LINN 9000 SERVICE MANUAL

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PART 1 - SERVICE INFORMATION

LINN 9000 SERVICE MANUAL

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I. POWER SUPPLIES

General Description

There are three DC power supplies in the 9000; +5 volts, +12 volts and -12 volts. The +5 volts powers all logic circuits, and the +/-12 volts powers the analog circuitry. All power supplies use linear series-pass regulators.

A. +5 Volt SUPPLY

The +5V supply consists of a full-wave rectifier (CR13 & CR15), a filter capacitor (C96), and a series regulator consisting of U90, Q5 and one of the 2N3055's on the rear heatsink through connector "C". Current sensing and limiting is provided by R66 and R67. Trimmer R70 provides output voltage adjustment, and should be adjusted to +5.1V, measuring from pin 40 of U10 to pin 20 of U10.

B. +/- 12 V SUPPLY

The +/- 12 V supplies consist of a full-wave diode bridge rectifier (CR8 - CR11), filter capacitors (C95, C97), and 2 series-pass regulators. The -12V regulator is a 3 terminal IC regulator (VR1). The +12V regulator is designed for higher current rating than the -12V regulator, to accomodate the floppy disk drive. The +12V regulator consists of a 723 IC regulator (U18) and a 2N3055 pass transistor mounted on the rear panel below the 5V heatsink through connector "D".

C. BATTERY CIRCUIT

A 3.6 V battery supply is provided to power the CMOS memory chips when the AC power is turned off, and thus provide a non-volatile memory for the unit. The battery consists of 3 Ni-Cad cells which are re-charged from the +5V supply, though diode CR7, when the AC power is turned on. The battery charging current is limited by R68. With AC power applied, the CMOS memories are powered directly through CR7 from the +5V power supply.

II. PROCESSOR AND SUPPORT CIRCUITRY

A. CPU

The microprocessor (U10) is an Intel 8088 16-bit CPU running at a clock speed of 5 MHz. Although this processor has an internal data width of 16 bits, there are only 8 external data lines. Therefore, all I/O is accomplished one byte at a time. In addition, the CPU data lines (D0 - D7) are multiplexed with address line A0 - A7. The processor provides control signals to de-multiplex the data and address lines (ALE, HLDA, DEN, DT/R). The processor also provides 20 address lines, allowing direct addressing of 1 Megabyte.

B. CLOCK GENERATOR / DRIVER

The system master clock is generated by a 15 MHz crystal oscillator consisting of inverters U89. Flip-flops U91 and 1 gate of U53 are configured as a divide by 3 to provide the system clock of 5 MHz, with the specified 33% duty cycle.

C. COUNTER / TIMER

The 8254 counter/timer chip (U36), provides 3 16-bit programmable timer/counters: Timer 0 is the clock which generates the tempo innterrupts that control the real-time playing and recording. The speed of this clock is proportional to the selected tempo; providing 48 clock cycles per 1/4 note, and is connected to interrupt request 3 of the interrupt controller (8259 U42). Timer 1 is used to generate the sync and cassette data signals. Timer 2 is connected to the interrupt controller on interrupt Request 1, and is not currently used.

II. PROCESSOR AND SUPPORT CIRCUITRY

D. POWER UP CIRCUIT

1. This power detection circuitry detects the presence or absence of AC power, and is used to reset the CPU and inhibit writing to the RAM's when the power is switched off, and put the CMOS RAM's into standby mode, so that they can be powered by the battery with minimal current consumption.

2. The circuitry works by detecting the AC power directly from the power transformer 5 volt secondary winding, and uses this signal reset the 8088 processor and to enable or disable the RAM address decoders.

3. The address decoders are high-speed CMOS devices which are powered from the battery. When AC power is not present, the decoders are disabled, thus pulling all RAM chip-select lines high, inhibiting operation and putting them in low-power standby mode. AC power from the 5v winding of the transformer is full wave rectified and smoothed by CR4, CR5, and C51.

4. This signal then charges C45 through R36 and R38. When C45 becomes charged (after timeconstant RC), it switches on Q2, which is also powered from the battery, enabling the RAM decoders. The large charging timeconstant RC is necessary to ensure that the power supplies have had time to come up and stabilize before enabling the RAM.

5. When AC power is removed, C45 discharges rapidly through CR3 and R37, turning off Q2 and disabling the RAMs before the stored charge on the front end to 5 volt supply has had time to decay below 4.5 volts.

II. PROCESSOR AND SUPPORT CIRCUITRY

E. DATA & ADDRESS BUSS BUFFERS

1. All data and address lines from the processor are buffered from the rest of the circuitry. All address lines and adress data (AD0 through A19) from the processor are fed to 745373 latches (U16, U15, U20) whose outputs are the put on the system buss.

2. The addresses are latched by ALE (Address Latch Enable) from the processor. This is necessary because address lines AD0 through A07 of the MPU are also used for Data Lines. In addition, the 4 most significant address lines (A16 through A19) generate control signals during part of the processor cycle, so the address lines must be latched to provide stable signals on the system address buss.

3. The data lines are buffered via a bi-directional buffer (U21). The data lines are terminated on the front panel circuit board by resistor packs RP2B amd RP3B.

4. The processor signal DT/R determines whether the buffer is inputing or outputing data. The data buss is additionally buffered from the counter/timer chip, the interrupt controller, and the MIDI usart by U52 (74LS245) and from the voice boards by U24 (74LS244). This is to isolate these devices from the main data buss because of their limited drive capability.

II. PROCESSOR AND SUPPORT CIRCUITRY

F. INTERRUPT CONTROLLER

1. The interrupt controller (U42) is used to priority encode interrupts from 8 different sources. Four (4) of the interrupt requests are dedicated, and the other 4 are available on the expansion buss connectors, and are currently not used.

2. The highest priority interrupt request comes from the MIDI USART. This is so that the MIDI data will not be lost due to other interrupts. The next highest priority interrupt is Timer 2, which is currently unused. Next is the sync interrupt, which comes from the external sync input, and lastly, the Tempo interrupt from timer 0 of U36, which controls the playing of the machine.

III. MEMORY AND DECODING

A. GENERAL COMMENTS

Sockets and decoding are provided on the processor board for up to 128 K of RAM. The 9000 comes stock with 32 K bytes, using 64 K bit chips. Memory expansion can be accomplished by adding 8 more 64 K RAM chips. There can also be expansion memory boards installed in the peripheral slots.

B. MEMORY DECODING

Memory decoding is accomplished via address decoders U40, U41, U86 and U28, plus gates U27 and U35. U86 and U27 gates provide chip-select signals for the EPROMs only. The rest of the decoders plus gates U35, provide decoding of the CMOS RAMs, and must be high-speed CMOS type, as they are powered from the memory back-up battery when power is off.

IV. DIGITAL I/O

GENERAL COMMENTS

U28 (74LS257) generates I/) read and write strobes plus memory read and write strobes from signals provided by the processor. These I/O strobes are then decoded into specific device addresses by U82, U73, U76 and U77.

A. DRUM TRIGGERS

Strobes VTRIG0* through VTRIG3* from U6 are used to generate the individual voice triggers from the data buss via U4, U5 and U9.

B. TRIGGER OUTS

Output strobes EXTR0* and EXTR1* from U73 trigger flip-flops U88, which are configured as one-shots with a pulse width of approximately 8ms. The outputs of the one-shots are buffered by Q3 and Q4 before going to the Trigger Out jacks J25 and J23.

C. CLICK

The Metronome Click Circuit (U8 and Q10 works in the same manner, the only difference being that the collector of the buffer transistor is fed by a control voltage, thus allowing the volume of the output to be controlled. Also, this output is AC coupled by capacitor C14, and filtered by C8.

D. FOOTSWITCHES

1. The state of the two footswitch inputs are read in through the two buffers of U3 when enabled by strobe CASSI* from U82. The jacks have pull-up resistors, so the footswitches must provide a momentary closure to ground.

2. The footswitches used must be normally open momentary type. The inputs to the buffers U3 are pulled up to +5 by R1 and R2. The footswitch shorts the line to ground when activated.

E. MIDI INTERFACE

1. The MIDI interface circuitry consists of a USART (U48), and gates U43, U32 and part of U37. Gates U43 and U32 plus R41 and C58 are required to generate the proper timing signals for the USART, which is designed for use with a 6800-type processor. This USART was chosen because it can operate at the high data-rate required by MIDI (31.25 Kbaud).

2. The interrupt line of the USART is connected to the highest priority input of the interrupt controller (U42). Both transmitting and receiving MIDI data generates processor interrupts. An interrupt is generated whenever there is MIDI data received which must be stored by the processor, and also when ever the USART is ready to transmit another MIDI byte.

3. The transmit output of the USART is buffered by U85, and sent to the MIDI OUT jack via R49. Incoming MIDI data from the MIDI IN jack is buffered via opto-isolator U84, and fed back to the MIDI THRU jack via buffers U85, as well as to the USART receive IN/OUT.

4. The clock signal for the USART (500 Hz) is generated by U49 and gate U37, which divides down the 5 Mz system clock.

F. CASSETTE/SYNC INTERFACE

The cassette and sync outputs are generated directly by the counter/timer U36. The various output levels are created by voltage divider R30, R28 and R27. Two volumes of cassette data are provided to accomodate different types of cassette recorders. The casssette and sync inputs are amplified by U14 and translated to 0-5 v by CR1, CR2, and U37. The data is then read onto the data buss by U3, using strobe CASSI*. Half of U26 provides a bias offset to opamp U14, when not in cassette mode, to improve noise immunity for the sync signal.

V. CONTROL VOLTAGE OUTPUTS

GENERAL COMMENTS

1. The volume and tuning of every drum, the volume of the click and the hi-hat decay times are all controlled by voltages generated by the processor.

2. The control voltages are generated by a digital-to-analog convertor/ The output of the convertor is multiplexed to 40 sample/hold circuits, which then feed the analog signals to specific control inputs on the voice boards.

3. The convertor itself actually consists of 2 DACs, U13 and U30. The DACs (DAC0800) are 8 bit linear multiplying type. The output of U13 is the product of its digital input (via U12) and its analog reference voltage, which is supplied by the other DAC (U30). U30's digital input is supplied by U31 off the system voice data buss. Thus, the final output of the convertor is the product of digital words DAC0* and DAC1*.

4. This multiplexing mode is used to set the volume of the drums: The signal DAC0* is the overall volume of the drum in the mix, as set by the volume sliders in the front panel or programmed mix. DAC1* is the relative volume of the touch-sensitive drumpad. The final volume is the product of the two. The output multiplexer consists of 5 4051's (U23, U34, U39, and U18).

5. The signal DAC2* provides the output channel number to the appropriate MUX via U25, which latches the data from the system voice data buss. Since the output channel of the multiplexer is directly addressable, control voltages are updated only as required, rather than constantly.

6. The 40 sample/hold circuits consist of FET input op-amps U22, U29, U33, U38, U45, U44, U1, U11, and U17 plus capacitors 31, 32, 33, 34, 44,, 41, 43, 42, 47, 48, 46, 49, 56, 53, 54, 55, 57, 68, 67, 50, 66, 63, 64, 65, 3, 5, 4, 6, 13, 10, 11, 12, 19, 18, 20, 17, 27, 30, 29, and 28. The outputs of the sample/hold circuits are routed directly to the voice board slots.

VI. FRONT PANEL CIRCUIT BOARD

A. TOUCH SENSITIVE DRUM PADS

1. The Linn 9000 employs a unique touch-sensitive playing pad which provides an output proportional to the force applied. One advantage of this over a velocity sensing device is that you can use the drumpads as controllers and input selectors, as well as just triggering drums. Erasing on the fly is an example of this application.

2. The transducers consist of a voltage divider, with one leg varying in resistance according to pressure. The fixed leg of the divider consists of resistor pack RP6B, or one of several discrete resistors. The variable leg is a conductive rubber contact. The rubber contact has a convex surface, and as more force is applied, the area and resistance of the contact are changed.

B. PANEL CONTROL A/D CONVERTOR AND MULTIPLEXING

1. The outputs of the 18 drumpads are multiplexed together, along with the DC control voltages from 19 of the 23 long travel sliders on the front panel, plus the hi-hat pedal input. (Master volume and Ext 1 and 2 are audio controls.)

2. The multi-plexer consists of 5 4051 CMOS 8-channel multiplexers (U11B, U5B, U10B U6B, and U7B). U8B, an octal latch, provides the channel adress, which it latches from the system data buss during command AD2*. The combined output from the multiplexers is buffered by voltage follower U4B, and fed to the input of an analog-to-digital convertor, U9B (ADC0804). The processor command AD0* starts a new conversion, and the command AD1* reads the data from the convertor.

VI. FRONT PANEL CIRCUIT BOARD

C. LEDs

The 5 LEDs on the front panel are driven directly by latch U1B, which takes its input off of the system data buss. The bits indicating LED "ON" (active low) are transferred from the buss by command LED*.

D. LCD

The Linn 9000 incorporates a 32 character backlit liquid crystal type alphanumeric display. The display itself is a self-contained module which accepts format ASCII and control commands data directly from the system data buss. Read and Write Commands DISPWR* and DISPRD* are supplied by the processor board I/O decoding circuits. Power for the backlight is supplied directly from the transformer primary via a current limiting resistor and cable. The resistor is part of the transformer harness and is covered by heat-shrink tubing.This is a 110V line (regardless of line voltage) and should be treated with caution.

E. AUDIO OUTPUTS

The audio outputs of the voice board's
inputs from the rear panel are routed to the front panel pan pots via ribbon cable "A". The external audio inputs are also run from the back panel through shielded cable under the processor board to the cable "A", and up to their front panel volume control sliders, which feed their respective panpots. The pan pots feed left and right summing busses and summing amps U12B. Immediately following is a dual-gang master volume control and output buffers with single-pole lowpass filtering.

F. PUSH-BUTTON DECODING

The push-button decoding consists of a 1-of-8 decoder, U3B, and an octal buffer, U2B. The normally open switches are read one column at a time, the column being selected by system address lines A0, A1 and A2. During input command KBD*, the processor reads in the status of one column of switches, which when open are pulled up to +5V by RP1B.

VII. VOICE BOARDS

A. GENERAL DESCRIPTION

The drum voices are generated by dedicated hardware located on the plug-in voice boards. Each voice typically consists of a VCO, a binary counter, an EPROM which holds the voice data, a digital-to-analog convertor, and output filters and buffers.

1. EPROM

The actual voice data is contained in 64K EPROMs as 8-bit sound samples. Although most voices fit into one 64K ROM, some voices use 2 or 4 EPROMs, depending on their duration.

2. D/A CONVERTOR

The sound samples from the EPROM are fed into the digital-to-analog convertor, where they are converted to analog sound signals. The AM6070 convertor is a non-linear companding multiplying type, so that the output level is proportional to the reference input voltage. This reference voltage is fed from a control voltage generated on the processor board to control the volume of that voice.

3. VCO

A 556 timer generates the clock signal used to read out the voice data. The frequency of the clock determines the pitch of each voice. The control voltage input of the 556 is fed from a control voltage generated on the processor board so that the processor can control the pitch of the drums. The timing resistors and capacitors on the TOM and CONGA boards must be 1% values to prevent noticeable pitch differences between successive strikes of the same drum sound.

4. ADDRESS COUNTER

1. The sequential addresses of the voice data in the EPROMs are generated by a 4040 12-bit binary counter, plus one or more flip-flops, depending on the amount of voice data. The EPROMs and the output of the D/A are disabled by the last stage of the counter chain when the drums are not sounding to conserve power.

2. This signal also gates off the clock from the 556 to the first stage of the counter chain to stop the sound from playing again. Triggering causes a reset of the counter chain, reseting the last stage and gating the clock on.

5. AUDIO OUPUT

1. The D/A convertor provides a differential current output, which is converted to a voltage by a FET-input opamp. In most cases, this opamp is configured as a two-pole low-pass filter, to smooth the discrete output of the D/A convertor.

2. The toms and congas use instead a 4-pole voltage controlled low-pass filter to smooth the output. The voltage controlled filter's cutoff frequency is controlled by an envelope generated by a flip-flop, a transistor, and an RC time constant. This dynamic filtering provides emphasis for the attack of the drum, and optimal filtering for the sustained decay.

3. The audio output of the filter is buffered with an op-amp and split; one feed goes to the stereo mixer on the front panel circuit board, via cable and connectors A on the processor and front panel board. The other feed goes to the rear panel jack mounted on the board.

6. DMA INPUT/CONTROLS

Each voice circuit has a data buffer which connects between the data of the D/A convertor, and the voice data lines of the processor board. This 74LS374 can read data off the voice data buss, and latch it to the D/A convertor. When operating in this mode, the outputs of the EPROMS must be disabled to avoid a conflict on the data lines. This is accomplished with signals MODE1* and MODE2* from the processor board, which clocks a 74LS74 flip flop which enables the 74LS374 and disables the EPROMs. The flip flop is provided with a data input from one of the voice data lines.

DMA Select Assignments

Drum	MODE *	Voice Data Line	Option Jumpers
Snare/Stick	MODE1*	VD1	
Bass	MODE1*	VD0	
Hihat	MODE1*	VD2	
Toms	MODE1*	VD4	Jumper W1A
Ride	MODE1*	VD6	Jumper W4A
Crash	MODE1*	VD7	Jumper W4B
Conga	MODE2*	VD4	Jumper W1B
Cowbell	MODE2*	VD2	
Clap	MODE2*	VD3	
Tambourine	MODE2*	VD0	
Cabasa	MODE2*	VD1	

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MAP OF SAMPLE AND HOLD DEVICES TO CONTROL VOLTAGE FUNCTIONS

ANALOG SWITCH (DEMULTIPLEXER)	OUTPUT PIN	HOLD CAPACITOR	OP AMP & INPUT PIN	CV FUNCTION
U2	4	C3	U1,12	SNAR VOL.
	2	C5	U1,5	SSTK TUNE
	5	C4	U1,10	BAS TUNE
	1	C6	U1,3	BAS VOL.
	12	C13	U7,10	HAT VOL.
	15	C10	U7,5	SNAR TUNE
	14	C11	U7,3	SSTK VOL.
	13	C12	U7,12	HAT DECAY
U18	4	C19	U12,3	CLICK VOL.
	1	C17	U11,10	TOM1 VOL.*
	12	C27	U17,10	RIDE1 VOL.
	15	C30	U17,5	TOM2 VOL.*
	14	C29	U17,3	TOM2 TUNE*
	13	C28	U17,12	TOM1 TUNE*
U23	4	C32	U22,3	RIDE2 TUNE
	2	C33	U22,12	RIDE1 TUNE
	5	C31	U22,5	RIDE2 VOL
	1	C34	U22,10	CRSH1&2 VOL
	12	C44	U29,10	CGA1 VOL *
	14	C42	U29,3	CRSH1&2 TUNE
U34	4	C47	U33,3	CGA1 TUNE*
	2	C48	U33,12	CGA2 TUNE*
	5	C46	U33,5	CGA2 VOL*.
	1	C49	U33,10	TAMB VOL
	12	C56	U38,10	CLAP TUNE
	15	C53	U38,5	COW TUNE
	14	C54	U38,3	CABA VOL.
	13	C55	U38,12	CLAP VOL
U39	4	C57	U45,10	HAT TUNE
	2	C68	U45,3	DI1A1 TUNE
	5	C67	U45,5	DI1A3 TUNE
	1	C50	U45,12	DI1A2 TUNE
	12	C66	U44,10	DI1A0 TUNE
	15	C63	U44,5	CABA TUNE
	14	C64	U44,3	TAMB TUNE
	13	C65	U44,12	COW VOL

*TOM1 & TOM2 HERE REFER TO THE TWO CHANNELS ON THE TOM CARD. THERE ARE NOT INDIVIDUAL C.V.s FOR EACH OF THE FOUR TUNINGS. THE TWO CHANNELS ARE ALLOCATED TO PLAY THE TWO MOST RECENTLY PLAYED TOMS REGARDLESS OF WHICH TUNING, VOLUME OR DIRECT OUTPUT IS TO BE USED. THIS IS ALSO TRUE OF THE CONGAS, i.e. EITHER CONGA CAN BE GENERATED BY EITHER CHANNEL. PITCH MISMATCHES BETWEEN SUCCESSIVE STRIKES OF THE SAME TOM OR CONGA ARE USUALLY CAUSED BY MISMATCHES OF TIMING RESISTORS, CAPACITORS OR TIMER I.C. ON THE TOM OR CONGA CARD ITSELF.

(OVER)

TROUBLESHOOTING PITCH DRIFT: PITCH DRIFTING IS CAUSED BY EXCESSIVE LEAKAGE OF THE SAMPLE AND HOLD CIRCUITS. FIRST, INSTALL A 1K ohm RESISTOR ON THE ASSOCIATED ANALOG SWITCH DEMULTIPLEXER (4051) FROM ITS PIN 16 TO PIN 6. NEXT, CLEAN ENTIRE AREA OF THE PROCESSOR BOARD WHERE THE CV DMULTIPLEX CIRCUITRY IS. NEXT, REPLACE THE ASSOCIATED OP AMP AND HOLD CAPACITOR. IF THIS FAILS, REPLACE THE ASSOCIATED ANALOG SWITCH. NEXT, TRY TO FIND ANOTHER CV THAT WHEN CHANGED AFFECTS THE CHARACTERISTICS OF THE ONE THAT DRIFTS AND PULL UP PIN 6 OF OR REPLACE ITS ASSOCIATED ANALOG SWITCH. ALWAYS THOROUGHLY CLEAN ANY FLUX OR OTHER CONTAMINANTS AFTER REPLACING ANY PARTS IN THIS CIRCUIT. HUMID ENVIRONMENTS WILL ADVERSELY AFFECT THE STABILITY OF THIS CIRCUIT. IN THESE CASES, CLEANING THE BOARD IS OFTEN ENOUGH TO REMEDY THE PROBLEM.

IN CASES WHERE THE PITCH IS ERRATIC OR EXHIBITS SUDDEN JUMPS, SUSPECT INTERACTION BETWEEN ANALOG SWITCHES, OR INSUFFICIENT DRIVE FROM U25. THIS CAN BE HELPED BY PULLING IT'S OUTPUTS UP TO +5V WITH 1K ohm RESISTORS, OR REPLACING IT WITH A 74HCT374.

B. ADDITIONAL CIRCUITRY

1. HI-HAT DECAY

1. The hi-hat voice has an envelope generator to create variable "open" or "closed" volume envelope. The circuit consists of a flip flop that generates a pulse, 2 transistors, a capacitor and an op-amp, which provide a voltage controllable decay time, so that the decay envelope of the hi-hat can be controlled via a control voltage from the processor board.

2. The decay also lenthens slightly with higher control volume voltages for more natural dynamics. The combined volume and decay envelope signal is fed to the reference input of the DAC.

2. MEMORY TYPE SELECTION JUMPERS

The Bass, Snare/Stick, cowbells, clap, tambourine and cabasa voices have option jumpers to select between 2764 EPROMS or 2732 EPROMS such as those used in the LinnDrum.

Revision	Drum	2764	2732
REV 1*	Snare/Stick	W3B	W3A
REV 1	Bass	W1B, W2A	W1A, W2B
REV A	Snare/Stick	W1B	W1A
REV A	Bass	W4A, W5B	W4B, W5A
	Cowbell	W7B, W8A	W7A, W8B
	Clap	W1A, W2B	W1B, W2A
	Tambourine	W5A, W6B	W5B, W6A
	Cabasa	W3A, W4A	W3B, W4B

VII. VOICE BOARDS

B. ADDITIONAL CIRCUITRY

3. ALTERNATE TOM/CNGA TRIGGERS/DECODING

The toms and congas use a special switching scheme which allows the drum to be re-struck without cutting itself off. For the congas, there are two voice generators, and two outputs. The toms have two voice generators and four outputs. Any output can be fed from either of the voice generators. The processor always triggers the least recently used voice generator, and routes its output to the appropriate channel. This is accomplished by 4013 latches, which read voice data lines VD1 & VD2 from the processor. These data bits are then used to select the correct channel of the 4052 output de-multiplexers.

4. CYMBAL CIRCUITRY

The cymbal board can be configued in one of two ways: one configuration is used for the ride cymbal, and one for the crash. When the "dual" and "ride" jumpers are installed, the voice will play from the first 4 EPROMS or from the last 4, depending on whether TRIGA or TRIGB is exerted. In addition, the audio output is switched to the corresponding output jack. In the case of the crash cymbal, the memory is configured to play the entire 8 ROMS on either trigger. The cymbal counter ciruit is extended with flip-flops U7, U5, U2 and gate V4. Memory chip selection is generated by decoder U10.

