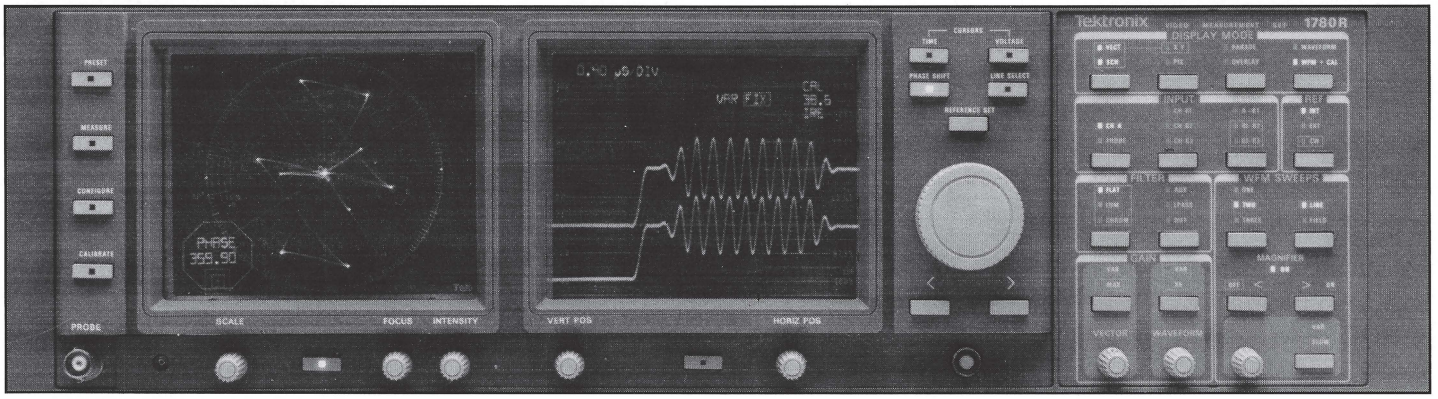
1780R SERIES VIDEO MEASUREMENT SET



1780R Video Measurement Set.

- **Full bandwidth analog video processing**
- **Precision waveform and vector measurements**
- **Polar SCH presentation, with calibration mode**
- **Four loop-through video input channels**
- **Front panel probe input**
- **Component or composite waveform evaluation**
- **Measurement-grade time and voltage cursors**
- **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**

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.

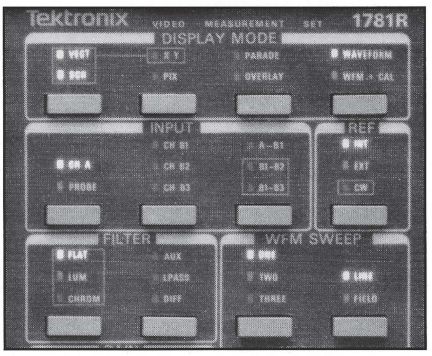
The advantages of separate waveform and vector instruments are provided in a single rack width, 5¼ inch high package. In addition, specific measurements take advantage of the 1780R Series' shared waveform monitor and vectorscope internal processing. Separate, optimized waveform and vector display CRTs allow simultaneous monitoring of several video parameters. Routine and specialized video evaluation is easily and quickly performed in this full function measurement instrument.

New features and levels of performance previously unavailable in an integrated measurement instrument have been incorporated, and some features that were optional are now standard.

Traditional Capabilities

The 1780R Series provides a full menu of traditional waveform/vector/SCH monitor capabilities. Levels of performance previously unavailable, even in separate instruments, are characteristic of the 1780R Series.

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 facilitates component signal measurements.

Tektronix®
COMMITTED TO EXCELLENCE

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 external 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, an option on other video waveform monitors, 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 new enhancements which make measurements more accurate and consistent:

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

The Tektronix **double trace differential** phase measurement technique has been 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 using the on-screen readout.

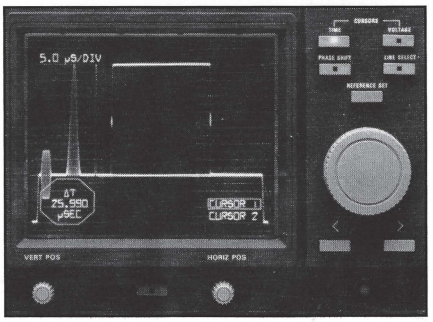
A new **double trace differential gain** display is provided. Measurements are now more repeatable. The digital recursive vertical filter may also be used in this mode.

