TEKTRONIX®

INFORMATION

DISPLAY

PRODUCTS

T-4002
GRAPHIC
COMPUTER
TERMINAL

TEKTRONIX®

Reference Information

T4002 GRAPHIC COMPUTER TERMINAL

The T4002 is a completely self-contained, desk-top information system which provides a high-resolution, flicker-free display with both high-speed complex graphic and high-density alphanumeric capability. Its unique direct-view storage tube eliminates the requirement for a separate refresh memory and minimizes the information rate requirements of the data source. The annoying flicker associated with most refreshed displays is also eliminated. The new data is written only once and data can therefore be sent to the terminal at a convenient rate of 5,000 characters per second (AVERAGE).

The T4002 Graphic Computer Terminal consists of a display unit, terminal control, character generator, keyboard module, input/output interface and auxiliary unit.

The direct-view bistable storage tube provides most of the economic advantage of this type of system by eliminating costly refresh memory devices. The slower speed allows the use of software for much of the data formatting and data control functions. An analog character generator, with its characteristic of high-accuracy and low-slew rate also contributes to the low-system cost.

The 11-inch, flicker-free display (6-1/2 x 8-1/4-inch screen) accommodates 39 lines of alphanumeric characters of 85 symbols each, permitting more than 3000 characters to be displayed. Resolution is equivalent to 287 x 400 line pairs. Stored information may be erased in less than 0.5 second.

The terminal control provides timing logic, data buffers, interconnection logic, function decoding, line-buffer control, D/A converters and plot logic for the character generator, keyboard and auxiliary module. All the data is routed and priorities determined by the terminal control.

The character generator provides a complete set of USASCII printable characters with both upper and lower case, numerals and special symbols. Two sizes of characters are under program control.

The control panel is designed for ease of operation with panel controls held to a minimum by automatic control functions. The standard keyboard contains keys for 96 USASCII characters and 32 control characters.
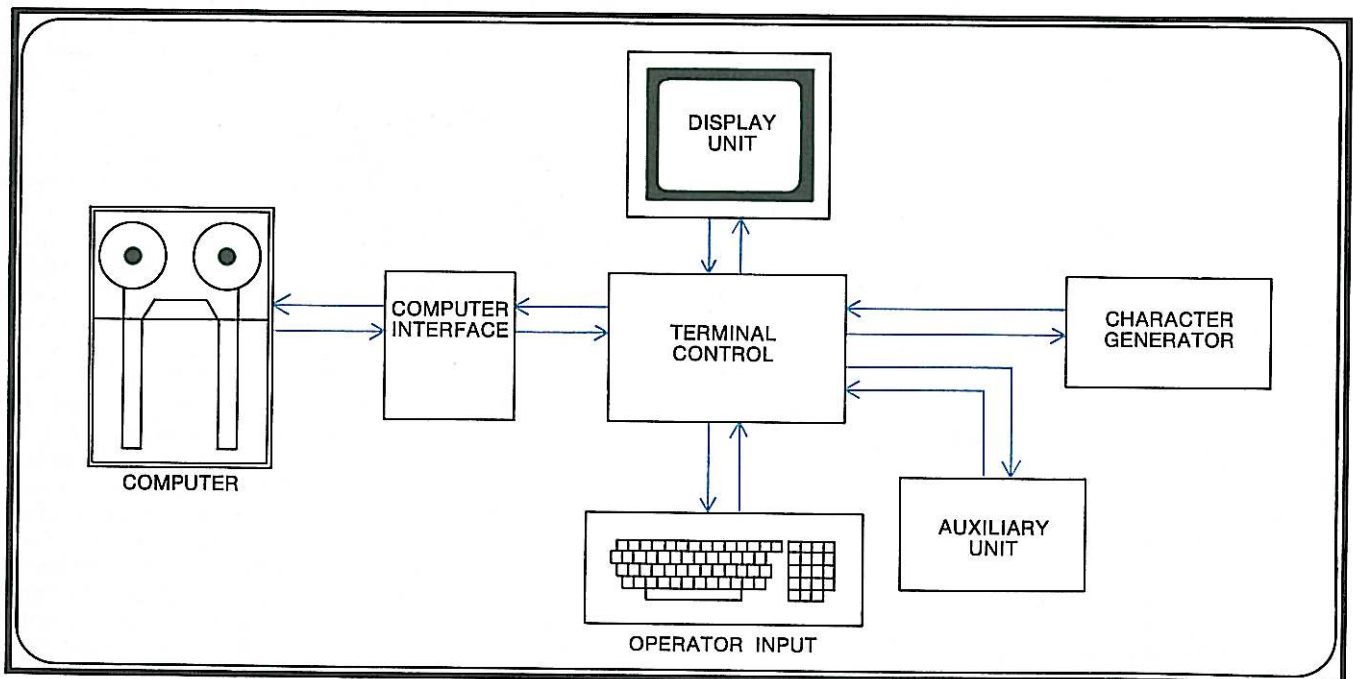
T4002 GRAPHIC COMPUTER TERMINAL BASIC BLOCK DIAGRAM

