DS-2
DIGITAL SEQUENCER

Instruction
and
Service
Manual

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IF YOU'RE IN A HURRY . . .

CONNECTING THE DS-2 TO YOUR SYNTHESIZER

1. The DS-2 stores *control voltage* signals from your synthesizer: Connect a patch cord from your control voltage output to the jack labeled "CV IN" on the back of the DS-2.

2. The DS-2 sends stored control voltages back to your synthesizer: Connect a patch cord from the jack labeled "CV OUT" on the back of the DS-2 to the control voltage input of at least one VCO in your synthesizer.

3. The DS-2 also stores the length of time between *trigger signals* from your keyboard: Connect a patch cord from the trigger connection of your synthesizer to the jack labeled "TRIG OUT (TRIG IN)" on the back of the DS-2. (For ARP 2600's, also connects a patch cord from the "+15" jack on the DS-2 to the "GATE" jack on the 2600.)

4. For most synthesizers, the connection made in (3), above, serves for both trigger signals to the DS-2 and trigger signals from the DS-2. For certain synthesizers, however, an additional patch cord must be connected between "TRIG IN" on the DS-2 to the trigger output on your synthesizer.

5. Set up a standard keyboard patch on your synthesizer, using as your sound source only the VCO(s) that are under the control of the DS-2. Be sure, of course, that the synthesizer is turned on.

GETTING READY WITH THE DS-2

1. Turn on the power to the DS-2 with the power switch in the lower left corner of the upper panel.

2. Press the first LOAD button on the right-hand side of the lower panel.

3. Set the CLOCK RATE knob so the arrow is pointing to the "12 o'clock" position.

4. Be sure that the three toggle switches in the middle of the lower panel are off (down).

AND NOW USE IT. IT'S AS SIMPLE AS . . .

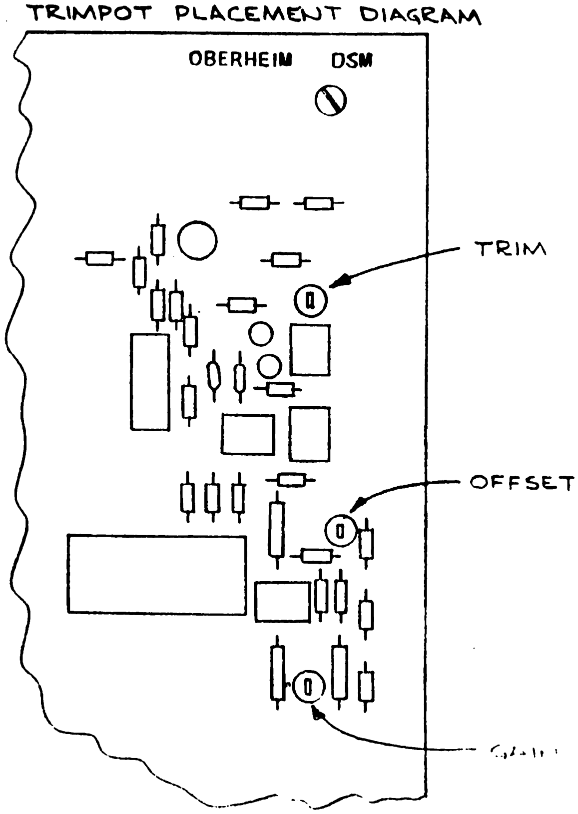
. . . ABC. Play any series of notes—high, low, long, short, but not more than 24. As soon as you've hit the last one, punch the TERMINATE button. You will hear the sequence repeated exactly by your synthesizer, under the control of the DS-2.

MAKING THE ADJUSTMENTS

The DS-2 stores control voltages from your synthesizer which occur in discrete increments, namely 1/12 volt per semitone. While most popular synthesizers (such as Arp and Moog) *nominally* put out such a voltage, in reality, the *actual* voltage put out by your synthesizer may be slightly different. If your DS-2 is not precisely adjusted for your synthesizer, notes may sound flat or sharp during play, and/or certain notes may be skipped or repeated when a chromatic scale is loaded into the DS-2. *However, don't make these adjustments needlessly if the pitch of the DS-2 during playback seems okay.*

The diagram below shows the locations of the three DS-2 adjustments:

TRIMPOT PLACEMENT DIAGRAM



All adjustment procedures assume that the DS-2 is connected to your synthesizer and sequences can be loaded and played back.

1. TRIM Adjustment

This adjustment doesn't actually have anything to do with your synthesizer and, when adjusted at the factory, shouldn't require any further attention. It is accomplished by alternately *connecting* and *removing at the synthesizer* the patch cord that comes from "CV OUT" and adjusting the "Trim" adjustment until no pitch change is discernible. The DS-2 should be in LOAD mode.

2. OFFSET Adjustment

Load a one-note sequence into the DS-2, with the one note being the lowest note on your keyboard. After terminating in the normal way, alternately press the LOAD and PLAY buttons and adjust the "Offset" adjustment until no pitch change is heard.

3. GAIN Adjustment

Load a one-note sequence into the DS-2, with the one note being a few notes above the lowest note on your keyboard. After terminating, alternately press the LOAD and PLAY buttons and adjust the "Gain" adjustment until no pitch change is heard. Repeat this operation several times, with the single note being higher and higher on the keyboard until the adjustment has been made for the highest note. It is important to work up the keyboard in this manner because it is quite possible to have the highest note right on while skipping or repeating notes in the middle of the keyboard.

THE NITTY-GRITTY DETAILS

"OK, NOW WHAT?" (THE CONTROLS, ONE AT A TIME)

1. Don't be so impatient. You've gotten this far in record time. You'll get to the rest fast enough just by taking things one at a time. First of all, there's the CLOCK RATE knob. While the sequence you just recorded is still playing, turn the knob slowly clockwise a little. The tempo of the sequence will speed up. Turn it counterclockwise and the tempo will slow down.

2. After you've messed around with the clock rate for a while, return it to its 12-noon position and take a look at the left-hand side of the lower panel. There are four pushbutton switches and three knobs. The bottom button is lighted. Push the one just above it; then turn the knob next to that button in any direction. What happens? As the knob is turned to the left, the pitch of your note-sequence goes down. As you turn it to the right, the pitch goes up. The other two switches work the same way. Spend as long as you like familiarizing yourself with these TRANSPOSE controls.

3. By this time you're probably getting bored silly with hearing the same sequence of notes over and over. You can stop the sequence by punching TERMINATE. It will start over again, from the beginning, every time you punch the PLAY 1 button. *Note: When you stop the sequence, you may hear a continuous tone still coming from your synthesizer. If you do, bring down the SUSTAIN level on your envelope generator and form the habit of working with only the first two variables on the generator, i.e., ATTACK TIME and INITIAL DECAY TIME (sometimes this is called simply DECAY).*

4. So much for starting and stopping. Now observe the toggle switch in the middle of the lower panel, labeled STEP. Push it up (on). Punch PLAY 1. Again. Again. Again. Still again. Once more—well, you've got the idea. Using the DS-2 this way lets you step through your sequence one event at a time, in any new rhythm you please. More on the STEP switch later.

5. Now do a new sequence. This time think out musically (if you didn't do that with the first one) what you might want to do with it. Remember that the DS-2 is a *musical* accessory for your synthesizer, and think about how you join the last note of your sequence back to the first one. Load it into section number two by first pressing the LOAD 2 button, then playing the sequence on the keyboard and pressing TERMINATE.

6. The first sequence you stored is still there; you can produce it by punching the PLAY 1 button. If you want to store a new one, just push the LOAD 1 again and play a new sequence. The old one will be erased as you load the new one.

7. Altogether, you can load three different note-sequences of up to 24 notes each. Now take a look at the other two toggle switches in the center of the lower panel, labeled EXTEND 1-2 and EXTEND 2-3. Flip EXTEND 1-2 on and you'll find that if you start loading a sequence into the first section (LOAD 1) of the DS-2 and load more than 24 notes, the DS-2 will automatically switch to LOAD 2 on the 25th note. So now you can store up to 48 notes in a row.

8. Likewise, if you flip the EXTEND 2-3 switch on in addition to the EXTEND 1-2 switch, you can store up to 72 notes in a row. On the 25th note, the DS-2 will switch over automatically to the LOAD 2 position, and on the 49th it will switch to LOAD 3. *Note: If, after loading a 72-note sequence this way, you turn the EXTEND switches off, each 24-note group of notes can be activated separately.*

9. By this time you have certainly noticed that the digital number display on the upper panel does not count *time*. It counts the number of events stored in each section of the memory unit. Thus, for example, when you press LOAD 1, the counter reads 1-1, and when you have played four notes, it reads 1-4. We have noticed that beginners have a tendency to treat this like a time counter (like a metronome), and to program sequences of constant-duration notes into the DS-2. Don't limit yourself or your imagination by thinking of the sequencer this way. *Remember that your sequences do* not *have to be "sewing-machine" series of equal-length notes. They can be rhythmically varied, with note durations of anywhere from .05 sec. to about 8 sec. when the CLOCK RATE is in the 12-noon position.*

10. The only two things we haven't mentioned so far are the little red light labeled FULL and the little white light labeled MAXIMUM DURATION. The FULL light is so obvious we shouldn't have to say anything—but, just for the record, it lights up when you've stored the maximum 24 notes in any one section of the DS-2 memory. The MAXIMUM DURATION is a little more subtle—basically, it tells you when you're about to reach the maximum length for *one event*. Exactly how long that is depends on the CLOCK RATE setting. It's longer for slow rates and shorter for fast ones. With the CLOCK RATE set at 12 noon, the maximum duration is about eight seconds, and the MAXIMUM DURATION light comes on after four.

THE SOLID, ROCK-BOTTOM DETAILS (HOW IT WORKS—AND WHY)

1. Up to now, we've assumed that you didn't know, and didn't want to know, exactly what the internal details of the DS-2 were. But after a few days of playing with it, you're likely to come up with questions about those details—or some of them, at any rate—because they have a lot to do with exactly how you use the DS-2. They determine both what it *can* and what it *cannot* do. You might, by this time, be asking some questions. Typically:

   a. Why does it sometimes seem to miss notes, or make longer or shorter notes on playback than I meant to store in it?
   b. Why can't I use the SUSTAIN and FINAL DECAY on my synthesizer's envelope generator when I'm using the DS-2?
   c. What are the CLOCK OUT and CLOCK IN jacks for on the back if I'm not supposed to use them with my synthesizer?
   d. And what about the END OF SEQUENCE jack?

2. Most of these questions will be answered by just knowing the facts about how the DS-2 works. So here they are.

3. Some electronic circuits used in synthesizers are *digital* circuits and some are *analogue* circuits. Digital circuits *count;* analogue circuits—well, they sort of *flow*. If you could slow down an average digital computer by a million times or so, and see what the circuits inside it were doing, you'd find that they were—um, sort of ticking, maybe twice each second. Millions of switches, all of them with only two positions: *on* or *off*. *Everything* that the computer can do arises simply from the way the switches are hooked up to each other, and from the fact that there are so many of them. The DS-2, being a *digital* device, counts. And it counts in two ways:

   a. to determine how long a period of time elapses between the keyboard triggers it receives from your synthesizer, and
   b. to determine which of 61 possible voltages it is receiving from your synthesizer keyboard.

4. In other words, your DS-2 never really stores anything but a series of *numbers*. Special circuitry at the input and output ends of the DS-2 converts incoming voltage levels to numbers and outgoing numbers back to voltage levels again. The circuit at the input end of the sequencer is called (who would have guessed it!) an *analogue-to-digital* converter—A/D converter for short—and the output circuit is called (the opposite, of course) a *digital-to-analogue* converter, or D/A converter, or simply DAC.

5. In order to determine how much time passes between one trigger signal and the next, the DS-2 must have something to count. So there is a "clock" inside it—simply an oscillator that puts out little trigger signals of its own. The frequency of this oscillator *is determined by the CLOCK RATE knob* on the front panel.

6. When the CLOCK RATE knob is set at 12 o'clock, the oscillator frequency is equivalent to about 20Hz; in other words, the "clock" is ticking 20 times each second. When the knob is turned as far left as possible, the clock is running about 16 times slower, i.e., just a little faster than one tick each second. When the knob is turned as far right as possible, the clock runs about 16 times faster, i.e., about 320Hz.

7. The digital *counting* and *memory* units inside the DS-2 can only count and store *whole numbers. Here is your answer to question (a) on the preceding page.* If, for example, the clock is running at a frequency of 2Hz—only two ticks each second—then the counter circuit can say, in effect, "one tick" or "two ticks since the last trigger came in." It is the *number* of clock cycles that gets stored in the memory unit, and it is the *number stored* that is converted, on playback, to the time that elapses from one output trigger to the next. And so . . .

8. . . . The counter unit in the DS-2 *rounds off* stored durations to the nearest whole number of clock cycles that occur between the appearance of one trigger at the TRIG INPUT jack to the appearance of the next trigger signal.

9. For this reason, as you work more with the DS-2, you will find that it is important to set the clock correctly for LOADing sequences as well as for PLAYing them back. The faster the clock rate, the more accurately the DS-2 will remember the exact duration of each note; the slower the clock rate, the more obvious the "rounding off" effect is going to be on playback. There are some very good reasons why we set the clock rate for 20Hz in the middle of its frequency range. At 20Hz, the DS-2 can distinguish between a note with a duration of, say, .5 sec. and one of, say, .55 sec. That's a smaller difference—only .05 sec.—than most people (even musicians) can hear. For a comparison, look at paragraph (7), above, and note that at the slowest clock rate, the DS-2 can't even distinguish between a note 1 sec. long and a note 1.5 sec. long. Musically, that's a big difference.

10. There is an important trade-off, however, between *accuracy* and *maximum duration* of the sequences you store. It is based on the fact that there is a limit, too, to how high the DS-2 can count.

