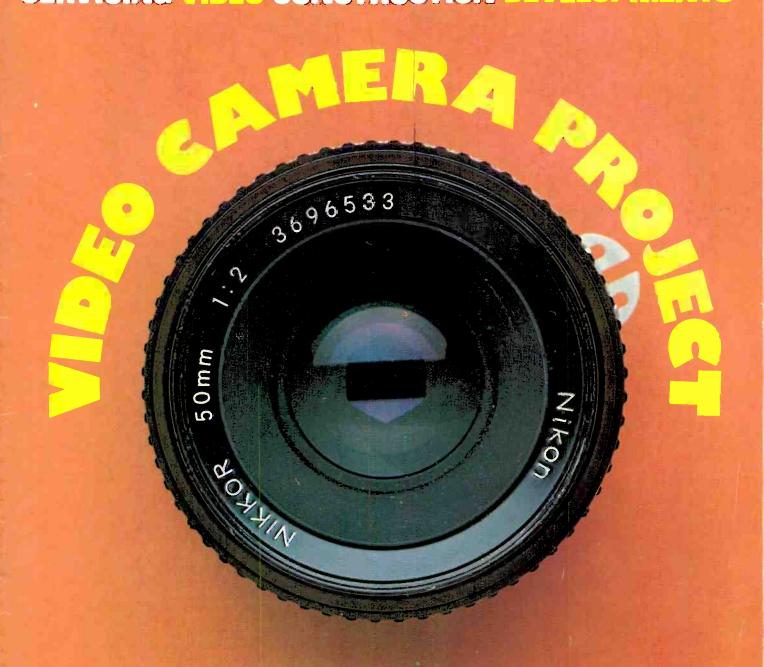
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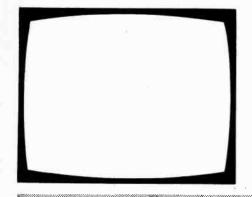
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BZY88 37V 0.10 62338					TBA231	1.20	EL84	2.00	TCE 9000 400/400	3.00
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TELEVISION

October 1980

Vol. 30, No. 12 Issue 360

by Malcolm Burrell

by Eugene Trundle

by S. Simon

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QUERIES

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Requests for advice in dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Service Bureau". Send to the address given above (see "correspondence").

this month

643	Leader

644 Teletopics

News, comment and developments.

646 Readers' PCB Service

649 Studio 80 Project: Video Camera, Part 1
Details of a simple monochrome camera which, along with a mixer and effects generator, will provide constructors with an easy to assemble

video studio.
651 Servicing the Indesit T12S

by John Law

The problem with these common portables is their unusual power supply circuitry. An account of how it operates and simple fault-finding procedures.

All on a Quiet Afternoon by Les Lawry-Johns
A sudden avalanche of customers threatens to engulf
our intrepid trouble-shooter.

656 Letters

657 Next Month in Television

658 Vintage TV: The HMV Model 901 by David Looser
Restoring one of the very first TV sets, a dual-standard model produced in 1936.

661 Bionic Alternatives
A review of various transplants available for use with Pye colour receivers.

662 VCR No-colour Faults

Colour signal processing in most VCRs is quite a complex affair, so that a fair chunk of circuitry can be responsible for the no-colour symptom. An

investigation of the possibilities.

666 Components for TV, Part 4 by Harold Peters
Delay lines, crystals, ceramic filters and SAWFs.

668 Service Notebook by George Wilding
Faults and how to tackle them.

670 Long-distance Television by Roger Bunney
Reports on DX reception and conditions, and news from

Whistling TV Sets
Sets that whistle and sing have become something of an epidemic. How to find the cause and cure it.

673 The Philips Projection TV System by Harold Peters
The workings of the new Philips colour projection TV system.

The Simon column takes a new course—practical notes on servicing particular chassis. This time the Thorn 8000/8000A/8500/8800 chassis.

676 New CTV Signals Board, Part 2

Layouts, construction, component details and a description of the i.f. module.

679 Service Hints by Mike Dutton
Faults and their causes.

680 Scan Currents

The c.r.t.'s beam has to be deflected to the right and to the left, also upwards and downwards. This involves current reversal in the timebase output stages. A look at the basic deflection arrangements.

