



ELECTRONIC TUBE REFERENCE

1400A

Specialized - Cathode Ray electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION
CONSTRUCTION
CATHODERAY

Rectangular flat-faced single-gun oscilloscope CRT with post-deflection acceleration, a thin aluminum-backed screen, and deflection blanking. Designed for instrument display service, it combines a flat viewing area with several-kilovolt final acceleration.

GENERAL CHARACTERISTICS

BASE DESIGNATION	B12F	BASE PINS	12
NOMINAL HEATER	6.3 V / 300 mA	PARALLEL HEATER	– / –
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 0 Cathode Ray	
MAXIMUM PLATE VOLTAGE	7000 V
Fourth anode absolute maximum 7.0 kV.	

1400A — Instrument Cathode Ray Tube

The **1400A** is a rectangular, flat-faced, single-gun instrument cathode ray tube (CRT) designed for precision oscilloscope applications. Manufactured by The M-O Valve Company Limited (a member of the GEC Group of Companies), the tube features a spiral post-deflection accelerator (p.d.a.) and provides a full 8 x 10 cm display area. The design is optimized for precision measurement and display of electrical waveforms, offering high deflection sensitivity and excellent pattern linearity.

The tube is typically supplied with a type 24 phosphor (E.I.A. designation P31) under the designation **1424A**, which provides a green fluorescence and phosphorescence with a short persistence of 1 to 5 milliseconds. Other phosphor screens can be supplied to special order to meet specific application requirements.

Physical Construction and Mechanical Specifications

The 1400A features a robust glass envelope with a rectangular faceplate. The physical dimensions and mechanical limits are tightly controlled to facilitate precise alignment within oscilloscope enclosures:

- **Maximum Overall Length:** 368 mm
- **Neck Diameter:** 56 ± 1.5 mm
- **Maximum Bulb Width (Horizontal):** 128.5 mm
- **Maximum Bulb Height (Vertical):** 103 mm
- **Faceplate Dimensions:** 125 ± 1.5 mm by 100 ± 1.5 mm
- **Faceplate Diagonal:** 145 mm
- **Faceplate Radius of Curvature:** 508 mm
- **Corner Radius:** 19 mm
- **Weight:** Approximately 1.0 kg (tube alone)

Mounting and Shielding

The 1400A can be mounted in any physical orientation. However, it must not be supported by its electrical base alone. The recommended mounting method involves holding the tube in a suitable rubber mask at the screen end and securing it with a clamp around the magnetic shield near the base. The electrical socket must have sufficient freedom of movement to accommodate tolerances in overall length and base orientation.

Because CRTs are highly sensitive to external magnetic fields, care must be taken not to expose the 1400A to strong magnetic fields during operation or storage. A suitable magnetic shield is recommended to prevent beam deflection or pattern distortion from stray fields.

Heater and Screen Characteristics

The 1400A utilizes an indirectly heated cathode. The heater is designed for AC or DC operation with the following nominal ratings:

- **Heater Voltage:** 6.3 V
- **Heater Current:** 0.3 A
- **Calculated Heater Power:** 1.89 W (calculated as 6.3 V multiplied by 0.3 A)

The standard screen characteristics for the type 24 (P31) phosphor are summarized below:

Parameter	Specification
Fluorescence	Green
Phosphorescence	Green
Persistence	1-5 ms
E.I.A. Phosphor Code	P31

Parameter	Specification
GEC Phosphor Code	24
Pro Electron Phosphor Code	GH

Base Connections and Interelectrode Capacitances

The 1400A uses a **B12F** base (conforming to BS448) for primary electrical connections, along with a **CT8** side contact (conforming to BS448) for the fourth anode (a_4).

