ZX81 - 32KB internal RAM

Build-up description

06.04.2018

History	History	History	History	History
V1.0				
06.04.2018				

Introduction

The idea behind the ZX81 – 32KB internal RAM project goes back into the 1990‘s where Peter Liebert-Adelt created a 32KB internal RAM extension to enhance the ZX81 capabilities.

(see ZX81 webpage: http://www.zx81.de/hardware/32k-ramd.htm)

I‘ve taken this idea, because I‘d liked to enhance my own ZX81. So based on above page I build a small PCB board (without the backup battery buffer) that can be directly placed into your ZX81 after doing some solderwork.

I’d like to say thank you to the following helping hands (ZX Team members), providing support in different flavours:

- S. Engel aka Siggi
- P.Liebert-Adelt aka Peter Liebert-Adelt
- J. Merkl aka Joachim
- H. Junek aka ZX-Heinz

06.04.2018 - TOKABLN aka T. Kapke (Berlin – Germany)

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1 General build up tips

As always when soldering electronic components, you should start with the smallest components, e.g. Resistor, Diodes first following next size components until all components are soldered.

THIS IS TYPICALLY NOT DONE BY THE SUPPLIER OF YOUR PURCHASED PACKAGE.

2 32KB internal RAM extension

2.1 Short description

This little PCB board gives you full 32K-RAM internal memory from 16K to 32K and from 48K to 64K.

The schematic is shown at the end of this document… while here's a small description:

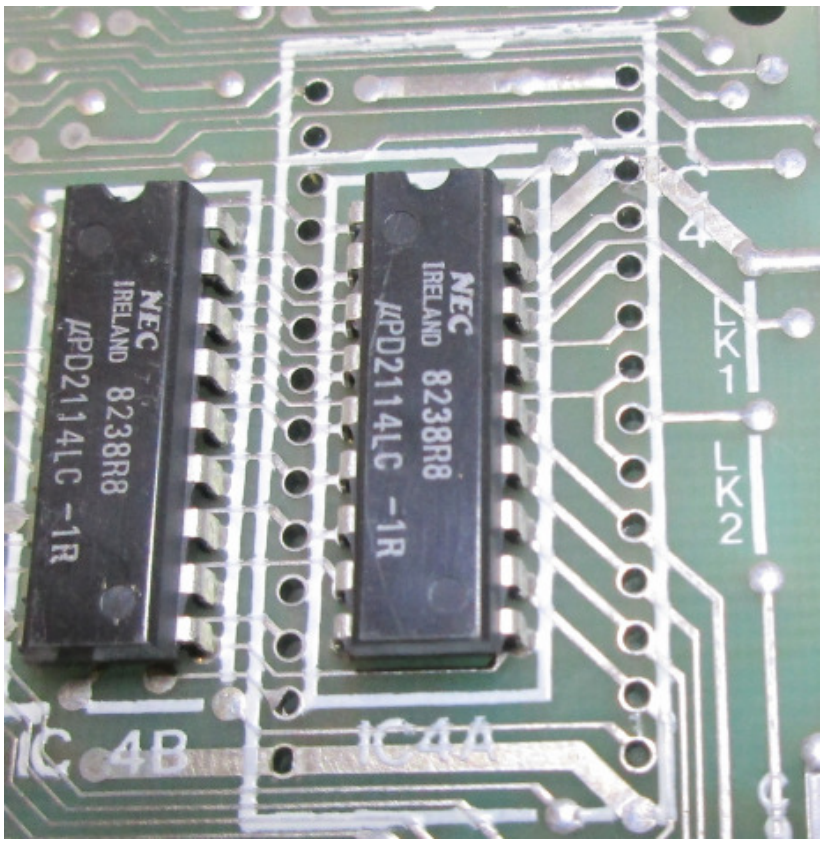
IC1 is a 74LS00 circuit (4 NAND gates in a SMD SOIC housing), while we only use 2 of the NAND gates as follows:
When the ULA is forced to output the display-file to your screen, this is indicated to the ULA with the signal /M1 = LOW and A15 = HIGH. Because the display-file is located in the 16-32K area of your ZX81, A15 for the RAM must be LOW when /M1 = LOW. The two NAND-gates take care about this situation. As we are using 2 NANDs this will form an AND at the end.

Resistor R1 is used optionally if you like to use HRG8 screen mode. I'll recommend adding this component.

IC2 is a HM62256-70 SRAM PDIP housing IC (32Kx8 RAM-chip) all these parts enables your ZX81 to have at least 2 x 16KB of RAM available. So let's start to upgrade your ZX81.

First work items to be done is, to open your ZX81 and to carefully remove the PCB board to do some reworks which allows the usage of the new 32KB internal RAM board. Having the ZX81 board carefully detached from the keyboard flat cables, please start locating the existing RAM chip(s).