681 Service Bureau 683 Test Case 214

TV Servicing

674

OUR NEXT ISSUE DATED NOVEMBER WILL BE PUBLISHED ON OCTOBER 22

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	IF	LUM	CHROMA	EHT	REG	CON	S/OUTPUT	POWER	L/TB	F/TB
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GEC/Sobell	5.00	5.50			_	5.00	_	_	-	7.50
Philips	5.00	7.00	_			5.00	_	_		5.00
Decca	5.00	9.00	9.00	-	_	5.00	2.00 (19" only)	6.00		5.00
Thorn 2000	5.00	5.00	5.00	6.50	6.50	7.00	_	6.50	10.00	5.00
Pye	7.00	6.00	7.00	_	_	5.00		_	_	5.00
Baird	6.50	8.50	7.00	_	_	5.00		_	_	5.00
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		2/2 AILD	AND COLOUR	STAILLIA				
	IF	LUM	CHROMA	VIDEO	CON	POWER	L/TB	F/TB
Bush 184	9.50		12.00		6.00	6.00	12.00	_
GEC Hybrid	6.00	6.50	9.00		5.00	_	_	12.00
Philips G6 S/S	9.50	_	10.00	_	5.00	_	_	6.00
	6.00	6.00	6.00		5.00	20.00	20.00	6.00
Thorn 3000		6.00	8.00	_	5.00	_	15.00	5.00
Pye 691/693	6.00		6.00	6.50	12.00	20.00	20.50	6.00
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AC115	0.17	AF178	0.49	BC177	0.12	BD225/	T1P31A	BF263	0.25	OC70	0.22	1N4003	0.06
AC117	0.24	AF180	0.60	BC178	0.12	UDILO,	0.39	BF271	0.20	OC71	0.28	1N4004	0.07
AC125	0.20	AF181	0.30	BC179	0.12	BD234	0.34	BF273	0.12	OC72	0.35	1N4005	0.07
AC126	0.18	AF186	0.29	BC182L	0.09	BD222	0.50	BF336	0.28	OC74	0.35	1N4006	0.08
AC127	0.19	AF239	0.43	BC183L	0.09	BDX22	0.73	BF337	0.24	OC75	0.35	1N4007	0.08
AC128	0.17	AU113	1.29	BC184L	0.09	BDX32	1.98	BF338	0.29	OC76	0.35	1N4148	0.03
AC131	0.13	70113	1.23	BC186	0.18	BDY18	0.75	BFT42	0.26	OC77	0.50	1N4751A	0.11
AC141	0.23	BA130	0.08	BC187	0.18	BDY60	0.80	BFT43	0.24	OC78	0.13	1N5401	0.12
AC142	0.19	BA145	0.14	BC209	0.11	BF115	0.80	BFX84	0.27	OC81	0.13	1N5404	0.12
AC141K	0.19	BA148	0.14	BC212	0.09	BF121	0.24	BFX85	0.27	OC810	0.14	1N5406	0.13
AC142K	0.29			BC213L	0.09		0.12					1N5408	0.16
AC151	0.23	BA155	0.08	BC214L	0.09	BF154		BFX88 BFY37	0.24	OC82	0.20		
AC165	0.16	BAX13	0.05	BC237	0.03	BF158	0.19	BFY50	0.15	OC820	0.13		
AC166	0.16	BAX16	0.08	BC237	0.07	BF159	0.24	BFY51	0.15	OC83 OC84	0.22	VALVE	
AC168	0.18	BC107	0.10	BC240 BC281	0.31	BF160	0.23				0.28	DY87	0.52
		BC108	0.10	BC262	0.24	BF163	0.23	BFY52 BFY53	0.15	OC85	0.13	DY802	0.64
AC176	0.17	BC109	0.10			BF164	0.17			OC123	0.20	ECC82	0.52
AC176K	0.28	8C113	0.09	BC263B	0.20	BF167	0.23	BFY55	0.27	OC169	0.20	EF80	0.40
AC178	0.16	BC114	0.12	BC267	0.19	BF173	0.21	BHA0002	1.90	OC170	0.22	EF183	0.60
AC186	0.26	BC115	0.10	BC301	0.22	BF177	0.26	BR100	0.20	OC171	0.27	EF184	0.60
AC187	0.21	BC116	0.10	BC302	0.30	BF178	0.24	BSX20	0.23	OA91	0.05	EH90	0.60
AC188	0.20	BC117	0.11	BC307	0.10	BF179	0.28	BSX76	0.23	BRC4443	0.65	PC86	0.76
AC187K	0.30	BC119	0.22	BC337	0.11	BF180	0.30	BSY84	0.36	R2008B	1.50	PC88	0.76
AC188K	0.30	BC125	0.12	BC338	0.09	BF181	0.34	BT106	1.18	R2010B	1.50	PCC89	0.65
AD130	0.50	BC126	0.09	BC307A	0.10	BF182	0.30	BT108	1.23	R2305	0.38	PCC189	0.65
AD140	0.65	BC136	0.12	BC308A	0.12	BF183	0.29	BT109	1.09	R2305/BD		PCF80	0.70
AD142	0.73	BC137	0.12	BC309	0.14	BF184	0.23	BT116	1.23		0.37	PCF86	0.68
AD143	0.70	BC138	0.21	BC547	0.09	BF185	0.29	BT120	1.23	SCR957	0.65	PCF801	0.70
AD145	0.70	BC139	0.21	BC548	0.11	BF186	0.30	BU105/02		TIP31A	0.38	PCF802	0.74
AD149	0.64	BC140	0.24	BC549	0.11	BF194	0.09	BU105/04		TIP32A	0.36	PCL82	0.67
AD161	0.40	BC141	0.22	BC557	0.11	BF195	0.09	BU126	1.40	TIP3055	0.53	PCL84	0.75
AD162	0.40	BC142	0.19	BD112	0.39	BF196	0.12	BU205	1.20	T1590	0.19	PCL86	0.78
AD161 (1.30	BC143	0.19	BD113	0.65	BF197	0.10	BU208	1.60	T1591	0.19	PCL805	0.75
AD162 €		BC147	0.07	BD115	0.30	BF198	0.11	BY126	0.09	TV106	1.09	PLF200	1.00
AF106	0.42	BC148	0.07	BD116	0.47	BF199	0.14	BY127	0.10			PL36	0.90
AF114	0.23	BC149	0.07	BD124	1.30	BF200	0.28					PLB4	0.74
AF115	0.22	BC153	0.12	BD131	0.32	BF216	0.12	OC22	1.10			PL504	1.10
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AF121	0.33	BC159	0.11	BD136	0.26	BF220	0.12	OC26	1.00	313176	5.00	PY81/800	0.57
AF124	0.33	BC160	0.22	BD137	0.26	BF222	0.12	OC2B	1.00			, 101/000	5.57
AF125	0.29	BC161	0.22	BD138	0.26	BF221	0.21	OC35	1.00		-		
AF126	0.29	BC167	0.09	BD139	0.40	BF224	0.12	OC36	0.90				
AF127	0.29	BC168	0.09	BD140	0.28	BF256	0.37	OC38	0.90			SPECIAL O	FFER
AF139	0.39	BC169C	0.09	BD144	1.39	BF258	0.27	OC42	0.45			Philips PL80	02
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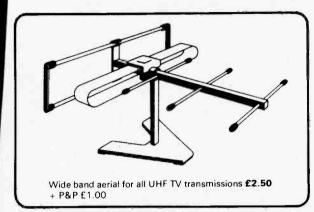
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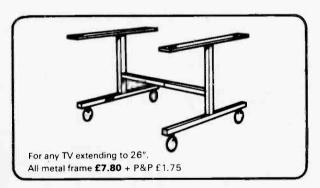
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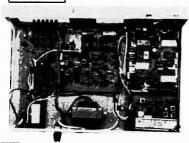
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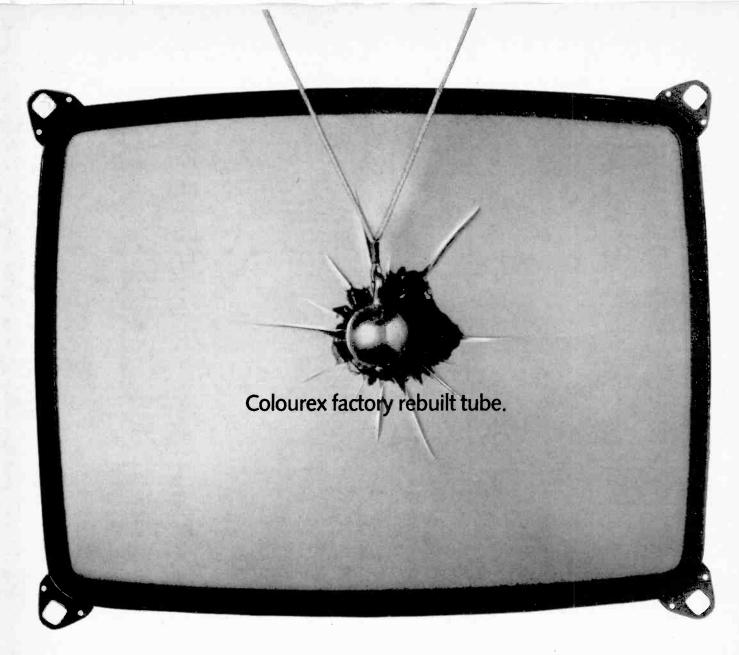
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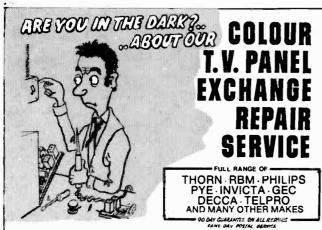
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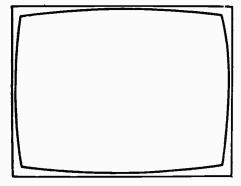
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REBUILT TUBES

In our article on the above subject last month it was stated that anode and grid bombing is not carried out by independent tube rebuilders. We have since learnt that in fact some independents do carry out this procedure. Yates Electronics Ltd. (Units 1-2, Lee Smith Street, Hull, North Humberside) for example employ equipment imported from the USA for the purpose, and carry out bombing as a standard part of their tube rebuilding process. Our apologies for the incorrect impression given.

What's Economic?

To the layman, the economics of having something repaired or serviced must inevitably seem rather odd. And in fact when you come to look a little deeper into this subject, the whole basis of advanced, modern economies begins to look odder and odder.

You buy a nice new set, at a very reasonable price when you consider the technology that's gone into it, and say five years later there's a major failure. Or maybe only a minor one. In either case you could find yourself in for a bill that seems quite disproportionate to the original purchase price. This holds true of course whether it's a TV set, a car, a watch, an item of domestic electrical equipment, a pair of shoes or what have you. Those of us in the know may not be too surprised about this, but even so the underlying situation seems to be not quite what it could perhaps be in the best of all possible worlds.

There are many contributory factors to this state of affairs. To start with of course the economics of carrying out a repair and selling a complete set are much the same. Both take time — the repair often much longer. In both cases premises have to be provided, stocks carried and various overheads paid for.

The situation with TV servicing has been aggravated by the remarkable way in which the price of new sets has risen at a much lower rate than inflation. As a result, the effects of inflation on servicing costs have been much greater than the rise in the price of the new sets one can offer. How you put that across to the unsuspecting public I don't know—though various explanatory leaflets are now available and should help. A reasonable charge for replacing some i.c.s is say £15, and for most LOPTs £25 upwards. That makes them draw in their breath, doesn't it? But there's no way around the predicament, which we feel incidentally is the explanation for the absence of service only shops in the UK. Whereas in the States there has been a tradition of separate servicing and retailing stores, in the UK it would be almost impossible to run a servicing shop without some income from the sale of new equipment—and with negligible profit margins on these items, even this combination hardly adds up to economic sense.

Possibly one answer is that the price of new domestic electronic equipment has been rather too low for rather too long. After all, where else have prices consistently lagged behind the rate of inflation? This may sound like heresy in view of the prevailing belief in free trade. But for one thing trade isn't quite so free in most countries as it is here, and we do tend to flog whatever we can lay our hands upon. The present government doesn't believe in "artificially low" prices, as its energy policies show.

