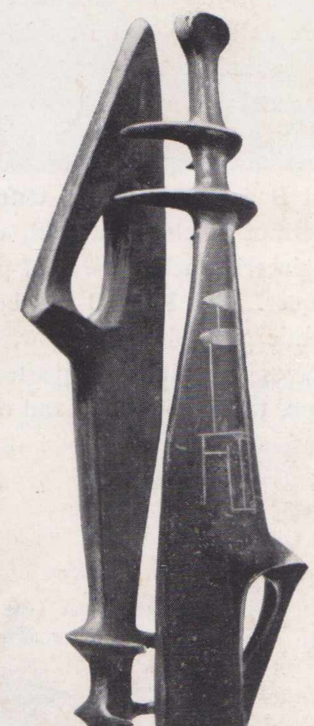
Mullard Outlook

Australian Edition



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1961

MULLARD - AUSTRALIA PTY. LTD.

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Editorial Office:
35-43 Clarence Street, Sydney.
Telephone—BX 2006.

Editor:
JOERN BORK

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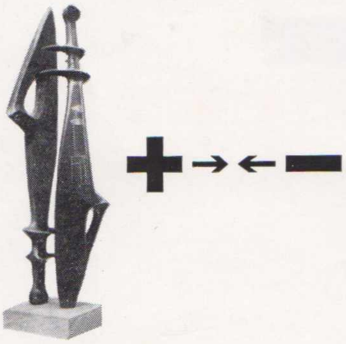


The winning design (above left) of the MULLARD SCULPTURE COMPETITION represents the well-known scientific principle that "like poles repel, unlike poles attract". In its final form, it will stand six feet high in front of the large new extension of the Mullard Research Laboratories at Salfords, England. (See also page 52.)

MULLARD-AUSTRALIA PTY. LTD.

35-43 CLARENCE STREET, SYDNEY
Phone: BX 2006

123-129 VICTORIA PDE., COLLINGWOOD, N.5
VICTORIA
Phone: 41 6644

Associated with
MULLARD LTD., LONDON.

An Orderly Pattern

After a relatively late start six years ago, Australia at last had television.

Far be it that we should dwell on the excesses and difficulties that have beset the Industry since then, but rather reflect on one steady, calculated and orderly Instrumentality responsible for the introduction, the timing and the technical standards of our TV service.

The Electronics Industry is a virile one and TV part of it, certainly competitive and somewhat unpredictable, with a wide difference of opinion between the optimists and the less so, as to the future market potential. Nevertheless, new areas, new homes, second sets, obsolescence and some existing receivers no longer worth maintaining, all lead to new business.

The Industry has risen to the occasion in supplying the receivers and the Australian Broadcasting Control Board has steadily unfolded their recommendations for an orderly pattern of development, with a thoroughness and dignity befitting the fine engineering achievement of present day TV transmitting and receiving techniques. With Phase 3 now being implemented, shortly Phase 4 and systematic gap-filling to follow, this writer feels that, except for a divergence of opinion in some quarters on such matters as FM broadcasting and so on, the deliberations and activities of the Board are apt to be overlooked.

M.A.B.

THE QUEEN HONOURS MULLARD LTD. MANAGING DIRECTOR

S. S. ERIKS, K.B.E.

The Queen has been pleased to appoint Mr. S. S. Eriks, Managing Director of Mullard Limited, an honorary Knight Commander of the Order of the British Empire in recognition of his valuable services to British official interests.

He was appointed General Manager of the Mullard Company in 1930 after periods in Australia and New Zealand, and subsequently became Managing Director.

On the outbreak of war he immediately set up production plants to assist the British war effort and Mullard, in fact, provided nearly 50% of the valves supplied to the British defence services.

The rapid post-war development of the Company under Mr. Eriks' leadership is exemplified by the many new factories built to meet the increasing demand for its products. He was responsible, too, for setting up the Mullard Research Laboratories at Salfords in Surrey immediately after the war and has made a considerable contribution to the British export drive, establishing trading companies or agencies in most of the countries of the world.

Mr. Eriks was awarded the O.B.E. in 1948 and was appointed Officer in the Order of Orange-Nassau by Queen Juliana of the Netherlands in 1953.

TV MARKET DEVELOPMENT

PROVINCIAL AND COUNTRY AREAS

When the Phase 3 stations are established, it is estimated that the population coverage with a useful TV service will be as follows:—

New South Wales (including Australian Capital Territory)	79%
Victoria	92%
Queensland	72%
South Australia	77%
Western Australia	63%
Tasmania	94%
Commonwealth	81%

DWELLINGS

At July, 1961, the total number of dwellings within the Phase 1, 2 and 3 service areas was approximately 2,300,000, with an annual rate of increase from 2 to 2½%.

Most retailers in the areas covered by Phase 3 stations already have an approximation of the number of dwellings, in the main gleaned from their local Shire Council statistics, the area population related to the number of persons per home and estimates from the TV receiver manufacturers from whom they have a franchise.

Where there is already some degree of saturation and they themselves have supplied many of these receivers, their local knowledge and anticipated coverage of the local station related to the number of dwellings is somewhat confusing. For example, retailers in Wollongong and similar areas are perplexed as to where the theoretical coverage from Sydney ceases and Wollongong commences, and on this score an accurate estimate of the number of dwellings is difficult.

Therefore, to arrive at a rate of sale figure, we have taken as examples the completely new areas where there are no receivers, or very few, at this time. Nevertheless, we believe the same rate will apply for the remainder of homes where relatively high levels of saturation already exist.

Number of dwellings in useful service area:—

Central Tablelands of N.S.W.	60,000
Canberra	33,000
Richmond-Tweed	33,000
Rockhampton	22,000
Townsville	22,000

DEVELOPMENT RATE

We estimate that the penetration at the end of the first year of station operation will be well in excess of 50%.

This assumption is based on:—

1. The increased penetration rate of each Australian capital city where the last to be covered by TV, Hobart, had a saturation in the first year of 40% (due allowance being made for the more buoyant economic conditions and triggered by a winter selling season).
2. The greater urge for TV in isolated areas—Canberra included. It is probable Canberra might have the highest penetration rate and, we feel, might reach 65% within the first year.

continued on page 52

TV MARKET DEVELOPMENT
— continued

3. Price factors. A sampling of potential set owners in new areas has revealed the influence of constant national press TV price encounters and an awareness that today's receivers are superior in performance, appearance and reliability, relative to the early counterparts and above all, 35% lower in price—in short, less hesitancy.
4. The self-evident selling motive for manufacturers to find a home for their sets and maintain production at an economic level.
5. Factors relating to better fringe performance (more efficient aerials, tuners, improved noise immunity and so on).
6. That similar provincial cities in the United States achieved a penetration of 55% in the first six months and 70% within a year! In this regard, our friends across the Pacific must have done some hard selling.

