

Galaksija

Assembly Instructions

Ciao!

Thank you for choosing a product from Apulia Retrocomputing - Odv!

What you are reading is all the documentation, in our opinion, necessary and sufficient to assemble and enjoy the performance of a Galaksija computer.

The manual is divided into five parts:

- Pre-assembly
- Assembly
- Modifications
- Verification
- Attachments

We invite you to visit our website to learn about the history of the computer and the project.

We also remind you that our member Guido Cauli has made an interesting documentary on the subject: "[The Ages of Galaksija](#)".

We have also collected other documentation from the web that has proven very helpful in solving the problems encountered during the implementation of the project, useful for assembling the Galaksija.

The manual has been written and structured to be as complete, clear, and exhaustive as possible without being dispersive.

In case of problems, you can consult the attachments at the end of the manual, containing electrical diagrams, silk-screening, and a list of components. Although it is not mandatory, we strongly recommend the use of an oscilloscope.

For any needs, feel free to contact the following email:

laboratorio@apuliaretrocomputing.it

Apulia Retrocomputing - Odv
THE LAB

PRE-ASSEMBLY

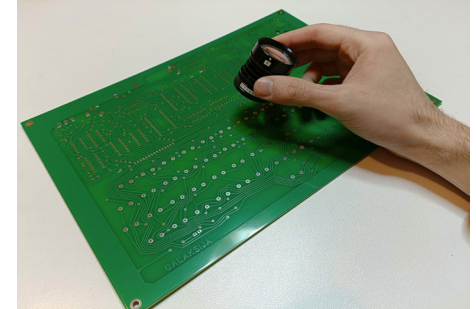
PCB Verification

Before starting the assembly of the Galaksija computer, it is recommended to perform a visual inspection of the printed circuit board (PCB). Although the boards have already been checked at the factory, detecting a problem at this stage would make diagnostics more convenient and less complicated than later on.

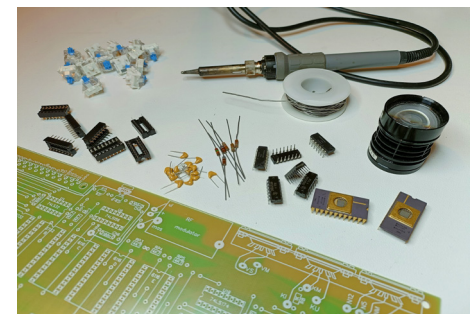
It is recommended to use a magnifying glass or microscope to examine the traces.

Components List

The manual provides a handy list of all the electronic components needed to build the computer in the attachments.



PCB inspection



Retrieve the necessary components

ASSEMBLY

Jumpers

Start assembling the Galaksija computer by installing the jumpers on the top side of the board. It is recommended to use single-core conductor wires with an appropriate diameter (e.g., AWG 20). The wires should not be pulled or bent too much to avoid breaking the internal conductor. Check the solder joints with a multimeter continuity test. This operation needs to be performed with great care, as an error at this stage could complicate later diagnostics.

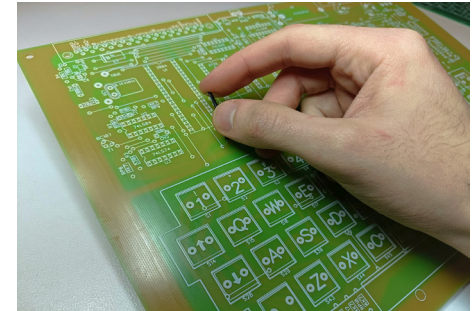
Components

Proceed with the installation of the remaining components. Use a multimeter to check the tolerances of the various components to avoid reading errors (e.g., 24 Ohms instead of 24 KOhms) or defective components. It is recommended to solder the smaller components, such as resistors and capacitors, before moving on to the larger ones, such as sockets and integrated circuits.

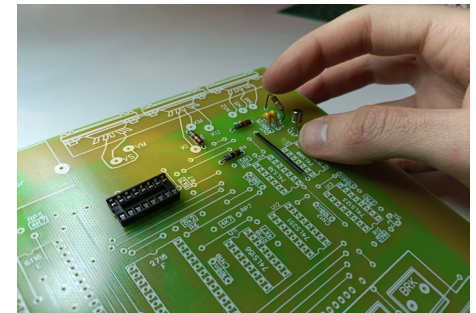
Remember that prolonged exposure of the pads to high temperatures can cause delamination or the loss of the pads. For TTL chips, use components from the LS series. No critical issues have been found for CMOS components.

