EXCITING POSSIBILITIES IN A SIDEWAYS RAM

Sideways RAM expansion system, Solidisk Technology, 17 Sweyne Avenue, Southend-on-Sea, Essex SS2 5JJ (0702 354674).

IN VIEW of the rapid development of various ROM-based languages and utilities for the Beeb, many users may be considering an expansion board for extra 'sideways ROMs': Others might like to try developing their own ROM-based software: A new product from Solidisk Technology, the sideways RAM expansion system, should interest both camps: By using RAM in the area normally occupied by a sideways ROM a number of benefits are claimed:

How close does the system come to meeting these claims?

At 16k, Solidisk's sideways RAM board is the baby of a family of RAM expansion modules, going right up to 'silicon discs' of 128k or so: The 16k model consists of three hardware elements: a 'cartridge base', a 'ROM cartridge' and the 16k sideways RAM card itself. Also included are a few pages of instructions and a 40-track disc containing a number of utility programs (see table 1):

The cartridge base is a minuscule PCB which fits, via 28 pins, into the rightmost sideways ROM socket on the BBC's circuit board. Six additional 'control wires' lead from the PCB, four of them connected, via a pair of jumpers, to links S20 and S22 on the board, and the other two inserted into pins on the 6502 CPU socket: The ROM cartridge is an even smaller PCB, which holds nothing more than a 28-pin IC socket, to accommodate a sideways ROM. The ROM cartridge can then be plugged into a mating edge-connector in the cartridge base: In this configuration, the BBC micro behaves as normal, just as if the sideways ROM in question were installed directly in the rightmost socket:

Now for something completely different. Remove the ROM cartridge and install the 16k sideways RAM via the same indirect connector on the cartridge base. You now have an extra 16k of RAM which can be accessed like any other sideways ROM: What can you do with it?

First of all, you can now commit a potentially infinite number of ROM based utilities to disc-(or even tape), and then load them into sideways RAM as and when required. Using this technique, you need never worry about extra ROM expansion boards: Admittedly, loading the programs from disc isn't as fast as switching between ROMs, but a few seconds' wait is a small price to pay for the extra versatility: Two programs on the disc have been specially provided to facilitate the transfer of ROM software to disc. The first, *COPY 2*, saves any ROM that is already fitted to the main BBC board; the second, *ROMCOPY*, saves any additional ROM installed via the ROM cartridge:
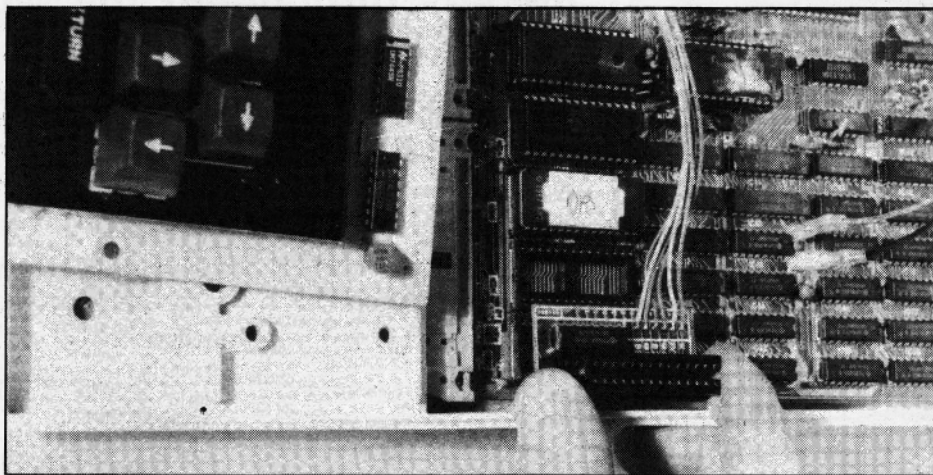
Push the base unit firmly into place. With issue 3 motherboards, bend down or – better still – cut off resistor R153 and make a link instead.
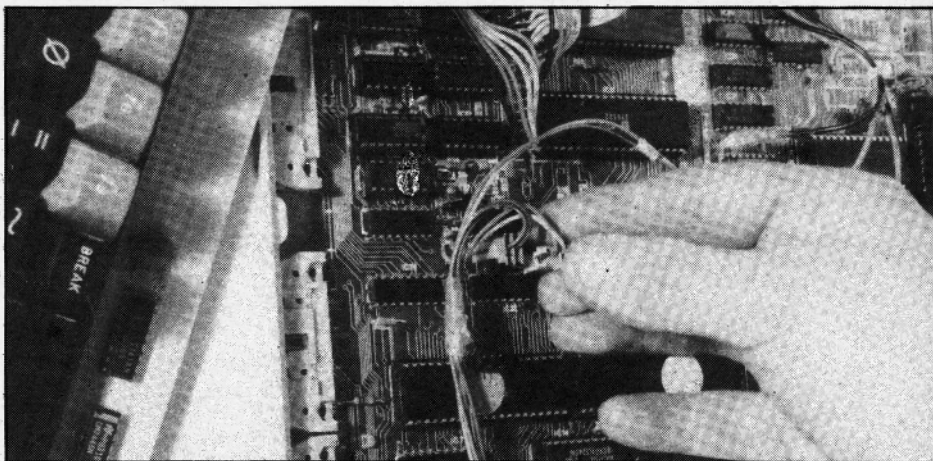
Remove two jumpers at locations S20 and S22 and install the wire plugs as labelled.

