

Analog Metropolis

AM2430 Ring Modulator

Project Notes V1.0

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1 Module Description

This module is a typical implementation of the MC1496 Balanced Modulator chip (as used in Roland 100M and other late 80's synthesizers). It echoes the E-mu Systems modular design by having attenuation on both inputs and AC/DC mode switches that switch back to back 1uF capacitors in and out of the signal paths.

INPUTS: CARRIER, MODULATOR

OUTPUTS: AUDIO OUTPUT

POTS: MODULATION, CARRIER, LFO RATE

SWITCHES: MODULATION AC/DC, CARRIER AC/DC,
LFO HIGH/LOW RANGE, LFO WAVFORM TRI/SQUARE

2 The Original Circuit

E-mu Systems made a Ring Modulator module – the 2430. This was a discrete transistor design that uses rare dual transistors and it has minimal facilities. This circuit will be replicated at some time in the future.

3 The AM Circuit

Rather than replicate this unique design, I have chosen to use a MC1496 chip, then added DC and AC coupling like the original Dave Rossum Ring Modulator. I also added a simple on-board LFO which provides triangle and square waveforms across 2 ranges, with a LED driven off the triangle waveform.

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 MODULATION and CARRIER 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?
MOD_IN	Pin 1	Mod AC Input	Modulator AC/DC switch upper
	Pin 2	Mod DC Input	Modulator AC/DC switch lower
			Centre pole of switch to Modulator input Jack Socket
CARR_IN	Pin 1	Carrier AC Input	Carrier AC/DC switch upper
	Pin 2	Carrier DC Input	Carrier AC/DC switch lower
			Centre pole of switch to Carrier input Jack Socket
OUT	Pin 1	RM Output	RM Output Jack Socket
	Pin 2	RM Output	Not Used
LFO_SW	Pin 1	LFO range	LFO RANGE Switch Centre
	Pin 2	Slow Range	LFO RANGE Switch Upper
	Pin 3	Fast Range	LFO RANGE Switch Lower
LFORATE	Pin 1	LFO RATE Pot	LFO RATE Pot Pin 1
	Pin 2	LFO RATE Pot	LFO RATE Pot Pin 2
	Pin 3	LFO RATE Pot	LFO RATE Pot Pin 3
LFO	Pin 1	Triangle LFO out	LFO Wave Switch Lower
	Pin 2	Square LFO out	LFO Wave Switch Upper
LED1	Pin1	LFO LED Anode	LFO LED Anode
	Pin 2	LFO LED Cathode	LFO LED 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 AM2430 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.

Power up and try out the ring modulator. Then proceed to trimming.

10 Trimming

Trimming the balanced modulator is important and is accomplished as follows:

Apply a 1 kHz sine or triangle waveform to the CARRIER input only, and then adjust CARR_TRIM for minimum output. Then apply a signal to the MODULATOR input only, and then adjust MOD_TRIM for minimum output.

It should be possible to trim the feed through to be around 10mV (-60dB, ref 10V input) for the CARRIER input and around 40mV (-48dB, ref 10V input) for the MODULATOR input.

