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INTRODUCTION

The design philosophy behind the Xpander was to include all the features of a modular synthesizer in a programmable and easy to use instrument. At the same time, reliability, accuracy, and ease of servicing have been a prime concern through every step of the design. The result is the most complete and accurate analog polyphonic synthesizer ever built, despite the inclusion of 6 trimmers.

Besides the schematics and the calibration procedure, this manual includes basic explanations of some of the Xpander's circuits. We hope that despite their simplicity they will lead you to a better understanding of the Xpander and therefore to faster and easier servicing.

All of the Xpander general operation procedures are contain in the Xpander Owner's Manual.



When ordering spare parts from Oberheim Electronics, always indicate the **Oberheim part number** (see the Oberheim part number cross reference at page 60). This will speed up your order and avoid possible errors.

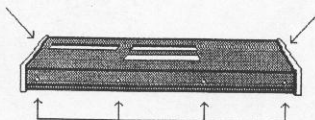
Warning: To avoid loss of data, save customer's data on tape prior to any technical servicing.

MECHANICAL ASSEMBLY

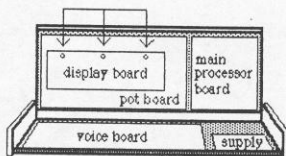
To access the inside of the Xpander you must:

- Remove the 4 screws along the front of the unit.
- Remove the top screw on the right and left wooden end-bells.

The whole front panel can now hinge back.



To access the vacuum fluorescent displays (alpha numeric displays), you must remove the three screws along the top of the display board. The display board can now hinge down.



XPANDER CIRCUITRY OVERVIEW

The key to the outstanding performance and features of the Xpander is the intensive use made of its two built-in microprocessors.

The first microprocessor is called the main processor and is located on the processor board. Its main tasks are :

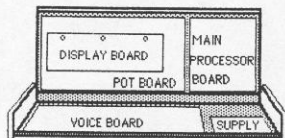
- Collecting and processing information coming from the front panel controllers (encoders and switches).
- Collecting and processing information coming from the outside of the Xpander through MIDI or control input jacks (CVs and GATES, PEDAL etc.).
- Controlling the displays (alpha numeric and LEDs).
- Storing sound parameters in battery back up memory.
- Receiving and sending cassette data.
- Controlling the sound parameters of the voices.

The second microprocessor, called the voice processor, is located on the voice printed circuit board.

The voice processor receives the sound parameter data from the main processor (VCO frequency, LFO 2 speed, envelope 3 attack time etc..) and generates all the modulations and controls that drive the analog circuitry. It also performs a number of automatic calibrations and corrections which insure the accurate behavior of the analog circuitry of each voice.

The Xpander's circuitry is spread on five printed circuit boards:

- The processor board
- The pot board
- The display board
- The voice board
- The power supply board



THE PROCESSOR BOARD:

The processor board is located in the upper right corner (when the unit is open). It holds :

- The 16 MHZ clock.
- The main processor.
- The power up/down detection circuit (PUP).
- The battery back up memory for the program retention as well as the battery itself.
- The MIDI in and out circuitry.
- The cassette in and out circuitry.
- Some of the LED latches.
- The analog noise generator.

THE POT BOARD:

The pot board is located in the upper left. It holds:

- The switch decoding circuit.
- The external CVs and gates circuit.
- The pedal circuit.
- The step encoder decoding circuit.
- Some of the LED latches.
- The audio master volume control.

THE DISPLAY BOARD:

The display board is located on top of the pot board. It holds:

- The decoding for the display's digits.
- The high voltage buffer for the diplays.
- The three 40-digit vacuum fluorescent display tubes.

THE VOICE BOARD:

The voice board is located on the bottom left. It holds:

- The processor interface circuit.
- The voice processor and its ROM and RAM.
- The DAC.
- The analog circuitry for the 6 voices.
- The panning circuit.

THE POWER SUPPLY:

The power supply is located on the bottom right.

THEORY OF OPERATION:

The following chapter provides information only on the parts of the Xpander's circuitry which present some originality and innovation. A basic knowledge of synthesizer electronic circuits is required.

SWITCHING POWER SUPPLY:

In order to decrease the heat dissipation without using bulky heat sinks, the Xpander uses a switching power supply which operates as follows:

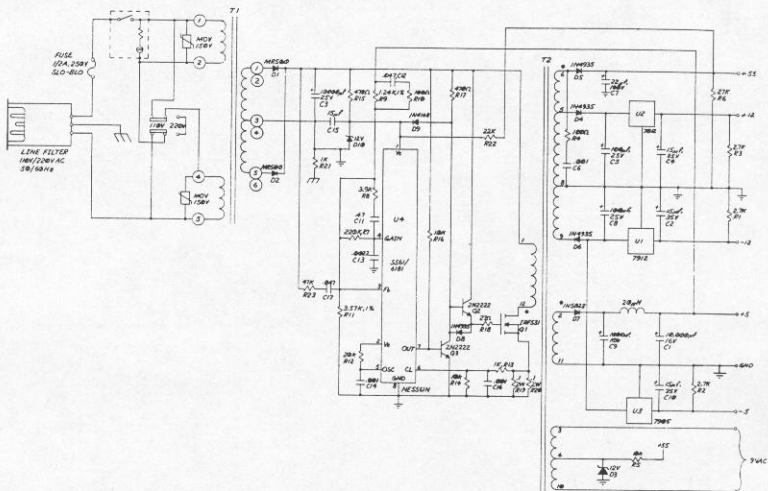
The line AC voltage is first stepped down, rectified and filtered by T1, D1, D2 and C3 to produce a low DC voltage (approximately 13 volts). This DC voltage is then chopped (switched) by Q1 at a frequency of approximately 30 KHz to produce a variable pulse width wave. This pulse is applied through the primary of the step transformer T2 which provides in return on its secondary windings all the different voltages used in the Xpander. Those AC voltages (30 KHz frequency) are then rectified (D5,D4,D6,D7), filtered (C7,C5,C8,C9,C1,C10) and if necessary, regulated (U2,U1,U3). Finally, the 5 volt supply is fed back into the "oscillator/pulse width modulator" integrated circuit U4 to modulate the pulse width and provide the basic voltage regulation.

The advantage of this method over the conventional voltage regulation scheme lies in the fact that the regulation is achieved by modulating the width of a pulse wave rather than the resistance of a transistor. The modulated pulse turns on and off the power MOS transistor Q1 which will therefore always be in one of the two following states:

ON: voltage across = 0 , drain current = max ---> power=0

OFF: voltage across =max , drain current = 0 ----> power=0

As there is no power across the transistor in both states, there is no heat production.



DUAL MICROPROCESSOR INTERFACE:

The two microprocessors of the Xpander are running two different programs in parallel; the main processor is mainly in charge of collecting and processing the information of the front panel, and the voice processor generates the envelopes, LFOs, LAG etc. for the 6 voices. At some point it is necessary for the main processor to write a new sound parameter into the voice processor memory (for example, a new speed value for an LFO or a new note value for a voice). This is done through the microprocessor interface circuitry located on the voice board. This circuitry includes: one bidirectional octal buffer (U904), four 3-state buffers (U903, U902, U901, U916), 3 OR gates (U906) and a transistor (Q901).

Every time the main processor has to change a parameter in the voice processor memory, the following sequence of events occurs:

A) The main processor sets the HALTREQ* (halt request) line LOW (pin 10 of U906 OR gate).

B) If the voice processor did not previously set the HALTDS (halt disabled) line high, the voice processor will halt, meaning that it will:

- 1) Stop execution of its program after completion of the current instruction.
- 2) Put its data and address lines in high impedance state.
- 3) Set high the BA line (bus available).

C) BA high will do two things:

1) Through U904, U903, U902, U901 it will connect the data and address lines of the main processor to the data and address line of the voice processor and through U903 and U916 it will switch the read and write lines of the voice processor for the read and write lines of the main processor.

2) Set the HALTAKN* (halt acknowledge) line low (Q901 collector).

D) By sensing the HALTAKN* line low, the main processor knows that its data and address lines are now connected to the voice processor memory and that it can therefore read from or write into it.

E) When the data transfer is completed, the main processor sets the HALTREQ* line high again, allowing the voice processor to retrieve control of its bus and resume its operation.

NOTE: If during normal operation (no tuning or cassette transfer) the voice processor does not acknowledge a halt request in less than 1 second, the main processor will sense a malfunction and will display: "VOICE PROCESSOR MALFUNCTION".

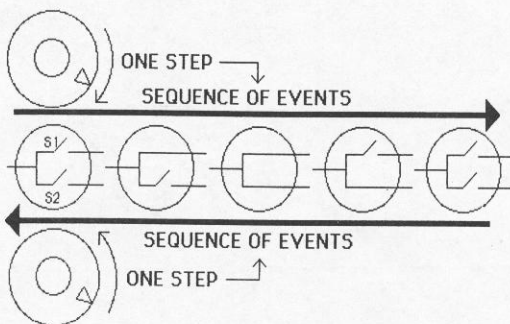


STEP ENCODERS:

In order to facilitate parameter edition, the Xpender uses six step encoders located at the bottom of the PAGE MODIFIER section.

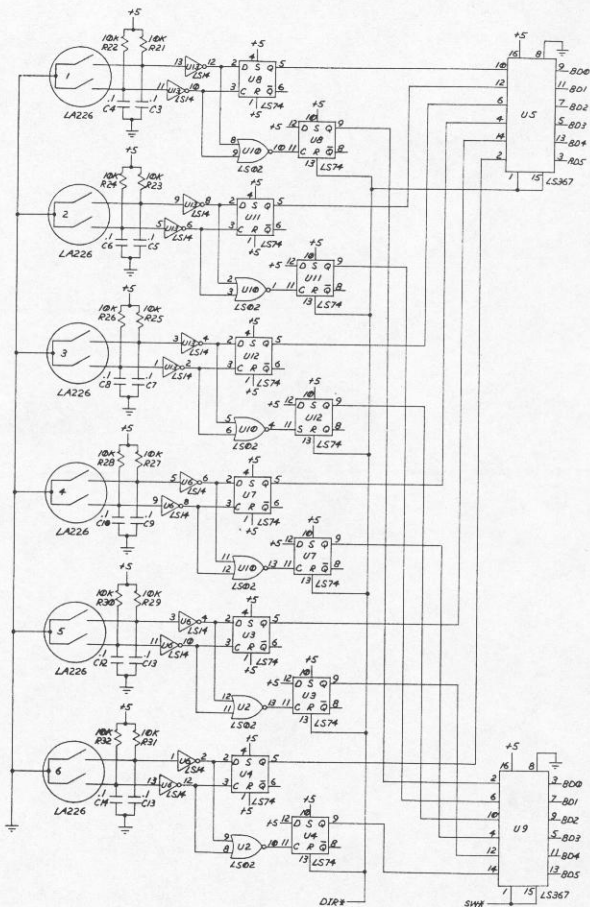
Step encoders, from the outside, seem to behave and look like 360 degree potentiometers, but in practice operate in a completely different way.

They are internally made of two switches and a toothed wheel with 30 teeth. Each of the steps (clicks) generates a sequence of closing and opening for the two switches s1 and s2. The sequence will be different according to the direction of the rotation.



Each encoder is connected to decoding circuitry that automatically senses every step and its direction.

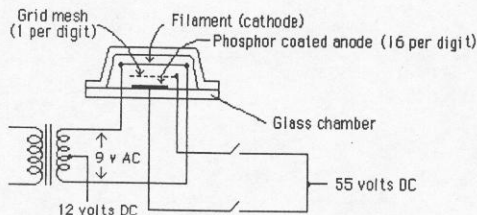
Consider the circuitry of the encoder number 1 where R22, R21, C3 and C4 debounce the encoder switches. Whenever one of the 2 switches closes, pin 10 of the NOR gate U10 will go low until both switches are open again. This low to high transition will latch a high level on pin 9 of U8 indicating that the sequence of events for one step has been completed. The main processor can read the status of the six encoders through the tri-state gate U9. In parallel, pin 5 of U8 is set high or low according to the direction of the rotation of the encoder. The main processor can read the direction through the tri-state gate U5. Note that when U5 is enabled (DIR* is low) all the step sensor latches are reset.



VACUUM FLUORESCENT DISPLAYS:

The three 40-digit vacuum fluorescent displays (VFD) and their drivers are located on the display board.

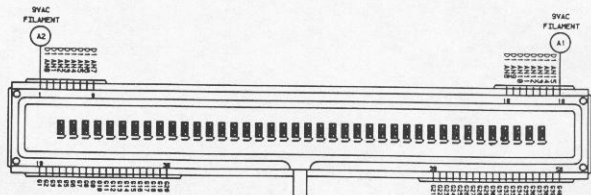
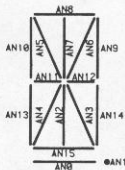
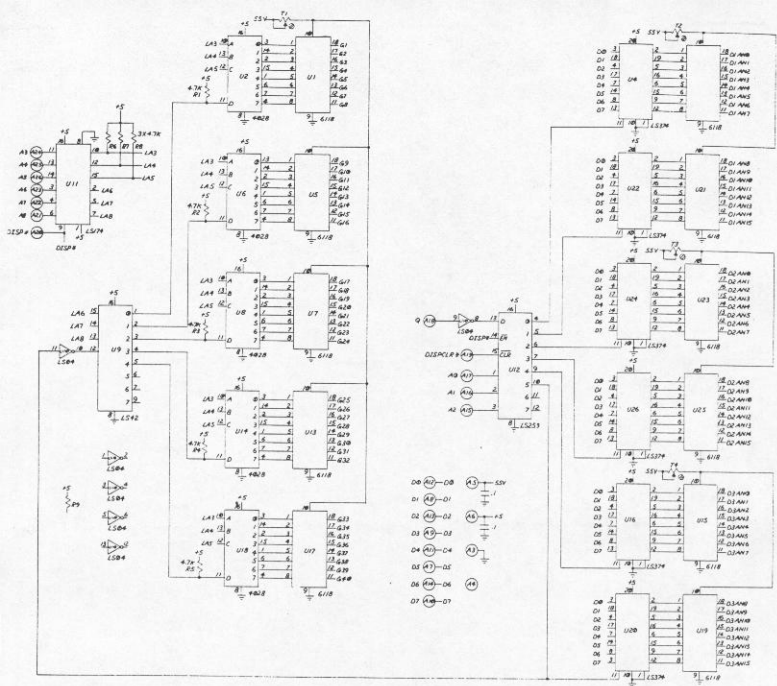
The VFD consists of three basic electrodes in an evacuated glass chamber (see fig. below). The electrodes are the cathode, grid and anode. The cathode is a small diameter oxide-coated tungsten filament running across the length of the display and is directly heated by an AC current. The grid is a thin metal screen mesh covering the area over each digit. The anode is coated with phosphor and is arranged in 16 independent segments for each digit.