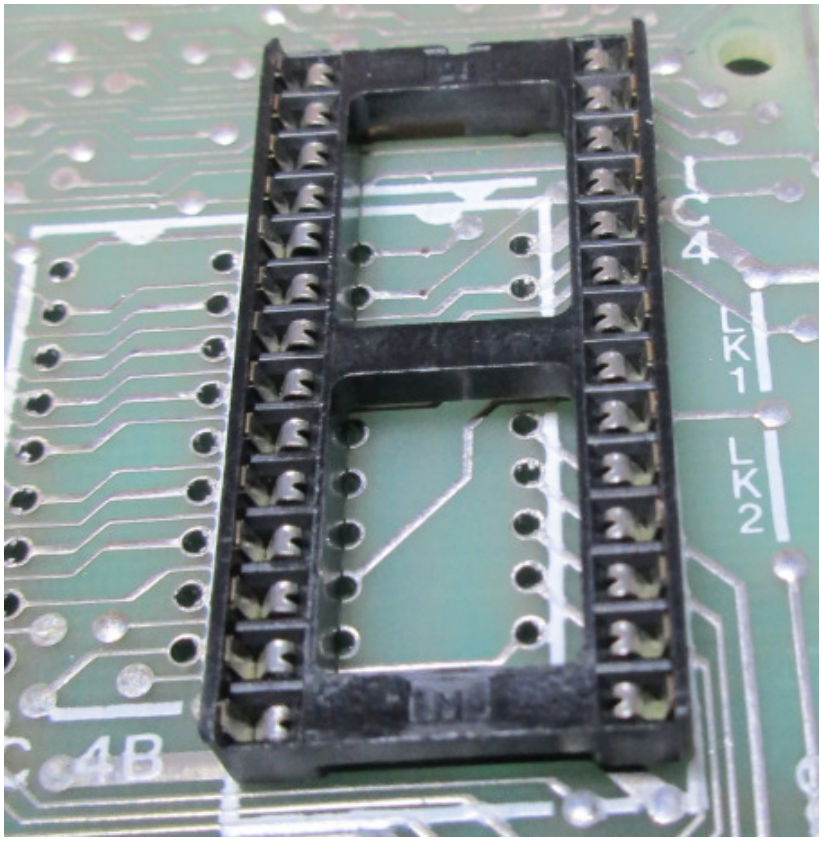
- Depending on your PCB issue, remove the original 1 or 2k memory chip(s) from your ZX81 PCB. If the memory chip(s) is/are soldered, I recommend to cut the IC leads on top of the PCB with a side-cutting tool and to unsolder the remaining leads afterwards.
    - Then use a solder sucker or some solderwick to get the remaining solder out of the solder pads



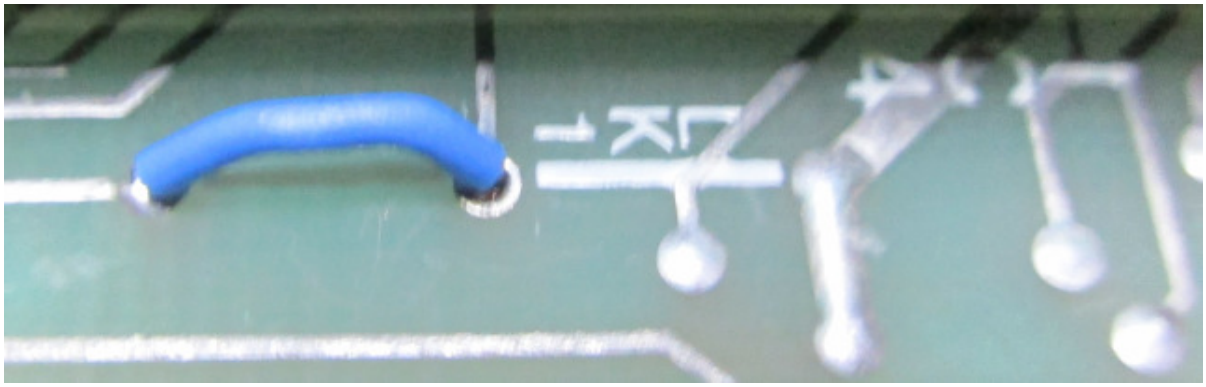
(example picture ZX81 Issue 3 board)

- After you successfully removed the old RAM chips and you've cleaned the solder pads, solder a standard IC-socket with 28 pins at the place of IC4 (take care about the orientation… the notch needs to point to the edge connector of your ZX81 PCB).

    - If you use precision pin headers instead of the standard pin headers, you may solder a precision IC socket rather the standard one. But when using the above shown pin headers, only a standard socket will work.



- Having finished soldering the IC socket, fit some short wire at the place of LK2 (see above LK1/LK2 silk print at the right side of IC4)



That's all for the first time when it comes to the ZX81 PCB board.

Now let's start assembling the new 32KB PCB board.

2.2 Component List (default)

Resistors:

1x	SMD 0805 - 10K ohm resistor (optional for HRG8 usage)	R1

ICs:

1x	IC 74LS00 SMD SOIC (NAND chip)	IC1
1x	IC HM 62256-70 SRAM PDIP (32K x 8 RAM-chip)	IC2

