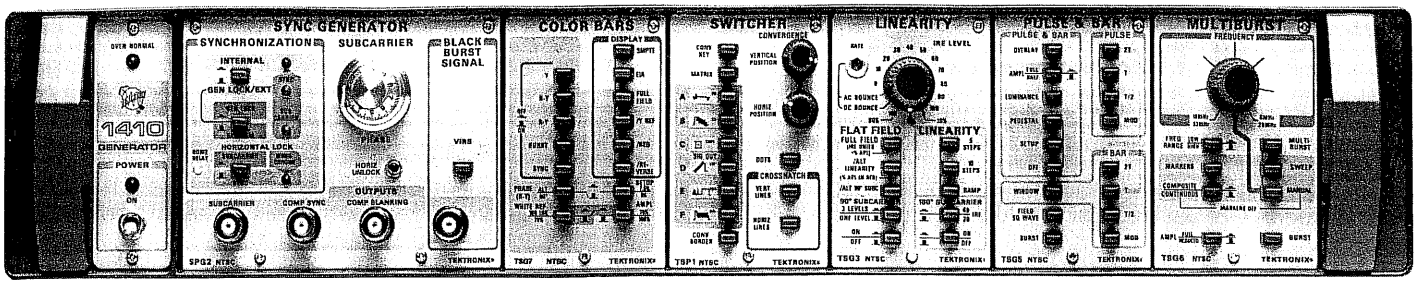


1410R Option 04 Test Signal Generator

1410 NTSC/1411 PAL/1412 PAL-M

Five Test Signal Generators and One Switcher

Conforms to EIA Standard RS-170A (1410)

Sync to Subcarrier Phasing Maintained or Corrected

Color Frame Reference Output

Genlock to Composite Video

Lock to External References

Adjustable Blanking Widths

Adjustable Sync Delays (H and V)

Broadcast Quality

The 1410 Series Sync and Test Signal Generators are precision generators for use in studios, remote vans, maintenance facilities and anywhere high quality sync or test signals are required.

Three different models are available. The 1410 is for NTSC applications, the 1411 for PAL and the 1412 is for PAL-M applications.

Each 1410 Series generator includes a genlock sync pulse generator. Five different test signal generators (four for PAL-M) and one signal switcher are available for each color standard (NTSC, PAL, PAL-M). Any combination of up to five test signal generators and signal switchers can be installed in one mainframe. The following components are available for each color standard.

1410 SERIES PRODUCTS

	Color Standard		
Description	NTSC	PAL	PAL-M
Mainframe	1410	1411	1412
Sync Pulse Generator	SPG2	SPG12	SPG22
Color Bars Generator	TSG7	TSG11	TSG21
Convergence Generator	TSG2	TSG12	
Linearity Generator	TSG3	TSG13	TSG23
Pulse & Bar Generator	TSG5	TSG15	TSG25
Multiburst Generator	TSG6	TSG16	TSG26
Signal Switcher	TSP1	TSP11	TSP21

The 1410 Series generators may be ordered with standard combinations of signal generators or they can be configured to your specific requirement. A 1410 Series generator can be ordered with a minimal complement of signal generators now and others added later as your needs grow.

1410 Series test signal generators begin on page 190. If further assistance is needed contact your local Tektronix Television Sales Engineer.

Unless otherwise indicated by a statement enclosed by parentheses ( ), all information characteristics and descriptions of the 1410 NTSC Series and its generators applies equally to equivalent mainframes or generators for the 1411 PAL and 1412 PAL-M Series. Information in parentheses applies only to the specified series.

SYNC PULSE GENERATORS

The SPG2, SPG12 and SPG22 are high quality sync generators designed for use in systems where accuracy, stable SCH (sync-to-subcarrier) phasing capability, and lockup mode versatility are of prime importance.

Two external synchronization modes, external reference and genlock, are available. In the genlock mode, line field, subcarrier, and PAL pulse (SPG12, SPG22) timing are derived from the incoming composite video signal.

In the external reference mode, line, field, subcarrier, and PAL pulse timing is derived from individual reference signals applied to the generator.