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.

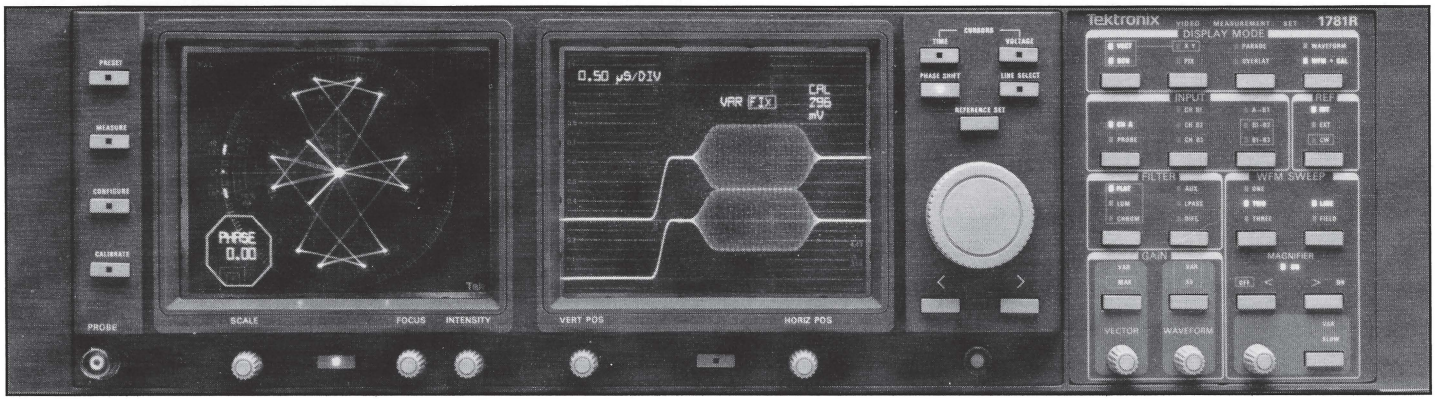
An **SCH calibration mode** assures the accuracy of the SCH phase indicator. This mode provides a calibration check completely within the instrument, and does not require an external signal source of known accuracy.

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 2 ns. Signal may be magnified for precise cursor positioning.

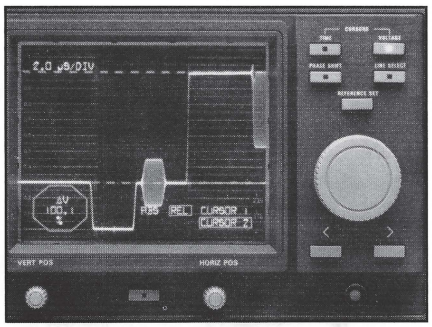
Cursor operation is both logical and intuitive. For example, time measurements are often defined from one-half amplitude point on a fast rise-time signal feature, to a zero crossing of another feature. For precision measurements, the 1780R Series time cursors appear as bright-up dots that can be set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



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

Copyright©1988. Tektronix, Inc. All rights reserved.

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 alpha-numeric 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.



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

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 −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.

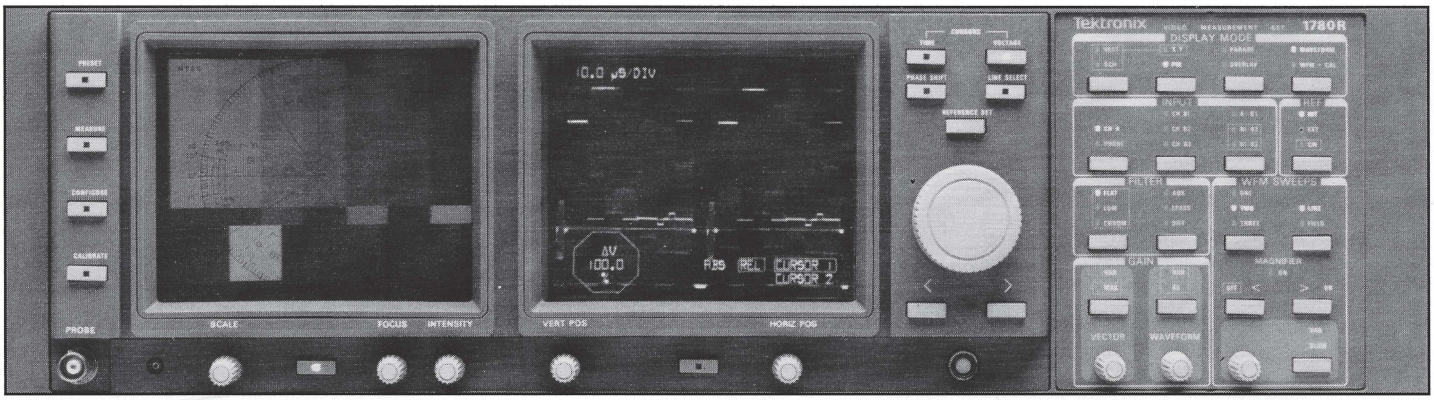
Full line select for 4-field NTSC, or 8-field PAL, is provided with selected line(s) indicated digitally on-screen and marked on both the internal and external picture monitors.