The credit mechanism also works to aggravate the situation. Most of the time the credit merchants fall over themselves to finance the purchase of new equipment, but if you asked them to help out with the cost of say a new tube you'd get a rather dusty answer. And for quite legitimate reasons. The change from purchase tax to VAT was another burden on the servicing industry as a whole. Another factor is the low cost of new equipment due to the rock-bottom prices at which manufacturers are able to buy their components. This latter point could explain some of the difficulties being experienced by component manufacturers — how do you invest in meeting the more stringent specifications demanded by setmakers in the interests of greater reliability when profits are almost non-existent?

One could argue that society has been brainwashed into accepting the throw-away approach to goods. Those of us whose childhood coincided with the war years, when there wasn't anything to throw away and the motto was make do and mend, possibly acquired a degree of immunisation to this attitude. But one really does wonder whether the economy's dependence on a continuous flood of cheap new goods is entirely sound. After all, we've seen market saturation in one field after another. And after the boom, what then? The manufacturer finds himself with a drastically reduced market, and the retailer with hardly any customers. Ah, but then something else always comes along, doesn't it? Like video maybe? Well, one can be less than convinced that it's possible to go on repeating this trick indefinitely.

It's interesting to reflect on the very different situation found in third world economies. They vary enormously of course, so that generalisation must be treated with caution. But in one respect they do seem to be more efficient — in recycling goods and materials. Almost everything in fact, from cardboard, used bottles and old tin cans to jalopys and reconditioned domestic electronics. Now I'm not suggesting that we return to expensive, small-scale manufacture and get busy washing old jam jars and living in large numbers (as happens in some parts of the world) on the municipal refuse heap. But our present situation does seem excessively wasteful from every point of view. Oh yes, and very difficult for those struggling to provide a repair service.

Teletopics

PHILIPS V2020 LAUNCHED

We originally announced the joint Grundig/Philips V2000 VCR system in these columns well over a year ago. Deliveries of Grundig machines (the 2×4) started last March, and it was stated at the summer trade shows that the Philips V2020 was about to appear on the market. Deliveries in quantity of the Philips V2020 to the trade are now understood to have started, the suggested retail price being around £675.

We hope we don't sound sarcastic about the delays. It's perfectly in order to announce forthcoming developments when these will affect distributors' policies and customers' decisions, and a sophisticated item such as this obviously requires a great deal of development work. It's worth remembering that this is the first $\frac{1}{4}$ in. track system (two $\frac{1}{4}$ in. tracks on the $\frac{1}{2}$ in. tape), and that in order to keep the heads aligned with the minute tracks technology (the dynamictrack following system) that's entirely new to domestic equipment is involved.

Visionhire are understood to be taking a substantial proportion of the initial machines. There have also been delays, due to manufacturing difficulties, with the longer playing cassettes. Grundig four and six hour tapes have been available for some time, but the eight hour cassettes are still hard to come by.

CONSUMER ELECTRONICS SHOWS – 81

There are to be two major European consumer electronics shows next year in Germany. The usual "International Radio and TV Exhibition" will be held in West Berlin on September 4-13th. In addition, a new exhibition, organised by the West Midlands firm Industrial and Trade Fairs Ltd., is to be held in Nuremburg on May 10th-13th. It will be interesting to see whether manufacturers take to the idea of annual exhibitions in the spring and autumn.

The "Entertainment '81 – Audio, Video and Television Fair" is to be held on May 10-17th at the National Exhibition Centre, Birmingham. The first three days will be set aside for trade only – assuming that the trade hasn't decamped to Nuremburg at the time, or vice versa.

CASSETTE WARNING

JVC have issued a warning about the increasing number of "pirate" blank VHS cassettes appearing in the UK. They point out that the cassettes, which come from Taiwan, Singapore and Hong Kong, where there are no VHS cassette making licensees, are of inferior quality in addition to being illegal. They don't conform to the standard VHS dimensions, construction, mechanical operation and electrical specifications, all of which can affect the overall performance and operation of VHS machines. JVC intend to take legal proceedings to protect their rights.

We're not surprised to hear of this since a similar situation, with both VHS and Betamax cassettes, has been plaguing the US for some time. It seems that most of the "counterfeit" cassettes there come from Taiwan. The cassettes are apparently loaded with computer tape instead

of tape correctly formulated for VCR use. Thanks to Radio-Electronics for that warning.

ANOTHER IBA ENGINEERING FIRST

Work being carried out by the IBA is showing that the transmission of video signals in digital form could have useful advantages for news gathering and national and international signal distribution via satellites. The latest success reported by the IBA is the transmission for the first time of digital colour television signals via a European space satellite, using compact small-dish aerials at both ends of the link. The test signals were transmitted and received at the IBA's Crawley Court Engineering Centre using a 14GHz 2.5m dish for the up-link (transmitter power about 1.5kW) and a 3m dish receiver terminal. The IBA's experimental 60Mbit/s digital converter was used to encode and decode the signals. The bandwidth of the satellite's transponder is 120MHz.

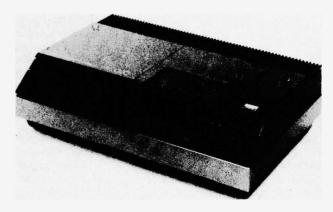
INDUSTRIAL CHANGES

Thorn-EMI have announced a co-operation agreement with Japanese consumer electrical/electronics manufacturer Sharp involving mutual licensing, the exchange of technology and reciprocal trading. EMI's Central Research Laboratories at Hayes and Sharp's Research Centre near Osaka are to co-operate on a "positive programme of joint research and development". Initially, the agreement will affect mainly domestic electrical products, with Thorn-EMI producing Sharp microwave ovens at Spennymore, Co. Durham, and Sharp handling Kenwood Chefs in Japan. Sharp has an annual turnover of around £760 million, of which half is exported, and is a major TV setmaker.

ITT have sold their French TV and consumer appliance businesses to the Swedish domestic electrical appliance manufacturer AB Electrolux. Included in the sale are Oceanic SA, Sonolor SA and Televisso SA.

PRESTEL ADAPTOR

Ayr Viewdata have announced that UK made adaptors to convert ordinary domestic TV sets for use with the PO's Prestel service will be available this autumn. The trade price will be "around £100", and rental could be as little as £1 per week.



The Philips V2020 VCR, which is now becoming available in quantity. The flip-over cassette gives up to eight hours' recording time. There's microcomputer control of the various operations, with touch-sensitive controls, also search tuning and memory programming for up to five separate programmes 16 days in advance.

This is the second such "black box" to be announced — we mentioned the Radofin Electronics adaptor last July. Such adaptors could well provide a stimulus to the Prestel service which, like teletext, doesn't seem to be exactly setting the Thames on fire at present.

UNUSUAL LT CIRCUIT

Last month we mentioned some of the interesting circuitry used in the new Salora G chassis, devoting a separate article to the main power supply/line timebase arrangement. The l.t. supply is also unusual, featuring as it does a circuit that's a cross between a series regulator and a chopper (see Fig. 1).

A 20V supply is obtained from pin 5 of the line output transformer by DB17/CB40. Most of the low-voltage circuitry in the set is powered by a stabilised 12.5V rail which is derived from the 20V line by the circuit just mentioned, using transistors TB17-TB20. TB17 can be considered as a normal series regulator, driven by TB18 and TB19, with the latter sensing variations in the output voltage. TB17 also acts as a chopper however, in conjunction with its inductive reservoir MB3 and the efficiency diode DB26 - a standard series chopper arrangement in fact as used in the Thorn 3000/3500 chassis for example. The chopper switching is controlled by TB20. 180V peak-peak line flyback pulses are integrated by RB80 and CB44 to produce a 1.2V sawtooth waveform which is fed to the base of TB20. When the sawtooth is sufficiently positive, TB20 conducts. The increased current through, and voltage across, RB74 then switch TB18 and TB17 off. Thus TB17 is acting as a chopper to drop the voltage from 20V to 12.5V, and as a series regulator during its on periods. An efficient, power-saving circuit.

The inductive reservoir also enables a -23V supply to be obtained, via a secondary winding and rectifier DB25.

RB75 provides the start-up action.

BATC'S ANNUAL CONVENTION

The British Amateur Television Club's annual convention is being held this year at the Post House Hotel, Braunston Way, Leicester on October 5th. The hotel is located just off the A46, about a mile into Leicester from the M1. Attractions will include a "video tape" show, an OB van belonging to G8GQS, etc.

