Linn

LM-1 Drum Computer
Service Schematics

SERVICE NOTES FOR LM-1 DRUM COMPUTER

There are 3 versions of the LM-1 Drum Computer:

Version 1: These first units have the master volume control in the upper left corner of the front panel, and only 1 LED in the "Record Drumbeat" section.

Version 2: These units have the master volume control in the top center of the front panel, and 13 LEDS in the "Record Rhythm Pattern" section. All boards were redesigned, schematics redrawn.

Version 3: Same as Version 2, except:

a) Internal clock rotary switch removed from rear panel - internal clock frequency is instead set by "Auto Correct" setting.

b) Record/Safe Switch removed from rear panel.

c) "External Clock In" jack removed from rear panel

d) "Main Output Lo" jacks removed from rear panel.

There is a pair of schematics and service notes for Version 1, and another pair of schematics and service notes for Versions 2 and 3. Each version has it's own software. The correct software revisions are: 1.1, 2.1, and 3.1, respectively.

SERVICE NOTES FOR LM-1 DRUM COMPUTER VERSION 1

(Units with master volume control in upper left corner of front panel)

The LM-1 is a microcomputer-based device using the Zilog Z80 microprocessor. It consists of 5 circuit boards:

LM1-A/Keyboard--Contains key switches, discrete leds, and tempo pot.

LM1-B/Display board--Contains two dual-digit numeric led displays. LM1-C/Mixer board--Contains 13 slide pots, master volume, summing and output amps.

LM1-D/CPU board--Contains microprocessor, program roms, rams, and all input/output driver circuitry.

LM1-E/Voice board--Contains all drum voice generators.

ALL CIRCUITRY IS CONTAINED IN TWO SCHEMATICS:

#1) Includes LM1-D, LM1-A and LM1-B.
#2) Includes LM1-E, LM1-C.

Circuit description of schematic:
Looking at left side of drawing, IC5 is the microprocessor, A ZILOG Z80 (or equivalent). IC11 and IC12 buffer the address buss lines A0-A11. IC13 and IC49 split the Z80's bi-directional data buss into an 8-BIT buffered input buss, and an 8-BIT buffered output buss. IC's 1, 2, 3 and 4 are used to decode the memory and I/O enable lines from the Z80's A10, A11, A12, A13 and memrq lines. The computer's control program is contained in roms IC30, IC31, and IC59. M1-M8 are 4k X 1 CMOS rams, and M9-M16 are sockets for 8 more (memory expansion). IC51, IC52 and IC53 (on the fix board) comprise the power-fail, memory protect, and reset circuits, which work as follows: The +10V signal at the power connector is taken from the input to the main +5V regulator, which is also provided at the power connector. The idea behind the power-fail circuit is that if the +5V logic supply is going to fail, this +10V signal will fall first, giving a warning. The power-fail signal is produced by pin 8 of IC53--when it goes high, the chip enable and write signals to the rams are disabled, protecting volatile memory during power down. At this point, the rams are kept active by the nickel cadmium batteries (totaling approximately +3.6V) which are trickle charged by the 7805--the CMOS +5V supply. The reset signal to the Z80 is also forced low, causing a CPU re-initialization when power is re-applied. The power-fail trimpot (connected to pin 9 of IC53 sets the threshold at which the power-fail signal sets.

The system clock is a rat-race type, oscillating at 14.318 MHZ, which is divided in 8 by counter 1C48. Tempo oscillator, foot switch, record/safe switch, tape storage PLL output, and internal clock out select switch are sensed by input port IC44. Keyboard status is provided by input port IC37. Discrete led's

on keyboard are driven by octal latch IC10 and buffer IC36. Dual digit displays are driven by octal latches IC8 and IC9, and 7-segment decoders IC32, IC33, IC34, and IC35. Enable lines for aforementioned input port (IC44) and output latches (IC latches (IC8, IC9 and IC10) as well as PLAY DRUM enable signals are provided by IC40 and IC41 (3 to 8 line decoders)

IC45 and IC47 are identical single chip phase locked loops (XR 2211) used to decode frequency shift keying (FSK) signals from the tape sync and tape storage inputs, respectively. Both signals shift between 1.3 KHZ and 2.1 KHZ, so the PLL's VCOS should be set to 1.7 KHZ (halfway between 1.3 KHZ and 2.1 KHZ). Both FSK signals are generated by a single chip FSK oscillator with sine wave output, IC43 (XR 2206).

Another XR 2206 (IC42 is used as the tempo oscillator. It's square wave output, divided down by counter IC48, is sampled by input port IC44.

Setting of the trimpots(these should not require adjustment in the field):

1) Power fail threshold (located on "fix" board - mounted to rear of CPU board) --This requires a variable voltage AC power source. Plug the LM-1 into the variable voltage source and set to the normal 120V (or 240V). Now, while typing numbers on the front panel, (to see if the computer is still responding) slowly decrease the voltage. The computer should shut off at approximately 90VAC (180VAC)--the displays will no longer echo the numbers typed. Now, slowly increase the voltage. The computer should re-initialize at approximately 100VAC (200VAC). This 10VAC of hysteresis is provided by the 62k resistor around IC56. If your LM-1 does not shut off and on at these voltages, carefully adjust trimpot near IC56.

2) FSK oscillator freq: IC43 (XR 2206) provides the sine wave output for tape storage and tape sync FSK (frequency shift keying) data. The lower frequency should be 1.3KHZ. This can be adjusted by the trimpot next to IC43 which is closer to the rear of the LM-1. Pushing load on the front panel will cause the oscillator to produce its higher frequency, which is 2.1.KHZ. This can be adjusted with the other of the two trimpots.

3) Phase locked loop freq: IC45 and IC47 are two identical circuits using the single chip FSK decoder, the XR 2211, to decode the tape sync and tape storage signals,respectively, The freq of its free running VCO should be exactly between the FSK frequencies, or 1.7 KHZ. To check this, short pin 2 to pin 10 and measure the freq at pin 3. It can be adjusted with the trimpot nearby.

Operation of drum generators:

There are eight drum generators, and one click generator on the voice board LM1-C2. The click generator is simply a 556 dual one-shot (one for the loud click and one for the soft)--IC72.

The eight drum generators are:

1) Clave/Cowbell
2) Toms
3) Claps
4) Hi-Hat
5) Cabasa/Bass
6) Tambourine
7) Snare (identical to tambourine)
8) Congas (identical to toms)

The generators are basically the same with subtle differences tailored to each particular drum. The most straightforward is the claps generator:
A play claps strobe is generated on the CPU board and arrives at pin 3 of IC24, the clock input of a 74LS74 dual latch. On its rising edge, the data input (pin 2) is sampled, which is connected to data output buss bit 0. If a 1 is sampled, pin 6 goes lo (Q output). This starts the count of the 74LS393's (dual 4-bit ripple counters) at a rate determined by IC10 (an XR2206 oscillator,controlled by the rear panel clap pitch pot). The counters are connected for a 12 bit count (11 bits to address all 2048 words contained in a 2716 2048-word prom; and a 12th bit which is inverted by IC8 and resets latch IC24 to disable counters. The output of the prom is passed to the multiplying D/A converter IC50 (AM6070DC), whose output is the product of the digital input and the current input, pin 11. The differential current outputs, pins 16 and 17, are converted to a voltage by IC73 (4558 OPAMP), and the output is routed to the output connector.

Clave/Cowbell--These generators use only one 2716 for each sound (2048 words, 11 bits each), so are able to share a 74LS393.

Tambourine--In this generator, the latch, IC7, also samples data out buss bit 1. The corresponding output, pin 9, sums into the current input of the D/A converter, IC70 to provide a selection of loud or soft play volume.

Snare--Identical to tambourine.

Cabasa/Bass--Similar to clave/cowbell, except 2 volume circuitry used in tamb is implemented.

Toms--This generator can play a tom-tom at one of two pitches. Operation is as follows: Data buss bit 1 contains the pitch data (Hi=High pitch, Lo=Lo pitch). This data is passed to the output (pin 9) of latch IC5 on the rising edge of the play strobe at pins 3411. This signal causes oscillator IC6 to select between the pitch control resistors connected to pins 7 and 8. This signal also causes the D/A converter, IC58, to select either output pins 14 and 15 or output pins 16 and 17. This produces a high tom-tom at IC70 pin 1 and a low tom-tom at IC70 pin 7.

Congas--Same as toms.

Hihat--In this generator, the counters (IC25 and IC26 are always counting, so digital words are always being received at the D/A converter (IC62). To produce output, IC75 (TL082) pin 1 must produce an output positive voltage to feed the current input of the D/A, pin 11. The envelope produced by IC61 and IC75 can be small or large (loud or soft hihat) depending on the state of IC61 pin 5, the true output of a 74LS74 dual latch. The input of this latch is connected to data output buss bit 1, providing volume information. In addition, the envelope can be long or short decay (open or closed hi-hat), depending on the state of IC74 pin 8. The data input to this half of the latch pin 12, is connected to the data output buss bit 2, which provides open/closed hihat information. If a 0 is sampled at pin 12,IC74, a 1 will appear at pin 8 (Q not output), turning transistor ON and discharging envelope capacitor quickly through hihat decay pot. If state at pin 12 were 1, capacitor would be discharged slowly through 2.2 meg resistor (open hihat).

