

Sheet: CPU  
File: cpu.sch

Sheet: TED  
File: ted.sch

Sheet: RAM  
File: ram.sch

Sheet: ROMs  
File: rom.sch

Sheet: Keyboard  
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Sheet: Datassette & Serial Bus  
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Sheet: PLA & Chip Selection  
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V0  
LOGO

V1  
PCBWAY\_LOGO

V2  
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H11  
H12  
H13  
H14

GND

H1  
H3  
H5  
H7  
H9

GND

H2  
H4  
H6  
H8  
H10

GND

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**SukkoPera**

Sheet: /  
File: LittleSixteen.sch

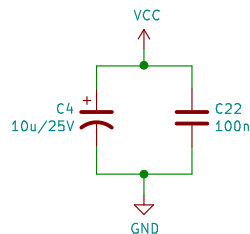
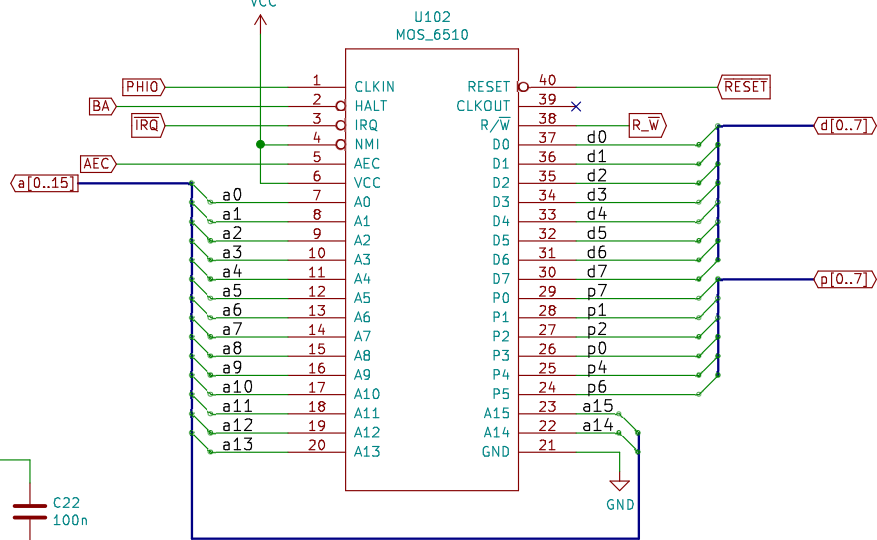
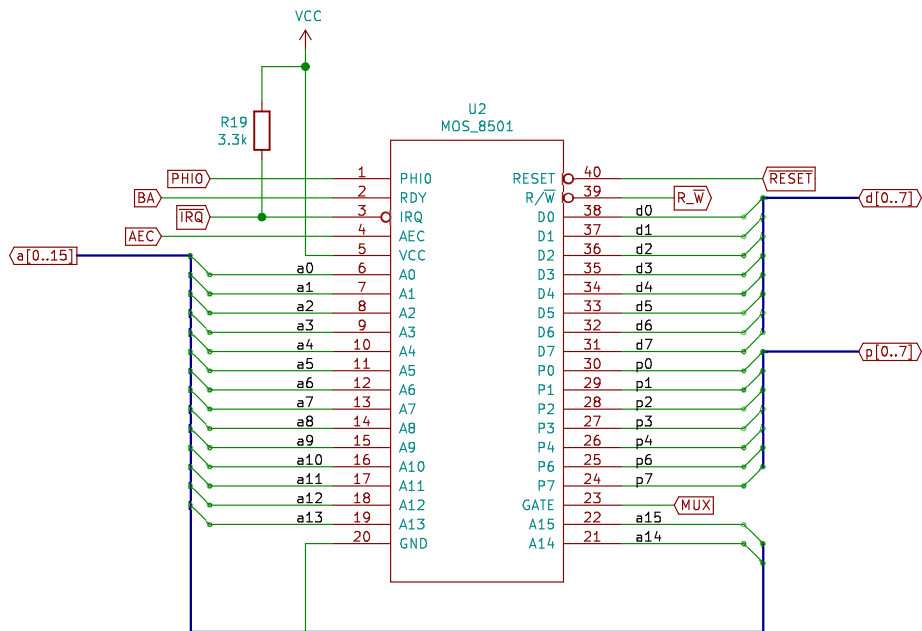
Title: LittleSixteen

Size: A4Date: 2021-11-17

Rev: 3git

KiCad E.D.A. kicad 5.1.12

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The 7501/8501 CPU used in the x264 series is not much different from the 6510 that was used in the C64. Mapping of most pins is straightforward. Some signals change names but they are obviously the same.

6510s were working at 1MHz in the C64, while the x264 design is able to push them to nearly 2 MHz during video blanking. Since most 6510s seem to be pretty forgiving in this regard, we are left with two issues:

– GATE\_IN: There is a lot of myth and inaccuracy about the purpose of this pin that is not available on the 6510. Here's a quote from the TED System Hardware Manual that should clarify things:

"GATE IN: TTL level input, used to gate the R/W line to prevent the R/W line from going low during a read cycle, before RAS and CAS go high (resulting in a Read/Write cycle). Normally connected to the MUX line in a system configuration to synchronize the DRAM memory cycle to the processor clock cycle.

If AEC is low when Gate In makes a low to high transition, the R/W line will go to a high impedance until the next transition of the Gate In line and AEC is high prior to the transition."

