tynemouth software

TYNEMOUTH SOFTWARE ZX SPECTRUM IO BOARD

PARTS LIST

CAPACITORS – CERAMIC RATED 6.3V OR HIGHER

4 x 100nF axial *(usually marked 100n or 104)*

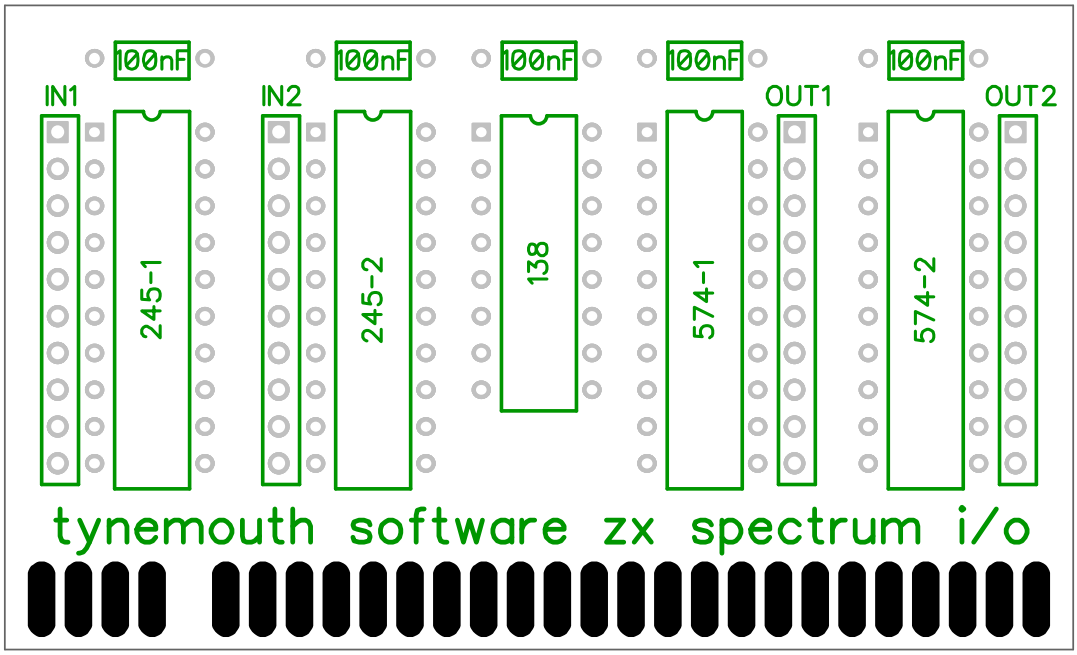
SEMICONDUCTORS – HCT RECOMMENDED, LS COULD BE USED, HC NOT RECOMMENDED

1 x 74HCT138
2 x 74HCT245
2 x 74HCT574

CONNECTORS

4 x 10 way 0.1” header or other 0.1" connector (molex / jst / dupont etc.)
56 way 0.1" edge connector (68 way are easier to locate, cut down to size)

