LiNC80
SBC1

Assembly guide

version 0.9

LiNC

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Introduction

Thank you for choosing this LiNC80 SBC1 8-bit microcomputer kit!

This kit is not a beginners kit, but thanks to the use of though-hole components and open PCB layout, the complexity of assembly is intermediate. If the builder has some experience assembling other intermediate level PCBs, or even advanced beginners level, this kit should pose no problems.

Note that the LiNC80 SBC1 does not include any voltage regulation, but requires an externally regulated, stable 5V DC supply capable of 400mA current (2Watts).

Before starting assembly, carefully inspect the contents of the kit, to ensure that no parts are missing, and that no damage has occurred during transport. Also make sure to read (at least skim) through this document, to be familiar with the steps required, but also to notice all assembly tips that are located throughout the guide.

Parts list

Part type	Value/designation	Positions
Capacitor, El	47u	C1
Capacitor, ceramic	100n	C2,C8,C9,C10,C11,C12,C13,C14, C15,C16,C17,C18,C19,C20,C21
Capacitor, ceramic	220n	C3
Capacitor, El	1u	C4,C5,C6,C7
Resistor, radial	330R	R1,R39
Resistor, radial	470k	R10
Resistor, radial	4k7	R2,R3,R4,R5,R6,R7,R8,R9,R11
CPU	Z84C00	U2
SIO	Z84C42	U8
CTC	Z84C30	U7
PIO	Z84C20	U12
RAM	AS6C62256-55P	U10, U11
ROM	AT28C256	U9
Logic IC	74LS08	AND1
Logic IC	74LS04	IN1
Logic IC	74LS32	OR1,OR2,OR3
Logic IC	74LS138	U4,U1
Logic IC	74LS273	U5
Transceiver IC	MAX232	U6
IC	NE555	U3
Oscillator	TCXO3	X1
Jumper, 3 pin		J2,J3,J4,J5,J6,J7,J8,J9
Connector, 14 pin male	PARPORTx	P10,P11
Connector, 30 pin male	ROMSLOT	P2
Connector, 10 pin male	MEMBANK	P3
Connector, 50 pin female	Z50Bus	P4
Connector, 40 pin male	IDE	P5
Connector, 2 pin male (1x2)	RST_CONN	P6
Connector, 10 pin male	RS232_DTK	P8
Connector, 6 pin male (1x6)	SERIO	P9
LED	5mm LED	LED1,LED39
Screw terminal	PWR_IN	P1
Push button	SW_Push	RESET_SW1

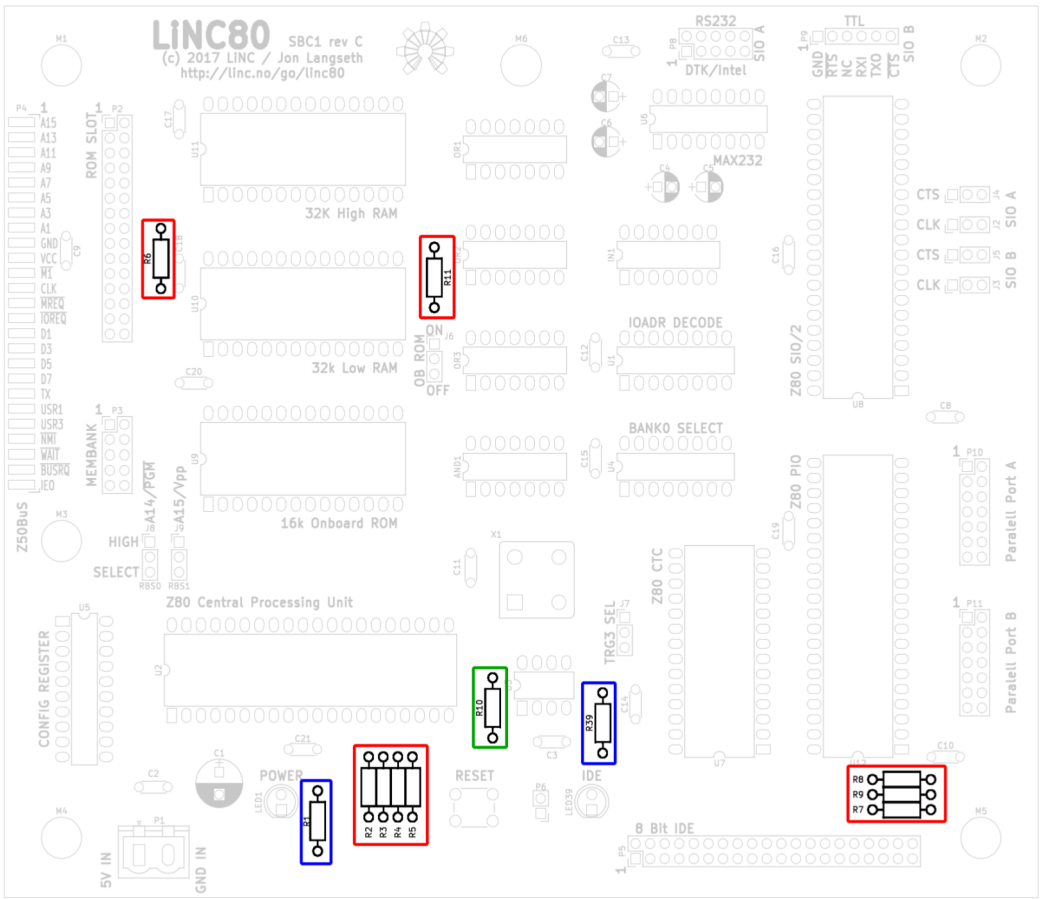
Assembly

Step 1: Add resistors

Start by soldering in the resistors that are different from 4.7kOhm. There are only three resistors that are not 4.7kOhm, so by mounting those first, the rest can be placed and soldered without much risk of mixing values.

