

# **Analog Metropolis**

## **AM8035 ARP Voltage Controlled "Moog" Low Pass Filter**

### **Project Notes V1.0**

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### **3 The AM8035 Circuit**

The cloned circuit is exactly the same as the original, as all the components are easy to locate. The AM module contains the original ARP module circuit as well as the additional circuitry of CV and signal summing which is held on the main ARP PCB's. This provides a self contained module for use within any modular system, rather than a replacement module for ARP synthesizers.

CA3046 transistor arrays have been used, as they have closer tolerances than the CA3086. However CA3086's can be used, although you might want to do some matching of the transistors. Modern Op Amps have been used, such as TL071 but I use top quality components: OP177GP as the CV summing Op Amp and the OPA134 Op Amp in the audio circuits. The original dual FET (2N3958) has been retained.

All capacitors have been upgraded as well; WIMA and Panasonic Audio capacitors in the audio signal paths and Panasonic FC capacitors in the power supply. The trimmers are all cermet 20 turn. These upgrades pay off, the filter sounds fantastic!

The Tempco resistor can be omitted (and a standard metal film resistor used) if you are not concerned about the filter oscillation tracking properly. We have had 1K87 3500ppm Tempco resistors specially manufactured, and we recommend fitting one of them.

The frequency control circuitry of the original has been expanded to include a dedicated keyboard CV input, as well as a FINE front panel control and an internal frequency trimmer for setting up the filters response.

The REV01 board is the production board, with no errors or corrections.

### **4 Parts**

The parts for the AM8035 are easy to find, except the 2N3958 and CA3046 which may be harder to locate, try [www.ebay.com](http://www.ebay.com).

### **5 Front Panel Format**

The AM8035 is designed to be used with a standard 3" FracRac panel, although other shapes and sizes can be used. I built my module with 6 jack sockets on the left hand side, the PCB mounted in the middle with the on board pots and then the off board pots for the signal levels and resonance on the right.

## 6 PCB, Pots and Power

The PCB is held to the front panel at 90 degrees by the use of four pot brackets. 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 PCB is double sided with solder mask, component names are shown in the silk screen but not the component values. The size of the PCB is 80mmx100mm.

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 (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.

PCB Header Name	Pin #	What is it?	Where does it go?
<b>RESO</b>	Pin 1	Resonance Pot	RESONANCE Pot Pin 1
	Pin 2	Resonance Pot	RESONANCE Pot Pin 2
	Pin 3	Resonance Pot	RESONANCE Pot Pin 3
<b>CV_INS</b>	Pin 1	CV1 In	Jack socket CV1 IN
	Pin 2	CV2 In	Jack socket CV2 IN
	Pin 3	CV In	Keyboard CV bus or optional CV
<b>CV1</b>	Pin 1	CV1 Pot	CV1 Pot Pin 1
	Pin 2	CV1 Pot	CV1 Pot Pin 2
	Pin 3	CV1 Pot	CV1 Pot Pin 3

<b>CV2</b>	Pin 1	CV2 Pot	CV2 Pot Pin 1
	Pin 2	CV2 Pot	CV2 Pot Pin 2
	Pin 3	CV2 Pot	CV2 Pot Pin 3
<b>OUTPUTS</b>	Pin 1	Signal Output	Jack socket OUT
	Pin 2	Signal Output	Not Used
<b>PAD</b>	Pin 1	Panel Earth	Jack socket earth bus

The AM8035 has a MTA connector for 3 signal inputs but there are no individual connectors for each signal level pot (as per many other AM modules). This has been done to save PCB space and achieve a 100x80mm PCB size. The individual pots for each signal levels need to be manually wired up as shown below:

<b>SIGNALA</b>	Pin 1	Signal A Pot	Wire to GND (CV Pin 1)
	Pin 2	Signal A Pot	Wire to SIG_INS Pin 1
	Pin 3	Signal A Pot	Wire to SIGNALA Jack Socket
<b>SIGNALB</b>	Pin 1	Signal B Pot	Wire to GND (CV Pin 1)
	Pin 2	Signal B Pot	Wire to SIG_INS Pin 2
	Pin 3	Signal B Pot	Wire to SIGNALB Jack Socket
<b>SIGNALC</b>	Pin 1	Signal C Pot	Wire to GND (CV Pin 1)
	Pin 2	Signal C Pot	Wire to SIG_INS Pin 3
	Pin 3	Signal C Pot	Wire to SIGNALC Jack Socket

## 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.

Power up and try out the filter. Then proceed to trimming. Watch out for the speaker shredding resonance.