OPPORTUNITIES

In Australia for many years, TV was "just around the corner". When it did arrive there was an abundance of everything — manufacturers, receivers, ancillary components, retailers and service.

Whether it be hard selling or otherwise, or the loyalty of country folk to their local retailers, there is once more opportunity abounding, more so where half the market potential is catered for in the first twelve months and each retailer is able to cope with his share. The well prepared will benefit, particularly those providing service and installation facilities, for experience has shown where retailers have identified themselves with a new product in the first wave of popularity and have conscientiously followed this up with after-sales service, they have established a firm base for future trading, when the rate of sale is lower and the householders' available funds can be channelled to other appliances—in the long run profits also from an efficient service department.

TV RECEIVER USEFUL LIFE

This is extremely difficult to assess and can be related in some measure to the useful life of the picture tube and with TV receivers equipped with Mullard Radiant Screen Long Life picture tubes, the tubes will probably outlive the sets. However, it is a little early to make any real assessment and if considering technical factors alone, without the viewer tiring of the particular cabinet style, it could be eight or nine years, unless of course some entirely new development may cause premature obsolescence.

Every reason then to go all out for initial business whilst it is there and plan for the second set and replacement set market by winning customer confidence and goodwill with the first sale.

RECEIVER AVAILABILITY

The Australian industry has production capacity in excess of 500,000 TV receivers per annum. In August 1960, it produced 50,089 receivers and for the twelve months ended 30th September, 1960, production was 451,800 and for the twelve months ended 30th September, 1961, 245,000. It is anticipated this rate will continue until 1965 and then progressively increase to 350,000 in 1970 at which time 200,000 receivers might be absorbed by the replacement market.

REPLACEMENT MARKET

These figures are not particularly impressive, nor for that matter enterprising, but we believe are factual, unless in the meantime we as an industry by positive measures can encourage an earlier obsolescence and a second set potential. There are many Australian homes with antiquated AM radio receivers, some even of pre-war vintage, yet the motor cars of these households are regularly replaced, likewise ladies' fashions lasting but one season at the most. Technological progress is a good old standby but something more is required to push our industry along in the conditioning of householders to second sets and earlier replacement of their existing sets, for example, linked in some measure to trade-ins and the doubtful economy of retaining their old receivers and paying higher annual service contract fees.

OUTLOOK SUBSCRIPTION

The ever-increasing requests to be placed on the distribution list for Outlook have been most heartening and encouraging to those responsible for its preparation. However, in view of the quantities now involved and anticipated in the future, we have decided to limit free distribution to key personnel within the companies, large and small, in this Industry, Government Departments, training establishments and technical libraries.

Where members, experimenters or enthusiasts require personal copies, as from Vol. 5, No. 1, January-February 1962, there will be a small charge of 12/- per annum, post free.

To ensure delivery of your copies for 1962, please complete the card enclosed with this issue and mail today.

SCHOOL MEMORIES WIN HIM £500

At a press conference in Mullard House recently Sir Kenneth Clark announced the result of the Mullard Sculpture Competition, organised to obtain a design symbolising the work of the Research Laboratories at Salfords.

The winner, 45 year old Nottinghamshire-born artist, Keith Godwin, lives and works in London and his design, pictured on the cover of this issue, represents the well-known scientific principle that 'like poles repel, unlike poles attract'. (Remember those classroom experiments with magnets?) Thanking the Company and the judges, Keith Godwin said that the competition had been a stiff challenge. Like all the competitors he'd had the chance to visit Salfords to see the kind of work that went on there. "But," he confessed, "it was all so much above my head that I went back to dimly remembered schooldays for my inspiration".

In its final form the design will stand 6′ high in front of the Laboratories' big new extensions and will be cast in ciment fondu, overlaid with polished Genoa green marble.

Congratulating the Company on its enterprise, Sir Kenneth Clark said that the artist must look increasingly to industry for the patronage once supplied by wealthy individuals. While some artists preferred to express their own ideas, most welcomed the growing interest shown by large commercial firms like Mullard.

Three other distinguished art authorities helped Sir Kenneth judge the competition; Sir Hugh Casson, who was Director of Architecture to the Festival of Britain; Royal Academician, James Fitton; and Sir Gordon Russell, for many years Director of the Council of Industrial Design.

QUICK-HEATING TRANSMITTING VALVES

FOR MOBILE EQUIPMENT

The power demands of mobile transceivers have been reduced in recent years by transistorisation of the receiver and (in part) of the transmitter—and by the use of transistor DC converters for the HT supply. A further substantial reduction is achieved if the heaters of the transmitting valves are switched off during standby. This is not possible with conventional valves which have a considerable heating time; but the introduction of quick-heating valves, which are ready for operation within less than a second from cold, solves the problem. It also brings the incidental advantages of reduced temperature in the equipment and the elimination of the growth of cathode interface which can occur when valves are operated under standby conditions with their heaters on but with no anode current flowing.

Abridged Advance Data

	QZ06-20	QQZ03-10	QQZ03-20	QQZ06-40	
V_h	1·6	3·15	1·5	2·3	V
I_h	3·2	1·65	4·5	4·5	A
t_h max (70% P_{out})	1	1	1	1	s
Characteristics (each section)					
I_a	100	30	20	30	mA
g_m	7·0	3·0	2·5	4·5	mA/V
μ_{g1-g2}	4·5	7·5	8·0	8·0	
Class 'C' telegraphy or F.M. telephony (intermittent mobile service)					
Limiting Values (absolute ratings)					
f_{max}	175	200	500	500	Mc/s
V_a max	400	300	450	500	V
p_a max	25	2×7·0	2×10	2×20	W
V_{g2} max	200	200	300	300	V
p_{g2} max	5·0	2×0·5	2×1·5	2×3·5	W
p_{g1} max	—	2×0·2	2×0·5	2×1·0	W
I_{g1} max	5·0	2×4·0	2×2·5	2×5·0	mA
I_k max	170	2×65	2×60	2×120	mA
$i_{k(pk)}$ max	850	2×300	2×280	2×700	mA
V_{g1} max	150	150	75	100	V
Typical Operating Conditions					
f	60	200	200	200	Mc/s
V_a	600	250	600	600	V
V_{g2}	180	250	250	250	V
V_{g1}	−71	−40	−60	−80	V
I_a	150	2×45	2×50	2×100	mA
I_{g2}	15	2×2·1	2×6·0	2×9·0	mA
I_{g1}	2·8	2×1·5	2×1·5	2×3·5	mA
P_{load} (driver)	0·6	1·0	1·5	4·0	W
p_a	24	2×4·5	2×7·5	2×17·5	W
P_{out}	66	14	45	85	W
η_a	73	62	75	71	%
P_{load}	53	11	35	75	W
$\eta_{transfer}$	81	80	77	88	%
Mechanical					
Max overall length	96	78·5	86	104·5	mm
Max seated height	82·5	71·5	73·5	92·5	mm
Max diameter	39·5	22·2	46	46	mm
Base	Octal	B9A	B7A	B7A	

NEW TYPES OF CATHODE

Two methods of achieving a quick-heating directly-heated cathode have been developed. In the first, the cathode consists of a short coated ribbon with a large cross-section operating at a low voltage. In the second method a number of thin oxide-coated wires are connected in parallel, the operating voltage again being low. These techniques enable heating times of less than a second to be achieved, with no loss of the high efficiency of the valves at VHF.