The second advantage is that users can develop their own sideways ROM software more easily by storing, testing and running code in the very locations it will ultimately occupy: Normally, one would have to program an EPROM, then erase and reprogram it whenever bugs appeared: Now all you need to do is set P%=&8000 (or above), and machine code will be assembled exactly where you want it. This is of particular benefit to Basic I users, to whom the dual assembler pointers, 0% & P%, of Basic II are not available:

How can you assemble code at &8000 onwards when the assembler you're using (in the Basic ROM) also resides at &8000 onwards? The answer is that the system can distinguish between read and write cycles from the CPU: A read cycle will select the Basic ROM as the assembler is running, while a write cycle selects the sideways RAM whenever the generated object code needs storing. This has one unfortunate, but slight, side-effect. Although the correct machine-code is generated and stored for addresses above &8000, the hex values displayed by any assembler listing will be incorrect — see

FILENAME	FUNCTION
!BOOT	Loads and runs AC90MOD.
AC90MOD	Object code for Solidisk's modified version of Acorn's DFS 0.90.
COPY2	Copies sideways ROM, on BBC board, to disc.
ROMCOPY	Copies sideways ROM, on ROM cartridge, to disc.
STL0E00	Source code for AC90MOD.
STLDISC	Source for 'silicon disc' program (for larger SWRAMs)
SWR1	Demo: how to move sideways ROM code to sideways RAM.
SWR2	Demo: how to call machine code in SWRAM from Basic. (Example saves and restores a hi-res screen to and from SWRAM).

Table 1. Solidisk's sideways RAM utilities disc

listing 1 (the values displayed are, in fact, those in the Basic ROM at the specified addresses):

Another exciting possibility is that of modifying existing ROM-based programs. To give you a concrete, and useful, idea of what can be achieved, Solidisk have developed a modified version of the Acorn DFS: The new version resides in sideways RAM, along with the RAM-based workspace needed by the DFS. In other words, you can now use addresses &E00 to &1900 for your own Basic (or other) programs and still use all the facilities of the DFS, which now has its own private, uncorrupted workspace in sideways RAM: Of course, if you use this RAM-based version, you cannot load another utility into the sideways RAM without overwriting the RAM-DFS. However, even this potential problem could be circumvented: Solution? – buy a bigger sideways RAM board:

The extra RAM is an ideal location for storing machine code; to be called by Basic, or even RAM-based languages like Forth or Lisp: The more machine code you can store above &8000, the more space you have in lower memory for actual Basic code, or whatever: Similarly, any application requiring large areas for data storage could exploit the extra sideways RAM: The utilities disc holds a demo program, `SWR2', which moves a hi-res screen between sideways RAM and screen memory: This technique could be profitably explored for animation effects and the like:

The system is straightforward to install: The RAM card itself lies perpendicular to the main board, rather like Apple expansion boards. Being flush against the right-hand side of the computer casing, it gives an end result that is neat and uncluttered: I imagine that tne system is less prone to overheating, a problem which can apparently beset those boards which lie parallel to the Beeb's circuit board: Certainly, during testing no overheating problems manifested themselves:

Initially, I was not happy with the need to plug tne two flying leads into the CPU socket: To quote the instructions, it is 'quite simple, although a little unprofessional': On the other hand, it does mean that no soldering is required to install the system: To minimise problems caused by hole enlargement, I inserted an extra IC socket into the CPU's socket before replacing the CPU and two extra wires: I would recommend users to do likewise: Unfortunately, there is no space to add an extra IC socket underneath the cartridge base (I tried it: the case wouldn't shut):

Disc users are, of course, most likely to benefit from the sideways RAM, having both the utilities disc, and fast access times at their disposal: However, there is no technical reason why a tape-based BBC could not be used, providing one is willing to put up with longer loading and saving times.