When a positive voltage is applied to the grid and anode, the resultant electrical field will accelerate electrons toward the grid. Since the grid is a mesh, most of the electrons will pass through the grid. Electrons that have passed the grid are further accelerated toward the anode, but collide with the phosphor before reaching it. The electrons deposit most of their energy on the phosphor. This transfer of energy excites the phosphor, which emits a rich blue-green light.

All the identical segments of the 40 digits are connected together and brought out on pins AN0 through AN15 (for example, all the underline segments are connected to pin AN0). The 40 grids are individually available on pin G1 through G40.

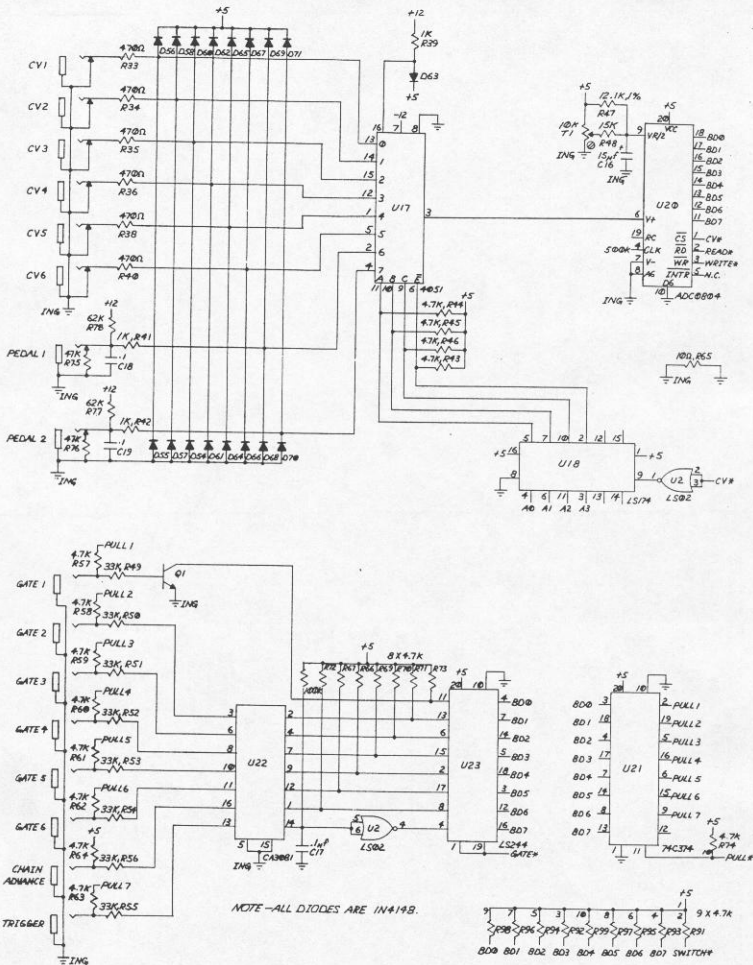
The VFD drive circuitry is shown on the next page. On the left side are the grid drivers (U11,9,1,2,5,6,7,8,13,14,17,18), and on the right side are the anode drivers (U12,3,4,21,22,23,24,25,26,15,16,19,20). Under the control of the main processor, the grids of the 3 VFD are sequentially turned on one at a time from G1 through G40. Before turning on the next grid, a new combination of anodes, determining the displayed pattern, is latched for each of the 3 VFDs.



GATE AND CV INPUTS:

The six gates, chain advance and trigger signals are buffered through Q1 and the seven transistors contained in U22. The eight resistors R57 through R63 are either pulling up or down the input according to the state of the lines PULL1 through PULL7. These lines will be set low if the corresponding gate polarity is set for + and set high if the gate polarity is set for - . This setup automatically forces an unused input into its passive state.

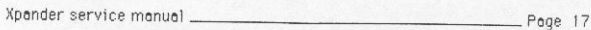
The CV and pedal voltages present on the rear panel jacks are multiplexed through U17 under the control of the main processor. Each of the voltages are then sequentially converted to an 8-bit digital value by the analog to digital converter U20. Only the six most significant bits are used. The diodes D55 through D71 limit the range of the input voltage to 0 and 5.6 volts.



VCO TEMPERATURE COMPENSATION:

Each 3374 dual VCO chip used on the analog voices includes a temperature sensor circuit that provides on pin 10 a voltage proportional to the chip internal temperature. These voltages are filtered and buffered on each voice by CX35 and UX05. The six voltages are then routed to U805 in the DAC area. The circuitry composed of U805, U814, U815 allows selection, under the control of the main processor, of one of the six temperature reference voltages or a fixed reference to be the DAC reference. Because the DAC used in the Xpander is a multiplying DAC, the voltage on the output of the DAC circuitry is directly proportional to the reference. When the DAC loads a sample and hold controlling the frequency of a VCO, the temperature reference voltage of this VCO will be used as reference for the DAC. Therefore, if the internal temperature of a VCO rises, its frequency voltage control will raise proportionally, keeping the resulting frequency stable. When the DAC loads the sample and hold of a non-temperature dependant parameter (Pulse width for example) the fixed voltage reference will be used as DAC reference.

The temperature stability of the VCO's frequency resulting from this method is far better than the one achieved with the CEM 3340 VCO chip because the correction scaling is performed by the multiplying DAC rather than by the analog multiplier built into the CEM 3340.



HIGH RESOLUTION DAC:

The Xpander uses a 14 bit DAC which provides the high resolution needed for the generation of smooth and accurate modulations. However an even higher resolution is required to achieve the very high standard of tuning accuracy that Oberheim likes to offer. This is accomplished by the circuitry on the right of the DAC U811 (see next page).

Whenever a control voltage requiring a very high level of resolution (VCO or VCF frequency control) must be generated, this voltage will be obtained in two phases:

- 1) The DAC is first loaded with the fine tune value which is stored in the sample and hold formed by U814, C805 and U815

- 2) The previously mentioned sample and hold's input is then disconnected from the DAC and the DAC is loaded with the most significant part of the control value. At this moment U814 connects the output of U815 (pin 14) to the summing node of U813 making its output equal to the sum of the control value and the fine tune value previously stored in C805. Simultaneously, the final destination sample and hold is connected to U813 output and stores the final value.

As the summing resistor for the fine tune sample and hold is three times the value of the other summing resistor's (R849 and R846), the resolution obtained from the fine tune sample and hold is three times better than the original resolution of the 14 bit DAC.

When a control voltage which does not require this extra resolution has to be loaded in a sample and hold, the connection between pin 14 and 12 of U814 is open and the S&H is loaded in one phase.

Note that when the very high resolution mode is used, R850 is connected to the summing node of U813 bringing its output down of approximately 5 volts. This allows the use of a -5 to +5 voltage range for the VCO and VCF frequency controls, making the line noise proportionally smaller.



VCO AND VCF FREQUENCY TUNING:

The volts per octave (scaling) parameters of the Xpander's 12 VCOs are adjusted by the voice microprocessor whenever the VCO function is selected in the tune page.

By using the timer U921, the microprocessor measures successively the five following frequencies: C4, E5, G#5, C6, E6 for each VCO, and calculates the proper correction voltages to bring each oscillator in tune. These correction values are stored in the main processor's battery back up memory for instant recall upon power on.

During normal operation, whenever a VCO will be required to produce a E5 for example, the correction value for this VCO at this frequency will be added to it's control voltage. For the notes between the sampled frequencies, the voice microprocessor calculates a linear interpolation from the two adjacent correction values and a linear extension from the two last values for the notes under C4 or over E6.

After the VCFs have been set to oscillation by setting the resonance controls at maximum, their frequencies are tuned like the VCO frequencies.

PULSE WIDTH CALIBRATION:

The 50 percent duty cycle of the Xpander's 12 pulse width modulators are adjusted by the voice microprocessor whenever the PW function is selected in the tune page.

By using the timer U921, the microprocessor measures the duty cycle for each pulse width modulator, and calculates the proper correction voltages to bring them to 50 percent for a control value of 31. These correction values are stored in the main processor's battery back up memory for instant recall upon power on.

FILTER RESONANCE CALIBRATION: for voice software version 1.1

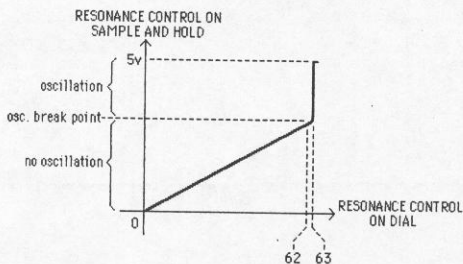
Every time the RES function is selected in the tune page, the voice microprocessor performs the following tests.

1. The software checks that the filter is oscillating when its frequency is set for E9, and its resonance control is at maximum (5 volts). This test insures that the VCF will be able to oscillate over the keyboard range.

2. The filter frequency is set for E5 and the resonance control is decreased until the filter stops oscillating.

3. The resonance is slowly increased until the filter starts oscillating again. The resonance value at this point is saved as the "oscillation break point".

During normal operation, the microprocessor scales the resonance control as shown on the figure below.



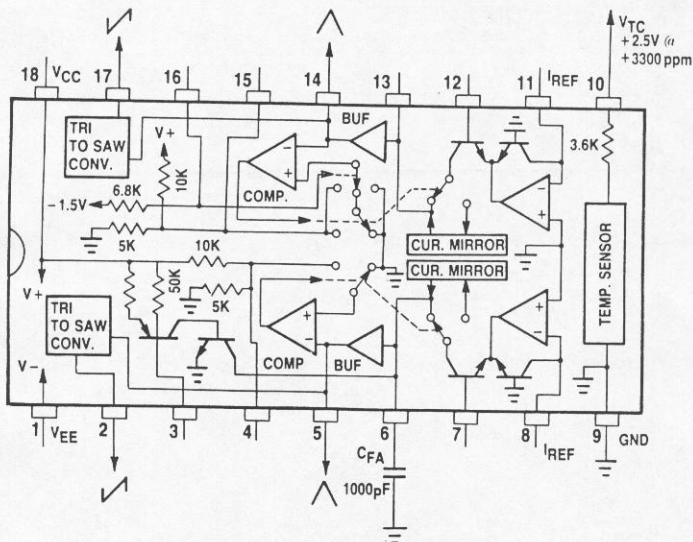
As the frequency of the CEM 3372 changes slightly with its resonance setting, the VCF frequencies are automatically retuned after the resonance calibration has been performed.

DUAL VCO CEM 3374:

The CEM 3374 contains two completely independent precision voltage controlled oscillators. The 3374 includes an on-chip temperature sensor which generates an output voltage, nominally +2.5V, proportional to the chip temperature with a T.C. of +3300 ppm.

CEM 3374 BLOCK DIAGRAM:

Reproduced with permission of Curtis Electromusic Specialities

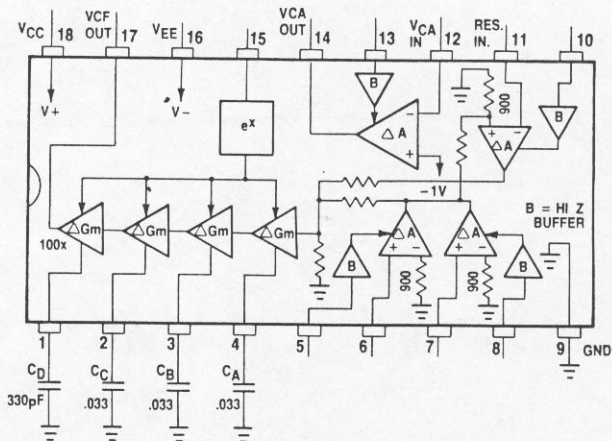


SIGNAL PROCESSOR CEM 3372:

The CEM 3372 is an audio signal processing device. It includes a two channel voltage controlled mixer, a dedicated 4-pole low pass VCF with voltage controlled resonance and a final VCA. With the exception of the filter cut-off frequency, all control inputs are very low bias current, high impedance which range from 0 to 5 volts.

CEM 3372 BLOCK DIAGRAM:

Reproduced with permission of Curtis Electromusic Specialities



DYNAMIC FM IMPLEMENTATION:

The Xpander voice allows dynamic linear modulation of VCO1 frequency by VCO2 triangle output.

This is done by sending the triangle output of VCO2 (pin 5 of UX09) to the reference input of the multiplying DAC UX04 which has its combination inputs controlled by the latch UX03. The op amp UX05 converts the current output of the DAC into a voltage.

The three IC's mentioned above act as a digitally controlled variable gain amplifier where pin 15 of UX04 is the amplifier input, pin 1 of UX05 is the amplifier output and pin 4 through 11 of UX04 are the digital gain control inputs. The analog switch UX14 routes the modulation signal either to the linear frequency control input of VCO1 (pin 11 of UX09) or to the VCF frequency input (pin 15 of UX12).

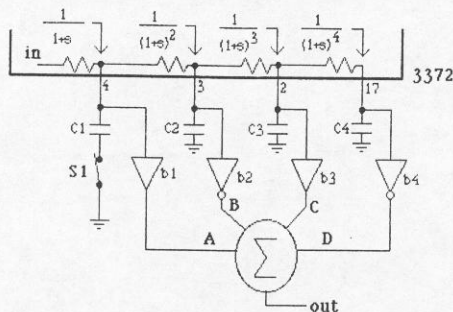
This method is preferred over using a conventional VCA because of the much better temperature independancy and linearity of the multiplying DAC.

