8-bit simple digital I/O card for Z50Bus

Assembly guide

Version 0.1

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Introduction

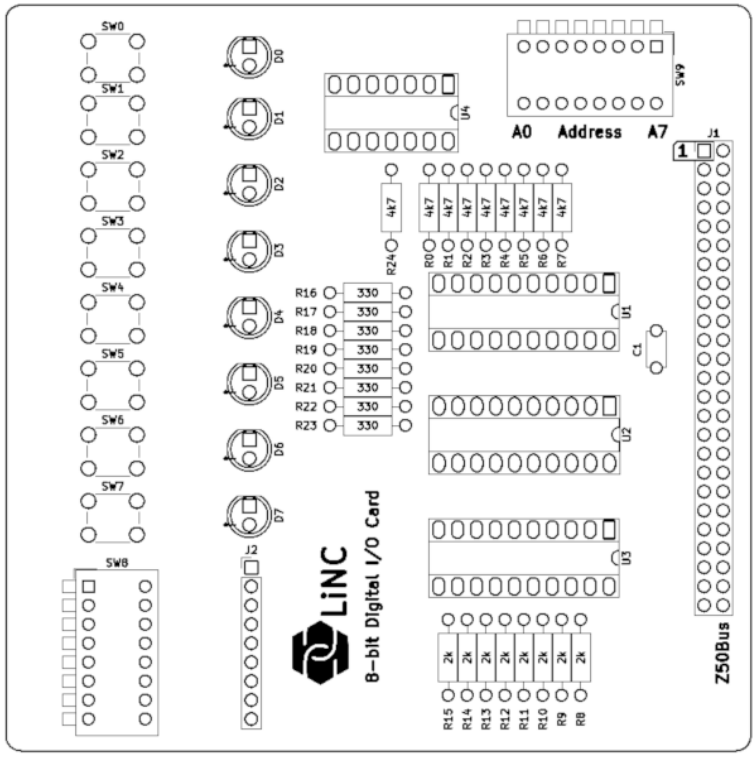
This simple 8-bit digital I/O card provides 8 lines of digital output controlling 8 LEDs, and 8 lines of digital input via pushbuttons and/or a DIP switch. The I/O card occupies a single I/O address. The address of the card can be fully selected as any one address value in the range 0x00 to 0xFF.

Writes to the selected address will be latched as output, driving the 8 LEDs on the card. Reads from the selected address is taken immediately from the combined state of the input DIP and push-buttons. The buttons have pull-down resistors in their passive/off state, and the buttons and the DIP switches are connected in parallel.

A proficient user that wants to use this card to connect to the “outside”, may choose to omit the buttons and LEDs. A connector J2 is provided to allow easy connection of inputs. Each LED position has an indicating marker for Pin2/anode, which corresponds to the Output signal pin from the 74xx273 chip on the card.

