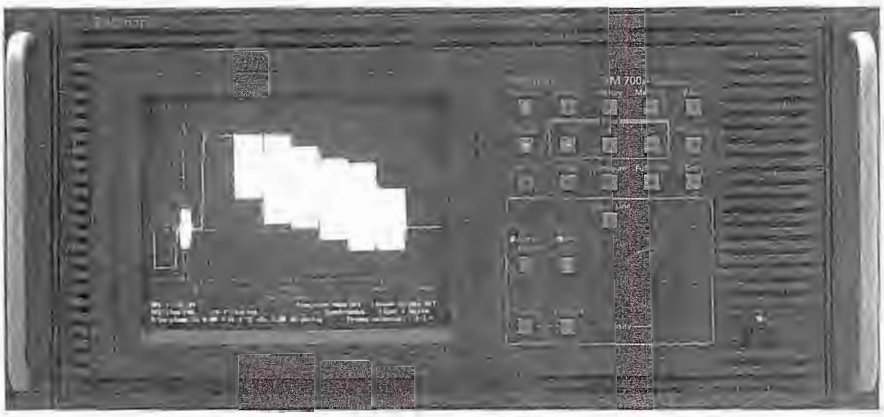
TEKTRONIX TELEVISION PRODUCTS 1989-1990

Tektronix®

THE VISIBLE EDGE

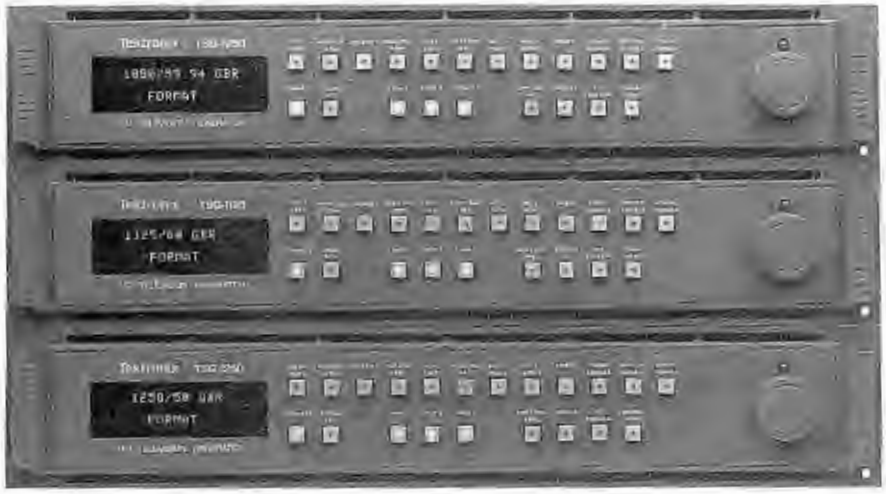
CONTENTS

NEW TELEVISION PRODUCTS



VM 700A

The new **VM 700A OP 11 PAL Video Measurement Set** is a complete video monitoring and measuring instrument which can be used for automatic measurements and monitoring, as well as for manual measurements of the PAL television signal. *See page 13.*

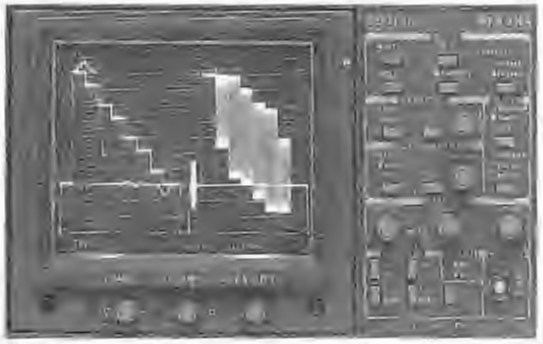


TSG 1000

The new **TSG 1000 Series High Definition Television Generators** are HDTV signal generators for today's requirements, with built-in flexibility to meet future needs in R&D, as well as equipment and system manufacturing and testing. *See page 91.*

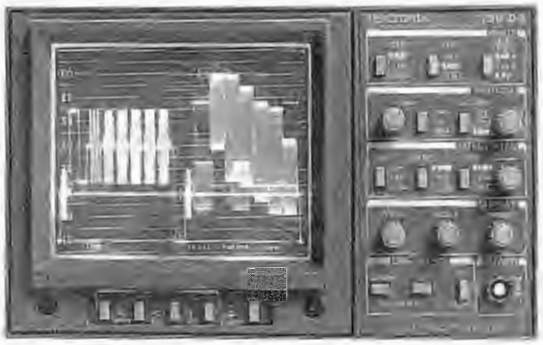
TSG 370

The new **TSG 370 Component/NTSC** and **TSG 371 Component/PAL Television Generators** are test signal and sync generators designed for the operation and maintenance of facilities working in analog component, NTSC, or PAL formats. *See pages 83-88.*



WFM 300A

The new **WFM 300A Component/Composite Waveform Monitor** is a comprehensive component television signal monitor with important features to monitor associated composite signals. *See page 25.*



1730 D-2

The new **1730 D-2 Digital/analog Waveform Monitor** is a version of the industry leader 1730 Series Waveform Monitors providing digital D-2 input capability, and with standard analog capability. *See page 37.*

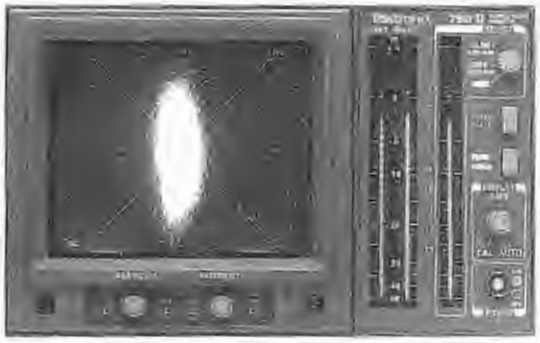
NEW TELEVISION PRODUCTS

VITS 201

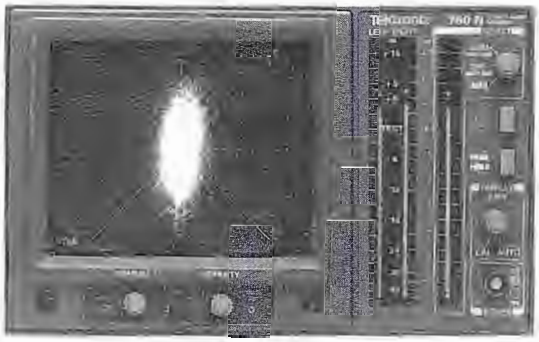
The new **VITS 201 PAL Insertion Generator** is a low cost, high quality ITS generator and inserter/deleter with features found only in the most expensive transmission grade ITS inserters. *See page 95.*

728 D/728 E

The new **728 E NICAM Encoder** and **728 D NICAM Decoder** provide a complete package for your NICAM broadcast needs. *See pages 114-117.*



760 D



760 N

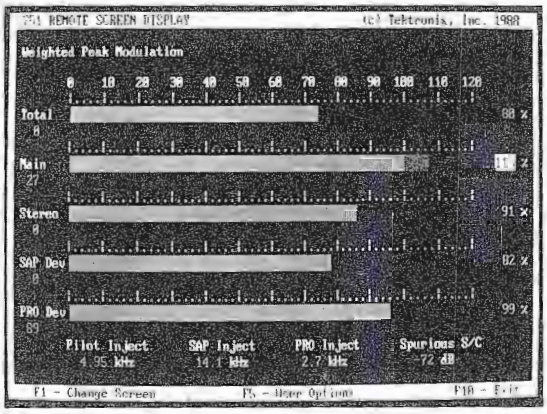
The **760 D** and **760 N Stereo Audio Monitors** complete the 760 Series providing versions to monitor and measure stereo audio with the DIN or Nordic scales. *See page 123.*

TPG 625 OP 01

The new **TPG 625 Option 01 PAL Pattern Generator** is a special version of the TPG 625 designed for use with the VM 700A Video Measurement Set. *See page 65.*

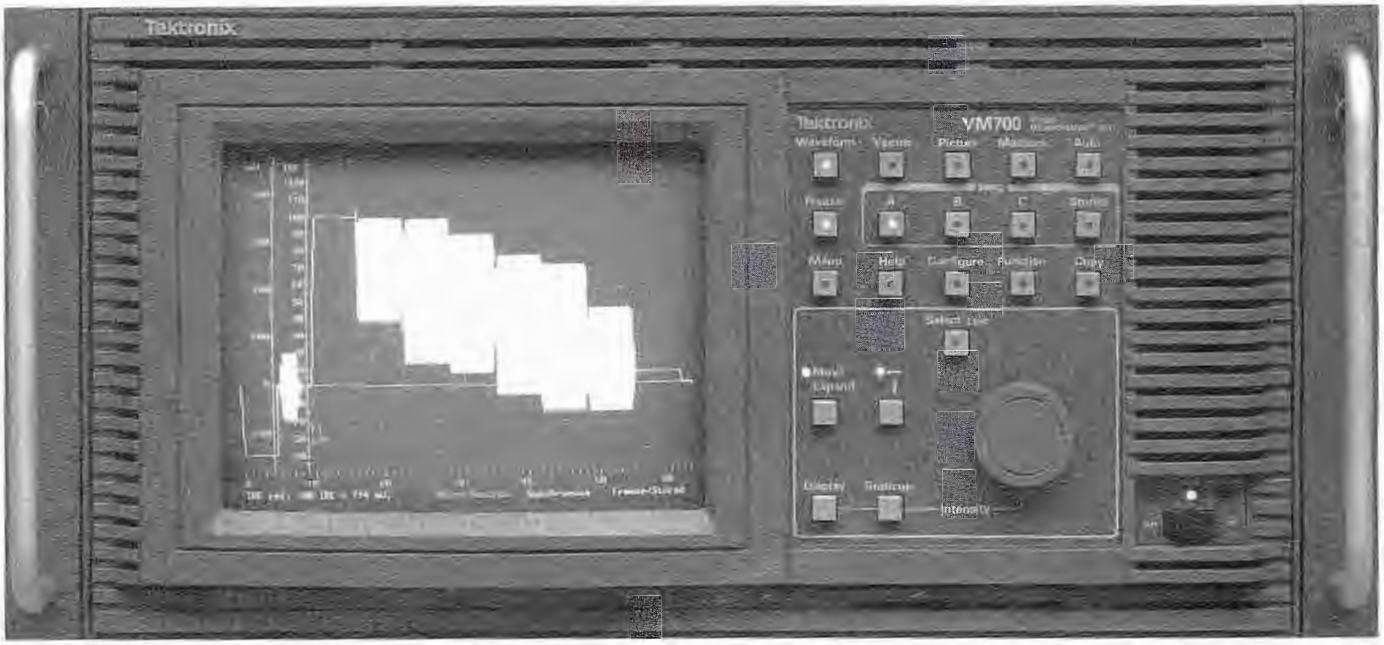
TSG 100 OP 01

The **TSG 100** is a low cost NTSC Test Signal Generator ideally suited for the maintenance and alignment of video equipment in most television environments. The new **Option 01** provides a special set of test signals for the transmission environment. *See page 66.*



PC 751

The new **PC 751 Remote Display Software Package** provides the ability to view, remotely, the Peak Modulation and Processed Audio screens from the Tektronix 751 BTSC Aural Modulation Monitor/Decoder. *See page 121.*



VM700 Option 01 NTSC Video Measurement Set.

VM700 OPTION 01
NTSC Video Measurement Set

Many capabilities in one instrument
- Digital waveform monitor
- Digital vectorscope
- Group delay and frequency response
- Noise measurement set
- Automatic measurement set

Auto mode
- Unattended monitoring of NTSC video signals from studios, STLs, Earth Stations, and transmitters
- User-specified limits

Measure mode provides graphic display of measurements
- K factor
- Differential gain and phase
- Chrominance to luminance delay
- Noise spectrum
- Group delay with sin x/x
- Color bars
- Chrominance noise
- Relative to reference on most measurements

Three input channels

Averaging on most measurement modes

Picture mode for source ID

Hardcopy for analysis and documentation

Remote control operation

The VM700 is a complete video monitoring and measuring instrument which can be used for automatic measurements and monitoring, as well as for manual measurements. The user can select a display of numeric values to confirm the quality of the signal path, or may select graphic displays for more detailed analysis.

Automatic video measurement set
The VM700 Auto Mode makes standard video measurements automatically, including those specified in RS-250B/EIA-250C, NTC-7, and RS-170A. These measurements can be compared with user-defined limits. A caution or alarm message is generated when these limits are violated. Reports can be made and printed automatically at operator scheduled times.

Digital waveform monitor/vectorscope
For a more detailed analysis of the waveform, the actual signal may be displayed and additional measurements made manually.

In Waveform Mode, cursors are available to aid in measuring time, frequency and amplitude. These cursors allow a very quick and precise location of the 10%, 50% and 90% points on any transition.

The waveform display can be expanded around any point both vertically and horizontally. Since the data is digitized, the display remains bright at all expansion factors. The axes automatically expand with the waveform, so all units are correct as displayed.

The Vector Mode provides the normal vectorscope display. The vectors may be rotated or expanded, with the rotation angle and gain values displayed numerically on the screen.

A unique "Find Colorbars" feature searches all video for colorbars and displays the vectors if found.

"Select Line," in both Waveform and Vector modes, can be used to quickly specify any line for display or automatic measurement if it is the proper signal.

Graphic displays of measurements
Measure Mode provides graphic displays of measurements such as noise spectrum, group delay, and K-factor, for adjustments or closer analysis of the measurement. Most measurements can be made relative to a stored reference to eliminate or minimize signal source errors. Most measurements have averaging to reduce the effect of random noise.

Picture mode
The signal source can be quickly verified using the picture display, and any line may be selected on the picture for viewing in the waveform or vector displays.

User-programmable functions
The user can define a sequence of operations as a new function. For example, the measurements to be made on a transmitter demodulator video output could be identified with a function labeled DEMOD. A user would simply select this function to make all measurements, and provide a printout.

Hardcopy
All information on the screen may be printed on printers supporting Postscript® or 24-pin Epson® graphics via the standard RS-232C interface. Automatic measurement results can be printed on most ASCII printers using the same interface.

Remote operation

The VM700 can be operated from a remote terminal via RS-232C to monitor unattended transmission systems and/or put systems under computer control.

Specifications

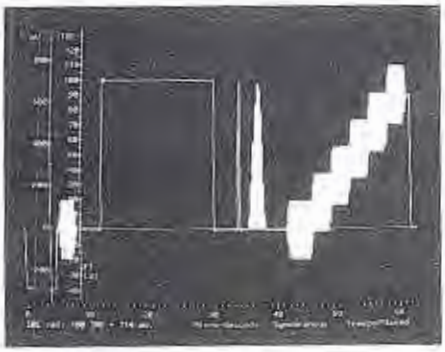
The performance requirements cited in this section are valid only within the following environmental limits:

Temperature range of 0 to 50 degrees Celsius, with a minimum warm-up time of 20 minutes. The following tables list each measurement and its performance requirement.

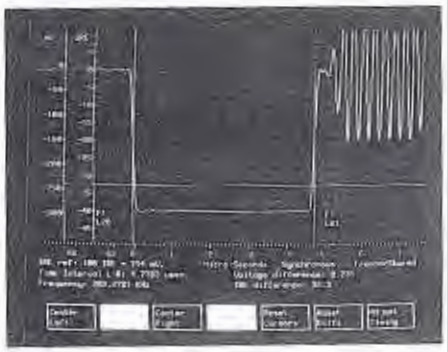
The range specifies the extremes between which a measurement can be made.

All measurement accuracies specified are valid only with nominal input signals with an unweighted signal-to-noise ratio of at least 60 dB on the incoming signal and a termination accuracy of ±0.025% (Tektronix PN 011-0102-01 or equivalent).

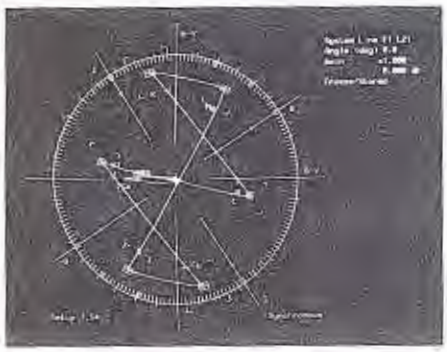
Due to the statistical nature of digitizing measurement methods, reported results will meet these specifications 97% of the time.



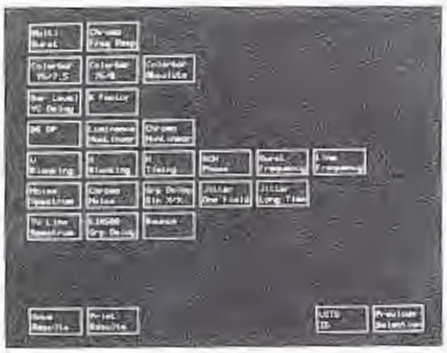
Vertical interval test signals can be seen very clearly for additional analysis of the signal. These can be printed as support documentation for automatic measurement results.



Even a single horizontal synchronization pulse can be displayed at a high intensity.



In Vector Mode, the VM700 becomes a digital vectorscope with an electronic graticule. A "Color Bar Search" feature makes it easy to quickly display a line containing a color bar test signal.



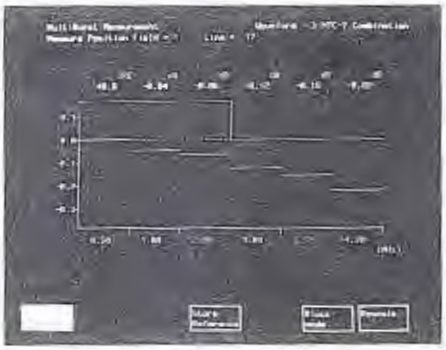
Main Measure Mode display of available measurements.

Picture Mode display. (Video courtesy of KOIN-TV, Portland, Oregon.)

CHARACTERISTICS
MEASURE MODE

MULTIBURST[3]

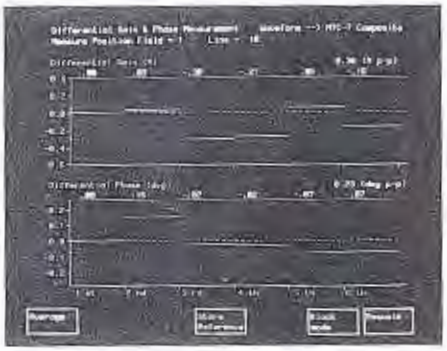
Measurement	Range	Absolute Mode Accuracy	Relative Mode Accuracy[2,3]
Multiburst 1st Packet Amplitudes	0 to 100 IRE	±1%	±0.5%
Other Packets (1st Packet is Ref.)	−40 to +6 dB	±0.1 dB	±0.03 dB



Multiburst measurement.

DIFFERENTIAL GAIN AND PHASE[1]

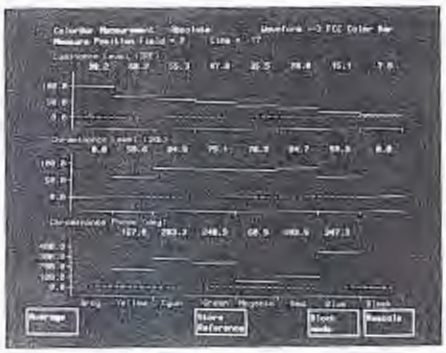
Measurement	Range	Absolute Mode Accuracy	Relative Mode Accuracy[1,2]
Differential Gain	0 to 100%	±0.3%	±0.03%
Differential Phase	0 to 360 deg	±0.3 deg	±0.03 deg



Differential Gain and Phase measurement.

COLOR BAR (ABSOLUTE)

Measurement	Range	Absolute Mode Accuracy	Relative Mode Accuracy[1,2]
Luminance Level	30 to 100 IRE (0 to 714.3 mV)	±0.5% or ±0.5 IRE whichever is greater	±0.2%
Chrominance Level	0 to 100 IRE (0 to 714.3 mV)	±1.0% of nominal	±0.2%
Chrominance Phase	±180 deg of nominal	±0.5 deg of nominal	±0.1 deg



Color Bar Absolute measurement.

SMPTE COLOR BARS NOMINAL VALUES

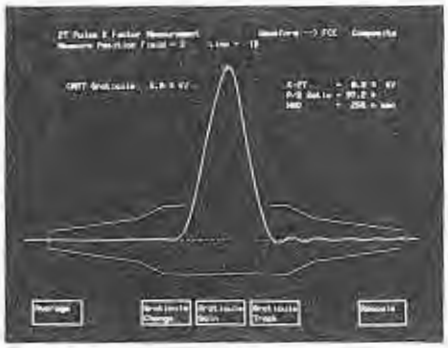
Color	LUM (mV)	Chroma P-P (mV)	Phase (degrees)
Yellow	494.6	444.2	167.1
Cyan	400.4	630.1	283.4
Green	345.9	588.5	240.8
Magenta	256.7	588.5	60.8
Red	202.2	630.1	103.4
Blue	108.1	444.2	347.1

BAR LEVEL AND CHROMINANCE TO LUMINANCE[1]

Measurement	Range	Absolute Mode Accuracy	Relative Mode Accuracy[1,2]
Bar Level	50 to 130 IRE	±0.3%	±0.2%
Sync Level	20 to 45 IRE	±0.5%	±0.2%
Sync to Bar Ratio	10 to 80%	±0.5%	±0.2%
Chrominance to Luminance Delay	±300 ns	±5 ns	±1.0 ns
Chrominance to Luminance Gain Ratio	10 to 160%	±1.0%	±0.1%
Line Time Distortion	0 to 20%	±0.2%	±0.1%

K-FACTOR

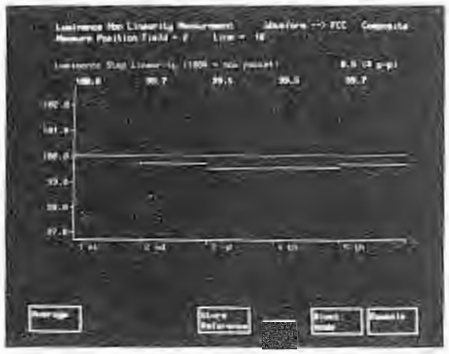
Measurement	Range	Absolute Mode Accuracy
2T Pulse K-Factor	0 to 10% Kf	±0.3%
Pulse to Bar Ratio	10 to 125%	±0.7%
Pulse Half Amplitude Duration (HAD)	100 to 500 ns	±5 ns



K-factor measurement.

LUMINANCE NON-LINEARITY[1]

Measurement	Range	Absolute Mode Accuracy	Relative Mode Accuracy[1,2]
Luminance Non-Linearity	0 to 50%	±0.4%	±0.2%



Luminance Non-Linearity measurement.

CHROMINANCE NON-LINEARITY

Measurement	Range	Absolute Mode Accuracy	Relative Mode Accuracy[1,2]
Chrominance Amplitude	0 to 100%	±0.4%	±0.2%
Chrominance Phase	0 to 360 deg	±1 deg	±0.2 deg
Chrominance to Luminance Intermodulation	−50 to +50%	±0.2%	±0.2%

HORIZONTAL TIMING

Measurement	Range	Absolute Mode Accuracy
Burst Level	10 to 80 IRE	±0.5%
Horizontal Sync Rise and Fall Time	80 ns to 1 μs	±10 ns
Horizontal Sync Width	3 to 7 μs	±10 ns
Burst Width	6 to 13 cycles	±0.1 cycles
Sync to Burst Start (RS-170A)	4 to 10 μs	±140 ns (0.5 cycles) ±20 ns
Sync to Burst End (FCC)	4 to 10 μs	±20 ns
Front Porch	0.1 to 3.5 μs	±10 ns (FCC) ±20 ns (RS-170A)
Sync to Setup	8.8 to 13.0 μs	±20 ns
Breezeway (FCC)	0.1 to 5 μs	±25 ns

SCH PHASE

Measurement	Range	Absolute Mode Accuracy
SCH Phase	±90 deg	±5 deg

HORIZONTAL BLANKING

Measurement	Range	Absolute Mode Accuracy
Blanking Start	0.1 to 4.2 μs	±200 ns
Blanking End	6.8 to 12.2 μs	±200 ns
Blanking Width	6.9 to 16.4 μs	±200 ns

VERTICAL BLANKING

Measurement	Range	Absolute Mode Accuracy
Equalizing Pulse Width	0.1 to 6.0 μs	±10 ns
Serration Pulse Width	0.1 to 10 μs	±10 ns
Vertical Blanking Field 1	19 to 30 lines	±0.1 lines
Vertical Blanking Field 2	19 to 30 lines	±0.1 lines

JITTER

Measurement	Range	Absolute Mode Accuracy
Jitter 1 Field	±20 μs	±10 ns

BURST AND LINE FREQUENCY[4]

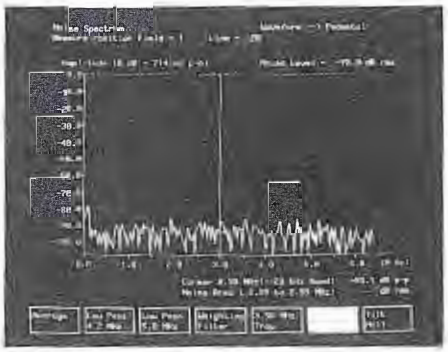
Measurement	Range	Relative Mode Accuracy[2]
Burst Frequency	±100 Hz	±1.0 Hz
Line Frequency	±3%	±0.1%

CHROMINANCE NOISE

Measurement	Range	Absolute Mode Accuracy
AM Noise	−20 to −80 dB	±1 dB (−20 to −60 dB)
PM Noise	−20 to −70 dB	±1 dB (−20 to −60 dB)

NOISE LEVEL

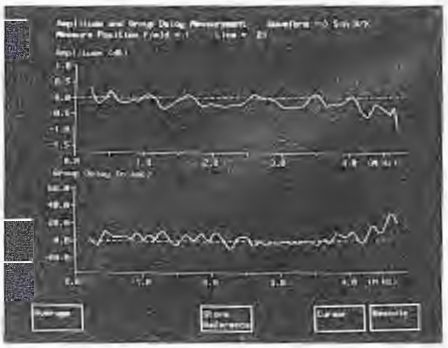
Measurement	Range	Absolute Mode Accuracy
Unweighted Signal-to-Noise Ratio	−20 to −80 dB	±0.4 dB (−20 to −60 dB) ±1.0 dB (−60 to −70 dB)
Weighted Signal-to-Noise Ratio	−20 to −80 dB	±1.0 dB (−20 to −60 dB) ±2.0 dB (−60 to −70 dB)



Noise Spectrum.

FREQUENCY RESPONSE AND GROUP DELAY

Measurement	Range	Absolute Mode Accuracy	Relative Mode Accuracy[1,2]
Frequency Response	±40 dB	±1.0 dB	±0.3 dB
Group Delay	±1.0 μs	±20 ns	±5 ns



Frequency Response and Group Delay with Sin X/X.

[1] Measured using block mode on two consecutive lines averaged to a weighting factor of 32.

[2] Measured relative to a reference averaged to a weighting factor of 256.

[3] Total Harmonic Distortion on packets must be ≤ 46 dB.

[4] Requires a reference signal.

AUTO MODE

RS-170A HORIZONTAL BLANKING INTERVAL TIMING MEASUREMENTS

Measurement	Range	Accuracy	Test Signal
Color Burst Width	6 to 13 cycles	±0.1 cycles	Horizontal Blanking
Front Porch Duration	0.5 to 2 μs	±20 ns	Horizontal Blanking
Horizontal Blanking Width	6 to 30 μs	±50 ns	Horizontal Blanking
Horizontal Sync Rise Time and Fall Time	80 to 120 ns 120 to 300 ns 300 ns to 1.0 μs	−10 to +30 ns ±20 ns ±30 ns	Horizontal Blanking
Horizontal Sync Width	1 to 8 μs	±10 ns	Horizontal Blanking
SCH Phase	±90 deg	±5 deg	Horizontal Blanking
Sync to Setup	5 to 18 μs	±20 ns	Horizontal Blanking
Sync to Start of Burst	4 to 8 μs	±140 ns (0.5 cycles) ±20 ns	Horizontal Blanking

RS-170A VERTICAL BLANKING INTERVAL

Measurement	Range	Accuracy	Test Signal
Equalizing Pulse Width	1 to 20 μs	±10 ns	Vertical Blanking
Serration Width	1 to 20 μs	±10 ns	Vertical Blanking
Vertical Blanking Width	19 to 29 lines	−0.1 lines to +0.2 lines	Vertical Blanking

FCC HORIZONTAL BLANKING INTERVAL TIMING MEASUREMENTS

Measurement	Range	Accuracy	Test Signal
Breezeway Width	0.2 to 3.5 μs	±25 ns	Horizontal Blanking
Color Burst Width	6 to 13 cycles	±0.1 cycles	Horizontal Blanking
Front Porch Duration	0.5 to 2 μs	±10 ns	Horizontal Blanking
Horizontal Blanking Width	6 to 30 μs	±10 ns	Horizontal Blanking
Horizontal Sync Rise Time and Fall Time	80 to 120 ns 120 to 300 ns 300 ns to 1.0 μs	−10 to +30 ns ±20 ns ±30 ns	Horizontal Blanking
Horizontal Sync Width	1 to 8 μs	±10 ns	Horizontal Blanking
Sync to Setup	5 to 18 μs	±20 ns	Horizontal Blanking
Sync to End of Burst	6 to 15 μs	±20 ns	Horizontal Blanking

FCC VERTICAL BLANKING INTERVAL TIMING MEASUREMENTS

Measurement	Range	Accuracy	Test Signal
Equalizing Pulse Width	25 to 100% of nominal horizontal sync pulse width	±0.3%	Vertical Blanking
Serration Width	1 to 20 μs	±10 ns	Vertical Blanking
Vertical Blanking Width	19 to 29 lines	−0.1 lines to +0.2 lines	Vertical Blanking

AMPLITUDE AND PHASE MEASUREMENTS

Measurement	Range	Accuracy	Test Signal
Average Picture Level (APL)	0 to 100%	±3.0%	Full Field
Bar Top	0 to 90% of Maximum Carrier	±0.1%	FCC/NTC-7 Composite
Bar Amplitude	0 to 200 IRE	±0.3 IRE	FCC/NTC-7 Composite
Chrominance to Luminance Delay (Relative Chroma Time)	±300 ns	±5 ns	FCC/NTC-7 Composite
Chrominance to Luminance Gain (Relative Chroma Level)	0 to 160%	±1%	FCC/NTC-7 Composite
Differential Gain	0 to 100%	±0.3%	FCC/NTC-7 Composite
Differential Phase	0 to 360 deg	±0.3 deg	FCC/NTC-7 Composite
Luminance Non-linear Distortion	0 to 50%	±0.4%	FCC/NTC-7 Composite
Relative Burst Gain	±100%	±0.3%	FCC/NTC-7 Composite
Relative Burst Phase	±180 deg	±0.3 deg	FCC/NTC-7 Composite
Burst Amplitude (% of sync)	25 to 200% of sync	±1.0%	Horizontal Blanking
Burst Amplitude (% of Bar)	10 to 80% of Bar (10 to 80 IRE when Bar is not used)	±0.4% (±0.4 IRE)	Horizontal Blanking
Sync Amplitude (% of Bar)	20 to 80% of Bar (20 to 80 IRE when Bar is not used)	±0.2% (±0.2 IRE)	Horizontal Blanking
Blanking Level	0 to 90% of Maximum Carrier	±0.2%	Horizontal Blanking
Sync Variation	0 to 50% of Maximum Carrier (0 to 50% of Bar when Zero Carrier is not used and 0 to 50 IRE when Zero Carrier and Bar are not used)	±0.3% for Zero Carrier (±0.3% for Bar and ±0.3 IRE for no Zero Carrier and no Bar)	Horizontal Blanking
Blanking Variation	0 to 50% of Maximum Carrier (0 to 50% of Bar when Zero Carrier is not used and 0 to 50 IRE when Zero Carrier and Bar are not used)	±0.3% for Zero Carrier (±0.3% for Bar and ±0.3 IRE for no Zero Carrier and no Bar)	Horizontal Blanking

FREQUENCY RESPONSE MEASUREMENTS

Measurement	Range	Accuracy	Test Signal
Multiburst Flag Amplitude	0 to 90% of Maximum Carrier (20 to 130% of Bar when Zero Carrier is not used and 20 to 130 IRE when Zero Carrier and Bar are not used)	±0.5% for Zero Carrier (±0.5% for Bar and ±0.5 IRE for no Zero Carrier and no Bar)	FCC Multiburst or NTC-7 Combination
Multiburst Packet Amplitudes	0 to 100% of Flag	±1% of Flag	FCC Multiburst or NTC-7 Combination

INCIDENTAL CARRIER PHASE MODULATION

Measurement	Range	Accuracy	Test Signal
ICPM (requires Zero Carrier Pulse and the quadrature output of the demodulator on channel C)	0 to 30 deg	±1.0 deg	FCC or NTC-7 Composite

COLOR BAR MEASUREMENTS

Measurement	Range	Accuracy	Test Signal
Color Bar Amplitude Errors	±100% of nominal	±1.0%	FCC Color Bars
Color Bar Phase Errors	±180 deg from nominal	±0.5 deg	FCC Color Bars
Color Bar Chrominance to Luminance Gain Ratio	0 to 200% of nominal	±2%	FCC Color Bars

OUT-OF-SERVICE MEASUREMENTS

Measurement	Range	Accuracy	Test Signal
Long Time Distortion	0 to 20 IRE 20 to 100 IRE	±0.5 IRE ±1.0 IRE	Bounce
Field Time Distortion	0 to 40%	±0.5%	Field Square Wave

WAVEFORM DISTORTION MEASUREMENTS

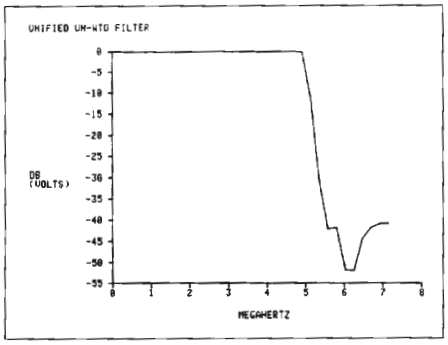
Measurement	Range	Accuracy	Test Signal
Line Time Distortion	0 to 40% of Bar	±0.2%	FCC or NTC-7 Composite
Pulse to Bar Ratio	10 to 125%	±0.7%	FCC or NTC-7 Composite
Short Time Waveform Distortion	0 to 25% SD	±0.5% SD	NTC-7 Composite
Chrominance Non-linear Gain Distortion	5 to 35 IRE (20 IRE chroma) 45 to 160 IRE (80 IRE chroma)	±0.4 IRE	NTC-7 Combination
Chrominance Non-linear Phase Distortion	0 to 360 deg	±1.0 deg	NTC-7 Combination
Chrominance to Luminance Intermodulation	±50 IRE	±0.2 IRE	NTC-7 Combination
2T K-Factor	0 to 10% Kf	±0.3% Kf	FCC or NTC-7 Composite

VIRS MEASUREMENTS

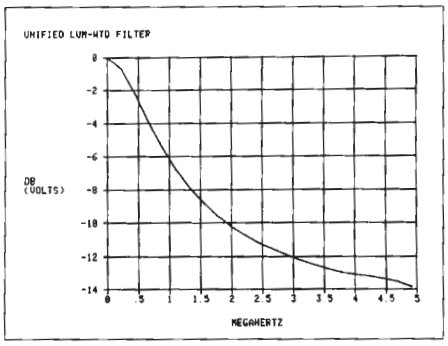
Measurement	Range	Accuracy	Test Signal
VIRS Setup (Reference Black)	−20 to 130% of Bar (−20 to 130 IRE when Bar is not used)	±0.2% (±0.5 IRE when Bar is not used)	VIRS
VIRS Chrominance Reference Amplitude	0 to 200% of burst amplitude (0 to 80% of Bar when burst is not used and 0 to 80 IRE when burst and bar are not used)	±1% (±0.1% when burst is not used and ±1 IRE when burst and Bar are not used)	VIRS
VIRS Chrominance Phase Relative to Burst	±180 deg	±0.5 deg	VIRS
VIRS Luminance Reference	30 to 100% of Bar (30 to 100 IRE when Bar is not used)	±0.2% (±0.2 IRE)	VIRS

SIGNAL-TO-NOISE RATIO MEASUREMENTS

Measurement	Range	Accuracy	Test Signal
Unweighted SNR	26 to 60 dB 61 to 70 dB	±1.0 dB ±2.0 dB	Quiet Line
Luminance Weighted SNR	26 to 60 dB 61 to 70 dB	±1.0 dB ±2.0 dB	Quiet Line
Periodic SNR	26 to 60 dB 61 to 70 dB	±1.0 dB ±2.0 dB	Quiet Line



Unified Unweighted filter response curve per CCIR Recommendation 567.



Unified Luminance weighted filter response curve per CCIR Recommendation 567.

Measurement Methods — Auto Mode

The following paragraphs describe the measurement methods for each measurement. Each timing measurement method is written for the FCC method. If there is an RS-170A method for that same measurement, and the RS-170A method differs from the FCC method, the RS-170A requirement is enclosed within square brackets in the FCC description.

Horizontal Interval Timing Measurements

These timing measurements are made within the active picture area, averaging the results over 32 lines starting at line 50 and skipping 1 frame plus 5 lines for each successive sample (i.e., average over line 50 of first field, line 56 of second field, line 62 of the third field, etc.).

Breezeway Width: Measured from the 10% point on the trailing edge of horizontal sync (nominally −4 IRE) to the leading half-amplitude point of the burst envelope.

Page 1

VM700 Video Measurement Set

Channel B 20-Apr-89 12:05:47

				Violated Limits Lower	Upper	
Avg. Picture Level	42.3	%				At Meas. Cycle Start
Bar Top	13.0	% Carr				
Blanking Level	76.7	% Carr	*	74.0	76.0	
Bar Amplitude	89.9	IRE	**	96.0	104.0	
Sync Amplitude	36.6	% Bar	*	37.0	43.0	
Blanking Variation	1.8	% Carr				
Blanking Variation	2.9	% Bar				
Sync Variation	2.1	% Carr				
Sync Variation	3.5	% Bar				
Burst Amplitude	101.5	% Sync				
Burst Amplitude	37.5	% Bar				
FCC H Blanking	10.87	us				
FCC Sync Width	4.74	us				
FCC Sync-Setup	9.60	us				
FCC Front Porch	1.27	us	**	1.30	-------	
Sync to Burst End	7.78	us				
Breezeway Width	0.76	us				
FCC Burst Width	8.1	Cycles				
Sync Risetime	206	ns	*	0	190	
Sync Falltime	175	ns				
RS-170A H Blanking	11.13	us	*	10.71	11.09	
RS-170A Sync Width	4.54	us	**	4.58	4.82	
RS-170A Sync-Setup	9.48	us				
RS-170A Front Porch	1.39	us	*	1.41	1.59	
Sync to Burst Start	5.40	us	*	5.21	5.39	
RS-170A Burst Width	8.1	Cycles				
V Blank 4 IRE F1	20.0	Lines				
V Blank 4 IRE F2	20.1	Lines				
V Blank 20 IRE F1	20.0	Lines	*	20.1	20.9	
V Blank 20 IRE F2	20.1	Lines	*	20.1	20.9	
FCC Equalizer	50.0	% S.W.				
FCC Serration	5.01	us	*	3.98	4.92	
RS-170A Equalizer	2.17	us	**	2.18	2.42	
RS-170A Serration	4.80	us	*	4.61	4.79	
VIRS Setup	8.3	% Bar				
VIRS Luminance Ref	51.9	% Bar				
VIRS Chroma Ampl	106.5	% Burst	*	95.0	105.0	
VIRS Chroma Ampl	40.6	% Bar				
VIRS Chroma Phase	-4.1	Deg				
Line Time Distortion	8.4	%	**	0.0	1.5	
Pulse/Bar Ratio	103.2	%				
2T Pulse K-Factor	3.6	% Kf	**	0.0	2.5	

Measurement results are displayed in an easy-to-read format indicating the time, signal source, measurement, and whether the measured value exceeded caution (*) or alarm (**) limits (page 1 of 2).

Color Burst Width: Measured from the leading half-amplitude point on the burst envelope [leading zero crossing of the first half-cycle of burst that exceeds 50% of burst amplitude] to the trailing half-amplitude point on the burst envelope [trailing zero crossing of the last half-cycle of burst that exceeds 50% of burst amplitude].

Front Porch Duration: Measured from the 10% point on the trailing edge of setup (+4 IRE nominally) to the 10% [50%] point on the leading edge of sync (nominally −4 [−20] IRE).

Horizontal Blanking Width: Measured between the points on the leading and trailing edges of horizontal blanking that are at an amplitude of 10% [50%] of sync above blanking level (nominally +4 [+20] IRE).

Horizontal Sync Rise Time and Fall Time: Measured between the 10% and 90% points on the leading and trailing edges of horizontal sync, respectively (nominally −4 IRE and −36 IRE).

Horizontal Sync Width: Measured between the 10% [50%] points on the leading and trailing edges of horizontal sync (nominally −4 [−20] IRE).

SCH Phase: Phase at the middle of burst relative to the 50% point on the sync leading edge.

Sync to Setup: Measured from the 10% [50%] point on the leading edge of sync (nominally −4 [−20] IRE) to the point on the trailing edge of blanking that is equivalent to 10% of sync (nominally +4 IRE).

Page 2

VM700 Video Measurement Set

Channel B 20-Apr-89 12:05:47

				Violated Limits Lower	Upper	
S/N Unweighted	41.0	dB	**	58.0	------	RMS
S/N Lum-Weighted	50.9	dB	**	54.0	------	RMS
S/N Periodic	35.5	dB	**	58.0	------	RMS
Chroma-Lum Delay	34.5	ns				
Chroma-Lum Gain	95.2	%				
Differential Gain	7.84	%	*	0.00	6.00	
Differential Phase	4.64	Deg	**	0.00	2.50	
Lum Non-Linearity	3.15	%				
Relative Burst Gain	1.94	%				
Relative Burst Phase	-1.17	Deg				
FCC Multiburst Flag	15.6	% Carr	**	10.0	15.0	
FCC Multiburst Flag	101.0	% Bar				
FCC MB Packet #1	56.2	% Flag	**	57.1	63.0	
FCC MB Packet #2	79.1	% Flag	**	56.2	64.2	
FCC MB Packet #3	54.4	% Flag	**	54.8	65.6	
FCC MB Packet #4	70.1	% Flag	**	53.5	67.3	
FCC MB Packet #5	57.2	% Flag				
FCC MB Packet #6	14.0	% Flag				
SCH Phase	43.3	Deg				

FCC Color Bars

	Amplitude Error (%)	Phase Error (Deg)	Chr/Lum Ratio Error (%)	
Yellow	-3.9	-3.2	-5.1	
Cyan	-7.9	-5.3	-11.3	
Green	-0.4	-5.4	-5.6	
Magenta	-4.3	-4.1	-11.9	
Red	-5.4	-5.9	-14.6	
Blue	-5.2	-1.6	-18.1	*

Measurement results (page 2 of 2).

Sync-to-Start-of-Burst: Measured from the 50% point on the leading edge of sync (nominally −20 IRE) to the leading zero crossing of the first half-cycle of burst that exceeds 50% of burst amplitude.

Sync-to-End-of-Burst: Measured from the 10% point on the leading edge of horizontal sync (nominally −4 IRE) to the half-amplitude point on the trailing edge of the burst envelope.

Vertical Interval Timing

Equalizing Pulse Width: Measured between the 10% [50%] points on the equalizing pulse (nominally −4 [−20] IRE).

Serration Width: Measured between the 10% [50%] points of serration (nominally −4 [−20] IRE).

Vertical Blanking Width: Measured between the points on setup [active picture] at a level equal to 10% [50%] of sync amplitude (nominally +4 [+20] IRE), where setup [active picture] immediately precedes and follows the vertical blanking interval.

Color Bar Measurements

Color Bar Amplitude Error: Measured as deviation of the peak-to-peak amplitude of each color bar from the nominal value for that color bar expressed as a percent of the nominal value. Six values reported.

Color Bar Phase Error: Measured as deviation of the phase of each color bar from the nominal phase for that color bar, relative to burst phase. Six values reported.

Color Bar Chrominance-Luminance Gain Ratio: Measured as ratio of chrominance level to luminance level of each color bar, relative to the nominal ratio for each color bar. Six values reported.

Color	Amplitude	Phase	C/L Gain Ratio
Yellow	67.36%	167.59 deg	1.0092
Cyan	94.74%	283.54 deg	1.8045
Green	89.04%	240.67 deg	2.0123
Magenta	89.04%	60.67 deg	2.8957
Red	94.74%	103.54 deg	4.2106
Blue	67.36%	347.59 deg	8.1652

FCC Color Bars Nominal Values (Source: FCC Rule 73.699, Figure 14).

Amplitude and Phase Measurements (FCC or NTC-7 Composite VITS)

Bar Top: Measured as the ratio of the bar top to Zero Carrier amplitude to the blanking (at back porch) to the Zero Carrier amplitude. Result expressed as a percent of Max Carrier.

Bar Amplitude: Measured from the reference blanking level (at back porch) contained within the test line to the level at the center of the bar.

Burst Amplitude: VITS not required. Burst amplitude must be at least 10 IRE. Measured as peak-to-peak amplitude of the color burst at burst center.

Chrominance-Luminance Delay Inequality (Relative Chrominance Time): Measured as the time difference between the luminance component and chrominance component of the modulated 12.5T pulse.

Chrominance-Luminance Gain Inequality (Relative Chrominance Level): Measured as the peak-to-peak amplitude of the chrominance component of the modulated 12.5T pulse.

Differential Gain: Measured as the absolute amplitude difference between the smallest and largest staircase chrominance packets. Result expressed as a percent of the largest packet amplitude.

Differential Phase: Measured as the largest difference in phase between any two staircase chrominance packets.

Luminance Non-linear Distortion: Measured as the difference between the largest and smallest step amplitudes of the staircase at the center of each step. Result expressed as a percent of the largest step amplitude difference.

Relative Burst Gain: Measured as the difference between the peak-to-peak amplitude of burst and the staircase chrominance packet located at blanking. Result expressed as a percent of the packet amplitude.

Relative Burst Phase: Measured as the difference in phase between the color burst and the staircase packet located at blanking.

Sync Amplitude: Measured from the tip of the horizontal sync pulse to blanking level.

Blanking Level: Measured as the ratio of the blanking (at back porch) to Zero Carrier amplitude to the sync tip to Zero Carrier amplitude. Result expressed as a percent of Max Carrier.

Sync Variation: Measured as the peak-to-peak variation of the horizontal sync pulse amplitude within every third line of a field.

Blanking Variation: Measured as the peak-to-peak variation of the blanking level within every third line of a field.

Frequency Response Measurements (FCC Multiburst or NTC-7 Combination VITS)

Multiburst Flag Amplitude: Measured from back porch blanking to the center point of the flag top.

Multiburst Amplitude: Measured as the peak-to-peak amplitude of each of the multiburst packets. Six results reported.

Waveform Distortion Measurements (FCC or NTC-7 Composite VITS)

Line Time Distortion: Measured as the peak-to-peak amplitude change of the bar top, excluding the first microsecond and the last microsecond.

Pulse-to-Bar Ratio: Measured as the peak amplitude of the 2T pulse, expressed as a percent of the bar amplitude.

Short-Time Waveform Distortion: Measured as a weighted function of time, the result is the peak deviation from flatness within 1 microsecond of the center of a bar transition. ANSI/IEEE Std. 511-1979, Section 4.4, Appendix B.

Chrominance Non-linear Gain Distortion: Measured as the peak-to-peak amplitude of the first (nominally 20 IRE) and last (nominally 80 IRE) chrominance packets in the 3-level chrominance signal, referenced to the peak-to-peak amplitude of the middle packet (nominally 40 IRE).

Chrominance Non-linear Phase Distortion: Measured as the difference between the largest and the smallest deviation in phase among the 3-level chrominance test signal subcarrier packets.

Chrominance to Luminance Intermodulation: Measured using the 3-level chrominance test signal. Result is the maximum amplitude departure of a filtered part of the luminance pedestal from a part of the pedestal upon which no subcarrier has been superimposed.

2T Pulse K-factor: Measured as the greatest weighted amplitude of a positive-going or negative-going echo-term half-wave which is within one microsecond before the 2T pulse leading edge half-amplitude point or within one microsecond after the 2T pulse trailing edge half-amplitude point. Result expressed as a K-factor which is the ratio of the weighted amplitude of the echo-term half-wave to the sampled amplitude of the 2T pulse.

VIRS Measurements

VIRS Setup (Reference Black): Measured from the blanking level included in the test signal to setup level.

VIRS Chrominance Reference Amplitude: Measured as the amplitude of the VIRS chrominance packet, expressed as a percent of burst (or percent of bar if no burst).

VIRS Chrominance Phase Relative to Burst: Measured as the difference between the VIRS chrominance packet phase and color burst phase.

VIRS Luminance Reference: Measured from the blanking level included in the test signal to luminance reference level (nominally 50 IRE).

Signal-to-Noise Ratio Measurements

Unweighted SNR: Measured as the ratio of bar amplitude to the unweighted rms amplitude of the noise on a quiet line.

Luminance Weighted SNR: Measured as the ratio of bar amplitude to the luminance weighted rms amplitude of the noise on a quiet line.

Periodic SNR: Measured as the ratio of bar amplitude to the peak- to-peak value of the periodic noise.

Out-of-Service Measurements

Low Frequency SNR: Measured as the ratio of bar amplitude to the peak-to-peak low frequency noise voltage (with no video signal).

Long Time Distortion: Measured as the peak overshoot and settling time in a flat field test signal switched from 10% to 90% APL in less than 10 μsec.

Field Time Distortion: Measured as the peak-to-peak amplitude change of the 100 IRE field squarewave top. The first and last 250 μsec are excluded. Expressed as a percent of the field squarewave amplitude.

Power Requirements — Mains Voltage Range: 87 Vac to 132 Vac or 174 Vac to 250 Vac. Mains Frequency: 47 Hz to 63 Hz. Power Consumption: 250 Watts.

Environmental — Operating Temperature Range: 0°C to +50°C ambient.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	483	19.0
Height	222	8.75
Depth	566	21.90
Weight	**kg**	**lb**
Net	20	45

ORDERING INFORMATION

When ordering, please use the nomenclature given here:

The standard instrument is shipped as a rack mount product.

VM700 Option 01 NTSC Video Measurement Set

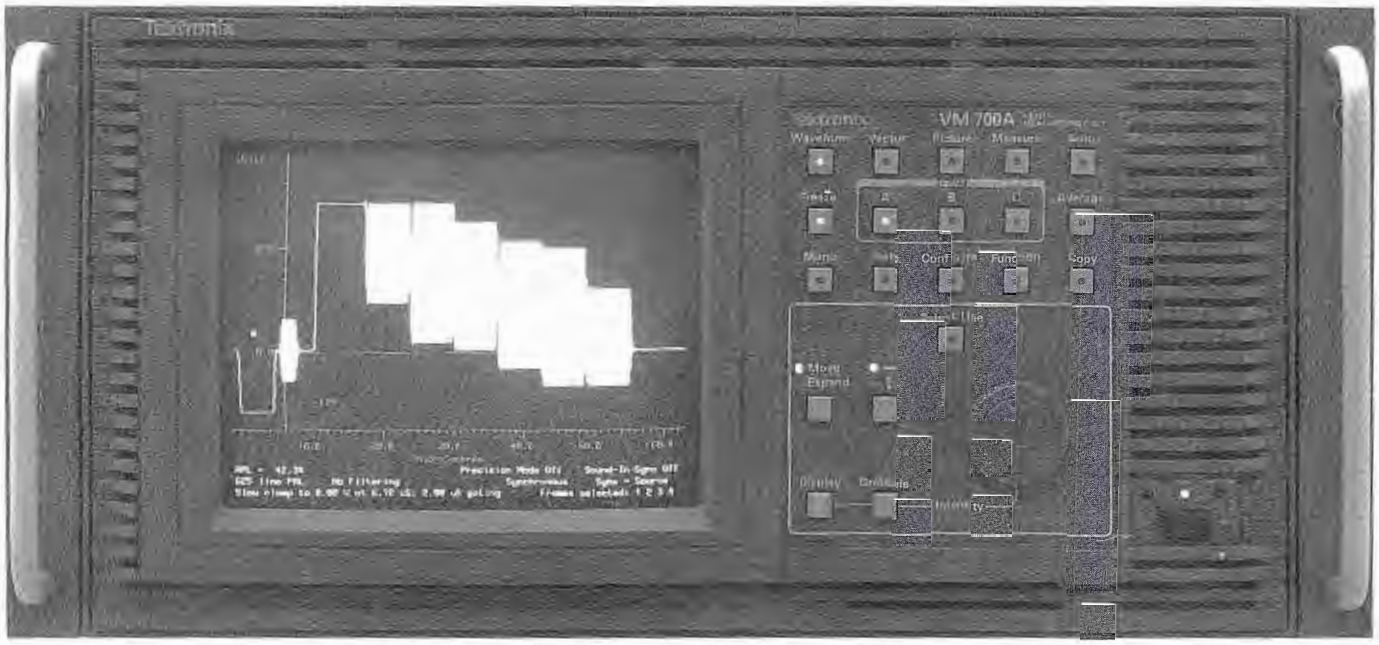
OPTIONAL ACCESSORIES

VM7FC1 — Field installable conversion kit to convert rack mount unit to cabinet.

VM7FR1 — Field installable conversion kit to convert cabinet to rack mount unit.

INCLUDED ACCESSORIES

Instruction manual; 75 Ω terminators (3) 011-0102-00; power cord.



VM700A Option 11 PAL Video Measurement Set.

VM700A OPTION 11

PAL Video Measurement Set

Many capabilities in one instrument
- **Digital waveform monitor**
- **Digital vectorscope**
- **Noise measurement set**
- **Automatic measurement set**

Auto mode
- **Unattended monitoring of PAL video signals from studios, STLs, Earth Stations, and transmitters**
- **User-specified limits**

Measure mode provides graphic display of measurements
- **K factor**
- **Differential gain and phase**
- **Luminance to chrominance delay**
- **Noise spectrum**
- **Color bar**
- **Group delay and frequency response with sin x/x**
- **Relative to reference on most measurements**

Three input channels

Averaging on all measurement modes

Picture mode for source ID

Hardcopy for analysis and documentation

Remote control operation

The VM700A is a complete video monitoring and measuring instrument which can be used for automatic measurements and monitoring, as well as for manual measurements.

The user can select a display of numeric values to confirm the quality of the signal path, or may select graphic displays for more detailed analysis.

Automatic video measurement set

The VM700A Auto Mode makes standard video measurements automatically, including those specified in CCIR Rep. 624-1, Rec. 567, and Rec. 569. These measurements can be compared with user-defined limits. A caution or alarm message is generated when these limits are violated. Reports can be made and printed automatically at operator scheduled times.

Digital waveform monitor/vectorscope

For a more detailed analysis of the waveform, the actual signal may be displayed and additional measurements made manually.

In Waveform Mode, cursors are available to aid in measuring time, frequency, and amplitude. These cursors allow a very quick and precise location of the 10%, 50% and 90% points on any transition. Enabling cursors also enables an automatic calculation of the sine peak-to-peak amplitude, frequency, and offset from blanking of the waveshape in the center of the display. This is very useful for frequency response measurements with the multiburst signal.

The waveform display can be expanded around any point both vertically and horizontally. Since the data is digitized, the display remains bright at all expansion factors. The axes automatically expand with the waveform, so all units are correct as displayed. A channel difference mode (A–B, A–C, B–A, B–C, C–A, and C–B) is also provided.

The Vector Mode provides the normal vectorscope display. The vectors may be rotated or expanded, with the rotation angle and gain values displayed numerically on the screen.

A unique "Find Colorbars" feature searches all video for colorbars and displays the vectors if found. The vectors can be referenced to either the selected channel's burst or the burst of one of the other two channels or continuous subcarrier. The phase difference between the selected channel and the reference is always displayed.

Select Line in both Waveform and Vector modes can be used to quickly specify any line for display or automatic measurement if it is the proper signal.

Graphic displays of measurements

Measure Mode provides graphic displays of measurements such as noise spectrum, group delay, and K-factor, for adjustments or closer analysis of the measurement. Most measurements can be made relative to a stored reference to eliminate or minimize signal source errors. Most measurements have averaging to reduce the effect of noise. A channel difference mode (A–B, A–C, B–A, B–C, C–A, and C–B) is also provided and is useful in input to output analysis of a device.

Picture mode

The signal source can be quickly verified using the picture display. Any line may be selected on the picture for viewing in the waveform or vector displays.

User-programmable functions

The user can define a sequence of operations as a new function.

For example, the measurements to be made on a transmitter demodulator video output could be identified with a function labeled DEMOD. A user would simply select this function to make all measurements, and provide a printout.

Hardcopy

All information on the screen may be printed on printers supporting Postscript® or 24-pin Epson® graphics via the standard RS-232C interface. Automatic measurement results can be printed on most ASCII printers using the same interface.

Remote operation

The VM700A can be operated from a remote terminal via RS-232 to monitor unattended transmission systems and/or put systems under computer control. In addition, all files could be uploaded to a main computer, and downloaded to other VM700As. Two difference protocols are supported: FTP (File Transfer Protocol) and TELNET. The user can also select a "no protocol" mode of the RS-232 interface when dealing with low baud rates. However, file transfers can only take place with FTP.

Specifications

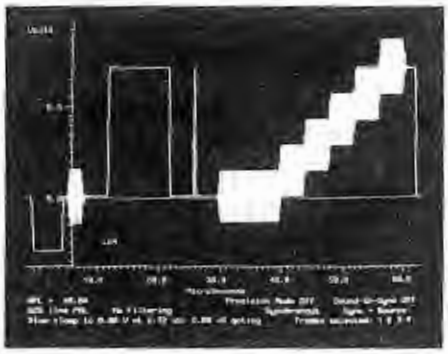
The performance requirements cited in this section are valid only within the following environmental limits:

Temperature range of 0 to 50 degrees Celsius, with a minimum warm-up time of 20 minutes. The following tables list each measurement and its performance requirement.

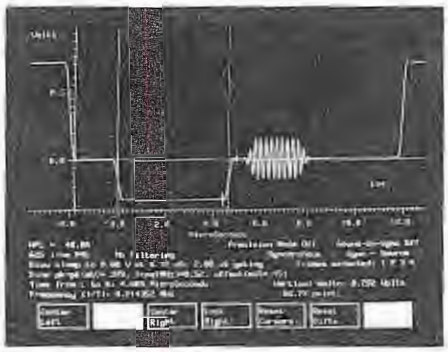
The range specifies the extremes between which a measurement can be made.

All measurement accuracies specified are valid only with nominal input signals with an unweighted signal-to-noise ratio of at least 60 dB on the incoming signal and a termination accuracy of ±0.025% (Tektronix PN 011-0102-01 or equivalent).

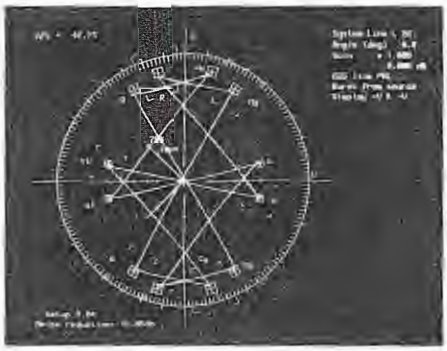
Due to the statistical nature of digitizing measurement methods, reported results will meet these specifications 97% of the time.



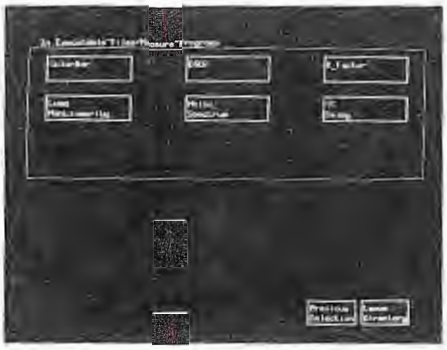
Vertical interval test signals can be seen very clearly for additional analysis of the signal. These can be printed as support documentation for automatic measurement results.



Even a single horizontal synchronization pulse can be displayed at a high intensity.



In Vector Mode, the VM700A becomes a digital vectorscope with an electronic graticule. The "Color Bar Search" feature makes it easy to quickly display a line containing a color bar test signal.



Main Measure mode display of available measurements.

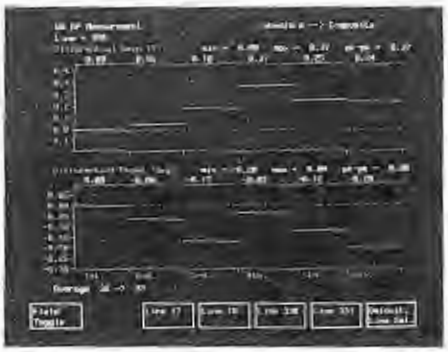
Picture mode display.

CHARACTERISTICS

MEASURE MODE

DIFFERENTIAL GAIN AND PHASE[1]

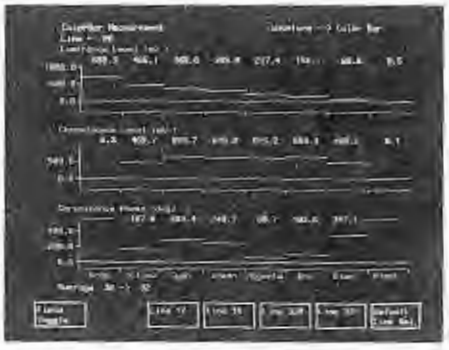
Measurement	Range	Absolute Mode Accuracy	Relative Mode Accuracy[2]
Differential Gain	0 to 100%	±0.3%	±0.03%
Differential Phase	0 to 360 deg	±0.3 deg	±0.03 deg



Differential Gain and Phase Measurement.

COLOR BAR

Measurement	Range	Absolute Mode Accuracy	Relative Mode Accuracy[2]
Luminance Level	0 to 700 mV	±0.5% or 3.5 mV whichever is greater	±0.2%
Chrominance Level	0 to 700 mV	±1.0% of nominal	±0.2%
Chrominance Phase	±180 deg	±0.5 deg	±0.1 deg



Color Bar Measurement.

BAR LEVEL AND CHROMINANCE TO LUMINANCE[1]

Measurement	Range	Absolute Mode Accuracy	Relative Mode Accuracy[2]
Bar Level	0 to 1.4 volts	±0.5%	±0.2%
Sync Level	140 mV to 560 mV	±0.5%	±0.2%
Chrominance to Luminance Delay	±300 ns	±5 ns	±1.0 ns
Chrominance to Luminance Gain Ratio	0 to 160%	±1.0%	±0.1%
Bar Tilt	0 to 20%	±0.2%	±0.1%
Line Time Distortion	0 to 20%	±0.2%	±0.1%

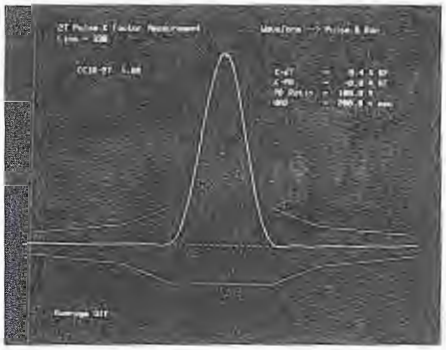
[1] Measured using block mode on two consecutive lines.

[2] Measured relative to a reference which was averaged to a weighting factor of 256.

MEASURE MODE (continued)

K-FACTOR

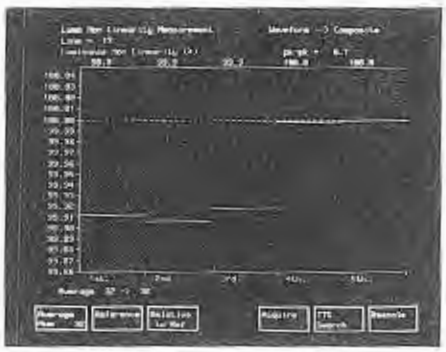
Measurement	Range	Absolute Mode Accuracy
2T Pulse K-Factor	0 to 10% Kf	±0.3%
Pulse to Bar Ratio	10 to 125%	±0.7%
Pulse Half Amplitude Duration (HAD)	100 to 500 ns	±5 ns
Kpb	0 to 40% Kpb	±0.3%



K-factor Measurement.

LUMINANCE NON-LINEARITY[1]

Measurement	Range	Absolute Mode Accuracy	Relative Mode Accuracy[2]
Luminance Non-Linearity	0 to 100%	±0.4%	±0.2%



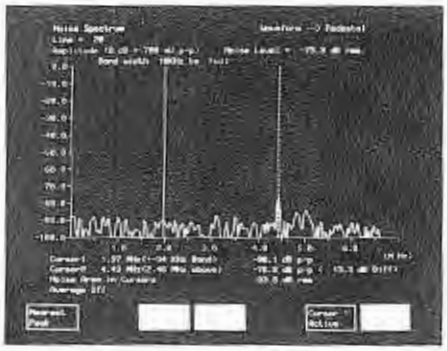
Luminance Non-Linearity Measurement.

HORIZONTAL TIMING

Measurement	Range	Absolute Mode Accuracy
Burst Level	0 to 600 mV	±1.0%
Horizontal Sync Rise and Fall Time	80 ns to 1 μs	±15 ns
Horizontal Sync Width	1 to 8 μs	±10 ns
Burst Width	6 to 13 cycles	±0.1 cycles
Sync to Burst Start	1 to 10 μs	±20 ns

NOISE LEVEL

Measurement	Range	Absolute Mode Accuracy
Unweighted Signal-to-Noise	−20 to −80 dB	±0.4 dB (−20 to −60 dB) ±1.0 dB (−60 to −70 dB)
Luminance Weighted Signal-to-Noise	−20 to −80 dB	±1.0 dB (−20 to −60 dB) ±2.0 dB (−60 to −70 dB)
Chrominance Weighted Signal-to-Noise	−20 to −80 dB	±1. dB (−20 to −60 dB) ±2.0 dB (−60 to −70 dB)



Noise Spectrum.

MULTIBURST[3]

Measurement	Range	Absolute Mode Accuracy	Relative Mode Accuracy[2,3]
Multiburst Flag Amplitude	0 to 700 mV	±0.5%	±0.25%
Packets 1-5 (0.5, 1.0, 2.0, 4.0, 4.8 MHz)	−40 to +6 dB	±0.1 dB	±0.03 dB
Packet 6 (5.8 MHz)	−40 to +6 dB	±0.2 dB	±0.06 dB

FREQUENCY RESPONSE AND GROUP DELAY

Measurement	Range	Absolute Mode Accuracy	Relative Mode Accuracy[1,2]
Frequency Response to 5 MHz to 6 MHz	±40 dB ±40 dB	±1.0 dB ±2.0 dB	±0.3 dB ±0.6 dB
Group Delay to 5 MHz to 6 MHz	±1.0 μs ±1.0 μs	±20 ns ±40 ns	±5 ns ±10 ns

CHROMINANCE TO LUMINANCE GAIN AND DELAY

Measurement	Range	Absolute Mode Accuracy	Relative Mode Accuracy[1,2]
Chrominance to Luminance Gain Inequality	10 to 160%	±1.0%	±0.2%
Chrominance to Luminance Delay Inequality	±300 ns	±5.0 ns	±1.0 ns

CHROMINANCE NON-LINEARITY

Measurement	Range	Absolute Mode Accuracy	Relative Mode Accuracy
Chrominance Amplitude	0 to 100%	±0.4%	±0.2%
Chrominance Phase	±180 deg.	±1.0 deg.	±0.2 deg.
Chrominance to Luminance Intermodulation	−50 to +50%	±0.2%	±0.2%

BOUNCE

Measurement	Range	Accuracy
Peak Deviation	0 to 50%	±1%
Settling Time	0 to 10 sec	±100 msec

1 Measured using block mode on two consecutive lines.

2 Measured relative to a reference which was averaged to a weighting factor of 256.

3 Total harmonic distortion on packets must be ≤46 dB.

AUTO MODE

LINE BLANKING TIMING MEASUREMENTS

These measurements are all made on samples acquired from the live signal area. With the exception of Line Sync Rise Time and Fall Time, these measurements are made in accordance with CCIR Report 624-1.

Measurement	Range	Accuracy
Colour Burst Duration	6 to 13 cycles (10 cycles nominal)	±0.1 cycle
Front Porch Duration	0.5 to 3 μs (1.5 μs nominal)	±20 ns
Line Blanking	9 to 16 μs (12 μs nominal)	±50 ns
Line Sync Rise and Fall Times	120 to 300 ns 300 ns to 1 μs	±15 ns ±30 ns
Line Sync	1.4 to 6.6 μs (4.7 μs nominal)	±10 ns
Sync-to-Start of Burst	2.2 to 8 μs (5.6 μs nominal)	±20 ns

FIELD BLANKING TIMING MEASUREMENTS

Measurement	Range	Accuracy
Equalizing Pulse Duration	1.4 to 20 μs (2.35 μs nominal)	±10 ns
Broad Pulse Separation	1.4 to 20 μs (4.7 μs nominal)	±10 ns

OTHER TIMING MEASUREMENTS

Measurement	Range	Accuracy	ITS Element	Standard
Bar Rise Time	120 to 300 ns 0.3 to 1.0 ms	±20 ns ±30 ns	B2	Measured from 10% to 90% points

AMPLITUDE AND PHASE MEASUREMENTS

Measurement	Range	Accuracy	ITS Element	Standard
Sync Amplitude Error	+100 to −50% (300 mV nominal)	±0.3% of nominal	Live picture area	CCIR Rec. 569
Sync Amplitude Error (with Sound-in-Sync)	+100 to −50% (300 mV nominal)	±0.3% of nominal	Last broad pulse in field	CCIR Rec. 569
Burst Amplitude Error	+80 to −50% (300 mV nominal)	±1.0%	Live picture area	CCIR Rec. 569
Chrominance Reference Amplitude Error	−80 to +50% (300 mV nominal)	±1.0%	D2	CCIR Rec. 569
Luminance Bar Amplitude Error	+30 to −70% (700 mV nominal)	±0.3%	B2	CCIR Rec. 569
Luminance Bar Amplitude	200 to 900 mV	±2.2 mV	B2	
Luminance Bar Amplitude (% of carrier)	0 to 90% of Maximum Carrier	±0.3%	B2 and Zero Carrier	
Residual Carrier (Bar Top)	0 to 90% of Maximum Carrier	0.3%	B2 and Zero Carrier	
Blanking Level	0 to 90% of Zero Carrier	±0.2%	Live picture area	CCIR Rep. 624-1
Chrominance-Luminance Gain Inequality	±75% of bar amplitude	±1.0%	G1 or G2	CCIR Rec. 569
Chrominance-Luminance Delay Inequality	±300 ns (0 ns nominal)	±5 ns	F or G1 or G2	CCIR Rec. 569

FREQUENCY RESPONSE MEASUREMENTS

Measurement	Range	Accuracy	ITS Element	Standard
Multiburst Flag Amplitude	20 to 130% of bar (60% nominal)	±0.5%	C1	CCIR Rec. 567
Multiburst Amplitude	0 to 200% of flag (100% nominal)	±1.5% of flag (±2.5% of 5.8 MHz packet)	C2	CCIR Rec. 567

LINEAR WAVEFORM DISTORTION MEASUREMENTS

Measurement	Range	Accuracy	ITS Element	Standard
Baseline Distortion	50% of bar	±0.3%	B1	CCIR Rec. 569
2T Pulse/Bar Ratio Error	+25 to −90% (0% nominal	±0.5%	B1	CCIR Rec. 569
2T Pulse K-factor	0 to 10% Kf (0% Kf nominal)	±0.3% Kf	B1	CCIR Rec. 569
Bar Tilt (End Points)	0 to +40% (0% nominal)	±0.2%	B2	CCIR Rec. 567
Bar Tilt (Peak-to-Peak)	0 to +40% (0% nominal)	±0.2%	B2	CCIR Rec. 567

NON-LINEAR WAVEFORM DISTORTION MEASUREMENTS

Measurement	Range	Accuracy	ITS Element	Standard
Chrominance-Luminance Intermodulation	±50% (0% nominal)	±0.2%	G1 or G2	CCIR Rec. 569
Differential Gain	0 to +100% (0% nominal)	±0.3%	D2	CCIR Rec. 569
Differential Phase	0 to 360 deg (0 deg nominal)	±0.3 deg	D2	CCIR Rec. 569
Luminance Non-linear Distortion	0 to 50% (0% nominal)	±0.4%	D1	CCIR Rec. 569

LOW FREQUENCY ERROR

Measurement	Range	Accuracy	Standard
Low Frequency Error	0% to 25% (0% nominal)	±0.8%	CCIR Rec. 569

NOISE MEASUREMENTS

Measurement	Range	Accuracy	Standard
Unweighted SNR (567)	26 to 60 dB 61 to 70 dB	±1.0 dB ±2.0 dB	Measured on one quiet line per CCIR Rec. 567
Luminance Weighted SNR (567)	26 to 60 dB 61 to 70 dB	±1.0 dB ±2.0 dB	Measured on one quiet line per CCIR Rec. 567
Chrominance Weighted SNR	26 to 60 dB 61 to 70 dB	±1.0 dB ±2.0 dB	Measured on one quiet line per CCIR Rep. 637-2
Periodic SNR	26 to 60 dB 61 to 70 dB	±1.0 dB ±2.0 dB	Measured on one quiet line per CCIR Rep. 637-2
Unweighted SNR (569)	26 to 60 dB 61 to 70 dB	±1.0 dB ±2.0 dB	Measured on one quiet line per CCIR Rec. 569
Luminance Weighted SNR (569)	26 to 60 dB 61 to 70 dB	±1.0 dB ±2.0 dB	Measured on one quiet line per CCIR Rec. 569

INCIDENTAL CARRIER PHASE MODULATION

Measurement	Range	Accuracy
ICPM (requires zero Carrier Pulse and the quadrature output of the demodulator on Channel C)	0 to 30 deg.	±1.0 deg.

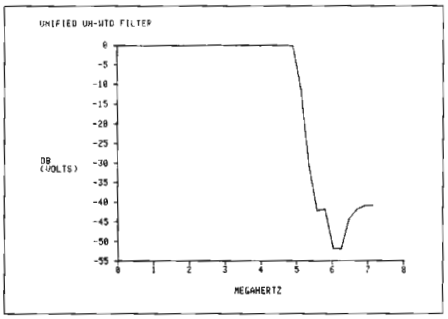
Page 1

VM700 Video Measurement Set

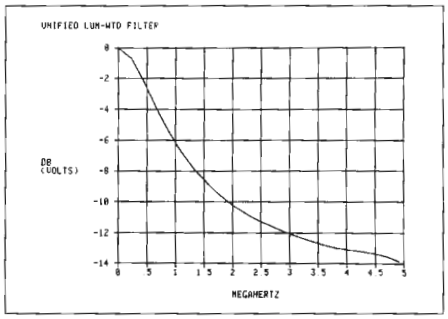
Channel A System Default 02-Jun-89 14:47:41

				Violated Limits Lower	Upper	
Luminance Bar Ampl	693.6	mV				
Luminance Bar Ampl	------	% Carr	**	0.0	200.0	No Zero-C Pulse
Lum Bar Ampl Err	-0.9	%				
Bar Tilt (Pk-Pk)	0.1	% Bar				
Bar Tilt (End Pts)	0.1	% Bar				
Bar Rise Time	196.3	ns				
Baseline Distortion	0.3	% Bar				
Blanking Level	------	% Carr	**	69.0	79.0	No Zero-C Pulse
Pulse/Bar Ratio Err	-1.1	% Bar				
2T Pulse K-factor	0.4	% Kf				
Chr/Lum Gain Ineq	-2.5	% Bar				
Chr/Lum Delay Ineq	-5.7	ns				
Lum. Nonlin. Dist.	0.3	%				
Chrom Ref Ampl Err	-2.0	%				
Pk-Pk Diff Gain	0.5	%				
Peak Diff Gain	0.4	%				
Pk-Pk Diff Phase	0.2	Deg				
Peak Diff Phase	0.2	Deg				
Chr/Lum Intermod	0.1	% Bar				
Sync Ampl Error	-0.7	%				
Residual Carrier	------	% Carr	**	2.5	20.0	No Zero-C Pulse
Sync-to-Burst Start	5.67	us				
Burst Duration	2.19	us				
Burst Duration	9.7	Cycles				
Burst Ampl Error	-2.5	%				
Sync Duration	4.70	us				
Sync Rise Time	256.4	ns				
Sync Fall Time	255.5	ns				
Front Porch	2.17	us	*	1.20	1.80	
Line Blanking	14.03	us	*	11.70	12.30	
Broad Pulse Sep	4.71	us				
Equalizing Pulse	2.35	us				
Multiburst Flag	59.9	% Bar				
Multiburst Flag	415.8	mV				
MB Packet #1	99.3	% Flag				
MB Packet #2	99.0	% Flag				
MB Packet #3	98.5	% Flag				
MB Packet #4	97.9	% Flag				
MB Packet #5	97.3	% Flag				
MB Packet #6	93.9	% Flag				
CCIR LF Error	0.1	% Bar				
50-550 Hz LF Error	0.2	% Bar				
10-1000 Hz LF Error	0.1	% Bar				
S/N Unweighted (567)	75.2	dB				
S/N Lum-wgtd (567)	81.0	dB				
S/N Chr-wgtd	79.0	dB				
S/N Periodic	------	dB	**	40.0	999.0	Random >> Periodic
S/N Unweighted (569)	76.8	dB				
S/N Lum-wgtd (569)	84.0	dB				

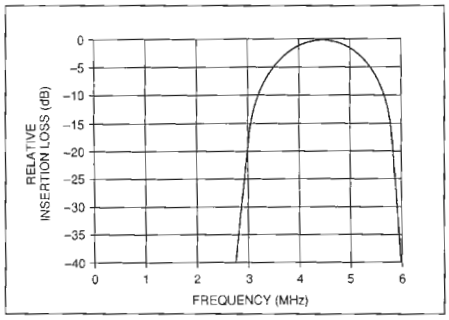
Measurement results are displayed in an easy-to-read format indicating the time, signal source, measurement, and whether the measured value exceeded caution (*) or alarm (**) limits.



Unified Unweighted filter response curve per CCIR Recommendation 567.



Unified Luminance weighted filter response curve per CCIR Recommendation 567.



Chrominance Weighting filter response curve per CCIR Report 637-2.

Measurement Methods

The following paragraphs specify the methods for each Option 11 measurement. Where appropriate, reference is made to the relevant CCIR recommendation.

Line Blanking Timing Measurements

Color Burst Duration: Measured between the half-amplitude points of the burst chrominance envelope. Result expressed as the number of cycles between the half-amplitude points. See duration "h" in waveform diagram. CCIR Report 624-1.

Front Porch Duration: Measured from the half-amplitude point between peak white-level and blanking to the half-amplitude point of the leading edge of sync. See duration "c" in waveform diagram. CCIR Report 624-1.

Line Blanking Interval: Measured from the half-amplitude point between peak white-level and blanking at the front porch to the half-amplitude point between blanking-level and peak white level at the back porch. See duration "a" in waveform diagram. CCIR Report 624-1.

Line Sync Rise and Fall Time (Build-up Times): Measured between the 10% point and the 90% point of the line-synchronizing pulse leading edge (Rise Time) and trailing edge (Fall Time).

Line Sync Width: Measured between the half-amplitude points on the leading edge and trailing edge of sync. See duration "d" in waveform diagram. CCIR Report 624-1.

Sync-to-Start of Burst: Measured from the half-amplitude point of the leading edge of sync to the half-amplitude point of the leading edge of the burst chrominance envelope. See duration "g" in waveform diagram. CCIR Report 624-1.

Field Blanking Timing Measurements

Equalizing Pulse Duration: Measured between the half-amplitude points of the leading edge and trailing edge of the equalizing pulse. See duration "p" in waveform diagram. CCIR Report 624-1, Figure 2-1 (a), (b), and (c).

Broad Pulse Duration: Measured between the half-amplitude points of the leading edge and trailing edge of the broad pulse. See duration "q" in waveform diagram. CCIR Report 624-1, Figure 2-1 (a), (b), and (c).

Other Timing Measurements

Bar Rise Time: Measured between the 10% and 90% points on the leading edge of bar. See element B2.

Amplitude and Phase Measurements

Sync Amplitude Error: Measured as the difference between the sampled sync pulse amplitude and a nominal 300 mV amplitude. Result expressed as a % of the nominal 300 mV. Sign is positive if the sampled sync pulse amplitude is greater than 300 mV.

Burst Amplitude Error: Measured as the difference between the sampled peak-to-peak amplitude at the center of burst and a nominal 300 mV amplitude. Result expressed as a % of the nominal 300 mV amplitude. Sign is positive if the sampled peak-to-peak burst amplitude exceeds 300 mV.

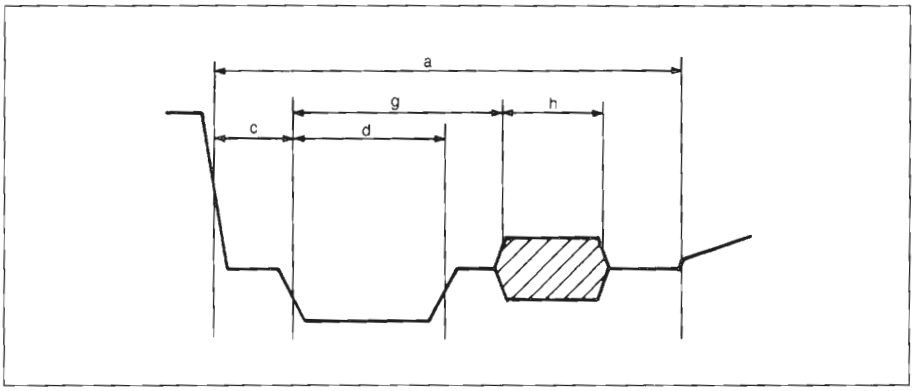
Chrominance Reference Amplitude Error: Measured as the difference between the sampled peak-to-peak amplitude of the blanking-level chrominance packet and the normalized value (0.4 of the measured bar amplitude). Result expressed as % of the normalized value. Sign is positive if the sampled peak-to-peak amplitude exceeds 280 mV. See element D2 and CCIR Recommendation 569.

Luminance Bar Amplitude Error: Measured as the % deviation of the sampled bar amplitude from a nominal value of 700 mV. Sign is positive if the sampled bar amplitude exceeds 700 mV. See element B2 and CCIR Recommendation 569.

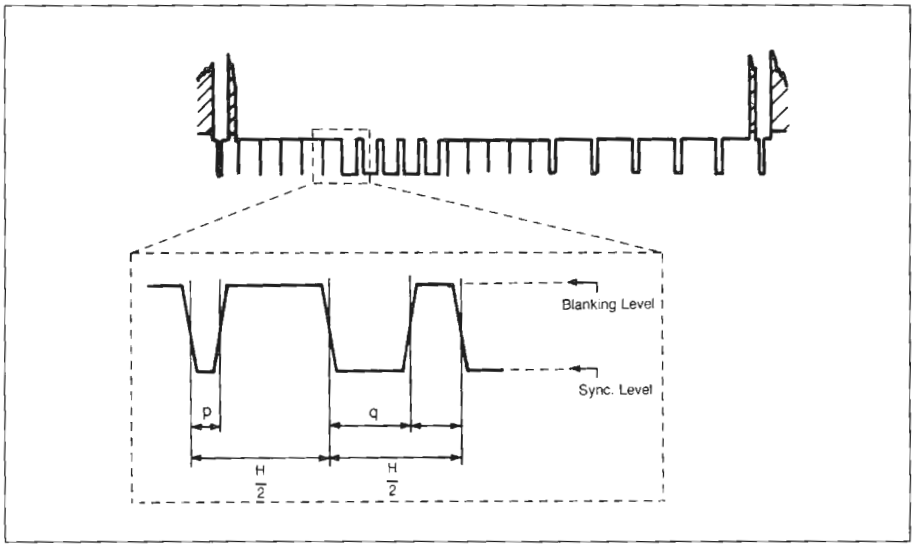
Luminance Bar Amplitude: The absolute amplitude of sampled bar. Result expressed as mV and % of Carrier (if Carrier is present). See element B2.

Bar Tilt Error: Measured as the maximum departure of the bar top from the sampled bar amplitude at bar center, excluding the bar portion one microsecond past the bar leading edge half-amplitude point and one microsecond before the bar trailing edge half-amplitude point. The sign of the difference is always positive. Result expressed as a % of sampled bar amplitude. See element B2 and CCIR Recommendation 567.

Blanking Level: Measured as the mean level over 32 sampled lines of 16 samples centered around the back porch. Result expressed as % of Carrier. Not measured if Carrier not present in the vertical interval.



Line Blanking Timing Waveform Measurements.



Field Blanking Timing Waveform Measurements.

2T Pulse K-factor: Measured as the greatest weighted amplitude of a positive-going or negative-going echo-term half-wave which is within one microsecond before the 2T pulse leading edge half-amplitude point or within one microsecond after the 2T pulse trailing edge half-amplitude point. Result expressed as a K-factor, which is the ratio of the weighted amplitude of the echo-term half-wave to the sampled amplitude of the 2T pulse. The weighting is based on the graticule shown in Figure 29a of CCIR Recommendation 567. See element B1.

C/L Gain Inequality: Measured as the difference between the sampled peak-to-peak amplitude of the 700 mV (nominal) chrominance packet (G1 or G2) and the sampled amplitude of the luminance bar (also nominally 700 mV). Result expressed as a % of sampled bar amplitude. Sign is positive if the chrominance amplitude is greater than the luminance amplitude. See element G1 or G2 and CCIR Recommendation 569.

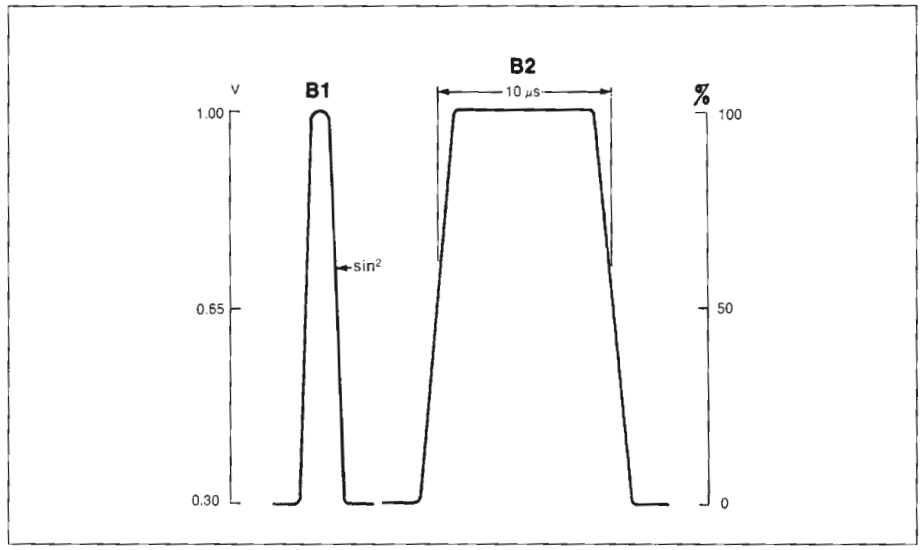
C/L Delay Inequality: Measured as the time-difference between the 10T or 20T composite pulse chrominance component center and the composite pulse luminance component center. Result expressed in nanoseconds. The sign of the result is positive if the chrominance component lags the luminance component. See element F and CCIR Recommendation 569.

C/L Intermodulation: Measured on a 350 mV pedestal, part of which has had chrominance packet superimposed and part of which has not. The result is the difference between the pedestal level under the chrominance packet after the chrominance has been filtered out and the pedestal level where no chrominance pedestal was superimposed. Result expressed as a % of sampled bar amplitude. Sign is positive if the level of the pedestal which was under the chrominance is greater than the other level. See element G1 or G2 and CCIR Recommendation 569.

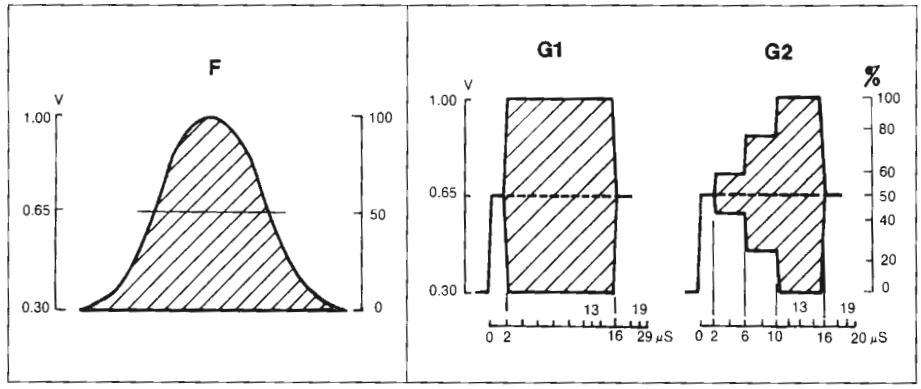
Differential Gain: Measured as peak-to-peak differential gain. The 5-riser staircase chrominance packet with the greatest peak-to-peak amplitude is found and the ratio of that amplitude to the peak-to-peak amplitude of the blanking level chrominance packet is determined and subtracted from unity. A similar ratio is determined using the packet with the least peak-to-peak amplitude and that ratio is subtracted from unity. The measurement result is the sum of the two differences. See element D2 and CCIR Recommendation 569.

Differential Phase: Measured as peak-to-peak differential phase. The maximum phase difference (absolute value) between a 5-riser staircase chrominance packet and the blanking-level chrominance packet is determined. Likewise, the minimum phase difference (absolute value) is determined. The measurement result is the sum of these two phase differences and is expressed in degrees. See element D2 and CCIR Recommendation 569.

Luminance Non-linear Distortion: Measured by comparing the differences between adjacent pairs of the six luminance levels that make up the 5-riser staircase. The measurement result is the largest % deviation in adjacent step sizes. The sign is always positive. See element D1 and CCIR Recommendation 569.



Elements B1 and B2 (CCIR Recommendation 567).

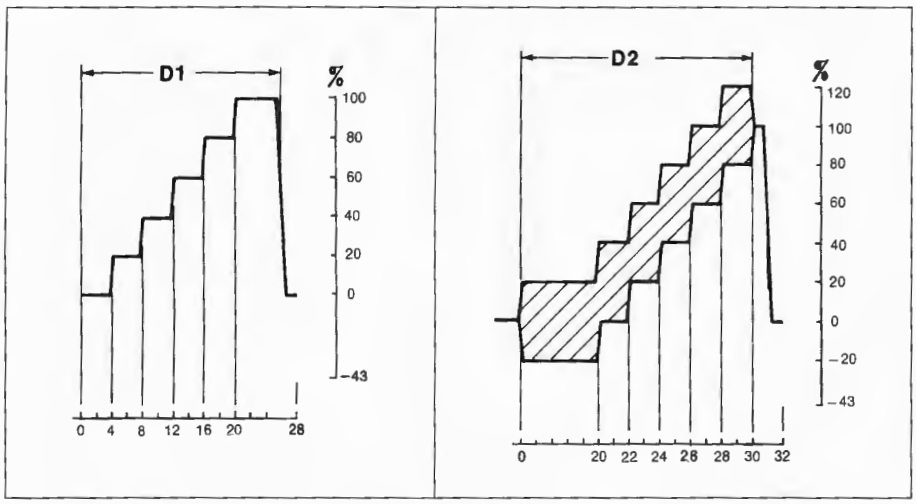


Element F, G1, and G2 (CCIR Recommendation 567).

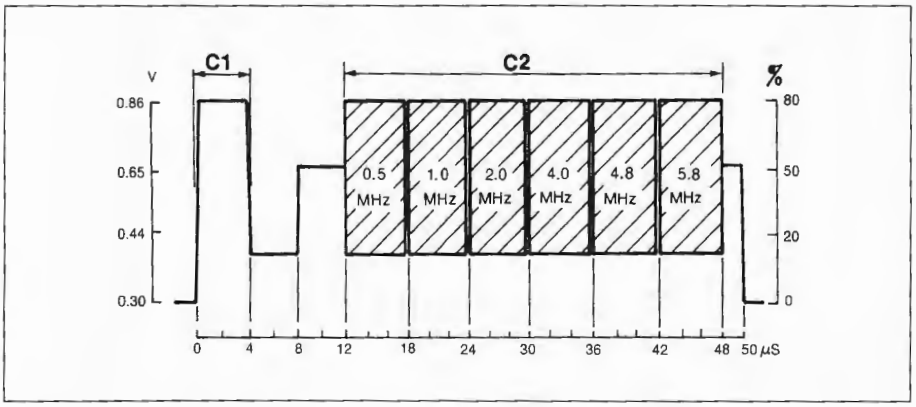
Frequency Response Measurements

Multiburst Flag Amplitude: Measured from the center point of the flag top to the ensuing bottom of the flag. Result expressed as % of sampled bar amplitude. See element C1 and CCIR Recommendation 567.

Multiburst Amplitude (five packets): Measured as the peak-to-peak amplitude of each of the first five multiburst packets. The peak-to-peak amplitude is measured over a 4.5 μsec window at the center of the first two packets, and over a 1.13 μsec window at the center of the next three packets. The last packet is not measured. Results expressed as % of sampled flag amplitude. See elements C1 and C2 and CCIR Recommendation 567.



Element D1 and D2 (CCIR Recommendation 569).



Elements C1 and C2 (CCIR Recommendation 569).

Linear Waveform Distortion Measurements

Baseline Distortion: Measured as the difference between the signal level 400 nanoseconds after the half-amplitude point of the trailing edge of the bar, and the signal level at blanking reference. The signal is first band-limited to 3.3 MHz. Result expressed as a % of sampled bar amplitude. Sign is positive if level nearest bar is highest. See CCIR Recommendation 569 (paragraph 2.4) and Figure 1.

2T Pulse/Bar Ratio Error: Measured as the difference between the sampled amplitude of the 2T pulse and the sampled bar amplitude. The sign is positive if the 2T pulse amplitude is greater. Result expressed as a % of sampled bar amplitude. See elements B1 and B2 and CCIR Recommendation 569.

Low Frequency Error

Low Frequency Error: Measured as the peak-to-peak amplitude of the most extreme sampled fluctuations from black-level that are in the frequency band between 10 Hz and 2 kHz. Expressed as a % of sampled bar.

ORDERING INFORMATION

When ordering, please use the nomenclature given here.

The standard instrument is shipped as a rack mount product.

VM700A Option 11 PAL Video Measurement Set.

OPTION

Option 1C — Cabinet Version.

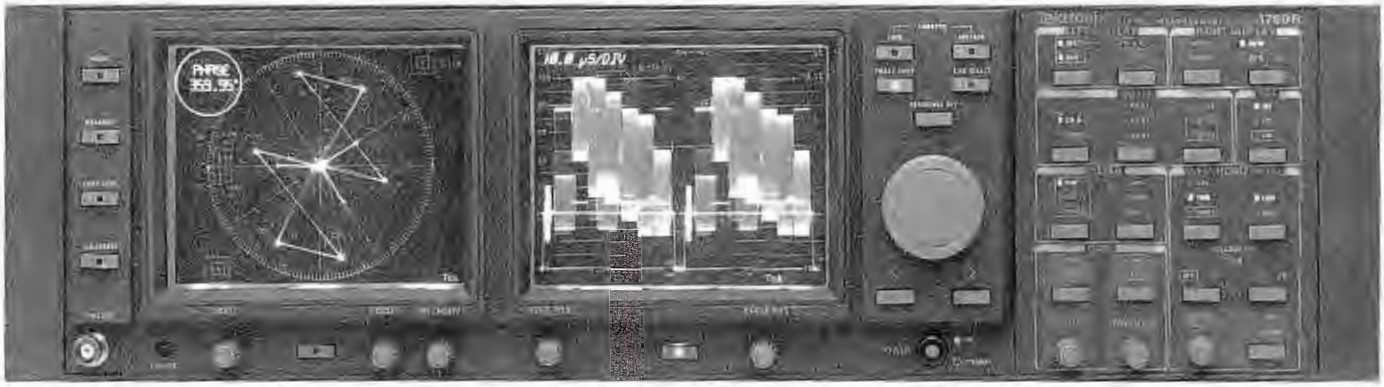
OPTIONAL ACCESSORIES

VM7FC1 — Field installable conversion kit to convert rackmount unit to cabinet.

VM7FR1 — Field installable conversion kit to convert cabinet to rackmount unit.

INCLUDED ACCESSORIES

Instruction manual, 75 Ω terminators (3) 011-0102-00, power cord.



1780R Video Measurement Set.

1780R Series
Video Measurement Set

Full bandwidth analog video processing

Precision waveform and vector measurements

Component and composite waveform display

Polar SCH presentation, with calibration

Four loop-through video input channels

Front panel probe input

Component or composite waveform evaluation

Measurement-grade time and voltage cursors

Electronic K-Factor and ICPM graticules

Precision differential phase/differential gain measurements even with noisy signals

Stereo audio phase and amplitude display

Digital control of all functions

Touch screen user interface

User-definable semi-automatic setups

Full function RS-232/RS-422 remote control

Available for either NTSC or PAL standards

UL, CSA, FM, ANSI, IEC and FCC approved

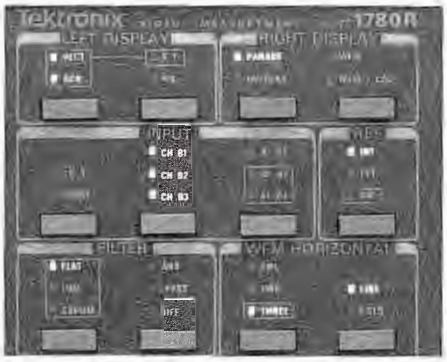
The 1780R Series Video Measurement Set offers features for precise evaluation of studio and transmission performance. This multi-function instrument is a wide bandwidth, multi-input, waveform/vector/SCH measurement package.

The advantages of separate waveform and vector instruments are provided in a single rack width, 5¼ inch high package. In addition, specific measurements take advantage of the 1780R Series' shared waveform monitor and vectorscope internal processing. Separate, optimized waveform and vector display CRTs allow simultaneous monitoring of several video parameters.

Traditional Capabilities

The 1780R Series provides a full menu of waveform/vector/SCH monitor capabilities.

Four video inputs may be individually displayed or selected in various combinations on the waveform monitor. Vector presentations may be individually displayed, overlaid for comparison, or compared to an external reference. A fifth video signal may be selected for individual display via the high impedance **front panel probe input.**



Multiple inputs and parade display mode facilitate component signal measurements.

Internal video filters are provided for specialized measurements. **Dual and triple filter** modes permit simultaneous display of video signal spectral components. External filter use is facilitated by an auxiliary video path.

A selection of **internal and electronic graticules and electronic cursors** permit measurements specific to many studio and transmission system applications.

Sweep rates and line standards are appropriate to the instrument operating standard. An **external horizontal** input facilitates ICPM measurements.

External staircase from a camera control unit may be selected remotely.

Slow sweep is standard in the 1780R Series. Low frequency transient phenomena, such as bounce, are easily observed.

A full function vectorscope configured for monitoring and measurement of the color video signal is incorporated in the 1780R Series.

New Capabilities

In addition to the waveform and vector capabilities expected in measurement quality instruments, the 1780R Series provides significant enhancements which make measurements more accurate and consistent:

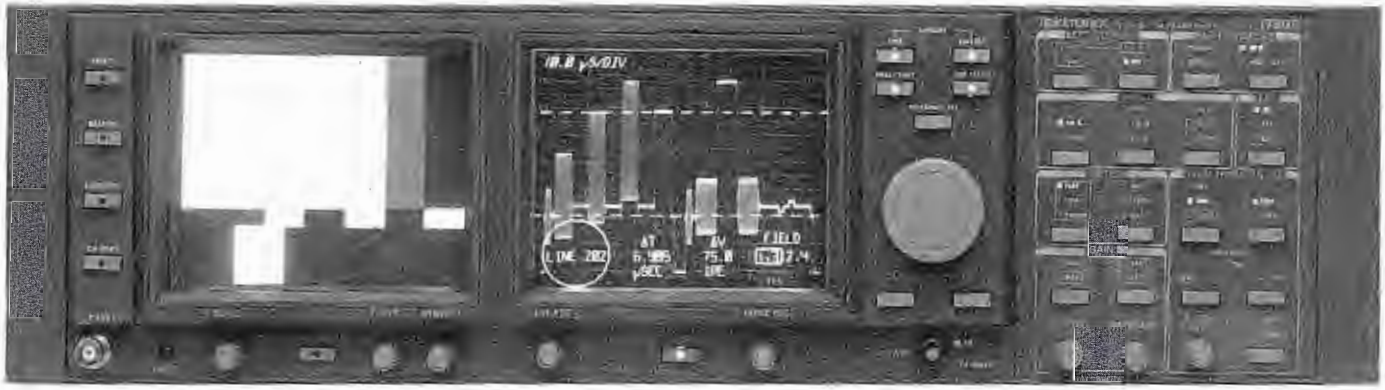
A precision phase control and on-screen readout allows differential display resolution to within .05 degrees, with an absolute accuracy of .1 degree around the full 360 degree vector range.

The Tektronix **double trace differential** phase measurement technique is enhanced with a **digital recursive vertical filter** to permit accurate readings in the presence of noise. The display may be overlaid with a much greater degree of accuracy. Differential phase value is indicated by the on-screen readout.

A double trace differential gain display is provided. Measurements are more repeatable. The digital recursive vertical filter may also be used in this mode.

Differential gain and phase may be displayed simultaneously, side-by-side on the waveform display CRT.

The **polar SCH display** provides a graphic indication of the phase of color burst relative to the leading edge of horizontal sync. In internal reference (absolute SCH mode), the selected video signal is evaluated for SCH phase as defined by the appropriate signal standard. In external reference (relative SCH mode), this same information is displayed, plus an indication of whether subsequent signals are on the same color field. The graphic display of SCH provides a quick visual indication of SCH phase, and an indication of any phase jitter or discontinuity.



Parameter assigned to knob is highlighted by on-screen box.

An **SCH calibration mode** in NTSC (1780R) instruments assures the accuracy of the SCH phase indicator. This mode provides a calibration check completely within the instrument, and does not require an external signal source of known accuracy.

Timing cursors are integrated into the waveform display and are fully operational and accurate even in magnified horizontal sweep modes.

Relative time cursors are accurate to within 5 ns. Signal may be magnified for precise cursor positioning.

Cursor operation is both logical and intuitive. For example, time measurements are often defined from one-half amplitude point on a fast risetime signal feature, to a zero crossing of another feature. For precise measurements, the 1780R Series time cursors appear as bright-up dots that can be set to any point on the waveform. Time difference between the reference and second cursor may be read directly from the on-screen digital readout.

Voltage cursors, more often used to represent standard values for comparison in video measurements, appear on the CRT as adjustable reference horizontal lines to which the video signal may be adjusted. Voltage measurements are defined as the difference in voltage (mV), or IRE units, between one signal feature and another. One cursor may be identified as the reference, or zero value, and the on-screen alphanumeric readout will indicate the difference between the two cursors in terms of voltage or IRE units. Accuracy is enhanced by insertion of the cursors into the video path at an early stage, removing the possibility of error in later stages and avoiding possible deflection linearity and CRT geometry errors.

Both timing and voltage cursors may appear on-screen simultaneously, facilitating system adjustment and **waveform photography.**

A picture display is provided as a standard feature for positive identification of the video signal being measured. This display is especially useful to indicate the line selected in line select mode.

Operational video noise measurement by the tangential method is provided as a standard capability of the 1780R Series. This method provides an indication of noise content on any video input by matching a constant luminance video segment with the same segment using a calibrated dc offset. This method is accurate and repeatable to within approximately 1 dB to −56 dB; 2 dB to −60 dB.

Analog component measurements may be made by using parade and overlay displays of the three GBR or color difference signals. The Tektronix-developed bowtie signal, a sensitive indicator of relative signal amplitude and delay, is supported.

The matching of **chrominance to luminance** delay and amplitude is facilitated by an X/Y display of the demodulated composite signal. No special test signals are required. Taped color bars may be used for recorder playback adjustment. A modulated $\sin^2$ pulse test signal or color bars may be used for transmission path confirmation.

The **front panel input** accepts a standard Tektronix oscilloscope probe.

Full line select for 4-field NTSC, or 8-field PAL, is provided with selected line(s) indicated digitally on-screen and marked on both the internal and external picture monitors.

Separate lines of the same video signal may be selected for simultaneous waveform and vector evaluation.

Stereo audio phase and amplitude is displayed as an X/Y presentation of two balanced audio inputs. Incoming signal errors may be instantly spotted for corrective action.

Relative voltage cursors may be set to indicate mV, IRE units, or percent.

Picture display identifies the signal selected for measurement.

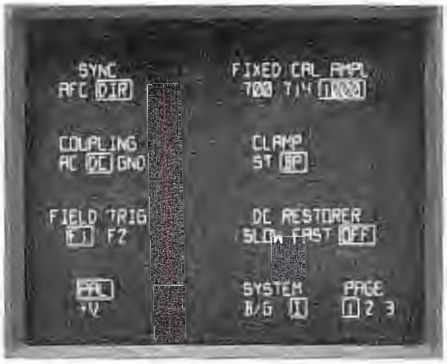
User Interface

Operator/instrument interface has been given a great deal of attention in the 1780R Series. Flexibility and ease of operation have been designed into the instrument. Measurements may be made by operators with limited experience. Seasoned operators will find measurements less time consuming and more repeatable.

User programmable semi-automatic setups, along with on-screen voltage/timing cursors and electronic graticules, contribute to operational simplicity. Simple, straightforward controls present choices to the operator only when input is needed. Complex measurement setups are pre-programmed, and operators may define, name, save and recall their own presets.

Many functions of the 1780R Series are accessed by the **touch screens**. This permits easy function availability, allows complete, descriptive labeling and eliminates front panel clutter.

Frequently used controls are grouped logically and are interactive to access desired operating modes with a minimum of keystrokes. The potential for selecting invalid modes is minimized.



