Multi Mode Transistor Ladder Filter

SMD Version

Build Guide

Dannysound

1 Introduction

The Multi-Mode Ladder (MML) Filter is based on the classic transistor ladder low pass filter by Dr. Robert A. Moog.

The MML Filter has been updated from the classic Moog design to provide Band Pass and High Pass filter responses as well as the traditional Low Pass filter.

The SMD version also includes bipolar CV attenuverters for normal or inverted CV control of the filter cutoff frequency plus a RED MODE (accessible by holding the mode button) that enables positive feedback distortion within the core of the filter.

In red mode the filter will self-oscillate at a low frequency when the resonance control is increased. This self oscillation combines with the input signal to produce the distortion effect.

The effect is most unusual when the input signal is a saw or square wave with melodic content that covers a 2 or 3 octave range. Altering the input level, resonance and filter frequency all change the characteristics of the distortion and the interaction of the self-resonant low frequency and input signal. The effects range from soft clipping to more harsh sounding distortion and at some settings the original melodic content of the input signal can be altered to produce sub harmonic variations in pitch.

The circuit features a fully discreet transistor design with an op-amp buffered output, this allows soft saturation of the input to get the classic overdriven tones of the ladder filter.

A bass compensation circuit has been included to retain the bass response in Low Pass mode when the resonance is increased. The bass compensation also helps to improve the response of the High Pass filter.

Features:

Low Pass, Band Pass and High Pass modes.
Red Mode feedback distortion
CV controlled resonance.
2 x bipolar attenuverter frequency CV inputs.

Controls:

1 x Filter mode selector switch (red mode activated / deactivated by holding)
1 x Frequency control pot
1 x Resonance control pot

Connections:

Inputs

2 x Frequency CV
1 x Resonance CV
1 x Audio

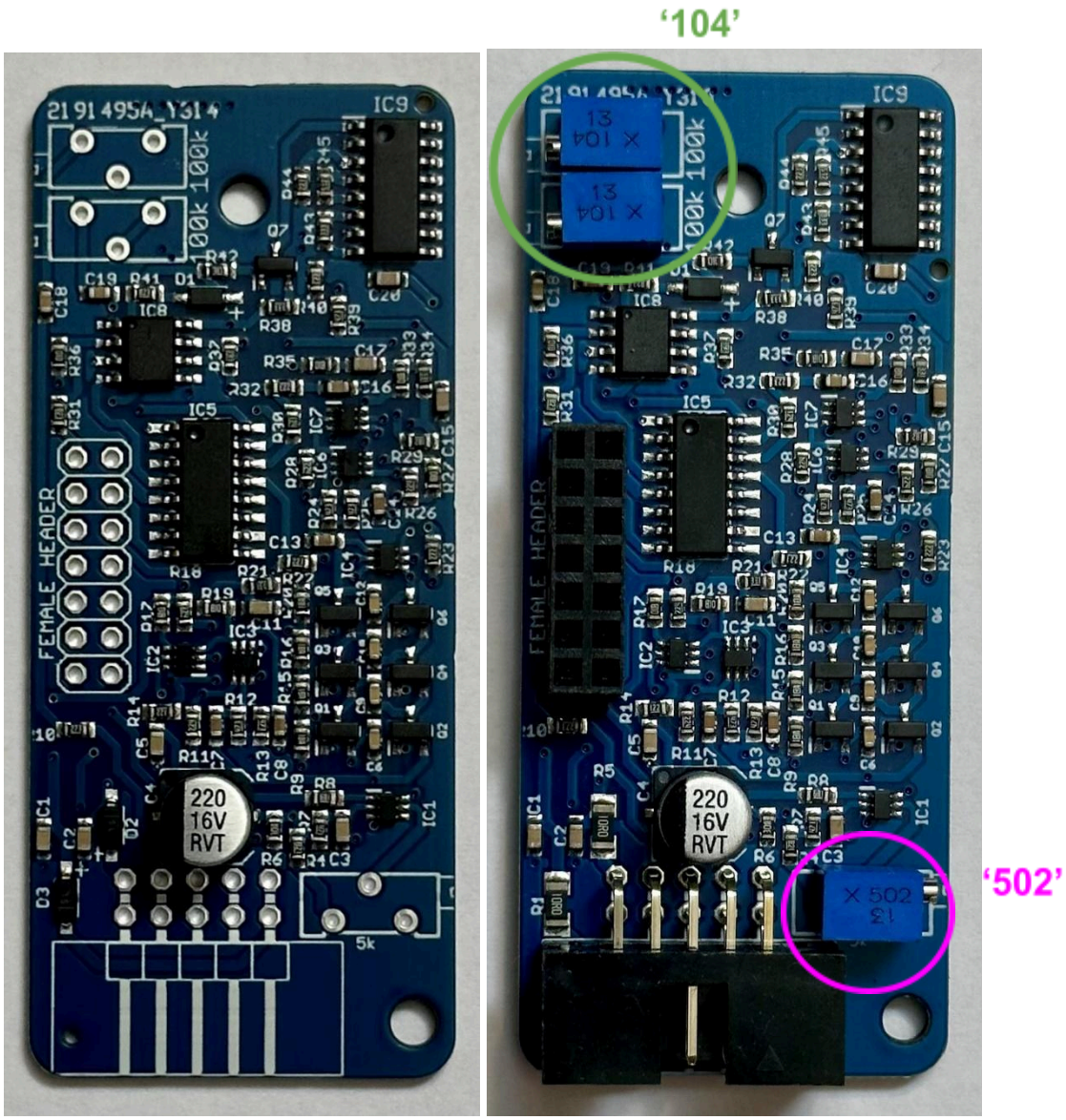
Output

1 x Filter Output

2 Parts Lists

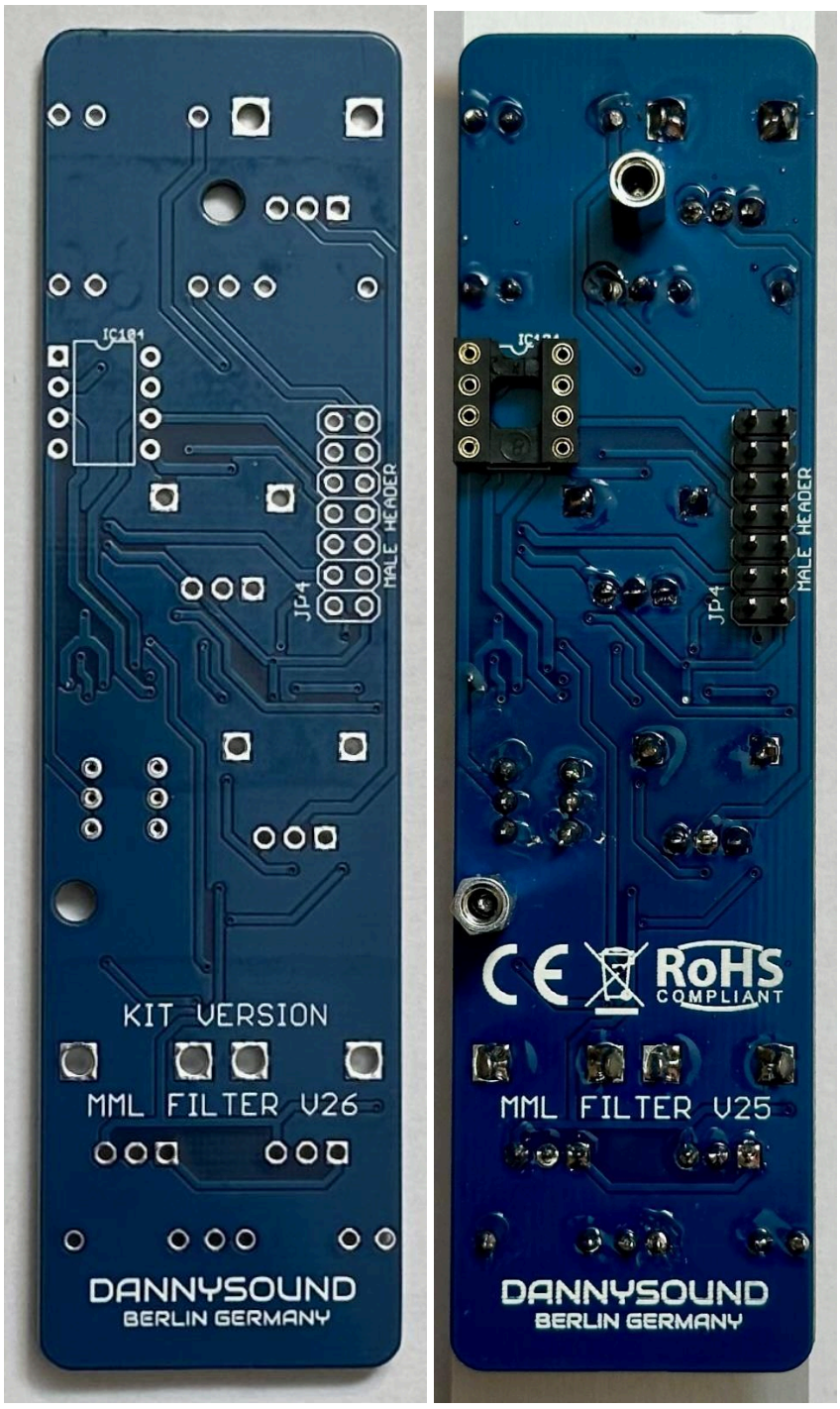
MML Filter Parts List			
3266X Side adjust trimpot	HPT, BPT	2	100k
3266X Side adjust trimpot	RES	1	5k
10-16 Pin	POWER CABLE	1	
Tall Trimmer Centre Detent	CV1, CV2	2	B50kCC
Tall Trimmer	IN-VOL	1	B100k
ALPHA Vertical 9mm	RES, FREQ	2	B100k
Thonkiconn-PJ398SM	CV1, CV2, INPUT, RES, OUTPUT	5	
Knurled Nuts		5	
ROGAN SMALL SKIRTED	Black	1	
ROGAN SMALL	Black	1	
Pre-programmed switch IC	PIC12F629	1	
8 pin DIL Socket		1	
LIGHT PIPES 3MM		3	
LIGHT PIPES 5MM		2	
Mom PB Switch	Mode switch	1	
Switch Cap red		1	
2x5p Shrouded Right angle	Power Connector	1	
2x7 pin 2.54mm male header		1	
2x7 pin 2.54 female header		1	
11mm Hex Standoffs		2	
M3 6mm Screws		6	