TI AWARDED SPEECH SYNTHESIS PATENTS

Three US patents covering solid-state speech synthesis have been awarded to Texas Instruments. They are for an i.c. that digitally synthesizes human speech using linear predictive coding (LPC), a single-stage speech synthesis filter and a digital-to-analogue converter capable of driving a speaker directly from a speech chip. All these operations are carried out in a single i.c., which produces synthetic speech from digital filter coefficients and excitation control values stores in an external memory device. Talking TVs have already been announced by two Japanese setmakers, and an article on the subject will be appearing in *Television* during the next couple of months.

US TV INDUSTRY WORRIED

Whilst controls on imports of colour sets from Korea and Taiwan to the USA have been extended for a further two years, restrictions on imports from Japan have been lifted. This has produced a strong reaction from Compact (the

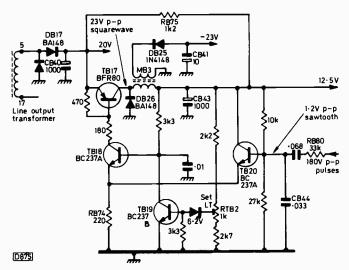


Fig. 1: L.T. supply circuit used in the Salora G chassis.

Committee to Preserve American Colour Television), a joint union-manufacturers organisation. The restrictions were apparently lifted because imports from Japan had fallen from 1.75 million in 1978 to 500,000 in 1979. This could simply be explained by exchange rate alterations and the fact that most major Japanese setmakers now have plants in the USA. Compact is not impressed however, and points out that the industry has already lost some 60,000 jobs and sees the remaining 65,000 in jeopardy. In the midsixties there were 25 US owned setmakers: only six now remain. Profitability has fallen from 9.6% in 1972 to just 1.2% last year. TV imports to Taiwan face a 35% duty, while imports to Korea face a 50% duty. Trade with the far east rather often seems to be a one way affair.

HIGH-SPEED VIDEOTAPE COPIER

One of the advantages of videodiscs compared to prerecorded videocassettes is the low cost of disc production. The duplication of videocassettes has at present to be done in real time, i.e. a three hour tape takes three hours to duplicate. The helical-scan format precludes the use of the conventional high-speed copiers used in the audio cassette field. At this year's NAB (National Association of Broadcasters) Exhibition in the USA however Matsushita demonstrated a prototype high-speed VHS copier that can duplicate a three hour tape in three minutes.

The machine is intended for automatic operation and incorporates a number of interesting features (see Fig. 2). The method of duplication used is based on the bifilar printing system, in which a high-coercivity master tape is wound in close contact with a blank tape, both being exposed to a magnetic field. As a result, the master tape's image is copied on to the blank tape. Matsushita say that

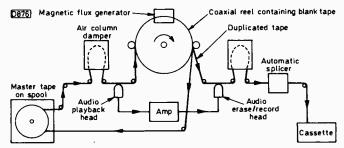


Fig. 2: Basic operation of Matsushita's prototype bifilar highspeed tape duplicator. The audio signal is transferred separately to achieve optimum quality.

the machine can handle PAL, NTSC and SECAM signals, and reckon that a master tape should be able to give up to 1,000 copies without noticeable degradation. The machine can be linked to an automatic cassette changer which stores twelve cassettes.

Otford (Kent) TV4 ch. 53, BBC-1 ch. 57, Thames/London Weekend Television ch. 60, BBC-2 ch. 63.

Apart from Headingley and Millport, the above transmissions are vertically polarised.

STATION OPENINGS

The following relay stations are now in operation:

Grassington (N. Yorkshire) Yorkshire Television ch. 23, BBC-2 ch. 26, TV4 ch. 29, BBC-1 ch. 33.

Headingley (Leeds) TV4 ch. 54, BBC-1 ch. 58, Yorkshire Television ch. 61, BBC-2 ch. 64. Note: Horizontal polarisation.

Macclesfield (Cheshire) BBC-1 ch. 22, Granada Television ch. 25, BBC-2 ch. 28, TV4 ch. 32.

Millport (Firth of Clyde) TV4 ch. 54, BBC-1 ch. 58, Scottish Television ch. 61, BBC-2 ch. 64. Note: horizontal polarisation.

Netherton Braes (Glasgow) BBC-1 ch. 22, Scottish Television ch. 25, BBC-2 ch. 28, TV4 ch. 32.

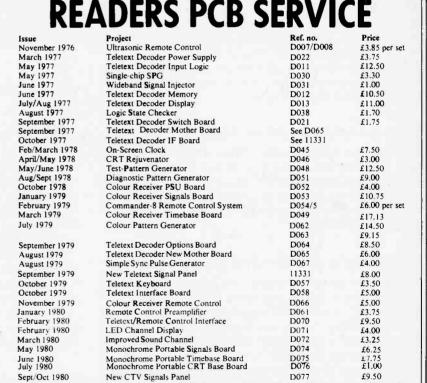
NEW SHADOWMASK STEEL

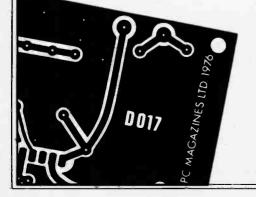
NKK (Nippon Kokan) and Nippon Mining Co. Ltd. have jointly developed a new type of sheet steel for making shadowmasks for colour c.r.t.s. The new material is aluminium-killed steel, which is being produced through specially controlled cor.tinuous casting — rimmed steel is usually used for shadowmasks. The new sheet is being marketed in Japan and abroad. The advantage of the new sheet steel is a much higher yield ratio. Cold-rolled sheets for shadowmasks call for ultra-stringent quality, much higher than for conventional cold-rolled sheet, and for this reason the yield ratio of cold-rolled rimmed steel up to the finished stage of shadowmask production is less than 50%. With aluminium-killed steel the yield ratio is improved to almost 100%.



