

WASP SYNTHESISER

ELECTRONIC DREAM PLANT LTD

TEST INSTRUCTIONS - WASP

Visual Inspection.

1. Check p.c.b. for soldering faults, particularly:
 - top soldering on all i.c.s
 - soldering on pots (partic middle pin of GLIDE pot)
 - GLIDE pot wiring reversed
 - top soldering on regulator middle pin
2. Check i.c.s for reversal.
3. Check electrolytics for reversal (partic in GLIDE circuit).

Initial Settings.

4. Set controls as follows. "Off" means fully anti-clockwise, "on" means fully clockwise.

BEND	central	GLIDE	off
OCT 1 (5)	central	OCT 2 (5)	central
PW	central	PITCH	3/4 on
SELECT (3)	central	SELECT (3)	central
LFO FREQ	on	NOISE	off
PITCH MOD	off	LFO SEL (6)	off
FILT FREQ	on	LFO FILT CONT	central
Q	off	ENV FILT CONT	central
ATTACK	off	ATTACK 2	off
DECAY	off	DECAY 2	off
SUSLEV	on	DELAY	just above click
VOLUME	on		

FILT SEL (3) off and all presets central, except for KBD SENS which should be fully on. Check for correct number of ways in each switch (in brackets).

Power Consumption.

5. Apply power (+9 volts, current limited to 500 mA). Check current consumption; this should lie in the range of 42 to 52 mA. If it is about 100 mA check for a reversed regulator. If 200 mA or more check for regulator output shorted to earth (e.g. bridged decoupling capacitor).
6. If current is low check for +5 volt supplies throughout the circuit, looking for dry joints wherever the power rail passes from one side of the board to the other.

Preliminary Keyboard Setup.

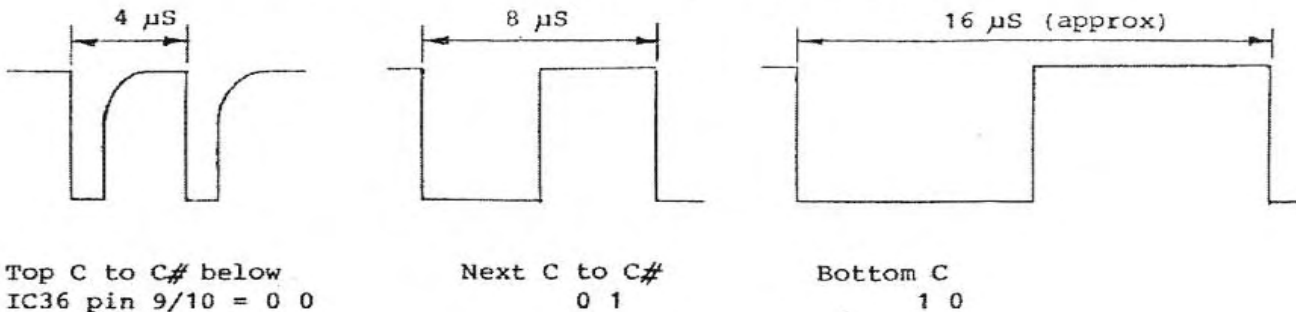
7. Check for presence of keyboard scanning clock on IC5 pin 8. If absent check oscillator (IC35) and components. The period should be 35 - 45 μ S; if C45 is a 10 nF by mistake the whole unit will behave as if the VCA Envelope Generator is switched to "repeat".
8. Scope probe on TRIG output from keyboard should show a CMOS-level narrow negative-going pulse of period 20 mS. If not found check for successive division of clock in IC32 then proceed to check circuitry around IC35. The WASP should self-trigger with the KBD SENS control fully on.
9. Turn down the KBD SENS control and at some point the TRIG signal should disappear. It may be necessary to increase R140 temporarily to 91k or 100k. (The final value can be selected when the keyboard overlay is applied). Now touching any key with one fingertip should produce a TRIG pulse again.
10. Touch all other keys and check that the m/s ratio of the TRIG waveform changes from very narrow positive for the lowest note up to very narrow negative for the highest note. The period should remain at about 20 mS. Note that some "jumps" in the m/s ratio are larger than average. This is because the keyboard coding runs from 0 to 11 for one octave then jumps to 16 for the next octave (see coding chart below).

Oscillator Checks.

11. Check pin 3 or 4 on IC7 (the PLL for Oscillator 1) for a square wave output whose frequency will depend on the last key touched. The output should persist even when the key is released.

If no output is found check pin 14 (input) of IC7 for a narrow negative-going pulse of the same frequency as the expected output. This is approx 2 kHz for the top note, 250 Hz for the bottom note.

If there is no input to IC7 check for an input (pin 1) on IC25. This should be either the master oscillator (IC2) output at 250 kHz, or this signal divided by 2 or by 4 in IC24, depending on which octave is being played. See the diagram below.



These signals are selected in IC36 depending on the 2-bit code presented at pin 9 and pin 10 of this IC, as shown in the figure.

IC26 is "programmed" by the eight inputs on pins 13-10 and 7-4, to divide the selected signal by the factors shown in the table below. If these factors are grossly too low (e.g. if pin 13 and pin 12 were to stick low) then the input to IC7 is outside the lock range of that PLL and the output from IC7 will remain at about 3 kHz, whatever key is played.

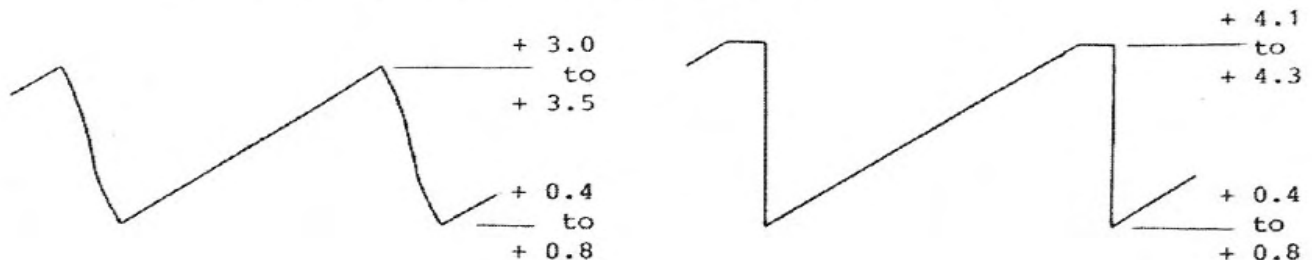
The block of logic below IC26 on the circuit diagram converts the binary code generated by the keyboard, and latched in IC30, to the correct division factors for IC25 and IC26. For reference, the latched outputs from IC30 are also shown in the table.

If a keyboard coding fault is apparent and the cause cannot be revealed by visual inspection, check the outputs from IC30 as the top 12 notes are played, followed by one note from each lower octave. This will help to localise the fault in either IC30 and earlier, or in the conversion logic (IC27, 28, 29, 40, 41).

KEY HELD	OUTPUTS from IC30						hex	DIVISION FACTORS								hex
	pin 15	12	10	7	5	2		13	12	11	10	7	6	5	4	
Top C	0	0	0	0	0	0	00	0	1	1	1	1	0	1	0	7A
B below	0	0	0	0	0	1	01	1	0	0	0	0	0	0	1	81
A# below	0	0	0	0	1	0	02	1	0	0	0	1	0	0	1	8A
A below	0	0	0	0	1	1	03	1	0	0	1	0	0	0	1	91
G# below	0	0	0	1	0	0	04	1	0	0	1	1	0	1	0	9A
G below	0	0	0	1	0	1	05	1	0	1	0	0	0	1	1	A3
F# below	0	0	0	1	1	0	06	1	0	1	0	1	1	0	1	AD
F below	0	0	0	1	1	1	07	1	0	1	1	0	1	1	1	B7
E below	0	0	1	0	0	0	08	1	1	0	0	0	0	1	0	C2
D# below	0	0	1	0	0	1	09	1	1	0	0	1	1	1	0	CE
D below	0	0	1	0	1	0	0A	1	1	0	1	1	0	1	0	DA
C# below	0	0	1	0	1	1	0B	1	1	1	0	0	1	1	1	E7
C below	0	1	0	0	0	0	10	0	1	1	1	1	0	1	0	7A
and so on, until																
Bottom C	1	0	0	0	0	0	20	0	1	1	1	1	0	1	0	7A

Note that a reversed electrolytic in the PLL damping circuit can prevent IC7 from oscillating.

- Repeat Step 11 for pin 3 or 4 on IC14.
- Check IC10 pin 10 for a ramp output (rising sawtooth) as shown below. All levels are marked in VOLTS.



The period of this waveform is determined by the key pressed and the setting of the Footage switch S1. Switch to the 2-foot range and press the highest key to observe a waveform as on the LHS above, then switch to the 32-foot range and press the lowest key to see a waveform as on the RHS.

There may be top clipping for up to 10% of the period on the lowest frequency. If clipping is severe (up to 80% of the period) then the KEYBOARD VOLTAGE which defines the integrator input current may be stuck high. This is pin 9 on IC10 and should vary from about + 1.40 volts for the lowest key to about + 3.30 volts for the highest key, independent of footage. Some ripple will be observed.

If IC10 pin 10 shows an output for some footages but not for others, check for the relevant squarewave outputs from IC8.

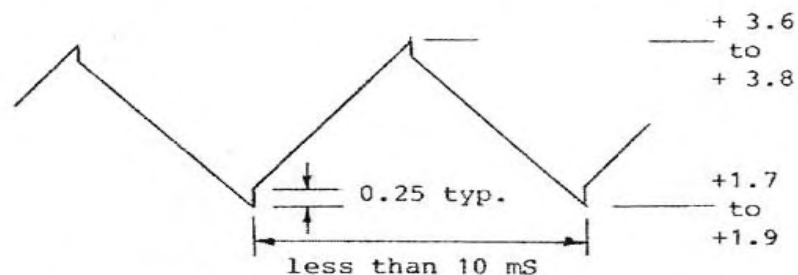
If there is no output for any footage visually inspect around IC10 and also check for the presence of a narrow (width approx 30 uS) positive pulse from the output of IC16 pin 13. This is necessary to discharge the integration capacitor C22.

If the sawtooth does not fall far enough (for example, not below + 2 volts) check the width of the discharge pulse; if this is significantly less than 20 uS then C22 may not be sufficiently discharged by the analogue switch IC17.

14. Repeat Step 13 for pin 4 on IC10.

Low-Frequency Oscillator Setup.

15. Put scope probe on the bottom end of R107 (33k resistor by IC18). A "sinewave" output should be observed as below (note that if PR4 is set too far towards either end of its range the LFO will not operate):



Note that as the LFO FREQ is lowered the switching transients will reduce. (This is not however true of the ramp waveforms produced by this circuit).