Touch screens allow rapid configuration for special applications.

The 1780R Series is a **digitally controlled** instrument. All front panel controls, including knobs, touch screen operations, and pushbuttons, may be recalled remotely via an RS-232D/RS-422A serial communications port. Additionally, user programmed semi-automatic setups may be accessed by a ground closure through the remote control connector.

Outstanding CRT performance is a basic design feature of the 1780R Series. The waveform CRT is extremely bright, permitting test signal measurements in the vertical interval, even in highly magnified sweep modes. A carefully controlled beam creates a very small, finely focused spot.

Waveform photography is simple. A Tektronix camera, model C-5C Opt 2, may be quickly mounted to either CRT. This same camera may be used with all Tektronix 1700 Series Signal Monitors. A waveform digitizing camera, model DCS01, is available if a data record of the display is required. Important status, sweep and gain settings appear on-screen, within the field of the camera.

The 1780R Series is supplied as a **single 5¼ inch high package,** ready for rack mounting. A **portable cabinet** is available, providing handle, feet, and front and rear covers.

The instrument is equipped with a **high reliability cooling fan.** Clearance is not required above or below the 1780R Series instruments.

1780R CHARACTERISTICS

INPUT/OUTPUT

Vertical range, full scale — Fixed: 1.0 V ±.007 V; Variable: ≈ 0.67 to 2.00 V

Vertical magnification — Fixed, Variable, X5

Maximum input signal — AC coupled: 2.0 V p-p, 10%-90% APL; DC coupled: ±1.5 V (dc + peak ac); Loop-through common to chassis: 2 V maximum RMS at mains frequency

Return loss — Inputs A, B1, B2, or B3: >40 dB dc to 5 MHz; Aux video in, Aux video out, pix mon out: >34 dB dc to 5 MHz; External sync input: >46 dB, dc to 5 MHz

WAVEFORM MONITOR VERTICAL SYSTEM

Frequency response (flat X1) —
50 kHz - 5 MHz: Input Ch A, B_1, B_2, and B_3: 1%;
5 MHz - 10 MHz: Input Ch A: 1%; Ch B_1, B_2, and B_3: 2%;
10 MHz - 15 MHz: Input Ch A, B_1, B_2 and B_3: +2%, −5%;
15 MHz - 20 MHz: Input Ch A, B_1, B_2, and B_3: +2%, −15%

Voltage cursor — Accuracy: ±0.2%; Resolution: 1 mV

Cal amplitude — Accuracy 1.00 V ±0.2%; Resolution 1 mV at 1.00 V

DC restorer — Mains hum attenuation: Slow clamp: ≤0.9 dB; Fast clamp: ≥26 dB

Lum/chroma gain ratio — 1:1 ±1%

Vertical overscan — 1 V p-p modulated $\sin^2$ composite signal, X5 gain: <7 mV variation in baseline of chroma when positioned anywhere between sync tip and 100% white

DC channel matching — Typically within 10 mV

Common mode rejection (A-B) — 60 Hz: A-B ≥46 dB; 15 kHz: A-B ≥46 dB; 1 MHz: A-B ≥40 dB; fsc: A-B ≥34 dB

Filters — Luminance: <3 dB down at 1 MHz, ≥40 dB down at fsc; Low pass: ≥14 dB down at 500 kHz; Chrominance: Typically ±1% of flat at fsc, 3 dB points ±.75 MHz fsc, within ±.15 MHz; Diff'd steps: >40 dB at fsc

Linear waveform distortion — Pulse overshoot and ringing: ≤1% of applied pulse amplitude; 25 μs bar tilt: ≤1% of applied square wave amplitude; 2T $\sin^2$ pulse to bar ratio: 1:1 ±1%

Non-linear waveform distortion — Aux video and pix mon out: Differential gain: ≤0.25%, 10%-90% APL; Differential phase: ≤0.25°, 10%-90% APL

PROBE INPUT

Input resistance — nominally 1.0 MΩ

Input RC product — nominally 20 μs (20 pf)

Gain full scale — 0.1 V, 1.0 V ±3%

Frequency response — 25 Hz to 10 MHz: ±3%

Probe calibrator — 1.0 V ±0.5%

WAVEFORM MONITOR HORIZONTAL DEFLECTION SYSTEM

Sweep rates and timing accuracy — 1H (5μs/div): ±2%; 2H (10μs/div): ±2%; 3H (15μs/div): ±2%; 1F displays 1 full field including field rate sync; 2F displays 2 full fields, first field selectable even or odd; 3F displays 3 full fields, first field selectable even or odd

Sweep linearity — 1H, 2H, or 3H: ±1%; 1F, 2F, or 3F: ±0.5 div; Slow sweep: ±5% full screen over sweep length

Magnified sweep accuracy — X5 (1μs/div): ±1%; X10 (0.5μs/div): ±2%; X20 (0.25μs/div): ±3%; X25 (0.2μs/div): ±3%; X50 (0.1μs/div): ±3%; X100 (50 ns/div): ±5%

Magnified sweep linearity — ±1 minor division (≤2%)

Variable sweep range — >±20%

Slow sweep duration — 4 - 12 sec.

Timing cursors — Accuracy: 5 ns any delay within one line

Line select — Range: full field, waveform and vector monitors may select different lines; Field selection: 1 of 4 for NTSC (1780R) or 1 of 8 for PAL (1781R), even, odd, or all fields

RGB/YRGB — Staircase input: 10 V p-p for 9 division wide display ±1.4 major divisions; Staircase operating signal: dc signal levels plus peak ac, not to exceed −12 V to +12 V; Maximum ac signal: 12 V p-p; Field or line rate: front panel selectable

External horizontal input — 0 to +5 V. 5 V is nominally a 10 div H sweep

WAVEFORM MONITOR DIFFERENTIAL GAIN AND DIFFERENTIAL PHASE DISPLAY

Differential gain (DG) — Deflection factor: 5% DG deflects the trace 50 IRE (1780R) or 500 mV (1781R) ±5%; Residual DG (10%-90% APL): ≤0.2% last 90% of trace; Calibrated DG (CRT readout): Resolution: 0.1%; Accuracy: 0.1% ±10% of reading; Range: ±5%

Differential phase (Dϕ) — Deflection factor: 5° Dϕ deflects the trace 50 IRE (1780R) or 500 mV (1781R) ±5%; Residual Dϕ: (10%-90% APL) ≤0.1° last 90% of trace; Calibrated Dϕ (CRT readout): Resolution: 0.05°; Accuracy: Burst lock ±0.1° over any 10° increment; ±0.2° over full 360° range; Ext ref ±0.1° over full 360° range

Digital Recursive vertical filter — Displayed signal white noise reduction: approximately 15 dB; Cross luminance rejection: approximately 30 dB; Unit sample response: settles to within 1 dB in 50 samples; Chrominance bandwidth: 500 kHz ±100 kHz baseband

SYNCHRONIZATION

Sync input — Internal: Reference sync separator: 0.2 to 2.0 V p-p composite video; Internal sync separator: 0.5 to 2.0 V p-p composite video. External: Black burst: 286 mV (1780R), 300 mV (1781R) sync and burst amplitude, +6/−14dB; Composite sync: 0.2 to 8.0 V p-p; SCH modes: 286 mV (1780R), 300 mV (1781R) sync burst ±3 dB

Direct Sync — Horizontal frequency range: 15.734 kHz ±100 Hz

AFC sync — Horizontal frequency range: 15.734 kHz ±200 Hz; Lock-in time: <1 second

Slow sweep triggering — Signal APL change from ≤10% to 90%; Sensitivity: 0.4 to 2.0 V p-p composite video with APL change; Rate: ≥0.2 Hz

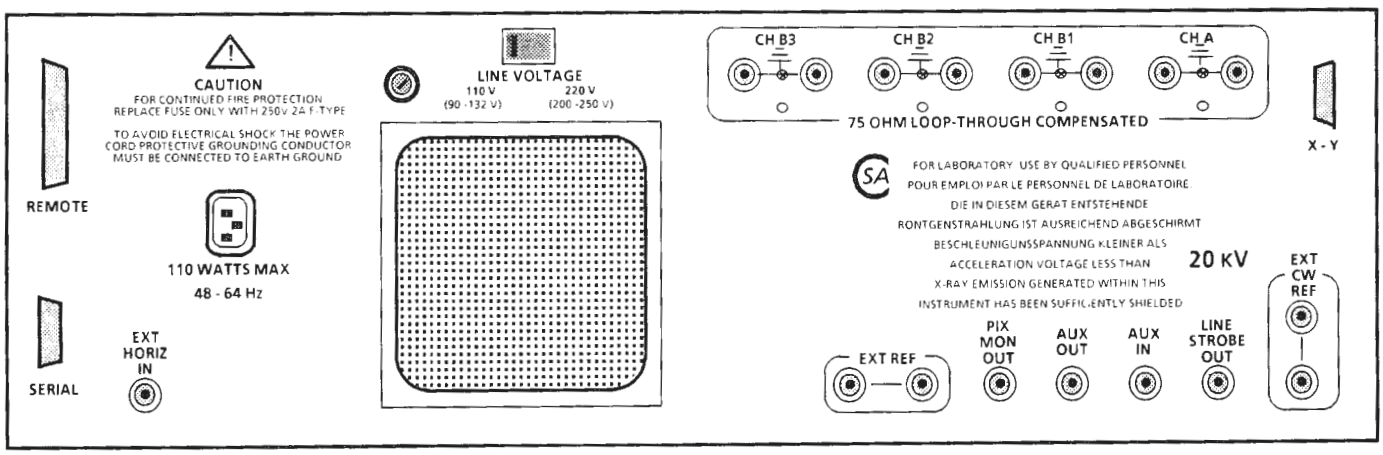
Remote sync — Amplitude: 2.0 to 5.0 V squarewave, or 4.0 V composite sync

VECTORSCOPE VECTOR DISPLAY

Digital phase shifter phase accuracy — 0.1°

Chrominance bandwidth — Upper −3 dB point: fsc +500 kHz, ±100 kHz; Lower −3dB point: fsc −500 kHz, ±100 kHz

Display — Vector phase accuracy: ±1.25°; Quadrature phasing: ±0.5°



1780R Rear Panel.

Subcarrier regenerator — Pull-in range: ±50 Hz of fsc (1780R), ±10 Hz of fsc (1781R, typically ±50 Hz); Phase shift with burst amplitude change: ≤2° to ±6 dB; Phase shift with input channel change: ≤2°

Clamp stability — better than 0.4 mm

Variable gain range — +14 dB to −6 dB of 75% colorbar preset gain

Variable gain phase shift — ≤1° as gain is varied +3 dB to −6 dB

VECTORSCOPE XY DISPLAY

DC coupled differential inputs through rear panel connector — Input amplitude: 2 to 9 V p-p, adjustable internally for full scale deflection 0 dBm to +12 dBm for 600 Ω system. Factory set to 0 dBm; Maximum input voltage: ±15 V combined peak signal and dc; Frequency response: dc to >500 kHz; X and Y input phase matching: <one trace width of separation to 20 kHz

VECTORSCOPE SCH PHASE DISPLAY

Accuracy — Absolute: ≤5° phase at 25°C.; Relative: typically ≤2°; Acquisition time ≤1 second.

Display range — Absolute (internal reference): ±70°; Relative (external reference): 360°. Indicates correct color framing

CRTs AND HIGH VOLTAGE SUPPLIES

Waveform monitor — Viewing area: 80 mm × 100 mm; Accelerating potential: nominally 20 kV; Orthogonality: ±1°

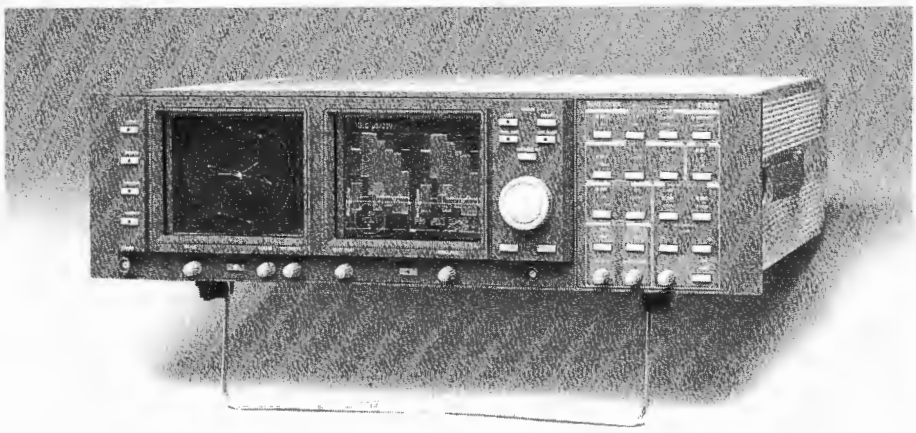
Vectorscope — Viewing area: 80 mm ×100 mm; Accelerating potential: nominally 13.75 kV; Orthogonality: ±1°

POWER REQUIREMENTS

Mains voltage ranges — 110 Vac: 90-132 V; 220 Vac: 200-250 V

Mains frequency range — 48-86 Hz

Power consumption — 110 W max.



Portable Cabinet.

ENVIRONMENTAL SUMMARY

Temperature range — Operating: 0°C to 50°C; Non-operating: −55°C to +75°C

Altitude — Operating: to 15,000 ft (4.5 km) max. Non-operating: to 50,000 ft (15 km) max.

Humidity — 90-95% noncondensing

Vibration — Operating: 0.015 in (0.38mm) p-p, 10-55 Hz, 75 minutes

Shock — Non-operating: 30 g acceleration, 3 times each major axis, 11 ms, halfsine

Bench handling — 4 in drop to table top on each of four bottom corners

Transportation — Vibration: qualified under National Safe Transit Association (NSTA) Test Procedure 1A-B-1; Drop test: qualified under NSTA Test Procedure IA-B-2

CERTIFICATIONS

Safety/EMI — Designed to meet or exceed: UL-1244; Factory Mutual 3820; CSA Bulletin 556B; IEC 348; FCC EMI Compatibility (FCC Rules Part 15 Subpart J, Class A); VDE 0871.5 (Class B)

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	133.4	5.25
Width	483	19.0
Depth	460	18.0
Weight (approximate)	**kg**	**lb**
Net	12.75	28.0
Shipping	20.10	45.0

ORDERING INFORMATION

When ordering, please use the following nomenclature.

1780R NTSC Video Measurement Set (525 line/60 field)

1781R PAL Video Measurement Set (625 line/50 field)

Includes: Operator's manual, service manual, power cable assembly, spare fuse, replacement air filter.

OPTIONS

Option A1 — 220 V Euro plug

Option A2 — 240 V UK plug

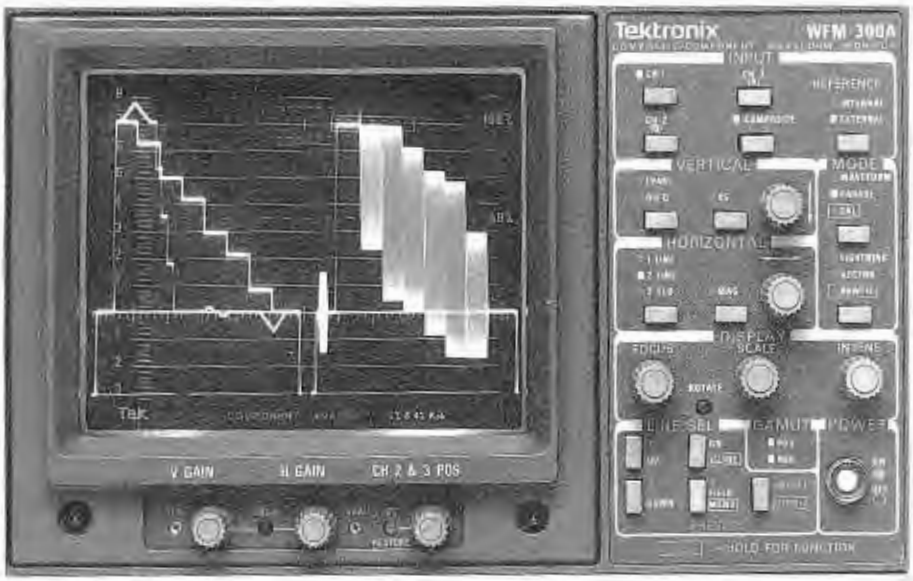
Option A3 — 240 V Aust plug

OPTIONAL ACCESSORIES

Portable cabinet, including handle, feet, front & rear covers. Order 1780F02.

Cameras. Order Tektronix C5C (Option 02), C7 (Option 03), C30 or C31

Probe. Suggested probe is P6108 10X 2m (010-6108-03) or 3m (010-6108-05).



Dual input display of composite and component Y-channel color bar signals.

WFM300A
Component/Composite Waveform Monitor

Component and composite waveform display

Menu selectable electronic graticules

Lightning display for equipment setup and monitoring

Bowtie display for system timing

Menu selectable component format options

Menu selected 625/50 or 525/60 configuration

Separate GBR and composite picture monitor outputs

Color gamut violation indication

Front panel user recalls for fast operation

UL, CSA, ANSI, IEC and FCC approved

The WFM 300A is a comprehensive component television signal monitor with important features to monitor associated composite signals. It is designed specifically for signal evaluation and equipment alignment in production suites using RGB, Betacam®, or MII component formats. In addition, composite (NTSC or PAL) waveforms existing in the facility may be monitored with the WFM 300A and composite vectors displayed on a companion 1720 Series composite vectorscope.

The WFM 300A provides a full set of component monitoring features. Its innovative and unique Lightning display allows accurate adjustment of component equipment to replay Betacam or MII format tapes without a requirement for special test signals. Off-tape color bars provide all necessary information to quickly set the playback recorder setup, video gain, chroma, and Y/C delay for accurate reproduction. All of these recorder adjustments are accomplished while viewing one convenient, easy-to-interpret display. Electronic graticules for the various component formats used throughout the world are selected from an on-screen menu.

The traditional parade display of the three component signals provides side-by-side comparison. In addition, any combination of the three signals can be overlaid for accurate comparison. A composite signal may also be compared to the component luminance signal. Three sweep rates (1 line, 2 lines, and 2 fields) are provided. Both horizontal and vertical magnification can be applied for detailed inspection of the signals being observed.

A component vector mode, useful for estimating color hue and saturation values, provides a familiar color bar vector display of color difference signals.

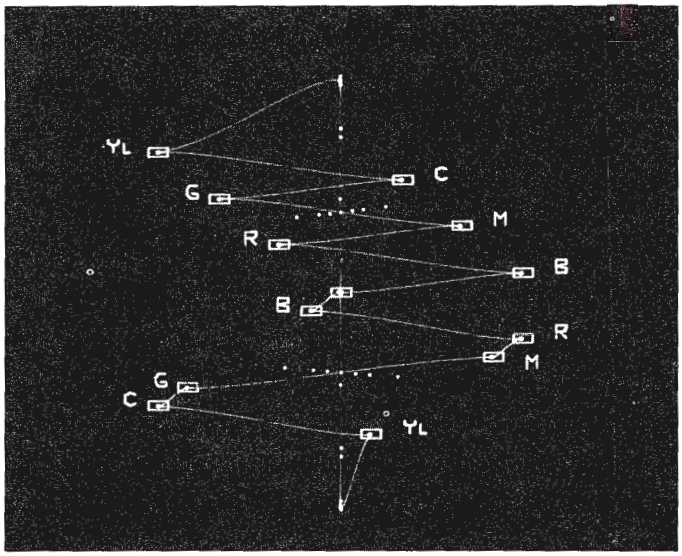
The Bowtie mode uses the Tektronix Bowtie timing test signal from the TSG300 or TSG370 test signal generators, allowing precise timing of three wire component television systems. This utilizes a channel 1 minus channel 2 and 3 mode to provide a side-by-side differential comparison (1–2 and 1–3) of all three channels.

In addition to a luminance filter, which provides a smooth roll-off of chroma components in a composite signal, the WFM 300A provides a differentiated step filter for measurement of luminance non-linearities in component signal channels.

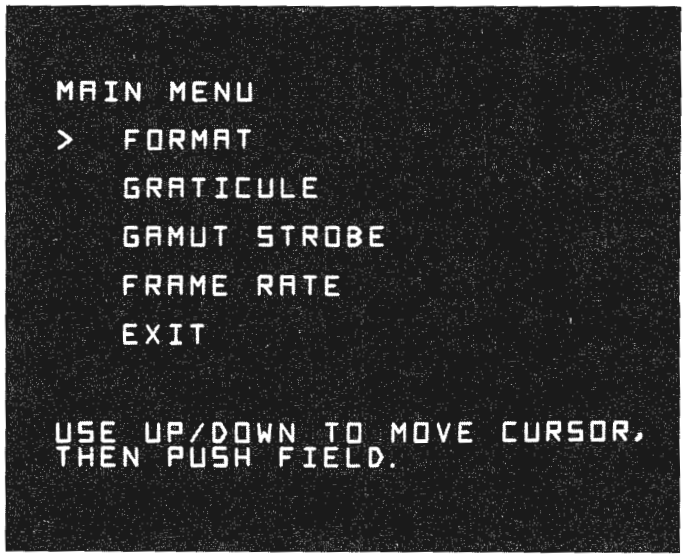
Two separate picture monitor outputs are provided, one for the composite PAL or NTSC input signal, and one GBR set for the component input signal. All color difference format component input signals are transcoded to GBR using one of two plug-in resistor matrixes supplied with the WFM 300A. The valid GBR gamut limit is monitored to ensure the operator is warned if a combination of signals will not be valid when later encoded into PAL or NTSC composite format. Front panel LEDs indicate whether positive or negative gamut limit has been exceeded, and the operator may enable a flashing on-screen indication of the offending area on the picture monitor.

The WFM 300A has full frame line select, with alphanumeric readout. Any one or two lines of the entire frame can be selected and displayed, or the same line(s) in both fields may be viewed at one time. In addition, any successive 15 lines can be overlaid. An intensified zone, in the two-field sweep and on the composite picture monitor output, indicates the location of the selected line.

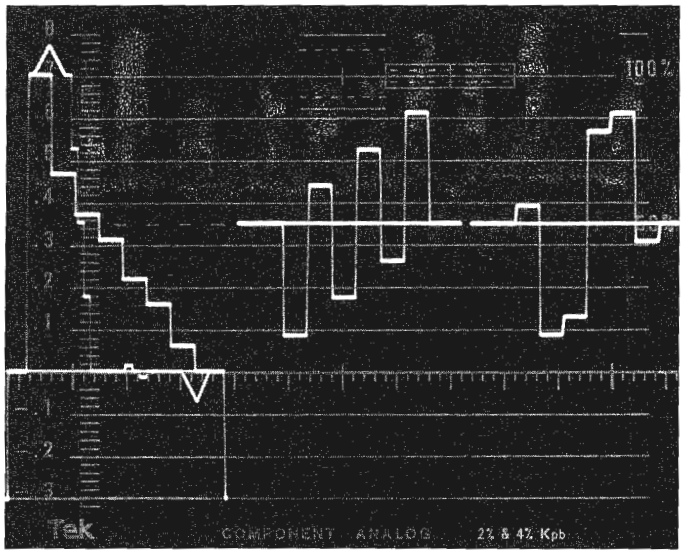
Operator interface has been given careful attention in the WFM 300A. Component and composite inputs are clearly identified for easy signal selection. Regularly used controls, including three front panel user recalls, are readily available for immediate selection on the front panel. Less often used controls, such as electronic graticule selection for different component formats, selection of 525/60 or 625/50 line/field rates, 75%/100% color bar graticules, and gamut strobe enable/disable are accessed from on-screen menus. The internal CRT graticule supplied is calibrated in mV or IRE units appropriate to the PAL or NTSC composite format selected.



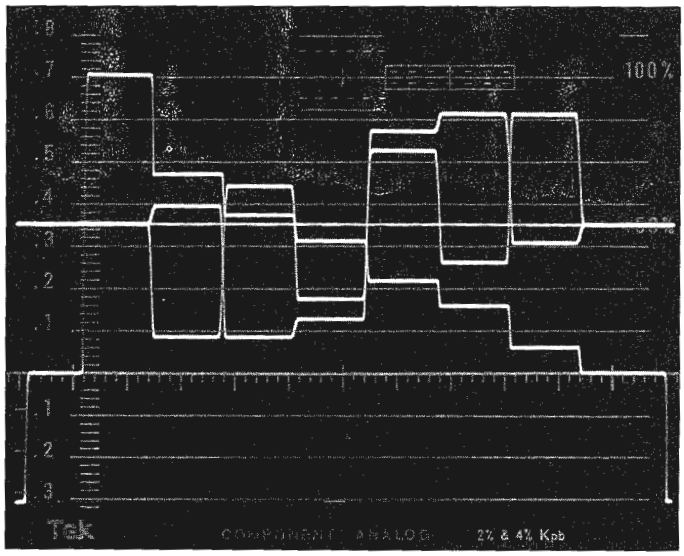
Lightning display allows monitoring of important component parameters using just color bars.



Instrument is configured to the desired application through on-screen menus.



Component Parade Display.



Component Overlay Display.

CHARACTERISTICS

Vertical Deflection System — Frequency Response: 1 V Full Scale; 50 kHz to 6 MHz within 2% of response at 50 kHz. X5 gain; 50 kHz to 5 MHz within 2% of response at 50 kHz. Diff'd step filter; ≥ −20 dB at 14 kHz and 2 MHz. Luminance filter; > −25 dB at 3.58 and 4.43 MHz. Transient Response: 1 V Full Scale; Pulse-to-bar 0.99:1.00 to 1.01:1.00. Ringing and Overshoot: ≤2%. Tilt: ≤1%. Variable Gain Range: 1 V Full Scale; Input signals between 0.7 V and 2.0 V can be adjusted to 1.0 V display. Deflection Accuracy: 1 V within 2% with 1 V input.

DC Restoration — Attenuation of 50 Hz on Input Signal: ≤20%. Blanking Level Shift with 10% to 90% APL Change: ≤1%.

Inputs — Component Channels 1, 2, 3, and External Reference: Return Loss (75 ohms) at least 40 dB from 50 kHz to 6 MHz. Composite Channel: Return Loss (75 ohms) at least 30 dB from 50 kHz to 6 MHz. Cross Talk Between Channels: >46 dB isolation between channels. Loop-Through Isolation: >60 dB isolation between channels. Maximum Input Level for Normal Operation: Component channels 1, 2, 3, and Composite; ±2 V (dc + peak ac). External Reference: +2 to −4 V peak ac (compatible with composite sync).

Horizontal Deflection System — (Waveform and Parade Mode) Sweep will occur in all sweep rate settings with or without a reference signal. Synchronization: Sweep will synchronize to sync amplitude of 0.3 V p-p ±6 dB. 2 FLD Sweep Repetition Rate: Equal to frame rate of selected reference. 2 FLD MAG (Magnification): Approximately X20. 1 LINE Sweep Repetition Rate: Equal to line rate of selected reference. 2 LINE Sweep Repetition Rate: Equal to half line rate of selected reference. Timing Accuracy: 1 μs/div; within 2%. 0.2 μs/div; within 2%. Linearity (1 μs/div and 0.2 μs/div): Within 2 %.

Parade Mode Sweep Repetition Rate — Field or line.

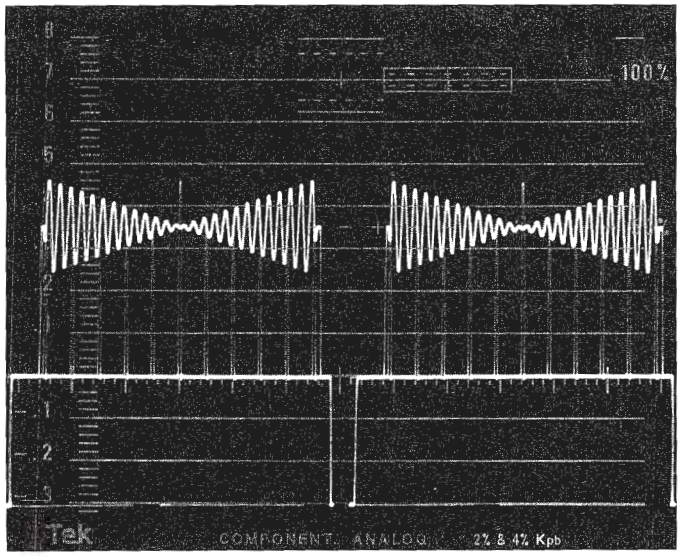
Vector Mode — Vertical Bandwidth: 900 kHz ±100 kHz. Horizontal to Vertical Bandwidth Matching: No eye opening at 500 kHz or 2 MHz. Vertical Gain Accuracy: ±1%. Horizontal Gain Accuracy: ±1%. Electronic Graticule Accuracy: ±1%.

Bowtie Mode — Common Mode Rejection Ratio: >40 dB. Calibration: Calibrator accuracy within 1%.

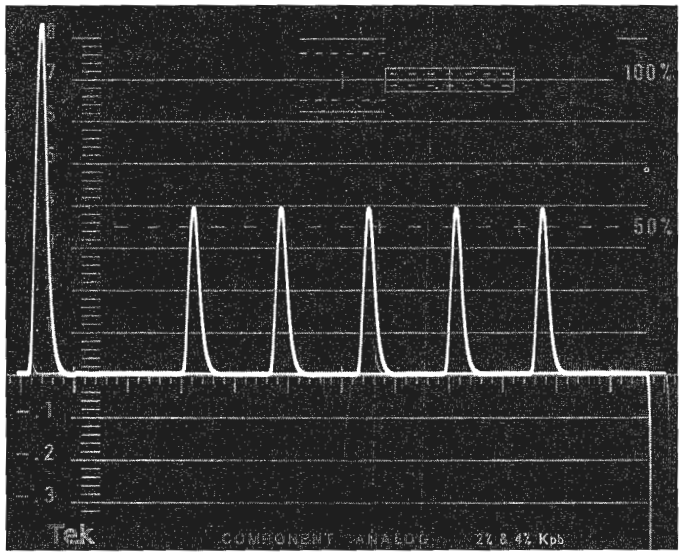
Transcoder: — Accuracy: Within 1%. GBR Outputs: Impedance 75 ohms nominal. Back porch clamped to 0.0 V. Gamut Limit: Preset threshold settings are nominally +735 mV and −35 mV within ±5 mV.

CRT Display — CRT Viewing Area: 80 × 100 mm. Horizontal = 12.5 div. Accelerating Potential: Nominally 13.75 kV. Trace Rotation Range: >±1° from horizontal.

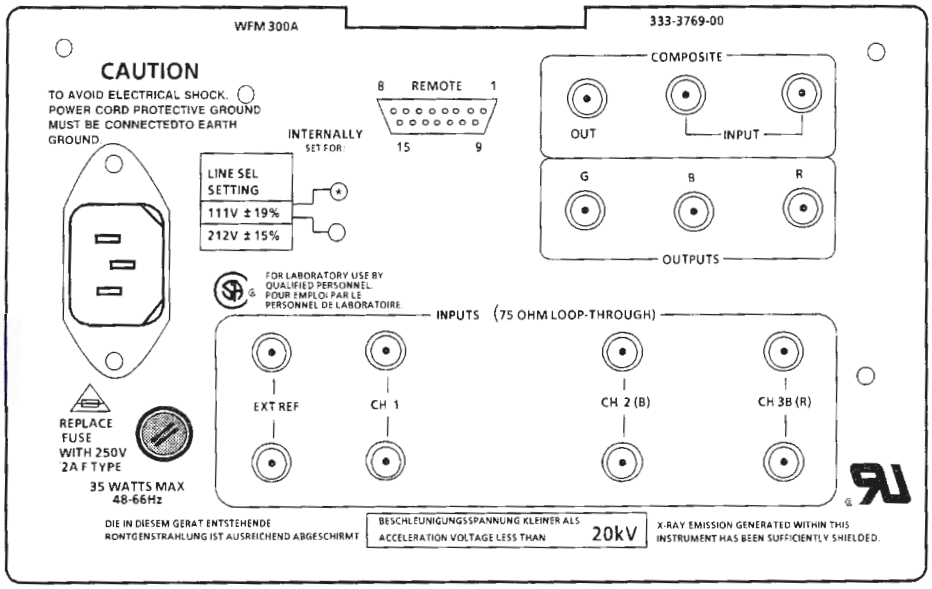
Power Source — Mains Voltage Ranges: 110 V (88-132 V); 220 V (198-242 V). Mains Frequency Range: 48 Hz to 66 Hz. Power Consumption: 35 Watts maximum.



Bowtie Display of Inter-channel Timing Error.



Luminance Linearity Display.



WFM 300A Rear Panel.

ENVIRONMENTAL

Temperature non-operating — −55°C to +75°C.

Temperature operating — 0°C to +50°C.

Altitude non-operating — to 50,000 feet.

Altitude operating — to 15,000 feet.

Vibration operating — 15 minutes each axis at 0.15 inch, frequency varied from 10-55-10 Hz in 1-minute cycles with instrument secured to vibration platform. Ten minutes each axis at any resonant point or at 55 Hz if no resonant point is found.

Shock non-operating — 30 g's, ½ sine, 11 ms duration, 3 shocks per surface (18 total).

Transportation — Qualified under NSTA Test Procedure 1A, Category II (24-inch drop).

Humidity — Meets Tektronix Standard 062-2847-00.

CERTIFICATION

Safety — UL-1244; ANSI C39.5; CSA Bulletin 556B; IEC 348.

FCC EMI Compatibility — FCC Rules Part 15 Subpart J (Class A). VDE 0871.5 (Class B).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	214	8.424
Width	133	5.25
Depth	464	18.125
Weight (approximately)	**kg**	**lb**
Net	4.0	9.0

ORDERING INFORMATION

The standard instrument is shipped without a case or handle. Please order the appropriate enclosure from the optional accessories list. The WFM 300A is a UL recognized component and meets the requirements for listing when used in the appropriate enclosure.

WFM 300A Component/Composite Waveform Monitor. 625/50 line/field rate. PAL mV CRT graticule. SMPTE/ EBU N10 (Betacam or MII as used in PAL countries) transcoder installed. Wired for 110 V power, with U.S. power cord. Select Option A1, A2, or A3 for 220 V/240 V ac mains operation.

OPTIONS

Option 05 Delete color shutter for white display of electronic graticules.

Option 10 525/60 line field rate. NTSC IRE CRT graticule. Betacam® 60 Hz transcoder (Betacam as used in NTSC countries) installed. Wired for 110 V power, with U.S. power cord.

Option 14 525/60 line field rate. NTSC IRE CRT graticule. SMPTE/EBU N10 transcoder (MII as used in NTSC countries) installed. Wired for 110 V power, with U.S. power cord.

Option A1 Wired for 220 V power, with European power cord and two fuses.

Option A2 Wired for 240 V power, with United Kingdom power cord and two fuses.

Option A3 Wired for 240 V power, with Australian power cord and two fuses.

Transcoders for both Betacam and SMPTE/EBU N10 are supplied with all WFM 300A instruments. Only one transcoder can be installed at a time. GBR operation is selectable from the front panel on all instrument/option combinations.

INCLUDED ACCESSORIES

Instruction manual; Power cable assembly; Spare fuse; Spare graticule lamps; Remote control mating connector.

OPTIONAL ACCESSORIES

Cameras — Regular, with Polaroid pack film back: order C5C opt. 2. Automatic, with Polaroid AutoFilm motorized back: order C7 opt. 3.

Cabinets — Plain, no handle or feet, painted silver gray: order 1700F00.

Cabinets - Portable, including handle and feet, painted silver gray: order 1700F02.

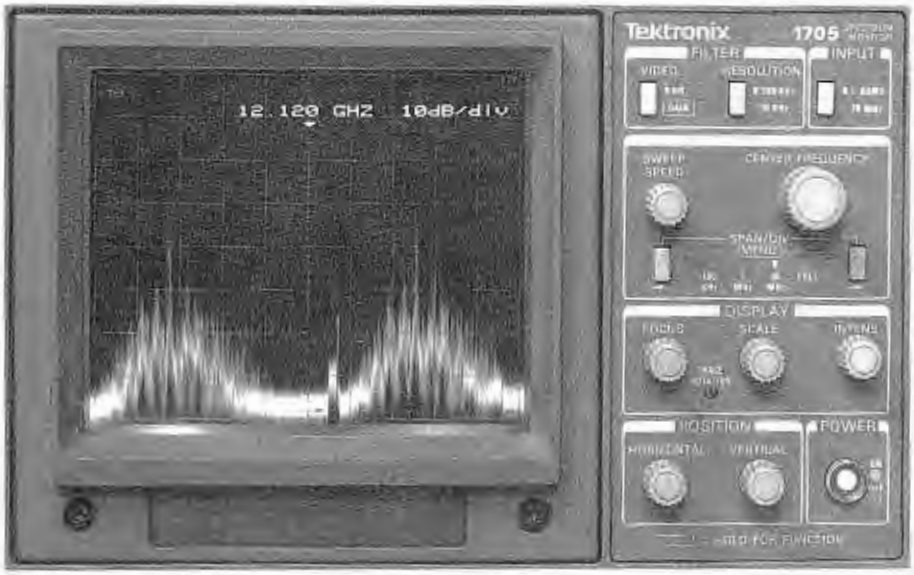
Rack Adapter — Side-by-side rack mount, adjustable front panel depth: order 1700F05.

Blank Panel — Blank half rack width panel: order 1700F06.

Viewing Hood — Blue: order 016-0475-00.

Front Cover — Blue, snap-on: order 200-1566-00.

Betacam® is a registered trademark of Sony Corporation



1705 Spectrum Monitor.

1705 Spectrum Monitor

Designed for satellite news gathering

Easy, reliable operation

Cost effective

On-screen Ku or C-Band frequency readout

On-screen setup menu

L-band and 70 MHz IF inputs

Selectable 2 dB or 10 dB/Div sensitivity

Resolution switchable to 10 kHz or 300 kHz

Span range and video filter selection

Center frequency control

Bright clear display

Portable DC power and battery available

The Tektronix 1705 Spectrum Monitor is a special purpose radio frequency monitor designed for rapid response television satellite news gathering applications. Using the 1705, an operator can identify the spectral pattern of a particular satellite and transponder to determine which video, audio, and SCPC carriers are present. It assists in the accurate adjustment of azimuth, elevation and polarization of the downlink/uplink antenna. It also provides a display of satellite and locally generated signals.

Dual Band Operation

The 1705 features front panel selectable inputs for L-band (900-1450 MHz) monitoring of television downlink signals from a low noise blockconverter (LNB) located at the receive antenna, and 70 MHz band (45-100 MHz) monitoring of the television uplink exciter or other IF signals. Input frequency is displayed on-screen in both L-band and 70 MHz modes, and the L-band readout may be reconfigured to display a satellite frequency in the range of 0.9-20.0 GHz.

Microprocessor Control and Frequency Readout

Front panel switches are momentary touch type polled by the internal microprocessor. Function indicators are lighted for quick identification of current status. Spectrum monitor frequency readout characteristics are selected from the on-screen menus and stored in non-volatile memory. Self diagnostics of the instrument are also facilitated by the on-screen menu display.

RF Spectrum Display

Span per division, filter bandwidth and video bandwidth may be selected for full satellite, transponder, or discrete carrier display. The frequency band of interest is highlighted in the FULL span mode, with frequency indicated as an alphanumeric readout. In 10 MHz, 1 MHz and 100 kHz span modes, the readout indicates the frequency of the spectrum displayed directly under a cursor. A CENTER FREQUENCY control moves the spectral view through the entire selected band, either 45-100 MHz or 900-1450 MHz.

Bright CRT Display

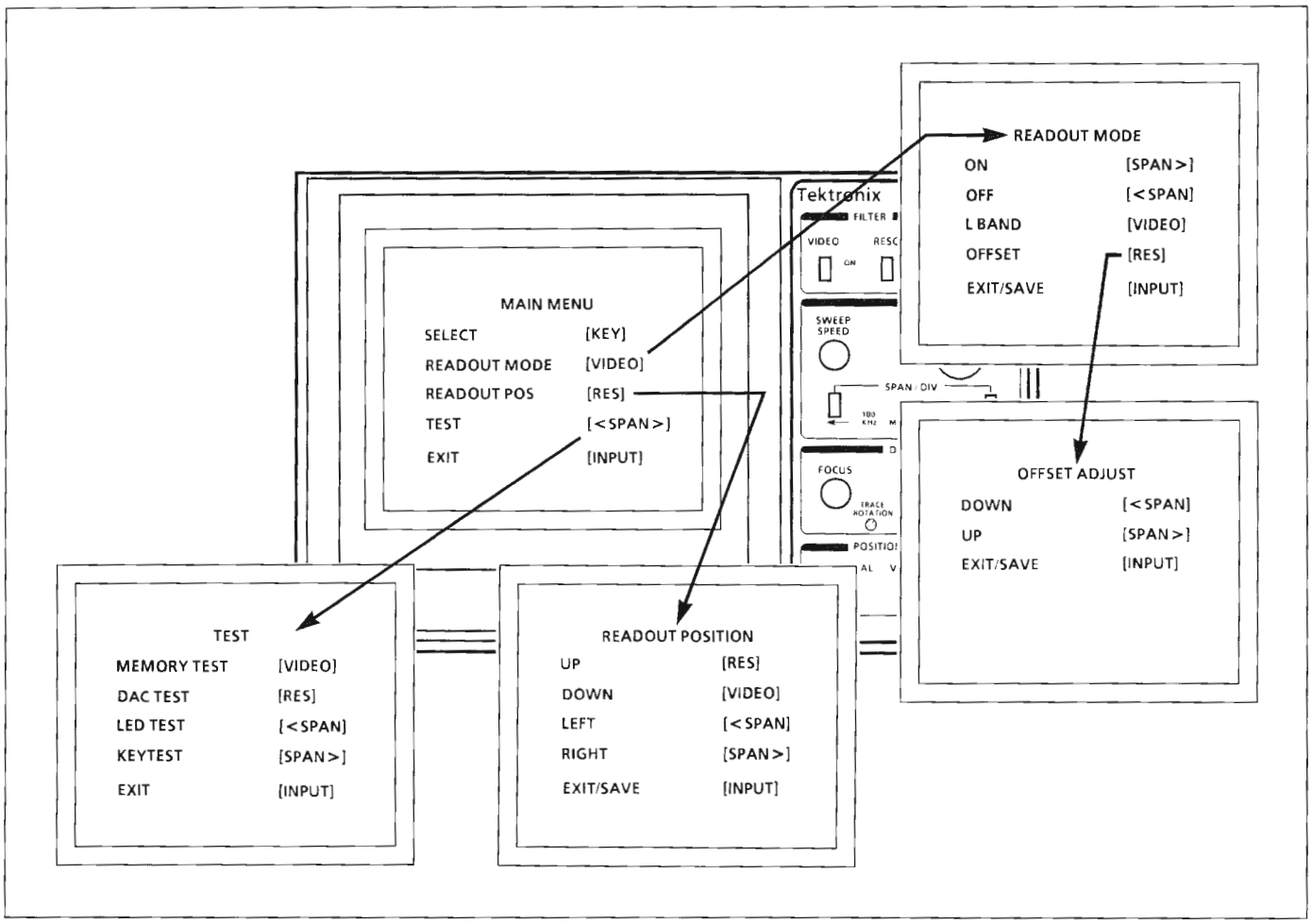
The signal is displayed on a bright, mesh type CRT with an internal graticule to eliminate parallax. Variable graticule illumination improves readability under difficult conditions. The CRT bezel accepts camera and viewing hood options.

Compact and Portable

The Tektronix 1705 Spectrum Monitor is designed so it can be rack mounted in a dual width, 5¼″ high rack adapter, along with a half-rack monitor, such as a Tektronix 1740 Series Waveform/Vector Monitor. It may also be used as a portable instrument with the optional portable cabinet, powered from an AC source or, with the addition of a field upgrade kit, an external 12 Vdc supply or BP1 battery pack. An internal 18 V supply may be switch selected on the rear panel of the Spectrum Monitor to provide power via the type F L-band connector to the system LNB.

Designed for Rugged Use

The 1705 Spectrum Monitor is designed to provide reliable operation in a portable satellite news application. The 1705 is built to withstand extremes of temperature, altitude and vibration. Various packaging and ac/12Vdc/battery power options provide freedom of system design so critical to the rapidly changing competitive television news environment.



1705 Menu Flow.

CHARACTERISTICS

Frequency Range — L-band: 900-1450 MHz (F-type connector); 70 MHz: 45-100 MHz (BNC connector).

Frequency Span — L-band: Full (900-1450 MHz with 500 MHz on screen), 10 MHz/div., 1 MHz/div., 100 kHz/div.; 70 MHz: Full (45-100 MHz with 50 MHz on screen), 1 MHz/div., 100 kHz/div.

Frequency Readout — Alphanumeric on screen display with center frequency marker. Offset may be adjusted to read satellite frequency in range of 0.9 GHz to 20.00 GHz.

Readout Accuracy — ±10 MHz.

Frequency Marker — Full Span: Bright up marker at indicated frequency. Marked frequency will be on screen in next narrower span; MHz/div Spans: Selected center frequency indicated by caret marker.

Span/Div Accuracy — L-band: Full span typically 0.5 minor division; 70 MHz: Full span typically 1.0 minor division.

Relative Amplitude Accuracy — Typically ±0.5 dB/50 MHz.

Flatness — L-band (900-1450 MHz) ±5 dB; 70 MHz (45-100 MHz) ±2 dB.

Positioning range — Vertical: ±3 divisions; Horizontal: ±2 divisions.

Resolution — Filter bandwidth 6 dB down: 10 kHz or 300 kHz.

Maximum Input Signal Level — L-band: −30 dBm, 75 Ω; 70 MHz: −20 dBm, 75 Ω.

Video Filter — Reduces display video bandwidth to ≈ 10 kHz.

Low Noise Blockconverter (LNB) DC Supply — +18 Vdc ±5%, 250 mA max. Output through L-band input connector, switched on/off by rear panel slide switch. LED indicator on rear panel.

CRT DISPLAY

CRT Viewing Area — 80 × 100 mm.

Accelerating Potential — 13.75 kV.

Trace Rotation Range — >±1 degree from horizontal. Total range typically 8°.

Graticule — Internal, 8 × 10 div. spectrum monitor graticule with variable scale illum.

POWER SOURCE

Mains Voltage Ranges — 110V: 90-132 V., 100-132 V. with LNB supply switched on; 220V: 180-250 V., 200-250 V. with LNB supply switched on.

Mains Frequency Range — 48 Hz to 66 Hz.

Power Consumption — 25 watts, 35 watts max. with LNB supply switched on.

ENVIRONMENTAL

Temperature — Non-operating: −55°C to +75°C; Operating: 0°C to +50°C.

Altitude — Non-operating: To 18,000 M (50,000 feet); Operating: To 5,500 M (15,000 feet).

Shock — Non-operating: 30 g's, ½ sine, 11 ms duration, 3 shocks per surface (18 total).

Vibration — Operating: 15 minutes each axis at 0.015″ (frequency varied from 10-55-10 Hz in 1-minute cycles with instrument secured to vibration platform.) 10 minutes each axis at any resonant point or at 55 Hz if no resonant point is found.

Transportation — Qualified under NSTC Test Procedure 1A, Category II (30″ drop).

CERTIFICATION

Safety/EMI — Designed to meet or exceed: UL-1244; Factory Mutual-3820; CSA Bulletin 556B; IEC 348; FCC EMI Compatibility (FCC Rules Part 15, Subpart J, Class A)

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	133.4	5.25
Width	215.9	8.50
Depth	460.4	18.1
Weight	**kg**	**lb**
Approximately	3.8	8.5

ORDERING INFORMATION

When ordering, please use the nomenclature given here. **The standard instrument is shipped without a case or handle.** If your application is for bench or portable use, please order the appropriate enclosure from the optional accessories list. The 1705 is a UL-recognized component and meets the requirements for listing when used in the appropriate enclosure.

1705 Spectrum Monitor

Includes: Instruction manual; Adapter, F-type male connector to BNC female connector; Power cord (with correct plug for the selected power plug option).

PORTABLE DC POWERED APPLICATIONS

1700F10 DC Power Converter Kit: BP1 Battery Pack, battery charger not included.

1700F02 Portable Cabinet.

OPTIONAL ACCESSORIES

Cabinets — Plain (painted silver grey). Order 1700F00. Portable (painted silver grey). Order 1700F02.

Side-by-side rack adapter — Order 1700F05.

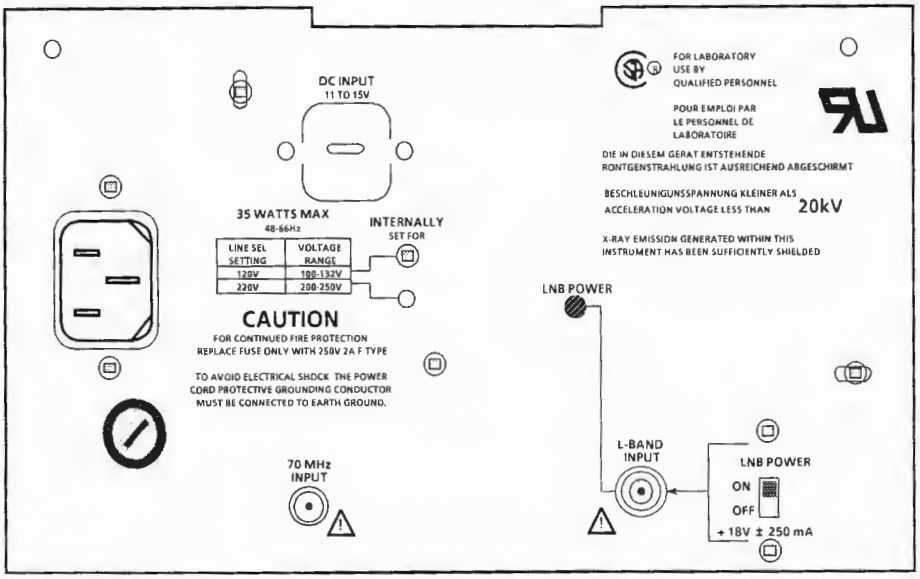
Blank half-rack width panel — Order 1700F06.

DC power converter kit — Order 1700F10.

Battery pack (for use with 1700F10 power converter) — Order BP1.

Cameras — Order C5C Opt. 02; C7 Opt. 03

Viewing hood — Order 016-0475-00.



1705 Rear Panel.

1710B Waveform Monitor with carrying case and BP1 Battery Pack (carrying case & BP1 are optional accessories).

1710B Series
Waveform Monitors

Cost Effective
Easy Operation
Burst Phase Indicator
Dual Filter Display
Half Rack Width
Bright CRT Display
Internal Graticule
Light Weight
Low Power Consumption
DC Operation Available
Available in NTSC, PAL and PAL-M Standards

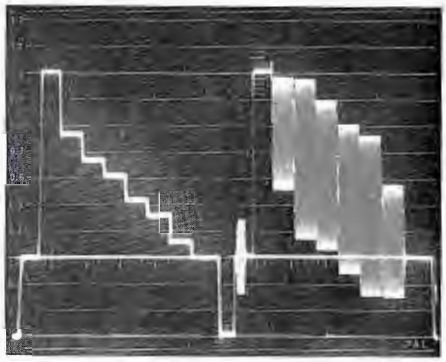
The 1710B Series waveform monitors provide all of the commonly used display modes. In addition, the 1710B Series adds relative burst phase indication and dual filter display. All of this in a cost effective package for the user who wants high quality at a low price. These new monitors are mechanically compatible and retrofit into an existing system that uses half rack width, 5¼ inch waveform monitors.

Because of its extreme light weight, low power consumption, and dc operation (field installable kit) the 1710B Series is ideal for field production, mobile operations, and any other application where space, power consumption and/or portability are prime considerations.

Easy Operation
This monitor was also designed with the user in mind. Controls have clear nomenclature and are laid out in a logical order. This makes the operation of this powerful tool easier than one might expect.

Burst Phase Indication
The relative burst phase between inputs is displayed on the LED bar graph. The center green LEDs indicate the two signals are phase matched. The yellow ones warn the phase is slipping out of an acceptable range. Finally, the red LEDs flag an unacceptable amount of phasing error. This feature allows one instrument to do the complete job of timing and phasing in a basic television system.

Dual Filter Display
The dual filter display allows the user to view both the complete video signal and the luminance information at the same time using just one instrument. This eliminates the need for switching back and forth between filters and makes the instrument easier to operate. Ideal for camera setup.



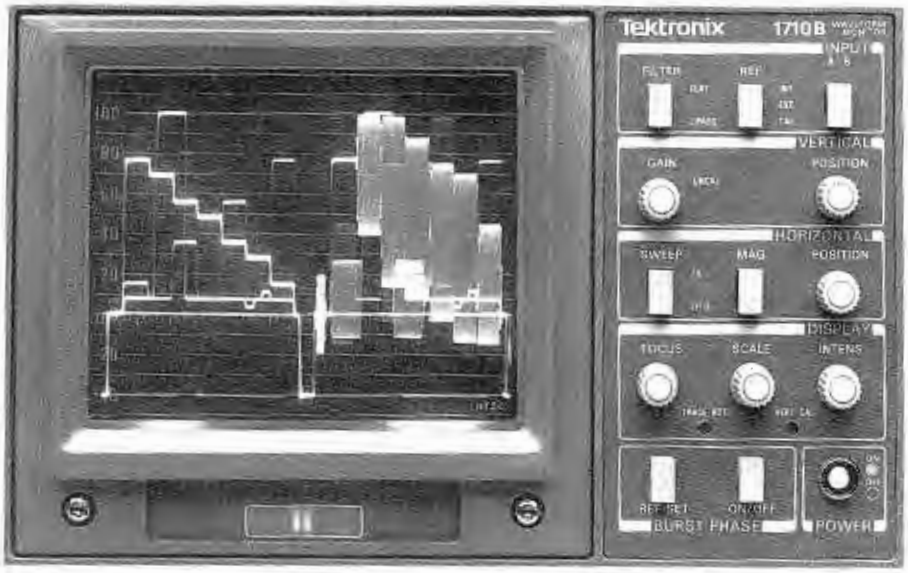
1711B Waveform Monitor Dual Filter Display.

Bright CRT Display
The bright CRT display permits use of the 1710B Series in high ambient light conditions. Brightness remains high in the magnified sweep modes enhancing the 1710B's use in system timing applications. The internal graticule is parallax-free to reduce errors and improve its monitoring and measuring capabilities.

NTSC and PAL Standards
The 1710B Series waveform monitors are available in both NTSC and PAL versions.

1710B	NTSC
1711B	PAL

PAL-M instruments are available as a modified product.



1710B Waveform Monitor Dual Filter Display.

CHARACTERISTICS

ELECTRICAL SPECIFICATIONS

VERTICAL DEFLECTION SYSTEM

Frequency Response — Flat: Within 5% of the response at 50 kHz from 50 kHz to 6 MHz. The response at Fsc is within 2% of the response at 50 kHz. L PASS: At least 97% attenuation at Fsc.

Transient Response

Pulse to Bar Ratio — 0.99:1.00 to 1.01:1.00. Ringing: 2% or less. Overshoot: 2% or less. Tilt (Field Rate Square Wave, Vertical Window, or 25 μs Bar): 1% or less of active video.

Gain Range — Input signals between 0.25 V and 2.0 V can be adjusted to 140 IRE (NTSC) or 1 V (PAL) display.

Maximum Absolute Input Level — ±2 V (dc + peak ac).

Deflection Accuracy

1710B: 1 V input for 140 IRE display within 2%.
1711B: 1 V input displays 1 V within 2%.

Dc Restoration — Dc Restorer Clamp Time: Back Porch. Low Frequency Response at 50 Hz: Attenuation of 50 Hz on Input Signal 20% or less. Blanking Level Shift with 10% to 90% APL Change: 1% or less of 100% video. Blanking Level Shift Due to Presence or Absence of Burst: 1% or less of 100% video.

HORIZONTAL DEFLECTION SYSTEM

Sweep — Sweep will occur in all Horizontal mode settings with or without synchronization.

Synchronization — Sweep will synchronize to composite video 0.5 V p-p to 2.0 V p-p or to composite sync 143 mV p-p to 8 V p-p.

2FLD Sweep Repetition Rate — Equal to frame rate of applied video or external sync.

2H Sweep Repetition Rate — Equal to half line-rate of applied video or external sync.

Timing Accuracy — 1 μs/div sweep within 2%.

Linearity (1 μs/Division) — Within 2%.

Differential Linearity (1 μs/Division) — Within 3% 0.1 div (0.5 minor div) or less compression or expansion of a center screen four division signal, when positioned anywhere horizontally.

POWER SOURCE

MAINS Voltage Ranges — 115 V (90 V to 132 V); 220 V (180 V to 250 V).

Power Consumption — 25 Watts (85.25 BTU/hour) maximum.

CALIBRATION SIGNAL

Frequency — 100 kHz ±1 kHz.

Amplitude — 1 V within 1%.

BURST PHASE INDICATOR

Phase of selected input (A or B) relative to the stored reference phase is displayed.

ENVIRONMENTAL

Temperature — Operating: 0°C to +50°C. Nonoperating: −55°C to +75°C.

Altitude — Operating: To 4500 m, (15,000 ft). Nonoperating: To 15,000 m, (50,000 ft).

CERTIFICATION

Safety — UL-1244, CSA Bulletin 556B, IEC 348.

EMI Compatibility — FCC Rules Part 15 Subpart J, (Class A). VDE 0871.5 (Class B).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	133	5.25
Width	214	8.42
Depth	429	16.88
Weight	**kg**	**lb**
Net	3.6	8.0

ORDERING INFORMATION

When ordering please use exact nomenclature given here. The **standard instruments are shipped without a case or handle.** If your application is for bench or portable use, please order the appropriate enclosure from the optional accessories list. The 1710B and 1711B are UL recognized components and meet the requirements for listing when used in the appropriate enclosure. These instruments are configured for rackmounting and are shipped without cases or covers. Order appropriate optional accessories to configure for bench, rackmount or portable use.

1710B Waveform Monitor (NTSC System Applications).
Includes: Power cable assembly, instruction manual.

1711B Waveform Monitor (PAL System Applications).
Includes: Same as 1710B.

PAL-M instruments are available as a modified product.

"Basic Waveform Monitoring" videotape available. Request through the Business Reply Card in the back of the catalog.

OPTIONAL ACCESSORIES

Cabinet — Plain. Order 1700F00.

Cabinet — Portable. Order 1700F02.

Side-By-Side Rack Mount — For mounting two half-rack instruments in a standard 19 inch rack. Order 1700F05.

Blank Panel Adaptor — For the side-by-side rack mount. Order 1700F06.

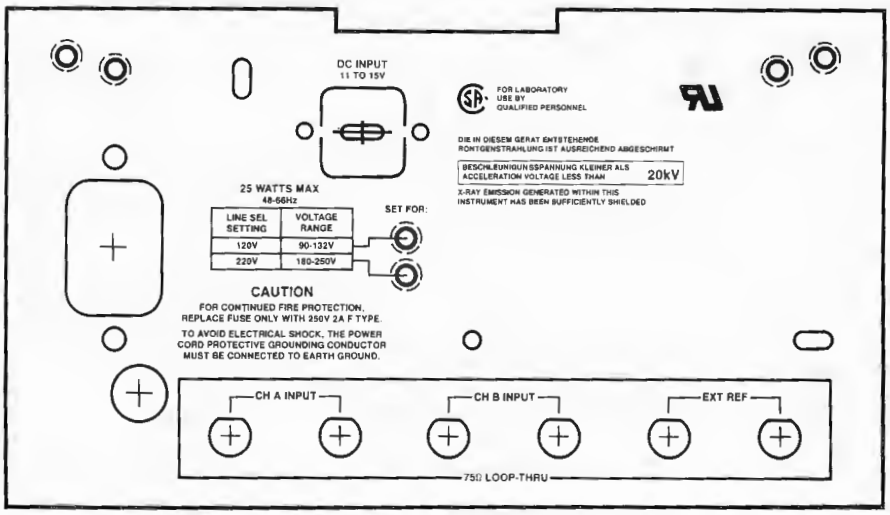
Viewing Hood — For high ambient light environments. Order 016-0475-00.

Dc Operation Kit — 12 VDC. Order 1700F10.

Camera — Order C-5C Option 02 (Regular) or C7 Option 03 (Automatic).

Battery Pack — Requires 1700F02 case to mount the BP1 to the 1710B or 1711B. Order BP1. (Battery charger not included.)

Snap Lock Power Cord Kit — North America. Order 040-1185-00. Universal Euro. Order 040-1186-00.



1710 Rear Panel.

1730 Waveform Monitor — Simultaneous Channel A and B Display.

1720 Vectorscope — Vector and Stereo Audio Dual Display Mode.

1720 Series
Vectorscopes

1730 Series
Waveform Monitors

Performance and Economy

Complete Line Select

Simultaneous Channel A & B Display

Dual Filter Display

One-Button Front Panel Recall

Differential Phase and Gain Measurement

Stereo Audio Phase Measurement

RGB/YRGB Display Capability

Vector Center Dot Clamping

Parallax-Free Internal Graticules

Portable DC Power and Battery Available

Remote Control Capability

Available in NTSC, PAL, Dual NTSC/PAL, and PAL-M Standards

The Tektronix 1730 Series Waveform Monitors and 1720 Series Vectorscopes provide a new dimension in television signal monitoring for both NTSC and PAL applications. These versatile new instruments are light weight, half-rack width, and have bright CRTs for comprehensive video signal monitoring. Both instruments exceed normal monitoring capabilities. Their unique features make them even more powerful when operated in tandem. Each monitor has its own advanced feature set and the proven 1700 Series family performance to provide more monitor for the money. These new monitors do the job faster, better and easier at an economical price.

Complete Line Select
The 1730 Series Waveform Monitor has full frame line select, with alpha-numeric readout that can be tracked by the 1720 Series Vectorscope when in Auxiliary mode. Any one or two lines of the entire frame can be selected and displayed, or the same line(s) in both fields can be viewed at one time. An intensified zone in the two-field sweep and on the picture monitor output signal indicates the location of the line selection. In addition, any successive 15 lines can be overlaid for camera and VTR adjustments.

Simultaneous Channel A and B Display
These new instruments have state-of-the-art microprocessor front panel control. They are operator-friendly and provide new features in half-rack waveform monitors or vectorscopes. Both the 1730 Series Waveform Monitor and the 1720 Series Vectorscope have dual channel display capability, allowing both input channels to be displayed on the CRT simultaneously.

Dual Filter Display
The 1730 (NTSC) and the 1731 (PAL) Waveform Monitors include dual filter display, which provides low pass and flat information in the same display. The 2-Field and 2-Line Display Modes have the Low Pass Filter applied to the left half of the trace. In the 1-Line Mode, the two signals are overlaid. These filter modes can also be used independently. All versions of the 1730 Series have chroma filters centered around the subcarrier frequency.

One-Button Front Panel Recall
Once the front panel has been set up in a frequently used mode, the configuration can be stored for later, one-button recall. In addition, when the 1720 is used in tandem with the 1730, it will respond to this Store/Recall operation. Up to four operator-selected front panel configurations can be stored from the front panel. Four other front panel configurations are factory-programmed settings and are accessible from the Remote Control interface.

Differential Phase and Gain Measurements
The 1720 Series Vectorscope graticule has scales for measuring Differential Phase and Gain. The Differential Phase scale has markings at 2° intervals. The Differential Gain scale has markings at 5% intervals. For even greater precision, the 1720 and 1730 Series can be coupled for differential phase measurements using the field or line sweep on the 1730 Series Waveform Monitor. The Waveform Monitor Chroma filter can be used for differential gain measurements.

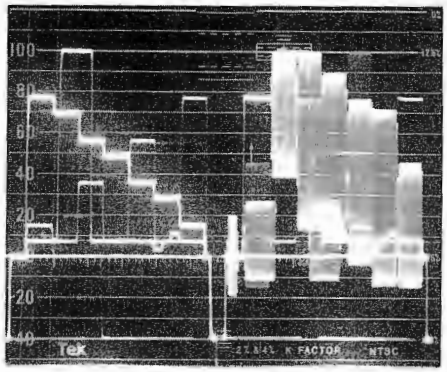
Stereo Audio Phase Measurements
Balanced inputs for the X Y mode are available on the 1720 Series Vectorscope through a separate input connector. This mode is particularly useful for evaluation of stereo audio with the special X Y graticule scale for both amplitude and phase measurements. X Y measurements can be displayed individually or in combination with a vector display. This input can also be used for other applications where X Y monitoring is useful.

RGB-YRGB
The Waveform Monitor can display RGB or YRGB. The RGB/YRGB staircase input is through a rear panel connector.

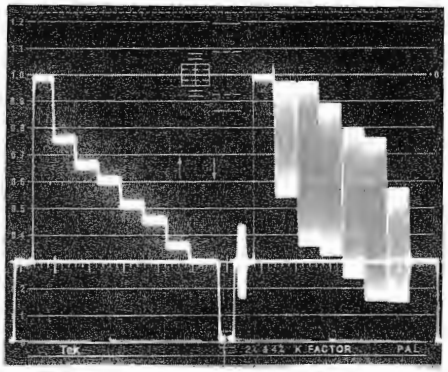
D-2 Format Videotape Recorder Option
A 1730 Series Waveform Monitor option is available for operation with composite digital videotape recorders. Option 16 provides 90/100 Hz sweep for display of D-2 format RF and servo signals. The RGB/YRGB display feature is disabled when Option 16 is installed.

Vector Center Dot Clamping
The 1720 Series vectorscope employs center dot clamping in Vector mode for easy detection of residual subcarrier on the signal. In addition, with no signal present, the center dot automatically dims prolonging the CRT life.

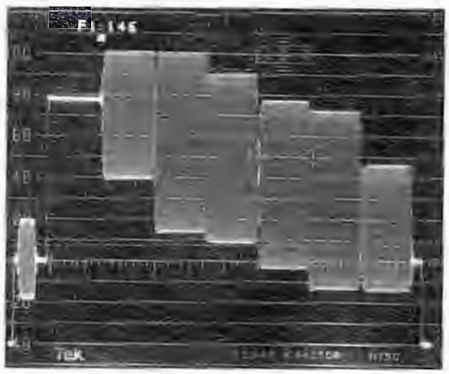
Parallax-Free Internal Graticules
Both instruments utilize post-accelerated, mesh-type CRTs equipped with internal graticules to provide parallax-free displays. Variable, evenly-illuminated scales, along with molded bezels, make waveform photography a snap.



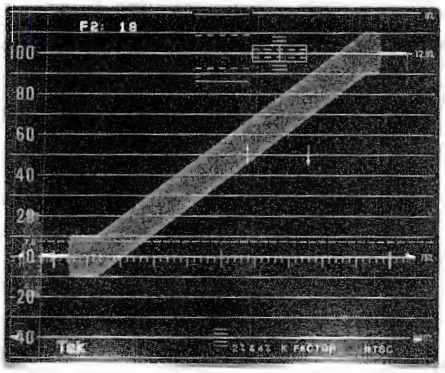
1730 NTSC Dual Filter Display.



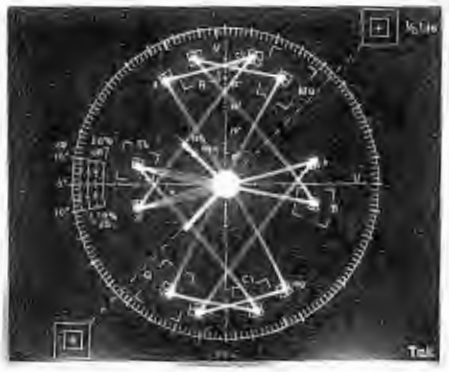
1731 PAL Dual Filter Display.



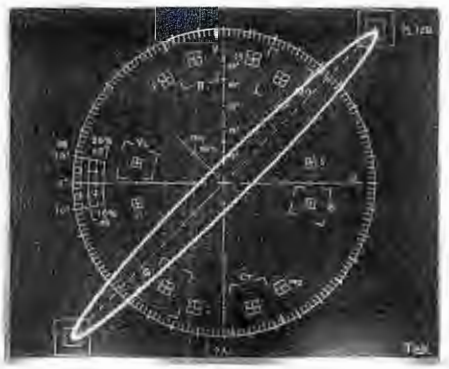
15 Line Display.



Line Select Test Signal Display.



1721 PAL Vector Display.



1721 Stereo Audio with 10° Phase Error.

Portable DC Power

In addition to being ideal for camera control units and video tape recorders, these instruments can be equipped with cabinet and field upgrades allowing them to operate from a 12 Vdc source for portable operation. They can be used with the Tektronix BP1 battery pack or other 12 V supply. Coupling this dc operation with their light weight (about 9 pounds, including cabinet), low power consumption, and compact size make these instruments well suited for use on a portable production cart.

Remote Control

Internal front panel presets, RGB/YRGB enable (or 90/100 Hz sweep with Option 16 installed), and front panel recall/setup can be accessed through the Waveform Monitor Remote connector.

Available in NTSC, PAL, and PAL-M

Both the 1730 Series and the 1720 Series are available in either NTSC or PAL versions. The 1721 Vectorscope and the 1731 Waveform Monitor are the PAL versions. The 1735 Waveform Monitor provides PAL/NTSC Dual Standard Monitoring. PAL-M instruments are available as a modified product.

1730 CHARACTERISTICS

1730 and 1731 WAVEFORM MONITOR

Signal input (video and external reference) — Return loss: >40 dB, 50 kHz to 6 MHz, power on or off. Maximum input: ±5 Vdc + peak ac. Loop-through isolation: >80 dB at F_{SC}. Channel isolation: >50 dB at F_{SC}. Impedance: >15 kΩ.

Vertical deflection — Deflection factor: Within 1% of 1 V. Gain range: Input signals between 0.8 V and 2 V can be adjusted to a 1 V display; (160 mV and 400 mV for X5 gain). Position range: 1 V signal can be positioned so that peak white and sync tip can be placed at blanking level regardless of gain range.

Frequency response — Flat: 50 kHz to 6 MHz within 2% (X1), within 5% (X5). Low pass: 40 dB attenuation at F_{SC}. Low pass response within 1% of flat response. Chroma: Nominal bandwidth 1 MHz. 2X F_{SC} attenuation >20 dB. Chroma response within 1% of flat response.

Transient response — Preshoot: <1%. Overshoot: <2%. Ringing: <2%. Tilt: <1%. Pulse-to-bar ratio: 0.99:1 to 1.01:1.Differential gain: <1%.

DC restoration — Clamp time: Back porch. Frequency response: Attenuation of 60 Hz on input signal, slow mode: <20%; fast mode: >90%. Blanking level shift: A 10% to 90% APL change will cause <1% of blanking level shift. Presence or absence of color burst will cause <1% of blanking level shift.

PIX MONitor OUTput — Frequency response: 50 kHz to 6 MHz within 3%. Differential gain: <1%. Differential phase: <1%. DC level on output: <0.5 V into 75 ohms load. Intensification (brightup): 180 mV dc offset on select lines. Output impedance: 75 ohms nominal. Return loss: >30 dB, 50 kHz to 6 MHz. Input to output (PIX MON) gain ratio luminance: 1:1 ±5% at 15 kHz.

Calibrator — Frequency: 100 kHz ±0.1 kHz. Timing accuracy: 10 μs, ±0.01 μs. Amplitude: 1 V, ±1%.

Horizontal deflection system — Sweep: Sweep will occur with or without input signal. 1-Line repetition rate: Equal to applied line rate, magnification equals 0.2 μs/div. 2-Line repetition rate: Equal to half applied line rate, magnification equals 1 μs/div. 2-Field repetition rate: Equal to applied frame rate, magnification equals approximately X25. Timing accuracy: 1 μs/div. within 2%. 0.2 μs/div. within 3%. Linearity: Within 2%. Differential linearity: Within 2%. Sweep magnification registration: Magnification occurs about the center of the screen. Position range: Any portion of a synchronized video sweep can be positioned on screen in all sweep modes.

Synchronization — Internal: Composite video or black burst with sync ±6 dB of nominal. External: Sync amplitude of 143 mV to 4 V. Remote sync: 2.0 to 5.0 V square wave or 4.0 V comp sync (sync polarity can be internally inverted). RGB/YRGB: Repetition rate: Field rate and line rate with magnification of X25 and X10, respectively. Sweep length: 3-Step (RGB) — 3.4 to 4.1 divs.; 4-Step (YRGB) — 2.5 to 3.1 divs.

1720 and 1721 Vectorscope

Signal input (video and external reference) — Return loss: >40 dB, 50 kHz to 6 MHz, power on or off. Maximum input: ±5 Vdc + peak ac. Loop-through isolation: >70 dB at F_{SC}. Channel isolation: >70 dB at F_{SC}. Impedance: >15 kohms.

Chrominance bandwidth — Upper: −3 dB point, F_{SC} +500 kHz, ±100 kHz. Lower: −3 dB point, F_{SC} −500 kHz, ±100 kHz. Vector phase accuracy: Within 1.25°. Vector gain accuracy: Within 2.5%, typical. Quadrature phasing: Within 0.5°, typical.

Subcarrier regenerator — Pull-in range: Fsc ±50 Hz. Pull in time: Within 1 second. Phase shift with subcarrier frequency change: 2° ±50 Hz. Phase shift with burst amplitude change: <2° with ±6 dB change from nominal. Phase shift with input channel change: <0.5°. Phase change with variable gain control: ±1°. Phase control range: 360° continuous rotation. Burst jitter: <0.5°. Display differential phase and gain: ±1° and ±1%. Center dot clamp stability: <0.4 mm spot movement.

Synchronization — Internal: Composite video with sync ±6 dB of nominal. External reference: Composite video or CW subcarrier.

X Y mode — Input: Differential, dc coupled. Input amplitude: 2 to 9 V p-p, adjustable full scale deflection 0 dBm to +12 dBm for 600-Ohm system, factory set to 0 dBm. Maximum input: ±15 V peak signal + dc. Frequency response: Dc to 500 kHz (dc to 100 kHz high-gain mode). X and Y phase match: Less than a trace width separation at 20 kHz.

1720, 1721, 1730, 1731, and 1735

Specifications — CRT viewing area: 80 × 100 mm. Trace rotation: 8° range, typical. Graticule: Internal scale with variable illumination.

Power source — Mains voltage ranges: 115 V, 90-132 V. 220 V, 180-250 V. Mains frequency range: 48 Hz to 66 Hz. Power consumption: 35 watts (119 BTU/HR) maximum. Battery operation: 12 Vdc (when 1700F10 is field installed).

ENVIRONMENTAL

Temperature non-operating — −55°C to +75°C.

Temperature operating — 0°C to +50°C.

Altitude non-operating — To 18,000 M (50,000 feet).

Altitude operating — To 5,500 M (15,000 feet).

Shock — Non-operating: 30 g's, ½ sine, 11 ms duration, 3 shocks per surface (18 total).

Transportation — Qualified under NSTA Test Procedure 1A, Category II (30-inch drop).

Humidity — Meets Tektronix Standard 062-2847-00.

CERTIFICATION

Safety — UL-1244-1980. Factory Mutual-3820. CSA Bulletin 556B. IEC 348. ANSIC 39.5.

EMI compatibility — FCC Rules, Part 15, Subpart J, Class A, VDE 0871.5 (Class B).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	133.4	5.25
Width	215.9	8.5
Depth	460.4	18.125
Weight (approximate)	**kg**	**lb**
Net	4.7	10.3

ORDERING INFORMATION

The standard instruments are shipped without a case or handle. If your application is for bench or portable use, please order the appropriate enclosure from the optional accessories list. The 1720, 1721, 1730, 1731, and 1735 are UL-recognized components and meet the requirements for listing when used in the appropriate enclosure.

1720 Vectorscope
(for NTSC system applications)

1721 Vectorscope
(for PAL system applications)

1730 Waveform Monitor
(for NTSC system applications)

1731 Waveform Monitor
(for PAL system applications)

1735 Waveform Monitor
(for PAL/NTSC Dual Standard applications)

For D-2 format digital videotape recorder applications order 1730, 1731 or 1735 Option 16.

PAL-M instruments are available as a modified product.

PORTABLE DC POWERED APPLICATIONS

17XX (from above) plus 1700F10 DC Power Converter kit, 1700F02 Portable Cabinet and BP1 Battery Pack

INCLUDED ACCESSORIES

Instruction manual; Power cable assembly; Spare fuse; Remote control mating connector; Auxiliary control cable (1720 series only).

OPTIONAL ACCESSORIES

Cabinets — Plain (painted silver grey). Order 1700F00.

Cabinets — Portable (including handle and feet, painted silver grey). Order 1700F02.

Side-by-side rack adapter — Order 1700F05.

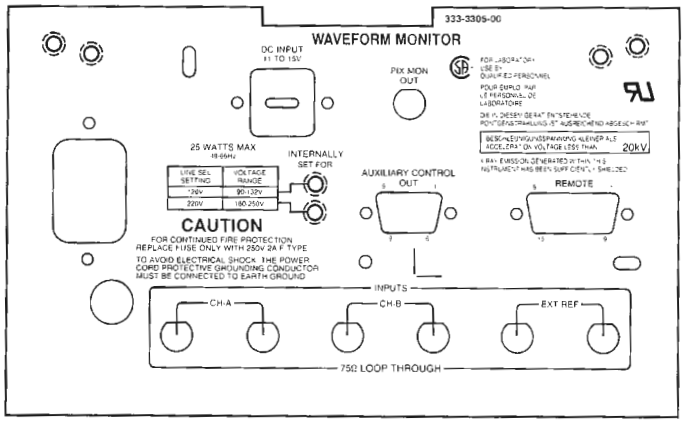
Blank half-rack width panel — Order 1700F06.

DC power converter (kit) — Order 1700F10.

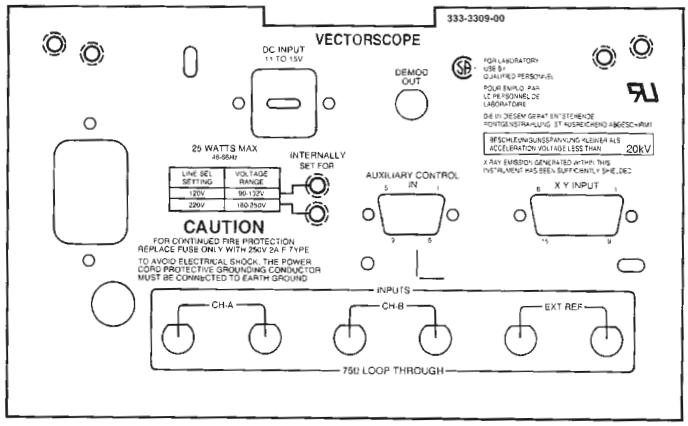
Battery pack — Order BP1 (Contact Tektronix sales representative for BP1 charging information).

Cameras — Order C5C Opt. 02; C7 Opt. 03.

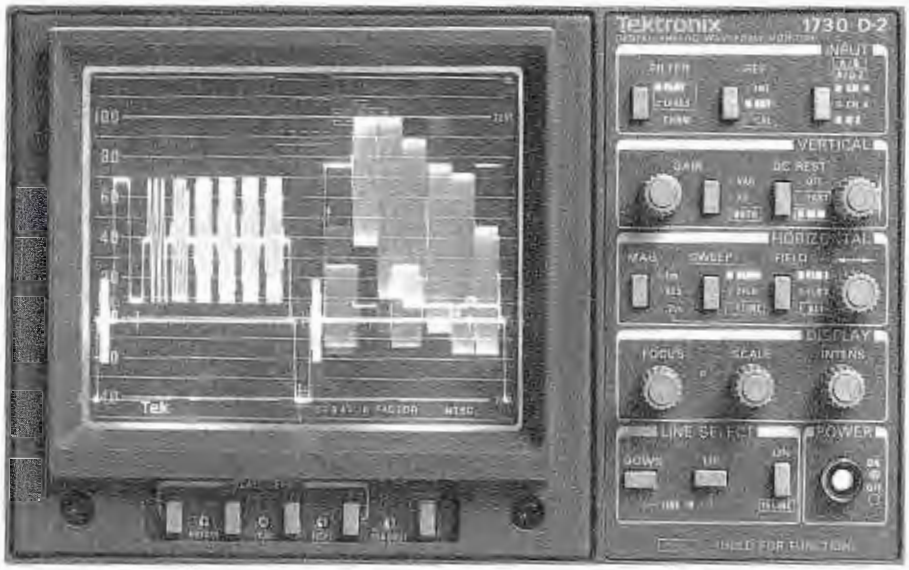
Viewing hood — Order 016-0475-00.



1730 Series Rear Panel.



1720 Series Rear Panel.



1730 D-2 Digital/Analog Waveform Monitor.

1730 D-2
Series Digital/Analog Waveform Monitor

Cost effective D-2 monitoring

Accurate 10 bit D-2 to analog conversion

Parallel D-2 loop through

Two analog inputs

Simultaneous Digital and Analog Display

Timing comparison between digital and analog input

Full time DAC output

All 1730 Series features

Can be used with any vectorscope or other measurement instruments

Displays D-2 servo waveforms

The Tektronix 1730 D-2 Series Digital/Analog Waveform Monitor are a version of the industry leader 1730 Series Waveform Monitors that provide digital D-2 input capability, along with standard analog capability.

A Tektronix developed precision digital-to-analog converter provides measurement quality D-2 decoding. The decoded analog signal can be displayed on screen and routed from a rear panel connector to the location of the user's choice.

Full 1730 Series Feature Set
All of the unique features of the 1730 Series have been retained on the 1730 D-2 Series. Features such as front panel recalls, full line select, dual filter display, and dual channel display have made the 1730 Series industry's most popular waveform monitor. These features have also been incorporated in the 1730 D-2 Series. Front panel layout is almost identical as well. So, no training is required for operators familiar with the 1730 Series.

Fully Compatible with the 1720 Series Vectorscopes and Other Instruments
The 1730 D-2 Series can be used with the 1720 Series vectorscope to provide a decoded D-2 vector display. An analog output is provided to give full time, decoded D-2 output. This output may be routed to a vectorscope, or other equipment of the user's choice. All control functions on the 1730 Series which are used to control the 1720 Series have been retained on the 1730 D-2 Series.

Active D-2 Loop Through
The 1730 D-2 Series provides an active loop through of the D-2 signal. The active loop-through eliminates the possibility of the instrument impairing the digital stream, which is important when a long signal run is connected to the instrument. Passive loop-throughs impair the signal slightly and can cause problems on cable runs near the maximum recommended length. Since the D-2 signal is completely regenerated, longer signal paths are possible than without the instrument.

One-Button Front Panel Recall
Once the front panel has been set up in a frequently used mode, the configuration can be stored for later one-button recall. In addition, when the 1720 Series is used in tandem with the 1730 D-2 Series, it will respond to this Store/Recall operation. Up to four operator-selected front panel configurations can be stored from the front panel.

Simultaneous Channel A and B and Simultaneous Analog and Digital Display
The 1730 D-2 Series provides simultaneous display of both the digital D-2 input and the channel A analog input. This allows comparison of the VTR digital output to the VTR analog output. Comparison between the two analog channels is also possible.

Dual Filter Display
The 1730 D-2 Series includes a dual filter display, which provides low pass and flat information on the same display. The two-field and two-line display modes have the low pass filter applied to the left half of the trace. In the one-line mode the two signals are overlaid. These filter modes can also be used independently. A Chroma filter centered at 3.58 MHz is also provided and can be used for Differential Gain Measurements.

CHARACTERISTICS

Analog Inputs (CH A, CH B, and External Reference) — Return loss: >40 dB, 50 kHz to 6 MHz, power on or off. Maximum input: ±5 Vdc + peak ac. Loop-through isolation: >80 dB at F_{SC}. Channel isolation: >50 dB at F_{SC}. Impedance: >15 kΩ.

Digital Input — Input type: Differential ECL (10K family). Input impedance: 110 ohms nominal.

Vertical deflection — Deflection factor: Within 1% of 1 V. Gain range: Input signals between 0.8 V and 2 V can be adjusted to a 1 V display; (160 mV and 400 mV for X5 gain). Position range: 1 V signal can be positioned so that peak white and sync tip can be placed at blanking level regardless of gain range.

Frequency response — Flat: 50 kHz to 6 MHz within 2% (X1), within 5% (X5). Low pass: 40 dB attenuation at F_{SC}. Low pass response within 1% of flat response. Chroma: Nominal bandwidth 1 MHz. 2X F_{SC} attenauation >20 dB. Chroma response within 1% of flat response.

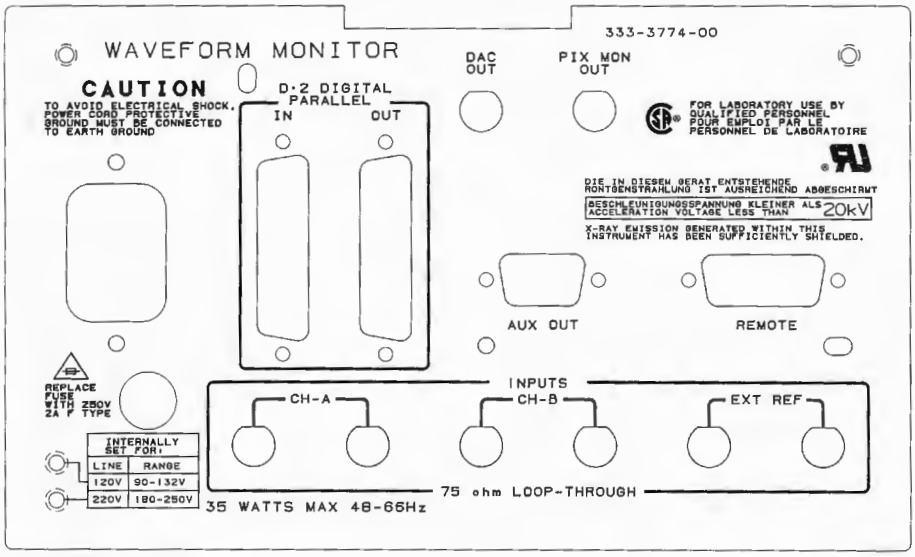
Transient response — Preshoot: <1%. Overshoot: <2%. Ringing: <2%. Tilt: <1%. Pulse-to-bar ratio: 0.99:1 to 1.01:1. Differential gain: <1%.

DC restoration — Clamp time: Back porch. Frequency response: Attenuation of 60 Hz on input signal, slow mode — <20%; fast mode — >90%. Blanking level shift: A 10% to 90% APL change will cause <1% of blanking level shift. Presence or absence of color burst will cause <1% of blanking level shift.

DAC output — Frequency response: 50 kHz to 4.2 MHz (NTSC) ±1% (±0.09 dB). 4.2 MHz to 5.5 MHz (NTSC) ±5% (±0.5 dB). 50 kHz to 5.5 MHz (PAL) ±1% (±0.09 dB). 5.5 MHz to 6 MHz (PAL) ±2% (±0.18 dB). Differential gain: <0.6%. Differential phase: <0.3°. Output impedance: 75 ohms nominal. Return loss: >36 dB 50 kHz to 4.2 MHz.

Digital output — Output type: Differential ECL (10K family). Load impedance: 110 ohms nominal.

Pix Monitor Output — Frequency response: 50 kHz to 6 MHz within 3%. Differential gain: <1%. Differential phase: <1%. Luminance amplitude accuracy: ±1%. Luminance nonlinearity: <1%. 2T pulse preshoot and overshoot: <1%. 2T pulse-to-bar ratio: ±1%. Chrominance-to-luminance gain: ±1%. Chrominance-to-luminance delay: <10 ns. SCH phase error: <10 deg. DC level on output: <0.5 V into 75 ohms load. Intensification (brightup): 180 mV dc offset on select lines. Output impedance: 75 ohms nominal. Return loss: >30 dB, 50 kHz to 5 MHz. Input to output (PIX MON) gain ratio luminance: 1:1 +5% at 15 kHz.



1730 D-2 Series Rear Panel.

Calibrator — Frequency: 100 kHz ±0.1 kHz. Timing accuracy: 10 μs, ±0.01 μs. Amplitude: 1 V, ±1%.

Horizontal deflection system — Sweep: Sweep will occur with or without input signal. 1-Line repetition rate: Equal to applied line rate, magnification equals 0.2 μs/div. 2-Line repetition rate: Equal to half applied line rate, magnification equals 1 μs/div. 2-Field repetition rate: Equal to applied line rate, magnification equals approximately X25. Timing accuracy: 1 μs/div. within 2%. 0.2 μs/div. within 3%. Timing accuracy digital-to-analog: ±40 ns at 0.2 μs/div. Linearity: Within 2%. Differential linearity: Within 2%. Sweep magnification registration: Magnification occurs about the center of the screen. Position range: Any portion of a synchronized video sweep can be positioned on screen in all sweep modes.

Synchronization — Internal: Composite video or black burst with sync ±6 dB of nominal. External: Sync amplitude of 143 mV to 4 V. Remote sync: 2.0 to 5.0 V square wave or 4.0 V comp sync (sync polarity can be internally inverted).

RGB/YRGB — Repetition rate: Field rate and line rate with magnification of X25 and X10, respectively. Sweep length: 3-Step (RGB) — 3.4 to 4.1 divs.; 4-Step (YRGB) — 2.5 to 3.1 divs.

CRT viewing area — 80 × 100 mm. Trace rotation: 8° range, typical. Graticule: Internal scale with variable illumination.

Power source — Mains voltage ranges: 115 V, 90-132 V. 230 V, 200-250 V. Mains frequency range: 48 Hz to 66 Hz. Power consumption: 35 watts (85 BTU/HR) maximum.

Environmental — Temperature Non-operating: −55°C to +75°C. Temperature Operating: 0°C to +50°C. Altitude Non-operating: To 18,000 M (50,000 feet). Altitude Operating: To 5,500 M (15,000 feet). Shock Non-operating: 30 g's, ½ sine, 11 ms duration, 3 shocks per surface (18 total). Transportation: Qualified under NTSC Test Procedure 1A, Category II (30-inch drop). Humidity: Meets Tektronix Standard 062-2847-00.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	215.9	8.5
Height	133.4	5.25
Depth	460.4	18.125
Weight (approximate)	**kg**	**lb**
Net	3.8	8.5

ORDERING INFORMATION

When ordering, please use the nomenclature given here. The standard instruments are shipped without a case or handle. If your application is for bench or portable use, please order the appropriate enclosure from the optional accessories list.

1730 D-2 Digital/Analog Waveform Monitor (for NTSC Applications)

1731 D-2 Digital/Analog Waveform Monitor (for PAL Applications)

INCLUDED ACCESSORIES

Instruction manual; Power cable assembly; Spare fuse; Remote control mating connector.

OPTIONAL ACCESSORIES

Cabinets — Plain (painted silvery grey), 1700F00; Portable (including handle and feet, painted white), 1700F02; Side-by-side rack adapter, 1700F05; Blank half-rack width panel, 1700F06.

Cameras — C5C Opt. 02; C7 Opt. 03; Viewing hood, 016-0475-00; Snap-on front cover, 200-1566-00

1730 HD Front Panel, 3-Channel Display.

1730 HD
High Definition Waveform Monitor

HDTV and transmission sweep speeds

Full 30 MHz bandwidth

Six video input channels

Parade and overlay displays

Half rack width

Complete line select

Accepts tri-level sync

On screen readouts

The Tektronix 1730 HD is a multi-standard, wide bandwidth, television waveform monitor developed in support of new generation High Definition television production and transmission systems. The familiar 1730 series operating system has been expanded to allow full High Definition waveform monitoring capabilities in camera, telecine, video tape and video transmission facilities.

Selectable Operating Formats

In addition to supporting 1050 line/60 field, 1125 line/60 field and 1250 line/50 field High Definition production formats, the 1730 HD also provides monitoring capabilities in 525 line/60 field and 625 line/50 field transmission standards. The 875 line/60 field high definition monochrome format is also supported. Sweeps are digitally derived and other High Definition line, field, and synchronizing formats may be ordered factory installed. The 1730 HD accepts tri-level or traditional bi-level synchronizing signals.

Multiple, Wideband Inputs

Six wide bandwidth input channels are provided for monitoring composite or component signals. SMD (Surface Mount Device) input amplifiers provide flat frequency response and excellent return loss characteristics through 30 MHz, permitting faithful display of High Definition video signals.

Input signal processing provides a choice of DC Restoration or an unclamped display. One signal may be displayed in a dual filter mode, with one line or field low pass filtered, and one unfiltered. Up to six inputs may be selected for simultaneous display, in specific combinations of side by side and overlay modes. When two or three different input signals are displayed, the second and third may be offset from the first to allow accurate comparison.

Accurate Timing Measurements

To facilitate timing measurements in the critical, High Definition environment, up to three signals may be presented side by side or overlaid. Calibrated timing is facilitated by a selectable horizontal magnifier.

Full Line Select

Full frame line select, with on-screen readout of line number, is provided in each television line/field standard. The line to be displayed may be selected at the front panel and a predefined line may be easily recalled. The selected line is intensified in the field rate display and on the picture monitor output. A 14 line mode is also provided. A companion 1720 series vector monitor may be connected to display a selected line (or full field) vector presentation in composite (NTSC or PAL) applications.

Microprocessor Control

The 1730 HD High Definition waveform monitor is a microprocessor controlled instrument with a non-volatile memory. An on-screen menu allows selection of operating standard and screen display functions. Four user defined front panel setups are available through a remote input connector. Also available for remote operation are selection of sweep rates, input channels, and activation of a four line/field rate. The companion 1720 series vector monitor's front panel setup follows the 1730 HD selection for quick recall of desired test and monitoring configurations.

Half Rack Configuration

The instrument is configured in the familiar Tektronix half-rack package to allow immediate integration into existing and new systems. A variety of cabinets and an adjustable front panel depth dual rack mount is available.

1730 HD CHARACTERISTICS

Signal format — 525/60, 625/50, 875/60, 1050/60, 1125/60, and 1250/50 line/field rate, selected by reference to on-screen menu.

Signal inputs (video and external reference) — Six video channels. One external reference channel. Return loss: >35 dB, 50 kHz to 30 MHz, power on or off. Maximum input ±2 V, dc + peak AC. Loop-through isolation: >80 dB at 30 MHz. Channel isolation: >50 dB at 30 MHz. Input impedance: >15k ohms.

Vertical deflection — Deflection factor: Within 1% of 1 V. Variable Gain range: +0, −14 dB. Position range: 1 V signal can be positioned so that peak white and sync tip can be placed at blanking level regardless of gain range. Channels 2 and 3 may be offset from channel 1. Channel group B may be offset from channel group A.

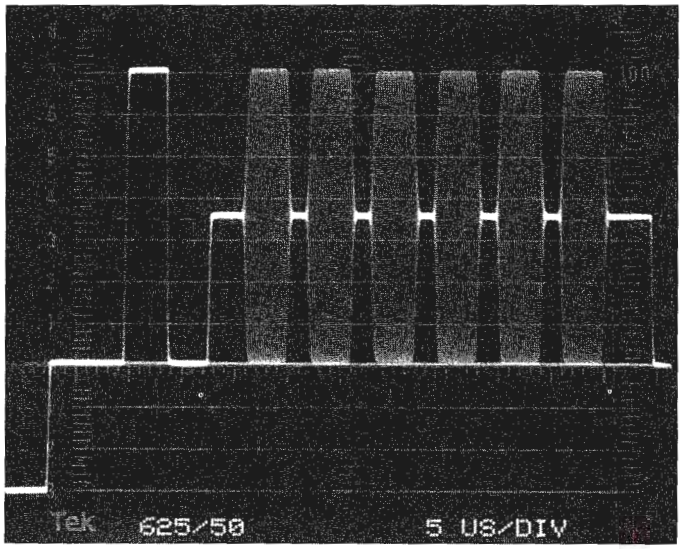
Frequency response — Flat: 50 kHz to 10 MHz within 2%, 3% to 20 MHz, +3-5% to 30 MHz (x1), within 5% to 6 MHz (x5). Low pass: 10 dB attenuation at 20 MHz. Low pass response within 1% of flat response at 15 kHz.

Transient response — Overshoot: <2% (x1), <4% (x5). Ringing: <2% (x1). <4% (x5). Tilt: <1%.

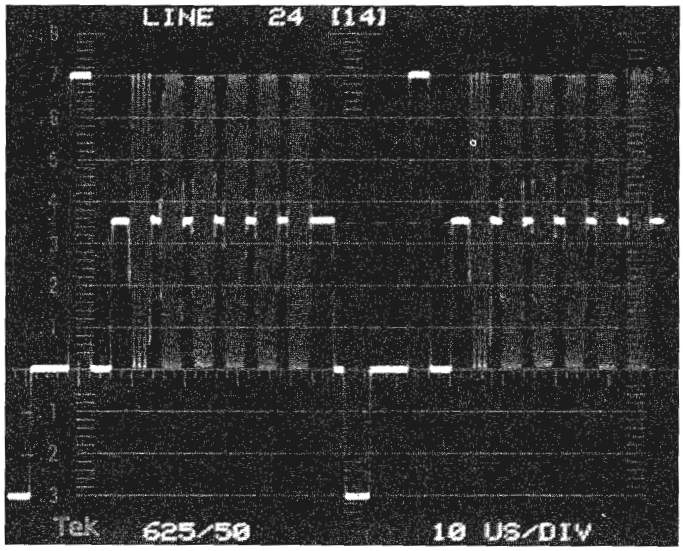
DC restoration — Clamp time: Back porch. Frequency response: Attenuation of 60 Hz on input signal >90%. Blanking level shift: A 10% to 90% APL change will cause <1% of blanking level shift. Presence or absence of a color burst will cause <1% of blanking level shift.

Picture monitor output — Corresponds to waveform display. Frequency response 50 kHz to 30 MHz within 5%. Differential gain <1% at 4.43 MHz. Differential phase <1% at 4.43 MHz. DC level on output <0.5 V into 75 ohm load. Intensification (brightup): 180 mV offset on select lines. Output impedance: 75 ohms nominal. Return loss >30 dB 50 kHz to 30 MHz. Input to output gain ratio: luminance 1:1 ±5% at 15 kHz.

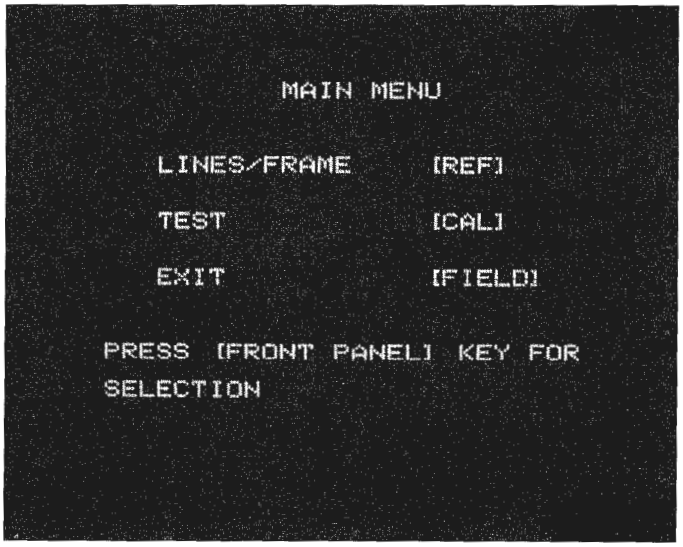
Calibrator — Amplitude: 700 mV, ±1%.



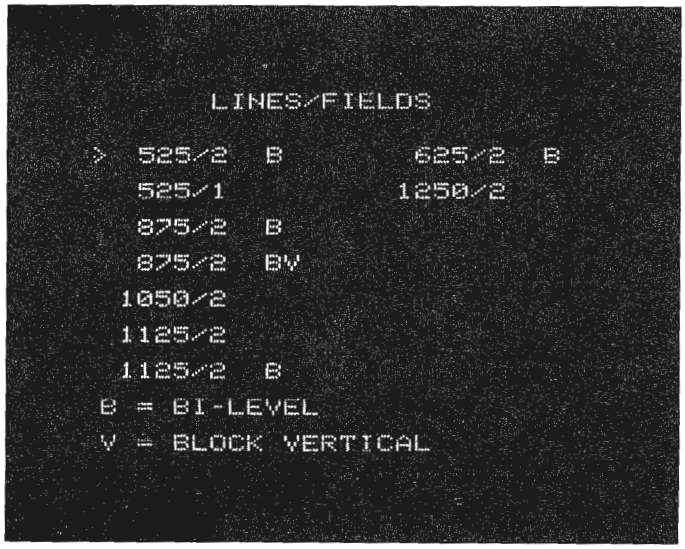
One Line Display, High Frequency Multiburst.



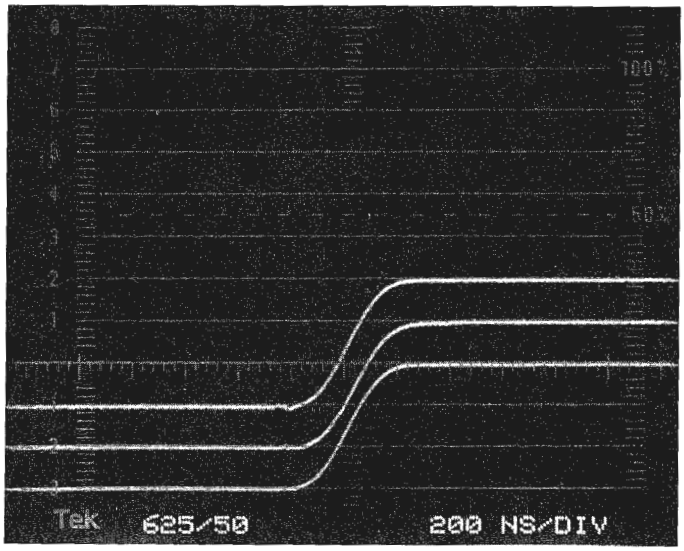
Two Line, Line Select Display.



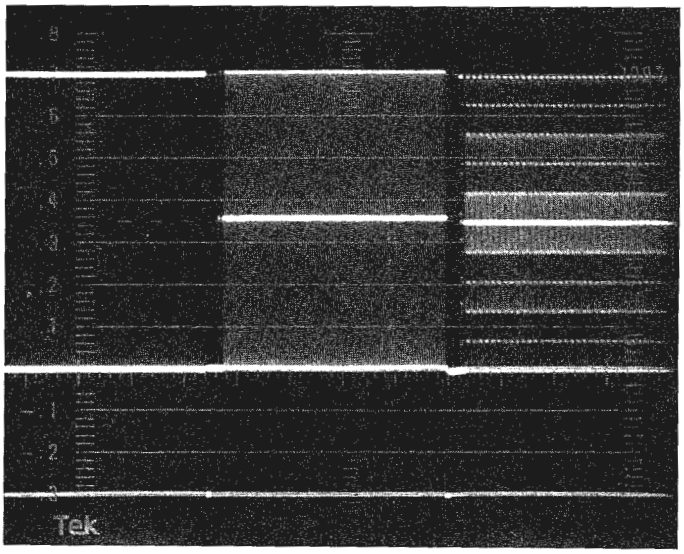
Sweep Standards and Microprocessor Test Routines are Menu Selectable.



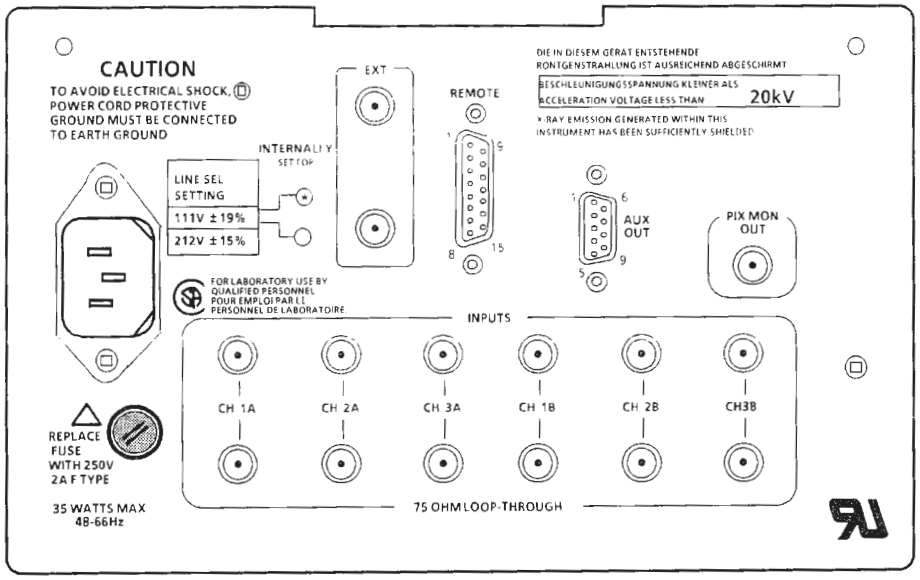
Sweep Standards are Installed to Customer Requirement.



Channels 2 & 3 Vertically Offset From Channel 1.



Three Field, Multiple Input Display.



1730 HD Rear Panel.

Horizontal deflection system — Sweep: Sweep will occur with or without input signal. Line and Field sweep modes, with the following characteristics: One: Displays one complete line or field. Two: Displays two lines or fields. Three: Displays sync trailing edge and video of three selected inputs. Four: Displays sync trailing edge and video of four selected inputs (mode accessed through remote connector). Line magnification equals approximately x25 in one and three line modes; x10 in two line mode. Field magnification equals approximately x20. Time/div appears on-screen if readout is turned on. Timing accuracy: 1 μS/division within 2%, 0.2 μS/division within 3%. Linearity: Within 2%. Differential linearity: Within 2%. Sweep magnification registration: Magnification occurs about the center of the screen. Position range: Any portion of the synchronized video sweep can be positioned on screen in all sweep modes except 1-Line and 1-Field.

Synchronization — Internal or external: 1 V composite video or 300 mV (black to sync tip) sync ±6dB of nominal. Sync type: Bi-level or Tri-level. Remote sync: TTL level, positive or negative edge, jumper selectable.

Safety Standards— The following safety standards apply: UL 1244-1980; FM 3820; ANSI C39.5; CSA Electrical Bulletin No. 556B; IEC 348, Second Edition; VDE 0871.5 (Class B).