R10 is the single 470kOhm, and is positioned to the right of the CPU.

R1 and R39 are 330Ohm resistors used as ballast resistors for the two LED's. These are located very close to the LED positions.

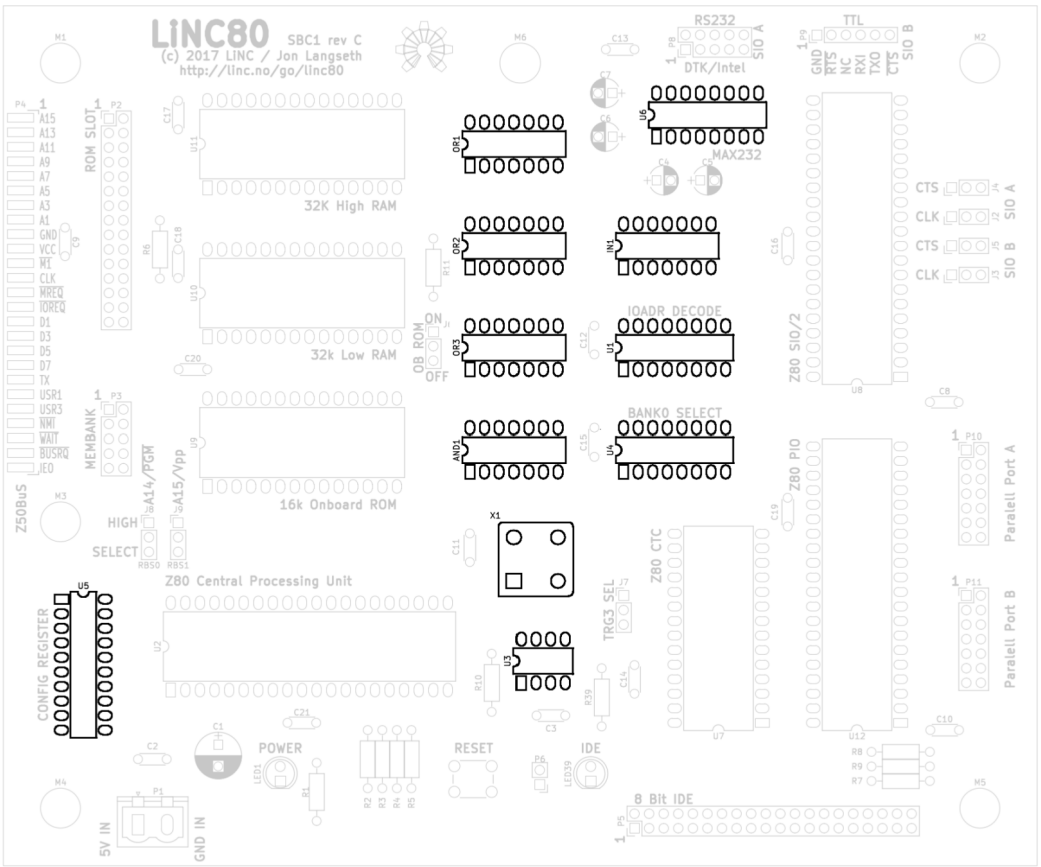


Red = 4k7, Blue = 330R, Green = 470k

Part 2: Place logic IC sockets

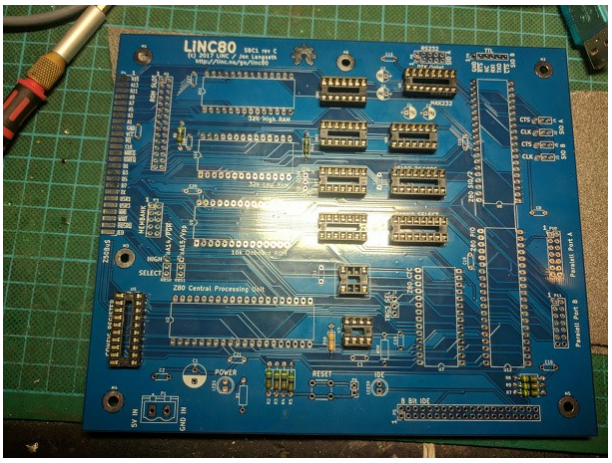
Placing the narrow (smaller) IC sockets is straight forward. When installing the sockets, make note of the indicators for pin one on both silkscreen and socket. By making sure the socket clearly indicates the correct orientation in relation to pin one, you avoid mistakes later when the IC components get installed later.

The only significant point to mention is that the oscillator X1 is intended to be socketed. The kit includes two 8-pin sockets, and one of those may have half of the pins removed. Take care to mount that socket on the X1 oscillator location. If your kit includes two 8-pin sockets with all pins present, you have to modify one of those to fit the four-hole mounting pattern.

