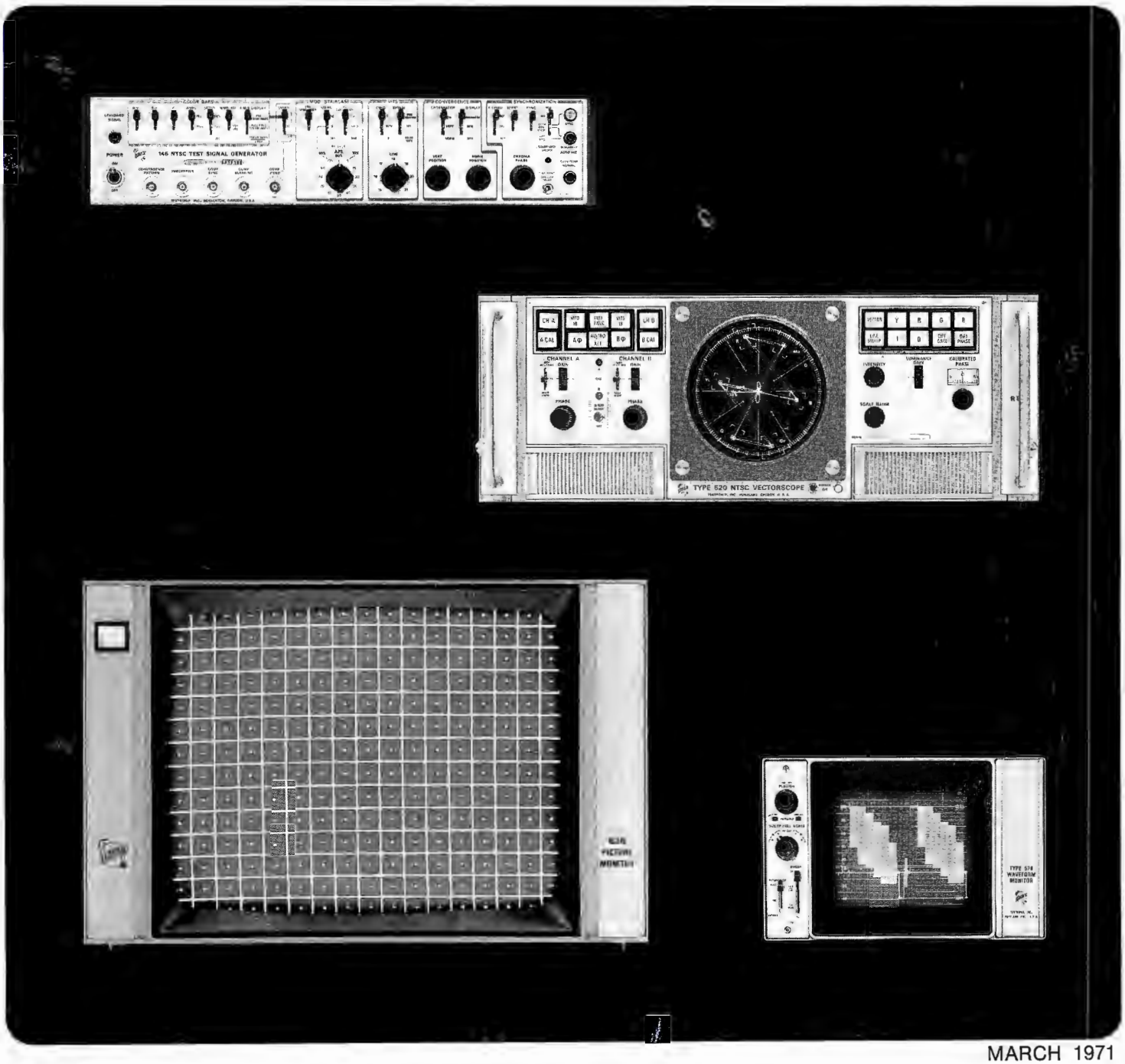
TEKTRONIX®

Television Products



MARCH 1971

PRODUCT	DESCRIPTION	PAGE	NTSC 525/60	PAL 625/50	PAL 525/60	CATV
140	Signal Generator	24	Yes			
141A	Signal Generator	32		Yes		
142	Signal Generator	32			Yes	
144	Signal Generator	23	Yes			Yes
146	Signal Generator	18	Yes			Yes
147	Signal Generator	25	Yes			Yes
520	Vectorscope	2	Yes			Yes
521	Vectorscope	6		Yes		
522	Vectorscope	6			Yes	
528	Waveform Monitor	10	Yes	Yes with MOD 188G	Yes	Yes
529	Waveform Monitor	14	Yes	Yes with MOD 188D*	Yes	Yes
630	Monochrome Picture Monitor	36	Yes	Yes	Yes	Yes
650	Color Picture Monitor	38	Yes			Yes
453A MOD 127C	Oscilloscope	41	Yes	Yes	Yes	Yes
4501	Scan Converter	44	Yes	Yes	Yes	Yes
4551	Light Pen	44	Yes	Yes	Yes	Yes

*Other modified Type 529 Waveform Monitors are available for 625-line, 50-field television standards. Please confer with your Tektronix Field Engineer, Representative or Distributor.

VECTORSCOPES

The vectorscope has emerged as an essential instrument to those making measurements in color television systems. Vectorscopes are capable of a wide variety of specialized measurements. Differential phase and differential gain are measurable directly, whether the test signal is a full field signal as in out-of-service and proof of performance testing, or a single line per frame vertical interval test signal for in-service testing.

The vectorscope may be thought of as an oscilloscope having a circular time base which has extreme stability (it is determined by the frequency of the color subcarrier). Time delay between two signals can be checked, because the phase difference at any particular frequency can be related to time difference. An example of this is the setup of two color cameras some distance apart. The two signals can be viewed together on a time-shared basis. Any time-delay difference between the two camera links will appear as a phase difference in the vectorial display. This time-delay difference can be determined by noting that 360° on the graticule equals 280 nanoseconds of time in the Type 520 and 522 (225 nanoseconds in the Type 521). The difference can be minimized by adjusting the connecting cable lengths so that there will be no hue or phase difference from one camera to the other.

The chromaticity of any televised material can be measured. Here the measurements are not expressed directly in the customary units in which colorimetry deals, but in terms of the phase angle of the color subcarrier.

WAVEFORM MONITORS

In the field of waveform monitors, Tektronix offers the Type 529 in full rack width and half rack width versions for a variety of mounting arrangements with picture monitors. The Type 529 finds wide acceptance as a transmission test instrument because of its digital line selector and bright, sharp trace which makes it suitable for monitoring vertical interval test signals. For analyzing individual lines per frame of the picture, a variable line selector and line strobe are provided so that the line being examined may be identified on the associated picture monitor.

For a large number of applications, single line viewing is not required, as in camera control and routine monitoring. For these applications, the Type 528 is finding widespread acceptance due to its simplicity and compactness. Two Type 528 instruments occupy only 5¼ inches of rack space, yet the screen size is 8 x 10 cm.

TELEVISION SIGNAL GENERATORS

Tektronix Signal Generators are available for both NTSC and PAL color TV systems. The instruments are all solid-state utilizing digital integrated circuits to achieve the stability, accuracy and reliability expected of instruments which generate test, sync and subcarrier signals. They provide operating capabilities usually found in much higher priced generators.

SCAN CONVERTER and LIGHT PEN UNITS

The 4501 Scan Converter Unit accepts alphanumeric and graphic data in analog form and converts it to displays on TV receivers and monitors. Heart of the 4501 is the Tektronix bistable storage CRT, upon which data is written then scanned with the TV raster. An external video signal can be mixed with the data output.

The 4551 Light Pen Unit can be used in broadcasting, teaching, or computer-aided instruction to point, or, with the Scan Converter Unit, draw, write or magnify an enclosed area on TV monitors and receivers.

RETURN LOSS BRIDGE

The 75-ohm Return Loss Bridge was developed to assess the performance of television transmission lines and their terminal equipments in carrying television signals without picture impairment. The Return Loss Bridge measures quantitatively the energy reflected in a transmission system due to impedance mismatching at or before the termination. Unlike fast pulse systems, the return loss technique uses standard TV test signals so that energy reflections at frequencies above those of interest are not measured. In this way, results are obtained which are meaningful in assessing transmission quality for television. Fast pulse techniques on the other hand locate impedance discontinuities when the return loss technique has determined that there are relevant reflections at video frequencies.

The Tektronix Return Loss Bridge is used in conjunction with the Type 1A5 or 7A13 Differential Plug-In Units. The Return Loss System is specified at —54 dB over the full 10 MHz bandwidth of the system. Since —46 dB is equivalent to an impedance discontinuity of less than 0.5%, the bridge provides more resolution than is usually required.

GLOSSARY OF TERMS

APL: Average picture level. The average luminance level of the unblanked portion of a television line.

BRUCH SEQUENCE: An arrangement of color burst signals which assures that the starting polarity of the burst signal is the same at the start of each field for improved stability of color synchronization.

CATV: Community Antenna Television.

CHROMINANCE: This term is used to indicate both hue and saturation of a color.

CHROMINANCE SIGNAL: In television, the sidebands of the modulated chrominance subcarrier which are added to the monochrome signal to convey color information. The chrominance signal components transmit the qualities of hue and saturation but do not include luminance or brightness.

COLOR BAR: A test signal, typically containing six basic colors—yellow, cyan, green, magenta, red and blue, which is used to check chrominance functions of color TV systems.

COLOR BURST: Refers to a burst of 8 to 10 cycles of subcarrier on the back porch of the composite video signal. This serves as a color synchronizing signal to establish a frequency and phase reference for the chrominance signal.

COLOR SUBCARRIER: The carrier signal whose modulation sidebands are added to the monochrome signals to convey color information.

COMPOSITE VIDEO SIGNAL: The complete video signal. For monochrome, it consists of the picture signal and the blanking and synchronizing signals. For color, additional color synchronizing signals and color picture information are added.

DIFFERENTIAL GAIN: The amplitude change, usually of the color subcarrier, introduced by the overall circuit, measured in dB or per cent, as the picture signal on which it rides is varied from blanking to white level.

DIFFERENTIAL PHASE: The phase change of the color subcarrier introduced by the overall circuit, measured in degrees, as the picture signal on which it rides is varied from blanking to white level.

GEN-LOCK: A system of regenerating subcarrier and sync from a composite video source.

H RATE: The time for scanning one complete line, including trace and retrace, NTSC equals 1/15734 sec (color) or 63.5 μs.

HUE: The attribute of color perception that determines whether an object is red, yellow, green, blue, purple, or the like. White, black, and gray are not considered as being hues.

IRE UNIT: 7.14 mV.

LUMINANCE: This indicates the amount of light intensity which is perceived by the eye as brightness.

NTSC: National Television Standards Committee.

PAL: Phase alternation line. A system in which the subcarrier derived from the burst signal is switched 180° in phase from one line to the next. This system helps to minimize hue errors which may occur in a color transmission.

SATURATION: The degree to which a color is pure and undiluted by white light, distinguished between vivid and weak shades of the same hue. The less white light in a given color, the greater is its saturation.

STAIRCASE: A video test signal containing several steps at increasing luminance levels. The staircase signal is usually amplitude modulated by the subcarrier frequency and is useful for checking amplitude and phase linearities in video systems.

VITS: Vertical interval test signal (NTSC), vertical insertion test signal (PAL). A signal which may be included during the vertical blanking interval to permit on-the-air testing of video circuitry functions and adjustments.

520

NTSC Vectorscope

- ***PUSH-BUTTON OPERATING CONVENIENCE***
- ***AMPLITUDE CALIBRATED DISPLAYS***
- ***LUMINANCE AMPLITUDE, CHROMINANCE PHASE AND AMPLITUDE, DIFFERENTAL PHASE AND DIFFERENTIAL GAIN MEASUREMENTS***
- ***THE LUMINANCE CHANNEL AND THE LINE-RATE TIME BASE PERMIT DECODED R, G, B and Y DISPLAYS***
- ***ALL SOLID-STATE, COOL, QUIET OPERATION***

The Tektronix Type 520 NTSC Vectorscope is designed to measure luminance amplitude, and chrominance amplitude and phase of the NTSC composite color television signal. Self-canceling pushbutton switches permit rapid selection of displays for quick analysis of television signal characteristics, and to check Vectorscope calibration. All solid-state circuitry provides low power consumption and cool, quiet operation.

Dual inputs provide time-shared displays for comparison of input-output signal phase and gain distortion. A chrominance channel is provided which demodulates the chrominance signal to obtain color information from the composite video signal for use in VECTOR, LINE SWEEP, R, G, B, I, Q, Differential Gain (dA) and Differential Phase (dϕ) displays. A luminance channel separates and displays the luminance (Y) component of the composite color signal. The Y component is combined with the output of the chrominance demodulators for R, G and B displays at a line rate.

A digital line selector permits the display of a single line Vertical Interval Test Signal from a selected line of either field 1 or field 2.

VECTOR PRESENTATION

The vector presentation graphically displays the relative phase and amplitude of the chrominance signal on polar coordinates. To identify these coordinates the graticule (see fig 1) has points which correspond to the proper phase and amplitude of the primary and complementary colors: R (Red), B (Blue), G (Green); Cy (Cyan), Y_L (Yellow) and M_G (Magenta).

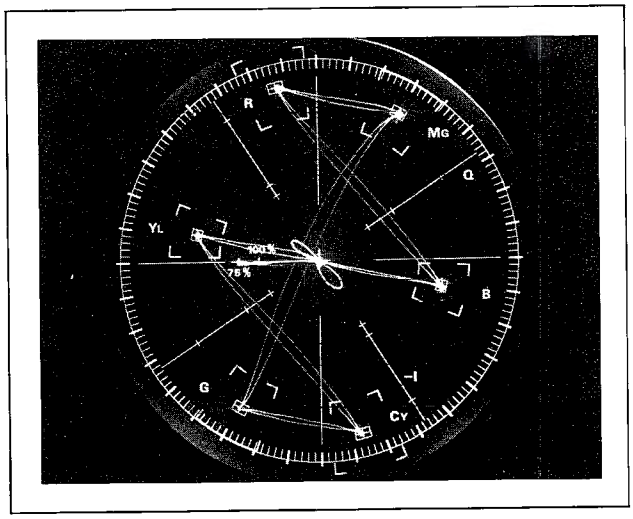


Fig 1—Vector display—full field color bars, 75% amplitude, 100% white reference, 10% set-up. Conforms to EIA standard RS189. Type 140 NTSC Test Signal Generator used as a signal source.

Any errors in the color encoding, video tape recording or transmission processes which change these phase and/or amplitude relationships cause color errors in the television receiver picture. The polar coordinate type of display such as that obtained on the Type 520 CRT has proved to be the best method for portraying these errors.

The polar display permits measurement of hue in terms of relative phase of the chrominance signal with respect to the color burst. Saturation is expressed in terms of the displacement from center (radial length) toward the color point which corresponds to 75% (or 100%) saturation of the particular color being measured.

The outer boxes around the color points correspond to phase and amplitude error limits per FCC requirements (±10°, ±20%). The inner boxes indicate ±2.5° and 2.5 IRE units and correspond to phase and amplitude error limits per EIA specification RS-189, amended for 7.5% setup.

An internally generated test circle matched with the vector graticule verifies quadrature accuracy, horizontal to vertical gain balance and gain calibration for chrominance signal amplitude measurements. Two methods of measuring phase-shift are provided. Large phase-shifts can be accurately read from the parallax-free vector graticule. A precision calibrated phase shifter with a range of 30°, spread over 30 inches of dial length, is provided for measuring small phase-shifts.

LINEAR-SWEEP PRESENTATION

The linear time base operates at the line rate. Color signals are demodulated along any desired axis, I, Q, R-Y, B-Y, etc. and displayed at the line rate on a linear time base.

DUAL DISPLAY

In dual-channel operation, successive samples of channels A and B are displayed on a time-shared basis. The switching rate is locked to horizontal sync and switching transients are blanked. Input-output signals from video equipment can be conveniently compared on channel A and B for phase and/or amplitude distortion. The subcarrier processing channel contains two uncalibrated 0° to 360° phase-shifters and one 30° CALIBRATED PHASE shifter. While viewing channel A or B, either of the uncalibrated phase-shifters, Aϕ or Bϕ, can be switched into the subcarrier processing channel. Aϕ and Bϕ will lock to channel A and B respectively, when A and B channel are time-shared, permitting independent phase control of channel A and B displays. Phase shifts caused by unequal signal paths are easily cancelled, leaving only phase and amplitude distortion caused by equipment deficiencies. Video cable lengths can be accurately matched for time delay at color subcarrier frequency to less than 0.5° phase difference. Accurate amplitude measurements of chrominance and luminance are provided from the CRT. An internal 1-V luminance amplitude calibration test signal is provided to check the gain accuracy of channel A and B amplifiers and the luminance channel.

DIFFERENTIAL GAIN AND DIFFERENTIAL PHASE MEASUREMENTS

The two main chrominance-signal distortions are differential gain and differential phase. Both can be measured on the

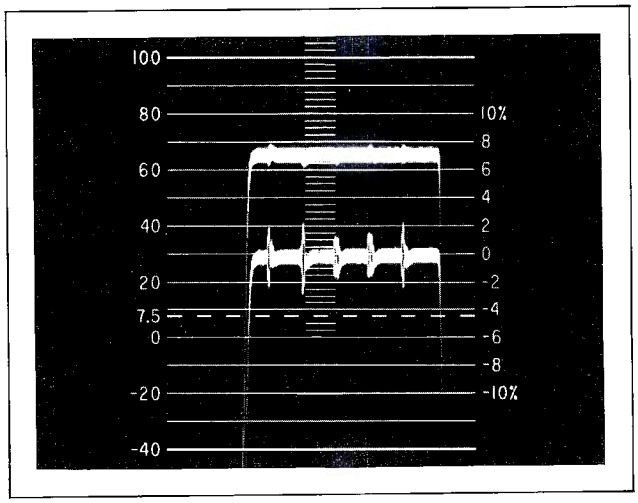


Fig 2—Differential Gain display from the Type 520 using the Type 140 NTSC Test Signal Generator. Lower trace, luminance is on. Upper trace, luminance is off. Minor divisions of graticule indicate .5% Differential Gain. Double exposure.

Type 520 Vectorscope. Differential gain (fig 2) is a change in color subcarrier amplitude as a function of luminance. In the reproduced color picture, the saturation will be distorted in the areas between the light and dark portions of the scene. The IRE graticule major divisions represent % of voltage gain or loss when making a differential gain measurement. The 520 permits differential gain measurements with accuracy to better than 1%.

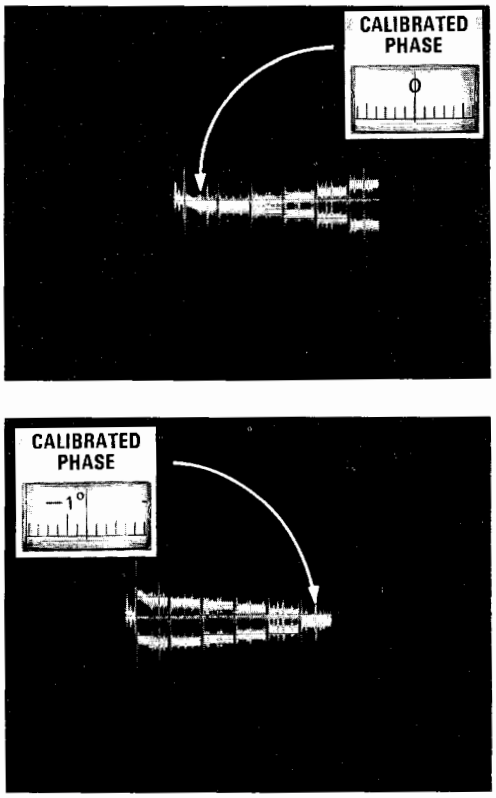
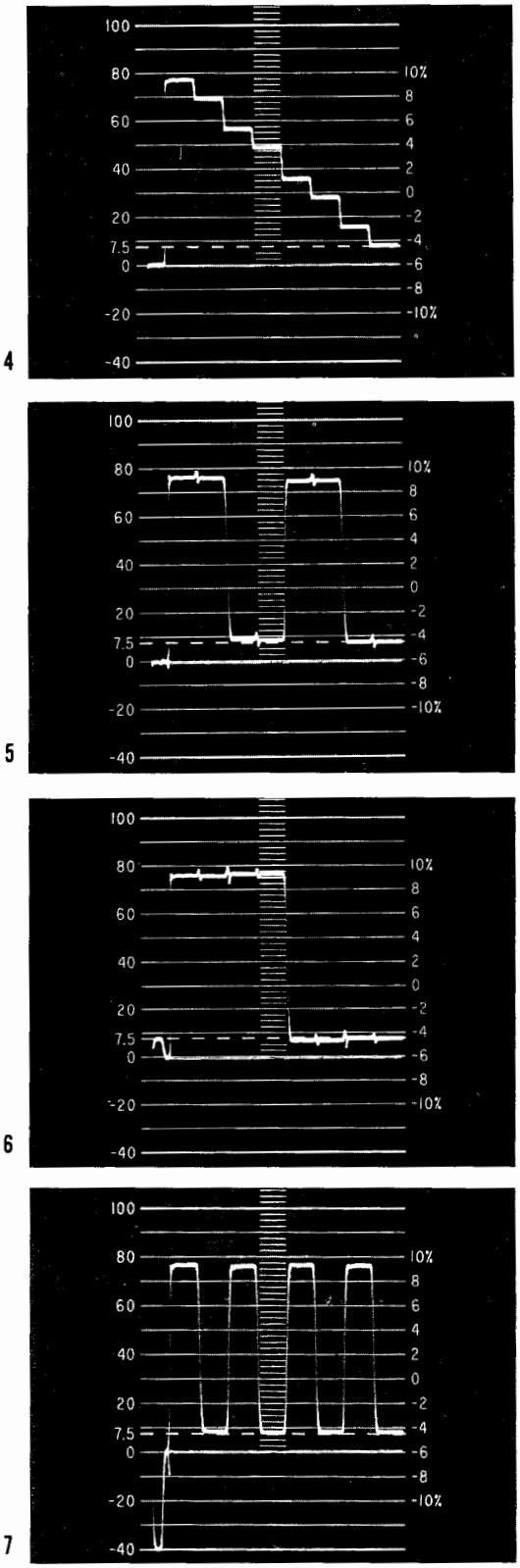


Fig 3—Differential Phase presentation using a modulated staircase signal. A trace overlay technique provides excellent resolution for measuring small phase changes. From reference point in top photo (1st step of staircase signal overlayed) to point of measure in bottom photo (6th step overlayed) represents 1.2° differential phase distortion.

Differential phase (fig 3) is a phase modulation of the chrominance signal by the luminance signal. In the reproduced color picture, the hue will vary with scene brightness. Differential gain and differential phase may occur separately or together. The causes of these distortions are amplitude non-linearity and time delay that are not independent of the signal level. Differential phase is read from the precision calibrated phase shift control. Dial resolution is excellent with 1° phase shift represented by approximately 1 inch of dial movement. The vertical deflection of the display is greatly magnified and inverted on alternate lines allowing the use of a trace overlay technique and the slide-back method for measuring small phase changes. The CALIBRATED PHASE control provides direct readout of differential phase. Using the standard linearity test signal, differential phase of 0.2° can be measured. Reference burst is selectable, internal or external.

RED (R), GREEN (G), BLUE (B) AND LUMINANCE (Y) OBSERVATIONS

The Type 520 provides a luminance channel which permits the separation and display of the luminance (Y) component from the composite color signal (fig 4). The Y component can also be combined with the output of the chrominance demodulators for R, G and B displays at a line rate (fig 5, 6, 7). Amplitude measurements of color signal components can be made with an accuracy of 3%.



75% amplitude EIA Color Bar Signal. Line-sweep displays of Luminance (fig 4), decoded Red (fig 5), decoded Green (fig 6), and decoded Blue (fig 7). Displays photographed with a Tektronix C-27-549 Camera, using a Tektronix Type 140 NTSC Test Signal Generator as a source.

VERTICAL INTERVAL TEST SIGNAL OBSERVATION

Vertical Interval Test Signals from preselected lines of either field 1 or field 2 can be displayed on the Type 520 Vectorscope.

Binary counters operate in conjunction with the field selector to select lines in either field that may carry suitable test signals. These circuits enable the Vectorscope to be used for measuring differential gain and differential phase from test signals transmitted in the vertical blanking interval of color broadcasts.

Normally, lines 18 and 19 in either field 1 or field 2 are selected by means of the VITS 18 and VITS 19 push buttons in conjunction with the FIELD switch. Internal quick-disconnect jumper wires permit selecting any line from 7 through 21 of either field. Intensity and focus are automatically adjusted for optimum viewing of VITS.

GRATICULE

Two separate graticules provide references for vector and line sweep displays. The parallax-free vector graticule, or the IRE graticule, is automatically selected and edge-lighted concurrent with operating mode selection.

Z AXIS INPUT

The Z-AXIS INPUT connector accepts external trace-brightening pulses for intensifying a portion of the display during the time of interest. A 1-V negative-going pulse is required.

VIDEO INPUTS

Dual input BNC connectors (fig 8) for each channel permit 75-Ω loop-through operation with a return loss greater than 46 dB* to 5 MHz. Amplitude range is 0.7 V to 1.4 V VIDEO (sync tip to peak white).

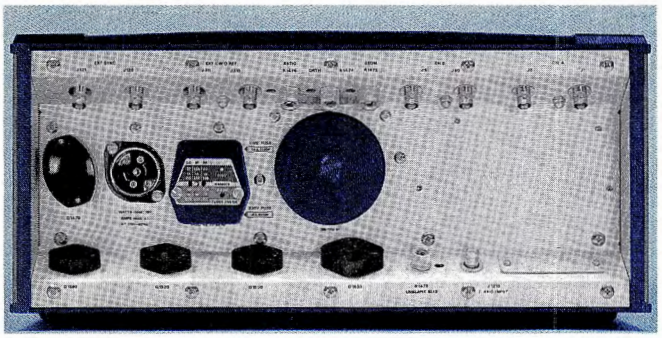


Fig 8—Rear view of 520 Vectorscope. The mounting angle of the coax connectors permit connecting cables to leave the instrument without protruding excessively and with a minimum of clearance space required.

POWER REQUIREMENTS

90 to 136 VAC or 180 to 272 VAC, 47 to 63 Hz, 95-watts maximum at 115 V and 60 Hz. Rear panel selector provides rapid accommodation for six line-voltage ranges.

ENVIRONMENTAL CAPABILITIES

Ruggedly designed to withstand temperature and altitude variations, vibration, shock, and transportation. Listed instrument characteristics are valid over a temperature range of 0° C to +50° C ambient.

MECHANICAL CHARACTERISTICS

The Type 520 Vectorscope is available in two mechanical configurations. A cabinet model and a rackmount model (Type R520). Both instruments are electrically identical. The R520 mounts in a 19-inch rack and is provided with a slide-out assembly for convenient access to internal components.

*Exceeds CCIR recommendation 451-2, paragraph 3.1 and 3.2

DIMENSIONS AND WEIGHTS

TYPE 520	Height	7 in	17.8 cm
	Width	16⅞ in	42.9 cm
	Depth	19⅛ in	48.7 cm
	Net weight	33 lb	15 kg
TYPE R520	Height	7 in	17.8 cm
	Width	19 in	48.3 cm
	Depth	19¾ in	50.2 cm
	Net weight	33 lb	15 kg
Domestic shipping weight		≈61 lb	≈27.7 kg
Export-packed weight		≈82 lb	≈37.3 kg

INCLUDED STANDARD ACCESSORIES

TYPE 520: Smoke-gray filter, installed (378-0581-00); camera gasket and mounting screws (016-0114-00); power cord (161-0036-00); instruction manual (070-0639-01).

