Alphanumeric 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, Report C25-010-101, focuses on the major display vendors, market segments, and market trends. Report C25-010-301 contains comparison columns presenting key characteristics and pricing for 211 terminals offered by 52 vendors.

Market 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. With microprocessor code residing in replaceable read-only memory (ROM), updating older equipment or customizing display characteristics is easy and inexpensive.

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.

While terminals are generally very competitive in price and performance, differences exist in emulation capability, the range of interfaces supported, the level of screen customization allowed, and the convenience features incorporated in the display. Taking all of these factors into account, along with pricing and the level of postsale service, will help guarantee a good selection.

Analysis

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 as a distinct product for general-purpose use in the United States and Canada.

Technology Basics

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 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

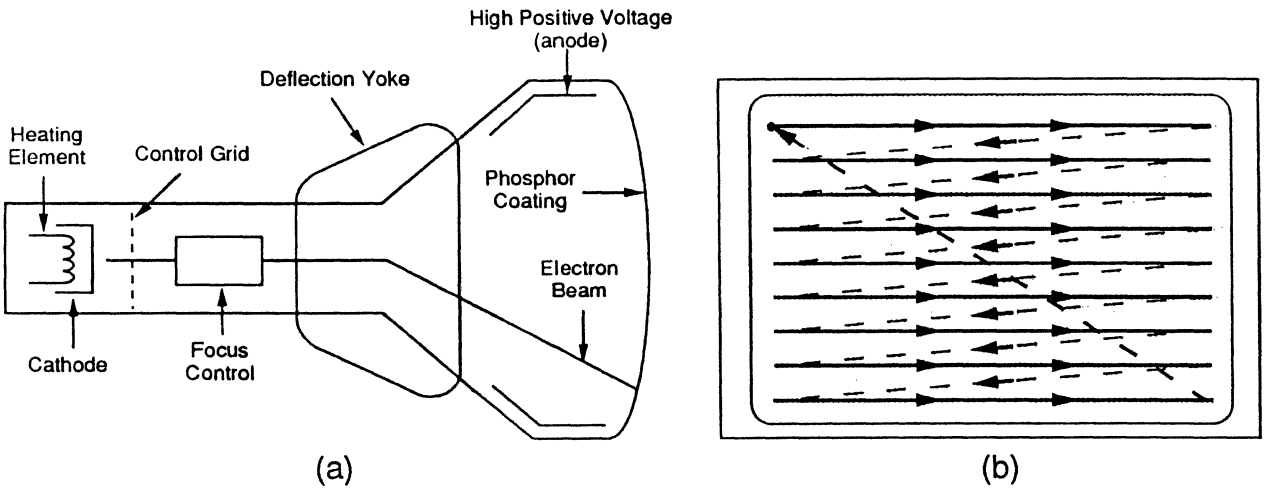
The most widely accepted display medium for terminals is the cathode-ray tube (CRT). This device, similar to a television picture tube, displays textual and graphic information. Its flexibility, high-character capacity, and low cost are the primary factors contributing to its popularity.

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, 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.

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, which 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 monitors, developed for portable electronic products, include liquid crystal displays (LCDs), electroluminescent displays (ELDs), and gas-plasma displays

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.

(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.

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 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 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 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.

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.

Compatibility issues 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 format protection are important. Format protection 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 sizes, and an abundance of programmable function keys can enable the user to customize the terminal to a particular task. Some displays support windowing—the capability to display multiple sessions in separate windows on a single screen. Although monochrome multiwindowing 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 calculators, rulers, notepads, and ports for display-attached printers, which improve worker productivity. Comparing features with price among terminals of the same class is an important step in finding the best buy.

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. ■