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"CORONA" 256-COLOR PERIPHERAL + TIC-TAC-TOE PROGRAM
8085 SINGLE-BOARD COMPUTER + 16 BIT Vs. 8 BIT CPUs

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"CORONA"
256-Color Peripheral

BY JEFF LOWENSON, ROBERT MARSH & JAMES SPANN

Upcoming S-100 bus compatible kit with full color graphics and alphanumerics.

Editors at Popular Electronics are frequently privy to exciting new products that are in the final stages of pre-production design. This information includes all the details on how it works and "hands on" experience with custom-wired samples. One such product about which we'd like to share information with readers is Processor Technology's "Corona," a high-resolution, full-color graphics accessory for microcomputers. The Corona will provide 256 colors (or shades of grey in a 256-by-208 display with graphics and alphanumerics mixed—all under software control.

The Corona is designed to be fully bus compatible with the SOL-20 microcomputer and VDM-1 video display module, both made by Processor Technology. However, it can be modified as required to operate with other S-100 bus formats. The Corona-1K kit with 8K of memory will be marketed through computer stores in the near future for $395.

Technical Details. The display resolution of the Corona is 256 × 256, with a display size of 256 horizontal by 208 vertical. Its 53,248 pixels can be used with a selection of any 16 out of 256 possible colors (or grey levels). The alphanumerics can be mixed and overlaid with the graphics and/or external video input. The Corona uses 8K of 8-bit bytes in the low-color range and 24K of 8-bit bytes in the full-range version. (See Corona Specifications Table.)

In addition to game playing, this new graphics system is a powerful tool for business, artistic, scientific, and educational applications, since vivid graphics, poster-like displays, and full-color animation are available.

Since the Corona's signals can be mixed with video from a low-cost monochrome TV camera and with alphanumerics from a computer, the final video can display a scene from a camera with

Note: on the cover is an artist's conception of a computer game using the Corona.
a set of color graphs superimposed on it. Scientific data can be transformed into a presentation that can be observed while an experiment is in progress. Alpha feedback experimenters will find this color approach valuable because of the wide range of its 256 colors.

It is recommended that the Corona be used with a color monitor to take advantage of the better color and crisper images available.

**Circuit Operation.** As shown in Fig. 1, the heart of the Corona system is the Graphic Display Memory that stores information in three $256 \times 256 \times 1$ bit planes, each of which represents a $256 \times 256$ CRT screen matrix. The three combined planes contain three bits of color information for each dot on the TV screen. The memory can be used in two ways—for color-picture storage or as conventional computer memory. This means that when the graphics are not used, the computer memory is expanded by the amount of memory contained in the graphics interface (see Fig. 2 memory map).

Memory access by the computer is handled in two modes. In the **bit mode**, each full-color point can be individually read or written to by the computer. This mode simplifies interfacing with BASIC and FORTRAN to take advantage of their powerful trigonometric and matrix functions. (Matrix operations enable the programmer to write powerful software for scaling, translation, and rotation of graphic images.) In this mode, the graphics display area looks to the programmer like a $256 \times 256$ Cartesian coordinate system, with the origin at the lower left corner.

In the byte mode, graphics data is transferred from the computer to the Corona, eight bits at a time, with the RAM organized as conventional 24K by 8-bit memory. The byte mode permits very fast loading of complete screens from peripheral devices, such as a floppy-disk or a cassette-tape system.

The bus interface and control logic section (Fig. 1) controls the flow of data between the computer and the Graphics Display Memory. This logic synchronizes the TV scan and computer memory requests. This functional block also contains the command registers, memory timing, and fast erase logic.

The address multiplexer selects the source of the display memory address, which can originate either from the computer or from the X-Y logic. The X-Y counters generate the X-Y address coordinates that represent a point on the CRT screen. Data from the display memory is thus mapped on the TV.

The bit/byte multiplexer is used in the bit mode to change or read one bit into each of the three memory planes. The shift registers convert the eight and 24 bits of parallel data from the Graphics Display Memory into a serial address for the color-map RAM.

The video generator section can provide up to 256 different colors (or 32 shades of gray), eight of which can be displayed graphically at one time. Either SOL-20 or VDM-1 alphanumeric characters can be mixed under program control to interleave graphics and text information anywhere desired on the screen. All the video sync signals are provided by the SOL-20 or VDM-1.

Alphanumeric can be displayed in a distinct ninth color that is selected under software control to provide the best contrast with the eight graphics colors. There are also an additional eight colors where the graphics and alphanumericics intersect.

Any one or all of the displayed colors can be rapidly changed without rewriting the graphics memory contents (that is, without changing the form or shape of the picture). This unique feature can create a shimmering rainbow effect with very simple programming.

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**Fig. 1. Block diagram of Corona shows logic interconnections. The NTSC output means that it can be video recorded. Sync can also be obtained from an external source for interfacing to other video systems.**

**Fig. 2. Memory map shows RAM arrangement of Corona.**
The color-map RAM is a high-speed 16-word by 8-bit RAM array. This organization permits the choice of 256 colors (more precisely, 64 colors, each of which has four intensities). Colors for each point on the screen are determined by the three-bit code stored in the Graphic Display Memory that addresses the color-map RAM. The color-map RAM is loaded under program control via the A register.

The function of the color-video encoder is to transform the red, green, blue, and luminance data from the color map into NTSC color signals. This encoder is comprised of timing, four two-bit D/A converter, and the actual color-encoder sections.

The timing section generates the color-burst flag and composite sync (from the SOL-20 or VDM-1 composite sync). The red/green/blue/luminance D/A converters accept digital data from their respective sections of the color map and convert it to analog color-difference signals (R - Y and B - Y). The encoder section is designed around an IC that modulates the color subcarrier with the color-difference signals and outputs the composite video that consists of the video, blanking, and sync signals.

**Physical Details.** The Corona’s circuitry mounts on two large printed circuit boards. The larger board plugs directly into the S-100 bus of the computer and contains 73 ICs, four voltage regulators, and miscellaneous discrete components. The smaller board, which contains 32 ICs that include the RAM memory system and the data multiplexers, is then connected to a jack on the larger board.