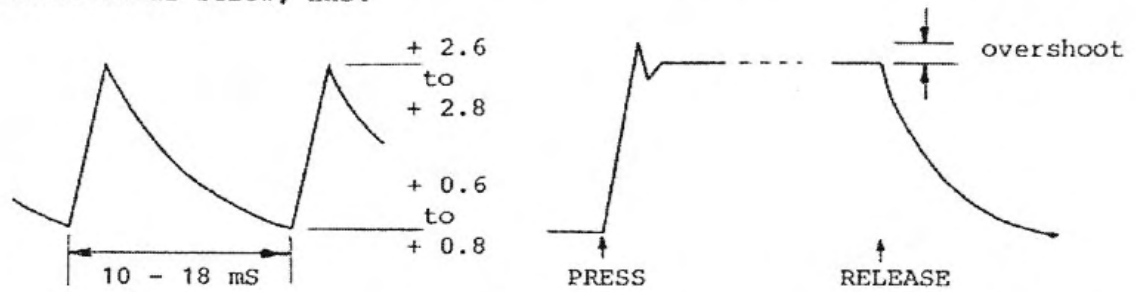
16. Switch LFO SEL (S5) to the fourth position clockwise and observe a squarewave output, amplitude as for "sine", decreasing at the higher frequencies. Adjust PR4 for unity m/s ratio (not excessively critical).
17. Set LFO SEL to all other positions and check for: rising and falling sawtooth and sampled noise (limits about 1.3 - 3.9 volts) and noise (2.1 - 3.5 volts). If sampled noise amplitude is too low but noise is correct, C37 may be 10nF.

18. Check that the maximum frequency available from the LFO exceeds 100 Hz (i.e. the waveform period is less than 10 ms).
19. Leave the LFO SEL set on "sine" wave.

VCA Envelope Generator Check.

20. Scope probe on bottom end of R38 (top RH corner of main pcb by IC6). It may be easier to solder a stub of wire to the top-most tag of the SUS LEVEL control, VR9, and connect to this.

Switch the SUS LEV control to "repeat" by turning it off past the click. Press and hold any key. A repetitive waveform should be observed as below, LHS.



If no output is observed check visually around IC12 and check the voltages on this IC. Pins 2 and 3 should go no higher than + 0.7 volts since IC12 is a current-difference amplifier and its inputs look like forward-biased diodes.

If pin 2 is at 0 volts and pin 3 at + 0.6 volts but the output of IC12 is unexpectedly high do not immediately suspect IC12 but check for a dry joint in R76 or VR8 since the lack of a decay path can result in the output of IC12 being stuck high.

To function this circuit needs to receive repetitive positive clock pulses from IC21. These set IC20 pin 13 high which causes the "attack" phase. This terminates when IC12 pin 4 crosses the switching threshold (approx + 2.5 volts) of the inverter IC22 pin 11-10. This forces a reset of IC20 (pin 12 high) and starts the "decay" phase.

If the switch on VR9 is closed the SET input to IC20 will be permanently inactive, so the circuit operates in "single-shot" mode. Opening the switch means that when the output of IC12 decays below approximately + 0.7 volts Tr4 turns off and forces IC30 to set, thus initiating another "attack" phase. The circuit will continue in this "repeat" mode until the key is released, removing the SET and applying a RESET to IC30.

21. Turn up the ATTACK and DECAY controls (VR7, VR8) and observe their effects on the leading and trailing edges of the waveform. Check that the circuit still oscillates with DECAY up full; if not, shunt VR8 with 3M3 or 2M2.

22. Turn the SUS LEVEL control (VR9) fully on. This has an effect only in "single-shot" mode and allows a note to be sustained at a level varying from zero (full decay) to peak amplitude (no decay until the note is released).

With VR9 turned right down its slider is positioned on IC12 pin 4 and Tr3 is always ON, which inhibits the sustain. As VR9 is turned on its slider moves towards R85. Now Tr3 will start to turn OFF at some point in the "decay" phase. This turns on the transmission gate pins 10-11 of IC19, injecting current into pin 2 of IC12 to stop the decay process (it also inhibits the usual decay path via IC21 pin 10).

A linear feedback loop is established with the result that the output from IC12 pin 4 remains at the preset sustain level until the key is released, when IC21 pin 13 drops and removes the supply to Tr3. A "decay" phase now occurs. Pin 12 on IC21 ensures that Tr3 cannot function during the "attack" phase.

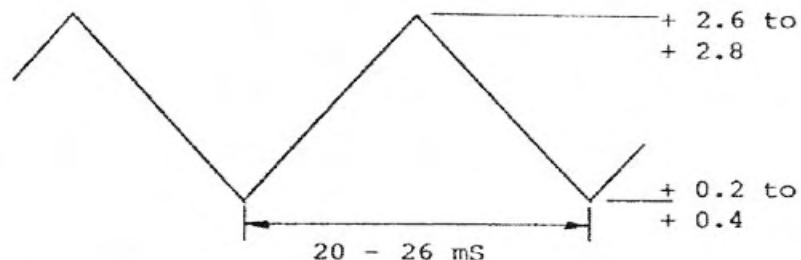
23. Touch any key repetitively to display a waveform as on the RHS above. When the circuit is correctly set up there will be no overshoot visible. In other words, the maximum sustained level must just exceed the peak level.

If any overshoot is present shunt R85 (starting with 68k) to raise the maximum sustained level and thereby eliminate the overshoot. The shunt can be soldered conveniently on the top of the pcb between the lower-most tag of VR9 and the bottom of R85.

24. Leave the SUS LEVEL control fully on.

Control Envelope Generator Check.

25. Scope probe to top of R114 (56k by IC19). Turn the DELAY control fully off, past the click. Observe the repetitive waveform below:



This circuit is a simpler version of the VCA Envelope Generator, having a repeat and single-shot modes but no sustain facility. However there is a variable DELAY function linked to the REPEAT switch (VR13).

Note that this circuit derives its trigger from the VCA Envelope Generator, IC30 pin 13.

IC20

26. Turn the DELAY/REPEAT control VR13 up just past the click, press any key and observe a single occurrence of the waveform shown (the trough level will be slightly lower, approx 0.1 volt).
27. Turn the DELAY/REPEAT control fully on and touch any key. There should be a delay of approx 1 second (time it mentally) before a single pulse as in Step 26.
28. Turn the DELAY/REPEAT control back but not so it clicks into the "repeat" mode.

Filter Control Voltage Check.

29. Scope probe to the bottom of R21 or R22 (4k7 by FILTER FREQ control). Check that the LFO FILTER AMOUNT control VR14 is central. Touch the highest key. Vary the FILTER FREQ control VR15 and observe a d.c. level which should vary from 0.5 - 0.7 volts with the control off, smoothly to 3.3 - 3.5 volts with the control on. Note that the variation is not linear, the voltage being about 1.0 volt with the control midway.
30. Touch the lowest key on the keyboard, vary the FILTER FREQ control and observe a similar variation but from 0.5 - 0.7 volts up to 1.5 - 2.5 volts (with some ripple). Note that temperature differences between Tr1 and Tr2 can alter the second reading markedly, as can severe transistor mismatching.

The control voltage is generated using a multiplier circuit IC12, Tr1, Tr2. One input to the multiplier is a current defined by R141, R72 and the KEYBOARD VOLTAGE, into pin 13 of IC12. This ensures that the filter tracks the keyboard. IC12 will adjust the emitter voltage on Tr2 so that a balancing current is set up into pin 2 via R75.

The other input to the multiplier is a variable base drive through R77, and this depends on the settings of the FILTER FREQ, LFO FILTER AMOUNT and ENV FILTER AMOUNT controls. All these can be varied either side of a mid-position. The output pin 10 of IC12 should be variable typically between 0.3 and 4.2 volts.

Note that if Oscillator 1 is not functioning there is no KEYBOARD VOLTAGE and the filter control voltage will stay at 0.6 volts independent of control settings. This sets the filter corner frequency (in low-pass mode) so low there is no output from the WASP.

When faultfinding look for approx 0.7 volts on pins 11, 12, 8 and 13 of IC12 and similar forward biases on the bases of Tr1 and Tr2.

Filter Bias Stability Check.

31. Scope probe to low-pass filter output, IC5 pin 12. Touch the highest key. Vary the FILTER FREQ control and check that the d.c. level observed does not vary by more than 1 volt (it will typically sit at about + 3 volts). If necessary turn off both oscillators.

If the variation is excessive there is a chance that the filter will clip the audio signal. The problem is an excessive bias change in one or both of the Output Transconductance Amplifiers, IC3 and IC4. Replace these ICs.

If the steady-state d.c. voltage is outside the range of 1.5 to 4.0 volts the likely suspect is IC5. Change this IC.

Listening Test.

32. At this stage the WASP should be producing an output; if not, check around IC6. Its control input (pin 5) should sit at about 0.7 volts and the output (IC5 pin 8) at roughly half the supply voltage.

Another fault involves poor control range, where there is still an appreciable output when no key is touched. Change IC6.

Reset all controls as in Step 4.

33. Check that the output is quiet for all settings of the ATTACK, DECAY and DELAY controls; this checks for switching transient breakthrough.
34. Turn off Oscillator 2 and check the footages in Oscillator 1; check IC24 and IC36 if any footage does not sound.
35. Set Oscillator 1 to 8-foot. Switch S2 to squarewave. Check variation of timbre with the PW control, VR2. (If checking on a scope note that the pulse width will not vary past 50% duty cycle).
36. Turn Oscillator 1 off and Oscillator 2 on. Check footages operate.
37. Set Oscillator 2 to 8-foot. Switch S4 to squarewave then back to sawtooth.
38. Switch both oscillators on and to sawtooth. Check that the PITCH control can swing OSC 2 from about 1 octave below to slightly above OSC1. Synchronise the pitches.
39. Turn GLIDE control fully on and hit a low note followed by a high note. The glide should take about 2 seconds. The oscillators will "beat" during the glide but should be in tune again at the end. They should arrive at the end at about the same time (if grossly out of step, change C17 and C32).
40. Turn GLIDE control off.

