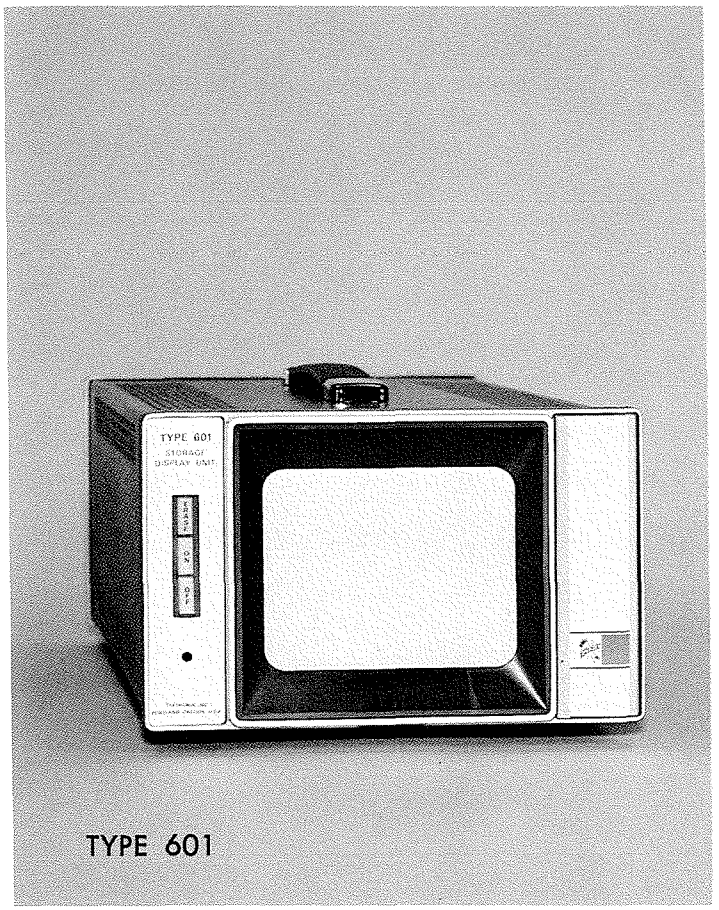
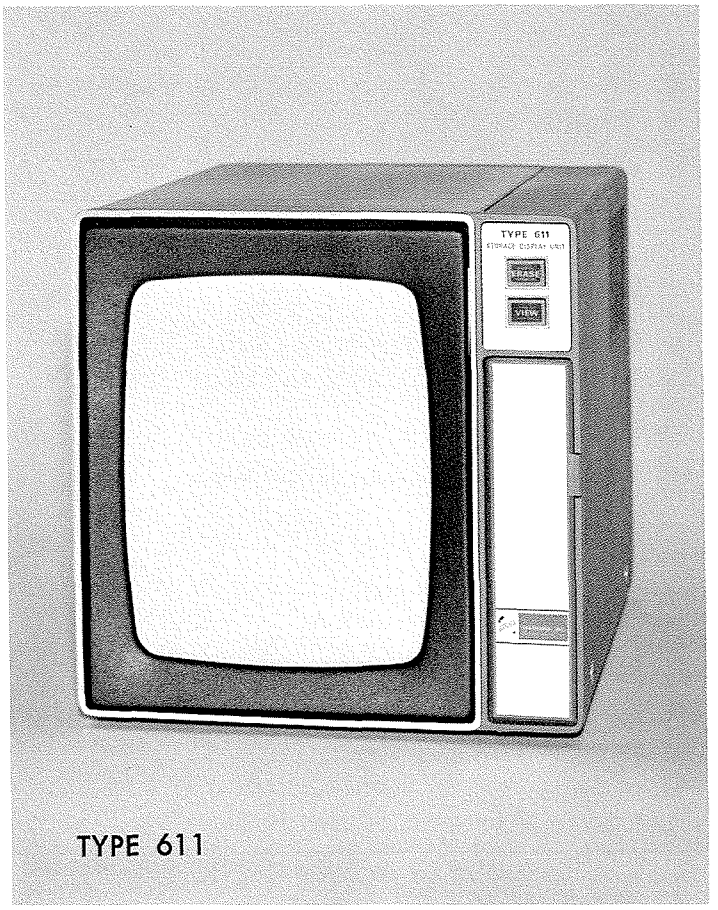
STORAGE DISPLAY INSTRUMENTS





INTRODUCTION

The Type 564 Storage Oscilloscope, a measuring instrument, served as an excellent exploratory tool to determine the advantages of bistable-storage cathode-ray tubes as computer readout devices. Several groups experimented with the bistable storage tube in this application and the results show that a bistable storage tube when used with the appropriate periphal equipment provides high-resolution, non-refreshed, alpha-numeric and graphics displays without flicker or fade.

