# TEST INSTRUCTIONS - GNAT

## Equipment Required.

D.c. Power Supply, output 9 volts stabilised to 500 mA, short-circuit protected.

Oscilloscope, single-beam, vertical sensitivity 10mV/div, timebase 10mS/div to 50uS/div, with 10:1 low-capacitance probe.

## Visual Inspection.

1. Check p.c.b. for soldering faults, particularly:
   - top soldering on all i.c.s
   - soldering on pots
   - soldering on link wires
   - top soldering underneath electrolytics

2. Check i.c.s for reversal.

3. Check electrolytics for reversal.

4. Check connections to speaker - should be stranded wire returned to the earth connector on the LINE OUT socket.

5. Check that there are plastic insulating washers under VR4 and VR7 (the pots with sliced circular pads under their securing nuts).

## Modifications.

6. Solder a 33k 1/8W resistor from the junction of VR3 and R28 (3k3) to the +5V rail. This is an initial adjustment for the LFO symmetry.

7. Solder a 150k 1/8W resistor from pin 3 of IC14 (4069) to the +5V rail. This is an initial adjustment for symmetrical Pitch Mod drive clipping.

8. Route the long link between IC18 pin 6 and S2, which carries the NOISE signal, as far as possible away from IC12 to prevent noise entering the filter sweep circuitry. Replace the link with a longer one if necessary.

9. Top solder a 10nF (0.01uF or "103K") mylar capacitor between pin 6 of IC12 and earth - this also assists in removing noise from the filter sweep circuitry.

10. Link the output from S1 to pin 11 of IC26 directly, cutting out the existing 1 cm and 5 cm links if they are fitted. This reduces the level of switching transients on the audio output from the GNAT.

Initial Settings.

11. Check that the number of ways on all three switches is five (5), i.e. four clicks of rotation.

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

| | | |
|---|---|---|
| GLIDE | off | (no glide) |
| FOOTAGE | on | (2' range) |
| SELECT | 2nd posn | (sawtooth) |
| PITCH MOD | off | (no modulation) |
| LFO FREQ | on | (max freq) |
| LFO SEL | off | (sinewave) |
| FILT FREQ | on | (max freq response) |
| FILT CONTROL | central | (no LFO/Control Osc) |
| Q | off | (filter flat) |
| FILT CONTOUR | central | (short Control sweep) |
| ATTACK | off | (fastest) |
| DECAY | off | (fastest) |

Set all presets central, except for KBD SENS which should be fully on.

Disconnect the loudspeaker or plug in headphones.

Power Consumption.

13. Apply power (+9 volts). Current consumption should lie in the range of 35 to 45 mA. If it is about 100 mA check for a reversed regulator. If 200 mA or more check for the regulator output shorted to earth (e.g. a bridged decoupling capacitor).

14. 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 (e.g. right-hand tag of PR2).

Preliminary Keyboard Setup.

15. Put the scope probe on pin 12 IC28 (anode of diode). Set Y-gain to 0.1V/div, timebase to 5mS/div. Observe a narrow negative-going pulse of period 20 mS; the GNAT should self-trigger with KBD SENS fully on. Pulse amplitude should be 5V (use to check power rail).

    If no pulse check for a keyboard scanning clock on IC18 pin 8. If no clock check oscillator (IC18) and components. The period of this master clock should be 35 - 45 uS; if C13 is a 10 nF by mistake the whole unit will buzz at a low frequency.

    Also check for successive division of the clock in IC32 then check the circuitry around IC28. Increase R81 until the GNAT self-triggers.

16. Turn down the KBD SENS control and at some point the TRIG signal should disappear. It may be necessary to decrease R81 to 120k. Select R81 so that the GNAT self-triggers with KBD SENS turned halfway up; this gives a reserve of sensitivity for use with batteries.

17. Run a finger along the keyboard. The trigger pulse should reappear. It should change 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. If all correct go to Step 18.

    The keyboard scanning circuitry operates as follows: the CMOS 4051 and 4052 multiplexors connect each key in turn to pin 3 of IC19. Once per key, IC32 pin 5 generates a positive-going transition which is delayed by R80/C20 then clocks IC28 pin 11. The DATA input to IC28 is driven from this same signal delayed by an amount which depends on (R81 + KBD SENS) and the key capacitance.

    With low key capacitance (no touch) the DATA pin of IC28 will go high before the CLK pin so IC28 will set; however IC28 is forced to set at the start of each keyboard scan cycle by IC27 pin 11, so this extra setting has no effect.

    With high key capacitance (key touched) the DATA pin of IC28 will still be low when the CLK pin goes high so IC28 will reset. This drives the Q-bar output (pin 12) high for the rest of the keyboard scan cycle. This positive-going output is the TRIG signal. Its complement, the Q output (pin 13) is used to enable IC35 and put the key code onto the LINK bus.

    If no key is pressed IC35 is not enabled and the LINK bus floats, available for control by any other instrument linked to the bus.

    Whether the GNAT or an external source (e.g. a microprocessor) generates a key code and trigger, this code must be latched to provide a stable note. The leading (positive-going) edge of the TRIG signal clocks the second half of IC28, which is connected as a 70uS monostable. The Q-bar output (pin 2) strobes a 6-bit latch IC31. The outputs of IC31 retain the code of the last key pressed, even when that key is released.

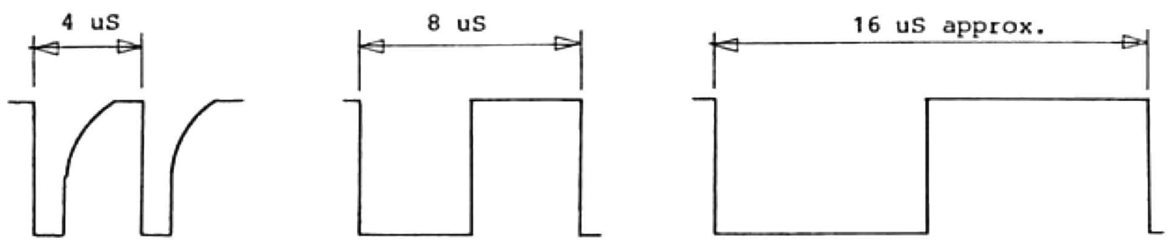
<u>Oscillator Checks.</u>

18. Put the probe on IC30 pin 4. Run a finger along the keyboard and check for a sawtooth (positive ramp) signal, the frequency of which depends on the last key touched. If correct go to Step 19.

    If no signal, check pin 3 or 4 on IC1 (the PLL) 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 IC1 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 IC1 check for an input (pin 1) on IC5. This should be either the master oscillator (IC2) output at 250 kHz, or this signal divided by 2 or by 4 in IC3, depending on which octave is being played. See the diagram below.




Top C to C# below — IC4 pin 9/10 = 0 0

Next C to C# — 0 1

Bottom C — 1 0

These signals are selected in IC4 depending on the 2-bit code presented at pin 9 and pin 10 of this IC, as shown in the figure. These 2 bits are the most significant bits of the keyboard code latched in IC31 and they define the octave. The remaining 4 bits from IC31 define the note within an octave.

IC5 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 IC1 is outside the lock range of that PLL and the output from IC1 will remain at about 3 kHz, whatever key is played.

The block of logic below IC5 on the circuit diagram converts the lowest 4 bits of the keyboard code to the correct division factors for IC5. For reference, the latched outputs from IC31 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 IC31 as the top 12 notes are played, followed by one note from each lower octave. This will help to localise the fault in either IC31 and earlier, or in the conversion logic (IC6, 8, 9, 13, 16).

Note that if the coding to pin 4 of IC5 (a low-order divisor bit) is incorrect this will affect the coding on pin 11, which is a much higher-order divisor bit.

Note that a reversed or very leaky C5 in the PLL damping circuit can prevent the PLL from operating. The function of the PLL is to convert the narrow output pulses from IC5, which are not very interesting musically, to a much more useful squarewave at the same frequency. Also a "glide" between notes can be easily introduced by increasing VR1 and slowing down the response of the PLL to variations in its input frequency.

## TABLE 1 - CODING LOGIC

| KEY | OUTPUTS from IC31 | | | | | | DIVISION FACTORS in IC5 | | | | | | | | MISC LOGIC | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| pin | 2 | 7 | 5 | 12 | 10 | 15 | 13 | 12 | 11 | 10 | 7 | 6 | 5 | 4 | A | B | C | D | E | F |
| Top C | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| B | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| A♯ | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| A | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 |
| G♯ | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| G | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| F♯ | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| F | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| E | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| D♯ | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 |
| D | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 |
| C♯ | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Mid C | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | | | | | | |
| and so on, until | | | | | | | | | | | | | | | | | | | | |
| Btm C | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | | | | | | |

The MISC signals shown are:

A = IC16 pin 10 D = IC16 pin 11
B = IC8 pin 4 E = IC8 pin 3
C = IC13 pin 11 F = IC13 pin 4

If the output from the PLL is correct but there is no sawtooth for any footage visually inspect around IC30 and also check for the presence of a narrow (width approx 30 uS) positive pulse on pin 13 of the monostable IC26. This is necessary to discharge the integration capacitor C25 and reset the sawtooth.