3 Main Board

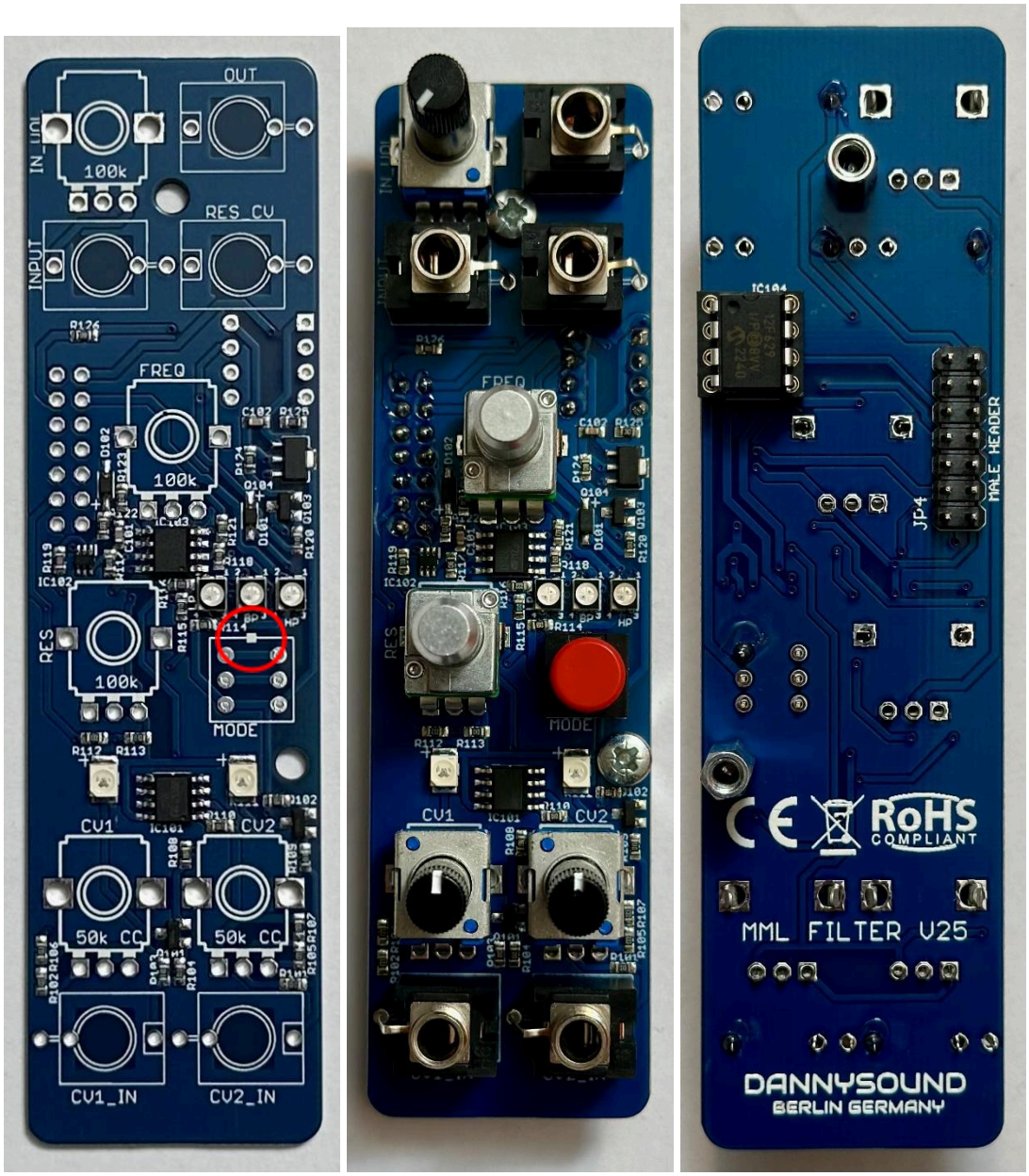


- Solder in the 2 x 100k trimpots in the top left positions, value identified on the trimmer body with '104'
- Solder in the single 5k trimpot in bottom right position, value identified on the trimmer body with '502'
- Solder in the 2x7 pin FEMALE header and the power socket. Note that two singles rows of pre split 7 pins are provided in this kit, make sure they are sitting flush together to the PCB.

4 Pots Board



- Solder in the 8 pin DIL IC socket and the two 7 pin MALE Headers as shown above. You may need to split a longer single row of headers into the correct length. Note, the IC socket must be oriented correctly with the indent on the socket matching up with the PCB outline.
- Ensure all components are soldered flush to the PCB surface.



- Insert the 2 x 11mm standoffs and screw them on from the top of the pots board as pictured.
- Put the red button cap onto the mode switch and insert the switch into the board. IMPORTANT: note the orientation tab on the switch is facing to the top of the module and lines up with the circled white dot on the PCB outline. Solder one pin of the switch to keep it in place and flush to the PCB.
- Insert the 8 pin PIC IC. IMPORTANT - Take note of orientation when placing all IC's, follow the above image for reference lining up the black dot on the chip with the curved side of the socket and PCB screen.
- Place the rest of the components onto the board but DO NOT SOLDER yet. Insert the 2 x 50k centre detent tall trimmers into CV1_IN and CV2_IN, the 100k tall trimmer to IN_VOL and the two metal 100k pots into FREQ and RES. Insert the five jack sockets into position with the nuts removed.

