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2235
OSCILLOSCOPE
OPERATORS

INSTRUCTION MANUAL

Tektronix, Inc.
P.O. Box 500
Beaverton, Oregon **97077**

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Each instrument has a serial number on a panel insert, tag,
or stamped on the chassis. The first number or letter
designates the country of manufacture. The last five digits
of the serial number are assigned sequentially and are
unique to each instrument. Those manufactured in the
United States have six unique digits. The country of
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B000000	Tektronix, Inc., Beaverton, Oregon, USA
100000	Tektronix Guernsey, Ltd., Channel Islands
200000	Tektronix United Kingdom, Ltd., London
300000	Sony/Tektronix. Japan
700000	Tektronix Holland, NV, Heerenveen, The Netherlands

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OPERATORS SAFETY SUMMARY

The general safety information in this part of the summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply and do not appear in this summary.

Terms in This Manual

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

Terms as Marked on Equipment

CAUTION indicates a personal injury hazard not immediately accessible as one reads the markings, or a hazard to property, including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

Symbols in This Manual

A This symbol indicates where applicable cautionary or other information is to be found. For maximum input voltage see Table I-I.

Symbols as Marked on Equipment

 **DANGER** – High voltage.

 Protective ground (earth) terminal.

A **ATTENTION** – Refer to manual.

Power Source

This product is intended to operate from a power source that does not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Grounding the Product

This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the product input or output terminals. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Danger Arising From Loss of Ground

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electric shock.

Use the Proper Power Cord

Use only the power cord and connector specified for your product.

Use only a power cord that is in good condition.

For detailed information on power cords and connectors see Figure 2-1.

Use the Proper Fuse

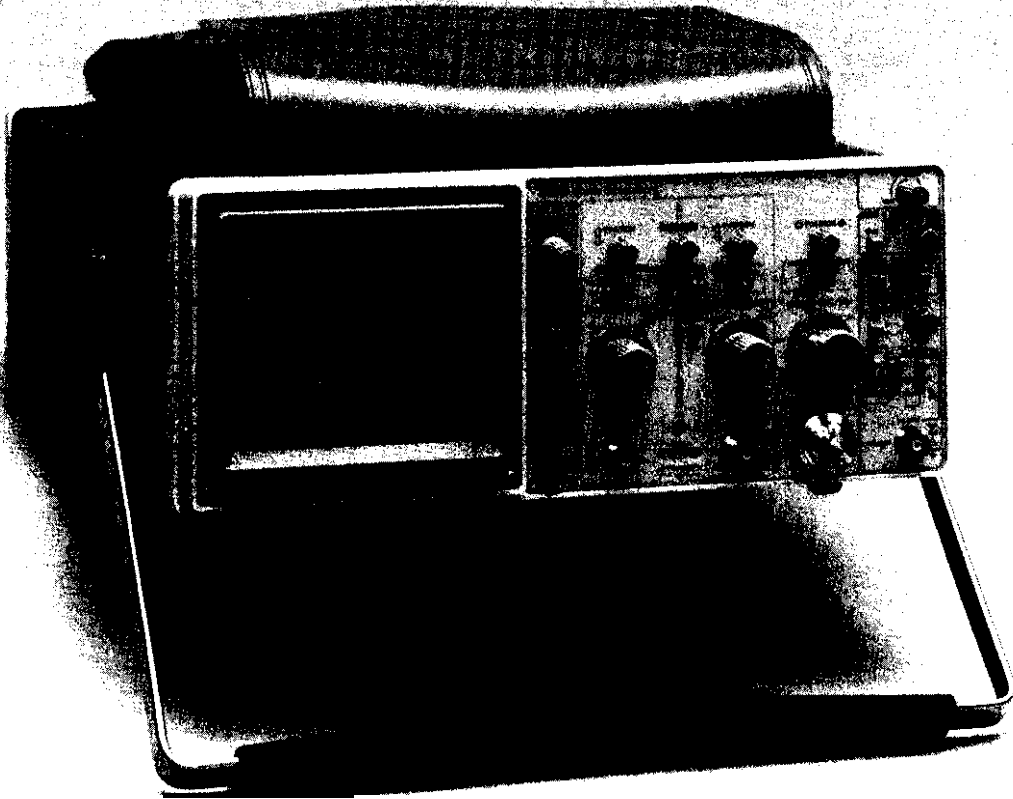
To avoid fire hazard, use only a fuse of the correct type, voltage rating and current rating as specified in the parts list for your product.