GETTING TO P.C. BOARDS FOR REPAIR:

CPU board--All that is necessary is to remove top by removing 6 black screws, then removing CPU board (if necessary) by removing 4 retaining screws. Important: If power connector is removed from CPU board, all memory will be lost! Also, if power connector is removed and reconnected to CPU board, power switch may have to be turned on and off up to 4 times before LM-1 will initialize properly.

Front panel boards-- Remove top,then remove wood sides with 8 screws, then remove front panel with 6 screws and nuts located at bottom front. NOTE: Nuts are loose inside. NOTE: On earliest units with ventilation holes on top, front panel does not remove.

Voice board--Remove top, unscrew CPU board, place insulating sheet over power supply, and fold CPU board over and rest it on insulating sheet. If voice board needs to be removed., remove 4 hex spacers, unplug all connectors from voice board, pull forward, and lift out.

POSSIBLE PROBLEMS AND SOLUTIONS:

Memory loss:

1) Check voltage at batteries. It should read approximately 3.6V. If lower, turn the LM-1 on for a day or two to charge them back up.
2) Check battery drain from rams--with power off, drain from battery should be no more than 200 microamperes. If it is, find the high current ram and replace it.
3) Check power fail circuitry:
   A) IC5 pin 26 should be high with power on, low with power off.
   B) Rams pins 10 and 8 should show battery voltage with

power off.

4) Test for hard memory errors:
   A) Turn on LM-1
   B) Press **chain on/off**
   C) While holding **record**, press **last entry**, then release
   D) If **drumbeat #** display blinks, it is blinking the number the bad ram (M1-M16). Otherwise no hard errors were found.

Tape won't load:

1) Read **tape storage** section of manual throughly.
2) Check PLL frequency (described earlier) IC47.
3) Make sure signal is getting to pin 2, IC47.

LM-1 won't initialize:

Proper power initialization is indicated by all leds turning off except **drumbeat #** display, which should show 00. If it doesn't (after powering on and off 3 or 4 times):

1) Check reset signal: Pin 26, IC5 should go high approximately 1/2 second after power-on, and go low on power-down.
2) Look for illegal logic levels around computer busses and control lines.
3) Is clock getting to U5, pin 6?

Buttons are bouncing:

1) Carefully remove cap of bad button from front panel by gently prying it off with screwdriver. Important: spring will pop out!
2) Clean contacts
3) Replace cap

SERVICE NOTES FOR LM-1 DRUM COMPUTER VERSIONS 2 AND 3

(Units with master volume in top center of front panel)

The LM-1 is a microcomputer-based device using the Zilog Z80 Microprocessor. It consists of 6 circuit boards:

LM1-A/keyboard--contains key switches, discrete leds, and tempo pot.

LM1-B/display board--contains two dual-digit numeric led displays.

LM1-C2/mixer board--contains 13 slide pots, master volume, summing and output amps.

LM1-D2/CPU board--contains microprocessor, program roms, rams, and all input/output driver circuitry.

LM1-E2/voice board--contains all drum voice generators.

LM1-F/input-output board--one half of board holds jacks and switches which connect to CPU board. The other half holds all audio output jacks and connects to voice board.

All circuitry is contained in two schematics:
#1) Includes LM1-D2, LM1-A, LM1-B, and half of LM1-F.
#2) Includes LM1-E2, LM1-C2, and other half of LM1-F.

Circuit description of schematic #1:
Looking at left side of drawing, U5 is the microprocessor, a Zilog Z80 (or equivalent). U11 and U12 buffer the address buss lines A0-A11. U13 and U49 split the Z80`s bi-directional data buss into an 8-bit buffered input buss, and an 8-bit buffered output buss. U53 is a dual 2 to 4 line decoder which is used to decode the memory and I/O enable lines from the Z80`s A10, A11, A12, A13 and memrq lines. The computer`s control program is contained in roms U30, U31, and U59. M1-M8 are 4K X 1 CMOS rams, and M9-M16 are sockets for 8 more (memory expansion). U55, U56, and U57 conprise the power fail, memory protect, and reset circuits, which work as follows: The input to the +5V regulator appears at the power connector, labled "+10V". In the event of a failure, the +10V signal will start to fall before the +5V supply fails giving an early warning. The power-fail signal is produced by pin 13 of U57--When it goes high, the chip enable and write signals to the rams are disabled, protecting volatile memory during power down. At this point, the rams are kept active by the nickel cadmium batteries (totaling approximately +3.6V) which are trickle charged by the 7805--the CMOS +5V supply. The reset signal to the Z80 is also forced low, causing a CPU re-initialization when power is re-applied. The power-fail trimpot (connected to pin 5 of U56) sets the threshold at which the power-fail signal sets.

The system clock is a rat-race type, oscillating at 3.57 MHZ, divided in half and squared by latch IC6.

Tempo oscillator, foot switch, record/safe switch (Version 2

only), tape storage PLL output, and internal clock out select switch (Version 2 only), are sensed by input port U44.

Keyboard status is provided by input port U37, discrete LED's on keyboard are driven by 2 octal latches, U10 and U50, buffer U36 and two 3 to 8 line decoders, U51 and U52.

Dual-digit displays are driven by octal latches U8 and U9, and 7-segment decoders U32, U33, U34, and U35. Enable lines for aforementioned input port (U44) and output latches (U8, U9, U10, an U50) as well as "play drum" enable signals are provided by U40 and U41 (3 to 8 line decoders).

U45 and U47 are identical single chip phase locked loops (XR 2211) used to decode frequency shift keying (FSK) signals from the tape sync and tape storage inputs, respectively. Both signals shift between 1.3KHZ and 2.1KHZ). Both FSK signals are generated by a single chip FSK oscillator with sine wave output, U43 (XR 2206).

Another XR 2206 (U42) is used as the tempo oscillator. Its square wave output is sampled by input port U44.

Setting of the trimpots (these should not require adjustment in the field):

1) Power Fail Threshold(located near M9)--this requires a variable voltage AC power source. Plug the LM-1 into the variable voltage source and set to the normal 120V (or 240V). Now, while typing numbers on the front panel (to set if the computer is still responding), slowly decrease the voltage. The computer should shut off at approximately 90VAC (180VAC)--The displays will no longer echo the numbers typed. Now, slowly increase the voltage. The computer should re-initialize at approximately 100VAC (200VAC). This 10VAC of hysteresis is provided by the 62K resistor around U56. If your LM-1 does not shut off and on at these voltages, carefully adjust trimpot near U56.

2) FSK oscillator freq: IC43 (XR 2206) provides the sine wave output for tape storage and tape sync FSK (frequency shift keying) data. The lower frequency should be 1.3KHZ. This can be adjusted by the trimpot next to IC43 which is closer to the rear of the LM-1. Pushing load on the front panel will cause the oscillator to produce its higher frequency, which is 2.1.KHZ. This can be adjusted with the other of the two trimpots.

3) Phase Locked Loop frequency: U45 and U47 are two identical circuits using the single chip phase locked loop FSK decoder, the XR 2211, to decode the tape sync and tape storage signals, respectively. The freq of its free running VCO should be exactly between the FSK frequencies, or 1.7 KHZ. To check this, short pin 2 to pin 10 and measure the freq at pin 3. It can be adjusted with the trimpot nearby.

Operation of drum generators:

There are eight drum generators, one click generator, and one beep generator on the voice board LM1-C2. The click generator is simply a "556" dual one-shot (one for the loud click and one for the soft)--U72. The beep is simply an inverter--the

beep is software-generated. The eight drum generators are:
1) Clave/Cowbell
2) Toms/Congas
3) Claps
4) Hi-Hat
5) Cabasa
6) Tambourine
7) Snare (identical to tambourine)
8) Bass

The generators are basically the same with subtle differences tailored to each particular drum. The most straightforward is the claps generator:

A "play claps" strobe is generated on the CPU board and arrives at pin 3 of U11, the clock input of a 74LS74 dual latch. On its rising edge, the data input (pin 2) is sampled which is connected to data output buss bit 0. If a "1" is sampled, pin 6 goes lo (Q not output). This starts the count of the 74LS393's (dual 4-bit ripple counters) at a rate determined by U10 (a 556 timer, used as an oscillator, controlled by the rear panel "claps pitch" pot). The counters are connected for a 13-bit count (12 bits to address all 4096 words contained in two 2716 2048-word proms; and a 13th bit which is inverted by U9 and resets latch U11 to disable counters. The outputs of the proms are sequentially passed to the multiplying D/A converter U58 (AM6070DC), whose output is the product of the digital input and the current input, pin 11. The differential current outputs, pins 16 and 17 , are converted to a voltage by U69 (4558 opamp), and the output is routed to the output connector via a DC blocking capacitor.

