



Section 1

Introduction and Specification

The TEKTRONIX 1730-Series is an 8-1/2-inch wide by 5-1/4-inch high waveform monitor, weighing approximately 8 pounds. The 1730 (System M, NTSC) and the 1731 (System I, B, etc., PAL, PAL-M), and the 1735 (dual-standard) versions can be powered from an ac source or, with the addition of a field upgrade kit (1700F10), 12 Vdc. The CRT occupies approximately two-thirds of the front-panel area, with the control panel taking up the remainder of the space. Operation is controlled by a microprocessor that polls the front-panel switches and remote ground closures. Front-panel switches are of the momentary touch type with lighted functional indicators. Most of the switches are also used to select special functions, which are accessed by holding the switches in until the microprocessor recognizes the request.

The signal is displayed on a bright CRT capable of displaying one line per frame. It is of the mesh type, for better geometry, and uses an internal graticule to reduce parallax. Variable graticule scale illumination provides even lighting to improve measurement accuracy and the quality of waveform pictures. Option 74 provides a P4 (white) phosphor tube.

The Channel A and B Composite Video Inputs and the External Reference Signal Input are high impedance bridging loop-throughs, in order to protect the integrity of the signal paths. The input switching allows for the display of either Channel A or Channel B Input or both inputs. Synchronization can be either internal or external, with the further choices of using remote sync or 90 or 100 Hz synchronization, from a VTR, where the application warrants.

The 1730-Series offers a choice of three basic sweep rates: 2 Field, 2 Line, and 1 Line, each of which can be magnified to provide three additional sweep rates: 1 μ s (2 Line), 0.2 μ s (1 Line), and X25 (2 Field) which provides for viewing the complete vertical interval. In addition, there is full frame line selection that can be displayed as 1 line, 2 lines, or 15 lines. A bright-up pulse, for picture monitors, that corresponds to the intensified region on the CRT display, is available through a rear-panel bnc connector.

The vertical signal processing provides a choice of fast or slow dc restoration, or an unclamped display. The input signal can be unfiltered (Flat) or either Low Pass or Chrominance filtered. There is also a combination of Flat and Low Pass filtering available when a 2 Line or 2 Field sweep rate is employed; the display consists of one line or field low pass filtered while the second is unfiltered. Vertical amplitudes can be displayed in a calibrated gain mode, which corresponds directly with the graticule vertical scales, magnified 5 times, or can be set to a specific amplitude by using the Variable GAIN control.

An RGB or YRGB Parade display, for camera setup, is accommodated with a shortened sweep. The input of the camera signal and an enable are through the rear-panel REMOTE jack. The choice of 3-step (RGB) or 4-step (YRGB) is made by changing the position of an internal jumper.

The 1730-Series has a unique Store and Recall function built in that allows for the storing of up to four front-panel setups that can be recalled by pressing the appropriate recall button, or a ground closure through the rear-panel REMOTE connector. In addition, four factory-programmed measurement setups can be accessed, by external ground closures input through the REMOTE connector.

An auxiliary output, to control a companion 1720-Series Vectorscope, is provided through a rear-panel connector. The auxiliary output contains a bus for two-way communications between the waveform monitor and vectorscope microprocessors and a strobe to provide line select unblanking for the Vectorscope.

Typical Configurations

The 1730-Series Waveform Monitor is designed for operation either alone or with a 1720-Series Vectorscope. Line select and measurement recall for this waveform monitor are also used by the vectorscope. Because of these capabilities, and the available 90 or 100 Hz triggering, the 1730-Series Waveform Monitor is ideally suited to operate in a VCR bridge. With its factory-preset measurement routines, that can be accessed through the rear-panel REMOTE connector and the Store/Recall functions, it is possible to have one-button measurements of key parameters, including various vectorscope measurements.

In addition to the VCR bridge and the typical Master Control monitoring applications, this monitor can be used in camera chains. It has a choice of RGB or YRGB Parade display that can easily be selected by changing one internal jumper setting. The Parade signal and enable are input through the rear-panel REMOTE connector.

A number of operating conditions can be altered by changing internal jumpers, using some of the factory-preset combinations, or setting up and saving the front panel with the Store/Recall function. Using these methods most of the current 528A operational modes can be accommodated. There is a difference in how the remote control operates — the 1730-Series uses ground closures, not positive voltage as the 528A did.

