

Service Manual



WVR500 Waveform/Vector Monitor 070-8897-01

Warning

The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing service.



Specifications

This section contains a brief functional description of the WVR500 monitor, followed by the characteristics tables.

Product Description

The Tektronix WVR500 monitor is a rasterizing television waveform/vector monitor which outputs a display signal to a remote monitor or video switcher. It has dual standard (NTSC and PAL) capability with the functionality of a waveform monitor, vectorscope, and picture monitor. The instrument is 8 1/2 inch wide by 1 1/2 inch high by 17 inches long, weighing 4 1/2 pounds, fitting the standard half-rack applications. The instrument can be powered from AC lines ranging from 90-250 V.

The WVR500 monitor uses a proprietary rasterizer which displays analog-like waveforms and vectors on the remote monitor simultaneously with the appropriate measurement graticules. The rasterized waveform and vector displays can fill the entire screen or be reduced to 1/4 sized windows overlaying the picture monitor display. The picture monitor display cannot be resized.

Instrument operation is controlled by a microprocessor which polls the front-panel switches. The front-panel switches are the momentary touch type, several of which have lighted functional indicators. Many of the monitoring functions are selected through the on-screen menus, which are entered by pressing front-panel buttons.

Displays can come from two channels of unterminated composite video input loopthrough connectors on the rear panel. An external reference input allows for the connection of an external sync signal. The rear-panel remote connector allows for full instrument operation from a remote location.

The Waveform display mode provides three standard sweep rates: 1 Line (5 $\mu\text{s}/\text{Div}$), 2 Line (10 $\mu\text{s}/\text{Div}$), and 2 Field. The line-rate sweeps can be magnified X10 to additional sweep rates: 1 Line Mag (0.5 $\mu\text{s}/\text{Div}$), and 2 Line Mag (1 $\mu\text{s}/\text{Div}$). The 2 Field sweep is magnified by approximately X20. Vertical gain is either fixed at X1 or X5, or variable from 50% to 120% of the input signal amplitude. The signal filter selections are Flat (no filter) and Luminance (low pass filter), which can be displayed separately or in a parade display in the 2 Line and 2 Field sweeps. The Line Select mode allows specific lines to be viewed. The Amplitude Alarm mode provides automatic video level monitoring by highlighting the portion of the waveform exceeding the 100 IRE (1.0 V PAL) graticule line.

The Vectorscope display mode displays signals with the standard vectorscope color bars amplitude and phase relationships. The vector display can also be used to make differential gain and phase measurements. The +V display (PAL only) overlays the -V axis on the +V axis to check the PAL system color encoders. A full 360° digital phase shifter, with 75% and 100% color bars settings, and variable gain are provided.

The Picture Monitor display mode displays the video input signal as a picture. The brightness, contrast, hue, and chroma of the display are set internally and are not adjustable.

The Waveform-in-Picture display mode displays the Waveform Monitor and/or the Vectorscope displays in 1/4-screen sized windows overlaying the Picture Monitor display. The reduced displays can be made semi-transparent for full viewing of the Picture display.

Options Refer to the *Options* section for a list of the available options for the WVR500 monitor.

Accessories Refer to the *Replaceable Parts* list for a list of the Standard and Optional accessories.

User Interface Many of the instrument monitoring parameters are configured through the menu system. The MENU, PRESETS, DISPLAY, CONFIG, and CLEAR buttons control menu access, while the numbered buttons are used to make selections from the displayed menus. The large unlabeled center knob is called the General Purpose (GP) Knob, and is assigned control of monitoring functions through the menu system. Instructions on how to make menu selections begin on page 2-12.

The current setting of several of the front-panel controls are displayed in the on-screen readout. A description of the on-screen readout begins on page 2-11.

Characteristics Tables

The tables that follow specify instrument electrical characteristics, mechanical characteristics, environmental characteristics, and certification. The tables are logically grouped under specific functions, beginning with video input and vertical channel specifications and ending with the instrument's certifications.

Categories Each table consists of a column that identifies the characteristics that are defined by the entries in the description column. A single item in the category column might have multiple description items, which could include performance requirements, reference information, and performance verification step numbers.

Descriptions The second column of the two column format contains all of the descriptive material about the listed characteristic. In addition, the performance verification procedure step number, used to verify the characteristic, is also in this column. Because this instrument is designed to operate on both PAL and NTSC standards, some of the tolerances are defined in millivolts and IRE units. In these dual-value tolerances, the PAL values appear in parentheses.

Performance Requirements (Req). Items with this designation are critical to instrument performance. In most cases they have a tolerance given and have a performance verification step number accompanying them. However, there are a few areas where instrument operation verifies that this performance requirement is met.

