Analog Metropolis

AM8105
Super JX VCF & VCA

Project Notes
V1.0

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1 Module Description

This module is a clone of the 24dB Low Pass Filter and Voltage Controlled Amplifier in the Roland JX-8P. The circuit is based around the Roland IR3R05 chip which first appeared in the MKS80 REV5 replacing the IR3109 and CEM3360, and then made its way into the JX-8P, MKS70, JX10 and Alpha Junos. The filter and VCA was usually followed by a 1-pole High Pass Filter in these polyphonic analog synthesizers.

The IR3R05 was the final analog filter chip designed by Roland, prior to the arrival of digital filter technology in 1985 and the D50. The 14-pin DIL chip contains two 2-pole State Variable Filters configured as a 4-pole Low Pass filter only. The chip has external capacitors with two internal VCA; one for voltage controlled Resonance and one as the final VCA in the signal chain - with both Exponential and Linear voltage control. The IR3R05 is probably based on the IR3109 OTA components but wired on the chip die as 2x SVF.

The chip replaced two IR3109 in the MKS80, which were configured as state variable filters, but both running as 2-pole Low Pass filters. The change to the IR3R05 chip was to eliminate the waveform clipping when the IR3109 filters were used in Unison mode. The IR3R05 does not go into self oscillation at high Resonance levels, this is a deliberate design by Roland to stop distortion and to provide a smoother sound. In the Jupiter 6 the two IR3109's are configured together to provide BP, LP and HP modes - from the same circuit topology as the MKS80.

The JX-8P and MKS70 have a High Pass Filter after the VCA, in fact this is the same filter as used in the Juno 106, with a Bass Boost as the first HPF setting. The MKS80 also uses the same bass boost circuit.

2 The AM8105 Circuit

The design uses 2x PCB's;

- AM8105 VCF contains the VCF, VCA and CMOS logic.
- AM8105 POTS contains the op amp buffers and voltage reference.

The PCB's are interlinked with a 16 way ribbon cable, and the jack sockets are connected via a 10 way ribbon cable.

The two audio inputs are summed and go via an Op Amp buffer which drops the signal level down for the IR3R05 chip. The Frequency, Resonance and linear VCA gain are controlled by CV's generated using Op Amp buffers that reduce the voltages down to the correct levels, the GAIN CV is derived from a high quality +10V reference chip.

The Resonance pot will take the filter into self-oscillation, although this can cause distortion and you may want to reduce the Resonance level and/or the VCA Gain.

The VCA is controlled in level by the GAIN pot, or by a signal plugged into ENV jack socket, such as a positive going envelope.

The VCF and VCA circuits a followed by a 4 mode high pass filter, which has two high pass cut off ranges, one flat frequency response and a bass boost. The filter mode is selected using a momentary push button switch which latches a 4013 flip flop driving one half of a 4052 analog switch chip. The LED's use the other half of the 4052 switch.

The module has the following front panel controls:

INPUTS: SIGNALA, SIGNALB
CV1, CV2, ENV

OUTPUTS: AUDIO SIGNAL

POTS: SIGNAL A, SIGNAL B,
FREQUENCY, RESONANCE
GAIN/ENV, CV1, CV2

SWITCH: HIGH PASS FILTER MODE

LEDS: 4x LED's indicate high pass filter mode

REV01 are production boards. There are 4 corrections; R9 is not fitted, R7 is Zero Ohms/wire link, D2 and D3 do not need to be fitted.

3 Front Panel Format

The AM8105 is designed to be used with a standard 14HP EuroRack panel, but it can be used in FracRac or 5U height modules.

There are six 3.5 mm jack sockets mounted on the left hand side of the panel, these are:

- Signal Inputs (x2)
- VCF CV Inputs (x2)
- VCA Input
- Signal Output

4 PCB, Pots and Power

The PCB's are high quality, double sided with solder mask, component names are shown in the silk screen but not the component values. The size of the VCF PCB is 80mm x 100mm, and the POTS PCB is 50mm x 100mm.

The PCB's are held to the front panel at 90 degrees by the use of three pot brackets (available from Omeg). 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 module should be powered from a well regulated +12V and -12V power supply, current consumption is around 25mA. The power connector is the standard 10-pin Doepfer connector. The circuit will also work on 15V.