Parts list

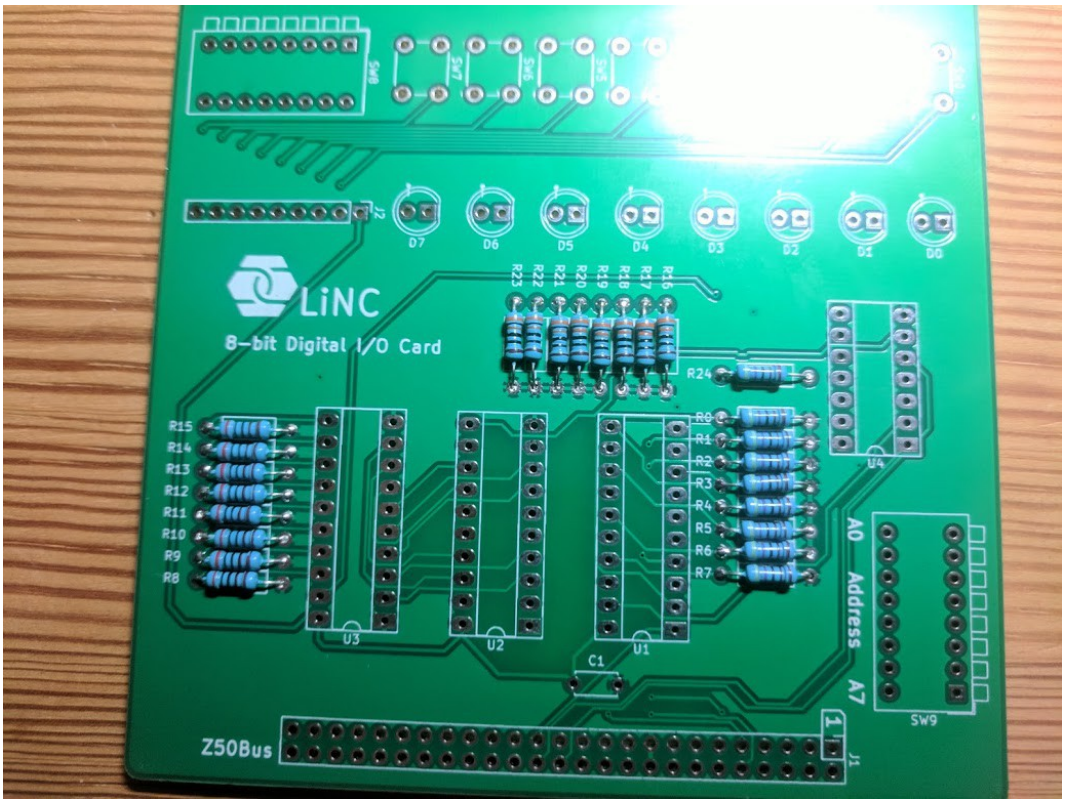
Part type	Value/designation	Positions
1x Capacitor, ceramic	100n	C1
9x Resistor, radial	4k7	R0,R1,R2,R3,R4,R5,R6,R7,R24
8x Resistor, radial	2k	R8,R9,R10,R11,R12,R13,R14,R15
8x Resistor, radial	330R	R16,R17,R18,R19,R20,R21,R22,R23
1x Logic IC	74LS688	U1
1x Logic IC	74LS273	U2
1x Logic IC	74LS245	U3
1x Logic IC	74LS32	U4
1x Connector, 50 pin male angled	Z50Bus	J1
8x Push button	SW_Push	SW0,SW1,SW2,SW3,SW4,SW5,SW6,SW7
8x LED	5mm LED	D0,D1,D2,D3,D4,D5,D6,D7
2x DIP Switch, 8 positions	SW_DIP_x08	SW8,SW9
4x Sockets	Assorted	1 per IC
1x PCB		



Assembly

Step 1: Add resistors

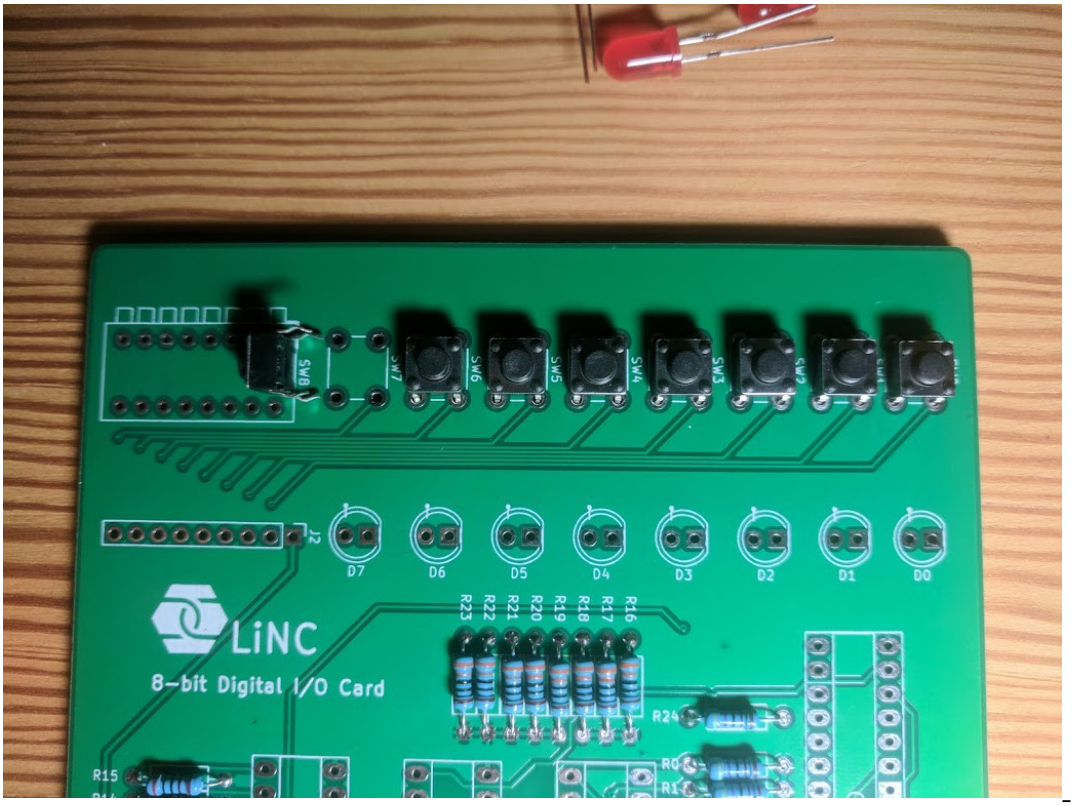
It is advantageous to solder the resistors grouped by value. Adding the 4.7kOhm resistors R0 through R7 plus R24, then adding the 330Ohm resistors at R16 through R23, then finishing off with the 2kOhm resistors R8 through R15 allows you to work “across” the PCB.



