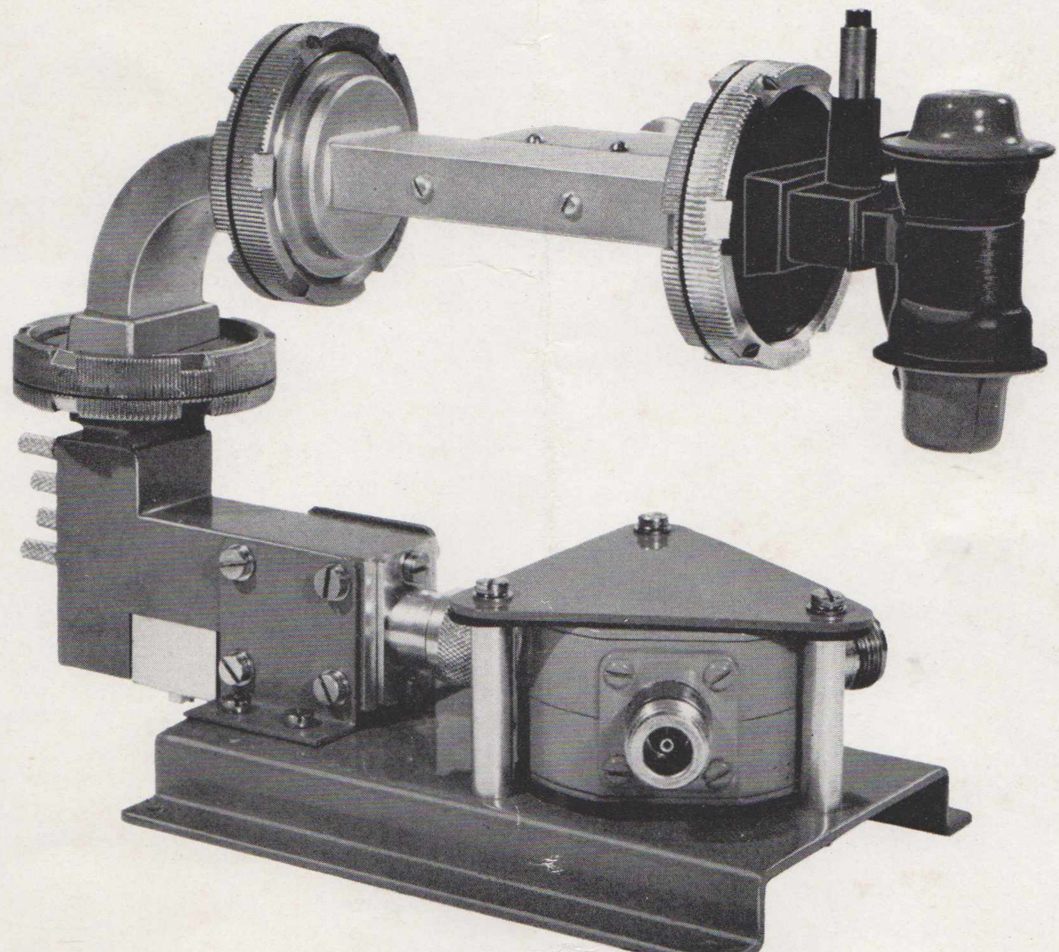
Mullard Outlook

AUSTRALIAN EDITION



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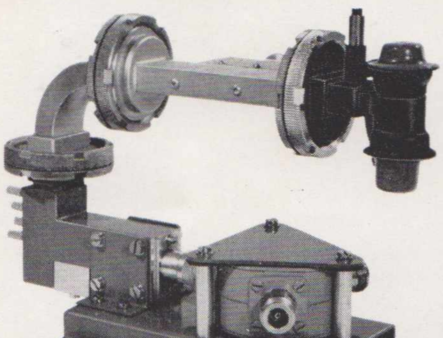

This S-Band Solid State Parametric Amplifier is for operation over a frequency range of 2·7Gc/s to 3·3Gc/s. It has a bandwidth of 25Mc/s and a noise figure as low as 3dB. Tuning over the 500Mc/s frequency range can be achieved by adjustment of the pump frequency and power level without alteration to the amplifier or the circulator. Pump power is provided by a suitable klystron.

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Some Play It By Ear

My thoughts on this particular editorial commenced as a cross between "East Lynne" and "Eric, or Little by Little" — something of a dilemma, poignant and courageous. When matched with to-day's telly and barely provoking reproachful criticism against the bizarre repertoire of 1963 youthful endeavour, it is directed towards the need for skilled technicians in the art of servicing transistor equipped devices. Trite nonsense to some, but to most the profound and inevitable desire to achieve.

For AM radio service and those who played it by ear, a well used test instrument was a slender screwdriver, preferably with insulated handle, augmented by the other well tried methods of brute force and ignorance, or suck it and see.

The fascinating and expanding world of semiconductors has a romance far removed from Fleming and de Forest. No wonder then our desire as semiconductor principals to assist in the training of technicians and offering our particular experience and skill in the application of semiconductors.

No question of playing it by ear, as also our customers right along the line; those who incorporate semiconductors in equipment for re-sale, retailers selling the end product, design engineers contemplating the use of semiconductors — they all know, with sound engineering abounding, the end product equipped with Mullard semiconductors can only enhance their sales, their profits and their prestige.

M.A.B.

VIEWPOINT WITH MULLARD

KNOW YOUR TRANSISTORS

Don't be Scared of Them

It was a toss up whether the analogous drawing would be Little Miss Muffet or one of our typists making an hysterical and noisy effort to avoid a mouse. Miss Muffet won, solely on the score that most transistors look more like a spider than a mouse. But transistor circuit techniques to the capable technician are as frightening as a mouse and a mouse far less than *Antrax robustus** and here the confusion must finish.

The Field

It is estimated that in the comparatively small Australian consumer domestic equipment market approximately 3,600,000 transistors and 2,000,000 semiconductor diodes will be absorbed this calendar year in new AM receivers alone. Add to this the number of present exotic and near exotic semiconductors used in telecommunications, professional and industrial electronic equipment and all the semiconductors already in service in Australia and we have only the beginning of an era.

Relate this to the research development and production of these devices elsewhere, the increasing tempo, the improvements, the tailoring of new types for a specific purpose, and the seeking of new applications for the types designed for other purposes, and this is where we came in!

Know your Product

Hackneyed these days and hammered into the salesmen at every consumer product sales conference and convention. By some now treated as a joke, with the back benchers chanting steadily and precisely "Next —— Saturday —— night, or rather Know Your Product, etc., etc." The technician *must* also know the product, why it works, how it works and how to swiftly fix it when it works erratically or stops working and there is going to be an awful lot of transistor equipped devices in service.

First Steps

As we at Mullard design, develop and make these things we need to know a bit about them, in fact we believe we are quite good at it, having been debunked and deflated on many occasions, and likely to be at any time. The 1963 boys at school make transistor sets and talk transistors long before they talk valves, which seem to be old stuff to them. The old campaigners, long since left the bench, getting bogged down with an avalanche (*sic*) of types and data. Our advice to them is to play with a few basic transistors in basic circuits, altering component values and looking at bottoming and what Zener gave his name to, rather than who he was.

Next Steps

By this time one is better fitted to do some selected reading, then tackle a composite device, perhaps a piece of useful test gear — or even a complete receiver! The latter, a good exercise after cleaning up the audio, sorting out the A.G.C. and taming the mixer. Back to the reading and perhaps a nibble at fancy control circuits or a closer examination of α, β and θ, and in no time the new experts are confident the original designer's compromise was inadequate or overdone and components values are changed, to say nothing of this new thing — spread.

The Touch

Touch and spread must be difficult words to the newcomer in English, particularly the mercenary translation of touch, and perhaps a better choice of word — feel, for the good technician must have a feeling for his work and a feel for transistors, much as the good linguist thinks in the language he is using, a good transistor technician thinks in semiconductors.

220 Attend Transistor Lectures

This language theme was emphasised by our General Manager, Mr. M. A. Brown, at the concluding night of a series of successful lectures on transistor receiver servicing recently held by Pye Industries Ltd. in Sydney and being repeated in other States. Mr. Brown complimented Mr. P. M. Threlfall, Pye Managing Director, and Harry Dennis, Pye Technical Liaison Officer, for their enterprise in seeing the need and arranging the lectures, which were presented by Mr. R. L. Webb, Mullard-Australia Senior Applications Engineer. At the final function the top student Ernie Venturato (specialist technician) of Eric Anderson's was presented with a AVO Multi-minor MK4, as also was the runner-up Bob Hedger of Reg. Lindsay Service Co., Wollongong. At the function Mr. Os Mingay said that the manufacturer could teach the technician many things and he commended the 220 technicians who attended the course for their enthusiasm and went on to say "All servicemen must be good salesmen — sell yourself, your service, your company and finally sell your product".

Pye Australasian Sales Manager, Bob Toone, reminded servicemen of their need for good customer relations in supporting the original sale and future sales and said "unless a favourable image is created by word of mouth we are both out of business. Consider this and aim for it. It is not enough just to fix up the problems. You must keep yourself sold to keep your company profitable and create a better image all round."

* Antrax robustus: the Sydney Funnel-Web Spider, generally black to red-brown in colour, about 1" in body length. ("Know Your Spiders & Ticks" by B. Hadlington).

MULLARD-AUSTRALIA PERSONALITIES

MR. T. DUNCAN

Tom Duncan, senior sales clerk in the Professional and Industrial Department, joined Mullard some three years ago, bringing with him a background of twelve years' experience in the electronics industry, including several years with the Newcastle branch of our New South Wales distributor, Martin de Launay Pty. Ltd.

He needs no introduction to our customers in the Professional and Industrial fields and Government Departments who, whilst they may not have met him personally, know Tom through contact over the 'phone and at some time or another have been grateful for his assistance with the "hard ones".

Having recently moved into a new home with his wife and two year old daughter, Tom's leisure time is divided between laying out lawns and gardens and setting up a darkroom to further his hobby — photography.

Mr. M. A. Brown congratulates top student Ernie Venturato

Training Aids and Facilities

From time to time we publish in Outlook a current list of Mullard 16 mm sound films, film strips, education series pamphlets, broadsheets and booklets, and many Outlook readers are subscribers to our advanced professional publications. We

Continued on page 58

Transistorised Modulator for Mobile Installations

The prototype modulator was based on the public address amplifier described in Chapter 17 (page 175) of the Mullard "Reference Manual of Transistor Circuits" (available from Mullard offices and distributors throughout the Commonwealth at 15/- plus 1/5d postage).