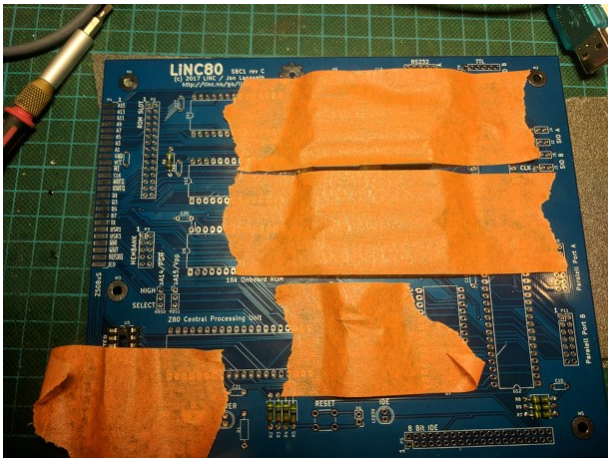


Tips for mounting of sockets

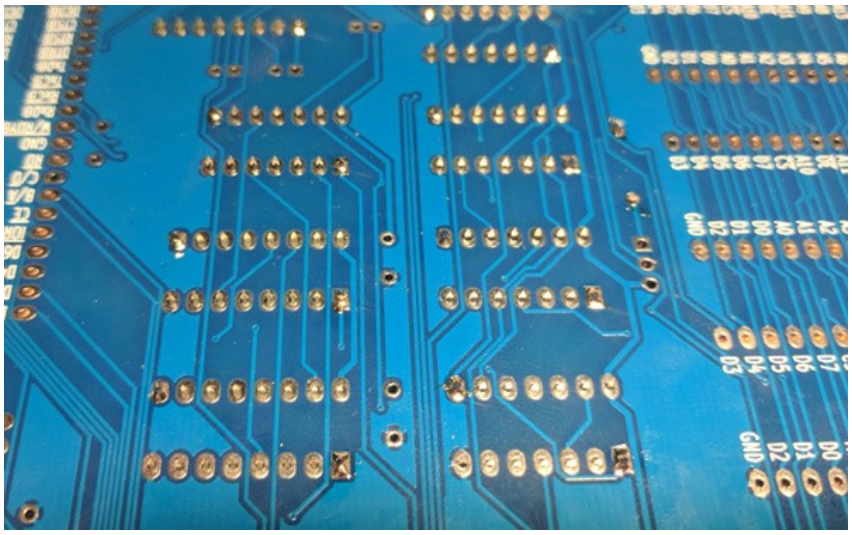
Place all the sockets in their positions before soldering. Use painters masking tape to hold the sockets in position, so they stay in place when you turn the board over. Once the board is turned so the pins are facing you, solder the pins on opposing corners of each socket. You can now remove the painters tape. Inspect how well seated the sockets are. If a socket is misaligned, heating the already soldered pins lets you tweak its position. Once all sockets are properly located, the remaining pins can be soldered in one go.