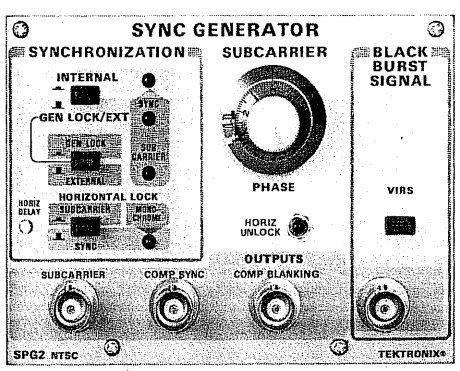
The SCH phasing can be set or maintained at any offset. This is made possible by locking the generator color subcarrier to the reference color subcarrier and referencing generator-line and field-sync-signal timing to subcarrier rather than line and field sync on the incoming reference signals. This feature is of value in editing and program assembly applications. A color frame identification pulse output identifies field 1 of the color field sequence. Should the user desire, the SCH phasing feature of the sync pulse generator can be disabled with a front panel control. In this mode of operation the SCH phasing of the incoming signal is maintained by locking subcarrier to incoming burst or subcarrier, sync to incoming sync.

A slow genlock mode is provided for those applications where fast-lock may upset the system.The slow-lock selector is located on the generator card sets.

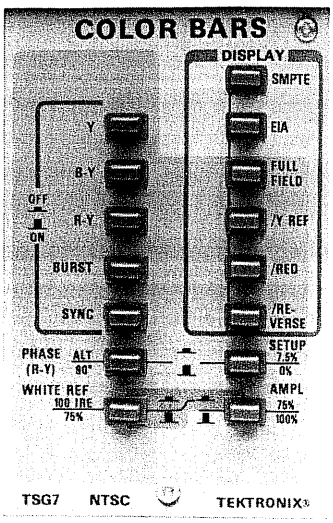
Genlock or external reference lock mode selection may be remotely controlled. Remote manual phasing of the SPG12 or SPG22 signal to an external source is possible in the internal mode. Vertical and/or horizontal timing are altered as in slow-lock operation. Front panel LED's are used to indicate generator lock status.

Internal adjustments permit some variation of burst and blanking widths on the burst flag, comp blanking, and black burst outputs. These adjustments are preset to conform to recognized standards. You can reduce widths initially to allow for the widening that sometimes occurs when the video signal is processed.

The subcarrier frequency accuracy is ±1 Hz when operated in the internal mode. An optional ±10 Hz oscillator (Option 10) is available for the 1410. A black burst output independent of all other outputs is provided. For NTSC systems, the VIRS (Vertical Interval Reference Signal) is factory programmed on line 19, Field 1 and 2 of the black burst when selected by a front panel switch on the SPG2. VIRS can be selected on line 18 if desired.



The SPG2 Genlock sync generator.



TSG7 Color Bars Generator

TSG7/TSG11/TSG21

Color Bars Generators

Color Bars Signals

SMPTE Color Bars (TSG7)

EIA (TSG7)

Fixed Full Field (TSG11/TSG21)

Full Field with Switchable Components

75% or 100% Amplitude

Split Field/Y Reference

Split Field/Red

Split Field Bars/Bars Reversed

The TSG7, TSG11 and TSG21 provide high-quality full field and split field color bars for the 1410 Series Signal Generators. The TSG7 operates independently from any other test signal installed in the mainframe. Its output is available simultaneously with all other test signal outputs. The composition of the signal can be altered by switching off Y, B-Y (U), R-Y (V), Burst, and Sync.

You may also select fixed or alternating R-Y (V) subcarrier phase, bar amplitude, white reference, and setup level (or pedestal).

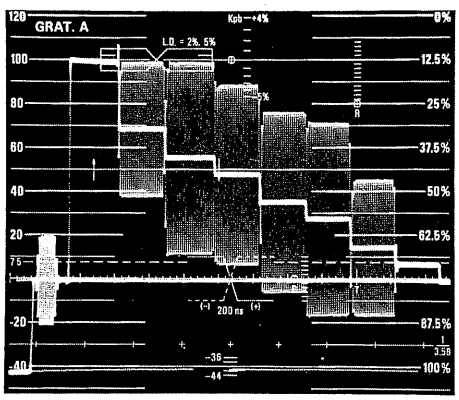
The /Y REF switch selects a split field display of color bars in the same sequence as full field, followed by the luminance portion of the color bars for the remainder of the field. The split can be ½ or ¾ field as selected by internal programming in the sync pulse generator. With this signal, you can check chrominance to luminance delay and picture monitor gray scale tracking while simultaneously evaluating color performance.