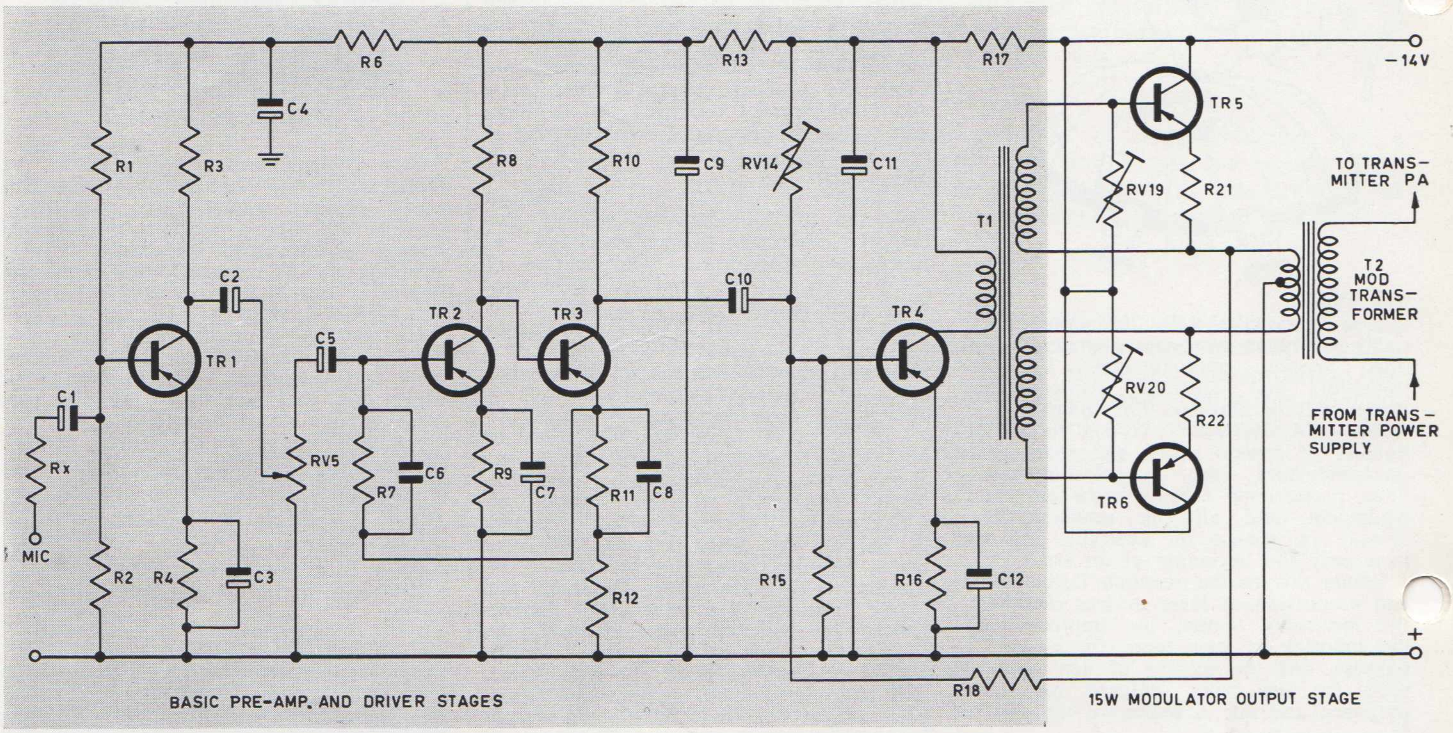
Following construction of the prototype it became obvious that there was a need for modulator designs of even higher power ratings and as a result three basic designs of 15W, 25W and 40W, are presented herein to cater for AM transmitters having a maximum DC input to the final RF amplifier of up to 80W.

When used with a valve transmitter having a transistorised power supply (see Outlook Vol. 4 No. 2) the standby current drain on the battery may be reduced to that required to supply the heaters of the RF valves in the transmitter. The availability of quick heating valves such as the QZ06-20, etc. (see Outlook Vol. 6 No. 2) will enable the transmitter standby current to be eliminated and such a transmitter, when used in conjunction with a fully transistorised receiver, will result in an AM installation which is capable of approaching the ultimate in battery economy for a given RF power output.

The power frequency response of the original design has been modified by changing component values in order to achieve a roll-off of some 12dB per octave below 300 c/s and above 3000 c/s. This form of speech processing is highly desirable since it contributes both to an increase in modulation efficiency and a reduction in transmitted signal bandwidth. Home constructors wishing to change the degree of speech processing may experiment with coupling and emitter bypass capacitors to achieve the desired results.

The microphone used in the prototype amplifier, Zephyr Products Insert type 192 is of the electro-magnetic rocking armature type and has an impedance rating of 2000Ω, thus enabling it to be connected to the input of the first transistor without the need for a matching transformer. The sensitivity of all three modulators is sufficient to achieve full output with this microphone at the appropriate gain control settings.

Fig. 1—Basic Pre-amplifier and Driver Stages and 15W Modulator Output Stage



COMPONENT PARTS LIST FOR PRE-AMPLIFIER AND DRIVER STAGE

Resistors

Circuit Reference	Value	Tolerance (±%)	Rating (W)
Rx	(see text)		
R1	18 kΩ	10	½
R2	10 kΩ	10	½
R3	3·9kΩ	10	½
R4	3·9kΩ	10	½
RV5	10 kΩ	log pot.	
R6	1 Ω	10	½
R7	2·2kΩ	10	½
R8	1·8kΩ	10	½
R9	1·0kΩ	10	½
R10	270 Ω	10	½
R11	270 Ω	10	½
R12	3·3 Ω	10	½
R13	68 Ω	10	1
*RV14	1 kΩ	WW trim pot. (see text)	
R15	220 Ω	10	½
R16	22 Ω	10 (see text)	1
R17	3·9 Ω	5	3

Capacitors

Circuit Reference	Value (μF)	Tolerance (±%)	Description	Rating (VW)
C1	4·0	10	electrolytic	6
C2	10·0	10	,,	12
C3	25·0	10	,,	6
C4	100	10	,,	12
C5	10	10	,,	12
C6	0·03	10	polyester	125 Volts
C7	50	10	electrolytic	6
C8	100	10	,,	6
C9	100	10	,,	12
C10	4	10	,,	12
C11	1000	10	,,	12
C12	100	10	,,	12

T1. Driver Transformer: Turns Ratio 2:1+1. Secondary wound bifilar. Primary DC resistance, ⩽5Ω. Secondary DC resistance 5Ω+5Ω (see Fig. 4). National Transformer type D5437 requires 1·5Ω additional resistance in series with each half secondary for 15W and 25W designs.

Mullard Transistors

TR1: OC71 or AC125; TR2: OC71 or AC125; TR3: OC74, OC74N or AC128; TR4: OC26.

** May be replaced by a fixed resistor after adjustment and measurement.*

COMPONENT PARTS LIST FOR 15W OUTPUT STAGE

Resistors

Circuit Reference	Value	Tolerance (±%)	Rating (W)
R18	3·3kΩ	10	½
*RV19	500 Ω	WW trim pot. (see text)	
*RV20	500 Ω	WW trim pot. (see text)	
R21	0·5 Ω	5	3
R22	0·5 Ω	5	3

Mullard Transistors

TR5
TR6 2-OC26 (matched pair)

Heat sinks 2 Ferris 7000

T2 Modulation Transformer A&R MT26 or similar.

** May be replaced by a fixed resistor after adjustment and measurement.*

Basic Pre-amplifier and Driver Stages

The use of a basic pre-amplifier and driver stage (see shaded area of Fig. 1) increases the flexibility of the overall design inasmuch as the output stage may be changed at any time without the need for modification of the basic unit. Whilst it will be obvious that the sensitivity of the modulator will be reduced when changing from a 15W output stage to a 40W output stage, there is still more than sufficient gain available to enable the use of the microphone insert type referred to above. This unit is capable of an output of 10 to 20mV peak-to-peak across 2000Ω, dependent of course on voice level.

Resistor Rx may be adjusted by substitution of lower values where increased sensitivity is required. As a guide, the recommended value for the 25W unit, when using the Zephyr Insert 192, is 6·8k. The 2000Ω resistor provides correct microphone matching, whilst Rx in conjunction with the input impedance of the first stage provides attenuation. This gives a useful range of control with RV5. The method of connection is shown in Fig. 2.

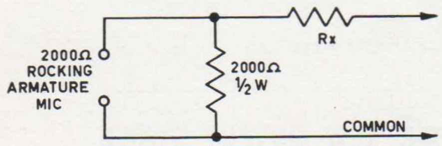


Fig. 2

Should home constructors wish to use a standard carbon microphone, the first transistor stage may be omitted, in which case the method of connection is as shown in Fig. 3.

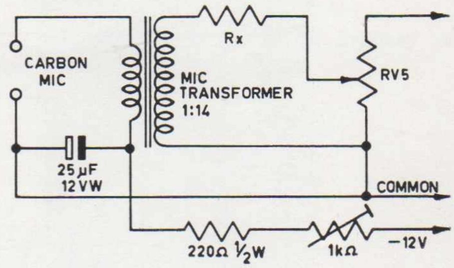


Fig. 3

Using the interstage transformer shown in the Parts List, the quiescent current of the OC26 driver should be set to 175mA by adjustment of RV14 with an applied voltage of 14V. Following adjustment, the resistance of RV14 may be measured and a suitable fixed resistor substituted.

The collector dissipation will be approximately 2W under "no signal" conditions, reducing to a lower value under "drive". Whilst the heat sink requirements of this stage are not stringent, the use of a Ferris type 7000 heat sink will be found most convenient.

The gain of the unit is quite high and normal layout precautions should be employed in constructing the pre-amplifier and driver. It is anticipated that a printed wiring board will become available for mounting the components from the microphone input to the OC26 driver. The interstage transformer and OC26 may be mounted on the chassis using a mica insulating washer for the OC26.

R18 may be adjusted to provide any desired degree of feedback up to a level somewhat below the stability margin, however, the recommended value of 3·3kΩ for the 15W unit will be found quite satisfactory for the 25W and 40W modulators.

15W MODULATOR

In this instance, the original design (see circuit page 176 "Reference Manual of Transistor Circuits") may be converted to a modulator by merely replacing the centre-tapped audio output choke by a transformer having the correct turns ratio to reflect a load of 15Ω to the primary (see non-shaded area Fig. 3).