Place sockets in their locations



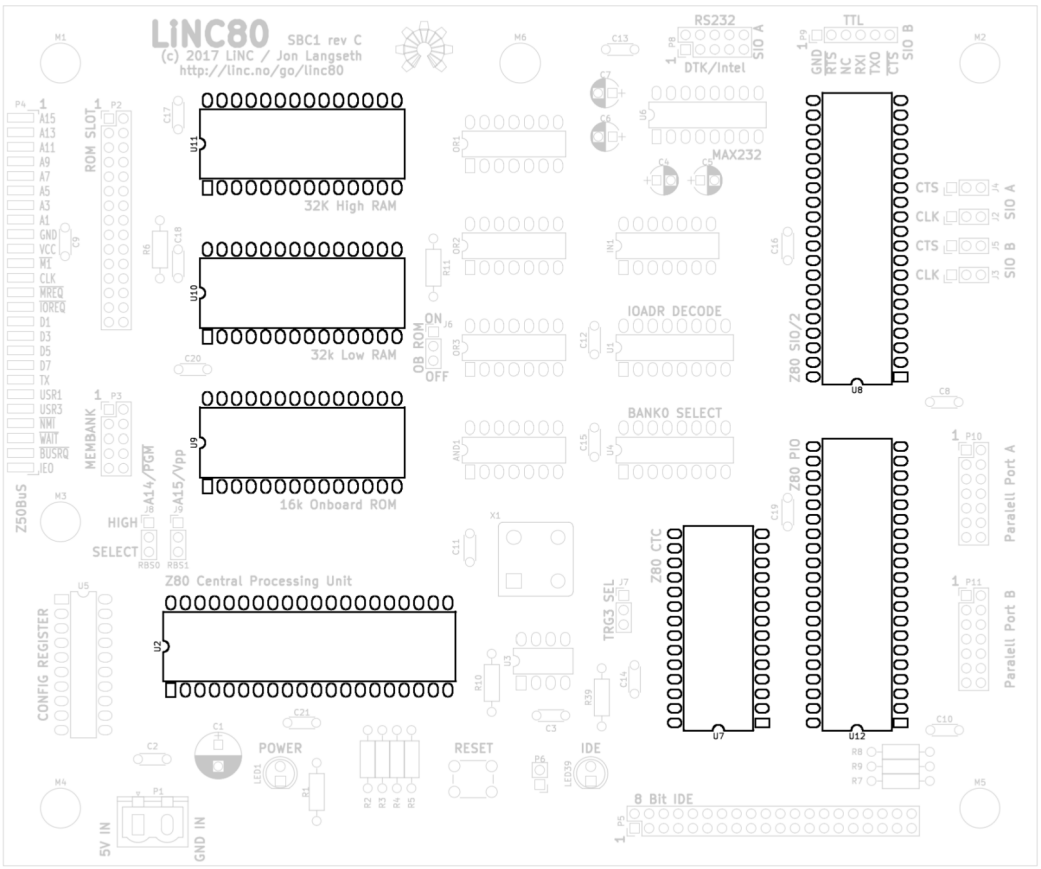
Hold in place with painters tape

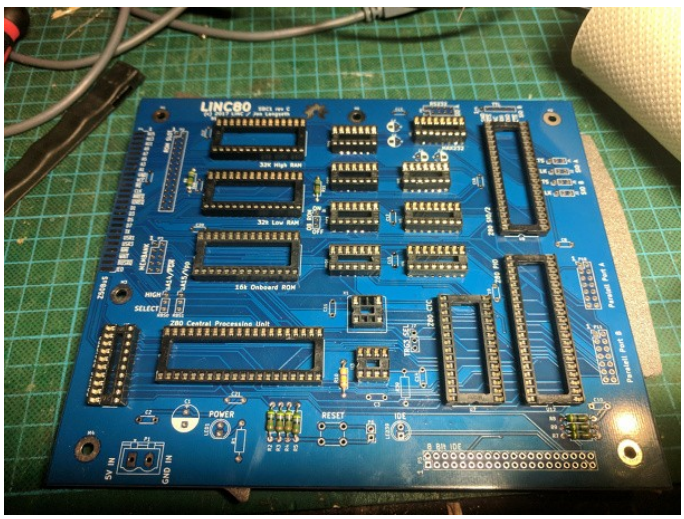


Initially, only solder two pins on each socket

Step 3: Add the wide IC sockets

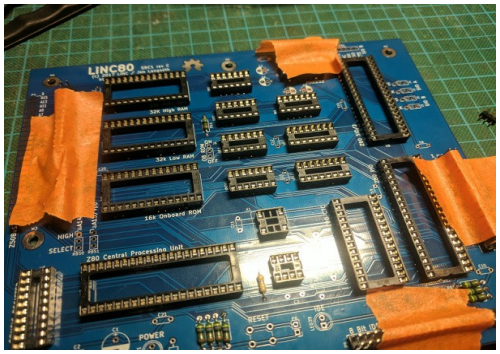
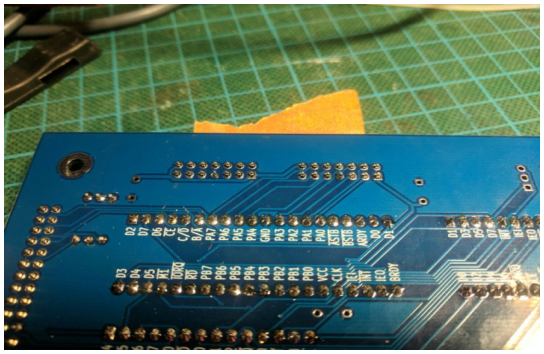
Proceed to place and solder the larger IC sockets, following the same approaches used to mount the smaller sockets from the previous step. Pay special attention to the orientation of the sockets and pin one.



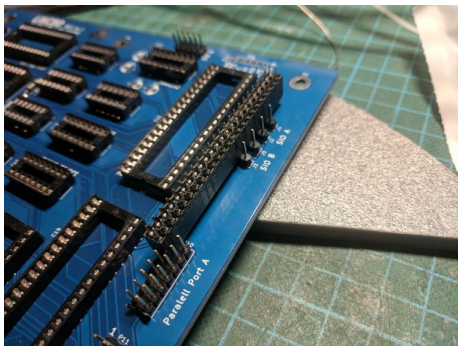
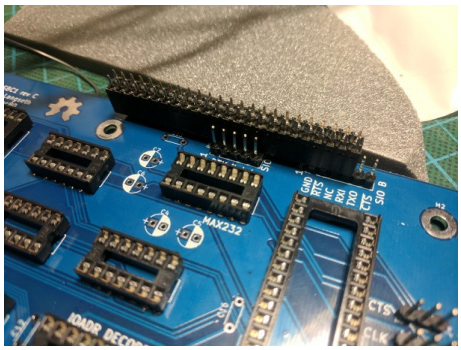


