RCA Studio II Rom replacement.

Oct 23, 2023

The RCA Studio II uses RCA CDP1831 Mask ROM's. These ROM's are designed specially to interface with the COSMAC 1802 microprocessor. What makes them impossible to be replaced with a single EPROM is three things.

1. They use a multiplexed address bus. A8 to A15 are multiplexed on A0 to A7 with a clock pulse from the 1802 TPA line.
2. They are internally programmed to be enabled at a certain address. Ie, the address decoder is built in
3. There is an output from the address decoder called CEO, Chip Enable Output. This is used to map the RAM.

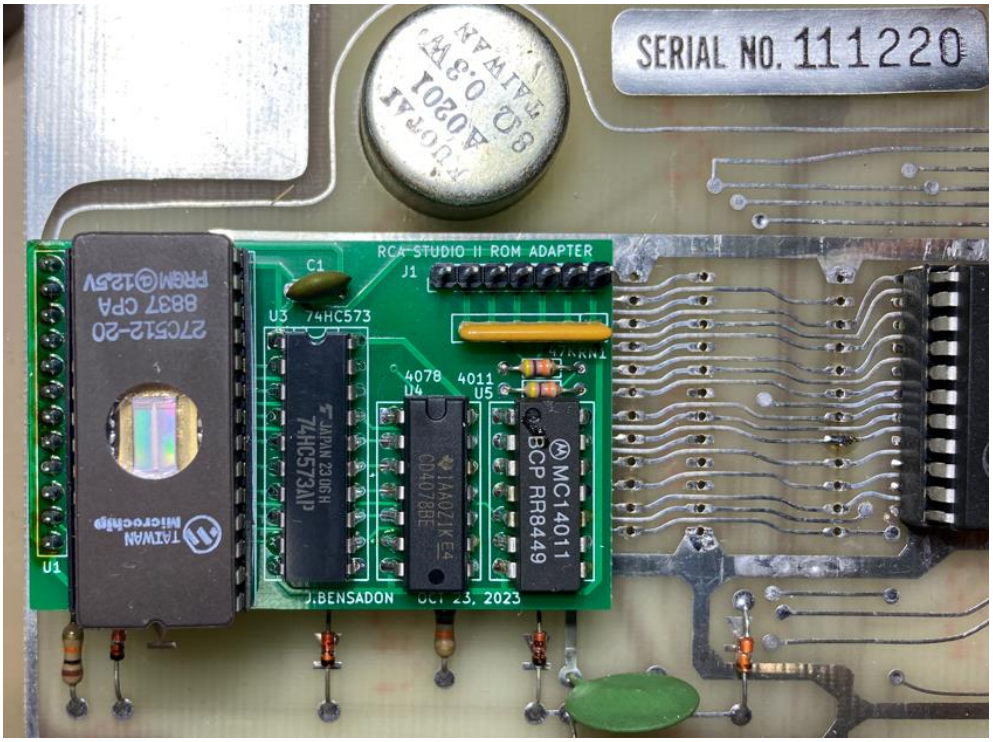
The following circuit handles the above to allow a standard EPROM to work. It replaces all 4 ROM's on the Studio 2. Each ROM is 512 bytes, for a total of 2K. It also allows the 3rd and 4th ROM's to be disabled while a cartridge is plugged in. ROM's 3 and 4 have 5 built in games and these ROM's get mapped out for the cartridge.

ROM 1	0000 – 01FF	BASE ROM 1
ROM 2	0200 – 03FF	BASE ROM 2
ROM 3	0400 – 05FF	GAME ROM 1
ROM 4	0600 – 07FF	GAME ROM 2

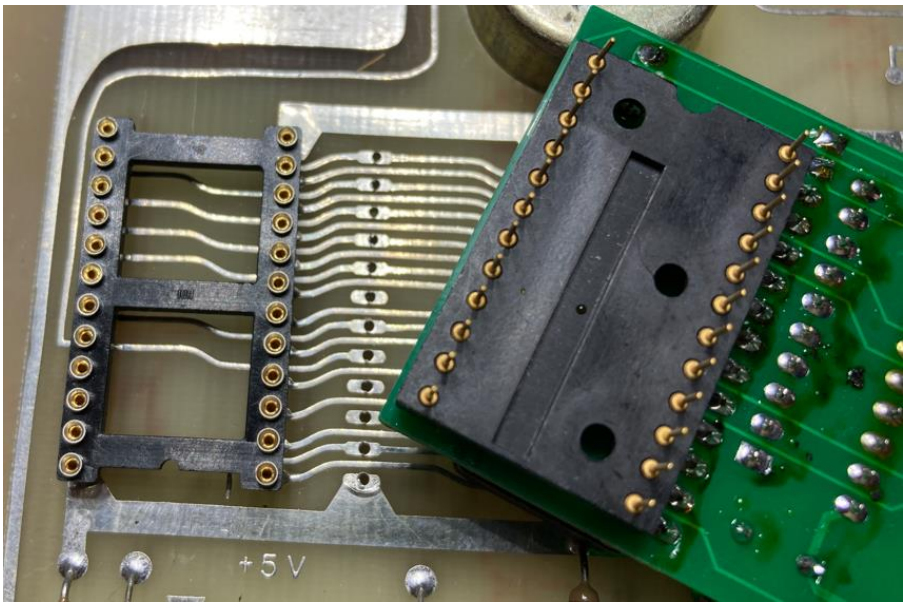
The ROM can be found online. It is included with the EMMA 02 Emulator by Marcel van Tongeren. Look in the C:\Program Files\Emma 02\data\Studio2 folder for the studio2.ROM file. It's in Intel HEX format.