19. Switch S1 down to the 16' range and verify that a sawtooth is present on all ranges. The limits of the waveform should be from approx + 0.6 volts to approx + 3.5 volts and may vary by up to 20% from one end of the keyboard to the other and between ranges. If correct go to Step 20.

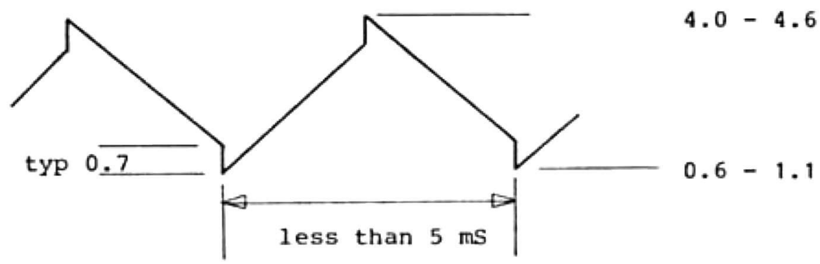
There may be top clipping for up to 10% of the period on the lowest frequency. If clipping is severe (up to 80% of the period) then the KEYBOARD VOLTAGE which defines the integrator input current may be stuck high. This is measured on Tr1 emitter and should vary from about + 1.0 volts for the lowest key to about + 2.1 volts for the highest key, independent of footage but depending on the setting of the TUNING preset.

If IC30 shows an output for some footages but not for others, check for the relevant squarewave outputs from IC3; these trigger the monostable IC26.

If the sawtooth produced does not fall far enough (for example, not below + 2 volts) check the width of the discharge pulse from IC26; if this is significantly less than 20 uS then C25 will not be sufficiently discharged by the analogue switch IC29.

Low-Frequency Oscillator Setup.

20. Put the scope probe on pin 6 of IC14 or the RH end of R29 (22k resistor below IC14). A "sinewave" output should be observed as below:




Note that as the LFO FREQ is lowered the switching transients will reduce. (This is not however true of the sawtooth waveforms produced by this circuit). If all correct go to Step 22.

The LFO uses one section of IC14 operating as an integrator (C9 being the integration capacitor). The output on pin 12 is the "sinewave" and drives a Schmitt trigger (two inverters in series with positive feedback) to produce a square wave which is fed back to the integrator through R28 and VR3.

Switching in diodes D1 or D2 bypasses R28/VR3 for one half of a cycle to produce a rising or falling sawtooth rather than a symmetrical triangle.

21. Check that the maximum frequency available from the LFO exceeds 200 Hz (i.e. the waveform period is less than 5 mS). This is an important design spec.

22. Switch LFO SEL (S3) to the fourth position clockwise and observe the squarewave output, limits about 1.6 to 4.4 volts. Reduce the LFO FREQ slightly to give a squarewave of period approx 20 mS (4 horiz divisions at 5mS/div). Adjust LFO FREQ to set either the mark or the space to exactly 2 horiz divisions. The other half of the squarewave should lie between 1.8 and 2.2 divisions. If the space is too small, increase the value of the 33k resistor added in Step 6 to 47k, and v.v.

23. Set LFO SEL to all other positions and check for the rising and falling sawtooth waveforms plus a "random" waveform. If all correct go to Step 24.

The random signal is produced by switching in D2 which puts the LFO into a very asymmetrical mode, when the output of the Schmitt trigger (pin 8 of IC14) becomes a narrow positive pulse instead of a symmetrical squarewave. This pulse turns on the two analogue gates connected to C8.

One gate couples the NOISE signal to pin 1 of IC14 while the other connects R25 as a feedback resistor. This section of IC14 then acts as a linear amplifier with a gain of about 0.5 so its output will follow the noise signal (losing much of the high-frequency content because of C8).

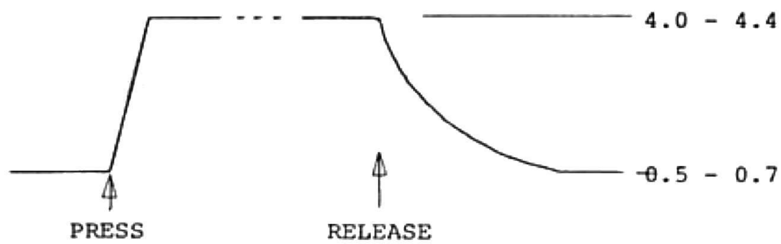
When the pulse ends and both analogue switches turn off C8 acts as a reservoir capacitor and holds its last value of the random signal until the next pulse arrives.

24. Put the scope probe on pin 4 of IC14 and switch S3 to sinewave. Turn PITCH MOD up full. The waveform observed may be a symmetrical sharp-pointed triangle or it may have rounded peaks (like a sinewave). If the top is considerably more rounded than the bottom, reduce the 150k resistor added in Step 7, and v.v.

25. Leave the LFO SEL set on "sine" wave. Turn PITCH MOD off or later measurements will be affected.

VCA Envelope Generator Check.

26. Put the scope probe on the LH end of R41 (6k8 above IC17). Press and release any key repetitively. A waveform as below should be observed for each press. If correct go to Step 27.




If no output is observed check visually around IC30 and check the voltages on this IC. Pins 13 and 8 should go no higher than + 0.7 volts since IC30 is a current-difference amplifier and its inputs look like forward-biased diodes.

The circuit is driven from R63/D5/C17 which stretch the short output pulse produced by IC28 from each TRIGG pulse. Pin 4 of IC22 will go low, and pin 6 high, for as long as a key is held. The "high" on pin 6 drives current into pin 13 of IC30 with acts as an integrator (with C24) to give a linear attack.

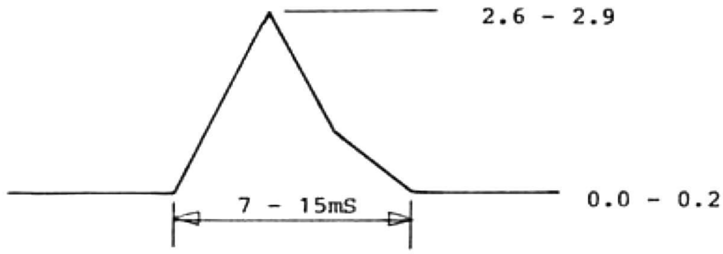
When the key is released the current into pin 13 disappears and the analogue switch in the circuit turns on, connecting R79 and VR9 as a decay path for C24. This gives an exponential decay.

If pin 8 is at 0 volts and pin 13 at + 0.6 volts but the output of IC30 is unexpectedly high do not immediately suspect IC30 but check for a dry joint in R79 or VR9 since the lack of a decay path can result in the output of IC30 being stuck high.

27. Turn up the ATTACK and DECAY controls (VR8, VR9) and observe their effects on the leading and trailing edges of the waveform. The attack time should lie between 4.0 and 8.0 seconds and the decay time (measured only down to the + 2 volt level because of the exponential shape) should lie between 4.5 and 9.0 seconds. Leave both controls turned off.

Control Envelope Generator Check.

28. Put the scope probe on the bottom of R60 (180k between IC22-26). Touch any key repetitively and observe one waveform as below for each touch. If correct go to Step 29.




This circuit is triggered simultaneously with the VCA Envelope Generator, from the stretched pulse on C17. C18 speeds up the edge of this pulse for greater reliability. When pin 3 of IC26 is triggered this IC sets (pin 1 high, pin 2 low). This turns on the analogue switch IC29 pins 6-8 and turns off the switch pins 10-12. This injects the collector current of Tr4 into pin 12 of IC30 which acts as an integrator and gives a linear attack.

The output (pin 10) of IC30 rises until it crosses the switching threshold of IC26 pin 4, approx 2.5 volts. This forces IC26 to reset. The analogue switches change state so now the collector current of Tr5 is injected into pin 11 of IC30, producing a linear decay.

With the FILTER CONTOUR control VR7 central the collector currents of Tr4 and Tr5 will be nominally equal since the circuit is symmetrical. Thus the attack and decay times will ideally be equal as shown in the diagram. Any gross inequality should be investigated.

29. Turn the FILTER CONTOUR control fully off. This increases the collector current of Tr5 only slightly but decreases that of Tr4 drastically. The waveform should now show an attack time of between 3 and 15 seconds, with a decay time virtually unaltered. If the attack time exceeds 15 seconds, or the circuit never completes the attack then shunt R74 (10k immediately to LH of VR7) with 100k or less if required. If the attack is under 3 seconds shunt R73 instead.

30. Turn the FILTER CONTOUR control fully on. Now the circuit should have a sharp attack and a decay time of between 3 and 15 seconds. If too long shunt R75; if too short shunt R76.

31. Leave the FILTER CONTOUR control central.

Filter Control Voltage Check.

