LiNC80
SBC1

Assembly guide

Version 1.0b

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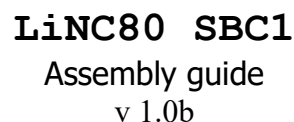
Note that the LiNC80 SBC1 does not include any voltage regulation, but requires an externally regulated, stable 5V DC supply capable of 400mA current (2Watts).

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.

If you are building from a bare PCB and not a kit, or if you make your own modifications, you can not rely only on this guide, but will need to examine the remaining documentation at
http://linc.no/go/linc80

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,R12,R15
Resistor, radial	4k7	R2,R3,R4,R5,R6,R7,R8,R9,R11,R13,R14
CPU	Z84C00	U2
SIO	Z84C42	U8
CTC	Z84C30	U7
PIO	Z84C20	U12
RAM	AS6C62256-55P	U10, U11
ROM	AT28/AT27C256	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, P20VCC	P6,P7
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
Sockets	Assorted	1 per IC plus Oscillator

Assembly

Step 1: Add resistors

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

The three 470kOhm resistors R10, R12 and R15 should be soldered in next. R10 is located close to the CPU location. R12 and R15 are located on the upper right corner of the board, on either side of a group of four resistors. The middle two in that group are 4.7kOhm R13 and R14, so take care so the correct value is placed.

When done soldering in the 330Ohm and 470kOhm resistors, all remaining resistors are 4.7kOhm, and can be soldered in the order you desire.
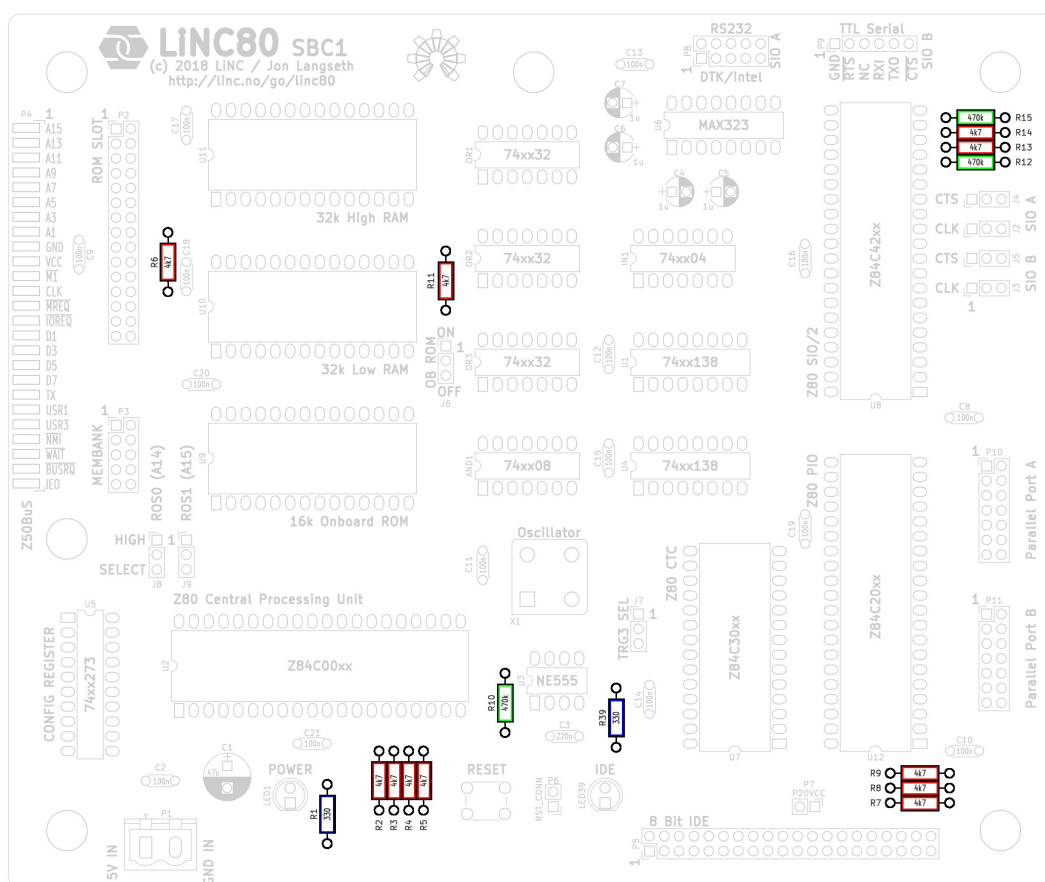

