XLR/RCA PreModul
Integrated Muses 72323 for Volume Control

The hardware and software of the above module are explained on the next pages.

Content

What is it about

This module was developed to provide a powerful input control for preamplifiers or power amplifiers. Thereby flexibility and high quality signal processing should be guaranteed.

The Hardware

The hardware was divided into two components, the input board and the microcontroller board (MC-board). The input board holds the input and output connectors and is also responsible for the volume control.

Input board:

      - 5 inputs XLR or RCA (one of them RCA, maximum 4 x XLR)
      - Balanced signal processing
      - Separable between inputs and volume control (e.g. for looping in a DSP)
      - Volume control by Muses 72323
      - Multichannel possible, any number of additional Muses chips can be plugged in
      - XLR and RCA output

Relays are used for input control. All signals (+ / - / gnd) are separated and switched on when an input is selected.

Figure 1 -- Inputs: 3 x XLR, 1 x RCA - Outputs: XLR und RCA

Microcontroller (MC) Board:

- MC Atmega328P
- Trigger output up to 15V
- Power output 110V/115V/230V AC / 8A (16 is possible)
- Connection protective conductor (PE) / gnd
- Connector for IR sensor, rotary encoder and 2.6 inch TFT EPS display

This is the control center of the system, which coordinates all functions.

Figure 2 - Control Center

Functionality

The input signal is forwarded to the Muses chip(s) via one of the 5 inputs. The Muses chip processes the signal and outputs it at its output depending on the selected volume.

From here, the signal can be taken via a 3-pole header (or directly via the corresponding solder pads) and fed into the subsequent preamplifier or power amplifier. When using the module at a preamplifier, the administered signal is led back to the input/output board and output again via the output sockets.

The Rotary Encoder button controls the volume or selects one of the five inputs. The other functions of the software can be found in the corresponding section.

The Software

Here you will find a description of all functions of the PreAmp module. The images each show sections of the displayed display. The colors may differ slightly, as photographing the display in ambient light is very challenging.

The software is operated via the rotary encoder and its button. The button for input selection must be pressed once briefly (<400ms).

To select the following menus, the button must be pressed and held down. The following options are displayed one after the other:

> - Balance control
> - Options menu
> - Standby
> - All functions are explicitly explained below.

Opening Screen

Figure 3 - switch-on process

During the power-up process, this welcome screen is displayed.

Depending on the hardware version, the corresponding outputs are now displayed.

After a restart it takes approx. 4 seconds until the outputs are switched. When waking up from standby mode it takes 3 seconds.

By setting the mute function, the startup process can be extended up to 30 seconds.

However, this extension of the mute only concerns the release of the short-circuit relays for the outputs. Thus, for example, the switch-on noise can be avoided with tube amplifiers, which have a longer preheating time.

The implemented outputs Trigger (is always present) or 230V (110V) Power On (at choice) are switched as described above.

After the outputs are enabled, the volume will smoothly ramp up and the main screen will be displayed.

Main Screen

'Figure 4 - Main Screen

The main screen is automatically displayed after the greeting.

Displayed here:

- Current volume (blue dots)
- Total control volume (white dots)
- Volume in dB
- Position of the balance control
- Selected input
- Volume increase per notch in dB

Increasing or decreasing the volume changes the ring displayed in blue according to the set value.

The digital dB display also changes accordingly.

Input Selector / Mute

A short press of the Rotary Encoder puts the unit into Input Select or Mute mode.

The volume is lowered gently. As an additional hint, the color of the current input (green) changes and gets a frame.

By turning the rotary encoder, you can now select a new input. You have a time frame of approx. 2.5 seconds for this. Each action (turning again) resets this time to 2.5 seconds.

Figure 5 - Input selection

Once they have selected the desired input, simply let the time run out.

The new input is switched on automatically. The previously set volume is gently brought up again. Any preset for the selected input is taken into account.

If you have not turned the rotary encoder, the mute symbol will appear after approx. 2.5 seconds. The volume was already turned down when you pressed the rotary encoder.