Do Not Operate in Explosive Atmospheres

To avoid explosion, do not operate this product in an explosive atmosphere unless it has been specifically certified for such operation.

Do Not Remove Covers or Panels

To avoid personal injury, do not remove the product covers or panels. Do not operate the product without the covers and panels properly installed.



The 2235 Oscilloscope.

4207-01

GENERAL INFORMATION

INTRODUCTION

The TEKTRONIX 2235 Oscilloscope is a rugged, light-weight, dual-channel, 100-MHz instrument that features a bright, sharply defined trace on an 80- by 100-mm cathode-ray tube (crt). Its vertical system provides 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 delayed-sweep features for accurate relative-time measurements. A X10 magnifier extends the maximum sweep speed to 5 ns per division.

The instrument is shipped with the following standard accessories:

1 Operators manual 2 Probe packages

For part numbers and further information about both standard and optional accessories, refer to the "Options and Accessories" section (Section 5) of this manual. Your Tektronix representative, local Tektronix Field Office, or Tektronix product catalog can also provide accessories information.

SPECIFICATION

The following electrical characteristics (Table 1-1) are valid for the 2235 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).

Environmental characteristics are given in Table 1-2. The 2235 meets the requirements of MIL-T-28800C for Class 5 equipment, except where otherwise noted.

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

Table 1-1
Electrical Characteristics

Characteristics	Performance Requirements
VERTICAL DEFLECTION SYSTEM	
Deflection Factor	
Range	2 mV per division to 5 V per division in a 1-2-5 sequence.
Accuracy	
+15°C to +35°C	±2%.
0°C to +50°C	±3%.
Range of VOLTS/DIV Variable Control	Continuously variable between settings. Increases deflection factor by at least 2.5 to 1.

Table I-I (cont)

Characteristics	Performance Requirements
VERTICAL DEFLECTION SYSTEM (cont)	
step Response	
Rise Time	
0°C to +35°C	
5 mV per Division to 5 V per Division	3.5 ns or less.
2 mV per Division	3.9 ns or less.
+35°C to +50°C	
5 mV per Division to 5 V per Division	4.1 ns or less. ^a
2 mV per Division	4.4 ns or less. ^a
Aberrations	
Positive-Going Step	
2 mV per Division to 0.5 V per Division	+4%, -4%. 4% p-p.
1 V per Division to 2 V per Division	+8%, -8%, 8% P-P.
5 V per Division	+10%, -10%. 10% p-p.
Bandwidth (-3 dB)	
0°C to +35°C	
5 mV per Division to 5 V per Division	Dc to at least 100 MHz.
2 mV per Division	Dc to at least 90 MHz.
+35°C to +50°C	
5 mV per Division to 5 V per Division	Dc to at least 90 MHz.
2 mV per Division	Dc to at least 80 MHz.
AC Coupled Lower Limit	10 Hz or less at -3 dB.
Bandwidth Limiter	Upper limits (-3 dB) bandpass at 20 MHz ±10%.
Chop Mode Switching Rate	500 kHz ±30%.
Input Characteristics	
Resistance	1 MΩ ±2%.
Capacitance	20 pF ±2 pF.

^arise time is calculated from the formula:

$$\text{Rise Time} = \frac{0.35}{\text{Bandwidth (-3 dB)}}$$

Table I-I (cont)



Characteristics	Performance Requirements		
VERTICAL DEFLECTION SYSTEM (cont)			
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.		
Common-Mode Rejection Ratio (CMRR)	At least 20 to 1 at 50 MHz.		
Input current	1.0 nA or less (0.5 division trace shift at 2 mV per division).		
Trace Shift with Attenuator Rotation	0.5 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 divisions or less.		
Channel Isolation	Greater than 100 to 1 at 50 MHz.		
POSITION Control Range	At least ± 11 divisions from graticule center.		
TRIGGER SYSTEM			
A TRIGGER Sensitivity			
P-P AUTO and NORM/TV LINE Modes	10 MHz	60 MHz	100 MHz
Internal	0.3 div	1.0 div	1.5 div
External	35 mV	120 mV	200 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.		
B TRIGGER Sensitivity (Internal Only)	10 MHz	60 MHz	100 MHz
	0.35 div	1.0 div	1.5 div
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).		
Input Resistance	1 M Ω \pm 2%.		
Input Capacitance	20 pF \pm 2.5 pF.		
AC Coupled	10 Hz or less at lower -3 dB point.		

