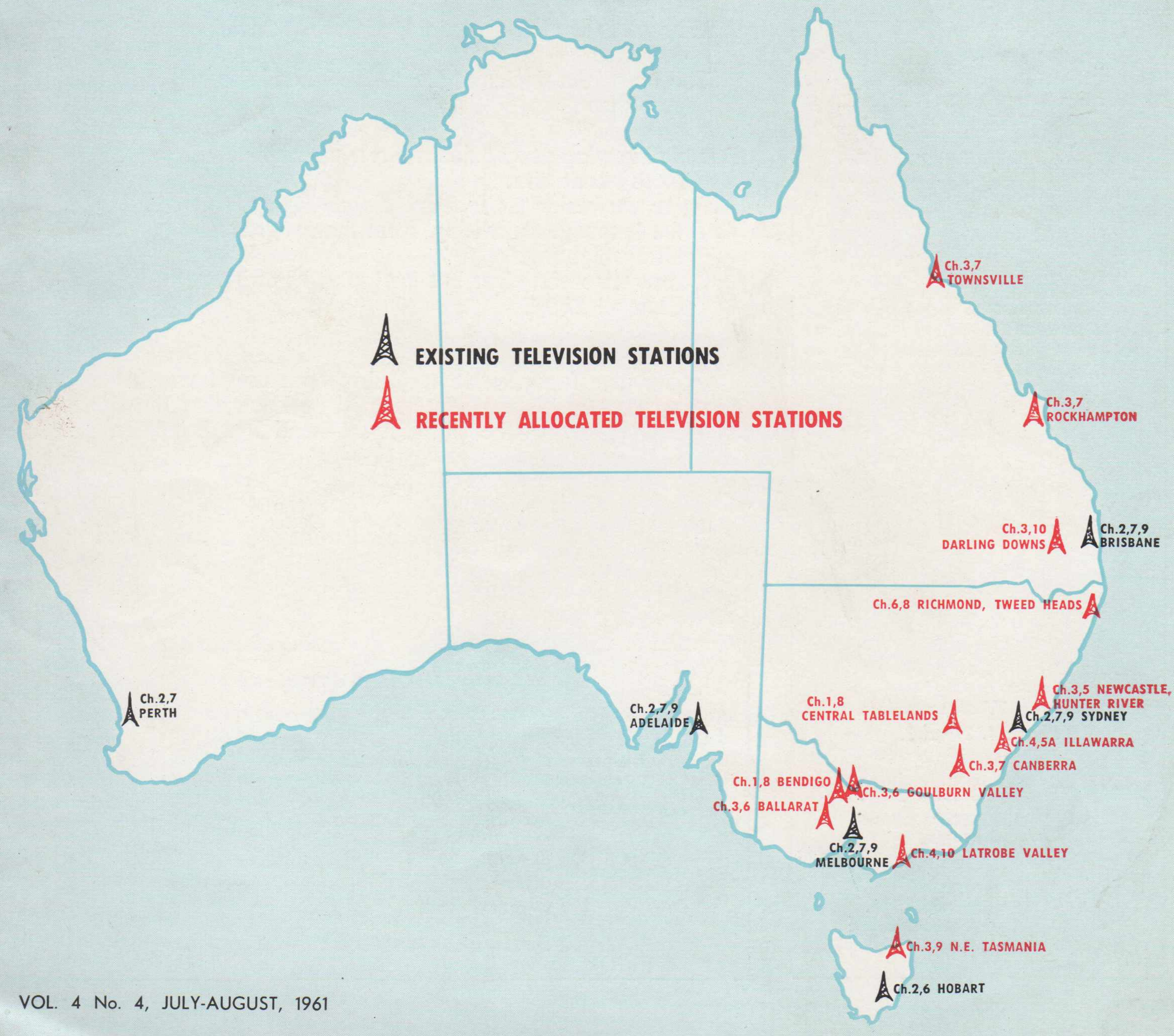
Mullard Outlook
Australian Edition



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MULLARD - AUSTRALIA PTY. LTD.

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JOERN BORK

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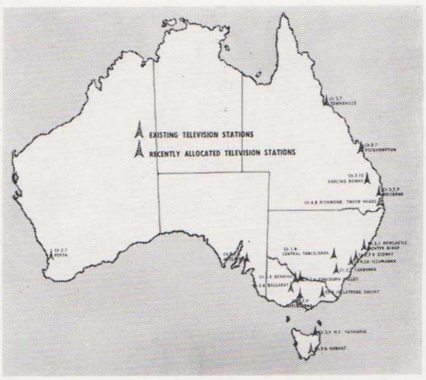

Maps showing TV area development, Phases 1, 2 and 3.

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VICTORIA
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Associated with
MULLARD LTD., LONDON.

And I somehow rather fancy that I'd like to change with Clancy,
  Like to take a turn at droving where the seasons come and go,
While he faced the round eternal of the cash-book and the journal—
  But I doubt he'd suit the office, Clancy, of The Overflow.

A. B. ("Banjo") Paterson.

In my wild erratic fancy, visions come to me of Clancy,
  With his 'telly' on the Lachlan and the Westerns all aglow,
And he sees the vision splendid, of Bart Maverick extended,
  The news, Jet Jackson, Lucy—and homicide, you know.

But the hurrying people daunt him, and their pallid faces haunt him,
  As he sits beside his sunburned shearing mate,
And the language uninviting, from the gangsters always fighting,
  Comes crisp and clear but jarring as he switches Channel Eight.

In our own fancy, what intriguing verse may have been written by "Banjo" Paterson, if he knew that the signal at The Overflow will be 10 millivolts—and 5 at Dandaloo!

M.A.B.

VIEWPOINT WITH MULLARD

PHASE 3 COUNTRY TELEVISION

The next few issues of Outlook will be devoted in some measure to statistics regarding the extension of television to country areas. In this issue a few general points are covered in that, as the pattern of television development in Australia unfolds, it is evident there are some interesting aspects of coverage and, no less, the challenge to manufacturers and retailers to provide country viewers with a useful signal—or, rather, to make the fullest use of what signal is available.

COVERAGE

With Phase 3 in the course of being implemented and Phase 4 around the corner, in this particular issue the comments are largely confined to Channels 1 and 8 shortly to come into service for the Central Tablelands area of New South Wales. In this regard we are indebted to Antiference (Aust.) Pty. Ltd. for their comprehensive service area maps, where it can be shown that within the useful signal areas there are in excess of 60,000 homes. This figure is taken as the total on a basis of 90% saturation and on the assumption that some of these receivers, at least for the time being, would be operated from 32 volt systems, with due allowances being made for difficult reception areas such as Crookwell, on the fringe edge of reception from Orange, Wollongong and Canberra. It must also be assumed that, under normal conditions of propagation, Channel 1 will provide a more useful signal than Channel 8.

