New Products

Peripheral equipment

# Graphics terminal displays attractive figure: under $10,000

Unit with storage crt handles alphanumerics and vectors; it's being unveiled at Fall Joint Computer Conference

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When Tektronix Inc. introduced last year a storage cathode-ray tube suitable for use in a graphic-display computer terminal [Electronics, Oct. 16, 1967, p. 165], many figured that it was only a matter of time before the company followed up with a complete terminal. They were right. At the Fall Joint Computer Conference in San Francisco, Tektronix is unveiling its type 4002 graphics computer terminal, including storage crt, terminal control, character generator, and keyboard. The terminal provides full alphanumeric and graphic display of data entered from a keyboard or auxiliary input, at a price which the company says will be under $10,000.

The storage tube, which doesn't require refreshment to maintain its display, is most suitable for time-shared computer systems, because it can operate at the end of a 2,000-bit-per-second telephone line. The first terminal has been tailored to the Digital Equipment Corp.'s PDP-8 computer; the terminal control inputs and outputs operate with standard DEC software. Tektronix has indicated that the terminal may be marketed through DEC or other computer manufacturers as well as through Tektronix' own
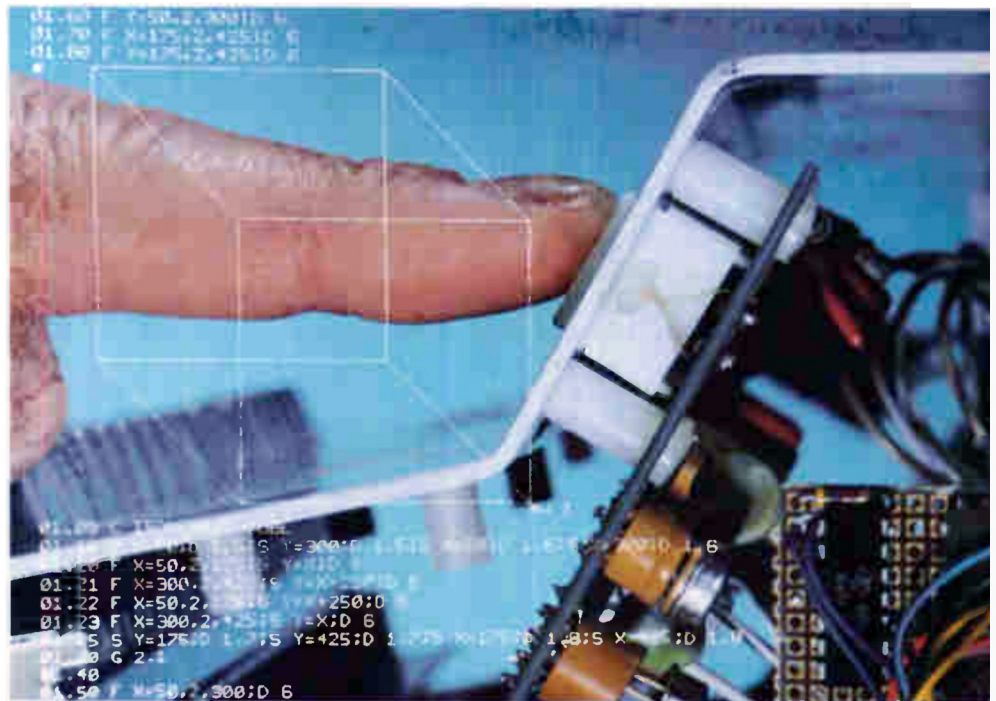
Controller. Pushbutton switches just above terminal keyboard use integrated circuits for switching and logic functions.

sales force and field offices.

Keith Williams, vice president and marketing manager, expects the 4002 to appeal to some users who are now making manual plots from computer data. He concedes that the popular x-y plotter made by California Computer Products Inc. does provide a kind of low-cost graphics, but he indicates that Tektronix thinks of the Calcomp plotter as complementary equipment to the 4002. Williams also says that the 4002's faster writing means using less computer time than either an x-y plotter or a teletypewriter

Loner. Terminal reads out alphanumerics and vectors,
retains display without recycling of information by computer.

is likely to use.

Blank buttons. The terminal won't be available until next August. John Griffin, manager of the electronics section of Tektronix' Information Display division, says the advance peek during the conference will "give computer people time to start thinking about graphics software." Three buttons that will be blank on the terminal shown at the conference will have a function that relates to one of the major drawbacks of the storage tube when used for computer display: the inability to erase selectively. Neither Williams nor Griffin will give details, but the terminal that will be available next summer will have some sort of off-line editing capability.

Meanwhile, Tektronix has doubled its ceramic tube production, indicating that it expects the storage tube to grab a good share of the terminal market. The 611 display unit introduced a year ago is already going into a rival computer terminal built by Computer Displays Inc. [Electronics, Feb. 19, p.

50]. It is priced at $12,750.

The 4002 has these features:

- Flicker-free display covering more than 50 square inches on an 11-inch diagonal.
- The ability to retain traces indefinitely; however, erasure after an hour is recommended.
- The ability to plot lines, points, and characters in any format.
- A writing speed of 1,000 characters per second and a line-drawing speed of 200 inches per second.
- The capacity to display 2,800 characters.
- The ability to generate the full ASCII code of 96 characters and 32 commands.

The terminal consists of the display unit, a character generator, a control unit that contains plotting logic and a digital-analog converter, an input/output module to interface with a computer or a data modem, and a keyboard. All but the last were designed and built by Tektronix; the keyboard is purchased from the Micro Switch division of Honeywell Inc. [Electronics, Sept. 16, p. 169].

Discrete memory. The tube is a modified version of the direct-view, bistable 611. The screen will present up to 35 lines of alphanumeric characters (with 80 characters per line) any kind of graphics, or both graphics and alphanumerics.

The graphics can be preplotted by subroutines, plotted incrementally, or drawn by linear interpolation, in which the computer plots a line between two addressed points on the crt. The interpolator, says Griffin, is a high-speed integrator consisting of two current sources to charge separate capacitors that deliver voltages to the x and y deflection plates.

Characters are generated in the usual way by a read-only memory built with 1,600 diodes. The ASCII code—seven bits from the computer —for a character is decoded into one of 96 lines that address the read-only memory. Simultaneously, x and y counters set the beam to stepping through a 7-by-9-dot matrix; these x and y lines are also two of three inputs to three-way AND gates in a scanning sense array; if it indicates that a given dot is in the character pattern, the gate opens and the signal unblanks the beam.

Griffin says that Tektronix may at some point integrate the read-only memory but that at present monolithic memories can't compete in price with the discrete types. There are, however, Tektronix-designed integrated circuits in a new type of pushbutton on the front panel. One such switch, for example, changes the terminal from keyboard to magnetic or paper tape operation.

The switches were designed to be shallow yet to permit multiple functions and be lighted from multiple sources. The button travels only 1/16 of an inch to operate the switch, and thus is unlikely to get out of trim. The IC has a flip-flop to establish its binary state and multiple outputs to send logic signals to the rest of the circuitry and to light the switch lamp. Eight packages perform the switching, logic functions, and lamp-driving for all 13 special switches on the front. Griffin says the new switches will undoubtedly show up in other Tektronix instruments.

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