Three “areas” of resistors, one value for each group.

Step 2: Add push buttons

The eight push buttons are all located in a group on one side of the PCB. The shape of the switch pin-out should only allow them to be inserted in the correct orientation, as they are rectangular.

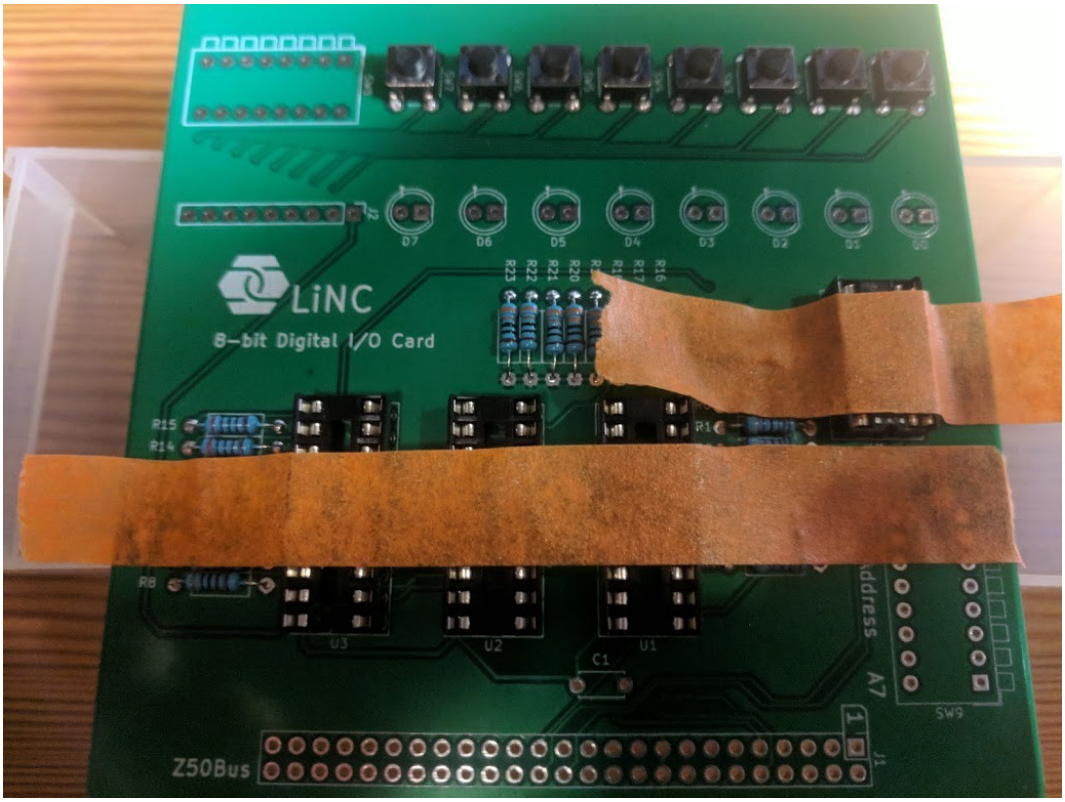


Push buttons should only fit in one orientation.

