

During February I received a plea from Mike Cumpsteys of Altrincham to explain the confusing array of PC display modes and their relationship to the Arc display modes. A not unreasonable request, so here we go!

First of all, we need to appreciate that all PCs have a display adaptor, physically a separate plug-in circuit board, which takes information from the computer's main memory and does whatever is necessary to present a visual image on screen. The Arc has to do the same, of course, but this is all handled on the motherboard. The plethora of PC display adaptors is, as with many other aspects of the PC, a consequence of short sightedness at the design stage. IBM could not believe that business would want a colour display, much less graphics, and the original PC in 1981 was provided with a text-only monochrome display adaptor (MDA). This was soon followed by the colour graphics adaptor (CGA) which would allow two-colour graphics at 640 by 200 pixel resolution or four colours at 320 by 200.

Bear in mind that at the time Acorn, bless them, were selling the BBC Microcomputer, able to display two colours at 640 by 256, four colours at 320 by 256 or a whole sixteen colours at 160 by 256 resolution. Not only that, but with commendable foresight the basic screen addressing was, and still is on the Arc, at a basic 1280 by 1024 resolution. Very soon after third parties such as Hercules (who are still with us) and Plantronics (who are not) started to supply more sophisticated colour graphics adaptors.

In 1984 IBM produced the enhanced graphics adaptor (EGA) allowing 16 colours at up to 640 by 350 resolution. EGA was, in turn, followed by the professional graphics controller (PGA) which was very little seen, but did establish the 640 by 480 standard. Eventually, in 1987, the video graphics array (VGA) standard 640 by 480 by 16 colours, was introduced. Bear in mind that at that time Acorn had released the Archimedes with 640 by 512 by 256 colours! SVGA (Super VGA)

The PC Emulator Survival Guide (13)

Gordon Gilmore attempts to shed light on the mysteries of the PC display modes.

came about through the efforts of third party developers who independently (and incompatibly) produced adaptors with higher resolution than the standard VGA. The situation was resolved by the Video Electronic Standards Association (VESA) which decreed that SVGA resolution should be 800 by 600 pixels, but still using only 16 colours. The standard has since been broadened to include 1280 by 768 and 1280 by 1024 (recognise that) resolutions with up to 16 million colours.

Obviously the more colours catered for and the

higher the resolution, the more bits and bytes need to be handled. Since the maximum size of the DOS regen (display) buffer is 64K, this has to be done in fast RAM on the display adaptor board itself using dedicated video RAM. On the Arc, higher resolution screen display just takes a larger slice of main memory. This is why the configuration of the PC Emulator involves selecting the size of the EGA display memory. The way in which the PC display is emulated is shown in figure 1. The information is paged into the adaptor via the regen buffer, each page or colour plane, representing one bit of the colour information.

Each of these adaptor types can handle particular screen modes, and are downward compatible. EGA can handle CGA modes, VGA can handle EGA and CGA modes for example, but a CGA adaptor is limited to its own screen modes. Table 1 shows the resolution used for all the current PC modes, with the exception of those intended for specific adaptors such as that for the ill-fated PC Junior. The table shows two mode numbers. If you are trying to alter the mode in DOS you would use the DOS mode, if you are using QuickBASIC or its equivalent, you would use the Basic screen mode number. Confusing isn't it?

For the programmer, the EGA adaptor presents difficulties because it uses write-only registers. This means that a program cannot interrogate the display board to find out what the current display mode is. Because of this true PCs may load a driver called EGA.SYS which gets around the problem by pretending to be EGA read-write buffers which keep track of the display mode parameters.

SCREEN MODES UNDER THE EMULATOR

What about the Arc, what screen modes does it use when running the PC Emulator?

First of all, when multi-tasking, the screen mode must be the normal Desktop mode, 12 or 15 on a normal monitor, 20 or 21 on a multisync, or whatever your favourite is. If you compare the

table above with the table of screen modes in your User Guide you will find that modes 25 to 28 are similar to some of the VGA modes. These are intended for use if you are using a VGA monitor on your Arc but would, I assume, be used when single-tasking the Emulator in VGA modes. Of course, unless you have a VGA or multi-sync monitor you cannot single-task the VGA modes at all.

When you run the Acorn PC Emulator, three new display modes, 44, 45 and 46, are defined by the ModesCGA module. These are used when single-tasking to emulate the CGA display. The alternative Emulator !FasterPC also sets up extra screen modes 54 to 58 in the same way. You can examine the characteristics of these extra modes if you have the !ModeAid application supplied on the RISC User magazine disc 5:3. In any case, you will find that after running the Emulator, you can select these extra modes using the icon bar Palette menu.