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CA270BE CA506 CA75BE CA920AE CA2121 CA3089E CA3080Q ETT6016 ETTR6016 LM1351 LM1370	3.70 3.86 1.72 4.50 2.68 2.38 4.56 1.96 2.90	SN76013N SN76023N SN76023N SN76033N SN76110N SN76226D SN78227N SN76226N SN76630P SN76632N	D 1.97 1.61 D 1.98 1.94 2.11 N 2.58 2.21 2.43 1.94 2.33 2.54 1.85 3.81	TBA720A TBA750 TBA800 TBA810AS TBA810AS TBA820 TBA820 TBA920 TBA920 TBA940 TBA9602A TBA9602A TBA990	3.48 2.01 2.30 2.93 2.93 1.96 5.20 3.01 4.06 2.61 5.40 3.33 4.39	CTV's alw prices. An Telephon prices. Personal of	yays availa y quantity e now Te callers we shouse of o, where the	able and conside elford ((lcome 9 n Hales nese sets	at very cored for de 0952) 58 am-5pm sfield 23	top qualit ompetitivelivery. 35799 fo Mon-Fri all, Telford	Delay lin Luminan Transduc Linearity Colour	e DL60 ce Detay Line For tor AT4041/37 Coil AT4042/02 Coil AT4042/04 rystal 4.433619 M I RVICE AIDS	Hz 37 94 SQI 95 60/40	2.87 3.04 2.41 1.43 1.43 1.69	PHILIPS GB PHILIPS GB PHILIPS GB PHILIPS 210 TCE 1500 GEC 201B RR1 640 TCE 8000A DECCA 20 PYE 731 TCE 1400 RR1 A823 GEC 2110(1):	OPPERS	.84 .49 .77 1.11 .82 .72 .85 1.47 .94 1.16 1.00
CA2708E CA506 CA758E CA920AE CA2121 CA3089C CA30800 ETT8016 ETTR6016 LM1351 LM1370 MC1310P MC1310P	3.70 3.86 1.72 4.50 2.58 2.38 4.56 1.96 2.90 2.00 2.08 2.34 2.62 2.20	SN76013N SN76023N SN76023N SN76023N SN76110N SN76227N SN76227N SN76529N SN76533N SN76533N SN76544N SN76544N SN76566N SN76566N	D 1.97 1.61 D 1.98 1.94 2.11 N 2.58 2.21 2.43 1.94 2.33 2.54 1.85 3.81 1.67	TBA720A TBA750 TBA800 TBA810A TBA8106 TBA8106 TBA820 TBA820 TBA960 TBA9602A TBA9602A TBA970 TBA940 TBA970 TBA970 TBA970	3.48 2.01 2.30 2.93 1.96 5.20 3.01 4.06 2.61 5.40 3.33 4.39 4.39 2.32	CTV's alw prices. An Telephon prices. Personal c our ware Shropshire	y quantity e now To callers we ohouse on the callers we on the callers we on the callers we display are	able and conside elford (de lcome 9 n Hales nese sets	at very cored for de 0952) 58 sam-5pm sfield 23 s can be s	top qualit ompetitiv livery. 35799 fo Mon-Fri a l, Telford seen work	Delay lin Luminan Transduc Linearity Linearity Colour Colo	e DL80 ce Delay Line For tor AT4041/37 Coil AT4042/02 Coil AT4042/04 rystel 4.433619 M I RVICE ALDS	87 84 SQI 85 50,40 91 24,64	2.87 3.04 2.41 1.43 1.43 1.69	PHILIPS GB PHILIPS GB PHILIPS GB PHILIPS 210 TCE 1500 GEC 201B RR1 840 TCE 8000A DECCA 20 PYE 731 TCE 1400 RR1 A223	OPPERS	.84 .49 .77 1.11 .82 .72 .85 1.47 .94 1.16 1.00
CA2708E CA506 CA758E CA920AE CA2121 CA3089E CA3080C ETT8018 ETT8018 LM1351 LM1370 MC1307P MC1310P MC1327AF MC1327AF	3.70 3.86 1.72 4.50 2.58 2.38 4.56 1.96 2.90 2.00 2.08 2.34 2.62 2.20	SN76013N SN76023N SN76023N SN76013N SN76110N SN76226D SN76228N SN76522N SN76532N SN76544N SN76544N SN76666	D 1.97 1.61 D 1.98 1.94 2.11 N 2.58 2.21 2.43 1.94 2.33 2.54 1.85 3.81 1.67 1.72	TBA720A TBA750 TBA800 TBA810A TBA8106 TBA820 TBA820 TBA920 TBA990 TBA9602A TBA9602A TBA1440G TBA1440G TBA1440G TBA1440G TBA1440G TBA1440G	3.48 2.01 2.30 2.93 1.96 5.20 3.01 4.08 2.61 5.40 3.33 4.39 4.39 4.39 2.32 5.40 2.61	CTV's alw prices. An Telephon prices. Personal cour ware Shropshire ing in our callso availa	rays availa y quantity e now Te callers we shouse o b, where the display are able troller	able and conside elford ((lcome 9 n Hales nese sets ea. y stands	at very cored for de 0952) 58 sam-5pm sfield 23 s can be s	top qualit ompetitiv livery. 35799 fo Mon-Fri a l, Telford seen work	Oetay tin Luminam Y Transduc Linearity Colour C IT SEE I, SERVISOI FREEZER AIR SPRA FDAM CLI	e DL80 ce Delay Line For tor AT4041/37 Coil AT4042/02 Coil AT4042/04 rystel 4.433619 M I RVICE ALDS	Hz 37 SQ4 92 50/40 ½ Kilo 2½ Kil	2.87 3.04 2.41 1.43 1.43 1.69 LDER 185WG 7.90 o 38.08	PHILIPS GB: PHILIP	OPPERS	.84 .49 .77 1.11 .82 .72 .85 1.47 .94 1.16 1.00
CA2708E CA506 CA758E CA920AE CA2121 CA3080E CA3080E CTT8016 ETTR6016 LM1351 LM1370 MC1307P MC1310P MC1327AF MC1327P MC13327P MC13349P	3.70 3.86 1.72 4.50 2.58 2.38 4.56 1.96 2.90 2.00 2.00 2.34 2.62 2.20 3.53	SN78013N SN78023N SN78023N SN78023N SN78110N SN78228D SN78227N SN78228D SN78530P SN78534N SN78534N SN78544N SN78546N SN78660 TAAS50A	D 1.97 1.61 D 1.98 1.94 2.11 N 2.58 2.21 2.43 1.94 2.33 1.94 2.33 1.85 3.81 1.85 3.81 1.72 31 31	TBA720A TBA750 TBA800 TBA810A TBA8106 TBA820 TBA820 TBA920 TBA940 TBA9602A TBA9602A TBA1440G TBA1440G TBA1441 TCA270 TCA270S TCA270S	3.48 2.01 2.30 2.93 2.93 1.96 5.20 3.01 4.08 2.61 5.40 3.33 4.39 4.39 2.32 5.40 2.61 3.92 4.51	CTV's alw prices. An Telephon prices. Personal c our ware Shropshire ing in our c Also availa	y ays availary quantity enow Tecallers we shouse on one of the control of the con	able and conside elford ((lcome 9 n Hales nese sets ea. y stands	at very cored for de 0952) 58 sam-5pm sfield 23 s can be s	top qualit ompetitiv livery. 35799 fo Mon-Fri a l, Telford seen work	Delay lin Luminan Transduc Linearity Linearity Colour Colo	e DL80 ce Delay Line For tor AT4041/37 Coil AT4042/02 Coil AT4042/04 rystel 4.433619 M I RVICE ALDS	Hz 37 SQ4 92 50/40 ½ Kilo 2½ Kil	2.87 3.04 2.41 1.43 1.43 1.69 LDER 185WG 7.90 o 38.08	PHILIPS GB PHILIPS GB PHILIPS GB PHILIPS 210 TCE 1500 GEC 201B RR1 640 TCE 8000A DECCA 20 PYE 731 TCE 1400 RR1 A823 GEC 2110(1):	OPPERS	.84 .49 .77 1.11 .82 .72 .85 1.47 .94 1.16 1.00
