RADIOTRONICS

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1/-

AMALGAMATED WIRELESS VALVE COMPANY PTY. LTD.

EDITORIAL

CONTENTS

Following the announcement, last month, of the range of Radiotron valves, picture tubes and special components for television, we are pleased to give data on the only valves and picture tubes not included in the R.C.A. Receiving Tube Manual RC17, namely Radiotron 5AS4 rectifier and 17HP4B picture tube. In addition, we also give a helpful article on the operation and application of the 17HP4B picture tube.*

Following on from the article in the March issue entitled "Modern methods of testing amplifiers — (3) Harmonic Measurement using Wave Analyser," we now include the results of similar tests using a Marconi Wave Analyser. These tests confirm the earlier ones, and give the measured distortion arising in the Marconi Wave Analyser. These two articles are unique in the world, as nothing comparable has appeared in any article from overseas. A further helpful article gives Revised Germanium Diode Data.

Next month we hope to publish two short articles on amplifiers — what sensitivity is required in pre-amplifiers, and square wave tests with loudspeaker load on the leak TL/12 main amplifier. In addition we hope to publish another article on television by one of our engineers, the subject being Picture Tube Mounting.

* Available from this office at 8/9 post free.

Arthur J. Gabb.

CORRECTIONS

Radiotron Valves, Picture Tube and Special Components for Television

Some errors occurred in the article appearing under this heading on pages 40 and 41 of the April issue.

Type 6SN7-GTB should read 6SN7-GTA. These two types are identical except that the "B" version has controlled heating time which is unnecessary for Australian conditions.

12AU7: Medium mu triode. A miniature type for use in circuits in which the stability of the 6SN7-GTA is *not* required.

Special components.

The code Number of the Horizontal Blocking Oscillator Transformer should read THB1.

RADIOTRON 17HP4B PICTURE TUBE

Rectangular Glass Type

Low-voltage Focus

Magnetic Deflection

DATA

General:

Heater, for Unipotential Cathode:
- Voltage .... 6.3 ac or dc volts
- Current .... 0.6 amp

Direct Interelectrode Capacitances:
- Grid No. 1 to All Other Electrodes .... 6 $\mu\mu$F
- Cathode to All Other Electrodes ...... 5 $\mu\mu$F

External Conductive Coating to Ultor* .... {1500 max. $\mu\mu$F, 750 min. $\mu\mu$F}

Faceplate, Spherical .... Filterglass
- Light Transmission (approx.) 66%

Phosphor .... P4 — Sulfide Type
- Fluorescence and Phosphoresence ..... White
- Persistence of Phosphorescence .... Short

Focusing Method .... Electrostatic

Deflection Method .... Magnetic

Deflection Angles (approx.):
- Diagonal .... 70°
- Horizontal .... 65°
- Vertical .... 50°

Ion trap gun:
Requires External, Single-Field Magnet

Overall Length .... $19\frac{3}{16}''$ ± $\frac{3}{8}''$

Greatest Diagonal of Tube ...... $16\frac{5}{8}''$ ± $\frac{1}{8}''$

Greatest Width of Tube .... $15\frac{3}{8}''$ ± $\frac{1}{8}''$

Greatest Height of Tube .... $12\frac{9}{32}''$ ± $\frac{1}{8}''$

Screen Size .... $14\frac{3}{8}''$ x $11\frac{1}{16}''$

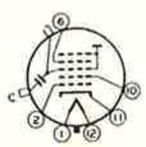
Mounting Position .... Any

Cap .... Recessed Small Cavity

Base .... Small Shell Duodecal 6-Pin

Bottom View

Pin 1 — Heater
Pin 2 — Grid No. 1
Pin 6 — Grid No. 4
Pin 10 — Grid No. 2
Pin 11 — Cathode
Pin 12 — Heater



Cap — Grid No. 3, Grid No. 5, Collector
C — External Conductive Coating.

Maximum Ratings, Design Centre Values:

Ultor* Voltage .... 16000 max. volts

Grid — No. 4 Voltage:
- Positive Value .... 1000 max. volts
- Negative Value** .... 500 max. volts

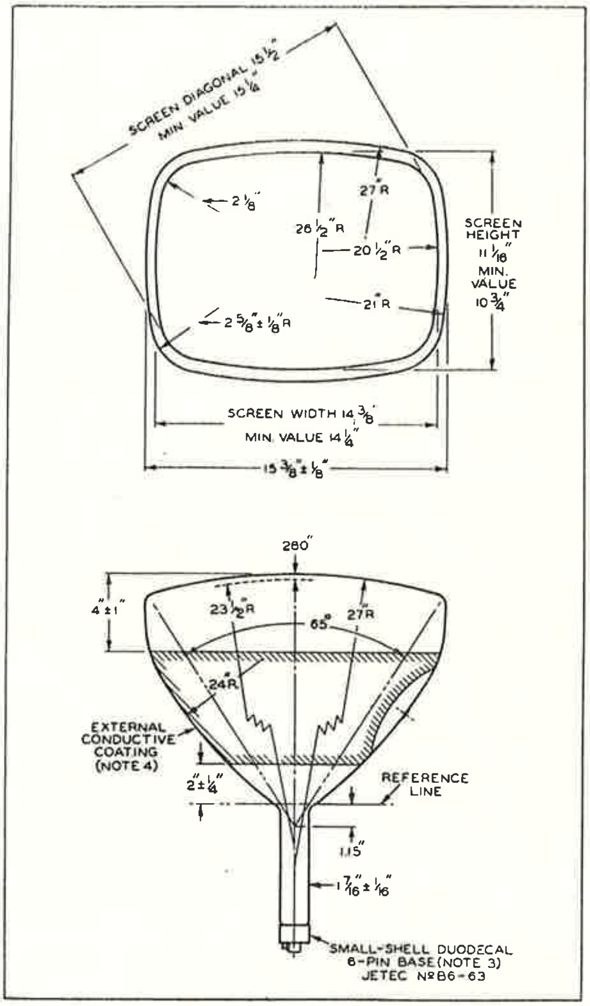
Grid — No. 2 Voltage .... 500 max. volts

Grid — No. 1 Voltage:
- Negative bias value .... 125 max. volts
- Positive bias value .... 0 max. volts
- Positive peak value .... 2 max. volts

Peak Heater — Cathode Voltage:

Heater negative with respect to cathode:
- During equipment warm-up period not exceeding 15 seconds .... 410 max. volts
- After equipment warm-up period .... 180 max. volts

