Lell PSR (1991) Drum Synthesizer Instruction Manual

Roughly translated from the original Russian user manual in 08 2023
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DEVICE DESCRIPTION AND TECHNICAL DATA

Instrument count: 12
Fixed rhythm count: 32
Custom rhythm count: 64
Custom song count: 8
Max bar count per song: 255
Tempo adjustment range: 40...200
Signal to noise ratio: min 60dB
Output voltage: max 2.4V
Mains voltage: 198...242V
Power consumption: max 11VA
Weight: 3.2kg

CONTROLS

SONG - song (+/-) - selects song for programming or playing
TEMP - tempo (+/-) - adjusts the play tempo
RITM - rhythm (+/-) - selects predefined or custom rhythm
+ / **-** - increase/decrease, works combined with SONG, RITM, TEMP, 4/4, ~3~ for changing these parameters, or alone for selecting the bar
KOPIYA - copy - save a selected rhythm to a song
STIR - delete - delete an instrument or a rhythm
4/4 - select for using meter for programming
~3~ - select for using triplet count for programming
SHAG - step - step-by-step rhythm programming
METR - metronome - metronome-assisted rhythm programming
FF / **PP** - volume up/down
STOP - pause or resume playing a rhythm or a song
START - start or restart playing a rhythm or a song
AKCENT - stress - play the instrument louder (combined with an instrument button in programming, replaying or real-time play)

INSTRUMENTS

KAUBEL - cowbell,
RIM - rimshot,
HET O - open hihat,
HET - hihat,
GONG,
BONGO,
KLAP - clapping,
BAS - kick drum,
SNER - snare drum,
TOM 1 / **2** / **3**

VFD INDICATORS

SONG (0...8, default: 0): 0 means no song is selected and a rhythm can be selected and played.
RITM - rhythm (1...96, default: 1): 1...32 are predefined rhythms, 33...96 are custom rhythms.
TAKT - bar (1...225, default: 1): number of bar in a song currently played or programmed,
SHAG - step (default: 1): n/12 or n/16 note of the bar currently played or programmed,

After pressing ~3~ (triplet), 4/4 (meter), tempo, ff/pp (volume up/down), a different set of parameters is displayed.
RAZMER TAKTA - meter - x/y (e.g. 44 for 4/4), default: 4/4,
TEMP - tempo (40...200bpm, default: 80),
PP-FF - volume (1...64, default: 32).

"**M**" on the left indicates that your PSR is in the programming mode.

REAR PANEL CONNECTORS

L, P - L/R outputs (1/4" TS),
TF - headphones (1/4"; originally mono TS, possible to mod for binaural mono TRS),
MAG - line out (DIN stereo),
MIDI in/out - present and described in the manual, but NOT IMPLEMENTED!

PREDEFINED RHYTHMS, two per musical style:

1,2 bossa nova
3,4 samba
5,6 cha cha
7,8 kazachok
9,10 swing
11,12 bals
13,14 big band
15,16 tango
17,18 beat
19,20 rock
21,22 disco
23,24 reggae
25,26 lezginka
27,28 march
29,30 heavy metal
31,32 slow rock

SHORT DESCRIPTION

A Lell PSR programmable rhythm synthesizer is designed for programming and playing percussive instrument notes for music bands or amateur music making.
The device has a pair of line outputs (left and right) and a mono headphone output.
The synthesizer is a programmable device based on a microcontroller. Instrument sounds were stored as digital samples in the device's memory, with following features:
-playing the instrument sounds independently,
-playing fixed rhythms,
-programming rhythms in selected sections of a chosen bar, in the metronome and step mode, and playing them,
-programming songs using fixed and custom rhythms, and playing them.
The programmed data is held in RAM by using battery backup (4 AA batteries) that should last for at least 4000 hours.

The left and right outputs can be connected to a stereo amplifier or two monoblock amps to get panoramic sound. The headphone output is mono (summed L+R).
The **MAG** output (DIN socket) is stereo - uses pins 3 and 5 for L and R output, parallel with the 1/4" jacks. It can be connected to a tape machine or an audio amplifier.

The power input (marked 12V) is a 5.5/2.1 DC barrel jack, 12VDC center positive. Any modern power supply capable of 0.7A or more will work.
Transformer power supply is recommended. The original PSU (transformer wall wart) has a flat plug which will fit into the old Soviet socket but not CEE7/5 or Schuko, unless an adapter is used.