Table 1-1 (cont)

Characteristics	Performance Requirements	
TRIGGER SYSTEM (cont)		
LEVEL Control Range		
A TRIGGER (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$\div 10$	At least ± 16 V, 32 V p-p.	
B TRIGGER		
Internal	Can be set to any point of the trace that can be displayed.	
VAR HOLDOFF Control	Increases A Sweep holdoff time by at least a factor of 10.	
Trigger View System		
Deflection Factor		
Internal	Same as vertical.	
External		
AC and DC	100 mV per division.	
DC $\div 10$	1 V per division.	
Accuracy	$\pm 20\%$.	
Delay Difference Between EXT INPUT and Either Vertical Channel	Less than 2.0 ns.	
HORIZONTAL DEFLECTION SYSTEM		
Sweep Rate		
Calibrated Range		
A Sweep	0.5 s per division to 0.05 μ s per division in a 1-2-5 sequence. X10 magnifier extends maximum sweep speed to 5 ns per division.	
B Sweep	50 ms per division to 0.05 μ s per division in a 1-2-5 sequence. X10 magnifier extends maximum sweep speed to 5 ns per division.	
Accuracy	Unmagnified	Magnified
+15° C to +35° C	$\pm 2\%$	$\pm 3\%$
0° C to +50° C	$\pm 3\%$	$\pm 4\%$
POSITION Control Range	Start of sweep to 10th division will position past the center vertical graticule line in XI or 100th division in X10.	
Sweep Linearity	$\pm 5\%$.	

Table I-I (cont)


Characteristics	Performance Requirements
HORIZONTAL DEFLECTION SYSTEM (cont)	
Variable Control Range	Continuously variable between calibrated settings. Extends the A and B sweep speeds by at least a factor of 2.5.
Sweep Length	Greater than 10 divisions.
A/B SWP SEP Range	f3.5 divisions or greater.
Delay Time	Applies to 0.5 μ s per division and slower.
Dial Control Range	<0.5 +300 ns to >10 divisions.
Jitter	One part or less in 20,000 (0.005%) of the maximum available delay time.
Differential Time Measurement Accuracy +15°C to +35°C	±1% +0.015 major dial division.
0°C to +50°C	±2% +0.015 major dial division.
X.Y OPERATION (X1 MAGNIFICATION)	
Deflection Factors	Same as Vertical Deflection System (with VOLTS/DIV Variable controls in CAL detent).
Accuracy	
X-Axis +15°C to +35°C	±3%.
0°C to +50°C	±4%.
Y-Axis	Same as Vertical Deflection System.
Bandwidth (-3 dB)	
X-Axis	Dc to at least 3 MHz.
Y-Axis	Same as Vertical Deflection System.
Phase Difference Between X- and Y-Axis Amplifiers	±3° from dc to 150 kHz.
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 intensitv.
Maximum Safe Input Voltage 	30 V (dc + peak ac) or 30 V p-p ac at 1 kHz or less.

Table 1-1 (cont)

Characteristics	Performance Requirements
Z-AXIS INPUT (cont)	
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.