Options

- CRT Options** The standard instrument is shipped with a P31 (green) phosphor CRT installed. Option 74 instruments are shipped with a P4 (white) phosphor CRT installed.
- Power Cord Options** Any of the power cord options described in Section 7 can be ordered for the 1730-Series. If no power cord option is ordered, instruments are shipped with a North American 125 V power cord and one replacement fuse.

Accessories

Standard Accessories The following accessories are shipped with the 1730-Series. Part numbers for these accessories are located at the end of the Replaceable Mechanical Parts list.

- 1 1730-Series Instruction Manual
- 1 Power Cord, with selected power plug option
- 1 Replacement Cartridge Fuse (correct rating for the power plug option)
- 3 Replacement Scale Illumination Bulbs (Tektronix Part No. 150-0168-00 or ANSI #73)

Optional Accessories There are a number of accessories that can be used with a 1730-Series Waveform Monitor. The following is a list of the most common accessory items for this series of waveform monitors. 1700F items are Field Upgrade Kits that are installed by the customer; instructions are included in all Field Upgrade Kits.

Viewing Hood (016-0475-00)

Front Panel Cover (200-3897-01)

1700F00, Plain Cabinet (painted silver-grey)

1700F02, Portable Cabinet (painted silver-grey)

1700F05, Side-by-Side Rack Adapter

1700F06, Blank Half-Rack Width Panel

1700F10, DC Power Converter

Safety Information

The 1730-Series is intended to operate from an ac power source that will not apply more than 250 V rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor is essential for safe operation (except for those instruments that are operated from a battery supply).

The 1730-Series was tested for compliance in a cabinet. To ensure continued compliance, the instrument will need to be enclosed in a cabinet that is equivalent to the Factory Upgrade Kits that are listed as Optional Accessories for the 1730-Series. A drawing of the 1700F00 plain cabinet is contained in the Installation Instructions (Section 3).

Specification

In the specification tables that follow, some items are identified as performance requirements. These can be verified by performing the Performance Check Procedure in Section 5. Not all performance requirements have a measurable tolerance, and therefore do not have a performance check step; however, they are either verified by indirect means, through other portions of the procedure, or are design criteria that do not need to be tested for individual instruments.

Whenever there is a verifiable performance requirement, in the specification table, there will also be a reference to identify the location, in the Performance Check Procedure, of the appropriate performance verification procedure.

The supplemental Information designation in the tables indicates that this is information that either amplifies a performance requirement or is special information that is of importance. Unlike performance requirements, there is no need, and often no way to check these items to any specific tolerance.

Table 1–1: Vertical Deflection System

Characteristic	Requirement	Supplemental Information	Step Number
Frequency response Flat	Flat: 50 kHz to 6 MHz within 2% of response at 50 kHz. Flat (X5): 50 kHz to 6 MHz within 5% of response at 50 kHz.	Specifications apply for full screen height video input signal, with variable GAIN off.	13
Low-pass filter	1730: At least 30 dB attenuation at 3.58 MHz 1735: 4.00 MHz 1731: 4.43 MHz	Response at 15 kHz does not vary between FLAT and LPASS by more than 1%	17
Chroma filter	NTSC and PAL-M: Nominal bandwidth 1 MHz. Attenuation at 7.2 MHz 20 dB or greater. Response at 3.58 MHz does not vary between FLAT and CHROMA by more than 1%.	Upper and lower –3 dB points are approximately ± 350 kHz from 3.579545 MHz. 15 to 35 °C operating temperature.	18
	PAL: Nominal bandwidth 1 MHz. Attenuation at 8.9 MHz 20 dB or greater. Response at 4.43 MHz does not vary between FLAT and CHROMA by more than 1%.	Upper and lower –3 dB points are approximately ± 350 kHz from 4.433619 MHz. 15 to 35 °C operating temperature.	
Transient response	Preshoot: $\leq 1\%$ Pulse-to-Bar Ratio: X1: 0.99:1 to 1.01:1 X5: 0.98:1 to 1.02:1 Overshoot: X1: 2% or less X5: 4% or less Ringing: X1: 2% or less X5: 4% or less	Specifications apply for full screen height video input signal, with variable GAIN off.	15, 16
Field rate tilt	$\leq 1\%$	Field rate square wave or vertical window	15
Line rate tilt	$\leq 1\%$	25 ms bar	15
Overscan	Less than 2% variation in baseline of 100 IRE (700 mV) 12.5T (20T) modulated pulse as it is positioned over the middle 80% of the screen.		15
Differential gain	Displayed differential gain is $\leq 1\%$ with 10% to 90% APL changes.	Chroma filter must be selected. Baseline at 50 IRE and displayed subcarrier adjusted to 100 IRE with VAR gain.	
Deflection factor	140 IRE (1.0 V) within 1% with 1 V input.	1 V full scale. 20-30 °C, Flat response selected. Vertical gain temperature coefficient is $-0.3\%/10$ °C.	9

