

Analog Metropolis

AM2110 Voltage Controlled High Pass Filter

Project Notes V1.0

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1 Module Description

This module is an exact replica of the high pass filter in the Eμ Systems Modular Synthesizer, SSM Voice Card and Audity synthesizer.

The High Pass Filter is an exponentially controlled high pass filter with no variable Q. Three audio signals are mixed together (SIGNAL A, B C) and then low pass filtered with a cut-off frequency determined by the sum of the initial frequency set by the front panel controls (FREQ and FREQFINE) and the three control inputs. The cut-off is 24dB/octave and the signal is DC coupled.

The control inputs are accurately calibrated to 1V/octave, and there are two full level un-attenuated inputs (one for the front panel, another for an internal CV bus from a CV keyboard or MIDI to CV controller), as well as + and - CV inputs, which have front panel attenuators (+FREQ CNTL and - FREQ CNTL).

INPUTS SIGNALA, SIGNALB, SIGNALC
 +FREQ CNTL, -FREQ CNTL

OUTPUTS AUDIO OUTPUT

POTS SIGNALA LEVEL, SIGNALB LEVEL, SIGNALC LEVEL
 FREQUENCY, FINE,
 +FREQ CNTL, -FREQ CNTL

SWITCH an optional 2-way centre off for control CV from keyboard or sequencer

2 The Original Circuit

This module is based on the SSM2040 datasheet and is a standard SSM2040 High Pass VCF. It sounds very warm and is one of the best HPF's available.

3 The AM Circuit

The Analog Metropolis circuit is a straight copy of the original Eμ Systems High Pass Filter in the SSM Voice Card. The design uses a SSM2040 filter chip, with a TL082 FET Op Amp performing audio summing duties and a 741 Op Amp serving as the CV summer. The Op Amps should be upgraded; two OPA134's to replace the TL082 with improved offset and faster slew rate, and OP177's to replace the 741's with improved offset.

The REV03 board is the prototype and production board.
There are no errors in the PCB.

4 PCB

The PCB is double sided with solder mask and silkscreen on the upper surface. The component names are shown in the silk screen but not the component values. The size of the PCB is 80mmx100mm.

The PCB is held to the front panel at 90 degrees by the use of two pot brackets manufactured by Omeg (www.omeg.oc.uk). These brackets (and pots) are centred at 40mm apart. The FREQ and FINE pots hold the PCB to the front panel.

5 PCB Connections

The PCB has a number of connections designed for MTA 0.1" headers, so that the panel components can be connected to the PCB. I use headers and sockets to enable the board to be easily replaced, however you can solder wires straight to the PCB.

PCB Header Name	Pin #	What is it?	Where does it go?
INPUTS	Pin 1	Input Signal A	Jack Socket SIGNALA
	Pin 2	Input Signal B	Jack Socket SIGNALB
	Pin 3	Input Signal C	Jack Socket SIGNALC
SIGNALC	Pin 1	Signal C Pot	SIGNALC Pot Pin 1
	Pin 2	Signal C Pot	SIGNALC Pot Pin 2
	Pin 3	Signal C Pot	SIGNALC Pot Pin 3
CV_INS	Pin 1	CV- In	Jack socket CV- IN
	Pin 2	CV+ In	Jack socket CV+ IN
	Pin 3	CV1 In	Keyboard CV bus or optional CV
	Pin 4	CV2 In	Keyboard CV bus or optional CV
CV-	Pin 1	CV- Pot	CV- Pot Pin 1
	Pin 2	CV- Pot	CV- Pot Pin 2
	Pin 3	CV- Pot	CV- Pot Pin 3
CV+	Pin 1	CV+ Pot	CV+ Pot Pin 1
	Pin 2	CV+ Pot	CV+ Pot Pin 2
	Pin 3	CV+ Pot	CV+ Pot Pin 3
FREQ	Pin 1	FREQ Pot	FREQ Pot Pin 1
	Pin 2	FREQ Pot	FREQ Pot Pin 2
	Pin 3	FREQ Pot	FREQ Pot Pin 3
FINE	Pin 1	FINE Pot	FINE Pot Pin 1
	Pin 2	FINE Pot	FINE Pot Pin 2
	Pin 3	FINE Pot	FINE Pot Pin 3

OUTS	Pin 1	Signal Output	Not Used
	Pin 2	Signal Output	Jack socket OUTPUT
PAD	Pin 1	Panel Earth	Jack socket earth bus

6 Pots

The PCB is designed to be used with Spectrol 248J conductive plastic pots; they are a reasonable price and very high quality. The PCB will work with either 3.18mm or 6.35mm spindle diameter models. The PCB can be used with other pots such as sliders provided they are all mounted off the PCB.