Base Pinout (B12F)

The pin connections, viewed from the base of the tube, are as follows:

Pin	Electrode Connection
1	Control grid (g_1)
2	Heater-cathode (hk)
3	Heater (h)
4	Second anode / Focus electrode (a_2)
5	Blanking plate / Grid 2 (g_2)
6	Third anode (a_3)
7	Y-deflection plate 1 (y_1)
8	Y-deflection plate 2 (y_2)
9	Geometry correction electrode (s)
10	X-deflection plate 1 (x_1)
11	First anode (a_1)
12	X-deflection plate 2 (x_2)
Side Contact	Fourth anode / p.d.a. (a_4) via CT8 connector

Interelectrode Capacitances

Typical capacitances of the tube electrodes are measured without external shielding:

Electrode Combination	Typical Capacitance
Cathode to all other electrodes	5.5 pF

Electrode Combination	Typical Capacitance
Control grid to all other electrodes	11.0 pF
Blanking plate to all other electrodes	10.0 pF
Deflector plates y_1 to y_2	1.8 pF
Deflector plate y_1 to all electrodes except y_2	6.4 pF
Deflector plate y_2 to all electrodes except y_1	6.4 pF
Deflector plates x_1 to x_2	2.0 pF
Deflector plate x_1 to all electrodes except x_2	6.8 pF
Deflector plate x_2 to all electrodes except x_1	6.8 pF

Absolute Maximum and Minimum Ratings

The absolute ratings define the limiting values within which the 1400A must be operated to ensure reliability and prevent damage. All voltage ratings are specified with respect to the cathode unless otherwise noted.

Parameter	Symbol	Minimum	Maximum	Unit
Fourth anode voltage (p.d.a.)	V_{a4}	2.5	7.0	kV
Third anode voltage	V_{a3}	0.6	1.7	kV
Voltage ratio	V_{a4}/V_{a3}	—	4.0	—
Focus voltage	V_{a2}	0	1.0	kV
First anode voltage	V_{a1}	0.6	1.75	kV
Control grid voltage	$-V_{g1}$	1.0	200	V
Blanking plate to first anode voltage	V_{g2-a1}	—	± 200	V
Y plate to third anode voltage	V_{y-a3}	—	500	V

Parameter	Symbol	Minimum	Maximum	Unit
X plate to third anode voltage	V_{x-a3}	—	500	V
Heater-cathode voltage	V_{h-k}	—	± 150	V
Grid-to-cathode circuit resistance	R_{g1-k}	—	1.5	M Ω
Y deflector plate circuit resistance	R_{y-a3}	—	100	k Ω
X deflector plate circuit resistance	R_{x-a3}	—	500	k Ω

Note: The ratio of maximum to minimum fourth anode voltage is calculated as $7.0 \text{ kV} / 2.5 \text{ kV} = 2.8$. The ratio of maximum to minimum first anode voltage is calculated as $1.75 \text{ kV} / 0.6 \text{ kV} = 2.92$.

Typical Operation and Equipment Design Range

The typical operating conditions represent a standard setup for the 1400A, while the equipment design range provides the limits that a circuit designer must accommodate to account for tube-to-tube variations.

Typical Operating Conditions

All operating potentials are specified with respect to the cathode:

- **Fourth Anode Voltage (V_{a4}):** 4 kV
- **Third Anode Voltage (V_{a3}):** 1 kV
- **Focus Voltage (V_{a2}):** 175 to 400 V
- **First Anode Voltage (V_{a1}):** 1 kV
- **Nominal Blanking Plate Voltage ($V_{[g2]}$)(/tubes/G2):** 1 kV
- **Nominal Geometry Correction Voltage (V_s):** 1 kV
- **Control Grid Voltage for Spot Cut-off ($-V_{g1}$):** 35 to 65 V
- **Maximum Y Deflection Factor (D_y):** 9.5 V/cm
- **Maximum X Deflection Factor (D_x):** 18.0 V/cm
- **Typical Line Width:** 0.6 mm (measured at the geometric center of the faceplate with a microscope at a beam current of 5 α A on a type 24 phosphor; or 0.3 mm using the shrinking raster method)

Equipment Design Range

These values are normalized to the anode voltages to allow scaling across different operating points:

- **Focus Voltage (V_{a2}):** 175 to 400 V per kilovolt of V_{a3} (V/k V_{a3})