Table 1-1: Vertical Deflection System (Cont.)

Characteristic	Requirement	Supplemental Information	Step Number
X5 gain accuracy	±5%	1 V input signal	9
X5 gain registration	≤1 major div. of vertical shift from baseline.	Unmagnified to magnified display	9
Variable gain range	Input signals between 0.8 V and 2 V can be adjusted to 140 IRE (1.0 V) display. 160 mV and 400 mV for X5 gain.		9
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 on, regardless of gain setting.	Applies to calibrated gain positions only	9
Maximum absolute input level	±5 VDC + peak AC	Displays in excess of 200 IRE (1.428 V) may cause frequency response aberrations.	
DC input impedance	Greater than 15 kΩ (unterminated)		
Return Loss (75 Ω) video inputs (CH-A, CH-B)	≥40 dB from 50 kHz to 6 MHz	A and B channels, loop-through terminated in 75Ω. Input in use or not in use, instrument power on or off, all deflection factor settings.	19
Crosstalk between channels		Greater than 50 dB of isolation between channels. Measured at F _{SC} between Channel A, Channel B, and EXT REF.	
Loop through isolation		Greater than 80 dB of isolation between loop-throughs. Measured at F _{SC} between Channel A, Channel B, and EXT REF.	
PIX MON frequency response	50 kHz to 6 MHz, within 3% of response at 50 kHz	Terminated in 75 Ω	14
PIX MON differential gain (50% APL)	Within 1% with a 140 IRE (1.0 V) unit display		
PIX MON differential phase (50% APL)	Within 1° with a 140 IRE (1.0 V) unit display		
PIX MON DC level on output	0.5 V or less into 75 Ω. load	No input signal	11
PIX MON intensification (bright-up)		During line select only. Active video of selected lines has a DC offset of approximately 180 mV.	
PIX MON output impedance		75 Ω. (nominal)	
PIX MON return loss (75 Ω)	≤30 dB, 50 kHz to 6 MHz	With instrument turned on	19
Input to PIX MON output gain ratio	1:1 ±5% at 15 kHz		11

Table 1-2: DC Restoration

Characteristic	Requirement	Supplemental Information	Step Number
DC restorer clamp time		Back porch	
Frequency response at 60 Hz	Slow: 20% or less Fast: 90% or greater	Attenuation of 60 Hz on input signal	12
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) or less.		12
Blanking level shift due to presence or absence of burst	1 IRE unit (7.14 mV) or less shift from no color burst to presence of color burst.		12

Table 1-3: Calibrator

Characteristic	Requirement	Supplemental Information	Step Number
Frequency	100 kHz \pm 100 Hz	Synchronizes in 2H and 1H sweeps. Crystal controlled. Timing accuracy is 10 μ s, \pm 0.01 μ s. Can be used as 10 μ s and 1 μ s timing calibrator.	3
Amplitude	140 IRE (1 V) within 1%		10
Position		Top of waveform must be between 80 IRE (0.86 V) and 120 IRE (1.14 V) on graticule when backporch is positioned to 0 IRE (0.300 V) line, with DC RESTORER on.	

Table 1-4: Horizontal Deflection System

Characteristic	Requirement	Supplemental Information	Step Number
Sweep	Sweep occurs in all horizontal mode settings with or without synchronization.		5
2FLD sweep repetition rate	Equal to frame rate of applied video or external sync		
2FLD sweep magnification		Approximately X25	

Table 1–4: Horizontal Deflection System (Cont.)

