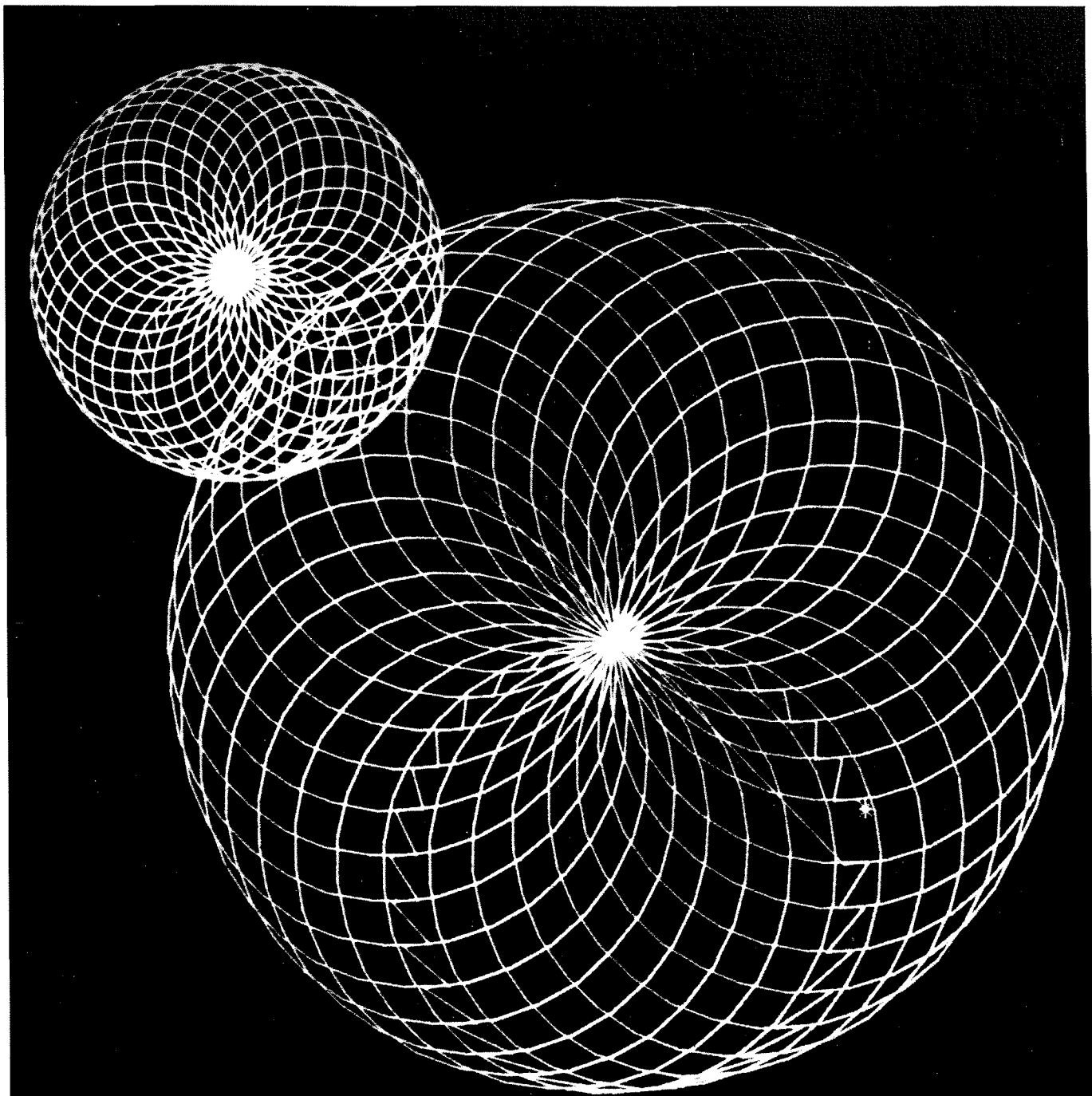
TEKSCOPE

JUNE 1969



A New Look in Information

1 **Low-Cost Graphics**

2 **Offline Editing**

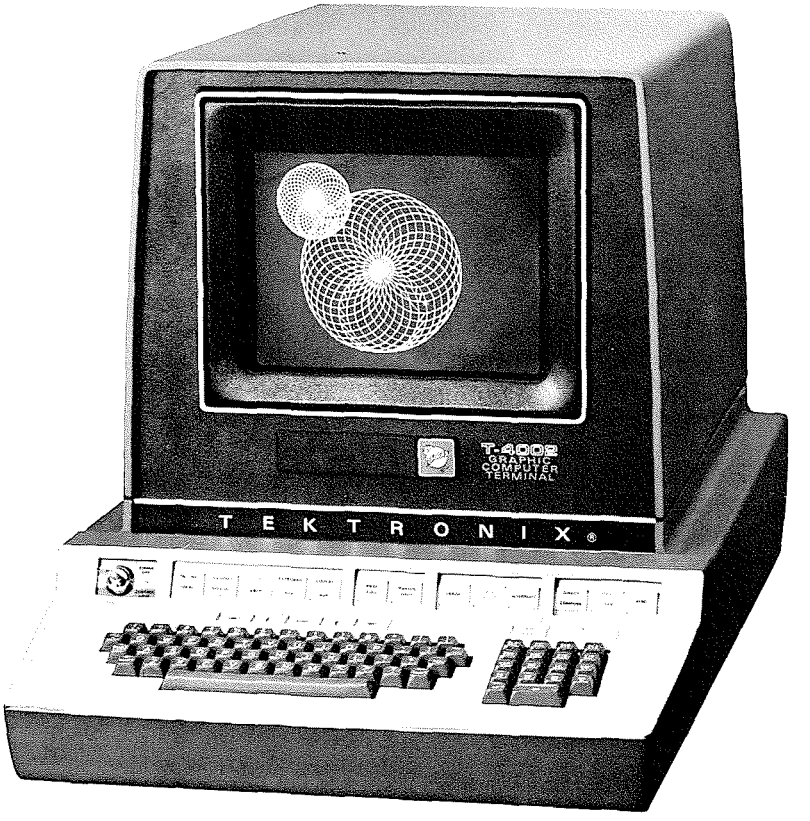
3 **Storage Basics**

4 **Scan Conversion**

Five years ago Tektronix introduced the Type 564 low-cost, direct-view bistable Storage Oscilloscope. Many customers involved in computer readout projects found this instrument to be the best overall compromise for a computer readout device. Since that time customer interest in this area has resulted in the formation of an Information Display Division. The June issue of TEKSCOPE discusses some of the significant developments of this new Tektronix technology.

COVER
Circle on circle program. This graphic display is formed when the locus of the centers of circles form a circle.

