SEQUENTIAL
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MODEL 2000

PROPHET-2000
DIGITAL SAMPLING KEYBOARD
(Including Model 877/878 Memory Expansion)

TECHNICAL MANUAL

by Rick Davies

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Data sheets for the CEM3379 are courtesy of Curtis Electromusic Specialties.

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SECTION 0

THE PROPHET-2000 SYSTEM AND CHASSIS

FUNCTIONAL DESCRIPTION

The following pages describe how the Prophet-2000 operates as a system. The 2000 is divided into three interacting subsystems, which are also broken down into sections by function. Figure 0.1 Abstract Schematic (page 0.3) shows the interconnection of these sections. Often, as in the case of the "decoding circuits," the line dividing one section from another is hazy. This is the result of trading-off technical details against clarity of the general represention. For detailed descriptions of the circuits themselves, refer to the schematics and hardware descriptions mentioned below.

Operating System

Please refer to Figure 0.1 on page 0.3. The function of the 2000's computer is to coordinate all activities. On power-on, -RESET goes low, ensuring that the 2000 always starts from "scratch." The 68B09 CPU operates at 8 MHz, supplied by the crystal oscillator and divider circuits. The CPU communicates with other devices through the Address Buss, the Data Buss, the Q, E, and R/-W signals, and three interrupt lines which notify the CPU of activities requiring immediate attention.

The 68B09 CPU features sixteen address lines for accessing memory. IC size and cost prohibit most of the above circuits from running directly off all sixteen Address lines, so additional address decoding circuits are required to provide the "chip selects" required for any ICs accessed by the CPU.

Generally, these control signals are produced by combining Address lines with the CPU's Q, E, and R/-W lines according to the address and nature of the circuit. All of the decoding circuits are located on PCB2. For details, see Schematic A and U218 hardware description.

As mentioned above, the CPU must sometimes drop everything it is doing to respond to "interrupts" from various circuits. There are four sources of interrupts in the 2000:

The clock divider,

the keyboard processor,

the sample ADC, and

the MIDI UART.

Each of these interrupts may be disabled with corresponding enable/disable control signals depending on the CPU's currrent activity.

Each section of hardware interfacing with the CPU through these signals is described below.

256K ROM (Read Only Memory)
Contains the operating software which determines how the 2000 behaves. Its contents are fixed and may only be altered by replacing U214 itself. The only time the 2000 does not execute instructions in ROM is when diagnostic tests are loaded from disk, in which case the 2000 executes instructions located in RAM (see below). For details, see Schematic A and U214 hardware description.

1K Scratchpad RAM (Random Access Memory)
During normal operation, used for "scratchpad," temporarily storing results of calculations, arpeggiator, stack, and "key handler" data. When power is switched off, all data is lost. Does not contain sample data, unless transmitting data over MIDI (see below). For details, see Schematic A and U212/13 hardware description.

Program Interval Timer
Interacts with the 8 MHz clock to generate accurate timing signals for the Sample Memory (TUNE CLOCK and SAMPLE CLOCK), A-440, and 500kHz for the MIDI UART. Also operates with the Control Panel ADC to read knob settings (see below). To carry out these three independent activities, U216 Program Interval Timer contains a "programmer" section which interfaces with the CPU through the Data Bus, and three gated counter/timer sections which connect directly to each circuit affected. For details, see Schematic A and U216 hardware description.

MIDI UART
Used exclusively for sending and receiving MIDI data. Incoming data is optoisolated, while transmitted data is driven by Q201/02 transistors. For transmitting, data is "stored" at the UART's address like any other memory location. When data is received, the UART generates an interrupt signal which is combined with the sample interrupt (ADCINT, see below), then drives the CPU's -FIRQ input. For details, see schematic A and hardware descriptions for U211 and U215.

Disk Drive
The disk drive used for storing program data (samples, maps, etc.) is accessed in the same manner as other memory devices. The Disk Drive Controller simplifies the hardware --and hence, the number of control signals-- needed in addition to the Data and Address busses. For details, see Schematic B and U205 hardware description.

Keyboard
U206 Keyboard Processor is a computer-on-a-chip dedicated to scanning the 5-octave keyboard. When a key is pressed or released, U206 interrupts the CPU with -KBDINT. The CPU then reads the note information from U206. As the keyboard consists of a switch matrix with two switches per note, delegating the keyboard scanning to U206 saves a great deal of time for the CPU to take care of other activities. For details, see Schematic B and U206 hardware description.

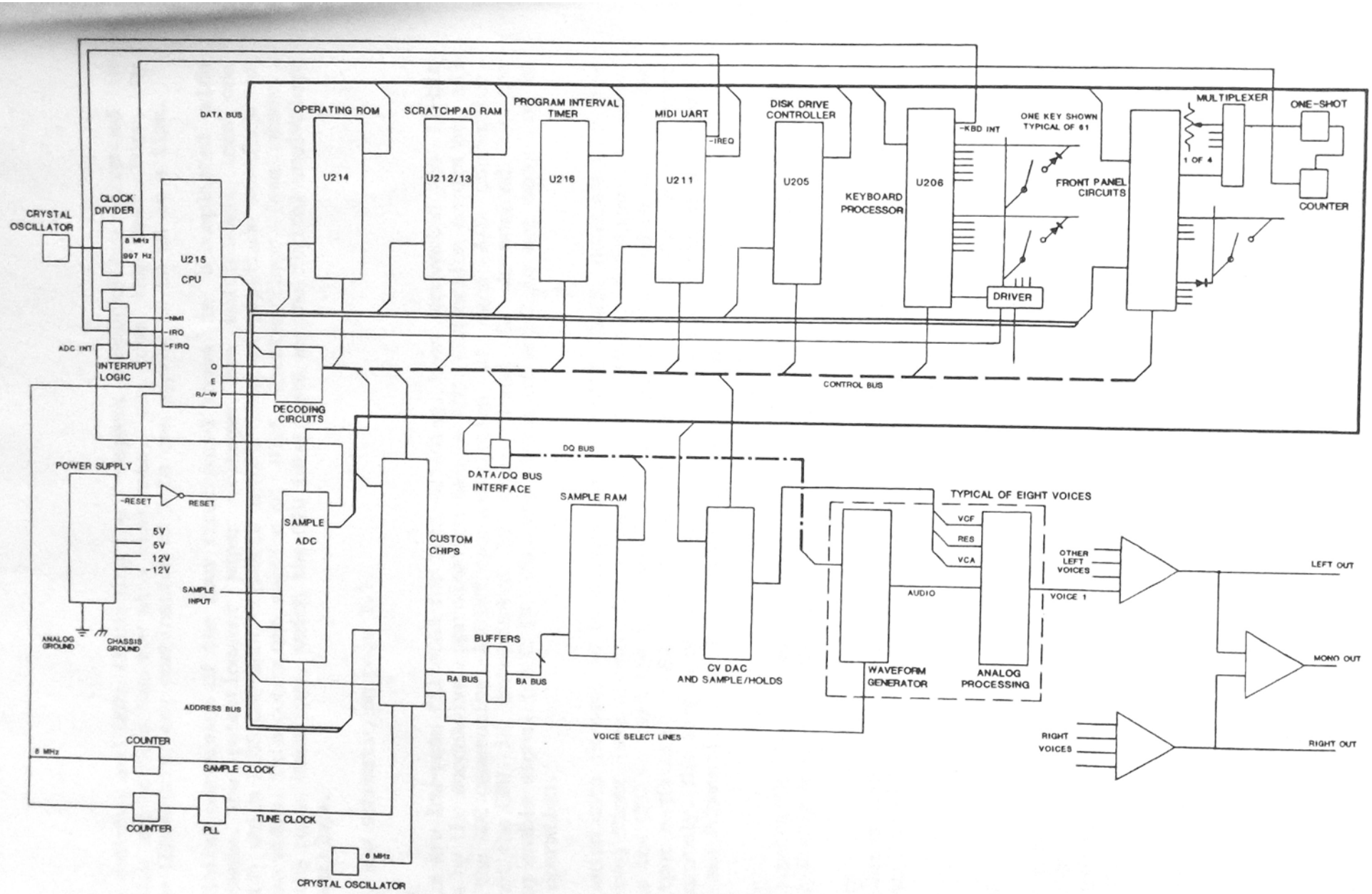


Figure 0.1
ABSTRACT SCHEMATIC

Front Panel

Front panel switches and LEDs (including the 7-segment displays) are arranged in matrices which are strobed one row at a time onto, or from the Data Buss. By strobing the LED matrix, any combination of LEDs can appear to be on at a time.

Analog-to-digital conversion of the four front panel knobs is accomplished with minimal hardware. The potentiometer wiper voltages are multiplexed into one voltage (VOUT) which U105 One-shot converts into a constant-amplitude waveform of varying pulse width. This gates one section of U216 Counter/Timer (see above). U216 times the pulse durations, which the CPU interprets as the digital equivalent of the pot settings.

For details, see schematic on page 1.3.

Sample Input

Audio signals are low-pass filtered for anti-aliasing, then converted to 12-bit digital data by the successive approximation Sample ADC. Conversion occurs at all times, with the ADC generating -ADCINT upon completion of each A/D conversion. Whether or not the CPU is interrupted by this signal is determined by the corresponding enable signal (-ADC INT EN), the status of which is set according to the current operation.

The rate at which data is sampled is determined by SAMPLE CLOCK, generated by the Program Interval Timer (see above). When the CREATE SAMPLE function is used, -ADCINT tells the CPU to read the twelve-bit sample data in the sample ADC's two eight-bit output registers. -LSADC and -MSADC are generated to access each register separately. The sample data is then placed in sample memory (see below). For details, see Schematic E and U306 hardware description.

Sample Memory

The CPU coordinates the input and output of sample data, but delegates the addressing of Sample Memory to custom ICs. (See below.)

Voice Circuits

The CPU calculates control voltages for the analog circuits (including envelopes) which are distributed to the 2000's eight voice circuits. (See below.)

Sample Memory

256K of dynamic RAM is used exclusively for storage of sample data either loaded from disk, or converted from the audio sample input by the sample ADC. The sample memory is addressed by the BA (sample address) lines (buffered RA Bus lines) generated by custom ICs which simplify the CPU's interaction with the sample memory.

The four custom ICs operate similarly, each routing sample data to two of the eight output channels through the DQ (sample data) Bus, one at a time with the Voice Select lines. For details, see Schematic D and U233-36 hardware descriptions.

In addition, U233 alone handles the reading of sample data onto the Data Bus, while U234 handles writing sample data from the Data Bus to sample memory. For details, see Schematic D and hardwaredescriptions for U233-36 and U237-40.

Note that earlier production models clocked the custom ICs with 8 MHz, while later models use 6 MHz clocking for improved performance. For details on modifying earlier units, see UPDATES, page 0.12.

Voice Circuits

Detailed descriptions of the 2000's voice structure are already provided in the Prophet-2000 Operation Manual (CM2000). The voice circuits can be divided into the following sections:

Waveform Generators

Twelve-bit sample data is converted into analog by the eight Voice DACs. To eliminate clock jitter and noise, two sets of latches are used. The first set is updated at the cycle rate of the custom ICs (approximately 92 kHz). The second set is updated at the playback rate. The first set of latches is decoded from the custom IC CHIP ON signals. When sample data is clocked through to the latch outputs, the corresponding Voice Select line clocks this data to the outputs of the second set of latches, to the Voice DAC. The ouput of the Voice DAC is then processed like any other analog signal source.

Analog Processing

Each Voice DAC is followed by a combination VCF/VCA which requires only three control voltages (filter cutoff (VCF), resonance (Res), and voice volume (VCA)). Control voltages are converted from twelve-bit data to analog by the CV DAC, then distributed to the VCF/VCAs. For details, see Schematic F and U315 and U325 hardware descriptions.

Voices 1-4 are summed to produce the LEFT audio output, voices 5-8 to produce the RIGHT output, and both of these are summed for the MONO output.

The divison of the digital and audio circuits in the Prophet-2000 is similar to that in Sequential's previous computer-controlled analog synthesizers. The majority of digital circuitry is located on the Prophet-2000 "2-Board," while all audio circuits are on the "3-board." For information on the physical interconnections inside the 2000, see Figure 0.5 Interconnection Diagram on page 0.9.

MECHANICAL ASSEMBLY/DISASSEMBLY

WARNING! Be sure to disconnect the 2000 power connector before disassembling or reassembling the 2000.

Opening The 2000

Place the 2000 face down on a soft flat surface. Watch out for any surfaces which might scratch the front panel.

Remove the two bottom panel screws (6-32 panhead phillips) which fasten the top panel at both ends of the keyboard. (See figure 0.2 below.)

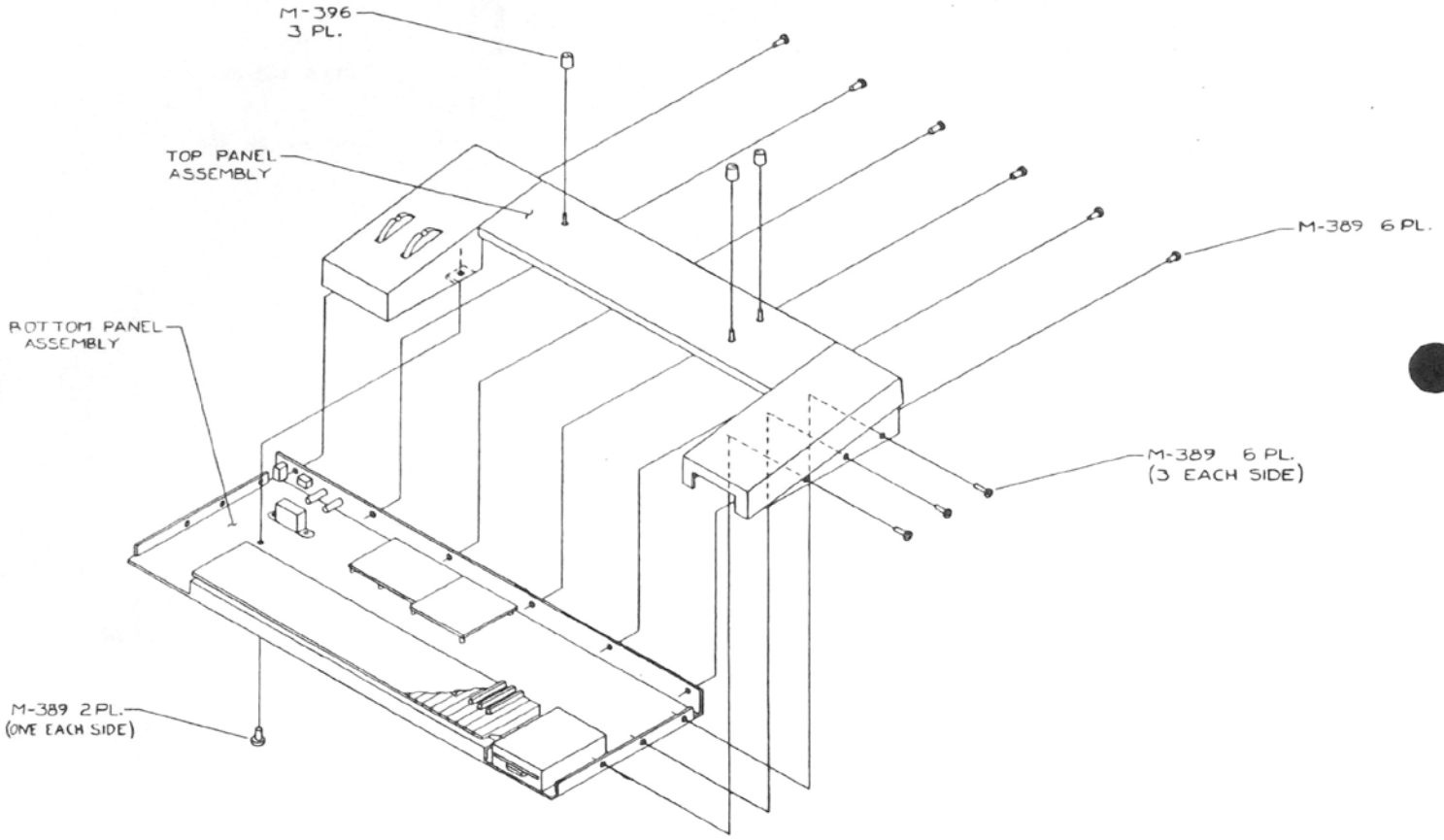


Figure 0.2
POSITION OF BOTTOM PANEL SCREWS

Turn the unit right side up.

Remove the three 6-32 panhead phillips screws from each side of the unit. The top panel can then be opened by lifting the sides.

If the 2000's software is going to be replaced, or if you are going to need access to the computer or output circuits, you will also need to remove the keyboard.

Removing The Keyboard Or Disk Drive

Please refer to Figure 0.3 below. Due to the 2000's dimensions, the keyboard covers a portion of PCBs 2 and 3, which contain the computer and output circuitry respectively. For servicing either of these boards, it may be necessary to remove the keyboard.

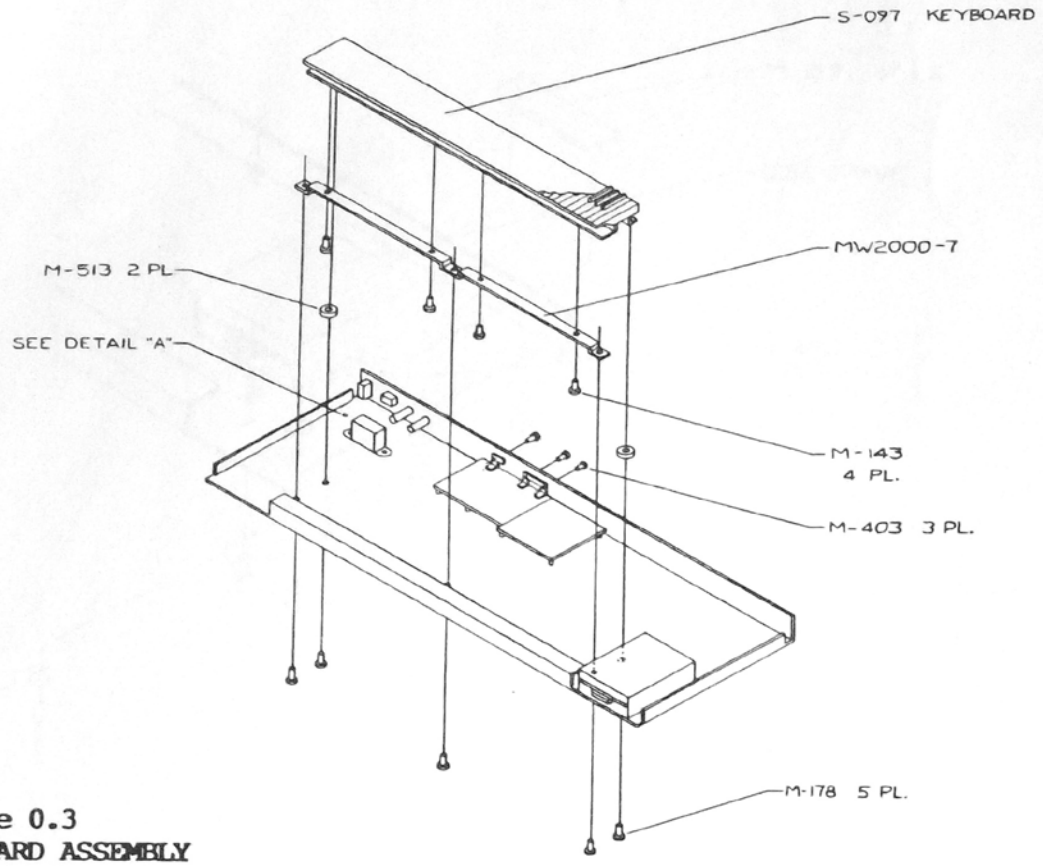


Figure 0.3
KEYBOARD ASSEMBLY

Note: For software change, may only be necessary to remove the two keyboard screws nearest the back panel. This allows the keyboard to be lifted enough to access the EPROM (U214).

Open the 2000 (see above).

Lift the unit up by the front, then remove the front center screw under the keyboard.

Position the unit so that one end hangs over the edge of the bench, then remove the screw holding the front foot under the keyboard and the back silver 8-32 keyboard screw (see Figure 0.3 above). Repeat this procedure for the other end of the 2000.

Slowly lift the left end of the keyboard a few inches, then carefully remove the ribbon cable.

Remove the keyboard from the unit and set it aside.

To remove the disk drive, remove the four screws (see Figure 0.4).