Low voltage AC operation reduces the disadvantage of having a considerable DC potential difference between the two ends of a directly-heated cathode. The physical shortness of the structure contributes to a reduction in microphony, a lower risk of grid-cathode shorts, and greater robustness—features which are essential in mobile equipment.

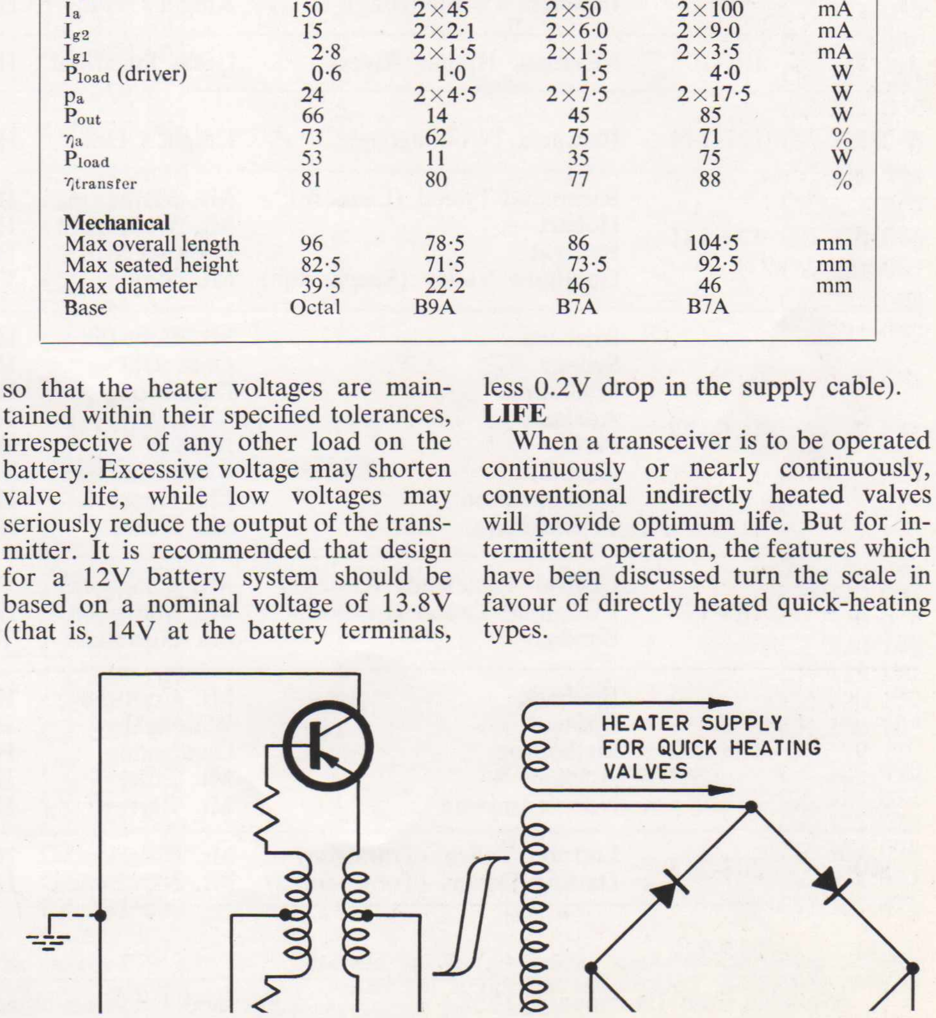
Since the cathodes of these types require a supply voltage of about 3V, or less, direct operation from a 6V or 12V battery is undesirable. Series connection is ruled out, since the transmitter may not have enough valves to make up the total battery voltage. A dropping resistance is wasteful, and it increases the cathode heating time. Instead, a transistorised inverter can be used to provide an AC supply at the correct low voltage. In practice, a low voltage square wave supply is taken from an additional output winding on the DC converter of the transmitter.

HEATER SUPPLY

The heater supply circuit for these quick-heating valves must be designed so that the heater voltages are maintained within their specified tolerances, irrespective of any other load on the battery. Excessive voltage may shorten valve life, while low voltages may seriously reduce the output of the transmitter. It is recommended that design for a 12V battery system should be based on a nominal voltage of 13.8V (that is, 14V at the battery terminals, less 0.2V drop in the supply cable).

LIFE

When a transceiver is to be operated continuously or nearly continuously, conventional indirectly heated valves will provide optimum life. But for intermittent operation, the features which have been discussed turn the scale in favour of directly heated quick-heating types.



Partial Circuit showing separate heater winding on DC-DC Converter transformer.