This is confirmed by some guys who recently decapped an 8501 and analyzed its die, please see <http://forum.6502.org/viewtopic.php?f=4&t=6617>.

A forum thread (<http://www.softwoles.com/arkiv/cbm-hackers/16/16855.html>) seems to suggest that when using DRAMs the signal is pretty useless, but it would be needed if SRAMs were used. I'm not sure this is correct and I really can't judge by myself, but since experience shows that leaving GATE\_IN unconnected doesn't "seem" to hurt, we'll go with that for the moment, but for the future we might do something along the lines of this quote from Bil Herd himself:

"[During the development of the x264 family, where we were using 6510 CPUs] I think I did the Gated Read/Write with a 74LS73 only I drove the R/W line high, not HiZ."

– I/O Port: The 8501 has a 7-bit I/O port while the 6510 only has a 6-bit, plus the exposed bits are numbered differently, so some remapping is needed, which implies that some modding to the KERNAL is required as well. I decided to follow what Andrew Challis did at <http://hackjunk.com/2017/06/23/commodore-16-plus-4-8501-to-6510-cpu-conversion/>. So, the 6510 socket is basically Andy's adapter built into the mainboard. If you go with a 6510 you will need to use his modified KERNAL and to solder the diode and resistor at D/R93. This comes at a compromise though:

- Disk fastloaders will not work (unless they are modified themselves to match our pin shuffling).
- The Datasette motor will spin whenever one of its keys is pressed, the computer will no longer be able to control it.

I think these drawbacks are acceptable, as most fastloaders won't work anyway when using an SD2IEC, which is what most people do these days, I guess, while the loss of tape control isn't much of an issue in itself. Make sure to send a small donation to Andy if you go this way.

