PET_32K

Short description

This is a very simple circuit consisting of just 3 ICs originally designed to give a PET 2001 32 kbyte of RAM. The circuit is however universal and can be used for any 65(C)02 system to replace the address area $0000 - $7FFF with RAM.

Reason d' être

Originally this circuit was devised to revitalize a PET 2001 computer that had a defective but effectively unobtainable 6550 RAM chip, while at the same time expanding the user RAM of the machine to the maximum possible of 32 kbyte. The resulting design does not require any changes on the motherboard of the PET or mechanical changes to the cabinet.

Circuit description

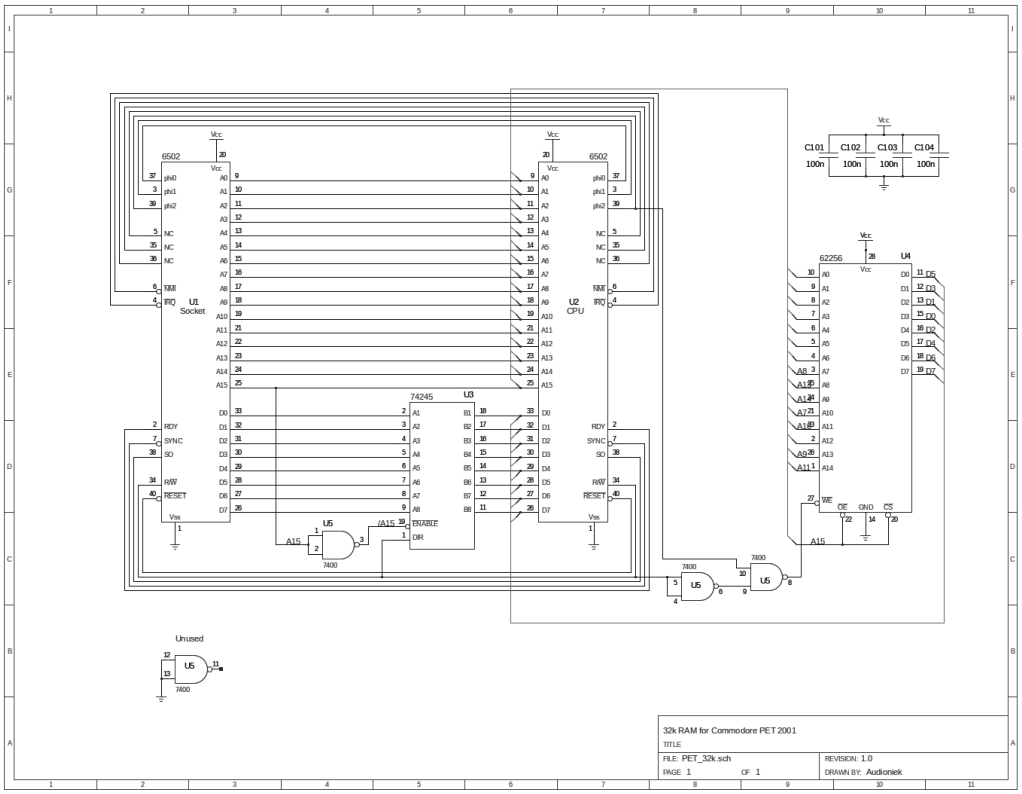
The key to the simplicity of the circuit is the fact that in a PET (or CBM) computer the RAM area exactly divides the address range of the CPU in two. This has the net result of the A15 address line indicating RAM (A15=0) or ROM / I/O (A15=1). The circuit uses a 74LS245 or compatible octal bus buffer to isolate the CPU data bus from the motherboard when A15 is low. This approach makes anything on the motherboard invisible to the CPU when A15 is low while at the same time accessing the CMOS RAM connected directly to the CPU, and permits normal access to the motherboard when A15 is high. Apart from the RAM and the bus buffer only one 74LS00 IC is used for the glue logic using three gates of it. Getting access to the necessary signals is done by lifting the CPU from its socket and providing a new socket for it on the circuit's PCB that is installed in the CPU's place on the main board, a technique also used in the 8096 and SuperPET models.

Due to its simplicity and standard design, the circuit is suitable for use in all PET/CBM computers of the era and has been successfully tested in an 8 kbyte PET 2001, a 9 inch CRT 3016, a 12 inch CRT 4016 and an 8032. It should also work in an 8296(D), the 8096 and the SuperPET. In case of the latter two, the PCB is inserted in the CPU socket on the computer's main board, the flat cable goes into the PCB and the CPU sits on the extension board where it already was.