Figure 6 - Mute

Balance settings

By turning the rotary encoder, the balance can now be changed in 0.25dB steps. The attenuation is displayed as a real value in the lower section.

At the same time the red dot (here centered) moves to the corresponding position of the ring

The maximum change is 9dB in 36 steps.

In the gain variant, this function is overridden as soon as a positive dB value (i.e. gain) is set. The red dot then disappears. A back control below 0dB causes the previous settings to be available again.

Figure 7 - Balance

Optionen-Menu

Turning the Rotary knob will "highlight" an entry. Pressing the button selects the corresponding entry. Turning the Rotary again now selects the values; further pressure saves the selected value permanently.

Figure 8 - Options Menu

From here the possible settings of the module are performed:
- Lowest adjustable volume
- Volume after power on
- Volume increase per detent
- Display settings
- Remote control programming
- Maximum gain
- Attenuation of individual inputs
- Delay of the opening time of the mute relays
- Exit
- Program version

.

lowest Volume:

This allows you to set the range and the lowest adjustable volume between -111 and -50 dB. The intention is that the clarity is improved. If the complete control range is used with the Muses 72323, this means in the highest resolution (0.25dB) over four hundred adjustment possibilities During the

practical tests I found that actually perhaps 20 to 30dB control range is used. Of course, this depends on the output power of the amplifiers used, as well as personal listening habits.

Start Volume

The volume selected here is permanently saved as the switch-on volume.

Step

This menu is used to set the volume increase per detent.
Muses 72320: 0,5 bis 2,5dB in 0,5dB-Steps
Muses 72323: 0,25 bis 1,5DB in 0,25dB-Steps

Set Display

This entry leads to the display settings, which are explained further below.

IR-Codes

This takes you to the menu for learning your remote control. This means that the module learns the commands of an existing remote control.

Set Gain

Via this entry the highest possible amplification can be set. This allows you to adapt the module to amplifiers that require a higher input voltage than the input signal provides.
To use this function, the hardware must be equipped with a corresponding OPAmp, which is directly controlled by the Muses chip. If this option was not purchased/needed, the entry "Gain" is not selectable.
As soon as the Muses 72323 is in gain mode, the balance control is switched off. Only channel differences in 3dB steps would be possible. For what reason the gain was set to 3dB steps on the newer Muses Chip 72323 has not become clear to me. If you want a finer adjustment of the balance using the gain function, you should switch to the Muses 72320.

Preset

The menu for presetting the attenuation of individual inputs is also described below.

Delay Mute

Here you can artificially extend the switch-on delay. For example, you can ensure that an amplifier switched on by the module does not make any switch-on noise.

Exit takes you back to the main screen

Set Display

From here the possible settings of the display are controlled:

- Step display
- Balance display
- Optical indication of IR reception
- Brightness during operation
- Options for dimming the display

With Exit you return to the options menu.

Figure 9 - Options Display

As in the previous menu, you can select the individual settings by Rotary.

Show-Elements Step/Balance/IR-Codes

Eine Abwahl/Anwahl hat folgende Bedeutung:

- Step - the value of the set volume increase per detent is displayed/not displayed
- Balance - a red dot inside the blue/white ring documents the status of the balance control; if deselected, this is not displayed
- IR codes - if the IR sensor receives an impulse from the remote control, a small green dot is displayed in the main menu screen for a short time. This can be prevented by selecting "no".

Helligkeit

This menu item is used to set the brightness during operation. The brightness changes immediately when the rotary knob is turned. Automatic dimming can be set in the next menu item.

Disp dark

Im ersten Schritt wird der Zeitraum eingestellt, nachdem die Abdunkelung oder das Ausschalten des Displays erfolgen soll.

The time can be set between 0 and 60 seconds.

- 0 seconds means: This function "Dimming of the display" is switched off.
- 1 to 5 seconds - The setting is automatically changed to 6 seconds, as a shorter period makes no sense.

- 6 to 60 seconds - after this period has elapsed, the action selected in the next menu (dimming or switching off the display) is performed.