Red = 4k7, Blue = 330R, Green = 470k

Part 2: Place logic IC sockets
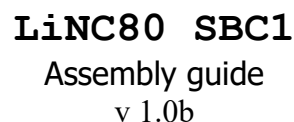
Placing the narrow (smaller) IC sockets is straight forward. When installing the sockets, make note of the indicators for pin one on both silkscreen and socket. By making sure the socket clearly indicates the correct orientation in relation to pin one, you avoid mistakes when the IC components get installed 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.
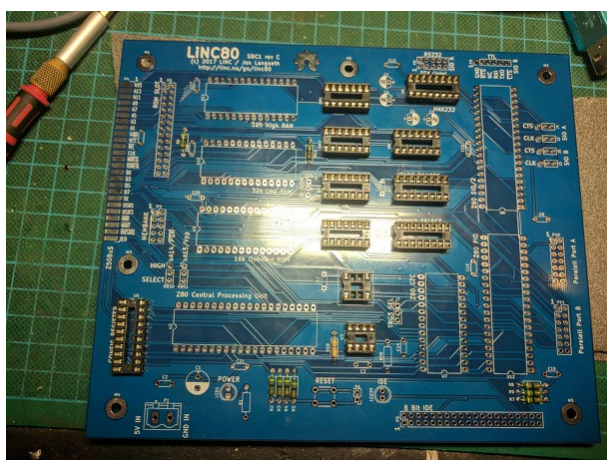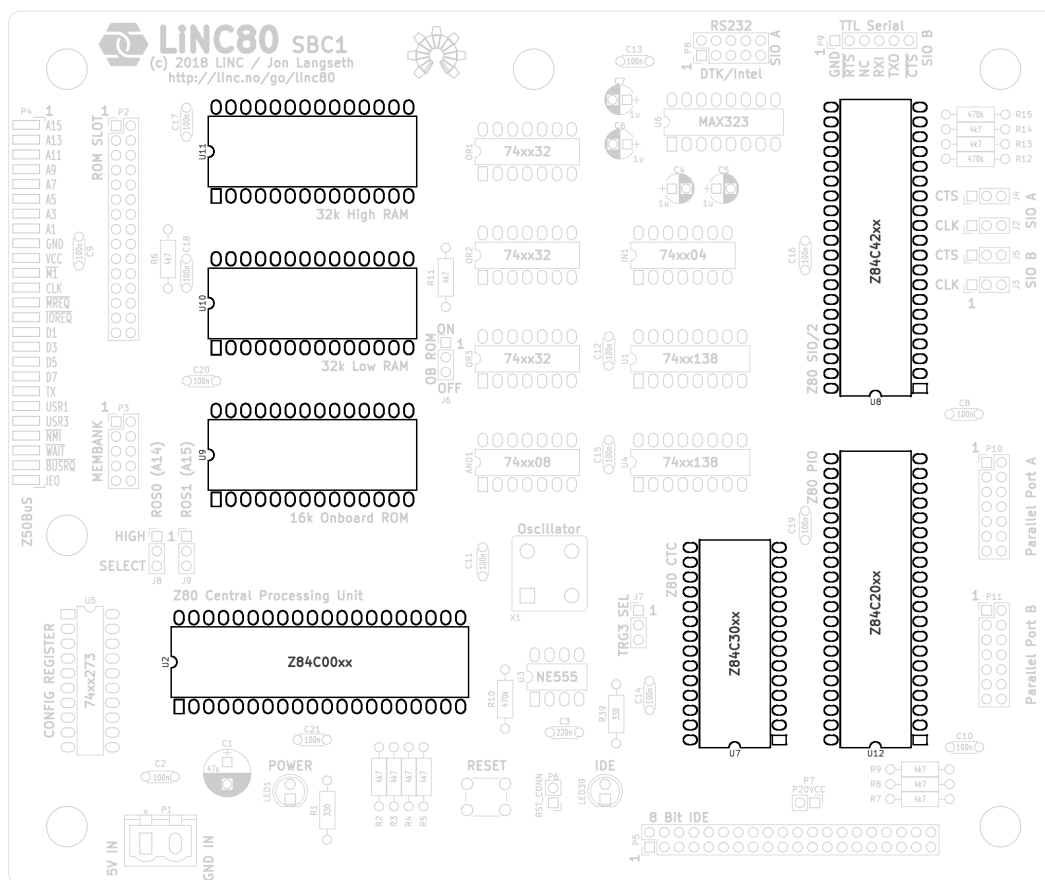