Clave/Cowbell--these generators use only one 2716 prom each (2048 word, 11 bits each), so are able to share a 74LS393.

Tambourine--in this generator, the latch, U15, also samples data out buss bit 1. The corresponding output, pin 9, sums into the current input of the D/A converter, U60, to provide a selection of loud or soft play volume.

Snare--Identical to tambourine.

Cabasa--same as tambourine except only one 2716 prom is used.

Bass--this generator is similar to the tambourine or snare circuits, with the addition of a 24 DB/OCT low pass filter, U75 (CEM 3320). The cutoff freq. is controlled by the offset trimpot, and an envelope generator (U18 generates a pulse, which quckly charges .047 MFD CCAP, which slowly discharges through 2.2 MEG RESISTOR). This allows the high freq. components of the drum's strike to pass, and reduces noise present in the decay of the recording.

Tom/Conga--this generator can play a tom-tom at one of two pitches, or a conga at one of two pitches. The operation is very similar to the bass generator, except:

1) Data output buss bit 2 is also sampled by U2, pin 2 to select whether the tom recording or the conga recording will play.

2) A dual 4-way CMOS Analog Multiplexer is used to select:
   A) One of 4 outputs
   B) One of 4 pitch pots

Hi-Hat--in this generator, the counters (U25 and U27) are always counting, so digital words are always being received at the D/A converter (U59). To produce output, U70 (TL082) pin 1 must produce an output positive voltage to feed the current input of the D/A, pin 11. The envelope produced by U12, U13, and U70 can be small or large (loud or soft hihat) depending on the state of U13 pin 5, the true output of a 74LS74 dual latch. The input of this latch is connected to data output buss bit 1, providing volume information. In addition, the envelope can be long or short decay (open or closed hihat), depending on the state of U13 pin 8. The data input to this half of the latch pin 12 is connected to the data output buss bit 2, which provides open/closed Hihat informtion. If A 0 is sampled at pin 12, U13, a "1" will appear at pin 8 (Q not output), turning transistor "on" and discharging envelope capacitor quickly through 1 meg rear panel hihat decay pot. If state at pin 12 were "1", capacitor would be discharged slowly through 2.2 meg resistor (open hihat).

Getting to P.C. boards for repair:

CPU Board--all that is necessary is to remove top by removing 6 black screws, then removing CPU board (if necessary) by removing 5 retaining screws. Important: If power connector is removed from CPU board, all memory will be lost! Also, if power connector is removed and reconnected to CPU board, power switch may have to be turned on and off up to 4 times before LM-1 will initialize properly.

Front Panel Boards--remove top, then remove wood sides with 8 screws, then remove front panel with 6 screws and nuts located at bottom front. NOTE: Nuts are loose inside.

Voice Board--remove top, unscrew CPU board, place insulating sheet over power supply, and fold CPU board over and rest it on insulating sheet. If voice board needs to be removed., remove 5 male/female hex spacers, unplug all connectors from voice board, pull forward, and lift out.

Possible Problems and Solutions:

<u>Memory Loss:</u>

1) Check voltage at batteries. It should read approximately 3.6V. If lower, turn the LM-1 on for a day or two to charge them back up.
2) Check battery drain from rams--with power off, drain from battery should be no more than 200 microamperes. If it is, find the high current ram and replace it.
3) Check power fail circuitry:

A) U5 pin 26 should be high with power on, low with power off.

B) Rams pins 10 and 8 should show battery voltage with power off.

4) Test for memory errors:

A) Turn on LM-1

B) Press "chain on/off"

C) While holding "record" press "last entry," then release

D) If "drumbeat #" display blinks, it is blinking the number of the bad ram (M1-M16). Otherwise no hard errors were found.

Tape Won't Load:

1) Read "Tape Storage" section of manual thoroughly.
2) Check PLL Frequency (described earlier) U47.
3) Make sure signal is getting to pin 2, U47.

LM-1 Won't Initialize:

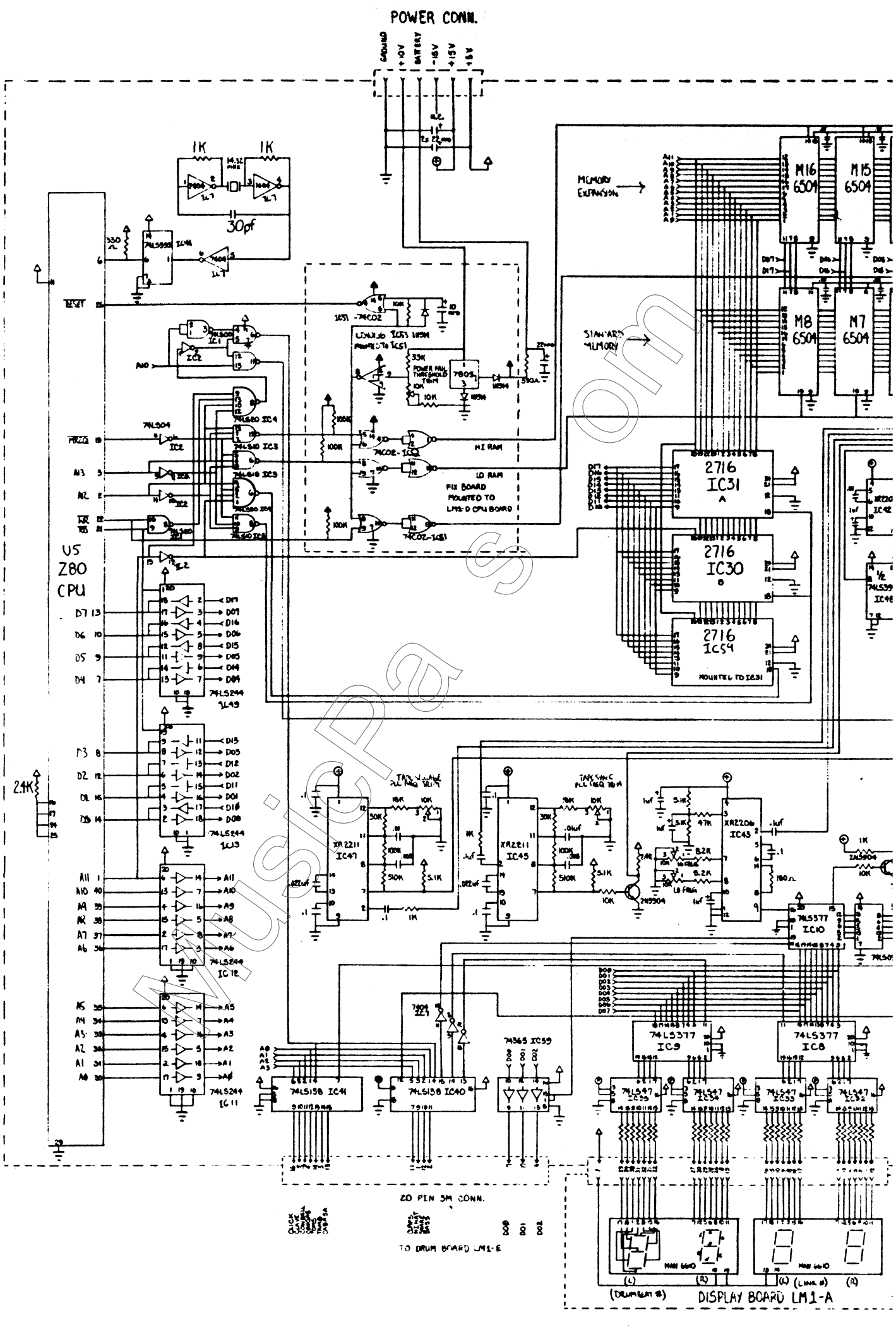
Proper power initialization is indicated by all LED's turning off except "drumbeat #" display, which should show "00". If it doesn't (after powering on and off 3 or 4 times):

1) Check reset signal: Pin 26, U5 should go high approximately 1/2 second after power-on, and go low on power-down.
3) Is clock getting to U5, Pin 6?

Buttons are Bouncing:

1) Carefully remove cap of bad button from front panel by gently prying it off with screwdriver. Important: Spring will pop out!
2) Clean contacts
3) Replace cap

NOTE: Some units used a different type of button which when pressed, a "click-stop" is felt (Shadow collapsable diaphragm switch). These switches cannot be cleaned, so must be replaced.


