

Mid-Atlantic Antique Radio Club

Collecting and Preserving Our Electronics Heritage

U.S. MAGIC EYE TUBES



Dave Rossetti 20 March 2022

WHAT IS A MAGIC EYE TUBE?

- > Also called a Tuning Indicator, Electron-Ray Indicator Tube, or Cat's Eye Tube
- Indicates amplitude of an electronic signal
 - Radio Signal Strength
 - > Nulls (for Bridges Capacitor/Resistor Checkers)
 - » RF/Audio Output (for Signal Tracers)
- > A simple cathode ray tube (CRT) device
- Cheaper alternative to standard meters (no d'Arsonval movement nor pilot light)

SAMPLE MAGIC EYE TUBES









1629



6AL7





HISTORY

- The eye tube was developed by Allen DuMont in 1932
- Sold the patent to RCA for \$19,500 (and used that to buy his first manufacturing plant)
- > RCA 6E5 First Commercial Tube with 6 pin base - 1935
- > Originally end-viewed with 90° fan indicator
- Later tubes featured round, dual fan, and linear displays





U.S. MAGIC EYE TUBE TIME LINE



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HOW RO THEY OPERATE?

- Miniature CRT, generally with a triode signal amplifier
- Tube has two plates, one for the triode & one for the eye green willemite (zinc orthosilicate) phosphor "target" at 150 - 250 volts
- Control "grid" (blade/tab extending from the triode plate) closes eye as signal voltage increases



MAGIC EYE TUBE SCHEMATIC

- > Typical way a magic eye tube works
- The 1 megohm resistor above the tube is the one that is often found inside the socket



PINOUTS FOR COMMON EYE TUBES

CIRCUIT SCHEMATICS

EYE TUBE STATS

Tube	Year	Еуе Туре	Shape	Base	Filament	Comments	
6E5	1935	90° Fan	ST & GT	6 Pin	6.3V	Introduced by RCA. Used sharp cutoff triode.	
2E5	1936	90° Fan	ST & GT	6 Pin	2.5V	Same at 6E5 with 2.5 volt fil. to modernize sets.	
6G5	1936	90° Fan	ST	6 Pin	6.3V	Vari-µ remote cutoff triode (larger volt swings).	
2G5	1936	90° Fan	ST	6 Pin	2.5V	Same as 6G5 with 2.5 volt fil. to modernize sets.	
6H5	1936	90° Fan – Top Shadow Stationary	ST	6 Pin	6.3V	Used remote cutoff triode.	
6N5	1936	90° Fan	ST	6 Pin	6.3V	Half filament consumption of 6G5 for battery sets.	
6AB5	1937	90° Fan	GT	6 Pin	6.3V	GT Version of the 6N5.	
6U5	1937	90° Fan	GT	6 Pin	6.3V	Vari-µ triode. GT Version of the 6G5.	
6T5	1937	Annular ring shadow	GT	6 Pin	6.3V	Short lived. Hard to see annular ring shadow.	
6AD6	1938	2 individually controlled 90° Fans	GT	Octal	6.3V	No internal triode. Two control grids. Rare.	
6AF6	1938	2 individually controlled 90° Fans	GT	Octal	6.3V	No internal triode. Shorter 6AD6.	
1629	1941	90° Fan	GT	Octal	12.6V	Introduced for WWII military equipment. Like 6E5.	
6AL7	1946	3 individually controlled bars	GT	Octal	6.3V	Designed for FM tuners and TVs. Not widely used.	

Tube and Triode Type	Eye Open	Eye Closed
6E5, 2E5, & 1629 – Sharp Cutoff Triode	0 Volts	-8 Volts
6G5, 2G5, 6H5, & 6U5 – Remote Cutoff Triode	0 Volts	-22 Volts
6N5 & 6AB5 – Remote Cutoff Triode	0 Volts	-12 Volts
6T5 – Remote Cutoff Triode	0 Volts	-15 Volts

APPLICATIONS - BARIO SIGNAL STRENGTH

- > Typically driven from the Automatic Volume / Gain Control (AVC/AGC) voltage in a superhet radio
- As the signal is tuned in, AVC voltage is increased causing the eye tube shadow to decrease to minimum size (fan or 'pupil' closes)

STRONGER SIGNAL - EYE CLOSES

APPLICATIONS - BRIDGES/B.C. CHECKERS

> Used to check capacitors and resistors
> Eye opens when bridge is balanced

APPLICATIONS - SIGNAL TRACERS

> Eye closes when signal detected

665 TYPE EYE TUBES (665, 265, 665, 265, 615, 605, 6685, & 615)

- ≻ 90° Fan
- Internal triode
- 6 pin base
- > 2.5 or 6.3 volt filament
- Fresh tubes test well on Hickok testers