## 10 Trimming

This module has three 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 and FINE pots to minimum and turn RESO (Q) up so that the filter begins to oscillate. Monitor the filter output with an oscilloscope or frequency counter and adjust FC\_TRIM for a 62.5ms period or 16Hz.

**TRIM** This trimmer adjusts the filter for minimum CV bleed through. Listen to the audio output whilst patching an ADSR into the CV1 input. Adjust the trimmer for minimal output whilst repeatedly triggering the ADSR.

**V/OCT** This trimmer adjusts the CV input response, so that the filter accurately tracks the keyboard and oscillators. Turn RESO (Q) so that the filter begins to oscillate. Patch the keyboard CV into the CV1 socket on the PCB. Press C4 on the keyboard and adjust the FREQ control so that turning V/OCT trimmer has minimal effect. Tune a reference oscillator so that it zero-beats with the note appearing at the Band Pass output. Be sure the reference oscillator is not controlled by the keyboard. Now, press C5 on the keyboard and trim V/OCT so the note from the filter zero-beats with the reference oscillator. Repeat as necessary.

## 11 Special Components

The AM8035 makes use of a small number of specialist components:

### Tempco Resistor

The 1K87 3500ppm/°C Tempco can be obtained from Precision Resistors, they have UK and USA distribution. You need the PT146 resistor, and they may ask for a minimum order of 5 or 10 items.

<http://www.precisionresistor.com/>

A 1K87 1% resistor can be used if you aren't concerned about the filter tracking the keyboard when it is self-oscillating.

### Pot Brackets

ECO pot brackets can be obtained from Omeg in the UK.