MULTI FUNCTION VCF:

Although the VCF implemented in the 3372 is a standard 4-pole low pass, the additional circuitry made of UX14, UX13, UX15, UX17, and the one percent resistor array on the left of UX17 allows 15 different filter modes including high pass, band pass, notch and all pass.

Understanding how this magic trick happens requires a little theory.

The figure below shows a simplified representation of the circuitry.



The complex representation of the transfer function of a 1-pole low pass filter is: $\frac{1}{1+s}$. Therefore, the transfer function of the network will be:

$$\frac{\text{out}}{\text{in}} = \frac{A}{1+s} - \frac{B}{(1+s)^2} + \frac{C}{(1+s)^3} - \frac{D}{(1+s)^4} = \frac{As^3 + (3A-B)s^2 + (3A-2B+C)s + A-B+C-D}{(1+s)^4}$$

Selecting specific values for A, B, C and D allows different transfer functions. For example, selecting A=1, B=1, C=0 and D=0 transforms the above equation into:

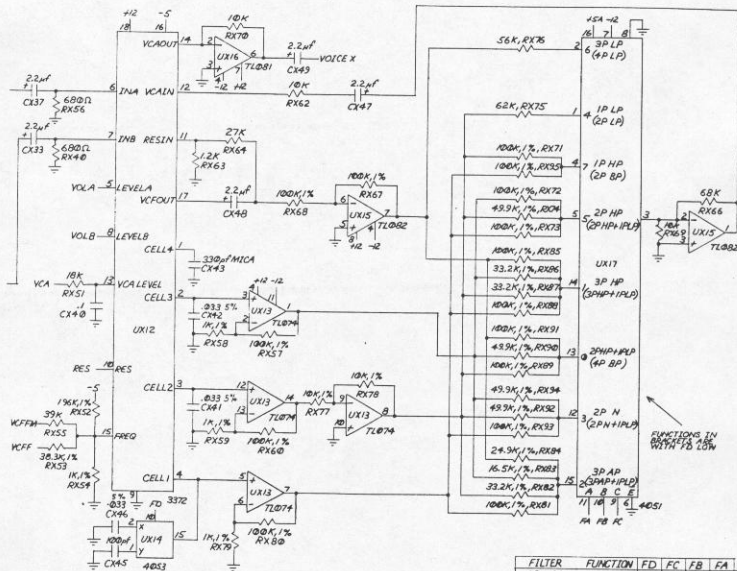
$$\frac{s}{(1+s)^2}$$

which is the transfer function of a 2 pole band pass filter.

Getting different responses from this network will be just a matter of adjusting the coefficients A, B, C and D in order to transform the transfer function into the desired one.

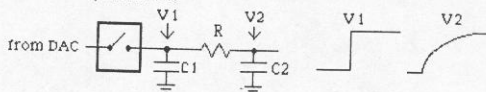
For the high pass and all pass filter modes, it is necessary to cancel the first cell of the filter. This is accomplished by opening the switch S1.

In practice, S1 is implemented by one cell of the analog switch UX15, the buffers b1, b2 and b3 are the four op amps of UX13, b4 is the op amp UX15 (output pin 7) and the summation is performed by the second cell of UX15 (output on pin 1). The coefficients A, B, C and D are set by the value of the summing resistors. The analog multiplexer UX17 allows to select from eight different resistor combinations providing eight different filter modes. Seven additional modes are obtained by selecting the previous modes and opening S1.



SMOOTHING SAMPLE AND HOLD:

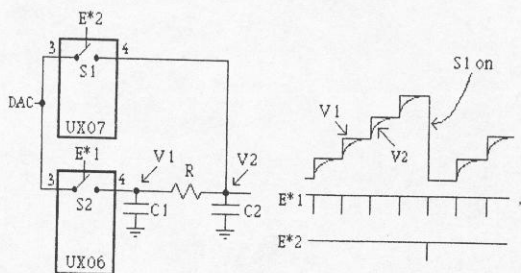
Most of the modulations in the Xpander are generated by the voice micro processor and are transmitted to the analog part of the voice through the DAC and sample and hold. Every 10 ms, the processor computes a new value of the modulation and updates the corresponding sample and hold. Without any special attention in the design of the sample and hold, this would produce a step in the control voltage every 10 ms. To avoid this problem, the Xpander S&H use a circuit which allows smoothing of the transition between successive samples. This is done by adding an RC network after the sample and hold capacitor C1:



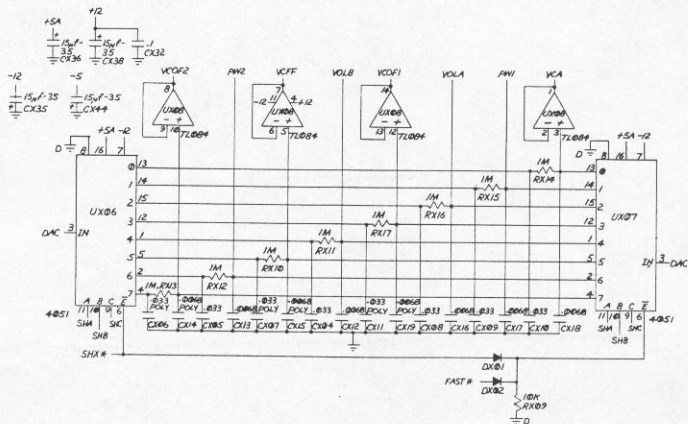
Because C1's value is much larger than C2, it acts as a voltage generator for the 10 ms time interval between refresh.

It is, however, necessary for some specific modulations, such as an LFO with a sawtooth wave, to cancel this RC time constant in order to produce the sharp edge of the wave. This is done in practice by short-circuiting the resistor R.

The figure below shows one of the eight sample and holds of a voice with a slightly different placement of the components.



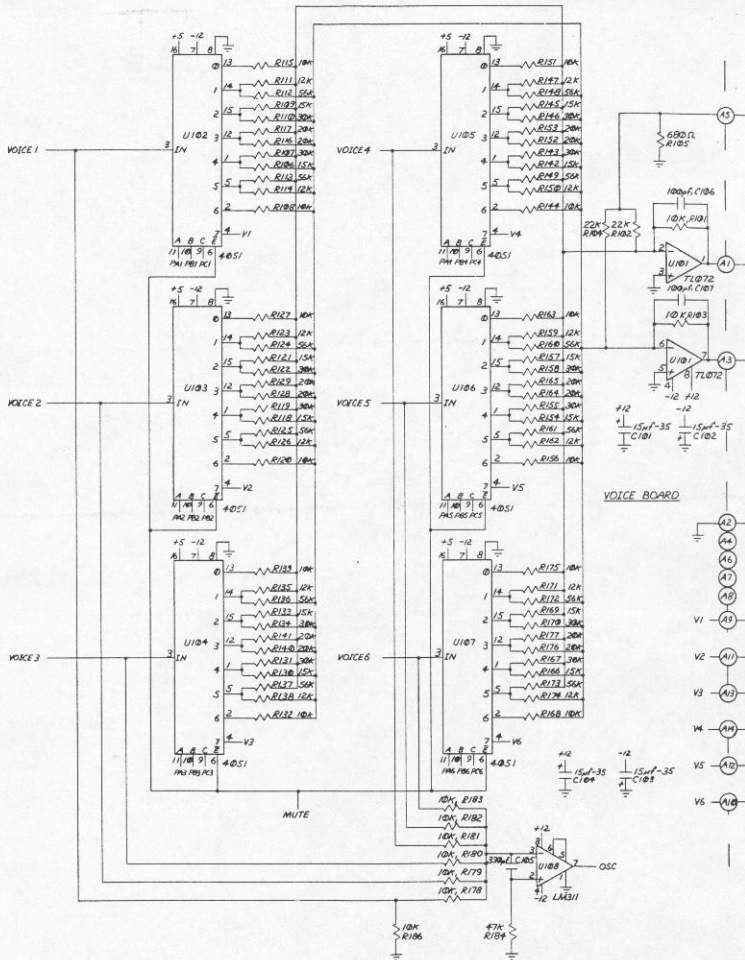
If a smooth transition is required, S2 is switched on while S1 remains open. For a sharp transition S2 and S1 are closed simultaneously.



PROGRAMMABLE PANNING:

The programmable panning is implemented by the IC's U102 through U107.

The output signal of a voice is routed to one of the eight outputs of its associated IC. The one or two resistors connected to this point distribute the signal to the left and right audio bus. The eighth output is connected to the direct output jack. The enable inputs of those ICs (pin 6) allow muting of all the outputs during the tuning.



TEST AND CALIBRATION:

The only equipment required to perform the Xpander test and calibration are a well calibrated digital voltmeter (DVM) with 4 1/2 digit resolution and a sound system.

POWER SUPPLY TEST:

1. Attach the negative lead from the DVM to the ground lug on the voice board at the left of the DAC.

2. Set the DVM for: DC volt, range 10v.

With the positive probe, test the 6 following voltages at the power supply connector on the voice board.

+12	+/- 750 mv	(11.250v to 12.750v)
-12	+/- 750 mv	(-11.250v to -12.750v)
-5	+/- 500 mv	(-4.500v to -5.500v)
+5A	+/- 500 mv	(4.500v to 5.500v)
+5D	+/- 500 mv	(4.500v to 5.500v)
ANGD 0v	+/- 10 mv	

3. Check the +5M (+5 MEMORY) on the right lead of D4 located at the middle top of the processor board.

With power ON 4.4v +/- 600 mv (3.80v to 5.00v)

With power OFF 2.7v + 1.3v /- 300 mv (2.40v to 4.00v)

4. Set the DVM for: DC volt, range 100v.

Check the 55v on pin 6 of the power connector of the pot board.

55v +/- 4v

5. Set the DVM for: AC volt, range 10v.

Check the 9v AC between pin 7 and 8 of the power connector on the pot board.

9v AC +/- 2v

NOTE: The AC frequency at this point is approximately 30 KHz. Make sure that your AC DVM reading is valid for this frequency range, if not, use an oscilloscope.

MAIN PROCESSOR ROM AND RAM TEST:

1. Turn the memory protect switch off on the back panel.
2. Select MASTER PAGE.
3. Select PAGE 2.
4. Select SERVICE.
5. Select MEM
6. Check for the following successive messages:

RAM 0 OK

RAM 1 OK

RAM 2 OK

ROM 0 OK

ROM 1 OK

ROM 2 OK

ROM 3 OK

If one of the test fails (RAM or ROM X BAD) replace the corresponding chip. RAM 0 = U2, RAM 1 = U3, RAM 2 = U4, ROM 0 = U8, ROM 1 = U7, ROM 2 = U6, ROM 3 = U5.

VOICE PROCESSOR ROM AND RAM TEST:

1. Select MASTER PAGE.
2. Select PAGE 2.
3. Select SERVICE.
4. Select VMEM.
5. Allow 20 seconds delay and check for message "CA MEM OK".

If the test fail (CA MEM BAD), replace successively U912, U914, U917 until the test run successfully.

LEDs TEST:

1. Select MASTER PAGE.
2. Select PAGE 2.
3. Select SERVICE.
4. Select LED.
5. Check for all 16 LEDs lit for approximately 2 seconds.

Check then for all LEDs lighting one after each other one at a time.

VACUUM FLUORESCENT DISPLAY TEST:

1. Select MASTER PAGE.
2. Select PAGE 2.
3. Select SERVICE.
4. Select DISP.
5. Check for all segments ON for all 120 digits.

Check for all segments ON for 1 digit at a time.

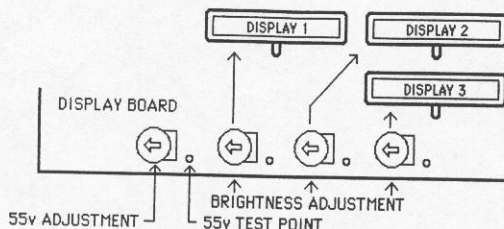
Check for 1 segment ON at a time for all digits of display 1, then display 1 & 2, then display 1, 2 & 3.

YFD BRIGHTNESS ADJUSTEMENT:

1. Set the DVM for: DC volt, range 100v.
2. Adjust the 55v.

55v

+/- 4v



3. Turn the three brightness trimmers all the way up (maximum brightness).
4. Turn down the trimers of the brightest displays to match the dimmest one.

4 VOLT REFERENCE TEST:

1. Attach the negative lead of the DVM to the ground lug on the voice board at the left of the DAC.

2. Set the DVM for: DC volt, range 10v.

3. With the positive probe check the 4 v reference voltage on pin 8 of U815 (TL084) in the DAC area of the voice board.

$$3.920\text{v} < 4\text{v ref} < 4.080\text{v} \quad (4\text{v} \pm 2\%)$$

DAC CALIBRATION:

1. Set DVM for: DC volt, range 10v

2. Attach the negative lead from the DVM to the ground lug on the voice board at the left of the DAC.

3. Select MASTER PAGE.

4. Select PAGE 2.

5. Select SERVICE.

6. Select DAC OFFSET.

7. With the positive probe of the DVM, check the output voltage of the DAC on pin 6 of U812 (TL081) and adjust with DAC trimer T801 for:

$$0\text{v} \quad \pm 1 \text{ mv}$$

NOTE: The IC U814 (4053) in the DAC area is very sensitive to short circuit. Be very careful when testing pin 6 of U812.

DAC MONOTONICITY TEST:

1. Select MASTER PAGE.
2. Select PAGE 2.
3. Select SERVICE.
4. Select DAC MONO.
5. Check for no or very seldom beep on the audio output.

ANALOG TO DIGITAL CONVERTER CALIBRATION:

Note: This calibration is going to set the volt per octave of the CV in. It is assumed that the controlling CVs are in the range 0 to 5 volt, that they are set for 1 volt per octave $\pm .2\%$ with a linearity of at least .1% and that the offset is no more than ± 15 mv. If the controlling device does not fulfill these requirements it will have to be corrected.

