Mullard Outlook

AUSTRALIAN EDITION

VOL. 7 No. 5
SEPTEMBER-OCTOBER, 1964

Mullard

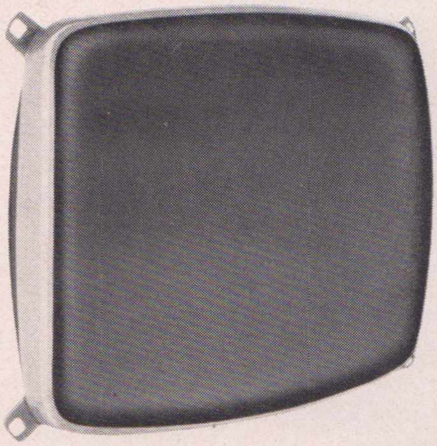
MULLARD-AUSTRALIA PTY. LTD.

VOL. 7— No. 5 SEPTEMBER-OCTOBER, 1964

Editorial Office:
35-43 Clarence Street, Sydney.
Telephone: 29 2006

Editor:
JOERN BORK

TABLE OF CONTENTS



The new Mullard Panorama Radiant Screen Long Life Picture Tube A59-11W is discussed on pages 60 and 61 of this issue.

MULLARD-AUSTRALIA PTY. LTD.
35-43 CLARENCE STREET, SYDNEY
Phone: 29 2006
123-129 VICTORIA PDE., COLLINGWOOD, N.5
VICTORIA
Phone: 41 6644
Associated with
MULLARD LTD., LONDON

THE SILENT G

One of our starry-eyed young animal lovers told us the other day that she thought Norbits were a pre-prepared dog food and she had some doubts when we started explaining 'gates', these being analogous to her canine friends jumping over them, barking behind them or preferring them to lamposts!

Indeed, a number of folk have been puzzled about Norbits, for as solid switching devices they are indeed silent, very silent, completely trouble free, intriguing to apply and an elegant example of circuit logic. Logic of which Boole himself would have been proud. These sophisticated circuit elements are yet another example of Mullard developing with electronics, in many cases leading.

If you have a switching problem or are anxious to avail yourselves of the latest techniques, we are happy to assist and our Viewpoint page this issue tells a little of our contribution with publications, lectures, displays and for our future engineers and technicians, the Mullard Film and Filmstrip Service.

M.A.B.

VIEWPOINT WITH MULLARD

MULLARD TECHNICAL SERVICE

"This booklet is issued in order to provide a rapid guide to answer technical queries, such as 'what Mullard valve am I to use in the first stage of an audio frequency amplifier and what H.T. current does it require?' ".

The above paragraph appeared in the introductory page of one of the earliest Mullard Valve Data Booklets published in Australia. Whilst the valves featured at that time were known by some weird and wonderful type numbers by today's standards, they were nevertheless well to the fore in design and performance and, when backed by the well-known Mullard Technical Service, in application.

In this regard the name "Mullard" has always been synonymous with service, not only in the U.K., but in most parts of the world.

Phone Enquiries and Correspondence

We in Australia are proud to be part of the Mullard organisation and our technical people are always willing to answer queries, both on the telephone and by letter. As you may well imagine, this is no mean task and the magnitude of these queries may vary from a simple question on the pin connections of a certain valve to the use of a Mullard solid state device in some sophisticated circuit application. Much of this load is borne by members of the Technical Service Department, who are also responsible for the preparation and dissemination of technical literature.

Technical Literature

A large proportion of our publicity budget is expended on the local production of technical leaflets, data sheets and technical booklets (by no means the least of these being the journal you are now reading!). Publications such as Mullard Bulletin, Mullard Technical Communications and reprints, are received from Mullard Limited London, our Parent Company in the U.K., and these are allocated to key engineering personnel within the Industry.

Mullard Film Service

This film service is a well-established and popular division of the Mullard Technical Service Departments, and already well-known to training establishments throughout Australia. The film library contains a selection of 16mm sound films and 35mm filmstrips with lecture notes. They are available for loan for screening on specified forward dates and application should be made at least three weeks prior to the intended screenings.

Films and filmstrips on new topics are being added to the film library from time to time and announcements of these new additions are published in Outlook. At present, a revised film catalogue is being printed, copies of which may be obtained on application.

Technical Handbook Service

The Mullard Technical Handbook is a loose-leaf publication comprising six volumes (ten covers) issued on a subscription basis. It contains data sheets on Mullard valves, tubes, semiconductor devices and electrical and magnetic components. The information provided includes standard ratings, recommended operating conditions and performance figures for various applications, limiting values, characteristic and performance curves and outline diagrams.

The loose-leaf system has the advantage that the Handbook can be kept up-to-date by the issue of supplementary or revised sheets, thus providing subscribers with early information on new product types.

Subscription

From July, 1964, the initial subscription to the Mullard Technical Handbook covers the supply of supplementary issues in perpetuity, thus relieving subscribers of the need to renew subscriptions annually.

The subscriptions for the various volumes are as follows:—

Volumes 1, 3, 4, and 6	£4 5 0 each
Volumes 2 and 5	£2 10 0 each

Intending subscribers may order Handbooks by contacting the Technical Service Departments at Mullard Offices.

CONTENTS OF THE MULLARD TECHNICAL HANDBOOK

VOLUME 1

Current receiving and amplifying valves
Current television picture tubes
Special quality receiving valves
Electrometer valves

VOLUME 2

Maintenance-type receiving and amplifying valves and picture tubes

VOLUME 3

Cathode ray tubes:	Oscilloscope, radar, monitor, viewfinder and flying spot scanner tubes
Gasfilled valves and tubes:	Voltage stabiliser and reference tubes Counter, selector and indicator tubes Cold-cathode trigger tubes Thyratrons and ignitrons Thermionic power rectifiers
Transmitting, industrial heating and high power audio valves	
Microwave devices:	Disc seal valves, klystrons, magnetrons, backward wave oscillators and forward wave amplifiers
Vacuum devices	

VOLUME 4

Semiconductor devices:	Diodes, rectifiers, controlled rectifiers and transistors
Photoelectric devices:	Photoconductive and photoemissive cells Photodiodes and phototransistors Photomultiplier tubes Image converter and storage tubes

VOLUME 5

Electrical components:	Capacitors, resistors, thermistors voltage dependent resistors, electro-mechanical components

VOLUME 6

Magnetic components:	Permanent magnets Ferroxcube yokes, transformer cores and storage cores Vinkors

AN ELECTRONIC THERMOMETER

Since the publication of the article entitled "An Electronic Thermometer" in Outlook, Volume 7 Number 4, many readers have enquired regarding a suitable meter and switch for this unit.

The meter investigated by Mullard was supplied by Master Instruments Pty. Ltd., type number PT35 and is approximately 4¾" wide x 4" deep; it features a mirror-backed dial scale. The meter may be obtained from the manufacturers* who advise that it may be ordered with 100 dial divisions marked on the scale. These divisions may be used for the individual range calibration and returned to the manufacturers who will then supply a printed dial scale with the five ranges marked.

The range switch for the thermometer may be of either push-button or wafer type and may be obtained from most distributors.

* Master Instruments Pty. Ltd., Cnr. Sloane & Saywell Streets, Marrickville, N.S.W.

DIRECT MAILING SCHEME

In Outlook, Volume 7 Number 3, we discussed the Mullard Direct Mailing Scheme. The response to this article has been most gratifying and we are at present preparing the portfolios. The readers who have expressed interest in the Scheme will be contacted shortly.

