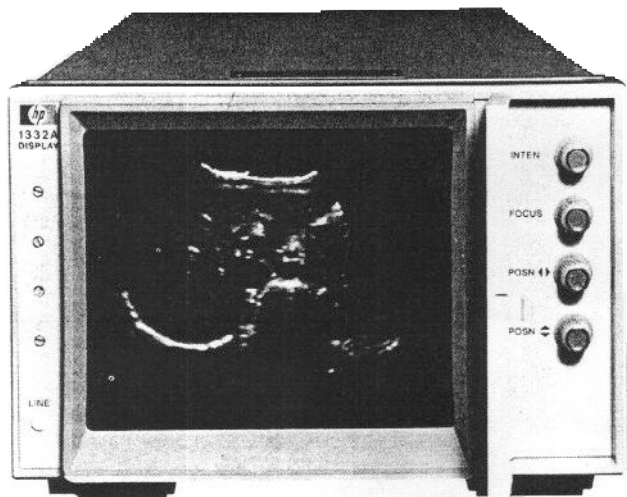


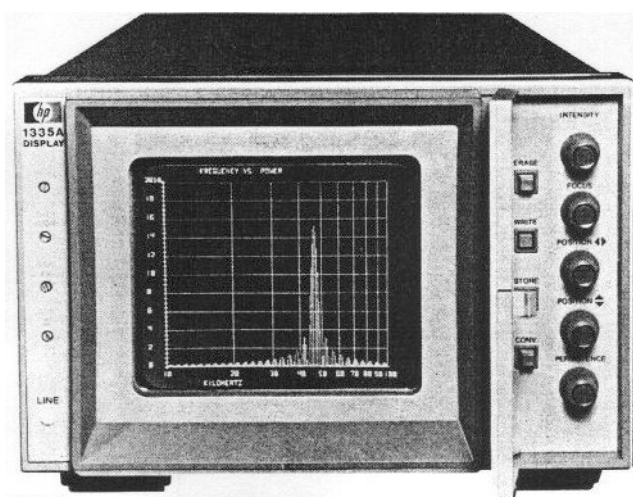
# CATHODE-RAY TUBE DISPLAYS

## Imaging

Models 1332A, 1333A, 1335A & 1336S



1332A



1335A

### Introduction

Models 1332A, 1333A, 1335A, and 1336S are high-quality cathode-ray tube displays designed to satisfy a wide range of OEM medical and electronic instrument display needs. They provide optimum performance when used as continuous tone imaging displays. Continuous tone images are so called because the image space in the X-Y plane is filled with a continuum of brightness levels ranging from black to maximum brightness, where the brightness represents some physical parameter such as radar return amplitude, ultrasonic reflectivity of body tissues, etc., having a varying spatial distribution of magnitude.

### Bright for Easy Viewing

**Model 1332A:** has a large  $9.6 \times 11.9$  cm display area with the resolution and picture quality required for medical diagnosis systems plus a bright display for differentiating between many gray shades, or for viewing in brightly lighted areas. Option 530 provides even greater brightness with up to  $500 \text{ cd/m}^2$  line brightness.

Spot size is only 0.3 mm over the entire quality area and over the full range of intensity levels. This resolution makes the 1332A well suited for applications requiring sharp focusing on multiple gray shades or varying writing speeds with frequent video drive level changes, e.g., alphanumeric characters mixed with traces, curves, or graphs.

The large viewing area and bright display make the 1332A ideal for the OEM with both visual and some photographic requirements. Display brightness lets you view the display in high ambient light conditions while maintaining resolution and gray shades for photographic work. Whenever uniform photographic recording of the display becomes critical, the 1333A or 1336S should be used.

### Optimized for Photographing

**Model 1333A:** has a high resolution CRT with an  $8 \times 10$  cm viewing area specifically optimized for photographic applications such as gamma camera systems. The 1333A's combination of high resolution, excellent uniformity, and speed permits crisp, easy-to-read, diagnostic-quality photographs to be obtained from state-of-the-art nuclear, ultrasonic, thermographic, and X-ray scanning systems.