5 PCB Connections

The PCB's are inter-connected using 16 way ribbon cable and a 10 way ribbon cable to either an AMSynths Jack PCB or to individual jack sockets. Refer to the schematics for details.

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. This is highly recommended given we are using a rare IR3R05.

Power up and try out the filter. Then proceed to trimming. Job done!

Please remember that the GAIN/ENV pot will need turning up for the module to make any sounds.

7 Trimming

This module has one trimmer 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 to minimum and connect a VCO output of around 80Hz to a filter input with the SIGNAL pot at maximum. Monitor the filter audio output and adjust FTRIM so that the FREQ pot cuts off the signal at low values, or to taste.

8 Special Components

The AM8105 makes use of a small number of specialist components:

IR3R05

This chip can be occasionally found on eBay.

Push Switch

The module uses a PCB mounted Omron B3F-3155 Momentary Push button switch and a round red button.

6X6MM 6.15MM 260GF SQ TACT SWITCH R/A RC

Pot Bracket

ECO pot brackets can be obtained from Omeg in the UK.
http://www.omeg.co.uk/

9 Parts Listing

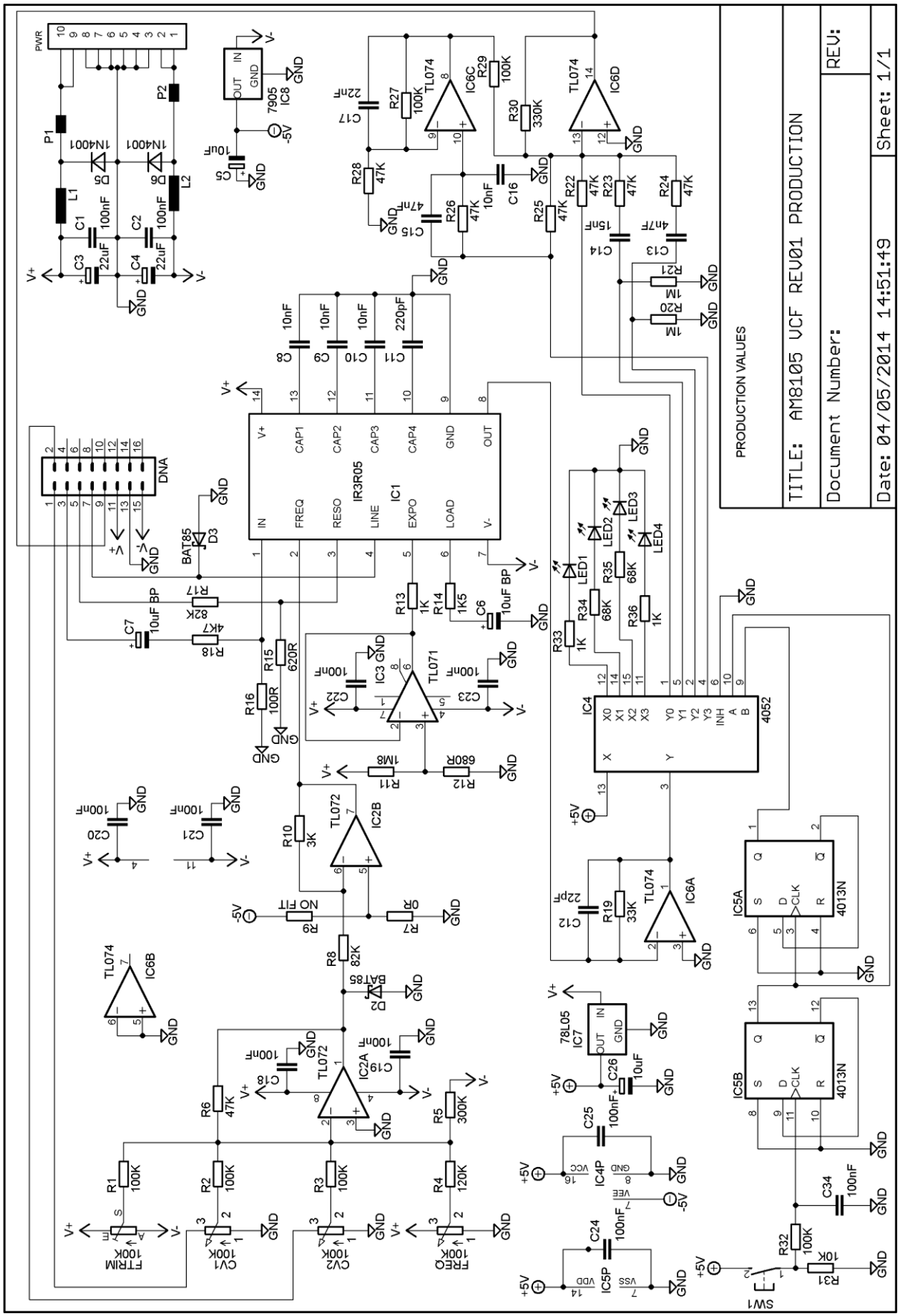
VCF PCB			
Part Number	**Value**	**Quantity**	**Comments**
Capacitors			5mm spacing unless noted
C1, C2, C18, C19, C20, C21, C22, C23, C24, C25	100nF	10	Ceramic 2.5mm spacing
C3, C4	22uF 25V	2	Radial Electrolytic 2.5mm spacing
C5, C6, C26	10uF 25V	3	Radial Electrolytic 2.5mm spacing
C7	10uF 25V	1	High Quality Audio Radial Electrolytic 2.5mm spacing
C8, C9, C10	100nF	3	High quality 5% Polypropylene
C11	220pF	1	High quality 5% Polypropylene
C12	22pF	1	Low-K Ceramic 2.5mm spacing
C13	4n7F	1	High quality Polyester
C14	15nF	1	High quality Polyester
C15	47nF	1	High quality Polyester
C16	10nF	1	High quality Polyester
C17	22nF	1	High quality Polyester
C34	100nF	1	Polyester
Resistors			All 1% Metal Film
R1, R2, R3, R27, R29, R32	100K	6	
R4	120K	1	
R5	300K	1	
R6, R22, R23, R24, R25, R26, R28	47K	7	
R7	0R	1	ZERO OHM RESISTOR OR A WIRE LINK
R8, R17	82K	2	
R9	NO FIT	1	DO NOT FIT A RESISTOR
R10	3K	1	
R11	1M8	1	
R12	680R	1	
R13, R33, R36	1K	3	
R14	1K5	1	
R15	620R	1	
R16	100R	1	
R18	4K7	1	
R19	33K	1	
R20, R21	1M	2	