Place sockets in their locations
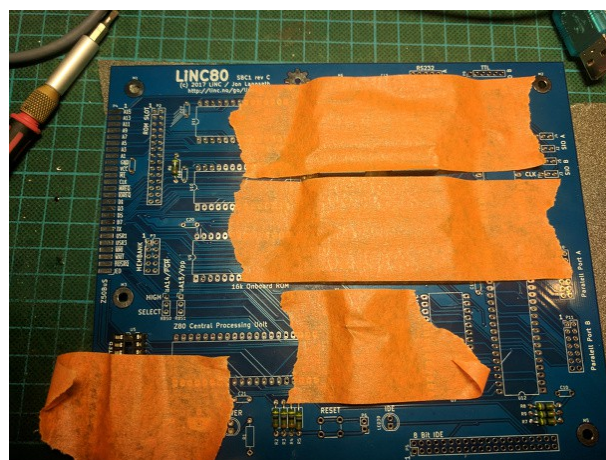
Hold in place with painters tape
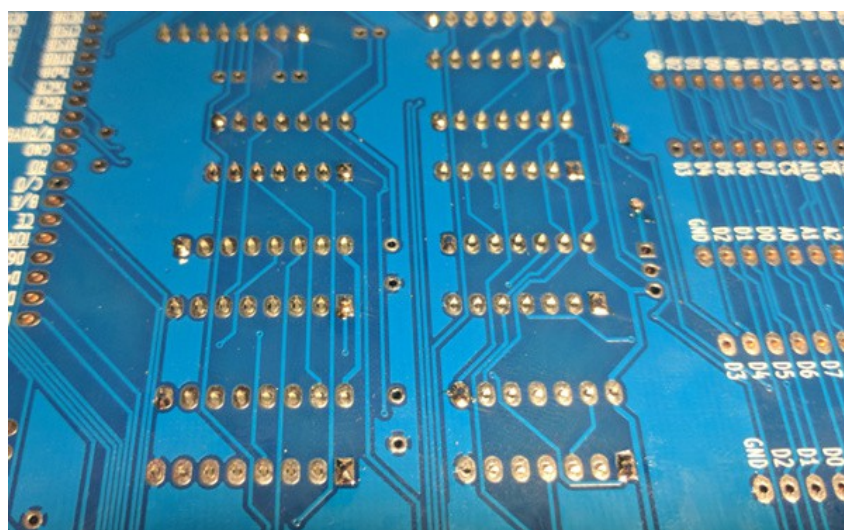
*Initially, only solder two pins on each socket*

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.
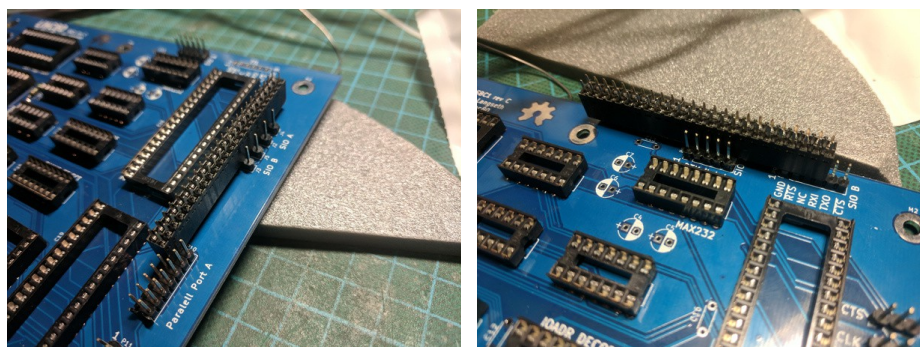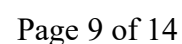
Step 4: Add connectors and jumper pins