To simplify the assembly, the “Attachments” section at the end of the manual provides the PCB design with original silk-screening and a checklist showing the component values. Note that capacitor C3 (5nF) must be replaced with a 6.8nF one, and capacitor C1 (5nF) with a 4.7nF one. This replacement is not due to a design error but is necessary because of the different tolerances of modern components.

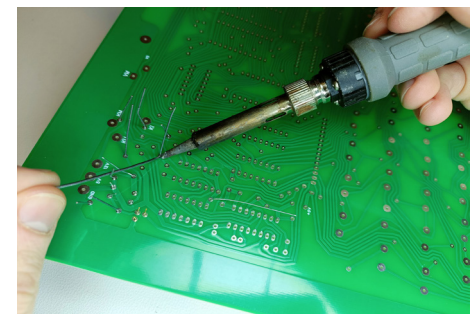
It is highly recommended to consult the “Modifications” section for the correct functioning of the Galaksija.



Insert the jumpers



Install the components



Solder the components

ASSEMBLY

EPROM Programming

Along with the manual, image files to be loaded onto the EPROM are also provided. It is important to remember that EPROMs 2716 and 2732 require a specific programmer.

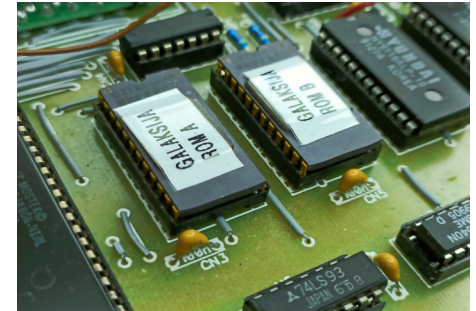
Load the file “Galaksija_G.rom” onto the 2716 EPROM labeled “F”.

On the 2732 EPROMs labeled “A” and “B”, load the files “minusA.rom” and “minusB.rom” respectively.

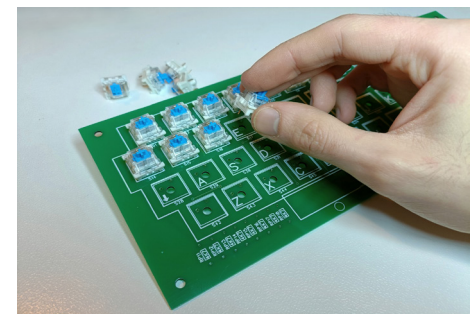
Keyboard

The Galaksija computer allows for a keyboard to be directly soldered onto the board. However, it is important to remember that to use Cherry switches (or compatible ones), an external keyboard is necessary.

Apulia Retrocomputing offers this board only in the Galaksija Replica ADVANCED kit.



Program the EPROM



Assemble the keyboard

MODIFICATIONS

This section covers all the modifications made (compared to the original project) for the correct functioning of the Galaksija computer.

Video Patch

Due to certain design choices, the Galaksija may encounter difficulties in generating the video signal with modern Z80 CPUs. Apulia Retrocomputing has developed a video patch that solves this problem based on a modification found on an original Galaksija. It is a monostable multivibrator that corrects the timing errors of newer CPUs.

Although older Z80 CPUs produce the correct timing, it is still recommended to install the patch. Depending on the revision of the patch, the filter capacitor C1 placed across the U3 chip might not be present. While not mandatory, it can be added by soldering it to pins 7 and 14.

The patch should be inserted in place of the U9 chip. It is recommended to consult the circuit diagram and the component list of the

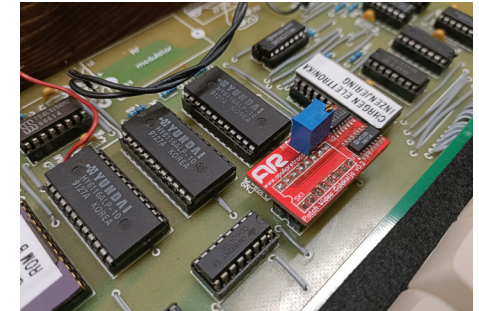
video patch in the attachments at the end of the manual.