11. The counter in the DS-2 can count up to 256 and no further. When it is counting clock cycles to determine time-between-triggers, obviously the actual frequency of the clock is going to determine the maximum period represented by a count of 256. For example, again at 20Hz, a 2-sec. interval will be represented as a count of 40 cycles, a 2.5-sec. interval by a count of 50 cycles, and so on. The longest interval you could store would be equal to 256/20, or a little less than 13 sec. Higher clock frequencies, while increasing the *resolution* of the stored sequence, would decrease its *length*. And lower clock frequencies would have the opposite effect.

12. For similar reasons—i.e., the "rounding-off" effect—the DS-2 stores voltages in 1/12-volt increments. It will round off any control voltage given to it to the nearest 1/12 volt. This means that the control voltages it sends back to your synthesizer will always correspond to notes on a standard 12-notes-per-octave tempered scale. *Note: Of course you can produce other scales and intervals by simply attenuating the CONTROL VOLTAGE output from the sequencer. Our point here is to show you why you couldn't accomplish such a result by attenuating the control voltage that you feed* into *the DS-2.*

13. The TERMINATE button has two different roles, depending on whether it is depressed while the DS-2 is in LOAD or in PLAY mode. In PLAY mode, depressing the TERMINATE button simply stops the sequence. When you are LOADing a sequence, on the other hand, depressing the TERMINATE button (a) establishes the duration of the last note in the sequence, (b) loads an "automatic reset" signal into the memory unit, and (c) switches from LOAD to PLAY mode.

14. When used with envelope generator circuits that use independent GATE and TRIGGER inputs, such as the Arp 2600 and 2500 synthesizers, it is necessary to keep the GATE input high in order to get the TRIGGER signal to work. That is the reason for the patch-cord connection between "+15" on the back of the DS-2 and the gate jack on the 2600. When the gate voltage is kept permanently high in this fashion, the SUSTAIN and FINAL DECAY portions of the envelope should not be used.

15. The END-OF-SEQUENCE jack on the back of the DS-2 produces a trigger signal at the instant that a sequence resets to its first count. Among its possible uses are (a) triggering a S/H to change the pitch of the oscillator(s) performing the sequence or the timbre (VCF cutoff frequency) of the sequence, or both; and (b) triggering an envelope generator with relatively long attack and initial decay constants to produce an "expressive" modulation of the sequence, etc. More suggestions will be found in the section on musical uses and useful patches.

16. The CLOCK IN and CLOCK OUT jacks on the back of the DS-2 enable you to interconnect two or more units. They are not designed to accept signals from two synthesizers. Details of how to interconnect two or more DS-2 sequencers will be available in a separate short pamphlet, which will also include suggestions as to possible uses for such a setup. Please note that the signals on CLOCK IN and CLOCK OUT are not the same signals described under (5) and (6) of this section.

17. There is more to the STEP button than we told you in "The Nitty-Gritty Details," paragraph (4). And here it is. When you have loaded a long sequence into the DS-2, and you find on playback that you hit a wrong note somewhere, or a note that was too long or too short, you can use the STEP button to reload just that one note.

18. Suppose you load a simple scale passage with a wrong note—say, c-d-e-f# -g-a-b-c—and you want to change the f# to an f. Here is the procedure:

a. Flip the STEP switch on.
b. Assuming the sequence is loaded into the first-position memory, press PLAY 1. This will produce the first note in the sequence.
c. Continue to press PLAY 1 until you reach the note *just before* the wrong note.
d. Press LOAD 1.
e. Play the right note on the keyboard. Depress that key *twice*. The first time you press it, the sequencer will record the new pitch; the second time you press it, the sequencer will record the duration.
f. Switch out of the STEP mode and press PLAY 1 to check the accuracy of your revision. It may take a few times to get it right.
g. If, while in the STEP mode, a PLAY button is pressed very rapidly, the digital display may get behind in its operation. This is normal. To prevent this from happening, simply turn up the clock frequency.

INTO THE WILD BLUE:
EXAMPLES, SUGGESTIONS, PATCHES, IDEAS FOR . . .

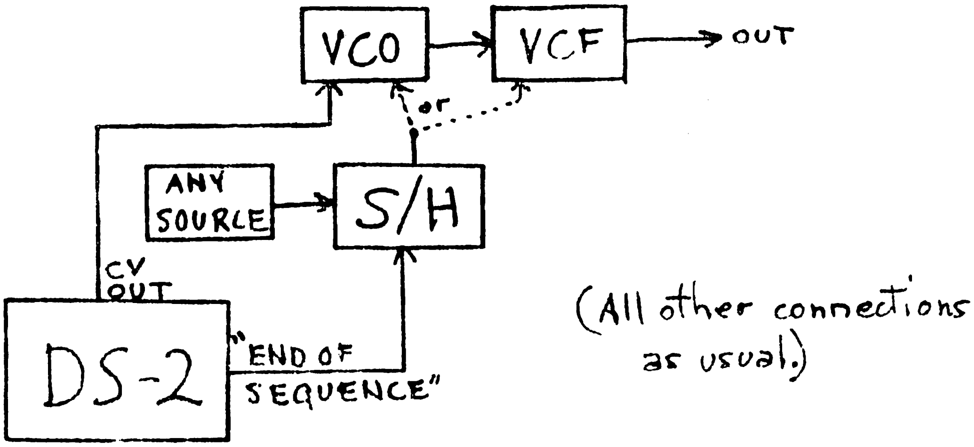
1. If you are already completely familiar with the operation of your synthesizer, there is a lot we don't need to talk about. Just using the DS-2 control voltage output as though it were a second keyboard unit will suggest doing some of the same things you've done with the keyboard you already have. Some examples:

   a. Play two VCO's tuned to fifths or fourths or major or minor thirds.
   b. Invert the DS-2 output voltage to one of the VCO's and figure out useful inverted melodic sequences.
   c. Use the trigger output to fire a sample-and-hold circuit, and then use the S/H output to control one VCO while another is under the direct control of the sequence voltage. Then feed the two VCO's into a ring modulator.
   d. Attenuate the sequencer output voltage by 50% and use it to play quarter-tones over a two-and-a-half-octave range.

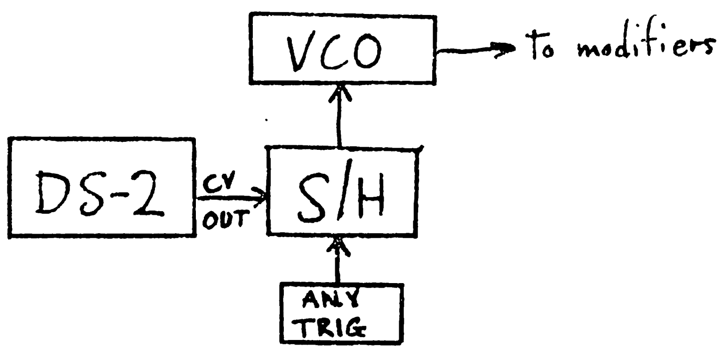
2. So happy landings on that kind of experimentation. But before you get to that, here are some simpler useful techniques just for reference.

   a. SETTING THE TRANSPOSE KNOBS. The quickest way to do this is to load a one-note sequence. Then, while the DS-2 is playing this sequence back, press each transpose button in turn and set the knob for whatever new pitch you want. From this point on, no matter what new sequences you load into the DS-2, the transpose switches will preserve the interval relationships you set them to.
   b. TEMPO OR RHYTHM CHANGES. Try loading one section of the memory with a slow bass line, one note to the measure, terminating after six measures. Load the next section with twelve notes, double time, following the same general bass line. In the last section load all 24 notes, quadruple time, again following the same general outlines. There is no limit to the complexities you can achieve this way—don't be afraid to sit down, if necessary, and figure them out in advance on a sheet of paper if you need to. You'll find that it takes some practice to do this with precision, so that each sequence is exactly the same length as each other one.
   c. CHANGING THE CLOCK RATE. This is difficult to do reliably during live performance. It helps to mark on a piece of tape around the CLOCK RATE knob beforehand; and be sure your arrangement allows for any inaccuracies when you make the change.

3. Here's a bare schematic patch illustrating one use of the "END OF SEQUENCE" output on the back of the DS-2.



4. And here's a "sample" (pardon the pun) of the kind of unorthodox use of a sequencer that Roger Powell has developed into a fine art:



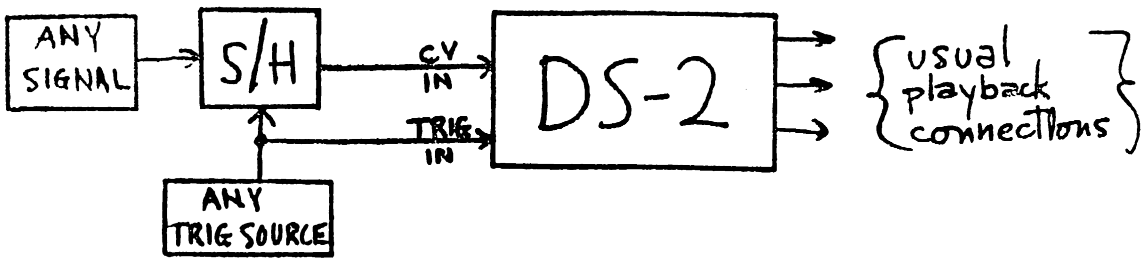
NOTES:

a. The point, of course, is that you load a sequence of only a few notes into the sequencer, then turn the clock rate as fast as it will go, and sample the result. If you're unfamiliar with this sort of thing, you'd best begin by loading something really simple—like an arpeggio on a single major chord or a scale passage.

b. Note the effect of the clock rate on the patterns you get.

c. The DS-2 is being used here only as a voltage source. There is no need to connect anything but the "TRIG IN," "CV IN," and "CV OUT."

5. If you ever get tired of loading the DS-2 directly from the keyboard, you can load it this way:



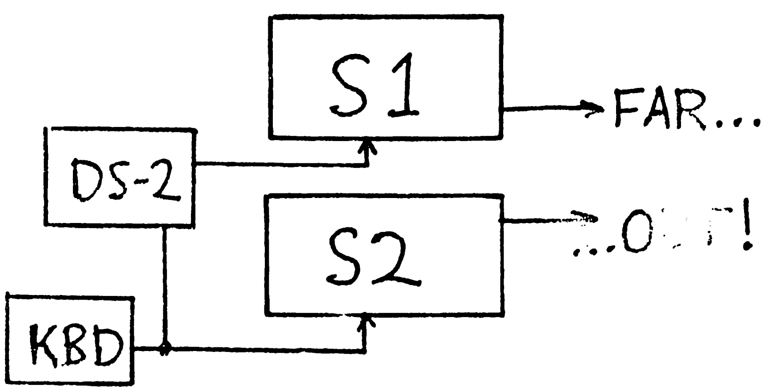
NOTES:

a. If you use noise as the signal-to-be-sampled, you've got to offset it by about +5V with the first voltage processor and cut its amplitude by about 80% at the S/H input; the DS-2 does not store negative voltages, and has a maximum positive range of 0-5V.

b. You may want to attenuate even more; five octaves is a hell of a wide range for a melody to cover. But then who are we to say you've got to be looking for a melody?

c. In some ways the "rounding off" mentioned earlier is an advantage here—even though the S/H voltages you're feeding into the DS-2 are completely random, they come back from storage "customized" to fit a chromatic, tempered scale. If that's not what you want, don't complain—there are plenty of ways to destroy the fit again.

6. Finally, the paradise patch, if you're fortunate enough to own two synthesizers:



NOTES: Who needs any at this point?!

ENJOY!

THEORY OF OPERATION

Introduction

1. The Digital Sequencer Module (DSM) is used in digital sequencer systems to store sequences of discrete analogue voltage levels upon command of trigger pulses. These analogue voltage levels and trigger pulses generally originate in an electronic music synthesizer and represent a melody played on the synthesizer keyboard. The Digital Sequencer Module has the capability of storing any of 63 discrete voltage levels as well as the time duration between trigger pulses over a wide range.

2. Two modes of operation are provided. During the LOAD mode, the discrete voltage levels are converted from analogue form to digital form and stored in a digital memory along with a digital representation of the length of time between trigger pulses. During the PLAY mode, the digital memory is accessed at a rate determined by the previously stored duration between trigger pulses, and the previously stored digital representations of the discrete voltage levels are converted to analogue form and output to the synthesizer along with DSM-generated trigger pulses.

3. The digital memory is organized in data groups called "notes." Each note data group contains 14 binary digits (bits) divided into two fields: six bits for the digital representation of a discrete analogue voltage and eight bits for the digital representation of the duration between two incoming trigger pulses. The digital memory has the capability of storing 1008 bits, thereby allowing for the storage of 72 notes. These 72 notes can be divided into three groups, or sequences, and external control panel switching can control whether the storage is of three separate sequences of up to 24 notes, or a sequence of up to 48 notes along with one of up two 24 notes, or one sequence of up to 72 notes.

4. The DSM contains a digital clock generator whose frequency can be adjusted over a wide range by an external potentiometer. If the DSM is loaded with the frequency adjust potentiometer set at a nominal value, resulting playback tempo can be varied over the range from 1/16 of original tempo to 16 times original tempo.

5. The analogue voltage received from the synthesizer is passed through an electronic switch and during the LOAD mode is sent back unaltered to the synthesizer. During PLAY mode the electronic switch causes the DSM-generated analogue voltage to be sent to the synthesizer. This allows the user to listen to the melody he is playing during LOAD and the stored sequence during PLAY.