A) DVM METHOD: (calibration relative to internal DVM reference)

1. Set the DVM for: DC volt, range 10v
2. Attach the negative lead of the DVM to the ground reference of the ADC on the left side of R65 (10 Ohm) on the pot board.
3. With the positive probe of the DVM, test the ADC reference voltage (pin 9 of U20) on the lower lead of R47 on the pot board. Adjust with trimer T1 for:

2.667v ± 2 mv (2.665v to 2.669v)

B) AUDIO METHOD: (Calibration relative to the CV generator reference)

1. Select a single patch appropriate for checking voice tuning.
2. Set voice 1 and 2 to be controlled by CV 1 and CV 2.
3. Supply simultaneously CV1 input with 0.000 volt and CV2 with 5.000 volt. Gate voice 1 and 2 (Using a well calibrated DSX is one way to do it).
5. Adjust trimer T1 to obtain two stable notes C0 and C5.

MISCELLANEOUS:

SOFTWARE RESET:

In case of program lockup or abnormal software behavior, you can reset the memory of the processors to an initial default configuration.

To do so;

1. Hold down the CLEAR switch (most right switch in the modulation source select area) while you turn the power on.

2. Select YES under display 3. (selecting NO will cancel the reset).

The patch memory remains unaffected by this operation.

SOFTWARE VERSION NUMBER:

You can find out the software revision numbers actually installed in an Xpander by:

1. Select MASTER PAGE.

2. Select PAGE 2.

3. Select VERSION.

UNTUNE:

You can cancel all the automatic correction (VCO, PW, RES, VCF tuning) by:

1. Select MASTER PAGE.

2. Select PAGE 2.

3. Select SERVICE.

4. Select UNTUNE.

All the correction parameters will be set to 0. This may be useful when for example you wish to find out how much apart the resonance control of two VCFs really are, or if you want to check the linearity of a sample and hold ... etc.

To retrieve the tuning parameters, do a tune all in the TUNE PAGE.

MISCELLANEOUS:

SOFTWARE RESET:

In case of program lockup or abnormal software behavior, you can reset the memory of the processors to an initial default configuration.

To do so;

1. Hold down the CLEAR switch (most right switch in the modulation source select area) while you turn the power on.

2. Select YES under display 3. (selecting NO will cancel the reset).

The patch memory remains unaffected by this operation.

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UNTUNE:

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1. Select MASTER PAGE.

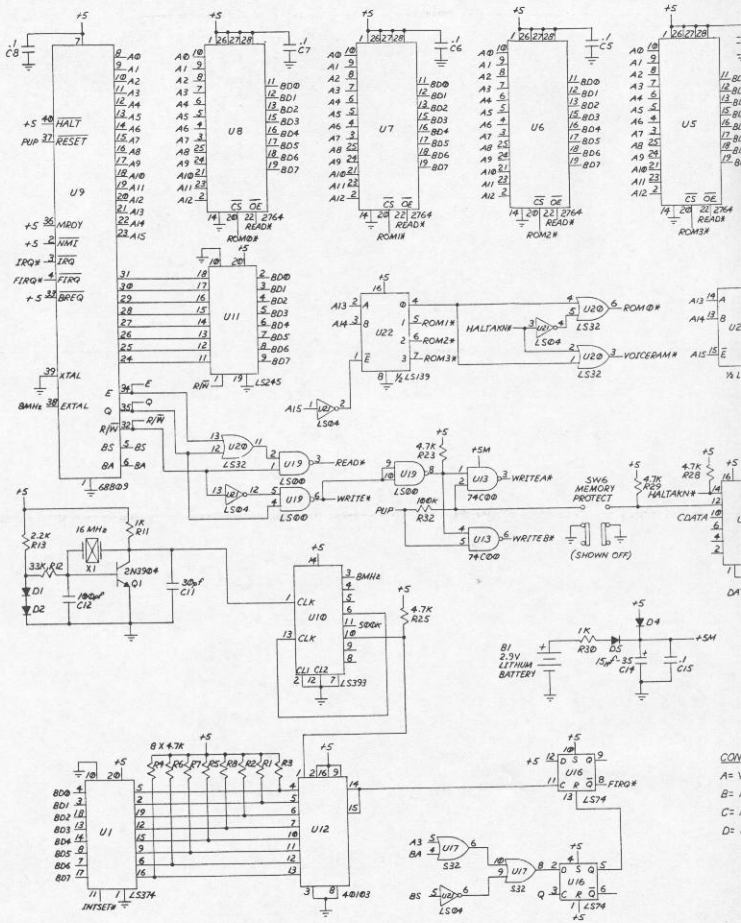
2. Select PAGE 2.

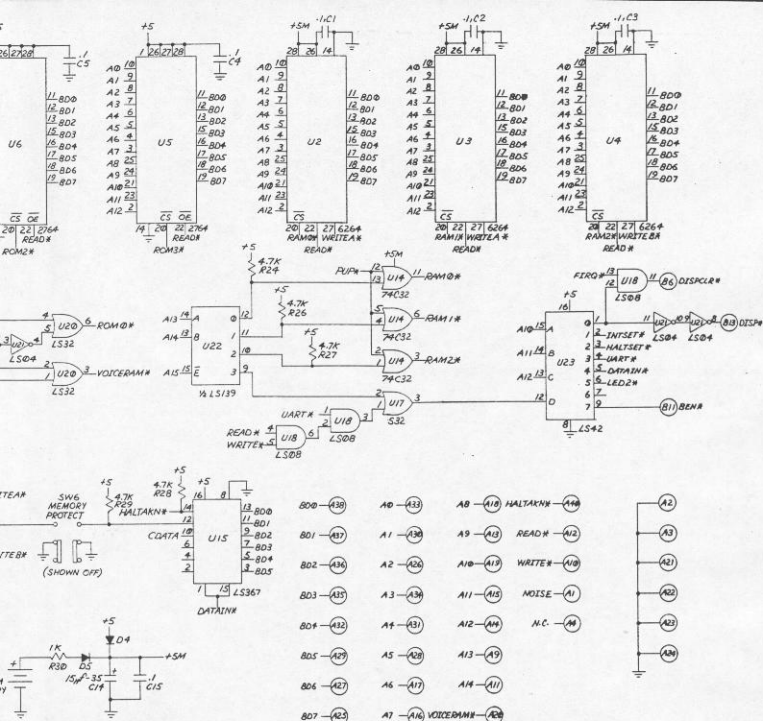
3. Select SERVICE.

4. Select UNTUNE.

All the correction parameters will be set to 0. This may be useful when for example you wish to find out how much apart the resonance control of two VCFs really are, or if you want to check the linearity of a sample and hold ... etc.

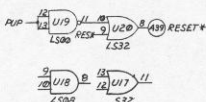
To retrieve the tuning parameters, do a tune all in the TUNE PAGE.





CONNECTORS:

A= VOICE BOARD
B= POT BOARD
C= POWER SUPPLY
D= CLOCK



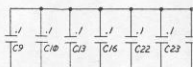
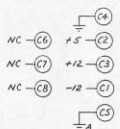
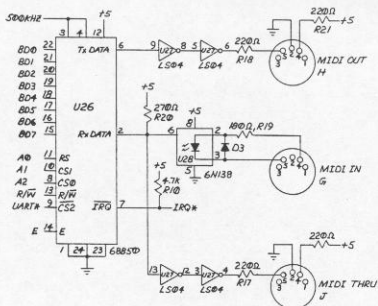
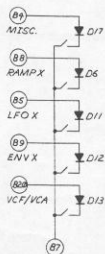
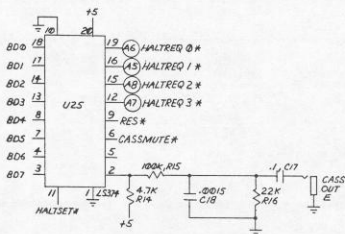
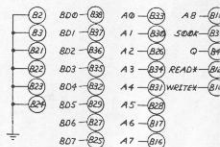
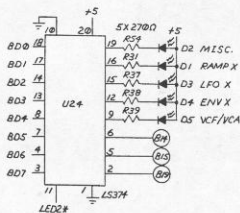
OBERHEIM

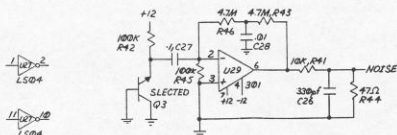
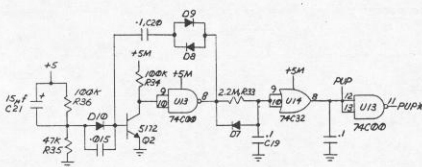
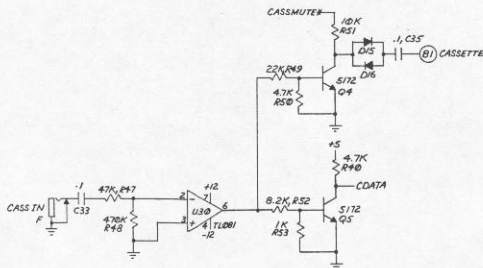
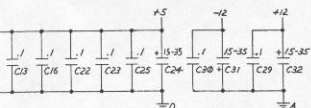
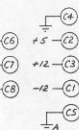
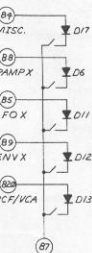
-SCHEMATIC-
EXPANDER PROCESSOR BOARD

LT#	REVISION	DATE	SHEET
			1 OF 2

J.R.

1/851





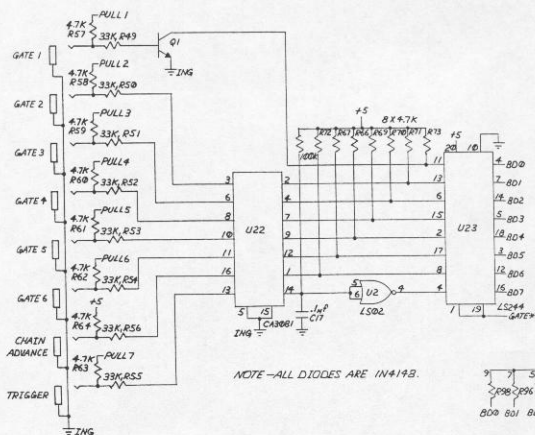
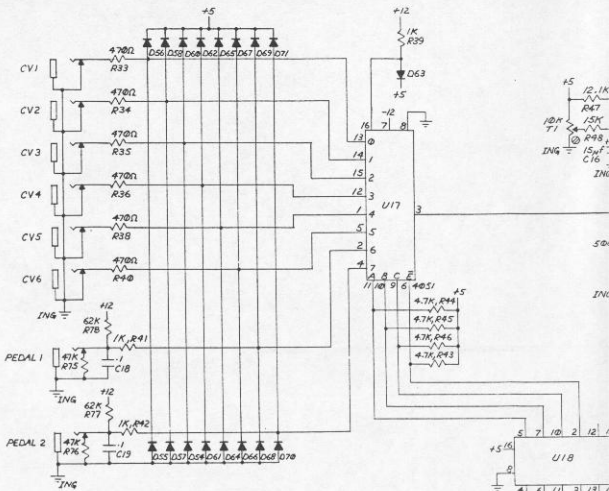
OBERHEIM

-SCHEMATIC-
EXPANDER PROCESSOR BOARD

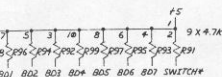
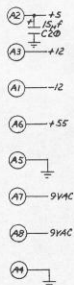
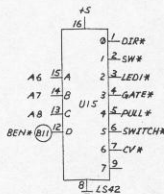
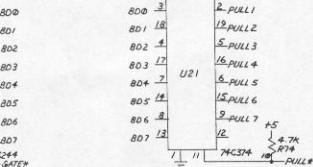
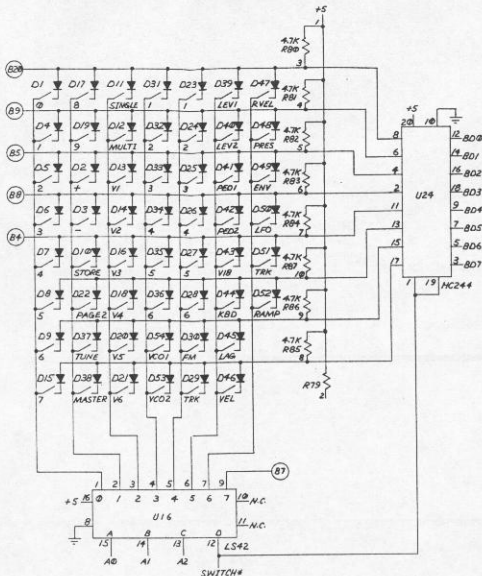
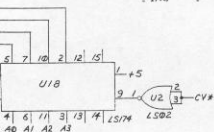
SHEET
2 OF 2

J.T.R.

1851



NOTE--ALL DIODES ARE 1N4148.

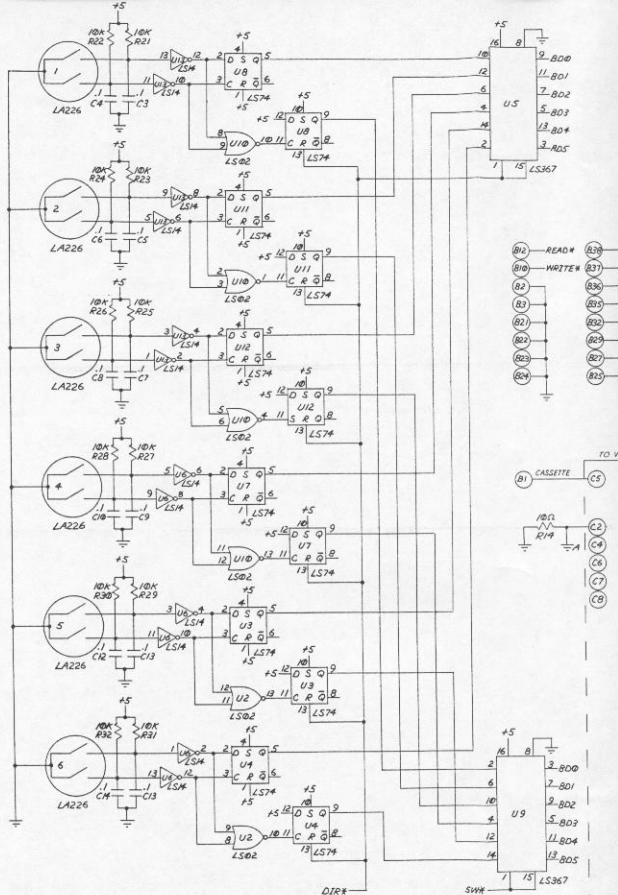


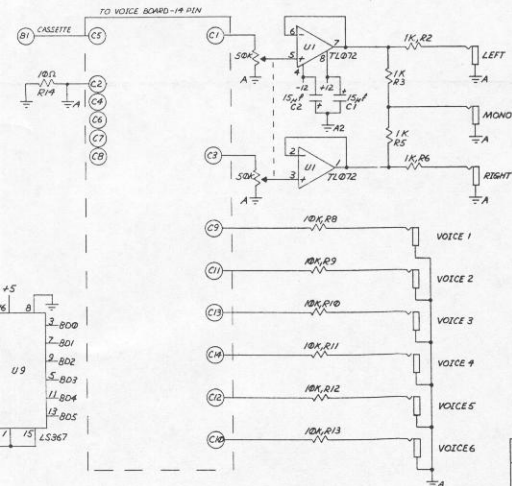
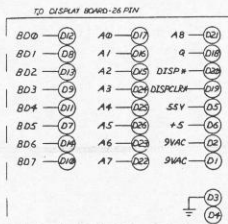
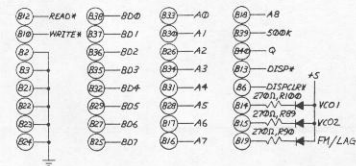
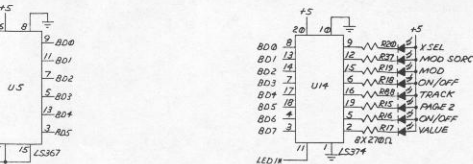
LTR	REVISION	DATE	SHEET JOF?

