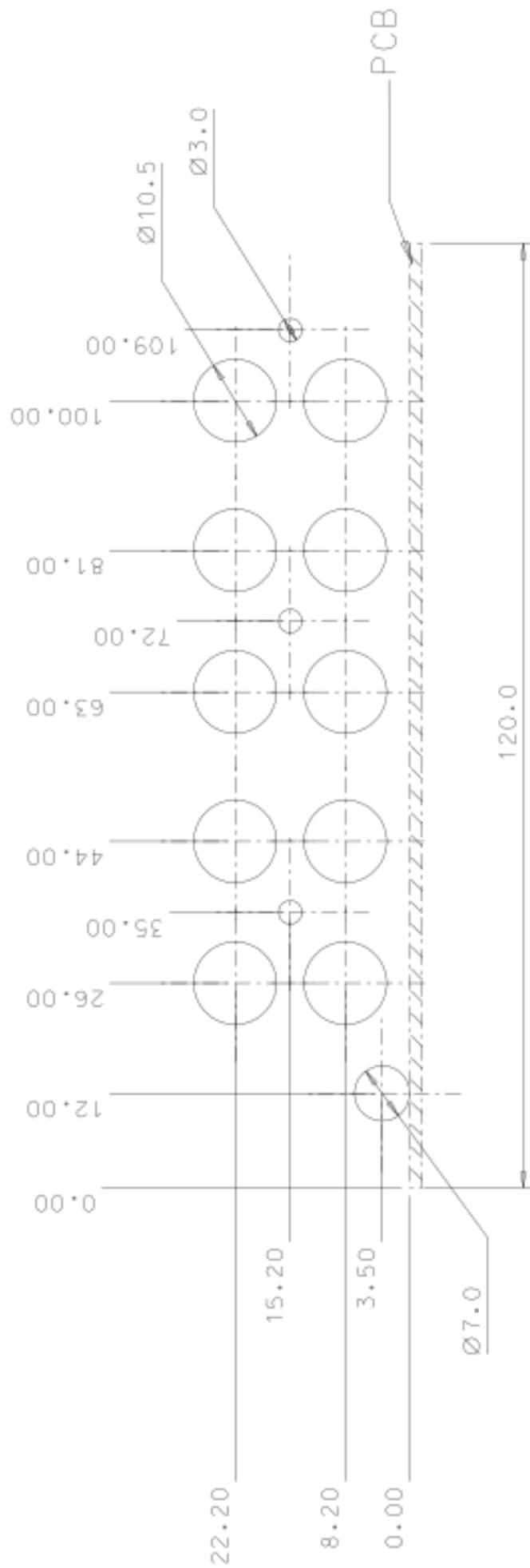
This Application Note describes how to set up systems using Tentlabs modules. Enthusiastic hobbyists may want to fully build their own surrounding electronics. For those, technical information is available on the Tentlabs website.

