TELEVISION

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

25p

FEBRUARY 1975

CRT Tester and Reactivator

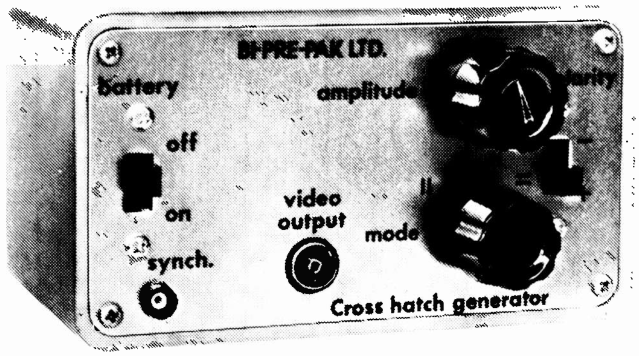
Also:

TWO-TERMINAL STABILISERS

AUTOMATIC GREY-SCALE CORRECTION

SERVICING THE DECCA MS1700/MS2001/MS2401

LINE IT UP WITH A B-P-P MARK-2 CROSS-HATCH GENERATOR



in kit form or ready-built

Based on the design originally published in "TELEVISION" this unit is invaluable to industrial and home users alike. Improved circuitry assures reliability and still better accuracy. very compact; self-contained. Robustly built. Widely used by TV rental and other engineers. With strong metal case, instructions, but less batteries. INDISPENSABLE FOR COLOUR.

In Kit form **£7.93** *Ready built and tested* **£9.93**

add 8% for V.A.T. to total value of order and inc. 15p postage and packing (*in U.K.*)

★ **TV Signal Strength Meter** as described in this journal. Complete kit as specified **£19.50**+40p. postage & packing+£1.59 VAT.

★ 4–PATTERN SELECTOR SWITCH
★ SIZE 3″×5¼″×3″ (76×133×76mm)
★ OPERATES FROM 3 SELF-CONTAINED U.2 TYPE BATTERIES
★ FUNCTIONS TO PROFESSIONAL STANDARDS

This is one of the many attractive items sold by Bi-Pre-Pak. For catalogue of these and audio modules, semi-conductor bargains, books, etc., send large S.A.E. envelope with 6p stamp.

BI-PRE-PAK LTD Dept. X, 222-224, WEST ROAD WESTCLIFF-ON-SEA, ESSEX SS0 9DF

(Reg. No. 820919) Telephone: Southend (0702) 46344

BI-PRE-PAK LTD. 222 West Rd., Westcliff, Essex SS0 9DF

Please send X-Hatch Generator Kit ☐ Built ☐

TV Signal Strength Meter

for which I enclose, £............inc. V.A.T. & post & packing.

NAME ....

ADDRESS ....

....

BENTLEY ACOUSTIC CORPORATION LTD.

7a GLOUCESTER ROAD, LITTLEHAMPTON, SUSSEX

All prices inclusive of V.A.T. *Telephone: 6743*

														EB34	0·25	EF80	0·26	FW4/800	£1	PCF84	0·59	PY500A	·95	UM80	0·44
														EB91	0·20	EF83	1·00	GY501	0·70	PCF86	0·60	PY800	0·40	URIC	1·00
														EBC41	0·75	EF85	0·34	GZ30	0·45	PCF801	·50	PY801	0·40	UU5	1·00
														EBC81	0·35	EF86	0·45	GZ32	0·50	PCF802	·50	PZ30	0·48	UU12	0·29
														EBC90	0·45	EF89	0·27	GZ33	1·25	PCF805	·80	QQV03/10		UY41	0·45
														EBC91	0·45	EF91	0·37	GZ34	0·60	PCF806	·50		1·75	UY85	0·35
														EBF80	0·39	EF92	0·50	GZ37	1·00	PCF808	·78	QS75/20	1·00	U10	1·00
														EBF83	0·43	EF97	0·80	HABC80		PCH200	·80	QS95/10	1·00	U12/14	1·00
														EBF89	0·32	EF98	0·80		0·60	PCL82	0·38	QS150/15		U16	1·00
OB2	0·40	6AM8A	0·55	6F13	0·70	6Y6G	0·80	12SQ7GT	·65	35L6GT	·75	AZ41	0·25	EBL21	2·00	EF183	0·30	HL23	0·60	PCL83	0·50		1·50	U17	0·75
OZ4	0·47	6AN8	0·70	6F14	0·75	6Y7G	1·00	12SR7	0·75	35W4	0·50	BL63	2·00	EC52	1·00	EF184	0·35	HL23DD	·75	PCL84	0·45	QVO4/7		U18/20	1·00
1A3	0·45	6AQ5	0·45	6F15	0·65	7A7	1·00	14H7	0·55	35Z3	0·75	CL33	1·60	EC53	1·00	EF804	1·25	HL41	1·00	PCL85/805			1·00	U19	2·50
1A5GT	0·50	6AR5	0·60	6F18	0·55	7B6	0·75	14S7	0·80	35Z4GT	·70	CV6	0·53	EC54	1·00	EFP60	2·00	HL41DD	£2		0·55	R16	1·75	U22	0·75
1A7GT	0·65	6AR6	1·00	6F23	0·80	7B7	0·70	19AQ5	0·50	35Z5GT	·75	CV63	0·75	EC86	0·70	EH90	0·55	HL42DD	£2	PCL86	0·47	R17	0·88	U25	0·85
1B3GT	0·50	6AT6	0·45	6F24	0·85	7C7	1·00	19G6	6·00	42	0·50	CY1C	1·00	EC88	0·70	EL32	0·50	HN309	1·50	PCL88	1·10	R18	0·70	U26	0·66
1D5	0·60	6AU6	0·30	6F25	1·00	7F8	1·50	19H1	2·00	50B5	0·85	CY31	0·50	EC92	0·45	EL34	1·00	HVR2	1·00	PEN4DD		R19	0·60	U31	0·40
1D6	0·80	6AV6	0·45	6F28	0·67	7H7	0·75	20D1	0·60	50C5	0·60	D63	0·25	ECC32	1·50	EL35	2·50	HVR2A	£1		2·00	R20	0·66	U33	1·50
1G6	1·00	6AW8A	0·95	6F32	0·50	7R7	0·80	20D4	2·00	50CD6G		DAF96	0·50	ECC33	1·50	EL37	2·50	1W4/350	£1	PEN45	0·80	R52	0·45	U35	1·50
1H5GT	0·60	6AX4	0·75	6G6G	0·50	7V7	1·50	20F2	0·75		1·25	DC90	0·60	ECC35	0·95	EL41	0·90	1W4/500	£1	PEN45DD		RK34	1·00	U37	1·75
1L4	0·28	6B8G	0·30	6GH8A	0·75	7Y4	0·75	20L1	1·10	50EH5	0·75	DD4	1·00	ECC40	1·00	EL81	0·60	KT2	0·75		0·80	TH4B	1·00	U45	1·00
1LD5	0·60	6BA6	0·28	6GK5	0·65	7Z4	0·80	20P1	0·55	50L6GT	·65	DF91	0·30	ECC81	0·34	EL83	0·55	KT8	2·50	PEN46	0·50	TH233	1·00	U50	0·45
1LN5	0·60	6BC8	0·60	6GU7	0·75	9BW6	0·75	20P3	0·80	72	0·60	DF96	0·50	ECC82	0·33	EL84	0·31	KT41	1·00	PEN453DD		TP22	1·00	U76	0·70
1N5GT	0·65	6BE6	0·35	6H6GT	0·25	9D7	0·65	20P4	1·00	77	0·53	DH63	0·50	ECC83	0·33	EL85	0·44	KT44	1·00		2·00	TP25	1·00	U78	0·40
1R5	0·45	6BG6G	1·05	6J5GT	0·45	10C2	0 65	20P5	1·30	85A2	0·60	DH77	0·45	ECC84	0·35	EL86	0·38	KT63	0·50	PENA4	1·00	TP2620	1·00	U81	0·80
1S4	0·33	6BH6	0·60	6J6	0·30	10DE7	0·75	25A6G	0·60	85A3	0·60	DH81	0·75	ECC85	0·40	EL91	0·50	KT66	2·50	PEN/DD/		UABC80		U191	0·75
1S5	0·30	6BJ6	0·55	6J7G	0·30	10F1	0·75	25L6GT	·60	90AG	2·50	DK40	0·70	ECC86	0·85	EL360	1·20	KT81	2·00	4020	2·00		0·40	U193	0·40
1U4	0·60	6BK7A	0·60	6J7(M)	0·45	10F9	0·65	25Y5	0·80	90CG	2·40	DK92	0·70	ECC88	0·44	EL506	0·90	KTW61	1·50	PFL200	·70	UAF42	0·60	U251	0·80
1U5	0·75	6BQ5	0·31	6JU8A	0·75	10F18	0·55	25Y5G	0·70	90CV	2·40	DK96	0·60	ECC189	·65	ELL80	1·25	KTW62	1·50	PL33	0·50	UBC41	0·60	U281	0·90
2D21	0·45	6BQ7A	0·55	6K7G	0·30	10LD11	·70	25Z5	0·80	90C1	0·75	DL96	0·55	ECC804	·80	EM80	0·45	KTW63	1·00	PL36	0·60	UBC81	0·45	U282	0·55
2X2	0·60	6BR7	1·00	6K8G	0·45	10P13	0·75	25Z6GT	·70	150B2	0·75	DM70	0·60	ECF80	0·45	EM81	0·65	M8162	1·00	PL81	0·50	UBF80	0·40	U301	0·65
2GK5	0·55	6BR8	1·50	6L1	2·00	10P14	2·00	28D7	1·00	807	1·00	DM71	1·50	ECF82	0·45	EM83	0·55	MHL4	0·75	PL81A	0·55	UBF89	0·40	U403	0·75

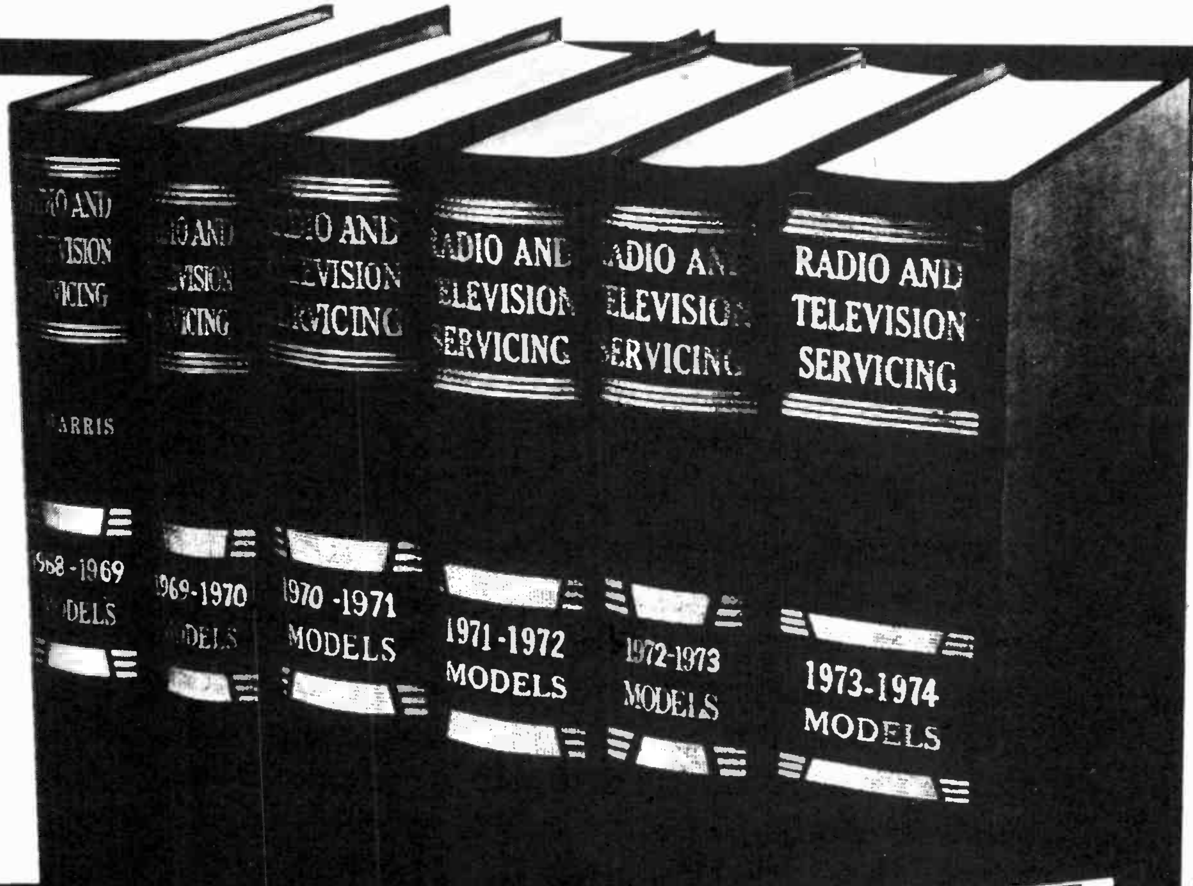
VALVES ALSO REQUIRED FOR CASH. LOOSE OR BOXED, BUT MUST BE NEW. OFFERS MADE BY RETURN.

3A4	0·50	6BS7	1·40	6L6GT	0·58	12A6	1·00	30A5	0·65	4033X	6·50	DW4/500	£1	ECF86	0·75	EM84	0·40	MHLD6	£1	PL82	0·37	UBL21	0·77	U404	0·55
3B7	0·45	6BW6	0·80	6L7	0·50	12AC6	0·70	30C1	0·40	5702	1·00	DY87/6	0·35	ECF804	2·25	EM85	1·00	N339	1·10	PL83	0·45	UC92	0·45	U801	0·85
3D6	0·40	6BW7	0·70	6L18	0·55	12AD6	0·65	30C15	0·80	6057	1·00	DY802	0·35	ECH21	2·00	EM87	0·70	P61	0·50	PL84	0·40	UCC84	0·75	VP13C	0·60
3Q4	0·60	6BZ6	0·49	6L19	2·00	12AE6	0·65	30C17	0·80	6060	1·00	E80CC	2·20	ECH35	1·25	EMM803		PABC80	·38	PL504/500		UCC85	0·45	VP23	0·75
3Q5GT	0·55	6C4	0·35	6LD20	0·75	12AT6	0·40	30F5	0·80	6067	1·00	E80F	1·40	ECH42	0·70		2·00	PC86	0·60		0·75	UCF80	0·70	VP41	0·75
3S4	0·40	6C5G	0·50	6N7GT	0·60	12AT7	0·34	30FL1	0·67	7193	0·53	E83F	1·30	ECH81	0·33	EY51	0·40	PC88	0·60	PL505	1·45	UCH21	2·00	VR105	0·50
3V4	0·70	6C6	0·40	6P15	0·31	12AU6	0·45	30FL2	0·67	7475	1·00	E88CC	0·75	ECH83	0·44	EY83	0·54	PC95	0·60	PL508	0·90	UCH42	0·75	VT61A	0·65
4CB6	0·55	6C9	1·00	6Q7G	0·50	12AU7	0·33	30FL13	·55	9002	0·50	E92CC	0·60	ECH84	0·44	EY84	0·70	PC97	0·38	PL509	1·45	UCH81	0·40	VU111	0·80
5CG8	0·55	6C12	0·33	6Q7(M)	0·55	12AV6	0·50	30FL14	·78	9006	0·30	E180CC	·70	ECL80	0·55	EY87	0·33	PC900	0·48	PL802	0·95	UCL82	0·38	VU120	£1
5R4GY	0·80	6C17	2·00	6Q7GT	0·50	12AX7	0·33	30L1	0·40	A1834	1·00	E180F	1·00	ECL82	0·34	EY88	0·40	PCC84	0·40	PM84	0·65	UCL83	0·55	VU120A	£1
5T4	0·40	6CB6A	0·40	6R7	0·75	12BA6	0·45	30L15	0·75	A2134	1·00	E182CC	1·25	ECL83	0·70	EY91	0·58	PCC85	0·44	PY33/2	·50	UF41	0·70	VU133	0·80
5U4G	0·40	6CD6G	1·25	6R7G	0·60	12BE6	0·50	30L17	0·70	A3042	1·00	E1148	0·53	ECL84	0·60	EZ40	0·50	PCC88	0·60	PY80	0·40	UF42	0·70	W107	1·00
5V4G	0·50	6CG8A	0·75	6SA7	0·44	12BH7	0·50	30P4MR		AC2/PEN		EA50	0·27	ECL85	0·60	EZ41	0·55	PCC89	0·50	PY81	0·35	UF80	0·35	W729	1·00
5Y3GT	0·45	6CL6	0·65	6SC7GT	·33	12E1	3·00		1·00		1·00	EA76	1·00	ECL86	0·40	EZ80	0·28	PCC189	0·57	PY82	0·35	UF85	0·44	X41	1·00
5Z3	0·75	6CL8A	0·80	6SG7	0·44	12J5GT	·33	30P12	0·80	AC6/PEN	60	EABC80	·38	EF22	1·50	EZ81	0·29	PCC805	0·75	PY83	0·38	UF86	1·00	X66	1·25
5Z4G	0·45	6CM7	0·75	6SH7	0·44	12J7GT	·60	30P19/		AC2/PEN/		EAC91	0·75	EF40	0·75	FC4	1·00	PCC806	0·70	PY88	0·40	UF89	0·40	X101	2·00
5Z4GT	0·45	6CU5	0·75	6SJ7	0·55	12K5	1·00	30P4	0·75	DD	1·00	EAF42	0·75	EF41	0·70	FW4/500		PCF80	0·40	PY301	0·75	UL41	0·75	XH/1·5	·48
6/30L2	0·80	6CW4	1·00	6SK7GT	·44	12K7GT	·50	30PL1	0·85	AC/PEN(7)		EAF801	·75	EF42	0·70		1·00	PCF82	0·40	PY500	0·95	UL84	0·42	Z759	5·00
6A8G	1·25	6D3	0·60	6SQ7GT	·45	12Q7GT	·45	30PL12	·38		1·00														
6AC7	0·49	6DE7	0·75	6U4GT	0·70	12SA7GT	·55	30PL13	·95	AC/TH1	1·00														
6AG5	0·27	6DT6A	0·75	6U7G	0·45	12SC7	0·50	30PL14	1·10	AL60	1·00														
6AH6	0·60	6EW6	0·75	6V6G	0·17	12SG7	0·40	30PL15	·90	ARP3	0·60														
6AJ5	0·65	6E5	1·00	6V6GT	0·45	12SH7	0·35	35A3	0·65	ATP4	0·50														
6AK5	0·40	6F1	0·75	6X4	0·40	12SJ7	0·44	35C5	0·75	AZ1	0·25														
6AK6	0·60	6F6G	0·50	6X5GT	0·45	12SN7	0·60	35D5	0·75	AZ31	0·60														

All goods are unused, boxed, and subject to the standard 90-day guarantee. Cash or cheque with order. Despatch charges:—Orders below £5, add **10p** total to cover up to three items, then each additional item **3p** extra. Orders between £5 and £10 add **25p** total. Orders over £10 post free. Same day despatch. Any parcel insured against damage in transit for only **3p** extra per parcel. Terms of business free on request. Please enclose S.A.E. for a reply to any correspondence. Many other types in stock too numerous to list.

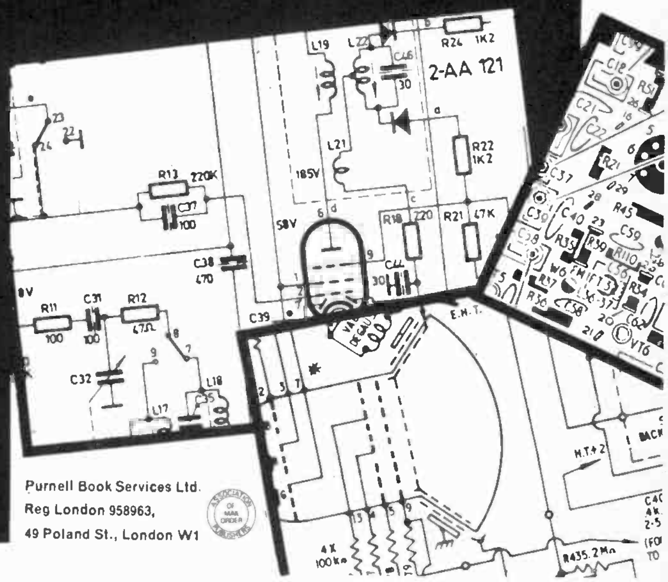

If you're doing it yourself,
do it with us.

RADIO & TV SERVICING



Essential data for over 1500 popular models

With this vast 6-volume library at your fingertips you have all the necessary servicing data you need covering almost every popular model from 1968 to the very latest on the market today. And not only radio and TV but stereograms, record players and tape recorders too. Much of the earlier information on this equipment is quite unobtainable elsewhere and *Radio & TV Servicing* is now the only available source of technical data. The 1974 edition, now ready, brings the library right up-to-date with abstracts from manufacturers' service bulletins issued during the past year. *Radio & TV Servicing* is the only work of its kind—a money-spinner that no service engineer should be without.



Purnell Book Services Ltd.
Reg London 958963,
49 Poland St., London W1

TELEVISION

VOL 25 No 4
ISSUE 292

SERVICING·CONSTRUCTION·COLOUR·DEVELOPMENTS FEBRUARY 1975

CURRENT

Electrical current consists of the movement of electrons, which carry a negative charge: they travel towards a point at a positive potential therefore. We need hardly remind readers of that! There is however that mythical beast conventional current, which one might have expected by now to have long since become extinct. It is supposed to flow from a point at a positive potential towards one at a negative potential, and indeed articles and books say that this happens and show arrows indicating current movement in this direction—even though everyone knows that nothing of the sort takes place!

Why is this confusion allowed to continue? It would surely fade away rapidly if the technical education authorities were to agree to let it die. But it still seems to be firmly ensconced in the educational establishment.

Its origin of course is simply that when electrical phenomena were first being investigated the basic physics of electricity were not known. Suppositions had to be made, and this one has stuck.

The history of electrical engineering, science in general in fact, is one of experiments first, theory after. That's the way it has to be of course if the theory is to fit the facts. An extraordinarily interesting example in TV history is the invention of the Emitron/Iconoscope camera tube—the tube that made TV broadcasting a practical proposition. The theory of the time said it couldn't work, but experimenters somehow felt it would. And it did! So the reasons why, the correct theory, then had to be worked out.

Is it conceivable that camera tube engineers would have decided to stick instead with a theory that was demonstrably wrong? A lot of help that would have been! Yet the whole field of electrical engineering is still in the thrall of the idea of conventional current.

Since it is generally assumed that everyone realises that current flows in the opposite direction to which it is so often shown it also seems to be assumed that there is no harm in continuing to live with this situation. But it can't really do any good whatsoever to allow two opposite theories to continue to coexist. And when it comes to trying to puzzle out how some rather involved or unusual circuit actually works, something we all have to do from time to time, the best clue to start off with is that those little electrons are negative and will flow towards a point at a positive potential. Maybe some people can analyse circuits in a purely mathematical way instead, though we have yet to meet anyone who does and we are comforted in our perhaps rather literal way of looking at things by the knowledge that so many of the famous in electrical engineering have done likewise.

So far as this magazine is concerned the policy is to stick with the facts. We try to keep the ghost of conventional current out of our pages, though possibly the odd arrow pointing in the wrong direction may from time to time slip by us. We firmly believe that this is the best policy, and wonder just how long it will take for everyone finally to agree. One point that we know causes confusion from time to time is the positive indication often given to the cathode of a semiconductor rectifier. This of course is the n part of the pn structure, the part that has to be negative with respect to the other side for conduction to occur. Its origin would appear to be the fact that it's the side from which one gets one's positive h.t. or l.t. supply, and that's how early engineers (metal rectifiers long preceded thermionic ones) presumably saw it.

L. E. HOWES—*Editor.*

THIS MONTH

THE NEXT ISSUE DATED MARCH WILL BE PUBLISHED ON FEBRUARY 17

TELETOPICS

NEW COLOUR CHASSIS

New chassis are still coming from UK setmakers despite the soft-pedalling of 110° colour which was for a time expected to be the next major change. **Rank** have entered the 18in. colour set market with the **Bush** Model BC6100. This employs a new chassis built around a Toshiba in-line gun c.r.t. The set carries a recommended price of £229·95 including VAT. New sets from **Thorn** featuring the PIL in-line gun/vertical phosophor striped screen c.r.t. and their 9000 chassis are understood to have been held up as a result of the lengthy stoppage at their Bradford colour TV factory. **Decca** have introduced their first all solid-state colour TV chassis, the "45". This employs a completely integrated circuit i.f. strip (MC1352P and MC1330P) and a two i.c. sound channel (TBA750 and TAA621); a further i.c. (Texas SN76227) is used in the decoder for chroma signal demodulation, PAL switching and G−Y signal matrixing. A single BU108 line output transistor is used and the stabilised power supply is of the thyristor variety. In addition to the sound and vision i.c.s a discrete component a.f.c. circuit is included on the i.f. board.

A number of US setmakers have introduced colour chassis using in-line gun/vertical phosphor striped screen c.r.t.s in their 1975 ranges. Such sets have been announced by GE, Magnavox, Panasonic (fitted with the Quintrix tube, see below), Sony (the Trinitron of course, but now with 114° deflection and black guard bands) and RCA who call their PIL tube the Acculine. The RCA chassis fitted with this c.r.t. has four dynamic convergence adjustments compared to the twelve or so usual with delta-gun c.r.t.s. It had been suggested that no dynamic convergence adjustments would be required with this tube but even so a reduction to four is a very worthwhile simplification—the controls are probably required to take up component tolerances. Magnavox's latest chassis is fitted with a high-impedance m.o.s.f.e.t. i.f. strip which is said to give improved sensitivity and freedom from overloading. The remote control system used by Zenith is based on mechanical ultrasonic operation: rods in the remote control unit are stuck by a tiny hammer when a button is depressed and vibrate at a specific ultrasonic frequency, activating the appropriate control channel in the receiver.

JAP UK OPERATIONS

National Panasonic, the Matsushita subsidiary, has introduced in the UK a set fitted with their new Quintrix colour c.r.t. A factory is at present being built for National Panasonic at Pentwyn, Cardiff and is expected to be producing some 5,000 sets a month by early 1976. The new set, Model TC86G, has a recommended retail price of £279·95. The new tube used in the set is an 18in., 110° type with integrated (i.e. common electrodes apart from the cathodes) in-line gun, a slotted shadowmask and vertical stripe phosphor screen. It is also of the "black matrix" or "negative guardband" type, i.e. with an opaque black material surrounding the phosphor stripes on the screen. Without black matrixing in a colour c.r.t. the openings in the shadowmask are such that the beams passing through are of smaller diameter than the phosphor stripes (or dots in the case of a delta-gun shadowmask tube) they excite: this is done in the interests of maintaining colour purity. With black matrixing the shadowmask slits/holes can be made larger so that the entire phosphor area is excited by the electron beams, the black surrounding material providing the purity protection. The result is greater light output for a given beam current. In addition since the aluminised screen backing no longer reflects light from the front of the tube the glass screen need not be tinted, further improving the light output obtained.

Sony's Bridgend (South Wales) colour TV plant is now in operation, producing some 500 18in. sets a week. The aim was originally to build production up to 5,000 sets a week but whether this will be proceeded with in view of the changed economic situation seems open to question.

WALES TO GET FOURTH CHANNEL

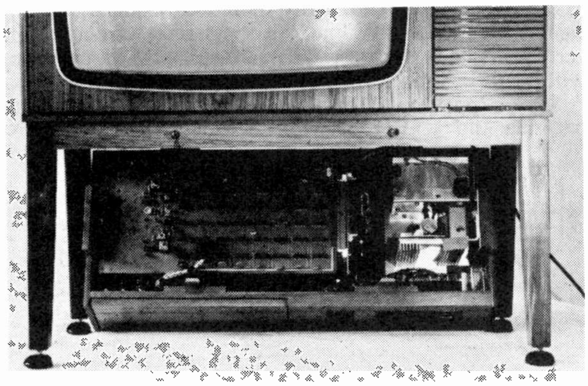
It looks as if Wales will be the first part of the UK to have a full four-channel TV service. A report presented to the House of Commons by the Committee on Broadcasting Coverage recommends that the fourth channel in Wales should be allotted to a separate service which would give priority to Welsh language programmes. The report suggests that such a service would take at least two years to launch from the decision to go ahead being made, that the initial costs would be £6-7 million and the annual running cost £2 million, and recommends that the service should be operated by the BBC and HTV in co-operation. A further recommendation is that the Government should consider paying a subsidy for the operation of the "Welsh" channel. The committee, which was appointed in 1973, also advocates giving the highest priority to completing the 625-line coverage, particularly in Northern Ireland.