Characteristic	Requirement	Supplemental Information	Step Number
1LINE sweep repetition rate	Equal to line rate of applied video or external sync		
2LINE sweep repetition rate	Equal to half line rate of applied video or external sync		
Sweep length		2LINE and 2FLD sweep length is nominally 12.5 divisions.	
Timing accuracy		All timing and linearity specifications exclude the first and last major divisions of the unmagnified display. Timing can be adjusted $\pm 5\%$ with front-panel H CAL.	
10 $\mu\text{s}/\text{div.}$ (2LINE) sweep accuracy	Within 2%		6
5 $\mu\text{s}/\text{div.}$ (1LINE) sweep accuracy	Within 2%		6
0.2 $\mu\text{s}/\text{div.}$ (1LINE + MAG) sweep accuracy	Within 2%		6
Integral linearity	Within 1%	Measured between the 10 ms and 110 ms points on the 10 ms/division sweep. Calibrator transitions fall exactly on graticule marks.	6
Sweep magnifier registration		Magnification occurs about center of screen	
HORIZONTAL position	Any portion of a synchronized video sweep can be positioned on screen in all sweep modes.		

Table 1-4: Horizontal Deflection System (Cont.)

Characteristic	Requirement	Supplemental Information	Step Number
LINE SELECT	Displays the selected line in 1LINE. Displays the selected line first in 2LINE. Intensifies selected line in 2FLD. In 15LINE, displays overlaid lines in 1 or 2LINE, intensifies the selected 15 lines in 2FLD. A small 15 is added to the bottom of the CRT readout in 15LINE mode.		
Readout		NTSC: Field 1: Lines 1 to 263 Field 2: Lines 1 to 262 All: Lines 1 to 262 PAL Field 1: Lines 1 to 313 Field 2: Lines 314 to 625 All: Lines 1 to 312 PAL-M Field 1: Lines 1 to 263 Field 2: Lines 264 to 525 All: Lines 1 to 262	

Table 1-5: Synchronization

Characteristic	Requirement	Supplemental Information	Step Number
Input requirements, internal reference NTSC and PAL-M	Composite video or black burst with sync amplitudes 40 IRE ± 6 dB		4
PAL	Composite video or black burst with sync amplitudes 300 mV ± 6 dB		4
External reference	Sync amplitude between 143 mV and 4 V will synchronize sweeps		4
External reference, DC input impedance (unterminated)		Greater than 15 k Ω	
Return loss (75 Ω)	At least 40 dB from 50 kHz to 6 MHz	Loop-through terminated in 75 Ω , instrument power on or off	19
Absolute maximum input voltage		± 12 VDC plus peak AC	

Table 1–5: Synchronization (Cont.)

Characteristic	Requirement	Supplemental Information	Step Number
Remote sync Amplitude	2.0 to 5.0 V square wave, or 4.0 V comp sync	Input and enabled through rear-panel REMOTE connector. Input Impedance 1 MΩ. 30/60 Hz (25/50 Hz) square wave will sync 2FLD Sweep. Remote sync bypasses the sync stripper and field ID circuits.	
Sweep trigger polarity		Internal jumper selects polarity. Normal: Negative-going edge line sync, positive edge of field sync. Inverted: Positive-going edge line sync, negative edge of field sync.	
90/100 Hz triggering amplitude		2.0 to 5.0 V square wave	
90/100 Hz triggering frequency	NTSC: 90 Hz ±15% PAL: 100 Hz ±15%		9

Table 1–6: RGB/YRGB Mode

Characteristic	Requirement	Supplemental Information	Step Number
RGB/YRGB	Will display either a 3-step or 4-step RGB/YRGB parade or overlay display.	Internal jumper is used to change from 3-step to 4-step capability. Factory set to 3-step.	7
Staircase amplitude	A 10 V input will result in a horizontal display of 9 divisions ±1.4 major divisions.	Internal adjustment offsets any incoming signal DC component between ±12 V. Input impedance 1 MΩ shunted by approx. 3 pF.	7
Sweep repetition rate	Field or line rate of displayed video or external sync signal as selected by front-panel HORIZONTAL controls.	Field or line rate, if enabled from the REMOTE connector.	7
Control		RGB/YRGB mode and parade/overlay selected by applying ground (TTL low) at the RGB enable pin on the rear-panel REMOTE connector. RGB components may be overlaid with normal sweep length by not activating RGB enable.	
Magnifier		Approx. X25 for 2FLD, and X10 in 1 or 2LINE.	
Sweep length	3-step: 3.4 — 4.1 divs 4-step: 2.5 — 3.1 divs	Field or line rate sweeps. A 1FLD sweep is selected by grounding the 1FLD/1LINE pin of the rear-panel REMOTE connector.	7