Such a unit is the A&R MT26 which, when terminated at the nominal 4000Ω tap with a modulating impedance of 4760Ω, will provide a correct match.

For example, a transmitter having an applied power to the final stage of 380V at 80mA requires a modulating impedance of

$$\text{Mod Z} = \frac{380}{80 \times 10^{-3}} = 4750\Omega.$$

$$\text{Power input to final} = 380 \times 80 \times 10^{-3} = 30{\cdot}4\text{W}.$$

This represents an ideal application for the 15W modulator using the A&R MT26 modulation transformer.

The quiescent current for the OC26 output transistors should be set to 30mA for each output transistor by adjustment of RV19 and RV20. Following adjustment, the resistance of the preset pots may be measured and fixed resistors substituted.

With the method of bias stabilisation employed it is important that the resistance of each half of the driver transformer secondary should be adjusted to 5Ω by the insertion of additional resistance R if necessary (see Fig. 4).

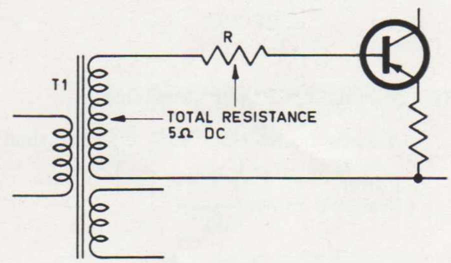


Fig. 4

25W MODULATOR

The design procedures for the 25W and 40W modulator designs make certain assumptions and because of this it is desirable for home constructors to carry out a complete set of measurements on the output stage to ensure that the output transistors are operating within the limits set down in the published data.

These simplified design procedures make it possible for home constructors without a great deal of experience with semiconductors, to design output stages for public address amplifiers and modulators. The procedures are based on the information contained in Chapters 9, 13, 14 and 17 of "Mullard Reference Manual of Transistor Circuits" and represent a quite practical approach to the design of Class 'B' output stages.

This unit is an extension of the former 15W Modulator with the substitution of OC29's for the OC26's in the output stage, thus enabling the higher values of peak current to be provided to achieve a power output of 25W (see Fig. 5).

(1) **Load impedance** — To allow for losses in R_e (0·15Ω) and the modulation transformer a total AC power from the supply of 32W will be assumed. The power supply rail will be 14V.

$$P_{AC} = \frac{(V_{cc})^2}{2R_{ce}}$$

V_{cc} = supply rail voltage.

R_c = load presented to collector circuit of one transistor.

R_{ce} = $R_c + R_e$. R_e is chosen to be 0·15Ω for adequate stability.

Therefore:—

$$R_{ce} = \frac{(V_{cc})^2}{2P_{AC}} = \frac{14^2}{2 \times 32}$$

$$= 3{\cdot}06\Omega.$$

(2) **Knee Voltage** — tan ϕ for OC29 is a constant having a value of 0·1Ω.

$$\text{Max output voltage} = \frac{V_{cc} \times R_{ce}}{R_{ce} + \tan\phi}$$

where

tan ϕ = slope of transistor knee characteristic expressed as a resistance.

therefore

$$V_{out(pk)} = \frac{14 \times 3{\cdot}06}{3{\cdot}06 + 0{\cdot}1}$$

$$= 13{\cdot}55\text{V}.$$

(3) **Output current**

$$\text{Max output current} = \frac{V_{ce(pk)}}{R_{ce} + \tan\phi}$$

$$= \frac{13{\cdot}55}{3{\cdot}06 + 0{\cdot}1}$$

$$= 4{\cdot}3\text{A}.$$

(4) **Max output power**

$$P_{tot} = \frac{V_{ce(pk)} \times I_{c(pk)}}{2}$$

$$= \frac{13{\cdot}55 \times 4{\cdot}3}{2}$$

$$= 29{\cdot}2\text{W}.$$

(5) **Useful output power in primary of modulation transformer**

$$P_{out} = \frac{P_{tot} \times R_c}{R_{ce}}$$

$$= \frac{29{\cdot}2 \times 2{\cdot}91}{3{\cdot}06}$$

$$= 27{\cdot}7\text{W}.$$

(6) **Modulating Power Available**

Assume transformer 90% efficient, then

$$\text{Power available} = \frac{27{\cdot}7 \times 90}{100}$$

$$= 24{\cdot}9\text{W}.$$

(7) **Load $R_{(c-c)}$**

$$R_{(c-c)} = R_c \times 4 = 2{\cdot}91 \times 4$$

$$= 11{\cdot}64\Omega.$$

Using the component values shown in the Parts List and recalculating for an 11·64Ω load 12V and 16V supply rails:—

Supply rail	*12V*	*16V*
$V_{out(pk)}$	11·62	15·5 V
$I_{out(pk)}$	3·68	4·9 A
P_{tot}	21·4	38 W
$P_{out(primary)}$	20·4	36·2 W
$P_{out(secondary)}$	18·36	32·58W

The above figures show the spread of output power with changes in supply voltage and emphasise the need to provide good power supply regulation.

The resistance of each half of the driver transformer secondary should be made up to 5Ω for bias stabilisation (see Fig. 4).

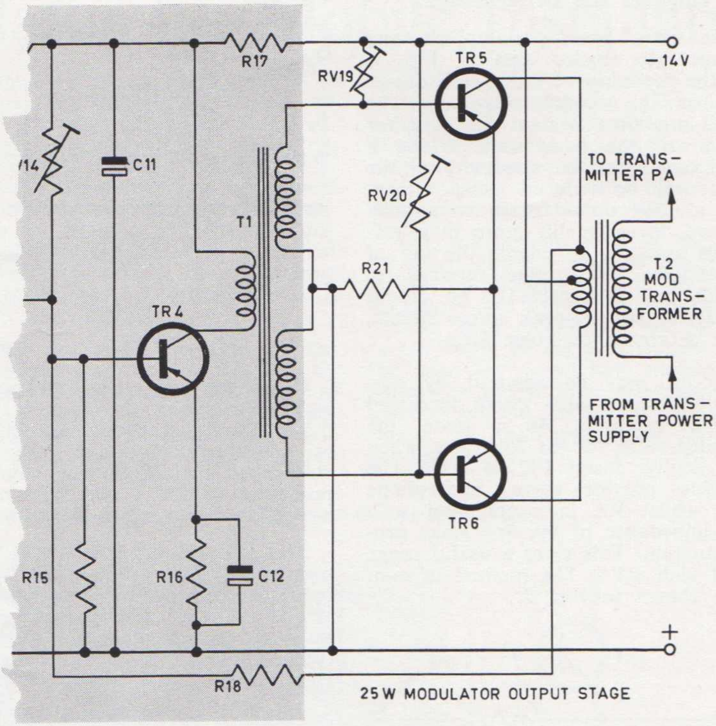


Fig. 5—25W Modulator Output Stage

COMPONENT PARTS LIST FOR 25W OUTPUT STAGE

	Circuit Reference	*Value*	*Tolerance (±%)*	*Rating (W)*
Resistors				
	R18	3·3 kΩ	10	½
	*RV19	1 kΩ	WW trim pot. (see text)	
	*RV20	1 kΩ	WW trim pot. (see text)	
	R21	0·15 Ω	5	5

Mullard Transistors

TR5
TR6 2-OC29 (matched pair)

Heat Sinks 2 Ferris 7000

Modulation Transformer turns ratio to reflect 11·64Ω between collectors OC29's.

Primary wound bifilar $R_p < 0{\cdot}1\Omega$ per side.

** May be replaced by a fixed resistor after adjustment and measurement.*

Heat Sink Requirements—With a Class 'B' stage maximum dissipation per transistor

$$P_c = \frac{2}{\pi^2} \times \frac{(V_{cc})^2}{2R_{ce}} \simeq \frac{1}{5} P_{tot}$$

now since, with the 25W design $P_{tot} = 29{\cdot}2\text{W}$

$$P_c \text{ (per transistor)} = \frac{29{\cdot}2\text{W} \times 1}{5}$$

$$= 4{\cdot}82\text{W}.$$

From OC29 data:—

$$P_c = \frac{T_{j(max)} - T_{(amb)}}{\theta_{j\text{-}amb}}$$

$\theta_{j\text{-}amb}$ (when using a mica washer coated with silicone grease between the transistor and a Ferris 7000 heat sink)

$$= \theta\text{case} + \theta\text{i} + \theta\text{h}$$

$$= 1{\cdot}5^\circ\text{C/W} + 0{\cdot}5^\circ\text{C/W} + 3{\cdot}6^\circ\text{C/W}$$

$$= 5{\cdot}6^\circ\text{C/W}.$$

For continuous operation $T_{j(max)} = 90^\circ\text{C}$ therefore the maximum permissible ambient temperature

$$T_{(amb)} = T_{j(max)} - \theta_{j\text{-}amb}$$

$$= 90 - (4{\cdot}82 \times 5{\cdot}6)$$

$$= 63^\circ\text{C}.$$

40W MODULATOR

Where higher output powers are required, the 40W modulator design is recommended (see Fig. 6) and the following calculations show how a nominal 40W may be obtained from a matched pair of OC29's and a 14V supply rail. As a compromise between the requirements of temperature stabilisation and minimisation of cross-over distortion, the quiescent current will be set to 60mA for the matched output transistors (i.e. 30mA per transistor).

(1) **Load impedance** — to allow for losses in R_e and modulation transformer, for an output of 40W, assume an initial value of 60W with a 14V supply rail. Then

$$P_{AC} = \frac{(V_{cc})^2}{2R_{ce}}$$

V_{cc} = supply rail voltage.
R_c = load presented to collector circuit for one transistor.
R_{ce} = $R_c + R_e$. R_e is chosen to be $0{\cdot}15\Omega$ for adequate stability.