Display



Low-Cost Graphics

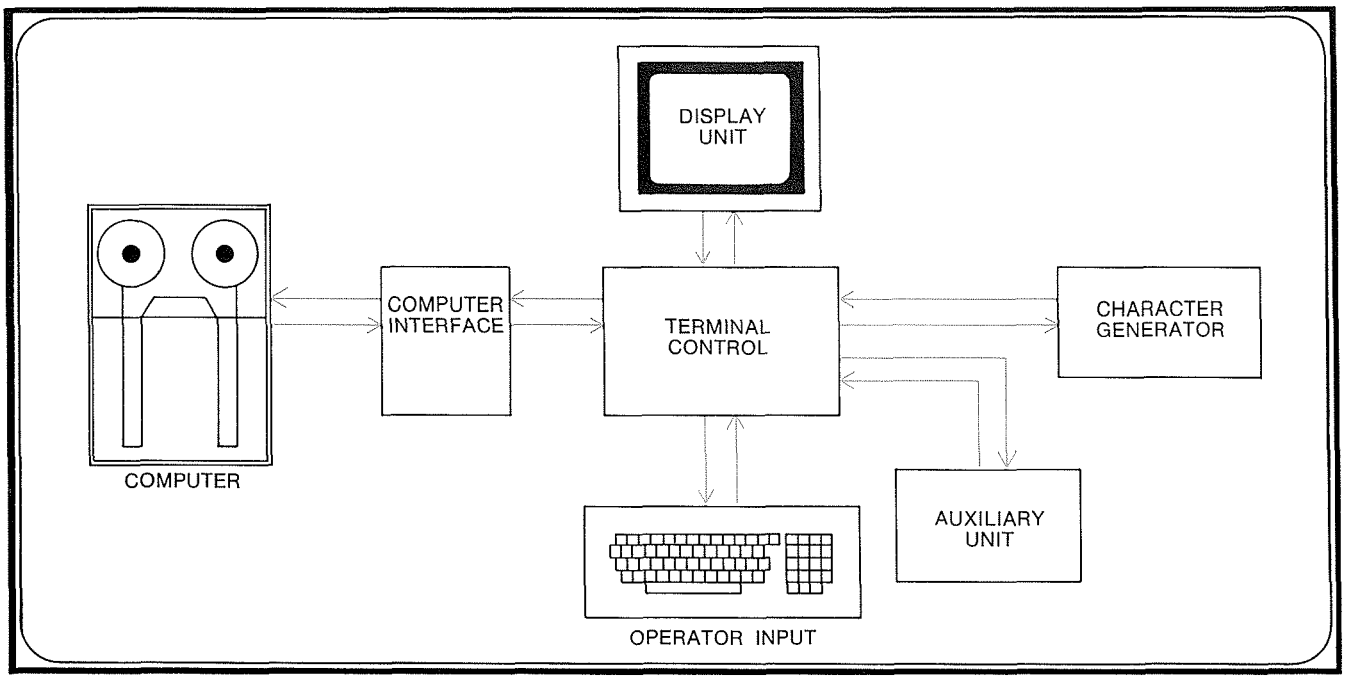
A new low-cost graphic computer terminal is capable of presenting high-information content messages at speeds of up to 2000 characters per second. For the first time, low-cost (less than $9000, including interface) complex graphic and high-density alphanumeric displays are possible. This breakthrough in information display technology allows users to now consider graphic displays where cost has been prohibitive in the past. The Tektronix T4002 Graphic Computer Terminal offers greater information content at approximately one third the price of other graphic systems.

The Tektronix Type T4002 Graphic Computer Terminal 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 refreshed memory and minimizes the information rate requirements of the data source. With no display refreshing circuitry, 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 up to 2,000 characters per second.

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

To ensure maximum flexibility, the terminal uses a standard control and input signal interface that is compatible with the following Tektronix Display instruments.

Type 601 . . . . . (5-in storage monitor)
Type 602 . . . (5-in high-resolution monitor)
Type 611 . . . . . (11-in storage monitor)
Type 4501 Scan Converter (large-screen TV display)



T4002 GRAPHIC COMPUTER TERMINAL BASIC BLOCK DIAGRAM

A solid-state, data-entry keyboard and the visual display of high-resolution alphanumerics and graphics provide a truly interactive system. No longer is the user required to obtain his information from columns of data or lists of numbers. The low cost of this graphics system allows managers to now obtain trends quickly and easily. Information may now be summarized in graphs, electrical circuits drawn, flow diagrams developed, etc.

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 Type T4002 may be utilized.

Four modes of display are selectable on the Type T4002: (1) Alphanumeric, (2) Point plotting, (3) Incremental plotting and (4) Linear interpolation plotting. A fixed grid of 1024 x 780 calibrated addressable points are available in any of the three graphic modes.

The three modes of graphic displays selectable on the T4002 are discussed at right. Programs that have been developed in any of the three modes mentioned below will generally be suitable for use with the Type 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 is inefficient because of the amount of bits 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 when sending 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" pro-

grams, 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.

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

The 11-inch, flicker-free display (6½ x 8¼-inch screen) accommodates 37 lines of alphanumeric characters of 85 symbols each, permitting more than 3000 characters to be displayed. Resolution is equivalent to 300 x 400 line pairs.[1] Stored information may be erased in less than 0.5 second.

The terminal control provides timing logic, data buffers, interconnection logic, function decoding, scratchpad 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[2] printable characters with both upper and lower case, numbers and special symbols. In addition, two sizes of characters are under program control.

The control panel is designed for ease of operation with panel controls held to a minimum with automatic control functions. In addition to the standard keyboard with 96 USASCII characters and 32 control characters, the following functions are provided.

ON LINE/LOCAL—Controls status of terminal.

TRANSMIT/RECEIVE—Indicates status of data transmission.

TTY/ASCII—Permits selection of keyboard code.

1. Refer to April 1968 Service Scope "Direct-View Bistable-Storage CRT Resolution
2. USA Standard Code for Information Interchange

INPUT—Permits selection of KEYBOARD and/or AUXILIARY.

OUTPUT—Permits selection of DISPLAY and/or AUXILIARY.

PAGE FULL—Indicates full page and stops computer information (when input is available).

MARGIN SHIFT—Choice of four-margin positions.

ERROR—Indicates communication or echoplexed character error.

DATA RECEIVED—Indicates when computer makes display entry.

INTERRUPT—Stops transmission.

FORMAT CONTROLS—Cursor indicator in alphanumeric mode.

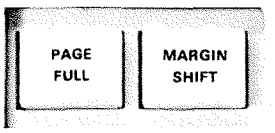
VIEW—Switches display from a hold mode to a view mode for 1 minute.

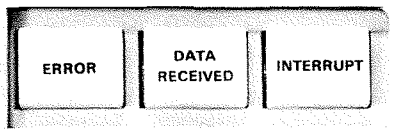
ERASE—Erases the display.

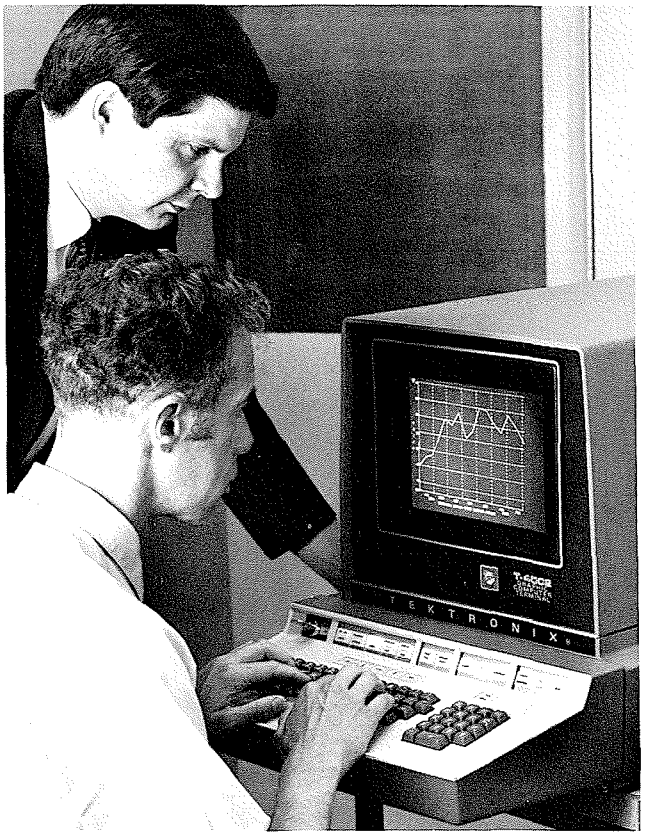
The format controls determine the positioning of the cursor. The adjacent VIEW and ERASE button allow holding or changing of the stored display. These seven buttons differ from the control functions in that they do not go to the computer, but into the display. Thus, formatting the location on the display does not disturb the output from the computer. The HOME button returns the cursor to a fixed reference.

Color-lighted buttons are used to simplify operation and to alert the operator of the terminal status. By pushing a button, the status can be changed. Five colors are used with the following logic.

Green — On Line — Normal Operation.
Blue — Local or Auxiliary.
White — Status (completion of operation).
Amber — Incomplete Operation — Error may occur unless corrective action is taken.
Red — Operator action is required.







Stu McNaughton, Project Engineer, and Ernst Massey, Mechanical Engineering Manager, discuss a graphic display on the T4002 Graphic Computer Terminal.

2 Offline Editing

John Griffin, Project Manager, Information Display Electronics

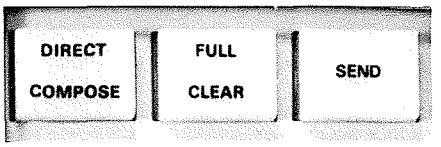
The large-screen storage tube used in the T4002 has a number of advantages for graphic and alphanumeric displays. The tube is rugged, low-cost, has flicker-free operation, and is capable of very high information density. Because the Tektronix storage tube stores the information in analog form (a series of lines and/or dots on the screen) the information is not stored in discrete locations in coded form.