OBERHEIM

-SCHEMATIC-
EXPANDER POT BOARD

1859





NOTE: ALL DIODES ARE 1N4148

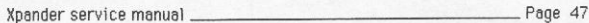
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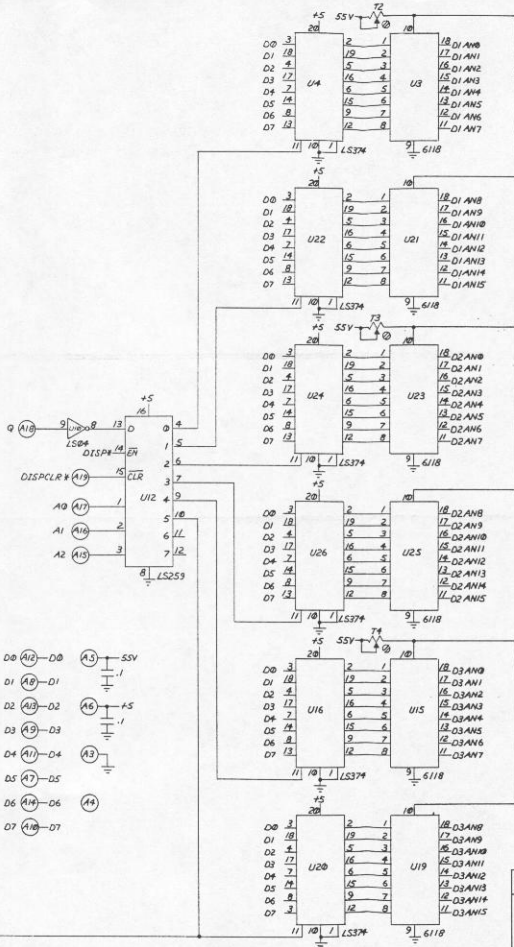
-SCHEMATIC-
EXPANDER POT BOARD.

SHEET
2 OF 2

J.R.

1859





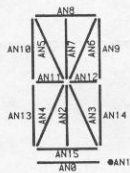
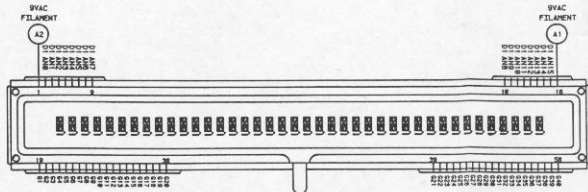
OBERHEIM

-SCHEMATIC-
EXPANDER DISPLAY BOARD

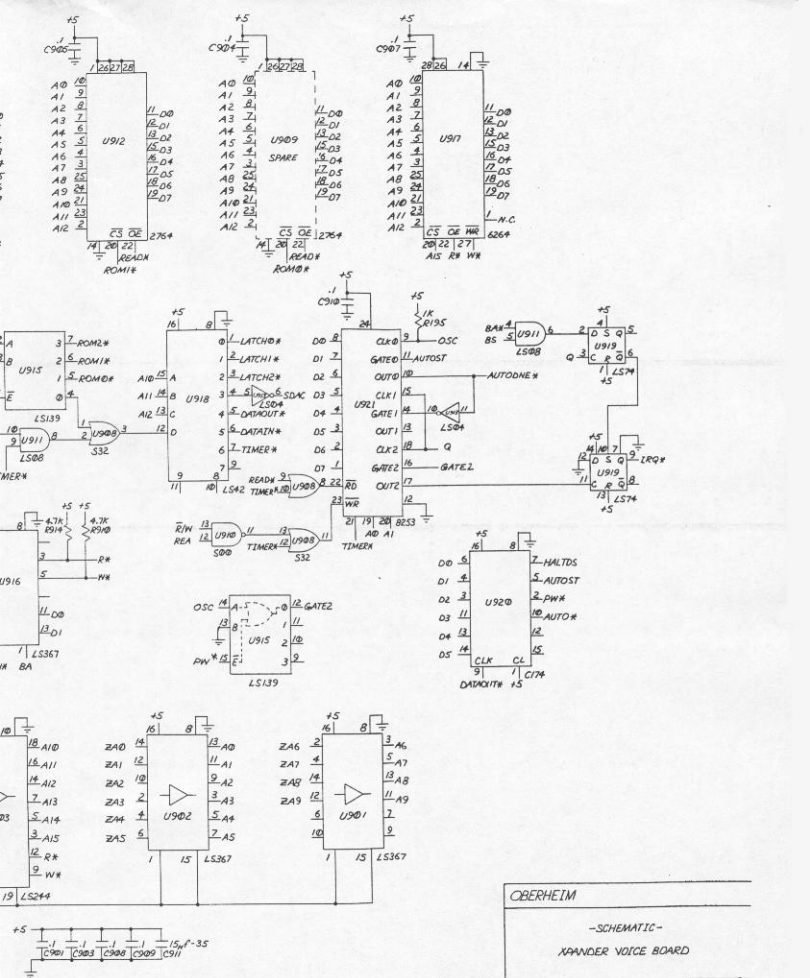
SHEET
1 OF 2

J.R.

1841







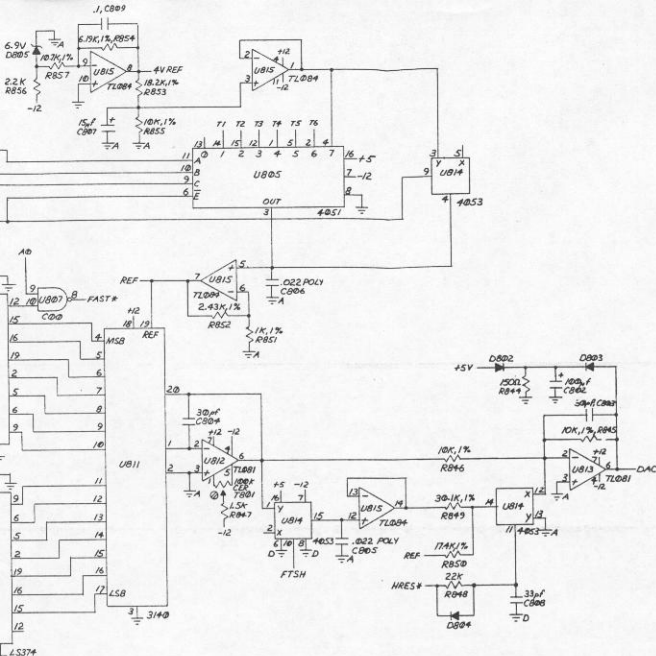
OBERHEIM

-SCHEMATIC-
XANDER VOICE BOARD

SHEET 1 OF 4 J.T.R.

1808

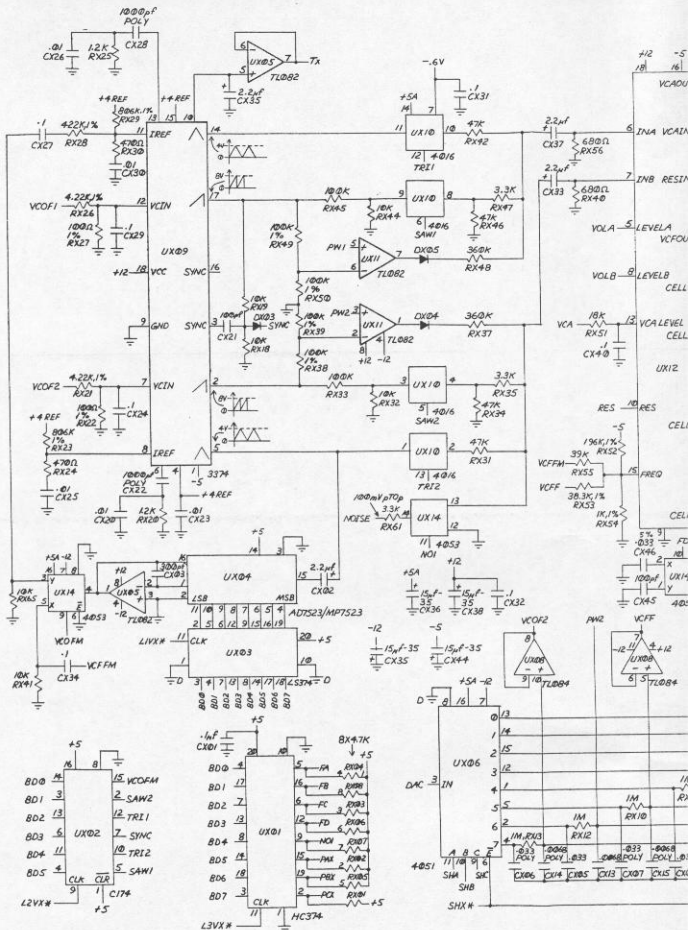


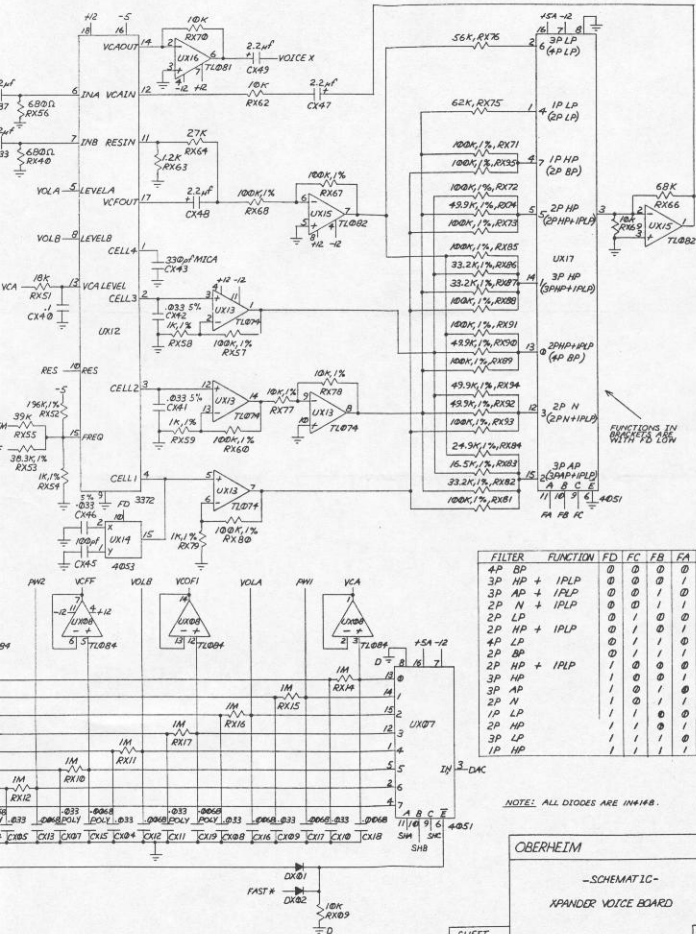


OBERHEIM

-SCHEMATIC-

XPANDER VOICE BOARD





FILTER	FUNCTION	FD	FC	FB	FA
4P BP		0	0	0	0
3P HP + 1PLP		0	0	0	1
3P AP + 1PLP		0	0	0	1
2P N + 1PLP		0	0	1	1
2P LP		0	1	0	0
2P HP + 1PLP		0	1	0	0
4P LP		0	1	1	0
2P BP		0	1	1	1
2P HP + 1PLP		1	0	0	0
3P HP		1	0	0	0
3P AP		1	0	0	0
2P N		1	0	1	0
1P LP		1	1	0	0
2P HP		1	1	0	1
3P LP		1	1	1	0
1P HP		1	1	1	1

NOTE: ALL DIODES ARE 1N4148.