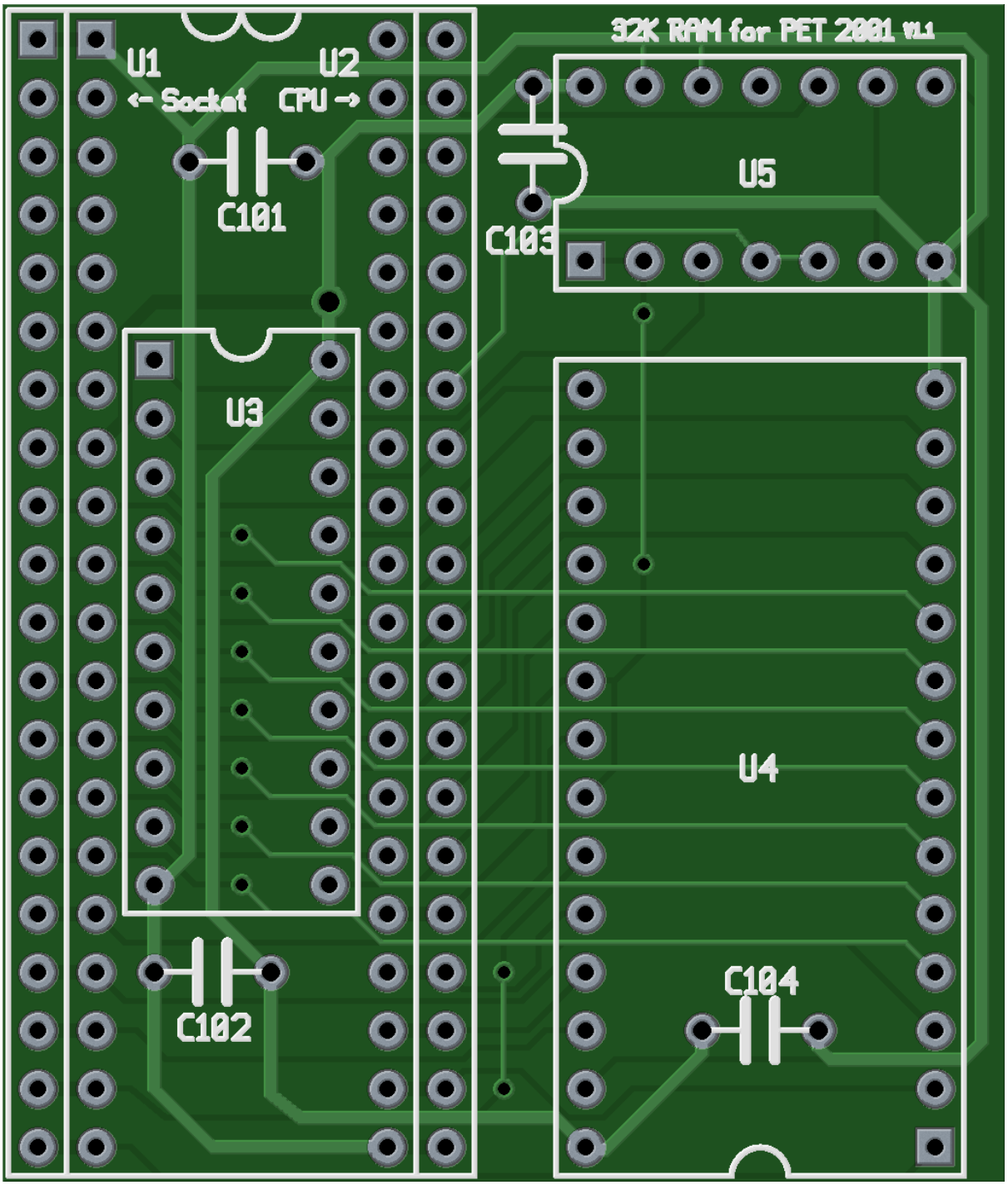
As all CPU pins are routed through, the board can also be used with all variants of the 65C02.

The board has very little impact on the total power consumption of the system as the extra components used draw approximately an additional 180 mA (worst case) from the +5V supply. As all model PETs have oversized power supplies this should not be an issue. If you think it is, remove the now not used socketed RAM chips from the motherboard for a total power consumption that is even less than original.

