Display Terminals: Market Overview

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Synopsis

Editor's Note
This report presents an overview of the display terminal market. It identifies the major vendors and measures the market impact of technological developments. A separate technology overview discusses the technical aspects of display terminals and summarizes the important issues related to selecting a display terminal. A comparison column report contains key characteristics and pricing for more than 159 displays offered by 30 vendors.

Market Highlights
Greater functionality and lower prices have made display terminals even more attractive to users. Advances in microprocessor and CRT technology have made this trend possible. The driving force, however, has been the need for display terminal vendors to remain competitive with the growing base of diskless workstations and PCs. Fierce competition and price wars within the display market itself have reduced the per-unit profits of display vendors, forcing many of them out of the market altogether.

The shift from host-based display terminals to intelligent LAN workstations tied to a file server has brought the future of traditional alphanumeric displays into question. For the major vendors, such as IBM and Digital Equipment Corp., however, the market remains viable.

In contrast to alphanumeric displays, the X terminal, a relatively new display product that offers high-resolution graphics, fast processing power, and windowing capability for access to multiple computer environments, is growing in popularity. Sales of X terminals are expected to grow at an annual rate of over 100 percent per year through 1994.

—By Martin Dintzis
Assistant Editor

Analysis

The first third-party "dumb" terminal, featuring limited editing capabilities, was introduced in 1972 by the Data Products Division of Lear Siegler, Inc. This terminal was used mostly for data entry applications. Originally invented as a "glass Teletype," the cathode-ray tube (CRT) used in this early product has evolved to the point where it is the primary component in most modern computer applications, such as data entry, inquiry/response, telemarketing, computer graphics, and word processing/text editing.

CRTs are used in both personal computer monitors and host-based display terminals. PC monitors possess no intelligence; they are controlled by analog signals from a nearby desktop processor. Display terminals, in contrast, may incorporate limited intelligence and communicate digitally with local or remote hosts.

Market Overview

The video display terminal market can be broken into two major segments: the alphanumeric display industry and the graphics display industry. Integrated voice/data terminals form a third, smaller market segment; these products, however, are covered in a separate report. All alphanumeric display terminals provide manipulation of text, and many provide limited graphics capability as well.

An alphanumeric display provides access to an IBM synchronous midrange, IBM synchronous mainframe, or asynchronous host environment. Many synchronous displays provide access to both IBM and asynchronous hosts with the help of a communications controller such as the IBM 3174 Establishment Controller.

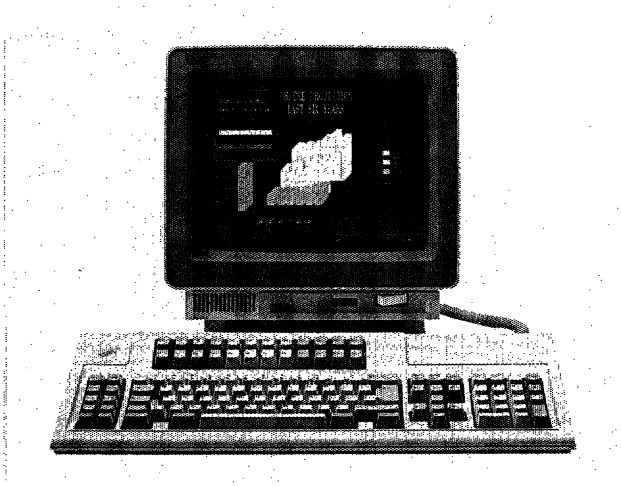
The X terminal, a new breed of graphics workstations that made its appearance in 1988, provides access to multiple incompatible hosts and host applications. These sessions appear on the terminal screen in separate windows whose sizes, positions, and other characteristics can be manipulated by the user.

A thriving industry only a decade ago, the alphanumeric display terminal market is now fighting a losing battle with personal computers, which provide both terminal emulation and local processing capability for an increasingly competitive price. The rapid spread of local area networks, which permit the sharing of network resources among multiple users, has further accelerated movement away from host-based alphanumeric displays.

Vendors of alphanumeric displays have preserved their product lines by making displays more compact, improving price/performance, adding productivity features, and offering multihost/multivendor connectivity and LAN gateways through multifunction communications controllers. Fierce competition and price wars within this market, however, have reduced the per-unit profits of many vendors, forcing them to sell more and more displays to make up the lost income.

In 1990 alone, numerous vendors withdrew from the alphanumeric display terminal market. Lee Data's family of IBM 3270-compatible displays, for example, was sold to Intelligent Information Systems, while AT&T signed control of its 3270-compatible products over to Memorex Telex. Some of these vendors have switched their market focus to LAN workstations, while others have begun to aggressively market X terminals.

The X terminal is a solution for users who need a low-cost method of simultaneously accessing multiple applications running in different com-



The IBM InfoWindow Graphics-5 3472 Model GC is a seven-color display that supports multiple windows, allowing a user to access up to five alphanumeric sessions and a graphics session simultaneously. Notepads support data transfer between sessions.

puter environments. Traditional displays do not provide the necessary processing power, resolution, and customization capability. Until the debut of the X terminal, this level of functionality was available only from powerful multitasking workstations running the UNIX operating system, which can easily cost more than $10,000. Using the X Windows system originally developed by Digital Equipment Corp. and MIT in 1984, however, the X terminal provides windowing capability, high-resolution graphics, and fast processing speed for as little as $1,500.

In contrast to the alphanumeric display market, the demand for X terminals is increasing. International Data Corp., of Framingham, MA, predicts that X terminal sales will increase 112 percent per year—from 68,000 units in 1990 to 486,000 units by 1994.

Market Leaders

The Alphanumeric Display Terminal Market

The alphanumeric display terminal market comprises two major segments: the asynchronous display market and the IBM 3270-compatible (synchronous) display market. The asynchronous display market is the largest of the two in terms of the number of vendors, the number of models marketed, and the quantity sold.

The asynchronous display market includes proprietary products from major computer vendors such as Digital Equipment and Data General, as well as general-purpose asynchronous displays offered by independent manufacturers such as Wyse Technology, TeleVideo Systems, Applied Digital Data Systems (ADDS), Esprit Systems, Visual Technology, and Qume. In addition to IBM, the 3270-compatible market includes products from such vendors as Memorex Telex, IDEA Courier, and Apertus Technologies.

Asynchronous Displays

The four major categories of general-purpose, asynchronous display terminals are entry-level ASCII displays; ANSI (Digital VT compatible) displays; combination ASCII/ANSI displays; and combination ASCII/ANSI/PC terminals. PC terminals, as their name implies, connect to a supermicrocomputer to form a multiuser system in which applications, files, and printers can be shared by multiple users.

ASCII display terminals use the ASCII (or TTY) protocol, which differs from the protocol used by Digital Equipment Corp.'s VT Series displays. Digital was the first vendor to support the X3.64 standard for two-dimensional data devices, which was published by the American National Standards Institute (ANSI) in 1977 to standardize control codes for all terminals. To provide true ANSI X.364 code compatibility, many vendors now provide Digital VT emulation in their terminals.

Wyse Technology is the leading vendor of asynchronous display terminals. With control of about 50 percent of this market, Wyse is second only to IBM in overall alphanumeric display terminal sales. Trailing Wyse in market shares are Applied Digital Data Systems, TeleVideo Systems, and the other asynchronous display vendors mentioned previously.

Digital's VT display family forms a sizable but distinct subset of the asynchronous terminal market. More than 1 million displays in each of the VT100, VT200, and VT300 families have been shipped.

The venerable VT100 is the most widely emulated asynchronous terminal, with more than a million imitators sold. When the VT100 was first introduced, Digital did not anticipate its popularity and was unable to meet the huge demand. As a result, several competitors created VT100 look-alikes. The popularity of Digital's VT200 and VT300 families has also led to numerous imitators.

The Synchronous Display Terminal Market

The IBM 3270 Display System has strongly influenced the alphanumeric display terminal market since deliveries began in 1972. For a detailed overview of the evolution of this system, see Table 1.

IBM has made dramatic improvements to the 3270 family within the past two years. In 1989, IBM overhauled the 3174, giving it greater speed, more memory capacity, and the capability to connect to up to three synchronous hosts. IBM's spotlight is clearly focused on the 3174 Establishment Controller, no longer just a shared-logic controller, but now a connectivity device for local area network interaction, serving as either a gateway or a network node. That year, IBM also introduced the InfoWindow 3471 and 3472 families of displays, which offer higher resolution and improved ergonomics. In 1990, IBM introduced versions of the

Wyse Technology's X terminal, the WY-X5, includes a flat, 17-inch, noninterlaced monochrome display with amber-white characters. The screen provides a 1,280-by-1,024 pixel resolution, 108 dots per inch, and a 70 Hz flicker-free refresh rate. Intuitive setup menus provide easy access to a variety of features, including configuration parameters, diagnostics, and network statistics.

3174 supporting IBM's new System/390 Enterprise Systems Connection (ESCON) architecture, which utilizes fiber optic media, and a new terminal multiplexer that raises the maximum number of attachable ASCII terminals from 32 to 64.

This year, IBM has introduced an ISDN Basic Rate Interface Adapter for the 3174, enabling it to accommodate up to eight PS/2s configured for ISDN communications. Big Blue has also announced future enhancements to the 3174 operating code, Configuration Support-C, which will add Advanced Peer-to-Peer Networking capability to the controller.

IBM has made this steady stream of enhancements and new product introductions to protect its large 3270 installed base, which numbers well over 1.5 million units. Vendors such as Memorex Telex, IDEA Courier, and Apertus Technologies, through lower prices or improved price/performance, have managed to erode IBM's share of the market. These vendors also offer communications controllers that support simultaneous access to multiple synchronous and asynchronous sessions and hosts for attached displays. Through multitasking windows, users can transfer data between these concurrent sessions. This flexibility is highly desirable for businesses using different systems in various locations.

The X Terminal Market

X terminals began to appear toward the end of 1988, with the first offerings introduced by California-based Network Computing Devices (NCD). X terminal announcements then followed from Tektronix, Visual Technology, Digital Equipment, Hewlett-Packard, Human Designed Systems, NCR Corp., Data General, Wyse Technology, and numerous other vendors. For many of these vendors, which have long since seen the writing on the wall for traditional display terminal products, X terminals are a means to diversify.

NCD currently leads the other vendors in market shares. According to International Data Corp. (IDC), the vendor holds over two thirds of the U.S. market and more than half of the worldwide market. By September 1990, it had shipped over 29,000 X terminals to more than 900 customers. NCD also OEMs its products to Bull, Tektronix, Pyramid Technology, Ardent, Stellar, and Mips Computer Systems in multimillion dollar deals.

NCD boasts that it offers a cheaper alternative to even low-end workstations. The NCD17c, for example, apparently offers three times the performance of the Sun 2/80 workstation.

Major competitors to NCD—Visual Technology, Tektronix, NCR Corp., and Human Designed Systems—largely fill the remaining portion of the domestic market.

Survey Results

Alphanumeric Display Terminals

About 50 percent of the alphanumeric display terminals covered in our survey are general-purpose asynchronous products (ASCII, ANSI, ASCII/ANSI, or ASCII/ANSI/PC terminals). The rest are IBM 3270- or IBM 5250-compatible products.

Prices for synchronous terminals range from $395 for Applied Digital Data Systems' Model 1010 monochrome ASCII terminal to $1,699 for Human Designed Systems' HDS3200 Model 5C color graphics ASCII/ANSI display. Prices for synchronous alphanumeric displays range from $1,060 for Memorex Telex' 1471 A/G Display to $3,630 for the IBM 3193 graphics display terminal.

Table 1. The Evolution of the IBM 3270 Family

1972	IBM delivered the first generation of 3270 devices: the 3271 Control Unit, the 3272 Control Unit, the 3275 Standalone Display Station, the 3277 Cluster Display Station, the 3284 Matrix Printer, the 3286 Matrix Printer, and the 3288 Belt Printer.
1977	IBM introduced a new generation of components offering increased capabilities at much lower prices, including the 3274 Control Unit, the 3276 Control Unit Display Station, and the 3278 Cluster Display Station.
1979	IBM added the first color products: the 3279 Color Display Station and color versions of the 3278 Printer.
1983	March: IBM announced several additions to the 3270 product line, including the 3178 Display Station (a smaller and less expensive version of the popular 3278 Model 2 display); the 3290 Information Panel, a gas plasma display; four new 3274 Control Unit models (41A, 41C, 41D, and 61C); the 3299 Terminal Multiplexer, a coaxial cable eliminator; and an option permitting the attachment of the IBM PC to the 3278 Display Station. October: IBM introduced the 3270 Personal Computer, a version of IBM's PC capable of supporting up to seven concurrent sessions: four 3270 sessions, one DOS session, and two notepad sessions. IBM also introduced the 3279 Personal Computer Attachment.
1984	IBM unveiled the 3180 Display Station and 3179 Color Display Station.
1985	IBM unveiled two graphics versions of the 3179 Color Display Station, Models G1 and G2, supporting selectable screen formats and all-points-addressable graphics.
1986	IBM realigned the 3270 family to highlight the 3174 Subsystem Control Unit, the first processor to support a token-ring connection and communications with asynchronous hosts. IBM released 3174 Controller Models 1L, 1R, 2R, 51R, and 52R that year. The vendor also announced the 3191, 3192, 3193, and 3194 display station series.
1987	IBM released 3174 Controller Models 3R and 53R and announced Models 81R and 82R.
1989	IBM overhauled the 3174, giving it greater speed, memory capacity, and connectivity options, and renaming it the 3174 Establishment Controller. IBM also introduced the InfoWindow 3471 and 3472 families of displays.
1990	IBM introduced 3174 Establishment Controller Models 12L and 22L, which support fiber optic connections to IBM's System/390 hosts. IBM also introduced the 3299 Terminal Multiplexer Model 32, which provides the fiber optic cable interface and increases the number of controller-attachable 3270 devices from 32 to 64.
1991	IBM introduced the 3174 ISDN Basic Rate Interface Adapter, which provides 64K bps communications speed over an integrated services digital network (ISDN) for up to eight PS/2s equipped with the ISDN Co-Processor/2 Model 2 Adapter and ISDN Co-Processor Support Program Version 1.1. IBM also pledged a future enhancement to Configuration Support-C, the 3174's operating code, which will provide Advanced Peer-to-Peer Networking capability.

X Terminals

Of the 37 X terminal models, 18 products offer display screen sizes as large as 19 inches. Most other terminals provide 14- to 17-inch screens. The products covered include 20 color display models.

Both the standard amount of memory and the maximum amount possible vary greatly from vendor to vendor. While Data General's AVX-30 comes with 0.5M byte of memory and expands to 4.5M bytes, the NCD17c comes with 4M bytes and is expandable to 32M bytes. Digital's VT1300, in contrast, comes with 8M bytes of memory standard, but it does not provide for further expansion.

Prices for X terminals vary from $995 for Visual Technology's X-14/ES to $13,950 for Jupiter Systems' Model 412.

Trends and Issues

IBM's 3270 Information Display System and Digital's VT display family continue to dominate the market. Full-featured, competitively priced imitators, however, are abundant. As a result, both IBM and Digital have had to adjust their prices downward to maintain their market shares.

Although the market for alphanumeric display terminals is expected to decline through the 1990s, lower prices and increased functionality and feature selection have made them more attractive than ever and will continue to play a major role in their continued acceptance as a low-cost alternative to PCs.

Terminals are now more compact, with tilt/swivel monitors and detachable, easy-to-use keyboards; glare-free screens with higher resolution and multiple screen formats; and windowing capability for multisession/multihost access.

Ergonomics and improved user interfaces now play an important part in display terminal marketing. Much publicity has recently been given to the health and safety aspects of working with displays. Repetitive strain injury (RSI), the result of prolonged keyboard activity, is a common user complaint. Other maladies, such as back- and headaches, are attributed to unnatural posture and screen flicker.

Another major concern is the terminal's radiation emissions level. Some vendors, such as ADDS and Idea, have reduced emissions in their products. Vendors now realize that ergonomically designed equipment addressing the causes of these problems has a large market. Employers are beginning to realize that taking ergonomic and environmental considerations seriously results in improved worker efficiency.

While the price of a display is still proportional to the level of functionality it offers, advances in technology have made the lines of definition between what is dumb and what is smart less distinct and have caused a drastic drop in prices. A decade ago, only the most basic dumb terminals carried a price tag below $1,000. Today, the price of some smart terminals has fallen below $500. It is obvious that the technological improvements in display terminals have had a significant impact on their prices.

The proliferation of PCs and diskless workstations, which support terminal emulation on LANs, has cut into the display terminal market. The diskless workstation lacks disk drives and other features normally found on a standalone PC, which makes it an affordable alternative to the traditional display. The multiuser microcomputer market, however, provides another avenue into which the display terminal vendor can sell.

The display terminal industry is expected to remain an important part of the office environment for the foreseeable future. The products most likely to succeed over the next few years are X terminals and those alphanumeric displays that are competitively priced, ergonomically designed, and user friendly. ■

Alphanumeric Display Terminals: Market Overview

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Synopsis

Editor's Note

This report presents an overview of the alphanumeric display terminal market. It identifies the major vendors and measures the market impact of technological developments. A separate technology overview, Report C25-010-201, discusses the technical aspects of display terminals and summarizes the important issues related to selecting a display terminal. Report C25-010-301 provides comparison columns containing key characteristics and pricing for 211 displays offered by 52 vendors.

Market Highlights

Greater functionality and lower prices have made display terminals even more attractive to users. Advances in microprocessor and CRT technology have made this trend possible. The driving force, however, has been the need for display terminal vendors to remain competitive with the growing base of diskless workstations and PCs. Fierce competition and price wars within the display market itself have reduced the per-unit profits of many display vendors, forcing them to sell more and more displays to make up the lost income.

The shift from host-based display terminals to intelligent LAN workstations tied to a file server has brought the future of displays into question. For now, however, the alphanumeric display terminal market remains viable.

Analysis

The first third-party "dumb" terminal, featuring limited editing capabilities, was introduced in 1972 by the Data Products Division of Lear Siegler, Inc. This terminal was used mostly for data entry applications. Since then, the video display terminal (VDT, or CRT, as it is commonly called) has grown into the principal interface between people and computers. As computers continue to permeate society, more and more people are exposed to them, not only as a business tool but also as a useful household and educational commodity. Originally invented as a "glass Teletype," the display terminal has developed to the point where it is a primary component in most modern computer applications, such as data entry, inquiry/response, telemarketing, computer graphics, and word processing/text editing. This report focuses on alphanumeric display terminals designed for general-purpose business applications.

Market Leaders

The alphanumeric display terminal market comprises two major segments: the asynchronous terminal market and the IBM 3270-compatible (synchronous) terminal market. The asynchronous market includes proprietary products from major computer vendors such as Digital Equipment and Data General as well as general-purpose ASCII displays offered by independent manufacturers such as Wyse Technology, TeleVideo Systems, Applied Digital Data Systems (ADDS), Esprit Systems, Visual Technology, and Qume. In addition to IBM, the 3270-compatible market includes products from such vendors as Memorex Telex, AT&T, IDEA Courier, and Lee Data.

The Asynchronous Display Market

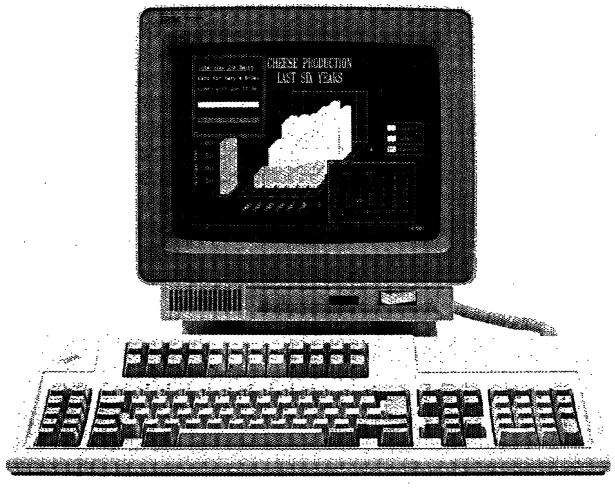
The asynchronous display market is the largest of the two major markets in number of vendors, number of models marketed, and quantity sold. This market originated as the Teletype (TTY) replacement market, with units intended to replace the highly popular Teletype ASR 33/35 teleprinter terminals. Although few of the asynchronous terminals purchased actually replaced the older Teletype units, the asynchronous terminal market is still often referred to as the Teletype-compatible market.