The selection is confirmed with the button of the Rotary. An action during the "Bright time", operation of the module by the Rotary or the remote control, will reset the timer. The expiration of the set time always starts after the last action.

The second setting concerns the brightness that the display should assume after the set time frame has elapsed. The brightness can be set in 5 percent increments between 15% and 80%. During the setting, the brightness changes accordingly. Thus, it is possible to estimate which brightness is comfortable.

Setting to 15% causes the display to turn off after the specified time. If the value 15% is set during the setting process, the display remains switched on. Switching off the display during the switch-on process would cause irritation.

After confirming with the rotary, the brightness is raised again.

The *Disp dark* function only works while the main screen is displayed. After actuating the Rotary control or the remote control, the brightness of the display is raised again.

IR-Codes

After selecting the IR Codes function, the Possible commands are displayed:

- Vol+
- Vol-
- Mute
- Input 1 – Input available inputs (here five)
- Standby

Durch Drücken einer Taste auf der (eigenen vorhandenen) Fernbedienung, wird diese Taste der entsprechenden Funktion zugeordnet.
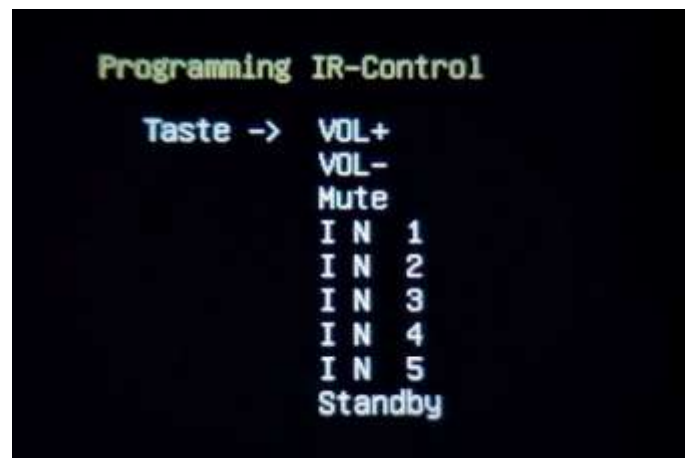

Figure 10 - IR-Codes

Nach dem Programmieren der letzten Funktion, hier Standby, wird die Speicherung durch eine After programming the last function, here Standby, the saving is confirmed by a short display "-> saved". After that, the program automatically jumps back to the previous menu.

All keys must be programmed in one go. It is not possible to select the commands individually.

Preset

Figure 11 - Preset

In this menu the attenuation of individual inputs can be preset.

The inputs can be selected individually. Pressing the rotary knob leads to the selection mode. Now the attenuation can be adjusted in 0.5dB steps up to -20dB.

This function refers to the current volume when changing an input.

When restarting or switching on from standby, the device starts with the power-on volume.

With Exit you return to the options menu.

Standby

Figure 12 - Standby

Pressing the Rotary Encoder for a longer time (> 2s) or the corresponding key on the remote control will switch to standby mode. After releasing the rotary encoder, the switching off of the corresponding outputs is displayed.

The volume is turned down. All inputs are locked.

The display and the analog and digital power supply of the MC are switched off.

This process takes about 4 seconds in total. After the display has been switched off, it took approx. another 2 seconds until you can switch the device on again.

Pressing the rotary encoder (>2s) or the corresponding key on the remote control switches the module on again.

Notes on Installation

General Hints

Usually the module is delivered fully configured. All cable connections are configured so that confusion is not possible.

Input Board

The input board is supplied with soldered XLR sockets (according to your requirements). Since flush installation of the RCA jacks is only possible after installation, these jacks are supplied loose.

Please proceed as follows:

Drill the back plate according to the template. Before installation, make any external signal connections that may be required. Remember the GND connection between the two boards. Once everything is prepared, plug the RCA jacks into the corresponding solder pads. Now screw the XLR sockets to the rear panel and insert the RCA sockets into the corresponding holes. You can now screw them loosely. Now solder the RCA jacks to the input board. After that, only a slight tightening of the nuts is necessary to get a stable connection with the backplane. A further connection with stud bolts or spacers is not necessary.