Reference Information

The T4002 is designed to use existing software as much as possible. TTY teletype interface is provided to allow complete compatibility with common existing teletype terminals. Thus, the user who is connected into a time-share service or computer with a regular teletype can connect the terminal with no change in software. Note: There may be a teletype-speed limitation unless the computer interface is modified to eliminate the time delays for TTY teletype. Once this high-speed link is available, however, the full capabilities of the Tektronix T4002 may be utilized.

Four modes of display are selectable on the T4002: (1) Alphanumeric, (2) Point plotting, (3) Incremental plotting, and (4) Linear interpolation plotting. A fixed grid of 1024 x 760 viewable points are available in any of the graphic modes.

The following discusses three modes of graphic displays selectable on the T4002. Programs that have been developed in any of the three modes mentioned below will generally be suitable for use with the T4002 with only minor modifications.

1. Point Plot: The point-plot mode generates a display by providing a separate address for each point and then plotting it. Although there is no restriction on where the point is placed, this mode can be inefficient because of the amount of data required to draw a graphic display.

2. Incremental Plot: Incremental-plot mode is widely used by mechanical plotters. The display is generated by providing an address for the beginning point. The next point must be adjacent in one of eight directions and may be printed or not printed. This incremental technique saves data bits compared to the point-plot mode.

3. Linear Interpolation: The linear-interpolation mode provides a beginning and ending address. A line is then generated between the two points. This vector-type display allows smoother lines to be drawn since the beginning and ending points are the only points that must be on the fixed grid. Because minimal data is required to draw graphics, this mode is particularly appropriate for transmitting data over phone lines.

One of the greatest advantages of the computer terminal is the fact that programming is made so much easier and quicker. When writing and "debugging" programs, a teletype readout is slow enough that the programmer often loses his train of thought. The mind usually thinks much faster than a teletype can print out program elements. The tremendous speedup of the T4002 with its quick readout allows a rapid input back into the system. Thus, ideas and changes are applied without delay and the effects may be immediately observed. This interactive display capability is particularly important when developing graphics programs, since there is little delay from program development to program observation.

LINE BUFFER

The Line-Buffer feature of the T4002 Graphic Computer Terminal consists of a one-line, 84-character local memory. This memory is used in conjunction with a 1-cm x 21-cm refreshed area at the bottom of the tube. The information is in alphanumeric form, thus the user can edit the text before sending the information to the computer as a one-line message block. Information may be updated and verified, corrected if necessary, before it is sent to the computer.

Use of the Line-Buffer feature is as follows: The COMPOSE button is pressed to change operation from DIRECT to COMPOSE. At this time, any characters previously entered into the Line Buffer are presented in one line across the bottom of the tube. Information can be changed in one of several manners.

The CLEAR button clears the Line Buffer and the cursor reverts to the left-hand edge of the refreshed area (point of entry of next character). The desired text is typed, entered into the buffer memory and appears in the line-Buffer area. When maximum capacity is reached, the FULL button is lighted to alert the operator. Once the message is complete, pressing the SEND button sends all of the text to the computer as a block of data. The buffer memory is not erased until the CLEAR control is pressed. Therefore, if an error is made during transmission, the text can be recalled and sent to the computer a second time.

This operation offers two advantages. First, text is edited and you know it is correct before you send it; second, it allows you to send a burst of text (i.e., one complete line as opposed to a number of individual characters) which minimizes transmission time.

The Line-Buffer area is also convenient for correcting messages. If the message is not correct as first typed, editing is accomplished as follows: The keyboard is backspaced until the cursor is positioned above the location where a change is desired. Backspacing across a character erases that character from the buffer memory. The character is deleted and the erased part of the text is retyped.

The Line Buffer operation combines many of the advantages of refreshed terminal with the advantages of the direct-view storage tube. This feature is particularly desirable where relatively unskilled operators require information over a time-share network, e.g., parts information and parts drawing applications where a very small amount of input must be accurate.

Another area of Line-Buffer usage is when the terminal is used as a remote "batch" device. Such a use requires updating of information in computer files. The information that is being sent to the computer is the updated information and must be correct. Therefore, it is desirable to compose and verify the entire entry before sending it to the computer.

INTERFACE UNITS

Several interface options are available for the T4002 which increase its efficiency and versatility as a data communications terminal.