Two interfaces are currently available for the T4002 Graphic Computer Terminal. The Type 4801 (parallel interface) interfaces with the DEC PDP-8 family of computers; the Type 4802 (serial data communications interface) interfaces with Bell System Type 132, Type 201 and Type 202 Data Sets and other EIA compatible modems or high-speed data systems. Both interfaces permit alphanumerics and all graphic modes to be sent over normal ASCII communication circuits.

The T4002 is designed to accept an auxiliary plug-in module to expand future capability. Inputs to peripheral gear and outputs from peripheral gear such as teleprinters, tape readers and magnetic recorders are feasible.

The T4002 offers a substantial improvement over electromechanical teleprinters in speed, noise of operation, and flexibility in the formatting and editing of data. These advantages, combined with a complex graphic capability, provide a complete versatile system for less than $9000 (including interface). For further information on Tektronix Information Display products, refer to pages 276-293 of the Tektronix 1969 Catalog 28, or consult your local field engineer.

The new offline editing feature of the T4002 Graphic Computer Terminal incorporates a scratch-pad memory of a one-line (84-character) discrete memory. This memory is used in conjunction with a small refreshed area at the top of the tube. The information is in numeric form and 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 electronic scratch pad is as follows: The COMPOSE button is pressed to change operation from DIRECT to COMPOSE. At this time the refreshed scratch pad area is displayed and the characters in the buffer memory are presented in one line across the top of the tube.

Information may be changed in one of several manners. The CLEAR button clears the text from the 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 in and entered into the buffer and appears in the scratch pad area. (When editor-buffer 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 though it were coming from the keyboard.

Fig. 1. The 84-character refreshed memory shown below, allows text to be quickly and easily corrected and edited before being sent to the computer.

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 the transmission time of the machine.

The scratch pad buffer is also convenient for incorrect messages. If the message is not correct the first time typed, editing is accomplished as follows: The keyboard is backspaced until the cursor is located where a change is desired (the scratch pad cursor consists of an underline so as not to obliterate the dot matrix of the character block).

Once the cursor is at the desired location you have one of two options: a) Delete the character. b) Insert a character before the character designated by the cursor. Striking the DELETE button removes the character from the buffer and you have one character less. If you wish to insert a character, you simply start typing characters and they will be inserted just before the character which has the cursor underneath it. Fig. 2 illustrates these editing operations.

When the editing is finished the SEND button is pressed

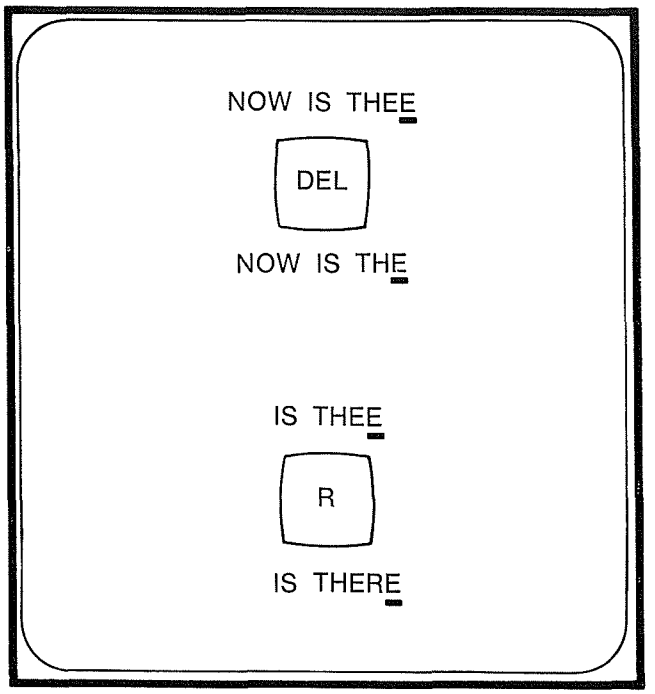


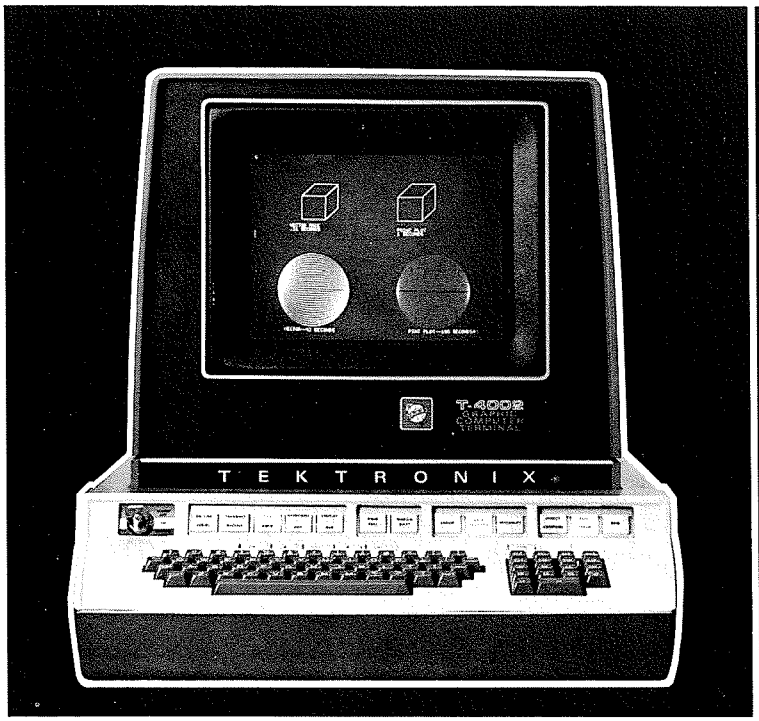
Fig 2. Characters are deleted by striking the DEL button and inserted (before the character designated by the cursor) by striking a character button.

and the information is sent to the computer as a block of data. Pressing the SEND button automatically returns the terminal to the DIRECT mode and it is necessary to return it to COMPOSE to edit the next line.

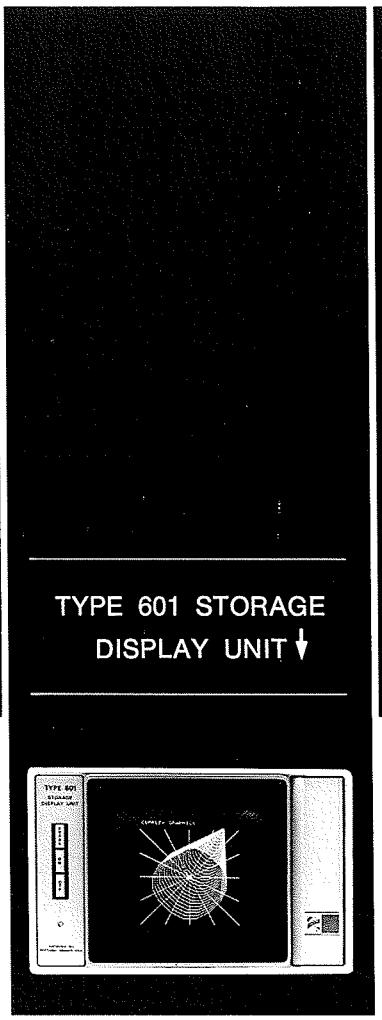
Another point of interest is that the text buffer is not erased by the SEND command. Therefore, if an error is encountered in transmission, the entire text buffer could be sent out to the computer again, simply by striking the COMPOSE and SEND buttons.

Scratch-pad operation combines many of the advantages of refreshed terminals with the advantages of the direct-view storage tube. The result is a low-cost remote terminal well suited for text editing applications. Scratch-pad operation 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.

