

PACKAGING FOR SHIPMENT

If this instrument is to be shipped for long distances by commercial transportation, it is recommended that the instrument be packaged in the original manner. The carton and packaging material in which your instrument was shipped should be saved and used for this purpose.

Also, if this instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag to the instrument showing the following: Owner of the instrument (with address), the name of a person at your firm who can be contacted, complete instrument type and serial number, and a description of the service required.

If the original packaging is unfit for use or not available, package the instrument as follows:

1. Obtain a corrugated cardboard shipping carton having inside dimensions at least six inches greater than the instrument dimensions; refer to Table 1-3 for carton test strength requirements.
2. Enclose the instrument with polyethylene sheeting or equivalent to protect the finish of the instrument.

3. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the instrument, allowing three inches on each side.

4. Seal the carton with shipping tape or with an industrial stapler.

5. Mark the address of the Tektronix Service Center and your return address on the carton in one or more prominent locations.

TABLE 1-3
Shipping Carton Test Strength

Gross Weight (lb)	Carton Test Strength (lb)
0-10	200
10-30	275
30-120	375
120-140	500

SPECIFICATION

The electrical characteristics listed in Table 1-4 apply when the following conditions are met: (1) Calibration of the instrument must have taken place at an ambient temperature between +20° and +30° C, (2) the instrument must be allowed a 20-minute warm-up period, (3) all specifications are valid at an ambient temperature of 0° to +50° C, unless otherwise stated, (4) the instrument must be in an environment that meets the limits described in Table 1-5.

Any applicable conditions not listed above are expressly stated as part of that characteristic. Environmental characteristics are listed in Table 1-5 and Physical characteristics are listed in Table 1-6.

TABLE 1-4
Electrical Characteristics

Characteristic	Performance Requirement
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VERTICAL SYSTEM

Deflection Factor	Compatible with all 7000-series plug-in units.
Difference Between Vertical Compartments	1% or less.
Low-Frequency Linearity	0.1 div or less compression or expansion of a center-screen 2-div display positioned anywhere vertically within the graticule area.
Frequency Response	Varies with plug-in unit selected. See 7104 Oscilloscope Vertical Systems Specification, Table 1-7.
Step Response	
Risetime (10 to 90%), with 7A29 Amplifier Unit	350 ps or less (calculated from bandwidth).

TABLE 1-4 (CONT.)
Electrical Characteristics

Characteristic	Performance Requirement
Isolation Between Vertical Compartments (8 division signal) LEFT, RIGHT, ALT Modes	At least 160:1 from dc to 100 MHz and at least 80:1 from 100 MHz to 1 GHz.
Delay Line	Permits viewing leading edge of triggering signal. NOTE <i>7B50-series time-base units will not display leading edge of the trigger signal in 7104 (except 7B50A).</i>
Difference in Signal Delay Between Vertical Compartments	50 ps or less.
Vertical Display Modes	Selected by front-panel VERTICAL MODE switch.
LEFT	Left vertical-unit displayed.
ALT	Display alternates between left and right vertical units at a rate determined by the horizontal plug-in unit(s).
ADD	Display is algebraic sum of left and right vertical units.
CHOP	Display chops between Left and Right vertical units asynchronously to horizontal plug-in unit(s).
Repetition Rate	1 MHz within 20%.
RIGHT	Right vertical unit displayed.
"Slaved ALT"	Slaved operation occurs if: (1) VERT MODE switch set to ALT, (2) HORIZ MODE switch set to ALT or CHOP, (3) time-base unit is installed in each horizontal compartment and (4) time-base unit installed in A HORIZ compartment operates in Independent mode. When in slaved operation the display alternates between: (1) trace produced by LEFT VERT unit displayed at sweep rate of B time-base unit and (2) trace produced by RIGHT VERT unit displayed at sweep rate of A time-base unit. NOTE <i>VERT TRACE SEPARATION (B) critical in operation in "Slaved ALT" Mode</i>
VERT TRACE SEPARATION (B)	Positions "B" trace at least 4 div above and below "A" trace, when 7104 operates in ALT or CHOP horizontal modes. See note concerning "Slaved ALT" vertical mode.