## Installing the module - Mechanical

The drawing below facilitates the mounting process



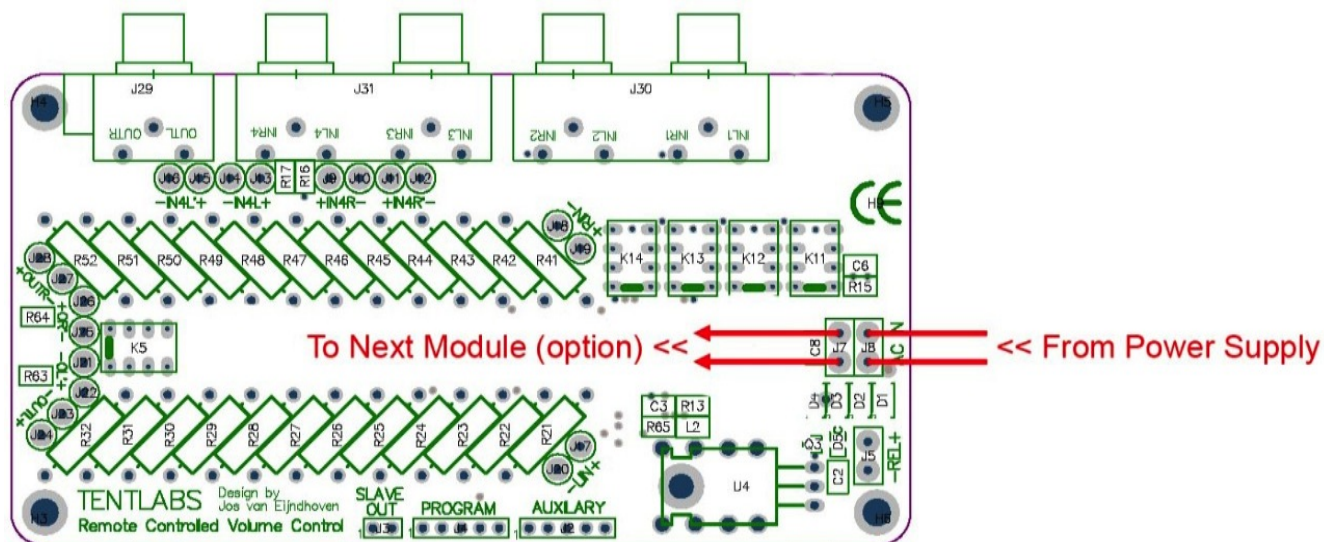
The back plane drawing is shown here



**Volume control backpanel layout**

## 1. Connecting the volume control

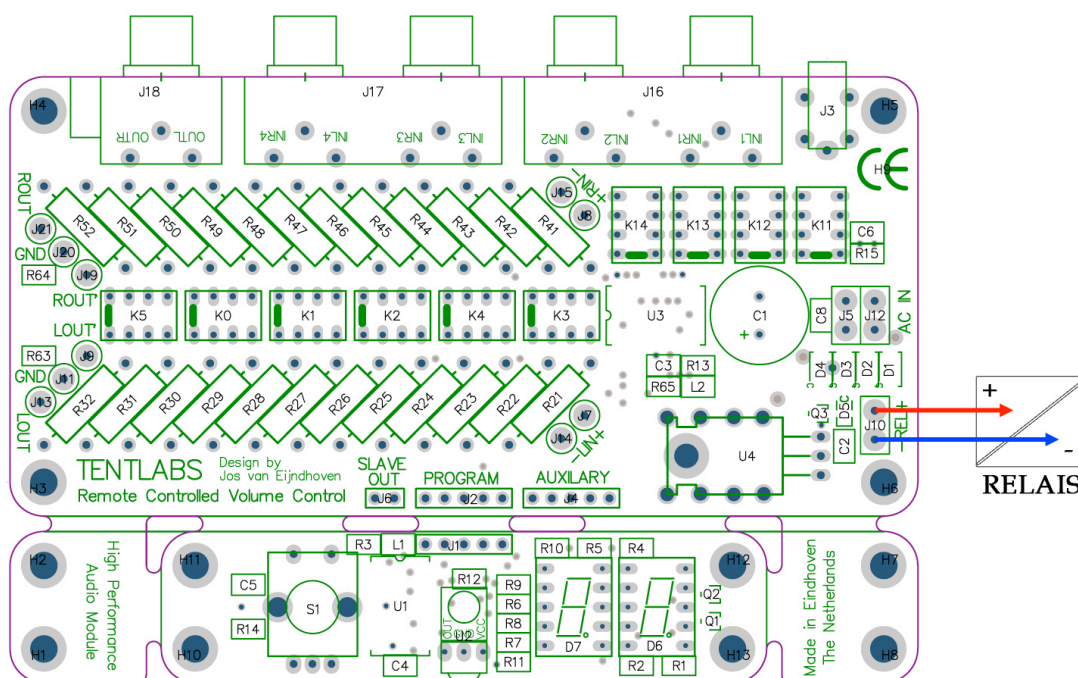
Power supply. Any AC or DC voltage source between 6 and 10V can be connected as shown below. A second unit can be powered using the parallel connectors. In that case the current consumption from the power supply doubles.