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**SukkoPera**

Sheet: /CPU/

File: cpu.sch

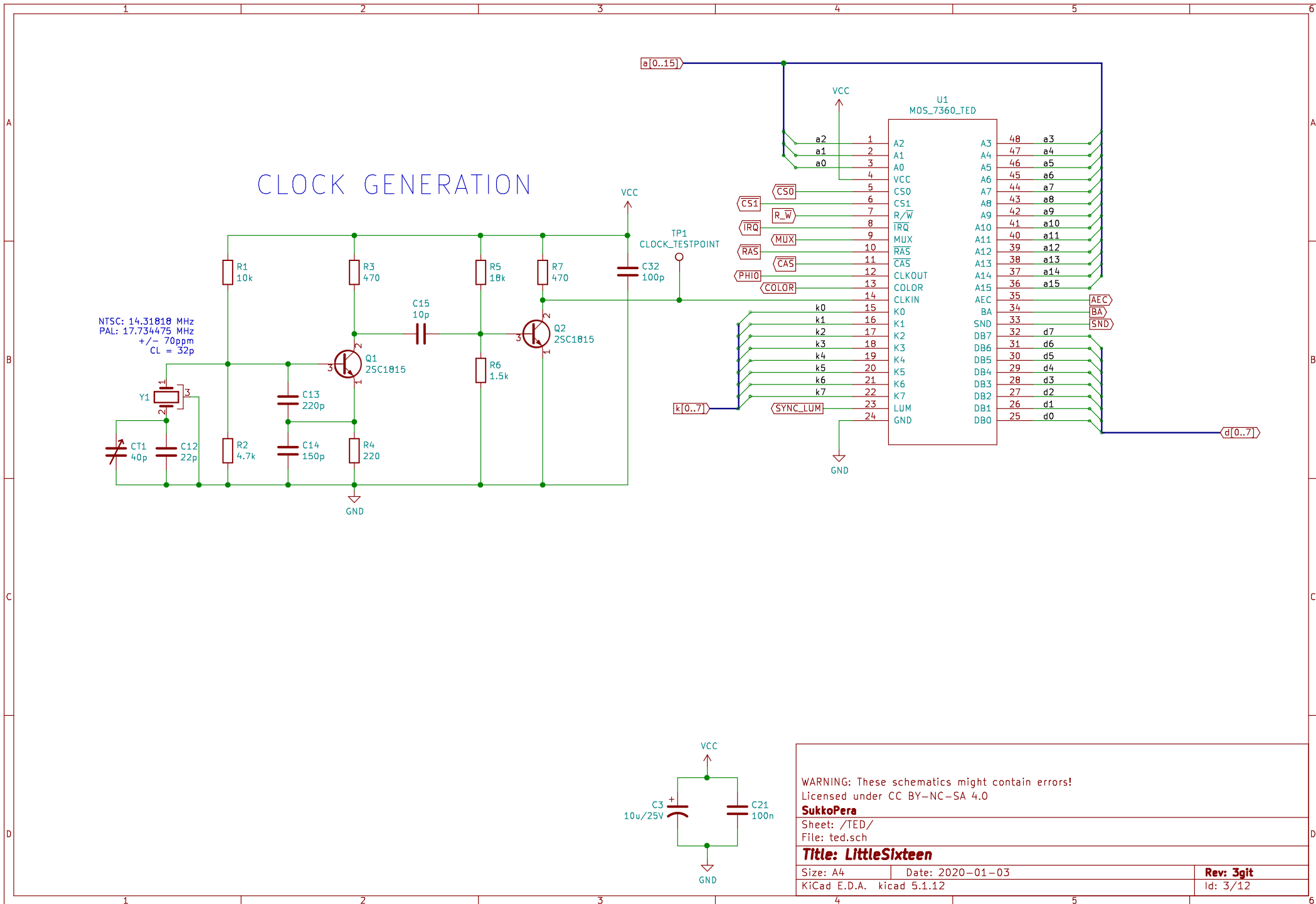
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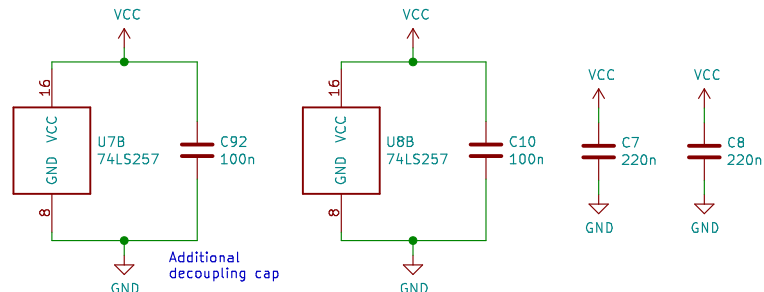