41. Use the PITCH control to beat the oscillators (about 3 beats per second is ideal). Swing the BEND control from side to side. If the beat frequency is not the same at either extremity, adjust the OSC BAL control (PR1) until it is.
42. Leave the BEND control central. Re-synchronise the oscillators.
43. Turn off oscillators and turn the NOISE signal on full. Noise is generated digitally using an 18-stage shift register with feedback (IC33, 34, 35). If there is no output first check for a clock frequency of 5 kHz at IC34 pin 3.
44. Set FILT FREQ control 2/3 up. Touch a high key then a low key and note the variation in timbre as the filter tracks the keyboard.
45. Touching a middle key, sweep the FILTER FREQ control and note a similar variation. Also the bottom 20% of the FREQ control has no effect.
46. With the FREQ control turned 2/3 up, turn the Q control fully up. Note the characteristic hollow whistle as the filter sits on the verge of oscillation.
47. Turn the NOISE and Q controls off. Turn both oscillators on again.
48. Check that LFO SELECT is on the sinewave position (off). Set the LFO FILTER AMOUNT control (VR14) fully on. Touch any key. A buzz will be heard superimposed on the note. Rotate the LFO FREQ control acw and the buzz will slow to a minimum of typically one sweep per 3 seconds (spec is 1 second minimum).
49. Sweep the LFO FILTER AMOUNT control from side to side and note the varying effect with a central dead band.
50. Check that the other positions of the LFO SELECT switch operate. The rising and falling sawtooth waveforms can be distinguished, as can the squarewave, noise and sampled noise ("random") effects.
51. Reset to the sinewave and turn the PITCH MOD control VR4 fully on. Note the regular rise and fall of pitch.
52. Turn PITCH MOD off.
53. Turn Q fully on and listen for a characteristic "chirp" on each cycle.
54. Check that the BAND and HIGH positions of the FILTER SEL switch operate.
55. Reset to Q off, FILTER SEL off, LFO FILTER AMOUNT central. Leave FILTER FREQ about 2/3 up.
56. Turn the ENV FILTER AMOUNT control fully off. Turn the DELAY control off past the click (repeat). Hold any note and note a rapid repetitive sweep of the filter.

57. Check the operation of the ATTACK2 and DECAY2 controls.
58. Swing the AMOUNT control from side to side and note the varying effect. Leave it at one extreme.
59. Turn the DELAY control fully on; hit any key and note the nominally 1 second delay before a single filter sweep occurs.
60. Reset the ATTACK2 and DECAY2 controls off, the DELAY control off but not clicked in repeat mode, and the ENV FILTER AMOUNT control midway.
61. Turn SUS LEVEL to "repeat" mode. Hold any note and check the operation of the ATTACK and DECAY controls.
62. Repeat Step 61 while advancing the SUS LEVEL control to maximum.
63. Leave the ATTACK and DECAY controls off, SUS LEVEL fully on.
64. Holding any note, check for the smooth operation of the volume control.
65. Check that no double-triggering occurs when a note is released.
66. Holding down a low note, press and release a high note and check that the low note sounds when the high note is released, but only with SUS LEVEL turned on full (otherwise the note should not return when the output has decayed).
67. Set both oscillators to the OFF position. Link either LINK socket to another functioning WASP using a 7-pin DIN to DIN cable. Play the other WASP and check that the unit under test sounds correctly. Note: if the second unit is a DELUXE the WASP will not sound the lowest C on the DELUXE keyboard.
68. Repeat Step 67 for the other LINK socket.
69. Turn both oscillators on again. Link the SIGNAL OUTPUT to the EXT INPUT on another WASP and check that audio is generated. Alternatively plug headphones into the SIGNAL OUTPUT socket, when a weak mono signal should be heard.
70. Turn off OSC 2. Turn OSC 1 to 8-foot pitch and hold down note A3 (fourth from top). Adjust FILTER FREQ and Q for a mellow tone (a near-perfect sinewave can be produced). Adjust the TUNE control (PR3) to set this note to A440 using a tuning fork.
71. Scrape the keyboard clean and further clean it with solvent. Apply a self-adhesive plastic overlay carefully. Now play the instrument with different settings of the KBD SENS control. When this control is at minimum then the keyboard should not function. At maximum setting the unit should play itself. In between the "touch" should vary from a light brush with one fingertip to heavy pressure with two or three fingers together. Select R140 until this is the case.

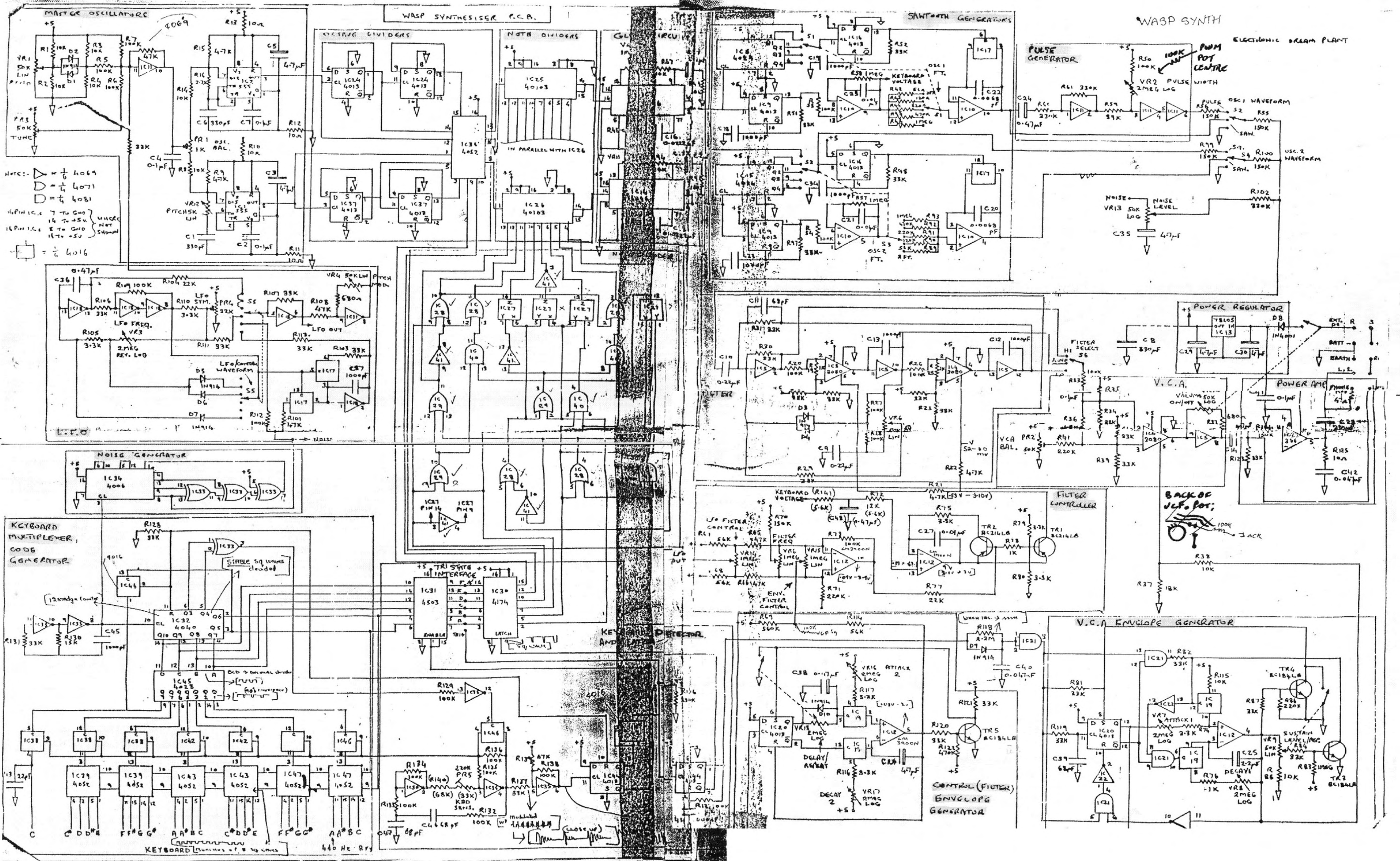
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72. Turn both oscillators off. Set SUSLEV to "repeat" mode and turn the VOLUME on full. Press any key. The residual buzz that can be heard is due to an offset in IC6. Adjust the VCA BAL control (PR2) for minimum buzz.