Nevertheless, it is interesting to see that the coverage from Orange will provide 2.7% of the total population of Australia with a useful television signal and an area where there are very few television receivers at this time.

PRESENT SATURATION

It can be shown that in Newcastle and Wollongong, by the time transmitters are operating in these areas, the service coverage of Newcastle will already have received 30% saturation and Wollongong 55%, perhaps more. Much the same applies in other areas such as the Darling Downs where it could be 25% and, around Morwell, perhaps 50%. In a following issue these aspects will be covered and an "estimation of saturation" chart will be presented.

INFLUENCE OF PHASE 4

Crookwell, in New South Wales, is a typical case on the edge of three areas of fringe reception, but more so in that the concentration of homes is in a shielded valley and typical of the pockets on the Western slopes of the Great Dividing Range and other similar areas in Australia. The challenge therefore is how to serve these areas, whether Phase 4 will do so effectively and what ways and means are available to cater for these cases and the smaller and more isolated communities so deserving of useful television reception.

AERIALS

Given a receiver with good front-end performance and stable line and frame hold under conditions of almost no signal, the importance of a high-efficiency aerial is paramount and, in view of the introduction of vertical polarisation in Phase 3, the major challenge is directed towards the aerial manufacturers, for in these areas there is no compromise in aerial design but the ultimate for each and an understanding by the end-user that the aerial is the most important link in the chain—and, no less, a costly one.

OTHER METHODS

Much has been written about passive repeaters, but in practice these have proven to be of little use and the more practical alternatives are towards community aerials with mast-head amplifiers and town reticulation, repeaters within the existing 13 channels, repeaters on the UHF bands, and in isolated cases remote tuning in the true sense, with intermediate frequency piped from the top of the hill to the homestead.

We all know that television plays a dominant part in our daily lives and the urge to have television in the home is one that undoubtedly will be greater with the new areas shortly coming into service. It is with this in view that in following issues we will be devoting much space to this subject and trust that it will be of benefit to retailers in these areas, most of whom are already skilled in obtaining the last ounce of useful signal.

MULLARD-AUSTRALIA PERSONALITIES

MR. B. P. A. BERESFORD

Mr. B. P. A. Beresford administers a most important aspect of our activities—the Technical Service Department—dealing with technical correspondence and enquiries, preparing technical publications, leaflets and brochures, maintaining Film and Film Strip service, supervising the warranty system and operation of valve and tube service centres and preparation of publicity material.

His Department, apart from preparing technical information and advising present and potential users of details of our products, also maintains a technical library with comprehensive data on similar items on the international scene, a service used extensively by the Industry, but until now unpublicised.

Last year he graduated from the School of Management at Sydney Technical College and was awarded the Bradmill Prize for production management. An Associate Member of the Institution of Radio Engineers, he served in an instructional capacity with the R.A.A.F. during the war and later with Qantas Empire Airways Ltd.

Mr. Beresford is a member of the Management Executive of Mullard-Australia Pty. Ltd.

Mullard

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* within Australia

LEAFLETS

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An AM broadcast tuner for use with existing amplifier designs

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A new concept in Pot Core Design

"Ultra-violet to Infra-red"
An Introduction to Photocells

"Valves and Semiconductors"
For the Radio Amateur

"On-off Control with Photocells"
A guide to cadmium sulphide cells and their application

"Mullard Thyratrons"
For the control of large currents

The above publications are obtainable from Mullard-Australia Pty. Ltd., branches, distributors and wholesalers in all States. Alternatively, selected leaflets will be mailed on receipt of a stamped, self-addressed, foolscap envelope.

MULLARD FILM LIBRARY

(16 mm SOUND FILMS)

	Approximate Running time in minutes
"From Us To View"	30
"Industrial Applications of Ultrasonics"	21
"The Junction Transistor in Radio Receivers"	
Part 1: "The Design of IF Amplifiers"	15
Part 2: "The Complete Receiver"	10
"Made for Life"	34
"Manufacture of Radio Valves"	22
"Modern Magnetic Materials"	16
"Particles Count"	15
"Special Quality Valves"	25
"The Spectrograph" (colour)	20
"The Transistor—its Principles and Equivalent Circuits" (colour)	20
"Discharge through Gases"	11
"The Linear Accelerator"	12
"Photo Emission"	18
"Principles of the Transistor"	20
"Principles of Ultrasonics"	15
"Vacuum Practice"	16
"Conquest of the Atom" (colour)	22
"Mirror in the Sky"	22
"Manufacture of Frame Grid Valves" (colour)	10
"Principles of X-Rays"	16

CONDITIONS OF LOAN

The films and filmstrips are on loan for screening on specific forward dates. To avoid disappointment, application should be made 21 days prior to the intended screening dates. Before returning, borrowers are requested to rewind the films on their original spools and detail any damage encountered.

Films and filmstrips are returned at the borrower's own expense and, to ensure smooth running of the loan system, borrowers are requested to make despatch arrangements to allow the films to arrive on their due dates. In this regard, where films are on loan in country districts or interstate, it is requested that the fastest means of transport available be employed. The film service is also available from the Victorian branch of Mullard-Australia Pty. Ltd., at 123-129 Victoria Parade, Collingwood, N5, Victoria. Films should always be returned to the office of issue.

Films and filmstrips on new topics are being added to the Film Library from time to time and announcements of these new additions are published in Outlook.

35 mm FILM STRIPS

(With Lecture Notes)

ELECTRONIC VALVES AND TUBES

- E1 An Introduction to Electronics
- E2 Electronic Devices — 1 (Electron Tubes)
- E4A Basic Valve Circuits
- E4B Basic Valve Circuits
- E7 The Meaning of Valve Characteristics
- E15 The Manufacture of Thermionic Valves
- E28 Thermionic Valves—The Diode and Triode
- E50 The History of Radio

SEMICONDUCTORS

- E3 Electronic Devices II (Semiconductors)

CATHODE RAY TUBES

- E6 Principles of the Cathode Ray Tube
- E17 The Manufacture of Cathode Ray Tubes
- E29 The Cathode Ray Oscilloscope

MAGNETS AND MAGNETIC MATERIALS

- E21 Magnets and Magnetic Materials

SECONDARY CELLS AND DC MACHINES

- E22 Secondary Cells
- E23 DC Machines
- E24 Armature Windings
- E25 Armature Reaction
- E26 Commutation
- E27 DC Motors

ILLUMINATION

- E30 Filament Lamps
- E31 Discharge Lamps
- E32 Photometry
- E33 Indicating Instruments
- E34 Energy Meters

ALTERNATING CURRENT AND ALTERNATORS

- E35 Alternating Current and the Alternator
- E36 Vectors
- E37 Transformers
- E38 Rectification
- E39 Power Distribution Systems and Equipment
- E40 Underground Power Cables

TELEVISION

- 7 Television — Part 1
- 8 Television — Part 2
- 14 The Story of Television
- E51 The History of Television
- E60 Servicing the Projection Television System

VALVE APPLICATIONS

- E75 Thermionic Oscillators, Parts 1 and 2
- E76 Thermionic Oscillators, Parts 3 and 4

MODULATORS

- E77 Modulation and Modulators

MULLARD TUBES AT WORK

MULTI-CHANNEL HEART MONITOR

Readers may be interested in the application, by Wagner Industries Pty. Limited, 53 Sydenham Road, Marrickville, N.S.W., of the Mullard DP16-22, a rectangular cathode ray tube, in their Multi-Channel Heart Monitor.

