Seven Up on EGA

Thanks to burgeoning software support, IBM's Enhanced Graphics Adapter is fast becoming the de facto standard for graphics on the PC. But can EGA compatibles do better for less?

Eric Knorr and Karl Koessel

▍▍▍▍ IBM's Enhanced Graphics Adapter (EGA) is helping raise a new generation of graphics-intensive software for the PC. Surpassing even the Macintosh's hard-edged graphics, the EGA's 640-by-350-pixel enhanced graphics resolution supplies PCs with the crispness vital to personal publishing, CAD (computer-aided design), and Mac-like user interfaces. And with 16 simultaneous colors available from a palette of 64, the EGA makes quality slide-show presentations on your PC a viable option.

But for most users, the EGA promises an end to the Hobson's choice of monochrome monotony or the eyestrain of poor-quality color text. Featuring an 8-by-14-dot-matrix character box, the EGA produces color text approaching the sharpness of the IBM Monochrome Display Adapter's 9-by-14 box. The specs of other boards may outstrip those proffered by the EGA, but IBM's hardware hegemony has ensured the EGA's position as the prevalent graphics standard. Consequently, software vendors in increasing numbers are rallying behind the EGA.

Now a herd of EGA compatibles has arrived to capitalize on the EGA's widespread software support. Aware that the IBM board's high cost has daunted many users, most vendors are selling compatible products for about half the price of IBM's trendsetter. Along with the influx of boards comes a flock of low-cost monitors that mimic IBM's Enhanced Color Display (ECD), the 350-line monitor matched to the EGA's capabilities. With an EGA compatible and a third-party ECD monitor (or your old monochrome marvel), moving up to EGA quality won't cost you an arm and a leg (see the sidebar "Monitoring the Possibilities").

The EGA struts its stuff on an Enhanced Color Display with 16 simultaneous colors.

Copying Complexity

Pity the poor board maker. The EGA is among the most complex video adapters ever produced for the PC, introducing its own enhanced graphics standard as well as being able to run any monochrome text-based application and a handful of programs written for IBM's Color/Graphics Adapter (CGA). Within each video standard are a variety of modes, which means that fashioning a fully compatible board is an arduous engineering task.

The EGA is not limited to running with a 640-by-350-pixel enhanced graphics monitor. As a result, a board compatible with the EGA must have not one but two character sets in ROM: one for enhanced color graphics monitors and monochrome monitors, and another for standard color displays. Depending on the video mode and the type of monitor indicated (determined by the EGA's on-board switch block and jumper), the EGA reads the appropriate character set from ROM into its on-board RAM when you start your PC. EGA software can then add to (or, for other modes, exchange) that character set.

Confusion has also plagued PC users deciding which EGA configuration to buy. The basic EGA

sells for $524, but because just 64K of RAM is on board, only 4 simultaneous colors are available in enhanced graphics mode. To exploit the board's potential of 16 simultaneous colors in all modes and the ability to replace the EGA's default character sets with two other sets of 256 characters, you need the Graphics Memory Expansion Card (GMEC), a 64K piggyback board that sells separately for $199. For smooth scrolling and panning, IBM offers the Graphics Memory Module Kit (GMM), basically a 128K handful of RAM chips that brings the price of a fully loaded EGA to slightly less than $1000.

With one exception, the EGA compatibles evaluated here have collapsed these three modules—basic EGA, GMEC, and GMM—into a single 256K board that sells for approximately the same price as the bare-bones IBM EGA. A few firms have even compressed the circuitry to a single short board that will function in the XT's notorious eighth slot. Whatever their length, all these boards are built around a four-chip set from Chips and Technologies, a company that's sucessfully duplicated the IBM board's essential hardware. Each manufacturer has, however, used its own EGA BIOS (basic input/output system); some add hardware for CGA emulation, some include Hercules Graphics Card (HGC) emulation, and some offer both. Such departures from the IBM path naturally result in varying degrees of compatibility (see Table 1).

