HEWLETT-PACKARD JOURNAL

TECHNICAL INFORMATION FROM THE -hp- LABORATORIES

CORPORATE OFFICES • 1501 PAGE MILL ROAD • PALO ALTO, CALIFORNIA 94304 • VOL. 17, NO. 6 FEBRUARY, 1966

COVER: A NEW OSCILLOSCOPE FOR 'VITS' TESTING OF TV CHANNELS

SEE ALSO: 'VITS' SIGNALS, p. 7

INTERCITY TV NETWORKS, p. 12

PRINTED IN U.S.A.

A NEW TV WAVEFORM OSCILLOSCOPE FOR PRECISION MEASUREMENTS OF VIDEO TEST SIGNALS

For testing TV transmission systems to meet the standards required for color TV, a special wideband oscilloscope has been designed

COLOR TELEVISION imposes severe requirements on video transmission channels. Because color signals are more complex than black-and-white signals, channels must be more distortion-free in order to deliver an acceptable color picture to the viewer. This means that TV video channels must now be tested more frequently and more accurately than before.

The old visual test patterns transmitted during idle periods are not adequate to meet today's requirements. Consequently, TV broadcasters and networks have recently begun to transmit special test signals, called Vertical Interval Test Signals (VITS), along with the normal TV video signals. These test signals are sensitive to the types of distortion which are most disturbing to viewers. Since they are transmitted while the channel is in actual operation, they make it possible to check the quality of the channel continuously and accurately.

Displaying the TV video waveform and the new test signals, and making accurate measurements of them, calls for an oscilloscope with special capabilities, plus unusual accuracy and stability. These requirements are met by a new –*hp*– television waveform oscilloscope (Fig. 1) which displays and measures black-and-white and color TV video signals, and VITS.

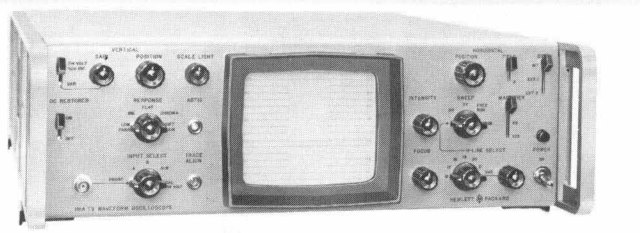


Fig. 1. New –hp– Model 191A Television Waveform Oscilloscope. Oscilloscope is specially designed to facilitate testing of color and black-and-white TV transmission lines and systems in which new VITS signals are used. Instrument is all solid-state (except CRT).

The new television oscilloscope is a precision instrument of advanced design. It is capable of measuring signal amplitudes with 1% accuracy, which is a capability not usually found in oscilloscopes of any type. It produces bright, sharp displays of fast pulses that have low repetition rates. Its frequency response and phase characteristics are carefully controlled, not only within the nominal bandwidth, but also on the rolloffs or skirts of the response curves. Its differential input amplifier has high common mode rejection over an unusually wide frequency range. Transient response is also controlled to insure high-fidelity reproduction of the test signals.

The one percent accuracy of the new oscilloscope is achieved by means of stable, wideband amplifiers and passive filters of special design, by a mesh-type CRT with extremely constant deflection sensitivity over the entire display, by an internal graticule with a new type of flood gun illumination, and by an advanced CRT gun structure which produces a sharper spot. Brightness is 7.5 times that of other –*hp*– oscilloscopes, made possible by the new gun structure, which delivers more current to the screen in a sharper spot, and by the mesh structure, which makes it possible to use a 20 kV accelerating potential without losing deflection sensitivity.

The new oscilloscope displays VITS and video signals without discernible jitter. This results from the use of logic circuits for positive selection of the portion of the waveform to be displayed, and from the use of a special synchronizing circuit which works well even with very noisy input signals.

Front panel controls on the new oscilloscope permit easy selection of the displays that are needed in television testing. Discrete selection is provided for the parts of the video signal which contain VITS. Five special vertical-amplifier gain-filter combinations are available for distortion tests using VITS waveforms.

For minimum size and weight and maximum reliability, the oscilloscope is all solid state except for the CRT. It is designed to operate at temperatures between 0° and 50°C and at high altitudes, so that it can be used in hot locations which are crowded with electronic equipment or in mountain-top radio relay stations.

TV waveform oscilloscopes like the new –*hp*– instrument are used in the Television Operating Centers of the intercity TV network, where video signals are adjusted and switched to the proper channels. Television broadcasting stations also use TV waveform oscilloscopes in their master control consoles, in video tape recorders, in adjusting both black-and-white and color cameras, and in monitoring incoming network programs. Other users include TV producers and manufacturers, and private TV systems.

VIDEO AND TEST SIGNALS

TV picture information occurs at a rate of 30 pictures, or frames, per second, each frame consisting of two fields of $262\frac{1}{2}$ lines each. Lines 1 to 21 of each field constitute the vertical blanking interval, which produces the black areas between frames on a TV receiver. The other lines contain the picture signals. Each line consists of a horizontal sync pulse of maximum carrier amplitude followed by the picture signals, which are used to intensity modulate the electron beam (or beams, in color receivers) of the TV picture tube.

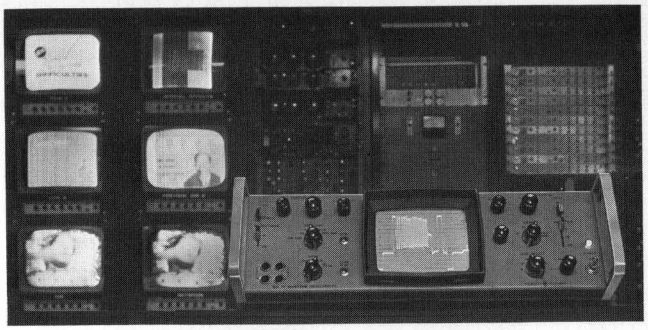


Fig. 2. *New TV Waveform Oscilloscope in typical TV control room. Waveform shown is multiburst signal used for checking frequency response of network.*

Vertical Interval Test Signals are inserted on lines 18 and 19 of both fields. The three VITS waveforms are:*

1. Multiburst (line 18, fields 1 and 2): White bar followed by bursts of 0.5 MHz (Mc/s), 1.5 MHz, 2.0 MHz, 3.0 MHz, 3.6 MHz, and 4.2 MHz. This signal gives a quick check of the amplitude vs. frequency response of the channel. The six bursts have equal amplitudes if the response is correct, and vice versa. To check that the multiburst baseline is at the same level for each burst, the sine waves are removed with a low pass filter.

2. Sine-Squared Pulse and Bar (line 19, field 1): Pulse with sine-squared shape and half-amplitude duration of either 0.125 μs (T pulse), 0.0625 μs (T/2 pulse), or 0.25 μs (2T pulse), followed by bar with sine-squared leading and trailing edges and duration of one-half line. A symmetrical sine-squared pulse indicates that the phase characteristic of the channel is correct, and vice versa. Droop on the top of the bar indicates poor mid-frequency response. Overshoots or ringing indicate poor transient response.

3. Modulated Stairsteps (line 19, field 2): 10 equal steps going from black level to white level with burst of 3.58 MHz sine wave on each step. This signal is used for checking the channel for differential gain (variations in gain with signal amplitude) and differential phase. Low frequency differential gain is checked by filtering out the 3.58 MHz sine waves with a low pass filter and checking the steps for equal amplitudes. Differential gain at 3.58 MHz is checked by filtering out the steps with a band pass filter and checking the bursts for equal amplitudes.

VERTICAL AMPLIFIER FILTER RESPONSES

The filters needed for accurate VITS distortion measurements are built into the vertical amplifier of the new –hp– TV waveform oscilloscope.

The FLAT response is used for general observation of the waveforms, for checking the frequency response of the channel by means of the multiburst signal, and for checking phase and transient responses by means of the sine-squared pulse and bar.

With the RESPONSE control in the FLAT position, the vertical amplifier has a frequency response which is flat within a small fraction of one dB (see specifications) up to a frequency of 4.5 MHz. The response then decreases monotonically, and is down 20 dB at 20 MHz (Fig. 3). The function of this fast rolloff, which is faster than a Gaussian rolloff, is to eliminate high-frequency noise, which can be troublesome in TV waveform observations.