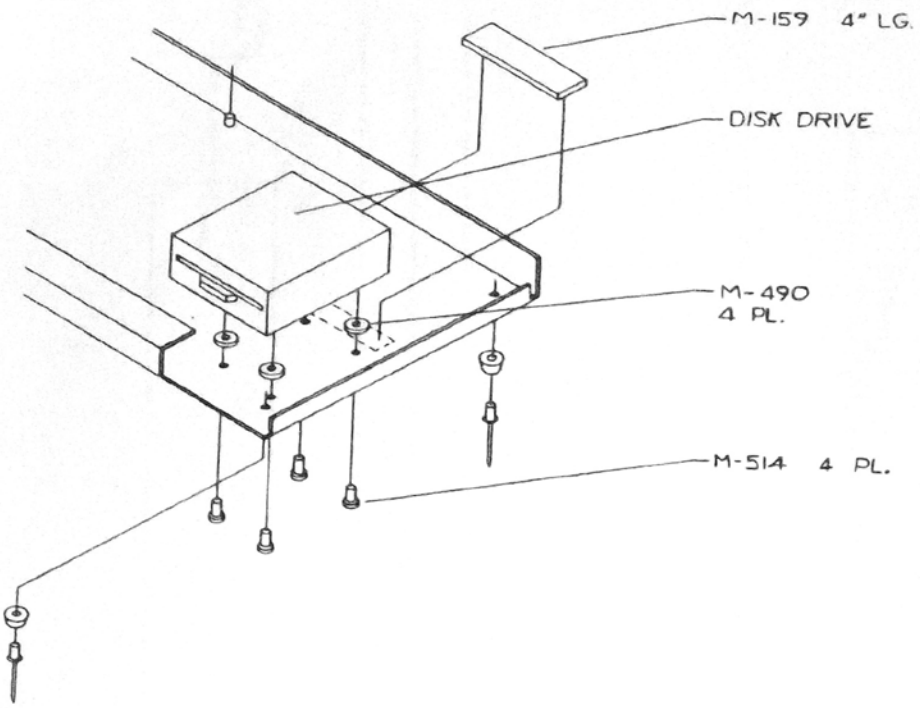


Figure 0.4
POSITION OF DISK DRIVE SCREWS

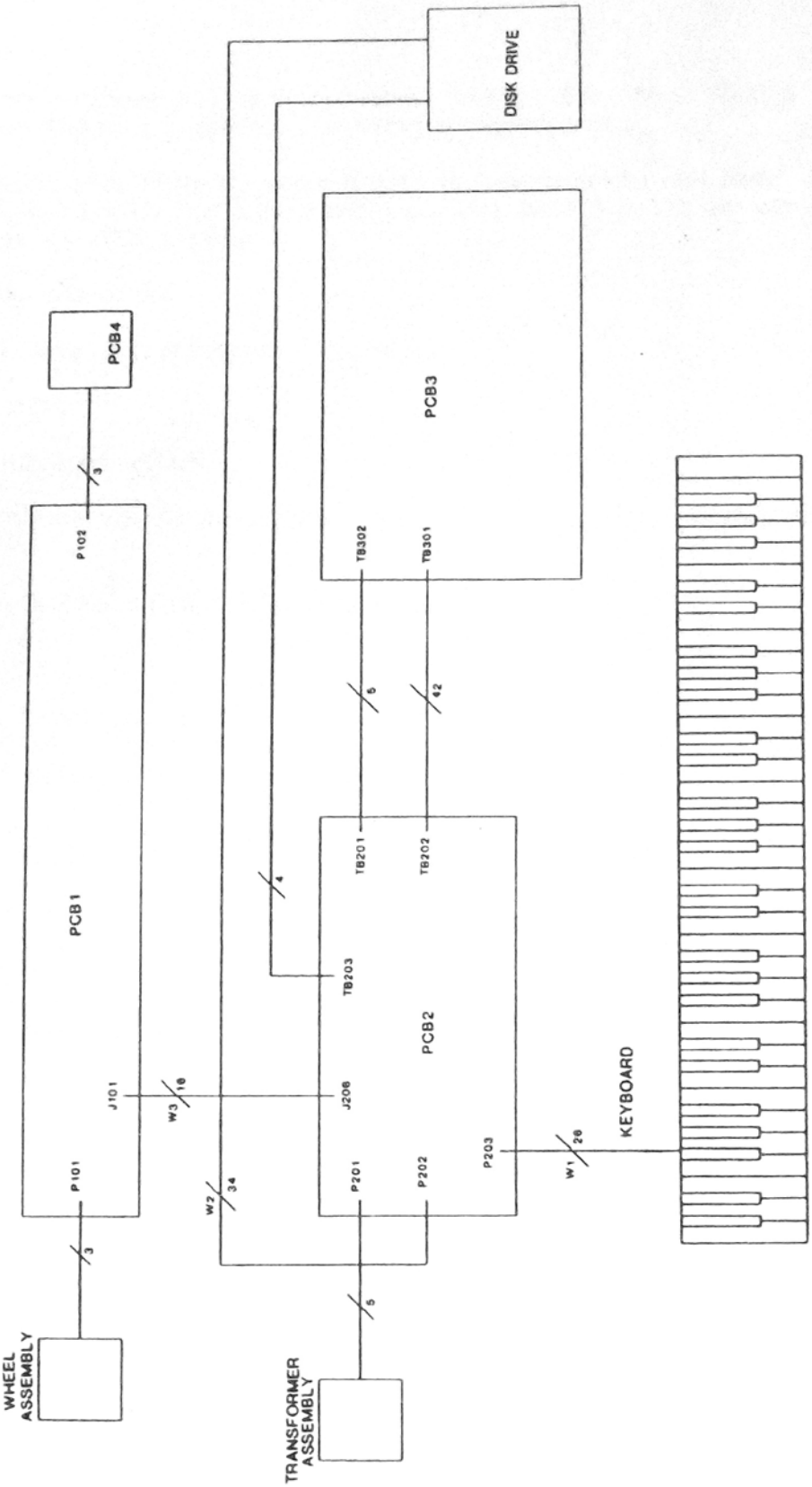


Figure 0.5
INTERCONNECTION DIAGRAM

DIAGNOSTIC TESTS

The Model 879 factory diagnostic disk provides tests for the 2000's hardware. Order the Model 879 through Sequential's service department.

Note: The diagnostics disk must be auto-loaded on power-on in the same manner as sound disks. (If loaded with the LOAD function, the 2000's built-in waveshapes may interfere with test #3 (VCF test).

To load the diagnostics disk:

If necessary, save current memory to disk.

Switch power off.

Plug in the AUX footswitch.

If a second footswitch is available, plug it into the **ALTERNATE RELEASE** input.

Insert the diagnostics disk in the disk drive.

Switch power on.

The disk drive whirrs for several seconds, then the display reads "??" until you select one of the five main diagnostic tests. (Otherwise, the 2000 will periodically strobe through all front panel LEDs.)

To select the desired diagnostic tests, use preset switches 1 through 8, assigned as follows:

KEY	TEST	SEE PAGE
1	Counter/timer test	2.1
2	Keyboard test	2.2
3	Output filter test	3.1
4	DAC test	3.2
5	Sound RAM test	2.2
6	LED test	1.1
7	Switch test	1.2
8	Footswitch test	2.3

Each test may contain several layers of related tests. Each test is described in detail in the section of this manual indicated above.

To exit the diagnostics, switch off 2000, then reload desired sound disk.

UPDATES

Since it's introduction, the 2000 has undergone several hardware and software updates. To bring earlier models up to date, check for the presence of each modification. Only in the case of PCB2 has the printed circuit board itself been changed to rev B, but the changes can be implemented on rev A boards.

It is recommended that all models be modified to include all the items listed below. In the case of the eight resistor value changes in the VCF circuits, the filters will sound "brighter," and it may be necessary to lower the filter cutoff settings of sounds created with an unmodified instrument.

Currently software version 2-1 is implemented.

PCB1 Control Panel

Current version is rev A. Modifications to PCB1 are listed below.

R103 and C112 hardwired to P101-1. C112 soldered to ground plane.

Trace cut, jumper added as shown in Figure 0.5. Avoids possible shorting of +5V to ground or to the potentiometer (R-101) body.

RP101 changed from 39 X 8 (R-300) to 100 X 8 (R-316) package, or eight 100 Ohm resistors (R-068).

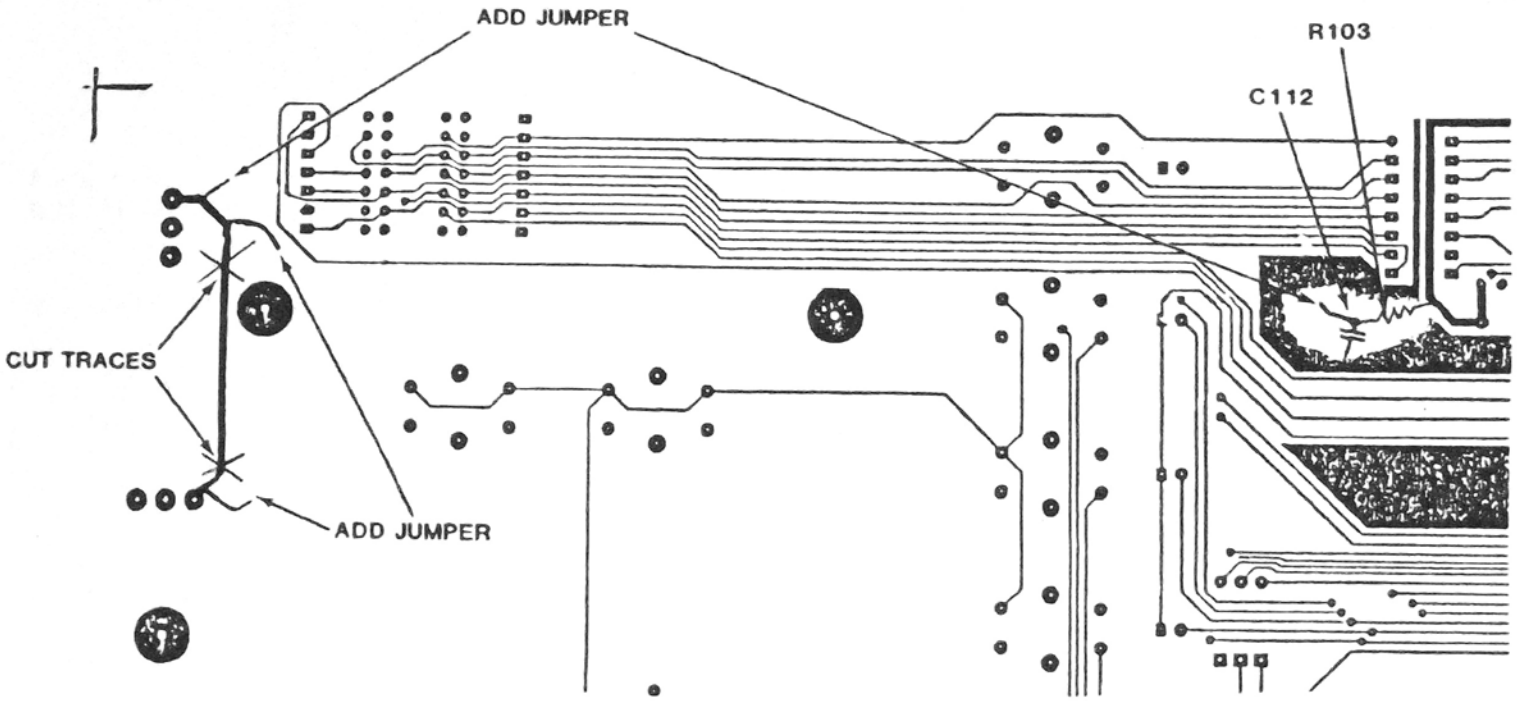


Figure 0.6
LOCATION OF PCB1 (REV A) MODIFICATIONS

PCB2 Computer Board

Current version is rev B. The following mods should be made to all rev A boards. (To check for these mods, refer to Figure 0.7.)

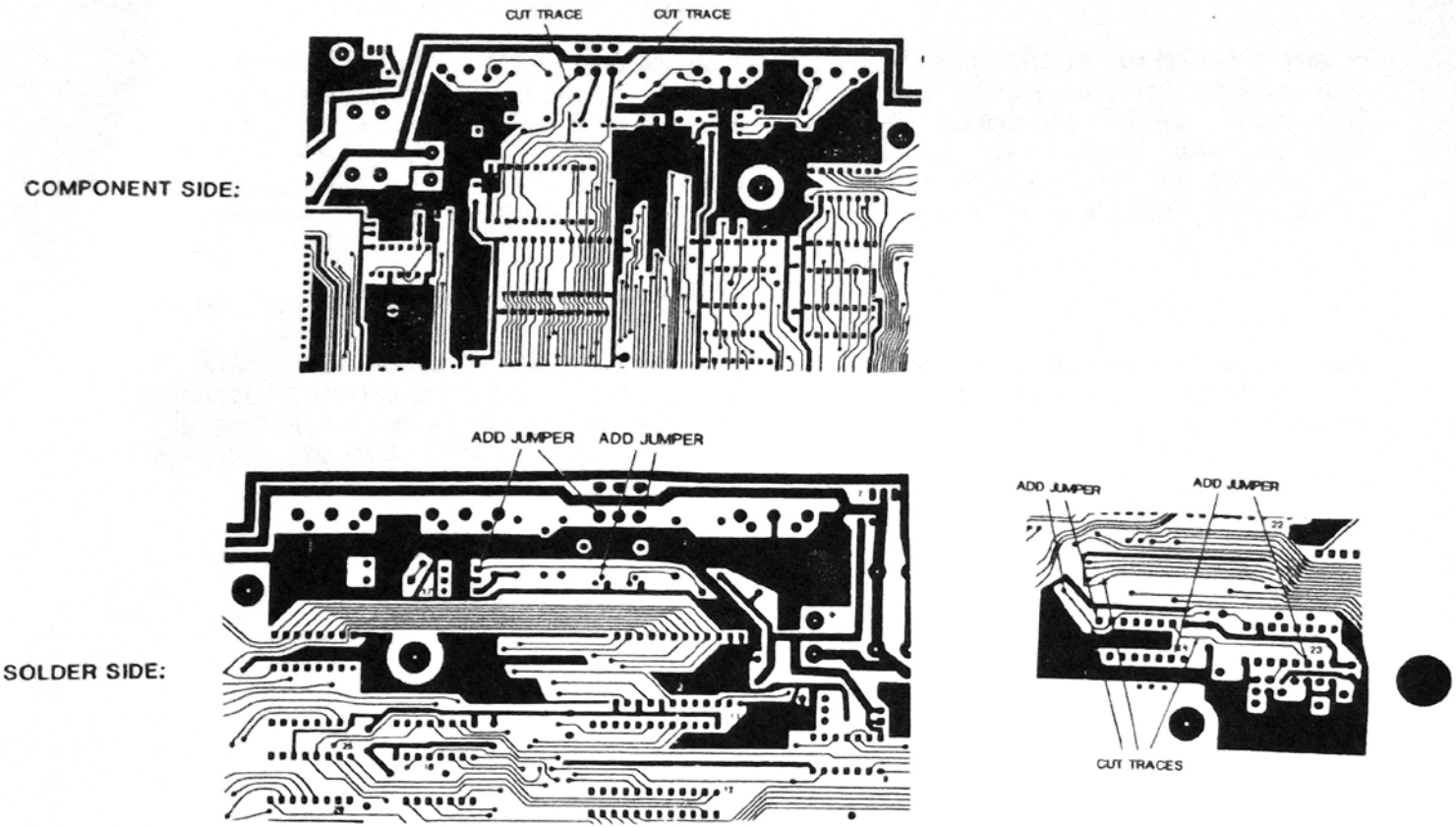


Figure 0.7
MODIFYING REV A PCB2 TO REV B

On component side of PCB2:

Cut traces from MIDI OUT/THRU switch.

Cut trace from U229-12 (passes between U224-4 and -5).

Hardwire U220-10 to TB301-0 on PCB3.

On solder side of PCB2:

Hardwire U217-4 to S201, and base of Q-202 to S201 as shown in Figure 0.7.

Hardwire U220-12 to TB202-1 (connector to PCB3).

U224-10 disconnected from U233/38/39. Instead, U224-9 wired to U233/38/39. (Cut trace and add jumper as shown in Figure 0.7.)

Add jumper between U224-1 and U223-3.

In addition to these updates, several modifications are used on rev B boards (and hence rev A also) to improve the instrument's performance. These mods may not be needed in some models, and should be installed if a customer complains. Descriptions of these modifications follow.

1. PCB5 installed in PCB2, replacing U218. U218's circuit is unchanged, but a 6MHz clock circuit is added. A trace is cut on the solder side of PCB2, and the 6MHz clock is hardwired from PCB5 to PCB2 component side. This mod improves the performance of the custom ICs in the sound RAM section (described in Section 2), and is vital for proper operation. A jumper is wired from PCB5 to U236-39 (pin -33). This mod should be installed in all rev A and B PCB2s.

2. R223=2.7k (was 10k).

3. R225 (next to U223) is changed to 100 Ohms, then disconnected from +5V and connected diredtly to pin 11 of U223. (See Figure 0.8 below.) Depending on the serial number of the 2000, R225 may be either 470 or 200 Ohms. (Update UD2000-1 changed R225 to 200.)

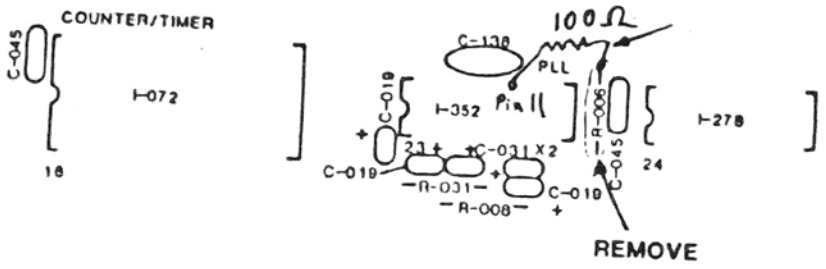


Figure 0.8
MODIFICATION OF U223 CIRCUIT

4. For future expansion, U201-1 should no longer be grounded. This section of U201 is used when using double-sided disk drives. Check solder side of U201 for pin -1 short to ground. If there is a wire creating the short, remove it. If the board is rev B, cut the solder-side trace between pin -1 and ground.

5. Hardwire pin U201-1 to U220-10 on solder-side of PCB2.

PCB3 Voice Board

Current version is rev A. There have been several changes in component values. For location of these updates, refer to PCB3 designator map on page 3.10.

1. Eight resistors in the filter circuits changed from 33.2k to 42.2k. Update kit UD2000-1 covers this mod. Note that this update affects the filtering of samples, and presets may need adjustment. For location of these resistors, see Figure 0.9, below. (Model 876 factory preset disks are intended for operation with updated units, and are supplied with UD2000-1.)

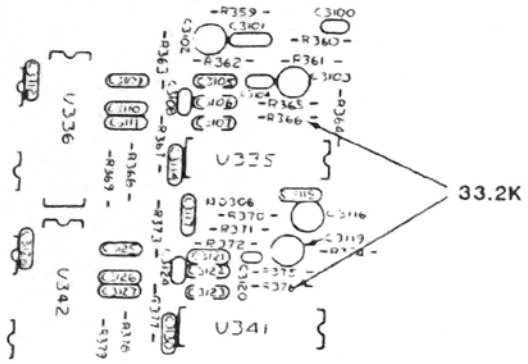


Figure 0.9
LOCATION OF 33.2K RESISTOR RELATIVE TO FILTER IC

2. Other part changes:

C309 is now C-001 (5pF).
U309 is now I-323 (LF356).
U311 is now I-324 (5532).
R320 is now R-112 (15k 1%).

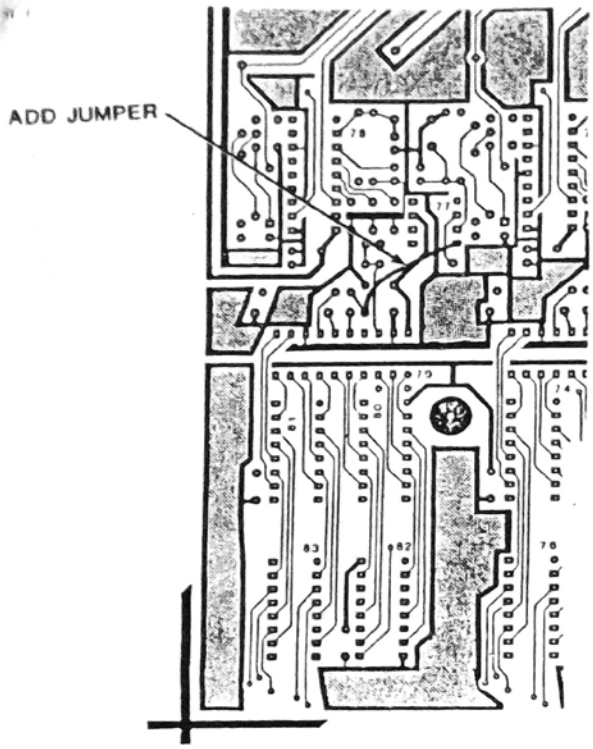
The following are hardware modifications to Rev A PCB3:

1. Pin -7 of U325, U328, and U331 lifted from PCB, then hardwired to U327-11 (-12V). (See Figure 0.10, below.)

2. U377-4 hardwired to -12V as shown in Figure 0.10, below.

3. R3132 disconnected from trace going to U326-9 as shown in Figure 0.10, below.

4. Ground plane cut around C381 (near U384).



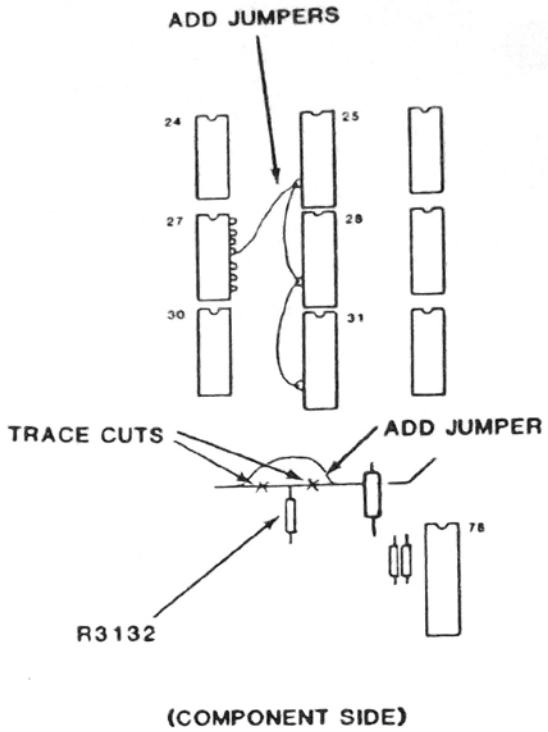


Figure 0.10
MODIFYING REV A PCB3

4. There are two versions of rev A PCB3. One version requires corrections to traces off TB301. Figure 0.11 shows the differences between these versions, and the modification required.