C. EXTERNAL TRIGGER INPUT BOARD

1. INPUT BUFFERS/RECTIFIERS - PEAK HOLD CIRCUIT

The input buffers and full wave rectifiers consist of quad op-amps U13 (inputs #1 and #2), U12 (inputs #3 and #4) and U11 (inputs #5 and #6). Each input uses two op-amps, one producing a non-inverted output and the other an inverted output. Each output is half-wave rectified by one of diodes D1-D12. The two half-wave outputs are tied together to produce a full wave rectified signal. Each output charges one of peak hold capacitors C6-C11, and is presented to an input of the A/D input multiplexer and the discharge multiplexer.

2. A/D INPUT /DISCHARGE MULTIPLEXER

The A/D input multiplexer consists of a 4051 analog switch U9 and A/D input buffer U8. One of the six trigger inputs is selected by the address lines on pins 9, 10 and 11. The charge on that input's capacitor is then read by the A/D convertor U6. The address lines are latched by flip flops U3 and U4 on command of the I/O decoder consisting of flip flop U1, gates U2 and U5, and the option jumper W1. The jumper determines whether the board will be inputs 1-6 or 7-12. The outputs of the flip flops are buffered by transistor circuits comprised of R2, R4, R5, R8-10 and Q2-4.

Upon completion of the A/D conversion, the A/D convertor sends a signal (buffered by R1, R7 and and Q1) that enables the discharge multiplexer U10, which discharges that inputs hold capacitor to ground.

3. A/D CONVERTOR

The A/D convertor is an ADC0804 8 bit linear convertor U6. A conversion is started by the I/O decoder's output inverted by gate U2. This also enables the output of data latch U7, which puts the A/D data on the data buss. When the conversion is complete, the A/D convertor sends a conversion complete signal, which is inverted by gate U5. This signal latches the new data into U7, and enables the discharge multiplexer, as detailed above. The convertor requires a 1.25 mHz clock, which is divided down from the 5 mHz system clock by flip-flops U1 and U4.

D. DMA CARD

1. The DMA card uses a 3237 DMA Controller Card U14 to support up to 4 channels of custom drum sounds. Data for the sounds is transferred from system memory directly to the voice cards via the voice data buss. Each of the four DMA channels has an associated 556 timer (U2, U4) and half of 74LS74 flip flop (U1, U7, U10) which control the transfer rate of the data, and therefore the pitch of the custom sound being reproduced. The 8237 receives a 5mHz clock, which is inverted by gate U18. This signal also clocks a flip flop (U1), which synchronizes the DMA hold request with the system timing.

2. Each 556 timer receives a tuning control voltage from the control voltage de-multiplexer on the processor board (DVC0-DVC3). The timing capacitors (C1, C2, C3, C4, C5) must be 5% values to ensure accurate tuning. The circuit consisting of gates U18, U21 and the higher number pins of U22 control the direction of the data transfer through U13 (74LS245), which allows the processor to write data to the DMA's status control registers. The circuit consisting of gates U19 and the rest of U22 decode I/O addresses in the range of 90-9F (H) to enable the chip select of U14. Further decoding for the individual registers is performed internally to U14.

3. The address of memory read out to the voice data buss is placed on the system adress buss by 3237 via U13 for address A0 to A7 and via U16 for A8 to A15. U20 (74LS670) is a 4 x 4 register file that is loaded with addresses A16 to A19. Each of U20's four registers contains the most signifigant address bits for one of the four DMA channels. U19 provides U20 with an address based on which channel is requesting DMA, causing that channel's register to be used for A16 to A19. Decoding for the register file is performed by U15 (74LS138). Data to be loaded into the register file (which will be used as A16 to A19) is supplied by data bits D0 to D3, and data bits D4 and D5 select which register the data is to be written to.

4. Decoder U15 also decides for latches U11 & U12, which receive data from the data buss via U 23. The outputs of these latches are fed to the four DMA latch selectors (74LS156, U5, U6, U8, U9). These perform the function of assigning a DMA channel to an individual voice output by routing DMA acknowledge signals from the four channel of the 3237 (via gates U3) to a DMA latch on one of the drum voice cards. These signals complete the DMA transfer by latching the data on the data buss into the DMA latch on the voice card. The data is coming from memory locations indicated by the address supplied by the 8237 via U13, U16 and U26.

A. OPERATIONAL OVERVIEW

1. The Linn 9000 operates in one of two MODES - DRUMS or SYNTH. In DRUMS MODE, you can select, record, or edit only drum sequences, while in SYNTH Mode you can select, record, or edit only synth sequences. The 9000 will remember 50 drum sequences, numbered 00 through 49, and 50 synth sequences, also numbered 00 through 49.

   Mode selection does not affect playback. When PLAY is pressed, the presently selected Drum and Synth Sequence numbers will both play. You won't be able to record or hear the playback of SYNTH sequences, however, unless your MIDI-equipped synthesizer is correctly connected to the Linn 9000, using MIDI cables (5 pin DIN plugs).

   Changing the sequence number while in DRUMS mode changes only the DRUM sequence playing, so you may enter DRUMS mode to try several drum sequences against one synthesizer sequence. The display screen gives the user information relevant to the drum sequence presently playing.

   Changing the sequence number while in SYNTH mode changes only the SYNTH sequence playing, so that you may try several SYNTH sequences against one drum part. The display screen gives the user information relevant to the synthesizer sequence playing.

2. The SELECT SEQUENCE Option is the normal operating mode of the machine - playing or stopped - unless another option is selected. This mode displays the most commonly needed information on the display screen. In the two different MODES - DRUMS or SYNTH - the SELECT SEQUENCE Option will display different information, pertinent to the DRUM or SYNTH sequences.

3. The front panel of the Linn 9000 is divided into four sections: the Mixer Section, the Touch Sensitive Drum Pad Section, the Option Buttons Section and the Controls Section.

   a. The TOUCH-SENSITIVE DRUM PADS and Hi Hat Decay controls are used to play the digital drum sounds, and offer you a wide degree of creative control over your drum patterns. The pads are both velocity and pressure sensitive.

   b. The MIXER controls the volume and stereo placement of the individual drums.

   c. The OPTIONS are used to record, play and edit drum and synth sequences, as well as to display or change any operational parameters.

   d. The CONTROLS include the Display, which gives the user information and explains the options, the keypad, which accepts input from the user, and the transport controls, which emulate those of a multi-track tape deck in recording and playback of drum and synth sequences.

B. Hooking Up the Linn 9000

1. To a Mixer/Amplifier

1. Making sure that the power switch on the rear panel is off (the bottom half of the red button DOWN), then plug the Linn 9000 into an appropriate AC power source. Turn the POWER on.

2. Using 1/4" mono phono plugs, connect the LEFT or RIGHT or both AUDIO OUT jacks to a mixer or amplifier. (See Figure 1) Adjust the volume level of your amplifier to a comfortable average volume, to prevent damage to your speakers.

3. You can also amplify individual drums separately from the Left and Right stereo mix outputs, by using 1/4" mono phono plugs to connect the outputs labeled with individual drum names to your mixer/amplifier.

4. Two External Audio Inputs are also provided. You can hook up two ouputs from a mixer, synthesizer or other line out source to the 1/4 " mono phono inputs on rear panel of the 9000 marked Audio Inputs Ext 1 and Ext 2. These audio signals will be mixed with the drums into the Left and Right Audio Outputs. You can control the volume and stereo placement of these outputs from the sliders marked Ext 1 and Ext 2 on the front panel of the Linn 9000. For a complete description of all jacks on the rear panel, please see Section 7, "Rear Panel Connections/Controls".

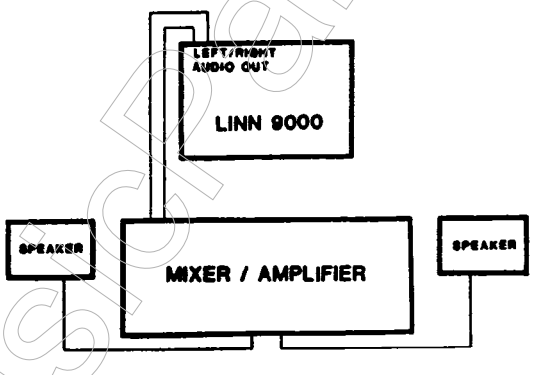


Figure 1: Hooking up the Linn 9000 to Mixer/Amplifier

5. Move the MASTER VOLUME slider to its mid position. The lower set of sliders controls the volumes of the individual drums - the sliders' positions indicate the drums' volumes. To change the relative volumes (the mix) of the drums, move the sliders up or down. This is the normal operating mode of the 9000's mixer (if the Drum Mix Status Option is set to Manual). If you wish, however, the mix can be programmed. For information on programming the drum mix, see the Section 3 for a description of the Drum Mix Status Option.

6. The PAN sliders control the placement of the individual drums in the stereophonic mix. Move them towards the center if you wish to achieve a monophonic mix.

B. Hooking Up the Linn 9000

2. To One or More MIDI Synthesizers

1. Connect the Linn 9000 to a power source and mixer amplifier as explained and illustrated on the previous page.

2. Use MIDI cables (5 pin DIN connectors) to connect the MIDI OUT jack of your MIDI equipped synthesizer to the MIDI IN jack on the Linn 9000, and the MIDI IN jack of your synthesizer to the MIDI OUT jack of the Linn 9000. This is illustrated in Figure 2.

3. To connect more than one synthesizer to the Linn 9000, connect MIDI THRU jack on Synth 1 to the MIDI IN jack on Synth 2, and so on to "daisy chain" any number of synthesizers. If your MIDI synthesizers are not equipped with MIDI THRU Jacks, then you can set up your synthesizers in a "pseudo-star" configuration using a MIDI Thru Box. These configurations are illustrated in Figure 3.

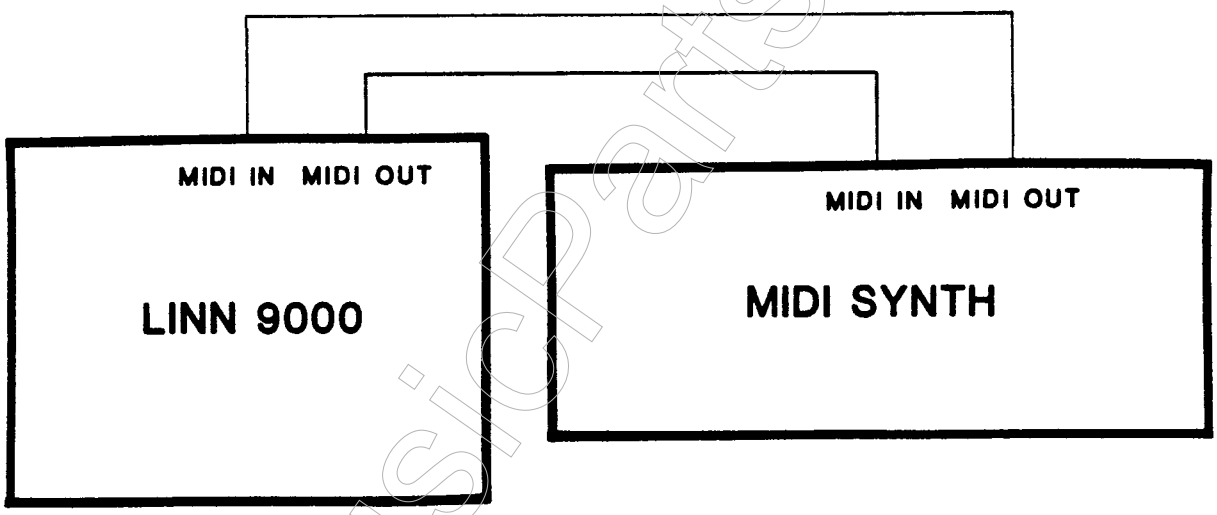


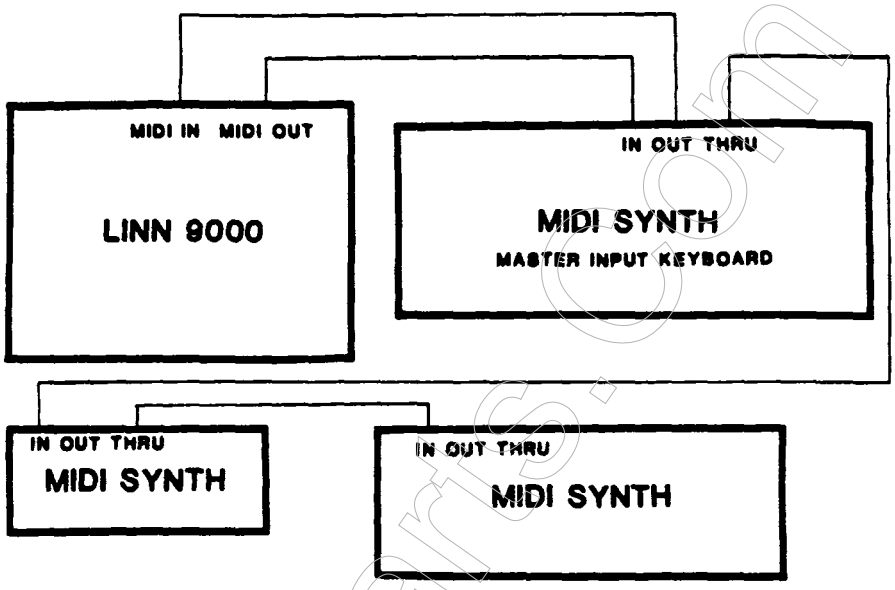
Figure 2: Connecting the 9000 to 1 MIDI Synth

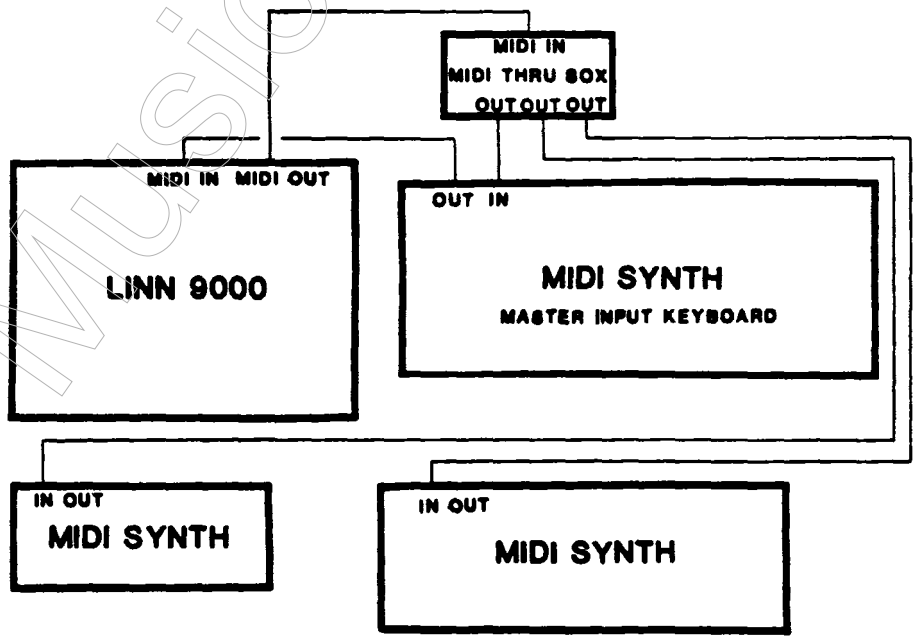
4. You can use the 9000 to control any number of MIDI synthesizers. However, you can only record sequences on the 9000 from one keyboard at a time - your Master Input Keyboard. You will probably want to record your sequences with a velocity and pressure sensitive keyboard. This will give you the option of recording synth sequences with dynamics, then assigning these sequences to be played by other MIDI synths or expansion modules that respond to this information.

B. Hooking Up the Linn 9000 (Continued)

Figure 3: Daisy Chain and "Pseudo-Star" MIDI Configurations

Daisy Chain Configuration





"Pseudo-Star" Configuration

C. QUICK START

Playing the Drum Pads

1. Once you've connected the Linn 9000 to a mixer amplifier as explained in the preceeding pages, you can begin playing the drum sounds and the preset drum sequences.

2. Adjust the volume sliders so that they are set to about 2/3 of the maximum volume. Tap the touch-sensitive drum pads to play the drums.

3. The pads are touch sensitive, so you can play the drums dynamically. You can adjust the touch sensitivity by using the ADJUST PAD DYNAMICS option. You can go from no touch sensitivity to full touch sensitivity as you become accustomed to the "feel" of the pads. See the description of the ADJUST PAD DYNAMICS option in the reference manual if you have questions about adjusting the sensitivity.

Playing the Preset Drum Sequences

1. Press the "Drums" Mode button. The LED next to this button will light, indicating that you are in "Drums" Mode.

2. Press the button marked "Play" on the front panel of the Linn 9000. You will hear the first preset drum sequence, number 00. Synth sequence 00 will also play, but you will not hear it unless you have your MIDI synth properly connected and set to receive on MIDI Channel 1.

3. The Linn 9000 comes with 44 factory preset drum sequences. You may change the currently selected drum sequence number in one of two ways:

   a. Use the Up Arrow/Down Arrow keys. Press the Up arrow key to change from drum sequence 00 to 01, then the Down Arrow Key to change from drum sequence 01 to 00.

   b. Use the number keys to choose a new sequence number.

4. While the drum sequence is playing, hold the Repeat button and press any drum pad. The drum will repeat as long as you hold both the pad and the Repeat button. By pressing harder or softer on the drum pad, you can create dynamic drum rolls.

5. While you change drum sequences, the last synth sequence selected will continue playing independently of the drum sequence you select.

6. Press the button marked Stop when you want to stop the playback of all sequences.

C. QUICK START

Playing the Preset Synth Sequences

1. Connect one or more MIDI synthesizers as explained in the previous pages. Set them to Omni Mode, or Poly Mode, receiving on MIDI Channel 1. Poly Mode is preferable, because you can assign different synths to different MIDI Channels.

2. Press the "Synth" Mode button. The LED next to this button will light, indicating that the 9000 is in Synth Mode.

3. Press the "Play" button. The first preset synth sequence, number 00, will play. There are seven preset synth sequences in the Linn 9000, numbered 00 to 06. The last selected drum sequence will also play.

4. You can change the currently selected synth sequence number in one of two ways:

   a. Use the Up Arrow/Down Arrow keys. Press the Up arrow key to change from synth sequence 00 to 01, then the Down Arrow Key to change from synth sequence 01 to 00.

   b. Use the number keys to choose a new sequence number.

4. While you change Synth sequences, the last selected drum sequence will continue playing independantly of the synth sequence you select.

5. Press the button marked Stop when you want to stop the playback of all sequences.

C. Understanding the Display, Keypad and Transport Controls

1. Because the display, keypad and transport controls are unique to the Linn 9000, it is important for the user to understand the features of these controls and indicators.

The Display

1. The display is a 32 character alphanumeric LCD, and displays information relative to the operation currently being performed by the 9000. Since the 9000 features a number of options, there are a large number of display screens, each containing different information. However, most display screens will share some characteristics, explained below:

Figure 4: The Display Screen

a) The Cursor - The cursor is a small underline indicator on the display screen that shows the user which value he or she is choosing or changing. When the Linn 9000 is waiting for the user to enter a value, the cursor appears as a blinking square These "values" may be bar numbers, numbers of quarter notes, sequence numbers, tempo values or other units, depending on the option screen presently being displayed.

b) Cursor Prompt Arrow - This arrow will appear at the right edge of the screen in some options, when the cursor movement keys must be pressed to advance the option to its next screen. The direction that the arrow points is the way the cursor can or should be moved to complete the operation started when the option button was pushed.

The Keypad

1. The 16 key keypad is what you will use to enter information into the Linn 9000. In addition to the 10 number keys, this keypad contains 6 special keys used in telling the 9000 what to do:

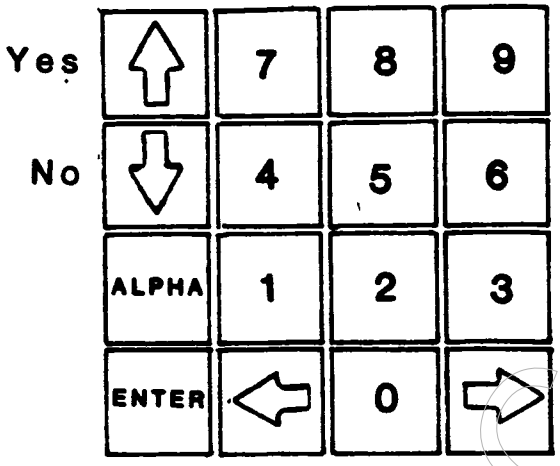


Figure 5: The Keypad

a) **Yes/Up Arrow, No/Down Arrow Keys:** These keys can be used to answer Yes/No (Y/N) questions that the Linn 9000 will ask the user - press the Yes/Up Arrow key to answer a question Yes, or the No/Down Arrow key to answer a question No. For example, if you are entering a new time signature for a sequence, the display will ask if you wish to erase the old sequence (Y/N). You will press the Yes/Up Arrow key to answer Yes, if you wish to have the old sequence erased.

Some options (like Insert/Copy/Merge) offer several choices that cannot be displayed on one screen, and in these options, you will use the Up/Dn keys to move between these choices.

Another use for the Yes/Up Arrow, No/Down Arrow keys is to increase or decrease the value that appears in screens. This is particularly useful for the ENTER TEMPO Option, as it allows you to increase (or decrease) the tempo in increments of 1 or 0.1 BPM, until you reach the perfect tempo. You can also change the sequence number in this fashion, moving from sequence number 01 to 02 by pressing the Yes/Up Arrow key, or from sequence number 49 to sequence number 48 by pressing the No/Down Arrow key.

For the sake of brevity, these keys will be called the Up/Dn keys for the rest of the manual.

b) **Alpha key** - This key changes the option button labeled A through Z to their alphabet functions, and is used in naming sequences.

c) **Enter** - In the instructions that follow, you will often be asked to "Enter" a number. Often (but NOT ALWAYS), you will need to press the "Enter" key to let the 9000 know that you have made a decision. You will only need to use the "Enter" key to "enter" a number when that number can be two or more digits. There is one exception to this rule: The Sequence Number. Sequence numbers are between 00 and 49, but you do not need to press enter to change sequence number. Simply type in the new sequence number that you wish to start playing, and you will see the number change.

You do not need to press enter to choose a menu item from a screen. For example, the Programmed Tempo Changes option asks the user if he or she wants to 1)Add a change or 2)List Changes. In this and similar situations, you will only need to type 1 or 2 to make a choice.

d) **Left Arrow/Right Arrow (Cursor Control Keys)** - These keys are used to move the cursor from one part of a screen to another, or to move from one screen to another. If there is more than one value displayed that can be changed, you will use these keys to move from one value to another. If the Cursor Prompt Arrow appears, you can use these keys to move from one screen to another. These keys will control what value is changed when you make entries with the number keys, so it will probably be a good idea to play with them and practice moving the cursor until you get a "feel" for how these keys work. Moving the cursor after typing an entry but before pressing the Enter key will enter what you have typed so far.

The Transport Controls

1. The Linn 9000 operates like a multi-track tape deck, recording digital MIDI information rather than audio signals. The Transport Controls, then, serve the same purpose on the Linn 9000 that they do on a multi-track tape deck, but rather than working in feet or inches of tape, they work in bars of music - something much easier for the musician to work with.

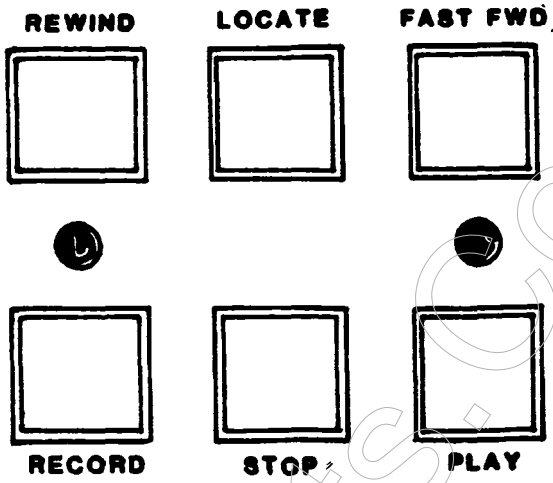


Figure 6: The Transport Controls

2. The transport controls perform the following functions:

   a) Play - Pressing the Play Button will start play of the presently selected drum and synthesizer sequence. Both drums and synth will play in either Drums or Synth Mode. However, you can, if you wish, defeat the playback of selected Synth Tracks (see the procedure for the Select Sequence Option for details), and in all cases, your synth must be properly connected to the Linn 9000 and enabled to receive the correct MIDI Channels. The PLAY FROM START: ON/OFF Option determines whether the 9000 starts playing from the first bar or the bar where it was stopped.

   b) Stop - The Stop button stops playback of the sequence. You can also use the stop button to return to the Select Sequence Option display when performing another option. If you want to stop anything at any point in time, press Stop.

   c) Record - Holding this button, then pressing the Play button starts the recording of drums or synthesizer, depending on the mode you are in. For synths, there are four different Track Status Indicators - Record (which allows overdubbing), Mute, which allows recording or playback of one Track with all others muted, and Punch-In and Solo, which will be available in software updates.

d) **Fast Forward & Rewind** - Pressing and holding this button moves the Linn 9000 through bars of the sequence without playing the sequence. Regardless of the setting of the Play From Start: On/Off Option, pressing PLAY immediately after moving to a bar number using these buttons starts play from the displayed bar number. These buttons allow the user to "browse" through a sequence, and check what is recorded.

e) Locate - This allows the user to Locate a particular bar in a sequence. Press this button, then type in the 1, 2 or 3 digit bar number that you wish to locate, then press enter. When you press Play immediately after locating a bar number, the sequence will start playing from that bar number, regardless of the Play from Start: On/Off Option setting. If no numbers are entered after Locate is pressed, then the 9000 assumes that you want to find the last entered bar number again. Pressing Locate twice returns you to bar 1, the beginning of the sequence. When using the Locate feature, it will take the 9000 a short amount of time to find the bar you designate.