32. Put the scope probe on the RH end of R61 or R62 (4k7 to right of IC23). Check that the FILTER CONTROL pot VR5 is central. Touch the highest key. Vary the FILTER FREQ control VR4 and observe a

d.c. level which should vary from 0.5 - 0.7 volts with the control off, smoothly to 3.3 - 3.7 volts with the control on. Note that the variation is not linear.

If some ripple is observed on the control voltage, check that the PITCH MOD is off and the FILTER CONTROL is central, and check IC12, IC15 and associated components.

33. Turn the FILTER FREQ control about 1/3 down, run a finger along the keyboard and observe a variation in the control voltage of between 20 and 50%. If correct goto Step 34.

    The control voltage is generated using a multiplier circuit IC30, Tr2, Tr3. One input to the multiplier is a current defined by R70, R71 and the KEYBOARD VOLTAGE, into pin 1 of IC30. This ensures that the filter tracks the keyboard. IC30 will adjust the emitter voltage on Tr3 so that a balancing current is set up into pin 6 (the collector current of Tr3).

    The other input to the multiplier is a variable base drive which is the sum of the outputs of IC12 and IC15 plus current through R49. The current through R49 will depend on the setting of the FILTER FREQ control.

    IC12 and IC15 act as variable-gain amplifiers, IC12 amplifying the output from the Control Envelope Generator while IC15 amplifies the output of the LFO. The gains of IC12 and IC15 are controlled by the currents into pins 5 of these ICs. These currents depend on the setting of VR5. With VR5 central very little current flows into either pin 5 so the LFO and Control Env. Gen have no effect on the filter; this provides VR5 with a "dead band".

    As VR5 is turned off more control current flows into pin 5 of IC15 and the LFO waveform begins to swep the filter. Conversely with VR5 on the Env. Gen starts to affect the filter.

    Note that if the oscillator IC2 is not functioning there is no KEYBOARD VOLTAGE and the filter control voltage as measured in Step 32 will stay at 0.6 volts independent of control settings. This sets the filter corner frequency so low there is no output from the GNAT.

    When faultfinding look for approx 0.7 volts on pins 1 and 6 of IC30, pin 5 of IC12 and pin 5 of IC15 (which all appear as forward-biased diodes). Also look for similar forward biases on Tr2 and Tr3.

<u>Filter Bias Stability Check.</u>

34. Put the scope probe on the filter output, IC22 pin 2. Touch the highest key. Vary the FILTER FREQ control and check that the d.c. level of the signal observed does not vary by more than 1 volt (it will typically sit at about + 3 volts).

If the variation is excessive there is a chance that the filter will clip the audio signal, particularly at high Q settings. The problem is an excessive bias change in one or both of the Output Transconductance Amplifiers, IC20 and IC23. 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 IC22. Change this IC.

Listening Test.

35. Connect a loudspeaker. Turn the FILTER FREQ fully on and press any key. The GNAT should produce an output; if not, check around IC17. Its control input (pin 5) should sit at about 0.7 volts and the output (pin 6) at roughly 2.2 volts. Both inputs (pins 2-3) should be at 2.5 volts. If all seems correct but there is no output, change IC17.

    Another fault involves poor control range, where there is still an appreciable output when no key is touched. Change IC17.

    The output from IC17 is about 1 volt peak-to-peak with the FILT FREQ control at maximum and Q at minimum. If such a signal is present but the GNAT still gives no sound, check IC34. No signal will be seen at pin 3 since this is a virtual earth, but about 4 volts p-p should be seen on pin 5. If this is not so, change IC34. Otherwise check C27, the loudspeaker, and the wiring to the LINE OUT cutout switch.

36. Reset all controls as in Step 12.

37. Check all footages; check IC3 and IC4 if any footage does not sound.

38. Set to 8-foot. Switch S2 to squarewave, enhance and noise positions and verify the various tones. Noise should be present since the noise generator was checked earlier. If the ENHANCE signal sounds like an ordinary squarewave check that IC7 is oscillating. Pin 12 of this IC should show a roughly symmetrical triangle wave between 2.2 volts and 3.8 volts at a frequency of about 1/3 Hz. This is used to modulate the threshold of IC7 pin 1 and thus the m/s ratio of the output, pin 4.

39. Turn the GLIDE control fully on and hit a low note followed by a high note. The glide should take between 1 and 4 seconds for the full keyboard. If it "sticks" on the way up, suspect a leaky C5.

40. Leave the GLIDE control off.

41. Turn S2 to NOISE. Set the FILT FREQ control 2/3 up. Turn Q fully up. Touch a high key then a low key and note the variation in noise timbre as the filter tracks the keyboard; the high Q setting emphasises a narrow band of frequencies.

42. 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.

43. Turn S2 to sawtooth. Turn Q off. Leave FILTER FREQ about 2/3 up.

44. Check that LFO SELECT (S3) is in the sinewave position (off). Set the FILTER CONTROL (VR5) off. Touch any key. A buzz will be heard superimposed on the note. Rotate the LFO FREQ control acw and check that the buzz slows to one sweep per second, or slower.

45. Check that the other positions of the LFO SELECT switch operate. The rising and falling sawtooth waveforms can be distinguished, as can the squarewave and sampled noise ("random") effects.

46. Reset S3 to sinewave and turn the PITCH MOD control VR2 fully on. Note the regular rise and fall of pitch.

47. Leave the PITCH MOD off.

48. Turn the FILTER FREQ control fully off. Lightly touch the keyboard repetitively, listening closely to the loudspeaker. A click will be heard for each touch. Adjust the VCA BALANCE preset PR2 for minimum click.

49. Turn FILTER CONTROL (VR5) on full. Check that FILTER CONTOUR is still central. Press any note repetitively and note a rapid sweep of the filter (a "blip") for each press. Note that the GNAT provides an upwards sweep only.

50. Turn the FILTER CONTOUR control off, touch any key and note that the sweep now has a slow attack and fast return.

51. Turn the CONTOUR control fully on and note the reverse.

52. Leave the CONTOUR control central.

53. Repetively hitting any key, advance the ATTACK control and the DECAY/RELEASE control and note their effects on the VCA envelope.

54. Reset both ATTACK and DECAY off.

55. Holding down a low note, press and release a high note and check that the low note returns.

56. Scrape the keyboard clean and further clean it with solvent. Apply a self-adhesive plastic overlay carefully. Now re-check the KBD SENS settings - adjust R81 so that the GNAT self-triggers with KBD SENS halfway.

57. Play from one end of the keyboard to the other, listening for dropouts or wrong coding. If a coding fault is evident, use the LINK socket as in the next step to determine whether the fault lies in the keyboard or coding logic.

58. Connect the LINK socket to another GNAT, WASP or DELUXE and check that it functions.

59. Link the LINE OUT socket to the EXT INPUT on a DELUXE and check that audio is generated. Alternatively plug headphones into the LINE OUT socket, when a very weak mono signal should be heard.

60. Switch to 8-foot pitch and hold down note A3 (fourth from top). Check that by varying the TUNING preset (PR1) the GNAT will reach at least one tone either side of A440, as determined by comparison with a calibrated synth. Shunt R6 with 120k or so if the tuning is too low. Finally set tuning exactly to A440.