TYPE R520. Same as Type 520 but includes rackmounting hardware, and slide-out assembly (351-0195-00).

ORDERING INFORMATION

Cabinet model, order TYPE 520 NTSC VECTORSCOPE $2500

Rackmount model, order TYPE R520 NTSC VECTORSCOPE $2550

UHF connectors are optional and may be specified without extra cost.

OPTIONAL ACCESSORIES

75-Ω VOLTAGE STEP-UP TERMINATION

The 75-Ω Voltage Step-Up Termination provides a X5 increase in chrominance amplitude and permits Differential Gain and Differential Phase measurements to be made to a higher degree of accuracy when used with a Tektronix Vectorscope. Input impedance to the termination is a constant 75 Ω. Use of the termination requires a source of external sync to the Vectorscope.

For use with Type 520 Vectorscope

UHF connectors, order 011-0100-00 . . . . . $27.50

BNC connectors, order 011-0100-01 . . . . . $27.50

SINGLE SIDEBAND CHROMA AMPLITUDE CORRECTOR

The Single Sideband Chroma Amplitude Corrector is designed for use with a Tektronix Vectorscope in transmitter applications where a vestigial sideband signal is being demodulated with a detecting diode. The corrector provides a X2 increase in chrominance amplitude and passes luminance components with little or no attenuation. Input impedance is 75 Ω.

For use with Type 520 Vectorscope

UHF connectors, order 011-0107-00 . . . . . $27.50

BNC connectors, order 011-0107-01 . . . . . $27.50

C-27 TRACE RECORDING CAMERA

f/1.9, 1:0.5 lens; Polaroid Land* Pack-Film back.

Order C-27-549 . . . . . $500

Type 520 to C-27 Camera Adapter, order 016-0225-02 . . $16

R520 CRADLE ASSEMBLY

For mounting the Type R520 in a WECO backless rack.

Order 426-0667-00 . . . . . $8.50

[1]Registered Trademark Polaroid Corporation

U.S. Sales Prices FOB Beaverton, Oregon

521 and 522*

PAL Vectorscopes

- ***PUSH-BUTTON OPERATING CONVENIENCE***
- ***AMPLITUDE CALIBRATED DISPLAYS***
- ***LUMINANCE AMPLITUDE, CHROMINANCE PHASE AND AMPLITUDE, DIFFERENTIAL PHASE AND DIFFERENTIAL GAIN MEASUREMENTS***
- ***THE LUMINANCE CHANNEL AND THE LINE-RATE TIME BASE PERMIT DECODED R, G, B and Y DISPLAYS***
- ***ALL SOLID-STATE, COOL, QUIET OPERATION***

The Tektronix Type 521 PAL Vectorscope is designed to measure luminance amplitude, and chrominance phase and amplitude of the PAL composite color television signal. It is designed for 625 line 50 field PAL Color TV signals utilizing a color subcarrier frequency of 4.43361875 MHz and is calibrated to observe video signals with 0 set-up level. Self-canceling push-button switches permit rapid selection of displays for quick analysis of television signal characteristics, and to check Vectorscope calibration. All solid-state circuitry provides low power consumption and cool, quiet operation.

Dual inputs are provided permitting time-shared displays for comparison of input-output signal phase and gain distortion. A chrominance channel is provided which demodulates the chrominance signal to obtain color information from the composite video signal for use in VECTOR PAL, VECTOR NTSC, R, G, B, U, V, Differential Gain and Differential Phase displays. A luminance channel separates and displays the luminance (Y) component of the composite color signal. The Y component is combined with the output of the chrominance demodulators for R, G and B displays at a line rate.

A digital line selector permits the display of a single line Vertical Insertion Test Signal from a selected line of either field 1 or field 2.

*For 525-line 60-cycle field, 3.575611 MHz subcarrier (Brazilian system)

VECTOR PRESENTATION

The vector presentation graphically displays the relative phase and amplitude of the chrominance signal on polar coordinates. To identify these coordinates the graticule (see fig 1) has points which correspond to the proper phase and amplitude of the primary, complementary and conjugate chrominance vectors: Red (R) (r), Green (G) (g), Blue (B) (b), Cyan (Cy) (cy), Magenta (Mg) (mg) and Yellow (Yl) (yl).

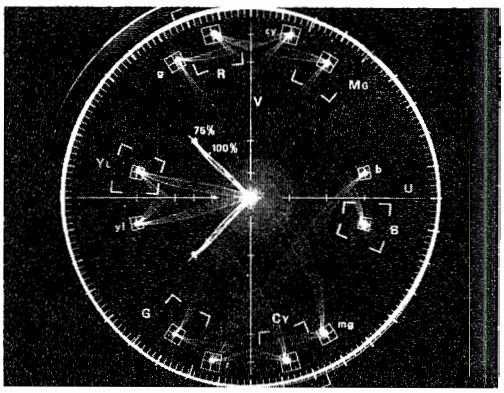


Fig 1A—Vector PAL presentation of PAL color bar signal.

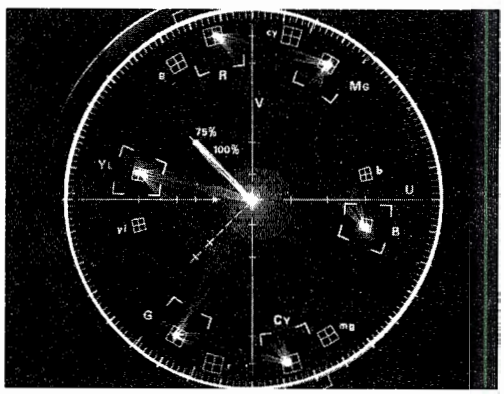


Fig 1B—Vector NTSC presentation of PAL color bar signal.

Any errors in the color encoding, video tape recording or transmission processes which change these phase and/or amplitude relationships cause color errors in the television receiver picture. The polar coordinate type of display such as that obtained on a vectorscope has proved to be the best method for portraying these errors.

The polar display permits measurement of hue in terms of relative phase of the chrominance signal with respect to the color burst. Saturation is expressed in terms of the displacement from center (radial length) toward the color point which corresponds to 75% (or 100%) saturation of the particular color being measured.

The outer boxes around the color points correspond to phase and amplitude error limits (±10°, ±20%). The inner boxes indicate ±3° phase angle and ±5% amplitude.

(+V), (+V and —V) and (—V) vector displays are provided, permitting observation of the 135° and 235° burst-related color information, individually or combined.

An internally generated test circle matched with the vector graticule verifies quadrature accuracy, horizontal to vertical gain balance and gain calibration for chrominance signal amplitude measurements. Two methods of measuring phase-shift are provided. Large phase-shifts can be accurately read from the parallax-free vector graticule. A precision calibrated phase shifter with a range of 30°, spread over 30 inches of dial length, is provided for measuring small phase-shifts.

LINEAR-SWEEP PRESENTATION

The linear time base operates at the line rate. Color signals are demodulated along any desired axis, U, V, etc. and displayed at the line rate on a linear time base.

DUAL DISPLAY

In dual-channel operation, successive samples of channels A and B are displayed on a time-shared basis. The switching rate is locked to horizontal sync and switching transients are blanked. Input-output signals from video equipment can be conveniently compared on channel A and B for phase and/or amplitude distortion. The subcarrier processing channel contains two uncalibrated 0° to 360° phase-shifters and one 30° CALIBRATED PHASE shifter. While viewing channel A or B, either of the uncalibrated phase-shifters, Aϕ or Bϕ, can be switched into the subcarrier processing channel. Aϕ or Bϕ will lock to channel A and B respectively, when A and B channel are time-shared, permitting independent phase control of channel A and B displays. Phase shifts caused by unequal signal paths are easily cancelled, leaving only phase and amplitude distortion caused by equipment deficiencies. Video cable lengths can be accurately matched for time delay at color subcarrier frequency to less than 0.5° phase difference. Accurate amplitude measurements of chrominance and luminance are provided from the CRT. An internal 1-V luminance amplitude calibration test signal is provided to check the gain accuracy of channel A and B amplifiers and the luminance channel.

DIFFERENTIAL GAIN AND DIFFERENTIAL PHASE MEASUREMENTS

The two main chrominance-signal distortions are differential gain and differential phase. Both can be measured on the Type 521 PAL Vectorscope. Differential gain (fig 2) is a change in color subcarrier amplitude as a function of luminance. In the reproduced color picture, the saturation will be distorted in the areas between the light and dark portions of the scene. The luminance graticule major divisions represent percent of voltage gain or loss when making a differential gain measurement. The 521 PAL Vectorscope permits differential gain measurements with accuracy to better than 1%.

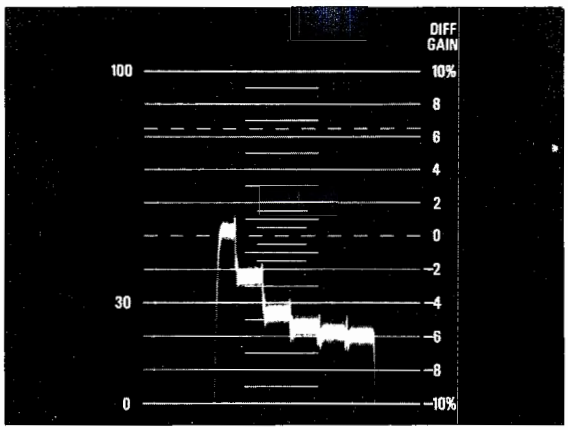


Fig 2—Type 521 PAL and Type 141A system being used to measure differential gain of a typical cascade of video amplifiers. Indicated differential gain is 6½%.

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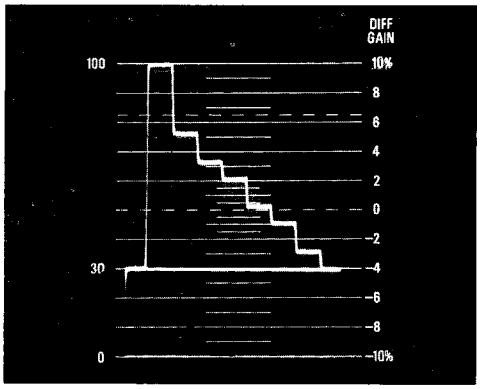

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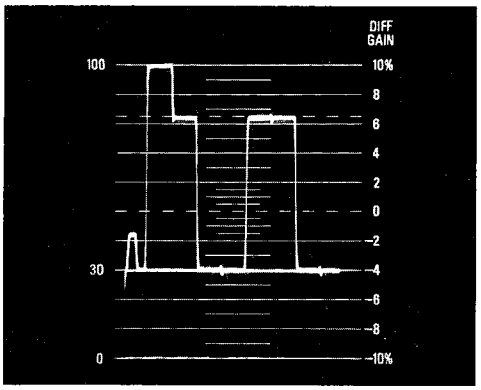

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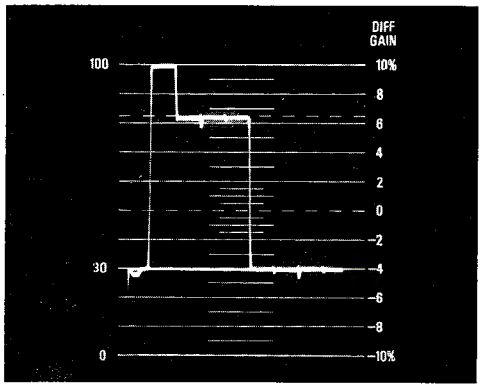

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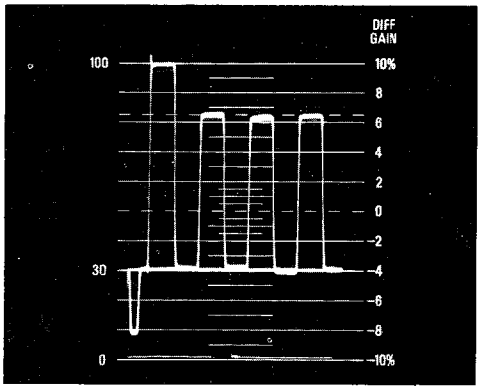
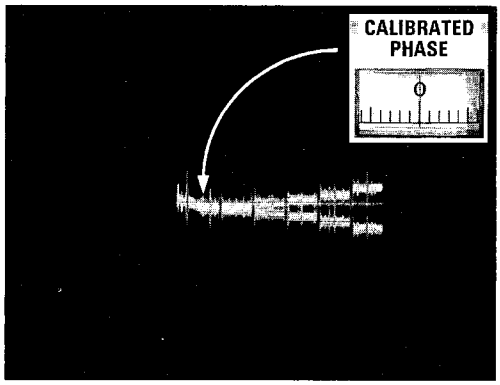


Line sweep presentations of Luminance (signal sequence; white, yellow, cyan, green, magenta, red, blue, and black, fig 3), decoded Red (fig 4), decoded Green (fig 5), and decoded Blue (fig 6), components of the PAL color bar signal. Photos were taken using a Type 141A PAL Television Test Signal Generator, a Type 521 PAL Vectorscope, and a C-27-549 Camera.



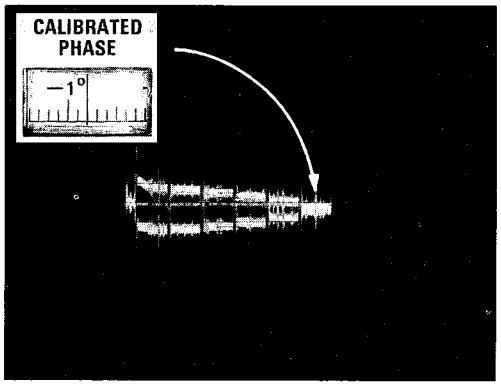


Fig 8—Differential Phase presentation using a modulated staircase signal. A trace overlay technique provides excellent resolution for measuring small phase changes. From reference point in top photo (1st step of staircase signal overlayed) to point of measure in bottom photo (6th step overlayed) represents 1.2° differential phase distortion.

Differential phase (fig 8) is a phase modulation of the chrominance signal by the luminance signal. Differential phase may result in picture impairment.

Differential gain and differential phase may occur separately or together. The causes of these distortions are amplitude non-linearity and time delay that are not independent of the signal level. Differential phase is read from the precision calibrated phase shift control. Dial resolution is excellent with 1° phase shift represented by approximately 1 inch of dial movement. The vertical deflection of the display is greatly magnified and inverted on alternate lines allowing the use of a trace overlay technique and the slide-back method for measuring small phase changes. The CALIBRATED PHASE control provides direct readout of differential phase. Using the standard linearity test signal, differential phase of 0.2° can be measured. Reference phase is selectable, from an internal subcarrier regenerator or an external CW source.

RED (R), GREEN (G), BLUE (B) AND LUMINANCE (Y) OBSERVATIONS

The Type 521 PAL Vectorscope provides a luminance channel which permits the separation and display of the luminance (Y) component from the composite color signal (fig 3). The Y component can also be combined with the output of the chrominance demodulators for R, G and B displays at a line rate (fig 4, 5, 6). Amplitude measurements of color signal components can be made with an accuracy of 3%.

VERTICAL INSERTION TEST SIGNAL OBSERVATION

Vertical Insertion Test Signal from preselected lines of either field 1 and 3 or field 2 and 4 can be displayed.

Binary counters operate in conjunction with the field selector to select lines in either field that may carry suitable test signals. These circuits enable the Vectorscope to be used for measuring differential gain and differential phase from test signals transmitted in the vertical blanking interval of color broadcasts.

Specific lines are selected by means of the VITS I and VITS II push buttons. Vectorscopes normally are shipped from the factory with the following lines selected by these switches:

	(VITS I) FIELDS 1 and 3	(VITS II) FIELDS 2 and 4
Type 521/R521	lines 17 and 18	lines 330 and 331

Internal quick-disconnect jumper wires permit selecting any line from 4 through 22 or 316 through 335. Intensity and focus are automatically adjusted for optimum viewing of VITS.

GRATICULE

Two separate graticules provide references for vector and line sweep displays. The parallax-free PAL vector graticule, or the luminance graticule, is automatically selected and edge-lighted concurrent with operating mode selection.

Z AXIS INPUT

The Z-AXIS INPUT connector accepts external trace-brightening pulses for intensifying a portion of the display during the time of interest. A 1-V negative-going pulse is required.

VIDEO INPUTS

Dual BNC input connectors (fig 9) for each channel permit 75-Ω loop through operation with a return loss greater than 46 dB* to 5 MHz. Amplitude range is 0.7 V to 1.4 V VIDEO (sync tip to peak white).

POWER REQUIREMENTS

90 to 136 VAC or 180 to 272 VAC, 47 to 63 Hz, 95 watts maximum at 115 V and 60 Hz. Rear panel selector provides rapid accommodation for six line-voltage ranges.

ENVIRONMENTAL CAPABILITIES

Listed instrument characteristics are valid over a temperature range of 0°C to +50°C ambient.

MECHANICAL CHARACTERISTICS

The Type 521 PAL Vectorscope is available in two mechanical configurations, a cabinet model and a rackmount model. Both instruments are electrically identical. The Type R521 mounts in a 19-inch rack and is provided with a slide-out assembly for convenient access to internal components.

DIMENSIONS AND WEIGHTS

Type 521	Height	7 in	17.8 cm
	Width	16⅞ in	42.9 cm
	Depth	19⅛ in	48.7 cm
	Net weight	33 lb	15 kg
Type R521	Height	7 in	17.8 cm
	Width	19 in	48.3 cm
	Depth	19¾ in	50.2 cm
	Net weight	33 lb	15 kg

*Exceeds CCIR recommendation 451-2, paragraph 3.1 and 3.2

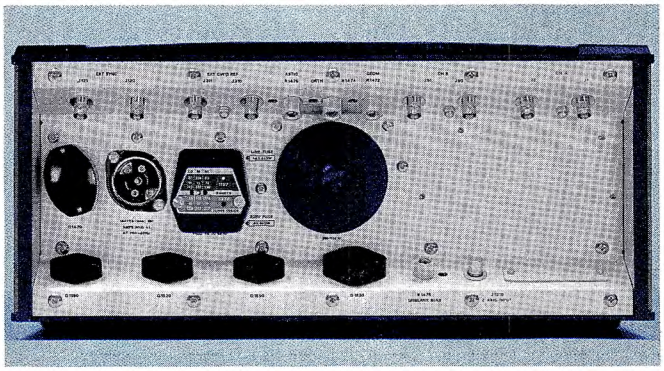


Fig 9—Rear view of Type 521 PAL Vectorscope.

INCLUDED STANDARD ACCESSORIES

Smoke-gray filter (378-0581-00); camera gasket and mounting screws (016-0114-00); power cord (161-0036-00); instruction manual 521/R521 (070-1027-00).

Type R521 same as Type 521 but includes rackmounting hardware, and slide-out assembly (351-0195-00).

ORDERING INFORMATION

Cabinet model, order

TYPE 521 PAL VECTORSCOPE **$2500**

Rackmount model, order

TYPE R521 PAL VECTORSCOPE **$2550**

For 525-line, 60-cycle field, 3.575611 MHz subcarrier (Brazilian system):

TYPE 522 PAL VECTORSCOPE **$2750**

TYPE R522 PAL VECTORSCOPE **$2800**

UHF connectors are optional and may be specified without additional cost.

OPTIONAL ACCESSORIES

R521 CRADLE ASSEMBLY

For mounting the Type R521 in a WECO backless rack.
Order 426-0667-00 ..... $8.50

C-27 TRACE RECORDING CAMERA

f/1.9, 1:0.5 lens; Polaroid Land* Pack-Film back.
Order C-27-549 ..... $500
Type 521 to C-27 Camera Adapter.
Order 016-0225-02 ..... $16

75-Ω VOLTAGE STEP-UP TERMINATION

The 75-Ω Voltage Step-Up Termination provides a ×5 increase in chrominance amplitude and permits Differential Gain and Differential Phase measurements to be made to a higher degree of accuracy when used with a Tektronix Vectorscope. Input impedance to the termination is a constant 75 Ω. Use of the termination requires a source of external sync to the vectorscope.

FOR USE WITH TYPE 521 VECTORSCOPE
BNC connectors, order 011-0109-00 ..... $27.50

SINGLE SIDEBAND CHROMA AMPLITUDE CORRECTOR

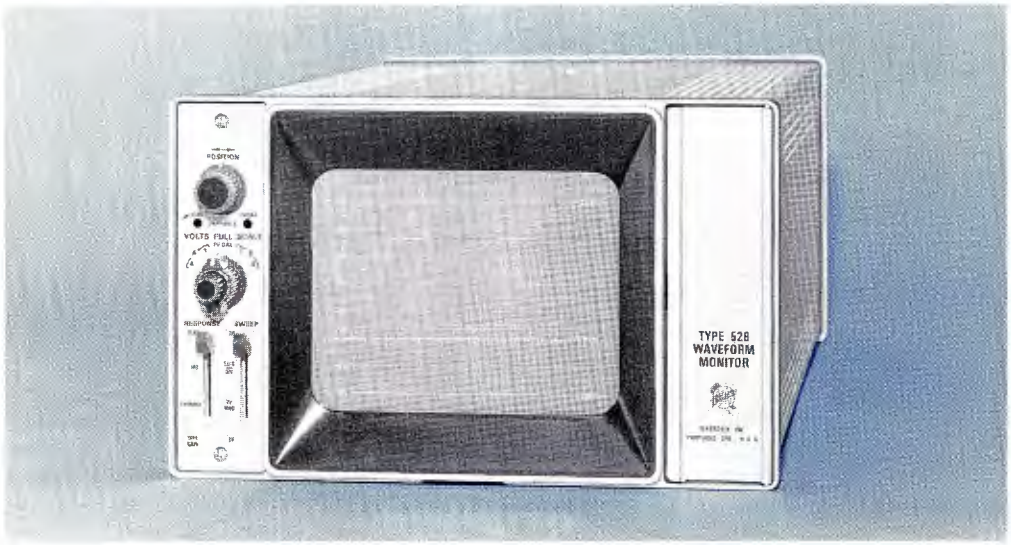
The Single Sideband Chroma Amplitude Corrector is designed for use with a Tektronix Vectorscope in transmitter applications where a vestigial sideband signal is being demodulated with a detecting diode. The corrector provides a ×2 increase in chrominance amplitude and passes luminance components with little or no attenuation. Input impedance is 75 Ω.

FOR USE WITH TYPE 521 VECTORSCOPE
UHF connectors, order 011-0108-00 ..... $27.50
BNC connectors, order 011-0108-01 ..... $27.50

*Registered Trademark Polaroid Corporation

U.S. Sales Prices FOB Beaverton, Oregon

528
Waveform Monitor



- ***LARGE 8 x 10-cm DISPLAY AREA***
- ***1/2 RACK SIZE***
- ***TWO VIDEO INPUTS***
- ***PICTURE MONITOR OUTPUT***
- ***SELECTABLE 1-VOLT AND 4-VOLT FULL SCALE DEFLECTION FACTORS***
- ***YRGB AND RGB INPUTS***
- ***ALL SOLID-STATE—LOW POWER CONSUMPTION***

The solid-state Type 528 Television Waveform Monitor provides bright, easy-to-read video waveform displays on a 5-inch CRT, yet requires only 5-1/4-inch vertical height and 1/2-rack width mounting space. This compact instrument is especially well suited for monitoring signals from camera outputs, video system output lines, transmitter video input lines, closed-circuit TV systems and educational TV systems.

Either of two video inputs, selectable from the front panel, may be displayed. The displayed video signal is also provided at a video output jack for viewing on a picture monitor. Calibrated, 1-volt and 4-volt full scale (140 IRE unit) sensitivities are provided for displaying common video and sync signal levels. A variable sensitivity control permits uncalibrated displays from 0.25-volt to 4.0-volt full scale. The built-in 1-volt calibration signal may be switched on to check vertical sensitivity calibration. Flat, IRE, Chroma, and Diff Gain frequency response positions permit observation of various signal characteristics.

Horizontal Sweep selection provides 2 H (two line), 1 μs/div (expanded two line), 2 V (two field) and 2 V MAG (expanded two field). Displays of RGB and YRGB waveforms from color processing amplifiers are provided for with interconnection through a rear-panel 9-pin receptacle.

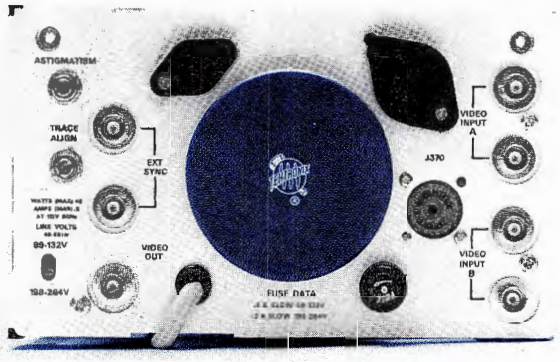
A DC Restorer maintains the back porch at an essentially constant level despite changes in signal amplitude, APL and color burst. May be turned off when not needed.

All solid-state circuitry provides low power consumption, and long-term reliability.

VIDEO FEATURES

INPUTS

Rear-panel BNC connectors provide two unbalanced inputs (A & B) which may be used with either 75-Ω loop-through or bridging connection. Maximum return loss for A and B video inputs, terminated in 75 Ω, operating or non-operating is 46 dB or greater to 5 MHz. Normally AC coupled but may be easily modified by user for DC coupling.



Rear panel of Type 528 Waveform Monitor.

DEFLECTION FACTOR

Calibrated 1-volt and 4-volt (for 140 IRE unit deflection) positions are provided for video inputs A or B with accuracy within 1% for the 1-volt positions and 3% for the 4-volt positions. A variable sensitivity control permits uncalibrated displays from 0.25-volt to 4.0-volt full scale.

FREQUENCY RESPONSE

4 response positions are provided: FLAT—25 Hz to 3.6 MHz within 1% of response at 50 kHz, 3.6 MHz to 5 MHz +1%, —3% of response at 50 kHz, and +1%, —3% of response at 3.58 MHz; IRE—per IEEE Standard IEEE 205. Response at 4.43 MHz attenuated at least 22 dB; CHROMA—30% down between 3.1 MHz and 3.4 MHz, 30% down between 3.8 MHz and 4.1 MHz. Response at 3.58 MHz does not vary between FLAT and CHROMA by more than 1%. DIFF GAIN—same as CHROMA response with additional gain for displaying 100 IRE units of 90 mV to 143 mV subcarrier levels.

DIFFERENTIAL GAIN

1% or less with 10 to 90% APL changes using DIFF GAIN operating mode with modulated staircase signal, baseline adjusted to 50 IRE units position, and signal adjusted to 100 IRE units P-P.

TRANSIENT RESPONSE

1-volt or 4-volt calibrated deflection factor, FLAT response position, using 125-ns HAD $\sin^2$ pulse and bar test signal: preshoot is not more than 1 IRE unit, overshoot not more than 2 IRE units, ringing not more than 2 IRE units and pulse to bar ratio within 0.99:1 to 1.01:1.

LOW FREQUENCY TILT

1% or less tilt on the vertical window or 60 Hz squarewave (DC Restorer off).

MAXIMUM INPUT LEVEL

MAXIMUM DC INPUT

5 volts‡ for all response positions using AC coupling.

