TEK 1781R

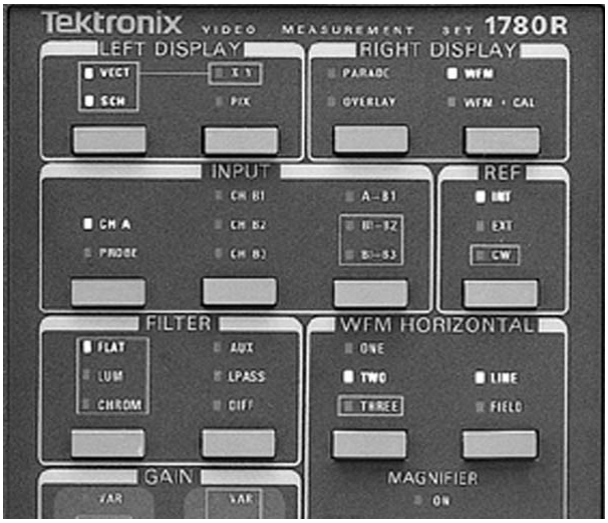
Features And Benefits

- 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 Semiautomatic Setups
- Available for Either NTSC or PAL Standards
- UL, CSA, FM, ANSI, IEC and FCC Approved. Meets EMC Directive 89/336/EEC

Applications

- High Accuracy Video Monitoring and Measurement for Broadcast and Post-production Facilities

Multiple inputs and parade display mode facilitate component signal measurements.



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, 5.25 in. or 133.4 mm 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 monitoring 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.

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.

Advanced 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 also 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.

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.

Cursor operation is both logical and intuitive. For example, time measurements are often defined from one-half amplitude point on a fast rise-time 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 (VM), 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.

A picture display is provided 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

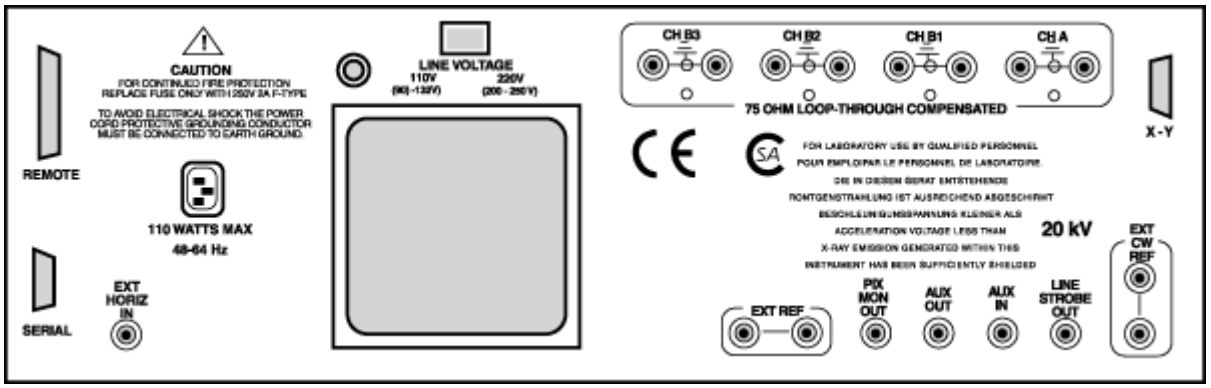
oscilloscope probe.

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.

Picture display identifies the signal selected for measurement.



1780R rear panel.

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 semiautomatic 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 preprogrammed 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.

The 1780R Series is a digitally controlled instrument. All front panel controls, including knobs, touch screen operations and push-buttons, may be recalled remotely via an RS-232D/RS-422A serial communications port. Additionally, user programmed semiautomatic 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-9 Opt. 20, 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 DCS0 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 5.25 in. or 133.4 mm high package, ready for rack mounting. An optional zero clearance mounting shelf, 1780F05, is available to allow removal and replacement with the 1780R Series cabinet in place. A portable cabinet is also 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.