Basic Operation

LOAD Mode

1. LOAD mode is initiated by the pressing of an external load switch. The first incoming trigger pulse resets the N, Q, D, and P counters and allows them to count. In addition, this pulse presets the M counter to the correct starting address. The output of the P counter is applied to the digital-to-analogue converter (D/A converter), and its output, which is a staircase waveform, is compared with the incoming analogue voltage. When the D/A converter staircase waveform is equal to the incoming analogue voltage, an A/D pulse is produced which transfers the contents of the P counter into the appropriate section of the shift register. The N, Q, and D counters continue counting until the next trigger pulse is received, at which time the contents of the D counter are transferred to the appropriate section of the shift register. At this point, the left six bits of the shift register contain "pitch" information and the right eight bits contain "duration" information.

2. Immediately following the trigger pulse, the 14-stage counter is started causing a group of 14 clock pulses to be generated. These 14 clock pulses cause two simultaneous events to occur: The shift register is shifted right 14 places into the memory and the M counter is counted up 14 counts. This causes the 14 bits of note data to be loaded into the next available 14-bit memory location. After all 14 bits have been loaded into memory, the N, Q, D, and P counters are reset and allowed to count, thereby beginning the processing operation of the next note.

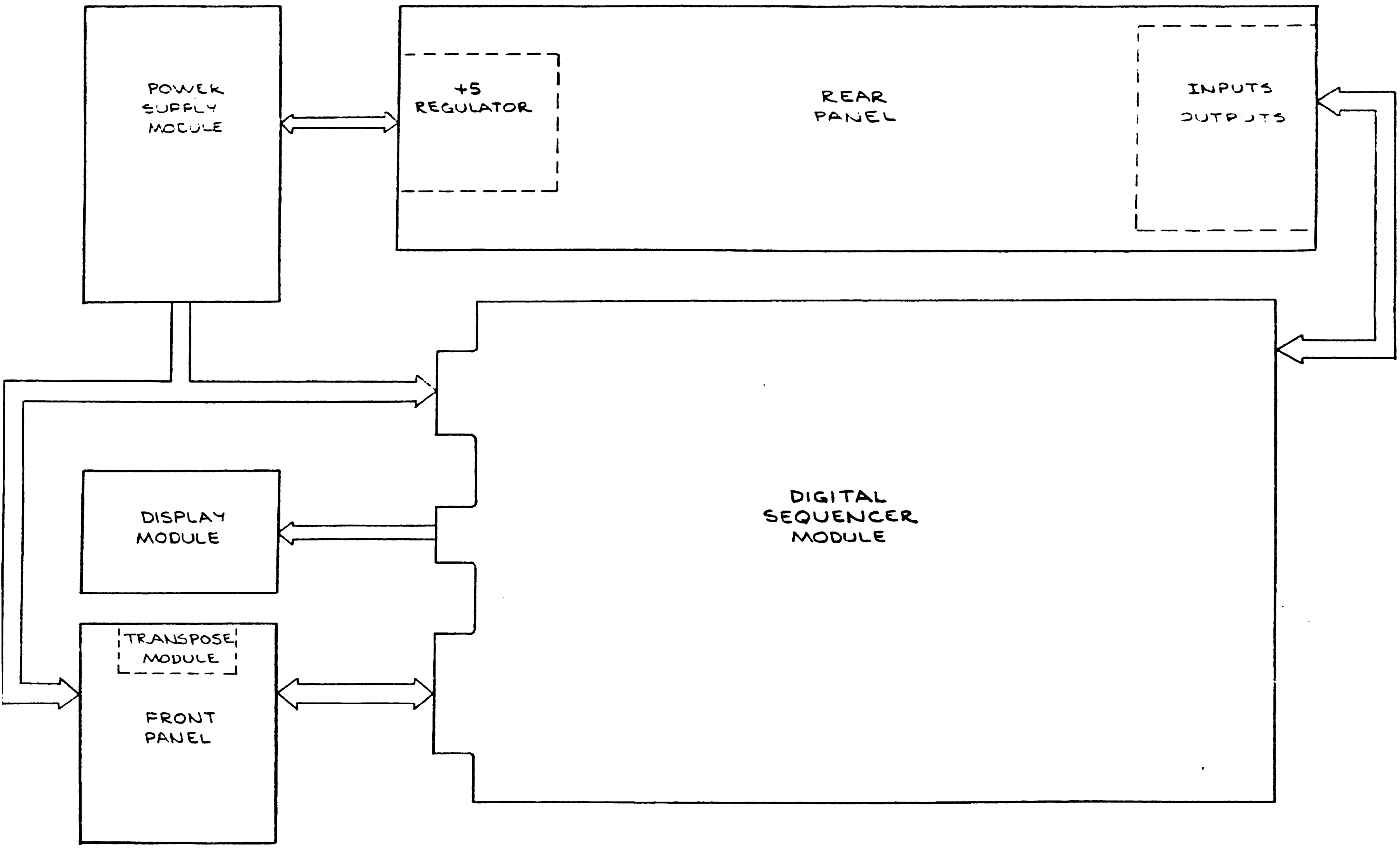
3. The LOAD operation described above is repeated for each note played and is terminated by the pressing of the external TERMINATE switch. This causes a terminate pulse to be produced which serves as a replacement for the trigger pulse in completing operations on the last note in the sequence. That is, when a terminate pulse is produced, the D counter is transferred to the shift register and the shift register is shifted into the memory, as with a trigger pulse. However, at this point a second group of 14 clock pulses is immediately generated, but instead of the shift register being shifted into memory, the next 14-bit memory location is loaded with zeroes. This all-zero location is then used in the PLAY mode to signify the end of the sequence, in the usual case in which the sequence has fewer notes than the maximum allowed. The terminate pulse also causes an automatic transfer to the PLAY mode and initiates the playback of the sequence just loaded.

PLAY Mode

1. PLAY mode is initiated by either the pressing of an external PLAY switch or by the pressing of the external TERMINATE switch while in the LOAD mode. This causes the M counter to be preset to the correct starting address and also causes the 14-stage counter to start. The 14 clock pulses produced thereby cause the first 14-bit memory location to be loaded into the shift register. In addition, a trigger pulse is generated. The eight-bit duration section of the shift register is examined and if it is not all zeroes, the left six bits of the shift register are transferred to the P counter and the right eight bits of the shift register are logically inverted (complemented) and this result is transferred to the D counter. The P counter is applied to the D/A converter and its output is sent to the synthesizer. The D counter, which now contains the complement of the note duration, is allowed to count. When it reaches the all-ones state, the 14-stage counter is again started and the above play-one-note operation is repeated.

2. Two conditions can occur which will cause the playing of the sequence to begin over with the first note. If, after being read out of memory, the duration data of a note contains all zeroes, the shift register data is not transferred to the P and D counters. Instead, an internal condition is forced which is operationally equivalent to pressing the appropriate external PLAY switch. That is, the sequence starts over from the beginning. The second condition which can cause the sequence to start over occurs when the maximum number of notes has been played. For instance, if external conditions dictate a 24-note sequence and the twenty-fourth note has just been played the sequence is automatically started over.

3. The playing of a sequence continues over and over until either the external TERMINATE switch or an external LOAD switch is pressed.



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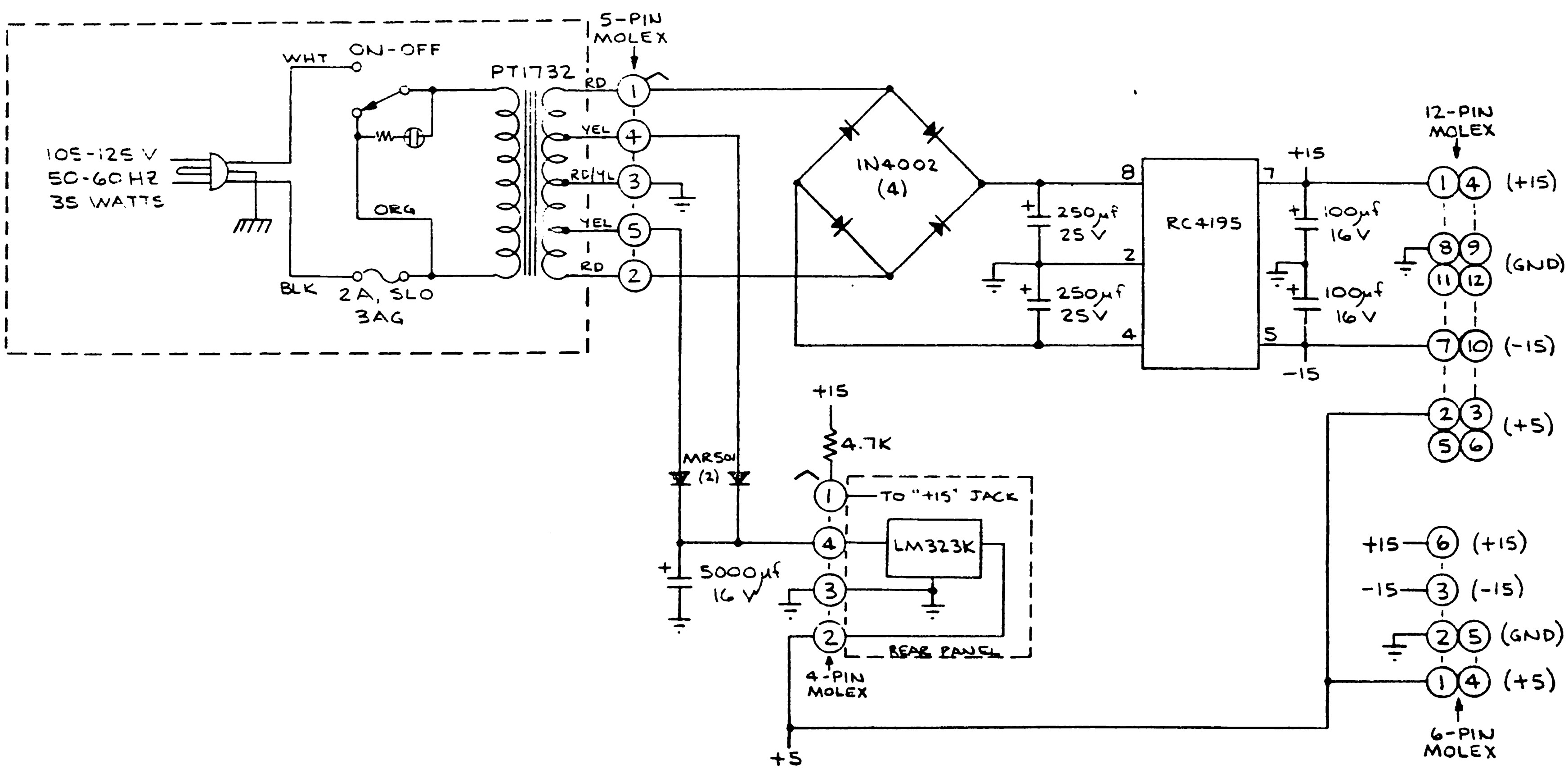
OBERHEIM ELECTRONICS, INC.

DS-2
BLOCK DIAGRAM

POWER SUPPLY MODULE



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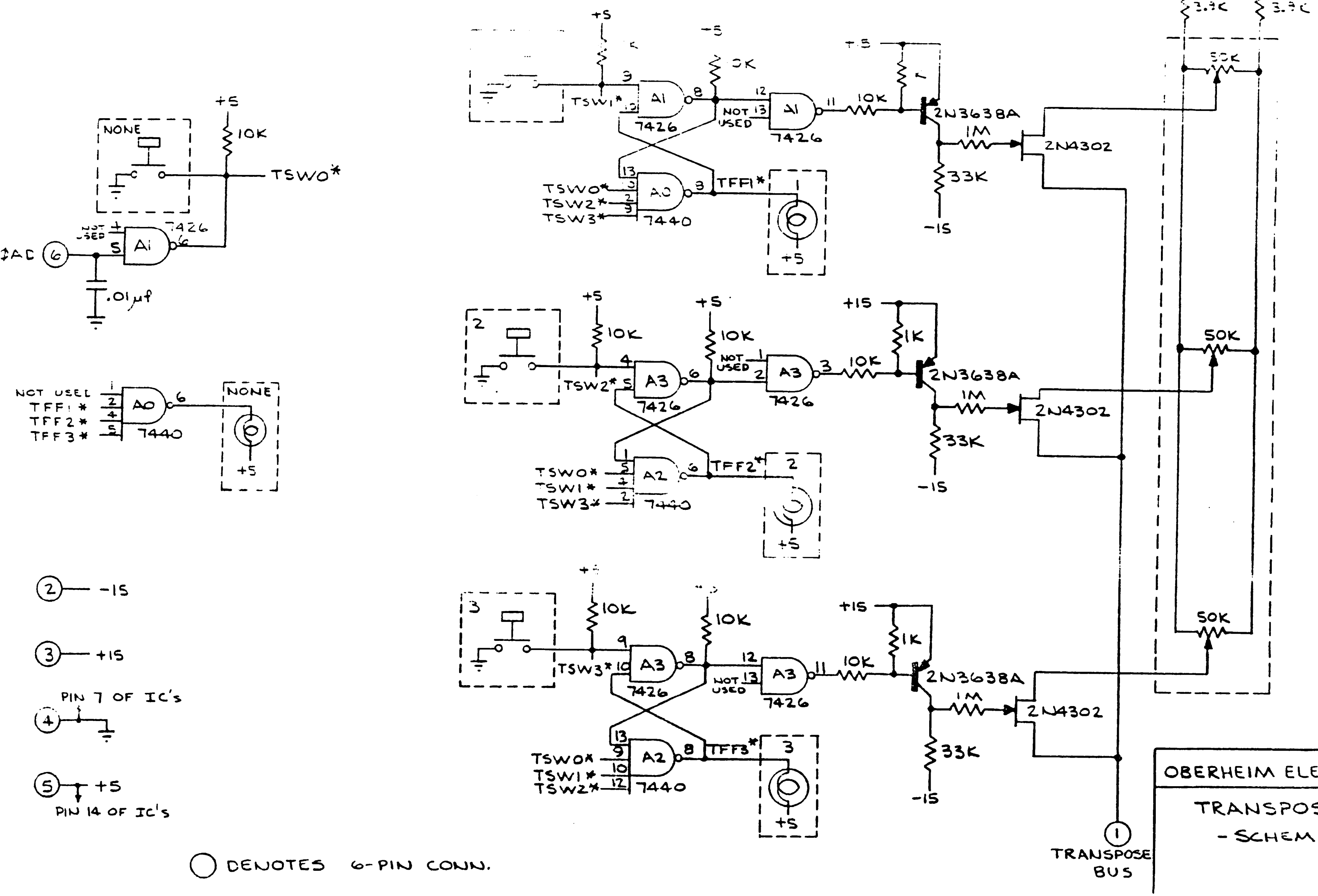
POWER SUPPLY MODULE
- SCHEMATIC -