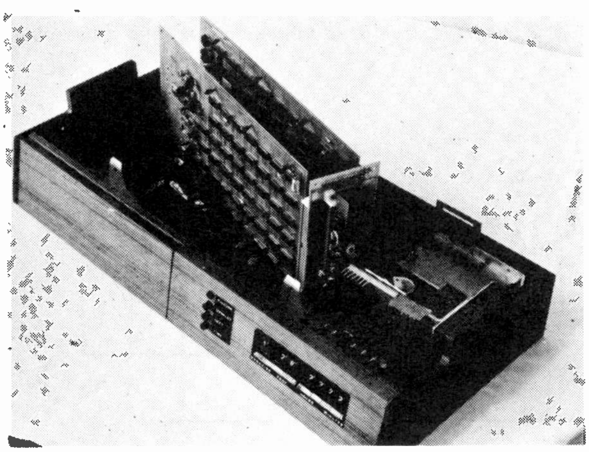
From what we can see the broadcasting authorities have already, within the possibilities set by supplies and their budgets, made an extraordinary effort in extending the u.h.f. coverage so that it reaches the vast majority of the population and a large number of the less easy to serve communities.

Once Wales gets its fourth service pressure will certainly start for an additional service elsewhere. This of course raises financial problems since the BBC and the independent companies have difficulty enough in meeting their present commitments. The idea of co-operative working between the BBC and the ITV companies is certainly an interesting one, presenting possibilities ranging from a lowest common denominator programme at worst to an unleashing of the fresh talent that probably exists in both sets of organisations.

COLOUR SERVICING CERTIFICATE

The Radio, Television and Electronics Examination board has announced that its Certificate of Competence in colour television servicing scheme has now come into full operation following a pilot run period. Details of the certificate and the method of testing candidates were given in *Teletopics*, September 1974. Those who are successful are to be issued with a "credit card" for ready identification in addition to a certificate. Tests are at present being held at five Government Skillcentres (previously known as Government Training Centres) but it is hoped to extend the number of test centres and to obtain the co-operation of technical colleges. The Skillcentres participating in the scheme are those at Bristol, Cardiff, Coventry, Glasgow and Letchworth and the next examinations are due to be held in March 1975. Present plans are to test some 500 candidates this year and since it is anticipated that the demand will exceed this number the RTEEB recommend early application. The fee is £10 and those interested should apply to the Examinations Officer, RTEEB, Faraday House, 8-10 Charing Cross Road, London WC2H 0HP.





Internal views of GEC's experimental Ceefax/Oracle decoder.

STATION OPENINGS

The BBC's services from the **Knock More** (Banffshire) high-power transmitting station are now in operation. BBC-2 is on channel 26 and BBC-1 on channel 33. A horizontally polarised group A receiving aerial is required. The following relay stations are also now in operation:

Abertridwr (Glamorgan) BBC-Wales channel 57, ITV (HTV Wales programmes) channel 60, BBC-2 channel 63. Receiving aerial group C/D.

Great Missenden (Bucks) BBC-1 channel 58, ITV (Thames Television and London Weekend Television programmes) channel 61, BBC-2 channel 64. Receiving aerial group C/D.

Tay Bridge (Fife) ITV (Grampian Television programmes) channel 41. Receiving aerial group B.

All these relay transmissions are vertically polarised.

US PUBLIC TV

It is an often overlooked fact that alongside the well known commercial TV stations in the US exists a public service TV system which does not rely for its revenue on advertisements. In fact by 1972 US public service TV stations reached 156 million viewers, the number of stations having grown from 56 in 1961 to 227 in 1972. The extremely poor average quality of the programmes available from the commercial networks is of course one of the main reasons for the growth of public service TV in the states. Financing public service TV in a country where there are no receiver licences to provide a source of revenue is a difficult matter however. Those interested in the problems of setting up this service will find the full story in *To Irrigate a Wasteland* by John W. Mary Jr, published by the University of California Press at £3.95.

COLOUR RECEIVER MAINS TRANSFORMER

We understand from Electrokit (8, Cullen Way, London NW10) that they have now completed all outstanding orders for replacement mains transformers for the TELEVISION colour receiver project. They now hold a supply of these transformers in stock.

LASER BEAM FILM RECORDER

An interesting PAL videotape-to-film transfer equipment has recently been installed in London by Rank Video. It is based on a system originally developed by CBS Laboratories, employing three modulated laser beams instead of a c.r.t. to convert videotape recordings into high-quality colour films. A precision mechanical scanning system is used to deflect the laser beams, providing good colour registration, geometric linearity and uniformity while avoiding problems such as phosphor decay associated with colour c.r.t.s. A description of the equipment appeared in the November-December 1974 issue of *The Royal Television Society Journal*.

CRT Tester and Reactivator

Richard M. Langner, G8JLE

During the course of television servicing, low-emission c.r.t.s are sometimes encountered. The symptoms are that the picture lacks brilliance and on advancing the brightness control the darker areas of the picture increase to the same maximum level as the brightest parts, giving a "silvery" picture.

One of the causes of low emission is cathode poisoning, caused by impurities on the surface of the cathode. The device described in this article will give a reading of emission from the cathode and, if necessary, clean the impurities from it. It also checks for leakage between the heater, cathode, grid and the first anode of the tube.

The process can also be applied to colour c.r.t.s, though care must be taken not to overdo the treatment. A selector switch is used so that it is possible to check and compare the emission of the red, green and blue guns.

Measurement of Emission

Fig. 1. shows a simplified circuit from which the instrument was developed. Current flows to h.t. through the c.r.t. and R1, giving half-scale deflection on the meter. At the same time current flows through R2, also giving half-scale deflection. The two currents add and providing the c.r.t. is good the meter will read approximately full scale.

The Treatments

The device performs in two ways. For reactivation it is necessary to increase the temperature of the cathode. This is done simply by increasing the heater voltage and current so that the impurities "boil off".

The other process involves the application of short pulses of high voltage between the grid and cathode. Fig. 2 shows the basic circuit for processing the cathode. When the relay contacts are in the rest position capacitor C1 charges via R3 to 300V. When the relay is operated, +300V is applied to the tube's control grid and current flows, limited by R3. This system ensures that only a short pulse of current can flow.

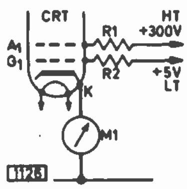
The relay is switched on and off about once every two seconds by a multivibrator—see the main circuit diagram, Fig. 4.

Leakage Circuit

Interelectrode short-circuits or leakage may also be encountered. A facility for checking this is therefore included. The basic circuit is shown in Fig. 3 and uses a neon lamp as the leakage indicator. Small mains neons are fairly cheap and robust and it was decided to use this method rather than become involved in extra meter switching at high voltages.

With the switch in position 2 the circuit is from the c.r.t. cathode, through S3b, through the neon lamp and associated resistor (normally included inside the neon casing) to the +300V line. As the heater circuit is at zero volts, any leakage between heater and cathode will result in the neon lamp glowing.

Switch position 3 checks for leakage between the cathode and grid connections. Notice that the h.t. is



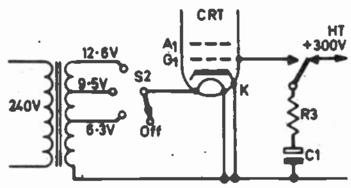


Fig. 1 (left): Basic circuit for emission measurement.

Fig. 2 (right): Circuit used for reactivation and processing.

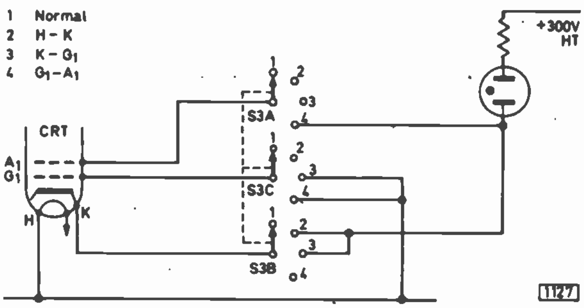


Fig. 3: A neon lamp is used to indicate inter-electrode leakage.

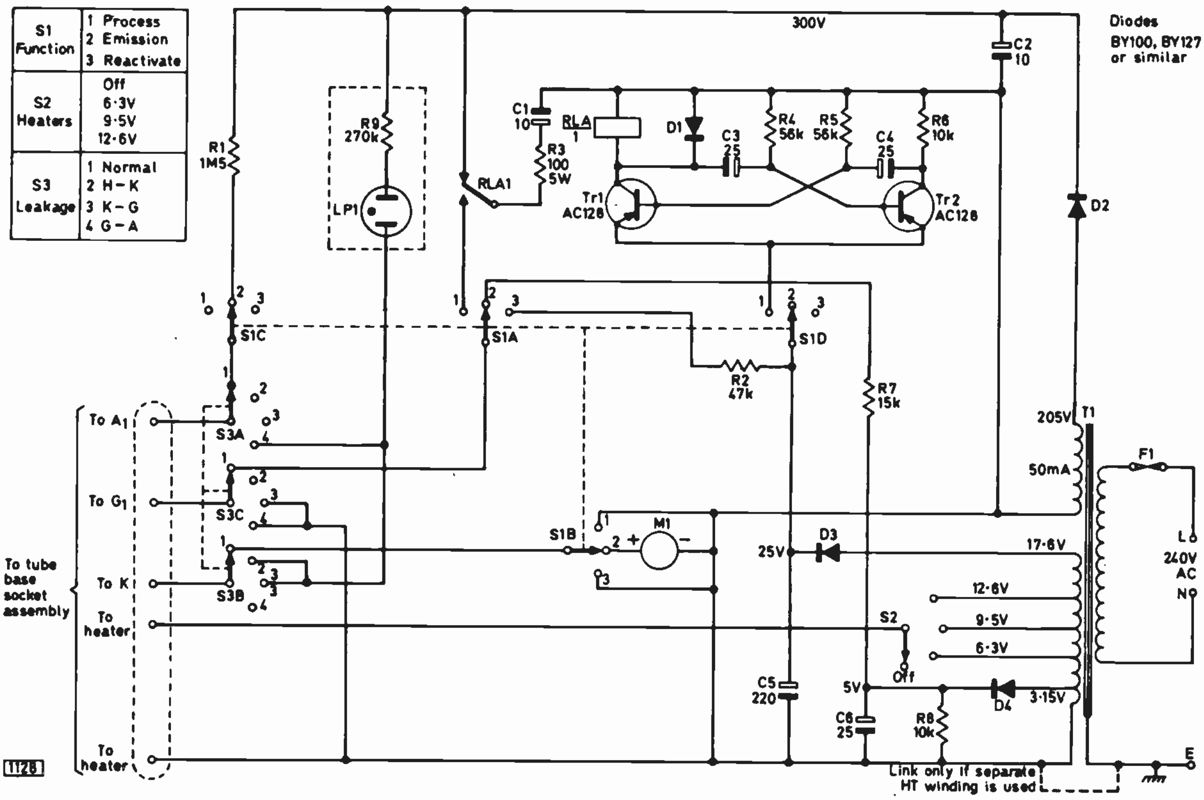


Fig. 4: Circuit diagram of the meter unit. Transformer T1 may be an auto-transformer—see text.

★ Components list

Resistors

R1	1.5M Ω ½W	R4	56k Ω	R7	15k Ω
R2	47k Ω	R5	56k Ω	R8	10k Ω
R3	100 Ω 5W	R6	10k Ω	R9	270k Ω

All ¼W unless specified

Capacitors

C1	10μF 450V	C3	25μF 25V	C5	220μF 25V
C2	10μF 450V	C4	25μF 25V	C6	25μF 25V

Switches

S1 4 pole 3 way S2, S3, S4 3 pole 4 way

Semiconductors

Tr1, Tr2 AC128 D1—D4 BY 100, BY127 etc.

Miscellaneous

LP1 Min. panel neon; M1 500μA; RLA 2p c/o heavy duty, 700 Ω coil; T1 see text; monochrome and colour tube base sockets; metal boxes; knobs; materials for pcb.

now applied via the neon lamp to the cathode, the grid being taken to chassis. The reason for this is that if the tube cathode is warm, current will flow due to the normal emission of the tube. So we have to reverse bias the grid/cathode diode.

Position 4 on the switch checks for grid to anode leakage, operating in the same way as position 2. In switch position 1 the tube electrodes are connected to the Function switch.

Construction

All the smaller components except the relay are mounted on the printed circuit board shown in Fig. 6. The switch S4 is mounted in the tube base socket assembly. Most of the components with the exception of the meter were found in the junk box and in fact the project was attempted for this reason. Even the stainless steel box used was an offcut from a central heating boiler flue!

In the multivibrator circuit a miniature relay was used which had a coil resistance of 700 Ω and operated at 20V for positive action. Any relay used in this circuit must have break-before-make contacts and insulation suitable for the voltages involved.

The transistors specified are both AC128 but the type is not critical. Several others, for instance the AC169, should function just as well. The mains plug should be fitted with a 3A fuse.

Mains Transformer

Although in the main circuit diagram the mains transformer is shown as a double wound (isolating) transformer, the prototype used a filament transformer

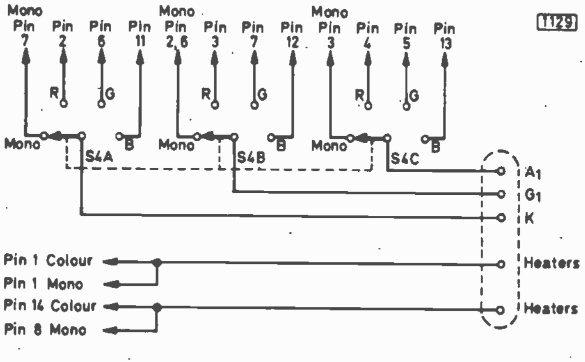


Fig. 5: Switch wiring for the tube base socket assembly.

with two windings of 6·3V centre-tapped and one 5V winding all rated at 1A. This combination when wired in series gives 3·15V, 6·3V, 9·45V, 12·6V and 17·6V.

The 205V tap shown on the secondary h.t. winding can in fact be taken from the mains primary winding, thereby using it as an autotransformer. This means that all the wiring must be insulated from the case, and should only be used by the experienced constructor. For the less experienced the use of a double-wound transformer is strongly advised.

Unfortunately suitable transformers for either mode of operation are becoming increasingly difficult to obtain. Those who have such a component in their junk box will of course have no problems. For the less lucky, we offer some suggestions of ways around the problem.

With either mode of operation, if no 5V winding is available, a further 6·3V may be used instead, with a resulting slight increase in the 25V rail. Three separate 6·3V centre-tapped heater transformers could then be used, with the tapped primary of one supplying the 205V for the h.t. rail.

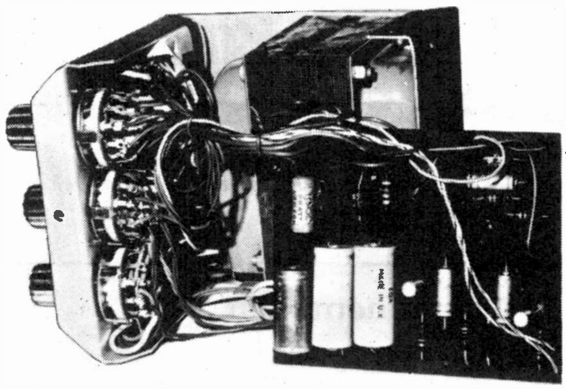
For the fully isolated mode, a transformer with an h.t. secondary winding higher than 205V can be used providing the value of R1 is increased to compensate for the rise in the 300V rail. The limiting factor will usually be the safe working voltage for S1 and RLA contacts.

The method of determining the value of R1 is simple and can be done in the following manner. Place a short piece of wire between the A1 and K pins on the tube base socket assembly. Now fit a 2M Ω variable resistor in place of R1 on the printed circuit board, and set it for maximum resistance. Switch to Emission, connect up the mains supply and adjust the variable resistor to make M1 read half scale. Switch off the power and measure the resistance.

Select a value of resistor nearest to the value of the variable resistor, if necessary using two resistors in series to obtain a more accurate result.

Choice of Meter

If difficulty is encountered in obtaining a 500µA meter movement a 1mA movement may be used instead. This means that resistors R1 and R2 will have to be changed in value. Find the value of R1 as described above. The value of R2 can be found in a similar manner, in this case linking the G1 and K pins on the tube base socket assembly.



Interior view of the completed meter unit.

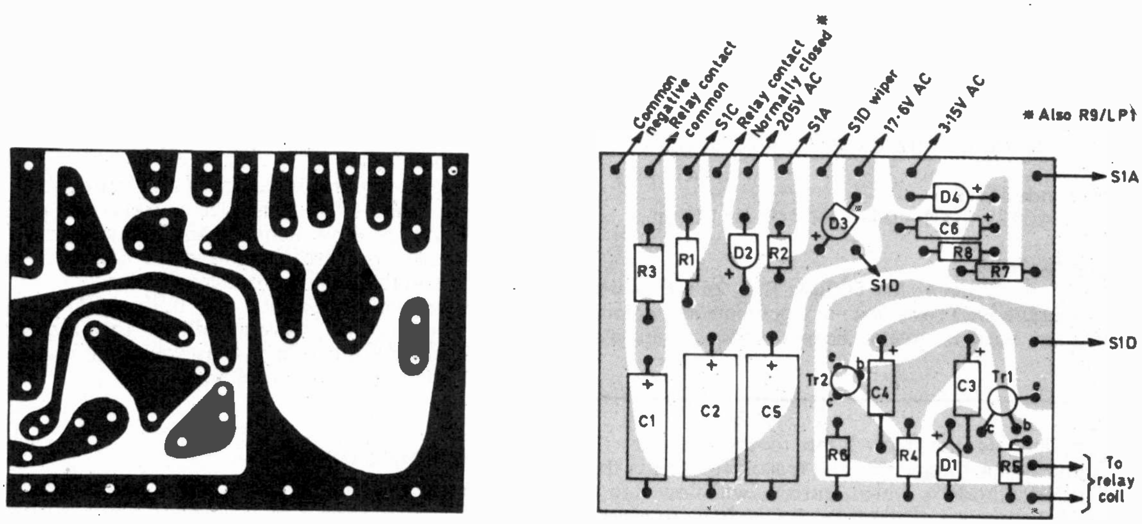


Fig. 6: Printed board layout and component location, both shown half-scale.

Operation

Plug the tube base assembly on to the c.r.t. and switch S1 to Emission, S3 to Normal. The heater switch should be in the off position.

Now turn the Leakage switch slowly clockwise and watch the neon lamp. If it does not glow the inter-electrode leakage is very low, so return the switch to Normal again.

Next turn the heater switch to 6·3V: the tube heaters will glow. After a short while the meter reading will rise and settle, hopefully, in the green area of the meter scale. This means that the emission of the tube is good. If the reading is in the red section the tube has low emission and requires processing.

This being the case, turn the heater switch to 9·5V and wait for the tube cathode to reach the higher temperature. Move the Function switch into the Reactivate position and allow the tube to remain in this state for two minutes. Then increase the heater voltage to 12·6V for one second **only**, and return it to 9·5V. After a further thirty seconds increase the voltage again to 12·6V for one second. Switch back to 9·5V and turn the Function switch to Process.

Now listen for the relay to operate, and count the number of operations. No visual indication is necessary because of the loud click given by the relay when it snaps in. The author finds that four or five operations of the relay are sufficient, the exact number being dependant upon the original condition of the tube.

Return the Function switch to Emission and note the improvement gained. At first the user is recommended to progress one pulse at a time, noting the emission reading of the c.r.t. after each.

The finished unit measures only 5×5×6in. and has proved a reliable and valuable service instrument. ■

LAUNCH ELEMENTS ADDED TO MULTIBEAMS

In addition to moving to new premises (see mention in *Long-Distance Television*, December) and changing their name from J Beam to Jaybeam the company have now introduced a new range of Multibeam u.h.f. aerials. Before describing the new range, a few words on multi-element aerials generally. The Yagi aerial—named after its inventor—established the principle of using director elements which are excited by mutual inductance and do not require individual feeder connections. Most current TV aerial arrays are based on the use of this technique. The gain of such an aerial depends on the number of elements used, each element contributing to the signal that is coupled to the active element—the dipole—to which the feeder is connected.

One of the main concerns of aerial designers has been in devising methods of improving the coupling between the director chain and the dipole. Gain has been improved in recent years with the advent of the multidirector assembly in which single straight directors are replaced by quadruple assemblies. Jaybeam have always concentrated on using a skeleton-slot type of active element instead of a conventional dipole, and have coupled the feeder to the slot by means of an inverse balun to ensure optimum match over the required bandwidth. As a result of continuing research Jaybeam have found that the use of conventional straight director elements in combination with quadruple director assemblies gives greatly improved coupling between the director chain and the active element. In their new Multibeam range Jaybeam use two single director elements, which they term "launch directors", to concentrate the signal energy fed to the skeleton slot and thus improve the coupling between the active and passive elements in the array (see Fig. 1). The improved performance is quite considerable and has made it possible for Jaybeam to reassess the number of elements required to provide a given performance at a certain distance from the transmitter.

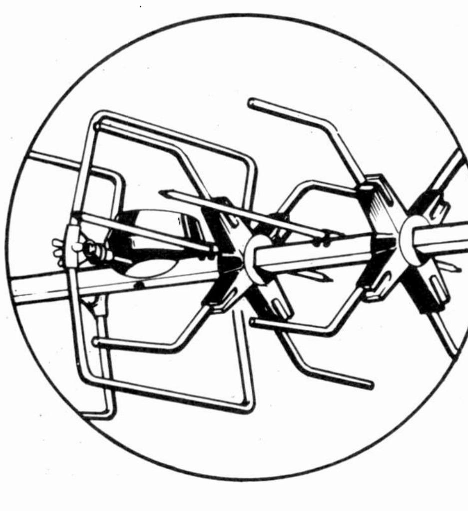
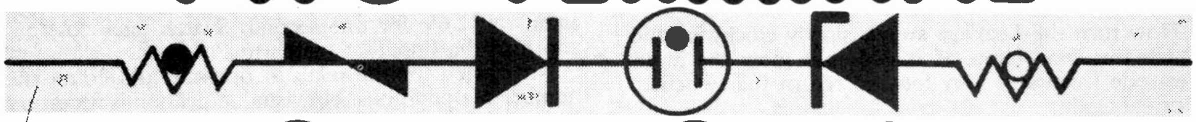


Fig. 1: Close-up showing position of the 'launch directors'.

At the top end of the range the MBM70 has been replaced by the MBM88. In addition to using two launch directors there are four extra quad director assemblies, all mounted on the same boom length as the previous MBM70. The MBM46 has been replaced by the MBM48. This incorporates two launch directors and has a reduced boom length, yet gives greatly improved gain. Similarly the MBM30 has been replaced by the MBM28; also the MBM16 by the MBM18 (same boom length here). Thus adding two launch directors has in all cases improved the performance with no increase in boom length. Jaybeam comment that "the basic aim in all aerial design is maximum gain for the minimum of metal used: the use of launch directors on the multidirector type array achieves this object, giving a better gain/aluminium ratio".

The new address of Jaybeam Ltd. is Moulton Park Industrial Estate, Northampton NN3 1QQ, telephone number 0604 46614. R. B.

TWO-TERMINAL



STABILISERS

PHOSPHOR

THE purpose of this article is to review some of the two-terminal devices available for providing voltage and current stabilisation.

Semiconductor Diodes

The semiconductor diode can be used as a voltage stabiliser in either the forward or reverse conduction mode—the latter applies in the case of zener diodes.

When forward biased, a silicon diode has about 0·7V across it regardless of type and over a wide current range. It is often used as a biasing mechanism in transistor amplifiers since its negative temperature coefficient closely matches that of a transistor's base-emitter junction. The "diode drop" is frequently used as a unit of voltage in describing the operation of integrated circuits, both linear and digital.

Selenium rectifiers were sometimes used in this mode before silicon diodes became readily available: the voltage across a forward biased selenium rectifier is about 1·4V.

The Zener Diode

The zener ("breakdown") voltage of a reverse biased zener diode depends on its doping. Diodes are available with breakdown voltages from 2·4V to over 100V. There is a change in the physical process of reverse conduction as the reverse voltage is increased. This gives rise to a negative temperature coefficient below 5V and a positive one above 6V, with zero in between at some voltage which varies from diode to diode and also with the current. Very low temperature reference diodes are made more consistent by combining a positive coefficient zener diode with a forward biased silicon diode, giving a voltage of typically 6·5V.

Voltage Dependent Resistors

Various polycrystalline materials are also used to make voltage stabilisers. An example is the voltage dependent resistor which is often used to stabilise l.t. lines in TV receivers in place of the more costly zener diode. Prior to the use of v.d.r.s, Metrosils and Atmites were sometimes used for stabilisation or clipping.

Gas-filled Valves

Another stabilising device used before the zener diode was the cold-cathode, gas-filled valve which was generally found in the range 70-180V, though a corona stabiliser operated in the kV range. The gas-filled neon stabiliser (not always filled with neon however) is still used in certain applications but needs a striking voltage which is higher than its running (stabilising) voltage. This implies a negative slope in the voltage/current curve, giving rise to undesirable oscillation—particularly if a capacitor is used in parallel in an attempt to bypass the valve for noise reduction or r.f. purposes. It is precisely this characteristic that earns it its place in one colour television chassis however, the backlash being used to trigger an h.t. overvoltage trip in the line oscillator circuit, thus removing the e.h.t. One touch tuner (RR1) uses neons to indicate the channel selected and inhibit the other channels.

Some people realised that the hot-cathode, gas-filled triode (thyratron) could be used diode-connected as a stabiliser in the 10-15V region, depending on the nature of the filling. This was exactly suited to the needs of medium-power class B triode audio amplifier valves but the use did not extend beyond the ham world.

The Vbe Multiplier

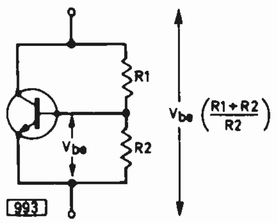
The forward base-emitter bias voltage required for the onset of conduction of a silicon transistor is around 0·7V. This can be amplified by the voltage-follower circuit (Fig. 1) to give a two-terminal voltage stabiliser —often called a *V*be multiplier. The circuit is characterised by the temperature dependence of *V*be and it is just this feature that makes it suitable for supplying bias to class B audio amplifiers in order to overcome crossover distortion (see Fig. 6, page 503, September). Close thermal coupling between the *V*be multiplier and the power transistors will stop thermal runaway.

Transistor Zener Characteristic

Another way of using a transistor for stabilisation purposes is to make use of the zener characteristic of its junctions—the base-emitter junction is the more suitable. When the breakdown voltage is reached no damage is done if the current flow is limited, as with a normal zener diode. The collector-base junction remains cut off under these conditions. The technique is sometimes used in i.c.s. Planar transistors work well, having a close breakdown voltage spread—for example the ZTX300 gives typically 8V with a dynamic resistance of 20Ω at 20mA, can dissipate 200mW and has a temperature coefficient of +5·45mV/°C (0·059%/°C).

Dynamic Resistance

Dynamic resistance is a measure of the imperfection of a stabiliser. If you think of the ohm as being just another name for volts per amp (or millivolts per



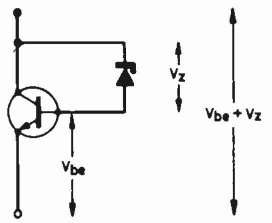
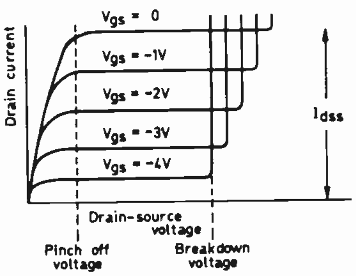


Fig. 1 (left): The Vbe multiplier.

Fig. 2 (right): Active zener.



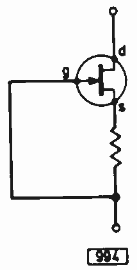


Fig. 3 (left): Id/Vds characteristics of an n-channel junction field effect transistor.

Fig. 4 (right). Source-biased field effect transistor as a current stabiliser.

milliamp) then 20Ω for example means that for every milliamp change of current through the diode the voltage will change by 20mV—which is good for a simple device.