The /RED switch selects a split-field display of color bars, as in /Y REF, followed by red chrominance. (Same phase and amplitude, and at the same luminance level as the red bar.) Use this signal for adjusting VTR playback controls. Head equalization errors and noise are easily spotted on a red field. Other bar colors can be chosen by internal programming. The signal is also remotely switchable to color bars/white.

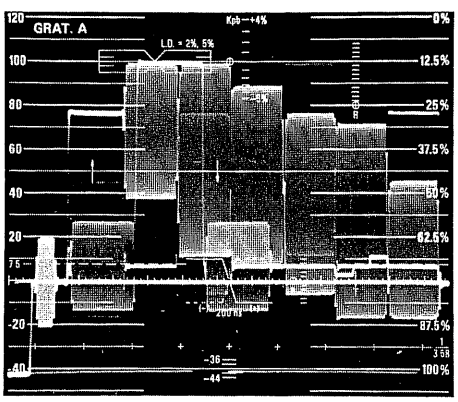
The /REVERSE switch selects a split field display of color bars as in /Y REF, followed by color bars in a reverse sequence. That is black, blue, red, magenta, green, cyan, yellow, white. This signal helps detect chrominance to luminance delay while viewing the kinescope of a color monitor/receiver. Reverse bars are also useful in detecting VTR velocity errors.

The TSG7 will produce color bars VIT on any VIT line desired. (VIT signals cannot be inserted on the program line. Use a 147A, 148, 148M, or 1910 for insertion of VITS on a program line.)

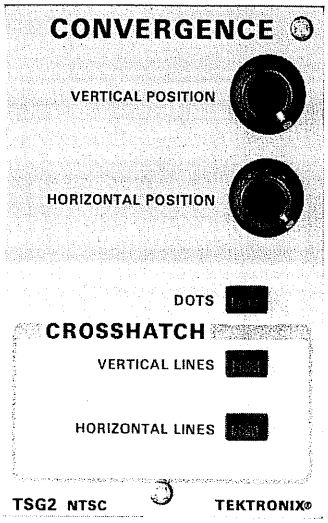
The SMPTE switch (TSG7) is used to select the alignment color bar test signal for television picture monitors. This signal is generated in accordance with the format outlined in SMPTE Engineering Committee Recommendations, ECR 1-1978. SMPTE bars provide an easy way to objectively adjust picture monitor chroma, hue, and brightness.



Color Bars/Y Reference



SMPTE Color Bars



TSG2 Convergence Generator

TSG2/TSG12

Convergence Test Signal Generators

Dots and Crosshatch

Dots Only

Vertical Lines Only

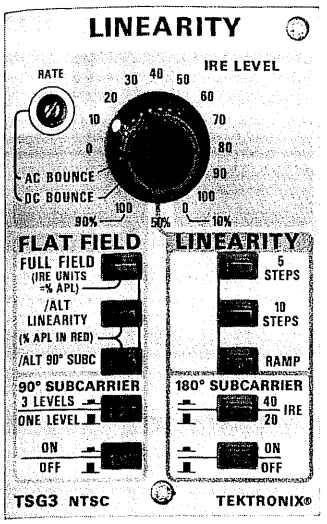
Horizontal Lines Only

Vertical and Horizontal Lines

Position Controls

The TSG2 and TSG12 provide high-quality convergence test signals for the 1410 Series signal generators. You can use them to determine picture monitor or camera scanning linearity, aspect ratio, and geometric distortion. Signals for the TSG2 conform to IEEE Standard 202.

Provision is made for on/off switching of the dots, vertical lines, and/or horizontal lines and for positioning vertical and horizontal lines. The signal output is located on the rear panel of the mainframe in which the test signal generator is installed. The convergence signal output is available simultaneously with all other test signal generator outputs.



TSG3 Linearity Signal Generator

TSG3/TSG13/TSG23

Linearity and Modulated Pedestal Test Generators

5 and 10 Step Staircase Signal
Ramp Signal
2 Modulation Amplitudes

One or Three Level Modulated Pedestal

Flat Field with 11 Fixed Levels

Ac and Dc Bounce

The TSG3, TSG13 and TSG23 provide high-quality linearity and modulated pedestal test signals for the 1410 Series signal generators.

Combine variable APL with either of these signals to measure nonlinear distortions. The generators operate independently of all other test signal generators installed in the mainframe, while the rear panel output is available simultaneously with all other test signal generators' outputs.

You can select the 5 step and 10 step staircase signals and the ramp signal with or without 180° subcarrier modulation for NTSC, or U subcarrier modulation for PAL and PAL-M. The subcarrier amplitude is front panel selectable at 20 IRE or 40 IRE on the TSG3, or at 140 mV and 280 mV on the TSG13 and TSG23. Applications include measuring differential phase and gain, dynamic gain, luminance linearity, and burse phase errors.

With the TSG3, the flat field signal can be used on all active picture lines with levels set by the IRE Level control (% peak white on the TSG13, TSG23) or flat field on four lines can be alternated with one line of linearity or modulated pedestal. When using the alternate mode APL is controlled by the IRE level control (% peak white on the TSG13, TSG23).

The ac Bounce position of the IRE level switch (TSG3) or the % peak white switch (TSG13, 23) provides a signal in which the active portion of each line (excluding sync) changes APL levels at a rate determined by the rate control (1 to 30 second intervals).

For the TSG3, amplitude of the bounce excursions is fixed at 0 to 100 IRE in flat field mode and 10% to 90% APL in alternate modes. Blanking level remains fixed at 0 V. To check ac coupled circuitry use ac bounce.

With the switch set to dc bounce, ac bounce occurs as described above. In addition, the entire signal changes dc level in the opposite direction at the same rate resulting in no change in average dc level. Clamp circuits may be checked using dc bounce.

TSG5/TSG15/TSG25

Pulse and Bar Generators

Pulse and Bar Overlay

Full and Half Amplitude Pulse and Bar

Field Squarewave and Window

Modulated Pulse and Modulated Bar

Front Panel Selection of 2T, T, and T/2 Pulse Width and Bar Risetime

The TSG5, TSG15, and TSG25 are sin² pulse and bar television test signal generators designed for use with the 1410 Series signal generators. They're well suited for testing on equipment manufacturers' production lines and for testing of television transmitters, common carrier microwave and wire lines, and studio distribution systems. Front panel controls provide most test signal options, while internally selectable options provide additional versatility.

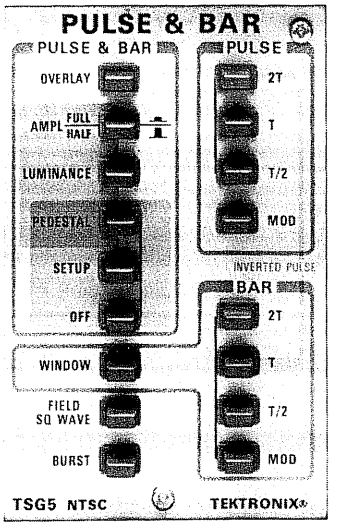
The pulse and bar test signal consists of a sin² modulated pulse, a sin² pulse, and luminance bar. The pulse and bar overlay mode lets you conveniently compare pulse to bar ratio without manipulating waveform monitor controls.

The inverted and noninverted 2T pulses may be overlaid to compare shape and HAD (half amplitude duration). This capability is particularly useful in detecting quadrature distortion which results from envelope detection of the RF modulated video signal. The pulse and bar test signal is also useful in measuring line time and short time distortions.

For sin² pulse signals, three self-cancelling switches permit independent selection of pulse half amplitude duration (2T, T, T/2) independent of bar risetime. In the bar mode, four self-cancelling switches permit selection of luminance bar risetime (2T, T, T/2) or modulated bar.

Full or half amplitude pulse and bar test signals can be provided with or without pedestal or setup (the TSG15 and TSG25 do not offer setup capability). For the TSG5, full amplitude is 100 IRE units with no setup. Half amplitude is 50 IRE with no setup. For the TSG15 and TSG25, full amplitude is 100% (700 mV) with no setup. Half amplitude is 50% (350 mV) with no setup.

The luminance pulse, luminance bar, and luminance components of the modulated pulse and modulated bar may be switched off to provide chrominance pulse and chrominance bar. The chrominance pulse and bar may be placed on a