OBERHEIM

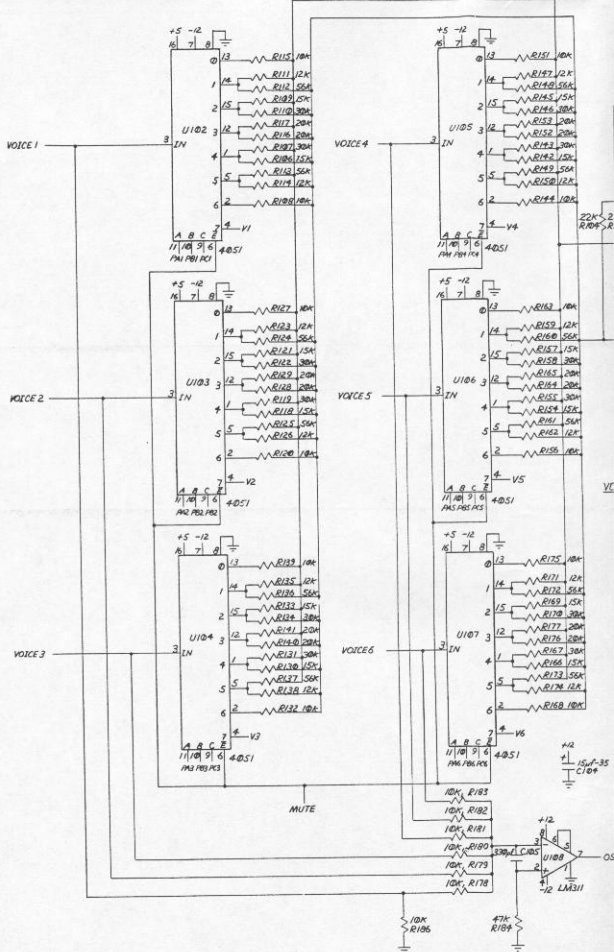
-SCHEMATIC-

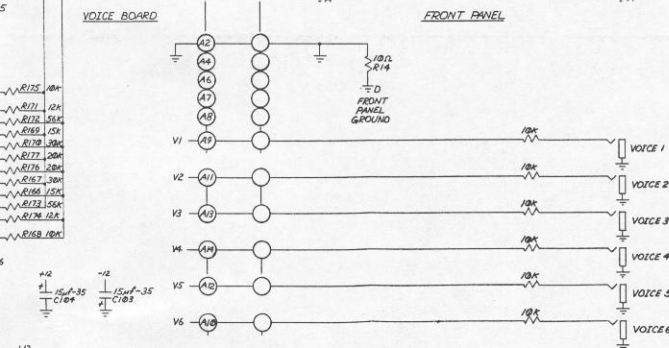
XPANDER VOICE BOARD

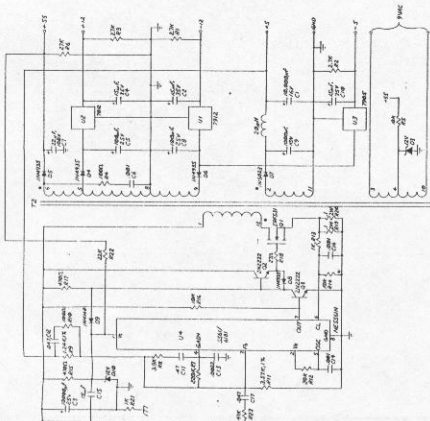
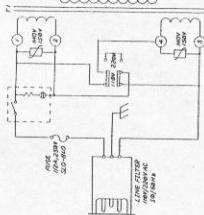
SHEET
3 OF 9

J.R.

1808







REV	DATE	BY	CHKD
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

LAST COMPONENT NOT USED

REV	DATE	BY	CHKD
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

LAST COMPONENT NOT USED

GERBETH ELECTRONICS INC.
-SCHEMATIC-
SUMMER POWER SUPPLY
1/65

OBERHEIM PART NUMBER CROSS REFERENCE:

PROCESSOR BOARD:

<u>Oberheim number</u>	<u>Description</u>	<u>Quantity</u>
219028	MINI JACK PCMT	2
219029	DIN 180 DEGREES 5 PINS PCMT	3
281066	SCREW #2 X 1/4 PPSMS BLUNT PHIL PAN	6
289019	CABLE TIE 4" OVERALL LENGTH T18R	1
310007-XP1.0-0	XPANDER 2764 XP 1.0-0	1
310007-XP1.0-1	XPANDER 2764 XP 1.0-1	1
310007-XP1.0-2	XPANDER 2764 XP 1.0-2	1
310007-XP1.0-3	XPANDER 2764 XP 1.0-3	1
316003	MICROPROCESSOR 68B09 8-BIT	1
317013	EPROM 2764	4
317014	RAM 6264 8K CMOS RAM	3
318007	ACIA(SERIAL INTERFACE IC) MC68B50P	1
318008	OPTICAL IC PHOTOCOUPLER HP 6N138	1
401002	BATTERY 2.9V LITH 440-SPC G 32/13	1
510409	SWITCH SLIDE PC MOUNT SWRFT C62206L	1
151024	CAP ALUM ELECT 15 25V RADIAL	5
153001	CAP MYLAR FLM .015	1
153004	CAP MYLAR FLM .01 .4LS	1
153013	CAP MYLAR FLM .1 .4LS	6
153018	CAP MYLAR FLM .0015 .4LS	1
157005	CAP CER DISC 100 PF 1000V	1
157006	CAP CER DISC 330 PF 500V	1
157012	CAP CER DISC 30 PF 1000V	1
157021	CAP CER DIP .1 MF 20% 50V	19
217005	TERM FEED THROUGH-025 PIN CONCORD	3
219335	CONN PCMT 8 CKT F AMP 1-350212-1	1
219340	CONN PCMT 3 CKT MOLEX 22-03-2031	1
219901	IC SOCKET 8 PIN ICY-083-S3	3
219902	IC SOCKET 14 PIN ICY-143-S3	10
219903	IC SOCKET 16 PIN ICY-163-S3	4
219906	IC SOCKET 24 PIN	1
219907	IC SOCKET 40 PIN	1
219909	IC SOCKET 20 PIN AMP #640464-3	4
219910	IC SOCKET 28P AMP #640362-3	7
230003	CRYSTAL 16.000 MHZ	1
245106	LED RED 1/8" STANLEY SAR3931	5
286006	SPACER 1/4X1/8X.140 ID NYLON	5
311016	IC 74LS00 QUAD2 IN NAND	1

PROCESSOR BOARD:

Oberhelm number	Description	Quantity
311018	IC 74LS139 DUAL 10F4 DECOD/DMULXR	1
311019	IC 74LS42 BCD-TO-DEC DECODER 16 PIN	1
311021	IC 74LS74 D F/F	1
311022	IC 74LS04 HEX INVERTER	2
311025	IC 74LS367 HEX BUFFER	1
311029	IC 74LS08 QUAD3 IN AND GATE	1
311032	IC 74LS245 OCTAL BUSS TRANSCEIVER	1
311033	IC 74LS374 OCTAL D FLIP-FLOP 3-S	3
311034	IC 74LS393 DUAL 4BIT RIPPLE COUNTER	1
311037	IC 74LS32 QUAD2 IN OR GATE	1
311041	IC 74S32 SCHOTTKY QUAD OR GATE	1
313017	IC 301A HI-PERF OP AMP LM301AN	1
313025	IC TL081 SING B1 FET OP AMP TL081CN	1
315041	IC 40103 8-STAGE DOWN COUNTER	1
315047	IC 74C32 QUAD 2-IN OR GATES - CMOS	1
315052	IC 74C00 CMOS QUAD NAND	1
478102	RESISTOR FXD 1/4W 2-5% 1 K	3
478103	RESISTOR FXD 1/4W 1-5% 10 K	2
478104	RESISTOR FXD 1/4W 2-5% 100 K	6
478181	RESISTOR FXD 1/4W 2-5% 180 OHM	1
478221	RESISTOR FXD 1/4W 2-5% 220 OHM	4
478222	RESISTOR FXD 1/4W 2-5% 2.2 K	1
478223	RESISTOR FXD 1/4W 2-5% 22 K	2
478225	RESISTOR FXD 1/4W 2-5% 2.2 MEG	1
478271	RESISTOR FXD 1/4W 2-5% 270 OHM	6
478333	RESISTOR FXD 1/4W 2-5% 33 K	1
478470	RESISTOR FXD 1/4W 2-5% 47 OHM	1
478472	RESISTOR FXD 1/4W 2-5% 4.7 K	4
478473	RESISTOR FXD 1/4W 2-5% 47 K	2
478474	RESISTOR FXD 1/4W 2-5% 470 K	1
478475	RESISTOR FXD 1/4W 2-5% 4.7 MEG	2
478822	RESISTOR FXD 1/4W 2-5% 8.2 K	1
479003	RESISTOR NETWORK 4.7K SIP 10 PIN	1
479007	RESISTOR NETWORK 4.7K SIP 8 PIN	1
481001	DIODE SIGNAL 1N4148	16
485003	TRANSISTOR SS NPN MPS5172	3
485005	TRANSISTOR SS NPN 2N3904	1
485502	TRANSISTOR SS NPN MPS5172 SEL BLUE	1
510024-C	SWITCH MARQUARDT 6401 0005 BLK PLN	5
651851	XPANDER PROCESSOR PCB ART 1852-1853	1
750187-0	CABLE SUB-ASSY OB-XPANDER #6	1
750188-0	CABLE SUB-ASSY OB-XPANDER #7	1

POT BOARD:

<u>Oberheim number</u>	<u>Description</u>	<u>Quantity</u>
151024	CAP ALUM ELECT 15 25V RADIAL	4
157002	CAP CER DISC .1 MF 20V	14
157021	CAP CER DIP .1 MF 20% 50V	1
219021	PH JACK 2 COND PCMT SWRFT RN111PC	17
219027	PH JACK 2 C PCMT W/SWITCH RN 112APC	8
219335	CONN PCMT 8 CKT F AMP 1-350212-1	1
219521	CONN RIBBON 40P RIGHT ANGLE HEADER	1
219525	CONN RIBBON 14P VERTICAL HEADER	1
219901	IC SOCKET 8 PIN ICY-083-S3	1
219902	IC SOCKET 14 PIN ICY-143-S3	10
219903	IC SOCKET 16 PIN ICY-163-S3	7
219909	IC SOCKET 20 PIN AMP #640464-3	5
245106	LED RED 1/8" STANLEY SAR3931	11
282003	NUT 3/8-32X12X.093 HEX NI PLT	2
286006	SPACER 1/4X1/8X.140 ID NYLON	11
286523	WASHER BELLEVILLE .380X.690X.035BL	1
311017	IC 74LS02 QUAD2 IN NOR	1
311019	IC 74LS42 BCD-TO-DEC DECODER 16 PIN	2
311021	IC 74LS74 D F/F	6
311025	IC 74LS367 HEX BUFFER	2
311031	IC 74LS244 OCTAL 3-STATE BUFFER	1
311033	IC 74LS374 OCTAL D FLIP-FLOP 3-S	1
311035	IC 74LS14 HEX SCHMITT TRIGGER	2
311038	IC 74LS174 HEX D-TYPE FLIP-FLOP W/R	1
313047	IC TL072CP DUAL BI FET L NOI OP-AMP	1
313049	IC 16 P TRANSISTOR ARRAY NPN CA3081	1
315025	IC 4051 ANAL MULTI-DEMULTI CD4051BE	1
315049	IC 74HC374 CMOS OCTAL D FLIP FLOP	1
315050	IC 74HC02 QUAD2 IN NOR	1
315051	IC ADC 0804 ANALOG TO DIGITAL CONV.	1
315053	IC 74HC244 CMOS OCTAL TRI STATE BUF	1
475410	RESISTOR FXD MT FLM 12.1 K 1% 1/8	1
476010	TRIMMER 10 K 375E103B CRMT	1
477037	POT 50K STEREO 20% CTS U2-450SF	1
478100	RESISTOR FXD 1/4W 2-5% 10 OHM	2
478102	RESISTOR FXD 1/4W 2-5% 1 K	5
478103	RESISTOR FXD 1/4W 1-5% 10 K	20
478104	RESISTOR FXD 1/4W 2-5% 100 K	1
478153	RESISTOR FXD 1/4W 2-5% 15 K	1

Oberheim number	Description	Quantity
478271	RESISTOR FXD 1/4W 2-5% 270 OHM	11
478303	RESISTOR FXD 1/4W 2-5% 30 K	8
478471	RESISTOR FXD 1/4W 2-5% 470 OHM	6
478472	RESISTOR FXD 1/4W 2-5% 4.7 K	12
478623	RESISTOR FXD 1/4W 2-5% 62 K	2
479003	RESISTOR NETWORK 4.7K SIP 10 PIN	3
481001	DIODE SIGNAL 1N4148	71
485003	TRANSISTOR SS NPN MPS5172	1
510024-0	SWITCH MARQUARDT 6401 0105 BLK W/0	1
510024-1	SWITCH MARQUARDT 6401 0015 BLK W/1	1
510024-2	SWITCH MARQUARDT 6401 0025 BLK W/2	1
510024-3	SWITCH MARQUARDT 6401 0035 BLK W/3	1
510024-4	SWITCH MARQUARDT 6401 0045 BLK W/4	1
510024-5	SWITCH MARQUARDT 6401 0055 BLK W/5	1
510024-6	SWITCH MARQUARDT 6401 0065 BLK W/6	1
510024-7	SWITCH MARQUARDT 6401 0075 BLK W/7	1
510024-8	SWITCH MARQUARDT 6401 0085 BLK W/8	1
510024-9	SWITCH MARQUARDT 6401 0095 BLK W/9	1
510024-A	SWITCH MARQUARDT 6401 0325 BLK W/+	1
510024-B	SWITCH MARQUARDT 6401 0335 BLK W/-	1
510024-C	SWITCH MARQUARDT 6401 0005 BLK PLN	41
510024-D	SWITCH MARQUARDT 6401 0006 RED PLN	1
510603	STEP ENCOD NUTS WASHER 25MM 30 ALPS	6
651960	XPANDER POT BOARD PCB ART 1861-1862	1
750189-0	CABLE SUB-ASSY OB-XPANDER #8	1

DISPLAY BOARD:

<u>Oberheim number</u>	<u>Description</u>	<u>Quantity</u>
241012	V FLOURESCENT DISPLAY FG405A2 ITRON	3
476010	TRIMMER 10 K 375E103B CRMT	4
153013	CAP MYLAR FLM .1 .4LS	1
157021	CAP CER DIP .1 MF 20% 50V	1
217005	TERM FEED THROUGH-025 PIN CONCORD	6
219512	CONN RIBBON 26P RIGHT ANGLE HEADER	1
219902	IC SOCKET 14 PIN ICY-143-S3	1
219903	IC SOCKET 16 PIN ICY-163-S3	8
219905	IC SOCKET 18 PIN	9
219909	IC SOCKET 20 PIN AMP #640464-3	6
311019	IC 74LS42 BCD-TO-DEC DECODER 16 PIN	1
311022	IC 74LS04 HEX INVERTER	1
311033	IC 74LS374 OCTAL D FLIP-FLOP 3-S	6
311038	IC 74LS174 HEX D-TYPE FLIP-FLOP W/R	1
311042	IC 74LS259 BCD TO DEC DECODER	1
315008	IC 4028 BCD-DEC DECODER MC14028CP	5
315055	IC UDN-6118 OCTAL HIGH VOLTAGE BUFF	11
479003	RESISTOR NETWORK 4.7K SIP 10 PIN	1
651842	XPANDER DISPLAY PCB ART 1843-1844	1