The phase characteristic of the FLAT response is linear, enabling the oscilloscope to produce extremely symmetrical displays of the three sine-squared pulses (the T/2 pulse contains significant frequency components up to 16 MHz). The symmetry of the sine-squared pulse is a measure of the freedom of a channel from phase distortion, so it is important that no assymmetry is introduced by the oscilloscope.

In achieving its excellent amplitude and phase characteristics, the FLAT filter response causes small preshoots and overshoots. However, these are significant only on the T/2 pulse, where they are typically 3%* and equal to each other within 1%.*

The LOW PASS response is used for filtering out the multiburst frequencies in order to check the baseline of the multiburst waveform for dc components which indicate amplitude nonlinearities. It is also used for eliminating the 3.58 MHz color subcarrier bursts from the modulated stairstep signal in order to check for low-frequency differential gain.

The LOW PASS position of the RESPONSE control gives the vertical amplifier a frequency response which is down more than 30 dB near 0.5 MHz and more than 40 dB at all frequencies greater than 1.5 MHz, so that the displays of the multiburst baseline and unmodulated stairsteps are free of residual sine waves. The response is flat within 2 dB to 150 kHz so that the multiburst baseline, the unmodulated stairsteps and the sync pulses are displayed without appreciable rounding.

A typical multiburst waveform consists of a white flag followed by about 6.4 μs of 0.5 MHz sine wave and about 4.7 μs of 1.5, 2.0, 3.0, 3.6, and 4.2 MHz sine waves. The waveform is generated simply by gating the outputs of six oscillators in sequence, without regard to relative phase. Consequently, when the multiburst generator switches from one burst frequency to the next, an abrupt change of voltage may occur in the output waveform. This makes the step response of the oscilloscope's LOW PASS filter critical, for if the transients induced in the oscilloscope do not die out quickly, the baseline of the multiburst waveform will be obscured. In the new –hp– instrument, the 0-to-100% rise time of the LOW PASS response is about 2 μs, and overshoot is less than 2%. This means that, if an abrupt voltage change does occur in the multiburst waveform when the LOW PASS filter is being used, all transients are reduced to less than 2% of their initial amplitudes within 2 μs, leaving 4.4 or 2.7 μs of undisturbed baseline for measurement purposes.

The IRE response of the vertical amplifier is used for attenuating the color signal and any noise that may be present in order to make amplitude meas-

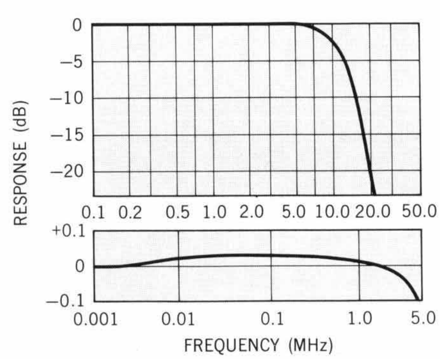


Fig. 3. *Basic FLAT frequency response of oscilloscope is down less than 0.1 dB below 4.5 MHz, less than 1 dB at 8 MHz, 3 dB at 10.5 MHz, then has very fast rolloff and is down 20 dB at 20 MHz. This eliminates high-frequency noise if present on incoming line. Lower diagram shows ±0.05 dB flatness below 1 MHz.*

* See p. 7 herein for a more complete discussion of VITS.

* Similar tolerances apply to the step response. Rise time is less than 50 ns.

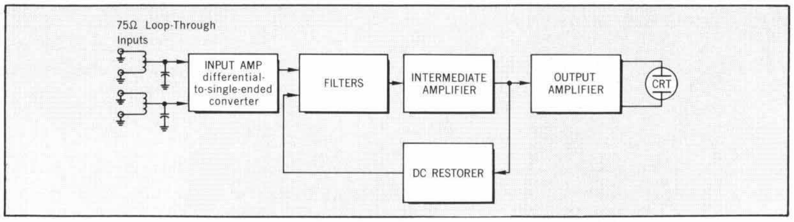


Fig. 4. *Block Diagram of Vertical Amplifier in –hp– Model 191A Television Waveform Oscilloscope. Passive filters of special design give accurately-shaped responses with high stability. Differential-to-single-ended input amplifier permits use of more stable single-ended filters, has high common mode rejection over wide frequency range.*

urements on the monochrome signal. The IRE response gives the vertical amplifier a standard rolloff as described in IEEE Standards.[1] It is down 20 dB at the color subcarrier frequency of 3.58 MHz.

The CHROMINANCE response is used to remove the stairsteps from the modulated stairstep signal in order to check a channel for high-frequency differential gain. The filter puts the 10 bursts of 3.58 MHz on the same line to permit easy comparison of their amplitudes. With the RESPONSE control in the CHROMINANCE position, the vertical amplifier has a bandpass response with center frequency of 3.58 MHz, the color subcarrier frequency.

The DIFFERENTIAL GAIN response is the same as the CHROMINANCE response, except that an additional voltage gain of 5 (14 dB) is provided for making differential gain measurements with respect to 100%.

VERTICAL AMPLIFIER

Fig. 4 is a block diagram of the vertical amplifier. To permit 1% distortion measurements, the four frequency responses of this amplifier had to be carefully shaped and held within tight tolerances. This kind of requirement is unusual in oscilloscope design; usually only the 3 dB bandwidth is specified, and the shape of the rolloff is not.

In order to achieve the four frequency response characteristics with accuracy and stability the vertical amplifier is designed to have a wide bandwidth, and passive filters are used to shape the response. This eliminates any possibility that changes in transistor characteristics with temperature or age, or differences between transistors, will change the responses. Each amplifier block has adequate feedback, even at the high frequencies, so that expected component and temperature variations will not affect either the basic response or the overall response.

The input amplifier is a differential-to-single-ended converter, which allows the oscilloscope to accept the normal two-wire TV cables, but permits the use of single-ended filters, which are much less sensitive to component variations and stray capacitance. The interstage amplifier is also simplified by this arrangement.

Common mode rejection of a differential amplifier is the amount by which signals common to both inputs are reduced in the output. In a TV oscilloscope, high common mode rejection results in a display which is free of any noise and interference common to both wires of two-wire TV cables. In the new –hp– oscilloscope, the common mode rejection of the input amplifier is greater than 46 dB up to 2 MHz, with a 6 dB-per-octave rolloff up to 20 MHz. In actual production instruments the amplifier-filter combinations have overall common mode rejections better than 30 dB up to 20 MHz.

To permit video signals to be observed without disturbing the waveforms, the input connections to the vertical amplifier are made by means of 75 ohm and 124 ohm 'loop-through' systems. Video signals in operating centers and control rooms are carried either by a coaxial cable with a characteristic impedance of 75 ohms or by a balanced two-wire cable with a characteristic impedance of 124 ohms. The input circuits of the oscilloscope are designed to look like short sections of 75 ohm and 124 ohm lines, so that the instrument can be inserted into either type of cable without mismatch.

When distortion measurements are to be made, the display of the video signal is adjusted for a standard maximum amplitude of 140 IRE units. In the polarity most often used, the sync pulses have a magnitude of — 40 IRE, the blanking level is 0 IRE, black is + 7.5 IRE, and white is + 100 IRE. In standard TV practice, 140 IRE units is equal to 1 volt. The new oscilloscope has a switch-selected gain setting which will display 100 IRE units for an input signal amplitude of 0.714 volt peak-to-peak. A variable gain control permits proper adjustment of the display for other input signal amplitudes. The gain can be switched to the fixed gain position without disturbing the setting of the variable gain control, so that the display can be calibrated quickly without readjustment. Also provided is a calibrator which supplies to the vertical amplifier a 30 kHz signal with a peak-to-peak amplitude of 0.714 volt.

Because of the presence of picture information in the composite video signal, the average value of the signal changes continually. To make the display stable, the oscilloscope has a dc restorer which, when the front-panel control is in the ON position, references the display to the blanking level instead of to the average value of the signal. To determine the blanking voltage, the restorer circuit samples the 'back porch,' which is about 5 microseconds of blanking level following each horizontal sync pulse. The presence or absence of the color synchronizing burst on the back porch does not affect the restorer.

