

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.

- **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

### 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.



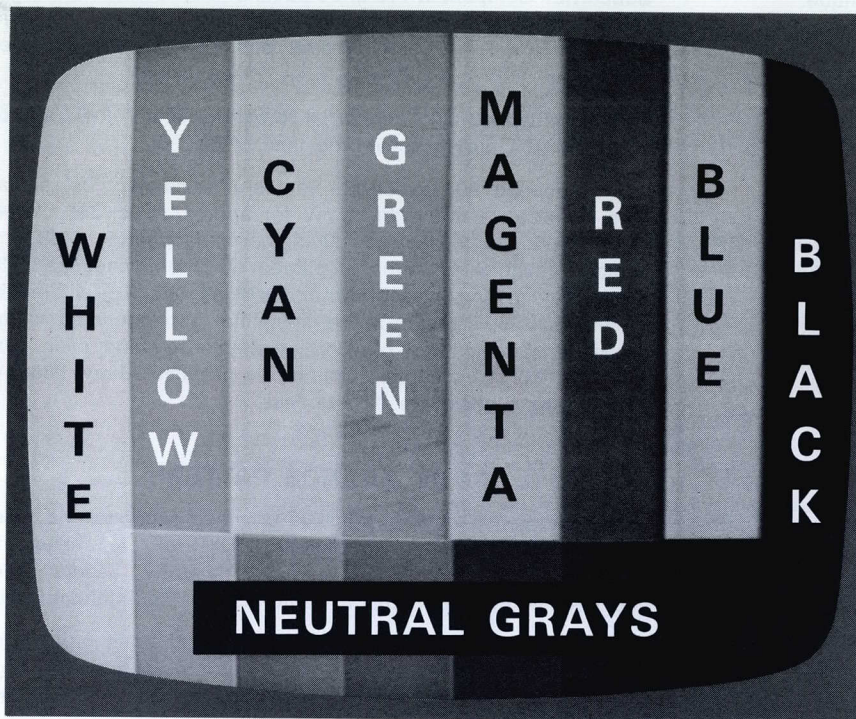


Fig 1. New, split-field signal on color picture monitor. Color bars 100% and 0% saturation. Useful to show gray-scale tracking.



Fig 2. New split field display on waveform monitor. Color bars occupy  $\frac{3}{4}$  field; corresponding luminance signal only completes field. Useful to check picture monitor gray scale rendition.

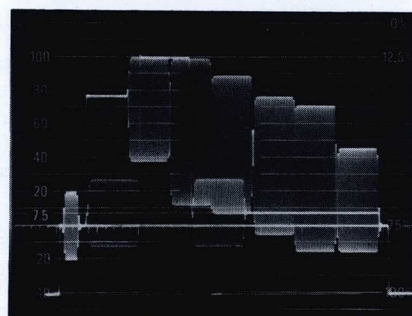


Fig 3. Standard EIA Color Bar Signal defined in RS-189. Setup can be conveniently changed to 10% or 0.

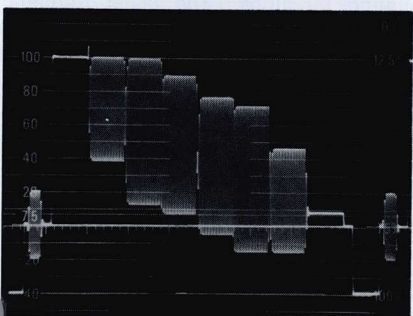


Fig 4. Full field color bars. 75% amplitude with 100% or 75% white bar amplitude.

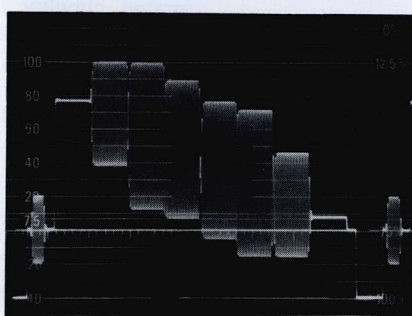


Fig 5. Full field color bars. 75% or 100% selectable. Black bar follows blue bar.

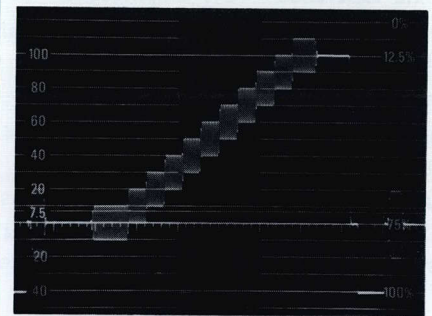


Fig 6. 10-step modulated staircase. Subcarrier is precisely in phase with burst.