MAXIMUM AC INPUT

Flat and IRE response—Signal levels should be limited to produce displays not exceeding 200 IRE units.

CHROMA response—Chroma levels up to 140 IRE units may be displayed, provided the chroma plus luminance level does not exceed 200 IRE units when viewed in the FLAT response mode.

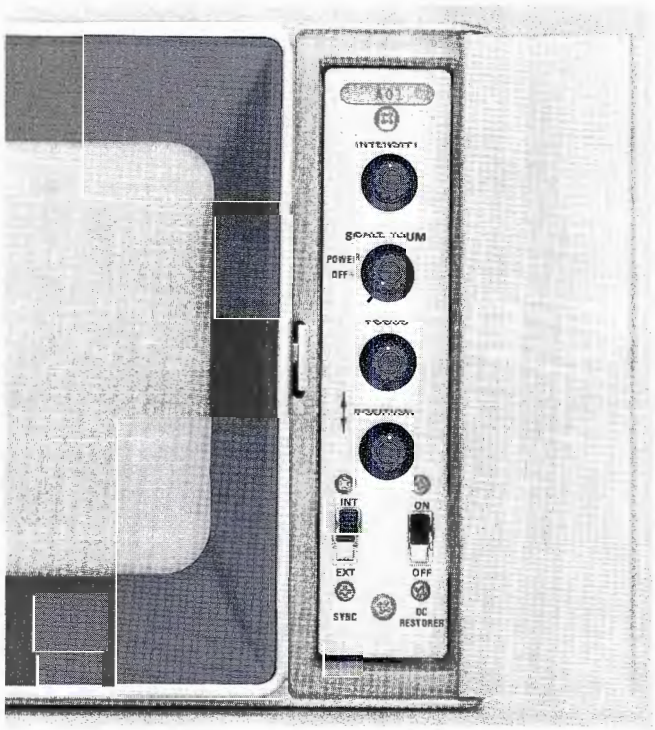
DIFF GAIN—Subcarrier signal levels of 90 mV to 143 mV peak to peak may be expanded, using the variable gain control, to 100 IRE units for measurement of differential gain with 10 to 90% APL.

DC RESTORER

Slow acting back porch DC restoration. Blanking level shift due to presence or absence of burst or changes in APL from 10% to 90% will not exceed 2 IRE units. May be disabled when desired.

VIDEO OUTPUT

The displayed signal is provided at a rear-panel BNC connector. Frequency response is 25 Hz to 5 MHz within 3%. Output signal amplitude is 1 volt within 15% for 140 IRE unit display using the FLAT response mode. DC level is 2 volts‡ or less into 75-Ω load. Nominal output impedance is 75 Ω.



Infrequently used operating controls are conveniently located behind a front-panel hinged door.

‡Exceeds CCIR recommendation 451-2 paragraph 3.2.

TIME BASE FEATURES

SYNCHRONIZATION

Internal or external sync is provided and is selectable by a switch behind the front panel hinged door. Internal sync is derived from composite video input. External sync is via a rear panel BNC loop-through connector and requires 1.5-volts to 4.5-volts composite sync input. The unterminated sync input impedance is approximately 15 kΩ paralleled by approximately 5 pF and maximum input voltage is 20 volts.‡

SWEEP MODES

4 sweep modes are provided: 2-V SWEEP—repetition rate equal to frame rate of applied video or external sync; 2-V MAG SWEEP—expands the vertical blanking interval (approximately 20X magnification of 2 V); 2-H SWEEP—repetition rate equal to half-line rate of applied video or external sync; 1-μs/div SWEEP—calibrated sweep with accuracy within 3% for center 10 div of 12-div sweep, and linearity within 3% throughout horizontal POSITION range, excluding first and last div.

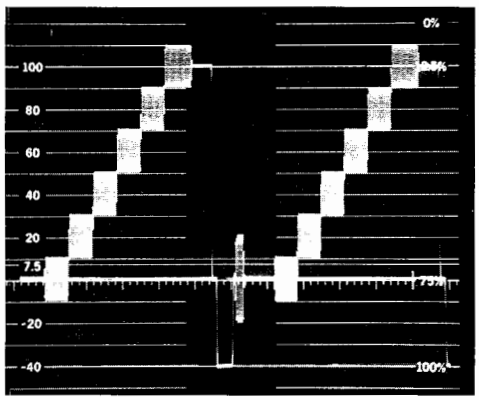


Fig 1. Modulated staircase signal. 2 H SWEEP, FLAT response.

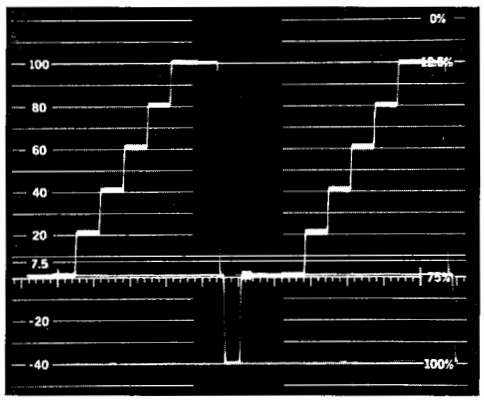


Fig 2. Modulated staircase signal. 2 H SWEEP, IRE response.

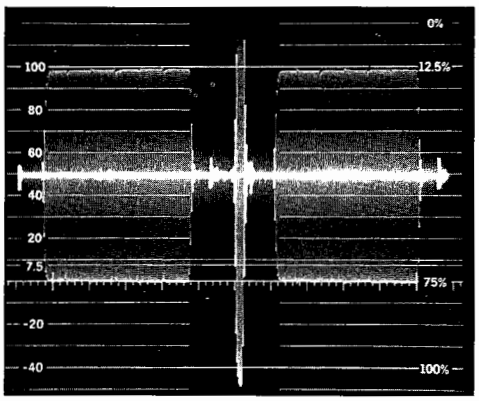


Fig 3. Modulated staircase signal. 2 H SWEEP, DIFF GAIN response.

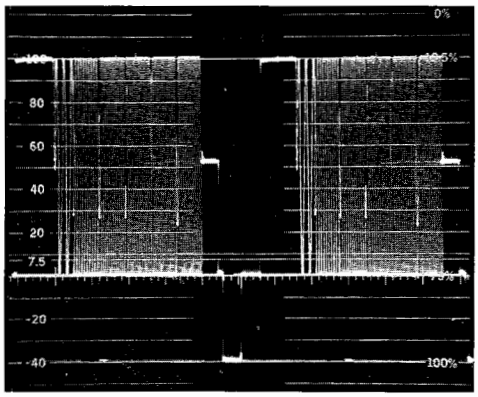


Fig 4. Multiburst signal. 2-H SWEEP, FLAT response.

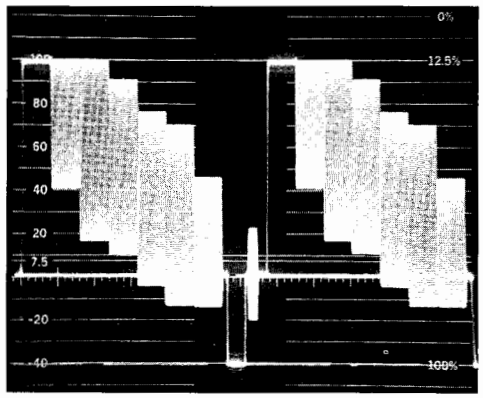


Fig 5. 75% saturated color bar signal. 2-H SWEEP, FLAT response.

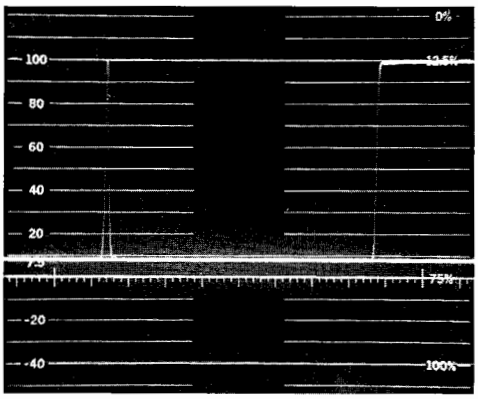


Fig. 6. .125 μs HAD Sin² Pulse and Bar. 1-μs/div calibrated sweep, FLAT response.

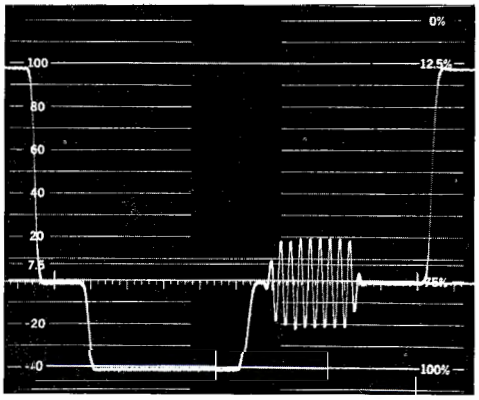


Fig. 7. Horizontal Blanking Interval. 1-μs/div calibrated sweep.

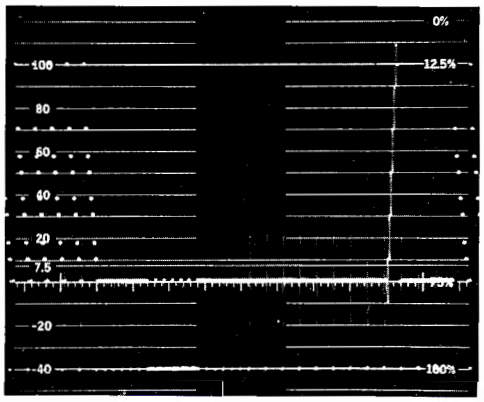


Fig 8. Vertical Blanking Interval. 2-V MAG SWEEP. 20X magnification permits convenient vertical blanking interval observation.

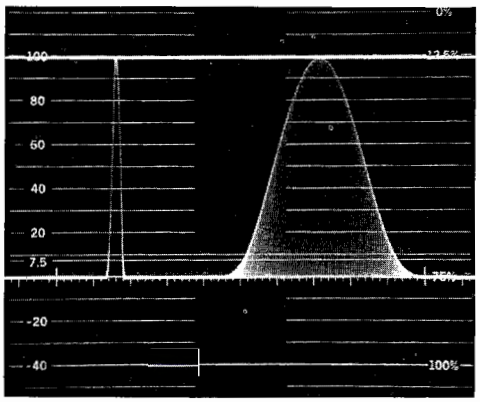


Fig 9. .250 μs HAD Sin² Pulse (left) and Modulated 20 T Sin² Pulse (right) with superimposed Bar Signal (top).

‡Exceeds CCIR recommendation 451-2, paragraph 3.2

YRGB AND RGB DISPLAYS

The Type 528 can be used with color camera processing amplifiers which provide the necessary sequential signal switching and staircase signals. A rear panel 9-pin receptacle provides the necessary interconnections. Factory wired for RGB (3 step) input.

STAIRSTEP AMPLITUDE

A 10-volt amplitude stairstep signal will produce a 9-div display length within 15%.

STAIRSTEP DC LEVEL

Peak AC plus DC signal levels shall not exceed limits of −12 to +12 volts. Maximum AC signal level is 12-volts peak-to-peak.

CONTROL SIGNALS

The RGB or YRGB modes may be initiated through the use of external voltage (12 volts to 15 volts) or ground connection at the rear panel 9-pin receptacle. A 9-pin plug is supplied with the included standard accessories.

OTHER FEATURES

REGULATED POWER SUPPLY

Operates on 99 volts AC to 132 volts AC and 198 volts AC to 264 volts AC, 48 Hz to 66 Hz line frequency. Operates on 115 volts ±10% or 230 volts ±10% at line frequencies from 66 Hz to 440 Hz. POWER CONSUMPTION: approx 48 watts at 115 volts AC, 60 Hz.

TEKTRONIX CATHODE-RAY TUBE

Flat-faced 5-inch rectangular CRT providing an 8 x 10-cm display area. P31 phosphor supplied. External graticule with variable illumination.

CALIBRATOR

An internal calibration signal provides a convenient reference for verifying deflection factor. Amplitude is 1.0 volt within 1%.

AMBIENT TEMPERATURE

Performance characteristics are valid over an ambient temperature range of 0° C to +50° C.

DIMENSIONS AND WEIGHTS

Type 528:	Height	5¼ in	13.3 cm
	Width	8½ in	21.6 cm
	Depth	18½ in	47.0 cm
	Net weight	15 lb	6.8 kg

INCLUDED STANDARD ACCESSORIES

9-pin connector (136-0099-00), connector cover (200-0249-00), instruction manual (070-0800-00).

ORDERING INFORMATION

ORDER TYPE 528 FOR 525-LINE, 30-FRAME TELEVISION STANDARDS

TYPE 528 WAVEFORM MONITOR **$1,000**

TYPE 528 MOD 146B WAVEFORM MONITOR **$975**

As above, but less cover, for mounting in Tektronix rack adapter (016-0115-02).

ORDER TYPE 528 MOD 188G FOR 625-LINE, 25-FRAME TELEVISION STANDARDS, CALIBRATED WITH CCIR SIGNALS WITH CHROMA RESPONSE CENTERED AT 4.43 MHz.

TYPE 528 MOD 188G WAVEFORM MONITOR **$1,000**

TYPE 528 WITH PROTECTIVE CABINET

The Type 528 MOD 147B is a standard Type 528 provided with a protective cabinet for table-top use or portable applications. Cabinet is aluminum construction, blue vinyl finish.

TYPE 528 MOD 147B WAVEFORM MONITOR **$1,030**

OPTIONAL ACCESSORIES

MOUNTING CRADLES

Two different cradle assemblies, with associated bezels and mounting brackets, allow the Type 528 Waveform Monitor to be mounted alongside an 8-inch or 9-inch Conract Picture Monitor, in a standard 19-inch rack.

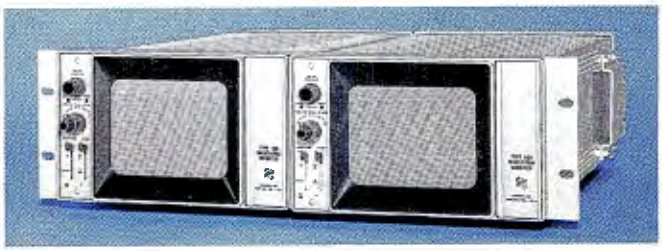
FOR MOUNTING 8-INCH CNB-8 PICTURE MONITOR (REQUIRES 10½-INCHES RACK SPACE)

Description	Part Number	Price
Cradle Assembly	014-0021-00	$35
Bezel and brackets for mounting Type 528 on operator's left	014-0035-00	40
Bezel and brackets for mounting Type 528 on operator's right	014-0036-00	40

FOR MOUNTING 9-INCH RND-9 PICTURE MONITOR (REQUIRES 8¾-INCHES RACK SPACE)

Cradle Assembly	014-0020-00	$35
Bezel and brackets for mounting Type 528 on operator's left	014-0038-00	40
Bezel and brackets for mounting Type 528 on operator's right	014-0037-00	40

TEKTRONIX 14-INCH MONOCHROME AND COLOR PICTURE MONITORS ARE AVAILABLE



RACK ADAPTER

For mounting two Type 528's side-by-side in a standard 19-inch rack. Included are rim clamps which allow fastening or removing of instruments from the front, order 016-0115-02 . . . . . $95.00

PANEL ASSEMBLY

For covering ½ of rack adapter when only one Type 528 is rackmounted, order 016-0116-00 . . . . . $8.00

C-27 CAMERA

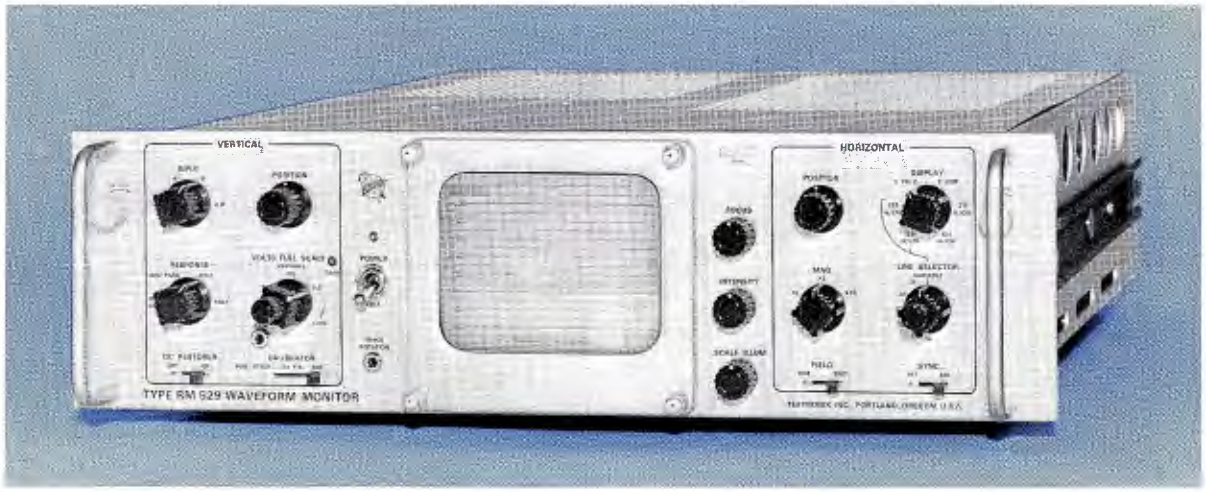
f/1.9, 1:85 lens, Polaroid Land* Pack-Film back, order C-27 . . . . . $460.00

Type 528 to C-27 camera adapter 016-0249-03 . . . . . $16.00

†Registered Trademark Conrac Corporation, Conrac Division
*Registered Trademark Polaroid Corporation

U.S. Sales Prices FOB Beaverton, Oregon

529
Waveform Monitor



- ***LINE SELECTOR***
- ***FLAT TO 8 MHz***
- ***4 FREQUENCY RESPONSES***
- ***POSITIVE FIELD SELECTOR***
- ***COOL—QUIET—CLEAN***
- ***NO FAN—ONLY 80 WATTS***
- ***AVAILABLE FOR USE WITH SEVERAL TV STANDARDS***

The Type 529 and RM529 bring to the Industry a flexibility in waveform monitoring: signal-level monitoring, bandwidth and differential gain measurements, $\sin^2$-pulse and bar testing, monitoring Vertical Interval Test Signals, transmitter percent-of-modulation measurements, YRGB displays (in conjunction with color-processing amplifiers) and others. Included are four video response characteristics, HIGH-PASS, LOW-PASS, IEEE, and FLAT. Both instruments feature FLAT RESPONSE to 8 MHz, assuring excellent waveform fidelity for sine squared testing with 2T, T and $\frac{1}{2}$T pulses.

DC RESTORATION maintains the back porch at an essentially constant level despite changes in signal amplitude, APL, and color burst, and may be turned off for viewing other than video signals. The circuit can easily be modified for sync-tip restoration.

Sensitivity range is 0.12 volts to 1.5 volts for full-scale deflection. Full-scale calibration at 0.714 V or 1.00 V is provided.

BRIGHT WAVEFORM DISPLAYS in line selector operation are obtained with a highly-efficient 5-inch aluminized CRT. The instrument uses the best of both solid-state and vacuum-tube circuitry resulting in improved stability and reliability. These instruments do not require a fan, resulting in cleaner operation and complete freedom from noise.

HORIZONTAL SELECTION provides 2-field or 2-line displays, plus calibrated sweep rates of 0.125 H/cm or 0.25 H/cm. Either calibrated rate may be delayed for line selection. SWEEP MAGNIFICATION extends the sweep rate by X5 or X25, offering calibrated sweep rates from 0.250 H/cm to 0.005 H/cm. POSITIVE FIELD SELECTION assures stable displays in the presence of random noise bursts and video switching. The LINE SELECTOR permits detailed study of any portion of any desired line(s), and a front panel switch selects lines 16 through 21 for viewing VIT signals. A VIDEO-OUTPUT AMPLIFIER supplies video and a brightening pulse to the associated picture monitor, intensifying the same line, or lines, displayed on the instrument when using the LINE SELECTOR.

VIDEO FEATURES

INPUTS
Two unbalanced inputs through rear-panel BNC connectors may be used with either 75-Ω loop-through or bridging connection (input R & C is 1 MΩ and 24 pF). Return loss is greater than 46 dB to 5 MHz using 75-Ω loop-through. Alternatively, one balanced, differential input may be used.

DEFLECTION FACTOR
120 mV to 1.5 V full scale. Continuously variable between ranges. Calibrated full-scale: 1.0, 0.50 and 0.20 V.

FREQUENCY RESPONSE
4 response characteristics provide: FLAT: +0.0 — 1% to 6 MHz; +0.0 — 3% to 8 MHz. IEEE: IEEE Standard IEEE 205. HIGHPASS: 3.58 MHz plus and minus 400 kHz at 15% to 30% down. LOW PASS: At least 80% down at 500 kHz.

DC RESTORER
Keyed back porch* type eliminates drift in DC-coupled vertical amplifier. Does not distort color burst. Waveform will remain on screen if there is a loss of sync pulses for DC restorer keying. DC restorer may be disabled by front-panel switch.

VERTICAL AMPLIFIER
May be DC-coupled to diode demodulator as in % Video Modulation Monitoring. Details are available in manual.

VIDEO OUTPUT
Signal is provided for driving a picture or line monitor with amplitude into 75 ohms approx equal to input signal to 529/RM529.

TIME-BASE FEATURES

CALIBRATED TIME BASE
0.125 H/cm. Magnifier extends calibrated time base to 0.025 H/cm and 0.005 H/cm within 3%. Rep rate is ½ of the TV line rate. The time base can be calibrated using TV signals. Color burst is displayed without phase interlace.

UNCALIBRATED TIME BASE
2 LINE: Triggered time base with rep rate of ⅓ TV line frequency. Provides complete 2-line display with horizontal blanking centered on the screen.

2 FIELD: Synchronized time base with rep rate the same as the TV frame rate. Entire frame of video is displayed with the vertical blanking centered on the screen. Time base will free-run in the absence of signal, indicating loss of incoming signal.

TIME-BASE MAGNIFIER
X5 and X25. Accuracy is within 3%. Magnifier expands the center of the display, convenient for monitoring equalizing or serrated pulses.

*Sync tip restoration available by simple modification.

COLOR CAMERA YRGB DISPLAYS
Can be used with color camera processing amplifiers providing these sequential signals and the staircase signal. To provide YRGB display directly, switching is done in the color processing amplifier. Receptacle to interconnect color processing amplifier (relay control, staircase signal input, and ground) is provided on rear panel.

VIT SELECTOR
Front-panel switch selects lines 16 through 21. Knob position indicates line selected for viewing.

LINE SELECTOR
Variable delay allows any line of either field to be viewed.

FIELD SELECTOR
Positive-acting field selection.

TRIGGER SELECTION
Stable triggering on composite video signals. INTERNAL: 200 mV to 1 V or more, peak to peak. EXTERNAL: 400 mV to 1 V or more, peak to peak.

OTHER FEATURES

REGULATED POWER SUPPLY
Operates on 115 V or 230 V line ± 10% RMS. LINE FREQUENCY: 48-66 Hz. POWER CONSUMPTION: Approx 80 W at 115 V, 60 Hz.

TEKTRONIX CATHODE-RAY TUBE
Flat-faced, 5-inch rectangular CRT, operating at 6.4 kV accelerating potential. Calibrated viewing area, 7 x 10 cm. Electrical beam rotator provides trace alignment. P31 phosphor is normally supplied. External graticule, variable illumination.

CALIBRATOR
Two internal calibration voltages of 0.714 V and 1.00 V on 1-volt full-scale range of VERTICAL GAIN switch. An external calibration signal may be used. Internal calibration pulse amplitude ±1% over ambient temperature range and line-voltage range. Reference is a Zener diode.

VENTILATION
Convection air-cooled. Operating Temperature Range: 0° C to +50° C.

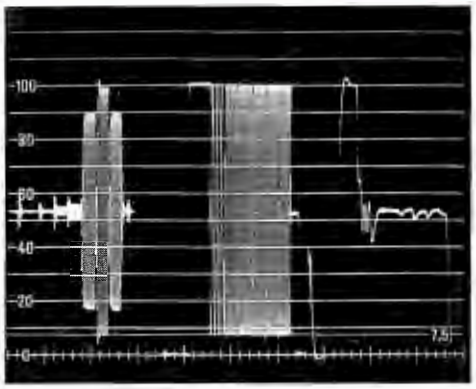
DIMENSIONS AND WEIGHTS

TYPE 529:	Height	8¼ in	21 cm
	Width	8½ in	21.6 cm
	Depth	19½ in	49.7 cm
	Net weight	27 lb	12.2 kg
	Domestic shipping weight	≈34 lb	≈15.5 kg
	Export-packed weight	≈47 lb	≈21.4 kg

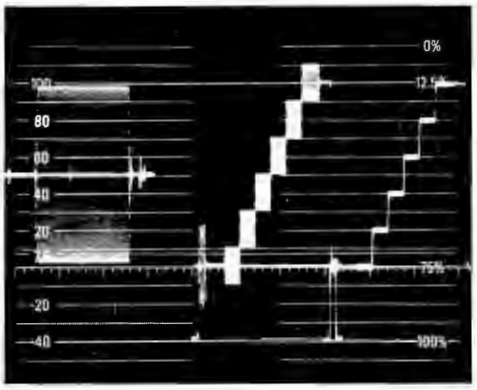
Two Type 529 Waveform Monitors can be mounted side-by-side, or one mounted alongside an associated picture monitor in a standard 19-inch rack or console.

TYPE RM529:	Height	5¼ in	13.3 cm
	Width	19 in	48.2 cm
	Rack depth	18¼ in	46.4 cm
	Net weight	30½ lb	13.9 kg
	Domestic shipping weight	≈59 lb	≈26.8 kg
	Export-packed weight	≈81 lb	≈36.8 kg

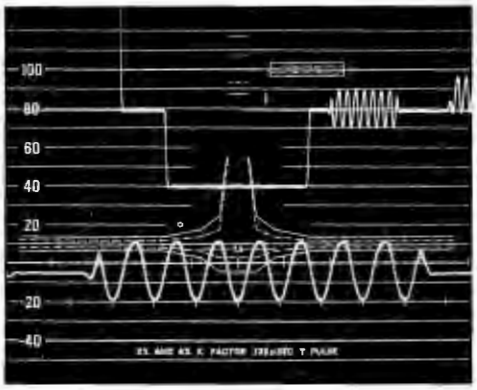
Instrument fits standard 19-inch rack, can be tilted 90°.



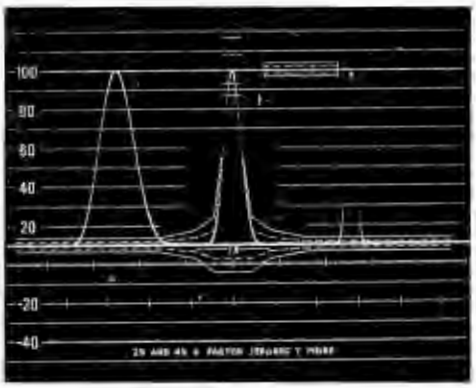
Multiburst Signal. Multiple exposure showing High-pass, Flat, and Low-pass response.