Power source — Mains Voltage Ranges: 90-132 V or 180-243 V. Mains Frequency Range: 48-66 Hz. Power Consumption: 35 Watts maximum.

Environmental — Temperature: Operating, 0 to +50°C. Altitude: Operating, to 15,000 ft. Transportation: Qualified under NSTA Project 1A, Category II.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	133.4	5.25
Width	215.9	8.5
Depth	460.4	18.125
Weight	**kg**	**lb**
Net	4.7	10.3

ORDERING INFORMATION

When ordering, please use the nomenclature given here. **The standard instrument is shipped without a case or handle.** If your application is for bench or portable use, please order the appropriate enclosure from the optional accessories list. The 1730 HD is a UL-recognized component and meets the requirements for listing when used in the appropriate enclosure.

1730 HD High Definition Television Waveform Monitor

OPTIONAL ACCESSORIES

CABINETS

Plain (no handle or feet, painted silver grey) — Order 1700F00.

Portable (including handle and feet, painted silver grey) — Order 1700F02.

Side-by-side rack mount, adjustable front panel depth — Order 1700F05.

Blank half rack width panel — Order 1700F06.

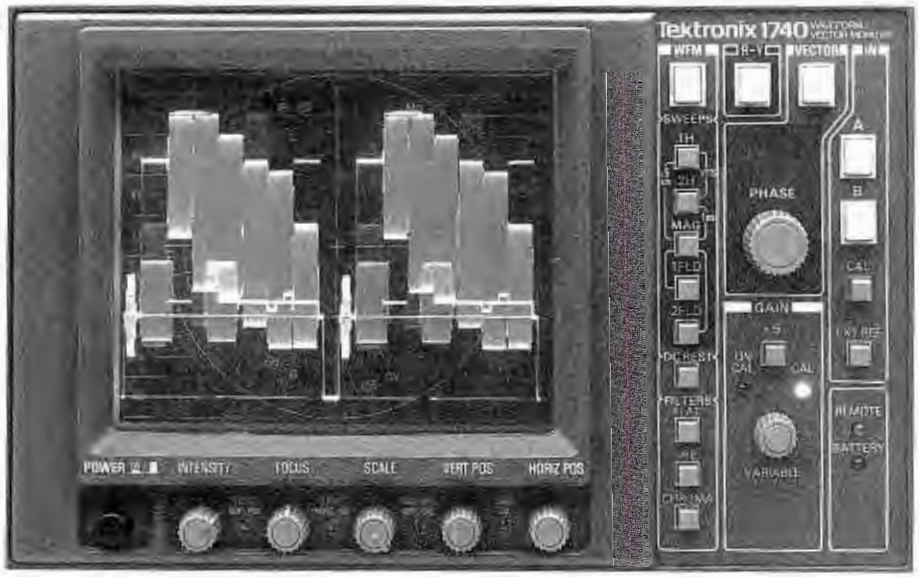
CAMERAS

Polaroid pack film back — Order C5C Opt. 02.

Polaroid AutoFilm motorized back — Order C7 Opt. 03.

Viewing Hood — Order 016-0475-00.

Snap on protective front cover (blue) — Order 200-1566-00.



1740 Waveform/Vector Monitor.

1740 Series
Waveform/Vector Monitors

Two Instruments in One
Optional DC Power Capability
Bright CRT Display
R-Y (V-Axis) Mode
VITS Monitoring
RGB/YRGB Display Capability
Remote Control Capability
Available in NTSC, PAL, and PAL-M

The 1740 Series provides all the basic waveform monitoring and vectorscope functions in a single, compact package. In addition, the 1740 Series adds dc power operation (optionally), single line vertical interval display which is internally preset, an R-Y/sweep mode for differential phase measurements, and remote control of waveform/vector mode and most of the front panel sweep and vertical amplifier response functions.

The 1740's half rack width package allows easy installation where space and power requirements are important considerations. The 1740 is mechanically compatible with other 1700 Series instruments.

Typical applications include video signal monitoring in VTR bridges, camera control units, production switcher consoles, and in mobile vans and field production units.

Optional DC Power Capability
An instrument option provides a dc input for powering the monitor from a 12 volt dc power source. Option 07 provides the dc capability. The BP1 Battery Pack quickly and securely mounts to the bottom of the portable case. Total package weight of the instrument with the BP1 mounted is approximately 13.6 kg (30 lb).

The BP1 is designed to be charged by an automatic news camera charger supplying 3 to 5.5 amps. Contact your nearest Tektronix sales representative for information. A 1740 Series instrument will operate from a BP1 for at least two hours before recharging is required. Spare BP1 Battery Packs are available as optional accessories.

Bright CRT Display
The bright CRT display permits use of the 1740 Series in high ambient light conditions, such as those encountered in field production applications. Brightness remains high in the 1 μs and 0.5 μs maginified sweep speeds, thus enhancing the 1740's use in system phasing applications. An internal waveform graticule and independently illuminated external vector graticule are available (Option 05). A parallex free composite internal graticule, including both the waveform and vector features, is standard with the 1740 and 1741.

R-Y (V-Axis) Mode
The demodulated chrominance may be displayed with a horizontal sweep using the R-Y mode for NTSC signals or the V-axis mode for PAL or PAL-M signals. When the burst is phased properly in the vector mode, the R-Y mode displays the chrominance demodulated on the R-Y axis (V-axis in PAL systems). Differential phase markings on the right side of the vector graticule are calibrated for use in this mode. Different sweep speeds may be used to examine differential phase as a function of time.

VITS Monitoring
VITS (Vertical Interval Test Signals) or ITS (Insertion Test Signals) can be monitored in all modes. Each instrument model is internally set for a particular line. The 1740 is set to display line 19, usually occupied by the VIRS. The 1741 is set to line 17/330, and the 1742 to line 17/280. The 1740 may be reset for any line from 6 through 36, the 1741 from line 3/316 through 33/346, and the 1742 from line 3/266 through 33/296.

RGB/YRGB Display
Facilities for a parade display of camera RGB signals are included in all 1740 Series instruments. The monitor's REMOTE connector accepts the required enable and three-step staircase signals from the camera. An internal jumper change permits display of a YRGB parade signal.

Remote Control Capability
Remote control of input channel selection, mode, sweep speeds, and vertical amplifier filters is available through a rear panel connector. The remote function is useful for VTR applications.

CHARACTERISTICS

ELECTRICAL SPECIFICATIONS

VERTICAL WAVEFORM MODE

Deflection Factor
1740: 140 IRE display within 1% with 1 V input.
1741/1742: 1 V display within 1% with 1 V input.

Variable Gain Range
1740: Input signals between 0.7 V and 2 V can be adjusted to 140 IRE display.
1741/1742: Input signals between 0.7 V and 2 V can be adjusted to 1 V display.

Maximum Absolute Input Level — ±2 V (dc + peak ac).

Video Input Return Loss — At least 40 dB from 50 kHz to 6 MHz.

FREQUENCY RESPONSE

FLAT — ±2% from 50 kHz to 6 MHz. ±5% from 6 MHz to 8 MHz.

IRE — (1740) Conforms to IEEE Standard 205. Response at 15 kHz does not vary between FLAT and IRE by more than 1%.

LUM — (1741/1742) <3 dB down at 1 MHz, >40 dB down at 4.43 MHz, response at 15 kHz does not vary between FLAT and LUM by more than 1%.

CHROMA — (1740/1742) Response at 3.58 MHz does not vary between FLAT and CHROMA by more than 1%.
Lower: −3 dB point at 2.83 MHz to ±0.15 MHz.
Upper: −3 dB point at 4.33 MHz to ±0.15 MHz.
Attenuation at 7.2 MHz: >25 dB.

CHROMA — (1741) Response at 4.43 MHz does not vary between FLAT and CHROMA by more than 1%.
Lower: −3 dB point at 3.68 MHz to ±0.15 MHz.
Upper: −3 dB point at 5.18 MHz to ±0.15 MHz.
Attenuation at 8.9 MHz: >25 dB.

RESPONSE DISTORTIONS

Preshoot — 1% or less.

Pulse-to-Bar Ratio — 0.99:1 to 1.01:1.

Overshoot — 2% or less.

Ringing — 2% or less.

Tilt (Field Rate Squarewave, Vertical Window, or 25 μs Bar) — 1% or less.

Differential Gain — Displayed differential gain is 1% or less with 10% to 90% APL changes.

VIDEO OUTPUT

Frequency Response — 50 kHz to 6 MHz, within 3% of response at 50 kHz.

Dc Level on Output — 0.5 V or less into 75 Ω load.

Output Impedance — 75 Ω.

Return Loss — At least 30 dB, 50 kHz to 6 MHz.

DC RESTORATION

Dc Restorer Clamp Time — Back porch (internally selectable to sync tip).

Low-Frequency Response at 60 Hz — Attenuation of 60 Hz or input signal: 20% or less.

Blanking Level Shift with APL Change
1740: APL changes from 50% to either 10% or 90% will cause blanking level shift of 1 IRE unit or less.
1741/1742: APL changes from 50% to either 10% or 90% will cause blanking level shift of 7.2 mV or less.

CALIBRATOR SIGNAL

Frequency — 100 kHz, ±0.1 kHz. Synchronizes in 2H and 1H sweep, providing reference for sweep and magnifier calibration.

Amplitude — 1 V display within 0.5%.

HORIZONTAL DEFLECTION SYSTEM

Timing Accuracy — 1 μs/div sweep within 2%. 0.5 μs/div sweep within 3%.

Linearity — 1 μs/div and 0.5 μs/div within 2%.

SYNCHRONIZATION REQUIREMENTS

Internal References
1740: Composite video or black burst with sync and burst amplitudes 40 IRE to ±6 dB.
1741/1742: Composite video or black burst with sync and burst amplitudes 300 mV to ±6 dB.

External References — Waveform Mode: Sync amplitude between 143 mV and 4 V will synchronize sweeps.

Vector Mode
1740: Composite video or black burst with sync and burst amplitudes 40 IRE to ±6 dB.
1741/1742: Composite video or black burst with sync and burst amplitudes 300 mV to ±6 dB.

EXTERNAL REFERENCES INPUT

Dc Input Impedance — >15 kΩ.

Return Loss — At least 40 dB from 50 kHz to 6 MHz.

RGB/YRGB MODE

Will display either a 3-step or 4-step RGB/YRGB display.

Staircase Amplitude — A 10 V input will result in a horizontal display of 9 divisions ±1.4 major divisions.

Maximum Operating Staircase Signal Voltage — 12 V p-p ac component. Signal voltage not to exceed ±12 V dc + peak ac.

VECTOR MODE

Chrominance Bandwidth
Upper: −3 dB point Fsc +500 kHz ±100 kHz.
Lower: −3 dB point Fsc −500 kHz ±100 kHz.

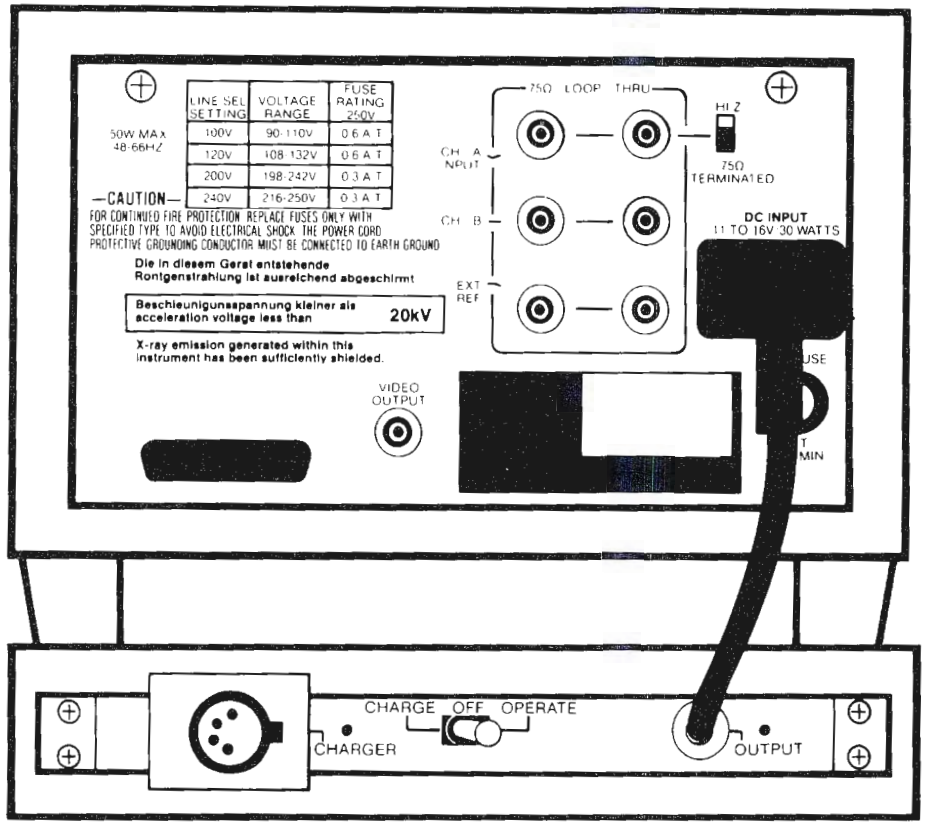
Vector Phase Accuracy — Within 1.25 degrees.

Vector Gain Accuracy — 1740: Within 1.25 IRE. 1741/1742: Within 1.25%.

Quadrature Phasing — Within 0.5 degrees.

SUBCARRIER REGENERATOR

Pull-In Range — 1740: Within 50 Hz of Fsc. 1741/1742: Within 10 Hz of Fsc.



1740 Rear Panel with Optional Battery Pack Attached.

Phase Shift with Subcarrier Frequency Change — 1740: Within 0.5 degrees from Fsc to (Fsc +50 Hz), or Fsc to (Fsc −50 Hz).
1741/1742: Within 0.5 degrees from Fsc to (Fsc +10 Hz), of Fsc to (Fsc −10 Hz).

Phase Shift with Burst Amplitude Change — Within 2 degrees from nominal burst amplitude to ±6 dB.

Phase Shift with Reference Switched Between Internal and External References — Within 0.5 degrees.

Phase Shift with Input Channel Change — Within 0.5 degrees.

Phase Shift with X5 Gain — Within 2 degrees.

Phase Shift with Variable Gain — Within 1 degree as gain is varied from +3 dB to −6 dB.

Phase Control Range — 360 degrees continuous rotation.

DISPLAY CHARACTERISTICS

Differential Phase — Within 1 degree.

Differential Gain — Within 1%.

Variable Gain Range — 1740: Input subcarrier signals between 28 IRE and 140 IRE can be adjusted to normal burst vector length.
1741/1742: Input subcarrier signals between 210 mV and 1.0 V can be adjusted to normal burst vector length.

CRT DISPLAY

CRT Viewing Area — 80 mm x 100 mm.

Accelerating Potential — Nominally 15 kV.

POWER SOURCE

Mains Voltage Ranges — 100 V (90 V to 110 V); 120 V (108 V to 132 V); 220 V (198 V to 242 V); 240 V (216 V to 250 V).

Mains Frequency Range — 48 Hz to 66 Hz.

Power Consumption — 50 W maximum in ac. 30 W nominal in dc.

DC BATTERY OPERATION (OPTION 07)

Voltage Input Range — 11 V to 16 V.

Over Voltage and Polarity Reversal Protection — Fuse blows if >20 V dc or opposite polarity is applied to the dc INPUT.

Under Voltage Protection — Instrument shuts down when battery voltage (under load) is below 9 V.

Battery Current — 3.5 A or less at 12 V.

ENVIRONMENTAL

Temperature — Operating: 0°C to +50°C. Nonoperating: −55°C to +75°C.

Altitude — Operating: 4500 m (15,000 ft). Nonoperating: 15,000 m (50,000 ft).

CERTIFICATION

Safety/EMC — UL 1244.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	133	5.3
Width	216	8.5
Depth	460	18.1
Weight	**kg**	**lb**
Net	8.2	18.8
Battery Pack	13.6	30.0

ORDERING INFORMATION

These instruments are configured for rackmounting and are shipped without case or handle. Order appropriate options or optional accessories to configure for bench or portable use. The 1740, 1741 and 1742 are UL-recognized components and meet the requirements for listing when used in the appropriate enclosure.

1740 Waveform/Vector Monitor (NTSC Applications).

1741 Waveform/Vector Monitor (PAL Applications).

1742 Waveform/Vector Monitor (PAL-M Applications).

OPTIONS

Option 05 — Internal Waveform graticule, External Vector graticule. (1740/1741 only.)

Option 07 — Adds dc power operation capability, must be installed during manufacture.

For portable operation, order Option 07, BP1 Battery Pack, and 1700F02 Cabinet.

OPTIONAL ACCESSORIES

Battery Pack — Requires 1700F02 case to mount the BP1 to the 1740 or 1741 Option 07. (Charger is not included.) Order BP1.

Cabinet — Painted, no handle or feet. Order 1700F00.

Cabinet — Painted, with handle and feet. Order 1700F02.

Side-By-Side Rack Mount — For mounting two half-rack instruments in a standard 19 inch rack. Order 1700F05.

Blank Panel — For one half of the side-by-side rack mount. Order 1700F06.

Viewing Hood — For high ambient light environments. Order 016-0475-00.

Camera — Order C-5C Option 02 or 04, or standard C-4.

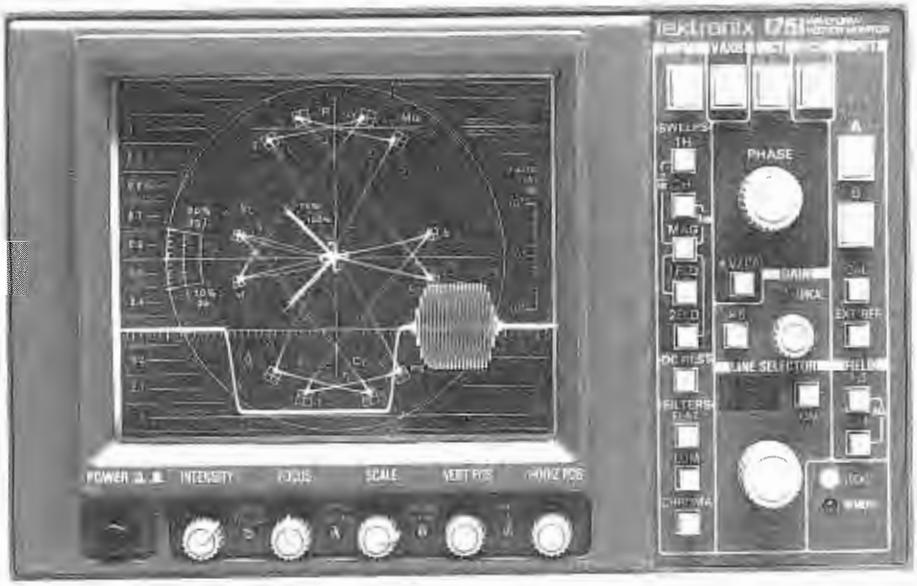
MAINTENANCE ACCESSORIES

Extender Board — 64 pin. Order 670-7980-00.

Extender Cable BNC to Peltola — Order 067-0709-00.

Deflecton Leads Extender Cables — (Order four each) Order 196-0939-00.

NTSC Simultaneous Display with Waveform Horizontal Magnification.



PAL Simultaneous Display with Waveform Horizontal Magnification.

1750 Series Waveform/Vector Monitors

SCH Phase Monitoring and Measurement

Simultaneous Displays

Dual Filter Display

Line and Field Selection For VITS/ITS Monitoring

Bright CRT Display

Comprehensive Signal Monitoring

R-Y (V Axis) Mode

RGB/YRGB Display Capability

Remote Control Capability

Available in NTSC and PAL Standards

The 1750 Series Waveform/Vector Monitors are comprehensive signal monitors that also provide extended measurement capability. These signal monitors from Tektronix can be retrofit into existing systems that use 1/2 rack width, 5 1/4 inch waveform or vector monitors.

The 1750 Series combines conventional monitoring capabilities with the ability to perform SCH phasing tasks that until now have required additional instrumentation. SCH phase and color frame matching can be measured directly by using the SCH mode. This capability makes the 1750 Series ideally suited to production and editing applications where the maintenance of SCH phase and color frame relationship is critical.

SCH Phase Measurement and Monitoring

The SCH phase display presented by the 1750 Series is unique. It presents a clutter-free graphic display of the burst vector(s) and a vector representing sync phase relative to burst. Not only is this an easily interpreted display for monitoring purposes, but it is ideal for SCH phase adjustments. By combining the "SCH" and "external reference" functions, two signals may be simultaneously compared for burst phase and sync timing differences. Improper color framing is readily apparent in this mode and, therefore, may be corrected before attempting to mix the signals.

System Timing

Complete system timing on one display is possible with the simultaneous display mode. The SCH, burst phase and horizontal sync are time shared for simultaneous viewing, making system timing a one step operation (see photo).

Dual Filter Display

The dual filter display mode allows both full bandwidth and IRE/LUM displays to be viewed simultaneously for live video level monitoring and camera set up.

Line Selection for VITS/ITS Monitoring

The 1750 Series has front panel line and field selection for monitoring of VITS, ITS, or data throughout the vertical blanking interval. Field selection can be either fields 1 and 3, fields 2 and 4, or all fields. Line selection is by continuous rotary switch and field selection is by push-button switches.

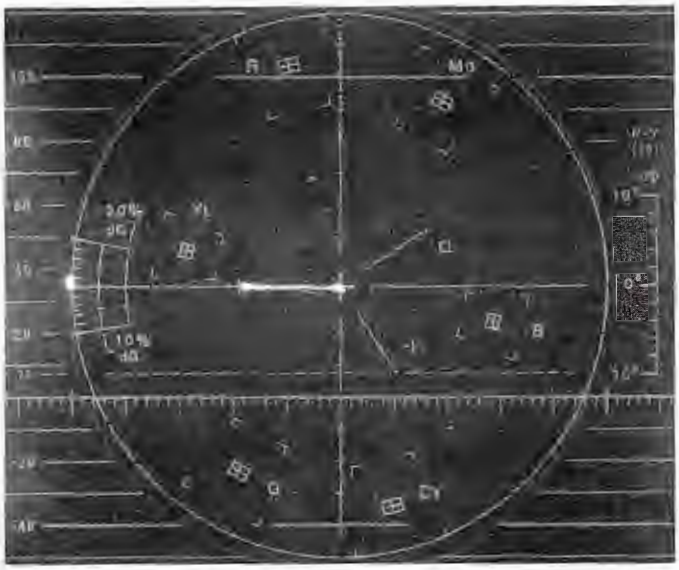
The front panel controls allow selection of lines 8 through 23 (NTSC) or 6/319 through 21/334 (PAL). Use of remote input (via a rear panel connector) in conjunction with the front panel switch allows selection of any line in the raster. An LED numeric readout indicates which line is being displayed and a strobe pulse is applied to the video output signal.

Bright CRT Display

The bright CRT display permits use of the 1750 Series in high ambient light conditions. Brightness remains high in the 1 and 0.2 μs per division sweep rates even when using the line selector, thus enabling detailed analysis of VITS/ITS or vertical interval data signals. The 1750 Series employs a parallax free, internal, combination waveform and vector graticule to further enhance its monitoring and measurement capabilities.

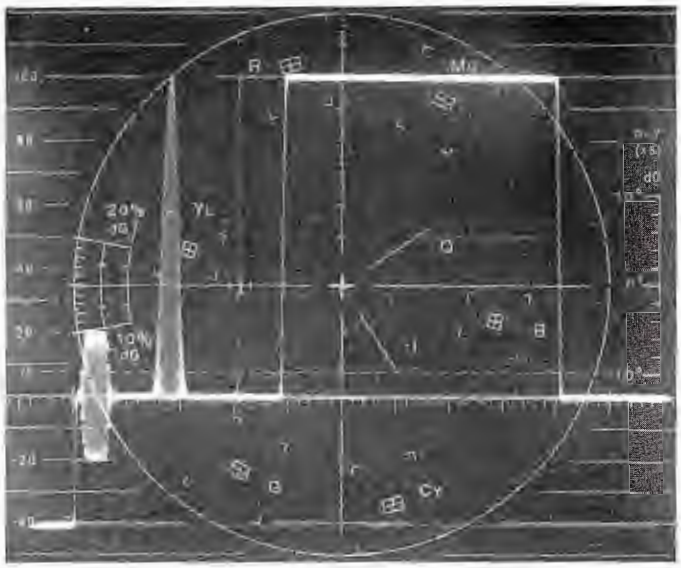
R-Y (V axis) Mode

The demodulated chrominance can be displayed with a horizontal sweep using the R-Y mode for NTSC or the V axis mode for PAL signals. When burst phase is set properly in the Vector mode, the R-Y mode displays the chrominance demodulated on the R-Y axis (V axis in the PAL system). A graticule marking is provided for use with the R-Y (V) mode and x5 vertical gain to provide greater resolution than the usual "vector" technique for evaluating differential phase. Horizontal positioning and various sweep speeds may be used to examine differential phase as a function of time.

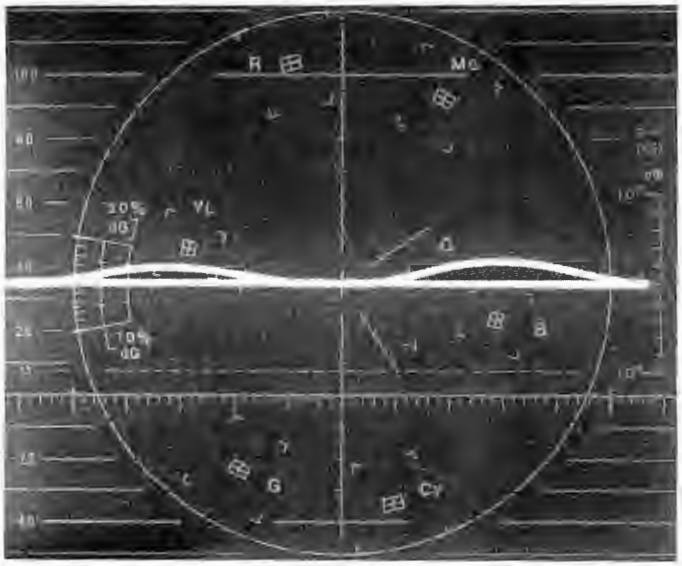


NTSC SCH Display.

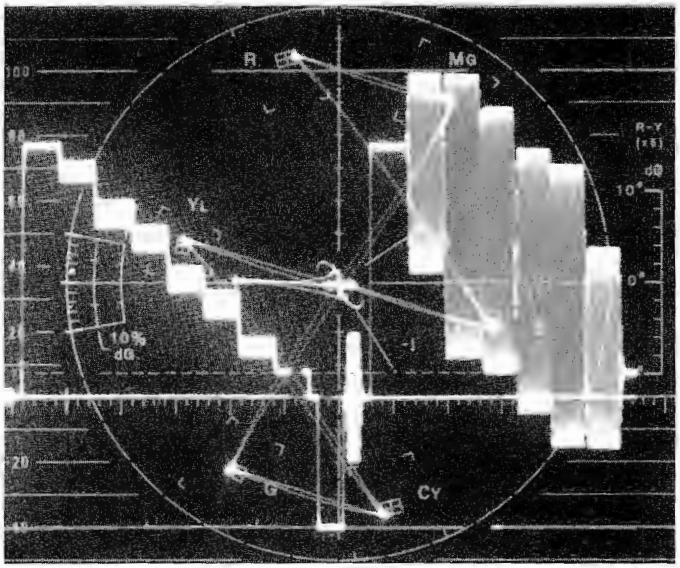
PAL SCH Display.



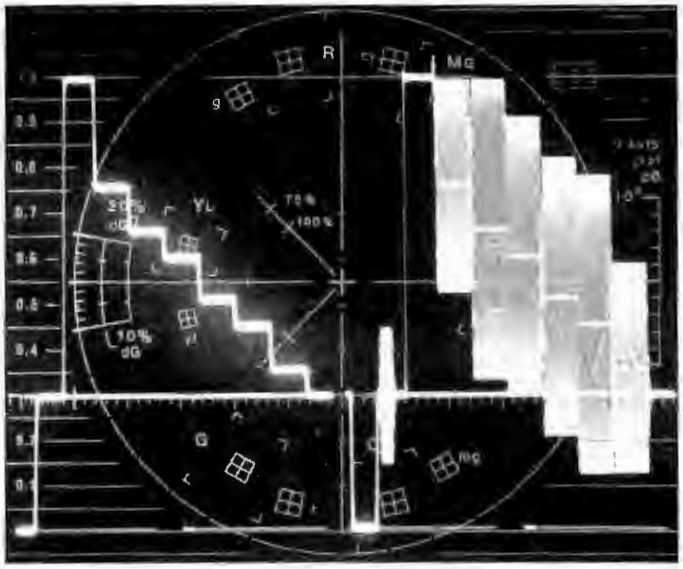
VITS/ITS Test Signal Display.



Time Base Error Display.



Simultaneous Display and Dual Filter Display (NTSC).



Dual Filter Display (PAL).

RGB/YRGB Display

Facilities for a parade display of camera RGB signals are included in the 1750 Series instruments. The enable and 3-step staircase signals are input through the rear-panel REMOTE connector. Repositioning an internal jumper changes the display to a YRGB parade.

Remote Control Capability

Any of the front panel switches (except power and line select) may be remotely controlled through rear panel remote connectors. The control interface is compatible with ground closure or TTL circuits.

Available in NTSC and PAL

The 1750 Series Waveform/Vector Monitor is available for NTSC and PAL color television systems:

1750 NTSC
1751 PAL

CHARACTERISTICS

WAVEFORM MODE (VERTICAL DEFLECTION SYSTEM)

Deflection Factor
1750: 1V input for 140 IRE display within 1%.
1751: 1 V input displays 1 V within 1%.

Gain Ranges — Input signals between 0.7 V and 2 V can be adjusted to 140 IRE (NTSC) or 1 V (PAL) display.

Maximum Absolute Input Level — ±2 V (dc + peak ac).

FREQUENCY RESPONSE

FLAT — ±2% from 50 kHz to 6 MHz. ±5% from 6 MHz to 8 MHz.

IRE (1750) — Conforms to IEEE Standard 205. Response at 15 kHz does not vary between FLAT and IRE by more than 1%.

LUM — (1751) <3 dB down at 1 MHz, >40 dB down at 4.43 MHz, response at 15 kHz does not vary between FLAT and LUM by more than 1%.

CHROMA — (1750) Response at 3.58 MHz does not vary between FLAT and CHROMA by more than 1%. Lower: −3 dB point at 2.83 MHz ±0.15 MHz. Upper: −3 dB point at 4.33 MHz ±0.15 MHz. Attenuation at 7.2 MHz >25 dB.

CHROMA — (1751) Response at 4.43 MHz does not vary between FLAT and CHROMA by more than 1%. Lower: −3 dB point at 3.68 MHz ±0.15 MHz. Upper: −3 dB point at 5.18 MHz ±0.15 MHz. Attenuation at 8.9 MHz >25 dB.

TRANSIENT RESPONSE

Preshoot — 1% or less.

Pulse-to-Bar Ratio — 0.99:1 to 1.01:1.

Overshoot — 2% or less.

Ringing — 2% or less.

Tilt (Field Rate Square Wave, Vertical Window, or 25 μs Bar) 1% or less.

Differential Gain — Displayed differential gain is 1% or less with 10% to 90% APL changes.

DC RESTORATION

DC Restorer Clamp Time — Back Porch (Internally selectable to Sync Tip).

Low-Frequency Response at 60 Hz — Attenuation of 60 Hz on Input Signal 20% or less.

Blanking Level Shift with 10% to 90% APL Change — 1750: APL changes from 50% to either 10% or 90% will cause blanking level shift of 1 IRE unit (7 mV) or less. 1751: APL changes from 50% to either 10% or 90% will cause blanking level shift of 7.2 mV or less.

PIX MON OUTPUT

Frequency Response — 50 kHz to 6 MHz, within 3% of response at 50 kHz.

DC Level on Output — 0.5 V or less into 75 Ohm load.

Output Impedance — 75 Ohms.

Return Loss — At least 30 dB, 50 kHz to 6 MHz.

CALIBRATOR SIGNAL

Frequency — 100 kHz, ±0.1 kHz. Synchronizes in 2H and 1H sweep, providing reference for sweep and magnifier calibration.

Timing Accuracy — 10 μs, ±10 ns.

Amplitude — 1 V within 0.5%.

WAVEFORM MODE (HORIZONTAL DEFLECTION SYSTEM)

Sweep — Sweep will occur in all Horizontal mode settings with or without synchronization.

1FLD Sweep Repetition Rate — Even or Odd: Equal to frame rate of applied video or external sync. Both: Equal to field rate of applied video or external sync.

2FLD Sweep Repetition Rate — Even or Odd: Equal to frame rate of applied video or external sync, and displays 2 fields. Both: Equal to field rate of applied video or external sync, and displays 1 field.

1H Sweep Repetition Rate — Equal to line rate of applied video or external sync.

2H Sweep Repetition Rate — Equal to half line rate of applied video or external sync.

Timing Accuracy — 1 μs/div Sweep: Within 2%. 0.2 μs/div Sweep: Within 2%.

Linearity — (1 μs/div and 0.2 μs/div): Within 2%.

VECTOR MODE

Chrominance Bandwidth — Upper: −3 dB Point Fsc +500 kHz, ±100 kHz.
Lower: −3 dB Point Fsc −500 kHz, ±100 kHz.

Vector Phase Accuracy — Within 1.25 degrees.

Vector Gain Accuracy — 1750: Within 1.25 IRE. 1751: Within 2.5%

Quadrature Phasing — Within 0.5 degrees.

SUBCARRIER REGENERATOR

Pull-In Range — 1750: Within 50 Hz of Fsc. 1751: Within 10 Hz of Fsc.

Phase Shift with Subcarrier Frequency Change — 1750: Within 0.5 degree from Fsc to (Fsc +50 Hz), or Fsc to (Fsc −50 Hz). 1751: Within 0.5 degree from Fsc to (Fsc +10 Hz), or Fsc to (Fsc −10 Hz).

Phase Shift with Burst Amplitude Change — Within 2 degrees from nominal burst amplitude to ±6 dB.

Phase Shift with Reference Switched Between Internal & External References — Within 0.5 degrees.

Phase Shift with Input Channel Change — Within 0.5 degrees.

Phase Shift with ×5 Gain — Within 2 degrees.

Phase Shift with Variable Gain — Within 1 degree as gain is varied from +3 dB to −6 dB.

Phase Control Range — 360 degrees continuous rotation.

DISPLAY CHARACTERISTICS

Differential Phase — Within 1 degree.

Differential Gain — Within 1%.

Variable GAIN Range — Input subcarrier signals between 210 mV and 1.05 V can be adjusted to normal burst vector length (may be extended to 43 mV via x5 gain).

SCH MODE

Accuracy — Absolute: ±5 degrees phase at 25 degrees C. Relative: ±2 degrees.

Acquisition Time — Less than 1 sec.

SYNCHRONIZATION REQUIREMENTS

Internal References — 1750 (1751) SCH Mode: Composite video or black burst with sync and burst amplitudes 286 mV, (300 mV) ±3 dB. Other Modes: Composite video or black burst with sync and burst amplitudes 286 mV, (300 mV) ±6 dB

External References — Waveform Mode: Sync amplitude between 143 mV and 4 V will synchronize sweeps. Vector Mode 1750 (1751): Composite video or black burst with sync and burst amplitudes 286 mV, (300 mV) ±6 dB.

External Reference Input — DC Input Impedance: Greater than 15 k ohm. (Unterminated)

Return Loss (75 ohm) — Greater than 40 dB from 50 kHz to 6 MHz.

RGB/YRGB MODE

Will display either a 3- or 4-step RGB/YRGB display.

Staircase Amplitude — A 10 V input will result in a horizontal display of 9 divisions ±1.4 major divisions.

Maximum Operating Staircase Signal Voltage — 12 V p-p ac component. Signal voltage not to exceed ±12 V (dc plus peak ac).

CRT DISPLAY

CRT Viewing Area — 80×100 mm.

Graticule — Dual internal, variable SCALE illumination.

POWER SOURCE

Mains Voltage Ranges — 115V (90-132 V); 230V (200-250 V).

Mains Frequency Range — 48 Hz to 66 Hz.

Power Consumption — 48 Watts (163 BTU/hr) maximum.

ENVIRONMENTAL

Temperature — Non-Operating: −55 degrees C to +75 degrees C. Operating: 0 degrees C to +50 degrees C.

Altitude — Non-Operating: To 18,000M (50,000 feet). Operating: To 5,500M (15,000 feet).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	133	5.25
Width	216	8.5
Depth	460	18.1
Weight	**kg**	**lb**
Approximately	8	18

CERTIFICATION

Safety/EMI — UL-1244. Factory Mutual-3820. CSA Bulletin 556B. IEC 348.

FCC EMI Compatibility — (FCC Rules Part 15 Subpart J, Class A). VDE 0871.5 (Class B).

ORDERING INFORMATION

When ordering please use exact nomenclature given here. The standard instruments are shipped without a case or handle. If your application is for bench or portable use, please order the appropriate enclosure from the optional accessories list. The 1750 and 1751 are UL recognized components and meet the requirements for listing when used in the appropriate enclosure.

1750 Waveform/Vector Monitor (For NTSC system applications.)

1751 Waveform/Vector Monitor (For PAL system applications.)

Includes: Instruction Manual (070-4472-00); Power Cable Assembly (161-0066-00); 250V 0.5A Fuse (159-0032-00); 250V 1.0A Fuse (159-0022-00); Clear Filter (378-0219-00) 25-Pin Remote Connector (131-0569-00); Housing (200-1667-00); Strain Relief (358-0314-00); 9-Pin Remote Connector (131-1006-00); Housing and Strain Relief (200-1170-00).

OPTIONAL ACCESSORIES

Cabinets — Plain (painted silver grey): Order 1700F00; Portable (including handle and feet, painted silver grey): Order 1700F02.

Side-by-side rack adapter — Order 1700F05.

Blank half-rack width panel — Order 1700F06.

Cameras — Order C5C Opt. 02; C7 Opt. 03.

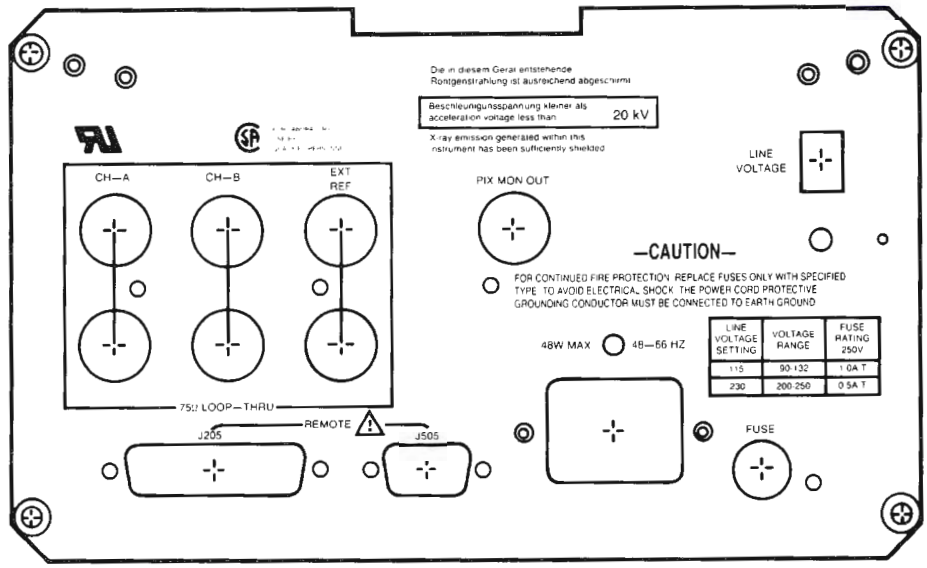
Viewing hood — Order 016-0475-00.

Extender board, 64-pin — Order 670-7980-00.

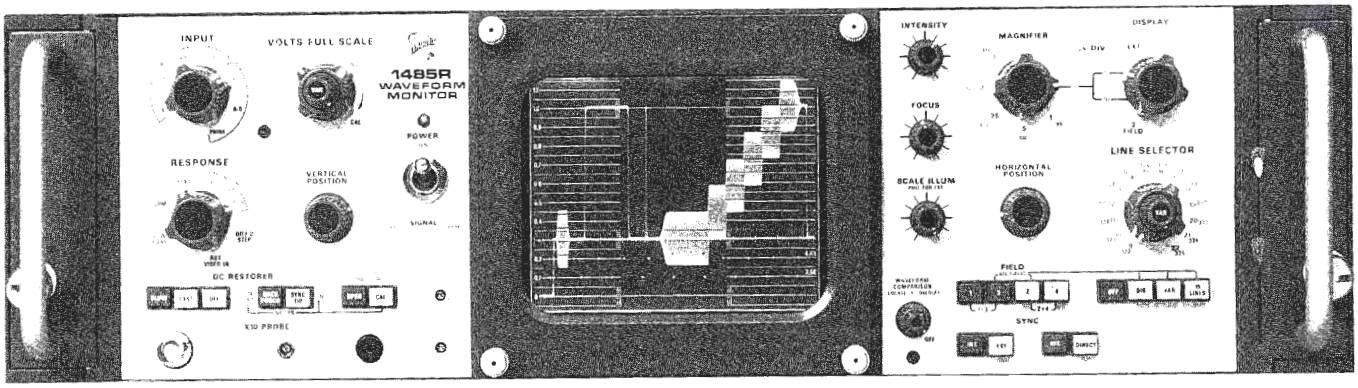
Extender board, 32-pin — Order 670-7981-00.

Extender cable bnc to Peltola — Order 067-0709-00.

Deflection leads extender cables — (4 required) Order 196-0939-00.



1750 Rear Panel.



1485R Option 01 PAL/NTSC Dual Standard Waveform Monitor (Rackmount).

1480 Series
Waveform Monitors

Bright CRT Especially Suitable for Vertical Interval Testing

Advanced Measurement Modes

Amplitude Measurement Accuracy Approaching 0.2%

Digital Selection of Line and Field

Probe Input Option

15-line Display for VTR Applications

The 1480's have excellent amplitude measuring accuracy and many unique operating modes that enable you to work more precisely and accurately. The monitoring needs of CCU, VTR, control room, transmission facilities, transmitter, and special systems have been researched thoroughly in order to assure that the 1480's will fit your expressed needs. We believe that the 1480's have anticipated your needs for years to come. We will describe the things that 1480's can do, but there is nothing like seeing one to really communicate the impressive performance of these monitors.

The 1485C and 1485R PAL/NTSC Dual Standard Monitors (see photos) represent the essentials of all eight monitors in the 1480 Series. The differences between the monitors in the series are essentially confined to what lines in the vertical interval are selectable, what filters are selectable in the response mode, and in the field selection modes. Dual Standard Monitors recognize the signal standard in use automatically and indicate that standard with front panel indicators.

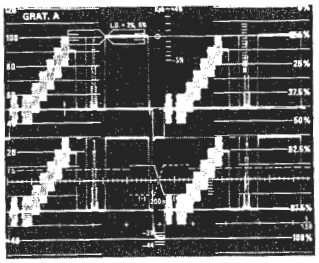
Vertical Interval Testing

Have you ever had to turn the lights down or shade a CRT with your hand to see a particular Vertical Interval Test Signal? That is not necessary with the 1480 Series because the CRT is bright. So bright that one Vertical Interval Test Signal selected out of four fields, can be seen with ease even in a well-lit area. This solution to VITS display problems required the design of a very high light-output, cathode-ray tube. But the bright CRT is just one of the unique features of the 1480 Series.

More Accuracy, Greater Resolution

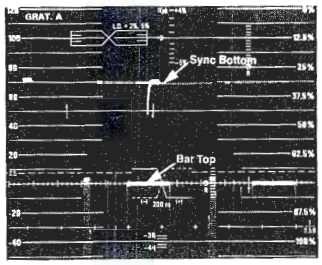
In recognition of the need for more accuracy the 1480 provides several advanced measurement modes. In these modes the 1480 gives you the capacity to make amplitude measurements with accuracy approaching 0.2%. In one mode a precision display offset is used. A proven video measurement technique offsetting displays with an amplitude standard is an easy-to-use method that achieves accuracy by eliminating parallax and transfer errors. Transfer errors are eliminated because you compare your signal to a precise one volt standard rather than to graticule calibration. Measurements made with comparison techniques also have a high order of consistency and repeatability. When your signal precisely matches the standard, your signal amplitude will be determined to the value and accuracy of the offset. The tolerance of the internal calibration signal used as the standard is 0.2%.

DISPLAY OFFSET
. . .compare your signal to a precise one volt standard for accurate results.



In this photo we reduced sensitivity below normal operating values to show how OFFSET places the top of one display on the same level as the bottom of another display of the same signal. Since the top and bottom line up, the signal equals the offset standard.

Resolving power is an important factor in achieving very accurate amplitude measurements. The 1480's provide great resolving power through calibrated five-times expansion of the vertical display. Expansion not only means that signal and standard comparison is more precise, it means that differences (errors) between signal and standard are easier to see and to measure.



In this photo, scale factor is expanded 5 times to 0.2 volts full scale. Offset used with 5X expansion provides exceptional resolving power plus comparison accuracy. The signal shown is 10% low.

Greater resolution of the five times expansion is facilitated by a vernier position control. With this control any portion of a standard amplitude signal can be positioned on screen and then examined in detail. A 0.2% amplitude standard, 5X expansion, offset comparison, fine CRT spot size, these are some but not all of the factors that make the 1480's very accurate video monitoring instruments.

A Fast Time Base with an AFC Mode

The fastest sweep of the 1480's is 0.1 microseconds per division. Fast enough and bright enough (remember the bright CRT) to examine T pulses even in the vertical interval.

The 1480's are calibrated in microseconds with a basic 2% time base accuracy. Less than ±3% when using the multiplier. 50X is the greatest range of magnification with steps of 10, 5, 2, and 1; calibration is in time and magnification value. The sync recognizer has an automatic frequency control mode for the display of sync jitter.

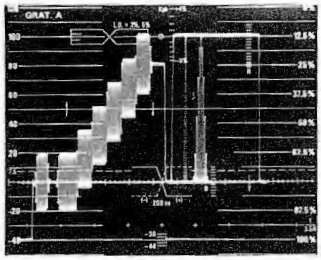
DC Restoration and DC Coupling

Other improvements provided by the 1480's include slow dc restoration which will display any hum present, or a fast mode that filters

out hum so that measurements can be made more accurately. Also selectable are back-porch or sync tip dc restoration. A dc coupled input mode is provided for measuring diode demodulator output and other applications.

A Mode for Side-by-Side Comparison
We call this mode overlay or sweep foldBack. The 1480's can actually overlay a later segment of a display on the earlier segment. Superimposing waveforms over other waveforms allows exact comparison of levels.

OVERLAY (SWEEP FOLDBACK) . . . overlay signal elements for side-by-side comparison.



Pulse and Bar overlaid for precise comparison. Expansion can be used for more resolution.

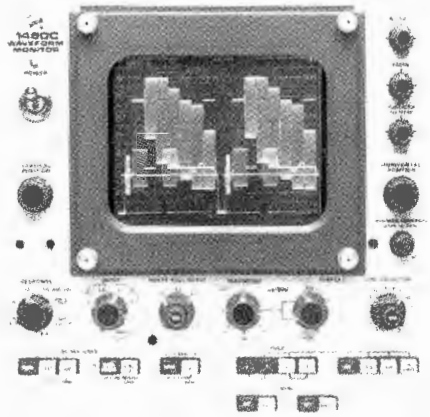
With overlay you can exactly compare the elements of complex vertical interval test signals. Add the extra resolving power of five times vertical expansion with precision offset and the overlay mode reaches its full potential.

Sure Line Selection, Positive Field Identification
Digital selection of field and line assures positive identification of displayed information. For example when you select line 18 of field 2 it is certain that what you will see is line 18, field 2. Digital techniques will not allow an incorrect selection.

Variable selection of other lines is provided for full field signal analysis. In all line selection modes a line intensifying strobe is provided with video for picture monitor displays. A second line strobe output is provided to strobe 520A Series Vectorscopes, etc. Intensified two-field displays on the 1480 help you locate the line or lines selected.

15 Line Display for VTR Applications
With the 15-line mode the 1480's are particularly well suited to examine head by head peformance of a video-tape recorder. Without the conflicting pattern of signals from other heads, time base instability, jitter, distorted sync pulses, missing sync pulses, and field time distortions can be easily displayed. In addition the 1480 line strobe is very useful in selecting just the output from an individual head for measurement by a TEKTRONIX 520A Series Vectorscope. That makes it possible to measure chrominance phasing, differential phase and differential gain.

Response Selection and a Unique Auxiliary Mode
Many television measurements require the filtering of some components from the composite signal. For example, luminance signal rejection by 3.58 MHz or 4.43 MHz subcarrier filters for differential gain measurements. A selection of appropriate filters is provided in the 1480's; including low pass, IRE, subcarrier and a one for staircase linearity measurements called differentiated staircase. And, when your specialized or unique measurements require a special filter, insert that filter between the auxiliary video output and auxiliary input. The auxiliary video input mode, selected by the response control, allows you to add any filter or other device you choose without breaking into the program line. The auxiliary video input and output are buffered by amplifiers to provide a precise 75-ohm source and load.



1480C NTSC Waveform Monitor (Cabinet).

Graticules, Focus and Intensity, and Factors Affecting Displays
Two graticules are provided. The illuminated and internal graticule is useful for most applications, and has no parallax. The external graticule can be easily changed, a feature useful for special applications. The external graticule is illuminated by a separate system with a control that turns the internal one off — getting it out of sight so you can see only the external one.

In the 1480 Series monitor focus and brightness controls compensate for changes when switching from two field to a faster time base and can easily be set to an optimum level.

Working Impedances Other Than 75-Ohms. . . A Probe Option (Option 01)
Did you ever want to use the special abilities of a waveform monitor in a high impedance circuit or where loop thru is inconvenient? The 1480's make convenient high impedance probing available with a Probe Option. This Option provides an input that accepts most TEKTRONIX probes. As a part of this option a probe compensation waveform test point is provided (A ten-times amplifier keeps full screen sensitivities at 1.0 V, 0.5 V, and 0.2V while using X10 attenuator probes.) Without probe the ten-times amplifier can be used to achieve sensitivities as high as 20 millivolts full screen for special applications such as measuring noise and residual subcarrier.

Option 06 for 124-Ohm Balanced Operation
The 1480R Option 06 is a high-performance television waveform monitor designed for use in your television operating center or by your field service force. It is designed for measurements in long-distance, video transmission systems using 124-ohm balanced lines. WECO-style input jacks allow this instrument to operate in either a 124-ohm balanced or 75-ohm unbalanced system.

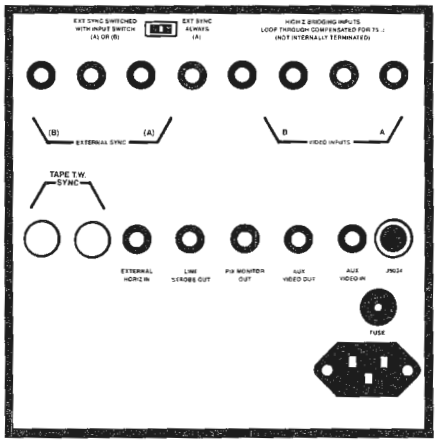
Vertical sensitivity, with automatic bandpass limiting, has been increased to 0.05 volts full scale for making differential phase and gain measurements with Bell Kelley or Telemet Test Sets. A 5 to 12 second, variable sweep has been added to measure low frequency distortions and system bounce caused by large APL changes in the video signal.

The STOC transmission measurement graticule (Graticule A) has been incorporated in the 1480R Option 06. Insertion Gain, Line Time Distortion, Short Time Distortion, and Chrominance to Luminance Gain Inequality are a few of the measurements made easier and more precise with this new graticule.

Each 1480R Option 06 is supplied with hardware for both rackmounting and portable configurations.

Option 07 Slow Sweep
A random sampling technique is employed by a 1480 Series Option 07 Waveform Monitor to display long-time distortions. Sampling maintains display intensity at a level suitable for viewing and photography. Long-time distortions occur over a longer period of time than the field rate; generally one-half to several seconds. The signal most often used for long-time distortion testing is a flat field video signal with a changing Average Picture Level (APL) and sync pulses. This test method, called "Bump" or "Bounce" testing, contains a level change at selected intervals, usually 1 to 10 seconds. The effect is then viewed on a waveform monitor whose time base is between 5 and 10 seconds per sweep. When the waveform monitor is triggered by the change in APL, the effect of that change can be viewed for a period of time up to at least 10 seconds after the change has occurred.

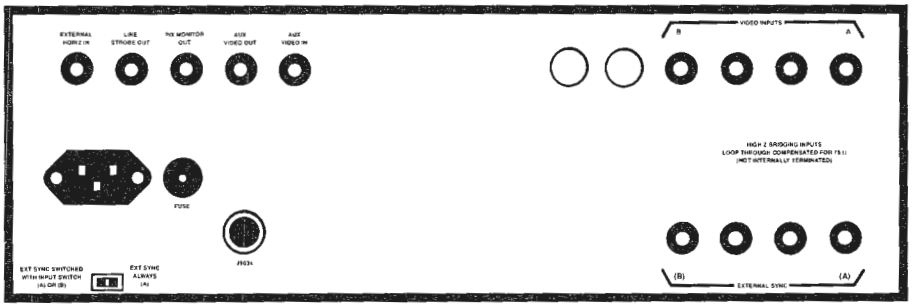
A 1480 Series Option 07 in the slow sweep mode is triggered from APL change or by a 50-60 Hz square wave that has no field sync and filtered line sync thru a loop-thru rear panel input. Either – polarity, starting the



Rear Panel Inputs BNC
- Video A Loop Thru
- Video B Loop Thru
- External Sync A Loop Thru
- External Sync B Loop Thru
- External Horizontal
- Auxiliary Video

Rear Panel Outputs BNC
- Line Strobe
- Pix Monitor
- Auxiliary Video

1485C Rear Panel.



1485R Rear Panel.

slow sweep on the transition from at or near black level to peak or near peak white, or – polarity, white to black, may be selected. In addition, a choice of trigger source, either internal, stripped from incoming video, or external, through the External Sync Inputs, is available. If insufficient or no trigger is present, the slow sweep will operate in a free-run mode. This free-running mode has a noticeably reduced repetition rate; however, sweep duration and linearity are unchanged.

The sweep duration is controlled by a variable front panel control, located on the display switch. Range of control over the duration of the sweep is approximately 4 to 15 seconds. The status of the sweep is easily determined by observing the waveform comparison indicator light.

CHARACTERISTICS

VERTICAL DEFLECTION

INPUTS — Input A and B are 75Ω high impedance loop-through. Return loss is ≥40 dB from dc to 5 MHz in a 75Ω system. Aux Video input is internally terminated in 75Ω. Return loss is ≥34 dB from dc to 5 MHz.

SCALE FACTOR — A and B input calibrated 1.0 ±7 mV, 0.5 ±15 mV, 0.2 ±7 mV. (0.05 ±2.5 mV Option 06) volts full scale. Variable: range for each scale factor at least +40% to –50%. Aux Video Input 1.5 dB gain.

MAX INPUT VOLTAGE — 2 volts peak-to-peak (ac coupled).

FREQUENCY RESPONSE — Flat: 50 kHz to 5 MHz ±1% (1.0 V.F.S., VAR in detent). 5 MHz to 8 MHz +2, –3%, 8 MHz to 10 MHz +2, –6%. Typically within +2, –15% to 18 MHz and typically –3 dB at 20 MHz.

Low Pass: Attenuation ≥14 dB, 500 kHz and above. 3.58 MHz Bandpass: Amplitude within ±1% of amplitude in Flat response position. Bandpass ≈ 600 kHz. 4.43 MHz Bandpass: Amplitude within ±1% of amplitude in flat response position. Bandpass ≈ 800 kHz. IRE: Conforms to IEEE Standard 205, 1972.

DC RESTORER — Keyed type, may be turned off. Clamping point: BACK PORCH/SYNC TIP. TIME CONSTANT: FAST reduces mains hum ≥26 dB, SLOW reduces mains hum <0.9 dB.

CALIBRATOR — Amplitude selected by dc Restorer switch. Sync Tip: 1 volt ±0.2%, Back Porch: 714 mV or 700 mV ±0.5%.

LINEAR WAVEFORM DISTORTION — Pulse/bar ratio ±1%. SHORT TIME: preshoot, overshoot, ringing ≤0.5% on 100 ns $\sin^2$ pulse. LINE TIME: TILT or rounding ≤1.0%. FIELD TIME: (AC coupled) ≤1%.

NON-LINEAR DISTORTION — Differential gain ≤0.5%.

HORIZONTAL DEFLECTION

TIME-BASE — 5 μs and 10μs timing accuracy ±2% (center 10 divisions); 5 μs and 10 μs linearity ±1% (center 10 divisions).

EXTERNAL SYNC INPUT — Two loop-through high impedance, with ≥46 dB return loss in a 75Ω system. Inputs are slaved to A and B input or to A external sync input only.

EXTERNAL SYNC INPUT REQUIREMENTS — 400 mV to 2 volts composite video or 200 mV to 8 volts composite sync.

FIELD SELECTOR — Positive selection of Field 1 or 2 in the NTSC system. Positive selection of 1, 2, 3, 4, or 1 & 3, 2 & 4 in the PAL systems.

LINE SELECTOR — DIG - Selects lines 9 to 22 NTSC, line 9/322 to line 22/335 PAL, line 9/272 to line 22/285 PAL-M, VAR: Approx. line 20 of the selected field to line 4 of the next related field. 15 lines: Identical to VAR, except 15 successive lines are displayed.

SYNC — AFC: Horizontal frequency range is 15.75 kHz ±200 Hz. Max. jitter with respect to input sync 10 ns with 4 volts rms hum (30 ns with the addition of –36 dB white noise). Direct: Horizontal frequency up to ≤20 kHz. Max jitter with respect to input sync 12 ns with 4 volts rms hum (90 ns with the addition of –36 dB white noise).

OUTPUTS

LINE STROBE — TTL amplitude pulse. Pulse coincident with line or lines selected by VAR, 15 LINE or DIG modes of DISPLAY switch.

PICTURE MONITOR — Output of incoming video with LINE STROBE added. Output impedance is 75Ω. Output adjusted to unity with respect to A and B video input.

AUX VIDEO — Output of incoming video. 75Ω output impedance. Gain adjustable to unity with respect to A and B video input.

OTHER CHARACTERISTICS

RGB/YRGB STAIRCASE INPUT — Approx. 12 volts for 12.7 divisions deflection. RGB sweep length internally selected for ⅓ normal sweep. YRGB sweep length internally selected for ¼ normal sweep length.

MAINS VOLTAGE — Ranges: 100 Vac, 110 Vac, 120 Vac, 200 Vac, 220 Vac, 240 Vac ±10%. Frequency: 48 Hz to 62 Hz, max power consumption 75 W. At factory, 1480 preset for 110 Vac, 1481, 1485 preset for 220 Vac, 1482 preset for 110 Vac.

OPTION 01

10X PROBE CHANNEL — Scale Factor 1 V, 0.5 V, 0.2 V full screen with 10X attenuator probe. GAIN range ±10%. Tilt ≤5% on 50 Hz square wave, high frequency response ±3%, 25 Hz to 5 MHz. Referenced to 50 kHz. Input resistance 1 MΩ, ±2%, not including probe. Input RC Product 20 μs, ±1%, not including probe. BNC connector accepts most TEKTRONIX probes.

10X PROBE CALIBRATOR — Output voltage 1.000 V ±0.005 V or 0.995 to 1.005 V.

SLOW SWEEP (OPTION 06 & 07)

Duration — 4 to 12 seconds, variable with front panel control.

Linearity — ±5% of full-screen over the length of the sweep.

Indicator — Front panel indicator on when slow sweep is operating but sweep is not running.

Triggering Signal — APL change ≤10% to 90% (Bump or Bounce), front panel selectable for either + or – level change.

Sensitivity — 400 mV to 2 V p-p composite video with APL change.

Rate — ≥0.2 Hz, free-runs at rates <0.2 Hz or with no triggering signal.

Input — Internal or External.

50/60 Hz Squarewave Triggering — Sensitivity: 400 mV to p-p min to 3 V p-p max. Input Impedance: ≈ 10 kΩ ac coupled (Rear Panel loop-through connectors not return loss compensated).

DIMENSIONS AND WEIGHTS

CABINET VERSIONS — Height: 210 mm (8.25 inches). Width: 216 mm (8.50 inches). Depth: 430 mm (16.95 inches). Net Weight: 9.8 Kg (21.5 lb.). Shipping weight (approximate): 24.1 Kg (53.1 lb.).

RACKMOUNT VERSIONS — Height: 133 mm (5.25 inches). Width: 482 mm (19.0 inches). Depth: 457 mm (18.0 inches). Net weight: 11.2 Kg (24.6 lb.). Shipping weight (approximate): 24.1 Kg (53.1 lb.).

ORDERING INFORMATION

1480C NTSC Waveform Monitor.

1480R NTSC Waveform Monitor.

1481C PAL Waveform Monitor*1

1481R PAL Waveform Monitor*1

1482R PAL-M Waveform Monitor

1485C PAL/NTSC Dual Standard Waveform Monitor*1

1485R PAL/NTSC Dual Standard Waveform Monitor*1

Includes: Two BNC right angle adaptors (103-0031-00), one pair rackmount ext DWR sides (351-0195-01), various external graticules (see matrix below), manual

External Graticules	1480R/C	1481R/C	1482R	1485R/C
Blank	x	x	x	x
NTSC				x
CCIR				
CCIR K (V)		x		x
CCIR K (P)		x		x
GRAT A (V)				x
GRAT B (V)	x			x
GRAT A (P)				x
GRAT B (P)	x			x

(V) Visual (P) Photo

**1 1481C/R, 1485C/R meets European Broadcast Union Tech. 3221-E, Guiding Principles for design of Television Waveform Monitors.*

OPTIONS

Option 01 — 1 MΩ, 20 pF Probe input (not available with Option 06, probe not included).

Suggested Probe: P6108 10X Probe 2 m (010-6108-03), or 3 m (010-6108-05).

Option 06 — (1480R only) 124 Ω WECO Style Inputs.

Option 07 — Slow Sweep*2 (Option 07 performance included with Option 06. Do not order with Option 06).

Option 08 — (1481C, 1481R, 1485C and 1485R only) SECAM Field Identification.

*2 Option 07 satisfies EBA Tech 3321-E § 3.2.2.

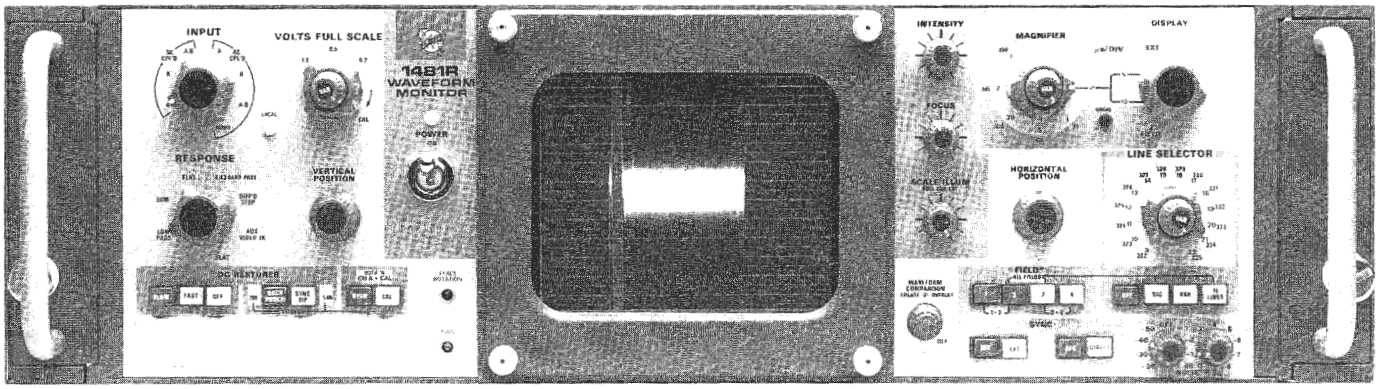
OPTIONAL ACCESSORIES

1480F30 Noise Measurement Kit — For field installation in a 1480R Series rackmount instrument to provide tangential noise measurement capability. Order 1480F30.

1480R Cradle Assembly — For mounting the 1480R in a WECO backless rack. Order 426-0309-00.

Field Case — (For cabinet versions only). Order 016-0084-01.

Trace Recording Cameras — Both the Tektronix C-53P and the C-59AP can be used.



1481R Waveform Monitor with 1480F30 Noise Measurement Kit Installed.

1480F30
Noise Measurement Kit

Low Cost Noise Measurement

Noise Measurement at Any Video Level
- **White**
- **Sync Tip**
- **Black**

Random Noise Measurement in the Presence of Coherent Noise

Vertical Interval, Line by Line and Field Rate Measurement

In-Service Noise Measurement

Noise is constantly present in television facilities. The 1480F30, when installed in a 1480R Series Waveform Monitor, provides a convenient method to quantify the amount of noise present on a video signal. This field installable kit makes comprehensive noise measurement available to television engineers and operators throughout the video signal chain. Using the tangential method an operator can typically quantify the true RMS noise level within 1 dB. The presence of coherent noise, such as residual subcarrier, can be identified and removed from the measurement allowing a more representative evaluation of the true RMS value.

Several methods of measuring signal-to-noise ratio in the presence of video are presently used and they are summarized here to clarify the 1480F30 method. Three popular methods are the quasi-peak technique, the noise comparison method, and gating techniques.

The quasi-peak technique involves observing the noise waveform on a waveform monitor and estimating the RMS value of the fuzzy trace so the signal-to-noise ratio can be calculated. This method is limited by its dependence on the CRT trace intensity and by ambient room lighting.

The noise comparison technique requires keying out the video signal at an appropriate time and inserting white noise on an adjustable pedestal in its place. The inserted noise amplitude and pedestal are then adjusted such that the inserted noise matches the system noise. S/N ratio can then be read from a calibrated scale on the insertion test signal generator.

Noise comparison techniques can be used to measure S/N ratio at any point in a stationary picture. Position the noise insertion pedestal to the appropriate horizontal position, select the appropriate line number by using the waveform monitor's line select feature, and then perform the measurement in the normal manner. The noise comparison technique requires a long enough constant luminance amplitude to allow for insertion of the noise source. Repeatability for this test method has been shown to be better than 2 dB when used in line select mode and 0.5 dB when used full field.

Another popular method of assessing S/N ratio involves sampling the signal for a brief time and performing an RMS measurement on the sampled signal. By sampling the signal multiple times (each slightly narrower than the previous sample) and by providing gain between the sample times, the effects of sampling transients can be minimized. The results can be averaged over a long time period to increase resolution. Similarly, the video signal may be sampled, digitized, and the resulting digital information manipulated to produce accurate indication of signal-to-noise ratio.

A fourth method of making noise measurements is the tangential method, as used in the 1480F30 field installable kit. The tangential method utilizes several facts to achieve accuracy and repeatability.

- The distribution of successive, independent samples of the random noise voltage is Gaussian. The RMS value of the noise voltage is equal to the standard deviation of that Gaussian distribution.
- The cross-section of the light output from a noisy trace on a CRT is Gaussian.
- The Gaussian distribution of the samples is independent of the spectral distribution of the noise.
- If two Gaussian distributions of equal variances, with means that are different by two standard deviations are added, the result is a flat topped distribution. If the difference between the two means is greater than two standard deviations, there will be a sag in the sum distribution. See Figure 1.

Therefore, noise measurements may be accurately made using a waveform monitor by overlaying sections of the trace and adjusting the separation of the overlaid sections until the brightness sag between the two sections just disappears. The RMS value of the noise is then equal to one half of the offset voltage required to meet this criteria.

Since the video signal contains known intervals where the signal voltage is constant, the noise power can be easily measured independent of the video signal power. The TV waveform monitor is ideally suited to determine or view these intervals and allow the operator to separately measure the additive noise power.

The 1480F30 installed in a 1480R Series instrument permits noise measurements using tangential techniques. Using this system, measurements in any area of the waveform that provides a constant luminance level for at least 5 microseconds may be made. This method permits the user to disregard any coherent perturbations that may have caused inaccuracies using other measurement schemes. An additional feature of this system is that no equipment is required other that the 1480R Series with the 1480F30 installed.

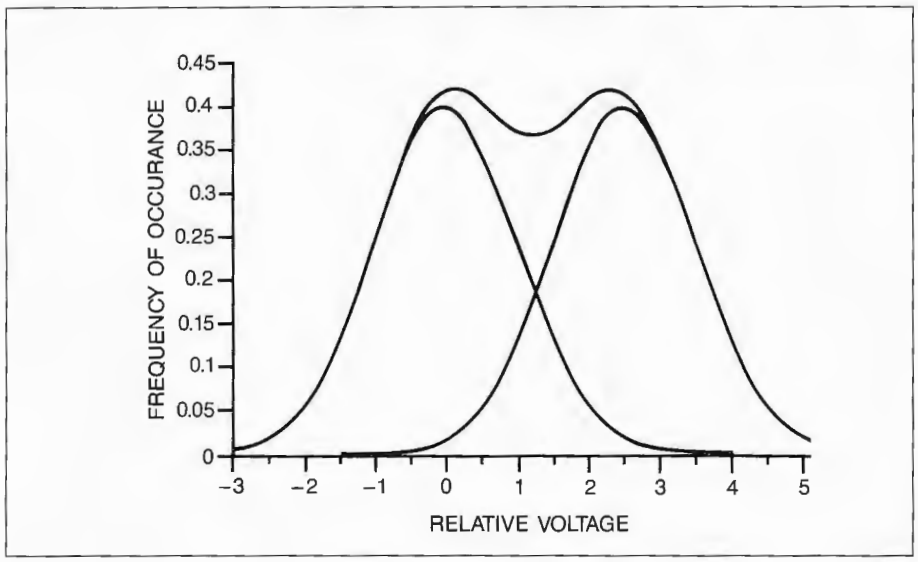


Figure 1. 2.5 Standard Deviation Separation.

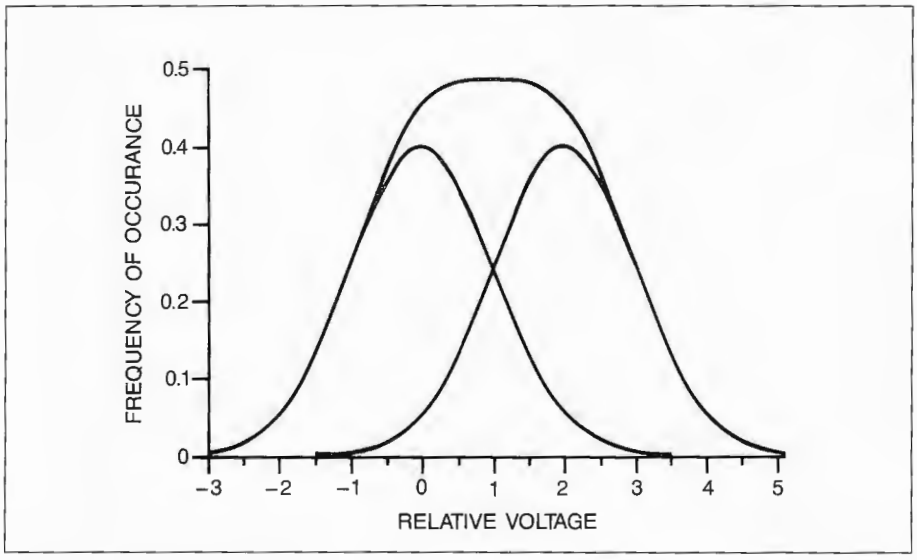


Figure 2. 2.0 Standard Deviation Separation.

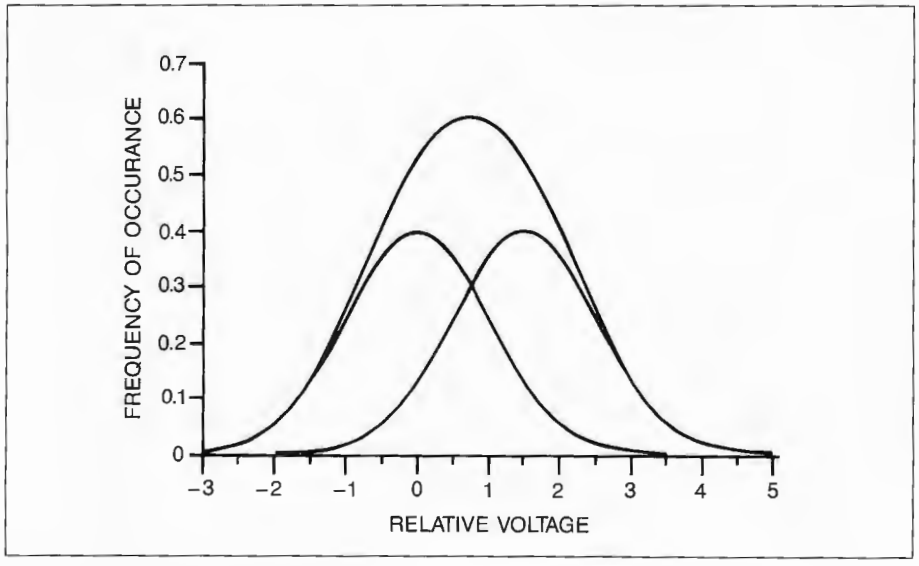
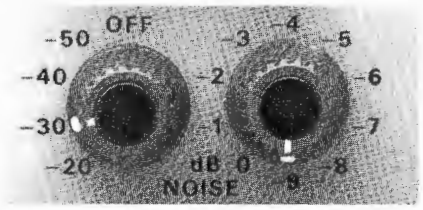


Figure 3. 1.5 Standard Deviation Separation.

The 1480F30 is implemented by using the existing WAVEFORM COMPARISON feature in the 1480R Series in conjunction with the added dB NOISE controls. The WAVEFORM COMPARISON controls are used to provide the overlaid display and the calibrated dB NOISE controls are used to adjust the separation of the traces to the point where the gap just disappears. The video signal-to-noise ratio is read off the scales on the dB NOISE controls which are calibrated in 1 dB increments from −20 dB to −59 dB. This technique has proven to be consistent to within 2 dB and typically within 1 dB.



RMS Noise Value of −39 dB.

Procedure

1. Using the appropriate filter, connect the signal to be analyzed to the 1480R Series instrument. A convenient method of doing this is to connect the filter between the AUX VIDEO OUT and AUX VIDEO IN connectors on the rear of the instrument.

2. Select the appropriate input signal using the INPUT selection switch.

3. Set the RESPONSE switch to FLAT. If the AUX VIDEO OUT and AUX VIDEO IN connections are being used, set the RESPONSE switch to AUX VIDEO IN.

4. Set the DC RESTORER switch to either FAST or OFF.

5. For in-service noise measurements, select the line of the waveform for which S/N is to be measured by using the line select features of the 1480R Series. If the selected line is the same on all fields, use the ALL FIELDS mode. If a full-field test signal is available, the noise should be measured with the line selector off since this method yields more consistent results due to the increased number of samples. Use 5 microseconds per division for the horizontal display timing.

6. Turn the OVERLAY control to its just out of detent position to enable the WAVEFORM COMPARISON mode. Adjust the LOCATE control to select the point at which the overlay comparison will be made. Adjust the OVERLAY control such that the selected waveform sections are overlaid.

7. Adjust the VOLTS FULL SCALE and VAR controls for maximum gain. Adjust the VERTICAL POSITION and HORIZONTAL POSITION controls to display the overlaid waveforms to the center of the display.

8. Starting at a low numeric figure, adjust the dB NOISE controls such that the gap between the overlaid waveforms just disappears as illustrated in Figure 5.

9. Read S/N from the dB NOISE calibration marks.

10. Perform any additional S/N measurements at other signal levels, then return the OVERLAY control to its OFF position.

CHARACTERISTICS

Measurement Range — −29 to −59 dB, in 1 dB steps relative to 700 mV RMS

Measurement Consistency — Typically within 1 dB

Calibration Accuracy — Within 0.5 dB

ORDERING INFORMATION

The 1480F30 field modification kit has been designed for field installation by technical personnel. Installation is available at Tektronix Service Centers.

1480F30 Noise Measurement Kit

Only 1480R, 1481R, 1482R, and 1485R Waveform Monitors are retrofitable with this kit. **The serial number of the 1480R Series Waveform Monitor to be modified must be provided with the order.**

OPTIONAL ACCESSORIES

Continuous Random Noise Measurement Weighting Networks — For use in making measurements on 75 ohm video systems.

4.2 MHz Weighting Network — Order 015-0214-00.

5.0 MHz Weighting Network — Order 015-0215-00.

Unified Weighting Network — Usable in either 4.2 MHz or 5.0 MHz systems. Order 015-0283-00.

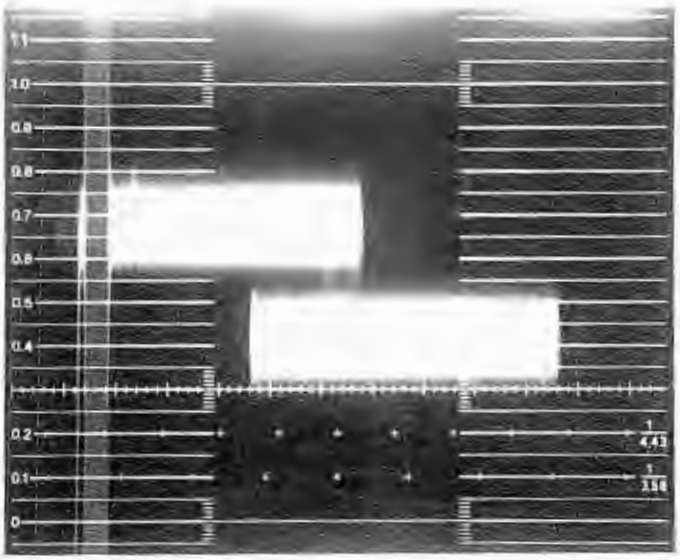


Figure 4. Excessive Trace Separation.

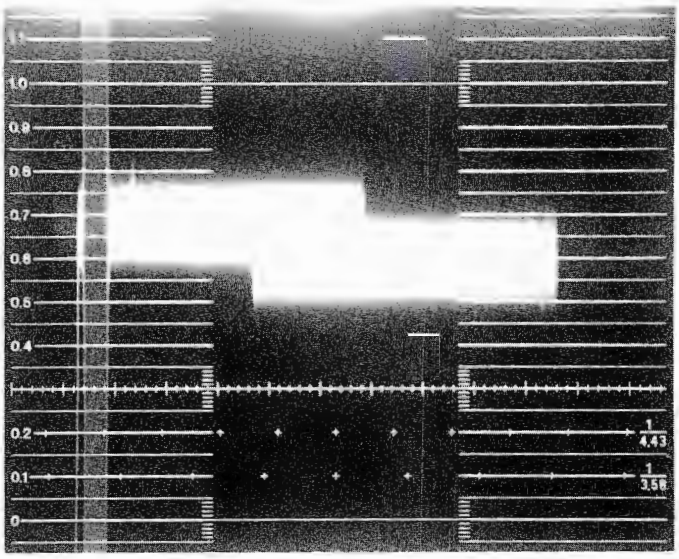


Figure 5. Correct Trace Overlap.

SIGNAL MONITOR SELECTION GUIDE TEK

	1480	1705	1710B	1720	1730	1730 D-2	1730 HD	1740	1750	1780R	WFM300A
Waveform Display	X		X		X	X	X	X	X	X	X
D-2 Input						X					
Digital Decoder Output						X					
Composite Vector				X				X	X	X	
CAV Vector Display											X
CAV Lightning											X
Picture Display										X	
RF Spectrum Display		X									
Burst Phase Indicator			X								
Picture Monitor Out	X				X	X	X	X	X	X	(6)
VITS Monitoring	X			(5)	X	X	X	(1)	X	X	X
R-Y Sweep Mode				(5)				X	X	X	
Multi Filter Mode			X		X	X	X		X	X	
Multi Input Display				X	X	X	X			X	X
A-B Input Display	X						X			X	X
Remote Control				X	X	X	X	X	X	X	X
RGB/YRGB Display	X				X	X	X	X	X	X	X
X-Y Input				X						X	
SCH Mode									X	X	
Probe Input	(4)									X	
Line/Field Select	X			(5)	X	X	X	X	X	X	X
15 Line Display	X			(5)	X	X	X			X	X
Trace Overlay	X				X	(10)				X	X
Precision Amplitude Measurements	X									X	
Precision Phase Measurements										X	
Precision Timing Measurements	X						(8)			X	
NTSC Available	X		X	X	X	X	X	X	X	X	X
PAL Available	X		X	X	X	X	X	X	X	X	X
PAL-M Available	X		(2)	(2)	(2)		X	X	(2)		
NTSC/PAL Dual Standard	X				X		(9)				
HDTV Formats							(9)				
Component Formats							X			X	(7)
UL/CSA Recognition		X	X	X	X	X	X	X	X	X	X
Half Rack Width		X	X	X	X	X	X	X	X		X
Internal Graticule	X	X	X	X	X	X	X	X	X	X	X
DC Power/Battery		(3)	(3)	(3)	(3)			(4)			

(1) Limited capability
(2) Available as a modified product
(3) Available as a field mod kit
(4) Available as an ordered option
(5) When connected to a 1730/31
(6) Separate Composite and Green/Blue/Red Format outputs
(7) Available in SMPTE, YQI, Betacam® or MII Format 625/50 or 525/60 selectable
(8) Measures tri-level sync timing transition
(9) 525/60/2, 525/60/1, 625/50/2, 625/50/1, 875/60/2, 1050/60/2, 1125/60/2, 1250/50/2
(10) Provides timing comparison between analog and D-2 digital inputs

ECO-170A Synchronous Changeover.

ECO-170A
Synchronous Changeover

Automatic Sync Changeover

Clean Electronic Switching

Unique Fault Detection System

8 Channels

Manual Override

Remote Control with Fault Indicators

Compatible with NTSC and PAL Systems

The ECO-170A Synchronous Changeover provides transparent, automatic selection of sync sources. Front panel controls allow simple access to changeover functions. Front panel lockout protects these controls in critical master sync systems.

Transparent Switching

The ECO-170A employs electronic switching to ensure uninterrupted sync for critical production and on-air operations. Unlike other sync changeovers, the ECO-170A uses relay switching only for bypass in case of power failure or changeover fault. This gives optimum sync system performance while ensuring maximum system reliability. Manual sync source selection provides a means for periodic verification of changeover and backup sync generator operation.

Fault Detection

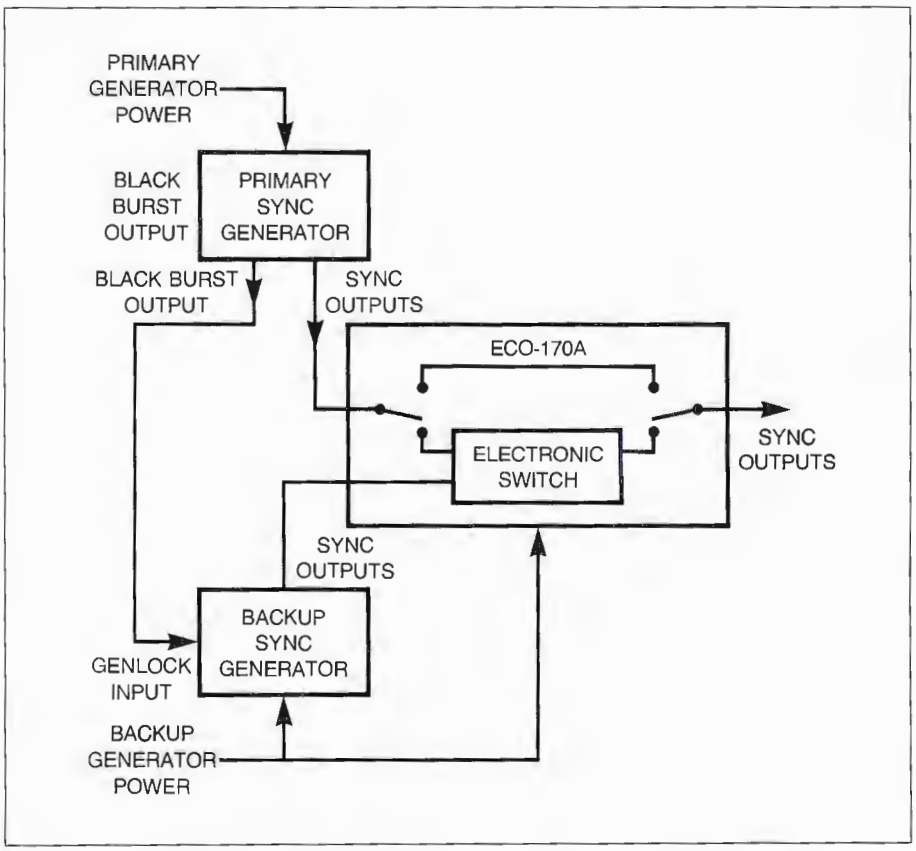
By testing both pulse amplitude and pulse timing, the ECO-170A provides two methods of error checking for your sync system. While conventional amplitude detection finds missing pulses quickly, the ECO-170A's additional timing detection identifies errors that would otherwise be undetected. When the ECO-170A detects a fault, it automatically switches to the backup generator, unless the backup generator also has a fault. Front panel and remote indicators, in addition to an audible alarm, display sync system faults. These indicators remain on, until cleared by an operator.

System Configuration

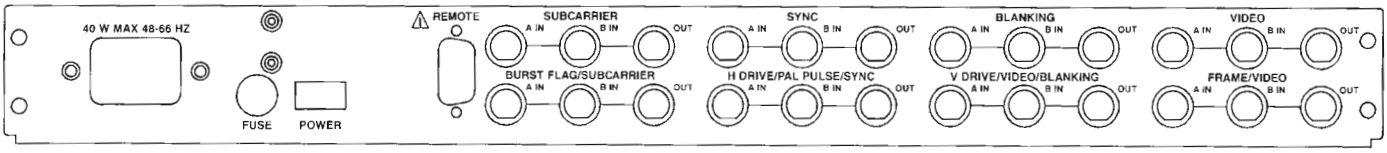
The flexibility of the ECO-170A lets you configure it to your specific system needs. The ECO-170A has eight channels for each sync generator. Four channels for Composite Video, Subcarrier, Sync, and Blanking are fixed. Four selectable channels can be used for BURST FLAG, H DRIVE, V DRIVE, PAL PULSE, and COLOR FRAME PULSE, or they can be used to provide an additional set of channels for the pulses most commonly used in modern television facilities.

Reliable Sync

With its clean switching and two level fault detection, the ECO-170A teams with your sync generators to provide a reliable master sync system.



A Master Sync System using the ECO-170A.



ECO-170A Rear Panel.

CHARACTERISTICS

Channel	Function
1	Subcarrier
2	Burst Flag or Subcarrier
3	Sync
4	H Drive/PAL Pulse or Sync
5	Blanking
6	V Drive, Blanking or Video
7	Video
8	Color Frame or Video

Fault Detection Time — 2 missing pulses max.

Remote Control Connector — 9 pin D.

Remote Functions — Source select control, A source on line indicator, B source on line indicator, System fault indicator, Alarm output, Cross genlock enable, A source genlock control, B source genlock control.

POWER SOURCE

Mains	
Voltage Range	90 to 132 VAC or 180 to 250 Vac
Frequency Range	48 to 62 Hz
Power Consumption	20 W typical, 40 W maximum

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	44	1.734
Width	483	19.0
Depth	561	22.1
Weight	**kg**	**lb**
Net	6.14	13.5
Shipping	10.4	22.9

ENVIRONMENTAL

Temperature	
Operating	0° to 50 °C
Nonoperating	−40° to 65°C

ORDERING INFORMATION

ECO-170A Synchronous Changeover

Auto Switching Fault Criteria

Signal	Amplitude Criteria	525 Timing Criteria	625 Timing Criteria
Video	Sync −3 dB ±1 dB	Sync width	Sync width
Subcarrier	2V −3 dB ±1 dB	Not used	Not used
Pulses	2V or 4V −3 dB ±1 dB		
Sync		4.7 µs ±.56 µs	4.7 µs ±.45 µs
Blanking		10.9 µs ±.84 µs	11.85 µs ±.9 µs
Burst Flag		2.51 µs ±.84 µs	2.25 µs ±.9 µs
H Drive		6.2 µs ±.84 µs	—
V Drive		571.5 µs ±.84 µs	400 µs ±80.9 µs
PAL Pulse			
Pulse		—	4.7 µs ±.9 µs
Square Wave		—	64 µs ±.9 µs
Color Frame			
Pulse		63.55 µs ±.84 µs	64 µs ±.9 µs
Square Wave		33.337 ms ±.84 µs	80 ms ±.9 µs

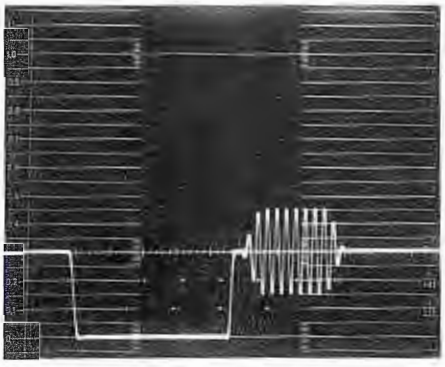
SPG-170A NTSC Sync Generator.

SPG-170A
NTSC Sync Generator

Digitally Generated RS-170A Black Burst
Digital Genlock
High Stability Subcarrier
Flexible Pulse Outputs
Pulse Timing Independent of Black
Four Character ID Presets
Eight Genlock and Sync Timing Presets
Remote Control
Optional SMPTE Bars, ID, and Audio Tone

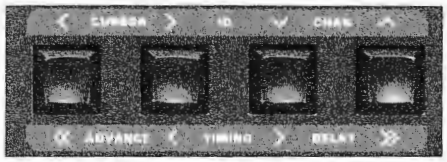
The SPG-170A sync generator offers all the features expected in a sync generator, plus the advantages of digital accuracy and system flexibility. Ideal for either master or slave generator operation, the SPG-170A features stable RS-170A performance and a rugged 1¾″ package. The SPG-170A Option 1 provides even more versatility by adding SMPTE bars with programmable identification and audio tone.

Digital Accuracy



All SPG-170A signals are digitally generated to provide excellent SCH and timing accuracy. The SPG-170A also has a digital genlock to ensure consistent color framing and to eliminate timing drift inherent in other genlock systems. This microprocessor-based system calculates genlock input burst phase and sync timing to control output timing and color framing. All outputs are correctly SCH phased, even if the SPG-170A is locked to an improperly SCH phased input. When no input signal is present, it switches to an internal oscillator. This high stability crystal oscillator, enclosed in a constant temperature oven, ensures long term frequency accuracy and stability.

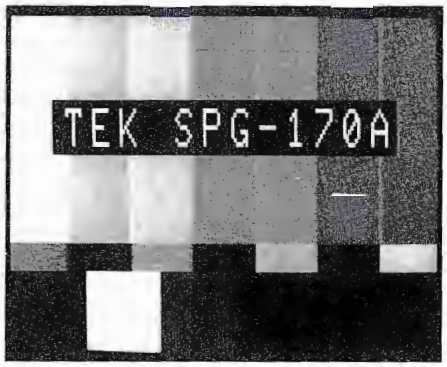
System Flexibility



The flexibility of the SPG-170A's pulse outputs allows you to configure it to your specific system needs. The SPG-170A has eight sync generator outputs: SYNC, SUBCARRIER, BLANKING, BLACK BURST, and four selectable outputs. The selectable outputs can be used for BURST FLAG, H DRIVE, V DRIVE, and COLOR FRAME PULSE, or they can be used to provide an additional set of outputs for the pulses most commonly used in modern television facilities. Horizontal blanking can be set to 10.5, 10.7, or 10.9 μs and vertical blanking can be set to either 19 or 20 lines.

Front panel controls are provided for phasing of all outputs relative to the genlock source. In addition, a separate set of timing controls is provided to move the pulse and subcarrier outputs relative to the black burst and test signal outputs. This simplifies system timing and eliminates delay lines. Up to eight genlock and sync timing settings may be stored in nonvolatile memory to prevent loss in the event of a power failure. The timing presets may be recalled through the remote control port. A front panel lockout feature prevents inadvertant changes to the front panel timing controls.

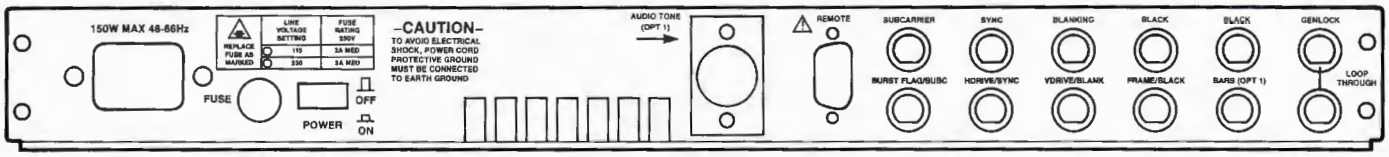
SMPTE Bars with ID and Audio Tone (Option 1)



By specifying Option 1, basic video and audio test capabilities are added to the SPG-170A. Option 1 includes SMPTE bars and audio tone generators for setting program levels. Also, a preset ID of up to 12 characters can be added over the SMPTE bar output. This ID is stored in nonvolatile memory from the front panel, and up to four preset IDs can be recalled through the remote control. Additionally, the remote control allows the ID to be replaced by a countdown, providing a tape leader function. The vertically locked 450 Hz audio tone provides a unique method for checking audio edit quality. The audio tone can be combined with a variable rate click to distinguish various audio sources.

Total System Solution

Tektronix provides a cost-effective solution to your sync and test signal requirements. The SPG-170A NTSC Sync Generator is ideal in a master sync system with the ECO-170A Synchronous Changeover and TSG-170A NTSC Television Generator.



SPG-170A Rear Panel.

TEST SIGNAL AND BLACK BURST GENERATOR

Luminance Amplitude Accuracy	±1%
Chrominance-to-Luminance Gain	±1%
Output Impedance	75 ohm
Return Loss	30 dB to 4.2 MHz
Option 01 Color Bars	SMPTE bars
Identification	12 characters, 7×9 matrix
Audio Tone	450 Hz (locked to vertical), distortion less than 0.01%, 0 to +8 dBu into 150Ω, 600Ω, or high impedance. Click ID adjustable 0.2 to 4 Hz.

SYNC GENERATOR

Subcarrier Stability	3.579545 MHz ±1 Hz over temperature. Long term stability typically less than 1 Hz drift per year.
Black Burst Output Setup	7.5 IRE
Blanking	10.7 μs
Pulse Outputs (General Characteristics) Amplitude	4.0 ±0.2V
Impedance	75 ohm
Return Loss	30 dB to 4.2 MHz
Rise Time	140 ns ±20 ns
Pulse Outputs (Signals) Composite Sync	
Blanking Horizontal Blanking Duration	10.7 μs ±0.1 μs jumper selectable for 10.5 μs or 10.9 μs
Burst Flag	
Horizontal Drive	
Vertical Drive	
Color Frame Pulse	Field 1, line 11
Subcarrier Output Amplitude	2 Vp-p ±0.2V
Sync Timing Range	4 μs advance, 4 μs delay

GENLOCK

Genlock Source (Comp Video) Input Configuration	75 ohm loop-through
Return Loss	At least 40 dB to 4.2 MHz
Burst Amplitude	286 mV +1 to −6 dB
Sync Amplitude	286 mV +3 to −6 dB
Genlock Performance Horizontal Timing Range	8 μs advance, 8 μs delay
Vertical Timing Range	0, 1, or 2 lines advance or 1 line delay, jumper selectable
Burst Lock Range	3.579545 MHz ±20 Hz
Jitter	0.5° maximum

POWER SOURCE

Mains Voltage Range	90 to 132 Vac or 180 to 250 Vac
Power Consumption	40 W typical, 60 W maximum

PHYSICAL CHARACTERISTICS

Dimensions	**mm**	**in**
Height	44	1.734
Width	483	19.0
Depth	561	22.1
Weight	**kg**	**lb**
Net	6.14	13.5
Shipping	10.4	22.9

ENVIRONMENTAL

Temperature Operating	0° to 50 °C
Non-Operating	−40° to 65°C

ORDERING INFORMATION

SPG-170A NTSC Sync Generator

OPTIONS

Option 01: Adds separate SMPTE Bars output with 12 character ID, Audio Tone output and Tape Leader Countdown.

Kit to add Option 01 to the SPG-170A — Order TVGF01.

SPG-271 PAL Sync Generator.

SPG-271
PAL Sync Generator

Conforms to EBU Statement D23 and D25

Precise 12 bit digitally generated colour bars and black burst

SCH phase accuracy guaranteed by use of a single DAC

High stability internal reference for master sync system applications

Reliable slave operation provided by digital genlock

Separate genlock and sync timing controls with presets

Character identification, audio tone option

Colour Bars/Black Burst

The SPG-271 uses digital signal generation and a precision 12 bit DAC to ensure accuracy and long term stability. Digital generation of the composite PAL signal, without analogue modulators, allows use of a single DAC which inherently match chrominance and luminance timing. This ensures accurate SCH phasing.

Composite outputs, both colour bars and black burst, include a white pulse inserted on line 7 of field 1 for colour-frame identification.

100% or 75% colour bars may be selected from the front panel.

Sync Generator with Digital Genlock

The SPG-271 sync generator's stable subcarrier standard and unique digital genlock make it ideal for either master generator or slave operation. All outputs are correctly SCH phased, even if the SPG-271 is locked to an improperly SCH phased reference input. The digital genlock calculates sync timing and subcarrier phase to correctly identify colour framing of the reference signal. The SPG-271 automatically senses composite video reference input and, in the absence of a reference input signal, automatically switches to its own internal reference. With its constant temperature oven, this high stability crystal oscillator ensures long term frequency stability.

Flexible Timing Controls

Front panel controls allow timing of all outputs relative to the genlock source. In addition, a separate set of timing controls move the pulse outputs relative to the black burst and colour bar outputs. This simplifies system timing and eliminates delay lines. All timing settings are stored in non-volatile memory to prevent loss in the event of a power failure. A front panel lockout feature prevents inadvertent changes to the front panel timing controls.

ID, Audio Tone, Tape Leader Countdown (Option 01)

Option 01 adds a second colour bar output over which a twelve character identification may be superimposed. The identification is front panel programmable and up to three different identification presets may be stored in non-volatile memory.

Option 01 also provides a tape leader countdown feature consisting of a ten to two second countdown overlayed on a black background. The black background remains until the countdown program is terminated.

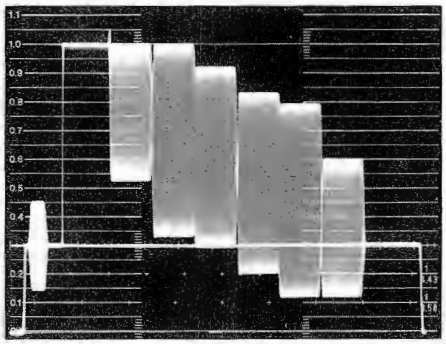
Also included in Option 01 is an audio tone output. Tone frequency is 500 Hz or 1 kHz (user selectable) with output level adjustable over a 0 to +8 dBu range.

Remote Control

Remote selection of internal/external reference, ID preset, genlock and sync timing presets, and tape leader countdown is provided. Selections are made with ground closures through a rear panel connector.

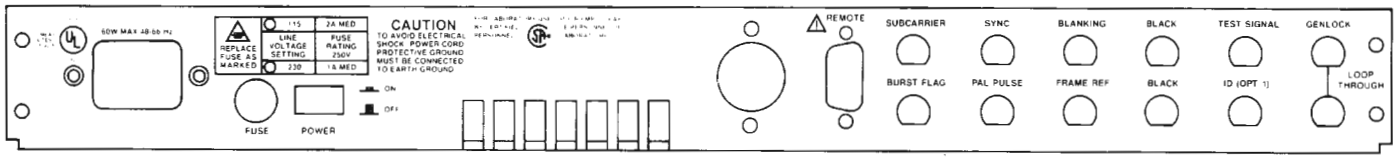
Packaging

The SPG-271's rugged 1¾ inch (1 unit rackmount) package makes it ideal for outside broadcast vans, or anywhere space is at a premium.



75% Bars.

Bars with Character Identification.



SPG-271 Rear Panel.

CHARACTERISTICS

COLOUR BAR GENERATOR

Luminance Amplitude Accuracy	±1%
Frequency Response	±1% to 5 MHz
Chrominance to Luminance Gain	±1%
Chrominance to Luminance Delay	≤5 ns
SCH Phase	
Jitter	<1 ns
Drift	<1 ns
Nominal	0° ±5°
Line Blanking	12.05 μs
Output Impedance	75 Ω
Return Loss	≥36 dB to 5 MHz

OPTION 01 OUTPUT

Colour Bars	75% and 100% Full Field
Phasing	Within 2° of the primary colour bar output
Character Identification	12 characters, 7 × 9 matrix
Audio Tone	
Amplitude	0 to +8 dBu, user adjustable
Frequency	500 Hz or 1 kHz, user selectable
Distortion	≤0.01%

SYNC GENERATOR

Subcarrier Output	
Frequency	4.43361875 MHz
Stability	±1 Hz over temperature; typically less than 1 Hz drift over a year after initial aging
Amplitude	2 V ±0.2 V
Return Loss	30 dB to 4.43 Mhz
Black Burst Output	
Phasing	Within 2° of the colour bar output
Line Blanking	<11.2 μs
Pulse Outputs (General Characteristics)	
Amplitude	2 V ±0.2 V (4 V selectable)
Impedance	75 Ω
Return Loss	30 dB to 5 MHz
Risetime	250 ns ±50 ns
Pulse Outputs (Signals)	
Sync	Mixed line and field
Blanking	Mixed line and field
Line	11.84 ±0.1 μs (11.6 or 12.1 selectable)
Field	25 lines (24 selectable)
Burst Flag	
PAL Pulse	H/2 squarewave; selectable polarity; factory set high for 135°
Frame Reference	Selectable pulse or squarewave
Pulse	Low for line 7, field 1
Squarewave	Low for fields 1 through 4
Pulse Outputs (Timing Range)	3.5 μs advance and delay relative to the colour bar, black burst, and subcarrier outputs

GENLOCK

Genlock Input	
Configuration	75 Ω loop through
Return Loss	≥40 dB to 5 MHz
Burst Amplitude	300 mV ±6 dB
Sync Amplitude	300 mV ±6 dB
Burst Lock Range	4.43361875 MHz ±20 Hz
Jitter	
Colour Lock	≤0.4° typical
Monochrome Lock	≤10 ns
Genlock Timing Range	
Line	7 μs advance and delay
Field	1 line advance and delay

POWER SOURCE

Mains	
Voltage Range	90 to 132 Vac or 180 to 250 Vac
Frequency Range	48 to 62 Hz
Power Consumption	40 W typical, 60 W maximum

PHYSICAL CHARACTERISTICS

Dimensions	**mm**	**in**
Height	44	1.734
Width	483	19.0
Depth	561	22.1
Weight	**kg**	**lb**
Net	6.14	13.5
Shipping	10.4	22.9

ENVIRONMENTAL

Temperature	
Operating	0° to 50°C
Non-Operating	−40° to 65°C

ORDERING INFORMATION

When ordering, please use the following nomenclature.

SPG-271 PAL Sync Generator

OPTION

Option 01 — Adds 12-Character ID, Audio Tone, and Tape Leader Countdown

OPTIONAL ACCESSORIES

Kit to add Option 01 to the SPG-271 — Order TVGF02.

TPG-625 Television Pattern Generator.

TPG-625
PAL Television Pattern Generator

PAL television test pattern

Color monitor and receiver testing

Programmable character identification

10 bit digital generation

Digital genlock

Black burst outputs

The TPG-625 Television Pattern Generator is a test pattern generator for the PAL color television system. The TPG-625 pattern contains the elements needed to perform a comprehensive visual check of both the monochrome and color aspects of color monitor and television receiver performance. In addition, the TPG-625 provides text insertion in two areas of the pattern for source identification. This facility is useful for broadcast and cable system transmission during non-program hours.

The TPG-625 uses 10 bit, digital signal generation. All elements of the pattern are stored in memory. This architecture, coupled with a precision 12 bit DAC converter provides a high degree of accuracy with superior long term stability.

Evaluation of Scanning Characteristics
The center of the picture is marked by the white cross in the center of the crosshatch pattern. Centering is also indicated by noting the position of the alternating black/white border relative to the limits of the display area.

The circle and crosshatch provide a check on scan linearity. Distortion of the circle is readily apparent on any axis, and more detailed evaluation may be made by noting the size and shape of the crosshatch elements. The crosshatch is also useful in checking static and dynamic convergence of color displays.

Evaluation of Luminance Signal Processing
The alternating light/dark pattern in the border and upper part of the circle will show smearing, ringing, or ghost images if poor transient response, echoes, or multiple path distortions are present. The narrow black on white and white on black pulses in the upper and lower parts of the circle, and the vertical lines of the crosshatch will indicate similar distortions effecting the higher frequencies in the video signal.

The black/white border detail will exercise clamp and sync separator circuits in the display. Jaggedness of the vertical lines in the pattern indicates problems in these circuits.

The multiburst signal present in the lower part of the circle provides an indication of luminance channel frequency response, display resolution, and the presence of crosstalk between luminance and chrominance channels.

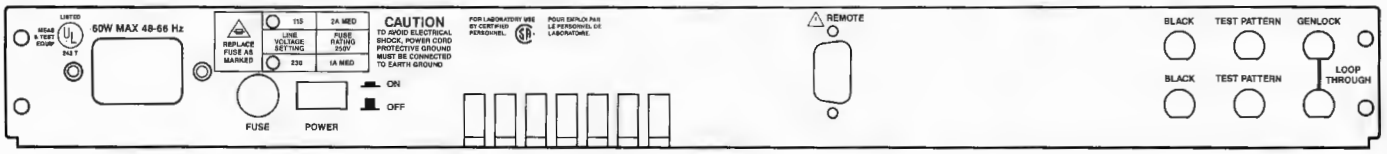
Evaluation of Chrominance Channel Processing
The first and last columns of the crosshatch pattern contain R-Y and B-Y signals which are coded such that R-Y is non-alternating and B-Y is alternating. A properly operating PAL decoder will display these areas without color.