E. Using the 9000 as a Drum Machine

1. Playing Existing Drum Sequences

1. Make sure that the Linn 9000 is properly connected to an amplifier or mixer as illustrated under "Hooking Up the Linn 9000".

2. You may play the individual pads by tapping them, as explained previously. Since the drum pads are touch sensitive, you can play the drums dynamically, by hitting a pad harder to get a louder sound.

3. Press the Drums Mode button to set the 9000 into Drums Mode. If the LED next to this button is lit, then the 9000 is already in Drums Mode. In this mode you can select, record and edit drum sequences.

4. The Linn 9000 will store up to 50 drum sequences with a length up to 999 bars,as memory permits, and sequence numbers ranging from 00 and 49. Factory preset sequences are recorded in 00 through 43, and sequences 44 through 49 are left empty, so that you may record your own sequences.

5. To PLAY a factory preset drum sequence, press the Select Sequence option button, select a sequence number, then press Play. The last selected synth sequence will also play, but you will not hear it unless your MIDI synth is correctly connected and set to receive MIDI Channel 1.

6. To change from one factory preset drum sequence to another, type in the number of the sequence you wish to play, or use the Up/Dn buttons to change sequence numbers. When you change sequence numbers while playing, the bar of the sequence presently playing finishes before the 9000 starts playing the newly selected sequence number.

7. The drum (and synth) programs that are recorded at the factory may be changed. You can edit, erase, or re-program them, just like any sequence.

8. To change the TEMPO, use the Enter Tempo option or tap 1/4 notes on the TAP TEMPO button. When this button is tapped twice within a certain period of time, the timing interval is assumed to be a 1/4 note, and the new tempo is automatically computed, entered, and displayed. If you tap more than twice, the 9000 will continue to average out the taps and increase the accuracy of the tapped tempo. The tempo of the Linn 9000 can be between 50 and 250 BPM.

9. The Enter Tempo Option allows you to "fine tune" the tempo in increments of 1 or 0.1 BPM (depending on which field the cursor is currently located in), using the Up/Dn keys, or by entering a number.

10. To stop playback of all sequences on the Linn 9000, press the Stop button.

11. The display screen in Drums Mode for Select Sequence gives the user the following information:

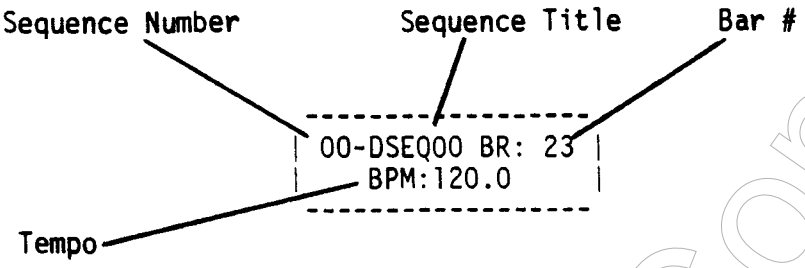


Figure 7: Select Sequence Screen, Drums Mode

a) **SEQUENCE NUMBER** - This is a two digit number between 00 and 49. You may select a new sequence number by entering the two digits into the keypad, or by using the Up/Dn keys to increase or decrease the sequence number. If the machine is playing when you enter the new sequence number in, it will finish the measure of the old sequence number presently playing before starting to play the new one.

b) **TEMPO** - The tempo is displayed in Beats per Minute and is adjustable in increments of 0.1 BPM, using the Enter Tempo Option. The Tempo may also be displayed in Frames per Beat and other formats useful for video and film production. See the procedure for the Enter Tempo Option for further details.

c) **SEQUENCE TITLE** - Up to 6 alphanumeric characters may be used to identify a sequence. To change the title of a sequence, move the cursor to this field, then hold the ALPHA key, which changes the Option buttons labeled A through Z to their Alpha function, then type in the new title and press enter.

c) **BAR NUMBER** - If playing, this is the bar number within the sequence that is presently playing. If stopped, this is either the bar the 9000 was stopped at or the bar you have selected using Fast Forward, Rewind or Locate. A sequence can be up to 999 bars, within the limits of available memory. See the description of the MEMORY STATUS OPTION in Section 3 for information telling how to check available memory.

2. Recording Your Own Drum Sequences

1. Select one of the empty sequence numbers, 44 through 49. These are all empty 2 bar, 4/4 sequences, which is the default value that the 9000 assigns to an empty sequence. To change either of these factors, you may use the Time Signature / # of Bars Option, explained in Section 3 of this manual.

2. You may use the ALPHA KEY of the keypad to change the option buttons to "typewriter keys", and use them to give your sequence a name.

3. While holding RECORD, press the PLAY button to begin recording.

4. Adjust the CLICK volume slider in the MIXER section to a comfortable volume. The click counts off 1/4 notes, a value which may be changed by using the CLICK option button, explained in the "Description of Front Panel Functions" Section of this manual. The click is accented on the downbeat of each bar.

5. Use the ENTER TEMPO option to adjust the tempo to a comfortable rate.

6. Record the drums for your sequence by playing the pads. The dynamic level of your playing is remembered. You can change the touch-sensitivty level of the pads using the ADJUST PAD DYNAMICS Option. The sequence will loop over two bars until you press the Stop button. Anything you play will be recorded.

7. You can use the Repeat Button to record (or play) dynamic drum rolls. Hold the Repeat Button, and any drum pads that you wish to repeat. By varying the pressure on the drum pad while repeating a drum, you can create unique percussive effects. The repeat rate is controlled by the 9000's Timing Correction Option.

8. To ERASE drums while RECORDING, hold the ERASE button and press the pad of the drum you wish to erase when the drumstroke you wish to erase occurs. Other ERASE options are explained in the "Description of Front Panel Functions" Section of this manual.

9. When you have finished RECORDING the drums for your sequence, press the STOP button.

10 Press PLAY to hear the drum sequence you recorded play back. You will notice that any slight errors you may have made have been corrected by the 9000's Timing Correction option. You can change the settings of the Timing Correction Option as explained in the "Description of Front Panel Functions" section of this manual.

11. You can, if you wish, RECORD more drums ("overdub") on top of the sequence you have just recorded. To do this, hold Record, then press Play, then play the drums you want to "overdub" into the present sequence. Once you have started recording, you can "punch out" by pressing record. The sequence will continue to play, but new notes will not be recorded. You can then "punch in" to begin recording again by pressing the Record button.

12. Once you have recorded a drum sequence, you should immediately save that drum sequence to Cassette using the procedure described in Section 3, Select Sequence Options (Mode/Sel Seq Options), "Cassette/Disk Storage". This prevents loss due to accidental erasure. As you store more sequences to tape, you will quickly build up a library of songs and patterns that will make composition of songs extremely easy.

13. Be efficient with your memory resources. After you've dumped data onto cassette, erase the sequences you don't need. Also, remember that if you don't have your 9000 full of unneeded programs, you'll have an abundance of usable memory. If, however, you insist on keeping multitudes of programs in the memory, you'll have less memory available, and the 9000's processing speed will be slower, due to all of the extra sequences it will need to look at.

F. Using the Linn 9000 as a MIDI Keyboard Recorder

1. Playing Existing Synth Sequences

1. Connect to an amplifier/mixer and one or more MIDI synths as illustrated and explained in the "Hooking Up the Linn 9000".

2. Press the SYNTH Mode button to enable Synth Mode. This will cause the Linn 9000 to display information on a synthesizer sequence in the display. Note that even in DRUMS mode, however, the synthesizer sequence will play, just as the drum sequence will play in SYNTH Mode.

3. Set the synthesizer(s) Omni Mode, or to Poly Mode, receiving on MIDI Channel 1. Poly Mode is preferable, because it allows you to assign different synths to receive different MIDI Channels, and play different musical parts.

4. Press the "Play" button. The first preset synth sequence, number 00, will play. The last selected drum sequence will also play.

5. The Linn 9000 will hold up to 50 synth sequences, numbered 00 through 49. There are five preset synth sequences in the Linn 9000, numbered 00 to 04. The synth sequence presets, like the drum sequence presets may be changed. You can edit, erase, or re-program them, just like any other sequence.

6. You may change the TEMPO in SYNTH mode by using the Enter Tempo Option, or by using the Tap Tempo button and tapping two 1/4 notes. These will be averaged and the new tempo will be computed.

7. To stop playback of all sequences, press the Stop button.

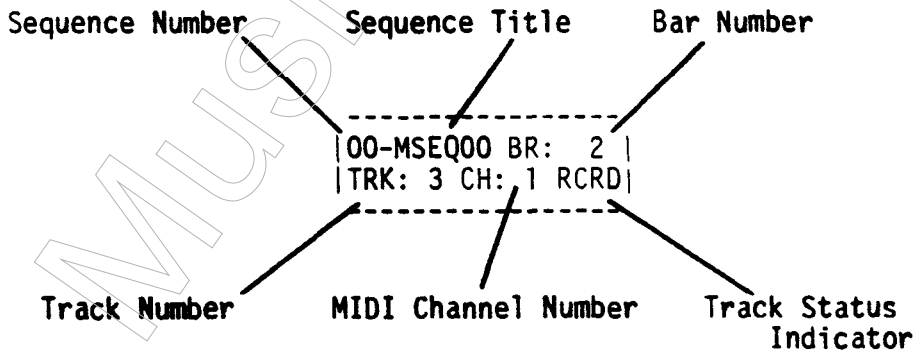


Figure 8: Synth Mode, Select Sequence Screen

8. In SYNTH Mode, the Display gives you the following information, illustrated in Figure 5. The items in the top line give the same information given in DRUMS mode, while the items in the bottom line give information specific to playing and recording synth sequences.

F. Using the Linn 9000 as a MIDI Keyboard Recorder (Continued)

a) SEQUENCE NUMBER, TITLE and BAR NUMBER are all precisely the same as in DRUMS mode, and may be changed in the same fashion. Changing the SEQUENCE NUMBER changes the synth sequence number but not the drum sequence number. This feature allows you to try different synth sequences against one drum sequence and vice versa.

b) The TRACK NUMBER can be between 1 and 32. This feature allows the use of multiple tracks to drive a single synthesizer, and tells you what track will be recorded onto when you begin recording. To change this number, use the cursor movement keys to move the cursor to this field, then enter a new track number.

c) MIDI CHANNEL NUMBER ranges from 1 to 16, and tells the user which of the MIDI channels the sequence will be sent through. Each TRACK is assigned a MIDI CHANNEL through which the sequence data is sent. To change the MIDI CHANNEL assignment, move the cursor to this field, then enter a new MIDI CHANNEL number.

d) The TRACK STATUS INDICATOR tells the user the status of the presently selected Synth Track - RECORD, PUNCH, MUTE or SOLO. These are explained in depth in the description of the Select Sequence Option. You may use the Up/Dn buttons to rotate between the four choices.

8. The factory preset synth sequences were recorded with the bass-line on Track 1, the chord progression on Track 2 and the melody or lead on Track 3. If you are hooking up several MIDI synths or expansion modules to the Linn 9000, you can hear the three Tracks of the factory preset sequences played in different voices.

   a) Move the cursor to the Track Number field. Change the Track number to 2 by pressing 2 in the numeric keypad, or by using the Up Key.

   b) Move the cursor to the MIDI Channel (CH:) field and enter 2 to assign Track # 2 to MIDI Channel 2.

   c) Use the same method to re-assign Track # 3 to MIDI Channel 3.

   d) Set the first synth to receive on MIDI Channel 1, the second synth to receive on MIDI channel 2, and the third to receive on channel 3. Check the manual or refer specific questions about the MIDI capabilities of your synthesizer to your dealer or the manufacturer of the synthesizer.

F. Using the Linn 9000 as a MIDI Keyboard Recorder (Continued)

e) Now press Play on the Linn 9000. Each of the three synths will play a different Track of the presently selected sequence.

f) If you select a new sequence number, and wish to hear the Tracks played by different synthesizers, you will need to re-assign the Tracks of that sequence as described above.

Using the Linn 9000 as a MIDI Keyboard Recorder

3. Recording Your Own Synth Sequences

1. Press the SYNTH Mode button to select Synth mode.

2. The Linn 9000 accepts MIDI information for recording through any MIDI Channel (Omni On). No matter what Channel your MIDI synth sends on, the Linn 9000 will receive and record that information. The playback of any Track can be assigned to any MIDI Channel. Using the MIDI Echo feature of the MIDI Parameters Option, you can play other MIDI keyboards or expansion modules connected to the Linn 9000 from your Master Input MIDI keyboard, without having to change the MIDI connections.

2. Choose one of the empty sequences, numbers 07 to 49. You do not need to have drums recorded to use the sequencer, but if there are drums, they will play as you record your synth part.

3. As in DRUMS mode, the default sequence for SYNTH MODE is a two bar 4/4 sequence, and is changed using the Time Signature / # of Bars Option, explained in Section 3 of this manual.

4. To begin recording a synth sequence, simply hold Record, then press PLAY, and begin playing your synthesizer. The notes you play will be recorded into the sequence and play back as the sequence loops. The CLICK Option allows you to enable a countoff of four 1/4 notes to make recording the beginning of a sequence easier.

5. To ERASE Synth notes in a sequence, begin recording, then hold Erase and the synth notes in the sequence you wish to erase on the keyboard you are recording.

6. Once you have started recording, you can "punch out" by pressing Record again. The sequence will continue to play, but new notes will not be recorded, allowing you to rehearse parts. You can then "punch in" by pressing Record again.

7. You cannot select a new sequence number while recording.

8. When you have finished RECORDING a synth Track for your sequence, press the STOP button.

9. Press PLAY to hear the synth sequence you recorded play back. You will notice that any slight errors you may have made have been corrected by the 9000's TIMING CORRECT option. You can change the settings of the TIMING CORRECT Option as explained in the "Description of Front Panel Functions" section of this manual.

10. You can, if you wish, overdub synth notes on the same Track, or on different Tracks. To overdub on the Track of the sequence you have just recorded, press PLAY and RECORD, then play the notes you want to "overdub" into the present selected Track.

9. To overdub new notes on a different Track of the same sequence number, change the Track number, then begin recording again. The first Track you recorded will play through its assigned MIDI Channel as you record on the second Track. You can also change the Track Number while recording.

11. Recording ("overdubbing") on different Tracks allows you assign different Tracks to separate MIDI synths.

10. It is possible to use a 6-voice synthesizer to record a piece of music that requires 8 (or more) voices to play at once. This capability allows the user to record all parts of a piece of music with one synthesizer, then take the Linn 9000 into the studio and assign the various parts of the sequence to MIDI synths owned by the studio. However, if 8 (or more) voices are required by one (or more) Tracks on the Linn 9000, a 6 voice synth will not play all 8 voices.

11. Once you have recorded a synth sequence, you should immediately save that synth sequence to Cassette using the procedure described in Section 3, Select Sequence Options (Mode/Sel Seq Options), "Cassette/Disk Storage". This prevents loss due to accidental erasure. As you store more sequences to tape, you will quickly build up a library of songs and patterns that will make composition of songs extremely easy.

G. Error Messages

1. The Error Messages identify problems or incorrect procedures. If you receive one of these Error Messages when performing an option, turn to the description of that option in the manual, and you'll be able to find out the correct procedure for using the option. Listed below are some examples of Error Messages that the Linn 9000 displays. Most, as you can see, are rather self-explanatory.

1. NOT IN RECORD - You tried to erase a drum or synth note while Playing. You must be in record to erase drums or synth. See the Procedure for the ERASE Option.

2. DISK STORAGE UNAVAILABLE - You tried to Save to or Load From diskette without a disk drive installed. See your dealer for information on disk drive installation.

3. TAPE LEADER NOT FOUND - You tried to Load from cassette, but the 9000 has not found the "Leader" signal that it records. See the DISK / CASSETTE STORAGE Option Procedure.

4. OUT OF MEMORY - The Linn 9000 has insufficient memory to load, record or copy new drum or synth sequence information. Erase unused sequences, then check the MEMORY STATUS Option Display.

H. BASIC TROUBLESHOOTING

1. Some Common Problems & Solutions

PROBLEM: The Linn 9000 is "Stuck" on a Screen

While entering information or using an option, the Linn 9000 may appear to become "jammed", or "stuck" on a screen. Pressing any option button, transport control or keypad key makes no change in the screen displayed by the 9000. Turning the 9000 on and off makes no difference - only one screen is displayed, and that screen cannot be changed. The 9000 will not play or record sequences. Sometimes a screen could appear incomplete, as illustrated below:

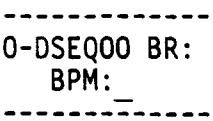


Figure 9: Example of Display when the 9000 has "Frozen"

CAUSE: Accidental Entry

If, while using an option, you enter too quickly or accidentally push two buttons at once, there is the chance that you can cause the 9000 to "freeze" - that is, display only one screen as described above. When entering information into the 9000, it's always best to push the buttons slowly and deliberately. This will also keep you from making mistakes while entering.

SOLUTION: Clear the Memory (Erase All Sequences)

You will use the procedure described below to clear all of the memory of the Linn 9000. Any sequences you have recorded and not saved to cassette will be lost. For this reason it's best to save drum or synth sequence that you like, using the Cassette/Disk Storage Option. Then, if the 9000 freezes, you will be able to re-load in the important drum and synth sequences, and suffer no loss of information. Once you have cleared the memory using the procedure described in the second part of this section, you will be able to record new sequences and load in important sequences you have saved to tape.

PROBLEM: Synth Does Not Play (or Record) Sequence

You have connected your MIDI synthesizer to the 9000, and tried to play the factory presets and the synth does not play the factory preset sequence. Or, you have tried to record a sequence yourself, but the notes you play on the synthesizer do not seem to be recorded by the 9000.

H. BASIC TROUBLESHOOTING (Continued)

CAUSE: Incorrect MIDI Channel Assignment
Incorrect MIDI Connections

The 9000 is set to send a sequence on a different MIDI channel than the one your MIDI synth is set to receive on, or your MIDI cables are incorrectly connected.

SOLUTION: Change MIDI Channel Assignment
Check MIDI Cable Connections

First, make sure that your MIDI cables are correctly connected: MIDI IN on the 9000 to MIDI OUT on your synth and MIDI OUT on the 9000 to MIDI IN on your synth. For more information on correctly connecting the 9000 to one or more MIDI Synths, see "Hooking Up the Linn 9000".

If your MIDI cables are correctly connected and the synth sequence still does not play, check the MIDI channel assignment on both your synth and the Linn 9000. The MIDI Channel Number displayed in the Select Sequence Screen in Synth Mode should be the same. (See Section 3, or "Using the Linn 9000 as a MIDI Keyboard Recorder").

Since the Linn 9000 accepts input from any MIDI Channel (Omni On), it will record notes no matter what the MIDI Channel assignment is on your synth and the 9000. However, once these notes are recorded, they will not be played by your synth unless it is set to receive the correct MIDI Channel.

Some MIDI synthesizers do not allow you to specify MIDI Channel Receive. The manual for your MIDI Synth should give details of the MIDI implementation in the synth, or you can contact the manufacturer of that instrument.

Most MIDI synthesizers can be set to Omni Mode (receive all channels). This can help identify a channel assignment problem.

H. BASIC TROUBLESHOOTING

2. Clearing the Memory of the 9000

GOAL:

To clear the memory of the 9000, erasing all sequences.

PROCEDURE:

1. Turn the power switch on the rear panel of the 9000 OFF. (The bottom half of the red button DOWN.)

2. Wait at least ten seconds.

3. Hold the Record button in the Transport Controls and the Erase button.

4. Turn on the power. (Bottom half of the red button UP.)

5. Once you see the first screen illustrated below, release both the Erase and Record buttons. You will hear a series of beeps, then the screen will display the Select Sequence, Drums Mode screen (second screen illustrated below). You can now record sequences, or load them from tape.

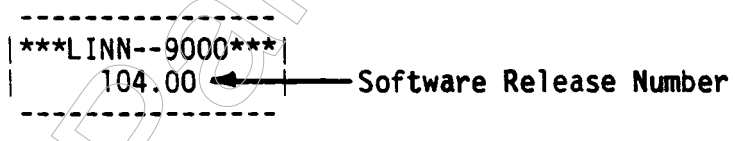


Figure 10: Clearing the Memory - Power Up Screen

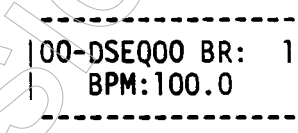
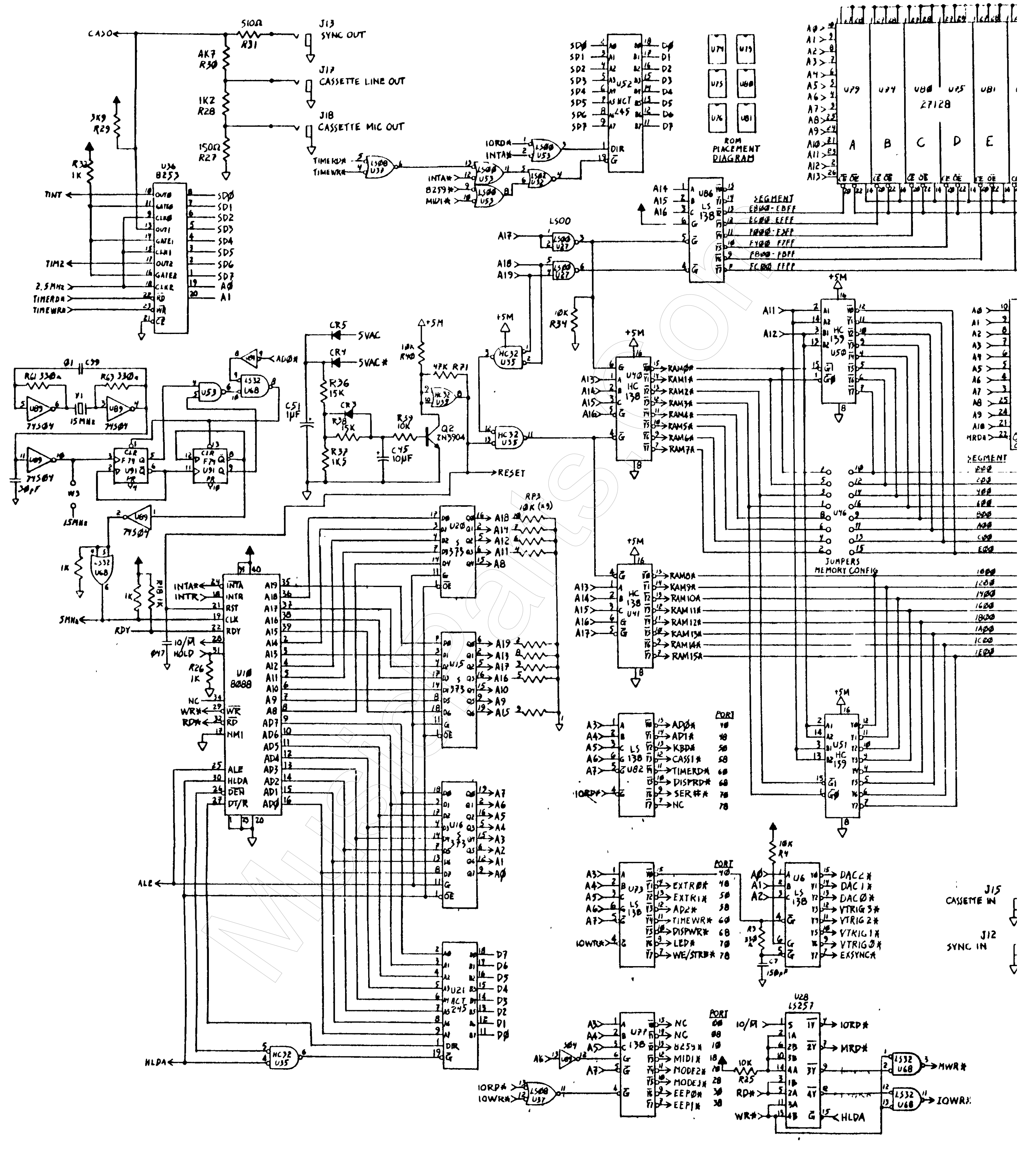