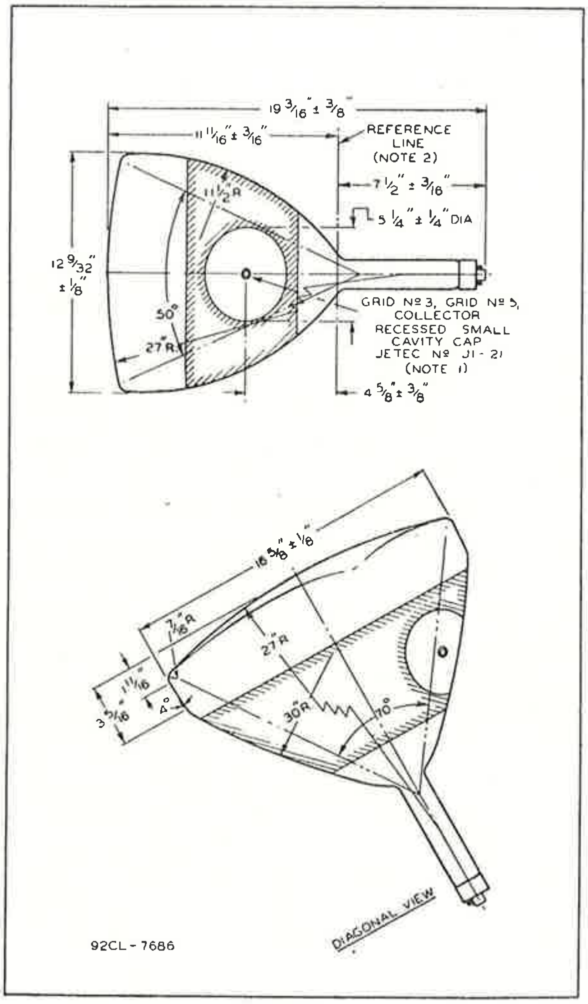
Heater positive with respect to cathode .... 180 max. volts



Equipment Design Ranges:

For any ultor voltage (E_u) between 12000† and 16000 volts and grid No. 2 voltage (E_{c2}) between 150 and 500 volts.

Grid — No. 4 Voltage for Ultor Current of 100 μamp	—0.4% to 2.2% of E_u volts
Grid — No. 1 Voltage for Visual Extinction of Undeflected Focussed Spot	11% to 25.7% of E_{c2} volts
Grid — No. 4 Current	—25 to +25 μamp
Grid — No. 2 Current	—15 to +15 μamp
Field Strength of Single-field Ion-Trap Magnet (approx.)#	$\sqrt{\left(\frac{E_u}{12000}\right)} \times 42$ oersteds
Field Strength of Adjustable centring Magnet . .	0 to 8 oersteds



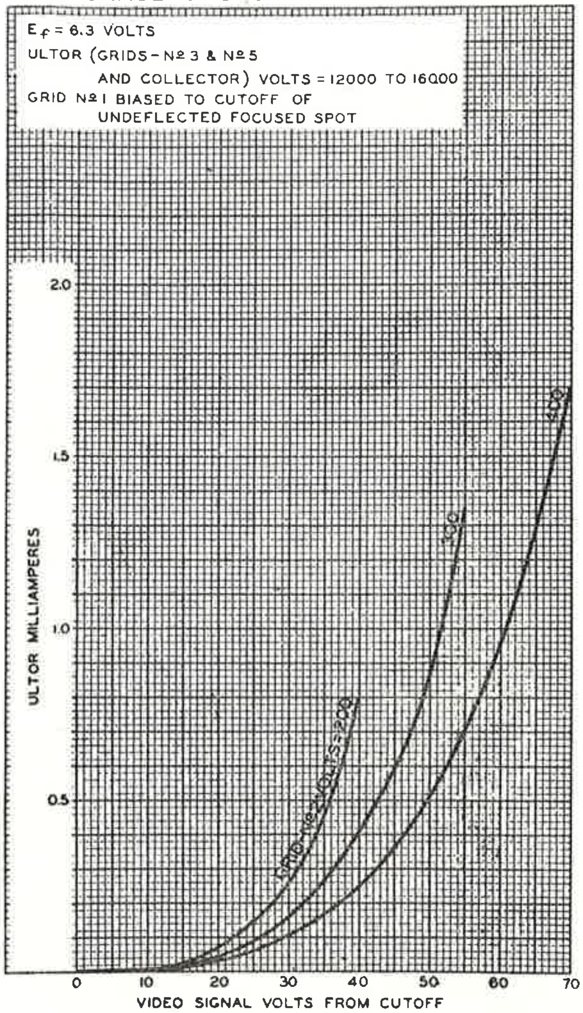
Examples of Use of Design Ranges:

For ultor voltage of	14000	16000	volts
and grid No. 2 voltage of	300	300	volts
Grid — No. 4 Voltage for Ultor current of 100 μamp:	—55 to +300	—65 to +350	volts
Grid — No. 1 Voltage‡:	—33 to —77	—33 to —77	volts

OPERATING NOTES

X-Ray Warning — When operated at ultor voltages up to 16 kilovolts, the 17HP4B does not produce any harmful X-ray radiation. However, because the rating of the tube permits operation at voltages as high as 17.6 kilovolts (absolute value), shielding of the 17HP4B for X-ray radiation may be needed to protect against possible injury from prolonged exposure at close range whenever the operating conditions involve voltages in excess of 16 kilovolts.

AVERAGE GRID-DRIVE CHARACTERISTICS



The following notes refer to the tube outline drawings:

Note 1:

The plane through the tube axis and pin No. 6 may vary from the plane through the tube axis and bulb terminal by an angular tolerance (measured about the tube axis) of ±30°. The bulb terminal is on the same side as pin No. 6.

Note 2:

With the tube neck inserted through the flared end of the reference-line gauge and with the tube seated in the gauge, the reference line is determined by the intersection of the plane CC′ of the gauge with the glass funnel.

Note 3:

The socket for this base should not be rigidly mounted; it should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle concentric with the bulb axis and having a diameter of 2¾″.

Note 4:

The external conductive coating must be grounded.

Maximum Circuit Values,

Grid — No. 1 Circuit Resistance:
1.5 max. megohms

* In the 17HP4B, grid No. 5 which has the ultor function, grid No. 3, and collector are connected together within the tube and are conveniently referred to collectively as "Ultor". The "Ultor" in a cathode-ray tube is the electrode, or the electrode in combination with one or more additional electrodes connected within the tube to it, to which is applied the highest dc voltage for accelerating the electrons in the beam prior to its deflection.

** This value has been specified to take care of the condition where an ac voltage is provided for dynamic focusing.

† Brilliance and defintion decrease with decreasing ultor voltage. In general, the ultor voltage should not be less than 12,000 volts.

‡ For visual extinction of undeflected focused spot.

♯ Direction of the field of the ion-trap magnet should be such that the north pole is approximately adjacent to pin location No. 8 and the south pole to pin No. 2.

RADIOTRON 17HP4B PICTURE TUBE

OPERATION AND APPLICATION

*By F. J. ROBERTS, A.S.T.C.**

This article gives helpful information on the operation and application of Radiotron 17HP4B picture tube, and it is hoped that the prospective user will thus be assisted to obtain the best pictures possible.

Radiotron 17HP4B is a 70° rectangular glass aluminized picture tube using magnetic deflection and low voltage electrostatic focusing. An ion trap is provided in conjunction with the aluminium backing to protect the screen from negative ion bombardment. The trap also serves to protect the cathode from positive ion bombardment. The bulb incorporates a neutral density filter glass face plate, light transmission through the face plate being approximately 66%, to improve contrast and to minimise halation effects. An external conductive coating on the bulb acts both as a shield to minimise beam radiation and as a filter capacitor for the usual type of "flyback" high tension power supply.

The electrostatically-focused tetrode gun is of the low voltage symmetrical lens type. The electron optical system in a picture tube, commonly referred to as the electron gun, has as its function the focusing of a beam of electrons emitted by the cathode to a small spot on the screen, and the control of the intensity of that electron beam.

In conventional picture tubes there are at least two electron lens systems employed (as shown in Fig. 1) for focusing the electron beam. The first lens forms a cross-over point of electrons a short distance in front of the cathode. A second lens focuses the cross-over point on to the screen, resulting in the small spot used for scanning. The first lens is always electrostatic and is formed in a tetrode gun by the cathode, G_1 and G_2, typical voltages applied to these elements (referred to the cathode) being shown in Fig. 2.

