

Analog Metropolis

AM2470 Dual Low Frequency Oscillator

Project Notes V1.0

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1 Module Description

This module is a clone of the Low Frequency Oscillator section of the Ep Modular 2451 Potpourri module. It has two identical LFO's, each with square and triangle waveforms, a frequency control and two level controls. Whilst this is not the most exciting LFO, with just two waveforms, but it is simple and effective.

INPUTS:	none
OUTPUTS:	LFO1 – TRIANGLE LFO1 – SQUARE LFO2 – TRIANGLE LFO2 – SQUARE
POTENTIOMETERS:	LFO1 - FREQUENCY LFO1 – TRIANGLE LEVEL LFO1 – SQUARE LEVEL LFO2 – FREQUENCY LFO2 – TRIANGLE LEVEL LFO2 – SQUARE LEVEL
LED's:	LFO1 – RATE LFO2 - RATE

2 The Original Circuit

The Ep Systems analog modular synthesizer originally used wide ranging VCO's which could be set as sub-sonic LFO's, just like Moog and ARP. However in March 1976 Dave Rossum created a multi-purpose module - the Potpourri (2451), which included a LFO as well as analog and digital inverters.

The circuit is quite traditional, and uses a 741 Op Amp, 556 and 558 Op amps. The frequency range is from 0.02Hz to 50Hz.

3 The AM Circuit

The AM circuit uses the same schematic as the original, but has NE5532 Op Amps instead of the impossible to get 556/558. I have added a simple LED drive circuit from the square wave. The frequency range from the prototype is 0.06 Hz to 32Hz, and the waveforms are clean.

The REV03 board is the production board. There are no errors, however it is advisable to add a diode across the LED's – see the build instructions.

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?
OUTS1	Pin 1	Square Output 1	Jack Socket SQUARE OUT 1
	Pin 2	Triangle Output 1	Jack Socket TRIANGLE OUT 1
OUTS2	Pin 1	Square Output 2	Jack Socket SQUARE OUT 2
	Pin 2	Triangle Output 2	Jack Socket TRIANGLE OUT 2
TRI1	Pin 1	Triangle Level 1 Pot	TRIANGLE LEVEL 1 Pot Pin 1
	Pin 2	Triangle Level 1 Pot	TRIANGLE LEVEL 1 Pot Pin 2
	Pin 3	Triangle Level 1 Pot	TRIANGLE LEVEL 1 Pot Pin 3
TRI2	Pin 1	Triangle Level 2 Pot	TRIANGLE LEVEL 2 Pot Pin 1
	Pin 2	Triangle Level 2 Pot	TRIANGLE LEVEL 2 Pot Pin 2
	Pin 3	Triangle Level 2 Pot	TRIANGLE LEVEL 2 Pot Pin 3
SQR2	Pin 1	Square Level 2 Pot	SQUARE LEVEL 2 Pot Pin 1
	Pin 2	Square Level 2 Pot	SQUARE LEVEL 2 Pot Pin 2
	Pin 3	Square Level 2 Pot	SQUARE LEVEL 2 Pot Pin 3
FREQ2	Pin 1	Frequency 2 Pot	FREQUENCY 2 Pot Pin 1
	Pin 2	Frequency 2 Pot	FREQUENCY 2 Pot Pin 2
	Pin 3	Frequency 2 Pot	FREQUENCY 2 Pot Pin 3
LED1	A	LFO 1 RATE LED	LED1 Anode
	C	LFO 1 RATE LED	LED1 Cathode
LED2	A	LFO 2 RATE LED	LED2 Anode
	C	LFO 2 RATE LED	LED2 Cathode
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 AM2470 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 LED driver circuit is very simple, in fact too simple. Reverse voltages can get into the LED causing it to fail. So a IN4148 or 1N914 diode should be soldered onto the rear of the PCB on each LED connector, connect this in the reverse of the LED. This protects the LED. Future revisions will add a proper Op Amp buffered LED driver.

Power up and try out the module.

10 Trimming

There is no trimming on this module.