POWER CONN.
GROUND
+10V
BATTERY
-15V
+15V
+5V
1K
1K
30pf
330 Ω
RESET
MEMORY EXPANSION
M16 6504
M15 6504
M8 6504
M7 6504
STANDARD MEMORY
2716 IC31 A
2716 IC30 B
2716 IC54
MOUNTED TO IC31
HI RAM
LO RAM
FIX BOARD MOUNTED TO LM1-D CPU BOARD
U5 Z80 CPU
74LS244 IC49
74LS244 IC13
74LS244 IC12
74LS244 IC11
2.4K
XR2211 IC47
XR2211 IC45
XR2206 IC43
74LS377 IC10
74LS377 IC9
74LS377 IC8
74LS138 IC41
74LS138 IC40
74365 IC59
74LS47 IC55
74LS47 IC54
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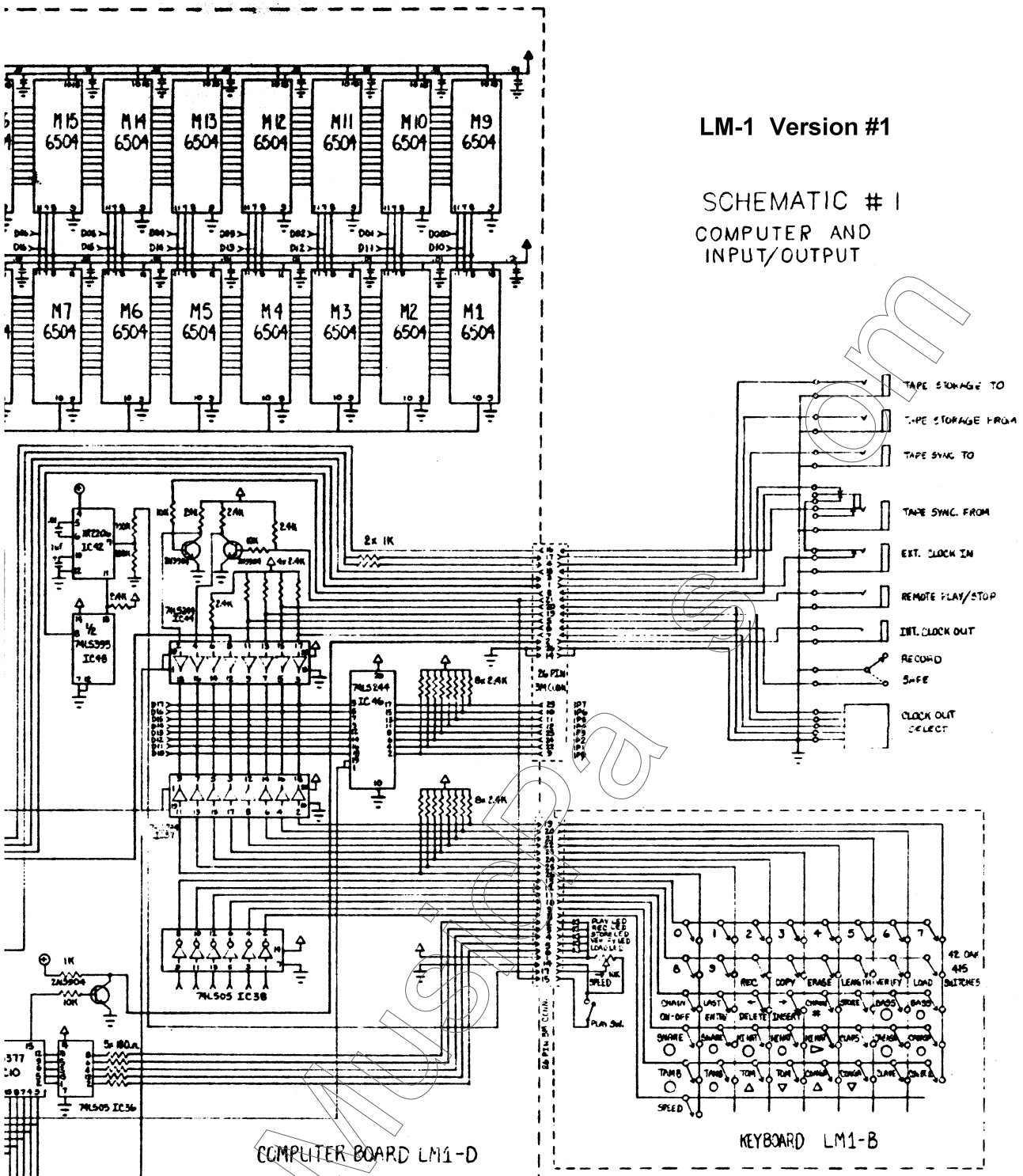
TO DRUM BOARD LM1-E
DISPLAY BOARD LM1-A
(DRUM SEL #)
(LINK #)


LM-1 Version #1
SCHEMATIC # 1
COMPUTER AND
INPUT/OUTPUT
M15 6504
M14 6504
M13 6504
M12 6504
M11 6504
M10 6504
M9 6504
M7 6504
M6 6504
M5 6504
M4 6504
M3 6504
M2 6504
M1 6504
TAPE STORAGE TO
TAPE STORAGE FROM
TAPE SYNC TO
TAPE SYNC. FROM
EXT. CLOCK IN
REMOTE PLAY/STOP
INT. CLOCK OUT
RECORD
SAFE
CLOCK OUT SELECT
74LS395 IC48
74LS244 IC46
74LS05 IC38
74LS05 IC36
74LS47 IC32
34 PIN 3M CONN.
26 PIN 3M CONN.
42 DIM 41S SWITCHES
REC
COPY
ERASE
VERIFY
LOAD
SPEED
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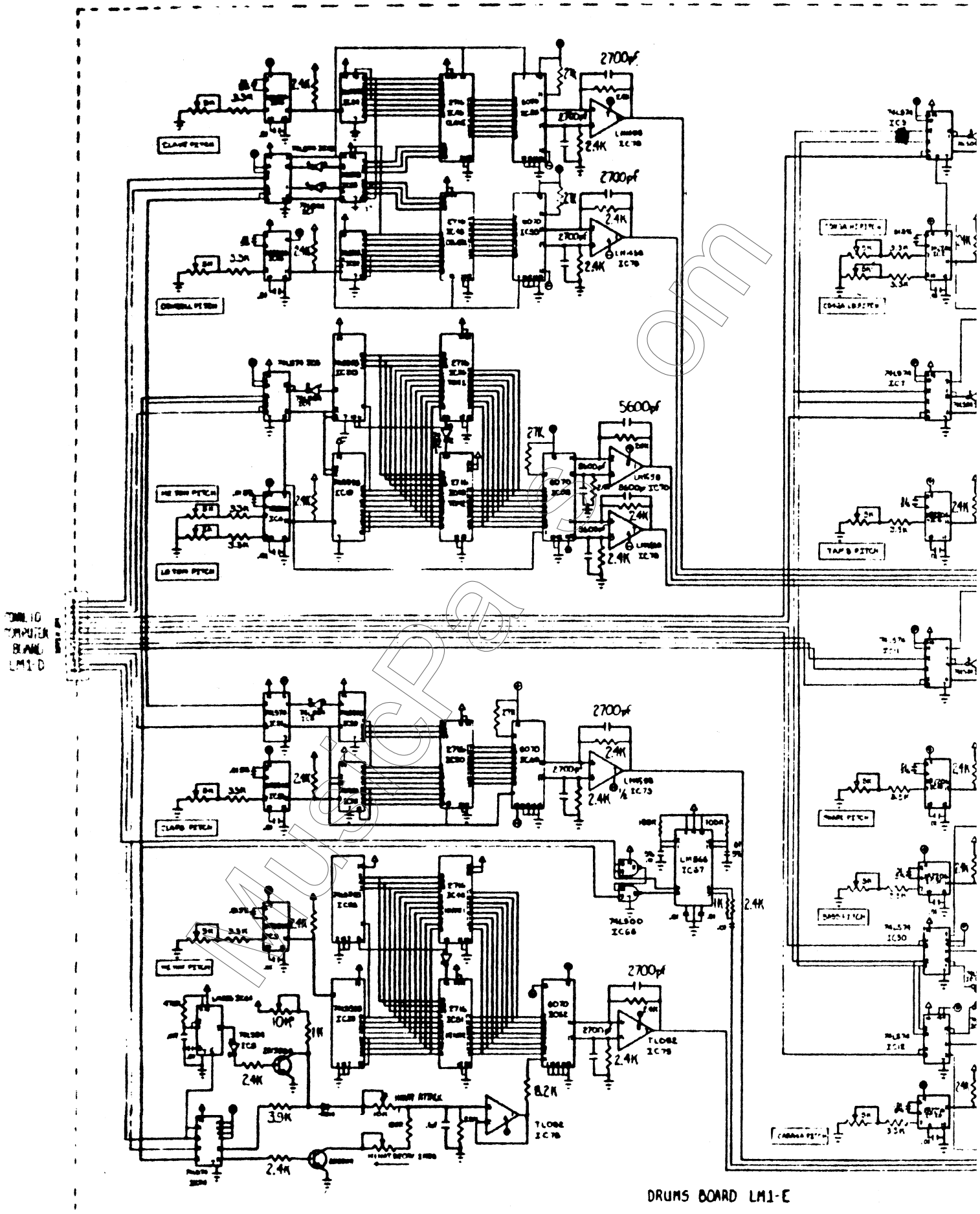
KEYBOARD LM1-B
+5 VOLTS
+5 VOLTS CMOS
+15 VOLTS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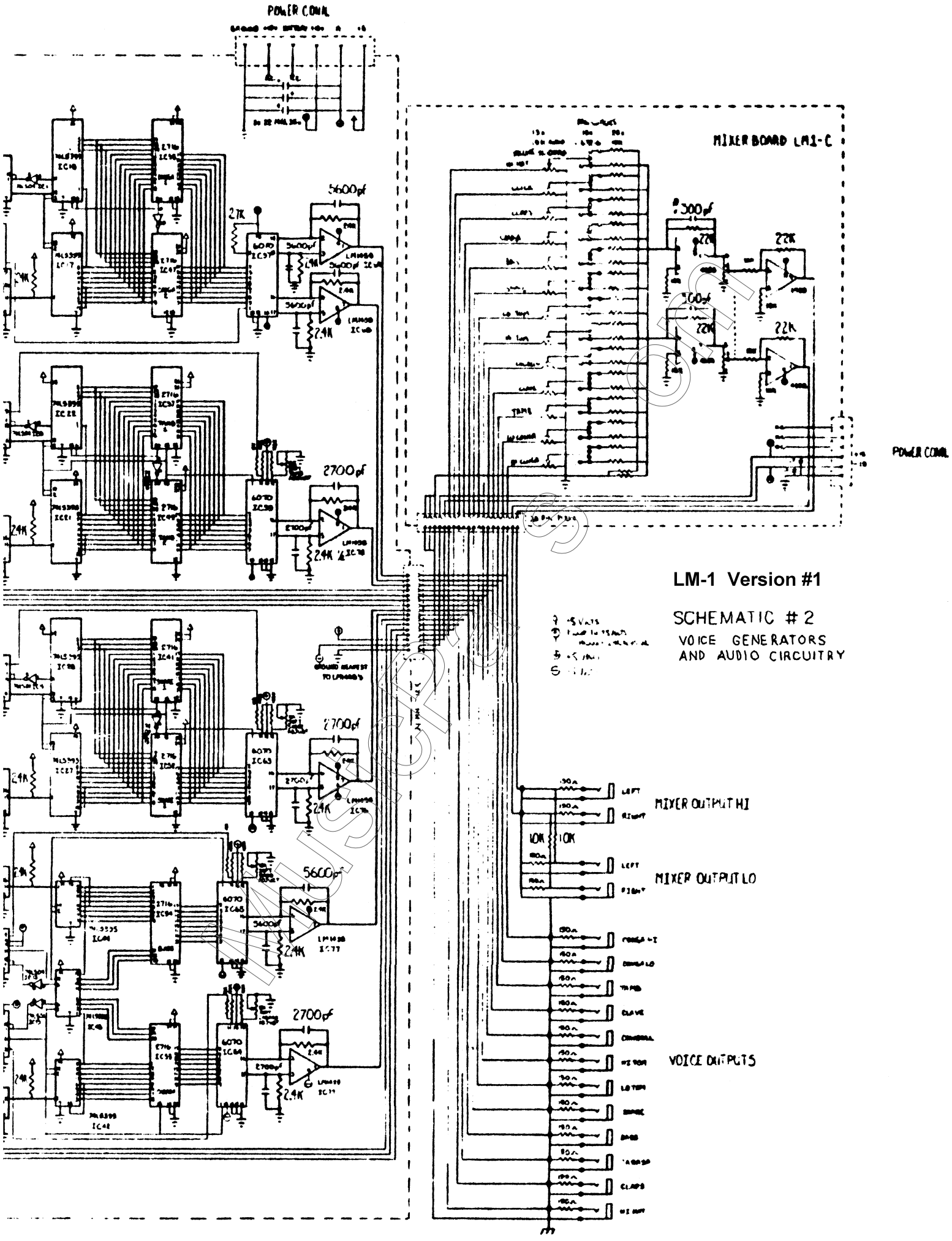
2700pf
5600pf
2700pf
2700pf
8.2K
2.4K
3.9K
10MF
DRUMS BOARD LM1-E