The six-channel Monitor (illustrated) was specially designed for the Adolph Basser Institute of Cardiology, at the Royal Alexandra Hospital for Children, Camperdown, N.S.W.

This equipment is used in the monitoring of major cardiac surgical procedures, where it is necessary to monitor by display, and to constantly control the arterial and venous pressures and pressure gradients between the various chambers of the heart simultaneously with electro-cardiographic changes—provision being made for electroencephalography and cardiac catheterisation.

The DP16-22 cathode ray tube was selected from other available tubes for its extremely robust design, almost perfect symmetry and, because of the physical dimensions of this tube, its ability to be readily stacked. The equipment is therefore more compact and has a high degree of mobility so necessary in hospitals.

DC-coupled to the DP16-22 cathode ray tube are the four centrally positioned, carrier-balanced 1 kc/s strain-gauge amplifiers actuated by four pressure-type transducers to which are connected polythene tubing, filled with distilled water. This tubing is for insertion into selected arteries.

The top and bottom panels of the amplifier rack contain two DC amplifiers, having a sensitivity of 500μV/cm for display of electro-cardiographic phenomena.

The lower compartment contains two LT power supplies, two EHT power supplies of 4000V and two linearised time-base units which are variable from 5 sec/cm to 50 msec/cm. These are of identical design for parallel or single operation in the event of component failure.

The whole monitor uses 62 semi-conductors, 34 valves and 6 cathode ray tubes, type DP16-22.

Similar equipment using 2 and 8 channel amplifiers with appropriately stacked DP16-22 cathode ray tubes is under construction for a number of hospitals.

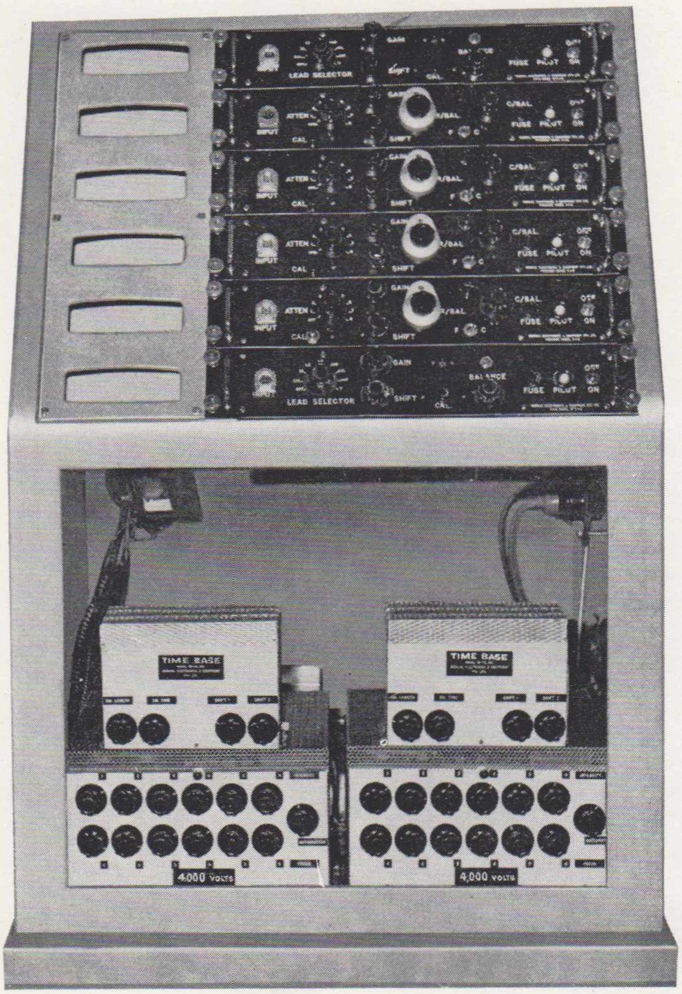


Illustration by courtesy of Adolph Basser Institute of Cardiology at the Royal Alexandra Hospital for Children, Camperdown, N.S.W.

INSTRUMENT TUBE DP16-22

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

TYPICAL OPERATING CONDITIONS

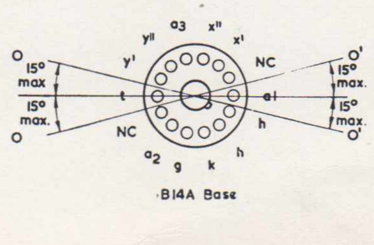
V_{a3}	5.0	kV
V_{a2}	600 to 700	V
V_{a1}	1.8	kV
*V_g	–25 to –70	V
S_x	0.19mm/V	
S_y	0.21mm/V	

*In no circumstances must the grid be allowed to become positive with respect to the cathode.

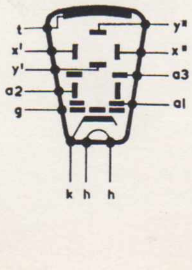
DEFLECTION SENSITIVITY LIMITS

$$S_x \quad \frac{850 \text{ to } 1000}{V_{a3}} \text{ mm/V}$$

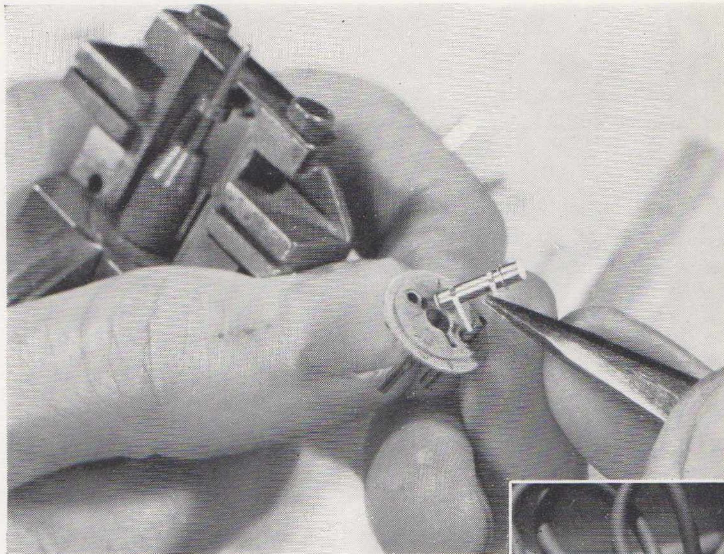
$$S_y \quad \frac{900 \text{ to } 1100}{V_{a3}} \text{ mm/V}$$