TABLE 1-4 (CONT.)
Electrical Characteristics

Characteristic	Performance Requirement						
TRIGGERING							
A and B TRIGGER SOURCE	Selected by front-panel switches. Lights behind pushbuttons are illuminated to indicate trigger source.						
VERT MODE	<p>The trigger source is controlled by vertical display mode selection. Source (sources) is (are) shown by the illumination of the LEFT and RIGHT trigger source buttons. Source follows (is same as) the vertical display with the following two exceptions:</p> <table border="1"> <tr> <td>VERT MODE</td><td>Trigger Source</td></tr> <tr> <td>CHOP</td><td>LEFT</td></tr> <tr> <td>"Slaved ALT"</td><td>RIGHT for A TRIGGER LEFT for B TRIGGER</td></tr> </table> <p>See Vertical Display Modes for slaved operation.</p>	VERT MODE	Trigger Source	CHOP	LEFT	"Slaved ALT"	RIGHT for A TRIGGER LEFT for B TRIGGER
VERT MODE	Trigger Source						
CHOP	LEFT						
"Slaved ALT"	RIGHT for A TRIGGER LEFT for B TRIGGER						
LEFT	Trigger source: LEFT vertical unit. LEFT trigger source button illuminated.						
RIGHT	Trigger source: RIGHT vertical unit. RIGHT trigger source button illuminated.						
HORIZONTAL SYSTEM							
Deflection Factor	Compatible with all 7000-series plug-in units.						
Gain Difference Between Horizontal Compartments	1% or less.						
DC Linearity	0.05 division or less error at each graticule line after adjusting for no error at second and tenth graticule lines.						
Fastest Calibrated Sweep Rate	200 ps/div. (See 7104 Horizontal System Specs., Table 1-8.)						
Horizontal Display Modes	Selected by front-panel HORIZONTAL MODE switch.						
A	A horizontal unit displayed.						
ALT	Display alternates between A and B horizontal units.						
CHOP	Display chops between A and B horizontal units.						
B	B horizontal unit displayed.						
Chopped Mode							
Repetition Rate	200 kHz within 20%.						
Phase Shift Between Vertical and Horizontal Deflection Systems	2° or less from dc to at least 50 kHz.						
Option 2 (B HORIZ compartment only) with 7A19s or 7A29s, at least one of which has the variable delay option	2° or less from dc to 50 MHz after adjusting variable delay for balance at 35 MHz. Phase balance can be obtained at any frequency up to 250 MHz.						
Bandwidth	350 MHz						

TABLE 1-4 (CONT.)
Electrical Characteristics

Characteristic	Performance Requirement
X-Y Displays	X-Y displays can only be obtained in conjunction with a time-base unit. With an amplifier unit installed in the A(B) horizontal compartment the Z-axis can only be controlled by the time-base unit in the B(A) horizontal compartment. This is independent of the horizontal mode switch selection.

CALIBRATOR

Waveshape	Square wave.
Polarity	Positive going, with baseline near 0 volt.
Output Resistance	450 Ω .
Output Voltage	(Selected by front-panel CALIBRATOR switch.)
Into 100 k Ω or greater	40 mV, 0.4 V, 4 V.
Into 50 Ω	4 mV, 40 mV, 0.4 V.
Output Current	40 mA available through CALIBRATOR output with optional bnc-to-Current Loop adapter. CALIBRATOR must be set to 4 V for calibrated output.
Amplitude Accuracy (P-P Voltage)	Within 1%.
Repetition Rate	1 kHz within 0.25%.
Duty Factor	49.8% to 50.2%.
Rise Time and Fall Time	500 ns or less into 100 pF or less.

SIGNAL OUTPUTS

*SAWTOOTH OUT	
Source	Selected by front-panel switch. A: A HORIZ time-base unit. B: B HORIZ time-base unit.
Polarity	Positive-going with baseline at 0 V within 1 V into 1 M Ω .
Output Voltage	
Rate of Rise	
Into 50 Ω	50 mV/unit of time selected by time-base unit time/div switch, within 15%, 100 ns/div maximum sweep rate.
Into 1 M Ω	1 V/unit of time selected by the time-base unit time/div switch, within 10%, 1 μ s/div maximum sweep rate.
Output Resistance	Approximately 950 Ω .
*GATE	
Source	Selected by front-panel switch. A: A Gate, derived from A HORIZ time-base unit main gate. B: B Gate, derived from B HORIZ time-base unit main gate.