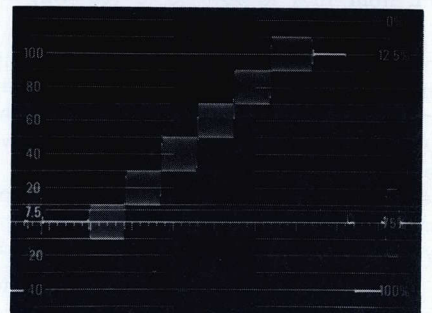


Fig 7. 5-step modulated staircase. Subcarrier amplitude may be increased to 40 IRE by internal adjustment.

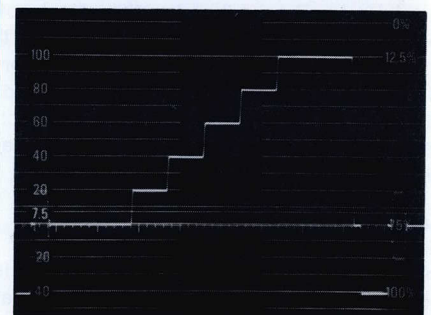


Fig 8. 5-step unmodulated staircase.

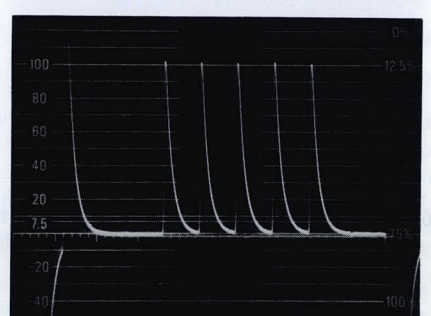


Fig 9. Differentiated 5-step staircase using the Video Staircase Differentiator (015-0075-00) to measure line time nonlinearity. Subcarrier modulation is off.



**White Reference**—75% amplitude or 100% amplitude.

**Chrominance Envelope Risettime and Faltime**—375 ns within 15%.

**Setup**—10%, 7 1/2% or 0%.

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

**Luminance Risettime and Faltime**—115 ns within 15%.

**I and Q Chrominance Signal Width**—9.4  $\mu$ s 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  $\mu$ s within 5%. Intermediate step durations are 6.6  $\mu$ s 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**—Risettime is 375 ns within 15% and duration is 40  $\mu$ s within 5%. Envelope delay from horizontal sync is 16.1  $\mu$ s 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  $\mu$ s.

The modulated 90° subcarrier is the chroma-step test signal. This signal is 30 mV within 5 mV for approx 13  $\mu$ s, 286 mV (40 IRE) within 3% for approx 20  $\mu$ s (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  $\mu$ s 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 geometric 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



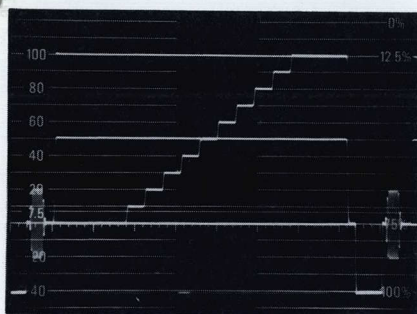


Fig 10. 10-step unmodulated staircase with 10%, 50%, and 90% APL (triple exposure).

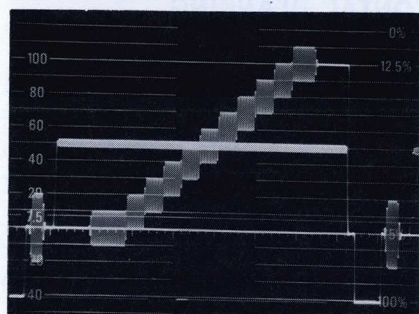


Fig 11. 10-step modulated staircase with APL pedestal at 50 IRE. Pedestal carries unmodulated (5 IRE) subcarrier at 90°. Subcarrier component provides phase markers when measuring differential phase,  $\pm 12^\circ$  for 20 IRE modulation.

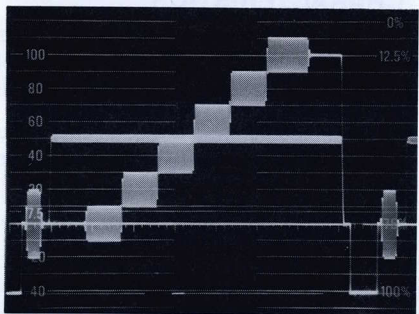


Fig 12. 5-step modulated staircase with APL pedestal at 50 IRE. Subcarrier component on pedestal provides phase markers when measuring differential phase,  $\pm 12^\circ$  for 20 IRE modulation.



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

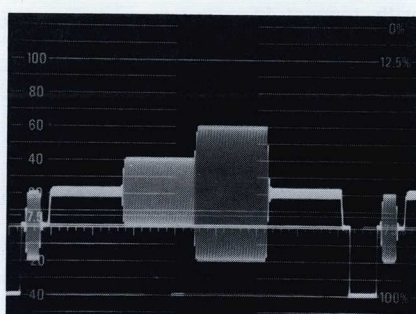


Fig 14. Modulated 90° subcarrier test signal, luminance of 20 IRE shown, variable 0 to 100 IRE in 11 equal steps.