Now

$$R_{ce} = \frac{(V_{cc})^2}{2P_{AC}} = \frac{14^2}{2 \times 60} = 1{\cdot}63\Omega.$$

(2) **Knee Voltage** — $\tan\phi$ for OC29 is a constant having a value of $0{\cdot}1\Omega$.

$$\text{Max output voltage} = \frac{V_{cc} \times R_{ce}}{R_{ce} + \tan\phi}$$

Therefore

$$V_{out(pk)} = \frac{14 \times 1{\cdot}63}{1{\cdot}63 + 0{\cdot}1} = 13{\cdot}2\text{V}.$$

(3) **Output current**

$$\text{Max output current} = \frac{V_{cc(pk)}}{R_{ce} + \tan\phi}$$

Therefore

$$I_{out(pk)} = \frac{13{\cdot}2}{1{\cdot}63 + 0{\cdot}1} = 7{\cdot}63\text{A}.$$

(4) **Max output power**

$$P_{tot} = \frac{V_{ce(pk)} \times I_{c(pk)}}{2} = \frac{13{\cdot}2 \times 7{\cdot}63}{2} = 50\text{W}.$$

(5) **Useful output power in Primary of Modulation Transformer**

$$P_{out} = P_{tot} \times \frac{R_c}{R_{ce}} = 50 \times \frac{1{\cdot}48}{1{\cdot}63} = 45\text{W}.$$

(6) **Modulating power available** — assume transformer 90% efficient.

Then

power available in secondary

$$= \frac{45 \times 90}{100} = 39{\cdot}5\text{W}.$$

(7) **Load $R_{(c-c)}$**

$$R_{(c-c)} = R_c \times 4 = 1{\cdot}48 \times 4 = 5{\cdot}92\Omega.$$

Using the component values given above and re-calculating for a $5{\cdot}92\Omega$ load 12V and 16V supply rails:—

Supply Rail	*12V*	*16V*	
$V_{out(pk)}$	11·3	15·1	V
$I_{out(pk)}$	6·53	8·73	A
P_{tot}	32	66	W
$P_{out(primary)}$	29	60	W
$P_{out(secondary)}$	26·1	54	W

Whilst the output power may appear at first sight to be unduly dependent on supply voltage, it must be realised that the DC input to the RF section of the transmitter will vary with supply rail voltage changes, irrespective of whether a vibrator, genemotor or DC-DC converter is employed for the HT supply. This, in some measure, tends to level out the effect of supply rail variations and results in a sound, practical design.

Heat Sink requirements

With a Class 'B' stage maximum dissipation per transistor

$$P_c = \frac{2}{\pi^2} \times \frac{(V_{cc})^2}{2R_{ce}} \simeq \frac{1}{5} P_{tot}$$

now since with the 40W design $P_{tot} = 50\text{W}$

$$P_c \text{ (per transistor)} = \frac{50 \times 1}{5} = 10\text{W}.$$

From OC29 data:—

$$P_c = \frac{T_{j(max)} - T_{(amb)}}{\theta_{j-amb}}$$

θ_{j-amb} (when using a mica washer coated with silicone grease between the transistor and a Ferris 7001 heat sink)

$$= \theta\text{ case} + \theta\text{i} + \theta\text{h}$$
$$= 1{\cdot}5^\circ\text{C/W} + 0{\cdot}5^\circ\text{C/W} + 2{\cdot}1^\circ\text{C/W}$$
$$= 4{\cdot}1^\circ\text{C/W}.$$

For intermittent operation $T_{j(max)} = 100^\circ\text{C}$, therefore the maximum permissible ambient temperature

$$T_{amb} = T_{j(max)} - 10\,(\theta_{j-amb}) = 100 - (10 \times 4{\cdot}1) = 59^\circ\text{C}.$$

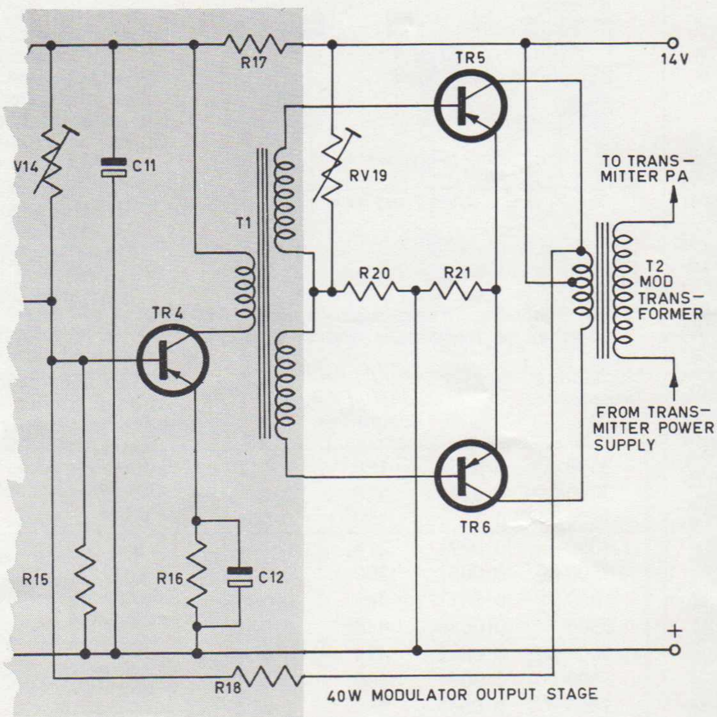


Fig. 6—40W Modulator Output Stage

COMPONENT PARTS LIST FOR 40W OUTPUT STAGE

Resistors

Circuit Reference	*Value*	*Tolerance (±%)*	*Rating (W)*
R18	3·3kΩ	10	½
*RV19	500Ω	WW trim pot. 5W (see text)	
R20	3·9Ω	5%	1
R21	0·15Ω	10	7

Mullard Transistors

TR5
TR6 2-OC29 (matched pair)

Heat Sinks

1 Ferris 7000
2 Ferris 7001

Modulation Transformer turns ratio to reflect 6Ω between collectors of OC29's.

Primary wound bifilar $R_p < 0{\cdot}1\Omega$ per side.

** May be replaced by a fixed resistor after adjustment and measurement.*

Mullard

40W Modulator (Continued)

Drive requirements

(1) Transistor gain spreads dictate that lowest gain transistors are assumed to be in use and a lower limit OC29 will have a large signal current gain in common emitter of

$$\bar{\alpha}' \simeq 35$$

Therefore drive current

$$i_b = \frac{i_c}{\bar{\alpha}'} = \frac{7\cdot63}{35} = 218\text{mA}.$$

(2) **Drive voltage required**

(a) $V_{drive} = (i_e - 2I_q) R_e + V_{be(i_c)} - V_{be(I_q)} + i_b R_b$

Where

i_e = peak emitter current

I_q = 30mA per transistor chosen as a compromise between linearity and temperature stability

$V_{be(i_c)}$ = peak base-emitter voltage for i_c

R_b = 5Ω for a practical transformer.

(b) From OC29 data and 40W design above:—

$$V_{drive} \simeq 2\cdot8\text{V}$$

(3) Drive power (RMS)

$$= \tfrac{1}{2}(i_b \times V_{drive}) = \frac{0\cdot218 \times 2\cdot8}{2} = 305\text{mW}.$$

(4) Drive impedance Z_b

$$= \frac{V_{drive}}{i_b} = \frac{2\cdot8}{0\cdot218} \simeq 13\Omega$$

therefore

$$Z_{b\text{-}b} = 13 \times 4 = 52\Omega.$$

Driver Stage

To ensure that adequate drive is available under all conditions, the driver should be capable of providing an output power of 750mW.

An OC26 in Class 'A' is capable of achieving this figure and the ready availability of interstage transformers having a turns ratio of 2 : 1 + 1, with the two halves of the secondary wound bifilar suggests the choice of this ratio.

Such a transformer, under maximum drive conditions, will reflect an impedance of 52Ω into the primary winding and an OC26 operating at a quiescent current of 175mA will provide an output power approaching 800mW which is quite sufficient to accommodate circuit losses at the same time providing the desired drive to the final stage, i.e.,

$$P_{out(max)} = \tfrac{1}{2} I_q^2 R_L = \frac{(0\cdot175)^2 \times 52}{2} = 796\text{mW}.$$

This stage in turn is adequately driven by an OC74, OC74N or AC128.

ADDITIONAL NOTES

High-level Clipping

The circuit of a typical high level clipper is shown in Fig. 7. It is fully automatic in operation and allows extension of the positive peaks of modulation whilst, at the same time, limiting the negative peaks.

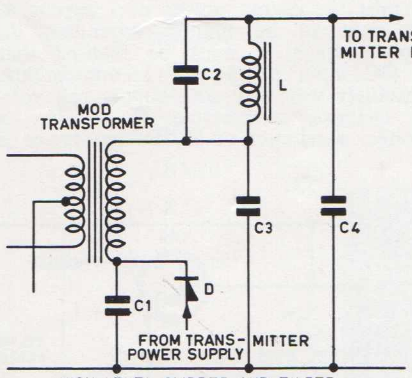
Since a form of splatter may result from clipping of the negative modulation peaks, it is essential to follow the clipper with a low pass filter placed between the secondary of the modulation transformer and the RF power amplifier.

Capacitors C2, C3 and C4, in conjunction with choke L form the low pass filter, whilst an additional constant k section is provided by the leakage inductance of the modulation transformer secondary in conjunction with C1 and C3.

The Table gives details of the values of L and C for a wide variety of modulating impedances, however C1 is dependent on the inductance of the modulation transformer secondary and some experimentation may be necessary. As a starting point a value of 0·001μF is a good choice.

A suitable clipping diode may be selected from the range of silicon power diodes now available for power rectification. In practice, the OA210 will be satisfactory in most applications involving HT supplies up to 400V. Above this figure the OA211 is recommended.

The RF plate supply bypass capacitor in the transmitter may be modified to act as C4 by changing it to the correct value.



HIGH LEVEL CLIPPER AND FILTER

Fig. 7

***Table showing component values for attenuation of frequencies above 3000 c/s.**

Modulating Impedance (Ω)	*C3, C4* (μF)	*L1* (*mH at PA operating current*)	*C2* (μF)
2500	0·015	180	0·011
3000	0·013	210	0·01
3500	0·11	250	0·0085
4000	0·009	270	0·007
4500	0·008	300	0·0062
5000	0·007	380	0·0055
5500	0·0066	420	0·0052
6000	0·0062	470	0·0047
6500	0·006	500	0·0043
7000	0·0055	540	0·004
7500	0·005	580	0·0038

Construction and Installation

1. When constructing mobile equipment it is essential to ensure that heavy components are securely mounted and this applies equally in the case of transistorised equipment.

2. Reliability under high ambient temperatures dictates the use of effective heat sinks. It is preferable to err on the generous side when designing high-power transistor devices.

3. Where the modulator is built as an integral part of the transmitter, the transistors should be isolated from the high power RF amplifier as induced RF can cause heating of the transistor junction, apart from difficulties associated with RF feedback. Ensure that the inherent temperature rise is not excessive and provide some means of effective convection cooling or provide a blower to increase air circulation.