8T5 EYE TUBE

- Introduced in 1937
 Predominately found in Zenith Robot-Dial and Shutter-Dial radios
- Center "Pupil" closes as signal strength increases
- Short lived discontinued in 1939

6AR6 / 6AF6 EYE TUBES

- Octal-based, 6.3 volt filament
- > 2 individually controlled 90° fans
- 6AD6 has no internal triode
 works with the 6AE6 twin triode
- As one eye closes (at 7 volts AVC) the second eye closes (at 27 volts AVC)
- Fresh tube tests well on Hickok testers

See Radio Age, December 2020, page 12

1629 WWII EYE TUBE

- > Octal-based, 12.6 volt equivalent to the 6E5
- Developed in 1941 by RCA for military equipment
- Fed Hannah found it does work with an adaptor in place of 6E5 type tubes at 6 volts (more to follow)
- Fresh tube tests well on Hickok testers

USING THE 1629 IN 6.3 VOLT APPLICATIONS

- Charlie Scarborough found that although the 1629 works at 6 volts, it is dim with low sensitivity
- He developed a simple voltage doubler using:
 - 2 1N4000 diodes and
 - 2 220+ μF 10-16 volt capacitors

that can fit in the adaptor

Pin 1 of the 6E5/6U5 to Pin 2 of the 1629 Pin 2 of the 6E5/6U5 to Pin 3 of the 1629 Pin 3 of the 6E5/6U5 to Pin 5 of the 1629 Pin 4 of the 6E5/6U5 to Pin 4 of the 1629 Pin 5 of the 6E5/6U5 to Pin 8 of the 1629 Pin 6 of the 6E5/6U5 to Pin 7 of the 1629

See Radio Age, December 2001, pages 11 - 12

6AL7 EYE TUBE

- > Octal-based, 6.3 volt filament
- Introduced in 1946 for FM tuners and TVs
- > 3 individually controlled bars (2 narrow at top, 1 wide at bottom)
- > Not widely used
- Fresh tubes test well on Hickok testers

TERMARKET TUNING EYE DEVICES

FOR OCTAL BASE TUBES

No. MEA8 - S1.25 List

Installation Kits

See Radio Age, October 2009, page 12

Magic Lion

See Radio Age, January 2001, page 13

Aluminum Airplane

See Radio Age, October 2009, page 13

BRIGHTENING & MAGIC EYE TUBE

- Older eye tubes loose their brilliance due to a gradual "sickening" of the phosphor top layer caused by electron bombardment heating – Rejuvenation does not work
- Deeper phosphor material can be excited by higher velocity electrons
- > To 'brighten' the tube, we must:
- 1. Increase display anode voltage (from ~250 to 450 DC)
- 2. Increase sensitivity to AVC voltage (doubled)
- 3. Reduce cathode current to the display anode (by reducing heater voltage to increase phosphor life)

BRIGHTENING & MAGIC EYE TUBE

MAARC member Joe Sousa (with help from Ron Roscoe, Robert Lozier, and Karl Laurin) developed a circuit to do just that - See Radio Age, Nov 2012 and Jan 2013

GETTING MORE THAN & 90° FAN

- > 1937 RCA Review article
- Used a type 76 triode (T1) in place of the eye tube's triode, allowing the triode's plate to operate over a wider range of voltages, even negative, with respect to the

negative, with respect to the indicator's cathode

- > 150° to 180° fan, similar to the Rodgers (Canadian) 6X6G eye tube used in Rogers-Majestic and deForest radios
- Can use a 6P5, 6J5, or 6C5 GT, a 6C4 miniature, or a 5975 subminiature for T1

See Radio Age, January 2003, pages 7-9 and May 2011, pages 9-12

THE "JIM RANRY" EYE TUBE CHECKER

MAARC member Cliff Hensley (inspired by Joe Koester) - eye tube field tester See Radio Age, Aug 2016 p12

REFERENCES

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- Franks Electron Tube Pages 6T5 <u>https://www.sm5cbw.se/tubes/htm/6t5.htm</u>
- > Radiomuseum <u>https://www.radiomuseum.org/tubes/</u>
- > Ludwell Sibley *Tube Lore* 1996
- Ludwell Sibley Tube Lore II 2019
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 - June 1997, page 13
 - □ January 2001, page 13
 - **December 2001, pages 11-12**
 - □ January 2003, pages 7-9
 - October 2009, pages 10-13 & 15
 - **Given Sebruary 2010, pages 1-9**
 - □ May 2011, pages 9-12
 - □ November 2012, pages 1-7 & 15
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 - □ August 2016, pages 12-13
 - December 2020, page 12