USING YOUR LELL PSR RHYTHM SYNTHESIZER

Getting started:
Connect the power supply and amplifier (turn the volume down first to avoid pops). Switch the device on by putting the switch in the left position.
The VFD should light up indicating song 0, rhythm 1 (bossa nova), bar 1 and step 1.
Press **START** to play the rhythm. Press **FF** or **PP** to adjust the volume.
You can change the tempo by holding down **TEMP** and pressing or holding down **+/-**.
Change the rhythm by holding down **RITM** and pressing (or holding down) **+/-**.
Pause the rhythm by pressing **STOP**. Resume from current bar/step by pressing **STOP** again.
Restart from scratch by pressing **START** after the rhythm is stopped; pressing **START** while it is playing does nothing.

Programming the rhythm:
Select a custom rhythm (33...96) by holding down **RITM** (rhythm) and pressing **+/-**.
It can be programmed in a step-by-step mode or in a metronome assisted mode.
Clear a rhythm by pressing **RITM** and **STIR** (delete) in the metronome-assisted mode.
Press the **SHAG** (step) button. The VFD will display **M** on the left, indicating the programming mode. Hold down the *4/4* button, choose the meter (4/4, 3/4, 2/4 or 1/4) by pressing +/-; the **RAZMER TAKTA** number on the VFD will change accordingly.
Save a percussive instrument in a desired note of the bar by pressing its respective button.
The number of notes (steps) in the bar depends on the selected meter and will be equal to 16, 12, 8 or 4. Pressing the +/- changes the step you're working on. Skipping a step without saving any instrument will save a pause.

In triplet notation mode (*~3~*) every quarter of a bar consists of three notes (steps). The selected tempo is preserved as well.

For your convenience it's recommended to draw a table of a desired rhythm before programming it. Several instruments can be saved simultaneously in every note of the bar or, alternatively, saved to all notes. If removing an instrument from a part of the bar is necessary, hold down **STIR** (delete) and press the instrument's button.

A bar is cleared by pressing **RITM** (rhythm) and **STIR** (delete) in the metronome-assisted mode. To finish editing a rhythm and save it, press **STOP**. Press **START** to make sure if your freshly programmed rhythm sounds good. If you wish to modify the rhythm, press **STOP** and then **SHAG** (step), and do modifications using a method described above.

Programming a rhythm can also be done in a semi-automatic mode using a metronome. Choose one of the programmable rhythm slots (33...96) with **RITM** + **+/-**, then choose the metre (4/4, 3/4, 2/4 or 1/4), and press **METR**. You'll hear evenly spaced beats coinciding with every quarter of the selected bar. The first note is stressed. Pick up a convenient metronome tick tempo, save the desired instruments in the suitable steps. It is recommended to record each instrument individually, starting with the kick drum, following with the snare drum, hihats etc.

If you wish to remove an instrument, press its button together with **STIR** (delete). After you get a desired rhythm, press **STOP** to finish programming.

It will be stored in the RAM as long as the unit is powered or batteries are inserted.

Programming the song - An Example from the Original Manual:

Hold down the **SONG** button and press **+/-** to select a song slot (1...8). Press **SHAG** (step) or **METR**. By pressing **-**, set the first bar.

Hold down **RITM** (rhythm) and set the 17th rhythm. Press **KOPIYA** (copy). The synthesizer will automatically select the next bar.

Press **KOPIYA** again to save rhythm #17 into the second bar. Working on the third bar, choose rhythm #19 and press **KOPIYA**, and then, for the fourth bar, choose rhythm #21, press **KOPIYA**. Finally, press **STOP**. You have just programmed a four-bar song consisting of 2x beat, rock and disco rhythms. After pressing **START** the song will be played once.

You can program up to 225 bars per song by copying rhythms from the fixed or custom pool.

In a song, you can write the score with a time signature other than the time signatures suggested above (4/4, 3/4, 2/4, 1/4). For example, you can get a 5/4 time signature by alternating between 4/4 and 1/4 time signatures.

MIDI CONTROL

the „wishful thinking" part that was not implemented - included here for the sake of completeness

MIDI (Musical Instruments Digital Interface) is used for communication between two or more instruments supporting the standard, in order to control one with another.