CA2708E CA506 CA758E CA920AE CA2121 CA3089E CA3080Q ETTR6018 LM1371 LM1370 MC1307P MC1310P MC1327AF MC1327P MC1330P	3.70 3.86 1.72 4.50 2.68 2.38 4.56 2.90 2.90 2.08 2.34 2.62 2.20 3.53 1.56 .85	SN76013N SN76023N SN76023N SN76023N SN76110N SN76226D SN76227N SN76530P SN76530P SN7654N SN76544N SN76546N SN76546N SN7654AN SN76550A TAAS50A	D 1.97 1.61 1.98 1.94 2.11 N 2.58 2.21 2.43 2.53 2.54 2.33 2.54 1.85 3.81 1.67 1.72 31 31 31 2.16 3.65 5.16	TBA720A TBA750 TBA800 TBA800 TBA8106 TBA820 TBA820 TBA920 TBA9602A TBA9602A TBA9602A TBA9602A TBA9602A TBA9602A TBA9602A TBA9602A TBA9602A TBA9602A TBA9602A TBA9602A TBA9602A TBA9602A TBA9602A TBA9602A	3.48 2.01 2.30 2.93 1.96 5.20 3.01 4.08 2.61 5.40 3.33 4.39 4.39 2.32 5.40 2.61 3.92	CTV's alw prices. An Telephon prices. Personal c our ware Shropshire ing in our c Also availa	y ays availary quantity enow Tecallers we shouse oo, where the display are able trollers.	able and conside elford ((lcome 9 n Hale: nese sets ea. y stands	at very cored for de 0952) 58 sam-5pm sfield 23 s can be s	top qualit ompetitiv livery. 35799 fo Mon-Fri a i, Telford seen work est makes.	Delay lin Luminan Transduc Linearity Linearity Colour Colo	e DL69 co Delay Line For tor AT4041/37 Coil AT4041/37 Coil AT4042/02 Coil AT4042/04 Coil AT4042/	97 94 SCH 92 50/40 95 11 2½ Kilo 12½ Kilo 12½ Kilo 12½ Kilo 12½ Kilo 155 2½ Kilo	2.87 3.04 2.41 1.43 1.43 1.69 LDER 18SWG 7.90 0 38.08	PHILIPS GB PHILIPS GB PHILIPS GB PHILIPS GB PHILIPS GB PHILIPS GB PHILIPS 210 TC 1600 GEC 2018 RR1 640 TC 8000A TC 1400 RR1 A823 GEC 2110/11 TCE 3500	(47R) (2R5 + 12R5)	.84 .49 .77 1.11 .82 .72 .85 1.47 .94 1.16 1.00 .66 .93
CA2708E CA506 CA758E CA920AE CA2121 CA3089E CA3080Q ETTR018 ETTR6018 EM1351 LM1370 MC1307P MC1310P MC1327A MC1329P MC1349P MC1349P MC1349P MC1349P MC1349P	3.70 3.86 1.72 4.50 2.68 2.38 4.56 1.96 2.90 2.08 2.34 2.62 2.20 3.83 1.56 85 2.28 2.08 1.85	SN76013M SN76023N SN78023N SN78023N SN76110M SN76222N SN76222N SN76532N SN76534N SN76534N SN76548N SN76548N SN76548N SN76548N SN76548N SN76548N SN76548N SN76548N SN76564N SN76564N SN76564N SN76564N SN76564N SN76564N SN76564N SN76564N SN76564N SN76564N SN76564N SN76564N SN76564N SN76564N SN76564N SN76564N SN76564N SN76564N SN7656N SN76564N SN7656N SN76564N SN7656N	D 1.97 1.61 1.98 1.94 2.11 8N 2.21 2.43 2.54 1.85 3.81 1.67 1.72 31 31 2.16 3.16 3.16 3.16 5.16 5.16	TBA720A TBA750 TBA810A TBA810A TBA810A TBA810A TBA820 TBA820 TBA920 TBA940 TBA940 TBA990 TBA940 TBA970 TBA970 TCA440 TCA440 TCA440 TCA450 TCA450 TCA450	3.48 2.01 2.30 2.93 1.96 5.20 3.01 4.06 2.61 5.40 3.33 4.39 2.32 5.40 2.61 3.92 4.51 4.25	CTV's alw prices. An Telephon prices. Personal c our ware Shropshire ing in our c Also availa	y ays availary quantity e now Tecallers we shouse oo, where the display are able troller ROLYTIC	able and conside elford (forme 9 n Hales sets ea. y stands	at very cored for de (0952) 56 sam-5pm sfield 23 s can be sto suit mo	top qualit ompetitiv livery. 35799 fo Mon-Fri a i, Telford seen work est makes.	Delay lin Luminan Y O I I SEI I SERVISO F F AIR SPRA F D AM F COLOR I SULICONE SOLDER I 2.87	o DL60 co Delay Line For tor AT4041/37 coil AT4041/37 coil AT4042/02 coil AT4042/04 coil AT4042/04 d.433619 M IPVICE ALDS COIL AT4041/04 d.433619 M IPVICE AT4041/04 d.433619 M IPVICE ALDS COIL AT4041/04 d.433619 M IPVICE ALDS COIL AT4041/04 d.433619 M IPVICE A	## SO	2.87 3.04 2.41 1.43 1.43 1.69 2.69 2.790 3.808 2.790 3.808 2.46 3.76 4.46	PHILIPS GB GEC 2018 RR1 640 RR1 A823 GEC 22110/11 TCE 3500 TCE 3500 TCE 4000 TCE 4000 TCE 4000 TCE 4000 TCE 4000	(47R) (275 + 12R5) 6.6 6.5	.84 .49 .77 1.11 .82 .72 .85 1.47 .94 1.16 1.00 .88 .93
CA2708E CA506 CA758E CA220AE CA2121 CA3089E CA3089C ETT8018 ETTR6018 EM1351 LM1351 LM1351 MC1307P MC1310P MC1310P MC1327AF MC1327P MC1358P MC1358P MC1358P MC1358P	3.70 3.56 1.72 4.50 2.58 2.38 4.56 2.90 2.90 2.08 2.34 2.62 2.20 3.53 1.56 85 2.28 1.84 1.87 1.79	SH78013N SH78023N SH78023N SH78033N SH78110N SH78228N SH7822N SH78228N SH78532N SH78533N SH78544N SH78544N SH78546N TAA550A TAA550A TAA550A TAA550C TAA561 TAA6618	D 1.97 1.61 1.98 1.98 1.94 2.11 N 2.58 2.21 2.43 1.94 2.33 1.84 2.33 1.67 1.67 1.72 31 31 31 2.16 3.61 5.61 5.61 5.61 5.61 5.61 5.61 5.61 5	TBA720A TBA750 TBA850 TBA810AS TBA810AS TBA810AS TBA8106 TBA820 TBA820 TBA920 TCA270 TCA270S TCA440 TCA270 TCA250 TCA450 TCA550 TCA450 TCA550	3.48 2.01 2.93 2.93 1.96 5.20 3.01 4.08 2.61 5.40 3.439 4.39 2.32 5.40 2.61 3.92 4.51 4.25 3.20 3.58	CTV's alw prices. And Telephon prices. Personal cour ware Shropshire ing in our calso available. TCE 1400 150+100+100 TCE 1500 150+100+150	y ays availary quantity e now Tecallers we shouse oo, where the display are able trollers.	able and conside elford (forme 9 n Hales sets ea. y stands	at very cored for de (0952) 58 (am-5pm sfield 23 s can be sto suit mo	top qualit ompetitiv livery. 35799 fo Mon-Fri a i, Telford seen work est makes.	Delay Iiin Luminan Transduc Linearity Linearity Colour C II SET II SERVISO FREEZER AIR SPRA FDAM CLI SILICONE SOLDER II	o DL69 co Delay Line For tor AT4041/37 coil AT4041/37 coil AT4042/02 coil AT4042/04 coil AT4042/04 d. 4.33619 M l RVICE AIDS grant d. 4.33619 M l RVICE AIDS g	Hz SO(40 15	2.87 3.04 2.41 1.43 1.69 1.69 1.69 2.7.90 3.8.06 1.46 3.76 4.46 4.46 4.46 6.44 7.13	PHILIPS GB TCE 1600 GEC 2018 TCE 1400 RR1 A823 GEC 22110/12 TCE 3500 TCE 4000	6. 6. 5. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7.	.84 .49 .77 1.11 .82 .72 .85 1.47 .94 1.16 1.06 .86 .93