Mullard

AUSTRALIAN TV CHANNELS—1961

Channel Number	Frequency Mc/s	Transmitting Area	Transmitting Site	Aerial Polarisation	National	Commercial
* † 0	45-52	—	—	—	—	—
* † 1	56-63	Bendigo	Mt. Alexander	Vertical	ABCV 1	—
		Central Tablelands (Orange)	Mt. Canobolas	Vertical	ABCN 1	—
2	63-70	Brisbane	Mt. Coot-tha	Horizontal	ABQ 2	—
		Sydney	Gore Hill	Horizontal	ABN 2	—
		Melbourne	Dandenong	Horizontal	ABV 2	—
		Adelaide	Mt. Lofty	Horizontal	ABS 2	—
		Perth	Bickley	Horizontal	ABW 2	—
		Hobart	Mt. Wellington	Horizontal	ABT 2	—
3	85-92	Canberra	Black Mountain	Vertical	ABC 3	—
		Ballarat	Lookout Hill	Horizontal	ABRV 3	—
		Goulburn Valley (Shepparton)	Mt. Major	Vertical	ABGV 3	—
		Darling Downs (Toowoomba)	Mt. Mowbullan	Horizontal	ABDQ 3	—
		Rockhampton	Mt. Hopeful	Horizontal	ABRQ 3	—
		Townsville	Mt. Stuart	Horizontal	ABTQ 3	—
		N.E. Tasmania	Mt. Barrow	Horizontal	ABNT 3	—
		Newcastle	Great Sugarloaf	Horizontal		NBN 3
† 4	94-101	Latrobe Valley (Traralgon)	Mt. Tassie	Horizontal	ABLV 4	
		Illawarra (Wollongong)	Knight's Hill	Horizontal	—	WIN 4
† 5	101-108	Newcastle-Hunter River	Great Sugarloaf	Horizontal	ABHN 5	—
* † 5A	137-144	Illawarra (Wollongong)	Knight's Hill	Horizontal	ABWN 5A	—
6	174-181	Richmond-Tweed (Lismore)	Mt. Matheson	Horizontal	ABRN 6	—
		Hobart	Mt. Wellington	Horizontal	—	TVT 6
		Ballarat	Lookout Hill	Horizontal	—	BTV 6
		Goulburn Valley (Shepparton)	Mt. Major	Vertical	—	GMV 6
7	181-188	Brisbane	Mt. Coot-tha	Horizontal	—	BTQ 7
		Sydney	Gore Hill	Horizontal	—	ATN 7
		Melbourne	Dandenong	Horizontal	—	HSV 7
		Adelaide	Mt. Lofty	Horizontal	—	ADS 7
		Perth	Bickley	Horizontal	—	TVW 7
		Canberra	Black Mountain	Vertical	—	CTC 7
		Rockhampton	Mt. Hopeful	Horizontal	—	RTQ 7
		Townsville	Mt. Stuart	Horizontal	—	TNQ 7
8	188-195	Central Tablelands (Orange)	Mt. Canobolas	Vertical	—	CBN 8
		Richmond-Tweed (Lismore)	Mt. Matheson	Horizontal	—	RTN 8
		Bendigo	Mt. Alexander	Vertical	—	BCV 8
9	195-202	Brisbane	Mt. Coot-tha	Horizontal	—	QTQ 9
		Sydney	Willoughby	Horizontal	—	TCN 9
		Melbourne	Dandenong	Horizontal	—	GTV 9
		Adelaide	Mt. Lofty	Horizontal	—	NWS 9
		N.E. Tasmania	Mt. Barrow	Horizontal	—	TNT 9
10	208-215	Latrobe Valley (Traralgon)	Mt. Tassie	Horizontal	—	GLV 10
		Darling Downs (Toowoomba)	Mt. Mowbullan	Horizontal	—	DDQ 10
* † 11	215-222	—	—	—	—	—

* Available from 1st January, 1962. † For modified turret tuner biscuits, see page 55.

Channel Numbers listed are in accordance with the recommendations of the Australian Broadcasting Control Board.

TELEVISION TURRET TUNERS

BISCUIT ASSEMBLY PART NUMBERS

Model AT7580 Biscuits

Channel Number	Description	Type Number
2	Aerial	A3 747 08
3	,,	A3 747 09
6	,,	A3 746 75
7	,,	A3 746 76
8	,,	A3 746 77
9	,,	A3 746 78
10	,,	A3 746 79
2	RF and Oscillator	A3 747 03
3	,, ,, ,,	A3 747 04
6	,, ,, ,,	A3 746 70
7	,, ,, ,,	A3 746 71
8	,, ,, ,,	A3 746 72
9	,, ,, ,,	A3 746 73
10	,, ,, ,,	A3 746 74

Model NT3001/01 Biscuits

Channel Number	Description	Type Number
2	Aerial	CZ 320 058
3	,,	CZ 320 059
6	,,	CZ 320 062
7	,,	CZ 320 063
8	,,	CZ 320 064
9	,,	CZ 320 065
10	,,	CZ 320 066
2	RF and Oscillator	CZ 321 038
3	,, ,, ,,	CZ 321 039
6	,, ,, ,,	CZ 321 042
7	,, ,, ,,	CZ 321 043
8	,, ,, ,,	CZ 321 044
9	,, ,, ,,	CZ 321 045
10	,, ,, ,,	CZ 321 046

Model NT3006 Biscuits

Channel Number	Description	Type Number
0	Aerial	CZ 320 084
1	,,	CZ 320 085
2	,,	CZ 320 086
3	,,	CZ 320 087
4	,,	CZ 320 088
5	,,	CZ 320 089
5A	,,	CZ 320 090
6	,,	CZ 320 091
7	,,	CZ 320 092
8	,,	CZ 320 093
9	,,	CZ 320 094
10	,,	CZ 320 095
11	,,	CZ 320 096
0	RF and Oscillator	CZ 321 057
1	,, ,, ,,	CZ 321 058
2	,, ,, ,,	CZ 321 059
3	,, ,, ,,	CZ 321 060
4	,, ,, ,,	CZ 321 061
5	,, ,, ,,	CZ 321 062
5A	,, ,, ,,	CZ 321 063
6	,, ,, ,,	CZ 321 064
7	,, ,, ,,	CZ 321 065
8	,, ,, ,,	CZ 321 066
9	,, ,, ,,	CZ 321 067
10	,, ,, ,,	CZ 321 068
11	,, ,, ,,	CZ 321 069

MODIFIED BISCUITS (NEW FREQUENCIES)

Model AT7580 Biscuits

Channel Number	Description	Type Number
0	Aerial	CZ 320 104
1	,,	CZ 320 105
4	,,	CZ 320 106
5	,,	CZ 320 107
5A	,,	CZ 320 108
11	,,	CZ 320 109
0	RF and Oscillator	CZ 321 078
1	,, ,, ,,	CZ 321 079
4	,, ,, ,,	CZ 321 080
5	,, ,, ,,	CZ 321 081
5A	,, ,, ,,	CZ 321 082
11	,, ,, ,,	CZ 321 083

Model NT3001 Biscuits

Channel Number	Description	Type Number
0	Aerial	CZ 320 097
1	,,	CZ 320 098
4	,,	CZ 320 100
5	,,	CZ 320 101
5A	,,	CZ 320 102
11	,,	CZ 320 103
0	RF and Oscillator	CZ 321 070
1	,, ,, ,,	CZ 321 071
4	,, ,, ,,	CZ 321 073
5	,, ,, ,,	CZ 321 074
5A	,, ,, ,,	CZ 321 075
11	,, ,, ,,	CZ 321 076

Modified biscuits for Tuner AT7580 may be identified by a red paint marking on the end of the coil former. The addition of the suffix "M" following the channel number identifies the modified biscuits for the Tuner NT3001.

Modified biscuits are readily available and, when ordering biscuit assemblies, servicemen and retailers should take care to quote the correct part numbers.