4. Transistors are less tolerant of load changes than valves. Attempt to achieve as perfect a match as possible between the transmitter modulating impedance and modulator load.

5. Fit fuses of correct minimum values, preferably of the English Electric "quick blow" type. Do not use a 20A fuse where a 5A unit is adequate.

6. Arrange switching sequences so that a load is always presented to the modulator. For example, make sure that the transmitter final is providing output before power is applied to the modulator. The reverse sequence should apply on switch-off. This may be achieved by an interlocking circuit, operated by sampling the RF output, rectifying and amplifying the sample and using it to close a relay which applies power to the modulator.

   A less sophisticated, but quite practical, method is to fit an RF indicator at the operating position and refrain from speaking into the microphone until an indication of RF output appears.

7. For hand-held microphones, the Zephyr Rocking Armature Insert type 192 is excellent, however, where a lighter insert suitable for a boom extension on a headband is required, the M4 hearing-aid insert may be preferred.

The filter capacitors must have a working voltage rating at least 3 times the RF amplifier supply voltage and the choke L should preferably have high voltage insulation between the winding and core or, alternatively, may be insulated from the chassis.

The rated inductance of the choke, which should not approach saturation, should be achieved at the desired DC current level.

***Reference:** CQ Mobile Handbook, First Edition (1963).

B. P. A. Beresford.

100 LITRE PER SECOND PENNING PUMP

Latest addition to the wide range of Mullard ultra-high vacuum devices* is a new 100 litre per second pump type number VPP-100.

This pump, which is continuous in operation, is based on the principle of the Penning gauge, in which electrons are made to oscillate between cold cathodes. A magnetic field perpendicular to the direction of electron movement causes the electrons to traverse spiral paths as they oscillate in the electrostatic field formed by the cathodes and the anode. Ions produced by these electrons are accelerated to the cathodes and liberate more electrons, the combined action being self-supporting.

The pump comprises many Penning electrode units in parallel using common titanium cathodes on each side of a nest of anodes. During operation, the titanium sputters from the cathode, forming fresh surfaces which getter very actively.

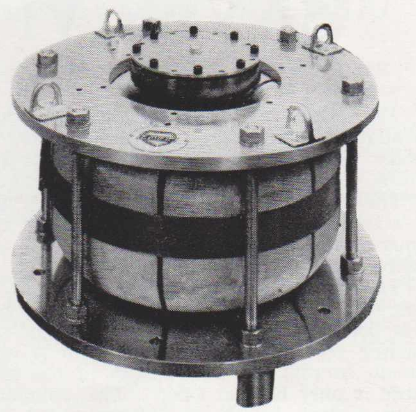
The size, shape, pumping speed and bake-out temperature of the VPP-100 make it particularly suitable for use in nuclear physics and space research. For example, the pump could be used to evacuate the particle acceleration cavities of cyclotrons and space simulation chambers.

The pumping action of the VPP-100 will begin at a pressure of 5×10^{-3} torr and continue until a pressure as low as 10^{-10} torr is reached. Over this range the pumping speed for air is approximately 100 litres per second.

Although an anode voltage of 3kV is used to operate the pump, a higher pumping speed may be obtained by increasing this voltage to 5kV. This increase in pumping speed can be usefully applied to counteract outgassing which is often troublesome in vacuum systems at very low pressures. At a pressure of 10^{-6} torr the pump has a life expectancy of approximately 40,000 hours.

Features of the VPP-100 include all-welded stainless steel construction, magnets that may be left in position during bake-out and interchangeable cathodes. Care has been taken to keep the stray magnetic field to a minimum. The pump is connected to a vacuum system by means of a demountable flange joint with a gold-wire seal. The seal has a 4″ orifice and can be baked to a temperature of 450°C.

* Operating notes and data on other ion pumps and high vacuum gauges may be found in Volume 3 of the Mullard Technical Handbook.



ABRIDGED DATA

CHARACTERISTICS

Pumping range	5×10^{-3} to 10^{-10} torr
Pumping speed (air)	100 litre/sec
Fore pressure required to start pumping operation	5×10^{-3} torr

Over the operating range of the pump the pumping speed is independent of pressure, but varies with different gases.

LIMITING VALUES

Maximum operating temperature	150°C
Maximum bake-out temperature	450°C

POWER REQUIREMENTS

Operating voltage	3·0 kV

WEIGHT 205 lbs

OVERALL DIMENSIONS 15″ diameter × 9″ height

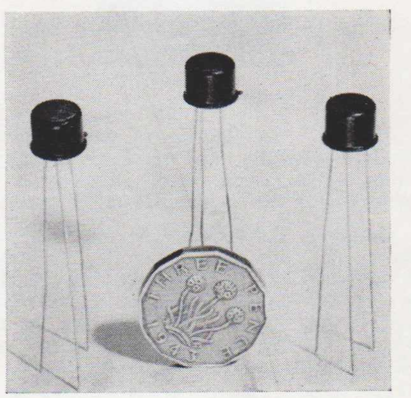
Three New High-Voltage Medium-Power Silicon P-N-P Transistors

Three new large-signal transistors, the BCY38, BCY39 and BCY40 complete a compatible range of Mullard silicon p-n-p transistors in TO-5 encapsulation.

With good bottoming characteristics and extremely efficient heat dissipation, these types are intended for use in pulse and audio applications, in oscillator and switching circuits and in servo process control.

With their high peak current ratings and good linearity, they are suitable for push-pull output stages; whilst their high maximum junction temperature of 150°C, coupled with low thermal resistance, provides a high dissipation factor.

The complete range, shown in the Table, consists of eight types falling into two groups according to their voltage ratings, with further subdivisions into low-current and high-current types.



TABLE

Type Number	V_{CB} *max (V)*	*Current Amplification Factor*	*at* I_C *(mA)*	I_{CM} *max (mA)*
BCY33		15 to 35	1·0	100
BCY38	−32	10 to 30	150	500
BCY34		25 to 60	1·0	100
BCY40		16 to 120	150	500
BCY30		15 to 35	1·0	100
BCY32	−64	35 to 80	1·0	100
BCY31		25 to 60	1·0	100
BCY39		10 to 50	150	500

NEW STOCKS

The Mullard Vinkor Manual, which has been temporarily out of stock, is again available from Mullard Offices and Distributors throughout the Commonwealth, priced at 5/3d plus 8d postage.

NEW 23-inch PICTURE TUBE SAVES VITAL INCHES

The flatness of the screen of the 23-inch Mullard picture tube AW59-91 offers a wide viewing angle and greater freedom from distortion when viewed obliquely.

The "unipotential" focusing lens in the AW59-91 prevents deflection defocusing and thus ensures excellent spot quality over the whole picture area.

The design of the electrode structure of the AW59-91 is such that a very short gun has been achieved. In addition to this, the sealing pip at the base of the gun is very small, so that the total length of the tube neck is only 110mm (4⁵⁄₁₆"). This compares with a neck length of 130mm (5¼") for the AW59-90. The overall reduction in the length of the AW59-91 resulting from the short-neck construction has made possible even greater reduction in the depth of television cabinets, leading to the more slender appearance of present-day receivers.

The AW59-91 may be used as a replacement for the following 23-inch television tubes in common use in Australia — AW59-30, AW59-90, AME2351B, AME-2354B, 23MP4J and 23WP4.

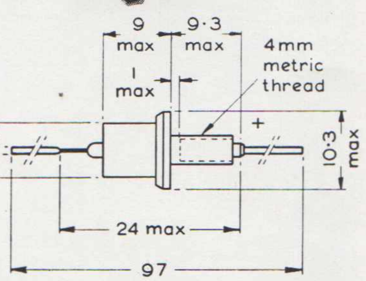
TWO NEW SILICON RECTIFIERS

The range of Mullard silicon power diodes has been supplemented by two new types, the OA605 and the OA610, in SO-17 encapsulation.

These silicon diodes may be used as power rectifiers where an average current of 0·5A, at an ambient temperature of 70°C, is not exceeded.

ABRIDGED PRELIMINARY DATA

	OA605	OA610	
Max. PIV	50	100	V
Max. forward current peak (at PIV max.)	5	5	A
Av. current (averaged over any 50 msec. period or DC component)	0·5	0·5	A



WATSON OVERSEAS

Mr. H. S. Watson, Chief Engineer Mullard-Australia, and heading our applications engineering team, left Sydney on 19th August for an extended visit overseas.

Outlook, Volume 6, No. 2, page 15, shows and tells something of the Applications Engineering Laboratory and, needless to say, the outcome of Mr. Watson's visit will be to enhance the facilities of this activity and, in turn, the applications service to our customers.

Mr. Watson will be spending most of his time with our Parent Company, Mullard Limited, London, and in addition will be visiting the United States, Canada, Holland, Switzerland, Western Germany and France. He is scheduled to return to Australia mid-December.

Continued from page 51

remind readers that we are glad to provide lecturers, instructional films and group publications for clubs, institutions, schools, indeed wherever enthusiasts gather for the common purpose of improving their technical knowledge.

The Technical Service Department also maintains a healthy and ever growing technical answer service by correspondence and telephone, both from our Head Office in Sydney and the branches in the other States; visitors are always welcome and invariably depart with a handful of Mullard books and data sheets.

May we be of assistance to you?

New Medium Power Output Transistor

In addition to the preferred range of transistors for entertainment applications, the AD139 output transistor has been made available for use in audio amplifiers and radio receivers.

The AD139 is a medium power, alloy-junction transistor of the p-n-p type designed for an output power of 2W in Class 'A'. When used in a transformerless single-ended push-pull DC-coupled amplifier, two AD139 transistors are capable of delivering to the loudspeaker voice coil 10W of audio power at very low distortion levels.

ABRIDGED ADVANCE DATA

Absolute Maximum Ratings

V_{CB}	−32	V
V_{CE}	−32	V
V_{EB}	−10	V
I_C (averaged over any 50msec period)	1	A
I_{CM}	2	A
I_B (averaged over any 50msec period)	0·2	A

Temperature Ratings

Junction temperature continuous operation	90	°C
Storage temperature	75	°C
Temperature rise junction to mounting base	⩽ 4	°C/W
Dissipation P_C	13	W

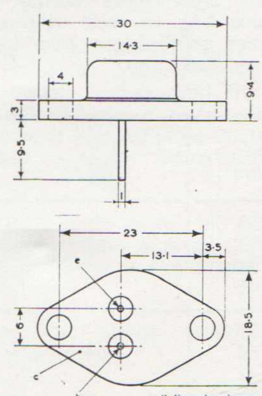
Characteristics

At $T_{amb} = 25°C$.