Step 3: Add IC sockets

There are three 20-pin IC sockets and one 14 pin socket. Make note of their orientation, fit them with the notch matching the legend on the PCB. 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.

One suggested tip for mounting the sockets follows:
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.

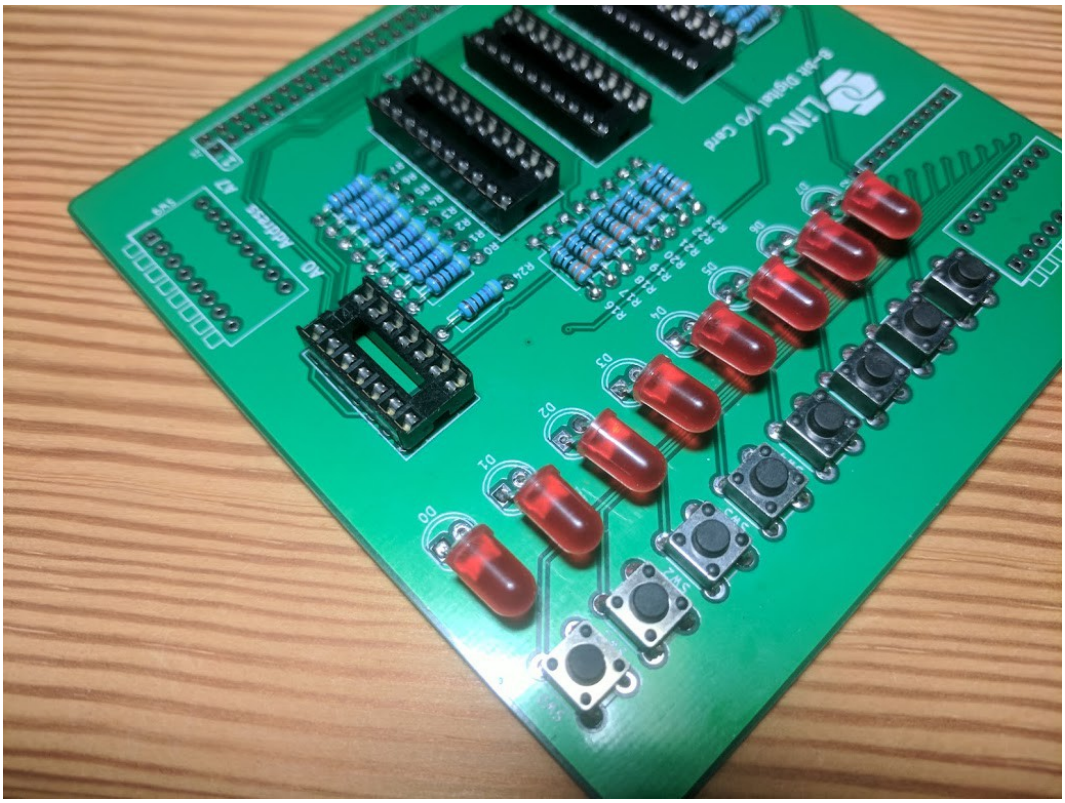


Using painters tape to temporarily hold IC sockets

Step 4: Add the LEDs

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 PCB has some unused space between the LEDs and the switches. This is done to give you flexibility. When mounting the LEDs, it is completely up to you if you want them mounted flush, or if you want to add a 90 degree bend to the legs, and mount them raised and right-angled.