The second lens may be magnetic or electrostatic or a combination of the two. In magnetically focused tubes an external magnetic field is used to form the second lens. In the 17HP4B the lens is formed by the G_3 G_5 G_4 combination shown in Fig. 2.

* Picture Tube Section, Valve Works, Ashfield.

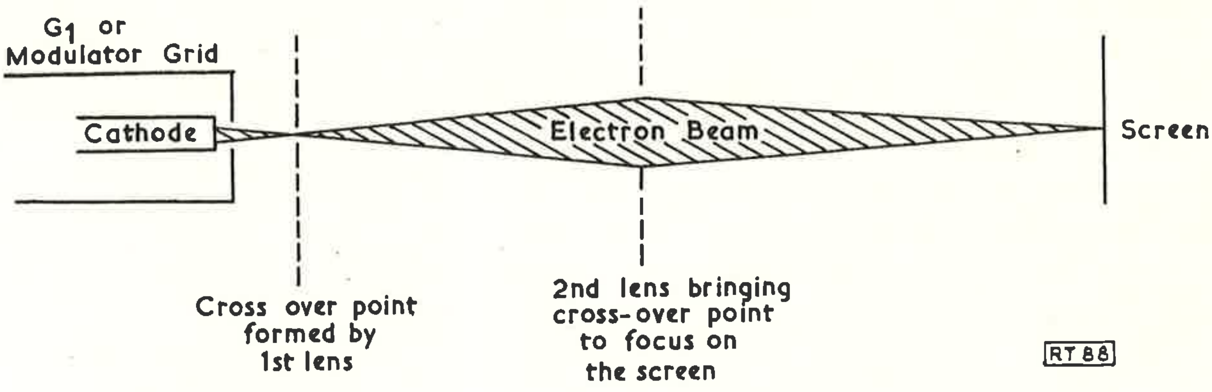


Fig. 1. A typical electron gun with two lenses (RT88).

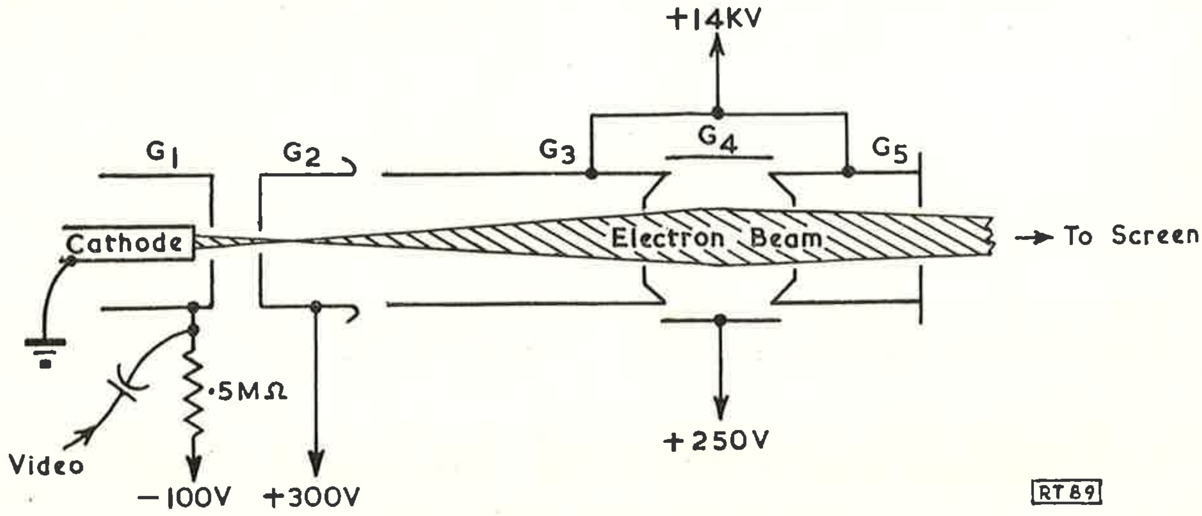


Fig. 2. The tetrode electron gun with electrostatic second lens as used in Radiotron 17HP4B. The ion trap has been omitted from this diagram for simplicity (RT89).

The element designated G_4 is the focusing electrode. The elements G_3 and G_5 are electrically connected internally and through bulb spacers make contact, via the internal graphite and aluminium coatings, with the high tension contact on the side of the bulb. These elements form the ultor of the tube.

As indicated in the design range for the 17HP4B, G_4 voltage for focusing a 100 μa beam will lie between -0.2% and $+2.2\%$ of E ultor.

The focus characteristic of this type of gun is very soft, that is, it will hold focus over a wide range of beam currents and the value of G_4 voltage can be carried in most cases by 50 volts or 100 volts without visible defocusing occurring. By connecting the G_4 electrode to a fixed voltage relative to the cathode some degree of automatic focus compensation for changing ultor voltage is achieved. Typical overseas practice is to operate the picture tube in a T.V. receiver with the G_4 connected to the chassis, B+ or B boost, whichever provides the best focus for the electrical conditions used. The high voltage rating of $+1000$ volts for the G_4 ensures that B boost can always be used, and a negative rating of -500V permits dynamic control of the G_4 voltage if required.

Comparing the low voltage electrostatic focusing used in the 17HP4B with magnetic focusing, the former eliminates the need for a large and costly component, namely the magnet used for focusing and centring. Both systems are capable of giving good results; however, with magnetic focusing, spot size and freedom from aberration effects are largely dependent upon the quality of the magnet used and care taken in mounting and adjusting and in the maintenance of adjustment during transport. Even a slight tilt or off-centre operation will spoil the sharpness of the focus.

In order to centre the picture on the screen of an electrostatically focused tube it is necessary to provide a centring adjustment. Slightly off-centre operation will otherwise occur because of any small asymmetry in bulbs and gun location within the neck. With the 17HP4B the centring is adjusted

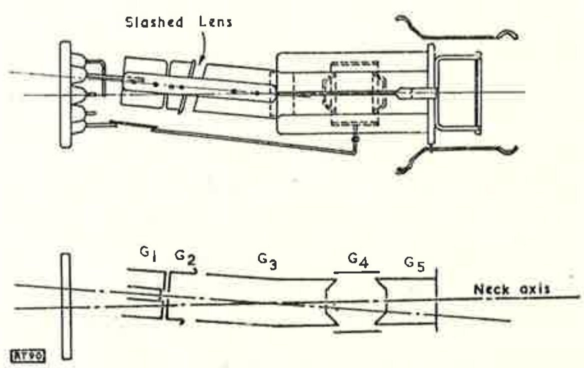


Fig. 3. Complete gun assembly of type 17HP4B (RT90).

by means of a weak centring magnet only slightly larger than an ion trap magnet. The centring magnet clips on to the neck and is located between the end of the gun and the deflection yoke.

The complete gun assembly is shown in Fig. 3. The ion trap is formed by the slashed lens between the G_2 and G_3 cylinders, and requires a single magnet to re-bend the electron beam. The object in adjusting the ion trap magnet is always to centre the beam of electrons in the aperture at the farther end of the G_3 cylinder. Failure to centre the beam in this aperture will result in defocusing, since this aperture marks the commencement of the focusing lens.