The power supply is connected to audio ground using a parallel network of 10kΩ and 1μF.

## Connecting a stand-by relay

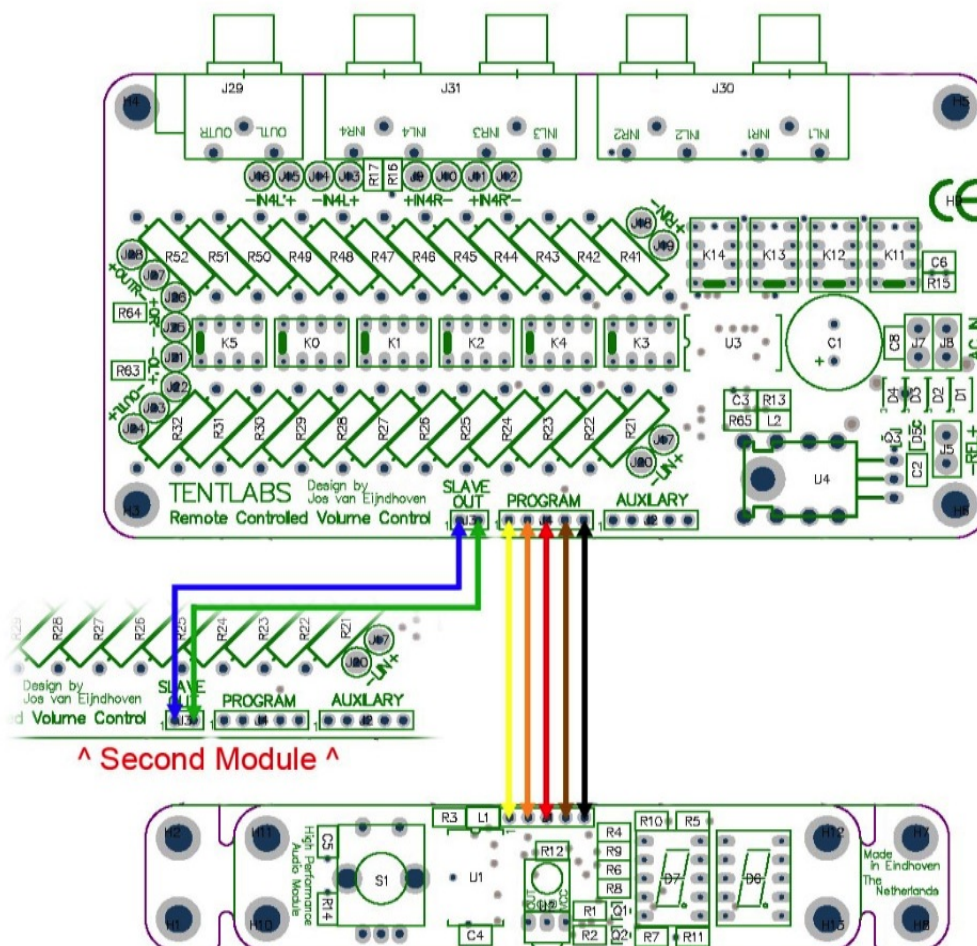
A relay can be connected as shown below. This relay can for instance be used to switch a (pre) amplifier into standby, using the remote control.





