

ELECTRONIC TUBE REFERENCE

14ARP4

Specialized - Cathode Ray electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION
CONSTRUCTION
CATHODERAY

Fourteen-inch cathode-ray display tube documented by Philco. The available source identifies it as a CRT but provides insufficient extracted functional detail to justify a narrower functional classification or specialized canonical tags.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	0
NOMINAL HEATER	— / —	PARALLEL HEATER	— / —
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION1 Cathode Ray
No fixed ratings recorded.
Published values promoted where clearly attributable to this section.

14ARP4 — Electrostatic-Focus Cathode Ray Tube

The **14ARP4** is a 14-inch, 90-degree rectangular, direct-view cathode ray tube (CRT) designed specifically for cathode-drive television receiver applications. It features electrostatic focusing, magnetic deflection, a metal-backed screen, and a short overall length. The electron gun is engineered to provide extreme uniformity of characteristics, eliminating the need for an external ion trap magnet. By optimizing the design for cathode-drive operation with a low Grid #2 voltage, the 14ARP4 achieves high highlight brightness and excellent contrast while maintaining moderate drive voltage requirements.

Mechanical Design and Bulb Geometry

The 14ARP4 utilizes a rectangular glass bulb designated as bulb number **J112A1**. The faceplate is designed with a light transmission of approximately 78 percent at the center. The tube features a small-shell duodecal 6-pin base (**B6-63**) with a **12 L** basing arrangement, and an anode contact designated as **J1-21**. The anode terminal is aligned with Pin #6 within a tolerance of ± 30 degrees.

Physical Dimensions

The physical envelope of the 14ARP4 is characterized by its short overall length and compact neck, which facilitate space-saving chassis designs.

Dimension Parameter	Nominal Value	Tolerance
Overall Length	13-3/16 inches	$\pm 5/16$ inch
Neck Length	5-1/2 inches	$\pm 3/16$ inch
Greatest Bulb Diagonal	14 inches	$\pm 1/8$ inch
Greatest Bulb Width	13 inches	$\pm 1/8$ inch
Greatest Bulb Height	10-9/16 inches	$\pm 1/8$ inch
Minimum Useful Screen Diagonal	13 inches	(Minimum assured)
Minimum Useful Screen Width	12-1/16 inches	(Minimum assured)
Minimum Useful Screen Height	9-1/2 inches	(Minimum assured)

Mechanical Installation Notes

The reference line of the tube is determined using the standard R.E.T.M.A. #116 reference line gauge. To ensure proper operation and minimize stray capacitance effects, the external conductive coating must be grounded. The minimum size and location of the contact area for this external conductive coating are specified in the mechanical layout, and the actual area of the coating is designed to provide the required external coating capacitance. Additionally, the area immediately surrounding the anode button is covered with an insulating coating to prevent high-voltage arcing.

Heater, Basing, and Pin Connections

The 14ARP4 is equipped with an indirectly heated cathode. The heater is designed to operate from a nominal 6.3-volt supply.

Heater Parameter	Value
Nominal Heater Voltage	6.3 V

Heater Parameter	Value
Nominal Heater Current at 6.3 V	0.60 A $\pm$ 10%
Heating Method	Indirect

Pinout Configuration (12 L Basing)

The B6-63 small-shell duodecal base provides the following electrical connections, viewed from the bottom of the tube base:

- **Pin 1:** Heater
- **Pin 2:** Grid #1
- **Pin 6:** Grid #4 (Focusing Electrode)
- **Pin 10:** Grid #2 (Screen Grid)
- **Pin 11:** Cathode
- **Pin 12:** Heater
- **Recessed Button Cap:** Anode (Grid #3 and Grid #5 are connected internally to each other and to the collector/anode, terminated at the J1-21 cap)

Electrical Characteristics and Capacitances

The direct interelectrode capacitances and external coating capacitances of the 14ARP4 are kept low to maintain signal integrity in high-frequency cathode-drive circuits.

- **Cathode to all other electrodes (approximate):** 5 μ F (pF)
- **Grid #1 to all other electrodes (approximate):** 6 μ F (pF)
- **External conductive coating capacitance:** 800 pF minimum, 1200 pF maximum

Optical Characteristics

The screen of the 14ARP4 is coated with **P4** phosphor, which produces a white fluorescent color with medium persistence. This phosphor is backed by a reflective metal layer (metal-backed screen) to maximize light output and prevent ion burn without requiring an external ion trap magnet.

Typical Operating Conditions

For standard television receiver service, the 14ARP4 is operated under the following typical conditions, specifically optimized for cathode-drive configurations:

Parameter	Typical Value
Anode Voltage	10,000 V
Grid #4 Voltage (for focus at 100 μ A anode current)	-50 to +350 V

Parameter	Typical Value
Grid #2 Voltage	50 V
Grid #1 Voltage	0 V
Cathode Voltage (for visual extinction of undeflected focused spot)	50 V maximum
Cathode Current at Zero Bias	1,000 μ A minimum

In this operating mode, Grid #1 is maintained at ground potential (0 V) while the video signal and bias are applied directly to the cathode.