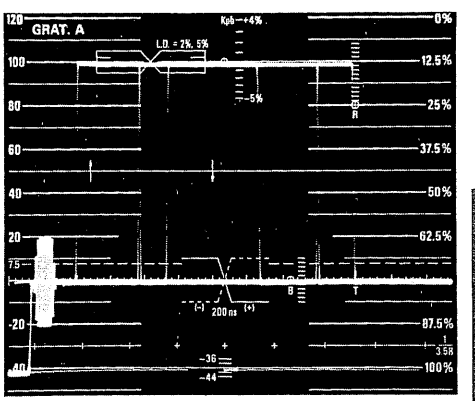


TSG5 Pulse and Bar Signal Generator

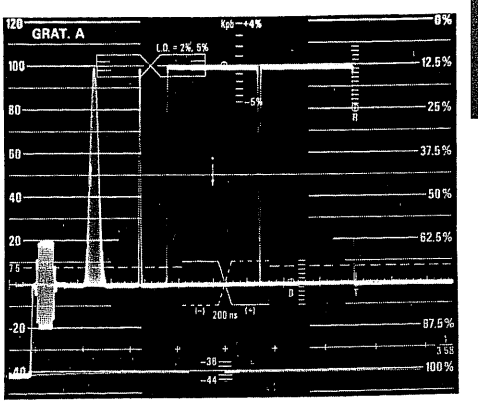
pedestal (50 IRE for the TSG5, 50% for the TSG15 and TSG25) to prevent chrominance from extending below blanking level.

Use the standard field squarewave (with full amplitude and no setup) to measure field time distortion, and the window signal to measure line time distortion and picture monitor smearing. You can switch the color burst off without affecting the chrominance components of the test signals.

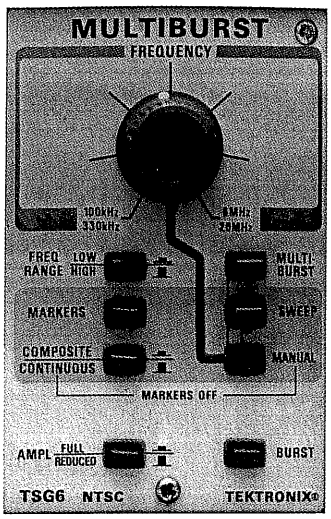
Use the TSG5 for measuring overall gain, transient response, line and field time tilt, and chrominance to luminance delay and gain.



Pulse and Bar Overlay.



Sin² Pulse and Bar with Inverted Pulse.



TSG6 Multiburst Signal Generator

TSG6/TSG16/TSG26

Multiburst Signal Generators

Multiburst Signal

Controlled Risetime Burst Packets

Last Burst Frequency Variable

Manual and Field Swept Frequency Signals to 20 MHz

Markers for Both Frequency and Amplitude Reference

Full and Reduced Amplitude on all Signals

The TSG6, TSG16 and TSG26 are television multiburst and video sweep test signal generators designed for the 1410 Series signal generators.

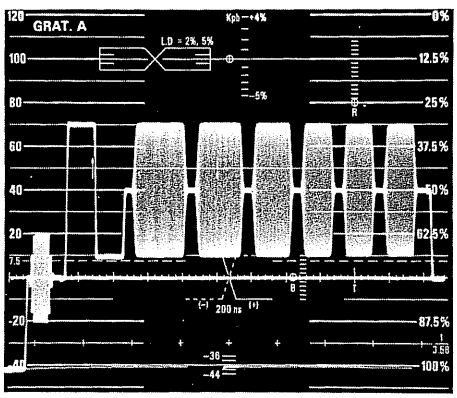
They feature front panel controls for most test signal options, plus special Remote functions for additional versatility. They can be used in many testing applications, including equipment manufacture and microwave or long-line transmission systems.

Performance advances include reduction in harmonic content of sinewave signals and skirt energy associated with gating burst packets. Phase modulation of the burst packets aids ease of measurement by filling in shape of packets. Two ranges of multiburst frequencies are available: the 500 kHz to 4.1 MHz (TSG6) range aids in testing television transmitters and common carrier links, while the 1.25 MHz to 12 MHz range is used in testing television studio equipment and cabling.

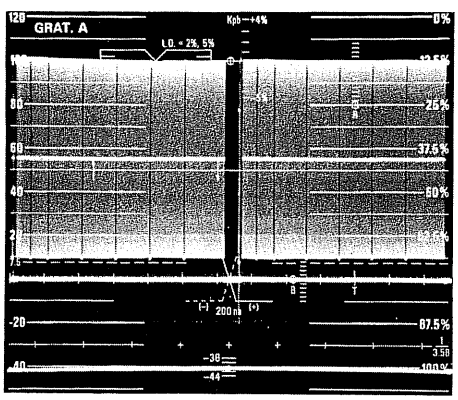
Use these new generators where nonlinearities make reduced amplitude test signals desirable. The reduced amplitude multiburst signal allows accurate testing of video tape record/playback systems, since it is not subject to the false distortion of the full amplitude multiburst that often occurs in such applications.