Manufacturers of asynchronous terminals generally aim their products at educational and commercial users who require large numbers of low-priced terminals for applications such as time-sharing and order entry.

Digital's VT display family forms a sizable but distinct subset of the asynchronous terminal market. More than 1 million displays in each VT family (VT100, VT200, and VT300) have been shipped.

Digital was the first vendor to support the X3.64 standard for two-dimensional data devices, which was published by the American National Standards Institute (ANSI) in 1977 to standardize control codes for all terminals. To provide true Digital emulation, many vendors now provide ANSI X3.64 code compatibility on their terminals.

The vendors in the Digital emulation market include those general-purpose terminal vendors mentioned previously. In fact, most major asynchronous terminal manufacturers provide at least one Digital emulator in their product line.



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The venerable VT100 is the most widely emulated asynchronous terminal, with more than 1 million imitators sold. When the VT100 was first introduced, Digital did not anticipate its popularity and was unable to meet the huge demand. As a result, several competitors created VT100 lookalikes. The popularity of Digital's VT200 and VT300 families has also lead to numerous imitators.

IBM and the Synchronous Terminal Market

The IBM 3270 has strongly influenced the alphanumeric display terminal market since deliveries began in 1972. For a detailed overview of the evolution of the IBM 3270 Display System, see Table 1.

IBM's most recent improvements to the 3270 family came in 1989, when it overhauled the 3174, giving it greater speed, more memory capacity, and the capability to connect to up to three synchronous hosts. IBM's spotlight is clearly focused on the 3174 Subsystem Control Unit, no longer just a shared-logic controller, but now a connectivity device for local area network interaction, serving as either a gateway or a network node. In 1989, IBM also introduced the InfoWindow 3471 and 3472 families of displays which offer higher resolution and improved ergonomics. IBM also reduced prices on older models.

IBM has made a steady stream of product enhancements and new product introductions to protect its large 3270 installed base, which numbers well over 1.5 million units. Vendors such as IDEA Courier, Memorex Telex, AT&T, and Lee Data, through lower prices or improved price/performance, have managed to erode IBM's share of the market. Memorex Telex, AT&T, and Lee Data, in particular, offer communications controllers that support simultaneous access to multiple synchronous and asynchronous sessions and hosts for attached displays. Through multitasking windows, users can transfer data between these concurrent sessions. This flexibility is very desirable for businesses using different systems in various locations.

Survey Results

About 60 percent of the products covered in our survey are general-purpose ASCII/ANSI displays; the rest support synchronous communications with IBM System/370 or midrange systems.

Nearly 80 percent of the asynchronous terminals support VT100 emulation; 56 percent offer

The Digital Equipment Corporation VT300 family consists of the VT320, VT330, and VT340 displays. The VT320 is a single-session text terminal; the VT330 is a monochrome text/graphics terminal with dual-session capability; and the VT340 is a color text/graphics terminal, also with dual-session capability.

VT200 emulation, and only six percent (13 products in all) are VT300 compatible.

Half of all terminals surveyed support multiwindowing capability, although only one fourth of them offer graphics capability for creating pie charts, bar graphs, etc.

Prices for synchronous terminals range from $749 for Decision Data's Model 3596 display to $2,700 for Informer's 205/374 IBM-Compatible Portable Terminal. Only one fifth of these synchronous products are priced below $1,000, although about half of them sell for less than $1,500.

Prices for asynchronous terminals range from $249 for Computerwise's Transterm compact industrial terminal to $6,000 for General Digital Corporation's Graphics Vuepoint industrial terminal. About half of the asynchronous products are priced less than $1,000; more than one third sell for less than $700.

Trends and Issues

IBM's 3270 Information Display System and Digital's VT display family continue to dominate the market. Full-featured, competitively priced imitators, however, are abundant. As a result, both IBM and Digital have had to adjust their prices downward to maintain their market shares.

Both segments of the display market continue to enjoy steady growth, particularly the asynchronous terminal market. Lower prices and increased functionality and feature selection have made display terminals more attractive than ever and will continue to play a major role in the direction of each of these segments.

Terminals are now more compact, with tilt/swivel monitors and detachable, easy-to-use keyboards; glare-free screens with higher resolution and multiple screen formats; and windowing capability for multisession/multihost access.

While the price of a display is still proportional to the level of functionality it offers, advances in technology have made the lines of definition between what is dumb and what is smart less distinct, and have caused a drastic drop in prices. Eight or nine years ago, only the most basic dumb terminals carried a price tag below $1,000. Today, the price of some smart terminals has fallen below $500. It is obvious that the technological improvements in display terminals have had a significant impact on their prices.

The proliferation of PCs and diskless workstations, which support terminal emulation on LANs, has cut into the display terminal market. The diskless workstation lacks disk drives and other features normally found on a standalone PC, which makes it an affordable alternative to the traditional display. The multiuser microcomputer market provides another avenue into which the display terminal vendor can sell. However, we expect the display terminal industry to remain an important part of the office environment for the foreseeable future. ■

Display Terminals: Technology Overview

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Synopsis

Editor's Note
This report covers the basics of display technology and offers display selection criteria. A separate market overview focuses on the major display vendors, market segments, and market trends. A comparison column report presents key characteristics and pricing for more than 155 display terminals offered by 30 vendors.

Technology Highlights
Important milestones in the evolution of the display terminal include the addition of a microprocessor and improvements in ergonomics. The microprocessor can handle many functions, including protocol emulation, definition of character code sets, control of parameter settings, and special capabilities such as windowing.

Ergonomics, the study of the effects of workstation design on the operator, has brought forth improvements in both the display screen and the keyboard. Displays are now detachable from the keyboard and have tilt and swivel capability. This allows the user to position the keyboard and screen for maximum typing comfort and minimum eyestrain. Displays also offer brightness and contrast controls and nonglare screens, and some meet strict health standards for radiation emission.

In environments where many users require simultaneous access to multiple applications running across different hosts, the limitations of displays and the high cost of workstations left a gap in the market. X terminals, which first made their appearance in 1988, implement the same X Windows system used in high-end multitasking workstations. With windowing and high-resolution graphics, X terminals offer the processing power and functionality of a high-end workstation for a fraction of the price.

—By Martin Dintzis
Assistant Editor

Analysis

Technology Basics

Since the introduction of the display terminal, the single most important development in the industry has been the addition of the microprocessor. Improvements have also occurred in cathode-ray tube (CRT) technology, ergonomics, and more recently, the graphics and multisession/multiwindowing technology offered by the X Windows system.

Microprocessor Control

In 1975, only 10 percent of the terminals installed offered this feature; now, all terminals manufactured are microprocessor controlled. Microprocessor-based programs (firmware) reside in read-only memory (ROM) or programmable read-only memory (PROM). ROM-resident programs, inexpensive when produced in large quantities, control those features that are permanent and unchangeable, while PROM-resident programs are typically produced in smaller quantities and implement customized or modifiable features. Users can replace either type by simply removing the old chip and inserting a new one. This flexibility is highly beneficial to the manufacturer; older equipment can be updated and nonstandard customer specifications can be met without costly hardware changes. Theoretically, program interchangeability might also benefit the user, but in practice it is doubtful that the requirements of a particular user would change often enough to make it a great advantage. The fact that PROM replacement generally must be done at the factory or by a field service technician precludes frequent PROM changes.

In addition to controlling basic terminal functions, the microprocessor firmware can provide protocol emulation, definition of the character/code sets to be generated by the keyboard and displayed on the screen, implementation of special features such as windowing capability, and control of parameter settings. Firmware specifications are generally determined at the time of order, and once the firmware is in place, execution is transparent to the user. Some vendors have predetermined programs from which to choose; a few permit users to submit their own firmware specifications.

Display Media

The most widely accepted display medium for terminals is the cathode-ray tube (CRT). This device, similar to a television picture tube, displays textual and graphic information. Its flexibility, high-character capacity, and low cost are the primary factors contributing to its popularity.

The CRT can display alphanumeric characters in an endless number of formats. Through this medium, users can achieve visual attributes such as blinking, underlining, reverse video, double-size characters, and varying levels of brightness.

A growing number of alphanumeric display terminals offer graphics character sets for creating forms, report formats, graphs, and pie charts on-screen. Some also permit the creation of business graphics—for example, bar, column, and pie charts reflecting sales, income, expense, and inventory levels.

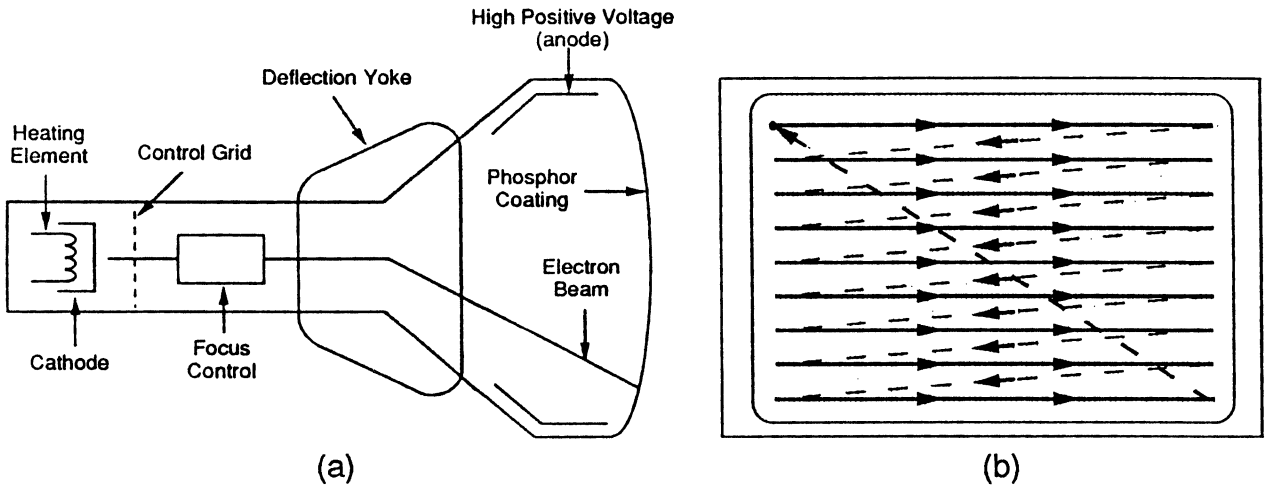
Unlike entry-level alphanumeric displays, which process text only, graphics workstations such as X terminals use bit mapping to display both text and nontext elements. Bit mapping allows an unlimited number of character fonts (styles) and character sizes to be displayed. Text and other elements, moreover, appear on the screen exactly as they will appear on the printed page.

CRT Operation

The CRT consists of a vacuum tube enclosed in glass. An electron gun at one end of the tube generates a fine beam of electrons that strikes a flat, phosphorous-coated screen at the other end of the tube. When struck by the beam, the phosphor glows. Focusing and deflection coils control the direction of the beam, causing it to strike any desired point on the CRT screen. The electron beam sweeps across the screen in successive horizontal lines (see Figure 1). This pattern is called a raster scan.

Although the CRT offers high resolution and is the most inexpensive type of display, it is bulky and consumes much power. Other types of display

Figure 1.
CRT Image Generation



(a) The CRT produces images by generating a beam of electrons and focusing it onto a phosphorous-coated screen, which fluoresces or emits light at the point of contact. (b) The beam sweeps the screen from top to bottom and left to right in a pattern called a raster scan.

screens, developed for portable electronic products, include liquid crystal displays (LCDs), electroluminescent displays (ELDs), and gas-plasma displays (GPDs), all of which use flat panel technology. LCDs, which consume as little as 80 milliwatts of power, are widely used in laptop microcomputers.

Ergonomics

The effect of display terminal design on the operator has been studied for some time. This interest in ergonomics—the study of interactions between workers and their environments—began in Europe, where powerful unions representing clerical workers have implemented guidelines on the types of display terminals their members will use. Although the United States has not implemented such guidelines, vendors, realizing the market value of enhancing their products with these ergonomic features, have done so voluntarily. Indeed, ergonomic improvements are listed prominently on much vendor marketing literature under headings such as "Health and Safety" and "Human Features," specifying beneficial features such as a tilt/swivel display, a movable low-profile keyboard, matte finish keycaps, external brightness and contrast controls, antiglare screens, and conformance to European safety standards for radiation emissions.

Ergonomic improvements have concentrated on the two components with which the operator interacts most: the display screen and the keyboard. Most screens and keyboards were once integrated as one unit; that arrangement is now the exception rather than the norm. Keyboards are now detached or detachable, connecting to the display via a coiled cord that allows the operator to position the keyboard for optimum comfort. Keyboard color and the arrangement of keys have also been affected by improved ergonomics. These changes make it simpler to identify specific sets of keys and simpler to train personnel already familiar with the typewriter-style key arrangement. In addition, some vendors have included palm rests for operator comfort and have replaced flat caps with sculptured keycaps. Studies have shown that a slope of 5 to 15 degrees is the most comfortable profile angle for keyboard operators, while thickness, or distance from the base of the keyboard to the home row of keys, generally should not exceed 30 mm.

When making CRTs more "user friendly," manufacturers placed considerable emphasis on the display screen because eyestrain and fatigue were major points of dissatisfaction. In the past, when the display and keyboard were attached, there was little or no chance of positioning the screen. Since undertaking the task of improving terminal ergonomics, most manufacturers have

incorporated tilt and swivel mechanisms into their units. These features allow the display screen to be raised or lowered to alleviate strain on the eye muscles, the neck, and the back. The swivel capability offers flexibility in operator position.

X Windows Technology

X Windows is the result of a project initiated by a group of programmers at the Massachusetts Institute of Technology (MIT) in 1984. It was born out of a project called Athena to investigate the educational application of a large network of graphics workstations in a multivendor (IBM, Digital Equipment, and others) environment where portability of applications and system software was important. The institute worked with Digital Equipment, IBM, and others to produce X Windows System Version 11.1, which was publicly released in October 1987.

MIT designed X Windows as a distributed, network-transparent, hardware-independent, multitasking, windowing, and graphics system. It allows the display of multiple applications on the same screen and lets one application use many windows. It supports overlapping and hidden windows, text with soft fonts, and two- and/or three-dimensional graphics drawing.

Hardware independence is achieved because the X architecture splits windowing into two distinct parts, using the client/server model. The application program (client) and the display station (server) may be separated across a network or resident on the same system, as in the case of a single user executing a program locally. A workstation running a client application could display graphics on an intelligent terminal running on an X server. The client can make requests of the server to draw windows, text, and other objects. The server program runs on each workstation, drawing the required objects on the display.

Several clients' programs may communicate with a single server, and each client application can control one or more windows on the screen. The function of the server program is to ensure that applications do not interfere with one another.

The client communicates with the server by sending packets of instructions conforming to the X Protocol, which is effectively a high-level graphics-description language. Each workstation has its own server containing the hardware-dependent drivers for that device. An X server controls not only the screen but also the keyboard and pointing device.

What Is an X Terminal?

An X terminal includes a monitor equipped with a graphics co-processor, 1M byte or more of internal memory, a system box that runs the X Windows and network communications, a keyboard, and a mouse port. For the X terminal to function, users must install windowing software on the host processor running the application.

X terminals can communicate with multiple hosts over an Ethernet network. As an alternative, one or two X terminals can tap the processing power of an existing high-end graphics workstation, yielding three workstations for the price of about two.

Because they use existing computing resources, X terminals minimize hardware and software costs, making them viable alternatives for organizations that cannot justify the purchase of additional standalone systems.

Some critics of X terminals claim they consume too many resources. Because the X terminal operates in a timesharing mode, users can also experience slow response time during busy days. Another area of concern is that the X terminal may exceed its internal memory capacity when managing several concurrent applications, thereby causing the system to crash.

Selection Guidelines

Issues to consider in evaluating a display terminal include its compatibility with an existing or future computer environment; its suitability, in terms of features supported for a particular range of applications; the price/performance ratio it offers in comparison to other similar displays; and the level of postsale support offered by the vendor. This section provides selection guidelines for both alphanumeric displays and X terminals.

Alphanumeric Displays

Compatibility issues for alphanumeric displays include emulation capability, flexibility of interfacing, and transmission speed. Desirable terminal features, including the appropriate keyboard layout, may differ with the type of application. In

data entry, for example, a numeric keypad, editing capabilities, and a protect format mode are important. The protect format allows users to enter data onto a screen template resembling a commonly used printed form. While information can be entered into certain variable fields within the template, field identifiers and other standard elements are protected from alteration or erasure. In an environment in which multiple sessions must be accessed concurrently, the ability to transfer data between sessions (cut-and-paste capability) is a crucial feature.

The greater the range of applications for which a terminal is to be used, the more versatile it must be. A user-definable screen setup mode, a choice of multiple screen arrangements, and an abundance of programmable function keys can enable the user to customize the terminal to a particular task. Some alphanumeric displays support windowing. Although monochrome windowing displays exist, a color monitor that supports the ability to customize the color and appearance of each window greatly improves visibility.

Many terminals support extras such as alarm clocks, calendars, calculators, rulers, notepads, and record/playback capability, which improve worker productivity. Comparing features with price among terminals of the same class is an important step in finding the best buy.

X Terminals

The size of the display screen alone does not determine the amount of information that the X terminal can display; the image quality must also be considered. Image quality is determined by the screen resolution, expressed in pixels (picture elements); the image clarity, expressed in the number of dots per inch; the levels of brightness and contrast that are possible; and the refresh rate.

Many X terminals have, in addition to the main processor, a separate graphics processor. A dual-processor architecture, obviously, can provide faster screen painting and scrolling.

The memory capacity must be capable of supporting the number of concurrent windows needed, window management systems such as OSF Motif and DECwindows, and future extensions or enhancements to the system. Generally, 1M byte is the minimum acceptable amount of memory.

X terminals support varying numbers of communications ports (from two to five) for hosts and peripheral devices. The product should support multiple interfaces, such as Ethernet ThickNet and ThinNet, twisted pair, RS-232-C, and RS-422; it should also provide future compatibility with the ISDN basic rate interface (BRI) and the fiber distributed data interface (FDDI). The communications software should likewise support multiple protocols, such as TCP/IP; DECnet for DECwindows; Telnet for access to non-X environments; and font access protocols such as DAP, NFS, and TFTP.

The X terminal should provide a menu-driven setup menu allowing the user to customize screen colors and/or shades, select fonts, choose network protocols, enable specific I/O devices, and define other operational parameters.

Important network management features to look for include diagnostics capability, network statistics reporting, an out-of-memory alarm, and SNMP protocol support.

On-Site Service

Vendors vary in the level of service they offer. Smaller vendors often offer free factory service over the display's warranty period, which may last anywhere from 90 days to 3 years. Thereafter, this arrangement can be extended for an annual fee. A few of these smaller vendors also offer on-site service through a third party. Larger vendors generally offer walk-in service at an approved distributor or on-site repair for an annual fee. ■

Alphanumeric Display Terminals

The first "dumb" terminal, featuring limited editing capabilities, was introduced in 1972 by Lear Siegler, Inc./Data Products Division. This terminal was used basically for data entry applications. Since that time, the video display terminal (VDT, or CRT, as it is commonly called) has grown into the principal interface between people and computers. As computers continue to permeate every aspect of society, more and more people are exposed to them, not only as a business tool, but as a useful household and educational commodity. Originally invented as a "glass teletype," the display terminal has developed to the point where it is a primary component in the vast majority of modern computer applications, such as data entry, inquiry/response, telemarketing, computer graphics, and word processing/text editing. This report focuses on alphanumeric display terminals designed for general-purpose business applications.