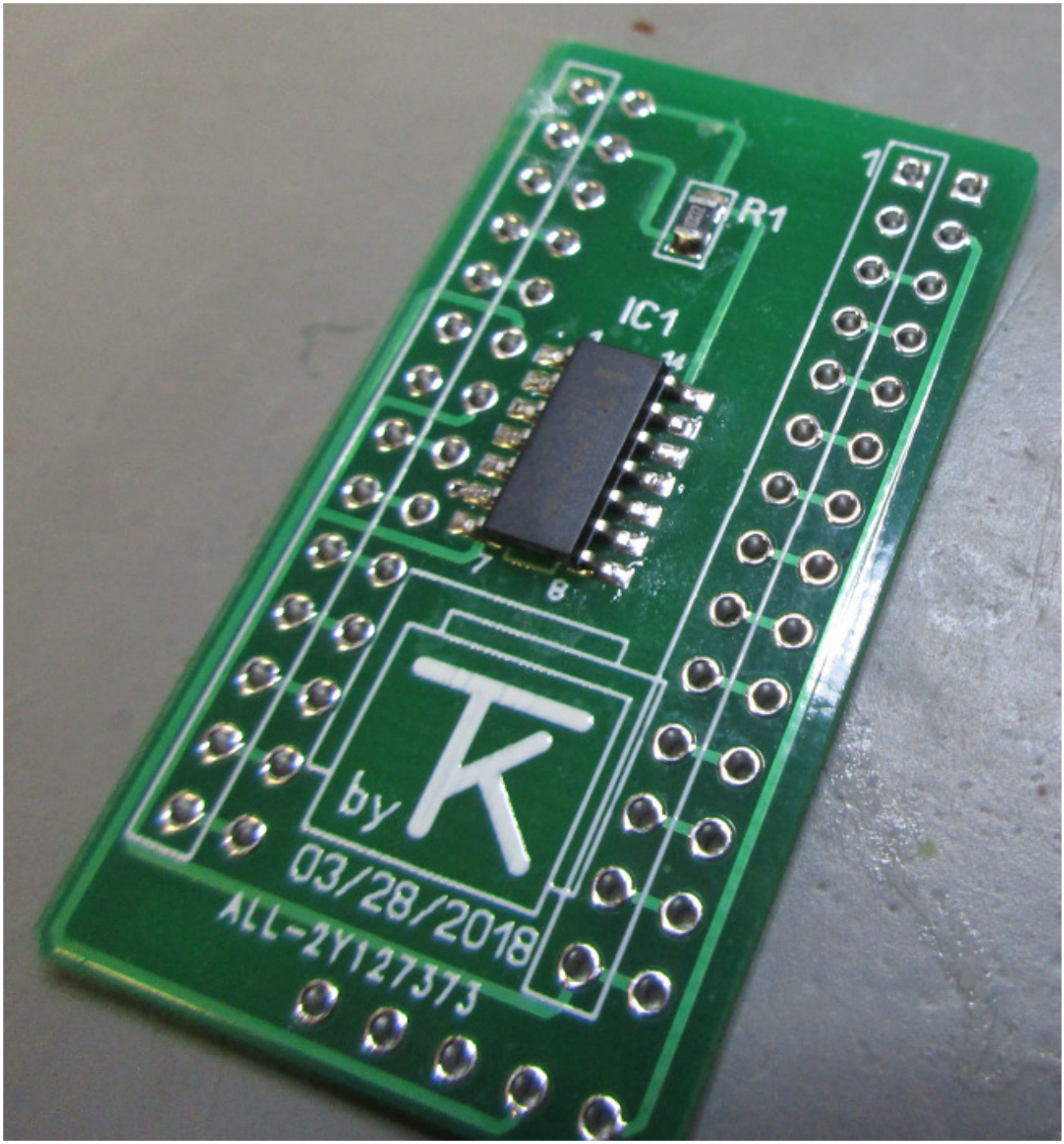
Connectors:

2x	Pin Header, 14 Pins, RM2,54	Soldered at SMD side (rectangles)

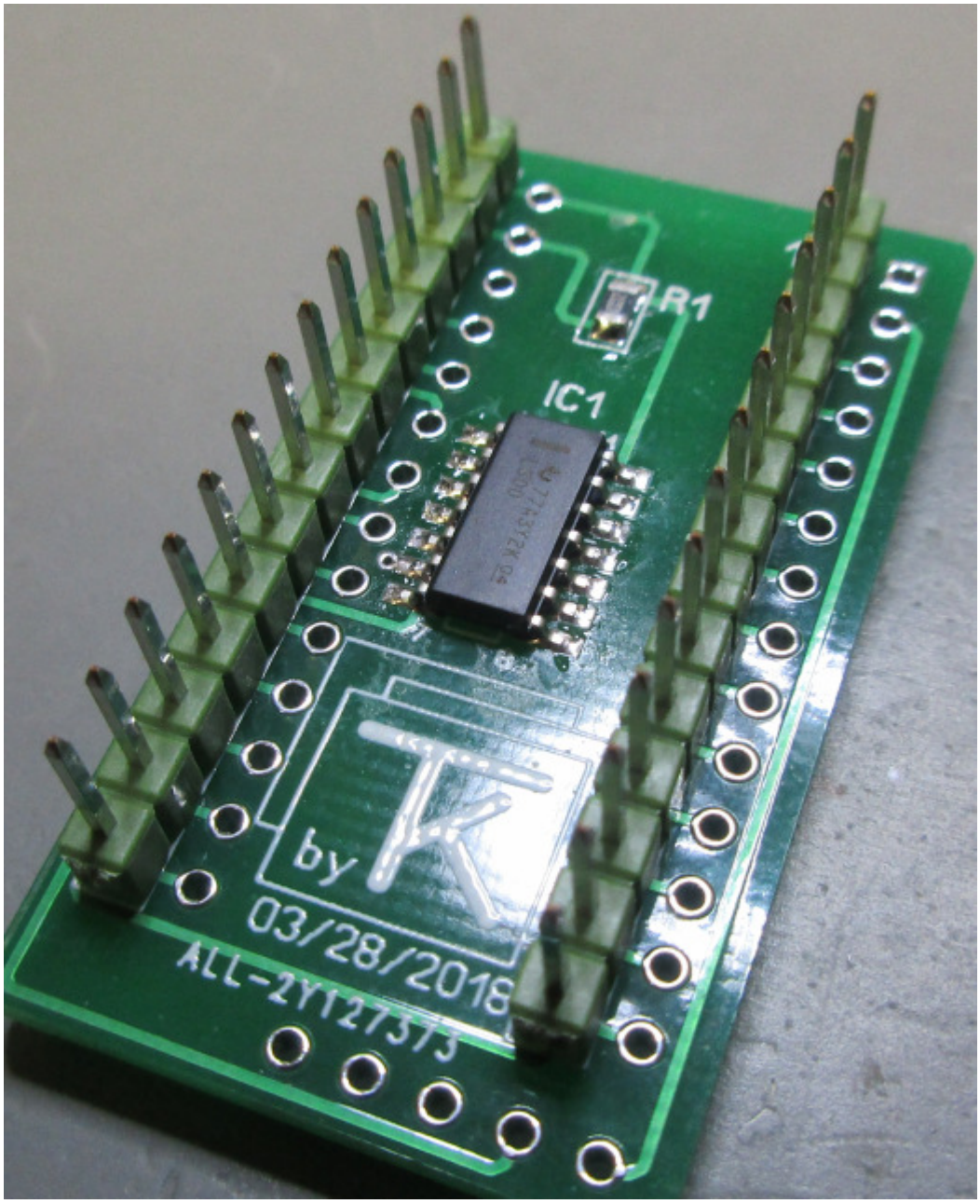
Other parts:

1x	32KB PCB board	
4x	Leads (3cm length) - **A11, A12, A13, A15**	wired to the cathodes of diodes
1x	Lead (7cm length) - **/M1**	edge connector Pin A22
1x	DIL socket, 28 pin, standard	Soldered at ZX81 PCB position IC4
1x	Jumper lead (1cm length)	Soldered to ZX81 PCB Jumper LK2

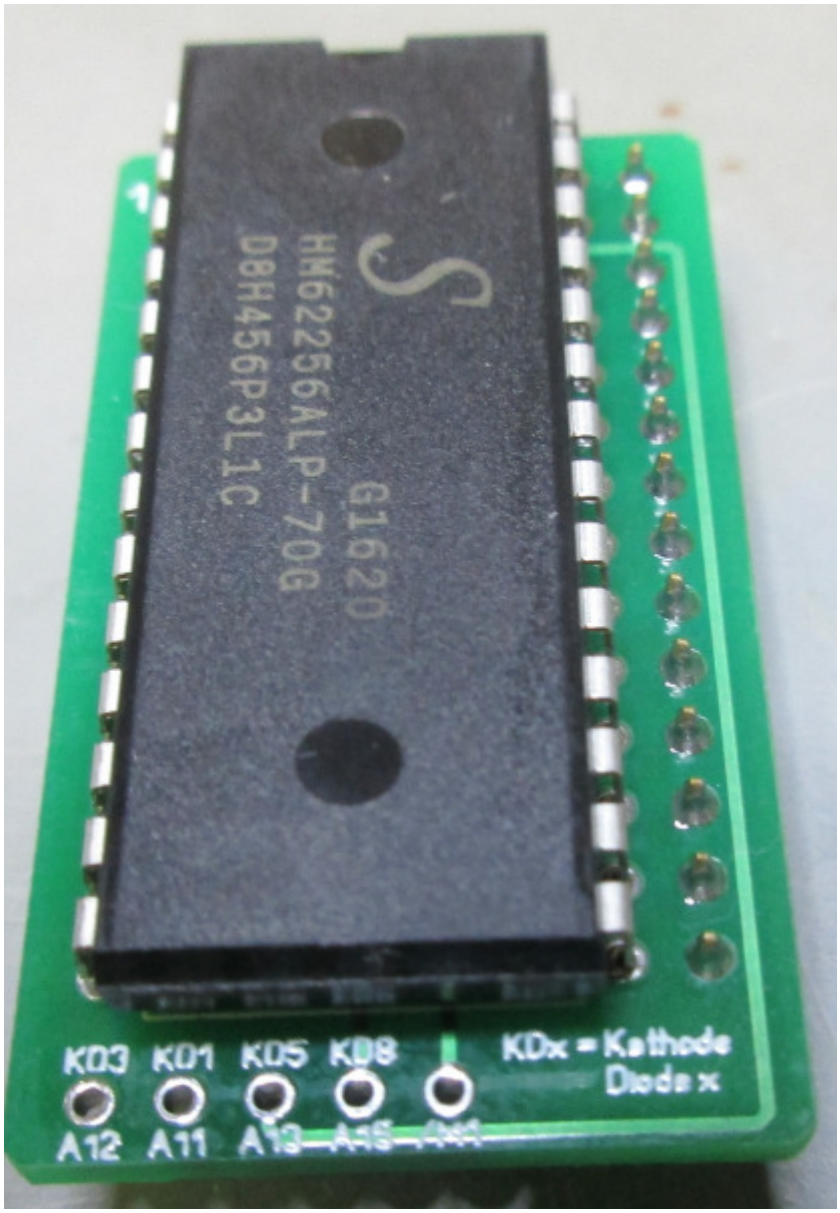
2.3 32KB PCB component placement(s) in pictures