A sequence of events occurred as the computer market developed that contributed toward the development of the bistable storage tube as a computer display device.

(1) Computer usage was being discouraged by man-to-machine interface problems, that is, a problem is submitted through a programmer, a misunderstanding is found after a period of time, the problem is resubmitted, etc.

(2) Larger and faster computers were developed to help offset computation costs.

(3) Techniques to improve computer time utilization were developed.

(4) Computer time-sharing appeared to be a solution to efficient use of computer time but because of input-output limitations, many parallel or time-shared users are required in order to keep the computer busy.

(5) Time-sharing a central computer requires remote terminals convenient to the users.

(6) The cost per remote terminal for time-sharing application must be sensibly low.

(7) A major economic consideration of remote terminals is local memory cost, especially if arbitrary format alpha-numeric and graphic capabilities are required. It is not economically wise to provide display refreshing from the computer memory, and even with a buffer memory the communication link bandwidth may be too narrow to allow refreshing a display at above flicker rates.

(8) For applications where flexible format is required and large amounts of data are to be presented, the Tektronix simplified direct-view bistable-storage CRT provides an economic solution to the memory/display problem.

A NEED FOR NEW INSTRUMENTS

The interested groups who experimented with the Type 564 Storage Oscilloscope as a computer remote-terminal readout device were encouraged by the results obtained and indicated the need for an instrument optimized for computer display rather than measuring applications. Producing an instrument specifically for computer readout purposes required different design objectives than those for measuring devices.

(1) Writing-speed parameters could be traded off for more uniform and smaller spot size.

(2) Plug-ins replaced with built-in amplifiers resulting in a more compact unit.

(3) The Z axis modified for "on-off" operation.

(4) The CRT target modified for improved isolated stroke or dot appearance (a key contribution).

NEW DISPLAY DEVICES

The recently announced Types 601 and 611 Storage Display Units were designed to be used as integral parts of computer remote terminals. When driven by the appropriate peripheral equipment these units will present non-refreshed displays of alpha-numerics and graphics without flicker or fade.

The Type 601 and 611 are intended for *individual* use, *not* group viewing. The high resolution of the 601 and 611, require the viewer to sit fairly close to the instruments in order to resolve the displayed information.

5-INCH STORAGE DISPLAY UNIT

The Type 601 Storage Display Unit features a new, Tektronix developed, 5-inch bistable-storage display tube, providing clear, non-fading presentations. Resolution in an 8-cm x 10-cm display area is 100 stored line pairs in the vertical axis and 125 stored line pairs in the horizontal axis providing an information capacity of about 400 alpha-numerics. The information storage rate is 100-thousand dots per second and time required to erase the stored information is 200 ms. All solid-state modular circuit design insures long-term stable performance.

The operating functions are remotely programmable by simply grounding program lines at a rear-panel connector. Access to X, Y and Z inputs is through rear-panel BNC connectors or a remote program connector.

11-INCH STORAGE DISPLAY UNIT

The Type 611 Storage Display Unit features an 11-inch magnetically deflected, bistable-storage display tube developed by Tektronix. This new storage tube offers high information density and excellent resolution on a 21-cm x 16.3-cm display screen. The information capacity of the Type 611 is about 4000 alpha-numerics. Dot settling time is 3.5 μs/cm plus 5 μs and dot writing time is 20 μs. The time required to erase and return to ready-to-write status is 0.5 seconds.

The operating functions are remotely programmable through a rear-panel connector with access to X, Y and Z inputs through rear BNC connectors or the remote program connector. A "Write-Through Cursor" feature permits positioning the writing beam to any point on the display area without storing the cursor or destroying previously stored information. Write through for alpha-numerics and graphics can be done by shortening the unblank pulse duration from the normal value of 9 μs (Type 601) or 20 μs (Type 611). This mode of operation is useful for manual graphics, with the aid of equipment like the Rand Tablet or with an SRI Mouse. An internal test signal provides a quick check of focus, storage and general performance status of the instrument.