If the beam is allowed to strike the sides of the aperture light output will suffer, and there is also a great risk of local heating of the aperture taking place with consequent evolution of gas. The positioning of the ion trap magnet, centring magnet and yoke on the neck of a 17HP4B can be seen in Fig. 4.

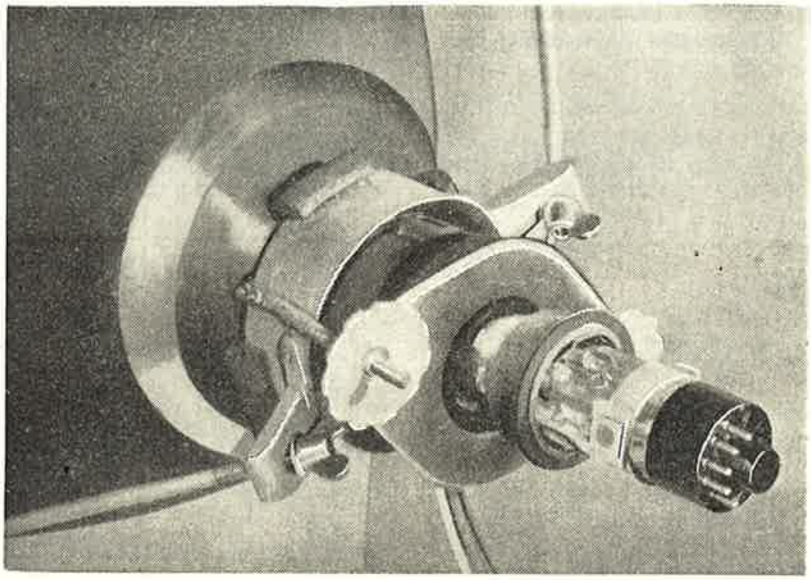


Fig. 4. Photograph showing the position of the ion trap magnet, centring magnet and yoke on the neck of type 17HP4B (RT91).

The yoke should always be placed as far forward on the neck as possible, with the formed winding lightly pressing against the picture tube bulb. Failure to position the yoke far enough forward will result in neck shadows as the deflected beam fails to clear the neck of the tube.

The 17HP4B uses a metal backed (aluminized) screen. There are several advantages resulting directly from the use of an aluminized screen, these being:—

1. At normally used values of high-tension voltage the light output is almost doubled or alternatively the same light output can be obtained with a greatly reduced beam current. The increased light output is obtained by reflecting forward the light which, without the aluminium backing, would be directed towards the rear of the picture tube. This is illustrated in Figs. 5 and 6.
2. The picture contrast is improved by the elimination of glare caused by reflection of the backward-directed light, this being inevitable without the aluminium backing.
3. Ambient light shining on to the face of a picture tube from the front spoils picture contrast by illuminating areas of the picture which would otherwise be dark. Also, light shining from the front can cause glare by reflection from the curved surface of the picture tube face plate. It is therefore advantageous to be able to attenuate this light.
   Having increased light output from an aluminized tube it is possible to use a light-absorbing safety glass in front of the picture tube whilst still maintaining the same high-light brightness as that obtainable from a non-aluminized tube.
   The unwanted light from the front is thus attenuated twice, since it passes through the light absorbing glass twice, and a contrast improvement of 2:1 can easily be obtained in this manner. Alternatively, use can be made of higher ambient lighting whilst still maintaining good picture contrast.
4. The phosphor is protected from the effects of bombardment by negative ions. It is true that modern ion traps are very efficient, but in the event of stray ions not being trapped or being formed outside the influence of the trap the aluminium backing forms a protecting barrier.
5. The aluminium ensures that the phosphor screen is electrically rather than electronically connected to the source of high potential. With non-aluminized tubes, secondary emission from the screen is relied upon to maintain the screen potential close to the potential of the final anode in the gun. Depending upon the phosphor used, when high values of final potential are employed the screen can become charged negatively, which means that the screen potential lags behind that of the final anode. Under these conditions, ions

formed as a result of gas liberation during the life of the tube can, in conjunction with the negatively charged screen, cause the phenomenon known as X or cross burn. By maintaining the phosphor screen at essentially the same potential as the final anode, the aluminizing process eliminates this trouble.

6. Aluminizing results in an improvement in pattern stability as regards surface leakage effects on the face of a picture tube. The effect can be demonstrated by touching the face of an operating tube.

The aluminium backing is evaporated on to the back of the screen and the bulb inside surface after the phosphor screen has been settled and the neck area has been internally graphite-coated. The aluminium backing must be smooth in order to obtain good light-reflecting properties. The phosphor surface is rough, and for this reason the aluminium cannot be evaporated directly on to the phosphor screen. A thin plastic film is first applied to the back of the screen. This film fills in irregularities and presents a smooth, even surface. The aluminium coating is then evaporated directly on to the plastic film to a thickness of about 4 x 10^{-6} inch.

Before the gun assembly is sealed into the neck of the tube, the aluminized bulb is baked at a temperature high enough to decompose the plastic film. The vapour escapes through pores in the aluminium coating and when the process is complete the aluminium backing remains, resting on the high spots of the phosphor screen.

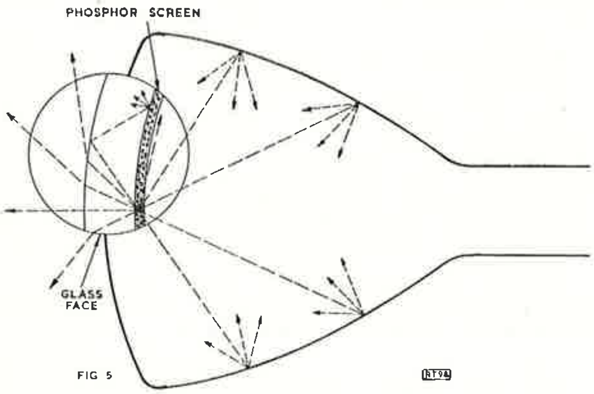


Fig. 5 (upper). Conventional non-aluminized picture tube showing typical distribution of light from a spot (RT92).

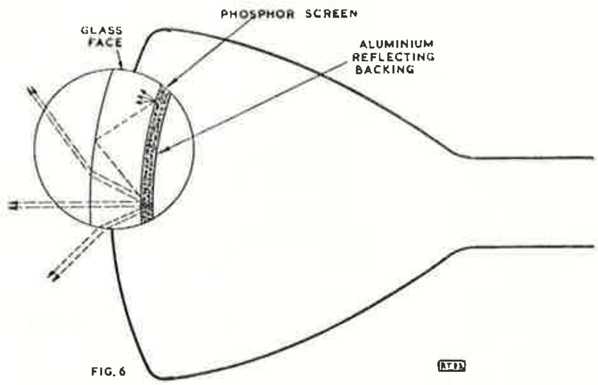


Fig. 6 (lower). Picture tube with aluminium backing film showing gain due to improved distribution of light (RT93).

NOTE: Figs. 5 and 6 were based on D. W. Epstein and L. Pensak, "Improved cathode ray tubes with metal-backed luminescent screens", published in R.C.A. Review, March 1946, modified.

TUBE ENVELOPE TEMPERATURE

(*Continued from last month*) —P.42

In general, the envelope temperature of small receiving-type power tubes should be kept below 175 deg. centigrade for increased reliability. The chief effect of high temperature on vacuum tubes is not a sudden change in operating characteristics but a gradual deterioration of characteristics. Table II indicates the operating bulb temperatures for five types of tubes, having various sized envelopes for plate dissipations ranging from 20 percent up to maximum rated dissipations. This gives an idea of the extent to which it is possible to reduce bulb temperatures by decreasing the total tube plate dissipation.