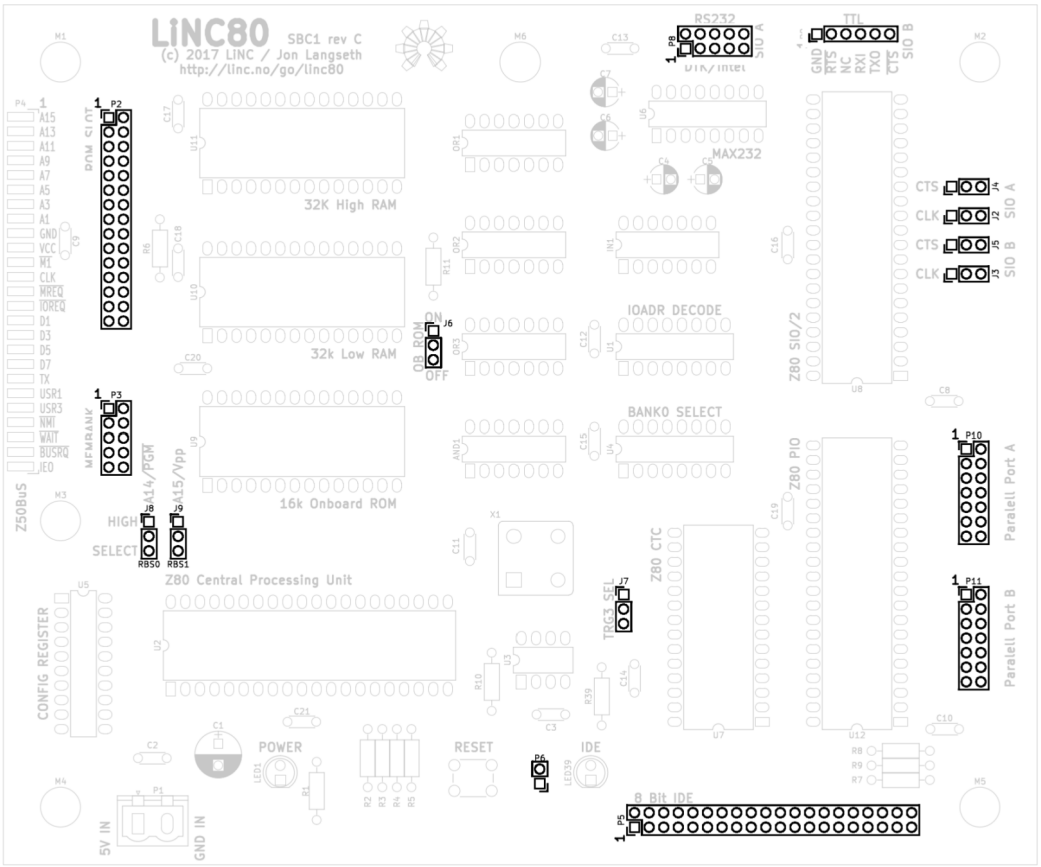
Step 4: Add connectors and jumper pins

Identify the various male 2.54mm pitch connectors, and place them in their positions. To help mounting the connectors, use the basic tip from mounting sockets: hold the connectors in place temporarily using painters masking tape. When «tacking», use a single central pin in stead of two, as this makes the step of aligning easier.

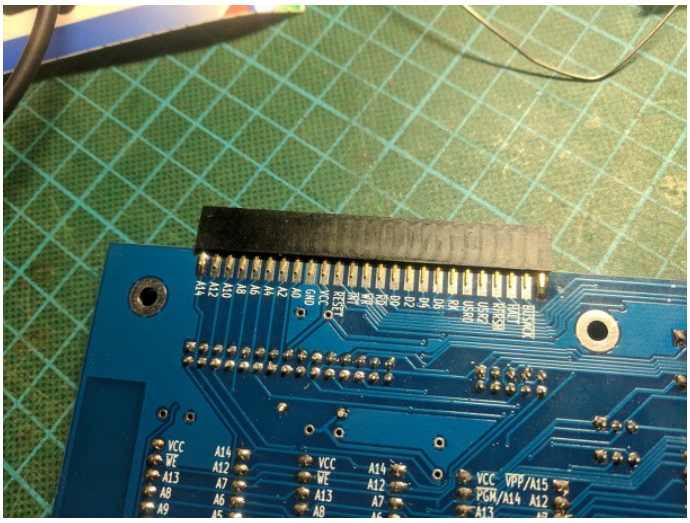



To align connectors, the 50-pin female connector that will later be used for the Z50Bus connector can be used. With the male connectors held in place with a single pin as a «tack», place the 50-pin female connector across several connectors. This makes the connectors line up on a 2.54x2.54mm ordered grid. Align and solder remaining pins on the connectors.



Mounting the Z50Bus is optional, but if you intend to use the expansion bus later, it should naturally be mounted. The 50-pin female connector gets used on P4, mounted on-edge. Place the connector so it straddles the PCB edge connector, making sure that pins and pads line up. Tack the connector in place with two solder points, and adjust the position so it is level, even and as close to the board as possible. Then proceed to solder the remaining pins, by heating the pad and tip of pin, while adding a small amount of solder, allowing the solder to flow between the pin and pad.



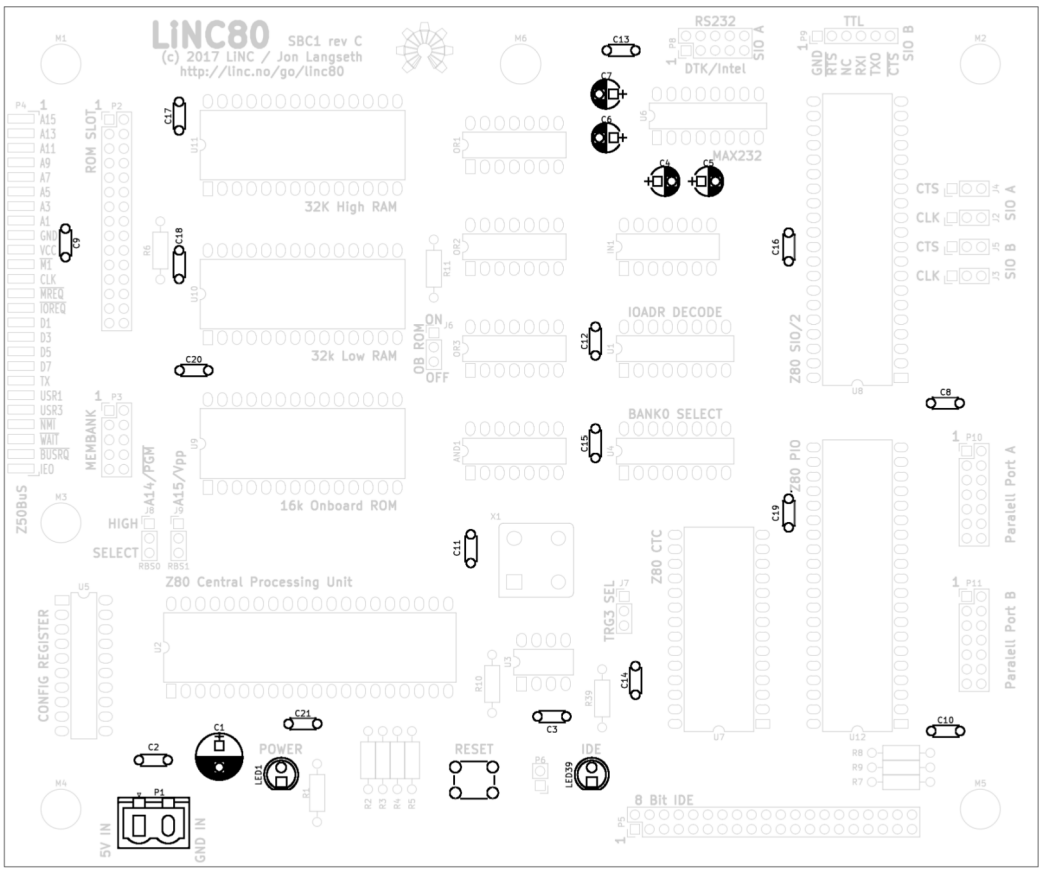
Step 5: Add remaining passive components