Enhancements in the design and functionality of the cathode-ray tube (CRT) have contributed to the growth of the market. However, one of the major controlling factors, in terms of how it affects the end user, is price. Originally, dumb terminals were the least expensive, while smart terminals and user-programmable terminals were each more expensive; price was proportionate to capability. While this is still true, advances in technology have made the lines of definition between what is dumb and what is smart less distinct. These technological advances are responsible for the drastic drop in prices over the past 10 years and the virtual extinction of the dumb terminal. When considering that seven or eight years ago, only the most basic dumb terminals carried a price tag below $1,000, and that today the price of some smart terminals has fallen below $400, it is obvious that the technological improvements in display terminals have had a significant impact upon their prices. Prices for terminals listed in this year's survey range from $390 to $6,810.

The Cumulus Technology Model HCT is compatible with the Hewlett-Packard 239X and 700/9X terminals and supports eight memory screens. The terminal sells for $795 and has a five-year warranty.

The terminal market has experienced continuing upheaval over the last few years, with declining prices and dwindling margins creating fierce competition. Nevertheless, the alphanumeric display terminal market remains viable. Terminal vendors continue to come and go, but the major players are successfully maintaining respectable market shares. This report will focus on alphanumeric display terminals designed for general-purpose business applications. It includes a brief historical summary of the market, market trends, developments in ergonomics, and a look at the industry's major segments. Also included are comparison columns detailing the specifications of 115 display terminal models offered by 25 vendors.

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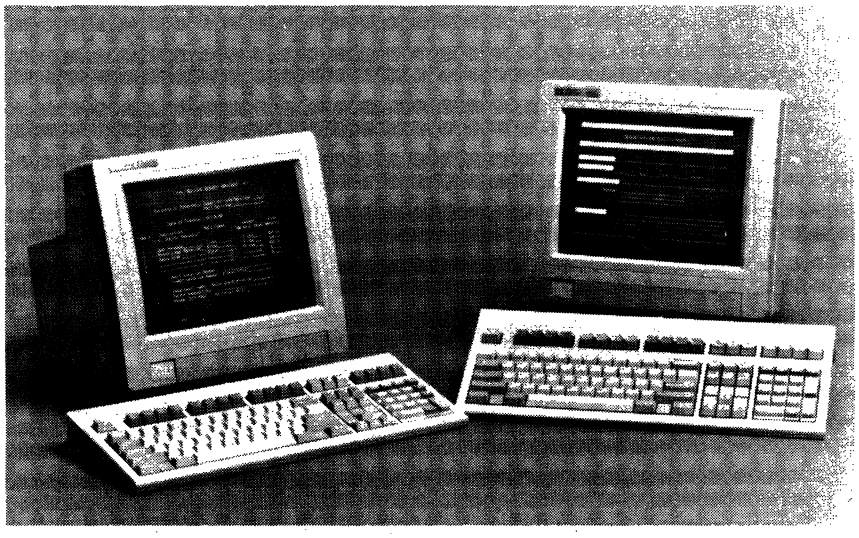
Another factor contributing to the decline in prices is terminal emulation. Although IBM continues to dominate the market with its popular 3270 Information Display System, 3270-compatible terminals and peripherals are plentiful in today's market. This market saturation of full-featured, lower-priced IBM imitators caused IBM to adjust its prices downward to maintain the upper hand in its own market.

Other popular compatible markets are the Digital Equipment Corporation VT100 and VT200 markets. Like IBM,

Alphanumeric Display Terminals



The Hewlett-Packard HP 700/43 (left) is an ASCII terminal with 12 terminal compatibility modes and four pages of display memory. The HP 700/44 (right) can be connected to a PC running Santa Cruz Operation's Xenix operating system and then can share the applications and capabilities of the PC.

Digital has a sizable following in these areas. Many vendors are raking in profits by marketing cheaper clones of the VT100 and VT200 Video Display Family terminals. Digital has discontinued these families, however, and now markets the VT300 family.

GENERAL CATEGORIES

All display terminals discussed in this report have three features in common: 1) each has a keyboard and monitor that can generate and display a full alphanumeric character/code set; 2) each has the capability to send and receive data via communication lines to a remote host computer; and 3) each is marketed for general-purpose usage in the United States and Canada and is identified as a distinct product to end users.

MICROCOMPUTERS VS TERMINALS

The acceptance of the microcomputer by corporations has somewhat jeopardized the display terminal market. The microcomputer market has also experienced a steady decline of prices, making the microcomputer a more attractive buy. A number of firms are using them as multipurpose workstations that duplicate some of the functions traditionally performed by terminals. As microcomputer-to-mainframe links improve, more and more microcomputers will be capable of performing terminal tasks as well as microcomputing tasks. The multiuser microcomputer market provides another arena into which the display terminal vendor can sell. However, we expect the display terminal industry to remain an important part of the office environment for the foreseeable future.

MICROPROCESSOR CONTROL

Since the introduction of the display terminal in 1965, the single most important development in the industry has been the addition of the microprocessor. In 1975, only 10 percent of the terminals installed offered this feature; now, all terminals manufactured are microprocessor controlled.

Microprocessor-based programs (firmware) reside in ROM or PROM. ROM-resident programs, which are inexpensive when produced in large quantities, control those features that are permanent and unchangeable, while PROM-resident programs are typically produced in smaller quantities and implement customized or modifiable features. Users can replace either type by simply removing the old chip and inserting a new one. This flexibility is highly beneficial to the manufacturer, since older equipment can be updated and nonstandard customer specifications can be fulfilled without costly hardware changes. Theoretically, program interchangeability might also benefit the user, but in practice it is doubtful that the requirements of a particular user will change often enough to make it a great advantage. The fact that PROM replacement generally must be done at the factory or by a field service technician precludes frequent PROM changes.

In addition to controlling basic terminal functions, the microprocessor firmware can provide protocol emulation, definition of the character/code sets to be generated by the keyboard and displayed on the screen, implementation of special features, and control of parameter settings. Firmware specifications are generally determined at the time of order and, once the firmware is in place, execution is transparent to the user. Some vendors have predetermined programs from which to choose; a few permit users to submit their own firmware specifications.

Alphanumeric Display Terminals

DISPLAY MEDIA

The most widely accepted display medium for terminals is the cathode-ray tube (CRT). This device, similar to a television picture tube, displays textual and graphic information. Its flexibility, high character capacity, and relatively low cost are the primary factors contributing to its popularity.

The CRT has the capability to display alphanumeric characters in an endless number of formats. Through this medium, users can achieve visual attributes such as blinking, underlining, reverse video, and varying levels of brightness. Some CRT terminals can display double-size characters. A growing number of CRT vendors are offering graphics character sets for creating forms, report formats, graphs, and pie charts on-screen. Some CRTs also permit the creation of business graphics—for example, bar, column, and pie charts reflecting sales, income and expense, and inventory levels. Interactive graphics and engineering graphics, on the other hand, are completely different disciplines that require a high-resolution graphics terminal. Graphics terminals can also display alphanumeric characters, but they are considerably more expensive.

In addition to the CRT, other display media include light-emitting diodes (LEDs), which are popular in calculators and point-of-sale (POS) terminals, and gas-discharge displays. These media generally produce higher resolution displays than CRTs, but their high cost has prevented them from overtaking the CRT in popularity.

ERGONOMICS

The effect of display terminal design on the operator has been under consideration for some time now. This interest in *ergonomics*, which is defined as the study of interactions between workers and their environments, began in Europe, where powerful unions representing clerical workers have implemented guidelines on the types of display terminals their members will use. Although the United States has not implemented such guidelines, vendors, realizing the market value of enhancing their products with these ergonomic features, have done so voluntarily.

Ergonomic improvements have concentrated on the two components with which the operator interacts most: the display screen and the keyboard. The majority of screens and keyboards were once attached as one unit; that arrangement is now the exception rather than the norm.

Keyboards are now detached or detachable, connecting to the display via a coiled cord that allows the operator to position it for optimum comfort. Keyboard color and the arrangement of keys have also been affected by improved ergonomics. These changes make it simpler to identify specific sets of keys and simpler to train personnel already familiar with the typewriter-style key arrangement. In addition, some vendors have included palm rests for operator comfort and have replaced flat caps with sculptured key caps. Studies have shown that a slope of 5 to 15 degrees is the most comfortable profile angle for keyboard operators, while thickness, or distance from the base of the keyboard to the home row of keys, generally should not exceed 30 mm.

When making CRTs more "user friendly," manufacturers placed considerable emphasis on the display screen because eye strain and fatigue were major points of dissatisfaction. In the past, when the display and keyboard were attached, there was little or no chance of positioning the screen to avoid glare. Since undertaking the task of improving terminal ergonomics, most manufacturers have incorporated tilt and swivel mechanisms into their units. These features allow the display screen to be raised or lowered to alleviate strain on the eye muscles, the neck, and the back. The swivel capability offers flexibility in operator position.

MAJOR DISPLAY MARKETS

The alphanumeric display terminal market generally is acknowledged to contain two major segments: the ASCII (asynchronous) terminal market and the IBM 3270-compatible (synchronous) terminal market.

The IBM 3151 ASCII Display Stations are available in three models and feature 10 non-IBM ASCII emulations including TeleVideo, Zentec, ADDS, and Hazeltine. In addition, the Models 310/410 include IBM 3101 emulation and accept five optional slim-line cartridges supporting a total of 20 additional emulations.

Alphanumeric Display Terminals

- The ASCII, or asynchronous, terminal market includes general-purpose displays from independent manufacturers such as Wyse Technology, TeleVideo Systems, Applied Digital Data Systems (ADDS), Esprit Systems, Visual Technology, and Qume, as well as terminals from computer system makers such as Digital, AT&T, and Data General.

- The IBM 3270-compatible market includes the IBM 3270 Information Display System product line and compatible offerings from vendors such as Memorex Telex, AT&T, and Lee Data.

Both segments continue to enjoy healthy growth, particularly the ASCII market. Low prices and increased price/performance have made display terminals more attractive than ever to potential users and continue to play a major role in the direction of each of these segments. Increased functionality and feature selection coupled with rapidly declining price levels mark both of the major segments of the market.

THE ASCII TERMINAL MARKET

The ASCII display terminal market is the largest segment of the two major display markets, with regard to number of vendors, number of units marketed, and quantity sold. This market originated as the Teletype (TTY) replacement market, with units intended to replace the highly popular Teletype ASR 33/35 teleprinter terminals. Although few of the ASCII terminals purchased are actually replacing the older Teletype units, the ASCII terminal market is still often referred to as the teletype-compatible market.

Manufacturers of ASCII terminals generally aim their products at educational and commercial users who require large numbers of low-priced terminals for applications such as timesharing and order entry.

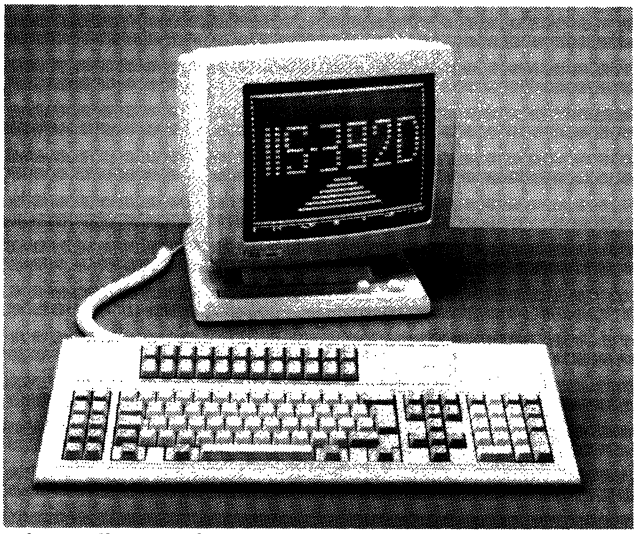
As mentioned previously, price is a key factor for success in this market. The continuing price war between the low-end entries in the ASCII terminal market has made recent activity in this segment even greater than in the past. Initially, only the truly "dumb" terminals (like the original dumb unit, the Lear Siegler ADM 3) were available for less than $1,000. Now, features such as block mode transmission and editing capabilities are available at below traditional dumb terminal prices. In addition to price cuts, vendors are attempting to make their offerings more attractive by adding enhanced features such as business graphics, split-screen or windowing capabilities, and a variety of visual attributes. ASCII terminal vendors are also paying much attention to ergonomics, incorporating features such as tilt/swivel screens and low-profile keyboards into their products.

Leaders in the ASCII field generally provide a full range of terminal models, ranging from low-end units to editing models. The current leaders include Wyse Technology, TeleVideo Systems, Applied Digital Data Systems (ADDS), Esprit Systems, and Qume. TeleVideo was the first to offer terminals at extremely low prices by manufacturing them overseas.

An active, but somewhat separate, subsection of the ASCII terminal market consists of the Digital VT100 and its successors, the VT220 and VT300 family, and those terminals that offer Digital emulation. A large number of vendors are involved in the Digital emulation market, including those general-purpose terminal vendors previously mentioned; in fact, most major ASCII terminal manufacturers provide at least one Digital emulator in their product line. The venerable VT100 is the most widely emulated ASCII terminal, with more than 1 million imitators sold. When the VT100 was first introduced, Digital did not anticipate its popularity and was unable to meet the huge demand. As a result, several competitors created VT100 look-alikes.

The Digital Equipment Corporation VT300 family consists of the VT320/330/340. The VT320 is a single-session text terminal; the VT330 is a monochrome text/graphics terminal with dual-session capability; and the VT340 is a color text/graphics terminal also with dual-session capability.

Alphanumeric Display Terminals



The Intelligent Information Systems (IIS) Model IS-392D is plug compatible and interchangeable with the IBM 3192 Model D Display Station. The terminal features four user-selectable screen formats and extended data highlighting facilities.

As a by-product of Digital emulation, vendors are now providing ANSI X3.64 code compatibility on their terminals. The American National Standards Institute (ANSI) first published the X3.64 standard for two-dimensional data devices in 1977 to standardize control codes for all terminals. The Digital VT100 was the first display terminal to conform to the ANSI standard, and the VT220 also conforms. In order to provide true Digital emulation, the makers of Digital emulators must provide ANSI X3.64 code compatibility on their products.

In addition to Digital, most of the major mainframe and minicomputer vendors offer terminal product lines for use with their computer systems. Hewlett-Packard claims a large installed base of display terminals, as does Data General.

IBM'S BEST-SELLER—THE 3270

The IBM 3270 has strongly influenced the alphanumeric display terminal market since deliveries began late in 1971. The first generation of devices, which were discontinued as IBM products in late 1982, included the 3271/3272 control units, 3275 display station, 3277 display, and 3284/3286/3288 printers. In 1977, IBM radically overhauled the product line and announced a second generation of components (the 3274 control unit, 3276 control/display, 3278 display, and 3287/3289 printers) that offered increased capabilities at much lower prices than comparable older models. Along with that announcement came major price reductions on the older equipment. In late 1979, IBM added color displays and printers to the family.

In March 1983, IBM made some long-awaited changes and enhancements to the 3270 product line. It unveiled the 3178 Display Station, a smaller and less expensive version of the popular 3278 Model 2 display; new versions of the 3274 Control Unit, offering improved price/performance; the 3290 Information Panel, a gas plasma display; the 3299 Terminal Multiplexer, a coaxial cable eliminator; and an option permitting the attachment of the IBM Personal Computer to the 3278 Display Station. IBM also announced price reductions on older existing 3270 models and purchase discounts of 40 percent on the 3178 for quantities of 3,000 or more, with the conversion of leased 3278s applying to that quantity. These announcements were followed later that year with the introduction of the 3270 Personal Computer, a version of the firm's PC for use as part of a 3270 cluster. The 3179 color display and 3180 display, both compact terminals built along the same lines as the 3178, were unveiled in March 1984.

On June 16, 1986, IBM realigned the 3270 family to highlight the 319X display station series and 3174 Subsystem Control Unit. In addition to the 3191, 3193, and 3194 display stations, IBM also announced the 3192, which replaced the 3179-1 and 3180-1 Display Stations. IBM's spotlight is clearly focused on the 3174 Subsystem Control Unit, no longer just a shared logic controller, but now a connectivity device for local area network interaction, serving as either a gateway or a network node.

IBM made these changes to protect its large (and lucrative) 3270 installed base, which numbers well over 1.5 million units. The independent 3270-compatible terminal vendors, through lower prices or improved price/performance, were seriously eroding IBM's share of the market. These independents include vendors such as IDEA Courier (formerly Alcatel Courier), Memorex Telex (recently formed by the merger of Memorex and Telex), AT&T, and Lee Data. In order to remain competitive, these vendors were forced to reply to the IBM announcements with new products and/or price reductions of their own.

The advent of local area networks (LANs), many of which support 3270 devices, breathed new life into the 3270-compatible market. IBM's recent changes to its 319X display terminals and its introduction of the 3174 Subsystem Control Unit have intensified the competition even more.

With the increased pressure from IBM, it is now more important than ever that independent vendors offer a complete line of 3270-compatible products. Today's successful independents must couple a full range of products with lower prices, improved price/performance, and added value in order to create the opportunity to penetrate an IBM shop.

To reap the benefits of both worlds, some vendors have introduced systems that provide synchronous and asyn-

Alphanumeric Display Terminals

chronous communications. Users can simultaneously gain access to more than one host computer, transfer data among them, and view operations through multitasking display terminals. These capabilities are particularly significant for businesses using different systems in various locations. The AT&T 6500 Multifunction Communications System and the IBM 3174 Subsystem Control Unit are among the systems that offer this versatility.

THE VENDORS

For your convenience in obtaining additional information, the following report provides a list of alphanumeric display terminal vendors' names, addresses, and telephone numbers.

Nearly all of the information was supplied by the manufacturers during January 1989. Their cooperation is acknowledged and greatly appreciated.

Datapro sent requests for information to over 55 companies known or believed to be in the display terminal business. The usable responses, summarized in our comparison columns, provide a comprehensive picture of the commercial display terminals available in the United States and Canada. *The absence of any specific company from our columns means that the company failed to respond to our information requests.*

KEY TO ALPHANUMERIC DISPLAY TERMINAL COMPARISON COLUMNS

The accompanying comparison columns summarize the characteristics of 115 commercially available alphanumeric display terminals from 25 vendors. The column entries and their significance are explained in the following key.

VENDOR AND MODEL

The model number or name of the product and the name of the company that manufactures it is listed at the top of each column.

PHYSICAL SPECIFICATIONS

Screen Size. Information is displayed in a rectangular area, slightly smaller than the total surface of the display screen. The factors that determine the required size of the screen area are the display arrangement and the size of the displayable characters. For example, the typical 1,920-character display uses a 12- or 15-inch (diagonal) screen area.

Screen Capacity/Screen Arrangement. Information displayed on the screen of a CRT is generally arranged according to an orderly format consisting of a maximum number of printed lines per screen and characters per line. The electronic circuitry that produces the display image is designed to a specified set of parameters that define the *screen capacity* (i.e., the maximum number of display positions) and the *screen arrangement* (i.e., the maximum number of displayable lines and displayable characters per line). The most common display capacity is 1,920 characters arranged in 24 lines of 80 characters. Many vendors offer 132-character display lines, which can eliminate the need to revise or patch software designed for standard 132-column printers or to maintain dual sets of programs for 80-column and 132-column output.

Status Line. This line usually appears at the bottom of the display screen and provides status information on the terminal, such as the display parameters in use.

Character Color. Designers can make characters clearer by increasing the number of dots within the matrix. The stroke technique forms characters by drawing short straight lines between specified points. *Character phosphor* refers to the physical coating of phosphorous on the back side of the screen which, when illuminated, creates the displayed characters. The type of phosphor used defines the color of the displayed character, as well as the persistence of the phosphor. A long-persistence phosphor is less likely to cause image flicker problems than a short-persistence phosphor; however, the image of a long-persistence phosphor is more likely to smear when lines are scrolled. Among the more common phosphors are P4 (white) and P31 or P39 (green). Amber and yellow-green phosphors are also available on some terminals.