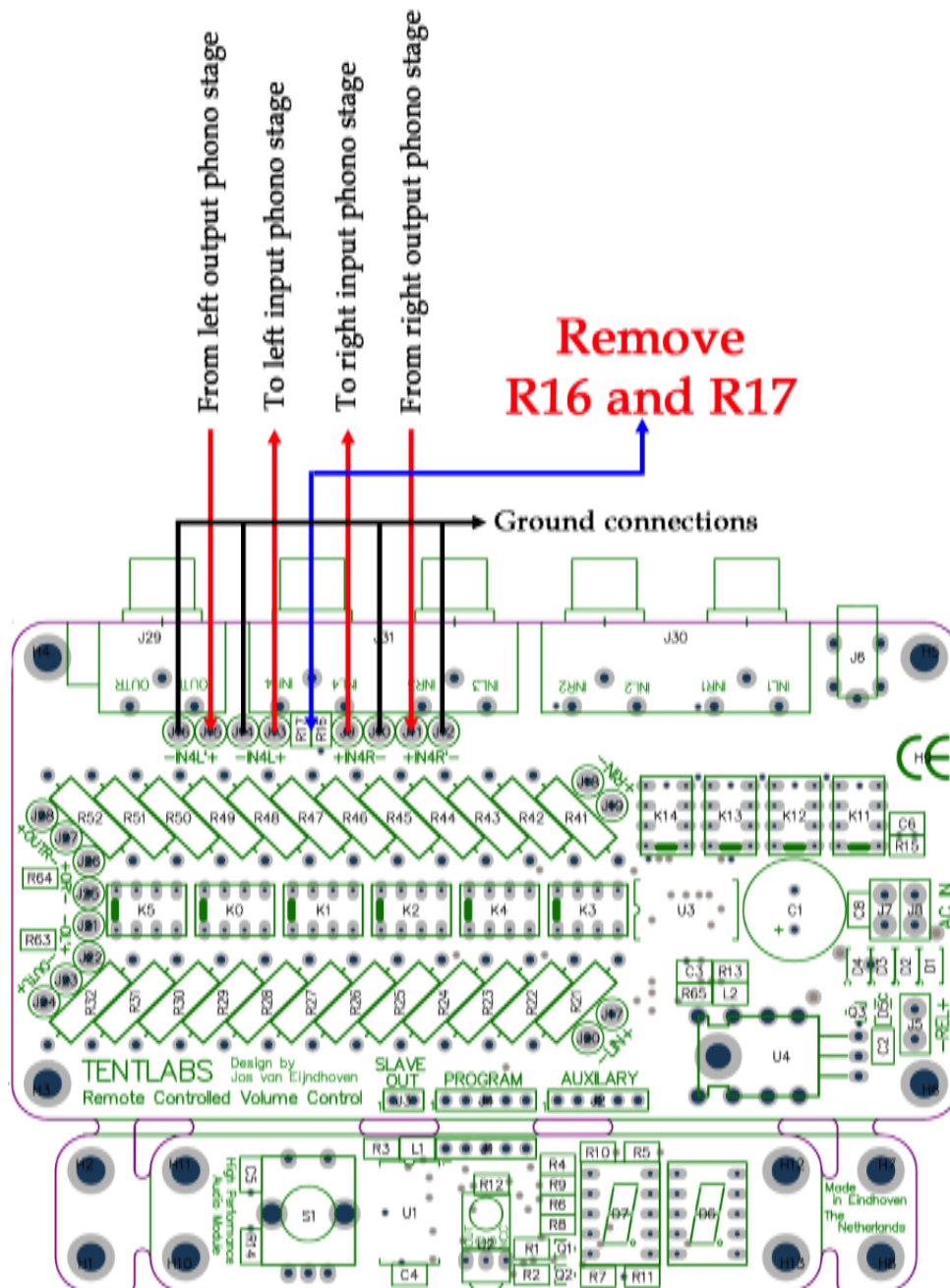
## 2. Connecting the volume control

The front panel PCB is connected using the 5-wire colored cable and a connector. A second relay module can be controlled using the same front panel PCB. A 2-wire interface (blue-green) does the job. This option is required if balanced use of the volume control is needed. See section 5.



