

# Analog Metropolis

## AM2350 Transient Generator

### Project Notes V1.0

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## 1 Module Description

This module is a clone of the Dual Transient Generator in the Eμ Modular. I have decided to build it as a single TG rather than dual, to make construction easier.

The Transient Generator has four phases as well as the usual sustain level. Dave Rossum has added Delay to the usual Attack, Decay, Sustain and Release controls. The original 2350s module can be voltage controlled with the 2355, which connects over an internal connection. There is no provision for this on the AM2350.

INPUTS      GATEIN

OUTPUTS    ENVELOPE OUT

POTS        DELAY, ATTACK, SUSTAIN, DECAY, RELEASE

SWITCH     GATEON

LED         GATEON

The front panel controls for the TG consists of DELAY, ATTACK, SUSTAIN, DECAY and RELEASE potentiometers, a GATEON push button. The front panels jacks are GATE IN and envelope CV OUTPUT.

## 2 The Original Circuit

The original Revision 1 design dates back to late 1973, when Eμ Systems introduced the 2350 to replace the existing 2310 and 2320 TG modules. The 1350 sub-module was built from discrete components, and was available without the initial DELAY control as the 1351 sub-module (which was therefore a bit cheaper).

When Dave Rossum redesigned the Modular synthesizer with SSM chips in 1978, the Dual TG was probably reworked with the SSM2050 chip as a Revision 2. It is this design that has been replicated in the AM2350.

The Revision 3 version came out in 1979/1980, and it is based around the SSM2055 TG chip, which has slightly better specifications than the SSM2050, and the sub-module is called the 1352. A separate AM2351 module is available for the SSM2056 chip.

The SSM2050 was used in the original Prophet Rev1 as well as the SCI 700 Programmer and the SSM Voice Card.

### 3 The AM Circuit

The circuit is based around the SSM2050 datasheet and the AM2350 module. I have made some modifications, by adding an output offset trimmer, as the SSM2050 can have 500mV of offset voltage, which can mean the VCA that it is controlling may bleed the audio signal when the TG is inactive.

Earlier AM2350 revisions had a trimmer for adjusting the envelope times to match individual modules (as SSM2050 chips vary in timing by up to 20%), however this proved an unnecessary feature and it has been removed.

The DELAY control is implemented outside the SSM TG chip with a CA3046, a dual Op Amp and some CMOS digital chips. The circuit is easy to replicate and the front panel has manual control of GATE ON, and gate selection between two internal busses of a Modular can be added if desired. There is no separate trigger control. A front panel LED is controlled by the gate signal.

The REV03 schematic 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.oc.uk](http://www.omeg.oc.uk)). These brackets (and pots) are centred at 40mm apart. The ATTACK and DELAY 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?
<b>INS</b>	Pin 1	+15V	SWITCH Pin 2
	Pin 2		
	Pin 3		
	Pin 4		
<b>DECAY</b>	Pin 1	Decay Pot	Decay Pot Pin 1
	Pin 2	Decay Pot	Decay Pot Pin 2
	Pin 3	Decay Pot	Decay Pot Pin 3
<b>SUSTAIN</b>	Pin 1	Sustain Pot	Sustain Pot Pin 1
	Pin 2	Sustain Pot	Sustain Pot Pin 2
	Pin 3	Sustain Pot	Sustain Pot Pin1
<b>RELEASE</b>	Pin 1	Release Pot	Release Pot Pin 1
	Pin 2	Release Pot	Release Pot Pin 2
	Pin 3	Release Pot	Release Pot Pin 3
<b>OUT</b>	Pin 1	CV Output	Jack Socket Envelope Output
	Pin 2	CV Output	Not used
<b>PAD</b>	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 Switches

Switch Name	Pin #	What is it?	Where does it go?
<b>SWITCH</b>	1		
	2		

## 8 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).

## 9 Front Panel

The AM2010 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.

## 10 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 TG. Then proceed to trimming.

## 10 Trimming

This module is simple to set-up.

**OFFSET** The offset trimmer adjusts the inactive envelope output to be as close to 0V as possible. The SSM 2050 has an inactive output voltage of around 100 - 200mV. At low sustain values the SSM2050 output will drop below the initial envelope voltage output by 70 - 80 mV or so. This odd behaviour disappears once higher sustain values above 300mV are used.

Set all controls to minimum and hold the GATE on. Adjust OFFSET so that the output voltage from the module is at or slightly above 0V and never goes negative, even at low SUSTAIN settings. It will not be possible to trim out all the voltage offset, without creating negative voltage envelopes. But you should be able to reduce the offset to 70 - 80mV rather than 100 - 200mV.

## 11 Special Components

The AM2350 makes use of a small number of specialist components:

### SSM2050

The SSM2050 chip is hard to locate, but it can be found, especially on eBay.

