

8. THE UNCOMMITTED LOGIC ARRAY

The ULA is Sinclair's special chip. It has been designed to replace lots of smaller logic chips which were used in older computers. The way in which it operates is defined when the chip is manufactured, and can never be changed with software. Its function is to take the heavy burden of input and output from the CPU. It performs the tedious output of information to the television all of the time when power is applied to the Spectrum. Apart from this major task, the ULA also deals with output to the buzzer and cassette plus input from the keyboard and cassette.

ULA PIN DESCRIPTIONS

DRAM A0 — DRAM A6 from the memory address multiplexer chips IC3 and IC4. These enable the ULA to determine which address is being selected by the CPU. Also used by the ULA to select the address of video data from the video memory. When used by the ULA as outputs in this way, they are able to override the output from the address multiplexers because of the set of series 330 ohm resistors.

DRAM CAS — dynamic RAM column address strobe ($\overline{\text{CAS}}$) output. Used to latch in the column address for the dynamic RAM from the address multiplexer (see chapter 5 for more details).

ROMCS — ROM chip select output enables the 16K ROM chip IC5 whenever the CPU wishes to read from it. The ULA can monitor this with its A14 and A15 address inputs, so it can be outputting video information at the same time as the CPU is reading from the ROM.

IORGE — input connected to the Z80A $\overline{\text{IORQ}}$ pin via R27. If this $\overline{\text{IORGE}}$ connection is held high by connecting it to +5 volts, the Z80A $\overline{\text{IORQ}}$ signal no longer reaches the ULA. This can be useful for adding extra I/O devices. See chapter 15 for more details.

RAS — used as row address strobe on the dynamic RAM chips. (see chapter 5 for more details about refreshing dynamic memories). This pin is also connected to the Z80A refresh pin via R57 (330 ohms). The memories can then be refreshed by the CPU during the video field sync time, when regular accessing by the ULA stops for about 5 ms.

KBD09 — KBD13 — inputs from the Spectrum keyboard. See chapter 7 for further details.

U — blue — yellow colour difference output.

V — red — yellow colour difference output.

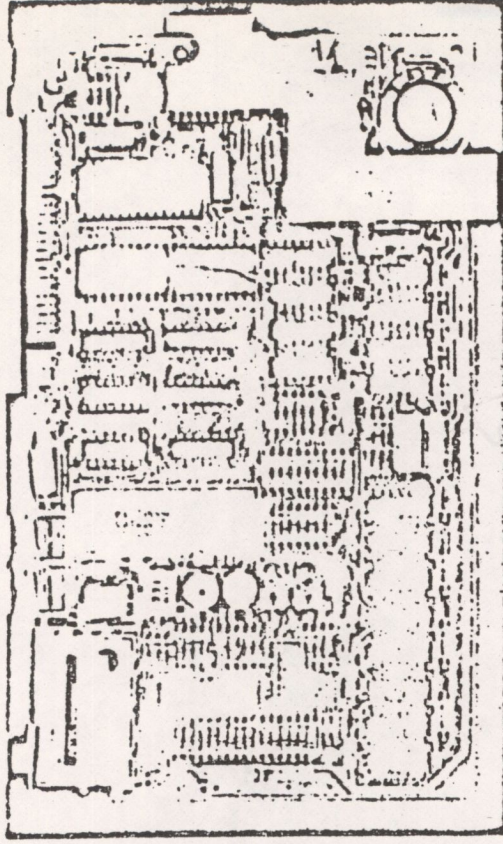
Y — luminance and sync outputs for the video.

D0 — D7 — 8 bit bidirectional databus. Connected directly to the video memory databus and via 470 ohm resistors to the main system databus. This enables asynchronous operation of the ULA accessing video RAM and the CPU accessing the rest of memory. The computer therefore runs faster than it would if the ULA stopped it every cycle.

CLK — 3.5 MHz clock output to the Z80A CPU. This clock may occasionally be stopped by the ULA to prevent the CPU from accessing the video RAM when the ULA is using it.

WR — tells the ULA when the CPU is writing to some device. If that device happens to be the ULA then the ULA will use this signal to latch the incoming data.

ISSUE 2 BOARD



ISSUE 1 BOARD

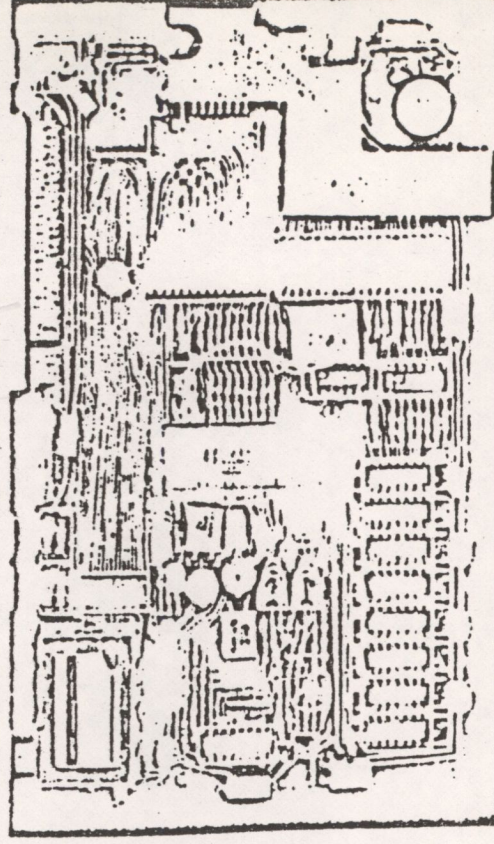


PLATE 7 — PHOTO OF MAIN SPECTRUM BOARD
WITH ULA OUTLINED