The Active Zener

There is a combination of zener diode and transistor (see Fig. 2) which is called an active zener and is used to enhance the current carrying capacity of the zener diode. For voltages less than the zener voltage plus *V*be the transistor is cut off while for voltages above this the transistor conducts: the combination acts to stabilise the voltage at this value, in much the same way as would the diode alone. There is the possibility with this arrangement of setting the transistor's negative *V*be temperature coefficient against a similar but positive zener temperature coefficient.

Current Stabilisers

The devices so far described have been for shunt voltage stabilisation (i.e. they are connected across the voltage to be stabilised). The alternative approach to stabilisation is to employ a series current stabiliser.

Use of FETs

An elegant approach to this is to use a field effect transistor. Typical n-channel junction f.e.t. drain current/drain-source voltage characteristic curves for varying gate-source voltages are shown in Fig. 3. From the pinch-off voltage to the breakdown point the drain current is remarkably constant, though there is a large variation between individual samples—the drain current for a 2N3819 may lie between 2 and 20mA. Two-terminal devices that look like diodes but are f.e.t.s with the gate tied to the source are available and are graded by the manufacturer into current ranges. An f.e.t. with a source resistor can be used (see Fig. 4) to get any current less than *I*dss, and for one particular resistor value the temperature coefficient can be reduced to zero. The resistor value will vary from sample to sample of course but without it the coefficient is only about 0·006mA/°C.

Barretter

Some years ago barretters were used to stabilise the heater current of series operated valves against supply voltage variations. The barretter had a positive temperature coefficient iron filament which was enclosed in hydrogen in a glass envelope. If the supply voltage rose increased current would flow, heating the iron filament more: this sent up its resistance, thus preventing a proportional rise in current. Mains voltages are now standardised at 240V and the need for barretters in portable mains radios has disappeared along with the valves themselves. Whether the constancy of the 240V these days is any better than the variation over the country of yesteryear is open to doubt however. Barretters are more expensive than silicon diodes, get hotter and are bigger so we are better off without them.

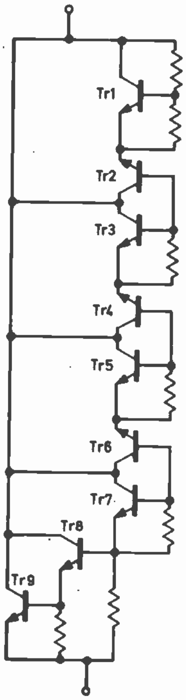
Thermistors

Positive temperature coefficient thermistors can be similarly used but for many purposes have too long a time-constant. The negative temperature coefficient thermistor is much more common—to limit the switch-on current surge. As the temperature increases its resistance falls while that of the valve heaters increases. The same principle is employed in the field output stage where a negative temperature coefficient thermistor is used in series with the deflection coils to compensate for the increased coil resistance as temperature rises, thus preventing height reduction. Negative temperature coefficient thermistors also find application as voltage stabilisers for *RC* oscillators.

IC Stabiliser

The varactor tuner has created a demand for a stabiliser operating at about 35V with a very low temperature coefficient and low dynamic resistance. These requirements make the zener diode unsuitable, a 30V 400mW zener diode having a temperature coefficient of +26mV/°C (0·087%/°C) and a dynamic resistance of 95Ω. So try six 5·6V zener diodes in series, with the chance of zero temperature coefficient but a dynamic resistance now of 130Ω.

The i.c. manufacturers provided the solution by producing devices with a low temperature coefficient and a dynamic resistance of only 10Ω. The published circuit is shown in Fig. 5, redrawn in Fig. 6 so as to show the basic action. On the face of it Fig. 5 looks as if everything is shorted, but the collectors of Tr2, Tr4 and Tr6 do not draw current. These transistors are used in fact as zener diodes, in the manner previously explained (making use of the base-emitter junctions for this purpose). Tr2-Tr7 can be considered as a single zener diode, in series with Tr1 which is a *V*be multiplier, making the whole chain equivalent to the active zener circuit shown in Fig. 2. Tr3, Tr5 and Tr7 are emitter-followers, providing more current than the zeners Tr2, Tr4 and Tr6 can give. The positive temperature co-



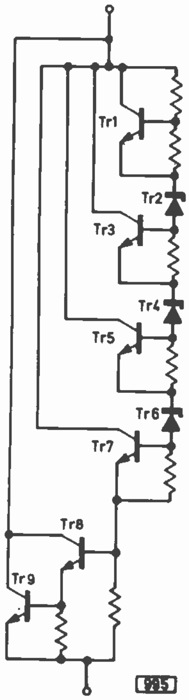


Fig. 5 (left): 35V i.c. stabiliser—internal circuit. Types TAA550 and TBA271.

Fig. 6 (right): Circuit redrawn to show operation. Tr2, Tr4 and Tr6 act as zener diodes; Tr3, Tr5 and Tr7 are emitter-followers: Tr1 is a Vbe multiplier; Tr8 and Tr9 form a Darlington pair.

efficient of the zeners is offset by the negative temperature coefficient of Tr1 and the base-emitter voltage across the Darlington pair Tr8-Tr9. This gives the device a temperature coefficient lying between −3·1 and +1·55mV/°C.

The i.c. should be fed with 5mA from a higher voltage line through a suitable resistor. Capacitor bypassing is not only permissible but required, in order to reduce the noise generated by all the transistors inside and also to help prevent damage due to transients.

Conclusion

It has been a long time from the development of the neon stabiliser to this i.c. The intervening devices have played their part and in some circumstances have been resurrected to fill gaps more cheaply than newer ones. It is perhaps fortunate that the late German doctor George Simon Ohm never encountered any of them—we might have had to wait longer for the law that now bears his name! ■

SPECIAL HEATHKIT TV OFFER

The Heathkit GR9900 portable TV receiver kit (white cabinet version only) is being offered for a limited period at a special price of £54 which includes delivery, VAT and a GRA-9900-1 table-top aerial. A review of this kit will be published in our next issue.

LONG-DISTANCE TELEVISION

ROGER BUNNEY

AUTUMN has the tradition of being the "Tropospheric Season". Unfortunately this year seems to be the exception since up to the end of November there has been little sign of any enhanced Tropospheric conditions: indeed in the British Isles the only thing that has been enhanced this Autumn has been the rain! This seems to have persuaded the famed Leonids meteor shower to show a similar reluctance to produce any reasonable signal activity—at least during the periods that I monitored. Except for some Sporadic E activity during the middle of the month the only activity has been meteor shower/scatter (MS) which for myself did at least produce a new station and country for Band III reception—Sweden. An interesting note came from Hugh Cocks (Devon) who received signs from the recent Aurora some two solar revolutions later—these signs appeared as "splurges on Band I for 15 minutes" on November 11th at 1830GMT.

My own log for the period doesn't make for exciting reading:

1/11/74 ORF (Austria) ch. E4—MS.
2/11/74 WG (West Germany) E4—MS.
3/11/74 TVE (Spain) E4—MS.
4/11/74 CST (Czechoslovakia) R1; SR (Sweden) E2; NRK (Norway) E3—all MS.
6/11/74 WG E2 (using Telefunken card!), E4; SR E2; ORF E2a; unidentified E5—all MS.
7/11/74 DFF (East Germany) E4—MS.
8/11/74 RAI Italy) IB; WG E2—both MS.
9/11/74 DR (Denmark) E3, 4; WG E4; ORF E2 all MS.
10/11/74 TVE E2—MS.
11/11/74 DR E4; SR E3; WG E2, 3—all MS.
12/11/74 DFF E4; SR E3—both MS.
13/11/74 DR E4; TVP (Poland) R1; WG E2—all MS.
14/11/74 DFF E4; DR E3; CST R1—all MS.
15/11/74 DR E4; ORF E2a—all MS.
16/11/74 RAI IB; WG E2—both MS.
18/11/74 Swiss E2, 3; WG E2; TVE E4; CST R1—all MS.
19/11/74 *DFF E5*; WG E3; RAI IB—all MS; SR E2; TSS (USSR) R1—both SpE (Sporadic E).
20/11/74 Swiss E3; WG E2—both MS; SR E2; MT (Hungary) R1; TSS R1—all SpE.
21/11/74 SR E3, 4, *5*; WG E2, 4—all MS; TSS R1—SpE.
25/11/74 WG E2, 4; SR E2—all MS.
26/11/74 CST R1—MS.
27/11/74 WG E3, 4; ORF E2a; TVP R1—all MS.
28/11/74 DR E4; CST R1; TVP R1; TSS R1 (at 2245 GMT!)—all MS.

Apart from the DFF and SR receptions via MS in Band III the short spells of early morning SpE are the only items of special note, at least from my Hampshire location. The period 22nd–24th was strangely quiet and although close watch was kept during the productive early morning hours little of note was logged.

Following recent comments on the possibilities of long-haul DX TV via MS in Band III Clive Athowe has been very active: during October he logged a great number of stations. Most of the signals were of short duration—characteristic of MS—though one NRK ch. E6 signal persisted for some six seconds. Clive's successes are briefly as follows: Swiss E7, 10; RAI ch. D, H; TVP R7; TSS R7; ORF E8, 10; NRK E6; also many unidentified signals including blank FUBK test cards and EBU bar patterns. Our congratulations must go to Clive for his R7 TSS reception—as far as is known this is the first time that TSS has been received in the UK in Band III. Clive has sent us a shot of his aerial system which includes a group C MBM46, a B2MBM46, an A2MBM70 and a Band III Fuba wideband array beneath which are fixed arrays for various transmitters and, on a separate mast, the main wideband Band I array. The triangular mast is some 50ft. a.g.l. Very few signals escape Clive!

Whilst on the subject of weak signals, Garry Smith (Derby) received ORF ch. E3 during the SpE opening on October 1st: the interesting point however is that the outlets on this frequency are of relay powers only—in fact there are four transmitters ranging from 100W downwards. This illustrates that we must at all times be aware of and alert for even the very low-power transmitters.

New EBU Tx List

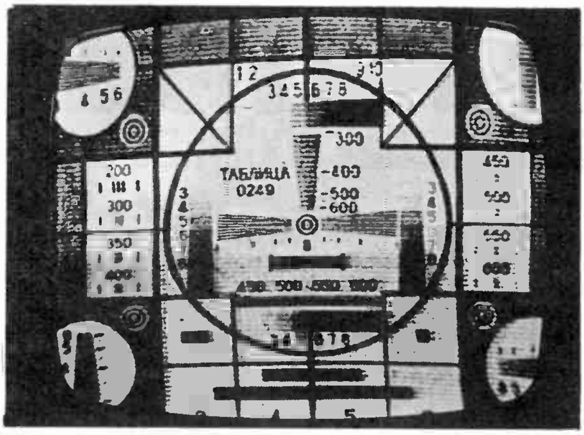
The subscription for the new *List of Television Stations—European Broadcasting Area* is now due. This list is extremely comprehensive and in fact is an essential tool for the TV DXer. The cost remains at 300 Belgian Francs—this includes six bimonthly supplements and a map—from the European Broadcasting Union (EBU), Technical Centre, 32 Avenue Albert Lancaster, Bruxelles 18, Belgium.

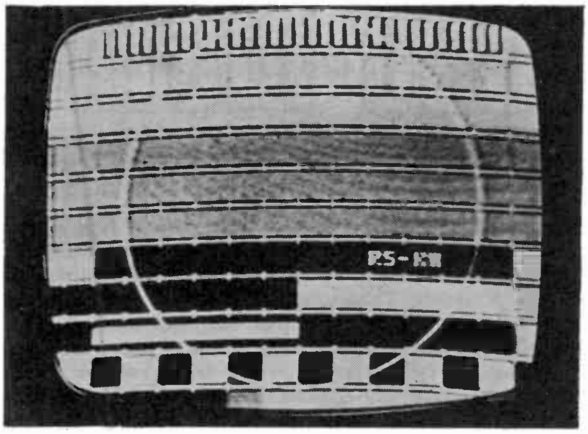
Foreign News

New Zealand: Ten high-power Marconi television transmitters will be supplied to the NZBC as part of the second colour network. The new transmitters will be installed in pairs with the outputs combined. AKTV Auckland has a 30kW combination at Waitaru; a 20kW system on Mount Te Aroha will radiate second chain programming to the Waikato and Bay of Plenty areas; a 30kW transmitter will be at Wharite and a further 30kW unit at Wellington.

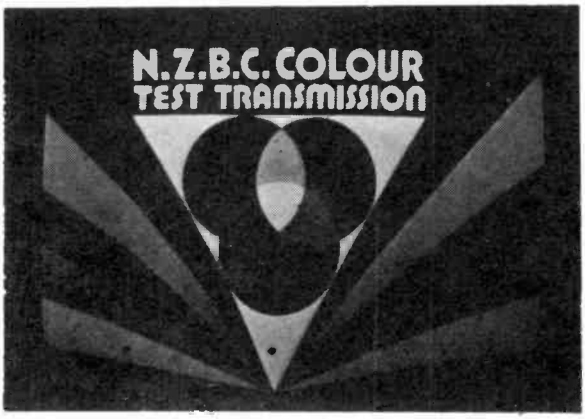
Hong Kong: EMI is to supply equipment for a new Chinese language commercial TV service in Hong Kong. Called Commercial Television Ltd., the company has been formed by the principal radio authority in the colony. A new studio centre is under construction and "on-air" is anticipated to be mid-1975. The service will cover some 95% of the population.

China: Reports coming out of the Republic of China via a rather circuitous route indicate that the Republic is considering establishing a colour television service—even though there are at present only some 200,000 monochrome sets in the huge nation and a very limited broadcast TV service. It seems that the PAL colour system will almost certainly be adopted. Following last year's purchase of a single Marconi Mark VIII colour camera and a PAL coder, reports from Germany say that the Japanese manufacturer Toshiba has received an order for two colour OB units, again equipped with PAL coders. Colour receivers





TSS (USSR) 0249 test card (ch. R1) and CST (Czechoslovakia) test pattern. *Photos G. Harrison.*



NZBC test transmission caption.

Network Television caption (NZBC).

Photos of New Zealand captions from D. Mcfadyen, North Island.

AKTV (New Zealand) caption.

have been ordered in some quantity from German and Japanese manufacturers and negotiations are under way with Telefunken in Germany for a manufacturing licence under which China will produce PAL colour TV sets.

From Our Correspondents . . .

We have heard again from our Libyan contact Dr. M. Baloch. Of importance are his listings of local TV networks since these update previous ones and reveal some inaccuracies. The situation is now as follows: Benghazi E5, Merje E7, Derna E8, Tripoli E6, Khims E12, Elbeida E9, Tobruk E6, Musarata E10, Saba E7. In addition the American oil companies operate a number of local TV stations. These are microwave linked through the country. The Saba (ex Sebah) listing is interesting as we had previously understood this station to be operating in ch. E4 with low power.

Graham Harrison has joined the ranks of the TV DX fraternity. Using a "renovated TV" obtained for £7.00 he initially received NRK on test card. This reception led to his constructing a two-stage wideband Band I aerial amplifier and the improved omnidirectional array featured in the March 1974 column. A black-level clamp has been added to the receiver together with video detector diode switching (for positive or negative video). Graham is also now processing his own film. Two examples of his reception (and photography!) are shown above.

Doug Mcfadyen (North Island, New Zealand) has sent us some excellent and unusual shots of his local TV. Doug is contemplating the construction of a stacked array using upwards of four dipoles and a reflector assembly. With the spread of colour television in NZ the main transmitters are being upgraded. This has resulted in first class reception from his "local" some 65 miles distant—he described previous reception as mediocre. With the approach of the Australasian summer SpE has been improving. Some sort of reception is currently being received via F2 from Korea, China etc.—mainly of f.m. links etc.

Anthony Mann (Western Australia) is also receiving a great many signals of various types via F2: frequencies up to 47MHz are often received; ch. R1 signals have been observed though their origin is so far unknown.

Test Card Origin Identifications

Certain identifications appear on test patterns from time to time and can cause confusion. Alex Gordon of Theydon Bois, Essex has kindly supplied a list of the more common identifications on the EBU/OIRT networks. The following currently used identification initials are worth noting:

CNCT (National Technical Control Centre): Refers to the point where EBU signals are received by the broadcasters in each country, e.g. in West Germany Frankfurt. At times CNCT-v, CNCT-s are used, indicating that the vision and sound signals have separate routes.

CNCP (National Programme Control Centre): The production facility handling the programme requirements for each country. (Has direct access to CICP.)

CICT (International Technical Co-ordination Centre): This is located in the domes of the Palace du Justice, Brussels. All the main switching for the entire Eurovision network is done here.

CICP (International Programme Co-ordination Centre): This is located at the point of origination of a Eurovision broadcast, though at times this can be located at Brussels.

CEPT (Postal Authority): Where the PTT operates the radio link network.

DR (Kobenhavn): Acts as sub-CICT for North Germany and Scandinavia.

Albis-Schweiz: Acts as sub-CICT for Switzerland, Italy and Austria.

The following identifications are now used on Swiss test cards: B Bantiger; C St. Chrisschona/Busel; D La Dole; S Santis; T Monte Generoso; U Uetliberg; A SRG OB van; G Geneva SSR Studio; L TSI OB van; R SSR OB van; Z Studio Zurich SRG.

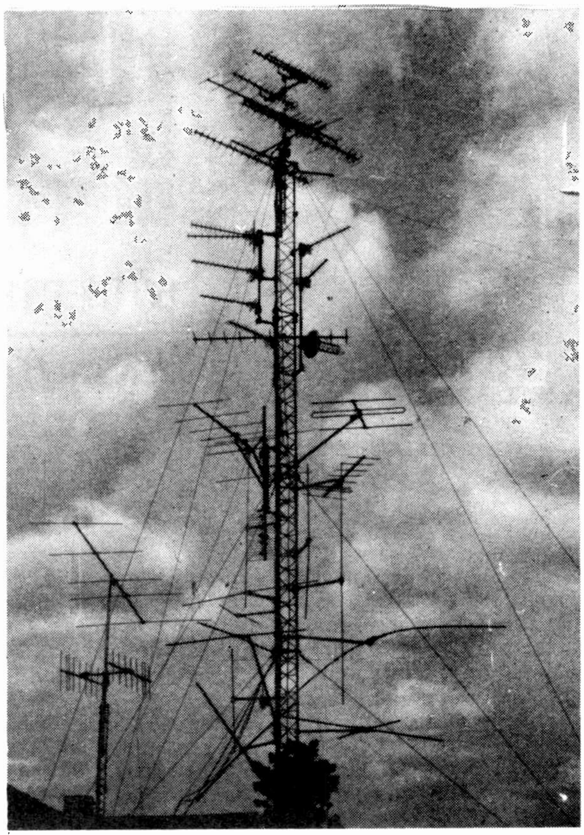
Auroral Reception

We have commented in recent months on the number of enthusiasts who have been successful in receiving signals resulting from Auroral activity. Reception of this type is rare—in fact in some years it seems to occur on only about three days. Even an active DXer may miss such events for several years therefore.

It is possible to predict Auroral activity with a degree of certainty by observing the Sun's surface for Sun-spot activity. There is a peak in this activity every eleven years and at such times there is a good possibility of solar flares occurring. Such flares can also occur at other times however as the recent events, occurring during a period of minimum Sun-spot activity, demonstrate.

When a solar flare erupts particles are sent through space and after about 24 hours reach the Earth where they are influenced by the Earth's radiation belts. The charged particles concentrate at the poles, producing Auroras which can be seen as a display of coloured light in the sky. A more important effect is the resulting magnetic storms in the D, E and F layers exploited for radio communcations. These layers are disrupted and as a result communications deteriorate.

An Aurora produces a reflecting sheet capable of reflecting signals up to the v.h.f. spectrum however, and television signals which have been reflected from the sheet can thus be received. Such signals tend to be severely distorted unfortunately, suffering from hum, smearing on vision and a hum on the sound. Vision signals reflected from Auroral sheets have been seen and identified in recent months—YLE (Finland) was logged on chs. E2 and E3 via this mode for example.

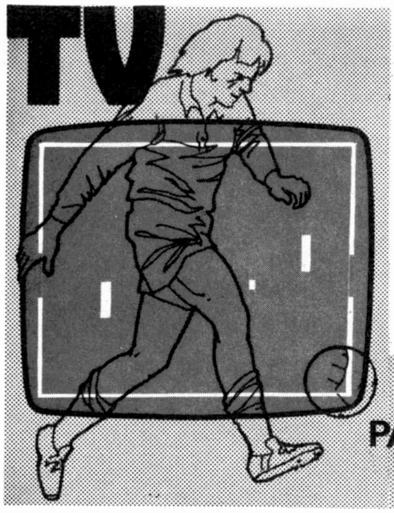


Clive Athowe's aerial mast (near Norwich).

An extremely large solar flare takes some time to die down. Consequently 27 days after an Aurora, when the Sun has rotated once more, there is a good possibility that the event will be repeated. A flare at the centre of the Sun produces greater activity than one towards its edges.

Since the Aurora occurs at the Earth's magnetic poles it follows that in the northern hemisphere reflected signals will arrive from the north or a direction close to this, though the origin of the signals received may be from a location to the east or west. There is a tendency for an Aurora to have two phases, one in the afternoon and the other in the evening—either phase may be the stronger one. Band I signals are the ones generally reflected, though Auroral effects have been noted on Band III.

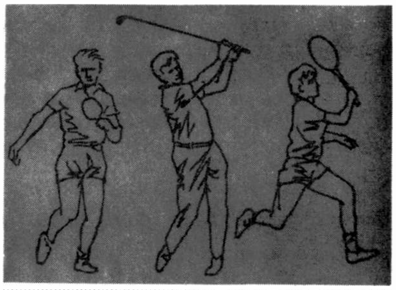
The current Sun-spot situation can be ascertained by observing the Sun's surface—an extremely large area spot is capable of producing a flare. The simplest method of observation is to aim a telescope at the Sun and project the image on to a piece of white card. I find it convenient to use one of the popular Japanese 45×60 telescopes—these are mounted on a tripod and are relatively inexpensive. It is of extreme importace to project the image on to a card—no attempt should be made to view the Sun's surface directly through the telescope, even with a smoked glass filter over the lens. These can fracture (and have done) resulting in serious and permanent eye damage. Similarly, when aligning the telescope to project the image on to the card no attempt should be made to sight the telescope using the eye.



TV FOOTBALL & other GAMES ON THE TELEVISION SCREEN

P. BUSBY* B Sc

*I PC SERVICES LTD.



PART SEVEN

THE design philosophy for the tennis game was to produce a game with as few components as possible. To this end, embellishments such as boundaries and nets were dispensed with: they could, in any case, be painted on a transparent overlay mask and applied to the face of the tube.

It must be admitted however that the screen does look somewhat bare with just two men and a ball. The simple net circuit shown in Fig. 32 makes the game more appealing and puts it on a par with the commercial games.

Net Generator

The circuit follows the same principles that we used for the men and ball circuit except that the gated oscillator IC601a, IC602a is used to give a realistic dotted line for the net. The Schmitt trigger gate IC601a, with feedback resistor R601 and capacitor C601, forms a relaxation oscillator having an asymmetrical square wave output. The additional feedback path from the output of IC601a to the input of IC602a prevents the gate signal (the field time-base) from acting until the output of IC601a is high. This ensures that the oscillator always produces an integral number of cycles and is thus locked in phase with the time-base.

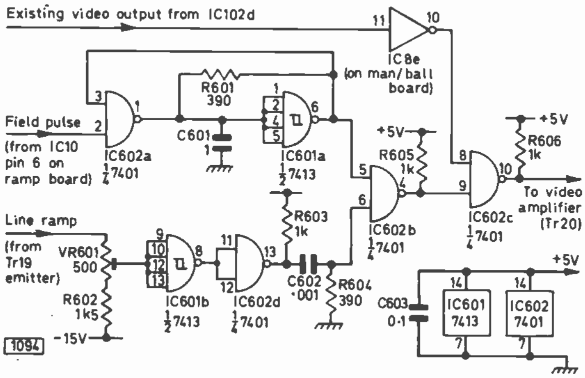


Fig. 32: Circuitry to produce a net for the tennis game.

Superman

So far, we have concentrated on imitating a real football game on our 20in. or so TV screen. We cannot of course expect a game with the same subtleties as on a 100 × 70yds. football field. If we adopt the opposite approach however we can realise electronically what may be desirable in a game for home entertainment but unfeasible in a real ball game: imagine a robot football player that could play the real game with the skill of Pele! In our electronic counterpart we can provide just this with the circuit shown in Fig. 33.

The way in which our automated man fields the ball is simplicity itself, for all that is necessary is to preset the man's horizontal position and tie his vertical position to that of the ball. A Man/Ball collision is then inevitable. The circuit shown in Fig. 33, which replaces the left joystick, does just this. R526, D503 provide −0·5V to *Lx* to preset the horizontal position while the circuitry associated with IC501 ties *Ly*, the left man vertical position, to *By* the corresponding coordinate for the ball. In fact, because the display circuitry for the men and the ball differ slightly an interface between *By* and *Ly* is required. Disregarding VR501, C501, the voltage *By* is fed into a high input impedance amplifier with a gain of two. VR502, R503 provide an offset voltage whilst the overall gain can be adjusted between 0·5 and 1·5 by the attenuator R504, VR503, R505 at the output.

As it is no fun playing against a perfect opponent, the *RC* network VR501, C501 is included to vary the lag between *By* and *Ly*. Thus by adjusting VR501 we can vary Superman's agility from perfect to very sluggish.

Scoring

The remaining circuitry determines the velocity which Superman imparts to the Ball. In Fig. 34 we see how Superman scores in three ways depending on the vertical position of the opposing player (Right Man).

Consider the simple kick in Fig. 34a. The horizontal velocity is preset and the vertical velocity is proportional to the distance *y*. In Fig. 33 the operational amplifiers IC506, IC507 are unity-gain voltage followers which feed directly into the analogue board E in place of the differentiator circuits. The input to IC506 is preset by VR506 which determines the horizontal velocity. IC505 is a summing amplifier which measures the value *y* and multiplies it by a fixed factor *K*. If we assume that the input into R519 is at zero (which it will be for Fig. 34a), *y* is determined by subtracting the

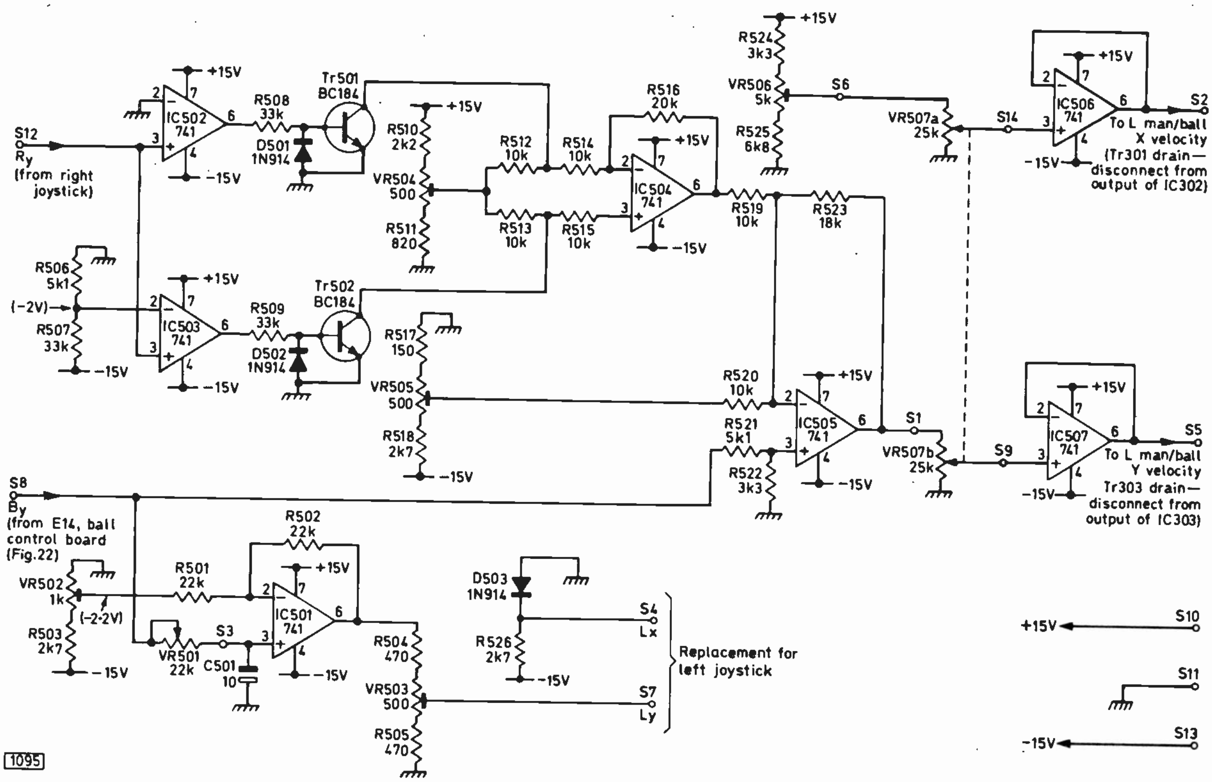


Fig. 33. Circuit for Superman, intended as a plug-in replacement for the left joystick. VR501 and VR507 are front-panel controls for setting the speed of response and kick respectively.

value of *By*, when it is coincident with Superman, from the value of *By* at the centre of the goal. This latter value is preset by VR505 feeding the inverting input whilst *By* is fed via a potential divider R521, R522 to the non-inverting input. The gain factor *K* is determined by the feedback resistor R523.