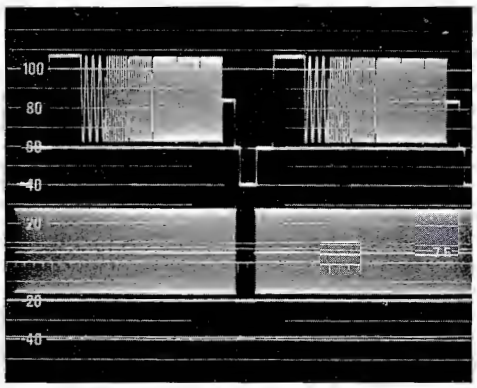
Modulated Staircase Signal. Multiple exposure left to right. High-pass position for measuring differential gain, Flat-response position, IEEE response position.



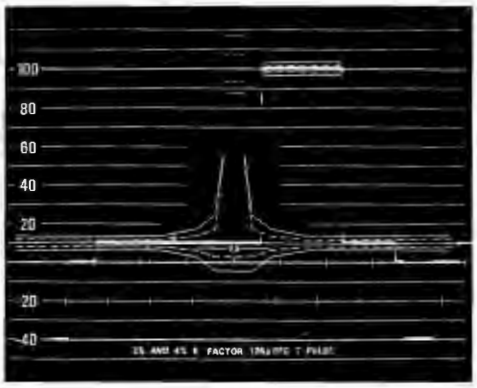
Color-Burst Signal. Double exposure. Top: X5 magnification. Horizontal display: 0.125 H/cm. Bottom: X25 magnification. Horizontal display: 0.125 H/cm.



Multiple exposure. Left: 2T. Center: T. Right: ½ T Sin², 0.25, 0.125, 0.0625 μs HAD.



Double exposure showing complete two-field displays and two-line displays.



Sin² Pulse and Bar Signal. 0.125 μs HAD T-Pulse and Bar.

INCLUDED STANDARD ACCESSORIES

TYPE 529: Smoke-gray light filter (378-0560-00); composite graticule, shown lower center (331-0156-01); noncomposite graticule, shown top left (331-0077-01); dual scale graticule, shown top center (331-0157-00); sin², K factor, and IRE graticule, shown top right, lower left, lower right (331-0161-06); 75-ohm termination resistor (011-0102-00); instruction manual (070-0509-01); graticule light insert (377-0064-00). Type RM529: same as Type 529 but includes four retainer bars (381-0187-00); one pr tracks (351-0040-02); instruction manual (070-0466-01).

TYPE 529 WAVEFORM MONITOR $1400

TYPE 529 MOD 147B WAVEFORM MONITOR $1430

Type 529 installed in a field case.

TYPE RM529 WAVEFORM MONITOR $1475

TYPE 529 MOUNTING CRADLES

Two different cradle assemblies, with associated bezels, allow the Type 529 Waveform Monitor to be mounted alongside an 8-inch or 9-inch Conrac* Picture Monitor, in a standard 19-inch rack. A cradle and bezel are also available for mounting two Type 529's side-by-side.

FOR MOUNTING 8-INCH CNB-8 PICTURE MONITOR (REQUIRES 10½-INCHES RACK SPACE)

Description	Part Number	Price
Cradle Assembly	014-0021-00	$35.00
Bezel, for mounting Type 529 on operator's left	014-0027-00	50.00
Bezel, for mounting Type 529 on operator's right	014-0028-00	50.00

FOR MOUNTING 8-INCH CZB-8 PICTURE MONITOR (REQUIRES 10½-INCHES RACK SPACE)

Description	Part Number	Price
Cradle Assembly	014-0021-00	$35.00
Bezel, for mounting Type 529 on operator's left	014-0025-00	50.00
Bezel, for mounting Type 529 on operator's right	014-0026-00	50.00

FOR MOUNTING 9-INCH RND-9 PICTURE MONITOR (REQUIRES 8¾-INCHES RACK SPACE)

Cradle Assembly	014-0020-00	$35.00
Bezel, for mounting Type 529 on operator's left	014-0023-00	40.00
Bezel, for mounting Type 529 on operator's right	014-0024-00	40.00

FOR MOUNTING TWO TYPE 529 WAVEFORM MONITORS SIDE-BY-SIDE (REQUIRES 8¾-INCHES RACK SPACE)

Cradle Assembly	014-0020-00	$35.00
Bezel	014-0022-00	40.00

RM529 CRADLE ASSEMBLY

For mounting the Type RM529 in a WECO backless rack, order 426-0309-00 ..... $ 9.50

TEKTRONIX 14-inch monochrome and color picture monitors are available.

*Registered Trademark Conrac Corporation, Conrac Division

529
Multi-Standard Waveform Monitor

Type 529 or RM529 MOD 188D

The Type 529 Mod 188D and Type RM529 Mod 188D Waveform Monitors are adapted for use with 405-line 50-Hz field rate, 525-line 60-Hz field, 625-line 50-Hz field, and 819-line 50-Hz field standard television systems. Added Vertical RESPONSE switch positions, added MAGNIFIER steps and VARIABLE control, 5 and 10 μs/cm sweep rates in addition to line and field rates, and a PAL FRAME SELECTOR permit quick setup for use on any of four systems without internal adjustments. Panel marking, color-coordinated with Line/Field indicator light colors, identifies control positions associated with the selected system.

The added PAL FRAME SELECTOR permits normal display from all frames or selection of either frame of the four-field PAL color system cycle.

The Vertical system features selectable DC coupling for Video Input A, and added 1.1 MHz and 4.43 MHz Bandpass positions of the RESPONSE switch. The CALIBRATOR switch has an added 0.70 F.S. position for proper calibration for systems based on a 30-unit (of 100) blanking level. Sweep rates based on line and field intervals are supplemented by fixed 5 μs/cm and 10 μs/cm rates. Extra X10 and X20 MAGNIFIER positions and a VARIABLE MAGNIFIER provide maximum flexibility of adjustment for various test signals.

VERTICAL SYSTEM:

Response Switch: Added positions of 1.1-MHz Bandpass (—18 dB at 0.2 MHz) and 4.43-MHz Bandpass (—3 dB bandwidth ≥800 kHz) at double sensitivity.

Calibrator: 0.70 F.S. position added for CCIR standards.

Input Switch: Added DC-coupled position for Input A.

HORIZONTAL SYSTEM:

Line/Field Rate Selection: 405/50, 525/60, 625/50, 819/50.

Sweep Rates: 2 Field, 2 Line, 1 Line, 5 μs/cm, and 10 μs/cm.

Line Selector Sweep Rates: 1 Line, 5 μs/cm, 10 μs/cm. Discrete line selection provided for 525/60 and 625/50 systems; for 405/50 and 819/50 systems, continuously-variable line selection only.

Accuracy: All sweep rates (except 2 Field, an uncalibrated rate) are accurate within 3% (MAG X1).

Magnifier: X1, X5, X10, X20, X25, plus VARIABLE (±20% from selected step).

Field Switch: Added Even/Odd marking for PAL standards. Positive field selection provided except for CCIR System E (change-of-field only).

Pal Frame Selector: 3-position switch for viewing all frames or selecting alternate frames.

GENERAL:

Line Voltage: +10%, —8% accommodation range at 105, 110, 115, 120, 210, 220, 230, or 240-V center voltage, 48 to 66 Hz. Normally wired and fused for 240 V. Multi-tap transformer can be changed for use with any of the listed nominal line voltages.

Accessories: The following graticules are furnished in addition to the standard 529/RM529 complement: 0-100 unit composite CCIR Video, 30-unit blanking level, PN 331-0184-00. 0-100 unit composite CCIR Video, with $\sin^2$ & K factor ruling for 0.1 μs T and 0.2 μs 2T pulses, 2% and 4% K factor, timing line for 4.43 MHz, PN 331-0185-00 (installed).

TYPE 529 MOD 188D **$1565**

TYPE RM529 MOD 188D (Rackmount) **$1630**

OPTIONAL ACCESSORIES

TYPE 529 FIELD CASE

Provides cabinet protection for the Type 529 when used for applications outside of the rack. Aluminum construction, blue vinyl finish; order 016-0084-00 ..... $35

C-27 CAMERA

f/1.9-1:0.85 lens; Polaroid Land* Pack-Film back, order C-27 ..... $460

Type 529 or RM529 to C-27 Camera Adapter, order 016-0224-00 ..... $16

*Registered Trademark Polaroid Corporation

MESH FILTER

For improving display contrast when viewing under high-ambient light conditions; includes special graticule cover. Order 378-0575-00 ..... $18

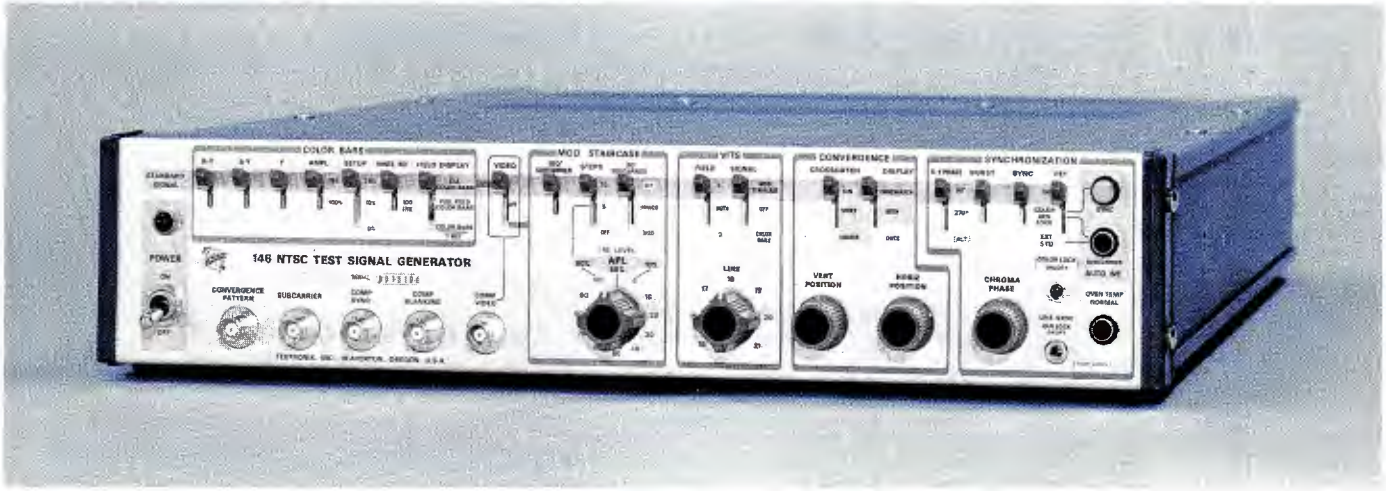
9-PIN CONNECTOR

Used with color processing amplifiers for RBG, etc. displays. Order 134-0049-00 ..... $6

See the catalog accessory pages for additional information on other accessory items not listed.

U.S. Sales Prices FOB Beaverton, Oregon

146
NTSC Signal Generator



- MASTER SYNC GENERATOR AND COLOR STANDARD
  CONFORMS WITH EIA STANDARD RS 170
- GEN-LOCK
  200 ms LOCK-IN
- TIMING JITTER LESS THAN 4 ns
- NTSC ENCODED COLOR BARS
  CONFORMS TO EIA STANDARD RS 189
  FULL-FIELD OR SPLIT-FIELD BARS
  75% OR 100% AMPLITUDE
  7½%, 10%, or 0% SETUP
- MODULATED STAIRCASE
  CONFORMS TO IEEE STANDARD IEEE 206
  VARIABLE APL, 10% to 90%—FIXED
  APL, 50%
  5 OR 10 STEPS
  SUBCARRIER PHASE-LOCKED TO BURST
- CONVERGENCE CROSSHATCH
- VERTICAL INTERVAL TEST SIGNALS
  MODULATED PEDESTAL, STAIRCASE OR COLOR BARS
  LINES 15 THROUGH 21, EITHER OR BOTH FIELDS

The 146 NTSC Signal Generator is a compact, solid-state source of high-quality television test, sync, and color sync burst signals for 525-line, 60-Hz field standard NTSC color TV systems. Combined in one compact unit are the test signals needed to accurately test, evaluate, and adjust laboratory and standard broadcast color video equipment. Each test signal conforms with industry standards, and provides additional refinements to enhance both the accuracy and range of measurements which can be made. The 146 offers a sync generator with a proportional control constant-temperature oscillator that has excellent short term frequency stability.

NTSC COLOR BARS

NTSC color bars are provided. The composition of these signals is in accord with EIA color bar signal specifications RS 189. In addition to basic signal requirements, these 100% saturated color bars are provided in either 75% or 100% amplitude with a choice of 0%, 7 1/2%, or 10% setup. The white bar amplitude may be independently selected at 75% or 100% for 75% amplitude bars. The 100% white bar amplitude level permits a convenient check of relative chrominance/luminance gain by comparing the peak amplitudes of the yellow and cyan, to the white bar. An additional refinement to the full field color bar is a black reference bar following the blue bar.

A new, split-field signal, COLOR BARS/Y REF, provides a picture monitor display and a waveform suitable for detecting the effects of rectified subcarrier on luminance (luminance cross-modulation). Standard color bars and the luminance component only of standard color bars are combined in a split-field, a combination that can clearly reveal the effects of luminance/chrominance time delay.

Luminance and Chrominance Component Amplitude Accuracies
Amplitudes comply with the NTSC signal requirements as defined by the FCC. Absolute amplitudes of luminance signal, setup, and sync are within 1% or 1.5 mV, whichever is greater. Absolute amplitudes of all subcarrier frequency components (chroma and burst) are within 3%. Relative amplitudes of all subcarrier frequency components (chroma and burst) are within 1% or 1.5 mV whichever is greater.

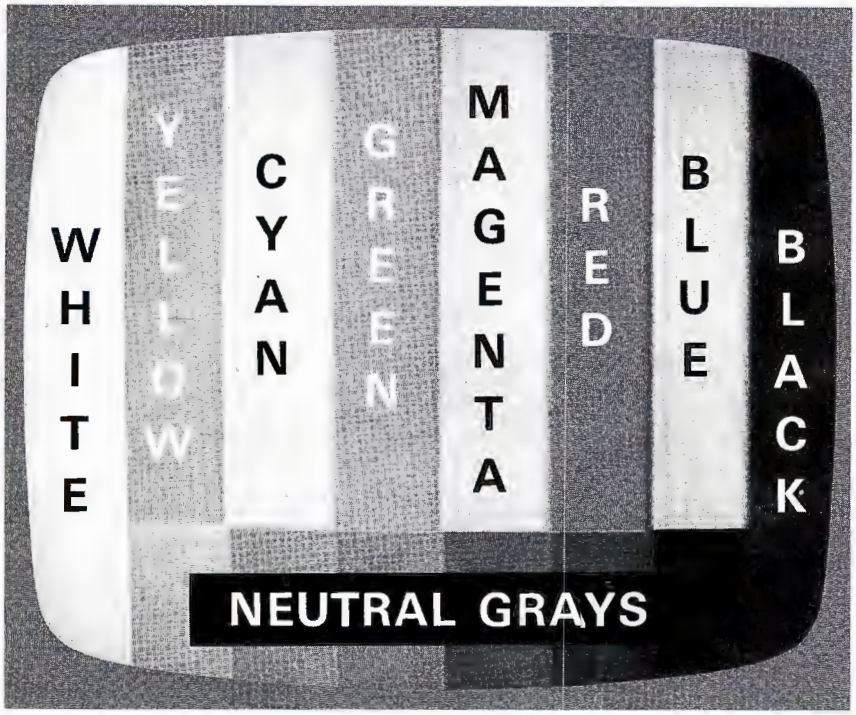


Fig 1. New, split-field signal on color picture monitor. Color bars 100% and 0% saturation. Useful to show gray-scale tracking.

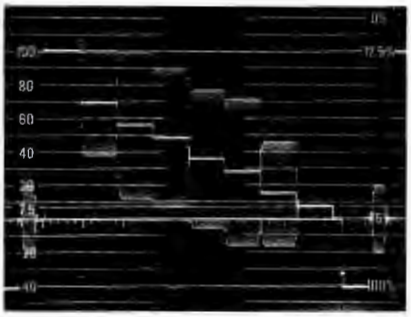


Fig 2. New split field display on waveform monitor. Color bars occupy ¾ field; corresponding luminance signal only completes field. Useful to check picture monitor gray scale rendition.

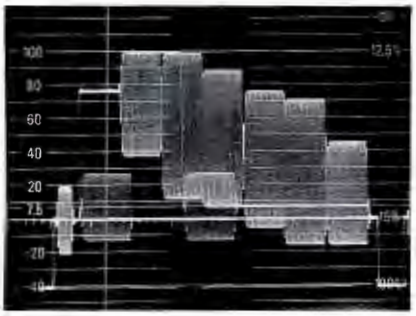


Fig 3. Standard EIA Color Bar Signal defined in RS-189. Setup can be conveniently changed to 10% or 0.

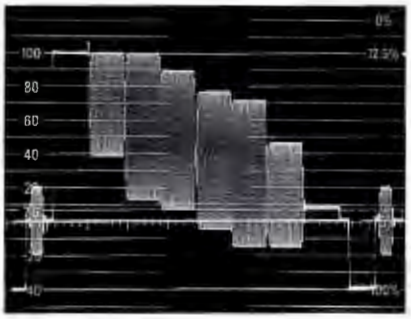


Fig 4. Full field color bars. 75% amplitude with 100% or 75% white bar amplitude.

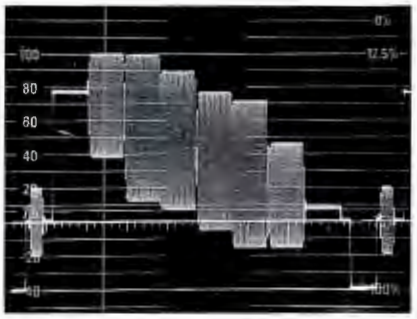


Fig 5. Full field color bars. 75% or 100% selectable. Black bar follows blue bar.

Fig 6. 10-step modulated staircase. Subcarrier is precisely in phase with burst.

Fig 7. 5-step modulated staircase. Subcarrier amplitude may be increased to 40 IRE by internal adjustment.

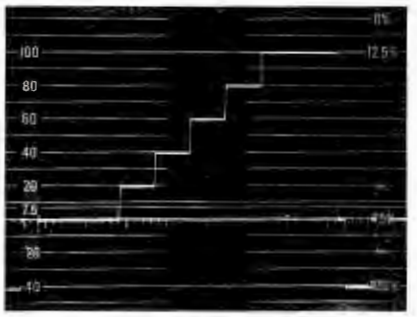


Fig 8. 5-step unmodulated staircase.

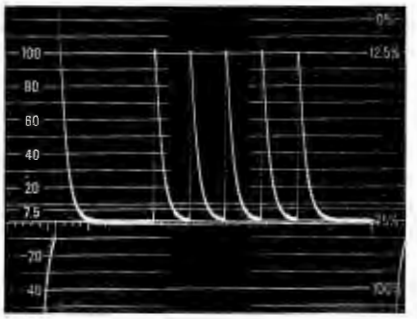


Fig 9. Differentiated 5-step staircase using the Video Staircase Differentiator (015-0075-00) to measure line time nonlinearity. Subcarrier modulation is off.

White Reference— 75% amplitude or 100% amplitude.

Chrominance Envelope Risetime and Falltime— 375 ns within 15%.

Setup— 10%, 7 1/2% or 0%.

Blanking to Peak White Amplitude— 714 mV (independent of setup).

Luminance Risetime and Falltime— 115 ns within 15%.

I and Q Chrominance Signal Width— 9.4 μs on the same lines as black and white references, amplitude of each within 1% of burst amplitude.

MODULATED STAIRCASE

The modulated staircase signal is provided with a selection of APL from 10% to 90% (0 to 100 IRE) in eleven equal levels, or at a fixed APL of 50%.

The staircase luminance component is either 10 equal, 10 IRE Unit; 5 equal, 20 IRE Unit; or OFF selected by front-panel switch. The subcarrier component is phase locked to color burst. The signal is in strict conformity with IEEE 206 and the definition of APL is rigorously observed. Applications include measurements of differential gain and phase, dynamic gain, luminance signal linearity, luminance signal distortion caused by chrominance signal non-linearity, and burst phase errors.

A unique, Tektronix-developed, chroma-step signal provides a means to check luminance signal distortion caused by rectification of the subcarrier signal. When a variable APL mode is selected, subcarrier, phased to lead burst by 90°, may be added to the pedestal lines either as a constant 30-mV signal or amplitude modulated to produce 30-mV, 286-mV (40 IRE), and 572-mV (80 IRE) amplitudes. The amplitude modulated subcarrier is used to determine the effects of subcarrier rectification upon luminance signals at all APL's through the entire TV system. The constant 30-mV subcarrier signal is used to eliminate unnecessary portions of the display when making differential phase measurements. The chroma-step signal is also useful when checking video tape recorders for "chroma banding".

Luminance Component—Peak amplitude with 5 or 10 step, 714 mV within 1%. Each step is 143 mV within 1% in 5 step and 71.5 mV in 10 step. Step risetime is 260 ns within 15% and aberrations are within 2%. Step duration at blanking level and at white level is 13.2 μs within 5%. Intermediate step durations are 6.6 μs within 5%.

Chrominance Component—Amplitude is 143 mV P-P within 3% and in phase with burst.

Differential Phase— 0.1° or less.

Differential Gain— 0.5% or less.

Subcarrier Envelope—Risetime is 375 ns within 15% and duration is 40 μs within 5%. Envelope delay from horizontal sync is 16.1 μs within 5%.

50% Fixed APL—Each active line carries the modulated staircase signal. APL is 50% per IEEE standard, IEEE 206.

Variable APL—Staircase signal is on every 5th line and on the same lines each frame. The variable amplitude pedestal signal is on the remaining 4 out of 5 lines. APL range is 10% to 90% with lines without staircase having eleven selectable pedestal levels from 0 IRE to 100 IRE. 0 IRE position provides 10% APL, 50 IRE position provides 50% APL, and 100 IRE position provides 90% APL.

Subcarrier Component—A three-position switch controls the insertion of subcarrier on the pedestal lines. Pedestal positions are: subcarrier off, unmodulated subcarrier, and modulated subcarrier.

The unmodulated 90° subcarrier provides 30 mV P-P (approx 5 IRE at 90°) during active line time of 52.3 μs.

The modulated 90° subcarrier is the chorma-step test signal. This signal is 30 mV within 5 mV for approx 13 μs, 286 mV (40 IRE) within 3% for approx 20 μs (corresponding to 6-dB amplitude reduction from the amplitude of chrominance on 75% amplitude red and cyan bars), and 572 mV (80 IRE) within 3% for the last 20 μs of the active line time (corresponding to the chrominance amplitude of 75% amplitude red and cyan bars phased at 90°). Incidental phase errors between 30-mV, 286-mV, and 572-mV signals are 0.5° or less.

CONVERGENCE PATTERN

The convergence pattern signal is provided separate and independent from the other test signals. It is useful for measuring picture monitor or camera scanning linearity, aspect ratio, and geometeric distortion. It conforms to IEEE standard 202.

Display Available—White crosshatch, vertical lines only, horizontal lines only, white dots only, and crosshatch plus dots (dots appear centered in the rectangles formed by the crosshatch pattern).

Convergence Pattern Signal Characteristics—The P-P amplitude is 1 V within 5%. Pulse amplitude is 77 IRE. Sync amplitude is 40 IRE. Setup is 7 1/2%.

VERTICAL INTERVAL TEST SIGNALS

The modulated staircase or the color bar can be added on any line from 15 through 21 of either or both fields. The phase of the burst together with all other subcarrier frequency components of the test signal outputs may be varied 360° with respect to an external subcarrier frequency source.

It is possible to test an entire video system during programming, including transmitters, with the 75% amplitude, full-field color bar signal or the modulated staircase signal inserted on line 18 or 19.

SYNC GENERATOR AND COLOR STANDARD

The EIA sync generator circuitry is largely digital, using integrated circuitry for counting functions. The usual frequency multiplier circuits and their attendant problems have been avoided resulting in exceptional time stability. Internal adjustments permit some variation of widths, including burst flag timing. These adjustments are preset to conform to FCC standards.

Color Gen-Lock, External Subcarrier, and Internal Subcarrier can be selected for color standard reference. The 146 NTSC Signal Generator can synchronize the time of occurrence of field, frame, line, and subcarrier from composite video input. Front-panel lamps indicate loss of gen-lock H sync and/or subcarrier due to excessive noise and/or low amplitude.

The color standard has a proportional control oven for the quartz crystal and the entire oscillator circuit. The frequency stability achieved is well within FCC specifications. A front-panel lamp indicates proper operation of the oven. When the

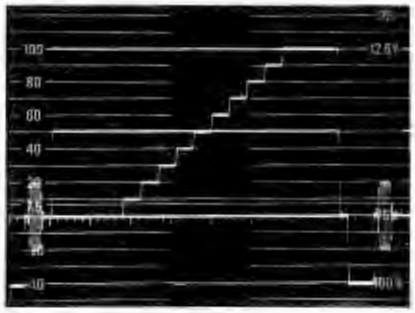


Fig 10. 10-step unmodulated staircase with 10%, 50%, and 90% APL (triple exposure).

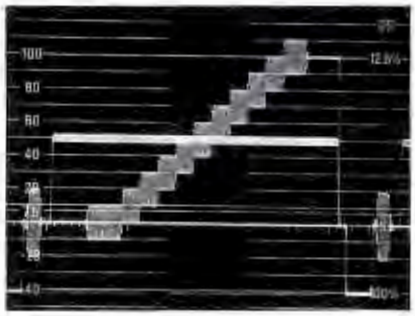


Fig 11. 10-step modulated staircase with APL pedestal at 50 IRE. Pedestal carries unmodulated (5 IRE) subcarrier at 90°. Subcarrier component provides phase markers when measuring differential phase, ±12° for 20 IRE modulation.

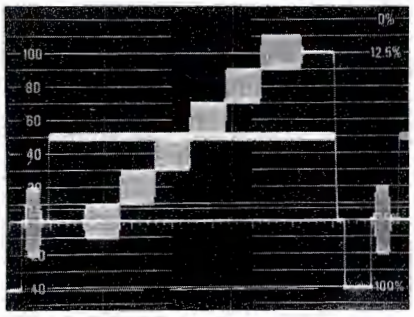


Fig 12. 5-step modulated staircase with APL pedestal at 50 IRE. Subcarrier component on pedestal provides phase markers when measuring differential phase, ±12° for 20 IRE modulation.

Fig. 13. Using a 146, 144, or 140 as a signal source, 90° unmodulated subcarrier on APL pedestal lines provides 12° phase markers in measuring phase difference. Using 40 IRE subcarrier on staircase, phase markers are ±6°. While this method is only approximate, it proves highly useful.

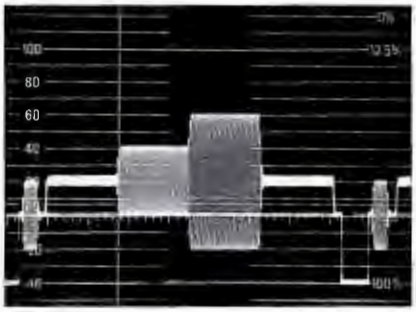


Fig 14. Modulated 90° subcarrier test signal, luminance of 20 IRE shown, variable 0 to 100 IRE in 11 equal steps.