Spot size is a crisp 0.2 mm everywhere on the  $8 \times 10$  cm display, which allows resolution of 193 354 picture elements. The spot remains round and sharply focused in all areas of the screen and at varying intensity levels, eliminating the need to readjust focus or astigmatism controls.

Light output uniformity is fully specified, both overall and for small increments, which assures you that the information content of the display is an accurate representation of the input signals. Additionally, light output drift is specified, including all effects of the Z-axis amplifier, high voltage supply, and CRT. A regulated dc CRT filament voltage is also used to assure constant light output independent of line

voltage fluctuations. The regulated dc filament voltage also reduces the possibility of interference patterns resulting from correlation between input signal frequencies and the high voltage oscillator or power line frequencies.

### Variable Persistence, Storage

**Model 1335A:** is a high resolution  $8 \times 10$  cm storage display which offers medical and instrumentation OEM users a variable persistence storage CRT display with outstanding performance and picture quality.

In the non-storage mode (called CONVENTIONAL), the CRT operates similar to a mono-accelerator conventional CRT with an exceptionally small spot that focuses uniformly over the entire quality area. Resolution is approximately 40 lines per cm (100 lines per in.). In addition, spot size is relatively independent of intensity settings or Z-axis input signals, eliminating the need to refocus at each intensity setting. The storage writing speed remains stable through use of regulated CRT filament voltage and stable Z-axis amplifier design.

The same excellent CRT performance is maintained in the Variable Persistence operating mode. Persistence is continuously adjustable with a front panel control from approximately 0.20s to  $> 1$  minute. This mode allows you to eliminate flicker on some presentations by increasing the persistence to match the refresh rate. The variable persistence mode is selected by pressing the WRITE pushbutton.

The storage CRT is preset to store dots having a Z-axis width of  $1 \mu\text{s}$  or greater for up to 30 minutes. The STORE mode offers the greatest contrast because the background is completely dark. Stored resolution is over 20 lines per cm (50 lines per in.) and stored traces retain sharp details for up to 1 minute in WRITE mode, 30 minutes in STORE mode.

The Model 1335A offers users flexibility in selecting ERASE, STORE, WRITE, CONVENTIONAL, and VARIABLE PERSISTENCE modes. These modes can be selected with the manual front panel controls, remote program inputs, or a combination of both.

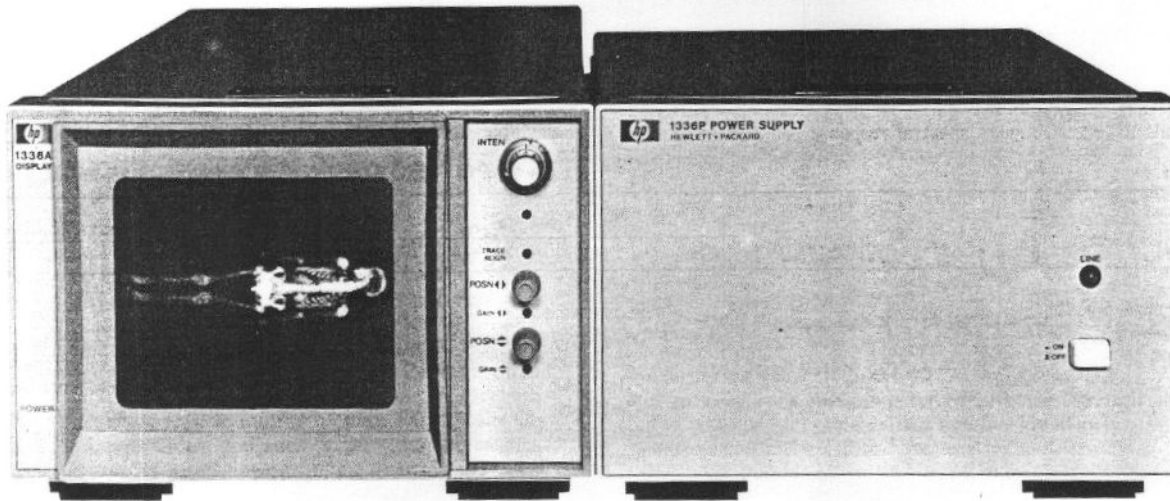
### Resolution up to 140 lines/cm

**Model 1336S:** consists of an  $8 \times 10$  cm display module (1336A) and a separate power supply module (1336P) for mounting flexibility. The display offers a choice of 140 lines/cm or 90 lines/cm (Option 005) resolution for all high-resolution imaging requirements such as multi-imaging for nuclear or ultrasound medical diagnostic systems, scanning electron microscopes, and scanning auger microprobes. A mono-accelerator CRT with an accelerating potential of approximately 5 kV produces a small, high intensity spot with only 100 watts power consumption.