Display Ergonomics. Ergonomics are increasingly important as terminal features. One popular feature is a *tilt and/or swivel screen.* This feature allows the mounting of the display monitor onto a separate desktop base or pedestal and allows the operator to twist the screen vertically ("tilt") and/or horizontally ("swivel") to the best position for viewing.

Keyboard Style. This entry defines the general arrangement of keys; e.g., typewriter or data entry (keypunch) style. Data entry keyboards have a numeric keypad embedded in the alphabetic part of the keyboard, which is accessed via numeric shift.

Function Keys. Some terminals are available with *program function keys,* which are special keys whose character codes are interpreted by the user's program. A function key is used to reduce the number of required input keystrokes to save time and reduce the number of input errors. Depressing one key could instruct the system to "sell one seat" or "call Chart A," for example.

Keyboard Ergonomics. Keyboards that can fit flush against the display or be located some distance away via cable connection are referred to as *detachable* keyboards. This feature provides increased configuration flexibility and operator convenience.

Scrolling. This feature moves all displayed lines of data up or down by one line as a new line is added and an existing one removed. In some cases, the first line is linked with the last so that the data is rolled but not lost. In others, data is lost as it rolls off the screen. This feature permits the user to scan through a volume of data to locate key information.

Alphanumeric Display Terminals

KEY TO ALPHANUMERIC DISPLAY TERMINAL COMPARISON COLUMNS (Continued)

Many vendors now feature smooth scrolling, in which data is rolled or scrolled smoothly up or down (much the same as the credits at the end of a movie).

Although scroll features can be software implemented in the host computer, the comparison column entry applies only to those terminals that implement the feature via hardware or firmware. Many terminals provide the scroll feature, but relatively few provide paging. Some provide both features.

Protect Format. Most businesses use printed forms for daily activities such as billing, ordering, and payroll. Some CRT terminals can duplicate the printed form on the face of the screen, and data can be keyed into the blank spaces just as a typist enters data into a printed form. This fill-in-the-blank approach to data entry requires a *protected format* capability. Display terminals that incorporate this feature treat the fixed format differently than they treat keyed data. Field identifiers such as "name" or "salesperson number" are protected from inadvertent key entry, and data entry is confined to the variable fields (blank spaces) following the field identifiers.

FUNCTIONAL SPECIFICATIONS

Compatibility. Some vendors provide *compatibility* and can replace terminals such as those produced by Digital, Honeywell, and Unisys (formerly Burroughs and Sperry).

Either of two types of compatibility can be offered: transmission compatibility or plug-to-plug compatibility. Transmission compatibility requirements include identical protocol, code and unit code structure, timing, asynchronous or synchronous operation, and transmission speed. Some vendors even provide identical cables, which is a cost-effective solution in a local cluster environment. Most vendors with transmission-compatible units offer additional features and functions not found in the original vendor's equipment, implemented via minor changes in host software. Units with true plug-to-plug compatibility not only have identical transmission parameters but also identical features and functions; no alteration to host software is necessary, but no enhancements beyond the original vendor's equipment are available.

In this year's survey, there are 47 terminals that offer Digital VT100 compatibility; 38 offer VT200 compatibility; and 33 are compatible with the IBM 3270 Information Display System.

Graphics Capability. Bar charts, pie charts, and graphs can be used to present certain types of information. In most cases, an affirmative answer in this category indicates the presence of line drawing or special graphics character sets. It generally does *not* indicate the presence of highly sophisticated graphics capabilities found on graphics-dedicated terminals.

Split Screen, Windows/Multisessions. Some vendors now offer a *split-screen* and/or *windows* feature on their terminals in which the display screen can be divided or partitioned into a number of separate workspaces. Data in these workspaces can be manipulated (e.g., scrolled, stored, or transmitted) independently of the rest of the screen.

Memory. In most terminals, the number of characters that can be stored by the terminal's display memory equals the maximum screen capacity. In some terminals, however, storage is provided for more characters than can be displayed on the screen at one time. This additional data may be stored character by character, by the line, or by the "page" (a full screen of data). *Memory* defines the total number of characters, lines, and pages that can be stored in the terminal's display memory.

Editing Capabilities. Editing features in a display terminal can consist of any combination of the functions that follow, although the best terminal for editing purposes would include all of them. Each function is performed with respect to the current position of the cursor. Desirable editing functions are:

- *Character insert*—the capability to insert a character into an existing line of displayed text; the remaining characters shift to the right or "spread" to accommodate the added character. The spreading capability may terminate at the last character position of the line or at the last displayable position on the screen. Data can be lost when it is spread beyond the termination point.
- *Character delete*—the capability to delete a character from an existing line of displayed text; the remaining text closes up when the character is deleted.
- *Line insert*—the capability to insert a line of text into existing text; the text spreads to accommodate the added line.
- *Line delete*—the capability to delete a line of text from existing text; the remaining text closes up when the line is deleted.
- *Erase*—the capability to erase a character, line of text, message, field, or the complete screen. Most terminals include character erase and some form of display erase, which may erase the entire contents of the display, just that portion following the cursor location, or a combination of both functions. Line erase is optional on many terminals.

TRANSMISSION PARAMETERS

Nearly every display terminal contains a communications interface that enables communications between the terminal and the central computer site.

Mode. This entry defines the operating mode. There are two operating modes: half duplex (transmission in both directions, but not simultaneously) and full duplex (simultaneous transmission in both directions).

Technique. This entry defines the method in which data is transmitted. Data is transmitted synchronously or asynchronously. Asynchronous transmission is characterized by the transmission of data in irregular spurts, where the duration of time can vary between successive transmitted characters; the transmission from an unbuffered teletypewriter is a good example. Synchronous transmission implies the transmission of data in a steady stream. The time interval between successive characters is always precisely

Alphanumeric Display Terminals

KEY TO ALPHANUMERIC DISPLAY TERMINAL COMPARISON COLUMNS (Continued)

the same. The communications interface either provides clocking or accepts external clocking signals from the data set. Sixty-one terminals described in this year's survey support asynchronous transmission; thirty-eight support synchronous transmission; only nine support both asynchronous and synchronous transmission.

Code. This entry refers to the bit pattern of the transmitted characters. Two codes predominate: EBCDIC and ASCII. The latter has been accepted as an industry and government standard and is now the most commonly used code by display terminals. EBCDIC is most commonly used with IBM equipment and its replacements.

Communications Protocol. This entry refers to the type of line discipline (control code sequence and control characters) that the terminal employs. The four most commonly used protocols are ASCII, IBM's System Network Architecture (SNA), IBM's Binary Synchronous Communications (BSC) technique, and IBM's Synchronous Data Link Control (SDLC) line discipline. Other large system vendors such as Honeywell and Digital have produced their own communications protocols. Many display terminals now also conform to the ANSI X3.64 standard for control codes; if ANSI standard conformity exists, it will be indicated here.

Format. This entry refers to the way data is transmitted (e.g., by block, by line, or by character). Terminals that are designed to be transmission compatible with a teletype unit transmit a character for each key depression. Buffered terminals transmit data in multicharacter blocks. The line or block mode permits data to be composed and edited prior to each transmission and generally permits more efficient utilization of the communications facility. Some terminals offer manual selection of modes.

Maximum Speed, bps. The CRT terminal is a high-speed device that is usually capable of transmitting and receiving several thousand characters per second; however, it must run at a speed that is compatible with the communications system in which it is used. Most terminals are used on voice grade facilities, which limit the transmission speed to a practical maximum of 4800 bits per second (bps) over the dial network and 9600 bps over leased or private lines.

Terminal Interface. Display terminals usually have a *terminal interface* that meets the standards of the EIA RS-232-C specification or the 20-mA current loop and connects to an external modem or acoustic telephone coupler. Other interface types include RS-422, RS-423, and MIL-188 (military). IBM 3270 and 3270-compatible terminals generally connect directly to a cluster controller via coaxial cable.

PRICING AND AVAILABILITY

Purchase Price. Pricing is provided for unit quantities (one terminal) unless otherwise specified. Single entries generally indicate the price of the basic unit without options.

Annual Maintenance. This entry shows the cost of service during regular business hours (usually 9 a.m. to 5 p.m., Monday through Friday).

Serviced by. This entry specifies the party responsible for maintaining the terminal. In some cases, the vendor provides total service; in others, a national service organization is responsible. Service is sometimes rendered under the combined efforts of both the vendor and an independent service organization; in this situation, the vendor usually handles those areas close to its headquarters or where it has a multiplicity of installations, and the service company handles other geographical areas.

Date of Announcement. This entry indicates the date that the terminal was announced to the public.

Date of First Commercial Delivery. This entry indicates when the first production model of each terminal was delivered (or is scheduled to be delivered) to a customer.

Number of Units Installed to Date. This entry shows how many display units of each type had been delivered to customers. All figures were supplied by the vendors, and a number of companies chose not to release this information.

VENDOR PHONE NUMBER

The vendor's phone number is supplied at the bottom of each comparison column as a courtesy to the reader.

COMMENTS

Comments at the bottom of the columns describe significant or unusual features, capabilities, or applications that are not reflected in the standard entries.

Alphanumeric Display Terminal Vendors

Applied Digital Data Systems (ADDS)
100 Marcus Boulevard
Hauppauge, NY 11788 (516) 231-5400

AT&T
295 N. Maple Avenue
Basking Ridge, NJ 07920 (201) 221-2000

Bull Worldwide Information Systems
300 Concord Road
Billerica, MA 01821 (508) 671-6000

Cumulus Technology Corp.
1007 Elwell Court
Palo Alto, CA 94303 (415) 960-1200

Data General
4400 Computer Drive
Westboro, MA 01580 (508) 366-8911

Datamedia Corp.
11 Trafalgar Square
Nashua, NH 03063 (603) 886-1570

Davox Corp.
3 Federal Street
Billerica, MA 01821 (508) 667-4455

Delta Data Systems Corp.
7175 Columbia Gateway Drive
Columbia, MD 21046 (301) 290-6400

Digital Equipment Corp. (DEC)
146 Main Street
Maynard, MA 01754-2571 (508) 897-5111

General Business Technology, Inc.
1891 McGaw Avenue
Irvine, CA 92714 (714) 261-1891

Harris Corp.
16001 Dallas Parkway
Dallas, TX 75380 (214) 386-2000

Hewlett-Packard Co., Business Computing Systems
19091 Pruneridge Avenue
Cupertino, CA 95014 (800) 752-0900

Human Designed Systems, Inc.
3440 Market Street
Philadelphia, PA 19104 (215) 382-5000

Intelligent Information Systems, Inc. (IIS)
92 Kansas Street
Hackensack, NJ 07601 (201) 343-8353

International Business Machines Corp. (IBM)
Old Orchard Road
Armonk, NY 10504
Contact your local IBM representative.

Lee Data Corp.
7075 Flying Cloud Drive
Eden Prairie, MN 55344 (612) 828-0300

Liberty Electronics USA
332 Harbor Way
San Francisco, CA 94122 (415) 742-7000

Memorex-Telex
6422 E. 41st Street
Tulsa, OK 74135 (918) 627-1111

Microterm, Inc.
3630 S. Geyer Road, Suite 300
St. Louis, MO 63127 (314) 822-4111

Qume Corp.
500 Yosemite Drive
Milpitas, CA 95035 (408) 942-4000

Random Corp.
581 Northland Boulevard
Cincinnati, OH 45240 (513) 825-0880

TeleVideo Systems, Inc.
1170 Morse Avenue, P.O. Box 3568
Sunnyvale, CA 94088-3568 (408) 745-7760

Unisys
P.O. Box 500
Blue Bell, PA 19424 (215) 542-4011

Visual Technology, Inc.
1703 Middlesex Street
Lowell, MA 01851 (508) 459-4903

Westinghouse Canada
777 Walker's Line, P.O. Box 5009
Burlington, ON, Canada L7R 4B3 (416) 528-8811 □

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Applied Digital Data Systems	Applied Digital Data Systems	Applied Digital Data Systems	Applied Digital Data Systems
MODEL	**ADDS 1010**	**ADDS 2020**	**ADDS 2025**	**ADDS 3220**
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	14	14	14
Screen Capacity (characters)	1,920	1,920, 3,168	1,920	1,920, 3,168
Screen Arrangement (lines x char./line)	24 x 80	24 x 132, 26 x 80	44 x 80, 26 x 80, 26 x 132	24 x 80, 24 x 132
Status Line	Vendor did not specify	Yes	Yes	Yes
Character Color	White	Green, white, amber	Green, white, amber	Green, white, amber
Display Ergonomics	Tilt, swivel	Tilt	Tilt, swivel	Tilt, swivel
Keyboard Style	Typewriter	Typewriter, PC keyboard optional	IBM PC compatible, ASCII	Typewriter
Function Keys	12	16	32	22
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable
Scrolling	Smooth	Smooth	Up, smooth	Up & down, smooth
Protect Format	No	No	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	ADDS, Lear Siegler, IBM 316X	ADDS, Lear Siegler, IBM 316X	VT100 Family, WYSE, TeleVideo, ADDS, Espirit/Hazeltine, ANSI X3.64, Link PCTerm, Kimtron KT7/PC	VT100 Family, VT200 Family, ANSI X3.64, VT52 Family
Graphics Capability	No	No	No	No
Split Screen	No	No	Yes	Yes
Windows/Multisessions	No	No	Yes	No
Memory (number of screens)	1	1	1	1
Editing Capabilities	Vendor did not specify	Vendor did not specify	Line insert/delete, character insert/delete	Line insert/delete, character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Code	ASCII	ASCII	ASCII	ASCII
Communications Protocol	ASCII	ASCII	ASCII, ANSI	ANSI
Format	Character	Character	Character	Character
Maximum Speed (bps)	19.2K	19.2K	19.2K	19.2K
Terminal Interface	RS-232-C	RS-232-C	RS-232-C	RS-232-C
PRICING AND AVAILABILITY				
Purchase Price ($)	395	595	625	595
Annual Maintenance ($)	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Serviced By	ADDS	ADDS	ADDS	ADDS
Date of Announcement	October 1986	October 1986	June 1988	August 1986
Date of First Commercial Delivery	October 1986	October 1986	June 1988	August 1986
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	(516) 231-5400	(516) 231-5400	(516) 231-5400	(516) 231-5400
COMMENTS	—	—	—	—

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Applied Digital Data Systems	AT&T	AT&T	AT&T
MODEL	ADDS 3320	605 Business Communications Terminal	615 Color Multitasking Terminal	615 Multitasking Terminal
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	14	14	14
Screen Capacity (characters)	1,920, 3,168	1,920	1,920, 3068	1,920, 3068
Screen Arrangement (lines x char./line)	24 x 80, 24 x 132	24 x 80, 24 x 132, 25 x 80	24 x 80, 24 x 132	24 x 80, 24 x 132
Status Line	Yes	Yes	Yes	Yes
Character Color	Green, white, amber	Green, amber	Multicolor	Green, amber
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt, swivel	Tilt, swivel
Keyboard Style	Typewriter	IBM PC compatible	Vendor did not specify	AT&T UNIX PC style optional
Function Keys	22	36	36	36
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable
Scrolling	Up & down, smooth	Smooth	Up & down, smooth	Up & down, smooth
Protect Format	Yes	Yes	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	VT100 Family, VT200 Family, ANSI X3.64, DEC VT320	TTY, ANSI X3.64	TTY, ANSI X3.64	TTY, ANSI X3.64
Graphics Capability	No	Yes	Yes	Yes
Split Screen	Yes	Yes	Yes	Yes
Windows/Multisessions	No	No	Yes	Yes
Memory (number of screens)	1	1	1, 3 for 4425 emulation	1, 3 for 4425 emulation
Editing Capabilities	Line insert/delete, character insert/delete, erase	Vendor did not specify	Vendor did not specify	Vendor did not specify
TRANSMISSION SPECIFICATIONS				
Mode	Half/full duplex	Full duplex	Full duplex	Full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Code	ASCII	ASCII	ASCII	ASCII
Communications Protocol	ANSI	ANSI, X3.64	ASCII, ANSI, X3.64	ASCII, ANSI, X3.64
Format	Character	Character	Character	Character
Maximum Speed (bps)	19.2K	300 to 38.4K	19.2K	19.2K
Terminal Interface	RS-232-C	RS-232-C	RS-232-C	RS-232-C
PRICING AND AVAILABILITY				
Purchase Price ($)	595	559	1,295	875
Annual Maintenance ($)	Vendor did not specify	72	171	120
Serviced By	ADDS	AT&T	AT&T	AT&T
Date of Announcement	November 1988	September 1987	March 1989	November 1986
Date of First Commercial Delivery	November 1988	November 1987	March 1989	December 1986
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	(516) 231-5400	(201) 898-2129 (800) 247-1212	(201) 898-2129 (800) 247-1212	(201) 898-2129 (800) 247-1212
COMMENTS	—	PC XT/AT mode keyboard, UNIX and MS-DOS applications	Priced to $1,315, multitasking windows, integrated dialer/modems available, expansion cart. port, 102-key PC-style kbd., VT220, 4425 emulat. available; 28 addit. function keys with window, jump scroll	Multitasking windows, integrated dialer/modems available, expansion cartridge port, 98-key std. keyboard, VT220, 4425 emulat. available, 28 addit. function keys with window, jump scrolling, 3 windows

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	AT&T	AT&T	Honeywell Bull, Inc.	Honeywell Bull, Inc.
MODEL	620 Multitasking Terminal with Graphics	630 Multitasking Terminal with Graphics	HDS-3 HDS 7403/7404	HDS-5, HDS7505/7506/ 7607
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	16	14	14
Screen Capacity (characters)	1,920	Variable	2000, 10560	2000, 10560
Screen Arrangement (lines x char./line)	24 x 80	Lines-61/69; character-89/109/140	25 x 80, 25 X 132	24 x 80, 24 x 132
Status Line	Yes	No	Vendor did not specify	Yes
Character Color	Green, amber	White, amber	Green, amber	Green, amber
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt, swivel optional	Tilt, swivel
Keyboard Style	AT&T UNIX PC Style optional	98-key standard	Typewriter	Typewriter, data entry
Function Keys	36	14	16	12
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable	Detachable, low profile, tilt adjustable
Scrolling	Up & down	Up & down	Up & down	Up & down, smooth
Protect Format	Yes	Vendor did not specify	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	TTY, ANSI X3.64, Tektronix 4014	TTY	VT100 Family, VT200 Family, WYSE	ANSI X3.64, Honeywell Bull VIP
Graphics Capability	Yes	Yes	Yes	Yes
Split Screen	Yes	Yes	Yes	Yes
Windows/Multisessions	Yes	Yes	Vendor did not specify	No
Memory (number of screens)	1	Over 5 pages/window	1, 25, 80, 132	3
Editing Capabilities	Vendor did not specify	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase, tabulation
TRANSMISSION SPECIFICATIONS				
Mode	Full duplex	Full duplex	Full duplex	Full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Code	ASCII	ASCII	ASCII	ASCII
Communications Protocol	ASCII, ANSI, X3.64	ANSI, X3.64	DTR, RTS	X3.64, Honeywell Bull VIP
Format	Character	Character	Character, block	Character, block, line
Maximum Speed (bps)	19.2K	19.2K	300 to 38.4K	9600
Terminal Interface	RS-232-C	RS-232-C	RS-232-C, RS-422	RS-232-C, RS-422
PRICING AND AVAILABILITY				
Purchase Price ($)	1,295	2,595	750	995
Annual Maintenance ($)	185	252	95	75
Serviced By	AT&T	AT&T	Honeywell Bull	Honeywell Bull
Date of Announcement	November 1986	September 1987	September 1986	March 1987
Date of First Commercial Delivery	December 1986	August 1987	January 1987	April 1987
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	(201) 898-2129 (800) 247-1212	(201) 898-2129 (800) 247-1212	(602) 862-8000	(602) 862-8000
COMMENTS	Multitasking window, integrated dialer/modems available, expansion cart. port, 98-key std. keyboard, 28 addit. funct. keys with window, Tektronix 4014 and GSS CGI graphics protocols, 6 windows	Multitasking windows, dual-host, downloadable, local intelligence, 1024 x 1024 bit mapped, non-glare coated screen, 7 window/host, optional 512K RAM, optional SSI/EIA board	Honeywell Bull Customer Assisted Maintenance Program (CAMP) is available at $57/yr, one-year warranty, 16/15 function keys, X-On/X-Off protocol supported	Honeywell Bull Customer Assisted Maintenance Program (CAMP) is available at $31/yr, one-year warranty, jump scrolling, X-On/X-Off protocol supported