B14A Base



HOW A TELEVISION PICTUR

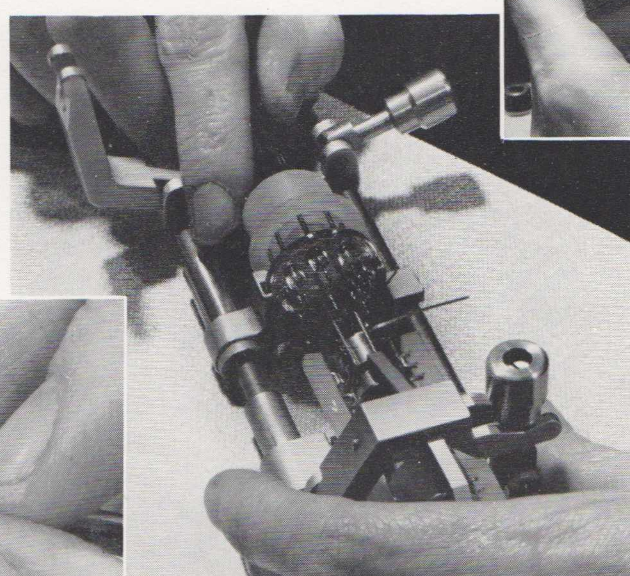


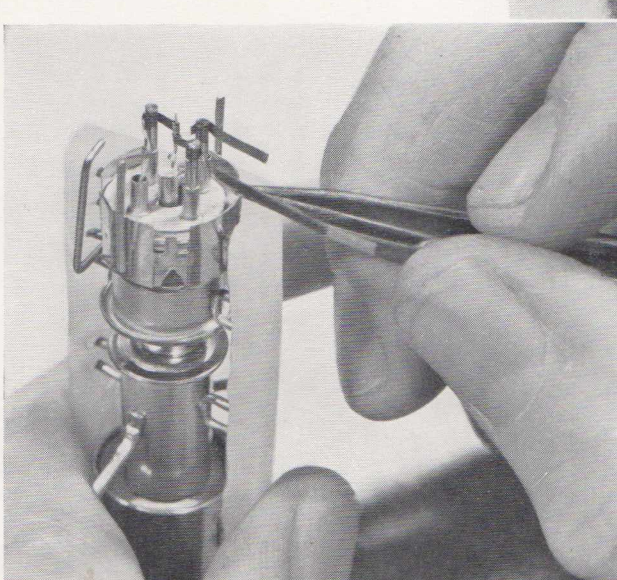
Had television research and gun technology remained at the 1938 level, the 23″ picture tube of today would be over 4 ft. long! Years of research, resulting in improvements to picture tube components—from the highly-efficient cathode to the new large screen—have resulted in the consistently high quality and long life of the Mullard Radiant Screen television picture tube.

The electron gun is now smaller, more accurate and robust than it has ever been, indeed a television tube could very well be categorised as a Special Quality Long-Life Tube. Thorough investigation of phosphors used in the activated luminescent layer has resulted in a bright, clear, crisp, true-to-life performance which has earned Mullard television picture tubes their name—Radiant Screen.

The photograph shown here will give readers some idea of the delicate and accurate work that goes into the manufacture of a Mullard television tube electron gun.

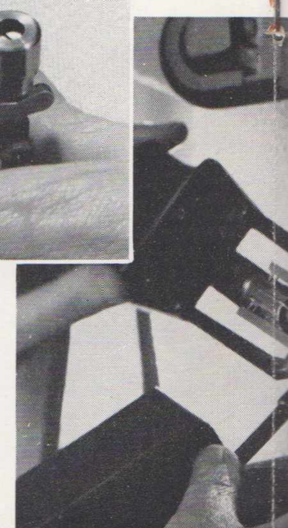
3. The major components of the gun are held together by sintered glass multiform rods. The components are accurately positioned in a jig and their relative positions fixed immovably by their fixing lugs, which are pushed into the heated rods, as in this picture. An important point in this process is the alignment of the gas burners so as to heat the glass in the exact places required



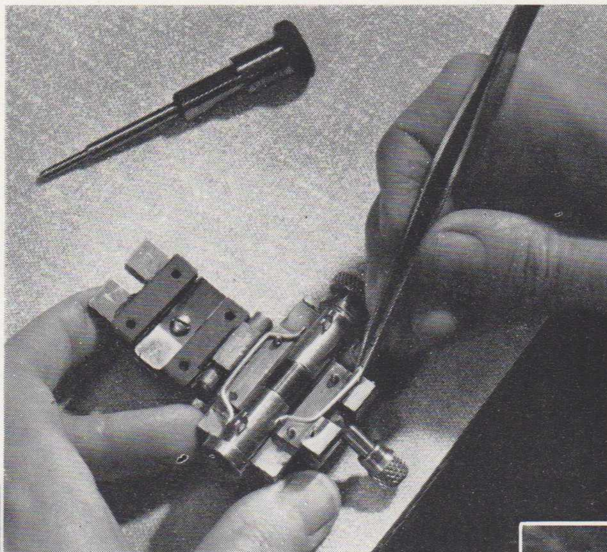


5. At this stage the cathode-heater-mica assembly, shown in the first picture, is inserted into grid 1 of the main assembly. It is retained in position by means of fixing lugs which form an integral part of grid 1.

6. After the assembly has been placed in position the glass foot is joined to the main assembly and the electrical connections welded to the foot and main assembly prior to welding.

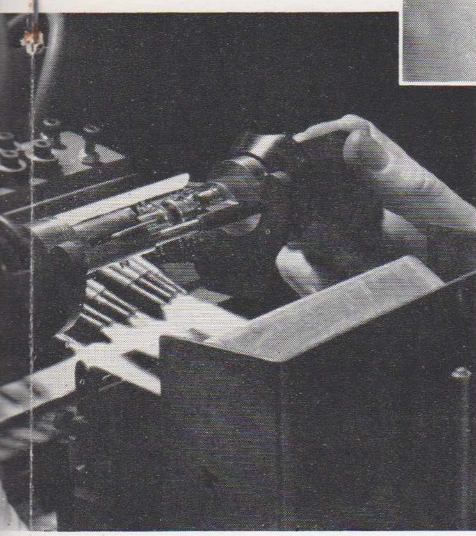


URE TUBE ELECTRON GUN IS MADE

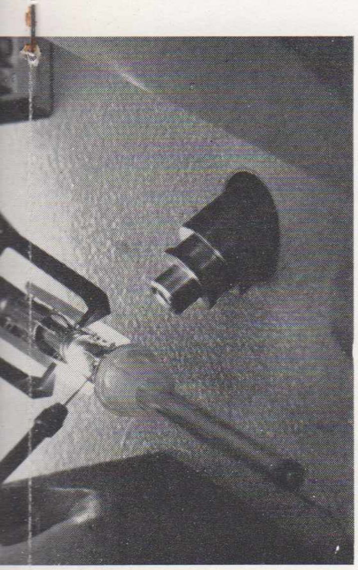


1. Before the assembly of an electron gun can commence, the cathode must be fixed in position in a sub-assembly, known as the "mica," and the heater then inserted. Here the cathode is threaded into the mica where it is affixed by welding in a special jig.