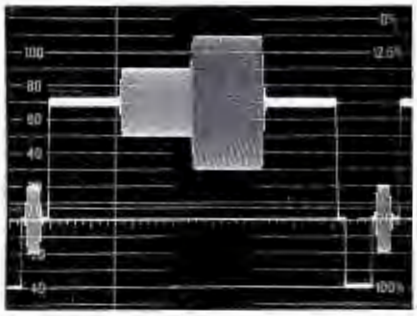


Fig 15. Modulated 90° subcarrier test signal at 70 IRE luminance level. Available as full field or as a VIT signal.

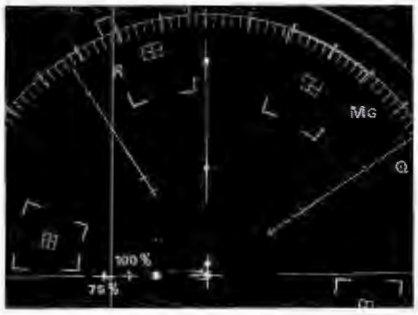


Fig 16. A portion of vectorscope display of 90° modulated subcarrier, 5, 40, 80 IRE. Color sync burst 40 IRE. Staircase subcarrier 20 IRE in phase with color sync burst.

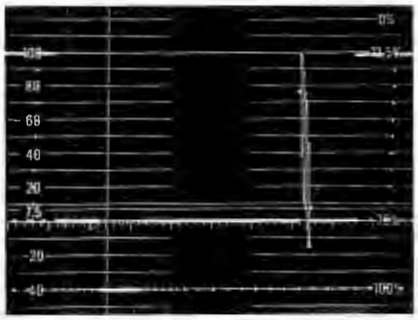


Fig 17. Vertical interval test signal. Color bars or staircase signal may be added to program signals. VITS is inhibited if gen-lock failure should occur, providing fail-safe operation.

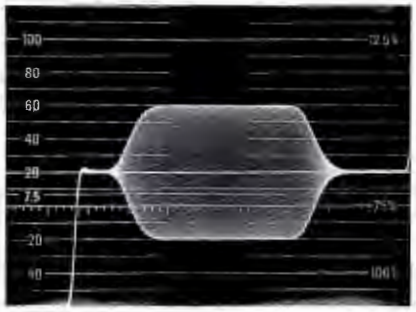


Fig 18. Color sync burst displayed in temporary unlock mode at 0.5 μs/cm to facilitate breezeway measurement. Burst width is measured between half-amplitude points.

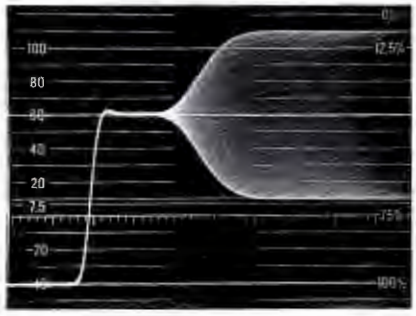


Fig 19. Burst breezeway color lock temporarily unlocked to facilitate breezeway measurement. Sweep speed is 0.25 μs/cm.

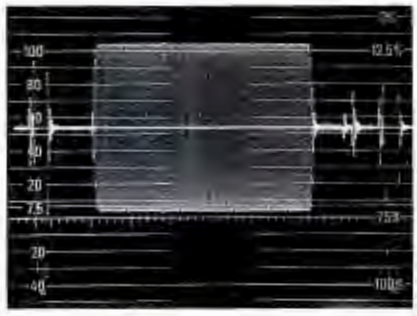


Fig 20. Differential gain measurement on waveform monitor using 10-step staircase. Note absence of luminance transients.

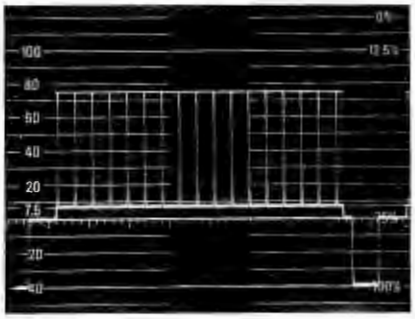


Fig. 21. Convergence pattern signal. Picture level is 77 IRE with 7½% setup. Pattern is electronically positionable in both axes.

internal color standard is used, the phase of the color subcarrier output is variable over a 360° range with respect to the phase of the burst contained in the video output. When an external color standard is used the phase of the burst (and all other subcarrier frequency components of the test signal outputs) may be varied 360° with respect to the external subcarrier source.

Phase-lock between the color subcarrier and the master sync clock can be interrupted by front-panel push button. The subcarrier frequency remains within specifications, but chroma appears as an "envelope" because of phase-lock interruption. This envelope facilitates measuring chroma to luminance delay and other measurements.

Subcarrier—Frequency is 3.579545 MHz within 5 Hz. Outputs are provided on the front and rear panels. Output impedance is 75 Ω within 5%. Isolation is at least 30 dB. Output level is 2 V P-P within 0.2 V into 75 Ω. Input requires 1 V to 4 V. Return loss is at least 46 dB at 3.58 MHz.

GEN-LOCK

Input—Can be composite video or black burst, sync negative.

Input Level Range— 0.5 V to 3 V (1 V nominal).

Input Return Loss— 46 dB to 5 MHz when terminated in 75 Ω.

Phase Accuracy—Within 1° input burst variations + or —10 Hz of 3.579545 MHz.

Within 5° with ambient temperature variation from 0°C to 50°C; within 1° for any 10°C variation within 0° to 50°. Burst must be 3.579545 MHz within 1 Hz and oven temperature normal.

Within 1° with input signal + or —3 dB from 1 V. Within 3° with burst/sync ratio variation —6 dB to +10 dB. Burst must be 3.579545 within 1 Hz, ambient temperature 20°C and oven temperature normal. Dynamic burst phase stability is within 0.1° with APL variation 10% to 90%; within 1° with —24 dB white noise.

Delay Range—Adjustable between 3 μs before input sync to 1 μs after. Delay is stable within 70 ns. Factory-set to coincidence.

Pull-In Time— 200 ms maximum.

Field/Frame Sync—Direct acting within one field.

COMPOSITE SYNC OUTPUT

Independent, front- and rear-panel outputs are provided with the two outputs isolated by at least 40 dB.

Output Level— 4 V within 0.2 V.

Return Loss—At least 30 dB to 5 MHz.

Risetime— 115 ns within 10%.

INPUT*

Required Amplitude— 2 V to 8 V, negative-going.

Return Loss—At least 46 dB using loop-through input on rear panel.

COMPOSITE BLANKING

Independent, front- and rear-panel outputs are provided with the two outputs isolated by at least 40 dB.

Output Level— 4 V within 0.2 V.

Risetime— 115 ns.

Return Loss—At least 30 dB.

*Inputs are optional and only required for synchronizing with another NTSC sync generator.

VERTICAL DRIVE

One rear-panel output provides 4 V within 0.2 V.

Risetime— 115 ns.

Return Loss— At least 30 dB.

HORIZONTAL DRIVE

One rear-panel output provides 4 V within 0.2 V.

Risetime— 115 ns.

Return Loss—At least 30 dB.

BURST FLAG

One rear-panel output provides 4 V within 0.2 V.

HORIZONTAL BLANKING

11.1 μs (digitally determined from 3.579545 MHz).

VERTICAL BLANKING

21 lines (digitally determined from 3.579545 MHz).

COMPOSITE VIDEO OUTPUT

Composite video consists of composite sync and video test signals as selected by front-panel controls. Independent front- and rear-panel outputs are provided with the two inputs isolated by at least 40 dB.

Output Level— 1 V P-P.

Return Loss— 30 dB from DC to 5 MHz.

OTHER CHARACTERISTICS

Power Requirements— 90 to 136 VAC or 180 to 272 VAC, 48 Hz to 66 Hz, 55 watts maximum at 115 VAC and 60 Hz. Rear-panel selector provides rapid accommodation for 6 line-voltage ranges.

Ambient Temperature—Performance characteristics are valid over an ambient temperature range of 0° to +50°C (except as noted).

Dimensions and Weights

	146		R146	
	in	cm	in	cm
Height	3 1/2	8.9	3 1/2	8.9
Width	16 3/4	42.6	19	48.3
Depth	18 1/2	47.1	18 1/2	47.1
	lb	kg	lb	kg
Net weight	17 3/4	8.0	18 1/2	8.4
Domestic shipping weight	≈34	≈15.4	≈35	≈15.9
Export-packed weight	≈54	≈24.4	≈55	≈25

INCLUDED STANDARD ACCESSORIES

75-Ω, through-line termination (011-0103-02); 3-conductor power cord (161-0036-00); instruction manual (070-1111-00).

R146 also includes rackmounting hardware.

146 NTSC TEST SIGNAL GENERATOR **$2,500**

R146 NTSC TEST SIGNAL GENERATOR (rackmount) **$2,500**

U.S. Sales Price FOB Beaverton, Oregon

144
NTSC Signal Generator

NEW

The 144 NTSC Signal Generator is a compact, solid-state source of high-quality color television test, sync, and burst signals for 525-line, 60-Hz field, cable, and broadcast TV systems. Combined in one compact unit are the signals needed to accurately test, evaluate, and adjust CATV, laboratory, and standard broadcast color video equipment.

The 144 is similar to the 146 NTSC Signal Generator with a Composite Color Test Pattern Signal Generator in place of Gen-Lock. For Gen-Lock applications, the 146 will be required. The 144 has an —I, W, Q, B signal in place of the Color Bar/Y REF split-field signal of the 146.

The 144 provides: NTSC encoded color bars (full-field or split-field), modulated staircase, convergence crosshatch or a composite color test pattern designed for use in CATV systems. The composite test pattern combines, in both fields, convergence, color bars, luminance only, and an insert area for displaying two external video inputs. The uses for this pattern are almost limitless. By locating the gray scale above the color bars, registry of the chrominance luminance signals can be easily checked. Luminance cross-modulation is also easily detected on picture monitors by comparing the brightness of the yellow color bar with the light gray directly above it, when the chrominance control is set to lowest possible gain. The lower insert area does not normally carry test signals. It is intended for message service: time and temperature, local news or commercial mesages, stock market ticker tape displays, etc. The crosshatch lines and/or dots are available for picture monitor linearity evaluation and convergence adjustment. Vertical interval test signals are provided by the 144.

The 144 can be used as the master sync generator for local program origination. The self-contained sync generator includes a temperature-controlled color standard with excellent frequency stability.

The 144 is available in rackmount (R144) and cabinet (144) styles.

COMPOSITE COLOR TEST PATTERN

This operating mode provides a convergence pattern (crosshatch lines and/or dots) with two inserts areas. Each insert is digitally controlled from the sync generator. The user may select the lines to be included in each insert area by proper placement of insulated color-coded jumpers within the instrument.

The first insert consists of either the staircase test signal or color bar signal. When the color bar is selected, the luminance portion of the color bars, is located directly above the first insert. The second insert can be controlled by the operator in the same manner as the first. Generally, the second insert will be below the center of the screen, as the center should carry the convergence pattern to permit proper converging of color receivers. This insert does not normally carry test signals since it is intended for message service.

Two video inputs are provided at the rear panel. Video input signals may be derived from TV cameras which are driven by the sync generator in the 144. A horizontal wipe control provides for smooth transition between the two signals, or allows them to be displayed simultaneously, sharing the selected insert area.

External Video Input—Two AC-coupled, 75-Ω, loop-through input connections are provided on the rear panel. Input requires 1.0 V P-P of composite video or 0.714 V P-P of non-composite video. Return loss is at least 30 dB to 5 MHz. External sync is stripped and sync from the 144 is inserted.

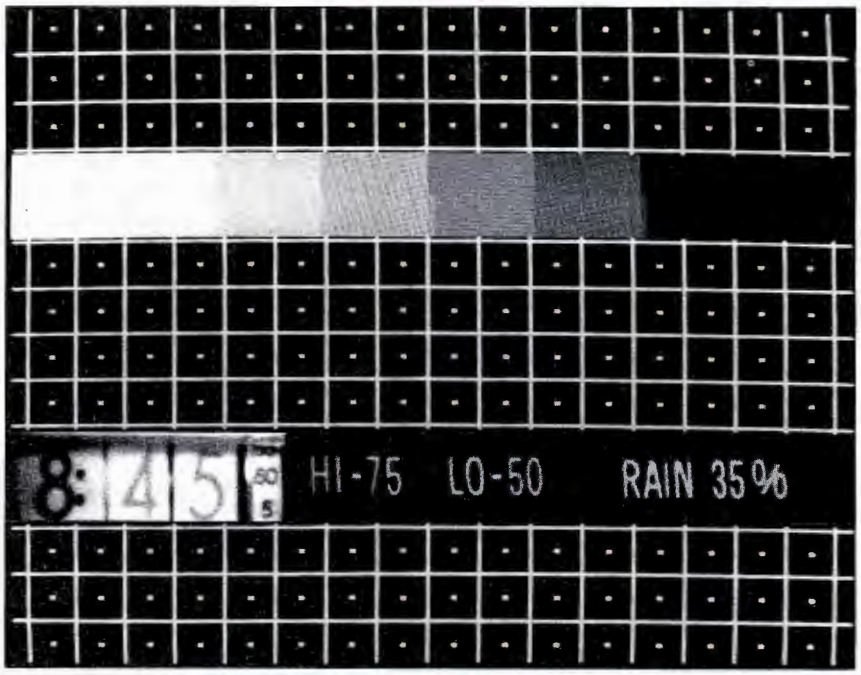
Composite Video Ouput—Composite video consists of composite sync and video test signals as selected by front-panel controls. Independent front- and rear-panel outputs are provided with the two inputs isolated by at least 40 dB. Output level is 140 IRE units with the exception of the crosshatch lines and dots which are set for 75 IRE units.

NEW

144
NTSC Signal Generator

COMPOSITE COLOR TEST PATTERN

Convergence pattern with full color bars and color bar luminance in upper insert and two video inputs displayed in lower insert.



Power Requirements— 90 to 136 VAC or 180 to 272 VAC, 48 Hz to 66 Hz, 55 watts maximum at 115 VAC and 60 Hz. Rear-panel selector provides rapid accommodation for 6 line-voltage ranges.

Ambient Temperature—Performance characteristics are valid over an ambient temperature range of 0°C to +50°C (except as noted).

INCLUDED STANDARD ACCESSORIES

Two 75-Ω, through-line terminations (011-0103-02); set of insulated jumpers, assorted colors (013-0117-00); power cord (161-0036-00); instruction manual (070-1084-00).
R144 also includes rackmounting hardware.

Dimensions and Weights	144		R144	
	in	cm	in	cm
Height	3 1/2	8.9	3 1/2	8.9
Width	16 3/4	42.6	19	48.3
Depth	18 1/2	47.1	18 1/2	47.1
	lb	kg	lb	kg
Net weight	17 3/4	8.0	18 1/2	8.4
Domestic shipping weight	≈34	≈15.4	≈35	≈15.9
Export-packed weight	≈54	≈24.4	≈55	≈25.0

144 NTSC TEST SIGNAL GENERATOR **$2500**
R144 NTSC TEST SIGNAL GENERATOR (rackmount) **$2500**

140 NTSC Signal Generator

The 140 NTSC Signal Generator is substantially similar to the 146 NTSC Signal Generator. The 140 has minor control differences in the color bar and modulated staircase sections. Applications for Color Gen-Lock will require use of the 146. CATV applications for Composite Color Test Pattern will require use of the 144.

The 140 has a —I, W, Q, B signal in place of the Color Bar/Y REF split-field signal of the 146.

Power Requirements— 90 to 136 VAC or 180 to 272 VAC, 48 Hz to 66 Hz, 55 watts maximum at 115 VAC and 60 Hz. Rear-panel selector provides rapid accommodation for 6 line-voltage ranges.

Ambient Temperature—Performance characteristics are valid over an ambient temperature range of 0°C to +50°C (except as noted).

Dimensions and Weights	140		R140	
	in	cm	in	cm
Height	3 1/2	8.9	3 1/2	8.9
Width	16 3/4	42.6	19	48.3
Depth	18 1/2	47.1	18 1/2	47.1
	lb	kg	lb	kg
Net weight	17 3/4	8.0	18 1/2	8.4
Domestic shipping weight	≈34	≈15.4	≈35	≈15.9
Export-packed weight	≈54	≈24.4	≈55	≈25.0

INCLUDED STANDARD ACCESSORIES

75-Ω, through-line termination (011-0103-02); power cord (161-0036-00); instruction manual (070-0944-00).
R140 also includes rackmounting hardware.

140 NTSC TEST SIGNAL GENERATOR **$2150**
R140 NTSC TEST SIGNAL GENERATOR (rackmount) **$2150**

U.S. Sales Prices FOB Beaverton, Oregon

147 NTSC Signal Generator

NEW

- VERTICAL INTERVAL REFERENCE SIGNAL
- VERTICAL INTERVAL TEST SIGNALS
- FULL FIELD TEST SIGNALS
- SAFE, IN-SERVICE VITS INSERTION
- NOISE MEASUREMENT
- APL BOUNCE SIGNAL
- SIMPLE SIGNAL MODIFICATION

The 147 is a NTSC television signal generator that supplies all the test signals commonly used for test and measurement of video transmission systems. The signals generated are available as full field composite-video test signals and as Vertical Interval Test Signals (VITS) inserted into the vertical blanking interval of an incoming composite video signal.

In-service test signal timing information is derived from the incoming composite video signal. There are extensive provisions within the instrument to modify the parameters of the test signals and their time location within the vertical blanking interval. This flexibility is provided through the use of easily-changeable pin connectors. All time locations of test signals as to position within the line and field are derived by digital counting from a master clock which in turn is gen-locked to the incoming synchronizing pulses; however, in the absence of incoming composite video (or sync), the 147 will operate in the full field test signal mode, deriving timing information from its own internal oscillator (clock).

VERTICAL INTERVAL INSERTION/DELETION and PROGRAM CONTROL

When, and only when, the 147 is gen-locked to a program signal, it can delete and insert selected VITS as determined by internal programming. As a VITS deleter/inserter function involves active circuit elements in the program line within the 147, fail-safe means are provided in the event of a malfunction within the instrument, loss of sync, or power. In addition to the automatic fail-safe protection, remote-control manual override capability is also provided.

A preview function allows observation of exactly what lines will be deleted and exactly what signals and levels will be inserted on the program signal before anything is done to the program signal itself. The preview/program function can be remotely controlled.

Changes in the time location of VIT signals are readily made by removing and/or moving color-coded jumpers within the 147. Any signal may be eliminated or moved. The front panel provides a means of indicating the actual VITS and their line and field location. Externally generated VITS may be added to the program line if desired.

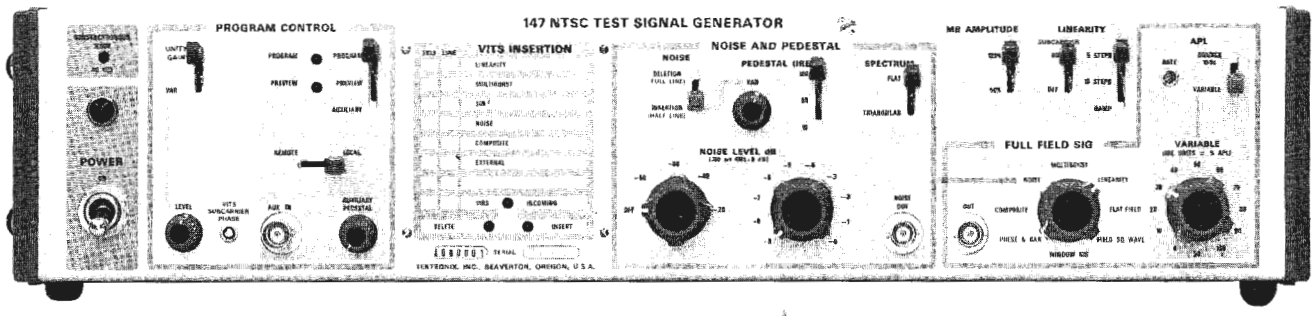
PROGRAM CONTROL FEATURES

Nonsynchronous Operation—Warning Light indicates absence of incoming synchronizing information without which VITS deletion or insertion is automatically discontinued.

Program Level—Switch selects whether a preset gain, normally adjusted for unity gain between program input and program output, is used or whether a front panel level adjustment is available to normalize incoming signal to provide 1 volt at the program output.

Local-Remote Control of Program or Preview—Switch shifts control of program or preview modes from front panel (local) to a remote position, controllable by connection of a remote switching circuit to a rear panel connector. When operating under local or remote control, a light indicates preview or program status, since the switch position may not indicate the actual operating mode.

Program-Preview-Auxiliary—This switch selects one of three modes: Program—VITS inserted on program line output



according to internal selection of test signals and their time address. Preview—VITS inserted only on program as viewed on the preview monitor output; used for verification prior to impressing these signals on program output. Auxiliary—Permits the use of a non-composite video signal at the auxiliary input (such as a sweep generator). This signal then appears at the preview monitor output connector with composite blanking and with sync added. This mode is not available by remote control.

Auxiliary Pedestal—This control provides a DC offset so that the auxiliary signal excursion may be positioned between the black and white limits of the resulting composite video signal.

VITS Subcarrier Phase—This control adjusts phase of color subcarrier on internally generated signals to be correct in relation to the phase of incoming burst.

VIRS Incoming Indicator—Light indicates the presence of a Vertical Interval Reference Signal on incoming composite video. In this case, the generation of an internal VIRS is inhibited (inhibition may be disabled internally). Incoming VIRS can be observed on a suitable waveform monitor* connected to the preview monitor output while internally-generated VIRS are added to the opposite field. Such displays easily detect small errors in the incoming VIRS.

PROGRAM CONTROL SYSTEM SPECIFICATIONS

Input Level—Adjusted to Unity Gain.

Variable Input Level— ±30%.

Input Return Loss—Less than 46 dB to 5 MHz.

Output DC Level—Less than 50 mV (no signal).

Isolation between Program and Program Monitor Outputs—Greater than 34 dB.

Inserted Signal Level— 714 mV (100 IRE) ±1% with 100 IRE reference from APL generator.

Frequency Response, Program and Preview Channels—±1%, 50 kHz to 5 MHz; +1%, −5%, 5 MHz to 8 MHz.

2 T Pulse to Bar Ratio— 100% ±0.5%.

Field Rate Squarewave Tilt—Less than 0.5%.

Line Tilt—Less than 0.5%.

Differential Phase at any APL, Standard Input—Program output less than 0.15°. Preview output less than 0.15°.

Differential Gain at any APL, Standard Input—Program output less than 0.2%. Preview output less than 0.4%.

Line Time Amplitude Non-Linearity—Less than 0.5%.

Random Noise Output Program Channel—Less than −75 dB RMS.

*529 with −25 V lead disconnected from the field selector switch to disable field selection.

Residual Subcarrier on Non-Inserted Lines—Less than −60 dB P-P.

Hum, Transients on Non-Inserted Lines—Less than −60 dB.

Spurious Signals During Blanking Time—Less than −40 dB.

Signal Attenuation in "Delete" Mode— 2 T pulse greater than −70 dB; subcarrier (color bars) greater than −60 dB.

Crosstalk into Program Channel from Internal Signals—2 T pulse less than −70 dB, subcarrier (color bars) −60 dB.

Unwanted Pedestal at Time of VIT Insertion—Program and Preview Channel: Less than ±0.5 IRE.

Line Timing Adjustment Range with External Sync—±3 μs.

Jitter—Less than 5 ns.

VERTICAL INTERVAL REFERENCE SIGNAL

The proposed VIR Signal is generated by the 147 and can be inserted on line 20 of either or both fields. Standard operational practices regarding the proposed VIR signal have not yet been worked out. Therefore the 147 has been designed to be programmable for a number of possible operating modes which in turn depend upon the presence or absence of a VIR signal on the incoming program line.

Indicator lamps indicate the presence of an incoming VIR signal, whether an incoming VIR is being deleted and whether a local VIR is being inserted. Remote control of the VIR signal functions is also available, with the indicators showing the actual operating mode. In the absence of burst, no VIR signal will be inserted.

MULTIBURST SIGNAL

Multiburst is generated by a function generator controlled by the digital programmer. The function generator approach eliminates the need for individual start-stop oscillators for each burst and individual amplitude and AC axis adjustments for each burst. Thus each burst start time is completely stable and each burst consists of an exact integer number of cycles, regardless of the frequency. Each burst starts at 0° of the first cycle and ends at 360° of the last cycle. Location of the white flag may be programmed with relation to the bursts as a means of source identification.

White Reference Amplitude—100 IRE ±1 IRE

Burst Amplitude—Full amplitude: 90 IRE plus 10 IRE setup or 100 IRE plus no setup. Half amplitude: 45 IRE plus 10 IRE setup or 50 IRE plus no setup.

Average Burst Level— 55 ±0.5 IRE with 10% setup; 55 IRE ±0.5 IRE with no setup.

Burst Frequencies— 0.5, 1.5, 2.0, 3.0, 3.6 and 4.2 MHz within 3%. Each independently adjustable.

Timing—Each burst starts at 0° of the first cycle and ends at 360° of the last cycle.

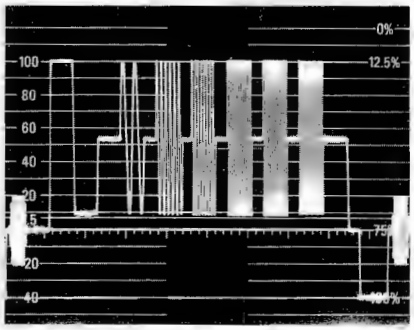


Fig 1. Full Amplitude Multiburst with white and black flags.

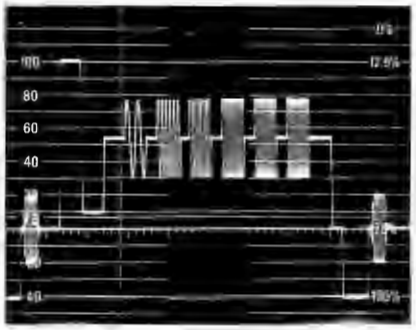


Fig 2. 50% Amplitude Multiburst for use where 100% tests are invalidated by non-linear distortions; e.g., transmitters.

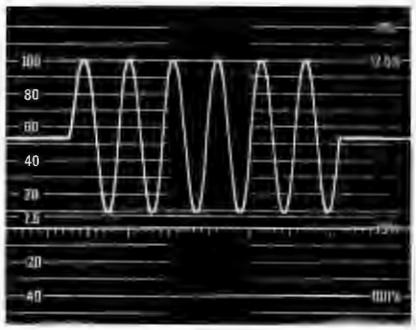


Fig 3. Digital programming produces jitter-free, whole number of cycles for each burst.

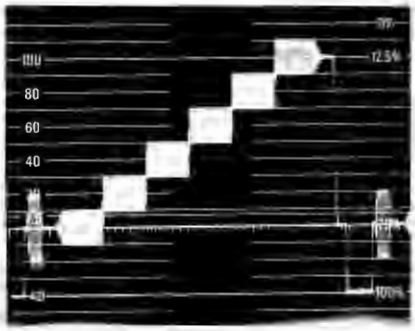


Fig 4. Linearity Test Signal 5 step, 20 IRE subcarrier at burst phase.

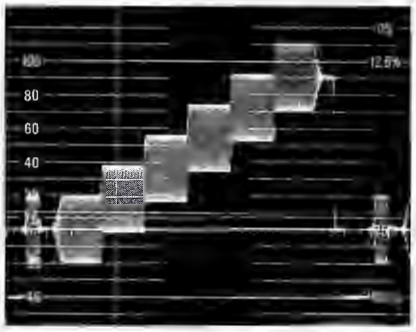


Fig 5. Linearity Test Signal 5 step with 40 IRE subcarrier 0 to 90 IRE steps.