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Honeywell Bull, Inc.	Cumulus Technology Corp.	Data General Corp.	Data General Corp.
MODEL	HDS-7 HDS 7807/7808	Model HCT	Dasher D412	Dasher D462
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	15	14	14
Screen Capacity (characters)	2000, 10560	3,564	1944, 3240	1944, 3240
Screen Arrangement (lines x char./line)	24 x 80, 24 x 132	27 x 132	24 x 81, 24 x 135	24 x 81, 24 x 135
Status Line	Yes	Yes	Vendor did not specify	Vendor did not specify
Character Color	Green, amber	White	Green, amber	Green, amber
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt, swivel, shielding of magnetic emissions	Tilt, swivel, shielding of magnetic emissions
Keyboard Style	Typewriter (multifunction)	HP 239X	Typewriter, Data General	Typewriter, Data General
Function Keys	12	8	15	15
Keyboard Ergonomics	Detachable	Detachable, low profile, tilt adjustable	Detachable, tilt adjustable	Detachable, tilt adjustable
Scrolling	Up & down, smooth	Up & down, smooth	Up & down, smooth	Up & down, smooth
Protect Format	Yes	Yes	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	Honeywell Bull VIP/3.64	HP 239X, HP 700/9X, ANSI X3.64	VT200 Family, Data General	VT200 Family, Data General, Tektronix 4010/4014
Graphics Capability	Yes	No	Yes	Yes
Split Screen	Yes	No	No	No
Windows/Multisessions	Vendor did not specify	No	Yes	Yes
Memory (number of screens)	3	8	1	1
Editing Capabilities	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Full duplex	Full duplex	Full duplex	Full duplex
Technique	Async/sync	Asynchronous	Asynchronous	Asynchronous
Code	ASCII	ASCII	ASCII	ASCII
Communications Protocol	DTR, RTS	ASCII, X3.64	X-on/X-off	X-on/X-off
Format	Character, block, line	Character, block, line	Character	Character
Maximum Speed (bps)	300 to 9600	38.4K	19.2K	19.2K
Terminal Interface	RS-232-C, RS-422	RS-232-C, RS-422	RS-232-C, RS-422	RS-232-C, RS-422
PRICING AND AVAILABILITY				
Purchase Price ($)	1,200	795	610	1,060
Annual Maintenance ($)	100	Vendor did not specify	Vendor did not specify	Vendor did not specify
Serviced By	Honeywell Bull	Authorized service centers	Data General	Data General
Date of Announcement	November 1986	December 1987	August 1988	August 1988
Date of First Commercial Delivery	December 1986	December 1987	September 1988	September 1988
Number of Units Installed to Date	Vendor did not specify	5,000	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	(602) 862-8000	(415) 960-1200	(508) 366-8911	(508) 366-8911
COMMENTS	Honeywell Bull Customer Assisted Maintenance Program (CAMP) is available at $60/yr, one-year warranty, ANSI X3.64 mode (std.), X-On/X-Off, VIP protocols supported, jump scrolling	5-year warranty, forms cache capabilities, flat profile screen, 75Hz refresh rate, built-in desktop accessories and help screens	Dual-ported, two simultaneous sessions may be maintained, optional model shielded against magnetic radiation	Dual-ported, two simultaneous sessions may be maintained, graphics screen arrangement is 810/1215 x 2881

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Data General Corp.	Datamedia Corp.	Davox Corp.	Davox Corp.
MODEL	Dasher D462E	COLORSCAN/2	4900	5900
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	14	12	12
Screen Capacity (characters)	1944, 3240	4488	2000 to 3000	2000 to 3000
Screen Arrangement (lines x char./line)	24 x 81, 24 x 135	24 x 80, 24 x 132, 34 x 132	24 x 80	24 x 80
Status Line	Vendor did not specify	Yes	Yes	Yes
Character Color	White	Multicolor	Green, amber	Multicolor
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt, swivel	Tilt, swivel
Keyboard Style	Typewriter, Data General	IBM PC compatible, DEC VT200 compatible	Typewriter	Typewriter
Function Keys	15	24	Vendor did not specify	Vendor did not specify
Keyboard Ergonomics	Detachable, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable	Detachable
Scrolling	Up & down, smooth	Up & down, smooth	Vendor did not specify	Vendor did not specify
Protect Format	Yes	Yes	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	VT200 Family, Data General, Tektronix 4010/4014	TTY, VT100 Family, VT200 Family	VT100 Family, VT200 Family, VT52, PC, other async.	VT100 Family, VT200 Family, VT52, PC, other async.
Graphics Capability	Yes	Yes	No	No
Split Screen	No	No	Yes	Yes
Windows/Multisessions	Yes	No	Yes	Yes
Memory (number of screens)	1	Variable	512K	1
Editing Capabilities	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Async/sync	Async/sync
Code	ASCII	ASCII	ASCII, EBCDIC	ASCII, EBCDIC
Communications Protocol	X-on/X-off	ASCII, ANSI	BSC, SDLC, SNA, ASCII	BSC, SDLC, SNA, ASCII
Format	Character	Character, line	Character, block	Character, block
Maximum Speed (bps)	19.2K	38.4K	300 to 19.2K	300 to 19.2K
Terminal Interface	RS-232-C, RS-422	RS-232-C	RS-232-C	RS-232-C
PRICING AND AVAILABILITY				
Purchase Price ($)	2,000	2,000	2,775	3,075
Annual Maintenance ($)	Vendor did not specify	Vendor did not specify	115 to 275	135-323
Serviced By	Data General	Datamedia	Davox	Davox
Date of Announcement	August 1988	June 1987	May 1986	May 1986
Date of First Commercial Delivery	November 1988	Vendor did not specify	June 1986	June 1986
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	8,000	6,500
VENDOR PHONE NUMBER	(508) 366-8911	(603) 886-1570 (800) 362-4636	(508) 667-4455	(508) 667-4455
COMMENTS	Black letters on white background, 72Hz screen refresh rate, character cell size is 16 x 16, graphics screen arrangement is 288 x 810 and 288 x 1215	—	Integral telephone with manual keypad and directory, autodial mode, screen dial, supports multiple, simultaneous on-line sessions with IBM, PC, Digital, and other async hosts, function keys	Integral telephone with manual keypad and directory, autodial mode, screen dial, supports multiple, simultaneous on-line sessions with IBM, PC, Digital, and other async hosts, function keys, scrolling

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Delta Data Systems Corp.	Digital Equipment Corp.	Digital Equipment Corp.	Digital Equipment Corp.
MODEL	Tempest DD220	VT320	VT330	VT340
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	14	14	13
Screen Capacity (characters)	1,920, 3,168	3300 with status line	3300 with status line	3300 with status line
Screen Arrangement (lines x char./line)	24 x 80, 24 x 132	24 x 80, 24 x 132	24 x 80, 24 x 132	24 x 80, 24 x 132
Status Line	Yes	Yes	Yes	Yes
Character Color	Amber	Green, white, amber	Green, white, amber	Multicolor
Display Ergonomics	Tilt, swivel	Tilt	Tilt, swivel	Tilt
Keyboard Style	Typewriter	Digital LK201	Digital LK201	Digital LK201
Function Keys	18	43	43	43
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable
Scrolling	Up & down	Up & down, smooth	Up & down, smooth	Up & down, smooth
Protect Format	Vendor did not specify	Yes	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	VT100 Family, VT200 Family, VT 52	VT100 Family, VT200 Family	VT100 Family, VT200 Family	VT100 Family, VT200 Family
Graphics Capability	No	No	Yes	Yes
Split Screen	Yes	Yes	Yes	Yes
Windows/Multisessions	No	No	Yes	Yes
Memory (number of screens)	1	1	Vendor did not specify	Vendor did not specify
Editing Capabilities	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Full duplex	Full duplex	Full duplex	Full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Code	ASCII	ASCII	ASCII	ASCII
Communications Protocol	ASCII, ANSI, X3.64	ASCII, ANSI, X3.64	ASCII, ANSI, X3.64	ASCII, ANSI, X3.64
Format	Character	Character	Character, block	Character, block
Maximum Speed (bps)	75 to 38.4K	19.2K	19.2K	19.2K
Terminal Interface	RS-232-C, RS-422, 20mA optional	RS-232-C, DEC 423	RS-232-C, DEC 423	RS-232-C, DEC 423
PRICING AND AVAILABILITY				
Purchase Price ($)	2,470	545	2,038	2,994
Annual Maintenance ($)	Vendor did not specify	Varies	Varies	Varies
Serviced By	Delta Data	DEC	DEC	DEC
Date of Announcement	November 1986	August 1987	April 1987	April 1987
Date of First Commercial Delivery	December 1986	1987	1987	1987
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	(301) 290-6400	(508) 493-5111 (800) 344-4825	(508) 493-5111 (800) 344-4825	(508) 493-5111 (800) 344-4825
COMMENTS	Meets NACSIM 5100A, priced up to $2,745	Quantity and system pricing available, international version available, built-in mouse/tablet support, total number of programmable function keys-15	Quantity and system pricing available, total number of programmable function keys-15, memory is six pages of text and 2 screens of graphics, supports REGIS, sixels, and Tektronix 4010/4014	Quantity and system pricing available, total number of programmable function keys-15, memory is six pages of text and 2 screens of graphics, supports REGIS, sixels, and Tektronix 4010/4014

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	General Business Technology, Inc.	General Business Technology, Inc.	General Business Technology, Inc.	Harris Corp.
MODEL	7720DS	7721DS	7722DS	H191-E
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	14	14	12, 14
Screen Capacity (characters)	1,920	1,920	1,920	1,920
Screen Arrangement (lines x char./line)	25 x 80	25 x 80	25 x 80	24 x 80
Status Line	Yes	Yes	Yes	Yes
Character Color	Green, white, amber	Green, white, amber	Green, white, amber	Green, amber
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt, swivel	Tilt, swivel
Keyboard Style	IBM 5291 style	3180 style	3180 style	Typewriter
Function Keys	24	24	24	24
Keyboard Ergonomics	Detachable	Detachable	Detachable	Detachable, low profile, tilt adjustable
Scrolling	Up & down	Up & down	Up & down	None
Protect Format	Yes	Yes	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	IBM AS/400, System/38	IBM AS/400, System/3X	IBM AS/400, System/3X	3270 family
Graphics Capability	No	No	No	No
Split Screen	No	No	No	No
Windows/Multisessions	No	No	No	No
Memory (number of screens)	1	Vendor did not specify	Vendor did not specify	Vendor did not specify
Editing Capabilities	Line insert/delete, character insert/delete	Line insert/delete, character insert/delete	Line insert/delete, character insert/delete	Line insert/delete, character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Vendor did not specify	Vendor did not specify	Vendor did not specify	Full duplex
Technique	Vendor did not specify	Vendor did not specify	Vendor did not specify	Synchronous
Code	EBCDIC	EBCDIC	EBCDIC	EBCDIC
Communications Protocol	Vendor did not specify	Vendor did not specify	Vendor did not specify	BSC, SDLC, SNA
Format	Character, block, line	Character, block, line	Character, block, line	Character
Maximum Speed (bps)	1MB	1MB	1MB	2.3M
Terminal Interface	Twinax	Twinax	Twinax	Coaxial, twisted pair
PRICING AND AVAILABILITY				
Purchase Price ($)	795	895	995	1,350
Annual Maintenance ($)	Vendor did not specify	Vendor did not specify	Vendor did not specify	50
Serviced By	Replacement	Replacement	Replacement	Harris
Date of Announcement	Vendor did not specify	Vendor did not specify	Vendor did not specify	September 1987
Date of First Commercial Delivery	Vendor did not specify	Vendor did not specify	Vendor did not specify	December 1987
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	(714) 261-1891 (800) 521-1891	(714) 261-1891 (800) 521-1891	(714) 261-1891 (800) 521-1891	(214) 386-2393 (800) 442-7747
COMMENTS	3-year warranty	3-year warranty	3-year warranty, system-addressable printer port	Part of the Challenger Information Display System, supports Harris Coax Multidrop and built-in RJ11 connector, attaches to Harris HX74 control units and equivalent IBM controllers

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Harris Corp.	Harris Corp.	Harris Corp.	Harris Corp.
MODEL	H191-S	H192-C	H192-D	H192-F
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	12, 14	14	14	14
Screen Capacity (characters)	1,920	1,920	1,920, 2,560, 3,440, 3,564	1,920, 2,560, 3,440, 3,564
Screen Arrangement (lines x char./line)	24 x 80	24 x 80	24 x 80, 32 x 80, 43 x 80, 27 x 132	24 x 80, 32 x 80, 43 x 80, 27 x 132
Status Line	Yes	Yes	Yes	Yes
Character Color	Green, amber	Multicolor	Green, amber	Multicolor
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt, swivel	Tilt, swivel
Keyboard Style	Typewriter	Typewriter, 3270	Typewriter, 3270	Typewriter, 3270
Function Keys	24	24	24	24
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable
Scrolling	None	None	Up & down	None
Protect Format	Yes	Yes	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	3270 family	3270 family	3270 family	3270 family
Graphics Capability	No	No	No	No
Split Screen	No	No	No	No
Windows/Multisessions	No	No	No	No
Memory (number of screens)	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Editing Capabilities	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Full duplex	Full duplex	Full duplex	Full duplex
Technique	Synchronous	Synchronous	Synchronous	Synchronous
Code	EBCDIC	EBCDIC	EBCDIC	EBCDIC
Communications Protocol	BSC, SDLC, SNA	BSC, SDLC, SNA	BSC, SDLC, SNA	BSC, SDLC, SNA
Format	Character	Character	Character	Character
Maximum Speed (bps)	2.3M	2.3M	2.3M	2.3M
Terminal Interface	Coaxial, twisted pair	Coaxial, twisted pair	Coaxial, twisted pair	Coaxial, twisted pair
PRICING AND AVAILABILITY				
Purchase Price ($)	1,200	1,830	1,725	2,045
Annual Maintenance ($)	40	85	60	85
Serviced By	Harris	Harris	Harris	Harris
Date of Announcement	September 1987	March 1988	February 1988	March 1988
Date of First Commercial Delivery	November 1987	April 1988	April 1988	May 1988
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	(214) 386-2393 (800) 442-7747	(214) 386-2000 (800) 442-7747	(214) 386-2393 (800) 442-7747	(214) 386-2393 (800) 442-7747
COMMENTS	Part of the Challenger Information Display System, supports Harris Coax Multidrop and built-in RJ11 connector, attaches to Harris HX74 control units and equivalent IBM controllers	Part of the Challenger Information Display System, supports Harris Coax Multidrop and built-in RJ11 connector, attaches to Harris HX74 control units and equivalent IBM controllers	Part of the Challenger Information Display System, supports Harris Coax Multidrop and built-in RJ11 connector, attaches to Harris HX74 control units and equivalent IBM controllers	Part of the Challenger Information Display System, supports Harris Coax Multidrop and built-in RJ11 connector, attaches to Harris HX74 control units and equivalent IBM controllers

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Hewlett-Packard	Hewlett-Packard	Hewlett-Packard	Hewlett-Packard
MODEL	HP 2393A	HP 2397A	HP 700/22	HP 700/41
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	12	12	14	14
Screen Capacity (characters)	1,920	1,920	3,168	1,920
Screen Arrangement (lines x char./line)	24 x 80	24 x 80	24 x 80, 24 x 132	24 x 80
Status Line	Vendor did not specify	Vendor did not specify	Yes	Yes
Character Color	P31 Green	Multicolor	Green, white, amber	Green, amber
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt, swivel	Tilt, swivel
Keyboard Style	Typewriter	Typewriter	VT220	ASCII layout
Function Keys	12	12	15	16
Keyboard Ergonomics	Detachable	Detachable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable
Scrolling	Up & down, smooth	Up & down, smooth	Up & down, smooth	Up & down, smooth
Protect Format	Yes	Yes	No	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	ANSI X3.64, Tektronix 4010/4014	ANSI X3.64, Tektronix 4010/4014	TTY, VT100 Family, VT200 Family, ANSI X3.64, VT52	TTY, WYSE, TeleVideo, ADDS, Espirit/Hazeltine, Lear Siegler, ANSI X3.64, QUME
Graphics Capability	Yes	Yes	No	No
Split Screen	No	No	No	Yes
Windows/Multisessions	Vendor did not specify	No	No	No
Memory (number of screens)	12	12	4	1
Editing Capabilities	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Full duplex	Full duplex	Full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Code	ASCII	ASCII	ASCII	ASCII
Communications Protocol	ASCII	ASCII	ASCII, ANSI, X3.64	ASCII
Format	Character, block, line	Character, block, line	Character	Character, block, line
Maximum Speed (bps)	110 to 19.2K	110 to 19.2K	38.4K	38.4K
Terminal Interface	RS-232-C	RS-232-C	RS-232-C, 20 mA	RS-232-C
PRICING AND AVAILABILITY				
Purchase Price ($)	2,430	3,810	499	390
Annual Maintenance ($)	Vendor did not specify	Vendor did not specify	24 to 60 (4 opts. avail.)	24-60 (4 options avail.)
Serviced By	HP	HP	HP	HP
Date of Announcement	June 1985	September 1985	September 1987	September 1987
Date of First Commercial Delivery	June 1985	September 1985	September 1987	September 1987
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	Contact local representative	Contact local representative	Contact local representative	Contact local representative
COMMENTS	Graphics terminal, optional touchscreen, bar code reader, tablet, mouse	Color graphics terminal, optional touchscreen, bar code reader, tablet, mouse	DEC VT220 compatible terminal, function keys shiftable to 30	An entry-level ASCII terminal

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Hewlett-Packard	Hewlett-Packard	Hewlett-Packard	Hewlett-Packard
MODEL	HP 700/43	HP 700/44	HP 700/71	HP 700/92
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	14	14	14
Screen Capacity (characters)	1,920, 3,168	1,920, 3,168, 3300, 2000	1,920	3,168
Screen Arrangement (lines x char./line)	24 x 80, 24 x 132	24 x 80, 24 x 132, 25 x 80, 25 x 132	24 x 80	24 x 80, 24 x 132
Status Line	Yes	Yes	Yes	Yes
Character Color	Green, white, amber	Green, white, amber	Green, white, amber	Green, white, amber
Display Ergonomics	Tilt, swivel, 72Hz refresh rate	Tilt, swivel, 72Hz refresh rate	Tilt, swivel	Tilt, swivel
Keyboard Style	ASCII	IBM PC AT	3270	HP block mode
Function Keys	16	12	24	8
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable
Scrolling	Up & down, smooth	Up & down, smooth	None	Up & down, smooth
Protect Format	Yes	Yes	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	TTY, WYSE, TeleVideo, ADDS, Espirit/Hazeltine, Lear Siegler, QUME	TTY, VT100 Family, VT200 Family, ANSI X3.64, VT52	3270 family	TTY, VT100 Family, VT200 Family, ANSI X3.64, HP Block mode, VT52
Graphics Capability	No	No	No	No
Split Screen	Yes	No	No	No
Windows/Multisessions	No	No	No	No
Memory (number of screens)	4	4	1	8
Editing Capabilities	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Character insert/delete, erase, word delete	Line insert/delete, character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Half/full duplex	Half/full duplex	Half duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Synchronous	Asynchronous
Code	ASCII	ASCII	EBCDIC	ASCII
Communications Protocol	ASCII	ANSI, X3.64	IBM 3270	ASCII, ANSI, X3.64
Format	Character, block, line	Character	Character	Character, block, line
Maximum Speed (bps)	38.4K	75 to 38.4K	Vendor did not specify	38.4K
Terminal Interface	RS-232-C, RS-422	RS-232-C	Coaxial	RS-232-C, RS-422
PRICING AND AVAILABILITY				
Purchase Price ($)	475	599	745	895
Annual Maintenance ($)	24 to 60 (4 opt. avail.)	24 to 60 (4 opt. avail.)	24 to 60 (4 opts. avail.)	24 to 60 (4 opts. avail.)
Serviced By	HP	HP and support organizations	HP	HP
Date of Announcement	March 1988	March 1988	September 1987	September 1987
Date of First Commercial Delivery	March 1988	March 1988	September 1987	September 1987
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	Contact local representative	Contact local representative	Contact local representative	Contact local representative
COMMENTS	ASCII terminal, function keys shiftable to 32	A multi-user PC terminal	IBM 3191A/B compatible	—