SEMICONDUCTOR RELIABILITY

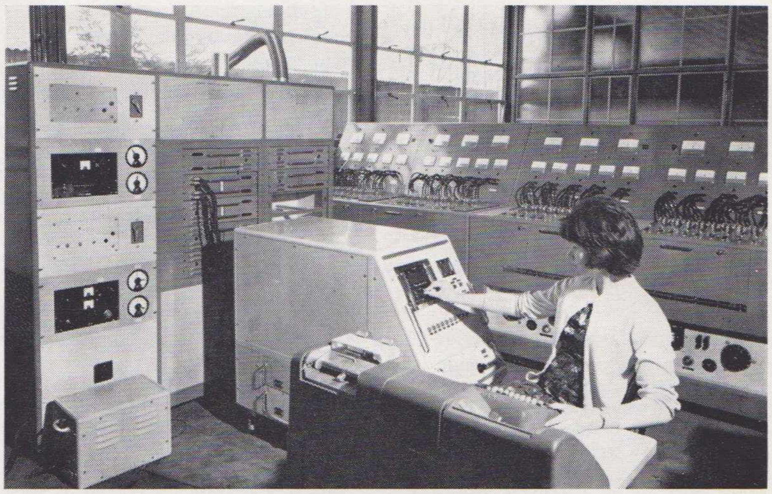
The Mullard semiconductor life test facilities have increased from 500 test positions in 1956 to the present number of 33,000 positions for life tests of small-signal transistors and diodes, power transistors, zener diodes, power rectifiers and thyristors. 15,000 of these are automatic in operation.

Sample quantities are taken at random from the production lines after they have passed the extensive series of factory tests to which every semiconductor device is subjected. Jigs containing 100 devices of the same type are loaded into life test consoles which run them under accurately-controlled conditions for the life test period of 1,000 or 10,000 hours. The tests are performed at three or more different combinations of voltage, current and temperature, at least one of which is the maximum rating of the device.

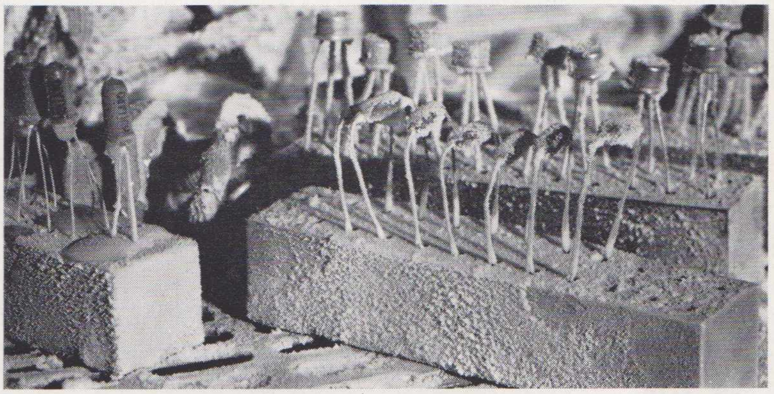
Periodically, during the life test the jigs are removed from the consoles and placed in the measurement cabinets, where all the significant characteristics of each semiconductor device are automatically measured and recorded on punched cards. On a typical transistor as many as ten characteristics will be measured.

The punched cards are subsequently fed to a computer which is programmed to produce in tabular form a complete history of the behaviour of each sample throughout the period of test. Usually, the characteristics are measured four times during a 1,000 hour test and ten times during a test of 10,000 hours.

Catastrophic failures (devices with short or open circuit) are searched daily using a mobile, automatic 'GO/NO-GO' scanner which can be connected quickly to any of the life test consoles. In this way, the time at which a particular semiconductor device fails can be recorded with accuracy.



Transistor characteristics being automatically measured during life testing.



Transistors and diodes undergoing environmental life testing at low temperatures.

Multi-Million Test Capacity

As an indication of the scale on which life testing is achieved, the equipment is capable of carrying out more than five million semiconductor-hours of testing a week, and in the last twelve months the computer has processed more than 1,500,000 punched cards.

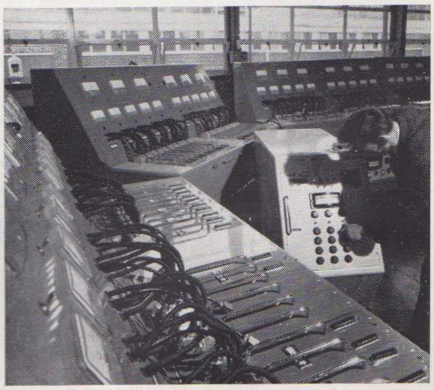
In addition to the facilities for electrical life tests, there is a great deal of equipment designed to test the endurance of those semiconductor devices likely to experience extremes of temperature, humidity and vibration during their working life. There are, for example, high-temperature storage ovens, low-temperature cabinets and climatic cycling cabinets which can simulate dry polar cold or steamy tropical heat. Vibration tests and shock tests are also carried out.

Progressive Improvements

The potential quality and reliability of a semiconductor device are, of course, built in to it at the design stage. One of the chief tasks is to make rigorous assessments of new devices to ensure that only those of proven life-performances are released.

Once the semiconductor device goes into production, there is a continual feedback of information to the development and production departments. An essential aspect of this process is the detailed analysis of semiconductor devices which fail during test so that the reason for the failure can be discovered and the cause eradicated from future production.

On examination of this recorded data it is found that the potential quality and reliability of a semiconductor are fully realised, that progressive improvements are made throughout the run and that a new device benefits from the outset by the experience gained on previous types.



Life test consoles for transistors and diodes. The trolley-mounted equipment is an automatic scanner used to discover semiconductors which fail catastrophically during the test.

BLY17 SILICON PLANAR N-P-N RF POWER TRANSISTOR with Interdigitated Structure

ABRIDGED DATA

The BLY17 is a triple diffused silicon planar transistor in TO-36 encapsulation intended for high-power RF amplifiers and for output stages in transmitters. The BLY17 is capable of giving 40W carrier power output at 30Mc/s with an efficiency of 60%.

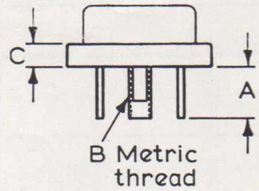
Limiting Values (absolute maximum values)

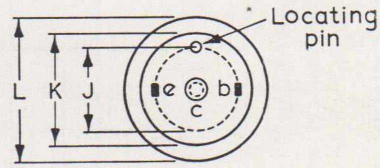
Collector	V_{CB}	max	100	V
	V_{CE}	max	80	V
	I_C	max	10	A
Emitter	V_{EB}	max	4	V
Temperature	T_S	−65 to	175	°C
	T_j	max	175	°C
Thermal resistance	$K_{j\text{-}c}$	⩽	1.5	°C/W

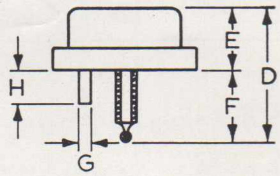
Characteristics at $T_{amb} = 25°C$

Collector to base voltage at $I_C = 50mA$	BV_{CBO}	>	100	V
Collector to emitter voltage at $I_C = 50mA$; $R = 10\Omega$	BV_{CER}	>	80	V
Emitter to base voltage at $I_E = 100mA$	BV_{EBO}	>	4	V
Base current at $I_E = 10A$; $V_{CB} = 1V$	I_B	<	2.0	A
Collector saturation voltage at $I_C = 10A$; $I_B = 2A$	V_{CES}	<	2	V
Base saturation voltage at $I_E = 10A$; $I_B = 2A$	V_{BES}	<	3	V
Collector base leakage current at $V_{CB} = 40V$	I_{CBO}		10	mA
High frequency current gain at $I_E = 1.5A$; $V_{CB} = 10V$; $f = 10Mc/s$	h_{fe}	>	5	
Collector capacitance (grounded base) at $V_{CB} = 10V$; $I_E = 0$	$C_{b'c}$		200	pF
$V_{CB} = 40V$; $I_E = 0$	$C_{b'c}$		100	pF