Schematic diagram



The matching PCB has been designed for a minimal footprint: three decoupling capacitors and the 74LS245 bus buffer sit underneath the RAM and the resocketed CPU. It looks like this:

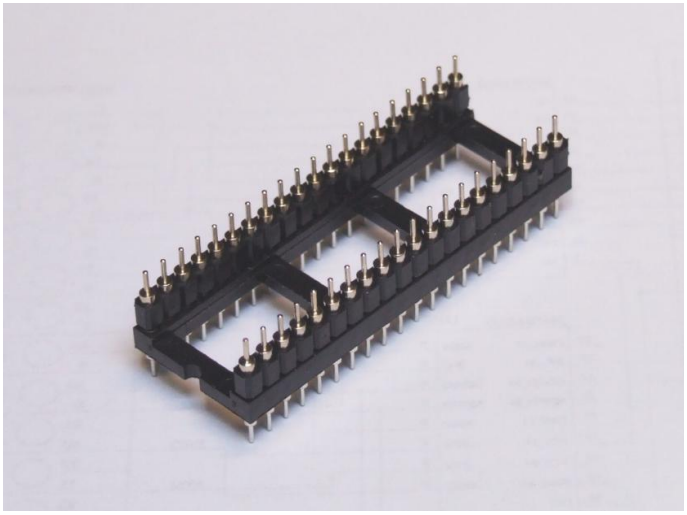


Building the circuit

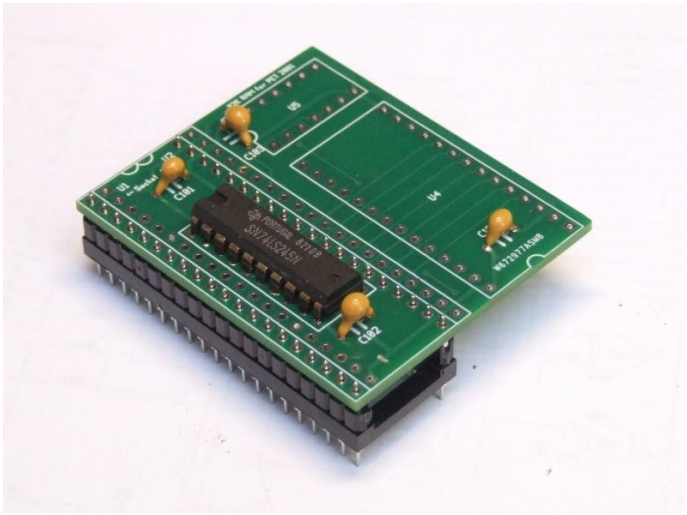
Start by soldering the four decoupling capacitors C101 through C104 on the PCB. All but C103 sit below a socketed component. Somewhat higher capacitors need to be folded flat; the capacitors shown in the photos can remain upright.

Next, solder the 74LS245 buffer U3 on the PCB. Note the position of the notch. Do not use a socket for it as this will increase the height and will prevent inserting the CPU in its socket later.

If you bought the needle pin strip as one row of 40 pins, cut it in half. Use the 40 pin DIL socket as a guide/template by inserting the thin needle ends of the two 20 pin needle strips into it. Work carefully as the needles are very thin and bend or break off easily:

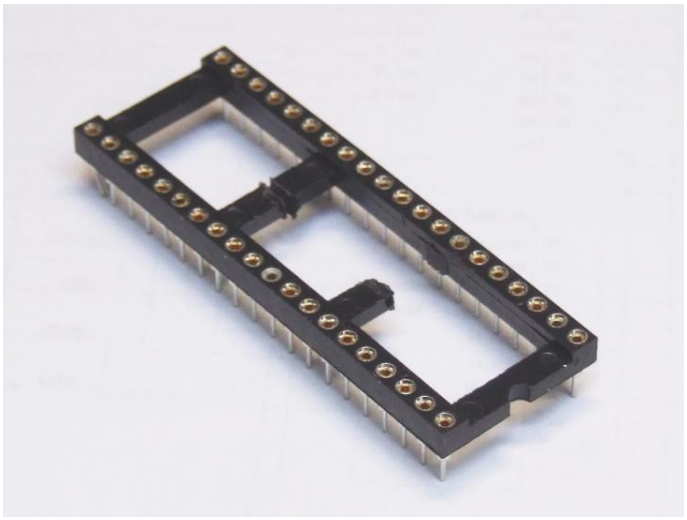


Insert the resulting package into the holes on the PCB intended for U1 on the solder side. Solder the strips on the component side of the PCB. This approach will ensure the correct spacing between the two rows of needle pins:



After soldering, carefully remove the 40 pin DIL socket from the needles.