Reference Information (RI). This is information about the operation of the instrument that is important enough to place it with the performance requirements. In some cases there may be a tolerance listed, but these should be considered as typical, not absolute.

Performance Verification Step. This item identifies the step number of the Performance Verification procedure, located in Section 4, which tests the listed requirement. Section 5 contains calibration information, if instrument readjustment becomes necessary.

Table 1-1: Vertical deflection system

Category	Description
Deflection Factor	<p>Req: 1 V Full Scale: 1 V input displayed within 1% of 140 IRE (1.0 V PAL).</p> <p>RI: Flat filter selected.</p> <p>Req: X5 Gain: Gain Accuracy $\pm 5\%$.</p> <p>RI: 1 V input signal.</p> <p>Req: X5 Gain Registration: ≤ 1 major division of vertical shift from baseline between unmagnified and magnified signal.</p> <p>Req: Variable Gain Range: Input signals between 0.8 V and 2 V can be adjusted to 140 IRE (1.0 V PAL) display. 160 mV and 400 mV for X5 Gain.</p> <p>Req: Position Range: 1 V signal can be positioned so that peak white and sync tip can be placed at blanking level, with the DC Restorer Clamp on, regardless of gain setting.</p>

Table 1-1: Vertical deflection system (cont.)

Category	Description
Frequency Response	<p>Req: 1 V Full Scale: 50 kHz to 6 MHz within 2% of response at 50 kHz.</p> <p>RI: Specifications apply for full screen height video input signal, with Variable Gain off, and Flat filter selected.</p> <p>Req: X5 Gain: 50 kHz to 6 MHz within 5% of response at 50 kHz.</p> <p>RI: Flat filter selected.</p> <p>Req: Luminance Filter: ≥ 30 dB attenuation at 4.00 MHz.</p> <p>RI: Response at 15 kHz does not vary between Flat and Luminance filters by more than 1%.</p>
Transient Response	<p>RI: Specifications apply for full screen height video input signal, with Variable Gain off, 1 V Full Scale or X5 Gain, using the 2T pulse and 2T bar.</p> <p>Req: Pulse-to-Bar Ratio: X1: 0.99:1 to 1.01:1. X5: 0.98:1 to 1.02:1.</p> <p>Req: Field Rate Square Wave or Vertical Window Tilt: $\leq 1\%$.</p> <p>Req: 25 μs Bar Tilt: $\leq 1\%$.</p> <p>Req: Overscan: $\leq 2\%$ variation in baseline of 100 IRE (700 mV PAL) 12.5T (20T PAL) modulated pulse as it is positioned over the middle 80% of the screen.</p> <p>RI: Preshoot: $\leq 1\%$.</p> <p>RI: Overshoot: X1: $\leq 2\%$. X5: $\leq 4\%$.</p> <p>RI: Ringing: X1: $\leq 2\%$. X5: $\leq 4\%$.</p>
Maximum Absolute Input Level	<p>Req: ± 5 VDC + peak AC.</p> <p>RI: Displays in excess of 200 IRE (1.428 V PAL) may cause frequency response aberrations.</p> <p>RI: Maximum Operating Input Voltage: Peak AC + DC should be within +8.0 V and -5.6 V for proper operation.</p>
DC Input Impedance	<p>Req: ≥ 15 kΩ.</p> <p>RI: Unterminated.</p>
Return Loss (75 Ω)	<p>Req: ≥ 40 dB from 50 kHz to 6 MHz.</p> <p>RI: CH-A and CH-B input channels, loopthrough terminated in 75 Ω. Input in use or not in use, instrument power on or off, all deflection factor settings.</p>
Loopthrough Isolation	<p>RI: ≥ 70 dB of isolation between loopthroughs. Measured at F_{SC} between CH-A, CH-B, and EXT REF inputs.</p>

Table 1-1: Vertical deflection system (cont.)

Category	Description
Crosstalk Between Channels	RI: ≥ 70 dB of isolation between channels. Measured at F_{SC} between CH-A, CH-B, and EXT REF inputs.
Video Out	<p>RI: Differential Gain (50% APL): Within 1% with a 140 IRE (1.0 V PAL) unit display.</p> <p>RI: Differential Phase (50% APL): Within 1° with a 140 IRE (1.0 V PAL) unit display.</p> <p>Req: Return Loss (75Ω): ≥ 30 dB from 50 kHz to 6 MHz.</p> <p>RI: With the instrument turned on.</p> <p>Req: Input to Video Out Gain Ratio: $1:1 \pm 5\%$ @ 15 kHz.</p> <p>RI: Picture display mode.</p>