Video Signal

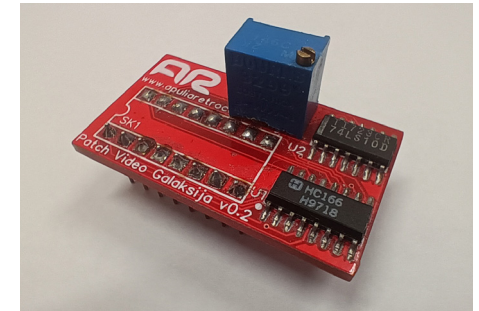
To generate a standard signal, some modifications are necessary. Using the original values, the video signal synchronizations are incorrect. The horizontal sync is too narrow, while the vertical sync is too wide. Specifically, for the timings:

- Replace resistor R12 with a 1.5k Ω resistor
- Replace resistor R13 with a 4.7k Ω resistor

The video signal from the monitor output is too wide; a normal amplitude signal can be taken from the RF modulator from the pin labeled "UL".



Video Patch in U9



Video Patch



Galaksija without patch

VERIFICATION

First Power-On

Before turning on the Galaksija, it is crucial to verify that the CPU, RAM, and ROM are correctly positioned and oriented, as any error in this regard could cause instant, irreparable damage. Ensure that each pin is properly inserted into its socket. Once these checks are complete, you can turn on the computer.

If no image is displayed, adjust the trimmer on the video patch using an oscilloscope or by trial and error, making small adjustments until the image appears on the screen.

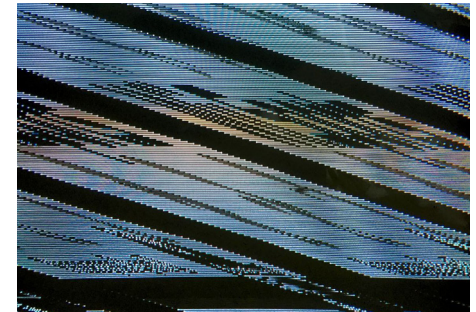
If an oscilloscope is available, observe the signal starting to oscillate on pin 9 of the 74LS38 (U14) until it becomes well-defined. The optimal point is reached when the signal amplitude is at its maximum. Fine-tuning may be necessary during subsequent power-ons.

An excessively high trimmer value on the patch causes the 74LS166 to produce overlapping signals, interfering with the normal operation of the video generator. A trimmer

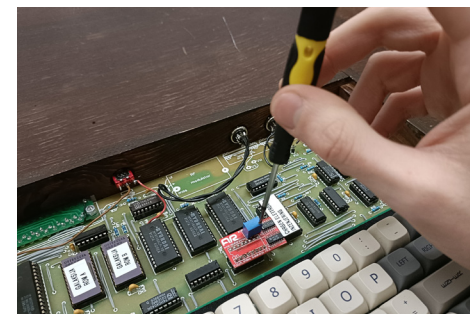
value that is too low will cause the 74LS166 to produce no signal at all, resulting in a stalled condition where the video generator no longer functions.

Video Centering

To center the video image on modern CRT/LCD TVs/monitors, it is recommended to replace resistors R12 and R13 with two trimmers. This modification allows for the adjustment of horizontal and vertical frequencies. However, it is important to note that operating outside certain limits may cause synchronization problems.



