GENERAL INFORMATION

INTRODUCTION

The TEKTRONIX 2213A Oscilloscope is a rugged, lightweight, dual-channel 60 MHz instrument that features a bright, sharply defined trace on an 80- by 100 mm cathode-ray tube (crt). Its vertical system supplies calibrated deflection factors from 2 mV per division to 5 V per division. Trigger circuits enable stable triggering over the full bandwidth of the vertical system. The horizontal system provides calibrated sweep speeds from 0.5 s per division to 50 ns per division, along with a delayed-sweep feature. A X10 magnifier circuit extends the maximum sweep speed to 5 ns per division when the SEC/DIV switch is set to 0.05 μs per division.

The instrument is shipped with the following standard accessories:

- 1 Operators manual
- 1 Power cord
- 2 Probe packages

For part numbers and information about instrument accessories, refer to the "Options and Accessories" section of this manual.

The service manual and all other optional accessories are orderable from Tektronix, Inc. A local Tektronix Field Office, representative, or the Tektronix product catalog can provide ordering and product information.

SPECIFICATION

The following electrical characteristics (Table 1-1) are valid for the 2213A when it has been adjusted at an ambient temperature between +20°C and +30°C, has had a warm-up period of at least 20 minutes, and is operating at an ambient temperature between 0°C and +50°C (unless otherwise noted).

Items listed in the "Performance Requirements" column are verifiable qualitative or quantitative limits, while items listed in the "Supplemental Information" column are either explanatory notes, calibration setup descriptions, performance characteristics for which no absolute limits are specified, or characteristics that are impractical to check.

Environmental characteristics are given in Table 1-2. The 2213A meets the requirements of MIL-T-28800C, paragraphs 4.5.5.1.3, 4.5.5.1.4, and 4.5.5.1.2.2 for type III, Class 5 equipment, except where otherwise noted.

Physical characteristics of the instrument are listed in Table 1-3.

Table 1-1
Electrical Characteristics

Characteristics	Performance Requirements	Supplemental Information
VERTICAL DEFLECTION SYSTEM		
Deflection Factor		5 mV per division to 5 V per division gain is adjusted with VOLTS/DIV switch set to 10 mV per division. 2 mV per division gain is adjusted with VOLTS/DIV switch set to 2 mV per division.
Range	2 mV per division to 5 V per division in a 1-2-5 sequence.	
Accuracy	±3%	
Range of VOLTS/DIV Variable Control	Continuously variable between settings. Increases deflection factor by at least 2.5 to 1.	
Step Response Rise Time		Rise time is calculated from the formula: $\frac{0.35}{\text{Bandwidth } (-3 \text{ dB})}$
Rise Time		
0°C to +35°C		
5 mV per Division to 5 V per Division	5.8 ns or less.	
0°C to 50°C		
2 mV per Division to 5 V per Division	7.0 ns or less.	
Bandwidth (−3 dB)		Measured with a vertically centered 6-division reference signal from a 50 Ω source driving a 50 Ω coaxial cable that is terminated in 50 Ω, both at the input connector and at the probe input, with the VOLTS/DIV Variable control in the CAL detent.
0°C to +35°C		
2 mV per Division	Dc to at least 50 MHz.	
5 mV per Division to 5 V per Division	Dc to at least 60 MHz.	
0°C to +50°C		
2 mV per Division to 5 V per Division	Dc to at least 50 MHz.	
AC Coupled Lower Limit	10 Hz or less at −3 dB.	
Bandwidth Limiter	Upper limits (−3 dB) bandpass at 10 MHz ±15%.	
Chop Mode Switching Rate	500 kHz ±30%.	
Input Characteristics		
Resistance	1 MΩ ±2%.	
Capacitance	20 pF ±2 pF.	
Maximum Safe Input Voltage ⚠		See Figure 1-1 for derating curve.
DC Coupled	400 V (dc + peak ac) or 800 V ac p-p to 10 kHz or less.	
AC Coupled	400 V (dc + peak ac) or 800 V ac p-p to 10 kHz or less.	

Table 1-1 (cont)