One sophisticated feature that gives some compatibles a tough time is the EGA's split-screen capability. The IBM board can hold more than one full-screen image in RAM. It can simultaneously display a second image, stored in a different location of the board's RAM; that image occupies any lower portion of the screen. This means that when the bottom image is removed, the full screen reappears instantly. IBM's imitators vary in their ability to perform this feat.

Close examination reveals other differences in the compatibles' im-

personations. A few EGA compatibles lack a number of the EGA's more esoteric hardware features—such as the 32-pin Feature Connector and dual RCA video jacks. These omissions are understandable, given that IBM has refrained from releasing a product using the connectors, and excluding them yields a less expensive board. Nevertheless, be aware that their absence means you may miss out on possible future enhancements.

■ **One-Upping IBM**
Although they may miss a trick here and there, most EGA compatibles possess more functionality than the genuine article. They generally offer a superior ability to run software written for the CGA and HGC; some boards also reveal hardware modifica-

tions. For example, Genoa's Spectra EGA and STB's EGA Plus skip the RCA jacks in favor of parallel ports, and STB offers a battery-powered clock as an option.

If space is at a premium in your XT, you should appreciate the short boards. In early ATs, however, some of the full-size EGA compatibles—and the EGA itself—are picky about their locale. Because early-model AT motherboard memory chips are taller

> *The EGA compatibles' most significant contribution is partial emulation of IBM's CGA.*

than those in a PC or an XT, a board whose bottom edge is not high enough to clear the AT's chips must be installed in the machine's first slot (which runs alongside, rather than over, motherboard RAM).

Not surprisingly, IBM neglected to offer compatibility with the Hercules Graphics Card. The EGA and its imitators can display enhanced graphics on a monochrome monitor, but only a handful of compatibles can handle software written for the HGC. This capability enables you to run pre-EGA, Hercules-compatible graphics software, provided you're willing to use a monochrome monitor with your new toy.

■ **Compatibility Conundrums**
The EGA compatibles' most significant contribution is partial emulation of IBM's CGA. Big Blue's EGA is not quite up to the task, accommodating CGA drivers from only a few well-behaved programs and failing miserably with

Table 1: EGA compatibles—a features compendium

Product	EGA	AST-36 Model 1	MegaGraph Plus	Basic Time EGA	Spectra EGA	Quad EGA + / Vega	SigmaEGA	EGA Plus
BIOS revision		D	1.03H	1	1.10	04B	1.06	1.07
Features								
Initial display memory	64K	64K	256K	256K	256K	256K	256K	256K
Two RCA video jacks	●	●	●			●	●	
Feature connector	●	●	●		●	●	●	●
Light-pen connector	●		●	●[1]	●	●	●	●
Switch block externally accessible	●	●	●			●	●	
Display's ground line jumper is external						●		
Half-size board			●			available	●	
Works in XT's eighth slot			●			●	●	
Parallel port		optional		●	●			●
Clock and battery								optional
CGA software compatible		2	partial[3]			partial[4]		
HGC software compatible		2	partial[3]			partial[4]	partial[4]	
1-2-3 CGA graphics		2	●[3]			●[4]		
1-2-3 HGA mono graphics		2	●[3]			●[4]	●[4]	
Runs Pinball (CGA game)			●[3]					
Dither flicker								●
Smooth scroll, split screen	●	●		●	●	●	●	●
Diagnostics included	●	●				●		
Warranty period	1 year	2 years	1 year	1 year	1 year	2 years	1 year	2 years
List price 256K	$982	$525	$499	$349	$599	$595	$595	$595

[1] Pin 2 not cut
[2] Available with 3G Plus
[3] When emulation mode is invoked via <F3> key
[4] When emulation mode is invoked via software

Monitoring the Possibilities

The EGA will drive the IBM Monochrome Display, the IBM Color Display, the IBM Enhanced Color Display (ECD), or any product compatible with them. The permutations of board and monitor can be confusing, but keeping on top of them can protect your system—and your pocketbook.

Consider the possibilities: You can install an EGA driving a Color Display or an Enhanced Color Display alongside a Monochrome Display Adapter that is driving a Monochrome Display. Or you can install an EGA driving a Monochrome Display alongside a Color/Graphics Adapter that is driving a Color Display. Note, however, that attached to an EGA, each display has its unique capabilities and characteristics.