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Hewlett-Packard Company	Honeywell Bull, Inc.	Human Designed Systems, Inc.	Human Designed Systems, Inc.
MODEL	HP 700/94	HDS-1 HDS 7101/7102	HDS3200 Model 10	HDS3200 Model 20
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	14	15	15
Screen Capacity (characters)	3,168	2000	1,920, 3,168, 2000, 3300	1,920, 3,168, 3,564, 2000, 3300, 3840, 4000
Screen Arrangement (lines x char./line)	24 x 80, 24 x 132	26 x 80	24 x 80, 24 x 132, 25 x 80, 25 x 132	24 x 80, 24 x 132, 25 x 80, 25 x 132, 48 x 80
Status Line	Yes	Vendor did not specify	Yes	Yes
Character Color	Green, white, amber	Green, amber	Green, amber, page white	Green, amber, page white
Display Ergonomics	Tilt, swivel	Tilt, swivel optional	Tilt, swivel	Tilt, swivel
Keyboard Style	HP block mode	Typewriter	DEC VT220	DEC VT220
Function Keys	8	14	Vendor did not specify	Vendor did not specify
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable
Scrolling	Up & down, smooth	Vendor did not specify	Up & down, smooth	Up & down, smooth
Protect Format	Yes	Yes	Vendor did not specify	Vendor did not specify
FUNCTIONAL SPECIFICATIONS				
Compatibility	TTY, ANSI X3.64, HP Block mode, VT52	WYSE, ADDS, TVI, ADM, Honeywell Bull VIP	TTY, VT100 Family, VT200 Family, Tektronix 4010/4014	TTY, VT100 Family, VT200 Family, Tektronix 4010/4014
Graphics Capability	No	Yes	Yes	Yes
Split Screen	No	No	Yes	Yes
Windows/Multisessions	No	Vendor did not specify	Yes	Yes
Memory (number of screens)	16	80, 25, 1	4, 8 screens optional	4, 8 screens optional
Editing Capabilities	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, erase	Line insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Half/full duplex	Full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Code	ASCII	ASCII	ASCII	ASCII
Communications Protocol	ASCII, ANSI, X3.64	DTR, RTS	ANSI, X-on/X-off, CTS/RTS	ANSI, X-on/X-off, CTS/RTS
Format	Character, block, line	Character	Character	Character
Maximum Speed (bps)	38.4K	300 to 38.4K	38.4K	38.4K
Terminal Interface	RS-232-C, RS-422	RS-232-C, RS-422	RS-232-C, 20 mA, RS-423	RS-232-C, 20 mA, RS-423
PRICING AND AVAILABILITY				
Purchase Price ($)	1,150	525	699	999
Annual Maintenance ($)	24 to 60 (4 opts. avail.)	85	54	54
Serviced By	HP	Honeywell Bull	Human Designed Systems or 3rd party	Human Designed Systems or 3rd party
Date of Announcement	September 1987	September 1986	November 1987	November 1987
Date of First Commercial Delivery	September 1987	January 1987	November 1987	November 1987
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	Contact local representative	(508) 671-6000	(215) 382-5000 (800) 437-1551	(215) 382-5000 (800) 437-1551
COMMENTS	—	Honeywell Bull Customer Assisted Maintenance Program (CAMP) is available at $51/yr, one-year warranty, up, smooth scrolling, X-On/X-Off protocol supported	Upgradable to other models in the 3200 Series, resolution 1056 x 400, function keys: 42 x 3	Upgradable to other models in the 3200 Series resolution 1056 x 800, optional 75Hz screen refresh, other screen arrg: 48 x 132, 50 x 80, 50 x 132, other screen capacity: 6336, funct keys: 42 x 3

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Human Designed Systems, Inc.	Human Designed Systems, Inc.	Intelligent Information Systems (IIS)	Intelligent Information Systems (IIS)
MODEL	**HDS3200 Model 30**	**Model 6500**	**IS-196/IS-196-1**	**IS-320**
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	15	15	14	14
Screen Capacity (characters)	1,920, 3,168, 3,564, 2000, 3300, 3840, 4000	1,920, 3,168	1,920	1,920, 3,168
Screen Arrangement (lines x char./line)	24 x 80, 24 x 132, 25 x 80, 25 x 132, 48 x 80	24 x 80, 24 x 132	24 x 80	24 x 80, 24 x 132
Status Line	Yes	Yes	Yes	Yes
Character Color	Green, amber, page white	Amber	Green, white, amber	Green, white, amber
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt, swivel	Tilt, swivel
Keyboard Style	DEC VT220	DEC VT220, Tandem 6530	Typewriter, IBM 5250, S/3X, AS/400	Typewriter, data entry
Function Keys	Vendor did not specify	Vendor did not specify	24	36
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable
Scrolling	Up & down, smooth	Up & down, smooth	None	Up & down, smooth
Protect Format	Vendor did not specify	No	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	TTY, VT100 Family, VT200 Family, Tektronix 4010/4014	VT100 Family, VT200 Family, ANSI X3.64, Tandem 6530, 6526	IBM 5250 twinax, IBM 3196	VT100 Family, VT200 Family
Graphics Capability	Yes	No	No	No
Split Screen	Yes	Yes	Vendor did not specify	No
Windows/Multisessions	Yes	Yes	No	No
Memory (number of screens)	4, 8 screens optional	4	1	1
Editing Capabilities	Line insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase, tabulation	Line insert/delete, character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Half/full duplex	Half/full duplex	Half duplex	Half duplex
Technique	Asynchronous	Asynchronous	Vendor did not specify	Synchronous
Code	ASCII	ASCII	EBCDIC	ASCII
Communications Protocol	ANSI, X-on/X-off, CTS/RTS	ASCII, ANSI, X3.64	IBM 5250	ASCII
Format	Character	Character, block	Character, block, line	Character
Maximum Speed (bps)	38.4K	19.2K	1M	19.2K
Terminal Interface	RS-232-C, 20 mA, RS-423	RS-232-C, 20 mA, RS-423	Twinax	RS-232-C
PRICING AND AVAILABILITY				
Purchase Price ($)	1,299	999	Vendor did not specify	Vendor did not specify
Annual Maintenance ($)	54	54	Vendor did not specify	Vendor did not specify
Serviced By	Human Designed Systems or 3rd party	Human Designed Systems or 3rd party	IIS and third party	IIS
Date of Announcement	November 1987	November 1988	March 1987	September 1987
Date of First Commercial Delivery	November 1987	November 1988	April 1987	October 1987
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	1,000	900
VENDOR PHONE NUMBER	(215) 382-5000 (800) 437-1551	(215) 382-5000 (800) 437-1551	(201) 343-8353	(201) 343-8353
COMMENTS	Resolution 1056 x 800, optional 75Hz screen refresh, other screen arrg: 48 x 132, 50 x 80, 50 x 132, other screen capacity: 6336, funct keys: 42 x 3, true pan and zoom with standard 256K display list	Tandem compatibility on Port 1, simultaneous ANSI (DEC) operation on Ports 2 and/or 3, 110 function keys	Additional standard features include printer port host addressable, record/play/pause, type ahead, and rule, optional features include bar code reader and magnetic strip reader	—

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Intelligent Information Systems (IIS)	Intelligent Information Systems (IIS)	Intelligent Information Systems (IIS)	Intelligent Information Systems (IIS)
MODEL	**IS-391A**	**IS-391D**	**IS-391D/V, IS-392D/V, IS-392C/V, IS-392F/V**	**IS-392 Model C**
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	14	14	14
Screen Capacity (characters)	1,920	1,920, 2,560	3,564	1,920, 2,560
Screen Arrangement (lines x char./line)	24 x 80	24 x 80, 32 x 80	24 x 80, 32 x 80, 43 x 80, 24 x 132	24 x 80, 32 x 80
Status Line	Yes	Yes	Yes	Yes
Character Color	Green, white, amber	Green, white, amber	Green, white, amber	Multicolor
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt, swivel	Tilt, swivel
Keyboard Style	Typewriter, data entry, 3270	Typewriter, data entry	Typewriter, data entry, 3270	Typewriter, APL, 3270
Function Keys	24	24	24	24
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable
Scrolling	None	Up & down	Up & down, smooth	Up & down
Protect Format	Yes	Yes	Vendor did not specify	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	3270 family, IBM 3191 A/B	3270 family, IBM 3191 D/E	3270 family, VT100 Family, VT200 Family, IBM 3191D, 3192 C, F, D	3270 family, IBM 3192-C
Graphics Capability	No	No	No	No
Split Screen	No	No	Yes	No
Windows/Multisessions	Vendor did not specify	Yes	Yes	No
Memory (number of screens)	1	1, 2	4	1
Editing Capabilities	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Half duplex	Half duplex	Half duplex	Half duplex
Technique	Synchronous	Synchronous	Async/sync	Synchronous
Code	EBCDIC	EBCDIC	ASCII, EBCDIC	EBCDIC
Communications Protocol	BSC, SDLC, SNA	BSC, SDLC, SNA, 3270	BSC, SNA, ASCII	BSC, SDLC, SNA, IBM 3270 coax
Format	Character, block, line	Character, block, line	Character, block, line	Character, block, line
Maximum Speed (bps)	2.34M	2.34M	2.34M	2.5M
Terminal Interface	Coaxial	Coaxial	RS-232-C, coaxial	Coaxial
PRICING AND AVAILABILITY				
Purchase Price ($)	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Annual Maintenance ($)	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Serviced By	IIS and third party	IIS and third party	IIS and third party	IIS and third party
Date of Announcement	August 1986	October 1987	January 1984	July 1987
Date of First Commercial Delivery	November 1986	October 1987	January 1984	July 1987
Number of Units Installed to Date	18,000	500	Vendor did not specify	5,000
VENDOR PHONE NUMBER	(201) 343-8353	(201) 343-8353	(201) 343-8353	(201) 343-8353
COMMENTS	Additional standard features include play/record, optional features include bar code reader, parallel printer port, and built-in balun RJ11, model supports multisessions but not windows	Additional standard features include parallel printer port, play/record, and rule, optional features include bar code reader, magnetic strip reader, light pen, and built-in balun	Dual host (IBM 3270 and DEC) workstation	Additional standard features include parallel printer port, 1,500 character record/playback, rule function, optional features include bar code reader, magnetic strip reader, and light pen

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Intelligent Information Systems (IIS)	Intelligent Information Systems (IIS)	Intelligent Information Systems (IIS)	Intelligent Information Systems (IIS)
MODEL	**IS-392 Model D**	**IS-392F**	**IS-396/IS-397 Model 1**	**IS-397 Model 1C**
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	14	14	14
Screen Capacity (characters)	1,920, 2,560, 3,168, 3,440, 3,564	1,920, 2,560, 3,440, 3,564	1,920, 3,564	1,920
Screen Arrangement (lines x char./line)	24 x 80, 32 x 80, 43 x 80, 27 x 132	24 x 80, 32 x 80, 43 x 80, 27 x 132	24 x 80, 27 x 132	24 x 80
Status Line	Yes	Yes	Yes	Yes
Character Color	Green, white, amber	Multicolor	Green, white, amber	Multicolor
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt, swivel	Tilt, swivel
Keyboard Style	Typewriter, data entry, APL, 3270	Typewriter, data entry, APL, 3270	Typewriter, data entry, IBM 5250 compatible	Typewriter, data entry, IBM 5250 compatible
Function Keys	24	24	24	24
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable
Scrolling	Up & down	Up & down	None	None
Protect Format	Yes	Yes	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	3270 family, IBM 3192-D	3270 family, IBM 3192-F	IBM 5250, System 3X, AS/400, 3180-1	IBM 5250, System 3X, AS/400, 3179-2
Graphics Capability	No	No	No	No
Split Screen	No	No	No	No
Windows/Multisessions	Yes	Yes	No	No
Memory (number of screens)	1, 2, 3, 4	1, 2, 3, 4	1	1
Editing Capabilities	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase, tabulation	Line insert/delete, character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Half duplex	Half duplex	Half duplex	Half duplex
Technique	Synchronous	Synchronous	Synchronous	Synchronous
Code	EBCDIC	EBCDIC	EBCDIC	EBCDIC
Communications Protocol	BSC, SDLC, SNA, 3270 coax	BSC, SDLC, SNA, 3270 coax	IBM 5250 twinax	IBM 5250 twinax
Format	Character, block, line	Character, block, line	Character, block, line	Character, block, line
Maximum Speed (bps)	2.5M	2.5M	1M	1M
Terminal Interface	Coaxial	Coaxial	Twinax	Twinax
PRICING AND AVAILABILITY				
Purchase Price ($)	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Annual Maintenance ($)	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Serviced By	IIS and third party	IIS and third party	IIS and third party	IIS and third party
Date of Announcement	May 1987	November 1987	October 1986	June 1987
Date of First Commercial Delivery	May 1987	November 1987	October 1986	June 1987
Number of Units Installed to Date	7,000	1,500	2,000	7,000
VENDOR PHONE NUMBER	(201) 343-8353	(201) 343-8353	(201) 343-8353	(201) 343-8353
COMMENTS	Additional standard features include parallel printer port, 1,500 character record/playback, and rule function, optional features include bar code reader, magnetic strip reader, and light pen	Additional standard features include parallel printer port, 1,500 character record/playback and rule function, optional features include bar code reader and magnetic strip reader	Additional standard features include printer port, play/record/pause, rule, and type head, optional features include bar code reader and magnetic strip reader	Additional standard features include printer port and play/record, optional features include bar code reader and magnetic strip reader

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Intelligent Information Systems (IIS)	Intelligent Information Systems (IIS)	International Business Machines Corp. (IBM)	International Business Machines Corp. (IBM)
MODEL	**IS-397-C**	**IS-397-D**	**3151 ASCII Display Station Model 110**	**3151 ASCII Display Station Model 310**
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	14	14	14
Screen Capacity (characters)	1,920, 3,564	1,920, 3,564	1,920	1,920, 3,168
Screen Arrangement (lines x char./line)	24 x 80, 27 x 132	24 x 80, 27 x 132	24 x 80	24 x 80, 24 x 132
Status Line	Yes	Yes	Yes	Yes
Character Color	Multicolor	Green, white, amber	Green	Green
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt and swivel optional	Tilt and swivel optional
Keyboard Style	Typewriter, data entry, IBM 5250	Typewriter, IBM 5250	Typewriter	Typewriter
Function Keys	24	24	12	12
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable
Scrolling	Up & down	Up & down	Up & down, smooth	Up & down, smooth
Protect Format	Yes	Yes	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	IBM 5250, IBM 3197-C	IBM 5250, IBM 3197-D	TeleVideo, ADDS, Lear Siegler, HZ 1500	TeleVideo, ADDS, Lear Siegler, HZ 1500; cartridges for DEC 220 and Wyse
Graphics Capability	No	No	No	Yes
Split Screen	Yes	Yes	No	Yes
Windows/Multisessions	Yes	Yes	No	No
Memory (number of screens)	2	2	1	1
Editing Capabilities	Line insert/delete, character insert/delete, erase, tabulation	Line insert/delete, character insert/delete, erase, tabulation	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Half duplex	Half duplex	Half/full duplex	Half/full duplex
Technique	Synchronous	Synchronous	Asynchronous	Asynchronous
Code	EBCDIC	EBCDIC	ASCII	ASCII
Communications Protocol	IBM 5250	IBM 5250	ASCII	ASCII, ANSI w/opt. cart.
Format	Character, block, line	Character, block, line	Character, block	Character, block
Maximum Speed (bps)	1M	1M	38.4K	38.4K
Terminal Interface	Twinax	Twinax	RS-232-C	RS-232-C, RS-422 w/opt. cartridge
PRICING AND AVAILABILITY				
Purchase Price ($)	Vendor did not specify	Vendor did not specify	415.00	555
Annual Maintenance ($)	Vendor did not specify	Vendor did not specify	27	27
Serviced By	IIS and third party	IIS and third party	IBM	IBM
Date of Announcement	March 1989	March 1988	June 1987	June 1987
Date of First Commercial Delivery	March 1989	March 1988	June 1987	June 1987
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	(201) 343-8353	(201) 343-8353	Contact local representative	Contact local representative
COMMENTS	Additional standard features include printer port, record/play/pause, type ahead, and alternate address, optional features include bar code reader and magnetic strip reader	Additional standard features include printer port, record/play/pause, type ahead, alternate address, and rule, optional features include bar code reader and magnetic strip reader	—	36 function keys using shift/alt; multisessions (not windows) supported with optional cartridge

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	International Business Machines Corp. (IBM)	International Business Machines Corp. (IBM)	International Business Machines Corp. (IBM)	International Business Machines Corp. (IBM)
MODEL	**3151 ASCII Display Station Model 410**	**3163**	**3164**	**3191**
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	12	14	12, 14
Screen Capacity (characters)	1,920, 3,168	1,920	1,920	1,920, 2,560
Screen Arrangement (lines x char./line)	24 x 80, 24 x 132	24 x 80	24 x 80	24 x 80, 32 x 80
Status Line	Yes	Yes	Yes	Vendor did not specify
Character Color	Amber	Green, amber	Multicolor	Green, amber
Display Ergonomics	Tilt and swivel optional	Tilt, swivel	Tilt, swivel	Tilt, swivel
Keyboard Style	Typewriter	Typewriter	Typewriter	Typewriter, data entry
Function Keys	12	24	24	24
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable	Detachable	Detachable
Scrolling	Up & down, smooth	Up & down, smooth	Up & down, smooth	None
Protect Format	Yes	Yes	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	TeleVideo, ADDS, Lear Siegler, HZ 1500; cartridges for DEC 220 and Wyse	VT100 Family, TeleVideo, IBM 3101	VT100 Family, TeleVideo, IBM 3101	IBM 3278, 3278 Model 2
Graphics Capability	Yes	Yes	Yes	No
Split Screen	Yes	Yes	Yes	No
Windows/Multisessions	No	Yes	Yes	Vendor did not specify
Memory (number of screens)	1	7,680 characters	7,680 characters	Vendor did not specify
Editing Capabilities	Line insert/delete, character insert/delete, erase	Erase	Line insert/delete, character insert/delete, erase	Character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Synchronous
Code	ASCII	ASCII	ASCII	EBCDIC
Communications Protocol	ASCII, ANSI w/opt. cart.	X-on/X-off	X-on/X-off	BSC, SDLC, SNA
Format	Character, block	Character, block	Character, block	Block
Maximum Speed (bps)	38.4K	50 to 19.2K	50 to 19.2K	1200 to 64K
Terminal Interface	RS-232-C, RS-422 w/opt. cartridge	RS-232-C, RS-422	RS-232-C, RS-422	Coaxial, twisted pair
PRICING AND AVAILABILITY				
Purchase Price ($)	555	585	1,290	1,290
Annual Maintenance ($)	27	25 to 46	30 to 56	41 to 56
Serviced By	IBM	IBM	IBM	IBM
Date of Announcement	June 1987	June 1985	February 1986	June 1986
Date of First Commercial Delivery	June 1987	June 1985	February 1986	June 1986
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	Contact local representative	Contact local representative	Contact local representative	Contact local representative
COMMENTS	36 function keys using shift/alt; multisessions (not windows) supported with optional cartridge	Screen may be divided into 3 horizontal or vertical viewports using a 7,680-character data buffer; printer port (standard); functional compatibility via optional cartridge; priced up to $715	Screen may be divided into 3 horizontal or vertical viewports using a 7,680-character data buffer, printer port (standard), functional compatibility viaoptional cartridge, priced up to $1,435	Part of 3270 Information Display System, attaches to 3174, 3274, or 3276 control unit, Models A10, A20, B10, and B20, printer port and record/play/pause (std.) on D, E, L models, light pen on Model L

