Luma-1 User Guide.pdf
Enregistré dans Dropbox • 9 mars 2024 à 18:25



Luma-1 Drum Computer

User Guide

(draft)

V

ersio

ersio
n
0.74

A Few Words from Roger

Dear Luma-1 Owner,

I'm so pleased to see how my friend Joe Britt resurrected my old LM-1 and added modern features that the original product never had. Joe is a superb design engineer, having designed a variety of highly influential consumer tech products over the years. So I'm honored that he liked my old LM-1 enough to take on this project.

I love how Joe did it, using the original software and keeping all of the original sound and sequencing hardware, thereby ensuring that everything that gave the LM-1 its sound and timing feel are identical to the original. But the genius is how he added the modern features, adding a new "computer overlord" that can take control of the original hardware and software as needed, but otherwise having no effect on it.

I'm also pleased to see that my new friends Andrei and Devin are building and supporting the Luma-1 units. They are also highly talented design engineers with a strong passion for music products, and are good people who truly care about what they're doing with Luma-1.

If you'd like to learn more about the story behind the Luma-1 project, here's a page on my site about it:
https://www.rogerlinndesign.com/about/joe-britt

Note that though I'm not involved in the Luma-1 project, it is done with my full consent and with my sincere thanks to Joe, Andrei and Devin for breathing new life into my old LM-1.

Roger Linn





Background, or The Soul of an Old Machine

Roger Linn's LM-1 Drum Computer was the first drum machine to feature sampled drum sounds.

Released in 1980, the LM-1 had a sound (and personality) unlike any other drum machine. Advertisements touted the sound of "Real Drums" -- and hearing was believing. Roger coupled his sampled drum playback hardware with an integrated drum sequencer which featured an unusually groovy "swing" feature.

Building a machine like the LM-1 in 1980 was expensive, and that led to a retail price of over $5,000 (about $18,000 in 2024 dollars). As a result, only very well-heeled musicians and studios could afford an LM-1. Ultimately, around 500 LM-1s were produced.

There had been nothing like it, and it must have felt like pure magic to hit a key in 1980 and have a very real drum hit blast out of a speaker. The sound and feel of the LM-1 wound up in some of the most popular and influential music of the time.

I grew up in the 1980s, and love so much of the music made with this magical machine. A stroke of luck landed one in my lap, and I could not resist digging into it.

Luma-1 is the result. This was not a simple project. It had 3 main goals:

1. Preserve the "soul" of the LM-1: sound generation and sequencing is electronically identical to Roger's original design.
2. Without compromising the soul of the machine, use a veneer of modern technology to add MIDI and downloadable

sounds.

3. Provide the design as open-source, enabling a new generation of LM-1 enthusiasts to build their own -- and enable a new generation of musicians to use an LM-1 that is “the real deal.”

There was a temptation to reduce the number of parts by using modern programmable logic (PALs or an FPGA). However, I wanted to avoid any special hardware or software development tools.

Once assembled, all you need is a computer with a USB port and the Arduino IDE to load code and sounds onto your Luma-1.

This has been purely a labor of love, and I’ve truly enjoyed following Roger’s footsteps from 40 years ago.

Roger, thank you for your friendship, support, and incredible work which has positively touched so many lives.

Joe Britt, Los Altos, California, 2024

What makes the LM-1 so special?

From the user’s point of view, the LM-1 experience is (not in priority order):

1. **User Interface**
    a. Keyboard buttons: functions, locations, feel
    b. Mixer: convenient and logical level/pan control
    c. Intuitive beat entry, LM-1 shuffle
    d. Pitch control for all drums
2. **Sonic Character**
    a. Continuous pitch control per voice (continuously variable sample rate, not sample rate conversion)
    b. 8-bit companded samples played through AM6070 DACs (one DAC per voice, no multiplexing)
    c. 555-timer based sample rate clock
    d. CEM3320 filters

3. **Sequencer Feel**

    a. Roger's Swing algorithm

    b. Internal tempo clock from XR2206, sampled with non-interrupt driven code

So, the best way to really make Luma-1 sound and feel like an LM-1 was to really make it work like an LM-1.

> *My LM-1 is was built in September of 1981, and is a Re*
> *So, that's what **Luma-1** is based on.*

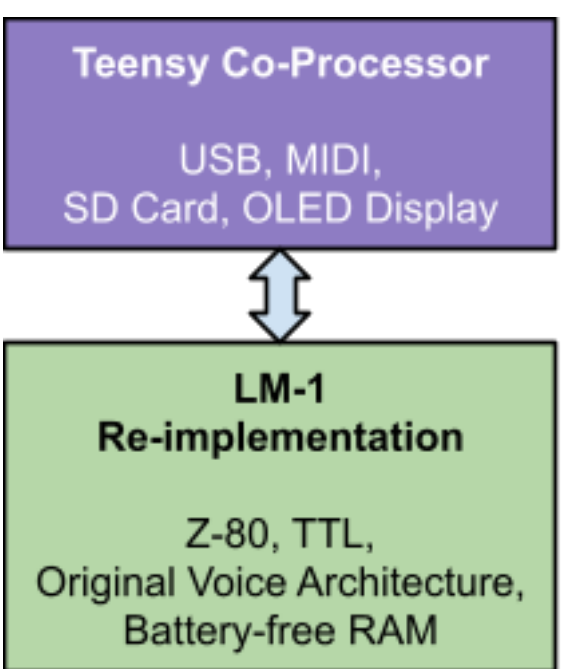
Summary of Similarities and Differences Between Luma-1 and LM-1

- **No Battery Needed**: Original LM-1 battery-backed 4K/8K RAM replaced by 8K FRAM
    - RAM can be saved to / loaded from SD card, or up/downloaded via SysEx
- **Loadable samples** (from SD Card, EPROM dump, or SysEx)
    - Original audio path, AM6070 DACs
    - Original CEM3320 Filters on Bass and Conga/Tom voices
    - SysEx tool converts various sample formats to needed μ-Law format
- **MIDI, via USB and DIN5**: Triggers in/out, MIDI Clock / Start / Stop, SysEx Sample Loading
- Original front control surface
    - Large keys, **modern replacement for original buttons**
    - Mixer, **modern faders**
    - LED displays and indicators
- **Pitch Pots and HiHat Decay moved from rear to front control surface**
- **New LED Trigger indicators**
- Bass and Conga/Tom Filter Cutoff controls moved to

rear panel (were only internally accessible on LM-1)

- All voices except HiHat can optionally be built with a CEM3320 VCF
- Original I/O, mixed and separate voice outputs
- **Original Z-80 system code** running on original discrete (TTL) hardware design
    - Intuitive keyboard / 7-segment LED UI
    - Roger's original Shuffle
    - VCO internal Tempo clock, front panel potentiometer controlled
- The Luma-1 **boards are drop-in replacements** for original LM-1 boards
    - Except for the Drum Generator, which needs the new CPU board
    - Surface-mount (SMT) components are used on the CPU and Drum boards
    - All TTL logic, no programmable logic parts
    - Connector and mounting point compatible

The Luma-1 design is a re-implementation of the LM-1 design, wi
microcontroller added. The Teensy can pause the LM-1 Z-80 CPU
bus cycles. This gives the Teensy access to all LM-1 memory and
which it uses to add new functionality.



Teensy Co-Processor c
start/stop the Z-80, and
access all LM-1 memor
and peripherals.