POWER CONN.
MIXER BOARD LM1-C
POWER CONN.
LM-1 Version #1
SCHEMATIC # 2
VOICE GENERATORS
AND AUDIO CIRCUITRY
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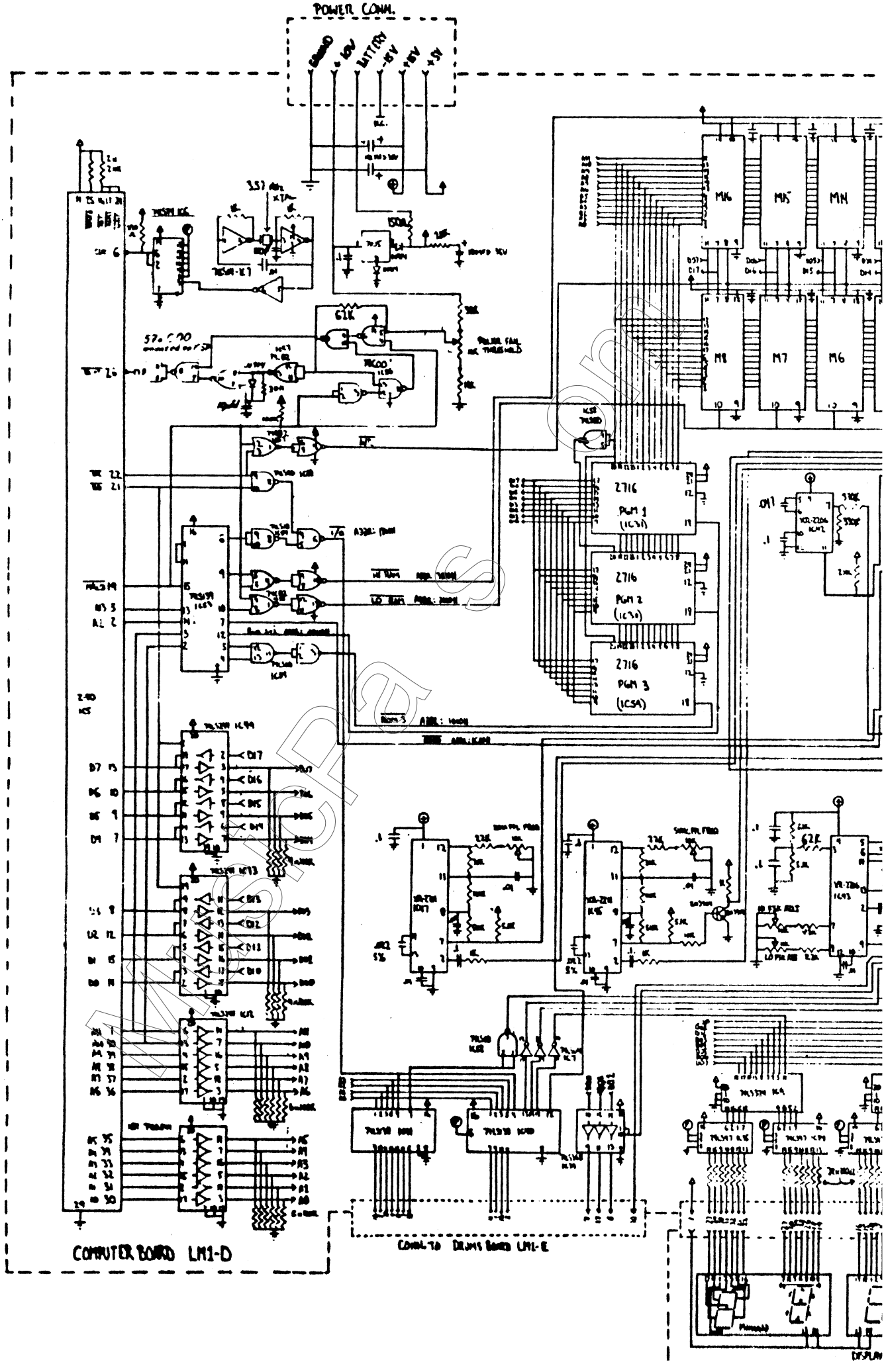