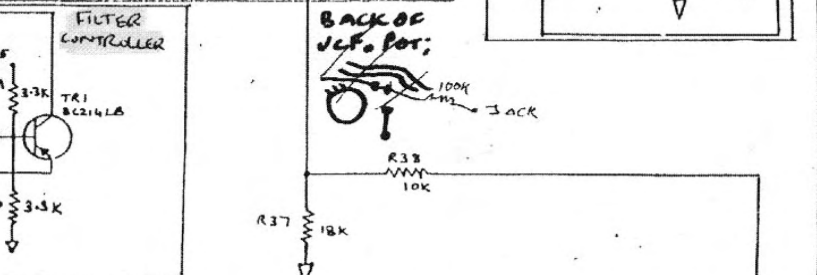
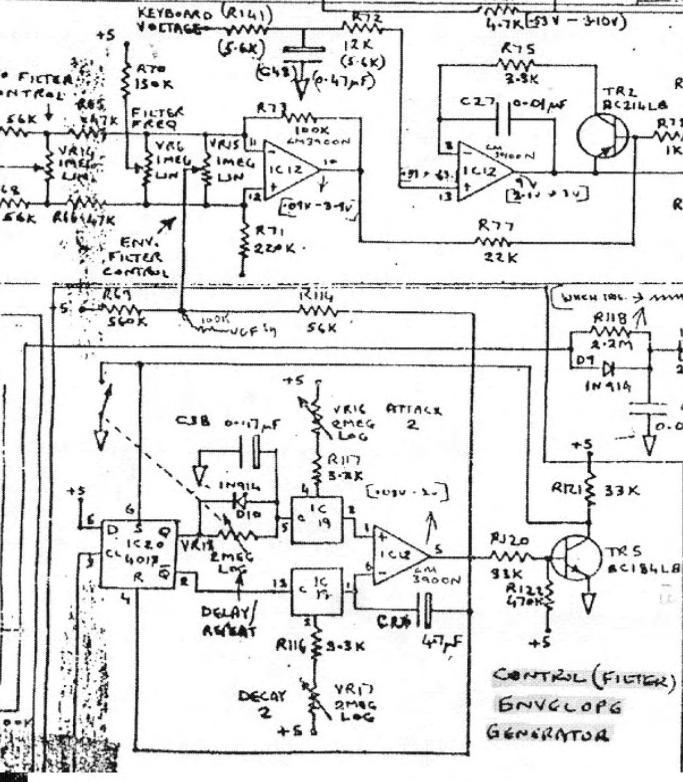
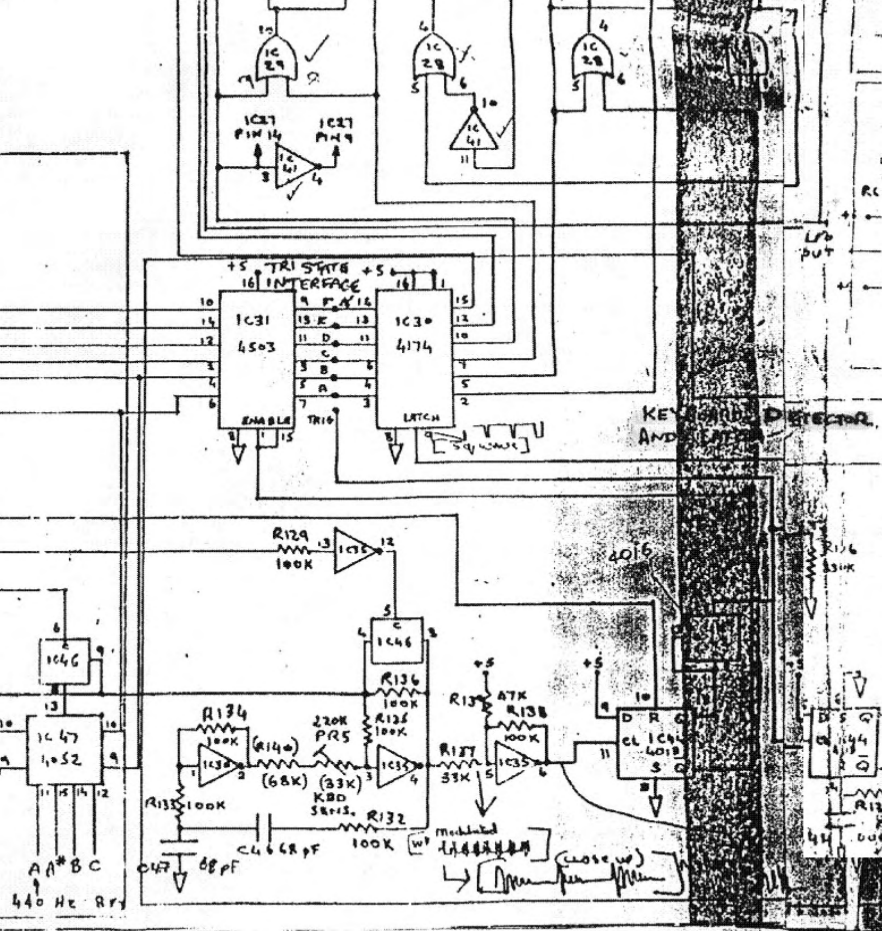
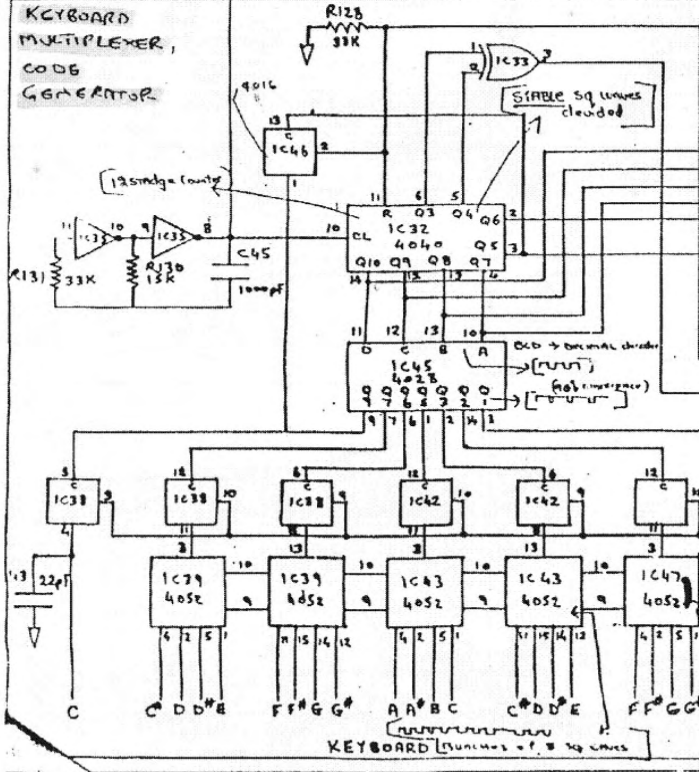
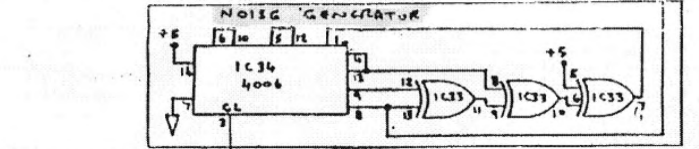
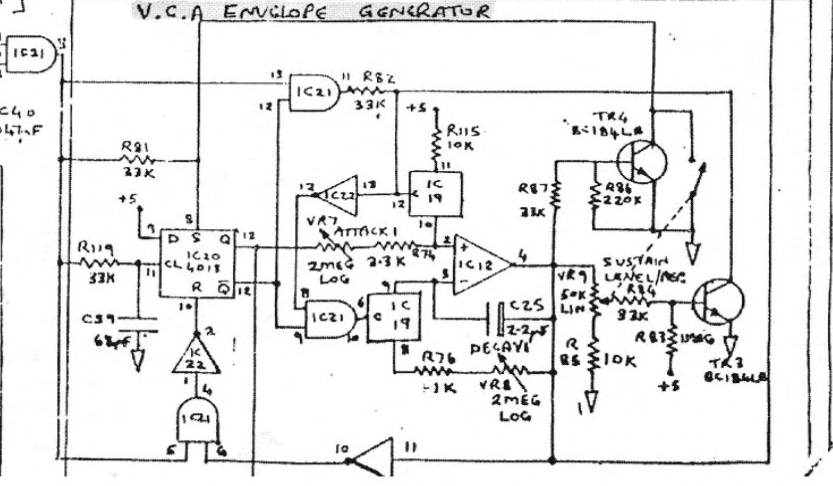
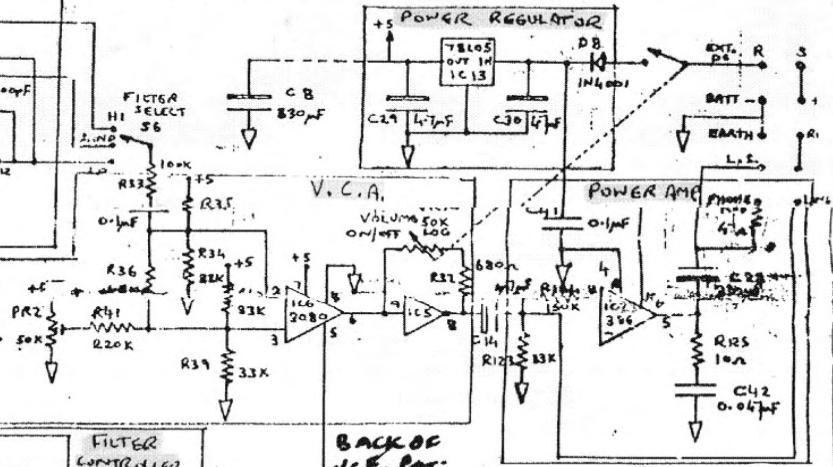
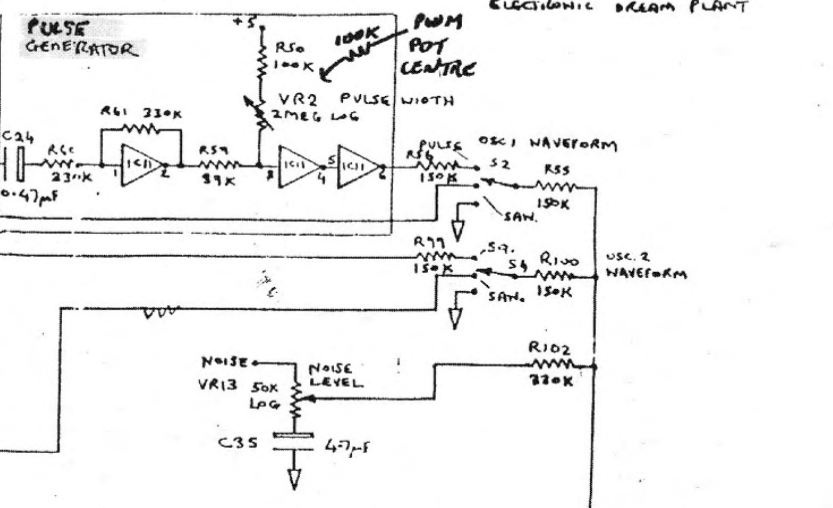
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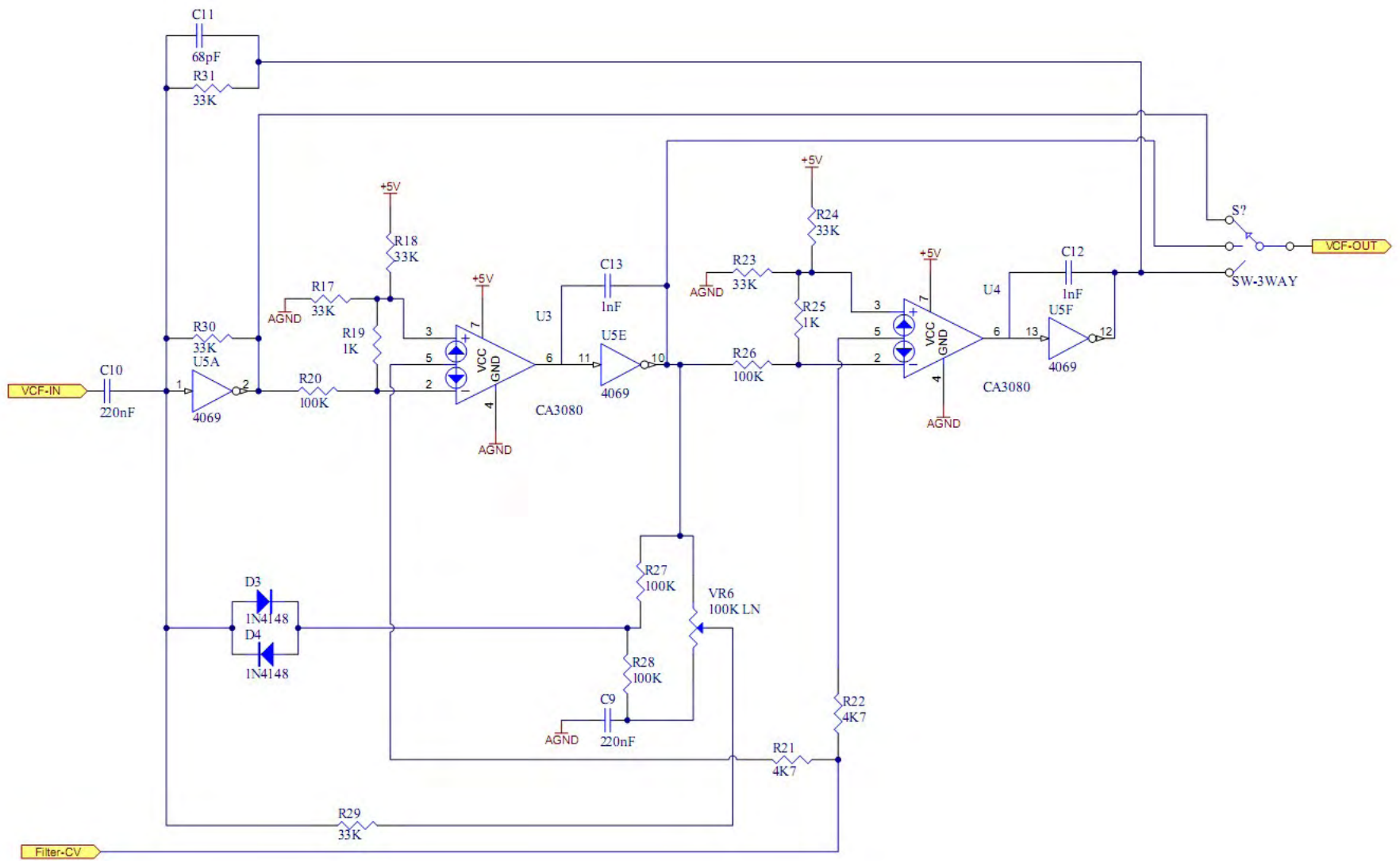
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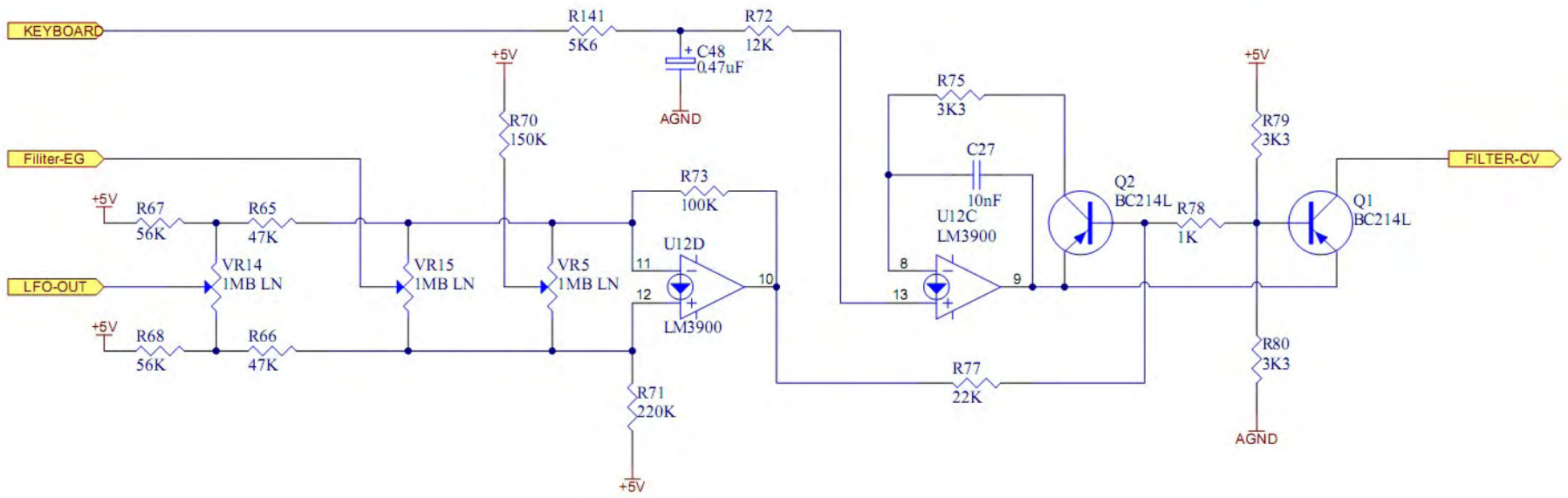