FOR DEC PDP-8 SERIES

Separate interfaces are available for computers with negative input/output buses and computers with positive input/output buses. Data is transferred in parallel under Program Data Transfer control of the PDP-8. When receiving input data from the PDP-8, the unit decodes the data, converts the logic, and provides transfer timing information to the Terminal Control. When transmitting output data, the unit changes the Terminal Control data to match the PDP-8 logic and transfers it under control of the computer's timing pulses. Each unit has its own external interconnecting cable wired for direct connection to the PDP-8's Input/Output Bus.

FOR DATA COMMUNICATION SYSTEMS

An interface allows the Tektronix Graphic Computer to communicate with devices which transfer data serially in either a full or half duplex mode. It is designed to conform to EIA Standard RS-232-B (October, 1968) which defines the minimum required circuits and electrical signal characteristics for exchanging binary serialized data. It has its own internal clocks or it can be synchronized with external timing signals. Therefore, it is compatible with synchronous and asynchronous modems. It has its own external interconnecting cable which matches up with many of the most common modems.

T4002
Graphic Computer Terminal

Shown with optional joystick

- INTERACTIVE GRAPHICS

- SOFTWARE SUPPORTED

- HARD-COPY COMPATIBLE

- RETAINS DISPLAYS WITHOUT REFRESHING

- HIGH DENSITY ALPHANUMERIC AND COMPLEX GRAPHIC DISPLAYS

- LINE-BUFFER AREA FOR EDITING

The Tektronix T4002 Graphic Computer Terminal is a completely self-contained, desk-top, Information Display System designed for rapid and efficient information exchange between man and computer. Complete communication interaction is achieved through the T4002 data-entry keyboard and the optional Tektronix 4901 Interactive Graphic Unit. The display device is a Tektronix developed, direct-view bistable storage tube which displays alphanumeric and graphic computer outputs without refreshing.

The Tektronix 4601 Hard Copy Unit or C-10 Camera produce permanent copies of the T4002 display. The Hard Copy Unit produces high quality, reproducible 8½ x 11-inch paper copies of the stored screen contents. Copy command is either manual or computer initiated. Copies may be computer initiated for unattended operation. The C-10 photographs the stored and line-buffer screen contents on 4 x 5 Polaroid* film.

*Registered Trademark Polaroid Corporation

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 THE TEKTRONIX TYPE T4002 grAPHIC coMPUTER teRMINAL wiTH ofFLINE edITING
 THE TEKTRONIX TYPE T4002 GRAPHIC COMPUTER TERMINAL WITH OFFLINE EDITING




 C-FOCAL , 8/68

 01.01 S X=X+1
 01.05 G 3.1
 01.10 F X=0,.2,6.08;S A=D+G*FSIN[X];S B=D+G*FCOS[X];D 1.2
 01.20 S M=A+G*FCOS[0];S K=B+G*FSIN[0];D 1.3
 01.30 S C=FDXS[K,M];D 2

 02.10 F L=0,.2,6.48;D 2.5
 02.30 RETURN
 02.50 S C=FDIS[B+G*FSIN[L],A+G*FCOS[L]]

 03.10 S D=500;S G=70;D 1.1
 03.15 Q
 03.20 S D=450;S G=150;D 1.1

 THE TEKTRONIX TYPE T4002 GRAPHIC COMPUTER TERMINAL WITH OFFLINE EDITING
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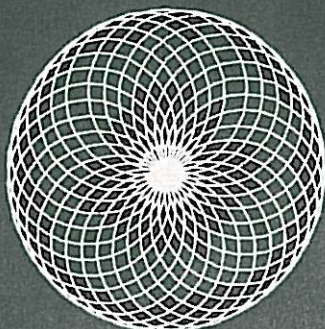
The Line-Buffer feature of the T4002 simplifies text composition, verification and correction. The first line in the above photograph is incorrect. The line is recalled from the buffer memory and corrected in the Line-Buffer area at the bottom of the display. After correction, the line is retransmitted to the stored display area.

CHARACTERISTIC SUMMARY

CONTROL PANEL
Power—Key switch.

Keyboard—Full USASCII (128 codes).

Control Lock—Key switch for security purposes.

Mode Controls and Indicators:

On Line/Local—Indicates on-line or off-line connection.

Transmit/Receive—Communication-mode status.

ASCII/TTY—Communication-code indicator.

Display/Auxiliary (or both)—Input source indicator.

Special Functions:

Page Full—Halts output when screen is full of alphanumerics.

Margin Shift—Allows four fixed margin positions for increased information.

Comm Error—Lights on detected error at interface bus.

Data Received—Indicates computer input to T4002.

Interrupt—Used to halt computer output.

DISPLAY CAPABILITY
96 USASCII symbols including both upper and lower case characters, numbers and special symbols.

Graphics:

1024 x 1024 addressable points.