My overall impression of the system was very favourable: At £35, including VAT, the


```
10 REM PUT MACHINE CODE IN S.W.RAM
20 FOR PASS = 0 TO 2
30 P%=&8000
40 [ OPT PASS
50 LDA #2
60 DEX
70 RTS
80 ]
90 NEXT
100 END
  >RUN
8000
8000  A9 02      OPT PASS
8002  CA         LDA #2
8003  60         DEX
                 RTS
```

Listing 1. Saving machine code in sideways RAM. Though hex values listed are incorrect, the correct machine code is saved in sideways RAM at &8000 onwards.
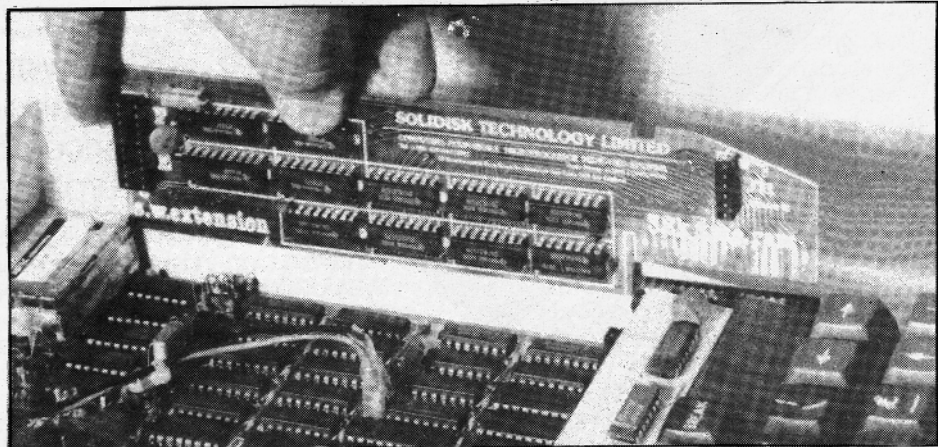
sideways RAM system offers very good value for money. Its versatility, and relative ease of use, should make it a worthwhile choice for those wishing to enhance their Beeb's potential in a number of exciting directions.

Vincent Fojut
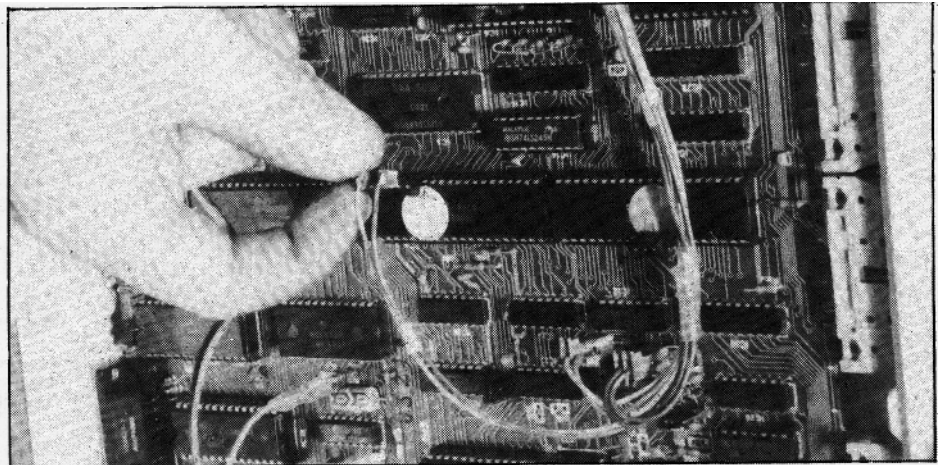
Solder or push the two pins Write and Phase 2 down to the same holes as the 6502 pins.

Replace the ROM cartridge by the sideways RAM Card – notice the two RAM ICs on the left which occupy position F (or 15). If an SWR 32 is installed there will be two extra RAM ICs in position E (14).