The columns midway between the border and edge of the circle contain plus R-Y (left) or B-Y (right) components in the upper half and minus signals in the lower half. These areas will indicate phase errors in the delay line circuits of PAL decoders by showing small horizontal bars and changes in color.

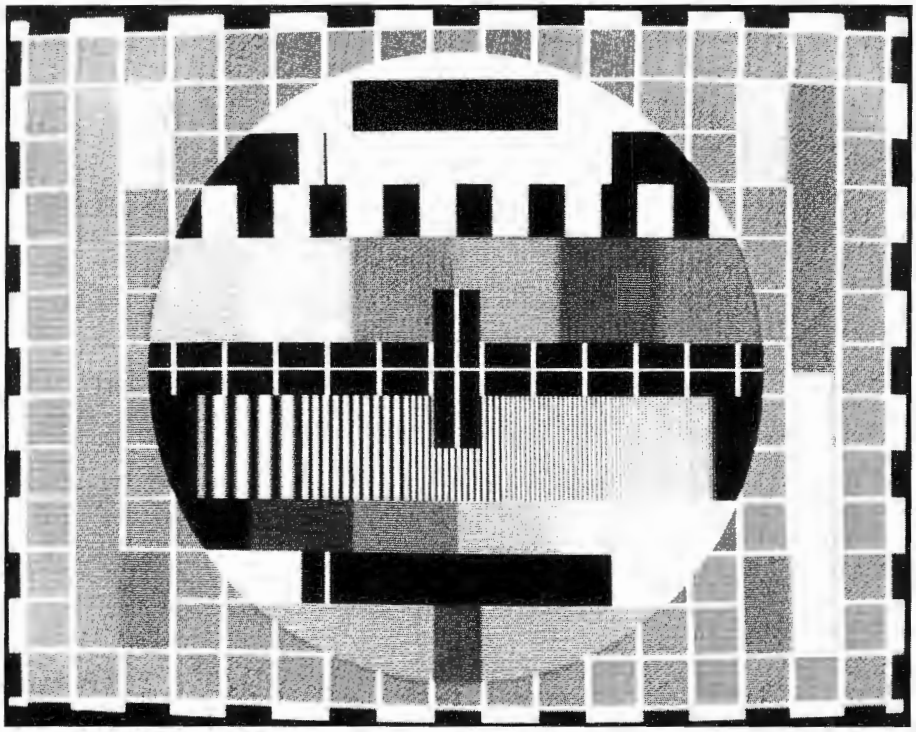
The smaller colored areas in the third column in from each border contain chrominance signals with zero G-Y content. If color signal matrixing is correct, these areas will match when viewing a green only screen.

The yellow/red/yellow transitions in the bottom part of the circle should align with the crosshatch lines immediately below. Errors indicate chrominance/luminance delay distortion.

TPG-625 Test Pattern with Text Inserted.



TPG-625 Rear Panel.



TPG-625 Test Pattern.

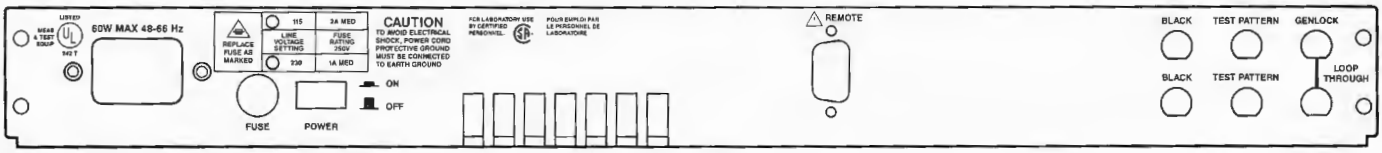
ORDERING INFORMATION

When ordering, please use the following nomenclature.

TPG-625 PAL Pattern Generator

Option 01 — PAL Pattern Generator for use with VM700A (See separate pages following)

TPG-625 Option 01 PAL Pattern Generator.



TPG-625 Option 01 Rear Panel.

TPG-625 OPTION 01

PAL Pattern Generator

Special pattern for VM700A Video Measurement Set

Programmable character identification

10 bit digital signal generation

Digital genlock

Black burst outputs

The TPG-625 Option 01 is a special version of the TPG-625 PAL Pattern Generator designed for use with the VM700A Video Measurement Set. The Option 01 version substitutes a full field test signal matrix for the standard color monitor/receiver evaluation pattern. With this matrix, all of the test signals required by the VM700A measurement routines are available simultaneously. This is especially useful in manufacturing environments where overall test time is a prime consideration. In addition, the matrix repeats twice in each field which permits use of the VM700A block mode for making specific measurements at different times in the video field. This is useful in VCR testing.

The test signal matrix consists of the following signals:

- CCIR 17, 18, 330 and 331
- UK National
- 75% color bars
- 75% red field
- Chroma frequency response
- Sin x/x
- Shallow ramp matrix
- 50% pedestal

The sin x/x signal has a bandwidth of 5 MHz and is used for frequency response and group delay measurements.

The chroma frequency response signal provides discrete frequencies at subcarrier and 325 KHz and 650 KHz above and below subcarrier. This signal is used for measuring chrominance channel frequency response.

The shallow ramp matrix provides 70 millivolt, full line ramp signals at twelve different amplitude levels. The lower most ramp spans levels from −35 millivolts to +35 millivolts while the upper most ramp spans levels from 665 millivolts to 735 millivolts. The shallow ramp matrix is used for noise testing of digital codecs. The multiple ramps permit testing of all codec cut points.

Like the standard TPG-625, the Option 01 version uses 10 bit digital signal generation coupled with a 12 bit DAC to ensure test signal accuracy and long term stability.

CHARACTERISTICS

TEST SIGNAL GENERATOR

Luminance Amplitude Accuracy	±1%
Frequency Response	±1% to 5 MHz
Chrominance-to-Luminance Gain	±1%
Chrominance-to-Luminance Delay	≤5 ns
Group Delay	≤5 ns to 5 MHz
Diff Gain[1]	0.6% maximum
Diff Phase[1]	0.3° maximum
Tilt	≤0.5%
Output Impedance	75 ohms
Return Loss	≥36 dB to 5 MHz

[1] Measured on CCIR line 330.

FULL FIELD MATRIX COMPOSITION

Test Signal	Located on Lines
CCIR 17	24 through 35 168 through 179 336 through 347 480 through 491
CCIR 330	36 through 47 180 through 191 348 through 359 492 through 503
CCIR 331	48 through 59 192 through 203 360 through 371 504 through 515
CCIR 18	60 through 71 204 through 215 372 through 383 516 through 527

FULL FIELD MATRIX COMPOSITION (continued)

Test Signal	Located on Lines
75% Color Bars	72 through 83 216 through 227 384 through 395 528 through 539
Sin x/x	84 through 95 228 through 239 396 through 407 540 through 551
75% Red Field	96 through 107 240 through 251 408 through 419 552 through 563
Chroma Frequency Response	108 through 119 252 through 263 420 through 431 564 through 575
50% Flat Field	120 through 131 264 through 275 432 through 443 576 through 587
Shallow Ramp	132 through 143 276 through 287 444 through 455 588 through 599
UK ITS 1	144 through 155 288 through 299 456 through 467 600 through 611
UK ITS 2	156 through 167 300 through 310 468 through 479 612 through 622

ORDERING INFORMATION

When ordering, please use the following nomenclature.

TPG-625 Option 01 PAL Pattern Generator

TSG-100 Option 01 Test Signal Generator.

TSG-100
NTSC Test Signal Generator

Simple yet functional test signal complement

Transmission test signal set (Option 01)

8 bit digital generation

Conforms to RS-170A timing specifications

1 kHz audio tone

H or V rate scope trigger signal

DC power operation

Compact and lightweight

The TSG-100 is a low cost NTSC Test Signal Generator ideally suited for the maintenance and alignment of video equipment in most television environments.

The 8 bit digital test signal generator ensures conformance to RS-170A timing specifications while providing good, long-term signal stability.

The standard TSG-100 test signal set includes:

- SMPTE color bars
- Convergence pattern
- Multiburst
- Pulse & bar with window and modulated pulse
- 5 step staircase
- Modulated 5 step
- White field
- Black burst

The optional transmission test signal set replaces the standard test signals with the following:

- NTC 7 composite
- NTC 7 combination
- Full field color bars
- Sin x/x
- 50% flat field
- 0% flat field
- Field square wave
- Test signal matrix

The test signal matrix consists of equal segments of NTC 7 composite, NTC 7 combination, color bars, sin x/x, and 50% flat field. This matrix is intended for use with automated measurement sets such as the Tektronix VM700 Video Measurement Set.

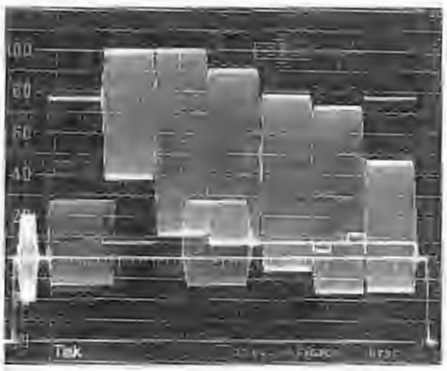
Front and rear panel test signal outputs provide convenient access to test signals for both rack mount and service bench applications.

A front panel scope trigger output is provided for service applications. Horizontal or vertical repetition rate is front panel selectable.

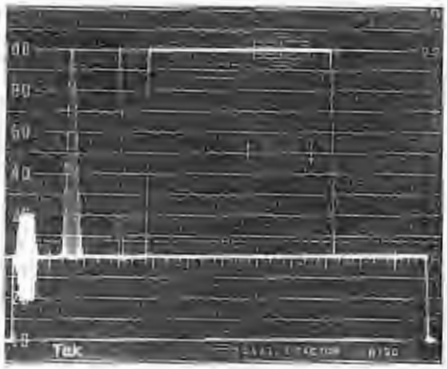
The TSG-100 includes a 1 kHz audio tone generator for continuity and level checks. Level of the tone is user adjustable over a 0 to +8 dBu range. The level 0 dBu is equivalent to 0 dBm in a 600 Ω environment. Output is on a rear panel XLR connector.

The TSG-100 is housed in a compact, rugged mechanical package and, with DC power operation, is suitable for studio, mobile unit, and field portable applications.

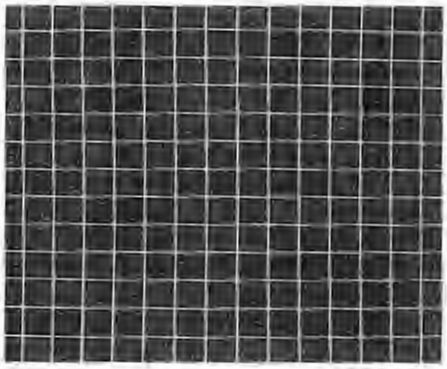
TSG-100 Standard Test Signal Set



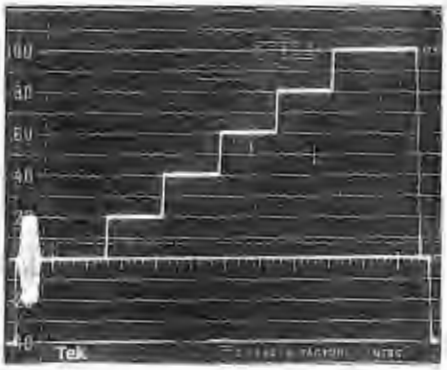
SMPTE Color Bars.



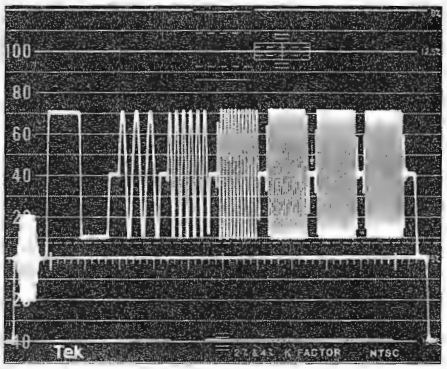
Pulse and Bar with Window and Modulated Pulse.



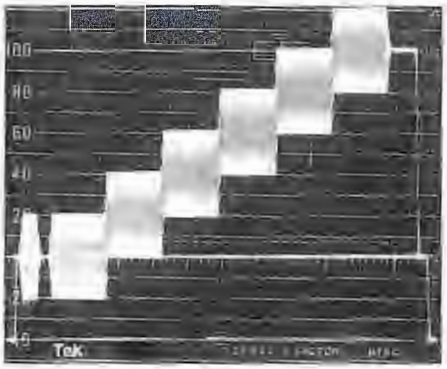
Convergence Pattern.



5 Step Staircase.

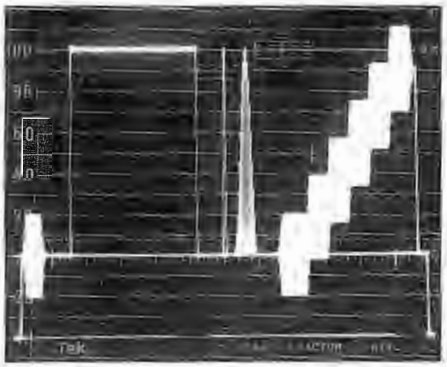


Multiburst.

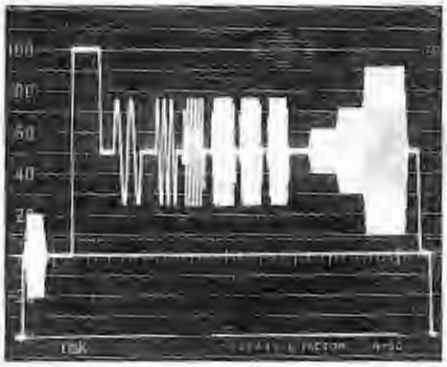


Modulated 5 Step.

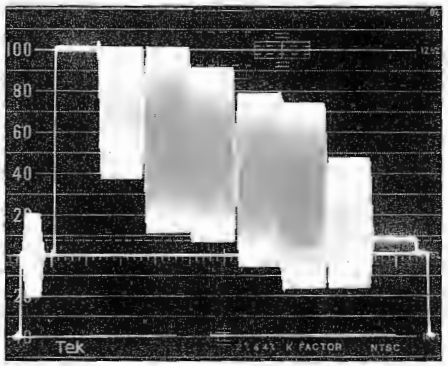
TSG-100 Option 01 Transmission Test Signal Set



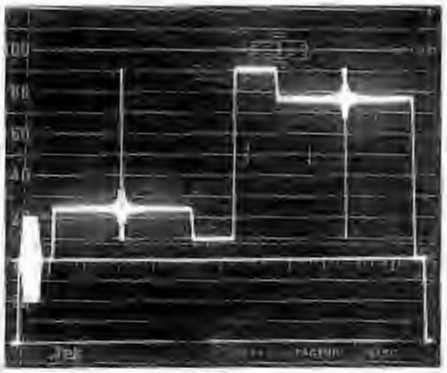
NTC 7 Composite.



NTC 7 Combination.

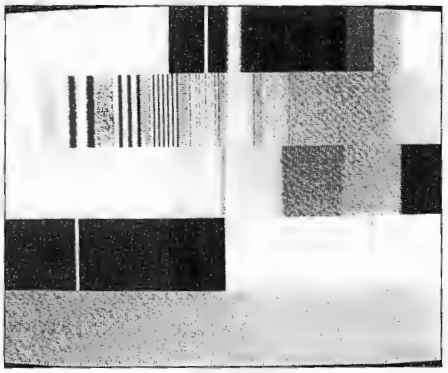


Color Bars.

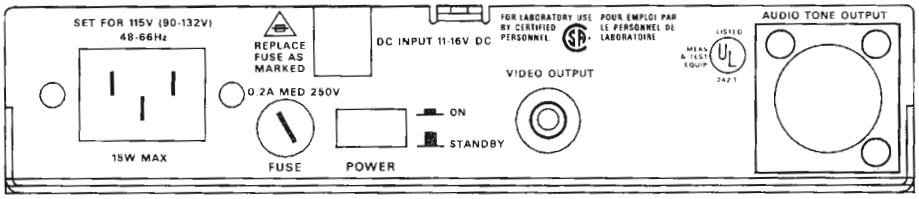


Sin x/x.

Field Square Wave.



Test Signal Matrix.



TSG-100 Back Panel.

CHARACTERISTICS

TEST SIGNAL GENERATOR

Luminance Amplitude Accuracy	±1%
Chrominance to Luminance Gain	±2%
Chrominance to Luminance Delay	±12 ns
Blanking Width	10.9 μs
Output Impedance	75 Ω

TEST SIGNALS

SMPTE Color Bars	
Convergence Pattern	14 lines per field, 17 lines per horizontal
Multiburst	
Reference bar and packet amplitude	60 IRE
Burst frequencies	0.5, 1.0, 2.0, 3.0, 3.58, and 4.2 MHz
Pulse & Bar and Modulated Pulse	
Bar amplitude	100 IRE
2T pulse HAD	250 ns
12.5T pulse HAD	1.56 μs
5 Step Staircase	100 IRE
Modulated 5 Step	
Chrominance amplitude	40 IRE
Diff gain	≤0.5%
Diff phase	≤0.5°
White Field	100 IRE
Black Burst	
Setup	7.5 IRE

TRANSMISSION TEST SIGNALS (OPTION 01)

NTC 7 Composite	
NTC 7 Combination	
Color Bars	75% amplitude, 7.5% setup, 100% white flag
Sin x/x	
Bandwidth	−3 dB at 4.75 MHz
Pedestal levels	24 IRE and 76 IRE
Matrix	Full field test signal matrix consisting of equal segments of NTC 7 composite, NTC 7 combination, color bars, sin x/x, and 50 IRE flat field
Field Square Wave	
Field timing	100 IRE on lines 70 through 213; all remaining lines at 0 IRE
Flat Fields	0 IRE and 50 IRE flat fields; no color burst on 0 IRE signal

INTERNAL REFERENCE

Subcarrier	
Frequency	3.579545 MHz
Stability over temperature	Within 10 Hz from 5° to 35°C.

AUDIO TONE GENERATOR

Frequency	1 KHz
Amplitude	0 to +8 dBu into 150Ω, 600 Ω, or a high impedance load
Distortion	≤0.5% THD + noise

POWER SOURCE

Mains	
Voltage range	90 to 132 Vac
Frequency range	48 to 66 Hz
DC Power Operation	11 to 16 Vdc
Power Consumption	10 W typical

PHYSICAL CHARACTERISTICS

Dimensions	**mm**	**in**
Width	206	8.1
Height	43	1.71
Length	305	12.0
Weight	**kg**	**lbs**
Net	1.48	3.25

ENVIRONMENTAL

Temperature	
Operating	0° to 50°C
Nonoperating	−40° to 65°C

ORDERING INFORMATION

When ordering, please use the nomenclature given here:

TSG-100 NTSC Television Generator

OPTION

Option 01 — Transmission test signal set.

OPTIONAL ACCESSORIES

Mounting Kits — Hardware for mounting in a 1700F02 portable cabinet or 1700F05 side-by-side rack adapter for 1700 Series signal monitors. Order TVGF10.

Hardware for mounting in a 1.75 inch high, 19.0 inch wide rack space. Order TVGF11.

Adapter for mounting to the bottom of a 1700F02 carrying case. Order TVFG12.

TSG-170A NTSC Television Generator.

TSG-170A
NTSC Television Generator

Simple, Effective Test Signal Complement

Correctly SCH Phased Sync Generator with Digital Genlock

Separate Timing Controls for Sync and Test Signals

Separate SMPTE Bars Output with Programmable ID (Option 01)

Audio Tone Output (Option 01)

Tape Leader Countdown

The Tektronix TSG-170A NTSC Television Generator offers you the test signals you need plus the advantages of master and genlock sync capability. It provides true 10 bit digital signal accuracy with a full complement of test signals and a stable RS-170A sync generator.

The rugged, compact TSG-170A is designed to support both operational and maintenance requirements. The TSG-170A Option 1 provides even more versatility by adding a separate SMPTE bar generator, programmable identification, and audio tone output.

Test Signal Generator

The accuracy and long term stability of the TSG-170A test signals are enhanced by its precision digital to analog converter. Each converter is automatically laser trimmed to 12 bit accuracy. The TSG-170A test signal generator's simple front panel controls provide selection of:

- SMPTE Bars
- Convergence
- Pulse & Bar with Window
- Multiburst
- 5-Step Luminance Staircase
- Luminance Ramp
- Modulated Ramp
- Selectable 10% or 90% APL
- Bounce
- 10 and 100 IRE Flat Fields
- Red Field
- Multibars
- NTC7 Composite
- System Test Matrix
- Monitor Setup Matrix
- 5 MHz Line Sweep
- Multipulse

Color bar blanking width is 10.9 μs to facilitate verification of proper blanking throughout your system.

RS-170A Sync Generator with Digital Genlock

The TSG-170A sync generator's stable color standard and unique digital genlock make it ideal for either master generator or slave operation. All outputs are correctly SCH phased, even if the TSG-170A is locked to an improperly SC-H phased reference input. The digital genlock calculates sync timing and subcarrier phase to properly identify color framing of the input reference signal. The TSG-170A automatically senses composite video or 3.58 MHz subcarrier reference inputs and, in the absence of a reference input signal, automatically switches to its own internal reference. This high stability crystal oscillator, with its constant temperature oven, ensures long term frequency stability.

System Timing Control

Front panel controls are provided for phasing of all outputs relative to the genlock source. In addition, a separate set of timing controls is provided to move the pulse and subcarrier outputs relative to the black burst and test signal outputs. This simplifies system timing and eliminates delay lines. Up to eight genlock and sync timing settings may be stored in nonvolatile memory to prevent loss in the event of a power failure. The timing presets may be recalled through the remote control port. A front panel lockout feature prevents inadvertant changes to the front panel timing controls.

Flexible Pulse Output

The TSG-170A has eight sync generator outputs; four fixed and four programmable. The primary outputs for SUBCARRIER, SYNC, BLANKING, and BLACKBURST, are fixed. The secondary outputs, BURST FLAG, H DRIVE, V DRIVE, and COLOR FRAME PULSE, are programmable and can be changed to provide a second set of primary outputs. The BLANKING output may be set to 10.2, 10.7, or 10.9 μs.

SMPTE Bars with Programmable ID, Audio Tone and Tape Leader Countdown (Option 01)

Option 01 adds a separate SMPTE bar output for routine studio needs, such as tape leaders, freeing the front panel selected test signals for engineering and maintenance.

SMPTE Bars with Character ID (Option 01).

An ID of up to 12 alphanumeric characters may be inserted in the SMPTE bar output. This front panel programmable ID is ideal for identifying satellite feeds, and videotapes.

Option 01 also provides a 400 Hz audio tone output, useful for checking program line continuity and adjusting audio levels. The tone can be adjusted over a 0 dBm to +8 dBm range into 150 Ω or 600 Ω.

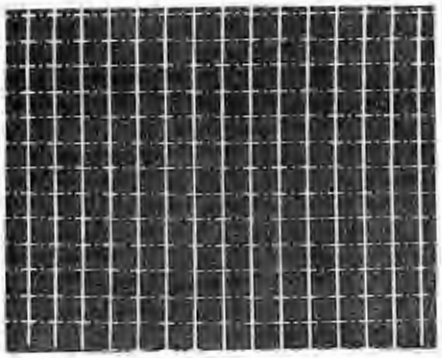
Also included in option 01 is a tape leader countdown. When initiated, the full time SMPTE Bars output goes to black and the audio tone is switched off. Simultaneously, a ten to two (in seconds) countdown is initiated and overlayed on the black background. The black background remains until the count down program is terminated. Control of the tape leader countdown is through the remote control connector.

Remote Control

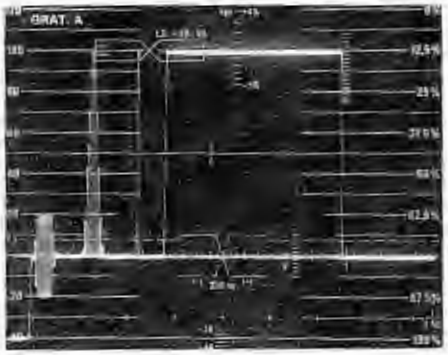
Remote selection of internal/external reference, ID preset, genlock and sync timing presets, and test signal is provided. Selection is made with ground closures through a rear panel connector.

Packaging

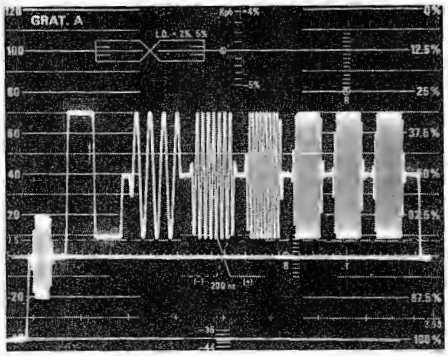
The TSG-170A's rugged, 1¾ inch package makes it ideal for remote vans or anywhere space is at a premium.



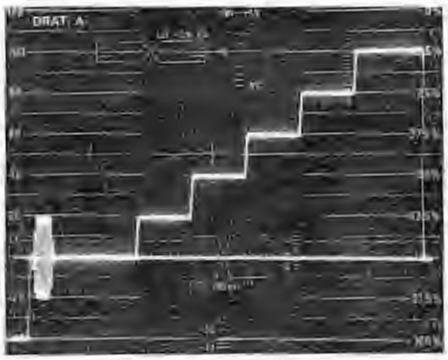
Convergence.



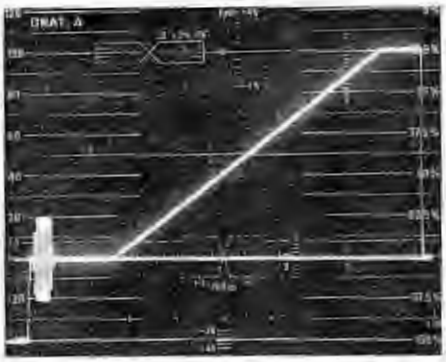
Pulse & Bar with Window.



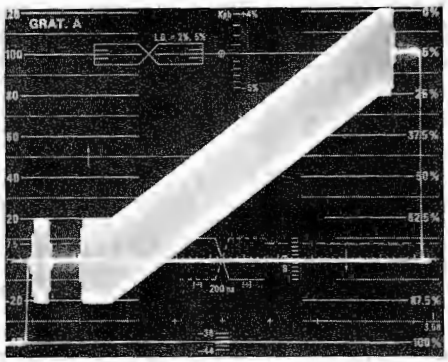
Multiburst.



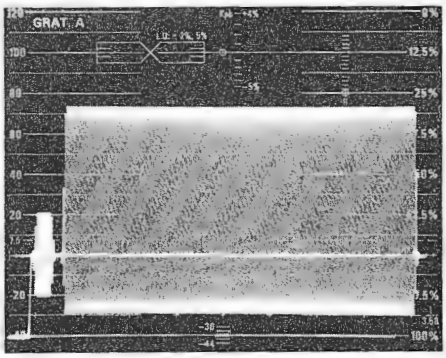
5-Step Luminance Staircase.



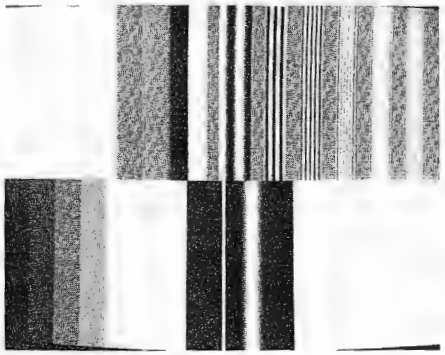
Luminance Ramp.



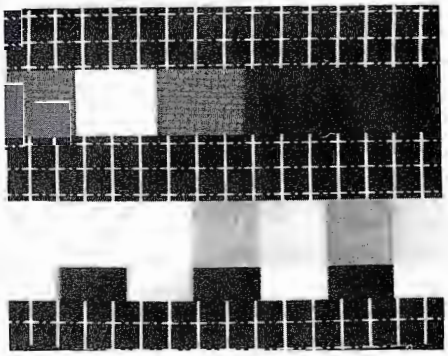
Modulated Ramp.



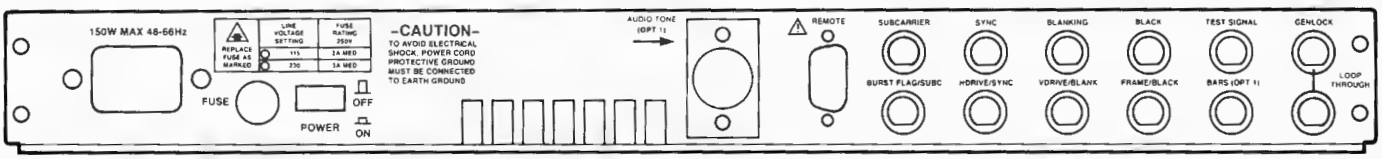
Red Field.



System Test Matrix.



Monitor Setup Matrix.



TSG-170A Rear Panel.

TEST SIGNAL GENERATOR

Luminance Amplitude Accuracy	±1%
Chrominance-to-Luminance Gain	±1%
Output Impedance	75 ohm
Return Loss	36 dB to 4.2 MHz

TEST SIGNALS

SMPTE Color Bars	
Convergence	14 lines per field, 17 lines per horizontal
Pulse & Bar with Window 2T Pulse HAD	250 ns ±25 ns
White Bar Amplitude	100 IRE
Field Tilt	0.5%
Line Tilt	0.5%
Multiburst White Reference Bar Amplitude	428.6 mV (60 IRE)
Packet Amplitude	428.6 mV (60 IRE) p-p
Burst Frequencies	0.5, 1.0, 2.0, 3.0, 3.58 and 4.2 MHz
5-Step Staircase	714.3 mV (100 IRE)
Luminance Ramp	0 to 714.3 mV (100 IRE)
Modulated Ramp Chrominance Amplitude	285.7 mV (40 IRE)
Diff Gain	0.6%
Diff Phase	0.3°
APL	10% and 90%
AC Bounce Bounce Rate	1 second high, 1 second low
Flat Fields	10 IRE, 100 IRE
Red Field Luminance Pedestal	153.6 mV (21.5 IRE)
Multibars	Color bars and multiburst
NTC7 Composite	80 IRE, 5-step modulated staircase and pulse & bar
Line Sweep	714.3 mV p-p. Linear sweep from 500 kHz to 5 MHz
Multipulse Amplitude	714.3 mV
Frequencies	0.5, 1.0, 2.0, 3.0, 3.58, and 4.2 MHz
System Test Matrix	Multibars and NTC7
Monitor Setup Matrix	Convergence, IWQB, convergence, color bars, reverse bars, and convergence
DAC Test	500 kHz and 3.58 MHz
Option 01 Color Bars	SMPTE bars
Identification	12 characters, 7×9 matrix
Audio Tone	450 Hz (locked to vertical), distortion less than 0.01%, 0 to +8 dBu into 150Ω, 600Ω, or high impedance. Click ID adjustable 0.2 to 4 Hz.

SYNC GENERATOR

Subcarrier Stability	3.579545 MHz ±1Hz over temperature; typically less than 1 Hz drift over a year after initial aging
Black Burst Output Setup	7.5 IRE
Blanking	Less than 10.6 μs
Pulse Outputs (General Characteristics) Amplitude	4.0 ±0.1V
Impedance	75 ohm
Return Loss	30 dB to 4.2 MHz
Rise Time	140 ns ±20 ns
Pulse Outputs (Signals) Composite Sync	
Blanking Horizontal Blanking Duration	10.7 μs ±0.1 μs, jumper selectable for 10.5 μs or 10.9 μs
Vertical Blanking Duration	20 lines, jumper selectable for 19 or 20 lines
Burst Flag	
Horizontal Drive	
Vertical Drive	
Color Frame Pulse	Field 1, Line 11
Subcarrier Output Amplitude	2 V p-p ±0.2V
Pulse and Subcarrier Outputs Timing Range	4 μs advance, 4 μs delay relative to the test signal and black burst outputs

GENLOCK

Genlock Source (Comp Video) Input Configuration	75 ohm loop-through
Return Loss	At least 40 dB to 4.2 MHz
Burst Amplitude	286 mV +1 dB to −6 dB
Sync Amplitude	286 mV +3 dB to −6 dB
Genlock Performance Horizontal Timing Range	8 μs advance, 8 μs delay
Vertical Timing Range	0, 1, or 2 lines advance or 1 line delay, jumper selectable
Burst Lock Range	3.579545 MHz ±20 Hz
Jitter	0.5°

POWER SOURCE

Mains Voltage Range	90 to 132 VAC or 180 to 250 Vac
Frequency Range	48 to 62 Hz
Power Consumption	40 W typical, 60 W maximum

PHYSICAL CHARACTERISTICS

Dimensions	**mm**	**in**
Height	44	1.734
Width	483	19.0
Depth	561	22.1
Weight	**kg**	**lb**
Net	6.14	13.5
Shipping	10.4	22.9

ENVIRONMENTAL

Temperature Operating	0° to 50 °C
Non-Operating	−40° to 65°C

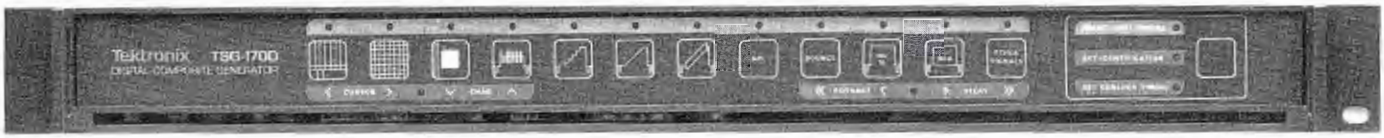
ORDERING INFORMATION

TSG-170A NTSC Television Generator

OPTIONS

Option 01 — Adds separate SMPTE Bars output with 12 character ID, Audio Tone Output and Tape Leader Countdown.

Kit to add Option 01 to the TSG-170A — Order TVGF01.



TSG-170D Digital Composite NTSC Generator.

TSG-170D
Digital Composite NTSC Generator

Digital and NTSC analog test signal outputs

Digital and analog audio tone outputs

Simple, effective test signal complement

Black burst output for master SPG application

Genlock with output timing offset

12 character identification

Tape leader countdown

The TSG-170D Digital Composite NTSC Generator is suitable for both the operation and maintenance of NTSC composite digital television equipment. The TSG-170D provides test signals and audio tone in both digital and analog form plus an analog black burst for equipment synchronization.

Test Signal Generator

The TSG-170D uses 10 bit digital test signal generation conforming to the Proposed American National Standard for digital encoding of composite video signals (System M/NTSC). The test signal digital output is a 10 bit parallel interface clocked at 4 Fsc.

The digital test signal data is converted to analog with a precision digital to analog converter. This ensures signal accuracy and long-term stability. The TSG-170D test signal complement includes:

- SMPTE Bars
- Convergence
- Pulse & Bar with Window
- Luminance Ramp
- Modulated Ramp
- Selectable 10% or 90% APL
- Bounce
- 10 and 100 IRE Flat Fields
- Multiburst
- 5-Step Luminance Staircase
- Red Field
- Multibars
- NTC7 Composite
- System Test Matrix
- Monitor Setup Matrix
- 5 MHz Line Sweep
- Multipulse

All TSG-170D test signals conform to RS-170A timing specifications.

An ID of up to 12 alphanumeric characters may be superimposed over the selected test signal. This ID is front panel programmable and is useful for source identification.

A tape leader countdown program is also included in the TSG-170D. When initiated, the test signal output switches to black and the audio tone is switched off. Simultaneously, a ten to two (in seconds) countdown is initiated and overlayed on the black background. The black background remains until the countdown program is terminated.

The character ID and tape leader countdown functions are available on both the digital and analog test signal outputs.

Internal Reference/Genlock Operations

The TSG-170D provides a stable RS-170A black burst output for equipment synchronization. Correct SCH phase is maintained in both internal reference and genlock operation. The digital genlock maintains proper color framing irrespective of reference signal SCH phase. In the absence of an external reference, the TSG-170D automatically switches to its own internal reference.

Front panel controls are provided for phasing the TSG-170D outputs relative to the genlock source. Nonvolatile memory storage of up to eight different timing offsets are provided for applications where the picture source output is delegated to different locations.

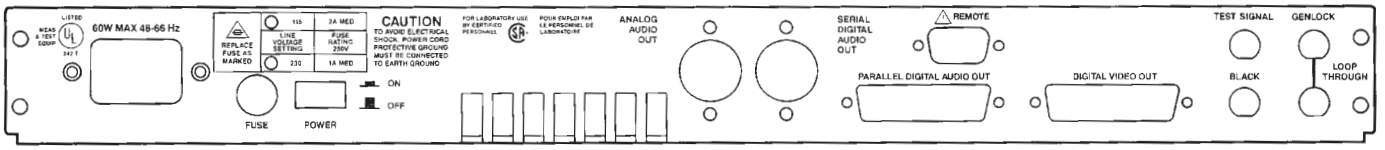
Audio Tone Generator

The parallel and serial audio tone generators produce 20 and 24 bit digital streams respectively, each representing a sine wave reference signal. Frequency of the reference signal is 800 Hz or 1 KHz, user selectable. The parallel digital data output is a byte-wide serial interface clocked at 768 KHz. The serial digital data is output in the AES/EBU serial format.

The analog tone output frequency will be the same as that selected for the digital tone outputs. Amplitude is adjustable over a 0 to +8 dBu range.

Remote Control

Remote selection of internal/external reference, ID preset, genlock timing preset, and test signal is provided. Selection is via ground closure through a rear panel connector.



TSG-170D Rear Panel.

TEST SIGNAL GENERATOR

Luminance Amplitude Accuracy	±1%
Chrominance-to-Luminance Gain	±1%
Chrominance-to-Luminance Delay	≤10 ns
Blanking Width	10.9 ±0.2 μs
Output Impedance	75 ohm
Return Loss	≥36 dB to 4.2 MHz

TEST SIGNALS

SMPTE Color Bars	
Convergence	14 lines per field, 17 lines per horizontal
Pulse & Bar with Window	
2T Pulse HAD	250 ns ±25 ns
White Bar Amplitude	100 IRE
Field Tilt	≤0.5%
Line Tilt	≤0.5%
Modulated Pulse	12.5T
Multiburst	
White Reference Amplitude	428.6 mV (60 IRE)
Packet Amplitude	428.6 mV (60 IRE) p p
Burst Frequencies	0.5, 1.0, 2.0, 3.0, 3.58 and 4.2 MHz
5-Step Staircase	714.3 mV (100 IRE)
Luminance Ramp	0 to 714.3 mV (100 IRE)
Modulated Ramp	
Chrominance Amplitude	285.7 mV (40 IRE)
Diff Gain	0.6% max
Diff Phase	0.3° max
Flat Fields	10 IRE, 100 IRE
Red Field	
Luminance Amplitude	202.2 mV (28.3 IRE)
Multibars	Color bars and multiburst
NTC7 Composite	90 IRE, 5-step modulated staircase and pulse & bar
Line Sweep	714.3 mV p-p. Linear sweep from 500 KHz to 5 MHz
Multipulse	
Amplitude	714.3 mV
Frequencies	0.5, 1.0, 2.0, 3.0, 3.58, and 4.2 MHz
System Test Matrix	Multibars and NTC7
Monitor Setup Matrix	Convergence, IWQB, convergence, color bars, reverse bars, and convergence
APL	10% and 90%
AC Bounce	
Bounce Rate	1 second high, 1 second low
Identification	12 characters, 7×9 matrix
Audio Tone	800 Hz or 1 KHz, 0 to +8 dBu into 150Ω, 600Ω, or high impedance. Connector: XLR (male pins)

SYNC GENERATOR

Subcarrier Stability	3.579545 MHz ±1Hz over temperature; typically <1 Hz drift over a year after initial aging
Black Burst Output	
Setup	7.5 IRE
Blanking Width	10.2 ±0.2 μs

GENLOCK

Genlock Source (Composite Video)	
Input Configuration	75 Ω loop-through
Return Loss	At least 40 dB to 4.2 MHz
Burst Amplitude	286 mV +1 dB to −6 dB
Sync Amplitude	286 mV +3 dB to −6 dB
Genlock Performance	
Horizontal Timing Range	8 μs advance, 8 μs delay
Vertical Timing Range	0, 1, or 2 lines advance or 1 line delay, jumper selectable
Burst Lock Range	3.579545 MHz ±20 Hz
Jitter	0.5° max

DIGITAL VIDEO INTERFACE

Sampling Frequency	4 Fsc (14.3 MHz)
Sampling Phase	I and Q axes
Digital Coding	10 bit linear PCM
Dynamic Range	Digital word:
Sync Tip	16
Blanking Level	240
White Level	800
LSB/IRE	5.6
Output Format	Balanced ECL (10K Series); 10 data pairs, 1 clock pair, system ground, chassis ground

PARALLEL DIGITAL AUDIO INTERFACE

Sampling Frequency	48 KHz
Digital Coding	20 bits linear PCM; two's complement coding
Dynamic Range (16 MSB's only)	
Positive Peaks	OCCD (hex)
Negative Peaks	F333 (hex)
Output Format	Byte serial transmission clocked at 768 KHz. Four channels transmitted every 48 KHz sample period. Balanced ECL (10K series): 8 data pairs, 1 clock pair, 1 sync pair, system ground, and chassis ground. Connector: 25 pin D

SERIAL DIGITAL AUDIO INTERFACE

Sampling Frequency	48 KHz
Digital Coding	24 bits linear PCM; two's complement coding.
Dynamic Range	
Positive Peaks	0CCD00 (hex)
Negative	F33300 (hex)
Output Format	Bit serial, biphase mark encoded. Two channels transmitted in every 48 KHz clock period. Balanced transformer coupled output; 1 signal pair and ground. Connector: XLR (male pins)

POWER SOURCE

Mains	
Voltage Range	90 to 132 or 180 to 250 Vac
Frequency Range	48 to 66 Hz
Power Consumption	60 W maximum

PHYSICAL CHARACTERISTICS

Dimensions	**mm**	**in**
Height	44	1.734
Width	483	19.0
Depth	561	22.1
Weight	**kg**	**lbs**
Net	8.6	18.9

ENVIRONMENTAL

Temperature	
Operating	0° to 50°C
Non-Operating	−40° to 65°C

ORDERING INFORMATION

TSG-170D Digital Composite NTSC Generator

TSG-271 PAL Television Generator.

TSG-271
PAL Television Generator

Until now, your choices in PAL test signal generators were limited. Some were too expensive; others were missing important test signals such as multiburst or pulse and bar. Now, with Tek's TSG-271 PAL Television Generator, you can choose performance unmatched for the price. Featuring a unique digital architecture and innovative technology, the TSG-271 provides:

- Precise 12 bit digitally derived test signals.
- SCH phase accuracy, guaranteed by use of a single DAC.
- Conforms to EBU Statements D23 and D25.
- Stable internal reference, ideal for master sync operation.
- Reliable slave operation through use of digital genlock.
- Separate front panel genlock and sync timing controls.

Test Signals
The TSG-271 uses digital signal generation and a precision 12 bit DAC to insure test signal accuracy and long term stability. Digital generation of the composite PAL signal, without analog modulators, allows use of a single DAC to inherently match chrominance and luminance timing. This insures accurate SCH phasing. With the TSG-271's simple front panel controls you can select the following test signals:

- Color Bars
- Color Bars over Red
- Pluge
- Convergence
- White Window
- Grey Window
- Ramp
- Modulated Ramp
- Staircase
- Modulated Staircase
- Pulse & Bar with Window
- Field Squarewave
- Multipulse
- Multiburst
- Line Sweep
- Sin x/x
- Flat Fields
- Red Field
- ITS (CCIR, EBU, UK)
- APL Level

Both 100% and 75% color bars over red are provided with a narrow blanking white flag to help verify proper blanking width throughout the system. Color bar signals are also available with normal blanking width.

Composite video outputs, both test signal and black burst, include a white pulse inserted on line 7 of field 1 for color-frame identification.

The ITS signals are available as full field signals and in the field blanking interval.

Sync Generator with Digital Genlock
The TSG-271 sync generator's stable color standard and unique digital genlock make it ideal for either master generator or slave operation. All outputs are correctly SCH phased, even if the TSG-271 is locked to an improperly SCH phased reference input. The digital genlock calculates sync timing and subcarrier phase to properly identify color framing of the reference signal. The TSG-271 automatically senses composite video reference input and, in the absence of a reference input signal, automatically switches to its own internal reference. With its constant temperature oven, this high stability crystal oscillator insures long term frequency stability.

Flexible Timing Controls
Front panel controls allow phasing of all outputs relative to the genlock source. In addition, a separate set of timing controls move the pulse outputs relative to the black burst and test signal outputs. This simplifies system timing and eliminates delay lines. All timing settings are stored in non-volatile memory to prevent loss in the event of a power failure. A front panel lockout feature prevents inadvertent changes to the front panel timing controls.

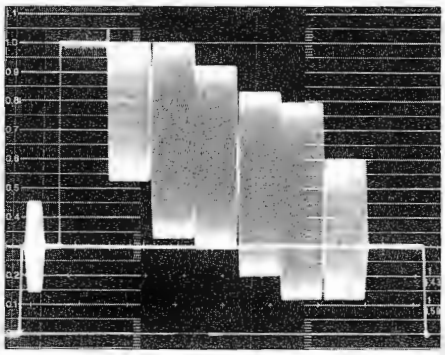
ID, Audio Tone, Tape Leader Countdown (Option 01)
Option 01 adds a second test signal output over which a twelve character identification may be superimposed. The identification is front panel programmable and up to three different identification presets may be stored in non-volatile memory.

Option 01 also provides a tape leader countdown feature consisting of a ten to two second countdown overlayed on a color black background. The black background remains until the countdown program is terminated.

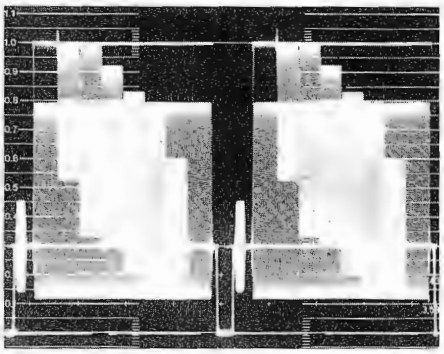
Also included in Option 01 is an audio tone output. Tone frequency is 500 Hz or 1 kHz (user selectable) with output level adjustable over a 0 to +8 dBu range.

Remote Control
Remote selection of internal/external reference, ID preset, genlock and sync timing presets, test signal, and tape leader countdown is provided. Selections are made with ground closures through a rear panel connector.

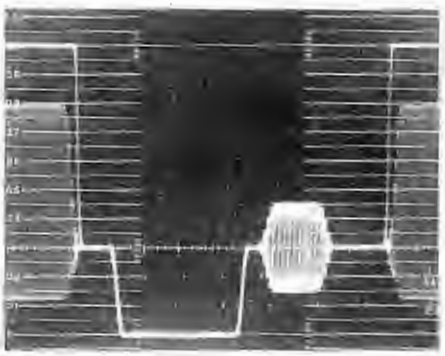
Packaging
The TSG-271's rugged 1¾ inch package makes it ideal for outside broadcast vans, or anywhere space is at a premium.



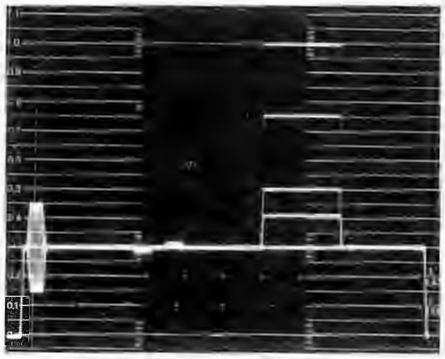
75% Bars.



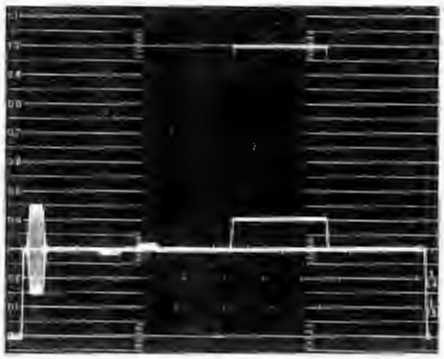
75% Color Bars with Red Field and Narrow Blanking White Flag.



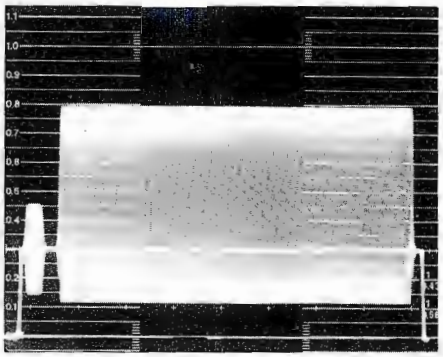
Blanking Interval with 11.6 μs Narrow Blanking White Flag.



Pluge No. 1.

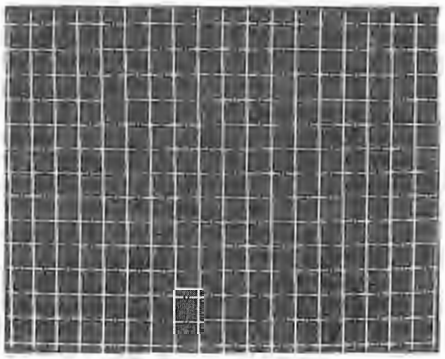


Pluge No. 2.

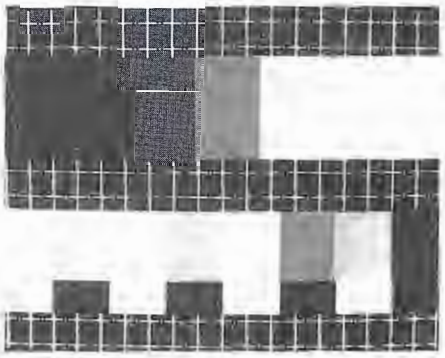


Red Field.

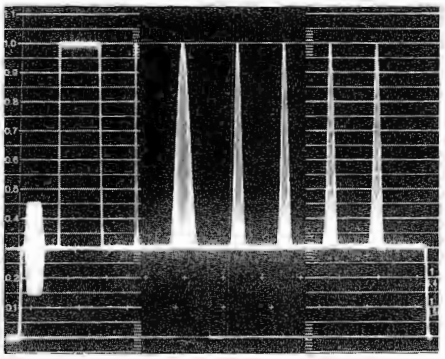
Bars with Character Identification.



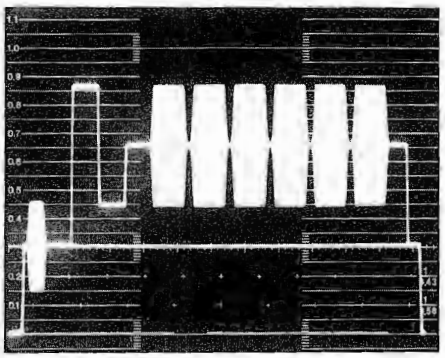
Convergence Pattern.



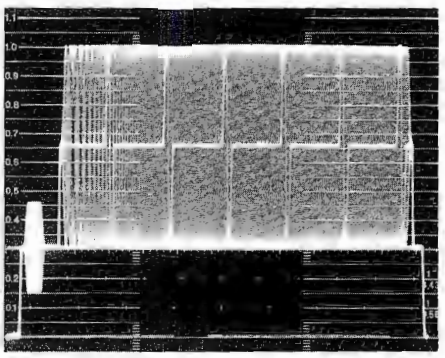
Monitor Setup Matrix.



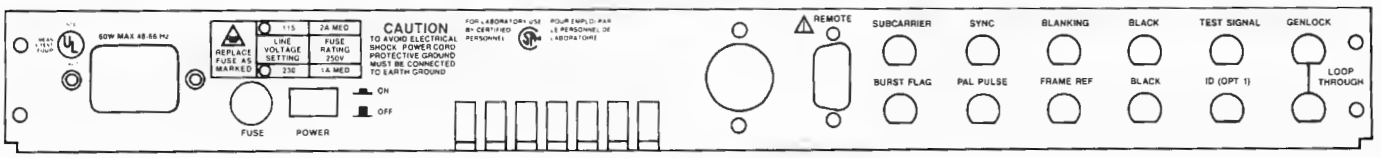
Multipulse.



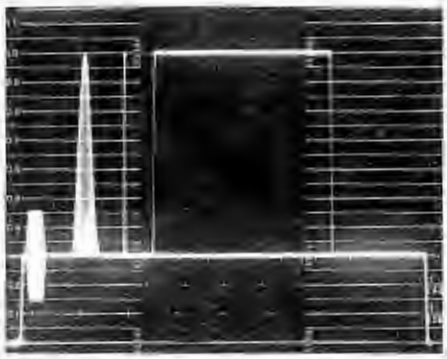
Multiburst.



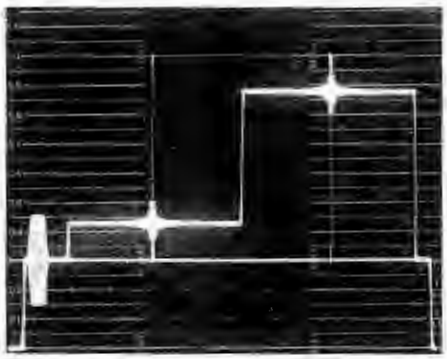
Line Sweep.



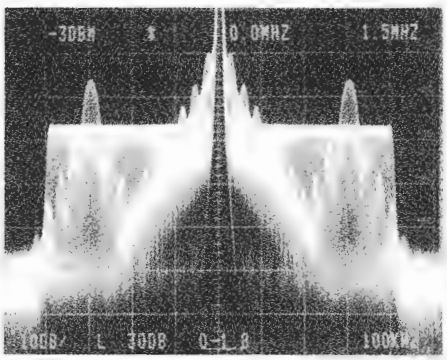
TSG-271 Rear Panel.



Pulse & Bar.

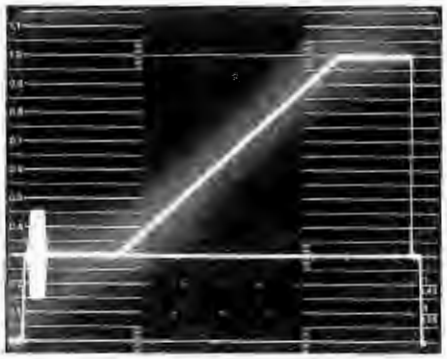


$\frac{Sin\ X}{X}$ (Time Domain).

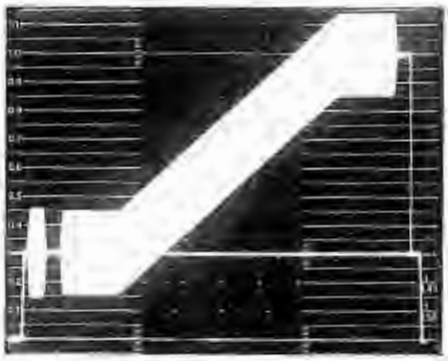


$\frac{Sin\ X}{X}$ (Frequency Domain).

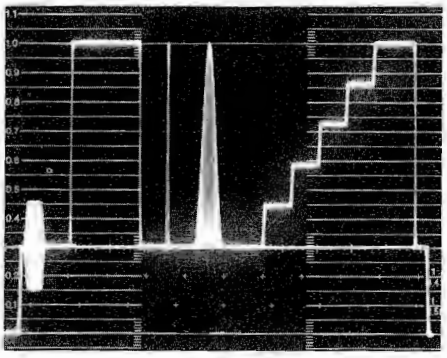
5 Step Staircase.



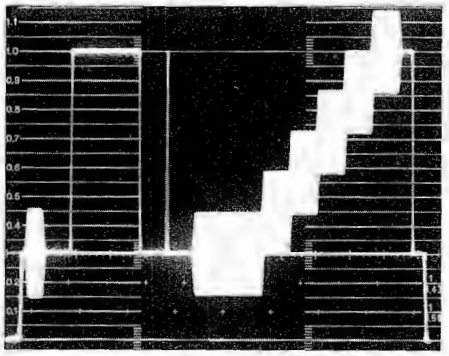
Luminance Ramp.



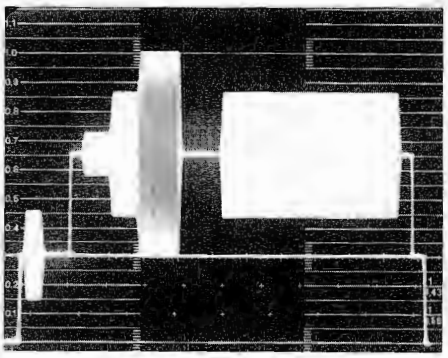
Modulated Ramp.



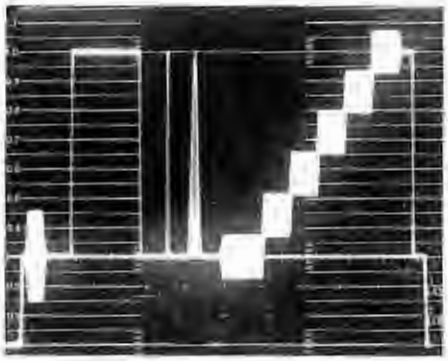
CCIR Line 17.



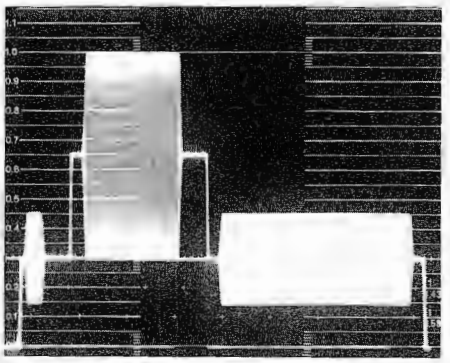
CCIR Line 330.



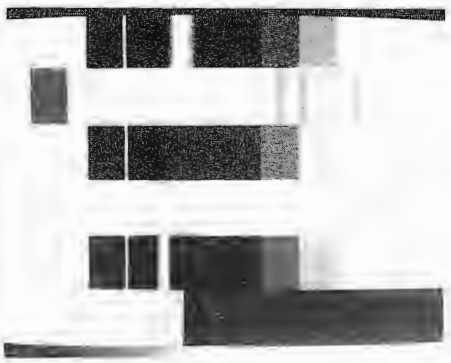
CCIR Line 331.



UK ITS 1.



UK ITS 2.



ITS Matrix.

CHARACTERISTICS

TEST SIGNAL GENERATOR

Luminance Amplitude Accuracy	±1%
Chrominance-to-Luminance Gain	±1%
Frequency Response	±1% to 5 MHz
Chrominance-to-Luminance Delay	≤5 ns
Group Delay	≤5 ns to 5 MHz
SCH Phase	
Jitter	<1 ns
Drift	<1 ns
Nominal	0° ±5°
Output Impedance	75 Ω
Return Loss	36 dB to 5 MHz
Color Bars	75% and 100% Full Field 75% and 100% Split Field Bars/Red Split Field Bars/Red with 11.6 μs Blanking on White Flag
Pluge No. 1	
Pluge Levels	−14 mV and 14 mV
Luminance Levels	700 mV, 450 mV, 200 mV and 110 mV
Pluge No. 2	
Pluge Levels	−14 mV and 14 mV
Luminance Levels	700 mV and 105 mV
Convergence	14 Horizontal lines and 19 Vertical Lines per Field
White Window	700 mV on Lines 83 through 251
Grey Window	105 mV on Line 83 through 251
Luminance Ramp	
Amplitude	0 to 700 mV
Linearity	≤1%
Modulated Ramp	
Luminance Amplitude	0 to 700 mV
Linearity	≤1%
Chrominance Amplitude	280 mV
Diff Gain	0.6% Maximum
Diff Phase	0.3° Maximum
5 Step Staircase	
Amplitude	700 mV
Linearity	≤1% Reltive Step Matching
Modulated 5 Step Staircase	
Luminance Amplitude	0 to 700 mV
Linearity	≤1% Relative Step Matching
Chrominance Amplitude	280 mV
Pulse & Bar & Modulated Pulse	
2T Pulse HAD	200 ns ±20 ns
Bar Amplitude	700 mV
Field and Line Tilt	≤0.5%
Pulse to Bar Ratio	1:1 ±0.5%
Ringing	≤1% Peak
Modulated Pulse HAD	20T
Chrominance-to-Luminance Gain	±1%
Chrominance-to-Luminance Delay	≤5 ns
Field Squarewave	700 mV on Lines 89 through 244
Multipulse	
Amplitude	700 mV
HAD	20T (1 MHz) and 10T
Frequencies	1.0, 2.0, 4.0, 4.8, and 5.8 MHz

TEST SIGNAL GENERATOR (Continued)

Multiburst	
White Reference	
Amplitude	560 mV
Pedestal	350 mV
Packets	
Frequencies	0.5, 1.0, 2.0, 4.0, 4.8, and 5.8 MHz
Amplitude	420 mV
Width	Equal Width
Risetime	350 ns; Phase Slewed Sinewaves
Line Sweep	
Amplitude	700 mV p-p
Frequency Range	200 kHz to 6 mHz
Markers	1.0, 2.0, 3.0, 4.0, and 5.0 MHz
Sin x/x	
Bandwidth	6 MHz
Pedestal	124.9 mV
Peak	575.1 mV
Flat Fields	0 mV, 350 mV, and 700 mV
Red Field	
Luminance Pedestal	157 mV
Chrominance Amplitude	663.8 mV
ITS	
CCIR	Lines 17, 18, 330, and 331
EBU	Lines 17, 18, 330, and 331
UK	ITS 1 and ITS 2
APL	12.5% and 87.5%; sequence is 36 lines flat field and 12 lines test signal

SYNC GENERATOR

Subcarrier Output	
Frequency	4.43361875 MHz
Stability	±1 Hz over temperature; typically less than 1 Hz drift over a year after initial aging
Amplitude	2 V ±0.2 V
Return Loss	30 dB to 4.43 MHz
Black Burst Output	
Phasing	Within 2° of the test signal output
Pulse Outputs (General Characteristics)	
Amplitude	2 V ±0.2 V (4 V selectable)
Impedance	75 Ω
Return Loss	30 dB to 5 MHz
Risetime	250 ns ±25 ns
Pulse Outputs (Signals)	
Sync	Mixed line and field
Blanking	Mixed line and field
Line	11.84 ±0.1 μs (11.6 or 12.1 selectable)
Field	25 lines (24 selectable)
Burst Flag	
PAL Pulse	H/2 squarewave; selectable polarity; factory set high for 135°
Frame Reference	Selectable pulse or squarewave
Pulse	Low for line 7, field 1
Squarewave	Low for fields 1 through 4
Pulse Outputs (Timing Range)	Approximately 3.5 μs advance and delay relative to the test signal, black burst, and subcarrier outputs

GENLOCK

Genlock Input	
Configuration	75 Ω loop through
Return Loss	≥40 dB to 5 MHz
Burst Amplitude	300 mV ±6 dB
Sync Amplitude	300 mV ±6 dB
Burst Lock Range	4.43361875 MHz ±20 Hz
Jitter	
Color Lock	≤0.4° typical
Monochrome Lock	≤10 ns
Genlock Timing Range	
Line	Approximately 7 μs advance and delay
Field	1 line advance and delay

POWER SOURCE

Mains	
Voltage Range	90 to 132 Vac or 180 to 250 Vac
Power Consumption	40 W typical, 60 W maximum

PHYSICAL CHARACTERISTICS

Dimensions	**mm**	**in**
Height	44	1.734
Width	483	19.0
Depth	561	22.1
Weight	**kg**	**lb**
Net	6.14	13.5
Shipping	10.4	22.9

ENVIRONMENTAL

Temperature	
Operating	0°C to 40°C
Non-Operating	−40°C to 65°C

ORDERING INFORMATION

When ordering, please use the following nomenclature.

TSG-271 PAL Television Generator

OPTION

Option 01 — Adds Character ID, Audio Tone, and Tape Leader Countdown

Kit to add Option 01 to the TSG-271 — Order TVGF02

TSG-300 Component Television Generator.

TSG-300
Component Television Generator

Multiple Formats and Standards
- Y,B-Y,R-Y (Y,Pb,Pr; SMPTE/EBU)
- GBR
- Betacam®
- MII
- 525/60 and 625/50

10 Bit Digital Signal Generation

New Test Signals for Component Video
- Bowtie
- Coring
- Valid Ramp
- Shallow Ramp

User Configurable Controls

Digital Genlock

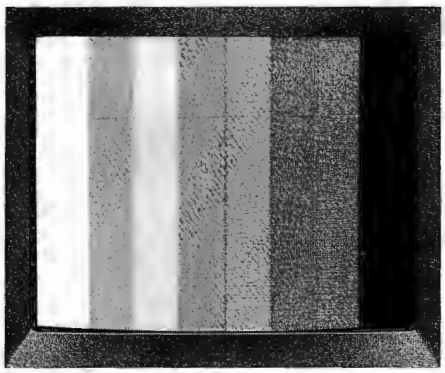


Figure 1a. Component Color Bars.

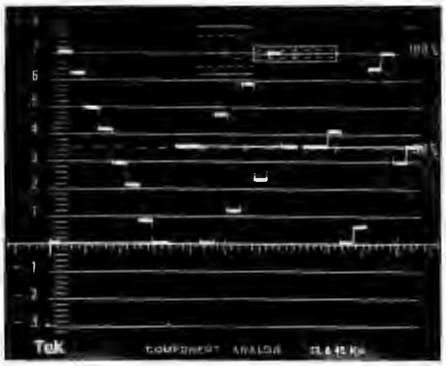


Figure 1b. Y, B-Y, R-Y Color Bars.

From news gathering to post-production, component television is providing new levels of image quality and operational flexibility. While component television solves many problems inherent in composite NTSC and PAL, it brings with it a new set of concerns. The TSG-300 Component Television Generator provides innovative solutions to the measurement problems encountered in component television systems.

Multiple Formats and Standards

While the EBU and SMPTE are setting standards for component video, there is already a large base of installed component equipment using many different operating levels. The TSG-300 bridges this gap between formal and de-facto standards, providing signals in SMPTE/EBU standard formats as well as previously existing component formats. Signal formats supported by the TSG-300, using color bars as an example (Figure 1), are Y, B-Y, R-Y (Y,Pb,Pr; SMPTE/EBU), GBR, Betacam, and MII. The TSG-300 also supports both 525/60 and 625/50 systems by either internal jumper selection or remote control.

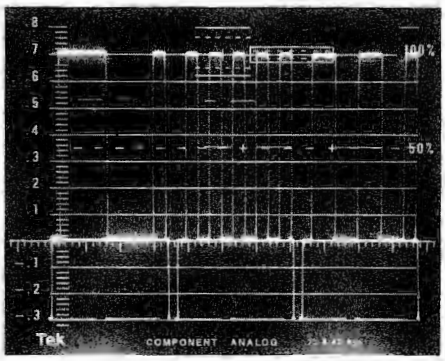


Figure 1c. GBR Color Bars.

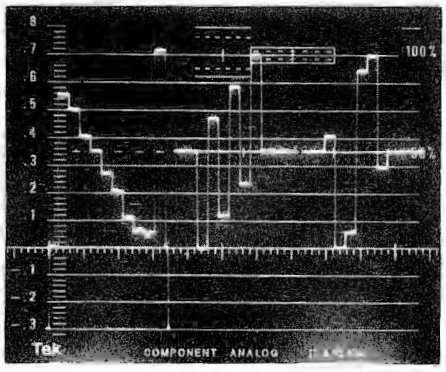


Figure 1d. Betacam® Color Bars.

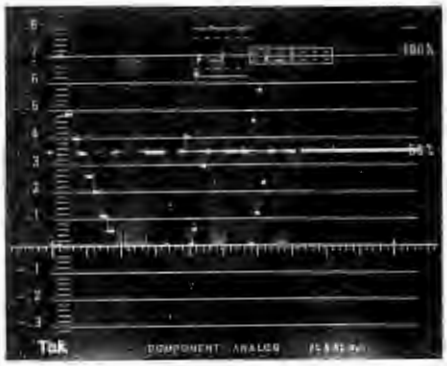


Figure 1e. Betacam® Y-CTM Color Bars.

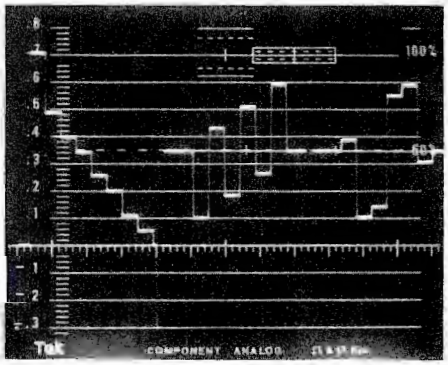


Figure 1f. MII Color Bars.

Digital Signal Generation

Precision digital signal generation insures the accuracy and stability of the TSG-300 test signals. 10 bit digital-to-analog conversion at 13.5 MS/s, even in the color difference channels, allows full bandwidth testing of GBR systems. Digital generation of each individual format eliminates transcoding artifacts.

Betacam is a registered trademark of Sony Corporation.

New Test Signals for Component Video
The TSG-300 provides unique solutions to component measurement problems with signals such as bowtie, coring, valid ramp, and shallow ramp, as well as a wide range of more conventional signals (Table 1).

Bowtie
Channel matching is critical in component systems. Timing mismatch causes color fringing on fine details, while amplitude mismatch causes color saturation and hue shifts. The bowtie signal simplifies channel timing and provides a quick check of gain matching.

The bowtie signal is composed of 3 separate sine-wave packets, one for each channel. You can compare luminance and color difference channel delays by subtracting channels with the A-B display on a waveform monitor. The WFM-300 Component Waveform Monitor simultaneously compares channel 1 with both channel 2 and channel 3, forming the bowtie display (Figure 2d).

Channel timing errors move the null off center (Figure 2c). Markers built into the bowtie signal indicate 20 nS delay increments, with resolution to 5 nS. Channel amplitude mismatch will appear as an incomplete null of the bowtie (Figure 2f).

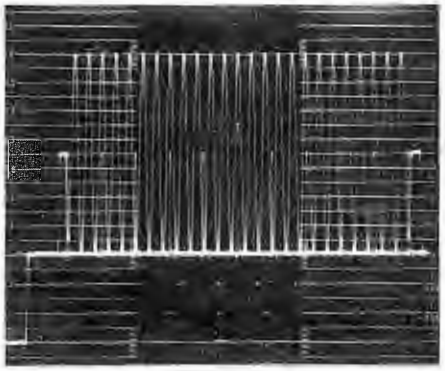


Figure 2a. Bowtie Luminance.

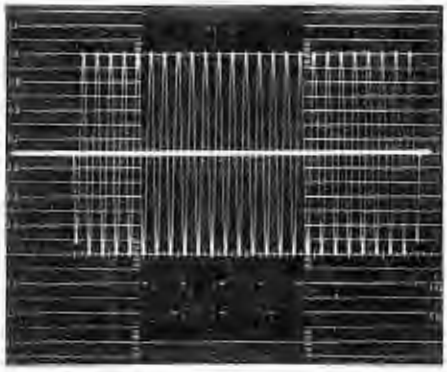


Figure 2b. Color Difference.

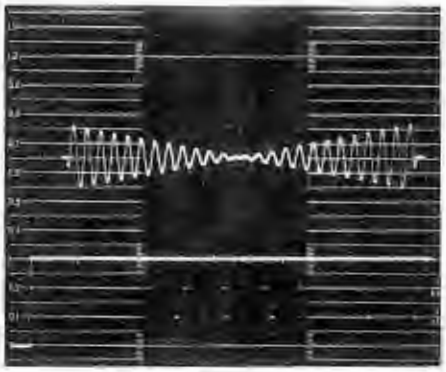


Figure 2c. Bowtie Display.

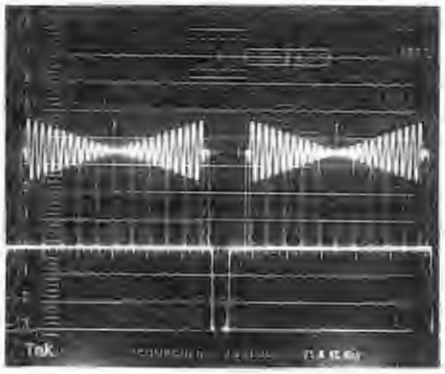


Figure 2d. Comparing Channel 1 with Channels 2 and 3.

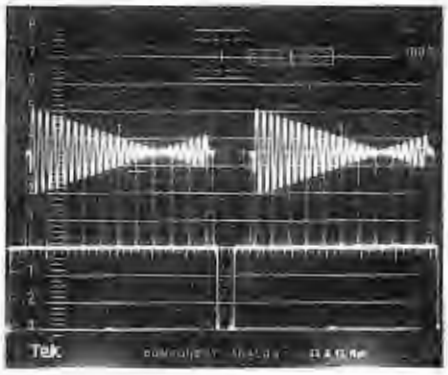


Figure 2e. Delay Error.

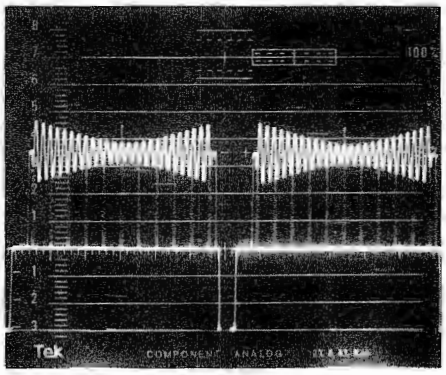


Figure 2f. Gain Error.

Coring
Coring is a technique used in some cameras and recorders to improve apparent signal-to-noise ratio. Coring circuits remove small high frequency noise, but unfortunately impair fine picture detail as well. Extreme application of coring can result in cartoon-like pictures after multiple tape generations (Figure 3a).

The TSG-300 coring test signal consists of low amplitude sine waves at different frequencies. Each packet is tapered to zero amplitude and will have the lowest amplitudes removed where coring is applied. The coring test signal aids in setting coring levels and identifying excessive use of coring.

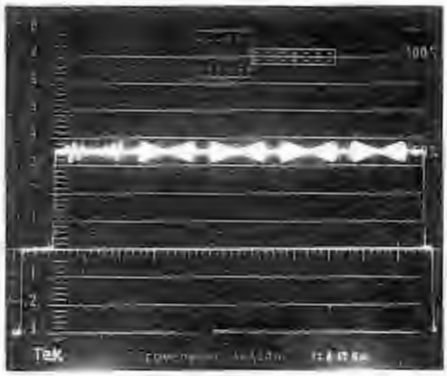


Figure 3a. Coring Test Signal.

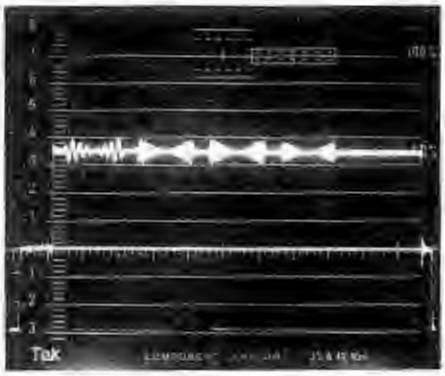


Figure 3b. Excessive Coring.

Valid Ramp

Component processing and switching equipment may transcode Y, B-Y, R-Y signals to GBR for internal processing. A linearity test in these mixed-format systems should not drive the GBR channels below zero or above maximum signal level. The valid ramp signal consists of 3 separate ramps in each of the 3 channels. Each ramp is optimized to test one channel and is accompanied by smaller ramps in the other channels to allow valid transcoding to GBR.

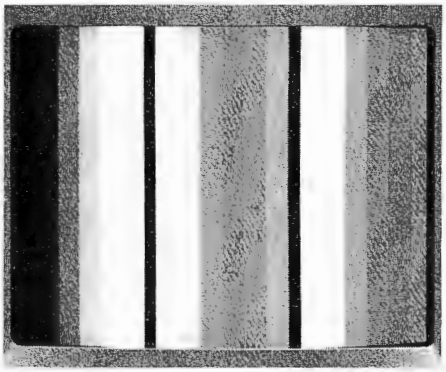


Figure 4a. Valid Staircase.

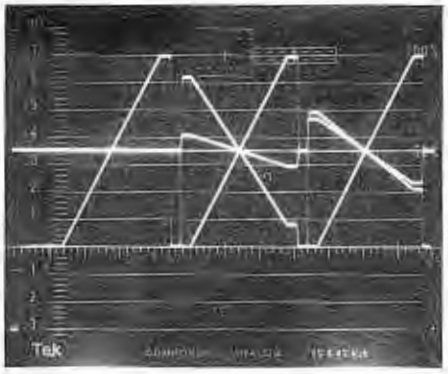


Figure 4b. Valid Ramp.

Shallow Ramp

Subtle linearity errors introduced by ADCs and DACs in video processors can accumulate on multiple generations. In the past, full scale ramps were used to test these converters but sometimes an error occurring at one specific digital word will be hidden when using conventional ramps. With full scale ramps (Figure 5a), single word errors last only a single clock cycle and are masked by the system anti-aliasing filters.

The TSG-300 shallow ramp (Figure 5b) extends the duration of these errors, making them easier to see. A digital system can be tested over its full dynamic range using the variable pedestal. The pedestal can be swept manually or automatically to move the shallow ramp from 0 to 700 mV in the luminance channel and −350 to +350 mV in the color difference channels.

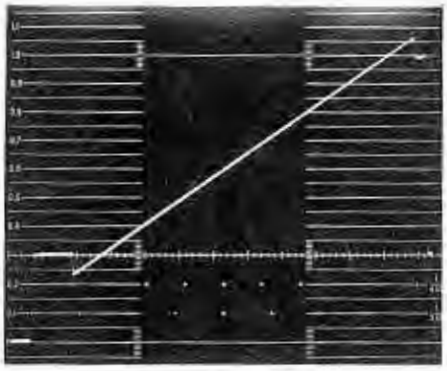


Figure 5a. Linearity Error on Conventional Ramp.

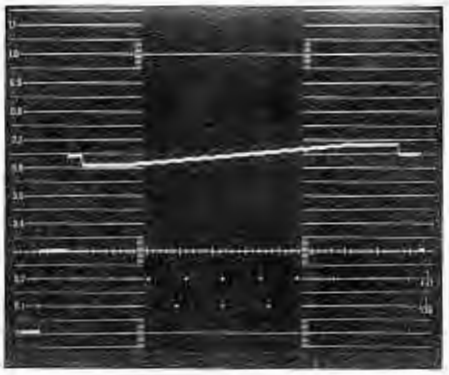


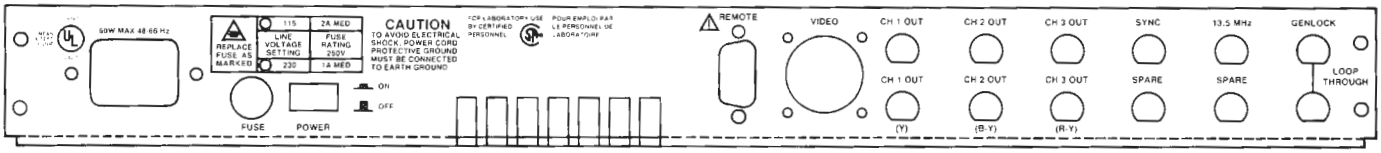
Figure 5b. Linearity Error on Shallow Ramp.

Table 1: TSG-300 Test Signals

Test Signal	GBR	Y,B-Y,R-Y (Y,Pb,Pr) (SMPTE/EBU)	3 CH VTR (Betacam) (MII)	2 CH VTR (Betacam CTDM) (MII CTCM)
100% Color Bars	*	*		
75% Color Bars	*	*	*	
Color Bars Plus Bowtie with Markers				*
Luminance Reference and Pluge	*	*		
5 Step	*	*	*	
Valid 5 Step		*		
120% Ramp	*	*		
Valid Ramp		*		
Shallow Ramp	*	*	*	
2T & 3T Pulse and Bar		*	*	
2T & 3T Pulse and Window		*	*	
2T & 5T Pulse and Bar		*	*	

Test Signal	GBR	Y,B-Y,R-Y (Y,Pb,Pr) (SMPTE/EBU)	3 CH VTR (Betacam) (MII)	2 CH VTR (Betacam CTDM) (MII CTCM)
2T & 5T Pulse and Window		*	*	
2T, 4T, & 8T Pulse & Bar		*	*	
2T, 4T, & 8T Pulse & Window		*	*	
2T Pulse and Bar with 20T Pulse	*	*	*	
2T Pulse and Window with 20T Pulse	*	*	*	
Field Square Wave	*	*	*	
Multipulse	*	*	*	
Wideband 60% Multiburst		*		
Narrowband 60% Multiburst		*	*	
Wideband 100% Line Sweep	*	*		

Test Signal	GBR	Y,B-Y,R-Y (Y,Pb,Pr) (SMPTE/EBU)	3 CH VTR (Betacam) (MII)	2 CH VTR (Betacam CTDM) (MII CTCM)
Narrowband Line Sweeps		*	*	*
Bowtie	*	*	*	
Convergence	*	*	*	
Coring		*	*	
Flat Field	*	*	*	
SMPTE Timing and Amplitude		*		
Variable Pedestal	*	*	*	
APL	*	*	*	
Bounce	*	*	*	
Switchable Channel On/Off	*	*	*	*
Selectable Sync On/Off	*	*	*	



TSG-300 Rear Panel.

User Configurable Controls

Operation of the TSG-300 is simplified by its user configurable controls. Many of the test signal controls access a variety of similar signals. These signals are accessed by pressing the switch repeatedly. By simply specifying which signal you want to appear first, the problem of searching for a commonly used signal is eliminated.

Digital Genlock

The TSG-300's unique digital genlock and stable internal oscillator make it suitable for either slave or stand-alone operation. After the incoming signal is digitized, a processor analyzes timing to control the TSG-300's system clock. The digital genlock works with component video or composite NTSC, PAL, or SECAM sources operating in either 525/60 or 625/50 systems. The TSG-300 automatically switches to its internal oscillator in the absence of a reference input signal. This high stability crystal oscillator, with its constant temperature oven, ensures long term frequency stability.

Remote Control

Remote operation of test signal selection, system timing, and line and field rate selection is available by simple ground closure control through a rear panel connector.

Packaging

The TSG-300's rugged, 1¾ inch package makes it ideal for use anywhere space is at a premium.

TSG-300 Specifications

Signal Formats	Y, B-Y, R-Y (SMPTE: Y,Pb,Pr; EBU) GBR Betacam (3 wire) MII (3 wire) Y-CTDM (Betacam 2 wire) YCTCM (MII 2 wire)
Systems	525/60 and 625/50 by jumper selection or remote control
Signal Generation	10 bit digital 13.5 MS/s Direct generation (no transcoders)
Outputs	Channel 1: 2 outputs Channel 2: 2 outputs Channel 3: 2 outputs Sync 13.5 MHz Reference Space for Betacam or MII Dub
Inputs	Genlock loop-through
Test Signals Luminance Amplitude Color Difference Sync Amplitude Blanking level	(Unless otherwise specified) 700 mV for 100% luminance ±350 mV for 100% color difference −300 mV on luminance channel 0 ±50 mV

TSG-300 Specifications (Continued)

Test Signals (Continued) Amplitude Accuracy Channel Amplitude Match Channel Timing Match Frequency Response Pulse Response Line Tilt Field Tilt Output Impedance Return Loss	(Unless otherwise specified) 1% 0.5% 5 ns 1% to 5 MHz 2% to 5.5 MHz 1% ringing on 2T pulse T = 100 ns 0.5% 0.5% 75 Ohm 36 dB to 5 MHz
Y, B-Y, R-Y (Y,Pb,Pr: SMPTE: EBU) 100/0/100/0 100/0/75/0	 700 mV luminance ±350 mV color difference 700 mV luminance ±262.5 mV color difference
GBR Bars 100/0/100/0 75/0/75/0	 700 mV all channels 525 mV all channels
Betacam Bars 100/7.5/75/7.5 100/0/75/0	 714 mV luminance in 525/60 53.6 mV setup ±14.3 mV pluge ±350 mV color difference Obtainable by applying the TSG-300 boost function (1.33 gain on color difference channels) to 75% SMPTE/EBU bars
Y,CTDM 100/7.5/75/7.5 100/0/75/0	 714 mV luminance in 525/60 700 mV luminance in 625/50 ±350 mV color difference
MII Bars 100/7.5/75/7.5 100/0/75/0	 700 mV luminance for 525/60 52.5 mV setup ±243 mV color difference Same as SMPTE/EBU bars
Y,CTCM 525/60 100/7.5/75/7.5	714 mV luminance ±350 R-Y ±250 B-Y
Y,CTCM 625/50 100/0/75/0	700 mV luminance ±262.5 mV color difference
Luminance Reference with pluge	0, 175, 350, 525, and 700 mV Gray scale references with −70 and +770 mV clipping indicators ±14 mV pluge
5 Step Staircase	700 mV luminace ±350 mV color difference
120% Ramp	−70 mV to +770 mV
Valid Ramp	700 mV p-p
Shallow Ramp	±350 mV from Pedestal 0 to 700 mV Pedestal luminance ±350 mV pedestal color difference in 5.5 mV increments
Pulse and Bar	2T Pulse and 2T Bar luminance 3T or 5T or 4T and 8T color difference Includes 3, 4, or 5 step staircase to indicate pulse HAD
Pulse and Bar with 20T Pulse	2T pulse and 2T bar luminance 20T pulse on all channels codes to modulated pulse in composite signal
Window	Pulse and Bar signal gated on during lines 72-202 in 525/60 and lines 78-234 in 625/50
Field Square Wave	700 mV luminance 350 mV color difference Vertical timing same as window

TSG-300 Specifications (Continued)

Multipulse	420 mV 60% amplitude selectable 1, 2, 3, 4, and 5 MHz luminance -350 to +70 mV color difference 0.5, 1, 1.5, 2, and 2.5 MHz color difference
Wideband Multiburst	420 mV p-p 60% on 350 mV pedestal for luminance 1, 2, 3, 4, and 5 MHz all channels
Narrowband Multiburst	420 mV p-p 60% 1, 2, 3, 4, and 5 MHz luminance 0.5, 1, 1.5, 2, and 2.5 MHz color difference
Wideband 100% Line Sweep	700 mV p-p 200 kHz to 5.5 MHz all channels
Narrowband Sweeps	420 mV p-p and 250 mV p-p 200 kHz to 5.5 MHz luminace 100 kHz to 2.75 MHz color difference
Bowtie	500 kHz luminance 502 kHz color difference ±100 ns delay range with markers every 20 ns
Convergence	525 mV (75%) 14 horizontal lines; 15 vertical lines
Coring	70 mV p-p 0 to 700 mV pedestal luminance ±350 mV pedestal color difference 1, 2, 3, 4, and 5 MHz luminance 0.5, 1, 1.5, 2, and 2.5 MHz color difference
Flat Field	0 to 700 mV variable luminance ±350 mV variable color difference
Sync Pulse Output	−4 V or −2 V selectable
13.5 MHz Output	1 V p-p
Genlock	Loop-through input Return loss 40 dB to 5.5 MHz Locks to NTSC, PAL, SECAM, or Component luminance
Genlock Timing	±8 μs delay range

POWER SOURCE

Mains Voltage Range Frequency Range	 90 to 132 Vac or 180 to 250 Vac 48 to 62 Hz
Power Consumption	60 W typical, 80 W maximum

PHYSICAL CHARACTERISTICS

Dimensions	**mm**	**in**
Height	44	1.734
Width	483	19.0
Depth	561	22.1
Weight	**kg**	**lb**
Net	6.14	13.5
Shipping	10.4	22.9

ENVIRONMENTAL

Temperature	
Operating	0° to 50°C
Non-Operating	−40° to +65°C

ORDERING INFORMATION

TSG-300 Component Television Generator

SDP-300
Signal Development Program

Supports TSG-300 Component Generator

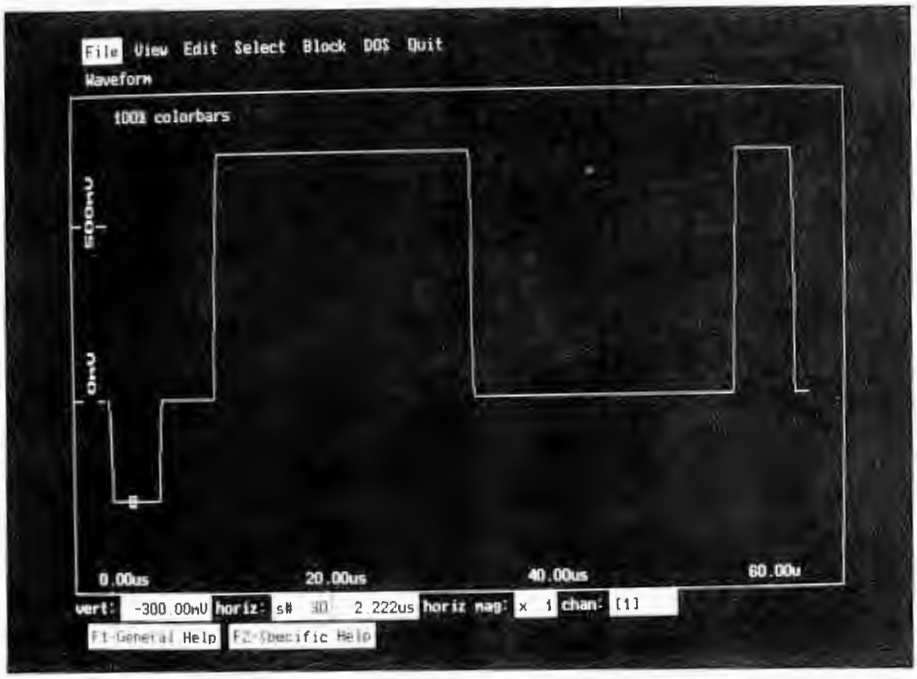
Waveform editing and creation

Waveform graphics

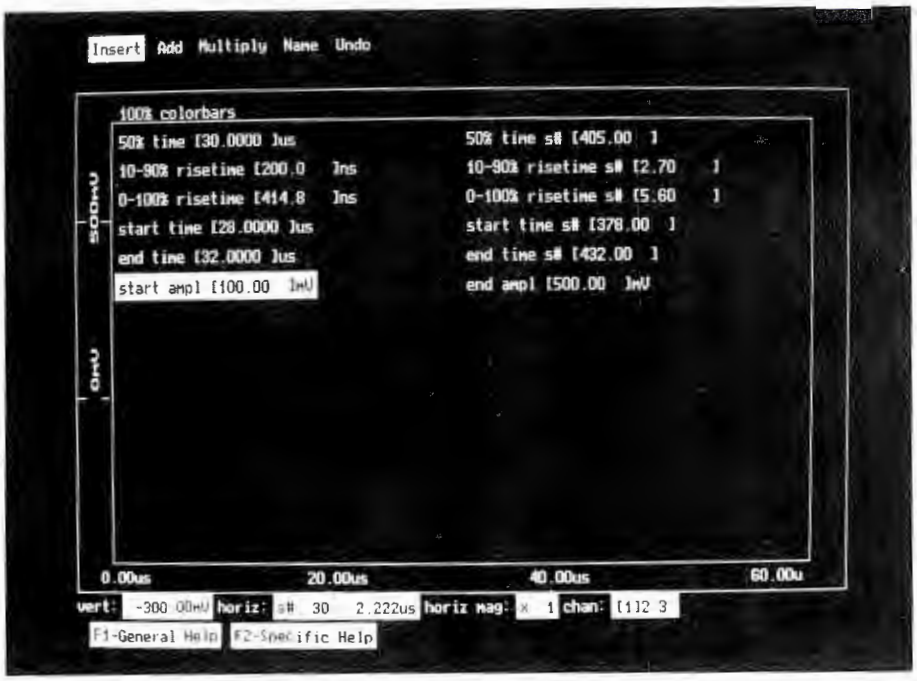
File building routine for ROM programming

Easy Installation

The SDP-300 is a test signal development software program for the TSG-300 Component Test Signal Generator. The SDP-300 provides facilities for the editing of existing waveforms, creation of new waveforms and the building of files for programming new ROM sets for the TSG-300. The program supports GBR, SMPTE/EBU, Betacam®, and MII formats for both 525/60 and 625/50 line and field rate systems. The SDP-300 is the ideal tool for the engineering, lab evaluation, and manufacturing environments.



Main menu of the waveform editor with channel one of GBR color bars displayed.



Template for creation of sine squared step.

Waveform Editor

The waveform editor is a versatile tool that permits modification of existing waveforms in the TSG-300 signal set. The editor also permits the creation of new waveforms for specific user applications. Command line menus are used for quick and easy maneuvering within the program. On-line help is also available. The editor graphics provide a display of all or individual channels of the waveform. Additional on-screen information includes channel(s) displayed, waveform amplitude and timing, and the help pointers.

ROM Files Routine

The ROM files routine uses the test signal file packs created by the waveform editor. From these, it builds the files needed to program the TSG-300 signal memory EPROMS. The ROM files are available in binary and Extended Tekhex format.

Required Hardware

The SDP-300 will run on an IBM PC XT, PC AT, PEP 301, or compatible. Minimum requirements: 640K memory; 1 floppy disk, 1 hard disk; CGA, EGA, VGA, or HERCULES graphics adaptor.

The TSG-300 must contain software revision 3.0 or higher. Older instruments will require installation of modification kit 020-1584-03 for compatibility with the SDP-300 program.

Programming new signal memory sets for the TSG-300 will require a ROM burner capable of using binary or Extended Tekhex files.

Required Software

IBM PC DOS or MS-DOS versions 3.0 or higher.

ORDERING INFORMATION

When ordering, please use the following nomenclature.

SDP-300 Signal Development Program

Includes: User's manual, blank signal memory EPROMS, signal select EPROM, and program EPROM.

Betacam is a registered trademark of Sony Corporation.

TSG-370 Component/NTSC Television Generator.

TSG-370
Component/NTSC Television Generator

Simultaneous and independent component and composite test signal outputs

10 bit signal generation in all channels

Test signals for routine maintenance and post production operations

High stability, correctly SCH phased internal sync generator

Black burst (6 outputs), comp sync, and comp blanking outputs

Full color genlock

Betacam®/NTSC and MII/NTSC versions

The TSG-370 is a test signal and sync generator designed for the operation and maintenance of facilities working in analog component and NTSC formats. The fully independent test signal generators provide continuous component and composite color bars as well as a stable, accurate reference black for post production operations. The test signal set is designed to satisfy routine equipment setup and maintenance requirements.

These features make the TSG-370 the perfect choice for today's analog component/NTSC environment and a wise selection for NTSC houses where analog component is possible in the future.

Test Signal Generators

The TSG-370 has two completely separate and independent test signal generators. Both use 10 bit signal generation and precision digital-to-analog converters to ensure signal accuracy and long term stability.

The component generator provides test signals in Betacam® or MII (Option 01) formats. The test signal complement includes:

- 75% full field color bars
- 5 step gray scale
- Crosshatch pattern
- Multiburst
- Line sweep
- Bowtie

The NTSC composite generator provides:

- SMPTE color bars
- 5 step gray scale
- Pulse & bar with window
- Multiburst
- Modulated ramp

Sync Generator

The TSG-370 contains a high stability, correctly SCH phased internal sync generator with a full color genlock. These features make it ideal for system master applications and easily integrated into a system where a master SPG already exists. The composite outputs maintain proper SCH phase in both internal and genlock operation modes.

There are six black burst outputs and one each comp sync and comp blanking output from the TSG-370. In small systems such as component edit suites, the multiple black outputs may eliminate the need for a distribution amplifier. In addition, the sync and blanking outputs may be converted to black burst, providing a total of eight outputs.

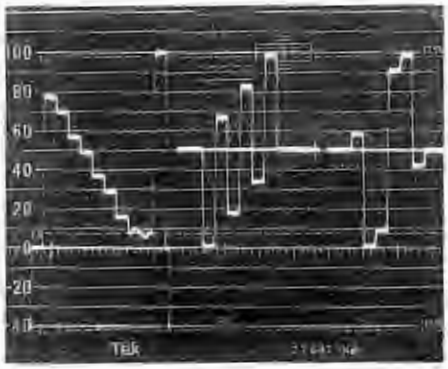
Automatic detection of incoming reference and a versatile output timing control system simplify genlock operation. In the auto mode, the TSG-370 operates in external lock when the incoming reference signal is present. When reference is absent, the generator switches to its own internal standard. The generator's output timing controls provide for phasing all generator outputs relative to the reference signal. In addition, the sync and blanking outputs may be phase offset from the composite and component outputs. This is useful in integrating the generator into a system where one or more devices lack sync phasing controls. Up to eight different timing settings may be stored in non-volatile memory.

Remote Control

Remote selection of test signal internal/external reference and the genlock and sync timing presets may be made with ground closures through a rear panel connector.

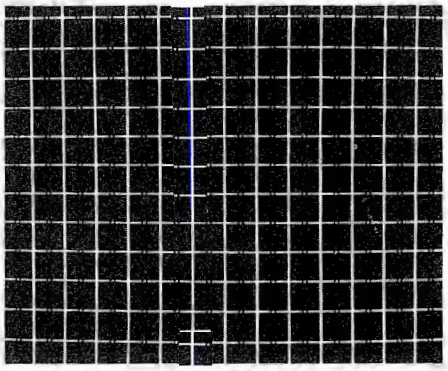
Betacam is a registered trademark of Sony Corporation.

Component Signals

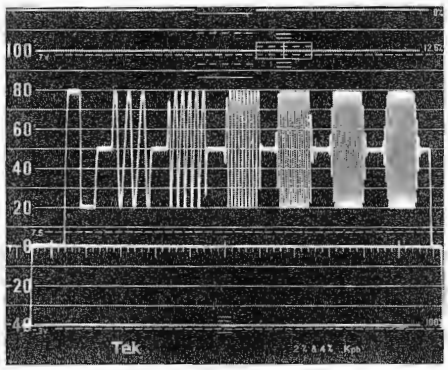


75% Betacam color bars.

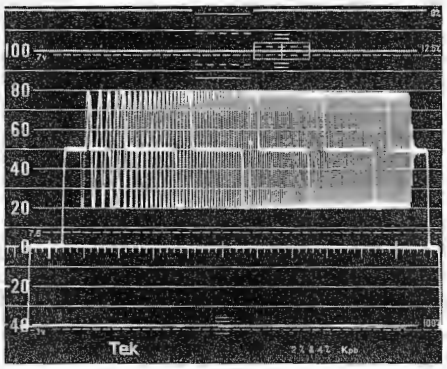
5 step gray scale.



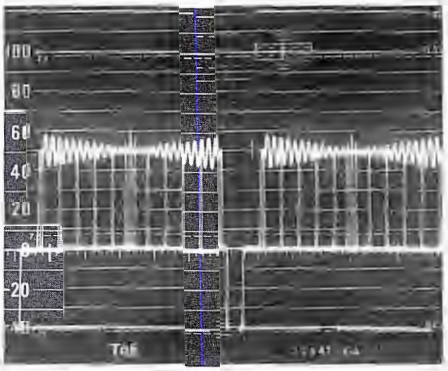
Crosshatch pattern.



Multiburst.

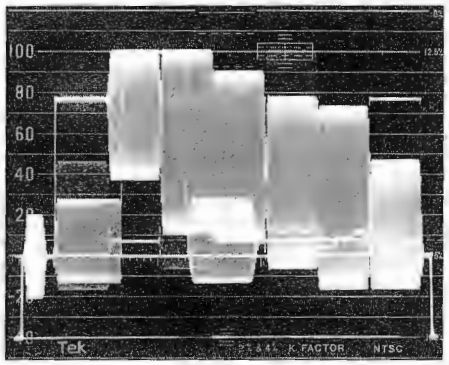


Line sweep with markers.

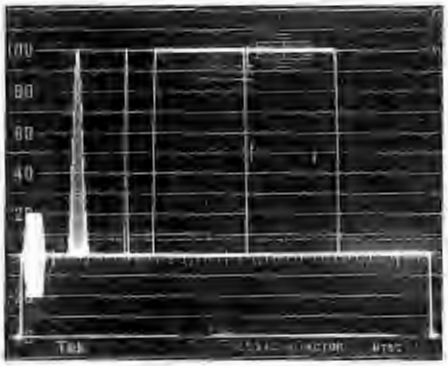


Bowtie timing.

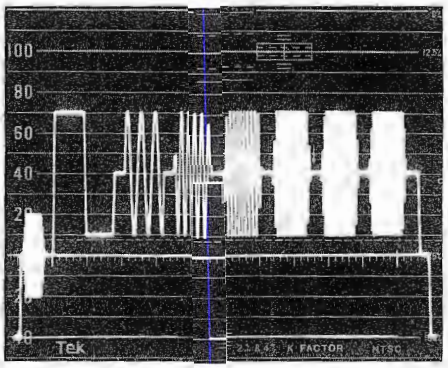
Composite Signals



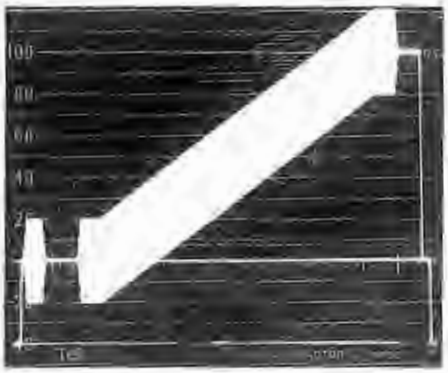
SMPTE color bars.



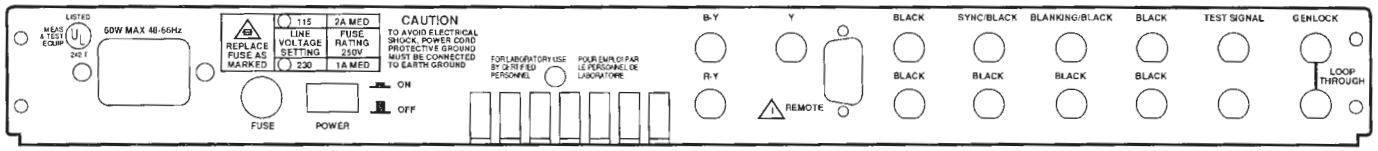
Pulse & bar with window and modulated pulse.



Multiburst.



Modulated ramp.



TSG-370 Rear Panel.

COMPONENT TEST SIGNAL GENERATOR

Betacam Levels	
Y channel	714.3 mV
B-Y, R-Y channels	±350 mV
MII Levels	
Y channel	700 mV
B-Y, R-Y channels	±350 mV
Amplitude	
Accuracy	±1% at full amplitude
Channel to channel match	±0.5%; B-Y, R-Y referenced to Y
Channel to Channel Delay	Within 5 ns, B-Y, R-Y referenced to Y
Frequency Response	±1% to 5 MHz; ±2% to 5.5 MHz
Risetime	
Y channel	250 ±10 ns
B-Y, R-Y channels	500 ns ±10 ns on color bars; 250 ns ±10 ns on all other signals
Sync Amplitude	
Betacam®	285.7 mV
MII	300 mV
Blanking Width	10.9 ±0.1 μs
Output Impedance	75 ohms
Return Loss	≥36 dB to 5 MHz

COMPONENT TEST SIGNALS

Color Bars	75% bars with 100% white flag
5 Step Gray Scale	
Y channel	Full channel amplitude
B-Y, R-Y channels	0 V
Convergence Pattern	
Amplitude	525 mV
Lines	14 horizontal, 17 vertical
Multiburst	
White reference	420 mV p-p
Pedestal level	
Y channel	350 mV
B-Y, R-Y channels	0 V
Packet amplitude	420 mV p-p
Frequencies	
Y channel	0.5, 1, 2, 3, 4, and 5 MHz
B-Y, R-Y channels	0.5, 1, 1.5, 2, and 2.5 MHz
Line Sweep	
Pedestal level	
Y channel	350 mV
B-Y, R-Y channels	0 V
Amplitude	420 mV p-p
Frequency	
Y channel	0.2 to 5.5 MHz
B-Y, R-Y channels	0.1 to 2.75 MHz
Markers	
Y channel	0.5, 1, 2, 3, 4, and 5 MHz
B-Y, R-Y channels	0.25, 0.5, 1, 1.5, 2 and 2.5 MHz
Bowtie	
Y channel	500 kHz sine wave
B-Y, R-Y channels	502 kHz sine wave
Timing markers	Five 20 ns markers on either side of channel coincidence; one 5 ns marker on either side of channel coincidence

NTSC TEST SIGNAL GENERATOR

Luminance Amplitude Accuracy	±1%
Chrominance-to-Luminance Gain	±1%
Chrominance-to-Luminance Delay	≤10 ns
Blanking Width	10.9 ±0.2 μs
Output Impedance	75 ohm
Return Loss	≥36 dB to 4.2 MHz

NTSC TEST SIGNALS

SMPTE Color Bars	
5 Step Gray Scale	714.3 mV (100 IRE)
Pulse & Bar with Window	
2T pulse HAD	250 ns ±25 ns
White bar amplitude	100 IRE
Field tilt	≤0.5%
Line tilt	≤0.5%
Pulse to bar ratio	1:1 ±1%
Modulated pulse	12.5T
Multiburst	
White reference	428.6 mV (60 IRE)
Packet amplitude	428.6 mV p-p (60 IRE)
Pedestal level	285.7 mV (40 IRE)
Burst frequencies	0.5, 1.0, 2.0, 3.0, 3.58 and 4.2 MHz
Modulated Ramp	
Luminance amplitude	714.3 mV (100 IRE)
Chrominance amplitude	285.7 mV (40 IRE)
Diff gain	0.6% max
Diff phase	0.3° max

SYNC GENERATOR

Subcarrier Stability	3.579545 MHz ±1 Hz over temperature, typically less than 1 Hz drift over a year after initial aging
Black Burst Output	
Setup	7.5 IRE
Blanking	10.1 ±0.2 μs
Pulse Outputs (General Characteristics)	
Amplitude	4.0 ±0.2 V
Impedance	75 ohm
Return loss	30 dB to 4.2 Mhz
Rise time	140 ns ±20 ns
Pulse Outputs (Signals)	
Composite sync	
Blanking	
Horizontal blanking duration	10.7 μs ±0.1 μs, jumper selectable for 10.5 μs or 10.9 μs
Vertical blanking duration	20 lines, jumper selectable for 19 or 20 lines
Pulse Outputs	
Timing range	3.5 μs advance, 3.5 μs delay relative to the test signal and black burst outputs

GENLOCK

Genlock Source (Comp Video)	
Input configuration	75 ohm loop-through
Return loss	At least 40 dB to 4.2 MHz
Burst amplitude	286 mV +1 dB to −6 dB
Sync amplitude	286 mV +3 dB to −6 dB
Genlock Performance	
Horizontal timing range	7 μs advance, 7 μs delay
Vertical timing range	0, 1, or 2 lines advance or 1 line delay, jumper selectable
Burst lock range	3.579545 MHz ±20 Hz
Jitter	0.5°

POWER SOURCE

Mains	
Voltage range	90 to 132 Vac or 180 to 250 Vac
Frequency range	48 to 62 Hz
Power Consumption	40 W typical, 60 W maximum

PHYSICAL CHARACTERISTICS

Dimensions	**mm**	**in**
Height	44	1.734
Width	483	19.0
Depth	561	22.1
Weight	**kg**	**lb**
Net	6.14	13.5
Shipping	10.4	22.9

ENVIRONMENTAL

Temperature	
Operating	0° to +50°C
Nonoperating	−40° to +65°C

ORDERING INFORMATION

When ordering, please use the nomenclature given here:

TSG-370 Betacam/NTSC Television Generator

OPTION

Option 01 — MII/NTSC Television Generator

TSG 371 Component/PAL Television Generator.