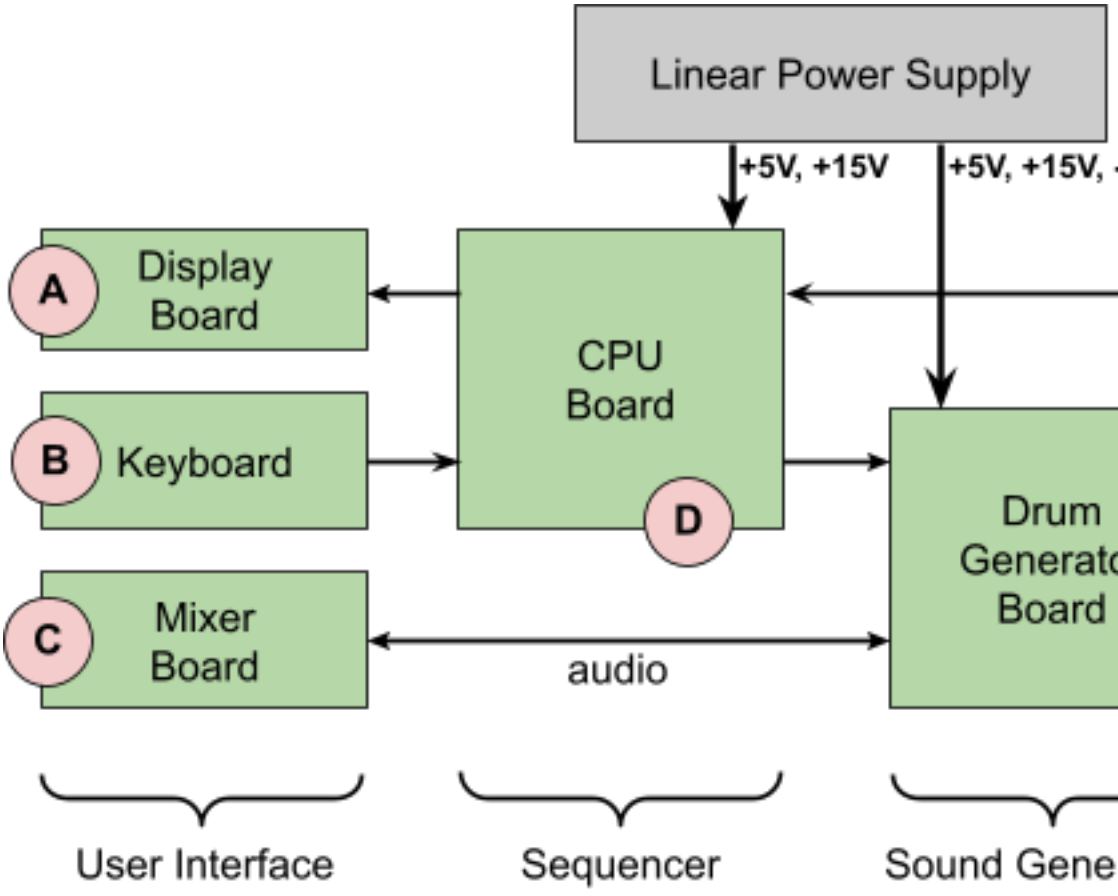
LM-1 Re-implementatio
gate-for-gate accurate,
runs the original LM-1 Z
firmware.

Luma-1 enhances the L
while preserving its so

Luma-1 is an expanded LM-1

Block Diagram / PCBs

An original LM-1 contains a linear power supply and 6 PCBs, connected as shown in the diagram below.

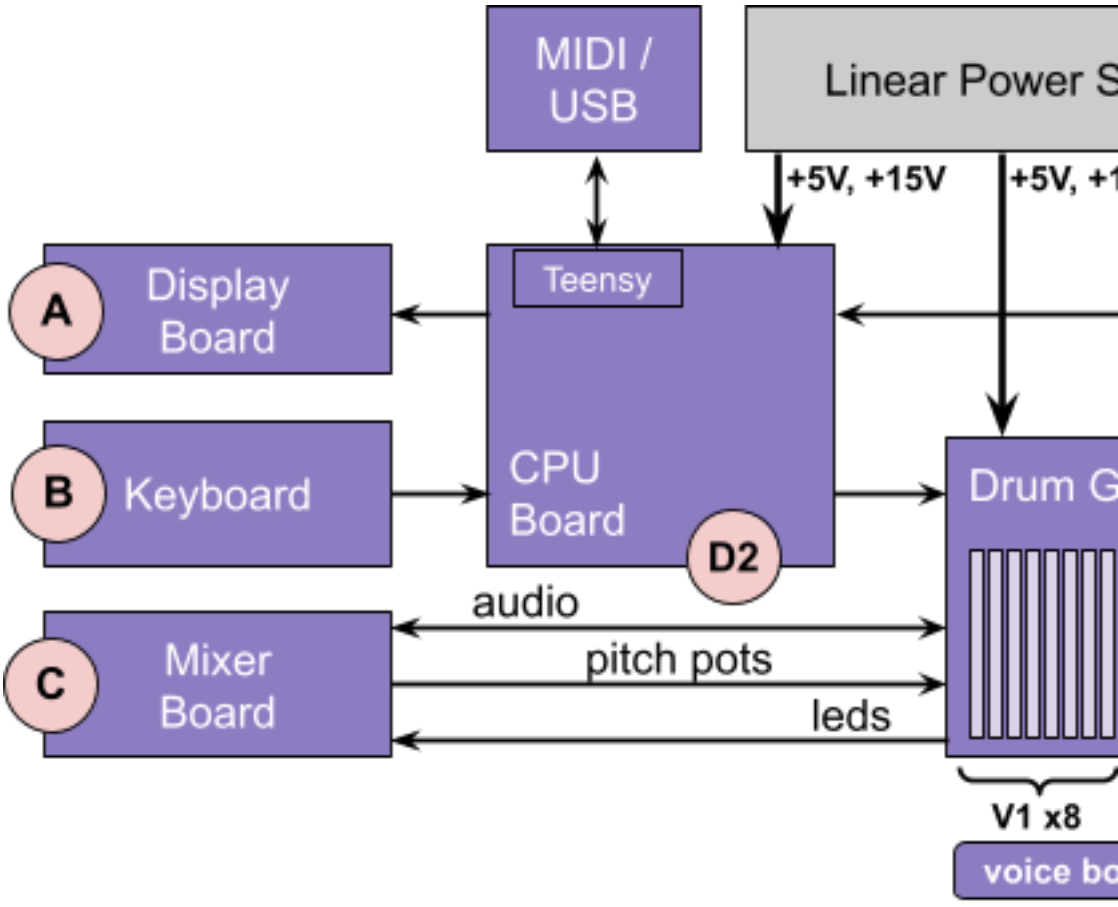


Original LM-1 Block Diagram

For the Luma-1 project, all 6 boards were replicated. All Luma-1 boards are mechanically and electrically compatible with the corresponding original LM-1 boards. This means that Luma-1 boards can be used as board-level replacement parts for original LM-1s.

The remaining LM-1 Drum Computers are all over 40 years old now. The LM-1 mixer sliders and keyboard buttons are problematic and hard to find, so the Luma-1 mixer and keyboard boards can be used as drop-in replacements to repair and update original machines.

Luma-1 Block Diagram / Differences



Luma-1 Block Diagram

In the LM-1, there are 9 drum voice generators, and all are integrated onto a single very large PCB. Note that the Conga/Tom voice generator is actually for 2 drums. Conga and Tom cannot play at the same time, as they share a DAC.

Of the 9 drum generators, the design and operation of the HiHat generator is quite different from the other drums. This is due to the very unusual way that the HiHat sound is produced from the μ-Law sample data.

For the other 8 drums, a trigger signal from the Z-80 enables a counter to step through each sample and send it to that voice's DAC. The Z-80 writes to the trigger, the counters play all the samples, and the sound is generated.

For the HiHat, the counters are continuously running, cycling through all HiHat samples over and over. When the Z-80 writes to the HiHat trigger, an analog envelope circuit opens and lets the samples be heard. That envelope closes exponentially for the Loud and Soft HiHat sounds. For the Open HiHat sound, that exponential decay is much longer

letting the hat “ring” for a long time, or until a Loud or Soft hat is triggered, which closes the Open hat.

The V2 voice board implements the HiHat voice architecture, there is one installed in Luma-1. The V1 voice board implements the other, simple voice architecture, and Luma-1 has 8 installed.

Rear Panel Controls and Connections

INDIVIDUAL OUTPUTS

Each drum has its own direct output independent of the mixer. Impedance is 1000 OHMS and level is 10V P-P. Inserting a ¼” plug into a direct output **does not** remove it from the mixed output. Use the corresponding mixer fader to set how much of the output goes to the mixed output.