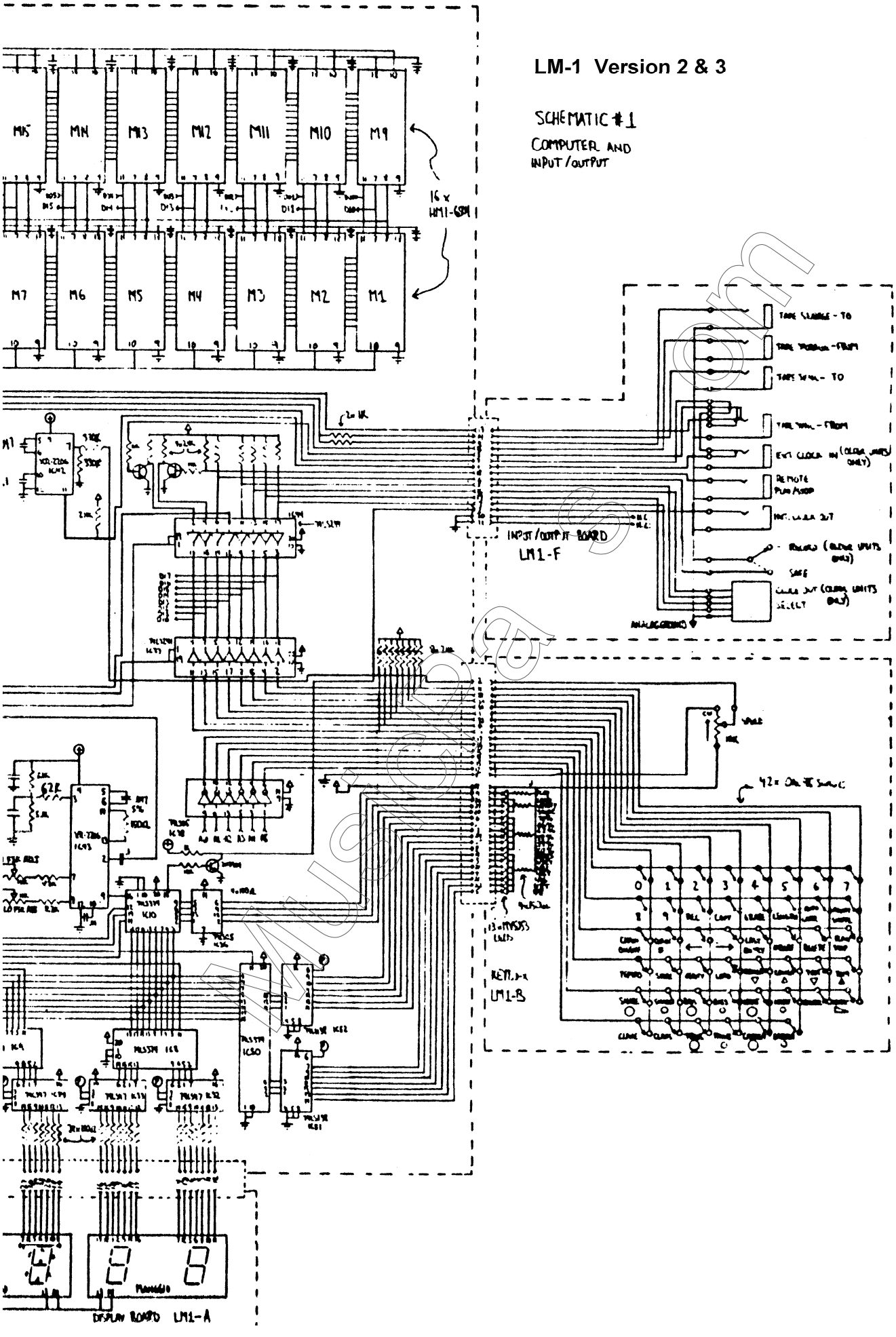
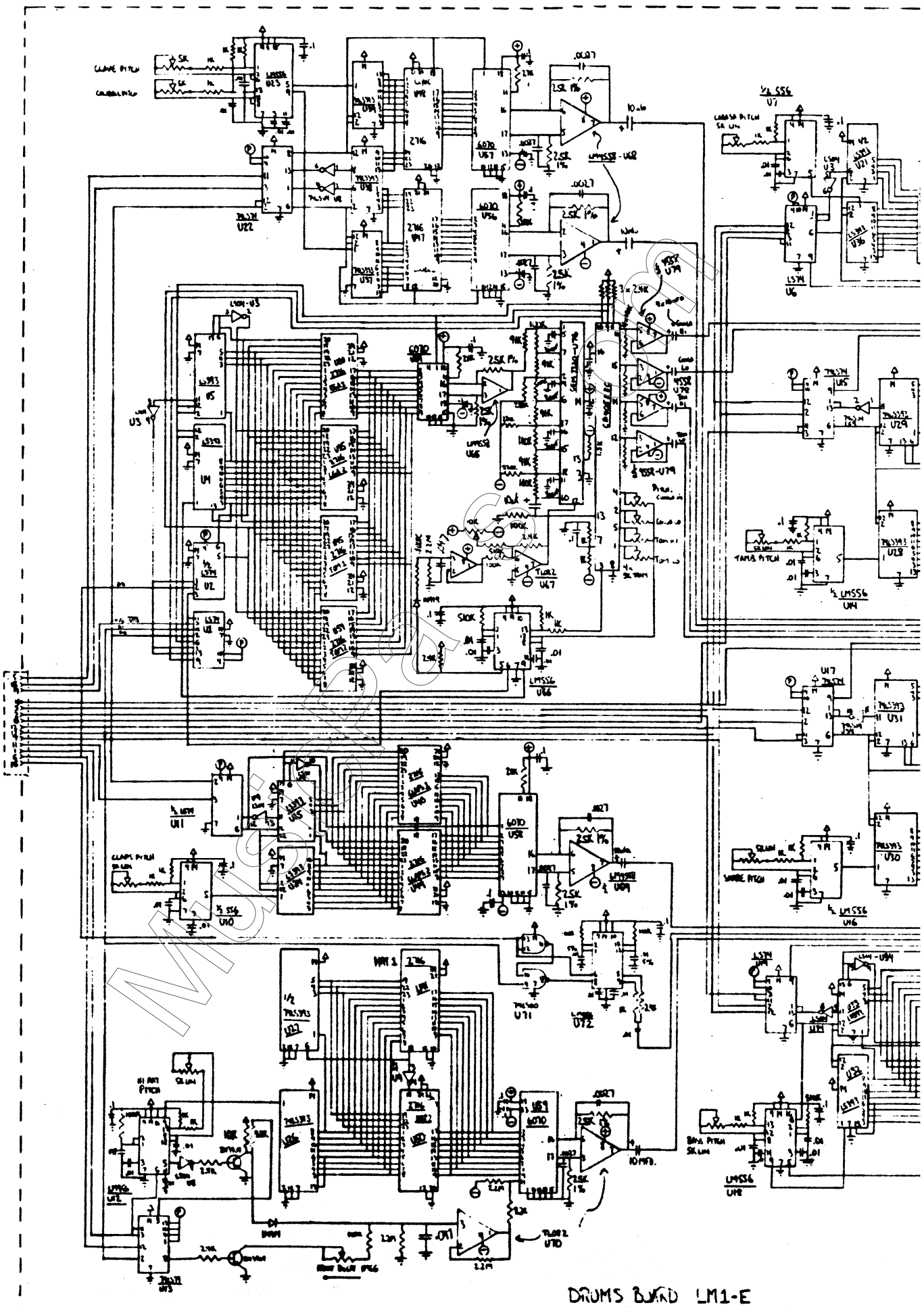
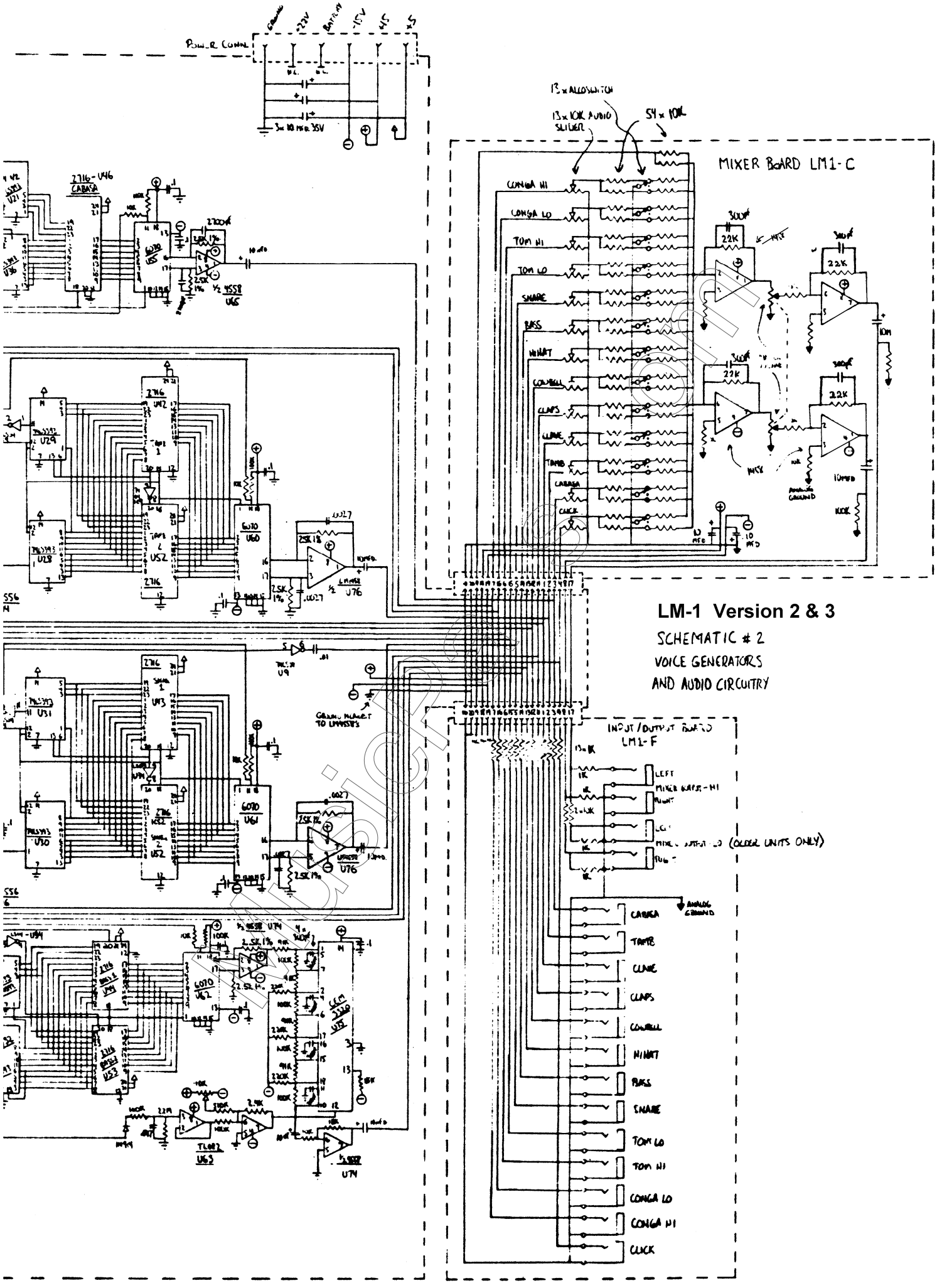
MIXER OUTPUT LO
VOICE OUTPUTS
5600pf
2700pf
2.7K
2.4K
10K
22K
300pf
100pf