6GV8/ECL85 A NEW TRIODE VERTICAL OUTPUT PENTODE

INTRODUCTION

The 6GV8 is a combined triode and power pentode designed for use in vertical oscillator and vertical output circuits of television receivers employing picture tubes with deflection angles of 110°/114°. The main requirement of a vertical output valve is that it should provide a high peak current at a low anode voltage, i.e. have a good "knee" characteristic. Compared with the 6BM8/ECL82 this new valve has a 50% higher peak current rating. At $V_{g2} = 170V$, $V_a = 50V$, the 6GV8 is capable of a peak current of 200mA compared with 135mA for the 6BM8.

THE SCREEN GRID

In the past the screen grid dissipation has often imposed a limit on the peak current available from the vertical output valve. As the valve is driven into the knee region the screen grid current rises, and with it the dissipation. A screen grid resistor was incorporated in the circuit to keep the valve within its screen grid dissipation limit, but this meant a drop in the screen grid voltage and a consequent reduction in the peak anode current that could be realised.

To avoid this limitation the screen grid and control grid of the 6GV8 have been optically aligned, so that the turns of the screen grid are in the "shadow" of the control grid wires when viewed from the cathode. By this method a considerable reduction in screen grid current (and hence dissipation) can be obtained. The I_a/I_{g2} ratio above the knee is 15:1 and in the knee region itself, 5.7:1. Similar figures for the 6BM8 are 4.5:1 above the knee, and 3:1 in the knee region.

The maximum screen grid dissipation is 2W, and this rating together with the reduced screen grid current means that the valve can be used without a screen grid resistor with HT lines up to 230V.

ANODE DISSIPATION

The increase in peak current has necessitated a higher anode dissipation than the 5W of the 6BM8, for frame output service. The 6GV8 is therefore rated at 7W.

ECONOMIES IN COMPONENTS

Although it is possible to design a vertical timebase circuit for 110°/114° deflection using the 6BM8, this necessitates the use of a fairly bulky and expensive transformer. By using the 6GV8, with its higher peak current rating, the size of the transformer "stack" can be considerably reduced, with a consequent reduction in cost.

This is particularly important in stabilised timebases, where the larger standing current required makes the transformer design more difficult.

TRIODE SECTION

The triode of the 6GV8 has been designed so that it can be used as a blocking oscillator or as a feedback amplifier. The first of these applications calls for a valve of medium μ, high g_m and high anode current at $V_g=0V$. When used as a feedback amplifier a moderately high amplification is required.

A triode with a μ of 50 and a gm of 5.5mA/V has therefore been incorporated. The anode current at $V_g=0V$ and $V_a=100V$ is 10mA.

TAPE RECORDER BIAS OSCILLATOR

Readers may be interested to learn that a new bias oscillator inductor design based on the Vinkor Ferroxcube assembly type LA2304, has now been released for the Mullard Tape Preamplifier (as described in the publication* "Circuits for Audio Amplifiers", Chapter 12). Coil former type DT2010 is used in this application and L1, the primary winding, consists of 107 turns tapped at 43¾, 53½ and 63½ turns. The secondary consists of 134¾ turns tapped at 13½ and 89¼ turns and the wire in both cases is 9/46 SWG ESS (Self-fluxing F).

**Available from Mullard Offices and Distributors throughout the Commonwealth, price 12/6 plus 1/5 postage.*

TRIODE PENTODE — 6GV8

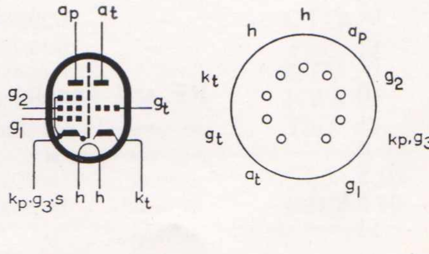
PRELIMINARY DATA

HEATER				
I_h			900	mA
V_h			6·3	V
CAPACITANCES				
c_{ap-gt}			<40	mpF
c_{at-g1}			<80	mpF
c_{gt-g1}			<30	mpF
c_{at-ap}			130	mpF
Pentode section				
c_{in}			12.5	pF
c_{out}			9.0	pF
c_{a-g1}			450	mpF
c_{g1-h}			<200	mpF
Triode section				
c_{a-k+h}			350	mpF
c_{g-k+h}			2.8	pF
c_{a-g}			1.9	pF
c_{g-h}			<140	mpF
CHARACTERISTICS				
Pentode section				
V_a	50	65	170	V
V_{g2}	170	210	170	V
I_a	200	285	41	mA
I_{g2}	35	45	2.7	mA
V_{g1}	−1.0	−1.0	−15	V
g_m	—	—	7.25	mA/V
μ_{g1-g2}	—	—	7.0	
r_a	—	—	25	kΩ
Triode section				
V_a			100	V
I_a			10	mA
V_g			0	V
g_m			5.5	mA/V
μ			50	
r_a			9	kΩ
LIMITING VALUES				
Pentode section				
$V_{a(b)\ max.}$			550	V
$V_{a\ max.}$			250	V
* $+V_{a(pk)\ max.}$			2.0	kV
$p_{a\ max.}$			7.0	W
$V_{g2(b)\ max.}$			550	V
$V_{g2\ max.}$			250	V
$p_{g2\ max.}$			2.0	W
$I_{k\ max.}$			75	mA
$R_{g1-k\ max.}$			1.0	MΩ
$V_{h-k\ max.}$			220	V
$R_{h-k\ max.}$			20	kΩ

* Max. pulse duration 7% of one cycle with a maximum of 1.4 ms.

Triode section				
$V_{a(b)\ max.}$			550	V
$V_{a\ max.}$			250	V
$p_{a\ max.}$			500	mW
$I_{k\ max.}$			15	mA
* $i_{k(pk)\ max.}$			200	mA
$R_{g-k\ max.}$			1.0	MΩ
$V_{h-k\ max.}$			220	V
$R_{h-k\ max.}$			20	kΩ

* Max. pulse duration=200μs.



B9A BASE

For outlines and dimensions *see P. 58*

6GW8/ECL86 A NEW AF TRIODE AND OUTPUT PENTODE

INTRODUCTION

The 6BM8/ECL82 has been included in the Mullard "World Series of Audio Valves" for many years. It was popular with designers of audio equipment as it combined a 7W output pentode and a high-mu triode within the same envelope. The valve was intended for two applications;

(a) as an audio amplifier and output valve,

(b) as a vertical oscillator and vertical output valve in television receivers.

The requirement that the valve should be suitable for both these applications meant that in some respects its design was a compromise, and the resultant characteristics as an audio valve were not optimum.

The 6GW8 is a triode-pentode intended for audio applications only. It has therefore been possible to make a valve which has a greatly improved audio performance as compared with the ECL82.