Scoring "in off" the touch lines is accomplished by adding or subtracting a voltage of *W* from the value of *y*. This *W* value corresponds to the difference of *By* between the two touch lines and is summed in R519. The output of IC504 will be $+W$, $-W$ or 0 volts depending on the position of the right man.

The magnitude of *W* is preset by VR504 which feeds both inputs of IC504. Transistors Tr501, Tr502 can earth either or both of these inputs. Thus if both transistors are off we have a gain of -1 at the inverting input and $+2$ at the non-inverting input giving $+W$ at the output. With Tr502 on and Tr501 off a gain of -1 gives $-W$ at the output. With both Tr501 and Tr502 on, both inputs are shorted to ground giving zero output.

The vertical position of the right man is fed to two comparators IC502, IC503 which determine whether he is in the top, central or lower part of the field. When he is in the lower area of the screen (Fig. 34c) IC502 and IC503 will both be below their switching thresholds, giving -15V at their outputs. Tr501, Tr502 will both be off and $+W$ will be produced at the output of IC504. In summing this with *y* in IC505, $+W$ is inverted to give the required $K(y-W)$ at the output of IC505. With the right man central (Fig. 34b) IC503 output will switch positive driving Tr502 on and $-W$ will be produced giving the overall function $K(y+W)$ at IC505 output. Finally, with the right man at the top (Fig. 34a) both comparators will switch positive driving both transistors on giving a zero output and the overall function of just *Ky*.

Construction

The prototype was wired on strip board and mounted in a die-cast case. Connections to the game circuits were made through the existing left-hand joystick socket. The extra wires needed were routed through spare pins on the socket. The differentiator outputs

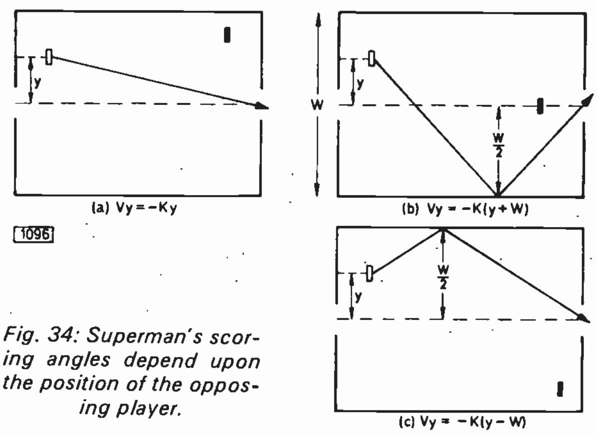


Fig. 34: Superman's scoring angles depend upon the position of the opposing player.

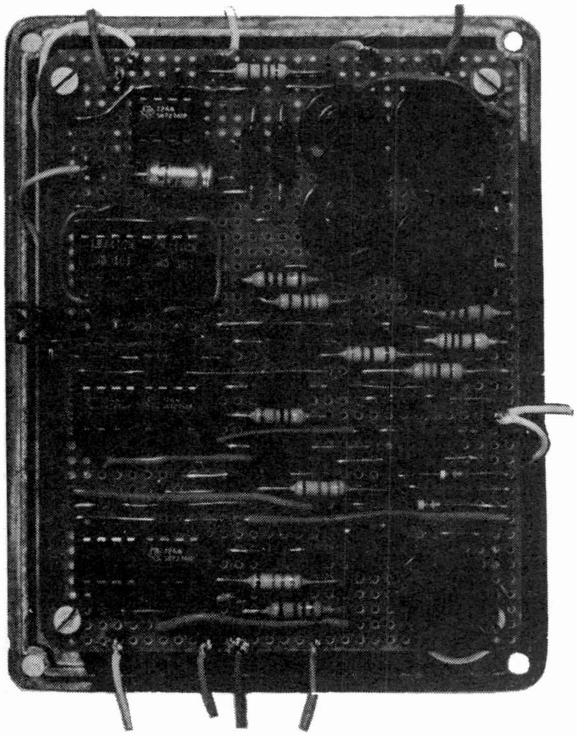
from IC302, IC303 were looped out and back to the sample and hold FET's via linking in the left joystick plug. Thus, when Superman is plugged in, the differentiators are disconnected from the sample and hold circuits and replaced with the computed ball velocity voltages.

Setting Up

With the response potentiometer VR501 turned right out, adjust the trimmers VR502, VR503 so that Superman intercepts the ball at any position on the field. Turn the kick velocity potentiometer VR507 to its mid position and adjust the preset VR506 to give a gentle kick. Put the right man in the top right-hand corner of the field and centre the ball with the joystick pushbutton so that it is directly in line with the goal centres. Adjust VR505 to give zero volts at the output of IC507. VR506 can now be set to give direct scoring with Superman in any position. Position the right man in front of the goal and adjust VR504 to give indirect scoring off the lower touch line. Finally, check the scoring off the upper touch line with the right man at the bottom of the field.

Conclusions

To wind up the series, a few ideas which enterprising constructors may like to follow up. Continuing with the previous theme; the next logical step is to make a second Superman for the right joystick. The constructor can then sit back and let them play each other. Should you prefer some involvement you could take the role of referee, perhaps an electronic whistle would be of use here.



Layout of the Superman board.

★ Components list

TENNIS NET GENERATOR

Resistors: (all ±5%, ¼W)

R601, R604	390 Ω	R603, R605, R606	1k Ω
R602	1·5k Ω		

Preset Potentiometers:

VR601 500 Ω miniature carbon

Capacitors:

C602	1nF	C603	0·1µF ceramic	C601	1µF

Semiconductors:

IC602	7401	IC601	7413

SUPERMAN

Resistors: (all ±5%, ¼W)

R517	150 Ω	R525	6·8k Ω
R504, R505	470 Ω	R512-R515, R519, R520	10k Ω
R511	820 Ω	R523	18k Ω
R510	2·2k Ω	R501, R502	22k Ω
R503, R518	2·7k Ω	R507-R509	33k Ω
R522, R524	3·3k Ω		
R506, R521	5·1k Ω		

Potentiometers:

VR503-VR505	500 Ω	VR506	5k Ω
VR502	1k Ω	All min. carbon presets	
VR501	22k Ω linear carbon		
VR507	25k Ω+25k Ω dual ganged		

Capacitors:

C501 10µF 25V electrolytic

Semiconductors:

Tr501, Tr502	BC184
D501-D503	1N914 or 1N4148
IC501-IC507	741 (DIL8 version)

Further sounds, such as a score sound, could be added to give the game more appeal. For this an imitation of a roaring crowd might be appropriate. The kick sounds could also be extended to cover rebounds from the boundary lines.

The addition of extra men is quite feasible; the game was, in fact, designed with this in mind. The complete control of ball direction over 360° was incorporated for the purpose of possible passing manoeuvres. Here the colour game is useful as it helps players to identify their men, which is important on a crowded field.

There is an alternative method of ball control which should give more precise control over the ball. A second joystick is manipulated with the left hand and is used to control the ball velocity in place of the differentiator circuits.

One of the unrealities of the existing games is the superhuman agility, of the men, enabling them to run from one end of the field to the other in a split second. Realism can be simulated here with a simple *RC* network (as we used for Superman) on the joystick controls.

Readers may wish to use this game coupled directly into the TV aerial socket. This should be feasible with a u.h.f. modulator such as the kit supplied by Crofton Electronics. It would also be necessary to provide some source of field and line sync pulses. With the saving of an isolating transformer, this method would not be costly, but it would be suitable only for a monochrome game. ■

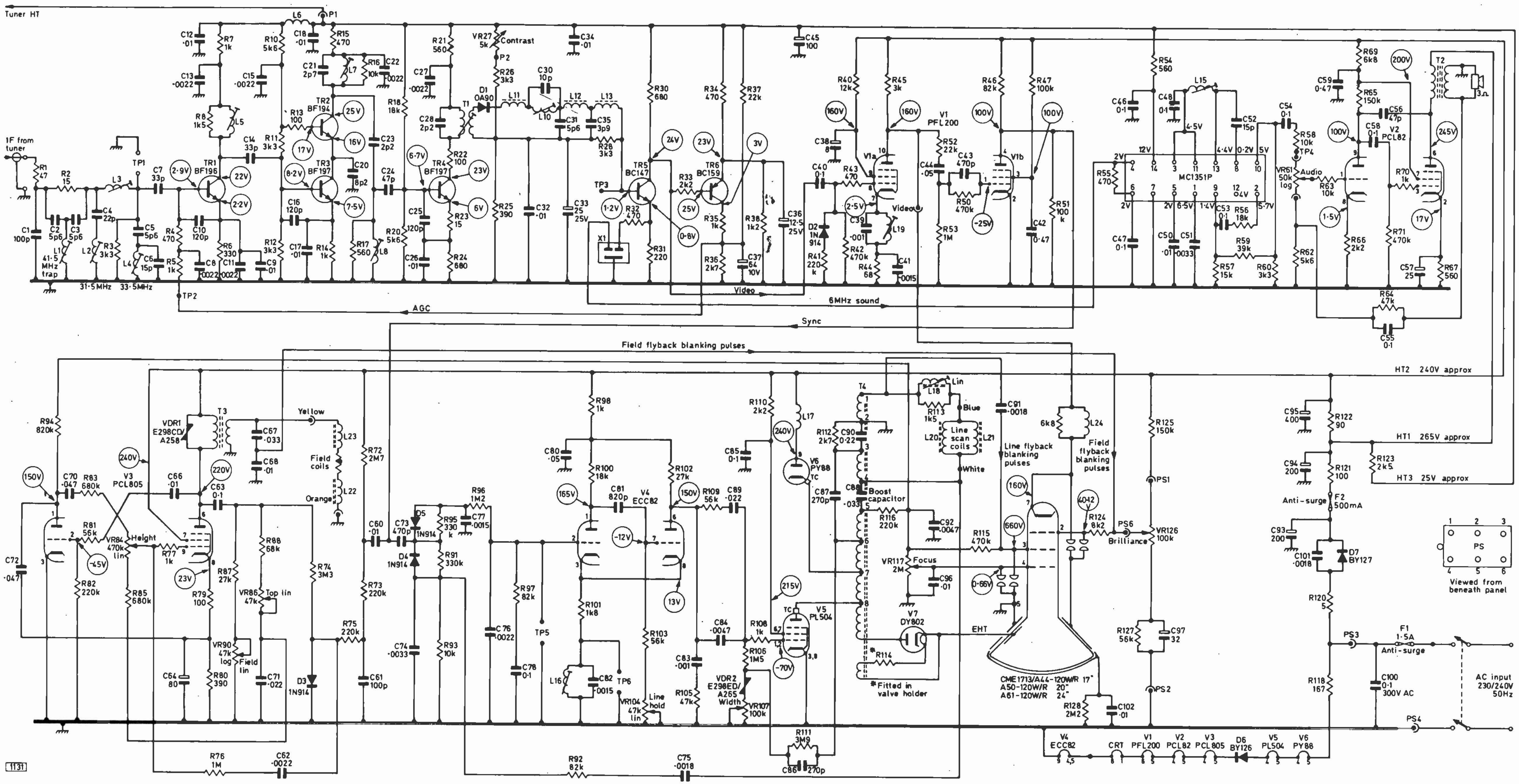


Fig.1: Circuit diagram (less tuner unit), Decca Models MS1700, MS2001 and MS2401.

via C40, with partial d.c. restoration by D2 The sound is picked off at TR5 emitter and fed via the 6MHz ceramic filter X1 to the sound i.c.

The other transistor is TR6 which is switched on by the sync pulses and produces an a.g.c. potential dependent on the sync pulse (i.e. signal) amplitude to control TR1. The contrast control VR27 sets the operating level of TR5 and thus TR6 as well since the base of TR6 is d.c. coupled to TR5 collector. When checking these transistors remember that TR5 is an npn type whilst TR6 is a pnp type. C36 can go short-circuit, producing uncontrollable contrast since the a.g.c. circuit is no longer operative. Another source of occasional trouble in this area is the other electrolytic C37 (see "Less Usual Faults").

The IF Stages

The output from the tuner is fed via a series of filters to the first i.f. stage (TR1, BF196) which is gain controlled. The signals developed across L5 are fed via C14 to the cascode stage consisting of TR2 and TR3. The output developed across L7 is passed via C23 and C24 to the final i.f. amplifier TR4. If trouble develops in the i.f. strip it is likely to be centred around TR4 (BF197). Loss of signals should—assuming that the supply line is intact—lead to a check on the emitter voltage of TR4. This should be about 6V. Absence of a reading here will normally indicate that the transistor's base-emitter junction is open-circuit.

The Sound Strip

Intercarrier sound signals filtered by X1 are applied to pin 4 of the MC1351P i.c. The only tuning associated with this is the quadrature coil L15. The setting of this is rather critical if distortion is to be avoided: many a PCL82 audio valve has been replaced only to find that all that was required was a "tweek" of L15's core.

This is not to say that distortion cannot be due to the PCL82 or an associated component however. But as used in these models the PCL82 seems to have a longer life than as used in some others. We attribute this to the lower (200V) screen grid voltage (dropped through R69). For all that the valve can run into grid current and R67 must be checked for correct value (560 Ω) should a new valve have to be fitted.

CONTINUED NEXT MONTH

VIDEO CIRCUITS & FAULTS part 2

S. GEORGE

In the preceding part the design features and common faults experienced with valve video circuits were considered. These generally consist of a single pentode output stage which is driven by the detector, various circuit refinements being used in order to obtain reasonably linear amplification over the video bandwidth.

Although transistor video circuits appear at first glance to have much in common with their valve counterparts, the design approach is completely different—due mainly to the markedly different electrical characteristics of transistors, in particular the low input impedance of a transistor operated in the common-emitter mode.

Transistor Input Characteristics

A pentode valve has a very high input resistance and low input capacitance. It imposes negligible loading on the vision detector load resistor therefore. The input capacitance of a video output transistor however, amplified by the equivalent of a valve's Miller effect, can approach 100pF. This equivalent to the Miller effect arises since while the input signal is charging the transistor's base-collector capacitance the amplified but opposite phase signal developed across its load resistor charges the base-collector capacitance from the collector: thus the effective input capacitance is stage gain plus one times the nominal value. Say the gain of a video output transistor is 24 and its nominal input capacitance 3pF: the effective input capacitance will be $24+1\times3=75$pF, to which must be added the unavoidable stray capacitance which may total about 20pF.

The input resistance of the transistor, approximating to the common-emitter gain multiplied by the value of the partially decoupled emitter resistance, presents less of a problem: the low value, average 3 to 4k Ω, has to be taken into consideration when designing the preceding stage however.

It is clearly impractical then to drive the video output transistor from the detector load resistor: to maintain the h.f. response to the required bandwidth with a capacitive loading approaching 100pF would necessitate the use of an unacceptably low value detector load resistor. As we saw last month the turnover frequency—the point at which the response falls to 0·7 of that at peak gain—occurs when the shunt reactance present is of equal value to the load resistor. A total shunt capacitance of 80pF means that the load resistor value would have to be in the region of 400 Ω if the turnover frequency is set at 5MHz. A value of this order would result in very low detector efficiency and also heavily load the preceding i.f. stage.

Need for a Driver Stage

Because of these factors it is necessary to employ an impedance matching or buffer stage between the vision detector and the video output transistor. An emitter-follower stage is generally used for this purpose because of the high input impedance and low output impedance of such a stage. The stage will provide less than unity voltage gain but a high current gain.

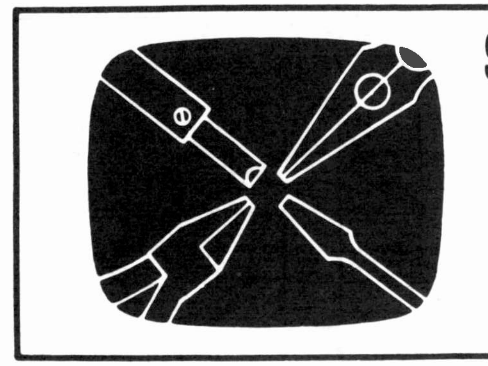
Let's see why an emitter-follower has a high input impedance. Since there is no decoupling capacitor across the emitter load resistor the emitter voltage closely follows the base voltage, the small difference between them—the base-emitter voltage—maintaining the flow of collector current. If this base-emitter voltage is taken to be only a tenth of the applied (base to chassis) signal the resulting input current will be only a tenth of what it would be if the entire signal was developed across the transistor's base-emitter junction. Thus looking at the input terminals—base and chassis—of the stage the input impedance is ten times the nominal value. In practice the input resistance of an emitter-follower stage is approximately equal to the gain multiplied by the emitter resistor value.

The low output impedance arises since the emitter load resistor need be of only a few hundred ohms value while this is in effect in parallel with the output resistance.

In a nutshell, the near 100% negative feedback present in an emitter-follower stage means that the input resistance is high while the output resistance is low, affording a high current gain with a large signal handling capacity and the output in phase with the input.

Ancillary Feeds

As well as acting as an impedance matching stage between the detector and the video output transistor the buffer stage also provides an ideal take-off point for signal feeds to the sync separator, a.g.c. circuit and intercarrier sound channel. A transistor sync separator requires only a small fraction of the peak-to-peak input signal a valve type requires while the sync pulse tips on 625 lines can be used to drive the a.g.c. circuit. If the intercarrier sound is extracted at the buffer stage a 6MHz rejector can be included in the output stage's



SERVICING television receivers

L. LAWRY-JOHNS

DECCA MODELS MS1700, MS2001 AND MS2401

These are single-standard, hybrid receivers with an intercarrier sound integrated circuit and a valve audio output stage—the preceding 2000 series covered in February and March last year featured a valve vision i.f. strip plus an intercarrier sound i.c. and a transistor audio output stage.

The chassis is the same in all three receivers but the layout of the MS1700 is "folded up" to obtain the more compact cabinet presentation required for this transportable model, the loudspeaker, mains input and tuner being mounted at the top. It is no surprise to find that a loudspeaker at the top of a cabinet suffers a higher mortality rate than a speaker mounted lower down, the heat rise causing the speech coil to distort and rub the pole piece in the same way that many unit audio speakers do when they have been run at a consistently high level.

These receivers revert to the use of a PCL82 audio output valve. The tube drive is conventional (d.c. coupled from the video amplifier). The line oscillator is simpler than in previous Decca chassis while the field timebase also departs from previous Decca practice and in fact is almost identical to the circuit used in the Baird 660 and earlier chassis (see previous article, December/January issues).

Power Supplies

The mains input is taken from the on-off switch to F1 which is a 1·5A antisurge fuse. An 0·1µF 300V a.c. capacitor (C100) filters the mains supply. The mains input is then taken to the junction of R118 (heater supply) and R120 (h.t. supply).

From R118 (167 Ω) the heater supply goes straight to pin 5 of the PY88 and thence from pin 4 to the PL504. A heater circuit diode (D6, BY126) is in series between the PL504 and the PCL805 heaters. We have found that the PL504 seems to develop heater to cathode leakage, thus blowing the mains fuse and often the PY88 to boot. When we find that this has happened we snip out the diode and move it up in series with R118. This gives the valves a better chance of surviving, reducing as it does the stress between the heater and cathode.

From R120 a BY127 rectifies the a.c. and fills up the reservoir capacitor C93. A 500mA surge fuse is placed between the rectifier and the smoothing resistor R121. After this point, which connects to the smoothing capacitor C94, the line splits up, going directly to the sound output transformer and indirectly (via R122) to the main h.t. line.

The transistor supply is obtained from the same source, via R123 (2·5k Ω), and this is the item which is likely to give trouble. Most droppers seem to fail in the sections associated with the mains input. It has been our experience with this chassis however that the 2·5k Ω section is the one most likely to be responsible for absence of sound and vision signals. If the correct replacement is not to hand and cannot be waited for some care is required in choosing a resistive element to replace it. Making up the value of 2·5k Ω is no trouble: it is the wattage rating that must be observed. 20W is the minimum and 30W is required for cool running. Either remove the previous R123 or make quite certain it is completely open-circuit: should it reconnect itself the increased supply voltage will have disastrous effects on the circuits supplied.

Notice that we were careful to say no sound and vision *signals:* this is quite different from the symptoms with no h.t. at all. In this case it would obviously be necessary to check farther back in the supply, say to the h.t. fuse F2 and then R120 if the valves are still alight. Only if the timebases are working should R123 be suspected.

Short-circuits

If the mains fuse F1 has failed it is prudent to bear in mind as mentioned earlier the possibility of a short in the heater line. If the fuse is blackened however it is likely that a more direct short-circuit has occurred. This is probably due to C100 shorting or to D7 (the BY127) if cutting one end of C100 does not clear the short.

A short in the h.t. rectifier D7 does not blow the h.t. fuse but it can impose a strain on the surge limiter R120 so that this may be damaged in addition to putting paid to the 1·5A mains fuse.

The Video Stage

A PFL200 is used in the video stage, the second section functioning as the sync separator. The video stage itself doesn't give much trouble except for the 8µF capacitor C38 which dries up impairing the line and field sync. This capacitor and the 100k Ω screen grid feed resistor (R47) in the sync separator stage are the items to suspect if the hold is poor and the PFL200 is not responsible.

Two transistors precede this valve in the circuit. The first is the video driver TR5. This supplies negative-going information to the video output valve control grid

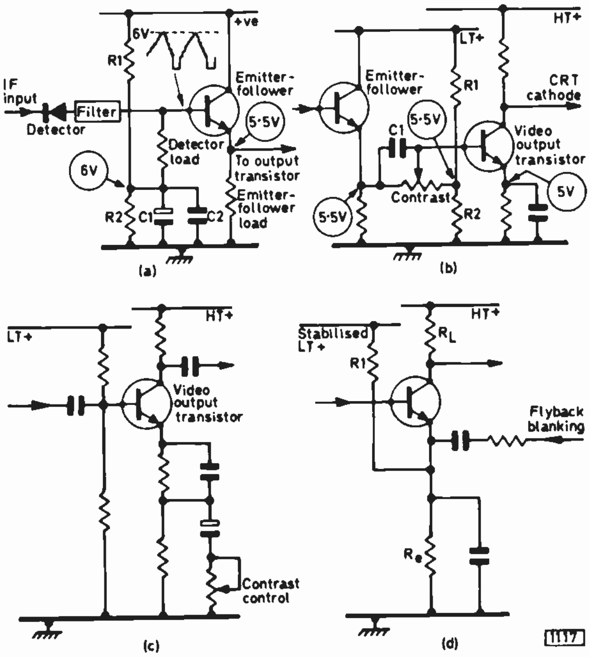


Fig. 1: Circuit techniques used in transistor video channels. (a) Method of biasing the driver stage. (b) Contrast control in a d.c. coupled circuit. (c) Contrast control by means of variable negative feedback in the emitter circuit of the video output transistor. (d) Bias stabilisation and flyback blanking techniques.

input circuit. The result of all this is that the only feed required from the collector of the output transistor is the video drive to the c.r.t., thus markedly reducing the capacitive loading at this point and enabling a higher value load resistor to be used.

DC Coupling

It is best to maintain d.c. coupling throughout the video stages in order to preserve the black level. Let us see what this involves in a solid-circuit design. First the coupling from the detector to the emitter-follower buffer, see Fig. 1(a). Instead of being returned to chassis as in a valve receiver the vision detector load resistor must be returned to the bias source (R1, R2) for the buffer stage, the detector output then adding to or reducing the bias applied to the transistor, depending on the polarity of the output from the detector. The lower end of the detector load resistor must be a.c. returned to chassis otherwise the bias network will form part of the detector load resistor. An electrolytic capacitor (C1) plus an r.f. bypass capacitor (C2) to decouple the electrolytic's inductance are used for this purpose. The detector output is negative-going in Fig. 1(a).

Contrast Control Techniques

If the contrast control is to be incorporated in the video channel instead of being used in the a.g.c. circuit to vary the i.f. gain as in valve circuits this can be done while maintaining the correct d.c. conditions by using the circuit shown in Fig. 1(b). Here the contrast control is used to vary the signal drive from the emitter-follower to the output transistor. It must be connected between points of equal voltage so that movement of the slider does not cause changes in the output transistor biasing—that would change the brightness level. The value of R1 and R2 are calculated so that the voltage across R2 under no signal conditions is equal to the voltage across the emitter-follower's load resistor. C1 provides h.f. signal coupling so that the contrast control does not detract from the h.f. response.

An alternative widely used contrast control technique is to connect a low-value variable resistor in series with an electrolytic decoupling capacitor in the video output transistor emitter circuit as shown in Fig. 1(c). This technique has the advantage, useful in portable sets which are often operated from low aerial inputs, that the contrast control actually sets the gain/bandwidth figure of the stage. With a strong signal, reducing the contrast control setting increases the amount of negative feedback, thus increasing the bandwidth.

Load Resistor Value

Since the total output capacitance of a transistor video output stage is lower than in the case of a pentode output stage rather higher load resistor values can be used for the same bandwidth. In many cases the bandwidth required can be obtained without the use of peaking coils which, although extending the frequency response, do so by introducing a minor peak or curve in the response rather than extending it in a truly linear manner. While the load resistor value for a video output pentode is dictated solely by gain/bandwidth considerations the first consideration with a transistor video output stage is the maximum power dissipation—determined by the h.t. supply voltage, the load resistor value and to a much smaller extent the value of the emitter resistor. Increasing the value of the load and emitter resistors reduces the dissipation within the transistor itself but if too high a load resistor value is used the h.f. response will be curtailed.

Blanking, Stability and Gain

It is worth noting that by applying the flyback blanking to the emitter of the video output transistor—see Fig. 1(d)—the power dissipation can be reduced by at least 15%—since the blanking pulses cut off the transistor's collector current during the line and field flyback periods.

For good stability the total resistance between the base of the output transistor and chassis should not be greater than 1kΩ while the emitter resistance should be not less than 100Ω. In many sets the emitter voltage—and thus the transistor's d.c. working conditions—is further stabilised by applying a current drain from the stabilised l.t. supply to the top of the emitter resistor—e.g. via R1 in Fig. 1(d).

With only partial emitter circuit decoupling, i.e. the use of a small value compensating capacitor in order to maintain the h.f. response (see last month), the medium and low frequency stage gain closely approximates R_L/R_e, averaging 20 to 30—a 3·9kΩ load resistor and 156Ω emitter resistance would result in a stage gain of 25.