### 3. Connecting the volume control

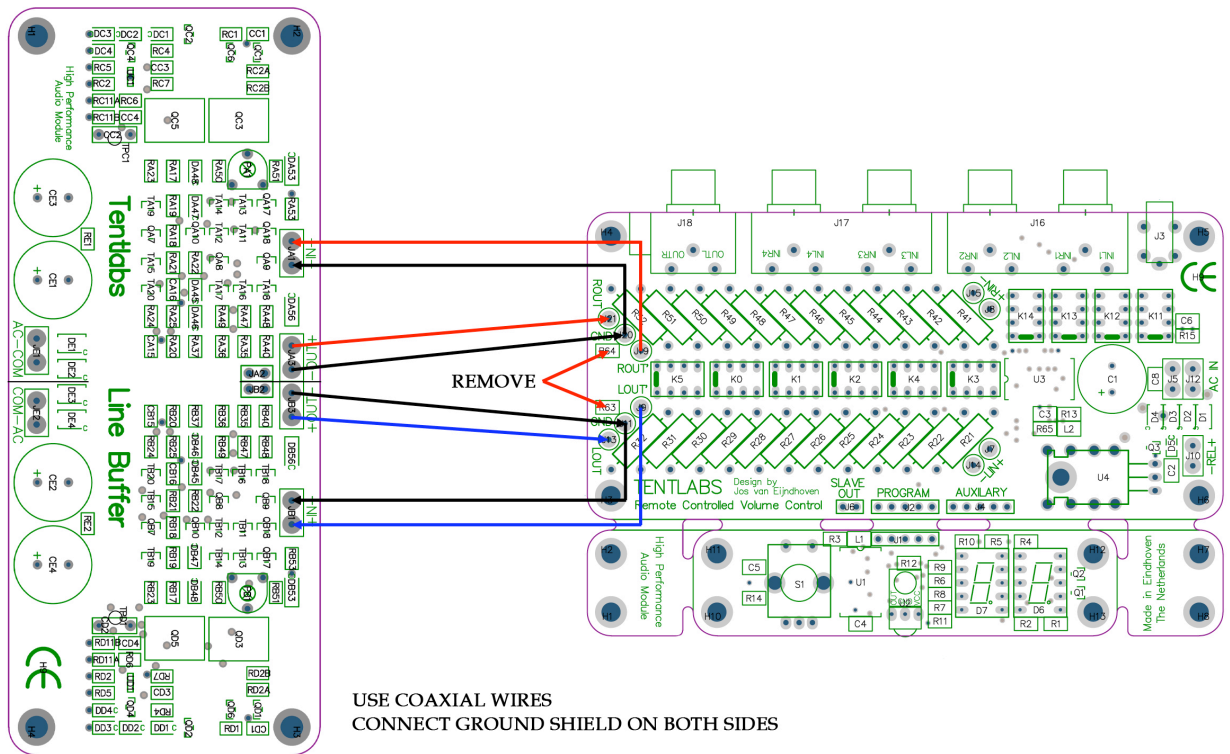
Input 4 can be transformed to a phono input by inserting a phono pre amplifier. Remove resistors R16 and R17, and connect a phono pre-amp as shown below. Use screened (coaxial) wiring, and connect the screen to ground at both sides.