Figure 11: Memory Cleared - Drums Mode, Sequence Number 00

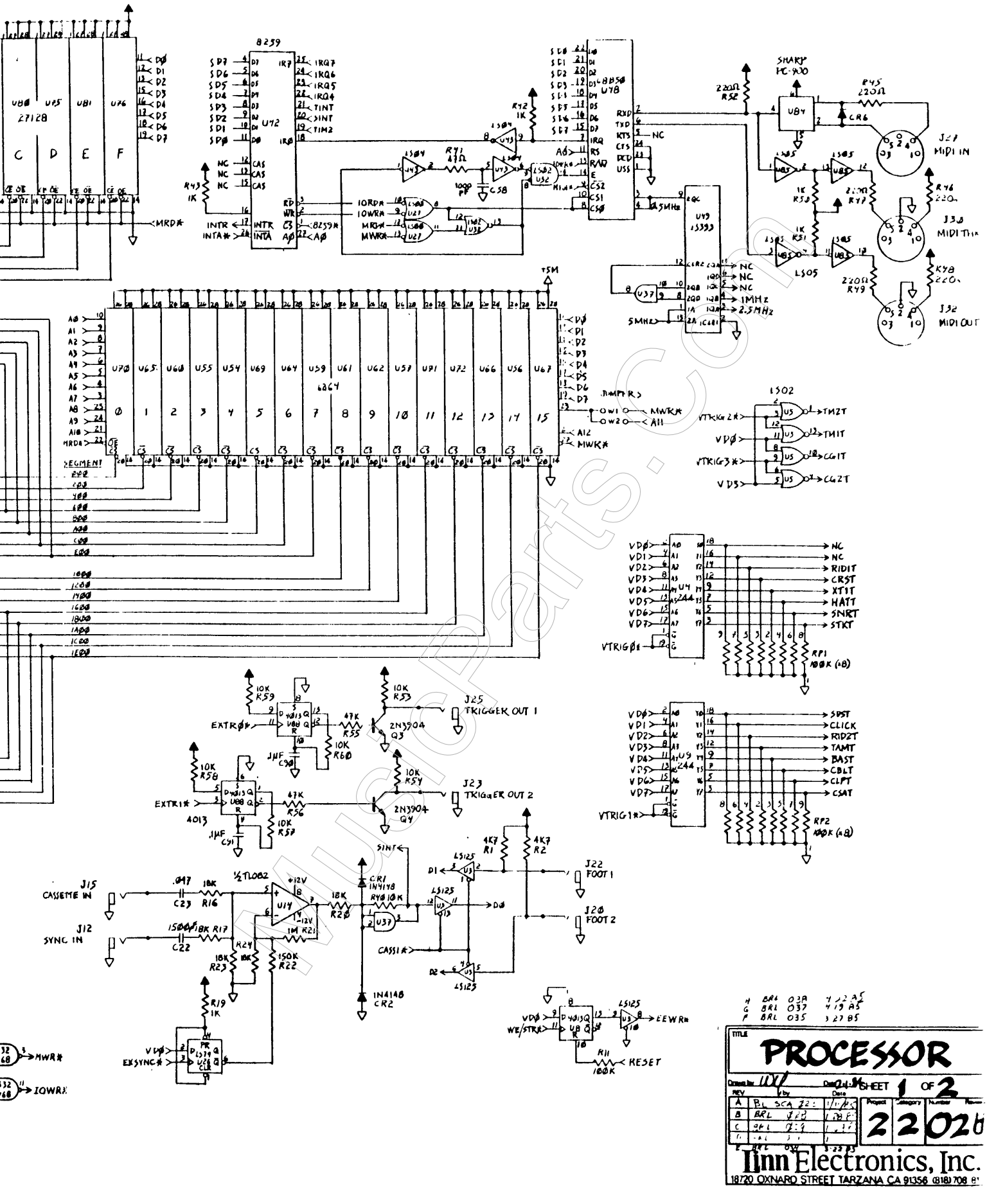
WHEN TO CLEAR THE MEMORY

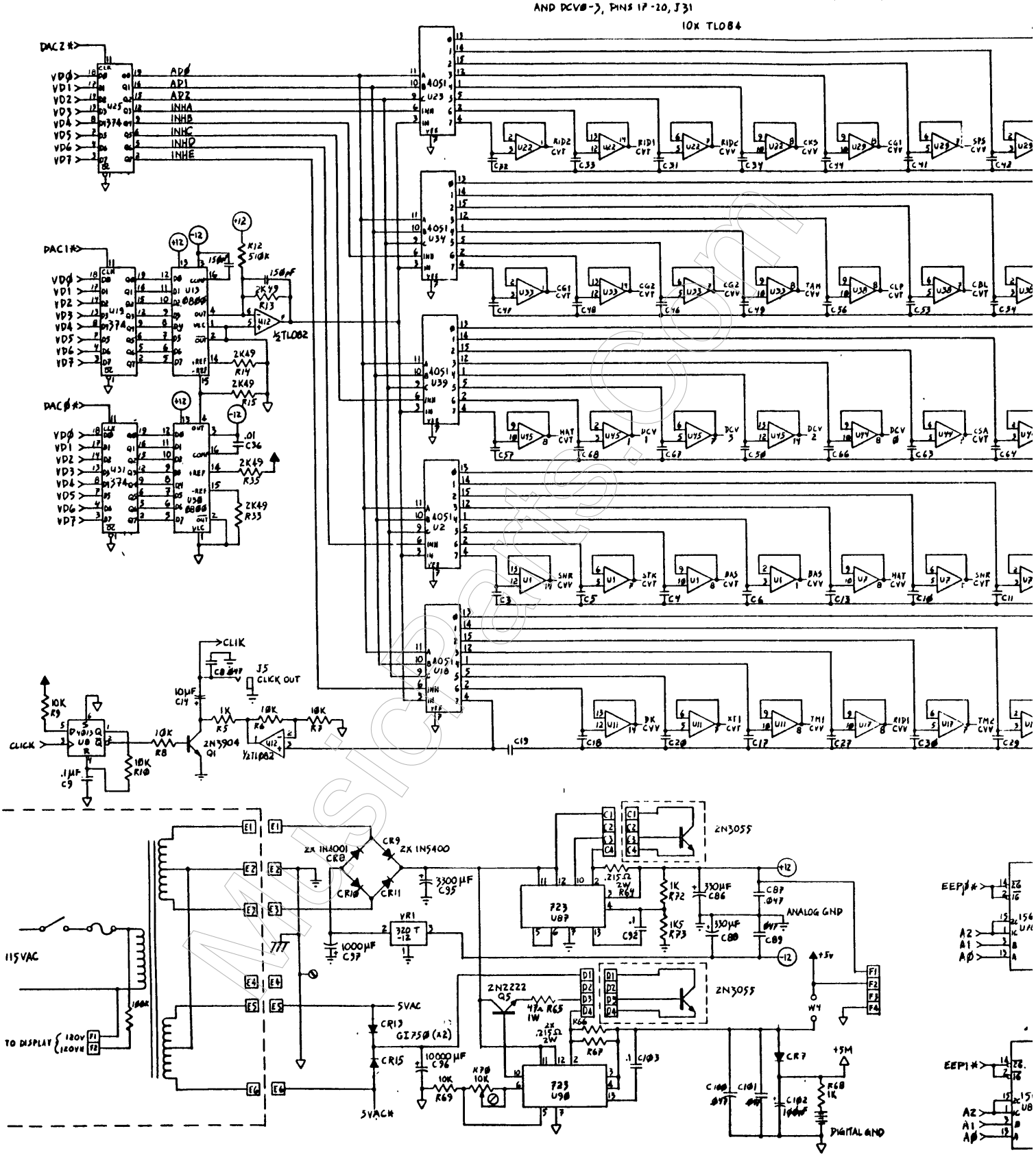
1. When the 9000 has "frozen" - that is, it appears stuck on one screen.

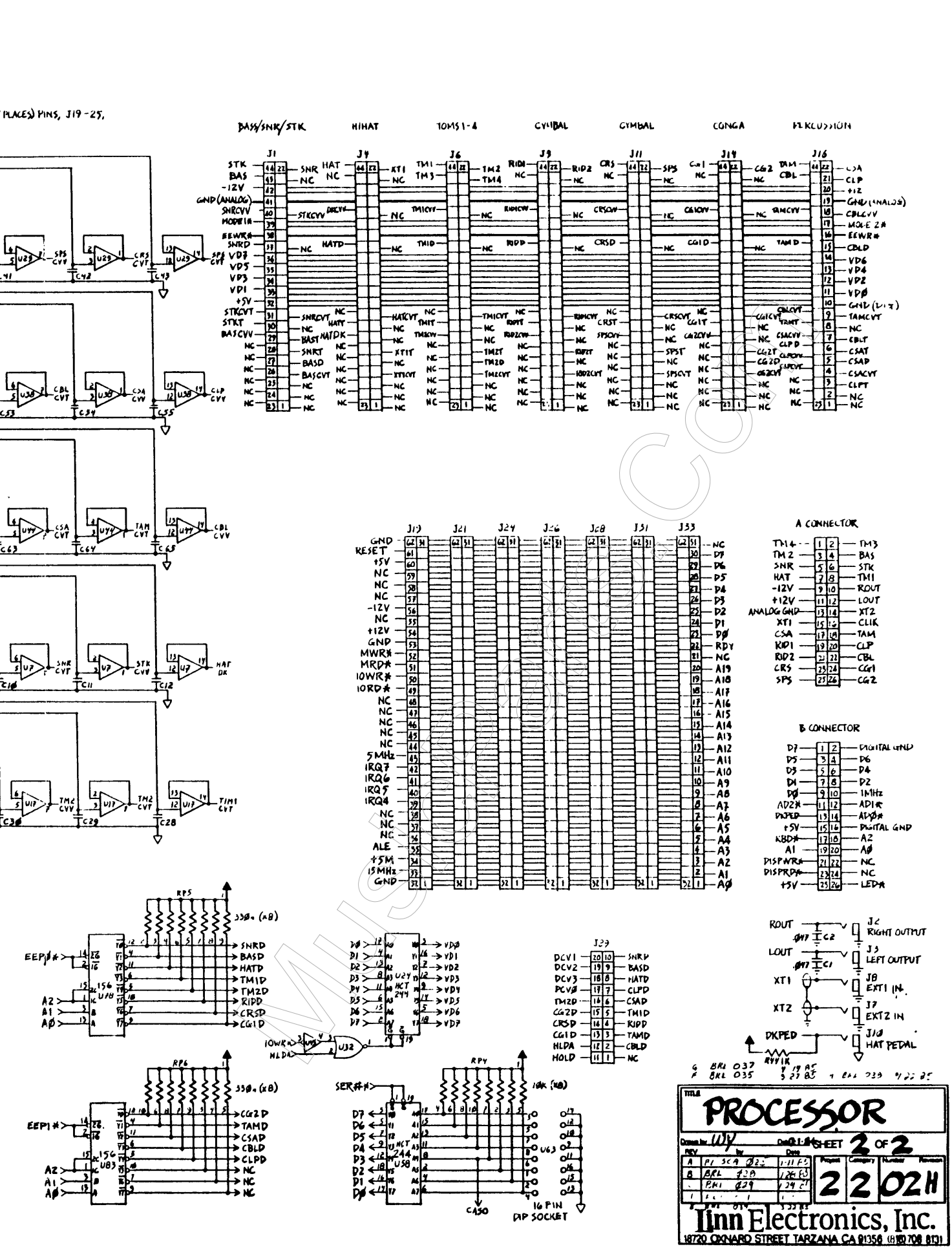
2. When you want to erase all sequences from the 9000's memory. Any sequences you wish to use at a later time should be saved to cassette prior clearing the memory.

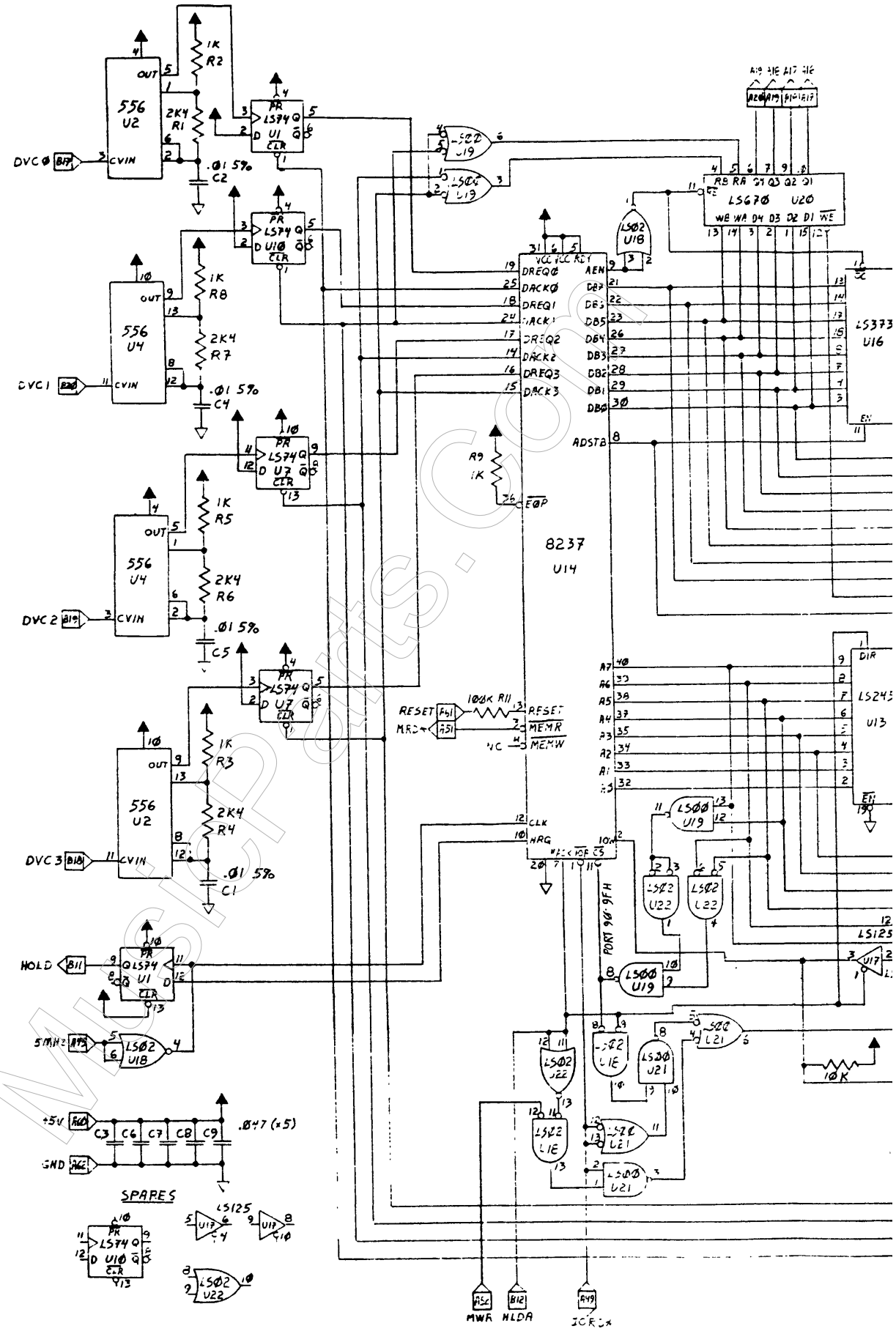

CASO
J13 SYNC OUT
J17 CASSETTE LINE OUT
J18 CASSETTE MIC OUT
U36 8253
TINT
TIM2
2.5MHz
TIMERDA
TIMEWRA
U52 HCT 245
IORDA
INTAA
INTAA
8259A
MIDIA
ROM PLACEMENT DIAGRAM
27128
U86 LS 138
SEGMENT
E800-EBFF
EC00-EFFF
F000-F3FF
F400-F7FF
F800-FBFF
FC00-FFFF
5VAC
5VAC*
Q2 2N3904
RESET
15MHz
74S04
U40 HC 138
RAM0A
RAM1A
RAM2A
RAM3A
RAM4A
RAM5A
RAM6A
RAM7A
U50 HC 139
U76
JUMPERS MEMORY CONFIG
U41 HC 138
RAM8A
RAM9A
RAM10A
RAM11A
RAM12A
RAM13A
RAM14A
RAM15A
U18 8088
INTAA
INTRA
5MHz
RDY
HOLD
WRA
RDA
ALE
HLDA
U20 S 373
U15 S 373
U16 S 373
U21 HCT 245
U82 LS 138
PORT
AD0A
AD1A
KBDA
CASS1A
TIMERDA
DISPRDA
SERA
NC
U51 HC 139
U73 LS 138
EXTR0A
EXTR1A
AD2A
TIMEWRA
DISPWRA
LEDA
WE/STBA
U6 LS 138
DAC2A
DAC1A
DAC0A
VTRIG3A
VTRIG2A
VTRIG1A
VTRIG0A
EXSYNCA
J15 CASSETTE IN
J12 SYNC IN
U77 LS 138
NC
NC
8259A
MIDIA
MODE2A
MODE3A
EEP0A
EEP1A
U28 LS257
IORDA
MRDA
MWRA
IOWRA
IORDA
IOWRA
HLDA

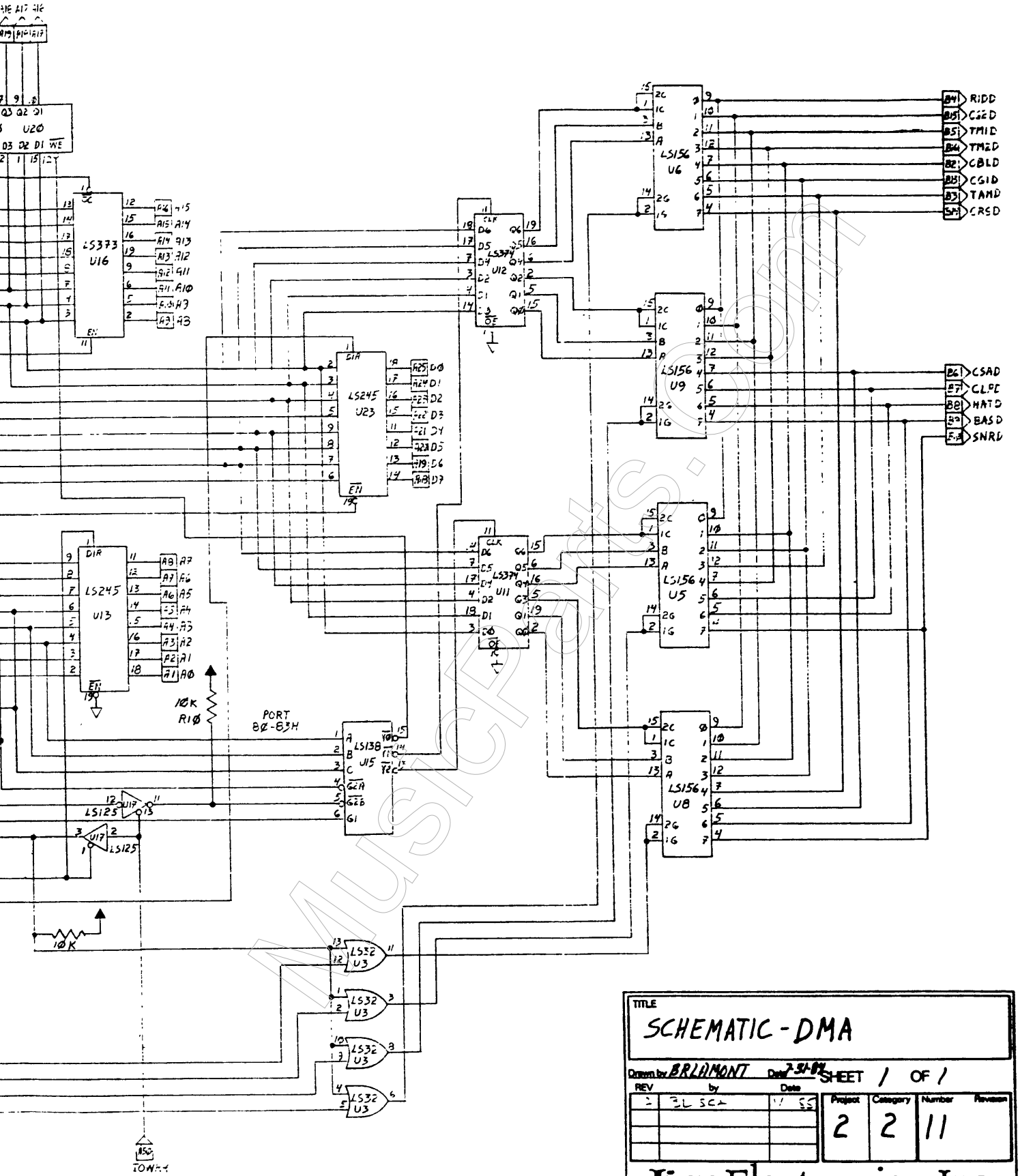
PROCESSOR


8259
8255
SHARP PC-900
MIDI IN
MIDI THRU
MIDI OUT
TRIGGER OUT 1
TRIGGER OUT 2
FOOT 1
FOOT 2
CASSETTE IN
SYNC IN
PROCESSOR
Linn Electronics, Inc.
18720 OXNARD STREET TARZANA CA 91356 (818) 708


CONTROL VOLTAGE DEMULTIPLEXER, OUTPUTS CONNECT TO CVV(10PLACES) & CVT(17 PLACES) PINS, J19-25, AND DCV0-3, PINS 17-20, J31
10x TL084
DAC2 #
DAC1 #
DAC0 #
VD0
VD1
VD2
VD3
VD4
VD5
VD6
VD7
AD0
AD1
AD2
INHA
INHB
INHC
INHD
INHE
U25 74374
U19 74374
U31 74374
4051
½TL082
2K49
CLIK
CLICK
CLICK OUT
2N3904
115VAC
TO DISPLAY
120V
120VA
5VAC
5VACH
ZK IN4001
ZK IN5400
3300µF C95
1000µF C97
10000µF C96
VR1 320 T -12
ZN3055
ZN2222
723
ANALOG GND
DIGITAL GND
+5V
+5M
EEP0 #
EEP1 #


BASS/SNR/STK
HIHAT
TOMS 1-4
CYMBAL
CYMBAL
CONGA
PERCUSSION
J1
J4
J6
J9
J11
J14
J16
A CONNECTOR
B CONNECTOR
J17
J21
J24
J26
J28
J31
J33
J29
RP5
RP6
RP7
U32
U63
16 PIN DIP SOCKET
J2 RIGHT OUTPUT
J3 LEFT OUTPUT
J8 EXT1 IN
J7 EXT2 IN
J10 HAT PEDAL
PROCESSOR
SHEET 2 OF 2
Linn Electronics, Inc.
18720 OXNARD STREET TARZANA CA 91356 (818) 708 8131


556 U2
1K R2
2K4 R1
.01 5% C2
556 U4
1K R8
2K4 R7
.01 5% C4
556 U4
1K R5
2K4 R6
.01 5% C5
556 U2
1K R3
2K4 R4
.01 5% C1
DVC 0
DVC 1
DVC 2
DVC 3
CVIN
LS74 U1
LS74 U10
LS74 U7
LS74 U7
LS74 U1
HOLD
5MHz
LS02 U18
LS00 U19
LS02 U19
LS670 U20
WB WA D4 D3 D2 D1 WE
LS02 U18
8237 U14
DREQ0
DACK0
DREQ1
DACK1
DREQ2
DACK2
DREQ3
DACK3
AEN
ADSTB
R9 1K
EOP
RESET
MRD
10ØK R11
RESET
MEMR
MEMW
CLK
HRQ
BACKUP CS
PORT 90-9FH
LS373 U16
LS245 U13
DIR
A7
A6
A5
A4
A3
A2
A1
A0
LS00 U19
LS02 U22
LS02 U22
LS00 U19
LS02 U22
LS02 U1E
LS00 U21
LS02 U22
LS02 U1E
LS00 U21
LS00 U21
LS125
U17
10K
+5V
GND
C3 C6 C7 C8 C9
.047 (x5)
SPARES
LS74 U10
LS125 U17
LS02 U22
MWR
HLDA