TABLE 1-4 (CONT.)
Electrical Characteristics

Characteristic	Performance Requirement
+GATE (continued)	
Polarity	Positive-going with baseline at 0 V within 1.0 V into 1 M Ω .
Output Voltage	
Into 50 Ω	0.5 V within 10%.
Into 1 M Ω	10 V within 10% (up to 1 μ s/div sweep rate).
Rise Time Into 50 Ω	5 ns or less.
Fall Time Into 50 Ω	15 ns or less.
Output Resistance	Approximately 950 Ω .
SIG OUT	Selected by B TRIGGER SOURCE switch.
Source	Same as B TRIGGER SOURCE.
Output Voltage	
Into 50 Ω	25 mV/div of vertical deflection within 25%.
Into 1 M Ω	For a maximum output of ± 2 V: 0.5 V/div of vertical deflection within 25%.
Bandwidth Into 50 Ω	Varies with vertical plug-in selected; see 7104-series Oscilloscope Systems Specification.
DC Centering	0 V within 1"V into 1 M Ω .
Aberrations	15% or less p-p within 50 ns of step.
Output Resistance	Approximately 950 Ω .

READOUT DISPLAY

Readout Modes	
Free-Run (Not Labeled)	Continuously displayed.
PULSED	Single-shot operation.
Pulse Source	<p>Selected by front-panel switches.</p> <p>+GATE: Triggered by the trailing edge of the +GATE selected by the front-panel switch.</p> <p>EXT: Controlled through rear-panel remote control connector.</p> <p>MAN: Manual trigger, independent of other pulse sources.</p>

TABLE 1-4 (CONT.)
Electrical Characteristics

Characteristic	Performance Requirement
DISPLAY	
Graticule	
Type	Internal, illuminated with variable edge lighting.
Lighting	
Normal	Continuously lighted.
PULSED	Single-shot operation. Lights are pulsed on for approximately 0.5 seconds.
Pulse Source	Selected by front-panel switches. +GATE: Triggered by trailing edge of +GATE selected by front-panel switch. EXT: Controlled through rear-panel remote control connector. MAN: Manual trigger, independent of other pulse sources.
Area	8 × 10 div 0.85 cm/div.
Phosphor	P31.
Vertical and Horizontal Resolution	17 lines/div.
High Voltage	
Screen Voltage	Approximately 12.5 kV.
Limited Viewing Time Indicator	
Steady Yellow	Crt display time is limited to approximately 1 hour.
Flashing Yellow	Crt display time is limited to approximately 1 minute and intensity is being limited.
Geometry	Within 0.1 div of vertical and horizontal graticule lines.
BEAMFINDER	When actuated, limits display to within graticule area and defocuses display.
Photographic Writing Speed	20 cm./nsec (without blue filter). Phosphor: Standard P31. Camera: TEKTRONIX C53; f/1.9 1:0.85 lens. Film: Polaroid Type 107; 3000 ASA.

REMOTE CONNECTORS AND SWITCHES

Control Illumination	HIGH, MEDIUM and OFF. Three position switch located on rear panel of power supply.
Camera Power	Three-contact connector compatible with TEKTRONIX C-50 Series Cameras.
Bottom Pin	Ground
Center Pin	Single sweep reset.
Top Pin	+15 V

TABLE 1-4 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement
REMOTE RESET INPUT	Input to reset single-sweep function of time-base units installed in A and B HORIZ compartments.
Signal Required	Closure to ground or switching from the high level (+50 to +10 V; sink less than 40 μ A) to low level (+0.5 V to -5 V; sink less than 12 mA) in less than 1 msec, resets the sweep. Compatible to 15 V open collector TTL source.
Minimum Pulse Width	10 μ s at 50% amplitude points.
Maximum Safe Input Voltage	+50 V to -5 V (dc + peak ac).
A SINGLE SWEEP READY	Connector (bnc) on rear panel. Remote ready indicator for A HORIZ time-base unit.
Output Signal	Open when not ready. +5 V at 47 Ω source impedance when ready. Output will light a No. 49 bulb.
B SINGLE SWEEP READY	Connector (bnc) on rear panel. Remote ready indicator for B HORIZ time-base unit.
Output Signal	Open when not ready. +5 V at 47 Ω source impedance when ready. Output will light a No. 49 bulb.
GRATICULE/READOUT SINGLE SHOT	Connector (bnc) on rear panel. Switching to the low level (+1 V to -5 V; sink less than 2 mA) from the high level (+10 V to +15 V; sink less than 0.3 mA), in less than 1 μ sec, triggers the readout to display one complete readout frame and the GRAT ILLUM to be illuminated for approximately 0.5 sec. Compatible to 15 V open collector TTL source.
Maximum Open Circuit Voltage	+15 V.
Maximum Safe Input Voltage	+15 V to -5 V (dc plus peak ac).
Probe Power	Two probe power connectors on rear panel.
Pin 1	+5 V.
Pin 2	Chassis ground.
Pin 3	-15 V.
Pin 4	+15 V.
Z-AXIS INPUT (External)	Connector (bnc) on rear panel.
Polarity and Sensitivity	Positive 2 V provides complete blanking from maximum intensity condition. Negative 2 V provides complete unblanking from minimum intensity condition.
Low Frequency Limit	Dc.
Input Resistance	Approximately 500 Ω .
Input Capacitance	Less than 50 pF.
Open Circuit Voltage	0 V.
Maximum Safe Input Voltage	15 V, dc plus peak ac.
Maximum Repetition Rate	1 MHz.