Start by placing and soldering in place the electrolytic capacitors C4, C5, C6, C7 and C1. Pay attention to the polarity of these capacitors! C1 is the larger power-supply capacitor, C4 to C7 are the four smaller capacitors for the RS232 charge pump.

When mounting the 5mm LEDs, the polarity can be identified by the flat on the LED housing, and the shorter leg. The short leg and the flat identify the (negative) cathode terminal, and connects to the square solder pad (also indicated by a flat on the silk screen.

The reset switch and power connector should be installed next. These two components should be straight forward to install.

The remaining components should all be passive capacitors. One of these, C3, is a 220nF with position next to the 8-pin NE555 timer IC. The remaining 15 ceramic capacitors are decoupling capacitors, all identical in size and type.



Step 6: Clean and dry the board, inspect

The LiNC80 SBC1 is a fairly sensitive circuit, and not a trivial PCB. This means that the system is sensitive to impedance mismatches. You may be surprised that most rosin based fluxes are to some degree conductive. This is extra true if the flux has by accident been overheated and started carbonizing. Because of this, the board needs to be thoroughly cleaned when the soldering has been completed.

To dissolve organic rosin based fluxes denatured alcohol (methylated spirits) or citrus based cleaners work very well. Do NOT use acetone or acetone based cleaners, as they will damage the plastic parts assembled on the board. Isopropyl/isopropanol is not suited, as it fails to properly dissolve the organic rosin (even if it otherwise is a very good cleaning agent).

After cleaning, the board needs to dry completely. Remaining alcohol or other cleaning agent will cause operating problems for the CMOS based Zilog parts. It will very likely not cause damage, but the system will not work reliably, if at all with moisture on the board. Also, if water has been used to rinse the board, this needs to evaporate completely before powering on, otherwise corrosion damage will most likely happen over time.

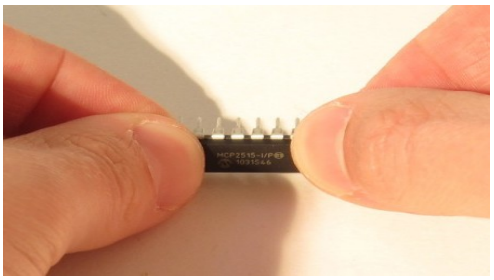
After cleaning, do a thorough and complete inspection. Look for solder bridges, cold or incomplete joints and similar defects. If you find problems during inspection, you should be able to correct them, but remember to clean the board again if you need to add (or remove) solder.

Step 7: Installing integrated circuits.

When installing (and preparing to install) the integrated circuits into their sockets, remember that these are all static sensitive devices, and should be treated with ESD precautions.

Before starting to install ICs, identify, sort and group the components. The components may have labeling that does not correspond 100% with the parts list. As example, the list may call for 74LS32, while the kit will contain a variant, like SN74LS32N. Also, the parts list calls for a Z84C00 CPU, the actual included part is most likely the Z84C0010PEG.

When you first receive just about any DIP IC, the legs will not be parallel to the main chip body. They will bend out slightly. To be able to install them in sockets without issues, the pins will need to be adjusted slightly. Carefully bend either row of pins evenly inwards by a small amount by pressing against a flat surface (eg. tabletop).



When installing the components, pay attention to pin one, normally indicated by a dot by pin one and/or a half-circle on the short edge where pin 1 is located. Pin one is indicated on the silk-screen by a half-circle/crescent on the pin-one side.