TITLE

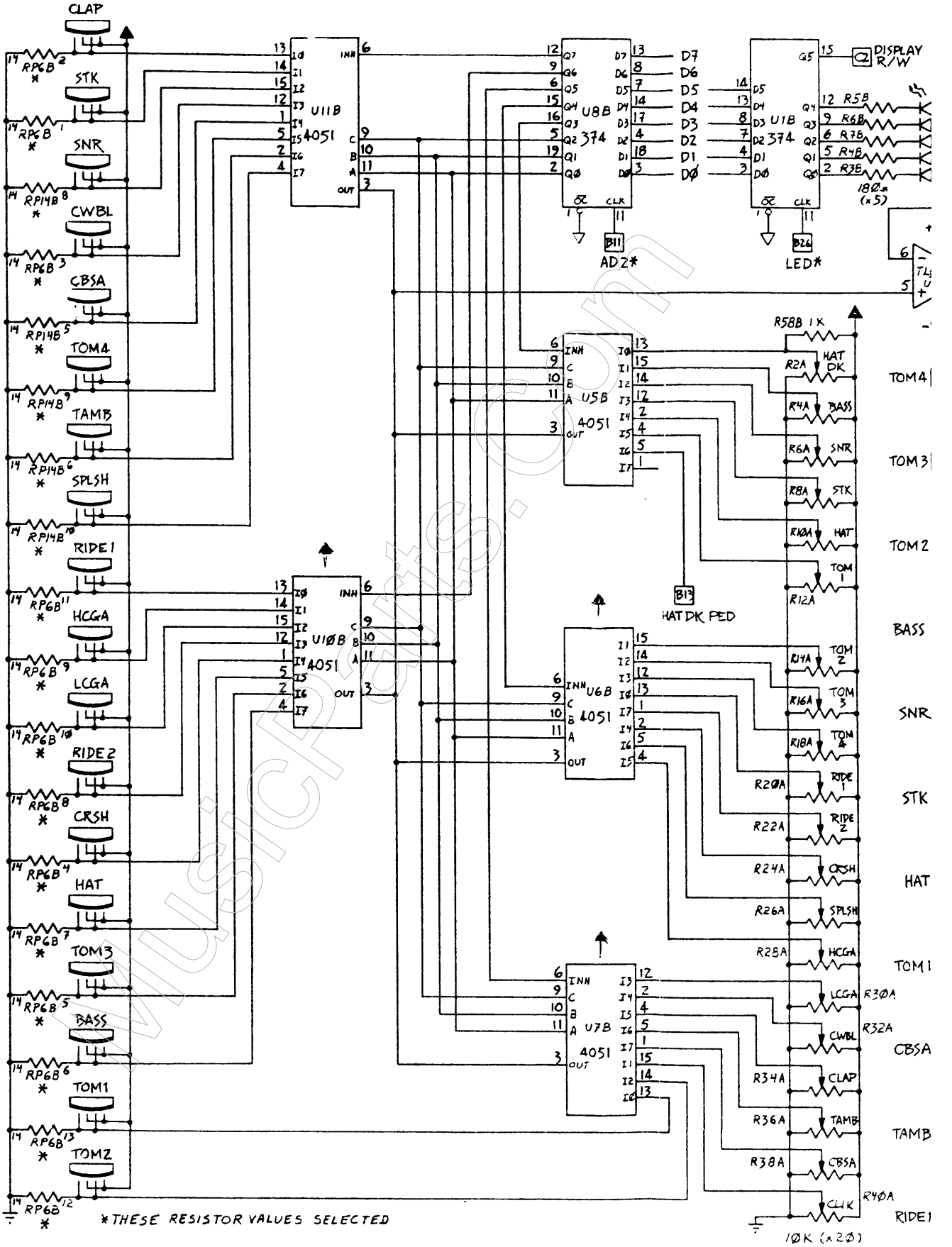
SCHEMATIC - DMA

Drawn by BRIAMONT Date 7-31-87 SHEET 1 OF 1

REV	by	Date
2	3L SCA	11 SS

Project	Category	Number	Revision
2	2	11	

Linn Electronics, Inc.
18720 OXNARD STREET TARZANA CA 91356 (818) 708-8131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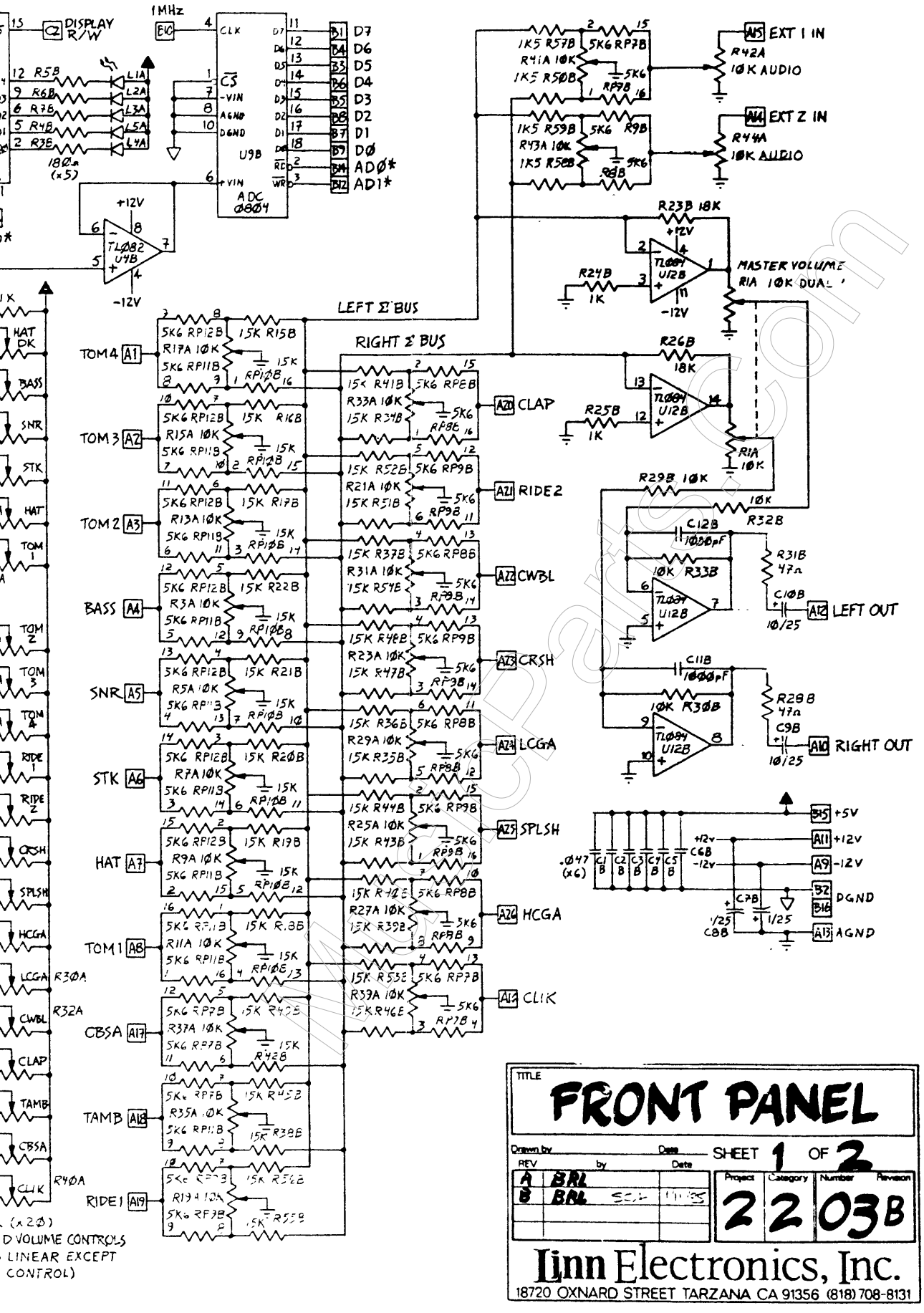
STK
SNR
CWBL
CBSA
TOM4
TAMB
SPLSH
RIDE1
HCGA
LCGA
RIDE2
CRSH
HAT
TOM3
BASS
TOM1
TOMZ
RP6B
RP14B
U11B
4051
U8B
374
U1B
DISPLAY R/W
R5B
R6B
R7B
R4B
R3B
180Ω (x5)
AD2*
LED*
R58B 1K
U5B
U10B
U6B
U7B
HAT DK PED
R2A
HAT DK
R4A
BASS
R6A
SNR
R8A
STK
R10A
HAT
R12A
TOM 1
R14A
TOM 2
R16A
TOM 3
R18A
TOM 4
R20A
RIDE 1
R22A
RIDE 2
R24A
CRSH
R26A
SPLSH
R28A
HCGA
R30A
LCGA
R32A
CWBL
R34A
CLAP
R36A
TAMB
R38A
CBSA
R40A
CLIK
10K (x20)
PROGRAMMED VOLUME CONTROLS
(ALL TAPERS LINEAR EXCEPT CLICK CONTROL)
*THESE RESISTOR VALUES SELECTED



TITLE

FRONT PANEL

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A	BRL	
B	BRL	

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22		03B	

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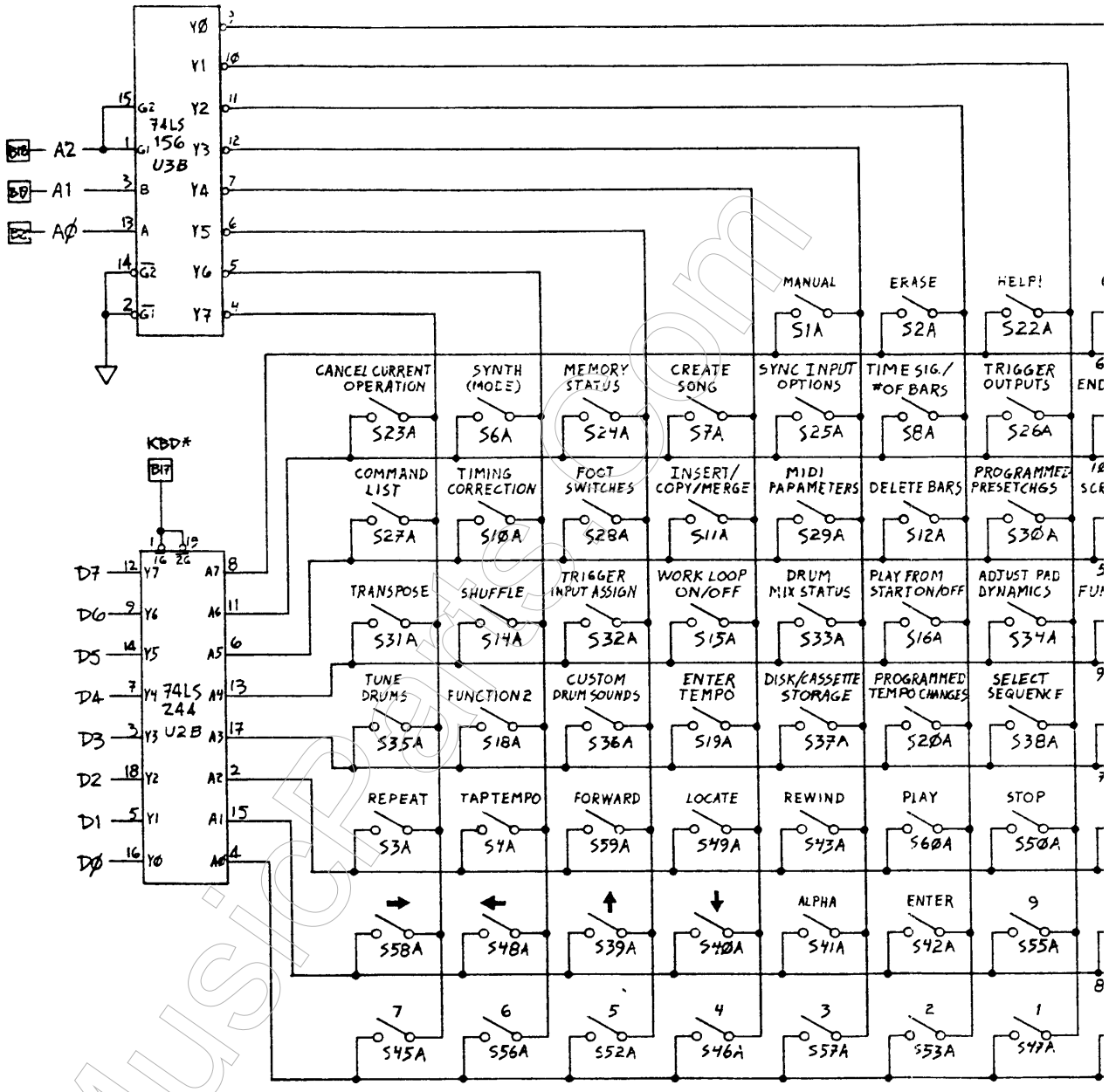
74LS 156 U3B
A2
A1
AØ
YØ
Y1
Y2
Y3
Y4
Y5
Y6
Y7
MANUAL S1A
ERASE S2A
HELP! S22A
CANCEL CURRENT OPERATION S23A
SYNTH (MODE) S6A
MEMORY STATUS S24A
CREATE SONG S7A
SYNC INPUT OPTIONS S25A
TIME SIG./ #OF BARS S8A
TRIGGER OUTPUTS S26A
COMMAND LIST S27A
TIMING CORRECTION S10A
FOOT SWITCHES S28A
INSERT/ COPY/MERGE S11A
MIDI PARAMETERS S29A
DELETE BARS S12A
PROGRAMMED PRESETCHGS S30A
TRANSPOSE S31A
SHUFFLE S14A
TRIGGER INPUT ASSIGN S32A
WORK LOOP ON/OFF S15A
DRUM MIX STATUS S33A
PLAY FROM START ON/OFF S16A
ADJUST PAD DYNAMICS S34A
TUNE DRUMS S35A
FUNCTION 2 S18A
CUSTOM DRUM SOUNDS S36A
ENTER TEMPO S19A
DISK/CASSETTE STORAGE S37A
PROGRAMMED TEMPO CHANGES S20A
SELECT SEQUENCE S38A
REPEAT S3A
TAPTEMPO S4A
FORWARD S59A
LOCATE S49A
REWIND S43A
PLAY S60A
STOP S50A
S58A
S48A
S39A
S40A
ALPHA S41A
ENTER S42A
9 S55A
7 S45A
6 S56A
5 S52A
4 S46A
3 S57A
2 S53A
1 S47A
KBD*
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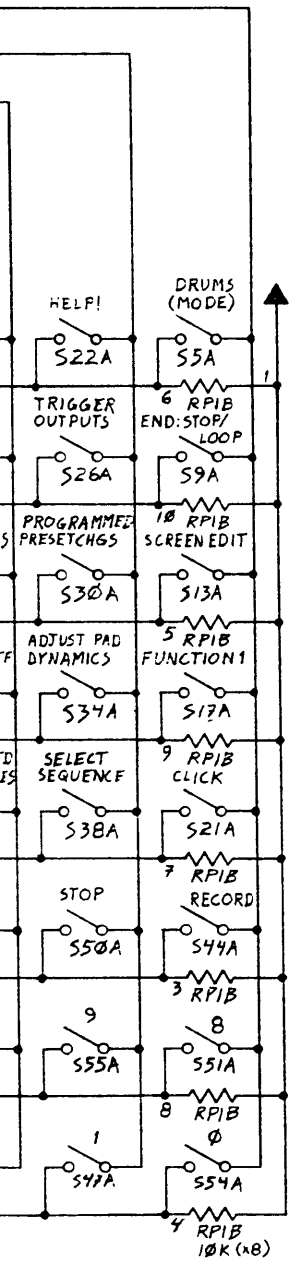
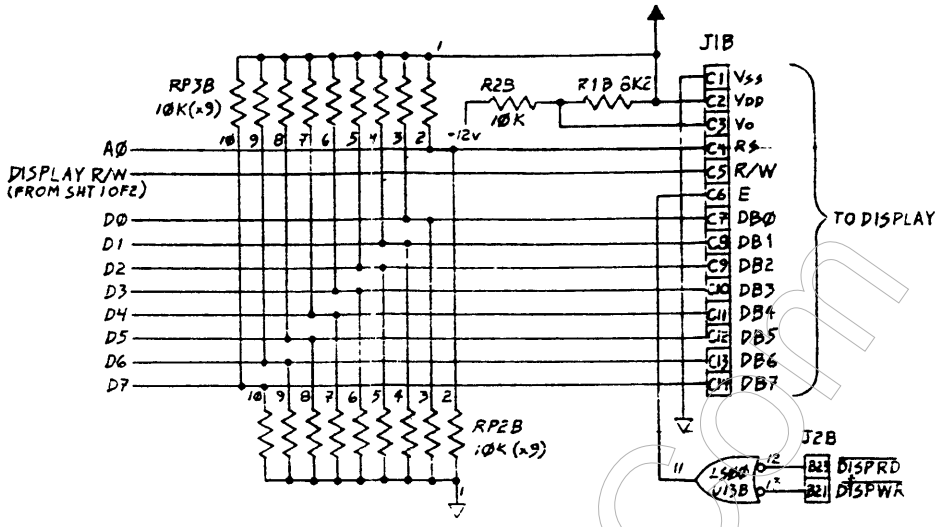
D6
D5
D4
D3
D2
D1
DØ





TITLE **FRONT PANEL**

Drawn by [illegible] Date [illegible] SHEET 2 OF 2

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Project	Category	Number	Revision
2	2	03	B

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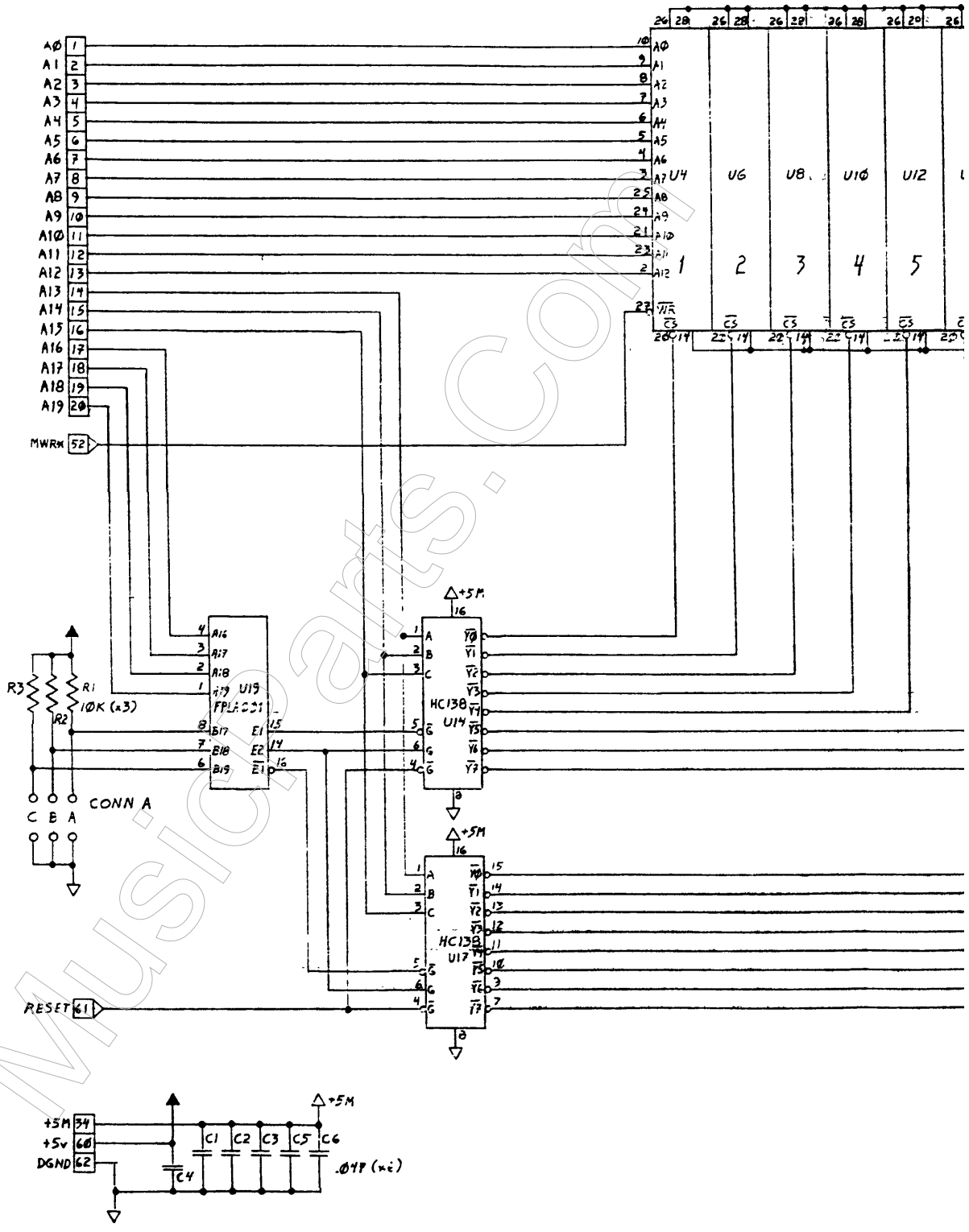
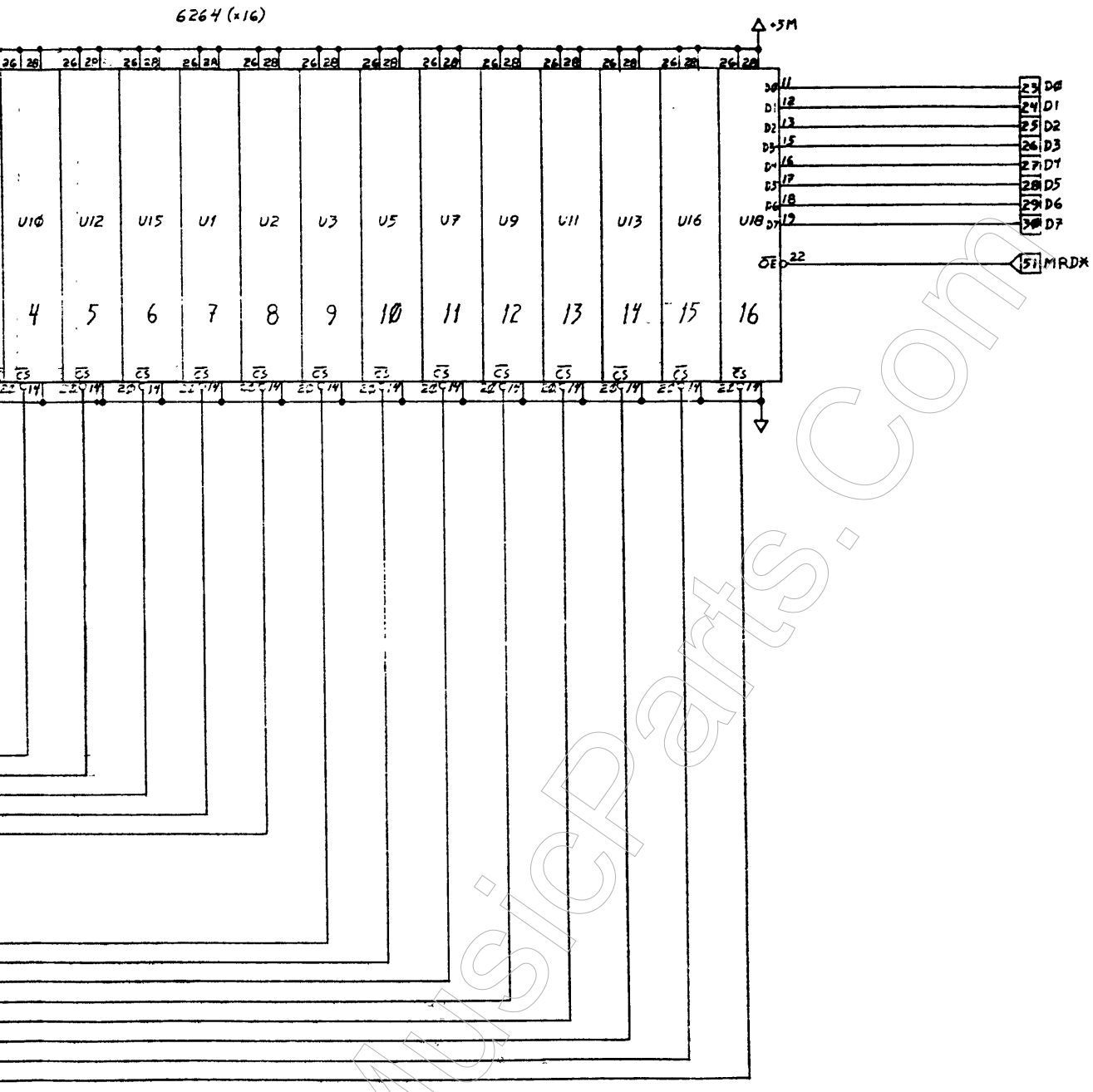
18720 OXNARD STREET TARZANA CA 91356 (818) 708-8131