The MIDI and PAUZA (pause) buttons on the Lell PSR will work with MIDI-capable instruments. For example, PSR can be controlled from a Lell 24 synthesizer. In order to do that, connect both units with a MIDI cable (Lell 24 MIDI out to PSR MIDI in). Select the MIDI channel 1...16 (e.g. 14) by pressing MIDI and +/-. Set the same channel on the Lell 24.

Your Lell PSR is now ready to receive information on MIDI channel 14. You can use synthesizer to start, stop, change the tempo or choose a song.

NOTES FROM THE VACUUM TUBE WITCH

I worked on a unit built in May 1991 or later, as markings on ICs indicate. The unit has a "Made in the USSR" on the bottom, so it must have been 1991 (the USSR was officially dissolved on 26th of December 1991... 30 years before the James Webb Space Telescope was launched!)
The specimen had a case of bad joints on the control board and corrupted EPROMs with some samples. I re-programmed and replaced these EPROMs; the main firmware EPROM died on me as a result of that bad joint case, I had to replace it as well. I also replaced an insulation pad under the control & DAC board connector, fixing a factory defect shorting the RAM battery which made it impossible to store the songs & custom rhythms through powerdown.
Speaking of which: If you want to preserve these for a long time, replace the batteries while the device is powered up so that RAM is constantly powered.
There's no data interchange format nor interface to upload and download your work to and from the PSR. Why? Meh.

Edward DTech and Dmitry Dubrovenko have their pages on Lell PSR that turned out to be an invaluable source of information:
https://www.dtech.lv/techarticles_lel_psr.html
http://www.dubrovenko.ru/ddssite/dshlelsw.htm
I'll try as best as I can ("asbestos-a-can!") to make info on those drum machines more complete and widespread.

MIDI in and out DIN sockets are present on the back panel but completely disconnected. Don't even count on that. The MIDI interface was planned to be implemented in this device, but work was discontinued, probably because of licensing issues. Back then (1991), MIDI was a proprietary standard, pretty much like today's HDMI in the AV world, and device manufacturers had to pay licensing fees to the managing organization. Even if suitable electronic components and connections were added as the original PCB layout included, the synth's firmware just doesn't support them. There's no alternative ROM dump implementing it either.
MIDI and pause buttons are unsupported by firmware either, even if their respective diodes are soldered in.

Firmware was developed for the antiquated COP402 a.k.a. KR1820VE18 ROM-less microcontroller (it uses an external ROM chip for firmware). Edward D-tech has this firmware disassembled but even he doesn't fully understand how it works. Without a COP402 assembler, it's no use modding it – no way to compile it into a binary file to upload to the ROM.

Funny enough, the user manual features MIDI functionality I translated. So, the rhythm synthesizer looks like it has MIDI capability, the manual mentions it, but it's NEVER gonna work because it's not implemented in hardware nor software! Talk about advertizing the functionality that never came. As if they couldn't just mention that it's not there in this version but may be implemented sometime in the future.

Hunting the bad joint issue was a pain in the ass and it took me a whole week to pin down!
Pfffft. I stayed determined and Keri'd on. Turns out it was probably some metallized via not contacting, or a short circuit between adjacent traces. This thing has no solder mask at all.
Military electronics used conformal coating, civilian stuff did not. Plus some sketchy PCB material, not the good FR-4…
I had all kinds of weird shenanigans going on in this device, sometimes a memory addressing line was failing, sometimes it was a data bus line… Time for debugging, looking at the signals.

A scope with decent parameters (even a Soviet S1-112A would suffice, though I prefer my Tek 468, haha!) is essential in fixing this. A logic analyzer would be even better, but I don't have one, had to scope things out.

Tracing connections is pretty easy, it's a double-layered PCB with no soldermask and none of that SMT rubbish, the traces are at least 0.7mm wide so you don't need a microscope, though their routing can be pretty confusing.

There's a lot of redundant traces going to unpopulated connectors on the control board. If I were to design the thing, I'd totally ditch them not to run into noise and crosstalk issues. Fortunately there seems to be none.

I modified the headphone output to send mono signal into both channels. Originally the ring was grounded. Why the designers didn't want to include a stereo output is beyond me. There's a UD608 (741) opamp summing both channels and feeding into headphones.