Incorrect video synchronization



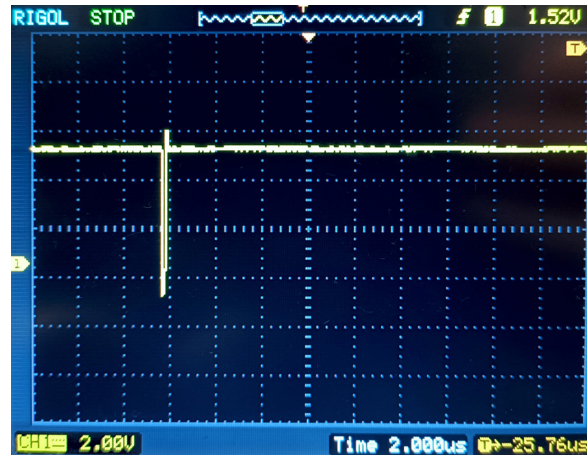
Patch adjustment

VERIFICATION

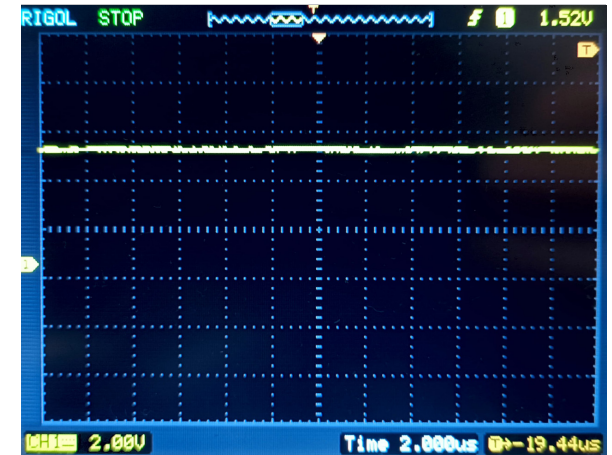
Signals output from pin 9 of 74LS38



Correct Adjustment

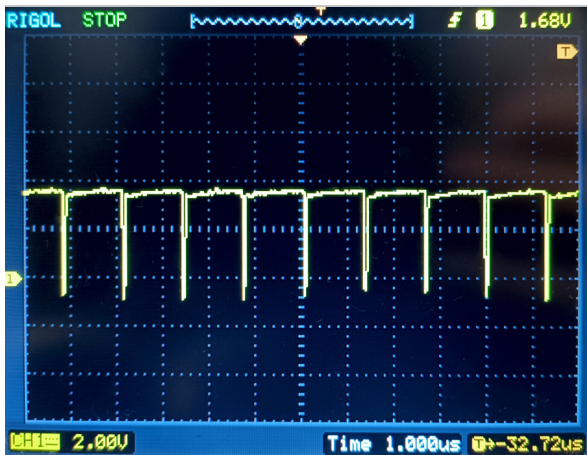


Setting too high

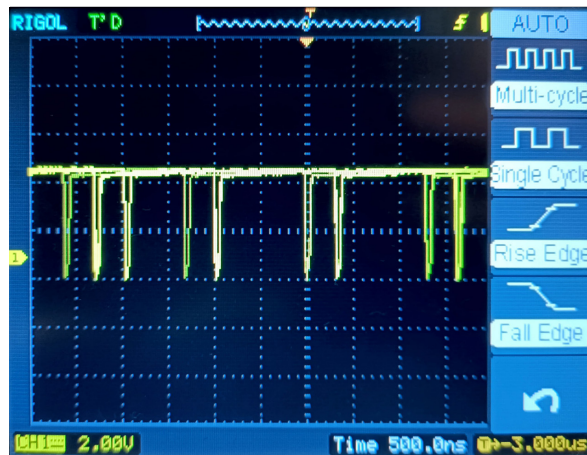


Setting too low

Correct signal on pin 15 of 74LS166



Correct Signal



Superimposed Signal



No Signal

VERIFICATION

Symptoms and Possible Causes

- No Raster and No Text - Z80A, 6116, 2732, 74LS04, 74LS93, 74LS74, 74LS123
- Raster Present but No Text - 2716, 74LS04, 74LS74, 74LS156
- Distorted Image - C3, C4, R12, R13
- Some Characters Not Decoded - 74LS156, 74LS251
- Characters Decoded but Some Parts Missing or Deformed - Z80A, 2732, 6116, 74LS174, video patch
- First and Fifth Line Displayed Parallel with the Same Character - 74LS174
- All Characters Displayed but Some Parts Missing - 74LS166, video patch
- Characters Striped Vertically, and on BRK Letters Appear to the Right - 74LS174
- Incorrect Characters in Various Parts of the Screen - Z80A, 74LS32, 74LS156
- Disturbances Across the Screen - Z80A, 74LS156
- Variable Raster Across the Screen - Z80A, 74LS156
- Incorrect Characters, Commands Not Registered - 74LS38, 74LS74
- Dashes Across the Screen - 74LS38
- Unrelated Text Appears Occasionally After READY - 74LS38
- READY on the Right Half of the Screen, Characters Everywhere Else - Z80A, 74LS74
- Image Moves Vertically - 74LS04, 74LS123
- Image Very Distorted and Moves Vertically - C3, R12, 74LS123
- Slanted Dashed Characters - 74LS123
- Pair of White Bars - 74LS123
- Characters Positioned Vertically or Diagonally - 74LS93, CD4040
- Image Moves Vertically Without Text - 74LS93
- Less Memory Displayed When Typing PRINT MEM - 6116, 74LS156

ALLEGATI

Components Checklist

RESISTORS

<input type="checkbox"/>	910Ω	x2	R1,R2
<input type="checkbox"/>	330Ω	x1	R3
<input type="checkbox"/>	18kΩ	x2	R4,R5
<input type="checkbox"/>	8.2kΩ	x2	R6,R7
<input type="checkbox"/>	1kΩ	x1	R8
<input type="checkbox"/>	62Ω	x3	R9,R15,R16
<input type="checkbox"/>	50Ω	x1	R10
<input type="checkbox"/>	1kΩ	x1	R11
<input type="checkbox"/>	390Ω	x1	R12
<input type="checkbox"/>	27kΩ	x1	R13
<input type="checkbox"/>	2.4kΩ	x1	R14
<input type="checkbox"/>	470Ω	x1	R17
<input type="checkbox"/>	4.7kΩ	x18	RP1/18

