

designed for older 8088-based designs by providing an overflow connector to pick up the additional 8 bits of the 80186's 16-bit external bus. However, the high performance of the 80186 would be lost on several of the popular cards.

To avoid potential incompatibility, we elected to take a different route. We investigated several of the popular 16-bit industrial bus formats, but we were not satisfied with the size of the cards; we would have to split the system card (the only card in the minimum system) into two cards, a costly limitation. Even with the high level of integrated circuitry used on the system card we still have 160 chips in the design (see figure 1 on page 170). We selected a size of 14½ by 11 inches for our card, and we squeezed the entire system onto a double-sided card (see photo 2). This fairly large card size, combined with the 5-slot motherboard in which it resides, allows us to expand the system to include high-resolution color graphics, a full megabyte of memory, and a network interface card with one slot to spare, in a total size of 15.4 inches high by 6.3 inches wide by 11 inches deep.

As should be the case with any high-performance system, the motherboard is shielded and terminated. The short width of the motherboard (4½ inches) further reduces the possibility of noise. The total bus bandwidth is 4 megabytes per second.

### The Color Graphics Option

We felt the color graphics option of the Pronto Series 16 should measure up to the high performance that the rest of the system provides. The resolution we selected is unusually high for a general-purpose system: 640 by 480 pixels with 8 simultaneous colors (see photo 3). We selected the vertical resolution (480) based on the highest possible resolution with the standard 15.75-kHz scan monitor. The horizontal resolution was selected to generate a square pixel based on the 4:3 aspect ratio of the color tube. The resulting video frequency is 13.33 MHz.

We based the graphics design on the newly introduced NEC 7220

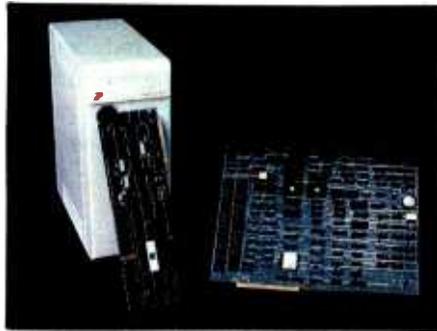


Photo 2: The graphics adapter of the Pronto Series 16 leaning against the system housing, and large main system card.

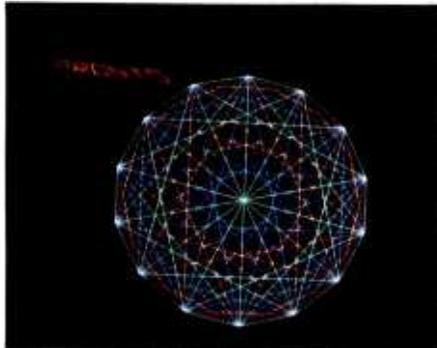


Photo 3: An example of the graphics possible with the color-graphics option of the Pronto Series 16.

graphics-display controller (GDC) because not only does the 7220 support the required resolution, but it contains hardware support for drawing basic graphic primitives, including lines, arcs, rectangles, and characters, and further supports very high performance area fills. The system provides the user with a vector-drawing rate of up to 400,000 pixels per second and an area-fill rate of up to 6,400,000 pixels per second. Another powerful feature of the graphics board is that it provides hardware-based panning along both axes and has the ability to zoom from 1 to 16 times normal size.

We added a RAM-based color table (which allows you to use 8 out of a possible 16 colors) and included an address line from a flash oscillator to allow individual pixels to be programmed to flash automatically or to alternate between two colors. The color table also provides animation capability by allowing alternating bit planes to be modified and displayed, making complex image transformations appear to be instantaneous.

To fulfill this high-resolution display's screen memory requirement of 113K bytes, we selected the same 64K-bit dynamic memory chips chosen for the system's main memory. Sixteen chips provide a graphics memory size of 128K bytes. This memory is isolated from the main processor bus by the GDC, so it does not affect the main processor. The three bit planes are contained in the same physical memory. The memory is cycled three times during one display cycle to read each bit plane.

When the graphics option is selected, the format in alphanumeric mode is 80 characters by 24 lines with a 7- by 9-dot matrix. The alpha characters may be positioned anywhere on the screen, limited only by pixel boundaries, and may be aligned at a 45-degree angle from either axis.

### Summary

As I mentioned earlier, bringing out a new business microcomputer is quite a challenge. It must do more than any of its competitors, and it must do it at a reasonable price. Although the real test of a product is in the marketplace, I believe that the Pronto Series 16 computer, which combines the new Intel 80186 microprocessor with the MS-DOS 2.0 operating system, floppy-disk drives, 128K bytes of RAM, a high-resolution monitor, communications interfaces, and a bundle of applications software, has met this challenge. ■

#### Sales and Service for the Pronto Series 16

Pronto Computers is setting up a dealer network to market the Series 16. This network will include approximately 200 dealers and should be fully established by the fourth quarter of 1983.

Service for these machines will be provided by the dealers and by a third party that has not yet been named. You can obtain more information from Pronto Computers Inc., 3170 Kashiwa St., Torrance, CA 90505; (800) 634-6400. In California and outside continental U.S. call (213) 539-6400.

#### About the Author

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