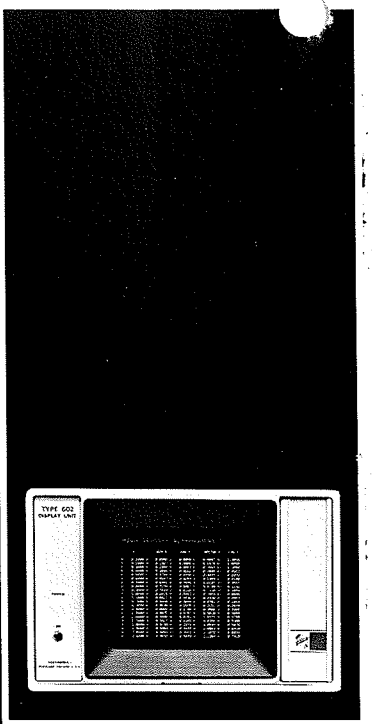
A second area of scratch-pad usage is when the terminal is used as a remote "batch" device. Such a use requires updating of information in computer files. The information that is being sent to the computer is the updated information and must be correct. Therefore, it is desirable to compose and verify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



T4002 GRAPHIC COMPUTER TERMINAL

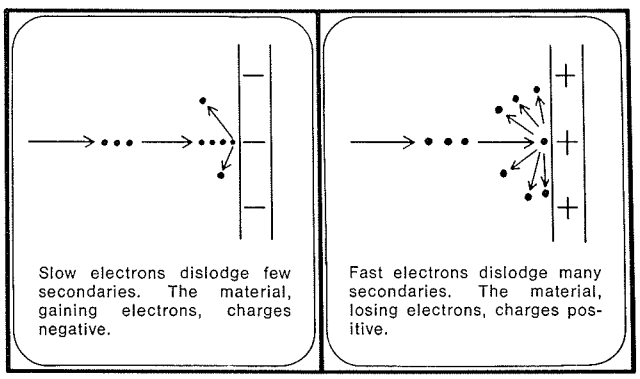


TYPE 601 STORAGE DISPLAY UNIT



TYPE 602 DISPLAY UNIT

3 Storage Basics



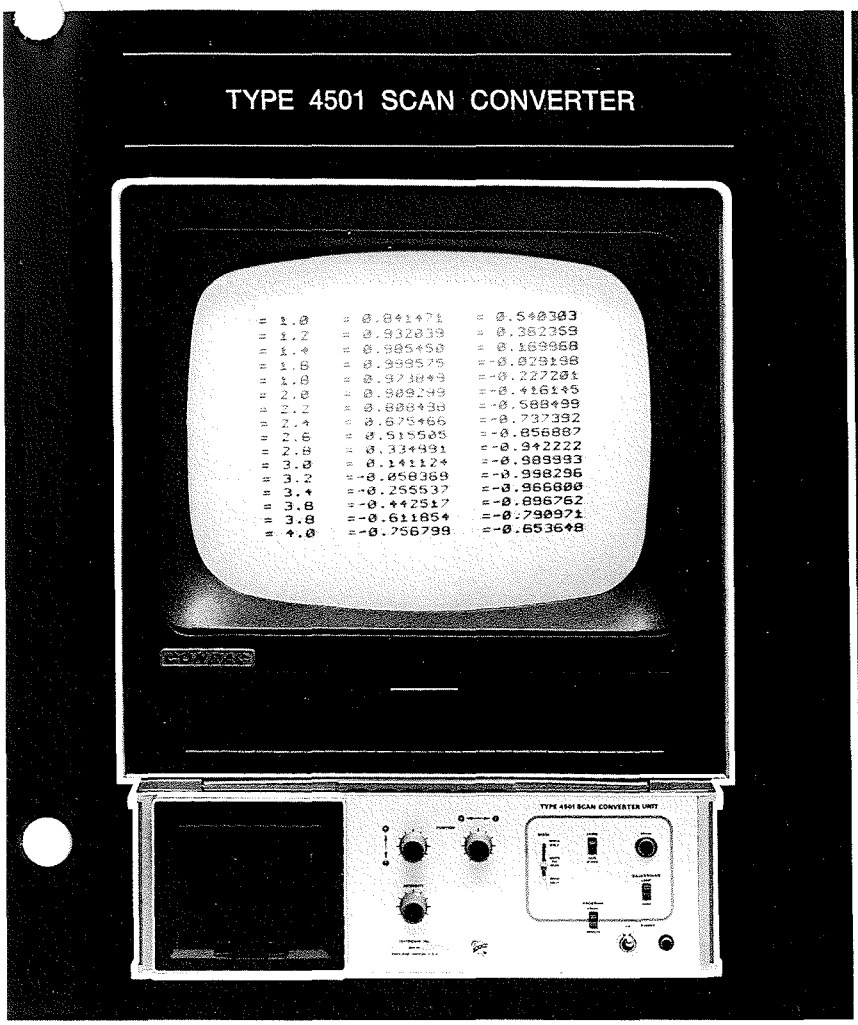
The Tektronix direct-view bistable storage tube (DVBST) is based on a secondary emission principle. When a stream of primary electrons strikes the phosphor target, secondary electrons are dislodged from the phosphor surface. As the potential increases, each primary electron displaces more than one secondary electron, resulting in the material charging positive.

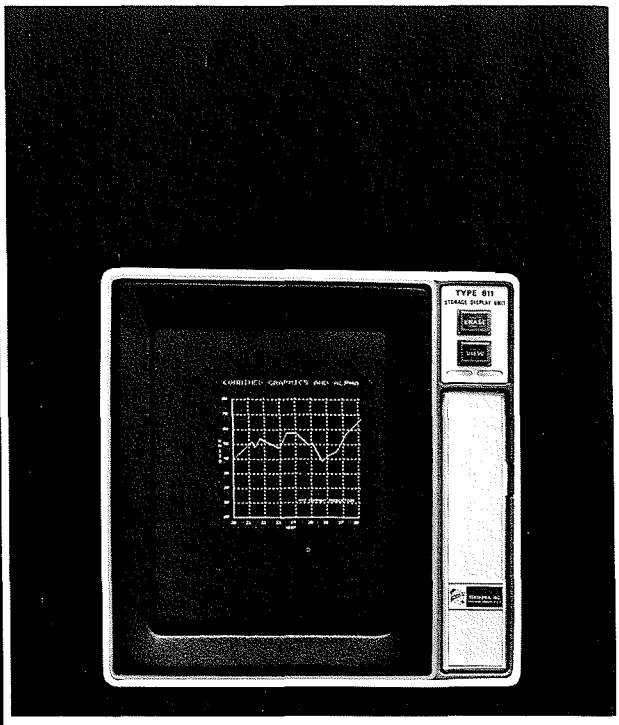
In addition to the normal CRT writing guns, flood guns are used to cover the complete phosphor screen uniformly with low-velocity electrons. A conductive transparent face plate under the phosphor completes the circuit and allows storage to take place.

The normal writing gun bombards the phosphor screen with a beam of high-speed focused electrons. The beam writes and also dislodges great numbers of secondary electrons. The written surface where the waveform is traced out loses electrons and charges positive.

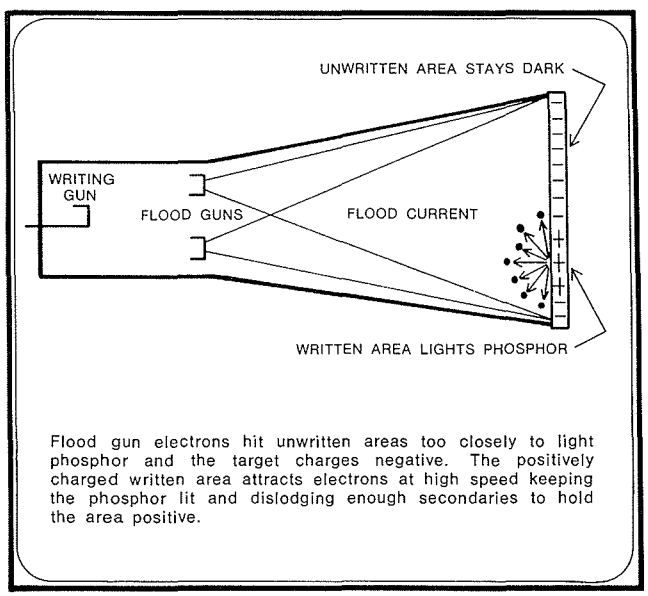
MATION DISPLAY INSTRUMENTS

TYPE 4501 SCAN CONVERTER





TYPE 611 DISPLAY UNIT



Flood gun electrons hit unwritten areas too closely to light phosphor and the target charges negative. The positively charged written area attracts electrons at high speed keeping the phosphor lit and dislodging enough secondaries to hold the area positive.

By using the flood-electron guns, the display may be stored. The flood guns emit low-velocity electrons over the whole CRT-screen area. The electrons strike the unwritten area too slowly to jar loose many secondaries. As a result, these areas merely collect electrons until they are driven negative and can attract no more current.

