19 Introduction to XGA

The foundation of the XGA standard

Since the introduction of Microsoft Corporation's *Windows 3.0™*, MS-DOS based PC users have continued to move to graphical user interfaces (GUIs) over conventional character-based display systems. The makers of VGA and Super VGA chip sets designed for AT bus adaptor implementation were the first vendors to benefit, initially upgrading their products to 640×480 pixels with up to 16 colors and then to 800×600 pixels with 256 colors.

Similar to the lower-resolution CGA and EGA standards, VGA is a dumb frame buffer that accepts data from the system processor running the application and reconfigures it in video memory into a frame for display on a CRT screen. Windows users have found that GUIs require considerable computing power. In traditional DOS applications, most operations are character based, with graphics functions estimated as requiring no more than 10% of the CPU's processing time. In contrast a GUI may typically require up to 35% of the CPU's processing time, since a number of tasks require intensive graphics support, including moving and re-sizing windows, manipulating pop-up menus, displaying and scrolling text and graphics, using and displaying multiple font types and sizes, performing cut-and-paste operations between windows and switching between applications and multiple windows. When the GUI graphics functions are run, overall system performance is degraded because of the additional computational load placed on the main CPU.

Several differing platforms for VGA enhancement are emerging which attempt to increase VGA performance by using higher clock rates, adding windowing features in hardware, implementing combination AT bus mastering with graphics accelerators and graphics co-processing units. GUI accelerators are now available with VGA or Super VGA compatibility and even higher pixel and color resolutions (1280×1024 display resolution and 65,536 colors). The diversity of Super VGA and other comparable performance solutions, coupled with the lack of a common standard and hence minimal driver support from large software vendors, strengthen the requirements for the foundation of a new adaptor standard.

The XGA (eXtended Graphics Array) standard, supported by IBM, answers the needs of PC users who have adopted GUIs and subsequently require improved graphics performance. The major components of the XGA subsystem are the IMS G191 Serializer Palette-DAC and the IMS G200/G201 Display Controller. These components, coupled with dual port VRAMs, form the basis of a high performance graphics subsystem aimed at GUI windowing environments. A brief description of the XGA subsystem is given below; for a more detailed description refer to the *XGA Software Programmer's Guide*, document number 72 OEK 258 01.

XGA subsystem features

The following features summarize the capabilities of the XGA subsystem:

VGA compatible mode

When in VGA mode, the XGA subsystem is VGA register compatible as defined in the *VGA Function* chapter of the *Video Technical Reference*, IBM document number '42G2193'.

132 column text mode

In this mode, text is displayed in 132 vertical columns using a number of scan lines, typically selected by BIOS display mode #14. Each character can be 8 or 9 pixels wide.

Extended graphics mode

The extended graphics mode provides the following enhancements over VGA:

Coprocessor
A 16-bit coprocessor provides hardware drawing-assist functions throughout real or virtual memory.

High resolution support
High resolution screen modes allow more windows to be displayed on the screen at any one time and give greater text clarity. Depending on the display attached and the amount of memory installed, the image on a screen can be defined using 1280 pixels and 1024 scan lines with 256 colors, interlaced.

16-bit true color mode
XGA introduces a new 16 bit per pixel mode allowing 65,536 colors to be displayed simultaneously on a 800 by 600 screen. True color mode does not use a color look up table (palette) in the conventional way. Instead, the bits in each pixel are assigned red, green or blue. Of the 16 bits in each pixel, 5 are assigned to red, 6 to green, and 5 to blue. This allows images from many sources (e.g. photographs, computer-generated materials) to be displayed with almost photo-realistic quality.

Hardware sprite
A hardware sprite allows a steady graphics cursor to be displayed without affecting the contents of video memory. This avoids the need for software collision detection. The sprite is a 64 by 64 pixel image. When enabled, it overlays the picture that is being displayed.

The 132 column text mode and all VGA modes are available on the XGA subsystem regardless of the amount of video memory installed.

When in extended graphics mode, the amount of video memory installed determines the screen resolutions and number of colors that are supported. The following table summarizes this relationship:

Video memory required	Resolution	Maximum colors	Notes
512 Kbytes	640×480	256	
	1024×768	16	
1 Mbyte	800×600	65, 536	
	1024×768	256	
	1280×1024	16	1
2 Mbytes	1280×1024	256	1

Note:
1 Interlaced display only

Table 19.1 Examples of screen resolution and number of colors for different VRAM sizes

XGA subsystem description

The following major components provide the extended graphics function:

- System bus interface (IMS G200/G201)
  The IMS G200 directly supports the Micro Channel bus. Direct support for both the AT bus and Micro Channel bus is provided by the IMS G201.
- CRT and memory controller (IMS G200/G201)
  The *system bus interface* and the *CRT and memory controller* manage the XGA subsystem and the screen display. They provide the system processor with direct access to the video memory. All video memory is accessible by the system processor through one of three apertures: one for real mode, one for protected mode on a 16-bit processor or operating system, and one for protected mode on a 32-bit processor with a 32-bit operating system.
- Drawing coprocessor (IMS G200/G201)
  The *drawing coprocessor* provides a range of hardware drawing functions that operate on pixels in video or system memory.
- Video memory (external VRAM)
  Dual port VRAM stores pixel data. VRAM offers better performance than DRAM, since one port updates the displayed information while the other refreshes the screen.

- Serializer, palette and digital-to-analog converters (IMS G191)
  The *serializer* takes pixel data from the serial port of the video memory, and passes it pixel by pixel to address the 256-entry palette. The color values from the palette are passed to the three 8-bit DACs (red, green and blue), which produce the analog video signals for the monitor. In 16-bit true color mode, the pixel data essentially bypasses the palette and is transferred directly to the DACs.

- Phase locked loop (IMS G191)
  Two *phase locked loops* are provided, one for the IMS G200/G201 controller clock and one for the video subsystem.

- Sprite controller (IMS G191)
  The *sprite controller* interfaces to the *sprite buffer* to display the 64×64 pixel sprite image on the screen.

- Sprite buffer (external SRAM)
  The *sprite buffer* stores the alphanumeric fonts in VGA modes and sprite data in XGA modes. 16 Kbytes of SRAM are needed to store two VGA fonts (2×(256×32)).

XGA software support

Drivers

XGA driver software for a range of GUI environments is available directly from SGS-THOMSON (Part Number IMS S7XD) and is compatible with all XGA-standard hardware platforms. This software may be distributed at zero charge in object code format with SGS-THOMSON XGA chipsets under the terms and conditions of a 'program licence agreement'. Driver source code is also available at a charge.

Range of current XGA drivers:

- MIcrosoft Windows 3.x
- OS/2 Presentation Manager
- DOS Application Interface (For 8514/A compatibility)
- Double Byte Character Set (supports Chinese and Japanese fonts in Windows, OS/2 PM)
- AutoCAD (display list driver) *

* Customers should contact **Panacea Computer Graphics Software Inc.** for higher performance AutoCAD driver availability, pricing or licensing information.

Alternatively, customers or independent software developers may wish to develop their own XGA drivers by referring to the *VESA XGA Extensions Standard* (VXE 1.0) and the *XGA Software Programmer's Guide* (SGS-THOMSON - 72 OEK 258 01).

BIOS (Basic Input Output System)

The XGA BIOS is an extension to the VGA BIOS to support the enhanced features of XGA. SGS-THOMSON has an agreement for **Phoenix Technologies** to develop, deliver and provide technical support for XGA BIOS software. Customers are advised to contact **Phoenix Technologies Ltd.** for all XGA BIOS inquiries, eg. availability, pricing or licensing.

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