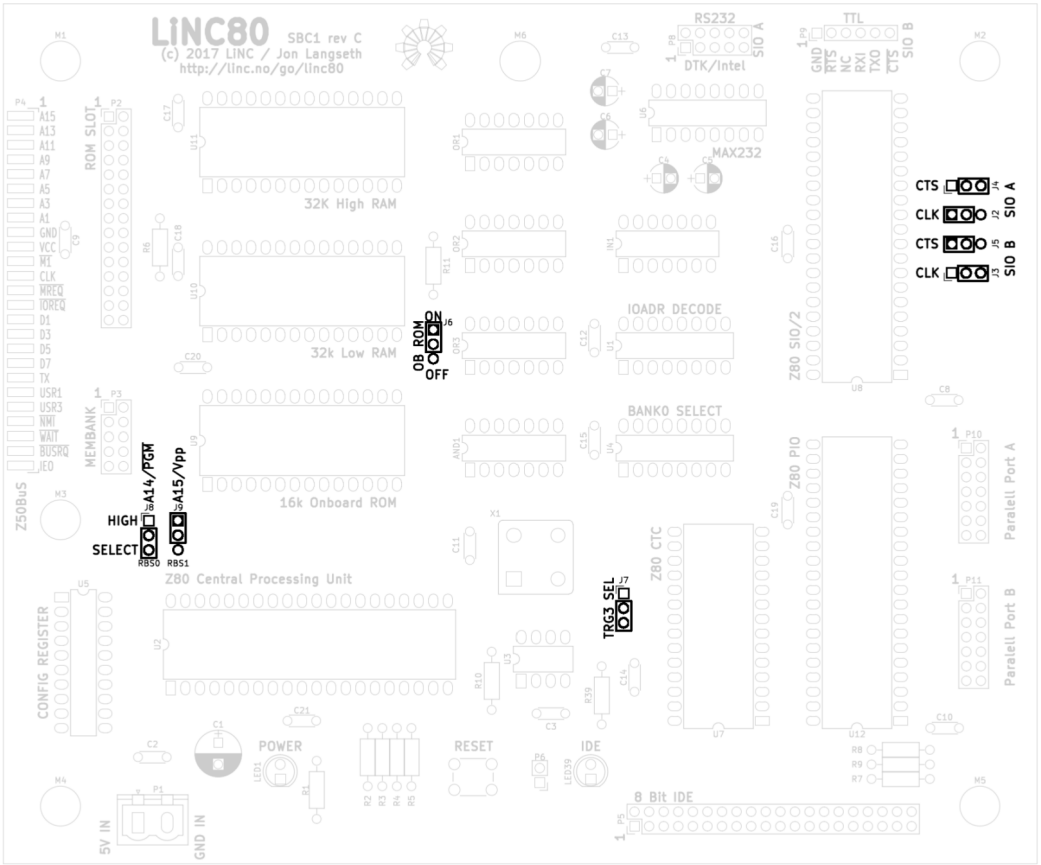
Step 8: Default jumper settings

Before proceeding to connecting the now almost complete LiNC80 SBC1 to a terminal and power, the default jumper settings need to be set, using the included 2-pin jumper blocks. Install jumpers according to this list (and reference image):

J2 SIOA CLK pins 1-2 (CTC clock)
J3 SIOB CLK pins 2-3 (CPU clock)
J4 SIOA CTS pins 2-3 (CTS ignored)
J5 SIOB CTS pins 1-2 (CTS active)

J6 OB ROM pins 1-2 (ON)
J7 TRG3 Sel pins 2-3 (CPU clock)

J8 A14 ROM source pins 2-3 (Select/ROS0/RBS0)
J9 A15 ROM source pins 1-2 (High) *Note



*Note: The settings of J8/J9 is correct for a 32kByte ROM chip (2xc256-type). If your kit included a 64kByte ROM chip (2xc512-type), set J9 to pins 2-3 (Select) also.

Connecting terminal and power

Serial connection

Interaction with the LiNC80 SBC1 is done using the serial ports. During the first connections, it is recommended to use a modern computer with a terminal emulator like PuTTY, Screen, Minicom, CoolTerm or TeraTerm as your terminal. Later, when you are comfortable the system is working, using a hardware terminal is possible.

The board has two serial connections, SIOA and SIOB. SIOA uses an RS232 line driver/transceiver, and requires a full RS232 port on your «host», either directly, or as an USB-RS232 adapter. SIOB is a 5V TTL-compatible direct serial port. Select one of them to use as your console.

To connect to SIOA, you need an appropriate DTK/Intel to DB9 adapter cable. These can be purchased from several sources, or if you have available parts from an older PC, many PC's before the introduction of Pentium IV used the DTK pin-out.

To connect to to SIOB, you need a 5V USB-serial adapter, and the board pin-out is made to be compatible with the «FTDI-cable» pin-out typically used on Arduino and many other 5V-serial devices.

Both ports use 8bit data, 1 stop bit, no parity settings (8-n-1), and enabling hardware RTS/CTS handshake is recommended. The default communication speed for SIOA is 9600bps, and SIOB defaults to 115200.

So, characteristics are:

- **SIOA**: RS232, 9600-8-n-1
- **SIOB**: TTL/5V, 115200-8-n-1

Power connection

The LiNC80 SBC1 requires externally regulated 5V power. Normal current draw of a non-expanded system is between 150mA and 300mA. The power supply chosen should be capable of stable 5V at 400mA (2W). Connection of the power source is done using the screw terminal at P1 (lower left corner of board). Positive voltage connects to the 5V IN terminal (closest to mounting hole M4), negative/ground to the GND IN terminal. If possible, a fuse should be included on the power supply wiring, (initially) using a 400-600mA fuse.

First time startup

Connect your serial cables first, and start your terminal emulator program, configured for the type of connection you wish to use.