The dc restorer is a soft clamp; that

[1] The IRE filter meets the requirements of the IEEE Standard on Television Measurement of Luminance Signal Levels (ASA C16.31 - 1959) except that the tolerances are tighter than those required by these standards.

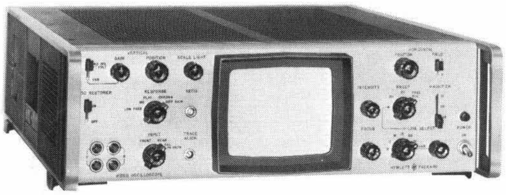


Fig. 5. *HO1-191A version of new TV Waveform Oscilloscope has front and rear telephone-style input jacks, no WRGB sweep mode.*

is, it has a long sampling time constant, so that it takes many samples to establish the final reference voltage. This means that if 60 Hz hum is present on the video signal it will appear on the display and be detected. A hard clamp would remove the 60 Hz hum.

HORIZONTAL SWEEP

Observations of individual VITS waveforms require that an oscilloscope be capable of displaying a single line of the TV picture. Because the picture is scanned in two fields, the scope must also be able to distinguish field one from field two. This is not very difficult, because the fields differ by one-half line in the position of the vertical sync pulses with respect to the horizontal sync pulses; however, it is difficult to make the field selection circuit operate reliably in the presence of noise and signal fluctuations, or when subjected to power line transients or temperature changes. In the new *-hp-* oscilloscope, the field to be displayed is selected with a front-panel switch. Internal logic circuits monitor the TV synchronizing waveform and trigger the sweep at the beginning of the desired field. The sync signal is checked continuously, so that if a noise pulse or other disturbance resets the sweep at the wrong time, the mistake is corrected automatically. The field selection circuit has large tolerances and requires no adjustment. This positive field selection and insensitivity to disturbances results in an easily selected, stable display.

Another front-panel control allows the operator to select for display a single line of the TV picture. Discrete selection of lines 16 through 21 is provided, plus continuously variable selection of the other lines. A video amplifier output supplies both video and a gate signal for causing the selected line to appear brighter on a picture monitor.

The oscilloscope is designed to operate with input signals having peak-to-peak amplitudes between 0.2 V and 2 V. This 10 to 1 range complicates the design of the synchronizing circuit, because a circuit which is designed to operate reliably at low input levels may be completely confused by noise at high input levels. The sync circuit of the new *-hp-* oscilloscope automatically senses the signal level and adjusts the triggering to keep the display jitter-free at all input levels.

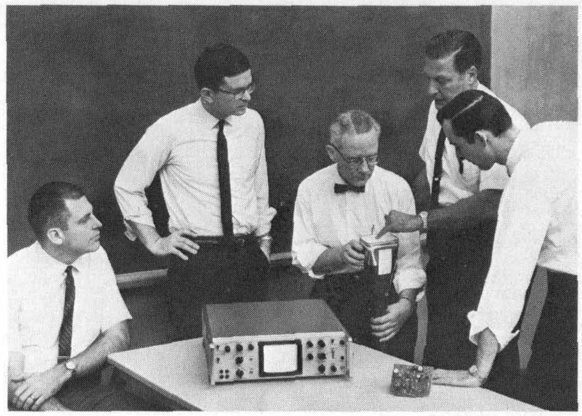


Fig. 6. *Bernard M. Oliver, -hp- Vice President for Research and Development, reviews design of new TV oscilloscope and CRT with part of initial design team at -hp- Research and Development Laboratories at Palo Alto. Engineers are (l. to r.) Edward Heinsen, Richard Monnier, project leader, William P. Kruger, CRT design leader, Dr. Oliver, and Gregory Justice.*

Five sweep modes are provided. They are:

1. 2 V, which gives a sweep length of two fields and a sweep speed without magnification of 0.175 V/cm (about 2.9 ms/cm). V is the duration of one field, or 1/60 s.
2. 2H, which gives a sweep length of two lines and a sweep speed of 0.125 H/cm (about 8 μs/cm). H is the duration of one line, or 63.5 μs.
3. LINE, which also gives a sweep speed of 0.125 H/cm and allows selection of a single line for display.
4. FREE RUN, which is used for envelope display (observation of entire waveform for checking maximum excursions of picture signal).
5. WRGB, which switches the sweep to the external white-red-green-blue staircase signal used in adjusting color cameras.

Sweep magnifications of 5 and 25 are available.

CATHODE RAY TUBE

One of the most challenging requirements for the new oscilloscope was that it must display the T/2 pulse, which is a sine-squared pulse with a half-amplitude duration of 62.5 nanoseconds, occurring at a repetition rate of only 30 Hz. To give the pulse adequate width for measurement purposes, the horizontal sweep speed of the oscilloscope must be magnified to 0.005 H/cm (0.3175 μs/cm). With older oscilloscopes, this fast sweep speed and the low repetition rate of the signal would produce a barely visible display. A partial solution to this problem is simply to increase the accelerating voltage of the CRT. However, the increase in brightness that can be obtained in this manner is limited, and with older CRT designs the higher voltage causes a loss of deflection sensitivity, which would make it impossible to drive the CRT with transistor amplifiers. To give the new oscilloscope considerably more brightness while retaining sufficient deflection sensitivity for transistor drive, a new cathode-ray tube had to be developed.

The basic design of the new CRT is similar to that introduced in *-hp-* high frequency oscilloscopes.[2] This design uses a thin, spherical, metal-mesh shield, to terminate the lines of force of the post-accelerator field. The resulting field configuration eliminates the loss of deflection sensitivity that would otherwise accompany a high accelerating voltage. Since brightness of the CRT increases with accelerating potential, the new CRT uses the highest practical accelerating voltage. Its 20 kV accelerating potential gives an improvement in spot brightness of about a factor of two over other *-hp-* oscilloscopes.

Further increase in brightness was achieved by developing a more efficient CRT gun structure. The new electron gun uses lenses of an improved design to focus the beam, so that it is able to deliver more than three times the current previously attainable. In spite of the higher current density, the spot is sharper than before. The net result of the higher accelerating voltage and the higher current density is an improve-

[2] Floyd G. Siegel, 'A New 50 MC Oscilloscope Based on an Advanced CRT Design,' 'Hewlett-Packard Journal,' Vol. 13, No. 8, April 1962.

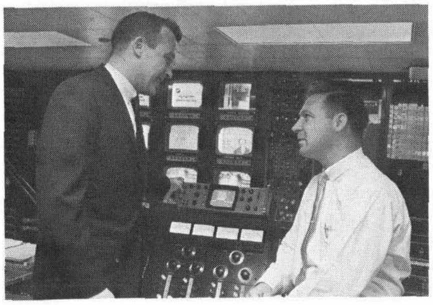


Fig. 7. Ralph R. Reiser, leader of TV Waveform Oscilloscope project at -hp- Oscilloscope Division, Colorado Springs, discusses new Model 191A with chief engineer H. H. Schubarth of station KBTV, Denver.

ment in brightness of about 7.5* over -hp- high-frequency oscilloscopes, and an easily interpreted T/2 pulse display.

Measurements of Vertical Interval Test Signals (VITS) must often be made to an accuracy of 1%. This means that an internal graticule is a necessity, because external graticules are subject to parallax errors. The new oscilloscope has an internal graticule in the same plane as the phosphor, which eliminates parallax and permits precise reading of the display from any angle or from a distance. The vertical scale of the internal graticule is marked in IRE units.

Certain VITS measurements call for external overlay graticules to be used in conjunction with the internal graticule. An array of external graticules for the new oscilloscope is being prepared.

Illumination of both internal and external graticules is accomplished by flooding the CRT screen with electrons. The method for doing this is another new -hp- development. The source of electrons is located behind the mesh structure of the tube, and the mesh helps to distribute the electrons evenly over the tube face. The amount of illumination can be controlled from the front panel.

P31 aluminized phosphor is used in the new CRT.

ENVIRONMENTAL DATA

The oscilloscope is designed to operate at temperatures from 0° to 50°C, at altitudes up to 15,000 feet, and under conditions of moderately severe vibration and shock.• Because it is all solid state except for the CRT, power requirements are low (70 watts), no cooling fan is needed, and weight is only 34 pounds. The low power dissipation and ability to operate in high-temperature environments make the new instrument especially suitable for operation in areas like TV control rooms, which are already crowded with electronic equipment. High-altitude operation and shock resistance make it capable of operating anywhere, even in mountain-top radio relay stations and mobile operating centers.