1024 (X) by 760 (Y) viewable points.

Incremental plot.

Point plot.

Linear interpolation (vector).

Alphanumeric:

39 lines, 85 characters per line in stored area.

1 line, 84 characters in Line-Buffer area.

2 sizes of characters under program control.

5000 characters per second (average) writing capability.

DISPLAY CHARACTERISTICS
Display Area—15.2 cm x 21 cm.

Erase Time—0.5 second.

Resolution—Equivalent to 400 x 287 line pairs.

INTERFACE UNITS
For Digital Equipment Corporation PDP-8 Series Computers with negative input/output buses.

For use with devices which transfer data serially in either full or half-duplex mode. Conforms to EIA Standard RS-232B (October, 1968).

For Digital Equipment Corporation PDP-8 Series Computers with positive input/output buses.

For minicomputers with TTY I/O port.

T4002
Graphic Computer Terminal

CONFIGURATION

The T4002 console contains the following system components: display unit, terminal control, character generator, input/output interface, and keyboard. Space is provided within the terminal to accommodate an auxiliary module for expanding system capability. Interfaces are available for direct coupling to computers or data communication systems.

DISPLAY UNIT

A Tektronix, 11-inch, direct-view, bistable storage tube is used as the display medium. High-density alphanumerics and complex graphics are presented without flicker or drift. The 15.2-cm by 21-cm screen will accommodate up to 39 lines of alphanumeric characters with 85 symbols per line. More than 3000 characters may be displayed with excellent clarity. Resolution achieved is equivalent to 400 x 287 line pairs. Viewing time is at least 15 minutes. Viewing time may be extended to one hour; however, successive erasure of previously stored information may be required.

LINE BUFFER AREA

The Line Buffer capability of the T4002 makes use of one 84-character line of discrete memory. Data is entered through the keyboard, stored in memory, and displayed in a 1-cm x 21-cm continuously refreshed, flicker-free area at the bottom of the screen. The information in this memory can be verified and edited before it is sent to the computer as a single message block.

A cursor is always positioned over the next area to be written. Any character may be changed by backspacing the cursor to the character to be changed. Backspacing past a character erases that character from local memory. Pressing the SEND control transmits the Line Buffer Area information to the computer if ON LINE, or to the designated output device if in LOCAL.

KEYBOARD

Manual entry of data is through a solid-state keyboard with full USASCII capability (128 codes). 96 upper and lower-case characters, numbers and special symbols are provided for alphanumeric data entry. Two sizes of characters are under program control. 32 additional control characters are included for communications between the computer and the terminal. All controls are program callable. The keyboard has 2-key rollover protection.

TERMINAL CONTROL

The Terminal Control is the traffic director which interfaces all of the major components of the system. It provides interface logic, code conversion, data timing, data-buffering, mode switching and digital/analog conversion. Terminal Control routes alphanumeric data to the character generator and controls graphics directly. The Terminal Control's I/O interface bus is TTL compatible.

The T4002 operates in one of four display modes set by Terminal Control in response to control characters or control bits.

Alphanumerics—Prints, on a fixed format, alphabetical and numerical characters according to the USASCII code.

Graphics—The T4002 operates in one of three modes to form graphic figures. The terminal then treats incoming data as XY information and either plots points or draws lines to form graphic figures. The three graphic modes are:

1. Incremental plot: In this mode, the T4002 increments the plot position one point in any one of eight directions from the last point location, according to an assigned code in the data word.

2. Point plotting: In this mode, the X and Y address in each data word is decoded and the point is printed on command from Terminal Control.

3. Linear interpolation: In this mode, the T4002 draws a smooth line between two sets of XY coordinates contained in a data sequence. The line (or vector) can be intensified or dark. The lines can be any length, but for uniform intensity, they should be held to two inches or less.

Character Input Speeds—Data character input speeds to Terminal Control are as follows:

Alphanumeric	— 5,000 characters per second (average)
Incremental Plot	— 75,000 points per second maximum
Point Plot	— 75,000 points per second maximum for adjacent points
Linear Interpolation	— 2 ms/vector for unintensified (dark) vectors
	8 ms/vector for intensified vectors

CHARACTER GENERATOR

The character generator provides a set of 96 USASCII characters, including 1 "space" and 1 "delete" character. Two sizes of characters are under program control, 70 x 90 mils and 140 x 180 mils. At least 5000 characters per second (average) may be generated.

CONTROLS AND INDICATORS

In addition to a standard alphanumeric keyboard, other labeled and light-coded controls are provided to enhance ease of operation. The number of panel controls is minimized and control functions made automatic where practical (see photo of control panel).