MECHANICAL OUTLINES AND DIMENSIONS

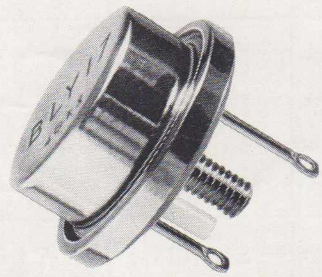






A	11·0	G	3·0
B	5·0	H	7·0
C	5·0	J	17·5
D	29	K	24·5
E	13·5	L	31
F	15·5		

(All dimensions in mm)



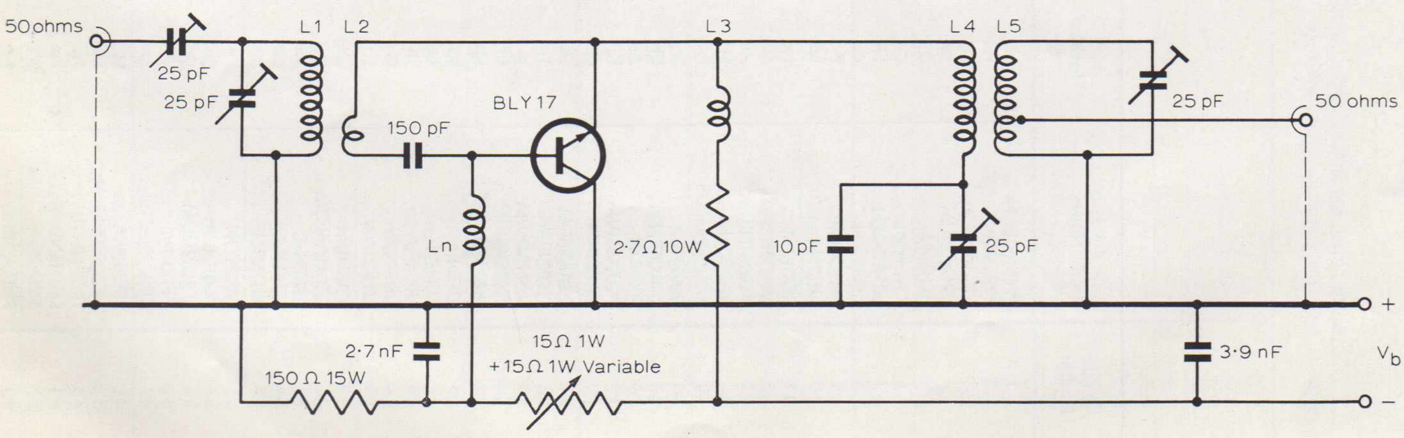
The BLY17 is a recent addition to the Mullard range of RF power transistors. It is a triple-diffused silicon planar transistor and it may be used as an RF amplifier in transmitters. A typical circuit is shown below.

INDUCTOR SPECIFICATIONS FOR THE CIRCUIT BELOW

L_1 = 14 turns of 1.2mm cu en wire; inner diameter 12mm
L_2 = 2 turns of 1.2mm cu en wire; inner diameter 12mm against "cold" side of L_1
L_3 = 5 turns of 1.2mm cu en wire; inner diameter 12mm
L_3 = RF choke; 27 turns of 0.5mm cu en wire; inner diameter 6mm
L_4 = 11 turns of 1.2mm cu en wire; inner diameter 12mm
L_5 = See L_1; tap at 2 turns from "cold" side.

RF performance in circuit (neutralised)

Output power at V_{CB} = 40V frequency f = 30Mc/s	P_o	>	30	W
Power gain	PG	>	6	dB
Efficiency	η	>	40	%



LIST OF THE ELEMENTS

Atomic Number	Name	Symbol	Atomic Weight	Distribution of Electrons within the Shells: K s	L s	L p	M s	M p	M d	N s	N p	N d	N f	O s	O p	O d	O f	P s	P p	P d	Q s	Group	Number of Neutrons	Atomic Number
1	HYDROGEN	H	1·008	1																		I	—	1
2	HELIUM	He	4·003	2																		—	2	2
3	LITHIUM	Li	6·939	2	1																	I	4	3
4	BERYLLIUM	Be	9·012	2	2																	II	5	4
5	BORON	B	10.81	2	2	1																III	6	5
6	CARBON	C	12·01	2	2	2																IV	6	6
7	NITROGEN	N	14·01	2	2	3																V	7	7
8	OXYGEN	O	16·00	2	2	4																VI	8	8
9	FLUORINE	F	19·00	2	2	5																VII	10	9
10	NEON	Ne	20·18	2	2	6																—	10	10
11	SODIUM	Na	22·99	2	2	6	1															I	12	11
12	MAGNESIUM	Mg	24·31	2	2	6	2															II	12	12
13	ALUMINIUM	Al	26·98	2	2	6	2	1														III	14	13
14	SILICON	Si	28·09	2	2	6	2	2														IV	14	14
15	PHOSPHORUS	P	30·99	2	2	6	2	3														V	16	15
16	SULPHUR	S	32·06	2	2	6	2	4														VI	16	16
17	CHLORINE	Cl	35·45	2	2	6	2	5														VII	18	17
18	ARGON	Ar	39·95	2	2	6	2	6														—	22	18
19	POTASSIUM	K	39·10	2	2	6	2	6	—	1												I	20	19
20	CALCIUM	Ca	40·08	2	2	6	2	6	—	2												II	20	20
21	SCANDIUM	Sc	44·96	2	2	6	2	6	1	2												IIIa	24	21
22	TITANIUM	Ti	47·90	2	2	6	2	6	2	2												IVa	26	22
23	VANADIUM	V	50·94	2	2	6	2	6	3	2												Va	28	23
24	CHROMIUM	Cr	52·00	2	2	6	2	6	5	1												VIa	28	24
25	MANGANESE	Mn	54·94	2	2	6	2	6	5	2												VIIa	30	25
26	IRON	Fe	55·85	2	2	6	2	6	6	2												VIII	30	26
27	COBALT	Co	58·93	2	2	6	2	6	7	2												VIII	32	27
28	NICKEL	Ni	58·71	2	2	6	2	6	8	2												VIII	30	28
29	COPPER	Cu	63·54	2	2	6	2	6	10	1												Ia	34	29
30	ZINC	Zn	65·37	2	2	6	2	6	10	2												IIa	34	30
31	GALLIUM	Ga	69·72	2	2	6	2	6	10	2	1											III	38	31
32	GERMANIUM	Ge	72·59	2	2	6	2	6	10	2	2											IV	42	32
33	ARSENIC	As	74·92	2	2	6	2	6	10	2	3											V	42	33
34	SELENIUM	Se	78·96	2	2	6	2	6	10	2	4											VI	46	34
35	BROMINE	Br	79·91	2	2	6	2	6	10	2	5											VII	44	35
36	KRYPTON	Kr	83·80	2	2	6	2	6	10	2	6											—	48	36
37	RUBIDIUM	Rb	85·47	2	2	6	2	6	10	2	6	—	—	1								I	48	37
38	STRONTIUM	Sr	87·62	2	2	6	2	6	10	2	6	—	—	2								II	50	38
39	YTTRIUM	Y	88·91	2	2	6	2	6	10	2	6	1	—	2								IIIa	50	39
40	ZIRCONIUM	Zr	91·22	2	2	6	2	6	10	2	6	2	—	2								IVa	50	40
41	NIOBIUM	Nb	92·91	2	2	6	2	6	10	2	6	4	—	1								Va	52	41
42	MOLYBDENUM	Mo	95·94	2	2	6	2	6	10	2	6	5	—	1								VIa	56	42
43	TECHNETIUM*	Tc	(97)	2	2	6	2	6	10	2	6	6	—	1								VIIa	(54)	43
44	RUTHENIUM	Ru	101·1	2	2	6	2	6	10	2	6	7	—	1								VIII	58	44
45	RHODIUM	Rh	102·9	2	2	6	2	6	10	2	6	8	—	1								VIII	58	45
46	PALLADIUM	Pd	106·4	2	2	6	2	6	10	2	6	10	—	—								VIII	60	46
47	SILVER	Ag	107·9	2	2	6	2	6	10	2	6	10	—	1								Ia	60	47
48	CADMIUM	Cd	112·4	2	2	6	2	6	10	2	6	10	—	2								IIa	66	48
49	INDIUM	In	114·8	2	2	6	2	6	10	2	6	10	—	2	1							III	64	49
50	TIN	Sn	118·7	2	2	6	2	6	10	2	6	10	—	2	2							IV	70	50

51	ANTIMONY	Sb	121·8	2	2 6	2 6 10	2 6 10 —	2 3			V	70	51
52	TELLURIUM	Te	127·6	2	2 6	2 6 10	2 6 10 —	2 4			VI	78	52
53	IODINE	I	126·9	2	2 6	2 6 10	2 6 10 —	2 5			VII	74	53
54	XENON	Xe	131·3	2	2 6	2 6 10	2 6 10 —	2 6			—	78	54
55	CAESIUM	Cs	132·9	2	2 6	2 6 10	2 6 10 —	2 6 — —	1		I	78	55
56	BARIUM	Ba	137·3	2	2 6	2 6 10	2 6 10 —	2 6 — —	2		II	82	56
57	LANTHANUM	La	138·9	2	2 6	2 6 10	2 6 10 —	2 6 1 —	2		IIIa	82	57
58	CERIUM	Ce	140·1	2	2 6	2 6 10	2 6 10 2	2 6 — —	2		IIIa	82	58
59	PRASEODYMIUM	Pr	140·9	2	2 6	2 6 10	2 6 10 3	2 6 — —	2		IIIa	82	59
60	NEODYMIUM	Nd	144·2	2	2 6	2 6 10	2 6 10 4	2 6 — —	2		IIIa	82	60
61	PROMETHIUM*	Pm	(145)	2	2 6	2 6 10	2 6 10 5	2 6 — —	2		IIIa	(84)	61
62	SAMARIUM	Sm	150·4	2	2 6	2 6 10	2 6 10 6	2 6 — —	2		IIIa	90	62
63	EUROPIUM	Eu	152·0	2	2 6	2 6 10	2 6 10 7	2 6 — —	2		IIIa	90	63
64	GADOLINIUM	Gd	157·3	2	2 6	2 6 10	2 6 10 7	2 6 1 —	2		IIIa	94	64
65	TERBIUM	Tb	158·9	2	2 6	2 6 10	2 6 10 9	2 6 — —	2		IIIa	94	65
66	DYSPROSIUM	Dy	162·5	2	2 6	2 6 10	2 6 10 10	2 6 — —	2		IIIa	98	66
67	HOLMIUM	Ho	164·9	2	2 6	2 6 10	2 6 10 11	2 6 — —	2		IIIa	98	67
68	ERBIUM	Er	167·3	2	2 6	2 6 10	2 6 10 12	2 6 — —	2		IIIa	98	68
69	THULIUM	Tm	168·9	2	2 6	2 6 10	2 6 10 13	2 6 — —	2		IIIa	100	69
70	YTTERBIUM	Yb	173·0	2	2 6	2 6 10	2 6 10 14	2 6 — —	2		IIIa	104	70
71	LUTETIUM	Lu	175·0	2	2 6	2 6 10	2 6 10 14	2 6 1 —	2		IIIa	104	71
72	HAFNIUM	Hf	178·5	2	2 6	2 6 10	2 6 10 14	2 6 2 —	2		IVa	108	72
73	TANTALUM	Ta	180·9	2	2 6	2 6 10	2 6 10 14	2 6 3 —	2		Va	108	73
74	TUNGSTEN	W	183·9	2	2 6	2 6 10	2 6 10 14	2 6 4 —	2		VIa	110	74
75	RHENIUM	Re	186·2	2	2 6	2 6 10	2 6 10 14	2 6 5 —	2		VIIa	110	75
76	OSMIUM	Os	190·2	2	2 6	2 6 10	2 6 10 14	2 6 6 —	2		VIII	116	76
77	IRIDIUM	Ir	192·2	2	2 6	2 6 10	2 6 10 14	2 6 9 —	—		VIII	116	77
78	PLATINUM	Pt	195·1	2	2 6	2 6 10	2 6 10 14	2 6 9 —	1		VIII	116	78
79	GOLD	Au	197·0	2	2 6	2 6 10	2 6 10 14	2 6 10 —	1		Ia	118	79
80	MERCURY	Hg	200·6	2	2 6	2 6 10	2 6 10 14	2 6 10 —	2		IIa	122	80
81	THALLIUM	Tl	204·4	2	2 6	2 6 10	2 6 10 14	2 6 10 —	2 1		III	124	81
82	LEAD	Pb	207·2	2	2 6	2 6 10	2 6 10 14	2 6 10 —	2 2		IV	126	82
83	BISMUTH	Bi	209·0	2	2 6	2 6 10	2 6 10 14	2 6 10 —	2 3		V	126	83
84	POLONIUM*	Po	(209)	2	2 6	2 6 10	2 6 10 14	2 6 10 —	2 4		VI	(125)	84
85	ASTATINE*	At	(210)	2	2 6	2 6 10	2 6 10 14	2 6 10 —	2 5		VII	(125)	85
86	RADON*	Rn	(222)	2	2 6	2 6 10	2 6 10 14	2 6 10 —	2 6		—	(136)	86
87	FRANCIUM*	Fr	(223)	2	2 6	2 6 10	2 6 10 14	2 6 10 —	2 6 —	1	I	(136)	87
88	RADIUM*	Ra	(226)	2	2 6	2 6 10	2 6 10 14	2 6 10 —	2 6 —	2	II	(138)	88
89	ACTINIUM*	Ac	(227)	2	2 6	2 6 10	2 6 10 14	2 6 10 —	2 6 1	2	IIIa	(138)	89
90	THORIUM*	Th	232·0	2	2 6	2 6 10	2 6 10 14	2 6 10 —	2 6 2	2	IIIa	142	90
91	PROTACTINIUM*	Pa	(231)	2	2 6	2 6 10	2 6 10 14	2 6 10 2	2 6 1	2	IIIa	(140)	91
92	URANIUM*	U	238	2	2 6	2 6 10	2 6 10 14	2 6 10 3	2 6 1	2	IIIa	146	92
93	NEPTUNIUM*	Np	(237)	2	2 6	2 6 10	2 6 10 14	2 6 10 4	2 6 1	2	IIIa	(144)	93
94	PLUTONIUM*	Pu	(244)	2	2 6	2 6 10	2 6 10 14	2 6 10 6	2 6 —	2	IIIa	(150)	94
95	AMERICIUM*	Am	(243)	2	2 6	2 6 10	2 6 10 14	2 6 10 7	2 6 —	2	IIIa	(148)	95
96	CURIUM*	Cm	(247)	2	2 6	2 6 10	2 6 10 14	2 6 10 7	2 6 1	2	IIIa	(151)	96
97	BERKELIUM*	Bk	(247)	2	2 6	2 6 10	2 6 10 14	2 6 10 8	2 6 1	2	IIIa	(150)	97
98	CALIFORNIUM*	Cf	(251)	2	2 6	2 6 10	2 6 10 14	2 6 10 10	2 6 —	2	IIIa	(153)	98
99	EINSTEINIUM*	Es	(254)	2	2 6	2 6 10	2 6 10 14	2 6 10 11	2 6 —	2	IIIa	(155)	99
100	FERMIUM*	Fm	(253)	2	2 6	2 6 10	2 6 10 14	2 6 10 12	2 6 —	2	IIIa	(153)	100
101	MENDELEVIUM*	Mv	(256)	2	2 6	2 6 10	2 6 10 14	2 6 10 13	2 6 —	2	IIIa	(155)	101
102	NOBELIUM*	No	(253)	2	2 6	2 6 10	2 6 10 14	2 6 10 14	2 6 —	2	IIIa	(151)	102
103	LAWRENTIUM*	Lw	(257)	2	2 6	2 6 10	2 6 10 14	2 6 10 14	2 6 1	2	IIIa	(154)	103
104				2	2 6	2 6 10	2 6 10 14	2 6 10 14	2 6	2			104
105				2	2 6	2 6 10	2 6 10 14	2 6 10 14	2 6	2			105
106				2	2 6	2 6 10	2 6 10 14	2 6 10 14	2 6	2			106
107				2	2 6	2 6 10	2 6 10 14	2 6 10 14	2 6	2			107
108				2	2 6	2 6 10	2 6 10 14	2 6 10 14	2 6	2			108
109				2	2 6	2 6 10	2 6 10 14	2 6 10 14	2 6	2			109
110				2	2 6	2 6 10	2 6 10 14	2 6 10 14	2 6	2			110

NOTES: 1. Elements marked * are unstable.
2. In all cases, the atomic weight is shown to four significant figures where these are available.
3. Room has been left at the bottom of the table for newly discovered elements to be inserted.
4. The number of neutrons in the nucleus is calculated for the most commonly found isotope.

Reprints of this leaflet are available on receipt of a stamped, self-addressed, foolscap envelope, endorsed "Elements".

MULLARD A59-11W PANORAMA RADIANT

This new Mullard picture tube, the Panorama Radiant Screen A59-11W, represents a radical new concept in picture tube development. No form of implosion guard is required; the face of the tube is completely uncovered.

The A59-11W is a 59cm (23in.) picture tube with a metal backed screen, electrically identical to the AW59-91.

During the last few years, work has been proceeding on a new concept in picture-tube design—an implosion-free picture tube. Intensive study into the nature of the causes of implosion in picture tubes has revealed that reinforcement of the envelope eliminates the risk of implosion. The outcome of these investigations is a revolutionary development—a picture tube with inherent safety, one in which violent disintegration of the glass envelope cannot occur.

The immediate consequence of this development is that no protective shield is required between the viewer and the faceplate of the new tubes. Mullard Panorama picture tubes thus make possible completely safe viewing.

Other advantages accruing from the inherent safety of the Mullard implosion-free picture tubes are that complete safety is afforded to the viewer and to anyone handling the tubes; also damage to a receiver in the event of tube breakage is prevented.

The benefits to be gained from the absence of a protective shield in a receiver are fourfold:

1. Problems of dust accumulation on the faceplate and the safety shield are eliminated and therefore, the cost of providing an efficient dust seal between faceplate and shield is also removed.
2. The number of reflecting surfaces between the viewer and the picture is minimised. Reflections of internal and external light are thus reduced and picture-contrast accordingly improved.
3. Greater freedom is allowed for cabinet styling since, in conventional receivers, the style is dictated to a large extent by the need to provide the safety screen.
4. Smaller and lighter receivers with better physical stability are possible. Absence of the safety screen eliminates the space between the faceplate and the screen, and gives a better distribution of weight. (Use of the 'short' electron gun also contributes to shallow cabinets.)

One further advantage of the Mullard Panorama picture tubes is that mounting in receiver cabinets is simplified. Four metal lugs are attached to the tubes, and these can be bolted directly to the cabinet. The cost of a mounting strap is thus removed. Guidance on the correct positioning of the fixing bolts is provided in the data for the tube.

Picture Tube Implosions

Implosion (the violent disintegration of an evacuated vessel under atmospheric pressure) can occur in a television picture tube when regions of the tube envelope under tensile stress are damaged. Those regions under compressive stresses are less vulnerable because of the 'keying' effect of the envelope itself, the effect being analogous with that of an arched bridge under load.

The early stages of an implosion in a conventional tube are marked by a rapidly growing network of cracks propagating and branching from the original point of damage before the internal and external air pressures are equalised through the collapse of the tube. The envelope shatters into fragments which are projected forcibly under the influence of the external pressure. To protect the viewer from glass it has hitherto been essential to introduce a transparent protective shield between the viewer and the picture tube screen, either separated from the screen or cemented to the faceplate. The new Mullard tubes represent a revolutionary departure from this procedure.

Prevention of Implosion

In the new Mullard tube type A59-11W, **prevention** of implosion has taken precedence over efforts to **contain** the effects of an implosion.

Implosion can occur in a conventional picture tube as a result of damage to regions of the tube under tensile stress. Very occasionally, an implosion has occurred spontaneously because some local weakness has developed in the tube envelope in these regions of tensile stress. In the new Mullard tubes, measures have been taken to protect the vulnerable regions of the tube and also to prevent the possible spread from the site of a blow or local weakness of the fissures that lead to an implosion.

A cadmium-plated mild-steel shell is sealed by means of a resin to the periphery of the faceplate of the tube—the region of greatest tensile stress. In addition to protecting the tube from damage, this shell also opposes deformation or expansion of the glass, thus preventing the widening and spreading of any crack which may occur. Under normal conditions, the band is free from stress, exerting force on the envelope only if the glass breaks.

Investigation of Safety

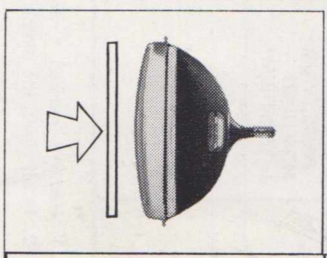
During the design stages, Mullard implosion-free picture tubes are tested with respect to implosion safety in various ways: by simulated spontaneous fracture, by external impact, and even by fire. The object of the tests is to establish that the omission of a protective screen between the faceplate and the viewer is justified under all conceivable circumstances, and that the reinforcement of the tubes is also an effective safeguard to the engineer who handles tubes without the protection afforded by the cabinet. Newly manufactured tubes and tubes which have undergone a series of climatic and life tests are therefore investigated. Strict controls in the factory and in technical departments ensure that every tube produced will be safe.

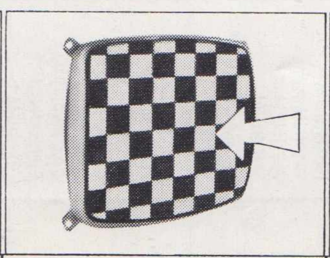
Tube Characteristics

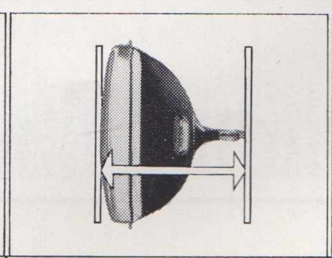
Electrically the Mullard A59-11W implosion-free picture tube is identical with the conventional Mullard AW59-91 tube. The new tube uses a unipotential focusing lens, and incorporates the short electron gun, so that the neck of the tube is only 110mm.

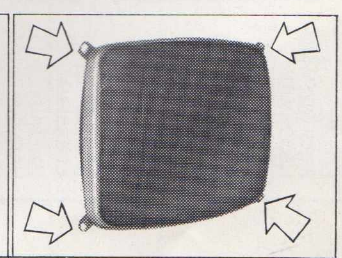
The screen transmission of the A59-11W is 53%.

A leaflet is available on receipt of a stamped self-addressed foolscap envelope, endorsed "Panorama" detailing the important characteristics of the A59-11W.


No safety glass required


Contrast-enriched picture


Slimmer cabinet (short neck)


Simplified Mounting

SCREEN LONG LIFE PICTURE TUBE

PRELIMINARY DATA

59cm (23in) direct viewing television tube with metal backed screen and reinforced envelope. A separate safety screen is not required. This tube is electrically identical to the AW59-91.

Deflection	110	deg
Focusing	Electrostatic	
Light transmission	53	%
Overall length	36.7	cm

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

Note—(applies to series operation only). The surge heater voltage must not exceed 9.5 $V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain, a current limiting device may be necessary in the circuit, to ensure that this voltage is not exceeded.

OPERATING CONDITIONS

V_{a2+a4}	18	18	kV
V_{a3} (focus electrode control range)	0 to 400	0 to 400	V
V_{a1}	400	500	V
V_g for visual extinction of focused raster	−40 to −77	−50 to −93	V
* V_k for visual extinction of focused raster	36 to 66	45 to 79	V

** For cathode modulation, all voltages are measured with respect to grid.*

SCREEN

Metal backed		
Fluorescent colour	White	
Light transmission (approx.)	53	%

FOCUSING

Electrostatic

The range of focus voltages is shown in the A59-11W data in Vol. 1 of the Mullard Technical Handbook.

DEFLECTION

Double magnetic

The deflection coils should be designed so that their internal contour is in accordance with JEDEC gauge 126, and should provide a pull-back of 4 mm on a nominal tube.

CAPACITANCES

c_{g-all}	6·0	pF
c_{k-all}	4·0	pF
$c_{a2+a4-M}$	1700 to 2500	pF
$c_{a2+a4-B}$	350	pF

EXTERNAL CONDUCTIVE COATING

This tube has an external conductive coating, M, which must be earthed, and the capacitance of this to the final anode is used to provide smoothing for the EHT supply. The tube marking and warning labels are on the side of the cone opposite the final anode connector and this side should not be used for making contact to the external conductive coating.

RASTER CENTRING

Centring magnet field intensity	0 to 10	G
Maximum distance of centre of centring field from reference line	57	mm

Adjustment of the centring magnet should not be such that a general reduction in brightness of the raster occurs.

MOUNTING POSITION

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40 mm diameter which is centred upon the perpendicular from the centre of the face.

This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handling the tube.

It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in any equipment.

DESIGN CENTRE RATINGS

* V_{a2+a4} max. (at $I_{a2+a4} = 0$)	18	kV
V_{a2+a4} min.	13	kV
+ V_{a3} max.	1·0	kV
− V_{a3} max.	500	V
** + $V_{a3(pk)}$ max.	2·5	kV
V_{a1} max.	550	V
V_{a1} min.	350	V
** − $V_{g(pk)}$ max.	400	V
‡ − V_g max.	150	V
± I_{a3} max.	25	μA
± I_{a1} max.	5	μA
† V_{h-k}		
Cathode positive		
DC max.	250	V
pk max.	300	V
Cathode negative		
DC max.	135	V
pk max.	180	V
R_{h-k} max.	1·0	MΩ
Z_{k-e} max. (f = 50 c/s)	100	kΩ
R_{g-k} max.	1·5	MΩ
Z_{g-k} max. (f = 50 c/s)	500	kΩ

*Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused by a possible high voltage flashover within the cathode ray tube.

**Maximum pulse duration 22% of a cycle with a maximum of 1.5 ms.

‡The DC value of bias must not be such as to allow the grid to become positive with respect to the cathode, except during the period immediately after switching the receiver on or off when it may be allowed to rise to + 2V. To ensure long life of the tube it is advisable to limit the positive excursion of the video signal to + 5V $_{(pk)\ max.}$ This may be achieved automatically by the series connection of a 10 kΩ resistor.

†In order to avoid excessive hum the AC component of Vh-k should be as low as possible.

During a warming up period not exceeding 15 secs, $V_{h-k\ (pk)max.}$ (cathode positive) is allowed to rise to 410V.

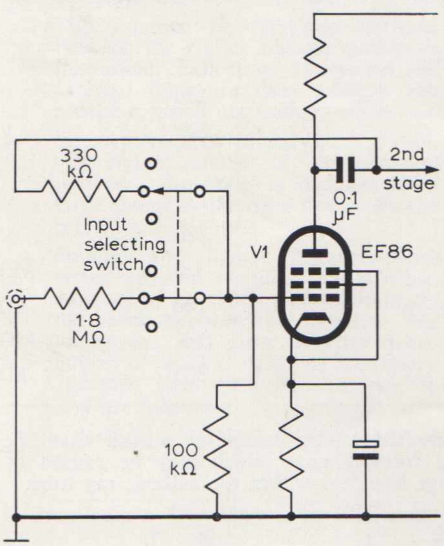
G.M. OVERSEAS

Mr. M. A. Brown, our General Manager, left Sydney on September 11th for overseas. He will visit the Far East, United Kingdom, the Continent, the United States and Canada. Mr. Brown expects to return early December. During his absence Mr. K. L. Robertson is acting on his behalf.

MULLARD VALVE PRE-AMPLIFIERS

Input Facilities For Ceramic Pick-Up Cartridges

Following the introduction of ceramic pick-up cartridges, a pre-amplifier input circuit is now necessary, having an input impedance of 2MΩ and sensitivity of approximately 350mV for full output. Constructors wishing to use such pick-up cartridges with the pre-amplifier designs described in the Mullard publication "Circuits for Audio Amplifiers" and "Stereo Sound Systems"* should alter the circuitry of one of the input positions to the arrangement shown in the diagram. Only the relevant component values are shown and the switching arrangements have been simplified for clarity.



The values given are applicable to the various pre-amplifier circuits, but it should be remembered that the alteration must be made to the same switch position on both channels of the stereophonic pre-amplifier.

* These publications are available from Mullard Offices and distributors throughout the Commonwealth priced as follows:—

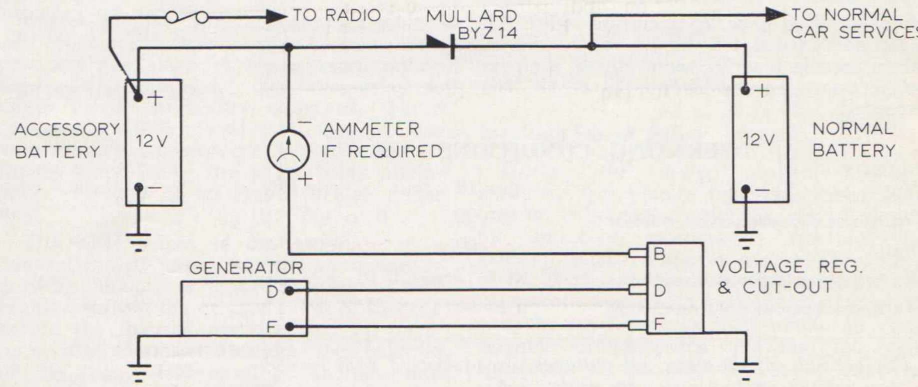
"Circuits for Audio Amplifiers"	12/6d plus 1/5d postage
"Stereo Sound Systems"	6/3d plus 8d postage