On the Monochrome Display, the EGA produces the same crisp, high-quality, 25-row-by-80-character text (including underlining) as the IBM Monochrome Display Adapter; both yield text with a 9-by-14-dot-matrix character cell. The EGA can also drive the Monochrome Display

in 43-line text mode, but characters are contained within a 9-by-8-dot-matrix character cell (see "EGA at Length" *.*, *PCW*, July 1986.) In enhanced graphics mode, the EGA generates a 640-by-350-pixel graphics screen with black, normal, blinking, and intensified attributes on the Monochrome Display. In this mode, characters are slightly narrower (an 8-by-14-dot-matrix character cell).

On the Color Display, the EGA produces the same output as the Color/Graphics Adapter: 16-foreground-color, 8-background-color text mode display of 25 rows by 40 or 80 characters (within an 8-by-8-dot-matrix character cell); 4-color, 320-by-200-pixel medium-resolution graphics; and 2-color, 640-by-200-pixel high-resolution graphics. You do get a bit more with an EGA and a Color Display: This hardware combination can display full 16-color, medium- and high-resolution graphics. The Color Display, cannot, however,

produce the EGA's 350-line enhanced graphics or 43-line text displays.

On the Enhanced Color Display, the EGA can be set to emulate the colors and resolutions of the Color Display. But in its enhanced resolution configuration, it can display 25 lines of 40- or 80-character 16-color text formed within an 8-by-14-dot-matrix character cell. The ECD can also display 16-color, 43-line text in 8-by-8-dot-matrix character cells. With 256K of video RAM, the enhanced configuration also permits display of 640-by-350-pixel enhanced graphics in 16 simultaneous colors chosen from a palette of 64. (For EGAs or compatibles equipped with only 64K of video RAM, only 4 colors are available from a palette of 16.)

Along with the current flood of EGA compatibles, ECD-compatible monitors are riding the enhanced resolution wave. Offering dot pitches as low as .28mm, black matrix tubes, and antiglare screens for sharper images, these monitors can represent a significant savings over

IBM's ECD. All produce vivid color, but the NEC MultiSync stands out from the crowd; it is clearly more than ECD compatible.

The NEC MultiSync, which can display up to 800-by-560-pixel resolution, can be driven by an array of adapters: the Monochrome Display Adapter, Hercules Graphics Card, Color/Graphics Adapter, and the EGA— plus high-resolution 400-line adapters like the Sigma 400 and the Persyst BoB/16 and even the 480-line IBM Professional Display Adapter. The MultiSync automatically adjusts to frequency rate and pin-out logic of the adapter to which it is attached. Controls for contrast, brightness, vertical hold, vertical size, vertical position, and horizontal position are conveniently located atop the monitor.

The NEC MultiSync monitor is truly an investment. While it can simply be plugged into and driven by all of the PC's current video adapters, its resolution and intelligence ensure its com-

patibility with future PC video standards for years to come. –K. K.

8042
*Nanao USA
  Corporation
373G Vintage Park Dr.
Foster City, CA 94404
415/341-7055
List price: $720*

*Enhanced RGB Color
  Monitor
Basic Time, Inc.
3040 Oakmead Village
  Dr.
Santa Clara, CA 95051
408/727-0877
List price: $659*

*HX-12E
Princeton Graphics
  Systems
601 Ewing St.
Princeton, NJ 08540
609/683-1660
List price: $785*

*JC-1401P3A MultiSync
NEC Home Electronics
1401 Estes Ave.
Elk Grove Village, IL
  60007
312/228-5900
List price: $799*

most others. When you try to display *1-2-3* release 1A's graphics, for example, IBM's board returns a blank screen.

The explanation for this deficiency lies in the way graphics software is written. If a program's CGA driver directs all its instructions to the EGA's BIOS, the BIOS in the board's ROM translates the software's requests for CGA functions into instructions compatible with the EGA, and the program functions without difficulty. But if a driver bypasses the BIOS and tries to address the hardware directly, the EGA's video chip can't respond to the CGA instructions; a complete communications breakdown between software and hardware results. The majority of programs written for the CGA make these inappropriate hardware calls.