ACKNOWLEDGMENTS

Design and development of the Model 191A TV Waveform Oscilloscope were joint efforts of several divisions of the Hewlett-Packard Company. The initial design was carried out by the Advanced Research and Development Laboratory. The design team was directed by Richard E. Monnier and included Edward A. Heinsen, Gregory Justice, Richard A. Marconi, and Philip G. Foster, with technical support from Bernard M. Oliver and Paul E. Stoft. Design and development of the new CRT were the responsibility of William P. Kruger, Domenick J. DeSimone, and James A. Chesebrough, with technical assistance from Bernard M. Oliver. Final design was under the direction of Ralph R. Reiser of the oscilloscope division. The design team included William G. Smith, Carlton E. Glitzke, Ed Allen Evel, Wayne O. Budge, George L. LeBaron, Jr., Donald E. Watson, Robert H. Briggs, and Leon Skidmore.

— Richard E. Monnier and Ralph R. Reiser

* The factor of 7.5 is a measured value. The eye would see an improvement in brightness of about three times.

• Vibration: 15 1 min cycles, 10-55 Hz, 0.010" peak-to-peak Shock: 4 in. drop of one edge, acceleration of 6 g for 11 ms, 3 ft. drop of shipping container.

SPECIFICATIONS

-hp-

MODEL 191A

TELEVISION WAVEFORM OSCILLOSCOPE

VERTICAL AMPLIFIER

INPUT CIRCUIT: 75 ohms unbalanced to ground, and 124 ohms balanced to ground.

INPUT IMPEDANCE (of amplifier): 12.5 k unbalanced to ground, and 25 k balanced to ground.
Power off-on transient less than 10 mV.
Protection to 100 volts, 1 μs pulses.

COMMON MODE REJECTION: -46 dB from 0 to 2 MHz; decreases at 6 dB/oct from 2 MHz to 20 MHz.

GAIN CONTROL: Variable control provides 140 IRE vertical deflection for composite TV video signal from .2 volts to over 2 volts peak-to-peak amplitude. Separate gain switch sets the vertical deflection to display 100 IRE units for a 0.714 volt ±1% peak-to-peak input signal.

DC RESTORER: "On" position restores to the back porch with a time constant greater than 0.3 second. Color burst effect on display will be less than 1 IRE unit. "Off" position restores to average value of signal.

CALIBRATOR: Automatically switches vertical channel to "flat" position, horizontal sweep to the "2H" position, and provides a 30 kHz, 0.714 volt ±1% signal to the vertical amplifier.

FILTER RESPONSES

"FLAT" POSITION: ±0.05 dB from 100 Hz to 1 MHz, monotonically decreasing to -0.10 ±0.05 dB at 4.5 MHz, -3 dB at 10.5 MHz, and -20 dB at 20 MHz. Rise time less than 50 nanoseconds. Overshoot and preshoots of the T/2 pulse are less than 5% with overshoot and preshoots equal within 1% of each other. Less than 1% tilt on 60-Hz cycle squarewave with dc restorer off.

"IRE" POSITION: Standard roll-off as described on page 484 of 1958 IRE Proceedings. 20 dB down at 3.58 MHz.

"CHROMINANCE" POSITION: A band-pass filter with a Q of 4 and a center frequency of 3.58 MHz.

"DIFFERENTIAL GAIN" POSITION: Same response as the Chrominance with 14 dB of additional gain.

"LOW PASS" POSITION: Down more than 30 dB at 0.500 ±0.015 MHz; down more than 40 dB at all frequencies 1.5 MHz and higher; down less than 2 dB at 0.15 MHz.

HORIZONTAL SWEEP

INTERNAL SWEEP:
"2V" POSITION (0.175 V/cm): 5% for ×1, ×5, and ×25 magnification.
"2H" POSITION (0.125 H/cm): 3% for ×1, and ×5 magnification. 5% for ×25 magnification.
"LINE" POSITION: 0.125 H/cm. Discrete line selection for lines 16, 17, 18, 19, 20, and 21. Variable line selection for all lines in the entire field.
"FREE RUN" POSITION: Envelope display for fast video setup.

EXTERNAL INPUTS: Two inputs to sync oscilloscope to external TV sync generators. Staircase input to accept a 4 step staircase for WRGB (may be modified to accept a 3 step staircase).

FIELD SELECT: A two position switch to positive select the desired field. Circuit is insensitive to noise pulses.

BLANKING: Decoupled to remove trace with no signal input.

LINEARITY: ±0.5% of full scale.

CRT DISPLAY

TUBE TYPE: 20 kV, post accelerator with high writing rate for viewing of T/2 sine^2 pulse; type P31 aluminized phosphor.

GRATICULE: Internal graticule eliminates parallax error. Rectangular 7 cm by 10 cm display; 140 IRE = 7 cm. External graticules for sine^2 pulse and bar, video modulation, etc. Beam alignment control.

BEZEL: Provision for external transparent plate with graticule markings. Provision for illumination of both the internal and the external graticule.

GENERAL

DESIGN: All solid state except for CRT.

POWER: Approximately 70 watts (no fan).

LINE: 115 or 230 volts line ±10%. 50 to 400 Hz.

TEMPERATURE: Operating range from 0°C to 50°C.

ALTITUDE: Operates from 0 to 15,000 feet above sea level.

DIMENSIONS: 16¾ inches wide, 5¼ inches high and 21½ inches deep. (426 mm × 133 mm × 546 mm).

RACK MOUNT: Rack mount kits are provided for all instruments.

PRICE: -hp- Model 191A $1295.
Prices f.o.b. factory.
Data subject to change without notice.

CONTINUOUS TV MONITORING WITH VERTICAL-INTERVAL TEST SIGNALS

A brief description of the signals being transmitted in TV channels for continuously checking channel quality.

To PROVIDE a picture acceptable to the average viewer, a television transmission system must meet rigorous standards. This is especially true for color signals, which are more complex than black-and-white signals and subject to more types of distortion.

Keeping picture distortion within desirable limits requires frequent testing of the transmission channels which carry TV video signals. Until recent years, this was done during the idle periods when no programs were being transmitted. Now, the increasing popularity of color television calls for more frequent checks, but increased use of television has reduced the time available for testing. The result has been the development of methods and signals for continuous, in-service monitoring of transmission quality.

In 1963, television broadcasters and the Bell System agreed on the general form of test signals which would accompany the normal video signal for continuous checking of the network and associated facilities under actual operating conditions. These signals are now being broadcast. Known as Vertical-Interval Test Signals (VITS), they are a combination of several test waveforms developed by television broadcasters, carriers, and manufacturers in the United States and Europe over a period of many years.

A difficulty of VITS is that they are fast signals which occur at low repetition rates (only 30 per second). Hence, viewing them has been difficult in the past. To overcome this problem, a new Television Waveform Oscilloscope has been designed in the -*hp*- laboratories in Palo Alto and Colorado Springs. The new oscilloscope is designed to perform all of the functions necessary for displaying television video signals and VITS and for detecting and measuring the various types of distortion.

The oscilloscope has been built to Bell System specifications for TV waveform oscilloscopes in Television Operating Centers. TOC's are facilities at which network TV programs are monitored, adjusted, and routed over the proper transmission channels. The oscilloscope is also intended to be used by local TV stations for monitoring the quality of programs received from the network and of their own transmissions. If the VITS waveforms indicate trouble, operators in communication with each other by telephone can trace the trouble to its source and initiate correction procedures.

Another major application for the oscilloscope is in video tape recorders to assure that signals being recorded are of acceptable quality.