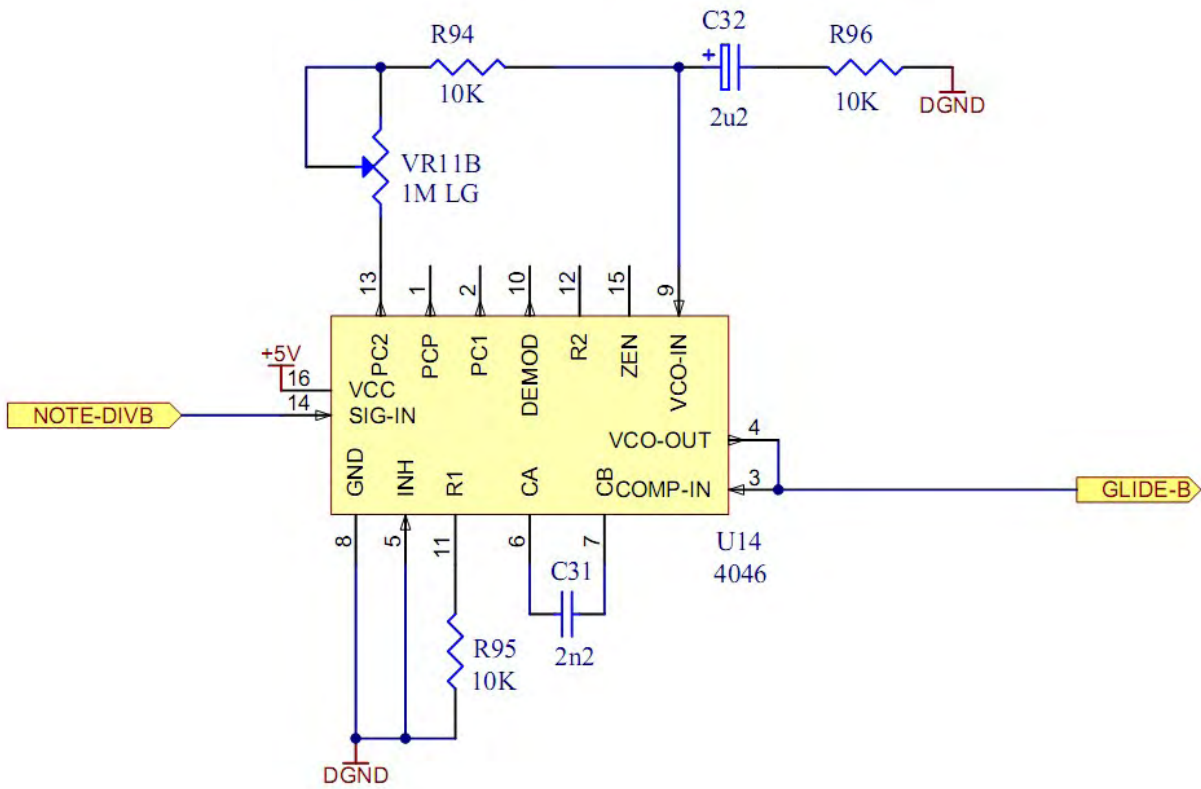
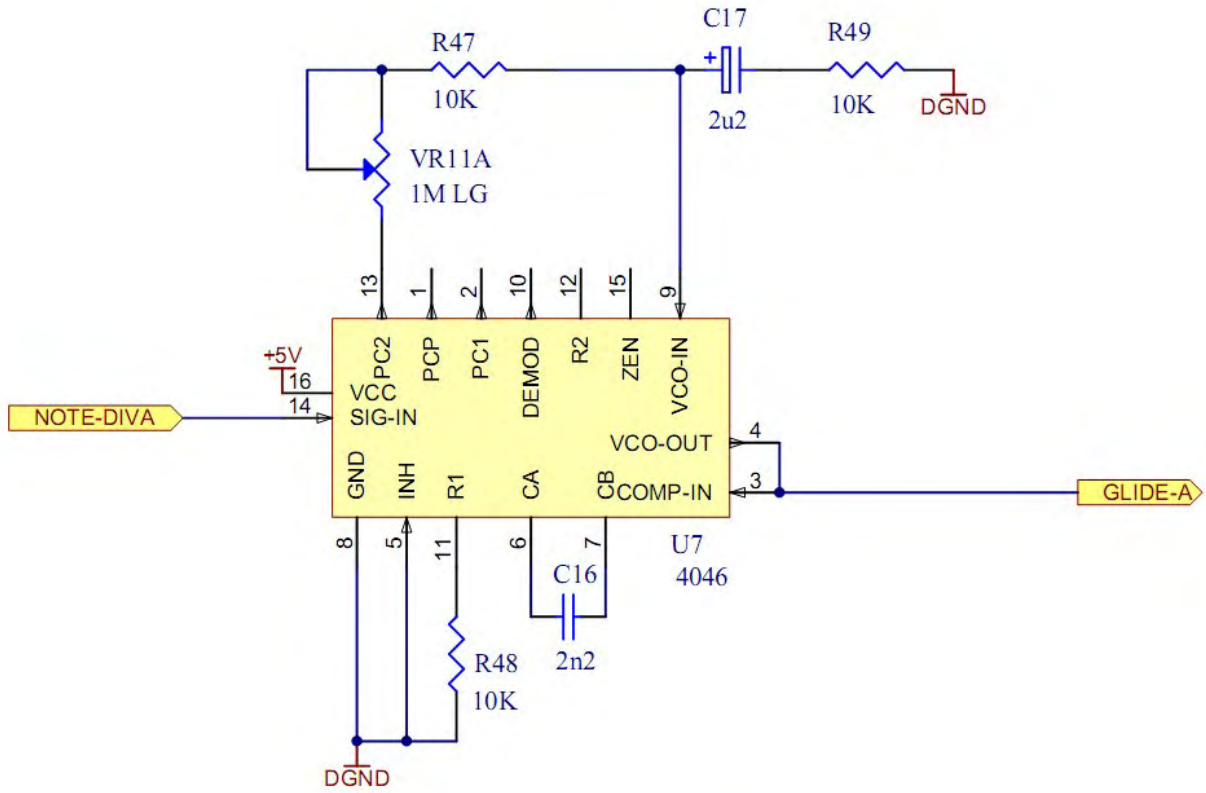
NOTES:
△ = 1/2 4069
▽ = 1/2 4071
□ = 1/2 4081
16 PIN IC: 7 TO GND
14 TO +5V UNLESS NOT SHOWN
18 PIN IC: 8 TO GND
16 TO +5V