A0 1
A1 2
A2 3
A3 4
A4 5
A5 6
A6 7
A7 8
A8 9
A9 10
A10 11
A11 12
A12 13
A13 14
A14 15
A15 16
A16 17
A17 18
A18 19
A19 20
MWR* 52
RESET 61
U4
U6
U8
U10
U12
1
2
3
4
5
R3
R2
R1
10K (x3)
CONN A
C B A
U19
FPLA 22V10
HC138
U14
U17
+5M
+5V 60
DGND 62
34
C1
C2
C3
C4
C5
C6
.047 (x6)



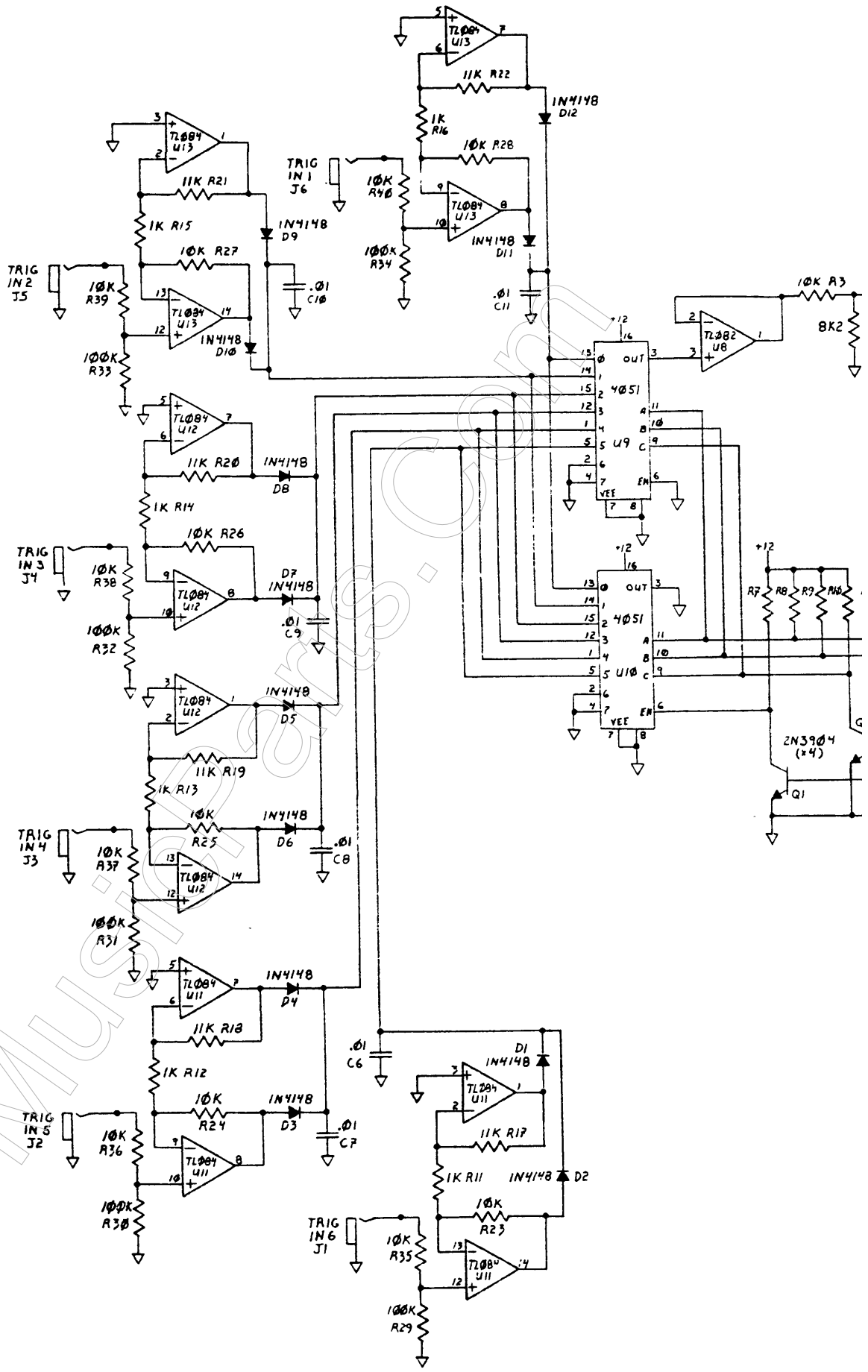
TITLE
SCHEMATIC-SRAM

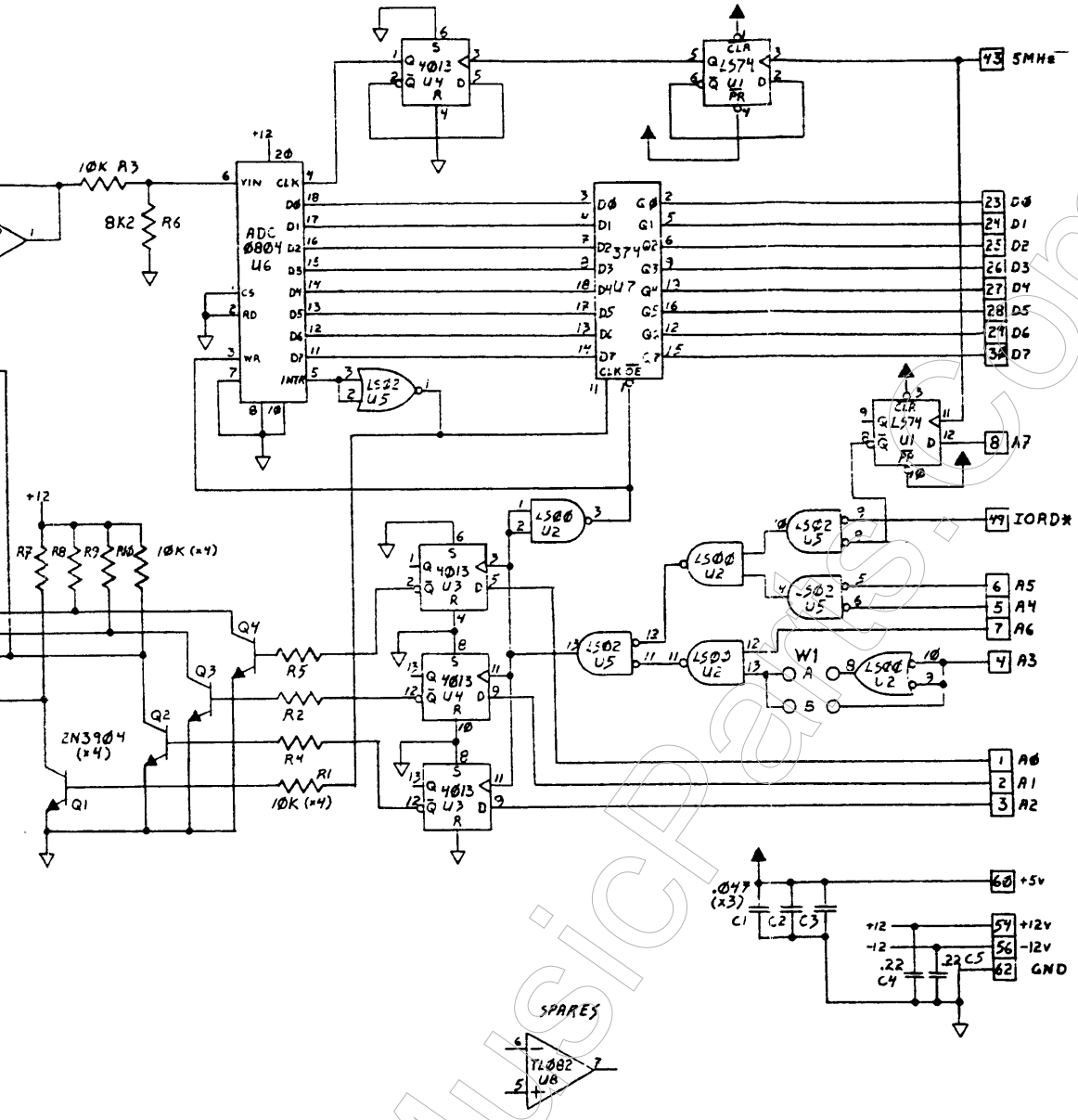
Drawn by BRIMONT Date 2-90 SHEET 1 OF 1

REV	by	Date
A	B. SC	1/25

Project	Category	Number	Revision
2	2	10	

Linn Electronics, Inc.
18720 OXNARD STREET TARZANA CA 91356 (818) 708-8131


TL084 U13
11K R22
1K R16
IN4148 D12
10K R28
TRIG IN 1 J6
10K R40
100K R34
IN4148 D11
.01 C11
11K R21
1K R15
IN4148 D9
.01 C10
10K R27
TRIG IN 2 J5
10K R39
IN4148 D10
100K R33
TL084 U12
11K R20
IN4148 D8
1K R14
10K R26
TRIG IN 3 J4
10K R38
IN4148 D7
.01 C9
100K R32
11K R19
IN4148 D5
1K R13
10K R25
IN4148 D6
.01 C8
TRIG IN 4 J3
10K R37
100K R31
TL084 U11
11K R18
IN4148 D4
1K R12
10K R24
IN4148 D3
.01 C7
TRIG IN 5 J2
10K R36
100K R30
.01 C6
IN4148 D1
11K R17
1K R11
IN4148 D2
10K R23
TRIG IN 6 J1
10K R35
100K R29
TL082 U8
10K R3
8K2
4051 U9
4051 U10
+12
VEE
2N3904 (x4)
Q1
R7
R8
R9
R10



TITLE
TRIGGER

Drawn by: [illegible] Date: [illegible] SHEET 1 OF 1

REV	by	Date
L	RL SCL	[illegible]

Project	Category	Number	Revision
2	2	09	

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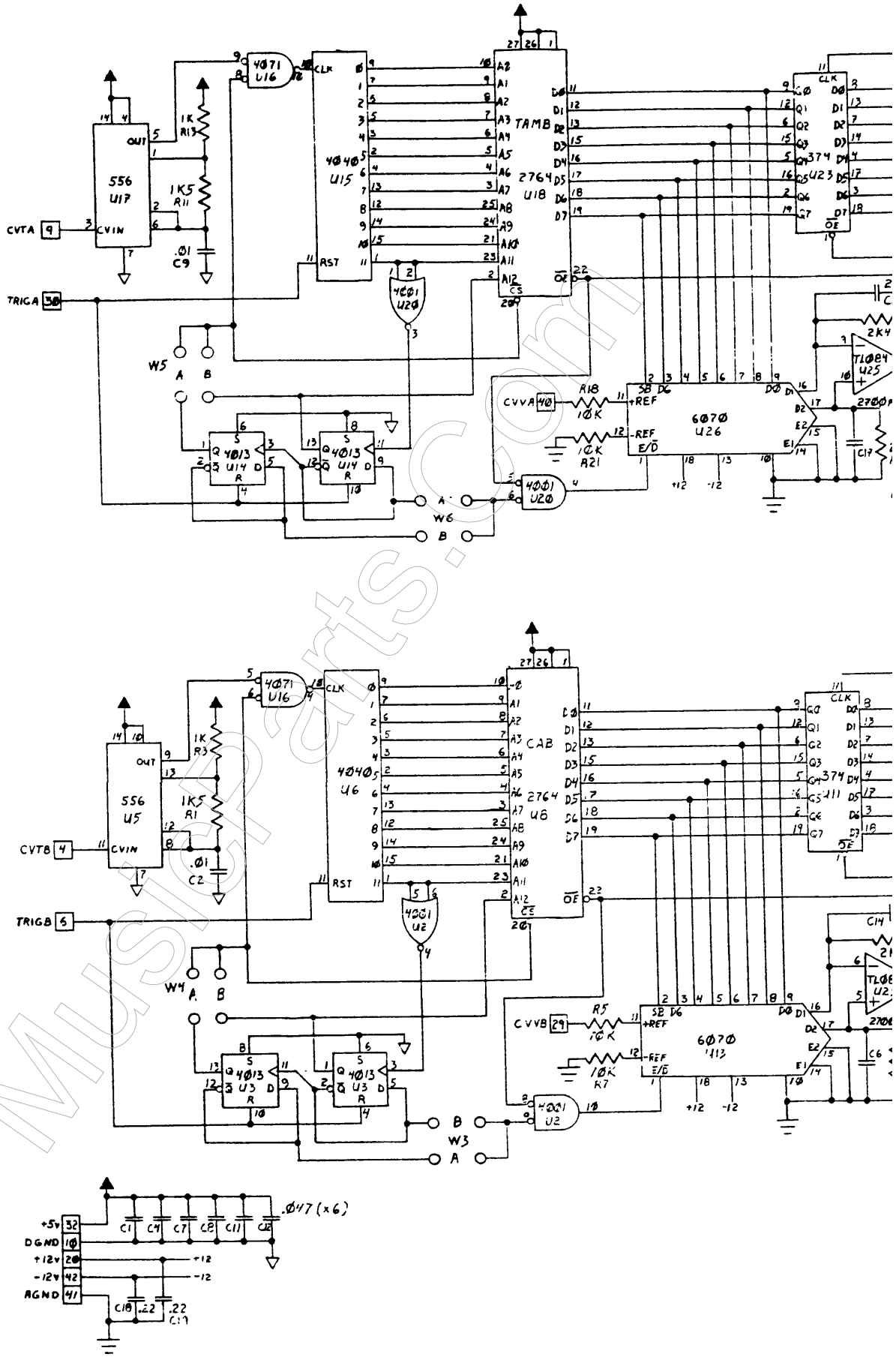
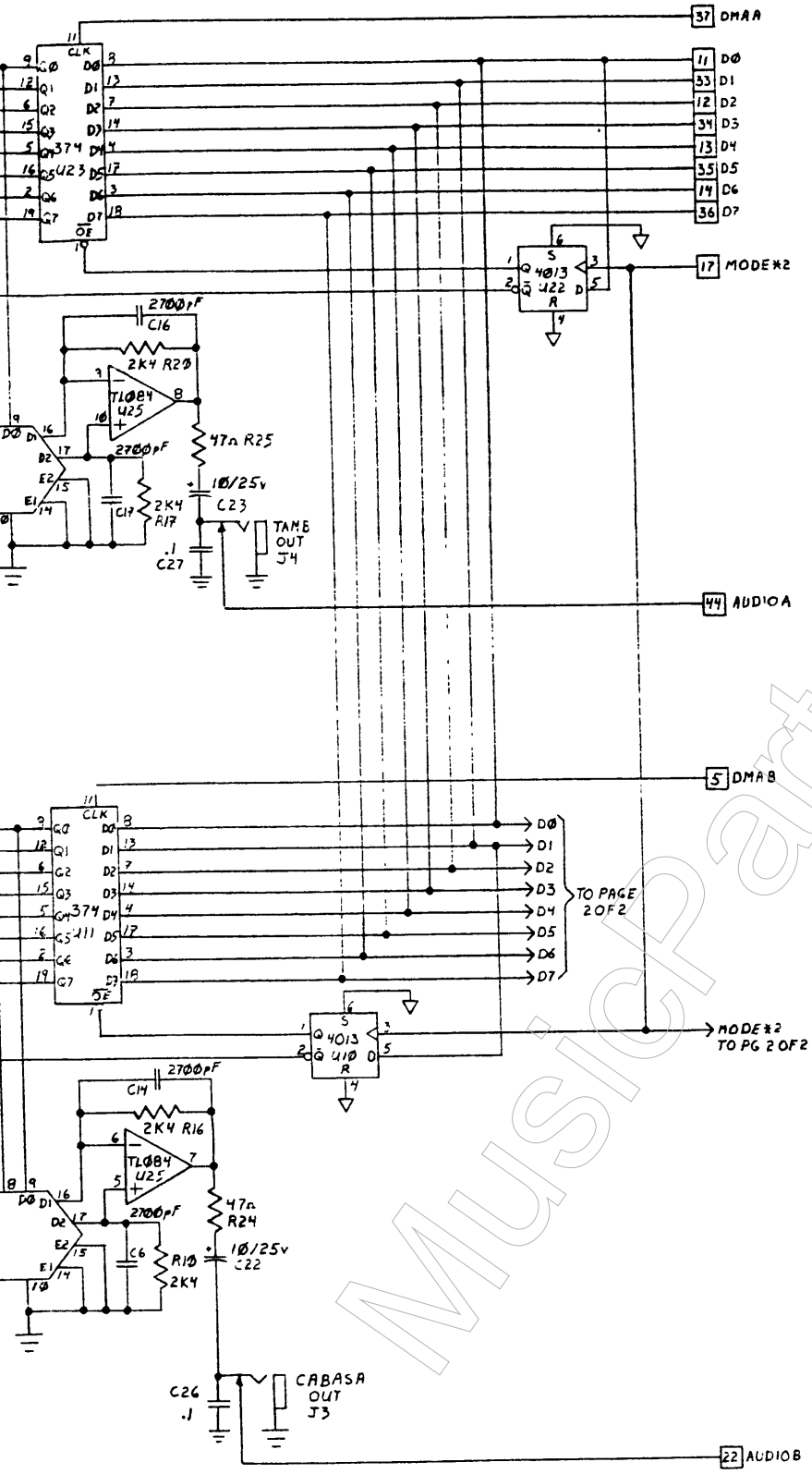

556 U17
1K R13
1K5 R11
.01 C9
CVTA 9
TRIGA 30
4071 U16
4040 U15
TAMB
2764 U18
4001 U20
W5 A B
4013 U14
CVVA 40
R18 10K
R21 10K
6070 U26
+REF
-REF
E/D
+12 -12
TL084 U25
2K4
2700
C17
W6 A B
556 U5
1K5 R1
.01 C2
CVTB 4
TRIGB 6
4071 U16
4040 U6
CAB
2764 U8
4001 U2
W4 A B
4013 U3
CVVB 29
R5 10K
R7 10K
6070 1113
W3 B A
+5V 32
DGND 10
+12V 20
-12V 42
AGND 41
.047 (x6)
C1 C4 C7 C8 C11 C12
C18 .22
C19 .22



TITLE: PERCUSSION

Drawn by B R L Date 2-16-84 SHEET 1 OF 2

REV	by	Date	Project	Category	Number	Revision
A	BRL SC2	1/11/85	2	2	08	A

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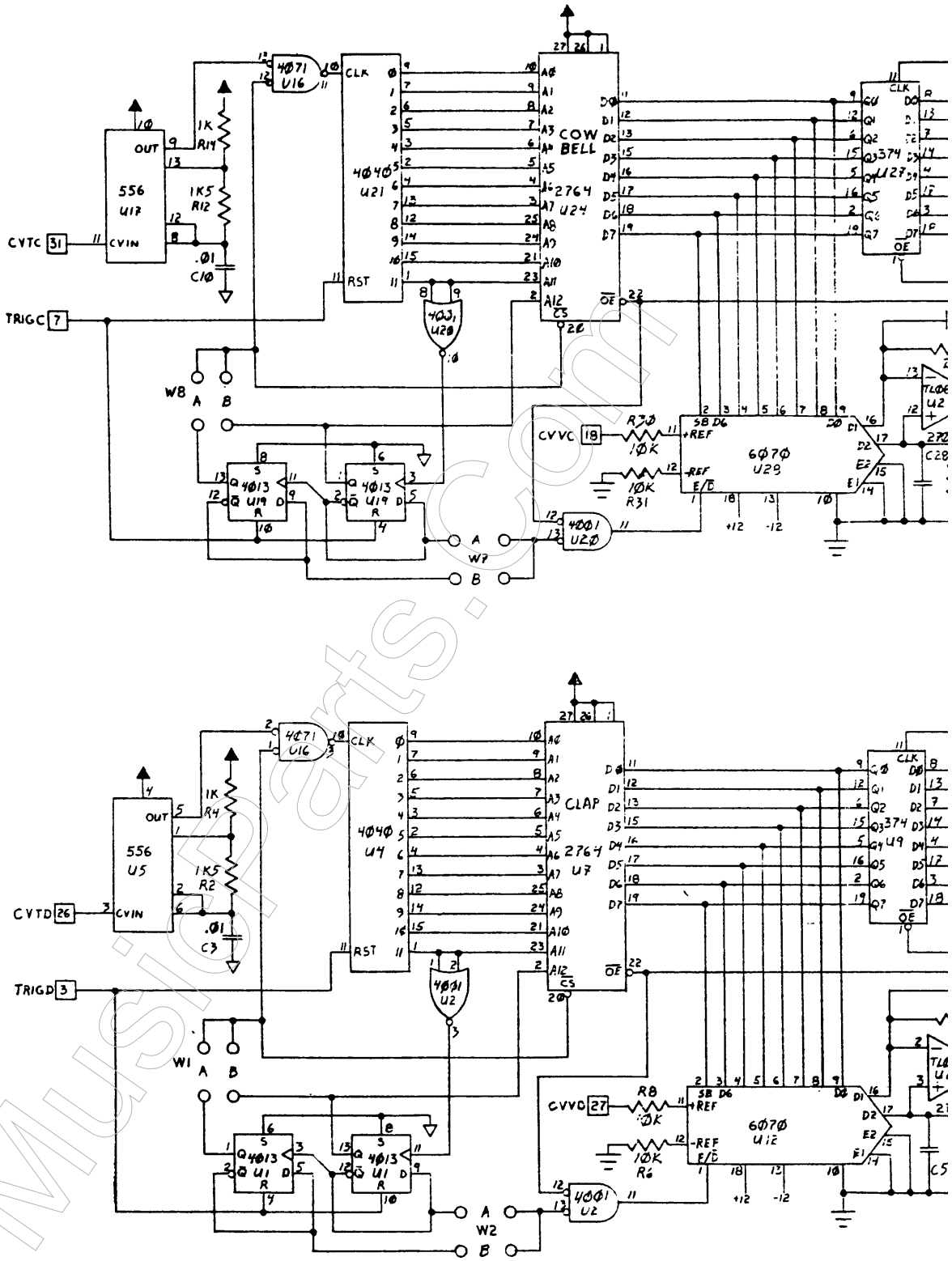