The CRT is designed to prevent spurious light from reaching photographic film during long time exposures. Light output uniformity is tested to assure that the information content of the displayed image is an accurate representation of the input signals.

## Imaging

### Models 1332A, 1333A, 1335A & 1336S (Cont.)



#### 1336S

##### CRT's

The 1332A, 1333A, and 1335A have post deflection accelerator CRT's to assure a bright, crisp trace. The 1336S display uses a mono-accelerator CRT design to achieve 140 lines/cm resolution at center screen with low power consumption. An opaque aluminum layer behind the phosphor (except in model 1336S, which is non-aluminized) enhances trace brightness.

Regulated, low power write gun and flood gun filaments assure a constant light output under varying line voltage conditions. More importantly, the low power filament operation significantly extends CRT life and eliminates grid and other stray emissions common to older, less efficient designs.

Models 1332A, 1333A, 1335A (Opt 330), and 1336S are listed with Underwriters Laboratories in accordance with the UL 544 Medical Safety Standard which defines detailed patient protection requirements. Regular inspection of our production facility by UL assures you that this patient protection is built into the display that you purchase.

##### Electronics

###### Models 1332A, 1333A, and 1335A

The X and Y amplifiers have 70 ns rise time (bandwidth is 5 MHz) and the Z-axis blanking amplifier has a 25 ns rise time. When faster X and Y amplifier response is required, Model 1332A has an Option available to obtain 25 ns rise times. All amplifiers are fully differential and operate at low power levels for stable, drift-free performance over wide ranges of operating temperatures.

The time required to make any size movement on the CRT, including the response time for the amplifiers to settle within one spot diameter of final position, is less than 300 ns. This means that many thousands of vectors and characters can be written on the display without flicker.

###### Model 1336S (1336A and 1336P)

The 1336A's deflection amplifiers settle to within one spot diameter in <500 ns after receiving an input step command. All amplifiers are fully differential and operate at low power levels for stable operation and minimum warm-up time. Dynamic focus circuits automatically correct for spot position to assure optimum resolution over the entire CRT face. A regulated dc CRT filament supply assures a stable light output.

Interfacing flexibility is provided by internal switches which allow selection of X, Y, and Z amplifier input characteristics. An optional TTL blanking input unconditionally overrides any analog Z-axis input and the intensity control, and can be used to provide CRT protection in the event of CRT failure.

##### Cabinet Sizes

Models 1332A, 1333A, and 1335A are 13.3 cm (5¼ in.) high, half rack width, 49.5 cm (19½ in.) long packages that can be combined with identical empty modules to form an attractive full width horizontal or vertically stacked OEM instrument. The 1336A Display Module has the same dimensions and the 1336P Power Supply Module has the same height and width but is 33.5 cm (13¼ in.) deep. If the 1336A/P are to be mounted together, 1336P Option 018 may be ordered to provide the same cabinet depth as the 1336A, with locking hardware to form a standard EIA rack width unit.

##### Options and Accessories

A wide range of options is available for tailoring the display to specific requirements; refer to data sheets for complete listing. Accessories available include rack mounting kits, OEM half module frames and rack slides, a light shield (Model 10183A), and BNC shorting caps for use with certain options. For convenient system interconnection, Model 10488A 3.6 m (12 ft) Display Cable is available as an accessory. Model 197B Option 006 camera is adapted for direct recording of 1332A, 1333A, 1335A, and 1336S displays. Refer to individual display data sheets for complete description of accessories.

##### Ordering Information

1332A Small Screen Display  
1333A Small Screen Display  
1335A Small Screen Display  
1336A Display Module  
1336P Power Supply Module  
1336S Display System (includes 1336A, 1336P)  
1336A or 1336S Opt: 005  
10184 Light Shield for 1332A, 1333A, 1335A, 1340A, 1338A  
OEM and quantity available.