Example of LEDs installed w/90 degree bend

Step 5: Add the DIP switches

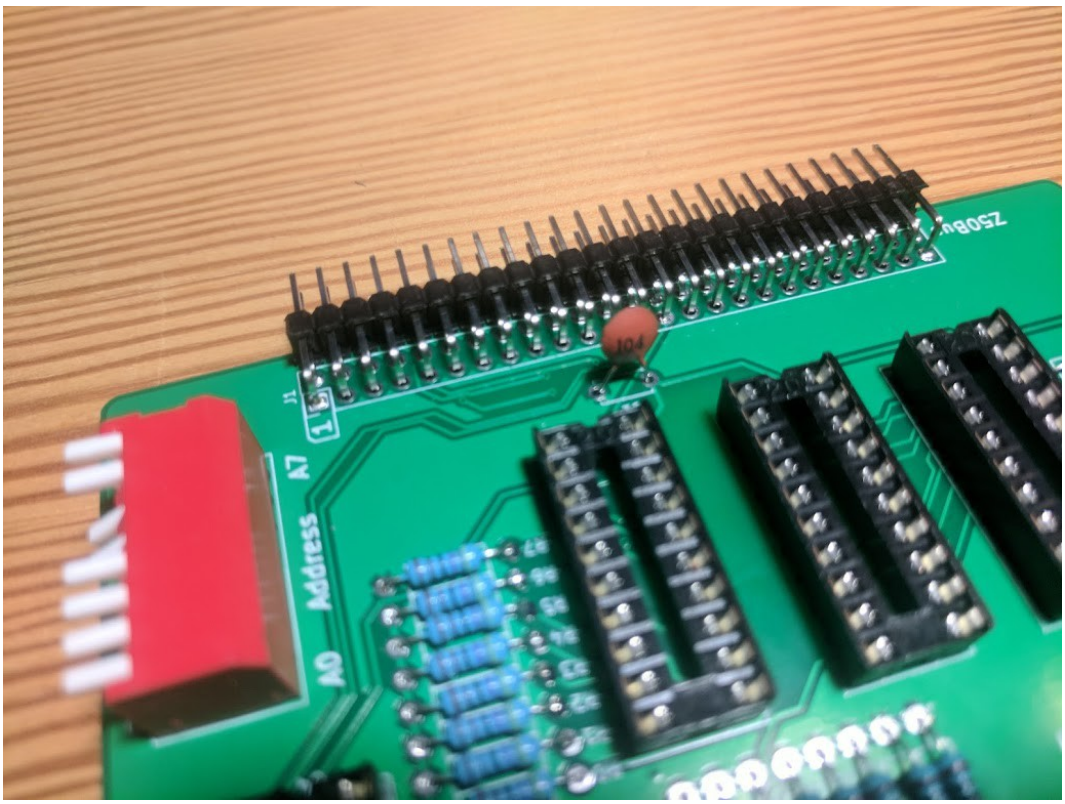
For the 8-position DIP switches, you can use the trick of holding them in place with painters tape while starting the soldering. Your kit may contain either sliding style or piano style switches. For the piano style, it is preferential to follow the silkscreen when orienting. For the sliding style, observe the switch body marking for ON position, and select an orientation that makes sense to you.

Step 6: Add the Z50Bus connector

The right-angled 50-pin connector gets fitted so the pins extend out over the edge of the PCB, so that it can be inserted into your host Z50Bus or back-plane. Insert and align the connector, and tack it in place on two diagonally opposed pins. Check the alignment, and adjust as needed before proceeding to solder the remaining pins.

Step 7: Add the capacitor

The decoupling capacitor C1 is located directly next to the 50 pin Z50Bus connector.



Location of Z50Bus connector and capacitor, and orientation of connector. Also shows the default address 0x30 selected on the DIP switch SW9

Step 8: Clean and dry the board, inspect

The typical implementation of a Z50Bus is unbuffered, which means that any impedance issues on an expansion card may make the whole system unstable, or inoperable. An example of an unbuffered Z50Bus system is the LiNC80 SBC1. 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.

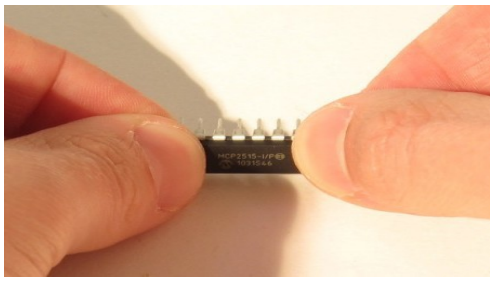
To dissolve organic rosin based fluxes denatured alcohol (methylated spirits) or citrus based cleaners work very well. Do NOT use acetone or acetone based cleaners, as they will damage the plastic parts assembled on the board. Isopropyl/isopropanol is not suited, as it fails to properly dissolve the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

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 8: 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.

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.

Preparing for use

The DIP switch SW8 is used to set "fixed" values for the Input of the card, overriding the push-buttons. To get predictable input values read, and to verify that there are no defects, all switches on the DIP SW8 should be set to their OFF position (up for piano-style, away from the ON marker for sliding style).