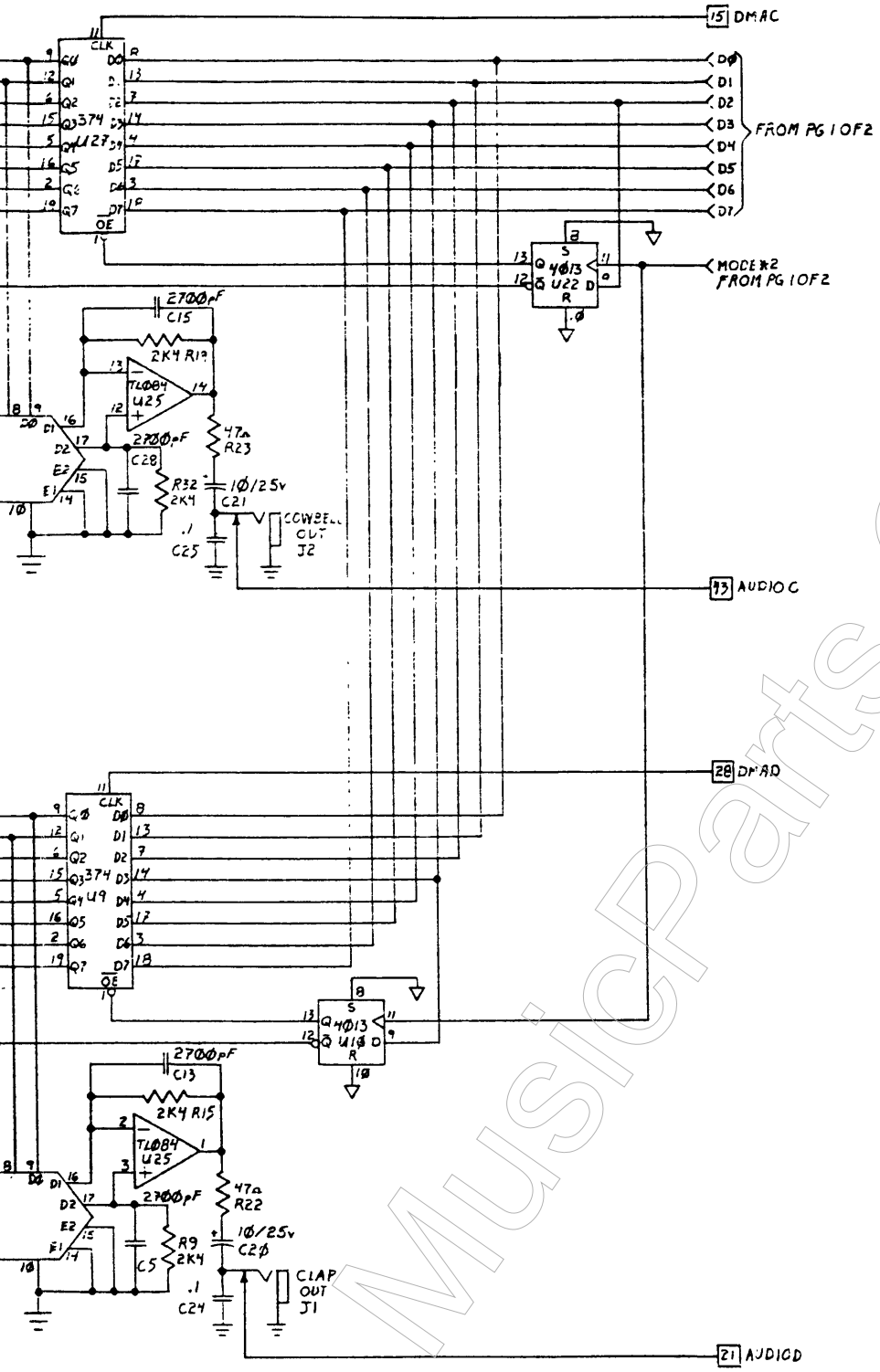

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TITLE
PERCUSSION

Drawn by SC Date 1/11/85 SHEET 2 OF 2

REV	by	Date
A	SC	1/11/85

Project	Category	Number	Revision
2	2	08	A

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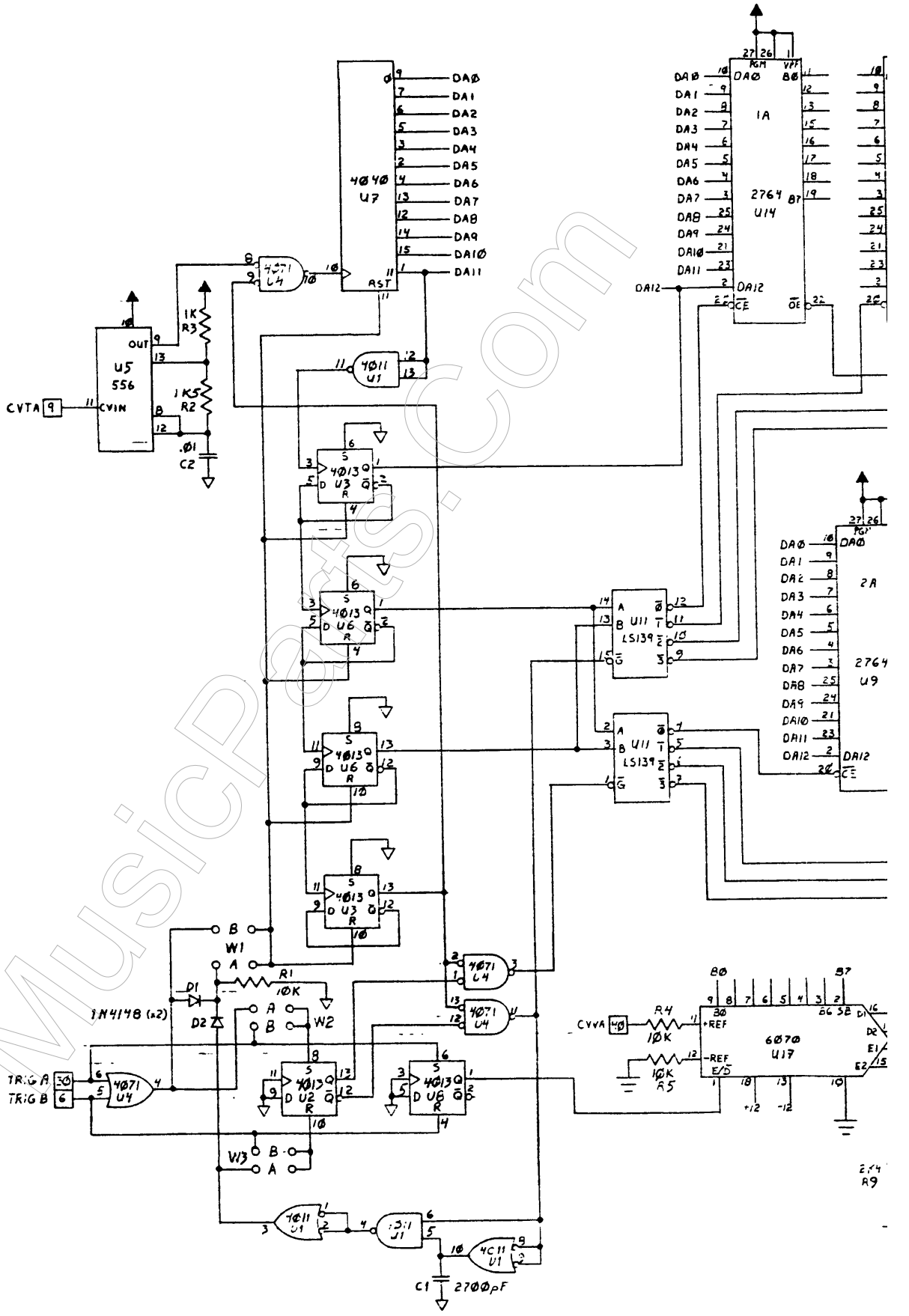
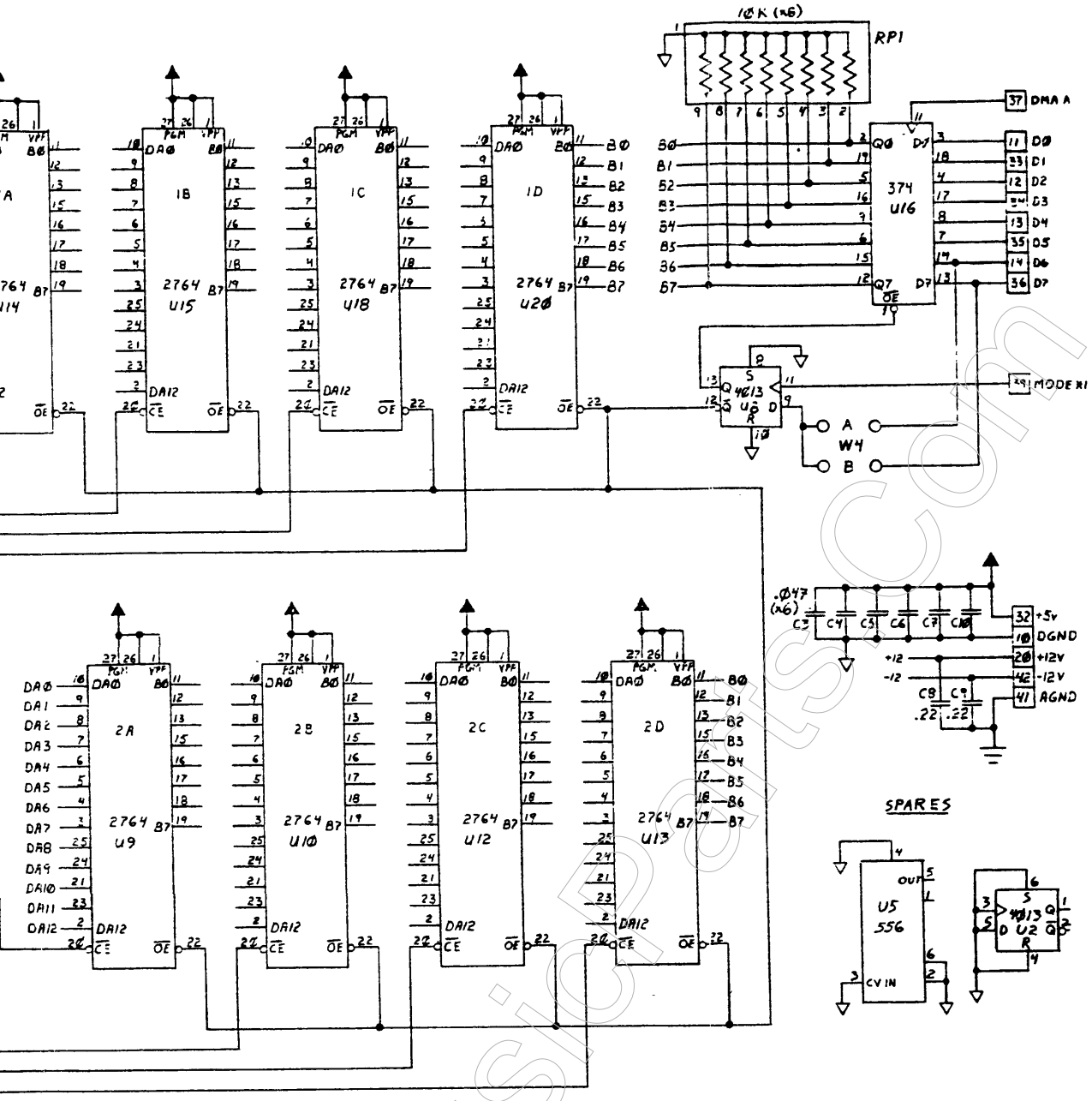
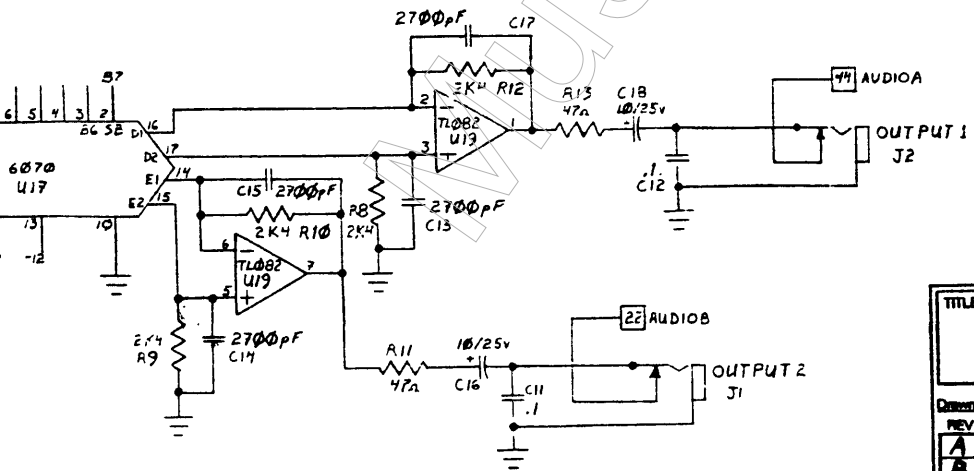




SPARES



TITLE	CYMBAL	
Drawn by	Date	SHEET 1 OF 1

REV	by	Date
A	ECO	10-16
B	ECO	11-9

Project	Category	Number	Revision
2	2	07	B

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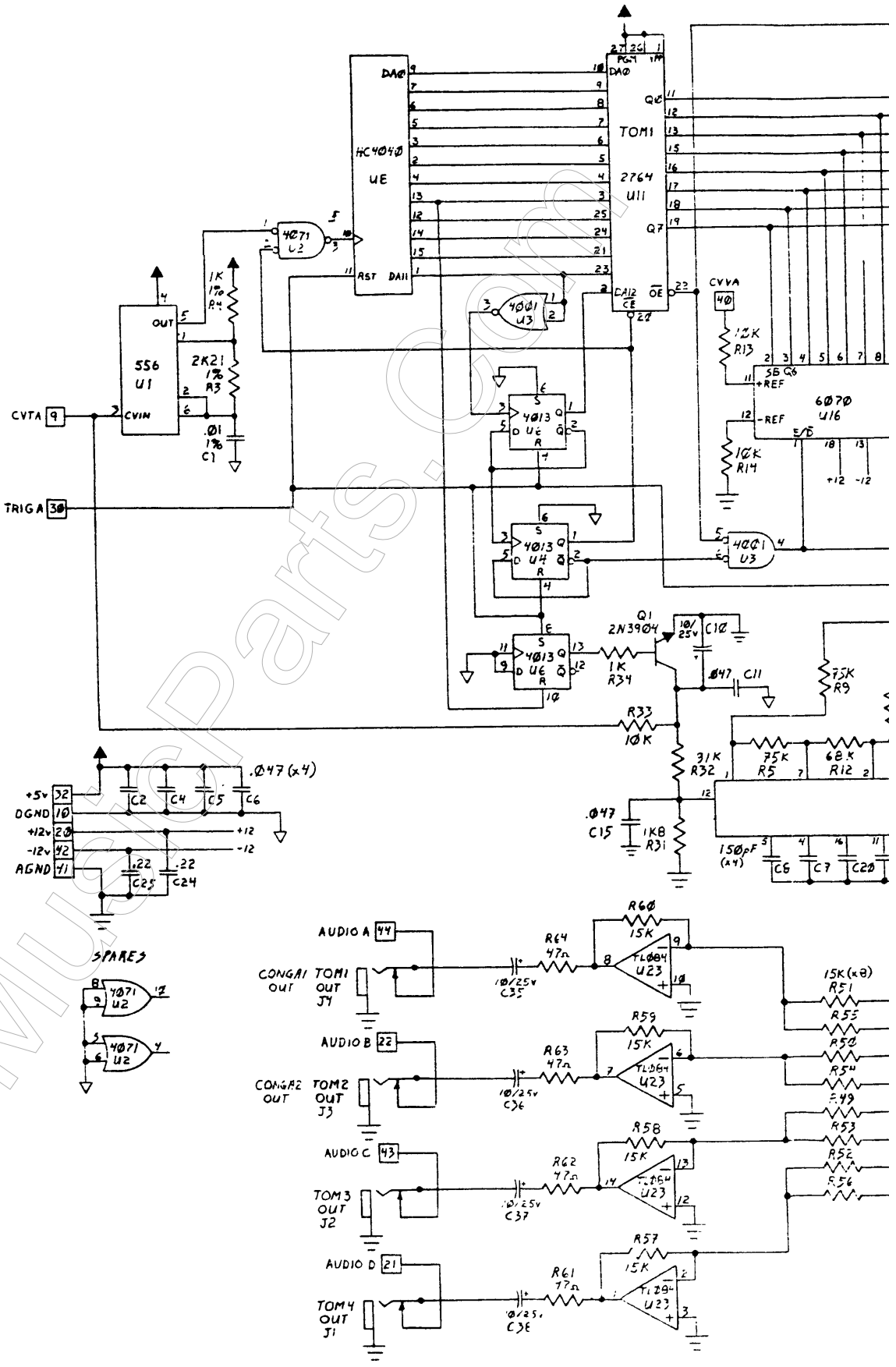
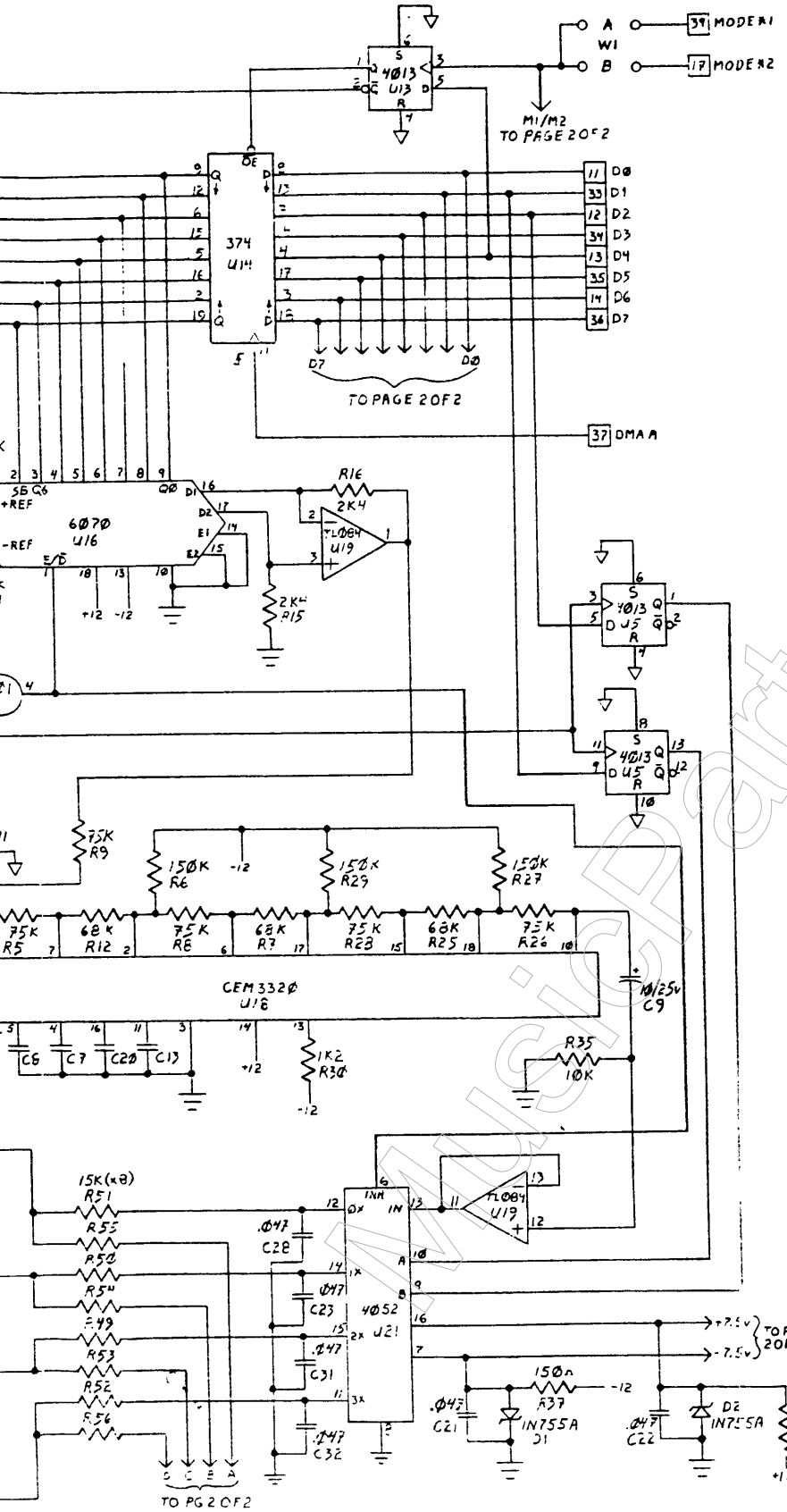

HC4040
U6
TOM1
2764
U11
556
U1
CVTA
TRIG A
CVVA
6070
U16
Q1
2N3904
TL084
U23
SPARES
AUDIO A
AUDIO B
AUDIO C
AUDIO D
TOM1 OUT J4
TOM2 OUT J3
TOM3 OUT J2
TOM4 OUT J1
CONGA1 OUT
CONGA2 OUT
+5v
DGND
+12v
-12v
AGND
.047 (x4)
150pF (x4)
15K(x8)



TITLE: TOM/CGA

Drawn by BP. FIRST Date 2-9-84 SHEET 1 OF 2

REV	by	Date
A	BRL	11/1/85

Project	Category	Number	Revision
2	2	06	A

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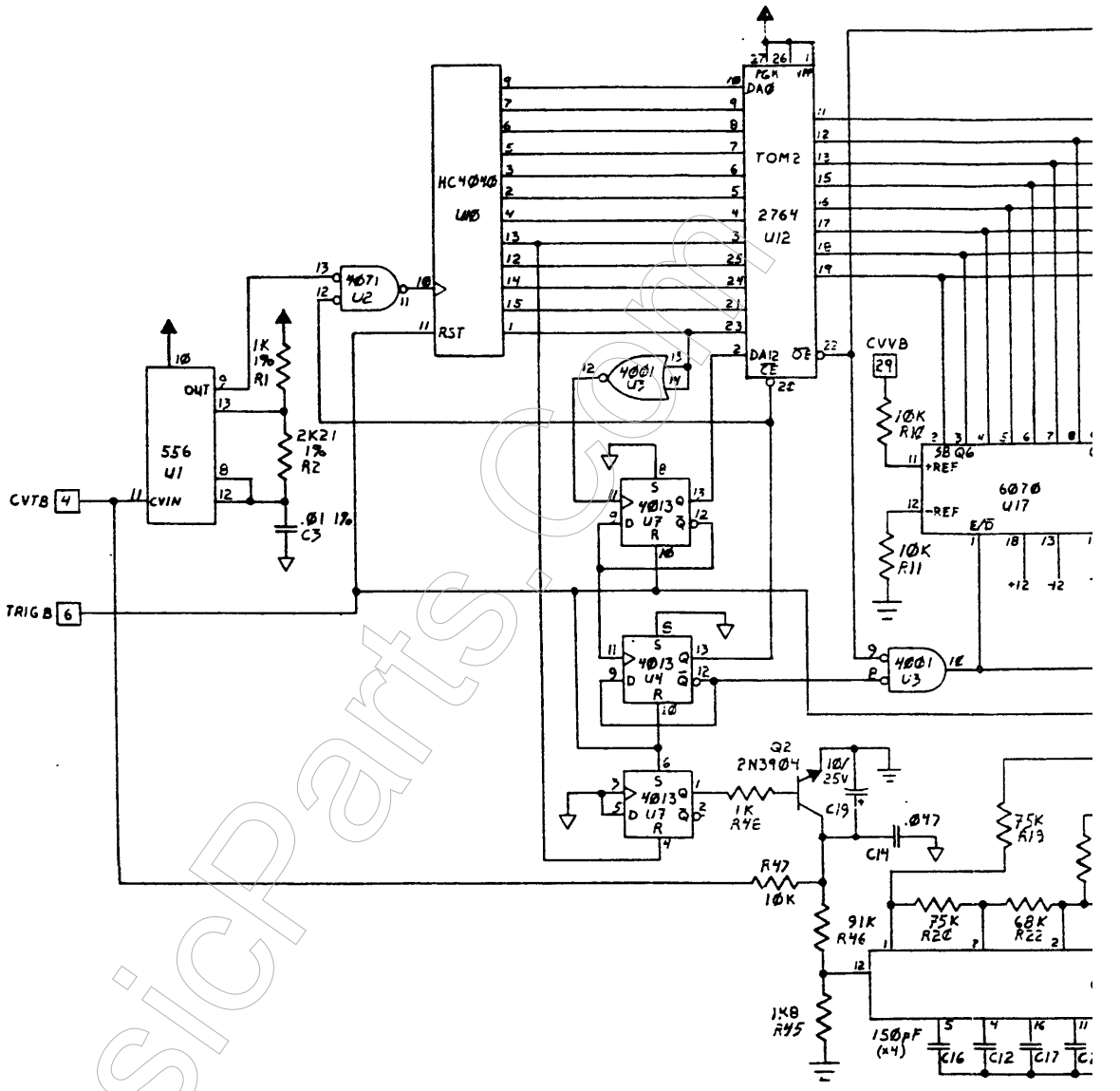
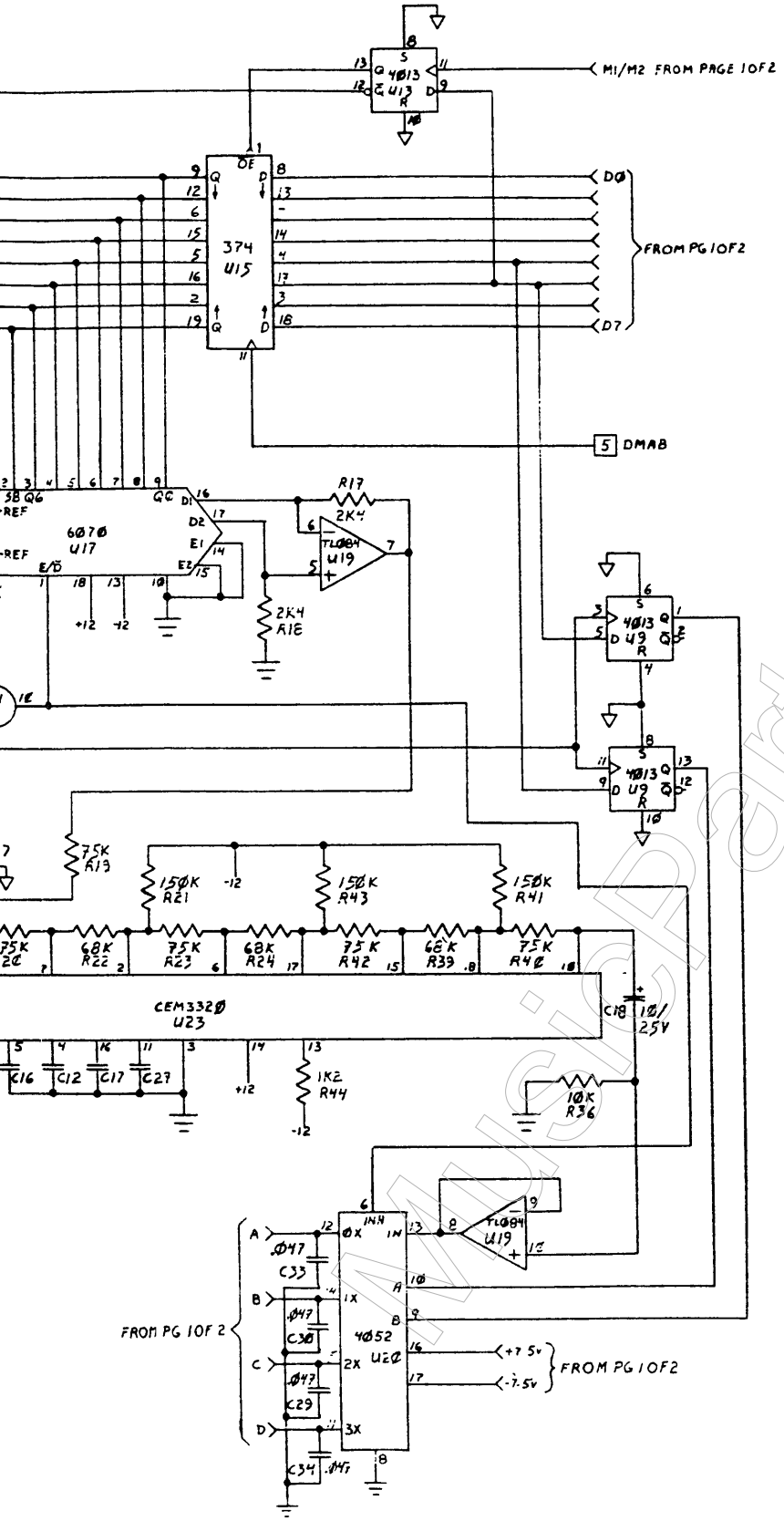