Several EGA-compatibles makers have dealt with this problem by using logic chips to trap CGA hardware calls and reroute them to the BIOS. Some have built the ability to activate these logic chips into firmware, while others supply their software on disk. In either case, boards that claim CGA compatibility can usually run most popular productivity

software written for the CGA. (But expect most games written for the CGA to bomb out.)

In a sense, the CGA compatibility issue is a red herring. The EGA's video RAM stores screen information in a different format from the CGA's video RAM. Because many CGA programs write directly to video RAM, perfect CGA emulation is an impossible dream. Furthermore, most major software vendors will send you a disk containing an application-specific EGA driver free of charge, rendering a board's ability to emulate the CGA superfluous.

Another compatibility issue involves Graphic Software Systems' virtual device interface (VDI), which the EGA's BIOS is designed to accommodate (see "The Myth of the Virtual Device," *PCW*, April 1985). IBM supported this software interface to spare programmers the labor of writing multiple drivers for the EGA's many modes; instead, the VDI permits use of a single driver. Even though few programs have been written for the VDI, all the EGA compatibles assessed here include VDI support on board.

One final compatibility question bears mention. Unless your PC's ROM BIOS was written after October 27, 1982, you'll need to install a ROM BIOS Upgrade Kit from IBM before you install an EGA. You can determine which ROM version you have by running the following BASIC program:

```
10    DEF SEG = &HF000
20    FOR I = &HFFF5 TO &HFFFF
30    PRINT CHR$(PEEK(I));
40    NEXT
```

For convenience, some EGA manufacturers include their own program that checks the date of your PC's BIOS.

■ **Compatibles Competition**
Defining the exact nature of the EGA compatibles is like aiming at a moving target. Several of the adapters offer various Hercules and CGA emulation options, and each manufacturer is constantly refining its board's BIOS. Consequently, many of the hardware and software problems that cropped up during testing may have been rectified by the time you read this.

AST-3G Model 1 (BIOS revision D) Renowned for its SixPakPlus memory expansion product, AST is the largest supplier of boards for the PC. Like all AST products, the full-size 3G Model 1 is well constructed, uses high-quality components, and is accompanied by lucid documentation. Among EGA emulators, the 3G also offers the most Byzantine array of configurations.

The board comes in two basic versions: the $450 Model 1, and the $500 Plus, which (although unavailable for review at press time) claims to add partial CGA and HGC emulation. If you purchase a Model 1 and later decide you want the Plus's added capabilities, an upgrade kit is available for $75. Either board is narrow enough to clear the stacked memory chips in older ATs and thereby fit in any full-length slot.

The AST boards are unique in that both basic versions come with only 64K of RAM. Buying the 256K incarnations of the Model 1 or the Plus (which cost $525 and $575, respectively) is definitely the

route to follow, because the separate memory enhancement kit costs twice as much as the same amount of factory-installed RAM. The maxim applies as well to the parallel port option—buy it built in and you'll save $25 on the price of an add-on kit.

As with the SixPakPlus, you can't use the rear bracket of the 3G to mount the parallel port; instead, you must run a ribbon cable from the board's internal connector to an external connector mounted on another bracket. You can configure the parallel port as LPT1 or disable it using the jumper on board. If you already have a parallel port, the 3G's port can be configured as LPT2 or LPT3 or can be disabled.

The 3G is the only board tested that omits the EGA's light-pen connector. Otherwise, the 3G is fully EGA compatible, performing smooth scrolling, panning, and split-screen functions without difficulty. Unlike the boards that reduce the complexity of purchasing an EGA, however, the AST-3G adds confusion with a tangled web of price breaks and options.