# CATHODE-RAY TUBE DISPLAYS

## Phosphor Selection Guide

### Choosing a Phosphor

The following tables will assist you in choosing the phosphor best suited to your application, and in determining the best combination of display, phosphor, film, and contrast filter. Also listed are important characteristics of some commonly used phosphors.

P31 phosphor is the first choice for imaging requirements with refresh rates of 50Hz or above. It is the brightest phosphor, i.e., has the greatest energy conversion efficiency. Its peak emission wavelength corresponds to the eye's peak spectral response for maximum cou-

pling efficiency between the eye and the phosphor. Also, P31 is the most burn resistant phosphor known, and is commonly available. In real time ultrasound systems with refresh rates from 20 to 40Hz, P4 phosphor is a good choice with its longer persistence and black and white appearance. For M-mode ultrasound, P39 phosphor is recommended. There is no phosphor with long enough persistence to be useful for direct viewing in nuclear medicine. In this case the 1335A variable persistence display is recommended.

Film Type	Phosphor		
	P31	P11	P4
<b>Kodak<sup>a</sup></b>			
NMB (formerly SO-179)	Recommended	Usable	Usable
NMC (formerly SO-241)	Recommended	Usable	Usable
X-OMAT G	Not Usable	Recommended	Not Recommended
X-OMAT L	Not Usable	Recommended	Not Recommended
X-OMAT M	Not Usable	Recommended	Not Recommended
CFA	Recommended	Usable	Usable
PF	Recommended	Usable	Usable
PFC	Recommended	Usable	Usable
Shellburst 2476	Not Recommended	Recommended	Not Recommended
<b>Du Pont<sup>b</sup> MRF 31, MRF 32</b>	Recommended	Usable	Usable
<b>Polaroid<sup>c</sup></b>			
611	Recommended	Usable	Usable
811	Recommended	Usable	Usable
084	Recommended	Usable	Usable
667	Recommended	Usable	Usable

Note: Cameras with a UV light, e.g., 197B, work well with P31, P11, and P7 phosphors, not as well with P4, and do not work with P39.

<sup>a</sup>Registered Trademark of Eastman Kodak Company.

<sup>b</sup>Registered Trademark of E. I. Du Pont De Nemours.

Application	Recommended Model(s)	Recommended Phosphor	Recommended Contrast Filter
<b>Medical Diagnostic Ultrasound</b>			
Real-time Linear Array	1332A	P4	Neutral Gray
Real-time Phased Array	1332A	P31	Blue
M-Mode	1332A	P39	Blue
A-Mode	1340A	P31	Blue
<b>Nuclear Medicine</b>			
Single-image Photographic Recording	1333A	See Film/ Phosphor table	Clear
Multiformat Photographic Recording	1336S		Clear
Patient Positioning	1335A	P31	Blue
<b>Scanning Auger Microprobe, Scanning Electron Microscope</b>	1336S	P11 or P31	Clear

Note: Filters and implosion shields are made of a polycarbonate material which does not transmit UV light. For photographing with UV sensitive film and UV emitting phosphors such as P11 or P18, the implosion shield or filter should be removed. Provision must be made to insure that the camera is locked in place and provides adequate implosion protection to the display operator.

Phosphor	P31	P4	P39	P11	P7
<b>Color</b>					
Flourescence	Green	Blue	Green	Blue-Violet -	Blue-Violet
Phosphorescence (decay)	Green	Yellow	Green	Blue-Violet	Yellow-Orange
<b>Efficiency</b> (relative to P31)	100%	50%	50%	100% (note 1)	40%
<b>Flicker Frequency</b>	50 Hz	30 Hz	20 Hz	N/A (note 2)	10 Hz
<b>Smear Velocity</b>	*	10"/s	0.1"/s	*	0.01"/s
<b>Burn Resistance</b>	Highest	Good	Good	Poor	Poor
<b>Recommended Contrast Filter</b>	Neutral Gray or Blue	Neutral Gray	Neutral Gray or Blue	None (note 2)	Amber

\* Persistence is short enough that no smearing is visible in rapidly changing pictures.

Note: P31 efficiency is blue relative to radiometric measurement; all others are as measured photographically.