This following circuit uses a 27C512 EPROM, but you can substitute for a smaller EPROM as you like. It must be a CMOS EPROM to keep power low since the Studio II has a limited power supply. With the 27C512 chip, there are 5 extra address lines giving 32 combinations of alternate memory. Other game cartridges can be combined with ROM 1 and ROM 2 to fill those other slots of 2K. The ST2 files from EMMA 02 can be used, just strip the first 256 byte header.

Built board, installed.

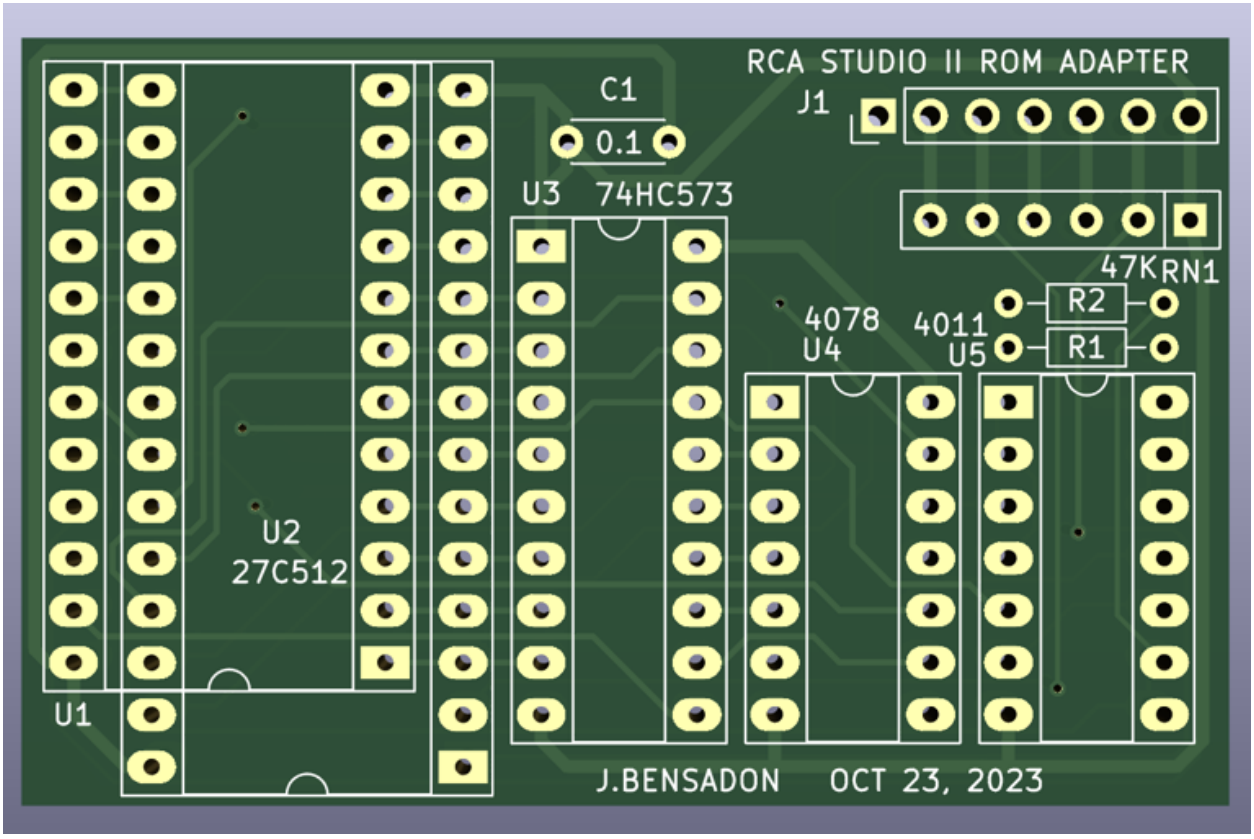


To install the board. Remove the existing ROM chips. The board is old and delicate. Use a desoldering tool to carefully suck out all solder while wiggling the ROM PIN. Hand solder suckers aren't good enough. Alternatively, cut the pins of the ROM's and pull out each pin, then use hand solder sucker to clean the holes of the furthest ROM (ROM 4).