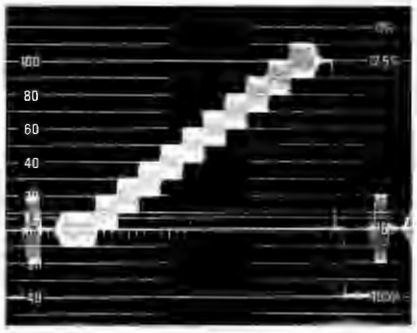


Fig 6. Linearity Test Signal 10 step with 20 IRE subcarrier at burst phase.

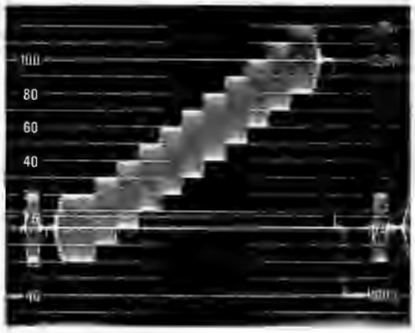


Fig 7. Linearity Test Signal 10 step with 40 IRE subcarrier 0 to 100 IRE steps.

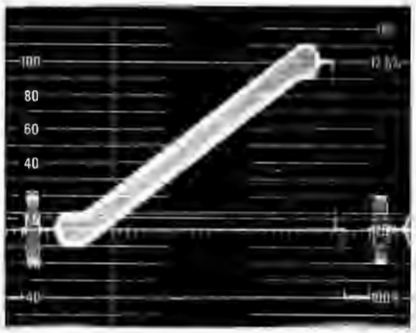


Fig 8. Linearity Test Signal Ramp 0 to 100 IRE with 20 IRE subcarrier in phase with burst.

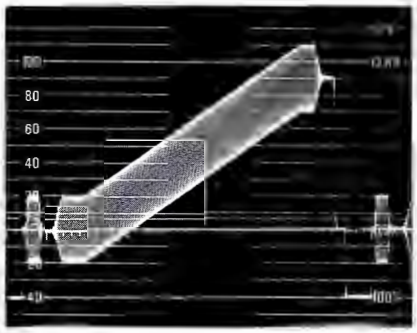


Fig 9. Linearity Test Signal Ramp 0 to 90 IRE with 40 IRE subcarrier in phase with burst.

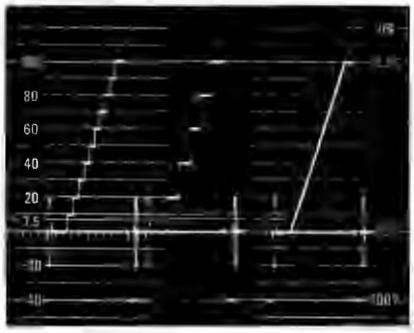


Fig 10. Triple exposure of linearity signals 5 step, 10 step and ramp.

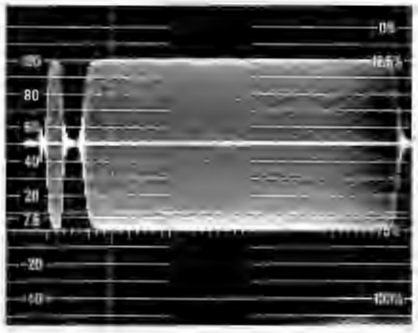


Fig 11. 40 IRE, subcarrier, 5 step linearity test signal displayed in high-pass mode. Note the lack of significant transients at step transitions.

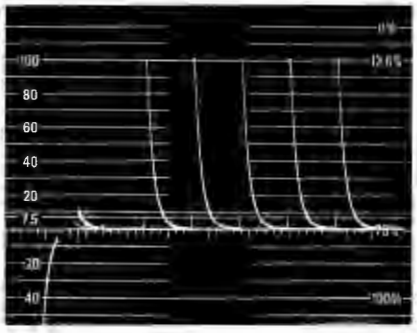


Fig 12. Differentiated 5 step staircase (subcarrier off) shows excellent linearity. (Tektronix 015-0075-01 used).

LINEARITY SIGNAL

Linearity—Three linearity test signals are front panel selectable: 5 step, 10 step and ramp either modulated or unmodulated. Luminance component is either 10 equal 10-IRE steps; 5 equal 20-IRE steps or a 100-IRE ramp, selected by front-panel switch. The subcarrier component is phase-locked to color burst. Applications include measurements of differential gain and phase, dynamic gain, luminance signal linearity, luminance signal distortion caused by chrominance signal non-linearity, and burst phase errors.

Measurements of differential phase and gain can be made more easily with 40-IRE subcarrier to override noise than with 20-IRE subcarrier. Subcarrier amplitude can be increased to 40 IRE by internal selection. Since this level of subcarrier should not be used together with full amplitude staircase or ramp where the test signal may be radiated, luminance amplitude of modulated linearity signals can be reduced to 90 IRE by internal adjustment.

Luminance Component—Peak amplitude 100 IRE within 1%. Each step is 20 IRE, within 1%, in 5 step and 10 IRE in 10 step. Step risetime is 230 ns within 15% and aberrations are within 2%. Duration at blanking level and at white level is 12 μs. Intermediate step durations are 6 μs for 5 steps and 3 μs for 10 steps.

Chrominance Component—Amplitude is 143 mV P-P (20 IRE) within 5% and in phase with burst (can be 286 mV (40 IRE) with internal adjustment.

Differential Phase— 0.2° or less.

Differential Gain— 0.5% or less.

Subcarrier Envelope—Risetime is 375 ns within 15% and duration is 40 μs within 5%. Envelope delay from horizontal sync is 16.1 μs within 5%.

Ramp Luminance Amplitude— 714 mV, 100 IRE ±1%.

Ramp Linearity—Within 1%.

Ramp Duration— 30 μs.

FLAT FIELD SIGNAL

The Flat Field Signal is used primarily for variable average picture level (APL) vertical interval testing. The Flat Field Signal is a composite video signal which during the active portion of each field has a constant luminance level. During the vertical interval there will be present each test signal which has been programmed for insertion as described in the Vertical Interval Insertion/Deletion section.

The luminance level of the Flat Field Signal is selectable in 10 IRE unit increments from 0 to 100 IRE. An alternate selection provides a "bounce" between 10 and 90 IRE at a 0.1 to 1.0 Hz rate. Thus the use of the Flat Field Signal permits the use of the several test signals in the presence of a selectable APL. This technique is useful in the measurement of APL-dependent distortions.

Luminance Level of the Flat Field Signal—Within 2% of the indicated level except the 100 IRE level which is within 1%.

Risetime—Shaped by $\sin^2$ filter with first zero in the frequency domain at 8 MHz.

FIELD SQUAREWAVE

A sensitive measurement of field time distortion can be made with this signal. In this mode, the 147 provides a composite video signal with 170 active lines at 100 IRE, which approximates a 60 Hz squarewave. A composite video signal such as this reveals low-frequency phase and gain distortions much as a simple 60 Hz squarewave will do, but unlike the latter, it can pass through clamper amplifiers.

Amplitude—Within ±1 IRE of white reference.

Number of White Lines—57 through 227 on each field, all remaining active lines are black.

Risetime—Shaped by $\sin^2$ filter with first zero in frequency domain at 4 MHz.

PULSE AND BAR SIGNAL

2 T, T pulses are generated to high precision by two 9-pole Kastelein Filters. The digital programmer provides the high degree of timing accuracy required in these pulses to eliminate jitter and long term drift. The programmer also exactly determines pulse-to-pulse spacing and bar duration. However, the programmer may be readily re-programmed to produce different spacings or bar widths in 2 μs increments.

The $\sin^2$ pulse may be either 2 T (0.25 μs HAD) or T (0.125 μs HAD). The transitions of the bar are controlled by either of two Kastelein filters so that frequency spectrum is limited to 4 MHz or 8 MHz. Shape of these transitions is integrated $\sin^2$.

For a specific application, the user may elect to program the 147 for any combination of T or 2 T pulse and T or 2 T bar. As shipped, the pulse is 2 T, the bar is formed by the T filter. This provides for K factor measurements of short time distortion. Thus the pulse and bar test signal is useful to measure line time and short time distortions.

The envelope of the modulated $\sin^2$ pulse is formed in the function generator rather than in a filter. The function generator can be readily programmed for any desired pulse width from 1.5 to 2.5 μs. Thus the 147 offers unique modulated $\sin^2$ pulse generator flexibility.

Modulated $\sin^2$ pulse (20 T) is used in measuring relative gain and delay errors between chrominance and luminance signals. The 20 T modulated $\sin^2$ pulse has a 2.5 μs HAD and hence, its frequency spectrum cuts off at 4.0 MHz. Greater sensitivity to chrominance-luminance delay errors may be had by reducing the pulse width (HAD).

As a full field test signal, the subcarrier component of the modulated $\sin^2$ pulse is phase modulated. The subcarrier could be free running, however, it could slowly drift in frequency in a manner annoying to the user. The frequency locked, phase modulated approach assures a stable display.

When used as a VIT signal, neither field rate phase modulation or frequency offsetting has utility. In the 147, a programmable phase offset between burst and the subcarrier component of the modulated $\sin^2$ pulse is provided. This conveniently source-codes the point in the system where the VIT signals are inserted. This subcarrier component may be viewed on either a vectorscope display or on most color monitors.

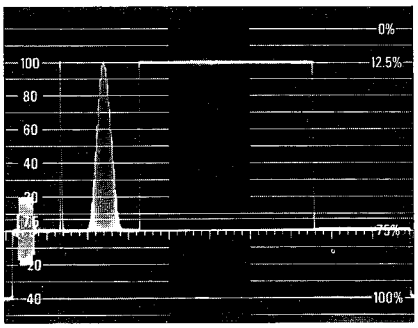


Fig 13. 2 T pulse with 20 T modulated pulse and bar.

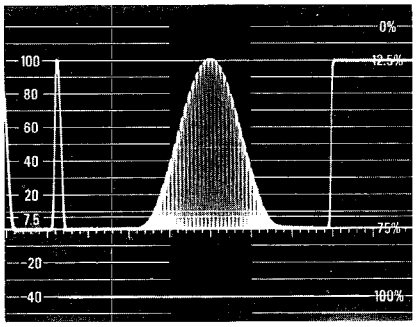


Fig 14. 2 T pulse with 20 T modulated pulse and bar.

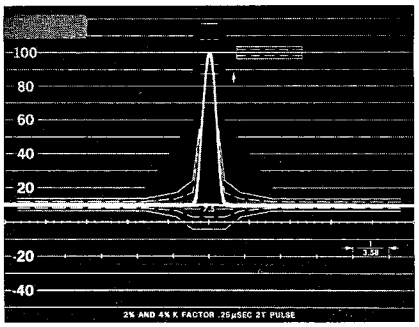


Fig 15. 2 T pulse.

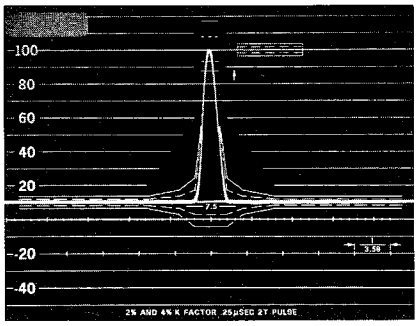


Fig 16. T pulse.

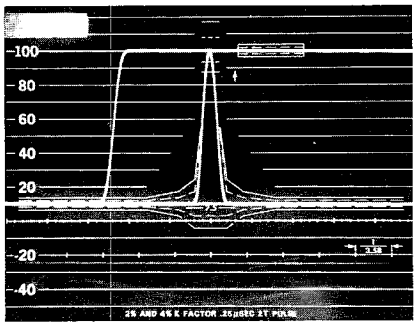


Fig 17. 2 T pulse with T Bar double exposed.

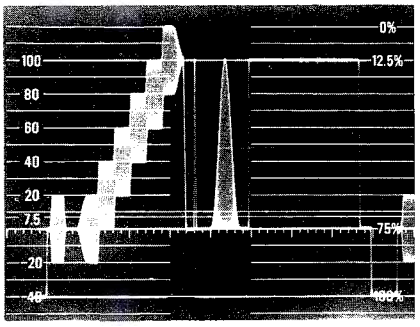


Fig 18. Typical Composite Signal on one full line.

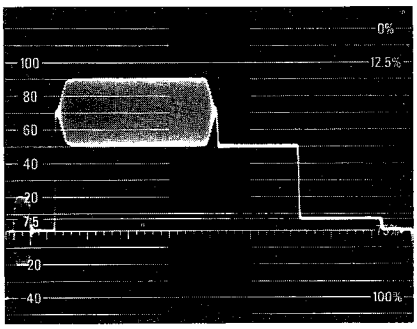


Fig 19. The Vertical Interval Reference Signal as generated by the 147.

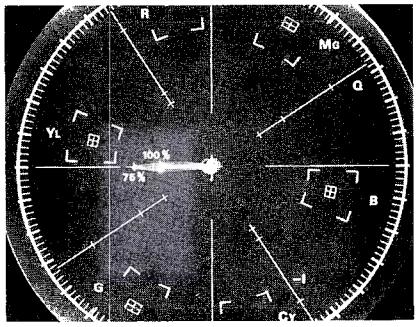


Fig 20. Distorted VIR signal on 520 Vectorscope. Chrominance is measured as too low indicating desaturation.

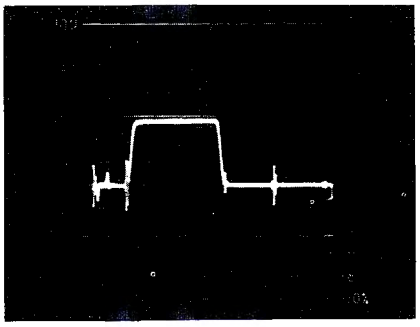


Fig 21. Distorted VIR signal on 520 Vectorscope I display. Burst and chrominance do not null indicating phase error.

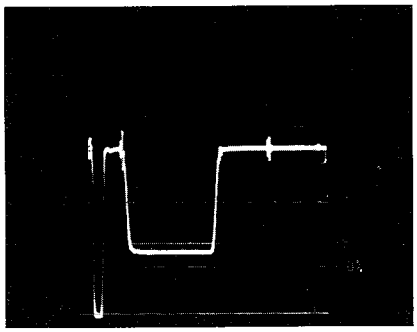


Fig 22. Distorted VIR signal with low chrominance on 520 Vectorscope Q display.

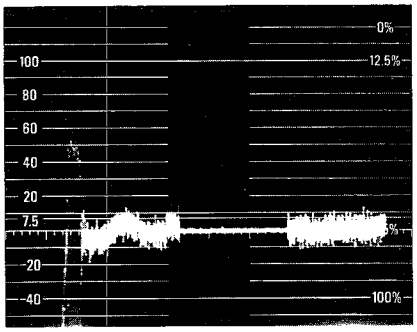


Fig 23. Noise test with inserted noise in center of line. Inserted noise is adjusted low for identification of time location.

147
NTSC Signal Generator

2 T Pulse Amplitude—Within 0.5 IRE of T Bar.

2 T HAD— 250 ns within 7.5 ns.

2 T Ringing—Amplitude less than 0.5 IRE; duration less than 2 cycles.

Time Location—Internally programmable in 2-μs increments.

T Bar Amplitude— 714 mV (100 IRE) ±1%.

T Bar Risetime— 125 ns ±15%.

T Bar Time Location—Start and Stop internally programmable in 1-μs increments.

20 T Modulated Pulse Peak Chrominance to Peak Luminance Amplitude Difference—Less than 0.5 IRE.

20 T Modulated Pulse HAD— 2.50 μs or can be internally set to 1.57 μs.

20 T Modulated Pulse Residual Subcarrier—Less than 0.5 IRE on insertion line.

2O T Modulated Pulse Relative Chroma-Luminance Time Delay—Less than 5 ns.

WINDOW SIGNAL

The Window Signal is the same as the Pulse and Bar except that the "Window" occupies lines 66 through 218 only. A window signal can be used to measure both line time and field time distortions. It is especially useful when observing picture monitors. Where field rate distortion is present, the window signal will be affected to a much greater extent than the pulse and bar signal.

Amplitude— 100 IRE within 1 IRE.

Risetime—Internally programmable: either 2 T pulse and T window or T pulse and 2 T window.

Window Duration—Lines 66 through 218.

COMPOSITE TEST SIGNAL

A composite test signal (fig. 18) is attractive as a multiple function signal for either VIT use, where the whole signal occupies only one line per frame, or as a full field signal which may be distributed throughout the entire plant on only one cable, with obvious economic advantage. The composite signal can be programmed in a variety of ways. Phase of the subcarrier of the modulated 20 T pulse may identify the signal insertion point.

NOISE

The 147 offers a unique signal-to-noise measuring technique for "in-service" testing during the vertical interval. The noise present in the middle portion of a line is deleted and noise generated in a calibrated source is inserted for measurement by comparison. The user varies a calibrated attenuator until inserted noise and incoming noise appear the same on a waveform monitor. The noise values measured are independent of operator interpretation errors to within 2 dB.

Where transmission noise is to be measured, the noise may be deleted on an entire line at the point from which the noise is to be measured using one 147. Further down the transmission system, a second 147 will match the noise level in the manner described previously. This process may be repeated and the transmission noise level determined for several sections of the transmission system, or its overall performance evaluated.

Noise may be measured at 10, 50 or 100 IRE luminance levels. The calibrated noise generator provides "flat" (white) noise or triangular noise.

Noise Pedestal Amplitude—Selectable 0, 50, or 100 IRE within 0.2 dB.

Variable Pedestal—Provided.

Noise Levels— —20 dB to —59 dB in 1 dB steps (0 dB = 700 mV RMS).

Flat Noise Spectrum—Energy unit bandwidth: 15 kHz to 5 MHz ±6 dB. (Spectrum extends well beyond 5 MHz.)

Output Impedance— 75 Ω.

Return Loss—Less than —30 dB to 5 MHz.

OTHER CHARACTERISTICS

Power Requirements— 90 to 136 VAC or 180 to 272 VAC, 48 Hz to 66 Hz, 55 watts maximum at 115 VAC and 60 Hz. Rear-panel selector provides rapid accommodation for 6 line-voltage ranges.

Inputs—External VITS Input, Program Input, Auxiliary Input, Composite Sync and Subcarrier.

Outputs—Program, Program Monitor, Preview Monitor (two each) and Full Field.

Ambient Temperature—Performance characteristics are valid over an ambient temperature range of 0° to +50°C (except as noted).

Dimensions and Weights

	147		R147	
	in	cm	in	cm
Height	3-7/8	9.9	3-1/2	8.9
Width	17-7/8	45.5	19	48.3
Depth	17-1/8	43.6	19-5/8	49.9
	lb	kg	lb	kg
Net weight	19	8.6	20	9.1
Domestic shipping weight	≈35	≈15.9	≈36	≈16.3
Export-packed weight	≈55	≈25	≈56	≈25.4

INCLUDED STANDARD ACCESSORIES

75-Ω, through-line termination (011-0103-02); 3-conductor power cord (161-0036-00); instruction manual (070-1169-00).

R147 also includes rackmounting hardware.

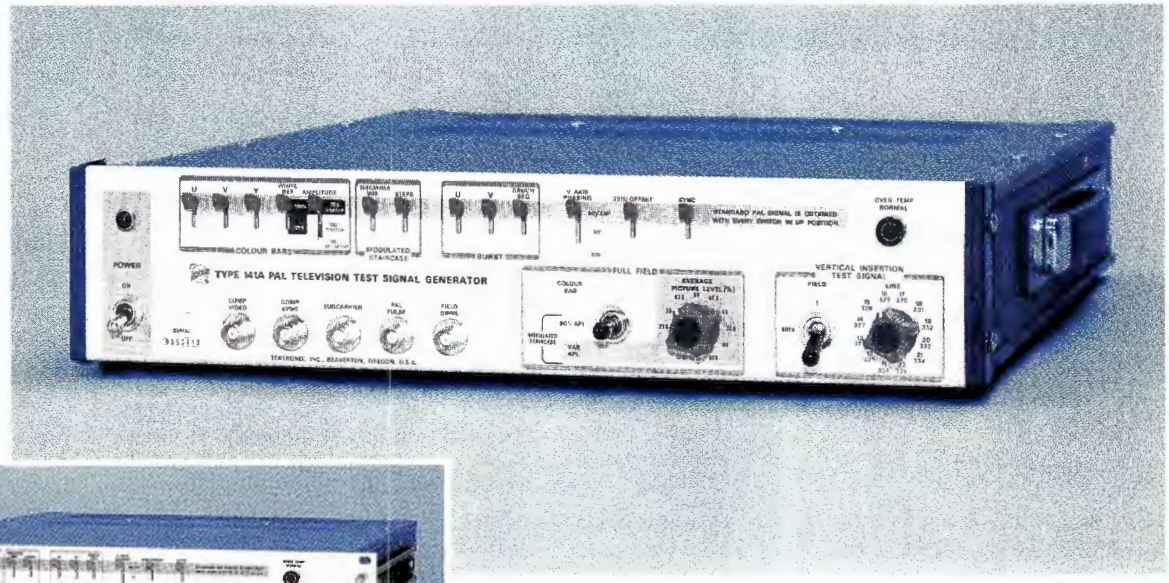
147 NTSC SIGNAL GENERATOR **$2700**

R147 NTSC SIGNAL GENERATOR (rackmount) **$2700**

U.S. Sales Prices FOB Beaverton, Oregon

141A and 142*

PAL Signal Generators



- ***625-LINE, 50-CYCLE FIELD 4.433618 MHz SUBCARRIER***
- ***PAL COLOUR BARS***

  EBU bars—75% amplitude, 100% saturated, 0% setup, 100% white reference (75% white reference also selectable)

  BBC 95% bars—75% amplitude, 100% saturated, 25% setup, 100% white reference

  100% bars—100% amplitude, 100% saturated, 0% setup, 100% white reference
- ***MODULATED 5-STEP STAIRCASE***

  Fixed or variable APL
- ***VERTICAL INSERTION TEST SIGNAL***

  Modulated staircase

  Field 1, Field 2, or both
- ***PAL SYNC GENERATOR***

The Type 141A PAL Television Test Signal Generator is a source of high-quality television test signals for 625-line, 50-cycle field standard PAL colour TV Systems. The all solid-state Type 141A utilizes Digital Integrated Circuits to achieve stability, accuracy and reliability.

Three operating modes provide PAL Colour Bars, a 5-Step Staircase with fixed Average Picture Level (APL), and the same Staircase with variable APL. The colour bar output is a full-field test signal appearing on every active line and consists of 75% amplitude colour bars in descending luminance order with 0% setup. The white reference can be set at 75% or at 100% (for standard EBU bars). Two other versions of colour bar signal can be selected: 75% amplitude, 100% white reference with 25% setup (BBC 95% bars) and 100% amplitude, 100% white reference, 0% setup (100% bars). Any component of the composite video colour signal may be turned off. This includes Y, U, V, the entire colour bar signal, sync, burst (either U or V component only or both), and the 25-Hz offset of colour subcarrier which drives the sync generator.

The staircase signal is particularly useful with a Tektronix Type 521 PAL Vectorscope to measure differential phase and differential gain. Luminance channel linearity may also be measured using the Tektronix video staircase differentiator part #015-0154-00 (the transient response of the staircase signal component is determined by a $\sin^2$ filter whose cut-off frequency limits the energy content in the region of the colour subcarrier frequency).

The PAL subcarrier (140 mV P-P) is accurately phased at 180° (it lies along the —U PAL axis and is at the same phase on alternate lines). Subcarrier may be switched off when desired.

To provide VITS (Vertical Insertion Test Signal) the staircase signal is keyed on during a selected line of the vertical blanking interval, either or both fields (line 11-22 on Field 1 and line 324-335 on Field 2).

Normal PAL colour burst is provided on the staircase and colour bar signals. The complex four-field Bruch blanking sequence during vertical interval is provided and may be switched off if desired.

A 1-MHz reference signal which is frequency "locked" to the 4.43361875-MHz PAL subcarrier oscillator is provided at the rear of the instrument. The accuracy of the internal subcarrier oscillator may be conveniently verified by comparing the 1-MHz reference with known frequencies, such as the Droitwich 200-kHz radio transmissions in Europe.

The Type 141A is available in either rackmount (R141A) or cabinet (141A) styles.

**For 525-line, 60-cycle field, 3.575611 MHz subcarrier (Brazilian system).*

PAL COLOUR BARS

LUMINANCE AND CHROMINANCE AMPLITUDE ACCURACIES (25°C reference) Component amplitudes comply with the CCIR signal requirements as defined by CCIR, 11th Plenary Assembly, 1966, Vol. 5, p. 281. Absolute amplitudes of luminance signal, setup and sync are within 1% or 1.5 mV, whichever is greater. Absolute amplitudes of all subcarrier frequency components (chrominance, U and V) are within 3%. Relative amplitudes of all subcarrier frequency components (chrominance and burst) are within 1% or residual subcarrier plus 1 mV whichever is greater, of the red chrominance bar.

BAR WIDTH—6.5 μs within 5%.

WHITE REFERENCE—100% amplitude (normal); or 75% amplitude.

CHROMINANCE—Time difference between luminance and chrominance channels is 20 ns or less. Risetime is 260 ns within 10%. U, V quadrature error is 0.5° or less, V axis phase-switcher error is 0.5° or less.

RESIDUAL SUBCARRIER—At least 52 dB below 1 V except 30 dB at end of H blanking.

ABERRATIONS—Within 4% of 1 V P-P.

SPURIOUS SUBCARRIER—At least 52 dB below 1 V when viewed on a Type 529 Waveform Monitor. Other spurious outputs are at least 52 dB below 1 V also.

MODULATED STAIRCASE

LUMINANCE COMPONENT—5-step amplitude is 700 mV within 1%. Single-step amplitude is 140 mV within 1%. Step risetime is 260 ns within 15%. Step duration at blanking level and white level is 13 μs within 5%. Intermediate step durations are 6.5 μs within 5%. Aberrations are within 2% of step amplitude.

CHROMINANCE COMPONENT—Amplitude is 140 mV P-P within 3%. Phase is 180°.

DIFFERENTIAL PHASE—0.1° or less.

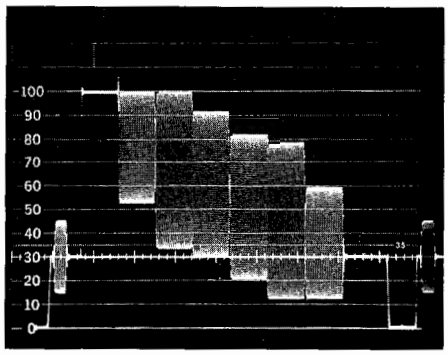
DIFFERENTIAL GAIN—0.5% or less at 0%, 50% and 100% APL.

SUBCARRIER ENVELOPE—Risetime is 260 ns within 15% and duration is 39 μs within 5%.

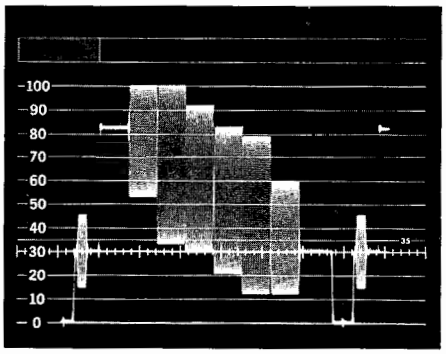
50% FIXED APL—Each active line carries the modulated staircase signal. APL is 50%.