The aspect ratio of the common Archimedes screen modes, 640 by 512 is not the same as that for the PC modes; 640 by 200, 640 by 350, or 640 by 480. In 640 by 256 modes such as 12 and 15 the displayed elements are rectangular, 2 pixels wide by 4 pixels high, rather than square, to retain the same aspect ratio. For that reason, when multi-tasking, it is inevitable that the PC window will have the wrong aspect ratio. The monitor cannot display one part of the screen at one pixel line spacing and another at a different one. If this is a problem then you should choose the most appropriate Archimedes mode from those available to you, the VGA modes 25 to 28 perhaps.

Incidentally, those of you with !FasterPC will be aware that the screen appears to be narrower than normal. This is because it uses the normal PC text height of 32 pixels per line in the CGA modes ($25 \times 32 = 800$ screen co-ordinates). The Acorn PC Emulator spreads the display vertically to about 962 screen co-ordinates, still a little less than the full Desktop height of 1024.

| DOS Mode | Resolution (x by y) | Colours | Basic Mode | Notes |
|--------------------|-----------------------------|------------------|------------|---|
| CGA Adaptor modes | | | | |
| 0,1 | 40 by 25 | 16 | 0 | Text only mode (also 40 by 43 or 50 with EGA) |
| 2,3 | 80 by 25 | 16 | 0 | Text only mode (also 80 by 43 or 50 with EGA) |
| 4,5 | 320 by 200 | 16 | 1 | Text width 40 |
| 6 | 640 by 200 | 2 | 2 | Text width 80 |
| EGA Adaptor modes | | | | |
| 13 | 320 by 200 | 16 | 7 | |
| 14 | 640 by 200 | 16 | 8 | |
| 15 | 640 by 350 | 4 | 10 | Monochrome monitor only (also 40 by 43 text) |
| 16 | 640 by 350 or 640 by 350 | 4 16 | 9 9 | (also 40 by 43 text) with more than 128 kb of EGA video memory |
| VGA Adaptor modes | | | | |
| 17 | 640 by 480 | 2 | 11 | 80 by 30 or 80 by 60 text |
| 18 | 640 by 480 | 16 | 12 | 80 by 30 or 80 by 60 text |
| 19 | 320 by 200 | 256 | 13 | 40 by 25 text |
| SVGA Adaptor modes | | | | |
| | 640 by 480 | 16 to 16 million | | |
| | 800 by 600 | 16 to 16 million | | |

MONITOR TYPES

As if all this confusion weren't enough, the different adaptors produce different types of output. MDA, CGA and EGA boards provide digital signals, whereas VGA boards produce analogue signals. Obviously the monitor must be capable of receiving the appropriate type of signal, but must also be able to synchronise to the different scan rates necessary to display the different number of lines per screen. The Arc provides an analogue RGB output, and can, therefore, with a suitable selection of Archimedes screen mode, feed a VGA monitor as well the normal RGB and multi-sync monitors. All VGA adaptors can handle the CGA and EGA screen modes and do not need to be set up specially to do this.

ANSI.SYS

Mike also asked what role ANSI.SYS has to play in deciding the screen mode. Normally the answer is none. ANSI.SYS can alter the screen mode at the DOS command line but it is difficult

to see why anyone would want to. One might want to alter the mode from within a program, but that is a different matter. Whatever the language used, the internal screen mode commands (which work via DOS interrupts) would be used. If you have ANSI.SYS loaded from your configuration file and you are running under DOS 5.0 or later, then the following commands will alter your display mode to the 640 by 480 graphics mode 17 and reset the prompt:

```
PROMPT $e[=17h
```

```
PROMPT $p$g
```

All very well, except that if you try it you will find that you no longer have a cursor. Type:

```
MODE C080
```

to get back to normal. The mode command can also be used (with ANSI.SYS loaded) to alter the text display format page thus:

```
MODE CON: COLS=40 LINES=43
```

ANSWERS TO LAST MONTH'S QUIZ

The Babylonians invented the abacus, the first mechanical aid to calculation. Hollerith invented the punched card system which formed the mainstay of computer data input for many years. The Manchester Mark I was the first computer to use a stored program. Dartmouth College (US) was the birthplace of Basic. VisiCalc was the first spreadsheet program. At the time