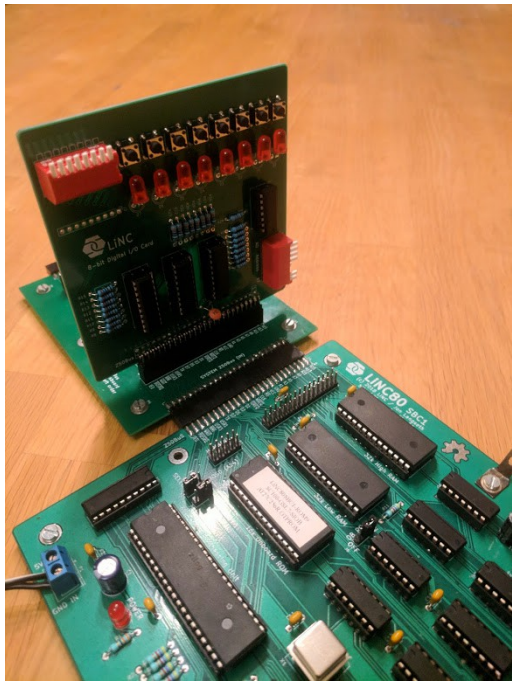
The DIP switch SW9 selects the I/O address of the card. This simple digital I/O card uses a single I/O address in the 0x00 to 0xFF range. The address is selected by setting SW9 so it creates an 8-bit value for the address bus. A7 is the most significant bit, A0 the least significant. The "default" address is 0x30. When used with LiNC80 SBC1 and SCMon 1.0, the 0x30 I/O address is used to output status indicators during power-on/boot-up, with this card type being the intended target.

Writes (OUT operations) to the selected address will output on the LEDs, and be latched so the value stays until the next write operation. Reads (IN operations) on the selected address will read the state of the buttons/SW8 dip switch. If one or more of the DIP switch positions are set to ON, that input bit will read as One/True/High, regardless of the state of the corresponding push button. The Read operation is an immediate operation, so it will return the state of the DIP/push-buttons as it was the moment the IN instruction executed, with no latching.

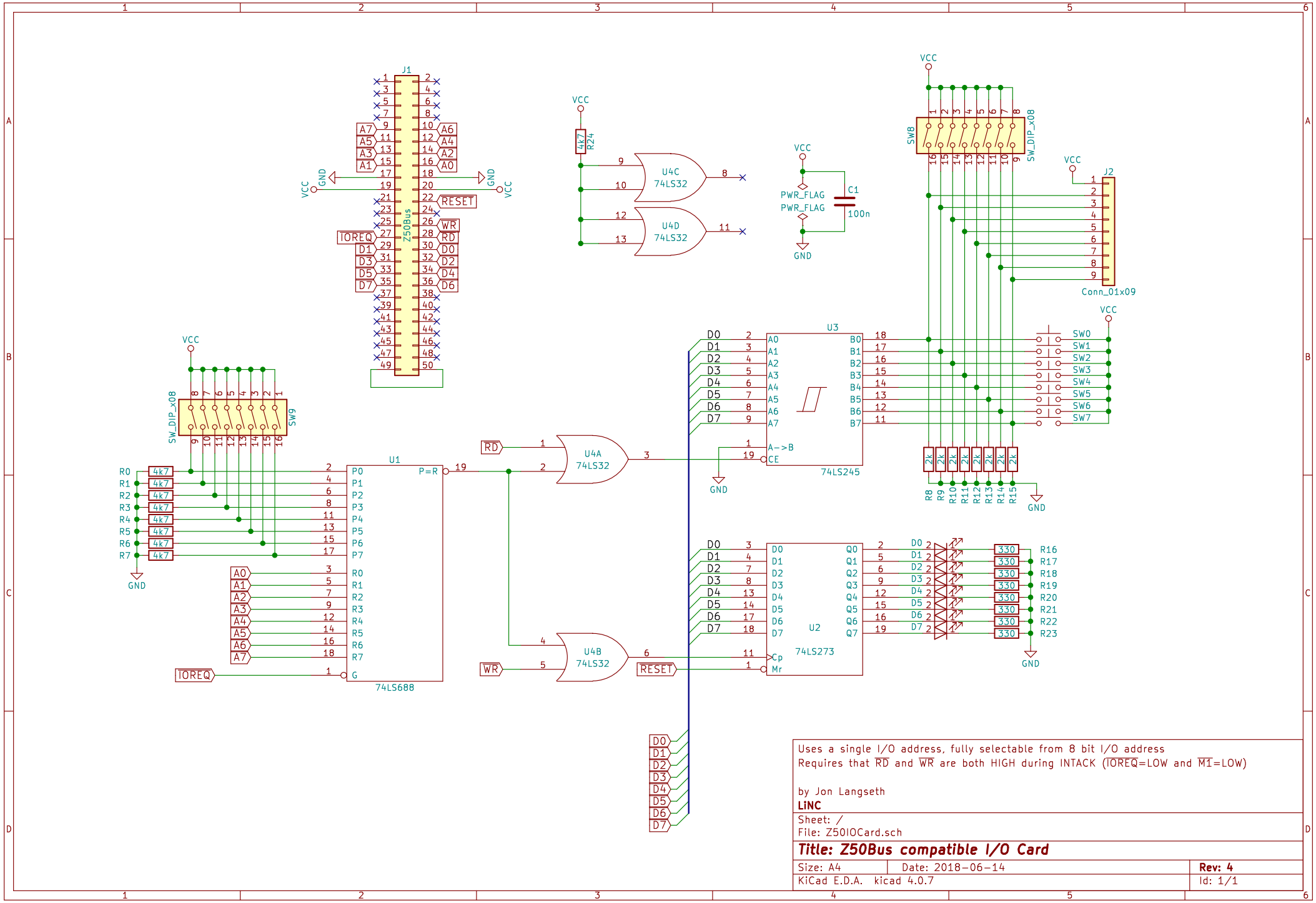
In SCMonitor, the `I` (in) and `O` (out) commands allow you to Read and Write, letting you verify the operation of the card, and do I/O directly from the monitor.