2. Assembly of the gun commences with the joining of grid 3 to grid 5 by means of brackets. This operation is performed in a special jig and the exact positioning of the grids the correct distance apart, is achieved by the insertion of a spacer, which may be seen between the grids in this picture. A further component, the nozzle, is also attached to grid 3 at this stage.



4. After the main assembly is completed the spacing between the various grids must be checked. These dial micrometers measure the distances between grids 3 and 5 and between grid 2 and the nozzle, all of which must be accurate to within half a millimetre.



7. Lining up the cathode in the gun is an operation needing great skill, a steady hand and a great deal of concentration. An enlarged image of the assembly is projected onto a graticule and the position of the cathode is adjusted by means of a fine needle, as shown in this picture. Whilst the theoretical tolerance of only two-hundredths of a millimetre is, by all accounts, small enough, our operators take considerable pride in getting it "spot on."

8. Assembly is completed by the addition of the top collar and the getter, and the electron gun is then ready for final inspection. In this picture a magnifying glass is used to reveal any hidden defect.

MULLARD TAPE PRE-AMPLIFIER CIRCUIT

EQUALISATION FOR A TAPE SPEED OF 1⅞ in/sec

Tape decks with the facility for recording and replaying at a tape speed of 1⅞ in/sec have appeared since the publication of the Mullard book "Circuits for Audio Amplifiers."* Consequently, some modifications are required if the tape pre-amplifier circuit described in Chapter 12 of the book is to be used satisfactorily with one of these new decks.

Bass boost is achieved by applying (during playback only) frequency-dependent negative feedback by way of a series CR combination from the anode to the control grid of V2, valve type EF86. The frequency at which peak boost is applied is fixed by the capacitor C22, and the different levels of boost for different tape speeds are determined by the value of resistance selected by the switch SB1. If the tape speed is halved, the value of resistance should be doubled, so that the resistance required for 1⅞ in/sec is eight times that required at 15 in/sec. The value of the resistance R33 in the circuit diagram is 680kΩ. Therefore, a position must be provided on SB1 for including a resistance of 5.6MΩ (the nearest preferred value to 8 x 680kΩ) at the tape speed of 1⅞ in/sec.

TREBLE BOOST

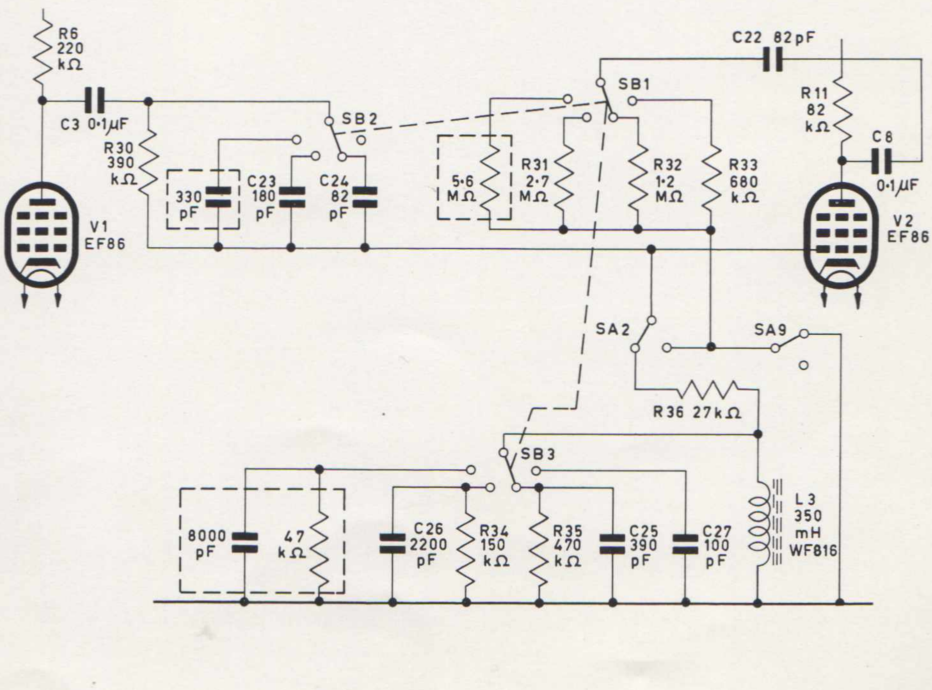
The main treble boost is applied during recording and is achieved by including a parallel-tuned circuit comprising L3 and the components at switch SB3 in the lower part of the potential divider R30, R36. The impedance of the tuned circuit is maximum at its resonant frequency, when maximum treble boost will be provided. The frequency at which this maximum boost is applied and the value of this maximum are determined by the values of capacitance and damping resistance included at SB3. The resonant frequencies obtained at tape speeds of 15, 7½ and 3¾ in/sec are approximately 16, 12 and 6 kc/s respectively. The corresponding resonant frequency for 1⅞ in/sec is 3 kc/s and this is achieved by switching in an 8200pF capacitor and a 47kΩ damping resistor at SB3.

Some treble boost is provided during both recording and playback by the capacitors at SB2 which bypass the upper resistor R30 in the potential divider R30, R36. The values in the original circuit are 0, 82 and 180pF for tape speeds of 15, 7½ and 3¾ in/sec respectively. For a tape speed of 1⅞ in/sec a 330pF capacitor should be available at SB2.

CHANGES TO THE CIRCUIT

The actual modifications to the circuit will depend on the facilities provided by the tape deck. If four tape speeds are required, then SB will need to be a 3-pole, 4-way switch. If the highest tape speed is not needed, then the present switch will be suitable. The components at position 3 can be omitted, the components at positions 2 and 1 can be moved to positions 3 and 2 respectively and the new components for 1⅞ in/sec can be included at position 1.