SENSITIVITY

Reference to the published data for the 6BM8 shows that for full output, the required input to the pentode grid is 6·6V r.m.s. The triode has an amplification factor of 70, which means that in a typical circuit a voltage gain of 50 can be realised. An input voltage of 132mV is therefore necessary at the triode grid to drive the output valve to full output.

The above figures take no account of negative feedback. In the design of the 6GW8, a much higher sensitivity was aimed for, in order to allow for the use of negative feedback. The triode input voltage required to drive the pentode section to full output with the 6GW8 is 44mV.

PENTODE SECTION

The anode dissipation of the 6BM8 pentode (for audio service) is 7W, which limits the audio output available from a single valve to about 3W.

The 6GW8 pentode is rated at 9W, which permits an output of 4W to be obtained.

The increase in overall gain of the valve has been achieved partly by an increased amplification factor in the triode, and partly by an increased slope in the pentode. The 6BM8 pentode has a slope of 6.4mA/V at an anode current of 35mA. By reducing the control grid to cathode spacing the slope can be increased, keeping the cathode area and anode current constant. If the spacing is reduced too far however, the tail of the I_a/V_{g1} characteristic becomes curved. The curvature can be reduced by reducing the pitch of the grid, but there are practical limits to this. A useful improvement in slope can be obtained, however, and the mutual conductance of the 6GW8 pentode is 10mA/V (I_a=36mA).

TRIODE SECTION

The triode section does not present the same problems as the pentode, and a triode having similar characteristics to one half of the well-known 12AX7/ECC83 has been employed.

This triode has an amplification factor of 100, which allows voltage gains of up to 70 times to be obtained in practical circuits. The triode structure is much shorter than the pentode and is supported by a balcony mica. This results in a very robust triode section, with good microphony characteristics.

CROSS COUPLING

The short triode structure helps to reduce the capacitances between the sections, which could be troublesome in a high-gain double valve of this type. It is particularly important that the capacitance between the output electrode (pentode anode) and input electrode (triode grid) is kept low. This constitutes a positive feedback path, and instability can result if the capacitance between these two points is too high.

By means of screening within the valve this capacitance has been kept below 10mpF. It can be further reduced, to about 6mpF, by the use of a skirted valve holder.

Particular care has also been taken in the design of this valve to minimize the possibility of leakage paths across the micas. Even a small leakage from the output electrode to the input electrode could cause instability in a valve having such a high overall gain. In order to ensure stability in an amplifier the effective impedance in the triode grid circuit should not exceed 250kΩ.

HUM AND MICROPHONY

Special care has been taken in the design of this valve to keep the hum and microphony to a minimum. The photograph clearly shows the U-shaped channel shielding the triode grid lead. The maximum hum level referred to the triode grid is 4μV. In order to obtain the lowest hum level when using the valve, pin 4 should be earthed.

The valve may be used without special precautions against microphony in equipment where the input voltage is not less than 5mV for an output of 50mW.

APPLICATIONS OF THE 6GW8

The 6GW8 is particularly suitable for use in stereo amplifiers. A low sensitivity stereo pick-up gives an output of approximately 70mV which is substantially more than the valve requires to give full output, and thus permits the use of negative feedback. It would of course be possible to design a two valve stereo amplifier using a double triode and a double pentode. It would not be possible however with such an arrangement to obtain such a high output on each channel with a double-pentode in noval construction, since the size of the noval bulb limits the total dissipation. For this reason, triode pentodes are considered preferable.

Using a simple arrangement with one 6GW8 per channel, Mullard engineers have designed a circuit similar to the 6BM8 stereo amplifier published previously.* This gives a power output of 3W per channel (compared with 2W) with a total harmonic distortion of 1.5% (compared with 5%).

A new 10W amplifier has also been designed.† This employs two 6GW8 and one-half of a 12AX7 per channel. The performance is superior to the 7W (6BM8) amplifier published previously and compares very favourably with the Mullard 5-10 High Quality amplifier circuit. The performance figures for the three circuits are tabulated on page 58:—

* "Circuits for Audio Amplifiers," Chapter 14.

† Due to be released early in 1962.

6GW8/ECL86 *—continued*

	6BM8 circuit	6GW8 circuit	5-10 circuit	
Power output	7	10	10	W
Harmonic distortion	<0.5	0.2	<0.3	%
Intermodulation distortion	<1.5	0.5	<1.0	%
Frequency response (3dB points)	15c/s to 20kc/s	7c/s to 30kc/s	3 c/s to 40kc/s	
Sensitivity	100	350	600	mV

TRIODE PENTODE 6GW8
ADVANCE DATA

HEATER

V_h	6.3	V
I_h	700	mA

CHARACTERISTICS

Pentode section

V_a	250	V
V_{g2}	250	V
V_{g1}	—7.0	V
I_a	36	mA
I_{g2}	6.0	mA
g_m	10	mA/V
r_a	48	kΩ
μ_{g1-g2}	21	

Triode section

V_a	250	V
V_g	—1.9	V
I_a	1.2	mA
g_m	1.6	mA/V
μ	100	
r_a	62	kΩ

LIMITING VALUES

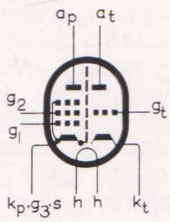
Pentode section

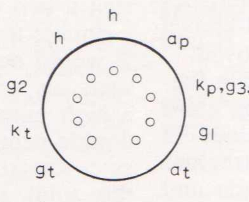
$V_{a(b)\ max.}$	550	V
$V_{a\ max.}$	300	V
$p_{a\ max.}$	9.0	W
$V_{g2(b)\ max.}$	550	V
$V_{g2\ max.}$	300	V
$p_{g2\ max.}$	1.5	W
$I_{k\ max.}$	55	mA
$R_{g1-k\ max.}$	1.0	MΩ
$V_{h-k\ max.}$	100	V
$R_{h-k\ max.}$	20	kΩ

Triode section

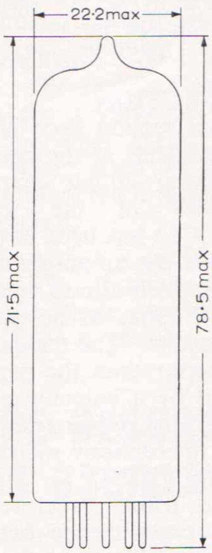
$V_{a(b)\ max.}$	550	V
$V_{a\ max.}$	300	V
$p_{a\ max.}$	500	mW
$I_{k\ max.}$	4.0	mA
$R_{g-k\ max.}$	1.0	MΩ
$V_{h-k\ max.}$	100	V
* $R_{h-k\ max.}$	20	kΩ

* When used as a phase inverter immediately preceding the output stage, $R_{h-k\ max.}$ may be 120kΩ.