MULLARD SILICON POWER RECTIFIER TYPE BYZ14

An Interesting Application

Many operators of mobile radio stations using comparatively high power, high frequency equipment have felt the need for primary power supplies having a greater capacity than available from the usual 12V 30A/h battery and 25A DC generator Whilst the availability of the alternator as standard equipment in some vehicles, and as an alternative in others, has in some measure alleviated the position by virtue of the alternator's ability to continue charging at idling speeds, this in itself does not provide the answer to the problem as there are many occasions when it is desirable to operate two-way radio equipment without the vehicle in motion or the motor in operation.

a silicon power diode having sufficient capacity to cope with charge currents and load currents under all conditions. The high power radio equipment may be connected to the accessory battery which will discharge without affecting the normal vehicle battery. The voltage regulator reference should be taken from the accessory battery which will charge the normal battery, through the silicon power diode. A suitable diode for this application is the Mullard BYZ14, which may be mounted on a heat sink and fitted to, but insulated from, the body of the vehicle. The heat sink, which on this occasion is a 6" length of Mullard 35D (Type 35D6C or 35D6CB),



The increasing popularity of vehicles fitted with automatic transmission, coupled with the elimination of the starting handle dictates the need for the vehicle battery to be maintained at a sufficiently high charge level to ensure trouble free engine starting. With a number of makes of vehicle having automatic transmission, the engine cannot be started by towing since the high pressure oil pump in the power transfer system, usually driven from the engine, must be in operation before power can be transferred from the wheels to the engine and vice versa.

A partial solution to the problem is to provide two batteries connected in parallel, preferably having as large a capacity as can be contained in the normal and accessory battery carriers. The accessory battery may be fitted in the engine compartment, the boot or in some other suitable location. In the writer's vehicle, sufficient space exists on the right hand side of the motor for an additional battery carrier and, in this case, the retailer fitted the desired battery carrier for a small extra charge. Whilst two batteries in parallel increase the overall capacity and make a worthwhile contribution to reliability, both batteries will still discharge together.

Although a greater initial capacity is available, it is nevertheless possible for both batteries to become discharged, thus resulting in difficult engine starts. Furthermore, should one battery become faulty through a short-circuited cell, one common cause of battery failure, then the second battery will also be discharged.

A superior and almost foolproof approach, is to isolate the two batteries with

provides adequate dissipation and a simple metal cover of either expanded steel or aluminium may be placed over the insulated heat sink, thus providing protection against accidental short circuits when working on the vehicle. Under start conditions the BYZ14 can be called upon to supply relatively high current from the accessory battery; however, examination of the data shows that under surge conditions the BYZ14 can withstand a current flow of 350A for a period of 10 seconds, or 260A for a period of 60 seconds, thus providing a more than adequate safety factor. Consideration could be given to the use of a low power silicon diode which would, no doubt, operate quite well under normal conditions, but the reserve safety factor, highly desirable for reliability, would perhaps be inadequate under the most adverse conditions, such as where the motor vehicle battery was in a state of discharge due to, say, failure of one cell. Whilst a system such as the one described is capable of an exceedingly high degree of reliability, it may be considered desirable to provide an ammeter to indicate the charge current being supplied by the generator or alternator since this, in some measure, will give warning of any tendency to malfunction. There are numerous possible refinements and this system must be considered somewhat basic; however, the system as described has been operating quite satisfactorily for some time in the writer's vehicle and is maintaining both batteries at the desired charge level.

B. P. A. Beresford.

ISO-Q CURVES

Iso-Q curves are constructed by joining points of equal Q-factor when plotted on inductance against frequency axes. These curves provide a simple and convenient method for the coil designer to check how variations of the various design parameters will affect the performance of an inductor, without having to carry out measurements on an actual component. Mullard is the first component manufacturer to make such curves available for its inductive components.

In the construction of passive networks, components are used which exhibit resistive, capacitive, or inductive characteristics. Resistors and capacitors are obtained from component suppliers ready for use. In the case of inductors, however, a 'skeletal' component is usually supplied to which a winding must be applied before the inductor can be installed in the circuit. The choice of skeletal component and the type of winding applied are decided by the coil designer after calculation and extrapolation from the data supplied by the component manufacturer.

One of the main parameters of a coil which the designer must guarantee is the Q-factor—that is, the ratio of reactive impedance to resistive impedance. In the past, the first stage in the selection and design procedure has been to consult the somewhat sketchy typical Q-factor curves published in the manufacturer's data. With the publication of Iso-Q curves (also known as equi-Q charts or Q-factor 'maps') for Mullard Vinkor inductive components, a great deal of the tedium in selection and design has been alleviated.

Construction of Iso-Q Curves

Iso-Q curves are constructed by joining points of equal Q-factor when plotted on inductance against frequency axes. They are similar to isobars (lines of equal pressure) or contours (lines of equal height). Iso-Q curves are constructed from a mass of data compiled from measurements made on the component and from a knowledge of good coil-design practice. For each size and permeability of component, a different set of Iso-Q curves will result and, in addition, the type of wire with which the component is wound will introduce further variations. In compiling these curves it has been assumed that the best Q-factor will result from the pot-core type of inductor when the bobbin is fully wound (it is acknowledged that at high frequencies and with small inductance values this is not strictly true). As the frequency rises and the inductance value falls, a larger gauge of wire can be used to fill the bobbin and at some frequency (usually above 25kc/s) a higher Q-factor will result from using stranded or bunched conductors rather than solid wire.

From the foregoing, it is apparent that several Iso-Q curve sets are needed to satisfy all conditions. For the Vinkor range of adjustable inductors, Iso-Q curves have been compiled for four types of wire: solid wire, and bunched conductors using 45, 48, and 50 s.w.g. strands. The three most suitable sets are provided with the data for each size and permeability of Vinkor.

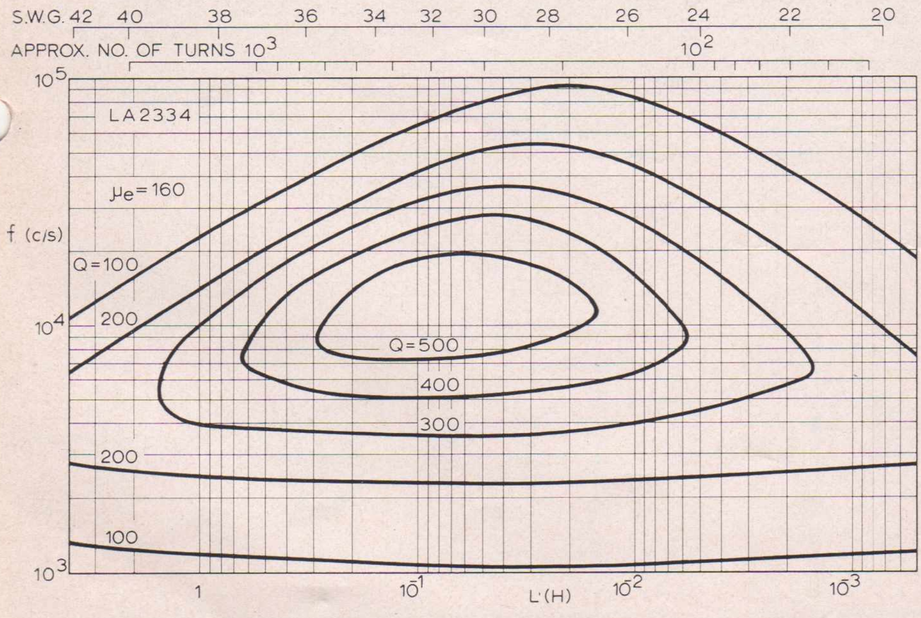
Use of Iso-Q Curves

With the aid of Iso-Q curves it is possible, for a particular inductance value and frequency, to compare the Q-factor resulting from the use of different sizes of pot core. It is also possible for the designer to explore the performance of an inductor when slight modifications are made to the required inductance value. The coil designer can then decide from both performance and economic considerations which is the best type of core to use without having to undertake a series of measurements on actual coil designs.

The Iso-Q curves published for Vinkors are based on typical values of core and coil parameters and it may be found that because of production variations, in some cases the actual Q-factors shown are not being attained. This is no way detracts from the usefulness of Iso-Q curves, as they are still valid as a method of comparison when modified by the individual user's own safety factors.

The Iso-Q curves shown below contain sufficient information for an inductor design. Inductance values are shown on a logarithmic scale along the base of the diagram; frequency, also on the logarithmic scale, is shown on the left-hand side. Along the top of the diagram are scales showing the number of turns and the gauge for solid wire.

Iso-Q curves are contained in the Vinkor section in Volume 6 of the Mullard Technical Handbook; comprehensive design data and other relevant information are contained in the Mullard publication "Vinkor Manual" priced at 5/3d plus 8d postage and available from Mullard offices and distributors throughout the Commonwealth.



Typical Iso-Q curves. These curves show typical Q-factors obtainable with windings of enamelled copper wire on coil former type DT2179, using Vinkor type LA2334.

NEW MELBOURNE MANAGER

Effective as from the 1st September, Mr. Graham Gale has been appointed Manager of our Melbourne office and is responsible for our activities in Victoria and Tasmania. Mr. Gale was previously Melbourne office Technical/Commercial Manager.

MAILING LIST

If you change your location, don't forget to let us know in good time, otherwise your Outlook may reach you late or never. And please, when you change, quote both your old and your new address. We can then be sure of destroying the obsolete mailing plate.

SIMPLE TRANSISTOR MEASUREMENTS

This article is the first of a series to be produced in Outlook containing suggestions and instructions on a number of experiments in which the properties and behaviour of alloy junction transistors are examined. They are intended to give the student engineer a better understanding of the basic operation of the transistor and to illustrate its practical application.

Junction transistor type OC71 is made from a thin plate of n-type germanium and two pellets of indium, one on either side of the germanium plate and opposite each other (Fig. 1).

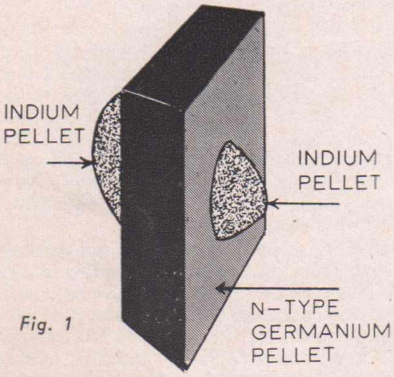


Fig. 1

Manufacture

During manufacture, this assembly is heated, causing the indium to alloy with the germanium and the process is continued until the alloy regions approach each other (but do not meet) in the middle of the germanium (Fig. 2).

The assembly is then cooled and the pellets re-crystallise to form a continuous mono-crystalline mass which consists of n-type germanium sandwiched between two regions of p-type germanium — in other words a p-n-p type junction transistor. This type of transistor is termed an alloy junction transistor.

The three regions are known as the **emitter**, the **base** and the **collector.**

Operation

Both emitter-base and collector-base junctions can be considered separately as simple diodes. One way to look at a junction transistor is to consider one diode (collector) as biased with respect to the base in the direction of easy current flow.

Consider first the diode formed by the base and collector. Assuming the emitter to be open-circuited, only the collector leakage current flows in the collector circuit (Fig. 3).

If the emitter circuit is now closed so that current flows in the forward direction in the emitter circuit, the leakage current in the collector circuit is greatly increased.

For example, in the circuit of Fig. 4, a forward current of 1mA through the emitter diode (which can be obtained by applying a positive potential of about 0·1V and thus represents a power input of 0·1mW) can cause a change of 0·9mA in the collector reverse current. (In this diagram the original reverse leakage current has been neglected.) At these operating conditions (collector potential —5V) the power in the collector circuit has been increased to 4·5mW. Thus, the device operates as a power amplifier with an internal power gain of 45. (Note the conventional circuit symbol for a transistor.)

Electrons and Holes

A physical explanation of this action can be obtained from the concept that conduction in germanium is either by electrons or by 'holes' i.e., 'positive' electrons. If the germanium is n-type, conduction is mainly by electrons and these electrons are known as 'majority carriers'. Holes, being fewer in number, are then said to be 'minority carriers' in n-type germanium.

If, on the other hand, the germanium is p-type, conduction is mainly by holes which are, therefore, the 'majority carriers' in p-type germanium and electrons are the minority carriers.

When, in a p-n-p junction transistor, the collector diode is so biased with respect to the base that the collector-to-base repels electrons approaching from the base, the only collector current that is able to flow corresponds to the few residual holes in the n-type germanium. These not only pass through the barrier but are even assisted on their way from base to collector. This current is the collector leakage current.

If, now, the emitter diode is biased with respect to the base in the direction of easy current flow, the emitter current into the base germanium consists mainly of holes (majority carriers in p-type germanium but minority carriers in the n-type base germanium). These holes will diffuse across the base region to the base-collector diode which, it will be remembered, is biased in the direction which prevents the passage of electrons but attracts the holes.

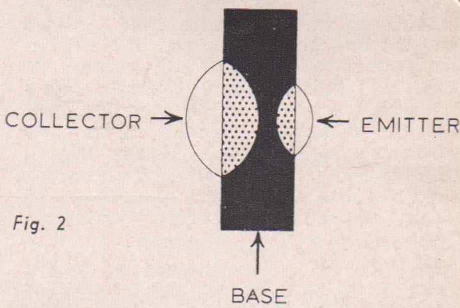


Fig. 2

Only a very small voltage (—0·1V) applied across the base-collector junction is required to collect all the available holes from the base region. Increasing this voltage results in only a very small increase in current i.e. the output impedance of the transistor is high. On the other hand since the emitter-base diode is biased in the direction of easy current flow, the input impedance is, of course, low.

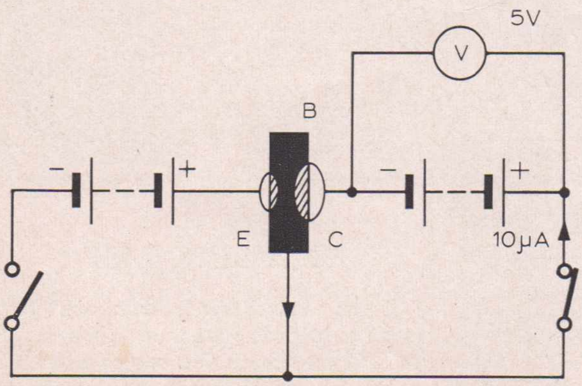


Fig. 3

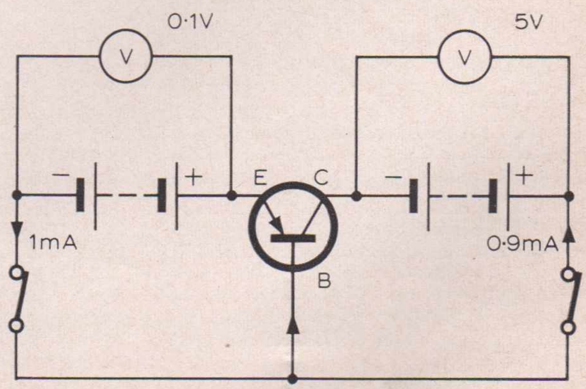


Fig. 4

STAR PRINTERY