The latent image where the beam has written attracts flood electrons at such a velocity so each entering primary dislodges sufficient secondaries to hold the phosphor target positive. Thus, the written area neither gains nor loses electrons but remains positively charged and continues to attract flood current. As a result of this equilibrium, the trace is stored.

This is the basis for all Tektronix direct-view bistable storage tubes. The same flood current that holds the background dark also holds the written trace bright.

4 Scan Conversion

Scan Conversion is a term which has been applied to several processes used to transmit images between two systems which are electrically incompatible, e.g., radar PPI to TV or PAL TV to NTSC TV. Although the basic principle is not a new one, modern techniques and components have made it possible to apply the principle in new ways.

Tektronix bistable storage tubes provide a medium for the conversion of analog inputs into TV format. These bright displays are ideal for individual or group viewing under high-ambient light conditions.

The heart of the Tektronix Type 4501 Scan Converter is a Tektronix-developed storage tube which acts as a graphic memory. A composite video output is provided for convenient viewing on large-screen television monitors and receivers. Single events stored on the CRT or dynamic displays of changing information may be scan-converted into TV format.

The Type 4501 Scan Converter Unit may be looped through a number of monitors for viewing at multiple remote locations. The Type 4501 output signal is suitable for mixing with another TV signal to create a picture that is an overlap of two signal sources. For example, an active TV camera output could be superimposed with information scanned from the Type 4501.

Once the analog input information is stored on the Type 4501 CRT, the input source may be removed. The stored image is then continuously scanned and displayed on TV monitors, until erased on command (200 ms). The tube also operates in a nonstorage mode where dynamic displays are desired. Resolution is equivalent to 100 x 125 stored line pairs and dot writing is less than 8 μs.

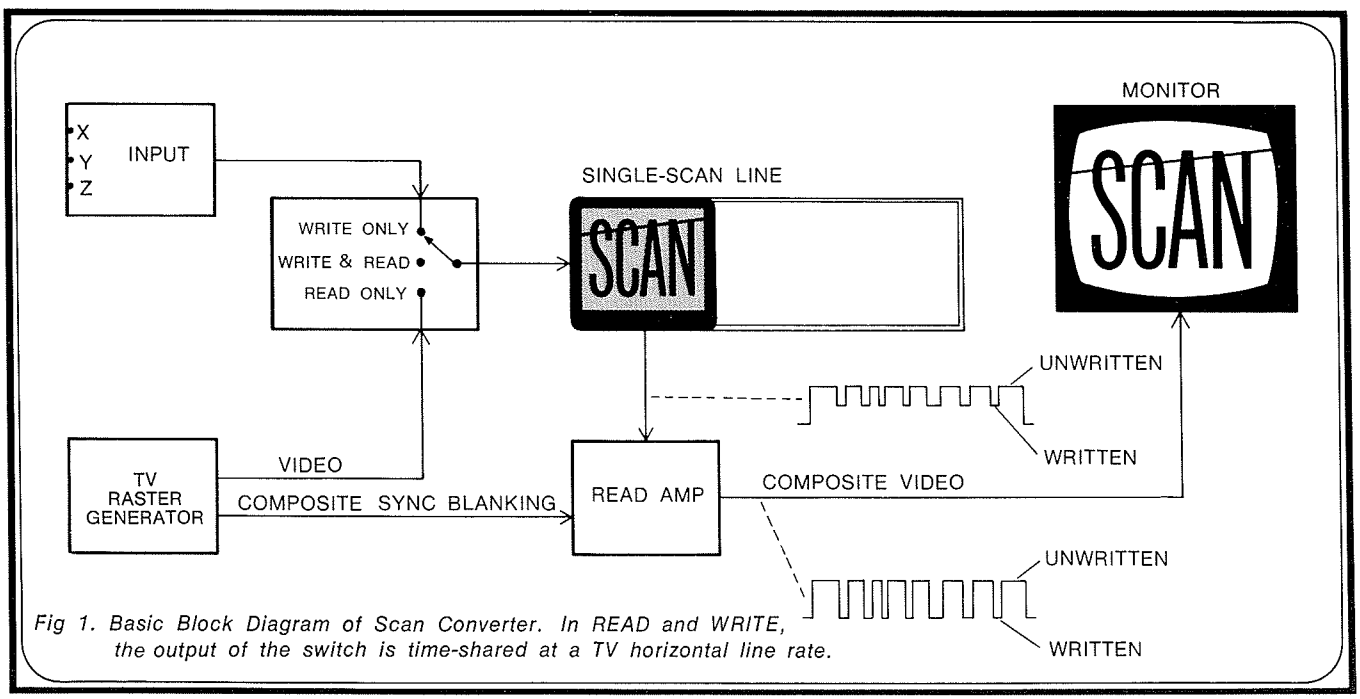


Fig 1. Basic Block Diagram of Scan Converter. In READ and WRITE, the output of the switch is time-shared at a TV horizontal line rate.

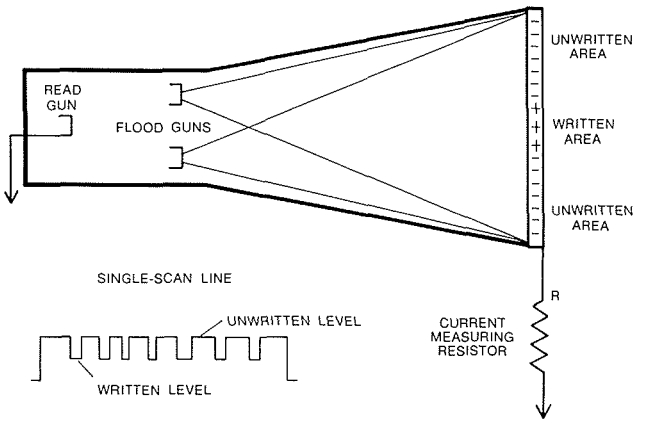


Fig 2. Read mode of basic scan converter. By measuring target current, written and nonwritten points may be differentiated.

Scan conversion is accomplished in the following manner. The storage target is raster-scanned by the CRT writing beam (read beam). The diagram in Fig 2 shows the basic circuit used to detect changes in voltage between written and nonwritten points as a read-gun raster scans the target.

A line is scanned as follows. When the raster line starts, the read beam is turned on and voltage across the current measuring resistor is developed. In the case of a nonwritten area that is negatively charged, current flows away from the target causing a voltage shift positive. When the read beam strikes a point that has been written positive, less current flows in the monitoring circuit. This causes the voltage shift to be less positive than when reading a nonwritten point. After a series of scans, a complete TV picture is developed.

Scan conversion then, consists of the following sequence: writing the target; monitoring the current fluctuation; processing these in the video amplifier; and mixing the video signal with sync and blanking to form a composite video signal (conforms with EIA (or CCIR) standards). Additionally, the composite video modulates an RF signal to allow the user to drive Channel 2, 3 or 4 of any TV set.

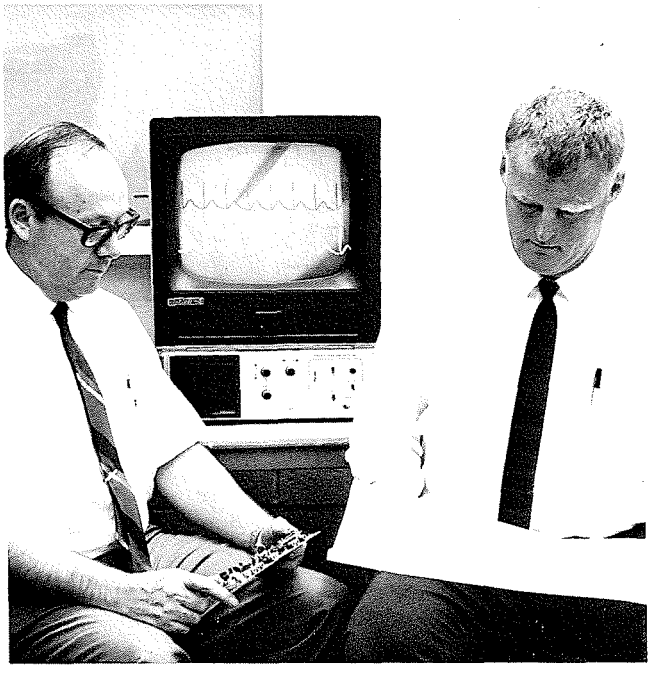
The CRT writing beam is used for both writing information and raster scanning in the WRITE AND READ mode. In this time-shared mode, writing is done during retrace of the raster (8 μs out of 63.5 μs) and information may be added to the display while the TV display is active. A WRITE ONLY mode provides no readout (monitor is blank) but allows observation of signals incompatible with beam time sharing. A READ ONLY mode is also provided. New information cannot be written on the storage target in this mode.