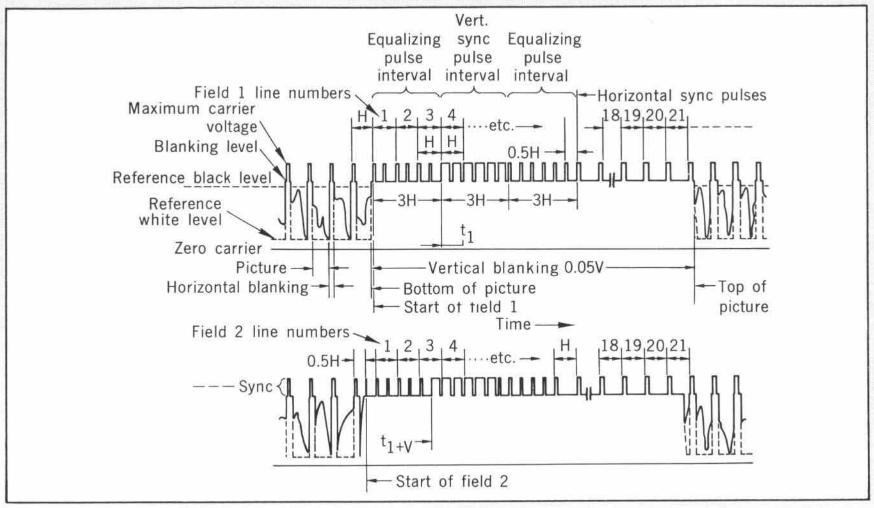


Fig. 1. *Video waveform after detection (carrier removed) for black-and-white television. Figure shows portions of video waveform near vertical blanking interval. Each complete picture, or frame, of 525 lines is scanned in 2 interlaced fields of 262½ lines each. Top waveform shows end of field two and start of field one, and bottom waveform shows end of field one and start of field two. Each line of picture consists of horizontal sync pulse followed by picture information which is used to modulate intensity of picture tube beam as it scans across screen. Vertical blanking intervals of 21 lines produce black area at top of TV picture. New Vertical-Interval Test Signals are inserted in lines 18 and 19.*

THE TELEVISION VIDEO WAVEFORM

The composite video signal is broadcast on an amplitude-modulated carrier with minimum carrier amplitude representing white and maximum carrier amplitude representing black. One complete picture is called a 'frame'. In the National Television Standards Committee system, there are 30 frames per second, each consisting of 525 lines. To reduce flicker in the picture presented to the viewer, each frame is scanned in two fields of 262½ lines each, and the lines of the second field are interlaced between the lines of the first.

Fig. 1 shows the detected video waveform near the beginning of each field. The interval between the last picture line of one field and the first picture line of the next field is called the 'vertical blanking interval'. The 21 lines in this interval do not contain any picture information; they produce a black area at the top of the picture which is normally not seen by the viewer. It is during this interval that the new test signals are inserted. Thus the viewer at home can see the effect of these signals on two lines of each field if he reduces his picture size or mis-adjusts his vertical hold control to cause his picture to roll.

In a correctly-adjusted home receiver, however, these lines are hidden behind the mask and do not degrade the picture.

The first several lines of the vertical blanking interval contain equalizer pulses and vertical sync pulses which return the beam to the top of the

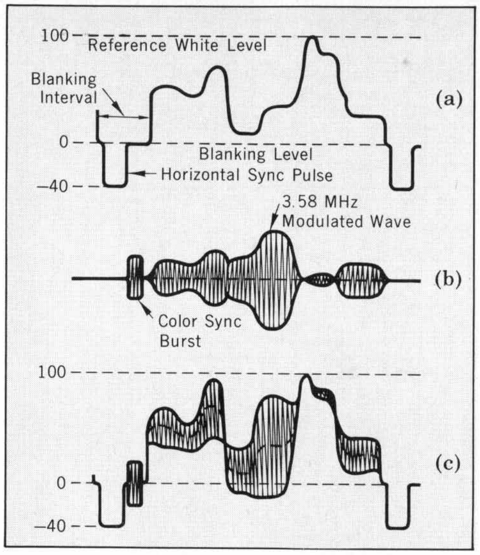


Fig. 2. *Development of composite color signal: (a) typical luminance or monochrome signal for one line of picture, (b) chrominance and color sync signals. To a first approximation, amplitude of 3.58 MHz subcarrier represents color saturation (e.g., deep red or pink), and phase with respect to sync burst determines hue (red, blue, green). (c) Composite color signal is sum of (a) and (b). Black-and-white TV receivers extract only luminance signal. (Vertical Scale is in IRE units: 140 IRE units = 1 volt.)*

screen. Lines 16 through 20 can safely be used for test signals, but line 21 remains free of signal as a guard interval before the start of the video signal. Although other arrangements are being considered by the television industry, Vertical-Interval Test Signals are now inserted only in lines 18 and 19 of each field. Lines 16, 17, and 20 are reserved for possible future use.

THE COLOR SIGNAL

The video signal for color programs is slightly more complex than for black-and-white TV. Fig. 2 shows how the composite color signal is developed. In both color and black-and-white, the brightness signal between the horizontal sync pulses is called the 'luminance' or 'monochrome' signal. Fig. 2(a) shows how the luminance signal might vary during one line. To this luminance signal is added a chrominance signal in the form of a phase- and amplitude-modulated color subcarrier of about 3.58 MHz, shown in Fig. 2(b). To a first approximation the amplitude of the subcarrier determines color saturation (whether a red is a deep red or a pink) and the phase of the subcarrier with respect to the color sync burst determines the hue (red, green, or blue). The composite color signal, consisting of the sum of the various components, appears as shown in Fig. 2(c). Note that the effective axis of the chrominance signal may vary through the luminance range since this axis coincides with the level of the monochrome signal component. Black-and-white sets filter out the color subcarrier to recover the original luminance signal.

The amplitude of the composite signal is measured in IRE units. 140 IRE units is defined as 1 volt peak-to-peak, which is the standard interface video signal maximum amplitude.

TYPES OF DISTORTION

Both black-and-white and color television are degraded by distortion in the following characteristics of the transmission system:

1. FREQUENCY RESPONSE (amplitude vs. frequency).

High frequency rolloff which starts at too low a frequency or occurs at too fast a rate causes the TV picture to look soft and lack detail. Color TV viewing tests have indicated that viewers can detect amplitude variations of only 1 or 2 dB in the frequency response, if the variations occur near the color subcarrier frequency.

2. PHASE RESPONSE (phase vs. frequency).

The phase response of a transmission system should be linear with frequency (constant time delay for all frequencies) up to 4.2 MHz and beyond. Deviations will cause lack of clarity and, in color, hue shift. Phase delay distortions as small as ±0.1 μs at the higher frequencies are easily detected by viewers.

3. TRANSIENT RESPONSE

Transient response includes both amplitude and phase response. If the phase characteristics of the system are not ideal, a black bar may appear at the leading or trailing edge of a sharp black-to-white transition. In a color picture, hue will be shifted with respect to outline: the red of an apple will be shifted with respect to the outline of the apple. Poor low-frequency response may cause streaking in the picture.

4. DIFFERENTIAL GAIN AND DIFFERENTIAL PHASE (gain and phase vs. signal amplitude).

Variations in gain with signal amplitude will cause white or black areas to shift towards gray, or color desaturation and a washed-out appearance. Variations in phase with amplitude are most harmful to color signals, and result in hue shift as a function of signal amplitude: saturated yellow, for example, may appear green or orange, so that a dress which appears yellow in dim light may change to green or orange in bright light.

In the VITS system, frequency response is checked by a 'multiburst' signal, phase and transient responses are checked by the 'sine-squared pulse and bar,' and differential gain and phase are detected by modulated stairsteps. These signals, along with black and white reference levels, are inserted at the point of program origin.

MULTIBURST

The multiburst signal (see Fig. 3) is inserted on line 18 of fields one and two. It consists of a 'white flag' used to establish the reference white level, followed by bursts of frequencies of 0.5 MHz, 1.5 MHz, 2.0 MHz, 3.0 MHz, 3.6 MHz, and 4.2 MHz. If the system has a frequency response characteristic which is flat through the 4.2 MHz range, as it should be, the amplitudes of the bursts will be the same, and vice versa. There are obviously large gaps between the multiburst frequencies where deficiencies could occur. This test is very useful, however, because it provides a spot check on the overall system response which can be evaluated visually in a few seconds.

The multiburst signal can also be used to detect frequency-selective distortion, such as amplitude nonlinearities at the burst frequencies. Filtering out the burst frequencies with a lowpass filter leaves only the base line, or average value [Fig. 3(b)]. If amplitude nonlinearity exists at one of the burst frequencies, the burst will be distorted and will contain a dc component which will cause a shift of the base line.