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.

User Interface

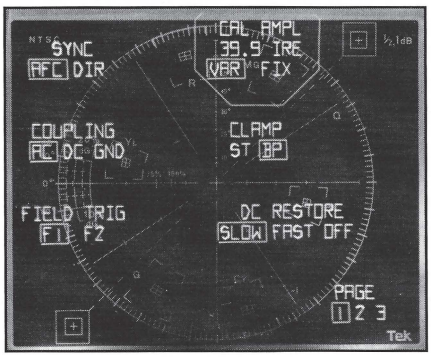
Operator/instrument interface has been given a great deal of attention in the 1780R Series. Flexibility and ease of operation have been designed into the instrument. Measurements that were previously difficult may now be made by operators with more limited experience. Seasoned operators will find measurements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



Picture display identifies the signal selected for measurement.

User programmable semi-automatic setups, along with on-screen voltage/timing cursors and electronic graticules, contribute to a new level of 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.



Touch screens allow rapid configuration for special applications.

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 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:

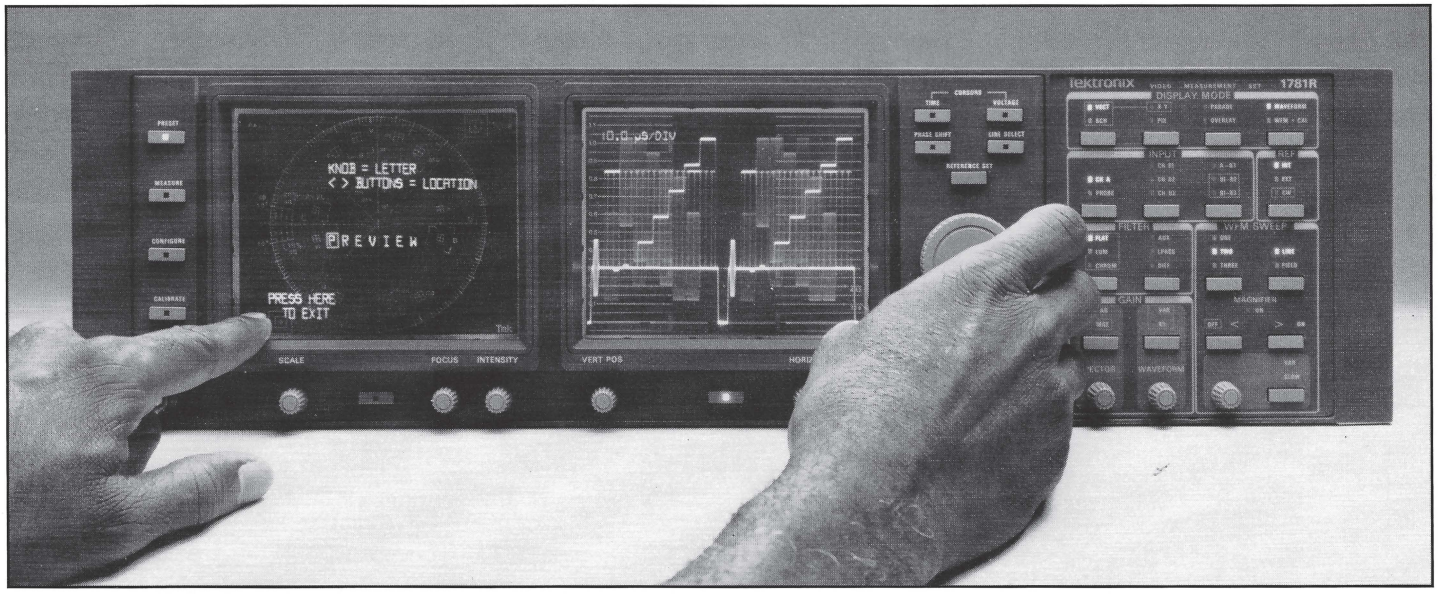
Input/Output:

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: >40 dB, dc to 5 MHz



Twelve individual setups may be user programmed for later recall.