TSG 371
Component/PAL Television Generator

EBU level component and PAL composite test signals

Simultaneous and independent component and composite test signal outputs

10 bit signal generation in all component channels

Digital composite signal generation

Test signals for routine maintenance and post production operations

High stability, correctly SCH phased internal sync generator

Black burst (6 outputs), comp sync, and comp blanking outputs

Full color genlock

The TSG 371 is a test signal and sync generator designed for the operation and maintenance of facilities working in analog component and PAL formats. The fully independent test signal generators provide continuous component and composite color bars as well as a stable, accurate reference black for post production operations. The test signal set is designed to satisfy routine equipment setup and maintenance requirements.

These features make the TSG 371 the perfect choice for today's analog component/PAL environment and a wise selection for PAL houses where analog component is possible in the future.

Test Signal Generators

The TSG 371 has two completely separate and independent test signal generators. The component genertor is 10 bit in all channels. The PAL composite signals are supplied by a digital composite generator which uses a single DAC to inherently match chrominance to luminance timing and to provide accurate SCH phasing. Both generators use precision digital-to-analog converters to ensure signal accuracy and long term stability.

The component generator provides test signals at 700 mV in all channels for 100% amplitude. The test signal complement includes:

- 75% and 100% full field color bars
- 5 step gray scale
- Crosshatch pattern
- Multiburst
- Line sweep
- Bowtie

The PAL composite generator provides:

- 75% and 100% full field color bars
- 5 step gray scale
- Pulse & bar with window
- Multiburst
- Modulated ramp

Sync Generator

The TSG 371 contains a high stability, correctly SCH phased internal sync generator with a full color genlock. These features make it ideal for system master applications and easily integrated into a system where a master SPG already exists. The composite outputs maintain proper SCH phase in both internal and genlock operation modes.

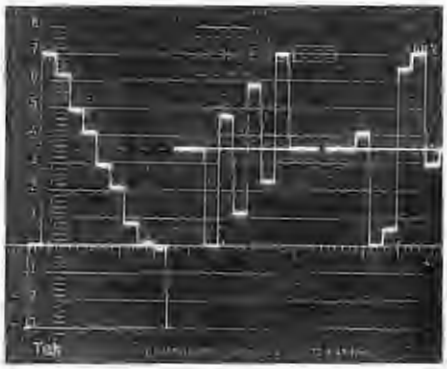
There are six black burst outputs and one each comp sync and comp blanking output from the TSG 371. In small systems such as component edit suites, the multiple black outputs may eliminate the need for a distribution amplifier. In addition, the sync and blanking outputs may be converted to black burst, providing a total of eight outputs.

Automatic detection of incoming reference and a versatile output timing control system simplify genlock operation. In the auto mode, the TSG 371 operates in external lock when the incoming reference signal is present. When reference is absent, the generator switches to its own internal standard. The generator's output timing controls provide for phasing all generator outputs relative to the reference signal. In addition, the sync and blanking outputs may be phase offset from the composite and component outputs. This is useful in integrating the generator into a system where one or more devices lack sync phasing controls. Up to eight different timing settings may be stored in non-volatile memory.

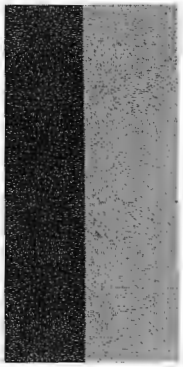
Remote Control

Remote selection of test signal internal/external reference and the genlock and sync timing presets may be made with ground closures through a rear panel connector.

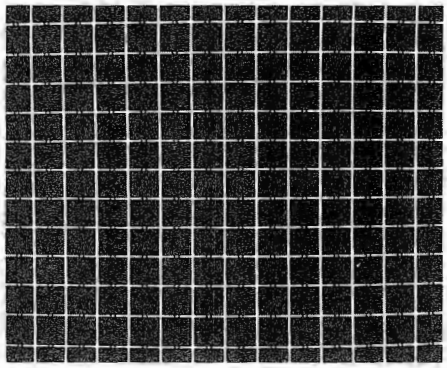
Component Signals



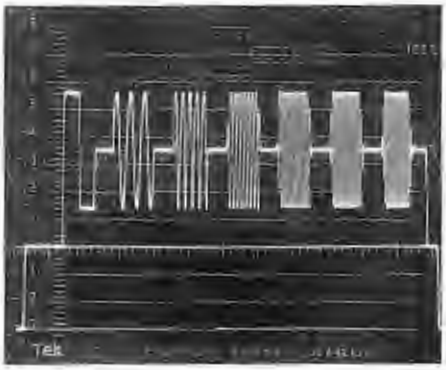
100% color bars. 75% color bars are also available.



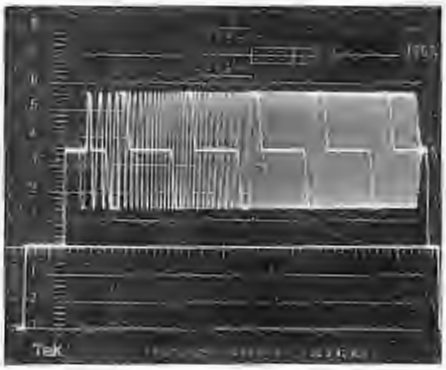
5 step gray scale.



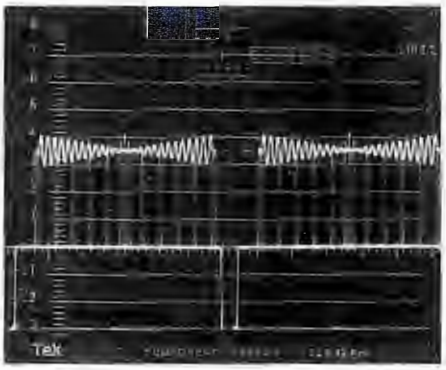
Crosshatch pattern.



Multiburst.

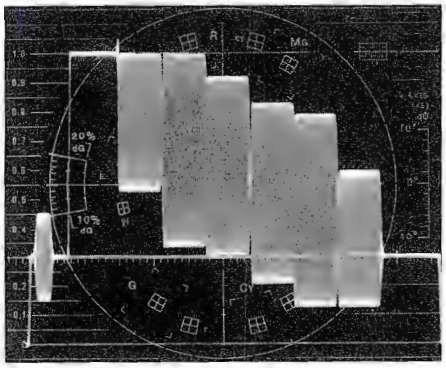


Line sweep with markers.

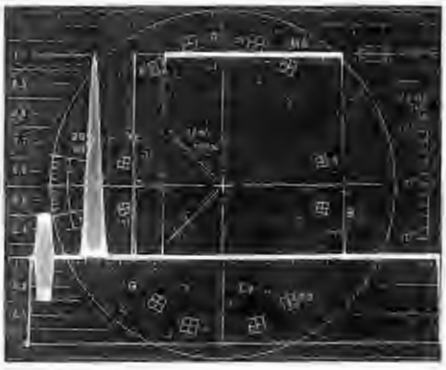


Bowtie timing.

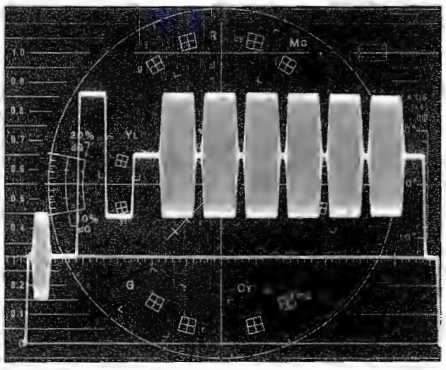
Composite Signals



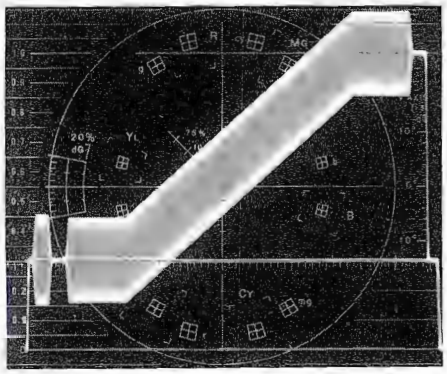
75% color bars. 100% color bars are also available.



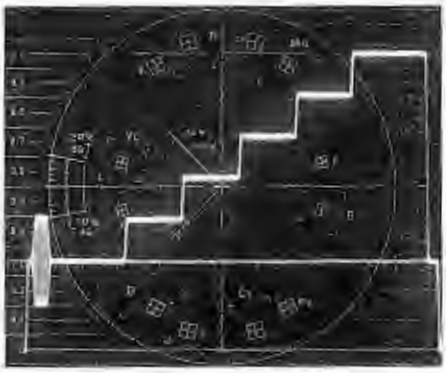
Pulse & bar with window and modulated pulse.



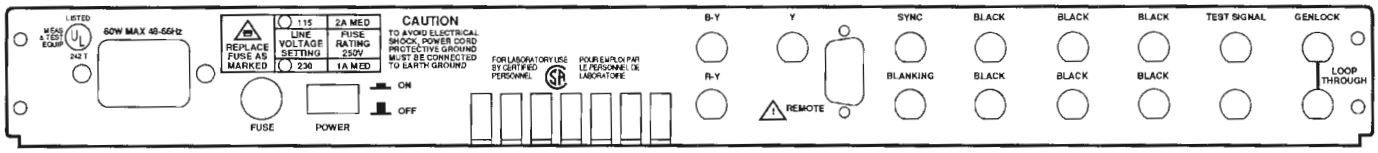
Multiburst.



Modulated ramp.



5 step staircase.



TSG 371 Rear Panel.

COMPONENT TEST SIGNAL GENERATOR

Levels	
Y channel	700 mV
B-Y, R-Y channels	±350 mV
Amplitude	
Accuracy	±1% at full amplitude
Channel to channel match	±0.5%; B-Y, R-Y referenced to Y
Channel to Channel Delay	Within 5 ns; B-Y, R-Y referenced to Y
Frequency Response	±1% to 5 MHz; ±2% to 5.5 MHz
Risetime	
Y channel	200 ±10 ns
B-Y, R-Y channels	400 ns ±10 ns on color bars; 200 ns ±10 ns on all other signals
Sync Amplitude	300 mV
Blanking Width	12.05 ±0.1 μs
Output Impedance	75 ohms
Return Loss	≥36 dB to 5 MHz

COMPONENT TEST SIGNALS

Color Bars	75% and 100% bars with 100% white flag
5 Step Gray Scale	
Y channel	Full channel amplitude
B-Y, R-Y channels	0 V
Convergence Pattern	
Amplitude	525 mV
Lines	14 horizontal, 17 vertical
Multiburst	
White reference	420 mV p-p
Pedestal level	
Y channel	350 mV
B-Y, R-Y channels	0 V
Packet amplitude	420 mV p-p
Frequencies	
Y channel	0.5, 1, 2, 3, 4, and 5 MHz
B-Y, R-Y channels	0.5, 1, 1.5, 2, and 2.5 MHz
Line Sweep	
Pedestal level	
Y channel	350 mV
B-Y, R-Y channels	0 V
Amplitude	420 mV p-p
Frequency	
Y channel	0.2 to 5.5 MHz
B-Y, R-Y channels	0.1 to 2.75 MHz
Markers	
Y channel	0.5, 1, 2, 3, 4, and 5 MHz
B-Y, R-Y channels	0.25, 0.5, 1, 1.5, 2 and 2.5 MHz
Bowtie	
Y channel	500 kHz sine wave
B-Y, R-Y channels	502 kHz sine wave
Timing markers	Five 20 ns markers on either side of channel coincidence; one 5 ns marker on either side of channel coincidence

PAL TEST SIGNAL GENERATOR

Luminance Amplitude Accuracy	±1%
Chrominance-to-Luminance Gain	±1%
Chrominance-to-Luminance Delay	≤5 ns
Frequency Response	±1% to 5 MHz
Group Delay	≤5 ns to 5 MHz
Blanking Width	12.05 ±0.1 μs
Output Impedance	75 ohms
Return Loss	≥36 dB to 5 MHz

PAL TEST SIGNALS

Color Bars	75% and 100% with 100% white flag
5 Step Gray Scale	700 mV
Pulse & Bar with Window	
2T pulse HAD	200 ns ±20 ns
Bar amplitude	700 mV
Field and line tilt	≤0.5%
Pulse to bar ratio	1:1 ±0.5%
Ringing	≤1% peak
Modulated pulse HAD	20T
Chrominance-to-luminance gain	±1%
Chrominance-to-luminance delay	≤5 ns
Multiburst	
White reference amplitude	560 mV
Pedestal	350 mV
Packets	
Frequencies	0.5, 1.0, 2.0, 4.0, 4.8 and 5.8 MHz
Amplitude	420 mV
Width	Equal width
Risetime	350 ns; phase slewed sinewaves
Modulated Ramp	
Luminance amplitude	0 to 700 mV
Linearity	≤1%
Chrominance amplitude	280 mV
Diff gain	0.6% maximum
Diff phase	0.3° maximum

SYNC GENERATOR

Subcarrier	
Frequency	4.43361875 MHz
Stability	±1 Hz over temperature, typically less than 1 Hz drift over a year after initial aging
Black Burst Outputs	
Phasing	Within 1° of the composite test signal output
Pulse Outputs (General Characteristics)	
Amplitude	2 V ±0.2 V (4 V selectable)
Impedance	75 ohms
Return loss	30 dB to 5 MHz
Rise time	250 ns ±25 ns

SYNC GENERATOR (continued)

Pulse Outputs (Signals)	
Sync	Mixed line and field
Blanking	Mixed line and field
Line	11.84 ±0.1 μs (11.6 or 12.1 selectable)
Field	25 lines (24 selectable)
Pulse Outputs (Timing Range)	Approximately 3.5 μs advance and delay relative to the test signal and black burst outputs

GENLOCK

Genlock Input	
Configuration	75 ohm loop-through
Return loss	≥40 dB to 5 MHz
Burst amplitude	300 mV ±6 dB
Sync amplitude	300 mV ±6 dB
Burst Lock Range	4.43361875 MHz ±20 Hz
Jitter	
Color lock	≤0.4° typical
Monochrome lock	≤10 ns
Genlock Timing Range	
Line	Approximately 7 μs advance and delay
Field	1 line advance and delay

POWER SOURCE

Mains	
Voltage range	90 to 132 Vac or 180 to 250 Vac
Frequency range	48 to 62 Hz
Power Consumption	40 W typical, 60 W maximum

PHYSICAL CHARACTERISTICS

Dimensions	**mm**	**in**
Height	44	1.734
Width	483	19.0
Depth	561	22.1
Weight	**kg**	**lb**
Net	6.14	13.5
Shipping	10.4	22.9

ENVIRONMENTAL

Temperature	
Operating	0° to +40°C
Nonoperating	−40° to +65°C

ORDERING INFORMATION

When ordering, please use the nomenclature given here:

TSG371 Component/PAL Television Generator

TSG-422 Digital Component Generator.

TSG-422
Digital Component Generator

Conforms to CCIR recommendation 601, SMPTE RP 125, and EBU Tech. 3246-E

4:2:2 format

8 bit signal generation

Digital test signal outputs

Separate Y, B-Y, R-Y clock outputs

525/60 and 625/50 operation

NTSC or PAL black burst outputs

Genlock to 525/60 or 625/50

The TSG-422 Digital Component Generator is a CCIR 601, 4:2:2 format digital test signal generator. The TSG-422 provides all the test signals needed to operate, maintain and evaluate 4:2:2 digital equipment. Analog black burst outputs are provided for equipment synchronization.

Test Signal Generator

The TSG-422 signal generation is 8 bit in all channels and is clocked at 13.5 MHz for the luminance channel and 6.75 MHz for the color difference channels. Color difference samples are co-sited with the odd numbered luminance samples.

The TSG-422 signal complement contains general purpose signals plus those tailored specifically to the 4:2:2 environment. Test signals included are:

- Color bars (100% and 75%)
- Pluge
- 5-step
- Ramp
- Limit ramp
- Valid ramp
- Light blue shallow ramp
- Shallow ramp
- Shallow ramp matrix
- Pulse & bar
- Field square wave
- Co-siting verification
- Multipulse
- Multiburst
- Full and reduced amplitude sweeps
- Bowtie timing
- 50% flat field
- Convergence pattern
- Digital/analog blanking markers
- Digital grey
- APL: high, low, and bounce

The ramp signal extends 5% below blanking and 5% above peak white to provide indication of clipping. The limit ramp provides signal information to test the maximum dynamic range of the system, levels 1 through 254 in an 8 bit system.

Shallow ramp, shallow ramp matrix, and light blue shallow ramp are provided for measurement of quantization noise and the detection of rounding and truncation errors.

The co-siting signal provides a one sample wide, peak white pulse on each horizontal scan line. The luminance channel pulse occurs on an odd sample and is coincident with the like pulses in the color difference channels. This signal is intended to provide an easy means of verifying correct luminance and color difference sample positioning in both the digital and analog domains.

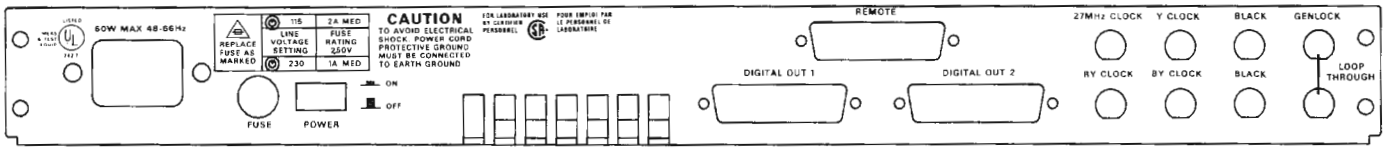
The blanking marker's signal provides peak white words at the beginning and end of both digital and analog blanking. Analog blanking widths comply to CCIR and RS-170A recommendations. This signal is useful in determining that proper blanking width is maintained throughout the system.

The digital grey signal sets the luminance channel to word 127 and the color difference channel to word 128. This sets up a high/low sequence on each of the parallel interface lines thus providing a high frequency signal for testing of the transmission medium.

The TSG-422 also provides facilities for time offsetting the clock and data information. This is useful in verifying receiver performance. In addition, the frequency of the 27 MHz interface clock may be shifted by 200 Hz in either direction. This provides a means for testing phase lock loops in clock regeneration circuits.

Two separate digital test signal outputs are provided.

Separate outputs of each clock signal are also provided. These outputs are useful in demultiplexing the digital test signal data for conversion to analog for further analysis.



TSG-422 Rear Panel.

CHARACTERISTICS

TEST SIGNAL GENERATOR

Sampling Frequency	
Luminance Channel	13.5 MHz
Color Difference Channels	6.75 MHz
Digital Coding	8 bit linear PCM in all channels
Video to Quantization Level Relationships	
Luminance Channel	220 levels with black at level 16 and white at level 235
Color Difference Channels	225 levels centered around level 128

DIGITAL INTERFACE

Output Format	Balanced ECL (10K series); 10 data pairs, 1 clock pair, system ground, chassis ground
Interface Clock	27.0 MHz

CLOCK OUTPUTS

Luminance Channel	13.5 MHz
Color Difference Channels	6.75 MHz
Connector	BNC

SYNC GENERATOR

Line & Field Rates	525/60 or 625/50 (user selectable)
Black Burst	2 outputs: NTSC in 525/60 mode PAL in 625/50 mode
Blanking Width	
NTSC	10.9 μs
PAL	12.0 μs
Genlock	Loop-through input; Locks to NTSC, PAL, SECAM, or component luminance.
Genlock Timing Range	8 μs of advance and delay

POWER SOURCE

Mains Ranges	
Voltage	90 to 132, 180 to 250 Vac
Frequency	48 to 66 Hz
Power Consumption	60 W typical; 80 W max

PHYSICAL CHARACTERISTICS

Dimensions	**mm**	**in**
Height	44	1.734
Width	483	19.0
Depth	561	22.1
Weight	**kg**	**lbs**
Net	6.14	13.5
Shipping	10.4	22.9

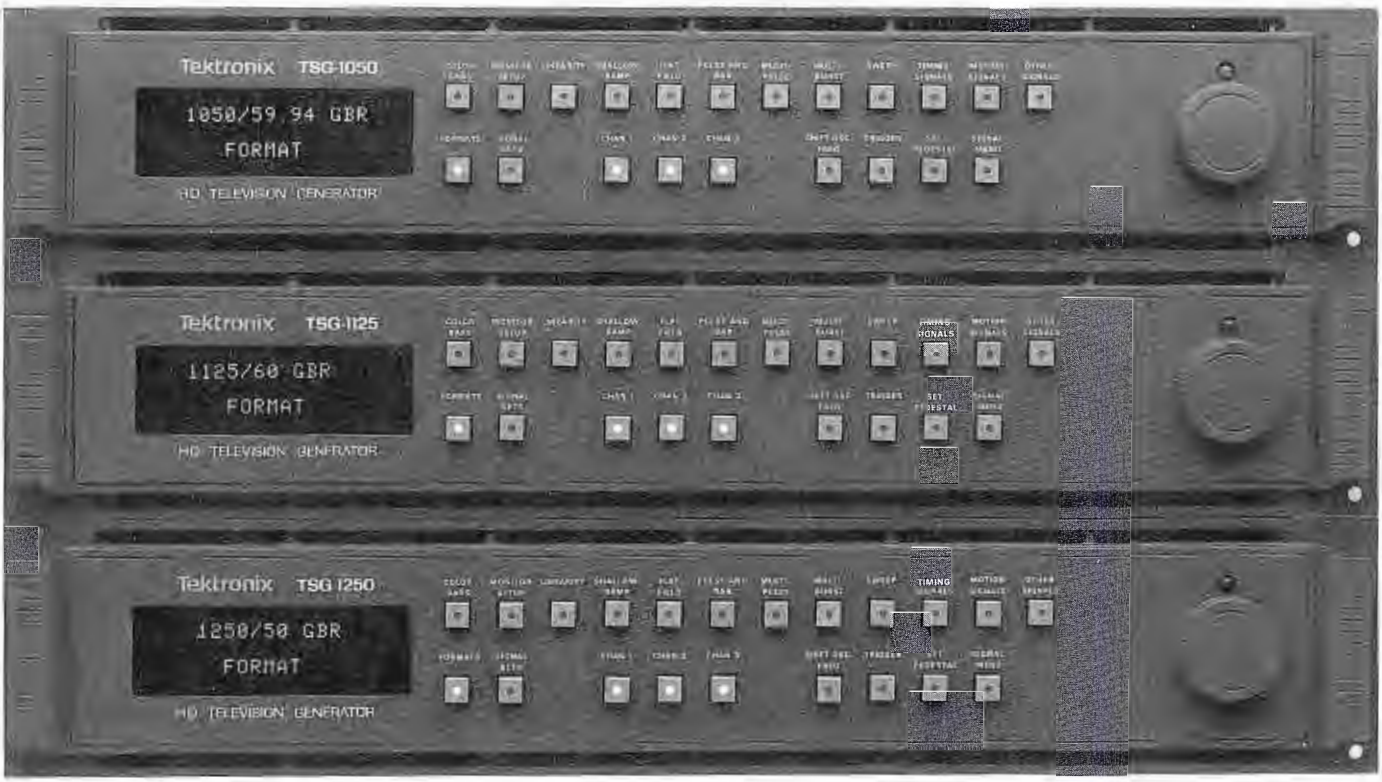
ENVIRONMENTAL

Temperature	
Operating	0° to 50°C
Non-Operating	−40° to 65°C

ORDERING INFORMATION

TSG-422 Digital Component Generator

Signal memory kit to replace the 8 bit signals with 10 bit signals — Order TVGF03.



TSG 1000 Series HD Television Generators.

TSG 1000
Series HD Television Generators

Supports the major proposed HDTV production standards

Comprehensive test signal complement including moving patterns

Analog and parallel digital test signal outputs

GBR and Y, P_B, P_R formats

30 MHz bandwidth

10 bit signal generation

Tri-level sync output

Front panel readout of generator status

Movable horizontal and vertical cursors

SDP 1000 Signal Development Package
- **PC based software program**
- **Waveform editing and creation**
- **ROM programming files**

The rapid evolution of the high definition television industry requires a new level of versatility and precision in HDTV test equipment. The new Tektronix TSG 1000 Series HD Television Generators are the HDTV signal generators for today's requirements with built-in flexibility to meet future needs in R&D as well as equipment and system manufacturing and testing.

The TSG 1000 Series members are the TSG 1050, TSG 1125, and TSG 1250. Each of the units provide a comprehensive test signal complement and operating conveniences that speed and simplify equipment and system testing. The SDP 1000 Signal Development Package provides a PC based software tool for development of special test signals for the user whose testing requirements are undergoing refinement.

Read on to learn more about how the TSG 1000 Series Generators can meet your needs now and in the future.

Test Signal Generator

The TSG 1000 Series Generators provide signals in the scanning and output formats outlined in Table 1. Signal Generation is 10 bit with 30 MHz output bandwidth. Two sets of analog and one set of digital outputs are provided.

The test signal complement is as follows:

- 75% and 100% color bars
- 75% and 100% color bars with pluge
- Vertical reverse color bars
- Color palette
- Convergence pattern with 5% overscan markers
- Convergence pattern with 8% overscan markers
- Grey scale
- Red field
- 5 step staircase
- 100% ramp
- Valid 5 step staircase (Y, P_B, P_R only)
- Valid ramp (Y, P_B, P_R only)
- Shallow ramp with variable pedestal
- Black field with variable pedestal
- White field with variable pedestal
- 2T30 pulse and bar
- Multipulse
- Low, mid, and high frequency multibursts
- Low and high frequency line sweeps with markers
- Full bandwidth two line sweeps with markers
- Bowtie timing with 1 ns markers
- Temporal impulse
- Diagonal motion
- 2 MHz and 5 MHz sines with horizontal motion
- 2 MHz and 5 MHz sines with temporal phase flip

Table 1
Scanning and Output Formats

FORMAT	GENERATOR		
	TSG 1050	TSG 1125	TSG 1250
525/59.94/1:1	X		
1050/59.94/2:1	X		
1125/60/2:1		X	
625/50/1:1			X
1250/50/2:1			X
GBR	X	X	X
Y, P_B, P_R	X	X	X
Analog	X	X	X
Parallel digital	X	X	X

Temporal Test Signals

The TSG 1000 Series Generators provide several moving test signals. These are multi-frame sequences of full-field test signals. These signals can be used to evaluate motion detection algorithms used in CODECs and other data compression applications.

The SDP 1000 software package allows the user to define custom multi-frame test signals for specialized temporal testing applications.

Equipment Synchronization

The TSG 1000 Series Generators include a stable, internal reference for master sync genlock applications. Tri-level sync output is standard.

Test and Operating Facilities

The TSG 1000 Series Generators provide several, highly useful test and operational features. These include the front panel display, a multifunction control knob, a cursor function, a menu display, channel on/off switches, and remote control via ground closure or RS-232.

Front panel display.

The vacuum fluorescent front panel display provides complete information on the generator operating status, including:

- Test signal selected
- Current scan rate and output format
- Pedestal level
- Cursor(s) selected

The front panel display follows selections made with the front panel push buttons, the control knob, or through the ground closure remote control.

The multifunction control knob provides a subordinate control function to the front panel push button controls. These include:

- Test signal selection of signals nested under a single front panel selector
- Selection of scan rate and output format
- Control of pedestal level
- Positioning of the horizontal or vertical cursors
- Up/down scrolling through the menu display

The cursor function provides front panel selection of horizontal or vertical, or simultaneous horizontal and vertical waveform cursors. Positioning of the cursors is done with the front panel knob. When enabled, the cursor function superimposes a single horizontal or vertical line or a crosshair on the picture monitor display of the selected test signal. At the same time, the generator outputs a trigger signal, coincident with the cursor position, for oscilloscope triggering. The cursor function will be very useful in analysis of distortions incurred in digital signal processing devices.

The menu function inserts a character identification of the selected function on the generator test signal output. This provides an easy means for identification of the selected function on a picture monitor display. The menu display provides information on the same items indicated on the front panel vacuum fluorescent display.

The channel on/off switches control channel output and are useful in determining channel to channel crosstalk characteristics.

The remote control provides control of all functions provided by the front panel push button selectors and the multifunction control knob.

Signal Development Program

The SDP 1000 is a personal computer based software tool for development of custom test signals for the TSG 1000 Series Generators.

The SDP 1000 provides facilities for the editing of existing waveforms, creation of new waveforms, and the building of files for programming of new ROM sets. The SDP 1000 supports all line and field rates and output formats included in the TSG 1000 Series Generators.

The two main parts of the SDP 1000 are the waveform editor and the ROM file generator. The waveform editor provides command line menus and on-line help screens to simplify operation. The editor graphics provide a display of all or individual channels of the waveform, amplitude and timing information, and the help function keys. The ROM file generator uses the test signal files created by the waveform editor to create the files required to program the EPROM test signal memory. The ROM files are available in binary, Extended Tekhex, and Intel Hex (Intel MCS-86 Hex Object).

An external clock signal may be used in conjunction with the SDP 1000 to define and generate test signals at arbitrary line and field rates.

SDP 1000 Requirements

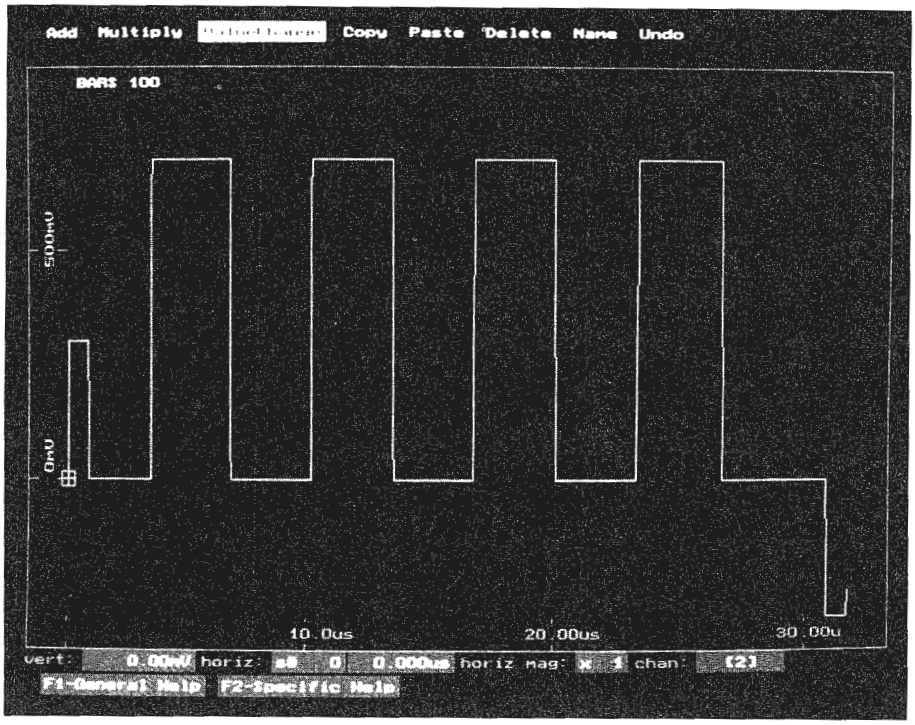
Hardware

The SDP 1000 will run on an IBM PC XT, PC AT, Tektronix PEP 301, or compatible. Minimum requirements: 640K memory, 1 floppy disk, 1 hard disk; CGA, EGA, VGA, or HERCULES graphics adaptor. A math coprocessor is highly recommended.

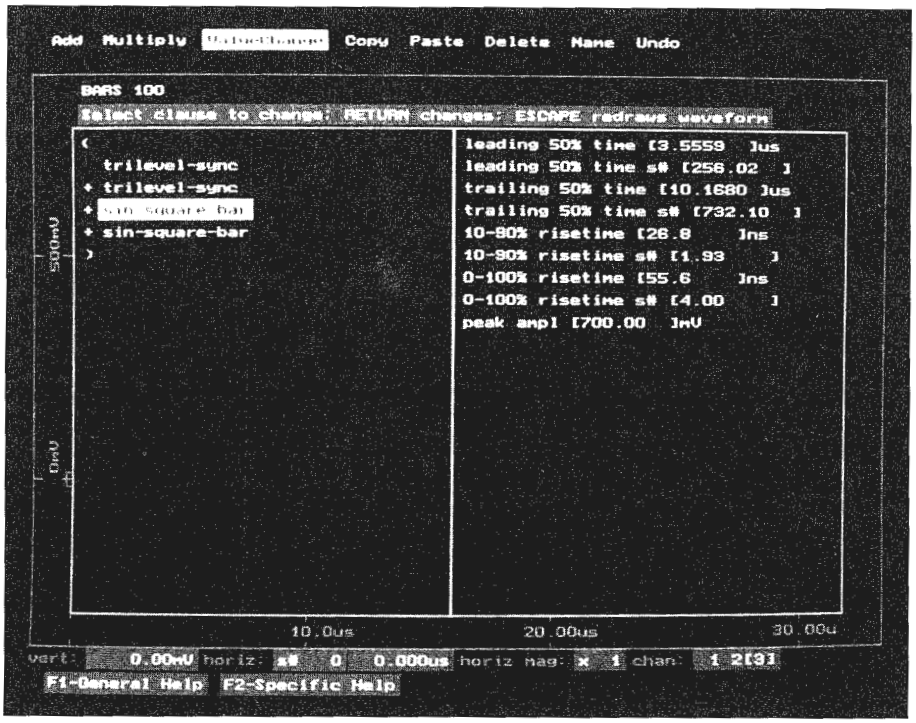
Programming new signal memory sets will require a ROM programmer capable of using binary, Intel Hex (Intel MCS-86 Hex Object), and Extended Tekhex files. The ROM programmer must also be able to program 27010 (128K × 8) and Cypress 7C251 EPROMS.

Software

IBM PC DOS or MS-DOS versions 3.0 or higher.



Main menu of the waveform editor with channel two of GBR color bars displayed.



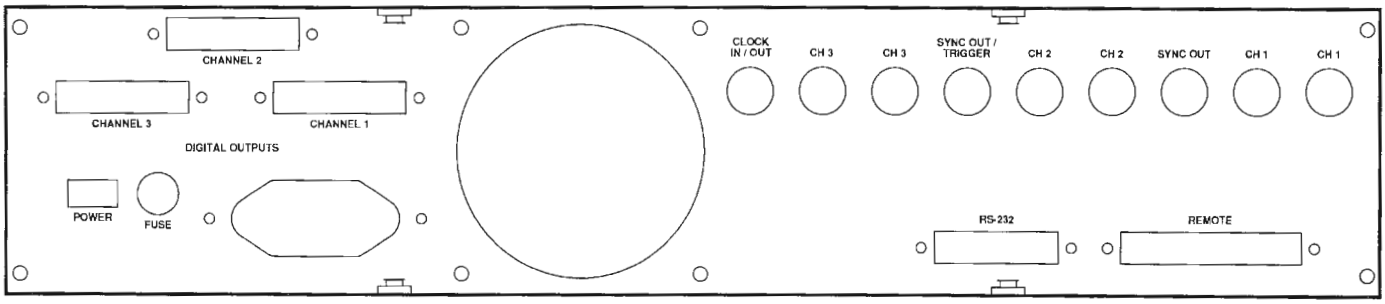
Template for a value change of a sine squared step.

TEST SIGNAL GENERATOR

Output Formats	GBR and Y, P_B, P_R
Levels GBR Y, P_B, P_R	 0 to 700 mV in each channel Y channel: 700 mV P_B, P_R channels: ±350 mV
Amplitude Accuracy Channel match	 ±1% at 700 mV ±0.5%; channels 2 and 3 referenced to channel 1
Frequency Response	±1% to 25 MHz ±2% to 30 MHz
Group Delay Distortion	≤3 ns to 25 MHz
Channel to Channel Delay	Within 1 ns; channels 2 and 3 referenced to channel 1
Field Tilt	≤0.5%
Line Tilt	≤0.5%
Sine Squared Pulses	HAD's accurate within ±2 ns
Pulse to Bar Ratio	1:1 within 1%
Risetimes GBR Y, P_B, P_R	 50 ns ±5 ns all channels Y channel: 50 ns ±5 ns P_B, P_R channels: 100 ns ±10 ns
Blanking Level	0 Vdc ±50 mV
Spurious Signals	<5 mV to 30 MHz <7 mV above 30 MHz
Output Impedance	75 Ω
Return Loss	≥40 dB to 30 MHz

TEST SIGNALS

Color Bars GBR 100% GBR 75% Y, P_B, P_R 100% Y, P_B, P_R 75%	 700 mV all channels 525 mV all channels 700 mV luminance ±350 mV color difference 525 mV luminance ±262.5 color color difference
Pluge GBR and Y P_B, P_R	 0, 175, 350, 525, and 700 mV amplitude references; ±35 mV black level sets; 840 mV clip indicators ±420 mV clip indicators
Vertical Reverse Color Bars	Color bars in horizontal picture display format going from white to black on the left side of the display and black to white on the right side of the display
Color Palette	Standard color chart for camera and monitor comparisons
Convergence Pattern 5% overscan marks 8% overscan marks	 Vertical and horizontal lines with dots and 5% overscan marks Vertical and horizontal lines with dots and 8% overscan marks



TSG 1000 Series Back Panel.

TEST SIGNALS (continued)

Grey Scale	0, 233, 466, and 700 mV levels on a 100 mV background
Red Field	100% amplitude red
Linearity Signals 5 step staircase Ramp Valid 5 step Valid ramp GBR and Y P_B, P_R	 700 mV ±350 mV
Shallow Ramp	70 mV p-p centered around 0 V Variable pedestal: GBR and Y: ±700 mV P_B, P_R: ±350 mV
Black Field White Field	0 V all channels GBR and Y: 700 mV P_B, P_R: 0 V Variable pedestal: GBR and Y: ±700 mV P_B, P_R: ±350 mV
2T30 Pulse & Bar GBR and Y P_B, P_R 2T pulse HAD 2T bar risetime 4T pulse HAD 4T bar risetime	 700 mV ±350 mV 33.33 ns 26.0 ns 66.66 ns 52.0 ns
Multipulse Amplitude Frequencies	 GBR and Y: 700 mV P_B, P_R: ±350 mV GBR and Y: 5, 10, 20, and 25 MHz P_B, P_R: 2.5, 5, 10, and 12.5 MHz
Multiburst Amplitude Frequency Low range Mid range	 GBR and Y: 700 mV P_B, P_R: ±350 mV GBR and Y: 1, 2, 3, 4, and 5 MHz P_B, P_R: 0.5, 1, 1.5, 2, and 2.5 MHz GBR and Y: 5, 10, 15, 20, and 25 MHz P_B, P_R: 2.5, 5, 7.5, 10, and 12.5 MHz

TEST SIGNALS (continued)

High range	GBR and Y: 26, 27, 28, 29, and 30 MHz P_B, P_R: 13, 13.5, 14, 14.5, and 15 MHz
Line Frequency Sweeps 100% amplitude 60% amplitude Frequency Range One line sweeps Two line sweeps Frequency Markers 1 to 30 MHz sweeps 1 to 15 MHz sweeps 15 to 30 MHz sweeps	 GBR and Y: 700 mV P_B, P_R: ±350 mV GBR and Y: 420 mV P_B, P_R: ±210 mV GBR and Y: 1 to 30 MHz 1 to 15 MHz 15 to 30 MHz P_B, P_R: 0.5 to 15 MHz 0.5 to 7.5 MHz 7.5 to 15 MHz GBR and Y: 1 to 15 and 15 to 30 MHz P_B, P_R: 0.5 to 7.5 and 7.5 to 15 MHz GBR and Y: 5, 10, 15, 20, and 25 MHz P_B, P_R: 2.5, 5, 7.5, 10, and 12.5 MHz GBR and Y: 3, 6, 9, and 12 MHz P_B, P_R: 1.5, 3, 4.5, and 6 MHz GBR and Y: 18, 21, 24, and 27 MHz P_B, P_R: 9, 10.5, 12, and 13.5 MHz
Bowtie Timing Amplitude Frequencies Timing markers	 GBR and Y: 700 mV P_B, P_R: ±350 mV G and Y: 5 MHz B, R, P_B, P_R: 5.001 MHz 5 each 1 ns markers on either side of channel coincidence

DIGITAL OUTPUTS

Sampling Frequency TSG 1050 TSG 1250 TSG 1125	 72.0 MHz 72.0 MHz 74.25 MHz
Digital Coding	10 bit linear PCM
Output Format	Balanced ECL (10K Series); 10 data pairs, 1 clock pair
Connector	25 pin D female

VITS 201 Front Panel.

VITS 201
PAL Insertion Generator

Low cost

Digital composite signal generation

CCIR, EBU, UK National ITS

Operates in the presence of sound in syncs

Five external ITS inputs

Source identification

Program line sync and burst regeneration

Loss of program input modes:
- **External input to program out**
- **Internal generator to program out**
- **Program line bypass**

User programmable text generator provides:
- **Message in program line vertical interval**
- **Message in active picture area for loss of program input modes**

User programs for:
- **Insertion of internal, external, and source identification signals**
- **Loss of program input modes**
- **Text insertion**

All user program settings saved in non volatile storage

Matched bypass/operate delay

Monitor output

Remote control

The VITS 201 is a low cost, high quality ITS generator and inserter/deleter with features found only in the most expensive transmission grade ITS inserters. In addition to a solid basic generator/inserter unit, the VITS 201 provides loss of program continuity modes, multiple inputs for external data insertion, source identification, a text generator for message insertion, and a versatile programmer with non volatile memory storage for setting up the unit's operation and loss of program modes.

Test Signal Generator

The VITS 201 uses digital signal generation and a precision 12 bit DAC to ensure signal accuracy and long term stability. Digital generation of the composite signal with conversion to analog using a single DAC ensures accurate chrominance to luminance gain and timing. The VITS 201 generates the following signals:

- CCIR 17, 18, 330, and 331
- U.K. National
- 75% color bars
- Sin x/x
- Proposed one line ITS with modulated 5 step
- Proposed one line ITS with provisions for external data insertion
- 0% and 100% luminance levels

Inserter/Deleter Functions

The VITS 201 may be programmed to insert any internally generated signal, external input, or the source identification signal on any line from 6 through 30 and 319 through 343. If desired, the same signal or external input may be programmed for insertion on multiple lines. This may be useful in insertion of teletext and other data signals. On the proposed one line ITS signal, provision is made to insert an externally generated data signal on the last portion on the internally generated ITS line.

Five external ITS inputs are provided for insertion of externally generated test and data signals. All inputs are AC coupled and clamped. The VITS 201 assumes the external input signals are locked to the program signal and correctly timed.

Delete and pass functions are available for the same lines as the insert function.

Program Channel

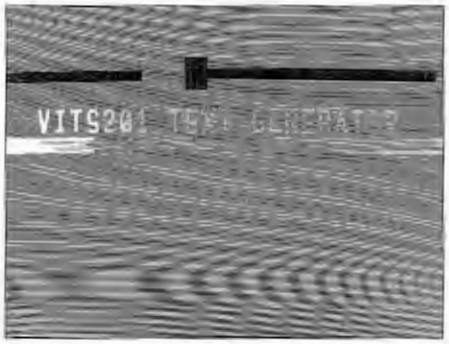
Maintaining transparency and continuity of the program channel are prime considerations in the VITS 201. Distortions and transients are virtually eliminated by the Tektronix developed channel switch integrated circuit. Insertion or deletion of ITS can occur only when genlock to the program input signal is attained. Loss of mains power or genlock causes the program line to be bypassed. Program signal delay in operate and bypass is matched.

The VITS 201 provides for replacement of the program line sync and burst signals with the internally generated sync and burst signals. This ensures the proper amplitude relationship of the inserted ITS to the sync and burst signals is established prior to inputting the signal to the broadcast transmitter or transmission system. Timing of the active video to the blanking interval is not affected in the sync and burst regeneration mode.

Loss of the program input signal will automatically enable one of three program line output states:

- Program line bypassed
- A user selected external input will be routed to the program line output
- A user selected internally generated signal will be routed to the program line output

When an internally generated signal is selected, a message may be superimposed over the active picture area. The message is generated by the VITS 201 text generator. Restoration of the program line input signal will terminate the program line continuity action and resume normal operation.

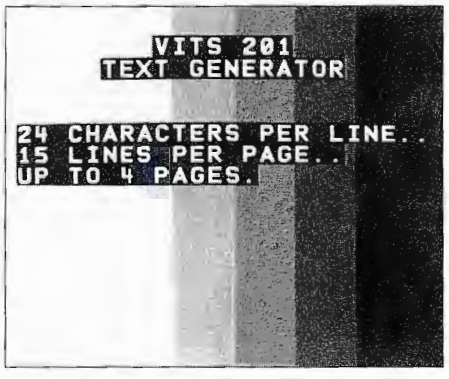


Vertical interval text.

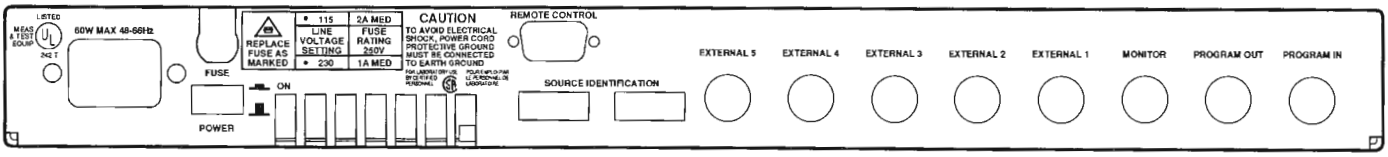
Text Generator

Should the program input line be interrupted, text may be inserted over the internally generated signal selected as the temporary program line replacement. The VITS 201 internal text generator provides up to four pages of text with a maximum of fifteen lines per page. Text insertion of a single line of 26 characters in vertical blanking is available in the normal operating mode. Remote control of page select, page text on/off, and vertical interval text on/off is provided.

The text generator font set consists of 120 characters and symbols, each a 32 × 32 pixel array.



Full field text.



VITS 201 Rear Panel.

Source Identification

The VITS 201 provides a one line 16-bit source identification code. The bits may be set in any high/low sequence providing up to 65,536 possible codes. Setting of the code is done with DIP switches accessible through the rear panel. The identification signal may be placed on any of the available lines in vertical blanking. The VM700A Video Measurement Set utilizes this signal for identification of sources on displays and print outs of measurement routines.

Remote Control

Ground closure remote control of the following functions is provided:

- Bypass/operate
- Full field text page select
- Full field text on/off
- Vertical interval text on/off

Indicator lines for program line bypass, power on, and genlock to program line are provided.

CHARACTERISTICS

PROGRAM CHANNEL

Gain	Unity ±1%
Frequency Response	±1% to 5.5 MHz
Chrominance-to-Luminance Gain	±0.5%
Chrominance-to-Luminance Delay	≤2 ns
Group Delay	≤2 ns to 5 MHz
Diff Phase	≤0.2°
Diff Gain	≤0.2%
Tilt	<0.5%
DC Matching of Program Video to Inserted Signal	±3 mV
Phase Matching of Program Video to Inserted Signal	Within 1° at subcarrier; signal-to-noise ratio of 45 dB or greater
Phase Matching of Relay Bypass Path to Signal Processing Path	Within 3° at subcarrier
Crosstalk	≥60 dB down
Switching Transients	≤2 mV
DC Output Level	0 V DC ±10 mV
Input Impedance	75 ohms
Return Loss	36 dB to 5 MHz

EXTERNAL INPUTS

Gain	Unity ±1%
Frequency Response	±1% to 5.5 MHz
Chrominance-to-Luminance Gain	±0.5%
Chrominance-to-Luminance Delay	≤5 ns
Group Delay	≤2 ns to 5 MHz
Diff Phase	≤0.2°
Diff Gain	≤0.2%
Tilt	<0.5%
DC Output Level	0 V DC ±10 mV
DC Matching of Program Video to Inserted Signal	±10 mV; AC coupled and clamped
Crosstalk	≥60 dB down
Switching Transients	≤2 mV
Input Impedance	75 ohms
Return Loss	36 dB to 5 MHz

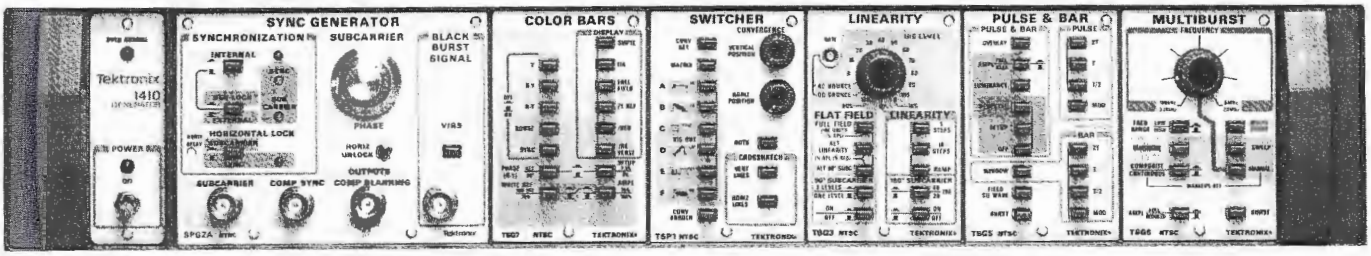
TEST SIGNAL GENERATOR

Luminance Amplitude Accuracy	±1%
Frequency Response	±1% to 5.5 MHz
Chrominance-to-Luminance Gain	±0.5%
Chrominance-to-Luminance Delay	≤5 ns
Group Delay	5 ns to 5 MHz
Diff Gain	≤0.3%
Diff Phase	≤0.3%
Tilt	≤0.5%
Output Impedance	75 ohms
Return Loss	36 dB to 5 MHz

ORDERING INFORMATION

When ordering, please use the nomenclature given here:

VITS 201 PAL Insertion Generator



1410R Option 04 Test Signal Generator.

1410R/ 1411R/1412R

NTSC/PAL/PAL-M

Five Test Signal Generators and One Switcher

Conforms to EIA Standard RS-170A (1410R)

700 mV White Level on Field 1, Line 7 (1411R)

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)

Parallel Test Signal Outputs

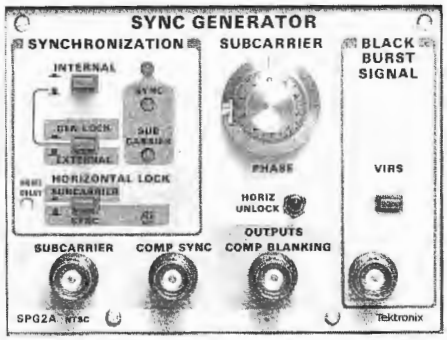
The 1410R Series sync and test signal generators are precision generators for use in studios, remote vans, maintenance facilities and anywhere high quality sync or test signals are required.

1410R SERIES PRODUCTS

	Color Standard		
Description	NTSC	PAL	PAL-M
Mainframe	1410R	1411R	1412R
Sync Pulse Generator	SPG2A	SPG12A	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

SPG2A/SPG12A/SPG22

Sync Pulse Generators



The SPG2A, SPG12A 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 (SPG12A, 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 of the generator outputs can be set for zero error or offset to match the SCH phase of the incoming genlock signal.

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.

Internal adjustments permit some variation of burst and blanking widths on the burst flag, comp blanking, and black burst outputs.

TSG7/TSG11/TSG21

Color Bars Generator

Color Bars Signals

SMPTE Color Bars (TSG7)

EIA (TSG7)

Fixed Full Field (TSG11/TSG21)

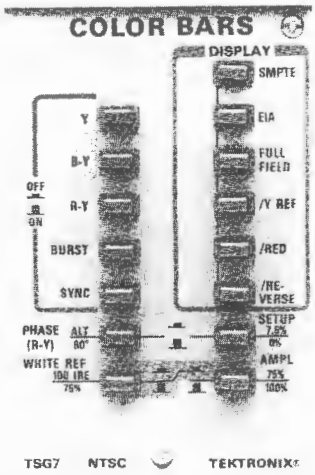
Full Field with Switchable Components

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 1410R series signal generators. Fixed configuration signals are available for operational environments such as post production. For lab and maintenance facilities, front panel control of luminance and chrominance signal components provides the flexibility to meet most engineering and testing requirements.

The split field bars/Y reference signal provides a convenient means for simultaneous checking of picture monitor color performance and gray scale tracking.

The split field bars/red field signal is useful in detection of VTR noise and moire.

The SMPTE Bars signal provides an easy way to adjust picture monitor chroma, hue, and brightness.

TSG2/TSG12
Convergence Test Signal Generators

Dots and Crosshatch

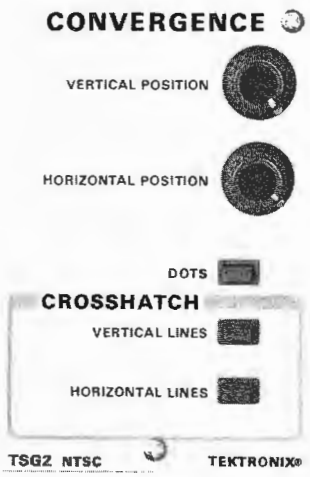
Dots Only

Vertical Lines Only

Horizontal Lines Only

Vertical and Horizontal Lines

Position Controls



The TSG2 and TSG12 provide high-quality convergence test signals for the 1410R 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.

TSG3/TSG13/TSG23
Linearity and Modulated Pedestal Test Generators

5 Step and 10 Step Staircase Signal

Ramp Signal

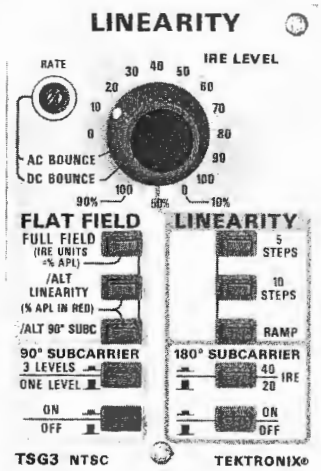
2 Modulation Amplitudes

One or Three Level Modulated Pedestal

Flat Field with 11 Fixed Levels

AC and DC Bounce

Variable APL



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

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. Applications include measuring differential phase and gain, dynamic gain, luminance linearity, and burst phase errors.

On the ac Bounce signal, the active portion of each line (excluding sync) changes APL levels at a rate determined by the rate control (1 second to 30 second intervals). Blanking level remains fixed at 0 V. To check ac coupled circuitry use ac bounce.

On the dc bounce signal, 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

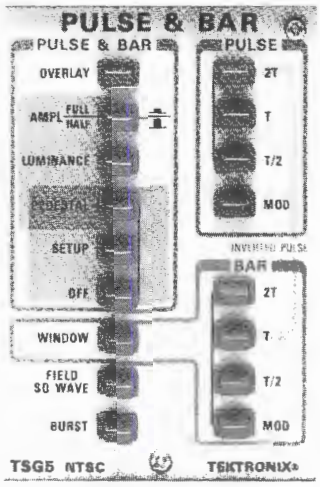
Pulse and Bar Overlay

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



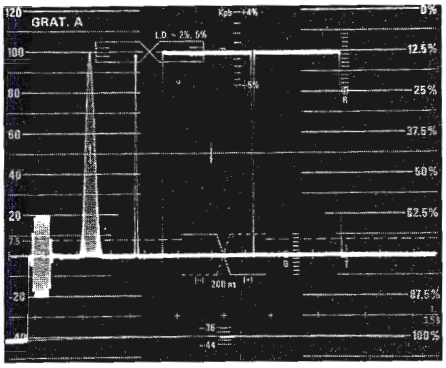
The TSG5, TSG15, and TSG25 are $\sin^2$ pulse and bar television test signal generators designed for use with the 1410R Series signal generators.

The pulse and bar test signal consists of a $\sin^2$ modulated pulse, a $\sin^2$ 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.

Front panel selection of pulse HAD and bar risetime is provided. In addition, half amplitude signals may be selected for testing in environments where non-linearities may affect measurement of linear parameters.

Other TSG5 applications include measurement of video gains; short time, line time, and field time distortion, and chrominance to luminance delay and gain.



Sin² Pulse and Bar with Inverted Pulse.

TSG6/TSG16/TSG26
Multiburst Signal Generators

Multiburst Signal

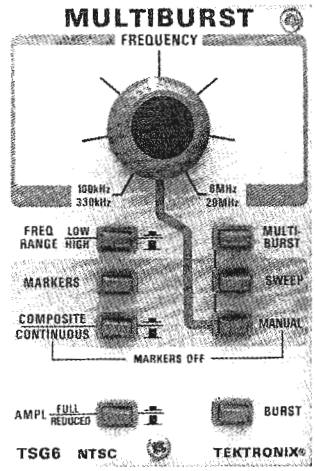
Controlled Risetime Burst Packets

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



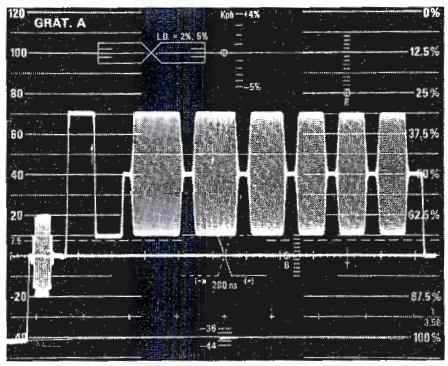
The TSG6, TSG16 and TSG26 are television multiburst and video sweep test signal generators designed for the 1410R Series signal generators.

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.

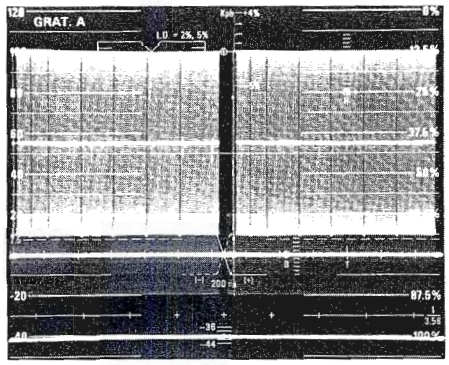
Use these generators where nonlinearities make reduced amplitude test signals desirable. The reduced amplitude multiburst signal allows accurate testing of video tape record/playback systems, since it is not subject to the false distortion of the full amplitude multiburst that often occurs in such applications.

High and low frequency bands are provided for both the multiburst and sweep signals. Amplitude and frequency markers may be added to the sweep signal.

Color burst and the horizontal and field sync signals may be removed when non-composite signals are required.



Reduced Amplitude Multiburst.



Field Rate Sweep Showing Amplitude and Frequency Markers.

TSP1/TSP11/TSP21

Switchers and Convergence Generators

Single Switchable Output for Two to Six Generated Signals

Blanking, Sync and Burst Insertion for External Signal

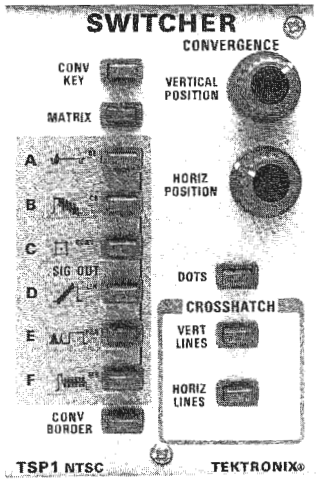
Matrixing — Eight Programmed Display Formats to up to Six Sequential Signals

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 1410R Series signal generators.

From a single, electronically switched output, you have access to all the test signals 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 non-composite). 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

1410R Subcarrier — Frequency (F_{SC}): 3.579545 MHz ±1 Hz. Pull-in Range: F_{SC} ±20 Hz.

1411R Subcarrier — Frequency F_{SC}: 4.43361875 MHz ±1 Hz. Drift ≤1 part in 10^7 per week. Pull-in Range: F_{SC} ±20 Hz.

1412R Subcarrier — Frequency F_{SC}: 3.57561149 MHz ±1 Hz. Drift ≤1 part in 10^7 per week. Pull-in Range: F_{SC} ±20 Hz.

PULSE OUTPUTS

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

Return Loss — ≥30 dB to 5 MHz.

Risetime and Falltime — 10% to 90% (Linear Ramp). 140 ns, (1410R, 1412R). 250 ns (1411R — Other values internally selectable).

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

Outputs — Comp sync, comp blanking, burst flag, H drive, V drive, Field reference, 1411R/1412R only: PAL pulse, V/2, V/4, and 64H.

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 (1410R); −300 mV ±3 mV (1411R, 1412R) from blanking. Burst: 286 mV ±2.86 mV (1410R). Absolute: 300 mV ±9 mV. Setup: 53.57 mV ±3.57 mV (1410R), 0% (1411R), 50 mV ±2.5 mV (1412R).

VIR Signal — (1410R Only) Chrominance Amplitude (40 IRE); phase within 0.5° of burst; envelope risetime Sin^2 shaped 1 μs ±150 ns. Luminance: Setup level (7.5 IRE ±0.5 IRE); gray level (50 IRE ±0.5 IRE); chroma pedestal (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 (1410R); ≥40 dB to 7 MHz (1411R); ≥40 dB to 5 MHz (1412R).

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).

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.

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).

Ten-Step Signal — Step Amplitudes Nominal: 71.5 mV (TSG3); 70 mV (TSG13, TSG23).

Ramp Signal — Linearity: ±1%.

Linearity Subcarrier — Absolute Amplitudes: ±3%. Relative Amplitudes: ±1%. 20 IRE: (TSG3); 140 mV (TSG13, TSG23). 40 IRE: (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: one level is 5 IRE to 20 IRE (TSG3); low level is internally adjustable (TSG13, TSG23). Three Levels: 20 IRE, 40 IRE and 80 IRE (TSG3); 140 mV, 420 mV and 700 mV (TSG13, TSG23).

Bounce Modes — Ac: Rate, $-\%_6$" to ½ Hz. Dc: Rate, slow $-\%_6$" to ½ Hz. Dc Rate, Fast Selectable: Line rate, field rate, or frame rate.

PULSE AND BAR GENERATOR (TSG5, TSG15, TSG25)

	Full Amplitude	Half Amplitude
Luminance Bar Amplitude Setup Off	714.3 mV	357.1 mV
(TSG5)	±7.1 mV	±3.6 mV
(TSG15, TSG25)	700.0 mV	350.0 mV
	±7.0 mV	±5.3 mV
Modulated Bar Amplitude		
Setup Off Luminance	357.1 mV	178.6 mV
(TSG5)	±3.6 mV	±1.8 mV
(TSG15, TSG25)	350.0 mV	175.0 mV
	±3.5 mV	±1.8 mV
P-P Chrominance	714.3 mV	357.1 mV
(TSG5)	±14.3 mV	±7.1 mV
TSG15, TSG25)	700.0 mV	350.0 mV
	±14.0 mV	±7.0 mV
Pulse Amplitude Setup Off		
2T (TSG5)	714.3 mV	357.1 mV
	±7.1 mV	±5.4 mV
−2T, T	714.3 mV	357.1 mV
	±10.7 mV	±7.1 mV
T/2	714.3 mV	347.1 mV
	±14.3 mV	±14.3 mV
Modulated	714.3 mV	357.1 mV
	±7.1 mV	±5.4 mV
2T (TSG15, TSG25)	700.0 mV	350.0 mV
	±7.0 mV	±5.3 mV
−2T, T	700.0 mV	350.0 mV
	±10.5 mV	±7.0 mV
T/2	700.0 mV	340.0 mV
	±14.0 mV	±14.0 mV
Modulated	700.0 mV	350.0 mV
	±7.0 mV	±5.3 mV
Pulse to Bar Ratio 2T	1:1 ±0.005	1:1 ±0.01
−2T, T	1:1 ±0.01	1:1 ±0.02
T/2	1:1 ±0.02	1:1 ±0.04
Modulated Pulse to Modulated Bar	1:1 ±0.01	1:1 ±0.02

Modulated Pulse and Bar — Chrominance-Luminance Gain: 3.6 mV (3.5 mV for TSG15, TSG25) maximum amplitude difference of peak chrominance and peak luminance. Delay Residual: 5 ns maximum.

Window — Line Timing: Bar Timing.

Field Timing: White lines from line 67 to line 218 (line 65 to line 270 for TSG15, line 64 to line 215 for TSG25) each field. Field Tilt: 0.5% maximum.

Field Squarewave — Field Timing: White line 75 to line 206 (line 65 to line 221 for TSG15, line 64 to line 215 for TSG25). Field Tilt: 0.5% maximum.

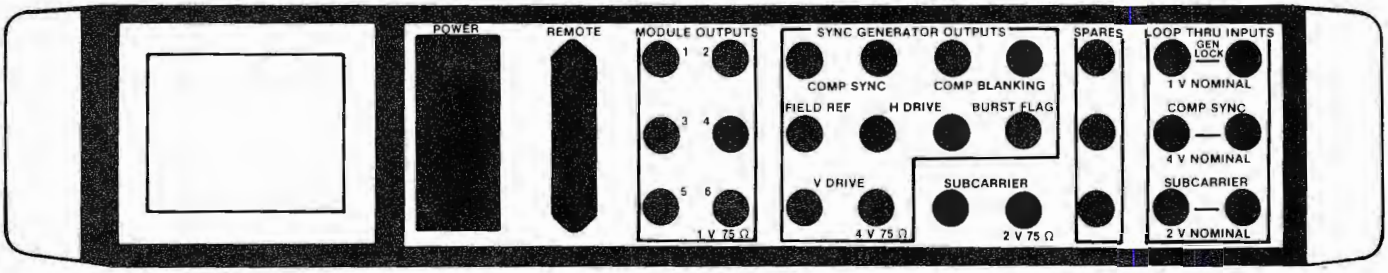
MULTIBURST SIGNAL GENERATOR (TSG6, TSG16, TSG26)

	Low Range	High Range
Multiburst Frequencies	500 kHz ±3%	1.25 MHz ±3%
(TSG6)	1.25 MHz ±3%	3.50 MHz ±3%
	2.00 MHz ±3%	5.50 MHz ±3%
	3.00 MHz ±3%	8.00 MHz ±3%
	3.58 MHz ±3%	10.0 MHz ±3%
	4.10 MHz ±3%	12.0 MHz ±3%
(TSG16)	500 kHz ±3%	1.00 MHz ±3%
	1.00 MHz ±3%	3.00 MHz ±3%
	2.00 MHz ±3%	5.00 MHz ±3%
	4.00 MHz ±3%	8.00 MHz ±3%
	4.80 MHz ±3%	10.0 MHz ±3%
	5.80 MHz ±3%	12.0 MHz ±3%
(TSG26)	500 kHz ±3%	1.00 MHz ±3%
	1.00 MHz ±3%	3.00 MHz ±3%
	2.00 MHz ±3%	5.50 MHz ±3%
	3.00 MHz ±3%	8.00 MHz ±3%
	3.58 MHz ±3%	10.0 MHz ±3%
	4.20 MHz ±3%	12.0 MHz ±3%
Amplitude (First Multiburst Packet) Full (TSG6)	643 mV (90 IRE) ±20 mv	643 mV ±25 mV
(TSG16., TSG26)	700 mV ±21 mV	700 mV ±28 mV
Reduced (TSG6)	428 mV (60 IRE) ±12 mV	428 mV ±16 mV
(TSG16, TSG26)	420 mV ±12 mV	420 mV 16 mV
Flatness, Reduced and full (TSG6)	10 mV or less	16 mV or less
(TSG16, TSG26)	10 mV or less	17.5 mV or less
Packet Envelope Risetime	400 ns ±60 ns	400 ns ±60 ns
Burst Phasing	Phase shifted at field rate to provide filled-in burst packets.	
Sweep/Manual Sinewave Frequencies		
Start	100 kHz minimum	330 kHz minimum
Stop	6 MHz ±10%	20 MHz ±10%
Markers Frequencies	500 kHz ±3%*1	1.0 MHz ±3%*1
	1.0 MHz ±3%*1	2.0 MHz ±3%*1
	2.0 MHz ±3%*1	2.0 MHz ±3%*1
	3.0 MHz ±3%*1	4.0 MHz ±3%*1
	4.0 MHz ±3%*1	8.0 MHz ±3%*1
	5.0 MHz ±3%*1	10.0 MHz ±3%*1
		12.0 MHz ±3%*2
		14.0 MHz ±3%*2
		16.0 MHz ±3%*2
		18.0 MHz ±3%*2
		20.0 MHz ±3%*2
Harmonic Distortion (Single Frequency Relative to Fundamental (TSG6, TSG26)	−44 dB, 0.3 to 4.2 MHz −40 dB, 0.1 to 0.3 MHz −40 dB, 4.2 to 6.0 MHz	−38 dB, 0.33 to 6.0 MHz −36 dB, >6 to 20 MHz
(TSG16)	43 dB, 300 kHz to 5.0 MHz −40 dB, 100 kHz to 300 kHz −40 dB, 5.0 MHz to 6.0 MHz	−38 dB, 330 kHz to 6.0 MHz −36 dB, 6 MHz to 20 MHz

*1 *Within one television line either side of the marker*

*2 *Above 10 MHz, difference frequency between markers is 2 MHz ±400 kHz.*

*3 *Maximum-minimum diode detected peak-to-peak voltages.*



Rear Panel of the 1410R.

SIGNAL SWITCHER (TSP1, TSP11, TSP21)

Input Signal — Amplifier Limits: 1.4 V p-p. Input Return Loss: ≥30 dB, to 5 MHz.

Input Isolation: ≥50 dB, internal inputs. Input impedance: 75Ω.

Switcher Output Signal — Timing: Same as inputs, delayed by ±10 ns (10° to 20° of subcarrier). Amplitudes: Within 2% of inputs. Blanking dc Level: 0 V ±100 mV.

AC POWER

Mains Voltage Ranges — 90 V ac to 112 V ac. 106 V ac to 132 V ac, 180 V ac to 224 V ac and 212 V ac to 250 V ac. Factory set at 106 V ac to 132 V ac (1410R, 1412R), 212 V ac to 250 V ac (1411R).

Power Consumption — 130 W maximum.

Mains Frequency — 47 Hz to 63 Hz.

ENVIRONMENTAL

Temperature Range — Operating: 0°C to +50°C. Non-operating: −40°C to +65°C.

Altitude Range — Operating: Sea level to 4600 m (15,000 ft). Non-operating: Sea level to 15,000 m (50,000 ft).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	88	3.5
Width	483	19.0
Depth	488	19.2
Weight (w/Plug-Ins)	**kg**	**lb**
Net	9.7	21.2
Shipping	21.4	47.1

SAFETY CERTIFICATIONS

Underwriters Laboratories, Inc.: Listed, 242T; Canadian Standards Association: Certified, LR37158; International Electro-technical Commission (IEC 348): Certified by Tektronix, Inc.

ORDERING INFORMATION

1410R NTSC PACKAGES STANDARD CONFIGURATIONS

	Option 03	Option 04
TSG2 (Convergence)	x	
TSG3 (Linearity)	x	x
TSG5 (Pulse and Bar)		x
TSG6 (Multiburst)		x
TSG7 (Color Bars)	x	x
TSP1 (Switcher)		x

1410R NTSC Mainframe and SPG2A

Includes: Extender board (670-4441-02); 1.5 A fuse (159-0016-00); 0.75 A fuse (159-0042-00); rackmount hardware; instruction manual.

OPTIONS

Option 03*1 — NTSC Package Installed and Tested Together.

Option 04*1 — NTSC Package Installed and Tested Together.

Option 1B — Adds TSG7 Installed.

Option 1S — Adds TSP1 Installed.

Option 2C — Adds TSG2 Installed.

Option 3L — Adds TSG3 Installed.

Option 4M — Adds TSG6 Installed.

Option 4P — Adds TSG5 Installed.

**1 Cannot be combined with any other option.*

Convergence Generator — Order TSG2.
Linearity Generator — Order TSG3.
Pulse and Bar Generator — Order TSG5.
Multiburst Generator — Order TSG6.
Color Bars Generator — Order TSG7.
Switcher — Order TSP1.

ORDERING INFORMATION

1411R PAL PACKAGES STANDARD CONFIGURATIONS

	Option 03	Option 04
TSG11 (Color Bars)	x	x
TSG12 (Convergence)	x	
TSG13 (Linearity)	x	x
TSG15 (Pulse and Bar)		x
TSG16 (Multiburst)		x
TSP11 (Switcher)		x

1411R PAL Mainframe and SPG12A

OPTIONS

Option 03*1 — PAL Package Installed and Tested Together.

Option 04*1 — PAL Package Installed and Tested Together.

Option 1B — Adds TSG11 Installed.

Option 1S — Adds TSP11 Installed.

Option 2C — Adds TSG12 Installed.

Option 3L — Adds TSG13 Installed.

Option 4M — Adds TSG16 Installed.

Option 4P — Adds TSG15 Installed.

**1 Cannot be combined with any other option.*

Color Bars Generator — Order TSG11.
Convergence Generator — Order TSG12.
Linearity Generator — Order TSG12.
Pulse and Bar Generator — Order TSG15.
Multiburst Generator — Order TSG16.
Switcher — Order TSP11.

ORDERING INFORMATION

1412R PAL-M PACKAGES

1412R PAL-M Mainframe and SPG22, TSG21

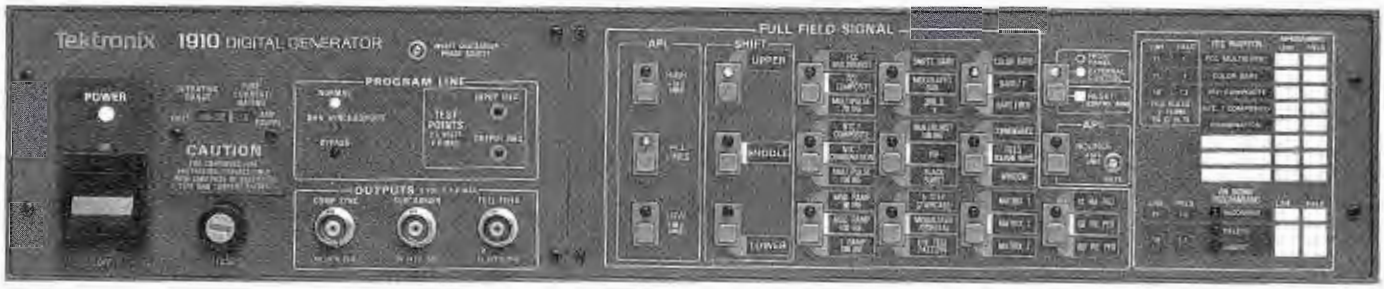
Option 05 — Adds TSG23/TSG25/TSG26/TSP21 Installed.

OPTIONAL ACCESSORIES (FOR ALL CONFIGURATIONS)

Single-Width Blank Panel — Order 333-2171-00.

Conversion Kit for SMPTE Bars — For TSG1 Module. Order 040-1010-00.

Rackmount to Cabinet Conversion Kit — Order 040-1152-00.



1910 Digital Generator.

1910 Digital Generator

Four External VITS Inputs for Insertion of Teletext, Closed Captioning, Source ID, etc.

Nonvolatile Memory to Maintain Selected VITS and Full Field Signal Configuration after Power Interruption

Signal Stored in Replaceable PROMs so Your 1910 won't Become Obsolete

The Accuracy and Stability of an all-Digital 10 Bit Sync and Signal Generation (RS-170A)

User Friendly RS-232C Control Port for Added Versatility

New Signals (Eye Test Pattern, Special Multipulse, Color Multipulse), New Functions (VITS Sequence, Field Sequence) and More

The 1910 Digital Generator is a state-of-the-art test signal generator designed for performance testing of NTSC video systems and equipment. The 1910 is especially suited where high accuracy and stability are required. It is also a VITS inserter (internal and external) with a full complement of signals that allow testing in studio, transmitter, production or research environments.

External interfacing of the 1910 is controlled by an internal microprocessor and its nonvolatile memory. Test signals are stored as 10 bit digital words and converted to analog form by a 10 bit precision DAC to ensure signal accuracy as well as long term stability and repeatability.

Since all signals are stored in replaceable EPROMs, changing needs and industry standards will not cause obsolescence.

Control and versatility of the 1910 are greatly enhanced by the use of its RS-232 control port. Most functions of the 1910 can be controlled, reconfigured and saved. This includes VITS and full field signal selection, matrix signal creation, sequences and other features.

Program Line

The 1910 offers full VITS and VIRS insertion capabilities which can be controlled through the RS-232 control port or through ground closures with the remote control unit. The 1910 may be used to insert either internally or externally generated test signals or data patterns in any combination on lines 10 through 21. Full sync and burst insertion capabilities with accurate SCH phasing eliminate the need for proc amps. When used as VITS inserter, the program line is bypassed upon loss of incoming sync to prevent non-synchronous VITS or sync insertion. The 1910 may be reconfigured so that transmitter protection may be enabled where the loss of incoming sync will automatically cause a test signal to be inserted on the program line to maintain sync continuity until normal operation is restored.

External VITS Inputs

Four terminated inputs are standard in the 1910. Externally generated VITS from another source such as teletext, source ID, closed captioning, etc. can be internally gated and inserted into the program. External VITS can be inserted on any field of lines 10 through 21 as selected by RS-232 control port or the remote control unit.

Pulse Out Feature

This included feature of the 1910 allows the user to change the four external VITS inputs to four pulse outputs for limited camera drive. The outputs available are H Drive, V Drive, Composite Blanking, and Burst Flag. Applications for pulse outputs are remote vans or standBy sync generators. Composite sync and subcarrier outputs are always available.

The 1910 can also be used as a stand-alone signal source that will remain SCH phased and locked to an internal oven-controlled reference.

Remote Control

Remote control via a ground closure interface allows the user to control the full field signals, VITS insertion on lines 14 through 21 (VITS changes are saved in nonvolatile memory), VIR mode, bypass/operate, genlock source, control mode and reset to preprogrammed condition.

Programmability and RS-232 Control Port Features

The 1910 has a friendly command language that allows the user to program its features to meet specific applications. The user does not need to be a programming expert as the 1910 has a language that allows him to concentrate on the applications and not on programming.

The 1910 can be programmed and controlled using an RS-232 terminal. It can also be controlled or run under program control using an RS-232 host computer, including some handheld models or personal computers. The host computer could also be the Tektronix 1980 Automatic Measurement Set which would use the 1910 as a programmable signal source to simulate television equipment or a transmission link.

The 1910 can also be controlled over telephone lines. An auto-answer modem connected to the 1910 will allow the user to take control of the 1910, observe or modify its status and subsequently release control. The control and reconfiguration can also be accomplished automatically by a host computer.

Some of the capabilities offered by the RS-232 port include the ability to redefine the signal selection on the front panels (1910 and remote control unit) to better meet particular user needs, such as placing frequently used signals in a preferred position or in a convenient sequence for calibration; production testing or other special uses.

Nonvolatile Memory

The 1910 has an EEPROM nonvolatile memory (no need for battery back up) where configurations different from the factory set can be saved even if the instrument is powered down or a power failure occurs (a nonvolatile memory retains the information stored in it even if the power has been turned off).

These Special Features are also Available Through the Control Port:

Signal Sequencing

Commands allow the user to program the VITS or full field signals to be displayed for definable periods of time in specific sequences.

Signal Sequence Applications:
An example of color frame sequence would be to set field one to white and the other three fields to black. In this way it becomes simple to identify color field one for an accurate indication of SCH framing. This particular color frame sequence can also test the delay through frame synchronizers, effects generators, etc.

The VITS sequence can optimize the use of the vertical interval by specifying different signals (e.g., test signals, teletext, etc.) for each of the four color fields. One line of the vertical interval can be used to insert up to four signals. These signals may be programmed to change to new signals with the time sequence feature, thus multiplexing many signals onto one vertical interval line.

Sequencing full field or VITS signals provides for manual or automated testing without operator interaction and is useful in generating programmable duty-cycle signals.

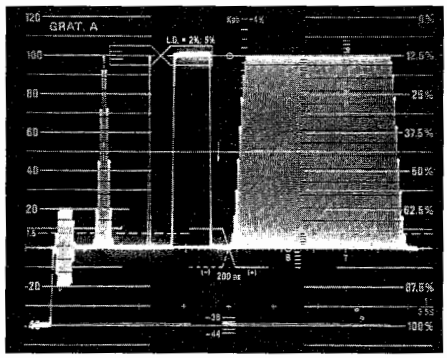
Digital Word Input and Output

The 1910 features a composite digital parallel data input and output. The digital data output provides a 10 bit digital word of the selected test signal. This accurate digital test signal may be used to evaluate and align DACs. It's a useful feature as the error incurred in digitizing an analog signal for this purpose is eliminated. The digital data is not modified to compensate for inadequacies in the analog reconstruction process.

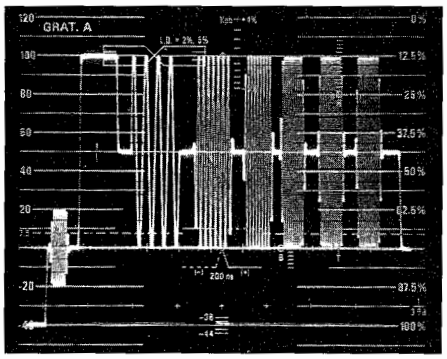
The digital data input will accept a user-generated digital word (up to 10 bits) for conversion to analog with the precision DAC in the 1910. The DAC, with its deglitching circuitry, will yield 10 bit accuracy, 0.6% differential gain and 0.3° differential phase performance.

Diagnostics

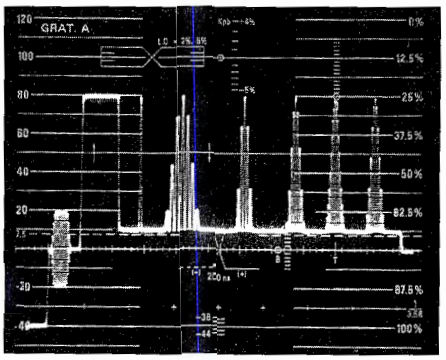
When powering up, the 1910 automatically performs a number of checks to determine if its microprocessor interface is working properly. More extensive internal diagnostics are available for further isolation of faults on an out-of-service basis.



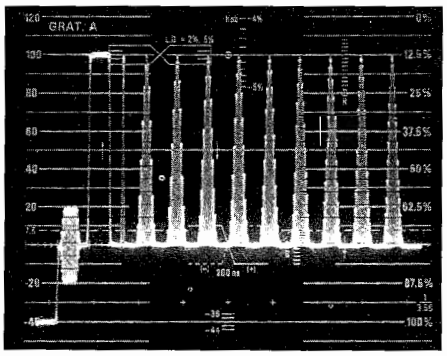
Modulated Bar.



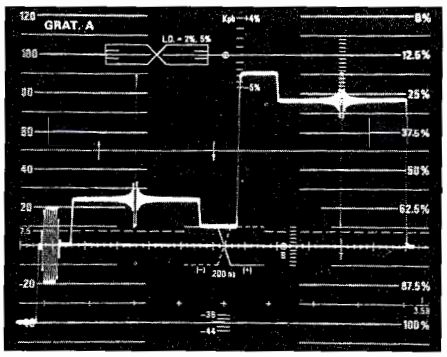
Multiburst 100 IRE.



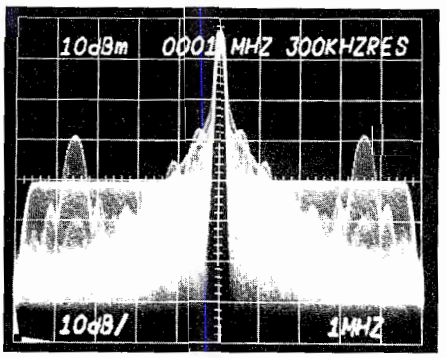
Multipulse 70 IRE.



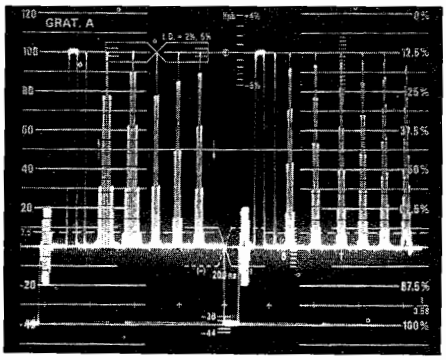
The Color Multipulse allows delay and amplitude measurements through chroma codecs.



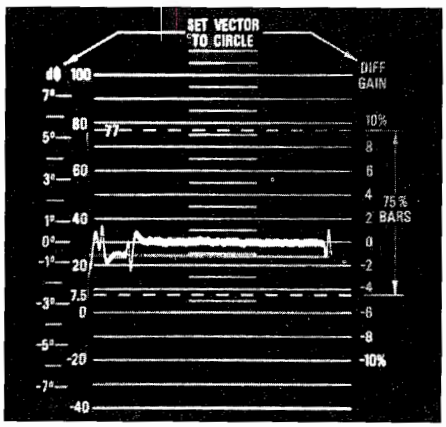
$\frac{\sin x}{x}$ *(Time Domain).*



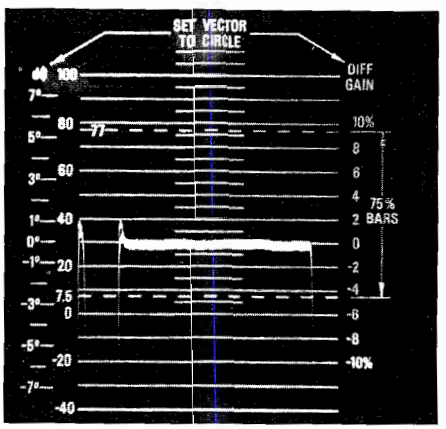
$\frac{\sin x}{x}$ *(Frequency Domain).*



The Special Multipulse has pulses which extend to 6 MHz allowing delay and amplitude measurements past the normal TV channel band edge.



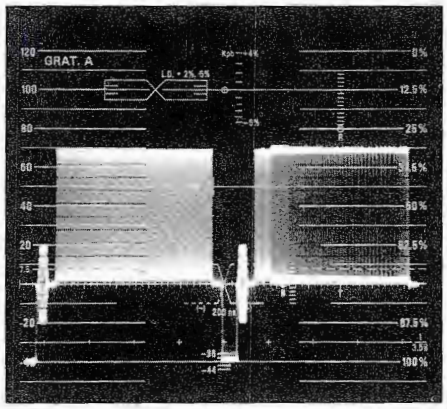
Modulated Ramp — Differential Phase.



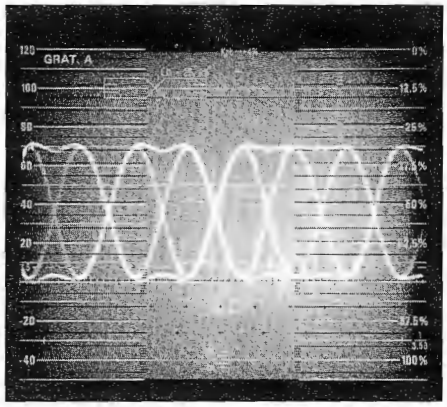
Modulated Ramp — Differential Gain.

EYE HEIGHT DATA TEST SIGNAL

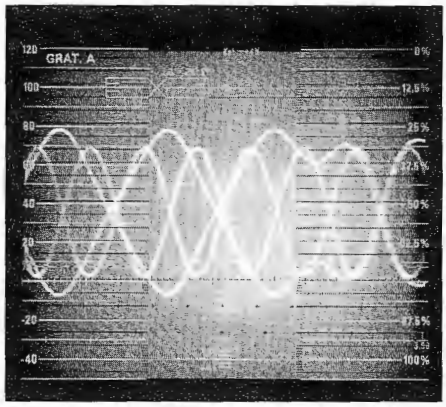
The eye test pattern signal indicates the capability of a system to pass teletext or similar data patterns. Programming the eye test pattern and the eye test reference signals into a VITS or a field sequence allows monitoring for the possibility of data errors. A standard waveform monitor can be used to observe the resulting zero crossings and data height relative to the clock reference.



Eye Test Data Pattern.



Data Pattern and Clock Pattern overlaid with no distortion.



Same position in signal as last photo but through an uncompensated 4.2 MHz low pass filter. Note the time displacement and the amplitude error closing the data pulse's usable window area.

CHARACTERISTICS

PROGRAM CONTROL SYSTEM

VITS INSERTER

Program Line Input Level — 1 V ±3 dB (0.7 V to 1.4 V) into 75 Ω.

PROGRAM LINE/MONITOR OUT

Impedance — 75 Ω nominal.

Hum Rejection — ≥10 dB (≥20 dB user selectable), referenced to 1 V hum.

Keyboard (No Noise) — <0.25 IRE.

Video Gain — Unity gain ±0.5%.

Inserted Pedestal Offset — 0 V hum: ≤2 mV. 1 V hum: ≤10 mV.

Pulse to Bar Ratio — T/2 Pulse to Bar Ratio: 100% ±2%. 1T Pulse to Bar Ratio: 100% ±0.5%. 2T Pulse to Bar Ratio: 100% ±0.25%.

Frequency Response — 0.5% to 5 MHz; 1.0% to 10 MHz; 3.0% to 15 MHz.

Differential Phase (10 APL to 90 APL) — ≤0.15°.

Differential Gain (10 APL to 90 APL) — ≤0.2%.

Random Noise (Weighted) — ≥75 dB (RMS) down, referenced to 1 V.

Spurious Signals During Blanking — Up to 5 MHz (Insertion Transient): ≥40 dB down (≤10 mV). Above 5 MHz (Clock Noise): ≥46 dB down (≤5 mV).

Delete Mode Signal Attenuation — 2T Pulse: ≥70 dB down, referenced to 0.714 V. Subcarrier: ≥60 dB down, referenced to 0.714 V.

Crosstalk (Internal to Program Line) — 2T Pulse: ≥70 dB down, referenced to 0.714 V. Subcarrier: ≥60 dB down, referenced to 0.714 V.

EXTERNAL VITS INPUT

Insertion Gain — Unity: ±1% (into 75 Ω).

Insertion Level — Dc Coupled: ±2 mV.

Frequency Response — Flat within 1% to 5 MHz.

Pulse to Bar Ratio — 2T: 100% ±1%. 1T: 100% ±2%.

External Input Isolation — >60 dB to 5 MHz.

Switching Transients — <10 mV p-p to 5 MHz.

GENLOCK

Source — Program Input or Black Burst Input.

Sync or Burst Amplitude — 40 IRE ±6 dB.

Burst Lockup Range — 3.579545 MHz ±20 Hz (sync must be locked to burst).

Sync Lockup Range — 15.73426 kHz ±0.079 Hz.

Free Run Frequency — 3.579545 MHz ±10 Hz. Temperature controlled, four times subcarrier oscillator normally locked to burst, or sync when burst absent.

Jitter — <5 ns (free run and burst lock mode).

FULL FIELD OUTPUT TIMING

Line Blanking Width — 11.5 μs ±100 ns at 50% amplitude points (measured on 100 IRE Ped).

Front Porch Width — 1.8 μs ±100 ns at 50% amplitude points (measured on 100 IRE Ped).

GENERAL

Output Impedance — 75 Ω nominal.

Dc Level — 0 V ±2 mV (Clamp On); 0 V ±50 mV (Clamp Off).

Luminance Gain — Within ±1%. All luminance levels are digitally defined and will be within ±0.5 LSB (±1.3 mV or ±0.2 IRE) of the correct value relative to the calibrated 100 IRE level.

Chroma Amplitude Accuracy — Within ±0.72% (adjustment accuracy) plus quantizing error.

$$\text{Definition of Quantizing error} = \frac{40\ \text{IRE} \times 0.6\%}{\text{chroma amplitude}}$$

Relative Frequency Flatness — ±0.3% typical from 56 kHz to 5 MHz with 0.714 mV p-p (digital sweep generator and p-p detector). ±1% maximum using 50 IRE Multiburst (500 kHz to 4.2 MHz).

Differential Phase — ≤0.3° using 100 IRE Mod Ramp with 40 IRE p-p subcarrier.

Differential Gain — ≤0.6% using 100 IRE Mod Ramp with 40 IRE p-p subcarrier.

2T Pulse to Bar Ratio — 100% ±1%.

2T Pulse Ringing — ≤1 IRE p-p.

Group Delay Error — ≤10 ns, up to 5.0 MHz.

FULL FIELD AND VITS SIGNALS TEST SIGNAL SPECIFICATIONS

FCC Multiburst and Multiburst 100 IRE — Frequencies: 0.5 MHz, 1.25 MHz, 2.0 MHz, 3.0 MHz, 3.58 MHz and 4.1 MHz.

NTC7 Combination — Frequencies: 0.5 MHz, 1.0 MHz, 2.0 MHz, 3.0 MHz, 3.58 MHz and 4.2 MHz. Chroma: 20 IRE, 40 IRE, 80 IRE at 90°.

Multipulse 100 IRE — Frequencies: Same as NTC7 Combination without 0.5 MHz.

Multipulse 70 IRE — All pulses on a 10 IRE pedestal. Frequencies: Same as FCC Multiburst without 0.5 MHz.

Color Multipulse — Subcarrier frequency for center pulse. Pulses to the left are decreasing in frequency by 300 kHz increments while pulses to the right are increasing in frequency by 300 kHz.

Special Multipulse — Frequencies: 1 MHz through 6 MHz at 500 kHz increments.
NOTE: This signal uses two adjacent lines.

Sin x / x

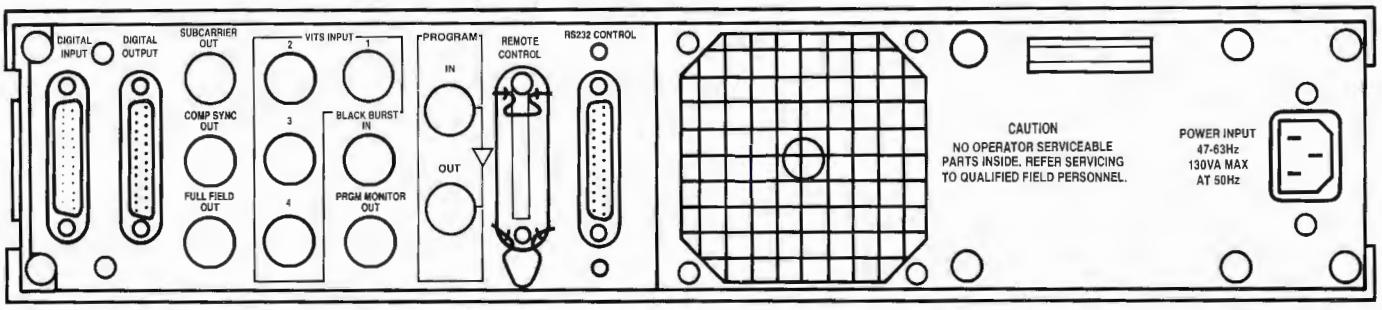
Spectrum: −3 dB at 4.75 MHz. Positive and negative pulses.

FCC Composite — 80 IRE staircase.

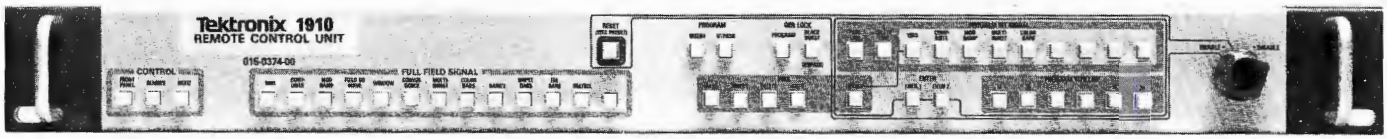
NTC7 Composite — 90 IRE staircase.

Ramp (100, 80) — Luminance: 100/80 IRE. Chroma: 40 IRE at 180°.

Staircase (5 Step, 10 Step) — Luminance: 100 IRE.
Chroma: 40 IRE at 180°.



1910 Rear Panel.



1910 Remote Control Unit.

Inverted Pulse and Bar — Positive and negative 2T pulses.

Modulated Bar — Chroma: 100 IRE at 33°.

Modulated Pedestal — Chroma: 20 IRE, 40 IRE, 80 IRE at 90°.

Color Bars, Y Bars — 75% amplitude, 7.5% setup, 6.5 μs/bar (8 bars).

Red Field — 75% amplitude, 7.5% setup.

Bars/Y — Split field of Color Bars followed by Y Bars.

Bars/Red — Split field of Color Bars followed by Red Field.

EIA Bar — 75% amplitude, 7.5% setup, 7.5 μs/bar (7 bars). SMPTE compatible.

IYQB (with PLUGE) — SMPTE compatible.

Reverse Blue Bars — Blue component of EIA Bar. SMPTE compatible.

SMPTE Bars — Split field of EIA Bar, Reverse Blue Bars, and IYQB.

VIRS — Luminance: 70 IRE, 50 IRE, 7.5 IRE. Chroma: 40 IRE at 180°.

VICR* — Luminance: 50 IRE, 100 IRE, 7.5 IRE. Chroma: 100 IRE at 180°.

Convergence — 14 x 17 crosshatch with dots.

APL, Bounce, Black Burst (7.5), 10 IRE, 25 IRE, 50 IRE and 100 IRE Ped — Full line width.

Field Bar — 100 IRE. 18 μs wide.

Field Squarewave — Same as 100 IRE Pedestal.

Window — Same as Field Bar.

Eye Test Pattern — Test pattern at 5.7 Mbit/s. Risetime: 100 ns.

Eye Test Reference — Alternate "1", "0" pattern at 5.7 Mbit/s. Risetime: 100 ns.

Matrix (Factory Set, but User Redefinable) — Matrix 1: Mod 10 Step, Color Bars, Red Field. Matrix 2: Mod Ramp 100 IRE, EIA Bar, Reverse Blue Bar, Multipulse 100 IRE. Matrix 3: Convergence, EIA Bars, Reverse Blue Bar, Convergence, IYQB, Convergence.

* Vertical interval color reference.

SYNC AND SUBCARRIER OUTPUT

All pulse outputs have negative going output levels of 4 V ±10% into 75 Ω and have a risetime and falltime of 140 ns ±20 ns.

Composite Sync Timing — EIA RS-170A Specifications.

Subcarrier Output — Frequency: See Genlock. Amplitude: 2 V p-p ±10%.

The following optional outputs replace the external VITS input function of the 1910.

Composite Blanking — Horizontal Blanking Width: 10.7 μs ±100 ns. Field Blanking: Field 1 = 21 lines, Field 2 = 21 lines.

Horizontal Drive Timing — Start of line blanking to end of line sync, ±100 ns.

Vertical Drive Timing — Coincident with start of field. Duration: 9 lines.

Burst Flag — Duration: 2.5 μs ±100 ns. Delay from Line Sync: 5.3 μs ±100 ns.

RS-232C INTERFACE

Supports EIA Standard RS-232C format to the extent shown below.

Baud — 300 bit/s, 1200 bit/s, 2400 bit/s or 4800 bit/s.

Input/Output — ASCII, serial, asynchronous data. Full duplex input and output.

Character Length — Eleven bits/character, including a start and two stop bits.

Parity — Input: No parity required and, if present, is ignored. Output: No parity sent.

DIGITAL DATA INTERFACE

Parallel, 12 balanced, signal pairs consisting of 10 bits/sample, a clock, a timing reference signal.

Sampling Frequency — Four times color subcarrier. Nominally 14.3 MHz.

Sampling Phase Angle — Referenced to I axis and Q axis.

Dynamic Range — Ten bits/sample: Blanking level (0 IRE) is at digital word 240. Reference white (100 IRE) is at digital word 800 (5.6 LSB/IRE).

Input Logic Levels Terminated in 100 Ω — 10 k ECL compatible.

Output Logic Levels — 10 k ECL compatible.

Digital Input Timing — Setup and hold times are 10 ns before and after the 50% point of the negative transition of the clock.

Output Clock Timing — The 50% point of the leading edge of the clock pulse preceeds the data by 5 ns ±5 ns.

POWER SUPPLY

Line Voltage Range — 90 Vac to 132 Vac. 180 Vac to 250 Vac.

Maximum Power Consumption — 130 W.

Line Frequency — 47 Hz to 63 Hz.

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in**	**mm**	**in**
Height	96	3.8	88	3.5
Width	442	17.4	486	19.1
Depth	525	20.6	525	20.6
Weight	**kg**	**lb**	**kg**	**lb**
Net	11.6	25.5	12.2	27.0
Shipping	16.7	37.0	16.7	37.0

ENVIRONMENTAL

Temperature — Operating: 0°C to +50°C. Nonoperating: −40°C to +65°C.

Altitude — Operating: To 4572 m (15,000 ft). Nonoperating: To 15,240 m (50,000 ft).

ORDERING INFORMATION

1910 Digital Generator

Includes: Pair of rack slides (351-0636-00); pulse out board (670-8007-00); cabinet hardware (655-3231-00); operator manual (070-4466-00); service manual (070-4523-00).

OPTION

Option 03 — CBC Test Signals.

OPTIONAL ACCESSORIES

Remote Control Unit — Order 015-0374-00.

Interconnecting Cable (6 ft) — Order 012-0108-00.

Interconnecting Cable (22 ft) — Order 012-0251-00.

110-S Video Synchronizer.

110-S
Video Synchronizer

True 10 Bit Accuracy and Resolution

Tracks Signals into the Noise

Optional Four-Field Memory for the Highest Picture Quality

Adaptive Decoding — Minimizes Picture Shifts while Preserving Horizontal and Vertical Detail, Provides Exceptionally High Quality Picture Freeze

Adaptive Clamping — Minimizes Streaking on Noisy Signals

Digitally Precise RS-170A Sync and Burst Insertion

Heterodyne Color Processing

Auto VTR Signal Recognition

Infinite Window Correction Range

Processing Amplifier

Passes the Vertical Interval

Precalibrated Boards in Modular Design

The 110-S Video Synchronizer is a high quality 10 bit, 4X Fsc video synchronizer. The 10 bit architecture, adaptive decoding, and adaptive clamping combine to provide a synchronizer that performs well on noisy signals, minimizes horizontal picture shifts, and is virtually transparent to the processed signal.

10 Bit Precision

A Tektronix-designed 10 bit digitizer and a sampling rate of four times the subcarrier frequency result in negligible quantizing errors, low differential gain and phase, and a flat frequency response. Compared to 8-bit synchronizers, the 110-S has four times the accuracy and resolution. The resulting transparency to the video signal allows cascading of 110-S synchronizers in the signal path with minimum signal degradation.

Tracking Into Noise

When noise from a fading ENG microwave feed or static interference degrades the S/N ratio, the 110-S will continue to track the signal. If the original sync and burst are clean, they may be passed with the original signal. Noisy sync and burst are replaced with precise, digitally-generated RS-170A sync and burst. The 110-S can be configured to track into the noise, freeze field, or go to black upon loss of the incoming signal. As noise increases, the adaptive clamp slows down to prevent horizontal streaking while still responding quickly to hot switches.

Four-Field Memory (Optional)

Four-field memory allows display of full color-frames with correct SCH phase and without decoder artifacts. Four-field storage also enables accurate synchronization without the 140 ns horizontal shift caused by frame overlapping. Freeze frames of one, two, or for maximum resolution, four fields may be selected with the 110-S four-field option.

Adaptive Signal Decoding

Correct color framing on the standard, two-field memory 110-S is maintained with an adaptive comb/notch decoder. Vertical correlation of the picture information (for example a flag pole) allows chrominance/luminance separation to be done by a 3-line comb filter, thus preserving the fine detail in the picture. Absence of vertical correlation in the picture causes the notch decoder to be activated, thus preserving vertical chroma resolution.

TBC Option

The 110-S TBC option adds time base correction for heterodyne color VTR's to the 110-S Synchronizer.

The Auto VTR Signal recognition feature allows the 110-S Synchronizer/TBC to recognize a heterodyne color VTR signal and activate the TBC function. If automatic operation is not desired, the user can force the TBC to operate continuously. When the TBC mode is manually disabled or the input signal has no time base error, the 110-S functions as a standard synchronizer.

With a standard memory capacity of two fields, the 110-S Synchronizer/TBC provides time base correction without feedBack to the VTR. This permits time base correction of remote location VTR feeds as well as backup TBC capability for studio VTR sources.