Characteristics

Input/Output

Vertical Range, Full Scale -
Fixed: 1.0 V ±.007 V.
Variable: Approximately 0.67 to 2.00 V.

Vertical Magnification - Fixed, Variable, X5.

Maximum Input Signal -
AC Coupled: 2.0 V_{p-p}, 10% -90% AP.
DC Coupled: ±1.5 V (DC + peak AD).

Return Loss -
Inputs A, B, 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, B2 and B3: 1%.

5 MHz - 10 MHz:

Input CH A: 1%.
CH B1, B2 and B3: 2%.

10 MHz - 15 MHz:

Input CH A, B1, B2 and B3: +2%, -5%.

15 MHz 20 MHz:

Input CH A, B1, B2 and B3: +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-B1) -
60 Hz: A-B ≥46 dB.
15 kHz: A-B ≥46 dB.
1 MHz: A-B ≥40 dB.
F_{SC}: A-B ≥34 dB.

Filters -
Luminance: <3 dB down at 1 MHz, ≥40 dB down at F_{SC}.
Low Pass: ≥14 dB down at 500 kHz.
Chrominance: Typically ±1% of flat at F_{SC}, 3 dB points ±.75 MHz F_{SC}, within ±.15 MHz.
Diff'd Steps: <40 dB at F_{SC}.

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 megaohm.

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 (5 µs/div): ±2%. 2H (10 µs/div): ±2%.
3H (15 µs/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 (1 µs/div): ±1%. X10 (0.5 µs/div): ±2%.
X20 (0.25 µs/div): ±3%. X25 (0.2 µs/div): ±3%.
X50 (0.1 µs/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 track.

Calibrated DG (CRT Readout) -
Resolution: 0.1%.
Accuracy: 0.1% ±10% of reading.
Range: ±5%.

Differential Phase (Dø) -
Deflection Factor: 5° Dø deflects the trace 50
IRE (1780R) or 500 mV (1781R) ±5%.
Residual Dø: (10-90% APL) ≤0.1° last 90% of trace.
Calibrated Dø (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 Error Signal White Noise Reduction: Approx. 15 dB.
Cross Luminance Rejection: Approx. 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 $\leq$10% to 90%.
Sensitivity: 0.4 to 2.0 V_{p-p} composite video with APL change.
Rate: $\geq$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: F_{sc} +500 kHz, ±100 kHz.
Lower -3 dB Point: F_{sc} -500 kHz, ±100 kHz.

Display - Vector Phase Accuracy: ±1.25°.

Quadrature Phasing - ±0.5°.

Subcarrier Regenerator -
Pull-in Range: ±50 Hz of F_{sc} (1780R), ±10 Hz of F_{sc} (1781R, typically ±50 Hz).

Phase Shift with Burst Amplitude Change:
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 Ohm 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 x 100 mm.
Accelerating Potential: Nominally 20 kV.
Orthogonality: ±1°.

Vectorscope -
Viewing Area: 80 mm x 100 mm.
Accelerating Potential: Nominally 13.75 kV.
Orthogonality: ±1°.

Power Requirements

Mains Voltage Ranges -
110 V AC: 90-132 V.
220 V AC: 200-250 V.

Mains Frequency Range - 48-66 Hz.

Power Consumption - 110 W max.

Environmental

Temperature Range -
Operating: 0°C to +50°C.
Nonoperating: -55°C to +75°C.

Altitude -
Operating: To 15,000 ft. (4.5 km) max.
Nonoperating: To 50,000 ft. (15 km) max.

Humidity - 90-95% noncondensing.

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

Shock -
Nonoperating: 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

EMC - Certified to the EMC Directive 89/336/EEC.

Safety -
UL1244, CSA231, EN61010-1, IEC61010-1.
Complies with: HD401 S IEC 348.

Physical Characteristics

Dimensions	**mm**	**in.**
Height	133.4	5.25
Width	483	19
Length	460	18
Weight (approximate)	**kg**	**lbs.**
Net	12.75	28
Shipping	20.1	45