CA2708E CA506 CA758E CA320AE CA320AE CA3000Q ETT8018 ETTR8018 ETTR8018 LM1351 LM1367 MC1307P MC1307P MC1337P MC1337P MC135P MC13	3.70 3.56 1.72 4.50 2.58 2.38 4.56 2.90 2.90 2.90 2.34 2.62 2.20 3.53 1.56 8.5 2.28 2.20 1.84 1.79 2.59 1.79 2.59 1.79 2.59 1.79 2.59 1.79 2.59 1.79 2.59	SA76013N SA76023N SA76023N SA76023N SA76023N SA76110N SA7622N SA7622N SA7622N SA76522N SA76532N SA76544N SA76564 SA7656	D 1.97 1.61 1.98 1.94 2.11 N 2.58 2.21 2.43 1.94 2.33 1.94 2.33 1.94 2.33 1.85 1.87 1.72 31 31 31 31 3.16 3.16 3.47 6.17 4.41	TBA720A TBA750 TBA800 TBA810A TBA810A TBA810A TBA810A TBA820 TBA820 TBA820 TBA820 TBA820 TBA960 TBA960 TBA960 TBA960 TBA960 TBA960 TBA960 TCA70A TCA440 TCA440 TCA470 TCA470 TCA470 TCA470 TCA550 TCA440 TCA560 TCA750 TCA600 TCA900 TCA900 TCA900 TCA900	3.48 2.01 2.30 2.93 2.93 1.98 5.01 4.08 2.61 3.01 4.39 4.39 4.39 4.39 4.39 4.31 4.32 5.40 2.61 3.92 3.93 4.95 3.95 3.95 3.95 3.95 3.95 3.95 3.95 3	CTV's alw prices. And Telephon prices. Personal cour ware Shropshire ing in our calso available. Tcc 1400 150+100+100 Tcc 1500 150+100+150 Tcc 1500 100+300+100	y quantity e now To dellers we shouse oo oo, where the display are able troller POLYTIC 1-100-150-3	able and conside elford (forme 9 n Hales sets ea. y stands	at very c red for de 0952) 58 am-5pm sfield 23 scan be to suit mo	top qualit ompetitiv livery. 35799 fo Mon-Fri a i, Telford seen work est makes.	Delay lin Luminary Y Transduc Linearity Colour C IT SE3 I, SERVISO F PREZER AIR SPRA FDAM CLI SILICOME SOLDER II 2.87 1.43 2.18	o DL69 co Delay Line For tor AT4041/37 coil AT4041/37 coil AT4042/02 coil AT4042/04 coil AT4042/	Hz SCI SCI SO/40 SCI SO/40 SCI SO/40 SCI	2.87 3.04 2.41 1.43 1.69 185WG 5 7.90 6 38.06 ULT TIPL 4.46 3.76 4.46 6.44 6.44	PHILIPS GB RATI 640 RATI	(47R) 2R5 + 12R5) 6.6 6.7 7 rd CTV 8.8	.84 .49 .77 1.11 .82 .72 .85 1.47 .94 1.10 .65 .93
CA2708E CA506 CA758E CA320AE CA320AE CA3000Q ETT8018 ETTR8018 ETTR8018 LM1351 LM1370 MC1307P MC1307P MC1337P MC1337P MC1351P MC1354P MC1354P MC1354P MC1358P M	3.70 3.56 1.72 4.50 2.58 2.38 4.56 2.90 2.00 2.04 2.34 2.62 2.20 3.53 1.56 85 2.28 2.08 1.84 1.67 1.79 2.59 2.59	SA76013N SA76023N SA76023N SA76023N SA76023N SA76110N SA76227N SA76227N SA76227N SA76522N SA76544N SA765644N SA76566 TAA350A TAA350A TAA550A TAA550A TAA560 TAA691	D 1.97 1.61 1.98 1.94 2.11 N 2.58 2.21 2.43 1.94 2.33 2.54 1.87 1.67 1.72 31 31 3.81 3.81 3.81 3.81 3.81 3.81 3.8	TBA720A TBA800 TBA800 TBA800 TBA810AS TBA810AS TBA8120 TBA820 TBA820 TBA820 TBA820 TBA920 TBA920 TBA920 TBA920 TBA920 TBA920 TBA940 TCA720 TCA720 TCA720 TCA730 TCA	3.48 2.01 2.93 2.93 2.93 3.01 4.08 5.20 3.01 4.08 3.33 4.39 4.39 4.39 4.39 4.39 4.39 4.39	CTV's alw prices. And Telephon prices. Personal cour ware Shropshire ing in our calso available. Tcc 1400 150+100+100 Tcc 1500 150+100+100 Tcc 1500 100+300+100 Tcc 3000/3500 175-100+100+100+100+100+100+100+100+100+100	y quantity e now To dellers we shouse oo oo, where the display are able troller POLYTIC 1-100-150 = 3 1-300v 1-18-300v 1-18-300v 1-350v	able and conside alford (Come 9 n Halenese sets a. y stands	at very c red for de 0952) 58 am-5pm sfield 23 s can be s to suit mo	top qualition ompetitive inverse state of the seen work ast makes.	Delay lin Luminary Y Transduc Linearity Colour C IT SE3 I, SERVISO F PREZER AIR SPRA FDAM CLI SILICOME SOLDER II 2.87 1.43 2.18	o DL69 co Delay Line For tor AT4041/37 coil AT4041/37 coil AT4042/02 coil AT4042/04 coil AT4042/	Hz SCR 22 60/40 22 60/40 25 60	2.87 3.04 2.41 1.43 1.43 1.69 185WG 7.90 3.8.06 3.70 4.46 4.46 4.45 6.44 7.13 8.44 7.13 8.44 7.74	PHILIPS GB RATI 640 TCE 8000 TCE 400 RATI AB23 RATI AB23B RATI AB23B RATI AB23B RATI AB23B RATI AB23B RATI ZATIB	(47R) 2R5 + 12R5) 6 6 6 7 7 rd CTV 8 8 7 7 8 7 7 8 7 7 8 7 7 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 7 7 8 8 8 7 7 8 8 8 7 7 8 8 8 7 7 8 8 8 7 7 8 8 8 8 7 7 8	.84 .49 .77 1.11 .82 .85 1.47 1.100 .86 .93 .90 .90 .90 .90 .90 .90 .90 .90 .90 .90
CA2708E CA506 CA758E CA220AE CA2121 CA3080Q ETT8018 ETTR8018 ETTR8018 LM1351 LM1350 MC1307P MC1307P MC1307P MC1319P MC1327AF MC1327AF MC1327AF MC1327AF MC1327AF MC1358P MC1358P MC1358P MC7324C ML237AF MC3588OS SA4570 SA5580 SA5580 SA5580 SA5580	3.70 3.86 4.50 2.68 2.58 4.56 1.96 2.90 2.90 2.90 2.06 2.20 2.20 3.83 1.56 8.228 2.06 1.67 1.79 2.61 1.67 1.79 2.61 8.33 8.33 8.33 8.33 8.33 8.33 8.33 8.3	SA76013N SA76023N SA76023N SA76023N SA76023N SA76110N SA7622PN SA7622PN SA7652PN SA7653PN SA7654AN SA7	D 1.97 1.61 1.91 1.98 1.98 1.98 1.98 1.98 1.91 1.94 2.33 2.54 1.85 3.81 2.16 3.16 3.16 3.16 3.16 3.16 3.16 3.16 3	TBA720A TBA800 TBA800 TBA800 TBA810S TBA810S TBA820 TBA820 TBA820 TBA820 TBA920 TBA920 TBA920 TBA920 TBA920 TBA920 TBA920 TBA920 TBA9602A TBA9602A TBA9602A TBA9602A TBA9602A TBA9602A TCA920 TCA940 TCA9400 TDA4400 TDA4400 TDA4400 TDA4400 TDA4400	3.49 2.01 2.93 2.93 2.93 3.01 5.20 3.01 5.40 2.61 5.40 2.61 4.39 2.32 5.40 2.61 4.39 4.39 2.32 5.40 3.58 3.00 4.39 4.39 4.39 4.35 4.35 4.36 4.36 4.36 4.36 4.36 4.36 4.36 4.36	CTV's alw prices. An Telephon prices. Personal cour ware Shropshire ing in our calso available. Tct 1400 150+100+100 Tct 1500+100+100+100+100+100+100+100+100+100	y quantity e now To dellers we shouse oo oo, where the display are able troller POLYTIC 1-100-150 = 3 1-300v 1-18-300v 1-18-300v 1-350v	able and conside elford (Come 9 nn Haler ness sets as. y stands	at very c red for de 0952) 58 28m-5pm sfield 23 s can be s to suit mo	top qualition ompetitive inverse state of the seen work ast makes.	Delay lin Luminary Y Transduc Linearity Colour C IT SEE I, SERVISO F REEZER AIR SPRA FDAM CL SILICOME SOLDER 2.87 1.43 2.18 3.97 2.78	o DL69 co Delay Line For tor AT4041/37 coin AT4041/37 coin AT4042/02 coin AT4042/04 coin AT4042/	Hz SCH 22 60/40 11 5 5 5 1 5 5 1 5 5 1 5 5 1 5 5 1 5 5 1 5 5 1 5 5 5 1 5 5 5 1 5 5 5 1 5 5 5 1 5 5 5 1 5 5 5 1 5 5 5 1 5 5 5 5 1 5 5 5 1 5	2.87 3.04 2.41 1.43 1.43 1.69 185WG 7.90 0 38.00 4.46 4.46 4.46 4.47 7.13 8.44 7.13 8.44 7.14 8.44 6.44 6.44 6.44 6.45	PHILIPS GB. RR1 640 TCE 8000 RR1 A823 GEC 2110112 TCE 3500 TCE 9000 T	(47R) 2R5 + 12R5) 8.6 6.7 7.7 8.8 8010,880 5.5	.84 .49 .77 1.11 .82 .72 .85 1.46 1.100 .86 1.00 .85 .93