Control Characters—The USASCII provides for 32 control characters to be utilized for communication between computers and remote I/O equipment. Keys to activate these control characters are provided on the right portion of the keyboard. Functions peculiar to the T4002 are also controlled from this keyboard area. Certain of these control characters are easily rewired to perform application oriented functions in addition to the defined functions.

View/Hold—Switches the display from a hold mode to a view mode for 60 to 250 seconds.

Erase—Erases the entire stored display area.

Format Controls—Provide a means of moving the cursor when fixed-format alphanumerics are used. The five format buttons (top left of keyboard) move the cursor UP, DOWN, RIGHT, LEFT or HOME (fixed point upper left corner—resets T4002 from Graphics to Alphanumerics).

Power Off/On/Control Lock—Key-operated, 3-position rotary switch controls line voltage to the T4002. A color-coded mechanical flag showing through the POWER ON aperture indicates the position of the switch. CONTROL LOCK is a "security" position in which input from the T4002's control panel and keyboard is locked out.

On Line/Local—Controls on-line and off-line terminal operation and indicates status.

Transmit/Receive—Controls and indicates the communication mode status.

ASCII/TTY—Controls and indicates communication code being output by the keyboard.

Input: Keyboard/Aux—Controls and indicates selection of KEYBOARD or AUXILIARY as input to computer.

Output: Display/Aux—Controls and indicates selection of the DISPLAY or AUXILIARY or both to receive output from computer.

Page Full—Indicates full page and stops information from computer (in alphanumeric mode only).

Margin Shift—Allows a choice of four fixed margin positions, starting on the left and moving to the right. Useful when writing columns of short statements.

Comm Error—Indicates an error at the terminal control interface.

Data Received—When the computer makes an entry to the display, the indicator lights. Pressing the control extinguishes the indicator.

Interrupt—Pushing this button initiates a function which may be interpreted by the computer as an interrupt.

Direct/Compose—Controls and indicates text editing function.

Direct: Each character is processed as it is typed.

Compose: Each character is sent to a line-buffer for future corrections, additions, or processing.

Full/Clear—FULL indicates the capacity of the 84-character line-buffer's memory has been reached. Pressing the CLEAR button while in the COMPOSE mode will clear the storage register.

Send—Pressing this control while in COMPOSE causes the information in the line-buffer to be transmitted to the computer if in ON LINE and to the designated output device if in LOCAL.

SOFTWARE

The T4002 Graphic Computer Terminal is supplied with a standard Utility Software Package. It provides the routines to exercise the various functions of the terminal in its different modes of operation; and also subroutines for outputting all ASCII characters.

In addition, a Fundamental Plot Package of FORTRAN subroutines is supplied enabling the user to graphically operate in Point Plot, Incremental Plot and Linear Interpolate, to draw axes, do scaling, and perform other graphic manipulations.

The Standard Software Package offered with the T4002 is for users facilities which support a FORTRAN capable of either "A" format (i.e., unspecified character format) or assembly level access from FORTRAN. The T4002 Graphic Computer Terminal software will be negotiated on an individual basis for users whose facilities do not support FORTRAN.

When ordering the T4002, please specify the following information about the intended facility:

Machine—Type, by make and model. Standard or special operating system.

Languages—What languages does your facility support (please note what levels). Which of these languages allow assembly level access?

OTHER CHARACTERISTICS

Power Requirements—A quick-change line-voltage selector provides six ranges: 90 to 110 V, 104 to 126 V, 112 to 136 V, 180 to 220 V, 208 to 252 V, and 224 to 272 V. Frequency range is 48 to 66 Hz. Maximum consumption at 115 V is 400 watts.

Operating Temperature Range—$+10°C$ to $+40°C$.

Dimensions and Weights

Height	19 3/8 inches	48.7 cm
Depth	34 7/8 inches	88.7 cm
Width	19 inches	48.3 cm
Net weight	130 pounds	46.8 kg
Domestic shipping weight	191 pounds	86.6 kg

Included Standard Accessories—Specifications manual (070-0996-00), display unit maintenance manual (070-1051-00), keyboard unit maintenance manual (070-1052-00), drawer unit maintenance manual (070-1053-00).

T4002 GRAPHIC COMPUTER TERMINAL, without interface **$8800**

U.S. Sales Price FOB Beaverton, Oregon
Please refer to General Information page

Terminal Interfaces

TELETYPE PORT INTERFACE UNITS

The Teletype Port Interface allows high-speed data transmission between the Tektronix T4002 Graphic Computer Terminal and computers through the computer's TTY I/O port. Currently, Teletype Port Interfaces are available to interface the T4002 to the following minicomputers: Digital Equipment Corporation PDP-8/I and PDP-8/L Computers, Data General Nova and Supernova Computers, Hewlett-Packard 2114, 2115 and 2116 Computers. Interfaces for other computers are under development.