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 instead of two, as this makes the step of aligning easier.
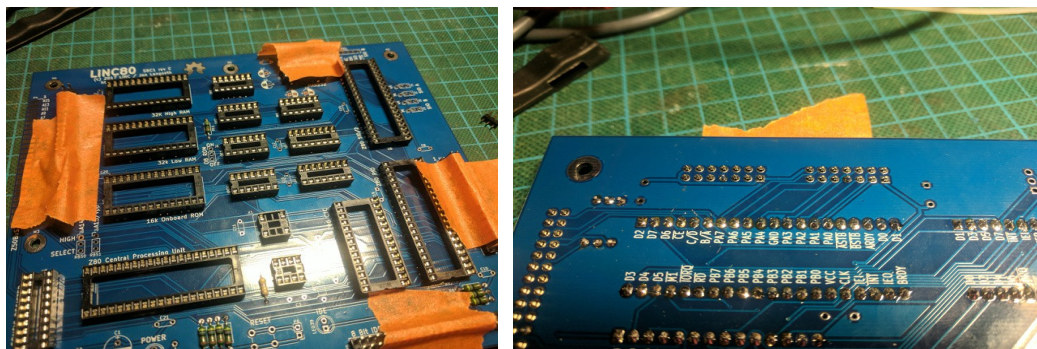
To align connectors, the 50-pin female connector that will later be used for the Z50Bus connector can be used. With the male connectors held in place with a single pin as a «tack», place the 50-pin female connector across several connectors. This makes the connectors line up on a 2.54x2.54mm ordered 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 reset switch. The shape of its pin locations is rectangular, so it should only fit in the correct orientation.

Next component to add is C3, the 220nF ceramic capacitor next to the 8-pin NE555 timer IC. In your kit, the 220nF ceramic capacitor should be the "odd one", i.e. the single ceramic capacitor that does not look like the other 15.

The electrolytic capacitors are 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 power-supply connector goes in the lower left corner of the board, and should be straight forward to install.

The remaining components that need to be soldered should be the 15 ceramic capacitors. These are all 100nF decoupling capacitors, identical in size and type.
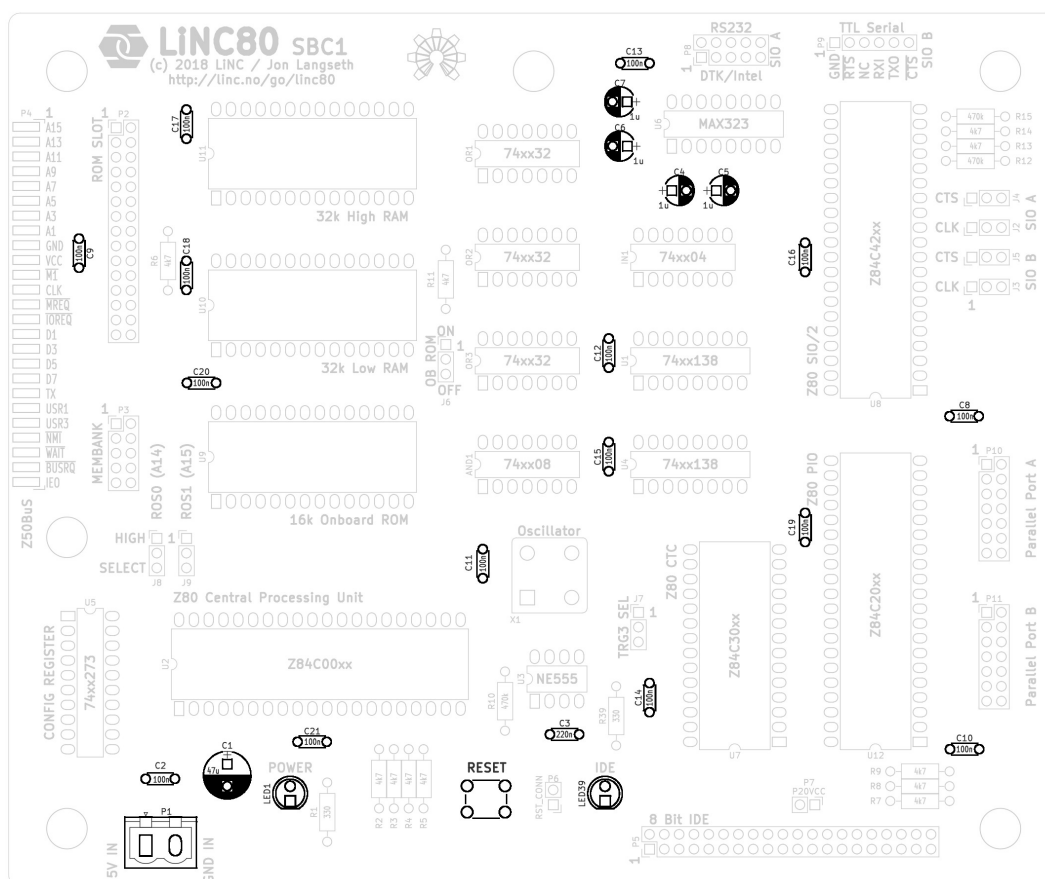
Step 6: Clean and dry the board, inspect

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). Use a toothbrush or similar brush to clean the board. You may after cleaning with alcohol or spirits use mineral-free water to rinse the underside of the board. If you used a citrus based cleaner, rinsing is required.