# CATHODE-RAY TUBE DISPLAYS

## Performance Specifications

1300 Series

CATHODE-RAY TUBE	1332A	1333A	1335A		1336S	1340A
			Conventional	Storage		
Viewing Area	≈9.6 x 11.9 cm (3.8 x 4.7 in.)	≈8 x 10 cm (3.1 x 3.9 in.)	≈7.1 x 9 cm (2.8 x 3.6 in.)		≈8 x 10 cm (3.2 x 3.9 in.)	≈9.6 x 11.9 cm (3.8 x 4.7 in.)
Quality Area	≈8.4 x 10.8 cm (3.3 x 4.3 in.)	≈8 x 10 cm (3.1 x 3.9 in.)	≈7.1 x 8.9 cm (2.8 x 3.5 in.)		≈6.4 x 8 cm (2.5 x 3.2 in.)	≈9.6 x 11.9 cm (3.8 x 4.7 in.)
Graticule	8 x 10 div 1 div = 1.2 cm	Opt, 8 x 10 div 1 div = 1 cm	8 x 10 div 1 div = 0.89 cm		None	8 x 10 div 1 div = 1.2 cm
Spot Size (within quality area)	≤0.30 mm	≤0.20 mm	≤0.25 mm	See "Resolution"	See "Resolution"	≤0.46 mm
Resolution	31.5 lines/cm (80 lines/in.)	49 lines/cm (124 lines/in.)	39 lines/cm (99 lines/in.)	20 lines/cm (51 lines/in.)	140 lines/cm (356 lines/in.) (center screen); 80 lines/cm (203 lines/in.) (quality area)	≈22 lines/cm (55 lines/in.)
Light Output (at 0.25 cm/μs, 60 Hz refresh, unless otherwise noted)	170 cd/m <sup>2</sup> (50 ft)	34 cd/m <sup>2</sup> (10 ft)	68 cd/m <sup>2</sup> (20 ft)	680 cd/m <sup>2</sup> (200 ft)	2 μW/cm <sup>2</sup> steradian (4 x 4 cm raster)	Not Specified
Light Output Uniformity	Not Specified	≤16% overall ≤6%/cm	Not Specified	Not Specified	≤16% overall ≤6%/cm	Not Specified
Light Output Stability	<10%/hr	<10%/hr	<10%/hr	Not Specified	<5%/hr	Not Specified
Writing Speed (Storage)	N/A	N/A	N/A	≥50 cm/ms	N/A	N/A
Dot Writing Time (Storage)	N/A	N/A	N/A	≤1 μs	N/A	N/A
Storage Time	N/A	N/A	N/A	<1 minute (Write Mode)	N/A	N/A
<b>X &amp; Y AXES AMPLIFIERS</b>	<b>1332A</b>	<b>1333A</b>	<b>1335A</b>		<b>1336S</b>	<b>1340A</b>
Deflection Factor Range	80–200 mV/div	80–200 mV/cm	80–200 mV/div		100–200 mV/cm 0.5–2.0 V/cm	80–200 mV/div, 0.4–1.0 V/div
Settling Time	≤300 ns	≤300 ns	≤300 ns		≤500 ns	≤300 ns
Linearity	≤3%	≤3%	≤3%		≤3%	≤5%
Dynamic Range	Up to ½ screen diameter off screen in any direction.					
Drift	≤1 mm in 24 hours.					
<b>Z-AXIS AMPLIFIER</b>	<b>1332A</b>	<b>1333A</b>	<b>1335A</b>		<b>1336S</b>	<b>1340A</b>
Blanking Range (Internal Adjust.)	1 V–2.5 V p-p	1 V–2.5 V p-p	1 V–2.5 V p-p		1 V–2.5 V p-p, 5 V–25 V p-p	1 V–2 V p-p
Rise Time	≤25 ns	≤25 ns	≤25 ns		≤25 ns	≤25 ns
X, Y, Z INPUTS	Single-ended BNC	Single-ended BNC	Single-ended BNC		Differential, Separate BNC's	Single-ended BNC
Input RC	≈1 MΩ, ≤60 pF (50 Ω Optional)	≈1 MΩ, ≤60 pF (50 Ω Optional)	≈1 MΩ, ≤60 pF (50 Ω Optional)		≥10 kΩ, <70 pF (50 Ω selectable)	≥1 MΩ, <40 pF (50 Ω selectable)
Maximum Input	±50 V	±50 V	±50 V		±50 V	±50 V
Line Power at 60 Hz, 120 VRMS	≈24 W	≈40 W	≈35 W		≈100 W	≈30 W
UL Medical & Dental Listing	Optional	Optional	Optional		Standard	Optional
UL Medical & Dental Component Recog.	Standard	Standard	Standard		N/A	Optional