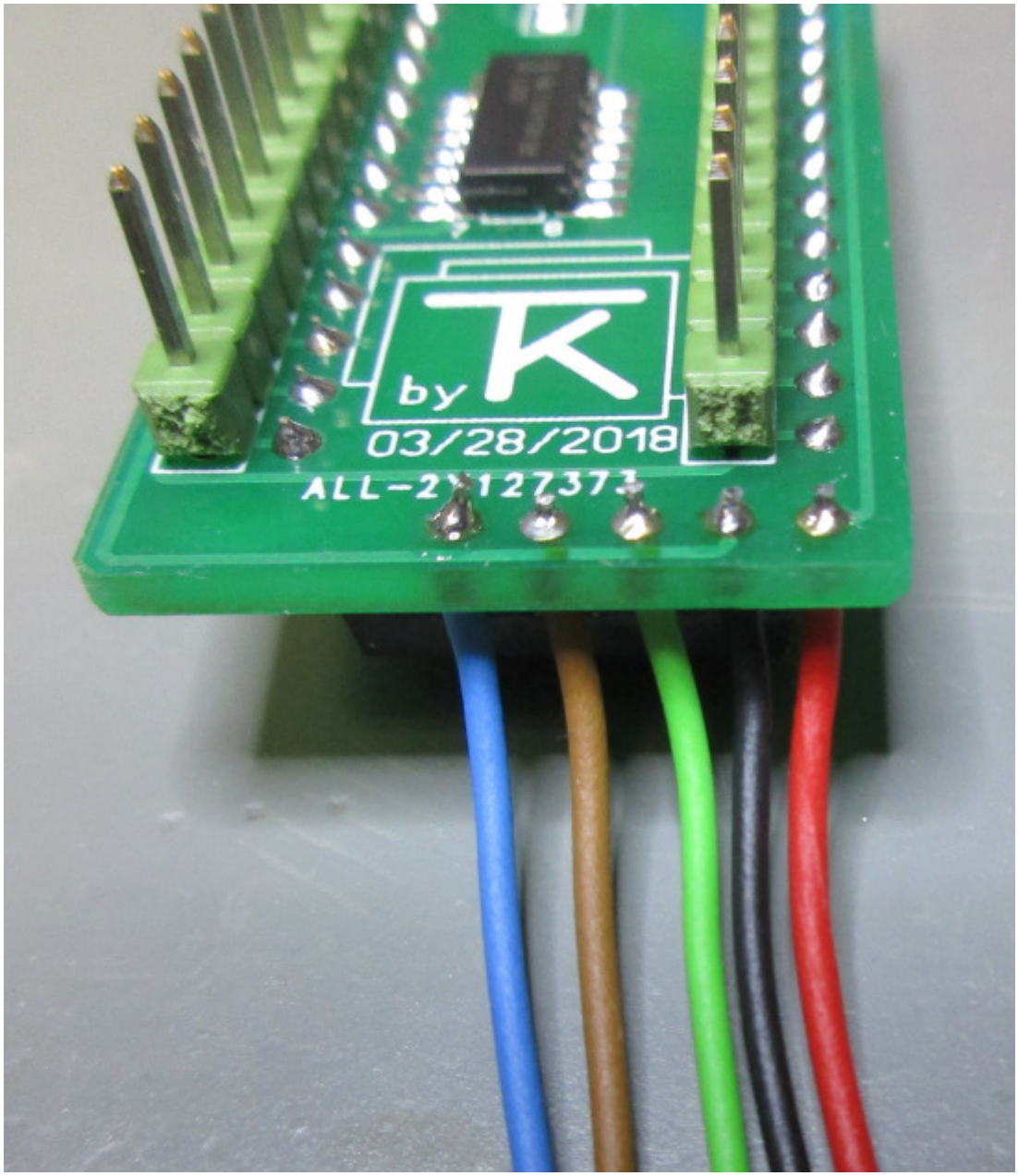
- Start soldering of the SMD part(s) – IC1 74LS00
  - if you want to run HRG8, solder a SMD 0805 resistor of 10K ohms at position R1