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	International Business Machines Corp. (IBM)	International Business Machines Corp. (IBM)	International Business Machines Corp. (IBM)	International Business Machines Corp. (IBM)
MODEL	**3192**	**3192-G**	**3193**	**3194**
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	15	14	15	14
Screen Capacity (characters)	1,920, 2,560, 3,440, 3,564	1,920, 2,560	1,920, 3840	1,920
Screen Arrangement (lines x char./line)	24 x 80, 32 x 80, 43 x 80, 27 x 80	24 x 80, 32 x 80	24 x 80, 32 x 80, 43 x 80, 48 x 80	24 x 80
Status Line	Vendor did not specify	Yes	Vendor did not specify	Vendor did not specify
Character Color	Green, white, multicolor	Multicolor	White	Multicolor
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt, swivel	Tilt, swivel
Keyboard Style	Typewriter	Typewriter, data entry	Typewriter, data entry	Typewriter, data entry
Function Keys	24	24	24	24
Keyboard Ergonomics	Detachable	Detachable	Detachable	Detachable
Scrolling	Up & down	None	None	None
Protect Format	Yes	Yes	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	IBM 3179/3180 Model 1	IBM 3179-G/3279-S3G	IBM 3278 Model 2, 3, 4; 3178	IBM 3179 Model 1
Graphics Capability	No	Yes	Yes	No
Split Screen	No	No	Yes	Yes
Windows/Multisessions	Vendor did not specify	No	Yes	Yes
Memory (number of screens)	Vendor did not specify	Vendor did not specify	Vendor did not specify	Yes
Editing Capabilities	Character insert/delete, erase	Character insert/delete, erase	Character insert/delete, erase	Character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Synchronous	Synchronous	Synchronous	Synchronous
Code	EBCDIC	EBCDIC	EBCDIC	EBCDIC
Communications Protocol	BSC, SDLC, SNA	BSC, SDLC, SNA	BSC, SDLC, SNA	BSC, SDLC, SNA
Format	Block	Block	Block	Block
Maximum Speed (bps)	1200 to 64K	1200 to 64K	1200 to 64K	1200 to 64K
Terminal Interface	Coaxial, twisted pair	Coaxial, twisted pair	Coaxial, twisted pair	Coaxial, twisted pair
PRICING AND AVAILABILITY				
Purchase Price ($)	1,880	2,925	2,610	2,550
Annual Maintenance ($)	61 to 180	113	51 to 77	125
Serviced By	IBM	IBM	IBM	IBM
Date of Announcement	February 1987	February 1987	June 1986	June 1986
Date of First Commercial Delivery	February 1987	February 1987	September 1986	September 1986
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	Contact local representative	Contact local representative	Contact local representative	Contact local representative
COMMENTS	Part of 3270 Information Display System, attaches to 3174, 3274, or 3276 control unit, printer port and record/play/pause (std.), light pen standard on Model L	Part of 3270 family; attaches to 3174/3274/3276 control units, Models G1 and G2; 3979 Expansion Unit ($309) provides auxiliary device ports; printer port standard; full screen graphics buffer	Part of 3270 Information Display System, attaches to 3174, 3274, or 3276 control unit, Models 010 and 020, provides multiple logical terminals, multiplepartitions, and imaging	Part of 3270 Information Display System, attaches to 3174, 3274, or 3276 control unit, Models H10/20/30, D10/20/30, C10/20/30, pricing up to $3,030, printer port (std.), async. interface option

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	International Business Machines Corp. (IBM)	International Business Machines Corp. (IBM)	International Business Machines Corp. (IBM)	Lee Data Corp.
MODEL	**3196**	**3197**	**3290**	**1191**
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	12	14, 15	10.7 x 13.4	14
Screen Capacity (characters)	1,920	1,920, 3,564	5300, 9920	1,920
Screen Arrangement (lines x char./line)	24 x 80	24 x 80, 27 x 132	50 x 106, 62 x 160	24 x 80
Status Line	Yes	Yes	Vendor did not specify	Yes
Character Color	Green, amber	Green, white, multicolor	Amber gas plasma	Green, amber
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt	Tilt, swivel
Keyboard Style	Typewriter	Typewriter, data entry	Typewriter, APL	Typewriter, data entry, 3270
Function Keys	24	24	24	24
Keyboard Ergonomics	Detachable	Detachable	Detachable	Detachable, low profile
Scrolling	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Protect Format	Yes	Yes	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	Vendor did not specify	IBM 3180 Model 2	Vendor did not specify	3270 family
Graphics Capability	No	No	No	No
Split Screen	No	Yes	Yes	No
Windows/Multisessions	Vendor did not specify	Vendor did not specify	Vendor did not specify	No
Memory (number of screens)	Vendor did not specify	Vendor did not specify	Vendor did not specify	1
Editing Capabilities	Character insert/delete, erase	Character insert/delete, erase	Character insert/delete, erase	Vendor did not specify
TRANSMISSION SPECIFICATIONS				
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Vendor did not specify
Technique	Synchronous	Synchronous	Synchronous	Vendor did not specify
Code	EBCDIC	EBCDIC	EBCDIC	Vendor did not specify
Communications Protocol	BSC, SDLC, SNA	BSC, SDLC, SNA	BSC, SDLC, SNA	Vendor did not specify
Format	Block	Block	Block	Vendor did not specify
Maximum Speed (bps)	1200 to 64K	1200 to 64K	1200 to 9600	Vendor did not specify
Terminal Interface	Twinax, twisted pair	Twinax, twisted pair	Coaxial, twisted pair	Coaxial
PRICING AND AVAILABILITY				
Purchase Price ($)	1,270	1,880	6,810	895
Annual Maintenance ($)	56	60 to 85	296	8
Serviced By	IBM	IBM	IBM	Lee Data
Date of Announcement	June 1986	February 1987	March 1983	1988
Date of First Commercial Delivery	June 1986	February 1987	Vendor did not specify	1988
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	Vendor did not specify	8,727
VENDOR PHONE NUMBER	Contact local representative	Contact local representative	Contact local representative	(612) 828-0300 (800) 533-3282
COMMENTS	Part of 5250 Information Display System, all models attach to 5294 or 5394 control unit or directly to S/36, S/38, or AS/400, 1,500 character record/play/pause (std.)	Part of 5250 Information Display System, all models attach to 5294 or 5394 control unit or directly to S/36, S/38, or AS/400, printer port (std.), 1,500 character record/play/pause (std.)	Part of 3270 Information Display System, attaches to 3174 and 3274 control units	Transmission specifications and editing capabilities not applicable

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MANUFACTURER	Lee Data Corp.	Lee Data Corp.	Lee Data Corp.	Lee Data Corp.
MODEL	1192	1222	1225	2131
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14, 15	27 x 132	14	27 x 132
Screen Capacity (characters)	3,564	1,920, 3,564	3,440	1,920, 3,564
Screen Arrangement (lines x char./line)	24 x 80, 32 x 80, 43 x 80, 27 x 132	24 x 80, 32 x 80, 43 x 80	24 x 80, 32 x 80, 43 x 80	24 x 80, 32 x 80
Status Line	Yes	Vendor did not specify	Yes	Vendor did not specify
Character Color	Green, amber, multicolor	Green	Green, white, amber	Multicolor
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt, swivel	Tilt, swivel
Keyboard Style	Typewriter, 3270	Typewriter, data entry, APL	Typewriter, 3270	Typewriter, data entry, APL
Function Keys	24	24	24	24
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable	Detachable, low profile, tilt adjustable	Detachable
Scrolling	Vendor did not specify	None	Vendor did not specify	None
Protect Format	Vendor did not specify	Yes	Vendor did not specify	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	3270 family	TTY, VT100 Family, VT 52, HP 2624B	3270 family	VT100 Family, VT 52
Graphics Capability	Vendor did not specify	No	No	Vendor did not specify
Split Screen	Vendor did not specify	No	No	Vendor did not specify
Windows/Multisessions	No	Yes	No	Vendor did not specify
Memory (number of screens)	Hot key between 5	Vendor did not specify	1	Vendor did not specify
Editing Capabilities	Line insert/delete, character insert/delete, erase field, erase end of message	Erase	Line insert/delete, character insert/delete, erase	Erase
TRANSMISSION SPECIFICATIONS				
Mode	Vendor did not specify	Half/full duplex	Vendor did not specify	Half/full duplex
Technique	Vendor did not specify	Async/sync	Vendor did not specify	Async/sync
Code	Vendor did not specify	ASCII, EBCDIC	Vendor did not specify	EBCDIC
Communications Protocol	Vendor did not specify	BSC, SDLC, SNA, ASCII	Vendor did not specify	BSC, SDLC, SNA, EBCDIC
Format	Vendor did not specify	Character, block, line	Vendor did not specify	Block
Maximum Speed (bps)	Vendor did not specify	19.2K	Vendor did not specify	19.2K
Terminal Interface	Coaxial	RS-232-C	Coaxial	RS-232-C
PRICING AND AVAILABILITY				
Purchase Price ($)	1,300	Vendor did not specify	800	Vendor did not specify
Annual Maintenance ($)	Vendor did not specify	Vendor did not specify	8	Vendor did not specify
Serviced By	Lee Data	Lee Data	Lee Data	Lee Data
Date of Announcement	1988	1985	1988	1985
Date of First Commercial Delivery	1988	1985	1988	1985
Number of Units Installed to Date	1,208	Vendor did not specify	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	(612) 828-0300 (800) 533-3282	(612) 828-0300 (800) 533-3282	(612) 828-0300 (800) 533-3282	(612) 828-0300 (800) 533-3282
COMMENTS	Has support for external bar code reader, station printer, and light pen, priced up to $1,500, transmission specifications not applicable	—	Optional internal bar code, transmission specifications not applicable, priced up to $1,140	Optional graphics capability

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Lee Data Corp.	Liberty Electronics	Liberty Electronics	Liberty Electronics
MODEL	2134	Freedom One ANSI	Freedom One	Freedom One Plus
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	14	14	14
Screen Capacity (characters)	1,920, 2,560, 3,440, 3,564	1,920	1,920	1,920
Screen Arrangement (lines x char./line)	24 x 80, 32 x 80, 43 x 80, 27 x 132, Mod 6	24 x 80, 24 x 132	24 x 80, 24 x 132	24 x 80, 24 x 132, 44 x 80, 44 x 132
Status Line	Yes	Yes	Vendor did not specify	Vendor did not specify
Character Color	Multicolor	Amber	Green	White, amber
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt, swivel	Tilt, swivel
Keyboard Style	Typewriter, 3270	Digital VT220, Data General	ASCII	IBM PC compatible, VT, ASCII
Function Keys	24	15	44	44
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable
Scrolling	Vendor did not specify	Vendor did not specify	Up & down, smooth	Up & down, smooth
Protect Format	Yes	Vendor did not specify	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	TTY, 3270 family, VT100 Family	VT100 Family, VT200 Family, Data General Dasher D210/D211	WYSE, TeleVideo, ADDS, ADM 31	WYSE, TeleVideo, ADM 31, PC-Terminal
Graphics Capability	No	Yes	Yes	Yes
Split Screen	Yes	Yes	Yes	Yes
Windows/Multisessions	Yes	No	No	Vendor did not specify
Memory (number of screens)	Vendor did not specify	1	4	4
Editing Capabilities	Vendor did not specify	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Async/sync	Asynchronous	Asynchronous	Asynchronous
Code	EBCDIC	ASCII	ASCII	ASCII
Communications Protocol	BSC, SDLC, SNA, ASCII	ANSI, X3.64	ASCII	ASCII
Format	Block	Character	Character, block	Character, block
Maximum Speed (bps)	19.2K	38.4K	38.4K	50 to 38.4K
Terminal Interface	RS-232-C, coaxial	RS-232-C	RS-232-C	RS-232-C, RS-422, 20mA optional
PRICING AND AVAILABILITY				
Purchase Price ($)	2,895	499	449	549
Annual Maintenance ($)	12	Vendor did not specify	Vendor did not specify	Vendor did not specify
Serviced By	Lee Data	Liberty, TRW	Liberty, TRW	Liberty, TRW
Date of Announcement	1988	1986	March 1986	October 1986
Date of First Commercial Delivery	1988	February 1987	Vendor did not specify	November 1986
Number of Units Installed to Date	575	10,000	20,000	10,000
VENDOR PHONE NUMBER	(612) 828-0300 (800) 533-3282	(415) 742-7000	(415) 742-7000	(415) 742-7000
COMMENTS	—	Entry level unit, no down-line loadable character set, function keys are user-programmable	1 year warranty, emulations: Freedom 200, ADDS VP A2, TVI 950/925, Lear Siegler ADM 31, Wyse WY-50, PICK compatible, 88 programmable function keys	3-year warranty, emulations: Freedom One and all emulations, IBM PC, IBM PC compatible with slave card, Unix/Xenix, UP/ix compatible, 88 programmable function keys

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MANUFACTURER	Liberty Electronics	Liberty Electronics	Memorex Telex NV	Memorex Telex NV
MODEL	Freedom One Turbo	LY-160	080A	090A
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	14	15	12
Screen Capacity (characters)	1,920	1,920	1,920, 2,560, 3,440, 3,564, 960 partition (ALC)	1,920, 2,560, 3,168, 3,440, 3,564, 960 partition (ALC)
Screen Arrangement (lines x char./line)	24 x 80, 24 x 132	24 x 80, 43 x 80, 24 x 132	24 x 80, 32 x 80, 43 x 80, 27 x 132	24 x 80, 15 x 64 (ALC)
Status Line	Vendor did not specify	Yes	Yes	Yes
Character Color	Green, white, amber	Green, white, amber	Green, amber	Green, amber
Display Ergonomics	Tilt, swivel	Tilt, swivel, overscan reverse video	Tilt, swivel	Tilt, swivel
Keyboard Style	IBM PC compatible, VT, ASCII	IBM PC compatible, VT, ASCII	3270	3270, customized
Function Keys	44	16	24	24
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable
Scrolling	Up & down, smooth	Up & down, smooth	Up & down, smooth	Up & down, smooth
Protect Format	Yes	Yes	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	VT100 Family, VT200 Family, WYSE, TeleVideo, VT52, PC-Terminal	VT100 Family, VT200 Family, WYSE, TeleVideo, ADDS, Lear Siegler, ANSI X3.64, PC-Terminal	3270 family, airline ALC	3270 family, Airline ALC
Graphics Capability	Yes	No	No	No
Split Screen	Yes	Yes	Yes	Yes
Windows/Multisessions	Vendor did not specify	No	Yes	Yes
Memory (number of screens)	4	4	2	2
Editing Capabilities	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Async/sync	Synchronous
Code	ASCII	ASCII	ASCII, EBCDIC	ASCII, EBCDIC
Communications Protocol	ASCII	ASCII	BSC, SDLC, SNA, ALC, SITA, UTS-20	BSC, SDLC, SNA, ALC, SITA, UTS-20
Format	Character, block	Character, block, line	Character, block	Character, block
Maximum Speed (bps)	50 to 38.4K	38.4K	64K	9600
Terminal Interface	RS-232-C, RS-422, 20mA optional	RS-232-C, RS-422, 20 mA	RS-232-C, 20 mA, coaxial	RS-232-C, 20 mA, coaxial
PRICING AND AVAILABILITY				
Purchase Price ($)	599	549	3,050	2,160
Annual Maintenance ($)	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Serviced By	Liberty, TRW	Liberty, TRW	Memorex-Telex	Memorex-Telex
Date of Announcement	October 1986	February 1989	Vendor did not specify	Vendor did not specify
Date of First Commercial Delivery	December 1986	April 1989	Vendor did not specify	Vendor did not specify
Number of Units Installed to Date	10,000	Vendor did not specify	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	(415) 742-7000	(415) 742-7000	(918) 627-1111 (800) 331-2623	(918) 627-1111 (800) 331-2623
COMMENTS	3-year warranty, emulations: PC compatible with slave card, IBM PC, Digital VT220/VT100/VT52, Data General Dasher D211 and D210	—	Custom function keys	—

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Memorex Telex NV	Memorex Telex NV	Memorex Telex NV	Memorex Telex NV
MODEL	1091 D/E	1091C	1092C	1191 A/B
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	15	12	14	12
Screen Capacity (characters)	1,920	1,920	1,920, 2,560, 3,440	1,920
Screen Arrangement (lines x char./line)	24 x 80	24 x 80	24 x 80, 32 x 80, 43 x 80	24 x 80
Status Line	Yes	Vendor did not specify	Yes	Yes
Character Color	Green, amber	Multicolor	Multicolor	Green, amber
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt, swivel	Tilt, swivel
Keyboard Style	Typewriter, data entry, APL, 3270	Typewriter, data entry, APL, 3270	Typewriter, data entry, APL, 3270	Typewriter, data entry, APL, 3270
Function Keys	24	24	24	24
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable
Scrolling	None	Up & down	None	None
Protect Format	Yes	Yes	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	3270 family	3270 family	3270 family	3270 family
Graphics Capability	No	No	No	No
Split Screen	No	No	No	No
Windows/Multisessions	Yes	Yes	Yes	Yes
Memory (number of screens)	1	1	1	1
Editing Capabilities	Character insert/delete, erase	Character insert/delete, erase	Character insert/delete, erase	Character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Synchronous	Synchronous	Synchronous	Synchronous
Code	EBCDIC	EBCDIC	EBCDIC	EBCDIC
Communications Protocol	BSC, SDLC, SNA	BSC, SDLC, SNA	BSC, SDLC, SNA	BSC, SDLC, SNA
Format	Block	Block	Block	Block
Maximum Speed (bps)	64K	64K	64K	64K
Terminal Interface	Coaxial	Coaxial	Coaxial	Coaxial
PRICING AND AVAILABILITY				
Purchase Price ($)	1,395	1,895	1,995	1,295
Annual Maintenance ($)	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Serviced By	Memorex-Telex	Memorex-Telex	Memorex-Telex	Memorex-Telex
Date of Announcement	December 1988	March 1988	March 1988	March 1988
Date of First Commercial Delivery	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	(918) 627-1111 (800) 331-2623	(918) 627-1111 (800) 331-2623	(918) 627-1111 (800) 331-2623	(918) 627-1111 (800) 331-2623
COMMENTS	—	—	—	—

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Memorex Telex NV	Memorex Telex NV	Memorex Telex NV	Memorex Telex NV
MODEL	1191 D2/E2	1192 C2	1192 D2	1192 F2
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	14	15	14
Screen Capacity (characters)	1,920, 2,560	1,920, 2,560	1,920, 2,560, 3,440, 3,564	1,920, 2,560, 3,440, 3,564
Screen Arrangement (lines x char./line)	24 x 80, 32 x 80	24 x 80, 32 x 80	24 x 80, 32 x 80, 43 x 80, 27 x 132	24 x 80, 32 x 80, 43 x 80, 24 x 132, 27 x 132
Status Line	Yes	Yes	Yes	Yes
Character Color	Green, amber	Multicolor	Green, amber	Multicolor
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt, swivel	Tilt, swivel
Keyboard Style	Typewriter, data entry, APL, 3270	Typewriter, data entry, APL, 3270	Typewriter, data entry, APL, 3270	Typewriter, data entry, APL, 3270
Function Keys	24	24	24	24
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable
Scrolling	None	Up	Up	Up
Protect Format	Yes	Yes	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	3270 family	3270 family	3270 family	3270 family
Graphics Capability	No	No	No	No
Split Screen	No	No	No	No
Windows/Multisessions	No	Yes	Yes	Yes
Memory (number of screens)	1	1	1	1
Editing Capabilities	Character insert/delete, erase	Character insert/delete, erase	Character insert/delete, erase	Character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Synchronous	Synchronous	Synchronous	Synchronous
Code	EBCDIC	EBCDIC	EBCDIC	EBCDIC
Communications Protocol	BSC, SDLC, SNA	BSC, SDLC, SNA	BSC, SDLC, SNA	BSC, SDLC, SNA
Format	Block	Block	Block	Block
Maximum Speed (bps)	64K	64K	64K	64K
Terminal Interface	Coaxial	Coaxial, twisted pair	Coaxial, twisted pair	Coaxial, twisted pair
PRICING AND AVAILABILITY				
Purchase Price ($)	1,490	2,045	1,895	2,245
Annual Maintenance ($)	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Serviced By	Memorex-Telex	Memorex-Telex	Memorex-Telex	Memorex-Telex
Date of Announcement	November 1988	October 1988	October 1988	October 1988
Date of First Commercial Delivery	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	(918) 627-1111 (800) 331-2623	(918) 627-1111 (800) 331-2623	(918) 627-1111 (800) 331-2623	(918) 627-1111 (800) 331-2623
COMMENTS	—	—	—	—