Should you use external sockets, you can attach the input board to the corresponding holes. The wiring is then made by hand.

MC-Board

Position the MC-board so that you can install the IR sensor, rotary encoder and display well in the front panel. The IR sensor only needs a small hole to receive well. The sensor is permeable from all sides, so the rounding does not necessarily have to point to the front. I usually stick the sensor with the flat side behind a 3mm hole that I drilled into the front panel.

The rotary encoder should be installed in such a way that the operating button, which will be attached later, can trigger the encoder's pushbutton by pressing it.

Now make all cable connections and connect the board to the power supply. The software now starts with the welcome screen and displays the main screen after a few seconds. The device is now ready for operation.

Figure 13 - MC board

Explanations:

- A - connection with the protective conductor. Use a galvanized screw or a galvanized metal spacer here. With this you have grounded the housing if the protective conductor connection at the screw socket has been made properly.
- B - gnd connection for connection to the input board. If the NTC and the rectifier are installed here, you have established a hum-free connection to the protective earth.
- C – Trigger output with desired voltage
- D – external outputs as desired
- E – G Connector sockets for IR sensor (F), rotary encoder (G) and display (E)
- H – Precision trimmer for adjusting the positive supply voltage to the negative voltage (analog). The voltage can be adjusted with mV precision.
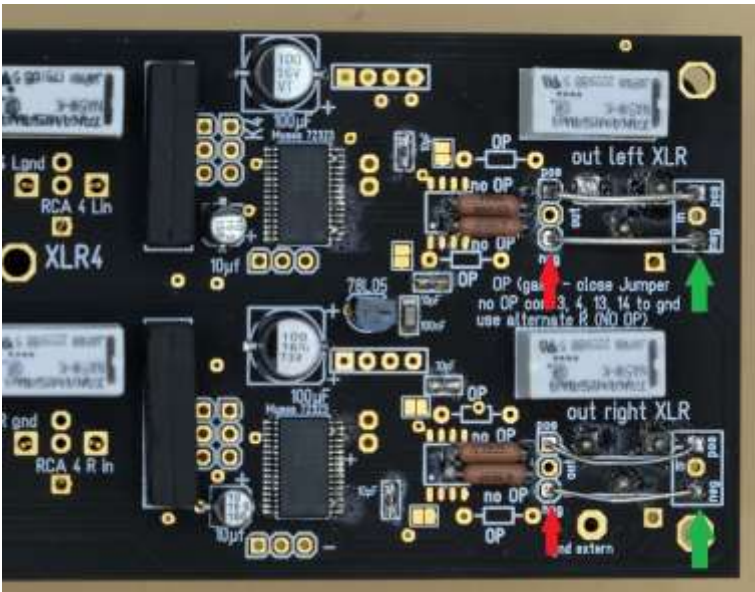
Use as passive PreAmp

Connect the output solder pads of the Muses chip (**red arrow**) to the output socket solder pads (**green arrow**) as shown in Fig. 14.

The gnd connections are through-connected and do not need to be made.

Figure 14 - passive PreAmp

This allows the module to be used as a passive preamplifier.

Loop in a PreAmp

Solder a signal cable to the output solder pads (**red arrow**, Fig. 14) of the Muses chip. Connect these cables to the input of the preamplifier electronics.

Connect the output of your preamplifier to the solder pads (**green arrow**, Fig. 14) for the output sockets. Your preamplifier is now ready for use.

Loop in a DSP

A little more effort is needed here.