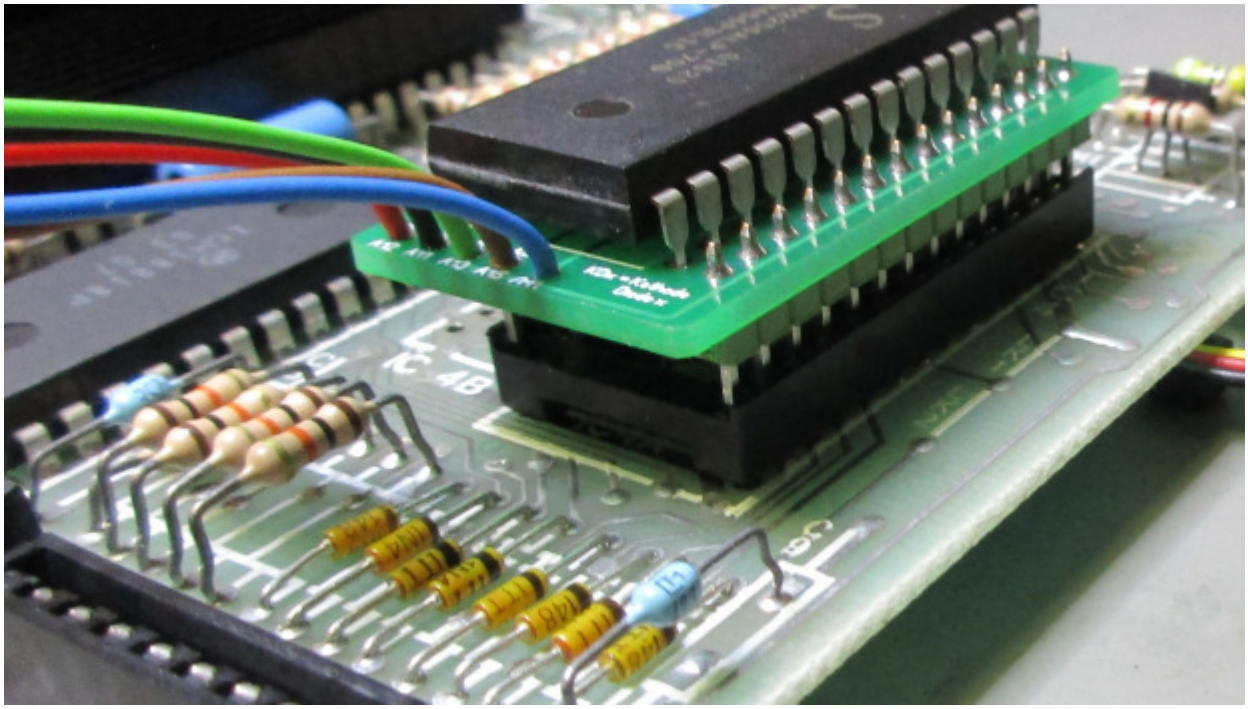
- now solder the 2 Pin Header, each 14 Pins, RM2,54 as shown above



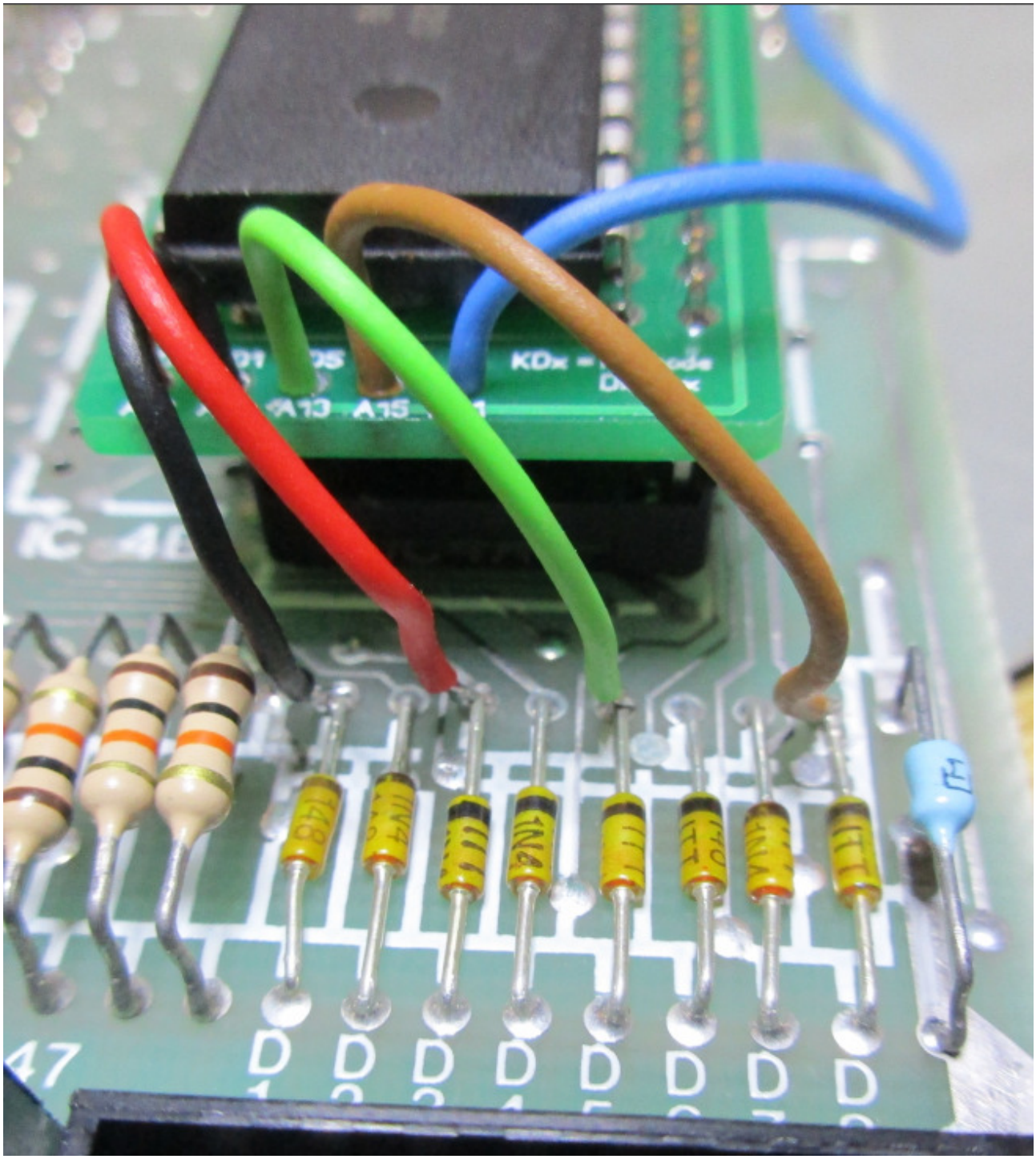
- place and solder IC2 – HM62256 SRAM PDIP