R30	330K	1	
R31	10K	1	
R34, R35	68K	2	
Potentiometers			
CV1, CV2, FREQ	100K LIN	3	Alpha 16mm
FTRIM	100K	1	3006 type 25 turn cermet trimmer
Semiconductors			
D2,D3	BAT85	2	DO NOT FIT
D5,D6	1N4001	2	Diode
IC1	IR3R05	1	VCF chip
IC2	TL072	1	Dual Op Amp
IC3	TL071	1	Single Op Amp
IC4	HEF4052	1	Single Op Amp
IC5	HEF4013N	1	MUST be HEF
IC6	TL074	1	Quad Op Amp
IC7	78L05	1	Voltage Regulator
IC8	79L05	1	Voltage Regulator
Passives			
L1, L2	1uH	2	Inductor
P1, P2	50V 170mA	2	PolyFuse
Hardware			
SW1		1	Omron B3F Push Switch
LED1		1	3mm Green LED
LED2, LED3		2	3mm Blue LED
LED4		1	3mm Red LED
DNA		1	16pin DIL Header
POWER		1	10pin DIL Header

POTS PCB

Part Number	Value	Quantity	Comments
Capacitors			
C1, C2, C5, C7, C8, C9, C10	100nF	7	Ceramic 2.5mm spacing
C3, C4	10uF 25V	2	Radial Electrolytic 2.5mm spacing
C6, C11	22pF	1	Low-K Ceramic 2.5mm spacing
Resistors			All 1% Metal Film
R1, R3, R5, R6, R7, R10	100K	6	
R2	18K	1	
R4	51K	1	

