LC3 Hardware Specification

CPU

Z80A running at 3.5 Mhz.

IRQ is called at frame sync rate (50Hz), meant to be used in IM1.

Memory

ROM "Operating system" of 8k from $0000-$1FFF

ROM "Cartridge" of up to 24k from $4000-$7FFF.

RAM Memory, 1k by default from $8000-$83FF (not properly decoded). The 1k RAM can be disabled.

This can be expanded as far as 64k.

OSEN = A15+A14+A13 = 0 (can be disabled using extension#2 flag)

ROMEN = !OSEN – because of the partial decoding (a 4k ROM would be mapped into memory 8 times).

Character memory is read via 7C00-7FFF (the top 1k) e.g. !OSEN and using the internal decoding of the ROM chip.

Graphics

The screen is a 32 x 20 character screen (640 bytes). The graphic numbers are stored at $8000-$827F.   (It can be extended to 32x24)

The attributes are stored in 32 x 24 Nibbles (e.g. 384 bytes), these are stored from $8680-$87FF. The low byte is the left hand pixel. The 4 bit attributes are the same as the Spectrum (e.g. half bright).   .

RAM UDGs are stored from $8800-$8BFF in theory and are graphics numbers $80-$FF.

In practice all this is packed into the same 1k. Because not all attributes are displayed when all in 1k a small area of RAM ($8680-$86BF mapped onto $8280-$82BF) is free, UDGs $D0-$D7, this is unrequired attribute area.

This should be accessed via $8E80-$8EBF ; in 4k mode this will be free memory, in 1k mode it will map onto that free space.

For more RAM set a row of attributes to background (or half a row, or whatever) which will free the mapping character rows.

Other Devices

Standard Sinclair Joystick (port $FE)

Beeper (port $FE) (bit 7 set means only display 20 lines)

Cassette I/O as per the Sinclair specification (port $FE)

Memory Maps

This shows how using partial decoding allows consistent addressing of memory whether the base 1k machine or higher. The addresses on the right ($8000,$8680,$8800 and $8E80) are used with 4k+ expansion memory and are the physical addresses used by the hardware, but map onto the correct addresses with 1k memory with 32 x mirroring.

Note that (for example) $86C0 will actually write to $8280 on a 1k RAM machine.

Range	1k Memory	4k + Memory
0000 3FFF	Built in ROM (can be disabled by cartridge line)	
4000 7FFF	Cartridge program memory (24k). Memory addressed by 7C00-7FFF is the lower 128 characters. This could be at the end of the ROM (4k) or in the middle (8k)	
8000 827F	Character RAM (32x20).	Character RAM (32x24).
8280 82BF	Free / UDG RAM	
82C0 83FF	Attribute RAM (32x20)	Free
8400 867F	Mirrored (1k)	Free
8680 87FF	Access attribute RAM 82C0-83FF via mirroring.	Attribute RAM (32x24)
8800 8BFF	Access 8 UDGs 8280-82BF via mirroring	128 UDG Memory (1k)
8C00 8E7F	Mirrored (1k)	Free
8E80 8EBF	Access for the 64 byte memory gap in 1k RAM 8280-82BF by mirroring (code/data)	Free, remembering this 64 byte slot is mapped here.f
8EC0 8FFF	Mirrored (1k)	Free
9000 FFFF	Mirrored (1k)	Expansion if > 4k