Characteristics	Performance Requirements		Supplemental Information
VERTICAL DEFLECTION SYSTEM (cont)			
Common-Mode Rejection Ratio (CMRR)	At least 20 to 1 at 25 MHz.		Checked at 10 mV per division for common-mode signals of 6 divisions or less with VOLTS/DIV Variable control adjusted for best CMRR at 50 kHz.
Trace Shift with Attenuator Rotation	0.75 division or less.		VOLTS/DIV Variable control in CAL detent.
Trace Shift as VOLTS/DIV Variable Control is Rotated	1.0 division or less.		
Trace Shift with Invert	1.5 division or less.		
Channel Isolation	Greater than 100 to 1 at 25 MHz.		
TRIGGER SYSTEM			
TRIGGER Sensitivity			External trigger signal from a 50 Ω source driving a 50 Ω coaxial cable terminated in 50 Ω at the input connector.
P-P AUTO/TV LINE and NORM Modes	**5 MHz**	**60 MHz**	
Internal	0.3 div	1.0 div	
External	40 mV	150 mV	
Lowest Useable Frequency in P-P AUTO Mode	20 Hz with 1.0 division internal or 100 mV external.		
TV FIELD Mode	1.0 division of composite sync.		
EXT INPUT			
Maximum Input Voltage ⚠	400 V (dc + peak ac) or 800 V ac p-p at 10 kHz or less.		See Figure 1-1 for derating curve.
Input Resistance	1 MΩ ±2%.		
Input Capacitance	20 pF ±2.5 pF.		
AC Coupled	10 Hz or less at lower −3 dB point.		
LEVEL Control Range (NORM)			
INT	Can be set to any point of the trace that can be displayed.		
EXT, DC	At least +1.6 V, 3.2 V p-p.		
EXT, DC ÷ 10	At least +16 V, 32 V p-p.		
VAR HOLDOFF Control	Increases Sweep holdoff time by at least a factor of 10.		

Table 1-1 (cont)

Characteristics	Performance Requirements		Supplemental Information
HORIZONTAL DEFLECTION SYSTEM			
Sweep Rate	0.5 s per division to 0.05 μs per division in a 1-2-5 sequence. X10 magnifier extends maximum sweep speed to 5 ns per division.		
Accuracy	**Unmagnified**	**Magnified**	Sweep accuracy applies over the center 8 divisions. Exclude the first 25 ns of the sweep for magnified sweep speeds and anything beyond the 100th magnified division.
+15°C to +35°C	±3%	±4%	
0°C to +50°C	±4%	±5%	
POSITION Control Range	Start of sweep to 10th division in X1 or 100th divisions in X10 will position past the center vertical graticule line.		
Sweep Linearity	+7%.		Linearity measured over any 2 of the center 8 divisions. With magnifier in X10, exclude the first 25 ns and anything past the 100th division.
Variable Control Range	Continuously variable between calibrated settings. Extends the sweep speed by at least a factor of 2.5.		
Delay Time			
Delay Positions	Minimum less than 1.0 μs, 20 μs, and 0.4 ms.		
MULTIPLIER	Increases delay time by at least a factor of 50.		
Jitter	One part or less in 10,000 (0.01%) of the maximum available delay time.		
X-Y OPERATION (X1 MAGNIFICATION)			
Deflection Factors	Same as Vertical Deflection System (with VOLTS/DIV Variable controls in CAL detent).		
Accuracy			Measured with a dc-coupled, 5-division reference signal.
X-Axis	±4%.		
Y-Axis	Same as Vertical Deflection System.		
Bandwidth (−3 dB)			Measured with a 5-division reference signal.
X-Axis	Dc to at least 2 MHz.		
Y-Axis	Same as Vertical Deflection System.		
Phase Difference Between X- and Y-Axis Amplifiers	±3° from dc to 100 kHz.		With dc-coupled inputs.

Table 1-1 (cont)

Characteristics	Performance Requirements	Supplemental Information
PROBE ADJUST		
Output Voltage of PROBE ADJUST Jack	0.5 V ±5%.	
Repetition Rate	1 kHz ±20%.	
Z-AXIS INPUT		
Sensitivity	5 V causes noticeable modulation. Positive-going input decreases intensity.	Useable frequency range is dc to 10 MHz.
Maximum Safe Input Voltage	30 V (dc + peak ac) or 30 VC p-p ac at 1 kHz or less.	
Input Resistance	10 kΩ ±10%.	
POWER SOURCE		
Line Voltage Ranges	90 V to 250 V.	
Line Frequency	48 Hz to 440 Hz.	
Maximum Power Consumption	40 W (70 VA).	
Line Fuse	1.0 A, 250 V, slow-blow.	
CATHODE-RAY TUBE		
Display Area	80 by 100 mm.	
Standard Phosphor	P31.	
Nominal Accelerating Voltage	14 kV.	