11 Special Components

ECO/Omeg Pot Brackets

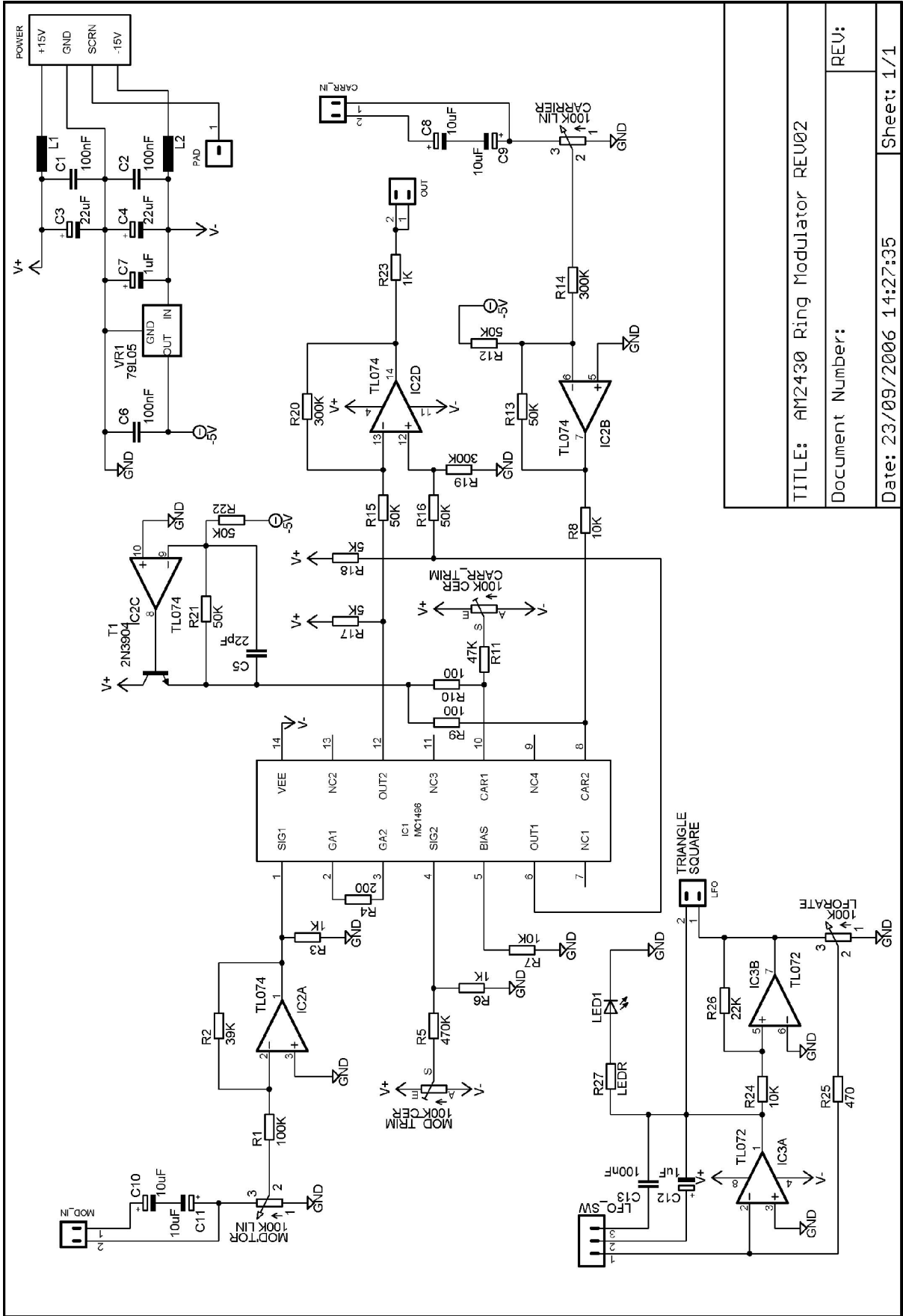
These can be obtained from Omeg in the UK. <http://www.omeg.co.uk/>. Oakley have them in stock again, and I stock them too.

12 Parts Listing

Part Number	Value	Quantity	Comments
Capacitors			
C1, C2, C6, C13	100nF 100V	4	Multi-layer Polyester
C3, C4	22uF 35V	2	Radial Electrolytic
C7, C12	1uF 25V	2	Radial Electrolytic
C5	22pF 100V	1	Low-K Ceramic
C8, C9, C10, C11	10uF 25V	4	Radial Electrolytic ¹
Resistors			
R1	100K	1	1% Metal Film
R2	39K	1	1% Metal Film
R3, R6, R23	1K	3	1% Metal Film
R4	200	1	1% Metal Film
R5	470K	1	1% Metal Film
R7, R8, R24	10K	3	1% Metal Film
R9, R10	100	2	1% Metal Film
R11	47K	1	1% Metal Film
R12, R13, R15, R16, R21, R22	50K	6	1% Metal Film
R14, R19, R20	300K	3	1% Metal Film
R17, R18	5K	2	1% Metal Film
R25	470	1	1% Metal Film
R26	22K	1	1% Metal Film
R27	LEDR ²	1	1% Metal Film
Potentiometers			
CARRIER, MODULATOR	100K LIN	3	BOURNS 91 or SPECTROL 248
LFO_RATE	10K LIN	1	BOURNS 91 or SPECTROL 248
Semiconductors			
IC1	MC1496N	1	Balanced Modulator
IC2	TL074N	1	Op Amp
IC3	TL072N	1	Op Amp
T1	2N3904	1	Transistor
VR1	79L05	1	Voltage Regulator
Passives			
L1, L2		2	Inductor
LED1		1	LED
Hardware			
CARR_IN, LFO_OUT, MOD_IN, OUT		4	MTA 0.1" 2-pin header
LFO_SW		1	MTA 0.1" 3-pin header
POWER		1	MTA 0.156" 4-pin header

¹ High quality Audio Capacitors should be used such as Panasonic M series ECA Model.

² Value depends on LED used.



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