You are now ready to start your system for the first time. Power on your LiNC80 SBC1. You should see the prompt

```
Press [SPACE] to activate console
```

If this prompt does not appear, try pressing the hardware reset button. If the board still does not boot, you need to start troubleshooting. Look for the troubleshooting tips at http://linc.no/go/linc80

Pressing space activates the console, greeting you with the ROM Monitor:

```
LiNC80 SBC1 Boot ROM 1.2 by G. Searle, modified by LiNC
Type ? for options

>
```

Typing *?* will show the monitor help text:

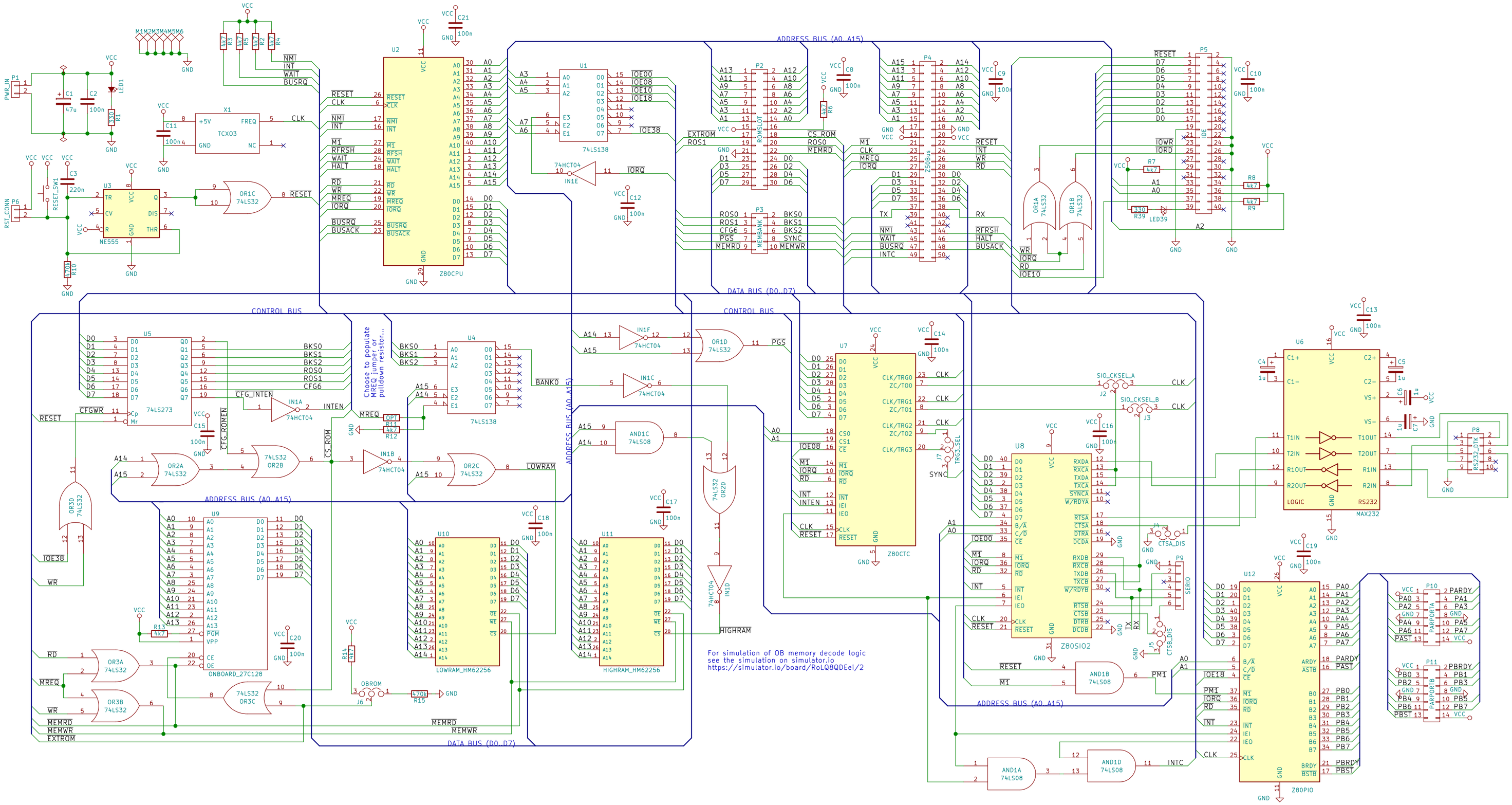
```
R - Reset
BC or BW - ROM BASIC Cold or Warm
X - Boot CP/M (load $D000-$FFFF from disk)
:nnnnnn... - Load Intel-Hex file record
>
```

Per the context of this assembly guide, the option X to boot CP/M will not work, as the CF card options have not been introduced.

Typing B will select BASIC, followed by C to select a Cold start. BASIC will now ask «Memory top?», where you can press *ENTER* to have BASIC automagically use the maximum available RAM (48kBytes, as 16kBytes are used as ROM).

Your system is now operational, and you can start using Microsoft BASIC!

```
10 for a=1 to 10
20 print a
30 goto 10
```


ADDRESS BUS (A0..A15)
DATA BUS (D0..D7)
CONTROL BUS
Choose to populate MREQ jumper or pulldown resistor...
For simulation of OB memory decode logic see the simulation on simulator.io https://simulator.io/board/RoLQ8QDEei/2
Design by Jon Langseth
Zilog Z80 based system w/banked memory
Expandable Single Board Computer
LINC
Sheet: /
File: L80S2.sch
Title: LINC80 Computer version 1
Size: A2
Date: 2017-11-04
Rev: 4.6
KiCad E.D.A. kicad 4.0.7
Id: 1/1