



ELECTRONIC TUBE REFERENCE

12AFP7

Specialized - Cathode Ray electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION
CONSTRUCTION
CATHODERAY

Twelve-inch round metal-envelope cathode-ray tube designed for radar use. It employs magnetic focusing and magnetic deflection, a flat gray-filter face, and a long-persistence screen, with high-voltage operation reaching approximately 14 kV.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	5
NOMINAL HEATER	6.3 V / 600 mA	PARALLEL HEATER	— / —
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1 Cathode Ray	
MAXIMUM PLATE VOLTAGE	14000 V
<i>CRT accelerator/final-anode maximum mapped to MaxPlateVoltage.</i>	

12AFP7 — Magnetic Focus and Deflection Cathode-Ray Tube

A 12-inch round metal envelope cathode-ray tube featuring magnetic focus, magnetic deflection, and a long-persistence screen, designed specifically for radar indicator applications.

Overview

The **12AFP7** and **12AFP7A** are specialized 12-inch cathode-ray tubes designed for radar applications. They utilize magnetic focus and magnetic deflection, incorporating a straight magnetic electron gun that operates without the need for an ion trap. To minimize parallax errors—a critical requirement for accurate radar plotting—the tubes feature an almost completely flat faceplate.

The faceplate is constructed from a specialized gray filter glass (luxide) to enhance image contrast under ambient light. The 12AFP7 is equipped with a long-persistence Phosphor No. 7 screen. The variant **12AFP7A** is identical to the 12AFP7 but incorporates a metal-backed (aluminized) screen to provide greater light output and minimize screen charging effects during operation.

Screen and Optical Characteristics

The screen of the 12AFP7 is optimized for radar display systems where persistent imaging is required to track targets between antenna sweeps. The primary characteristics of the Phosphor No. 7 screen are:

- **Fluorescence:** Blue
- **Phosphorescence:** Yellow
- **Persistence:** Long

The faceplate's gray filter glass has an approximate light transmission of **66%**. This reduction in transmission helps absorb reflected ambient light, thereby significantly increasing the contrast of the displayed trace.

For the **12AFP7A**, the addition of an aluminized backing on the phosphor screen serves two primary purposes:

1. It reflects forward-emitted light that would otherwise be lost inside the tube envelope, thereby increasing the overall brilliance and light output.
2. It provides a conductive path that minimizes screen charging effects, ensuring stable beam landing and preventing localized distortion of the raster.

Other phosphor options exist within the same physical tube family, such as Phosphor No. 14 (blue fluorescence, orange phosphorescence, mid-long persistence) and Phosphor No. 19 (orange fluorescence, orange phosphorescence, long persistence), which correspond to the **12AFP14** and **12AFP19** designations respectively. These represent distinct phosphor formulations rather than direct electrical substitutes.

Mechanical Construction and Physical Dimensions

The 12AFP7 is built with a robust round metal envelope. The mechanical dimensions and tolerances are tightly controlled to facilitate precise mounting in radar consoles:

- **Greatest Diameter of Envelope:** $12 \frac{7}{16} \pm \frac{1}{8}$ inches
- **Minimum Useful Screen Diameter:** $11 \frac{3}{8}$ inches
- **Overall Length:** $17 \frac{7}{8} \pm \frac{7}{16}$ inches (with a maximum limit of $18 \frac{5}{16}$ inches specified in mechanical drawings)
- **Face Radius:** 125 inches
- **Neck Diameter:** $1 \frac{7}{16} \pm \frac{1}{16}$ inches
- **Deflection Angle:** Approximately 54 degrees
- **Anode Contact:** Metal cone lip (minimum width of $\frac{5}{8}$ inches, with an 18-degree maximum angle)
- **Base:** Small shell Duodecal 5-pin (B5-57)

- **Basing Connection Designation:** [12D](#)

The neck length, measured from the reference line to the base, is $7 \frac{1}{2} \pm \frac{3}{16}$ inches. The distance from the reference line to the top of the faceplate is $10 \frac{5}{16} + \frac{3}{16}$ inches. The reference line itself is defined by the position where a standard reference line gauge (JETEC #112) rests on the glass funnel.

Heater and Electrical Connections

The tube features an indirectly heated cathode with the following electrical specifications:

- **Heater Voltage:** 6.3 V
- **Heater Current:** 0.6 A $\pm$ 10%
- **Heater Warm-up Time:** Approximately 11 seconds

The nominal heater power can be calculated as: $\text{Heater Power} = V_f \times I_f = 6.3 \text{ V} \times 0.6 \text{ A} = 3.78 \text{ W}$ This calculation is based on the nominal heater voltage of 6.3 V and the nominal heater current of 0.6 A.