Using the front panel controls, you can select a high or low-frequency band for each operating mode. SWEEP, allows selection of field sweep signal with or without markers. MARKERS inserts amplitude/frequency markers in Sweep, and amplitude markers in Composite/Manual. BURST allows insertion/deletion of color burst on composite video for use with systems that operate differently when burst is present. COMPOSITE/-CONTINUOUS determines whether sync, blanking, and a pedestal will be added to the sweep and manual signals.

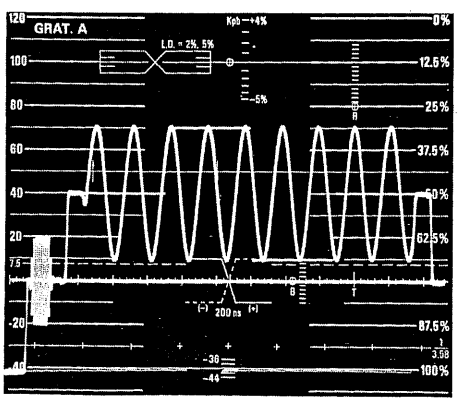
MANUAL selects a fixed-frequency sinewave with frequency determined by the Frequency control and Frequency Range switch. AMP allows selection of either full or reduced amplitude in all operating modes, MULTIBURST selects line-rate discrete-frequency packets with reference insertion levels.



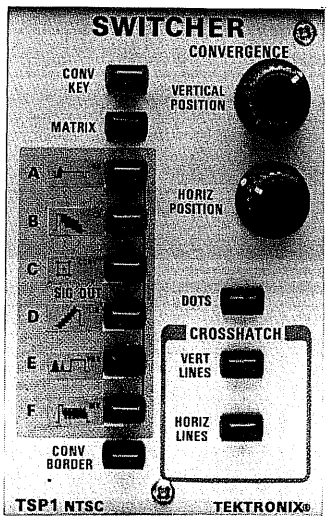
Reduced Amplitude Multiburst



Field Rate Sweep showing amplitude and frequency markers



Line Rate Display of manually selected frequency Showing Amplitude Marker



TSP1 Signal Switcher

TSP1/TSP11/TSP21

Switchers and Convergence Generators

Single Switchable Output for Two to Six Generated Signals

Blanking, Sync and Burst Insertion for External Signal

Matrixing — Eight Programmed Display Formats to up to Six Sequential Signals

Convergence Border

Convergence Key

Crosshatch or Dots

Combined Crosshatch and Dots

The TSP1, TSP11, and TSP21 combine the capabilities of a test signal switcher and convergence signal generator in a single unit. They simplify and expand the uses of the 1410 Series signal generators.

From a single, electronically switched output, you have access to all the test signals (from two to six) generated by the card sets in the mainframe. Meanwhile, you may continue to use the individual generator card sets' parallel outputs, so no restrictions are imposed on an established system. As an added feature, one of the input signals can be external (composite or noncomposite). All of the switcher inputs are provided with clamp circuitry.

Eight different matrixes are stored in the PROM. This signal matrixing capability, combined with the full-field mode of the TSP1 presents several combinations of signals sharing the full field display.

Most of TSP1 switching functions can be remotely controlled through the mainframe's Remote connector.

CHARACTERISTICS

SYNC PULSE GENERATORS

1410 Subcarrier — Frequency (Fsc): 3.579545 MHz ±1 Hz. Pull-in Range: Fsc ±20 Hz.

1410 Option 10 Subcarrier — Frequency (Fsc): 3.579545 MHz ±10 Hz. Pull-in Range: Fsc ±50 Hz.

1411 Subcarrier — Frequency (Fsc): 4.43361875 MHz ±1 Hz. Drift ≤1 part in 10^7 per week. Pull-in Range: Fsc ±20 Hz.

1412 Subcarrier — Frequency (Fsc): 3.57561149 MHz ±1 Hz. Drift ≤1 part in 10^7 per week. Pull-in Range: Fsc ±20 Hz.

PULSE OUTPUTS

Output Level (into 75 Ω) — 4 V (1410), 1 V, 2 V, or 4 V (selectable, 1411 and 1412) ±0.2 V.

Return Loss — ≥30 dB to 5 MHz.