CAPACITORS

<input type="checkbox"/>	5nF	x1	C1
<input type="checkbox"/>	470nF	x1	C2
<input type="checkbox"/>	6.8nF	x1	C3
<input type="checkbox"/>	100nF	x14	C4,CN1/13
<input type="checkbox"/>	20pF	x1	C5
<input type="checkbox"/>	10μF 10v	x1	C6
<input type="checkbox"/>	1μF 10v	x1	C7

VARIOUS

<input type="checkbox"/>	1N4148	x1	D1
<input type="checkbox"/>	6,144Mhz	x1	XC1
<input type="checkbox"/>	LED	x1	LED1
<input type="checkbox"/>	Z80A	x1	U1
<input type="checkbox"/>	2732	x2	EPROM A,B
<input type="checkbox"/>	6116	x3	SRAM C,D,E
<input type="checkbox"/>	2716	x1	EPROM F

IC

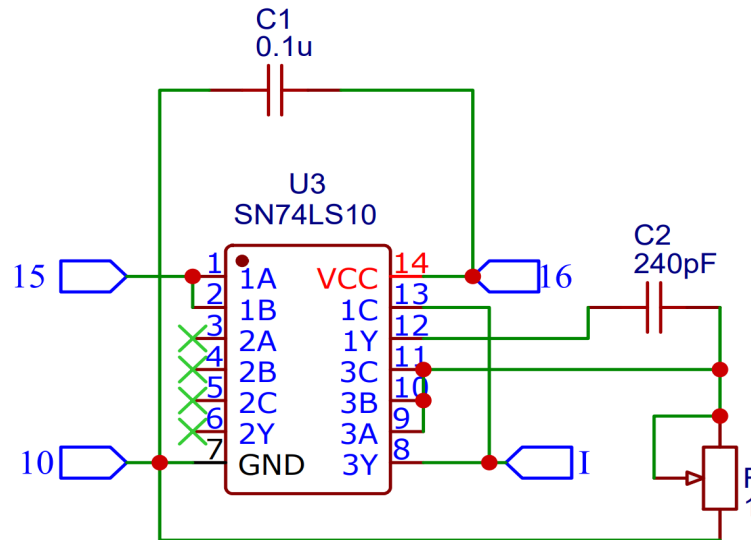
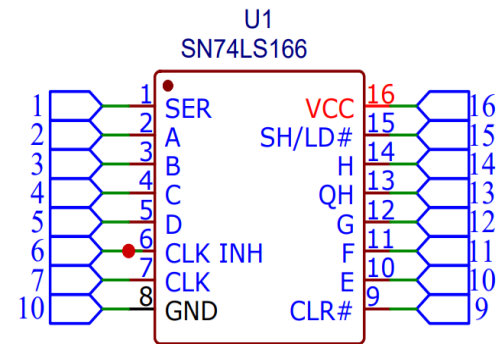
<input type="checkbox"/>	74LS04	x1	U2
<input type="checkbox"/>	74LS74	x1	U3
<input type="checkbox"/>	74LS32	x1	U4
<input type="checkbox"/>	74LS93	x1	U5
<input type="checkbox"/>	74LS156	x2	U6,U11
<input type="checkbox"/>	CD4040	x1	U7
<input type="checkbox"/>	CD4017	x1	U8
<input type="checkbox"/>	74LS166	x1	U9
<input type="checkbox"/>	74LS174	x1	U10
<input type="checkbox"/>	74LS251	x1	U12
<input type="checkbox"/>	74LS123	x1	U13
<input type="checkbox"/>	74LS38	x1	U14
<input type="checkbox"/>	74LS00	x1	U15
<input type="checkbox"/>	BC107	x2	T1,T2