Bias Conditions

So much then for the basic essentials of transistor video circuits. Another factor has to be taken into consideration however, as a result of the negative vision

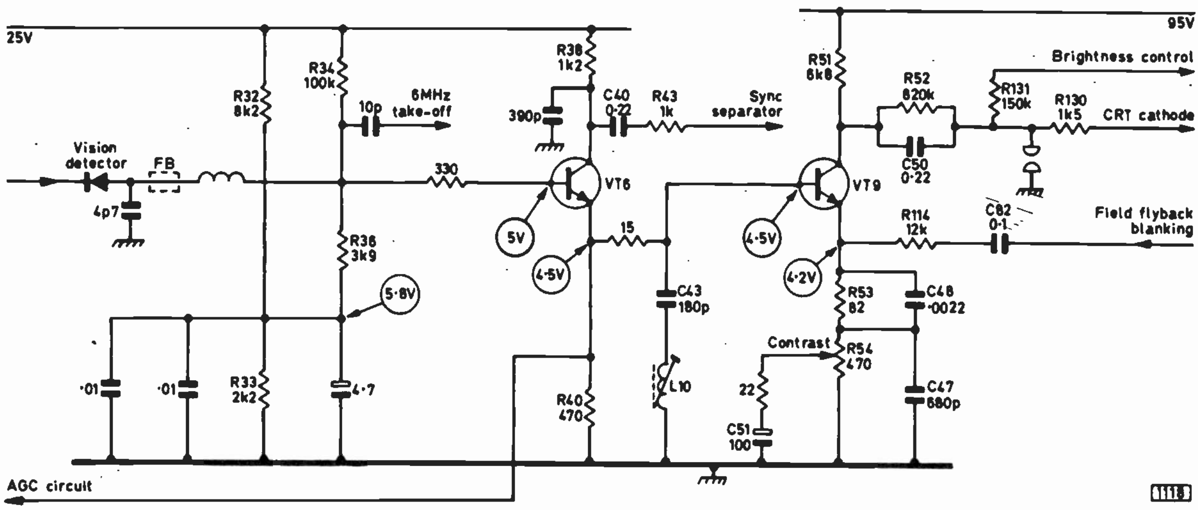


Fig. 2: D.C. coupled video circuit used in the Thorn 1590 chassis. VT6 acts as a sync preamplifier as well as a video buffer/driver stage. The 1591 chassis is the same except for R131 which is 100kΩ.

modulation used with u.h.f. transmissions. With cathode c.r.t. drive, as is generally employed, and d.c. coupling to the c.r.t., the video output transistor's collector voltage under no signal conditions will be at minimum—since the drive to its base is negative-going to cut it off at the sync pulse tips. This means that the forward bias applied to the stage must be such as to keep the transistor on the linear section of its transfer characteristic over the whole range of the negative-going input signal fed to its base—otherwise dark picture tones and the sync pulses will be cramped. The forward bias must not on the other hand be such that excessive collector current flows at peak white and light picture tones. The forward bias to the video output transistor must in fact be carefully set.

With d.c. coupling between an emitter-follower buffer stage and the output transistor via a contrast control—as in Fig. 1(b)—the emitter voltage of the emitter-follower must equal the base voltage required by the output transistor. With a.c. coupling between the two stages however the output transistor can be biased to a midpoint class A position, the drive signal then increasing or decreasing the output transistor's no signal collector current. With a.c. coupling between the output transistor and the c.r.t. the brightness control can be similarly used to set the tube bias to a midpoint position. These a.c. coupling techniques are often used in portable models: as such sets are frequently used under adverse lighting conditions the loss of the d.c. component of the signal is of little consequence while a.c. coupling simplifies circuit design and prevents the tube operating at peak brilliance, thus possibly straining the e.h.t. supply system, under no signal conditions. This last consideration is the reason why beam limiting diodes are generally used with d.c. coupling between the video output transistor and the c.r.t.: we shall look at this technique later.

Representative Circuits

Quite wide variation in design details is found in practical circuits. Let's take a look at some typical examples, starting with portable models.

The video circuit used in the BRC/TCE 1590/1591 chassis is shown in Fig. 2. VT6 is the video emitter-follower which produces a negative-going output across its emitter load resistor R40 to drive the video output transistor VT9 and also the a.g.c. circuit. The vision detector load resistor is R36. This is returned to the junction of R32/R33 which forward biases VT6 and also sets the bias on VT9 since this is d.c. coupled to the emitter of VT6. A small forward bias is applied to the vision detector diode via R34. Rather unusually, the intercarrier sound signal is tapped off from the vision detector load circuit. The npn sync separator requires a positive-going drive signal so this is developed across R38 and fed via C40 and R43. C43 and L10 form an acceptor wavetrap tuned to 6MHz to remove the intercarrier sound signal from the video signal feed. The contrast control R54 is of the negative feedback variety, in the emitter circuit of the video output transistor. Field flyback blanking is also carried out here, by feeding positive-going pulses via C82 and R114 to cut off VT9. C48 and C47 in the emitter circuit provide frequency compensation to maintain the h.f. response. The video output transistor's load resistor is R51, with coupling to the c.r.t. cathode via the low-frequency attenuation network R52/C50 and the flash-over protection resistor R130. The brightness control is linked to the c.r.t. cathode circuit via R131.

AC Coupled Circuit

As an example of a circuit using a.c. coupling between the driver and output transistor and to the c.r.t. cathode Fig. 3 shows the video circuitry used in the Sony Model TV110UK. The input developed by the detector for the emitter-follower (Q401) base is again negative-going. The negative-going output developed at the emitter of Q401 is fed to the a.g.c. circuit and the sync separator (which is a pnp device driving an npn sync amplifier which provides the usual negative-going sync pulses) and is a.c. coupled by C501 to the base of the output transistor Q501. The intercarrier sound signal is again tapped off in the detector circuit, a 6MHz trap across the emitter-follower's load resistor R404 acting as a short-circuit at this frequency to remove this signal from the video channel. C504

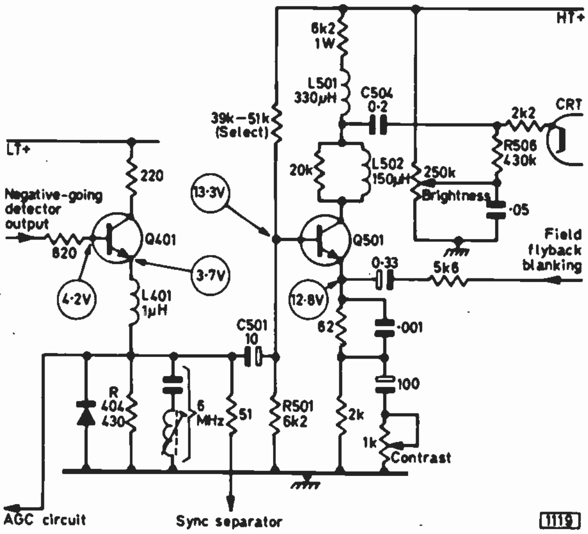


Fig. 3: A.C. coupled circuit used in the Sony Model TV110UK. With a.c. coupling the c.r.t. and the video output transistor can be biased to a midpoint.

couples the output to the c.r.t. cathode. This capacitor is only a fiftieth of the value of the coupler between the emitter-follower and the output transistor. The reasons for this wide variation in values are as follows. The input impedance of Q501 is quite low: thus unless a capacitor of comparably low reactance at the lowest frequency being handled is used there will be considerable low frequency attenuation (since C501 and R501 will act as a potential divider). The input impedance of the c.r.t. is quite high however, so an 0·2μF capacitor can be used with negligible l.f. loss (the signal developed across C504 will be small compared to that developed across R506). L501 and L502 are respectively shunt and series peaking coils; L401 provides peaking in the emitter-follower circuit.

High-Level Contrast Control

The video output transistor collector circuit used in the BRC/TCE 1580 portable receiver chassis is somewhat unusual—see Fig. 4. Contrast control in this circuit is effected by tapping the required degree of tube drive from a 22k Ω potentiometer in the collector

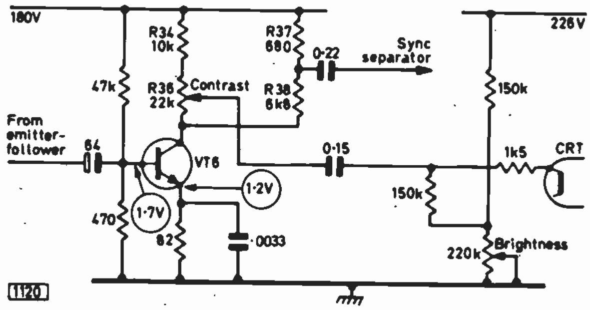


Fig. 4: Video output stage used in the Thorn 1580 chassis. Contrast is controlled by tapping the required degree of c.r.t. drive from the output transistor's collector load circuit.

circuit—in a manner similar to the high-level contrast controls used in a number of Pye/Ekco and Bush/Murphy dual-standard valve receivers—while the junction of R37/R38 provides a 10:1 step-down feed for the sync separator. The collector load consists of 22k Ω+10k Ω in parallel with 6·8k Ω+680 Ω, giving a net figure of about 6k Ω.

Large-Screen Models

Finally in this section reviewing representative circuitry we shall take a look at a couple of contrasting circuits used in large-screen monochrome chassis. In both the d.c. component of the signal is preserved from the detector through to the c.r.t.

Fig. 5 shows the circuit used in the all solid-state RRI A816 chassis. An integrated circuit synchronous vision demodulator is used, the output from this being fed via the video preset 3RV1 and a bridged-T filter tuned to 6MHz to the base of the video emitter-follower 4VT1. This is a pnp transistor with its emitter fed from an 18V rail. The output from this is fed via a trap tuned to 4·43MHz—to remove chroma signal components—to the contrast control and thence to the base of the video output transistor 3VT7. The switch across the chroma trap is included for setting-up purposes: 4R5 and 4C2 provide phase response correction. Since there is 3·7V at each side of the contrast control, adjustment of the slider does not alter the forward bias applied to the video output transistor. Flyback blanking is applied to the emitter of the output transistor; 3R37 and 3C21

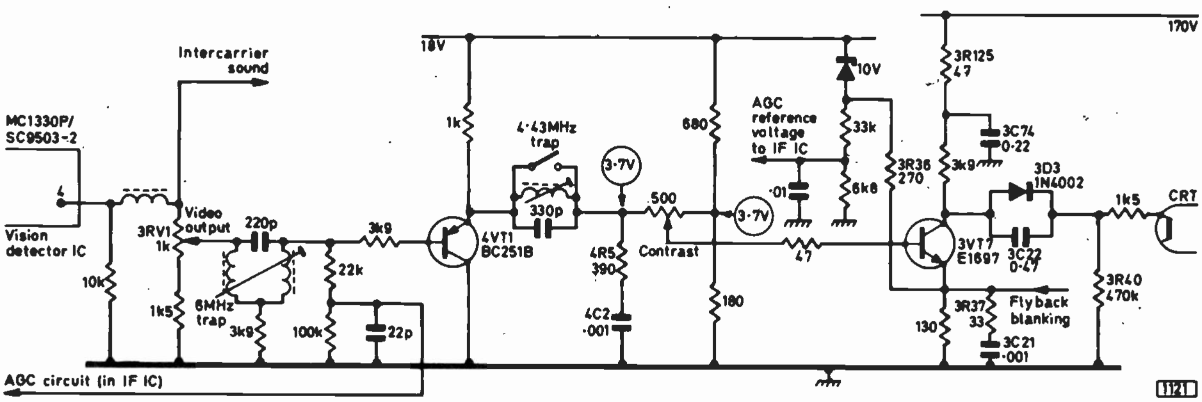


Fig. 5: Video channel used in the RRI A816 chassis, with diode beam limiter 3D3. 3RV1 sets the threshold for the a.g.c. circuit which is in the i.f. i.c. (MC1352P/SC9504P).

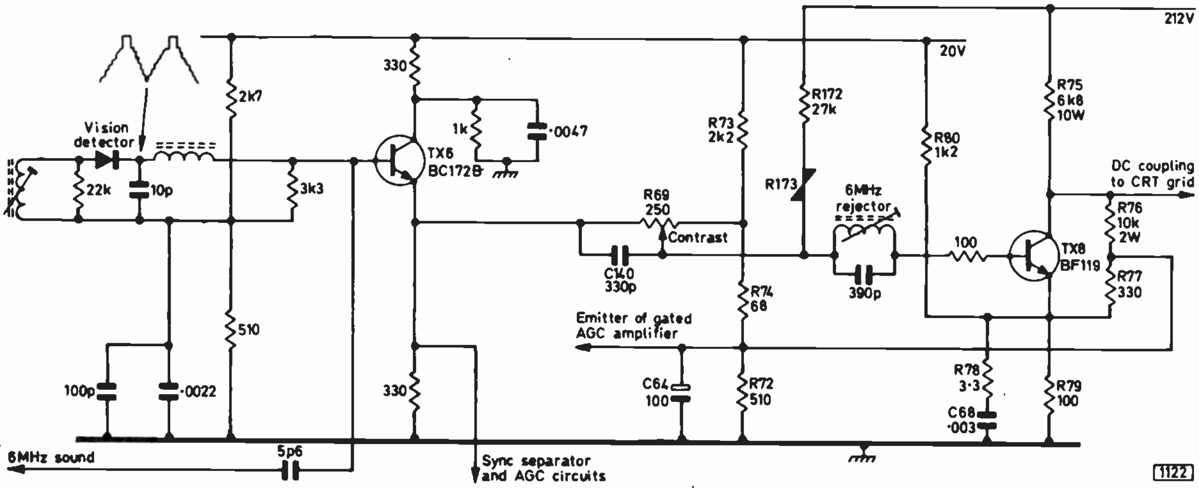


Fig. 6: D.C. coupled video channel used in the ITT VC200 chassis. The output is applied to the c.r.t. grid.

provide h.f. compensation; and the bleed current via 3R36 stabilises the d.c. conditions of the output stage. 3C74 decouples 3R125 at medium and high frequencies: it cannot do so for very low frequencies however, thus adding 3R125 to the load so far as these are concerned.

Beam Limiter Circuit

The video drive from the output transistor is fed to the c.r.t. cathode via beam limiter 3D3—the technique referred to earlier. With a picture of normal brightness 3D3 is held conductive because of the bias applied to its anode from the h.t. rail: the signal is d.c. fed to the c.r.t. cathode therefore. If the brilliance is excessive however the collector voltage of 3VT7 will be low while the c.r.t.'s beam current will be high, resulting in a high voltage across 3R40. As a result the cathode of 3D3 will be at a higher voltage than its anode and it will be cut off. The charge on 3C22 will reverse and so far as the c.r.t. is concerned this will be added to the collector voltage of 3VT7, increasing the bias on the c.r.t. The video drive will be via 3C22 only, removing the d.c. component—largely responsible for the excessive drive—of the signal and thus the degree of tube drive. This beam limiting diode technique is widely used with transistor video output stages in large screen monochrome receivers.

CRT Grid Drive

The video circuit used in the ITT/KB VC200 chassis is shown in Fig. 6. This chassis is interesting in that the video drive is applied to the grid of the c.r.t. instead of the cathode. Grid drive results in a smaller change in c.r.t. beam current per volt change in the drive signal than does cathode drive: it has the advantage on 625 lines however that the video output transistor's collector current is at minimum under no signal conditions, rising to maximum at the sync pulse tips. To achieve flyback blanking via the output stage would imply bottoming the output transistor: this is inadvisable so blanking in this chassis is effected by applying positive-going flyback pulses to the c.r.t. cathode.

With grid drive the signal applied to the c.r.t. must be positive-going for peak white of course. With signal inversion in the video output stage which is preceded by the usual emitter-follower this means that the detector diode must provide a positive-going output (with the sync tips the maximum positive excursion and peak white the minimum signal level). Thus the collector current in both the emitter-follower and output stages will be at minimum with no signal, rising to maximum at the sync pulse tips, and since the emitter-follower output is positive-going it can be used directly to drive the npn sync separator.

The contrast control R69 is of the usual d.c. type, with the 330pF capacitor C140 connected from its input end to the slider to ensure that the h.f. response is maintained at all contrast control settings. The v.d.r. R173 which is connected via R172 to the 212V rail is included to protect the output transistor from excessive switch-on voltage: at switch on it will have a low resistance, biasing TX8 on so that its collector voltage does not rise excessively.

The d.c. conditions of the output stage are stabilised by the current feeds via R73/R74 to the junction of R76/R77 and via R80 to the top of the emitter resistor R79. H.F. compensation is provided by R78 and C68. Since the collector of TX8 is returned to chassis via R76, R77 and R79 its collector voltage is prevented from rising to the full h.t. rail voltage in the event of a fault condition which cuts off collector current.

Fault Conditions

Since there are no screen grid supplies and decoupling, while the working voltages and the power dissipation of the associated resistors are lower, transistor video circuits give much less trouble than valve types. In fact when faults do occur they tend to result in either an unmodulated raster or a blank screen.

Blank Screen

Taking the blank screen symptom first, if this isn't due to lack of e.h.t. or c.r.t. first anode voltage it will be the result of the c.r.t. grid voltage being zero or too low or the cathode voltage being too high, the c.r.t. in either case being cut off. When the output transistor is d.c. coupled to the c.r.t. cathode—as in the majority of receivers—the most common cause of the failure is that the output transistor is not passing collector current, its collector voltage then rising to or approaching the h.t. rail potential. Causes of this can be an open-circuit emitter resistor, lack of forward base bias, an internal disconnection within the transistor or a base-emitter transistor short-circuit.

Absence of output transistor base voltage where there is d.c. coupling to a preceding emitter-follower indicates that this latter stage is at fault, due to lack of forward bias, zero collector voltage or an internal disconnection.

All these possibilities can be quickly checked by making straightforward voltage and resistance tests.

With a.c. coupling from the output transistor to the c.r.t. a disconnected or open-circuit resistor or brilliance control failing to establish the required grid and/or cathode voltages will produce the black screen symptom.

No Screen Modulation

Absence of screen modulation but with normal sound present, indicating that the i.f. strip and tuner are operative, also a normally operating brightness control, is an almost impossible condition with a d.c. coupled circuit since the output transistor's working collector voltage is largely determined by the base voltage of the emitter-follower stage, proving that there is circuit and signal path continuity. This fault can only arise in receivers which use a separate detector diode for the intercarrier sound signal therefore, and in this case will most probably be due to the vision detector diode giving zero output.

Checking AC Coupled Circuits

With a.c. coupling the d.c. isolation between stages permits normal brilliance control operation irrespective of the individual transistor voltages. Open-circuit or dry-jointed resistors as well as the coupling capacitors can be suspect. Here again voltage and resistance tests will speedily locate the source of the trouble. If an electrolytic coupling capacitor is suspected of being open-circuit however don't just for the sake of saving a few minutes shunt it with another while the set is switched on—the resulting surge could well damage the associated transistor.

Miscellaneous Faults

Impaired h.f. resolution is most commonly due to an open-circuit or dry-jointed emitter compensating capacitor or, in rarer cases, to the same faults with the low-value series resistor.

Since there are no valve heater-cathode leakage problems while the l.t. supplies are often derived from the line output stage hum bars are very rare in transistor video circuits. One effect occurring in some sets fitted with the ITT VC200 chassis is worth noting however. The symptoms are a dark shading or curtaining effect on the left-hand side of the screen, varying with picture content and the contrast control setting. The effect is due to storage phenomena in some BF119 video output transistors. While replacing the transistor will usually cure the fault it can also be rectified by increasing the value of the emitter resistor (R79 Fig. 6) from 100 Ω to 120 Ω. This resistor value change should be made only in sets which exhibit this fault.

A faulty beam limiter diode can cause variations in brightness level plus slight streaking across the screen.

Test Questions

Finally, three test questions which the information given so far should enable you to answer.

(1) The vision detector output to a d.c. coupled two-stage video amplifier is 2V peak-to-peak, the emitter-follower stage voltage gain is 0·8, the output transistor's load resistor 4·5k Ω and its emitter resistor 150 Ω. What is the peak-to-peak amplitude of the output signal at m.f. (when the effect of the load shunting capacitance can be ignored)?

(2) Sync pulse clipping causing weak timebase locking is found to be due to incorrect forward bias to the video output transistor in a single-standard receiver with cathode c.r.t. drive. Is the bias excessive or insufficient?

(3) The −3dB frequency of a stage with a 3·9k Ω video output stage load resistor is 3MHz. What is the total shunt capacitance present?

Answers on page 181.

CONTINUED NEXT MONTH

SERVICE NOTEBOOK: EHT ARCING

G. R. Wilding

E.H.T. arcing from a line output transformer winding to the core or from one winding to another quite often develops in receivers of all kinds. To see where the arcing is taking place the set must be operated of course, but if the effect is prolonged by even seconds the result can be that a possibly repairable transformer has to be written off. The nature of the arc usually indicates where the insulation breakdown is occurring. If the arc is blueish in colour and like miniature lightning it can be taken as a.c. and therefore from the live end of the winding supplying the anode of the e.h.t. rectifier. If the arc takes the form of thin streaks of a lightish colour on the other hand it is usually d.c. from the winding which feeds the e.h.t. rectifier heater to chassis or from the main winding.

A single-standard monochrome Bush receiver came our way recently with an arc over by the line output transformer. On removing the DY802 e.h.t. rectifier the arcing ceased. Clearly the one-turn e.h.t. rectifier heater winding on the transformer was involved—this winding is at e.h.t. potential of course when the rectifier is in operation. The one-turn winding was jammed between the live end of the main winding and the transformer core and by snipping the band of insulation that held it neatly in place we were able to move it to the centre of the main winding. On switching the set on again there was no more arcing so presumably the winding had been arcing across to the core. As is usually the case with modern line output transformers it was quite a simple matter to replace the one-turn heater winding using some thin e.h.t. cable. Doing this gave a complete cure.

Although quite rare nowadays you may on occasion find that there is persistent sparking between the c.r.t. aquadag coating and the earthing spring(s) in contact with this. The cause is a faulty e.h.t. rectifier which passes some current during the negative half-cycles, the sparking being the result of the charge-discharge currents into and out of the considerable capacitance formed by the c.r.t. glass and its coating.

Automatic Grey-scale Correction

E. TRUNDLE

THE TV sets produced by the Danish firm Bang and Olufsen have always been known for their quality; there have been many excellent designs in the past and the latest colour chassis maintains the tradition. It is a complete departure from their previous practice of using hybrid chassis however. The new 3500/4000/5000 range is their first to use a fully transistorised chassis in module form and a varicap tuner unit. It is a 110° chassis and B and O have adopted the thick-neck tube approach with a single transistor (BU108) line output stage. There are many novel features, including instant-on, the use of digital i.c. techniques, and the auto cut-off system which is the subject of this article. This incidentally is the feature referred to in the sales literature as "permanent colour truth". Eight i.c.s are used in the receiver, which is remarkably light and slim.

Auto Cut-off

One of the problems with a conventional colour c.r.t. is that of the ageing of the individual electron guns. Precise manufacturing techniques ensure that the guns are well matched electrically and dimensionally, while the setting-up procedure takes care of tolerances in the gun characteristics. The grey-scale needs resetting several times during the life of a set however. This is where B and O's patented auto cut-off circuit comes in: it checks and corrects the grey-scale no less than fifty times a second! The action occurs during the field blanking period.

RGB Grid Drive

The receiver uses RGB c.r.t. drive, with the primary-colour matrixing carried out three stages before the output transistors. Unusually however the drive signals are applied to the c.r.t. grids—this means that they are positive-going for white of course. Line and field blanking pulses are also fed via the RGB output stages to the c.r.t. grids, additional flyback blanking pulses being fed to the cathodes which are otherwise free for the application of the auto cut-off system.

CRT Cathode Circuits

The three c.r.t. cathodes are fed via identical circuits one of which (the red cathode feed) is shown in Fig. 1. The c.r.t.'s grid blanking pulses are such that they drive the c.r.t. almost but not not quite to cut-off. The cathode blanking pulses ensure that the c.r.t. is cut off except for the time when the auto cut-off action occurs. The small c.r.t. cathode current then flowing is measured by the auto cut-off circuit and used to correct the cathode voltage.

Measuring the Cathode Current

For approximately six lines (385μs) after the cessation of the cathode flyback blanking pulse—but still during the field blanking period—the collector of 2TR3 is fed with a positive-going gating pulse via diode 2D6, see waveform (a). Simultaneously, 2TR3 emitter receives a negative-going pulse via 2D11 and 2C8, see waveform (b). The transistor is thus furnished with supply voltages which enable it to amplify the small no-signal c.r.t. current. The c.r.t. current flows via 2TR3's base-emitter junction and 2R6, and amplified by the transistor charges 2C8 to a level which of course is proportional to the c.r.t. cathode current. This is the measuring phase of the circuit's operation. When the charge on 2C8 has stabilised, the auto cut-off pulses applied to 2D6 and 2D11 reverse polarity and 2TR3 cuts off, ready for the cathode voltage correction phase. Note that transistor 2TR7 takes no part in the measuring operation since it is switched off, its base and emitter being effectively at the same voltage (−5V) as waveforms (b) and (c) show.

Voltage Correction Phase

The next operation is the voltage correction phase during which the charge on 2C8 is adjusted and the c.r.t. cathode voltage clamped accordingly. When the polarities of the pulses fed to 2D6 and 2D11 reverse 2TR3 is robbed of its supply voltage and is therefore unable to amplify. Its base-emitter junction can still act as a diode however, and the c.r.t. cathode current flows via 2R6 and 2TR3's base-emitter junction.

As the waveforms show, 2TR7 now conducts, its base-emitter junction being forward biased. The c.r.t. cathode current flows via 2TR7 collector and 2C8 in the ratio of ß: 1 where ß is the common-emitter current gain of 2TR7. As a result 2C8 receives a small charge Ik/ß. The charge thus acquired, together with the reference voltage acquired by 2C8 during the initial measuring phase, are reduced by discharging 2C8 to 12V via 2R10. The modified current flowing via 2TR7 base is amplified and used to clamp the c.r.t. cathode voltage.

Cathode Blanking

When the voltage correction phase is over the c.r.t.

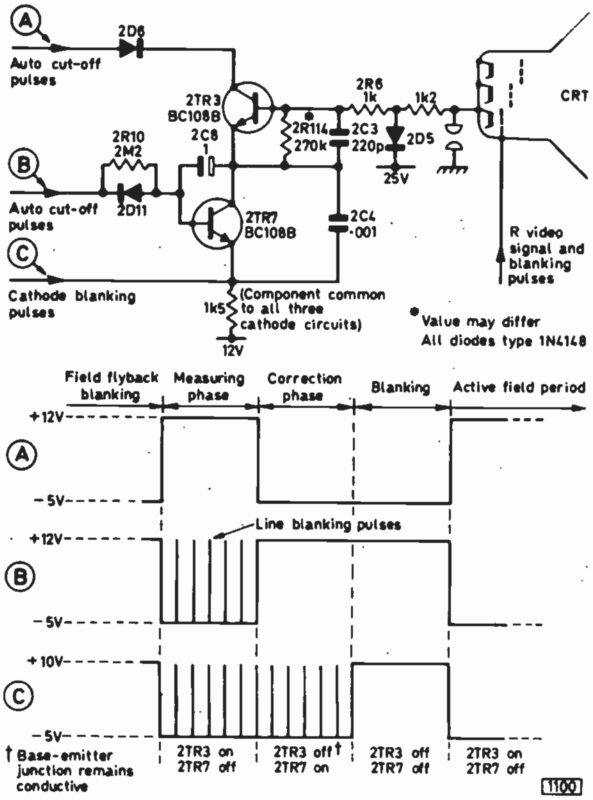


Fig. 1: Automatic grey-scale correction circuit used in the latest Bang and Olufsen colour chassis (red cathode circuit only shown), with associated waveforms beneath. During the measuring phase the cathode current is measured: during the following correction phase a clamping action sets the charge on 2C8. In this way the circuit automatically sets the cathode voltage at the start of each field period.

cathode is blanked again, the pulse waveforms cutting both 2TR3 and 2TR7 off. The blanking pulse passes via 2C4 and 2C3 to the c.r.t. cathode and the charge on 2C8 is held.

Net Effect

The effect of these actions is that the c.r.t. cathode current is set to a constant value in spite of changes in the gun characteristics due to ageing. Any differences in the performance of the three guns simply result in different voltages on 2C8 and its counterparts in the green and blue cathode circuits. The measured c.r.t. cathode currents remain similar throughout the life of the tube, ensuring maintenance of the correct grey-scale.

Thus at the end of the field blanking period the three circuits have ensured that the grey-scale is just as it should be. During the active picture period 2TR3 is conducting while the clamp transistor 2TR7 is cut off.

Flashover Protection

The purpose of 2D5 is to shunt away c.r.t. flashover pulses: this diode is reverse biased under all other circumstances. Transistors 2TR3 and 2TR7 are protected from flashover damage by the blanking pulse coupling capacitors 2C3 and 2C4.

Deriving the Pulse Trains

The rather complex pulse trains—waveforms (a), (b) and (c)—fed to the circuit during the field blanking interval are generated by the differentiation of field flyback pulses, followed by processing and inversion. Many of the pulse trains used in the receiver (c.r.t. cathode and grid blanking etc.) are produced by a digital i.c. (type SN15836N) which is on the decoder panel.

Performance

The only visible effect of the auto cut-off circuit is the presence of slight illumination on the screen at minimum settings of the brightness and contrast controls. This is due of course to the small c.r.t. cathode current permitted by the measurement and correction processes. The setting of the c.r.t. first anode voltages must be done with care and precision but once set need not again be disturbed.