In BASIC, the `INP` and `OUT` commands can be used. Note that Nascom/MS Basic as included in ROM on the LiNC80 prefers decimal addresses and values.

In assembly, the Z80 instructions `IN A, (adr)` and `OUT (adr), A` are your read and write instructions, respectively.



I/O Card on Z50Bus backplane connected to LiNC80



Uses a single I/O address, fully selectable from 8 bit I/O address
Requires that $\overline{RD}$ and $\overline{WR}$ are both HIGH during INTACK ($\overline{IOREQ}$=LOW and $\overline{M1}$=LOW)

by Jon Langseth

LiNC

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Title: Z50Bus compatible I/O Card

Size: A4	Date: 2018-06-14	**Rev: 4**
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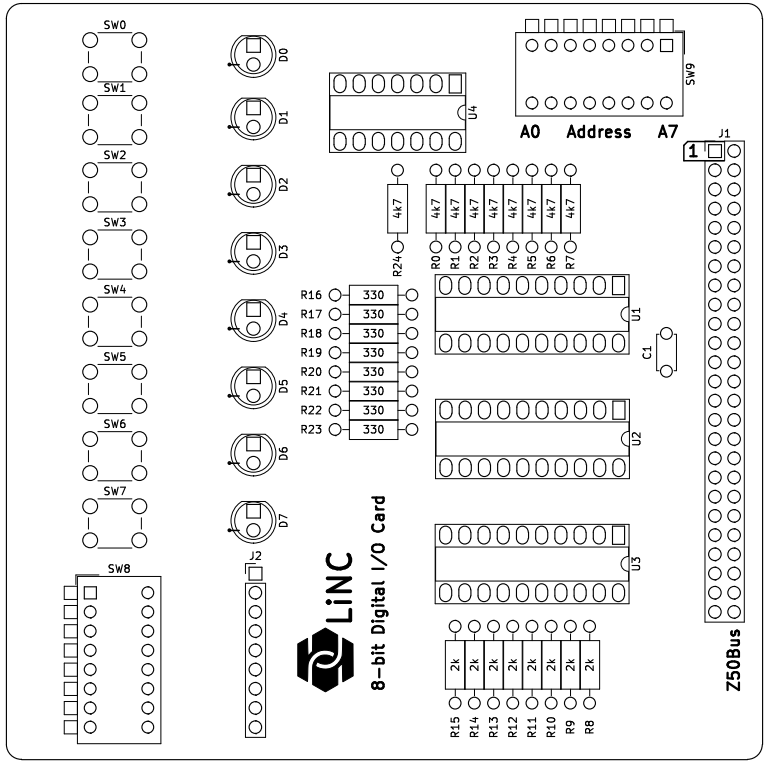

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