Waveform monitor vertical system

Frequency response
50 kHz – 10 MHz: ±1%
10 MHz – 20 MHz: +2% – 5%

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: 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: <2 dB 0.4 to 0.5 MHz
≥20 dB 14 kHz to 2.0 MHz
≥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 5 MHz: ±2%
5 MHz to 20 MHz: +3% to −5%

Non-linear distortion
Differential gain: <0.1%, 10%-90% APL
Differential phase: <0.1°, 10%-90% APL

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.lμs/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: 2 ns
Stability: ±1 ns
Readout Resolution: 5 ns

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 ±100 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°

Vector gain accuracy: ±2.5%

Quadrature phasing: ±0.5°

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: ≤0.5°

Position control range: ≥6 mm from center, H and V

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°

Trace rotation range: ≥1° from horizontal

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: 48-64 Hz

Power consumption: 110 W max.

Environmental summary

Temperature range

Operating: 0°C to 50°C

Nonoperating: −55°C to +75°C

Altitude

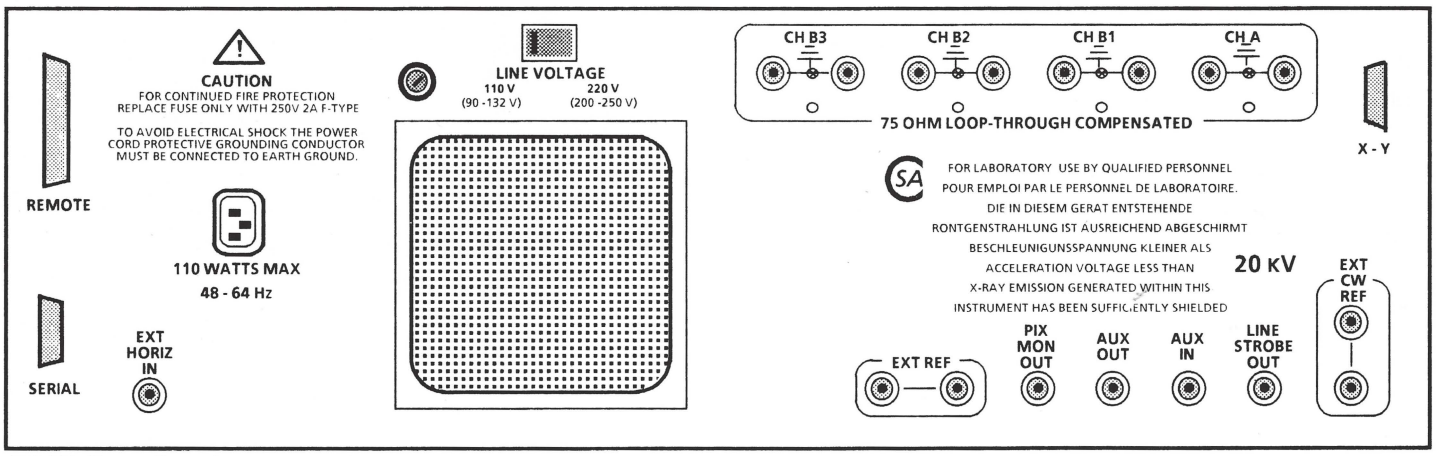
Operating: to 15,000 ft (4.5 km) max.

Nonoperating: to 50,000 ft (5 km) max.

Humidity: 90-95% noncondensing

Vibration

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



1780R Rear Panel.

Shock
Nonoperating: 30 g acceleration, 3 times each major axis, 11 ms, halfsine

Bench handling: 4 inch 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:
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
Height: 5¼″ (133.4 mm)
Width: 19″ (483 mm)
Length: 18″ (460 mm)

Net weight: approx 25 lbs (approx 11.35 kg)

Shipping weight: approx 31 lbs (approx 15.10 kg)

ORDERING INFORMATION

When ordering, please use the following nomenclature.