TRANSPOSE MODULE



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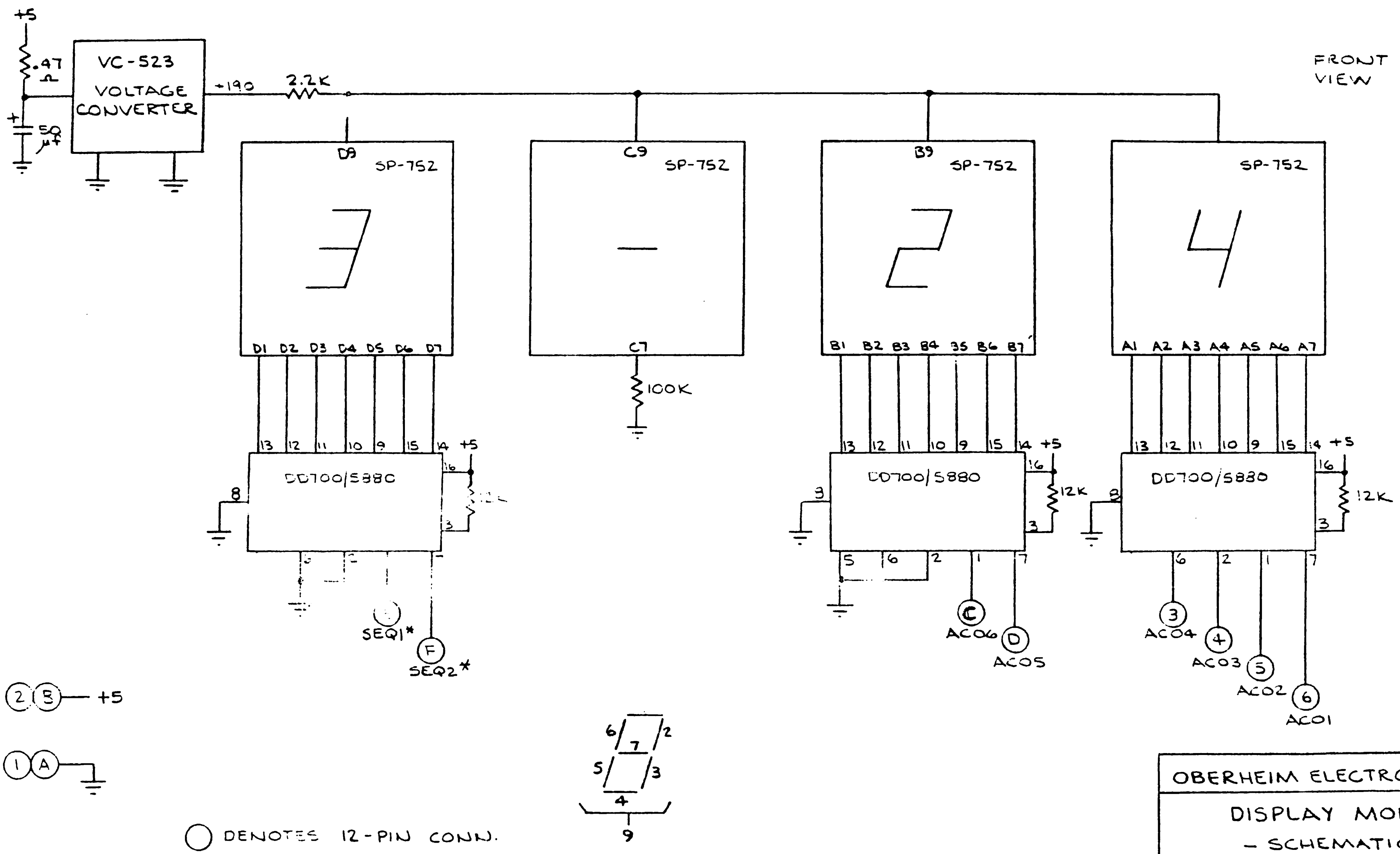
TRANSPOSE MODULE

- SCHEMATIC -

DISPLAY MODULE



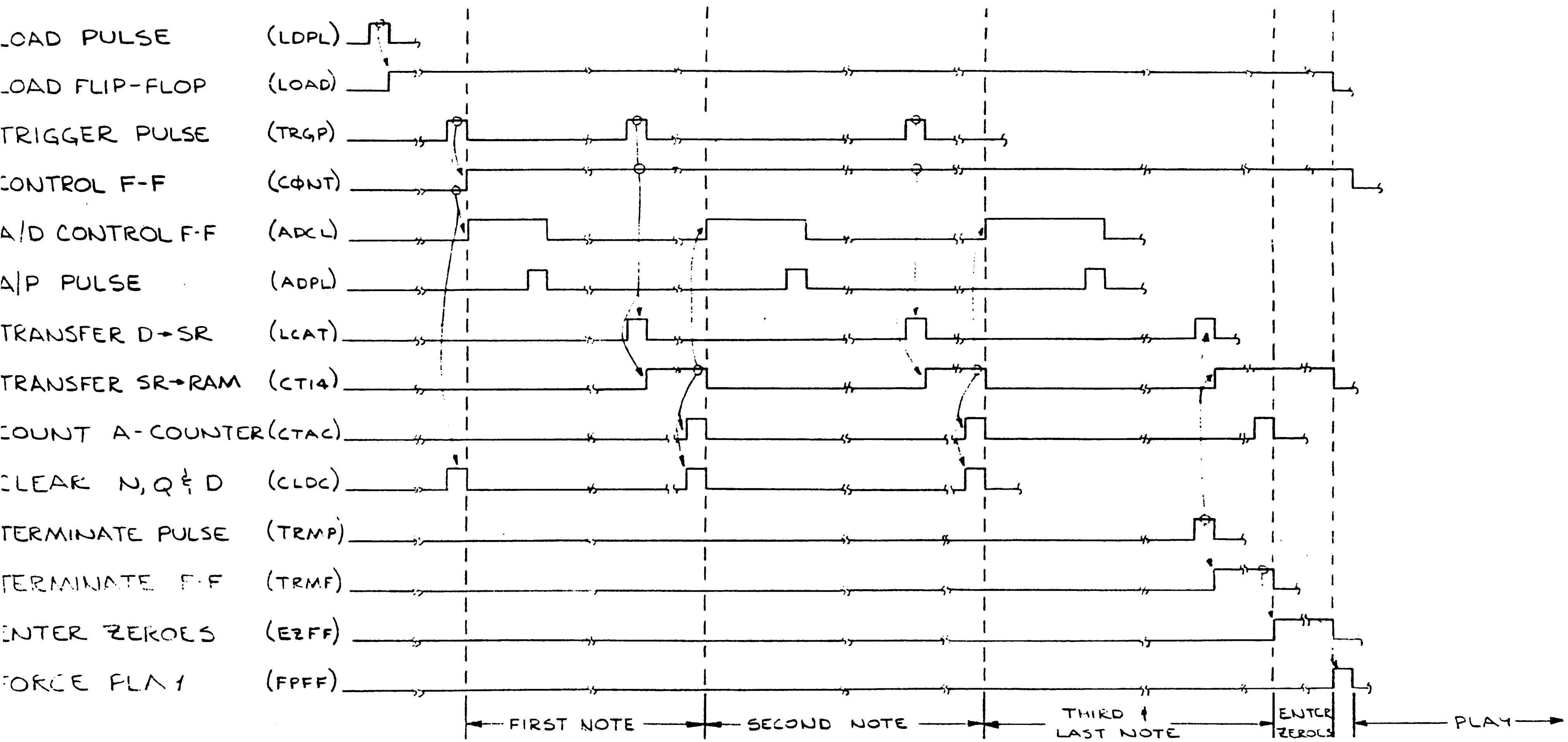
6-13-74

OBERHEIM ELECTRONICS, INC.

DISPLAY MODULE

– SCHEMATIC –

LOAD MODE TIMING DIAGRAM DSM



(EXAMPLE OF 3-NOTE SEQUENCE)

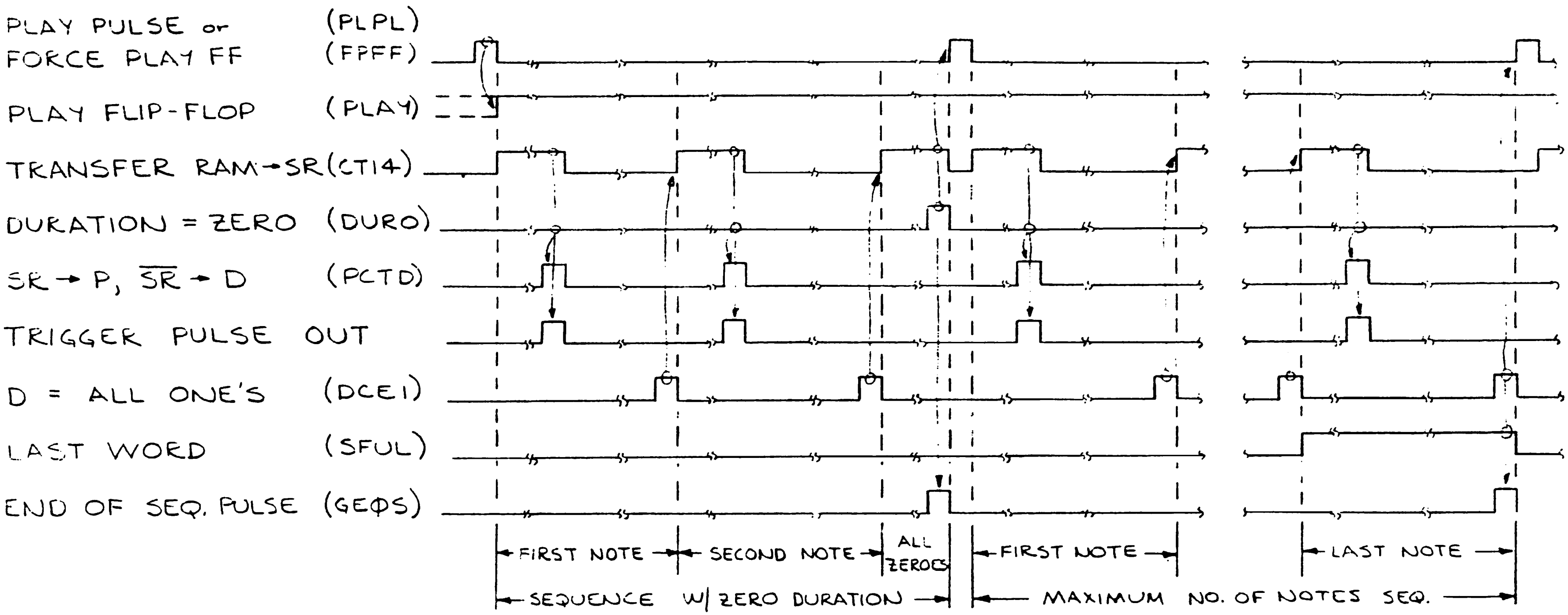
11-6-73

OBERHEIM ELECTRONICS, INC.