Risetime and Falltime — 10% to 90% (Linear Ramp). 140 ns, (1410, 1422). 250 ns (1411-Other values internally selectable).

Jitter — Linelock: ≤10 ns. Subcarrier Lock: ≤4 ns.

Composite Sync — Equalizing Pulse Duration: 2.3 μs (2.38 μs-1412) ±100 ns. Field Sync: Duration 27.0 μs ±200 ns (27.2 μs ±100 ns-1411). Interval Between Field Sync Pulses: 4.77 μs (4.8 μs-1411, 1412) ±100 ns. Line Sync Duration: 4.7 μs ±100 ns.

Comp Blanking — Line Blanking Duration: 10.7 μs (12.0 μs-1411, 11.1 μs-1412) nominal, adjustable 9 to 12 μs. Field Blanking Duration: 20 lines (25 lines-1411, 21 lines-1412) nominal, adjustable 16 to 21 lines (16 to 25 lines-1411).

Burst Flag — Delay from Line Sync: Adjustable. Duration: 2.51 μs ±50 ns (2.25 μs ±100 ns-1411) adjustable.

Horizontal Line Drive — Duration: Start of line blanking to end of line sync ±100 ns.

Vertical Drive — Duration: 9 lines (1410, 1412) 7 ½ lines (1411).

Field REF — Position: Field one, line 11 or field three, line ten (internally selectable 1410); field one line seven (1411); field one line eight (1412).

PAL Pulse, Phasing (1411, 1412 only) — Negative transition coincident with leading edge of line sync on either +V or −V lines. Factory set to +V. Duration: 4.7 μs, within 0.2 μs. Level: 2 V 75 Ω at H/2 Rate.

PAL Pulse Squarewave (1411, 1412 only) — May be internally selected in place of pulse. Level: 1 V, 75 Ω, H/2 rate. Phasing Transition is coincident with leading edge of line sync. Polarity may be high or low during −135° burst lines.

V/2 (1411, 1412 only) — Level: 1 V, 75 Ω. Rate: 25 Hz (1411) 30 Hz (1412) squarewave. Phasing: Positive during fields 2 and 4 (1411). 1 and 3 (1412).

V/4 (1411, 1412 only) — Level: 1 V, 75 Ω Rate: 12.5 Hz (1411); 15 Hz (1412) squarewave. Phasing: Positive during fields 1 and 4 (1411); 1 and 2 (1412).

64H (1411 and 1412 only) — Level: 1 V, 75 Ω. Frequency: 1 MHz (1411); 1.006993 MHz (1412).

SUBCARRIER OUTPUT

Amplitude — 2 V p-p into 75 Ω. Return Loss: ≥30 dB to 5 MHz.

BLACK BURST OUTPUT

Amplitudes — Sync: 286 mV ±3.57 mV (1410); −300 mV ±3 mV (1411, 1412) from blanking. Burst: 286 mV ±2.86 mV (1410). Absolute 300 mV ±9 mV. Relative: Alternate burst amplitudes equal within 1% (1411, 1412). Setup 53.57 mV ±3.57 mV (1410), 0% (1411), 50 mV ±2.5 mV (1412).

VIR Signal (1410 only) — Chrominance: Amplitude 286 mV ±2.85 mV (40 IRE); phase within 0.5° of burst; envelope risetime Sin^2 shaped 1 μs ±150 ns. Luminance: Setup level 53.57 mV ±3.57 mV (7.5 IRE ±0.5 IRE); gray level 357 mV (50 IRE ±0.5 IRE); chroma pedestal 500 mV ±5 mV (70 IRE ±0.7 IRE); risetime and falltime Sin^2 shaped, 250 ns ±39 ns.

GENLOCK

Input Configuration — 75 Ω loop-through with return loss: ≥−46 dB to 5 MHz (1410); ≥40 dB to 7 MHz (1411); ≥40 dB to 5 MHz (1412).

Input Requirements — 1 V nominal composite video or black burst, sync negative. Sync Amplitude: Nominal ±6 dB. Burst Amplitude: nominal ±12 dB. Burst Sync Ratio: Within 6 dB.

Subcarrier Phase Range — 360° via front-panel goniometer.

Line Sync Delay Range — Adjustable to advance output sync ≥10 μs or delay ≥4 μs (internal adjustment). A front panel screwdriver adjustment provides a delay/advance range of ±0.5 μs.