Table 1-2
Environmental Characteristics

Characteristics	Description
	NOTE *The instrument meets the requirements of MIL-T-28800C, paragraphs 4.5.5.1.3, 4.5.5.1.4, and 4.5.5.1.2.2 for Type III, Class 5 equipment, except where otherwise noted.*
Temperature	
Operating	0°C to +50°C (+32°F to +122°F).
Nonoperating	−55°C to +75°C (−67°F to +167°F). Tested to MIL-T-28800C paragraphs 4.5.5.1.3 and 4.5.5.1.4, except in 4.5.5.1.3 steps 4 and 5 (0°C operating test) are performed ahead of step 2 (−55°C nonoperating test). Equipment shall remain off upon return to room ambient during step 6. Excessive condensation shall be removed before operating during step 7.
Altitude	
Operating	To 4,500 m (15,000 ft). Maximum operating temperature decreased 1°C per 1,000 ft above 5,000 ft.
Nonoperating	To 15,000 m (50,000 ft).
Humidity (Operating and Nonoperating)	5 cycles (120 hours) referenced to MIL-T-28800C paragraph 4.5.5.1.2.2 for Type III, Class 5 instruments. Operating and non-operating at 95% +0% to −5% relative humidity. Operating at +50°C and +30°C. Non-operating at +30°C to +60°C.
Vibration (Operating)	15 minutes along each of 3 major axes at a total displacementof 0.015 inch p-p (2.4 g's at 55 Hz) with frequency varied from 10 Hz to 55 Hz to 10 Hz in 1-minute sweeps. Hold for 10 minutes at 55 Hz in each of the 3 major axes. All major resonances must be above 55 Hz.
Shock (Operating and Nonoperating)	30 g's, half-sine, 11-ms duration, 3 shocks per axis each direction, for a total of 18 shocks.
EMI	Meets radiated and conducted emission requirements per VDE 0871 Class B.

Table 1-3
Physical Characteristics

Characteristics	Description
Weight With Power Cord	
With Cover, Probes, and Pouch	6.0 kg (13.1 lb).
Without Cover, Probes, and Pouch	5.0 kg (10.9 lb).
Domestic Shipping Weight	7.0 kg (15.4 lb).
Height	
With Feet and Handles	137 mm (5.4 in).
Width	
With Handle	360 mm (14.2 in).
Without Handle	327 mm (12.9 in).
Depth	
With Front Cover	445 mm (17.5 in).
Without Front Cover	440 mm (17.3 in).
With Handle Extended	511 mm (20.1 in).