The ultimate bulb temperature depends not only upon the dissipation within the tube itself but also upon the temperature of the surrounding air immediately adjacent to the tube envelope. Table III

TABLE III—Sea Level Bulb Temperatures vs Dissipations and Ambient Temperature Variations

Ambient	Watts per Sq In. 1	2	3	4	5
	Bulb Temp deg C at Hottest Spot				
23C	100	170	230	280	310
160	220	260	300	340	370
250	310	350	390	420	450

shows how these ambient temperatures affect the bulb temperature for various watts per square inch dissipation. From these data it is apparent that precautions must be taken to keep the ventilation around the tubes such that the temperature will be as low as possible.

The importance of bulb temperatures on tube life can be noted in recent information published by various tube manufacturers showing the life which may be expected for subminiature tubes. Most of these tubes are rated for maximum bulb temperatures of 200 deg. with a few having a rating of 250 deg. C. A reduction of bulb temperature on the order of 20 percent when operating in the region of 200 deg. C bulb temperatures will result in a substantial increase in the life expectancy of the tubes. The cooling of the tube envelope is the most important consideration in mounting the tube.

A loose-fitting shield such as is commonly employed with miniature tubes may increase the temperature appreciably. The situation arises because the shield is not tight fitting but instead provides a blanket of hot air around the tube. Thus the shield does not provide a good thermal contact with bulb of the tube or to the chassis and cannot effectively cool the bulb.

If shields are employed, and they are tight fitting and can be fastened directly to the chassis, a considerable amount of heat can usually be removed in this manner. To obtain maximum heat radiation, the shield should not be plated and should not be polished.

So far, sea-level altitudes have been assumed. Many tubes operate at high altitudes some or all of the time. This environment aggravates the cooling problem still more since the density of the air decreases with altitude. The decreased effective cooling of a tube at higher altitudes requires that the total tube dissipation be derated in order not to exceed critical bulb temperatures. This derating depends upon the altitude and may amount to as much as 40 or 50 percent.

To obtain maximum reliability from vacuum tubes and equipment, it is important that pains be taken to keep the operating temperature of the bulb at its hottest spot within the limit specified by data sheets.

Biography

M. L. Miller, The Design of Electronic Equipment Using Subminiature Components, *Proc. IRE,* Feb. 1950.

B. O. Buckland, Electron Tube Heat Transfer Data, *Elec. Eng.,* Nov. 1951.

R. J. Bibberow, Electron Tube Ratings at Very High Altitudes, *Tele-Tech.,* May 1951.

P. T. Weeks, Reliability in Miniature and Subminiature Tubes, *Proc. IRE,* May 1951.

D. G. Koch, Increasing Tube Reliability in Industrial Circuits, *Prod. Eng.,* June 1952.

"Data on Subminiature Tubes," Sylvania Electric Products, Emporium, Pennsylvania.

"Data on Subminiature Tubes," Raytheon Manufacturing Company, Newton, Massachusetts.

R. J. E. Whittier, Mechanical Considerations Affecting Vacuum Tube Reliability, Part 1, *Tele-Tech.,* Feb. 1952.

REVISED GERMANIUM DIODE DATA

G.E.C. germanium diodes consist of a small piece of germanium and a point contact or catwhisker, the whole being sealed into a glass capsule.

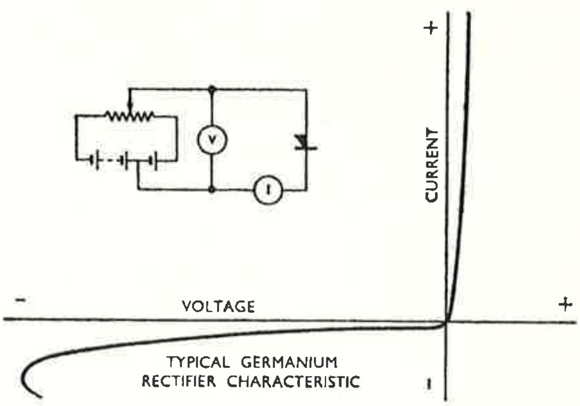
The advantages of this type of diode include very small size, robustness, low capacitance and ability to be soldered directly into the circuit. In addition, since a heater is not required, no hum is introduced.

Compared with other non-thermionic diodes, germanium diodes are outstanding in their H.F. performance and ability to handle relatively high voltages.

A typical characteristic curve is given below from which it will be noticed that when the reverse voltage exceeds a certain figure the reverse resistance suddenly decreases and then becomes negative. The potential at which this occurs is known as the "turnover" voltage.

Other curves show variations between different types and variations with temperature.

Germanium diodes are divided into two general categories, the first being the high back voltage types made from germanium of great purity and the other being the special low resistance types using germanium containing deliberately introduced impurities. The high back voltage types are differentiated mainly by their turnover voltage and back resistance figures which are the most important factors when considering their applications.



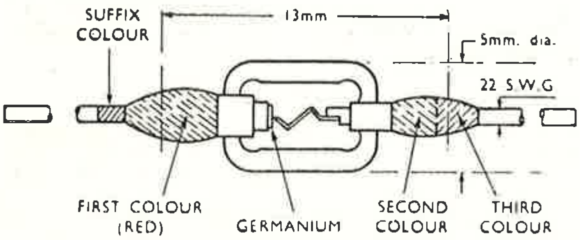
COLOUR CODE

In the colour coding system, red is an indication of the negative end of the rectifier. Thus, when compared with a thermionic diode the red end of the germanium diode corresponds to the cathode.

The second and third colours give the type number according to the standard code used for resistors. Where a suffix is used, e.g. GEX45/1, this is indicated by a colouring of the wire at the red end.

Certain popular types of diodes may also be identified by a plastic sleeve with the diode type number printed thereon. In such cases the colour coding will be omitted, the cathode end still being coloured red.

DIMENSIONS



GENERAL

Temperature Range

Germanium diodes will function satisfactorily in the range —40° to +80°C.

Humidity

Germanium diodes are hermetically sealed and it is impossible for moisture to penetrate to the working surfaces.

Vibration

All diodes are subjected to severe vibration test after manufacture.

Connection

Soldered joints may be made directly to the wire leads. No special precautions are necessary when carrying out this operation since they will withstand the 10 second test required by R.I.C. component specifications.

Expectation of Life

Shelf life is expected to be greater than 10 years Operating life is greater than 10,000 hours.

HIGH BACK VOLTAGE TYPES

Common Rating (at 20°C.)

Common Ratings (at 20°C.)