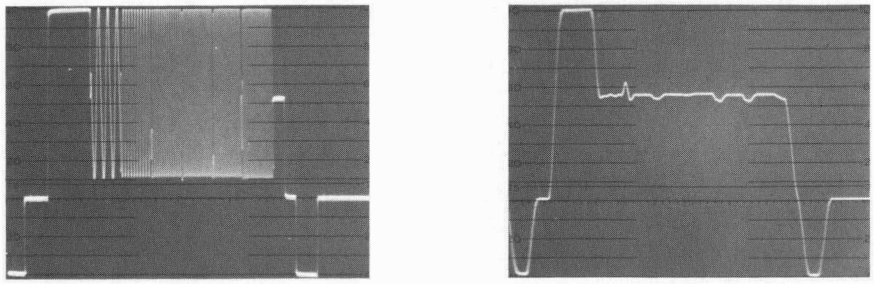
To permit making checks on the multiburst signal, the new TV Waveform Oscilloscope provides switches for selecting line 18 of fields one and two. A lowpass filter, selectable with a front-panel control, is built into the instrument and enables checking for base-line shifts.

SINE-SQUARED PULSE AND BAR

The sine-squared pulse and bar [see Fig. 4(a)] are inserted on line 19 of field one. The pulse and bar are really two separate test signals, but they are similar in that they subject the system to the same type of transient signals that are encountered during picture transmission.

When the finite-diameter beam of a camera tube scans across a black-to-white transition, the change in output voltage is not a perfect step, but is more S-shaped, closely resembling a sinusoidal peak-to-peak transition. The frequency of the sinusoid is limited by the system bandwidth, which is about 4 MHz. If such a system were tested with a faster-rise impulse or step voltage, overshoot, ringing, and phase shift might occur even in an adequate system because of excessive high-frequency components in the test signal. The sine-squared pulse is a more realistic test signal; it has accurately controllable frequency components which can be limited to the band of interest. It also has the advantages of being easily generated to an accuracy of 1% or better, and of being mathematically tractable.

The sine-squared pulse is shown in more detail in Fig. 4(b). This is a 0.125 microsecond (half-amplitude width) pulse, known as a 'T' pulse, which has the shape of one cycle of a 4 MHz sine wave. The frequency spectrum of this pulse is shown in Fig. 4(d). The half-voltage point is at 4 MHz, and there is little energy beyond 8 MHz. Thus, most of the test energy is contained in the frequency range of interest. A '2T' pulse, with a half-amplitude width of 0.25 μs, is often used for tests where the main interest is in the 0.5 to 2 MHz range. A 'T/2' pulse is also available for use when wider test bandwidth is desired. Fig. 4(b) shows typical T, 2T, and T/2 pulses.

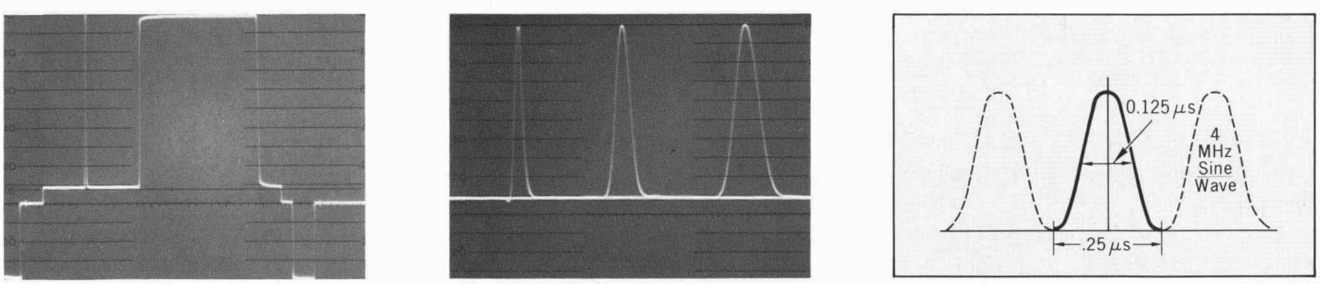


(a) (b)

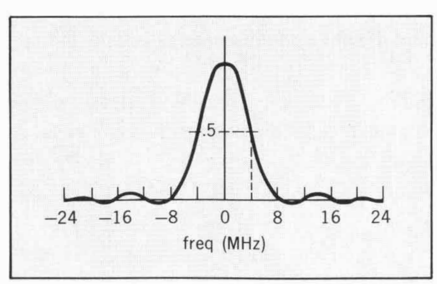
Fig. 3. *Oscillograms made with –hp– Model 191A TV Waveform Oscilloscope displaying Vertical-Interval Test Signals. (a) Multiburst signal consists of 'white flag' and burst of frequencies of 0.5 MHz, 1.5 MHz, 2.0 MHz, 3.0 MHz, 3.6 MHz, and 4.2 MHz. If frequency response of channel is correct, all bursts are reproduced with same amplitude. Sweep speed is 8 μs/cm. Model 191A vertical amplifier is in FLAT filter response position. (b) Same signal with Model 191A LOW PASS filter response, showing base line of multiburst.*

The sine-squared pulse reveals deficiencies in the high-frequency transient response of the system. Its amplitude will be reduced if the high frequency rolloff of the system occurs at too low a frequency. It is also particularly sensitive to phase distortion, because its phase characteristic is linear to a frequency well above the highest video frequency. Another way of saying this is that the group delay or envelope delay characteristic of the sine-squared pulse is constant to a high frequency (>16 MHz for the T/2 pulse). Hence, if the system does not delay all frequency components by the same amount, the sine-squared pulse will be distorted; it will no longer be symmetrical, and ripples will appear on its leading or trailing edge. If high frequencies are delayed less than low frequencies, for example, a ripple occurs on the leading edge.

The other test waveform on line 19 of field one is the sine-squared bar or 'window'. This is a flat-topped pulse with a duration of one-half line. Its leading and trailing edges have a sine-squared shape corresponding to the 2T pulse. The bar is sensitive to distortions at middle frequencies: droop appearing at the top of the bar is related to streaking in the TV picture, and as

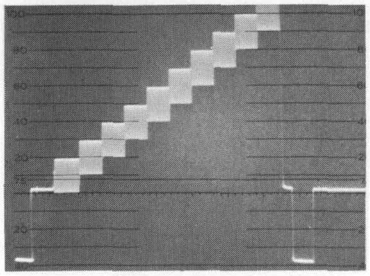


(a) (b) (c)

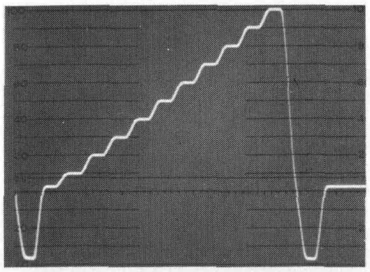


(d)

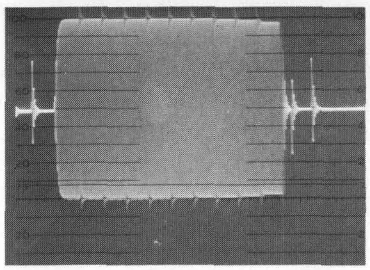
Fig. 4. *(a) Oscillogram made with Model 191A of sine-squared pulse and bar used for testing transient response of channel. Sine-squared shape subjects system to same type of transient as is encountered in picture transmission. Pulse tests high-frequency transient response and phase response. Bar tests mid-frequency response. Sweep speed 8 μs/cm. FLAT filter response of oscilloscope. (b) Triple exposure showing T/2 pulse (0.0625 μs sine-squared pulse), T pulse (0.125 μs), and 2T pulse (0.25 μs). Sweep speed is 0.3175 μs/cm, repetition rate is 30 Hz. Special CRT in Model 191A gives clear trace at high writing speed and low repetition rate. FLAT response. (c) Drawing of T pulse. T pulse is one cycle of 4 MHz sine wave. (d) Spectrum of T pulse is down by factor of two at 4 MHz and is zero at 8 MHz.*



(a)



(b)



(c)

Fig. 5. *Oscillograms of VITS made with Model 191A. (a) Modulated Stairstep signal used for detecting variations in gain and phase with signal amplitude. There are 10 steps, each with 3.58 MHz burst superimposed. FLAT filter response of Model 191A. Sweep speed 8 μs/cm. (b) Modulated stairstep. LOW PASS filter response. Sweep speed 8 μs/cm. (c) Modulated Stairstep with Model 191A DIFFERENTIAL GAIN filter response. This response provides bandpass filtering centered at 3.58 MHz, plus 14 dB amplification.*

little as 2 to 5% droop will indicate streaking that is readily detected by viewers.