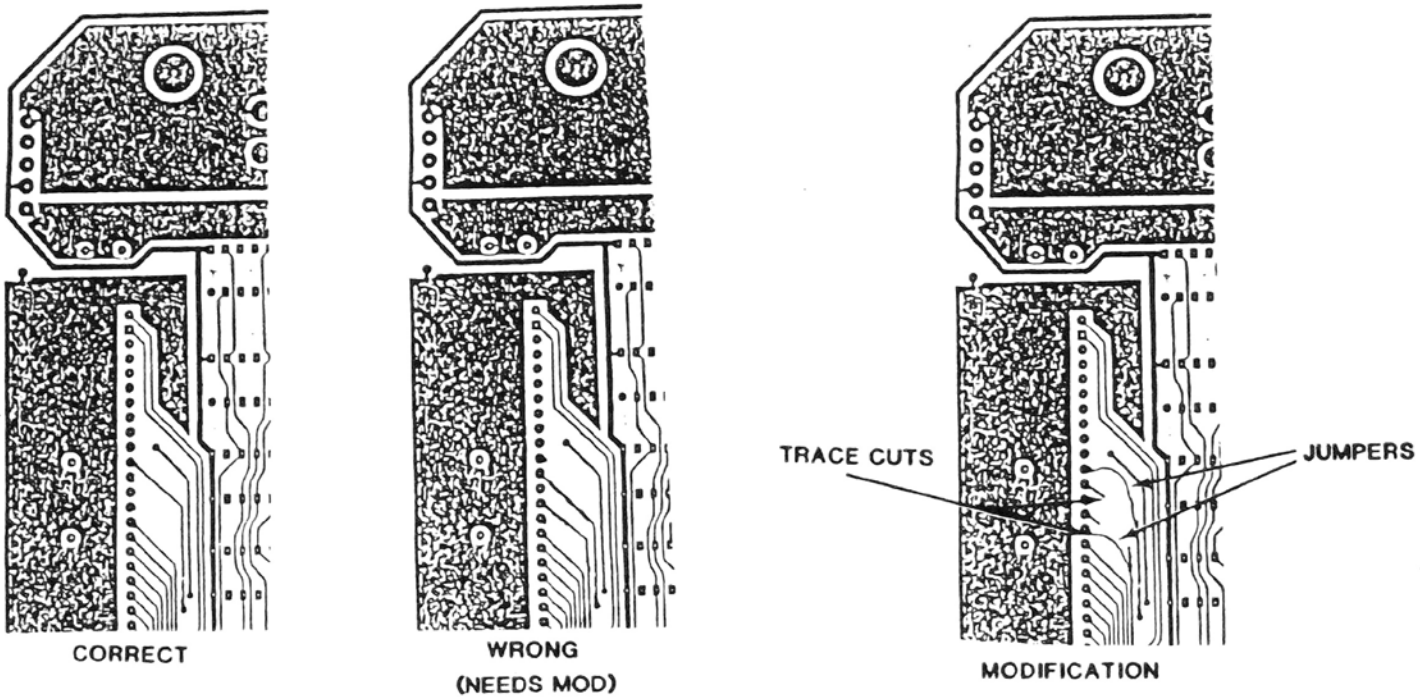


Figure 0.11
MODIFYING TB301 WIRING

PARTS LIST/HARDWARE DESCRIPTION

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
		E-019	1/2 AMP Slo-blo fuse
		E-128	SEMCO Fuse holder
		E-129	SEMCO fuse holder cap
		E-189	3 1/2 Disk drive
		E-185	Detachable power cord
		M-016	Large rubber feet
		M-019	1/4" Female faston
		M-020	12 AWG "10 Terminal ring lug
		M-035	6-32 Nuts 1/4" outside diameter
		M-071	6-32 X 1/4" Pan hd phil ms
		M-140	3 1/2" Tie wrap
		M-141	#6 Star washer ext tooth
		M-043	10-32 X 1/2" Pan hd phil ms
		M-150	3/16" Shrink tubing
		M-151	1/4" Shrink tubing
		M-178	10-32 X 3/4" Black pan hd phil
		M-396	Low profile knob/black cap
		M-403	8-32 X 3/8" Black pan hd phil
		M-490	.1" thick felt washer
		M-509	1/8" X 3/8" Alum pop rivet
		M-513	3/4" X 5/16" #10 Spacer
		M-514	3mm X 10mm long, blk pan hd phil
		MW2000-1	2000 Top panel
		MW2000-2	2000 Bottom panel
		MW2000-7	Keyboard bracket
		P-073	SEMCO AC connector
		S-054	240-Volt power switch
		S-062	110/220 Voltage selector
		S-097	5-octave weighted velocity kbrd

SECTION 1

PCB1 AND PCB4
FRONT PANEL

Before working on PCB1, check that the board is updated as described on page 0.11.

DIAGNOSTIC TESTS

The diagnostic disk offers two tests which verify that all LEDs work, and that the computer is correctly reading the front panel switches.

To run these diagnostic tests:

Check that the AUX footswitch is plugged in.

Auto-load (from power-on) the diagnostic disk. (See page 0.11.)

When the display reads "??", press the desired test number.
The tests are numbered as follows:

Switch	Test	Page
1	Counter/Timer Test	2.1
2	Keyboard test	2.2
3	VCF test	3.1
4	DAC test	3.2
5	Sound RAM test	2.2
6	LED test	1.1
7	Switch test	1.2
8	Footswitch test	2.4

Descriptions of tests #6 and #7 follow.

Test #6: LED Test

This test turns on each LED or display segment one at a time.

With the diagnostic "??" prompt, press **6**.
The LEDs light in sequence.

Check that all LEDs light.

To end this test, and return to the "??" prompt, press the AUX footswitch.

Test #7: Switch Test

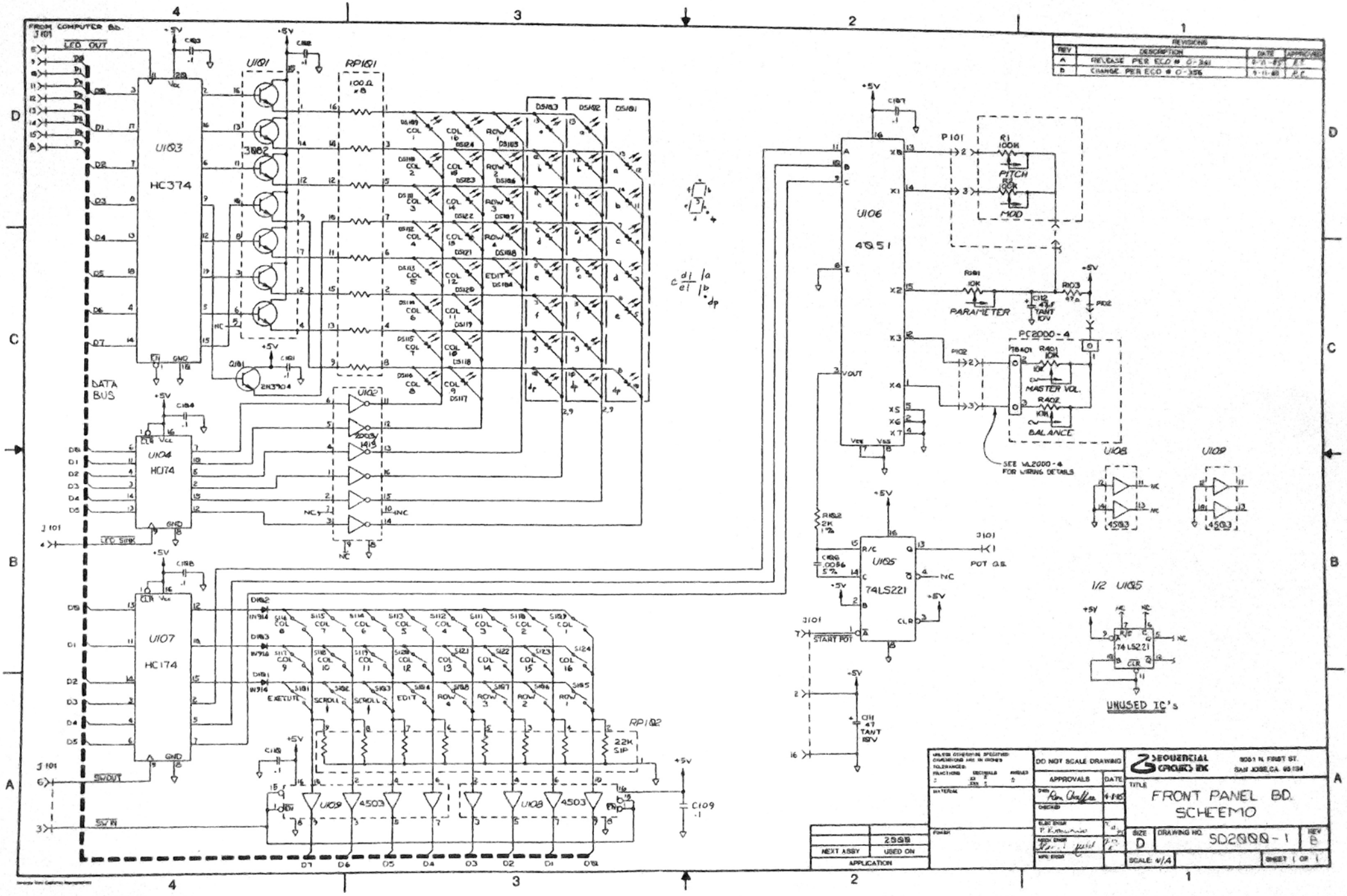
This test displays the name (two-segment abbreviation) of any switch pressed.

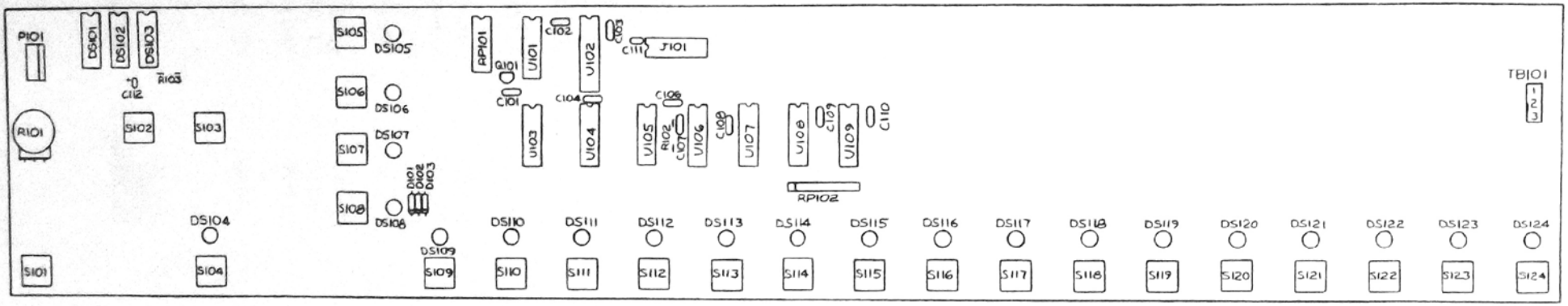
With the diagnostic "??" prompt, press 7.
The dissplay goes blank.

Press each switch, then check the display for the correct readout.
Switch names are abbreviated as follows:

Switch	Display
SAMPLE	r1
CONTROL 1	r2
ANALOG	r3
CONTROL 2	r4
PRESETS 1	c1
PRESETS 2	c2
PRESETS 3	c3
PRESETS 4	c4
PRESETS 5	c5
PRESETS 6	c6
PRESETS 7	c7
PRESETS 8	c8
PRESETS 9	c9
PRESETS 10	C0
PRESETS 11	C1
PRESETS 12	C2
STACK	C3
ARP ON/OFF	C4
SAVE	C5
LOAD	C6
EXECUTE	Ec
INC	Su
DEC	Sd
PRESET	PS

To end this test, and return to the "??" prompt, press the AUX footswitch.


FROM COMPUTER BD.
J101
LED OUT
DATA BUS
U103
HC374
U104
HC174
U107
HC174
U102
U101
RP101
100Ω x8
Q101
2N3904
U106
4051
P101
R1 100K
PITCH
R2 50K
MOD
R501 10K
PARAMETER
R103 47Ω
C112 47uF TANT 10V
PC2000-4
P102
R401 10K
MASTER VOL.
R402 10K
BALANCE
SEE WL2000-4 FOR WIRING DETAILS
U105
74LS221
R502 2K 1%
C106 .0056 5%
J101
POT GS
START POT
C111 47 TANT 15V
1/2 U105
UNUSED IC's
U108
4503
U109
4503
RP102
22K SIP
EXECUTE
SCROLL
EDIT
C109 .1
J101
SWOUT
SWIN
REVISIONS
REV A RELEASE PER ECO # 0-341 9-11-82 RC
REV B CHANGE PER ECO # 0-356 9-11-82 RC
DO NOT SCALE DRAWING
APPROVALS DATE
DRAWN Ron Chaffee 4-1-83
CHECKED
ENG APPR T. Kobayashi
MFG APPR
SEQUENTIAL CIRCUITS INC 1001 N. FIRST ST. SAN JOSE, CA 95134
TITLE FRONT PANEL BD. SCHEEMO
SIZE D DRAWING NO. SD2000-1 REV B
SCALE: 1/1 SHEET 1 OF 1
NEXT ASSY 2958 USED ON
APPLICATION



NOT USED	LAST USED
C105	C112
	D103
	P101
	Q101
	R103
	S124
	DS124
	RP101

					J
					H
					G
					F
					E
					D
					C
	7-11-85	R-336	CHANGE PER ECO #0-361		B
	8-21-85		RELEASE PER ECO # 0-356		A
PART LIST B/M	DATE	ECN No	REVISION		LTR

SEQUENTIAL

APPROVALS	DATE	TITLE: DESIGNATOR MAP
DWN Ron Chaffee	7-8-85	SIZE: — MODEL No 2000
CHK		DOCUMENT No: PP2000-1 REV: B
DSN		
PEN P. Rutgers U3	7/10/86	SCALE 1/1 SHEET 1 OF 1
ISS		

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
Z-357	PCB1 Assembly		
C101-04		C-045	.1 50V Decoupler Mono Radial
C105	Not used		
C106		C-046	.0056 100V 10% Mylar Radial
C107-10		C-045	.1 50V Decoupler Mono Radial
C111/12		C-023	47uF 10V 20% Tantalum Radial
D101-03		D-005	1N914
DS101		L-013	/- 1 display
DS102/03		L-009	7-segment display common cathode
DS104-24		L-015	T-1 3/4 High efficiency RED
P101/02		P-098	3-pos rt ang locking molex hdr
Q101		T-002	NPN Transistor 2N3904
R101		R-235	10k Nylon shaft
R102		R-512	2.0k 1/4W 1%
R103		R-043	47 1/4W 5%
RP101		R-316	100 X 8 Resistor network
RP102		R-309	22K X 9 SIP 10%
S101-24		S-089	OMRON Key switch
	Caps for S101-24	S-093	OMRON Grey switch cap
U101		T-011	Transistor pack CA3082
U102		I-235	MC1413 (2003)
U103		I-260	74HC374
U104		I-513	74HC174
U105		I-270	74LS221 Oneshot X 2
U106		I-211	4051 8-in Analog Mux
U107		I-513	74HC174
U108/09		I-216	4503 Hex 3-state buffer
	Connector to PCB2	E-075	11" 16-pin ribbon cable
		J-027	14-pin DIP socket
		M-370	Greaseless insulator
		PC2000-1	2000 1 Board

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
Z-354	**PCB4 Volume/Balance Board Assembly**		
R401/02	MASTER VOLUME and BALANCE pots	R-235	10k Nylon shaft
		P-049	Socket pins
		P-050	3-position locking
		PC2000-4	2000 4 board
Z-355	**Wheel Assembly**		
R1/2	PITCH and MOD wheels	R-247	100k potentiometer
		E-053	22 AWG Stranded yellow
		E-061	22 AWG Stranded light blue
		E-062	22 AWG Stranded green
		J-050	3-pin housing
		M-024	6-32 X 3/8" pan hd phil
		M-159	Black foam tape
		M-510	.385 ID X 1.00 Torsion spring
		M-511	Retainer ring
		MW0000-3	MOD Wheel brace
		MW0000-4	MOD Wheel bracket
		P-049	Socket pins
		PW0000-2	Spring return MOD wheel

SECTION 2

PCB2 AND PCB 5
COMPUTER

Before trooubleshooting PCB2, check that the board is updated as described on page 0.12.

DIAGNOSTIC TESTS

The diagnostics disk offers three tests which test the computer system counter circuits, the keyboard, sound RAM, and the footswitch inputs.

To run these diagnostic tests:

Check that the AUX footswitch is plugged in.

Turn the monitor system volume down. (The 2000's VOLUME control is bypassed during the diagnostics.)

Auto-load (from power-on) the diagnostic disk. (See page 0.10)

When the display reads "??", press the **PRESETS** switch corrresponding to the desired test.
The tests are numbered as follows:

Switch	TEST	See Page
1	Counter/Timer	2.1
2	Keyboard test	2.2
3	Output Filter	3.1
4	DAC (three tests)	3.2
5	Sound RAM	2.2
6	LED test	1.1
7	Switch test	1.2
8	Footswitch test	2.4

Descriptions of tests #1, #2, #5, and #8 follow.

Test #1: Counter/Timer Test

This test verifies proper operation of the 8254 counter's registers.

With the diagnostic "??" prompt displayed, press **1**.
The display blanks.

If all sections of the counter (there are three) test OK, the display reads "Gd". If any of the sections fails the test, the display reads "Cn" (n is the number of the section which failed).

The display then reads " x", where x is the type of test failure. If "1" or "2" is displayed, chances are that the counter chip needs to be replaced. If "3" is displayed, one of the counter chips inputs or outputs may be shorted.

To end this test, and return to the "??" prompt, press the AUX footswitch.

Test #2: Keyboard Test

This test displays the name of any key played.

With the "??" prompt displayed, press 2.
The display reads "--".

Play the keyboard, checking for the correct display for each key.
Sharps are indicated by a "+". The **PRESET** LEDs indicate the key velocity.

To end this test, and return to the "??" prompt, press the AUX footswitch.

Test #5: Sample RAM Test

There are two sets of two tests for the sample RAM. The first set of tests check the standard 256K of sample RAM. The second set of tests check expansion RAM (only if installed, see Section 4). All tests run similarly, and give the same indications.

To select the sample RAM tests:

With the "??" prompt displayed, press **5**.
The display reads "rt", meaning that the CPU is writing data to sample memory.

Press **1**.
The display reads "1" as the CPU writes a data pattern into sample RAM. The display then reads "r" as the CPU reads sample RAM, making sure that the pattern was stored. If the RAM passes the test, the display reads "Gd" for a moment, then "rt".

If the RAM fails the test, the A-440 tone turns on, and the **PRESET** LEDs display the bits (1-12) which failed the test, while the seven-segment display shows the number of the first failed IC (for example "47").

Press **2**.
The display reads "2" as the CPU writes a complimentary pattern to RAM (1's and 0's reversed). Test results are displayed in the same manner as test 1.

If expansion RAM is installed, select sample RAM tests #3 and #4 with the **3** and **4** switches. These tests are similar to tests #1 and #2, respectively.

To exit these tests, and return to the "??" prompt, press the **AUX** footswitch.

Test #8: Footswitch Test

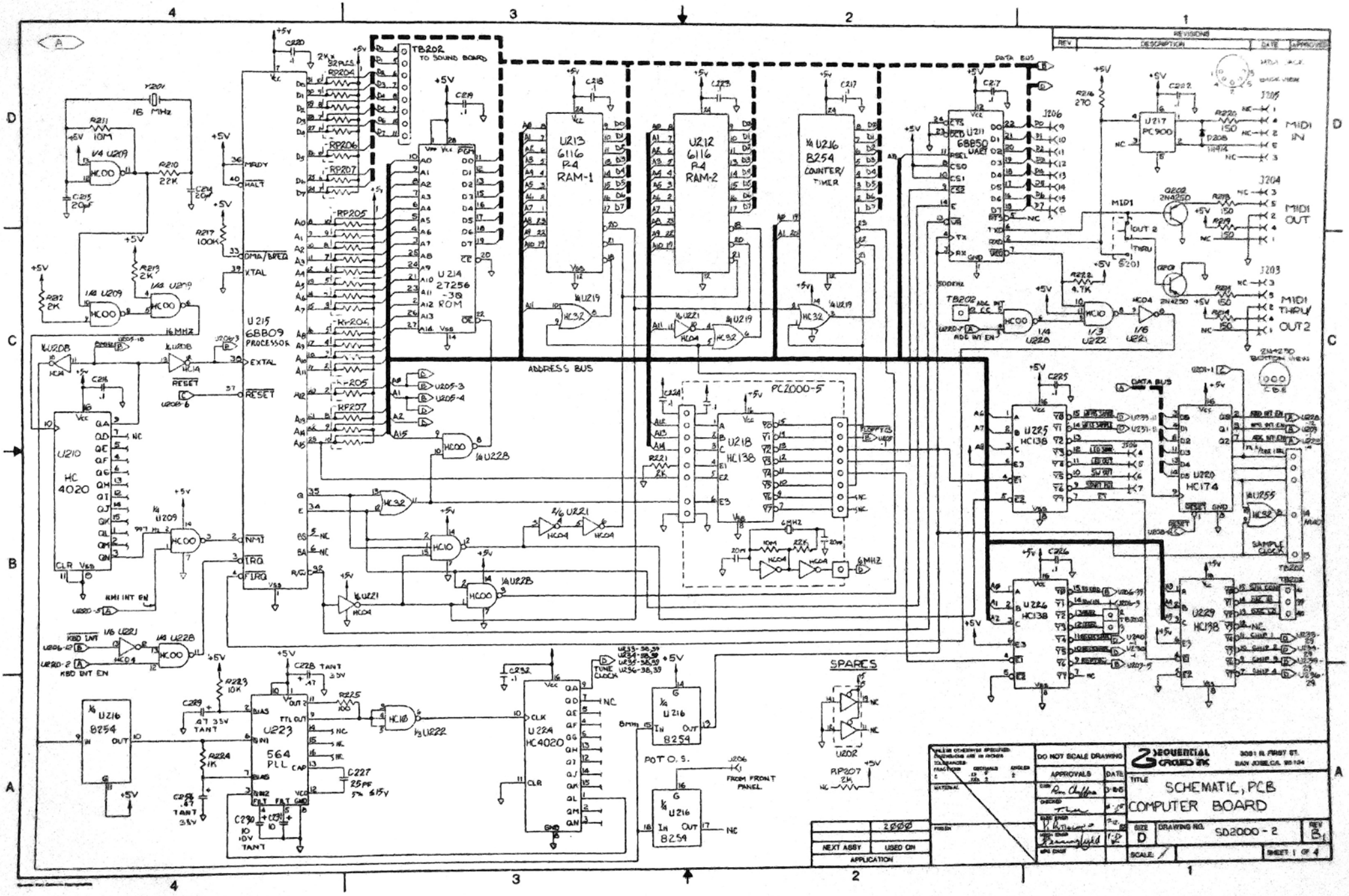
This test verifies opration of the two footswitch inputs.