J. A. Gaeth.
28 June 1981

# Note Digital Encoding

| EDP desig | F | E | D | C | B | A | Gnat | | | | Wasp | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Digital encoding | | | | | | 4051 | | | | 4028 | | | | |
| | 4040 output pins: | | | | | | Inh | Sel C | Sel B | Sel A | D | C | B | A | active |
| Note | 14 | 12 | 13 | 4 | 2 | 3 | 13.4 | 12 | 13+14 | 14+4 | 14 | 12 | 13 | 4 | o/p |
| C (top) | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | q0 |
| B | 0 | 0 | 0 | 0 | 0 | 1 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | q0 |
| A# | 0 | 0 | 0 | 0 | 1 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | q0 |
| A | 0 | 0 | 0 | 0 | 1 | 1 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | q0 |
| G# | 0 | 0 | 0 | 1 | 0 | 0 | | 0 | 0 | 1 | 0 | 0 | 0 | 1 | q1 |
| G | 0 | 0 | 0 | 1 | 0 | 1 | | 0 | 0 | 1 | 0 | 0 | 0 | 1 | q1 |
| F# | 0 | 0 | 0 | 1 | 1 | 0 | | 0 | 0 | 1 | 0 | 0 | 0 | 1 | q1 |
| F | 0 | 0 | 0 | 1 | 1 | 1 | | 0 | 0 | 1 | 0 | 0 | 0 | 1 | q1 |
| E | 0 | 0 | 1 | 0 | 0 | 0 | | 0 | 1 | 0 | 0 | 0 | 1 | 0 | q2 |
| D# | 0 | 0 | 1 | 0 | 0 | 1 | | 0 | 1 | 0 | 0 | 0 | 1 | 0 | q2 |
| D | 0 | 0 | 1 | 0 | 1 | 0 | | 0 | 1 | 0 | 0 | 0 | 1 | 0 | q2 |
| C# | 0 | 0 | 1 | 0 | 1 | 1 | | 0 | 1 | 0 | 0 | 0 | 1 | 0 | q2 |
| | 0 | 0 | 1 | 1 | 0 | 0 | 1 | | | | 0 | 0 | 1 | 1 | |
| not | 0 | 0 | 1 | 1 | 0 | 1 | 1 | | | | 0 | 0 | 1 | 1 | nc |
| used | 0 | 0 | 1 | 1 | 1 | 0 | 1 | | | | 0 | 0 | 1 | 1 | |
| | 0 | 0 | 1 | 1 | 1 | 1 | 1 | | | | 0 | 0 | 1 | 1 | |
| C | 0 | 1 | 0 | 0 | 0 | 0 | | 1 | 0 | 0 | 0 | 1 | 0 | 0 | q4 |
| B | 0 | 1 | 0 | 0 | 0 | 1 | | 1 | 0 | 0 | 0 | 1 | 0 | 0 | q4 |
| A# | 0 | 1 | 0 | 0 | 1 | 0 | | 1 | 0 | 0 | 0 | 1 | 0 | 0 | q4 |
| A | 0 | 1 | 0 | 0 | 1 | 1 | | 1 | 0 | 0 | 0 | 1 | 0 | 0 | q4 |
| G# | 0 | 1 | 0 | 1 | 0 | 0 | | 1 | 0 | 1 | 0 | 1 | 0 | 1 | q5 |
| G | 0 | 1 | 0 | 1 | 0 | 1 | | 1 | 0 | 1 | 0 | 1 | 0 | 1 | q5 |
| F# | 0 | 1 | 0 | 1 | 1 | 0 | | 1 | 0 | 1 | 0 | 1 | 0 | 1 | q5 |
| F | 0 | 1 | 0 | 1 | 1 | 1 | | 1 | 0 | 1 | 0 | 1 | 0 | 1 | q5 |
| E | 0 | 1 | 1 | 0 | 0 | 0 | | 1 | 1 | 1 | 0 | 1 | 1 | 0 | q6 |
| D# | 0 | 1 | 1 | 0 | 0 | 1 | | 1 | 1 | 1 | 0 | 1 | 1 | 0 | q6 |
| D | 0 | 1 | 1 | 0 | 1 | 0 | | 1 | 1 | 1 | 0 | 1 | 1 | 0 | q6 |
| C# | 0 | 1 | 1 | 0 | 1 | 1 | | 1 | 1 | 1 | 0 | 1 | 1 | 0 | q6 |
| | 0 | 1 | 1 | 1 | 0 | 0 | 1 | | | | 0 | 1 | 1 | 1 | |
| not | 0 | 1 | 1 | 1 | 0 | 1 | 1 | | | | 0 | 1 | 1 | 1 | nc |
| used | 0 | 1 | 1 | 1 | 1 | 0 | 1 | | | | 0 | 1 | 1 | 1 | |
| | 0 | 1 | 1 | 1 | 1 | 1 | 1 | | | | 0 | 1 | 1 | 1 | |
| C (btm) | 1 | 0 | 0 | 0 | 0 | 0 | | 0 | 1 | 1 | 1 | 0 | 0 | 0 | q8 |
| 4040 reset | 1 | 0 | 0 | 0 | 0 | 1 | 14 AND 3 | | | | q8 AND 3 | | | | q8 |

Notes:

1. The Gnat and Wasp both have 25 notes, so span 3 octaves: if the top two bits represent which octave, 4 bits are needed to cover the 12 notes within each octave. This leaves 16-12=4 numbers per octave that are not used. The way the Wasp and Gnat handle these gaps is quite different. The Gnat switches the keys through a 4051/multiple 4052 combination, and inhibits the 4051 during the unwanted counts. The Wasp uses a 4028/4016/multiple 4052 combination, and there are no connections at the 4028 at the unwanted counts.

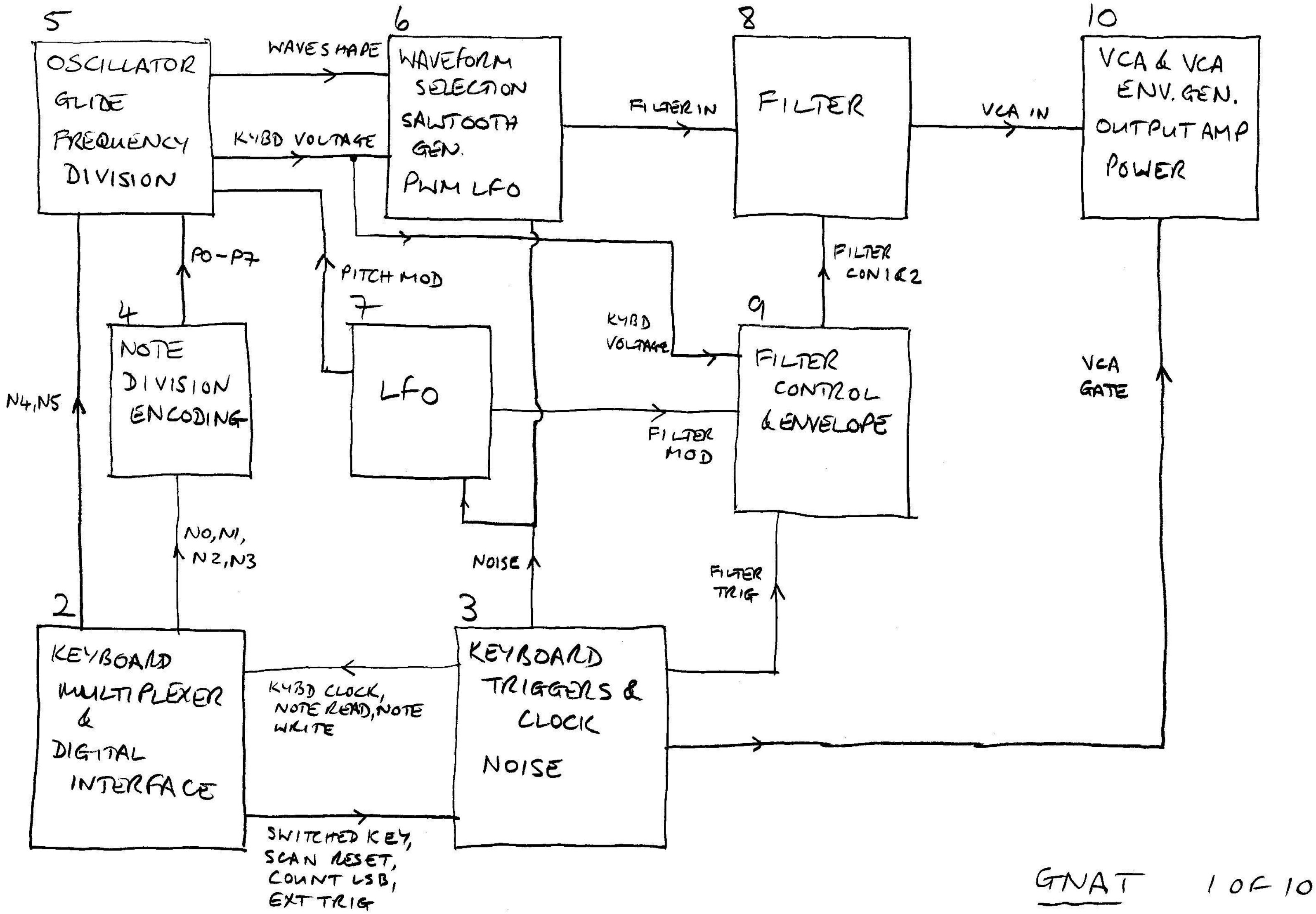
2. In the 4051 column, the 'Inh', 'Sel C' etc. refer to the 4051 input lines; underneath are the 4040 pins driving these, in the appropriate combinations, e.g. '13.4' is 'pin 13 AND pin 4', '13+14' is '13 OR 14' etc.

3. In the 4028 column, the letters refer to the 4028 inputs; underneath are the 4040 pins driving them (just the columns at left repeated so the patterns can be seen). The 'qx' refer to the output line of the 4028 driven high according to the given inputs; 'nc' means that line is 'not connected' (to any 4016 switch).

4. In both the Wasp and Gnat the same 4052 select lines are driven by the same 4040 pins: 'Sel A' by pin 3; 'Sel B' by 2.