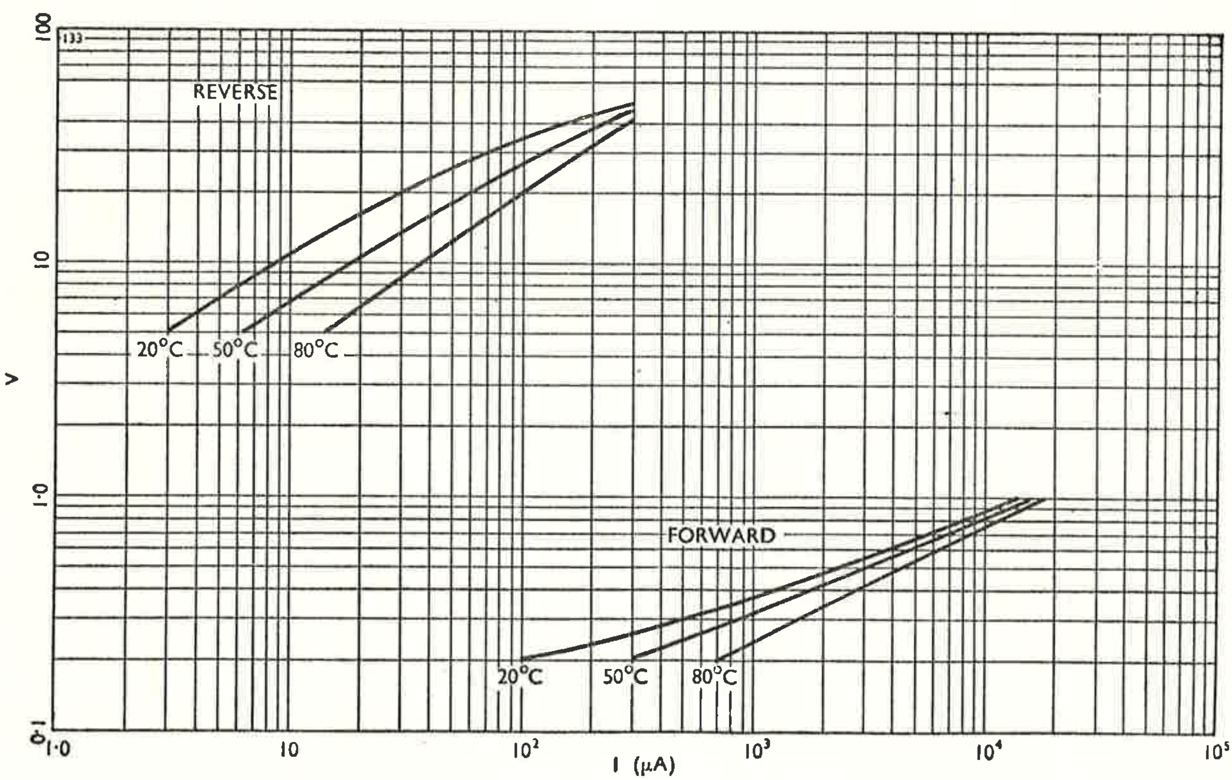
Forward current (continuous) ...	50 mA max.
Repetitive peak (sinusoidal)	100 mA max.
Repetitive peak (brief, recurrent)*	200 mA max.
Occasional one-second overload ..	0.5A max.
Dissipation with reverse voltage ..	100 mW max.

*On-off ratio 1/1000.

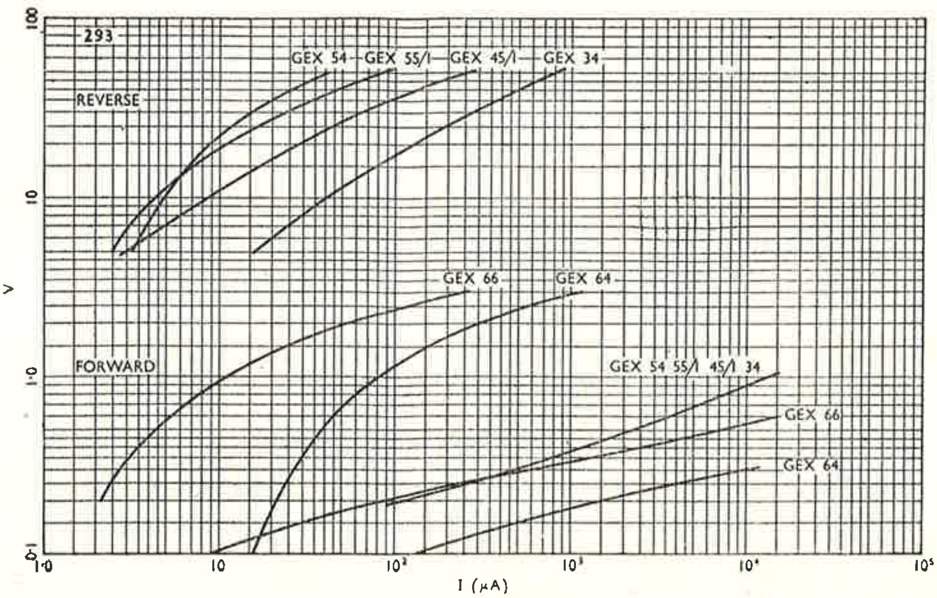
The above ratings are for operation at an ambient temperature of 20°C and for higher ambient temperatures must be reduced.

Capacitance (at 45 Mc/s)

0.2 $\mu\mu$F min.
0.7 $\mu\mu$F average.
1.0 $\mu\mu$F max.



Typical variation of characteristic curve with temperature, GEX45/1.



Typical characteristics at 20° C

INDIVIDUAL CHARACTERISTICS

GEX34

Colour code: Red/Orange/Yellow.

T.V. sound detector, sound noise limiter and high level vision detector. The effective R.F. turnover voltage is greater than 60V. Current at +1V greater than 1 mA. Current at —10V less than 100 μA. Current at —50V less than 2 mA. Replaces GEX44 and GEX44/1.

GEX35 *(A commercial equivalent of CV442)*

Colour code: Red/Orange/Green.

Low level vision detection. Turnover voltage greater than 30V. Functionally tested at 35 Mc/s to give 400 μA rectifier current in 6.8 kΩ load.

GEX36

Colour code: Red/Orange/Blue.

Mixer diode. For use as telephony modulator at higher voltage levels than GEX64. Available in groups matched for forward voltage at 5 mA in the range 0.625 to 0.875V.

GEX45/1 *(A commercial equivalent of CV425)*

Colour code: Red/Yellow/Green with Brown wire.

Medium back-resistance diode for all purposes. Turnover voltage greater than 75V. Current at +1V greater than 4 mA. Current at —50V less than 1 mA.

GEX54 *(A commercial equivalent of CV448)*

Colour code: Red/Green/Yellow.

High back-resistance diode. Turnover voltage greater than 100 volts. Current at +1V greater than 3 mA. Current at —10V less than 10 μA. Current at —50V less than 0.1 mA.

GEX54/3

Colour code: Red/Green/Yellow with orange wire.

100V diode. Turnover voltage greater than 120V. Current at +1 volt greater than 3 mA. Current at —3V less than 0.06 mA. Current at —100V less than 0.625 mA.

GEX54/4

Colour code: Red/Green/Yellow with Yellow wire.

150V diode. Turnover voltage greater than 170V. Current at +1V greater than 3 mA. Current at —100V less than 0.3 mA. Current at —150V less than 0.8 mA.

GEX55/1

Colour code: Red/Green/Green with Brown wire.

High back-resistance diode for all purposes. Turnover voltage greater than 75V. Current at +1V greater than 1 mA. Current at —50V less than 0.2 mA.

GEX56

Colour code: Red/Green/Blue.

Very high back-resistance diode for computer use. Current at +1V greater than 1 mA. Current at —10V less than 2 μA.

Low Resistance Types

GEX64

Colour code: Red/Blue-Yellow.

Mixer diode with very low forward resistance. Typical applications are telephony modulator in multi-channel systems and meter rectifier. Available in groups matched for forward voltage at 5 mA in the range +0.2 to 0.3V. The comparatively high capacitance of 30μμF limits the effective operating frequency in high impedance circuits.