You have to cut the signal lines between the inputs and the input of the Muses chip. For this purpose there are two double headers (or corresponding solder pads) per channel on the board. You have to cut the trace between the headers in a way that there is no contact between the pads anymore. It is only necessary to cut the lower and upper (positive and negative signal) traces. The gnd connection can remain.
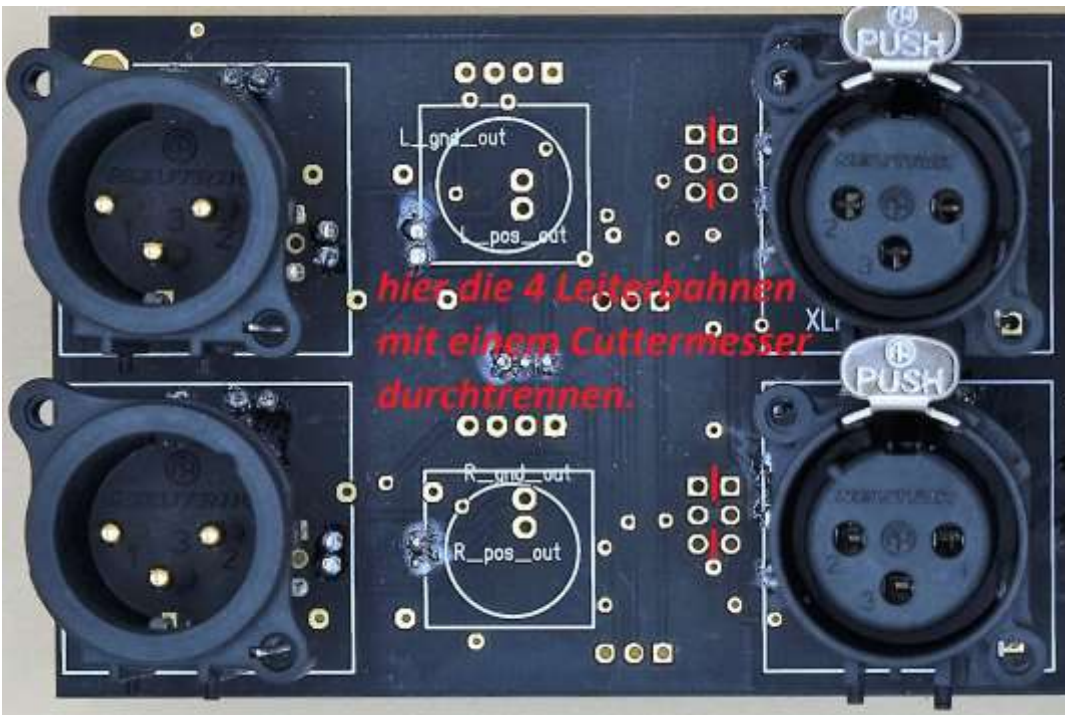
Figure 15 - Cut for DSP

Now connect the output of the input selector (**gelber Balken mit Pfeil**) to the input of your DSP. You connect the output of the DSP to the pads (**roter Balken mit Pfeil**), which are at the input of the Muses chip. Make sure to connect gnd to the DSP as well.
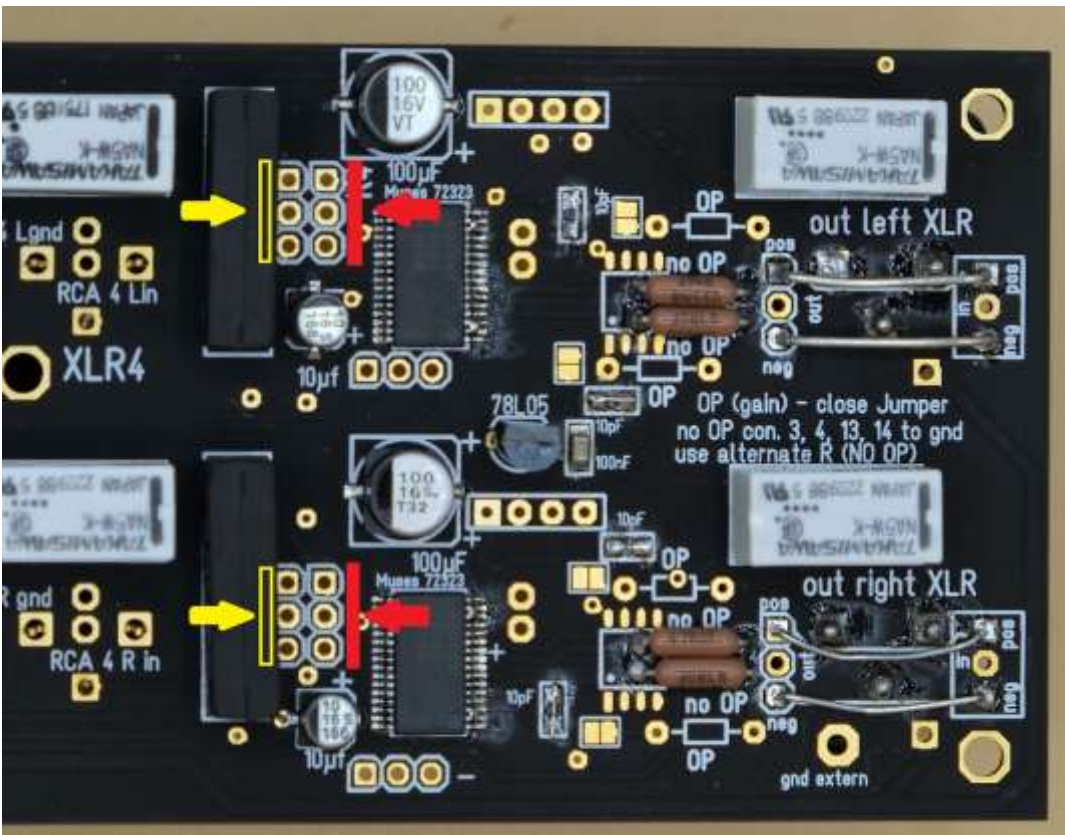