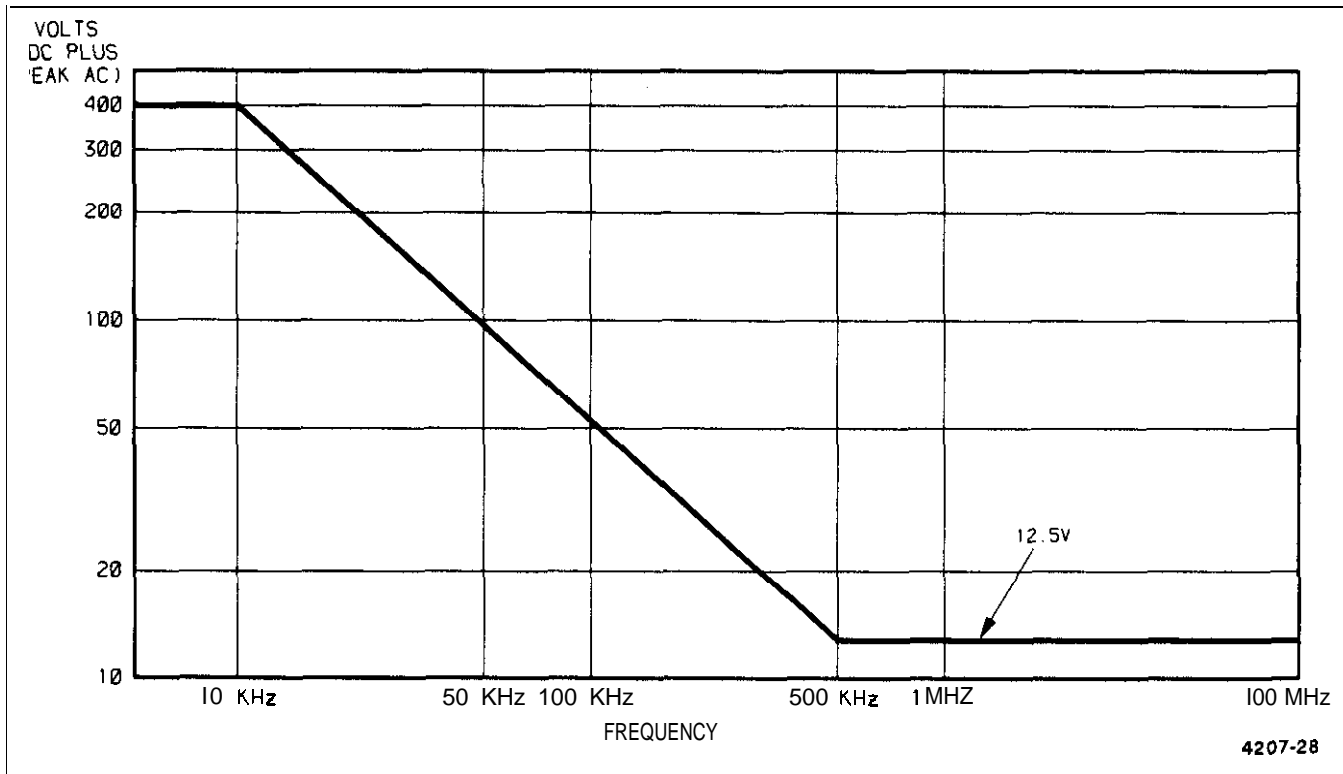


Figure 1-1. Maximum input voltage vs frequency derating curve for CH 1 OR X, CH 2 OR Y, and EXT INPUT connectors.

Table 1-2
Environmental Characteristics

Characteristics	Description
	NOTE <i>The instrument meets all the following MIL-T-28800C requirements for Type III, Class 5 equipment.</i>
Temperature Operating	0°C to +50°C (+32°F to +122°F).
Nonoperating	-55°C to +75°C (-67°F to +167°F).
Altitude Operating	To 4,500 m (15,000 ft). Maximum operating temperature decreased 1°C per 300 m (1,000 ft) above 1,500 m (5,000 ft).
Nonoperating	To 15,000 m (50,000 ft).
Humidity (Operating and Nonoperating).	5 cycles (120 hours) referenced to MIL-T-28800B, for Type III, Class 5 instruments.
Vibration (Operating)	15 minutes along each of 3 major axis at a total displacement of 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 axis. All major resonances must be above 55 Hz.
Shock (Operating and Nonoperating)	30 g's, half-sine, 1 1-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	6.2 kg (13.7 lb).
Without Cover, Probes, and Pouch	5.2 kg (11.5 lb)
Domestic Shipping Weight	7.3 kg (16.0 lb).
Height	
With Feet and Handle	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).