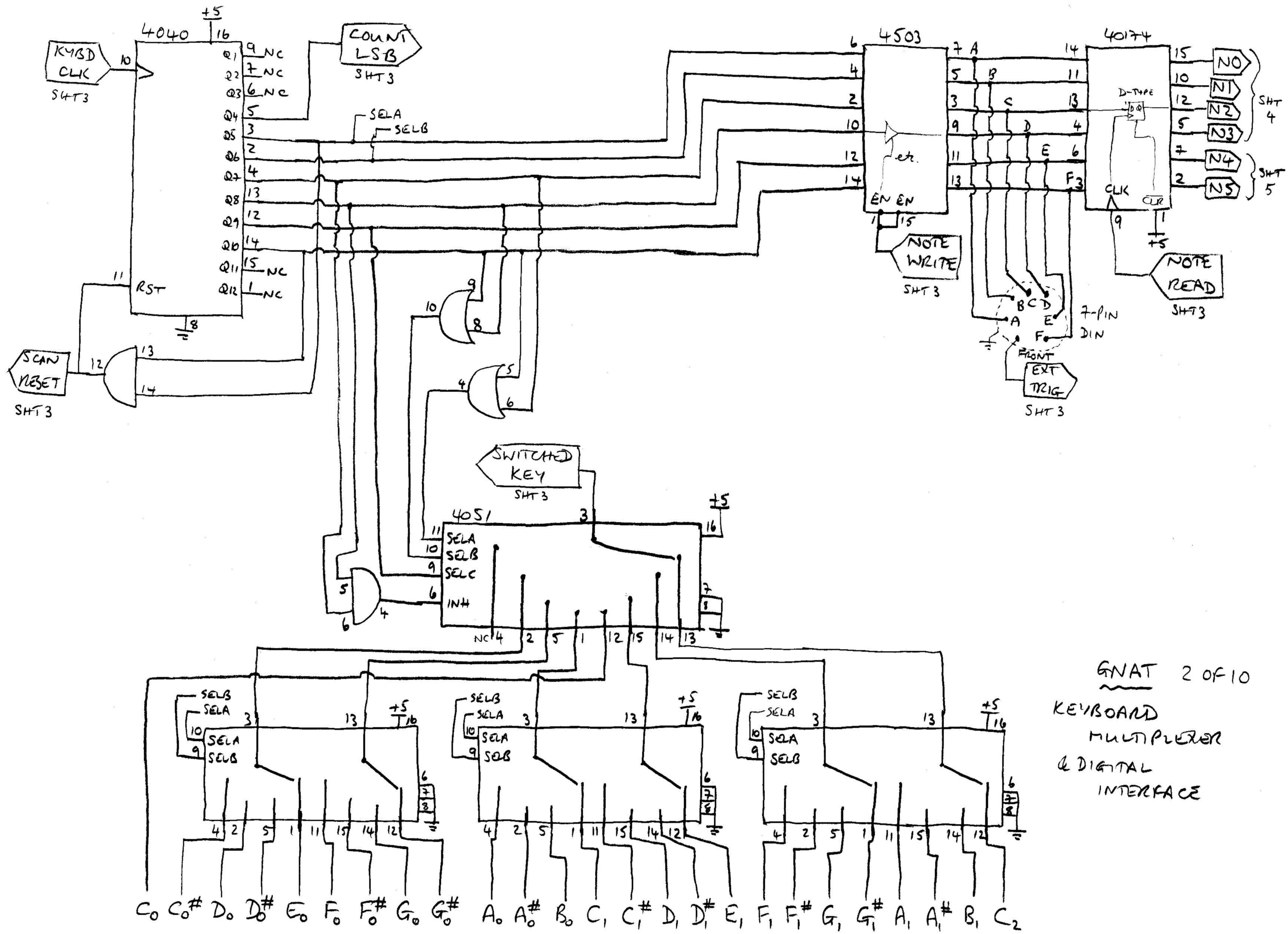
5. 'EDP desig' refers to the original designation of the equivalent of these lines at the tri-statable interface (i.e. between the buffers), as shown on the Wasp hand-drawn schematics.