Stability (Over Ambient Temperature Range 0°C to ±50°C) — Line Lock: Within 70 ns. Subcarrier Lock: Within 35 ns.

Field/Frame Sync — Fast Lock: Direct-acting in one field. Slow Lock: One line/field slew.

Loss of Lock — Indicated by front-panel LED's (automatic switching to full or partial internal).

EXTERNAL REFERENCE

Input Configuration — 75 Ω loop-through.

Subcarrier Input Requirements — Amplitude: 1.0 V to 4.0 V p-p. Frequency fsc: ±10 Hz. Return Loss: ≥46 dB to fsc.

Comp Sync Input Requirements — Amplitude: 2.0 V to 8.0 V p-p. Polarity: Negative.

PAL Pulse Input — Amplitude: 1.0 V to 8.0 V p-p, negative going. Waveshape: Pulse or squarewave. Timing: Pulse duration ≥4 μs. Squarewave Rate: H/2. Phasing: Pulse-negative going transitions coincident with start of line sync on either a +V or −V line (1411, 1412 only).

Loss of Lock — Indicated by front-panel LED indicators. Automatic switching to partial or full internal reference.

Subcarrier Stability — Output follows input.

Line Sync Delay Range — Adjustable to advance output sync ≥10 μs or delay ≥4 μs (internal adjustment). A front panel screwdriver adjustment provides a delay/advance range of ±0.5 μs.

Subcarrier Phase Range — 360° via front-panel goniometer.

COLOR BAR GENERATORS (TSG7, TSG11, TSG21)

Luminance Signal Accuracy — Within 1% or 1.5 mV, whichever is greater.

Chrominance Accuracy — Absolute Amplitudes: Within 3% (all subcarrier components). Relative Amplitudes: Within 1% of the red chrominance bars or 1 mV plus p-p residual subcarrier amplitude, whichever is greater.

Full Field Displays — Bar Width: 6.45 μs (TSG7); 6.5 μs (TSG11); 6.6 μs (TSG21). White Bar Risetime: 130 ns, +20 ns, −10 ns (TSG7); 115 ns ±15 ns (TSG11); 125 ns ±20 μs (TSG21). Time Difference Between Chroma and Lum Channels: ≤20 ns.

CONVERGENCE TEST SIGNAL GENERATOR (TSG2, TSG12)

Displays Available — Crosshatch, vertical lines only, horizontal lines only, dots only, and crosshatch plus dots (dots appear centered in the rectangles formed by the crosshatch pattern). Horizontal and vertical positioning.

Risetime and Falltime — Pulses and setup 135 ns ±15 ns (TSG2); 115 ns ±15 ns (TSG12).

Pulse Amplitude — 77 IRE ±3 IRE (TSG2); 525 mV ±25 mV (TSG12).

LINEARITY TEST SIGNAL GENERATOR (TSG3, TSG13, TSG23)

Luminance Risetime — 250 ns ±39 ns (TSG3); 250 ns ±50 ns (TSG13, TSG23).

Five-Step Signal — Step Amplitudes Nominal: 143 mV (TSG3); 140 mV (TSG13, TSG23). Relative: Largest within 1% of smallest.

Ten-Step Signal — Step Amplitudes Nominal: 71.5 mV (TSG3); 70 mV (TSG13, TSG23). Relative: Largest within 1% of smallest.

Ramp Signal — Linearity: ±1%.

Linearity Subcarrier — Absolute Amplitudes: ±3%.

Relative Amplitudes: ±1%. 20 IRE: 143 mV (TSG3); 140 mV (TSG13, TSG23). 40 IRE: 285.7 mV (TSG3); 280 mV (TSG13, TSG23).

Differential Gain: ≤0.5%. Phase: 180° ±1°. Differential Phase: 0.1°.

Subcarrier Envelope — Risetime: 400 ns ±60 ns (TSG3, TSG23); 350 ns ±50 ns (TSG13).

Modulated Pedestal — 90° Subcarrier. Amplitude: 1 level is 5 IRE to 20 IRE (TSG3); low level is internally adjustable (TSG13, TSG23). 3 Levels: 20, 40 and 80 IRE (TSG3); 140 mV, 420 mV and 700 mV (TSG13, TSG23).

Bounce Modes — Ac: Rate, 1/60 to ½ Hz. Dc: Rate, slow 1/60 to ½ Hz. Dc Rate. Fast Selectable: Line rate, field rate, or frame rate.