Processing Amplifier with Remote Control

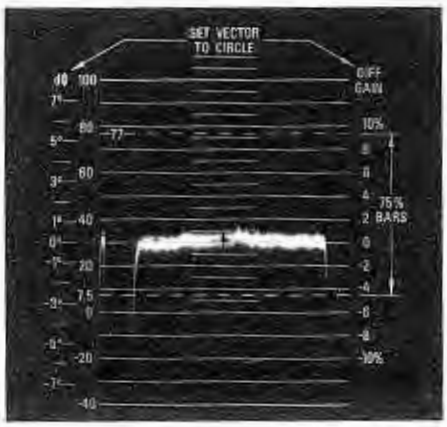
The 110-S processing amplifier provides adjustment of video gain, setup, chroma gain, and hue. Adjustments may be made with internal controls or via a rear panel remote control connector with externally supplied control voltages. The processing amplifer controls are located in the output circuitry and are active in both normal and freeze frame operation. The proc amp controls are included on the 110-RC Remote Control Unit.

Digital Test Ports

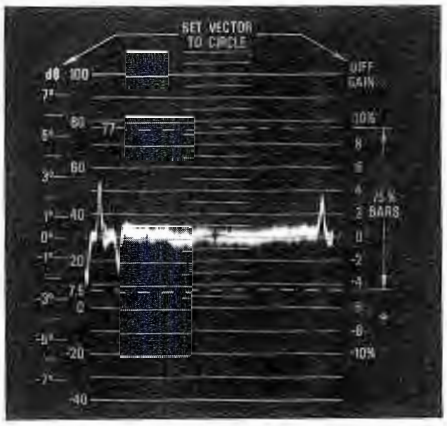
A Digital Test input port allows use of a digital signal from the Tektronix 1910 Series Test Signal Generator to test the decoder and digital-to-analog converter. A Digital Output port enables analysis of the input video signal after it has been digitized by the analog-to-digital converter and processed through memory. This data can drive the DAC in a 1910 Series generator.

Reliable Operation

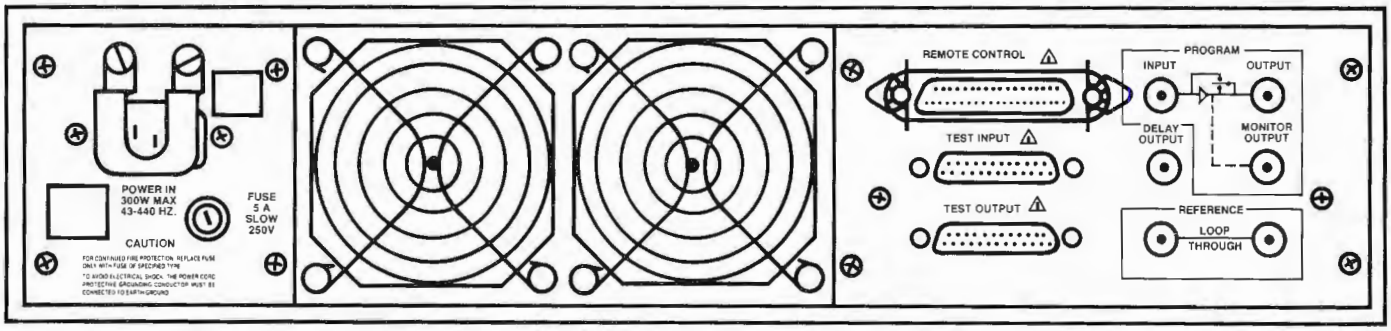
110-S reliability is assured by using high quality components, preconditioned IC's and two-piece connectors. Dual adaptive cooling fans provide overheating protection. The infrequent task of trouble shooting becomes fast



110-S Differential Gain.



110-S Differential Phase.



110-S Rear Panel.

and simple with modular, front-panel loaded circuitry designed so that the 110-S can be repaired without removing it from the rack. Factory precalibration of boards allows them to be replaced without disturbing the calibration of the synchronizer. Built-in diagnostics and input signal condition monitors continually check system status indicating possible problems. Memory error concealment allows in-service compensation of a memory fault, with remaining accuracy and resolution still better than 8 bit synchronizers. The 110-S automatically bypasses the signal when line power is lost.

Audio Delay

An Audio Delay control port allows automatic audio-video delay correction when used with a Tektronix 118-AS Audio Synchronizer.

Quantizing Error Included in Specifications

The industry has neglected the effects of quantizing error on synchronizer product specifications. The following 110-S specifications, however, include quantizing error for a modulated ramp with 40 IRE subcarrier.

CHARACTERISTICS

Digital Sampling — 10 bits at 14.3 MHz (1024 levels at four-times NTSC Subcarrier).

ELECTRICAL
PROGRAM CHANNEL

Gain — Program Output: Unity ±1%.

Frequency Response — ±1% to 4.2 MHz.

Signal-to-Noise Ratio — >60 dB unweighted.

Chrominance/Luminance Gain Error — <1%.

Chrominance/Luminance Delay Error — <10 ns.

Differential Gain — <1%.

Differential Phase — <1°.

2T Pulse K Factor — 0.5%.

2T Pulse to Bar Ratio Error — <1%.

Short Time Distortion — <1%.

Line Time Distortion — <0.5%.

Field Time Distortion — <0.5%.

PROGRAM CHANNEL (TBC OPERATING)

Meets all standard 110-S specifications except as listed below. Specifications reflect performance with a test signal generator input.

Frequency Response — Luminance: −3 dB at 2 MHz. Chrominance: −3 dB at ±600 kHz from 3.58 MHz.

Signal-to-Noise Ratio — >52 dB unweighted.

Differential Gain — 2% maximum.

Differential Phase — 2° maximum.

2T Pulse K Factor — Symmetrical with 5% ringing.

Output Jitter — Luminance: 20 ns maximum. Chrominance: 2° maximum.

PROCESSING AMPLIFIER

Input Gain Range — ±3 dB.

Output Gain Range — ±3 dB.

Setup Range — ±10 IRE.

Hue Adjustment Range — ±20°.

Chrominance Gain Range — ±3 dB.

Signal Correction Timing — Horizontal Blanking: 10.2 μs, 10.7 μs or 10.9 μs (selectable). Vertical Blanking: Start of field through line 21.

Sync and Burst Insertion Timing — Horizontal Insertion: 10.2 μs, 10.7 μs or 10.9 μs (selectable). Vertical Insertion: Start of field through line 9.

Sync and Burst Insertion Amplitude Accuracy — ±1 IRE.

VITS Deletion Timing — Vertical Timing: Line 10 through line 14 (selectable).

ADAPTIVE CLAMP

The adaptive clamp has 32 dB hum rejection in the absence of noise other than hum, and reduces hum rejection in the presence of other noise in order to minimize clamp streaking.

Clamp Speed — Slow: (<20 dB S/N)*−. Settling Time: Within 5 IRE in 30 lines or more. Medium: (<35 dB S/N)*−. Settling Time: Within 5 IRE in 10 lines to 30 lines. Fast: (>35 dB S/N)*−. Settling Time: Within 5 IRE in 2 lines to 3 lines.

*−Approximate signal-to-noise ratio.

CHROMINANCE DECODER

Video Signal Filtering Modes — Pass: Signal unaltered. Comb: Chrominance inverted using 3-line comb filter. Burst is comb decoded. Notch: Chrominance inverted using 9-point transversal notch filter. VITS are notch decoded. Adaptive: Chrominance inverted using combination of notch and comb filters.

SYNCHRONIZER TIMING

Output Timing Range — Horizontal: 13.41 μs advance to 4.40 μs delay. Vertical: Two lines advance to one line delay.

POWER SUPPLY

Line Voltage Range — 90 Vac to 132 Vac; 180 Vac to 250 Vac.

Peak Input Power — 300 W maximum.

Typical Power — 240 W.

ENVIRONMENTAL

Temperature — Operating: 0°C to +50°C. Nonoperating: −55°C to +75°C.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	89	3.5
Width	480	19.0
Depth	510	20.1
Depth (Rackmount)	491	19.4
Weight	**kg**	**lb**
Net	14.8	32.7

Remote Control Interface Functions — Remote Bypass, Manual Freeze, Freeze Field or Frame, Freeze Four-Field, Enable Auto Freeze, Inhibit Decode, Inhibit Sync and Burst Insertion, External Test Data Enable, (Digital Input Port), Status Indicator, Power LED, System Status LED, Proc Amp Active LED, Bypass LED, Hue Control, Setup Level, Chroma Level, Input Gain (ADC), Output Gain (DAC).

TBC Remote Control Interface Functions — TBC On/Off; Enable Auto VTR Signal Recognition; Forced Heterodyne Processing.

ORDERING INFORMATION

110-S Video Synchronizer.

Includes: Power cord (161-0066-00); remote plug 36-pin unwired connector with shell (131-0293-00); one set of rack slides (351-0636-00); circuit board extender (670-7754-00); operator manual, service manual.

OPTIONS

Option 10 — Four-Field Memory Adaptive Decorder.

Option 20 — Adds time base correction for heterodyne color VTR's.

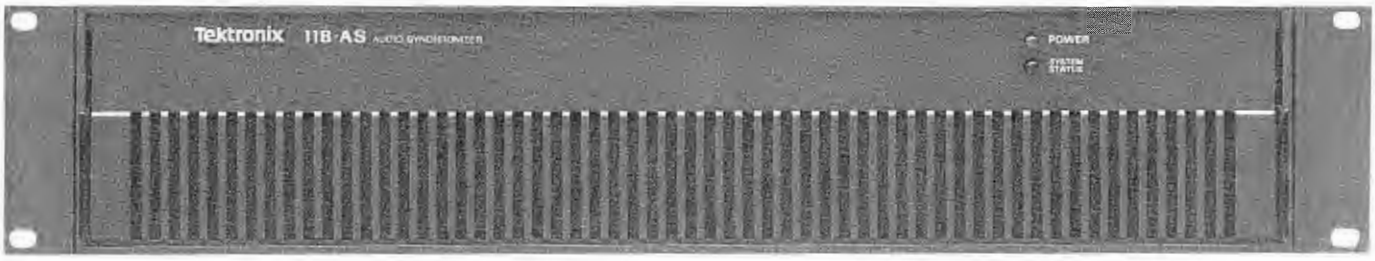
Remote Control Unit — Order 110-RC.

TBC retrofit kit — Order 110-F01.

OPTIONAL ACCESSORY

Spare Parts Kit — Order 020-0990-00.

6 Foot Cable — Order 174-0201-00



118-AS Audio Synchronizer.

118-AS
Audio Synchronizer

Automatic or Manual Control of Audio to Video Timing

Simple One-Wire Interface to 110-S Video Synchronizer

Expandable to Three Channels for Stereo and Auxiliary Channel

Compensates for up to Ten Fields of Video Delay

93.75 kHz Sampling Provides Accurate Stereo Phasing and Flat Frequency Response

18 bit Floating Point Code for Wide Dynamic Range

Built-In Diagnostics and Easy Module Access for Service

Frame synchronizers, digital video effects, noise reducers, and other video delay devices in the television signal path necessitate delaying the audio signal to avoid annoying lip-sync errors. When a number of video synchronizers are cascaded, each with its inherent delay variations, fixed audio delays leave significant delay uncertainty. With four-field video synchronizers such as the Tektronix 110-S, video delay may be as great as 66 ms, making audio synchronization even more important. The Tektronix 118-AS Audio Synchronizer provides automatic and/or manual control of audio delay to maintain proper audio to video timing. With 18 bit floating point code and 93.75 kHz sampling, the Tektronix 118-AS brings to audio synchronization the same high standards established for video synchronization by the Tektronix 110-S.

Automatic Audio Synchronization

The 118-AS Audio Synchronizer automatically tracks the 110-S Video Synchronizer using a simple one-wire digital interface. Additional audio delay may be added manually to compensate for audio to video timing errors present on an incoming signal. The standard 118-AS provides up to ten fields delay, with memory sockets for user expansion to 40 fields.

118-AS Audio Synchronizer Configuration

The standard 118-AS is a single channel audio synchronizer, which may be expanded to two or three channels for stereo or second language applications. Each additional channel may be added by installing a 118-F01 kit, which consists of two fully calibrated plug-in circuit boards. The 118-AS mainframe is prewired to accept up to three channels. All channels may be controlled by a single video synchronizer or each channel may be operated independently using three 110-S synchronizers.

Remote Control

The 118-RC Audio Synchronizer Control allows remote adjustment and monitoring of delay for up to three channels. Automatic, manual, or total delay is displayed in either fields or milliseconds. System Status, Input Clip, and Bypass LEDs indicate abnormal operating conditions. The 118-AS can be bypassed from the Remote Control.

Transparent Delay Change

To minimize program audio discontinuities, the 118-AS provides a controlled rate of audio delay change. This allows color frame boundary crossings without introducing audible artifacts. Manual delay changes are also rate controlled to guarantee smooth transitions.

Wide Dynamic Range

Precision floating point coding makes high signal to noise ratio and low distortion available over a wide range of input signal levels. The 118-AS floating point code provides nearly constant 75 dB S/N and 0.05% distortion over a wide range of signal levels instead of optimizing performance for a specification at clip level. While conventional 16 bit linear coding could provide 96 dB S/N and an impressive .002% distortion just below clipping (where most digital audio devices are specified), performance degrades substantially at lower, more realistic input signal levels, as illustrated in Figure 1. For example, if 16 dB headroom and 25 dB program dynamic range are allowed, a 16 bit linear PCM system might have 50 dB S/N and 0.2% distortion.

118-RC Remote Control Unit.

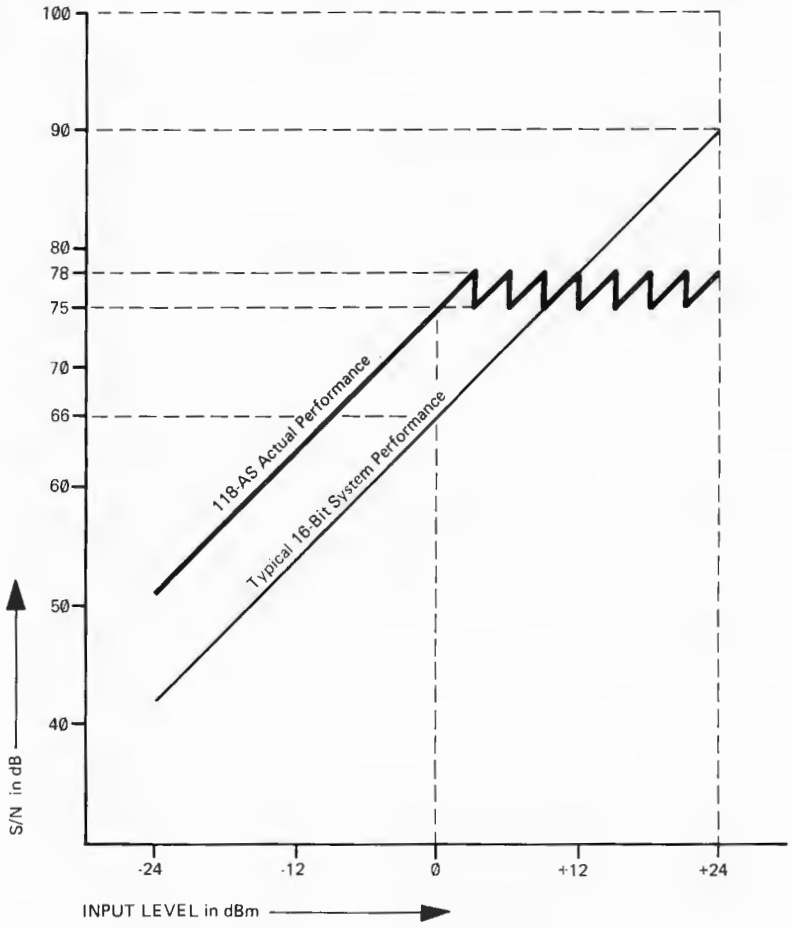


Figure 1. Signal-to-Noise Ratio in Floating Point and Linear PCM Systems.

Wide Bandwidth

A fundamental constraint of digitizing either audio or video is all frequencies above half the sample rate must be removed to avoid aliasing (see Figure 2). For example, with a typical 44 kHz sample rate and 20 kHz audio bandwidth only a 4 kHz transition band for the anti-aliasing filters is allowed. This necessitates performance trade-offs in frequency response and group delay. If compromises are made in filter design, aliasing may translate out-of-band energy, such as tape recorder bias frequencies, into the audio band.

With a sample rate of 93.75 kHz, the 118-AS filter transition band increases from 4 kHz to 53.75 kHz. As a result, wide frequency response, flat phase response, and accurate transient response is achieved without sacrificing attenuation of alias signals. The small delay through the wide transition band filters assures accurate matching of channel phasing for stereo applications.

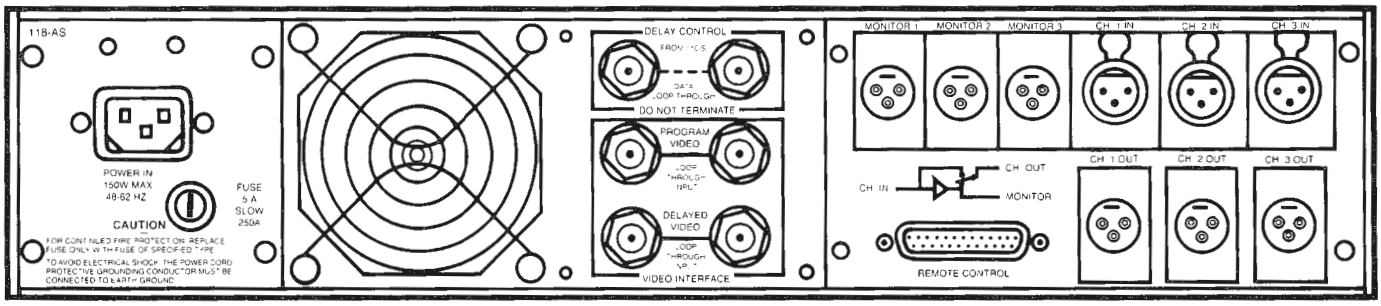
Diagnostics

118-AS operation is monitored by internal diagnostic circuits. Input signal level, A-D operation, memory, and power supplies are continuously checked. In addition, the microprocessor exercises an extensive set of digital power up diagnostics. Whenever a fault with the input signal or the 118-AS is detected, the front panel System Status LED flashes. For more detailed status information, diagnostic LEDs are provided on the circuit board modules.

Service

Repair of the 118-AS is simplified by modular construction. All modular assemblies are easily accessible without removing the 118-AS from the equipment rack.

In addition to the standard service programs, Priority Module Exchange Service is available for the 118-AS. This program provides quick response when downtime is critical.



Rear Panel.

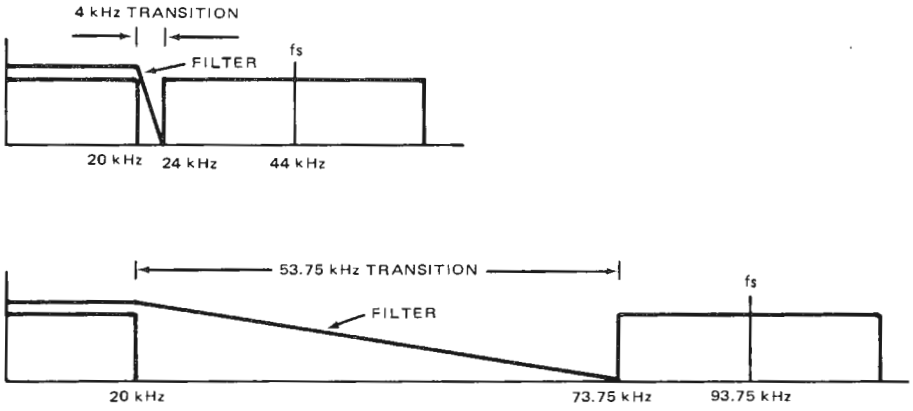


Figure 2. Anti-Aliasing Filter Responses for Low and High Sampling Frequencies.

CHARACTERISTICS

(For active balanced input)

Channels — 1 standard, expandable to 3 channels.

Delay — 10 fields total (user expandable to 40 fields). Automatic and manual delay control.

Encoding — 18 bit floating point code.

Sample Rate — 93.75 kHz.

Total Dynamic Range — 100 dB.

Peak Input Signal — +24 dBm into 600 Ω, configurable to other levels.

Gain — Fixed at unity gain with provision for variable gain.

Gain Accuracy — ±0.2 dB at unity gain.

Frequency Response — ±0.2 dB, 50 Hz to 15 kHz, ±0.5 dB, 20 Hz to 20 kHz.

Phase Accuracy — Channels match within: ±1° at 1 kHz, ±10° at 10 kHz.

Harmonic Distortion — 0.05% maximum, 0 dBm to +24 dBm, 20 Hz to 20 kHz.

IM Distortion — 0.08% maximum, 0 dBm to +24 dBm, 20 Hz to 20 kHz.

Signal to Noise Ratio — 75 dB, 0 dBm to +24 dBm, 20 Hz to 20 kHz.

Channel Separation — 80 dB.

Input Impedance — High impedance balanced input, configurable to 150 Ω or 600 Ω.

Input Coupling — Active balanced input, can be configured for transformer coupling.

Output Impedance — Low impedance to drive 150 Ω or greater.

POWER REQUIREMENTS

90 V to 132 V or 180 V to 250 V switchable. Fused 1.6 A (0.8 A for 220 V) on power supply and 5 A on rear panel. 80 W typical power for 3 channels.

ENVIRONMENTAL

Temperature — Operating: 0°C to +50°C. Nonoperating: −40°C to +65°C.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	88	3.5
Width	483	19.0
Depth	488	19.2
Weight	**kg**	**lb**
Net	11.6	25.6

Audio Synchronizer Control Functions — 118-AS Front Panel: Power LED; System Status LED.

Control and Indicators Behind Front Panel — Power Switch; Fuse; Line Voltage Selector; Bypass Switch and LED; Input Clip LED; Dead Output LED; Digital Diagnostics; Manual Delay Switches; Zero Remote Delay Switches; Auto Delay Disable Switch; Processor Reset Switch.

Remote Control Functions — System Status LED; Input Clip LED; Bypass Switch and LED; Delay Readout; Fields or mS Switch and LEDs; Manual, Auto, or Total Switch and LEDs; Manual Delay Set Switches; Auto Delay Disable Switch and LED.

ORDERING INFORMATION

118-AS Single Channel Audio Synchronizer

Includes: Power cord, rack slides; remote control mating connector; instruction manual.

Audio Channel Kit (adds one channel) — Order 118-F01.

Remote Control Unit — Order 118-RC.

Includes: Cable.

OPTIONAL ACCESSORY

Circuit Board Extender — (Same as 110-S Extender.) Order 670-7754-00.

AVC-20 Audio Vector Converter.

AVC-20
Audio Vector Converter

Use with Any NTSC Vectorscope

Balanced Line Level Inputs

User Selectable Display Formats
- **Lissajous Pattern with Calibrated Amplitude**
- **Lissajous Pattern and Sweep Displays of Both Channels**

Time Code or Third Channel Input
- **Field Locked For Time Code Phase**

Time Versus Amplitude Sweep Display
- **Selectable Among All Three Inputs**
- **Left Plus Right Sweep**

Low Power Consumption

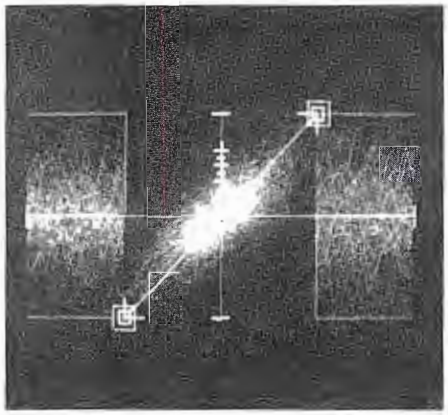
Cost Effective

No Front Panel Space Required

Simple Remote Control

The AVC-20 provides stereo audio monitoring capability when installed with an NTSC vectorscope. Complete audio monitoring can be added to VTR bridges, master control consoles and other locations requiring stereo audio monitoring without modifying the vectorscope and without using front panel space.

Stereo phase, individual signal amplitudes and audio distortions can be observed by simply using the B input to an existing vectorscope. A third audio input channel and a field locked sweep are available for monitoring time code or a second language program.



Live audio, left and right channels, time versus amplitude sweep display, and Lissajous pattern (center) with correct stereo phase.

The Tektronix AVC-20 is easy to operate, install and afford. It's an excellent choice for stereo television facilities.

Audio Monitoring

In an operational television facility, easy to use, reliable instrumentation is a necessity and the AVC-20 provides a multitude of selectable displays that fulfill many audio monitoring requirements. The most versatile display includes a left and right audio sweep displayed simultaneously with a Lissajous display for stereo phase at a glance (illus. A). A Lissajous only display is available for simple applications (illus. B). A time versus amplitude sweep display of the left channel, the right channel, or the left plus right channel are available for detailed inspection of each audio signal (illus. C).

A third input channel provides time code monitoring. It allows an operator to make sure the time code signal is locked to video, is adequately free of noise and of the correct amplitude. It also lets the operator see if the time code sync word is in phase with reference video (illus. D). Any of the eight display modes can be internally or remotely selected with a simple ground closure.

Stereo audio presents new challenges to maintaining audio quality in a television facility. The Tektronix AVC-20 employs an innovative concept allowing easy and inexpensive monitoring of a stereo audio signal without the need to use front panel space. Operators can set the audio level against the calibrated electronic graticule, while simultaneously checking for audio clipping, audio phase reversal, or measuring phase error. These observations can be made with this single display on an existing vectorscope.

The Tektronix AVC-20 brings unprecedented versatility at an affordable price to a stereo television facility.

Installation

The AVC-20 is designed for easy integration into an existing system. Starting with an NTSC vectorscope, audio capability can be added in a few minutes. The B input on many vectorscopes is not used and provides an ideal opportunity for fast and simple installation. As illustrated in Figure 1, the AVC-20 can be installed by looping the existing A signal through the AVC-20 and reconnecting it to the vectorscope A input. The AVC-20 vector output is then connected to vectorscope B input.

If the B input is being used, then the configuration in Figure 2 can be used by taking advantage of the Reference Video Out (Bypass) mode. A simple ground closure switch can be mounted at a convenient location and will select either the normal video signal or the AVC-20 vector signal.

The AVC-20 can be placed in several convenient locations within the VTR bridge or equipment rack. A mounting bracket and velcro strips are provided.

CHARACTERISTICS

Audio Inputs — Balanced Bridging >10K per side with >40dB common mode rejection.

Full Scale Input calibrated for 0, 4, 8, or 12dBm jumper selectable with range adjustable for levels from −6 to 12dBm (0dBm = 1mW).

Maximum Input is 18dBm.

Left or Right Phase Error <1 degree from 100Hz to 10KHz and <5 degrees from 20Hz to 20KHz.

Frequency Response from 20Hz to 20KHz within 0.2dB of response at 1KHz.

Time Code Input — Input is balanced bridging >10K Ohms with a bandwidth >100KHz.

Input level is adjustable for inputs from 0 to 12dBm while maintaining a 4cm deflection.

External Reference Loop-Thru — High Z input with >40dB return loss from 50KHz to 5MHz.

Input level from 0.75 to 1.5 volt composite video signal (black burst).

Subcarrier Genlock — Capture range within 50Hz of Fsc.

Quad phase error <= 1 degree.

Adjustable delay compensation of greater than 360 degrees.

Vector Output — Maximum output noncomposite (no sync) 1 volt peak to peak into 75 Ohms.

Return loss >26dB from 50 KHz to 5 MHz.

Power — Mains voltage range is 105 to 129 volts rms.

Power consumption is 10 Watts maximum (34 BTU/hour).

Mains frequency is 60Hz.

ENVIRONMENTAL

Temperature non-operating — −55 degrees C to +75 degrees C.

Temperature operating — 0 degrees C to +50 degrees C.

Altitude non-operating — to 50,000 feet.

Altitude operating — to 15,000 feet.

SAFETY/EMI

Designed to meet or exceed:

UL-1244
Factory Mutual-3820
CSA Bulletin 556B
IEC 348
FCC EMI Compatibility

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	510	2.0
Width	157	6.175
Depth	273	10.75
Weight (approximate)	**kg**	**lb**
Net	1.82	4

ORDERING INFORMATION

AVC-20 Audio Vector Converter

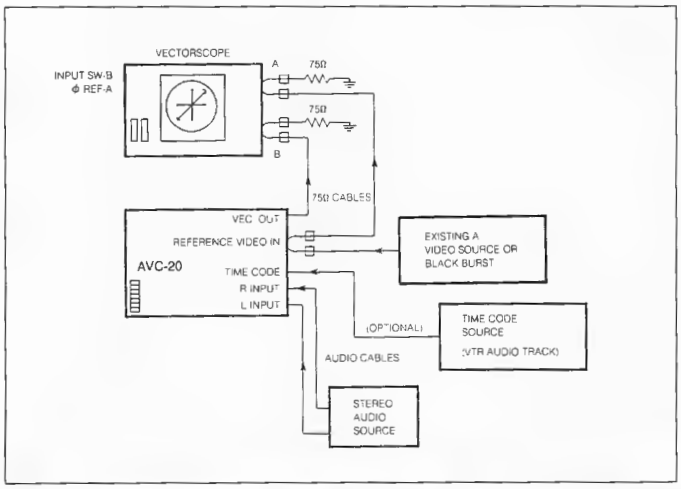


Figure 1.

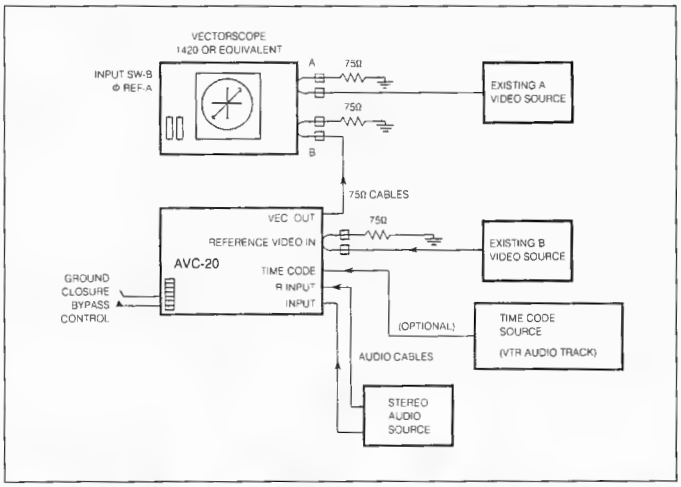


Figure 2.

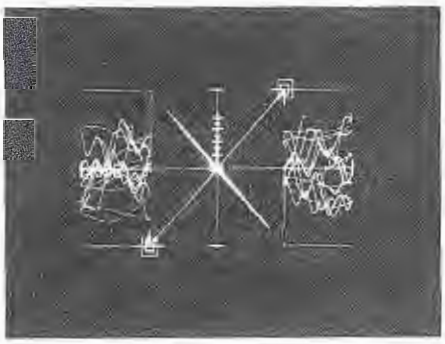


Illustration A. Live audio display with correct amplitude, 180 degree phase reversal.

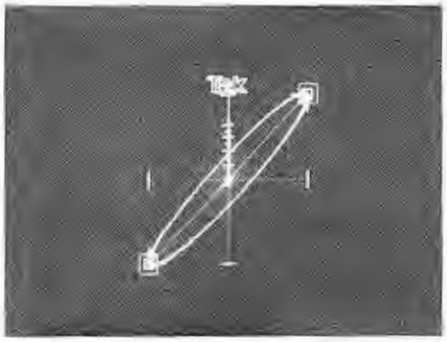


Illustration B. Lissajous pattern with 15-20 degrees of phase error, correct amplitude.

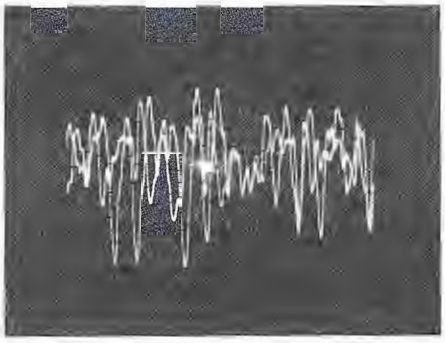


Illustration C. Time versus amplitude sweep display of an audio channel.

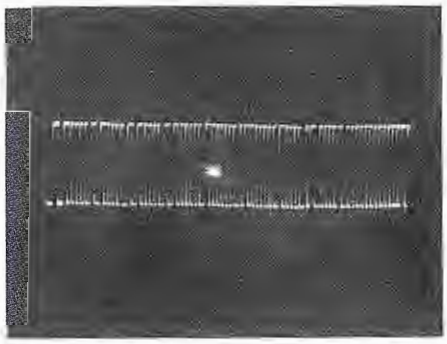
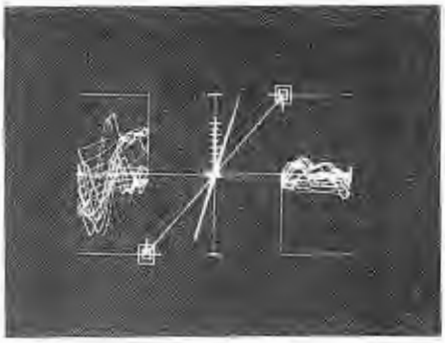
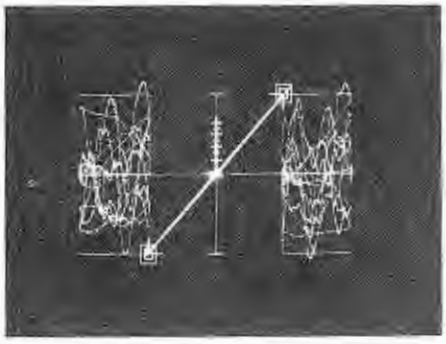


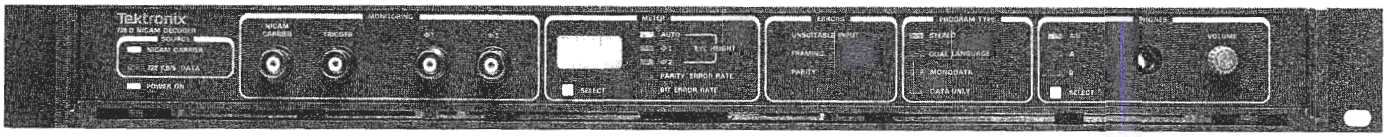
Illustration D. Time code display with correct sync word phase.



Live audio display with low amplitude, right channel.



Live audio display with correct amplitude, minimum phase error.



728D NICAM Decoder.

728D
NICAM Decoder

The Tektronix 728D NICAM Decoder demodulates the NICAM-728 carrier and decodes the left and right analog audio channels and a monaural channel derived from them as well as providing access to the user data bits and 728 kb/s data stream. It also monitors the performance of the digital bitstream and provides indications for service type, loss of carrier, and errors.

The 728D is packaged in a 1U rack-mountable package. It would normally be driven with the *carrier output** from the 1450-3 demodulator although it could be used with any source of a NICAM-728 carrier that meets the input specifications.

* A field-installable upgrade for the 1450-3 is available to provide this output.

Stereo audio

The decoded stereo audio (after J.17 de-emphasis) is available on balanced XLR connectors on the 728D rear panel. Audio output is muted when the channel is used for data. Parity errors are automatically concealed until the parity error rate exceeds one in 100 and the audio is muted.

Monaural audio

A monaural audio output is also provided on a rear panel XLR connector. This monaural audio is derived from the A and B channel audio as follows:

Program Service	Derived Monaural Sound
stereo	A + B
dual language	A or B (determined by internal jumper)
mono + data	mono source
data only	muted

In addition, error concealment and muting are applied to the monaural audio.

Numeric eye height/parity display

For convenient transmission monitoring, a 3 digit LED readout is provided on the front panel of the 728D. This readout may be switched to show either the eye height (in percent) or the number of parity errors in one second. A switch on the front panel is provided to make the selection.

Monitoring outputs

To assist in observing input signal characteristics, monitoring connections to the Φ1, Φ2 and filtered NICAM carrier signals are fitted on the front panel of the 728D. A trigger signal is also provided at the symbol rate. These signals can be connected to an oscilloscope for eye height or constellation display.

Digital bitstream connections

Two data outputs and two clock outputs are provided for access to the 728 kb/s digital bitstream. All outputs are provided in NRZ form and the data changes on the *high to low transition* of the clock output.

An internal jumper provides access to the data *before or after descrambling*. The descrambled data may be used for user-defined applications; the scrambled data may be fed to a Tek 728E NICAM encoder modulator if desired.

An internal jumper allows selection of an external 728 kb/s data stream to be the signal source via one data input and one clock input.

User data (AD0. . . AD10) port

The user data bits (AD0. . . AD10) and a clock are decoded and available as TTL level signals on the status connector.

Status connector

A 25 pin D type connector is fitted on the rear panel to provide the following TTL level status indications:

Signal	Description
AD0. . . AD10	user data (11 kb/s)
AD Clock	clock for user data (1 kHz)
Parity Error	high level during parity errors
Framing Error	high level during framing errors
Circuit Fail	high level indicates selftest error
Unsuitable Input	indicates loss of NICAM carrier
C0. . .C4	decoded channel status bits
Eye Low	indicates eye height below preset threshold
Muted	audio muted due to excessive parity errors

Alarm connector

A 9 pin D type connector is fitted on the rear panel to provide the following relay contact closures:

Alarm	Action
Parity Error	contacts closed if parity errors exceed preset threshold
Framing Error	contacts closed during framing errors
Circuit Fail	contacts open indicates selftest error or no power
Eye Low	contacts closed indicates eye height below preset threshold

User-defined error thresholds

Switches on the main circuit board allow the customer to set custom thresholds for the eye height and parity alarms.

Headphones

A front panel jack (and volume control) is provided for use with stereo headphones. A switch on the front panel allows you to select the audio for the headphones from the following choices:

- A/B. The A audio is placed in the left channel and the B audio is placed in the right channel.
- A. This places the A audio in both headphone channels.
- B. This places the B audio in both headphone channels.
- A and B. This places A and B audio in both headphone channels.

Choice of TV standard (B/G vs. I)

Decoders are available for either system I or systems B and G.

Front and Rear Panel Connectors and Indicators

Input connections (rear panel)

Modulated digital carrier — 1 BNC (50 Ω, 0 dBm nominal)

728 kb/s bitstream clock — 1 BNC (50 Ω ± 1 V nominal)

728 kb/s bitstream data — 1 BNC (50 Ω ± 1 V nominal)

Output connections (rear panel)

Monaural audio — 1 XLR (balanced)

Left and right audio — 2 XLR (balanced)

728 kb/s bitstream clock — 2 BNC (±1 V into 50 Ω)

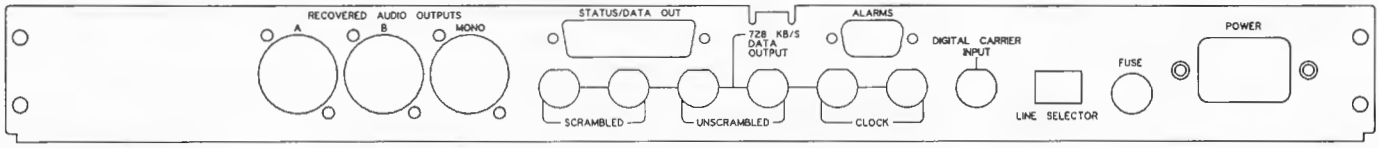
728 kb/s bitstream data — 2 BNC (±1 V into 50 Ω)

Operational status (and AD0. . . AD10 data) — 2 DB25

Alarm relay contacts — 1 DB9

Output connections (front panel)

Stereo headphones (with volume control) — ¼" jack



728D Rear Panel.

Received digital carrier — 1 BNC (1 V p-p into 50 Ω)

Recovered 01 and 02 channels — 2 BNC (1 V p-p into 50 Ω)

Trigger output — 1 BNC (0 to 1 V into 50 Ω) negative-going 170 ns pulse during clock instants

Indicators (front panel)
Power — green LED

Numeric display — 3 digits, 7-segment LED

Display selection — (green LEDs) eye height (%), parity error rate (errors/second), computed bit error rate

Service type LEDs — (green LEDs) stereo, dual language, mono + data, data only

Errors — (red LEDs) unsuitable input, framing error, parity error

Demodulator Performance Objectives
Nominal input level — 0 dBm

Input impedance — 50 Ω

Audio Performance Objectives (line outputs)
Output impedance — <30 Ω (nominal)

Output at maximum digital decoding level — +14.8 dBu at 2 kHz

Frequency response — ±0.4 dB 40 Hz to 15 kHz

THD+N — <0.1% at 1 kHz and +9 dBu

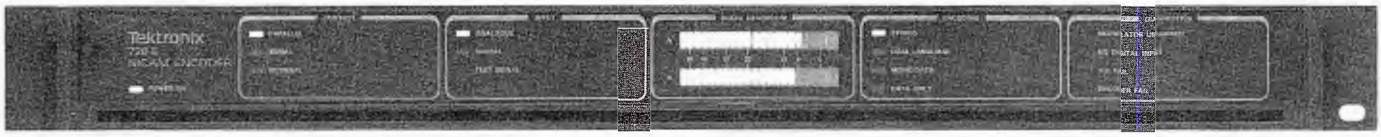
PHYSICAL CHARACTERISTICS

Cabinet Dimensions	cm	in
Width	48.3	19.0
Height	4.4	1.734
Depth	45.58	19.13
Weight	**kg**	**lb**
Net	6.14	13.5

ORDERING INFORMATION

When ordering, please use the nomenclature given here:

728D NICAM Decoder



728E NICAM Encoder.

728E
NICAM Encoder

The Tektronix 728E NICAM Encoder has been designed as a cost-effective solution to a broadcaster's requirements for NICAM-728 encoding and modulation.

The 728E consists of two main sections:

NICAM-728 encoder. The encoder takes a stereo analog audio input and encodes it into a NICAM-728 data stream. This data stream and clock are internally routed to the modulator, and appear on connectors on the rear panel for transmission of the data stream to a remote modulator.

NICAM-728 modulator. The modulator applies DQPSK modulation to the internal or external NICAM-728 data stream. Connectors are fitted on the rear panel to allow an external data stream to be modulated.

Where the digital input is used, it will be possible to instruct the unit to 'fall back' to the analog inputs upon loss of the digital input signal.

All encoding, modulation, and filtering are performed digitally for high reliability.

Multi Systems
The modulator may be strapped to work with either television system I or systems B or G.

Analog audio inputs
The 728E encoder will digitize and encode two channels of analog audio into a 728 kb/s NICAM-728 data stream. The audio level is nominally set up for A/D overload with a 2 kHz signal at +14.8 dBu.

Attenuators may be switched in prior to preemphasis to allow for more headroom.

Digital data input
The 728E's modulator may be driven with an external source of NICAM-728 encoded data. Connections on the rear panel are provided for NRZ data and clock. The data is latched on the low to high transition of the clock.

The digital data input is applied directly to the modulator section of the instrument. The data at this input must already be formatted into a 728 kb/s NICAM-728 data stream.

Digital data outputs
The encoded 728 kb/s bitstream and clock are provided on output connectors on the rear panel. They may be connected to a remote NICAM-728 modulator for applications where the coder and modulator are at separate locations.

I.F. mixer/combiner option
An IF mixer/combiner is available as an option for the 728E. This unit provides an IF output, and has an IF combiner built in, allowing the normal sound and NICAM sound signals to be combined at IF in the 728E. A loop-through input is provided for the transmitter local oscillator.

Parallel control connector
A connector is fitted on the rear panel to allow the user to control the instrument with simple contact-closures to a TTL-level parallel interface. The following functions are available via parallel control:

- **Program service:** Stereo or dual-language
- **Input source:** Analog or digital
- **Serial control:** Enable or disable
- **Modulation:** On or off
- **Preemphasis:** On or off

Serial control connector
A serial control interface connector is fitted on the rear panel to allow additional control capability. A standard RS-232 serial port is provided. Serial control is only active when it is enabled by the control line on the parallel control connector.

When enabled, serial control gives the customer access to all of the functions of parallel control. In addition there are several built-in test signals available only via serial control. These test signals include the capability of changing the modulation standard (I or B/G).*

* The user may disable the capability of changing modulation standard by moving a link on the circuit board.

Built-in test signals
The encoder is capable of encoding all service types: stereo, dual language, monaural +325 kbit data, and 704 kbit data. Only the stereo and dual language services are available using the analog audio inputs.

Internal test signals (available only from remote control) include reference tones, sine sweeps, silence, frame alignment word skips, control bit errors, and signals to test error concealment in decoders.

The modulator may also be commanded to generate an unmodulated digital carrier for setting up transmitters.

Audio level indicator
A LED bar graph display on the front panel shows program audio level at the analog-to-digital converters. The display is calibrated in decibels referred to the clip point of the analog-to-digital converters. The metering is after preemphasis and reflects the true level digitized. Additional LEDs indicate overload in the analog-to-digital converters.

AD0. . . AD10 inputs
A connector is fitted on the rear panel for the AD0. . . AD10 data and clock. Each time a clock transition is detected, the AD0. . . AD10 bits are coded into the next available packet. The data words may change up to a 1 kHz rate. The AD0. . . AD10 bits remain at their last values until a new clock transition is detected.

Status indication
Operational status information is provided on a rear panel connector via TTL-level outputs and LEDs on the front panel. The alarm indications are:

- **A/D error:** Error in the analog-to-digital converters
- **Encoder error:** Fault in the encoder
- **Modulator unlocked:** Modulator cannot lock to data input
- **No digital input:** Digital input selected but not present

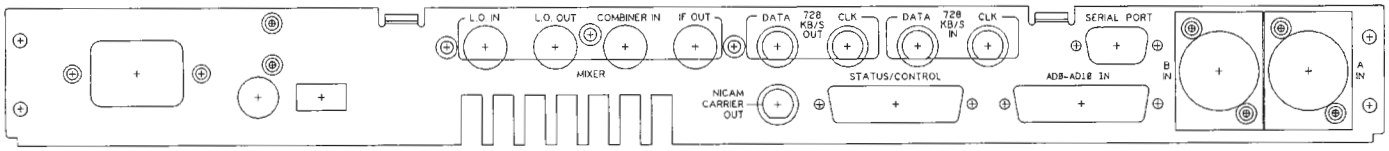
The rear panel status indications are:

- **C0, C1, C2, and C4:** Encoder and frame flag indications
- **ADC clip:** Input audio overload
- **System error:** Error in ADC, encoder, or modulator

Framing signal outputs
A frame alignment flag and C0 output are provided in the status/control connector to allow synchronization of multiple encoders.

Locking to external clocks
The 728E may be phase-locked to an external 728 kHz clock. Inputs are also provided to lock the encoder to the frame-level or the C0 multiframe, using the external framing and C0 inputs.

Multiple 728E's may be operated in synchronization by locking them all to a common 728 kHz clock.



728E Rear Panel.

Front and Rear Panel Connectors and Indicators

Connectors (rear panel)
A and B audio in — 2 XLR (balanced)

Modulated digital carrier out — 1 BNC

AD0. . . AD10 input — 1 DB25

Status and parallel control — 1 DB25

Serial control — 1 DB9 (RS-232)

Digital data (728 kb) to modulator — 1 BNC

Digital data clock to modulator — 1 BNC

Digital data out (from encoder) — 1 BNC

Digital data clock (from encoder) — 1 BNC

IF Mixer/Combiner Connections (rear panel)
LO in — 1 BNC

LO out — 1 BNC

Combiner in — 1 BNC

IF out — 1 BNC

Indicators (front panel)
Power — green LED

Control selection (green LEDs) — serial, parallel, internal

Input selection — analog (green LED), digital (green LED), test signal (red LED)

Audio headroom — 20 segment LED bar display

Audio overload — 2 red LEDs

Encoding type (green LEDs) — stereo, dual language, mono + data*, data only*

Errors (red LEDs) — A/D failure, encoder error, modulator unlocked, no digital input**

* These services only availble as test signals
** Only active if external bitstream selected and not present

Modulator Performance
Amplitude imbalance between I/Q axis — <0.1 dB*

Departure from phase quadrature between I/Q axis — <1°*

Carrier suppression during modulation — >60 dB under visual carrier*

Carrier frequency accuracy — ±1 ppm

Spectrum shaping — ±1/2 dB from nominal**

Out-of-band noise — 40 dB below modulated digital carrier

Output level — 0 dBm (nominal)

Impedance — 50 Ω

* The modulation and spectrum shaping are performed digitally
** Over the frequency range ±182 kHz from digital carrier

Audio Performance
Input impedance — 600 Ω or >10 kΩ (jumper selectable)

Maximum digital encoding level — +14.8 dBu at 2 kHz

Frequency response — ±0.2 dB 40 Hz to 14.67 kHz

THD+N — <0.1% at 2 kHz and 9 dBu input

Stereo phase match — within 1° 40 Hz to 14.67 kHz

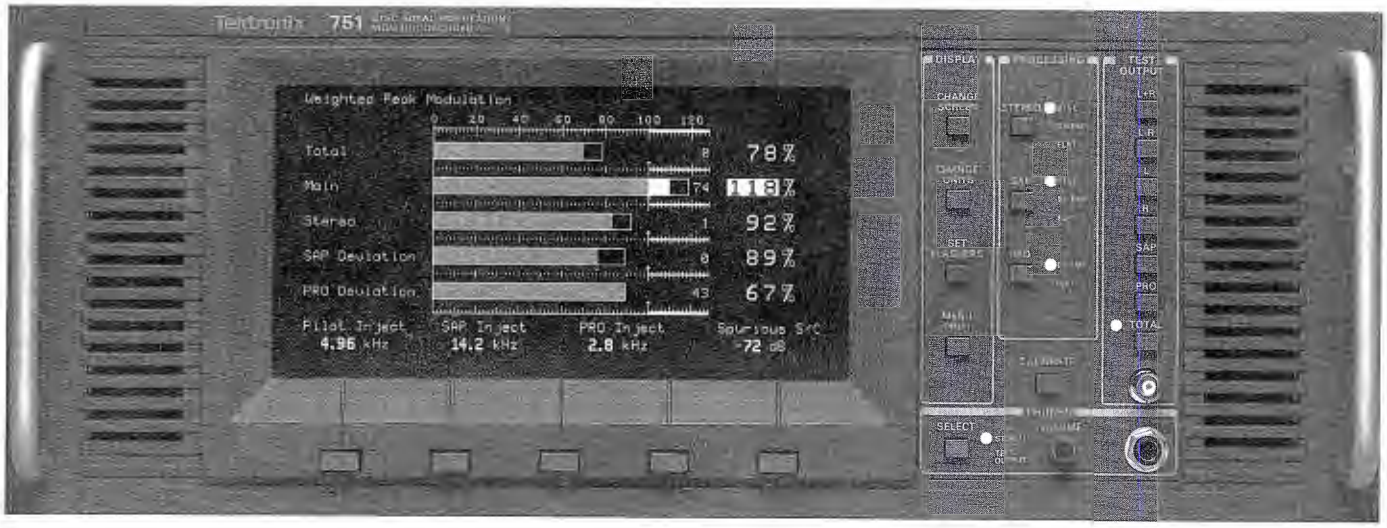
PHYSICAL CHARACTERISTICS

Cabinet Dimensions	mm	in
Width	483	19.0
Height	440	1.734
Depth	508	20.0
Weight	**kg**	**lb**
Net	6.14	13.5

ORDERING INFORMATION

When ordering, please use the nomenclature given here:

728E NICAM Encoder



751 BTSC Aural Modulation Monitor/Decoder in Weighted Peak Mode indicating overmodulation of Main channel.

751 BTSC
Aural Modulation Monitor/Decoder

Precision modulation monitor for entire BTSC sound channel

Simultaneously displays all components necessary to ensure modulation remains within legal limits

Bars feature peak indicators with timed peak hold and easily set peak limits

Digital readout accompanies each bar for accurate setups

Electroluminescent bar graph display with precisely controlled dynamics

Alternate display of processed audio levels for left, right, sum, difference, SAP and PRO

Internal auto-calibrator ensures accurate modulation measurements

Selectable true peak or weighted peak modulation indication

RS-232C data output for remote display or data logging

Variable bar peak hold times and decay rates

Overmodulation counter on screen (overmod flashes/minute)

Precise on-screen RMS meter with difference mode

The 751 BTSC Aural Modulation Monitor/Decoder provides accurate modulation monitoring and measurement of the BTSC encoded TV sound channel.

The 751 comes ready to monitor the entire BTSC sound channel, including SAP and PRO. Should the needs of your station change, a simple soft-key controlled menu can add or delete SAP or PRO from the display.

The bars on the PROCESSED AUDIO screen indicate audio levels of L+R, L–R, Left, Right, SAP and PRO. These levels represent audio levels *after* front panel controlled processing.

Two sets of parameters, peak modulation and processed audio, can be alternately displayed by a simple front panel selection.

The 751 is designed to be driven by the baseband signal from the Tektronix 1450-1 Demodulator's Deviation Output. A second input has adjustable sensitivity and is unterminated for either direct connection to a stereo generator, or to pick-off the baseband signal between the generator and the aural transmitter.

Bar graph and digital readout units of measure can be changed from percent of maximum to kHz deviation or dB with the simple push of a button.

Also displayed are injection levels for SAP, PRO, and Stereo Pilot, as well as the level of Spurious Stereo Subcarrier.

Instantaneous peak values as well as "held" peak values are displayed as calibrated bars. Each bar is accompanied by a digital readout that corresponds to the "held" peak value. The bar and readout both indicate when an easily set peak limit has been exceeded.

As an alternative to true peak values, the 751 has a "Weighted Peak Mode." This mode provides the choice to view "true peaks" or "weighted peaks."

The "weighted peak" provides an alternate representation of modulation peaks by ignoring short duration peaks which have no audible consequence. The Weighted Peak Mode ignores these transients and lets the operator monitor programming for appropriate modulation.

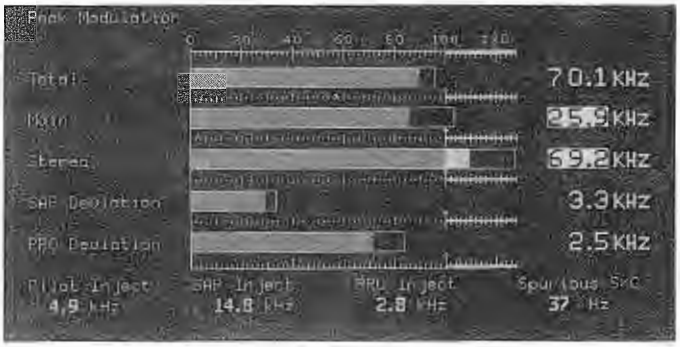
The 751 also retains its "true peak" measurement capability for broadcasters needing to view the highest peaks for engineering purposes. This registration is especially useful for broadcasters setting peak limiters and aural exciters, where highest peak accuracy is important.

In addition to standard BTSC processing, De-emphasis and Flat modes are available for test purposes. The TEST OUTPUT connectors, provided on both the front and rear panels, are for external measurements of the Left and Right stereo channels, L+R, L–R, SAP, PRO and TOTAL (full baseband). A switchable headPHONES output is also located on the front panel.

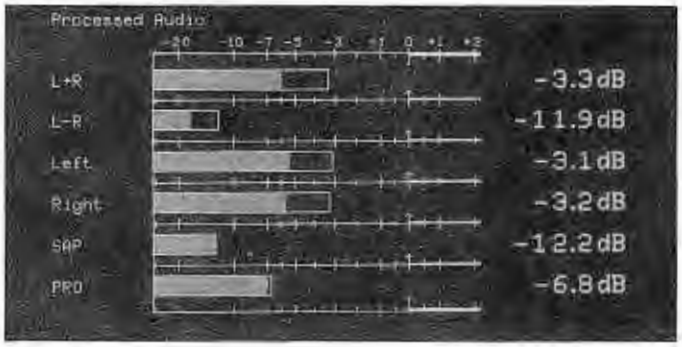
Precisely decoded Left and Right stereo channels, SAP and PRO 600 Ω balanced line outputs are provided on the rear panel through XLR connectors.

Remote alarm contact closures for No Pilot, Pilot/Sync Unlock and (stereo) Phase/Inverted are provided on the rear panel through a 9-pin D sub-miniature connector. Alarm conditions are also indicated on the display. H sync for measuring Pilot Phase Lock is obtained via the rear panel Composite Video loop-through connector.

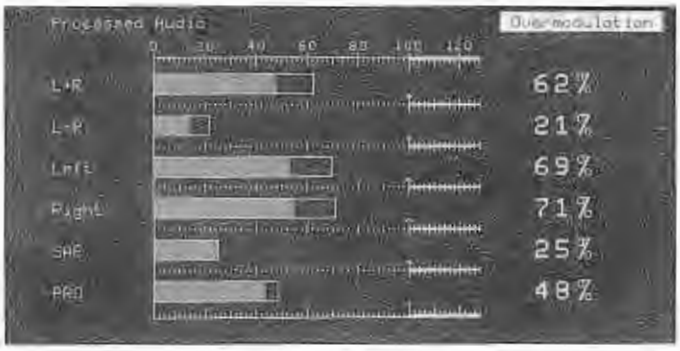
Automatic calibration of the display is accomplished by an internally generated direct digital synthesis calibration signal routed through the 1450-1, which provides a calibrated 1450-1 Deviation Out signal. This operation, as well as a calibration test, is software controlled.



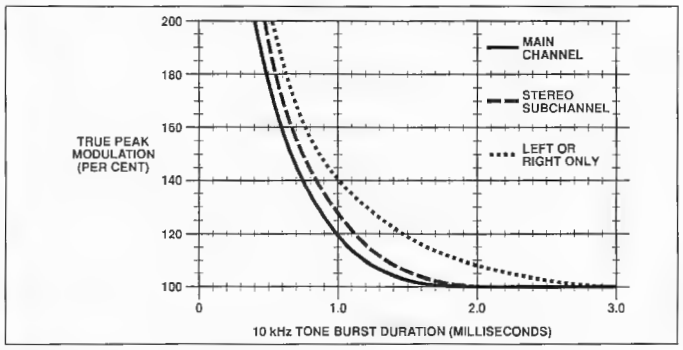
751 Peak Modulation screen indicating (in kHz) overmodulation of the Main channel and Stereo.



751 Processed Audio screen displaying audio levels in dB.



751 Processed Audio screen displaying audio levels (in %), with an OVERMODULATION flag indicating overmodulation of one or more bars on the Peak Modulation screen.



Typical time-weighting characteristic for Weighted Peak mode, showing what actual (True Peak) % modulation is required for a given length tone burst to indicate 100% with Weighted Peak indication selected.

CHARACTERISTICS

Calibrator — Internal calibrator FM deviation error @ 4.5 MHz <0.1% (CALIBRATION SIGNAL output to 1450-1 Aural Intercarrier Input).

Display (Peak Modulation Screen) — Aural Carrier Peak Deviation Accuracy with BTSC signal, 0-100% modulation, including crosstalk from other channels, for bars, digital indicators, and peak flashers; TOTAL: ±0.7 kHz, 50 Hz-120 kHz; MAIN: +1.5 kHz −0.4 kHz, 50 Hz-15 kHz; STEREO: +2.0 kHz −1.0 kHz, 50 Hz-47 kHz excluding pilot

Overshoot — TOTAL, MAIN, STEREO <1%

Subcarrier Peak Deviation Accuracy, 0-100% modulation — SAP deviation ±0.5 kHz, 50 Hz-10 kHz; PRO deviation ±0.15 kHz, 50 Hz-3.4 kHz

Injection Levels — Pilot injection ±0.1 kHz @ 5 kHz; SAP injection ±0.5 kHz @ 15 kHzl PRO injection ±0.2 kHz @ 3 kHz

Spurious S/C (spurious stereo subcarrier, in-phase component) — ±0.4 dB @ −46 dB ±10 Hz @ 250 Hz

Display (Processed Audio Screen) — Bars and digital peak indicators show same audio as is available at Test Output.

TEST OUTPUT

Frequency Response — TOTAL 50 Hz-50 kHz, ±0.05 dB; 50 Hz-120 kHz, ±0.1 dB; L+R, L−R, L, R 50 Hz-15 kHz, ±0.1 dB[1]; SAP BPF/LPF[2] in FLAT, 50 Hz-10 kHz, +0.3, −0.6 dB; DE-EMP 50 Hz-10 kHz, +0.4, −0.7 dB[1]; BTSC 50 Hz-10 kHz, ±1.0 dB[3]; BPF/LPF out FLAT 50 Hz-10 kHz, ±0.2 dB; DE-EMP 50 Hz-10 kHz, ±0.3 dB[1]; BTSC 50 Hz-10 kHz, ±0.5 dB[3]; PRO BPF in, FLAT, DE-EMP 50 Hz-3.4 kHz, ±0.5 dB[4]; BPF out, FLAT, DE-EMP 50 Hz-3.4 kHz, ±0.3 dB[4]

Distortion (THD+N @ 100% modulation) — L+R DE-EMP 50 Hz-14 kHz <0.2%[5]; L−R DE-EMP 50 Hz-14 kHz <0.2%; L, R DE-EMP 50 Hz-14 kHz <0.2%; L, R BTSC 300 Hz-14 kHz <0.2%[6]; SAP DE-EMP BPF/LPF in 50 Hz-3 kHz <1%, 3 kHz-10 kHz <1.5%; BPF/LPF out 50 Hz-10 kHz <0.2%; PRO DE-EMP BPF in 50 Hz-3.4 kHz <1.5%; BPF out 50 Hz-3.4 kHz <0.2%

Signal-to-Noise Ratio, DE-EMP mode — L+R, L−R, L, R >70 dB; SAP >66 dB; PRO >56 dB

Channel Separation — BTSC @ 10%-100% equivalent modulation; 100 Hz-1 kHz >40 dB; 50 Hz-14 kHz >36 dB @ 1% equivalent modulation; 100 Hz-8 kHz >32 dB; FLAT, DE-EMP 50 Hz-15 kHz >50 dB

[1] Referenced to ideal 75 μs de-emphasis in DE-EMP mode.
[2] Internal bandpass and lowpass filters are menu selected and switched in for normal operation, out for tests.
[3] 1-100% 75 μs equivalent input modulation.
[4] Referenced to ideal 150 μs de-emphasis in DE-EMP mode.
[5] <0.1% to 15 kHz with Main channel only present.
[6] Below 300 Hz with sine wave input, THD rises in a 1/f fashion conforming to ideal expanded-only behavior.

LINE OUTPUTS

Output Level — +8 dBm at 0 dB processed audio indication.

Frequency Response and Distortion — Same as Test Outputs.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	178	7.0
Width	483	19.0
Depth	597	23.5
Weight	**kg**	**lb**
Net	3.97	31.2

751 Peak Modulation Screen

COMPONENT DISPLAYED	DEFINITION	100% OR MAX
BARS and DIGITAL PEAK INDICATORS Total	Total modulation of aural carrier.	73 kHz*
Main	Sum (L+R) channel (30 Hz-15 kHz).	25 kHz
Stereo	Combination of Main channel (L+R) and stereo subchannel (L−R) (30 Hz-46.468 kHz less the 15.734 kHz pilot).	50 kHz
SAP Deviation	Modulation of Second Audio Program subcarrier at 78.671 kHz.	10 kHz
PRO Deviation	Modulation of PROfessional channel subcarrier at 102.273 kHz.	3 kHz
DIGITAL READOUTS Pilot Inject	Modulation of aural carrier by Pilot.	5 kHz, ±0.5 kHz
SAP Inject	Modulation of aural carrier by Second Audio Program subcarrier.	15 kHz
PRO Inject	Modulation of aural carrier by PROfessional channel subcarrier.	3 kHz
SPURIOUS S/C (SubCarrier)	Level of suppressed 31.468 kHz stereo subchannel subcarrier.	250 Hz or −46 dB

*TOTAL bar 100% point can be rescaled to 70 kHz deviation if PRO is not present, 58 kHz if SAP is not present, or 55 kHz if neither SAP or PRO are present.

DISPLAY RANGE: Bars indicate to 128%, Digital Peak Indicators to 200%.

751 Front Panel Connectors

CONNECTOR NAME	TYPE	INPUT/OUTPUT LEVEL	CONFIGURATION/COMMENTS
TEST OUTPUT	BNC	10 V p-p nominal for 100% or 0 dB signal	Selectable from L+R, L−R, L, R, SAP, PRO, TOTAL (full baseband)
PHONES	¼" stereo phone jack		Selectable from STEREO or TEST OUTPUT (tracks TEST OUTPUT selection)

751 Rear Panel Connectors

CONNECTOR NAME	TYPE	INPUT/OUTPUT LEVEL	CONFIGURATION/COMMENTS
POWER		Low Range: 115 V nominal (87-132 V, 47-63 Hz) High Range: 230 V nominal (174-250 V, 47-63 Hz)	
CALIBRATION SIGNAL	BNC	4.5 MHz frequency modulated cal signal	Connects to 1450-1 (wideband version) Aural Intercarrier In
TEST OUTPUT	BNC	10 V p-p for 100% or 0 dB signal	Selectable from L+R, L−R, L, R, SAP, PRO, TOTAL (same as front panel output)
VIDEO or H-SYNC LOOP-THROUGH (input)	BNCs (2)	0.5 to 2 V p-p	Provides H sync to check Pilot frequency lock
BTSC BASEBAND INPUTS 1450-1 DEMOD INPUT	BNC	10 mV/kHz deviation	Primary baseband input for connection to 1450-1 Deviation Out (menu selected) Z_{in} = 75Ω
STEREO GEN INPUT	BNC (BNC "Tee" supplied)	1 to 6 V p-p for generator output signal corresponding to 73 kHz deviation	For connection to stereo generator output: can be used with BNC "T" to pick off signal between stereo generator and aural transmitter modulation input (menu selected) Z_{in} >100 kΩ
REMOTE ALARMS CONTACT CLOSURES	Male 9-Pin D subminiature connector	Contact closures, 2 A @ 28 Vdc max (resistive)	Provides both normally-open and normally-closed contacts for the following conditions: Loss of Pilot, Pilot Unlocked, Stereo Phase Reversal
AUDIO OUTPUTS (LEFT, RIGHT, SAP, PRO)	Male XLR	+8 dBm into 600Ω	Active balanced line outputs

751 Processing Controls

CONTROL	SELECTION	EFFECT
STEREO	BTSC	BTSC expansion on Stereo subchannel and standard 75 μs de-emphasis on Main channel
	DE-EMP	75 μs de-emphasis on Main channel and Stereo subchannel
	FLAT	No processing on Main channel or Stereo subchannel
SAP	BTSC	BTSC expansion on SAP channel
	DE-EMP	75 μs de-emphasis on SAP channel
	FLAT	No processing on SAP channel
PRO	DE-EMP	150 μs de-emphasis on PRO channel
	FLAT	No processing on PRO channel

ORDERING INFORMATION

When ordering, please use the nomenclature given here.

751 BTSC Aural Modulation Monitor/Decoder

Includes: Operators manual, Power cable assembly (161-0066-00), 75Ω precision termination (011-0102-00), BNC T connector (103-0030-00), 9-pin female D connector (131-1006-00), 9-pin D connector housing (200-1170-00), Rackmount hardware (351-0636-00), Screw-lock assembly for 9-pin connector housing (213-0260-00), Loop clamp (343-0003-00), Loop clamp washer (210-0863-00).

OPTIONAL ACCESSORY

Extender board — Order 670-9584-00

PC 751
Remote Display Software

Remote display of 751 screens over RS-232 on a PC

Real time display of Peak Modulation and Processed Audio Screens

Data logging of the held peak data from both screens

User options for bar decay rate, peak hold time, and peaks/ minute enable

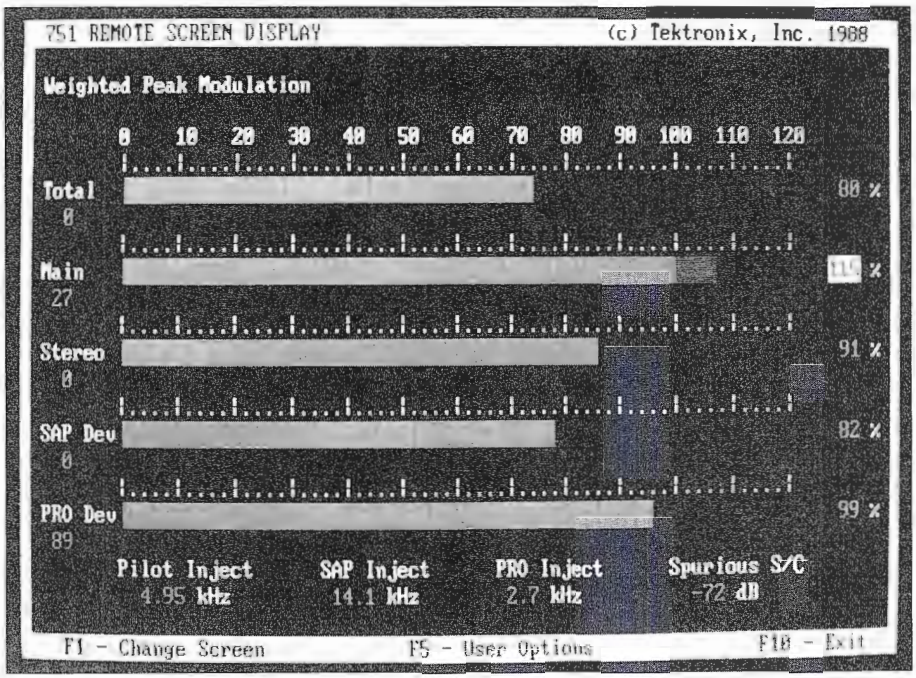
The PC 751 Remote PC Display Software provides a display very similar to the 751 BTSC Aural Modulation Monitor/Decoder. This software package can be displayed on any IBM compatible personal computer using DOS version 2.1 or higher. It provides either a real-time display of the 751's Peak Modulation and Processed Audio screens or a data log of the held peak data from both 751 screens on the PC screen. The remote display is sent by the 751 over the RS-232 port. The real-time display requires a baud rate of 9600 baud or greater. The data-log mode can operate at a baud rate of 1200 baud or higher. A standard null modem cable is required for the interconnection.

REQUIRED HARDWARE

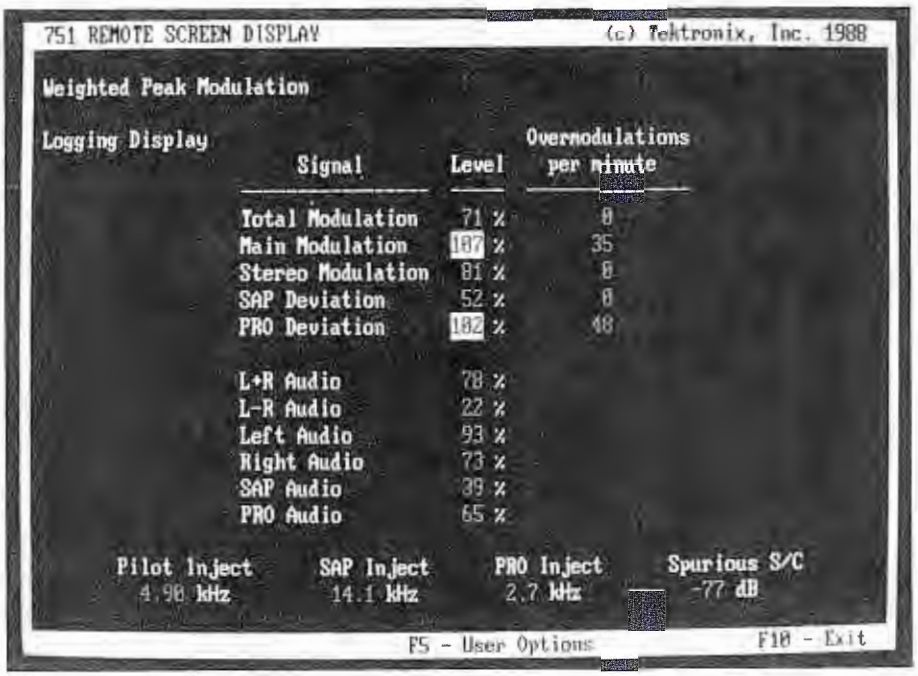
The PC 751 will run on an IBM PC, PC XT, PC AT, Tektronix PEP 301 or compatible. Minimum requirements: 256K memory; 1 floppy disk drive; CGA, EGA, VGA, or HERCULES graphics adaptor. The real-time mode requires a clock speed of at least 6 MHz.

REQUIRED SOFTWARE

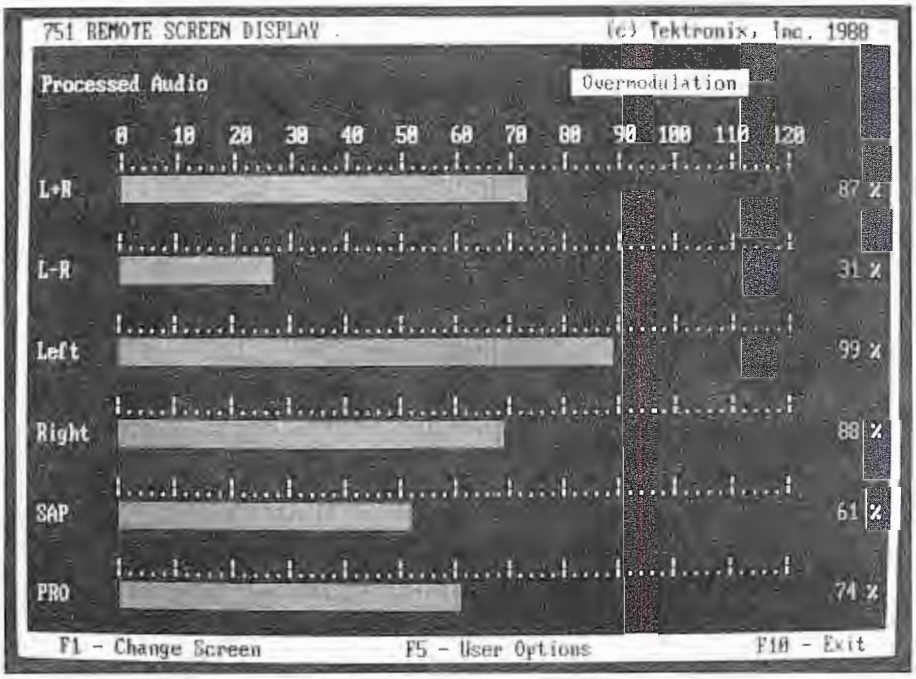
IBM PC-DOS or MS-DOS versions 2.1 or higher.



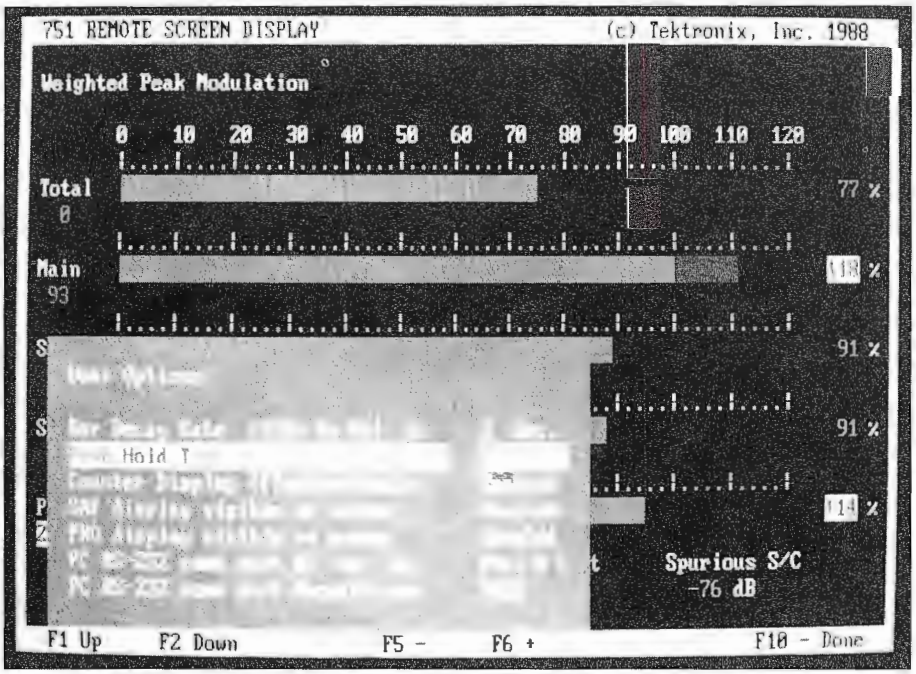
Peak Modulation Screen.



Data Log of Held Peak Data.



Audio Screen.

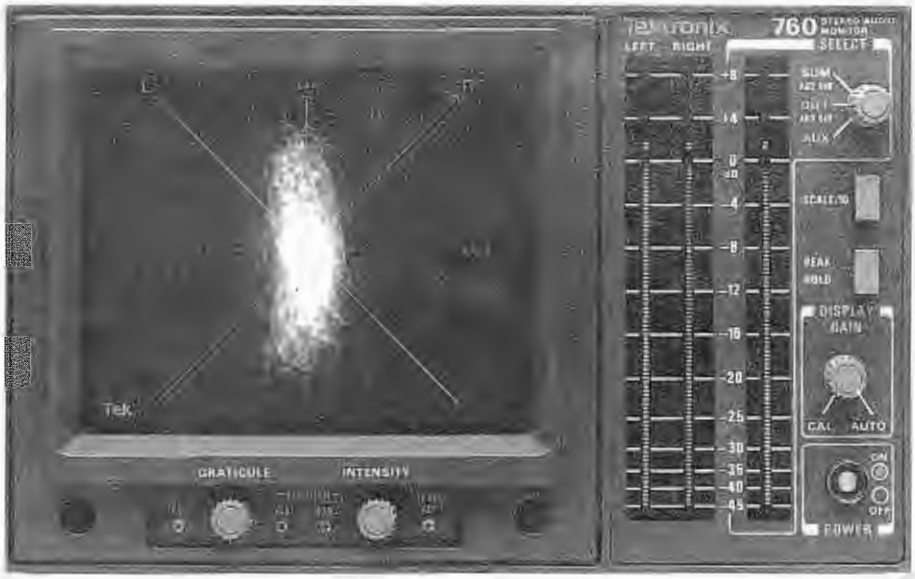


User Options Menu.

ORDERING INFORMATION

When ordering, please use the nomenclature given here:

PC 751 Remote Display Software
Includes: User's manual (070-7623-00)



760 Stereo Audio Monitor.

760 Series
Stereo Audio Monitor

Graphic CRT Display of Stereo Audio Signal

AGC for Continuously Viewable Pattern

Bar Graph for Quick Setups and Accurate Peak Indication

Third bar indicates mono compatability when set to SUM

Suitable for Phase and Amplitude Measurements

Optional Nordic or DIN Scale

760 N Nordic Scale Version.

760 D DIN Scale Version.

With Tektronix' 760 Stereo Audio Monitor, the audio engineer can analyze a pattern display of the stereo audio signal. This display, along with a high resolution bar graph, provides accurate monitoring and measurement capabilities. Used in both operation and setup, the instrument provides immediate feed-back of the audio signal for creative or technical correction. With the appropriate test signals, the unit can also be used for accurate phase and amplitude measurements.

On the CRT and adjacent bar graph, you can observe amplitude information, stereo separation, and phase correlation between the Left and Right channels. Also of great importance, you can see monaural amplitudes resulting from the stereo channels.

Your choice of automatic or manual gain control provides flexible control of the pattern size. With no input signal, the display will dim to prolong CRT life.

Two calibrated bars are dedicated to the Left and Right channels. The input to a third bar is selectable from Sum, Difference (both internally derived), and an Auxiliary input on the rear panel. These bars give the operator even greater resolution for setting levels when the SCALE/10 push button is depressed. This increases resolution by a factor of 10 around the 0 dB point of the bars. A selectable three second PEAK HOLD control makes level monitoring easier than ever.

Three product versions are available with various scales: 760 (standard), 760 N (Nordic), or 760 D (DIN) (see photos).

The 760 is ideally suited for use in editing suites, master control, transmission, and any other locations where monitoring the stereo audio signal is a must.

CHARACTERISTICS

Audio Inputs — Balanced Bridging: >10 kΩ/side. Termination: Selectable from >20 kΩ, 600 Ω, 150 Ω (internal jumper). Protection: Will withstand 50 V peak common-mode input, dc to 20 kHz, without damage. Sensitivity: Gain selectable for 0 dB bar indication for sine waves of 0, +4, +8, +12 and +16 dBu (internal jumper) for 760 only. 760 N and 760 D are fixed sensitivity (see chart).

CRT Display — Graticule: L, R, L=R and L=−R lines. Major and minor tics for phase measurements at 10° and 5° intervals respectively, on L axis. Automatic Gain Control (AGC): Control Range 30 dB. Gain Match and Tracking (over AGC range): ±0.3 dB. Phase Match: ±1° at 0 dB. Frequency Response: ±0.5 dB, 20 Hz to 20 kHz from +8 dB to −20 dB. Z-Axis Dimming: With absence of signal.

Bar Graph — 100 Segment LED: Green to 0 dB, red above 0 dB (+6 on 760N). Peak Hold: Approximately 3 seconds. Switchable On/Off. Attack/Decay Dynamics: PPM (Peak Program Meter) per DIN 45406 and Technical Recommendation N9 (Nordic Broadcasting Authorities). Frequency Response: ±0.5 dB, 20 Hz to 20 kHz from +8 to −20 dB. Gain Match: ±0.3 dB. Crosstalk (760): A +8 dB full scale signal on any channel causes no indication on remaining bars.

Front Panel Controls — Power On/Off. For CRT Display: Intensity; Gain Auto/Man/Cal; Horizontal/Vertical Position; Focus; Trace Rotation. For Bar Graph: Third Bar Selector SUM, DIFF, AUX; Peak Hold On/Off; SCALE/10 (760); Expand Scale (760 N, 760 D).

Rear Panel Connectors — XLR Inputs: Left, Right, Auxiliary. Power: Fuse

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	133	5.25
Width	214	8.424
Depth	429	16.875
Weight (approximate)	**kg**	**lb**
Net	4.5	10

	760	760 N	760 D
Display Range	Normal: +8 to −45 dB Scale/10: +0.8 to −4.5 dB Green to 0 dB Red above 0 dB	Normal: +15 to −39 dB Green to +6 dB Red above +6 dB Expanded: +3 to −6 dB Expands around TEST	Normal: +5 to −50 dB Green to 0 dB Red above 0 dB Expanded: −5 to −13 dB Expands around −9 dB
Resolution	Normal: +0.4 dB, +8 to −20 dB Scale/10: 0.04 dB	Normal: 0.5 dB, +15 to −24 dB Expanded: 0.1 dB	Normal: 0.25 dB, +5 to 0 dB Expanded: 0.2 dB
Sensitivity	Jumper selectable to 0, +4, +8, +12, +16 dBu for 0 dB indication	1.55 Vrms (+6 dBu) for +6 dB indication	1.55 Vrms (+3 dBu) for 0 dB indication
Accuracy @ 1 kHz	±0.3 dB at 0 dB	±0.3 dB at +6 dB	±0.3 dB at 0 dB

ORDERING INFORMATION

The standard instrument is shipped without a case or handle. If your application is for bench or portable use, please order the appropriate enclosure from the optional accessories list. The 760 is a UL recognized component and meets the requirements for listing when used in the appropriate enclosure.

760 Stereo Audio Monitor

760 N Stereo Audio Monitor (Nordic)

760 D Stereo Audio Monitor (DIN)

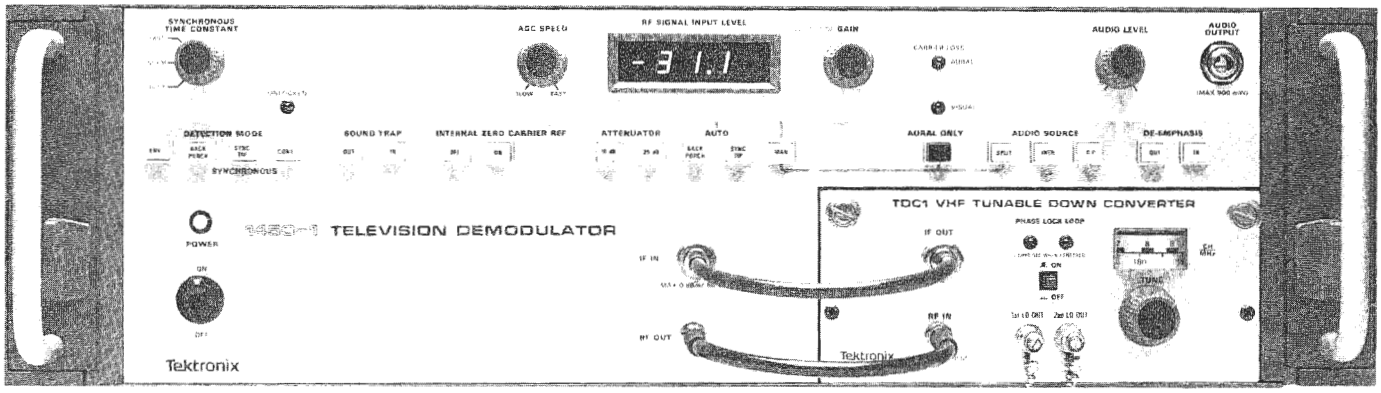
Portable DC powered applications — 760 Stereo Audio Monitor plus 1700F10 DC Power Converter, 1700F02 Portable Cabinet, and BP1 Battery Pack

INCLUDED ACCESSORIES

Instruction Manual (070-5992-00), Power Cable Assembly (161-0066-00).

OPTIONAL ACCESSORIES

Cabinets — Plain: Order 1700F00.
Cabinets — Portable: Order 1700F02.
Rack Adaptor — Order 1700F05.
Blank Panel — Order 1700F06.
DC Operation Kit (12 Vdc) — Order 1700F10.
Battery Pack — Order BP1.



The 1450-1 is compatible with System M Television Transmission, the 1450-2 is compatible with System B/G, and the 1450-3 is compatible with System I.

1450 Series
Television Demodulators

Measurement-Quality Performance for Negligible Distortion

Synchronous Detection Eliminates Quadrature Distortion

Envelope Detection for Accurately Determined Differential Phase

Surface Acoustic Wave Filter Provides Precise Nyquist Slope; Excellent Long and Short-Term Stability

Digital Readout of Input Power Level for Easy, Accurate Field Strength Readings

Constant-Bandpass Characteristics Over Wide Dynamic Range

Any Single VHF or UHF Channel Operation

UHF and VHF Tunable Down Converters

Conforms to EIA Standard RS-462 (System M Only)

Wideband Audio Output for BTSC Multichannel Sound Applications (System M Only)

Wideband Audio Output Compatible with Japanese Stereo Sound with FAX Channel (System M Only)

The 1450-1 (System M), 1450-2A (System B/G) and 1450-3A (System I) demodulator mainframes are combined with a Tektronix Television Down Converter (TDC) to provide an accurate link between your transmitter's RF signals and video baseband measuring equipment. Unique components work together to identify and eliminate any possible demodulation distortion in reproduced signal characteristics. You see a transparent picture of your transmitter's performance and signal output.

Tunable or Fixed-Channel Down Converters

For demodulating an RF signal at a TV channel frequency, the 1450 Series demodulator mainframes must be used with a Tektronix TDC. Three compatible TDCs are available for each system and provide a selection between tunable and fixed-channel performance. The TDC Fixed-Channel Down Converter supports your specified system channel number. Tunable Down Converters available for VHF and UHF channels are the TDC1 and TDC2, respectively.

Demodulation of the transmitter IF signal may be accomplished by using only the mainframe.

Synchronous and Envelope Detection

The 1450 Series demodulators allow you to select either synchronous or envelope detection. Each method has advantages, yet both are required for full measurement capability. For instance, synchronous detection is necessary for measurements that can be seriously affected by quadrature distortion.

The 1450 Series demodulators have two synchronous video detectors operating in phase quadrature. One detects the in-phase signal; the other detects the quadrature component of the video signal. (The quadrature component is a measure of change in visual carrier phase resulting from a change of video level.)

However, if incidental phase modulation is present on the picture carrier, the amount of differential phase measured on a synchronously detected signal will be erroneous. Because of this, an envelope detector is necessary to determine the actual differential phase present. The envelope detector has linear transfer characteristics down to 3% carrier and so provides optimum modulation depth indication.

ICPM (Incidental Carrier Phase Modulation)

This distortion can be easily measured with a Tektronix demodulator using synchronous detection and the quadrature signal output. It cannot be measured with envelope detection, nor can it be measured using a demodulator that is not equipped with two quadrature-phased synchronous detectors and having a quadrature output.

Because of the higher subcarrier frequencies used in BTSC multichannel sound, accurate ICPM measurement is even more critical in these applications.

A special waveform monitor graticule and low pass filter are provided with each 1450-1 for the measurement of this distortion.

Quadrature Distortion

Quadrature distortion occurs when a single sideband signal is demodulated with an envelope detector.

Quadrature distortion most severely affects the chrominance signal, causing a loss of brightness in highly saturated colors, especially those at high luminance levels. Narrow white picture elements against the dark backgrounds are reproduced at reduced brightness.

Synchronous detection of the television RF signal eliminates quadrature distortion, allowing the true performance of the transmitter to be determined.

Tektronix-Developed Surface Acoustic Wave Filter

The 1450 Series demodulators feature a SAW (surface acoustic wave) filter developed by Tektronix. It provides more precise Nyquist slope characteristics without group delay distortion, improves long-term and short-term stability, and lowers maintenance costs compared to conventional filter network circuitry.

In conventional demodulators, the more precisely the bandpass characteristics approach an ideal Nyquist curve, the more complex the filter network required. In the 1450 Series demodulator mainframes however, the bandpass characteristics are determined by just a single component, the SAW filter. Precision is the result.

Conventional tuned IF circuitry must be meticulously adjusted and is subject to change with mechanical and thermal shock. But the SAW filter is in a sealed unit and accurately provides the critical selectivity characteristics of the demodulator — and requires no adjustments.

Constant-Bandpass Characteristics

The Tektronix 1450 Series demodulators offer constant-bandpass characteristics over the entire dynamic range of input signal level. Amplifiers in the mainframe operate at a constant gain, and pin-diode attenuators are used to adjust the overall gain of the demodulator. This more sophisticated approach to AGC (automatic gain control) is necessary to maintain constant-bandpass characteristics over the entire dynamic range of input power (−69 dBm to −3 dBm). Additional attenuation of 30 dB, available in 10 dB steps, can shift the range for higher input power levels. In addition to AGC, demodulator RF/IF gain control can be set for manual operation.

Digital Reading of Input Power

With the accurate (to 0.1 dB) digital readout you get measurements of input power you can depend on at transmitter sites, remote sites, or for calibrated field strength measurements.

Split and Intercarrier Sound

For making measurements or adjustments on aural transmitters, the 1450 Series demodulators feature both split and intercarrrier sound channels. The split carrier channel, which will operate without the presence of the visual carrier, may be used when making measurements on the aural transmitter only.

Four audio outputs give added measurement capability: a 600 Ω output, two low impedance outputs for driving a speaker or headphones, and a calibrated output for making deviation measurements with an ac voltmeter or an oscilloscope.

Multichannel Sound Compatible (System M Only)

The 1450-1 provides three aural detection modes — Intercarrier, Split and Quasi-Parallel. The split carrier mode will operate with or without the presence of the visual carrier. Quasi-Parallel detection substantially reduces the buzz that might otherwise be introduced on the detected signal due to the IF signal passing through the Nyquist filter of the demodulator when the intercarrier detection mode is used.

The 1450-1 has four audio outputs. The speaker and headphone outputs are 8 ohm impedance outputs and are filtered and deemphasized to provide only the monophonic main channel. A 15.734 kHz notch filter is provided to reduce the BTSC stereo pilot tone to an inaudible level.

The 600 ohm balanced output normally provides a full 150 kHz bandwidth output but can be restricted to 20 kHz by moving an internal jumper. The fourth output is a 75 ohm unbalanced output with a 150 kHz bandwidth and a calibrated level of 10 mV per kHz deviation of the aural carrier. This output can be used for accurate measurement and monitoring of the aural channel and can be used to drive a professional multichannel sound decoder, modulation monitor or spectrum analyzer.

NICAM Compatible (1450-2A and 1450-3A Only)

The 1450-2A and the 1450-3A provide the NICAM intercarrier output for demodulation and monitoring by a separate NICAM decoder such as the Tektronix 728D.

CHARACTERISTICS

System RF Characteristics	Fixed Channel TDC	Tunable TDC1 or TDC2 (UHF)	System RF Characteristics	Tunable TDC1 (VHF) Fixed Channel TDC	Tunable TDC 1 or TDC2 (UHF)
RF Input Impedance	50 Ω (N)*	50 Ω (N)*	Image Rejection Ratio, Second IF Image:		≥60 dB
Return Loss with 0 dB Attenuation	≥20 dB	≥10 dB	IF Rejection Ratio:	≥60 dB	(TDC1 First IF) ≥50 dB
Return Loss with ≥20 dB Attenuation:	≥30 dB	≥30 dB			(TDC2 First IF) ≥30 dB
Frequency:	Any System M, B, G, or I assigned carrier frequency ±20 kHz	(TDC1) All System M or B VHF assigned carrier frequencies, plus CATV Channels 14 through 36, ±27 kHz (TDC2) All System M, G or I UHF assigned carrier frequencies, ±27 kHz	Adjacent Channel Cross Modulation:	≥60 dB	≥60 dB
			Alternate Channel Cross Modulation:	≥60 dB	≥60 dB
			Variation in System Frequency Response with AGC	(VHF) ≤0.1 dB (UHF) ≤0.15 dB	≤0.25 dB
Level Range*:					
0 dB Mainframe Attenuation	−69 to −3 dBm	−65 to +1 dBm	Variation in System Frequency Response, Channel to Channel:		≤0.3 dB across any 6 MHz channel bandpass
10 dB Mainframe Attenuation	−59 to +7 dBm	−55 to +11 dBm			
20 dB Mainframe Attenuation	−49 to +17 dBm	−45 to +21 dBm			
30 dB Mainframe Attenuation	−39 to +27 dBm	−35 to +31 dBm			
AGC Range:	66 dB	66 dB	Damage level at RF input	1 watt	1 watt
VHF Noise Figure:	≤10 dB	(TDC1) ≤19 dB	Readout Accuracy:	±2 dB	±2 dB
UHF Noise Figure:	≤11 dB	(TDC2) ≤19 dB	Readout Resolution:	±0.1 dB	±0.1 dB
Image Rejection Ratio, First IF Image:	≥60 dB	(TDC1) ≥50 dB (TDC2) ≥40 dB			

* In 50 Ω: +27 dBm = 5 V RMS +31 dBm = 8 V RMS
−3 dBm = 158 mV RMS +1 dBm = 251 mV RMS
−69 dBm = 80 μV RMS −65 dBm = 126 μV RMS

IF

Input Impedance (Z_{in}) — 50 Ω (BNC).

Return Loss — >18 dB.

IF Level Range — −20 dBm to −69 dBm. (Signal to noise ratio deteriorates below a signal level of −28 dBm.)

IF Frequency —
1450-1: Visual is 37 MHz, 38.9 MHz, or 45.75 MHz ±127 kHz (as specified by the mainframe/TDC options). Aural is 4.5 MHz below visual.
1450-2: Visual is 38.9 MHz ±127 kHz. Aural is 5.5 MHz below visual.
1450-3: Visual is 38.9 MHz ±127 kHz. Aural is 6.0 MHz below visual.

VIDEO

Video Output — Z_0: 75 Ω (2 BNC). Return Loss: ≥34 dB. Level 1 V p-p sync tip to peak white.

Dc Level — Back Porch AGC: Blanking level at 0 V ±50 mV. Sync Tip AGC: Referenced to blanking level, sync tip is at −286 mV ±5.7 mV (1450-1), −300 mV ±6 mV (1450-2, 1450-3).

Line Time Distortion — ≤0.5%, wideband IF, synchronous detection. 1.0% in all other IF, detection mode combinations.

Field Time Distortion — ≤0.5%.

Line Time Nonlinearity — ≤1%.

Differential Gain — Synchronous: ≤1%. Envelope: ≤4%.

Differential Phase — ≤1°.

Chrominance/Luminance Delay — ≤±20 ns.

Chrominance/Aural/Visual Carrier Intermod — ≥50 dB down.

Aural Signal Rejection — ≥46 dB.

Video Signal to Noise Ratio — Low Frequency (p-p video/p-p hum): ≥60 dB. Mid Frequency Coherent (p-p video/p-p noise): ≥50 dB. White Noise (p-p video/RMS noise): ≥60 dB.

Quadrature Output — Z_0: 75Ω (BNC). Return Loss: ≥34 dB.

Zero Carrier Reference Gate — 1450-1: Width is 30 μs ±10%. Delay is 20 μs ±10% from leading edge of sync. Carrier Cutoff is ≥50 dB. Zero Carrier is ±0.5 IRE. Timing is factory set to line 20 of both fields, internally selectable from line 10 through line 25 of both fields. 1450-2, 1450-3: Width is 30 μs ±10%. Carrier Cutoff is ≥50 dB. Zero Carrier is ±3.5 mV. Timing is factory set to line 16/329 of both fields, internally selectable from line 10/323 through line 25/338 of both fields.

EXT Zero Carrier Reference Drive Input — Z_{in}: ≥ 5 kΩ (BNC). Level Required: ≥ ±1 V.

AUDIO

Frequency Response — 1450-1: Deviation Output and 600 Ω Output ±0.1 dB (30 Hz to 50 kHz) ±0.5 dB (30 Hz to 150 kHz). 600 Ω Output can be limited to 20 kHz by jumper. Speaker and headphone Output ±0.4 dB (30 Hz to 20 kHz, 15.734 kHz Notch Filter jumper selecatble). 1450-2, 1450-3: All Outputs ±0.4 dB (30 Hz to 20 kHz).

De-emphasis — 1450-1: Follows standard 75 μs de-emphasis curve ±0.4 dB. 1450-2, 1450-3: Both follow standard 50 μs de-emphasis curve ±0.5 dB.

Harmonic Distortion — 1450-1: 0.1% for 30 Hz to 15 kHz inputs measured with 50 kHz band limiting. 0.5% for 16.5 kHz to 50 kHz inputs measured with 120 kHz band limiting (with ±25 kHz deviation). 1450-2, 1450-3: 0.2% (30 Hz to 15 kHz, with ±50 kHz deviation).

Audio Signal to Noise Ratio — 1450-1 wide band mode: ≥50 dB in all detection modes measured at the 75 Ω output, band limited to 130 kHz and modulation of visual carrier.

≥60 dB in all detection modes measured at the 75 Ω output, band limited to 50 kHz and no modulation of the visual carrier.

1450-1 narrow band mode, 1450-2, 1450-3: Intercarrier Mode: ≥55 dB. Split Carrier Mode: 1450-1, 1450-2 is ≥75 dB. 1450-3 is ≥70 dB. External Aural Intercarrier In: ≥75 dB. Aural Only Mode: ≥75 dB. All at 1 kHz modulation and ±25 kHz (±50 kHz for 1450-2 and 1450-3) deviation and modulation of the visual carrier.

Deviation Output — 1450-1: 10 mV/kHz ±1% (75 Ω BNC). 1450-2, 1450-3: 50 mV/kHz ±1% (600 Ω BNC).

Aural Intercarier In — Z_{in}: 50 Ω (BNC). Return Loss: ≥20 dB. Level: −30 dBm ±5 dB.

Aural Intercarrier Output — Z_0: 50 Ω (BNC). Return Loss: ≥20 dB. Level Nominal: −6 dBm up to 0 dBm.

600 Ω Balanced Line Output — 1450-1 Wideband Mode: 50 mV/kHz ±3%; Narrowband Mode: 10 dBm at 25 kHz deviation. 1450-2: 10 dBm at 50 kHz deviation. 1450-3: 8 dBm at 50 kHz deviation. Connector XLR.

8 Ω Speaker Output — Level up to 5 W RMS, front panel adjustable. Connector Barrier block.

Headphone Output — Level up to 50 mW into 8 Ω headphone (stereo or mono style). Connector phone jack (monaural output only).

Remote Connector — Alarm output SPDT relay contact rated at 28 V, 3 A. External synchronous/envelope switch. Ground for envelope detection.

Damage Level at RF Input — 1 W maximum (any attenuator setting).

AC POWER

Line Voltage Ranges — 100 V ac ±10%. 120 V ac ±10%, 220 V ac ±10%. 216 V ac to 250 V ac.

Power Consumption — 100 W maximum.

Mains Frequency — 48 Hz to 62 Hz.

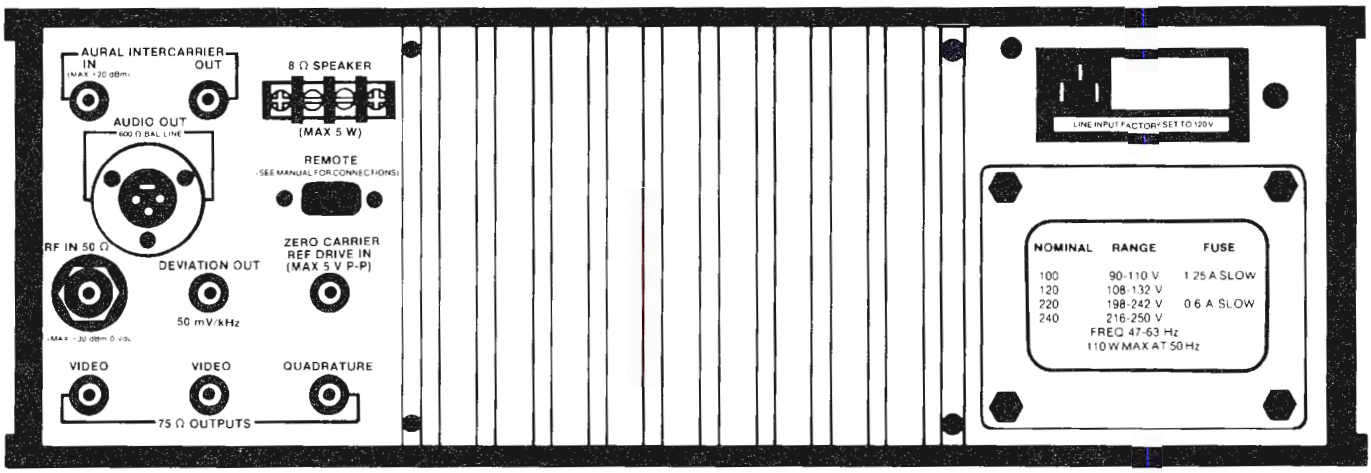
ENVIRONMENTAL

Temperature Range — Operating: 0°C to +50°C.

Altitude Range — Operating: Sea level to 4570 m (15,000 ft).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	133	5.3
Width	483	19.0
Depth	486	19.1
Weight	**kg**	**lb**
Mainframe	16.3	36.0
Down Converter	2.3	5.0



1450 Rear Panel.

ORDERING INFORMATION SYSTEM M

1450-1 Television Demodulator
(Order one vision IF option)

Includes: Pair rackmount slide guide (351-0301-03); N to BNC coaxial adapter (103-0045-00); extender circuit board (670-5034-00); 50 Ω BNC coax cable (012-0715-00); 50 Ω SMA double shield coax cable (012-0752-00); two BNC to square-pin adapter cables (175-2140-00); BNC to Peltola adapter cable (067-0709-00); TORX screwdriver (003-0816-00); male connector (131-1007-00); hood (200-1170-00); two screws (213-0260-00); low pass filter (015-0352-00). For 1450-1: ICPM graticule (331-0393-12); 0.6 A slow blow fuse (159-0043-00).

OPTIONS

Option 01 — 37 MHz Vision IF.

Option 02 — 38.9 MHz Vision IF.

Option 03 — 45.75 MHz Vision IF.

For demodulation of RF signals, one of the following three down converters must be plugged into the 1450-1 mainframe.

Order one vision IF option and either Option 11 or Option 14.

TDC Fixed Channel Down Converter — (Stipulate channel number when ordering.)

TDC-1 — Tunable Down Converter VHF Band.

TDC-2 — Tunable Down Conveter UHF Band.

Option 01 — 37 MHz Vision IF.

Option 02 — 38.9 MHz Vision IF.

Option 03 — 45.75 MHz Vision IF.

Option 11 — System M Countries. (See list.)

Option 14 — (See list.).

For upgrading 1450-1 and 1450 (S/N BO 19999 and below) to provide a wide band audio output suitable for use with BTSC System multichannel sound in North America install:

1450F20 Field Upgrade Kit.

ORDERING INFORMATION SYSTEM B/G

1450-2A Television Demodulator
(Order both Option 02 and Option 09)

Includes: In addition to 1450-1; a ICPM graticule (331-0393-15); 1.25 A slow blow fuse (159-0041-00); manual.

OPTIONS

Option 02 — 38.9 MHz Vision IF.

Option 09 — +90 ns/−170 ns Group Delay.

For demodulation of RF signals, one of the following three down converters must be plugged into the 1450-2 mainframe. Order both Option 02 and Option 12.

TDC Fixed Channel Down Converter — (Stipulate channel number when ordering.)

TDC-1 — Tunable Down Converter VHF Band.

TDC-2 — Tunable Down Converter UHF Band.

Option 02 — 38.9 MHz Vision IF.

Option 12 — System B/G/I Countries. Required for 1450-2 and 1450-3.

ORDERING INFORMATION SYSTEM I

1450-3A Television Demodulator
(Order Option 02)

Includes: Same as for 1450-2A.

OPTIONS

Option 02 — 38.9 MHz Vision IF.

For demodulation of RF signals, one of the following three down converters must be plugged into the 1450-3 mainframe. Order both Option 02 and Option 12.

TDC Fixed Channel Down Converter — (Stipulate channel number when ordering.)

TDC-1 — Tunable Down Converter VHF Band.

TDC-2 — Tunable Down Converter UHF Band.

Option 02 — 38.9 MHz Vision IF.

Option 12 — System B/G/I Countries. Required for 1450-2 and 1450-3.

ORDERING INFORMATION SYSTEMS D and K

1450 Series Television Demodulators and Down Converters with modifications. Contact Tektronix to request quote.

OPTION 11 COUNTRIES: SYSTEM M

Antigua, Barbados, Bermuda, Brazil, Canada, Chile, Columbia, Costa Rica, Cuba, Curacao, Dominican Republic, Ecuador, El Salvador, Guam, Guatemala, Johnston Islands, Korea, Mexico, Micronesia, Netherlands Antilles Nicaragua, Panama, Peru, Phillipines, Puerto Rico, Samoa, St. Kitts, Surinam, Taiwan, Trinidad/Tobago, Uruguay, U.S.A., Venezuela, Virgin Islands.