6. Where obvious, some entries have been omitted for clarity.



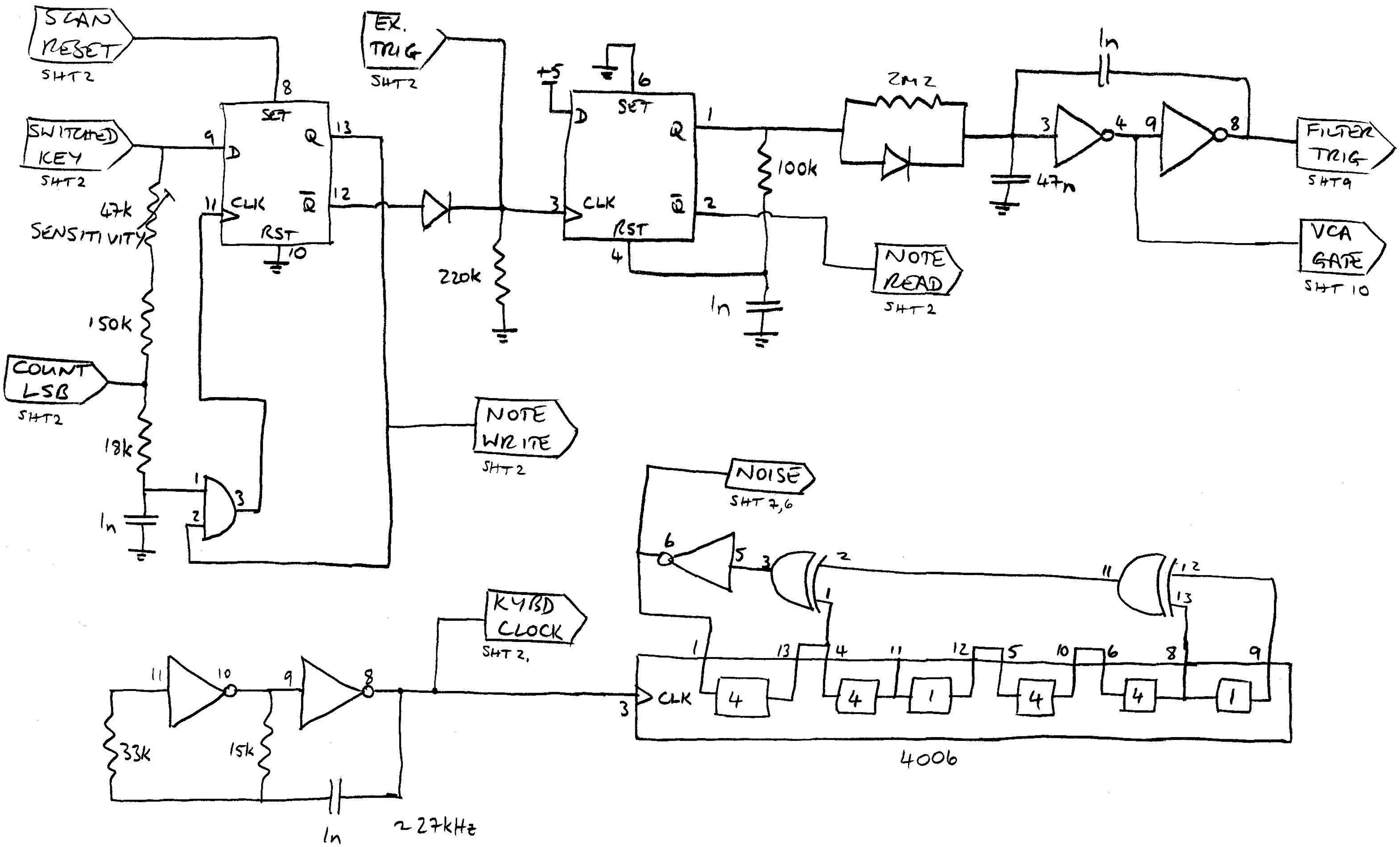

GNAT 1 OF 10

BLOCK DIAGRAM



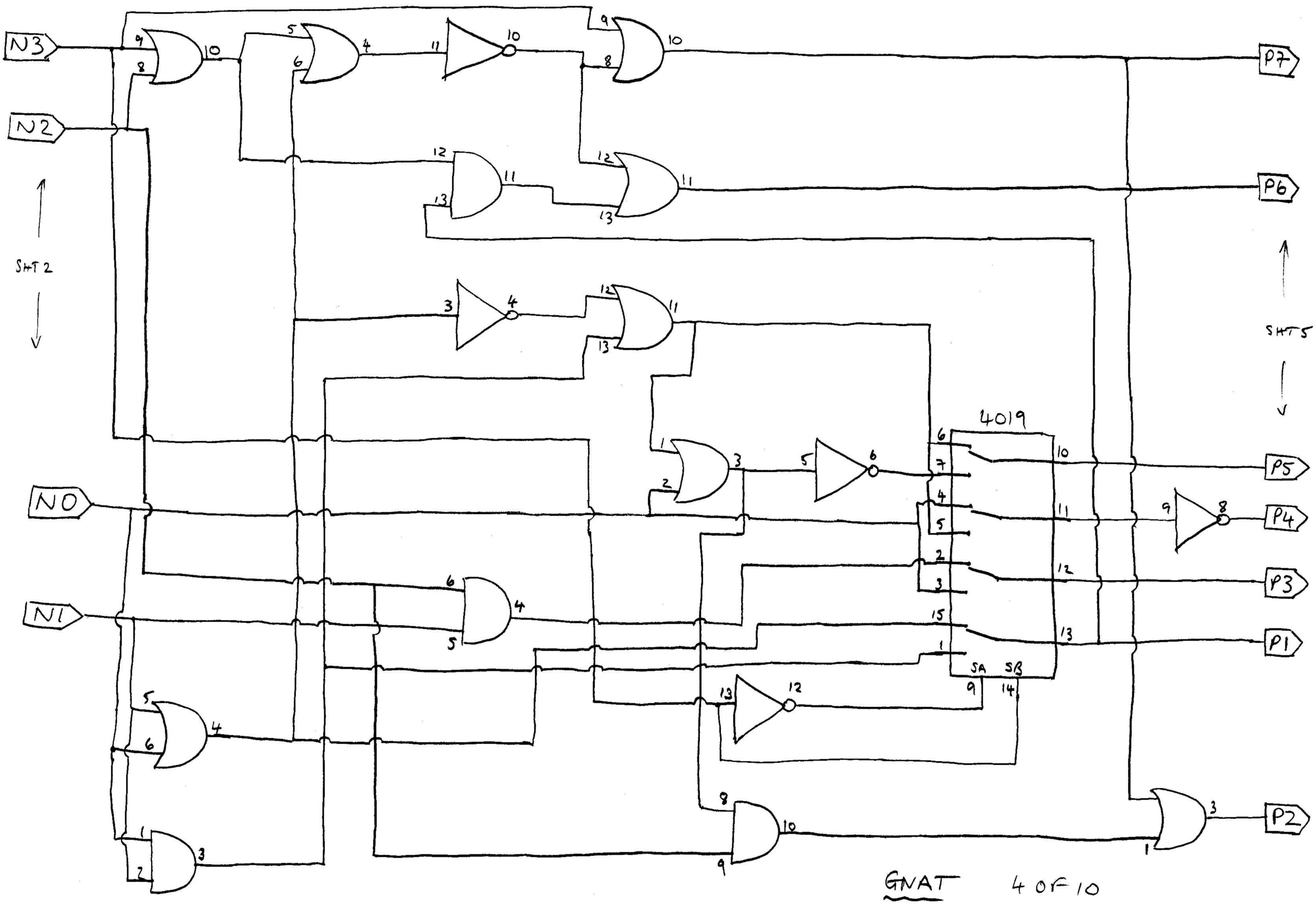

GNAT 2 OF 10

KEYBOARD MULTIPLEXER & DIGITAL INTERFACE



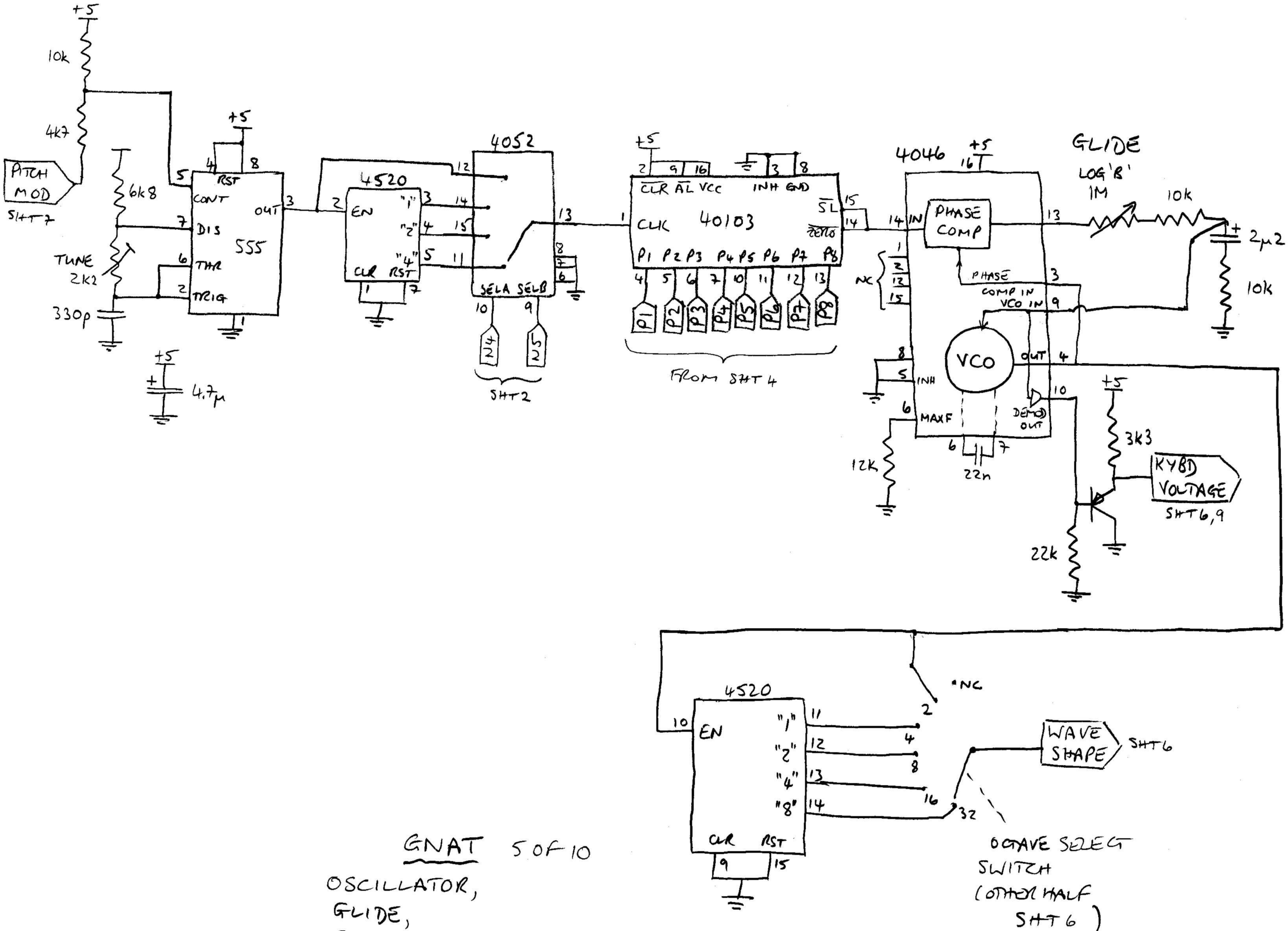