DSM TIMING DIAGRAM – LOAD MODE

PLAY MODE TIMING DIAGRAM

DSM



(EXAMPLES:

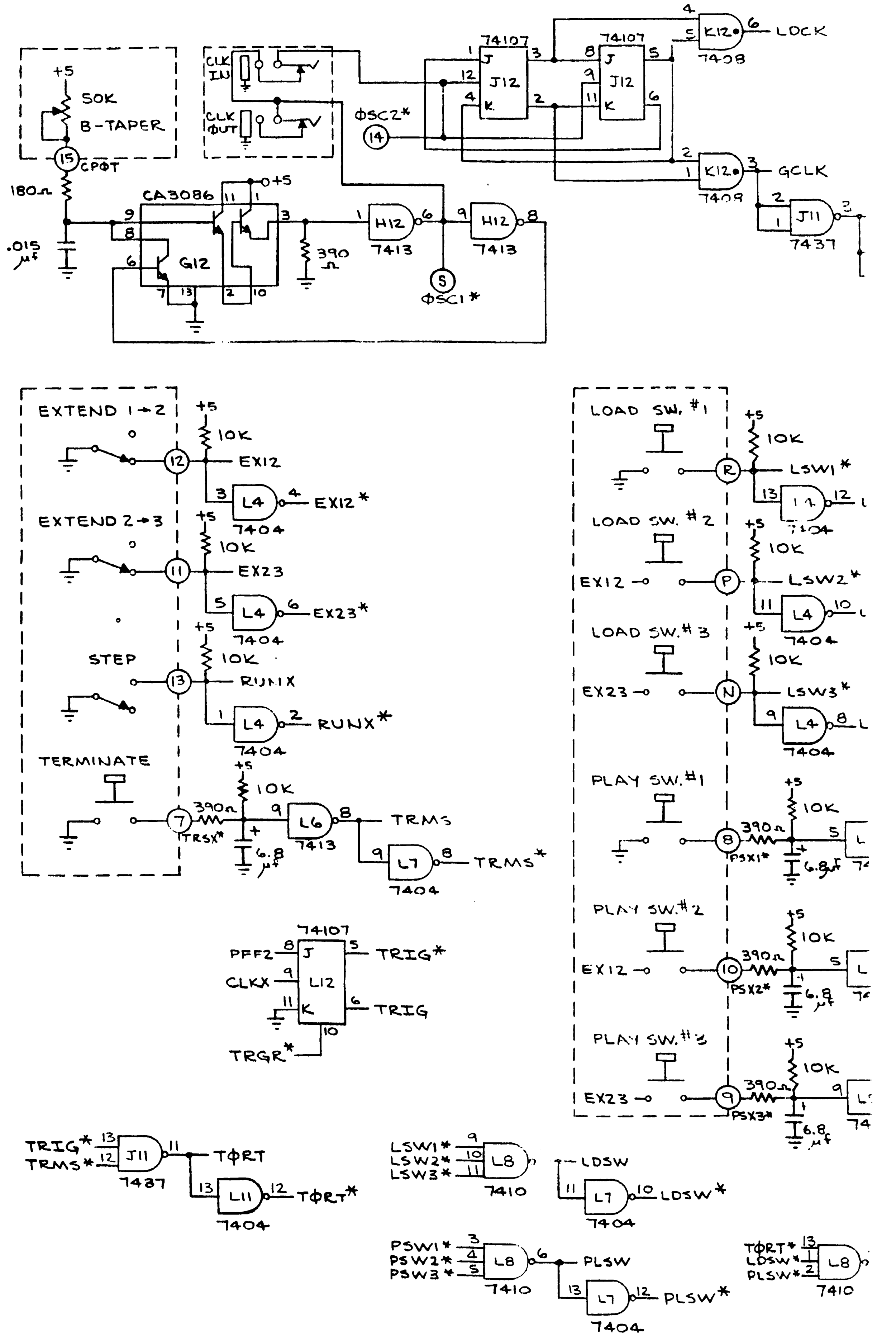
1. TWO NOTE SEQ.
2. SEQ. WITH MAXIMUM NO. OF NOTES (i.e. 24))

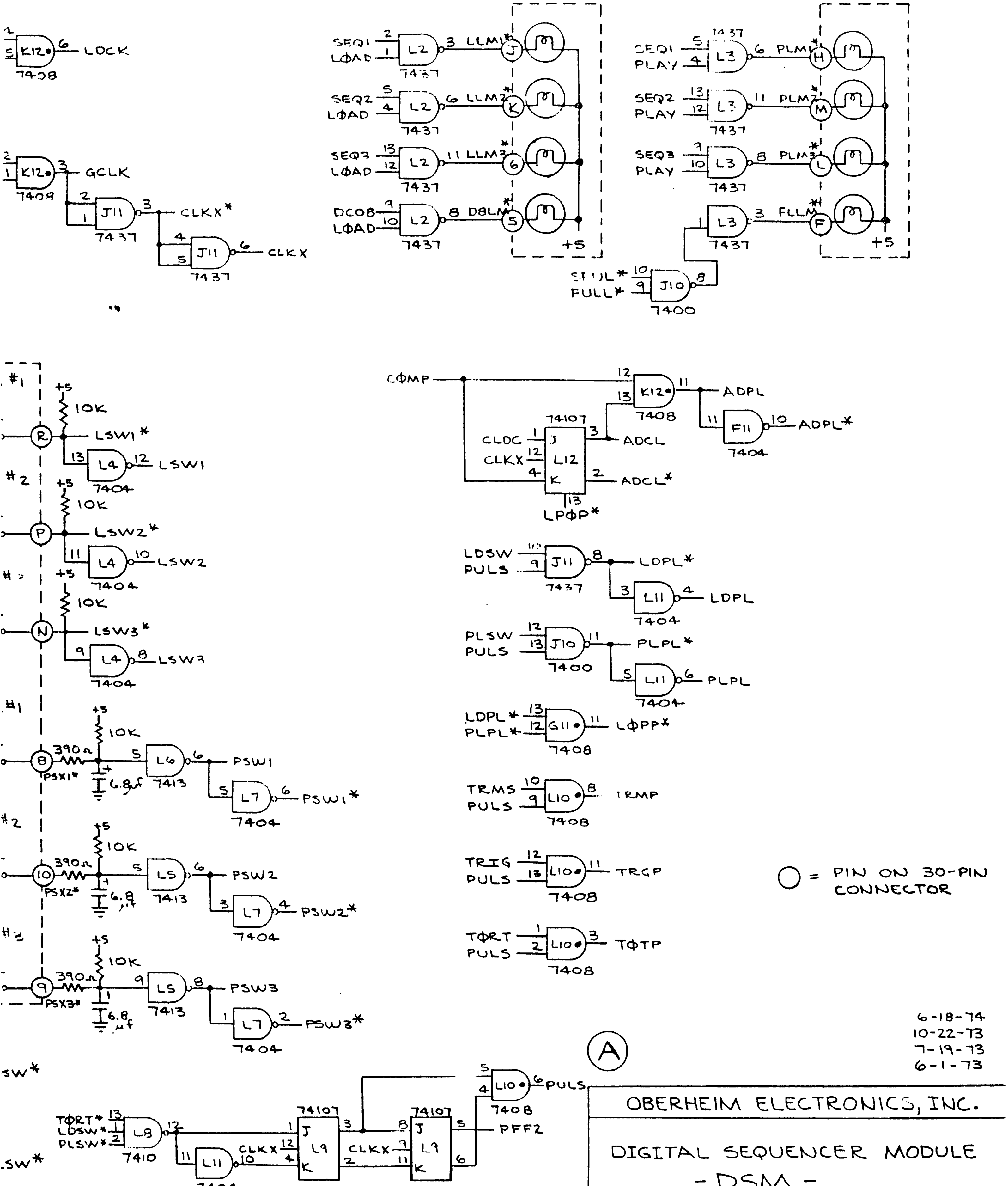
11-6-73

OBERHEIM ELECTRONICS, INC.

DSM TIMING DIAGRAM – PLAY MODE

1055


+5
50K
B-TAPER
CPØT
180Ω
.015 µf
CLK IN
CLK ØUT
CA3086
G12
390 Ω
H12
7413
ØSC1*
ØSC2*
74107
J12
K12
7408
LOCK
GCLK
J11
7437
EXTEND 1→2
EX12
EX12*
L4
7404
10K
EXTEND 2→3
EX23
EX23*
STEP
RUNX
RUNX*
TERMINATE
390Ω
TRSX*
6.8 µf
L6
TRMS
L7
TRMS*
PFF2
CLKX
L12
TRIG*
TRIG
TRGR*
LOAD SW. #1
LSW1*
LOAD SW. #2
LSW2*
LOAD SW. #3
LSW3*
EX12
EX23
PLAY SW. #1
PSX1*
PLAY SW. #2
PSX2*
PLAY SW. #3
PSX3*
TRIG*
TRMS*
TØRT
L11
TØRT*
LSW1*
LSW2*
LSW3*
L8
7410
LDSW
LDSW*
PSW1*
PSW2*
PSW3*
PLSW
PLSW*
TØRT*
LDSW*
PLSW*



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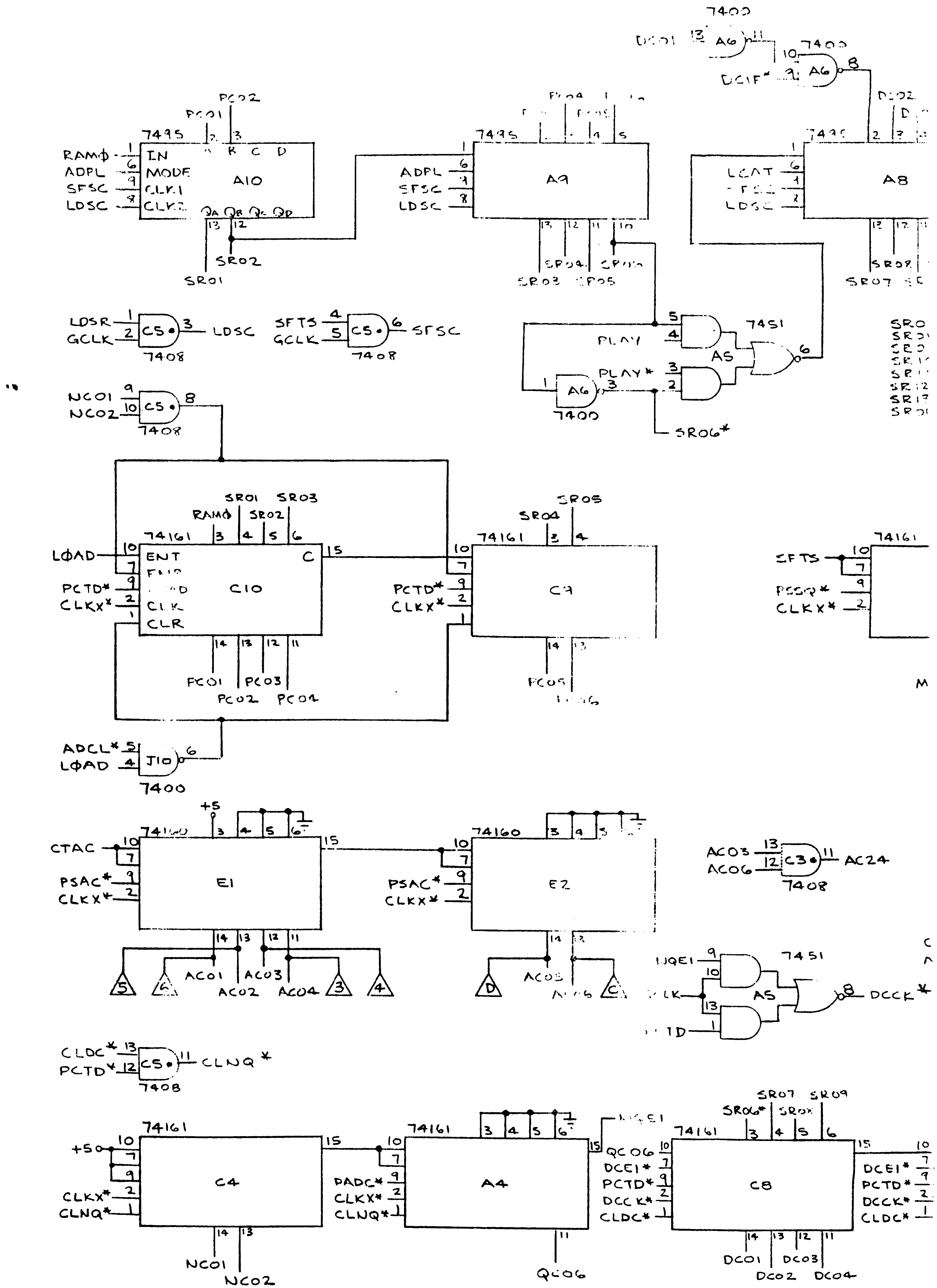
10-22-73
7-19-73
6-1-73

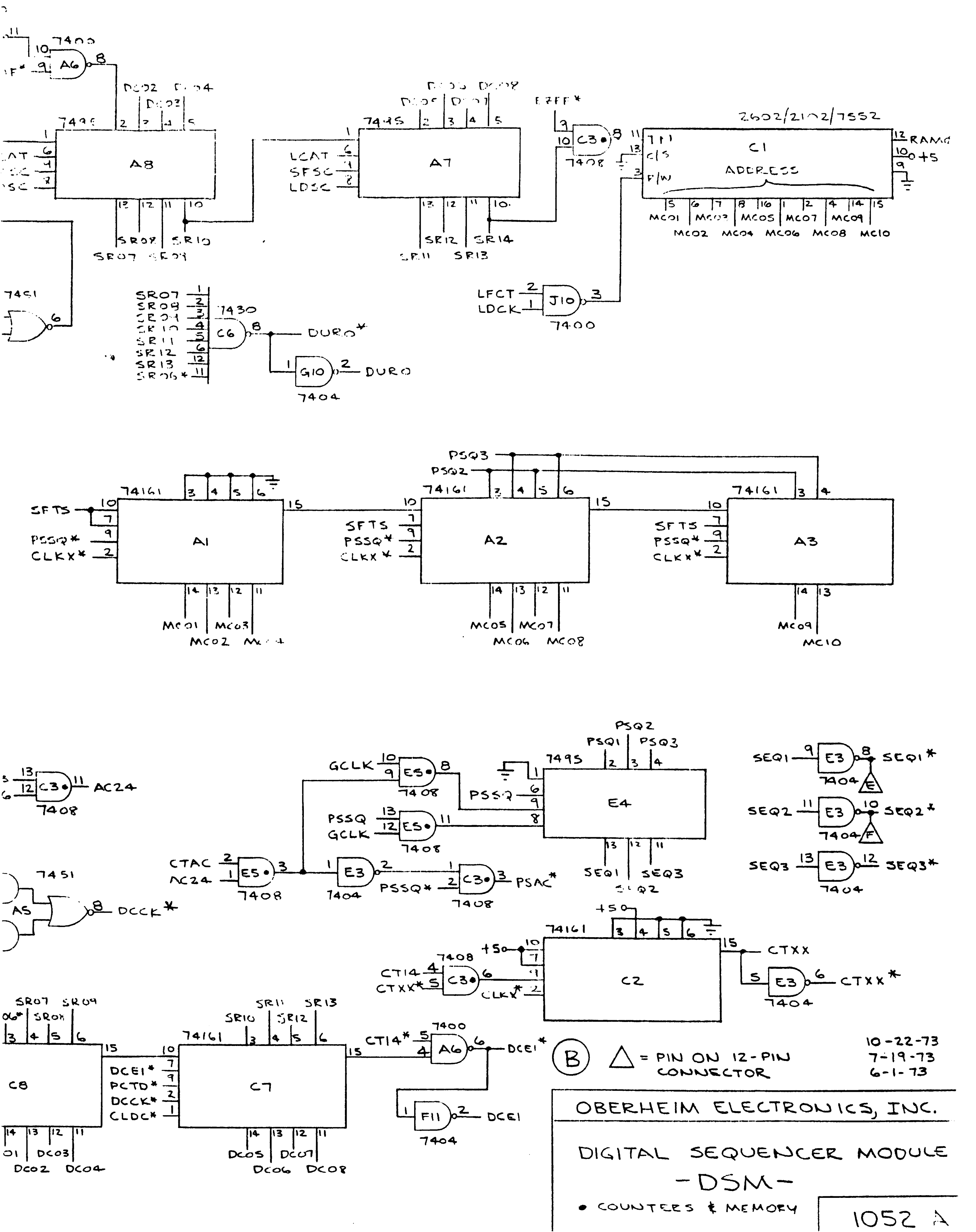
OBERHEIM ELECTRONICS, INC.