A LIGHT-DARK BACKGROUND switch is provided to change composite video polarity. This is particularly convenient when mixing the scan converter output with another video signal. The user can select the proper background to display his information most clearly.

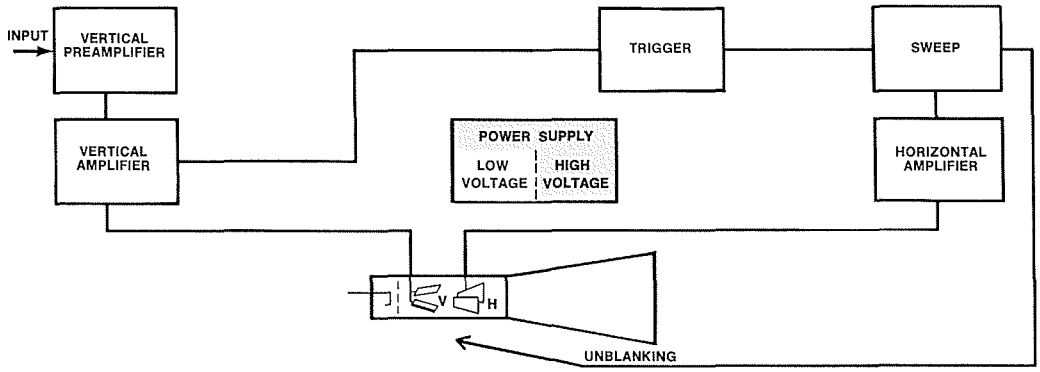
The Type 4501 Scan Converter was developed primarily to provide more flexibility in displaying information. By designing a basic unit that converts X-Y-Z inputs into TV format (EIA 525/60 or CCIR 625/50 scan rate selectable internally), the user can select the particular display best suited for his use. Differential inputs and 10-MHz bandwidth (X and Y) ensure versatile performance. In addition, two rear-panel remote program connectors provide external programming of major functions.

The price of the Type 4501 Scan Converter is $2200. For further information, refer to pages 290-293 of Catalog 28 (1969) or consult your local Tektronix field engineer.

George Edens, Project Engineer, and Chuck Gibson, Systems Manager, discuss a point of interest on the Type 4501 Scan Converter. The composite display on the monitor is composed of a camera video signal and two scan converter outputs.



SERVICE SCOPE



TROUBLESHOOTING THE HIGH-VOLTAGE SUPPLY

By Charles Phillips
Product Service Technician
Factory Service Center

This third article in the series discusses troubleshooting techniques for Tektronix high-voltage power supplies. The two previous articles available are: "Troubleshooting Your Oscilloscope", February TEKSCOPE: "Troubleshooting the Power Supply", April TEKSCOPE.

The high-voltage supply is fundamental to oscilloscope/CRT performance. Cathode-ray tubes require DC operating voltages much higher than those provided by conventional power supplies. To eliminate large vacuum tubes, bulky and dangerous capacitors and heavily insulated transformer windings, most Tektronix high-voltage power supplies use voltage multipliers to generate high voltages with a considerable savings in cost and space.

By using a frequency of approximately 60 kHz instead of 60 Hz, the required filter capacitor values are reduced by a factor of 1000. Thus, small and relatively inexpensive disc capacitors (0.02 - 0.03 μF) can be used instead of expensive 20-μF capacitors. A class C oscillator usually develops the 40-60 kHz voltage that supplies the primary winding of the high-voltage transformer.

Satisfactory regulation is achieved in most high-voltage supplies by controlling the amplitude of the high-frequency oscillator output. It is important to remember that CRT circuits are very low-current circuits and, as a result, are susceptible to leakage paths.

TYPICAL HIGH-VOLTAGE PROBLEMS

High-voltage power supply problems are usually indicated by one of the following CRT symptoms:

1. No intensity on CRT display.
2. Full intensity on CRT display.
3. No control over intensity and/or focus of CRT display.
4. Incorrect vertical and horizontal calibration.

The control-grid supply is normally 100 V more negative than the cathode supply. If these two supplies for some reason decrease their bias, the high-voltage supply can draw sufficient current to drive it out of regulation. The intensity control varies the bias of the CRT.

Most Tektronix cathode-ray tubes will cut off when the grid is approximately 65 V more negative than the cathode. If the tube is weak, you can never get down below the cutoff point of the tube.

Modern general-purpose oscilloscopes may have either a transistorized solid-state high-voltage supply (e.g., septupler) or the more common vacuum tube trippler high-voltage supply. Some of the more common troubleshooting symptoms are listed below.

1. Inability to turn off the intensity is often caused by a weak rectifier diode in the control-grid supply. If vacuum tube high-voltage rectifiers are used, check visually for filament glow. All the filaments in a properly functioning supply will glow with approximately the same intensity. A bright glow usually indicates a weak tube.

   A control grid to cathode short in the CRT will exhibit similar symptoms. To check for the latter, remove the

socket from the CRT and note if the CRT bias changes. If the bias changes, then the loading is caused by the CRT load. The CRT filament supply should also be checked to insure that the problem is not caused by leakage in the filament transformer.

2. No brightness with normal intensity control settings, but slight intensity as the control is moved further counter clockwise, usually indicates a weak rectifier diode in the cathode supply. Similar symptoms will be present if no unblanking is being received from the time-base generator, or in the case of a very gassy CRT. A gradual increase or decrease in intensity are symptoms of weak rectifier diodes in either the control grid or cathode supplies. Note: Grid and cathode vacuum rectifier diodes should be replaced at the same time to prevent differential aging problems.

3. No high voltage is commonly caused by loading (one or more of the secondary supplies is causing the oscillator to not run). To pin point the problem, break the feedback loop by removing the error amplifier stage. In most high-voltage supplies this step will cause the oscillator to free run at a frequency slightly higher than normal. If the oscillator still does not free run, then the problem is probably due to loading of the transformer by one of the secondary loads. By lifting the anode of the rectifiers in the secondary supplies, these stages may be eliminated. (Only the most positive anode need be disconnected in the high-voltage anode supply.) If the oscillator now oscillates, it is only necessary to put back the supplies one at a time to find which one is causing the loading. For example, if this procedure led to a problem in the grid supply, then the next step would be to check for resistance measurements from the intensity control to ground. A good idea is to remove the CRT socket to see whether this has any effect on the circuit symptoms. It is possible for a short in the CRT or extremely gassy tube to load one of the other supplies sufficiently to affect proper oscillator action.

   Typical resistance value in the grid circuit is 4 - 5 MΩ to ground. This holds true for almost any spot that you measure in the circuit. If the components check out properly, it is quite probable that the problem is in the high-voltage transformer and that one of the windings has a leakage path to the core.

Problems in the high-voltage anode supply sometimes show up as insufficient high voltage. Check the output filter capacitors and the anode coupling capacitors. Weak high-voltage rectifiers will also indicate insufficient high voltage. A poor connection at the CRT anode connector can show up as jitter in the sweep or poor regulation. Note: All solder joints on high-voltage chasses should have smooth surfaces. Any protrusions may cause high-voltage arcing, particularly at high altitutdes.

Some of the more recent Tektronix oscilloscopes have a control called the CRT bias control. This adjustment is sometimes used as a maximum intensity control to allow the user to protect his CRT. When the instrument is adjusted in this manner and the intensity is limited, dimness problems may occur at the faster sweep speeds. If there is a brightness problem with a cathode-ray tube, check to be sure that the CRT-grid bias is properly set.