R8	10K	1	
R9	1K	1	
Potentiometers			
RESO, GAIN	100K LIN	2	Alpha 16mm
SIGNALA, SIGNALB	100K LOG	2	Alpha 16mm
Semiconductors			
IC1	REF01	1	10V
IC2, IC3	TL072	2	Dual Op Amp
Hardware			
DNA		1	16pin DIL Header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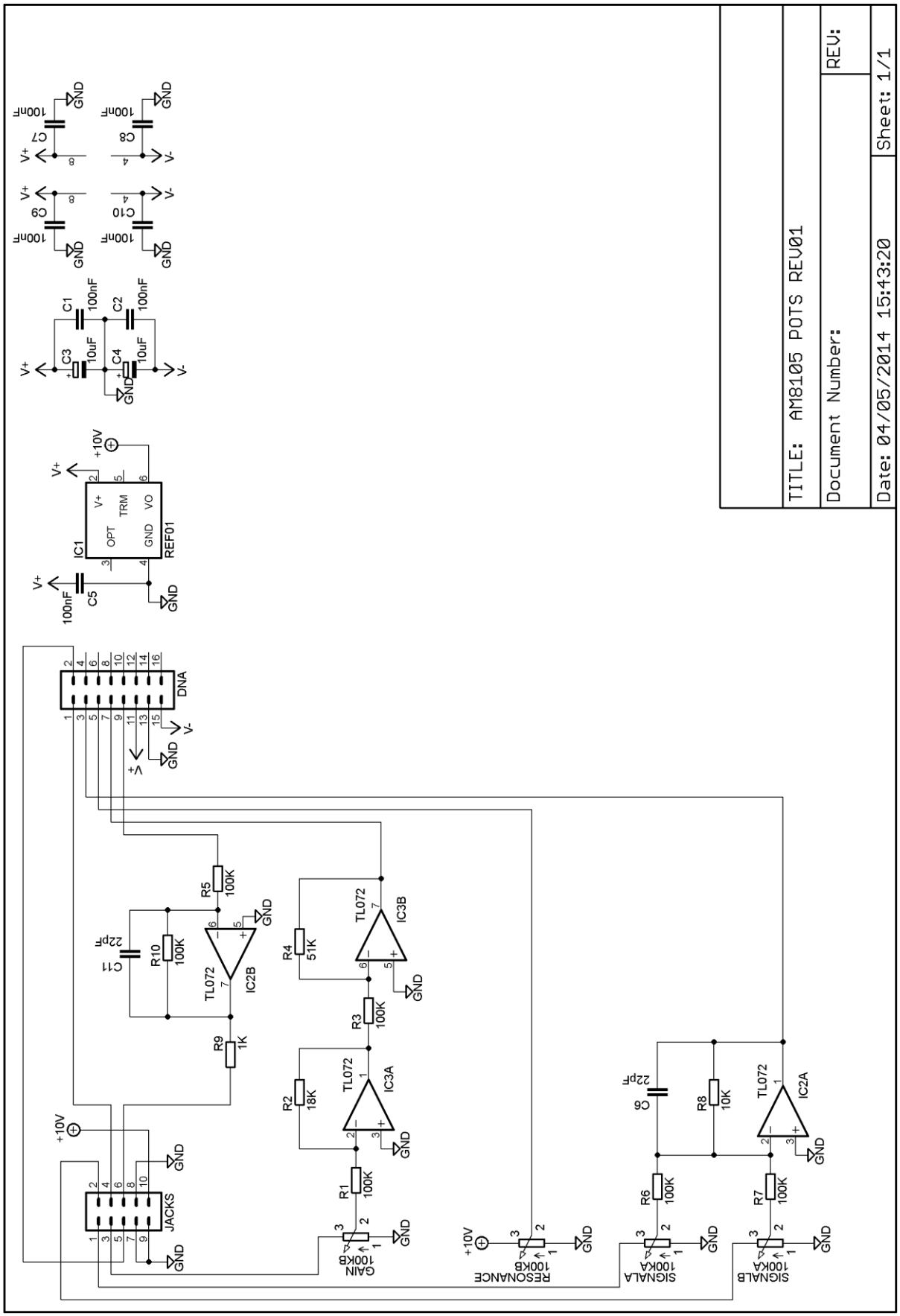
LED3
LED4
SW1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C10 100nF
C11 22pF
IC1 REF01
IC2A TL072
IC2B TL072
IC3A TL072
IC3B TL072
R1 100K
R2 18K
R3 100K
R4 51K
R5 100K
R6 100K
R7 100K
R8 10K
R9 1K
R10 100K
DNA
JACKS
GAIN 100KB
RESONANCE 100KB
SIGNALA 100KA
SIGNALB 100KA
+10V
V+
V-
GND