POWER CONN.
2716
PGM 1
(IC5A)
2716
PGM 2
(IC5A)
2716
PGM 3
(IC5A)
COMPUTER BOARD LM1-D
CONN. TO DRIVE BOARD LM1-E


LM-1 Version 2 & 3
SCHEMATIC #1
COMPUTER AND
INPUT/OUTPUT
M8
M7
M6
M5
M4
M3
M2
M1
16 x
LM1-SRM
INPUT/OUTPUT BOARD
LM1-F
LM1-B
DISPLAY BOARD LM1-A


CONN TO COMPUTER BOARD LM1-D
DRUMS BOARD LM1-E


MIXER BOARD LM1-C
13 x ALLOSWITCH
13 x 10K AUDIO SLIDER
54 x 10K
CONGA HI
CONGA LO
TOM HI
TOM LO
SNARE
BASS
HIHAT
COWBELL
CLAPS
CLAVE
TAMB
CABASA
CLICK
LM1-1 Version 2 & 3
SCHEMATIC # 2
VOICE GENERATORS
AND AUDIO CIRCUITRY
INPUT/OUTPUT BOARD
LM1-F
LEFT
MIXER INPUT - HI
MIXER INPUT LO (OLDER UNITS ONLY)
ANALOG GROUND
CABASA
TAMB
CLAVE
CLAPS
COWBELL
HIHAT
BASS
SNARE
TOM LO
TOM HI
CONGA LO
CONGA HI
CLICK

Linn Electronics, Inc.
MASTER PARTS LISTING
By ABC Class

PART NUMBER	DESCRIPTION	PRICE
CABLE/CPU	CPU TO DRM CABLE ASSEMBLY	7.500
CABLE/5VSR	5VSR TO DRM CABLE ASSEMBLY	6.600
CPU/STUFFED	COMPLETELY ASSEMBLED CPU BOARD	337.300
DRM/STUFFED	COMPLETELY ASSEMBLED DRM BOARD	661.000
MXR/STUFFED	COMPLETELY ASSEMBLED MXR BOARD	92.500
5VREG/STUF'D	5VSR BOARD COMPLETELY ASSEMBLD	31.020
74C00	CMOS QUAD NAND GATE	0.440
74C02	CMOS QUAD NOR GATE	0.440
74C32	CMOS QUAD OR GATE	0.440
CD4051BC	CMOS 1 TO 8 HUX/DEMUX (RCA)	0.900
CD4053BC	CMOS TRIPLE SPDT ANALOG SWITCH	0.900
74365	TTL HEX BUS DRIVER	0.620
74LS00	QUAD NAND GATE	0.360
74LS04	HEX INVERTER	0.360
74LS05	HEX OPEN COLLECTOR INVERTOR	0.360
74LS30	8 INPUT NAND GATE	0.360
74LS32	QUAD 2 INPUT OR GATE	0.360
74LS47	BCD TO 7 SEGMENT DECODER	0.940
74LS74	DUAL D TYPE LATCH	0.400
74LS138	3 TO 8 LINE DECODER	0.600
74LS139	DUAL 3 TO 8 LINE DECODER	0.600
74LS151	1 OF 8 DATA SELECTOR/MPX	0.640
74LS244	OCTAL BUFFER/LINE DRIVER/RECVR	1.120
74LS365	HEX BUS DRIVER	0.540
74LS374	OCTAL D LATCH	1.120
74LS393	DUAL 4 BIT BINARY COUNTER	0.950
74LS627	DUAL VCO (T.I. ONLY)	2.880
UPD780C	Z80 CPU	6.500
HM6116LP-4	2K X 8 CMOS RAM	18.700
CEM3320	CURTIS FILTER I.C.	5.780
CEM3360	CURTIS VCA I.C.	5.440
LM556	DUAL TIMER	0.860
MC14574	QUAD CMOS OP AMP	2.900
AM6070DC	COMPANDING D/A CONVERTOR	13.500
LH1605CK	+5 VOLT SWITCHING REGULATOR	17.100
LM340T-50	5 VOLT REGULATOR	1.440
LM341P-15	+15 VOLT REGULATOR	0.900
MC4558CP1	DUAL OP AMP	0.500
LM320MP-15	-15 VOLT REGULATOR	1.700
LM340T-5.0	5V REGULATOR FOR 5VSR BOARD	0.000
LM385BH1.2	VOLTAGE REFERENCE DIODE	12.000
LM385BZ-1.2	PRECISION REFERENCE DIODE IC	4.000
TL082CP	LOW NOISE OP AMP (T.I. ONLY)	1.180
10M 5%	STACKPAC CF-07 10M 5% RESISTOR	0.030
.215 OHM 1%	RWR80SR215FR (RESISTOR)	1.260
1K 5%	RF14J1K (1/4W RESISTOR C+F)	0.050
1M 1%	5043ED1M000FT (1/4W RESISTOR)	0.050
1M 5%	RF14J1M (1/4W RESISTOR)	0.050
10K 5%	RF14J10K(1/4W RESISTOR)	0.050

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PART NUMBER	DESCRIPTION	PRICE
11K 5%	RF14J11K(1/4W RESISTOR)	0.050
15K 5%	RF14J15K(1/4W RESISTOR)	0.050
18K 5%	RF14J18K (1/4W RESISTOR)	0.050
22K 5%	RF14J22K(1/4W RESISTOR)	0.050
3.3K5%	RF14J3.3K	0.050
3.6K5%	RF14J3.6K	0.050
30K 5%	RF14J30K(1/4W RESISTOR)	0.050
33K 5%	RF14J33K(1/4 W RESISTOR)	0.050
47K 5%	RF14J47K(1/4W RESISTOR)	0.050
51K 5%	RF1451K (1/4W RESISTOR)	0.050
75K 5%	RF14J75K (1/4W RESISTOR)	0.050
91K 5%	RF14J91K(1/4W RESITOR)	0.050
1.2K 5%	RF14J1.2K (1/4W RESISTOR C+F)	0.050
1.5K 5%	RF14J1.5K (1/4W RESISTOR C+F)	0.050
1.8K 5%	RF14J1.8K (1/4W RESISTOR C+F)	0.050
100K 5%	RF14J100K 1/4W RESISTOR	0.050
150K 5%	RF14J150K (1/4W RESISTOR)	0.050
2.4K 5%	RF14J2.4K(1/4W RESISTOR)	0.050
220K 5%	RF14J220K (1/4W RESISTOR)	0.050
287K 1%	5043ED287K0FT (1/4W RESISTOR)	0.100
390K 5%	RFJ390K (1/4W RESISTOR)	0.050
5.1K 5%	RF14J5.1K	0.050
5.6K 5%	RF14J5.6K(1/4W RESISTOR)	0.050
510K 5%	RF14J510K (1/4W RESISTOR)	0.050
680K 5%	RF14J680K (1/4W RESISTOR)	0.050
8.2K 5%	RF14J8.2K(1/4W RESISTOR)	0.050
19.1K 1%	5043ED19K100FT (1/4W RESISTOR)	0.050
2.00K 1%	5043ED2K000FT (1/4W RSSTR C+F)	0.100
2.21K 1%	5043ED2K210FT (1/4W RSTR C+F)	0.100
2.49K 1%	5043ED2K490FT(1/4W RESISTOR)	0.050
220 OHM 5%	RF14J220 (1/4W RESISTOR C+F)	0.050
330 OHM 5%	RF14J330 (1/4W RESISTOR C+F)	0.050
510 OHM 5%	RF14J510 (1/4W RESISTOR C+F)	0.050
.047MFDMYLAR	.047/10/100 NFR MYLAR CAP	0.100
29000MFD	88F5023AHA (MEPCO RAD LYTIC)	6.760
1MFD	1.0/10/63MKS-4 WIMA CAPACITOR	0.570
.1MFD	.1/10/160 MKS-4 (WIMA CAP)	0.196
10MFD	10/25LB (PANA AXIAL LYTIC CAP)	0.148
330PF	330PF/10/400 FKC-3 (WIMA CAP)	0.282
.01MFD	.01/10/160 FKS-3 (WIMA CAP)	0.140
.22MFD	.22/10/100MKS (WIMA CAPACITOR)	0.248
1000PF	1000PF/10/400 FKS-3 (WIMA CAP)	0.156
2700PF	.0027/10/630 FKS (WIMA CAP)	0.136
.047MFD	.047/10/160 FKS-3 (WIMA CAP)	0.172
10000MFD	10000/6.3PC (PANA RAD LYTIC)	1.360
1MFD-LYTIC	1/50PC (PANA RAD LYTIC CAP)	0.112
.05MFD-DISC	.05 /50-Z (PIHER CERAMIC DISC)	0.068
1000MFD-25V	1000/25PC (PANA RAD LYTIC CAP)	0.524
1000MFD-35V	1000/35PC (PANA RAD LYTIC CAP)	0.804