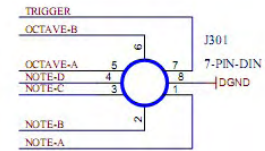
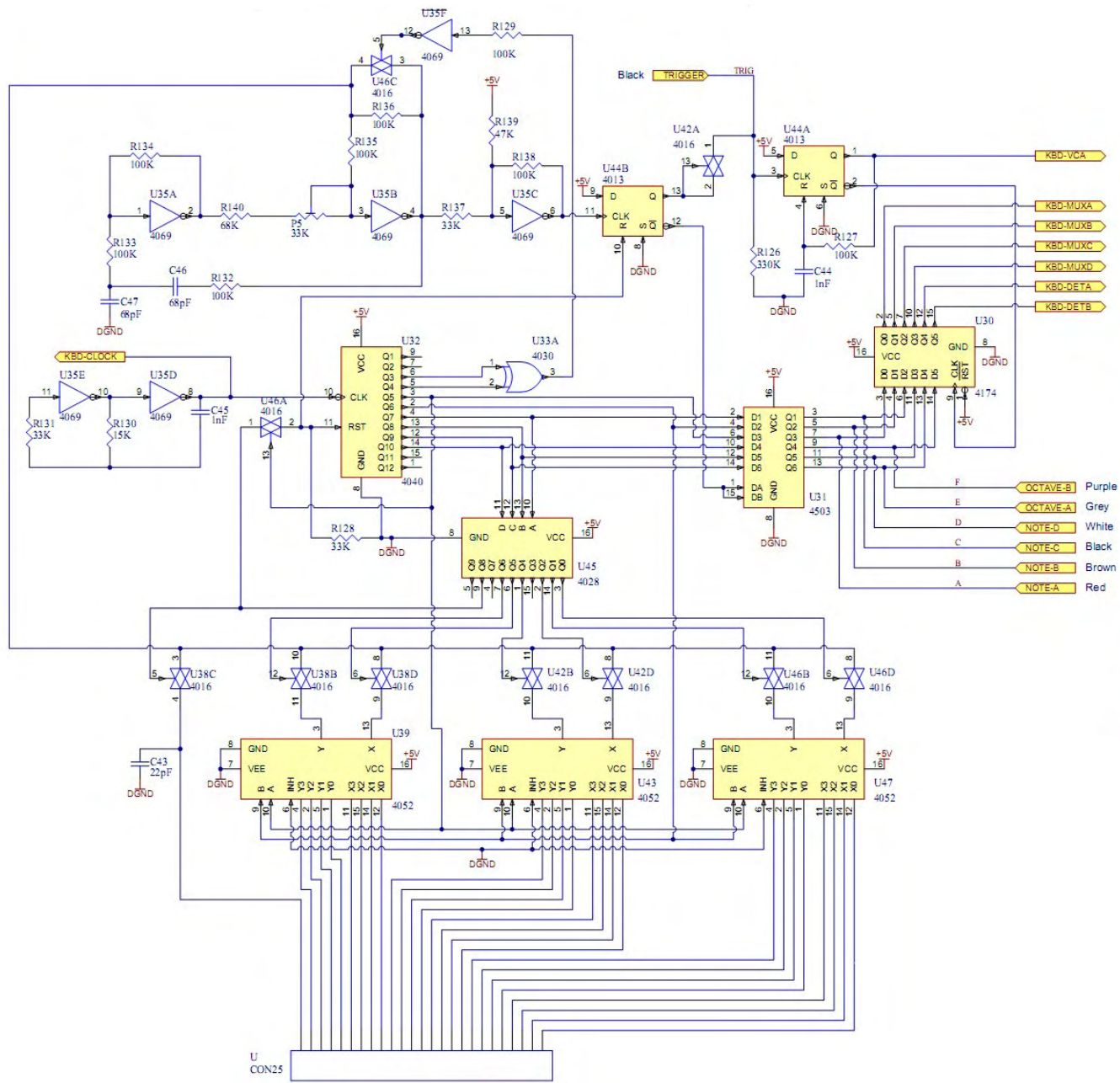
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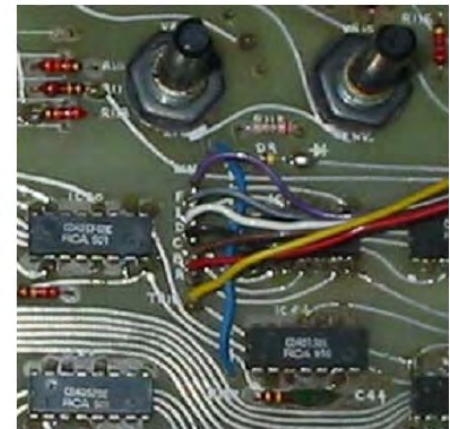