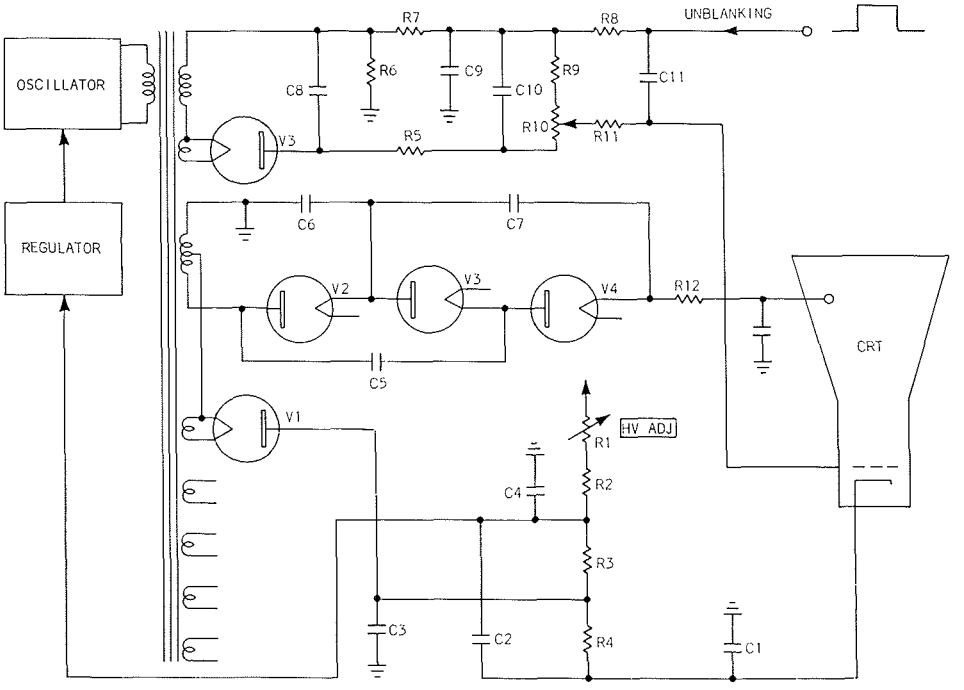


Fig 1. Simplified Schematic of Typical High Voltage Power Supply.

Intensity modulation (blank spots or uneven trace intensity) is often caused by heater-to-cathode leakage in the oscillator, the neons in the CRT-grid circuit, or leaky coupling capacitors in the unblanking circuitry. These symptoms are often seen when high-voltage tubular capacitors have been replaced with disc capacitors. The frequency is usually about 10 kHz or less (related to oscillator frequency) and the problem is present at any sweep speed.

CRT CONSIDERATIONS

Gassy CRT's may be identified by their "double-peaking" characteristic. When the CRT is cold, there are normally two very pronounced spots where the CRT turns on. As the intensity control is advanced CW, the trace comes on (usually dimly), decreases in intensity and then increases somewhat normally to the CW extreme. Once a tube begins to display this characteristic, a self-destructive process has begun and it is only a matter of time until the tube must be changed. Gassy CRT's also often exhibit poor focus and brightness characteristics, and static charge phenomenon. Static charge problems typically may be caused by dirt and if this characteristic is noted, the CRT face and cover should be thoroughly cleaned.

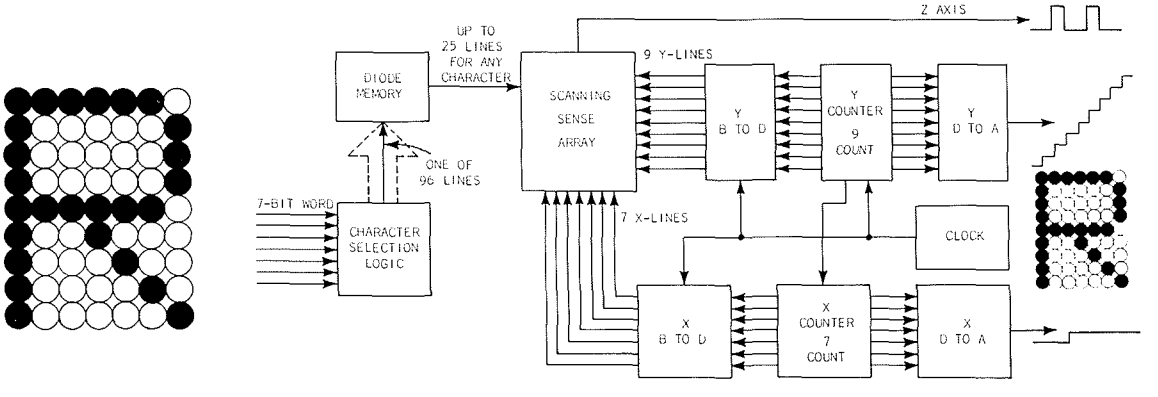
A problem similar to static charge is sometimes caused by the CRT-gun support rods becoming charged. This rod charge may sometimes be eliminated by deflecting the electron beam completly off-screen horizontally, turning the intensity full CW and varying the position control rapidly from the upper extreme to the lower extreme. After a few moments, the rod charge should be dissipated.

NEW CONCEPTS BOOKS

Four new concepts books are now available from your Tektronix Field Engineer. The new titles are: "Digital Concepts"; "Oscilloscope Trigger Circuits"; "Spectrum Analyzer Circuits"; and "Television Systems Measurements".

"Digital Concepts" discusses the binary number system, Boolean algebra, nand gates, nor gates, flipflops, implementing logic functions, implementing logic circuits using integrated circuits, counting circuits, counter readout circuits; "Spectrum Analyzer Circuits"—components and subassemblies, filters, amplifiers, mixers, oscillator and RF attenuators; "Oscilloscope Trigger Circuits"—trigger circuits, input triggering signals, pulse generators, delaying and delayed sweeps and triggered delayed sweep; "Television Systems"—cameras, television tape recorders, telecine, signal switching, transmitter, video distribution system, components of video waveform, measurements requirements, analysis of video transients, color -bar waveform analysis, multiburst test waveform and picture-waveform analysis.

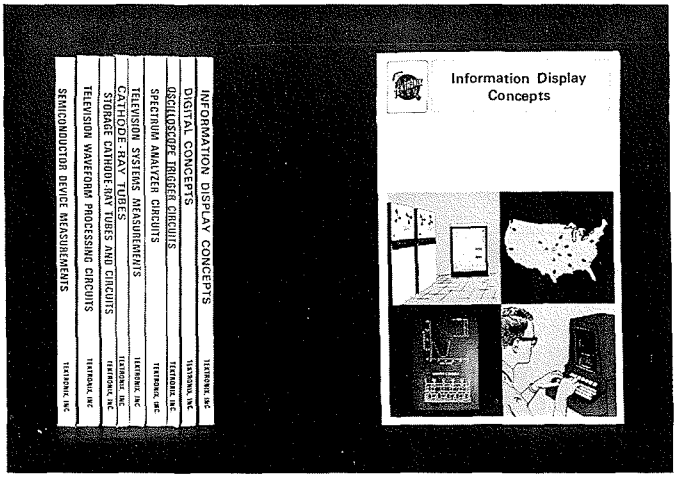
Information Display Concepts will be of special value to those interested in the Tektronix Information Display instruments discussed in this issue of TEKSCOPE. Material covered includes local computer peripherals, time sharing, programming, digital data transmission, computer display terminals, terminal output devices, digital-to-analog and analog-to-digital converters and vector and character generators, characteristics and specifications of direct-view bistable storage tubes and display-unit circuit design considerations.



Dot Character Generator

A character is generated by stepping the beam through 63 positions that make up a 7 x 9 dot character rectangle. When a character line is activated the appropriate diodes in the diode memory conduct. When the inputs from the X and Y B-to-D converters coincide with this information, a pulse turns on the Z axis. X and Y D-to-A converters output the appropriate voltage to step through the 7 x 9 dot matrix.

The block diagram on page 14 is taken from page 80 of "Information Display Concepts" and illustrates the major blocks that make up a dot character generator. The character generator used in the Tektronix Type T4002 Graphic Computer Terminal is of this basic configuration.



Other titles currently available are: "Oscilloscope CRT's", 2nd Edition; "Storage CRT's and Circuits", 2nd Edition; "Television Waveform Processing Circuits"; Power Supply Circuits", 2nd Edition; and "Semiconductor Device Measurement Concepts".

Should you wish further information on Tektronix Concepts Books, contact your local field engineer.

INSTRUMENTS FOR SALE

1—Type T Plug-In Unit, SN 002323. Price: $125. Contact: Mr. David Luce, Melville Clark Associates, 8 Richard Road, Cochituate, Massachusetts. Telephone: (617) 655-0906.

8—Type 533 with Plug-Ins. 2—Type 533A with Plug-Ins. Excellent condition. Sell or trade. Contact: Mr. Ralph Harris, Nuclear-Chicago Corporation, 333 East Howard Avenue, Des Plaines, Illinois 60018. Telephone: (312) 827 4456.