The Teletype Port Interface allows the operator to selectively use the full capabilities of both the T4002 and the Teletype machine. When operating the T4002 with the TTY and computer, standard computer/terminal procedures are followed while executing programs. To switch from T4002 to TTY operation, the user simply pushes the T4002 front panel LOCAL/ON LINE button. This disconnects the T4002, connects the TTY to the computer and automatically changes the data rate to 110 baud. This operation may be electronically controlled.

Data is transferred serially by the interface in a full duplex mode. Receiving rate is adjustable between 125 baud and 125 kilobaud. Transmitting rate is adjustable between 125 baud and 6.25 kilobaud. The interface is compatible with full USASCII and will assemble information in a graphic compatible format. The TTY Port Interface is current sensing and provided with necessary cabling and connectors for direct connection to the computer I/O Bus. However, it may be converted by the replacement of two optional plug-in cards to EIA RS-232-B configuration for use with modems and couplers. Also the computer's previously existing TTY interface electronics is utilized, retaining the computer/Teletype system capabilities, including the reader and punch.

The operational characteristics of each unit are determined by the computer with which it interfaces. The rear panel hardware configuration of each unit is compatible with the appropriate TTY and computer connections. A switch on the rear panel allows the user to select either MODEM or TTY capability when optional circuit boards are installed.

With this Interface, users of minicomputers utilize the many advantages of the T4002 Graphic Computer Terminal in applications where high display speeds and graphics are beneficial. One of the greatest advantages of the T4002 is the fact that programming is made so much easier and quicker than with slower terminals. The speed of the T4002 readout allows the programmer to retain his train of thought when writing and "debugging" programs. The tremendous speedup of the T4002 with its quick readout allows a rapid input back into the system. Thus, ideas and changes are applied without delay and the effects may be immediately observed. This interactive display capability is particularly important when developing graphics programs, since there is little delay from program development to program execution.

Also, the T4002 provides users the capability of displaying information in a graphic format. Many kinds of applications, such as scientific computations and process controls, give the user a clearer, more concise understanding of the information when it's presented graphically. Other problems lend themselves to easier solution where graphics reduce a mass of data to a format from which changes, trends and conclusions are easily drawn.

SOFTWARE

The Teletype Port Interface Unit is provided with software which facilitates program access to the T4002 and the 4901 Interactive Graphics Unit. Documentation includes program descriptions, flow diagrams and program listings.

ORDERING

When ordering, please specify your computer system configuration by manufacturer, model and/or type number, and your TTY or data communications I/O options.

Each interface includes an interconnecting cable and necessary accessories to match computer specified in order, software package to match computer specified in order, instruction manual, and user's manual.

For PDP-8/I & PDP-8/L, order 021-0004-00 .... $750

For Nova and Supernova, order 021-0005-00 .... $750

For 2114, 2115, and 2116, order 021-0006-00 .... $750

Optional Accessories—To convert the TTY Interface to a RS-232-B compatible Interface requires the substitution of two plug-in cards and replacement of an interconnecting modem cable.

U.S. Sales Prices FOB Beaverton, Oregon
Please refer to General Information page

Terminal Interfaces

INTERFACE OPTIONS

A choice of interfaces allows the Graphic Computer Terminal to communicate with dedicated computers as well as time-shared computers. Interfaces provide the required code conversion, logic levels, and necessary connections. The interface is housed inside the T4002 console.

Interface for Digital Equipment Corporation PDP-8/I Computer with Negative Input/Output Buses—Included standard accessories are: interconnecting cable to PDP-8/I (015-0151-00); circuit card assembly, I/O bus terminator card (018-0036-00); user's manual (070-1050-00); instruction manual (070-0997-00). Order 021-0001-00 .... $675

Interface for Data Communication Systems—This interface allows the Graphic Computer Terminal to communicate with devices which transfer data serially in either a full-duplex or half-duplex mode. It conforms to EIA Standard RS-232-B (October, 1968) which defines the minimum required circuits and electrical signal characteristics for exchanging binary serialized data. Internal clocks or external timing signals may be used. This interface is compatible with synchronous and asynchronous modems, and offers optional internal transmit and receive rates of 110, 150, 300, 600, 1200, 1800, 2000, or 2400 bits/second. Transmit and receive rates are independent of each other, and must be specified on order. Additional timing interface boards may be ordered if operation is desired at more than one transmit/receive rate. Included standard accessories are: interconnecting cable to RS-232-B type modems (015-0150-00); user's manual (070-1049-00); instruction manual (070-0998-00). Order 021-0002-00, specifying send and receive rates ... $600

Additional timing interface board for above, specify send and receive rates $125

Interface for Digital Equipment Corporation PDP-8/I or PDP-8/L Computer with Positive Input/Output Buses—Included standard accessories are: interconnecting cable to PDP-8/I (015-0151-00); interconnecting cable to PDP-8/L (015-0159-00) circuit card assembly, I/O bus terminator card (018-0035-00); user's manual (070-1050-00); instruction manual (070-1041-00). Order 021-0003-00 .... $675

ACCESSORIES

Hard Copy Unit—The 4601 used in conjunction with Tektronix Storage Display Units provides a convenient means for permanently copying alphanumeric and graphic displays. Hi-resolution displays obtained on the T4002 are copied by the 4601, providing an accurate representation of the stored display on 3M Type 777 Dry-Silver Paper.