It should be emphasised that the new component values recommended above have been deduced on a theoretical basis to correspond with the values already given for the tape speeds of 15, 7½ and 3¾ in/sec. It may well be found that, with the recent improvements in record/playback heads and in tapes, that the quoted resonant frequencies will be too low for suitable equalisation. In fact, with some combinations of heads and tapes, it has been found that the resonant frequency adopted in the original circuit for a tape speed of 15 in/sec is now more suitable for 7½ in/sec; that adopted for 7½ in/sec is more suitable for 3¾ in/sec and that adopted for 3¾ in/sec is suitable for 1⅞ in/sec. If the treble boost provided by the recommended component values proves to be excessive, then the simplest method of reducing it is to increase the damping across L3 provided by the resistors at SB3. The values of R34, R35 in the circuit diagram and the 47kΩ resistor recommended for 1⅞ in/sec should be reduced, and an additional resistor should be connected in parallel with C27 (original circuit) if the 15 in/sec equalisation is retained. Since the combinations of record/playback head and tape will be numerous, the optimum values for these damping resistors can best be determined experimentally by listening tests.



Equalisation networks modified for tape speeds of 7½, 3¾ and 1⅞ in/sec. The additional components necessary are indicated by a dotted line.

* *Available through Mullard Offices and distributors throughout the Commonwealth. Price: 12/6, plus 1/5 postage per copy.*

FRAME-GRID VALVES

DIRECT REPLACEMENTS OR NOT?

"If frame-grid valves are as good as claimed, would it not be possible to improve the performance of many television receivers by substituting frame-grid types in the vision IF stages?"

This is a question typical of many received from keen service engineers who wish to provide their customers with all the advantages of present-day valve manufacturing techniques. The answer to these questions is an uncompromising "No."

FRAME-GRID VALVES

The introduction of frame-grid valves to television circuits heralded major advances in receiver design. Sensitivity was increased, signal-handling capabilities were improved and noise was reduced. In fact, the performance with the new types of valves was so much better that today few, if any, commercial receivers do not use at least one frame-grid valve.

These receivers are specifically designed for this valve type; they are not old circuits with new types of valves. Not only would the old circuits fail to do justice to the potentialities of the new valves but, in many instances, the use of frame-grid valves would result in unacceptable performance. This is likely to happen if frame-grid valves are used by the service engineer as direct replacements in existing receivers.

Frame-grid valves feature extremely close winding of the fine wire of the control grid which is positioned in close proximity to the cathode. This results in a greater degree of control of electrons emitted from the cathode, by the signal voltage applied at the input grid. In other words, the mutual conductance or 'slope' of the valve is steeper, and higher amplification is thus possible for a given bandwidth. Because of the greater gain possible with frame-grid valves, care must be taken in circuit design to prevent instability or excessive drive to subsequent stages.

INSTABILITY

Instability may be caused by part of the voltage developed in the output circuit of an amplifier being transferred to the input circuit via the anode-to-control-grid capacitance or stray wiring capacitance. If this 'feedback' voltage is such that it reinforces the normal signal voltage at the input of the valve (that is, the feedback is 'positive') then, from the viewpoint of the valve, the input signal to be amplified is larger and, consequently, the output voltage will also be larger. Hence the voltage fed back to the input will be greater. If either the feedback factor (that is, the fraction of the output voltage which is fed back) or the forward gain is high, a condition can arise whereby the feedback is sufficient to sustain itself even when the normal signal ceases and, of course, oscillation will occur.

The capacitances which form the feedback path offer less impedance to high frequency signals than to low frequency signals so that the danger of instability is potentially greater in the RF and IF stages of a receiver, just where frame-grid valves are likely to be used.

It will be evident, therefore, that unless a receiver is designed to utilise the greater gain possible with frame-grid valves, whilst maintaining an adequate margin of stability, the extra gain may well ruin the performance of the receiver.

AUTOMATIC GAIN CONTROL

Automatic gain control is the means whereby the effective gain of a receiver is proportionately reduced in order that large input signals can be handled. This reduction is achieved by applying part of the rectified signal from later stages of the receiver to the earlier stages as negative bias. To prevent control of all signals—so reducing the overall gain of the receiver without discriminating against large signals—AGC systems are designed to operate only when relatively strong signals are received (AGC delay). If the forward gain of the receiver is increased by introducing frame-grid valves without making appropriate adjustments to the AGC system, the result will be to control all signals and thus the full potential of the higher-gain valves will not be realised.

REPLACEMENTS

The above examples should be sufficient to substantiate the answer always given when asked if frame-grid valves can be used as direct replacements for earlier types of valves in existing television receivers. Frame-grid valves are not suitable for use in pre-frame-grid valve-circuits. When used in suitably designed circuits, frame-grid valves are superior to other types and provide first-class television reception.

A NOTE FOR TELEVISION STATIONS

The Marconi BD627C picture and waveform monitor, which is to be found in a number of television stations throughout the Commonwealth, uses valve types 62BT and 62BTA in the EHT generator and line scan oscillator stages. Although not of Mullard manufacture, these valves may be replaced by the Mullard pulse modulator valve, type EL360. The EHT generator (V22) requires no modifications but in the case of the line scan oscillator (V17) it is necessary to:—

(a) Remove R143 (4.5Ω series resistor in heater supply to Pin 7);

(b) Connect Pin 7 of the valve socket to chassis;

(c) Insulate lead from transformer.

Where the Marconi picture and waveform monitors are already modified to take the 62BTR, the EL360 may be used as a direct replacement.

It should be noted that the EL360 is not a substitute for the above valve types in all applications and each case should be thoroughly investigated to ensure that EL360 ratings are not exceeded.

Component and valve references given above refer to BD627C. Circuit Diagram-Drawing WZ.6605/D.

A GEIGER-MÜLLER TUBE PROBE

(AMATEUR EXPERIMENTERS COLUMN)

The Geiger-Müller tube comprises a metal cylindrical cathode and an axially mounted wire anode, the space between these electrodes being filled with a special mixture of inert gases. (In many types of tubes, the envelope is of metal and functions as the cathode.)

The conductivity of the tube is low, under normal conditions, but high energy radiations striking the cathode or charged particles entering the gas volume may ionise the gas filling. The negative ions move towards the anode with sufficient energy to produce further ion pairs and thus the conductivity of the tube is considerably increased. The resulting pulse is used to trigger the associated counter circuit.

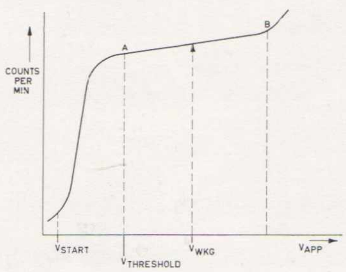


Fig. 1

Many types of G.M. tubes are currently available and each type is recommended for a specific application such as α-particle detection, β-particle detection or γ-radiation detection. Tubes are also made in various sizes and sensitivities. The basic electrical characteristics of all types of tubes are similar and the graph illustrated in Fig. 1 shows the relationship of counts per minute, plotted against applied voltage, for a typical tube. It will be seen that there is a minimum voltage, V STARTING, below which the tube is inoperative. Above V THRESHOLD, the curve is linear over the region A-B and this distance, measured in volts, is termed "PLATEAU LENGTH." It is important to ensure that the tube is operated within this region, i.e., that the working voltage lies on the plateau. In this respect, the mid-point is commonly selected.