B9A BASE
(All dimensions in mm.)



Physical Outlines and Dimensions are identical for 6GV8 and 6GW8

ASZ23
AVALANCHE TRANSISTOR

1 Nanosecond Rise Time for 60mA Pulse

The ASZ23 is an avalanche transistor which provides a 60 mA pulse with a rise time of only 1 nanosecond. It is one of the fastest transistors of its type in the world.

The ASZ23 is an alloy-diffused transistor which exploits the avalanche multiplication of current carriers, with completely dependable results and consistently high performance.

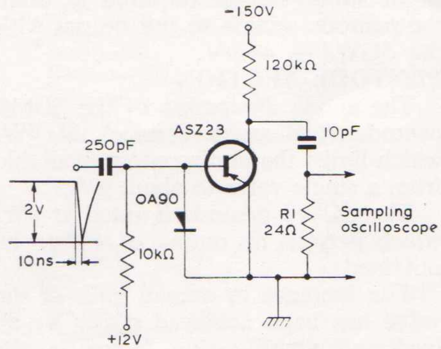
The avalanche properties of this transistor are the result of a special manufacturing technique which gives complete reliability of the avalanche mode.

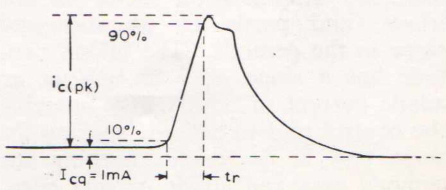
The ASZ23 is capable of generating repeatable high p.r.f. short-duration pulses with extremely fast rise times. It can be used as a calibrating pulse generator or as a fast trigger in instrumentation and nucleonics.

The ASZ23 is especially suitable for sampling oscilloscopes having effective bandwidths of several hundred Mc/s.

The figure shows a typical method of obtaining a predetermined sampling pulse by means of the ASZ23. The fast, repetitive waveform to be examined is sampled by a narrow gating pulse. Sampling takes place once per repetition of the wave, but is made each time at a different consecutive portion of the wave. By this technique high-brightness traces can be obtained up to bandwidths of 500 Mc/s and repetition rates of the order of 100 kc/s without counting down.

The ASZ23 is available from stock.





ABRIDGED PRELIMINARY DATA FOR ASZ23

Max peak collector current	100	mA
Max quiescent avalanche current	2·0	mA
Max reverse emitter-base voltage	−2·0	V
Storage temperature limits	−55 to + 75	°C
Collection depletion-layer capacitance*	4·0	pF

Ambient Temp. = 25°C.

	Min	Typ	Max	
Collector turnover voltage†	−15	−24	−30	V
Peak collector current‡	40	60	—	mA
Rise time of collector current§	—	1·0	—	nsec

*Measured at $V_{cb} = -6V$, $I_e = 0mA$, $T_{ambient} = 25°C$.
†Measured in grounded base, $I_c = 1mA$, $I_e = 0mA$.
‡Measured in the circuit shown, R1 being non-conductive.
§See test circuit and waveform.

TRANSISTOR DC-DC CONVERTER

Readers may recall an article published in Outlook, Vol. 3 No. 2 March/April, 1960, entitled "Transistorised Inverters and DC Converters". A commercial transformer has been made available by a leading Transformer Manufacturer as a result of the increasing demand by members of the electronics industry for such devices.

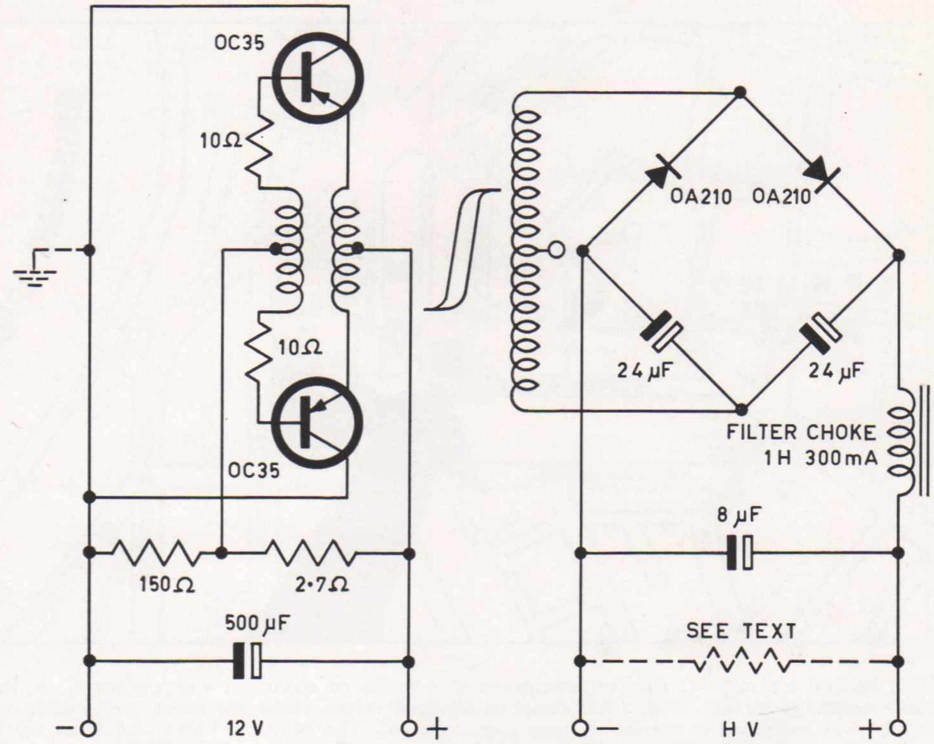
CIRCUIT MODIFICATION

This transformer, which is known as type DC/C125-325, is wound on a grain-oriented, silicon steel core and is designed to operate in conjunction with a pair of OC35 transistors, at a frequency of approximately 150 c/s. The transformer design calls for certain circuit modifications which include increasing the filter capacitors in the voltage doubler to 24 μF whilst the addition of a 1 Henry filter choke and 8 μF filter condenser provides a well-smoothed output. A 165kΩ 2W (2 x 330kΩ 1W in parallel) resistor connected across the output terminals ensures that such spiking as may occur will be maintained well inside a safe value should the load become accidentally disconnected. A resistor of 10Ω has been included in series with each base lead. These resistors, in addition to balancing the base drive, ensure that peak base currents are maintained within the ratings of the transistors under the most adverse conditions.

Modifications to the base voltage divider ensure reliable starting under load even at low battery voltages and it is important, in the interest of high efficiency, that the forward base bias be adequate to achieve this condition, without being excessive.