I_B at $I_E = 10mA, V_{CB} = 0V$	⩽ 0·6	mA
I_B at $I_E = 1A, V_{CB} = 0V$	⩽33	mA
V_{BE} at $I_E = 1A, V_{CB} = 0V$	⩽ 0·7	V

The case is smaller than the T03 case as used in OC26 and similar transistors, having the same mounting hole spacings as the OC30 transistor (now a maintenance type).

Outlines and Dimensions



Mullard Range of Preferred Semiconductors for Entertainment Applications

This issue of Outlook contains an insert sheet which provides abridged data on the Mullard preferred range of semiconductors for use in entertainment applications. Of particular interest is the AF114N series, which supersedes the OC170 series in RF applications. The new range of transistors may be used as direct replacements for the OC170 series listed below.

Applications

The AF114N — may be used as a replacement for the OC171 as an RF amplifier in VHF receivers. The increased power gain and lower noise figure at 100Mc/s provides superior performance.

The AF115N — may be used as a replacement for the OC171 as a mixer-oscillator in VHF receivers and for short-wave mixer-oscillator circuits at frequencies up to 26Mc/s. Increased conversion gain and lower noise figure are achieved.

The AF116N — may be used as a replacement for the OC170 as an AM mixer-oscillator up to 16Mc/s. The lower output conductance enables improved selectivity to be achieved, together with a reduced noise figure.

The AF117N — may be used as a replacement for the OC169 as an IF amplifier in AM receivers.

The adoption of the TO-44 case for the new transistor types contributes to a reduction in size of equipment when used in conjunction with the new preferred range of transistors for audio applications which are mounted in the TO-1 case.

Improved Characteristics

1. New small case.
2. Maximum collector voltage rating 32V instead of 20V.
3. Increased gain (h_{fe}) facilitates the design of AGC controlled stages, such as in car radios and portables.
4. Reduction of I_{CBO} from 260µA to 50µA at 60°C results in improved AGC performance in car radios operating at high ambient temperatures.
5. Increased emitter-to-base breakdown voltage V_{EB}. 1V compared with 0·5V for OC170 series.
6. Improved noise figure.

ALLOY-DIFFUSED GERMANIUM P-N-P TRANSISTORS AF114N, AF115N, AF116N, AF117N

ABRIDGED PRELIMINARY DATA

ABSOLUTE MAXIMUM RATINGS (for all four types)

Collector-to-base voltage	$-V_{CB}$	32	V
Collector-to-emitter voltage	$-V_{CE}$	32	V
Collector current	I_C	10	mA
Emitter current	I_E	11	mA
Reverse emitter current	$-I_E$	1	mA
Base current	I_B	1	mA
Collector dissipation at $T_{amb} \leqslant 45°C$	P_C	50	mW
Junction temperature			
Continuous operation	T_j	75	°C
Intermittent operation (200 hours max.)	T_j	90	°C
Storage temperature	T_{stg}	−55 to +75	°C

CHARACTERISTICS at $T_{amb} = 25°C$

Emitter breakdown voltage at $-I_E = 50µA$, $-I_C = 0$	$-V_{EB}$	(all types)	max 1	V
Frequency at which $h_{fe} = 1$ at $-V_{CB} = 6V$, $I_E = 1mA$,	f_1	(all types)	75	Mc/s
Current amplification factor at $-V_{CE} = 6V$, $I_E = 1mA$, f = 1 kc/s	h_{fe}	(all types)	150	
Intrinsic base impedance at $-V_{CB} = 6V$, $I_E = 1mA$, f = 2 Mc/s	$\lvert Z_{rb}\rvert$	(AF114N)	20	Ω
	$\lvert Z_{rb}\rvert$	(AF115N)	25	Ω
	$\lvert Z_{rb}\rvert$	(AF116N)	27	Ω
	$\lvert Z_{rb}\rvert$	(AF117N)	35	Ω
Feedback capacitance at $-V_{CE} = 6V$, $I_E = 1mA$, f = 450 kc/s	$-C_{re}$		1·5	pF
Noise figure at $-V_{CB} = 6V$, $I_E = 1mA$,				
f = 100 Mc/s, R_s = 60Ω	F	(AF114N)	8	dB
f = 100 Mc/s, R_s = 60Ω	F	(AF115N)	9·5	dB
f = 10·7 Mc/s, R_s = 200Ω	F	(AF116N)	3	dB
f = 1 Mc/s, R_s = 500Ω	F	(AF117N)	1·5	dB
Conversion noise figure at $-V_{CB} = 6V$, $I_E = 1mA$, f = 1 Mc/s, R_s = 500Ω	F_{conv}	(AF116N)	3	dB

SMALL SIGNAL Y PARAMETERS

For small signal y parameters and design curves, refer to AF114, AF115, AF116 and AF117 data in Volume 4 of the Mullard Technical Handbook.

Mercury Vapour Thyratron ZT1000

The mercury-vapour filled thyratron ZT1000 has a negative control characteristic and is rated for a maximum peak inverse voltage of 21kV at an average anode current of 2·5A. At peak inverse voltages below 15kV average anode currents of 3A are permissible and at 2·5kV the average anode current may be up to 5A.

The ZT1000 is intended for use in HT power supplies with DC output voltages up to 21kV. It may also be used as a quick-acting electronic switch or for regulation and stabilisation purposes in HT power supplies.

ABRIDGED DATA

Heater voltage	5·0	V
Heater current	13	A
Maximum operating frequency	150	c/s
Maximum peak inverse voltage	21	kV
Maximum average anode current	2·5	A
Maximum negative grid voltage before conduction	300	V
Maximum overall dimensions		
length	325	mm
diameter	75	mm
Weight	0·75	kg
Base	B4D (Super jumbo)	

SUB-MINIATURE VOLTAGE REFERENCE TUBE

The ZZ1000 is a new sub-miniature voltage reference tube intended for use in applications where a small physical size is an essential requirement.

At the recommended cathode current of 3mA the ZZ1000 has a stabilising voltage of 81V and an ignition voltage of 120V. Tests carried out on these tubes have shown that after 2000 hours of continuous operation at a bulb temperature of 45°C and with a cathode current of 3mA, the stabilising voltage did not change by more than 300mV. Life expectancy under these conditions is 30,000 hours.

The ZZ1000 will withstand maximum impact acceleration of 500g and a maximum vibrational acceleration, for extended periods, of 2·5g. Satisfactory operation is possible at altitudes up to 15 miles (24km) over a temperature range of −55°C to +125°C.

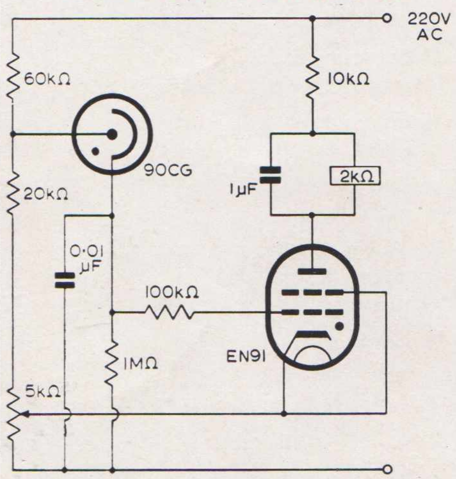
The ZZ1000 measures 300mm by 6·1mm diameter and may be soldered directly into the circuit.

MULLARD PHOTOEMISSIVE CELLS

BASIC CIRCUIT CONSIDERATIONS

Since the current drawn by the emissive photocell is very small, the output from the cell is usually taken as the voltage developed across a load resistor value of 1 to 10MΩ and used to control a valve amplifier. In most applications the load resistor is also the grid resistor of the first valve, the anode of the photocell being connected to the HT positive line or to a tap on a voltage dividing network across the HT supply. The first amplifying valve should be chosen with care since any grid current drawn by the valve will be shunting the cell, thus reducing the apparent sensitivity. The quoted maximum grid to cathode resistor for the valve should also be compatible with the value chosen for the cell load if these are to be the same resistor. The best results will be obtained by the use of an electrometer valve but satisfactory performance can be obtained by the use of an E80F operated as an electrometer valve. With $V_h=4{\cdot}5V$, $V_a=V_{g2}=75V$, $R_a=220k\Omega$, $R_{g2}=1M\Omega$. $V_a(b)=93V$ *and* $R_k=22k\Omega$, *an* $I_a=100\mu A$ *with* $V_{g1}\simeq -2{\cdot}0V$ *should be obtained. After ageing under these conditions for 20 to 30 hours the grid current should drop to rather better than* $10^{-9}A$ *permitting the use of grid to cathode resistors of up to* $10^{9}\Omega$. *This stage may then be followed by normal circuitry. A photoemissive cell may also be used to trigger a thyratron. In this application the thyratron and a vacuum photocell may be fed from AC supplies to give automatic extinction of the thyratron which is normally biased beyond the firing point.*

Thyratron Photoelectric Relay (1)

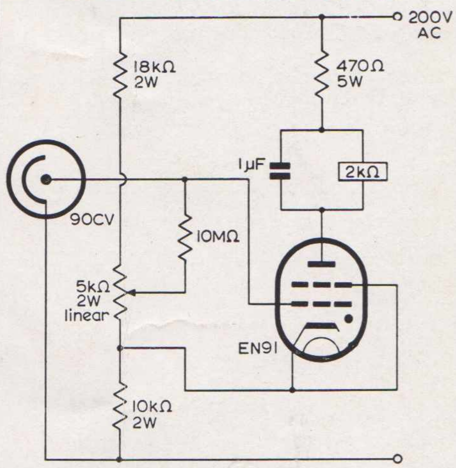


This is a simple photoelectric relay circuit. When the 90CG photocell is not illuminated, the thyratron grid holds the thyratron in non-conduction. Illumination of the 90CG causes cell current to flow, and the consequent voltage drop across the 1MΩ resistor shifts the thyratron grid voltage, initiating conduction between cathode and anode. The current in the anode circuit energises the 2kΩ relay.

The light level at which the circuit operates is determined by the setting of the 5kΩ variable resistor.

The circuit is for use on AC only.