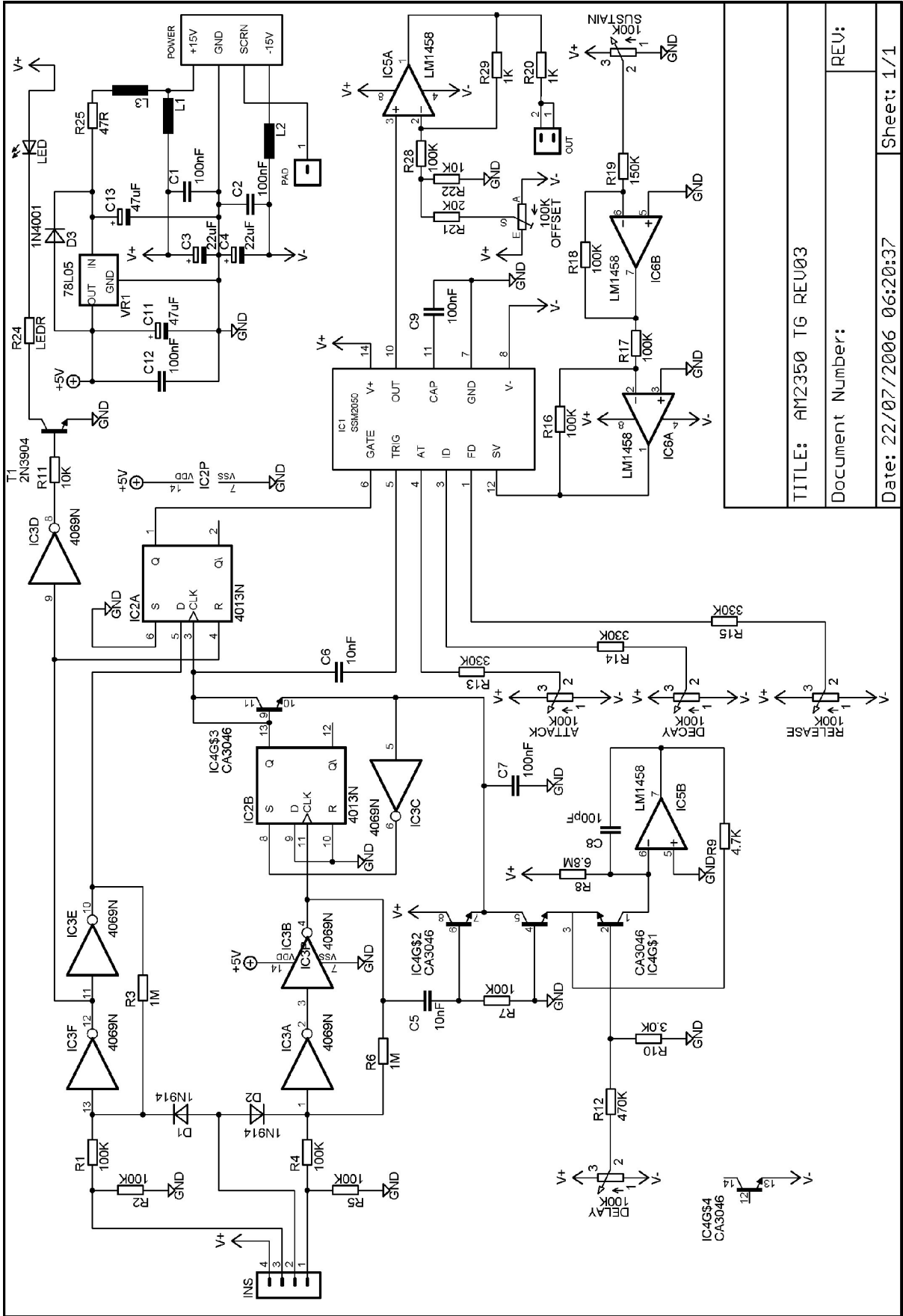
### ECO/Omeg Pot Brackets

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

## 12 Parts Listing

Part Number	Value	Quantity	Comments
<b>Capacitors</b>			
C1, C2, C7, C9, C12	100nF 100V	5	Multi-layer Polyester
C3, C4, C11, C13	22uF 35V	4	Radial Electrolytic
C5, C6	10nF	2	Multi-layer Polyester
C8	100pF	1	Low K Ceramic
<b>Resistors</b>			
R1, R2, R4, R5, R7, R16, R17, R18, R28	100K	9	1/4W 1% metal film
R3, R6	1M	2	1/4W 1% metal film
R8	6M8	1	1/4W 1% metal film
R9	4K7	1	1/4W 1% metal film
R10	3K	1	1/4W 1% metal film
R11, R22	10K	2	1/4W 1% metal film
R12	470K	1	1/4W 1% metal film
R13, R14, R15	330K	3	1/4W 1% metal film
R19	150K	1	1/4W 1% metal film
R20, R29	1K	2	1/4W 1% metal film
R21	20K	1	1/4W 1% metal film
R24	LEDR <sup>1</sup>	1	1/4W 1% metal film
R25	47R	1	1/4W 1% metal film
<b>Potentiometers</b>			
DELAY, ATTACK, DECAY, SUSTAIN, RELEASE	100K LIN	5	Spectrol 248
<b>Trimmers</b>			
OFFSET	100K	1	25 turn cermet trimmer
<b>Passives</b>			
L1, L2, L3		3	Inductor
LED		1	Red LED
<b>Semiconductors</b>			
IC1	SSM2050	1	TG chip
IC2	HEF4013N	1	Philips HEF CMOS
IC3	HEF4069N	1	Philips HEF CMOS
IC4	CA3046	1	Transistor Array
IC5	LT1013	2	Dual Op Amp, low offset
IC6	LM1458	2	Dual Op Amp
T1	2N3904	1	Transistor
VR1	78L05	1	Voltage Regulator
D1, D2	1N914	2	Signal Diode
D3	1N4001	1	Diode
<b>Hardware</b>			
INS		4	0.1" MTA 4-Pin Header
LED, OUT		2	0.1" MTA 2-Pin Header
POWER		1	0.156" MTA 4-Pin Header
SWITCH		1	Push Button Switch

<sup>1</sup> Value depends on LED used, 1k – 10K.



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