5 Panel Components and Final Assembly

- Insert the three smaller 3mm light pipes, turn the panel over and press down firmly to ensure the light pipes are fully pushed in. A piece of paper under the panel is handy to stop the light pipes getting scratched but it's not critical.
- Insert the two 5mm light pipes and follow the above method before securing the provided rubber fastenings to the back of the light pipes.
- Place the panel onto the pots pcb and add the nuts and washers to the two pots and 5 jacks securing everything in place.
- Test the red mode button pushes in and out and if necessary adjust the position.
- Once everything is fitted, solder the pots, jacks and switches in place.
- Finally place the main board and pots board together and secure with the remaining standoff screw. Attach the knobs to all pots using the provided allen key. Note: you might need to trim down a few of the solder joints before fitting the back PCB on. The spacing is quite tight above the side-adjust trimmers.


MULTIMODE
LADDER FILTER
AUDIO INPUT
OUTPUT
RES CV
LP
BP
HP
CV 1
CV 2
DANNYSOUND
MULTIMODE
LADDER FILTER
AUDIO INPUT
OUTPUT
RES CV
LP
BP
HP
CV1
CV2
DANNYSOUND
DANNYSOUND
BERLIN GERMANY
BPT HPT
MML FILTER V23
RoHS
COMPLIANT
-12V
RoHS
COMPLIANT
MML FILTER V23
DANNYSOUND
BERLIN GERMANY

6 Testing and Calibration

The calibration procedure can be done by ear and requires no special equipment.

The trimpot references have been highlighted in red to distinguish them from the panel controls.

The resonance calibration is not especially critical and can be set higher or lower on the trimpot once the initial calibration has been done.

Resonance calibration and initial test.

1. Connect the OUTPUT of the filter to an amplifier.
2. Connect an oscillator square or saw wave to the MML Filter INPUT.
3. Ensure LP filter is selected (Yellow LP LED should be lit) if necessary hold the mode button to change from red to yellow led colour.
4. Set INPUT VOLUME to 60% (From around 70% or higher the input will start to be overdriven with a ±5V input signal).
5. Rotate FREQUNCY control to ensure the filter is working as expected (no output at 0, full signal at 100%).
6. Set INPUT VOLUME to 0.
7. Set FREQUENCY to around 60%.
8. Set RESONANCE to around 55%.
9. Adjust R-TRIM trimpot so the resonance is just at the point of self oscillation.

Band Pass and High Pass Filter Calibration

1. Connect OUTPUT to an amplifier.
2. Connect Square or Saw wave output of an oscillator to the INPUT.
3. Set oscillator pitch to produce a bass type frequency.
4. Set INPUT volume to around 60%.
5. Set RESONANCE to around 30% – 40% and FREQUENCY up full.
6. Select BP filter.
7. Adjust BPT trimpot so the least amount of signal is audible.
8. Select HP filter.
9. Adjust HPT trimpot so the least amount of signal is audible.

Testing

The range of the front panel frequency control is quite large and the response for operation without any CV control is from 50% to 100%. This drops to between 20% to 70% when a CV to track a keyboard or sequencer is connected. The bipolar CV attenuverters also require a larger range of operation for the frequency control so that is why the overall freuqncy control range was increased.

To test the CV attenuverters insert a CV from and envelope and ensure the Frequency of the filter opens up when the control is at 100% and closes when the control is at 0.
To test the red feedback distortion mode.

Connect a saw or square wave from an oscillator into the input and set the input control to 60%.

Connect the output of the filter to a VCA.

Send a sequence into the oscillator to play a bassline or melody that extends over 3 octaves.

Set the frequency control to 3 o'clock and set the resonance to 0.

Set the filter to LP mode and hold the mode button so the LED turns red.

Increase the resonance to hear the distortion effect. As the resonance is increased the internal feedback should change the notes to lower some of the pitches of the sequence. This effect is dependent on the pitch of the sequence as well as the settings of the input level, frequency and resonance so playing around with controls is advised to explore all the different ways the distortion sounds.

Tapping the mode button cycles through LP BP and HP in red mode which produces different distortion textures.