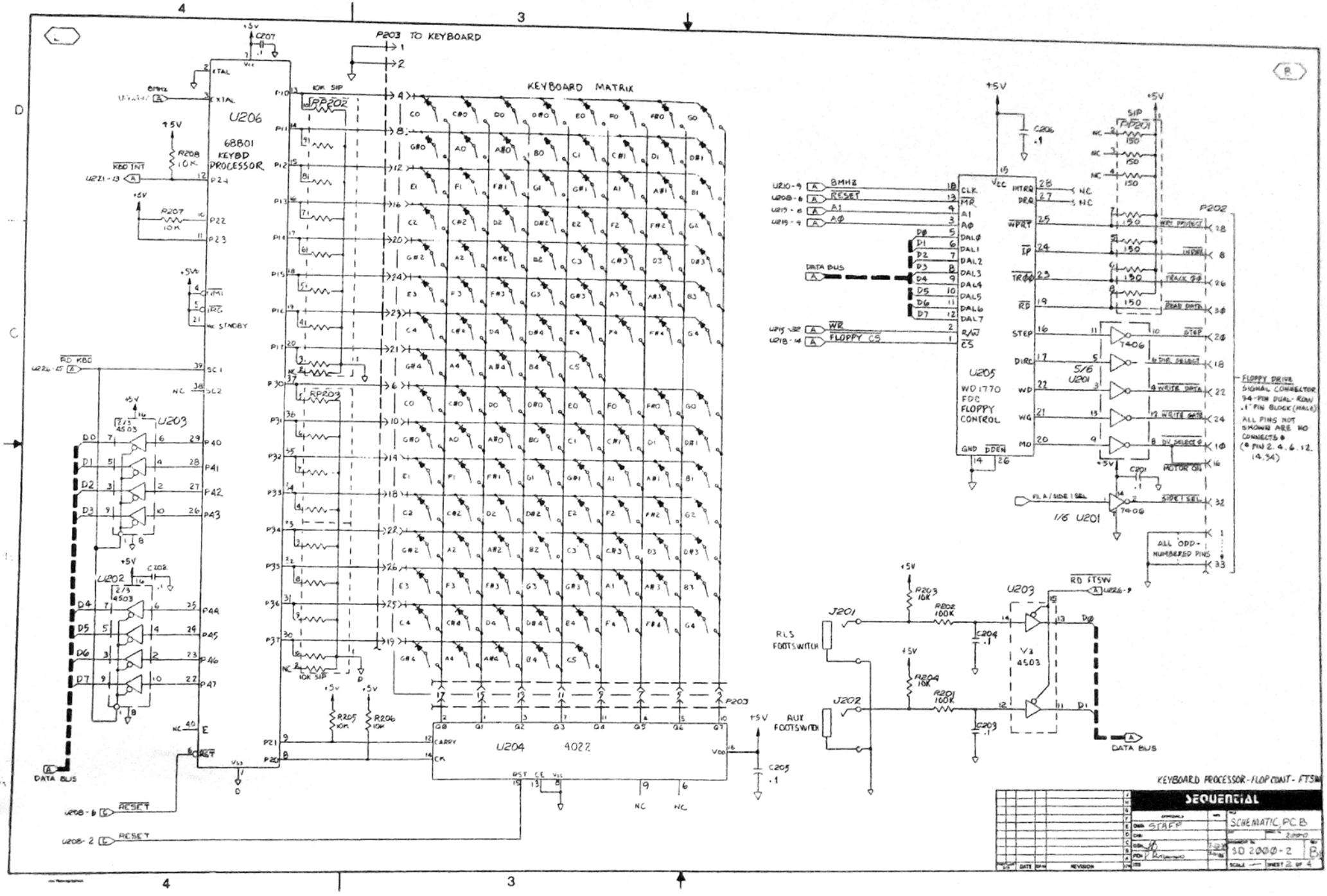
With the "??" prompt displayed, press **8**.
PRESETS 1 and **2** LIGHT.

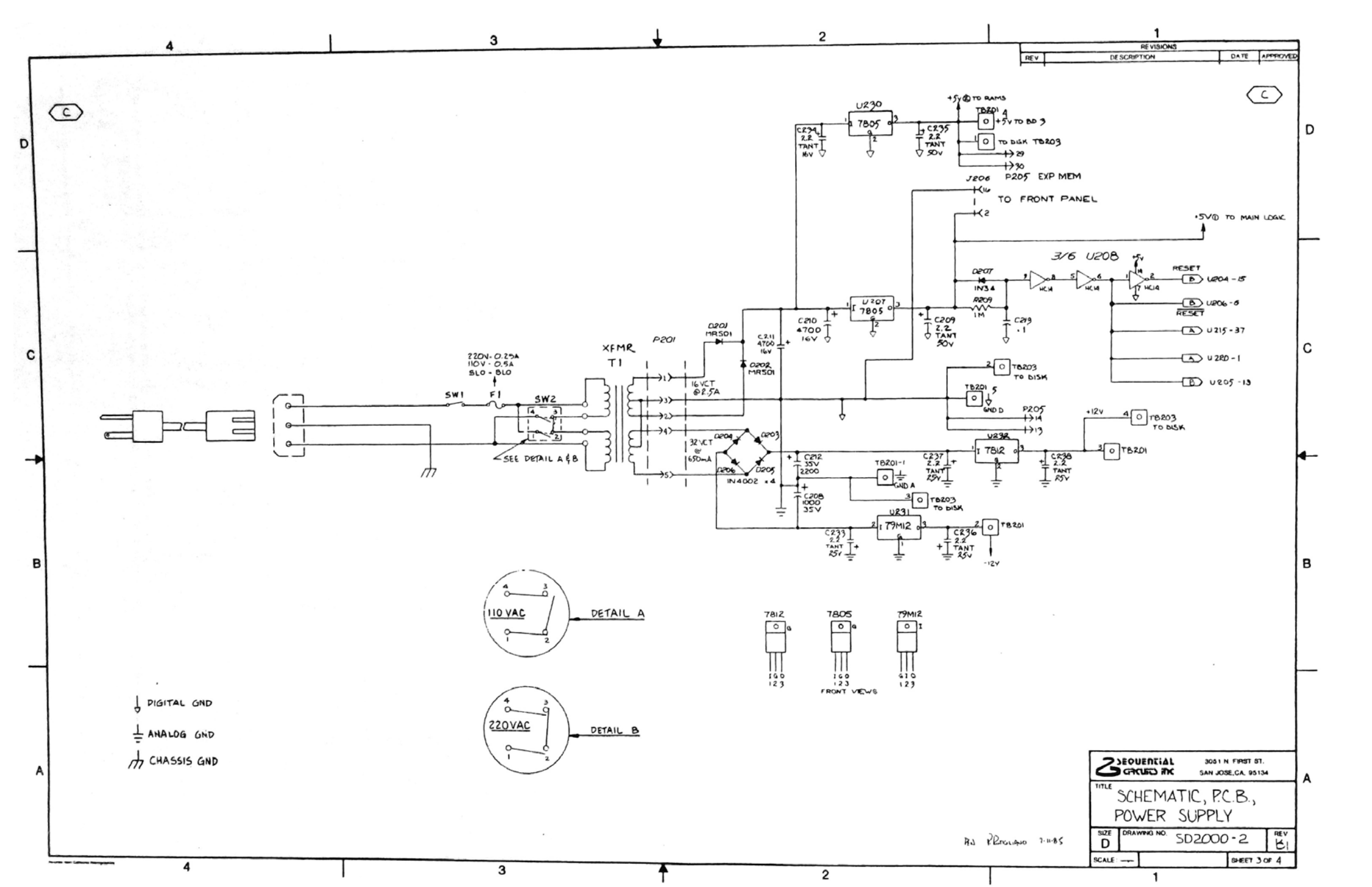
Press the AUX footswitch.
The **PRESET 1** LED turns off.

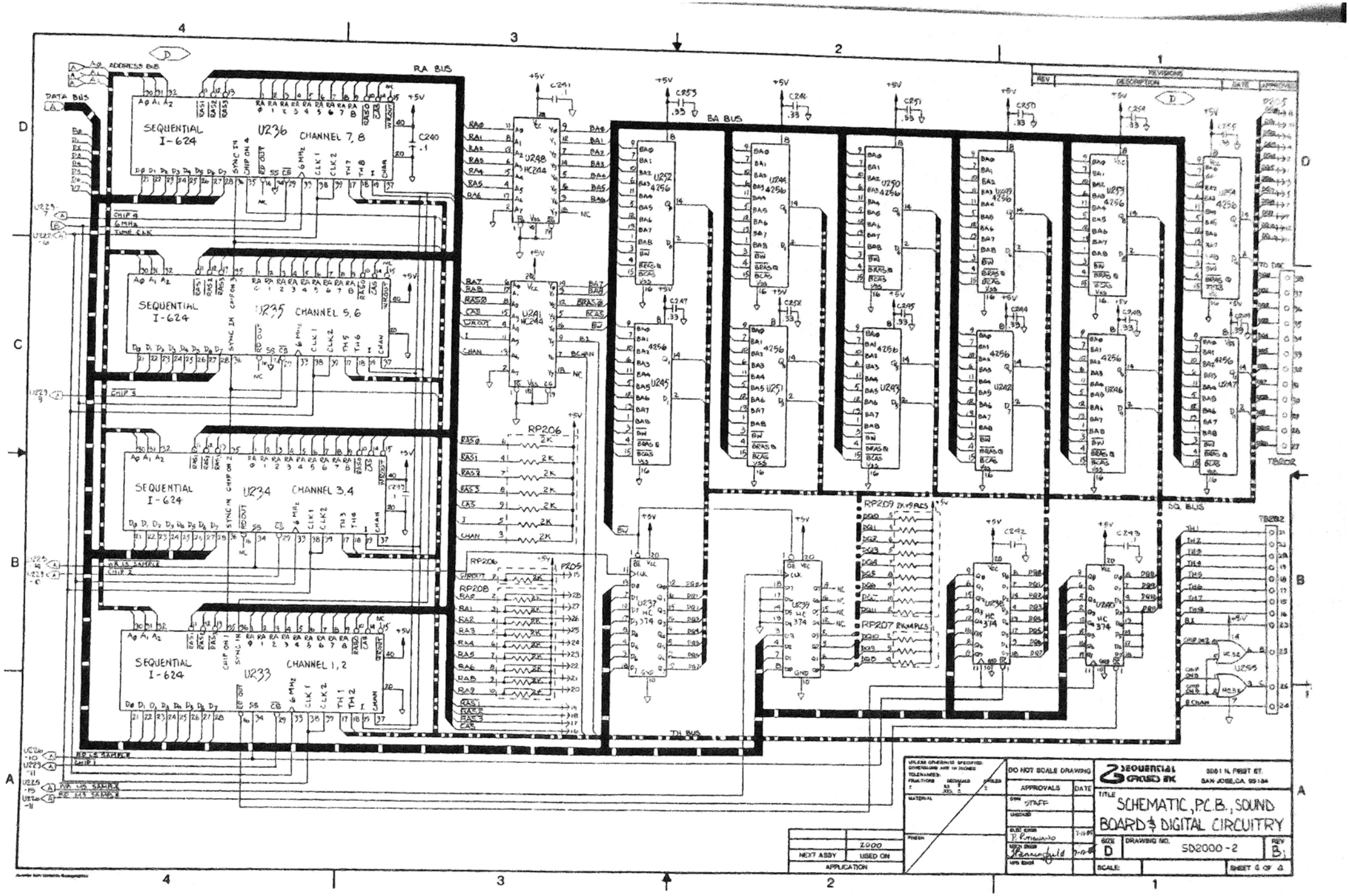
Press the ALTERNATE RELEASE footswitch.
The **PRESET 2** LED turns off.

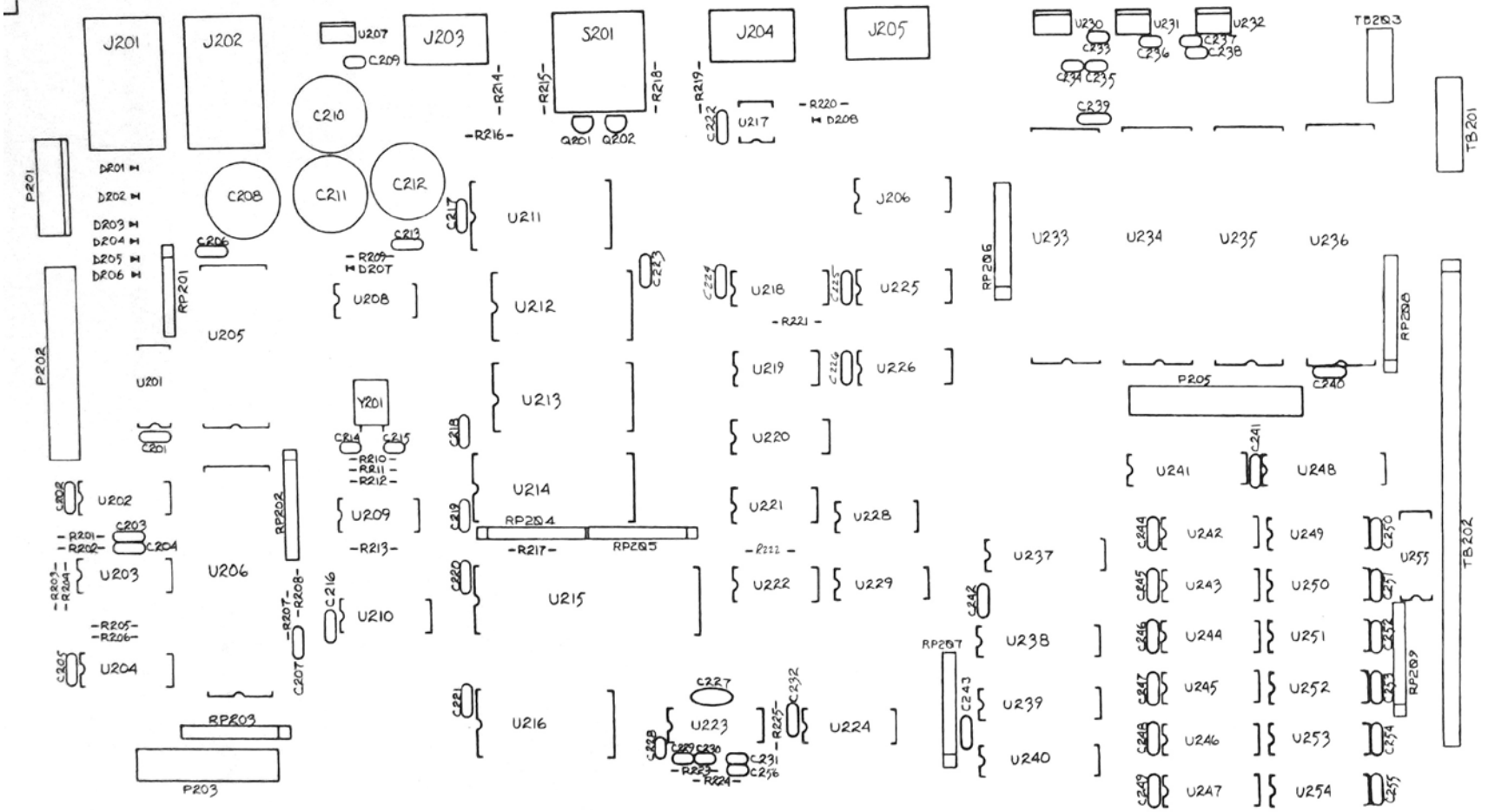
To exit this test, and return to the "??" prompt, press the **LOAD** switch.


TB202
TO SOUND BOARD
U213 6116 RA RAM-1
U212 6116 RA RAM-2
½ U216 8254 COUNTER/ TIMER
U214 27256 -30 ROM
U215 68B09 PROCESSOR
16 MHz
U210 HC 4020
U218 HC138
PC2000-5
ADDRESS BUS
DATA BUS
U225 HC138
U220 HC174
U226 HC138
U229 HC138
U224 HC4020
U223 564 PLL CAP
½ U216 8254
U202 RP207 2K
SPARES
MIDI IN
MIDI OUT
MIDI THRU
OUT 2
SAMPLE CLOCK
TUNE CLOCK
POT O.S.
FROM FRONT PANEL
RESET
NMI
IRQ
XTAL
EXTAL
HALT
MRDY
DMA/BREQ
KBD INT EN
NMI INT EN
ADC INT EN
DO NOT SCALE DRAWING
SEQUENTIAL CIRCUITS INC.
3051 N. FIRST ST. SAN JOSE, CA. 95134
TITLE
SCHEMATIC, PCB
COMPUTER BOARD
SIZE D
DRAWING NO. SD2000 - 2
REV B
SCALE:
SHEET 1 OF 4
NEXT ASSY
USED ON
APPLICATION
2000


P203 TO KEYBOARD
KEYBOARD MATRIX
U206
68B01
KEYBD
PROCESSOR
U205
WD1770
FDC
FLOPPY
CONTROL
U204 4022
U203
U202
RP202
RP203
RP201
P202
J201
J202
RLS FOOTSWITCH
AUX FOOTSWITCH
DATA BUS
FLOPPY DRIVE SIGNAL CONNECTOR 34-PIN DUAL-ROW .1" PIN BLOCK (MALE)
ALL PINS NOT SHOWN ARE NO CONNECTS
KEYBOARD PROCESSOR-FLOPPY UNIT-FTSW
SEQUENTIAL
SCHEMATIC, PC B
SD 2000-2
SHEET 2 OF 4


REVISIONS
REV
DESCRIPTION
DATE
APPROVED
U230
7805
+5V @ TO RAMS
TB201
+5V TO BD 3
TO DISK TB203
29
30
C234 2.2 TANT 16V
C235 2.2 TANT 50V
J206
P205 EXP MEM
TO FRONT PANEL
+5V@ TO MAIN LOGIC
3/6 U208
D207 IN34
HC14
RESET
U204 - 15
U206 - 6
U215 - 37
U210 - 1
U205 - 13
U207 7805
R209 1M
C209 2.2 TANT 50V
C219 .1
C210 4700 16V
C211 4700 16V
D201 MR501
D202 MR501
XFMR T1
P201
220V - 0.25A
110V - 0.5A
BLO - BLO
SW1
F1
SW2
SEE DETAIL A & B
16 VCT @ 2.5A
32 VCT @ 650mA
D204
D203
D206
D205
IN4002 x 4
TB203 TO DISK
TB201
GND D
P205
+12V
U232 7812
C237 2.2 TANT 25V
C238 2.2 TANT 25V
C212 35V 2200
C208 1000 35V
TB201-1
GND A
U231 79M12
C233 2.2 TANT 25V
C236 2.2 TANT 25V
-12V
110 VAC
DETAIL A
220VAC
DETAIL B
7812
7805
79M12
IGO 123
FRONT VIEWS
DIGITAL GND
ANALOG GND
CHASSIS GND
SEQUENTIAL CIRCUITS INC
3051 N. FIRST ST.
SAN JOSE, CA. 95134
TITLE
SCHEMATIC, P.C.B., POWER SUPPLY
SIZE D
DRAWING NO. SD2000-2
REV B1
SCALE —
SHEET 3 OF 4


SEQUENTIAL I-624
U236 CHANNEL 7, 8
U235 CHANNEL 5, 6
U234 CHANNEL 3, 4
U233 CHANNEL 1, 2
RA BUS
BA BUS
DQ BUS
TH BUS
DATA BUS
ADDRESS BUS
RP206
RP208
RP209 2K x 9 PACKS
RP207 9K PACKS
SCHEMATIC, P.C.B., SOUND BOARD & DIGITAL CIRCUITRY
SEQUENTIAL CIRCUITS INC.
SD2000-2



NOT USED	LAST USED
P204	C257
U227	D208
C257	(E203) NOT SHOWN
	J206
	P205
	R225
	S201
	TB203
	Q202
	RP209
	Y201
	U255

SEQUENTIAL

DESIGNATOR MAP
2000.2BD
2000

PP2000-2

SCALE NJ SHEET 1 OF 1

PARTS LIST/HARDWARE DESCRIPTION

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
Z-358	PCB2 Assembly		
C201-08		C-045	.1 50V Decoupler mono radial
C209		C-051	2.2 16V 20% Tantalum radial
C210-26		C-109	4700uF 16V Elect radial
C227		C-138	15pF 5% 20V Mica
C228/29		C-019	.47 35V 20% Tantalum radial
C230/31		C-031	10 10V 20% Tant radial
C232		C-045	.1 50V Decoupler mono radial
C233		C-021	2.2 25V 20% Tantalum radial
C234/35		C-051	2.2 16V 20% Tantalum radial
C236-38		C-021	2.2 25V 20% Tantalum radial
C239-43		C-045	.1 50V Decoupler mono radial
C244-55		C-121	.33uF 50V 20% Mono radial
C256		C-019	.47 35V 20% Tantalum radial
D201/02		D-004	1N5401 100V 3AMP
D203-06		D-001	1N4002 110V 1AMP
D207		D-008	1N34
D208		D-005	1N914
F1			Slo-blo fuse
J201/02	Footswitch Inputs	J-100	1/4" Mono phone jack low
J203-05	MIDI Jacks	J-087	5-pin rt angle PC-mnt DIN conn
P201	Power	P-069	5-pin locking
P202	Floppy Drive Connector	P-077	34-pin dbl row header
P203	Keyboard Connector	P-090	26-pin dbl row .1" header
P205	Expansion Board Header	P-095	30-pin dbl row header
Q201/02		T-003	2N4250 PNP Transistor
R201/02		R-025	100k 1/4W 5%
R203/04		R-012	10k 1/4W 5%
R205/06		R-012	10k 1/4W 5%
R207/08		R-012	10k 1/4W 5%
R209		R-029	1M 1/4W 5%
R210/11		R-040	22k 1/4W 5%
R212/13		R-010	2k 1/4W 5%
R214/15		R-402	150 1/4W 5%
R216		R-403	270 1/4W 5%
R217		R-025	100k 1/4W 5%
R218-20		R-402	150 1/4W 5%
R221		R-010	2k 1/4W 5%
R222		R-011	4.7k 1/4W 5%
R223		R-012	10k 1/4W 5%
R224		R-008	1k 1/4W 5%
R225		R-068	100 1/4W 5%
RP201		R-312	150 X 7 SIP network

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
RP202/03 RP204-09		R-304 R-314	10k X 9 SIP network 2K X 9 SIP network
S201	MIDI OUT/THRU Switch	S-096	DPTT rt angle slide switch
SW1 SW2	Power switch	S-054 S-062	240V Power switch 110/220 Voltage selector
U201	Floppy Controller Output Buffer	I-280	7406
U202/03	**Keyboard and Footswitch Tri-state Buffers**	I-216	4503 hex 3-state buffer

Normally, pins -12 and -14 of U203 are held high by R203 and R204. When ALTERNATE RELEASE or AUX footswitch is pressed, pin -14 or -12 (respectively) is pulled low. When -RD FTSW (from U226-9) goes low, the levels at these inputs are placed onto D0 and D1 of the Data Bus. Similarly, when -RD KBD (from U226-15) goes low, PA0-PA7 are placed of the Data Buss. When -RD FTSW goes low, U206 Keyboard Processor's outputs PA0-PA7 are placed on the Data Bus.