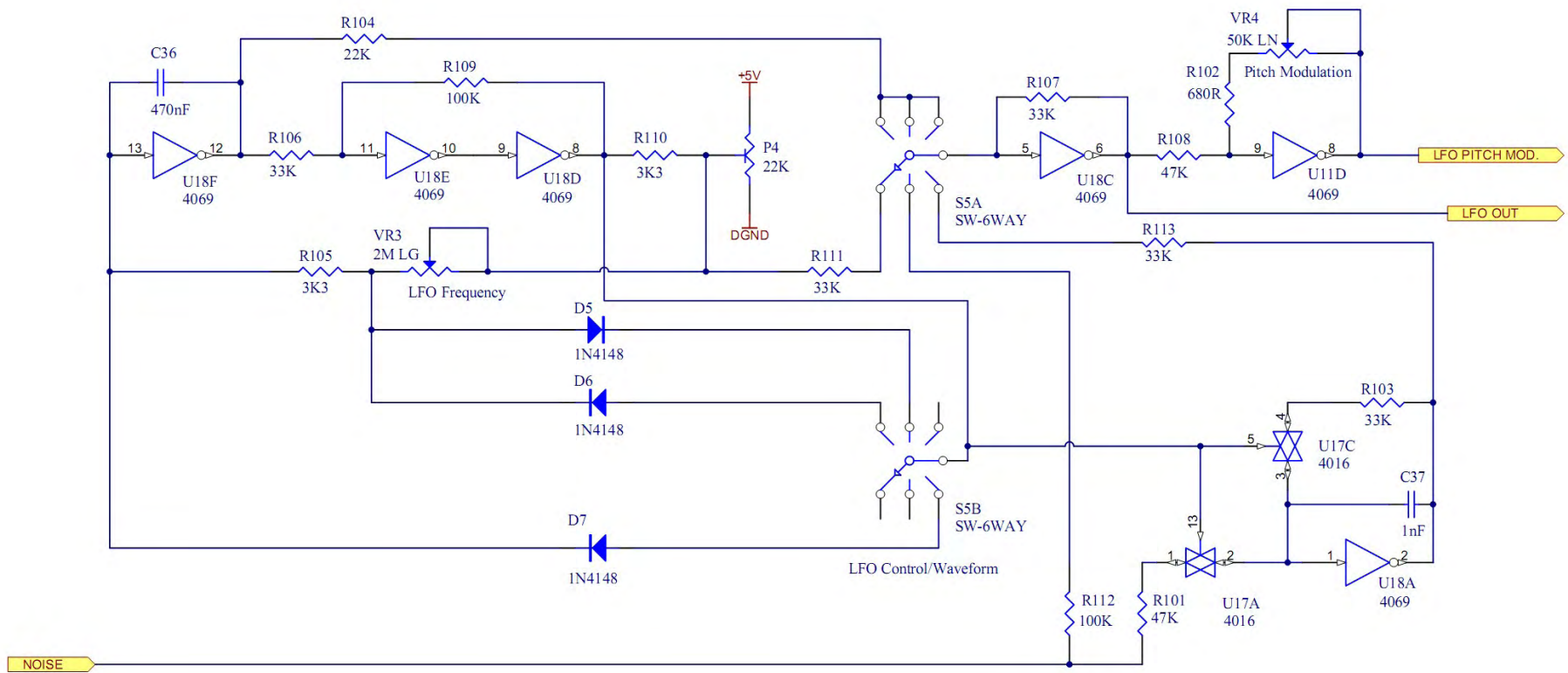


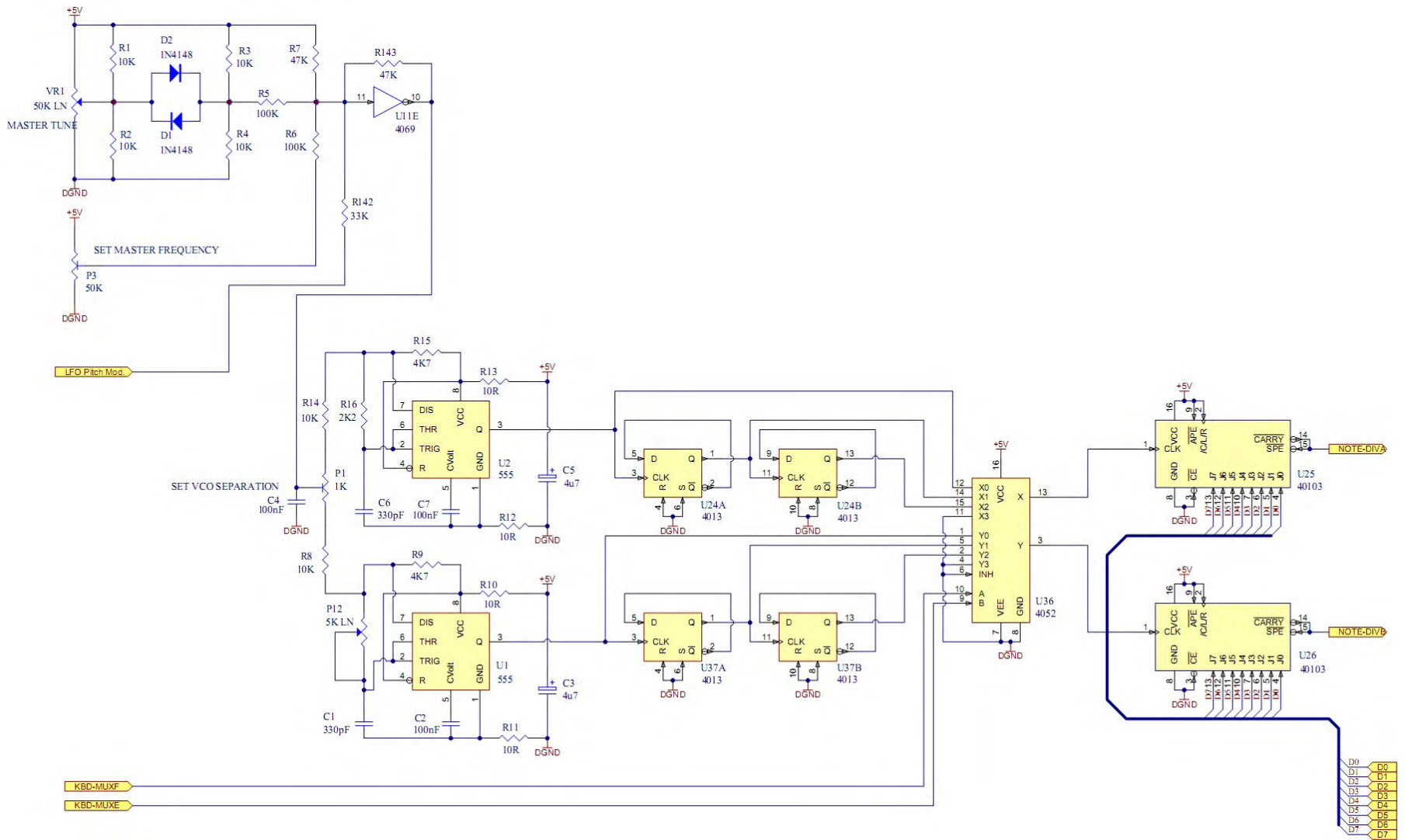


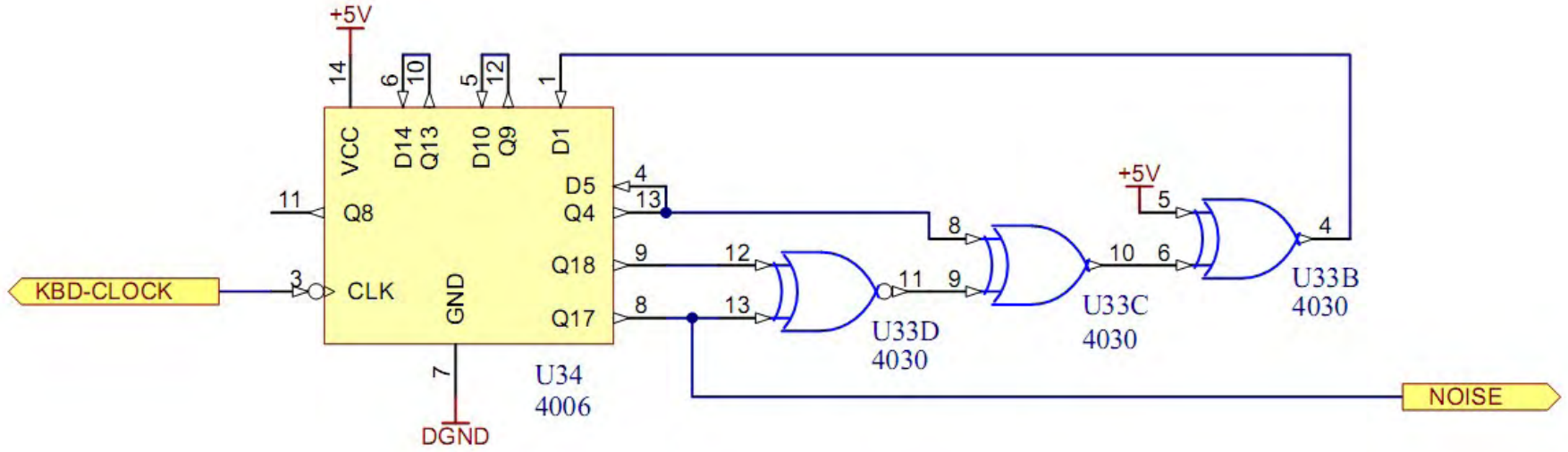


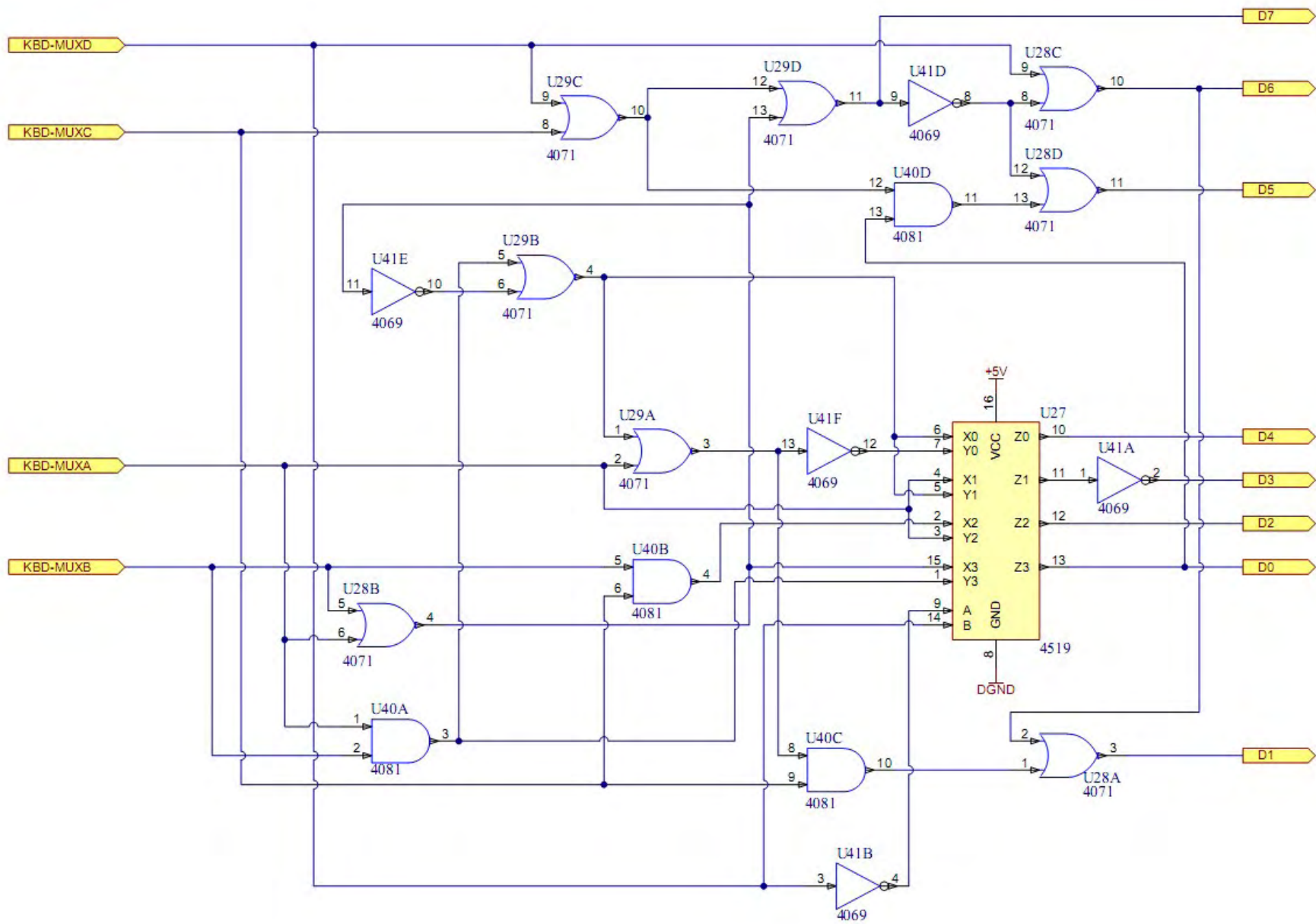
- F — OCTAVE-B Purple
- E — OCTAVE-A Grey
- D — NOTE-D White
- C — NOTE-C Black
- B — NOTE-B Brown
- A — NOTE-A Red