OPTION 12 COUNTRIES: SYSTEM B/G/I

Algeria, Austria. Bahrain, Bangladesh, Belgium*1, Brunei, Cyprus, Denmark, East Germany, Egypt, Equatorial Guinea, Ethopia, Finland, Ghana, Gibraltar, Greece, Hong Kong, Iceland, india, Indonesia, Iran, Iraq, Israel, Ireland (UHF)*1, Italy (UHF), Jordan, Kenya, Kuwait, Lebanon, Liberia, Libya, Malta, Mauritus, Netherlands, Nigeria, Norway, Oman, Pakistan, Portugal, Qatar, Rhodesia, Saudi Arabia*2, Sierra Leone, Singapore, South Africa (UHF)*1, Spain, Sudan, Sweden, Switzerland, Syria, Tanzania, Thailand*2, Tunisia, Turkey, Uganda, United Arab Emirates, United Kingdom (UHF)*1, West Germany, Yemen Arab Republic, Republic of Yemen, Yugoslavia, Zambia.

**1 System I.*
**2 System B only.*

OPTION 14 COUNTRIES: SYSTEM M

Japan and Okinawa.

Distortion Analyzer.

AA 501A
Distortion Analyzer

Fully Automatic: No Level Setting, Tuning or Nulling

Level, Total Harmonic Distortion, and dB Ratio Measurements

Total System Harmonic Distortion Plus Noise (THD+N) <0.0025%

≤3.0 μV Residual Noise

Digital Readout Plus Analog-Like "Bar Graph" for Peaking and Nulling

IMD to SMPTE, DIN, and CCIF (Option 01)

The AA 501A Distortion Analyzer provides completely automatic measurement of level, total harmonic distortion plus noise (THD+N), and (with Option 01) Intermodulation Distortion. Automatic level setting, automatic tuning, automatic nulling of the fundamental, and autoranging of the display all combine to permit completely hands-off operation once the mode is selected. Just apply the signal of interest and read the 3-digit display. A novel analog-like bar graph simulates an analog meter to assist in peaking and nulling of applied signals.

With Option 01, intermodulation distortion measurements can be made to any of the three common standards: SMPTE, DIN, or CCIF. Internal circuitry automatically identifies the signal being used and selects the proper filtering circuits to perform the measurement.

DB ratio measurements can be referenced either to 774.6 mV (1 mW in 600 Ω) or to a selected applied signal. The 0 dB reference memory remembers the selected level, and all subsequent measurements are referenced to that level.

The AA 501A allows readings to be expressed in true RMS or average response, RMS calibrated. Although true RMS is more accurate in most applications, the average response permits comparisons with measurements previously taken with older instrumentation.

The fundamental frequency range is 10 Hz to 100 kHz, with harmonics measured out to 300 kHz.

Any one of four built-in frequency-weighting filters can be switched into the signal paths for preconditioning of the signal to be measured. Provision is also made to permit the use of a user-selected filter. A dc level, which is a function of the display readout, is available at the rear panel of the AA 501A.

An Input Monitor connector and a Function Output connector are provided to permit oscilloscope display of the input signal or the result of the filter in the THD+N measurement.

The Option 02 version of the AA 501A is especially designed for use in accordance with CCIR recommendation 468-2 and DIN 45405 (typically used in Europe). In the Option 02 version, the 30 kHz filter and the "A" weighting filter of the standard unit are replaced by a 22.4-Hz-to-22.4-kHz filter and a CCIR-weighting filter, respectively, and the average-responding detection circuit is replaced by a quasi-peak detection circuit. The Option 02 also contains the intermod measurement capability of the Option 01.

The AA 501A Distortion Analyzer and the SG 505 Oscillator were designed to be used together as the heart of a state-of-the-art audio-analysis system. Used together, the two provide total system harmonic distortion of 0.0025% or less.

It should be noted that the automatic frequency tuning of the AA 501 does not depend upon the manual tuning of a companion oscillator. The AA 501A will automatically tune itself to its input signal whether the signal originates from an SG 505 alongside it in a TM 500 mainframe, or from some other signal source miles away.

CHARACTERISTICS

The following characteristics are common to the standard AA 501A, Option 01 and Option 02 unless otherwise noted.

HARMONIC DISTORTION FUNCTION

Fundamental Frequency Range — 10 Hz to 100 kHz automatically tuned to input frequency.

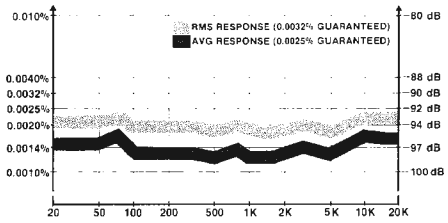
Distortion Ranges — Auto (100%), 20%, 2%, 0.2%, and dB (autoranging).

Accuracy (Readings ≥4% of Range) — 20 Hz to 20 kHz ±1 dB, 10 Hz to 100 kHz +1, −3 dB. (Accuracy is limited by residual THD+N and filter selection.)

THD — Complete Automatic Total Harmonic Distortion (THD) measurements to specified accuracy in seven seconds or less.

AA 501A/SG 505 System Residual THD+N — V_{in} ≥250 mV, (all distortion, noise, and nulling error sources combined). 20 Hz to 20 kHz: ≤0.0025% (−92 dB) Average Response with 80 kHz filter (standard and Option 01 only). ≤0.0032% (−90 dB) RMS Response with 80 kHz filter. 10 Hz to 50 kHz: ≤0.0071% (−83 dB) RMS Response. 50 kHz to 100 kHz: ≤0.010% (−80 dB) RMS Response.

TYPICAL THD+N



Typical Fundamental Rejection — At least 10 dB below specified residual THD+N or actual signal THD, whichever is greater.

Minimum Input Level — 60 mV (−22 dBm).

NOISE (OPTION 02)

Noise measurments to CCIR recommendation 468-2 and DIN 45405. True RMS or quasi-peak response. Total system THD+N = 0.0032% (90 dB) RMS response. Balanced input.

LEVEL FUNCTION

Autoranging digital voltmeter displays input signal level in volts, dBm, or dB ratios.

Modes — Volts, dBm (600 Ω), or dB ratio with push-to-set 0 dB reference.

Level Ranges — 200 μV full scale to 200 V full scale in ten steps, manual or autoranging.

Accuracy[*1]

Frequency	Volts	dBm or dB Ratio
20 Hz to 20 kHz	±2%	±0.3 dB
10 Hz to 100 kHz[*2]	±4%	±0.5 dB

*[*1] V_{in} ≥100 μV, level ranging indicators extinguished.*

*[*2] On the 200 μV range, accuracy above 50 kHz is +4%, −6% (+0.5 dB, −0.7 dB).*

Bandwidth — ≥300 kHz.

Residual Noise — ≤3.0 μV (−108 dBm) with 80 kHz and 400 Hz filters. ≤1.5 μV (−114 dBm) with "A" weighting filter.

INTERMODULATION DISTORTION FUNCTION (OPTION 01/02)

Fully automatic SMPTE, DIN, and CCIF difference frequency test measurements.

SMPTE and DIN Tests — Lower Frequency Range: 50 Hz to 250 Hz. Upper Frequency Range: 3 kHz to 100 kHz. Level Ratio Range: 1:1 to 5:1 (lower:upper). Residual IMD: ≤0.0025% (−92 dB) for 60 Hz and 7 kHz or 250 Hz and 8 kHz, 4:1 level ratio.

CCIF Difference Frequency — Frequency Range: 4 kHz to 100 kHz. Difference Frequency Range: 50 Hz to 1 kHz. Residual IMD: ≤0.0018% (−95 dB) with 14 kHz and 15 kHz. Minimum Input Level: 60 mV (−22 dBm).

Accuracy — ±1 dB.

ALL FUNCTIONS

Detection — Average or true RMS for waveforms with crest factors ≤3.

Filters —
400 Hz High Pass: −3 dB at 400 Hz ±5%; at least −40 dB rejection at 60 Hz.
80 kHz Low Pass: −3 dB at 80 kHz ±5%.
30 kHz Low Pass: −3 dB at 30 kHz ±5% (standard and Option 01 only). "A" Weighting: Meets specifications for Type 1 sound level meters (ANSI S 1.4, IEC Recommendation 179) (standard and Option 01 Only). Ext: Allows connection of external filters. 22.4 Hz to 22.4 kHz: −3 dB ±5% (Option 02 only). CCIR WTG: CCIR Recommendation 468-2 and DIN 45405, functional only with Q-PK detector (Option 02 only).

Input Impedance — 100 kΩ ±2%, each side to ground, fully differential.

Maximum Input — 300 V peak, 200 V RMS either side to ground or differentially. Fully protected on all ranges.

Common Mode Rejection — ≥50 dB at 50 Hz or 60 Hz. Typically ≥40 dB to 300 kHz.

FRONT PANEL SIGNALS

Input Monitor — Provides constant amplitude version of signal applied to input. Output Voltage: 1 V RMS ±10% for input signals >50 mV. Source Impedance: 1 kΩ ±5%.

Function Output — Provides a scaled sample of selected function signal (1000 count display = 1 V RMS ±3%). Source Impedance: 1 kΩ ±5%.

Auxiliary Input — Provides input to detector circuit when Ext Filter button is depressed. Sensitivity: 1 V RMS ±3% = 1000 count display. Impedance: 100 kΩ ±5%, ac coupled.

REAR INTERFACE SIGNALS

Rear INTFC Input — Front panel selected. Same as main Input except, maximum signal input is limited to 42 V peak, 30 V RMS. (Potential crosstalk at rear interface may degrade noise and distortion on performance.)

Monitor — Same as front panel Input Monitor.

Function Output — Same as front panel Function Output.

Auxiliary Input — Same as front panel Auxiliary Input.

Converter Output — Dc output of selected response converter. 1 V ±5% for 1000 count display. Source Z: 500 Ω ±5%.

dB Output — Dc output of logarithmic dB converter. 10 mV ±5% per 1 dB of display. Source Z: 1 kΩ ±5%.

SG 505
Option 01/Option 02

10 Hz to 100 kHz Sinewave Output

Ultra-Low Distortion: <0.0008% THD (Typically 0.0003%)

Floating or Grounded Output

600 Ω Source Impedance

Vernier Frequency Control

Fully Balanced Output (Option 02)

Uncalibrated Output to +28 dBm (Option 02)

Selectable Source Impedance (Option 02)

Intermodulation Test Signal (Options 01 & 02)

The SG 505 Oscillator generates an ultra-low distortion sinewave over the frequency range from 10 Hz to 100 kHz (<0.0008% THD, typically 0.0003% between 20 Hz and 20 kHz). In the standard and Option 01 units the output can be floated or referenced to chassis ground. In the Option 02 unit, the output is fully balanced and floating with a center tap that can be attached to system ground or to either side of the output signal. The oscillator also provides a fixed amplitude ground-referenced sinewave at the Sync Out connector that is identical in frequency to the signal from the Output connector.

Option 01 adds an intermodulation test signal function. This signal consists of a selectable 60 Hz or 250 Hz sinewave mixed with the selected frequency in a 4:1 amplitude ratio.

For communications and broadcast applications, Option 02 provides a fully balanced output of +22 to −68 dBm calibrated, into 600 Ω. A ten-position output-level control provides 10 dB/step calibrated attenuation. Uncalibrated outputs can range from +28 dBm (into 600 Ω from a 50 Ω source) to −78 dBm.

Option 02 has a front panel switch that allows the selection of three different source resistances: 50 Ω for low impedance applications (improves measurement accuracies on long cable runs and reduces loading effects), 150 Ω for matching microphone circuits, and 600 Ω for complying with audio/communication industry standard and general purpose applications.

Option 02 also includes the intermodulation test signal capability of the Option 01.

CHARACTERISTICS

MAIN OUTPUT

The following characteristics are common to the standard SG 505 and Option 01.

Frequency Range — 10 Hz to 100 kHz in four overlapping bands. Accurate within 3% of dual setting (with Vernier at center). Vernier Range is at least ±1% of frequency setting.

Calibrated Output — Selectable from +10 to −60 dBm into 600 Ω in eight 10 dB steps. Accurate to within 0.2 dB at +10 dBm and 1 kHz. Step accuracy is ±0.1 dB/10 dB step. An uncalibrated control provides continuous variation from at least +2.2 dB to <−10 dB from calibrated position.

Amplitude Response — Level flatness ±0.1 dB from 10 Hz to 20 kHz (1 kHz ref); within 0.2 dB from 20 kHz to 100 kHz (excluding >50 kHz on −60 dB output level range).

Harmonic Distortion — <0.0008% (−102 dB) THD from 20 Hz to 20 kHz (typically 0.0003%); 0.0018% (−95 dB) THD from 10 Hz to 20 Hz, and from 20 kHz to 50 kHz; 0.0032% (−90 dB) THD from 50 kHz to 100 kHz (R_L ≥600 Ω).

Output Impedance — 600 Ω ±2%; floating or grounded through ≈ 30 Ω. Output impedance does not change with Output On/Off selection. Maximum floating voltage ±30 V peak.

Maximum Output Voltage — At least 6 V RMS open circuit, 3.16 V RMS (+10 dBV or +12.2 dBm) into 600 Ω.

SYNC OUTPUT

Signal — 200 mV RMS ±20% sinewave to 20 kHz, at least 120 mV RMS at 100 kHz.

Frequency — Same as main output.

Impedance — Nominally 1 kΩ, ground referenced and isolated from main output.

REAR INTERFACE SIGNALS

Buffered Main Output — Buffered version of actual output signals from front panel connector. ≈ 300 Ω Output impedance.

Sync Output — Same as front panel Sync Output except impedance is ≈ 50 Ω.

Option 01 IM Test Signal

Selecting the IM Test Signal causes a LF sinewave to be mixed with the normal oscillator signal in a 4:1 amplitude ratio.

LF Frequency — Internally selectable 60 Hz (±1 Hz) or 250 Hz (±3 Hz).

Main Output — Composite p-p output within 0.2 dB of normal oscillator mode output.

Residual IMD — Typically <0.0005% from 2.5 to 10 kHz.

Sync Output — LF signal component only, 200 mV RMS ±20%.

Option 02 Oscillator

MAIN OUTPUT

Calibrated Output — Selectable from +22 to −68 dBm into 600Ω in ten 10 dB steps. Accurate to within 0.2 dB at +22 dBm and 1 kHz. Step accuracy is ±0.1 dB/10 dB step or 20 dB step change. An uncalibrated control provides continuous variation from <−10 dB to +0.3 dB from calibrated position.

Harmonic Distortion — <0.0008% (−102 dB) THD from 20 Hz to 20 kHz (typically 0.0003%); 0.0018% (−95 dB) THD from 10 Hz to 20 Hz, and from 20 kHz to 50 kHz; 0.0056% (−85 dB) THD from 50 kHz to 100 kHz (R_L ≥600 Ω).

Output Impedance — Selectable 600 Ω ±2%, 150 Ω ±2% or 50 Ω ±3% floating or grounded through ≈ 30 Ω. Output impedance does not change with Output On/Off selection. Impedance to CT is ½ the selected impedance. Maximum floating voltage ±25 V peak.

Maximum Output Voltage — At least 21 V RMS open circuit; 19.45 V RMS (+28 dBm) into 600 Ω from 50 Ω.

Balance — ≤0.5% mismatch of output open-circuit voltages referenced to CT for f ≤20 kHz with output grounded.

ORDERING INFORMATION

AA 501A Distortion Analyzer

Includes: Instruction manual (070-2958-00).

SG 505 Oscillator

Includes: Cable assembly for sync output (175-1178-00); instruction manual (070-2823-00).

OPTIONS
(AA 501A)

Option 01 — Intermodulation Distortion.

Option 02 — CCIR/DIN (Includes Option 01).

(SG 505)

Option 01 — IM Test Signal.

Option 02 — Oscillator (Includes Option 01).

SG 5010/ AA 5001

GPIB IEEE-488

The SG 5010 and AA 5001 comply with IEEE Standard 488.1-1987, and with Tektronix *Standard Codes and Formats*.

Fast, Accurate, Repeatable Measurements

Easy to use, Minimizes Training Needs

Automatic Low-Cost Documentation of Test Results

Automated Audio Test System Advantages

Tektronix SG 5010 and AA 5001 programmable instruments in a computer-controlled test system will make critical audio measurements consistently, accurately, and in two to four seconds each. Even complex tests can be made by technically unskilled operators since the procedures are controlled by software in the controller. In addition, permanent graphic or tabular records of test results can be produced at a very low cost.

An SG 5010/AA 5001 based system will automatically perform such industry-standard tests as harmonic distortion to IHF A202, intermodulation distortion to SMPTE TH 22.51, DIN 45403, IEC 268.3, and IHF A202, frequency response to IHF A202, and noise or signal-to-noise ratio to IHF A202 ("A" weighting filter complies with ANSI specification S1.4 and IEC specification 179 for sound level meters). With the Option 02 capability of the AA 5001, noise measurements can be made to CCIR 468-2 and DIN 45405 standards. The SG 5010 also generates the burst signal necessary for dynamic headroom tests per IHF A202.

A basic automated system consists of the SG 5010 Programmable Oscillator, the AA 5001 Programmable Distortion Analyzer, and an IEEE Standard 488 controller such as the Tektronix PEP 301 System Controller. Frequency counters, signal switchers, interface devices, disc storage, and hard copy units or plotters can be optionally added to the system.

Other Measurement Capabilities

Features and flexibility of the SG 5010 and AA 5001 permit a variety of other measurements to be easily automated. SMPTE-like IMD measurements can be made at a variety of lower frequencies and any value of upper frequency, and at 1:1 amplitude ratios in addition to the standard 4:1 ratio. A CCIF test with the frequencies selected near the upper band limit of the device under test has been shown to be a very effective and simple-to-implement test for transient or dynamic intermodulation (TIM and DIM). Burst signals of any desired duty cycle can be generated for IHF dynamic headroom measurements and to test compressors and limiters; the between-bursts level can be selected as Off or 20 dB below the burst level. Power measurements are made by a controller computation from a voltage measurement across a known load resistance. SINAD measurements of sensitivity of FM communications receivers are a standard capability of the AA 5001 plus an appropriate RF signal generator. The SG 5010 features an amplifier mode in which an external signal can be converted to the high level, multiple impedance, balanced and floating capability of the SG 5010 output circuitry. Fully program-selectable filters in the AA 5001 allow various choices of bandwidth for distortion measurements and weighting for noise measurements, or rejection of interfering signals. Phase measurements can be added to the system by use of the DC 5009 or DC 5010 Universal Counter-Timer.

SYSTEM CHARACTERISTICS

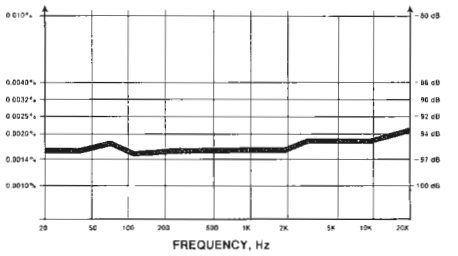
HARMONIC DISTORTION FUNCTION

Measurement Setting Time — Typically ≤2.5 s above 100 Hz, increasing by 1 s/octive below 100 Hz.

Residual THD+N — V_{in} ≥250 mV, RMS response, all distortion, noise, and nulling rescources combined. 20 Hz to 20 kHz ≤0.0032% (−90 dB) with 80 kHz filter. 10 Hz to 100 kHz ≤0.01% (−80 dB) no filters.

TYPICAL SYSTEM RESIDUAL THD+NOISE

V_{in} ≥250 mV with 80 kHz filter, RMS response.



INTERMODULATION DISTORTION FUNCTION

Measurement Setting Time — Typically ≤2 s.

Residual IMD — V_{in} ≥250 mV, RMS response.

SMPTE and DIN Tests — ≤0.032% (−90 dB) for 60 Hz and 7 kHz or 250 Hz and 8 kHz, 4:1 ratio.

CCIF Difference Frequency Test — ≤0.0018% (−95 dB) with 14 kHz and 15 kHz.

LEVEL FUNCTION

Measurement Setting Time — Typically ≤2 s.

Flatness — ±0.1 dB 20 Hz to 20 kHz.

SG 5010 CHARACTERISTICS

AVAILABLE FUNCTIONS

Sinewave, squarewave, SMPTE/DIN 4:1, SMPTE/DIN 1:1, CCIF, Sinewave Burst, IHF Burst (±20 dB or Off between bursts), External Input (Amplifier Mode).

FREQUENCY RANGE AND ACCURACY

Sinewave, Sinewave Burst — SMPTE/DIN: 10 Hz to 163.80 kHz ±0.01%. CCIF Center Frequency: 2.500 kHz to 163.80 kHz ±0.01%. Squarewave: 10 Hz to 16.380 kHz ±0.01%.

Resolution in Above Functions — 10.00 Hz to 163.80 Hz: 0.01 Hz. 163.9 Hz to 1.6380 kHz: 0.1 Hz. 1.693 kHz to 16.380 kHz: 1.0 Hz. 16.39 kHz to 163.80 kHz: 10.0 Hz.

SMPTE Lower Tone, CCIF Offset From Center Frequency — Selectable from: 40, 50, 60, 80, 100, 125, 250, 500 Hz, all ±2%.

Sine Distortion (Load ≥ 600 Ω, THD Including 2nd Through 5th Harmonics) — 20 Hz to 20 kHz: 0.001% (−100 dB). 20 to 50 kHz: 0.0032% (−90 dB). 10 to 20 Hz and 50 to 100 kHz: 0.01% (−80 dB). 100 to 163.8 kHz: 0.032% (−70 dB) any individual harmonic.

SMPTE, DIN or CCIF Distortion — See System Specifications.

Sine Flatness — 20 Hz to 20 kHz: 0.05 dB. 10 Hz to 163.8 kHz: 0.2 dB.

Squarewave Risetime — 1.5 μs ±10%.

Burst Range — 1 cycle to 65535 cycles On. 1 cycle to 65535 cycles Off. Off level either −20 dB or zero. All switching at sinewave zero crossing. Triggered, gated, or free-running burst modes available.

OUTPUT LEVEL RANGE AND ACCURACY

Balanced — Into Open Circuit: 200 μV to 21.2 V RMS. Into 600 Ω: −72.45 dBm to +28.05 dBm.[1]

Unbalanced — Into Open Circuit: 200 μV to 21.2 V RMS. Into 600 Ω: −72.45 dBm to +22.05 dBm.[1]

Resolution — 0.05 dB in dBm mode, 0.25% or better in volts mode.

Level Accuracy (Sinewave) — 20 Hz to 20 kHz ±2%. (0.2 dB). 10 Hz to 163.8 kHz ±3% (0.3 dB).

[1] *R_S = 50 Ω, for R_S = 150 Ω, subtract 1.25 dBm; for R_S = 600 Ω, subtract 5.35 dBm.*

OUTPUT IMPEDANCE AND CONFIGURATION

50 Ω ±3%, 150 Ω ±2%, or 600 Ω ±1%, balanced or unbalanced, floating or grounded.

EXTERNAL INPUT

A floating single-ended input is provided for accessing the variable gain stage and high level output amplifier, enabling the use of custom test signals. Input impedance is 20 kΩ; a 2 V RMS input (2.83 V peak maximum) provides a calibrated output.

SYNC OUTPUT

A ground referenced TTL-compatible signal is provided that allows stable oscilloscope display of all functions. In sine and squarewave modes, the output is at the signal frequency. In the IM modes, the sync output is at the lower or offset frequency. In both burst modes, the sync signal follows the burst envelope.

SWEEP MODE

Linear or logarithmic sweep of amplitude or frequency in any function. Sweep is composed of discrete steps. The following sweep functions are programmable via GPIB or from the front panel: swept parameter (frequency or amplitude), linear or log sweep, number of steps up to 99, time per step from 0.1 s to 25 s, start frequency or voltage, and stop frequency or voltage. Start and stop frequencies or voltages can be anywhere within the range of the generator, and sweep direction can be upward or downward. Pen lift and ramp outputs are available for interface to an analog plotter.

STORED SETUPS

Ten different complete front panel setups can be stored in the nonvolatile internal memory and recalled from front panel pushbuttons or via the GPIB. Additionally, the front panel settings at power down are retained and used at power up.

PROGRAMMABILITY

All functions, parameters, and modes can be controlled over the GPIB using simple English-like commands. All settings can be interrogated, with the resulting response usable as a command to return the instrument to that setting (Learn mode). The GPIB address can be displayed and changed from the front panel.

GPIB Interface Function Subsets Implemented — SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0.

AA 5001 CHARACTERISTICS

HARMONIC DISTORTION FUNCTION

Fundamental Frequency Range — 10 Hz to 100 kHz, automatically tuned to input frequency.

Distortion Ranges — Auto (100%), 20 %, 2%, 0.2%, and dB (autoranging).

Accuracy — 20 Hz to 20 kHz is ±1 dB. 10 Hz to 100 kHz is +1, −2 dB. (Accuracy is limited by residual THD+N and filter selection.)

Fundamental Rejection — At least 10 dB below specified residual THD+N or actual signal THD, whichever is greater.

Minimum Input Level — 60 mV (−22 dBm).

LEVEL FUNCTION

Autoranging digital voltmeter displays input signal level in volts dBm, or dB ratios.

Modes — Volts, dBm (600 Ω), or dB ratio with push-to-set 0 dB reference.

Level Ranges — 200 μV full scale to 200 V full scale in ten steps, manual or autoranging.

Accuracy

Frequency	Volts	dBm or dB Ratio
20 Hz to 20 kHz	±2% ±1 count	±0.3 dB*1 +0.5% of reading
10 Hz to 100 kHz	±4% ±2 counts	±0.5 dB*1 +0.5% of reading

*1 *V_{in} ≥ 100 μV, level ranging indicators extinguished ±0.2 dB at 1 kHz only. Flatness is ±0.1 dB, 20 Hz to 20 kHz, and ±0.3 dB, 10 Hz to 100 kHz.*

Bandwidth — ≥300 kHz.

Residual Noise —
≤3 μV (−108 dBm) with 80 kHz and 400 Hz filters, RMS response.
≤1.5 μV (−114 dBm) with "A" weighting filter, RMS response (standard instrument only).
≤5 μV (−104 dBm) with CCIR weighting filter, quasi-peak response (Option 02 instrument only).

INTERMODULATION DISTORTION FUNCTION

Fully automatic SMPTE, DIN, and CCIF difference tone measurements. Minimum input level 60 mV (−22 dBm). Accuracy ±1 dB.

SMPTE and DIN Tests — Lower Frequency Range: 50 to 500 Hz. Upper Frequency Range: Usable from 3 to 163.8 kHz. Level Ratio Range: 1:1 to 4:1 (lower:upper). Residual IMD: See System Specifications.

CCIF Difference Frequency Test — Frequency Range: Usable from 4 to 163.8 kHz. Difference Frequency Range: 180 Hz to 1 kHz. Residual IMD: See System Specifications.

ALL FUNCTIONS

Display — 3½ digits resolution at ≈ readings/s.

Detection — Average or true RMS for waveforms with crest factors ≤3. Option 02 replaces average detector with quasi-peak detector complying with CCIR Recommendation 468-2 and DIN 45405.

Filters —
400 Hz High Pass: −3 dB at 400 Hz ±5%; 18 dB/octave slope, at least 40 dB rejection at 60 Hz.
80 kHz Low Pass: −3 dB at 80 kHz ±5%; 18 dB/octave slope.
Audio Bandpass: −3 dB at 22.4 Hz and 22.4 kHz, both ±5%. Complies with CCIR Recommendation 468-2 and DIN 45405.
"A" Weighting: Meets specifications for Type One sound level meters (ANSI S1.4, IEC Recommendation 179). Option 02 replaces "A" weighting filter with CCIR weighting filter complying with CCIR Recommendation 468-2 and DIN 45405.
Ext: Allows connection of external filters.

Input Type — Balanced (full differential).

Input Impedance — 100 kΩ ±2%, each side to ground.

Maximum Input — 300 V peak, 200 V RMS either side to ground or differentially. Fully protected on all ranges.

Common-Mode Rejection — ≥50 dB at 50 or 60 Hz. Typically ≥40 dB to 300 kHz.

PROGRAMMABILITY

Function (Level or THD or IMD). Level Mode (Volts or dBm). Input Level and Distortion Ranges (Autorange or default to range selected by front panel switches).
Detector Type (RMS or AVG; or RMS or Q-PK on Option 02).
Filter Selection (400 Hz Hi Pass, 80 kHz Low Pass, 22.4 Hz to 22.4 kHz Band-Pass, "A" Weight (or CCIR WTG on Option 02, Ext Filter).

GPIB Interface Function Subsets Implemented — SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0.

FRONT PANEL SIGNALS

Input Monitor — Provides constant amplitude version of signal applied to input. Output Voltage: 1 V RMS ±10% for input signals >50 mV. Source impendance: 1 kΩ ±5%.

Function Output — Provides a scaled sample of selected function signal. Output Voltage: 1 V RMS ±3% for 1000 count display. Source impedance: 1 kΩ ±5%.

Auxiliary Input — Provides input to detector circuit when Ext Filter button is depressed. Sensitivity: 1 V RMS ±3% = 1000 count display. Impedance: 100 kΩ ±5%, ac coupled.

REAR INTERFACE SIGNALS

Duplicates of all front panel inputs and outputs are provided to allow external filter connections or oscilloscope monitoring within same mainframe without exposed cables. Detector outputs with specified scale factors also available to drive analog chart recorders, storage oscilloscopes, or similar devices.

ORDERING INFORMATION

SG 5010 Programmable Oscillator

Includes: Instruction manual (070-4331-00); instrument interface guide (070-4790-00); reference guide (070-4330-00).

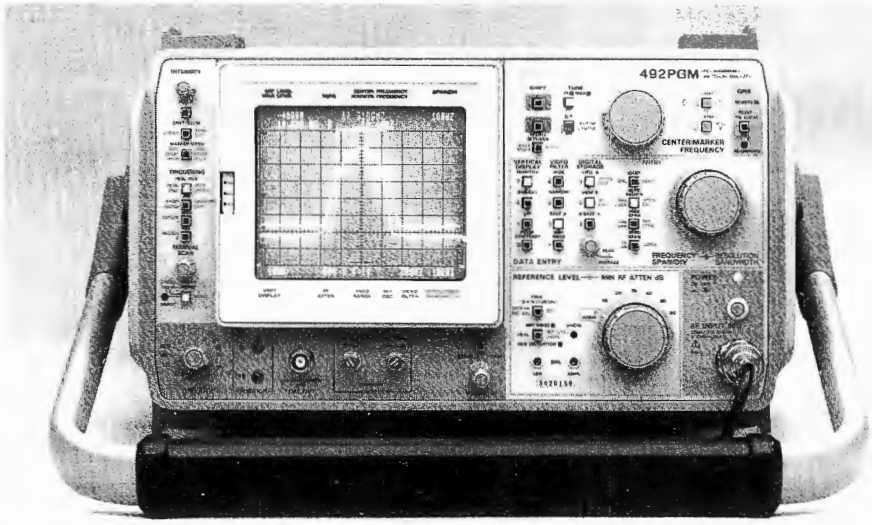
AA 5001 Programmable Distortion Analyzer

Includes: Instruction manual (070-4598-01); instrument interface guide (070-4788-00); reference guide (070-4597-00).

Option 02 — (AA 5001 only) CCIR/DIN.

SOFTWARE

See System Support section in Tek General Catalog for description.



492PGM Spectrum Analyzer.

490 Series Spectrum Analyzers

100 Hz to 325 GHz Frequency Coverage

Continuous-Resolution Frequency Tuning Combines "Synthesized" Settability and Accuracy with Analog Feel

Up to 90 dB Viewable Dynamic Range

Built-in Frequency Counters Provide Frequency Determination to within 0.0000001% (1×10^{-9}/day ref.)

Sensitivities to −134 dBm

Built-in Intelligence for Signal Processing/Marker Functions

Push Button Occupied-Bandwidth and Noise-Normalization Functions

Macro Capability with Nonvolatile Memory to Simplify and Speed Up Commonly-Used Routines

Optional Switch-Selectable 50/75-ohm Impedances

Nonvolatile Memory for up to Nine Waveforms and Ten Front Panel Settings

GPIB Programmability with Tek Codes and Formats for Standardized Bus Operation

Optional MATE/CIIL Compatibility for Military Applications

Ergonomically-Designed Front Panel Controls

Direct Screen Data Plots without a Controller

Many Application-Specific Options

Ruggedized for Harsh Field Environments

Portable Laboratory Performance with Affordable Prices

Tektronix 490 Series Spectrum Analyzers offer a broad selection of features and benefits to meet wide-ranging needs for laboratory-level frequency domain spectrum analysis. All units provide full IEEE-488 (GPIB) programmability, which means you can change front panel settings, read data from the crt display, and send waveforms from internal digital source memory to other GPIB devices. Frequency range of the instruments is as follows:

10 kHz to 325 GHz: 494AP and 492BP
10 kHz to 21 GHz: 492PGM
100 Hz to 7.1 GHz: 497P
100 Hz to 1.8 GHz: 495P

Built to rugged MIL-T-28800C environmental specifications, these units can withstand transportation shock and vibration to a remote site. Or they can simply be moved from the engineering lab to the production floor with complete confidence in measurement accuracy.

A wide array of price/performance alternatives are available. If you need 10 Hz resolution for an exacting close-in spectral purity measurement, consider the 494AP. For more routine uses, such as a microwave transmitter occupied-bandwidth measurement, the 492PGM may be the most cost-effective solution.

A Wide Array of Intelligent Features

Downloadable programming (macro) capability lets you execute your frequently-used measurement routines from the Spectrum Analyzer's nonvolatile memory. In addition, these Spectrum Analyzers can store up to 10 complete front-panel measurement parameter setups in nonvolatile memory to save you measurement time. You can also save up to 9 waveform displays, a real benefit when data analysis must be delayed.

Tedious, time-consuming, and often incorrect carrier-to-noise ratio calculations are eliminated; the instrument handles it all with a single keystroke, with automatic noise normalization to 1 Hz and automatic conversion for reference units such as dBm, dBmV, dBV, dBμV, and dB/Hz.

An internal high-stability reference provides marker or center frequency accuracy approaching 10^{-9}/day in the 494AP. For added confidence in measurements, a built-in microwave signal counter in the 494AP with 144 dB dynamic range means you can determine the exact frequency of marked signals only 10 Hz apart — or count the exact delta-frequency between two marked signals — even with greatly differing amplitudes. You also have the flexibility of tying in with a system clock, using the external reference lock capacity.

A permanent record of crt displays can be obtained at the push of a button, without a controller, using the direct plot capability and a GPIB plotter such as the Tektronix HC100.

Menu-selected dynamic markers automatically update frequency and amplitude data with every sweep. Unprecedented signal processing power results when you use these markers in conjunction with the built-in intelligence. With *PULSE* Mode, you can mark the peak of a main lobe and peaks of side lobes at the push of a button. The *CW* Mode locates signals that exhibit CW characteristics and ignores all other signals. The *SPUR* Mode marks all signals that meet user-defined or automatic threshold criteria. User-definable threshold criteria are available for all signal processing modes.

These instruments also offer operator convenience for measuring the bandwidth of filters, amplifiers, and other networks. Just enter the desired bandwidth point and select *BANDWIDTH* Mode, and the markers automatically update to display the new value.

Dedicated direct keypad data entry of major measurement parameters enables fast, accurate instrument setup. Screen messages prompt you for proper keypad inputs — all "valid" keys to push are illuminated to steer you to the proper selections. The unique marker keypad allows Peak Find, Right and Left Next, Next Higher and Lower, Left and Right X dB, and Peak Find and Center operations to be executed directly from the front panel. This makes signal searches much easier.

Optional switch-selectable 50-ohm and 75-ohm impedances add versatility. For applications such as baseband and CATV, 75-ohm/dBmV greatly simplifies spectrum analysis.

The performance leader is the 494AP, which offers frequency coverage from 10 kHz to 21 GHz with its internal mixer, and to 325 GHz with external mixers such as Tek's WM490 Series, or the new WM780 Series (each WM780 Series mixer is individually calibrated). Signal sensitivity is an impressive −134 dBm. The 494AP is optimized for use in baseband through millimeter-wave measurements, where the ability to identify and process signal frequencies and amplitudes over wide dynamic ranges with high accuracy is critical.

The 492BP covers the same frequency range as the 494AP, and provides nearly the same set of outstanding features and state-of-the-art specifications. It is designed as a cost-effective and productive solution to engineering needs.

The 497P provides the same cost-effective performance as the 492BP, but over a frequency range of 100 Hz to 7.1 GHz.

The 492PGM's frequency range of 10 kHz to 21 GHz is ideal for cost-sensitive applications that still require most of the powerful features of the product family, but can get by with slightly-reduced performance specifications.

The 495P features the same functionality and high level of performance as the 494AP, but over a frequency range of 100 Hz to 1.8 GHz. It is optimized for standalone or automated operation in baseband through UHF measurements, where the ability to identify and process weak signals is critical.

Remote Operation and Complete Spectrum Analysis Packages

Full GPIB-programmability lets you automate your spectrum analysis system needs. Programming is simplified and measurement repeatability ensured. Under program control you can operate the instrument, change front panel settings, read data from the crt display, and send waveforms from internal memory to other GPIB devices. Tek's Standard Codes and Formats keeps commands clear, consistent, and universally understood.

You can increase programming flexibility and power with the optional MATE/CIIL language extension. It provides direct memory access (DMA) for high-speed data transmission, a requirement for MATE/CIIL compliance.

TekSPANS software lets you use the 490 Series Spectrum Analyzers as system components, controlling them with popular instrument controllers such as the Tektronix PEP-Series, Compaq models, and other PC compatibles. Coupling the computer to the Spectrum Analyzer via the IEEE 488 bus lets you take advantage of the PC's capability, as well as the power and versatility of the Spectrum Analyzer.

Available Tektronix automated spectrum analyzer packages provide ordering convenience. They are configured around a DOS-based PC, one of the 490 Series of programmable Spectrum Analyzers, and Tek's General RF Applications Software Package (GRASP). The GRASP software offers many different applications and utility routines, which are selected through easy menu-driven operation. Also, EMI software is available for FCC, VDE, CISPR, and MIL-STD testing.

490 Series Spectrum Analyzer characteristics are given in the following tables.

TYPICAL MEASUREMENTS

- Baseband Measurements
- Carrier Level Monitoring
- Carrier ON/OFF Ratios
- Carrier/Noise Measurements
- EMI/RFI Compliance
- EW Gathering and Analysis
- Frequency Counting
- Harmonic Distortion
- IF Amplifier Adjustments
- Modulation Adjustments
- Pulse Analysis
- Spectral Monitoring
- Typical Spur Searches

TYPICAL APPLICATIONS

- Manufacturing ATE
- Avionics
- Broadcasting
- CATV
- Cellular Radio
- Design and Engineering
- Nuclear Physics
- Radio Astronomy
- Satellite Communications
- Terrestrial Microwave
- Two-Way Radio

490 SERIES CHARACTERISTICS

FREQUENCY RELATED

	494AP	492BP	492PGM	497P	495P
Frequency Range with Internal Mixers	10 kHz to 21 GHz	10 kHz to 21 Ghz	10 kHz to 21 GHz	100 Hz to 7.1 GHz	100 Hz to 1.8 GHz
Frequency Range with External Mixers	10 kHz to 325 GHz	10 kHz to 325 GHz	N/A	N/A	N/A
Frequency Readout Accuracy (center or marker), ±[2% span + (CF × Ref) + (2N + 25) Hz]	±20 kHz @ 1 GHz with 100 kHz/div span	±21 kHz @ 1 GHz with 100 kHz/div span	±30 kHz @ 1 GHz with 100 kHz/div span	±21 kHz @ 1 GHz with 100 kHz/div span	±20 kHz @ 1 GHz with 100 kHz/div span
Frequency Counter Accuracy, ±[(CF × Ref) + (5 + N) Hz + 1 LSD]	±100 Hz @ 1 GHz	±1 kHz @ 1 GHz	N/A	±1 kHz @ 1 GHz	±100 Hz @ 1 GHz
Delta Count Accuracy, ±[(D-F × Ref) + (10 × 2N) + 1 LSD]	±13 Hz for 1 MHz D-F	±14 Hz for 1 MHz D-F	N/A	±14 Hz for 1 MHz D-F	±13 Hz for 1 MHz D-F
Frequency Reference Accuracy	≤1×10^{-7}/yr (aging)	≤1×10^{-6}/yr (aging)	≤1×10^{-5}/yr (aging)	≤1×10^{-6}/yr (aging)	≤1×10^{-7}/yr (aging)
Frequency Stability (residual FM)	≤5 Hz @ 1 GHz	≤12 Hz @ 1 GHz	≤12 Hz @ 1 GHz	≤ 12 Hz @ 1 GHz	≤ 5 Hz @ 1 GHz
Frequency Stability (drift)	<50 Hz/minute	<50 Hz/minute	<50 Hz/minute	<50 Hz/minute	<50 Hz/minute
Single Sideband Phase Noise (30 kHz offset and N=1)	−105 dBc/Hz @ 1 GHz	−105 dBc/Hz @ 1 GHz	−103 dBc/Hz @ 1 GHz	−105 dBc/Hz @ 1 GHz	−105 dBc/Hz @ 1 GHz
Frequency Span Range (per div)	0 Hz, 10 Hz-10 GHz	0 Hz, 100 Hz-10 GHz	0 Hz, 200 Hz-1 GHz	0 Hz, 100 Hz-500 MHz	0 Hz, 10 Hz-100 MHz
Frequency Span Accuracy	±5%	±5%	±5%	±5%	±5%
Delta Frequency Accuracy Marker Mode	1% of span	1% of span	1% of span	1% of span	1% of span
Resolution Bandwidth (6 dB) Range	10 Hz to 3 MHz	100 Hz to 3 MHz	1 kHz to 3 MHz	100 Hz to 3 MHz	10 Hz to 3 MHz
Resolution Bandwidth Selectivity (−60 dB/−6 dB)	≤7.5:1 except 15:1 @ 10 Hz	≤7.5:1	≤7.5:1	≤7.5:1	≤7.5:1 except 15:1 @ 10 Hz
Video Bandwidth Range	0.3 Hz to 30 kHz	0.3 Hz to 30 kHz	3 Hz to 30 kHz	0.3 Hz to 30 kHz	0.3 Hz to 30 kHz

490 SERIES CHARACTERISTICS (continued)

AMPLITUDE RELATED

	494AP	492BP	492PGM	497P	495P
Reference Level Range	−117 to +30 dBm	−117 to +30 dBm	−117 to +30 dBm	−117 to +30 dBm	−117 to +30 dBm
Maximum Safe Input Power, CW	1 Watt (+30 dBm)	1 Watt (+30 dBm)	1 Watt (+30 dBm)	1 Watt (+30 dBm)	1 Watt (+30 dBm)
Maximum Safe Input Power, Pulse 0.1% duty factor	75 W Pk (1 μS pulse, 0.1% duty factor)	75 W Pk (1 μS pulse, 0.1% duty factor)	75 W Pk (1 μS pulse, 0.1% duty factor)	75 W Pk (1 μS pulse, 0.1% duty factor)	75 W Pk (1 μS pulse)
CRT Display Range, Log	1 to 15 dB/div	1 to 15 dB/div	1 to 15 dB/div	1 to 15 dB/div	1 to 15 dB/div
CRT Display Range, Linear	39.6 nV/div to 2.8 V/div	39.6 nV/div to 2.8 V/div	39.6 nV/div to 2.8 V/div	39.6 nV/div to 2.8 V/div	39.6 nV/div to 2.8 V/div
Input Attenuator Range	0 to 60 dB in 10 dB steps	0 to 60 dB in 10 dB steps	0 to 60 dB in 10 dB steps	0 to 60 dB in 10 dB steps	0 to 60 dB in 10 dB steps
Viewable Dynamic Range	90 dB (12 dB/div)	90 dB (12 dB/div)	80 dB (10 dB/div)	90 dB (12 dB/div)	90 dB (12 dB/div)
Residual Response (no signal and zero RF attenuation)	−100 dBm (input terminated)	−100 dBm (input terminated)	−95 dBm (input terminated)	−100 dBm (input terminated	−100 dBm (input terminated)
Second Harmonic Distortion, RF Frequency Range	−60 dBc (mixer level −40 dBm)	−60 dBc (mixer level −40 dBm)	−60 dBc (mixer level −40 dBm)	−60 dBc (mixer level −40 dBm)	−60 dBc (mixer level −40 dBm)
Second Harmonic Distortion, Microwave Frequency Range	−100 dBc (mixer level −20 dBm)	−100 dBc (mixer level -20 dBm)	−100 dBc (mixer level −20 dBm)	−100 dBc (mixer level −20 dBm)	N/A
Third Order Intermodulation Distortion	−70 dBc (mixer level −27 dBm)	−70 dBc (mixer level −27 dBm)	−70 dBc (mixer level −27 dBm)	−70 dBc (mixer level −27 dBm)	−70 dBc (mixer level −27 dBm)
Calibrator Accuracy	±0.3 dB	±0.3 dB	±0.3 dB	±0.3 dB	±0.3 dB
Gain Compression (1 dB)	−13 dBm	−13 dBm	−13 dBm	−13 dBm	−13 dBm
Frequency Response (10 dB RF attenuation referred to cal signal)					
Band 1 (10 kHz to 1.8 MHz)	±2.5 dB	±2.5 dB	±3.0 dB	±2.5 dB	±1.5 dB (100 Hz to 1.8 GHz)
Band 2 (1.7 GHz to 5.5 GHz)	±3.5 dB	±3.5 dB	±4.0 dB	±3.5 dB	N/A
Band 3 (3.0 GHz to 7.1 GHz)	±3.5 dB	±3.5 dB	±4.0 dB	±3.5 dB	N/A
Band 4 (5.4 GHz to 18 GHz)	±4.5 dB	±4.5 dB	±5.0 dB	N/A	N/A
Band 5 (15 GHz to 21 GHz)	±6.5 dB	±6.5 dB	±7.0 dB	N/A	N/A
In-band Flatness (with 10 dB RF attenuation)					
Band 1 (10 kHz to 1.8 MHz)	±1.5 dB	±1.5 dB	±2.0 dB	±1.5 dB (100 Hz to 1.8 GHz)	±1.0 dB (100 Hz to 1.8 GHz)
Band 2 (1.7 GHz to 5.5 GHz)	±2.5 dB	±2.5 dB	±3.0 dB	±2.5 dB	N/A
Band 3 (3.0 GHz to 7.1 GHz)	±2.5 dB	±2.5 dB	±3.0 dB	±2.5 dB (5.4 GHz to 7.1 GHz)	N/A
Band 4 (5.4 GHz to 18 GHz)	±3.5 dB	±3.5 dB	±4.0 dB	N/A	N/A
Band 5 (15 GHz to 21 GHz)	±5.0 dB	±5.0 dB	±6.0 dB	N/A	N/A
Displayed Average Noise Level (input terminated, narrowest resolution bandwidth and video filter)					
Band 1 (100 Hz)	−100 dBm (typical)	−40 dBm (typical)	N/A	−40 dBm (typical)	−100 dBm (typical)
Band 1 (1 kHz to 10 kHz)	−110 dBm (typical)	−90 dBm (typical)	−40 dBm (typical)	−90 dBm	−110 dBm
Band 1 (10 kHz to 100 kHz)	−110 dBm	−100 dBm	−90 dBm	−100 dBm	−110 dBm
Band 1 (100 kHz to 1 MHz)	−120 dBm	−115 dBm	−105 dBm	−115 dBm	−120 dBm
Band 1 (1 MHz to 1.8 GHz)	−134 dBm	−120 dBm	−110 dBm	−120 dBm	−131 dBm
Band 2 (1.7 GHz to 5.5 GHz)	−125 dBm	−120 dBm	−108 dBm	−120 dBm	N/A
Band 3 (3.0 GHz to 7.1 GHz)	−125 dBm	−119 dBm	−108 dBm	−119 dBm	N/A
Band 4 (5.4 to 12 GHz/12 to 18 GHz)	−111 −107 dBm	−105 / −100 dBm	−94 / −89 dBm	N/A	N/A
Band 5 (15 GHz to 21 GHz)	−105 dBm	−99 dBm	−88 dBm	N/A	N/A
IF Gain Uncertainty	±2 dB max over 107 dB range	±2 dB max over 107 dB range	±2 dB max over 107 dB range	±2 dB max over 107 dB range	±2 dB max over 107 dB range
Scale Fidelity, Log (80 dB range/90 dB range)	±2 dB max/ ±4 dB max	±2 dB max/ ±4 dB max	±2 dB max	±2 dB max/ ±4 dB max	±2 dB max/ ±4 dB max
Scale Fidelity, Linear	±5% of full scale	±5% of full scale	±5% of full scale	±5% of full scale	±5% of full scale
Input Attenuator Switching Accuracy (20 dB to 60 dB settings) 0 to 1.8 GHz	±0.5 dB/10 dB; ±1.0 dB max	±0.5 dB/10 dB; ±1.0 dB max	±0.5 dB/10 dB; ±1.0 dB max	±0.5 dB/10 dB; ±1.0 dB max	±0.5 dB/10 dB; ±1.0 dB max
1.8 to 18 GHz	±1.5 dB/10 dB; ±3.0 dB max	±1.5 dB/10 dB; ±3.0 dB max	±1.5 dB/10 dB; ±3.0 dB max	±1.5 dB/10 dB; ±3.0 dB max (1.8 to 7.1 GHz)	N/A
18 to 21 GHz	±3.0 dB/10 dB; ±6.0 dB max	±3.0 dB/10 dB; ±6.0 dB max	±3.0 dB/10 dB; ±6.0 dB max	N/A	N/A
Resolution Bandwidth Switching Uncertainty (reference BW X 3 MHz)	±0.4 dB	±0.4 dB	±0.4 dB	±0.4 dB	±0.4 dB

490 SERIES CHARACTERISTICS (continued)

TIME RELATED

FREQUENCY RELATED	494AP	492BP	492PGM	497P	495P
Sweep Time Range, Digitized Display	10 msec/div to 10 sec/div	10 msce/div to 10 sec/div	10 msec/div to 10 sec/div	10 msec/div to 10 sec/div	10 msec/div to 10 sec/div
Sweep Time Range, Real-Time Display	20 μsec/div to 10 sec/div	20 μsec/div to 10 sec/div	20 μsec/div to 10 sec/div	20 μsec/div to 10 sec/div	20 μsec/div to 10 sec/div
Sweep Time Accuracy	±5%	±5%	±5%	±5%	±5%
Marker Time Measurement Accuracy	±10%	±10%	±10%	±10%	±10%
Delta Marker Time Measurement Accuracy	±5%	±5%	±5%	±5%	±5%
Sweep Trigger	Free Run, Line, Video, Single, Ext	Free Run, Line, Video, Single, Ext	Free Run, Line, Video, Single, Ext	Free Run, Line, Video, Single, Ext	Free Run, Line, Video, Single, Ext

EXTERNAL INPUT

	494AP	492BP	492PGM	497P	495P
RF Input Impedance	50 ohms nominal	50 ohms nominal	50 ohms nominal	50 ohms nominal	50 ohms nominal
VSWR (10 dB input attenuation) <2.5 GHz 2.5 GHz to 6.0 GHz 6.0 GHz to 18 GHz 18 GHz to 21 GHz	 1.3:1 max 1.7:1 max 2.3:1 max 3.5:1 max	 1.3:1 max 1.7:1 max 2.3:1 max 3.5:1 max	 1.3:1 max 1.7:1 max 2.3:1 max 3.5:1 max	 1.3:1 max 1.7:1 max N/A N/A	 1.3:1 max N/A N/A N/A
Local Oscillator Emission Level (10 dB input attenuation)	≤ −80 dBm	≤ −80 dBm	≤ −80 dBm	≤ −80 dBm	≤ −80 dBm
External Mixer Input	Approx 2 GHz IF	Approx 2 GHz IF	N/A	N/A	N/A
External Reference Input	1, 2, 5, or 10 MHz	1, 2, 5, or 10 MHz	N/A	1, 2, 5, or 10 MHz	1, 2, 5, or 10 MHz
Horizontal Input/Trigger Input	0 to +10 V/1 to 50 V	0 to +10 V/1 to 50 V	0 to +10 V/1 to 50 V	0 to +10 V/1 to 50 V	0 to +10 V/1 to 50 V
Video Input/Marker Input	0 to +4 V/0 to −10 V	0 to +4 V/0 to −10 V	0 to +4 V/0 to −10 V	0 to +4 V/0 to −10 V	0 to +4 V/0 to −10 V

EXTERNAL OUTPUT

	494AP	492BP	492PGM	497P	495P
Calibrator	100 MHz ±10 Hz, −20 dBm ±0.3 dB	100 MHz ±100 Hz, −20 dBm ±0.3 dB	100 MHz ±1 kHz, −20 dBm ±0.3 dB	100 MHz ±100 Hz, −20 dBm ±0.3 dB	100 MHz ±10 Hz, −20 dBm ±0.3 dB
1st Local Oscillator	2 to 6 GHz, +7.5 to +20 dBm	2 to 6 GHz, +7.5 to +20 dBm	2 to 6 GHz, +6 to +20 dBm	2 to 6 GHz, +6 to +20 dBm	2 to 4 GHz, +6 to +20 dBm
2nd Local Oscillator	−7 to −17 dBm	−7 to −17 dBm	−7 to −17 dBm	−7 to−17 dBm	−7 to −17 dBm
Video Output (CRT center reference)	0.5 V of signal per div of video	0.5 V of signal per div of video	0.5 V of signal per div of video	0.5 V of signal per div of video	0.5 V of signal per div of video
Sweep Output (CRT center reference)	0.5 V/div; ±2.5 V max	0.5 V/div; ±2.5 V max	0.5 V/div; ±2.5 V max	0.5 V/div; ±2.5 V max	0.5 V/div; ±2.5 V max
Pen Lift	+5 V nominal; TTL-compatible	+5 V nominal; TTL-compatible	+5 V nominal; TTL-compatible	+5 V nominal; TTL-compatible	+5 V nominal; TTL-compatible
2nd IF Output (Opt. 42)	110 MHz, 0 dBm; 3 dB BW is 4.5 MHz	110 MHz, 0 dBm; 3 dB BW is 4.5 MHz	110 MHz, 0 dBm; 3 dB BW is 4.5 MHz	110 MHz, 0 dBm; 3 dB BW is 4.5 MHz	110 MHz, 0 dBm; 3 dB BW is 4.5 MHz
3rd IF Output	10 MHz, −5 dBm	10 MHz, −5 dBm	10 MHz, −5 dBm	10 MHz, −5 dBm	10 MHz, −5 dBm
Probe Power	+5 V, −15 V, +15 V; 100 mA max each	+5 V, −15 V, +15 V; 100 mA max each	+5 V, −15 V, +15 V; 100 mA max each	+5 V, −15 V, +15 V; 100 mA max each	+5 V, −15 V, +15 V; 100 mA max each

GENERAL SPECIFICATIONS

	494AP	492BP	492PGM	497P	495P
Power Requirements Voltage Frequency Power	 90-132/180-250 Vac 48-440 Hz 210 W max @ 115 Vac, 60 Hz	 90-132/180-250 Vac 48-440 Hz 210 W max @ 115 Vac, 60 Hz	 90-132/180-250 Vac 48-440 Hz 210 W max @ 115 Vac, 60 Hz	 90-132/180-250 Vac 48-440 Hz 210 W max @ 115 Vac, 60 Hz	 90-132/180-250 Vac 48-440 Hz 210 W max @ 115 Vac, 60 Hz
Weight (carrying), Nominal	22.2 kg (48 lbs)	21.76 kg (47 lbs)	21.3 kg (46 lbs)	20.83 kg (45 lbs)	19.44 kg (42 lbs)
Dimensions (without handle, feet, or cover), mm/inches	175 × 327 × 499/ 6.9 × 12.87 × 19.65	175 × 327 × 499/ 6.9 × 12.87 × 19.65	175 × 327 × 499/ 6.9 × 12.87 × 19.65	175 × 327 × 499/ 6.9 × 12.87 × 19.65	175 × 327 × 499/ 6.9 × 12.87 × 19.65
Digital Storage	1000 pts horizontal, 250 pts vertical	1000 pts horizontal, 250 pts vertical	1000 pts horizontal, 250 pts vertical	1000 pts horizontal, 250 pts vertical	1000 pts horizontal, 250 pts vertical
Digitizing Rate	9 μS	9 μS	9 μS	9 μS	9 μS
Macro Programming	8K	8K	N/A	8K	8K
Nonvolatile Memory	9 waveforms, 10 control settings	9 waveforms, 10 control settings	9 waveforms, 10 control settings	9 waveforms, 10 control settings	9 waveforms, 10 control settings
HELP Mode	10 Yes	Yes	Yes	Yes	Yes

490 SERIES CHARACTERISTICS (continued)

ENVIRONMENTAL PER MIL-T-28800C, TYPE III, CLASS 3, STYLE C

FREQUENCY RELATED	494AP	492BP	492PGM	497P	495P
Electromagnetic Compatibility (consult data sheet for compliance details)	MIL-STD-461B	MIL-STD-461B	MIL-STD-461B	MIL-STD-461B	MIL-STD-461B
Calibration Interval	1 Year	1 Year	1 Year	1 Year	1 Year

IEEE 488 GPIB

	494AP	492BP	492PGM	497P	495P
Interface Functions	SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and C0	SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and C0	SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and C0	SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and C0	SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and C0
Direct Plotter Output	Supports Tek HC100, HP 7470A	Supports Tek HC100, HP 7470A	Supports Tek HC100, HP 7470A	Supports Tek HC100, HP 7470A	Supports Tek HC100, HP 7470A
Waveform Transfer Speed	165 msec/1000 pts	165 msec/1000 pts	165 msec/1000 pts	165 msec/1000 pts	165 msec/1000 pts

ORDERING INFORMATION

494AP Programmable Spectrum Analyzer

Includes: Operator's Manual; Programmer's Manual; 6-ft, 50-Ω coaxial cable, N-N (012-0114-00); 18-inch, 50-Ω coaxial cable, BNC-BNC (012-0076-00); N male to BNC female adapter (103-0045-00); rear connector shield (337-3274-00); power cord and spare fuses; CRT filter set consisting of amber and gray light filters plus mesh filter (all except 492PGM); gray crt light filter (492PGM).

492BP Programmable Spectrum Analyzer

Includes: same as 494AP

492PGM Programmable Spectrum Analyzer

Includes: same as 494AP, except gray CRT filter (no filter set)

497P Programmable Spectrum Analyzer

Includes: same as 494AP

495P Programmable Spectrum Analyzer

Includes: same as 494AP

OPTION ORDERING INFORMATION

Opt. 07 — 75-Ω dBmV input and calibration in addition to the normal 50-Ω dBm input and calibration. (Not combinable with Options 21 and 22; no external mixer capability.) Includes 42-inch, 75-Ω BNC-BNC coax cable (012-0074-00) and BNC male to "F" female adapter (013-0126-00)

Opt. 19 (494AP, 492BP) — High-performance 18 to 40 GHz WM780 Series Waveguide Mixer Set

Includes: WM780K (18-26.5 GHz) and WM780A (26.5-40 GHz) Waveguide Mixers, Diplexer Assembly (015-0385-00), and interconnecting cable (012-0649-00)

Opt. 20 (494AP, 492BP) — High Performance 18 to 60 GHz WM780 Series Waveguide Mixer Set

Includes: same as Option 19 plus WM780U (40-60 GHz) Waveguide Mixer

Opt. 21 (494AP, 492BP) — High-performance 18 to 40 GHz WM490 Series Waveguide Mixer Set

Includes: WM490K (18-26.5 GHz) and WM490A (26.5-40 GHz) Waveguide Mixers, Diplexer assembly (015-0385-00), and interconnecting cable (012-0649-00)

Opt. 22 (494AP, 492BP) — High-performance 18 to 60 GHz WM490 Series Waveguide Mixer Set

Includes: same as option 21 plus WM490U (40-60 GHz) Waveguide Mixer

Opt. 23 — GRASP software (S26RF00), PC2A interface, GPIB cable.

NOTE: The PC2A is a National Instruments GPIB Interface Card.

NOTE: Options 24 through 29 and 32 through 34 are available only in the U.S. and Canada. For more information on any of these bundled software and computer packages, please contact your local Tek sales representative.

Opt. 24 — Compaq Portable II (with 80286 processor, built-in monitor, 640 kb RAM, 20 Mb hard drive, 360 kb diskette drive, serial/parallel interface, DOS 3.3), GRASP software, PC2A interface, and GPIB cable.

Opt. 25 — Compaq Deskpro 286E, Model 1 (with 80286 processor, VGA color monitor, 1 Mb RAM, 1.2 Mb and 360 kb diskette drives, serial/parallel interface, DOS 3.3), GRASP software, PC2A interface, and GPIB cable.

Opt. 26 — Compaq Deskpro 286E, Model 201 (with 80286 processor, VGA color monitor, 1 Mb RAM, 20 Mb hard drive, 1.2 Mb and 360 kb diskette drives, serial/parallel interface, DOS 3.3), GRASP software, PC2A interface, and GPIB cable.

Opt. 27 — Compaq SLT/286, Model 20 (with 80C286 processor, VGA backlit display, 640 kb RAM, 20 Mb hard drive, 1.44 Mb 3½" diskette drive, serieal/parallel interface, enhanced NiCad battery pack, desktop expansion base, DOS 3.3), GRASP software, PC2A interface, and GPIB cable.

Opt. 28 — Compaq Deskpro 386S, Model 20 (with 80386SX processor, VGA color monitor, 1 Mb RAM, 20 Mb hard drive, 1.2 Mb and 360 kb diskette drives, serial/parallel interface, DOS 3.3), GRASP software, PC2A interface, and GPIB cable.

Opt. 29 — Epson FX-850 printer with parallel interface cable

Opt. 32 — Tektronix PEP 301 system controller with additional 360K floppy disk drive

NOTE: The PEP 301 is an MS-DOS instrument/system controller based on the Intel 80386 with 80387 Coprocessor. It includes an EGA display, 40M hard disk, 1.2M floppy disk drive, and complete GPIB interface with cable.

Opt. 33 — Tektronix PEP 301 system controller with additional 360K floppy disk drive plus GRASP software

Opt. 34 — Tektronix PEP 301 system controller with additional 360K floppy disk drive plus EMI software

Opt. 39 — Non-lithium (Silver) batteries for battery-backed memory

Opt. 41 (all except 495P) — Digital Microwave Radio Measurement Enhancement package

Opt. 42 — Replaces MARKER/VIDEO input port on the rear panel with a 110 MHz IF output port that provides a 3 dB signal bandwidth ≥ 4.5 MHz

Opt. 45 (all except 492PGM) — MATE/CIIL language interface

Opt. B1 — Service manual(s)

Opt. B2 — Operator's manual, Programmer's manual, and Service manual(s) set

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 — Universal European 220 V/6 A, 50 Hz

Opt. A2 — UK 240 V/5 A, 50 Hz

Opt. A3 — Australian 240 V/6 A, 50 Hz

Opt. A4 — North American 240 V/12 A, 60 Hz

Opt. A5 — Switzerland 220 V/6 A, 50 Hz

OPTIONAL ACCESSORIES/ANCILLARIES (for all units unless otherwise noted)

1405 TV Sideband Analyzer Adapter (525/60 markers); TR503 Tracking Generator, 100 Hz to 1800 MHz; Microwave Comb Generator, TM500-Series compatible (067-0885-00, all except 495P); Tek HC100 Color Plotter; CRT Visor (016-0653-00); 75-Ω to 50-Ω minimum loss adapter (011-0112-00); DC blocking capacitor, N conn. (015-0509-00); 2-meter GPIB cable (012-0630-00); GPIB cable (012-0991-00); Programmer's Reference Guide (070-5567-00); Service Kit (006-3286-01).

WARRANTY

Tektronix 490 Series Spectrum Analyzers are warranted to be free from defects in material and workmanship for a period of one year from the date of shipment. Contact your local Tektronix sales representative for additional warranty information.

WARRANTY-PLUS SERVICE PLANS

Tektronix Warranty-Plus Service Plans for the 490 Series Spectrum Analyzers provide for both routine and remedial service, depending on the plan selected. They offer convenience plus an extra margin of protection for your newly-purchased Tektronix instruments by supplementing the warranties that accompany them. Warranty-Plus is an investment that provides up to five years of coverage, including options for calibration and remedial service. For more information on Warranty-Plus options, contact a Tektronix sales representative.

Opt. M1 — 2 years service and 2 calibrations

Opt. M2 — 4 years service

Opt. M3 — 4 years service and 4 calibrations

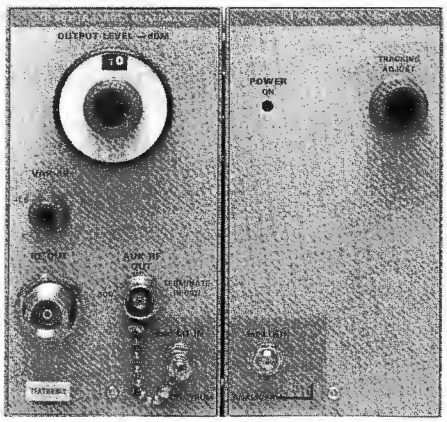
Opt. M4 — 2 years service and 5 calibrations

Opt. M5 — 4 years service and 7 calibrations

Opt. M7 — 2 calibrations

Opt. M8 — 4 calibrations

Opt. M9 — 2 years service



TR 503 Tracking Generator.

TR 503
Tracking Generator

Swept Measurements to 1.8 GHz

Enhances Dynamic Range to Better Than 110 dB

Very Stable — Useful as a CW Signal Source

Auxiliary, Constant Level Output Provides for Frequecny Counter Measurement Even of Signals at the Noise Floor

The TR 503 works with all 2750 and 490 Series spectrum analyzers to provide constant level, calibrated RF sources for swept frequency tests to 1.8 GHz. The tracking generator is a two-wide unit compatible with the TM 500 and TM 5000 Modular Instrument Series.

The low residual FM of these systems enhances narrow bandwidth frequency response measurements. When used as a CW signal source with the analyzer in a manual mode, these systems have excellent frequency stability.

The tracking generator sweep rates are controlled with the spectrum analyzer, and the output level is controlled from the tracking generator. The output frequency of the tracking generator is the same as the frequency of the analyzer at any instant of the sweep.

The TR 503 Aux RF Output may be used to drive a frequency counter package, such as the recommended DP 501, DC 509 Option 01. Frequencies up to 1.8 GHz may be measured accurately in the presence of high level adjacent signals to the sensitivity limits of the analyzer.

CHARACTERISTICS

TR 503/All 490 and 2750 Series

Frequency Range — 100 kHz 1.8 GHz

Output Level — (Max) 0 dBm ±0.5 dB

Range — 0 to 59 dB in 10 dB and 1 dB steps

Flatness — Within ±2.25 dB Max from 100 kHz to 1.8 GHz (Typically ±1.5 dB)

Dynamic Range — ≥110 dB

Residual FM — 50 Hz P-P

Output Impedance — 50 Ω Nominal, VSWR 2:1 or less to 1.8 GHz

Auxiliary Output — 0.1 V RMS into 50 Ω load 7 dBm minimum

Spurious Output — Harmonic 20 dBc; Non-harmonic 40 dBc

ORDERING INFORMATION

TR 503 Tracking Generator

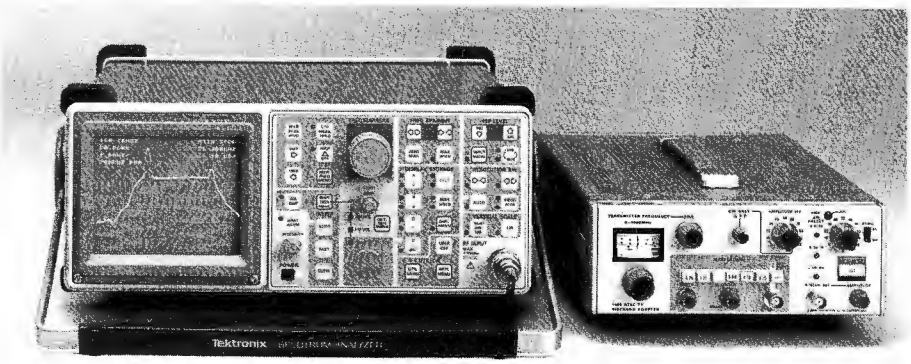
Includes: Two 50 Ω coax cables (012-0649-00); N male to BNC female adapter (103-0045-00); retainer plug-in (343-0604-00); 3 mm male to BNC female adapter (015-1018-00); instruction manual (070-3526-00).

OPTIONAL ACCESSORIES

TM 503A — Power Module

TM 504 — Power Module

Blank Panel — Order 016-0195-03



2710 Spectrum Analyzer and the 1405 TV Sideband Adapter.

1405
TV Sideband Adapter

Facilities In-Service Testing of Transmitter

Measure Transmitter Frequency Response to ±0.2 dB

Video Circuits Can be Swept

For In-Service Testing, Use of External Blanking Allows Either Full Field or Single Line Operation

Check Aural FM Deviation with Built-In Bessel Null Technique

Flexible Marker System Will Accept Standard Crystals

To analyze the sideband response of a television transmitter, the 1405 Sideband Adapter is recommended for use in tandem with the Tektronix 2710, 2750 Series and 490 Series spectrum analyzers. It generates a composite video signal, which is applied as modulation to a television transmitter. The output is displayed on the spectrum analyzer and appears as a response curve, to within ±0.2 dB, of the transmitter being tested.

The 1405/Spectrum Analyzer combination will display frequency response characteristics of RF and IF circuits for transmitters with frequencies to 1 GHz. Video circuits can also be analyzed.

Correct frequencies at the TV Channel marks on the dial readout for 2750 and 490 Series spectrum analyzers are provided with Option 02, and for the 2710 Spectrum Analyzer with Option 03.

Request Tek Brochure 26W-4787-1 for complete specifications or call your local sales engineer for additional information.

ORDERING INFORMATION

1405 TV Sideband Adapter 525/60 Markers

Includes: Instruction manual (070-2078-00)

OPTIONS

Opt. 01 — TV Sideband Adapter (625/50 Markers)

Opt. 02 — Dial Readout for 490/2750 Series Spectrum Analyzers

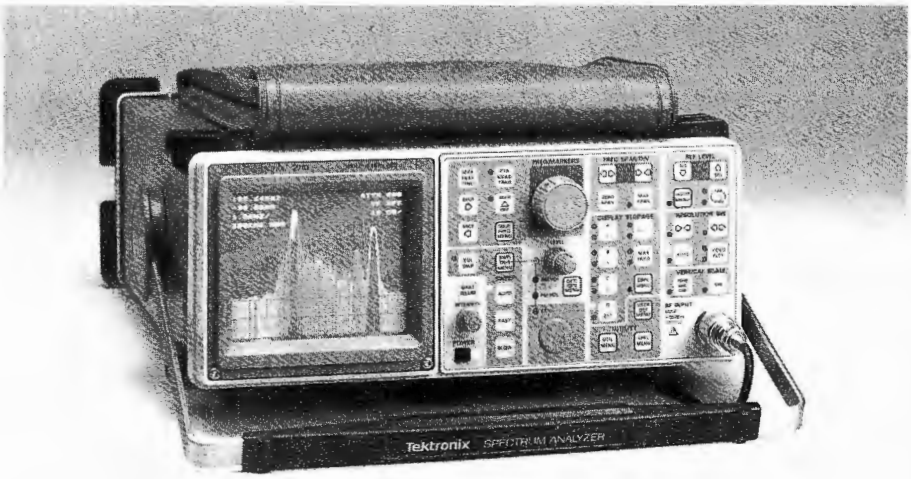
Opt. 03 — Dial Readout for use with 2710 Spectrum Analyzer

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 — Available. See previous page for description.

RACKMOUNT CONVERSION KIT

Standard 19-inch Rack — Order 016-0489-00



2710 Economy Portable Spectrum Analyzer.

2710
Economy Portable Spectrum Analyzer

BENEFITS

High Confidence in Frequency Measurements

Easily See Weak Signals

Ease of Use Enhanced by Automated Calibration (Normalization), Dedicated Function Keys, Microprocessor Control, Pushbutton Measurements

Short Waiting Time Before Making Measurements

High Portability

Enhanced Measurement Comparisons

Measurement Convenience with Full Marker/Delta Marker Capability

See Modulation-Related Phenomena and Low Level Beats

FEATURES

10 kHz to 1800 MHz Frequency Range

1 × 10^{-5} or Optional 5 × 10^{-7} Frequency Accuracy

1 Hz Frequency Resolution at Wide Span/Div Using Optional Internal Frequency Counter

Up to −127 dBm Sensitivity, or −139 dBm Sensitivity Using Built-in Preamp

9.5 Kg (21 lb.) Weight, Compact Size

Fast Warmup, High Stability

Full Display Area Usable With 80 dB Display Dynamic Range

Four-Trace Digital Storage

Direct-Reading 50 ohm and 75 ohm Operation Modes

True Analog Display

Signal Identification and Qualitative Analysis with Aural and Optional Video Demod

CHARACTERISTICS

The following specifications and features apply after a 15-minute warmup period unless otherwise noted.

FREQUENCY RELATED

Frequency Range — 10 kHz to 1800 MHz.

Center Frequency Accuracy — 1×10^{-5} ±5kHz; Option 01: 5×10^{-7} ±700 Hz.

Frequency Counter Accuracy (Opt. 02) — 1×10^{-5} ±10 Hz, 0°C to 50°C; 3 (10^{-6}) ±10 Hz/year; Opt. 01: 5×10^{-7} ±10 Hz, 0°C to 50°C, at 2×10^{-6} ±10 Hz/year.

Dot Marker Frequency Accuracy — CF Accuracy plus 3% of span.

Frequency Counter Readout Resolution (Opt. 02) — 1 Hz.

Typical Long-Term Drift — 10 ppm/yr; Opt. 01: 2 ppm/yr.

Short-Term Drift — 20 kHz maximum drift between correction cycles. Typical short-term drift between correction cycles is within 5 kHz. Opt. 01: ≤400 Hz maximum drift between correction cycles.

Residual FM — ±2 kHz p-p/20 μsec; Opt. 01: ±100 Hz p-p/20 μsec at span/div ≤20 kHz/div; ±2 kHz p-p/20 μsec at span/div >20 kHz/div.

Resolution Bandwidth — (−6 dB) 5 MHz, 300 kHz, 30 kHz, 3 kHz; Option 01: add 300 Hz.

Resolution Bandwidth Shape Factor — ≤7:1

Noise Sidebands — > −70 dBc at 30×RBW (Resolution Bandwidth).

Video Filter — Approx. 1/100 (Auto) of RBW. Manual Selection: 3 Hz to 300 kHz in 1-3 sequence.

Freq. Span/Div Range — 180 MHz to 10 kHz; Opt. 01: add 1,2,5 kHz/div. Selected in 1,2,5 sequence or 2 significant digits via menu. Max span, zero span keys.

Span Accuracy — ±3% measured over the center eight divisions.

AMPLITUDE RELATED

Flatness — ±1.5 dB measured with 10 dB RF attenuation (preamp off).

Vertical Display Modes — 10, 5, 1 dB/div, Linear.

Measurement Range — −129 (preamp on) to +20 dBm; Option 01: −139 (preamp on) to +20 dBm.

Display Dynamic Range — 80 dB max.

Reference Level Range — LOG Mode: −70 to +20 dBm (−23 to +67 dBmV). LINEAR Mode: 8.8 μV/div to 280 mV/div.

Reference Level Steps — LOG Mode: 1 dB or 10 dB. LINEAR Mode: 1,2,5 sequence: 10 μV/div to 280 mV/div.

Mixer Input Level — Automatically controlled by instrument for on-screen signals. Level selectable between −20 to −50 dBm.

Display Amplitude Accuracy — 10 dB/div: ±1.0 dB/10 dB to max. cum. error of ±2 dB over 80 dB range. 5 dB/div: ±1.0 dB/5 dB to max. cum. error of ±2.0 dB over 40 dB range. 1 dB/div: 1 dB max. error over 8 dB range. LINEAR Mode: ±5% of full scale.

RF Attenuation Range — 0 to 50 dB, 2 dB steps.

Maximum Sensitivity — −117 dBm at 3 kHz RBW. −129 dBm at 3 kHz RBW w/preamp. Opt. 01: −127 dBm at 300 Hz RBW, −139 at 300 Hz RBW w/preamp.

SPURIOUS RESPONSE (with preamp off)

Residual Spurious Response — ≤ −100 dBm referenced to input of 1st mixer.

3rd Order IM Distortion — ≤ −70 dBc, from any two on-screen signals within any frequency span at −20 dBm input level, 10 dB attenuation.

2nd Harmonic Distortion — ≤ −66 dBc with −30 dBm input and 0 dB attenuation.

INPUT RELATED

LO Emission — ≤ −70 dBm with 0 dB RF attenuation.

RF Input — Type N connector, 50 Ω

VSWR with 10 dB or more RF attenuation — 1.5:1 max.

Maximum Safe Input — +20 dBm (0.1 W) continuous peak with 0 dB RF attenuation; 100 V dc (initially applied with full attenuation).

1 dB Compression Point — ≥ −15 dBm with 0 dB RF attenuation.

SWEEP RELATED

Sweep Times — 1 μsec to 2 sec/div in 1, 2, 5 seq. (7 decade range); AUTO SWEEP mode; MANUAL SWEEP select.

Sweep Time Accuracy — ±10% over the center 8 divisions.

Trigger — Free run, internal, external, line, TV field, TV line, single sweep, manual scan.

Trigger Amplitude — Internal: One division or more of signal. External: 1.0 V peak, minimum; DC coupled (15 Hz to 1 MHz).

OTHER INPUTS/OUTPUTS

External Trigger — BNC connector, 10 kΩ impedance, DC coupled 0.1 μs minimum pulse width. 35 V max.

External Video Input — DC coupled, 0-100 kHz, 0-1.6 V (200 mV/div) signal input for vertical deflection of CRT beam.

Sweep Gate Out — TTL level signal that is HI while CRT beam sweeps.

Sweep Output — +1.3 to −1.3 V, negative going ramp, proportional to the horizontal sweep. Source impedance ≤50 Ω, load impedance ≥10 Ω.

Video Output — 0 to +1.6 V of video signal, proportional to vertical display amplitude. 0 V is top of screen. 1 kΩ impedance.

ENVIRONMENTAL

Temperature — Operating: 0°C to +50°C (MIL-T-28800C). Nonoperating: −55°C to +75°C.

Humidity — Nonoperating: Five cycles (120 hours) per MIL-T-28800C, class 5.

Vibration — Meets MIL-T-28800C Method 514 Procedure X (modified).

Shock — Operating and Nonoperating: Three guillotine-type shocks of 30 g, one-half sine, 11 ms duration each direction along each major axis; total of 18 shocks.

Radiated and Conducted Emissions — Meets FCC Part 15, sub-part J, class A and VDE 0871, class B.

Radiated and Conducted Susceptibility — Meets Part 7 MIL-STD 461B.

GENERAL CHARACTERISTICS

Power Requirements — 90 W MAX (1.2 A) at 115 V, 60 Hz. Operates 48Hz to 440 Hz, 90 to 250 V ac. Battery power option available.

Weight — 9.5 kg (<21 lb.) nominal for basic configuration.

Dimensions (H, W, D) with feet, handle and front panel cover — 137×361×445 mm (5.4×14.2×17.5 inches).

OTHER CAPABILITIES

Markers — Single marker/delta markers; next right, next left peaks; next lower, next higher peaks; (highest) peak find; marker to CF; select start/stop frequencies; transpose Δ markers.

Nonvolatile memory — Up to 18 displays and/or 8 front panel setups may be saved. Lithium battery backup.

Digital Storage Display — Selectable acquisition modes of positive peak only, positive/negative peak. SAVE A, B, C and active D trace; up to four traces on screen; MAX HOLD A, B; MIN HOLD A, B or C; B, C minus A; WATERFALL display mode; ensemble averaging; (min., max., mean, min/max); digital storage off provides analog display.

Ensemble Averaging — Provides weighted averaging of display resulting in reduction of random noise and impulse signals without sweep speed changes.

Direct Entry of Control Parameters — Frequency, span/div, reference level, RBW, video filter, vert. scale, sweep rate.

Measurement Modes — Noise, Carrier-to-Noise, Bandwidth (user definable "dB down" points).

Internal Freq. Counter (signal counter) — Opt. 02.

Internal Preamplifier — Preamp may be switched in/out of circuit (degrades flatness below 10 MHz and above 600 MHz, provides approx. 12 dB sensitivity improvement) with zero RF attenuation.

Alternate Reference Level Units — dBm, dBmV, dBV, dBm, dBμW, dBμV/m.

User-definable Power-on Status — Instrument powers up to user-definable state or supplied default settings.

Constant Rate Tuning — Same on-screen tuning sensitivity regardless of span/div selection.

Center Measure — Signal nearest CF (from any screen location) is centered with frequency and peak amplitude automatically read out (not a marker mode). The centered signal will be counted if the Opt. 02 Frequency Counter is installed.

Signal Track — Drifting signal is kept at display center with correct frequency and peak amplitude displayed.

Graticule Illumination — Contrast enhancement for CRT photography.

Centronics Interface — Opt. 09. Will support Epson FX Series Printers and compatibles and Tek HC100 Printer/Plotter.

Rackmount Option — Opt. 30. Converts unit to a rack mounted installation. Five-inch rack height, 19-inch rack width.

Portable-to-Rack Adapter — Opt. 34. Provides rackmounting of instrument in standard enclosure with handle. Offers immediate instrument portability when needed. Seven-inch rack height, 19-inch rack width.

AM/FM Detectors — Built-in amplifier, speaker and headphone jack for aural demodulation.

Video Monitor Mode — Opt. 10. Allows direct viewing of television picture on analyzer screen. Functions in NTSC, PAL and SECAM systems. Includes selectable horizontal line trigger.

2704 Inverter/2705 Battery Pack

The 2704 Inverter and 2705 Battery Pack can provide a minimum of one hour continuous operation for the 2710 in locations where ac power is not available. These units mount directly on the 2710 to form a portable package.

They can also be used for other remote applications requiring 115V, 60 Hz power. Maximum continuous output power is 125 watts.

Several 2705s can be used to provide an uninterruptible power source for the 2710 or other equipment. The 2704 includes a battery charger, and provides an auxiliary 18 volt output. The 2704 also accepts 12 volt input from other sources, such as car batteries. These units are described in more detail in Tektronix Specification/Ordering Information Sheet 26W-7061.

TYPICAL APPLICATIONS

- Cable Television
- VTR/VCR Maintenance
- Television and Audio Broadcasting
- Broadband Local Area Networks
- Education
- Manufacturing Test
- EMI/RFI
- Land Mobile/Two-Way Communication
- Avionics
- Cellular Radio

ORDERING INFORMATION

2710 Spectrum Analyzer

Includes: Power cord (U.S. 115 V/60 Hz) (161-0104-00); Operator's manual (070-6022-00); Front cover (200-2520-00); and 75/50 Ω min-loss pad (131-4199-00).

OPTIONS

Opt. 01 — 300 Hz resolution bandwidth/phase-lock stabilization/5 × 10^{-7} ±700 Hz frequency accuracy

Opt. 02 — Internal frequency counter with selectable 1 kHz/1 Hz readout resolution

Opt. 06 — 1106 Battery Operation

Opt. 07 — 2704 Inverter and 2705 Battery Pack

Includes: Power cord (U.S. 115 V, 60 Hz), Operator's Manual, 2710 Mounting Plate.

Opt. 09 — Centronics interface

Opt. 10 — Video monitor mode

Opt. 14 — Adds 1 kHz, 10 kHz, 100 kHz and 1 MHz RBW filters

Opt. 15 — Tek 1405 TV Sideband Analyzer Interface

Opt. 30 — Rackmount for 19-inch rack width, 5-inch height

Opt. 33 — Travel Line Package

Includes: Accessory pouch; carrying strap; smoke-gray CRT filter; vinyl rain cover

Opt. 34 — Portable to Rackmount adaptor for 19-inch rack width, 7 inch height

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 — Available. See page 139 for description.

WARRANTY-PLUS SERVICE PLANS

Opt. M1 — Available

Opt. M2 — Available

Opt. M3 — Available

OPTIONAL ACCESSORIES

2704 — Inverter

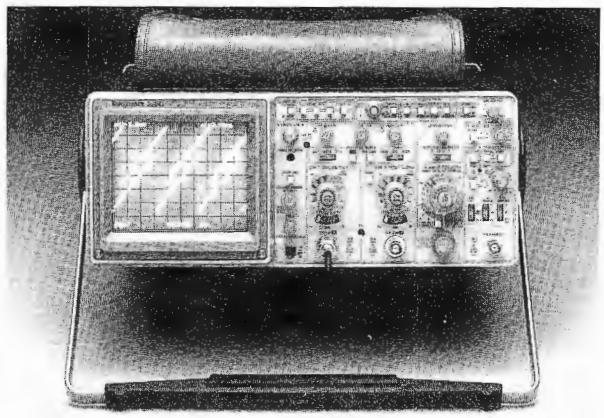
Includes: Power cord (U.S. 115 V, 60 Hz), Operator's Manual, 2710 Mounting Plate.

2705 — Battery Pack

Front Panel Cover — 200-2520-00

Accessory Pouch — Mounts on top. Order 016-0677-02

Viewing Hoods — (Collapsible) Order 016-0592-00



2230/ 2221/2220

GPIB IEEE-488

The 2230 Option 10, 2221 Option 10 and 2220 Option 10 comply with IEEE Standard 488-1978, and use Tektronix *Standard Codes and Formats*. The 2230 Option 12, 2221 Option 12 and 2220 Option 12 feature Standard RS-232C and use Tektronix *Standard Codes and Formats*.

100 MHz Digital Storage and Nonstorage (2230)

60 MHz Digital Storage and Nonstorage (2220, 2221)

100 ns Glitch Capture at Any Speed

Cursors for Time and Voltage Measurements (2230, 2221)

Point Selectable Pre/Posttriggering (2230)

Pre/Mid/Post Triggering (2221, 2220)

4K Record Length

Post Acquisition Expansion, Compression, and Positioning

GPIB or RS-232C Optional

26K Battery-Backed Save Reference Memory (2230 Option 10 or 12)

TYPICAL APPLICATIONS

Medical Equipment Servicing
Digital Design and Troubleshooting
Power Supply Design and Troubleshooting
Electromechanical
Stress/Vibration Analysis

The 2230, 2221 and 2220 are the answer for general and special purpose storage needs. These high performance portable scopes have storage and nonstorage bandwidths of 100 MHz (2230) and 60 MHz (2220, 2221).

All scopes have been designed with many features which enhance their usefulness in your applications. The 2230 and 2221 offer cursors and CRT readout enabling you to measure time or voltage differences easily and accurately. The multiple Save Reference memories (2230) allow you to view both stored and current waveform acquisitions onscreen simultaneously. Weighted signal averaging can be used to remove random noise from a signal and improve measurement accuracy.

Peak detection makes 100 ns glitch capture possible at any sweep speed. This mode digitizes and stores, in acquisition memory as a data pair, the minimum and maximum levels of the input signal. The resulting display can be used to catch glitches, as narrow as 100 ns, view frequency drift and amplitude modulation, or detect aliasing.

Unlimited storage time; expandable, compressible, repositionable stored traces; save reference memory; pre/post trigger viewing; roll mode; standard X-Y plotter output; and optional interfaces make the 2230, 2221 and 2220 the most sensible digital storage oscilloscopes to own.

GPIB IEEE-488

Option 10 GPIB Interface
Option 12 RS-232C Interface

GPIB (Option 10) and RS-232C (Option 12) interfaces are available for the 2230, 2221 and 2220. Either interface can transmit and receive waveform data. Most front panel settings can be queried and any functions can be controlled via the interface.

2230 Option 10 or 12 interfaces also allow messages or computed results to be displayed on screen, and include a battery-backed reference memory (minimum lifetime 3 years) for storage of up to 26 additional waveform sets.

Option 10 GPIB Interface

The Option 10 GPIB interface conforms to IEEE Standard 488-1978. It is fully compatible with *Tektronix Standard Codes and Formats*.

Option 12 RS-232C Interface

The Option 12 RS-232C interface has both DCE and DTE connectors. It is compatible with an extension of *Tektronix Standard Codes and Formats*.

Option 12 for the 2230 also includes 26K of battery-backed reference memory for the storage of up to 26 waveform sets.

GPIB/RS-232C Printers and Plotters

A 2230, 2221 or 2220 equipped with either Option 10 or Option 12 interface is fully compatible with any X-Y plotter that uses Hewlett-Packard Graphics Language (HPGL). The GPIB interface also supports the HP ThinkJet 2225A printer. The RS-232C interface also supports any Epson FX-Series format printer or the HP ThinkJet 2225D printer. Plotter output is directed to the interface if its control switches are set for the appropriate plotter or printer. Otherwise, plotting is directed to the X-Y outputs.

IEEE Standard 488-1978 Interface Function Subsets Implemented — SH1, AH1, T6, L3, SR1, RL2, PP0, DC1, DT0, C0.

ORDERING INFORMATION

2230 100 MHz Dual Time Base Digital Storage Oscilloscope

Includes: Two P6121 10X voltage probes; front panel cover (200-2520-00); accessory pouch (016-0677-02); operator manual (070-4998-00); user's reference card (070-5370-00).

2221 60 MHz Single Time Base Digital Storage Oscilloscope

Includes: Two P6121 10X voltage probes; front panel cover (200-2520-00); accessory pouch (016-0677-02); operator manual (070-5301-01); user reference guide (070-6532-00).

2220 60 MHz Single Time Base Digital Storage Oscilloscope

Includes: Two P6122 10X voltage probes; front panel cover (200-2520-00); accessory pouch (016-0677-02); operator manual (070-5301-00); user's reference card (070-5681-00).

OPTIONS

Option 10 — (2230) GPIB IEEE-488 Interface.
Includes: 26K of Battery-Backed Reference Memory.
Option 12 — (2230) RS-232C Interface.
Includes: 26K of Battery-Backed Reference Memory.
Option 10 — (2221) GPIB IEEE-488 Interface.
Option 12 — (2221) RS-232C Interface.
Option 10 — (2220) GPIB IEEE-488 Interface.
Option 12 — (2220) RS-232C Interface.
Option 33 — Travel line package.

FIELD RETROFIT KITS

2230F10 — Field Retrofit Kit for Option 10.
2230F12 — Field Retrofit Kit for Option 12.
2221F10 — Field Retrofit Kit for Option 10.
2221F12 — Field Retrofit Kit for Option 12.
2220F10 — Field Retrofit Kit for Option 10.
2220F12 — Field Retrofit Kit for Option 12.

INTERNATIONAL POWER PLUG OPTIONS

Option A1 — Universal Euro 220 V/16A, 50 Hz. Order 020-0859-00.
Option A2 — UK 240 V/13 A, 50 Hz. Order 020-0860-00.
Option A3 — Australian 240 V/10 A, 50 Hz. Order 020-0862-00.
Option A4 — North American 240 V/15 A, 60 Hz. Order 020-0862-00.
Option A5 — Switzerland 220 V/10 A, 50 Hz. Order 020-0863-00.

WARRANTY-PLUS SERVICE PLANS

M1 — (2230) 2 Calibrations.
M1 — (2221) 2 Calibrations.
M1 — (2220) 2 Calibrations.
M2 — (2230) + 2 Years Service.
M2 — (2221) + 2 Years Service.
M2 — (2220) + 2 Years Service.
M3 — (2230) 4 Calibrations & 2 Years Service.
M3 — (2221) 4 Calibrations & 2 Years Service.
M3 — (2220) 4 Calibrations & 2 Years Service.
M4 — (2230) 5 Calibrations.
M4 — (2221) 5 Calibrations.
M4 — (2220) 5 Calibrations.
M5 — (2230) 9 Calibrations & 2 Years Service.
M5 — (2221) 9 Calibrations & 2 Years Service.
M5 — (2220) 9 Calibrations & 2 Years Service.

For more information, contact your nearest Tektronix sales engineer or call the Tektronix National Marketing Center at 1-800-426-2200.

2246A/2245A
Portable Oscilloscopes

Bright, Crisp Display With High Writing Rate

Four Independent Channels

100 MHz Bandwidth With 2 ns/Div Time Base

Auto Setup

On-Screen Scale Factor Readouts

Flexible Triggering
- **Auto Level and Auto HF, LF, Noise Reject, TV Line and TV Field**

Delayed Sweep

Control Status Lights

2% Vertical and Horizontal Accuracy

2 mV/Div Vertical Sensitivity at Full Bandwidth

New Specially Designed Probe

Simple, Rugged Construction

New Labeled Volts Cursors With Ground-Referenced Readings and On-Screen Readouts

New Hands-Off Voltmeter Measurements
- **+Peak and −Peak**
- **Peak-to-Peak**
- **Gates Peaks**
- **Gated Peak-to-Peak**
- **Dc**

New SmartCursors™ Track Voltmeter Measurements

New SmartCursors™ Visually Indicate Trigger Level and Ground

Time Measurements with Cursors or Alternate Delayed Sweep Δ Time

Three Year Warranty — Five Year Optional

TYPICAL APPLICATIONS

Logic Design and Repair
Communications
Power Supply Design

Higher Performance, Lower Price
The performance/price ratio for portable oscilloscopes has been substantially upgraded. No other portable scope can offer the range of productivity enhancing features and performance characteristics at a comparably low price than the Tektronix *NEW* 2245A and 2246A.

Features That Promote Productivity
Auto setup of the front panel automatically adjusts vertical, horizontal, triggering and display controls to display the waveform, no matter where they were previously set. Store and recall 20 battery-backed front panel configurations, which aid in repetitive measurements (2246A).

More Triggering Flexibility
Hands-free triggering, made possible by the Auto-level mode, automatically places a stable display of almost any waveform on screen. The LF, HF and Noise Reject modes, together with a 10-to-1 holdoff range, deliver stable triggering on complex waveforms. The built-in TV Line and TV Field triggering capability extends measurements to most video-related applications with performance for the broadcast industry.

Performance Plus
The *NEW* 2245A and 2246A oscilloscopes have low noise vertical systems that produce sharp, bright traces. Their 2 ns time base and 100 MHz bandwidth bring out the details on high speed signals and render measurements with good timing resolution.

Low level signal measurements are easily managed by the 2 mV/div vertical sensitivity, even at full bandwidth, and by trigger sensitivity that extends to 0.25 div at 50 MHz (0.5 div at 100 MHz).

Voltage Measurements With The Push of a Button
A pushbutton activated measurement system on the 2246A enhances productivity even more. This scope turns out virtually hands-off measurments quickly of +peak, −peak, peap-to-peak, dc, and gated volts, all with convenient on-screen readout of values.

If more visual indication is desired, the unique cursor system can provide feedBack showing exactly where on the waveform an automatic measurement is being made. These feedBack cursors, when selected, even show ground and trigger level locations.

There is also the ability to use cursors in the conventional manual mode for making point-to-point time and voltage measurements, including time interval measurements between a point on the reference waveform and a point on any of four other displayed waveforms.

Three Year Warranty
As with all of our high quality 2000 Series Oscilloscopes, the 2245A and 2246A (including the CRT) are covered by the Tektronix three year warranty, making ownership more cost effective than ever.

ORDERING INFORMATION

2245A 100 MHz Oscilloscope
Includes: Two 10X, 1.3 m probes with accessories (P6109); clear accessories pouch with ziploc fastner (016-0537-00); blue plastic CRT filter (337-2775-00); 2A, 250 V fuse (159-0023-00); operator manual (070-6083-00); user reference guide (070-6082-00).

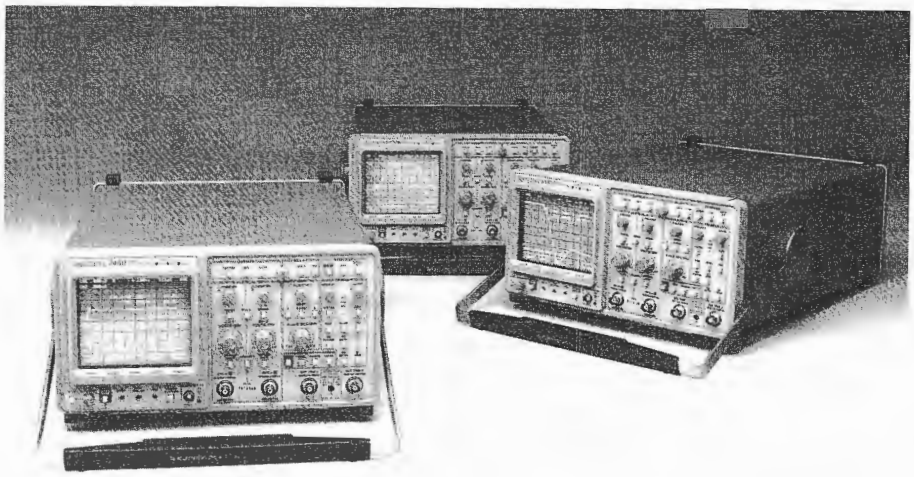
2246A 100 MHz Oscilloscope with Voltmeter, ΔTime, and SmartCursors™
Includes: Same as 2245A.

OPTIONS
Option 02 — Protective front panel cover and accessory pouch.
Option 1C — C-5C Option 02 Camera.
Option 1K — K212 Portable Instrument Cart.
Option 22 — Two additional P6109 probes.
Option 23 — Two 1X/10X P6062B, 6 ft. probes.

INTERNATIONAL POWER OPTIONS
Option A1 — Universal Euro plug, 220 V, 16 A, 50 Hz.
Option A2 — UK plug, 240 V, 13 A, 50 Hz.
Option A3 — Australian plug, 240 V, 10 A, 50 Hz.
Option A4 — North American plug, 240 V, 15 A, 60 Hz.
Option A4 — Switzerland plug, 220 V, 10 A, 50 Hz.

WARRANTY-PLUS SERVICE PLANS
M1 — 2 Calibrations.
M2 — 2 Years Service.
M3 — 2 Years Service and 4 Calibrations.
M4 — 5 Calibrations.
M5 — 9 Calibrations + 2 Years Service.

For more information, contact your nearest Tektronix sales engineer or call the Tektronix National Marketing Center at 1-800-426-2200.



2400
Option 05 Series Digitizing Oscilloscopes

500 MS/s Digitizing (100 MS/s for the 2430A; 250 MS/s for the 2432A) at probe tip

300 MHz Bandwidth (150 MHz for the 2430A)

2 ns Glitch Capture

Standard Accessory P6137 Autoprobe for Finger-Tip Control Functions (2440; 2432A)

Simultaneous Acquisition on Two Channels

Auto Sequencing for Building, Storing and Running Test Procedures — Without Programming

Auto Setup for Single-Button Scope Setups, Even With Unknown Signals

Auto Pass/Fail Waveform Testing for Unattended Decision-Making

21 Auto Measurements

Full GPIB Programmability

Three-Year Warranty, Five Years Optional

On-Screen HELP Text Describing Every Front-Panel Control

Selectable System M and Non-System M Protocols

Selectable Triggering on Any Line Within a Field, with Line-Number Readout

Compatible with Composite Video

Television Blanking Level Clamp (Back-Porch)

The Tektronix 2400 Series Includes:

- 2440 Digital Oscilloscope
- 2432A Digitizing Oscilloscope
- 2430A Digitizing Oscilloscope

Tektronix combines timesaving innovations with high standards of technical performance. The result — powerful and versatile scopes that speed measurements, simplify setups and automate test procedures — all from the front panel. Their portable, compact design easily serves benchtop as well as transportability needs.

Fully GPIB-Programmable, Proven Scopes
With the 2440's 500 MS/s digitizing rate — on two channels simultaneously — you can digitize, view and store wide bandwidth, complex signals. You have 8-bit vertical resolution, 1k record length per channel and a 0.0015% crystal-controlled time base for accurate voltage and time measurements.

No other portables let you:

- Capture glitches as narrow as 2 ns.
- Automatically catch intermittent failures in "babysitting" applications, using the patented auto pass/fail waveform testing feature.
- See waveform changes virtually *as they happen*, thanks to Tektronix' fast update rate.

Power and Flexibility in an Easy-To-Use Portable Digital Oscilloscope
With its advanced feature set, 2400 Series DSOs can meet your general purpose measurement needs while offering the advantages of a digitized waveform — including long term storage for future reference, data transfer, and waveform analysis.

Features include: 1024 point per channel record length, Average Mode for increased resolution and noise reduction on repetitive signals, Envelope Mode to capture events as fast as 2 ns at any sample rate, and pass/fail waveform testing to capture and save events that deviate from user-defined waveform templates.

New and powerful features that quickly set up the scope, build and store test procedures from front panel setups, conduct pass/fail tests, and provide on-line operating instructions.

ORDERING INFORMATION

2430A Option 05
100 MS/s Digitizing Oscilloscope

2432A Option 05
250 MS/s Digitizing Oscilloscope

2440 Option 05
500 MS/sec Digitizing Oscilloscope

OTHER OPTIONS

Option 03 — Word Recognizer Probe (P6407).
Option 22 — Two Additional Matching Probes.
Option 1R — Configure oscilloscope for rack-mount.
Option 11 — Probe Power.
Option B1 — Service Manual.

POWER CORD OPTIONS

Power cords are available to meet international requirements.

WARRANTY-PLUS

Service plans are available to extend warranty coverage. Contact your Tektronix sales engineer.

OPTIONAL ACCESSORIES

Carrying Strap — Order 346-0058-00.
Carrying Case — Order 016-0792-01.
GPIB Cables — Double shield, low EMC.
(1m) Order 012-0991-01.
(2m) Order 012-0991-00.
(4m) Order 012-0991-02.

RECOMMENDED PLOTTER

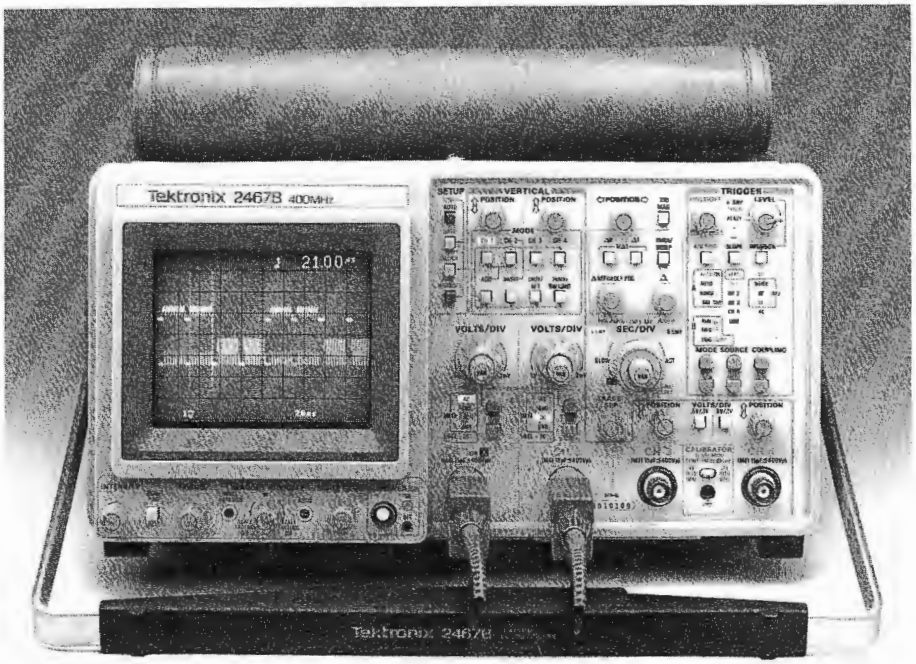
HC100 — 4-color pen plotter.

RECOMMENDED CART

K212 — Portable Instrument Cart.

TRAINING

Customer training is available on this product. Contact your Tektronix sales engineer.



2467B
Option 05 High Writing Speed Oscilloscope

4 div/ns Visual Writing Speed

1 ns Rise Time

400 MHz Bandwidth

Measure Risetime, Falltime, Frequency, Width, Volts and Time A to B at the Push of a Button

Volts and Time Cursors with On-Screen Readout

Auto Setup

Save and Recall Setups

Four Independent Channels

500 ps/Div Time Base

Switchable 1 MΩ and 50 Ω Inputs

20 ps Time Interval Resolution

Lightweight and Rugged

Selectable System-M and Nonsystem-M Protocols

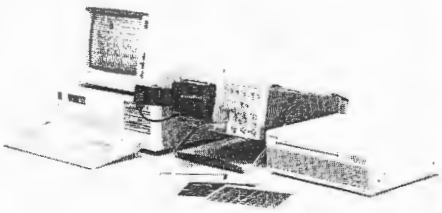
Selectable Triggering on Any Line within a Field, With Line-Number Readout

Compatible With Composite Video Having 13.1 kHz to 77 kHz Line Rates

TV Blanking-Level Clamp (Back-Porch)

Optimized Vertical Response Comparable to High Performance TV Waveform Monitors

Digitize Waveforms With DCS01/2467B



DCS01 Digitizing Camera System captures repetitive waveforms from analog scopes and transients according to a scope's CRT writing speed (400 MHz for 2467B).

2467B
Transient Intensifying Oscilloscope

Crisp Display of Single-Shot Events at 500 ps/Div in Normal Room Light

Digitize to 400 MHz With DCS01

Same Options as 2465B (Except DMM)

Now Expose Invisible Signals That Cause the Most Difficult Problems in Troubleshooting

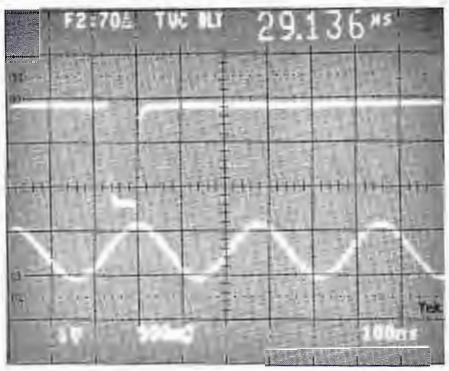
From occasional glitches and fast transients to metastability and jitter in high repetition rate signals, the Tek 2467B instantly reveals events that escape detection and measurement by any other portable instrument. You now can see high speed, single shot phenomena and low repetition rate digital and analog signals as they occur, at sweep speeds to 500 ps/div — in normal room light!