COMPONENT PLACEMENT



ASSEMBLY

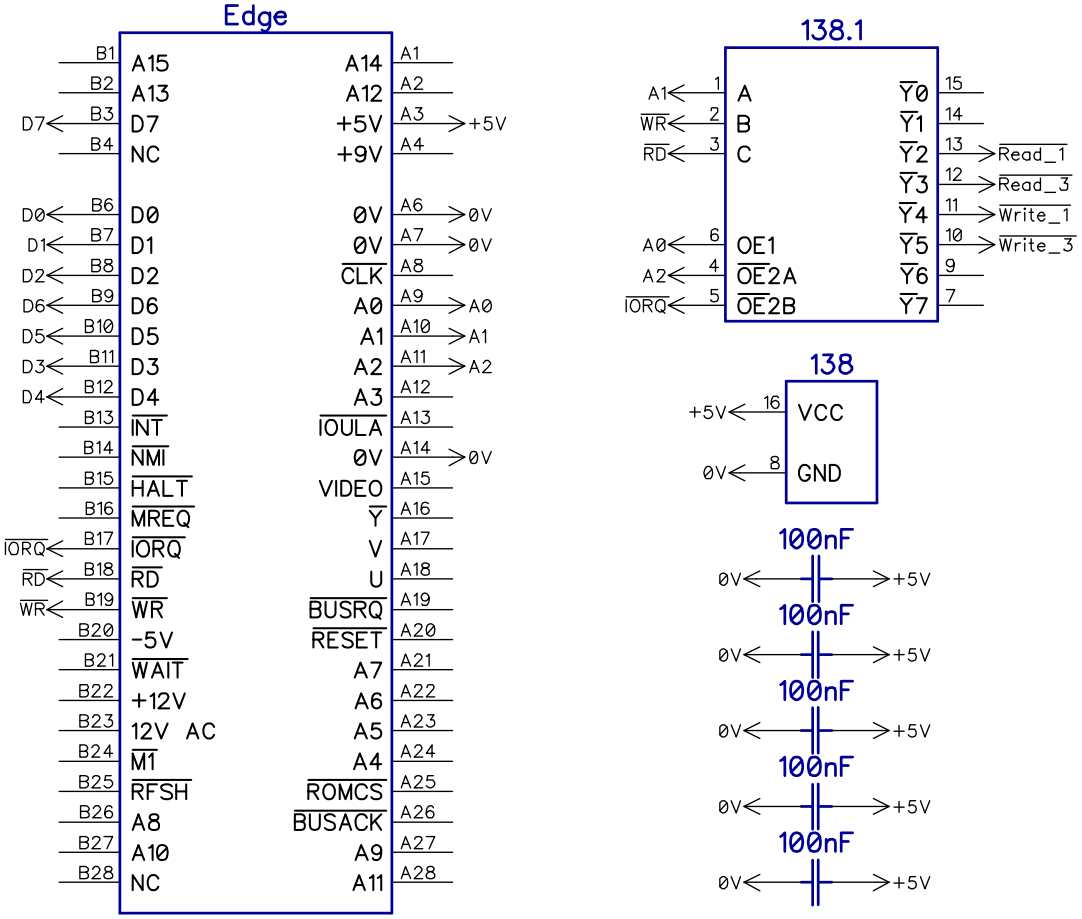
Start with the capacitors, then the ICs, or you can fit IC sockets if you like. You can omit the 74HCT245 chips if you are not using the input ports, or the 74HCT574 chips if you are not using the output ports.

If necessary, cut the edge connector down to size, and bend the pins reach the pads on the board. Two pins should be removed where there is a gap. Fit a piece of card or plastic cut to size into the connector so it will align with the ZX Spectrum

Finally, fit connectors as required for the inputs and outputs. The top pins with the square pads are ground, the opposite ends are 5V, and the 8 pins in between are D0-D7, with D0 nearest the square pad.

ADDRESS DECODING

EDGE CONNECTOR AND ADDRESS DECODING SCHEMATIC



ADDRESS DECODING

The 74HCT138 3 to 8 line decoder is used to generate the control signals for the input and output chips. The address bus is partly decoded. To enable any of the IO chips, A0 needs to be high, A2 needs to be low, and /IORQ needs to be low. This will be an IO request to address ending in 1 or 3. These include 0x01 and 0x03 through to 0xF1 and 0xF3. It also decodes as 0x09 and 0x0B through to 0xF9 and 0xFB. All even ports are avoided as these are used by the internal port on the ULA which only checks that A0 is low.

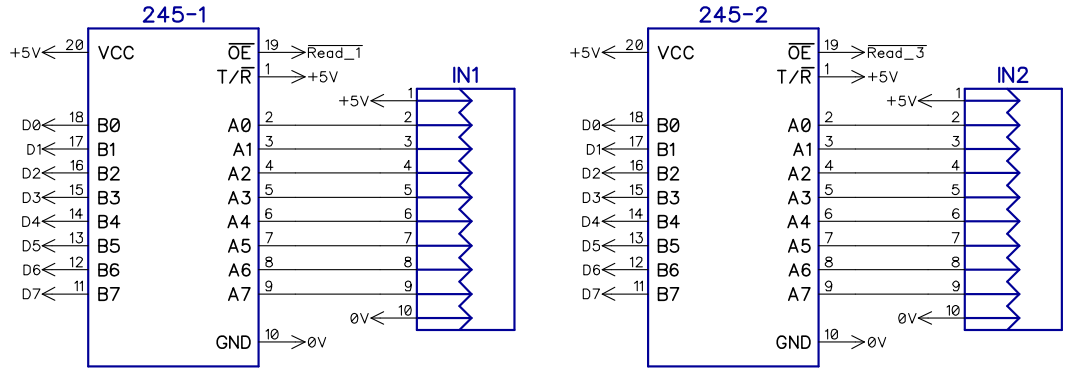
The 138 will generate eight active low enable lines, based on the three inputs, A1, /WR and /RD. The eight decoded outputs are as follows:

A1	WR	RD	Signal
0	**0**	**0**	Should never happen (unused)
1	**0**	**0**	Should never happen (unused)
0	**1**	**0**	Read from address *x*1
1	**1**	**0**	Read from address *x*3
0	**0**	**1**	Write to address *x*1
1	**0**	**1**	Write to address *x*3
0	**1**	**1**	Neither read nor write (unused)
1	**1**	**1**	Neither read nor write (unused)

tynemouth software

INPUTS

INPUT SCHEMATIC



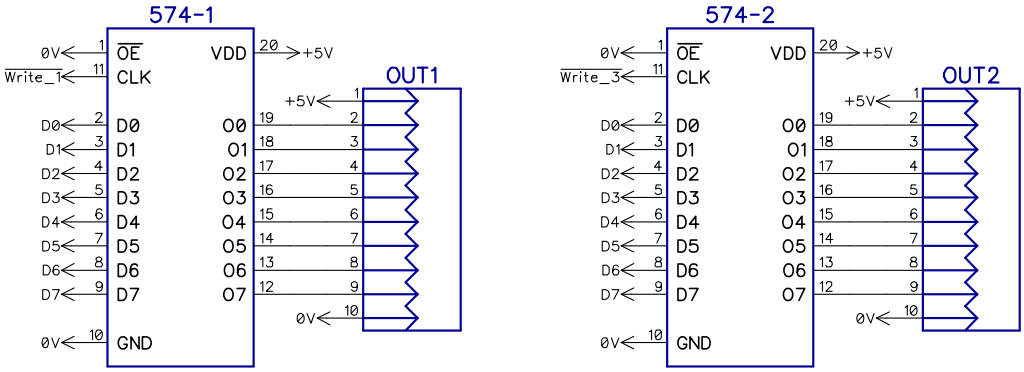
DESCRIPTION

To provide digital inputs, two 74HCT245 buffer chips are used. When the output enable line (/OE) is low, the A signals are connected to the B pins. This transfers the signals from the input connectors to the databus. The direction is fixed; these lines are for input only.

The 74HCT245 inputs are TTL level compatible, inputs should be approximately 0-1V for low and 3-5V for high. No pullups are provided; pullup or pulldown resistors should be fitted when using switches as inputs.

OUTPUTS

OUTPUT SCHEMATIC



DESCRIPTION

To provide digital outputs, two 74HCT574 latch chips are used. When the clock line (CLK) transitions from low to high, the current values of the D inputs is latched and when the output enable (/OE) is low (which it always is), this is output on the Q pins. The Q outputs remain in this state until the latch is triggered again.

The 74HCT574 outputs are totem pole style CMOS outputs, which can source or sink 6mA. This is sufficient to drive LEDs etc, but buffering circuitry should be used for loads such as relays or motors.

PROGRAMMING

BASIC

Both the input and output ports can be accessed from BASIC, using the IN and OUT commands.

INPUT

The input ports are at 0x01 and 0x03, and can be accessed from BASIC using the IN command.

```
IN 1
```

So for example,

```
PRINT IN 1
```

will print the value read from input port 1

```
IF IN 3 AND 8 THEN GO TO 100
```

Will test to see if digital input pin 4 on port 2 is high

OUTPUT

The output ports are also at 0x01 and 0x03, and are controlled using the OUT command.

```
OUT 1, 255
```

This will turn all of the pins of output port 1 on (5v).

```
OUT 3, 0
```

This will turn all the pins of output port 2 off (0v).

The output is latched, and will retain this setting until it is changed.

ASSEMBLY LANGUAGE

It is beyond the scope of this document to describe this in detail, but the standard Z80 instructions for input and output are used.

```
in a,($01)
out ($03),a
```

NOTES

The Spectrum +2 and +3 use all the even addresses, and also every forth address starting at 1, so will conflict with the address decoding. If you wish to use this board with a +2 or +3, cut the trace that goes from pin 1 of the 74HCT138 to pin 10 of the edge connector on the underside of the board and wire it instead to pin 12 of the edge connector (which is A3). The port addresses then becomes 0x03 and 0x0B.