Thyratron Photoelectric Relay (2)

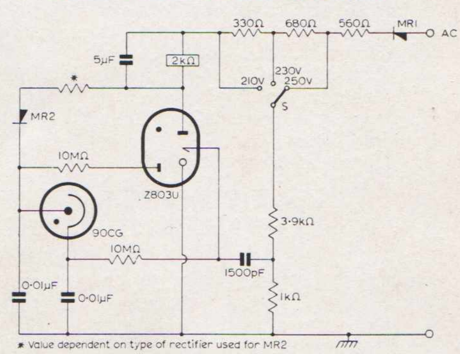


This relay system resembles the circuit for Thyratron Photoelectric Relay (1) but the thyratron is held in non-conduction while the photocell is *illuminated*. When illumination ceases, and there is no current flow through the 10MΩ resistor, the thyratron grid voltage rises to firing point.

Once again, a 5kΩ variable resistor provides adjustment to any desired light level.

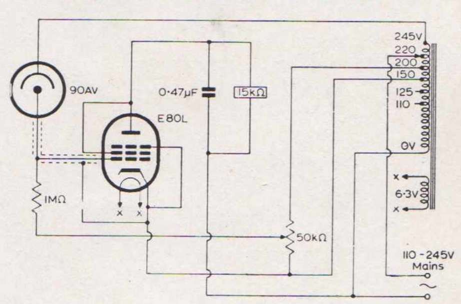
The circuit is for use on AC only.

Flame Failure Protection Circuit



Flame failure protection is provided by the operation of the Z803U cold cathode trigger tube. While the flame is present, the red-sensitive photocell maintains the Z803U in conduction, and the 2kΩ relay is held in by the half-cycles of current in the anode circuit. When the flame fails, conduction ceases and the relay falls out—giving appropriate protective action by means of auxiliary circuits.

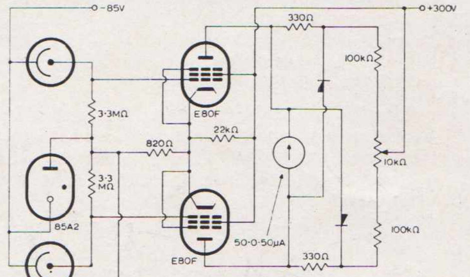
Hard-valve Photoelectric Relay



When the photocell is illuminated, the control grid of the E80L is biased beyond cut-off by the voltage across the 1MΩ resistor. When the light is interrupted, the bias is removed and the consequent flow of anode current energises the 15kΩ relay.

Adjustment of the operating point is provided by the 50kΩ variable resistor.

Colour and Brightness Comparator

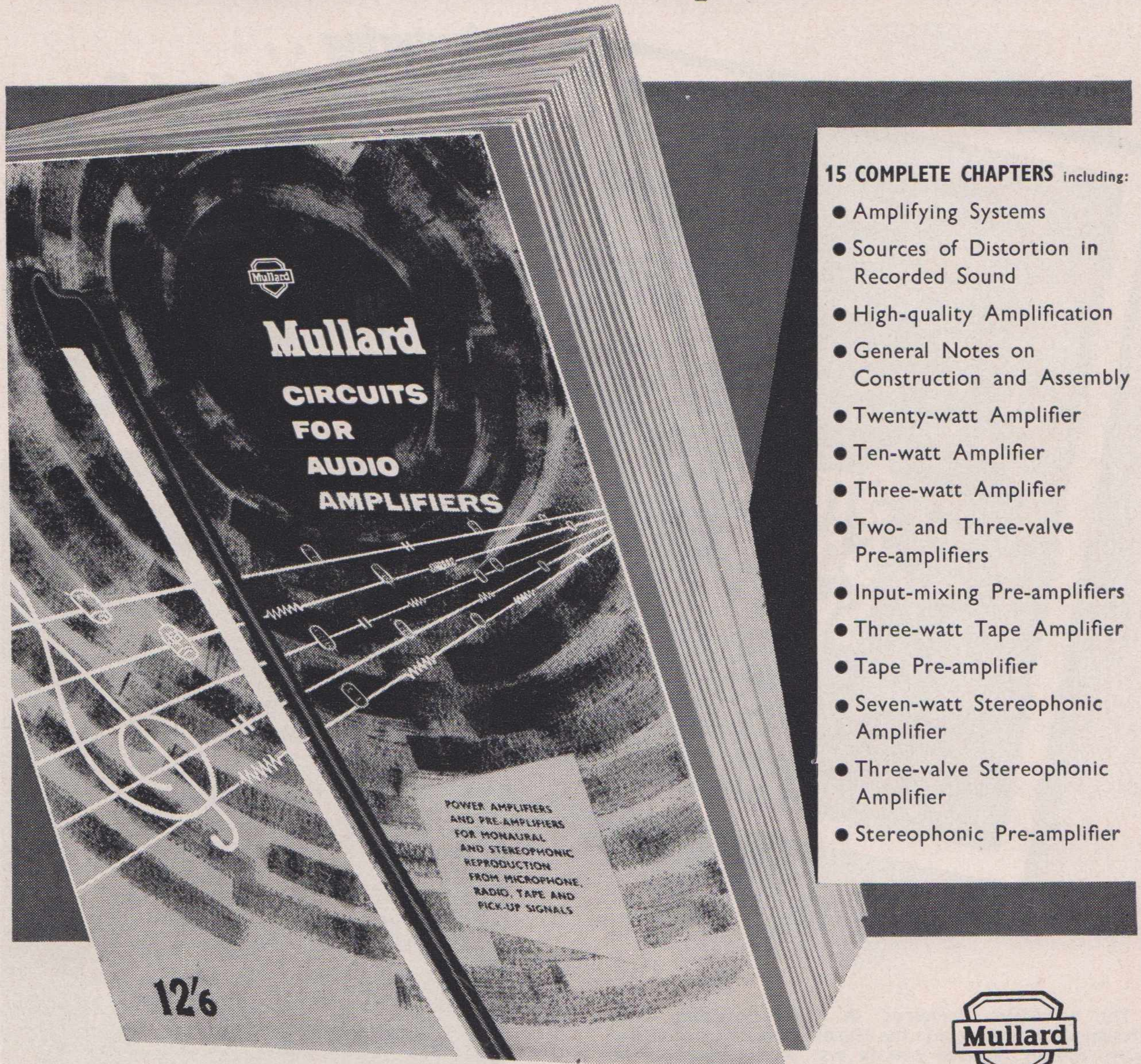


The two identical photocells are used for comparing two light sources for colour and brightness. The voltages developed by the cell currents across the 3·3MΩ resistors are fed to the grids of the E80F pentodes—which are connected as a long-tailed pair—and the unbalance of the outputs is indicated by the 50-0-50µA meter which is connected between the anodes. Two biased OA91 diodes protect the meter from damage in the event of a large disparity in the light sources.

Either red-sensitive or blue-sensitive vacuum photocells may be used, and the 90CV and 92AV are recommended.

STAR PRINTERY

Mullard Audio Amplifier Manual



15 COMPLETE CHAPTERS including:

- Amplifying Systems
- Sources of Distortion in Recorded Sound
- High-quality Amplification
- General Notes on Construction and Assembly
- Twenty-watt Amplifier
- Ten-watt Amplifier
- Three-watt Amplifier
- Two- and Three-valve Pre-amplifiers
- Input-mixing Pre-amplifiers
- Three-watt Tape Amplifier
- Tape Pre-amplifier
- Seven-watt Stereophonic Amplifier
- Three-valve Stereophonic Amplifier
- Stereophonic Pre-amplifier

Mullard

With the growing demand for high quality sound reproduction, more and more of the circuits in use today require specialised knowledge. This publication fully describes the wide range of high-quality audio amplifier circuits designed by engineers of the Mullard Developmental Laboratories in the United Kingdom.

Four introductory chapters give a full technical explanation of monaural and stereophonic sound reproduction. The rest of the book comprises circuit descriptions, constructional details and performance figures of twelve Mullard circuits. These circuits include well-known Mullard designs, some modifications and improvements to these designs and a number of completely new designs.

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Please send me .... copies of "Circuits for Audio Amplifiers"

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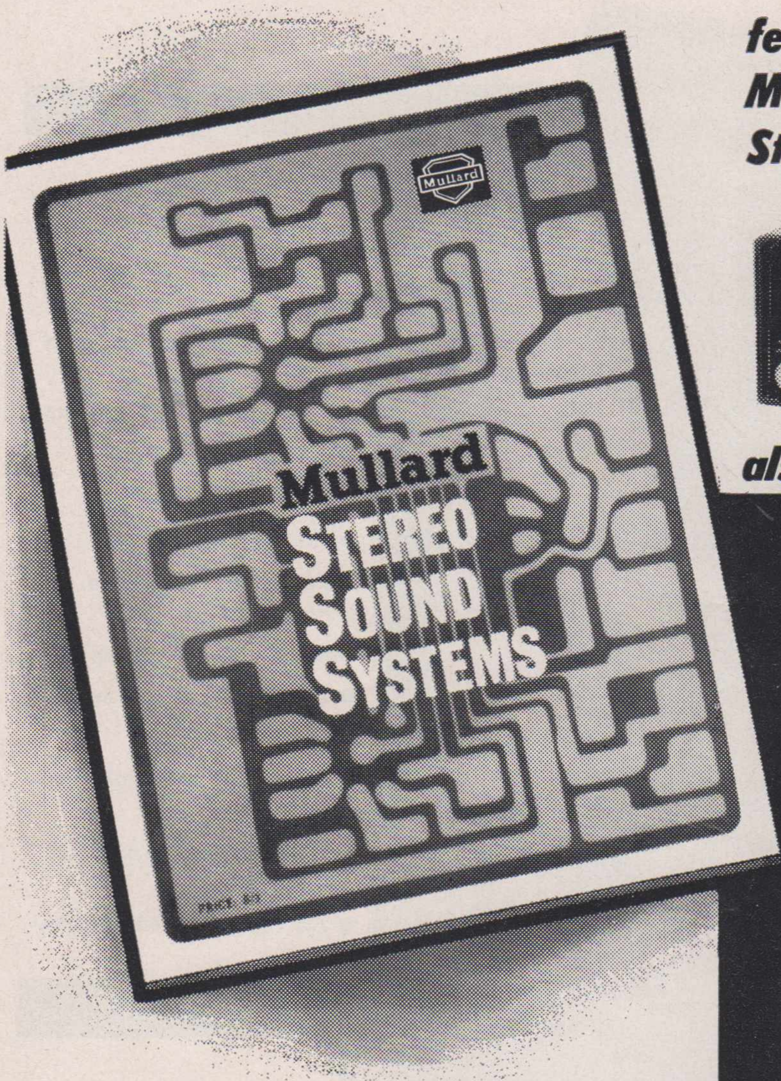
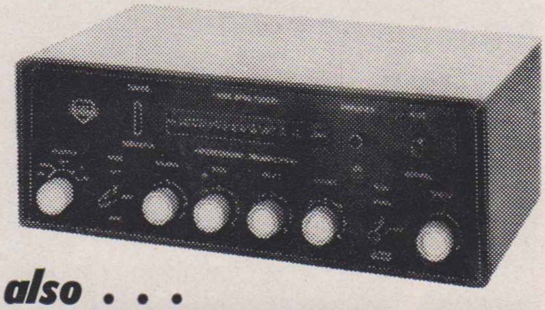
Mullard Stereo Sound Systems



featuring . . .
Mullard Wideband Tuner
Stereophonic Pre-amplifier



also . . .