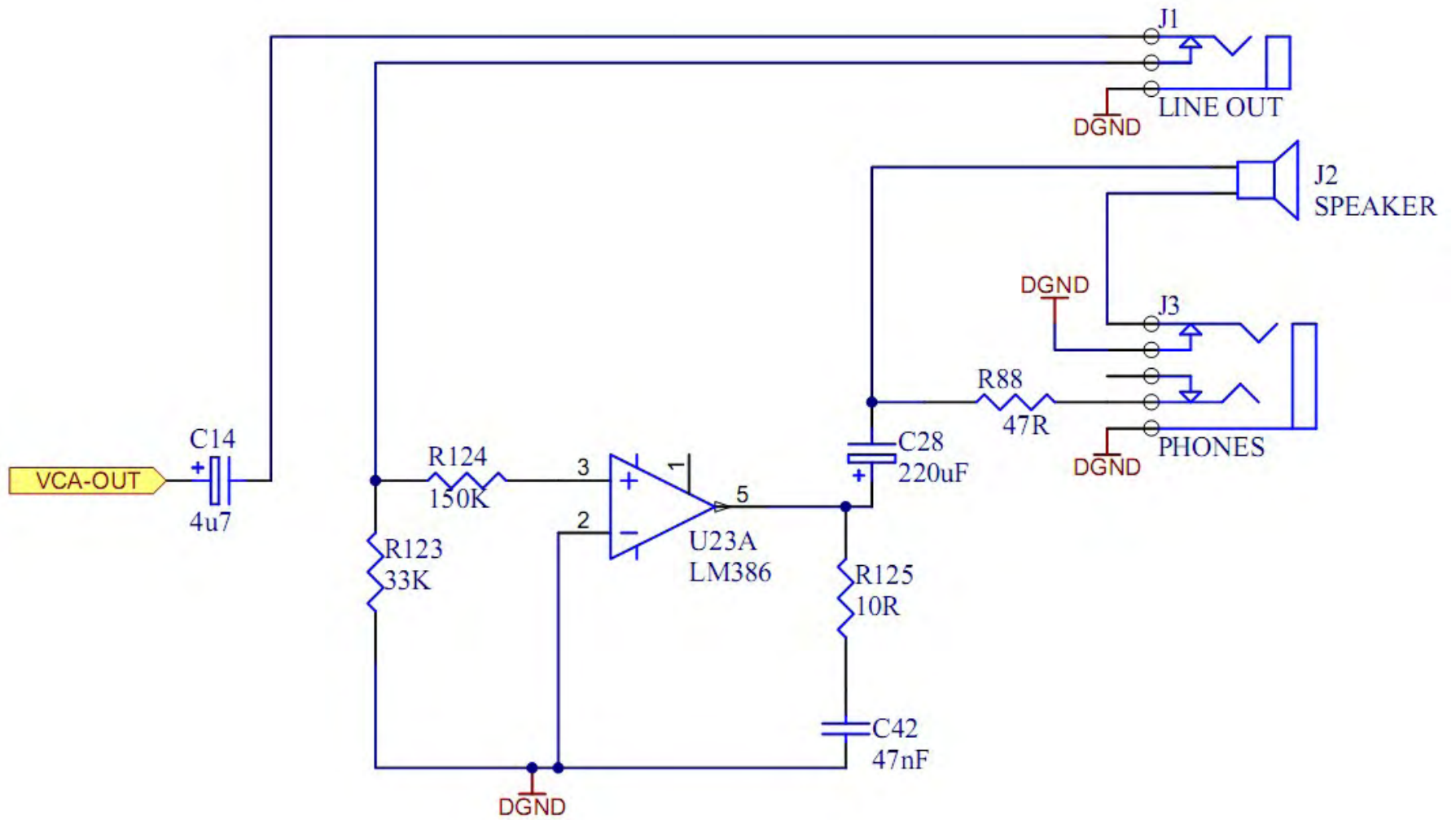


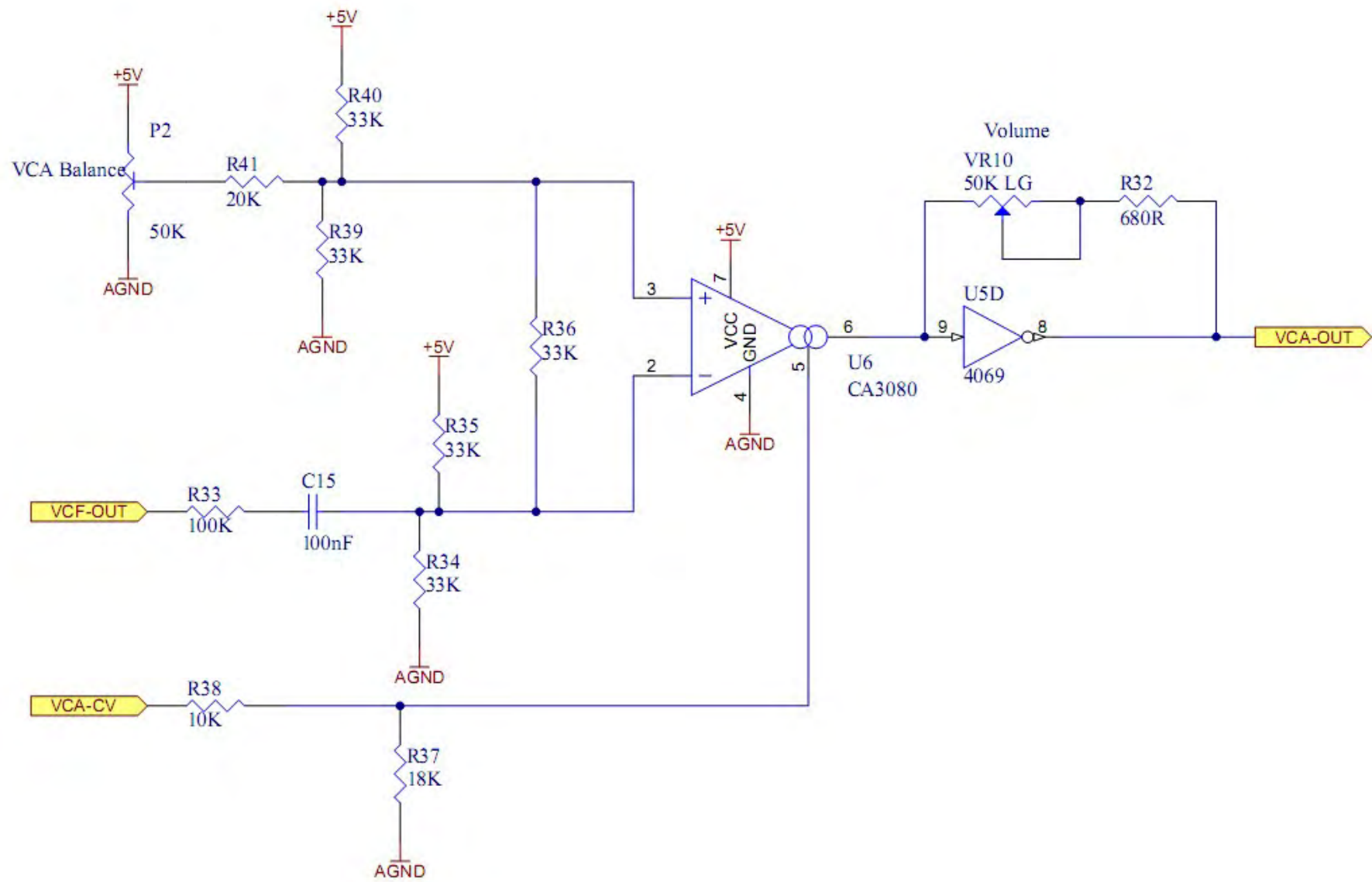


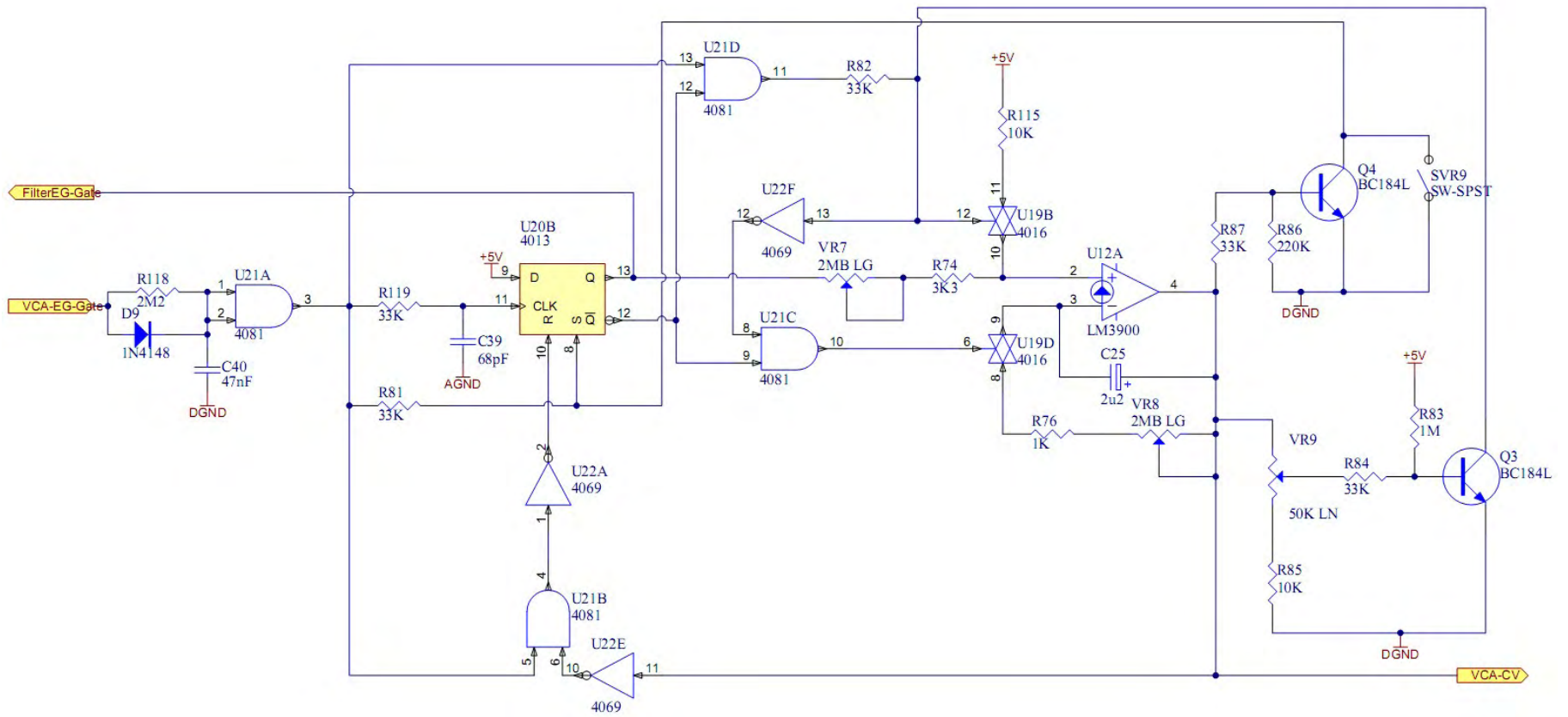


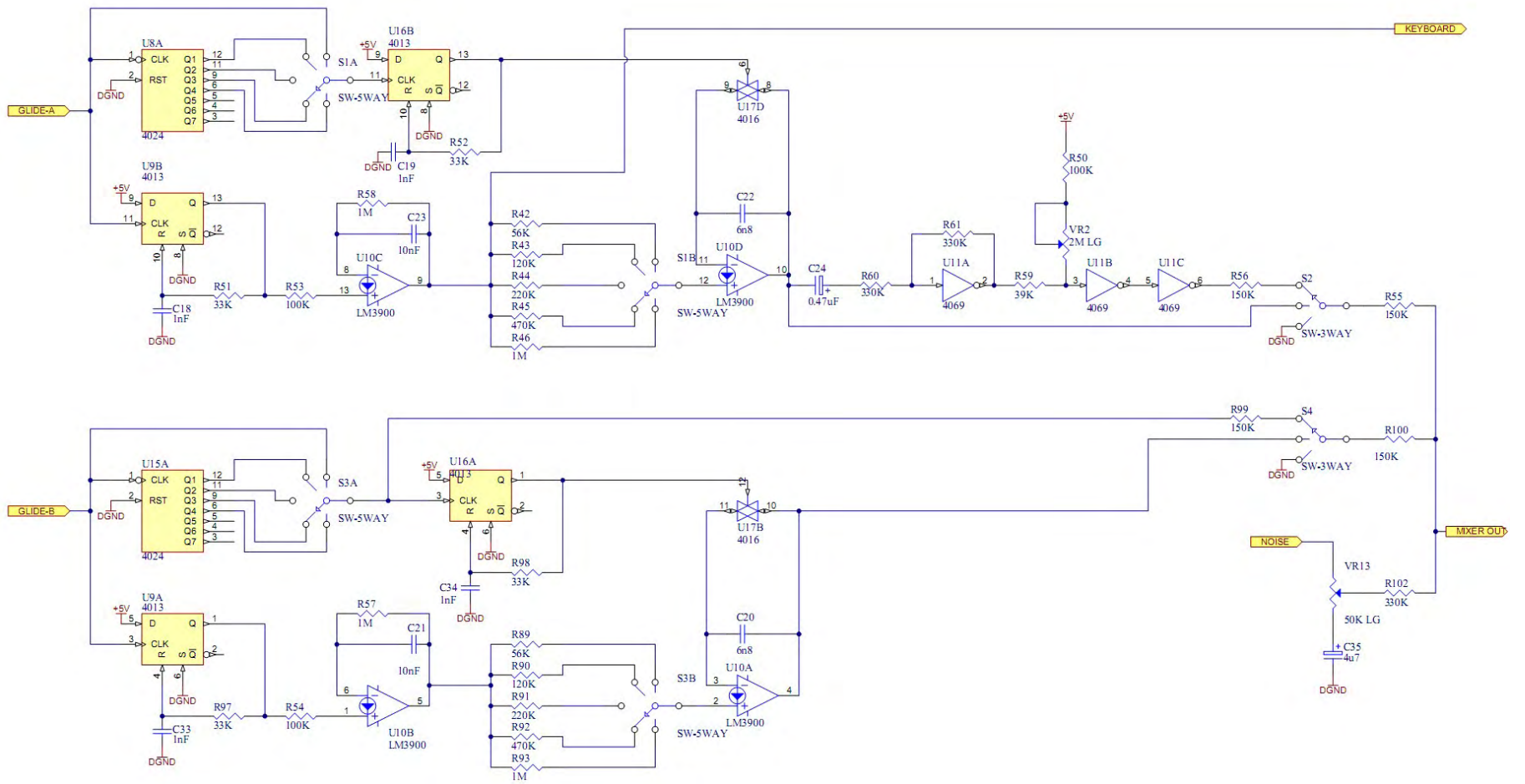












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