**Note:** These are condensed specifications; refer to applicable data sheet for complete specifications, including options and accessories.

### Common Specifications

#### Operating Environment

**Temperature:** 0°C to +55°C (+32°F to +131°F), operating; –40°C to +70°C (–40°F to +158°F), non-operating.

**Humidity:** to 95% RH at +40°C (+104°F).

**Altitude:** to 4600 m (15 000 ft), operating; to 6300 m (20 669 ft), non-operating.

**Shock:** 30 g peak, ½ sine wave, 11 ms duration.

**Vibration:** 15 min. in each plane at 0.38 (0.015 in.) mm p-p excursion, 5–55 Hz, 1 min./octave, 10 min. at each resonant frequency

(except 1332A, 1333A, 1335A: 15 min. in each plane, 0.25 mm (0.010 in.) p-p excursion, 10–55 Hz).

**Primary line voltage:** 100, 120, 220, or 240 Vac, +5%, –10% (1333A, 1336S: +5%, –20%).

#### Ordering Information

1332A Small Screen Display

1333A Small Screen Display

1335A Small Screen Display

1336A Display Module

1336P Power Supply Module

1336S Display System (includes 1336A, 1336P)

1340A Display Module (with control panel)

OEM and quantity discounts available.

CATHODE-RAY TUBE	1338A (Color)	1304A*	1310B	1311B	1317A	1321B
Viewing Area	≈9.6 x 11.9 cm (3.8 x 4.7 in.)	≈20 x 25 cm (7.9 x 9.8 in.)	≈28 x 38 cm (11 x 15 in.)	≈20.3 x 25.4 cm (8 x 10 in.)	≈26 x 34 cm (10.2 x 13.5 in.)	≈30.5 x 35 cm (12 x 14 in.)
Quality Area	≈8 x 10 cm (3.2 x 3.9)	≈20 x 25 cm (7.9 x 9.8 in.)	≈28 x 38 cm (11 x 15 in.)	≈20.3 x 25.4 cm (8 x 10 in.)	≈25.4 x 25.4 cm (10 x 10 in.)	≈30.5 x 30.5 cm (12 x 12 in.)
Spot Size (center screen) (corners)	≤0.36 mm (0.014 in.)	≥0.5 mm (0.02 in.)	≤0.51 mm (0.02 in.) ≤0.76 (0.03 in.)	≤0.43 mm (0.017 in.) ≤0.51 (0.02 in.)	≤0.51 mm (0.02 in.)	≤0.51 mm (0.02 in.)
Resolution	28 lines/cm (70 lines/in.)	20 lines/cm (50 lines/in.)	19.7 lines/cm (50 lines/in.)	24 lines/cm (61 lines/in.)	19.7 lines/cm (50 lines/in.)	19.7 lines/cm (50 lines/in.)
Light Output (at 0.25 cm/μs, 60 Hz refresh)	Color Dependent	19.2 cd/m <sup>2</sup> (5.6 ft)	84 cd/m <sup>2</sup> (24.5 ft)	84 cd/m <sup>2</sup> (24.5 ft)	82.4 cd/m <sup>2</sup> (24 ft)	82.4 cd/m <sup>2</sup> (24 ft)