The net result is a picture that always "looks right". The manufacturer's aim of "optimum picture performance" is certainly fulfilled in the 3500/4000/5000 series which is a worthy successor to the previous ranges: it is the author's opinion that it will be a long time before this design is improved upon. ■

LETTER

Faults Encountered

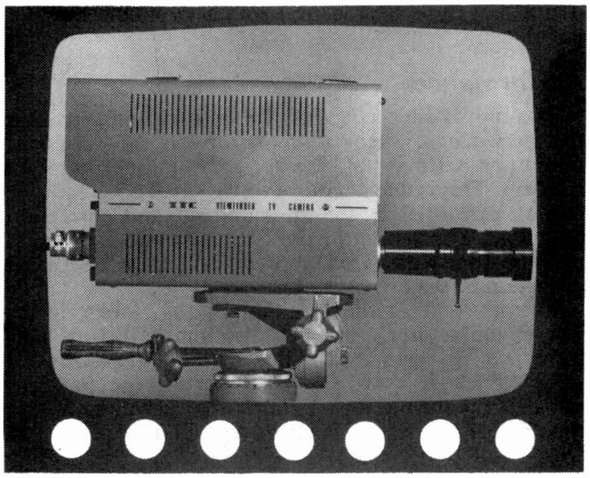
There was a printing error in *Your Problems Solved* on page 90 of the December issue. The capacitor which decouples the c.r.t. first anode supply in the Pye 691 chassis (see problem on the Pye Model CT152) is C224, not C244.

Whilst writing I would like to mention a couple of faults which are cropping up regularly. The first is found in all makes but is most common in the Thorn 950 chassis. The symptoms are bottom compression and top expansion, the height control affecting only the top of the picture. The faulty component is the thermistor in series with the field scan coils. In one case we found that its value was 150 Ω yet two-thirds of the picture were still being scanned.

The second fault occurs in the Thorn 1500 chassis. The symptom is pulling of three or four lines to the left and the right, forming a zigzag down the picture. It is due to the 1μF electrolytic C51 in the flywheel sync circuit going open-circuit. If it goes leaky line hold can be obtained only at the end of the line hold control track. If you use a 2·2μF capacitor as a replacement line float will be experienced. If a high-voltage replacement is used it will soon break down due to insignificant polarising voltage—in fact the lower working voltage the better.

If "belly dancing" is experienced with the Thorn 1500 chassis the first suspect should be C102 which smooths the supply to the line oscillator, flywheel sync d.c. amplifier and sync separator. Check the associated dropper resistor R134 as well. This may save the expense of fitting a new main h.t. smoothing electrolytic block.—**K. C. Alford**, *Wellingborough.*

CCTV



PART 11

Peter Graves

CORRECT setting of the scan sizes, positioning of the scanned area, and alignment of the scanning beam on the vidicon target are of the utmost importance in obtaining high-grade pictures. Because of the large number of controls involved—field shift, amplitude (height) and linearity, line shift, amplitude (width) and linearity, electronic focus (electrical focus or beam focus), X- and Y-align, not counting any physical movements of the camera and/or scan coils—this can at first encounter be a daunting task, particularly as most of the controls interact to some extent.

Electrical Focusing

The magnetic focusing coil and the alignment coils have been mentioned before in passing. We must now take a closer look at them. A vidicon requires a steady magnetic field along its length. This field is generated by a cylindrical coil mounted around the tube (see Fig. 1). The current flowing through this coil is generally not adjustable, focus variation being carried out by altering the relative potentials applied to the electron lens formed by the anodes inside the tube. In consequence these focus the electron beam in conjunction with the steady magnetic field provided by the focus coil. It is possible to achieve the same end by holding the anode potentials steady and varying the current flowing through the focusing coil. This is less common however. Note that in the present context focusing refers to focusing the electron beam on to the rear of the target layer: maladjustment will cause the picture to go out of focus but this adjustment cannot be used to compensate for deficiencies in the optical focusing.

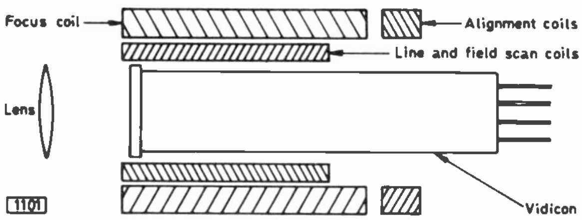
Fig. 2 shows a typical focus current supply circuit. It consists of a simple series regulator of the type commonly found in stabilised power supplies. The base of the transistor is held at a fixed potential by zener diode Z1 which is biased through R1, and as a result a constant, stabilised current flows through the focus coil in the transistor's collector circuit. The current can be trimmed by varying the value of R2—usually by connecting a higher-value resistor in parallel with it. Make the adjustment so that the picture is in optimum focus when the electronic focus control is in a central position.

Beam Alignment Coils

The alignment coils are also fed with direct current. They are mounted at right angles to each other at the rear of the rube. Provision is made to vary the current through them independently and to reverse its direction —Fig. 3 shows a typical circuit. Some cheaper cameras used magnetised discs round the tube in exactly the same way that picture shifting discs are used in domestic monochrome TV receivers. It is assumed in this article that the camera being set up has alignment coils: if discs are fitted they are set up for the same end result.

Focus Adjustment

The electronic focus control is set for the sharpest picture (after the beam has been aligned as described later) after the optical focus has been optimised. Rocking the focus control backwards and forwards about the point where sharpest focus is obtained (approximately the centre of its travel) causes the picture on the monitor to rotate about a point near its centre and go



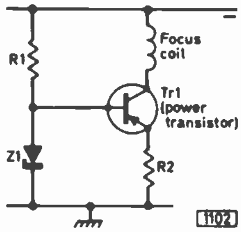
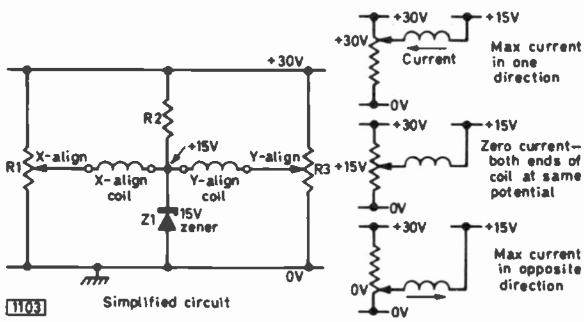


Fig. 1 (above): Cross-section through the vidicon and its associated coils.

Fig. 2 (right): Typical focus current regulator circuit.

Fig. 3 (below): Action of the X and Y alignment coils.



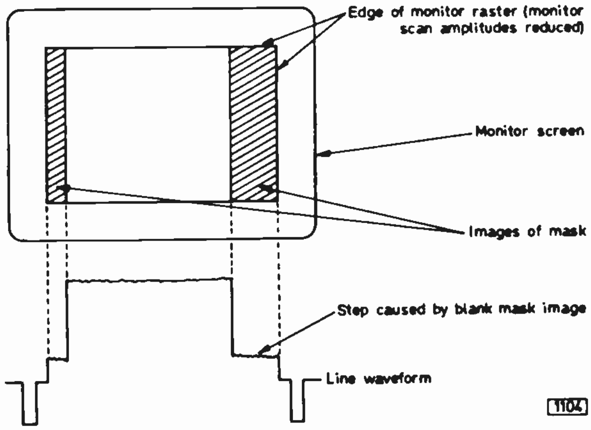


Fig. 4: Setting the line scan amplitude using the line waveform: the mask images must be centralised and expanded.

out of focus at the same time. The electrons which form the scanning beam do not travel along the tube in a straight line (though we assume this in describing the basic operation of the tube): they travel in a helical manner under the combined influence of the magnetic and electrostatic fields, coming to a focus on the target layer. Changing the field results in the beam being defocused; it also changes the pitch of the helix, causing the rotation.

Scanned Target Area

For a number of reasons it is important to ensure that the scanned area is of the correct size and position. A vidicon is designed to produce optimum pictures from a specified size and position of the scanned area: displacement will result in poor resolution. And if the raster is not set up so that it is in the correct position and of correct size, dark shadowy areas of previously unscanned target will appear on the picture. This is because the target layer is desensitised as a result of being scanned: thus previously scanned and unscanned areas will appear differently on the monitor screen.

Before commencing scan or indeed any other setting up, the monitor scans should be reduced in amplitude so that all the edges of the picture can be seen—the significance of this will be apparent later. Test monitors are not overscanned as domestic TV sets are.

Setting the Scans

Different manufacturers recommend different ways of setting the vidicon scans. There are four main methods. The first is to use on the tube a permanently fitted scan-defining mask—sometimes called a Palmer mask. This has an accurately cut rectangular aperture of the correct size in an otherwise opaque plastic mask which is clamped over the face of the tube (often forming part of the target connection clamping assembly). When the target layer of a vidicon fitted with such a mask is illuminated the edges of the mask—whether a scene is in focus or not—can be seen like black shadows on the monitor picture (depending on the camera shift and amplitude settings).

At first sight—and this applies to all cameras, not just those fitted with a mask—the amplitude controls appear to operate in reverse! As (say) the height is

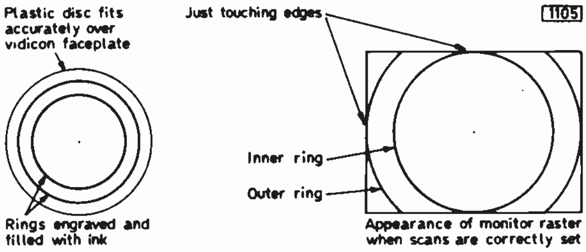


Fig. 5: Setting the scans with an engraved disc.

increased so the picture seen on the monitor decreases in height. This is not as absurd as it seems. Increasing the height means that the size of the target area being scanned is increased. A larger scene is being scanned but as the monitor raster does not change in size each individual part of the picture reproduced on the monitor must occupy a smaller area. So the picture apparently decreases in size: this is an odd effect when first encountered and often leads to controls being turned the wrong way to achieve a given effect!

To return to the scan defining mask however. Suppose we are going to set up the field scan first (it does not matter which scan is set first). Increase the height control setting until the mask edges can be seen at the top and bottom of the monitor picture. These should be parallel to the monitor raster edges (if not they should be set up as described later). Next by alternately adjusting the field shift and height (field amplitude) controls gradually expand and centre, expand and centre the mask edges until they disappear simultaneously over the edges of the monitor raster. They should be only just out of sight, i.e. the scanned area should just fill the mask aperture.

Use the same procedure for setting the width. The mask images should be expanded and centred, expanded and centred until they drop over the edges of the monitor raster.

The setting can be done more accurately by monitoring the appropriate (field or line) waveform with a 'scope and adjusting the controls until the step caused by the mask image just disappears from the waveform (see Fig. 4).

The second method of setting the scans is to use a thin disc of glass or plastic accurately engraved with two concentric circles (see Fig. 5). This fits in a suitable circular recess over the front of the vidicon faceplate and when the tube faceplate is illuminated the images of the rings can be seen on the monitor. The scans are then adjusted until the inner ring just touches the top and bottom of the picture and the outer ring just touches the edges—see Fig. 5. The disc is finally removed and stowed away safely as, being small, it is easily lost.

A professional method—more often found in broadcast standard cameras although versions for CCTV cameras are available—is to use a diascope. This is an accurately made little projector with a bulb, test card transparency (usually a single frame from a 16mm or 35mm film of a test card) and lenses. It screws into the camera's lens socket and projects an accurately positioned and sized image on to the faceplate. The scans are then adjusted until the image of the test chart just fills the monitor screen. Most commercial test charts (not only those found in a diascope) have a castellated edge, as in Fig. 6, to show where the scans should be set.

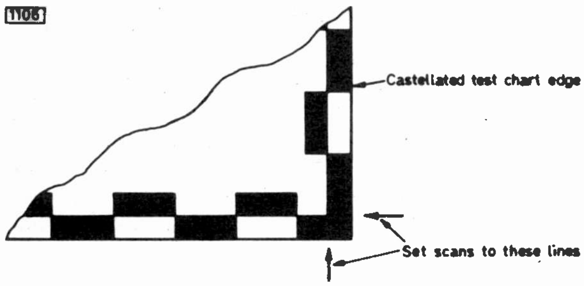


Fig. 6: Scan setting using a commercial test chart.

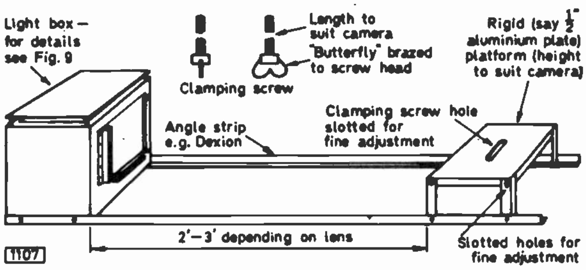


Fig. 7: Camera setting-up jig.

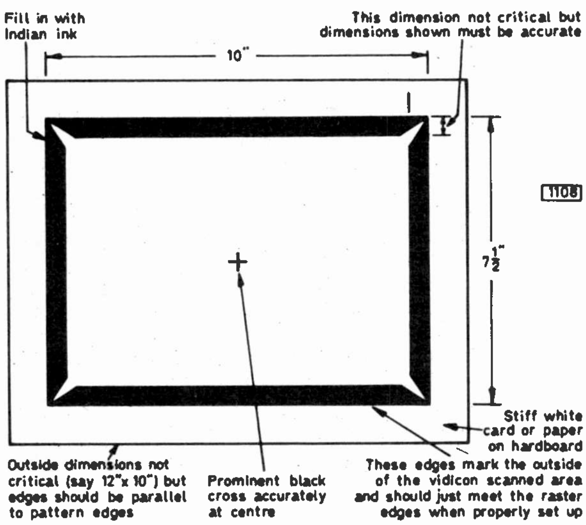


Fig. 8: Scan setting test chart.

The final method is a bench version of the diascope technique—it has a far wider use for testing and setting up cameras however (see Fig. 7). Basically, to set scans the camera is set up at a known distance from a test chart of known dimensions, using a lens of known focal length. It is possible therefore to precalculate the size and position of the image on the vidicon faceplate. The shift and amplitude controls are then set so that the image of the test chart fills the monitor raster.

Using Test Cards

There are two main types of test chart available, photographic transparencies mounted between glass sheets or a photograph mounted on stiff card. There are many designs to choose from but for setting the scans a homemade one (see Fig. 8) may make the task easier. Mount transparencies in front of a light box (see Fig. 9) with a screen of frosted glass over the aperture to diffuse the light and provide an evenly illuminated surface. Adequate ventilation for the lamps must be provided and it is advisable to use heat resistant cabling inside the light box—the author has heated pies for lunch inside light boxes of a similar design!

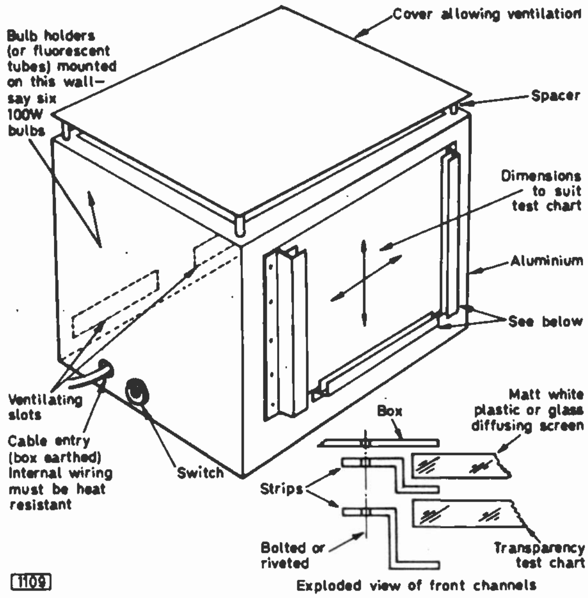


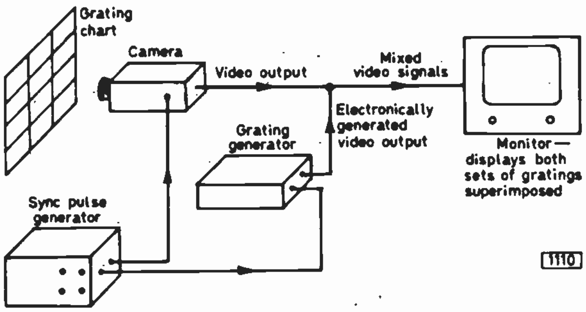
Fig. 9: Light box for CCTV setting-up work.

The design and dimensions of the mount for the camera will depend on the type of camera under test but it should be rigid and, preferably, have some means of moving the camera up and down by a small amount to compensate for minor differences between units. Alternatively the light box can be left on the bench and the camera mounted on a tripod standing on the floor. One of those tripods which has a handle to raise and lower the mounting platform will be found very useful.

The camera and test chart must be set up at right angles to each other, with the lens centre pointing at the centre of the test chart. A spirit level can be used to set the test chart and camera positions accurately. Opaque test charts must also be accurately mounted (and not twisted with respect to the camera) and illuminated with say two 100W bulbs in reflectors facing the chart. Take care to avoid direct reflections from the bulbs into the camera lens.

Squaring Up the Picture

Let's briefly go back to the beginning of the scan setting up procedure. Suppose the camera has been mounted in the jig and the video side set up. Assuming that the camera is set up correctly with respect to the test chart (as above), manipulate the shift and amplitude controls until an edge of the test chart (vertical or horizontal) is nearly at the edge of the monitor raster. The edge of the test chart and the edge of the monitor raster should be parallel. If they are not, the scanning yoke must be rotated. There is usually some sort of clamp fitted on the yoke. This must be loosened (take care not to short anything when doing this, or alternatively turn the camera off while doing it), the yoke



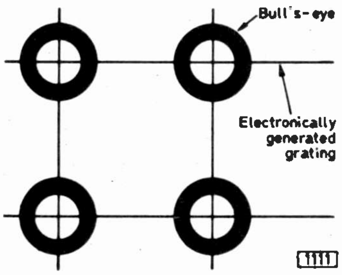


Fig. 10 (above): Seting the camera linearity.

Fig. 11 (right): Portion of the display on the monitor screen, showing how camera linearity is set up.

rotated and then the edges checked again after re-tightening. Some cameras (e.g. the Marconi V321 separate head camera) are tubular and secured to a base with metal bands which are loosened and the whole camera body rotated to make the edges parallel.

Hopefully after this adjustment all edges will be parallel with their respective monitor raster edges. If only one set of edges can be made parallel while the other edges are out the field and line coils must be adjusted independently—another clamp assembly. Not every camera has such an adjustment and a compromise is in this case necessary.

Scan Size and Position

Having reached this stage the scan sizes and positions can be set up using one of the methods described above. The final method is most suitable since the camera is already mounted on the jig! This method is not as accurate as the other three however as it depends on so many things being just right.

Beam Alignment

The electron beam is next aligned so that it strikes the target layer at right angles. This is done by manipulating the currents flowing in the alignment coils. The method of doing this was invented by the same three-handed engineer who suggested using a pair of pliers as a heat sink when soldering transistors (one hand for the pliers, one for the soldering iron, one for the solder)! Before starting it is helpful to stick a small triangle of sticky tape on the monitor screen, its arrowhead tip pointing to the centre of the cross in the middle of the test chart image. The electronic focus control is then rocked backwards and forwards about its in focus position while the X- and Y-align controls are adjusted until image rotation occurs around the centre of the picture (the cross marked with the tape). When the alignment is set correctly the cross will remain stationary and just go in and out of focus as the electronic focus is rocked.

This is easier to write down than to do! In practice it is very hard to judge when the cross stops rotating. Here are two hints: Don't rock the control too violently: the optimum rate and amount of rocking varies from person to person, so experiment for the best effect. And try coarse adjustments of the alignment controls at first so that their action can be easily seen.

When beam alignment has been completed it is necessary to start all over again as the alignment process will almost certainly have upset the scan setting.

Scan Linearity

The linearity must also be checked from time to time during the setting up as the shift and amplitude controls will affect it. This is not the simple business of checking for egg-shaped circles as with a domestic TV set since the linearity of the monitor will also affect the final picture linearity. If the monitor linearity is reasonable however this method may for many purposes be satisfactory. But before setting up make sure that the aspect ratio of the monitor is correct (the ratio of the image width to the image height on the monitor should be 4:3).

A more sophisticated method of linearity setting is shown in Fig. 10. The camera looks at a special linearity test chart which is accurately printed with squares or bull's eyes (see Fig. 11). An electronically generated video waveform also consisting of squares—if you have been following the television games series in this magazine you will be familiar with the techniques used to generate them—is mixed with the camera output signal. Theoretically a proper video mixer should be used to combine the two signals but for short cable runs (a few feet) a simple T-junction will do. The picture thus obtained on the monitor consists of two sets of gratings superimposed on each other, both being equally affected by any monitor non-linearity. It does not matter if the monitor display is not linear therefore. The electronic grating generator is set so that it produces the same number of squares as the linearity chart. Then, provided the camera is accurately aligned with the chart, it is just a matter of adjusting the camera's linearity controls until the best match is obtained between the two sets of squares, i.e. the maximum number of lines coincide. Note that the camera and the grating generator must be synchronised from a common source so that their outputs can be mixed.

Then it is right back to the beginning again. Optimise the scans, the beam alignment and the linearity until no further improvement can be obtained. This sounds very tiresome but a degree of dexterity is soon acquired.

ANSWERS TO QUESTIONS, PAGE 175

(1) The peak-to-peak output obtained is $2\times0{\cdot}8\times(4{,}500/150)=48$V.

(2) The signal applied to the base of the output transistor under the conditions specified is negative-going, with the sync pulses representing the maximum negative excursion. The forward bias is insufficient, so that a strong signal drives the transistor on to the non-linear part of its characteristic—i.e. towards cut off— and the sync pulses are clipped.

(3) At the half power point (−3dB) the load resistor value is equal to the reactance of the shunt capacitance. $Xc=1/(2\times\pi\times f\times C)$ and $C=1/(2\times\pi\times f\times Xc)$. Thus the shunt capacitance in picofarads $=10^6/(2\times3{\cdot}14\times3\times3{,}900)=13$pF.

YOUR PROBLEMS SOLVED

★ Requests for advice in dealing with servicing problems must be accompanied by an 11p postal order (made out to IPC Magazines Ltd.), the query coupon from page 185 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets or answer queries over the telephone. We cannot provide modifications to circuits published nor comment on alternative ways of using them.

FERGUSON 3712

There is intermittent colour on this set, the picture moving to monochrome for no apparent reason. When the fault occurs colour can be restored by removing plug 3—which connects to the colour control—and then quickly replacing it while the set is in operation. After this procedure colour remains for several hours. The electrolytic C144 which decouples the supply to the burst gate/amplifier was suspected but replacing it has failed to cure the fault.—J. Knowles (Dundee).

A likely cause of the problem is incorrect burst gate timing. Set up the line hold control (L405) and the set burst gate timing control R151 as detailed in the manufacturer's service manual. Note that any fault in the line timebase resulting in line phase drift will affect the burst gating, causing loss of colour. (BRC 8000 chassis.)

PHILIPS G25K512

The picture appears in the normal time after switching on but the sound takes anything up to three-quarters of an hour to come on, after which it continues quite normally. This loss of sound occurs whenever the set is switched on from cold.—T. Jenner (Newark).

The prime suspect is the PCL86 audio valve at the top of the chassis: check this and the printed circuit board around the valveholder—the valveholder itself could be responsible. Check for dry-joints along the HT5 supply—in particular at R1057 (2·7k Ω) which is at the bottom of the chassis (inside). A check of the voltages around this valve should reveal the trouble. If not try stabbing a capacitor of say 0·1µF across the coupling capacitors C2022 and C7113. (Philips G6 single-standard chassis.)

BUSH TV183SS

The problem with this set is cramping on the right-hand side of the screen.—T. Archer (Durham).

First make sure that the line linearity sleeve on the tube neck (beneath the deflection coils) has not been disturbed, then check the PL504 line output valve and PY88 efficiency diode and the scan-correction capacitor 3C49 (0·1µF) which is in series with the line scan coils. (RRI A774 chassis.)

DECCA CTV25

There is an annoying side-to-side "flicker" of the picture: occasionally the picture will move to the left about an inch and then jump back. The condition is worst during the first half hour after switching on. All valves have been renewed, the system switching checked, the line oscillator cathode coupling electrolytic C324 replaced and the oscillator coil carefully set with the hold control at mid-position. Line sync is obtained at both ends of the line hold control. The resistor (R317) in the feedback loop to the flywheel sync discriminator circuit has also been replaced.—J. Towers (Manchester).

We assume that you have checked carefully for dry-joints around the line oscillator stage. Check by substitution, in the following order, the electrolytic capacitor C320 (2µF) which decouples the slider of the hold control, the coupling capacitor C313 (0·01µF) in the flywheel sync feedback loop, the BA115 flywheel sync discriminator diodes, the flywheel sync circuit balancing capacitor C315 (70pF) and the sync pulse coupling capacitor C312 (100pF). If this does not clear the fault you will have to check all the other capacitors in the line oscillator stage.

SOBELL ST282

Sound is all right but there is no picture, neither the raster nor the line whistle being present. The valves light up except for the EY86 e.h.t. rectifier. I have tried removing the efficiency diode top cap but this makes no difference.—A. Hillier (Bolton).

We take it you have tried new valves in the line output stage. If the line output stage is overheating suspect the line oscillator valve V11 (ECC82). The voltage at its cathodes (pins 3, 8) should be about 4·3V and there should be −28V drive at the control grid (pin 5) of the PL36 line output valve. If the line oscillator is operating—line output stage cool—suspect the line output valve's screen grid feed resistor R134 (1·8k Ω).

DECCA CS2030

Although this set is only three months old the line timebase goes out of synchronisation on each channel. Line sync can sometimes be restored by pressing the channel selector button; alternatively it can always be restored by touching the top caps of the line output and efficiency diode valves with a screwdriver blade. This is only a temporary cure of course.—J. Porter (Havering).

Remove the sync control potential to the line oscillator by connecting TP400 to the adjacent pin TP401, then adjust the core in the oscillator coil (L401) until the picture hovers about its proper position. Normal sync should then be restored by removing the short. If not, replace the PCF802 line oscillator valve. If the trouble still persists the fault is probably due to a defective capacitor in this stage: the main suspects are the feedback coupler C427 and the cathode coupling electrolytic C419. (Decca series 30 chassis.)

FERGUSON 3703

We have a difficult case of line drift on one of these sets. The hold control and line oscillator coil have been reset in accordance with the instructions in the manual and the usual causes of this trouble—the flywheel sync discriminator diodes, the electrolytics in the flywheel filter and reactance stage (C506 and C511) and the 470 Ω resistor (R524) in the hold control network—have all been tried without success.—E. Unwin (Gloucester).

You will find a compensating thermistor (X501) in parallel with R524: due to spreads it often helps to add a 220 Ω resistor in series with X501 to obtain improved compensation. We have also known line drift to be the result of the line driver transistor VT503 being faulty. (BRC 3000 chassis.)

DECCA CTV25

The problem with this set is striations down the left-hand side of the screen. I've replaced the damping resistor R408 in parallel with the line linearity control. This has given some improvement but has not completely solved the problem.—T. Carstairs (Grantham).

R408 is certainly the most common cause of this problem. Make sure that your replacement is of the correct value (1·2k Ω). Then check the damping resistor (R419, 2·7k Ω) in parallel with the width control. Note that both these resistors should be rated at 2W. If necessary check the components in the flyback blanking circuit associated with the cathode of the luminance output valve V200.

HMV 2714

After the set has been on for a few hours the picture goes out of focus intermittently, correcting itself sometimes in a fraction of a second or at other times taking up to a couple of seconds each time to do so. The fault seems to occur quite randomly but sound and vision are otherwise good. A new focus control has not improved matters at all—R. Brough (Hadley Wood).

Check the spark gap associated with pin 9 (focus electrode) of the c.r.t., also the tube pin and socket. Check the resistors in series with the focus control on the focus panel, then suspect the e.h.t. tray—the focus control is fed from this via a 165M Ω resistor within the tray and this tends to change value. (Thorn 3500 chassis.)

KB ARISTOCRAT

There is an intermittent fault on this set—red tints are lost and the picture goes an intense green for a few moments, then returning to normal. A thump on the cabinet when the fault is present restores normal colour. Some days the set will work normally for several hours without the fault appearing.—A. Crayford (Harrogate).

Check for dry-joints on the three large 2·2μF coupling capacitors C82, C142 and C187 in the RGB channels on the left-hand board. The prime suspect however is the green output transistor T26d. A BF337, BF258 or BD115 can be used as a replacement. Before replacing this transistor make a thorough check for dry-joints in this area and around the preceding driver transistor T25d. (ITT CVC5 chassis).