INTERNAL CLOCK OUT

This output provides pulses to sync directly to a sequencer or synthesizer. The note timing value of the pulse follows the auto-correct setting. For example, if auto-correct is set to 1/16th notes, the internal clock out jack will provide a pulse every 1/16 note. If auto-correct is set to HI, a high frequency pulse wave will be output with 48 pulses for every 1/4 note of music. "On" pulse ~ + 15V; "off" - 0V.

Note that for Luma-1, the tape data storage is not used. RAM may be saved to and loaded from the Teensy’s SD card and via MIDI SysEx.

Also note that for Luma-1, the TAPE SYNC connectors are not used. The TAPE SYNC functionality was replaced with sync to MIDI Start/Stop/Clock.

The Tempo Clock can come from several sources. The default is the internal clock, which is generated by an XR2206 VCO on the CPU Board. The Tempo potentiometer controls the frequency of the XR2206 VCO.

If a clock is fed into the EXT CLOCK input jack, it is used instead of the internal VCO clock.

The Teensy can take in MIDI Clock and generate a tempo clock **which replaces the TAPE SYNC IN tempo clock that comes from the XR2211 tape sync decoder on an LM-1.**

This MIDI tempo clock can be routed to the Z-80's sequencer via a new toggle switch on the rear, where the TAPE SYNC IN jack was.

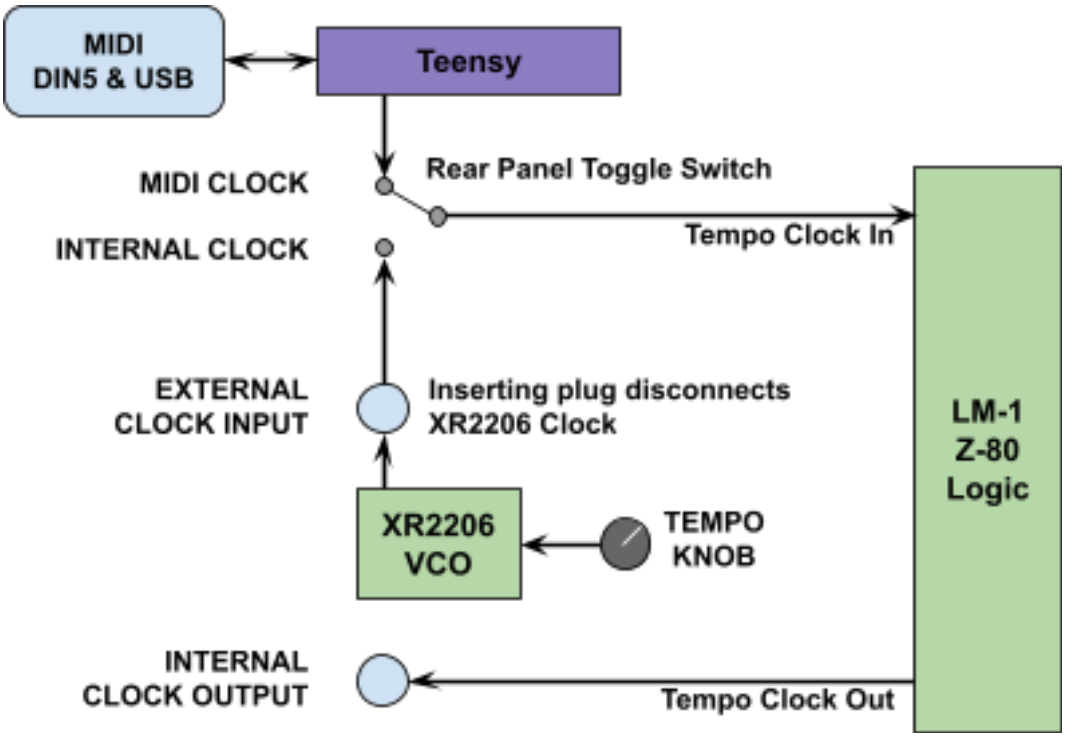
In place of the TAPE SYNC OUT, the Teensy generates MIDI Clock from whatever clock source the Z-80 sequencer is using. MIDI Start and Stop are generated when that clock source starts and stops.

EXTERNAL CLOCK IN

You can feed a tempo clock from an external source into this jack. The signal should swing from 0V (ground) to between +5V and +15V.

It will override the internally generated clock (the one controlled by the Tempo knob).

It will NOT override a MIDI clock, so the rear switch must be set to **INTERNAL CLOCK** for the **EXTERNAL CLOCK IN** signal to drive the sequencer.



Luma-1 Clock In / Out

FOOTSWITCH IN

Just like on the LM-1, a normally-open switch can be connected across the tip & sleeve of the plug inserted into this jack to start and stop the sequencer. It behaves the same as pressing the PLAY/STOP button on the front panel.

MIDI IN & OUT

Luma-1 has USB and DIN-5 MIDI connections.

MIDI In / Out support:

1. Drum triggers, with 2 levels of velocity
2. Program Change to select Voice Bank from SD card
3. MIDI Start / Stop / Clock
4. SysEx

Please see the MENU Command List below, MENU Command Group 7 is used to control the routing of MIDI messages over DIN-5 and USB.

NOTE

When taking in MIDI Start/Stop/Clock via USB or DIN-5, the Z-80
it is chasing LM-1 Tape Sync in.
This means that you have to **"arm" the Luma-1 sequencer**
PLAY/STOP before sending the MIDI Start and MIDI

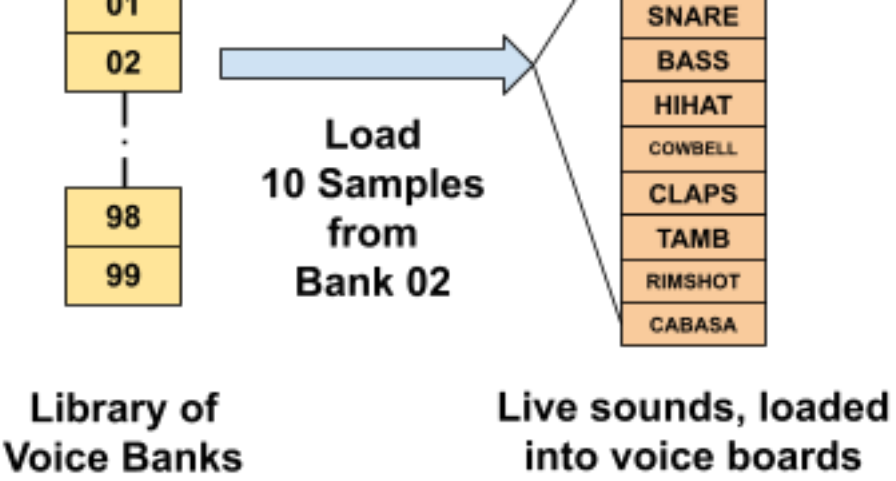
Voice Bank Concepts

On Luma-1, a *Voice Bank* is a set of 10 μ-Law samples, one for each hardware voice (note that Conga/Tom share a hardware voice, as they did on the LM-1).

Each sample can be 2KB, 4KB, 8KB, or 32KB long – except for the CONGA and TOM, which replace the 32KB option with 16KB. This is because those two voices share a DAC (as they do on the LM-1), and so share a 32KB sample memory chip.

Luma-1 supports 100 Voice Banks, named 00 through 99 and accessed through the MENU key.