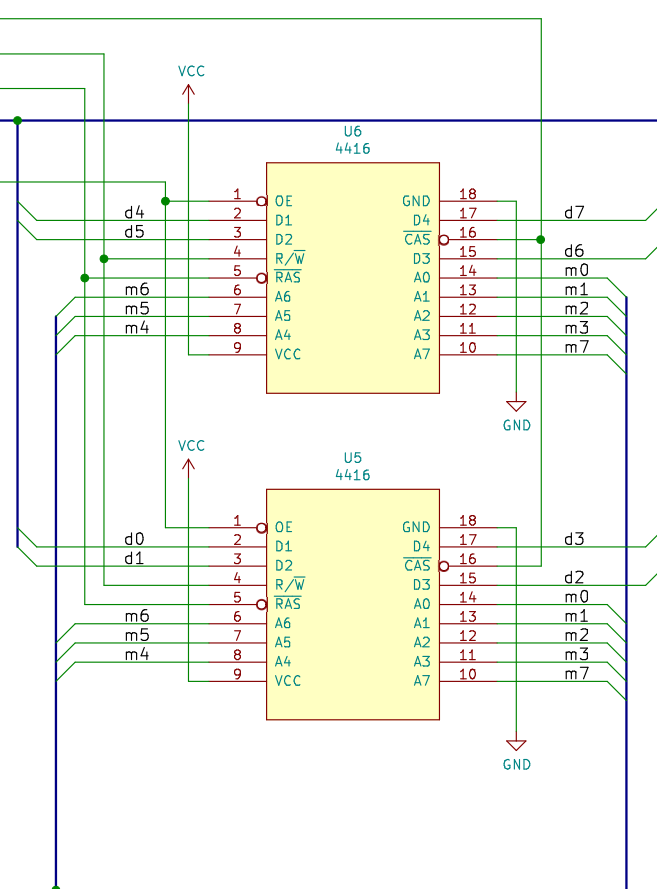
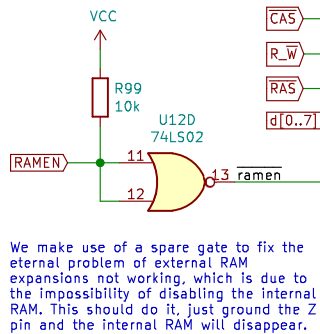
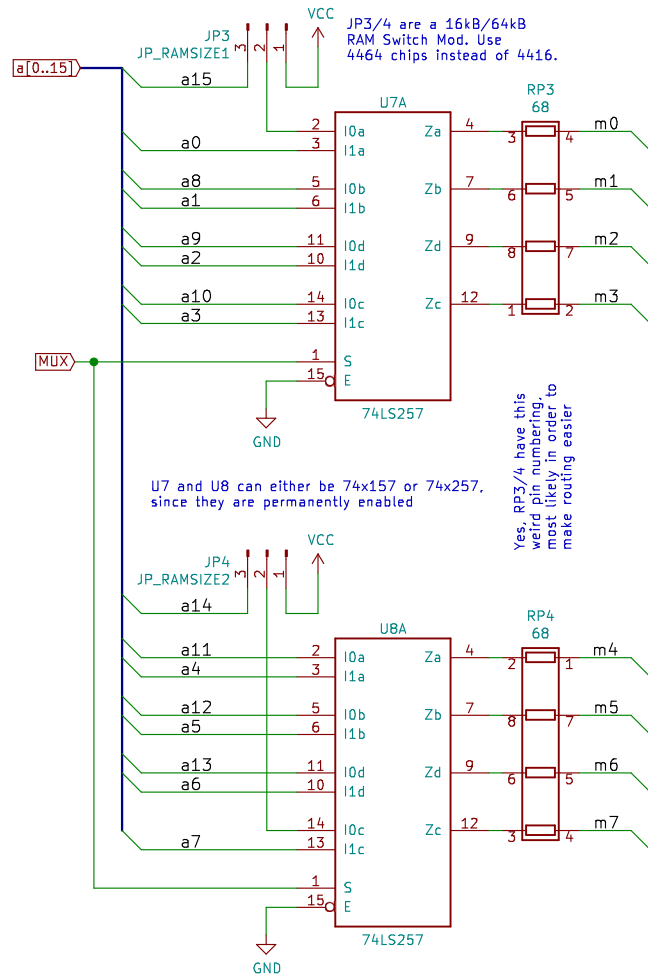
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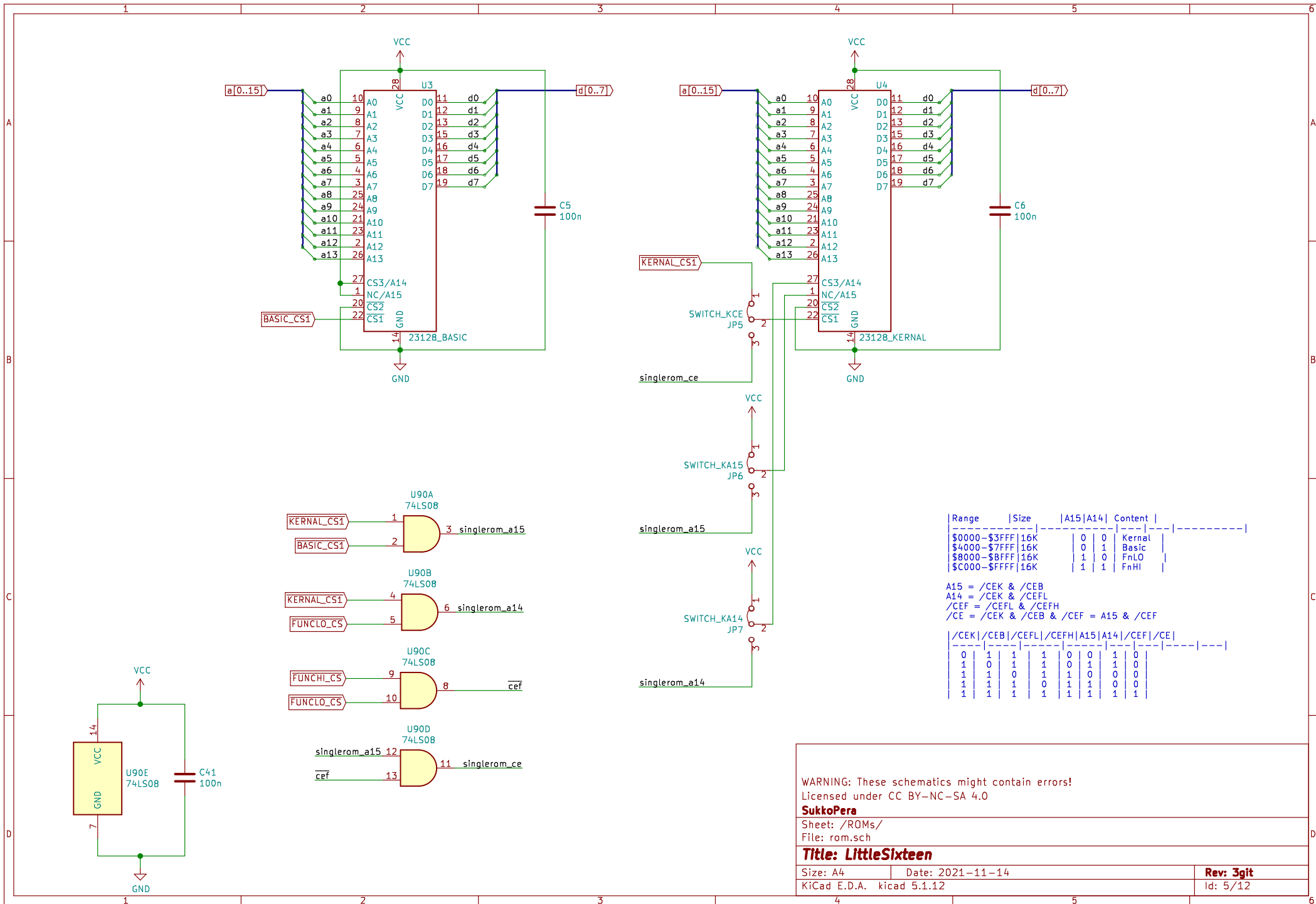
SukkoPera