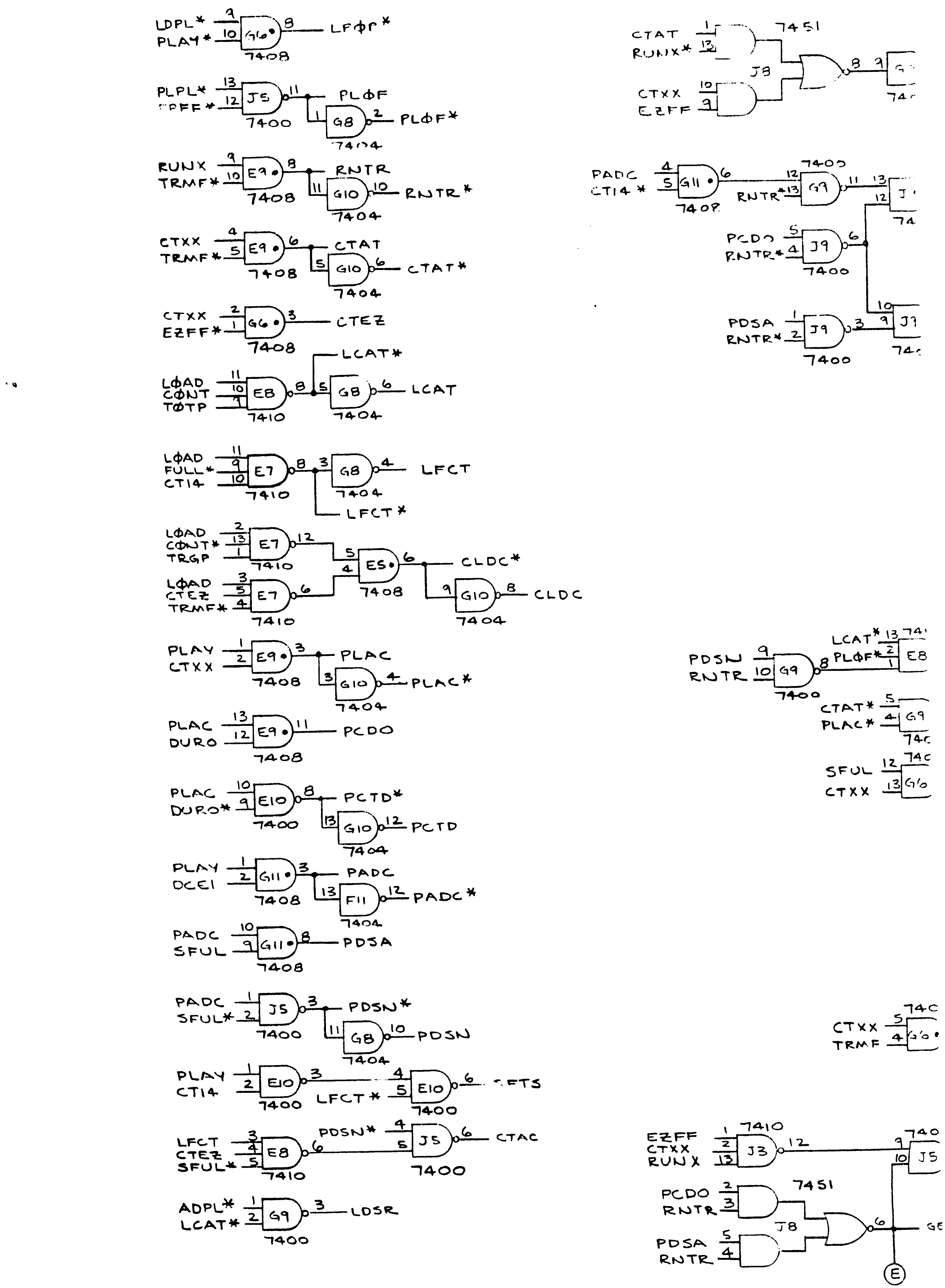
DIGITAL SEQUENCER MODULE
- DSM -

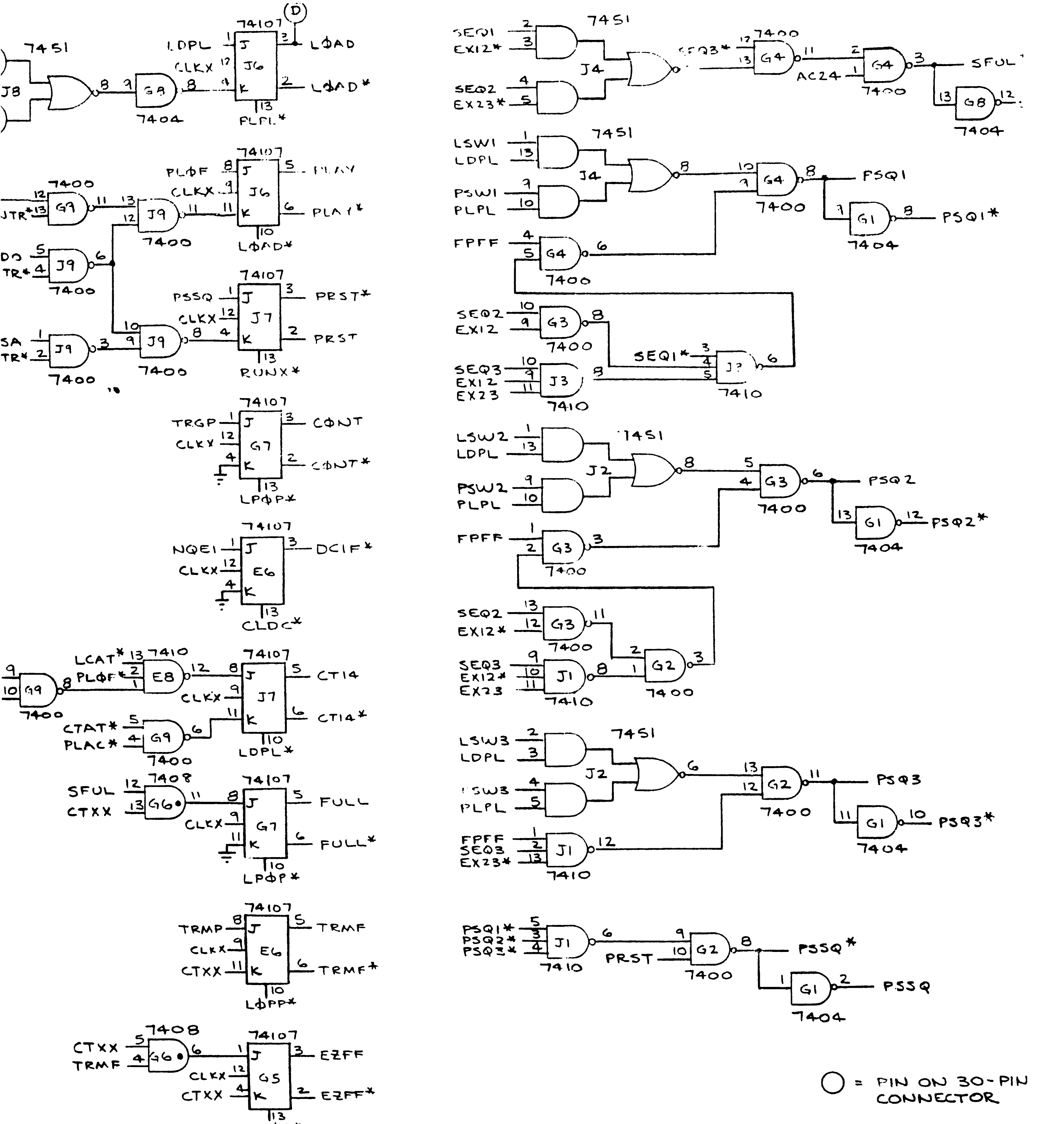
• CLOCK

1052 A


7400
A6
7400
A6
DCIF*
7495
RAMΦ
ADPL
SFSC
LDSC
IN
MODE
CLK1
CLK2
A10
PC02
PC01
SR02
SR01
7495
ADPL
SFSC
LDSC
A9
SR04
SR03
SR05
7495
LCAT
LDSC
A8
SR08
SR07
LDSR
GCLK
C5
LDSC
7408
SFTS
GCLK
C5
SFSC
7408
7451
PLAY
A5
PLAY*
A6
7400
SR06*
NC01
NC02
C5
7408
SR01
SR03
RAMΦ
SR02
74161
LΦAD
ENT
C
C10
CLK
CLR
PCTD*
CLKX*
PC01
PC03
PC02
PC04
SR05
SR04
74161
PCTD*
CLKX*
C9
PC05
74161
SFTS
CLKX*
M
ADCL*
LΦAD
J10
7400
+5
74160
CTAC
PSAC*
CLKX*
E1
AC01
AC03
AC02
AC04
74160
PSAC*
CLKX*
E2
AC05
AC03
AC06
C3
7408
AC24
7451
A5
DCCK*
CLDC*
PCTD*
C5
CLNQ*
7408
SR07
SR09
SR06*
74161
+5
CLKX*
CLNQ*
C4
NC01
NC02
74161
PADC*
CLKX*
CLNQ*
A4
QC06
QC06
DCE1*
PCTD*
DCCK*
CLDC*
74161
C8
DC01
DC03
DC02
DC04
DCE1*
PCTD*
DCCK*
CLDC*


OBERHEIM ELECTRONICS, INC.
DIGITAL SEQUENCER MODULE
- DSM -
• COUNTERS & MEMORY
1052 A
10-22-73
7-19-73
6-1-73
B
△ = PIN ON 12-PIN CONNECTOR
2602/2102/7552
C1
ADDRESS
RAM
A8
A7
A1
A2
A3
E4
C2
C7
C8
74161
7495
7400
7404
7408
7430
DURO*
DURO
LFCT
LDCK
SFTS
PSSQ*
CLKX*
PSQ1
PSQ2
PSQ3
SEQ1
SEQ2
SEQ3
SEQ1*
SEQ2*
SEQ3*
GCLK
PSSQ
CTAC
AC24
PSAC*
DCCK*
CTXX
CTXX*
CT14
CT14*
DCE1*
DCE1
PCTD*
CLDC*


LDPL*
PLAY*
G6
7408
LFØF*
PLPL*
J5
7400
PLØF
G8
7404
PLØF*
RUNX
TRMF*
E9
7408
RNTR
G10
7404
RNTR*
CTXX
TRMF*
E9
7408
CTAT
G10
7404
CTAT*
CTXX
EZFF*
G6
7408
CTEZ
LØAD
CØNT
TØTP
E8
7410
LCAT*
G8
7404
LCAT
LØAD
FULL*
CT14
E7
7410
G8
7404
LFCT
LFCT*
LØAD
CØNT*
TRGP
E7
7410
LØAD
CTEZ
TRMF*
E7
7410
E5
7408
CLDC*
G10
7404
CLDC
PLAY
CTXX
E9
7408
PLAC
G10
7404
PLAC*
PLAC
DURO
E9
7408
PCDO
PLAC
DURO*
E10
7400
PCTD*
G10
7404
PCTD
PLAY
DCEI
G11
7408
PADC
F11
7404
PADC*
PADC
SFUL
G11
7408
PDSA
PADC
SFUL*
J5
7400
PDSN*
G8
7404
PDSN
PLAY
CT14
E10
7400
LFCT*
E10
7400
LFCT
CTEZ
SFUL*
E8
7410
PDSN*
J5
7400
CTAC
ADPL*
LCAT*
G9
7400
LDSR
CTAT
RUNX*
7451
J8
CTXX
EZFF
PADC
CT14*
G11
7408
RNTR*
G9
7400
PCDO
RNTR*
J9
7400
PDSA
RNTR*
J9
7400
PDSN
RNTR
G9
7400
LCAT*
PLØF*
E8
CTAT*
PLAC*
G9
SFUL
CTXX
G6
CTXX
TRMF
EZFF
CTXX
RUNX
J3
7410
J5
PCDO
RNTR
7451
J8
PDSA
RNTR
E



○ = PIN ON 30-PIN CONNECTOR

(C)