GNAT 3 OF 10

KEYBOARD TRIGGERS & CLOCK, NOISE




GNAT 4 OF 10

NOTE DIVISION ENCODING

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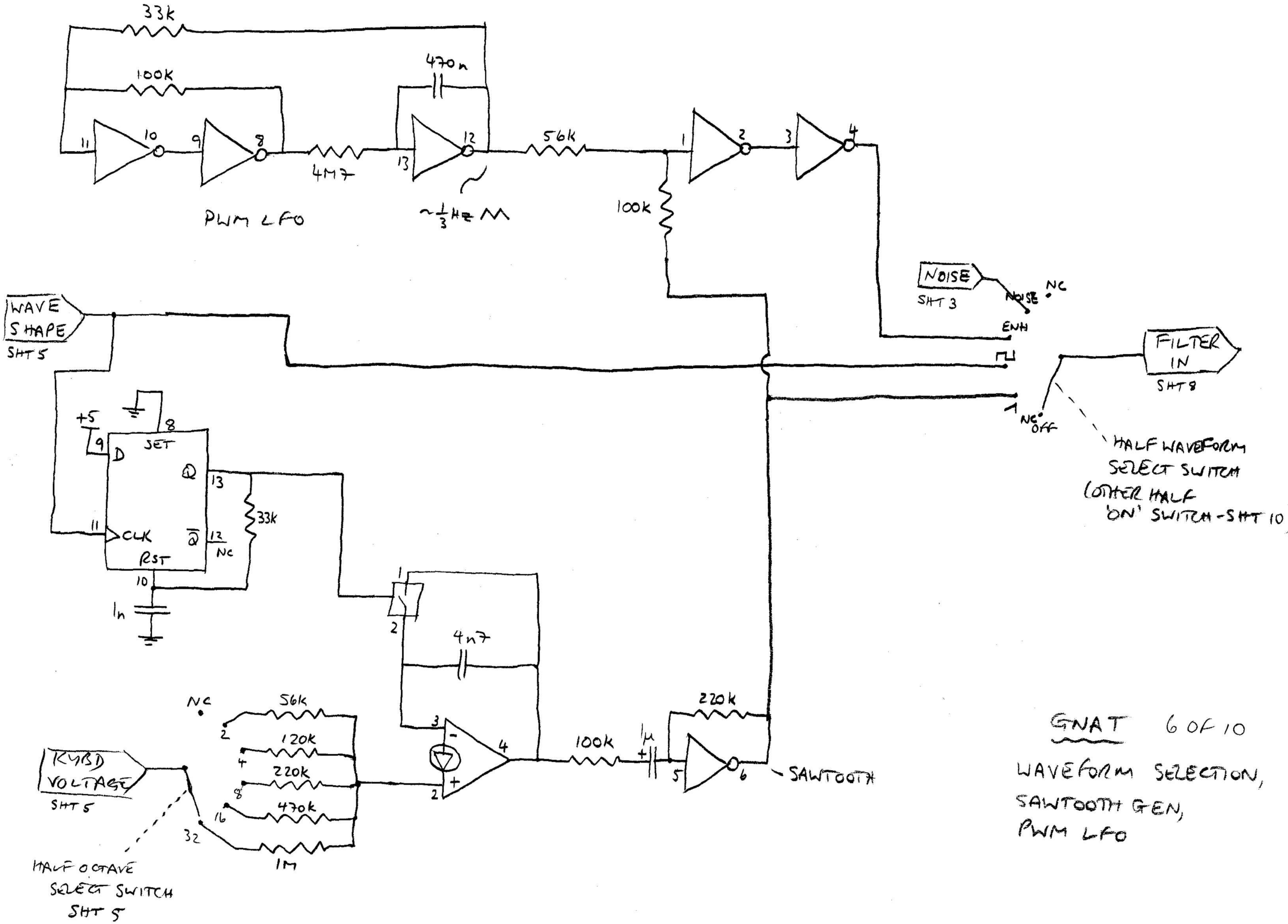
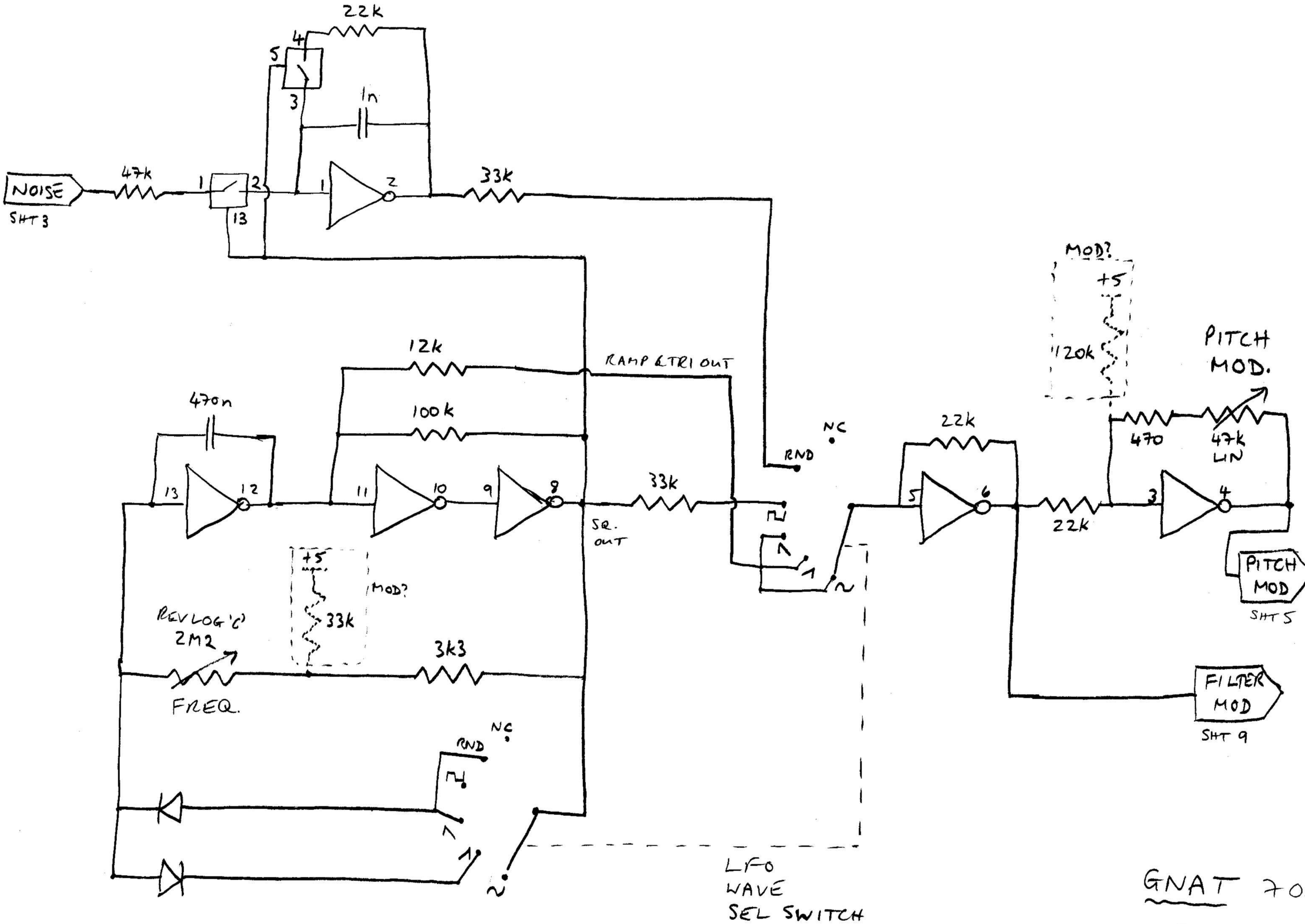
OSCILLATOR,
GLIDE,
FREQUENCY DIVISION