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PART NUMBER	DESCRIPTION	PRICE
1000MFD-50V	1000/50PC (PANA RAD LYTIC CAP)	0.804
3.3K 5%	RF14J3.3K (1/4 W RESISTOR)	0.026
IND 30060	TOLTEC#30060 INDUCTOR	2.720
V130LA10A	115 VOLT VARISTOR	1.640
2N2222	NPN TRANSISTOR	0.380
2N3904	GENERAL PURPOSE NPN TRANSISTOR	0.150
2N4403	PNP TRANSISTOR	0.160
1N4001	RECTIFIER DIODE FOR +/-15V	0.098
1N4148	GENERAL PURPOSE DIODE	0.128
1N5400	RECTIFIER DIODE FOR +5V	0.226
1N755A	7.55V ZENER DIODE	0.130
1N270	GERMANIUM DIODE	0.300
MV5053	DISCRETE RED LED	0.324
MAN4710	7 SEGMENT LED DISPLAY	2.500
MP04A	CTS 4 MHZ XTAL #MP04A	1.920
10KRESNET	4114R-001-103 (BOURNS RES NET)	0.650
15KRESNET	4116R-001-153 (BOURNS RES NET)	0.650
180RESNET	4114R-001-181 (BOURNS RES NET)	0.650
100KRESNET	4114R-002-104 (BOURNS RES NET)	0.650
5.6KRESNET	4116R-001-562 (BOURNS RES NET)	0.650
216AG29D	16 PIN AUGAT SOCKET	0.294
224AG29D	24 PIN AUGAT SOCKET	0.350
240AG29D	40 PIN AUGAT SOCKET	0.540
24-516-10	24 PIN ARIES ZIF SOCKET	9.000
WOODSIDES	OAK WOOD SIDES, OILED	24.000
POT-PAN	SV20N-1PC-CH15-BK10 (10K SLDR)	0.786
POT-PITCH	V16LPVN-MQ42-B100K (100K RTRY)	0.900
POT-TEMPO	V16LPVN-MQ29-B100K	0.716
POT-MASTER	V16LG3PVN-MQ42-A10K (DUAL10K)	1.610
POT-VOLUME	SV45NP-CH15-AK5 (5KAUD SLIDER)	0.810
72PR10K	HORZ MNT 10K BECKMAN TRIM POT	1.040
72XR10K	VERT MNT 10K BECKMAN TRIM POT	1.040
RN-111PC	SWITCHCRAFT P.C. PHONE JACK	0.740
J1022	J102Q06JJQ02J11 C+K PWR SWITCH	1.280
13001XXX	ECG BUTTON SWITCH	0.940
C56206L2	SWITCHCRAFT DPDT 110/220V SWCH	0.858
08-50-0106	LARGE CRIMP PIN	0.050
09-50-3061	6-PIN CRIMP CONNECTOR	0.220
09-50-3101	10-PIN CRIMP CONNECTOR	0.440
09-50-3201	20-PIN CRIMP CONNECTOR	0.750
09-65-1061	6-PIN FRICTION LOCK WAFER	0.330
09-65-1101	10-PIN FRICTION LOCK WAFER	0.560
15-04-0219	POLARIZING KEY	0.080
16-012-100	16-PIN RIBBON CABLE CONNECTOR	6.240
40-012-100	40-PIN RIBBON CABLE CONNECTOR	14.260
7637-BLACK	C+K BLACK SWITCH CAP (BOOTIE)	0.060
#6KEPS	#6 KEPS NUT	0.050
#8KEPS	#8 KEPS NUT	0.050
6/32X3/8BLK	6/32 X 3/8 BLK PHILLIPS SCREW	0.050

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PART NUMBER	DESCRIPTION	PRICE
6/32X3/8WZLK	6/32 X 3/8 WZ-LK HEX SCREW	0.080
6/32X5/8WZLK	6/32 X 5/8 WZ-LK HEX SCREW	0.070
8/32X3/8WZLK	8/32 X 3/8 WZ-LK HEX SCREW	0.140
8421 SMITH	SMITH 1/4 X 6/32 THRDED SPCR	0.100
8425 SMITH	SMITH 3/4 X 6/32 THRDED SPCR	2.000
HP1-T03-33CB	HEAT SINK FOR 5 VOLT SUPPLY	3.020
6063	THERMALLOY SM. HEAT SINK	0.260
61 KEYSTONE	KEYSTONE BATTERY HLDR CLIP	0.080
147 KEYSTONE	KEYSTONE AA SIZE BATTERY HLDR	1.620
NRAA	AA SIZE NICD BATTERIES	2.400
17251	BELDEN AC POWER CORD	4.500
241-8-1737	POWER TRANSFORMER	23.760
MANUAL-LD	LINNDRUM USER MANUAL	3.000
LGPHILSCREW		0.000
.012MFD	.012/10/160 MONO CAPACITOR	0.166
MDL1/2	BUSSMAN 1/2 AMP FUSE	1.012
1A1119-10	BUSSMAN FUSEHOLDER CLIPS	0.108
3MRUBBERFEET	RUBBER FEET FOR UNIT BOTTOM	0.080
G-100-WD	SMALL BLACK PLASTIC KNOBS	0.396
G-101-WD	LARGE BLACK PLASTIC KNOBS	0.658
XR2206	LM-1 FSK VCO	5.620
XR2211	LM-1 FSK DECODER	6.580
LM-XTAL	LM-1 3.579 MHZ CRYSTAL	3.700
LM-MASTVOL	LM-1 MASTER VOLUME POT	10.000
LM-DECAYPOT	LM-1 HIHAT DECAY POT - 1M AUD	3.000
LM-PITCHPOT	LM-1 PITCH OR TEMPO POT - 5K	3.000
LM-SYNCJACK	TAPE SYNC FROM JACK ON LM-1	2.580
LM-PANSWITCH	LM-1 PAN SWITCH	3.640
LM-SLIDEPOT	LM-1 VOLUME SLIDER (CTS)	0.960
MAN6610	LM-1 DUAL DIGIT DISPLAY	6.000
AM2716DC	E-PROM	0.000
CD4052BC	LM-1 CMOS MULTIPLEXOR	1.100
HM3-6504C-9	LM-1 4K X 1 CMOS RAM LOW POWER	7.700
LM1.1	LM-1 SOFTWARE VERS. 1	36.000
LM2.1	LM-1 SOFTWARE VERS. 2	36.000
LM3.1	LM-1 SOFTWARE VERS. 3	36.000
LM-CAB1	LM-1 STANDARD CABASA	24.000
LM-CGA1	LM-1 STANDARD CONGA	36.000
LM-CLV1	LM-1 STANDARD CLAVE	24.000
LM-COW1	LM-1 STANDARD COWBELL	24.000
LM-HAT1	LM-1 STANDARD HIHAT	36.000
LM-TOM1	LM-1 STANDARD TOM-TOM	36.000
LM-BASS1	LM-1 VERS.1 STANDARD BASS	24.000
LM-BASS2	LM-1 VERS.2 STANDARD BASS	36.000
LM-CLPS1	LM-1 VERS.1 STANDARD CLAPS	24.000
LM-CLPS2	LM-1 VERS.2 STANDARD CLAPS	36.000
LM-RMST1	LM-1 RIMSHOT	24.000
LM-SNAR1	LM-1 STANDARD SNARE	36.000
LM-TAMB1	LM-1 STANDARD TAMBOURINE	36.000

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PART NUMBER	DESCRIPTION	PRICE
OAK415	LM-1 KEYSWITCH (OAK #415)	1.080
LM-NICAD-C	LM-1 BATTERY- C SIZE	8.000