#### 4. Connecting the volume control

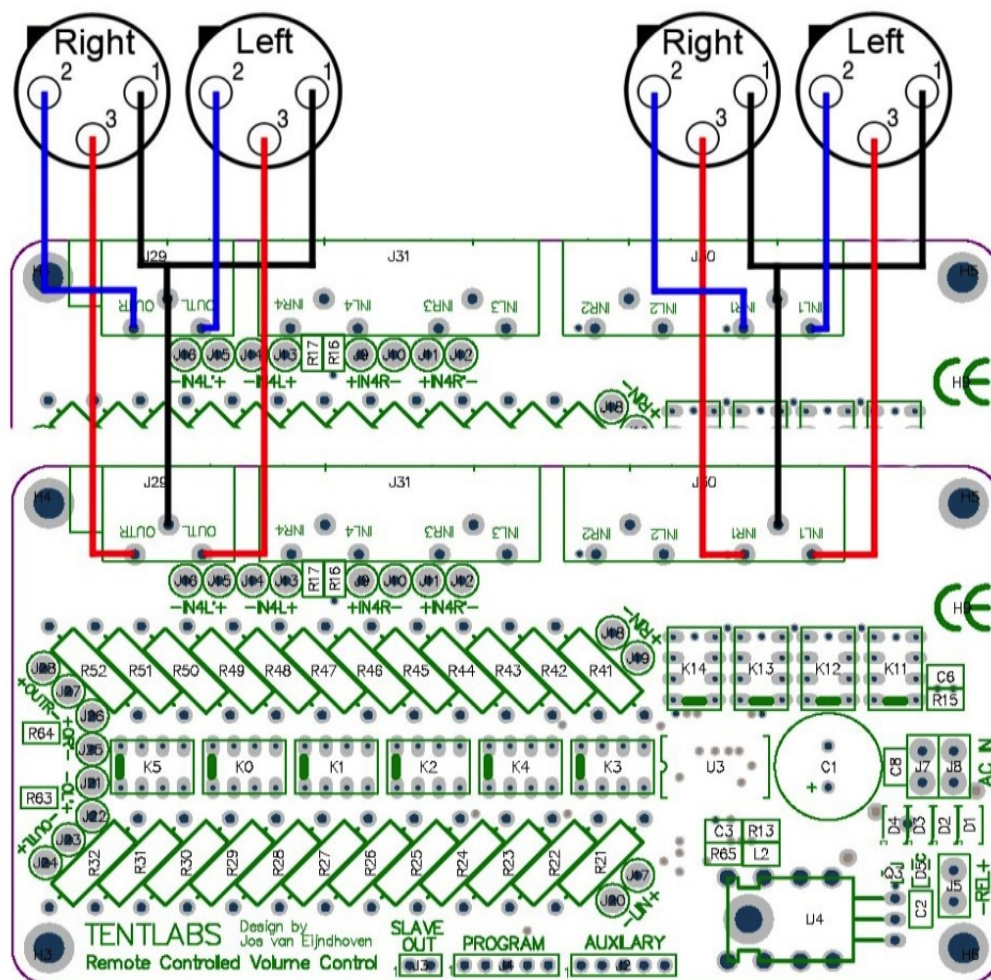
To create an active output, insert a line output buffer as shown below:



## 5. Connecting the volume control

Balanced use. A second module is required. The controller connection (cascade mode) is shown in chapter 2.

The XLR connections are shown below. For the sake of transparency, only channel 1 is wired. Successive channels are wired in a similar way.



## 6. Using the volume control

All settings can be altered using the control knob on front of the volume control. This knob can be pushed (after releasing it will release automatically) and turned to the left and right (indefinitely). The display has two numerical digits. The user interface of the volume control is relatively basic.

### **Basic settings**

The basic settings available on volume control are:

- Power ON and OFF (ON, OFF)
- Source selection (C1, C2, C3, C4)
- Attenuation (volume) in steps of 1dB each (00, 01, 02.... 62, 63, 64)

A while after the desired volume or input setting has been changed, the display will show the preferred constant information, which can be:

- the current selected input
- attenuation
- a blank display

#### **(a) Power**

*Power up:*

Push the knob until the display shows ON and then release it. After releasing the knob the display will show the current selected input source.

*Power down (stand-by):*

Push the knob until the display shows OFF and then release it. The output relays should click to mute.

Pressing the knob too long will open the special functions menu. Press and hold the knob again for some time to exit the special functions menu.

#### **(b) Source selection**

The volume control has four available analogue input sources, all stereo.

By pressing the knob briefly the sources change in a circular way;

C1, C2, C3, C4, C1, C2 etc.

#### **(c) Volume control**

The volume can be set in a range from 0 to 64 in steps of 1dB by turning the knob clockwise or counter-clockwise. A volume setting of 0 will completely mute the signal.

Turning the knob more quickly will automatically result in bigger attenuation steps

(±2 or ±4 dB). This way you can quickly get to the desired level, and still have fine resolution when turning the knob slower in turn.

## 7. Programming the volume control

In order to use a remote control, the volume control has to “learn” the IR codes as transmitted by your IR remote. This chapter is a step-by-step tutorial on how to program the volume control module.

All settings can be altered using the control knob on front of the volume control. This knob can be pushed (after releasing it will release automatically) and turned to the left and right (indefinitely). The display has two numerical digits.

The user interface of the volume control is relatively basic. This is fine for basic controls like volume and source settings. Controlling extra settings is admittedly cryptic sometimes.