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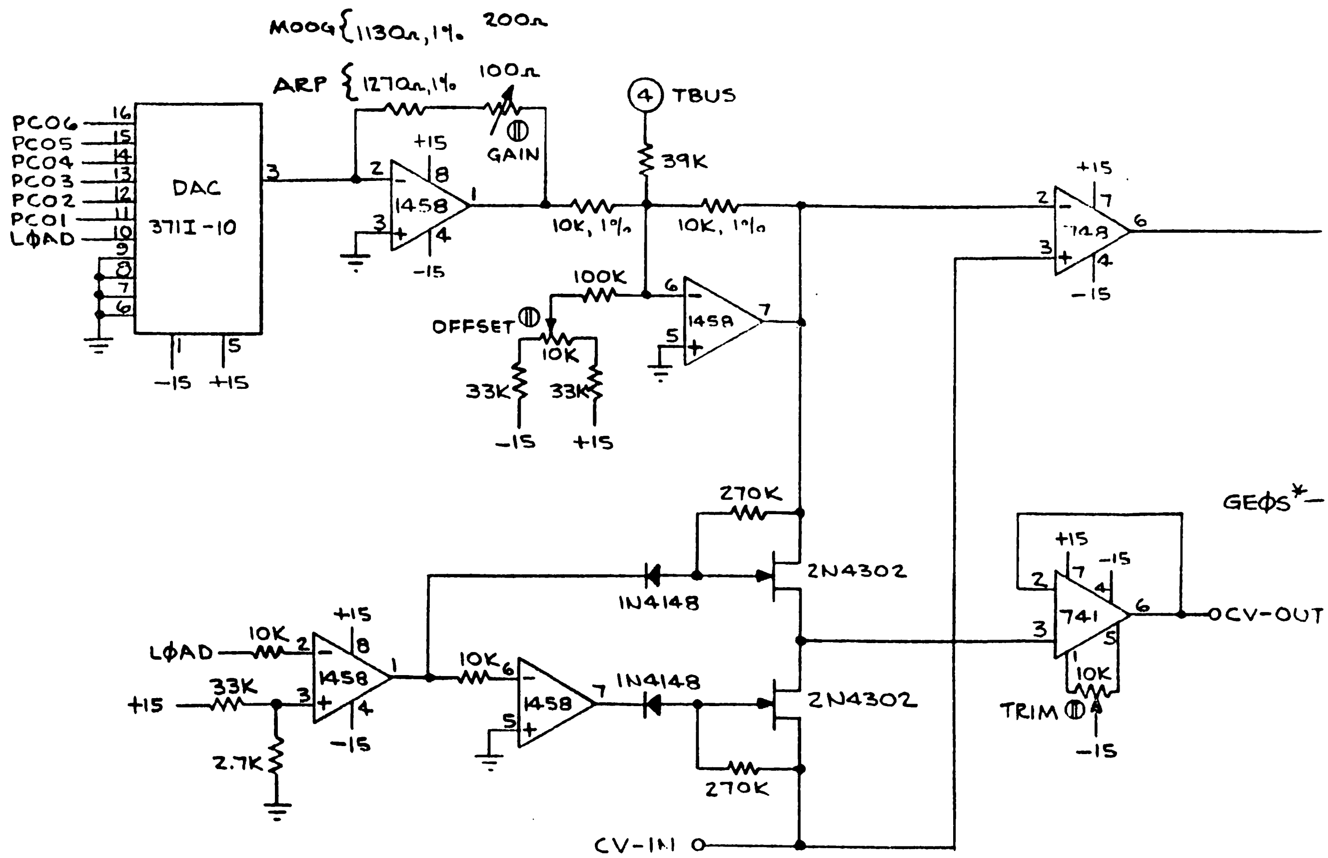
7-19-73
6-1-73

OBERHEIM ELECTRONICS, INC.

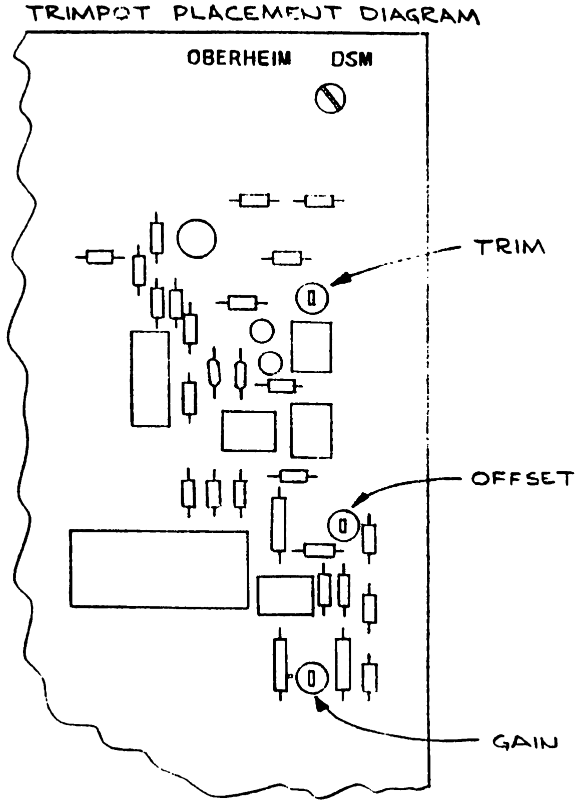
DIGITAL SEQUENCER MODULE
- DSM -

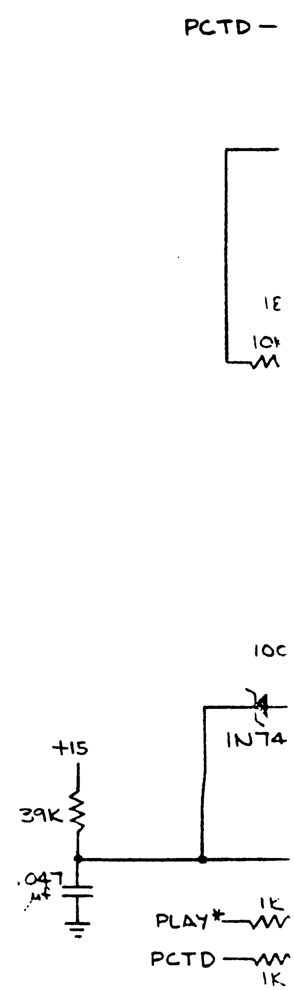
• CONTROL LOGIC

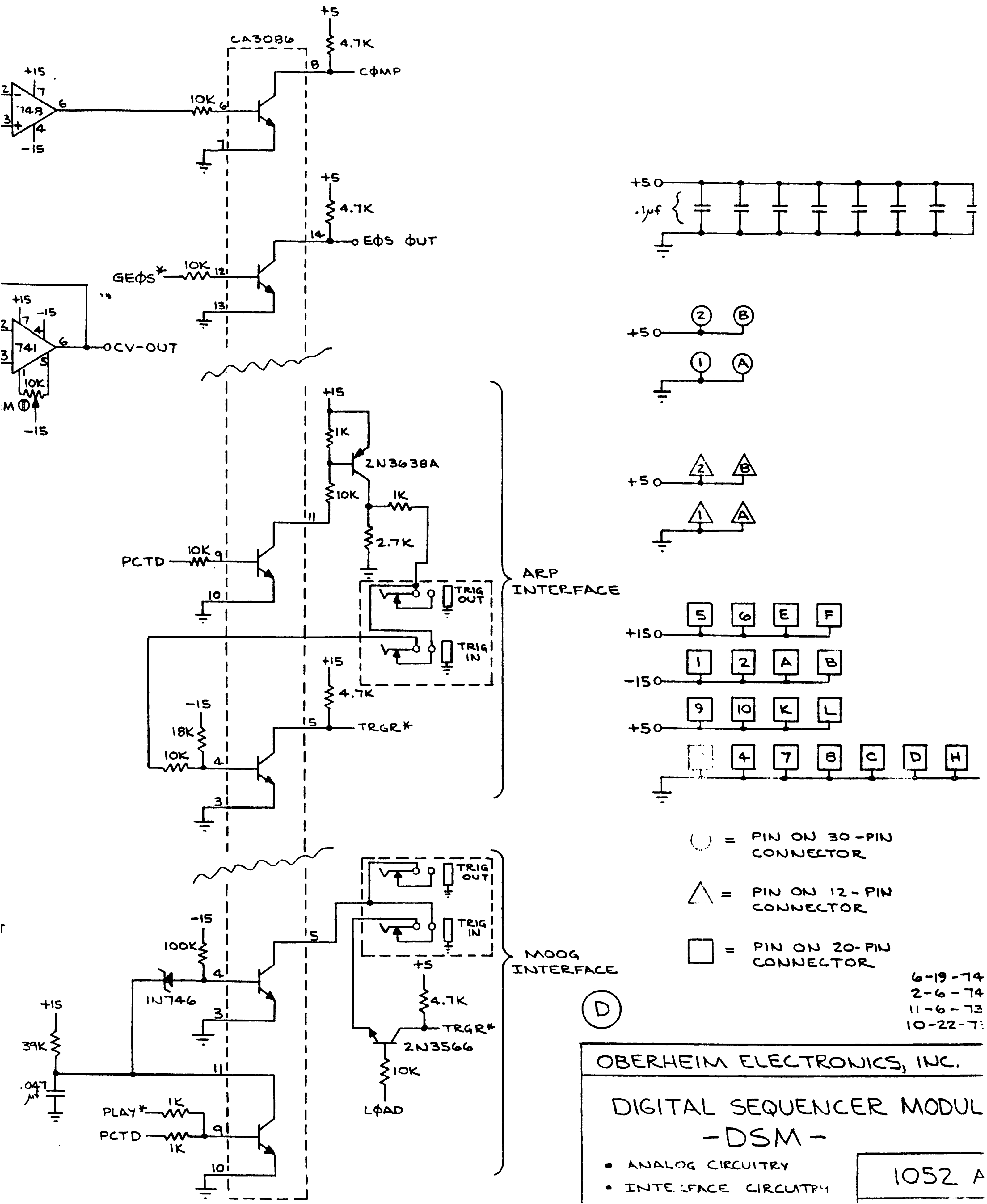
1052 A



TRIMPOT PLACEMENT DIAGRAM







D

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2-6-74
11-6-73
10-22-7?

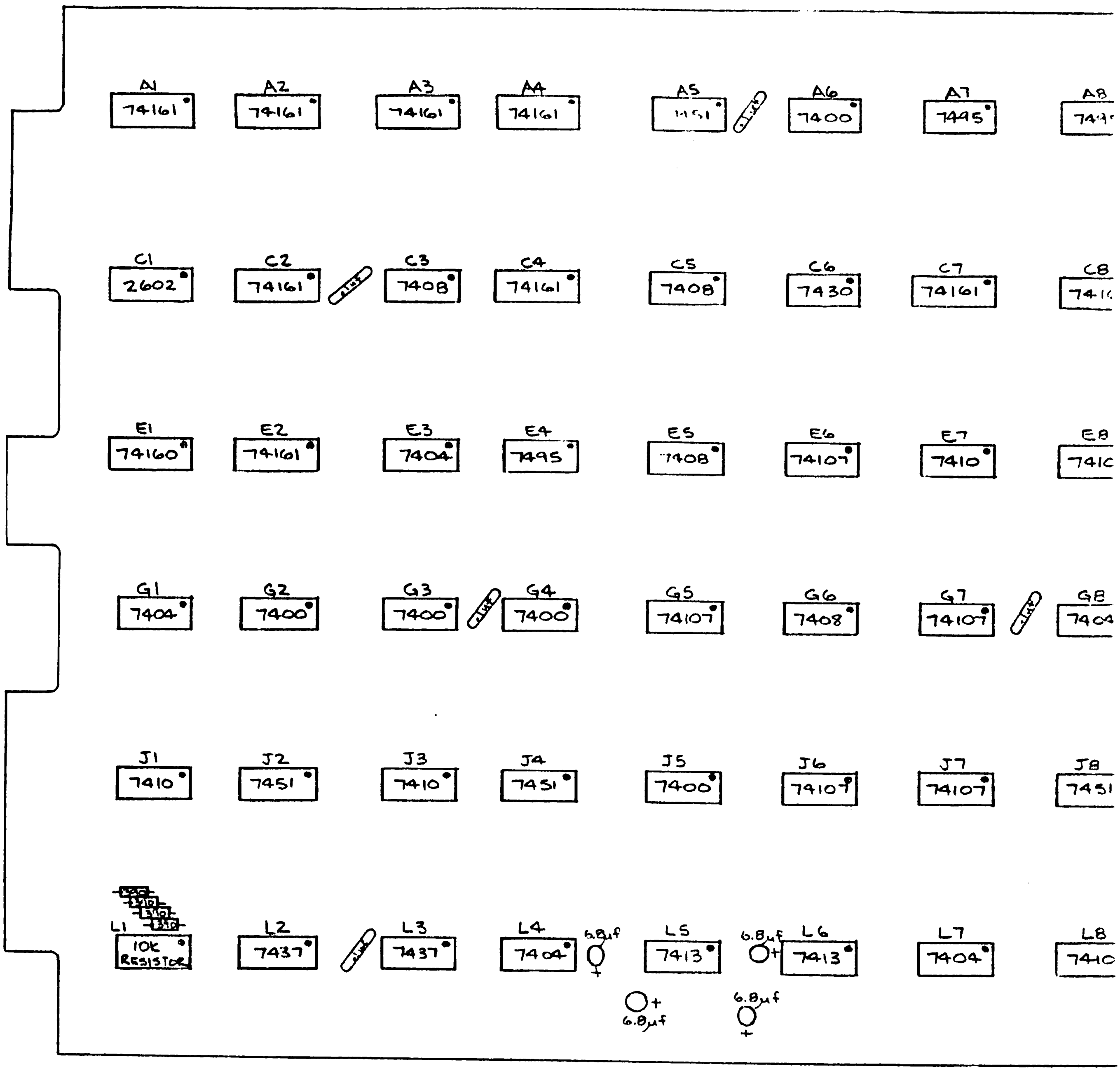
OBERHEIM ELECTRONICS, INC.