Use a machine socket to accept the round pins on the replacement module.

Building the ROM Module.



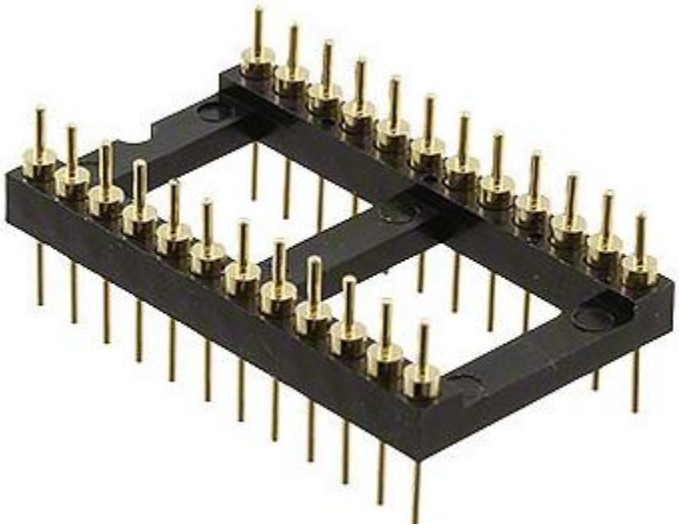
BOM - Bill of Material

Qty	Supplier	Part #	Description
1		27C512	CMOS EPROM (can be 27C64, 27C128 or 27C256)
1	Digikey	TC74HC573APF-ND	74HC573 8 bit latch CMOS

1	Mouser	595-CD4078BE	8 input OR/NOR CMOS Logic Gate
1	Mouser	595-CD4011BE	Quad 2 input NAND CMOS Logic Gate
1	Digikey	4606X-1-473LF-ND	Resistor Network 47K 5 Resistor Bussed, 6 SIP
2	Digikey	CF18JT47K0CT-ND	Resistor 47K 1/8W
1	Digikey	399-9877-1-ND	Capacitor 0.1 X7R
1	Digikey	1175-1524-5-ND	Connector Male-Male Pin
1	Digikey	2057-PH1-07-UA-ND	Connector Male Pin Header
1	Digikey	ED3052-5-ND	DIP Socket 28 pin for EPROM
1	Digikey	ED3054-5-ND	DIP Socket 20 pin for Latch (Optional)
2	Digikey	ED3045-5-ND	DIP Socket 14 pin for Logic Gates (Optional)
1	Digikey	952-2214-ND	DIP Socket 24 pin. For Studio II Mother board