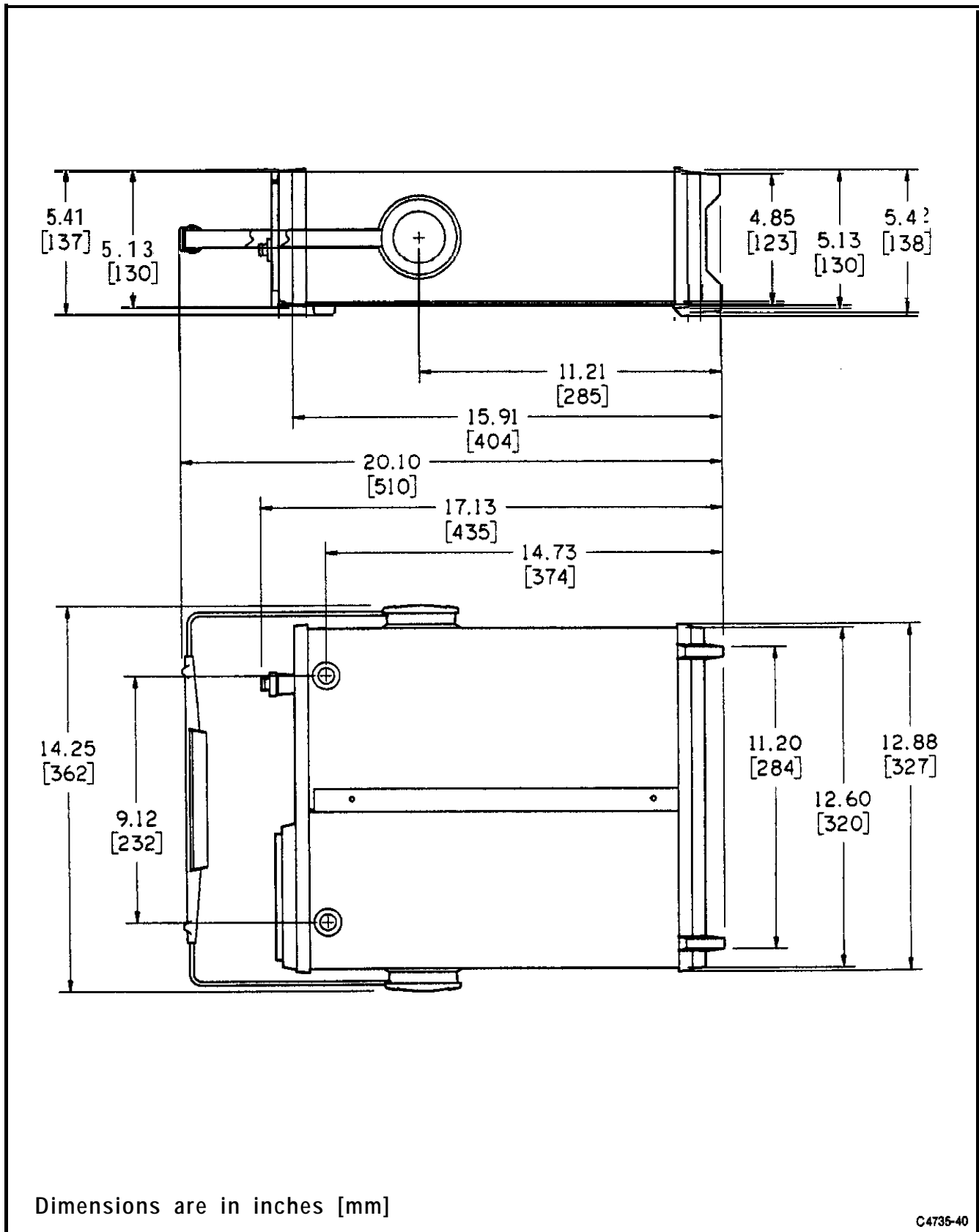


Figure I-2. Physical dimensions of the 2235 Oscilloscope.

CALIBRATION

Instrument performance should be checked after every 2000 hours of operation or once each year if used **infrequently**. A more frequent interval may be necessary if your

instrument is subjected to harsh environments or severe usage.

REPACKAGING FOR SHIPMENT

If the instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag showing: owner (with address) and the name of an individual at your firm that can be contacted. Include complete instrument serial number and a description of the service required.

Save and reuse the package in which your instrument was shipped. If the original packaging is unfit for use or not available, repackage the instrument as follows:

Surround the instrument with polyethylene sheeting to protect its finish. Obtain a carton of corrugated cardboard having a carton test strength of 275 pounds and having inside dimensions of no less than six inches more than the instrument dimensions. Cushion the instrument by tightly packing three inches of **dunnage** or urethane foam between carton and instrument, on all sides. Seal carton with shipping tape or industrial stapler.