

AMSynths

AM8121 Roland 100M VCF

Project Notes V1.0

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Rob Keeble
Contact: sales@amsynths.co.uk
Web Site: www.amsynths.co.uk

20 March 2015

1 Module Description

This module is a clone of the Voltage Controlled Filter from the legendary Roland 100M analog modular synthesizer. It is a simple non-voltage controlled single-pole 6dB High Pass Filter in front of a fully voltage controlled 4-pole OTA Low Pass Filter with resonance into full self oscillation. This is the "classic" Roland 4-pole OTA based Low Pass Filter, first developed for the Jupiter 4 and SH-7 in 1978 using discrete components.

The original OTA design made use of chips such as the CA3080 or BA662 and they produce a nice warm sound with a well controlled resonance. The design was gradually miniaturized, first as the IR3109 VCF chip in the Jupiter 8 and later as the D80017 VCF and VCA chip in the Juno 106.

INPUTS: SIGNALA, SIGNALB
CV1, CV2, CV3

OUTPUTS: AUDIO SIGNAL

POTS: SIGNAL A, SIGNAL B
FREQUENCY, RESONANCE
CV1, CV2, KYBD

ROTARY SWITCHES:
HP FILTER MODE (OFF, HP1, HP2, HP3)

2 The Original Circuit

The AMSynths design is a careful replication of the original Roland 100M design with the HP and LP filters in series. The OTA chips are BA662 in the original, but I have used the BA6110 chip which is still available at a low price. I have modified the CV circuit to make use of easily available 1K Tempco resistors and to use USA transistors (2N3904/06).

1% polystyrene capacitors are used for the filter stages and the audio path capacitors are high quality as well. The Op Amp used in the High Pass filter has been upgraded from a 4558 to a TL071, and the CV summing Op Amp can be a TL071 or a low offset OP177 Op Amp. The 2SK30 FET transistors after each OTA filter pole have been replaced with easy to locate 2N5485 FET.

I have not utilised the BA6110 buffer, although some other Roland filters used this approach. The feedback circuit that provides resonance and self oscillation has two diodes which act as voltage limiters preventing the feedback running away and ever increasing self oscillation. This rather tames the resonance peak and makes for a smoother filter than say the IR3109. A rotary 4-way switch selects the HPF cutoff frequency.

The blue solder mask REV03 boards are production status, with no errors or corrections.

3 Front Panel Format

The AM8121 is designed to be used with a standard 3U high EuroRack or 3" wide FracRac panel, although other shapes and sizes can be used, for example MOTM. I built my module with 6x 3.5mm jack sockets on the right hand side, the PCB mounted to the left with the on board pots and then the off board pots for the signal levels and resonance in the centre.

4 PCB, Pots and Power

The PCB is high quality, double sided with solder mask, component names are shown in the silk screen but not the component values. The size of the PCB is 80mm x 100mm.

The PCB is held to the front panel at 90 degrees by the use of three pot brackets (available from Omeg or AMSynths). These brackets are centred at 1.0 inch apart. These brackets can be omitted if you wish; the pots will still hold the PCB in place. The PCB is designed to take 16mm Alpha PCB mounted pots, either round or splined shaft. Other makes of the same pin spacing and size will work.



The module should be powered from a well regulated +/-12V or +/-15V power supply, current consumption is around 25mA. The power connector is the standard 10-pin Doepfer DIL socket or a two ground MOTM/Oakley 4-pin Molex connector can be fitted. One ground is for the circuit, the other is for the panel (PAD).

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.

Header Name	Pin #	What is it?	Where does it go?
Q	Pin 1	Resonance Pot	RESONANCE Pot Pin 1
	Pin 2	Resonance Pot	RESONANCE Pot Pin 2
	Pin 3	Resonance Pot	RESONANCE Pot Pin 3
CV_INS	Pin 1	CV1 In	Jack socket CV1 IN
	Pin 2	CV2 In	Jack socket CV2 IN
	Pin 3	CV3 In	Jack socket CV3 IN
OUTS	Pin 1	Signal Output	Jack socket OUT
	Pin 2	Not Connected	Not Used

The AM8121 has a 4-way MTA 0.1" connector for 2 signal inputs (INS) which are wired as follows:

Audio Input	Pin # of Pot	Name of Pot	Where does it go?
SIGNALA	Pin 1	Signal A Pot	Wire to GND (INS Pin 4)
	Pin 2	Signal A Pot	Wire to INS Pin 1
	Pin 3	Signal A Pot	Wire to SIGNALA Jack Socket
SIGNALB	Pin 1	Signal B Pot	Wire to GND (INS Pin 4)
	Pin 2	Signal B Pot	Wire to INS Pin 2
	Pin 3	Signal B Pot	Wire to SIGNALB Jack Socket

The HP Filter Mode switch is wired up as follows;

Switch	Pin #	Description	Where does it go?
SW1	Pin 1	Mix Output	Wire to centre tap of switch
	Pin 2	Keyboard CV	Wire to CV3 Jack Socket normalised input. So it feeds to CV3 In when no jack plug is inserted.
SW2	Pin 1	HP Flat	Wire to switch position 1
	Pin 2	HP 1	Wire to switch position 2
	Pin 3	HP 2	Wire to switch position 3
	Pin 4	HP 3	Wire to switch position 4

6 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. This is highly recommended!

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

7 Trimming

This module has two trimmers which need to be adjusted for accurate operation of the filter.

FTRIM This trimmer adjusts the initial cut-off frequency of the filter. Set the **FREQ** to minimum and connect a VCO output of around 80Hz to a filter input with the **SIGNAL** pot at maximum. Monitor the filter audio output and adjust **FTRIM** so that the **FREQ** pot cuts off the signal at low values, or to taste.

8 Special Components

The AM8121 makes use of a small number of specialist components:

BA6110

This chip is available on eBay or from UTSOURCE. Please mount the chips in SIL sockets as you may find one of the chips are dud or fail quickly.



Polystyrene Capacitors

The PCB is designed to take either axial or radial leaded. We recommend the radial EXFS 470PF available from Farnell as part number 9520228.



Tempco Resistor

The 1k PTC Tempco resistor can be obtained from Farnell, the part number is 1174306.

Rotary Switch

The splined rotary switch is an ALPS SRBM140700 available from Mouser.



Pot Bracket

ECO pot brackets can be obtained from Omeg in the UK or AMSynths.
<http://www.omeg.co.uk/>

9 Parts Listing

A Mouser BOM is available on the AMSynths web site for this PCB.

Part Number	Value	Quantity	Comments
Capacitors			
			All 2.5mm spacing unless stated
C1, C2, C11, C12, C15, C16	100nF	6	Axial Ceramic
C3, C4	22uF	2	Radial Electrolytic
C5, C6, C7, C8	470pF	4	1% Polystyrene 5mm spacing
C9, C10	10uF BP	2	Bi-Polar Radial Electrolytic
C13	1nF	1	Polyester 5mm spacing
C14	2n2F	1	Polyester 5mm spacing
C17	4n7F	1	Polyester 5mm spacing
C18	22pF	1	Low-K Ceramic
Resistors			
			All 1% Metal Film
R1, R2, R3, R33, R35, R36	100K	6	
R4	27K	1	
R5, R6, R21, R40	33K	4	
R7, R8, R12, R13, R17, R18, R23, R24	560R	8	
R9, R11, R14, R16, R19, R25	68K	6	
R10, R15, R20, R26	22K	4	
R27, R29, R31	10K	3	
R28	1K	1	
R30	100R	1	
R32	6K8	1	
R34	220K	1	
R37	1M	1	
R38	1M5	1	
R39	120K	1	
R41	1KT	1	PTC Tempco
R42	150K	1	
R43, R44, R45, R46	15K	4	
Potentiometers			
CV1, CV2, FREQ, RESO, KYBD	100K LIN	5	Alpha 16mm
SIGNALA, SIGNALB	100K LOG	2	Alpha 16mm
FTRIM	100K	1	Vertical 25 turn type
V/OCT	20K	1	Vertical 25 turn type
Semiconductors			
T1, T2, T3, T4	2N5485	4	
T5, T7	2N3904	2	
T6	2N3906	1	

Part Number	Value	Quantity	Comments
Passives			
L1, L2	0.1uH	2	Inductor
Hardware			
SW1	4W ROTARY	1	ALPS SRBM140700
OUTS, SW1		2	MTA 0.1" 2-pin header
CV_INS, Q		1	MTA 0.1" 3-pin header
INS, SW2		2	MTA 0.1" 4-pin header
POWER		1	16-pin DIL Socket OR MTA 0.156" 4-pin header