As already stated, Fig. 1 illustrates the basic counts per minute versus applied voltage relationship and in different tubes it is only the threshold voltage and plateau length which vary.

CIRCUIT DESCRIPTION

The basic counting circuit is as shown in Fig. 2. The tube is connected across the HT supply via a resistor R. Any fluctuation in tube current due to ionisation of the gas produces an additional potential difference across R. This counting voltage (V_c) may be used to trigger more complex equipment or produce a "click" in a suitable earpiece.

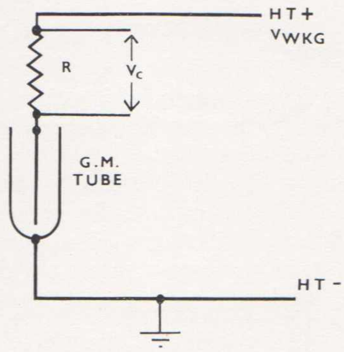


Fig. 2

The practical realisation of the circuit is illustrated in Fig. 3. Here the substitution of two resistors R_1 and R_2 in place of R means that the counting voltage may be taken from the junction of the two resistors and the HT negative line (earth). This increases the safety factor of the circuit and also results in a larger counting pulse. Capacitor C_1 provides DC blocking, thus the voltage at the output terminals is that resulting from ionisation only.

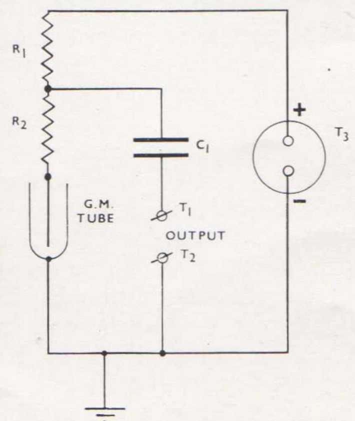


Fig. 3

The components list shows three types of G.M. tubes suitable for this probe. Power supply details are not shown since the necessary working voltage may be readily obtained from standard power supply units. Although nominally rated at 300V, or so, many power supplies will provide voltages well in excess of this figure under low current conditions. For portable operation series-connected, high voltage, low capacity batteries may be used or, alternatively, a transistorised DC-DC converter may be preferred.

CONSTRUCTIONAL DETAILS

There are numerous ways in which the circuit may be constructed, but the photographs shown overleaf illustrate one method which may be particularly useful for school laboratory work. The probe contains the G.M. tube, resistors and a pair of terminals to which an earpiece may be connected. Power is supplied to the unit by way of a suitable twin core cable and two-pin plug and socket, T_3 thus ensuring maximum portability.

The prototype probe was constructed around an 'adaptable' conduit box with a large hole at one end to accommodate the two-pin base for the G.M. tube. The resistors, capacitor and cable termination were mounted inside the box. Finally, the output terminals and carrying handle were fitted.

COMPONENTS

Most of the components used in constructing the prototype were of standard types and tolerances; special recommendations are only made in the case of the G.M. tube itself and the special two-pin base.

R_1	2.7MΩ	½ watt
R_2	2.7MΩ	½ watt
C_1	300pF	Mica

G.M. Tube Mullard MX108, MX115 or MX142 (see page 47)

Tube Base Mullard Type No. MX199

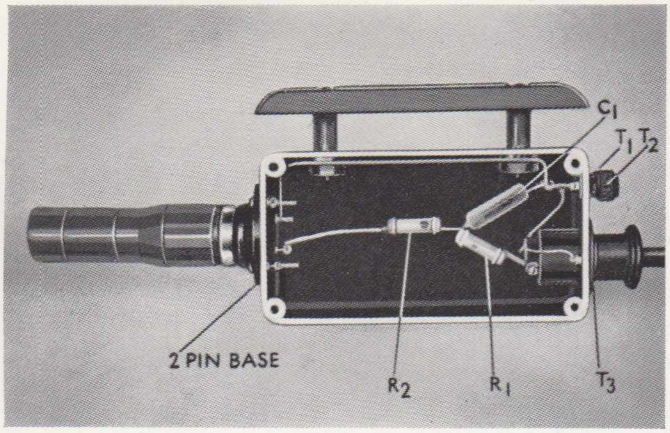
T_1, T_2 Standard screw-down terminals

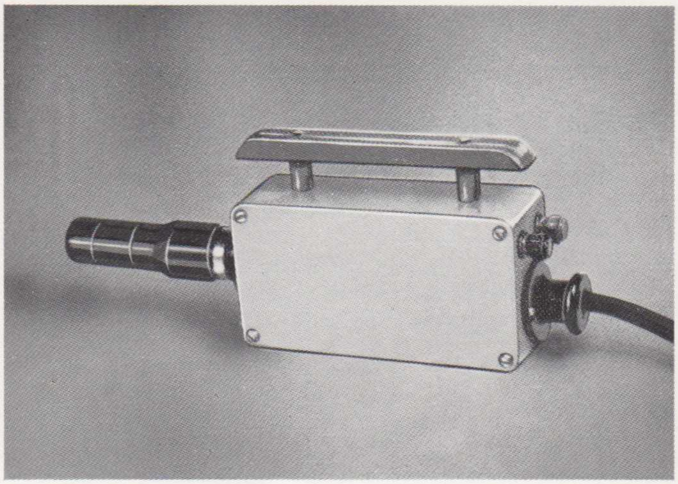
T_3 Two-pin plug and socket

CHOICE OF GEIGER-MÜLLER TUBE

As stated, there are many types of Geiger-Müller tubes available in the Mullard range and only three are mentioned here. These types are particularly useful as they are completely interchangeable in the probe. The type numbers of the tubes, together with relative data, are shown below.

Mullard-Australia Pty. Ltd. do not offer this unit either as a complete instrument or as a kit of parts. The prototype illustrated is only one of many possible interpretations of the circuit.





Type	Application	Plateau Length	Threshold Voltage	*Background Unshielded	Base
MX108	β-end window type	100V	370V	45 counts/min	2-pin
MX142	liquid sample type	100V	370V	—	2-pin
MX115	γ-tube	100V	370V	45 counts/min	2-pin

* Count from average 'background' radiation, e.g., X-rays, γ-rays, cosmic particles, etc.

SILICON RECTIFIER BYZ14

The Mullard Heavy Duty Silicon Rectifier, Type BYZ14, has a maximum average forward current rating of 20A, at a maximum recurrent peak inverse voltage of 200V. Its ratings include all safety factors appropriate to a heavy duty industrial rectifier and provide the designer with a device which is more than sufficient for the application for which it is intended. The BYZ14 is now available.