U204	**Keyboard Matrix Driver**	I-207	4022 Octal counter

Operates in conjunction with U206 Keyboard Controller to select one of eight columns of the keyboard matrix. (For details, see U206.)

U205	**Disk Drive Interface**	I-074	1770

Cordinates the storage and retrieval of data on disk. Selected by -FLOPPY CS (from U218-14). Initialized on power-on by -RESET (from U208-6).

U206	**Keyboard Processor**	I-626	68B01 Updated Kybrd controller

Strobes the keyboard matrix, then informs the CPU of key presses or releases, including velocity information for each note. When a key is pressed, -KBD INT goes low. If -KBD INT EN (from U220-2) is high, this level reaches U215 CPU's -IRQ input, and the CPU generates -RD KBD to read data from the keyboard processor. U204 Keyboard Matrix Driver places a high level on one coloumn of the keyboard matrix at a time, and inputs P10-17 and P30-37 --normally pulled low by RP202/03-- sense the closure of any switches on the column currently selected. After each column is checked, U206-8 clocks U204, advancing the counter and selecting the next column. After strobing the fourth column, U204 informs the keyboard processor by generating a carry signal which is sensed at U206-21.

U207	**+5V Regulator**	I-410	7805
U208	**Miscellaneous Inverters**	I-268	74HC14 Hex inv Schmitt trigger
U209	**Miscellaneous Gates**	I-264	74HC00 Quad 2-in NAND
U210	**Clock Divider**	I-278	74HC4020

Divides the 16 MHz clock signal (buffered by U209-8 and -6) to produce 8 MHz and 997 Hz clocks.

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION

U211 **MIDI UART** I-060 68B50

Converts parallel data from the CPU into serial form for transmition over MIDI, and transfers received MIDI data to the CPU.

The CPU communicates with the UART by means of the Data Bus, address line A0, R/-W, E, and the chip select from U218--12. To write or read, the CPU sets -CS2 (pin -9) low. To read, R/-W is set high; it is low to write. RSEL (A0) selects the UART internal register. Once the address and data lines are steady, the actual data transfer occurs on the falling edge of "E" (pin -14).

Once a byte to be transmitted has been placed in the UART, it is shifted out TXDATA, bit by bit, one for every 16 TX clock pulses (31.25 KHz from U216-13). When the TXD output is low, the emmiter of Q202 is low, and current flows through the external MIDI circuit. If TXD is high, no current flows.

Incoming data is converted from a current loop in the MIDI cable to a logic signal by U217 optoisolator, and applied to RXD (U211-2). This data stream is converted to parallel form by referring it to the RX clock (U211-3).

After a byte is completely received or transmitted, -IREQ (pin -7) goes high, requesting interrupt service from the CPU via U222-8 and U221-8. If ADC INT EN (U228-4 is low, then U226-6 is high, and the request reaches th CPU. If the CPU recives the request while ADC INT EN is high, then it knows the U306 Successive Approximation Register is the origin of the interrupt.

U212/13 **Scratchpad RAM** I-073 6116P-4

Decoded by U218-10, and address line A11. Stores results of calculations, arpeggiations, and other program parameters. At power-on, preset program parameters are loaded into RAM from U214 Operating ROM. When diagnostics disk is auto-loaded, the CPU executes instructions stored in scratchpad. Scratchpad RAM is volatile, so all data stored there is lost when power is switched off.

U214 **Operating ROM** Z-1067 27256

Contains the operating software for the CPU. Address and data lines are connected to the CPU, and the CPU reads the ROM by setting address line A15 and either "Q" (U215-35) or "E" (U215-34), then setting address line A0-A14.

U215 **CPU** I-075 68B09

This eight-bit microprocessor cordinates all activities in the 2000, and is driven by the 8 MHz clock from U210 (inverted at U208-12). At power-on, -RESET (from U208-6) causes the CPU to begin executing instructions. To execute instructions, U214 Operating ROM is selected by U228-8, then addressed by the sixteen-line Address Bus, then places instructions on the eight-line Data Bus. To carry out an instruction the CPU addresses other circuits similarly: a chip select is generated, often accompanied by eight-bit data, or further decoding by address lines. The

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION

CPU sets or resets R/-W (U215-32) for data input or output through these circuits. Q and E signals are generated for decoding purposes.

The CPU has three interrupt inputs at pins -2, -3, and -4. The priority of these interrupts is determined by the current operation, during which corresponding interrupt enable signals (KBD INT EN, NMI INT EN. and ADC INT EN --see U220) are generated as necessary. (For details of the circuits which cause these interrupts, see U206 Keyboard Processor, U210 Clock Divider, U211 UART, and U306 (Section 3).

U216 **Program Interval Timer** I-072 8254 Timer/counter

Carries out three independent programmable functions. Decoded by U218-15, U219-3, and U228-3. Address lines A0 and A1 select the internal registers, which then are read or written into. The counter/timer's three gates are used as follows:

1. U216-10 feeds U223 PLL to generate the sample memory TUNE CLOCK which responds to the PITCH wheel, LFO, and MASTER TUNE. The 8 MHz clock is divided by a variable value stored in one of U216's internal registers. This value is determined by the combined effect of the PITCH wheel, Master Tune setting, and LFO on the 2000's tuning.

2. U216-13 divides the 8MHz clock from U210-3 for 500kHz MIDI clock and A-440. U216-16 gates this section, which is clocked by U105-13 One-shot, which generates a pulse of a duration corresponding to the voltage at the wiper of one of the front panel potentiometers. While the pulse is generated, U216 counts the number of pulses received at pin -18. When the pulse ends, the CPU reads the timer's internal register which contains the final count, then interprets this count as the pot setting.

U217 **Optoisolator** I-330 PC900 Opto-isolator

See U211 MIDI ACIA.

U218 **Memory Decoder** I-253 74HC138

Decodes address lines A12-A14 to generate chip select signals for U216 Program Interval Timer, U205 Floppy Controller, U225/26 Decoders, U211 MIDI ACIA, and U212/13 Scratchpad RAM. Enabled by A15 and U219-11.

U219 **Miscellaneous Gates** I-251 74HC32

U220 **Latch** I-513 74HC174

Generates enable signals for interupt logic, the filter and side select switch, and A440 circuits. When pin -9 is strobed by U225-13, data lines D0-D5 are latched to outputs Q0-Q5. At power-on, -RESET is low, ensuring that all outputs are cleared.

U221 **Miscelaneous Inverters** I-249 74HC04

U222 **Miscellaneous NAND Gates** I-279 74HC10

See U225, U223, and U211.

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
U223	**Master Tune Oscillator**	I-352	564 Phase locked loop

Generates the TUNE CLOCK for the 2000's sample memory, by effectively muliplying the clock output from U216-10 which responds to the current PITCH wheel position and LFO and MASTER TUNE settings. U223-9 responds to changes in the frequency of the clock appearing at pin -6, but at 4096 times the frequency. U222-6 inverts this clock, which is divided by U224 Master Tune Divider. U224-1 feeds U223-3, completing the phase locked loop.

U224	**TUNE Clock Divider**	I-278	74HC4020

See U223.

U225/26	**Miscellaneous Latches**	I-253	74HC138

Decode address lines A0-A3 and A6-A8 respectively. Decoded by U218-13 and -11 respectively to generate one enable signal at a time.

U227	**Not used**		
U228	**Miscellaneous NAND Gates**	I-264	74HC00 Quad 2-in NAND
U229	**Miscellaneous Latches**	I-253	74HC138

Operates similar to U225. Decoded by U225-7. Decodes address lines A3-A5.

U230	**+5V Regulator**	I-410	7805
U231	**-12V Regulator**	I-415	79M12
U232	**+12V Regulator**	I-424	7812
U233-36	**Custom Chip**	I-624	2000 Custom chip

Coordinates the output of sample data from sample RAM to the eight voices. Each chip handles two voices (channels). Address lines A0-A2 select the internal registers, then specify the sample data to be output, including the pitch, direction, and voice on which it is to appear.

PCB5 supplies 6 MHz clock to pin -33 of each IC, and TUNE CLOCK is supplied by U224-9. Chip selects come from U229-11, -10, -9, and -7. Data is read from sample memory, one voice at a time. Following the output of data for one voice, the corresponding IC generates a CHIP ON pulse, which feeds the next IC's SYNC IN (pin -36), and sample memory is then read for the next voice.

The custom ICs address sample memory via the nine RA Bus lines, the four -RAS lines, the -CAS, and -WROUT (from U234-15). Pull up resistor packs RP205 and RP206 satisfy the custom IC open collector outputs. These signals are buffered by U241 and U248 to provide the BA Bus, and the other corresponding signals. Data is written from, or read onto the DQ (sample) Bus lines DQ0-DQ11 depending on the state of -BW (read/write select, from U241-16). -RAS0 selects the standard 256K memory. The remaining -RAS lines are provided for expanded memory. -CAS is used for refreshing the sample RAM.

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
	The TH Bus carries data defining the voice over which sample data is to be output. U233 is the only custom IC used for addressing sample data when reading onto the Data Bus rather than to the voice DACs (see U336). Similarly, U234 is the only one used for the writing of data from the Data Bus onto the DQ Bus. (For details see U238 and U239, below.)		
U237-40	**Data/DQ Latches** Control the flow of data from the 12-bit DQ Bus onto the eight-bit Data Bus, and visa-versa. When -BW is low, sample data is written into sample memory eight bits at a time. First, -WR LS SAMPLE goes low, and the lowest eight bits of sample data are latched from the Data Bus onto U237 outputs DQ0-DQ7. -WR MS SAMPLE then goes low, and the remaining four bits are latched to U239 outputs DQ8-DQ11. To read from sample memory, -RD LS SAMPLE goes low, and the lowest eight bits of sample data are placed onto the outputs of U238. Then -RD MS SAMPLE goes low, and the top four bits of sample data are placed on the outputs of U240.	I-260	74HC374
U241	**RA/BA Bus Buffers** See U233.	I-257	74HC244
U242-47	**Sample RAM** Each IC contains one bit of the sample memory. All ICs are addressed identically, but feed different lines of the DQ Bus.	I-076	256K X 1 DRAM
U248	**RA/BA Bus Buffers** See U233.	I-257	74HC244
U249-54	**Sample RAM** Same as U242-47.	I-076	256K X 1 DRAM
U255	**Misc OR Gates**	I-251	74HC32
	Used on PCB5.	I-249	74HC04
Y201		E-178	16MHz Crystal
Z-356	**2000 Transformer Subassembly**		
T1		E-179	Model 2000 transformer
		J-084	7-pin locking housing
		P-031	Polarizing pins
		P-049	socket pins
		E-001	18 AWG Stranded red
		E-002	18 AWG Stranded blue
		E-003	18 AWG Stranded black
		E-065	18 AWG Stranded yellow
		E-082	18 AWG Stranded green
	Used on PCB5.	E-103	6MHz Crystal
		E-189	4-pin Ribbon .1" housing

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
		E-190	21-pin 2" Ribbon jumper
		E-190	21-pin 2" Ribbon jumper
		J-007	16-pin DIP socket
	Used for U242-47, U249-54, and J205 (connector to front panel).		
		J-016	40-pin DIP socket
	Used for U233-36, and U206.		
		J-045	28-pin DIP socket
	Used for U214.		
	For mounting PCB5.	J-108	16-pin wire wrap socket
		M-024	6-32 X 3/8" Pan hd phil
		M-099	4-40 Nut 1/4" outside diameter
		M-100	4-40 X 3/8" Flat hd phil
		M-107	#411 Nylon shoulder washer
		M-141	#6 Star washer ext tooth
		M-155	1/2" Standoff
		M-370	T0-22 Greaseless insulator
		M-516	6-32 X 1/2" Nylon flathead screw
		M-517	6-32 Nlyon hex nut
		MW2000-5	One-regulator heatsink
		MW2000-6	3-regulator heatsink
		PC2000-2	2000 2 Board
		PC2000-5	2000 5 Board

SECTION 3

VOICE CIRCUITS
PCB3

Before troubleshooting PCB3, check that the board is updated as described on page 0.14.

DIAGNOSTIC TESTS

The diagnostics disk offers three tests which test the computer system counter circuits, the keyboard, sound RAM, and the footswitch inputs.

To run these diagnostic tests:

Auto-load (from power-on) the diagnostic disk. (See page 0.10)

When the display reads "??", press the **PRESETS** switch corrresponding to the desired test.

The tests are numbered as follows:

Switch	TEST	See Page
1	Counter/Timer	2.1
2	Keyboard test	2.2
3	Output Filter	3.1
4	DAC (three tests)	3.2
5	Sound RAM	2.2
6	LED test	1.1
7	Switch test	1.2
8	Footswitch test	2.4

Descriptions of tests #3, and #4 follow.

Test #3: Output Filter Test

This test is for verifying operation of each voice's analog circuits.

Note: When initially selected, the filter resonance is at its maximum setting, and the filter cutoff frequency is at minimum. To avoid possible damage to speakers or hearing, turn the monitor system volume down.

With the diagnostic "??" prompt displayed, press **3**.
The display goes blank.

Front panel switches control test operation as follows:

Switch	Function
DEC	Increases filter resonance
INC	Decreases filter resonance
EXECUTE	Increases filter cutoff frequency
1-8	Selects voice 1-8

PRESET LEDs **1** through **8** indicate which voice is currently selected. The display reads "uP" when **INC** is pressed and resonance is not at its maximum value. Similarly, the display reads "dn" when **DEC** is pressed and resonance is not at its lowest value.

Increase the monitor system volume to an agreeable level.

Check that all voices play approximately the same frrequency.

To exit this test, and return to the "??" prompt, press the **AUX** footswitch.

TEST #4: DAC TEST

This test verifies operation of U315 CV DAC, and is in three successive parts.

To select the DAC tests:

Press **4**.
The display reads "1", indicating that DAC test #1 is selected. (Descriptions of each DAC test follow.)

DAC Test #1

This test sets one DAC bit at a time, allowing careful monitoring of the DAC output.

Front panel switches control test operation as follows:

Switch	Function
INC	Set previous DAC bit (increase DAC output)
DEC	Set next DAC bit (decrease DAC output)
EXECUTE	Select ramp output to S/Hs.
PRESET	Select DAC test #2

Attach DVM to TP01 (next to U328).

Use **INC** and **DEC** to change the DAC output.

The **PRESET** LEDs show which DAC bit is currently set. Initially all DAC bits are off. Table 3.1 below shows the approximate voltage reading to expect for each DAC bit set.

Monitor the DAC output as it changes.

Each time the DAC output is increased, it doubles. Each time it is decreased, it is halved. The only exception to this is when the output moves to or from zero. (See Table 3.1, below.)

Bit #	Approximate Voltage
None	0
0	0.001V
1	0.002V
2	0.004V
3	0.009V
4	0.018V
5	0.037V
6	0.075V
7	0.150V
8	0.300V
9	0.600V
10	1.200V
11	2.400V

TABLE 3.1
DAC TEST #1 APPROXIMATE VOLTAGE READINGS

When done testing the DAC:

To select DAC test #2, press **PRESET**.

Or, to exit the DAC tests, press **EXECUTE**.

DAC Test #2

This test --like DAC test #1-- distributes the same voltage to all S/Hs. Rather than output a steady, manually variable level, however, this test generates three waveforms, poviding another convenient means of checking of the operation of the CV DAC.

When selected,the 2000 generates a ramp waveform going from 0 to 5V. This waveform can be seen at the output of the DAC buffer.

The display reads "2", indicating DAC test 2 is selected.

Front panel switches control test operation as follows:

Switch	Function
DEC	Select ramp output
INC	Select triangle output
EXECUTE	Select square output
PRESET	Select DAC test #3
SAMPLE	Decrease wave frequency
CONTROL 1	Increase wave frequency

The **PRESET** LEDs indicate which DAC bit is set.

Attach scope probe to TP01 (next to U328).

Check that the selected waveform appears at the DAC output.

When done testing the DAC:

To select DAC test #3, press **PRESET**.

Or, to exit the DAC tests, press **EXECUTE**.

DAC Test #3

This test outputs different signals to each S/H, allowing easy checking for correct operation of the S/H multiplexers (U325/28/31).

There are three test options:

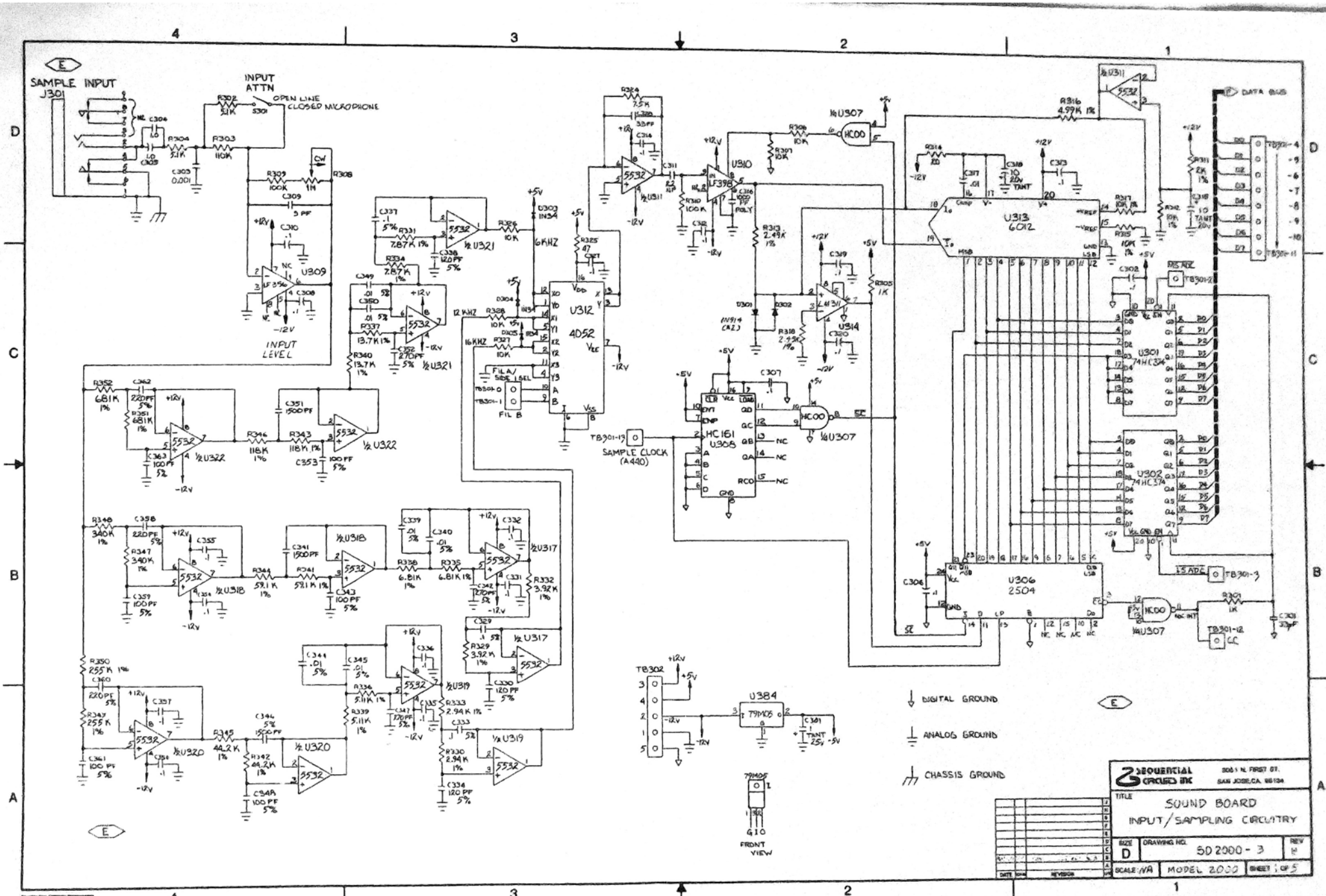
1. Output discrete voltages to each S/H.
2. Output 5 V peak to peak square wave to each S/H.
3. Output slow ramp to each S/H.

The display reads "3", indicating DAC test 3 is selected.