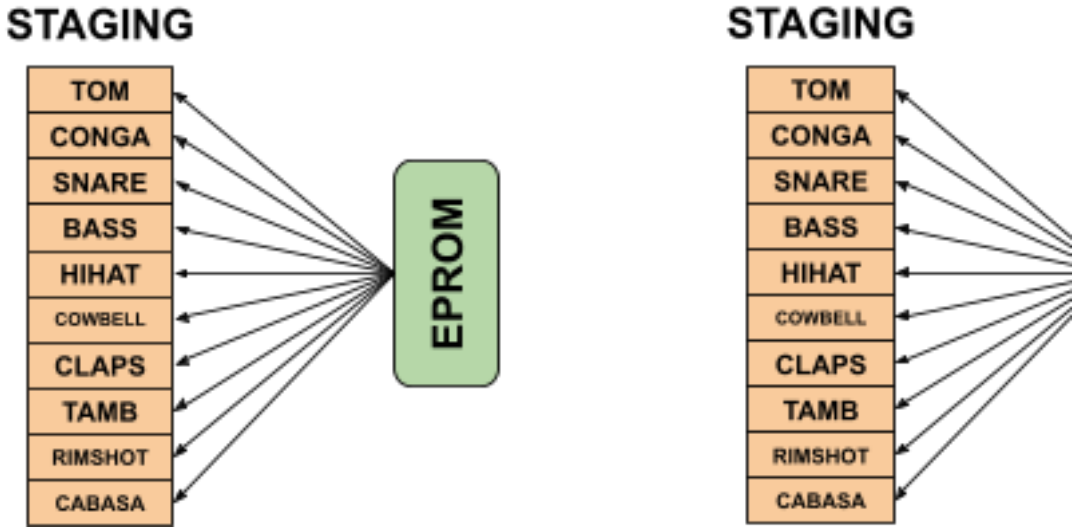




SD Card Voice Banks Contain 10 Samples

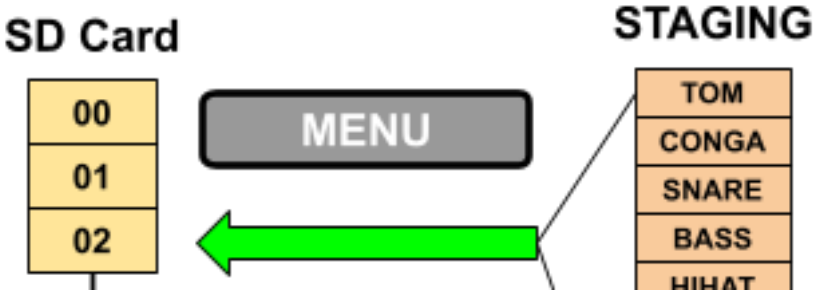
You can have 100 different sets of Luma-1 sounds, and load them quickly using the MENU 00 command.

It is also possible to load new sounds into the voice boards via the EPROM dumping socket and via SysEx.



Loading Voices from the EPROM Socket and SysEx

You can build up a custom Voice Bank from EPROM and SysEx sounds, and then save that Voice Bank back to the SD Card, using any of 100 Voice Bank slots on the card.





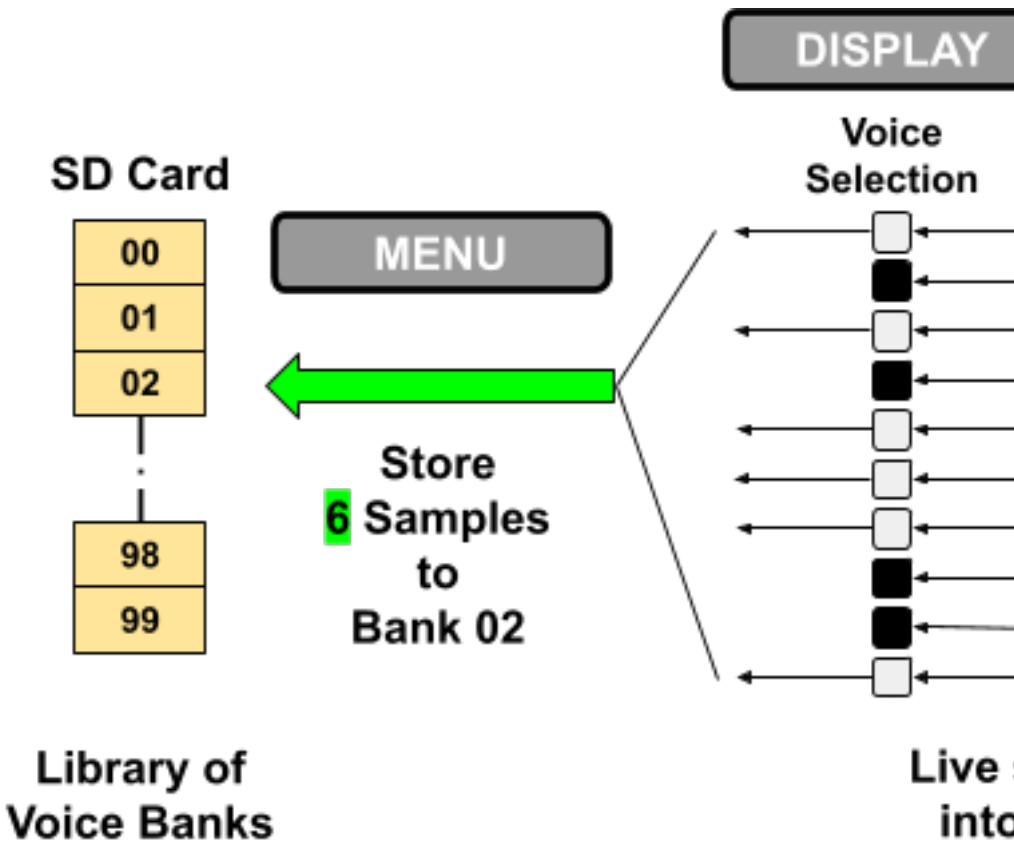
Storing a Modified Set of Samples Back to the SD Card

Load / Store Voice Selection

While in MENU mode, if you press DISPLAY you will see the Voice Selection status page. This shows which drums will be affected by Load and Store Voice Bank commands.

If you press a drum key, its state will toggle off (dark indicator) and on (white indicator).

When you Load or Store a Voice Bank, the voices that will actually Load or Store are those whose Voice Selection indicators are white.



Store (and Load) Voice Bank Subsets

These concepts:

- SD Card containing 100 Voice Banks, each with 10 samples
- MENU commands to Load and Store Voice banks
- Samples loadable from EPROM
- Samples loadable from SysEx
- Voice Selection controls to filter which voices are loaded/stored to the SD Card

enable flexible Voice Bank editing and creation on the Luma-1 machine itself.

The LumaTool web-based editor/librarian app allows even more convenient and flexible Voice Bank editing and creation.

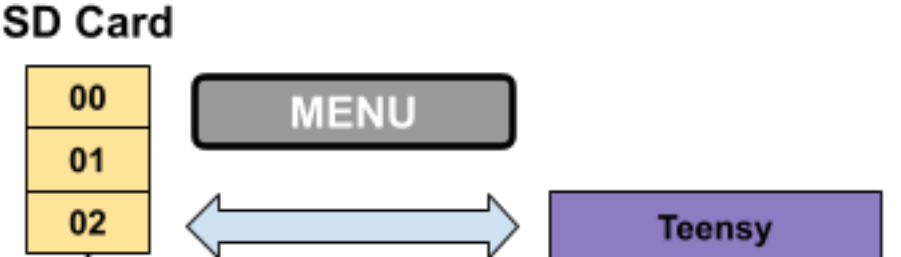
Pattern RAM Bank Concepts

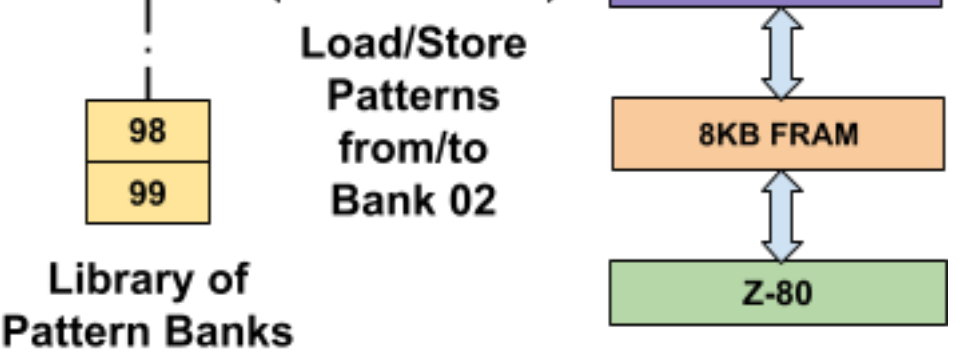
An LM-1 has either 4KB or 8KB of battery-backed RAM. Luma-1 has 8KB of FRAM, a modern nonvolatile memory that does not need a battery.

In an LM-1 and Luma-1, this 8KB of RAM holds all drum sequencer patterns, all variables for the LM-1 Z-80 code, and the Z-80 stack.