HMV 2809

After about an hour field hold is lost—the control is set fully anticlockwise. The rolling rapidly builds up to a high speed. Blowing cold air through the back of the set with a hair dryer stabilises the picture for about ten minutes. Clockwise rotation of the field hold control also stabilises the picture, but it is then only half size. The picture is otherwise all right.—E. Simpson (Wallington).

Replace the sync separator screen grid feed resistor R44 (47k Ω) with a 1W type. Then check the PCL805 field timebase valve and R91 (220k Ω) which is in series with the field hold control. Less likely possibles are C69 and C70 in the PCL805 triode grid circuit. (Thorn 1500 chassis.)

BUSH M69

When the set is switched on two field flyback lines appear at the top left of the raster, then the dot and pulse pattern appears at the top right-hand side, starting thin but thickening. The field timebase valves have been replaced (ECC83 and PCL82) and all resistors appear to be in order. As the set warms up the lines move farther down the screen and vary slightly in width.—P. Miles (Havant).

With a set of this age—dating from about 1957—the capacitors will be drying out and changing value or leaking. The fault is almost certainly due to a faulty capacitor, probably in the field linearity circuit or alternatively the field flyback blanking coupler C30 (820pF). Check the voltage conditions in the field timebase and change any capacitors which show a leakage of less than 10M Ω when checked on an Avo meter.

MARCONIPHONE 4621

There is a good, well contrasted picture when the set is first switched on. After about half an hour however the picture goes grey and weak, the field hold is touchy and the line hold weak with pulling to the right.—K. Harper (Loughborough).

This trouble is symptomatic of low gain in the vision channel. Try short-circuiting the a.g.c. clamp diode W1 when the fault occurs. If a strong picture then appears check R35 which links the a.g.c. line to the slider of the contrast control, also the contrast control itself. If not, suspect R7 which is the upper resistor of the potential divider feeding the screen grid of the first i.f. amplifier V3, also this valve and the following two. Check R26, the bias stabilising resistor in the video output stage. Checking the valve voltages should help to trace the source of the fault. (Thorn 980 chassis.)

DECCA CTV25

The problem with this set is that the field cannot be locked. There are multiple images about 1in. high running up the screen at high speed. This is the situation with the field hold control at either end of its track, though there is a change in the speed of the images as the control is rotated. With the speed at maximum there is also a fast plopping sound from the loudspeaker. Very occasionally the colour picture stabilises and is normal for a few seconds, but this is extremely rare.—B. Travers (Keighley).

Your field timebase is running too slowly. We assume that you have tried substituting a new ECC83 field oscillator valve. This is used in a cathode-coupled multivibrator circuit. Check the cross-coupling components C304 (0·01μF) and R307 (680kΩ). Disregard synchronisation until the images can be made to move up *and* down the screen. Other components to check are the resistor (R304 330kΩ) from the sync input grid of the oscillator to the h.t. line, the anode load resistor (R306 100kΩ) of this section of the valve and the common cathode components C305 (0·047μF) and R309 (2·2kΩ), in that order.

BUSH TV191D

There is normal sound but no picture on this set—the screen went blank on switching from v.h.f. to u.h.f. The e.h.t. is o.k. however, quite a good spark from the connector to chassis but not so good when the cap is plugged into the tube. On switching the set off a bright spot appears at the centre of the screen and gradually dies away.—F. Green (Romford).

The fact that a bright spot appears usually means that the e.h.t. is in order and that the c.r.t. base voltages should be checked to find out which one is incorrect. In all probability the first anode voltage at pin 3 is low or absent. This could be due to the associated decoupling capacitor 3C51 (0·1μF, 1kV) shorting. In this case 3R26 (180kΩ) would tend to overheat. A reading of over 600V should be obtained at pin 3. The cathode voltage at pin 7 should be about 160V—note that the video output stage is d.c. coupled, so the fault could be here. The grid voltage at pins 2 and 6 should vary with the setting of the brightness control, up to about 150V.

MARCONIPHONE 4703

The initial fault with this set was no sound or picture and the large h.t. reservoir smoothing electrolytic block C602/C603/C606 was found to have exploded. A replacement was fitted but it was then found that the 15Ω resistor R609 in the feed to the chopper circuit was becoming red hot. A reduced picture can sometimes be obtained if the set is switched off and on again.—T. Grable (Rugby).

First ensure that the capacitor is correctly wired. There are several possibilities for the fault, as follows in order of likelihood: crowbar thyristor W621 leaky or short-circuit; chopper transistor VT604 short-circuit; 72V zener W617 short-circuit or leaky; chopper drive incorrect due to faulty feedback amplifier transistor VT608 or possibly C615 or W615 in the monostable circuit being defective. We assume that the h.t. fuse F603 is of the correct rating and that it remains intact. (Thorn 3000 chassis.)

BUSH TV135R

The trouble with this set is rather low sound with a persistent buzz. This sometimes disappears when the set has been on for a while.—R. Petrie (Stroud).

The PCL82 audio valve could be faulty but we often find such troubles to be due to poor contact in the plug and socket connections between this stage and the volume control. The section (3C44, 100µF) of the can type electrolytic which smooths the supply to the audio output pentode can also stop working—sometimes due to poor contact on the leadout tag.

FERGUSON 3624

The fault on this set is striations of light and dark bars for about an inch at the left-hand side of the picture. This is assumed to be caused by insufficient damping or ringing.—D. MacAlister (Fife).

Check the line output valve's screen grid decoupling capacitor C103 (1µF), then diode W9 (OA81) and the other components in the line flyback suppression circuit back to the pulse winding on the line output transformer, i.e. the winding which is connected to tag 51 on the printed circuit board. (BRC 900 chassis.)

QUERIES COUPON

This coupon is available until February 17 1975 and must accompany all Queries sent in accordance with the notice on page 182. Don't forget the 11p (inc. VAT) postal order!

TELEVISION FEBRUARY 1975

TEST CASE

146

Each month we provide an interesting case of television servicing to exercise your ingenuity. These are not trick questions but are based on actual practical faults.

? *A set fitted with the Thorn 1400 chassis gave acceptable pictures on all channels. The sound however was marred by a "rough" background buzz which could be reduced but not eliminated by careful adjustment of the fine tuning. The buzz was more apparent during the transmission of captions and when the video signal contained information corresponding to swift changes from black to white and vice versa, though there was no accompanying sound-on-vision.*

Having previously encountered on other models vision-on-sound and sound-on-vision troubles which were caused by front-end overload and the consequent sound-vision intermodulation the service technician tried the effect of reducing the aerial input by connecting an attenuator between the aerial and receiver. In this case however the buzz remained even when the signal was reduced to the level where noise appeared on the picture.

In this model there is a preset control for balancing the f.m. ratio detector so the next move was to try the effect of adjusting this—the technician being well aware that imbalance here, as well as asymmetrical response of the intercarrier channel, can aggravate the symptom. Critical adjustment of this preset control during a pause in the sound further reduced the buzz, but it still remained at an uncomfortable level during captions etc. when the sound signal was at a low level, especially when the volume control was advanced for normal listening.

Before setting up instruments to check the i.f. and intercarrier alignment and the ratio of the sound and vision carriers at the video detector the technician decided to turn his attention to a different part of the circuit and after a few measurements discovered the component responsible. Replacing this completely eliminated the buzz.

What was the most likely circuit at fault and which component in this area did the technician change? See next month's TELEVISION *for the solution and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 145

Page 139 (last month)

Sound-on-vision and vision-on-sound troubles can arise from a wide variety of causes: careful analysis of the symptoms and how they are affected by operation of the controls etc. is essential in order to avoid a lot of unnecessary testing. In this case the technician proved that front-end overloading or an a.g.c. fault was not responsible. A critical area of course is the i.f. strip since if this goes out of alignment the sound/vision signal ratio at the video detector is likely to be disturbed—a common cause of the trouble experienced. If the transformers and rejectors have not been tampered with however it is always best before attempting any realignment to check on the components which if altered in value could affect the tuning. The valves (or transistors) are in this category but it will be recalled that the technician checked these.

It is probably not so well known that a changed value or open-circuit i.f. decoupling capacitor can upset the overall response characteristic without causing undue loss of gain or instability. The resulting response asymmetry will modify the sound/vision carrier ratio and precipitate the symptoms described. In this case it was the 0·001µF (2C17) screen grid decoupling capacitor in the second i.f. stage (2V3) that was responsible. Changing this component cleared the trouble.

Published on approximately the 22nd of each month by IPC Magazines Limited, Fleetway House, Farringdon Street, London EC4A 4AD. Printed in England by Fleetway Printers, Crete Hall Road, Gravesend. Sole Agents for Australia and New Zealand—Gordon and Gotch (A/sia) Ltd.; South Africa—Central News Agency Ltd. Publisher's subscription rate (including postage): for one year, £3.25 inland rate, £3.85 overseas rate. International Giro facilities Account No. 5122007. Please state reason for payment "message to payee". "Television" is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first having been given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, excluding Eire where the selling price is subject to VAT, and that it shall not be lent, resold, hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

TELEVISION CLASSIFIED ADVERTISEMENTS

The pre-paid rate for classified advertisements is 8p a word (minimum 12 words), box number 30p extra. Semi-display setting £4.50 per single column inch. All cheques, postal orders, etc., to be made payable to TELEVISION and crossed "Lloyds Bank Ltd." Treasury notes should always be sent *registered post.* Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, TELEVISION IPC Magazines Ltd., Fleetway House, Farringdon Street, London, EC4A 4AD, for insertion in the next available issue.

AERIALS

WRIGHT'S AERIALS

Full range of J Beam and Antiference aerials and accessories. Antiference Trucolour: TC10 £4.00, TC18 £5.30. J Beam High Gain: MBM 30 £5.15, MBM 46 £7.70, MBM 70 £13.25. New Antiference Extra Gain: XG8 £7.90, XG14 £14.00, XG21 £19.00. Please state transmitter or channel group if known. Labgear UHF masthead amplifiers: CM6000 (grouped) £11.05, CM6019 (wideband) £9.75. Both with mains power supply. Coax: semi air-spaced low-loss 12 p / yd. Prices include VAT and UK mainland postage. Comprehensive stocks of high gain aerials and accessories—VHF-DX aerials.
SAE for list. Information sheets and individual advice supplied with order if requested.
Dept. 1, 3 Cheltenham Rise, Scawsby, Doncaster, S. Yorks.

DX/TV aerials, Band I—£5. Band III—£3. Details. Cook, 90 Ewhurst Road, Crawley 23885, Sussex.

Jaybeam Multibeams: MBM 28 £5.00. MBM 48 £8.00. MBM 70 £12.00. Logperiodic LBM 2 £7.00. **Stereobeams:** SBM 3 £5.00. SBM 4 £5.50. SBM 6 £8.00. FM9S £19.00. UHF Masthead Amplifiers £11.00. Low Loss co-ax 12p/m.

We stock a good range of **Amtron Kits** and **BIB Hi-Fi Accessories.**

The shop has a good range of components and is open Tues - Sat 09.00 - 17.00.

J. & A. Tweedy, (Electronic Supplies) Ltd.
79 Chatsworth Road, Chesterfield, S40 2AP

SETS & COMPONENTS

MULLARD CAPACITORS

Polyester (280) 250V/W—.01, .022, .047, 3p (25p), .1, .15, 4p (36p). .22, .33, .47, 7p (55p). .68, 2.2, 12p (£1.00). **Electroltic-UF.** 1/63v, 10/25v, 40/10v, 80/25v, 100/6.4v, 220/10v, 400/25v, 400/4v, 470/10v, 8p (60p)—220/63v, 220/40v, 470/40v, 680/25v, 1000/25v, 11p (90p)
Prices in brackets for ten, price includes VAT, P & P 10p.
ELECTRONIC MAILORDER LTD.
62 Bridge Street, Ramsbottom, Bury, Lancs.

Top 20 Plus Electronically Tested TV Valves

PL504	18p	30FL1/2	15p
PCF801	15p	PCL84	10p
DY86/7	15p	PCL82	10p
PL36	15p	PD500/A	50p
PC88	15p	ECC82	10p
PC86	15p	EH90	10p
PC97	15p	EY86	15p
PCL805/85	15p		

Colour Valves Fully Tested

PL509	40p	PY500/A	30p
PL508	30p	GY501	50p
PL802	40p	PCF802	15p

Many others available including Mazda Types.
P. & P. 4p per valve, over 12 2½p per valve, orders over £4 post free.
Prompt service. S.A.E. for New free list
Mail order only.
L. & D. COMPONENTS LTD.,
71 Westbury Ave., London N22 6SA.
Tel. 01-888 2701.

250—New Resistors well assorted ⅛—2 watts. Carbon—Hi-Stab Oxide etc. £1.00 Post Free. Whitsam Electrical, 33 Drayton Green Road, London W.13.

VALVE LIST

ALL VALVES FULLY TESTED

One valve postage 4p. Over 5 valves postage paid.

DY86/87	13p	PC900	8p	PCL85	20p
DY802	20p	PCC84	8p	PFL200	25p
EB91	12p	PCC89	8p	PL36	20p
ECC82	10p	PCC189	8p	PL504	25p
ECL80	8p	PCC805	15p	PY81/800	15p
EF80	8p	PCC85	20p	PY801	20p
EF183	10p	PCF80	8p	U191	18p
EF184	10p	PCF86	13p	6F23	15p
EH90	13p	PCF805	20p	6/30L2	15p
EY86/87	13p	PCL82	13p	30F5	10p
PC86	15p	PCL83	13p	30FLI	20p
PC88	15p	PCL84	13p	30PL1	20p

AND MANY MORE AVAILABLE

S. W. ELECTRONICS
114 Burnley Road, Rawtenstall
Rossendale, Lancs.

COMPONENTS GALORE

Pack of 500 mixed components manufacturers surplus plus fall-out. Pack includes resistors, carbon and W.W., capacitors various, transistors, diodes, trimmers, potentiometers, etc. Send £1 plus 15p p & p. C.W.O. to:
Cascade Components Company, Dept. TV, Bankhead Farm, South Queensferry, West Lothian.

EX RENTAL TV's BARGAIN

23" & 19" 3 Channel with U.H.F. Tuner £3.50
19" & 25" Colour from £50.00
19" & 23" tubes guaranteed from £2
All sets complete.
EDWARDS & SONS
103 Goldhawk Road, London W.12
Telephone 743-6996
CALLERS ONLY

MAINS DROPPERS.
37-31-97-26-168 Ω 50p.
25-35-97-59-30 Ω 50p.
14-26-97-160 Ω 50p.
14-26-97-173 Ω 50p.
15-19-20-70-63-28-63 Ω 50p.
Post free. C.W.O.
Durham Supplies, 367 Kensington Street, Bradford, 8, Yorkshire.

MAINS DROPPERS. Philips 210, 95p 210HT 80p, G8 80p, Rank A640 75p. List SAE Ian Beckett, Chackmore, Buckingham.

TV Engineers–

come and join me in

New Zealand

I'm Dave Smith and I'm a TV service engineer in N.Z. I emigrated here from the U.K. 2 years ago and I reckon it's the best move I've ever made. The company I work for—Dominion Television—is looking for more TV engineers willing to escape to the sun in N.Z. Dominion TV is N.Z.'s leading TV rental organisation. They're a great crowd—a member of the international Thorn group. I get a great salary deal, my own vehicle—and many fringe benefits. The life in N.Z. is just fantastic for me, my wife and the kids. The standard of living is very high and there's always plenty to do—whether you're in the pub crowd or on a deserted beach. The great thing is that there aren't the pressures on me here that there were in England. That's not to say there isn't plenty of interesting work—but the Kiwi's attitude to life is so much more pleasant and relaxed. If, like me, you've got City and Guilds final with colour endorsement, I'd strongly advise you to consider a career with Dominion Television in N.Z. You must have 4 years experience in TV. Interviews will be held in the U.K. and sponsored fares will be offered to successful candidates.

Contact, with copies of testimonials:

Mr. S. Pemberton,
Managing Director,
Dominion Television Services Ltd.,
P.O. Box 9206,
Newmarket, AUCKLAND, N.Z.

LADDERS

ALUMINIUM Cat Ladders 12 ft-24 ft. Tel: Telford 586644. for Brochure.

SERVICE SHEETS

BELL'S TELEVISION SERVICES

SERVICE SHEETS • MANUALS • BOOKS

SERVICE SHEETS 40p plus S.A.E. ★ SERVICE SHEET CATALOGUE 25p

OVER 12,000 SERVICE SHEETS & MANUALS IN STOCK ON COLOUR/MONO TELEVISIONS RADIOS, RADIOGRAMS, T/RECORDERS, R/PLAYERS, ETC. S.A.E. WITH ENQUIRIES

Send large S.A.E. for FREE booklists

NEW BOOKS & PUBLICATIONS......PRICES INCLUDE POST & PACKING

	PRICE
TV FAULT FINDING BOOK by Data Publications Ltd. New Edition	£1.04
RECEIVING PAL COLOUR TELEVISION by A.G.Priestley. 261 pages	£5.25
RADIO & TELEVISION SERVICING 1973-1974 Edition. by McDonald & Co. Ltd	£5.75
COLOUR TV With Particular Reference to the PAL System by G.N.Patchett. 3rd Edn. 360 pages	£5.15
MAZDA BOOK OF PAL RECEIVER SERVICING by D.J.Seal. 276 pages	£5.10
COLOUR TELEVISION PICTURE FAULTS by K.J.Bohlman. 112 pages	£2.70
COLOUR TELEVISION THEORY by G.H.Hutson. PAL-System principles & Receiver circuitry	£4.40
COLOUR TELEVISION SERVICING by G.J.King. 2nd Edn. 352 pages	£4.70
NEWNES COLOUR TV SERVICING MANUAL. Vol.1. by G.J.King. 240 pages	£5.25
TV TECHNICIANS BENCH MANUAL by G.R.Wilding. 182 pages	£2.75
BEGINNER'S GUIDE TO ELECTRONICS by Squires & Deason. 3rd Edition. 240 pages	£2.07
RADIO TECHNICIANS BENCH MANUAL by H.W.Hellyer. 215 pages	£3.20
AUDIO TECHNICIANS BENCH MANUAL by John Earl. 182 pages	£3.20
Comprehensive COLOUR TV REPAIR MANUAL by McCourt. Vol.1. Covers most British models	£3.25
Comprehensive COLOUR TV REPAIR MANUAL by McCourt. Vol.2. Covers ITT/KB & Foreign sets	£3.25
Comprehensive B/W TV REPAIR MANUAL by McCourt. Vol.1. Covers approx 259 British models	£3.20
" " " " " " " Vol.2. Covers approx 197 British models	£3.20
" " " " " " " Vol.3. Covers UK & Foreign Portables	£3.20
Mechanics Course in Radio TV & Electronics 222 (433) by B.Fozard & G.N.Patchett	
PRINCIPLES & CALCULATIONS (FIRST YEAR). B.Fozard	£0.65
PRINCIPLES & CALCULATIONS (SECOND & THIRD YEARS). B.Fozard	£1.35
ELECTRONIC SYSTEMS (PART 1. FIRST YEAR). G.N.Patchett	£1.05
ELECTRONIC SYSTEMS (PART 11. SECOND YEAR). G.N.Patchett	£1.15
ELECTRONIC SYSTEMS (PART 11. THIRD YEAR). G.N.Patchett	£2.25
TELEVISION (COLOUR & MONOCHROME PART 111.). G.N.Patchett	£2.70

"RADIO & TELEVISION SERVICING" books available, from Volume 1 to 1974 edition. Prices on request.

Back issues of PW. PE. EE. TV. E-Today & Constructor available, Cover price plus 7p postage per copy..

OPEN UNTIL 6pm DAILY & 8pm SATURDAY. CALLERS WELCOME TO COME AND BROWSE

B.T.S (Mail Order Dept.) 190, KINGS ROAD, HARROGATE, YORKS. Tel. 55885

LARGE SUPPLIER OF SERVICE SHEETS

All at 50p each

(T.V., RADIO, TAPE RECORDERS, RECORD PLAYERS, TRANSISTORS, STEREOGRAMS, RADIOGRAMS, CAR RADIOS)

"PLEASE ENCLOSE LARGE S.A.E. WITH ALL ENQUIRIES & ORDERS"

Otherwise cannot be attended to

(Uncrossed P.O.'s please, original returned if service sheets not available.)

PLEASE NOTE
We operate a "by return of post" service. Any claims for non-delivery should be made within 7-days of posting your order.

C. CARANNA
71 BEAUFORT PARK
LONDON, NW11 6BX

We have the largest supplies of Service Sheets (strictly by return of post). Please state make and model number alternative.

Free T.V. fault tracing chart or T.V. list on request with order.

Mail order or phone 01-458 4882

SERVICE SHEETS, Radio, TV etc. 8,000 models. Catalogue 20p. S.A.E. enquiries. Telray, 11 Maudland Bank, Preston.

SERVICE Sheets for over 6,000 models of Televisions, Radios, Transistors, Stereo, Tape Recorders, Record Players etc., at only 30p plus S.A.E. with free Fault-Finding Guide. Over 50,000 sheets in stock for 10,000 models. S.A.E. enquiries. Catalogue 20p plus S.A.E. Hamilton Radio, 47 Bohemia Road, St. Leonards, Sussex. Telephone Hastings 429066.

'CAUSE & CURE' T.V. Manuals. Invaluable for professional and amateur. SAE details: Colis, 33 Maple Avenue, Morecambe, LA3 1HZ, Lancs.

FOR SALE

FOR SALE (due to bereavement) "TELEVISION" Colour T.V. project. Circuits built, not assembled. New 26" tube mounted in cabinet. Many spares. New meter "Supertester" 680R, also HOMREX transistorised signal generator model 27. Buyer to collect (Cardiff area). Offers: Box No. 122.

TELEVISION colour receiver, working b & w only. £120 or consider arrangement to get it working. Phone: 01-524 4497.

EDUCATIONAL

C AND G EXAMS

Make sure you succeed with an ICS home study course for C and G Electrical Installation Work and Technicians, Radio/TV/Electronics Technicians. Telecomms Technicians and Radio Amateurs.

COLOUR TV SERVICING

Make the most of the current boom! Learn the techniques of servicing Colour and Mono TV sets through new home study courses, approved by leading manufacturers

TECHNICAL TRAINING

Home study courses in Electronics and Electrical Engineering, Maintenance, Radio, TV, Audio, Computer Engineering and Programming. Also self-build radio kits. Get the qualifications you need to succeed.

Free details from:

INTERNATIONAL CORRESPONDENCE SCHOOLS
Dept 750, Intertext House, London SW8 4UJ Or Phone 01-622 9911 (All Hours)

TELEVISION TRAINING

16 MONTHS' full-time practical and theoretical training course in Radio & TV Servicing (Mono & Colour) for beginners.

13 WEEKS' full-time Colour TV Servicing course. Includes 100 hours practical training. Mono revision if necessary. Good electronics background essential.

NEXT SESSION commences on April 21st.

PROSPECTUS FROM:
London Electronics College, Dept. TT2
20 Penywern Road, London SW5 9SU.
Tel. 01-373 8721.

MISCELLANEOUS

Build the Mullard C.C.T.V. Camera

Kits are now available with comprehensive construction manual
(also available separately at 80p)

Send 5" x 7" S.A.E. for details to

CROFTON ELECTRONICS
124 Colne Road, Twickenham, Middlesex TW2 6QS

TRANSISTORS, ETC.

Type	Price (£)
AC107	0.35
AC117	0.24
AC126	0.25
AC127	0.25
AC128	0.25
AC141	0.26
AC141K	0.27
AC142K	0.19
AC151	0.24
AC152	0.25
AC153K	0.28
AC154	0.20
AC176	0.25
AC187	0.25
AC187K	0.25
AC188	0.25
AC188K	0.26
AC193K	0.30
AC194K	0.32
ACY28	0.25
ACY39	0.68
AD140	0.50
AD142	0.52
AD143	0.51
AD149	0.50
AD161	0.48
AD162	0.48
AF114	0.25
AF115	0.25
AF116	0.25
AF117	0.20
AF118	0.50
AF121	0.30
AF124	0.25
AF125	0.20
AF126	0.20
AF127	0.20
AF139	0.35
AF147	0.35
AF149	0.45
AF178	0.55
AF179	0.60
AF180	0.55
AF181	0.50
AF186	0.40
AF239	0.40
AF279	0.84
AL100	1.10
AL102	1.10
AL103	1.10
AL113	0.95
AU103	2.10
AU110	1.90
AU113	2.40
BC107	0.12
BC107A	0.13
BC107B	0.14
BC108	0.12
BC108B	0.13
BC109	0.13
BC109C	0.14
BC113	0.13
BC114	0.20
BC115	0.20
BC116	0.20
BC117	0.20
BC119	0.29
BC125	0.22
BC125	0.25
BC126	0.20
BC132	0.15
BC134	0.20
BC135	0.15
BC136	0.20
BC137	0.20
BC138	0.20
BC142	0.30
BC143	0.35
BC147	0.13
BC148	0.12
BC149	0.14
BC152	0.25
BC153	0.20
BC154	0.20
BC157	0.15
BC158	0.13
BC159	0.15
BC161	0.48
BC167B	0.15
BC168B	0.13
BC169C	0.13
BC170	0.15
BC171	0.15
BC172	0.14
BC173	0.20
BC176	0.22

Type	Price (£)
BC177	0.20
BC178	0.22
BC178B	0.22
BC179	0.20
BC179B	0.21
BC182L	0.11
BC183	0.11
BC183K	0.12
BC183L	0.11
BC184L	0.13
BC186	0.25
BC187	0.25
BC208	0.12
BC212L	0.12
BC213L	0.12
BC214L	0.15
BC238	0.10
BC261A	0.28
BC262A	0.18
BC263B	0.25
BC267	0.16
BC268C	0.14
BC294	0.27
BC300	0.58
BC301	0.35
BC303	0.60
BC307B	0.12
BC308A	0.10
BC309	0.15
BC323	0.38
BC377	0.22
BC441	1.10
BC461	1.58
BCY33	0.36
BCY42	0.16
BCY71	0.22
BCY88	2.42
BD115	0.65
BD123	0.98
BD124	0.80
BD130Y	1.42
BD131	0.45
BD132	0.50
BD135	0.40
BD136	0.46
BD137	0.48
BD138	0.50
BD139	0.55
BD140	0.62
BD144	2.19
BD145	0.75
BD163	0.67
BD183	0.56
BD234	0.75
BD519	0.76
BD520	0.76
BDX18	1,45
BDX32	2.55
BDY16A	0.38
BDY18	1.78
BDY20	0.99
BF115	0.20
BF117	0.45
BF120	0.55
BF121	0.25
BF123	0.28
BF125	0.25
BF127	0.30
BF158	0.25
BF159	0.27
BF160	0.22
BF161	0.45
BF162	0.45
BF163	0.45
BF167	0.25
BF173	0.25
BF177	0.30
BF178	0.33
BF179	0.33
BF180	0.35
BF181	0.33
BF182	0.44
BF183	0.44
BF184	0.26
BF185	0.26
BF194	0.15
BF195	0.15
BF196	0.15
BF197	0.17
BF198	0.20
BF199	0.25
BF200	0.35
BF218	0.35
BF222	1.08
BF224J	0.15
BF240	0.20

Type	Price (£)
BF241	0.20
BF244	0.18
BF254	0.45
BF255	0.45
BF256	0.45
BF257	0.49
BF258	0.66
BF259	0.93
BF262	0.70
BF263	0.70
BF273	0.16
BF336	0.35
BF337	0.35
BF458	0.46
BF459	0.57
BF596	0.70
BF597	0.15
BFR39	0.24
BFR41	0.30
BFR61	0.30
BFR79	0.24
BFT43	0.55
BFW10	0.55
BFW11	0.55
BFW16A	1.70
BFW30	1.38
BFW59	0.19
BFW60	0.20
BFW90	0.28
BFX16	2.25
BFX29	0.30
BFX30	0.35
BFX84	0.25
BFX85	0.26
BFX86	0.26
BFX87	0.28
BFX88	0.24
BFY18	0.53
BFY40	0.40
BFY41	0.43
BFY50	0.25
BFY51	0.23
BFY52	0.23
BFY57	0.32
BFY64	0.42
BFY72	0.31
BFY90	0.70
BLY15A	0.79
BPX25	1.65
BPX29	1.60
BPX52	1.90
BRC4443	0.60
BRY39	0.42
BR101	0.35
BSW64	0.38
BSX19	0.13
BSX20	0.19
BSX76	0.15
BSX82	0.52
BSY19	0.52
BSY41	0.22
BSY54	0.50
BSY56	0.80
BSY65	0.15
BSY78	0.40
BSY91	0.28
BT106	1.18
BU105/02	1.95
BU108	3.25
BU126	1.93
BU204	1.98
BU205	1.98
BU207	3.00
BU208	3.15
BU209	2.55
BUY77	2.50
BUY78	2.55
BUY79	2.85
D40N1	0.45
E1222	0.55
E5024	0.20
ME6001	0.16
ME6002	0.17
ME8001	0.18
MJE340	0.68
MJE341	0.72
MJE370	0.65
MJE520	0.85
MJE521	0.95
MJE2955	1.20
MJE3000	1.85
MJE3055	0.74
MPF102	0.40
MPS6566	0.21
MPSA05	0.47
MPSA55	0.50
MPSU05	0.66
MPSU06	0.76