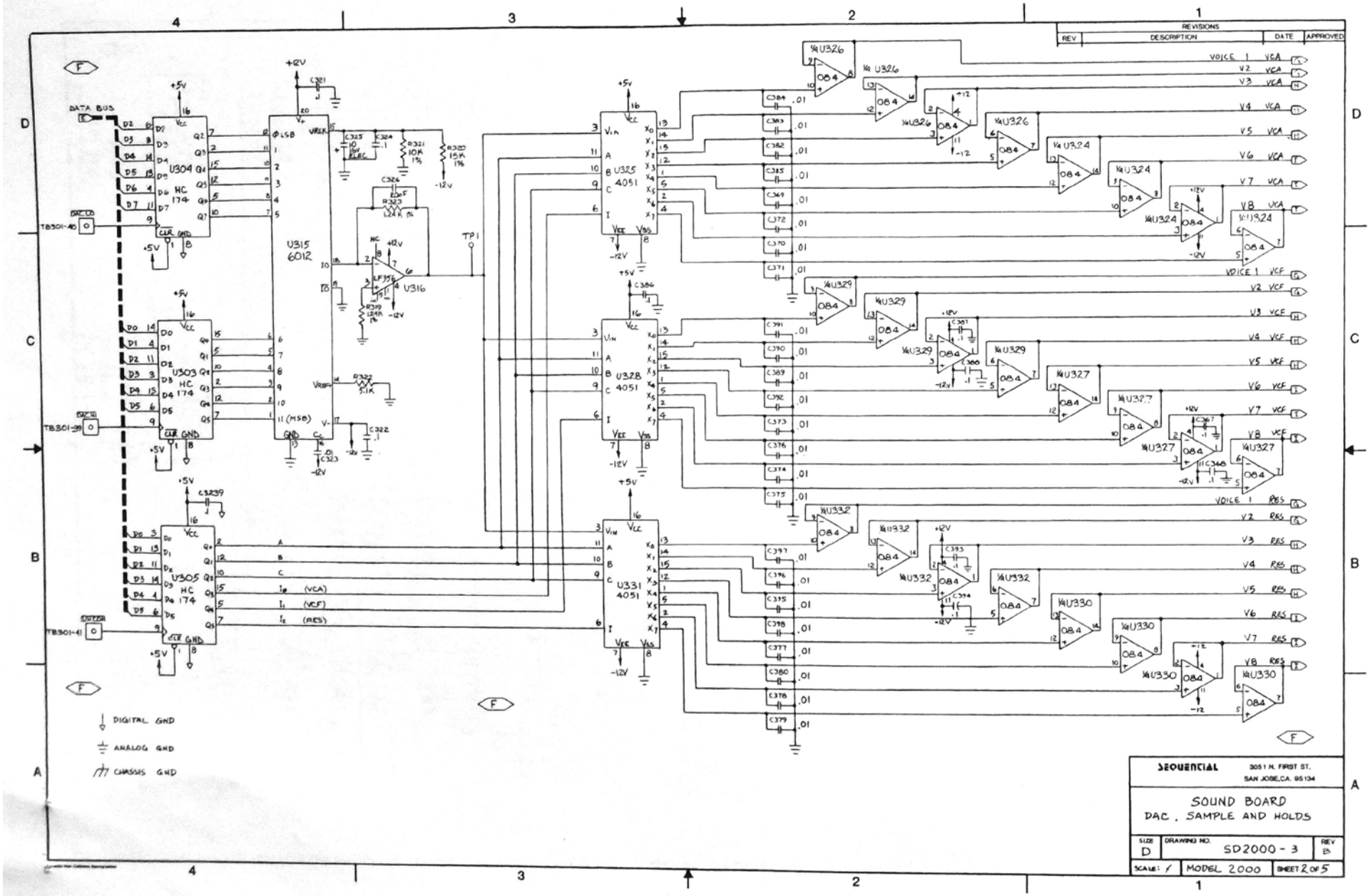
Front panel switches control test operation as follows:

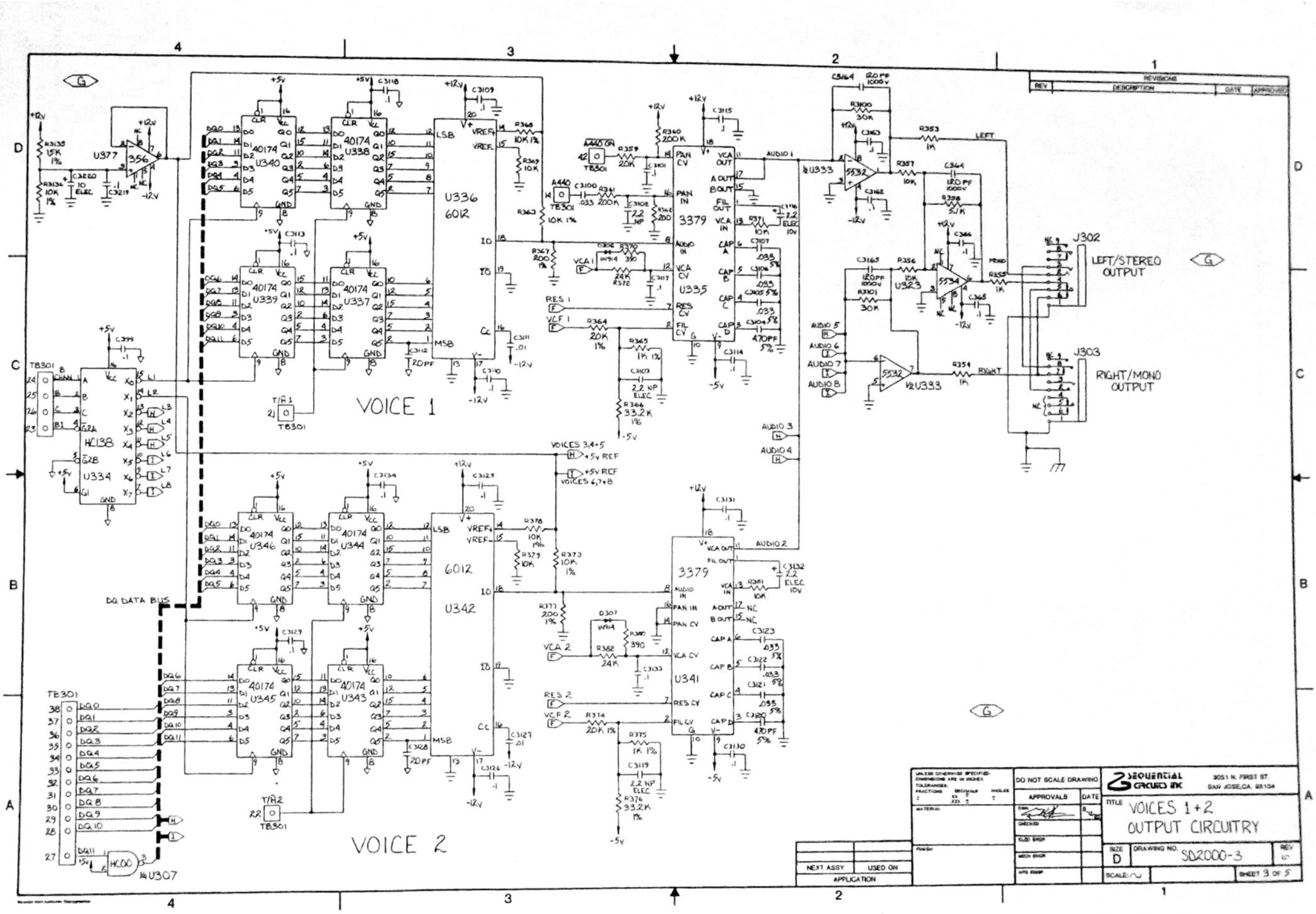
Switch	Function
DEC	Select square wave S/H outputs
INC	Select ramp output to S/Hs
EXECUTE	Select test #2
PRESET	Select test #1

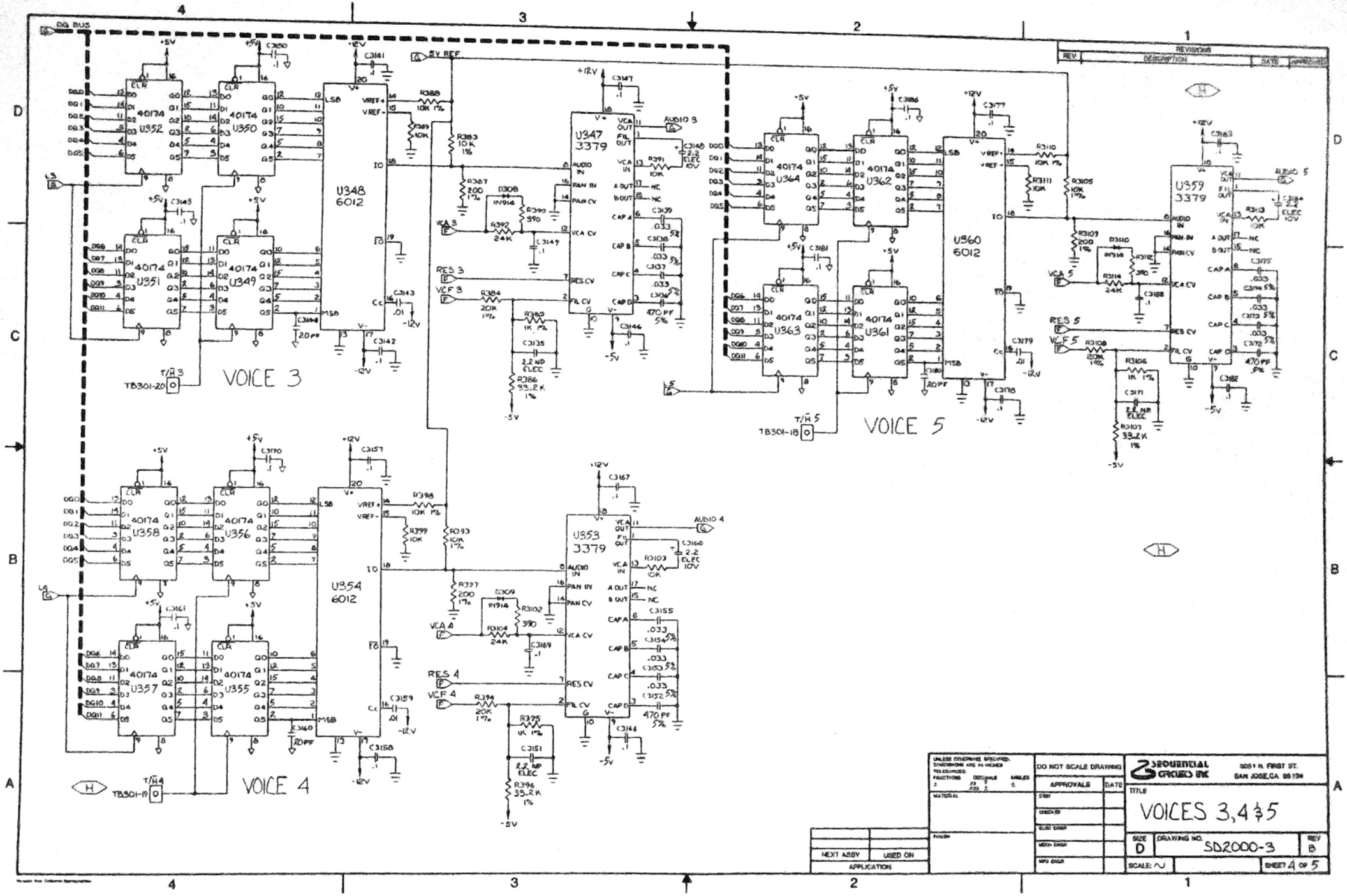
To exit the DAC tests, and return to the "??" prompt, press **EXECUTE**.

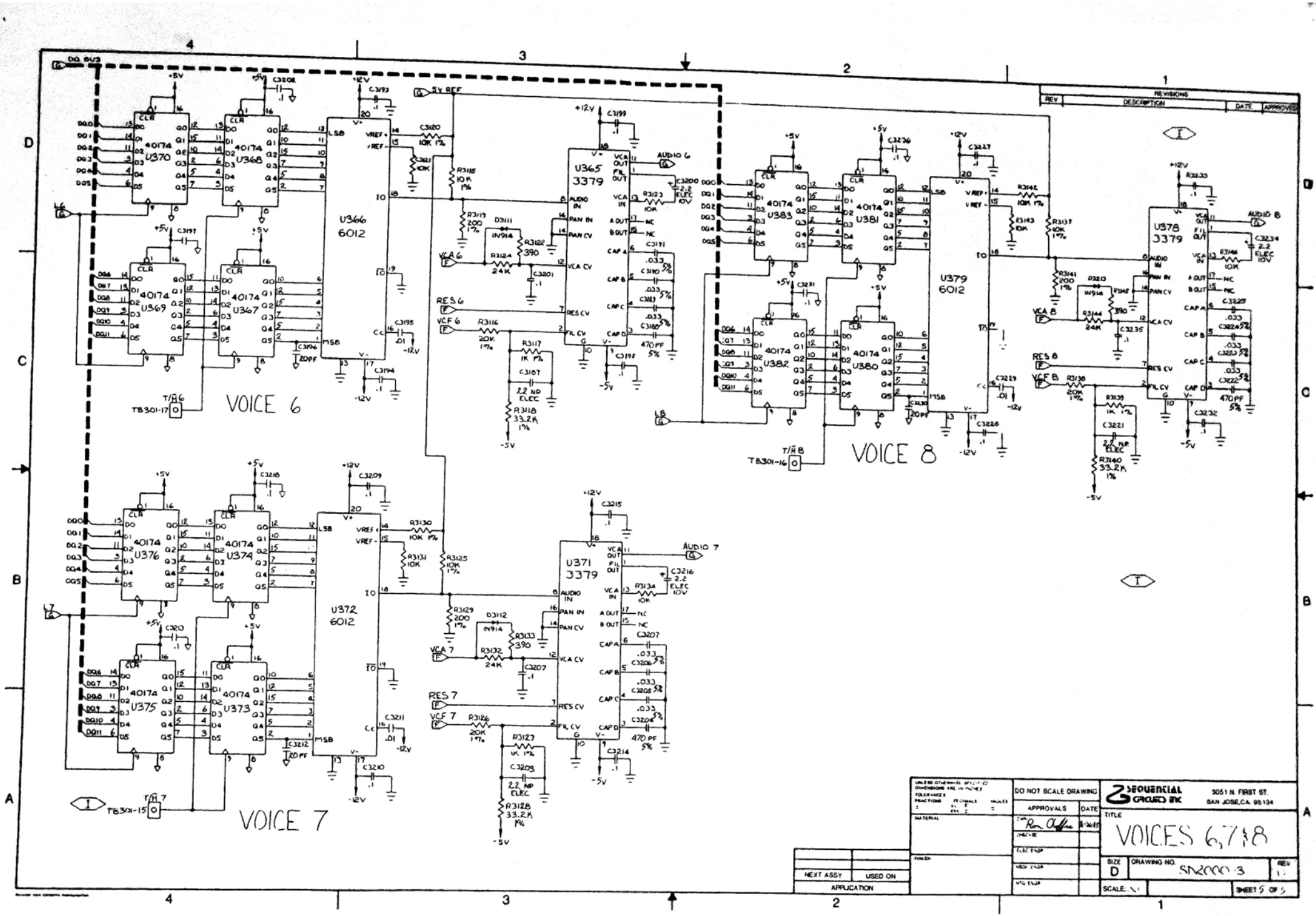

SAMPLE INPUT
J301
INPUT ATTN
OPEN LINE
CLOSED MICROPHONE
S301
INPUT LEVEL
U309
U310
U312
4052
U313
6012
U314
U301
74HC374
U302
74HC374
U306
2504
U308
HC 161
SAMPLE CLOCK
(A440)
½U307
HC00
U384
79M05
Q10
FRONT VIEW
FIL A/B SEL
FIL B
DATA BUS
RES RDY
I/O ADR
DIGITAL GROUND
ANALOG GROUND
CHASSIS GROUND
SEQUENTIAL CIRCUITS INC
2061 N. FIRST ST.
SAN JOSE, CA 95134
TITLE
SOUND BOARD
INPUT/SAMPLING CIRCUITRY
SIZE D
DRAWING NO. SD 2000-3
REV M
SCALE: NA
MODEL 2000
SHEET 1 OF 5

TMZ000A


REVISIONS
REV
DESCRIPTION
DATE
APPROVED
DATA BUS
U304 HC 174
U303 HC 174
U305 HC 174
U315 6012
U316
U325 4051
U328 4051
U331 4051
TP1
VOICE 1 VCA
V2 VCA
V3 VCA
V4 VCA
V5 VCA
V6 VCA
V7 VCA
V8 VCA
VOICE 1 VCF
V2 VCF
V3 VCF
V4 VCF
V5 VCF
V6 VCF
V7 VCF
V8 VCF
VOICE 1 RES
V2 RES
V3 RES
V4 RES
V5 RES
V6 RES
V7 RES
V8 RES
DIGITAL GND
ANALOG GND
CHASSIS GND
SEQUENTIAL
3051 N. FIRST ST.
SAN JOSE, CA. 95134
SOUND BOARD
DAC, SAMPLE AND HOLDS
SIZE D
DRAWING NO. SD2000-3
REV B
SCALE: 1/1
MODEL 2000
SHEET 2 OF 5


VOICE 1
VOICE 2
DQ DATA BUS
LEFT/STEREO OUTPUT
RIGHT/MONO OUTPUT
VOICES 1+2 OUTPUT CIRCUITRY
SEQUENTIAL CIRCUITS INC.
3051 N. FIRST ST. SAN JOSE, CA. 95134
DRAWING NO. SD2000-3
SIZE D
SHEET 3 OF 5
DO NOT SCALE DRAWING
NEXT ASSY
USED ON
APPLICATION


DG BUS
+5V REF
VOICE 3
VOICE 4
VOICE 5
TB301-20
TB301-19
TB301-18
U348 6012
U354 6012
U360 6012
U347 3379
U353 3379
U359 3379
AUDIO 3
AUDIO 4
AUDIO 5
VCA 3
VCA 4
VCA 5
RES 3
RES 4
RES 5
VCF 3
VCF 4
VCF 5
DO NOT SCALE DRAWING
SEQUENTIAL CIRCUITS INC
6051 N. FIRST ST.
SAN JOSE, CA 95134
TITLE
VOICES 3, 4 & 5
SIZE D
DRAWING NO. SD2000-3
REV B
SCALE: NONE
SHEET 4 OF 5
NEXT ASSY
USED ON
APPLICATION


VOICE 6
VOICE 7
VOICE 8
U366 6012
U365 3379
U372 6012
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U378 3379
U370 40174
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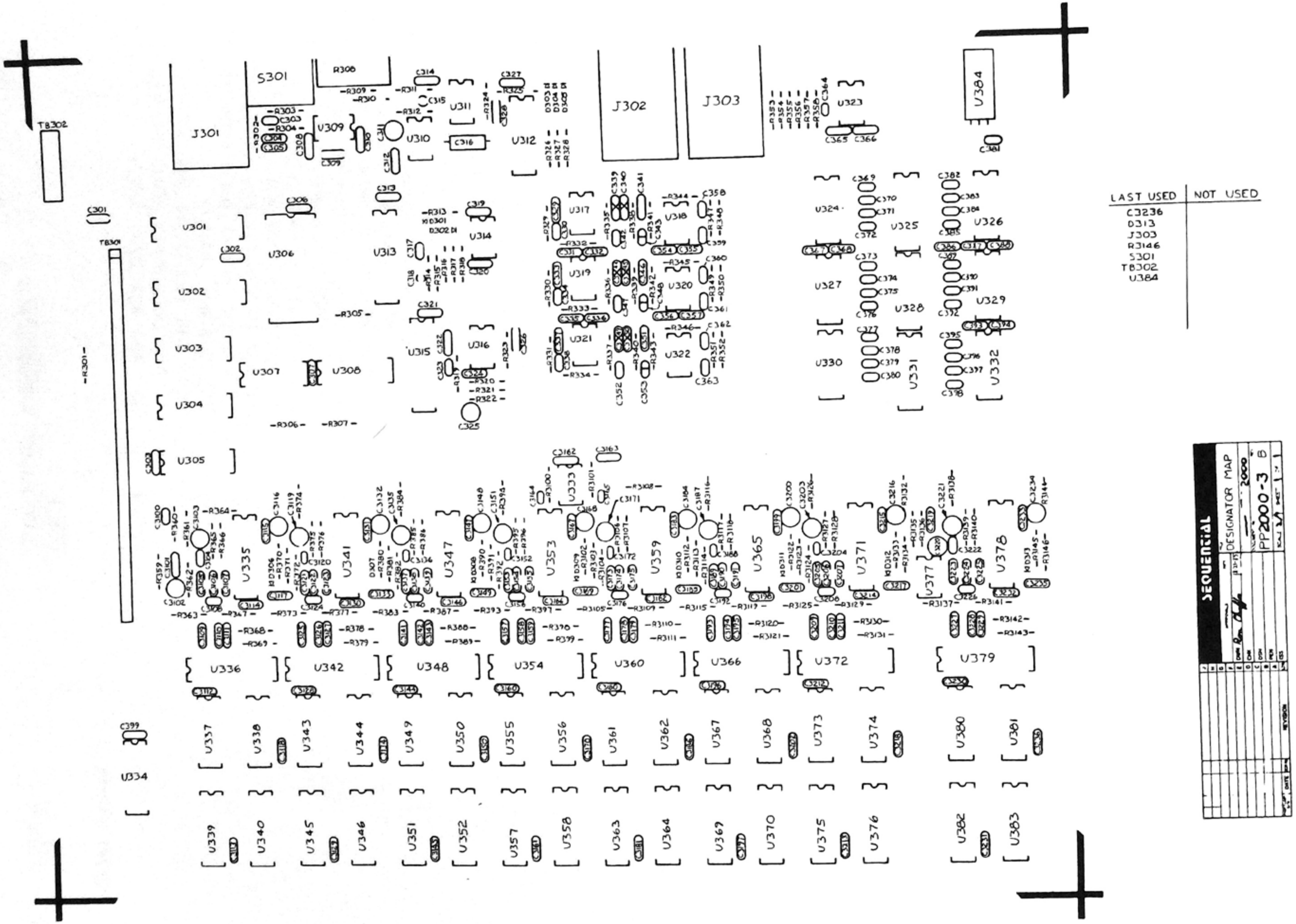
U369 40174
U367 40174
U376 40174
U374 40174
U375 40174
U373 40174
U383 40174
U381 40174
U382 40174
U380 40174
TB301-17
TB301-15
TB301-16
AUDIO 6
AUDIO 7
AUDIO 8
DO NOT SCALE DRAWING
APPROVALS
DATE
SEQUENTIAL CIRCUITS INC
3051 N. FIRST ST.
SAN JOSE,CA. 95134
TITLE
VOICES 6,7,8
SIZE D
DRAWING NO. SN2000-3
REV
SCALE:
SHEET 5 OF 5
NEXT ASSY
USED ON
APPLICATION