1—Type RM41A, SN 1065 with Type K Plug-In Unit, SN 13424. Price: $475. Contact: Mr. Melvin A. Holznagel, Route 4, Box 273A, Sherwood, Oregon 97140. Telephone: (503) 625-7121.

1—Type N Plug-In Unit, SN 00931. Like new. Price: $150. Contact: Cal-State Electronics Company, 5222 Venice Boulevard, Los Angeles, California 90019. Telephone: (213) 933-8187.

1—Type RM16, SN 001029. Price: $450. Contact: Mr. Leon Lacabanne, 3904 East 44th Street, Minneapolis, Minnesota 55406.

1—Type 422 with AC supply, complete with accessories. Less than 40 hours use. Price: $1200. Contact: Mr. Dave Hailey, Reece Corporation, 200 Prospect Street, Waltham, Massachusetts 02154. Telephone: (617) 894-9220.

1—Type 514D, SN 2561. Sell or trade for smaller scope. Price: $400. Contact: Mr. Pfalzer, Hoover Electric Company, Port Columbus, Columbus, Ohio 43219. Telephone: (614) 235-9634.

1—Type 422, with AC Supply, SN 3551. Less than three years old, used less than 30 hours. Price: $1000. Contact: R. Edward Stemm, Inc., 17W480 Lake Street, Addison, Illinois 60101. Telephone: (312) 279-2440.

1—Type 517A. Contact: Mr. Bruce Blevins, 176 Barranca Road, Los Alamos, New Mexico 87544. Telephone: (505) 668-4458.

1—Type 545B/CA, 535A/CA, RM529, 561A; 1—Type 3A6, 3A74, 3B3; 2—Type 515A; 1—Type A, B, D, H, S, R Plug-In Units. 1—Type TU-2 Test Load Plug-In Unit; 1—Type 107; 1—Type 111; 1—Type 181; 122 Amplifier. Contact: Mr. Posner, Pacific Combustion Engineering Company, Los Angeles, California. Telephone: (213) 225-6191.

1—Type 526, SN 00967. Price: $1000. 1—Type 261 Coax Switch. Price: $350. 2—Type 262 Programmer. Price: $695 each. Contact: Mr. Stewart Ex, Stewart Enterprises, 14827 Cohasset, Van Nuys, California. Telephone: (213) 873-7672 or (213) 786-7672.

1—Type 504, SN 001667. Price: $395. Contact: Mr. Jack Snow, General Design, Inc., P. O. Box 116, Melbourne, Florida 32901. Telephone: (305) 727-3191.

1—Type 317. Unused since reconditioning in Tektronix Service Center. Contact: Mr. William Wersing, Williams Laboratories, Inc., 125 Northview Road, Ithaca, New York 14850.

1—Type 175. One year old, never used. Contact: Mr. Earl Stridde, Skil Corporation, 5033 Elston Avenue, Chicago, Illinois 60630. Telephone: (302) 286-2000 Ext. 341.

1—Type B Plug-In Unit, SN 021854. Brand new condition. 1—Type 1A7 Differential Unit, SN 001830. Contact: Mr. Irv Sieger, General Resistance Division Chronetics, Inc., 500 Nuber Avenue, Mount Vernon, New York 10550. Telephone: (212) 292-1500.

1—Type 531; 1—Type 53/54C Plug-In Unit; 1—Type 202 Scope Mobile®; 1—100X, 2—10X, 1—1X Probes and Polarized Viewer. Good condition. Price: $950 complete. Telephone: (213) 422-1942.

1—Type E Plug-In Unit, SN 006618. Price: $120. Contact: Mr. Bob Goodman, Clark-Dunbar Company, 325 Jackson Street, Alexandria, Louisiana 71301. Telephone: (318) 443-7306.

INSTRUMENTS WANTED

Oscilloscope for personal research. Reasonable price. Prefer Plug-In versatility. Contact: Mr. C. S. Levine, 1002 Campbell Avenue, West Haven, Connecticut 06516. Telephone: (203) 934-6287.

1—Type C12 or C27 Camera. Contact: Mr. Bob Goodman, Clark-Dunbar Company, 325 Jackson Street, Alexandria, Louisiana 71301. Telephone: (318) 443-7306.

Usable Type 519 DC-to-1 GHz Oscilloscope. Contact: Professor Edward M. Eyring, Department of Chemistry, University of Utah, Salt Lake City, Utah 84112.

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DEVELOPING AN "INFORMATION AGE" TECHNOLOGY

THE BEGINNING . . . . Bob Anderson, inventor of the first simplified bistable, direct-view storage tube.

The art of inventing is a fusion of the imaginative and the practical.

The first step is in the realm of the practical, and typically consists of the identification of a specific and worthwhile need. This identification may come directly out of problems which are well recognized in existing devices, or may come out of the recognition of a previously unvoiced need.

The second step is in the realm of the imaginative, and consists of dreaming new dreams of better ways to reach the objective. At this stage, the untried uncertain conjecture is often the precursor of invention, for you cannot be truly new by building entirely on old and certain knowledge. There is no compromise with finished history—you either have something which differs from past knowledge, or you have no invention.

The third stage is again in the realm of the practical, and consists of experimental selection, verification and extension of the new concepts, and then the implementation through development, design, production and sales, which will involve many essential contributors besides the inventor.

All of these steps are equally important in the sense that, like the serial links of a chain, none can be omitted and still bridge the gap from "conception to contraption". However, the truly new idea is one of the more scarce commodities. The man who says "ideas are cheap" identifies himself as one who is not making his living and his career out of his ability to conceive new ideas. For the career inventor who takes the consequences of the ideas which fail, good ideas are crucial, scarce and most expensive—not cheap.

To the beginning inventor, I would offer these comments. Cultivate a deliberate sensitivity to problems, leading you to form a large and explicit backlog of unfilled needs. Then, think deeply about how you will select problems from this reservoir for your most intensive efforts. You will need to be working on many problems, and well chosen ones, since you will succeed so seldom. Do not scorn the imaginative, but be proud of your dreams, since they are at the source of creativity. Do not hesitate to use your own personal aids to the imaginative process, such as conjectural "bull sessions", graphic aids to visualization and information gathering activities. Do not be dismayed at those who persistently and critically ask why you need these procedures, for they are not equipped to understand your answer.

Be encouraged when an expert tells you that your concept is unworkable (if his reasons are vague), because he is really telling you that the novelty of your concept has taken him by surprise, and you are getting close to an answer.

Success often comes soon after such predictions of failure.

THE FUTURE . . . . C. Norman Winningstad, Information Display Manager.

Today, the general population still has little contact with the computer. Although many paychecks and bills are computer prepared and processed, there is little direct contact between man and machine. Even engineers and scientists usually interface the computer through a stack of cards or a programmer.

Often, companies with computer installations are disillusioned because information needed for decisions is not readily accessible from the computer. How many times have you had to wade through the pages of the weekly printout, vainly searching for what you want? If computer information was quickly and easily accessible, man could enter the "Information Age".

The remote computer terminal allows entry into the Information Age. Bring the information to the man! At Tektronix, we believe we have an excellent solution. Since one picture is worth 10,000 words, we are proposing graphic computer terminals rather than just alphanumeric terminals. We did not invent the idea of graphics, but Anderson's invention led us to a practical, economic solution to graphics. We feel we are performing a "pump priming" operation.

There is little now in existence in operational information systems for several reasons. Software, compatible communications language and terminals all need to evolve further. Now that the key item of reasonable-cost terminals is here, the others will follow quickly. Software development is proceeding rapidly, especially among the time-sharing services. The ASCII code is close to a universal language.

The main point here is compatible business procedures. Let's not use business in the broad sense of purposeful human activity, but confine it to the communication of information. Accountants, for example, are used to scanning columns of figures, and develop the skill of reading trends from numbers. They would prefer to express the numbers graphically, but until recently, it was not economically feasible to obtain graphical results. Almost everyone today operates his business in alphanumerics simply because typewriters, teletypes and computer printers cannot do graphics and humans take too long to generate a graph. Wouldn't you like to have a PERT chart available to you, up-to-date on a daily basis for your individual projects? Or any Standard and Poor's stock performance chart updated daily?

Low-cost graphics, and the availability of mass data bases will fundamentally change the way we do business. From education to medicine, from engineering to housekeeping—nothing will ever be the same.

We are proud to be among the pump primers!