Construction

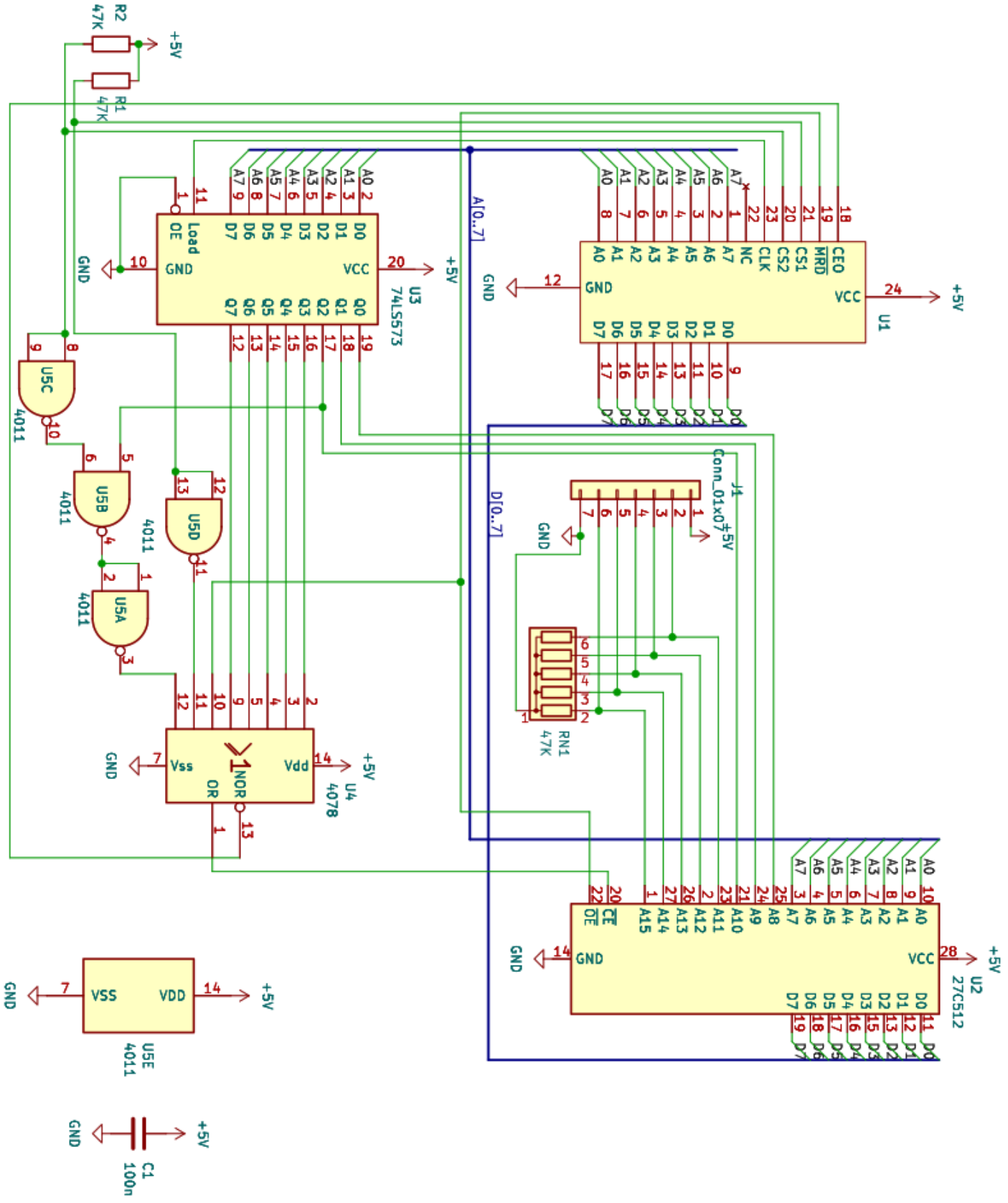
The Male-Male Connector has very skinny pins and thicker pins. The thicker pins are for soldering, they won't fit in a machine socket. The skinny pins are fragile, handle with care. Solder the 28 pin EPROM socket first (or first clip the frame near pin 14), then the rest of the parts. Solder this male-male connector last with care. A thin tip for soldering iron is needed for pins 11 and 12, alternatively, the EPROM frame can be clipped open to expose the header pins. Present both parts on the board and observe the task of soldering pins 11 and 12, then choose your method.

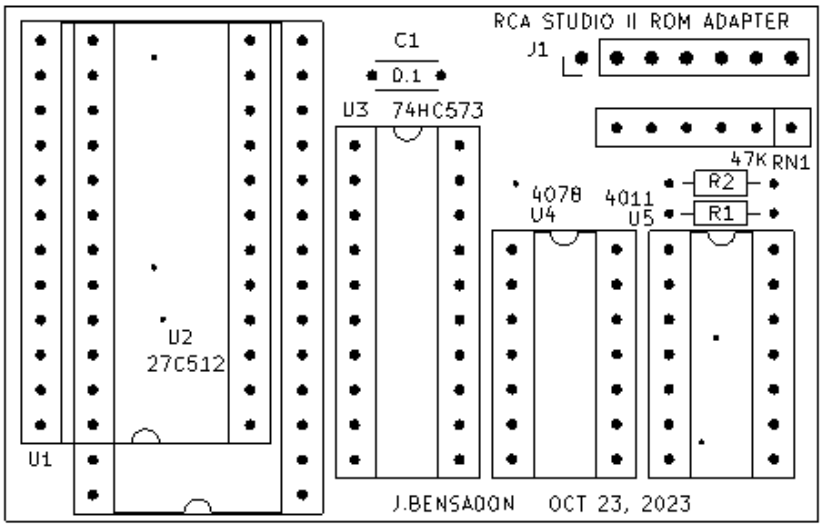


Finished Construction

Once the module is built, EPROM programmed, Studio II prepared. Install the module. Test your unit. Look online for an Arduino based tester that can be used to test the RAM on the Studio II. The header can be wired to some switch(s) for slot selection. The socket appears strong enough to securely hold the module, but if in doubt, layers of double sided tape can be added for additional support.

Schematic


R2
47K
+5V
R1
47K
A[0..7]
D[0..7]
GND
U3
74LS573
Load
OE
GND
VCC
U1
GND
VCC
CE0
MRD
CS1
CS2
CLK
NC
U5C
4011
U5B
4011
U5D
4011
U5A
4011
J1
Conn_01x07
RN1
47K
U4
4078
Vss
Vdd
NOR
OR
U2
27C512
CE
OE
GND
VCC
U5E
4011
VSS
VDD
C1
100n


RCA STUDIO II ROM ADAPTER
C1
0.1
J1
U3 74HC573
47K RN1
R2
R1
4078
U4
4011
U5
U2
27C512
U1
J.BENSADON OCT 23, 2023