ATronics International (ATI) MegaGraph Plus (BIOS revision 1.03H) Like AST's entry, the basic model MegaGraph is EGA compatible only; CGA and HGC emulation are available in a Plus version for an extra $50. The half-size MegaGraph Plus reviewed here appears to be superbly constructed; most components are affixed via surface mounting (that is, no sockets). While this technology makes repairs more difficult, it tends to ensure reliable connections.

Of the boards tested, the Mega-Graph Plus provides the easiest method of invoking CGA or HGC emulation. If your PC is hooked up to an IBM Enhanced Color Display, for example, pressing <F2> when starting your system turns on CGA emulation. With a monochrome monitor, the Mega-Graph's Hercules emulation kicks in via the same procedure. Because this approach doesn't use DOS software, you can use the board with any operating system.

Despite these niceties, the MegaGraph Plus's current EGA impersonation is second-rate. When scrolling and panning, the display jumps crazily. And with fast-moving, 640-by-350-pixel-resolution graphics—such as those provided by some slide-show animation software—the board fails to maintain coherent video memory, causing splotches of color to accumulate on screen. In CGA emulation mode, the board fares better: Unlike any other board tested, the MegaGraph Plus actually runs subLogic's *Night Mission Pinball*, although it appears in monochrome rather than in color.

The MegaGraph Plus's lackluster documentation doesn't exactly inspire confidence. The installation instructions are cursory and offer few illustrations, and a dim photocopy supplies vital update information. All in all, the MegaGraph Plus has some appealing attributes and superior CGA emulation, but the current version's rough edges prevent it from being a winner.

Basic Time EGA (BIOS version 1) The Basic Time EGA is the least expensive board evaluated here, tipping the register at a mere $349. This full-length adapter doesn't offer CGA or Hercules emulation but proves its mettle admirably when emulating the EGA—with one notable exception. When you load *PC Paintbrush*, the Basic Time EGA will implement palette changes saved in a file, but thereafter using a mouse to change palettes is fruitless. The Basic Time board was the only one in our sample to fail this test, which may portend palette problems with other programs.
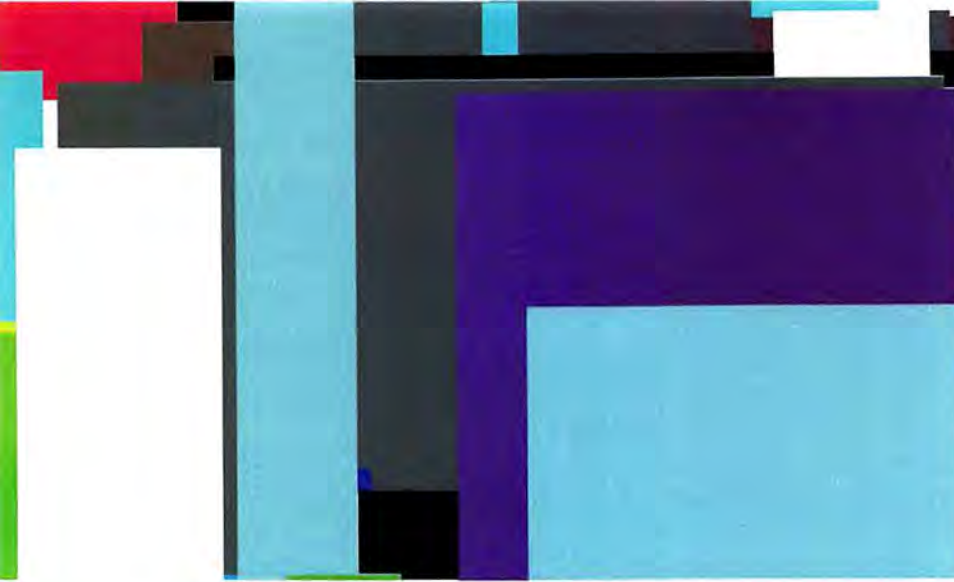
The list price includes a parallel port, which can emulate the port built into IBM's Monochrome Display Adapter (MDA). Because only one MDA parallel port can be active at a time (the MDA parallel port always uses port address 3BC), you can make Basic Time's parallel port emulate that of the IBM Serial/Parallel Adapter if an MDA is already installed. Installation instructions are fairly complete, although for some reason the cryptic terms *in* and *out* are used to describe jumper settings. The board's switch settings are not accessible once the unit is installed.