All settings are stored after a change, thus will remain the same after disconnection from mains power and / or switching to standby.

*Always keep the module powered when programming the unit*

### **Extra settings**

The extra settings menu can be reached by pressing the knob and holding it pressed until *E5* (Extra Settings) is displayed. After releasing the knob the display will show the first extra setting available: *d* (display mode). After a short while it will display the current setting and toggle between this and the menu name.

You can leave the extra settings at any point in the menu by pressing the knob and holding it pressed until the *E5* is shown again, indicating you have left the extra settings menu. After this the controls are limited again to the basic settings described in the previous chapter.

You can step through the available settings in a circular way by briefly pressing the knob. When a setting is displayed, you can alter it by turning the knob.

The available settings are successively (setting name, available options):

- *d* ([di]splay content), ( *in*, *UD*, *DF* )
- *P* ([P]rogramming remote)
- *br* (display [br]ightness)
- *v3* (software [v]ersion [3], [f]actory [r]eset), (*Fr*)

### ***d* (display content)**

The volume control can display different information on its 7 segment display during normal operation. There are three possible settings: Input source ( *in* ), volume (*UD*) or nothing (*DF*). *in* being the default.

### **br (display brightness)**

The brightness of the display can be changed in 25 steps. The default setting for brightness is somewhere in the middle. You can vary the brightness by turning the knob left or right. The display will live display  $d$  in the selected brightness.

### **P (Program functions for remote control)**

Your volume control has the ability to learn infrared commands from all kinds of remotes to control various settings. This means you can use a remote control you already own from another product to control the volume control. Supported IR formats include RC5, RC6 and Sony protocol. IR controllable settings are volume, input source selection, mute, and power on/off. The display will show the control to be programmed a while after  $P$  has showed up as the current menu step. This behavior is unlike other menu steps where the name of the menu step is displayed after a setting has been made.

You can step through the available controls in a circular way by turning the control knob.

- Volume up ( $\uparrow$ )
- Volume down ( $\downarrow$ )
- Mute ( $\text{M}$ )
- Channel up ( $\uparrow$ )
- Channel down ( $\downarrow$ )
- Power ( $P$ )
- Channel (input) 1 ( $1$ )
- Channel (input) 2 ( $2$ )
- Channel (input) 3 ( $3$ )
- Channel (input) 4 ( $4$ )

To link a function to the remote to a certain button, press said button (provide the IR code) when the matching function is selected. This functionality has its limits. You cannot map two buttons to one function. The new button mapped will overwrite the old one. Also no button may be mapped to two functions. Again the new button mapped will overwrite the old one.

*After a factory reset all the all button settings will be lost*

### **(Software version; Factory reset)**

This shows you the current software version ( $v$ ). Turning the knob will perform a factory reset ( $F$ ).



### Specifications Electrical

Input impedance:	> 40 k $\Lambda$ (value depends on volume setting)
Output impedance:	< 8 k $\Lambda$ (value depends on volume setting)
Input voltage:	6 to 10V max (AC or DC) This input is connected to audio ground by a parallel circuit of 10k $\Omega$ and 1 $\mu$ F
Current consumption:	150mA DC, 225mA AC (maximum values, excluding relay)
Volume setting:	64 steps of 1.0 dB
Channel imbalance:	< 0.15 dB
Inputs:	4
Connectors:	Cinch / RCA
Remote control:	Can learn to interact with Philips, Marantz and most Sony IR remotes
Standby output:	Open collector, 5V, max 100mA (this current is not included in the current consumption spec)

### Specifications Mechanical

<b>Main</b> PCB size:	120*58*28 mm (W*L*H)(excludes connectors)
Hole pitch:	111*49 mm (symmetrical)
<b>Display</b> PCB size:	120*20*8 mm (W*L*H) (excludes control shaft)
Hole pitch:	111*11 mm (symmetrical)
<b>Display</b> PCB small size:	80*20*8 mm (W*L*H) (excludes control shaft)
Hole pitch:	71*11 mm (symmetrical)

All mounting hole diameters are 3.2 mm

*All specs and parameters subject to change without prior notice*