SEQUENTIAL
DESIGNATOR MAP
2000
PP2000-3
B
LAST USED
NOT USED
C3236
D313
J303
R3146
S301
TB302
U384

3.10 TM2000A

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
Z-359	PCB3 Assembly		
C301		C-003	33p 50V 10% Disc radial
C302		C-045	.1 50V Decoupler Mono radial
C303		C-008	.001 50V 10% Mylar radial
C304/05		C-128	1uF 20% MLC radial
C306		C-045	.1 50V Decoupler Mono radial
C307		C-045	.1 50V Decoupler Mono radial
C308		C-045	.1 50V Decoupler Mono radial
C309		C-001	5pF 50V 20% Disc radial
C310		C-045	.1 50V Decoupler Mono radial
C311		C-081	2.2uF 50V Elect radial low leak
C312		C-045	.1 50V Decoupler Mono radial
C313		C-045	.1 50V Decoupler Mono radial
C314		C-045	.1 50V Decoupler Mono radial
C315		C-035	10 20V Tant radial
C316		C-039	1000pF 50V 5% Poly axial
C317		C-102	.01 50V 5% Mylar radial
C318		C-035	10 20V Tant radial
C319		C-045	.1 50V Decoupler Mono radial
C320		C-045	.1 50V Decoupler Mono radial
C321		C-045	.1 50V Decoupler Mono radial
C322		C-045	.1 50V Decoupler Mono radial
C323		C-012	.01 50V 20% Mylar radial
C324		C-045	.1 50V Decoupler Mono radial
C325		C-130	10MF 16V Elect radial
C326		C-065	20pF 10% 100V Ceramic radial
C327		C-045	.1 50V Decoupler Mono radial
C328		C-003	33p 50V 10% Disc radial
C329		C-045	.1 50V Decoupler Mono radial
C330		C-136	120pF 5% MLC radial
C331-333		C-045	.1 50V Decoupler Mono radial
C334		C-136	120pF 5% MLC radial
C335-337		C-045	.1 50V Decoupler Mono radial
C338		C-136	120pF 5% MLC radial
C339/40		C-012	.01 50V 20% Mylar radial
C341		C-133	1500pF 5% Mylar radial
C342		C-135	270pF 5% MLC radial
C343		C-132	100pF 5% MLC radial
C344/45		C-012	.01 50V 20% Mylar radial
C346		C-133	1500pF 5% Mylar radial
C347		C-135	270pF 5% MLC radial
C348		C-132	100pF 5% Mylar radial
C349/50		C-102	.01 50V 5% Mylar radial
C351		C-133	1500pF 5% Mylar radial
C352		C-135	270pF 5% MLC radial
C353		C-132	100pF 5% Mylar radial
C354-357		C-045	.1 50V Decoupler Mono radial
C358		C-131	220pF 5% MLC radial

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
C359		C-132	100pF 5% MLC radial
C360		C-131	220pF 5% MLC radial
C361		C-132	100pF 5% MLC radial
C362		C-131	220pF 5% MLC radial
C363		C-132	100pF 5% MLC radial
C364		C-047	120pF 1000V 10% Disc radial
C365-368		C-045	.1 50V Decoupler Mono radial
C369-80		C-012	.01 50V 20% Mylar radial
C381		C-020	1uF 25V Tant
C382-85		C-012	.01 50V 20% Mylar radial
C386-388		C-045	.1 50V Decoupler Mono radial
C389-92		C-012	.01 50V 20% Mylar radial
C393/394		C-045	.1 50V Decoupler Mono radial
C395-98		C-012	.01 50V 20% Mylar radial
C399		C-045	.1 50V Decoupler Mono radialy
C3100		C-125	.033 5% Mylar radial
C3101		C-045	.1 50V Decoupler Mono radial
C3102		C-064	2.2uF 50V Nonpolar elect radial
C3103		C-064	2.2uF 50V Nonpolar elect radial
C3104		C-134	470pF 5% Mylar radial
C3105-107		C-125	.033 5% Mylar radial
C3108	Not used		
C3109/110		C-045	.1 50V Decoupler Mono radial
C3111		C-012	.01 50V 20% Mylar radial
C3112		C-065	20pF 10% 100V Ceramic radial
C3113-115		C-045	.1 50V Decoupler Mono radial
C3116		C-081	2.2uF 50V Elect radial low leak
C3117/118		C-045	.1 50V Decoupler Mono radial
C3119		C-064	2.2uF 50V Nonpolar elect radial
C3120		C-134	470pF 5% Mylar radial
C3121-123		C-125	.033 5% Mylar radial
C3124	Not used		
C3125/126		C-045	.1 50V Decoupler Mono radial
C3127		C-012	.01 50V 20% Mylar radial
C3128		C-065	20pF 10% 100V Ceramic radial
C3129-131		C-045	.1 50V Decoupler Mono radial
C3132		C-081	2.2uF 50V Elect radial low leak
C3133/134		C-045	.1 50V Decoupler Mono radial
C3135		C-064	2.2uF 50V Nonpolar elect radial
C3136		C-134	470pF 5% Mylar radial
C3137-139		C-125	.033 5% Mylar radial
C3140	Not used		
C3141/142		C-045	.1 50V Decoupler Mono radial
C3143		C-012	.01 50V 20% Mylar radial
C3144		C-065	20pF 10% 100V Ceramic radial
C3145-147		C-045	.1 50V Decoupler Mono radial
C3148		C-081	2.2uF 50V Elect radial low leak
C3149/150		C-045	.1 50V Decoupler Mono radial
C3151		C-064	2.2uF 50V Nonpolar elect radial
C3152		C-134	470pF 5% Mylar radial
C3153-155		C-125	.033 5% Mylar radial
C3156	Not used		

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
C3157/158		C-045	.1 50V Decoupler Mono radial
C3159		C-012	.01 50V 20% Mylar radial
C3160		C-065	20pF 10% 100V Ceramic radial
C3161-163		C-045	.1 50V Decoupler Mono radial
C3164/165		C-047	120pF 1000V 10% Disc radial
C3166/167		C-045	.1 50V Decoupler Mono radial
C3168		C-081	2.2uF 50V Elect radial low leak
C3169/170		C-045	.1 50V Decoupler Mono radial
C3171		C-064	2.2uF 50V Nonpolar elect radial
C3172		C-134	470pF 5% Mylar radial
C3173-175		C-125	.033 5% Mylar radial
C3176	Not used		
C3177/178		C-045	.1 50V Decoupler Mono radial
C3179		C-102	.01 50V 5% Mylar radial
C3180		C-065	20pF 10% 100V Ceramic radial
C3181-183		C-045	.1 50V Decoupler Mono radial
C3184		C-081	2.2uF 50V Elect radial low leak
C3185/186		C-045	.1 50V Decoupler Mono radial
C3187		C-064	2.2uF 50V Nonpolar elect radial
C3188		C-134	470pF 5% Mylar radial
C3189-191		C-125	.033 5% Mylar radial
C3192	Not used		
C3193/194		C-045	.1 50V Decoupler Mono radial
C3195		C-012	.01 50V 20% Mylar radial
C3196		C-065	20pF 10% 100V Ceramic radial
C3197-199		C-045	.1 50V Decoupler Mono radial
C3200		C-081	2.2uF 50V Elect radial low leak
C3201		C-045	.1 50V Decoupler Mono radial
C3202		C-045	.1 50V Decoupler Mono radial
C3203		C-064	2.2uF 50V Nonpolar elect radial
C3204		C-134	470pF 5% Mylar radial
C3205-207		C-125	.033 5% Mylar radial
C3208	Not used		
C3209/210		C-045	.1 50V Decoupler Mono radial
C3211		C-012	.01 50V 20% Mylar radial
C3212		C-065	20pF 10% 100V Ceramic radial
C3213-215		C-045	.1 50V Decoupler Mono radial
C3216		C-081	2.2uF 50V Elect radial low leak
C3217		C-045	.1 50V Decoupler Mono radial
C3217		?	
C3218/219		C-045	.1 50V Decoupler Mono radial
C3219		C-045	.1 50V Decoupler Mono radial
C3220		C-130	10MF 16V Elect radial
C3221		C-064	2.2uF 50V Nonpolar elect radial
C3222		C-134	470pF 5% Mylar radial
C3223-225		C-125	.033 5% Mylar radial
C3226	Not used		
C3227/228		C-045	.1 50V Decoupler Mono radial
C3229		C-102	.01 50V 5% Mylar radial
C3230		C-065	20pF 10% 100V Ceramic radial
C3231-233		C-045	.1 50V Decoupler Mono radial
C3234		C-081	2.2uF 50V Elect radial low leak

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
C3235-238		C-045	.1 50V Decoupler Mono radial
C3239		C-045	.1 50V Decoupler Mono radial
D301/02		D-005	1N914
D303-05		D-008	1N34
D306-13		D-005	1N914
J301	Sample Input	J-090	1/4" Stereo jack w/swton
J302/03	**LEFT/RIGHT Audio Outputs** When the LEFT/SEREO output is not used, J302-4 connects with J302-5, routing the mono signal to J303-2 RIGHT/MONO output jack. When the LEFT/STEREO output is used, J302-5 disconnects from -4 and connects with -6, so the left audio from U333-7 appears at U303-2 RIGHT/MONO output jack.	J-090	1/4" Stereo jack w/swton
R301		R-008	1k 1/4W 5%
R302		R-064	5.1 1/4W 5%
R303		R-092	110 k 1/4W 5%
R304		R-064	5.1 1/4W 5%
R305		R-008	1k 1/4W 5%
R306/07		R-012	10k 1/4W 5%
R308	Sample Input Attenuator	R-249	1M Rt angle pot
R309/10		R-025	100k 1/4W 5%
R311		R-533	2k 1/4W 1%
R312		R-012	10k 1/4W 5%
R313		R-137	2.49k 1/4W 1%
R314		R-423	20 1/4W 5%
R315		R-012	10k 1/4W 5%
R316		R-107	4.99k 1/4W 1%
R317		R-012	10k 1/4W 5%
R318		R-137	2.49k 1/4W 1%
R319		R-532	1.24k 1/4W 1%
R320		R-112	15k 1/4W 1%
R321		R-108	10k 1/4W 1%
R322		R-064	5.1 1/4W 5%
R323		R-532	1.24k 1/4W 1%
R324		R-055	7.5k 1/4W 1%
R325		R-043	47 1/4W 5%
R326-28		R-012	10k 1/4W 5%
R329		R-530	3.92k 1/4W 1%
R330		R-524	2.94k 1/4W 1%
R331		R-523	7.87k 1/4W 1%
R332		R-530	3.92k 1/4W 1%
R333		R-524	2.94k 1/4W 1%
R334		R-523	7.87k 1/4W 1%
R335		R-529	6.81k 1/4W 1%
R336		R-527	5.11k 1/4W 1%
R337		R-184	13.7k 1/4W 1%
R338		R-529	6.81k 1/4W 1%
R339		R-527	5.11k 1/4W 1%
R340		R-184	13.7k 1/4W 1%

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
R341		R-197	59.1k 1/4W 1%
R342		R-526	44.2 1/4W 1%
R343		R-522	118k 1/4W 1%
R344		R-197	59.1k 1/4W 1%
R345		R-526	44.2 1/4W 1%
R346		R-522	118k 1/4W 1%
R347/48		R-528	340k 1/4W 1%
R349/50		R-525	255k 1/4W 1%
R351/52		R-521	681k 1/4W 1%
R353-55		R-008	1k 1/4W 5%
R356/57		R-012	10k 1/4W 5%
R358		R-064	5.1k 1/4W 5%
R359		R-015	20k 1/4W 5%
R360/61		R-026	200k 1/4W 5%
R362		R-422	200 1/4W 5%
R363		R-108	10k 1/4W 1%
R364		R-144	20.0k 1/4W 1%
R365		R-101	1k 1/4W 1%
R366		R-132	42.2k 1/4W 1%
R367		R-519	200 1/4W 1%
R368		R-108	10k 1/4W 1%
R369		R-012	10k 1/4W 5%
R370		R-005	390 1/4W 5%
R371		R-012	10k 1/4W 5%
R372		R-073	24k 1/4W 5%
R373		R-108	10k 1/4W 1%
R374		R-144	20.0k 1/4W 1%
R375		R-101	1k 1/4W 1%
R376		R-132	42.2k 1/4W 1%
R377		R-519	200 1/4W 1%
R378		R-108	10k 1/4W 1%
R379		R-012	10k 1/4W 5%
R380		R-005	390 1/4W 5%
R381		R-012	10k 1/4W 5%
R382		R-073	24k 1/4W 5%
R383		R-108	10k 1/4W 1%
R384		R-144	20.0k 1/4W 1%
R385		R-101	1k 1/4W 1%
R386		R-132	42.2k 1/4W 1%
R387		R-519	200 1/4W 1%
R388		R-108	10k 1/4W 1%
R389		R-012	10k 1/4W 5%
R390		R-005	390 1/4W 5%
R391		R-012	10k 1/4W 5%
R392		R-073	24k 1/4W 5%
R393		R-108	10k 1/4W 1%
R394		R-144	20.0k 1/4W 1%
R395		R-101	1k 1/4W 1%
R396		R-132	42.2k 1/4W 1%
R397		R-519	200 1/4W 1%
R398		R-108	10k 1/4W 1%
R399		R-012	10k 1/4W 5%

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
R3100/101		R-016	30k 1/4W 5%
R3102		R-005	390 1/4W 5%
R3103		R-012	10k 1/4W 5%
R3104		R-073	24k 1/4W 5%
R3105		R-108	10k 1/4W 1%
R3106		R-101	1k 1/4W 1%
R3107		R-132	42.2k 1/4W 1%
R3108		R-144	20.0k 1/4W 1%
R3109		R-519	200 1/4W 1%
R3110		R-108	10k 1/4W 1%
R3111		R-012	10k 1/4W 5%
R3112		R-005	390 1/4W 5%
R3113		R-013	13k 1/4W 5%
R3114		R-073	24k 1/4W 5%
R3115		R-108	10k 1/4W 1%
R3116		R-144	20.0k 1/4W 1%
R3117		R-101	1k 1/4W 1%
R3118		R-132	42.2k 1/4W 1%
R3119		R-519	200 1/4W 1%
R3120		R-108	10k 1/4W 1%
R3121		R-013	13k 1/4W 5%
R3122		R-005	390 1/4W 5%
R3123		R-012	10k 1/4W 5%
R3124		R-073	24k 1/4W 5%
R3125		R-108	10k 1/4W 1%
R3126		R-144	20.0k 1/4W 1%
R3127		R-101	1k 1/4W 1%
R3128		R-132	42.2k 1/4W 1%
R3129		R-519	200 1/4W 1%
R3130		R-108	10k 1/4W 1%
R3131		R-012	10k 1/4W 5%
R3132		R-073	24k 1/4W 5%
R3133		R-005	390 1/4W 5%
R3134/135		R-012	10k 1/4W 5%
R3136/137		R-108	10k 1/4W 1%
R3138		R-144	20.0k 1/4W 1%
R3139		R-101	1k 1/4W 1%
R3140		R-132	42.2k 1/4W 1%
R3141		R-519	200 1/4W 1%
R3142		R-108	10k 1/4W 1%
R3143		R-012	10k 1/4W 5%
R3144		R-073	24k 1/4W 5%
R3145		R-005	390 1/4W 5%
R3146		R-012	10k 1/4W 5%
S301	INPUT ATTEN. SWITCH	S-096	DPTT Rt angle slide switch
TB301	DATA + MISC		
TB302	POWER SUPPLIES		
TP1	DAC OUTPUT		

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION

U301/02 **Sample Word Latches** I-260 74HC374

Upon receiving -LSADC from U226 Decoder, U302 latches the eight least significant bits from U306 Successive Approximation Register outputs Q0-Q7 to the Data Bus. U301 is then enabled by -MSADC, latching the four most significant bits onto the main data bus, completing the 12-bit sample word.

U303/04 **CV DAC Latches** I-513 74HC174

Latch twelve-bit words to U315 CV DAC, six bits at a time. U229 Decoder generates -HI DAC, then -LO DAC to enable U303, then U304, placing twelve-bit values of control voltages for each voice's analog circuits (VCA and VCF).

U305 **CV Address Latch** I-513 74HC174

Provides address signals for U325/28/31 CV Demultiplexers. Upon receiving -S/HCON from U229, U305 latches A, B, C, and enable signals from the Main data bus.

U306 **Successive Approximation Register** I-019 2504 12-bit SAR

Generates 12-bit words for D/A conversion, then comparison with incoming analog sample voltages. At pin -13 receives Sample Clock from U216-13 Counter. Initially, -SC from U307-8 goes low, setting Q11 at pin -21. At the same time, -SC is inverted at U307-6, enabling U310 Sample/Hold, which samples, then holds the incoming audio signal at U310-5.

For each SAMPLE CLOCK received at pin -13, the next least significant bit (at U313 DAC inputs) is set, starting with bit 12. The output of U313 is compared with the value held at U310-5. If the original DAC output exceeds the sample input, U314-7 goes high. This level reaches pin -11, and determines whether or not the current DAC bit is reset for the next comparison. After twelve such comparisons, pin -3 goes low, U307-11 goes high, reaching U215-4, the CPU -FIRQ input. R301/C301 delay this level before it clocks the 12-bit sample word to U301/02 outputs.

U307-3, -6, -8, -11 **Miscellaneous gates** I-264 74HC00 Quad 2-in NAND

See U306.

U308 **Sample Clock Divider** I-281 74HC161 or 74HC163

Divides the SAMPLE CLOCK to the required sample rate. As all A/D conversions require the same amount of time, QC and QD are NANDed to produce -SC which is low for the first received sample clocks. While -SC is low, the audio sample input is switched through to U310-5, where this value is held when -SC goes high again.

U309 **Sample Input Buffer** I-323 LF356 FET Op amp

The audio sample input is initially ac-coupled by C304/05, filtered by R304/C303, then scaled by R308. When S301 is open, U309 offers between unity and times-ten gain. When the switch is closed, the gain range is 20 to 200. C309 compensates the op amp.

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
U310	**Sample and Hold**	I-355	LF398

Holds the filtered audio input signal during A/D conversion (see U306). When pin -8 is high, the input is switched to the output, and C316 charges. When pin -8 goes low, the output is isolated from the input and the sampled voltage remains at pin -5.

U311-7	**Final Sample Buffer**	I-324	NE5532 Dual op amp

See U312 Filter Switch.

U311-1	**Reference Buffer**	I-324	NE5532 Dual op amp
U312	**Filter Switch**	I-277	4052

Selects one of three filtered versions of the audio sample input according to the current sample rate. The audio input is processed by three parallel four-pole filter circuits with cutoff frequencies of 6 kHz, 12 kHz, and 16 kHz for sampling rates of 16 kHz, 31 kHz, and 41 kHz respectively. R326/27/28 act as input resistors to U311 Final Sample Buffer, so that when any of U312's inputs are gated to outputs -3 and -13, U312 is only switching a current. This allows negative "voltages" to be switched without needing dual supplies. D303/04/05 protect U312's inputs.

U313	**Sampling DAC**	I-517	6012 DAC

Converts 12-bit sample words from U306 into complimentary currents at IO and -ID. R313 senses these currents and converts them into a potential difference which is added to the voltage held at U310-5. When the voltage across R313 is identical to, but of the opposite polarity of U310-5, U314 Comparator switches, and U314-7 goes high.

U314	**Sample Comparator**	I-301	311 Precision comparator

Determines whether the output of U313 Sampling DAC exceeds that of U310 Sample and Hold. D301/02 protect non-inverting input U314-2.

U315	**CV DAC**	I-517	6012 DAC

Translates 12-bit control words from U303/04 into analog current, IO, which is turned into a current by U316 CV DAC Buffer. R320/21 and C324/25 set VREF- at 4.8V.

U316	**CV DAC Buffer**	I-323	LF356 FET Op amp

Converts the CV DAC output current into a voltage. R319, R323, C326.

U317-22	**2-Pole Low Pass Filter**	I-324	NE5532 Dual op amp

The audio sample input is processed by three chains of filters simultaneously, but only one filter output is selected at a time. Each IC half is configured as a 2-pole low pass filter with its cutoff frequency suited to the sample rate to which the filter chain corresponds.

U323	**Mono Output Driver**	I-317	NE5534 Signetics

Sums outputs U333-1 and -7 Left and Right Output Drivers through R356/57. R358 sets the gain of the MONO output.

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION

When the LEFT/SEREO output is not used, J302-4 connects with J302-5, routing the mono signal to J303-2 RIGHT/MONO output jack. When the LEFT/STEREO output is used, J302-5 disconnects from -4 and connects with -6, so the left audio from U333-7 appears at U303-2 RIGHT/MONO output jack.

U324 **VCA Sample/Holds** I-332 084/TL074CN Quad op amp
Voices 5-8
Each IC quarter buffers the voltage held at C369-72 from the 2000's analog voice circuits.

U325 **VCA Demultiplexer** I-211 4051 8-in analog mux
"Distributes" control voltages (CVs) to each of the 2000's voices by switching portions of the U316 CV DAC's output (Vcv) which appears at pin -3 (Vin) to U324/26 VCA Sample/holds one at a time.