The dual RCA video jacks and the Feature Connector are not included on the Basic Time EGA, although the manufacturer plans to add them if and when IBM puts

them to use. The light-pen connector reveals an annoying oversight: You must clip off pin 2 before you can attach most light-pen cables. For many users, however, the board's low price will excuse the scrimping on details.

Genoa Spectra EGA Model 4800 (BIOS revision 1.10) Given its high performance, full EGA compatibility, and superior documentation, Genoa's Spectra EGA is a class act. Its BIOS routines ran faster than those of any board tested, and the manual is crammed with helpful illustrations. The Spectra performed satisfactorily in

Given its high performance, full EGA compatibility, and superior documentation, Genoa's Spectra EGA is a class act.

all EGA compatibility tests. Considering that the board does not implement partial CGA or Hercules emulation, however, its $599 price tag is high.

The Spectra EGA comes with its own software to override the initial video mode specified by the switch block setting, but execution is sluggish. As with most of the other boards reviewed, you must still open up your PC to move a jumper in order to exchange a Monochrome or Color Display for an Enhanced Color Display.

In an AT with piggybacked 128K memory chips, the full-length board fits comfortably only in the first slot. Both a parallel port and a Feature Connector are on board, although the RCA jacks are missing. You can configure the parallel port as LPT1, LPT2, or LPT3, or you can disable it. As a

small bonus, the board's utility disk offers a program that checks the PC's BIOS ROM date.

Quadram QuadEGA+/Video 7 Vega (BIOS 04B)

Video 7 was the first company to release an EGA-compatible board, partly because it worked with Chips and Technologies to help develop the EGA chip set. A small firm, Video 7 decided to market its EGA compatible, the Vega, through Quadram under the QuadEGA+ moniker. Due to Quadram's large number of distributors and early entry into the market, the QuadEGA+ is currently the largest selling EGA compatible.

The Vega and the QuadEGA+ are absolutely identical, manufactured in the same facility and offering the same hardware, circuitry, and BIOS. Both come in long and short versions; both are sold for the same price and provide identical capabilities, including CGA and Hercules emulation. When emulating the EGA, the QuadEGA+/Vega performs flawlessly.

The QuadEGA+/Vega provides one convenience missing from any other board evaluated. Instead of using an internal jumper that you must change when swapping a monochrome or standard color monitor for an enhanced color display, the QuadEGA+/Vega provides an external toggle switch. Given that you can damage a monitor connected to a board that's improperly set, this commonsense feature could be a money saver for those who swap monitors often.

Like several other boards, the QuadEGA+/Vega uses software to invoke CGA and HGC emulation. This program also contains a screen-blanker function that extinguishes the display after a designated period of keyboard inactivity. Such a capability extends monitor life by minimizing burning of the screen's phosphors. Pressing any key recalls the image. The disk also includes a utility to check your system's ROM date, plus a diagnostics program that's enhanced by the manual's excellent discussion of troubleshooting.

Overall, the QuadEGA+/Vega offers one of the best CGA impersonations. Like the MegaGraph Plus, the QuadEGA+/Vega can run 1-2-3 release 1A's graphics, but without the ATI board's EGA emulation problems. Thanks to an early start, Video 7 is several

ROM upgrades ahead of the pack, coupling its software superiority with a well-constructed, reasonably priced board.

SigmaEGA (BIOS revision 1.06)

Sigma is best known for its Color 400 board, designed to drive high-res, 400-line monitors. Currently, the company is attacking the EGA market with two products—the $595 SigmaEGA, which is both EGA and Hercules compatible, and the $545 Color 350, a garden-variety EGA clone. A version incorporating CGA emulation may be in the works. For now, the SigmaEGA passes its EGA and Hercules compatibility tests with flying colors.

For the most part, the documentation is adequate, but it's a little thin when describing board installation. Fortunately, the SigmaEGA's diminutive dimensions let it slip easily into any PC slot.