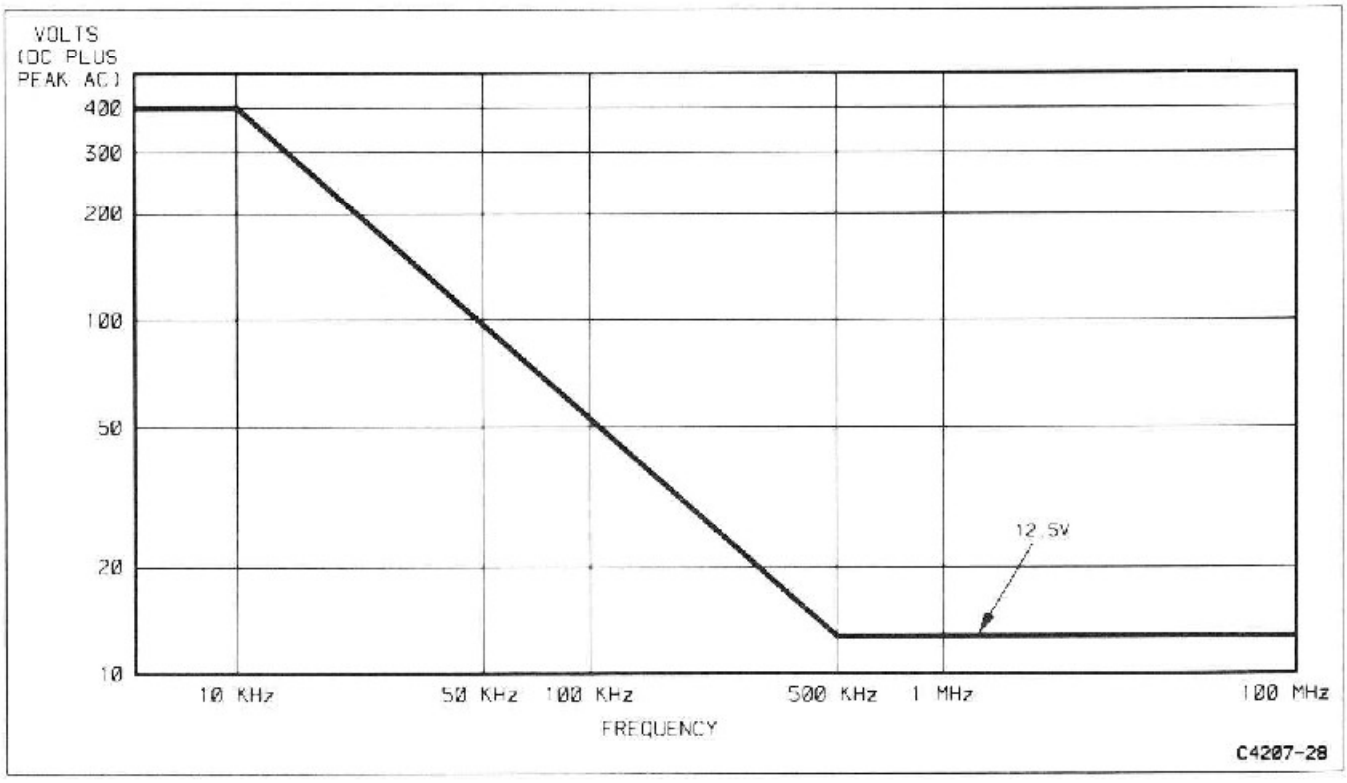

Figure 1-1. Maximum input voltage vs. frequency derating curve for CH 1 OR X, CH 2 OR Y, and EXT INPUT connectors.

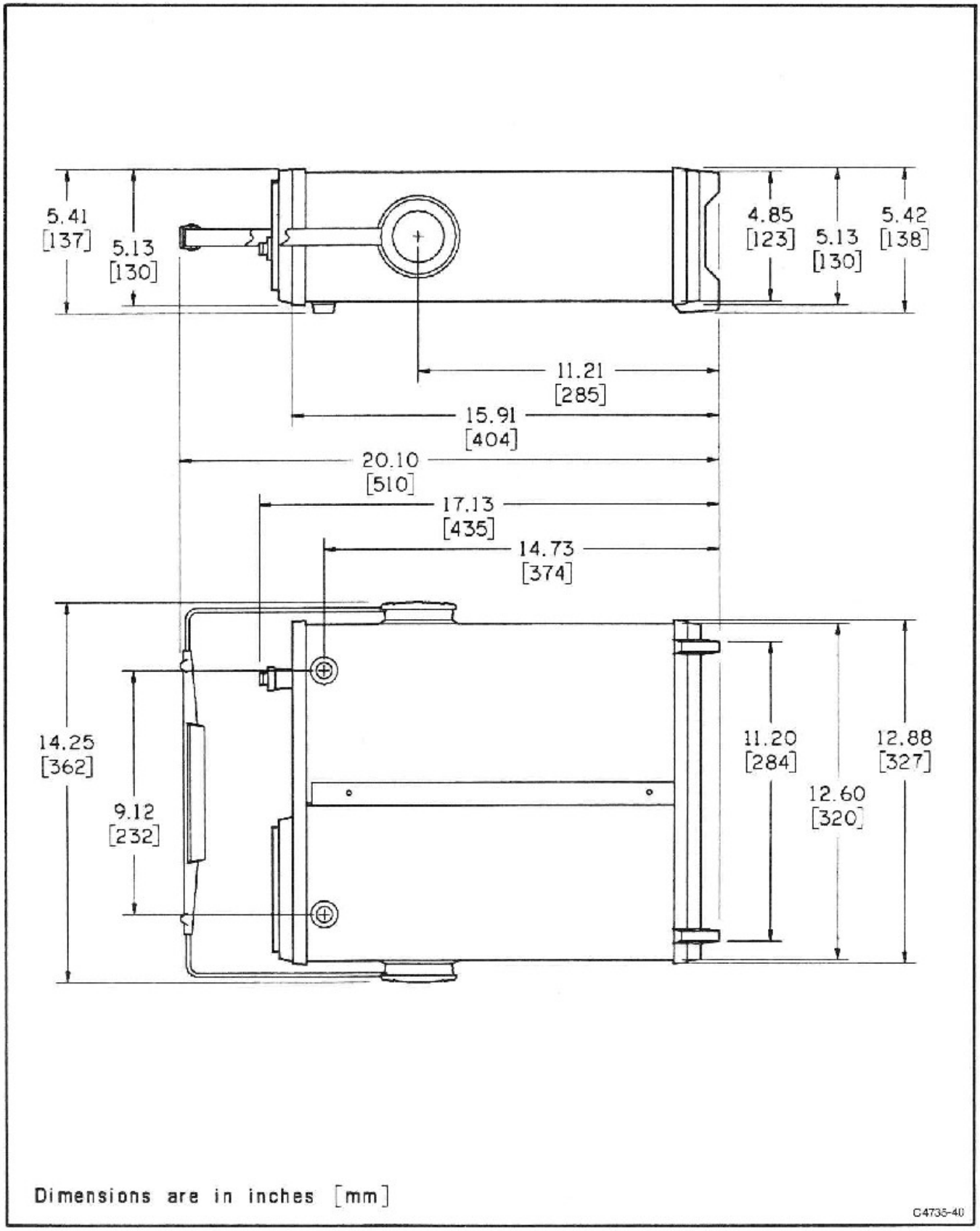

Figure 1-2. Physical dimensions of the 2213A Oscilloscope.