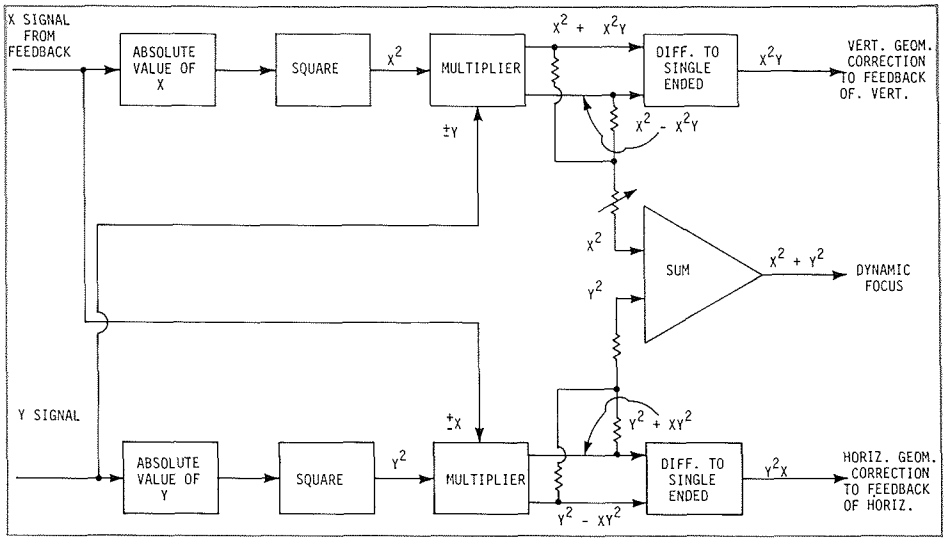


Fig 1—Block diagram of Type 611 pincushion and dynamic focus correction.

SOME DESIGN CONSIDERATIONS

Compatibility between the Types 601 and 611 is maintained with regard to the input connectors and selection of common functions, such as erase. However there are differences which should be kept in mind. The Type 601 has ± 6 cm continuously variable position controls for X & Y, while the Type 611 has three position switches that permit the operator to select one of nine beam resting positions. Variable controls provide a ±10% range for small adjustments of each position. The limited variable range was chosen because of the more stringent drift requirements of the Type 611. Both units have internal gain calibration adjustments to set the full screen deflection voltage within 2% of 1 volt. Both units have provision for other less-sensitive deflection factors.

Trace alignment of the two instruments is different. The Type 611, using an electromagnetrically-deflected tube, has an external deflection yoke which may be rotated to align the traces; orthogonality is a function of how well the yoke was manufactured. The larger screen requirement of the Type 611 requires magnetic deflection through an angle of 70°, in order to keep the length of the instrument reasonable (the Type 611 is about 20% longer than the Type 601). The wide magnetic deflection angle of the Type 611 CRT, together with the flat faceplate, requires correction to the deflection geometry, linearity and focus. Without going into the mathematical details, it can be said that both pincushion and dynamic focus require squared deflection terms. Figure 1 shows the block diagram. The squaring circuit is a single FET. The multiplier is a differential pair driven from a current source. Thus with comparatively simple circuitry, the circuit generates the required X^2Y and Y^2X for pincushion correction, and $X^2 + Y^2$ for focus correction. The dynamic focus summing circuit gets its input from the multipliers, rather than the squaring circuits directly, because of the signal levels involved; that is, the output of the multiplier is at a more convenient level than the squaring circuit. This combination of corrections appears to be new, and unexpectedly simple.

The Type 601 with an electrostatically deflected tube has a *unique* method of correction; instead of the usual rotation coil, signals are independently mixed from the X and/or Y amplifiers into the Y and/or X amplifier, thus introducing tilt and/or slant as necessary to correct trace alignment and/or orthogonality. Because of this cross-mixing, the use of the Type 601 as a waveform monitor should be restricted to applications involving bandwidths below 100 kHz. The smaller deflection angle and lower resolution requirement of the Type 601 make dynamic scan or focus corrections unnecessary.

SUMMARY

The first instrument to use the Tektronix developed bistable storage tube was the Type 564 Storage Oscilloscope, introduced in the spring of 1962. Since that time, the Type 564 has found extensive use in a multiplicity of applications including information display. Early experiments with the Type 564 as an information display device proved the validity of the concept and helped define new storage tube requirements; the Type 601 and 611 Storge Display Units are the first display instruments to employ these new storage tubes.

A more complete description of these new instruments is found in the Tektronix New Products Catalog Supplement recently distributed.

Type 601 Storage Display Unit .. $1050

Type 611 Storage Display Unit .. $2500

U.S. Sales Prices FOB Beaverton, Oregon