- **MULLARD STEREO "TEN-TEN"**
  (with printed circuit boards)
  Two 6GW8 triode pentodes and one low-noise AF pentode type EF86 in each channel provides a power output of 10 W at a total harmonic distortion of 0.05%. The input sensitivity (for 10 W output) is 260 mV.
- **MULLARD STEREO "THREE-THREE"**
  (with printed circuit boards)
  One 6GW8 triode pentode in each channel provides 3 W of audio power with a total harmonic distortion below 4%. The input sensitivity (for 3 W output) is 500 mV.
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  3 W per channel with synchronised oscillators and with a modulation level indicator.
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  Choosing and using loudspeakers.
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The amplifiers contained in this publication were designed by engineers in the Mullard Applications Laboratory, Sydney. Printed boards are used throughout to facilitate ease of assembly with the minimum of tools. Since "lay-out" problems are non-existent, the amplifiers, the pre-amplifier and the wideband tuner may be successfully constructed by the hobbyist and professional alike, to provide a source of high quality reproduction.

This booklet may be obtained by forwarding the coupon, together with remittance, to the addresses shown.

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MULLARD PREFERRED RANGE OF TRANSISTORS FOR ENTERTAINMENT APPLICATIONS IN AUSTRALIA

The following semiconductor types are included in the Mullard preferred range in Australia and, whilst the information provided is abridged, more comprehensive design information is contained in Volume 4 of the Mullard Technical Handbook.

Other semiconductor types not tabulated are also available upon application to Mullard-Australia Pty. Ltd.

Type Number	Description and Application	$-V_{CB}$ max (V)	$-V_{CE}$ max (V)	$-V_{EB}$ max (V)	$-I_C$ max (mA)	$-I_B$ max (mA)	T_j max (°C)	P_{tot} max T_{amb} 25°C (mW)	Outlines and Dimensions
AC125	General purpose audio pre-amplifier and driver of the p-n-p alloy junction type	32	32	10	100	5	90*	500**	TO-1
AC126	High-gain audio pre-amplifier and driver of the p-n-p alloy junction type	32	32	10	100	5	90*	500**	TO-1
AC127	n-p-n/p-n-p germanium alloy junction transistors for use in complementary Class 'B' output stages	+32	+32	+10	+200	+10	90*	280**	TO-1
AC132		32	32	10	200	10	90*	500**	TO-1
AC128 **2-AC128**	High-gain germanium alloy junction transistor of the p-n-p type designed for use in Class 'B' output stages	32	32	10	1A	20	90*	550**	TO-1
AF114N	Germanium transistor of the p-n-p alloy diffused type designed for use up to 100Mc/s	32	32	—	10	1	75	50***	TO-44
AF115N	Germanium transistor of the p-n-p alloy diffused type designed for use up to 100Mc/s as mixer-oscillator and for use as RF amplifier up to 27Mc/s	32	32	—	10	1	75	50***	TO-44
AF116N	Germanium transistor of the p-n-p alloy diffused type designed for use as mixer-oscillator and RF amplifier up to 16Mc/s	32	32	—	10	1	75	50***	TO-44
AF117N	Germanium transistor of the p-n-p alloy diffused type designed for use as mixer-oscillator and RF amplifier up to 6Mc/s	32	32	—	10	1	75	50***	TO-44
OC26 **2-OC26**	Power junction transistor of the p-n-p alloy type intended for use in output stages of car radio receivers	32	32	10	3·5A	500	100*	12·5W**	TO-3
OC74N **2-OC74N**	High-gain germanium alloy junction transistor of the p-n-p type designed for use in Class 'B' output stages	20	20	6	300	—	90*	550**	TO-1

*** $T_{amb} = 45°C$

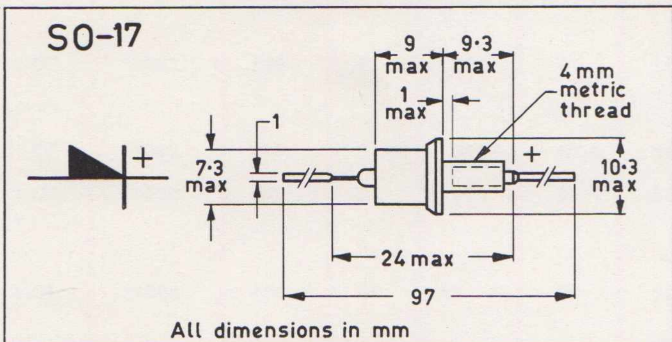
** with suitable heat sink

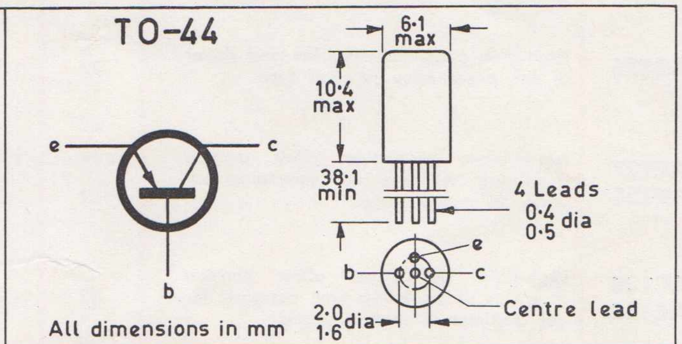
* 200 hours operation

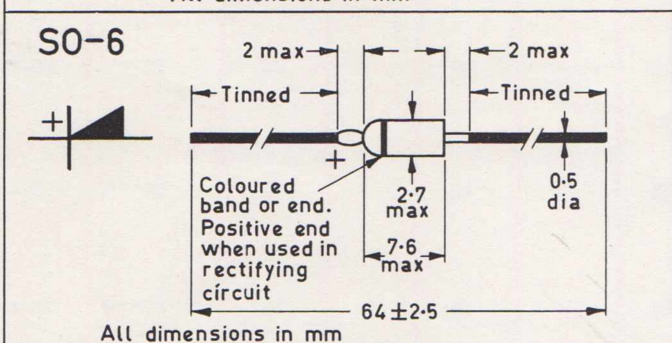
MULLARD PREFERRED RANGE OF DIODES FOR ENTERTAINMENT APPLICATIONS IN AUSTRALIA

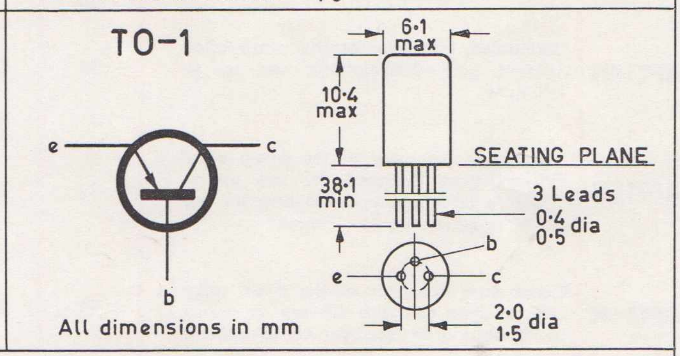
Type Number	Description and Application	Max PIV (V)	I_{FM} (mA)	$I_{F(AV)}$ (mA)	$I_{F(surge)}$ (A)	T_{amb} max (°C)	Outlines and Dimensions
AA119 **2-AA119**	AM/FM detector diode	45	100	35	0·2	60	SO-6
OA90	Sub-miniature HF detector diode	30	45	10	0·2	75	SO-6
OA91	Sub-miniature high-voltage general purpose diode	115	150	50	0·5	75	SO-6
OA95	Sub-miniature high-voltage general purpose diode	115	150	50	0·5	75	SO-6
OA210	Silicon junction power rectifier	400	5A	500	—	70	SO-17
OA211	Silicon junction power rectifier	800	4A	400	—	60	SO-17
OA675	Compensation diode for Class 'B' output stages	—	10	—	—	75	TO-1

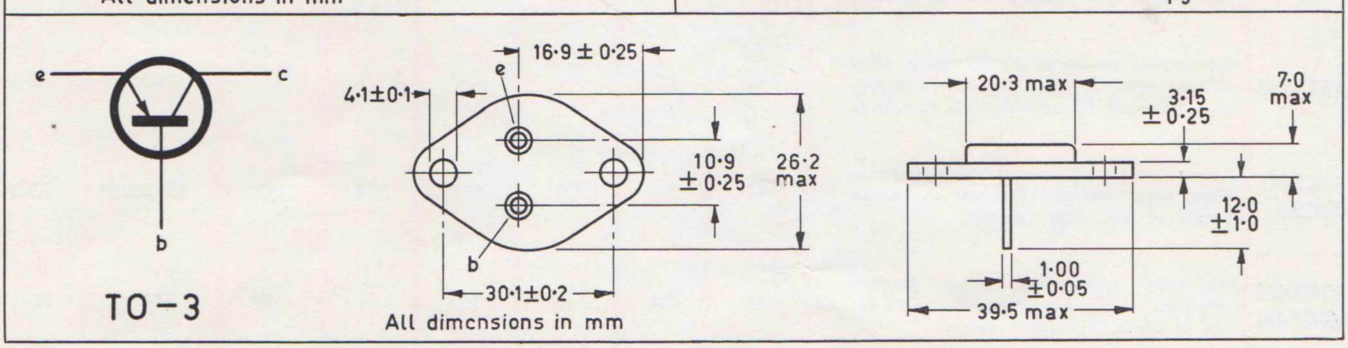
Semiconductor Outlines and Dimensions











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