VARIABLE APL—Staircase signal is on every 4th line and the same line every frame. Luminance level range is 700 mV in 10 equal increments, within 2%. The 90°/270° subcarrier modulation on the variable APL lines is 30 mV within 20%.

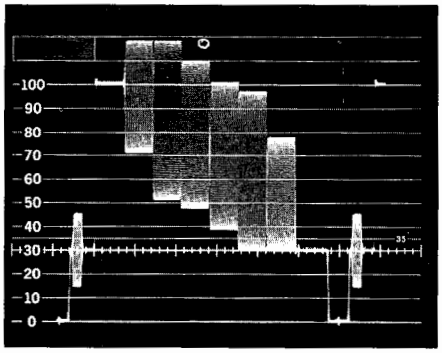
CONVERGENCE PATTERN—The Type 141A MOD 703Z provides a convergence pattern signal separate and independent from the other test signals. It is useful for measuring picture monitor or camera scanning linearity, aspect ratio, and geometric distortion. Displays available are: cross hatch, vertical lines only, horizontal lines only, and cross hatch plus dots (dots appear centered in the rectangles formed by the cross-hatch pattern). The Type 141A MOD 703Z retains all the features of the standard Type 141A.



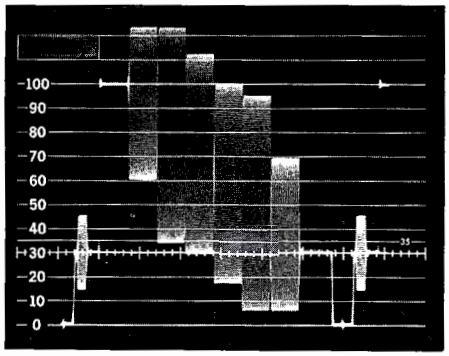
EBU colour bars—75% amplitude, 100% saturation, 0% setup and 100% white reference.



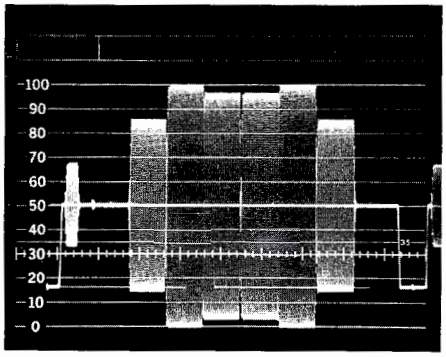
EBU colour bars—75% amplitude, 100% saturation, 0% setup and 75% white reference.



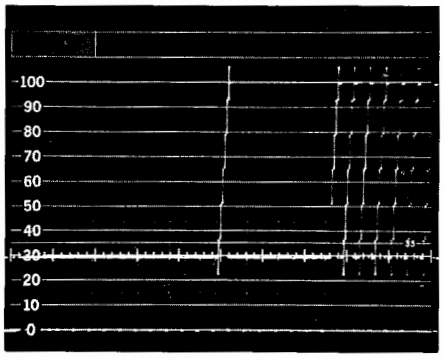
BBC 95% colour bars—75% amplitude, 100% saturation, 25% setup and 100% white reference.



100% colour bars—100% amplitude, 100% saturation, 0% setup, 100% white reference.

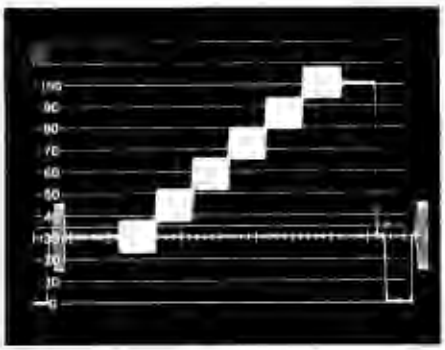


PAL colour bars, luminance component switched off (vertical gain of waveform monitor increased).

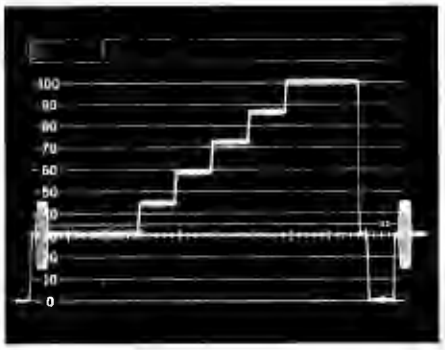


Vertical Insertion Test Signal, 5-step staircase with PAL subcarrier on line 16, field 1.

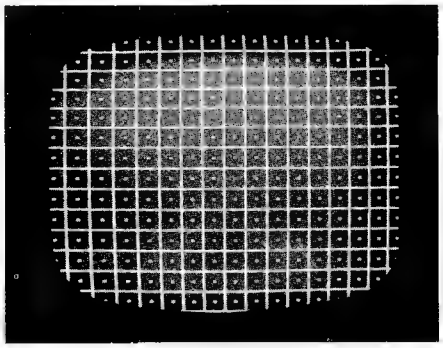
141A and 142
PAL Signal Generators



5-step staircase waveform with PAL subcarrier along -U axis. PAL burst is provided. Note white reference level following the modulation.

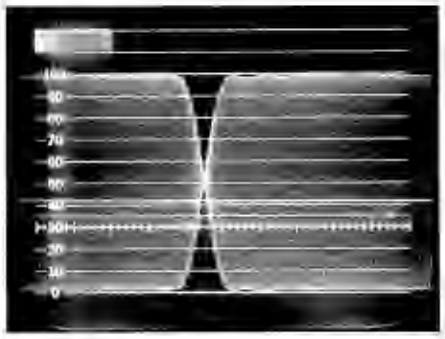


5-step staircase waveform, luminance only. Note double width black and white steps. Luminance transitions are sin² shaped of approx 260-ns risetime.

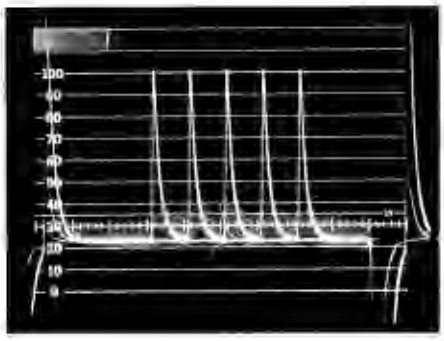


Convergence pattern, suitable for convergence, scanning linearity, and aspect ratio adjustments of monitors. Available with the Type 141A MOD 703Z and Type 142.

Vector PAL presentation of PAL colour bar.

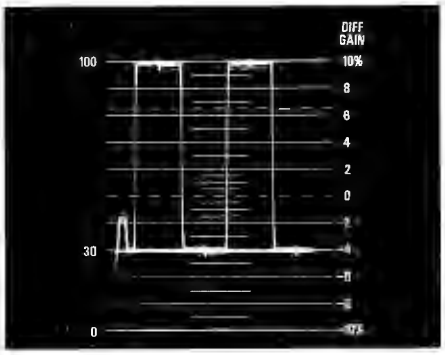


Chrominance signal, green-magenta transition, 250 ns/cm time base.

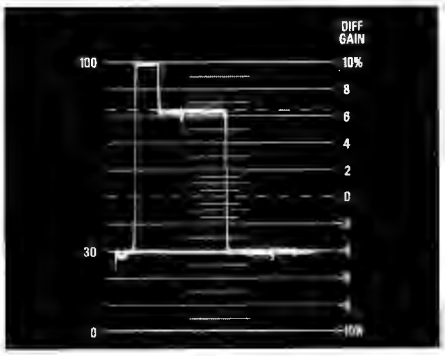


Stairstep luminance signal showing exact equality of individual transitions when differentiated by Tektronix Video Staircase Differentiator (part number 015-0075-00).

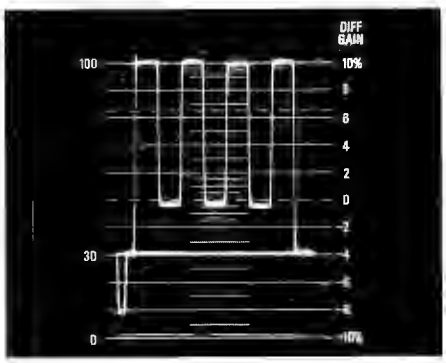
PAL colour bars, luminance signal only, 75% amplitude with 100% white reference.



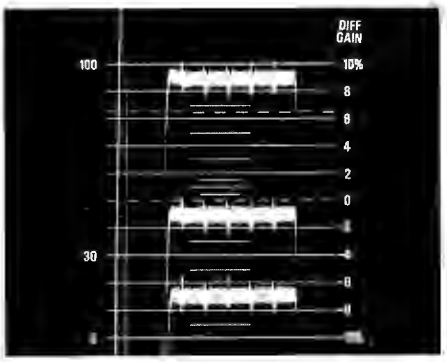
PAL colour bars, 100% amplitude, 100% white reference, demodulated to recover the RED signal.



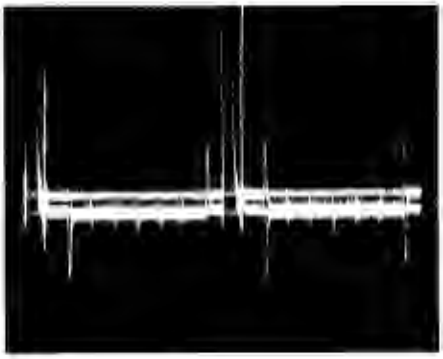
PAL colour bars, 75% amplitude, 100% white reference, demodulated to recover the GREEN signal.



PAL colour bars, 75% amplitude, 100% white reference, 25% setup, demodulated to recover the BLUE signal.



Combined differential gain of PAL Vectorscope and Type 141A Generator. Each minor scale division equals ½% differential gain. Top trace 87½% APL, middle trace 50% APL, bottom trace 12½% APL.



Combined differential phase of PAL Vectorscope and Type 141A Generator. Left trace 12½% APL, right trace 87½% APL.

VERTICAL INSERTION TEST SIGNAL

The staircase signal may be keyed on during a selected line of the vertical blanking interval, either or both fields (line 11-22 on Field 1 and line 324-335 on Field 2).

SYNC GENERATOR

ALL AMPLITUDES ARE SPECIFIED WITH 75-Ω LOAD IMPEDANCE. ALL CONNECTORS ARE BNC TYPE. RETURN LOSS (WHERE APPLICABLE) IS ALWAYS GREATER THAN 30 dB. ISOLATION BETWEEN ALL OUTPUTS IS ALWAYS GREATER THAN 40 dB.

SUBCARRIER—Frequency is 4.43361875 MHz (long term drift) within 1 Hz/2 week period. Outputs—Three outputs (one front panel and two rear panel). Output level is 2 V P-P within 0.2 V. Output frequency is unaffected by position of 25-Hz offset switch on front panel.

COMPOSITE SYNC—A front-panel and a rear-panel output is provided. Output level is 4 V within 0.2 V. Risetime is 260 ns within 15%.

PAL PULSE—Two outputs (one front, one rear panel). Amplitude and phasing are internally selected to be either of the following: 1) Squarewave—1 V P-P within 0.05 V with transitions occurring with each horizontal sync pulse. Either positive or negative transition is coincident with leading edge of line sync pulse with 135° or 225° burst phasing, (as internally selected). 2) Pulse—4 V P-P within 0.2 V, duration 4.7 μs within 0.2 μs with negative transition coincident with leading edge of line sync pulse on lines with 135° or 225° burst phasing, (as internally selected).

COMPOSITE BLANKING—One rear-panel output provides 4 V within 0.2 V. Risetime is 260 ns.

LINE DRIVE—One output (on rear panel). Output level is 4 V within 0.2 V. Risetime is 260 ns.

FIELD DRIVE—Two outputs (one front panel, one rear panel). Output level is 4 V within 0.2 V. Risetime is 260 ns.

BURST FLAG—One rear-panel output provides 4 V within 0.4 V. Duration is 2.2 μs within 5%, delay from horizontal sync is 5.5 μs within 5%.

1-MHz REFERENCE FREQUENCY—One rear-panel output. Frequency is 1.000000 MHz when subcarrier is 4.43361875 MHz with 25-Hz offset. Amplitude is 1 V P-P within 0.2 V.

25 Hz—One rear-panel output. Output level is 1 V within 0.2 V.

12.5 Hz—One rear-panel output. Output level is 1 V within 0.2 V.

LINE PERIOD—64 μs (derived from PAL subcarrier frequency).

BURST—Half amplitude duration of envelope is 2.2 μs within 5% (approximately 10 cycles). Burst delay is 5.5 μs within 0.2 μs. Burst component is 300 mV P-P within 3%. V component is 212 mV P-P within 3%. U component is 212 mV P-P within 3%. Amplitude ratio of U/V is 1.00 within 1%. Amplitude on successive lines—smaller is between 97% and 100% of the larger. Phasing—135° within 1° and 225° within 1° on successive lines. Phasing between successive bursts is 90° within 1°.

LINE BLANKING—11.8 μs to 12.2 μs.

FRONT PORCH—1.8 μs within 5%.

LINE SYNC PULSE—Width is 4.7 μs within 0.2 μs; risetime is 260 ns within 15%.

FIELD PERIOD—20 ms (digitally derived from 4.43361875 MHz).

FIELD BLANKING—25 lines, 1600 μs (digitally derived from 4.43361875 MHz).

EQUALIZATION PULSE SEQUENCE DURATION—First sequence, 2.5 H (lines); second sequence, 2.5 H (lines).

FIELD SYNC PULSE—Duration 27.3 μs within 0.2 μs.

INTERVAL BETWEEN FIELD SYNC PULSES—47 μs within 0.2 μs.

OTHER CHARACTERISTICS

COMPOSITE VIDEO OUTPUT
Two outputs are provided through BNC type connectors, one front panel and one rear panel. Composite video consists of composite sync and video test signals as selected by front-panel controls. Amplitude is 1 V P-P into 75 Ω. Return loss is at least 30 dB. Isolation is at least 40 dB.

POWER REQUIREMENTS
90 to 136 VAC or 180 to 272 VAC, 48 Hz to 66 Hz. 55 W max at 230 VAC, 50 Hz. A rear-panel selector provides accommodation for 6 line voltage ranges.

AMBIENT TEMPERATURE—Performance characteristics are valid over an ambient temperature range of 0°C to +50°C (except as noted).

DIMENSIONS AND WEIGHTS

Type 141A	Height	3½ in	8.9 cm
	Width	16¾ in	42.6 cm
	Depth	18½ in	47.1 cm
	Net weight	17¾ lb	8.0 kg
Type R141A	Height	3½ in	8.9 kg
	Width	19 in	48.3 cm
	Depth	18½ in	47.1 cm
	Net weight	18½ lb	8.4 kg

INCLUDED STANDARD ACCESSORIES
75-Ω through-line termination (011-0103-02); 7½ foot 3-wire power cord (161-0036-00); instruction manual (070-1008-00). Type R141A also includes rackmounting hardware.

TYPE 141A PAL TV TEST SIGNAL GENERATOR . . . $2150

TYPE R141A PAL TV TEST SIGNAL GENERATOR . . $2150

TYPE 141A MOD 703Z PAL TV TEST SIGNAL GENERATOR
(Includes convergence test pattern) **$2335**

TYPE R141A MOD 703Z PAL TV TEST SIGNAL GENERATOR
(Includes convergence test pattern) **$2335**

For 525-line, 60-cycle field, 3.575611 MHz subcarrier (Brazilian system):

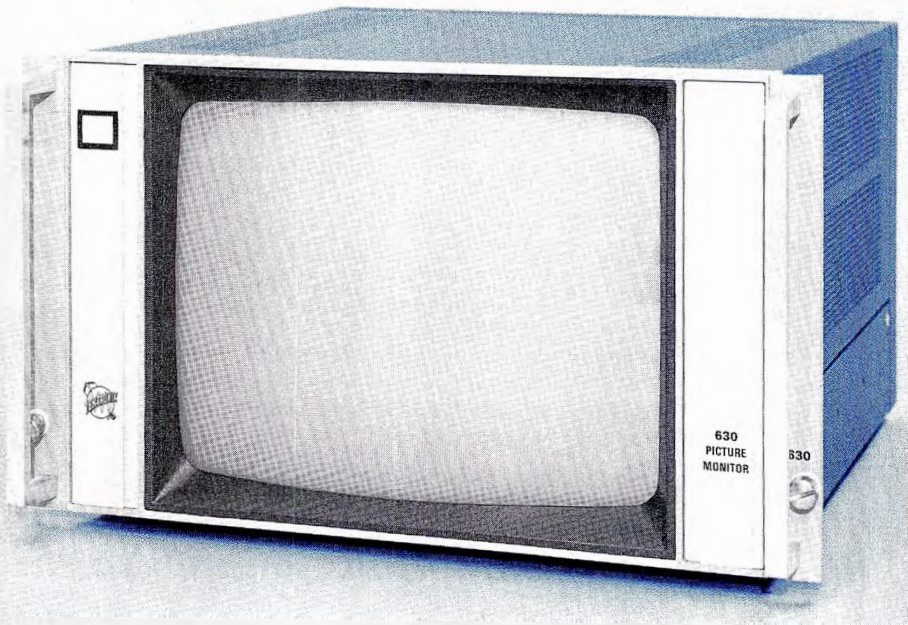
TYPE 142 PAL TV TEST SIGNAL GENERATOR $2350

TYPE R142 PAL TV TEST SIGNAL GENERATOR . . . $2350

U.S. Sales Prices FOB Beaverton, Oregon

630
TV Picture Monitor

NEW



- HIGH RESOLUTION AT FULL DRIVE
- NO-BOUNCE RASTER
- CALIBRATED BRIGHTNESS AND CONTRAST
- DISPLAY SHIFT (PULSE CROSS)
- SWITCHABLE 525/60 OR 625/50 STANDARD
- 6500° PHOSPHOR

The Tektronix 630 is a 15-inch Television Picture Monitor for 50-field, 625-line or 60-field, 525-line television. The monitor is designed for both measurement and qualitative evaluation of TV signals. The monitor uses all solid-state circuitry and requires only 10-1/2 inches in both its rackmount version and cabinet version. The 630 uses a rectangular picture tube with a choice of two phosphors. The tube has implosion protection and a mask that provides a 3:4 aspect ratio.

Two removable doors, one on each side of the picture tube, provide access to display controls (left side) and signal selection and conditioning controls (right side). Controls are detented where appropriate for standardized picture displays. Circuits are designed to maintain calibrated functions such as brightness and contrast for long periods without readjustment.

The display can be shifted horizontally or vertically or both to display blanking, sync and burst signals. When shifted, the brightness level is increased so that the blanking levels can be seen. A push button also provides a reduced size display (85%) so that corners and edges of the display can be seen.

The monitor has front-panel selection of one of two video inputs or the difference signal between the two video inputs. The video input connector grounds are isolated from the chassis. Center conductor and braid of the coax drive differential input amplifiers to provide rejection of ground current hum. The two video inputs are loop-through and compensated for optimum return loss. These can be terminated externally by a precision 75-ohm termination. A notch filter may be selected to reduce the effects of subcarrier on the picture.

Contrast (white level) and brightness (black level) can be either calibrated (for a 1.0 V P-P signal) or variable. The calibrated modes can be internally pre-set for a given video signal. The black level is stabilized (DC restoration) by a back porch sampling system, independent of varying video or sync amplitudes.

630
TV Picture Monitor

The monitor has either internal (displayed video) sync capability or external sync capability. The external sync input connector grounds are isolated from the chassis. Center conductor and braid of the coax drive a differential input amplifier to provide rejection of common-mode signals in the signal path. The two external rear panel inputs are high impedance loop-through connected. The sync input can be terminated externally by a precision 75 ohm termination.

VIDEO

Composite Video Inputs—Push buttons select one of two loop-through, compensated inputs (A or B) or a differential input (A-B). Inputs are on rear panel with outer coax conducter isolated from ground for common-mode rejection.

Unterminated Input Impedance—Approximately 15 kΩ paralleled by 25 pF.

Return Loss— 46 dB DC to 10 MHz.

Frequency Response— 0% to —5% to 6 MHz at 100% white amplitude, 0 to —3 dB to 20 MHz at 25% white amplitude.

Pulse Response— 0.98 to 1.02 pulse to bar ratio wth less than 2% overshoot. Bar will be flat within 2%.

Differential Gain Distortion—Less than 2%.

Dynamic Gain Distortion—Less than 1%.

DC Restoration—Keyed back porch clamp. No observable black level shift from 10% to 90% APL.

Noise—Monitor noise including cross talk from power supplies and deflection circuits is not observable.

Notch Filter—At least 12 dB reduction of subcarrier effect on displayed luminance. Push button enables or disables filter. Filter response is automatically changed when field/line rate is switched to accommodate NTSC and PAL subcarrier frequencies.

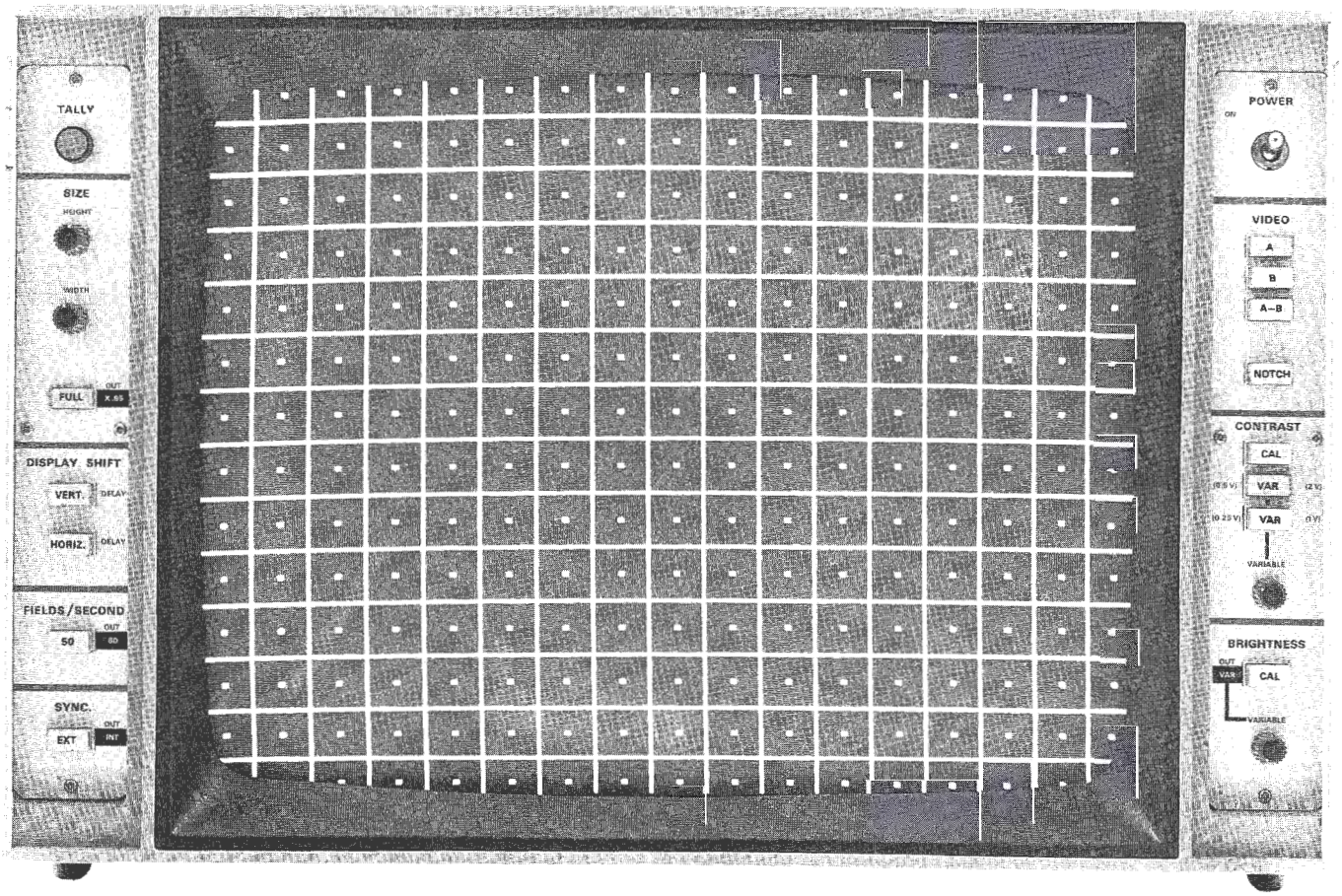
DISPLAY

Contrast—Calibrated contrast setting can be selected for 1 volt levels. Variable contrast can be selected for 0.25 V to 1 V and 0.5 V to 2 V levels.

Brightness—When operated with 1 V P-P composite signal with 10 IRE setup scanning lines will just be decernable. Calibration for other setup levels can be set internally. A variable control is provided for other than calibrated operation.

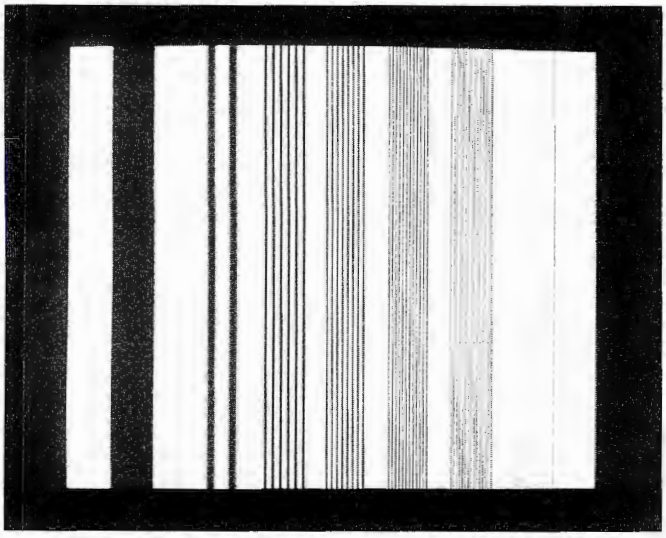
Display Size—Front-panel variable control of height and width is provided. A push button can select a 0.85 X display size for observing picture edges.

Display Linearity—Non-Linearity within 1.5% of full picture height; within 1% with 0.85 X size display.