Sheet: /RAM/  
File: ram.sch

Title: LittleSixteen

Size: A4 Date: 2021-11-28  
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**SukkoPera**

Sheet: /ROMs/  
File: rom.sch

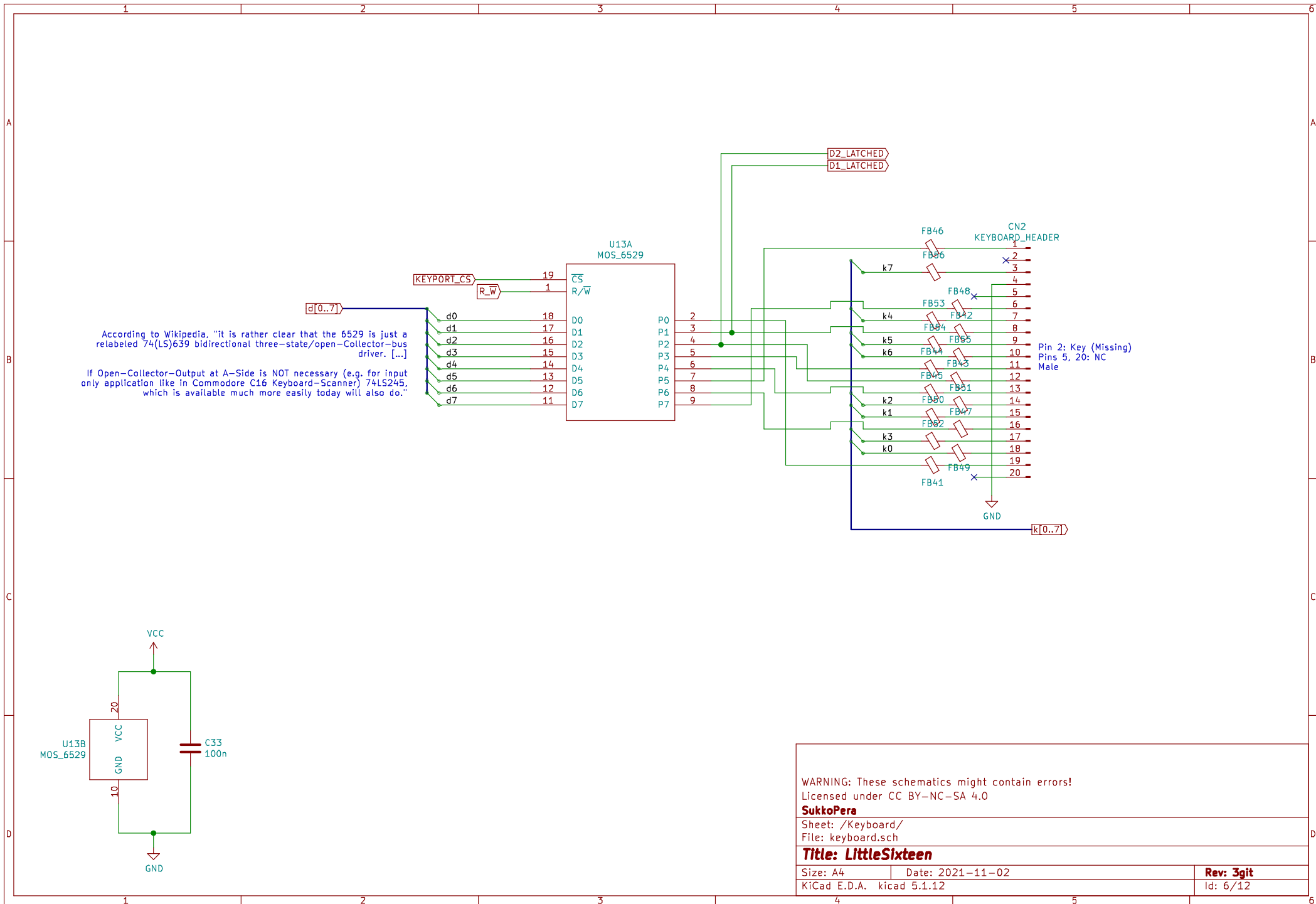
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**Rev: 3git**

Id: 5/12

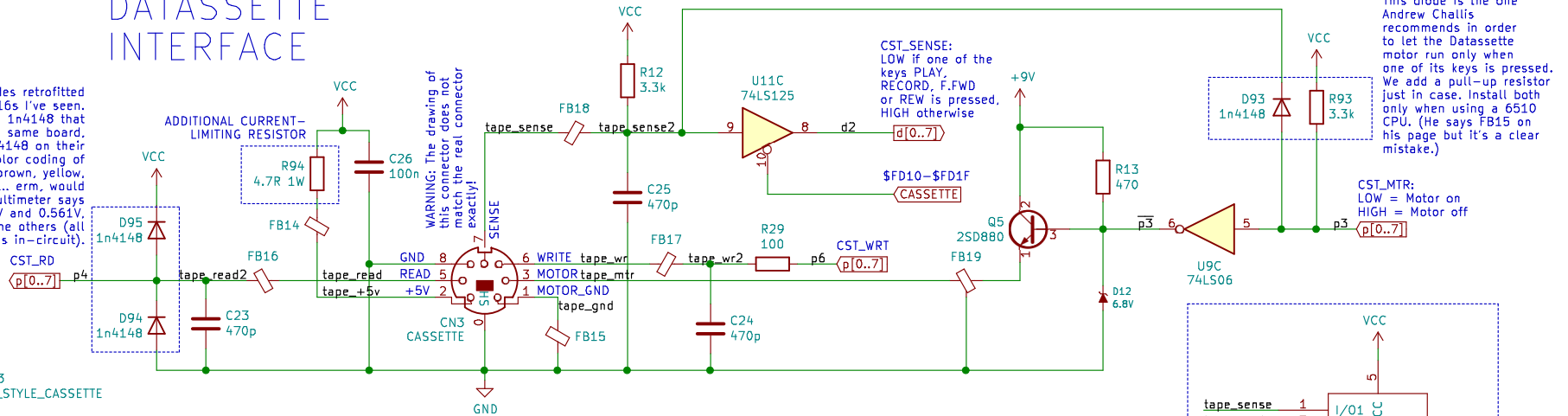


# DATASSETTE INTERFACE

These are protection diodes retrofitted after production on "some" C16s I've seen. These seem different from the 1n4148 that are retrofitted on p6/p7 on the same board, since those clearly say 1n4148 on their bodies, while these have a color coding of yellow (thick/cathode), brown, yellow, grey (or light blue?), which... erm, would make them 1n4148. Multimeter says their Voltage drops are 0.555V and 0.561V while it says 0.323 for the others (all measures in-circuit).