The new oscilloscope is specially designed for improved display of the T/2 sine-squared pulse. For proper evaluation of the response of the system to this signal, it is often necessary to magnify the time scale 25 times. This results in a fast cathode-ray tube sweep speed of 0.3175 μs/cm. Since the repetition rate of the signal is only 30 Hz (30 times per second), the signal would be barely visible on the usual oscilloscope. The new oscilloscope has a specially-developed CRT with a writing rate 7.5 times that of conventional high-frequency oscilloscopes, which produces a clear, usable trace.

MODULATED STAIRSTEP

The modulated stairstep used in detecting differential gain and phase is inserted on line 19 of field two. It consists of a 10-step stairstep signal going from black to white, with a 3.58 MHz sine wave superimposed on each step [see Fig. 5(a)].

Differential gain is the variation in the gain of a transmisison system as the luminance signal varies between the values for black and for white. In a properly-operating system, changes in luminance voltage should produce no change in either the height of the steps or the amplitude of the sine wave.

Low-frequency differential gain can be detected by removing the sine wave from the modulated stairstep with a low-pass filter and checking the steps for equal height [Fig. 5(b)]. High-frequency differential gain can be detected by removing the steps with a band-pass filter centered at 3.58 MHz; this puts the 10 bursts of sine wave on the same line and permits easy comparison of their amplitudes [Fig. 5(c)].

Differential phase is the variation in the phase characteristic of a system as the luminance level changes from black to white. The modulated stairstep can be used in conjunction with a synchronous phase detector to check for this type of distortion. Phase shifts of 1 degree can be detected in this manner.

To facilitate these measurements, the new oscilloscope includes both a low-pass filter for checking low-frequency differential gain and a band-pass filter centered at 3.58 MHz for checking differential gain at the color subcarrier frequency. An additional 14 dB of amplification is available for use with the band-pass filter if needed.

— Richard E. Monnier and Ralph R. Reiser

CORRECTION

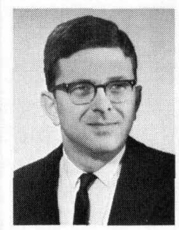
In the last issue the correct photograph for Fig. 3 in the article 'Measurement of Liquid Layer Thickness with Time Domain Reflectometry,' Vol. 17, No. 5, should show a 6-cm step, rather than the 5.5-cm step that appeared. The 6-cm step represents a reflection coefficient (ρ) of −0.60 which, when used in equation 2, yields the stated value of 16 for the dielectric constant e. Similarly, Fig. 4 should show a 6.5-cm step, representing a ρ of −0.65, which then yields the stated value of 22 for e.

OSCILLOSCOPE DESIGN LEADERS

Ralph R. Reiser

Ralph Reiser joined Hewlett-Packard in 1958. As a development engineer in the Frequency and Time Division, he contributed to the design of several electronic counters, and was project leader for the 5280A Reversible Counter. Since 1965, he has been with the Oscilloscope Division as project leader for the 191A Television Waveform Oscilloscope.

After five years in the U. S. Navy as an aviation mechanic, Ralph attended the University of Kansas and graduated with a BSEE degree in 1958. At Kansas, he was elected to Tau Beta Pi, Eta Kappa Nu, and Sigma Tau. He obtained his MSEE degree from Stanford University.



Richard E. Monnier

Dick Monnier joined Hewlett-Packard in 1958 as a development engineer. His first assignments included circuit design for the 185A and 185B Sampling Oscilloscopes. Later, as Group Leader, he contributed to the design of the 120B Oscilloscope, the 140A Oscilloscope and plug-ins, and the 132A Dual Beam Oscilloscope. In 1964 he joined the Advanced Research and Development Division where he contributed to the design of the Television Waveform Oscilloscope as Project Leader before transfer of the project to the Colorado Springs Division.

Dick received his BSEE degree from the University of California at Berkeley in 1958 and a MSEE degree from Stanford University in Jan. 1961.

IEEE EXHIBITION

At the IEEE Exhibition in New York City, Hewlett-Packard will have on display for your interest a large amount of new instrumentation. Included will be such new instruments as a sampling voltmeter, a programmable oscilloscope, an X-Band plug-in for frequency counters, and many, many more.

—hp— will be in Aisle 3E on the third floor of the Coliseum.

Be sure to visit us.

'VITS' PROGRAM

(cont'd from back cover)

seems to hold the most promise is the use of Vertical-Interval Test Signals (VITS).

VITS are signals generated and transmitted by equipment provided by the broadcasters. They are keyed into designated lines during the vertical blanking interval of the picture. These signals are then transmitted along with the normal picture signal. They may be observed, and/or photographed, at appropriate existing monitoring locations by network, Telephone Company, and local station personnel. They can be used for quantitative measurements. Appropriate comparison or analysis of the test results should facilitate trouble location during actual service. Incidentally, VITS signals may be seen in the picture on a home receiver if the picture is rolled half a frame to expose the vertical interval. They appear as a light horizontal streak in the normally dark area between frames.

The Network Transmission Committee has developed a plan and a program for implementing VITS, taking into account the following considerations:

1. Initially, the signals should be such that existing equipment may be used to observe the signals. There should be a minimum requirement for new or modified equipment during the early stages.
2. The following signals should be incorporated in the Vertical-Interval Test Signals:
   a. Multiburst
   b. Sine-squared signal (pulse and bar)
   c. Modulated stairstep
   d. A color signal (to be specified at a later date)
   e. White and black reference level signals, combined into one or more of the above
3. Directives and training should be initiated to insure early effective use of Vertical-Interval Signals.
4. Ultimately, all the test signals should be available simultaneously for most effective usage.
5. Any new equipment being developed should be designed to accommodate ultimate requirements.
6. The test signal specification should be capable of modification to incorporate the benefits of experience with initial use.

Paragraph 3.682 of Part 3 of the FCC Rules allocates the interval beginning with the last 12 microseconds of line 17 and continuing through line 20 for the transmission of test signals. Line 20 is reserved by the broadcasters for other purposes. The Committee felt it desirable that lines 18 and 19 of both fields contain different test signals. It was agreed, however, that most existing oscilloscopes were not adapted to this sophisticated technique. In addition, most equipment available for keying in these signals was not capable of meeting this requirement.

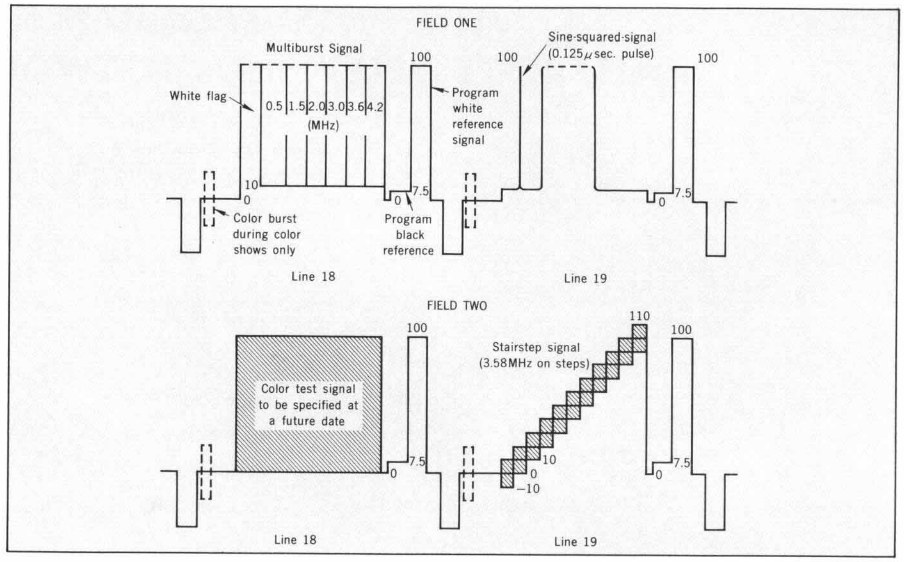


Fig. 2. Simplified Vertical-Interval Test Signals (VITS) used to provide in-service trouble diagnosis. VITS are keyed in to lines 18 and 19 of both fields and transmitted along with normal picture signal. They can be seen on home sets as a light horizontal streak in the normally dark area between frames (vertical blanking interval).