POSITIVE OR NEGATIVE EARTH

Constructors should note that the unit may be designed for use with positive or negative earth low-voltage systems, and, where a negative earth system is employed, if so desired, the negative lead to the high voltage supply may be connected to the positive lead from the low-voltage supply, thus taking advantage of an additional 12V DC provided by the low-tension battery. The secondary winding of the transformer is provided with a tap which enables an output voltage of 180V to be obtained by merely switching the junction of the OA210 rectifiers from the outer connection to the centre tap. Where this facility is incorporated, the switch or relay should be of the "make-before-break" type to guard against switching transients.



TRANSFORMER RATINGS

In the circuit shown, and when operated with an input voltage of 12·6V DC the nominal output ratings of the unit are 325V at 125mA.

HEAT SINK

The relatively high efficiency of this design makes it unnecessary to provide elaborate heat sink arrangements and in most cases the chassis itself will be adequate. In the prototype, a 6in x 4in x 1in chassis of 16 SWG aluminium was more than sufficient.

RESISTIVE LOAD

Starting current measurements were made with a resistive load of 2700Ω and the results observed were as follows:

Input Voltage (V)	Peak Starting Current (A)	"On-load" Input Current (A)
11·0	5·8	4·0
12·7	6·8	4·8

With higher input voltages, the peak starting current may be expected to be

Continued on Page 60

COMPONENT PARTS LIST

Resistors

Qty.	Value	% Tolerance	Rating	Type
2	10 Ω	10	1W	Carbon
1	150 Ω	10	3W	Wire Wound
1	2·7Ω	5	3W	Wire Wound
*2	330 kΩ	10	1W	Carbon

*Two 330kΩ resistors in parallel to make up 165kΩ across the HV output.

Capacitors

Qty.	Value	Rating	Type
1	500 μF	25 VW	Electrolytic
2	24 μF	300 VW	Electrolytic
1	8 μF	350 VW	Electrolytic

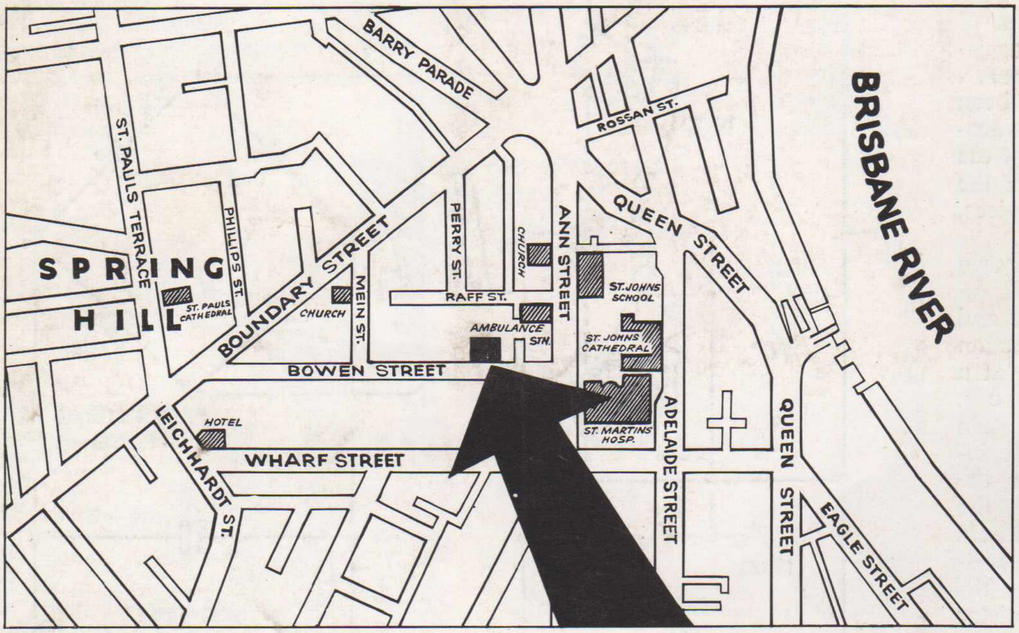
Transformer and Choke

1 National Transformer Type DC/C 125-325
1 Filter Choke, 1 Henry, 300mA

Semiconductors

Matched pair of Mullard OC35 or ASZ17 Transistors
2 Mullard OA210 Silicon Diodes

APPOINTMENT OF NEW MULLARD DISTRIBUTOR



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DC-DC CONVERTER—*continued*

slightly higher under the given load conditions. Provided the emitter current is no greater than 7·2A, the transistor current ratings will not be exceeded.

In order to ascertain the effect of the highly capacitive load represented by the voltage doubler rectifier circuit, the secondary of the transformer was disconnected from the rectifier and loaded to 40W with a resistor. No appreciable change in starting current or waveform was observed.

REGULATION

Measurements made at three nominal input voltages 10V, 12V and 14V provided the results listed in Table I.

It will be noted that the unit tested "failed safe" under all three sets of test conditions.

All output measurements were made on the output side of the filter choke which had a nominal DC resistance of 25Ω. The output ripple voltage with an input of 12V and a DC output of 320V at 100mA was 0·36V peak-to-peak.

TABLE I

Nominal Input Voltage	Input Voltage	Input Current	Input Watts	Output Voltage	Output Current	Output Watts	Efficiency	Load Resistance	Remarks
(V)	(V)	(A)	(W)	(V)	(mA)	(W)	(%)	(Ω)	
	9·7	4·8	46·5	228	150	34·2	73·5	1,540	
	9·78	4·6	45·0	240	140	33·6	74·6	1,715	"Failed Safe" at I_{out} = 152mA
10	9·8	4·0	39·2	250	120	30·0	76·6	2,080	R_L = 1490Ω V_{out} = 226V
	9·9	3·4	34·6	260	100	26·0	75·2	2,600	I_{in} = 4·8A
	10·0	3·0	30·0	265	85	22·5	75·0	3,120	
	11·8	5·0	59·0	300	150	45·0	76·2	2,000	"Failed Safe" at I_{out} = 170mA
12	11·9	4·23	50·4	310	130	40·3	80·0	2,380	R_L = 1500Ω V_{out} = 289V
	11·9	4·15	49·4	314	120	37·7	76·4	2,615	I_{in} = 5·3A
	*12·0	3·6	43·2	320	100	32·0	74·0	3,200	
	13·7	5·09	69·6	358	150	53·7	77·0	2,385	"Failed Safe" at I_{out} = 195mA
14	13·7	4·94	67·6	362	140	50·7	75·0	2,585	R_L = 1500Ω V_{out} = 302V
	13·75	4·29	59·0	366	130	47·6	80·6	2,715	I_{in} = 6·2A
	13·9	4·14	57·5	370	120	44·4	77·0	3,080	

*Ripple 0·36V peak-to-peak.

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