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 labelling 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, or a compatible part, like 74HCT32N. Also, the parts list calls for a Z84C00 CPU, the actual included part is most likely the Z84C0010PEG or Z84C0008PEG.

When you first receive just about any DIP IC, the legs will not be perpendicular 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).
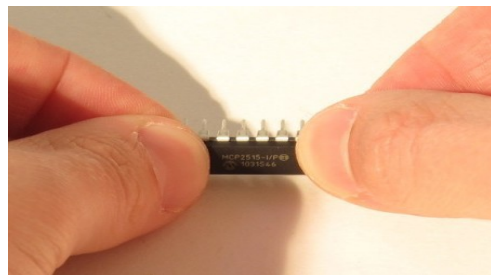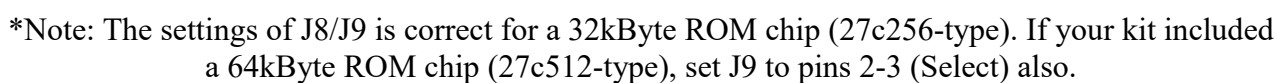
When installing the components, pay attention to pin one, normally indicated by a dot by pin one and/or a half-circle on the short edge where pin 1 is located. Pin one is indicated on the silk-screen by a half-circle/crescent on the pin-one side.

Step 8: Default jumper settings
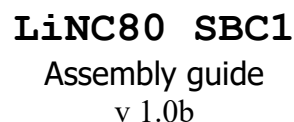
Before proceeding to connect the now almost complete LiNC80 SBC1 to a terminal and power, the default jumper settings need to be set, using the included 2-pin jumper blocks. Install jumpers according to this list (and reference image):

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 (27c256-type). If your kit included a 64kByte ROM chip (27c512-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.

The standard ROM that ships with the kit uses SIOB, the TTL Serial port as the console port. 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.

The SIOA RS232 port can be used as the console, by issuing the "CONSOLE A" ROM monitor command. It is also possible to make a ROM chip that uses SIOA as the default, but that is outside the scope of this guide. Please refer to the documentation at http://linc.no/go/linc80 for more information, in particular the Small Computer Monitor User Guide.

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

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.

Power connection

The LiNC80 SBC1 requires externally regulated 5V power. Normal current draw of a non-expanded system is between 100mA 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 adapter and cables to SIOB (TTL Serial) first, and start your terminal emulator program, configured for your USB serial port. Use 115200-8-n-1 settings.

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

```
Small Computer Monitor - LiNC80
*
```

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

Typing *?* followed by *ENTER* will show the monitor help text:

```
Small Computer Monitor by Stephen C Cousins (www.scc.me.uk)
Version 1.0.0 configuration L1 for Z80 based LiNC80 systems

Monitor commands:
A [<address>]  = Assemble       |  D [<address>]   = Disassemble
M [<address>]  = Memory display |  E [<address>]   = Edit memory
R [<name>]     = Registers/edit |  F [<name>]      = Flags/edit
B [<address>]  = Breakpoint     |  S [<address>]   = Single step
I <port>       = Input from port|  O <port> <data> = Output to port
G [<address>]  = Go to program
BAUD <device> <rate>            |  CONSOLE <device>
FILL <start> <end> <byte>       |  API <function> [<A>] [<DE>]
DEVICES, DIR, HELP, RESET
BASIC    Grant Searle's adaptation of Microsoft BASIC
WBASIC   Warm start BASIC (retains BASIC program)
CPM      Load CP/M from Compact Flash (requires prepared CF card)
GSL      Start G.Searle ROM Monitor/Loader
*
```

Typing BASIC followed by *ENTER* will cause the question «Memory top?» to appear, where you can press *ENTER* to have BASIC automagically use the maximum available RAM (47kBytes, as 16kBytes are used as ROM, and some by SCMonitor features).

The CP/M related options require additional hardware and steps not covered by this assembly guide. For information on what is required to run CP/M from a CF card, see separate documentation.

The Small Computer Monitor is a comprehensive operating environment for your LiNC80 and other Z80 based systems. Please visit http://linc.no/go/linc80 and go to the Software section to find a link to the newest version of the Small Computer Monitor User Guide relevant for your kit.