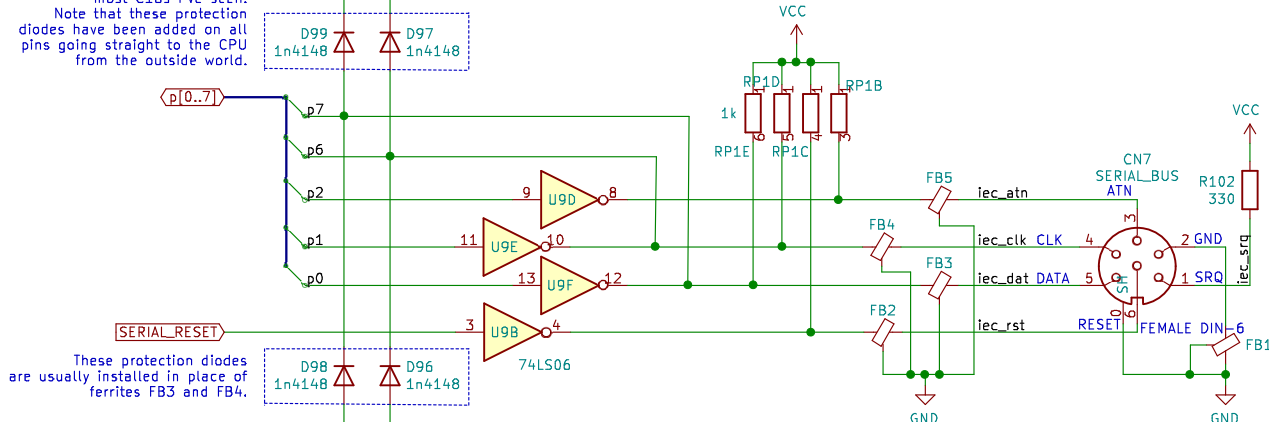
tape\_sense 6  
tape\_wr 5  
tape\_read 4  
tape\_mtr 3  
tape\_+5v 2  
tape\_gnd 1

CN93  
C64\_STYLE\_CASSETTE



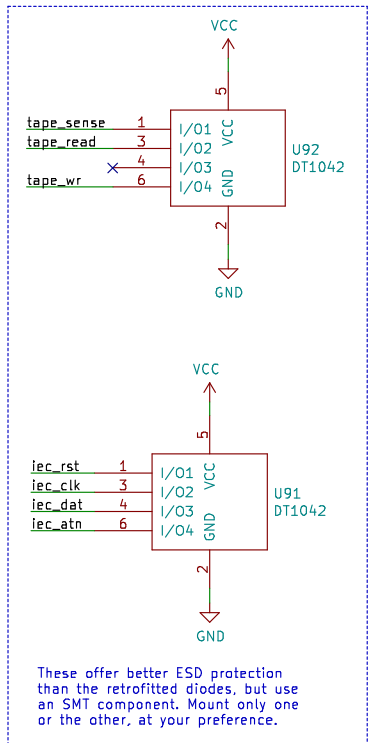
# SERIAL BUS (OR 1541 DISK DRIVE)

These (and the ones below) are more retrofitted protection diodes, these are present on most C16s I've seen. Note that these protection diodes have been added on all pins going straight to the CPU from the outside world.



NOTES:  
- Fastloaders might use these signals differently!  
- All signals are active-low  
- All signals are open collector, since this is a \*bus\*

This connector has all the Tape and IEC signals and can be used to implement an internal SD2IEC or Tapuino.



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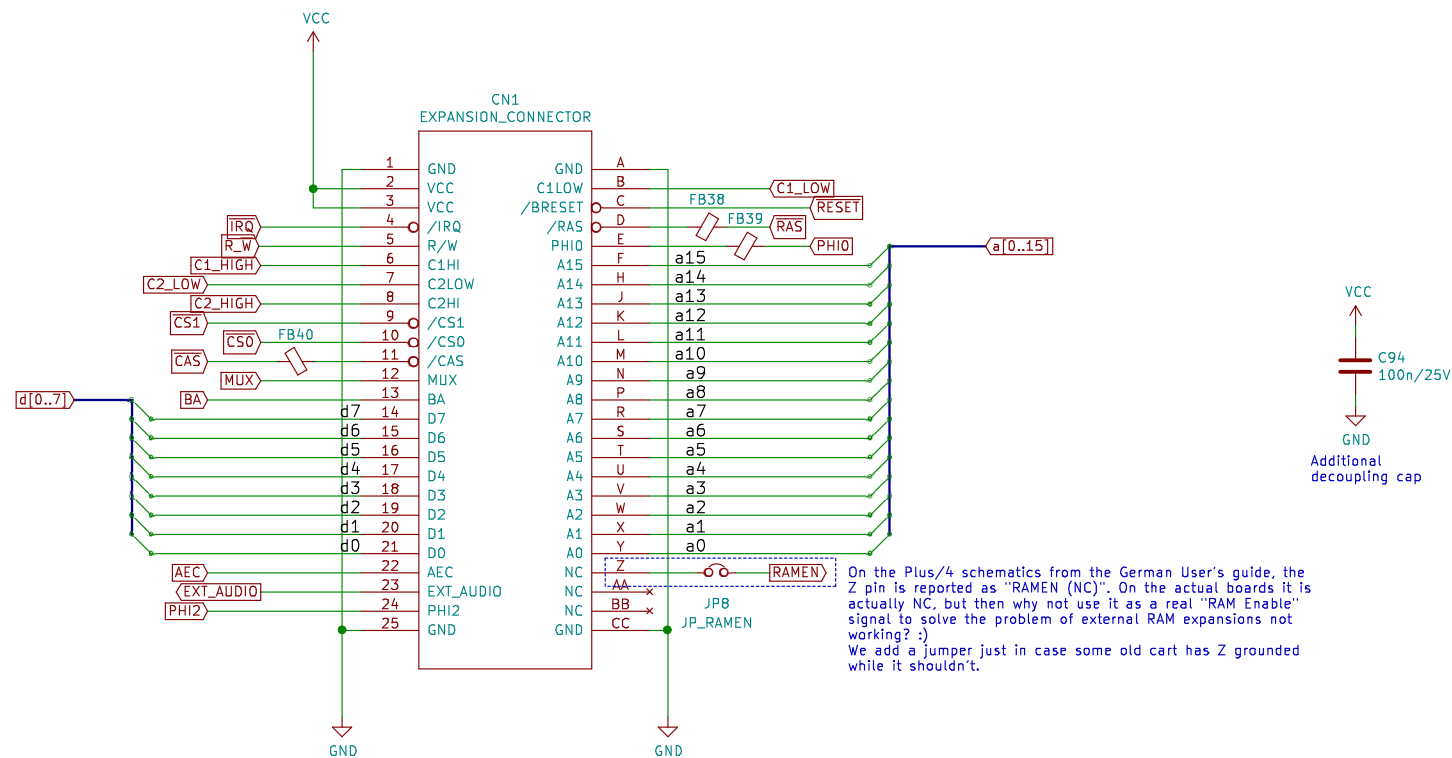
SukkoPera