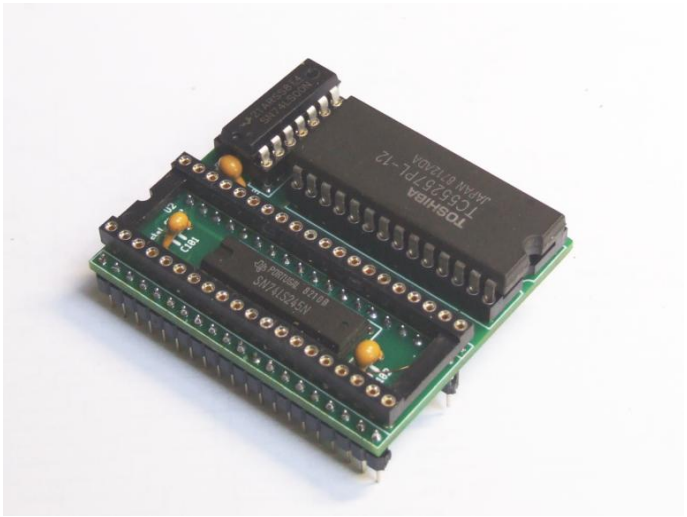
Most 40 pin DIL sockets have bridges in the middle. These unfortunately interfere with the 74LS245 data bus buffer and decoupling capacitors sitting below the CPU, so they have to be removed. Do not just cut them away with cutting pliers as this will probably snap the socket in two. Use an old but still sharp knife and heat it using a flame or your soldering iron. Use the heated knife to cut the bridges in the socket in the middle, and then cut them out of the socket with cutting pliers:



Then solder the now bridgeless socket into the holes intended for U2 on the PCB. Take care the notch is in the proper place. Soldering the socket is done from the soldering side of the PCB.

Mount the sockets for the RAM U4 and the logic IC U5 on the PCB observing the location of the notch. Insert the RAM and the logic IC in the sockets.

The PCB is now ready for use and should look like this:



Installing the PCB

Disconnect the PET from the mains. Open the PET and use the rod provided to support the opened upper half of the cabinet. Find the 6502 CPU on the main board. In most (if not all) main boards it is already in a socket. If so, carefully remove the CPU using a small screw driver as a prying tool. In case the CPU is soldered in, remove the main board from the cabinet, desolder the CPU and mount a 40 pin DIL socket in its place. Work carefully as both the CPU and main board need to survive this process intact. If you are not skilled in desoldering through hole components from a two sided PCB, ask someone who is to do this for you.

Put the CPU in the socket on the PCB, observing the notches. Put the CPU/PCB assembly in the CPU socket on the main board, again observing the notches. Close the cabinet and connect the PET to the mains. Switch it on. The PET should start and greet you with 31743 bytes free:

If you want, all RAM ICs on the main board can now be removed, as they are no longer accessed. This will reduce the energy consumption and heat production somewhat.

Bill of materials

Item	Description	Qty	Notes
U1	Needle pin strip 40 pins or: needle pin strip 20 pins	1 2	See text
U2	40 pin 600 mil wide DIL IC socket	1	
U3	74LS245 octal data bus buffer	1	See note below
U4	32 kbyte CMOS static RAM	1	See note below
U5	74LS00 quad NAND gate	1	
C101 - C104	Ceramic capacitor, 100 mil spacing, 100 nF, 50V or higher	4	
-	28 pin 600 mil wide DIL IC socket for U4	1	Do not omit as this will prevent mounting C104
-	14 pin 300 mil wide DIL IC socket for U5	1	
-	PCB made from the Gerber files provided	1	

For the 74LS245 equivalents such as the 74LS645 and compatible ones can be used. The use of HCT versions is possible but not recommended.

The 32 kbyte RAM must have a pin out compatible with the 62256 or 55257 CMOS static RAM (also see the schematic diagram). So called pseudo static RAMs with the same pin out can also be used but bring no advantages. If in doubt, consult the relevant datasheets. Access time can be as slow as 450 ns as the CPU runs at 1 MHz; all devices on the market meet this requirement easily and are quite a bit faster.

The small print in normal size:
