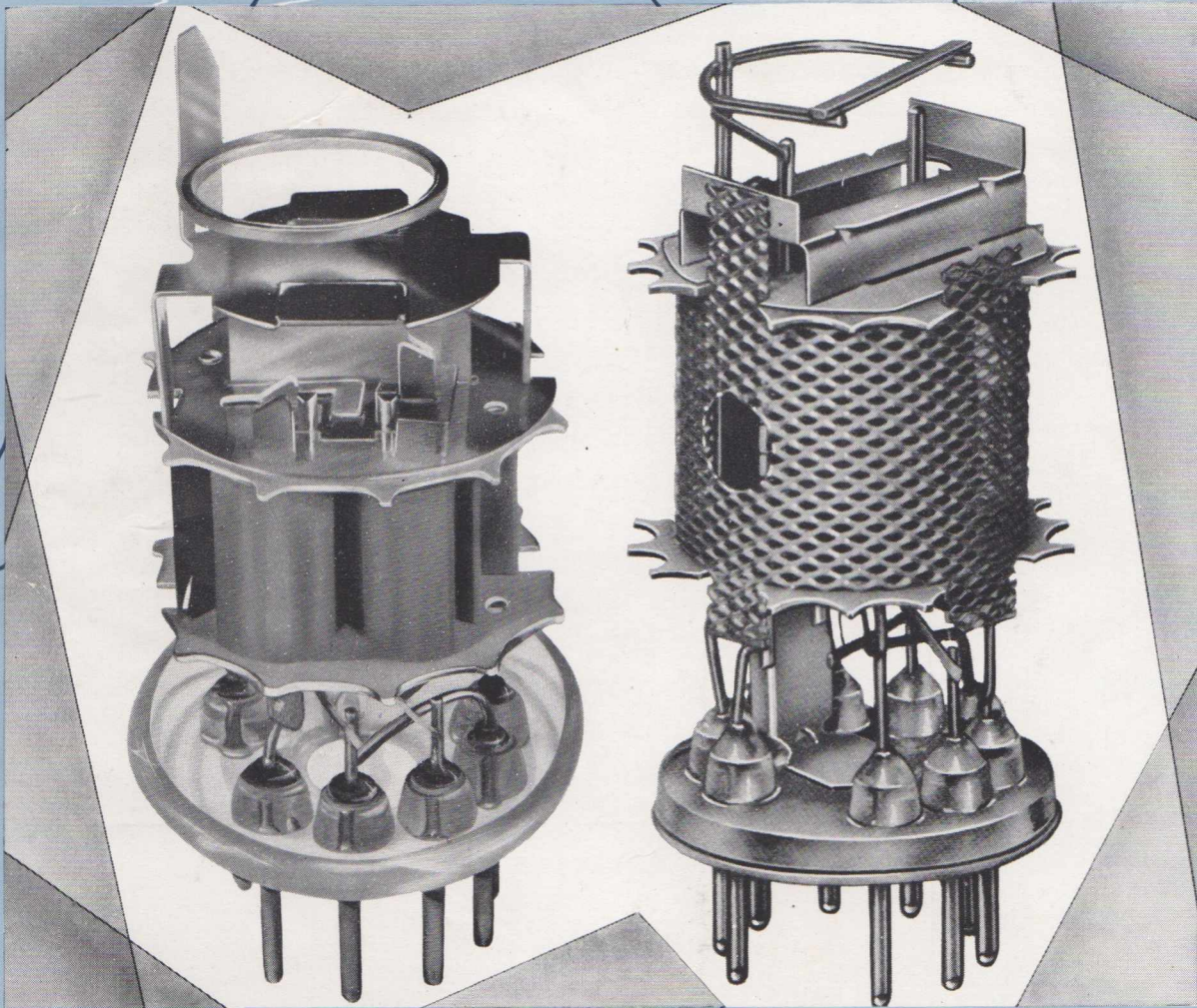


Mullard

Outlook

Australian Edition



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1960



MULLARD - AUSTRALIA PTY. LTD.



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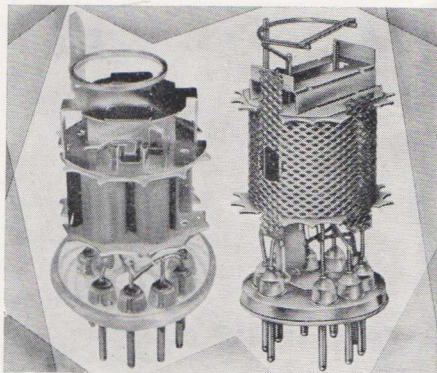
Editorial Staff:

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Frame Grid Valves, first developed for Special Quality valves for professional applications, are now well established in television receivers.

The valve types 6E58/ECC189 (left) and 6EH7/EF183 are shown. See also page 4 of this issue and page 65 and 66 of the previous Outlook.

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If confidence means respect for the ability to efficiently perform a set task, it could be appropriate at this time to consider what confidence we ourselves, and you our readers, may have engendered in others. As a manufacturer, retailer or service technician, has the necessary confidence been created to ensure enthusiastic and loyal support?

During 1960 and the years to follow, many television receivers will be released from H.P. insurance and maintenance contracts; for a time the set owner will be cast adrift and be seeking the trust of someone or some company for future service—all this unless he has confidence in a particular retailer, service man, service organisation or adviser—perhaps you yourself.

Reputation extends well beyond the skill, courtesies and service of one's self and one's personnel and centres on the quality of the components used and your confidence in a particular manufacturer. Develop your reputation and ensure the confidence of your customer by using Mullard Valves and Radiant Screen Television Picture Tubes.

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VIEWPOINT WITH MULLARD

AWARD FOR SCIENCE FILM

At the first International Festival of Films for Television held in Rome in 1959, the Mullard/E.F.V.A. film, "Conquest of the Atom" received the Gold Award, illustrated below, for Educational Films.

Sponsored jointly by Mullard Limited and the Educational Foundation for Visual Aids and produced by Realist Film Unit Limited, "Conquest of the Atom" is part of the U.K.'s contribution to a series of modern science films being produced by countries of Western European Union. An earlier contribution was "Mirror in the Sky," another Mullard/E.F.V.A. film which also won a first award in 1957.

"Conquest of the Atom" tells the fascinating story that led to the achievement of nuclear fission. Starting with J. J. Thompson's experiments which proved that an atom consisted of electrons and positive particles, it deals with Rutherford's work that culminated in the splitting of the nitrogen nucleus, and shows Sir John Cockcroft explaining how he and his colleague, Dr. Walton, succeeded in splitting the lithium atom by proton bombardment. It continues with Sir James Chadwick's discovery that the atom nucleus consisted of both protons and neutrons, and shows how nuclear fission was finally achieved in 1938 when the uranium atom was split by neutron bombardment.

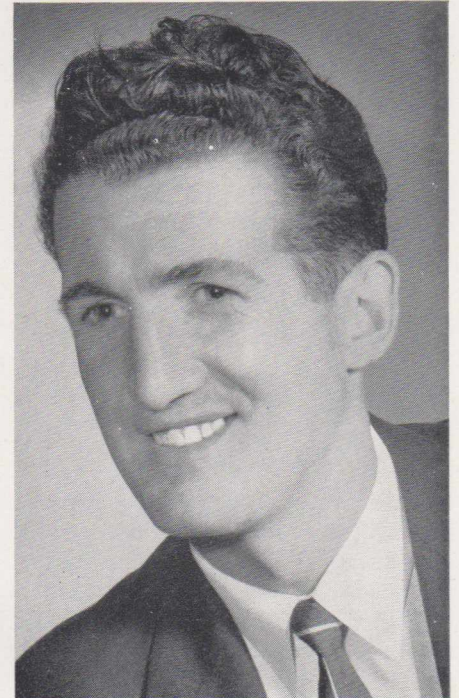


NEW FILM STRIPS

Two new film strips have been introduced to assist the students of electronics. First of the series is "Thermionic Oscillators"—Parts 1 and 2, which deals with the basic principles of oscillation and the various forms

of sinusoidal oscillators. Parts 3 and 4, comprising 22 colour frames on a single strip, will be completed shortly. This deals with the generation of non-sinusoidal wave-forms including squarewaves, pulses and sawtooth waves for television and oscilloscope timebases.

MULLARD-AUSTRALIA PERSONALITIES



The Mullard Valve and Electron Tube Service Centre at 123-129 Victoria Parade, Collingwood, is under the supervision of Mr. Graham W. Gale whose photograph appears above.

Mr. Gale joined the Company early in 1958 and has been engaged in all aspects of valve and picture tube testing whilst offering this important service to the electronics industry. In addition to directly supervising the service function, he will be glad to assist you with any technical queries you may have including those pertinent to the application of industrial and professional valve types.

Prior to joining Mullard, Mr. Gale was a member of the R.A.A.F. for some six years, during which time he obtained four years' experience with the Aircraft Research and Development Unit. His duties included the design and construction of specialised electronic test equipment and provided an appropriate background for his present appointment.

For recreation, Mr. Gale enjoys a fast-moving game of tennis or the more placid pastime of casting on a Victorian trout stream.

A TWO STAGE VISION I F AMPLIFIER USING 6EH7 AND 6EJ7

Investigations have been made to determine the order of performance possible with a two stage I F amplifier employing the frame-grid pentodes 6EH7/EF183 and 6EJ7/EF184 in conjunction with a tuner utilising the 6ES8/ECC189 (vide NT3001). A six-pole I F design was chosen and

and the inner poles between the 6EH7/EF183 and 6EJ7/EF184, although this is not the only possible arrangement.

Additional damping was necessary for the inner pair ($Q_w = 7.5$) as may be seen from the schematic whilst the

Primary 18 turns 0.0126" En. Cu. wire
 Secondary 13 turns 0.0126" En. Cu. wire
 Spacing $\frac{3}{16}$ "
 Terminations (reading top to bottom of former):—
 B+, anode, grid, earth.

TABLE 1

Pole No.	f	f _o -f	Q _w	3dB points		6dB points	
1	31.41	2.24	29	30.87	31.95	30.33	32.49
2	32.06	1.59	10	30.26	33.86	28.46	35.66
3	33.07	0.58	7.5	30.87	35.27	28.67	37.47
4	34.23	0.58	7.5	31.95	36.51	29.67	38.79
5	35.24	1.59	10	33.48	37.00	31.72	38.76
6	35.89	2.24	29	35.27	36.51	34.56	37.13

dimensioned according to the premises of the semi-circle graphical method. The relevant working Q's, tuning frequencies, etc., determined by this method for a design centred on $f_o = 33.65$ Mc/s with a band width of 4.5 Mc/s are tabulated herewith.

Equivalent bandpass-filters were then designed to substitute for the pairs of stagger poles where possible and the location of the poles in a practical circuit considered. In the interest of high gain the poles should be located so that minimum additional damping is required (i.e., working Q is dependent mainly upon the input damping of the valves and the diode detector). For this reason it was found desirable to position the outer poles between the tuner and the I F strip, the middle pair at the input to the detector

secondary of the tuned coupling is likewise modified by the 10kΩ A.G.C., feed resistor and the associated and adjacent sound channel traps. The inductor specifications are detailed in Table 2.

TABLE 2

Inductor Specifications

All coils wound on $\frac{3}{8}$ " phenolic formers fitted to $\frac{3}{4}$ " aluminium can and with $\frac{3}{8}$ " long dust cores.

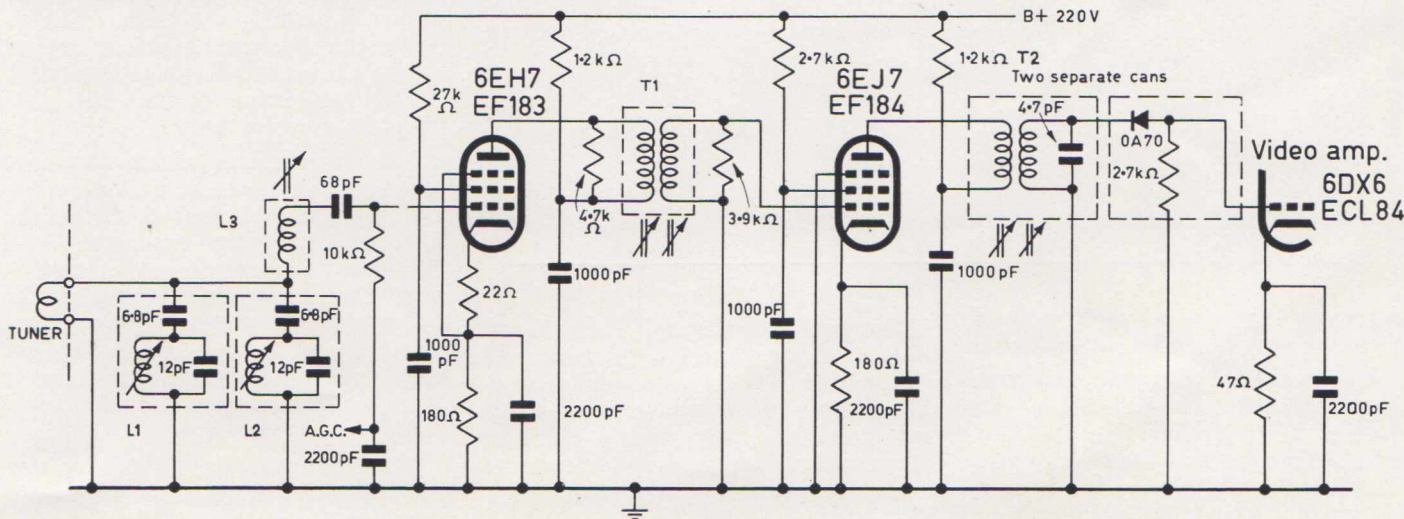
- L1: 30.5 Mc/s Trap
16 turns 0.0285" En. Cu. wire
- L2: 37.5 Mc/s Trap
13 turns 0.0285" En. Cu. wire
- L3: I F input coupling
13 turns 0.0126" En. Cu. wire
- T1: 33.65 Mc/s bandpass - filter (effective $Q_w = 7.5$)

T2: 33.65 Mc/s bandpass - filter (effective $Q_w = 10$)

Primary 17 turns 0.0126" En. Cu. wire
 Secondary 15 turns 0.0126" En. Cu. wire
 Spacing $\frac{1}{4}$ "
 Termination (reading top to bottom of former):—
 B+, anode, diode, earth.
 Secondary Tuning capacitor 4.7pF in can.

The measured performance of this design having a -3dB bandwidth of 4.35 Mc/s and a -6dB bandwidth of 4.82 Mc/s is 40 μV at the antenna terminals for 1 Volt D.C. at the diode detector. The combined A.G.C. characteristics of Tuner and I F Strip indicate that for a smooth transition a tuner delay of some five volts is required but noise measurements in this transition region have yet to confirm that this is the best practical point of compromise.

It should be mentioned that in this design the damping link in the NT3001 tuner must be severed.



"VINKORS"—A NEW RANGE OF CLOSE TOLERANCE ADJUSTABLE POT CORES

Mullard have introduced a new range of adjustable ferrite pot core assemblies which provide greater accuracy and flexibility in the manufacture of inductors for use in many types of electronic and line communication equipment.

Vinkors are made from a new high-stability, low-loss Ferroxcube, and incorporate advanced manufacturing techniques enabling their effective permeabilities to be controlled to very close limits. This allows the designer to pre-calculate within $\pm 3\%$ the inductance of the coil when wound.

A variable magnetic shunt is built into the core by means of which the inductance of the assembled coil can be adjusted over a range of $\pm 7\%$ to an accuracy of better than 0.02%. This provides adequate allowance for the small tolerances on the core itself and also for normal circuit tolerances. The adjuster is readily accessible when the assembly is mounted in position, it is self-locking and designed for easy adjustment with a screwdriver.

The geometry of the cores has been carefully designed to give optimum electrical performance—including, for example, the lowest possible ratio of d.c. resistance to inductance. Allied with the high intrinsic permeability of the Ferroxcube material, the design of the cores also ensures effective magnetic screening of the coil.

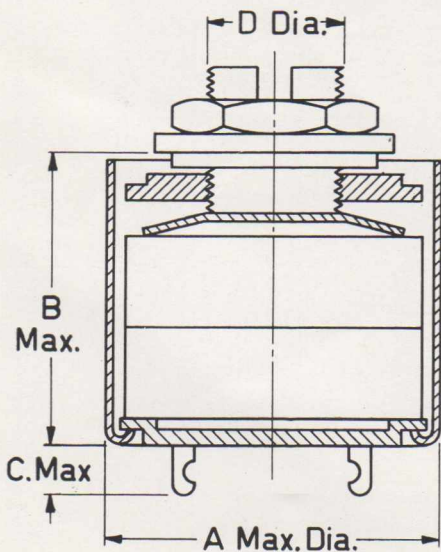


The design and construction of Vinkors have been planned to facilitate their assembly under conditions of both large and small scale production. Mounting is by a threaded shank and nut through a single hole in the chassis. A tag panel is incorporated to simplify wiring.

The present range of Vinkors comprises five basic types for use at fre-

quencies up to 200 kc/s, with outside core diameters of 18, 21, 25, 30 and 35 mm. respectively. Each size of core is available with an effective permeability of 160, 100 or 63 as required.

Type numbers and physical dimensions of the various core assemblies are given below:—



Core size (mm)	Type number LA	μe	Freq. range kc/s	A	B	C	D	Number of tags fitted to tag plate	Adjuster core part no. LA
18	2503	160	Up to 100	20	19	4	$\frac{3}{8}$ "	6	1037
	2504	100	" " 100						1037
	2505	63	" " 200						1048
21	2403	160	Up to 70	24	21	4	$\frac{3}{8}$ "	8	1037
	2404	100	" " 70						1037
	2405	63	" " 200						1048
25	2303	160	Up to 40	28	24	4	$\frac{3}{8}$ "	8	1036
	2304	100	" " 70						1036
	2305	63	" " 200						1050
30	2203	160	Up to 30	33	28	4	$\frac{1}{2}$ "	8	1036
	2204	100	" " 70						1036
	2205	63	" " 200						1050
35	2103	160	Up to 20	39	32	4	$\frac{1}{2}$ "	8	1036
	2104	100	" " 50						1036
	2105	63	" " 200						1050

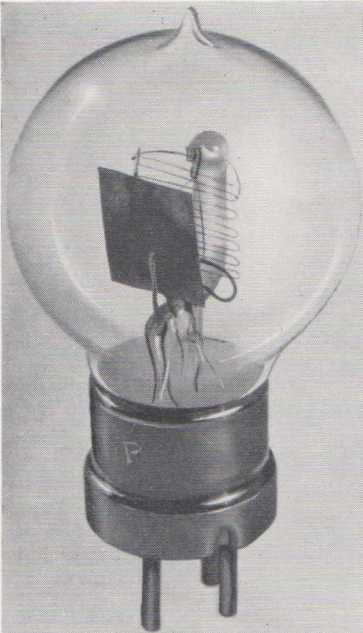
Dimensions A, B and C in millimetres.

Coil formers are not included in the assemblies and must be ordered separately according to their type numbers.

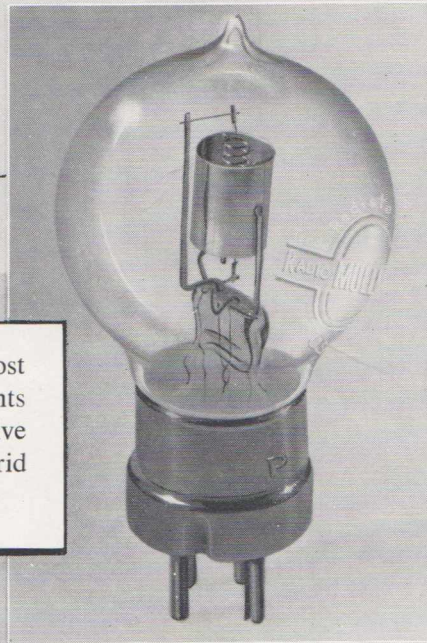
The Ferroxcube cores are in matched pairs and should not be interchanged.

Spare adjusters can be supplied and should be ordered according to their relevant type numbers, as shown in the table.

EARLY MULLARD VALVE HISTORY



TYPE 0RA—produced about 1920 was the forerunner of the vast range of Mullard types; it could oscillate, rectify or amplify—hence its title. The bright emitter filament operated at 3.6 volts and the planar grid construction has re-appeared in some of the more modern specialised valves.



TYPE 05 — the most notable improvements included in this Valve were the circular grid and anode structure.



TYPE D3 — Produced by Mullard in 1922 to meet the needs of Domestic Broadcasting, which commenced in Great Britain with the opening of Station 2LO. This Valve was the first to have a thoriated tungsten filament.



TYPE M175—Similar to Type D3, but employing the now familiar getter.

DH13-78 INSTRUMENT TUBE WITH HELICAL P.D.A.

The DH13-78 which is directly equivalent to the American 5BHP1, is an instrument tube with a 5 in. diameter screen and helical post-deflection acceleration. Its close tolerances, high deflection sensitivity, and high writing speed make it particularly suitable for measurement purposes at high frequencies.

The high-resistance helix allows a p.d.a. voltage of 12kV, which is six times the first accelerator voltage. This high ratio ensures high brightness and minimum distortion of the trace. A shield (a_5) between the two pairs of deflector plates provides correction of pincushion and barrel distortion. A screen (a_4) can be used to correct any non-linearity of the vertical deflection. The deflector plates are brought out directly to side contacts on the neck of the tube, thus ensuring minimum capacitance and inductance for high-frequency applications. The screen is of the recently introduced metal-backed medium-persistence H type.

Abridged Advance Data for DH13-78

V_h	6.3	V
I_h	300	mA
Focusing		electrostatic
Deflection		double electrostatic; x and y plates intended for symmetrical deflection
Min. helix resistance	300	M Ω
Screen		blue-green, medium persistence
Min. useful screen dia.	108	mm
Useful scan	40 × 100	mm
Typical line width	0.4	mm
Base		B14A diheptal
Max. overall length	468	mm
Max. diameter	134.5	mm

Typical Operating Conditions

V_{a6} (p.d.a.)	12.0	kV
V_{a5}	2.0	kV
V_{a4}	2.0	kV
$V_{a1,3}$	2.0	kV
V_{a2} (focus)	220 to 710	V
V_g for cut-off	-60 to -96	V
S_x	36	V/cm
S_y	8	V/cm

KLYSTRON TYPE NUMBERS

Some changes in the type numbering system of klystrons have been made. These changes mean that some existing type numbers have been revised.

The current range of Mullard klystrons is listed below. Where a change of type number has been made, the old number is shown in brackets.

KB9-2	(KT9-2)
KB9-150W	(KT9-150W)
KS7-85	
KS7-85A	
KS7-1000C	(KS7-1C)
KS9-20	
KS9-20A	
KS9-40	

The new system, on which these type numbers are based, is as follows:

First letter: K for klystron.

Second letter: Power output in accordance with the following code (the numerical value of the output is indicated by the second figure of the type number).

S output in mW (also implies that the klystron is of single-resonator design).

B output in W.

C output in kW.

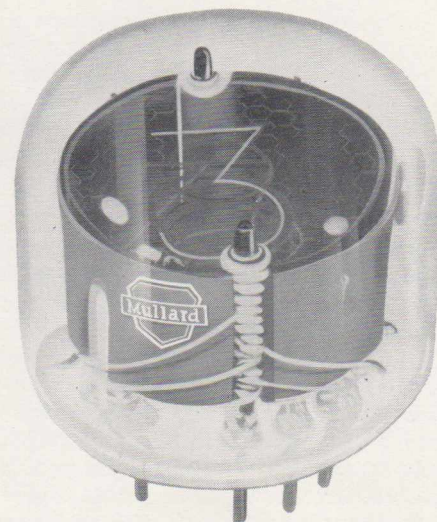
First figure: Frequency in kM/cs.

Second figure: Output in mW, W, or kW, as indicated by S, B, or C respectively.

Thus the KB9-2 is a klystron operating in the 9000Mc/s region with an output of 2.0W; and the KS7-85 operates at about 7000Mc/s with an output of about 85mW. Letters which follow the second figure usually indicate variants of a basic klystron type; for example, the KS9-20 and KS9-20A are both 9000Mc/s klystrons, but the actual tuning ranges of the two types are different.

It will, of course, be appreciated that any type-numbering system is necessarily a compromise. The best that can be done is to indicate the most important characteristics by means of a rational and uniform code. This basic guidance will then provide the first step in the selection of a suitable type from a lengthening list.

Z510M INDICATOR TUBE



Mullard-Australia Pty. Ltd., will shortly have available in sample quantities a numerical indicator tube which is electrically equivalent to the American type 6844. The Z510M is a gasfilled cold-cathode tube with one anode and ten cathodes. The cathodes are in the forms of the numerals 0 to 9, and they provide an end-view display of the triggered digit about 0.6in. (15mm) high. This tube is designed to operate with a current consumption of 2.0mA from a 170V supply. For further information please contact the Mullard Industrial and Professional Valve Department.

Abridged Advance Data For Z510M

Limiting Values (absolute max)

Anode supply voltage		
Max	400	V
Min	160	V
I_k max*	2.5	mA
$i_{k(pk)}$ max*	15	mA
Max extinction voltage	100	V

Typical Operating Conditions

V_a (ignition)	170	V
$V_{maintaining}$	130	V
I_k	2.0	mA
R_a	20	k Ω
Max overall length	35	mm
Max seated height	28.5	mm
Max diameter	30	mm
Base	Special 13-pin all glass	

*each digit

TRANSISTOR TRANSMITTER WITH

The following article provides an introduction to the application of transistors in transmitting equipment. Whilst power transistors at present available limit the transmitted frequency to the order of hundreds of kc/s, the techniques described below will enable technicians to become familiar with this type of circuitry. The keying unit provides an excellent example of timing techniques employing transistors and may be applied to the design of equipment in the rapidly increasing industrial field. In particular, a study of the techniques employed will be beneficial to those interested in sequential control and its application to manufacturing processes.

The recently introduced Mullard OC24 power transistor is suitable for high-frequency applications and is capable of dissipating several watts at the collector. The combination of these qualities has made possible the design of a 500kc/s push-pull amplifier capable of delivering an output of 4 watts into a resistive load. This amplifier may be used for the output stage of a transmitter such as that shown in the accompanying circuit.

The transmitter was designed for operation in the International Marine Low Frequency Band. It is particularly useful for lifeboats and life rafts but may be adapted, using an automatic-keying system, for life-jackets, air-sea rescue equipment, helicopters and radio beacons. The long life and reliability of transistors make them particularly suitable where extended standby conditions are experienced such as in the types of apparatus listed above. Low power consumption, light weight and compactness add to these advantages. A 4 ampere-hour accumulator will provide sufficient power to operate the transmitter for some 50 to 60 hours. For emergency applications a self priming battery is ideal as it requires no attention (other than initial charging and sealing) until it is to be used.

The transmitter is comprised of oscillator, modulator, driver and power amplifier stages. The oscillator is crystal controlled utilising a transistor type OC45. The collector circuit is tuned to the series-resonant frequency of the crystal which is connected in series with the feed-back winding to control the frequency of oscillation.

The modulator is an OC201 silicon transistor where output is applied to the driver amplifier and then to the push-pull power amplifier and aerial.

The design of the Class B push-pull amplifier follows the same basic technique as that for an audio amplifier, except that, as the collector circuit is resonant, base bias is unnecessary. The use of a shared emitter resistor reduces the effect of variations in base-emitter voltage V_{be} and reduces the

lengthening, caused by hole storage, of the collector current pulse. This reduction of hole-storage current results in a marked improvement in the efficiency of the amplifier.

The design procedure for the driver and modulator stages is similar to that for the output stage. The voltage limitation of the oscillator transistor suggests the use of a 6V power supply which is also employed for the modulator.

The oscillator operates under Class A conditions, base bias being provided by a potentiometer (R1R2). The emitter resistor is bypassed for r.f.

For c.w. operation, a morse key may be connected in series with the base winding of the modulator transistor, together with an r.f. choke and bypass capacitor to prevent r.f. voltages across the key.

Low-level modulation is used for radio telephony, the modulator transistor being biased for Class C operation, using a parallel CR combination, to a point where the output of the transmitter falls to half its normal value, and an a.f. signal is applied across the bias register.

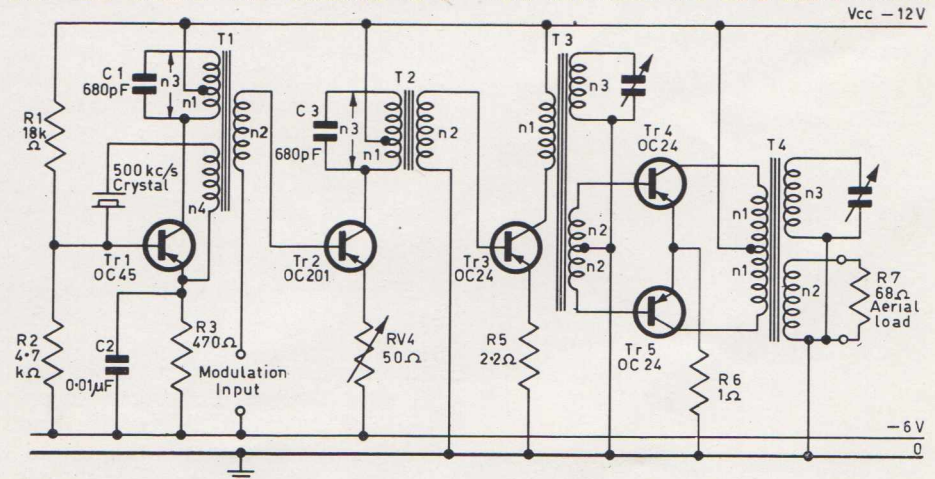
The circuit shown here is for an automatic-keying device which may be used to generate a distress signal. A time interval of 0.1 sec., was chosen for the duration of a dot and for the interval between successive dots and dashes. The duration of a

dash then becomes 0.3 secs.

Transistors Tr1 and Tr2 form the dot multivibrator and the Tr2, Tr3 combination is the dash multivibrator. As the spacing between dots is identical to the spacing between dashes gating is unnecessary for mixing and the output may be taken from the collector of the common transistor Tr2. The output waveform is squared by the emitter follower Tr4. The output signal from Tr2 is inverted by Tr13 to negative-going pulses required for keying the transmitter. A positive line is provided for the combined multivibrator by connecting the three emitters to a suitably decoupled resistor R2. This ensures that the appropriate transistor (Tr1 or Tr3) is cut off by the sequence multivibrator which acts as an on-off switch in the base leads of Tr1 and Tr3.

This multivibrator consists of transistors Tr6 and Tr7 which conduct alternately, switching the supply voltage across the base resistor R7 and R6 respectively. When Tr6 is on, Tr5 is off and the voltage across R9 (approximately V_{cc}) appears across R7, the base resistor of Tr1, and three dots are generated. The timing of this sequence is mainly governed by the combination C9, R11.

The capacitor C7 reduces the switch-on time of transistor Tr7. If it is omitted, the inhibiting signal from Tr7 does not reach the dash multivibrator



500 kc/s Transistor Transmitter

AUTOMATIC KEYING CIRCUIT

NOTE: In order to comply with the requirements of the Wireless and Television Act, 1904 (as amended), equipment such as that described may only be operated in accordance with the relevant Licence as issued by the P.M.G.'s Department.

soon enough and a spurious dash precedes the dot-dash sequence. When Tr7 is on, Tr8 is off, the supply voltage appears across R6, and Tr3 generates three dashes. Transistors Tr5 and Tr8 are emitter followers which square-off the collector wave-forms from Tr6 and Tr7. The sequence multivibrator is in turn controlled by the mark-space multivibrator by connecting R13, the base-feed resistor to Tr7, across the emitter load of Tr9. The mark-space multivibrator is free-running and controls the whole automatic timing circuit. Tr10 is an emitter follower which squares-off the collector wave-form of Tr11. A buffer stage, Tr9, is required to reduce interaction between the mark-space multivibrator and the previous stage.

The resistor R18, in the base lead of Tr10, is necessary to prevent pulses, fed back from the sequence and dot-dash multivibrators, triggering the mark-space multivibrator. It also reduces the voltage developed across the emitter resistor, R17, thereby reducing the on-period of Tr11. This time can be easily adjusted because it is the off-period for the complete timing circuit. If R22 is 270k Ω and C10 is 100 μ F, the space period between signals is about 15 secs.

Some of the timing components need careful selection; all the resistors

for these circuits should be of high stability, and the capacitors should have low leakage currents. These capacitors should preferably be metalised paper types (C1, C2, C3, C5, C7, C12) with tantalum electrolytic for the others. All the transistors operate at less than 500 μ A per stage; the total current drain from a 12V battery is about 4mA. The circuit operates satisfactorily with supply voltage down to about 10V, and over a range of temperature from 0 to 60°C. Taking into account the on-off power ratio of the combination of transmitter and keying circuit a life of 50 hours may be expected from a 4 ampere-hour accumulator.

However, the principles of the design described can be used for the automatic keying of any morse signal, such as a call sign, by suitable adjustment of the timing components.

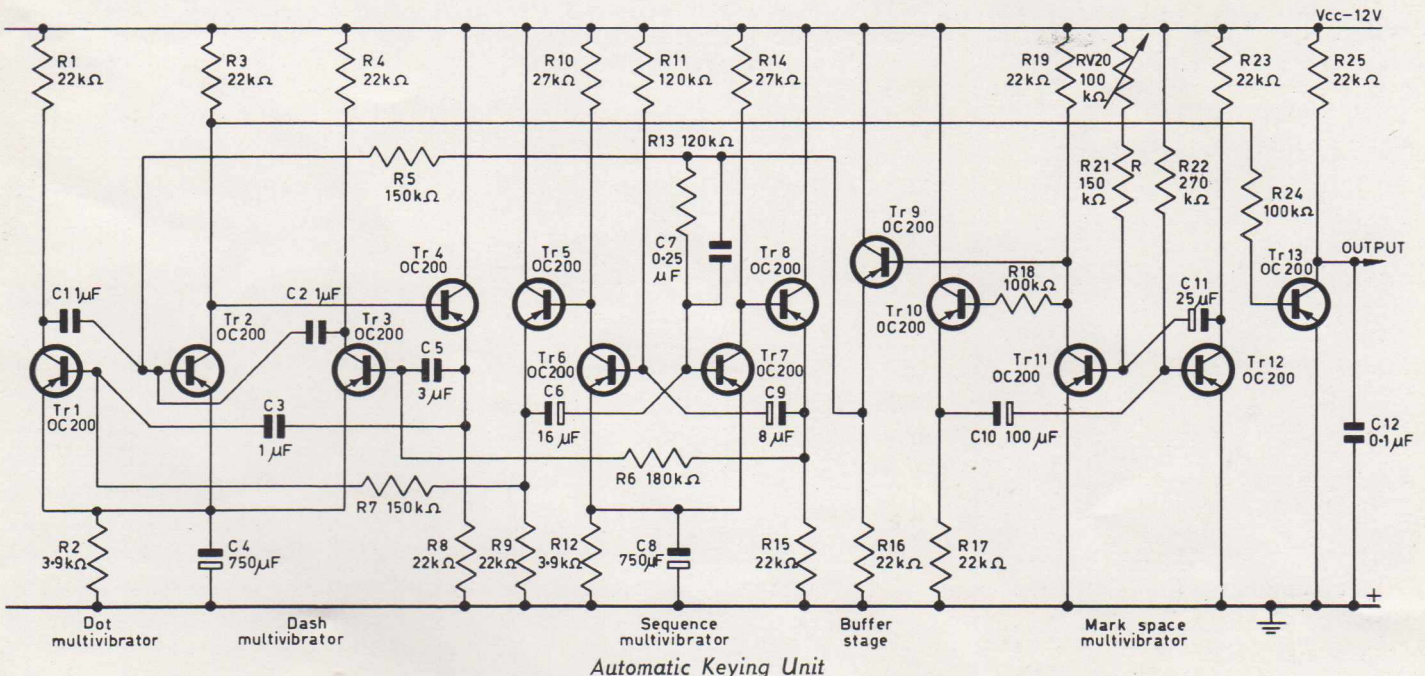
The tuning procedure adopted is the usual one of rough tuning at reduced power, followed by adjustment at full power. A resistor of 27 Ω is connected in the emitter lead of the modulator amplifier Tr2, the 12V supply is connected to the transmitter, and the oscillator tuned-circuit is adjusted to the series-resonant frequency of the crystal. The modulator amplifier is tuned next, followed by the driver and power-amplifier stages

which should be tuned for maximum power output (about 2 watts) across the 68 Ω load.

The emitter resistor of Tr2 should then be short-circuited. The complete transmitter, from the oscillator to the power amplifier, should be progressively readjusted. Careful tuning of the power amplifier is necessary, because excessive collector current flows if the stage is off tune. The full output of 4 watts should now be obtained.

An experimental transmitter was built and the performance tested over a temperature range from 0 to 60°C. The output falls gradually at temperatures above 25°C, although quite reasonable output is still available at 60°C. Field tests were carried out under license using a 520kc/s crystal, the transmitter being returned to this frequency. A transmitting aerial 30ft. high and a receiving aerial about 30ft. long were used and strong signals were received within 12 miles over land. This is not the maximum range over land, and a range of at least 50 miles may be expected at sea.

It cannot be emphasised too strongly that indiscriminate transmission of the international distress signal, whether licensed or not, is extremely undesirable.





QV08-100 BEAM POWER TETRODE FOR S.S.B. OPERATION

The Mullard QV08-100 is an indirectly heated beam power tetrode specifically designed for single-side-band operation, insomuch that an output of 120W can be obtained with an anode supply of 750V without driving into grid current. It may also be used in conventional A.M. and F.M. transmitting equipment.

Samples will be available shortly.

Advance Data for QV08-100

Characteristics

V_h	6.3	V
I_h	3.9	A
* g_m	9.0	mA/V
* μ_{g1g2}	5.7	
*at $V_a = 750V$, $V_{g2} = 250V$, $I_a = 100mA$		

Limiting Values

f_{max}	30	Mc/s
V_a_{max}	825	V
P_a_{max}	100	W
I_a_{max}	400	mA
$V_{g2_{max}}$	300	V
$P_{g2_{max}}$	12	W
$-V_{g1_{max}}$	100	V
$I_{g1_{max}}$	30	mA
$R_{g1_{max}}$	15	k Ω
$V_{h-k_{max}}$	100	V

Typical Operating Conditions

	A	B	C	
f	30	30	30	Mc/s
V_a	600	750	750	V
V_{g2}	250	250	310	V
V_{g1}	-100	-90	-45	V
I_a	300	385	270	mA
I_{g2} (approx)	20	30	26	mA
I_{g1} (approx)	4	10	0	mA
$V_{g1(pk)}$	110	120	45	V
P_{drive}	0.5	1.5	—	W
P_a	50	85	80	W
P_{g2}	5.0	7.5	8.0	W
P_{out}	130	200	120	W
η	72	70	60	%
Net weight	$\left\{ \begin{array}{l} 220 \\ 7\frac{3}{4} \end{array} \right.$			gr oz

A: Class C anode and screen grid modulation.

B: Class C telegraphy.

C: Class B S.S.B.

NEW MULLARD HIGH FREQUENCY TRANSISTOR

In the past, Mullard have concentrated their efforts on the production of a full range of germanium alloy transistors. The alloy technique, with its capabilities, made it possible to manufacture semiconductor devices in large numbers and at realistic prices. The OC44 probably represents the highest frequency obtainable in this alloy technique with full mass production methods and resultant reduced costs.

The OC170 is the first transistor in the Mullard range produced using a new alloy-diffusion technique. Previous types, manufactured by conventional production methods, were limited to a frequency cut-off of approximately 20 Mc/s.

This new alloy-diffusion process

makes it possible to produce accurately controlled thin layers thus making it a proposition to include the OC170, together with the OC169 from the same family, to replace the OC44 and OC45, in the Mullard preferred range. The OC170 may be used in A.M. receivers as a self-oscillating mixer, with the OC169 employed in the IF stages.

The OC170 has been followed by the OC171—a lower noise 100 Mc/s mixer transistor—and later on a superior type will become available with very low noise figure and a usable gain as a 100 Mc/s R F amplifier.

Further information on these latter types will be announced as soon as it comes to hand. In the meantime, the OC170 and OC169 are here.

ABRIDGED CHARACTERISTICS

MAXIMUM RATINGS	OC169	OC170	OC171
Collector voltage, grounded base	-20 V	-20 V	-20 V
Collector current	10mA	10mA	5mA
Collector dissipation (at $T_{amb.} = 45^\circ C$.)	50mW	60mW	60mW
TYPICAL CHARACTERISTICS			
Current amplification cut-off f_α	70Mc/s	70Mc/s	100Mc/s
Power gain	{ at $f = 0.45$ Mc/s	35 dB	57 dB
	{ at $f = 10.7$ Mc/s	20 dB	31 dB
	{ at $f = 100$ Mc/s	—	—
Noise figure	{ at $f = 0.45$ Mc/s	4 dB	4 dB
	{ at $f = 10.7$ Mc/s	5 dB	5 dB
	{ at $f = 100$ Mc/s	—	—

E88CC/01 LOW NOISE DOUBLE TRIODE

The E88CC high-slope special-quality double triode is used in a wide variety of applications. These may be classified in two groups:—

- (i) pulse applications, such as high-speed multivibrators;
- (ii) R F applications, such as the R F cascode input circuits and I-F stages of radar installations and telephone links.

In the second group of applications it is necessary to use a valve with a favourable noise factor.

Although the E88CC (CV2492) has a very good low-noise performance, there are some particularly critical applications for which the lowest possible noise figure is essential. To meet the needs of such applications, the E88CC is now also available in a specially tested version, the E88CC/01 (CV2493). The specification for this new type controls the noise figure to a limit of 2.2dB at 45Mc/s, with an A.Q.L. of 4%.

PRACTICAL NOTES ON VALVE MEASUREMENTS

This article is the second of a series now being published in the "Outlook" dealing with experiments for the examination of the properties and behaviour of thermionic valves. These experiments include measurements from which the characteristic curves of various types of valves may be plotted.

It has been found possible to design a comprehensive range of experiments using only two Valves, a Ferranti GRD7 and a Mullard EL38. Abridged data is given below.

DATA AND RATINGS OF GRD7

Base

International Octal (For connections see below).

Mounting Position

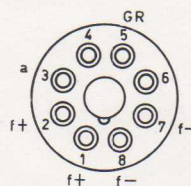
Vertical, base down.

Ratings

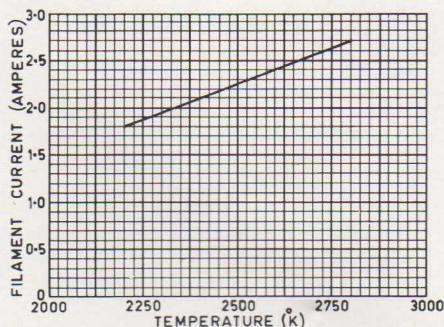
- Maximum filament voltage 7.0V
- Maximum anode voltage 300V
- *Maximum anode dissipation 2.0W
- *This rating applies to continuous operation. For short period operation, for example, as required for demonstration purposes, an anode dissipation up to 5 Watts is permissible.

Characteristics

- Filament voltage (for filament current = 2.2. A) 6.3V (Approx.)
- Filament current — variable (see graph)
- Anode length 14.5 mm.
- Anode internal diameter 6.5 mm.
- Effective filament length 14.5 mm.



GRD7 Pin Connections



Filament temperature plotted against filament current

Guard rings of the same diameter as the anode are fitted to the GRD7 and, if maintained at the same potential as the anode, the electric field between cathode and anode remains extremely uniform and end fringing effects are eliminated.

These non-magnetic electrodes are fitted with a window, thus permitting filament temperature checks by means of an optical pyrometer. In addition, the graph shows filament temperature plotted against filament current.

The Mullard EL38 is a power pentode with indirectly heated cathode primarily intended for line output applications in television receivers. Each electrode is brought out to a separate base pin, and there are no internal inter-element connections. By making suitable element connections externally

DATA AND RATINGS OF EL38

Base

International Octal (For connections see below).

Mounting Position

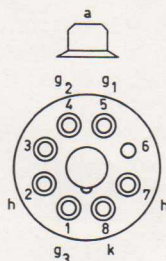
Any.

Heater

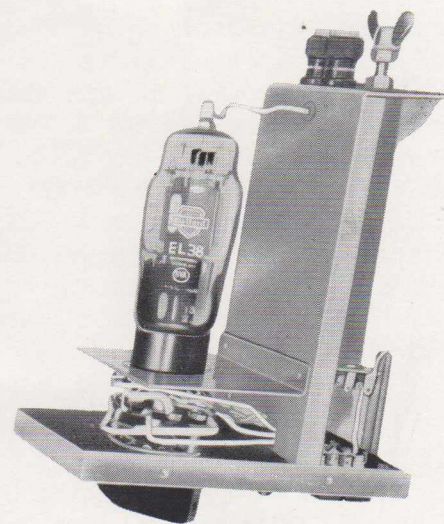
- Heater voltage (alternating or direct current) 6.3 V
- Heater current 1.4 A

Ratings

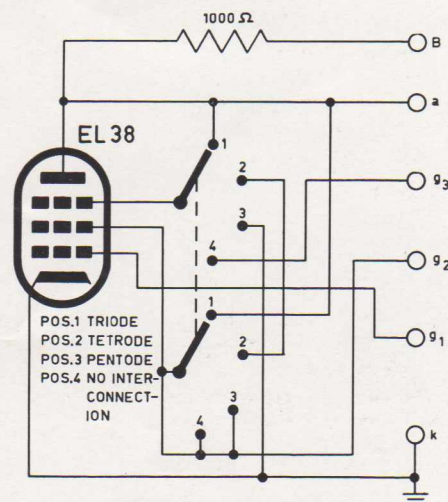
- Maximum anode voltage 800 V
- Maximum screen grid voltage 400 V
- Maximum anode dissipation 25 W
- Maximum screen grid dissipation 8.0 W
- Maximum cathode current (anode current + screen grid current) 200 mA



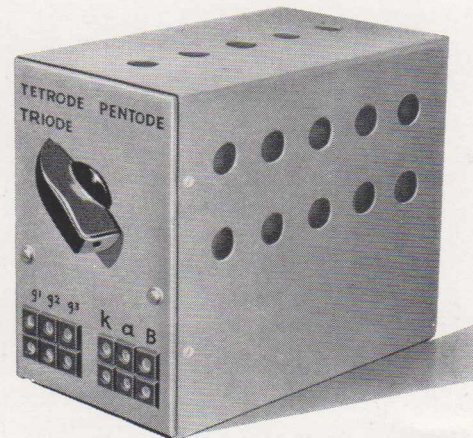
EL38 Pin Connections



EL38 Test Set-up (internal view)



Circuit Diagram EL38 Test Set-up



EL38 Test Set-up

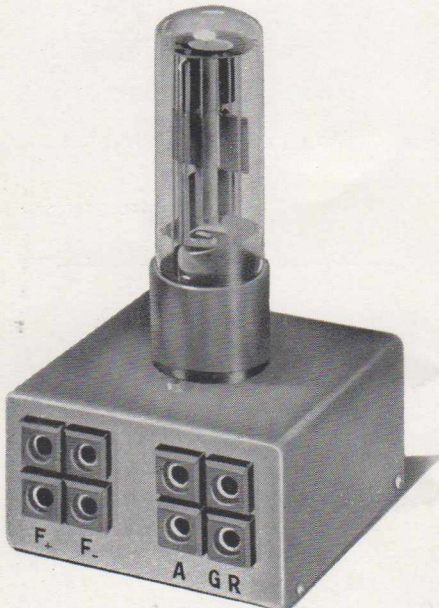


PRACTICAL NOTES ON VALVE MEASUREMENTS

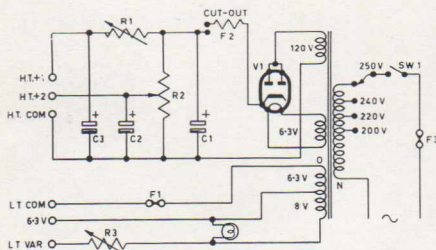
—continued

the valve may be operated as a triode, tetrode or pentode.

A possible method of mounting for each Valve type is shown. The duplicate test sockets facilitate the connection of voltmeters, etc. A four position switch is provided for the EL38 Test Set-up and, in the alternative anode connection, a 1,000Ω resistor is included in order to provide a suitable load. This resistor may be seen in the internal view of the chassis.



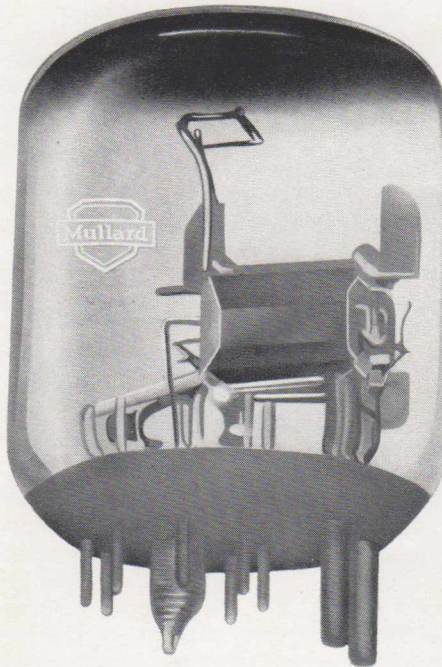
GRD7 Test Set-up



Power Supply Circuit

A diagram of a simple power supply circuit is shown, using valve type 6CA4/EZ81 as a half-wave rectifier. The supply will provide 160V at 120mA. Two H.T. output circuits are provided, each with a separate voltage adjustment.

NEW UHF DOUBLE TETRODE



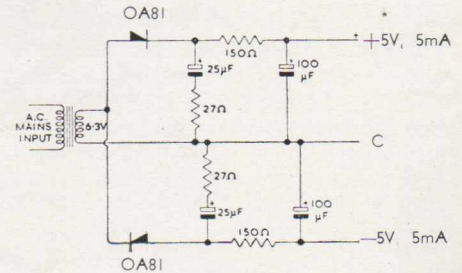
With the introduction of the QOV04-16 the frequency coverage of the Mullard double tetrode range is extended to 960 Mc/s. This valve is designed for use as an r.f. amplifier or frequency trebler in mobile transmitters or small fixed stations, and also in u.h.f. television links.

The single-ended valve structure is specially designed for efficient operation at u.h.f. The inductance of the anode leads is minimised by the use of two short thick pins which are remote from the other connections on the pressed-glass base. The pins can be used as integral parts of the anode circuit.

As in earlier valves in the double tetrode range, the anode-to-grid capacitances are neutralised internally. Frame grids are used, with the familiar advantages of high slope and short transit time, and a favourable ratio of slope to capacitance. The hard-glass bulb, with a working temperature limit of 220°C, allows a compact structure—an important consideration in mobile equipment. Radiation and convection will provide adequate cooling. There are no limitations on mounting position.

The operating conditions of the QOV04-16 are outlined below. Sample quantities should be available shortly and further details will be supplied on request.

AMATEUR EXPERIMENTERS COLUMN



This circuit is intended to supply power for experimental transistor circuits, and gives two outputs—+5V and -5V with respect to the common line. Various outputs can be obtained by changing the values of the 150Ω smoothing resistors. For improved hum reduction choke filtering may be used.

Abridged Advance Data for QOV04-16

Heater	series: 12.6V, 0.3A
	parallel: 6.3V, 0.6A
Max. diameter	44.5 mm
Max. overall length	63 mm
Max. seated height	50 mm

Characteristics*

g_m	10.5 mA/V
μ_{g1g2}	28
*each tetrode, at $V_a = 350V$, $V_{g2} = 200V$, $I_a = 25mA$	

Capacitances†

C_{a-g1}	0.145 pF
C_{a-k}	1.35 pF
C_{g1-k}	4.5 pF

†each tetrode

Limiting Values

	A	B	
f_{max}	960	960	Mc/s
V_a max	400	400	V
I_a max	2 × 45	2 × 40	mA
p_a max	2 × 8.0	2 × 8.0	W
V_{g2} max	225	225	V
p_{g2} max	2 × 1.5	2 × 1.5	W
$-V_{g1}$ max	100	100	V
I_{g1} max	2 × 4.0	2 × 4.0	mA

A: class C telegraphy or f.m. telephony, two tetrodes in push-pull, continuous service.

B: class C frequency trebler, two tetrodes in push-pull, continuous service.