ATTACHMENTS

Video Patch

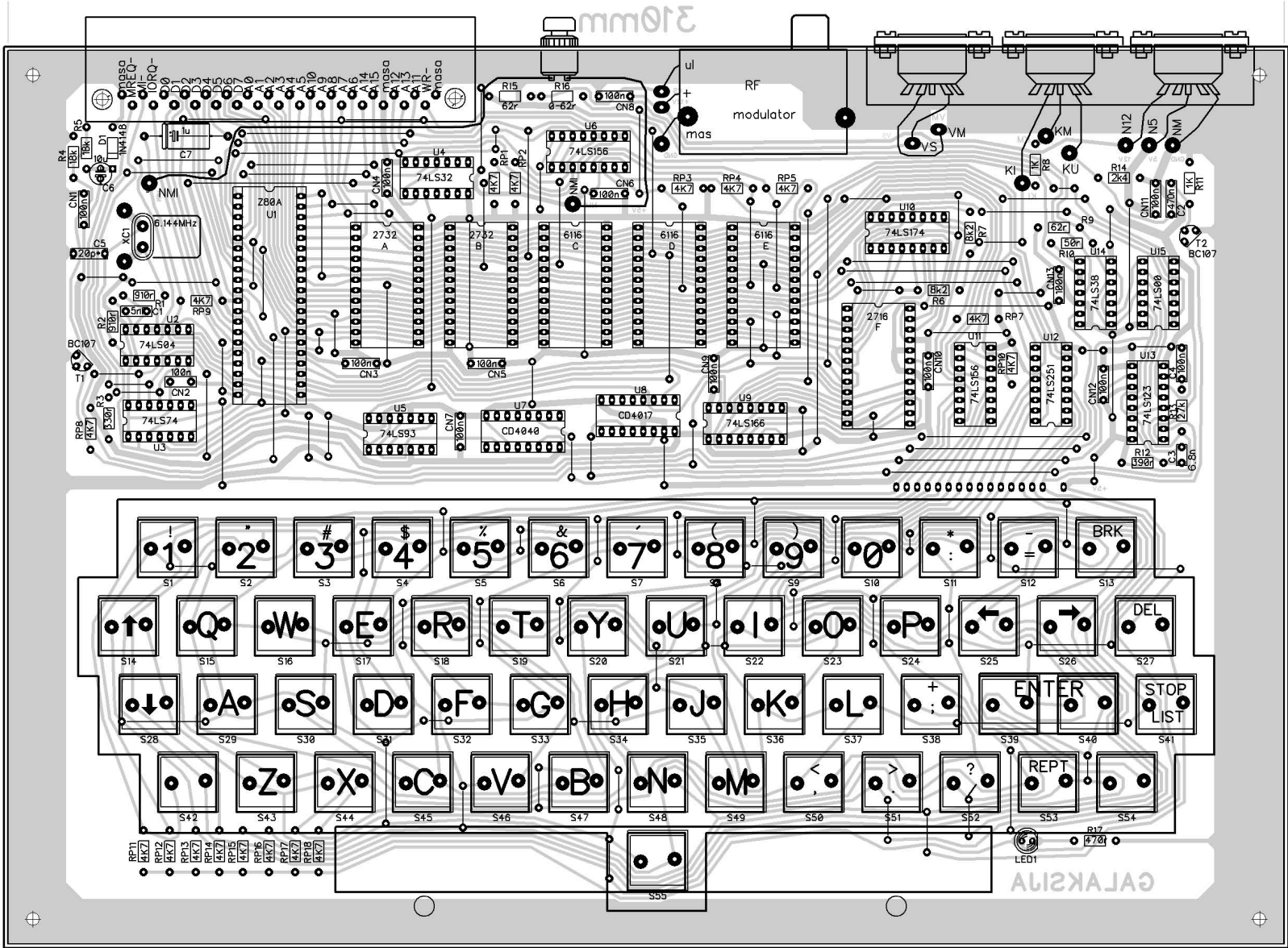
PATCH COMPONENTS

<input type="checkbox"/>	SN74LS166	x1	U1
<input type="checkbox"/>	SN74LS10	x1	U2
<input type="checkbox"/>	0.1uF	x1	C1
<input type="checkbox"/>	240pF	x1	C2
<input type="checkbox"/>	0-1kΩ	x1	RP1



ATTACHMENTS

PCB



PRE
ASSEMBLY

ASSEMBLY

MODIFICATIONS

VERIFICATION

ATTACHMENTS

PRE ASSEMBLY

ASSEMBLY



VERIFICATION

ATTACHMENTS

CREDITS

Galaksija - Assembly Instructions

Version 1.0 - September 2021

Version 2.0 - March 2024

Manual created by Gabriele Marchese

Special thanks for technical support:

- Antonio Caradonna
- Vito Fariello
- Guido Cauli

Video Patch created by Antonio Caradonna