When Luma-1 is powered off, the FRAM holds the state of that Z-80 memory. This preserves the drum sequencer patterns. The FRAM is rated to hold data while powered off for over 100 years, so no more worries about batteries.

Luma-1's Teensy Coprocessor can stop the Z-80 and swap out the entire 8KB bank of RAM to or from the SD card. In the root directory of the SD card there is a folder called /RAMBANKS. Inside of /RAMBANKS are 100 folders, named /RAMBANKS/00/ through /RAMBANKS/99/.





Store (and Load) Pattern Banks

This makes it easy to have 100 banks of 100 patterns at your fingertips.

You can also use the LumaTool Web Application to download and upload Pattern Banks, either directly to/from FRAM or to/from the SD Card.

When you save the active FRAM bank to the SD card, it is given the name RAM_BANK_xxxx, where 'xxxx' is a checksum of the FRAM at save time.

SysEx Support / LumaTool Web Application

SysEx can be used to:

- Download a sample (WAV, uLaw Raw, Linear Raw) into a voice
- Upload a sample from a voice to your computer (uLaw Raw only)
- Download patterns and songs (Z-80 RAM) into Luma-1
- Upload patterns and songs (Z-80 RAM) from Luma-1 to your computer

Downloading a Drum Sample

Tap the drum trigger key on Luma-1 for the drum you wish to load.

Use the Luma-1 Web Application in a **Chrome** browser (only!) (https://luma.tools/luma1/) to send files to Luma-1:

- Make sure MIDI is set to Luma-1
- Drag and drop the sound file you wish to load onto the Luma-1 Application

the Luma-1 Application
● You will see a waveform for that sound, use the endpoint cursors if you wish to send only a portion of the waveform
● Use the Preview button to hear the sound played through your computer speaker
● If you are happy with the sound, use the Send to Luma-1 button to download the sound to the selected voice.
● You will see Luma's 7-segment displays show voice and size status as the sound is loaded
● Done, now you can play it on Luma-1!

Send the SysEx file via MIDI, you will see the LED indicators show loading progress.

Advanced Features of the Luma-1

The Luma-1 extends the functionality of the LM-1 with a modern (and incredibly powerful) microcontroller. Press the **MENU** button to access its advanced features.

Upon pressing the **MENU** button, the light above it will light up and the Luma-1 will pause all operation, including whatever played chain or pattern you are currently on, and the PATTERN # display will show 'uu', with the first one flashing.

Pressing either the '←' or '→' arrow buttons will scroll through a series of advanced functions that you can access. Alternatively, you can press the number keys corresponding to the menu item you want to select. With the feature highlighted on the screen or entered in, press the PLAY/STOP button to select it.

Pressing the **MENU** button again will resume normal drum machine operation after the light above the menu button is fully off.

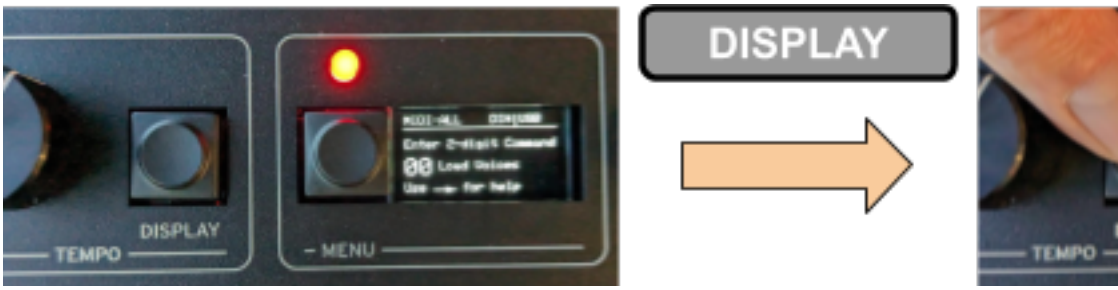
Voice Selection and Info Displays

Press DISPLAY while in MENU mode to switch the OLED display to INFO mode.

Pressing either the '←' or '→' arrow buttons will scroll through a series of other INFO screens, showing your unit's serial

number, Teensy firmware version, the name of the loaded sound bank, etc.

The first INFO screen you will see is the Voice Selection screen. This shows each of the drum voices and whether they are enabled for load/store operations. This lets you load / store a subset of the full bank of sounds.



DISPLAY button to see Voice Selection settings

Press drum keys while in MENU mode to toggle them off and on in the Voice Selection map. In the example shown **below**, the SNARE and BASS drums have been de-selected.



Voice Selection screen with SNARE and BASS de-selected

This is done by tapping drum keys while in MENU mode, regardless of whether the INFO screen is being shown.

When you tap a drum and it is de-selected, you will hear a double strike of that drum.
When you tap it again to re-select it, you will hear a single strike of that drum.

The Voice Selection map **resets to ALL DRUMS S**
when you exit MENU mode.

The idea is that you enter MENU mode, set up the Voice Selection map for some Voice Load or Store operation, then perform that operation: Load a bank of Voices from the SD card, save the currently staged bank to the SD card, etc.

MENU Command List

Command Group 0: Bank Business

00: Load Voices
01: Store Voices
02: Load Patterns
03: Store Patterns

Command Group 1: Special Voice Ops

10: Copy Voice
11: Reverse Voice

These operate on the active voices (STAGING). So you can use these to move and manipulate voices, audition them, and then save them to a bank on the SD card using MENU 01.

Command Group 5: EPROM Madness

55: Dump EPROM from CPU board socket.

FOLLOW ON-SCREEN INSTRUCTIONS!

Command Group 6: Fan Fun

66: Set Fan Mode
Selects whether the fan is always on, always off, or automatically turns on as needed.
You will usually want this set to Auto.

Command Group 7: Sysex Education

70: Send Sample
Sysex send sample for last drum that played

71: Send Sample Bank
Sysex send drum samples for selected bank, honoring

Sysex send drum samples for selected bank, honoring Voice Selection map

72: Send Patterns
Sysex send currently loaded Patterns

73: Send Pattern Bank
Sysex send specified Pattern Bank (00-99)

Command Group 8: MIDI Madness

80: MIDI Channel. Select ALL or 1-6. If you select ALL (OMNI), MIDI Transmit happens on channel 1 (since there is no out OMNI).
81: Notes **OUT** to DIN-5, USB, or Both (also Program Changes, for local Voice Bank loading)
82: Notes **IN** from DIN-5, USB, or Both (also Program Changes, which load Voice Banks)
83: Start/Stop/Clock **OUT** to DIN-5, USB, or Both
84: Start/Stop/Clock **IN** from DIN-5 or USB (not both)
85: SysEx **IN** and **OUT** via DIN-5 **OR** USB (not both)
86: DIN-5 Soft Thru (pass DIN-5 **IN** to DIN-5 **OUT**) **ON/off**

Command Group 9: System Science

90: Boot screen select
97: Dump SD Card directory (need serial terminal on USB to view to view)
98: Format SD Card, Create needed directory structures
99: Reboot

Loading New Sounds in the Luma-1

Using the Load Voice Bank command, you can load new sounds that you have downloaded onto the Luma-1 via its internal SD card or Luma-1 Web ApplicationLuma-1 Web Application by connecting your computer to the Luma-1 over USB.

Inside the Luma-1's internal storage, go to the DRMBANKS folder, then choose one of the numbered folders that you would like to reference your set of samples by. Upon opening *that* folder, you will see 10 folders corresponding to each of the drum sounds the machine can play: BASS, TOM, TAMB

the drum sounds the machine can play: BASS, TOM, TAMB, SNARE, HIHAT, COWBELL, CONGA, CLAVE, CLAPS, and CABASA. Put your sample file into each of these folders.

The sample files that you can load **MUST** be no larger than 32KB (except for CONGA and TOM, which must be smaller), and **MUST** be in the u-law format. Converting your existing samples to u-law format binary files can be done via a host of converter tools, one of which we have available for download on Github, and another of which has been built as a Luma-1 Web Application by Greg Simon.

If the sample file loaded is MORE than 32KB in size, it will simply be truncated arbitrarily to fit 32KB. If NO SAMPLE FILE is loaded into a folder in your custom bank, then a generic sawtooth wave will be loaded into that spot instead.