Vcv is a multiplexed signal, one divided into many sections, each section being at a voltage (corresponding to a CV) which is not expected to change in the next few microseconds. This sequence of voltages is repeated. The CPU generates addresses which determine to which sample/hold each CV should be routed. These addresses appear at outputs Q0-7 of U305 which feed U325, U328, and U331 Demultiplexers. Vcv is switched to only one output of a demultiplexer at a time. When an output is enabled, the capacitor at the output charges to the current Vcv level, then remains at that voltage as other sample/holds are "refreshed."

Each demux's Vin is fed by U316-6. Pin -6 (driven by U305-15, I0) must be driven high to be enabled, or else all outputs are disconnected from pin -3 (Vin). Signals A, B, and C (also from U305) detemine which of eight outputs is enabled.

Notice that each demultiplexer handles a different type of CV (for VCA, VCF cutoff, or resonance), and that the same addresses on each demux corresponds to the same voice (ie, voice 1 is handled by the demux "X0" output, voice 2 by "X1," and so forth). If any voice's VCA and VCF both exhibit problems, be sure to check the A, B, and C signals.

U326 **VCA Sample/Holds** I-332 084/TL074CN Quad op amp
Voices 1-4
Similar to U324.

U327 **VCF Sample Holds** I-332 084/TL074CN Quad op amp
Voices 5-8
Similar to U324.

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION

When the LEFT/SEREO output is not used, J302-4 connects with J302-5, routing the mono signal to J303-2 RIGHT/MONO output jack. When the LEFT/STEREO output is used, J302-5 disconnects from -4 and connects with -6, so the left audio from U333-7 appears at U303-2 RIGHT/MONO output jack.

U324 **VCA Sample/Holds** I-332 084/TL074CN Quad op amp
Voices 5-8
Each IC quarter buffers the voltage held at C369-72 from the 2000's analog voice circuits.

U325 **VCA Demultiplexer** I-211 4051 8-in analog mux
"Distributes" control voltages (CVs) to each of the 2000's voices by switching portions of the U316 CV DAC's output (Vcv) which appears at pin -3 (Vin) to U324/26 VCA Sample/holds one at a time.

Vcv is a multiplexed signal, one divided into many sections, each section being at a voltage (corresponding to a CV) which is not expected to change in the next few microseconds. This sequence of voltages is repeated. The CPU generates addresses which determine to which sample/hold each CV should be routed. These addresses appear at outputs Q0-7 of U305 which feed U325, U328, and U331 Demultiplexers. Vcv is switched to only one outout of a demultiplexer at a time. When an output is enabled, the capacitor at the output charges to the current Vcv level, then remains at that voltage as other sample/holds are "refreshed."

Each demux's Vin is fed by U316-6. Pin -6 (driven by U305-15, I0) must be driven high to be enabled, or else all outputs are disconnected from pin -3 (Vin). Signals A, B, and C (also from U305) detemine which of eight outputs is enabled.

Notice that each demultiplexer handles a different type of CV (for VCA, VCF cutoff, or resonance), and that the same addresses on each demux corresponds to the same voice (ie, voice 1 is handled by the demux "X0" output, voice 2 by "X1," and so forth). If any voice's VCA and VCF both exhibit problems, be sure to check the A, B, and C signals for shorts.

U326 **VCA Sample/Holds** I-332 084/TL074CN Quad op amp
Voices 1-4
Similar to U324.

U327 **VCF Sample Holds** I-332 084/TL074CN Quad op amp
Voices 5-8
Similar to U324.

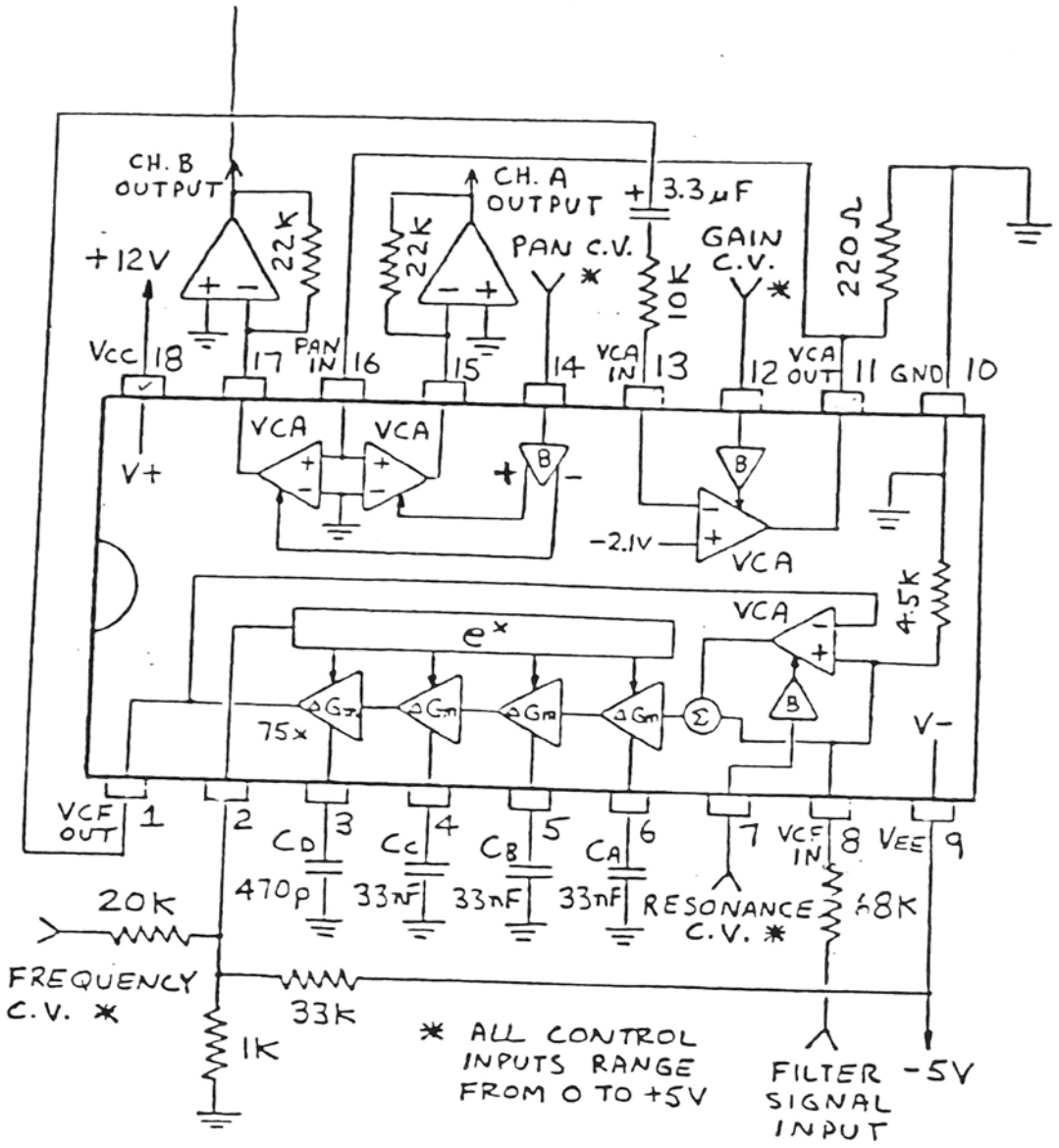
U328 **VCF Demultiplexer** I-211 4051 8-in analog mux
Similar to U325. Feeds U327 and U329 VCF Sample/Holds.

U329 **VCF Sample/Holds** I-332 084/TL074CN Quad op amp
Voices 1-4
Similar to U324.

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
U330	**Resonance Sample/Holds Voices 5-8** Similar to U324.	I-332	084/TL074CN Quad op amp
U331	**Resonance Demultiplexer** Similar to U325. Feeds U330 and U332 Resonance Sample/Holds.	I-211	4051 8-in analog mux
U332	**Resonance Sample/Holds Voices 1-4** Similar to U324.	I-332	084/TL074CN Quad op amp
U333	**Left and Right Drivers** Sum the voice VCA/VCF output currents. R3100 and R3101 set the output levels of the left and right output channels respectively.	I-324	NE5532 Dual op amp
U334	**Voice Decoder** Selects which of the eight voices receives a 12-bit sample word. Pins -5 and -6 are held at ground and 5V (respectively) so only BI is required to enable U334. BCHAN, B, and C signals determine which voice latch is enabled to receive sample data.	I-253	74HC138
U335	**VCA/VCF Voice 1** Provides analog processing of the audio output current from U336 Voice 1 DAC. Consists of separate filter, VCA, and panning circuits, but is configured for basic VCF/VCA analog processing. The signal received at pin -8 passes through the built-in 4-pole low-pass filter, then is scaled by the VCA. Normally, R360 pulls pin -14 high, keeping A-440 panned to the grounded "B OUT." During Sample Tuning function, -A440 pans the A-440 signal received at pin -16 to "A OUT" which is combined with voice 1's audio output. (Only voice 1 is used for A-440.) C3100/R361/C3102/R362 ac-couple and scale the A-440 suitably. Capacitors A-D set the frequency around which the VCF cutoff varies with VCF 1 (at pin -2), which is biased and scaled by R364-66 and C3103. The resonance CV received at pin -7 comes directly from the S/H, and requires no processing. C3116 ac-couples the VCF output to the VCA input. C3117, R370, R372, and D306 smoothe the VCA envelopes from the Sample/Holds, with D306 changing the RC time constant depending on the direction of the CV change. Finally, the VCA output is summed with the outputs from other voices by U333. For further details, refer to the 3379 data sheet.	I-351	3379
U336	**Voice 1 DAC**	I-517	6012 DAC
U337-40	**Sample Data Latches Voice 1**	I-228	4174 Hex latch

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
U379	**Voice 8 DAC**	I-517	6012 DAC
U380-83	**Sample Data Latches Voice 8**	I-228	4174 Hex latch
U384	**-5V Regulator**	I-411	LM7905/79M05 -5V 1A V-requlator
	For VCF/VCA ICs.	J-041	18-pin DIP socket
PC2000-3	2000 3 Board		

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
U341	**VCA/VCF Voice 2** Similar to U335.	I-351	3379
U342	**Voice 2 DAC**	I-517	6012 DAC
U343-46	**Sample Data Latches Voice 2**	I-228	4174 Hex latch
U347	**VCA/VCF Voice 3** Similar to U335.	I-351	3379
U348	**Voice 3 DAC**	I-517	6012 DAC
U349-52	**Sample Data Latches Voice 3**	I-228	4174 Hex latch
U353	**VCA/VCF Voice 4** Similar to U335.	I-351	3379
U354	**Voice 4 DAC**	I-517	6012 DAC
U355-58	**Sample Data Latches Voice 4**	I-228	4174 Hex latch
U359	**VCA/VCF Voice 5** Similar to U335.	I-351	3379
U360	**Voice 5 DAC**	I-517	6012 DAC
U361-64	**Sample Data Latches Voice 5**	I-228	4174 Hex latch
U365	**VCA/VCF Voice 6** Similar to U335.	I-351	3379
U366	**Voice 6 DAC**	I-517	6012 DAC
U367-70	**Sample Data Latches Voice 6**	I-228	4174 Hex latch
U371	**VCA/VCF Voice 7** Similar to U335.	I-351	3379
U372	**Voice 7 DAC**	I-517	6012 DAC
U373-76	**Sample Data Latches Voice 7**	I-228	4174 Hex latch
U377	**DAC Reference**	I-323	LF356 FET Op amp
U378	**VCA/VCF Voice 8** Similar to U335.	I-351	3379



CEM3379 BLOCK & TYPICAL CONNECTION DIAGRAM

SECTION 4

MEMORY EXPANSION

Standard Prophet-2000s are equipped with 256k of sample memory, divided into "A" and "B" memory halves of 128k. When the memory expansion kit is installed, each memory half is doubled to 256k. To accommodate the increase in sample data, disk storage capacity must also be increased. This is accomplished by using double-sided disks and disk-drives.

If the memory expansion is installed in a unit with a single-sided disk drive, the disk drive must be replaced. As some models already feature double-sided drives, there are two memory expansion kits:

Model 877
Includes the expansion board, new firmware, double-sided disk drive, and mounting hardware.

Model 878
Same as the Model 877, but without the disk drive.

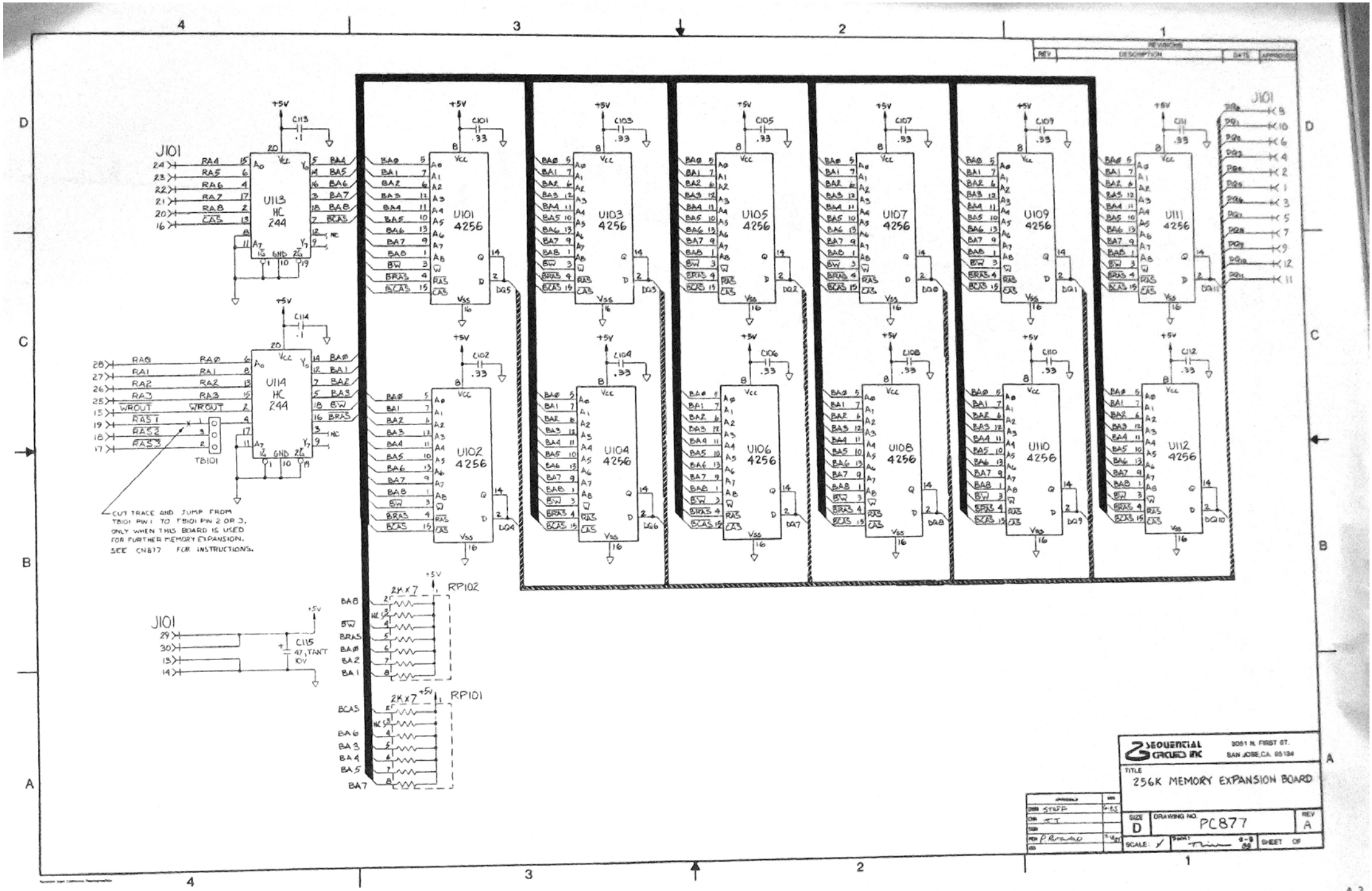
The only way to tell if a single-, or double-sided drive is installed is to open the 2000, and read the label on the back of the drive itself. Drive model MD351 is single-sided. Drive model MD350 is double-sided.

Sound disks created for standard-memory 2000s may still be loaded into expanded models, then transfered onto double-sided disks. The single-sided disks can then be kept for back-up.

Order the appropriate expansion kit through Sequential's service department.

When troubleshooting the 2000, the expansion board may be removed without affecting basic operation. The Model 879 Diagnostic Disk loads with standard or expanded memory.

NOTE: Double-sided disk drives will only function properly if PCB2 is modified as described on page 0.13.


J101
U113 HC 244
U114 HC 244
U101 4256
U102 4256
U103 4256
U104 4256
U105 4256
U106 4256
U107 4256
U108 4256
U109 4256
U110 4256
U111 4256
U112 4256
RP101
RP102
2K x 7
TB101
CUT TRACE AND JUMP FROM TB101 PIN 1 TO TB101 PIN 2 OR 3, ONLY WHEN THIS BOARD IS USED FOR FURTHER MEMORY EXPANSION. SEE CN877 FOR INSTRUCTIONS.
SEQUENTIAL CIRCUITS INC
3051 N. FIRST ST.
SAN JOSE, CA. 95134
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256K MEMORY EXPANSION BOARD
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DRAWING NO. PC877
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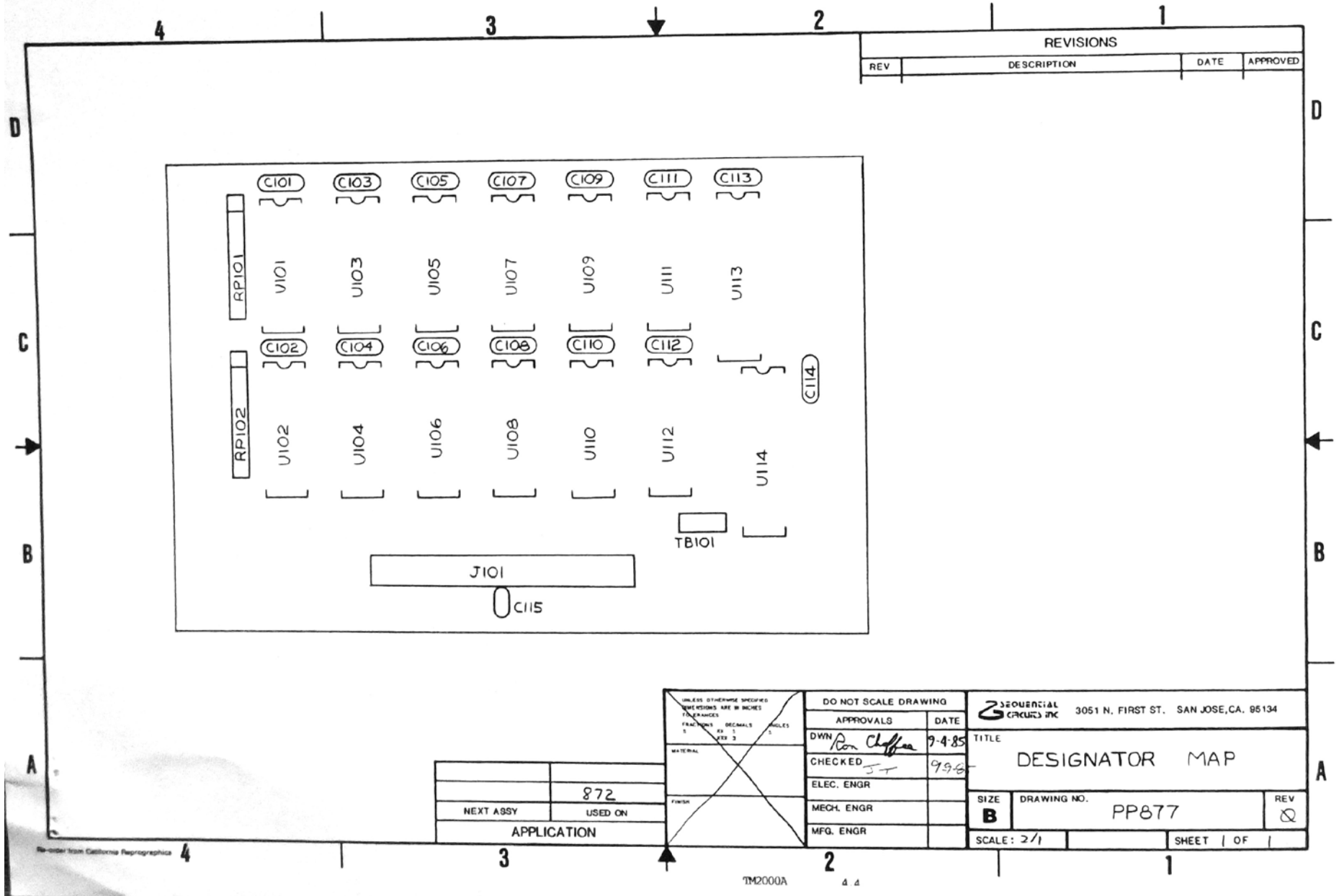
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APPLICATION
TM2000A

PARTS LIST/HARDWARE DESCRIPTION

DESIGNATOR	FUNCTION	SEQUENTIAL PART#	DESCRIPTION
U101-12	Sample RAM	I-076	256k X 1 DRAM
U113/14	Address line buffers	I-257	74HC244
C101-12		C-121	.33uF 50V 20% Mono radial
C113/14		C-045	.1 50V Decoupler Mono radial
C115		C-023	47uF 10V 20% Tant radial
RP101/02		R-308	2k X 7 SIP 10%
J101		J-102	30-pin dbl row PC mount
		Z-1068	Memory expansion software

Non-designated Parts

Only with Model 877 kit For U101-12	E-200	3 1/2" dbl-sided disk drive
	J-007	16 pin dip sockets
	M-024	6-32 X 3/8" pan hd phil
	M-141	#6 star washer ext tooth
	PC-877	Expansion PC board