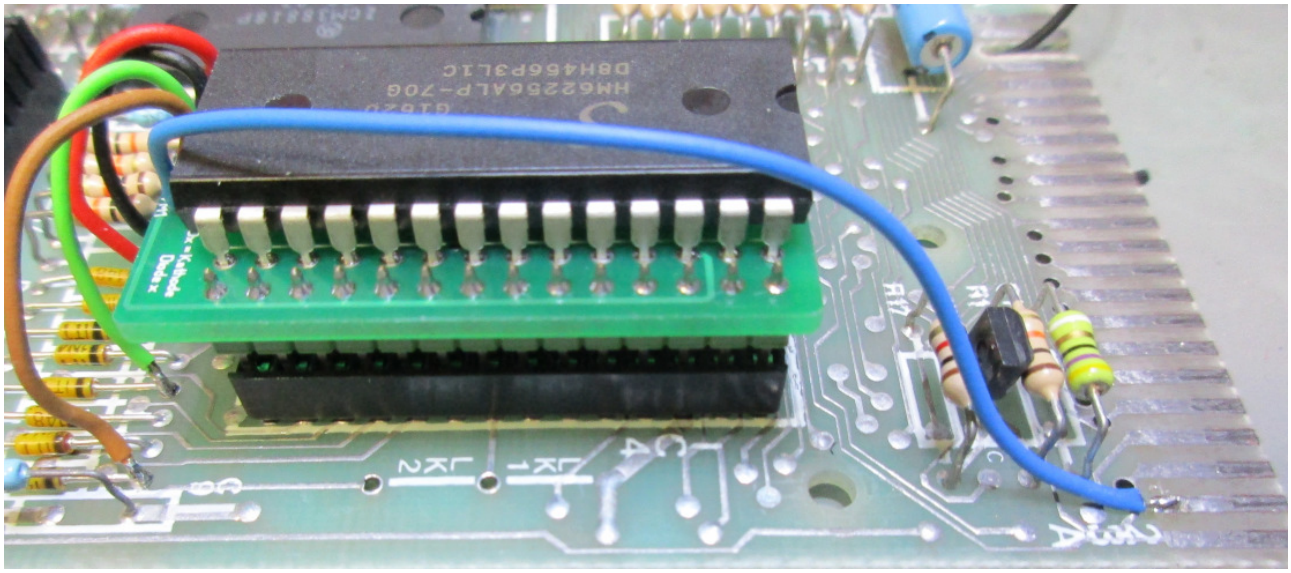
- now add and solder the leads according the BOM (I used coloured leads as you can see)



- it’s then time to put the assembled PCB into the ZX81 IC4 socket



- and to solder the leads according their written assignment to the corresponding diodes (cathode side)



- or with the edge connector pin A22

I hope that everything went well and it’s now time to reassemble your ZX81. Take care about the keyboard flat cables and that they are not bend or damaged.

Pause for a while… take some coffee/tea or some beer (depending on your choice) and start cleaning your workdesk.

The electromechanical part is done now.

3 Time to do some testing

Connect your ZX81 to your preferred screen and connect the power leads to start your ZX81.

It now takes some time until the **K** cursor appears because the first 16k will be tested per default.

To fully test your new environment… just enter the following quick and dirty program:

```
10 FOR N=16640 TO 32767 STEP 256
20 POKE N,0
30 IF PEEK N<>0 THEN GOTO 50
40 NEXT N
50 PRINT "MEMORY SIZE (4000-7FFF) ";(N/1024)-16;"K"
60 FOR N=49152 TO 65535 STEP 256
70 POKE N,0
80 IF PEEK N<>0 THEN GOTO 100
90 NEXT N
100 PRINT "MEMORY SIZE (C000-FFFF) ";(N/1024)-48;"K"
```