Table 1-7: CRT Display

Characteristic	Requirement	Supplemental Information
CRT viewing area		80 X 100 mm Horizontal = 12.5 div Vertical = 170 IRE units (1.19 V)
Accelerating potential		Nominally 13.75 kV
Trace rotation range	Greater than $\pm 1^\circ$ from horizontal	Total adjustment range is typically 8°
Graticule		Internal, variable illumination

Table 1-8: Power Source

Characteristic	Requirement	Supplemental Information
Mains voltage range	90 – 250 V	Continuous range from 90 to 250 VAC
Mains frequency		50 or 60 Hz
Power consumption		56 VA (35 Watts)

Table 1-9: Environmental Characteristics

Characteristic	Requirement
Operating temperature	0 to 50 °C (+32 to 122 °F)
Storage temperature	-40 to 75 °C (-40 to 158 °F)
Operating altitude	To 15,000 feet (4572 meters)
Storage altitude	To 50,000 feet (15,240 meters)
Vibration	5 minutes at 5 - 15 Hz with 0.060 inch displacement. 5 minutes at 15 - 25 Hz with 0.040 inch displacement. 5 minutes at 25 - 55 Hz with 0.020 inch displacement. Military Specification: Mil-T-28800D, Paragraph 1.2.2, Class 3.
Mechanical shock	Non operating: 50 g's 1/2 sine, 11 ms duration, 3 shocks per surface (18 total).
Transportation	Qualified under NSTA Test Procedure 1A, Category II (24 inch drop).
Humidity	Will operate at 95% relative humidity for up to five days. Do not operate with visible moisture on the circuit boards.

Table 1–10: Certifications and Compliances

Category	Standards or Description
EC Declaration of Conformity – EMC ¹	<p>Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Union:</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>¹ High-quality shielded cables must be used to ensure compliance to the above listed standards.</p> <p>This product complies when installed into any of the following Tektronix instrument enclosures:</p> <p style="padding-left: 40px;">1700F00 Standard Cabinet 1700F02 Portable Cabinet 1700F05 Rack Adapter</p>
Australia/New Zealand Declaration of Conformity – EMC	<p>Complies with EMC provision of Radiocommunications Act per the following standard(s):</p> <p>AN/NZS 2064.1/2 Industrial, Scientific, and Medical Equipment: 1992 AN/NZS 3548 Information Technology Equipment: 1995</p>
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.
Installation (Overvoltage) Category	<p>Terminals on this product may have different installation (overvoltage) category designations. The installation categories are:</p> <p>CAT III Distribution-level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location.</p> <p>CAT II Local-level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord-connected.</p> <p>CAT I Secondary (signal level) or battery operated circuits of electronic equipment.</p>
Pollution Degree	<p>A measure of the contaminates that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.</p> <p>Pollution Degree 1 No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.</p> <p>Pollution Degree 2 Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.</p> <p>Pollution Degree 3 Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.</p>

Table 1–10: Certifications and Compliances (Cont.)

Category	Standards or Description	
	Pollution Degree 4	Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.
Safety Standards		
U.S. Nationally Recognized Testing Laboratory Listing	UL1244	Standard for electrical and electronic measuring and test 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 93/69/EEC EN 61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use.
Additional Compliance	IEC61010-1	Safety requirements for electrical equipment 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 1 (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.	

Table 1–11: Physical Characteristics

Characteristic	Requirement
Dimensions	Height: 5 1/4 inches (133.4 millimeters) Width: 8 1/2 inches (215.9 millimeters) Depth: 18 1/8 inches (460.4 millimeters)
Weight	Net: 8.5 pounds (3.8 kilograms)



Operating Instructions