Sheet: /Datassette & Serial Bus/  
File: datassette.sch

Title: LittleSixteen

Size: A4 Date: 2021-12-05  
KiCad E.D.A. kicad 5.1.12

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Sheet: /Expansion Port/  
File: exp\_port.sch

**Title: LittleSixteen**

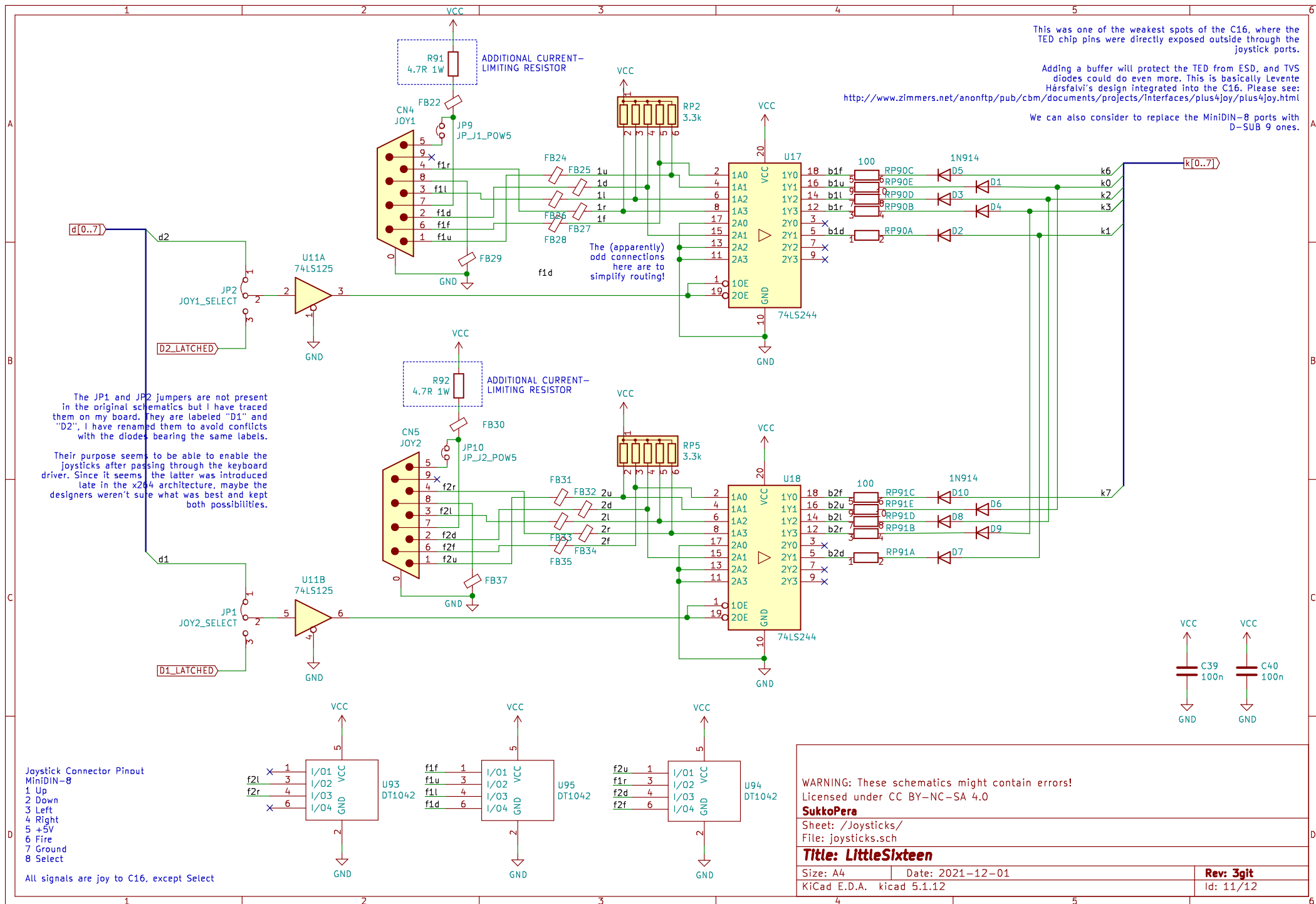
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KiCad E.D.A. kicad 5.1.12