Load your new Drum Bank by hitting MENU->'00'->PLAY/STOP->'##' (This is the number corresponding to the folder containing the folders with your loaded sounds)-> PLAY/STOP. The Luma-1 will take a very brief moment to process and then return to normal drum machine operation. Hit the buttons, and you'll hear that your samples were loaded!

Special Notes About Drum Sounds

The 10 folders that were used in the previous explanation correspond to the 10 sample memories, or ROMs that were originally in the LM-1. Each of these spots is subject to different behaviors as described:

TAMB, SNARE, COWBELL, CLAVE, CLAPS, CABASA: These sounds will play without any special differences. A 32KB sample can be loaded in each of these folders.

HIHAT: The sample put in this spot is constantly recirculating, or constantly playing. When you press any of the 3 buttons to play the hihat sound, an envelope is opened over this constantly recirculating sample. This gives it a 'natural feel' that is unique to the LM-1, and by extension, the Luma-1.

BASS: The bass sound is put through a voltage controlled filter. The adjustment for the cutoff of this filter can be found on the back of the machine

CONGA, TOM: Both of these sounds share one DAC, just as the original did. They also share the 32KB RAM chip used for each Luma-1 voice board. As a result, the max sample size for

each of these two voices is 16KB each. Like on the LM-1, only one of these sounds can be played on the same beat (You can't play the CONGA Low and the TOM high at once). Lastly, they are also put through a voltage controlled filter like the bass drum, and there is an adjustment for the cutoff of that filter on the back of the machine.

Loading Samples from Physical EPROMs

The Luma-1 is also capable of loading a sound from an EPROM, which can then be put into the sample memory of one of the voice boards.

→ **WARNING** ←

Do **NOT** just put EPROMs into the socket. Follow the on-s
MENU command 55, and **only insert EPROMs wh**

Unscrew the 6 screws holding the top lid of the Luma-1. You will notice a green socket on the left side of the CPU board. This socket has a lever: up, the socket is unlocked. After inserting an EPROM, push the lever down to lock the EPROM in place.

Use MENU 55 to access the guided UI for dumping EPROMs.

You will have to select from the UI the correct kind of EPROM that you are dumping, and follow the onscreen instructions. These will tell you when to insert and when to remove the EPROM.

Use the jumper (or switch, on some machines) located just in front of the EPROM socket (looking from the front of the machine) to set the type / package for 24 or 28 pins.

Once you've done this, the data from the EPROM is loaded into the drum channel. To load several channels with different sounds you simply repeat the procedure again, selecting different drum voice targets each time.

And once you have all of the drums loaded and in the voices you desire, you can save the current voices to the SD card using the MENU 01 command.

As of current firmware version, Luma-1 expects EPROM dat

Firmware update (MacOS/Win/Linux)

The Luma-1 firmware for Teensy microcontroller is open-source, hosted at the product Github page: https://github.com/joebritt/luma1/tree/main/TeensyCode

There three ways to perform FW update:

- Compile it from source code (**Experienced users only**):
  - Requires the full Arduino stack with Teensy extensions. Follow the official Teensy documentation hosted here: https://www.pjrc.com/teensy/td_download.html
  - It doesn't require opening Luma-1.
- Update from binary (**Teensy official SW tool**):
  - Simply download the pre-compiled hex file and load it with Teensy loader tool: https://www.pjrc.com/teensy/loader.html
  - It requires you to open Luma-1 and press on the bootloader button on Teensy controller while running the tool
- Update from binary (**The most user friendly**):
  - Using pre-compiled hex file load it with TyTools: https://github.com/Koromix/tytools
  - It's straightforward to use, however, is not the official tool by PJRC and may not be supported on all platforms.
  - It doesn't require opening Luma-1.

Special thanks to:

Roger
A.R.
aek
Andrei
Devin

Andrei, Devin, and I hope that you enjoy your Luma-1, and have as much fun playing it as we had making it.

All the best in 2024!

Joe B



LM-1 Drum Computer

Original User Guide

by Roger Linn

ORIGINAL LM-1 DRUM COMPUTER INSTRUCTION MANUAL

Contents

Contents

GETTING STARTED
Hook Up
Playing Drum Buttons
Playing Rhythm Patterns

CREATING YOUR OWN RHYTHM PATTERNS
Erasing Rhythm Pattern Data
Copying One Pattern Into Another
Altering the Length of Rhythm Patterns
Doubling the Length of Rhythm Patterns
Available Memory Function
Out of Memory Error

AUTO-CORRECT FUNCTION
Shuffle Settings

CHAIN SECTION
Building a Chain
Editing the Chain
Changing the Contents of a Link
Inserting a Link Between Two Existing Links
Deleting A Link
Changing the Chain #
Playing the Chain at a Specified Link #

WHAT TO DO IF THE LM-1 STARTS BLINKING

ALTERNATE DRUM SOUNDS IN THE LM-1 DRUM COMPUTER

TAPE STORAGE(obsolete)
SYNCING THE LM-1 TO TAPE (obsolete)
REAR PANEL CONTROLS AND CONNECTIONS(obsolete)

HOOK-UP

1) Plug power cord into wall outlet or quality outlet box.
2) Connect **LEFT** and **RIGHT** outputs to amplifier.
3) Turn power switch (rear panel) to up position; all lights
should be off, except pattern # display, which should show **OO**.
4) Turn up **VOLUME** knob (master volume).
5) **STEREO MIXER:** Volume sliders and pan switches (left, center,

or right) are provided for each of the 12 drums and the recording
click. If a mono only signal is desired, place all switches to
one position. To get started, turn all drums up.

PLAYING DRUM BUTTONS:

The 18 drum buttons in the section labeled **DRUMS** may be
played at any time (while playing or stopped).

NOTE: There are two volume levels (loud and soft) for the bass,
snare, hi hat, cabasa, and tambourine that permit limited program-
ming of dynamics and accents. The softer volumes are played on
the upper row, indicated by lower case type.

NOTE[2]: In addition to loud and soft hi hat buttons, there is an
"open" hihat button (hihat). Hitting one of the "closed"
hi hat buttons immediately after the "open" button (hihat)
will close the "open" hihat.

PLAYING RHYTHM PATTERNS:

The LM-1 can hold up to 100 distinct rhythm patterns,
numbered **OO to 99**. The first 25 (**00–24**) are factory programmed.
To play the pre-sets:

1) Select a pattern by pressing two digits from the **SELECT**
RHYTHM PATTERN section (e.g., to select pattern #16, type **1, 6**).

NOTE: Patterns 0 through 9 require a leading 0 (e.g., to select
pattern #8, type **0, 8**).

2) Press **PLAY/STOP**. The light above the button will go on and
drums will play. If not, check everything

drums will play. If not, check everything above.

3) To stop, press **PLAY/STOP** again. The light will go out.

NOTE: Another pattern may be selected while in play mode.
However, it will not begin playing until the previous pattern has
finished.

CREATING YOUR OWN RHYTHM PATTERNS

Unless you feel at the outset that you will not be using the
pre-sets, -for now select patterns numbered **25 –99** only.

1) Select a pattern (e.g.: #30--type **3,0**).

2) While holding **RECORD** (LED lights will go on and link # display
will change--this may be ignored for now), hit **PLAY/STOP**
(play/stop light will go on). You should now hear repeating
1/8th note clicks. If not, check to see that the master volume
and sliders are up and re-check previous steps. Note that after
every sixteen 1/8th note clicks (two measures of 4/4 time), a
louder click is heard and the PLAY/STOP light blinks. This
indicates the downbeat of the two measure, 4/4 time repeating
loop.

3) Use the **TEMPO** knob to achieve a comfortable pace (this can be
done either in record or playback mode). You may find it
convenient to obtain a reading of the tempo in "beats-per-minute."
Press the **DISPLAY** button. If the tempo is less than 100 BPM, it
will read-out in the **PATTERN** # display (the **LINK** # display will

remain blank). If the tempo is greater than 99 BPM (thereby
necessitating three digits), the first digit will appear in the
LINK # display and the following two digits will appear in the
PATTERN # display. "Beats-per–minute" can be displayed only when
the LM-1 is stopped.