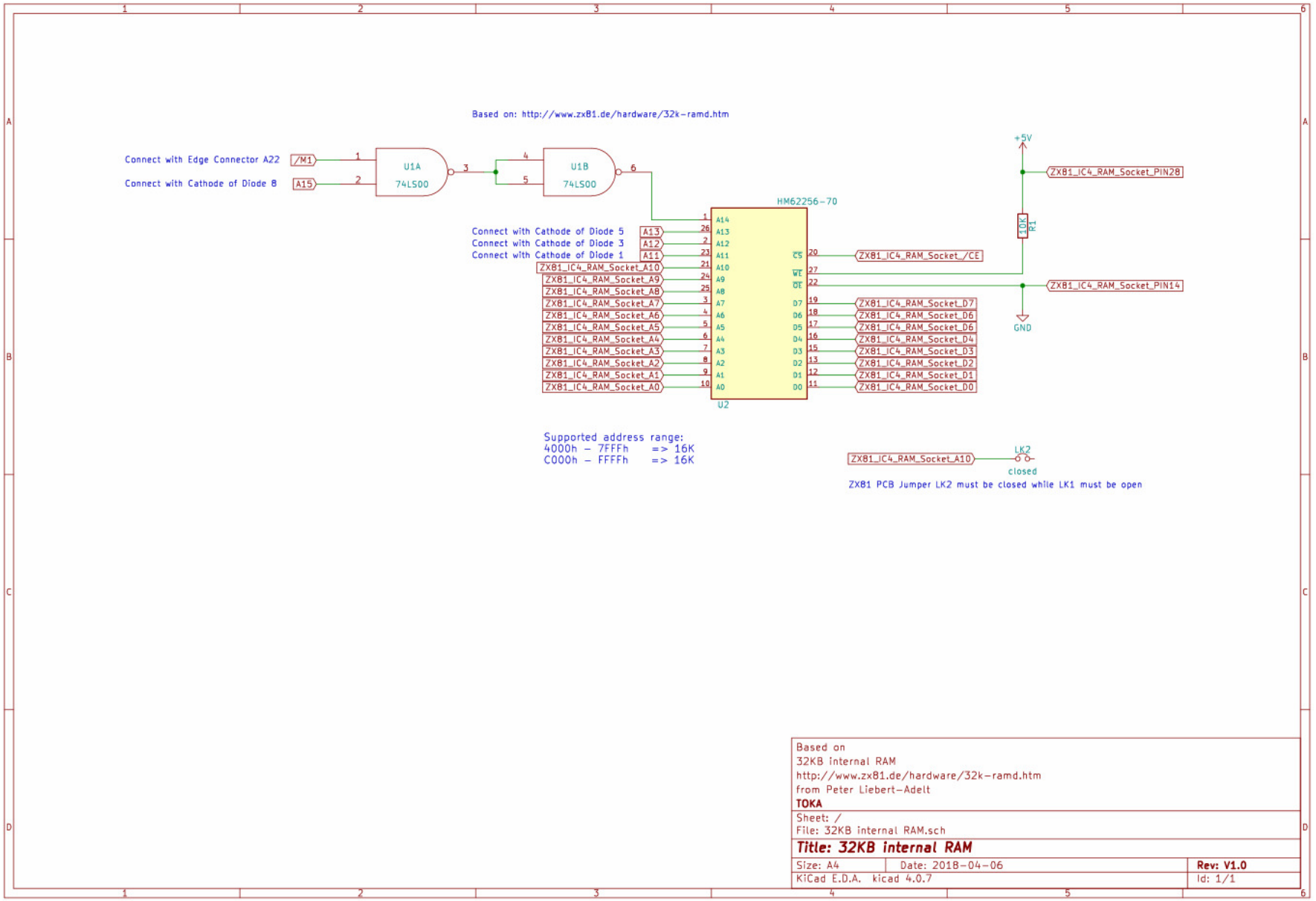
After starting the above program, it takes some time while the program should print the following lines onto your screen:

```
MEMORY SIZE (4000-7FFF)   16K
MEMORY SIZE (C000-FFFF)   16K


0/100
```

Now you've really done… and I hope you will enjoy this little HW enhancement.

4 Schematic


Based on: http://www.zx81.de/hardware/32k-ramd.htm
Connect with Edge Connector A22
/M1
Connect with Cathode of Diode 8
A15
U1A
74LS00
U1B
74LS00
HM62256-70
U2
Connect with Cathode of Diode 5
Connect with Cathode of Diode 3
Connect with Cathode of Diode 1
A13
A12
A11
ZX81_IC4_RAM_Socket_A10
ZX81_IC4_RAM_Socket_A9
ZX81_IC4_RAM_Socket_A8
ZX81_IC4_RAM_Socket_A7
ZX81_IC4_RAM_Socket_A6
ZX81_IC4_RAM_Socket_A5
ZX81_IC4_RAM_Socket_A4
ZX81_IC4_RAM_Socket_A3
ZX81_IC4_RAM_Socket_A2
ZX81_IC4_RAM_Socket_A1
ZX81_IC4_RAM_Socket_A0
+5V
10K
R1
GND
ZX81_IC4_RAM_Socket_PIN28
ZX81_IC4_RAM_Socket_/CE
ZX81_IC4_RAM_Socket_PIN14
ZX81_IC4_RAM_Socket_D7
ZX81_IC4_RAM_Socket_D6
ZX81_IC4_RAM_Socket_D5
ZX81_IC4_RAM_Socket_D4
ZX81_IC4_RAM_Socket_D3
ZX81_IC4_RAM_Socket_D2
ZX81_IC4_RAM_Socket_D1
ZX81_IC4_RAM_Socket_D0
Supported address range:
4000h - 7FFFh => 16K
C000h - FFFFh => 16K
ZX81_IC4_RAM_Socket_A10
LK2
closed
ZX81 PCB Jumper LK2 must be closed while LK1 must be open
Based on
32KB internal RAM
http://www.zx81.de/hardware/32k-ramd.htm
from Peter Liebert-Adelt
TOKA
Sheet: /
File: 32KB internal RAM.sch
Title: 32KB internal RAM
Size: A4
Date: 2018-04-06
Rev: V1.0
KiCad E.D.A. kicad 4.0.7
Id: 1/1