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

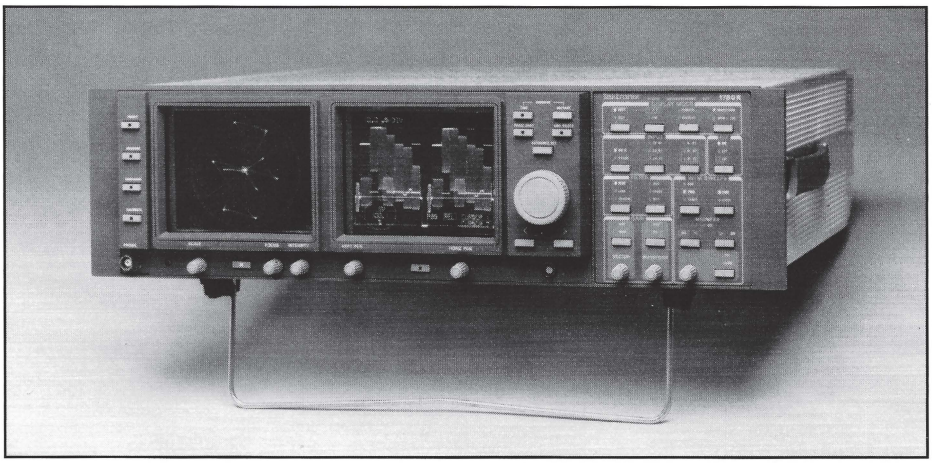
1781R PAL Video Measurement Set (625line/50 field)

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

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).



Portable Cabinet.

For further information, contact:

U.S.A., Asia, Australia, Central & South America, Japan
Tektronix, Inc.
Television Division, MS 58-699
P.O. Box 500
Beaverton, Oregon 97077
Phone: (503) 627-1843
Telex: 151754
FAX: (503) 627-5139

Federal Republic of Germany
Tektronix GmbH
P.O. Box 101544
D-5000 Cologne 1
Germany
Phone: 49 (221) 77220
Telex: (841) 8885417 ATEK D
FAX: 49 (221) 7722-362

France and Africa
Tektronix S.A.
Z.I. Courtaboeuf, Av. du Canada
BP. 13
91941 Les Ulis Cedex
France
Phone: 33 (169) 86 81 81
Telex: (842) 690332 TEKOR A
FAX: 33 (169) 07 09 37

North Europe Area
Tektronix Europe B.V.
P.O. Box 406
2130 AK Hoofddorp
The Netherlands
Phone: 31 (2503) 65265
Telex: (844) 74876 TEKE NL
FAX: 31 (2503) 30424

South Europe Area, Eastern Europe and Middle East
Tektronix Espanola, S.A.
Calle Condesa de Venadito, 1-5°
28027 Madrid
Spain
Phone: 34 (1) 404-1011
Telex: (831) 46014 TKME E
FAX: 34 (1) 404-0997

United Kingdom
Tektronix U.K. Limited
Fourth Avenue
Globe Park
Marlow
Bucks SL7 1YD
Phone: 44 (6284) 6000
Telex: (851) 847277, 847378
FAX: 44 (6284) 74799

Tektronix sales and service offices around the world:
Algeria, Argentina, Australia, Austria, Bahrain, Bangladesh, Belgium, Bolivia, Brazil, Bulgaria, Canada, Chile, Peoples Republic of China, Colombia, Costa Rica, Cyprus, Czechoslovakia, Denmark, Ecuador, Egypt, Finland, France, Federal Republic of Germany, Ghana, Greece, Hong Kong, Iceland, India, Indonesia, Ireland, Israel, Italy, Ivory Coast, Japan, Jordan, South Korea, Kuwait, Lebanon, Malaysia, Mauritius, Mexico, The Netherlands, New Zealand, Nigeria, Norway, Oman, Pakistan, Panama, Peru, Philippines, Poland, Portugal, Qatar, Saudi Arabia, Senegal, Singapore, Republic of South Africa, Spain, Sri Lanka, Sweden, Switzerland, Syria, Taiwan, Thailand, Tunisia, Turkey, United Arab Emirates, United Kingdom, Uruguay, U.S.S.R., Venezuela, Yugoslavia, Zimbabwe.

Copyright©1988, Tektronix, Inc. All rights reserved. Printed in U.S.A. Tektronix products are covered by U.S. and foreign patents, issued and pending. Information in this publication supersedes that in all previously published material. Specification and price change privileges reserved. TEKTRONIX, TEK, PLOT 10, TEKTEST, SCOPE-MOBILE, and ® are registered trademarks. For further information, contact Tektronix, Inc., PO. Box 500, Beaverton, OR 97077. Phone: (503) 627-7111; TWX: (910) 467-8708; TLX: 151754. Subsidiaries and distributors worldwide.

Tektronix®
COMMITTED TO EXCELLENCE

9/88 24W-7020