4601 HARD COPY UNIT $3750

Camera—The C-10 is a fixed-focus, light-weight camera designed for use with the Type T4002. An f/8 lens with sufficient depth of field and convenient hand grips allows the C-10 to be held against the display area for photographing displays. The C-10 housing accommodates a Graflok[1] 4 x 5 back.

C-10 CAMERA $400

Auxiliary Interface—Space is provided inside the terminal for a plug-in module to expand future capability. The module may be used for a customer designed interface unit to integrate input/output equipment, such as tape or disk drives, printers, mechanical plotters, card readers/punches, etc., into the system, or for some other purpose. A blank plug-in is available from Tektronix for use as a frame in which to build the auxiliary module. The Auxiliary Interface is TTL compatible.

BLANK PLUG-IN MODULE, order 040-0507-00 .... $83

Viewing Accessories—Combination light filters and implosion shields improve contrast for high ambient light viewing.

Circular polarizer with diffusing front surface,
order 015-0145-00 .... $35

Circular polarizer without diffusing front surface,
order 014-0040-00 .... $35

Circular polarizer encased in glass, with front surface optically coated to reduce reflections,
order 014-0039-00 .... $125

[1]Registered Trademark Graflex, Inc.

4901

Interactive Graphic Unit

- INTERACTIVE GRAPHICS FOR T4002 GRAPHIC COMPUTER TERMINAL

- SOFTWARE SUPPORTED

- CLEARLY VISIBLE, PARALLAX-FREE, FULL-SCREEN, HIGH-RESOLUTION CURSOR

- RESOLUTION WITHIN ONE LSB IN 1020 LEVELS

- COMPATIBLE WITH GRAPHIC INPUT DEVICES WHICH OUTPUT ANALOG SIGNALS OF 0 TO +5 V

The above photograph pictures the clearly visible parallax-free, crosshair cursor. The cursor always covers the entire X, Y dimensions of the display. Positioning accuracy is within one LSB along each axis.

The 4901 Interactive Graphic Unit interfaces the Tektronix T4002 Graphic Computer Terminal* with graphic input devices which output X and Y analog signals. Analog signals are received by the 4901 from the graphic input device. The 4901 continuously compares these signals with the data in the T4002 D/A converters. Upon command from the computer, the T4002 keyboard, or an external graphic device, the 4901 will digitize the graphic address of the intersection of the crosshair cursor. The digitized graphic address is sent to the computer through the T4002 I/O interface unit.

The 4901 generates a refreshed, clearly visible, full-screen cursor which always covers the entire X, Y dimensions of the T4002 storage display. The cursor forms perpendicular, horizontal and vertical lines which have a clearly discernible intersection. This provides a sharply defined point for use in accurate graphic formatting. Cursor positioning is controlled by the X, Y inputs from the external graphic device.

The cursor position accuracy is within one Least Significant Bit (LSB) in each of the two axes. This accuracy is accomplished by counting, in one direction only, the X, Y registers which generate the crosshair cursor. This means that the point of interest is always approached from the same direction, providing accuracy to one LSB.

The cursor generation system uses the T4002 D/A converter system. This common system provides several advantages. It eliminates tracking errors, and drift and registration problems which usually exist between the display system and the graphic input device in equipment where two different converter systems are used. A single system also eliminates a number of critical calibration adjustments and allows the user to take full advantage of the complete addressability of the display system.

The 4901 interfaces with the T4002 Graphic Computer Terminal through the T4002's auxiliary I/O and is housed in the T4002 console space provided for auxiliary modules. Instruction manual (070-1059-00) is included.