Type	Price (£)
MPSU55	1.26
OC26	0.38
OC28	0.65
OC35	0.50
OC36	0.55
OC42	0.35
OC44	0.15
OC45	0.15
OC70	0.15
OC71	0.15
OC72	0.15
OC73	0.51
OC75	0.25
OC76	0.22
OC81	0.25
OC81D	0.30
OC139	0.28
OC140	0.30
OC170	0.25
OC171	0.30
OC200	0.59
OCP71	0.43
ON188	2.19
ON236A	0.65
ORP12	0.55
R2008B	2.05
R2010B	2.10
TIC44	0.29
TIC46	0.44
TIC47	0.58
TIP29A	0.49
TIP30A	0.58
TIP31A	0.65
TIP32A	0.67
TIP33A	0.99
TIP34A	1.73
TIP41A	0.80
TIP42A	0.91
TIS43	0.30
TIS73	1.36
TIS90	0.23
TIS91	0.23
ZTX109	0.12
ZTX300	0.16
ZTX304	0.22
ZTX310	0.10
ZTX313	0.12
ZTX500	0.17
ZTX502	0.17
ZTX504	0.42
ZTX602	0.24
2N525	0.86
2N696	0.23
2N697	0.15
2N706	0.12
2N706A	0.15
2N708	0.35
2N744	0.30
2N914	0.19
2N916	0.20
2N918	0.42
2N930	0.35
2N1304	0.21
2N1305	0.21
2N1306	0.31
2N1307	0.22
2N1308	0.26
2N1309	0.36
2N1613	0.34
2N1711	0.45
2N1890	0.45
2N1893	0.48
2N2102	0.31
2N2217	0.36
2N2218	0.60
2N2219	0.50
2N2221A	0.41
2N2222A	0.50
2N2270	0.41
2N2369A	0.42
2N2401	0.60
2N2484	0.41
2N2570	0.18
2N2646	0.53
2N2712	0.12
2N2894	0.77
2N2904	0.22
2N2904A	0.26
2N2905	0.72
2N2905A	0.73
2N2926G	0.13
2N2926Y	0.12
2N2926O	0.12
2N2955	1.12
2N3019	0.75
2N3053	0.21
2N3054	0.55
2N3055	0.60

Type	Price (£)
2N3133	0.54
2N3134	0.60
2N3232	1.32
2N3235	1.10
2N3254	0.28
2N3323	0.48
2N3391A	0.23
2N3702	0.13
2N3703	0.15
2N3704	0.15
2N3705	0.11
2N3706	0.10
2N3707	0.13
2N3715	2.30
2N3724	0.72
2N3739	1.18
2N3766	0.99
2N3771	1.70
2N3772	1.90
2N3773	2.90
2N3790	4.15
2N3794	0.20
2N3819	0.35
2N3820	0.49
2N3823	1.45
2N3866	1.70
2N3877	0.25
2N3904	0.16
2N3905	0.18
2N3906	0.15
2N4032	0.31
2N4033	0.54
2N4036	0.52
2N4046	0.35
2N4058	0.17
2N4123	0.13
2N4124	0.15
2N4126	0.20
2N4236	1.90
2N4248	0.12
2N4284	0.19
2N4286	0.19
2N4288	0.13
2N4289	0.20
2N4290	0.14
2N4291	0.18
2N4292	0.20
2N4392	2.84
2N4871	0.24
2N4902	1.30
2N5042	1·05
2N5060	0.32
2N5061	0.35
2N5064	0.45
2N5087	0.32
2N5294	0.35
2N5296	0.37
2N5298	0.38
2N5322	0.85
2N5449	1.90
2N5457	0.30
2N5458	0.35
2N5494	1.85
2N5496	2.05
2N6027	0.65
2N6178	0.71
2N6180	0.78
2SC643A	1.36
2SC1172Y	2.80
3N140	1.21
40250	0.60
40327	0.67
40361	0.48
40362	0.50
40429	0.80
40439	2.67

MATCHED PAIRS

Type	Price (£)
AC128/AC176	0.52
AC141K/AC142K	0.56
AC187/AC188	0.60
AC187/AC188K	0.61
AC193K/AC194K	0.71
AD161/AD162	0.95
BC142/BC143	0.70

Any other transistors can be matched at a supplement of 20p per pair

All items advertised ex-stock on magazine copy date. All prices subject to availability.

Tel: Stoke Climsland (05797) 439
Telex: 45457 (A/B Mercury Calgton)

DIODES

Type	Price (£)
AA113	0.15
AA119	0.09
AA129	0.20
AA143	0.10
AAZ13	0.30
AAZ17	0.12
BA100	0.15
BA102	0.25
BA110U	0.30
BA115	0.12
BA141	0.17
BA145	0.17
BA148	0.17
BA154	0.13
BA155	0.16
BA156	0.15
BA157	0.25
BAX13	0.06
BAX16	0.07
BB103	0.25
BB104	0.45
BB105B	0.45
BB105G	0.35
BR100	0.50
BY100	0.15
BY103	0.22
BY126	0.16
BY127	0.17
BY133	0.23
BY140	1.40
BY164	0.55
BY176	1.00
BY179	0.70
BY206	0.31
BYX10	0.15
BYZ12	0.30
FSY41A	0.40
OA10	0.20
OA47	0.07
OA81	0.12
OA90	0.08
OA91	0.07
OA95	0.07
OA200	0.10
OA202	0.10
OA210	0.29
OAZ237	0.78
S2M1	0.22
TV20	1.20
IN914	0.07
IN914E	0.06
IN916	0.10
IN4001	0.05
IN4002	0.06
IN4003	0.07
IN4004	0.08
IN4005	0.09
IN4006	0.11
IN4007	0.14
IN4148	0.05
IN4448	0.10
IN5400	0.15
IN5401	0.17
IN5402	0.20
IN5403	0.22
IN5404	0.25
IN5405	0.27
IN5406	0.30
IN5407	0.34
IS44	0.07
IS310	0.45
IS920	0.07
IS923	0.12

Diodes can be supplied balanced at a supplement of 5p per device —e.g. four balanced OA91 would be £0.48 per set.

Variable capacitance diodes can be supplied matched at a supplement of 3p per device.

LINEAR INTEGRATED CIRCUITS

Type	Price (£)
CA3045	1.25
CA3046	0.70
CA3065	1.90
MC1307P	1.19
MC1310P	2.94
MC1327PQ	1.01
MC1330P	0.76
MC1351P	0.75
MC1352P	0.72
MC1358PQ	1.85
MC1496L	0.87
MC3051P	0.58
MFC4000B	0.43
MFC4060A	0.70
MFC6040	0.91
NE555	0.72
NE556	1.34
PA263	1.90
SL414A	1.91
SL901B	2.60
SL917B	3.80
SN76001N	1.45
SN76003N	2.92
SN76013N	1.95
SN76013ND	1.72
SN76023N	1.95
SN76023ND	1.72
SN76033N	2.92
SN76530P	1.05
SN76533N	1.20
SN76666N	0.90
TAA300	1.46
TAA320	0.94
TAA350	1.54
TAA435	0.85
TAA450	1.85
TAA550	0.49
TAA570	1.39
TAA630Q	3.29
TAA630S	3.29
TAA700	3.30
TAA840	1.64
TAA861A	0.49
TAD100	1.42
TBA120S	0.99
TBA240A	1.10
TBA480Q	1.24
TBA500	1.99
TBA500Q	2.00
TBA510	1.99
TBA520Q	2.72
TBA530	1.98
TBA530Q	1.99
TBA540	2.20
TBA540Q	2.21
TBA550Q	3.29
TBA560C	2.71
TBA560CQ	2.72
TBA570	1.17
TBA641	0.76
TBA673	1.80
TBA700	1.90
TBA720Q	2.20
TBA750Q	1.54
TBA800	1.75
TBA810AS	1.75
TBA920Q	3.29
TBA990	3.29
TBA990Q	3.29
TCA270Q	3.30
ZN414	1.25
µ6A995-159	2.25

Please enquire for linear op. amps, 709, 710, etc.

DIGITAL INTEGRATED CIRCUITS

Type	Price (£)
7400	0.20
7401	0.20
7402	0.20
7404	0.24
7406	0.45
7408	0.25
7410	0.20
7411	0.25
7412	0.28
7413	0.50
7416	0.45
7417	0.30
7420	0.20
7430	0.20
7440	0.20
7441	0.85
7447	1.30
7450	0.20
7451	0.20
7454	0.20
7460	0.20
7470	0.33
7472	0.38
7473	0.44
7474	0.48
7475	0.59
7490	0.65
7491	1.10
7492	0.75
7493	0.65
7494	0.85
7495	0.85
7496	1.00
74100	2.16
74121	0.60
74122	0.80
74150	1.44
74151	1.15
74154	1.66
74164	2.01
74192	2.05
74193	2.30

HARDWARE BASES

Type	Price (£)
DIL8	0.16
DIL14	0.16
DIL16	0.18

PADS

TO-5	½p
TO-18	½p

MOUNTING KITS

TO-3	0.06
TO-66	0.06

VALVES

Type	Price (£)
DY87	0.39
EB91	0.30
ECC82	0.41
EF80	0.41
EF183	0.53
EF184	0.53
EH90	0.55
PC86	0.67
PC88	0.76
PCC89	0.58
PCF80	0.47
PCF86	0.58
PCF801	0.58
PCF802	0.63
PCL82	0.50
PCL84	0.54
PCL805/85	0.58
PCL86	0.58
PFL200	0.74
PL36	0.80
PL84	0.61
PL504	0.80
PL508	0.95
PL509	1.44
PY81/800	0.45
PY88	0.52

ZENER DIODES

400mW 3.0-33V 12p each
1W 3.3-68V 18p each

MINIATURE BRIDGES

2A Plastic Encapsulated

N6001	50V	PIV	35p each
N6002	100V	PIV	38p each
N6003	200V	PIV	41p each
N6004	400V	PIV	45p each
N6005	600V	PIV	50p each
N6006	700V	PIV	59p each
N6007	800V	PIV	68p each

VDR'S, PTC & NTC RESISTORS

Type	Price (p)	Type	Price (p)
E295ZZ/01	12	E299DD/P116-P354	all 7
E295ZZ/02	12	VA1015	20
E298CD/A258	6	VA1026	17
E298ED/A258	5	VA1033	7
/A260	5	VA1034	7
/A262	5	VA1040	7
/A265	5	VA1053	7
/P268	5	VA1055S	9
E298ZZ/05	6	VA1077	10
/06	5	VA1104	27
		VA8650	85

RESISTORS

Carbon Film (5%)
¼W 5.6 Ω-330k Ω (E12) 1p ea
⅓W 10 Ω-10M Ω (E24) 1p ea
1W 10 Ω-10M Ω (E12) 2p ea
2W 10 Ω-10M Ω (E12) 3p ea

WIREWOUND (5%)

2½W 0.22 Ω-270 Ω 15p ea
5W 10 Ω-8.2k Ω 12p ea
10W 10 Ω-25k Ω 15p ea

CAPACITORS

Full range of C280, C296, tubular ceramic, pin-up ceramic, miniature electrolytics, mica, mixed dielectric and TV electrolytics stocked.—Please see catalogue.

MASTHEAD AMPLIFIERS

Labgear type CM6000 complete with mains power unit CM6001/PU.
Groups A, B, or C/D **£9.87**

PATTERN GENERATORS

Labgear CM6004/PG giving crosshatch dots, greyscale and blank raster on 625-lines. Tuning can be preset for anywhere in Bands IV and V as well as Band III (for relays). **£45.39**

COLOUR-BAR GENERATORS

Labgear CM6037/DB: Dual standard band generator gives standard 8 band colour bars +greyscale step wedge+red raster+centre cross+centre dot+crosshatch+dot pattern+blank raster. Sync output also provided **£101.31**

VHF/UHF CONVERTERS

Labgear "Televertas" for DX-ing or single-standard receiver use on relay systems. Type 6022/RA (with pre-amp gain control) **£12.27**

AERIALS, ETC.

Please see catalogue.

OUR NEW CATALOGUE IS NOW AVAILABLE AT 30p (refundable).

P. & p.: UK £0.08 per order
Overseas: At cost

Please Add 8% for V.A.T.

EAST CORNWALL COMPONENTS

CALLINGTON - CORNWALL

Marshall's

A. Marshall & Son (London) Limited Dept. T
42 Cricklewood Broadway London NW2 3HD Tel: 01-452 0161
& 85 West Regent Street Glasgow G2 2QD Tel: 041-332 4133

Everything you need is in our new 1975 catalogue. Available now price 25p

Trade and export enquiries welcome

PW TELETENNIS KIT

As featured on B.B.C. Nationwide and in the Daily Mail Oct 2nd 1974

This exciting new game is now available in kit form. Due to popular demand we are now able to offer a fantastic saving on list prices. Ideal game for whole family. No need to modify your TV set, just plugs in to aerial socket.

Parts list as follows . . .

A Resistor Pack	£1.00	p.p. 20p
B Potentiometer Pack	£1.25	p.p. 20p
C Capacitor Pack	£3.10	p.p. 20p
D Semiconductor Pack	£14.50	p.p. 20p
E IC Sockets	£4.00	p.p. 20p
F Transformer	£1.15	p.p. 25p
G PCB's	£7.50	p.p. 20p
H Switches	£4.50	p.p. 20p
I UHF Modulator Kit	£7.20	p.p. 20p

Special Prices—complete kit excluding case **£42.00** p.p. 50p. Sections A-F incl. **£23.50** p.p. 30p. Assembly instructions with complete kit or 75p on request.

SN7400	16p	SN7420	16p	SN7453	16p	SN7491	£1·10
SN7401	16p	SN7423	37p	SN7454	16p	SN7492	75p
SN7401AN	38p	SN7425	37p	SN7460	16p	SN7493	65p
SN7402	16p	SN7427	45p	SN7470	30p	SN7494	85p
SM403	16p	SN7430	16p	SN7472	38p	SN7495	80p
SN7404	24p	SN7432	45p	SN7473	44p	SN7496	£1·00
SN7405	24p	SN7437	35p	SN7474	48p	SN74100	£2·16
SN7406	45p	SN7438	35p	SN7475	59p	SN74107	43p
SN7407	45p	SN7440	16p	SN7476	45p	SN74118	£1·00
SN7408	25p	SN7441	85p	SN7480	75p	SN74119	£1·92
SN7409	33p	SN7442	85p	SN7481	£1·25	SN74121	57p
SN7410	16p	SN7445	£1·59	SN7482	87p	SN74122	80p
SN7411	25p	SN7446	£2·00	SN7483	£1·20	SN74123	72p
SN7412	28p	SN7447	£1·30	SN7484	95p	SN74141	£1·00
SN7413	50p	SN7448	£1·50	SN7485	£1·58	SN74150	£1·44
SN7416	45p	SN7450	16p	SN7486	45p	SN74190	£1·95
SN7417	30p	SN7451	16p	SN7490	65p		

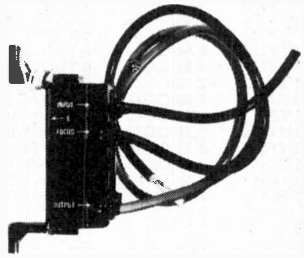
TRY OUR NEW GLASGOW SHOP

Prices correct at October 1974, but exclusive of VAT.
Post and Package 20p postage and package charges.

Popular Semiconductors

2N696	0·22	2N3707	0·13	AD142	0·50	BC309	0·10	LM709T099	
2N697	0·16	2N3708	0·70	AD143	0·60	BC327	0·21		0·48
2N698	0·40	2N3715	1·50	AD161	0·45	BC328	0·19	8DIL	0·38
2N699	0·45	2N3716	1·80	AD162	0·45	BCY70	0·17	14DIL	0·40
2N1302	0·19	2N3771	2·20	AD161 }	pr.	BCY71	0·22	LM723C	0·90
2N1303	0·19	2N3772	1·80	AD162 }	1·05	BCY72	0·13	LM741T099	
2N1304	0·24	2N3773	2·65	AF109R	0·40	BD123	0·82		0·40
2N1305	0·24	2N3819	0·37	AF115	0·24	BD131	0·40	8DIL	0·40
2N1306	0·31	2N3820	0·38	AF124	0·30	BD132	0·50	14DIL	0·38
2N1307	0·22	2N3823	1·42	AF125	0·30	BD135	0·42	LM747	1·00
2N1308	0·25	2N3904	0·27	AF126	0·28	BD136	0·49	LM7805	2·00
2N1309	0·36	2N3905	0·24	AF127	0·28	BD137	0·55	MC1310	2·92
2N1671	1·44	2N4036	0·63	AF139	0·39	BD138	0·63	MJ480	0·90
2N1671A	1·54	2N4037	0·42	AF178	0·55	BD139	0·71	MJ481	1·14
2N1671B	1·72	2N4126	0·20	AF179	0·65	BD140	0·87	MJ490	0·98
2N1671C	4·32	2N4289	0·34	AF180	0·58	BF115	0·25	MJ491	1·38
2N2102	0·50	2N4921	0·73	AF239	0·51	BF116	0·23	MJE340	0·45
2N2147	0·78	2N4922	0·84	AF240	0·72	BF117	0·43	MJE2955	1·12
2N2148	0·94	2N4923	0·83	AF279	0·54	BF154	0·16	MJE3055	0·68
2N2160	0·60	2N5190	0·92	AF280	0·54	BF163	0·32	MFC4000B	40
2N2218A	0·22	2N5191	0·95	BC107	0·16	BF180	0·35	MFC4010A	49
2N2219	0·26	2N5192	1·24	BC108	0·15	BF181	0·34	MFC4060	0·54
2N2219A	0·60	2NS195	1·46	BC109	0·19	BF184	0·30	MFC6040	0·91
2N2221	0·18	2N5245	0·47	BC147	0·12	BF194	0·12	NE555A	0·70
2N2221A	0·21	2N5457	0·49	BC148	0·13	BF195	0·12	NE560D	4·48
2N2222	0·20	2N5458	0·45	BC149	0·12	BF196	0·13	NE561	4·48
2N2222A	0·25	2N5459	0·49	BC167B	0·13	BF197	0·15	NE565A	4·48
2N2646	0·55	40361	0·48	BC168B	0·13	BF198	0·18	OC28	0·76
2N2904	0·22	40362	0·50	BC168C	0·11	BF200	0·40	OC42	0·50
2N2904A	0·24	40363	0·88	BC169B	0·13	BF237	0·22	OC71	0·17
2N2905	0·24	40406	0·44	BC169C	0·13	BF238	0·22	OC72	0·25
2N2905A	0·26	40407	0·33	BC182	0·12	BFX29	0·30	SL414A	1·80
2N2906	0·19	40408	0·50	BC182L	0·12	BFX30	0·27	TAA263	1·00
2N2906A	0·21	40409	0·52	BC183	0·12	BFX84	0·24	TBA800	1·50
2N2907	0·22	40410	0·52	BC183L	0·12	BFX85	0·30	TB810	1·50
2N2907A	0·24	40411	2·25	BC184	0·13	BFX87	0·28	TIP29A	0·49
2N2926	0·11	40602	0·46	BC184L	0·13	BFX88	0·25	TIP30A	0·58
2N3053	0·32	40604	0·56	BC212K	0·16	BFX89	0·90	TIP31A	0·62
2N3054	0·60	40669	1·00	BC212L	0·16	BFY19	0·62	TIP32B	0·74
2N3055	0·75	AC117	0·20	BC214L	0·21	BFY51	0·23	TIP33A	1·01
2N3441	0·97	AC126	0·20	BC237	0·13	BFY52	0·21	TIP34A	1·51
2N3442	1·69	AC127	0·20	BC238	0·13	BFY90	0·60	TIP35A	2·90
2N3415	0·10	AC128	0·20	BC239	0·13	BRY39	0·48	TIP36A	3·70
2N3416	0·15	AC151V	0·26	BC257	0·14	C1060	0·65	TIP41A	0·79
2N3417	0·21	AC152V	0·17	BC258	0·13	CA3020A	1·80	TIP42A	0·90
2N3702	0·11	AC153K	0·25	BC259	0·14	CA3046	0·70	TIP2955	0·93
2N3703	0·12	AC176	0·18	BC300	0·36	CA3048	2·11	TIP3055	0·60
2N3704	0·14	AC176K	0·25	BC301	0·34	CA3089E	1·96	ZTX 300	0.13
2N3705	0·12	AC187K	0·23	BC307	0·11	CA30900	4·23	ZTX 302	0.20
2N3706	0·09	AC188K	0·34	BC308	0·12	LM301A	0·46	ZTX 500	0.15

COLOUR 25 KV TRIPLERS



£1.70+13p V.A.T.

REPLACEMENT TRIPLERS

PYE CT72 SERIES 691, 693, EKCO CT103, CT120, CT105, CT125, CT121, CT122. GEC 2028, 2029, 2030 SOBELL 1028, 1029, TS25, 11TAZ	£3.00+24p V.A.T.
DECCA CS1730	£1.00+8p V.A.T.
E.H.T. RECTIFIER STICKS X80/150D	10p+1p V.A.T.
PYE TRANSISTOR TUNER UNITS VHF, UHF. *No* push button assembly	£1.50+12p V.A.T.
PHILIPS UHF UNIT	£1.50+12p V.A.T.
6 OR 4 PUSH-BUTTON UHF TUNER UNIT PYE	£3.00+24p V.A.T.
UHF AERIAL ISOLATING CO-AX SOCKETS & LEAD	30p+2p V.A.T.
22 MFD, 315V/W Condensers 25 MFD, 300V/W 470MFD 35 V/W 10 MFD, 250 V/W 1000 PF 8Kv	10p+1p V.A.T.
200+100 MFD, 325 V/W	30p+2p V.A.T.
200+200+100, 325 V/W	40p+3p V.A.T.
200+100+50+100	40p+3p V.A.T.
300+200+100 MFD, 350 V/W	50p+4p V.A.T.
200+200+100 MFD, 350 V/W	50p+4p V.A.T.
100 W/W Resistor	£1.00+8p V.A.T.
300 Mixed Condensers	£1.00+8p V.A.T.
350 Mixed Resistors	£1.00+8p V.A.T.
40 Mixed Pots	£1.00+8p V.A.T.

COLOUR T/V COMPONENTS MANUFACTURERS DISCARDED MATERIALS

VHF or UHF Varicap Tuners	£1.20+9p V.A.T.
Line o.p. Panels	£1.20+9p V.A.T.
Decoder Panels	£1.00+8p V.A.T.
G8 Type Yoke	50p+4p V.A.T.

Money returned if not completely satisfied

SENDZ COMPONENTS

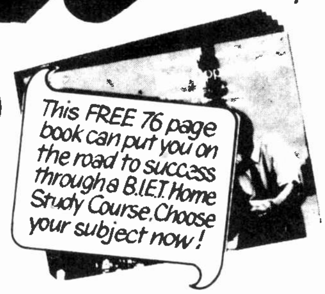
2 WOODGRANGE CLOSE
THORPE BAY, ESSEX

P.P. PAID U.K. ONLY

Reg Office Only—No Personal Callers Please

FREE!

Practical Radio & Electronics Certificate course includes a learn while you build ***3 transistor radio kit.*** Everything you need to know about ***Radio & Electronics*** maintenance and repairs for a ***spare time income*** and a ***career*** for a better future.



Over 150 ways to engineer a better future

HIGHER PAY | A BETTER JOB | SECURITY

find out how in just 2 minutes

That's how long it will take you to fill in the coupon. Mail it today and we'll send you full details and a free book. We have successfully trained thousands of men at home—equipped them for higher pay and better, more interesting jobs. We can do as much for YOU. A low-cost home study course gets results fast—makes learning easier and something to look forward to. There are no books to buy and you can pay-as-you-learn.

Why not do the thing that really interests you? Without losing a day's pay, you could quietly turn yourself into something of an expert. Complete the coupon (or write if you prefer not to cut the page). No obligation and nobody will call in on you . . . but it could be the best thing you ever did.

Others have done it, so can you

"Yesterday I received a letter from the Institution informing that my application for Associate Membership had been approved. I can honestly say that this has been the best value for money I have ever obtained, a view echoed by two colleagues who recently commenced the course".
Student D.I.B., Yorks.
"Completing your course, meant going from a job I detested to a job that I love, with unlimited prospects"—Student J.A.O. Dublin.
"My training quickly changed my earning capacity and, in the next few years, my earnings increased fourfold". Student C.C.P., Bucks.

FIND OUT FOR YOURSELF

These letters and there are many more on file at Aldermaston College, speak of the rewards that come to the man who has given himself the specialised know-how employers seek. There's no surer way of getting ahead or of opening up new opportunities for yourself. It will cost you a stamp to find out how we can help you. **Write to:**

Aldermaston College

Dept. TTV02, Reading RG7 4PF

HOME OF BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

CUT OUT THIS COUPON

Tick or state subject of interest. Post to address below.

MECHANICAL
- Society of Engineers—A.M.S.E. (Mech) ☐
- Institute of Engineer & Technicians (A.M.I.E.) ☐

CITY & GUILDS
- Gen. Mech. Eng. ☐
- Maintenance Eng. ☐
- Welding ☐
- Gen. Diesel Eng. ☐
- Sheet Metal Work ☐
- Eng. Inspection ☐
- Eng. Metallurgy ☐

ELECTRICAL & ELECTRONIC CITY & GUILDS
- Gen. Electrical Engineering ☐
- Electrical Installations ☐
- Electrical Maths ☐
- Computer Electronics ☐
- Electronic Eng. ☐
- Practical Radio & Electronics (with kit) ☐

MANAGEMENT & PRODUCTION
- Institute of Cost & Management Acctnts. ☐
- Computer Programming ☐
- Works M'ment ☐
- Work Study ☐
- Gen. Production Eng. ☐
- Estimating & Planning ☐
- Storekeeping ☐
- Management Skills ☐
- Quality Contro ☐

DRAUGHTSMANSHIP
- Institute of Engineering Designers (A.M.I.E.D.) ☐
- General Draughtsmanship ☐
- Elec. Draughtsmanship ☐
- Architectural Draughtsmanship ☐
- Technical Drawing ☐

RADIO & TELECOMMUNICATIONS
- City & Guilds Telecoms. ☐
- Gen. Radio & TV Eng. ☐
- Radio Amateurs Exam ☐
- Radio Servicing ☐

AUTOMOBILE & AERONAUTICAL
- Institute of the Motor Industry ☐
- A.M.I.I. ☐
- MAA/IMI ☐
- City & Guilds Auto Eng. ☐
- Gen. Auto Eng. ☐
- Motor Mechanics ☐
- Auto Diesel Eng. ☐
- Garage M'ment ☐
- AEC Aero Engineering Exams ☐
- Gen. Aero Eng. ☐

CONSTRUCTIONAL
- Institute of Building L.I.O.B. ☐
- A.B.T. Clerk of Works ☐

- Construction Surveyors Institute L.C.S.I. ☐
- City & Guilds General Building (all branches) ☐
- Heating & Vent. ☐
- Inst. Clerk of Works ☐
- Site Surveying ☐
- Health Engineering ☐
- Road Construction ☐
- Quantities Estimates ☐
- Hydraulics ☐
- Structural Eng. ☐

GENERAL
- Agricultural Eng. ☐
- Council of Eng. Institutions ☐
- Farm Science ☐
- Plastics ☐

Supplimentary courses for Nat. Certificates.

G.C.E. —choose from 58 'O' & 'A' level subjects

Coaching for many exams, including C & G

POST TODAY FOR A BETTER TOMORROW

To **Aldermaston College,**
Dept. TTV02, Reading RG7 4PF

NAME ....
Block capitals please
ADDRESS ....
....
.... POST CODE ....
OTHER SUBJECTS ....
.... AGE ....

Accredited by C.A.C.C. Member of A.B.C.C.