4) Hit any drum button, in time with the click, until you
establish the repeating pattern. You may continue to "overdub"
other percussion on the "loop" as long as you like--it is not
necessary to play all the parts at once.

5) To stop recording, hit **PLAY/STOP**. Drums will stop and lights
will go out. The rhythm you have entered is now permanently
stored (even with power off) under the pattern # you selected.

6) To play the rhythm pattern, hit **PLAY/STOP**. Hit it again to
stop.

If you wish to add more drums to your new pattern, simply repeat
the above steps. Re-entering record mode does not erase anything
from the selected pattern, but rather allows you to "overdub" on
top of it. Explanation of data erasure techniques follows in the
next section.

NOTE: The pattern you entered may sound neater when it plays
back. This is because the LM-l's **AUTO-CORRECT** feature has
corrected your errors by "moving" your entries to the nearest
1/16th note. To adjust or defeat this feature, see **AUTO–CORRECT**
section of the manual.

NOTE[2]: If, after recording many patterns, the pattern # display starts blinking, this means the LM-1 has run out of memory. To stop this blinking, hit **PLAY/STOP**. See "Out of Memory" section.

ERASING RHYTHM PATTERN DATA:

Rhythm pattern data may be selectively erased in four different ways (make sure LM-1 is not in chain mode):

1) To erase an entire pattern:
While holding **ERASE**, type the two digit # of the pattern to be erased.

2) To erase a specified drum throughout a pattern:
While holding **ERASE**, hit the drum you wish to be erased.

3) To erase a drum from a specified portion of a pattern:
Enter record mode (while holding **RECORD**, HIT **PLAY/STOP**, then release). With the pre-recorded pattern playing, hold down **ERASE**, then press the button of the desired drum to be erased precisely at the moment(s) it should be deleted.
Example: To erase a cowbell from the second measure of a two-bar pattern, enter record, then simply hold **ERASE** and **COWBELL** simultaneously during the second measure only.

4) To erase all 100 rhythm patterns:
While holding **ERASE**, hit **LOAD**.

(Erase mode 1,2, & 4 above will sound a "beep" to verify era-
sure)

sure).

COPYING ONE PATTERN INTO ANOTHER

(LM-1 must not be in "chain" mode)

1) Type the two digit # of the pattern to be copied from.

2) While holding **COPY**, type the two-digit number of the pattern to be copied into. The previous contents of this rhythm pattern will be lost. A "beep" will verify a sucessful copy.

ALTERING LENGTH OF RHYTHM PATTERNS:

(LM–1 must not be in "chain" mode)

This function allows you to change the length of the repeating loop of a specified pattern from the normal two measures to any length you desire. This is useful for odd time signatures, long non-repeating sections, etc.

1) Select desired pattern 4 (enter two digits).
2) While holding **RECORD**, hit **LENGTH**. You have now entered record mode, except that the pattern never repeats. (The PLAY/STOP light will blink continuously to indicate length function).

3) At the moment you wish the pattern to start repeating, hit **PLAY/STOP**. The amount of time that has elapsed between start (step 2) and stop (step 3) is the new length of the repeating loop.

Example: To change the length of pattern #30 to four measures:
Type **3,0**. While holding **RECORD**, hit. **LENGTH**. Count out four measures of clicks–on the downbeat of bar five, hit **PLAY/STOP**.

Pattern #30 is now four measures in length.

NOTE: When an entire rhythm pattern is erased, its length returns to the normal two measure length.

DOUBLING LENGTH OF RHYTHM PATTERNS (COPY LENGTH):

(LM-1 must not be in "chain" mode)

This function: 1) Doubles the length of a specified pattern (a two measure pattern becomes four measures); and 2) copies the data which previously existed in the pattern into the newly created second half. No data is lost, but rather a mirror image of the pattern is created and added on to the end of itself.

1) Type the two digit # of the specified pattern.

2) While holding **COPY**, press **LENGTH**. A "beep" will sound.

This doubling function can be repeated any number of times (e.g. four measures can be made into eight, eight into sixteen, etc.)

AVAILABLE MEMORY FUNCTION:

(LM-1 must not be in "chain" mode)

When **RECORD** is held down, a number will appear temporarily in the **LINK #** display. This is the percentage of memory available for recording new patterns. The highest this number can be (with all rhythm patterns erased) is 99 (%).

OUT OF MEMORY ERROR:

Even though the LM--1 has a capability of 100 rhythm patterns, it is possible to run out of memory before they

is possible to run out of memory before they are all utilized.
This is because the LM–1's memory use is based on the amount and
complexity of drum music contained, rather than the number of
patterns. The longer and more complex the patterns are, the less
memory remaining there will be.

If while recording, copying, or loading data from tape, the LM–1
runs out of memory, it will stop and the **PATTERN #** display will
blink, indicating "out of memory error". When this happens, you
must:

1) Stop the blinking and beeping by hitting **PLAY/STOP**.
2) Erase a few unimportant patterns to provide room for more.

AUTO-CORRECT FUNCTION

This function will automatically correct timing errors made
while recording rhythm patterns. This is accomplished by "moving"
your drum entries to the nearest, for example, 1/16th note. It
is possible to specify the degree to which your entries are
moved. For example, to enter a 1/16th note hi hat part, you
should use 1/16 note **AUTO-CORRECT** (this is also the default
setting when the unit is turned on). If you attempt to enter
1/32th notes with 1/16 note **AUTO–CORRECT**, your entries will be
moved to the nearest 1/16 notes. Therefore, it is sometimes
necessary to analyze the pattern you are recording, and adjust to
an appropriate setting.

NOTE: **AUTO-CORRECT** will not affect previous recordings, only

recordings, only
those about to be made.

To examine the current **AUTO-CORRECT** setting, hold record
(while not in chain mode): Two LEDs will light corresponding to
1/16 and **50%**. The percentage designation may be ignored for
now--it. will be discussed shortly. The **1/16** light indicates that
if record mode is entered (by holding **RECORD** and pressing **PLAY/
STOP**), all drum entries will be "moved" to the nearest 1/16th
note, thereby correcting timing errors.

To change to a different AUTO-CORRECT setting, hold **RECORD**
and type **AUTO–CORR** until the desired setting has been reached.

There are seven positions:

ENTRIES MOVED TO NEAREST:	**CLICK PLAYS:**
1/8 note	1/8 notes
1/8 note triplet	1/8 triplets
1/16 note	1/8 notes
1/16 note triplet	1/8 triplets
1/32 note	1/8 notes
1/32 note triplet	1/8 notes
Hi Resolution	1/8 notes

Note that if the **1/8T** or **1/16T** settings are selected, the click
will play 1/8th note triplets. Otherwise, straight 1/8th notes
clicks will always be heard in record mode.

The auto correct settings may be changed any number of times
between recording passes to facilitate the particular need of
each "overdub". However, these setting changes

may only be made
while the LM-1 is not playing.

HI (high resolution) setting is used when it is necessary to
record a part precisely as played in, or in other words, to
defeat the auto correct. This is particularly handy in achieving
flams, rolls, etc.

SHUFFLE SETTINGS:

As well as error correction, **AUTO-CORRECTION** has the added
capability, it specified, to move your drum entries on to time
slots that make the part "feel" more human. This is accomplished
by slightly "shuffling" the 1/8th or l/16th notes.

EX: A 1/16th note hihat pattern will lose its "stiffness" if the
odd numbered 1/16th notes receive 58% of each 1/8th note, and the
even numbered 1/16th notes receive 42% :

1 2 3 4 5 6 7 8

58% 42% 58% 42% 58% 42% 58% 42%

To implement this example, assuming that auto-correct is set
at the default setting (1/16), while holding **RECORD**, type **ADJUST**
SHUFFLE until the **58%** LED is lit. If record mode is now entered,
entries will be moved to the nearest 1/16th note, except that the
odd numbered l/16th notes will receive 58% of each 1/8 note.

If the **1/8** LED is lit while any of the

If the **1/8** LED is lit while any of the **percentage** lights are lit, the 1/8 notes will be shuffled, instead of the 1/16 notes. In this case, the percentage indicated would refer to the amount of each 1/4 note given to the odd numbered 1/8 notes.

