Analog Metropolis

AM2340
Voltage Controlled
Lag Processor

Project Notes
V1.2

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1 Module Description

This module is a clone of the Voltage Controlled Lag processor in the Eμ Systems Modular.

The Voltage Controlled Lag Processor is a control voltage processing module for delaying and shaping control voltages. With the shape control set to "linear" the module acts as a slew limiter. Whenever the input level changes at a rate faster than the appropriate rate control setting, the output slew rate is limited to that maximum slew rate. Highest accuracy is achieved in this mode, sufficient to use this module for voltage controlled keyboard portamento.

In exponential mode the module acts as a filter with time constant determined by the rate control settings. In this mode it can act as an attack/release transient generator with voltage controlled time constants.

The UP and DOWN rates are independently exponentially voltage controllable from 0.3 to 3000 Volts/second. The initial rates controls set the centre rates; the control inputs are attenuable and vary the rates at a maximum sensitivity of 2V/decade.

INPUTS:	SIGNAL INPUT UP RATE CONTROL INPUT DOWN RATE CONTROL INPUT
OUTPUTS:	SIGNAL OUTPUT
POTENTIOMETERS:	SHAPE UP INITIAL AMOUNT DOWN INITIAL AMOUNT UP RATE DOWN RATE

2 The Original Circuit

The original Revision 1 design dates back to 1974 when Eμ Systems introduced the module. The module was subsequently revised as the Revision 2. This removed the need for DOWN offset trimming.

Here are the specifications:

Slew Rate	= 0.2 to 5000 V/sec
Accuracy (linear, trimmed)	= 2mV
Output Impedance	= less than 1 ohm
Output Short Circuit Duration	= Indefinite

3 The AM Circuit

The AM circuit is a straight copy of the original Eμ Systems Revision 2 design. It uses a SSM dual transistor rather than the obsolete AD820 in the exponential control circuit and I have upgraded the CV Op Amps from LM1458 to modern and more stable LT1013's. The circuit requires the sometimes hard to find CA3046.

The REV01 board has a minor error. A 100pF ceramic capacitor (C7) should be added at the bottom of R1. This can be done by soldering a capacitor to R1 and then connecting the free resistor and capacitor leads to the PCB into the holes of R1.

The UP and DOWN INITIAL AMOUNT controls are counter intuitive, but as per the original design. Maximum lag is counter clockwise, rather than clockwise. Therefore set these pots to the right initially for minimum lag settings.

REV02 is the production board. There are no errors.

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.co.uk). These brackets (and pots) are centred at 40mm apart. The UP RATE and UP INITIAL AMOUNT 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?
INS	Pin 1	Signal Input 1	Jack Socket SIGNAL INPUT
	Pin 2	Signal Input 2	Optional
OUTS	Pin 1	Signal Output	Jack socket SIGNAL OUTPUT
	Pin 2	Signal Output	Not used
DU_IN	Pin 1	Down Input	Jack Socket DOWN INPUT
	Pin 2	Up Input	Jack Socket UP INPUT
DN_RATE	Pin 1	Down Rate Pot	DOWN RATE Pot Pin 1
	Pin 2	Down Rate Pot	DOWN RATE Pot Pin 2
	Pin 3	Down Rate Pot	DOWN RATE Pot Pin 3
DN_AMT	Pin 1	Down Amount Pot	DOWN AMOUNT Pin 1
	Pin 2	Down Amount Pot	DOWN AMOUNT Pin 2
	Pin 3	Down Amount Pot	DOWN AMOUNT Pin 3
SHAPE	Pin 1	SHAPE Pot	SHAPE Pot Pin 1
	Pin 2	SHAPE Pot	SHAPE Pot Pin 2
	Pin 3	SHAPE Pot	SHAPE Pot Pin 3
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 AM2340 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.

The circuit has some selected resistor components to ensure a highly accurate control voltage output for use with VCO's.

R16 and R17 (2K7) need to be matched to 0.1%
R12, R18 and R19 (100k) need to be matched to 0.1%

This can be achieved by buying 50x 1% resistors and checking each one with a DVM until you find a set within 0.1%. Alternatively you can use 0.1% resistors but that's a bit expensive.

R12 (100K 0.1%) is optional. Fit this resistor if you wish to have an additional signal input.

R21 (1K) is optional. Fitting it will reduce the accuracy of the module but enable the output CV to be mixed with other voltages outside the module. It depends whether you want to use the AM2340 for portamento.

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

10 Trimming

This module is simple to set-up; there is just one trimmer to be adjusted.

OFFSET Connect the signal output to a DC meter, ensure the signal input is not connected. Set the UP and DOWN controls to minimum. Adjust the trimmer to give zero volts when there is no signal input. You should be able to adjust the offset to below 1mV even as low as 0.1mV with care.

11 Special Components

The AM2340 makes use of a small number of specialist components:

CA3046

The CA3046 chip is obsolete but it can still be found at specialist electronic suppliers.

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	2	Axial Multi-Layer Polyester
C3, C4	22uF	2	Radial Electrolytic
C5	22pF	1	Low-K Ceramic
C6	100nF	1	Low-K Ceramic
C7	100pF	1	Low-K Ceramic
Resistors			
R1, R22	200	2	1% Metal Film
R2, R4, R5, R21	1K	4	1% Metal Film
R3	1M	1	1% Metal Film
R6	3M3	1	1% Metal Film
R7	2K2	1	1% Metal Film
R8, R9, R13, R15	100K	4	1% Metal Film
R10, R14	330K	2	1% Metal Film
R11	3K	1	1% Metal Film
R20	47K	1	1% Metal Film
R16, R17	2K7	2	0.1% Metal Film
R12, R18, R19	100K	3	0.1% Metal Film
Potentiometers			
DN_AMT, DN_RATE, UP_AMT, UP_RATE	100K LIN	4	SPECTROL 248
SHAPE	10K LIN	1	SPECTROL 248
Trimmers			
OFFSET	1M	1	25 turn cermet trimmer
Semiconductors			
IC1	CA3046	1	Transistor Array
IC2	TL082	1	Dual Op Amp
IC3, IC4	LT1013	2	Dual Precision Op Amp
DT2 (8-pin DIL)	SSM2220	1	Dual Matched Transistors
T1	2N4250	1	Transistor
Passives			
L1, L2		2	Inductor
Hardware			
DU_IN, INS, OUTS		3	MTA 0.1” 2-pin header
POWER		1	MTA 0.156” 4-pin header