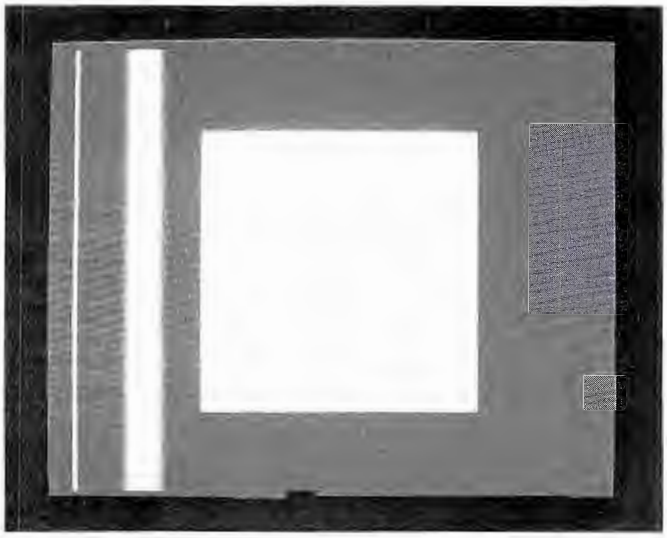


630
TV Picture Monitor

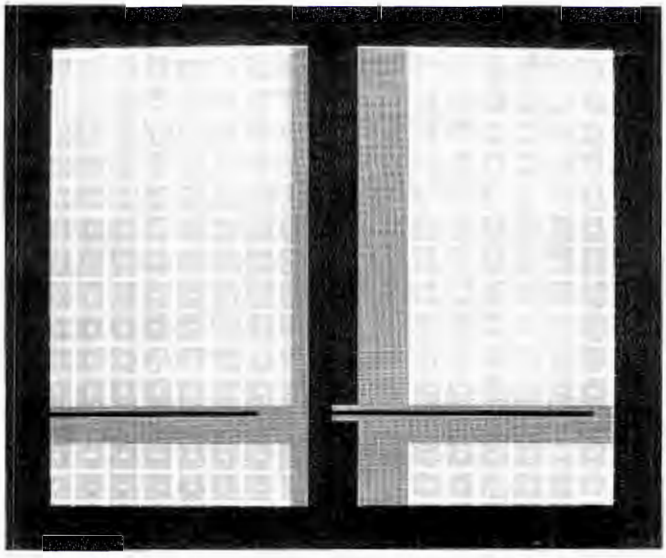
NEW



*Multiburst from 147 NTSC Test Signal Generator displayed on 630 Monitor**



*Window Signal from 147 NTSC Test Signal Generator displayed on 630 Monitor**



*Display shows horizontal and vertical display shift**

*Moiré pattern is a result of half-tone printing process and is not seen in direct visual observation

Resolution—At least 650 lines at center screen.

Phosphor Colorimetry—Standard WAx = 0.313, y = 0.344 (D6500°). Optional WAx = 0.27, y = 0.30 (9500° K).

Display Shift—Sync, blanking, burst, VITS and VIRS can be displayed by shifting the screen position of the vertical interval or the horizontal interval or both (pulse-cross). Brightness is automatically shifted to display blanking level.

Field/Line Selection—Either 625/50 or 525/50 standard can be selected.

Side Panel Adjustments—Focus, calibrated brightness and calibrated contrast can be screwdriver adjusted through a side panel access.

SYNC

Sync—Internal or external sync sources are push button selected. When operating with an A-B display, internal sync is selected from Video A.

Horizontal Sync Pull-In Range—±250 Hz.

Horizontal Sync Hold-In Range—±1000 Hz.

Effect of Noise—Less than 0.6 mm of display shift for white noise at 30 dB S/N.

Sync Input—Loop-through, compensated with outer cable isolated from ground for common-mode rejection. Isolated cable ground can be internally shorted to ground.

OTHER CHARACTERISTICS

Power Requirements—104 VAC to 126 VAC, or 198 VAC to 242 VAC; 48 Hz to 66 Hz; 100 W maximum.

Dimensions and Weights

	630		R630	
	in	cm	in	cm
Height	11	28.0	10-1/2	26.7
Width	16-3/4	42.6	19	48.3
Depth	18-1/2	47.1	17	43.2
	lb	kg	lb	kg
Net weight	37	16.7	38-3/4	17.6
Domestic shipping weight	≈57	≈25.8	≈59	≈26.7
Export-packed weight	≈78	≈35.4	≈80	≈36.3

INCLUDED STANDARD ACCESSORIES

Power cord (161-0036-00); tally light connector plug (134-0132-00) and clamp (343-0309-00); indication symbols for tally light (378-0683-00); three termination resistors; instruction manual (070-1176-00).

630 PICTURE MONITOR **$1050**

U.S. Sales Price FOB Beaverton, Oregon

NEW

650
Color TV Picture Monitor

- **MEASUREMENT and QUALITATIVE FUNCTIONS**
- **ONLY FOUR FRONT-PANEL CONVERGENCE CONTROLS**
- **CALIBRATED, SIMPLIFIED CONTROLS**
- **DIFFERENTIAL INPUTS**
- **DISPLAY SHIFT (PULSE-CROSS)**
- **DISPLAYS RESIDUAL SUBCARRIER when desired**

The Tektronix 650 Color Television Picture Monitor is a compact, NTSC instrument using a 12″ Trinitron* picture display tube. The 650 design as a measuring instrument enables it to display true pictures with minimal adjustment and maximum stability.

The Trinitron has many advantages over available shadow-mask color picture tubes since the simplicity of its convergence adjustment is outstanding. Only four front-panel controls, underneath a locked door, control convergence. Other convergence controls are located internally and are only adjusted during major servicing. Not only are there far fewer controls, but control operation is much simpler due to the simpler Trinitron arrangement of the red and blue beams on the same horizontal plane as the green beam. Convergence is primarily a matter of modulating the horizontal deflection component of the red and blue beams. The green beam, centered in the tube, is only slightly affected by the convergence adjustments. As the eye perceives green most accuately, the green beam is centered to produce the best focus.

Chromaticity of the Trinitron supplied in the Tektronix 650 color monitor is closely matched to that currently specified by CCIR recommendation for PAL and by the Canadian Television Practices Committee.

Reference white for the 650 is Illuminant D, whose color temperature is approximately 6500° K. The 650 is adjusted to this value at the time of manufacture using a white comparator. Screen color temperature is critical in accurate color reproduction, and does vary with aging of the picture tube, regardless of design. Slight differences in color temperature between various monitors in a given facility are far more serious than an absolute error in color temperature of all monitors at that facility. Thus, each customer will desire to maintain all his monitors to his own reference white standard.

*Registered Trademark SONY Corporation

650
Color TV Picture Monitor

NEW

Except for the Trinitron, all active devices are solid state. All transistors and diodes are silicon devices. All transistors and integrated circuits are socketed for ease in servicing. Semi-modular construction is used with the glass-epoxy etched circuit boards readily removable for servicing.

Several unique features beside the Trinitron tube set the 650 aside from other picture monitors intended for professional use in broadcast, closed circuit and educational fields.

CALIBRATED CONTROLS

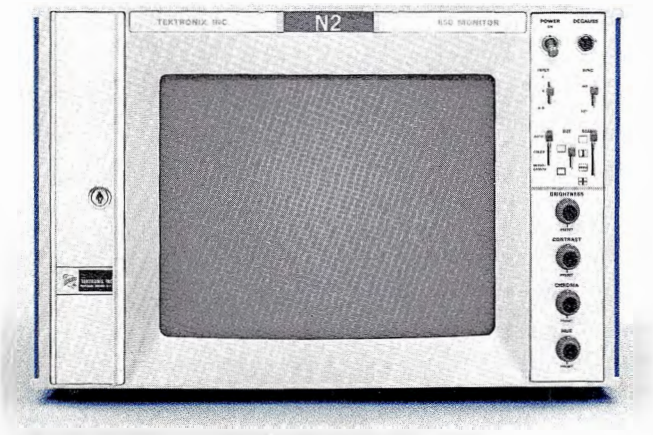
Chrominance gain, phase, contrast and brightness variable controls are all provided with calibrated, detented positions. In these detents, the instrument will produce a display in accord with NTSC specifications.

TWO VIDEO INPUTS

Two video inputs are provided. A only, B only, or A-B can be selected from the front panel. These inputs are high-impedance, loop-through 75 Ω types compensated for optimum return loss. Each input is isolated from the chassis to prevent ground-current-induced hum. Each input is also isolated from all others. Hum rejection is 60 dB at 60 Hz for 5 volts RMS. While using the differential input mode (A-B), the hum rejection feature is still available, even in the case of unequal hum levels.

SYNC SWITCHING

Internal or External Sync can be selected. A and B external sync loop-throughs are provided on the 650. When using external sync, a two-position, rear-panel switch allows the external sync to be taken from the A external sync input only, or switched with the front panel INPUT switch, in which case video input A would take external sync from the A sync input and video input B would take external sync from the B sync input.



PULSE CROSS AND DISPLAY SHIFT

The picture may be shifted either horizontally or vertically or both (pulse-cross). This allows monitoring of the sync burst, blanking and of vertical interval test and reference signals. Burst appears on a pulse-cross display as yellow-green. When in any shifted display mode, brightness is automatically advanced to permit observation of sync pulses.

Both video inputs may be used differentially to display the difference between two signals. This is especially useful when timing two signals relative to each other. The pulse-cross feature is used to observe the sync detail. Differential input performance is excellent throughout the entire video frequency band. Thus it is possible to observe the relative phase of two color bursts, an extension of the usual capability of picture monitors.

RESIDUAL SUBCARRIER DISPLAY

The 650 has been designed to display the actual compensation of the color signal. Therefore, it may be expected to display a significantly different color picture, in certain cases. Color subcarrier present during blanking will cause a change on the colorimetry of the reproduced picture. Subcarrier amplitudes too small to be easily noticed on a waveform monitor or vectorscope will change the observed colorimetry. This effect is especially noticeable on grey and white portions of the picture. This feature may be internally disabled if desired; however, the 650 as a measuring instrument is intended to display the true signal, and not compensate for signal errors.

650
Color TV Picture Monitor

MONOCHROME OR CHROMINANCE DISPLAY MODES

When monitoring color signals, it is essential that the chrominance subcarrier signal not reach the picture tube. The effects are objectionable dot structure crawling vertically. The 650 provides luminance bandpass switching with phase equalization as the best way of preventing chrominance signals from reaching the picture tube.

In the 650 care has been taken to regenerate the color subcarrier from the burst with great accuracy, despite the many possible errors which may occur in burst regarding timing, amplitude or transients (quadrature components).

Automatic—When in AUTO, the 650 automatically activates or deactivates the chrominance channel, depending upon whether the video signal is color or monochrome.

Color—In this mode the chrominance channel is continuously activated (forced color).

Monochrome—In this mode the chrominance channel is deactivated regardless of whether the video signal is color or monochrome and the luminance channel bandwidth is automatically increased.

DISPLAY SIZE

A front panel switch selects either a full screen raster or an underscan raster for visual inspection of the picture edges and VITS.

REGULATED POWER SUPPLIES

The Trinitron operates at 19 kV from a regulated EHT supply. The low voltage and EHT power supplies are fully regulated against line and load changes, giving excellent picture stability. The EHT power supply is interlocked with the horizontal and vertical deflection circuits to prevent kinescope damage in the event of a deflection failure.

OTHER FEATURES

Manual degaussing is provided. The 650 is available in either a 10-1/2″ rackmount form or cabinet form. A 24-volt tally lamp is provided with a set of numbers for the tally window.

Available as an extra-cost, factory installed option is a provision for monitoring unencoded video signals in addition to normal operation. Typically RGB signals will provide additional resolution over encoded signals, and this input may be used to observe color television signals decoded from another standard such as SECAM or PAL. The RGB inputs are isolated from each other and chassis.

For customers working with color TV signals encoded in PAL (625/50, 4.433 MHz subcarrier), a color picture monitor accepting PAL signals will also be available. This unit will have characteristics similar to the 650 and will also have provision for the factory modification to accept RGB signal inputs.

OTHER CHARACTERISTICS

Power Requirements— 104 VAC to 126 VAC, or 198 VAC to 242 VAC; 48 Hz to 66 Hz; 160 W maximum.

Dimensions and Weights

	650		R650	
	in	cm	in	cm
Height	11	28.0	10-1/2	26.7
Width	16-3/4	42.6	19	48.3
Depth	18-1/2	47.1	17	43.2
	lb	kg	lb	kg
Net weight	50	22.7	51-3/4	23.4
Domestic shipping weight	≈70	≈31.7	≈72	≈32.6
Export-packed weight	≈98	≈44.4	≈100	≈45.3

INCLUDED STANDARD ACCESSORIES

Power cord (161-0036-00); tally light connector plug (134-0132-00) and clamp (343-0309-00); indication symbols for tally light; instruction manual (070-1161-00).

650 PICTURE MONITOR **$2500**

U.S. Sales Price FOB Beaverton, Oregon

453A MOD 127C

Television Oscilloscope

NEW

- 5 mV/DIV to 10 V/DIV CALIBRATED DEFLECTION FACTORS
- 60-MHz BANDWIDTH at 20 mV/DIV
- 8 x 10 DIV CRT
- BRIGHT, HIGH RESOLUTION DISPLAYS
- CALIBRATED MIXED SWEEP
- CALIBRATED SWEEP DELAY
- FULL BANDWIDTH TRIGGERING
- 5 mV/DIV X-Y DISPLAYS
- ALL SOLID STATE
- DESIGNED FOR SEVERE ENVIRONMENTS

Increased bandwidth, larger, brighter displays, calibrated mixed sweep, color-coded front panel, and easy-to-use X-Y capabilities are some of the features of the 453A, the new version of the world's most widely used oscilloscope. The rugged, field proven design of the 453 is retained in the 453A. So is laboratory accuracy, and ease of maintenance.

With the Mod 127C, an internal TV Sync Separator circuit permits stable internal line or Field-rate triggering from displayed composite video or composite sync waveforms. External ÷ 10 trigger sources are replaced by internal TV Sync positions providing Line sync pulses to the B Sweep circuit and either Field or Line sync pulses to the A sweep circuit.

Individual lines can be selected with the delayed sweep features in the 453A. The wide range of delayed sweeps permits accurate alternate-frame color-burst observations in the PAL color system.

Conventional waveform displays and measurements can be made from standard broadcast or closed-circuit TV systems, domestic or overseas, with up to 1201-line, 60 Hz field rates. A parallax-free, 8 x 10 div, illuminated graticule is standard. Two additional snap-in TV graticules are supplied but may not be illuminated. Other characteristics are the same as 453A and R453A.

CHARACTERISTIC SUMMARY

VERTICAL
(2 Identical Channels)

Bandwidth and Risetime—DC to 60 MHz (5.8 ns) from 20 mV/div to 10 V/div, DC to 50 MHz (7 ns) at 10 mV/div, DC to 40 MHz (8.75 ns) at 5 mV/div.

Calibrated Deflection Factor— 20 mV/div to 10 V/div at full bandwidth, 5 mV/div and 10 mV/div at reduced bandwidth.

Input R and C— 1 megohm paralleled by approx 20 pF.

HORIZONTAL

Calibrated Time Base— 0.1 μs/div to 5 s/div.

X10 Magnifier—Operates over full time base, increases fastest rate to 10 ns/div.

Calibrated X-Y Operation— 5 mV/div to 10 V/div in 11 steps.

Delay Range— 0.2 μs to 50 s.

External Input— 270 mV/div or 2.7 V/div dual trace, 5 mV/div to 10 V/div single trace.

CRT

Display Area— 8 x 10 divisions (0.8 cm/div)

Accelerating Voltage— 14 kV

Phosphor—P31

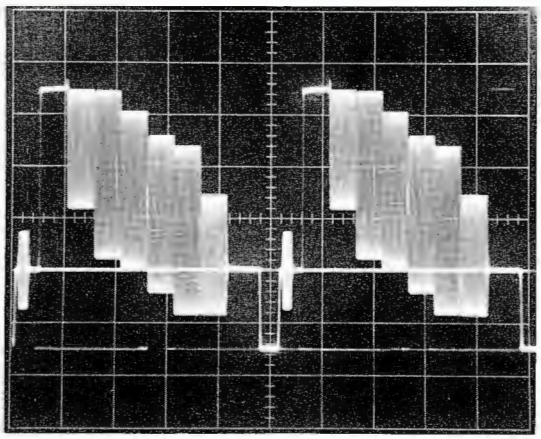
OTHER

Amplitude and Time Calibrator— 1 V or 0.1 V output, 5 mA output, 1-kHz squarewave.

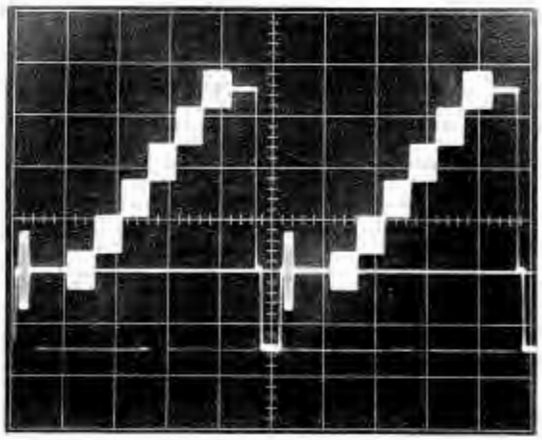
Power Requirements— 90 to 136 V or 180 to 272 V, 48 to 62 Hz, 92 W at 115 VAC.

453A MOD 127C

Television Oscilloscope



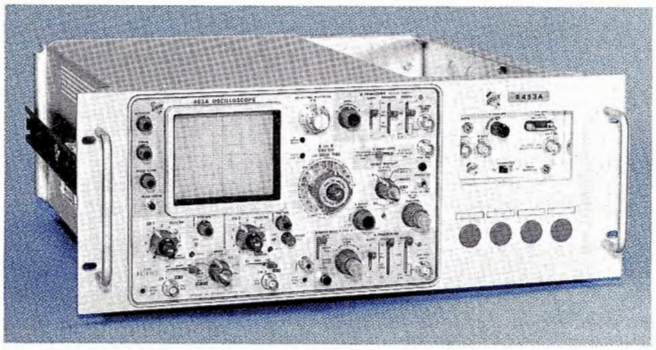
NTSC color bar test signal displayed on the 453A MOD 127C.



Modulated staircase test signal displayed on the 453A MOD 127C.

453A MOD 127C Dimensions and Weights

Height	7-1/8 in	18.2 cm
Width	12-1/2 in	30.8 cm
Depth (incl. panel cover)	20-1/2 in	52.0 cm
Depth (handle extended)	22-3/8 in	56.8 cm
Net weight (w/o panel cover)	29-1/4 lb	12.7 kg
Net weight (with panel cover and accessories)	31-1/4 lb	13.6 kg
Domestic shipping weight	≈43 lb	≈18.7 kg
Export-packed weight	≈57 lb	≈24.8 kg



R453A MOD 127C Dimensions and Weights

Height	7 in	17.8 cm
Width	19 in	48.3 cm
Depth (behind front panel)	18 in	45.7 cm
Net weight	33-1/2 lb	14.5 kg
Domestic shipping weight	≈65 lb	≈28.2 kg
Export-packed weight	≈86 lb	≈37.4 kg

Included Standard Accessories—Two P6061 6-foot Probes with accessories (010-6061-03); 50-Ω 18-inch BNC cable (012-0076-00); BNC jack post (012-0092-00); two 6-32 adapters (103-0051-01); snap-in light filter/TV graticule (NTSC) (378-0664-01); snap-in light filter/TV graticule (CCIR) (378-0664-02); blue light filter (378-0664-00) and CRT ornamental ring (354-0248-00), both installed; instruction manual (070-1089-00) with MOD 127C insert; operator's manual (070-1105-00); five fuses, assorted spares. Rack models also include mounting hardware, slide-out assembly (351-0101-00).

453A MOD 127C OSCILLOSCOPE **$2135**

R453A MOD 127C OSCILLOSCOPE **$2220**

CONVERSION KIT

Portable to Rackmount—Includes hardware and instruction to convert the 453A Mod 127C Portable Oscilloscope for rack-mount installation.
Order 040-0446-01 ..... $110

OPTIONAL ACCESSORIES

Optional accessories increase measurement capability and provide added convenience. The probes supplied with the 453A MOD 127C satisfy most measurement requirements; optional probes, including high-voltage and current-measuring probes, may be better suited for particular applications. See catalog accessory pages.

C-30A Compact Camera—f/1.9 lens, magnifcation variable from 1:1.5 to 1:0.7, Polaroid Land* Pack-Film back for 3000-speed film, order C-30A-P $480

Scope-Mobile® Cart— 200-1 is compact for easy maneuvering $95

Mesh Filter—Improved display contrast and EMI filtering is obtained with this filter, which is easily inserted in place of the ornamental ring.
Order 378-0648-00 ..... $15

Protective Cover—The protective cover can be used during transport or storage, and is constructed of waterproof blue vinyl, order 016-0074-01 ..... $10

*Registered Trademark Polaroid Corporation

U.S. Sales Prices FOB Beaverton, Oregon

75 Ω RETURN LOSS BRIDGE

The Tektronix Return Loss Bridge is a compact and rugged device featuring passive components and simple construction. It is designed to measure impedance errors in a 75-Ω system in terms of return loss, using a wideband, high-gain differential amplifier and oscilloscope (TEKTRONIX Type 1A5/547 or 7A13/7000-Series) as the error detector. The TEKTRONIX 011-0103-00 and 011-0103-01 are 75 Ω, 0.2% double-ended termination resistors supplied as removable bridge arms. Two matched coax cables extend the bridge arms and are permanently attached to the bridge. The ability to disconnect either or both bridge arms provides for a maximum degree of flexibility, during both calibration and in making measurements.

The bridge can be driven by a number of different sources such as VIT test signals, squarewaves, sinewaves, sine-squared pulses, multiburst, and swept-frequency sinewaves. With the Return Loss Bridge coupled to the differential amplifier and oscilloscope, a television test signal such as the multiburst can be used to measure impedance errors over the complete video spectrum with a single measurement.

CHARACTERISTICS

RETURN LOSS—At least 54 dB, DC to 10 MHz.

MAXIMUM INPUT VOLTAGE—6 V RMS (6 V RMS, DC to 1.2 MHz decreasing to 0.7 V RMS at 10 MHz when used with Type 1A5 or 7A13).

RETURN LOSS BRIDGE, order 015-0149-00 ..... $100
Includes instruction manual (070-1024-00).

TERMINATIONS

75-ohm termination. 75 ohms within 0.5% (at DC). Return loss is at least 52 dB, DC to 10 MHz, maximum input voltage is 5 V RMS, center conductor to ground.

BNC, order 011-0102-00 ..... $9.70

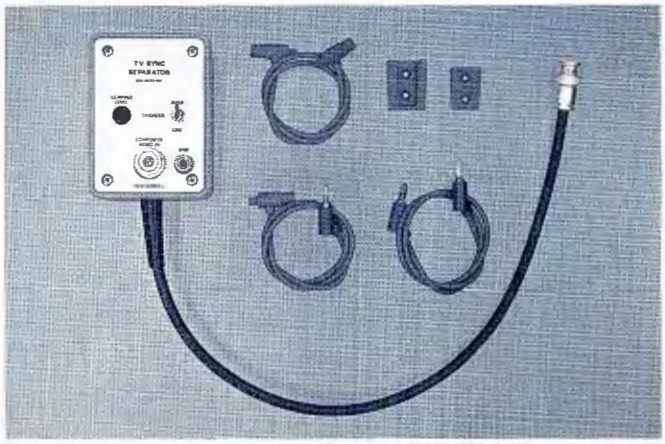
UHF, order 011-0104-00 ..... $9.70

75 ohm feed through termination. 75 ohms within 0.2% (at DC). Return loss is at least 52 dB, DC to 10 MHz, maximum input voltage is 3 V RMS, center conductor to ground.

BNC, order 011-0103-02 ..... $9.70

U.S. Sales Prices FOB Beaverton, Oregon

TV SYNC SEPARATOR



The TV Sync Separator provides the trigger facilities for viewing composite video signals on a conventional oscilloscope. It can be used with Tektronix general-purpose oscilloscopes that have a 100-volt calibrator output. When used with other instruments, a separate 100-V source is required to power the unit.

A front panel switch selects field- or line-rate triggers, and a separate output jack supplies field triggers continuously. The unit has a clipping level control, allowing it to be used with signals ranging from 0.5 V to 8.5 V in amplitude.

POWER REQUIREMENTS—7 mA; operates on 100-V DC, or from the output of an oscilloscope calibrator with a frequency near 1 kHz.

INPUT—Composite video signal from signal source or from Vert Sig Out jack on front panel of oscilloscope.

OUTPUT—≈8-V negative-going composite sync for line rate triggering or ≈6-V negative-going field-rate triggers. Selected by toggle switch. Also second output for field-rate triggers.

TV SYNC SEPARATOR, with illustrated accessories
Order 015-0062-00 ..... $95

VIDEO STAIRCASE DIFFERENTIATOR

The Video Staircase Differentiator permits the use of a general-purpose oscilloscope for measuring amplitude linearity in TV systems.

The staircase differentiator is a filter which differentiates the steps of an unmodulated, linearity staircase (VIT signal) into spikes. The spikes appear on a common-reference level. Amplitude linearity is checked by comparing the amplitude of the spikes on the oscilloscope display. The generator used must supply a staircase having equal risetime, for the output amplitude of the differentiator is proportional to the rate of rise. Input impedance of the differentiator is 75 ohms. Return loss is at least 36 dB.

VIDEO STAIRCASE DIFFERENTIATOR
UHF, order 015-0075-00 ..... $25
BNC, order 015-0154-00 ..... $25

NEW

4501 Scan Converter
4551 Light Pen

- LINKS DATA AND SIGNAL SOURCES TO LARGE-SCREEN TV MONITORS OR RECEIVERS
- CONFORMS TO EIA OR CCIR STANDARDS
- OUTPUT DRIVES SEVERAL MONITORS
- DC-TO-10 MHz X AND Y AMPLIFIERS
- REMOTELY PROGRAMMABLE

The 4501 Scan Converter accepts alphanumeric and graphic data—in the form of analog inputs—and converts it to displays on TV receivers and monitors. The hi-contrast TV displays are ideal for individual or group viewing—even under bright light conditions. The displays may be viewed as light data on a dark background or as dark data on a light background, selected from the 4501 front panel.

The 4501 uses a Tektronix bistable storage CRT. Data may be written once on the storage CRT and retained for an hour *without refreshing*. The results are: call for your data once, then view it as long as one hour on a TV-size display. The 4501 also transfers continuously written data to your TV display.

The output video signal is internally switchable to either EIA 525-line, 60-field or CCIR 625-line, 50-field standards. Selected displays may be light on a dark background or dark on a light background. Outputs provide composite video output for monitor use or modulated RF (channel 2, 3 or 4) for TV receivers.

TYPE 4501 SCAN CONVERTER UNIT **$2500**

TYPE R4501 SCAN CONVERTER UNIT (rackmount model) **$2500**

- POINT, DRAW, WRITE, MAGNIFY ON TV MONITORS AND RECEIVERS
- USE IN BROADCASTING, TEACHING, COMPUTER-AIDED INSTRUCTION
- ANALOG AND DIGITAL OUTPUTS

The 4551 Light Pen Unit, when used in any 525/60 or 625/50 line TV system, produces a visible location indicator (cursor) on all TV displays in the system. The cursor may appear as a crosshair +, a rectanglar box □, or the crosshair may be enclosed by the box ⊞. Size of the cursor is variable by a front-panel control. Conventional video mixing techniques are used to insert the cursor into the TV display system. The cursor tracks the position of a pen as the user moves it across the screen of the TV display.

The cursor calls the attention of the TV audience to any point of the display; the user reduces distractions by removing himself and physical pointers from the display.

To write or draw on the display, the 4551 is used in conjunction with the 4501 Scan Converter. As the pen is moved, its movements are converted to stored images in the 4501. The 4501 then displays the written image on the monitor or receiver appearing as if it is written directly on the TV screen. To remove written data from the 4501, the user pushes Erase, a Light Pen Unit front panel control. This erases all stored data from the 4501 and readies it to store new data.

To magnify, a cursor is placed over that portion of the display which is to be enlarged. With the Light Pen Unit operating in the MAG mode, the area enclosed by the cursor is stored on the 4501 and scanned, magnified up to five times. In the MIXED mode, the area enclosed by the cursor is displayed alternately as a magnified and then a non-magnified area. The user views this as superimposed displays.

4551 LIGHT PEN UNIT **$1800**

U.S. Sales Prices FOB Beaverton, Oregon

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