Because of these considerations, NTC decided on a program which was divided into two parts: an interim period and an ultimate period. The Vertical-Interval Test Signals specified for the interim period were planned to satisfy the first three considerations listed previously.

OPTIMUM VITS

The changeover from the interim period will be completed in 1966. The plan for the optimum test signals is shown in simplified form in Fig. 2.

This plan proposes a continuous display of four test signals, combined with amplitude reference signals, keyed into lines 18 and 19 of both fields. It leaves line 20 of both fields available for other purposes. In this optimum arrangement line 18 of field one has the multiburst, combined with black and white reference levels. Line 19 of field one has a sine-squared pulse, with bar, combined with black and white reference level signals.

Line 18 of field two will contain a color test signal, to be specified at a later date. Again, it will include black and white reference levels. Line 19 of field two contains the modulated stairstep, plus the reference levels as in the other three signals. Thus each frame displays the complete array of four test signals with black and white reference levels incorporated with each.

There are some problems involved in implementing a program which will result in Vertical-Interval Signals being useful. One problem is that of reaching agreement on signal standards for Vertical-Interval Signals. This problem is heightened by the fact that so far there is no agreement on standards for full frame test signals which are sent during test and line-up periods on the networks. NTC is working on both of these problems concurrently.

A ramification of the problem of determining standards for Vertical-Interval Signal observations is that these signals traverse a different path than test signals normally used. In the more usual case of out-of-service testing, the network does not go in and out of any broadcasting stations. While there may be several video sections in tandem, there are no local transmitting loops involved except at the originating point, and no local station facilities are in the transmission path. During actual program transmission, however, the networks utilize various configurations which include so called "in-and-out" points, where the signal actually is transmitted in and out of a local station. The Vertical-Interval Signals follow the picture. They go in and out at in-and-out points. Since tests are normally not made for this combination of facilities, no standards for evaluating such measurements are available. Determination of signal standards for Vertical-Interval Signals will thus be more complicated than for full frame test signals on an out-of-service basis. The standards will have to apply to a much greater range of network configurations. Considerable effort is being exerted on this problem, and progress is expected in the near future.

THE 'VITS' PROGRAM FOR INTERCITY TELEVISION NETWORK TESTING

S. C. Jenkins
Long Lines Department
American Telephone and Telegraph Company

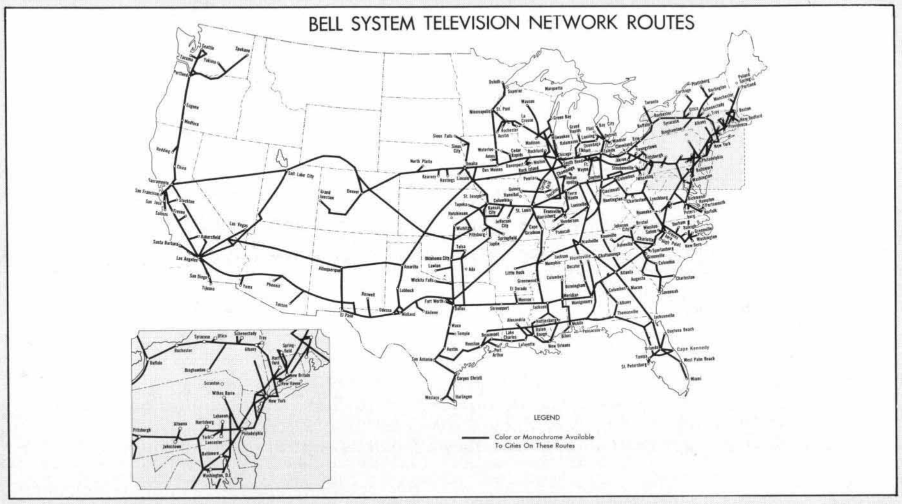


Fig. 1. *Bell System intercity television network in Jan., 1966. The network includes over 126,000 miles of routes, of which only 853 miles or 0.7%, are coaxial cable. Most video channels are radio relay with 4-MHz bandwidth. This represents a rapid conversion to radio relay in 11 years; in 1954, 30% of the 69,000 miles of channels then in service were coaxial cable.*

THE ELECTRICAL SIGNALS that transmit television programs often travel hundreds or thousands of miles in the United States on a vast network of intercity television channels. At the start of 1966 there were over 126,000 miles of video intercity channels on about 32,000 miles of intercity routes. This network is shown in Fig. 1.

Over 99% of the network is now on microwave radio systems providing channels of at least 4-MHz width. Only 853 miles, or less than 0.7% of the network, is furnished on coaxial facilities. In 1954, when the intercity video plant contained the maximum mileage of coaxial facilities, 30% of the 69,000 miles of intercity channels then in service was furnished on coaxial channels, some only 2.7 MHz wide.

The workhorse of the microwave radio relay systems is called the TD-2 system. It operates in the 4000-megahertz band. The system for future applications in the 4000-megahertz band is coded TD-3. It becomes available in 1966 and has a nominal 5-watt output level.

At locations where the intercity network facilities interconnect with local video facilities within a city, certain switching and monitoring functions are needed by the broadcasters. This role is performed at facilities known as Television Operating Centers. The Bell System now provides such Operating Centers at 141 points within the United States. At these centers the instruments necessary for testing and adjusting the video channels are maintained. Monitors and oscilloscopes are provided for the monitoring function.

ENGINEERING COORDINATING GROUPS

Several years ago two organizations were formed for coordinating between the Telephone system and the broadcasters. One organization is the Video Transmission Engineering Advisory Committee, called VITEAC for short from its initials. This group consists of the heads of the Engineering Departments of the three major broadcasting networks and corresponding representatives of the Telephone Company. The second group is a sub-committee of VITEAC, and is called the Network Transmission Committee (NTC). Its members come from the engineering and operating departments of the same organizations which form VITEAC. The Network Transmission Committee concerns itself with those problems of operation and transmission of video and audio networks which become chronic and cannot be, or are not satisfactorily, handled through normal organizational channels.

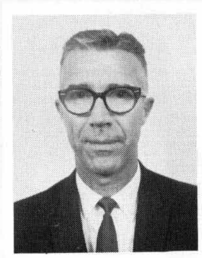
An activity of VITEAC which is of current interest is the investigation of noise measuring techniques for video channels. Both the broadcasters and the Telephone Company would like to see a standard method adopted.

VERTICAL-INTERVAL TEST SIGNALS

The Television networks, the individual TV broadcasting stations, and the Telephone Company are all concerned with improving the quality of the picture seen by the viewing public. In the day-to-day operation of the television networks, many changes are made in the interconnection of these transmission facilities. This includes changes in broadcasters' facilities, changes in local Telephone Company facilities, and changes in interexchange channels. Although designed for long term stable performance, no part of the overall network is immune to trouble. Since many of these troubles are temporary or transient, it is desirable that they be located quickly, while they are present. This means that trouble location must be done on an in-service basis, rather than by tests made on an out-of-service basis after the program is over.

In addition, it is often difficult either to identify or to diagnose troubles from observation of the normal picture signal. Some more rigorous test signal is needed. The technique which seems to come closest to meeting these requirements and

(concluded inside on p. 11)



S. C. Jenkins

Mr. Jenkins is Transmission Engineer in the Engineering Staff of the American Telephone and Telegraph Company, Long Lines Department. As such he is responsible for the transmission methods, practices, and designs used in the engineering, construction, maintenance, and operation of the Long Lines Telephone Plant.

Some of Mr. Jenkins' previous Bell System assignments were in the Transmission Engineering section of American Telephone and Telegraph's General Engineering Department, as Transmission Engineer of the Long Lines Eastern Area, and the engineering department of the Western Electric Company's Defense Projects organization. In the latter post he was responsible for engineering important aspects of communications for such projects as BMEWS and the Eastern Extension of the DEW Line.