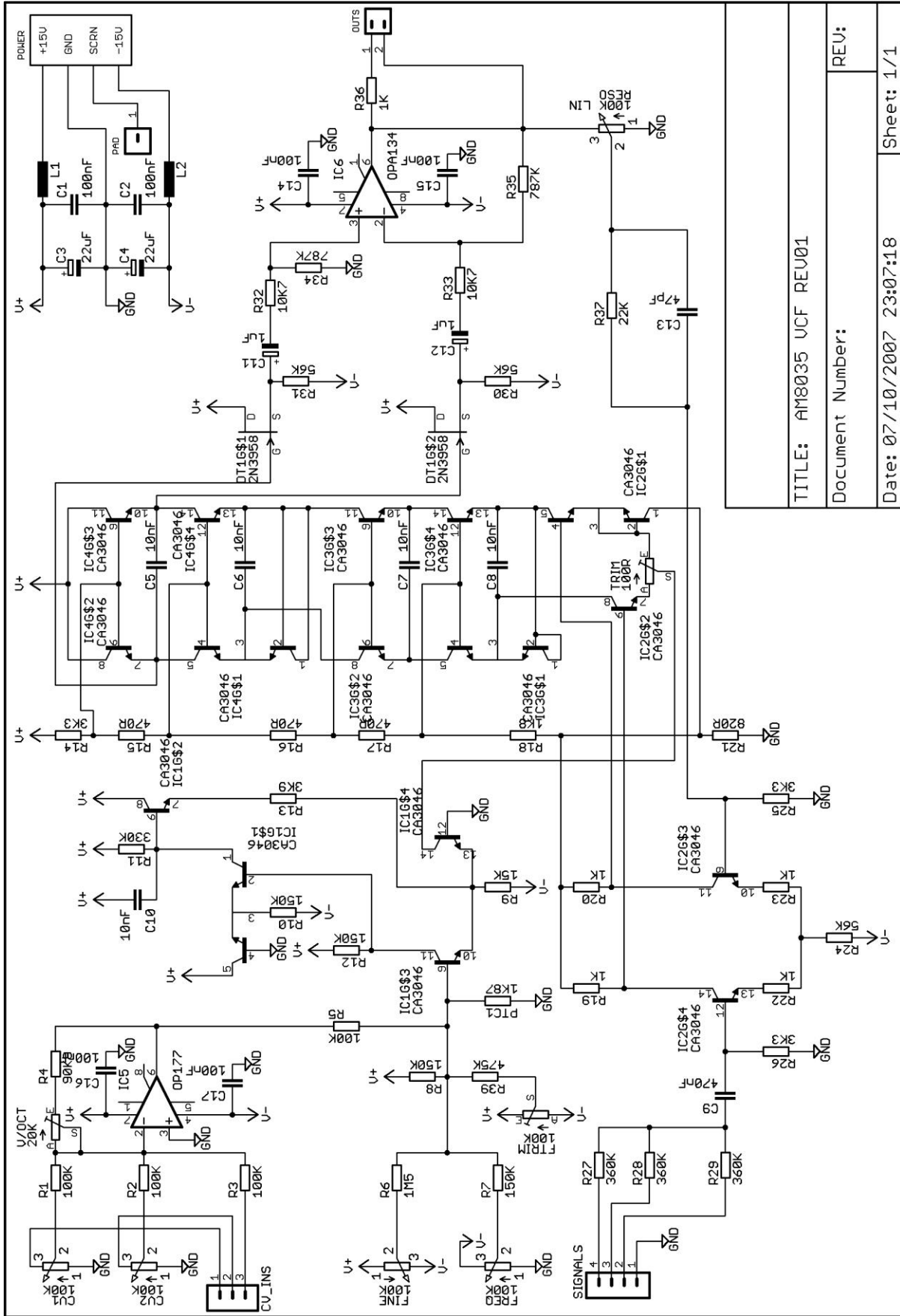
<http://www.omeg.co.uk/>

## 12 Parts Listing

Part Number	Value	Quantity	Comments
<b>Capacitors</b>			
C1, C2, C14, C15, C16, C17	100nF 100V	6	All 5mm spacing Axial Ceramic
C3, C4	22uF 25V	2	Radial Electrolytic
C5, C6, C7, C8, C10	10nF 63V	5	High quality Polyester
C9	470nF 63V	1	High quality Polyester
C11, C12	1uF 25V	2	Radial Electrolytic
C13	47pF 63V	1	Low-K Ceramic
<b>Resistors</b>			
All 1% Metal Film			
R1, R2, R3, R5	100K	4	
R4	90K9	1	
R6	1M5	1	
R7, R8, R10, R12	150K	4	
R9	15K	1	
R11	330K	1	
R13	3K9	1	
R14, R25, R26	3K3	3	
R15, R16, R17	470R	3	
R18	1K8	1	
R19, R20, R22, R23, R36	1K	5	
R21	820R	1	
R24, R30, R31	56K	3	
R27, R28, R29	360K	3	
R32, R33	10K7	2	
R34, R35	787K	2	
R37	22K	1	
R39	475K	1	
PTC1	1K87	1	3500ppm 1% Tempco
<b>Potentiometers</b>			
CV1, CV2, FREQ, RESO, FINE	100K LIN	5	SPECTROL 248
SIGNALA, SIGNALB, SIGNALC	100K LOG	3	SPECTROL 248
TRIM	100R	1	25 turn cermet trimmer
FTRIM	100K	1	25 turn cermet trimmer
V/OCT	20K	1	25 turn cermet trimmer
<b>Semiconductors</b>			
IC1, IC2, IC3, IC4	CA3046	4	Transistor Array
IC5	TL071	1	Single Op Amp
IC6	TL071	5	Single Op Amp
DT1	2N3958	1	Dual FET Transistor
<b>Passives</b>			
L1, L2		2	Inductor

<b>Part Number</b>	<b>Value</b>	<b>Quantity</b>	<b>Comments</b>
<b>Hardware</b>			
CV_INS		1	MTA 0.1" 2-pin header
OUTS		1	MTA 0.1" 3-pin header
SIGNALS		1	MTA 0.1" 4-pin header
POWER		1	MTA 0.156" 4-pin header

# AM8035 Module - ARP Voltage Controlled "moog" Low Pass Filter



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