Table 1-2: DC restoration

Category	Description
DC Restorer Clamp Time	RI: Back Porch.
Frequency Response at 60 Hz (50 Hz PAL)	<p>Req: Attenuation of 60 Hz (50 Hz PAL) on Input signal: Slow Mode – $\leq 20\%$. Fast Mode – $\geq 90\%$.</p> <p>Req: Blanking Level Shift with 10% to 90% APL Change: APL changes from 50% to either 10% or 90% will cause blanking level shift of 1 IRE unit (7.14 mV PAL) or less.</p> <p>Req: Blanking Level Shift Due to Presence or Absence of Burst: 1 IRE unit (7.14 mV PAL) or less shift from no color burst to presence of color burst.</p>

Table 1-3: Horizontal deflection system

Category	Description
Sweep	Req: Sweep will occur in all Horizontal mode settings with or without synchronization.
2FLD Sweep Repetition Rate	RI: Displays 2 full fields, including the field rate sync between them.
2FLD Sweep Magnification	RI: Approximately X20.
1LINE Sweep Repetition Rate	Req: Equal to the line-rate of applied video or external sync.
2LINE Sweep Repetition Rate	Req: Equal to half the line-rate of applied video or external sync.
Sweep Length	RI: 2LINE and 2FLD sweep length is nominally 12.5 divisions.

Table 1–3: Horizontal deflection system (cont.)

Category	Description
Timing Accuracy	<p>RI: All timing and linearity specifications exclude the first and last major divisions of the unmagnified display.</p> <p>Req: 10 μs/div. (2 LINE): Within 2%.</p> <p>Req: 5 μs/div. (1 LINE): Within 2%.</p> <p>Req: 1 μs/div. (2 LINE + MAG): Within 2%.</p> <p>Req: 0.5 μs/div. (1 LINE + MAG): Within 3%.</p>
Integral Linearity	<p>Req: Within 1%.</p> <p>RI: Measured between the 10 μs and 110 μs points on the 10 μs/division sweep.</p>
Sweep Magnifier Registration	<p>RI: Magnification occurs about the center of the screen.</p>
Horizontal Position	<p>Req: Any portion of a synchronized video sweep can be positioned on screen in all sweep modes.</p>

Table 1–4: Synchronization

Category	Description
Input Requirements	<p>Req: Internal Reference, NTSC: Composite video or black burst with sync amplitudes 40 IRE \pm6 dB.</p> <p>Req: Internal Reference, PAL: Composite video or black burst with sync amplitudes 300 mV \pm6 dB.</p> <p>Req: External Reference: Sync amplitude between 143 mV and 4 V will synchronize sweeps.</p>
EXT REF Input	<p>Req: DC Input Impedance (Unterminated): \geq15 kΩ.</p> <p>Req: Return Loss (75 Ω): \geq40 dB from 50 kHz to 6 MHz.</p> <p>RI: Loophrough terminated in 75 Ω, instrument power on or off.</p> <p>RI: Absolute Maximum Input Voltage: \pm12 VDC plus peak AC.</p>

Table 1-5: Vector mode

Category	Description
Chrominance Processing	<p>Req: Chrominance Bandwidth: Upper -3 dB Point: $F_{SC} + 500 \text{ kHz}$, $\pm 100 \text{ kHz}$. Lower -3 dB Point: $F_{SC} - 500 \text{ kHz}$, $\pm 100 \text{ kHz}$.</p> <p>RI: Nominal Subcarrier Frequency (F_{SC}) NTSC: 3.579545 MHz. PAL: 4.43361875 MHz.</p> <p>RI: +V Mode (Applicable to PAL operation only): +V-type display as selected by front-panel menu selection. When selected, V axis is inverted at a half line-rate to produce a single vector display.</p>
Display	<p>RI: Vector Phase Accuracy: $\pm 1.25^\circ$. Measured with color bar signal.</p> <p>RI: Vector Gain Stability: Typically $\pm 2.5\%$.</p> <p>RI: Quadrature Phasing: Typically $\pm 0.5^\circ$.</p>
Subcarrier Regenerator	<p>Req: Pull-In Range NTSC: $\pm 50 \text{ Hz}$ of F_{SC}. PAL: $\pm 10 \text{ Hz}$ of F_{SC}.</p> <p>RI: Subcarrier Regenerator free runs in absence of appropriate signal. Reference can be burst of either the displayed signal or the external reference signal.</p> <p>RI: Pull-In Time: Within 1 second, with subcarrier frequency within 50 Hz (10 Hz for PAL) of F_{SC}.</p> <p>Req: Phase Shift with Subcarrier Frequency Change: NTSC: $\pm 2^\circ$ from F_{SC} to ($F_{SC} + 50 \text{ Hz}$), or F_{SC} to ($F_{SC} - 50 \text{ Hz}$). PAL: $\pm 2^\circ$ from F_{SC} to ($F_{SC} + 10 \text{ Hz}$), or F_{SC} to ($F_{SC} - 10 \text{ Hz}$).</p> <p>Req: Phase Shift with Burst Amplitude Change: $\pm 2^\circ$ from nominal burst amplitude to $\pm 6 \text{ dB}$. RI: Internal or External burst reference.</p> <p>Req: Phase Shift with Input Channel Change: $\pm 0.5^\circ$. RI: With EXT REF selected.</p> <p>Req: Phase Shift with Variable Gain Control: $\pm 1^\circ$ as gain is varied from +3 dB to -6 dB. RI: Phase Control Range: 360° continuous rotation.</p> <p>Req: Burst Jitter: 0.5° rms or less. RI: With 140 IRE (1 V PAL) composite video input. Internal or external referenced.</p>
Display Characteristics	<p>RI: Differential Phase: $\pm 1^\circ$.</p> <p>RI: Differential Gain: $\pm 1\%$.</p> <p>RI: Measured with 140 IRE (1 V PAL) linearity signal (5-step, 10-step, or Ramp) with 40 IRE (300 mV PAL) of subcarrier.</p>