At the Heart of the 2467B's Extraordinary Capabilities is an Exclusive Microchannel-Plate (MCP) CRT

It brings the invisible to light by amplifying the intensity of infrequent and transient events while concurrently moderating the intensity of highly repetitive signals.

The result: an instrument able to display everything that happens in your circuit, whether it occurs once or repetitively. The technology that was pioneered by the 1 GHz Tek 7104 plug-in oscilloscope is available for a new range of applications in this portable, 400 MHz instrument.

With the 2467B you'll benefit from an approximate 100-fold increase in *visual* writing rate over that found in the fastest conventional CRT. Being able to see unexpected transients, even when masked by highly repetitive events, makes the critical difference in many troubleshooting situations.



2467B display of a digital control pulse (top trace–Ch1) relative to a video line signal (bottom trace–Ch2); notice the field 2 and line 70 trigger readout at the top, left of the display. The larger readout to the right is a line sync to digital pulse timing measurement. The 2467B microchannel plate (MCP) scope provides the writing speed and resulting display brightness necessary for viewing and measurement of this high-speed, low rep-rate signal.

Digitally Controlled Video Measurements

Making these measurements requires an oscilloscope with specialized capabilities. Tek's 2467B is the only oscilloscope that provides both the advanced video triggering capabilities and trace brightness (writing speed) necessary for locating and viewing the digital control signals found in digitally controlled video equipment.

The Waveform Visibility Problem

To expand on the waveform visibility problems of conventional oscilloscopes, consider the typical digital control signal used in video equipment. Generally, it will be a narrow TTL pulse, about 70-nanoseconds or less in width. That in itself raises little difficulty. The problem arises when this pulse occurs at video rates, every fourth field for example.

This would be every 33 or 66 milliseconds, resulting in a 30-Hz or 15-Hz pulse repetition rate.

On conventional oscilloscopes, these narrow, low rep-rate pulses are invisible, even at full intensity setting. A Time per Division setting of 100-nsec is needed for viewing the 70-nanosecond pulse. Because of the pulse's low rep-rate, the CRT electron beam is tracing at 33 or 66 milliseconds. The beam raises the CRT phosphor almost to its luminance level but the phosphor decays before the next beam is triggered.

Tek's 2467B's MCP CRT solves this problem by multiplying the beam's electrons just before they reach the phosphor, providing a sharp, clear display—in normal room light!

Advanced Video Triggering

See page 150 for Video Triger (Option 05) performance.

Making Single-Shot and Low-Repetition Rate Measurements

Even at 500 ps/div sweep speed, the 2467B's 4 div/ns visual writing rate displays the lowest repetition rate signals, even single shots, in normal room light. Its 400 MHz bandwidth faithfully reproduces your signal's high-frequency details. And for documentation, a C-30 Series oscilloscope camera produces high contrast photographs of single-shot signals at 500 ps/div using only ISO 3000 film.

Using the trigger-level readout feature, you can set the proper trigger point for your experiment the first time—no more guessing where the trigger point is set. And there's no wasted time and materials repeating the experiment just to properly set the trigger level.

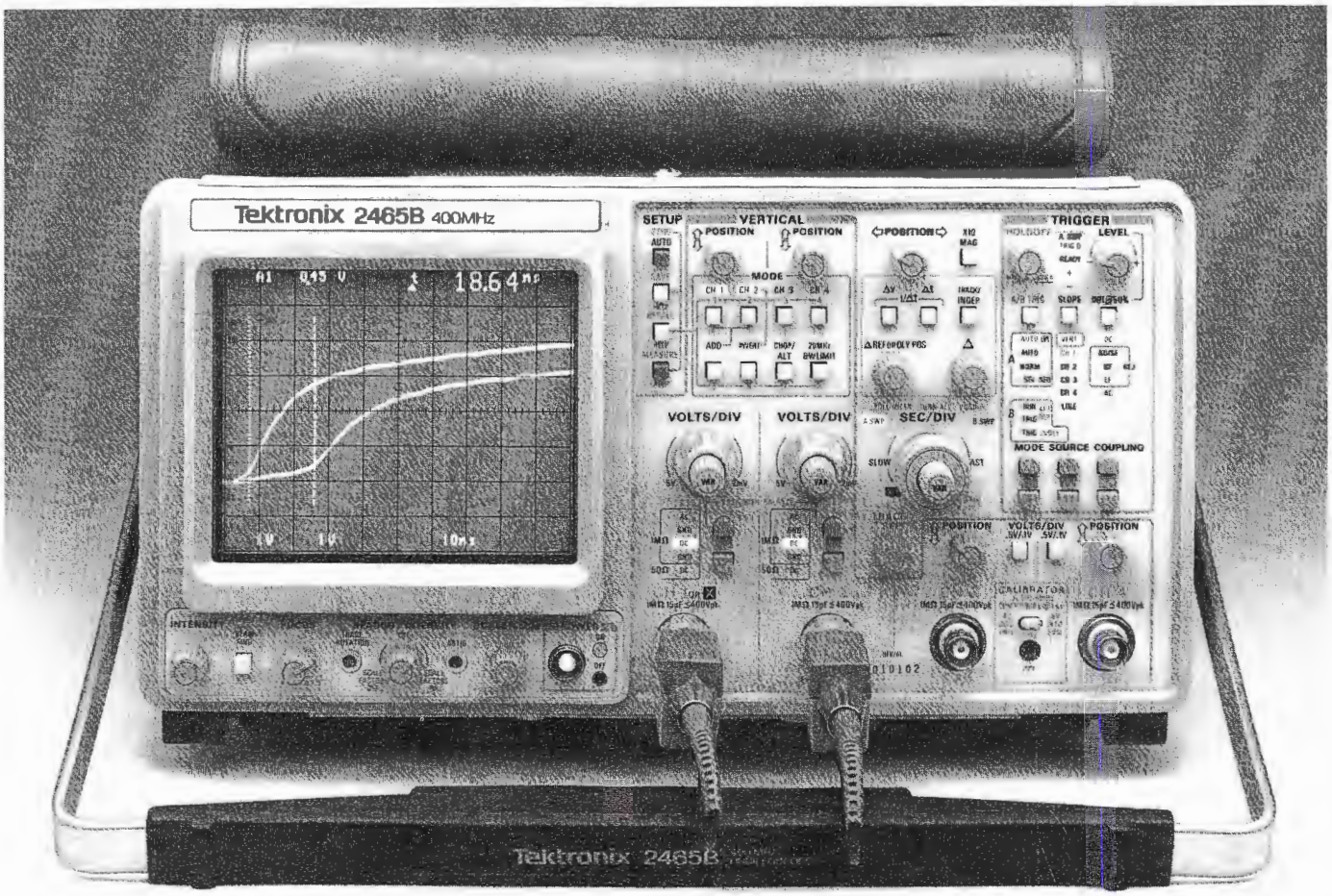
Excellent EMI protection means reliable operation even in the high fields generated by high power lasers, ESD testing, or NMR equipment.

GPIB IEEE-488

The 2467B Option 10 complies with IEEE Standard 488-1978 and with Tektronix *Standard Codes and Formats.*

PRODUCT SELECTION GUIDE

	Standard Models				Special Packages		
	2467B	**2465B**	**2455B**	**2445B**	**2465B CT**	**2465B DM**	**2465B DV**
Bandwidth	400 MHz	400 MHz	250 MHz	150 MHz	400 MHz	400 MHz	400 MHz
GPIB	Option 10	Option 10	Option 10	Option 10	Included	Included	Included
Counter/Timer/Trigger, Word Recognizer	Option 09	Option 09	Option 09	Option 09	Included	Included	Included
DMM		Option 01	Option 01	Option 01		Included	Included
Video Measurement System	Option 05	Option 05	Option 05	Option 05			Included
Counter/Timer/Trigger, No Word Recognizer	Option 06	Option 06	Option 06	Option 06			
Two Additional Probes	Included	Option 22	Option 22	Option 22	Included	Included	Included
Rackmount	Option 1R	Option 1R	Option 1R	Option 1R	Option 1R	Option 2R	Option 2R
Probe Power	Option 11	Option 11	Option 11				



2465B/2445B Option 05.

2465B/2445B

Option 05 Four Channel Oscilloscopes

All of the High-Performance Characteristics of Standard 2465B/2445B Oscilloscopes, plus Video Waveform Analysis Capabilities

Auto Setup

Save and Recall Setups

Setup Sequencing

1 ns/2.3 ns Rise Time

400 MHz/150 MHz Bandwidth

On-Screen Trigger Level Readout

Volts and Time Cursors With On-Screen Readout

Cursors After Delay

Switchable 1 MΩ and 50 Ω Inputs

20 ps Time Interval Resolution

2 mV/Div Vertical Sensitivity at 400 MHz/150 MHz

On-Screen Scale-Factor Readout

Lightweight and Rugged

500 MHz/250 MHz Trigger Bandwidth

Four Independent Channels

500 ps/1 ns per Div Time Base

Selectable System-M and Nonsystem-M Protocols

Selectable Triggering on Any Line within a Field, With Line-Number Readout

Compatible With Composite Video Having 13.1 kHz to 77 kHz Line Rates

TV Blanking-Level Clamp (Back-Porch)

Optimized Vertical Response Comparable to High Performance TV Waveform Monitors

Video measurement capabilities extend the 2465B/2445B's power and versatility to meet the challenges in broadcast and cable television, graphics displays and raster scan systems. The Video Waveform Measurement System (Option 05) makes quality measurements convenient during every stage of a product's life cycle: design, production, system calibration, quality assurance, maintenance and service.

With CRT readout of the line number and field selected for triggering, an operator knows precisely what the display represents. Any line can be selected from Field 1, Field 2, or Field 1 alternating with Field 2. The fourth video trigger selection is Lines, which superimposes all the lines in both fields. Systems with up to 1280 lines can be accommodated.

The back-porch clamp locks the video black level to a fixed point, so the display is stable and clean, even when the composite video contains low frequency hum or when the average picture level changes with AC coupling. Controls are provided for a wide variety of system protocols.

TV WAVEFORM MEASUREMENT SYSTEM (Option 05)

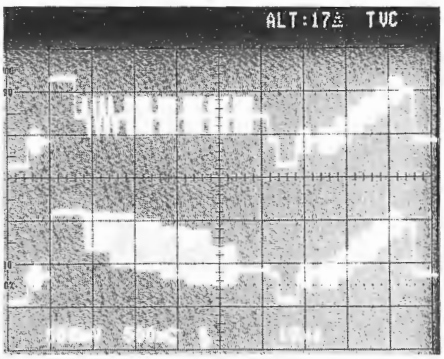
Trigger on Any Line within a Field, with Line Number Readout

Blanking Level (Back Porch) Clamp

Optimized Vertical Response Comparable to High Performance Waveform Monitors

Compatible with All Standard Protocols (NTSC, PAL, SECAM), System-M and Non-System-M

Compatible with Composite Video at 13.1 kHz to 77 kHz Line Rates, 525 Lines to 1280 Lines per Frame



Video systems including television and graphic displays, present special measurement challenges. Option 05 qualifies any 24XXB oscilloscope for practical application in every stage of the product lifecycle — design engineering, production, system calibration, quality assurance, and service/maintenance.

The back-porch clamp locks the video black level to a fixed point, so the display is stable and clean, even when the composite video contains low-frequency hum or when the average picture level changes with ac coupling.

With CRT readout of the selected triggering line number, an operator knows exactly what the display represents. Any line number can be selected from Field 1, Field 2, or Field 1 alternating with Field 2. A fourth video trigger source is Lines, which superimposes all the lines in both fields.

COUNTER/TIMER/TRIGGER (Option 06)

The Counter/Timer/Trigger is available without the Word Recognizer probe as Option 06.

COUNTER/TIMER/TRIGGER (CCT) WITH WORD RECOGNIZER (WR) (Option 09)

Semiautomatic Measurements Using the SAVE/RECALL SETUP Function, without a Separate Controller

Automatic Parametric Measurements with a Separate GPIB Controller, when Combined with Option 10

Two Independent B Triggers for Single- or Dual-Channel Dual-Delay Measurements

0.001% Accuracy for Frequency and Period

Outstanding Time Interval Measurement Capability with Interval-Selecting Markers and Independent Start/Stop Triggering

Totalize up to 9,999,999 Events

Delay-by-Events Triggering from 1 Event to 4 Million Events

Boolean Logic Triggering on Both Digital and Analog Signals

17 Bit Word Recognizer Probe

Option 09 gives the 24XXB crystal-controlled timing accuracy, along with the extra triggering power you need for digital systems.

Frequency and period are measured directly from any vertical channel. Time intervals such as pulse width, propagation delay, setup time, and rise time are measured with counter accuracy.

With the CCT, it's now possible to set different trigger levels and couplings for any two channels when making two-channel measurements — such as those needed in time-domain reflectometry — thus increasing both the accuracy and the versatility of the base scope. Two different trigger levels also can be set for each delay event — on the same channel — when making delta-delay setups and measurements.

Pinpointing the needle-in-a-haystack signal in a digital system becomes easy with the Word Recognizer and Delay-by-Events functions. These advanced triggering capabilities eliminate extraneous signals.

To unravel and characterize system operation, the CCT also can measure the frequency or period of recognized words, and it can delay the scope trigger by a selected number of words.

To record the passing of unusual events or to verify a burst of events, to Totalize function responds to a signal on any vertical input or to a recognized word.

CCT (Option 06) or CCT/WR (Option 09) Specification with Option 1E

The External Frequency Reference (Option 1E) changes only the accuracy and resolution of the frequency measurement mode. No other CCT measurements are affected.

The external reference signal supplied to Option 1E must be within 10 parts per million of the selected reference frequency. If the signal is not within 10 parts per million, the external reference may not be recognized.

The External Frequency Reference (Option 1E) signal input connector takes the place of the "Word Recognizer Out" connector. No World Recognizer Out signal is available with the External Frequency Reference option. All other aspects of the Word Recognizer function remain the same.

CHARACTERISTICS (OPTION 05)

The set of characteristics is the same as specified for standard 2465B/2445B oscilloscopes and includes the following additions:

VERTICAL SYSTEM (CHANNEL 1 AND CHANNEL 2)

Frequency Response — Applicable for Volt/Div settings between 5 mV and 0.2 V with Var Volt/Div control in calibrated detent and using a 5 div, 50 kHz reference signal from a 50 Ω or 75 Ω system.

Range	With Full BW	With BW Limiting
50 kHz to 5 MHz	±1%	+1%, −4%
>5 MHz to 10 MHz	+1%, −2%	*1
>10 MHz to 30 MHz	+2%, −3%	
>30 MHz	*1	*1

*1 *Same as basic instrument.*

Squarewave Flatness — 1% p-p for both 60 Hz and 15 kHz squarewaves, from a 50 Ω or 75 Ω system using a 1.0 V input with a 50 mV/Div setting and using a 0.1 V input at 20 mV/Div setting. 1.5% p-p using a 0.1 V input with 5 mV/Div and 10 mV/Div settings. Exclude first 50 ns following step transition. For signals with rise times ≤10 ns, add 2% p-p between 155 ns and 165 ns after step transition.

Television Blanking-Level Clamp (Back-Porch) 60 Hz Rejection (Channel 2 Only) — ≥18 dB at 60 Hz; with calibrated Volt/Div settings between 5 mV and 0.2 V, and a 6 div reference signal.

Television Blanking-Level Clamp (Back-Porch) Reference — Within 1.0 div of ground reference.

TRIGGERING

Sync Separation — Stable sync separation from sync-positive or sync-negative composite video on systems with 525 to 1280 lines/frame, 50 Hz or 60 Hz field rate, interlaced or noninterlaced scan.

Trigger Modes — LINES, FLD 1, FLD 2, and ALT (FLD 1-FLD 2).

Input Signal Amplitude for Stable Triggering — Channel 1 and Channel 2: 1.0 div for composite video and 0.3 div for composite sync signals (dc + peak video-signal amplitude must be within 18 div of input ground reference).

Channel 3 and Channel 4: 0.5 div for composite video and 0.25 div for composite sync signals (dc peak video-signal amplitude must be within 9 div of input ground reference).

GPIB Compatibility for Semiautomatic Measurement Systems — When combined with Option 10, the TV Waveform Measurement Systems (Option 05)/oscilloscope combination is fully programmable. Complies with Tektronix *Standard Codes and Formats.*

CHARACTERISTICS OPTION 1E (available with Option 06 or 09 only)

Option 1E — External Frequency Reference allows the Counter/Timer/Trigger (Option 06 or 09) frequency measurements to be extended from 7 digit (1 part in 10 million) to 8 digit resolution (1 part in 100 million). The accuracy is that of the external reference or one count in the least significant digit of the 8 digit readout, whichever is greater.

Option 1E automatically accepts any one of the following frequencies as the external reference:

100.00000 kHz
1.000000 MHz
3.579545 MHz (NTSC color burst frequency for video)
4.433618 MHz (PAL color burst frequency for video)
5.000000 MHz
10.000000 MHz

ORDERING INFORMATION

2467B Option 05 400 MHz MCP Oscilloscope
2465B Option 05 400 MHz Oscilloscope
2445B Option 05 150 MHz Oscilloscope

OTHER INSTRUMENT OPTIONS

Option 01[*3] — Digital Multimeter.
Option 06 — Counter/Timer/Trigger.
Option 09[*1*2] — Counter/Timer/Trigger and Word Recognizer.
Option 10 — IEEE-488 GPIB Interface.
Option 11[*1] — Rear Panel Probe Power.
Option 22 — Two Additional Matching Probes.
Option 1R[*3] — Configure Oscilloscope for Rackmount.
Option B1 — Service Manuals.

POWER CORD OPTIONS

Power cords are available to meet international requirements.

WARRANTY-PLUS

Service plans are available to extend warranty coverage. Contact your Tektronix sales engineer.

1 Option 11 may not be ordered with Option 09 or the 2445B.
2 Option 09 includes Option 06.
3 Option 1R may not be ordered with Option 01, 2465B DM, or 2465B DV. For rackmounting instruments equipped with Option 01, order Option 2R.

Viewing Hoods —
(Polarized Collapsible) Order 016-0180-00
(Folding Light Shield) Order 016-0592-00
(Folding Binocular) Order 016-0566-00

Carrying Case — Order 016-0792-01

Carrying Strap — Order 346-0199-00

Dc Power — 1106/1105.

Dc Inverter — 1107.

OPTIONAL ACCESSORIES

Probe Power Extender Cable for Rackmount 2445B/2465B Option 11 — Order 020-0104-00.

Word Recognizer Extender Cable for Rackmount 2445B/2465B Option 09 and 2465B CT — Order 020-0103-00.

GPIB Cables — Double shield, low EMC.
(1m) Order 012-0991-01.
(2m) Order 012-0991-00.
(4m) Order 012-0991-02.

RECOMMENDED CAMERAS

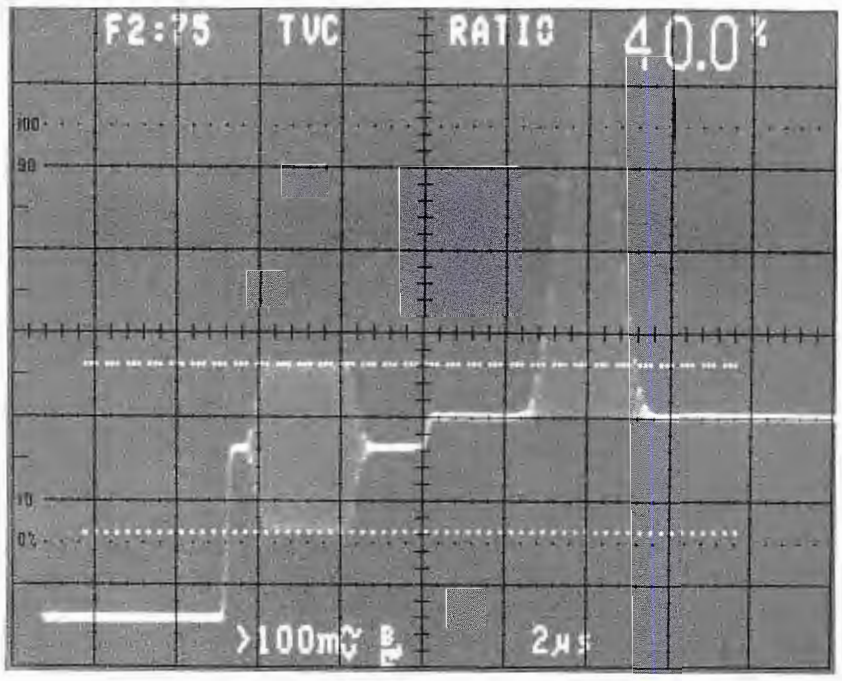
C-308P Option 01 — General Purpose.
C-5C Option 02 — Low Cost.

RECOMMENDED CART

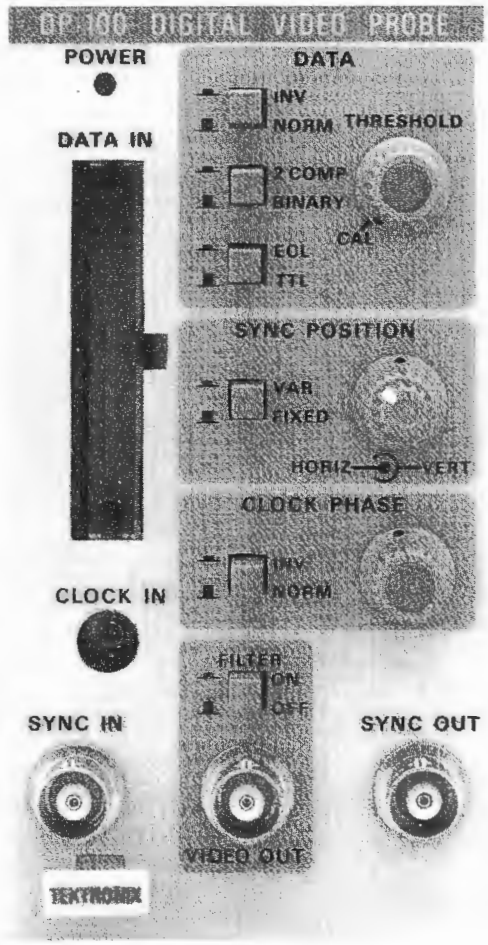
K212 Portable Instrument Cart — For on-site mobility.

TRAINING

Customer training is available on this product. Contact your Tektronix sales engineer.



This sample waveform and CRT readout show a 2445B's high-fidelity display and measurement of the color subcarrier amplitude on Line 75, Field 2 of an NTSC signal. The television blanking-level clamp (TVC) is engaged. The cursor readout of 40% is interpreted as 40 IRE units with appropriate adjustment of the vertical gain.



DP-100 Digital Video Probe.

DP-100
Digital Video Probe

Convenient Analog Display of Digital Television Signals

Fully Buffered ECL/TTL Probe

Up to 50 MS/s Data Rates

Precision 10 Bit DAC

Switchable Reconstruction Filter

Adjustable Clock Phasing

Adjustable Sync Timing

Digital technology is almost everywhere in modern television facilities, but making sense of digital data can be difficult. Logic analyzers and signature analyzers are helpful, but can be hard to use. Why not try a simpler way to look at digital television signals?

A Simple New Tool

The DP-100 Digital Video Probe is a simple, yet versatile, tool for evaluating digital television equipment. The DP-100 gives you an analog view of digital data. You can tap into a data bus, convert the signal to analog, and display it on any scope or waveform monitor, picture monitor or vectorscope.

TTL/ECL Compatible Probe

The DP-100 uses a fully buffered active logic probe to minimize loading of the circuit under test. This probe transfers data to the DP-100's DAC. A separate clock probe locks the DP-100 to your system clock.

Digital to Analog Converter

The DP-100 incorporates a 10 bit, 50 MS/s precision DAC for compatibility with a wide range of television equipment. The DAC's stepped analog output may be viewed directly or through a 5.5 MHz reconstruction filter. Sin X/X correction is optimized for 13.5 MS/s data rate.

System Clock

Propagation delays through signal processing circuitry pose no problem for the DP-100. With its front-panel adjustable clock phasing control, you can select the optimal timing to latch data into the DAC. The DP-100 clock processing operates from 1 MHz to 100 MHz, and you can mix logic families to use an ECL clock with TTL data.

Sync

The DP-100 inserts a blanking reference level on the video output, making it compatible with clamping circuits in conventional picture monitors and waveform monitors. The DP-100 also provides a sync pulse output to drive these monitors.

You can preset sync timing, or use the front-panel sync timing controls for continuous cross-pulse displays. Display range is from less than 4 μs to greater than 56 μs horizontally and from less than 10 lines to greater than 250 lines vertically.

The DP-100 Digital Video Probe comes complete with data and clock probes and is compatible with any TM 500 or TM 5000 Series Mainframe.

CHARACTERISTICS

Video Output

Dynamic Range — 1.3 V p-p into 75 Ω.

Frequency Response — Filter Off: ±5%, 0 to 50 MHz. Filter On: ±1%, 0 to 5 MHz (13.5 MS/s Data Rate).

Residual Noise — ≤3 mV p-p.

Impedance — 75 Ω, Return Loss ≥40 dB 0 to 5 MHz, ≥30 dB 5 to 50 MHz.

Pulse Response — <2% p-p ringing (2T pulse, Filter On).

Linearity — <±½ LSB.

Diff Gain — 0.6% Max.

Diff Phase — 0.3° Max.

Sync Input

Amplitude — 200 mV to 4 V p-p, composite video or composite sync.

Line and Field Rate — 525/60 or 625/50.

Impedance — 15 KΩ.

Sync Output

Impedance — 75 Ω.

Amplitude — 2 V to ±0.25 V into 75 Ω.

Horizontal Position Range — <4 μs to ≥56 μs.

Vertical Position Range — <10 lines to ≥250 lines.

Clock Input

Frequency — 1 MHz to 100 MHz.

Phase Range — 50% of clock period.

Impedance — 50 Ω.

Packaging

Single Width TM 500 Module — Compatible with TM 500 and TM 5000 Series Mainframes (mainframe not included).

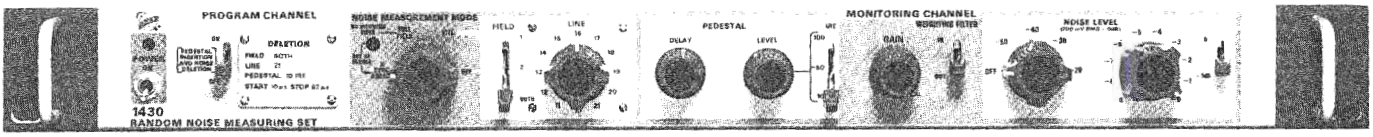
ORDERING INFORMATION

DP-100 Digital Video Probe

Includes: Instruction Manual (070-6506-00); P6460 Data Input Probe, P6454 Clock Probe.

OPTION

Option 01 — DP-100 Digital Video Probe minus the P6460 Data Probe and P6454 Clock Probe.



1430 Random Noise Measurement Set.

1430 Random Noise Measurement Set

Conforms to CCIR Recommendation 568

In-Service Testing

Out-of-Service Testing

Program Material Protected by Fail-Safe Provisions

525/60 or 625/50 Standards

The 1430 provides random noise measurement capabilities on an in-service basis using the spatially adjacent noise matching technique with a waveform monitor. A program channel allows deletion of VITS and/or noise on selected lines in the vertical blanking interval and a monitor channel is provided for making measurements in conjunction with a waveform monitor.

The 1430 has two sections. One section, permanently mounted in the rack, contains inputs and outputs and program protecting material. The second section, containing circuitry and controls, may be easily removed without cable disconnection.

Monitor Channel

The monitor channel has an output independent from program for waveform comparison of the noise on the incoming signal and noise from the internal noise generator. Front-panel controls determine monitor channel parameters with three operating modes: VITS, Full Field, and Out of Service.

In the VITS mode, any line between 10 and 21 in either or both fields may be selected for insertion of the reference noise. The Full Field mode provides insertion on all active lines.

The Out of Service mode is provided for measurements on sources that do not have composite sync. In particular, these include transmission circuits not carrying signals at the time testing is conducted. Horizontal sync is added for waveform monitor synchronization.

In all modes the insertion width is internally set at 26 μs. Delay between insertion and sync is controlled by the Delay adjustment. A switch and a potentiometer covering a range of 0 IRE to 100 IRE controls the insertion pedestal level.

Monitor channel gain control, with a $\pm$3 dB range, allows normalizing the signal for a 1 V peak-to-peak signal so that noise measurement relative to 1 V may be made. The internal noise weighting filter may be switched in or out from the front panel for evaluation of the spectral content of the incoming noise. This filter is in for the monitor channel only and does not affect the program output.

The 1430 may be used on both 625/50 and 525/60 systems but is shipped equipped for 525/60. The 1430 Option 01 is equipped for 625/50. Both models use the unified weighting filter per CCIR Recommendation 568. Insertion loss characteristics are as follows:

Insertion Loss ≈

1 MHz	5.9 dB
2 MHz	10.2 dB
3 MHz	12.0 dB
4 MHz	13.0 dB
5 MHz	13.6 dB

Program Channel

The Program Channel has a 75 Ω input impedance and unity gain and output impedance of 75 Ω. No program impairment is introduced. A relay provides program signal continuity if the 1430 loses power. Internal programming, readily changeable, controls all deletion parameters. Up to three lines between 10 and 21 in either or both fields may be deleted. The deletion may be varried between the first half, second half, or full active portion of the video line. A pedestal may be inserted in the deleted portion of a line at 10 IRE, 50 IRE, or 100 IRE levels.

CHARACTERISTICS

PROGRAM CHANNEL

Signal Input Level — 1 V nominal.

Input Impedance — 75 Ω nominal.

Input Return Loss — Power On: ≥46 dB to 5 MHz. Power Off or Bypass: ≥40 dB to 5 MHz.

Output Impedance (Operating) — 75 Ω nominal.

Output Return Loss (All) — ≥30 dB to 5 MHz.

Output Blanking, Dc Level — 0 V within 50 mV, for blanking pulses.

Inserted Pedestal Level — Adjustable to 100 IRE, 50 IRE, 10 IRE, or 0 IRE.

2T Pulse to Bar Amplitude — Within 0.25%.

Mod Sin^2 Pulse (Chrominance and Luminance) — 100% within 0.5%.

Waveform Tilt — Field Rate Squarewave ≤0.5%, 26 μs Bar, ≤0.5%.

Differential Phase (10% to 90% APL, Standard Input) — Program Output: ≤0.15°.

Differential Gain (10% to 90% APL, Standard Input) — Program Output: ≤0.2%.

Line Time Amplitude Nonlinearity (10% to 90% APL, Standard Input) — ≤0.5%.

Random Noise — Program Output: ≥75 dB (RMS) down (using weighting and low pass filters, 5 MHz).

Hum or Transients on Noninserted Lines — ≥60 dB down (using weighting and low pass filters, 5 MHz).

Spurious Signals During Blanking Lines — ≥40 dB down, low pass (5 MHz).

Signal Attenuation in Delete Mode — 2T Pulse: ≥70 dB down. Subcarrier (Color Bars): ≥60 dB down. Insertion pedestal: 10 IRE, 50 IRE, and 100 IRE, first half, second half, or entire line (up to 3; 10 to 21) or full field.

Unwanted Pedestal at Time of VITS Insertion — ≤0.7 IRE.

Time Jitter — ≤5 ns.

NOISE

Pedestal Level — Pedestal Amplitude: 10 IRE, 50 IRE, and 100 IRE.

Pedestal Position (Insertion Mode Only) — Delay: 10 μs to 50 μs.

Noise Amplitude — 20 dB to −59.5 dB (0 dB = 700 mV RMS).

Noise Attenuators — Absolute Amplitude: Within 1 dB.

Noise Spectrum — Energy/Unit Bandwidth: Flat within 6 dB, 15 kHz to 5 MHz.

Output Impedance — 75 Ω nominal.

Output Return Loss — ≥30 dB.

Noise Weighting and Low Pass Filter — Per CCIR recommendation 421-2.

AC POWER

Line Voltage Range — 115 Vac: 90 V to 132 V. 230 Vac: 180 V to 264 V. Standard 1430: Factory set at 115 Vac. 1430 Option 01: Factory set at 230 Vac.

Maximum Line Current — 0.25 A.

Maximum Power Consumption — 30 W.

Line Frequency Range — 48 Hz to 66 Hz.

PHYSICAL CHARACTERISTICS

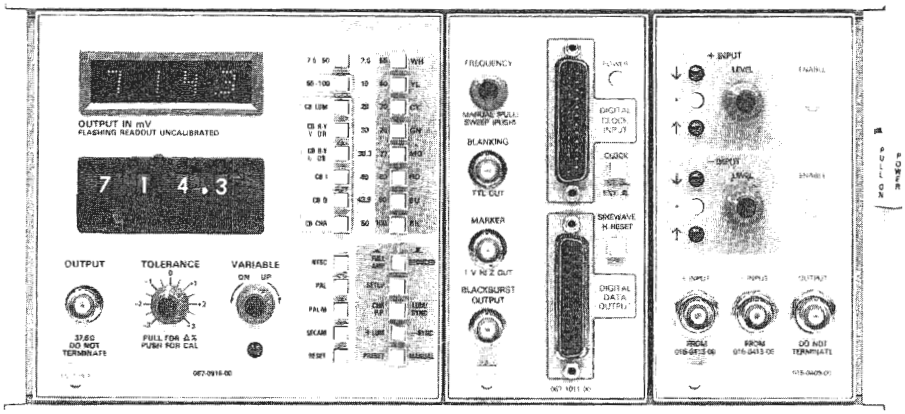
Dimensions	mm	in
Width	483	19.0
Height	44	1.7
Depth	429	16.9
Weights	**kg**	**lb**
Net	4.5	10.0
Shipping	7.2	16.0

ORDERING INFORMATION

1430 Random Noise Measuring Set (525/60).
Includes: One pair slide guide (351-0331-03); cover program front panel (200-1481-00); manual.

OPTION

Option 01 — Random Noise Measuring Set (625/50).



Video Amplitude Calibration Fixture, Digital Sweep Generator, and P-P Detector shown in a Tektronix TM 504 Mainframe.

Accurate calibration and verification of video equipment performance is essential for maintenance of optimum television system quality and thus signal quality.

New products, as well as calibration standards and procedures, have been developed to help provide accurate and NBS-traceable calibration and performance verification of Tektronix television products.

Video Amplitude Calibration Fixture

Provides a Standard Reference for Amplitude Calibration

Preset Values for Common Video Signals

NTSC, PAL, PAL-M, SECAM Compatible

The VAC (Video Amplitude Calibration Fixture) is a precision test fixture used in the measurement of common video signals and the calibration of video test signal generators and waveform monitors. It provides a simple means of measuring and calibrating luminance and chrominance amplitudes associated with most video signals.

The VAC provides a squarewave amplitude reference from 0.0 mV to 999.9 mV peak with a resolution of 0.1 mV and an accuracy of 0.05%. Signal amplitude may be selected using a four-digit front panel lever-switch or from over 500 preset values stored in EPROM. The VAC preset amplitudes are compatible with NTSC, PAL, PAL-M and SECAM television systems.

In the design of the VAC, careful attention was paid to thermal tilt to ensure accurate conversion from dc calibration to squarewave output. Unique choice of output impedance compensates loading effects when calibrating equipment with loop-through inputs.

The calibration of the VAC requires only a digital voltmeter with an accuracy of 0.01%.

The VAC operates in any of two compartments of the Tektronix TM 500 or TM 5000 Series power modules (except TM 501).

CHARACTERISTICS

Output Signal

Front Output Connector — 37.5 Ω; BNC connector located on front panel.

Rear Interconnect — 0.0 Ω; Rear edge connector pins 27A and 28A.

Amplitude Range (Tolerance Disabled) — 0 mV to 999.9 mV ±(0.05% +0.1 mV); p-p squarewave amplitude.

Amplitude Range (Tolerance Enabled) — 0 mV to 999.9 mV ±(0.5% +0.1 mV) + Tolerance reading; p-p squarewave amplitude.

Resolution — 0.1 mV.

Risetime — >1 μs.

Frequency — NTSC, PAL-M, 270 Hz nominal; PAL, SECAM, 275 Hz nominal.

ENVIRONMENTAL

Normal Operating Temperature — +15°C to +35°C.

Operating Temperature Range — 0°C to +50°C.

Weights — Net: 1.4 kg, (3.0 lb). Net Shipping: 4.5 kg, (10.0 lb).

ORDERING INFORMATION

Video Amplitude Calibration Fixture — Order 067-0916-00.

Includes: (±0.025%) 75 Ω Terminator (011-0102-01); 0.06% attenuator (011-0134-00); subcarrier harmonic rejection filter (015-0407-00); manual.

OPTIONAL ACCESSORY

Low Loss Cable 72 inch 75 Ω — Order 012-0159-01.

Peak-To-Peak Detector

NBS-Traceable Frequency Response Standard

Ultra Flat Response

Detector Amplifier Corrects Detector Diode Gain and Offset Errors

The 015-0408-00 Detector Amplifier, combined with a 015-0413-00 Detector Head, comprise an NBS-traceable peak-to-peak detector system for baseband video frequency response testing. This system allows precise comparison of sinewave amplitudes at frequencies throughout the video spectrum. Typical response is accurate to as low as ±0.02% (±0.002 dB).

The frequency response of an analog generator may be calibrated using the peak-to-peak detector system as a transfer standard. The generator may then be used as a frequency response transfer standard to calibrate frequency response and chrominance-luminance gain of test equipment such as waveform monitors and vectorscopes.

A second detector head may be ordered for differential measurements.

CHARACTERISTICS

Input Signal Range — 0.25 V to 1.0 V p-p.

Envelope Gain Unit — ±0.1% for 1% signal change.

Input Impedance — 75 Ω.

Frequency Response

Frequency	Peformance Requirements	Supplemental Information		
		Typical Response	Transfer Uncertainties	
			TEK	NBS
25 kHz	+0.1, −0.7%	+0, −0.25%	±0.05%	±0.01%
50 kHz	+0.1, −0.3%	+0, −0.1%	±0.05%	±0.02%
100 kHz	±0.1%	±0.05%	±0.05%	±0.02%
200 kHz	±0.1%	±0.02%	±0.05%	±0.05%
500 kHz	±0.1%	±0.02%	±0.05%	±0.05%
1 MHz	±0.0% (Reference)	±0.02%	±0.05%	±0.05%
2 MHz	±0.1%	±0.02%	±0.05%	±0.1%
5 MHz	±0.1%	±0.02%	±0.05%	±0.1%
10 MHz	±0.15%	±0.05%	±0.05%	±0.1%
20 MHz	±0.2%	±0.1%	±0.05%	±0.2%
30 MHz	±0.5%	±0.2%	±0.1%	±0.2%
50 MHz	±2.0%	±1.0%	±0.2%	±0.5%

ORDERING INFORMATION

Peak-to-Peak Detector — Order 015-0408-00.

Includes: Detector head and data sheet with NBS-traceability curves (015-0413-00); 72 inch low loss 75 Ω cable (012-0159-01); manual

OPTIONAL ACCESSORY

Extra Detector Head (For differential measurements) — Order 015-0413-00.

Digital Sweep Generator

Digitally Derived Sweep Signal

10 bit Digital Data for Use with 1900-Series Digital Test Signal Generators to Reconstruct Analog sweep

Frequency Range 55.9 kHz to 7.16 MHz Field Sweep or (Manually Adjustable) CW

The Digital Sweep Generator provides 10 bit, 14.31818 MHz, digital data words derived from a cosine lookup table. The output signal sweeps from 55.9 kHz to 7.16 MHz in each field with high spectral purity and amplitude accuracy when used with the DAC in a 1900 Series generator. A front panel connector provides SMPTE[1] compatible balanced eci data. Data is continuous through blanking so that it can be used with noncomposite video detectors. Sync and burst may be inserted by a 1900 Series generator using the blanking output on the DSG if desired. The Digital Sweep Generator may be locked to a 1900 Series generator using TRS and clock outputs from the 1900 Series generator. Alternatively, the 1900 Series generator may be genlocked to the black burst output from the sync generator in the Digital Sweep Generator. A separate marker output provides identification of 1 MHz intervals, as well as 3.58 MHz and 4.43 MHz, during the sweep.

The Digital Sweep Generator is enclosed in a single wide TM 500 package. The front panel includes an LED power indicator, two 25-pin digital data connectors, three BNC connectors for blanking, markers, and black burst outputs, and one variable control to manually set CW frequencies. Digital interfaces of the DSG conform to the signal levels, clock rate and pinout of the proposed SMPTE standard.

When the Digital Sweep Generator is used in conjunction with a 1900 and an 015-0408-00 peak-to-peak detector (included accessory), it will provide an NBS-traceable analog frequency response standard and completes an effort to provide NBS-traceable performance verification of Tektronix television generators, waveform monitors, and other television equipment.

[1] *The proposed SMPTE standard "Digital Format for a Parallel Interface (System M/NTSC)," draft of July, 1979.*

CHARACTERISTICS

Digital Sweep Output

Frequency Range — 55.93 kHz to 7.159 MHz in 55.93 kHz increments; Field Sweep, or CW digital data.

Format — SMPTE Standard parallel 10 bit signal.

Sample Clock Frequency — 14.31318 MHz (4 Fsc) ±100 Hz; also accepts external 14.3 MHz clock from 1900.

Blanking — Vertical: 22 lines to 23 lines. Horizontal: 10.8 μs.

Markers

1 V at 1.006747 MHz.
1 V at 2.013494 MHz.
1 V at 3.020241 MHz.
0.5 V at 3.579545 MHz.
1 V at 4.026988 MHz.
0.5 V at 4.418501 MHz.
1 V at 4.977805 MHz.
1 V at 5.984552 MHz.

Marker frequencies are multiples of 55.93 kHz.

ENVIRONMENTAL

Temperature Range — Operating: 0°C to +50°C. Nonoperating: −40°C to +65°C.

Altitude — Operating: To 4,752 m (15,000 feet). Nonoperating: To 15,240 m (50,000 feet).

Weights — Net: 0.6 kg (1.3 lb). Net Shipping: 1.3 kg (2.8 lb).

ORDERING INFORMATION

Digital Sweep Generator — Order 067-1011-00.

Includes: P-p detector (015-0408-00); ECL data cable assemblies (175-3671-00); 72 inch low loss 75 Ω cable (012-0159-01); manual.

OPTIONAL ACCESSORY

Detector head — Order 015-0413-00.

Test Modulator

High Quality Double-Sideband Modulator

Available in Five Versions Covering Systems M, I, B, and G

RF Output is −25 dBm ±3 dB

IF Output is −24 dBm ±3 dB

Separate Video and Aural Carrier Level Controls

Group Delay Precorrection Systems M, B, and G

The 1450 Series Test Modulator is used to test a television demodulator plus down converter (system) or the television demodulator alone. Test modulators are available for four CCIR Systems and three visual IF Carrier Systems. The Test Modulator converts baseband video frequencies to a specified IF or RF. The aural carrier is below the visual carrier frequency at the IF output and above the visual carrier at the RF output.

Group delay pre-correction and sound pre-emphasis switches are front panel mounted. The RF and IF outputs provide double-sideband modulated signals of high quality. State-of-the-art circuitry is used to achieve high accuracy and stability. The test modulator needs very little maintenance or recalibration.

ORDERING INFORMATION

TEST MODULATORS

Test Modulator (37 MHz for 1450-1) — Order 067-0886-01.

Test Modulator (38.9 MHz for 1450-2) — Order 067-0886-02.

Test Modulator (45.75 MHz for 1450-1) — Order 067-0886-03.

Test Modulator (38.9 MHz for 1450-2) — Order 067-0886-04.

Test Modulator (38.9 MHz for 1450-3) — Order 067-0886-05.

Extender Cable (for TDC/1450-1, -2, -3) — Order 067-0899-00.

Other Calibration Fixtures for Tektronix Television Products.

ORDERING INFORMATION

Diagnostic Prom — Order 067-0964-00.

Pattern Generator — Order 067-1039-00.

Tektronix Calibration Fixtures (067-XXX-0X part numbers) are designed for calibration and verification of specific products. Some fixtures may not be supported at the same level as standard Tektronix products. Your local Tektronix sales office can advise you regarding availability and support.

ADAPTORS

BNC Male — From Left to Right

	Order Part No.
—to UHF Female	103-0032-00
—to GR	017-0064-00
—to N Female	103-0058-00
—to Binding Post	103-0033-00
—to Dual Binding Post	103-0035-00
—to F Female (Not Shown)	103-0126-00

BNC Female — From Left to Right

	Order Part No.
—to UHF Male	103-0015-00
—to GR	017-0063-00
—to N Male	103-0045-00
—to EZ Clip Leads (Not Shown)	013-0076-01
—to Alligator Clip Leads	013-0076-00
—to Dual Banana (Not Shown)	103-0090-00
—to F Male (Not Shown)	103-0158-00
—to UHF Male (Not Shown)	103-0015-00
—to SMA Male (Not Shown)	015-1018-00

BNC to BNC

	Order Part No.
—Female to Female	103-0028-00
—Male to Male	103-0029-00
—T	103-0030-00
—Elbow, Male to Female	103-0031-00

BNC CABLES

Coaxial

	Order Part No.
50 Ω, 10 in	012-0208-00
50 Ω, 18 in	012-0076-00
50 Ω, 18 in, Male to Female	012-0104-00
50 Ω, 36 in, Precision	012-0482-00
50 Ω, 42 in	012-0057-01
50 Ω, 72 in	012-0113-00
75 Ω, RG59, 42 in	012-0074-00
75 Ω, 72 in	012-0113-01
75 Ω, 300 in (25 ft)	012-0157-00
75 Ω, Belden 8281, (72 in)	012-0159-01
75 Ω, Belden 8281, (42 in)	012-0159-00

MISC. INTERCONNECT CABLES

	Order Part No.
110S to 110RC, 6 ft	174-0201-00
1910 to RCU, 6 ft	012-0108-00
1910 to RCU, 22 ft	012-0251-00
118AS to 118RC, 4 ft	012-1133-00
1440 to RCU/RMU, 6 ft	174-0201-00
1720 to 1730, 12 in	174-0183-00
1720 to 1730, 18 in	174-0183-01

TERMINATIONS, ATTENUATORS

75 Ω termination, accuracy measured at dc.
Return loss is ≥52 dB, dc to 10 MHz.

	Order Part No.
BNC, End Line, 75 Ω ±0.2%	011-0102-00
BNC, End Line, 75Ω ±0.025%	011-0102-01
BNC, Feed-Through, 75 Ω ±0.2%	011-0103-02
50 Ω to 75 Ω Minimum Loss Attenuator	
—DC Coupled	011-0057-01
—AC Coupled	011-0112-00
50 Ω, 2.5X Attenuator	011-0076-02
50 Ω, 2X Attenuator	011-0069-02
50 Ω, 5X Attenuator	011-0060-02
50 Ω, 10X Attenuator	011-0059-02
75 Ω, 10X Attenautor	011-0061-00
DC Block, BNC	015-0221-00

NOISE MEASUREMENT FILTERS

	Order Part No.
Low Pass 4.2 MHz (525/60)	015-0212-00
Low Pass 5.0 MHz	015-0213-00
Low Pass 6.0 MHz 625/50	015-0220-00

CCIR recommendation 568 — Provides for measuring signal-to-weighted random noise on all international transmissions (both 525/60 and 625/50) with a 5.0 MHz low pass filter and a unified noise weighting filter.

Unified Noise Weighting Network	015-0283-00
Noise Weighting 4.2 MHz (525/60)	015-0214-00
Noise Weighting 5.0 MHz (625/50)	015-0215-00

OTHER FILTERS

	Order Part No.
75 Ω X5 Chroma Step Up Termination	
—for 520A, 1780R	011-0100-01
—for 521A, 1781R	011-0109-00
75 Ω X2 Chroma Step Up Termination	
—for 521, 521A, 1781R	011-0108-01
250 kHz Low Pass Filter	105-0352-00
Subcarrier Harmonic Rejection Filter	015-0407-00
Video Staircase Differentiator	015-0154-00

CAMERAS

C-4 Camera
Includes: Body, Pistol Grip (122-0901-00); hood (122-0894-01); operator manual (070-5000-01).

C-5C Camera
Includes: Adaptor hood (016-0357-01); flash unit (016-0642-02); instruction manual (070-2824-00).

C-7 Camera with Flash
Includes: Adaptor hood (016-0357-01); print holding chamber (122-1039-00); circuit board covers for 0.67 mag (200-3074-00); for 0.87 mag (200-3031-00); operator manual (070-5127-00).

C-30BP Camera
Includes: Polarcid pack film back (122-0752-02); split-image focus plate (387-0893-02); mounting adaptor (016-0306-01); instruction manual (070-2825-00).

Option 01 — Expanded Field of View
Includes: Same as C-30BP except it comes with 016-0269-03 mounting adaptor instead, plus corrector lens (352-0341-01).

C-53P Camera
Includes; Mounting adaptor for all 7000, 5000, and small 600 Series (016-0249-06); camera visor (337-0411-02); Polaroid film back (122-0926-02) with a focus plate (387-0893-02); instruction manual (070-1011-03).

C-59AP Camera
Includes: Mounting adaptor for all 7000, 5000, and small 600 Series (016-0249-06); camera visor (337-0411-02); Graflock film back (122-0931-01) with integral focusing screen; instruction manual (070-3632-00).

("P" denotes that the camera has a 3 in. x 4 in. pack film back. All models include Polaroid pack film back.)

CAMERA ADAPTERS

	Order Part No.
C4	
—to 528A, 1420 Series	122-0895-01
—to 1700 Series, WFM300A, 760	122-0894-01
C5C, C7	
—to 528A, 1420 Series	016-0357-01
—to 1700 Series, WFM300A, 760	016-0359-01
C5, C53, C59AP, C27, C28	
—to 520A Series	016-0295-01
—to 1480 Series	016-0342-00
—to 528A, 1420 Series	016-0249-06
—to 529	016-0224-01
C30BP, C31BP	
—to 528A, 1420 Series	016-0248-02
—to 1700 Series, WFM300A, 760	016-0269-03

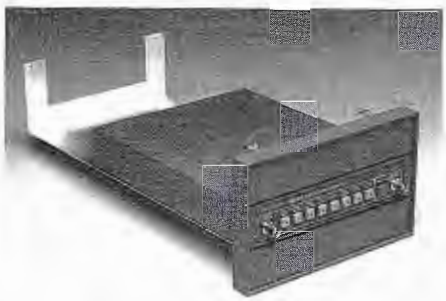
MISC. ACCESSORIES

BP1 Battery Pack

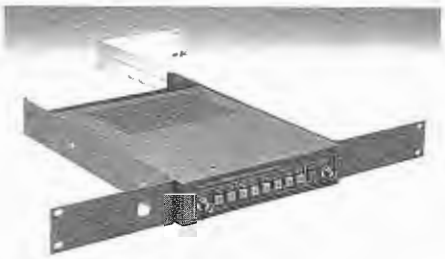
Attaches to 1700F02 portable case. Provides 12 VDC power to 1705, 1710, 1720, 1730, 760 Series monitors equipped with 1700F10 power converters, or 1740 Option 07. Requires automatic charger (not available from Tektronix), providing 3 to 4 amps charging current at 30 V.

	Order Part No.
Viewing Hood	
—for 1700 Series	016-0475-00
—for WFM300A	016-0726-01
10X Probes, for 1480 Opt. 1, 1780	
—2 meter	P6108A
—1 meter	P6108A Opt. 1
—3 meter	P6108A Opt. 2
Front Cover	
—for 1700 Series, WFM300A, 760	200-1566-00
—for 1780	200-3694-00
Mounting Cradle for WECO Racks	
—for 1480R Series	426-0309-00
—for 520A Series	426-0667-00
Blank Front Panel, Single Width	
—for 1410, 1411, 1412	333-2171-00

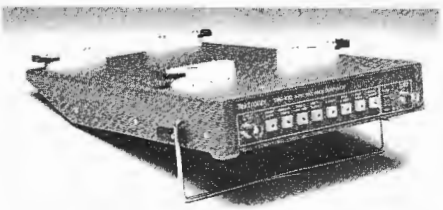
MOUNTING KITS
FOR USE WITH THE TSG100



Hardware for mounting in a 1700F02 or 1700F05 — Order TVGF10.



Hardware for mounting in a 1.75 inch high/19.0 inch wide rack space — Order TVGF11.

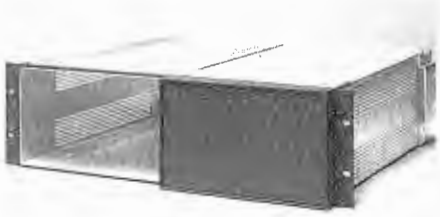


Adapter for mounting to the bottom of a 1700F02 carrying case — Order TVGF12.

FOR USE WITH HALF RACK WIDTH SIGNAL MONITORS, VECTORSCOPES, AND WAVEFORM/VECTOR MONITORS

Painted Metal Case — Order 1700F00.

Painted Carrying Case (Portable case with handle and feet) — Order 1700F02.



Rack Adapter — For side-by-side mounting of half rack width instruments. Order 1700F05.

Blank Panel Assembly — For one half of the side-by-side rackmount. Order 1700F06.

MISC. CONVERSION KITS

	Order Part No.
140 Series Instruments	
Cabinet-to-Rackmount Kit	040-0574-03
Rackmount-to-Cabinet Kit	040-0768-00
520A Series Instruments	
Cabinet-to-Rackmount Kit	040-0491-03
Rackmount-to-Cabinet Kit	040-1153-00
528 Series Instruments	
Internal NTSC Graticule Kit	
—Early S/N (Before B238840)	040-1219-00
—Late S/N (B238840 and later)	040-1220-01
Internal PAL Graticule Kit	
—Early S/N (Before B238840)	040-1221-00
—Late S/N (B238840 and later)	040-1222-00
650HR Series Instruments	
Analog Component Input Kits to display GBR, SMPTE Parallel, MII or Betacam signals	
—for the 650HR Kit	040-1293-00
—for the 651HR Kit	040-1294-00
—for the 655HR Kit	040-1295-00
1410 Series Instruments	
Rackmount-to-Cabinet Kit	040-1152-00
TSG1 to TSG7 (SMPTE Bars) Kit	040-1010-01
Options AA and AB add functions and specifications to maximize the utility of your 1410 or 1411 in a calibration lab environment	
Option AA, AB Kit for 1410	040-0260-01
Option AA, AB Kit for 1411	040-0264-02
1450 Series Instruments	
Wideband Audio Kit suitable for use with the North American BTSC audio Standard (1450-1 only)	1450F20
Audio Kit for use with the System I NICAM 728 audio standard (1450-3 only)	1450F3A
1480 Series Instruments	
Option 1, Scope Probe Input Kit	040-0796-04
Variable Horizontal Magnifier Kit	040-0824-02
Tangential Noise Measurement Kit	1480F30
1700 Series Instruments	
2 dB/10 dB Selectable Sensitivity Kit	
—for the 1705	040-1244-00
Option 16, 90/100 Hz Sweep Rate Kit	
—for the 1730 or 1731	040-1271-01
—for the 1740, 1741, or 1742	040-1270-00
Forced Air Cooling Kit	
—for the 1750 or 1751	040-1260-01
DC Power Operation Kit	
—for the 1705, 1710B, 1711B, 1720, 1721, 1730, 1731, 1735, and 760	1700F10
Dual Display Upgrade Kit	
—for the 1750	040-1178-03
—for the 1751	040-1179-03
1780 Series Instruments	
Rackmount-to-Cabinet Kit	1780F02
1980 Series Instruments	
PROM Formatter Kit	020-0994-00
Dual Standard Patch PROM Kit	
—for use with Options 2 & 3	020-0967-00
Option 1, Patch PROM Kit	020-1004-00
Option 12, AutoCall Kit	040-1104-00

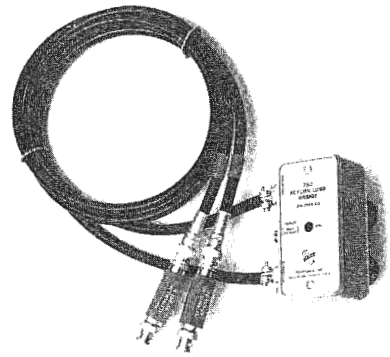
MISC. CONVERSION KITS (continued)

	Order Part No.
TSG Series Instruments	
Option 1, Color Bars, ID and Audio Tone Kit	
—for TSG170A and SPG170A	TVGF01
—for TSG271 and SPG271	TVGF02
Ten Bit Signal PROM Kit	
—for TSG422	TVGF03
10.9 μsec Horizontal Blanking Kit	
—for TSG170A	040-1298-00
—for SPG170A	040-1299-00
Power Cord,, Snap Lock Adapter Kit	
Snap Lock Adapter Kits are compatible with most Tektronix Television instruments introduced after 1984	
—for North American	040-1185-00
—for Europe	040-1186-00
VM700 Series Instruments	
Cabinet-to-Rackmount Kit	VM7FR1
Rackmount-to-Cabinet Kit	VM7FC1

TEST ACCESSORIES

	Order Part No.
Extender Boards/Cables	
—for use with 1740	670-7980-00
—for use with 1740, 1750, WFM300A	670-7981-00
—for use with 1410, 1411, 1412	670-4441-02
—for use with TDC, TDC1, TDC2	067-0899-00
—for use with 1450-1, 1450-2, 1450-3	670-5034-00
—for use with 110S, 118AS	670-7754-00
—for use with 1750, TSG6/16/26	067-0709-00
—for use with 1780, 1781	016-1011-00
—for use with TM500/TM5000 Compatible Instruments	067-0645-02
Connector Plugs	
9 pin, D, Male	131-1007-00
9 pin, D, Female	131-1006-00
9 pin, D, Cover	200-1170-00
15 pin, D, Male	131-0459-00
15 pin, D, Female	131-0458-00
15 pin, D, Cover	200-1666-00
24 pin, Male	131-2180-00
24 pin, Female	131-0346-01
25 pin, D, Male	131-0569-00
25 pin, D, Female	131-0570-00
25 pin, D, Cover	200-1667-00
36 pin, Male	131-0293-00
36 pin, Female	131-0294-00
Miscellaneous	
BNC "T" Cable Assembly	067-0525-02
Accessory Housing	011-0081-00

75 Ω RETURN LOSS BRIDGE



This Return Loss Bridge is compact and rugged. It features passive components and simple construction. It is designed to measure impedance errors in a 75 Ω system in terms of return loss, using a wide-band, high-gain differential amplifier and oscilloscope (Tektronix 7A13/7000 Series) as the error detector. The Tektronix 011-0103-00 and 011-0103-01 are 75 Ω, 0.2% double-ended termination resistors supplied as removable bridge arms. Two matched coax cables extend the bridge arms and are permanently attached to the bridge. Either or both bridge arms can be disconnected for maximum flexibility, during calibration and in making measurements.

The bridge can be driven by a number of different sources such as TV test signals, squarewaves, sinewaves, $\sin^2$ pulses, multiburst, swept frequency sinewaves. With the Return Loss Bridge coupled to the differential amplifier and oscilloscope, a television test signal such as the multi-burst can be used to measure impedance errors over the complete video spectrum with a single measurement.

CHARACTERISTICS

Return Loss — ≥ 54 dB, dc to 10 MHz.

Maximum Input Voltage — 6 V RMS (6 V RMS, dc to 1.2 MHz decreasing to 0.7 V RMS at 10 MHz when used with 7A13).

Return Loss Bridge — Order 015-0149-00

SERVICE TEK NOTES

Tektronix makes periodic technical information about its products available to customers that have elected to maintain their own Tektronix products. The information contains hints about maintenance techniques, product upgrades and product applications.

This information is published quarterly, is free of charge, and can be obtained by making a request for SERVICE TEK NOTES through your local Tektronix Sales Engineer.

SERVICE TEK NOTES can also be obtained by contacting the editor directly at:

Tektronix, Inc.
Del. Sta. 94-887
P.O. Box 4600
Beaverton, OR 97076-9958

QUALITY SERVICE OFFERINGS FOR YOUR TEKTRONIX TELEVISION PRODUCT

Full Spectrum of Support

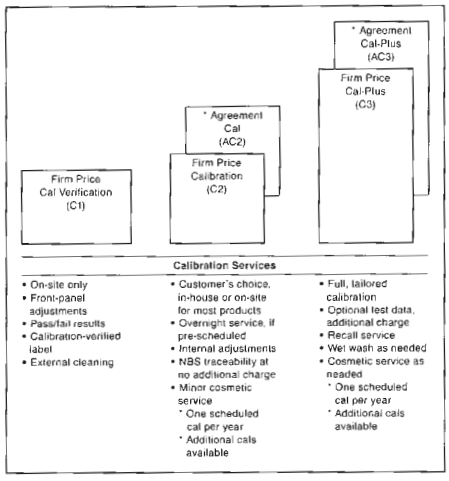
Our calibration and repair services provide you with a full spectrum of support for your Tektronix Television product. We believe you should be able to choose the services you need. For this reason, we have divided our offerings into categories: calibration, repair, a combination of both, or additional services such as time-and-material, and instrument repair. You choose how much and what type of coverage you want.

Warranty Coverage

Every new serialized Tektronix product is warranted against defects. Depending on the product, this warranty period ranges from three months to three years.

Calibration Services

Whatever your calibration needs, Tektronix has an offering to match. With three plans to choose from, you can receive calibration, overnight service, test data, wet washes, and cosmetic services. NBS traceability is available on request.

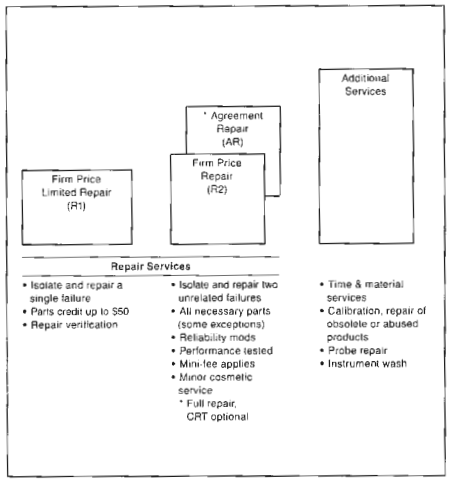


Repair Services

Depending on the service level, repair services include parts, performance testing, cosmetic repair, CRT and system accessories repair, and custom modifications.

Calibration and Repair Services

Get the best service possible when you purchase an offering which includes both calibration and repair services. Often when an instrument needs repairs, it also needs a calibration. Our three combination calibration and repair offerings make it economical and efficient for us to perform both tasks at once.



Additional Services

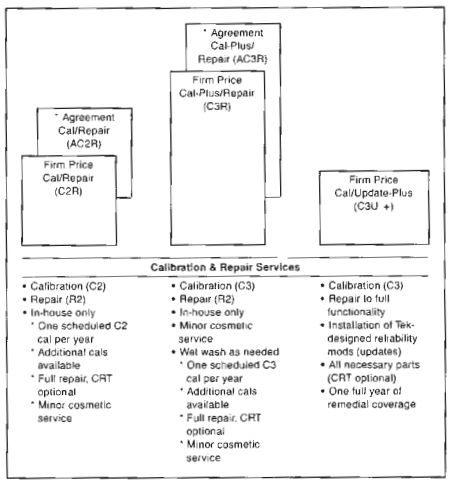
If your product is more than nine years old or does not qualify for coverage under a service agreement, you can choose time-and-material coverage. In addition to repairing your product, we can replace your CRT or system accessories.

Tektronix Maintenance Agreements

A Tektronix Maintenance Agreement provides you with more than one, two or three years of service coverage. It gives you improved product uptime, tighter control over your costs, priority service, and reduced paperwork.

Tektronix Warranty Plus

Extend your instrument repair coverage with a Warranty Plus agreement available at time of purchase. This offering allows you to establish up-front operating costs for 1, 2, or 3 years.



Service Commitment

Every maintenance agreement comes with a commitment from Tektronix. A commitment to thoroughly examine and replace marginal parts before they fail, to quickly respond to your service needs, and to provide you with engineering updates when they are released.

Tektronix' service commitment begins as soon as your product is shipped, and continues for the life of your product.

Not only are our repairs warranted for 90 days, but we maintain an extensive inventory of replacement parts and components, continually train our Service Technicians and use the latest diagnostic and test techniques to quickly analyze and repair your products. With over forty years of experience, Tektronix knows how to keep your products operating at optimum performance.

Nationwide Network of Service Centers

Contact your Tektronix Sales Representative or local Service Center for more information on Tektronix service, maintenance agreements and offerings. Sales and Service Centers that specialize in Television Products are highlighted on the US Sales Office listing in this catalog.

Tek Service:
Keep a good
thing going.

HARDWARE WARRANTY SUMMARY

Tektronix warrants to its Customers that the products that it manufactures and sells will be free from defects in materials and workmanship for the periods set forth in the table below. If any such product proves defective during the applicable warranty period, Tektronix, at its option, either will repair the defective products without charge for parts and labor or will provide a replacement in exchange for the defective products.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Tektronix will provide such service at Customer's site for certain categories of products, as indicated in the table below, if Customer's site is within the normal on-site service area. Tektronix will provide on-site service outside the normal on-site service area only upon prior agreement and subject to payment of all travel expenses by Customer. In all other cases, Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the service center is located. Customer shall be responsible for paying all shipping charges, duties and taxes, if the product is returned to any other location. The locations at which the services will be provided for different categories of products or product groups are set forth below.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; or c) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THE LISTED PRODUCTS IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE A DEFECTIVE PRODUCT IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

PRODUCT CATEGORIES	WARRANTY PERIOD	SERVICE LOCATION
Oscilloscopes (except 7250 and 2200, 2300, 2400 Series); TM 500/TM 5000 Series; Communications Network Analyzers (except 834, 835, 836); Logic Analyzers (except 9200 Series and LV Series); Spectrum Analyzers (except 3052); Television Products (except 1980 and 650 Series); Waveform Digitizers; Curve Tracers; Photometers/Radiometers; Cameras; Carts (except K217S, K318); Probes; CRTs; Isolators; Test System Interface Series; PEP Systems Controllers; Personal Test Systems	1 year from date of shipment	Service Center designated by Tektronix
Oscilloscopes: 2200 (except 2205), 2300, 2400 Series, Communications Network Analyzers: 834, 835, 836; Television Products; 650 Series	3 years from date of shipment	Service Center designated by Tektronix
Monitors: 606B, 608, 620, 634	3 months, except 1 year from date of shipment for CRT	Service Center designated by Tektronix
All 4000 Series: Graphics Workstations, Color Graphics Terminals (except those listed below), Color Graphics Output Systems, Graphics Tablets; Monitors: GMA201; 4041 Controller; Microprocessor Development Products (except V systems, MV Systems); Spectrum Analyzers: 3052; Television Products: 1980; Logic Analyzers: 9200 Series, LV Series	3 months, except 1 year from date of shipment for CRT	Customer's site if within normal on-site service area
Color Graphics Terminals: 4205, 4207, 4208, 4209; Graphics Netstation: 4211; Oscilloscopes: 7250	1 year from date of shipment	Customer's site if within normal on-site service area
Custom Test Systems; Semiconductor Test Systems: Microprocessor Development Products: V Systems, MV Systems	3 months, except 1 year for CRT, beginning on the date of installation by Tektronix, or one month from date of shipment, whichever is earlier	Customer's site if within normal on-site service area
Parts, Assemblies, Supplies and Test Fixtures: All 9-digit part numbered items except Probes, CRTs: K217S, K318	3 months from date of shipment	Service Center designated by Tektronix
Service	3 months from date of shipment or date of completion if performed on-site	Location where original service was performed

U.S. GENERAL TERMS OF SALE

Credit and Payment Terms

Tektronix, Inc. offers many different terms of sale in order to meet varied purchasing objectives and to assist in financial planning.

Credit accommodations must be arranged with Tektronix' Credit Department. Orders and request for credit accommodations should be placed with your local Tektronix Sales Office, listed on page 91 of this catalog.

If, in the judgment of Tektronix, the financial condition or payment record of the Buyer at any time does not justify shipment of order on the payment terms requested, Tektronix may refuse to ship unless it receives payment in advance, or at its option, payment upon delivery of equipment. Businesses established six months or less may not meet minimum requirements for extended and/or installment terms of sale.

The following terms may be arranged with a Tektronix Sales Office:

Net 30 Days Standard Terms

Standard terms of sale are Net 30 days following the date of invoice. There are no discounts for early payment.

60, 90 and 120 Days Extended Terms of Sale

Extended terms of 60 to 120 days are available on the same single payment basis as standard terms. Since the cost of extended terms is not included in catalog prices, a service chage is added to the invoice. The amount of the service charge depends upon the number of days the terms are extended. Request for extended terms must be made at the time of order placement.

Minimum Order

The minimum acceptable order is $25.00.

Shipment

All prices, quotations, and shipments are FOB Beaverton, Oregon, unless otherwise specified.

Unless otherwise specified, shipment will be made via most economical method and air shipments will be insured at full valuation unless your order instructs otherwise.

INTERNATIONAL — CONTACT YOUR LOCAL TEKTRONIX SUBSIDIARY OR DISTRIBUTOR.

ACTIVE VIDEO LINES

All video lines not occurring in the vertical blanking signal.

APL

The average signal level, with respect to blanking level, during the active picture scanning time expressed as a percentage of difference between blanking and reference white (IEEE Def).

BACK PORCH

That portion of the composite video signal lying between the trailing edge of the horizontal sync pulse and the trailing edge of the horizontal blanking pulse.

BLANKING LEVEL

The level of the composite picture signal separating the range containing picture information from the range containing synchronizing information (IEEE Def).

BREEZEWAY

The portion of the back porch between the trailing edge of the sync pulse and the start of the color burst.

BTSC MULTICHANNEL SOUND

Multichannel (stereo) television system used in the United States (Broadcast Television Systems Committee).

BURST FLAG

A keying or gating signal used in forming the color burst from a chrominance subcarrier source (IEEE Def).

B-Y

A color difference signal obtained by subtracting the luminance signal from the blue camera signal. It is ploted on the 0° to 180° axis of a vector diagram.

CHROMINANCE SIGNAL

That portion of the color television signal containing the color information (STOC Def).

COLOR BAR

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

COLOR BURST

In color systems, a burst of subcarrier frequency located on the back porch of the composite video signal. This serves as a color synchronizing signal to establish a frequency and phase reference for the chrominance signal.

COLOR GAMUT

The entire range of values a component signal or combination of component signals may take on that are reproducible at the display device. Some component formats are interdependent (Y, R-Y, and B-Y) and the valid color gamut cannot be evaluated by looking at a single component alone.

COLOR SUBCARRIER

In color systems, the carrier signal whose modulation sidebands are added to the monochrome signals to convey color information.

COMPONENT

The fundamental electrical signal for producing video images. Three of these signals are needed for color video and the term component is used to indicate one considered alone. The signals may be in digital or analog form. They may be in the combination of Red, Green and Blue or they may be in some other form such as Luminance, R-Y, and B-Y. In general the RBG signals can be arithmetically combined into any three components and decoded at the display device into the RGB components necessary to make the color picture.

COMPOSITE BLANKING

The complete television blanking signal, composed of both line rate and field rate blanking signals (see also Line Blanking and Field Blanking).

COMPOSITE SYNC

The combined line and field rate synchronizing pulses (including field equalizing pulses).

COMPOSITE VIDEO

The color picture signal plus blanking and all synchronizing signals (STOC Def).

CONVERGENCE

In color television, the meeting or crossing of the three electron beams at the phosphor screen.

CROSSHATCH

A test pattern consisting of vertical and horizontal lines used for converging color monitors and cameras.

DIFFERENTIAL GAIN

The difference in output amplitude (expressed in percent or dB) of a small high frequency sinewave signal at two stated levels of a low frequency signal on which it is superimposed (IEEE Def).

DIFFERENTIAL PHASE

The difference in output phase of a small high frequency sinewave signal at two stated levels of a low frequency signal on which it is superimposed (IEEE Def).

EIA

An abbreviation for Electronic Industries Association.

EQUALIZING PULSES

Pulses of one half the width of the horizontal sync pulses transmitted at twice the rate of the horizontal sync pulses during the portions of the vertical blanking interval immediately preceding and following the vertical sync pulse. These pulses cause the vertical deflection to start at the same time in each interval, and also keep the horziontal sweep circuits in step during the portions of the vertical blanking interval immediately preceding and following the vertical sync pulse.

FIELD

One of the two (or more) equal parts of information in which a frame is divided in interface scanning.

FIELD BLANKING

The blanking signals occurring at the end of each field used to make the vertical retrace invisible. Also called vertical blanking.

FIELD FREQUENCY

The number of complete fields scanned per second.

FRAME

One complete picture consisting of two (or more) fields of interlaced scanning lines.

FRONT PORCH

That portion of the composite picture signal lying between the leading edge of the horizontal blanking pulse and the leading edge of the corresponding horizontal sync pulse.

H RATE

The number of complete horizontal lines, including trace and retrace, scanned per second.

HORIZONTAL DRIVE

A pulse at horizontal rate used in TV cameras. Its leading edge is coincident with the leading edge of the horizontal blanking pulse, and the trailing edge is coincident with the trailing edge of the horziontal sync pulse (NTSC only).

HUE

The attribute of color perception that determines whether the color is red, yellow, green, blue, etc.

IRE

An abbreviation for Institute of Radio Engineers. An "IRE" unit is 1% of the voltage from blanking to peak white in the video signal.

IRE SCALE

An oscilloscope scale that applies to composite video levels. Typically there are 140 IRE units in one volt (1 IRE = 7.14 mV).

–I, W, Q, B

An NTSC test signal used to check television broadcast equipment. It consists of a –I signal followed by a white bar, then a Q signal and a black level on each line.

LINE BLANKING

The blanking signal at the end of each horizontal scanning line. Used to make the horizontal retrace invisible. Also called horizontal blanking.

LINE FREQUENCY

The number of horizontal scans per second, normally 15,734.26 times per second for NTSC color systems.

LISSAJOUS PATTERN

The looping patterns generated by a CRT spot when the horizontal (X) and vertical (Y) deflection are sinusoids. These patterns are very useful for evaluating the delay or phase of two sinusoids of the same frequency. A more general definition would allow XY deflection with more complex signals such as video components. The resulting Lissajous patterns would then be very useful for evaluating the interdependence of the signals as required for color gamut measurements.

LUMINANCE

The amount of light intensity perceived by the eye as brightness (referred to as "Y").

NTSC

National Television Systems Committee. An industry-wide engineering group which, during 1950-1953, developed the color television specifications now established in the United States.

PRO

Professional channel in the BTSC system used for data or voice communications.

QUADRATURE COMPONENT

The measure of change in visual carrier phase resulting from a change in video level.

R-Y

A color difference signal obtained by subtracting the luminance signal from the red camera signal. It is plotted on the 90° to 270° axis of a vector diagram.

SAP

Second Audio Program channel in the BTSC system. Normally used for a second language.

SATURATION

Indicates to what degree a color is not diluted by white light.

SETUP

The separation in level between blanking and reference black levels.

STAIRCASE

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

SYNC

An abbreviation for "synchronization," "synchronizing," etc. Applies to synchronization signals, or timing pulses, which lock the electron beam of the picture monitors in step, both horizontally and vertically, with the electron beam of the pickup tube. The color sync signal (NTSC) is known as the color burst.

TIME CODE

A digital or binary code used to label each frame of a video signal. This is very useful for editing the video since the time code is in the form of hours, minutes, seconds and frames.

TIME CODE SYNC WORD

A binary word that is used to synchronize the time code decoder or reader for proper identification of the data words. This sync word is visible on an oscilloscope display of audio time code as a fine structure band about 5 μsec in duration at the end of the video frame.

VERTICAL BLANKING INTERVAL

The blanking portion at the beginning of each field. It contains the equalizing pulses, the vertical sync pulses and VITS (if desired).

VITS

Vertical Interval Test Signal. A signal that may be included during the vertical blanking interval to permit on-the-air testing of the video system.

US SALES AND SERVICE OFFICES TEK

For our customers' convenience, Tektronix employs a group of select sales managers who specialize in the requirements of the television industry.

Located in key offices throughout the United States, they are available to assist you with additional information in the form of literature, demonstrations, or educational seminars.

See the highlighted *television offices listed below to locate the Tektronix Television Sales Manager nearest you.

ALABAMA

* **Huntsville**
Jim Edwards
TV Sales Manager
4900 Corporate Drive Suite H
Huntsville 35805
Phone: (205) 830-9212
FAX: (205) 837-2666

ALASKA
(Served by the Seattle, Washington field office)

ARIZONA

Phoenix
3015 S. 48th Street, Suite 100
Tempe 85282
Phone: (602) 438-1011
FAX: (602) 437-9210
Mailing Address:
P.O. Box 29540
Phoenix 85038
Tucson Area:
(602) 298-4860

ARKANSAS
(Served by the Oklahoma City, Oklahoma Field Office)

CALIFORNIA

* **Concord**
John Nielsen
TV Sales Manager
3451 Vincent Road
Pleasant Hill 94523
Phone: (415) 932-4949
From Oakland/San Francisco:
(415) 254-5353
From Sacramento: (916) 447-5072
From Fremont/Milpitas: (415) 490-7067
From Livermore: (415) 449-5176
FAX: (415) 932-8596
Mailing Address:
P.O. Box 4040
Concord 94524-2040

Manhattan Beach
3601 Aviation Blvd., Suite 1200
Manhattan Beach, 90266
Phone: (213) 643-6605
FAX: (213) 643-9439

* **Irvine**
Chris Davies
TV Sales Manager
17052 Jamboree Blvd.
Irvine 92714
Phone: (714) 660-8080
TELEFAX: (GP 1) (714) 660-8080 X311
FAX: (714) 474-1490
Mailing Address:
P.O. Box 19523
Irvine 92713

* **Los Angeles**
Tom Weems
TV Sales Manager
21300 Erwin Street
Service Center:
21220 Erwin Street
Woodland Hills 91367
Phone: (818) 999-1711
FAX: (818) 340-9840
Mailing Address:
P.O. Box 8500
Woodland Hills 91365

San Diego
5770 Ruffin Road
San Diego 92123
Phone: (619) 292-7330
FAX: (619) 292-7864

Santa Clara
3003 Bunker Hill Lane
P.O. Box 58086
Santa Clara 95052-8086
Phone: (408) 496-0800
TELEFAX: (GP 1) (408) 496-0800 X137
FAX: (408) 988-6051

COLORADO

* **Denver**
John Kelley
TV Region Sales Manager
393 Inverness Drive South
Englewood 80112
Phone: (303) 799-1000
Telex: (Infocom) 45-4455
FAX: (303) 790-4754

CONNECTICUT

Milford
40 Commerce Park Road
Milford 06460
Phone: (203) 877-1494
FAX: (203) 877-7201

DELAWARE
(Served by the Baltimore, Maryland and Philadelphia, Pennsylvania field offices)

DISTRICT OF COLUMBIA
(See MARYLAND)

FLORIDA

Fort Lauderdale
2003 N.W. 62nd Street, Suite 102
(known as) Cypress Creek Road
Fort Lauderdale 33309
Phone: (305) 771-9700
From Miami: (305) 947-6053
Also serves Puerto Rico and
U.S. Virgin Islands

* **Orlando**
Dave Walters
TV Sales Manager
12051 Corporate Blvd.
Orlando 32817
Phone: (407) 249-1600
From the Cape Canaveral Area:
(407) 636-0343
FAX: (407) 277-4723

Pensacola
4700 Bayou Blvd., Bldg. 1
Pensacola 32503
Phone: (904) 476-1897

GEORGIA

* **Atlanta**
Paul Hogan
TV Sales Manager
Technology Park/Atlanta
650 Engineering Drive
Norcross 30092
Phone: (404) 449-4770
Mailing Address: P.O. Box 6500
Norcross 30091
FAX: (404) 449-0358

HAWAII

* **Honolulu**
Eran Agmon
TV Sales Manager
320 Ward Avenue, Suite 111
Honolulu 96814
Phone: (808) 523-5817
FAX: (808) 523-7595
Hawaii Service Center
3049 Ualena St., Suite 1005
Honolulu, Hawaii 96819
Phone: (808) 831-0020

IDAHO

(Served by the Seattle, Washington and Salt Lake City, Utah field offices)

ILLINOIS

* **Chicago**
Mel Infanzon
TV Sales Manager
5350 Keystone Court
Rolling Meadows 60008
Phone: (312) 259-7580
TELEFAX: (GP 1) (312) 259-7580
FAX: (312) 259-8388

INDIANA

* **Indianapolis**
Steve Brant
TV Region Sales Manager
Paul Raymond
TV Sales Manager
8751 Wesleyan Road
Indianapolis 46268
Phone: (317) 872-3708
FAX: (317) 875-0661

IOWA

(Served by the Chicago, Illinois and Kansas City, Kansas field offices)

KANSAS

Kansas City
10513 West 84th Terrace
Lenexa 66214
Phone: (913) 541-0322
FAX: (913) 541-8039
Omaha, Lincoln, Wichita
Enterprise 6537

KENTUCKY

(Served by the Dayton, Ohio; St. Louis, Missouri; and Indianapolis, Indiana field offices.

LOUISIANA

(Served by the Houston, Texas and Dallas, Texas field offices)

MAINE

(Served by the Boston, Massachusetts field office)

MARYLAND

Baltimore
102 Lakefront Dr.
Cockeysville 21030
Phone: (301) 771-6400
FAX: (301) 771-1430

* **DC**
Jim Capps
TV Sales Manager
700 Professional Drive
P.O. Box 6026
Gaithersburg 20877
Phone: (301) 948-7151
FAX: (301) 921-0461

MASSACHUSETTS

* **Boston**
Tom Christenson
TV Sales Manager
482 Bedford Street
Lexington 02173
Phone: (617) 861-6800
FAX: (617) 863-5994

MICHIGAN

Detroit
37890 Interchange Drive
Farmington Hills 48331
Phone: (313) 478-5200
FAX: (313) 478-1521

MINNESOTA

St. Paul
2685 Long Lake Road
Building A
Roseville, Minnesota 55113
Phone: (612) 635-0525
FAX: (612) 635-0716

MISSISSIPPI

(Served by the Huntsville, Tennessee and Pensacola, Florida field offices)

MISSOURI

St. Louis
1854 Lackland Hill Parkway St.
St. Louis, MO 63146
Phone: (314) 569-1060
FAX: (314) 429-7952

MONTANA

(Served by the Salt Lake City, Utah and Denver, Colorado field offices)

NEBRASKA

(Served by the Kansas City, Kansas and Denver, Colorado field offices)

NEW JERSEY

* **Woodbridge**
John Newton
TV Sales Manager
40 Gill Lane
Woodbridge 07095
Phone: (201) 636-8616
TELEFAX: (GP 1) (201) 636-7234
FAX: (201) 636-7234

NEW MEXICO

Albuquerque
1258 Ortiz Drive, S.E.
Albuquerque 87108
Phone: (505) 265-5541
(800) 284-2127
FAX: (505) 256-0487

NEW YORK

Albany
26 Computer Drive West
Albany 12205
Phone: (518) 458-7291
FAX: (518) 458-7361

* **Long Island**
Bhaskar Pant
TV Region Sales Manager
Neil Portnoy
TV Sales Manager
1895 Walt Whitman Road
CS9008
Melville, N.Y. 11747-9008
Phone: (516) 756-9690
From NYC: (718) 895-8010
FAX: (516) 756-9277

Poughkeepsie
Beechwood Office Park
385 South Road
Poughkeepsie 12601
Phone: (914) 454-7540
FAX: (914) 454-7552

Rochester
1160 Pittsford-Victor Road Suite C
Pittsford, 14534
Phone: (716) 383-0070
FAX: (716) 383-0022

* **Syracuse**
Larry Sayer
TV Sales Manager
1 Northern Concourse
North Syracuse 13212
Phone: (315) 455-6661
FAX: 315) 455-2915

US SALES AND SERVICE OFFICES

TEK

NORTH CAROLINA
Raleigh
2950 Gateway Centre Blvd
Morrisville, 27560
Phone: (919) 481-3800
FAX: (919) 469-8823

NORTH DAKOTA
(Served by the St. Paul, Minnesota field office)

OHIO
Cleveland
6100 Rockside Woods Blvd., Suite 115
Cleveland 44131
Phone: (216) 447-5050
FAX: (216) 447-5057
Dayton
501 Progress Rd.
Dayton 45449-2396
Phone: (513) 859-3681
FAX: (513) 866-2093

OKLAHOMA
Oklahoma City
4400 Will Rogers Parkway, Suite 220
Oklahoma City 73108
Phone: (405) 943-8127
Oklahoma Wats Only: (800) 522-8196
FAX: (405) 942-6495

OREGON
* **Portland**
Warren Beals
TV Sales Manager
10220 S.W. Nimbus Drive, Suite K-4 Portland 97223
Phone: (503) 620-9100
FAX: (503) 620-9011
Factory Service Center:
Tektronix Industrial Park
Beaverton 97077
Phone: (503) 642-8600
TWX: (910) 467-8708
TLX: 15-1754

PENNSYLVANIA
* **Philadelphia**
Tom Jordan
TV Region Sales Manager
450 Sentry Parkway
Blue Bell 19422
Phone: (215) 825-6400
FAX: (215) 825-8839
* **Pittsburgh**
Rudy Niznansky
TV Sales Manager
1051 Brinton Road, Suite 300
Pittsburgh 15221
Phone: (412) 244-9800
FAX: (412) 244-1948

RHODE ISLAND
(Served by the Boston Field Office)

SOUTH CAROLINA
(Served by the Atlanta, Georgia and Rleigh, North Carolina field offices)

SOUTH DAKOTA
(Served by the St. Paul field office)

TENNESSEE
Knoxville
9041 Executive Park Drive, Suite 411
Knoxville 37923
Phone: (615) 690-6422
From Oak Ridge: (615) 482-7349
Fax: (615) 691-2972

TEXAS
Austin
4120 Commercial Center Drive Suite 500
Austin 78744
Phone: (512) 462-2400
FAX: (512) 462-2599
* **Dallas**
Tony Guess
TV Sales Manager
1551 Corporate Drive
Irving 75038
Mailing Address:
P.O. Box 165027
Irving 75016
Phone: (214) 550-0525
Metro: (214) 751-0470
FAX: (214) 550-8226 (FOS & Sales)
FAX: (214) 550-7363 (Service Only)
Houston
10887 S. Wilcrest Drive
Houston 77099
Mailing Address:
P.O. Box 4309
Houston 77210
Phone: (713) 933-3000
FAX: (713) 933-6233
Kelly
1831 South General McMullen
Suite 101
San Antonio 78226
Phone: (512) 432-1341
FAX: (512) 432-1859

UTAH
Salt Lake City
1515 West 2200 South, Suite A
Salt Lake City 84115
Phone: (801) 486-1091
FAX: (801) 486-0508

VERMONT
(Served by the Albany, New York field office)

VIRGINIA
Rosslyn
Rosslyn Center
1700 N. Moore Street, Suite 1620
Arlington 22209
Phone: (703) 522-4500
FAX: (703) 525-7802
Hampton
525 Butler Farm Road, Suite 102
Hampton 23666
Phone: (804) 865-1588
FAX: (804) 865-7892

WASHINGTON
Seattle
3709 157th Avenue NE
P.O. Box 97021
Redmond 98073-9721
Phone: (206) 885-0900
FAX: (206) 883-1388

WEST VIRGINIA
(Served by the Pittsburgh, Pennsylvania field office)

WISCONSIN
(Served by the Chicago, Illinois, and St. Paul, Minnesota field offices)

WYOMING
(Served by the Denver, Colorado and Salt Lake City, Utah field offices)

CORPORATE OFFICE
Tektronix, Inc.,
P.O. Box 500
Beaverton, Oregon 97077
Phone: (503) 627-7111
PRINCIPAL PLANT
Tektronix Industrial Park
Beaverton, Oregon 97077
DIRECT ORDER:
For United States, Virgin Islands, and Puerto Rico. Contact our National Marketing Center:
Phone: (800) 426-2200
Additional Literature or Tektronix office serving you:
P.O. Box 1700,
Beaverton, OR 97075
Phone: (800) 835-9433
TLX: 151754
TWX: (910) 467-8708

The Professional Video Dealers listed below may have branch offices located in your area. Contact main offices for further information.

ALABAMA
Pro Video Systems, Inc.
169 Oxmoor Road
Birmingham, AL 35209
(205) 942-7904

ARIZONA
Audio-Video Recorders of Arizona
3830 N. 7th Street
Phoenix, AZ 85014
(602) 277-4723

B & B Video, Inc.
1802 W. Grant Road
Suite 117
Tucson, AZ 85745
(602) 623-8201

CALIFORNIA
American Video Products
615 S. State College Blvd.
Fullerton, CA 92631
(714) 525-5772

B & B Systems, Inc.
28111 N. Avenue Stanford
Valencia, CA 91355
(805) 257-4853

CMTV, Inc.
1900 W. Burbank Blvd.
Burbank, CA 91506
(818) 843-6644

Hoffman Video Systems
1925 South Figueroa Street
Los Angeles, CA 90007
(213) 749-3311

J P Associates, Inc.
3115 Kashiwa Street
Torrance, CA 90505
(213) 539-8533

National TeleConsultants, Inc.
1651 Gardena Avenue
Glendale, CA 91304
(213) 245-8000

R. E. Snader and Associates
475 Gate Five Road
Sausalito, CA 94965
(415) 332-7070

Shoreline, Ltd.
1622 N. Highland
Hollywood, CA 90028
(213) 461-9800

TeleVideo San Diego
4783 Ruffner Street
San Diego, CA 92111
(619) 268-1100

Television Associates
2410 Charleston Road
Mountain View, CA 94043
(415) 967-6040

Videotape Products, Inc.
320 North Madison Avenue
Los Angeles, CA 90004
(213) 664-1144

COLORADO
CEAVCO Audio Visual Co.
1650 Webster Street
Denver, CO 80215
(303) 238-6493

Video Teknix, Inc.
109 Inverness Dr. East
Englewood, CO 80112
(303) 792-0101

FLORIDA
Barron Associates
1371 Merrifield Court
Deltona, FL 32725
(904) 789-8700

Florida Video Systems, Inc.
14422 N.W. 7th Avenue
Miami, FL 33168
(305) 688-6618

Gendra Broadcasting Corp.
2800 Biscayne Blvd., #700
Miami, FL 33137
(305) 372-8845

Professional Communications Systems, Inc.
5426 Beaumont Center Blvd.
Suite 350
Tampa, FL 33614
(813) 888-5353

GEORGIA
Broadcast Sales Corp.
328 14th Street N.W.
Atlanta, GA 30318
(404) 875-8621

Technical Industries, Inc. of Georgia
6000 Peachtree Road N.E.
Atlanta, GA 30341
(404) 455-7610

HAWAII
Sony Hawaii Company
960 Mapunapuna Street
Honolulu, HI 96819
(808) 834-6611

IDAHO
Aatronics, Inc.
5903 Franklin Road
Boise, ID 83709
(208) 343-0900

ILLINOIS
Roscor Corporation
1061 Feehanville Road
Mt. Prospect, IL 60056
(312) 229-8080

Swiderski Electronics Incorporated
1200 Greenleaf Avenue
Elk Grove Village, IL 60007
(312) 364-1900

Video Systems, Inc.
2117 Chestnut Avenue
Wilmette, IL 60091
(312) 256-0937

KANSAS
Kent Audio Visual
1131 E. First Street
Wichita, KS 67214
(316) 262-4487

KENTUCKY
Midwest Communications Corporation
One Sperti Drive
Edgewood, KY 41017
(606) 331-8990

MARYLAND
Professional Products, Inc.
4964 Fairmont Avenue
Bethesda, MD 20814
(301) 657-2141

MASSACHUSETTS
DLE, Inc.
5 Vernon Street
Middleboro, MA 02346
(617) 947-6801

Lake Systems Corporation
287 Grove Street
Newton, MA 02166
(617) 244-6881

MICHIGAN
General Television Network
13355 Capital Avenue
Oak Park, MI 48237
(313) 548-2500

Thalner Electronic Laboratories, Inc.
7235 Jackson Road
Ann Arbor, MI 48103
(313) 761-4506

MINNESOTA
Emmons Associates, Inc.
1121 Riverwood Drive
Burnsville, MN 55337
(612) 890-8920

Todd Communications, Inc.
6545 Cecilia Circle
Minneapolis, MN 55435
(612) 941-0556

MISSOURI
Lines Video Systems
219 S. Jefferson
Springfield, MO 65806
(417) 862-5533

Video Masters, Inc.
1616 Broadway
Kansas City, MO 64108
(913) 236-5595

VMI Company of St. Louis
2368 Schuetz Road
St. Louis, MO 63141
(314) 569-1334

NEBRASKA
Audio Visual, Inc.
8025 Maple St.
Omaha, NE 68134
(402) 393-9911

NEW JERSEY
A. F. Associates, Inc.
100 Stonehurst Court
Northvale, NJ 07647
(201) 767-1000

BTS Broadcast TV Systems
900 Corporate Drive
Mahwah, NJ 07430
(201) 529-1550

Landy Associates, Inc.
1890 E. Marlton Pike
Cherry Hill, NJ 08034
(609) 424-4660

Panasonic Broadcast Systems Co.
One Panasonic Way
Secaucus, NJ 07094
(201) 348-7685

Tele-Measurements, Inc.
145 Main Avenue
Clifton, NJ 07014
(201) 473-8822

Turner Engineering, Inc.
325 Division Street
Boonton, NJ 07005
(201) 263-0023

NEW MEXICO
Dyma Engineering
367 Main S.E.
Los Lunas, NM 87031
(505) 865-6700

NEW YORK
Audio-Video Corporation
213 Broadway
Menands (Albany), NY 12204
(518) 449-7213

The Camera Mart, Inc.
456 West 55th Street
New York, NY 10019
(212) 757-6977

FERCO
601 W. 50th Street
New York, NY 10019
(212) 245-4800

MPCS Video Industries, Inc.
514 West 57th Street
New York, NY 10019
(212) 586-3690

Reeves AV Systems, Inc.
227 E. 45th Street
New York, NY 10017
(212) 573-8652

NORTH CAROLINA
Clark-Powell Associates
110 Regent Dr.
Winston-Salem, NC 27114
(919) 760-4932

Technical Video Systems, Inc.
215 North Broad Street
Winston-Salem, NC 27101
(919) 748-0916

OHIO
Broadcast Video Corporation
1851 South High Street
Columbus, OH 43207
(614) 445-8800

OKLAHOMA
AFX Broadcast
4932 S. 83rd E. Avenue
Tulsa, OK 74145
(918) 664-8020

PENNSYLVANIA
Alpha Video & Electronics Co.
200 Keystone Drive
Carnegie, PA 15106
(412) 923-2070

GE Systems Integration
701 Ashland Avenue, Center 1-3
Folcroft, PA 19032
(215) 583-6800

Lerro Electrical Corp.
3125 N. Broad Street
Philadelphia, PA 19132
(215) 223-8200

Peirce-Phelps, Inc.
2000 N. 59th Street
Philadelphia, PA 19131
(215) 879-7171

TENNESSEE
Consolidated Media Systems, Inc.
1004 Old Tree Court
Nashville, TN 37210
(615) 244-3933

TEXAS
Broadcast Rentals & Sales, Inc.
1321 Valwood Parkway, Suite 420
Carrollton, TX 75006
(214) 241-1381

Industrial Audio/Video, Inc.
2617 Bissonnet
Houston, TX 77005
(713) 524-1956

MZB/Gray
6221 N. O'Connor, Suite 110
Irving, TX 75039
(214) 869-4895

UTAH
Visual Technology, Inc.
2141 South Main
Salt Lake City, UT 84115
(801) 466-7481

VIRGINIA
AVEC Electronics Corp.
2002 Staples Mill Road
Richmond, VA 23230
(804) 359-6071

WASHINGTON
Proline Industries, Inc.
11730 NE 12th
Bellevue, WA 98005
(206) 644-1999

WISCONSIN
Video Images, Inc.
285 North Janacek Road
Waukesha, WI 53186
(414) 785-8998

TEK WORLDWIDE SALES AND SERVICE OFFICES

For customers in areas not listed, see below for your nearest office.

Customers in Eastern Europe, Near- and Middle East contact: Tektronix Ges.m.b.H., Austria

Customers in Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Djibouti, Equatorial Guinea, Gabon, Guinea, Malagasy, Mali, Mauritius, Niger, Senegal, Togo, Zaire contact: Tektronix S.A., France

Customers in Andorra, Angola, Azores, Gibraltar, Spanish West Africa contact: Tektronix Española, S.A., Spain

Customers in unlisted African, South American, or Asian locations contact:
Tektronix , Inc., U.S.A.
Export Sales
P.O. Box 500 D/S 73-323
Beaverton, OR 97077 USA
Phone: (800) 835-9433 x1916
Telex: 4742110 TEKEXP
Fax: (503) 627-6905

ALGERIA

(Service)
Entreprise Nationale Des Industries Electroniques
MCE 1
Unite de Maintenance et Calibration des Equipements Electroniques
MCE 1, BP 121
Route de Mascara Zone - Industrielle
Sidi Bel-Abbes
Phone: 213 (7) 242269
Telex: 16021 MCE1 DZ
MCE 2
Lotissement El-Idrissi
Alger
Phone: 213 (2) 782074/782076
Telex: 66108 DELNA DZ

(Sales Office)
Tektronix, S.A.
Algeria Sales
ZA de Courtaboeuf, Av du Canada,
BP 13
91941 Les Ulis Cedex
France
Phone: 33 (1) 69 86 81 81
FAX: 33 (1) 69-07-09-37
Telex: (842) 604332 TEKOR A

(Product Information)
Tektronix, Bureau de Liaison-Algerie
Bureau N5, Niveau C
Hôtel El-Aurassi
BD Frantz-Fanon
Alger 2
Phone: 213 (2) 63 07 47
Telex: 67043 TEK DZ

ARGENTINA

Coasin S.A.
Buenos Aires Office
Virrey del Pino 4071
1430 Buenos Aires
Phone: 54 (1) 552-5248/-3485/-3185
FAX: 54 (1) 11-1427
Telex: (390) 122284 COASIN AR

Cordoba
25 de Mayo No. 1930
Cordoba
Phone: 54 (51) 3037

AUSTRALIA

Tektronix Australia Pty. Limited
Sydney Office
80 Waterloo Road
North Ryde, N.S.W. 2113
Phone: 61 (2) 888-7066
FAX: 61 (2) 888-0125
Telex: (790) 24269 TEKTRNX AA

Adelaide
128 Gilles Street
Adelaide, South Australia 5000
Phone: 61 (8) 223-2811
FAX: 61 (8) 223-7890

Brisbane
737 Logan Road
Greenslopes Brisbane
Queensland 4120
Phone: 61 (7) 394-1155
Fax: 61 (7) 397-8679

Canberra
Unit 14
Trevor Pearcey House
Fernhill Park
Bruce, Austr. Capital Terr. 2617
Phone: 61 (62) 51-6111
FAX: 61 (62) 51-4509

Perth
66 Wellington Street
East Perth, West Australia 6000
Phone: 61 (9) 325-8433
Fax: 61 (9) 221-2397

Victoria Branch Office
259-263 Whitehorse Rd.
Balwyn, Victoria 3103
Phone: 61 (3) 836-3355
FAX: 61 (3) 836-6592
Telex: (790) 35880 TEKMEL AA

AUSTRIA

Tektronix Ges.m.b.H.
Doerenkampgasse 7
A-1100 Vienna
Phone: 43 (222) 68-66-02-0
FAX: 43 (222) 68-66-00
Telex: (847) 111481 TEK A

BAHRAIN

International Agencies Co Ltd.
(Intercol)
P.O. Box 5841
Manama
Phone: 973(*)727 177
FAX: 971(*) 727 509
Telex: (490) 8661 INTCOL BN

BANGLADESH

A. Q. Chowdhury & Co.
33 Topkhana Road
Dhaka — 1000
Phone: 880 (2) 252329, 244258, 312492
FAX: 880 (2) 412296
Telex: (950) 642833 MIL BJ

BELGIUM

Tektronix nv/sa
Brussels Office
Bedrijfspark Keiberg
Zoning Keiberg
Excelsiorlaan, 3
1930 Zaventem
Phone: 32 (2) 720-80-20
FAX: 32 (2) 720-80-25
Telex: (846) 26713 TEKBEL B

BOLIVIA

Coasin Bolivia S.R.L.
Gabriel Gonzalvez 221
Casilla 7295
La Paz
Phone: 591 (2) 340962, 363365
FAX: 591 (2) 35 9268
Telex: (335) 3233 COALAP BV

BRAZIL

Tektronix Industria e Comercio Ltda.
São Paulo Office
Av. Vereador José Diniz, 3530
CEP 04604-Campo Belo
São Paulo, SP
Phone: 55 (11) 543-1911
FAX: 55 (11) 542-0696
Telex: (391) 01154068 TEKX BR

Rio de Janeiro Office
Av. Marechal Câmara, 160, Gr. 605
CEP 20020-
Rio de Janeiro, RJ
Phone: 55 (21) 240-7370
Telex: (391) 2130120 TEKX BR

BULGARIA

Trakia, Office V.M.E.I. Lenin
Oarvenitsa Bloc 2 RM 2325
BG-1156 Sofia
Phone: (*) 66 53 46
FAX: (*) 66 54 19
Telex: 22958

CANADA

Tektronix Canada Inc.
Barrie
50 Alliance Blvd.
Mail: P.O.Box 6500,
Barrie, Ontario L4M 4V3
Phone: (705) 737-2700
FAX: (705) 737-5588
Telex: 06875672 TEKTRONIX BAR

Calgary
Suite 106
3016, 19th Street NE
Calgary, Alberta T2E 6Y9
Phone: (403) 250-7583
FAX: (403) 291-9840
Telex: (*) 03821730 TEKTRONIX CGY

Edmonton
6025 103A Street
Edmonton, Alberta T6H 2J7
Phone: (403) 434-9466
FAX: (403) 436-2350
Telex: 0372795 TEKTRONIX EDM

Montreal
900 Selkirk Street
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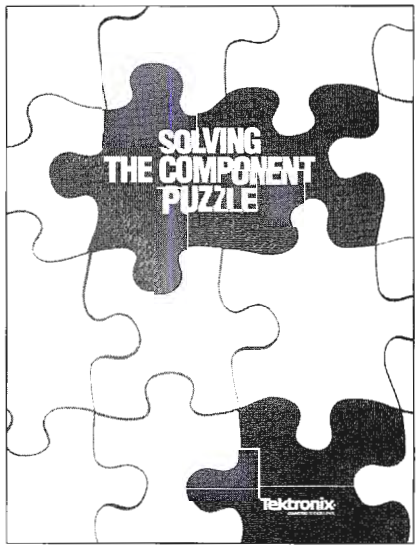

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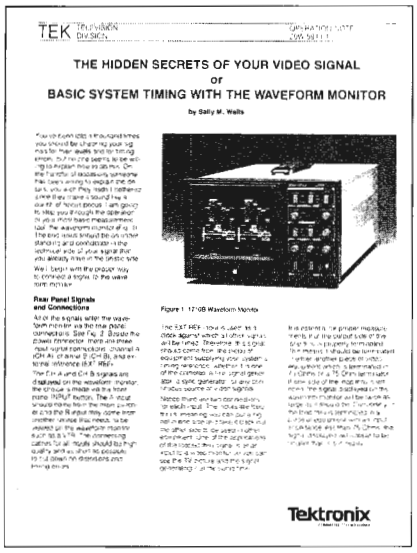
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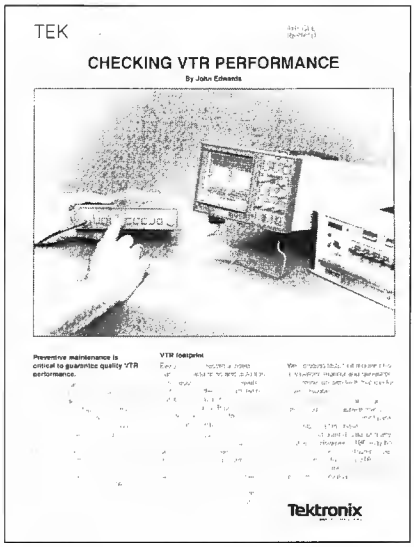

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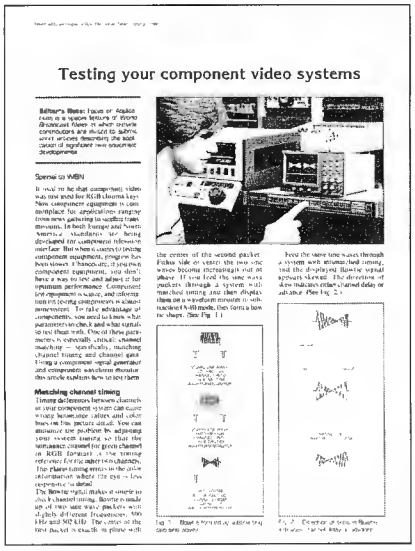

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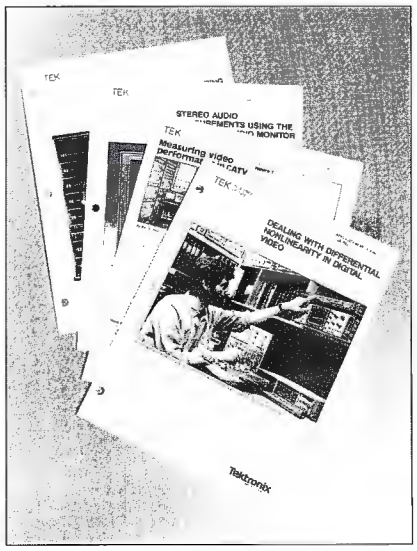

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