- **Control Grid Cut-off Voltage ($-V_{g1}$):** 35 to 65 V per kilovolt of V_{a1} (V/kV_{a1})
- **Blanking Voltage ($V_{[g2]}$)/(*tubes*/G2) w.r.t. a_1):** Maximum 60 V per kilovolt of V_{a1} (V/kV_{a1})
- **Y Deflection Factor (D_y at $V_{a4}/V_{a3} = 4$):** 7.8 to 9.5 V/cm/ kV_{a3}
- **X Deflection Factor (D_x at $V_{a4}/V_{a3} = 4$):** 14.8 to 18.0 V/cm/ kV_{a3}
- **Astigmatism Correction Voltage (V_{a3}):** -50 to $+50$ V per kilovolt of V_{a3} (V/kV_{a3})
- **Pattern Correction Voltage (V_s):** -50 to $+50$ V per kilovolt of V_{a3} (V/kV_{a3})

Display and Deflection Characteristics

Pattern Distortion and Correction

With pattern correction applied, the edges of a test raster will lie entirely between two concentric rectangles measuring 100 x 80 mm and 98 x 77.5 mm. The orthogonal alignment between the x and y deflection axes is maintained at $90^\circ \pm 1^\circ$.

Barrel or pincushion distortion can be minimized by applying an appropriate correction potential to the geometry correction electrode (s) with respect to the mean potential of the x-deflection plates. A range of adjustment of ± 50 V/ kV_{a3} should be provided for this purpose.

Astigmatism Correction

Astigmatism can be corrected by adjusting the potential on the third anode (a_3) relative to the mean potential of the y-deflection plates. Circuit designs should allow for an adjustment range of ± 50 V/ kV_{a3} . Both astigmatism and pattern correction specifications assume that the mean potentials of the x and y plates are equal. If a difference between these mean potentials is unavoidable, it should be kept to an absolute minimum.

Deflection Linearity

The deflection linearity of the 1400A is highly precise. For any deflection of less than 75% of the useful scan, the deflection factor will not deviate from the deflection factor at 25% of the useful scan by more than 2%.

Spot Position and Orientation

When the tube is undeflected and focused, the spot will fall within an 8 x 10 mm rectangle centered at the geometric center of the faceplate, with the larger dimension of the rectangle parallel to the x-axis.

When looking directly at the screen with pins 6 and 7 of the base positioned uppermost:

- A positive potential applied to the x_1 plate deflects the electron beam to the left.
- A positive potential applied to the y_1 plate deflects the electron beam upwards.

Scanned Area and Beam Blanking

The minimum scanned area is 10 cm along the x-axis and 8 cm along the y-axis. This scanned area is centered within 3 mm of the major and minor axes of the tube faceplate.

For beam blanking, a potential of $+60 \text{ V/kV}_{a1}$ with respect to the first anode (a_1) applied to the blanking electrode (g_2) will completely cut off the beam at a cathode current of 500 μA . The blanking electrode is designed solely for beam cut-off and must not be used as a brightness control.

Axis Alignment

The electrical x-axis of the tube lies within $\pm 5^\circ$ of the major physical axis of the faceplate. It can be precisely aligned with the physical axis by applying an external magnetic field from an axial coil. This coil should be positioned around the cone of the tube in the region indicated in the outline drawing. The maximum ampere-turns required for complete axis alignment will not exceed $12 \sqrt{V_{a4}}$, where V_{a4} is expressed in kilovolts. For example, at a typical fourth anode voltage of 4 kV, the maximum required alignment field is calculated as 12 multiplied by the square root of 4, which equals 24 ampere-turns.

Technical Summary

The **1400A** is a high-performance, single-gun instrument cathode ray tube designed by The M-O Valve Company Limited for precision oscilloscope displays. Featuring a flat, rectangular 125 x 100 mm faceplate and a spiral post-deflection accelerator, it provides a highly linear 8 x 10 cm display area. Operating with a nominal 6.3 V, 0.3 A heater, the tube is optimized for a typical fourth anode voltage of 4 kV and a first/third anode voltage of 1 kV.

With its standard B12F base and CT8 side contact, the 1400A integrates comprehensive correction electrodes, including dedicated connections for astigmatism correction, pattern correction, and beam blanking. Its low interelectrode capacitances, excellent deflection linearity (within 2%), and adjustable magnetic axis alignment make it an exceptionally reliable and precise component for professional test and measurement instrumentation.



SOURCE OPERATING CONDITIONS

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Published test conditions and operating points. Values on this page are preserved as reported by this source.

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Section 0 · Cathode Ray

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Third Anode Voltage Maximum	1700 V	—
Typical Fourth Anode Voltage	4000 V	TypicalOperation

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