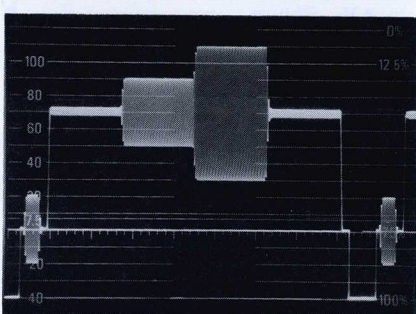


Fig 15. Modulated 90° subcarrier test signal at 70 IRE luminance level. Available as full field or as a VIT signal.

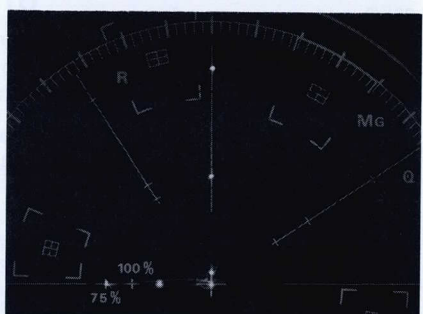


Fig 16. A portion of vectorscope display of 90° modulated subcarrier, 5, 40, 80 IRE. Color sync burst 40 IRE. Staircase subcarrier 20 IRE in phase with color sync burst.

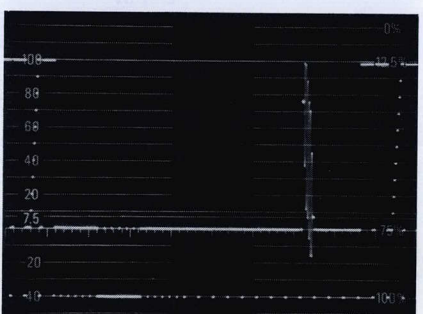


Fig 17. Vertical interval test signal. Color bars or staircase signal may be added to program signals. VITS is inhibited if gen-lock failure should occur, providing fail-safe operation.

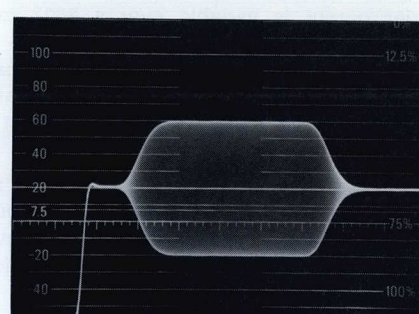


Fig 18. Color sync burst displayed in temporary unlock mode at  $0.5 \mu\text{s}/\text{cm}$  to facilitate breezeway measurement. Burst width is measured between half-amplitude points.

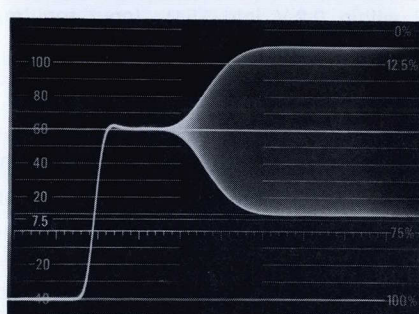


Fig 19. Burst breezeway color lock temporarily unlocked to facilitate breezeway measurement. Sweep speed is  $0.25 \mu\text{s}/\text{cm}$ .

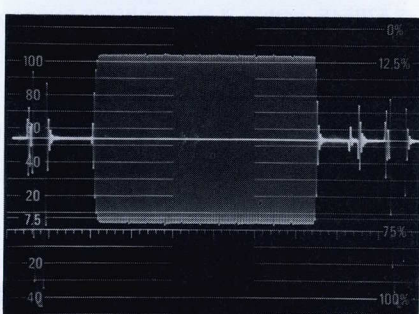


Fig 20. Differential gain measurement on waveform monitor using 10-step staircase. Note absence of luminance transients.

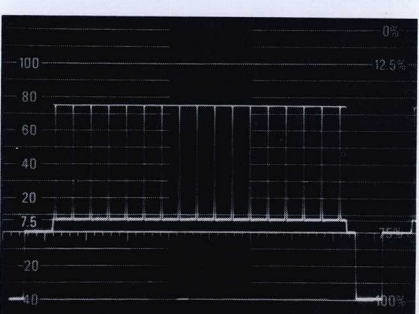


Fig 21. Convergence pattern signal. Picture level is 77 IRE with  $7\frac{1}{2}\%$  setup. Pattern is electronically positionable in both axes.



# 146

## NTSC Signal Generator

### TELEVISION PRODUCTS

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  
Please refer to General Information page