CHAIN SECTION

This function enables the LM-1 to be programmed to play entire complex song formats (intro, fills, changing sections, ending, etc.) automatically by "linking" a number of patterns together to form a "chain". When played, each pattern (or link) in the chain will be played one repetition only, then the next pattern , then the next, etc.

NOTE: As with rhythm pattern data, all chain data remains intact with power off.

BUILDING A CHAIN:

1) Record a few new patterns to be used as links in the chain (e.g.: record an intro in pattern #30, a verse in #31, a bridge in #32, etc.).

NOTE: You may want to alter the length of a pattern to be more suited to its position in the song. See **ALTERING LENGTH OF RHYTHM PATTERNS** section.

2) Enter **CHAIN** mode by pressing **CHAIN ON–OFF**. All of the functions described in this section will only operate while the LM-1 is in chain mode. Chain mode is indicated by the link # display being lit (it should display **0** when chain mode is first

entered).

NOTE: The **CHAIN ON-OFF** button is dual function: Pressing it once puts the LM-1 into chain mode; pressing it again takes the LM-1 out of chain mode. Chain mode may be entered or exited at any time, playing or stopped.

3) Write on a piece of paper the list of patterns to be entered, in the order you wish them to be played.

4) Enter this list of two-digit pattterns into the chain by typing the numbers into the **SELECT RHYTHM PATTERN** section. Notice that after each two-digit pattern is entered, the link # display automatically increments by one, indicating the number of the link you have just filled. Up to 99 patterns (or links) may be entered.

5) After the last pattern has been entered, press **LAST ENTRY**. A [ ] will appear in the pattern # display. This terminates the chain. When this "last entry" link is reached during playback of the chain, the LM-1 will immediately repeat the chain, starting at link #1. (EX: If four patterns are entered into the chain, and **LAST ENTRY** is entered into link #5, only the first four links, containing the patterns will be played, and they will be repeated in sequence until stopped).

NOTE: Chains immediately repeat from the top when the last entry is reached. To easily defeat this, pad the end of the chain by entering a few "empty" patterns.

NOTE[2]: If a **LAST ENTRY** is not entered at the end of the chain, the LM-1 will simply play the previously programmed contents of the unused remainder of the chain.

6) To play your chain, simply press **PLAY/STOP** (when in chain mode, PLAY/STOP will always play only the chain). Press it again to stop.

EDITING THE CHAIN:

When in chain mode, the pattern # display always shows the contents of the displayed link #. To examine a higher or lower link #, press <--- (lower) or ---> (higher). If either of these buttons is held down, they speed up considerably the access to a desired link.

CHANGING THE CONTENTS OF A LINK:

If you want to change the contents of a link from one pattern to another, or if you typed in an error:

1) Use the <--- and ---> buttons to locate the link just before the one you wish to change.

2) Type the "correct" two-digit pattern it. The link # display will increment by one, indicating that the pattern # has been placed in the proper link.

Example: To change the contents of link #15 from pattern #14 to pattern #21: Use <--- and ---> buttons to locate link #14. Type **2,1**. The link # display will increment by one, indicating that the pattern # has been entered into the proper link, link# 15.

link, link# 16.

```
LINK#:          12   13   14   15   16
 17
-----------------------------------
---
BEFORE                          CHANGE:
 11         12         13         14
      15         16
AFTER           CHANGE:
11         12         13         21
     15         16
```

INSERTING A LINK BETWEEN TWO EXISTING LINKS:

This function inserts a new pattern in the middle of a chain
and moves all links located above the insertion point up by one:

1) To insert a new link between two existing links, use the <---
and ---> buttons to locate the higher of the two existing links.

2) While holding **INSERT**, type the number of the pattern to be
inserted. A "beep" will sound to verify insertion.

Example: To insert pattern #24 between link #8 (which contains
pattern #7) and link #9 (which contains pattern #8), use the <---
and ---> buttons to find link #9. While holding **INSERT**, type
2,4. A "beep" will sound. Link #9 now contains pattern #08, and
the previous contents of link #9 (pattern #08) now resides in
link #10. All higher links have also been moved up one position.

```
LINK#:                  7   8   9
10  11  12  13
-----------------------------------
-------------
BEFORE INSERT:          06  07  08
 09  10  11  12
```

```
AFTER INSERTING
NEW PATTERN # :          06   07   24
 08   09   10   11
```

DELETING A LINK:

In deleting a link from a chain, the gap left by the deletion is automaticaly closed by moving all higher links down by one:

1) Use <--- and ---> buttons to locate the link # to be deleted.

2) Press **DELETE**. A "beep" will sound, indicating that the contents of the displayed link # have been deleted, and all higher numbered links been moved down by one to close the gap.

Example: To delete the contents of link # 3, use the <--- and ---> buttons to locate # 3. Press **DELETE** (a "beep" will sound). Notice that the pattern # display now reads **03** which has been moved down from link #4. All higher links have also been moved down by one.

```
LINK#:                   1   2   3
4   5   6   7
-----------------------------------
-------------
BEFORE DELETE:           00   01   02
 03   04   05   06

AFTER DELETE:            00   02   03
 04   05   06   07
```

CHANGING CHAIN #:

So far, we have described building and editing one chain. There are eight chains, each containing its own set of 99 links.
The chains are numbered 1 through 8. To see

The chains are numbered 1 through 8. To see which chain is currently being used, press **CHAIN #**. While it is held down, the link # display will show **C 1**. This means chain # 1. To change to a different chain #: While holding **CHAIN #**, type the # of the desired chain (1-8; enter one digit only). The chain number you enter will remain current until changed or until power is turned off and on again (chain # 1 is the default setting on power-up).

PLAYING CHAIN STARTING AT SPECIFIED LINK

Normally, when **PLAY/STOP** is pressed, the chain will start playing at link # 1. It is possible to play the chain starting at a specified link #:

1) Use <--- and ---> to locate the desired starting link #.
2) Exit chain mode by pressing **CHAIN ON-OFF**.
3) Start play by pressing **PLAY/STOP** (the desired starting link # is now playing).
4) Quickly re-enter chain mode by pressing **CHAIN ON–OFF**.

WHAT TO DO IF THE LM-1 STARTS BLINKING:

If the **Pattern # Display** is blinking, refer to the "Out of Memory" section.

ALTERNATE DRUM SOUNDS IN THE LM-1 DRUM COMPUTER

Each of the LM-1’s drum generators are optimised for the decay and frequency range characteristics of that particular drum. Therefore, an existing drum may be replaced with a different recording of the same type of drum or a different drum with the

same general characteristics.

SPECIFICS:

SNARE: The two buttons permit two playback volumes of the same drum recording. These may be replaced with an alternate snare or other drum containing high frequencies (i.e. snare, rimshot, cowbell, etc.) Lower frequency drums should use tom, conga, or bass generators.

TAMBOURINE: Same as snare generator.

COWBELL: Same as snare, except half the recording time and only one volume level.

RIMSHOT: Same as cowbell.

CLAPS: Same as snare, except only one volume level.

CABASA: Same as snare, except half the recording time.

BASS: Same as snare, except sweeping 24 db/oct filter attenuates highs after strike.

TOMS: Ihe hi and low tom buttons permit two playback pitches of the same recording--you cannot change one without changing the other. As with the bass drum, a 24 db/oct sweeping filter attenuates the highs after the strike.

CONGAS: Same as toms. These may be replaced with two more toms. Note: Only one tom OR one conga may sound on any one note.

HI-HAT: May not be changed.

LIMITED WARRANTY

Deftaudio LLC. will repair, free of charge, any Luma-1 Drum Computer that, in our opinion, is defective in materials and/or workmanship, and has not been subjected to abuse, for a period of one year from date of purchase. This warranty is issued to the original purchaser only, and is non-transferable.

This warranty is VOID if, in the opinion of Deftaudio LLC:

A) The product is modified in any manner.
B) The product has been repaired or serviced by anyone other than authorized personnel.
C) The product is damaged because it has not been properly installed, maintained or operated in accordance with the instructions contained in this booklet.

NOTE: Under no circumstances shall the manufacturer be liable for any loss or damage, direct or consequential, arising out of the use of, or inability to use, this product.