Figure 16 - In- and Outputs

Thus, the module is ready for use with DSP.

Multichannel

You will have received one or more pairs of piggyback boards. Your input board is provided with the corresponding socket connectors onto which these boards are plugged. Please note the coding for the right and left channel. Otherwise the balance control for these channels will work in the opposite way.

The boards can only be plugged in one direction. The connectors provide the contact to the power supply, the input signal and the SPI bus, through which the Muses is controlled. The boards can be cascaded. You can plug further boards onto the last additional board.

The additional outputs that are now available must be wired by hand. It is recommended to install additional output sockets in the rear panel to receive the output signal of the additional boards.

Technical Data:

Power consumption in standby:	max 200mW
Maximum current consumption:	< 8W
Volume control:	0 to –111.75dB / 0.25dB step,
Channel separation:	-110dB typ
Input Impedance:	20kOhm (min 14kOhm)
Maximum Input Voltage:	11 Vrms
Maximum Output Voltage:	10.3 Vrms
Total Harmonic Distortion:	0,000024% (1kHz), 0,0007% (10kHz)
Output Noise:	-124dBV (Vrms)
Mute Level	-120dB

- Fine control of volume in maximum 447 steps (adjustable)
- Muting function (smooth volume down or up)
- programming of the potentiometer to almost any remote control (RC5 or similar), Apple, etc.
- Display of volume in dB, smallest resolution 0.25dB
- Volume control adjustable between 0,25 and 1,5dB steps
- Visualization by a semicircular ring
- Display of IR reception
- Balance control, this can be read at a glance on the main screen
- Brightness adjustment of the display

Zero Cross Detection (no crackling when switching the pot).

Notes:

This is the first version of this documentation. So be a little forgiving if needed information is missing.

The software was further developed for years. It was first used for volume control without input selection. Later suggestions from customers and my own ideas were realized.

If you find any errors in the software or the documentation, I would be grateful for a short hint (info@audio-perfect.de).

You may also send me new ideas or improvements. But keep in mind that the software currently runs on a microcontroller with 32kb memory. Despite optimized programming, 98% of this has already been used. The variant with activated gain function will probably not be able to activate the preset option. Possibly the balance function will be removed instead. This is not yet decided.

Planned upgrades:

      - Change to another processor, ESP32?
      - So that OTA updates are possible
      - Operation of the module via the own smartphone
      - Assignment of own designations for the inputs
      - DSP on board

I wish you much fun with this device

Audio Perfect

Frank Wilker