The electrical connections are made via a 5-pin Duodecal base (B5-57) using the [12D](#) basing arrangement. Although the duodecal base has 12 potential pin positions, only 5 pins are physically present to prevent incorrect insertion and simplify wiring:

- **Pin 1:** Heater
- **Pin 2:** Grid No. 1 (Control Electrode)
- **Pin 10:** Grid No. 2
- **Pin 11:** Cathode
- **Pin 12:** Heater

The anode connection is made directly to the metal cone lip of the envelope.

Direct Interelectrode Capacitances

- **Cathode to all other electrodes:** Approximately 5 pF
- **Grid No. 1 to all other electrodes:** Approximately 6 pF

Maximum Ratings (Design Center Values)

Operating limits must be strictly observed to prevent premature tube failure or permanent damage to the phosphor screen:

Parameter	Maximum Rating
Accelerator Voltage	14,000 Max. Volts D-C
Grid No. 2 Voltage	1,000 Max. Volts D-C
Grid No. 1 Negative Bias Value	-125 Max. Volts D-C
Grid No. 1 Positive Bias Value	0 Max. Volts D-C

Parameter	Maximum Rating
Grid No. 1 Positive Peak Value	2 Max. Volts
Peak Heater-Cathode Voltage (Heater negative with respect to cathode)	180 Max. Volts D-C
Peak Heater-Cathode Voltage (Heater positive with respect to cathode)	180 Max. Volts D-C
Peak Heater-Cathode Voltage (Heater negative during warm-up, ≤ 15 sec)	410 Max. Volts D-C
Grid No. 1 Circuit Resistance	1.5 Max. Megohms

Typical Operating Conditions and Circuit Design

Under typical operating conditions, the 12AFP7 and 12AFP7A are configured with the following parameters:

- **Accelerator Voltage:** 12,000 Volts D-C
- **Grid No. 2 Voltage:** 500 Volts D-C
- **Grid No. 1 Voltage (for visual extinction of undeflected focused spot):** -33 to -77 Volts D-C
- **Field Strength of Adjustable Centering Magnet:** 0 to 8 Gauss
- **Focusing Coil Current:** Approximately 110 mA $\pm$ 20% (using a standard focusing coil RETMA No. 106 or equivalent, positioned 3-1/4 inches from the reference line)

Technical and Safety Considerations

1. **Screen Protection and Power Limits:** When operating at or near the maximum accelerator voltage of 14,000 V, the effective resistance of the high-voltage supply must be high enough to limit the accelerator input power to a maximum of **6 watts**. The phosphor screen can be permanently damaged (burned) if the electron beam current density is allowed to rise too high. To prevent burning, circuits should be designed to maintain minimum beam current densities and ensure the beam is never allowed to remain stationary at high intensity.
2. **Minimum Operating Voltage:** While the tube can operate at lower voltages, both brilliance and spot definition decrease as the accelerator voltage is reduced. In general, the accelerator voltage should not be allowed to fall below **8,000 volts**.
3. **Cathode Return:** To minimize hum and potential differences, the cathode should be returned either to one side of the heater transformer winding or to its center tap.
4. **Spot Alignment:** The mechanical alignment of the electron gun ensures that the center of the undeflected, focused spot falls within a circle of **20 mm radius** concentric with the physical center of the tube face. An adjustable centering magnet providing up to 8 Gauss of field strength can be used to achieve precise alignment.

Technical Summary

The **12AFP7** and **12AFP7A** are specialized 12-inch cathode-ray tubes engineered for high-contrast, long-persistence radar displays. Featuring a flat faceplate, a straight magnetic gun, and a metal envelope, they provide reliable performance without the complexity of an ion trap. The 12AFP7 utilizes a standard long-persistence Phosphor No. 7 screen, while the 12AFP7A incorporates an aluminized backing for enhanced brightness and stability. Operating typically at an accelerator voltage of 12,000 V, these tubes require careful power limiting to protect their sensitive screens from permanent burn damage, while delivering the precise spot focus and high contrast necessary for demanding radar applications.

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1963 Rauland

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

1963 RAULAND

Section 1 · Cathode Ray

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Heater voltage	6.3 V	—
Heater current	600 mA	—
Maximum heater-cathode voltage	180 V	Heater positive to cathode
Maximum grid 1 circuit resistance	1.5 Mohm	—

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Focusing method	Magnetic	—
Deflection method	Magnetic	—

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Cathode to all other electrodes capacitance	5 pF	—
Grid 1 to all other electrodes capacitance	6 pF	—

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