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Memorex Telex NV	Memorex Telex NV	Micro-Term, Inc.	Micro-Term, Inc.
MODEL	2192-DS	C19A	ForeSight 4520	ForeSight 4525
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	15	14, 15	14	14
Screen Capacity (characters)	1,920, 2,560, 3,440, 3,564	1,920	3,564	3,564
Screen Arrangement (lines x char./line)	24 x 80, 32 x 80, 43 x 80, 24 x 132	24 x 80	25 x 80, 25 x 132	25 x 80, 25 x 132
Status Line	Yes	Yes	Yes	Yes
Character Color	Green, white, amber	Green, amber, multicolor	Soft-white, overscan	Soft-white, overscan
Display Ergonomics	Tilt, swivel, non-glare filter	Tilt, swivel	Tilt, swivel	Tilt, swivel
Keyboard Style	Typewriter, data entry, APL, 3270	Typewriter, 3270, customized	Typewriter, data entry, VT100/220	Typewriter, data entry, VT100/220
Function Keys	24	24	30	30
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable
Scrolling	None	Up & down, smooth	Up & down, smooth	Up & down, smooth
Protect Format	Yes	Yes	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	3270 family	TTY, 3270 family, VT100 Family, VT200 Family	TTY, VT100 Family, VT200 Family, ANSI X3.64	TTY, VT100 Family, VT200 Family, ANSI X3.64
Graphics Capability	No	No	No	No
Split Screen	Yes	Yes	Yes	Yes
Windows/Multisessions	Yes	Yes	Yes	Yes
Memory (number of screens)	1	1	2	7
Editing Capabilities	Character insert/delete, erase, field erase	Character insert/delete, erase	Line insert/delete, character insert/delete	Line insert/delete, character insert/delete
TRANSMISSION SPECIFICATIONS				
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Synchronous	Async/sync	Asynchronous	Asynchronous
Code	EBCDIC	ASCII, EBCDIC	ASCII	ASCII
Communications Protocol	BSC, SDLC, SNA	BSC, SDLC, SNA, ASCII	ANSI, X3.64	ANSI, X3.64
Format	Block	Character, block	Character, line	Character, line
Maximum Speed (bps)	64K	19.2K	38.4K	38.4K
Terminal Interface	Coaxial	RS-232-C, coaxial, RJ11-C telephone, modem	RS-232-C, RS-422, 20 mA	RS-232-C, RS-422, 20 mA
PRICING AND AVAILABILITY				
Purchase Price ($)	2,295	2,695	695	795
Annual Maintenance ($)	Vendor did not specify	Vendor did not specify	Factory quote	Vendor did not specify
Serviced By	Memorex-Telex	Memorex-Telex	TRW	TRW
Date of Announcement	June 1987	February 1989	November 1986	November 1986
Date of First Commercial Delivery	Vendor did not specify	February 1989	January 1987	January 1987
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	15,000	8,000
VENDOR PHONE NUMBER	(918) 627-1111 (800) 331-2623	(918) 627-1111 (800) 331-2623	(314) 822-4111 (800) 325-9056	(314) 822-4111 (800) 325-9056
COMMENTS	—	2,695 (mono), $2,995 (color), 240 programmable soft keys, up to seven screens can be viewed via windowing capability, attaches to IBM 3274/3174, 3276, and Memorex control units, auto dimming screen	20 x 20 character cell size, displays black characters on a soft-white, over-scanned monitor, 2-year warranty	20 x 20 character cell size, displays black characters on a soft-white, over-scanned monitor, 2-year factory return with first 90 days on site maintenance free

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Micro-Term, Inc.	Micro-Term, Inc.	Micro-Term, Inc.	Micro-Term, Inc.
MODEL	**ForeSight 4540**	**ForeSight 4560**	**Micro-Term 5510**	**Micro-Term 5520**
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	14	14	14
Screen Capacity (characters)	3,564	3,564	3,168, 3300 with status line	3,168, 3300 with status line
Screen Arrangement (lines x char./line)	25 x 80, 25 x 132	25 x 80, 25 x 132	24 x 80, 24 x 132	24 x 80, 24 x 132
Status Line	Yes	Vendor did not specify	Yes	Yes
Character Color	Soft-white, overscan	Soft-white, overscan	Soft-white, overscan	Soft-white, overscan
Display Ergonomics	Tilt, swivel	Tilt, swivel	Vendor did not specify	Tilt, swivel
Keyboard Style	Typewriter, data entry, VT100/220	Typewriter, data entry, VT100/220	Typewriter	Typewriter
Function Keys	30	30	32	32
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable
Scrolling	Up & down, smooth	Up & down, smooth	Up & down, smooth	Up & down, smooth
Protect Format	Yes	Yes	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	TTY, VT100 Family, VT200 Family, ANSI X3.64, Tektronix 4010/4014, REGIS	TTY, VT100 Family, VT200 Family, ANSI X3.64, Tektronix 4010/4014	VT100 Family, VT200 Family, VT320	VT100 Family, VT200 Family, VT 320/220
Graphics Capability	Yes	Yes	No	No
Split Screen	Yes	Yes	No	Yes
Windows/Multisessions	Yes	Yes	No	Yes
Memory (number of screens)	7	7	2	6
Editing Capabilities	Line insert/delete, character insert/delete	Line insert/delete, character insert/delete	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Half/full duplex	Half/full duplex	Full duplex	Full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Code	ASCII	ASCII	ASCII	ASCII
Communications Protocol	ANSI, X3.64	ANSI, X3.64	ANSI	ANSI
Format	Character, line	Character, line	Character	Character
Maximum Speed (bps)	38.4K	38.4K	38.4K	38.4K
Terminal Interface	RS-232-C, RS-422, 20 mA	RS-232-C, RS-422, 20 mA	RS-232-C, RS-423	RS-232-C, RS-423
PRICING AND AVAILABILITY				
Purchase Price ($)	1,495	1,295	499	699
Annual Maintenance ($)	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Serviced By	TRW	TRW	G.E.	G.E.
Date of Announcement	November 1987	November 1986	May 1988	September 1988
Date of First Commercial Delivery	November 1987	January 1987	July 1988	October 1988
Number of Units Installed to Date	1,000	5,000	3,000	2,000
VENDOR PHONE NUMBER	(314) 822-4111 (800) 325-9056	(314) 822-4111 (800) 325-9056	(314) 822-4111 (800) 325-9056	(314) 822-4111 (800) 325-9056
COMMENTS	20 x 20 character cell size, displays black characters on a soft-white, over-scanned monitor, 2-year factory return with first 90 days on site maintenance free, memory also has 3 graphics screens	20 x 20 character cell size, displays black characters on a soft-white, over-scanned monitor, 2-year factory return with first 90 days on site maintenance free, memory also has 3 graphics screens	2-year warranty	2-year warranty

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Micro-Term, Inc.	Qume Corp.	Qume Corp.	Qume Corp.
MODEL	Micro-Term 5530	QVT 101 Plus	QVT 119 Plus	QVT 203 Plus
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	14	14	14
Screen Capacity (characters)	3,168, 3300 with status line	1,920	1920 to 3300	1920 to 3300
Screen Arrangement (lines x char./line)	24 x 80, 24 x 132	24 x 80	24/25 x 80/132 plus status line	24/25 x 80/132 plus status line
Status Line	Yes	Vendor did not specify	Yes	Yes
Character Color	Soft-white, overscan	Green, amber or white optional	Green, amber or white optional	Green, amber or white optional
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt, swivel	Tilt, swivel
Keyboard Style	Typewriter	Typewriter	Typewriter	Typewriter
Function Keys	32	44	44	15
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable	Detachable	Detachable
Scrolling	Up & down, smooth	Vendor did not specify	Up & down, smooth	Up & down, smooth
Protect Format	Yes	Yes	Yes	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	VT100 Family, VT200 Family, VT330/340	TeleVideo, ADDS, QVT 101, HZ1500, ADM 3/5A	WYSE, TeleVideo, ADDS, QVT 119	VT100 Family, VT200 Family, QVT 103/203
Graphics Capability	Yes	Yes	Yes	Yes
Split Screen	Yes	No	Yes	Yes
Windows/Multisessions	Yes	No	No	Vendor did not specify
Memory (number of screens)	6	4	4	4
Editing Capabilities	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Code	ASCII	ASCII	ASCII	ASCII
Communications Protocol	ANSI	Vendor did not specify	Vendor did not specify	ASCII
Format	Character	Character, block, line	Character, block, line	Character, block
Maximum Speed (bps)	38.4K	19.2K	38.4K	38.4K
Terminal Interface	RS-232-C, RS-423	RS-232-C, RS-422 or current loop optional	RS-232-C, RS-422 or current loop optional	RS-232-C, RS-423; RS-422 or current loop optional
PRICING AND AVAILABILITY				
Purchase Price ($)	1,665	429	525	575
Annual Maintenance ($)	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Serviced By	G.E.	Servcom	Servcom	Servcom
Date of Announcement	November 1988	April 1986	April 1986	November 1986
Date of First Commercial Delivery	March 1989	April 1986	June 1986	January 1987
Number of Units Installed to Date	500	Vendor did not specify	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	(314) 822-4111 (800) 325-9056	(408) 942-4000 (800) 223-2479	(408) 942-4000 (800) 223-2479	(408) 942-4000 (800) 223-2479
COMMENTS	2-year warranty	Foreign character sets, screen saver, function keys changed from square to round, pastel shaded break, escape, and clear keys, jump scrolling	Function keys changed from square to round, pastel shaded break, escape, and clear keys, programmable clock and calculator function	Function keys changed from square to round, multi-page support, clock and calculator functions

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Qume Corp.	Random Corp.	Random Corp.	Televideo Systems Inc.
MODEL	QVT PCT	Colleague PLUS	Colleague Portable	TeleVideo 9320
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	11	11	14
Screen Capacity (characters)	1920 to 3300	4000, 2000	4000, 2000	6468
Screen Arrangement (lines x char./line)	24 x 80, 25 x 132	25 x 80	25 x 80	24 x 80 to 80 x 132
Status Line	Yes	Yes	Yes	Yes
Character Color	Green, white, amber	Blue	Blue	Green, white, amber
Display Ergonomics	Tilt, swivel	Tilt	Tilt	Tilt, swivel
Keyboard Style	IBM PC compatible	Typewriter	Typewriter	Typewriter, VT220
Function Keys	12	20	20	30
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Low profile	Low profile	Detachable, low profile, tilt adjustable
Scrolling	Up & down	Up	Up	Up & down
Protect Format	Yes	No	Vendor did not specify	Yes
FUNCTIONAL SPECIFICATIONS				
Compatibility	VT100 Family, WYSE, TeleVideo, QUME PC terminal mode	VT100 Family, VT200 Family, ANSI X3.64, VT52	VT100 Family, VT200 Family, VT52	VT100 Family, VT200 Family, TeleVideo, ANSI X3.64, VT320
Graphics Capability	Yes	No	No	No
Split Screen	Yes	No	No	No
Windows/Multisessions	No	Yes	No	No
Memory (number of screens)	4	64K capture RAM	Vendor did not specify	1
Editing Capabilities	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete, erase
TRANSMISSION SPECIFICATIONS				
Mode	Half/full duplex	Half duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Code	ASCII	ASCII	ASCII	ASCII
Communications Protocol	ASCII	ANSI	ANSI	ANSI, X3.64
Format	Character, block, line	Character	Character	Character, block, line
Maximum Speed (bps)	38.4K	19.2K	19.2K	19.2K
Terminal Interface	RS-232-C, RS-422, 20mA optional	RS-232-C, selectable 12A modem	RS-232-C, selectable 212A	RS-232-C, DECconnect modular jack
PRICING AND AVAILABILITY				
Purchase Price ($)	545	1,295	995	499
Annual Maintenance ($)	Vendor did not specify	50	50	Vendor did not specify
Serviced By	Servcom	Random Corp.	Random Corp.	Vendor did not specify
Date of Announcement	October 1988	April 1987	May 1986	1988
Date of First Commercial Delivery	December 1988	October 1987	May 1986	1988
Number of Units Installed to Date	200	7,000	7,000	Vendor did not specify
VENDOR PHONE NUMBER	(408) 942-4000 (800) 223-2479	(513) 825-0880	(513) 825-0880	(408) 745-7760
COMMENTS	—	Built-in word processor with data capture, record, and send, insert text from Colleague section, recorded files playback off-line for user review, battery-powered, off-line editing capability	Laptop portable with dimensions of 10″ x 13″ x 2 5/8″, weight is 7.5 lbs, includes parallel/serial interface and internal modem, battery powered (battery lasts 15 hours on a full charge)	Additional six screens of memory available; DECconnect jack provides DEC423 compatibility

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Unisys Corp.	Visual Technology, Inc.	Westinghouse Canada, Inc.	Westinghouse Canada, Inc.
MODEL	UVT 12246	Visual 603	3276/3278	IPARS
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	14	14	14
Screen Capacity (characters)	1,920, 3,168	1,920, 3,168, 6600	2400	1,920, 1024, 2400, 2294
Screen Arrangement (lines x char./line)	24 x 80, 24 x 132	25 x 80, 25 x 132, 50 x 132	24 x 80, 30 x 80	24 x 80, 30 x 80, 16 x 64, 31 x 74
Status Line	Yes	Yes	Yes	Yes
Character Color	Green	White, green, amber optional	Amber	Amber
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt, swivel	Tilt, swivel
Keyboard Style	Typewriter, data entry, IBM PC compatible, Unisys OAS	Typewriter	Typewriter	Typewriter
Function Keys	20	45	30	30
Keyboard Ergonomics	Detachable	Detachable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable
Scrolling	Up & down	Up & down	Up & down	Up & down
Protect Format	No	Yes	Yes	No
FUNCTIONAL SPECIFICATIONS				
Compatibility	ANSI X3.64	VT100 Family, VT200 Family, VT52, Tektronix	3270 family, VT100 Family, IPARS, UTS20, VIP 7814	3270 family, VT100 Family, IPARS, UTS20, VIP 7814
Graphics Capability	Yes	Yes	No	No
Split Screen	No	Yes	Yes	Yes
Windows/Multisessions	Yes	Vendor did not specify	Yes	Yes
Memory (number of screens)	1	1	Up to 12 screens	Up to 12 screens
Editing Capabilities	Line insert/delete	Line insert/delete, character insert/delete, erase	Line insert/delete, character insert/delete	Line insert/delete, character insert/delete
TRANSMISSION SPECIFICATIONS				
Mode	Half duplex	Half/full duplex	Half duplex	Full duplex
Technique	Asynchronous	Asynchronous	Synchronous	Synchronous
Code	ASCII	ASCII	EBCDIC	ASCII
Communications Protocol	X3.64	ASCII	BSC, SDLC, SNA, X.25	ASCII
Format	Character, block	Character	Block	Block
Maximum Speed (bps)	38.4K	110 to 38.4K	19.2K	9600
Terminal Interface	RS-232-C	RS-422, RS-423	RS-232-C	RS-232-C
PRICING AND AVAILABILITY				
Purchase Price ($)	750	695	Vendor did not specify	Vendor did not specify
Annual Maintenance ($)	108 on site, 76 off site	Vendor did not specify	Vendor did not specify	Vendor did not specify
Serviced By	Unisys	Visual	WCI, third party	WCI, third party
Date of Announcement	Vendor did not specify	November 1986	July 1987	July 1987
Date of First Commercial Delivery	Vendor did not specify	December 1986	July 1987	July 1987
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
VENDOR PHONE NUMBER	(215) 542-4011	(508) 459-4903	(416) 528-8811	(416) 528-8811
COMMENTS	Supports Tektronix 4010/4014 graphics, Unisys PW2 and IBM PC	70Hz overscanned video, Tektronix 4010/4014 graphics std. with resolution of 1056 x 400, flat profile CRT, calendar, alarm clock, calculator accessories std.	Multi-emulation capability supporting concurrent operation, configured to meet customer requirements, 2 or 4 RS-232-C ports	Multi-emulation capability supporting concurrent operation, configured to meet customer requirements, 2 or 4 RS-232-C ports

Alphanumeric Display Terminal Comparison Columns

MANUFACTURER	Westinghouse Canada, Inc.	Westinghouse Canada, Inc.	Westinghouse Canada, Inc.	
MODEL	UTS 20	VIP 7814	VT100/VT52	
PHYSICAL SPECIFICATIONS				
Screen Size, inches (diagonal)	14	14	14	
Screen Capacity (characters)	1,920, 2400	1,920, 2400	1,920, 2400	
Screen Arrangement (lines x char./line)	24 x 80, 30 x 80	24 x 80, 30 x 80	24 x 80, 30 x 80	
Status Line	Yes	Yes	Yes	
Character Color	Amber	Amber	Amber	
Display Ergonomics	Tilt, swivel	Tilt, swivel	Tilt, swivel	
Keyboard Style	Typewriter	Typewriter	Typewriter	
Function Keys	30	30	30	
Keyboard Ergonomics	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	Detachable, low profile, tilt adjustable	
Scrolling	Up & down	Up & down	Up & down	
Protect Format	Yes	Yes	No	
FUNCTIONAL SPECIFICATIONS				
Compatibility	3270 family, VT100 Family, IPARS, UTS20, VIP 7814	3270 family, VT100 Family, IPARS, UTS20, VIP 7814	3270 family, VT100 Family, IPARS, UTS20, VIP 7814	
Graphics Capability	No	No	No	
Split Screen	Yes	Yes	Yes	
Windows/Multisessions	Yes	Yes	Yes	
Memory (number of screens)	Up to 12 screens	Up to 12 screens	Up to 12 screens	
Editing Capabilities	Line insert/delete, character insert/delete	Line insert/delete, character insert/delete	Line insert/delete, character insert/delete	
TRANSMISSION SPECIFICATIONS				
Mode	Full duplex	Full duplex	Half duplex	
Technique	Synchronous	Synchronous	Asynchronous	
Code	ASCII	ASCII	ASCII	
Communications Protocol	ASCII	ASCII	ASCII	
Format	Block	Block	Character	
Maximum Speed (bps)	9600	9600	9600	
Terminal Interface	RS-232-C	RS-232-C	RS-232-C	
PRICING AND AVAILABILITY				
Purchase Price ($)	Vendor did not specify	Vendor did not specify	Vendor did not specify	
Annual Maintenance ($)	Vendor did not specify	Vendor did not specify	Vendor did not specify	
Serviced By	WCI, third party	WCI, third party	WCI, third party	
Date of Announcement	July 1987	July 1987	July 1987	
Date of First Commercial Delivery	July 1987	July 1987	July 1987	
Number of Units Installed to Date	Vendor did not specify	Vendor did not specify	Vendor did not specify	
VENDOR PHONE NUMBER	(416) 528-8811	(416) 528-8811	(416) 528-8811	
COMMENTS	Multi-emulation capability supporting concurrent operation, configured to meet customer requirements, 2 or 4 RS-232-C ports	Multi-emulation capability supporting concurrent operation, configured to meet customer requirements, 2 or 4 RS-232-C ports	Multi-emulation capability supporting concurrent operation, configured to meet customer requirements, 2 or 4 RS-232-C ports	