GEX66 *(A commercial equivalent of CV2290)*

Colour code: Red/Blue/Blue.

V.H.F. mixer for use up to 1,000 Mc/s. In the T.V. range up to 100 Mc/s the noise as a mixer is no greater than that from the cartridge type silicon mixer. Efficiency is good and noise fairly low up to 1,000 Mc/s and there is considerable response at 10,000 Mc/s. Current at +0.5V greater than 5 mA. Reverse current of —1V less than 50 μA.

DATA ON RADIOTRON VALVES FOR TELEVISION

Data on Radiotron types 1B3-GT, 6AL5, 6AQ5, 6AU6, 6AV6, 6AX4-GT, 6BQ7-A, 6CB6, 6SN7-GTA, 6U8, 12AU7, 12BH7 and 12BY7 are given in the R.C.A. Receiving Tube Manual RC-17.

Data on type 6BQ6-GTB/6CU6 are given on page 312 of the R.C.A. Manual RC-17, and the same ratings also apply to the Australian TV standards with 625 lines and 25 frames per second. Note that the duration of the voltage pulse should not exceed 15% of one horizontal scanning cycle, equivalent to 10 microseconds in a 625 line, 25 frame system.

Data on type 5AS4 are given below.

Radiotron 5AS4 -- Full Wave Vacuum Rectifier

{See also Sept. '56, P. 105}

Tentative Data

Radiotron 5AS4 is a full-wave vacuum rectifier of the filamentary cathode type, intended for use in power supplies of television and radio equipment having high dc requirements. This valve is especially designed to permit operation at higher peak and average current ratings.

The 5AS4 has a maximum peak inverse plate voltage of 1550 volts, and a maximum peak plate current per plate of one ampere. When operated as a full-wave rectifier with an ac plate-to-plate supply voltage of 600 volts rms in a circuit with capacitor input to filter, the 5AS4 can deliver a dc output voltage of approximately 290 volts to the filter at a dc current of 300 milliamperes. Similarly, when operated as a full wave rectifier with an ac plate-to-plate supply voltage of 900 volts rms in a circuit with capacitor input to filter, the 5AS4 can deliver a dc output voltage of approximately 460 volts to the filter at a dc current of 275 milliamperes.

General Data

Electrical:

Filament, coated:

Voltage	5	A.C. or D.C. volts
Current	3	amperes

Mechanical:

Mounting position	Vertical, or Horizontal with pins 1 and 4 in Vertical plane
Maximum Overall Length	$5\frac{5}{16}''$
Maximum Seated Length	$4\frac{3}{4}''$
Maximum Diameter	$2\frac{1}{16}''$
Bulb	ST16
Base	Medium Shell Octal 5 pin

Full-Wave Rectifier

Maximum Ratings:

1550	max. volts	Peak Inverse Plate Voltage
1.0	max. amp.	Steady State Peak Current per Plate (see rating chart 9)
550	max. volts	A.C. Plate Supply Voltage (RMS) per plate (see rating chart 1)
		D.C. Output Current per Plate (see rating chart 1)
4.6	max. amp.	Transient Peak Plate Current per Plate (see rating chart 3)

Typical Operation with Capacitor — Input Filter:

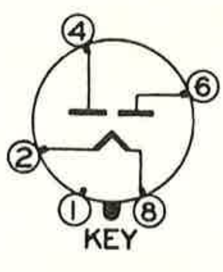
A.C. Plate to Plate supply voltage (RMS)*	600	900	volts
Filter Input Capacitor	40	40	μf
Total Effect. Plate Supply Impedance per Plate	21	67	ohms
D.C. Output Current	300	275	mA
D.C. Output Voltage at Filter Input	290	460	volts
Tube Voltage Drop	54	50	volts

Typical Operation with Choke-Input Flter:

A.C. Plate to Plate Supply Voltage (RMS)*	1100	volts
Filter Input Choke	10	henries
D.C. Output Current	275	mA
D.C. Output Voltage at Filter Input	420	volts

* Measured without load.

BASING DIAGRAM



Bottom view

Rating Charts

Rating chart 1 presents graphically the relationships between maximum ac voltage input and maximum dc output current derived from the fundamental ratings for conditions of capacitor input and choke input filters.

Rating chart 2 defines the limit of the steady state peak plate current. Operation within the boundary is permitted.

{Contn. ex July '56, P. 83}

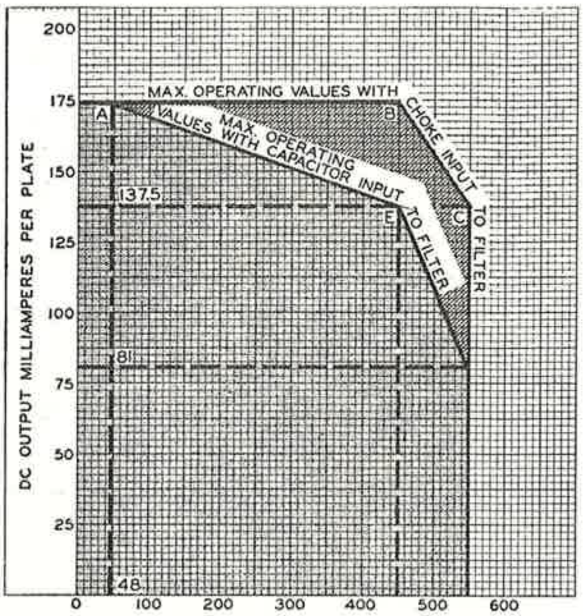
RADIOTRON 5AS4 (Continued)

The points of operation should fall within the proper boundaries on *all* charts for *any* application.

Plate supply voltages are measured with the rectifier tube non-conducting, i.e., with transformer unloaded. This unloaded voltage is used when calculating rectification efficiency.

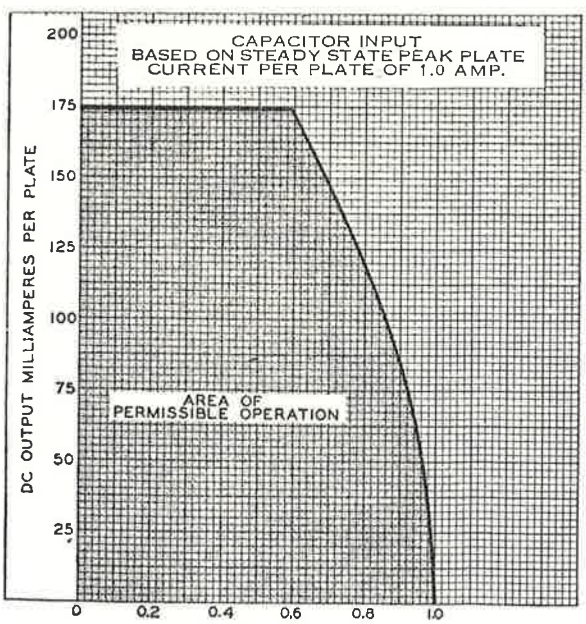
Terminal Connections

Pin 1 — No connection.
Pin 2 — Filament.
Pin 4 — Plate No. 2.
Pin 6 — Plate No. 1.
Pin 8 — Filament