VOICE BOARD:

<u>Oberheim number</u>	<u>Description</u>	<u>Quantity</u>
310007-CA1.0-0	XPANDER 2764 CA 1.0-0	1
310007-CA1.0-1	XPANDER 2764 CA 1.0-1	1
311039	IC 74LS273 OCTAL D-TYPE FLIP-FLOP	1
311043	IC 74HC374 HI-SPEED CMOS OCTAL D	6
315048	IC 7523 AD OR MP 8-BIT DAC	6
316003	MICROPROCESSOR 68B09 8-BIT	1
317013	EPROM 2764	2
317014	RAM 6264 8K CMOS RAM	1
318004	8253-5 PROGRAMMABLE INTERVAL TIMER	1
318005	14 BIT DAC HYBRI HS3140C-4/MP7614KN	1
319009	AUDIO SIGNAL PROCESSOR CEM-3372	6
319010	DUAL VCO CEM-3374	6
476011	TRIMMER 100 K 375E104B CRMT	1
151024	CAP ALUM ELECT 15 25V RADIAL	34
151035	CAP ALUM ELECT 2.2 25V RADIAL	42
151040	CAP ALUM ELECT 100MF 10V RADIAL	1
153004	CAP MYLAR FLM .01 .4LS	24
153013	CAP MYLAR FLM .1 .4LS	31
153017	CAP MYLAR FLM .0068 .4LS	30
153022	CAP MYLAR FLM .033 .4LS	30
153024	CAP MYLAR FLM .033 5% RA 333UM100K	18
157005	CAP CER DISC 100 PF 1000V	12
157006	CAP CER DISC 330 PF 500V	7
157012	CAP CER DISC 30 PF 1000V	3
157013	CAP POLYPROP 1000 PF 400V	12
157019	CAP POLYPROP .022 MF 2.5% 160V	2
157021	CAP CER DIP .1 MF 20% 50V	35
157031	CAP POLYPROP .033 20%	24
157033	CAP POLYPROP .0068 20%	24
157035	CAP SILMICA 330 PF 10% RADIAL	6
217005	TERM FEED THROUGH-025 PIN CONCORD	2
219335	CONN PCMT 8 CKT F AMP 1-350212-1	1
219340	CONN PCMT 3 CKT MOLEX 22-03-2031	1
219521	CONN RIBBON 40P RIGHT ANGLE HEADER	1
219525	CONN RIBBON 14P VERTICAL HEADER	1
219901	IC SOCKET 8 PIN ICY-083-S3	28
219902	IC SOCKET 14 PIN ICY-143-S3	21
219903	IC SOCKET 16 PIN ICY-163-S3	61
219905	IC SOCKET 18 PIN	12
219906	IC SOCKET 24 PIN	1
219907	IC SOCKET 40 PIN	1
219909	IC SOCKET 20 PIN AMP #640464-3	17
219910	IC SOCKET 28P AMP #640362-3	4
311018	IC 74LS139 DUAL 10F4 DECOD/DMULXR	1
311019	IC 74LS42 BCD-TO-DEC DECODER 16 PIN	4
311021	IC 74LS74 D F/F	2
311022	IC 74LS04 HEX INVERTER	1
311025	IC 74LS367 HEX BUFFER	3
311029	IC 74LS08 QUAD3 IN AND GATE	1
311031	IC 74LS244 OCTAL 3-STATE BUFFER	2
311032	IC 74LS245 OCTAL BUSS TRANSCEIVER	1
311033	IC 74LS374 OCTAL D FLIP-FLOP 3-S	8
311037	IC 74LS32 QUAD2 IN OR GATE	1
311040	IC 74S00 SCHOTTKY QUAD NAND GATE	1
311041	IC 74S32 SCHOTTKY QUAD OR GATE	1
313021	IC 311 VOLT COMPARATOR/BUF LM311N	1
313024	IC TL084 QUAD BI FET OP AMP TL084CN	7

Oberheim number	Description	Quantity
313025	IC TL081 SING BI FET OP AMP TL081CN	8
313026	IC TL082 DUAL 81-FET OP AMP TL082	18
313046	IC TL074CN QUAD BI FET L NOI OP-AMP	6
313047	IC TL072CP DUAL BI FET L NOI OP-AMP	1
315013	IC 4016 QUAD MULTIPLEXER MC14016CP	6
315015	IC 74C174 HEX D FLIP-FLOP MM74C174	7
315024	IC 4053 TRI 2-CH ANAL MULT C04053BE	1
315025	IC 4051 ANAL MULTI-DEMUL TI CD4051BE	26
315029	IC 74C42 BCD-TO-DECIMAL DECODER	1
315052	IC 74C00 CMOS QUAD NAND	1
315056	IC 4053 TRI 2-CH ANAL MULT SIG ONLY	6
475250	RESISTOR FXD MT FLM 100 OHM 1% 1/8	12
475302	RESISTOR FXD MT FLM 1.00 K 1% 1/8	25
475340	RESISTOR FXD MT FLM 2.43 K 1% 1/8	1
475362	RESISTOR FXD MT FLM 4.22 K 1% 1/8	12
475385	RESISTOR FXD MT FLM 6.19 K 1% 1/8	1
475402	RESISTOR FXD MT FLM 10.0 K 1% 1/8	15
475405	RESISTOR FXD MT FLM 10.7 K 1% 1/8	1
475423	RESISTOR FXD MT FLM 16.5 K 1% 1/8	6
475425	RESISTOR FXD MT FLM 17.4 K 1% 1/8	1
475427	RESISTOR FXD MT FLM 18.2 K 1% 1/8	1
475440	RESISTOR FXD MT FLM 24.9 K 1% 1/8	6
475448	RESISTOR FXD MT FLM 30.1 K 1% 1/8	1
475452	RESISTOR FXD MT FLM 33.2 K 1% 1/8	18
475458	RESISTOR FXD MT FLM 38.3 K 1% 1/8	6
475469	RESISTOR FXD MT FLM 49.9 K 1% 1/8	24
475501	RESISTOR FXD MT FLM 100 K 1% 1/8	114
475525	RESISTOR FXD MT FLM 196 K 1% 1/8	6
475559	RESISTOR FXD MT FLM 422 K 1% 1/8	6
475587	RESISTOR FXD MT FLM 806 K 1% 1/8	12
478102	RESISTOR FXD 1/4W 2-5% 1 K	3
478103	RESISTOR FXD 1/4W 1-5% 10 K	69
478104	RESISTOR FXD 1/4W 2-5% 100 K	12
478105	RESISTOR FXD 1/4W 2-5% 1 MEG	54
478122	RESISTOR FXD 1/4W 2-5% 1.2 K	18
478123	RESISTOR FXD 1/4W 2-5% 12 K	12
478151	RESISTOR FXD 1/4W 2-5% 150 OHM	1
478152	RESISTOR FXD 1/4W 2-5% 1.5 K	1
478153	RESISTOR FXD 1/4W 2-5% 15 K	13
478183	RESISTOR FXD 1/4W 2-5% 18 K	6
478203	RESISTOR FXD 1/4W 2-5% 20 K	12
478222	RESISTOR FXD 1/4W 2-5% 2.2 K	1
478223	RESISTOR FXD 1/4W 2-5% 22 K	3
478273	RESISTOR FXD 1/4W 2-5% 27 K	6
478303	RESISTOR FXD 1/4W 2-5% 30 K	12
478332	RESISTOR FXD 1/4W 2-5% 3.3 K	18
478333	RESISTOR FXD 1/4W 2-5% 33 K	12
478364	RESISTOR FXD 1/4W 2-5% 360 K	12
478393	RESISTOR FXD 1/4W 2-5% 39 K	6
478471	RESISTOR FXD 1/4W 2-5% 470 OHM	12
478472	RESISTOR FXD 1/4W 2-5% 4.7 K	9
478473	RESISTOR FXD 1/4W 2-5% 47 K	25
478563	RESISTOR FXD 1/4W 2-5% 56 K	18

<u>Oberheim number</u>	<u>Description</u>	<u>Quantity</u>
478623	RESISTOR FXD 1/4W 2-5% 62 K	6
478681	RESISTOR FXD 1/4W 2-5% 680 OHM	13
478683	RESISTOR FXD 1/4W 2-5% 68 K	6
479003	RESISTOR NETWORK 4.7K SIP 10 PIN	3
479007	RESISTOR NETWORK 4.7K SIP 8 PIN	10
481001	DIODE SIGNAL 1N4148	34
482017	DIODE ZENER 6.9V LM329CZ	1
485003	TRANSISTOR SS NPN MPS5172	1
604950	WIRE 28 EXE 1-28	6

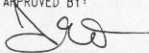
POWER SUPPLY:

<u>Oberheim number</u>	<u>Description</u>	<u>Quantity</u>
151024	CAP ALUM ELECT 15 25V RADIAL	4
151037	CAP ALUM ELECT 10000MF16V AXIAL	1
151041	CAP ALUM ELECT 22 100V RADIAL ESR	1
151042	CAP ALUM ELECT 100 25V RADIAL ESR	2
151043	CAP ALUM ELECT 1000 10V RADIAL ESR	1
151044	CAP ALUM ELECT 10000 25V AXIAL	1
153008	CAP MYLAR FLM .047 .4LS +/-10%	2
153009	CAP MYLAR FLM .47 .4LS	1
153014	CAP MYLAR FLM .0022 .4LS	1
153015	CAP MYLAR FLM .001 .4LS	3
180002	CHOK 20 MICRO HENRY 8103-LI INCON	1
219334	CONN PCMT 6 CKT F AMP 1-380999-0	1
261003	HEAT SINK TO-220 X 1/2" H 371	1
261009	HEAT SINK IERC 7-388-14X-BA	2
281018	SCREW 6-32X5/16 PHIL PAN BLK OX	2
281044	SCREW 6-32X1/4 PHIL PAN BLK OX	2
282009	NUT 6-32 W/LOCKWASHER KEPS CAD	4
289010	SOLDER LUG #6 SCREW CLEAR BT 1414-6	1
289045	CABLE TIE 7" OVERALL LENGTH 08470	1
313036	IC 7812 POWER REG +12V TO220	1
313038	IC LM7905CT POWER REG -05V TO220	1
313044	IC 7912 POWER REG-12V TO220	1
315057	IC SIGNET NE5561N SPRAGUE ULN8161M	1
474003	RESISTOR FXD WW 2W 5% .1 OHM BWH	2
475311	RESISTOR FXD MT FLM 1.24 K 1% 1/8	1
475353	RESISTOR FXD MT FLM 3.57 K 1% 1/8	1
478101	RESISTOR FXD 1/4W 2-5% 100 OHM	2
478102	RESISTOR FXD 1/4W 2-5% 1 K	2
478103	RESISTOR FXD 1/4W 1-5% 10 K	3
478203	RESISTOR FXD 1/4W 2-5% 20 K	2
478223	RESISTOR FXD 1/4W 2-5% 22 K	1
478224	RESISTOR FXD 1/4W 2-5% 220 K	1
478270	RESISTOR FXD 1/4W 2-5% 27 OHM	1
478272	RESISTOR FXD 1/4W 2-5% 2.7 K	3
478273	RESISTOR FXD 1/4W 2-5% 27 K	1
478392	RESISTOR FXD 1/4W 2-5% 3.9 K	1
478471	RESISTOR FXD 1/4W 2-5% 470 OHM	2
478473	RESISTOR FXD 1/4W 2-5% 47 K	1
481001	DIODE SIGNAL 1N4148	1
482003	DIODE ZENER 12.0V 10% 400MW 1N759	3
482018	DIODE MOTOROLA 1N4935, VARO TG4	4
482019	DIODE MOTOROLA 1N5823, VARO VSK520	1
483007	RECTIFIER MOTOROLA MR500, VARO V330	2
485006	TRANSISTOR SS NPN PN-2222	2
487009	TRANSISTOR PWR MOS IRF531 OR UFN531	1
561023	POWER XFMR 30 KHZ 8103-TI INCON	1
651869	XPANDER POWER SUP PCB ART 1870-1871	1
750182-0	CABLE SUB-ASSY OB-XPANDER #1	1
211072	CONN 8 CKT M W/ EARS AMP1-480283-0	1
930070	PRCHD OUTSD LABOR XPANDER CABLE #1	1
750183-0	CABLE SUB-ASSY OB-XPANDER #2	1
211072	CONN 8 CKT M W/ EARS AMP1-480283-0	1
930071	PRCHD OUTSD LABOR XPANDER CABLE #2	1
750184-0	CABLE SUB-ASSY OB-XPANDER #3	1
211072	CONN 8 CKT M W/ EARS AMP1-480283-0	1

ENGINEERING CHANGE ORDER

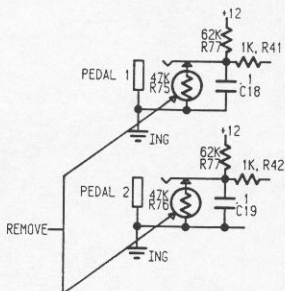
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XPANDER	XPANDER POT BOARD SCHEMATIC 1859 SHEET 1 OF 2	601

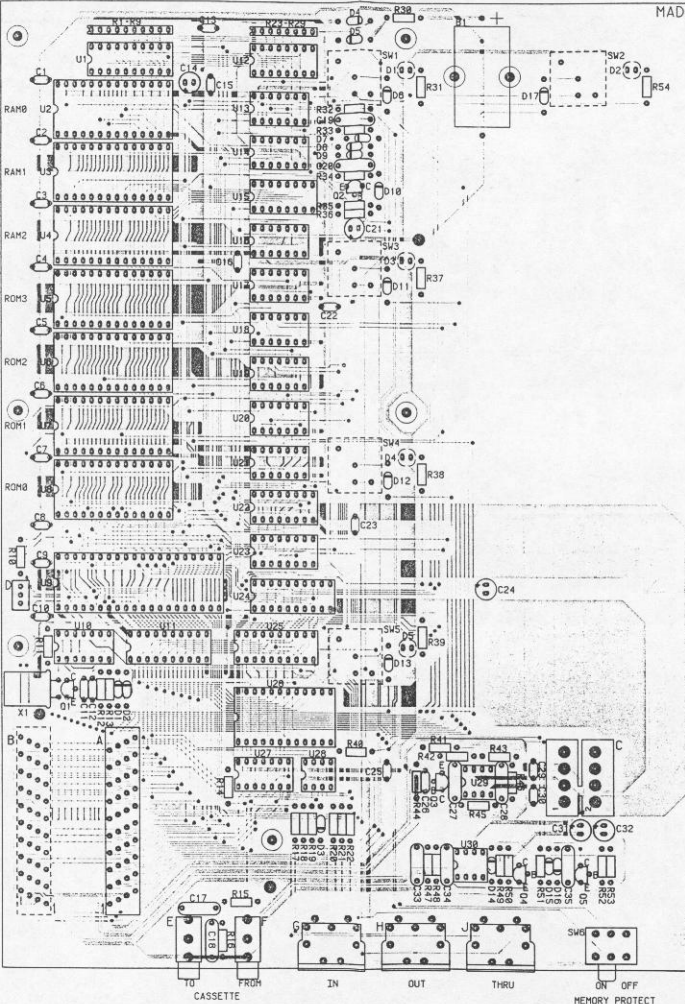
EFFECTIVITY:	REASON FOR CHANGE:
☐ AS REQUIRED IN TEST ☐ FUTURE PRODUCTION ☒ RETROFIT PRODUCTION AND INVENTORY ☐ RETROFIT IN FIELD ☐ AS NEEDED ☐ DRAWING CORRECTED ONLY ☐ _____	TO ALLOW PEDAL INPUTS TO BE SET AT MAXIMUM WHEN THE PEDAL JACKS ARE NOT PLUGGED IN.