Sigma sells an optional composite-video piggyback board that enables you to use the adapter to drive a standard composite color or monochrome monitor. To top it off, the company throws in a copy of *PC Paintbrush* with the SigmaEGA at no extra charge.

STB EGA Plus (BIOS revision 1.07)

The EGA Plus is another EGA compatible that refrains from attempting Hercules or CGA emulation. For $595, the board includes a parallel port; a battery-powered clock is a $29.95 option. Bundled software includes a RAM disk, a print spooler, and a clock-setting utility.

When emulating the EGA, the STB board has no problem splitting the screen, scrolling, or panning. Alone among the boards

tested, however, the EGA Plus suffers from a phenomenon known as *dither flicker*. Dithered colors are actually blends of the EGA's 16 primary colors, displayed in a checkerboard pattern of dots from two constituent hues. With the EGA Plus, swatches of certain dithered colors produce a rippling, rolling effect on screen, resembling a color monitor that's been turned on while the PC is off. Certain color combinations in text mode also cause flickering around the edges of characters.

STB's documentation is superior to most, offering detailed illustrations that augment installation instructions. Nevertheless, the flicker problem is distracting enough for the board to fall short of the STB mnemonic, which is "simply the best."

The Graphics Continuum

The enhanced graphics standard is claiming a growing share of the PC graphics market, driven by programs such as *Microsoft Windows* that need high resolution to be used effectively. Within this arena, EGA compatibles are selling well, thanks in part to a reported shortage of the IBM board. But don't assume that the current popularity of the EGA standard means it will last forever—or even approach the longevity of IBM's CGA.

Rumor has it that IBM may be decreasing production of the current EGA to set the stage for a new model sporting a 640-by-480-pixel mode. Even more intriguing is Intel's new graphics coprocessor, which, according to Rich Bader, general manager of Intel's Personal Computer Enhancement Operation, will "represent a quantum leap for graphics." Operating in conjunction with the EGA chip set, the Intel processor (dubbed the 82786) reportedly will run five times as fast as the EGA and offer twice the resolution. Furthermore, the 82786's ROM will contain CAD drawing routines plus the Direct Graphics Interface Specification (DGIS), an enhanced, streamlined successor to Graphics Software Systems' VDI that offers comprehensive raster graphics support. The Intel chip's high performance should make the performance decrease incurred by DGIS imperceptible.

Bader reports that 82786-based products will likely be shipping by the end of this year. In light of their advancements, you might be tempted to postpone buying an EGA or a compatible. But regardless of breakneck hardware advances (not to mention the possibility of add-on 82786 upgrades for existing EGA boards), now's the time to jump on the enhanced graphics bandwagon. Take a look at an EGA in action, and you'll wonder how you ever tolerated CGA "quality." And with an EGA compatible, you can move up without breaking your budget. ◉

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AST-3G Model 1
AST Research, Inc.
2121 Alton Ave.
Irvine, CA 92714
714/863-1333
List price: 64K $450, 256K $525, 256K with parallel port $25 additional, Plus $575

Basic Time EGA
Basic Time, Inc.
3040 Oakmead Village Dr.
Santa Clara, CA 95051
408/727-0877
List price: 256K $349

EGA Plus
STB Systems, Inc.
601 N. Glenville #125
Richardson, TX 75081
214/234-8750
List price: 256K $595

MegaGraph Plus
ATronics Int'l, Inc.
491 Valley Way, Bldg. #1
Milpitas, CA 95035
408/943-6629
List price: 256K $499

QuadEGA +
Quadram
One Quad Way
Norcross, GA 30093
404/923-6666
List price: 256K $595

SigmaEGA
Sigma Designs, Inc.
2023 O'Toole Ave.
San Jose, CA 95131
408/435-1480
List price: 256K $595

Spectra EGA Model 4800
Genoa Systems Corp.
73 E. Trimble Rd.
San Jose, CA 95131
408/945-9720
List price: 256K $599

Vega
Video 7, Inc.
550 Sycamore Dr.
Milpitas, CA 95035
408/943-0101
List price: 256K $595