Maximum Ratings and Circuit Limits

The maximum ratings for the 14ARP4 are established under the Design Center system. These limits represent the absolute boundaries within which the tube can be operated safely and reliably.

Rating Parameter	Maximum Limit
Anode Voltage	14,000 V DC
Grid #4 Voltage	1,000 V DC
Grid #2 Voltage	70 V DC
Cathode Positive-Bias Voltage	150 V DC
Cathode Negative-Peak Voltage	0 V
Cathode Negative-Bias Voltage	0 V DC
Grid #1 Circuit Resistance	1.5 M Ω

Peak Heater-Cathode Voltage Ratings

To prevent insulation breakdown between the heater and the cathode, strict voltage limits must be observed depending on the polarity and the operating state of the equipment:

- **Heater negative with respect to cathode:**
 - *During the warmup period (not to exceed 15 seconds):* 410 V maximum
 - *After the equipment warmup period:* 180 V maximum
- **Heater positive with respect to cathode:** 180 V maximum

Unless otherwise specified, all electrode voltages are referenced positive with respect to Grid #1.

Cathode-Drive Application and Specific Transconductance

The 14ARP4 is specifically designed to provide increased highlight brightness in television receivers utilizing cathode-drive circuitry. In a typical cathode-drive configuration, Grid #1 is operated at ground potential, and Grid #2 (the screen grid) is operated at a small positive voltage (typically 50 V). Vertical flyback blanking pulses can be applied to either Grid #1 or Grid #2.

Specific Transconductance (Gm') Definition

To specify and compare the performance of cathode ray tubes under large-signal conditions, a specific transconductance parameter, designated as Gm' , is defined as:

$$Gm' = \frac{IKO \text{ Min.}}{ES \text{ Max.}}$$

Where:

- $IKO \text{ Min.}$ is the lowest zero-bias cathode current of any tube of the given type that meets the minimum specification.
- $ES \text{ Max.}$ is the largest drive voltage required to swing any tube of the type from spot cutoff to $IKO \text{ Min.}$.

Because $IKO \text{ Min.}$ represents the minimum assured highlight brightness, and a drive voltage of $ES \text{ Max.}$ will always produce this brightness or greater, Gm' serves as a reliable measure of the minimum large-signal transconductance for the tube type.

Performance Calculations and Comparisons

For the 14ARP4, the minimum cathode current ($IKO \text{ Min.}$) is specified as 1000 μA at a Grid #2 voltage of 50 V, and the maximum drive voltage ($ES \text{ Max.}$) required to reach zero bias from cutoff is 50 V.

$$\text{Calculation: } Gm'_{(14ARP4)} = \frac{1000 \mu\text{A}}{50 \text{ V}} = 20 \mu\text{A/V}$$

Under typical emission conditions, the 14ARP4 exhibits a Gm' of **25 $\mu\text{A/V}$** .

In comparison, a conventional 14-inch cathode ray tube is typically operated with a much higher Grid #2 voltage of 250 V. Assuming its zero-bias cathode current is only 70% of a typical tube (with a typical $IKO \text{ Min.}$ of 410 μA and an $ES \text{ Max.}$ of 35 V), its low-limit specific transconductance is calculated as:

$$\text{Calculation: } Gm'_{(\text{conventional})} = \frac{0.7 \times 410 \mu\text{A}}{35 \text{ V}} = 8.2 \mu\text{A/V}$$

Under typical emission conditions, the conventional tube exhibits a Gm' of **11.4 $\mu\text{A/V}$** .

Tube Type	Gm' (Typical Emission)	Gm' (Low Limit Emission)
14ARP4 (Grid #2 = 50 V)	25 $\mu\text{A/V}$	20 $\mu\text{A/V}$
Conventional Tube (Grid #2 = 250 V)	11.4 $\mu\text{A/V}$	8.2 $\mu\text{A/V}$

These figures demonstrate that with only 50 V applied to Grid #2, the specific transconductance (Gm') of the 14ARP4 is more than double that of conventional cathode ray tubes. This high transconductance ensures that the 14ARP4 delivers more than twice the peak highlight brightness (achieving at least 200 foot-lamberts when operated at an anode voltage of 10 kV) and an improved contrast ratio, using essentially the same maximum drive voltage swing as conventional designs.

Technical Summary

The **14ARP4** is a specialized **14-inch, 90-degree rectangular cathode ray tube** optimized for **cathode-drive television receivers**. Utilizing electrostatic focusing and magnetic deflection, it features a metal-backed screen with a **P4 white phosphor** and does not require an external ion trap magnet. The tube is housed in a **J112A1** bulb with a **B6-63 small-shell duodecal 6-pin base** and a **12 L** basing configuration.

By operating with a low Grid #2 voltage of 50 V, the 14ARP4 achieves a minimum specific transconductance (Gm') of **20 $\mu\text{A/V}$** (rising to **25 $\mu\text{A/V}$** under typical emission), which is more than double that of conventional CRTs. This design allows the tube to deliver a highlight brightness of at least **200 foot-lamberts** at a 10 kV anode potential with a maximum drive requirement of only 50 V, providing superior brightness and contrast performance in cathode-drive television circuitry.

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