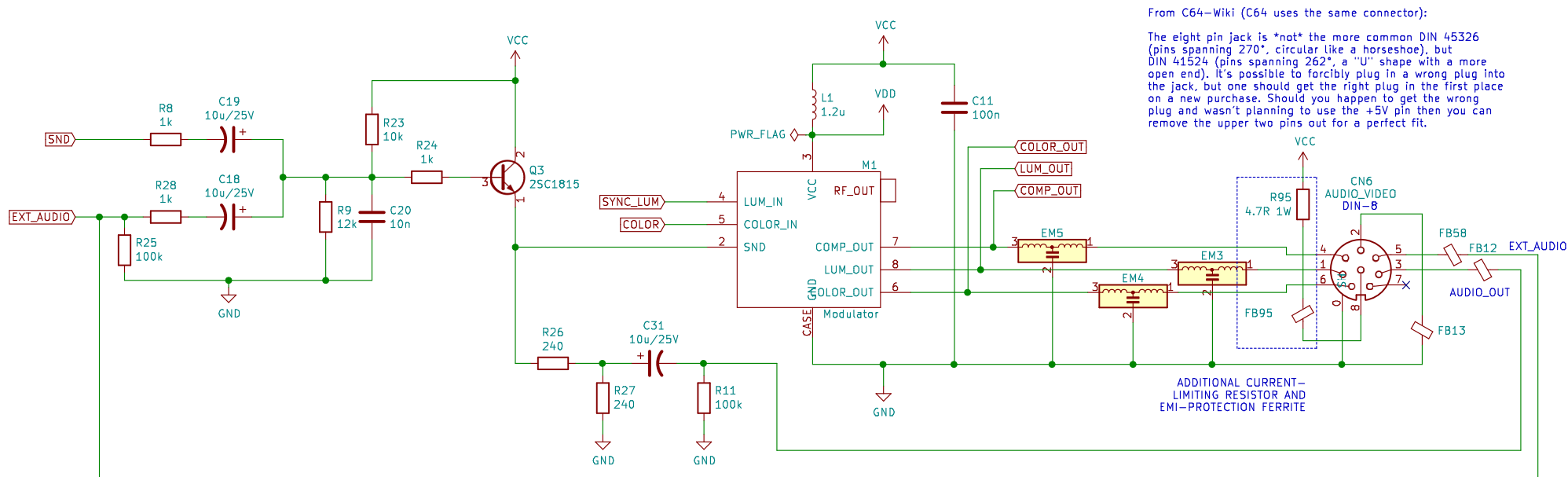
**Rev: 3git**  
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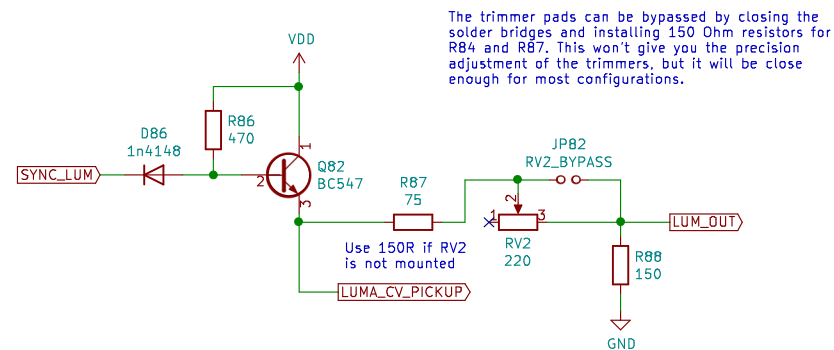
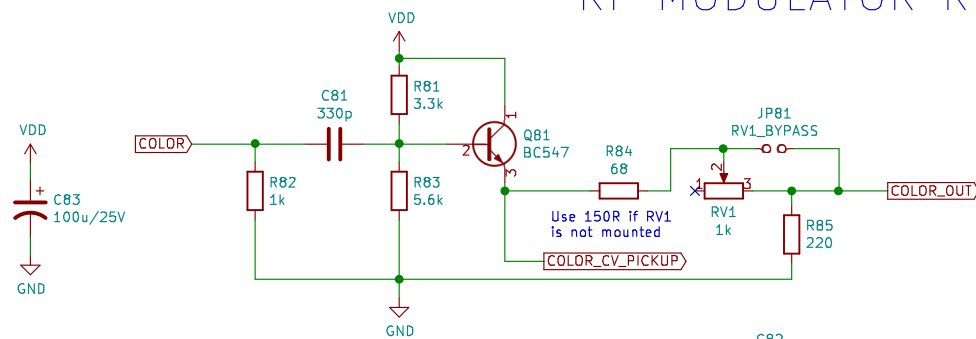






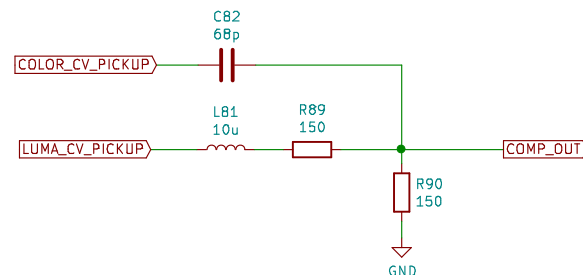


## RF MODULATOR REPLACEMENT



These circuits can replace the composite/luma/chroma output functionality of the original modulator.

It's basically the same as mbarszcz-pcb's c64-rf-modulator-replacement project for the C64, please see: <https://github.com/mbarszcz-pcb/c64-rf-modulator-replacement>



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## SukkoPera

Sheet: /Audio/Video Output/  
File: avout.sch

**Title: LittleSixteen**

Size: A4	Date: 2021-11-29
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KiCad E.D.A.	kicad 5.1.12

Rev: 3git

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