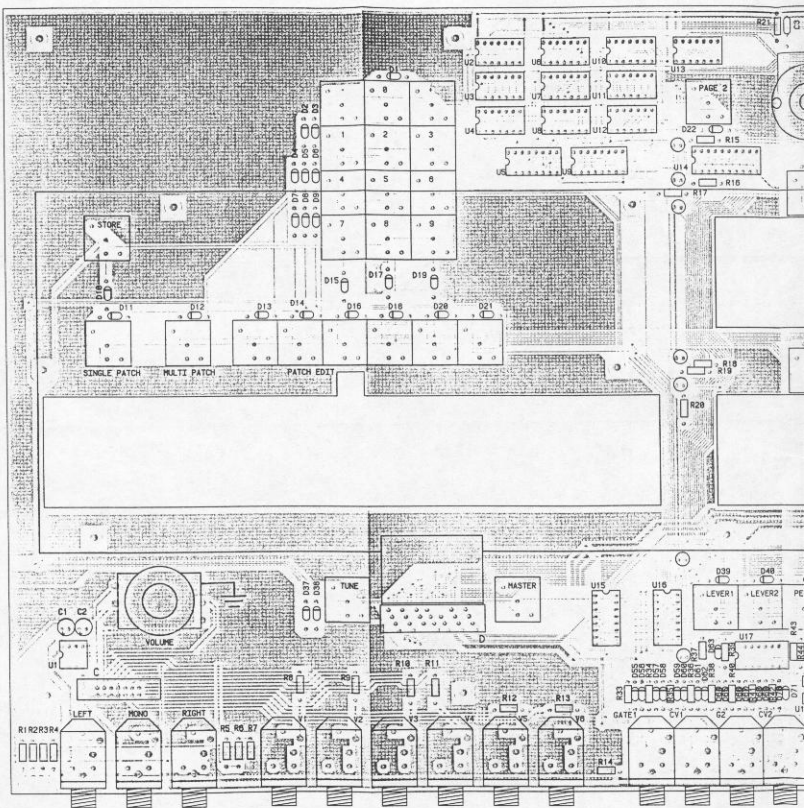
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MARAS	6/6/84		6/6/84

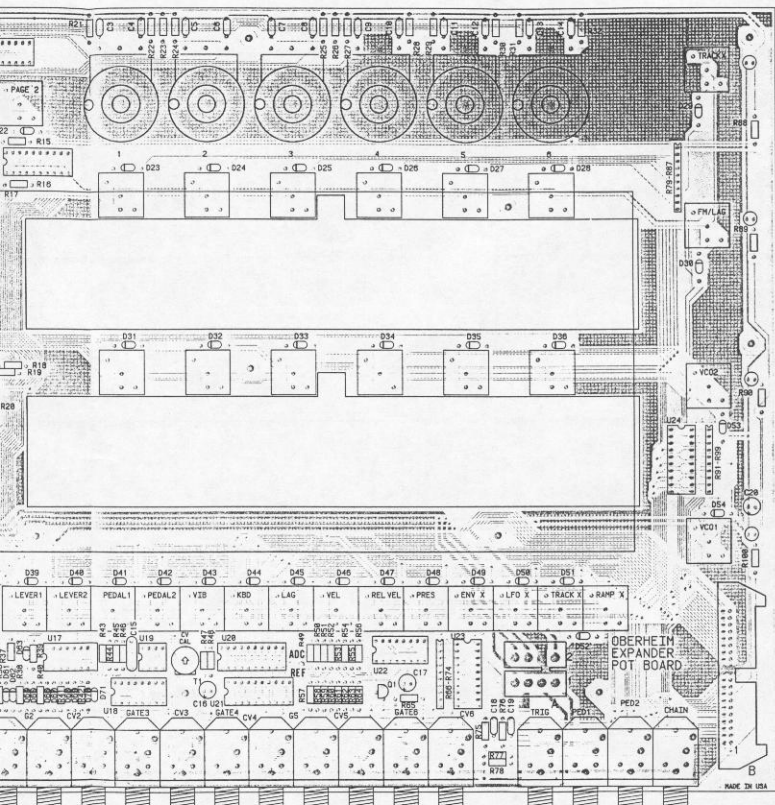
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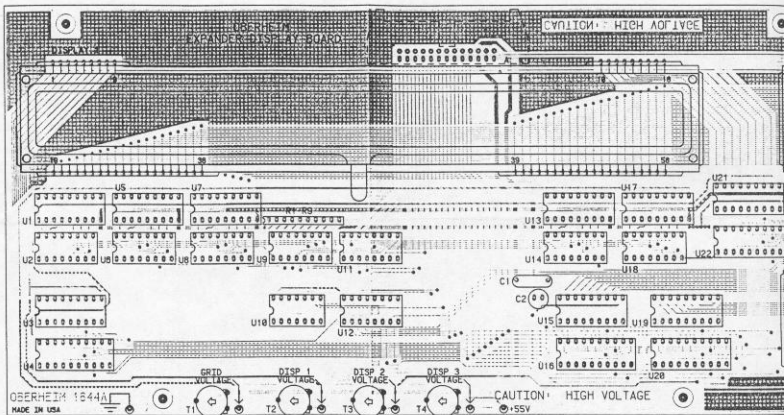
REMOVE 2 47K RESISTORS (OB. No. 478473)
 ON POT BOARD (ASSY. No. 720091),
 LOCATED AT R75 AND R76.

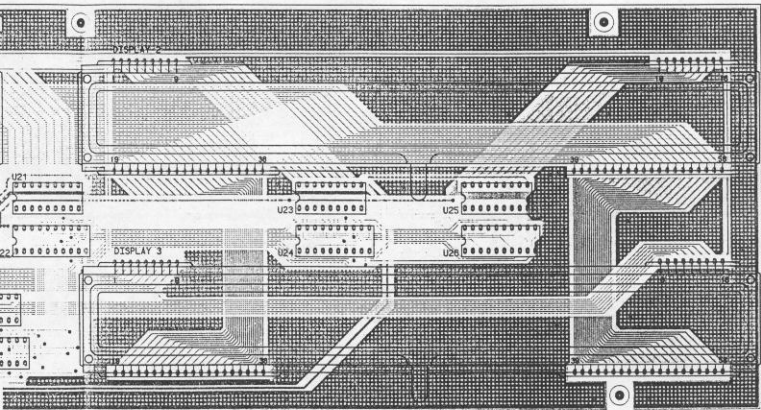


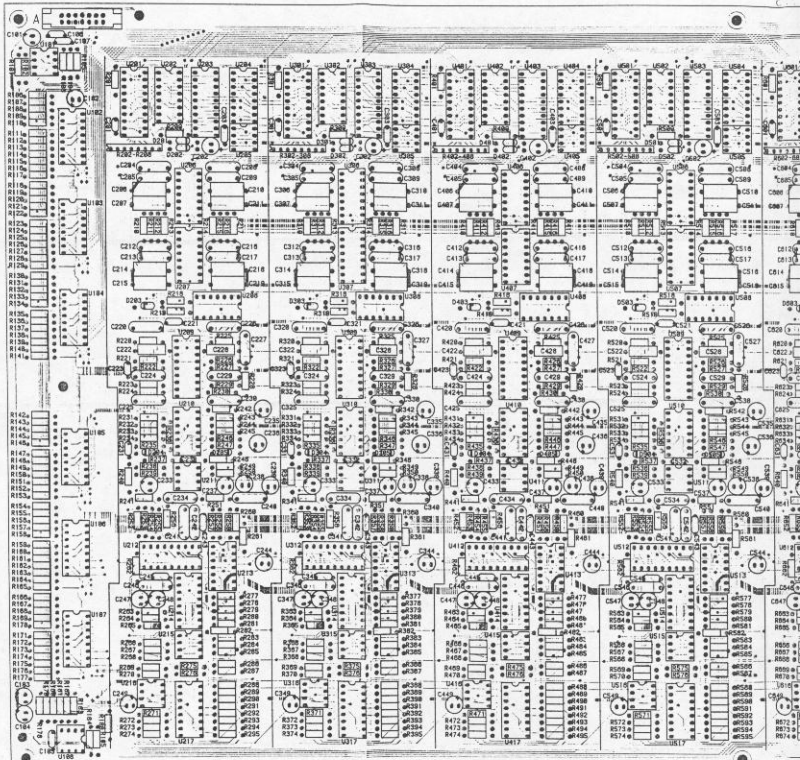


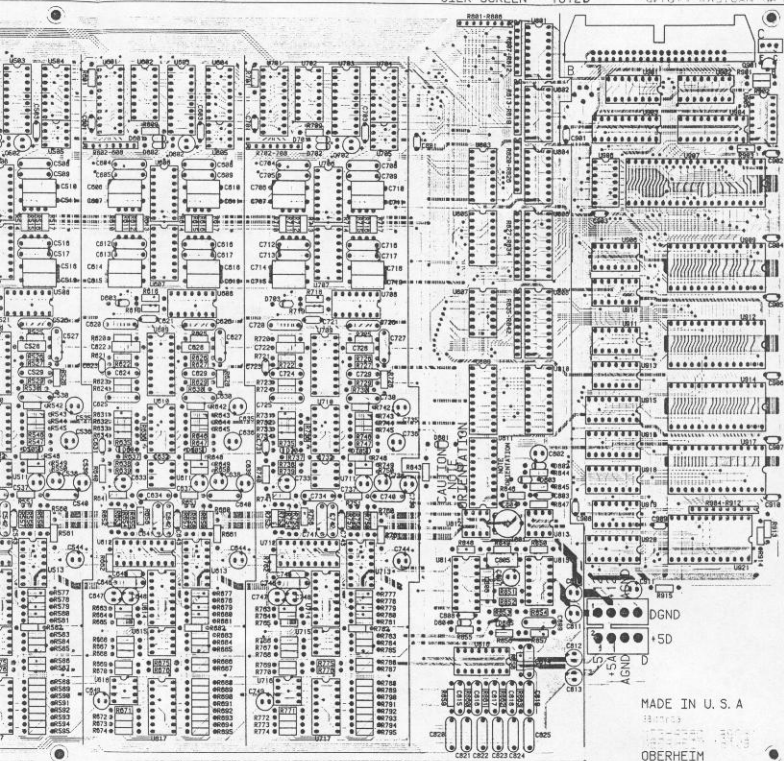


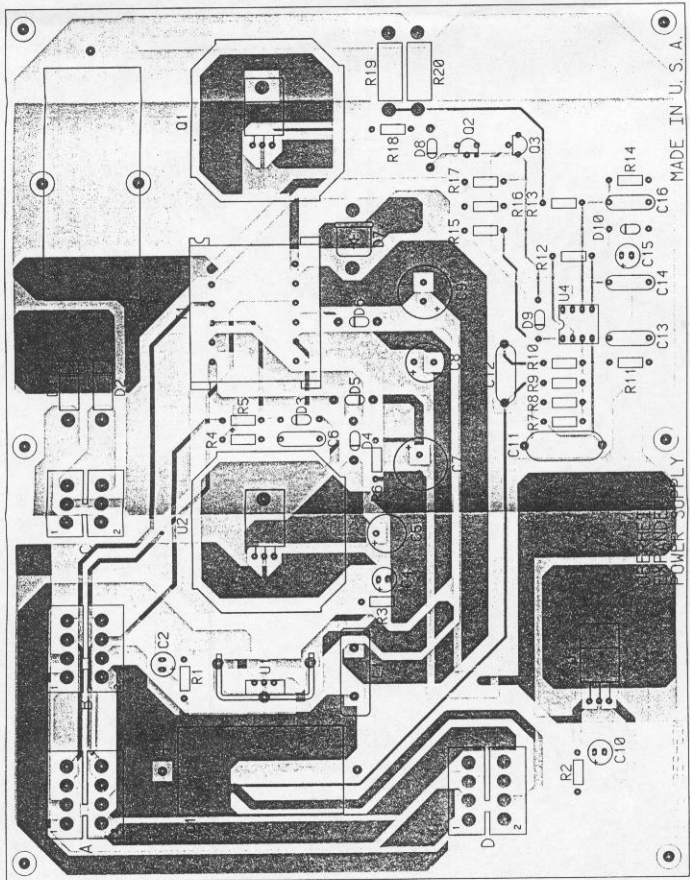












MADE IN U. S. A.

POWER SUPPLY

EXPANDED