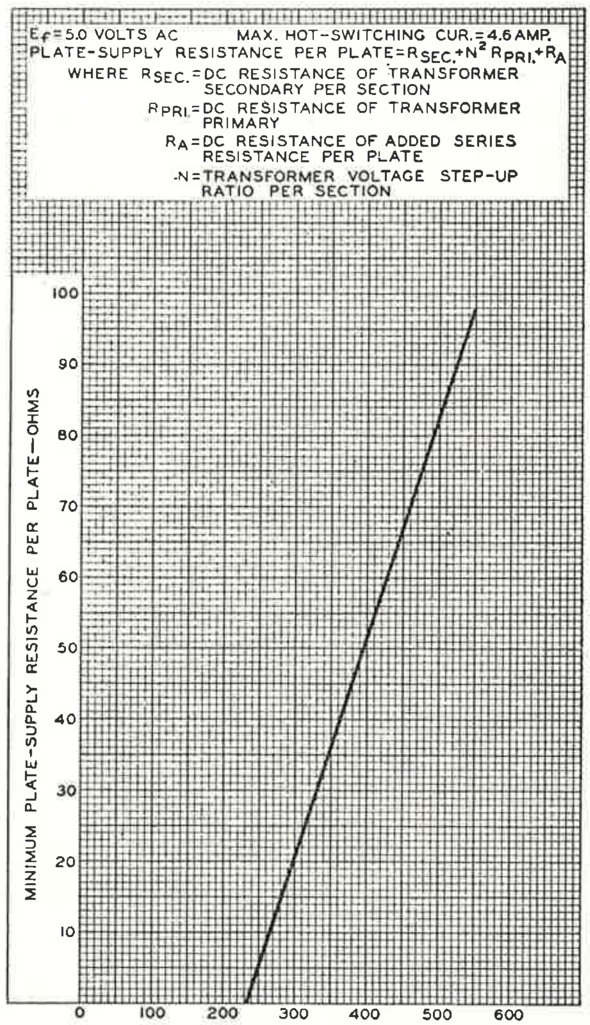
AC plate supply voltage (RMS) per plate (without load)

rating chart 1



rectification efficiency

rating chart 2



AC plate supply voltage (RMS) per plate (without load)

rating chart 3

rectification efficiency is defined as

$$\frac{\text{DC output voltage at filter input}}{\text{AC plate supply voltage per plate (without load)}}$$

MODERN METHODS OF TESTING AMPLIFIERS

(3) HARMONIC MEASUREMENT USING WAVE ANALYSER

ADDITIONAL TESTS USING MARCONI WAVE ANALYSER

By F. LANGFORD-SMITH

The results of tests made with the General Radio Type 736A Wave Analyser have been published (Ref. 1). The present article gives similar measurements using a Marconi Wave Analyser with the same oscillator and low distortion laboratory amplifier.

Briefly, these are tests, on a low distortion amplifier with and without a null network (to eliminate the respective harmonic) between the oscillator and the amplifier, and with and without a high pass filter between the amplifier and the Wave Analyser (to eliminate the effects of distortion in the Wave Analyser, by heavily attenuating the fundamental while measuring the harmonics). Following the procedure in the earlier article, the individual distortions in the oscillator amplifier and Wave Analyser were derived, and are shown in Table 2.

Reference should be made to the earlier article for the procedure. Table 1 here is arranged to be directly comparable with Table 1 of the earlier article.

The results in Table 2 were derived in a similar manner as for that in the earlier article, and for ease in making comparisons, the earlier values are shown here in brackets.

The tests made with the Marconi Wave Analyser gave about 38% greater amplifier distortion,

Set W.A.	Null Network	H.P. Filter	Harm.	Harmonics %						Test
				16	8	4	2	1	0.5V	
100mV	yes	yes	H_2	0.15	0.08	0.025	nil*	nil	nil	A_1
	yes	yes	H_3	nil	nil	nil	nil	nil	nil	A_2
	no	yes	H_2	.19	.13	.09	.06	.06	.06	A_3
	no	yes	H_3	.03	.03	.03	.03	.03	.03	A_4
	yes	no	H_2	.09	.04	.015	nil	nil	nil	A_5
	yes	no	H_3	nil	nil	nil	nil	nil	nil	A_6
	no	no	H_2	.12	.08	.06	.05	.045	.045	A_7
	no	no	H_3	.025	.025	.025	.025	.025	.025	A_8
300mV	yes	yes	H_2	.18	.075	.035	.015	.005	nil	B_1
	yes	yes	H_3	nil	nil	nil	nil	nil	nil	B_2
	no	yes	H_2	.22	.11	.1	.08	.08	.08	B_3
	no	yes	H_3	.045	.035	.035	.035	.035	.035	B_4
	yes	no	H_2	.075	.03	.015	.02	.03	.03	B_5
	yes	no	H_3	.015	.015	.015	.015	.015	.015	B_6
	no	no	H_2	.11	.075	.075	.1	.06	.05	B_7
	no	no	H_3	.04	.04	.065	.08	.04	.03	B_8

* nil = No indication on wave analyser.

although this is within the ±25% tolerances given in the earlier article. The results showed 60% and 50% respectively greater second and third harmonics for oscillator distortion, here also within the same tolerances.

The distortion in the Marconi Wave Analyser itself was only 15% second and 27% third harmonic of the values obtained for the General Radio instrument on the 300 mV setting. In both cases the performance of the Wave Analyser[1] is that of the particular one in the laboratory, and may not be representative of new instruments.

The combined oscillator and wave analyser (300 mV) second harmonic distortion is given by B7 as 0.05%. This is equal to the difference between the oscillator distortion (0.08%) and the wave analyser distortion (0.03%). The third harmonic given by B8 is 0.03%; this checks reasonably well with the difference between oscillator distortion (0.035%) and wave analyser distortion (0.015%) making 0.02%.

The combined oscillator and wave analyser (100 mV) second harmonic distortion is given by A7 as 0.045%. This checks, within the tolerance limits, with the difference between the oscillator and wave analyser distortion (0.065%). The third harmonic given by A8 is 0.025%. This checks very closely indeed with the difference between oscillator and wave analyser third harmonics.

Reference

1. Langford-Smith F, "Modern methods of testing amplifiers, (3) Harmonic measurement using Wave Analyser" Radiotronics 21.3 (March 1956) 27.

TABLE 2.

Summary of individual second and third harmonics as determined from the basic measurement in Table 1. Accuracy of individual values about ± 25%. Values in brackets are for the G.R. Type 736A Wave Analyser (Ref. 1).

			Source
Amplifier distortion at 16 volts output			
H_2	(0.13%)	0.18%	B_1
H_3	(<0.015%)	<0.015%	B_2
Amplifier distortion at 1 volt output			
H_2	(0.008%)	0.011%	B_1
H_3	(<0.001%)	<0.001%	B_2
Oscillator distortion			
H_2	(0.05%)	0.08%	B_3
H_3	(0.02%)	0.035%	B_4
Wave Analyser Distortion (300 mV setting)			
H_2	(0.20%)	0.03%	B_5
H_3	(0.055%)	0.015%	B_6
Wave Analyser Distortion (100 mV setting)			
H_2	(0.12%)	<0.015%	A_5
H_3	(<0.03%)	<0.015%	A_5
Oscillator and Wave Analyser (300 mV) distortion			
H_2	(0.25%)	0.05%	B_7
H_3	(0.075%)	0.03%	B_8
Oscillator and Wave Analyser (100 mV) distortion			
H_2	(0.17%)	0.045%	A_7
H_3	(0.05%)	0.025%	A_8

Editor .. .. A. J. Gabb, B.Sc.

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