ABRIDGED PRELIMINARY DATA FOR BYZ14

Max recurrent PIV	200	V
Max transient peak voltage	400	V
Max surge peak voltage (max duration 10ms)	400	V
Max average forward current	20	A
Max recurrent peak	100	A
Max junction temperature	150	°C
Junction temp. rise above mounting base	≤1.0	°C/W

Mounting-base temp. = 25°C

Max forward voltage drop		
At forward current of 1A	850	mV
At forward current of 100A†	1.85	V

Mounting-base temp. = 125°C

Max reverse current		
At reverse voltage of 200V	2.0	mA

†Measured under pulse conditions to prevent excessive dissipation.

OPERATING CONDITIONS

Resistive or inductive load with zero source impedance

Circuit	No. of rectifiers	DC output voltage (V)	Maximum average DC output current (A)	Maximum applied AC volts (Vr.m.s.)
Single-phase half-wave	1	60	20	140
Single-phase centre tap	2	60	40	(total) 140
Single-phase bridge	4	125	40	140
Three-phase half-wave	3	95	60	(line) 140
Three-phase bridge	6	190	60	(line) 140
Six-phase diametric	6	95	96	(line) 140
Six-phase double-star with interphase transformer	6	80	120	(line) 140
BATTERY-CHARGING SERVICE				
Single-phase centre tap	2	60	25	(total) 125
Single-phase bridge	4	120	25	125
Three-phase half-wave	3	70	37.5	(line) 125
Three-phase bridge	6	120	37.5	(line) 125
Six-phase diametric	6	60	75	(line) 125

SIMPLE OSCILLOSCOPE MEASUREMENTS

This is the fourth article of "Simple Oscilloscope Measurements" which is the second of the "Simple Measurement" series being published in Outlook and contains suggestions for a number of experiments which can be carried out in the laboratory with the aid of a cathode ray oscilloscope and auxiliary equipment.

MEASUREMENT OF DIRECT CURRENT

(a) Set up a circuit as shown in Fig. 7. The value and power rating of resistor R will depend upon the order of current to be measured.

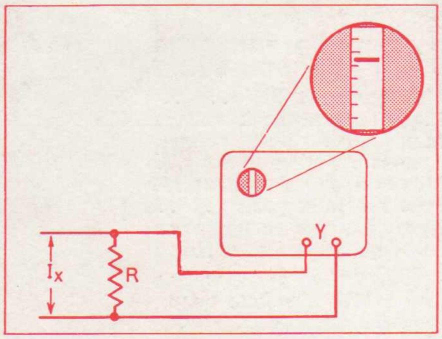


Fig. 7

(b) Connect up the unknown current so that it passes through resistor R and determine the potential difference across R, using the direct voltage calibration curve plotted in the previous experiment (Outlook, Vol. 4, No. 3).

(c) Calculate the value of the current I_x by the application of Ohms' law.

(d) Alternatively, plot a family of calibration curves in terms of *current* and *deflection* for various values of R. (See Fig. 8 as example.)

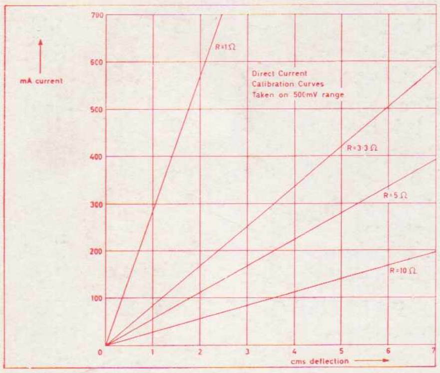


Fig. 8

MEASUREMENT OF RESISTANCE (DIRECT METHOD)

(a) Set up the circuit as shown in Fig. 9.

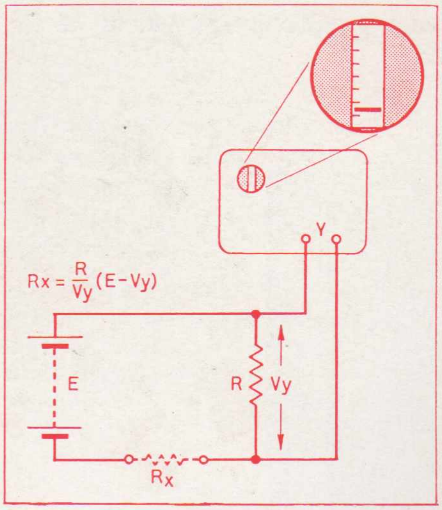


Fig. 9

(b) Measure the potential difference across resistor R by reference to the calibration curve plotted in the previous experiment (Outlook, Vol. 4, No. 3).

(c) Calculate the value of resistance from the formula:

$$R_x = \frac{R}{V_y}(E - V_y)$$

NOTE: The values of E and R will depend upon the order of resistance of R_x

Fig. 10 gives some suggestions as to appropriate values.

(d) Alternatively, plot a calibration curve in terms of R_x and deflection for various values of E and R.

Rx	E	R
1Ω – 2kΩ	1·5V	10Ω
10Ω – 20kΩ	1·5V	100Ω
90Ω – 140kΩ	9V	100Ω

Fig. 10

MEASUREMENT OF RESISTANCE (BRIDGE METHOD)

(a) Carefully adjust controls of oscilloscope so that the spot or trace is in the centre of the graticule with no Y input.

(b) Set up the circuit as shown in Fig. 11.

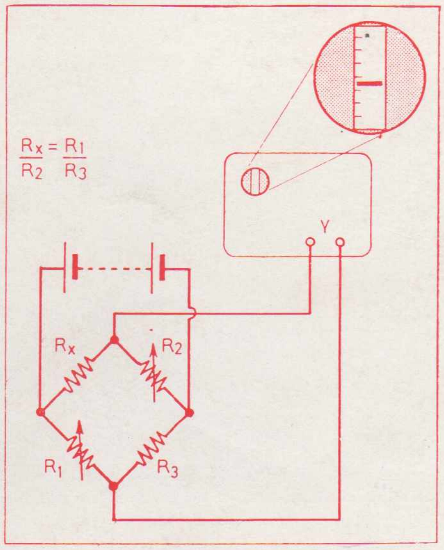


Fig. 11

(c) Adjust R_1 and R_2 until the spot centres on the screen.

(d) Increase gain of vertical amplifier and re-adjust R_1 and R_2 as necessary.

(e) Calculate the value of R_x from the standard formula:

$$\frac{R_x}{R_2} = \frac{R_1}{R_3}$$

NOTE: As with all standard bridge measurements, the values of R_1, R_2 and R_3 will depend upon the order of magnitude of R_x.

CIRCULATION

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