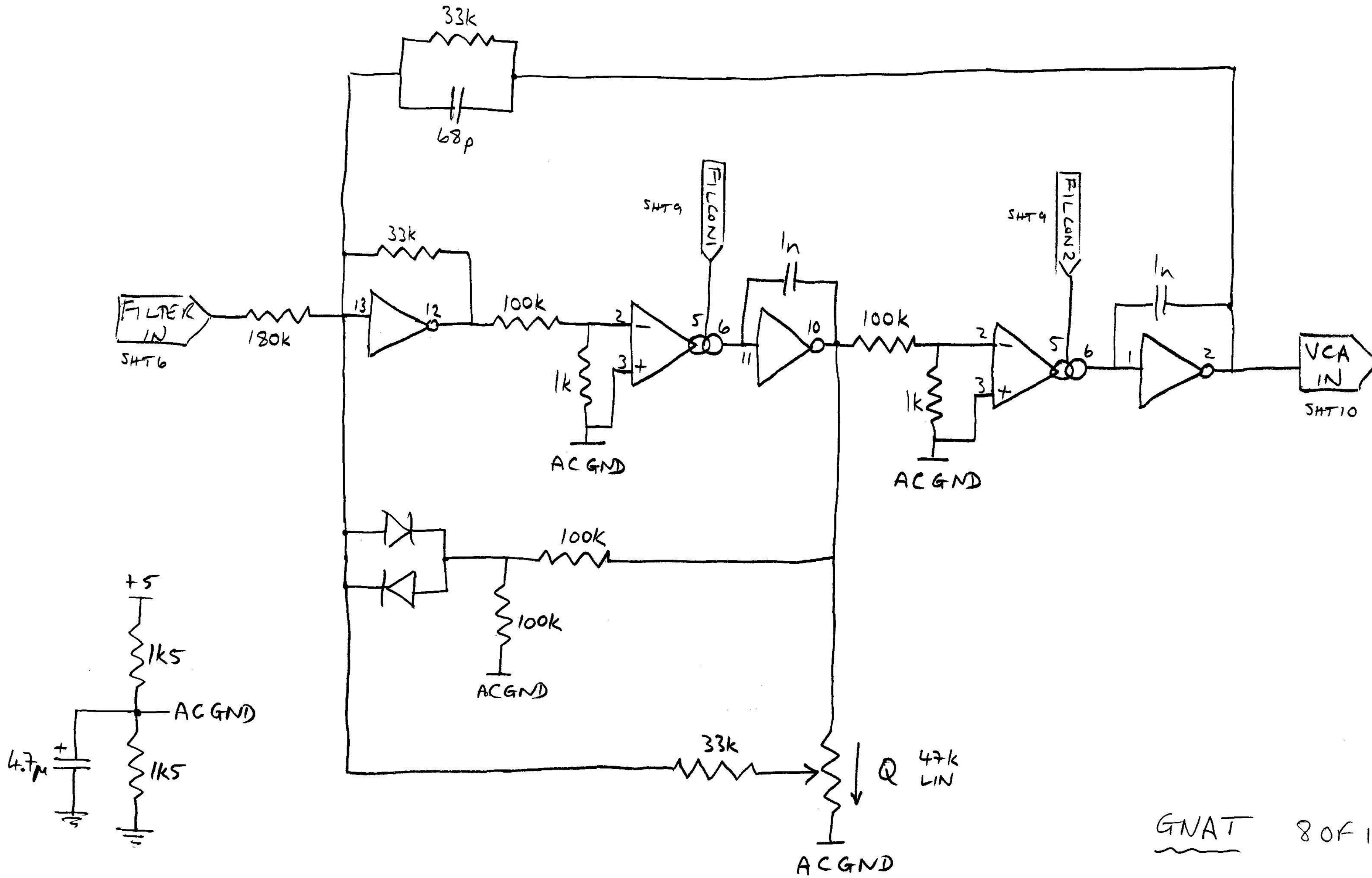

GNAT 6 OF 10

WAVEFORM SELECTION,
SAWTOOTH GEN,
PWM LFO




GNAT 7 OF 10

LFO

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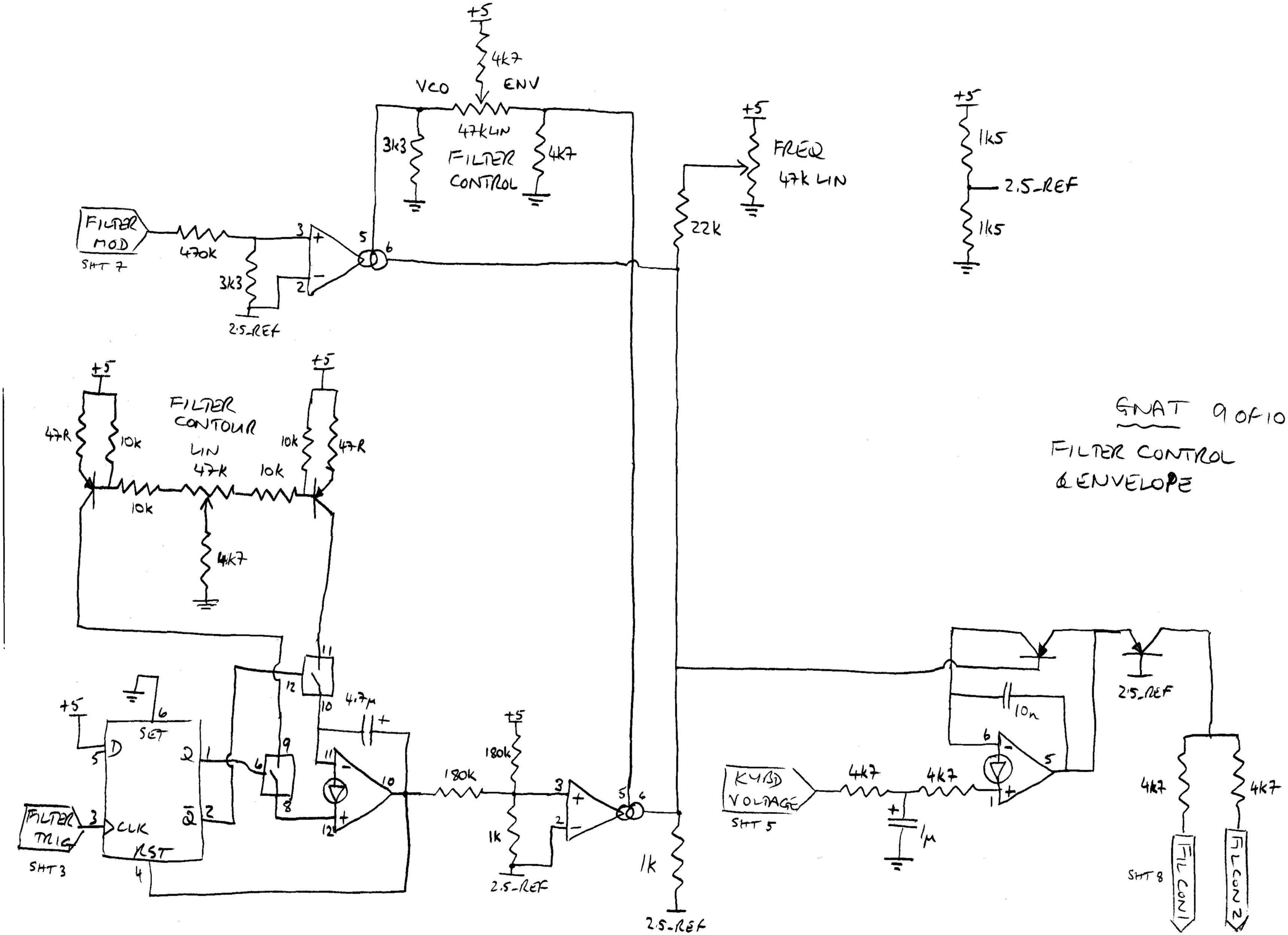
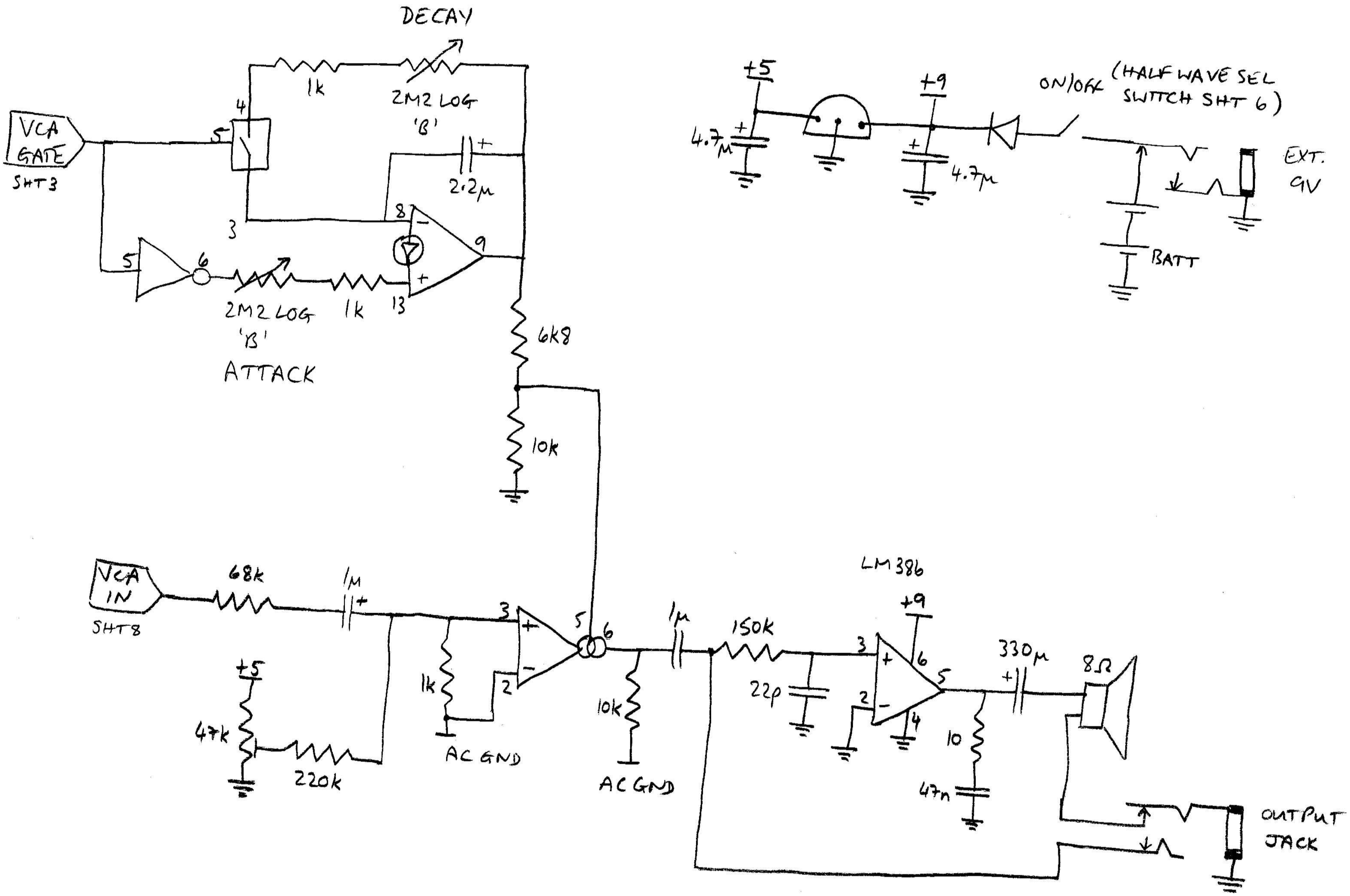
LOW-PASS FILTER


GNAT 9 OF 10
FILTER CONTROL
& ENVELOPE
+5
4k7
VCO
ENV
47kLIN
FILTER
CONTROL
3k3
4k7
FREQ
47k LIN
22k
1k5
2.5_REF
1k5
FILTER
MOD
SHT 7
470k
3k3
2.5_REF
FILTER
CONTOUR
LIN
47k
47R
10k
10k
10k
47R
10k
4k7
SET
D
CLK
Q
RST
FILTER
TRIG
SHT 3
4.7µ
180k
180k
1k
2.5_REF
1k
2.5-REF
10n
2.5_REF
KYBD
VOLTAGE
SHT 5
4k7
4k7
1µ
4k7
4k7
SHT 8
FIL CON1
FIL CON2




GNAT 10 OF 10

VCA
VCA ENV GEN
O/P AMP, POWER