7 Power

The module should be powered from a well regulated +15V and -15V power supply, current consumption is around 25mA. The power connector is the standard two ground MOTM/Oakley 4-pin Molex connector. One ground is for the circuit, the other is for the panel ground (PAD).

8 Front Panel

The AM2110 is a standard AM format module which can be built into a number of panel formats. You can use your own format or choose from the following:

AM High Density

This panel format enables a higher density of controls on each panel, and panels are usually 90mm wide. All the pots have a small spindle diameter of 3.18mm which enables the control knobs to be located closer together. Both 19mm and 13mm control knobs can be used. The "look and feel" is similar to the ARP 2500.

Panels are 4U high and 90mm wide. Panels are fitted to horizontal 12mm angled aluminium strip using 4mm diameter machine screws in each corner of the panel. The strip is mounted into a standard 19" rack unit with small wooden end strips.

AM Low Density

This panel format has a lower density of controls on each panel, and panels sometimes have to be 135mm wide to accommodate all the controls. All the pots have a spindle diameter of 6.35mm which means 19mm control knobs can be used, such as those used in the Eµ Systems Modular. The "look and feel" is similar to the Eµ Systems Modular.

Panels are 4U high and 90mm or 135mm wide. Panels are fitted to horizontal 12mm angled aluminium strip using 4mm diameter machine screws in each corner of the panel. The strip is mounted into a standard 19" rack unit with small wooden end strips.

MOTM Panels

This established panel format has pot spacing very close in dimensions to the AM PCB's, MOTM is 41.275mm compared with 40mm of the AM format. This means you can design MOTM style front panels but with 40mm spacing and this won't look significantly different. Alternatively you maybe be able to mount the AM PCB on 41.275mm hole centres by slightly bend the pot brackets to fit.

9 Building the Module

This module is simple to build. The recommended build order is:

- Resistors
- Inductors
- IC Sockets
- Capacitors
- Trimmers
- Connectors
- Transistors
- Pot Brackets and Potentiometers

Check all the electrolytic capacitors and transistors are fitted the right way round. Before fitting the IC's its worth connecting up the module to a power supply and checking that the power rail voltages are as expected at each IC socket, then power down, and fit the IC's ensuring correct orientation.

Power up and try out the filter. Then proceed to trimming.

10 Trimming

This module is simple to set-up, and only one trimmer needs to be adjusted.

V/OCT This trimmer adjusts the CV input response, so that the filter accurately tracks the keyboard and oscillators. Set this to its mid range position.

11 Special Components

The AM2110 makes use of a small number of specialist components:

SSM2040

The SSM2040 chip is hard to locate, but it be found especially on eBay.

ECO/Omeg Pot Brackets

These can be obtained from Omeg in the UK. <http://www.omeg.co.uk/>. Oakley have them again, and I have stock them too.

12 Parts Listing

Part Number	Value	Quantity	Comments
Capacitors			
C1, C2	100nF 100V	2	Multi-layer Polyester
C3, C4	22uF 25V	2	Radial Electrolytic
C5	10pF	2	Low-K Ceramic
C6	3.3pF	2	Low-K Ceramic
C7, C8, C9,C10	2000pF	4	1% Polystyrene
C11, C12	1uF 25V	4	Radial Electrolytic, Audio Quality
Resistors			
R1	130K	1	1% Metal Film
R2	33K	1	1% Metal Film
R3	100R	1	1% Metal Film
R4	5K6	1	1% Metal Film
R5, R7, R9, R11, R13	10K	5	1% Metal Film
R6, R8, R10, R12	200R	4	1% Metal Film
R14, R17, R18, R19, R20, R21, R23, R24, R27, R28	100K	10	1% Metal Film
R15, R16	1M	2	1% Metal Film
R22	47K	1	1% Metal Film
R25	220K	1	1% Metal Film
R26	2M7	1	1% Metal Film
Pots			
CV-, CV+, FREQ, FINE	100K LIN	4	SPECTROL 248
SIGNALA, SIGNALB, SIGNALC	100K LOG	3	SPECTROL 248
V/OCT	1M	1	25 turn cermet trimmer
Semiconductors			
IC1	SSM2040	1	
IC3, IC4	OP177GP	2	Single Op Amp, Low Offset
IC5, IC6	OPA134	2	Single Op Amp, Audio Quality
Passives			
L1, L2		2	Inductor
CV_INS		1	MTA 0.1" 4-pin header
OUTS		1	MTA 0.1" 2-pin header
FREQ, FINE, SIGNALC, CV-, CV+, INPUTS		6	MTA 0.1" 3-pin header
POWER		1	MTA 0.156" 4-pin header