X & Y-AXES AMPLIFIERS	1338A	1304A	1310B	1311B	1317A	1321B
Deflection Factor Range (approx.)	Internally Adjustable. ≈0.9 V to 2.5 V for full deflection	80-120 mV/div. 1 div = 20 mm (0.8 in.)	(Vertical) 35. 80-60.9 mV/cm. 90-153 mV/in. (Horizontal) 26.2-45.9 mV/cm. 67-117 mV/in.	(Vertical) 46.3-81 mV/cm. 118-207 mV/in. (Horizontal) 35.8-60.9 mV/cm. 90-153 mV/in.	39-69 mV/cm. 100-175 mV/in.	33-58 mV/cm. 83-147 mV/in.
Settling Time	≤300 ns	≤300 ns	≤500 ns	≤500 ns	≤1 μs	≤500 ns
Repeatability error	Not Specified	<0.15%	<0.15%	<0.15%	<0.15%	<0.15%
Linearity	≤2%	≤3%	≤1%	≤1%	≤3%	≤1%
Dynamic Range	Up to ½ screen diameter offscreen in any direction					
Drift	≤2.5 mm in 24 hours		8.9 mm in 24 hrs	6.3 mm in 24 hrs	8.9 mm in 24 hrs	10.2 mm in 24 hrs

Z-AXIS AMPLIFIER	1338A	1304A	1310B	1311B	1317A	1321B
Blanking Range	Internally adjustable from 1 V to 2.5 V p-p.					
Rise Time	≤30 ns	≤25 ns	≤25 ns	≤25 ns	≤20 ns	≤20 ns
X, Y, Z INPUTS	Differential, separate BNC's	Differential, separate BNC's	Single-ended BNC	Single-ended BNC	Single-ended BNC	Single-ended BNC
Input RC	≈100 Ω, ≈70 pF or 50 Ω	≥100 kΩ, ≤65 pF (50 Ω selectable)	(X, Y inputs) 50Ω or ≈10 kΩ/ ≈40 pF (Z input) 50Ω or ≈10 kΩ/ ≈60 pF	(X, Y inputs) 50Ω or ≈10 kΩ/ ≈40 pF (Z input) 50Ω or ≈10 kΩ/ ≈60 pF	(X, Y inputs) 50Ω or ≈10 kΩ/ ≈40 pF (Z input) 50Ω or ≈10 kΩ/ ≈60 pF	(X, Y inputs) 50Ω or ≈10 kΩ/ ≈40 pF (Z input) 50Ω or ≈10 kΩ/ ≈60 pF
Maximum Input	(High Z) ±50 V (50 Ω) ±2.5 V	(High Z) ±50 V (50 Ω) ±2.5 V	(High Z) ±50 V (50 Ω) ±5 V	(High Z) ±50 V (50 Ω) ±5 V	(High Z) ±50 V (50 Ω) ±5 V	(High Z) ±50 V (50 Ω) ±5 V
TTL Blanking Input (rear panel BNC)	Standard	Optional	Standard	Standard	Standard	Standard
Primary Line Voltage	100, 120, 220, or 240 Vac +5%, -10%	100, 120, 220 or 240 Vac +5%, -20%	100, 120, 220 or 240 Vac +5%, -20%	100, 120, 220 or 240 Vac +5%, -20%	100, 120, 220 or 240 Vac +5%, -10%	100, 120, 220 or 240 Vac +5%, -10%
Maximum Power	≈100 W	≈85 W	≈185 W	≈185 W	≈100 W	≈110 W
UL Medical and Dental Listing	Not Available	Optional	Optional	Optional	Optional	Optional

Note: These are condensed specifications; refer to applicable data sheet for complete specifications, including options and accessories.

### Common Specifications

#### Operating environment

**Temperature:** 0°C to 55°C (+32°F to +131°F), operating; -40°C to +70°C (-40°F to +158°F), non-operating.

**Humidity:** to 95% RH at +40°C (+104°F).

**Altitude:** to 4600 m (15 000 ft), operating; to 7600 m (25 000 ft), non-operating (15 300 m, 50 197 ft for 1304A).

**Vibration:** 15 min. in each plane, 0.25 mm (0.010 in.) p-p excursions (0.38 mm, 0.015 in. for 1304A, 1338A), 5 to 55 Hz; 1 min./octave, 10 min. at each resonant frequency.

### Ordering Information

\*1304A 32 cm (14 in.) Display

1310B 48 cm (19 in.) Display

1311B 36 cm (14 in.) Display

1317A 43 cm (17 in.) Display

1321B 53 cm (21 in.) Display

1338A Tri-color Display