11 Special Components

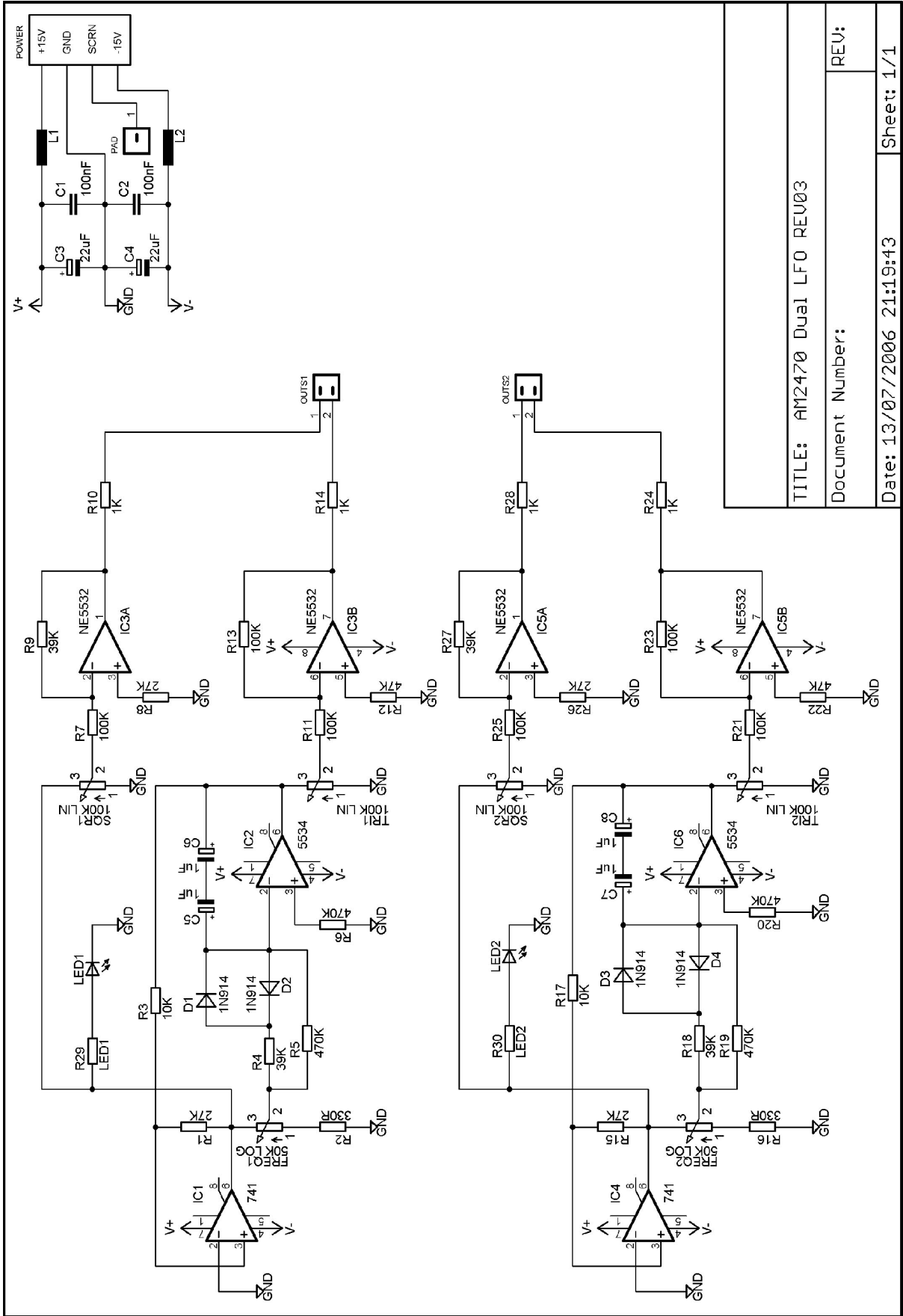
AM2470 makes use of:

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 63V	2	Axial Multi-Layer Polyester
C3, C4	22uF 25V	2	Radial Electrolytic
C5, C6, C7, C8	1uF 25V	4	Radial Electrolytic
Resistors			
R1, R8, R15, R26	27K	4	1% Metal Film
R2, R16	330R	2	1% Metal Film
R3, R17	10K	2	1% Metal Film
R4, R9, R18, R27	39K	4	1% Metal Film
R5, R6, R19, R20	470K	4	1% Metal Film
R7, R11, R13, R21, R23, R25	100K	6	1% Metal Film
R10, R14, R24, R28	1K	4	1% Metal Film
R12, R22	47K	2	1% Metal Film
Potentiometers			
SQR1, SQR2, TRI1, TRI2	100K LIN	4	SPECTROL 248
FREQ1, FREQ2	50K LOG	2	SPECTROL 248
LED's			
LED1, LED2		2	LED's
Semiconductors			
IC1, IC4	741	2	Single Op Amp
IC2, IC6	NE5534	2	Single Op Amp
IC3, IC5	NE5532	2	Dual Op Amp
Passives			
L1, L2		2	Inductor
Hardware			
OUTS1, OUTS2		3	MTA 0.1" 2-pin header
POWER		1	MTA 0.156" 4-pin header



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