ALL POWER CONNECTIONS FROM PAGE 1 OF 2

FROM



TITLE: TOM/CGA

Drawn by E.R.Lamont Date 2.9.85 SHEET 2 OF 2

REV	by	Date
A	BRL SCA	11.1.85

Project	Category	Number	Revision
2	2	06	A

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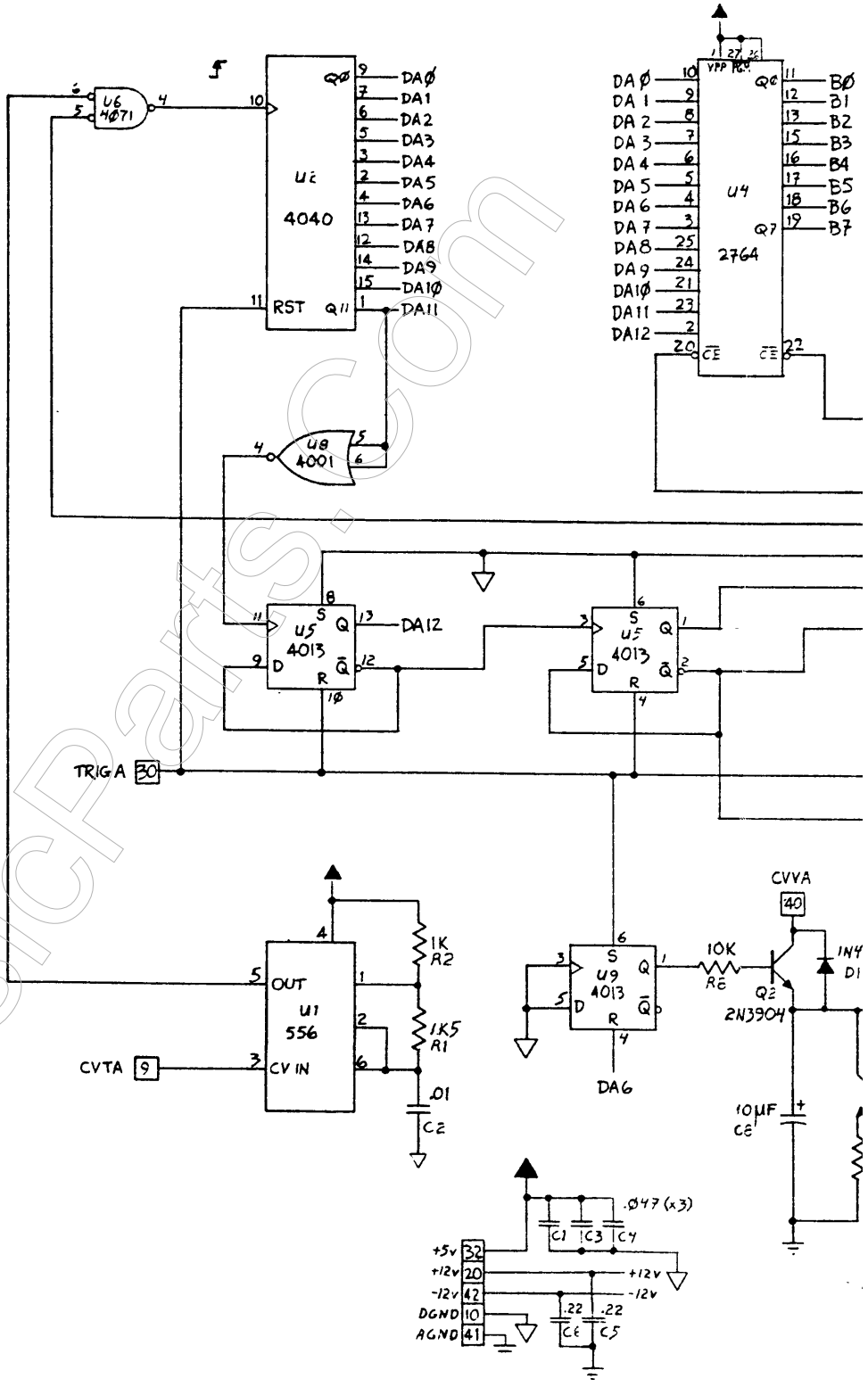

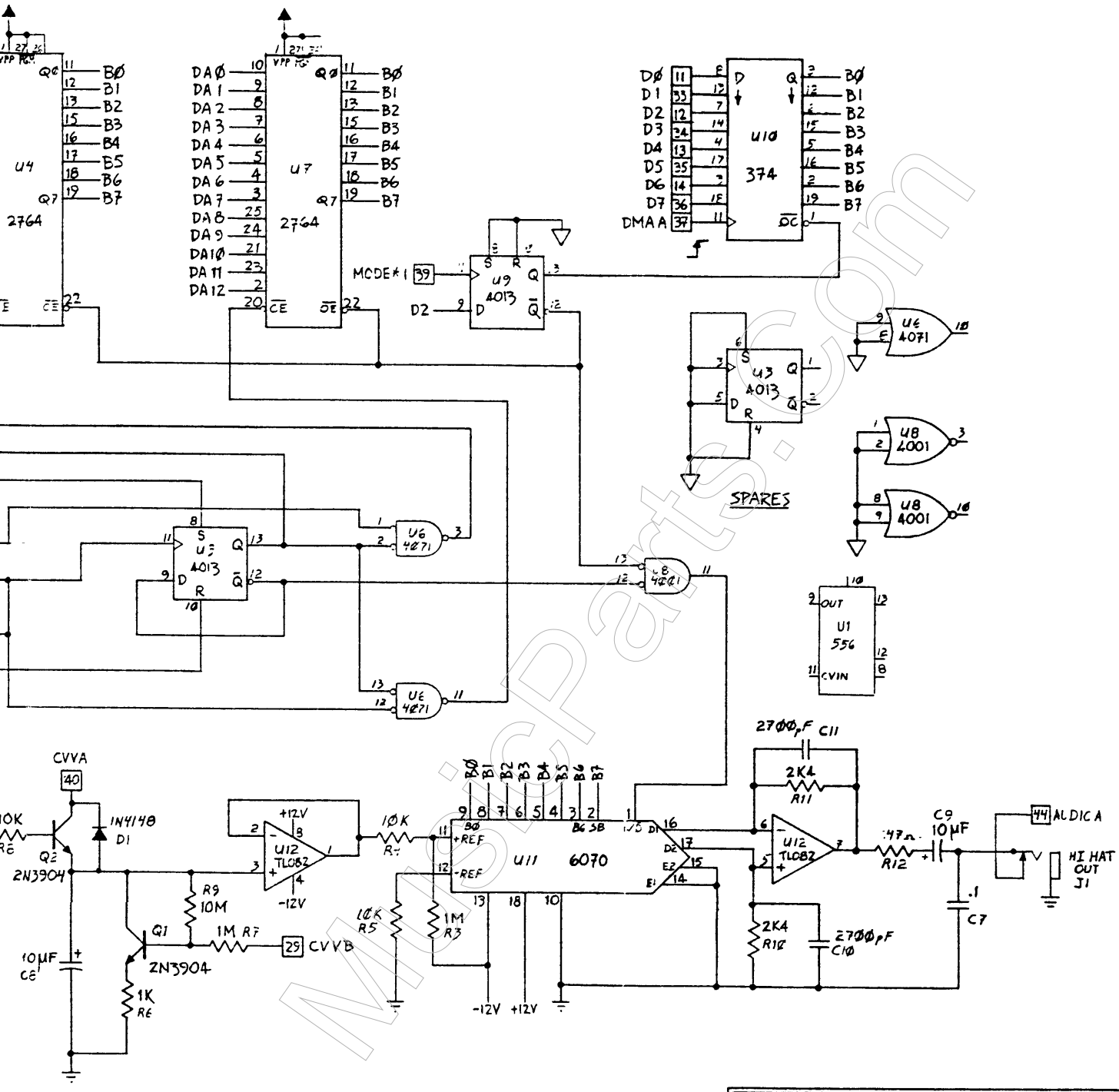

TITLE: HIHAT

Drawn by: [illegible] Date: 2/13/85 SHEET 1 OF 1

REV	by	Date
A	BL SA	1/9/85

Project	Category	Number	Revision
2	2	05A	

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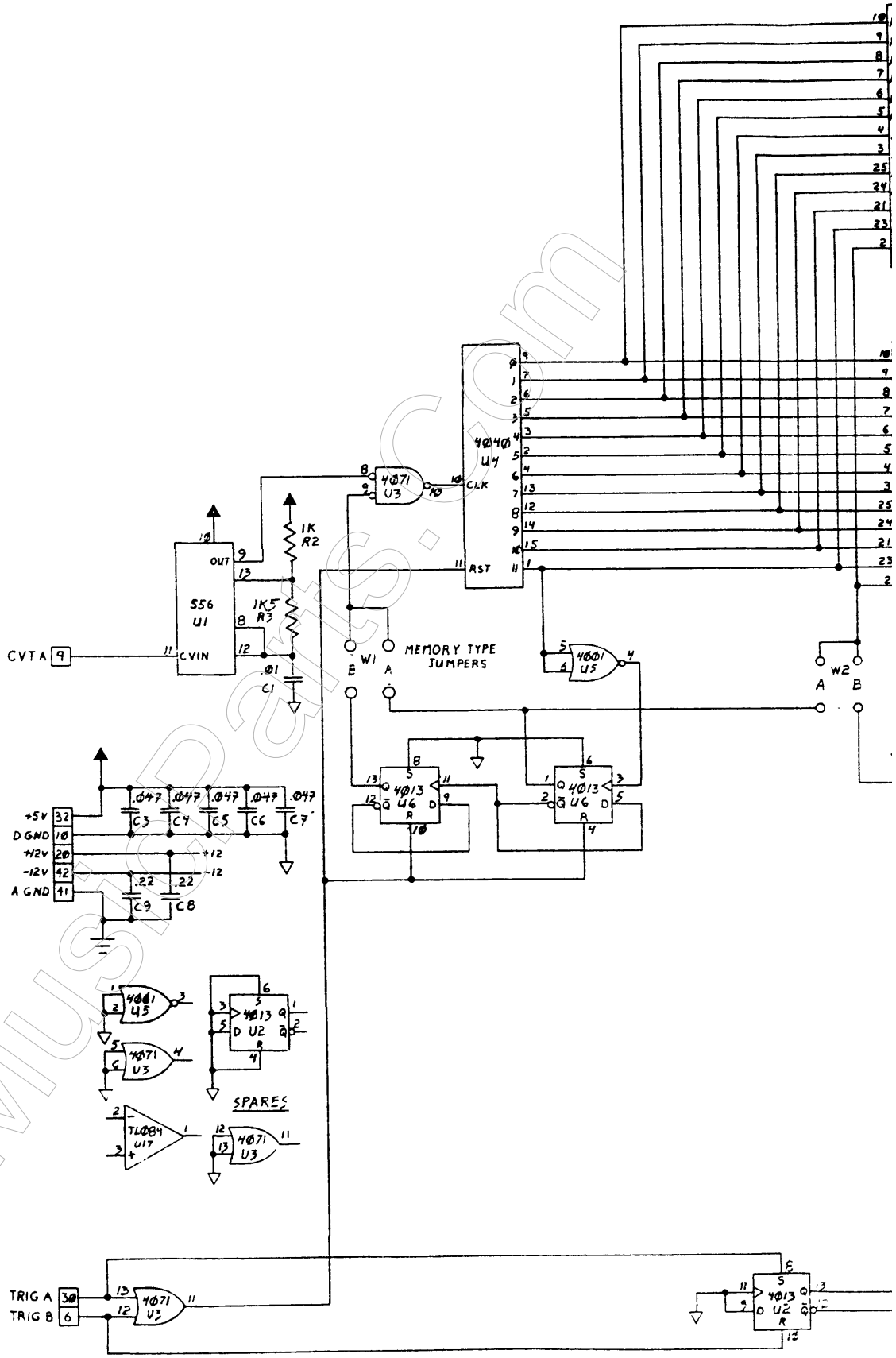
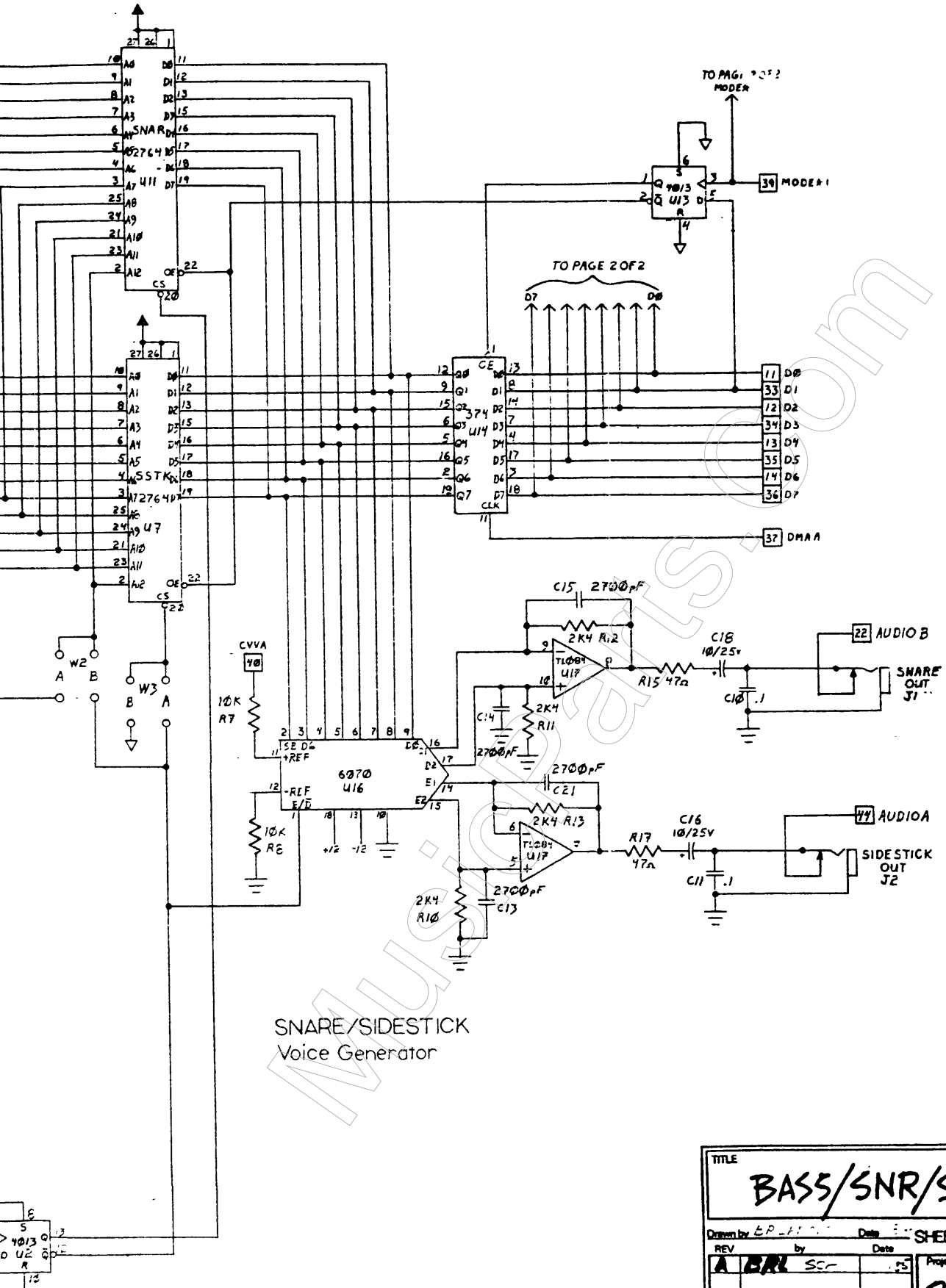

4040
U4
4071
U3
CLK
RST
556
U1
OUT
CVIN
CVT A
1K
R2
1K5
R3
.01
C1
MEMORY TYPE
JUMPERS
W1
W2
4001
U5
4013
U6
+5V
DGND
+12V
-12V
AGND
.047
C3
C4
C5
C6
C7
.22
C9
C8
+12
-12
4001
U5
4071
U3
4013
U2
SPARES
TL084
U17
TRIG A
TRIG B



SNARE/SIDESTICK
Voice Generator

TITLE: BASS/SNR/STK

Drawn by EP Date SHEET 1 OF 2

REV	by	Date
A	BRL SCC	.25

Project	Category	Number	Revision
2	2	04	A

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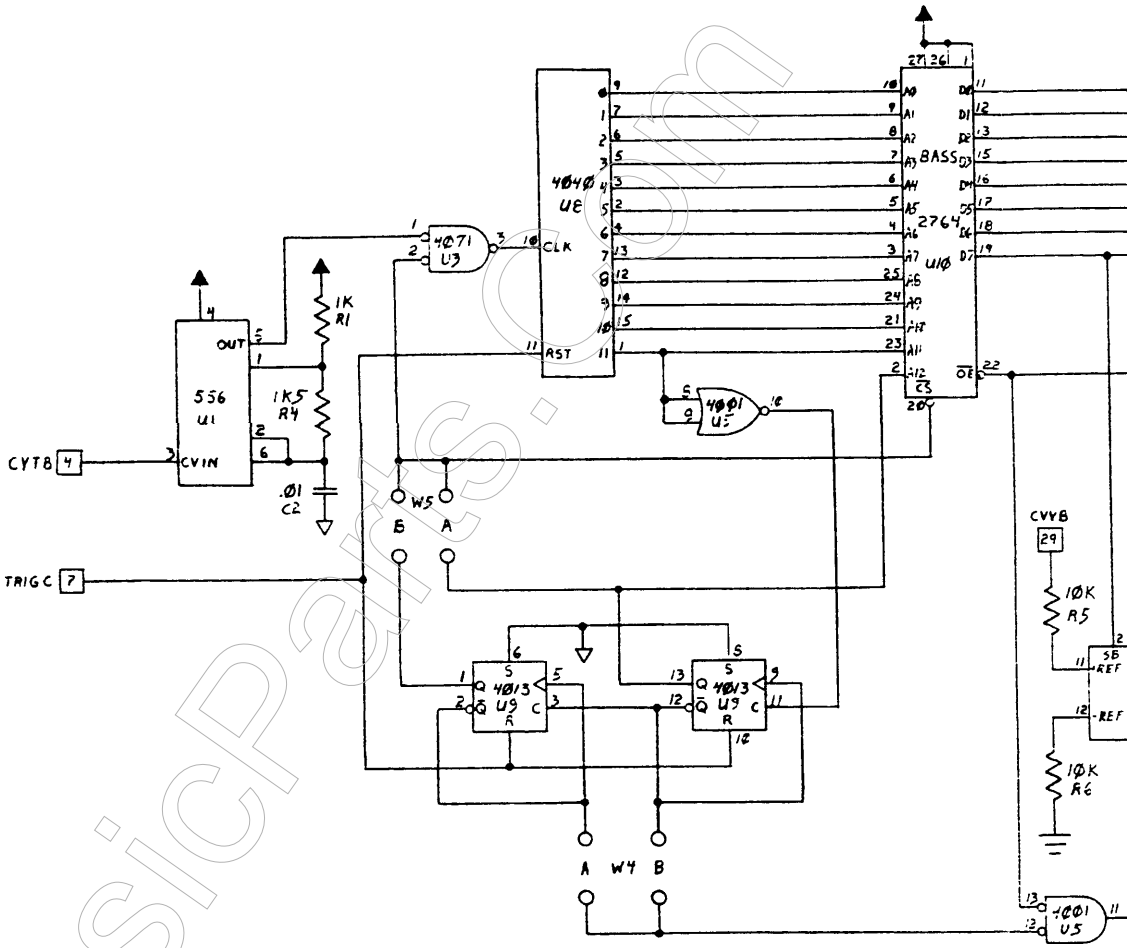
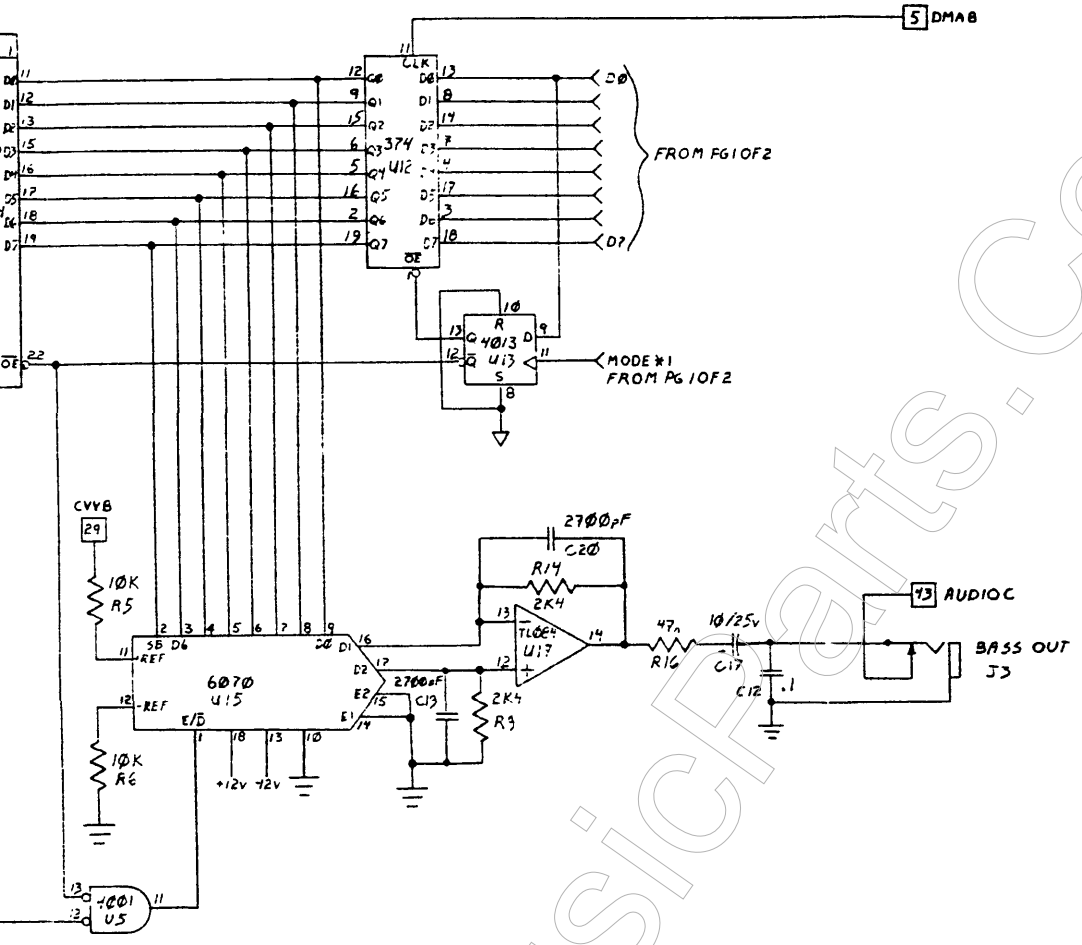


BASS
Voice Generator

ALL P



ALL POWER CONNECTIONS FROM PAGE 1 OF 2

TITLE: BASS/SNR/STK

Drawn by: [illegible] Date: [illegible] SHEET 2 OF 2

REV	by	Date
A	RRL	[illegible]

Project	Category	Number	Revision
2	2	04	A

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