TABLE 1-4 (CONT.)
Electrical Characteristics

Characteristic	Performance Requirement
POWER SOURCE	
Voltage Range (AC, RMS)	Selected by rear-panel LINE VOLTAGE SELECTOR switch.
115 V Rated	From 90 V to 132 V.
230 V Rated	From 180 V to 250 V.
Line Frequency	From 48 Hz to 440 Hz.
Maximum Power Consumption	215 W.
Maximum Current	3.3 A at 60 Hz, 90 V Line.
	1.7 A at 60 Hz, 180 V Line.
Fuse Data Line (P1200)	4 A fast blow. (For both LINE VOLTAGE SELECTOR ranges.)

TABLE 1-5
Environmental Characteristics

Characteristic	Information
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NOTE

This instrument will meet the electrical characteristics given in the Performance Requirement column of Table 1-4 over the following environmental limits.

Temperature	
Operating	0° to +50° C.
Storage	-55° to +75° C.
Altitude	
Operating	5 km (15,000 feet).
Storage	15 km (50,000 feet).

EMC (Electromagnetic Compatibility
Option 3 Only)

NOTE

Any unused plug-in compartments must be covered with a blank plug-in panel (EMI shielded) in order to meet EMC specifications. See Instrument Options section for additional information.

Meets requirements of MIL-STD-461 A, when tested in accordance with the following test methods of MIL-STD-462:

CE-01, CE-03, CS-01, CS-02, CS-06, RE-02, (Limited to 1 GHz), (T) RE-04, RS-01, and RS-03 (Limited to 1 GHz).

TABLE 1-6
Physical Characteristics

Characteristic	Information
Ventilation	Safe operating temperature maintained by dc fan. Automatic resetting thermal cutout protects instrument from overheating.
Finish	Anodized front- and rear-panel with blue-vinyl painted aluminum cabinet.
Overall Dimensions (measured at maximum points)	See Figure 1-1.
Height	13.6 inches. 34.5 cm.
Width	12.0 inches. 30.5 cm.
Length	23.5 inches. 59.2 cm.
Net Weight (Instrument without Plug-ins)	43.6 lb. 19.8 kg.

TABLE 1-7
Plug-In Incompatibilities

The 7104 Oscilloscope is compatible with Tektronix 7000 Series Plug-in units with the exceptions listed in the following table.

Plug-In Unit	Operating Condition	Symptom	Cause
LOGIC ANALYZER UNITS			
7D01 & 7D02	Any	Not compatible for use with the 7104 Oscilloscope. Any CRT damage caused by the use of the 7D01 or 7D02 in the 7104 Oscilloscope will not be covered under instrument warranty.	The 7104 display from these Logic Analyzers can cause permanent reduction in CRT microchannel plate gain; consequently, a permanent reduction in writing rate. For more information refer to "Reduction of Display Gain with Display Output Change".

SYSTEM ELECTRICAL SPECIFICATION

Your TEKTRONIX 7104 Oscilloscope system provides exceptional flexibility in operation with a wide choice of general- and special-purpose plug-in units. The type number of a particular plug-in unit identifies its usage as follows:

The first digit (7) denotes the oscilloscope system for which the plug-in is designed (7000-series).

The second letter describes the purpose of the plug-in unit:

- A—Amplifier unit
- B—"Real time" time-base unit
- C—Curve tracer
- D—Digital unit
- L—Spectrum analyzer
- M—Miscellaneous
- S—Sampling unit
- T—Sampling time-base unit

The third and fourth digits of the plug-in type number do not carry any special connotation.

A "N" suffix letter added to the normal four-digit type number identifies a unit not equipped with the circuitry necessary to encode data for the 7000-series readout system.

Table 1-8 lists the vertical specifications which are system dependent. For more complete specifications on plug-in units for 7000-series oscilloscope system, refer to the Tektronix Products catalog.

Table 1-9 lists the horizontal specifications which are system dependent. For more complete specifications on plug-in units for the 7000-series oscilloscope system, refer to the Tektronix Products catalog.

Table 1-10 lists some special purpose plug-in units available for use with the 7104 Oscilloscope.