T4002's below Serial #B020175 must be modified. Contact your Tektronix Application Engineer for information.
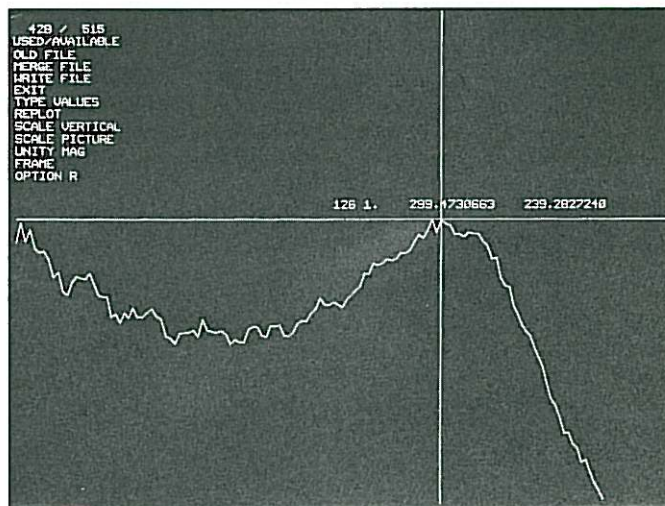
CHARACTERISTICS
X AND Y DIFFERENTIAL AMPLIFIERS

Sensitivity—1 bit/5 mV.

Gain Accuracy—Within 1.5% of full scale.

Common Mode Signal Range—At least ±15 V.

Differential Input Signal Range—5.115 V or less.

Maximum Safe Input Voltage—+22 V to −22 V, each input referenced to program ground.

Maximum DC Offset—50 mV or less.

Nominal Input Resistance—Single-ended 80 kΩ, differential 160 kΩ.

Maximum Input Current Offset—plus inputs, 75 μA; minus inputs, 250 nA.

GRAPHIC INPUT CONTROLLERS

T4002/4901/Graphic Input Device System Resolution—X axis resolution is within one addressable point (1 LSB) between and including points 3 to 1023. Y axis resolution is within one addressable point (1 LSB) between and including points 0 to 1020.

Program Digitize Delay—At least 10 ms must be allowed between cursor turn on and first digitized command following turn on.

Time to Digitize—XY point, 20 ms or less, including 10 ms cursor turn on; Y point only, 10 ms or less.

Data Multiplexing Time Delay Requirement—5 μs or less plus delay added by parallel interface units.

SOFTWARE

The 4901 Interactive Graphics Unit is provided with a Standard Software Package consisting of the routines necessary to facilitate communication between a computer and the T4002 Graphic Computer Terminal/4901 Interactive Graphics Unit.

The Standard Software Packages offered with the 4901 is for users facilities which support FORTRAN capable of either "A" format (i.e., unspecified character format) or assembly level access from FORTRAN. The 4901 Interactive Graphic Unit software will be negotiated on an individual basis for users facilities which do not support FORTRAN.

The Fundamental Interactive Graphic Package includes routines for the user to create, modify, and manipulate graphic displays.

Documentation for these standard packages provide program descriptions, flow diagrams and program listings.

When ordering the 4901, please specify the following information about the intended facility:

Machine—Type, by make and model. Standard or special operating system.

Languages—What languages does your facility support (please note what levels). Which of these languages allows assembly level access?

J1000 INTERFACE CONNECTION

Logic—The logic form is positive, and logic levels are standard TTL. All TTL input control lines present 5 or less normalized loads to a TTL output. Input pulse widths are at least 500 ns.

Cursor Intensity Input Voltage Range—+5 V to +15 V.

OTHER CHARACTERISTICS

Operating Temperature Range—+10° to +40°C.

Net Weight—Approximately 2 lb; 1 kg.

4901 INTERACTIVE GRAPHIC UNIT $450

JOYSTICK CONTROLLER

The Joystick Controller inputs signals to the Tektronix 4901 Interactive Graphic Unit. These signals provide the X and Y information for positioning the cursor generated by the 4901. The Joystick elements which sense the X and Y voltages are high-resolution potentiometers, controlled with a single handle, centered on a sphere mounted within a shroud. The potentiometers have low start-up and in-motion torque for very positive operator control of the screen position of the cursor.

The Joystick has an IG OFF/CURSOR BRIGHTNESS control which turns the Joystick on and adjusts the intensity of the displayed cursor. A READY light, when lit, indicates that the 4901 is ready to accept new information.

The Joystick Controller is equipped with its own interconnecting cable for the 4901 Interactive Graphic Unit. Instruction manual (070-1060-00) is included.

CHARACTERISTICS

X and Y Resolution—Within one LSB of a previously stored point.

Cursor Brightness Voltage Output Range— +6 V or less to at least +14 V.

Seek Input Voltage Range— +2.4 V to +5.5 V.

Joystick Excursion—Side-to-side excursion is 66° within 4°; corner-to-corner excursion is 94° within 4°.

Operating Temperature Range—0°C to +50°C.

Finish—Anodized aluminum.

Net Weight—2½ lb; 1.1 kg.

Dimensions—Diameter: 6 inches, 15.3 cm; height: approximately 5.4 inches, 13.8 cm.

JOYSTICK CONTROLLER, order 015-0175-00 .... $250