Table 1-6: Power source

Category	Description
Mains Voltage Range	Req: 90–250 V.
Mains Frequency Range	Req: 48 Hz to 66 Hz.
Power Consumption	RI: 25 Watts maximum.
Power Fuse Rating	Req: 250 V, 2 A, F-type.

Table 1-7: Physical characteristics

Category	Description
Dimensions	RI: Height: 1 3/4 inches (44.5 mm). Width: 8 inches (203.2 mm). Length: 18 1/2 inches (469.9 mm).
Weight	RI: Approximately 4.0 lbs (approximately 1.8 kg).

Table 1-8: Environmental characteristics

Category	Description
Temperature	RI: Non-Operating: –55° C to +75° C. Operating: 0° C to +50° C. (IEC 1010-1 compliance to +40° C.)
Altitude	RI: Non-Operating: To 50,000 feet. Operating: To 15,000 feet. (IEC 1010-1 compliance to 2000 meters.)
Equipment Type	RI: Measurement (as defined in IEC 1010-1, Annex H).
Equipment Class	RI: Class I (as defined in IEC 1010-1 Annex H).
Installation Category	RI: Installation Category II (as defined in IEC 1010-1, Annex J). Note: Rated for indoor use only.
Pollution Degree	RI: Pollution Degree 2 (as defined in IEC 1010-1).
Vibration — Operating	RI: 15 minutes each axis at 0.015 inch, 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 a resonant point is not found. MIL-T-28800D, Paragraph 1.2.2, Class 3.
Shock — Non-Operating	RI: 30 g, 1/2 sine, 11 ms duration, 3 shocks per surface (18 total).
Transportation	RI: Qualified under NSTA Test Procedure 1A, Category II (24 inch drop).
Humidity	RI: Will operate at 95% relative humidity for up to five days.

Table 1-9: Certifications and compliances

Category	Description
EC Declaration of Conformity	<p>Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:</p> <p>EMC Directive 89/336/EEC:</p> <p>EN 50081-1 (Emissions): EN 55022 Class B Radiated and Conducted Emissions</p> <p>EN 50082-1 (Immunity): IEC 801-2 Electrostatic Discharge Immunity IEC 801-3 RF Electromagnetic Field Immunity IEC 801-4 Electrical Fast Transient/Burst Immunity</p> <p>Conditional Statements: 1. High quality shielded cables must be used to insure compliance to the above listed standards.</p> <p>Low Voltage Directive 73/23/EEC, Amended by 93/68/EEC:</p> <p>EN 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use. Part 1: General Requirements.</p>
Safety Standards U.S. Nationally Recognized Laboratory Listing	UL1244 Standard for Electrical and Electronic Measuring and Testing Equipment.
Canadian Certification	CAN/CSA C22.2 No. 231 CSA Safety Requirements for Electrical and Electronic Measuring and Test Equipment.
European Union Compliance	Low Voltage Directive 73/23/EEC, Amended by 93/68/EEC. EN61010-1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use.
Additional Compliance	IEC1010-1 Safety Requirements for Electrical for Measurement, Control, and Laboratory Use.
Safety Certification Compliance Temperature, operating	+5 to +40° C
Altitude (maximum operating)	2000 meters
Equipment Type	Test and measuring
Safety Class	Class I (as defined in IEC 1010-1, Annex H) – grounded product
Overvoltage Category	Overvoltage Category II (as defined in IEC 1010-1, Annex J).
Pollution Degree	Pollution Degree 2 (as defined in IEC 1010-1). Note: rated for indoor use only.