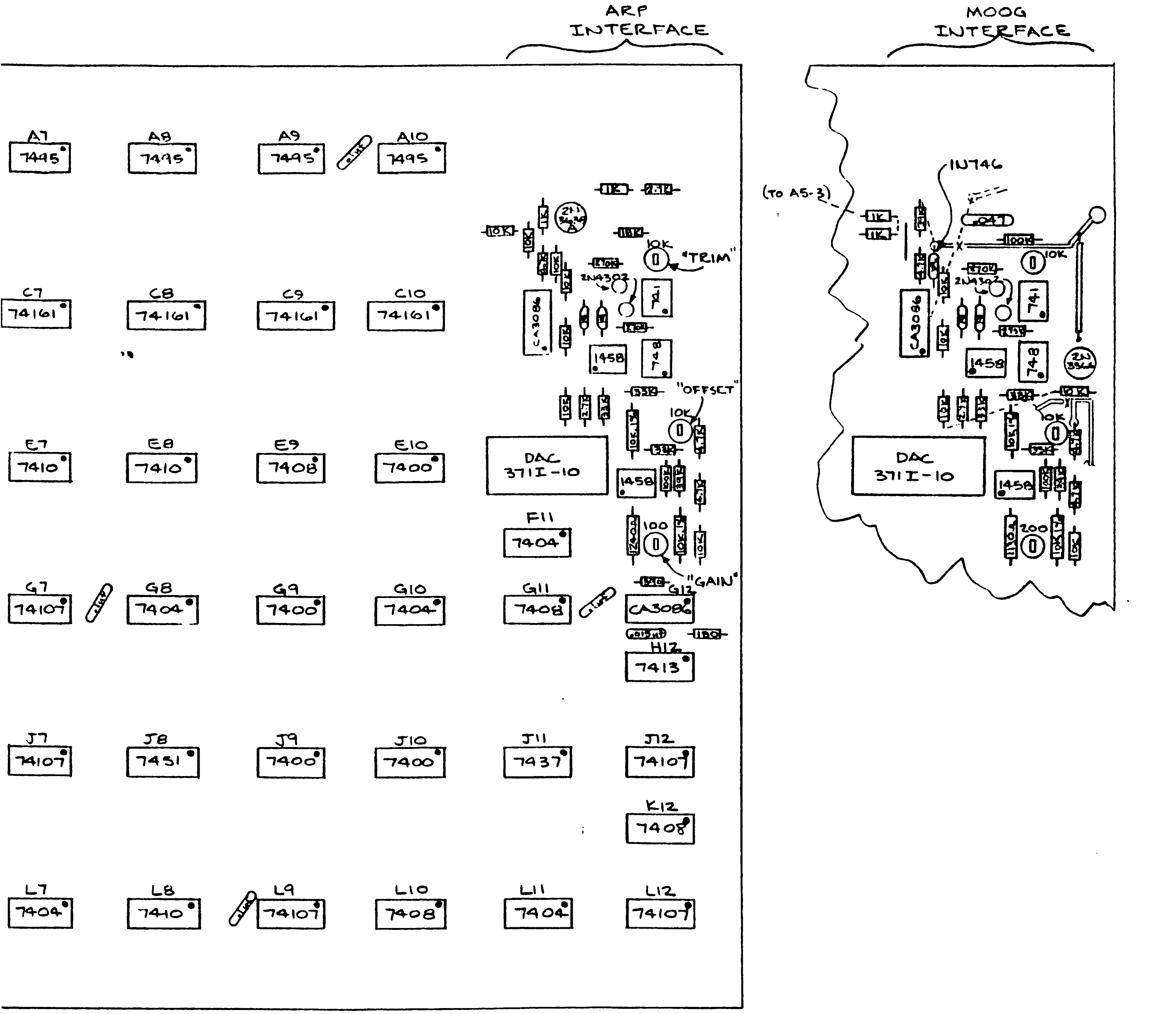
DIGITAL SEQUENCER MODUL

-DSM-

- ANALOG CIRCUITRY
- INTERFACE CIRCUITRY

1052 A


A1 74161
A2 74161
A3 74161
A4 74161
A5
A6 7400
A7 7495
A8
C1 2602
C2 74161
C3 7408
C4 74161
C5 7408
C6 7430
C7 74161
C8
E1 74160
E2 74161
E3 7404
E4 7495
E5 7408
E6 74107
E7 7410
E8
G1 7404
G2 7400
G3 7400
G4 7400
G5 74107
G6 7408
G7 74107
G8
J1 7410
J2 7451
J3 7410
J4 7451
J5 7400
J6 74107
J7 74107
J8 7451
L1 10k RESISTOR
L2 7437
L3 7437
L4 7404
L5 7413
L6 7413
L7 7404
L8
6.8µf
6.8µf
6.8µf
6.8µf



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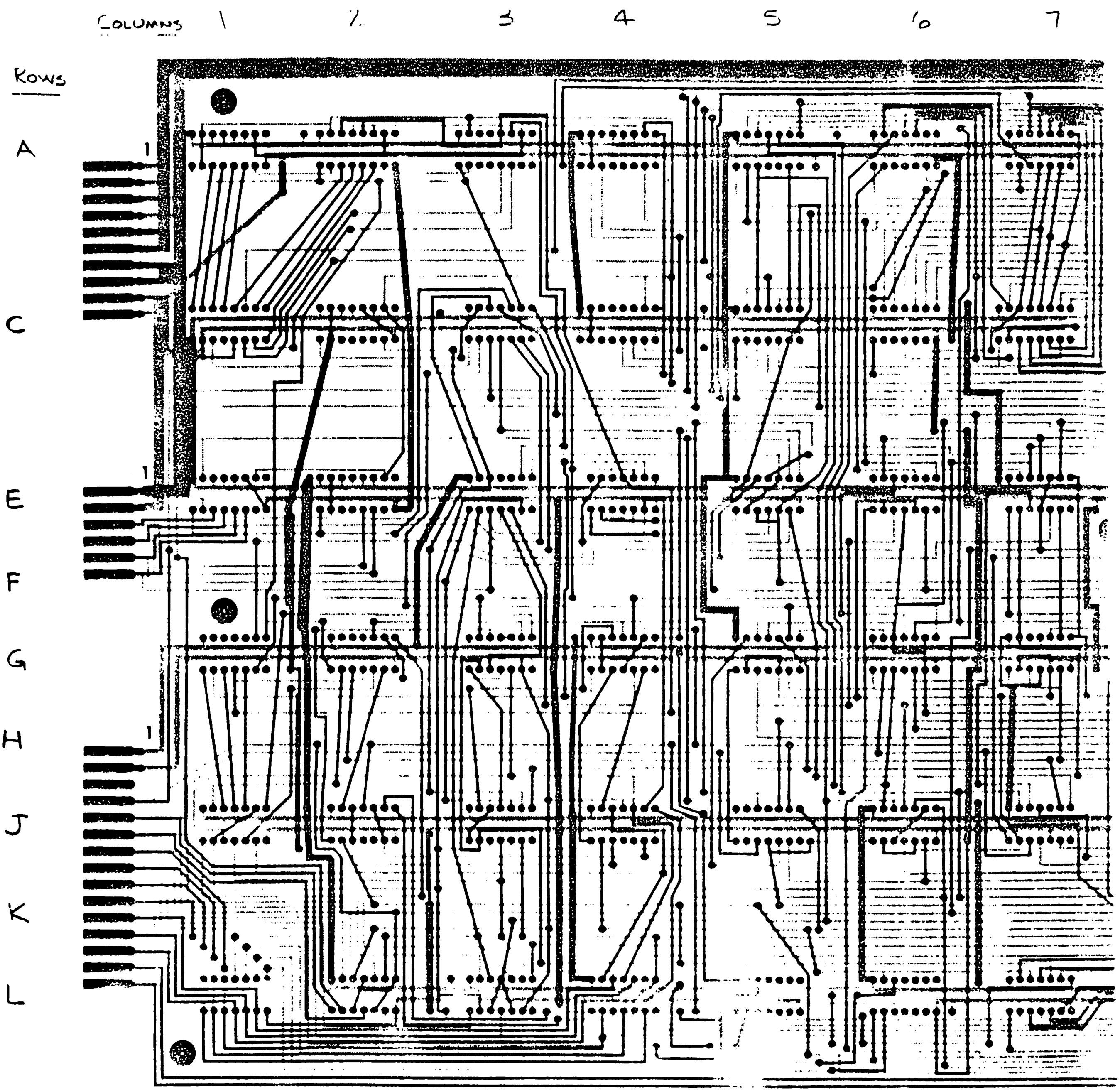
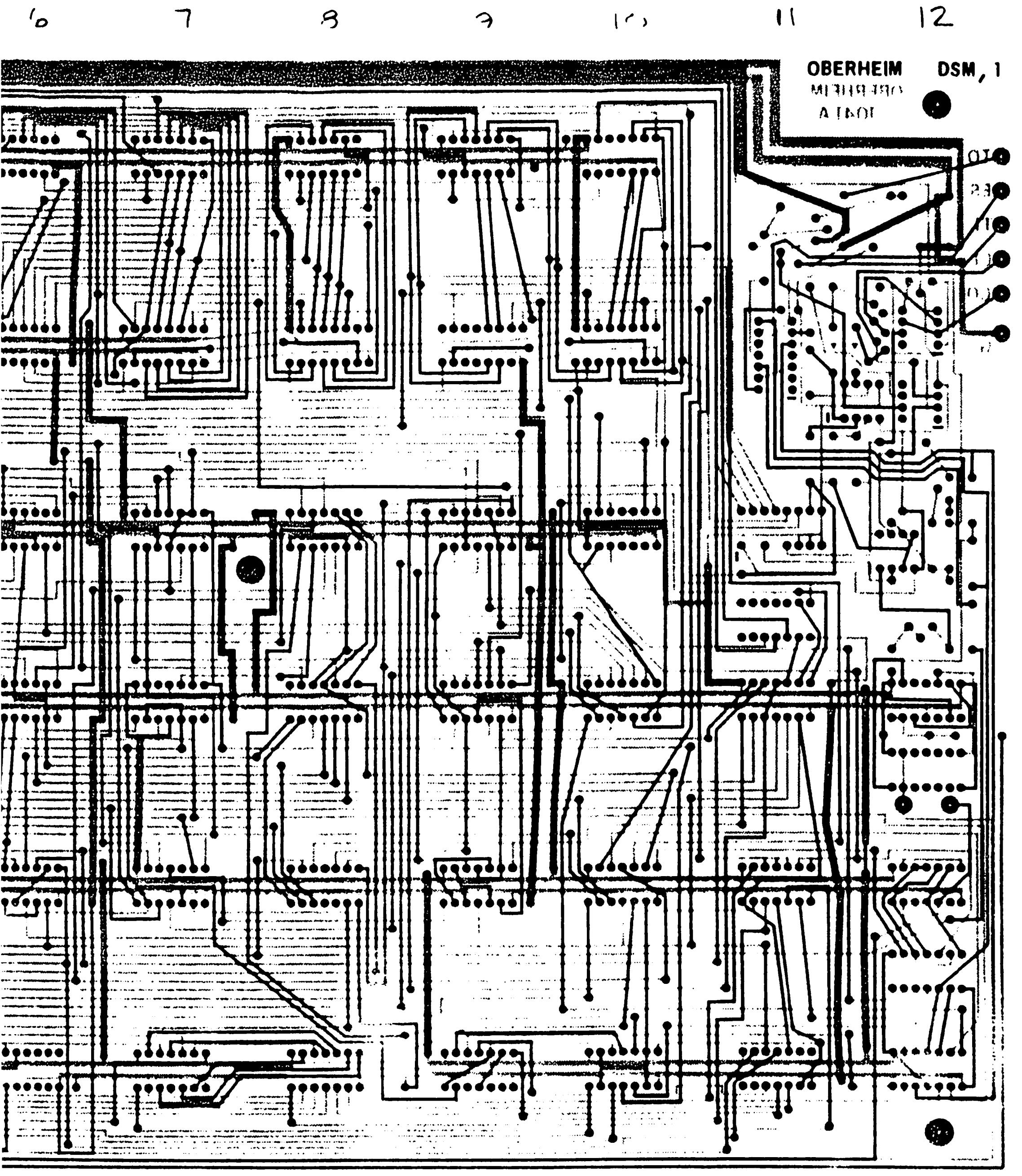
OBERHEIM ELECTRONICS, INC.

DIGITAL SEQUENCER MODULE
PARTS PLACEMENT


Columns
1
2
3
4
5
6
7
Rows
A
C
E
F
G
H
J
K
L
1
1
1



OBERHEIM ELECTRONICS, INC.

DIGITAL SEQUENCER MODULE

P.C. COMPOSITE

MODIFYING MINI-MOOG SYNTHESIZERS FOR USE WITH OBERHEIM DIGITAL SEQUENCERS

1. Expose electronic circuitry by removing metal cover held on by 18 sheet-metal screws.

2. Looking at rear of Mini-Moog, remove right-hand printed-circuit board (Board No. 1). Set aside temporarily.

3. Remove other right-hand printed-circuit board (Board No. 2) which resides behind Board No. 1.

4. Install two phone jacks, one a standard type (i.e., Switchcraft No. 11) and one a closed-circuit type (i.e., Switchcraft No. 12A) just left of the jack labeled "LOUDNESS EXTERNAL CONTROL INPUT." (See diagram below.) Label the closed-circuit jack "CONTROL VOLTAGE IN" and the standard jack "CONTROL VOLTAGE OUT."

5. On Board No. 2, cut etching going to connector pins 4A and 5A (see figure).

6. Solder 14-inch wires to the etching on each side of the cut.

7. Solder wire connected to etch which goes to internal circuitry on Board No. 2 to the tip terminal on jack labeled "CONTROL VOLTAGE OUT" and also to the closed-circuit terminal on the jack labeled "CONTROL VOLTAGE IN."

8. Solder wire connected to etch which goes to connector pins to the tip terminal on jack labeled "CONTROL VOLTAGE IN."

9. Connect the ground terminals of both new jacks to the ground terminal on an existing jack.

10. Replace both printed-circuit boards and the metal cover.