CA2708E CA506 CA758E CA220AE CA2121 CA3080Q ETT8018 ETTR8018 ETTR8018 ETTR8018 MC1307P MC1307P MC1307P MC1327AF MC1330P MC1327AF MC1327AF MC135P MC13	3.70 3.56 4.50 2.38 4.56 2.90 2.90 2.34 2.20 3.53 8.5 2.20 3.53 8.5 2.66 1.84 1.79 2.61 1.79 2.61 1.79 2.61 4.56 3.88 3.88 4.56 4.56 4.56 4.56 4.56 4.56 4.56 4.56	SA76013N SA76023N SA76023N SA76023N SA76023N SA76110N SA76229N SA76522PN SA76522PN SA76532N SA76544N SA76544N SA76540 TAA350A TAA350A TAA350A TAA550A TAA550A TAA550A TAA550 TAA591 TAA501	D 1.87 1.61 1.61 1.98 1.98 1.98 1.98 1.98 1.91 2.11 N 2.58 1.87 1.85 3.81 3.81 3.16 3.65 1.67 1.70 3.16 3.16 3.16 3.16 3.16 3.16 3.16 3.16	TBA720A TBA800 TBA800 TBA800 TBA810S TBA810S TBA8120 TBA820 TBA820 TBA820 TBA820 TBA820 TBA920 TBA920 TBA920 TBA920 TBA920 TBA990 TBA990 TBA990 TBA990 TBA990 TCA270 TCA270 TCA270 TCA240 TCA550 TCA550 TCA560 TCA56	3.49 2.01 1.96 5.20 3.03 4.06 2.61 5.40 3.03 4.39 4.39 4.39 4.31 3.92 4.51 4.51 4.51 4.52 4.51 4.52 5.03 1.95 6.03 1.95 1.95 1.95 1.95 1.95 1.95 1.95 1.95	CTV's alw prices. An' Telephon prices. Personal cour ware Shropshire ing in our calso available. Telephon 150-100-100-100-100-100-100-100-100-100-	y quantity e now To dellers we shouse oo oo, where the display are able troller POLYTIC 1-100-150 = 3 1-300v 1-18-300v 1-18-300v 1-350v	able and conside elford (Come 9 nn Haler nese sets la. y stands	at very c red for de 0952) 58 28m-5pm sfield 23 s can be s to suit mo	top qualition ompetitivelivery. 35799 for Mon-Fri at the first transfer of the first tr	Delay lin Luminary Y Transduc Linearity Colour C IT SEE I, SERVISO F REEZER AIR SPRA FDAM CL SILICOME SOLDER 2.87 1.43 2.18 3.97 2.78	o DL69 Con Delay Line For tor AT4041/37 Coil AT4042/02 Coil AT4042/04 Coil AT4042	Hz SCH 22 60/40 11 5 60/40 11 5 5 5 1 5 5 1 5 5 1 5 5 1 5 5 1 5 5 5 1 5 5 5 1 5 5 5 1 5 5 1 5 5 1 5 5 1 5 5 1 5 1 5 5 1 5 1 5 5 1	2.87 3.04 2.41 1.43 1.69 1.89WG 7.90 0 38.08 1ULTIPL 4.45 3.76 4.46 6.44 7.78 6.44 7.78 6.44 7.78 6.44 7.78 6.44 7.78	PHILIPS G8 PHILIPS GE 2019 RR 1842 GEC 211011 TCE 3500 TCE 3500 TCE 4000	(47R) 2R5 + 12R5) 8.6 8.7 7 7 7 8010,880 5.6 6.7 6.151/2	.84 .49 .77 1.11 .82 .72 .85 1.45 1.10 .86 1.00 .86 .93 .93 .90 .72 .62 .93 .90 .72 .63 .64 .93 .93 .93 .93 .93 .94 .94 .93 .94 .94 .95 .95 .95 .95 .95 .95 .95 .95 .95 .95
CA2708E CA506 CA758E CA220AE CA2121 CA3080Q ETT808 ETTR8018 LM1330 MC1307P MC1310P MC1330P MC1330P MC1327AF MC1332P MC1327AF MC13	3.70 3.56 4.50 2.38 4.50 2.90 2.90 2.90 2.90 2.34 2.90 2.90 2.34 2.90 2.90 2.34 2.90 2.90 2.34 2.90 2.90 2.34 2.90 2.90 2.34 2.90 2.90 2.90 2.34 2.90 2.90 2.90 2.90 2.90 2.90 2.90 2.90	SA76013N SA76023N SA76023N SA76023N SA76023N SA76110N SA76226N SA76226N SA76532N SA76532N SA76532N SA76544N SA76644N SA76646N SA76646N SA76646N SA76646N SA76646N SA76640N SA76640N SA76640N SA76640N SA76640N SA76640N SA76640N SA76640N SA76640N SA76640N SA76640N SA76640N TAA550A TAA550A TAA550A TAA550A TAA561 TAA561 TAA561 TAA561 TAA561 TAA561 TAA560 TBA460 TBA560 TBA660 TBA560 TBA660 TBA560 T	D 1.87 1.61 1.61 1.98 1.94 2.11 N 2.58 2.21 2.34 1.87 2.34 1.87 3.81 3.81 3.81 3.81 3.81 3.81 3.81 3.81	TBA720A TBA800 TBA800 TBA800 TBA8106 TBA820 TBA820 TBA820 TBA820 TBA820 TBA820 TBA820 TBA920 TBA920 TBA920 TBA920 TBA920 TBA920 TBA990 TBA990 TBA990 TBA990 TCA750 TCA750 TCA750 TCA440 TCA650 TCA750 TCA940	3.48 2.01 2.93 2.93 1.96 5.20 4.08 5.20 4.09 2.51 4.39 4.39 4.39 4.39 4.39 4.35 4.26 1.95 4.26 4.35 4.39 4.39 4.39 4.35 4.35 4.35 4.35 4.35 4.35 4.35 4.35	CTV's alw prices. And Telephon prices. And Telephon prices. Personal cour ware Shropshire ing in our callon also available. CE 1800 150-100-100 150-100-100 150-100-100 150-100-100 150-100-100 150-100-100 150-100-100 150-100-100 150-100-100 150-100-100 150-100-100 150-100-100 150-100-100 150-100-100 150-100-100 150-100-150 150-100-100 150-10	y quantity e now To callers we ob, where the display are able troller ROLYTE	able and conside elford ((come 9 n Haletenese sets) a. y stands	at very c red for de 0952) 51 0952) 51 08m-5pm sfield 23 s can be s to suit mo	top qualition ompetitive inverse state of the seen work ast makes.	Delay lin Luminary Y Transduc Linearity Colour C IT SEE I, SERVISO F PREZER AIR SPRA FDAM CLI SILICOME SOLDER II 2.87 1.43 2.18 3.97 2.78 3.04	o DL60 co Delay Line For tor AT4041/37 coin AT4042/02 coin AT4042/04 coin AT4042/	Hz SCH 22 60/40 11 5 60/40 11 5 5 5 1 5 5 1 5 5 1 5 5 1 5 5 1 5 5 5 1 5 5 5 1 5 5 5 1 5 5 1 5 5 1 5 5 1 5 5 1 5 1 5 5 1 5 1 5 5 1	2.87 3.04 2.41 1.43 1.43 1.89 188WG 7.90 0 38.08 18J. TiPL 4.48 6.44 7.76 6.44 7.73 6.44 6.44 7.76 6.44 6.44 6.45 6.44 6.44 6.45 6.44 6.44	PHILIPS GB. PHILIP	(47R) 2R5 + 12R5) 86 6 6 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	.84 .49 .77 1.11 .82 .85 1.45 1.16 1.00 .86 1.00 .86 .93 .93 .90 .72 .62 .93 .90 .72 .63 .83 .83 .83 .83 .83 .83 .83 .83 .83 .8
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	20 24" 110° £15.00 Tanty except Mullarde which	ECC83 ECC84	60 KT66 80 PC86	6.98 PL36 81 PL81	1.15 94	Thorn 1400 Thorn 8000		£3.85 £3.51	Korting (similar to Sier Philips 3113 550/1/3		£6 65 £5 35	Decca 1730 Decca 2230	f	£780
have 2 years	s warranty.	ECC85	98 PC88	81 PL82	46	Thorn 8500/8800		£5.40	Philips G8		£5.35	G E.C. 2040		£7.80 £9.20
REBUU	LT COLOUR TUBES	ECC88 ECF80	1.35 PC92 80 PC97	80 PL83 1.14 PL84	1 43 84	Thorn 9000 Decca CTV 19/25		£7.43 £5.35	Philips G9 Pye 691/3		£6,33 £513	GEC. 2047		£5.00
17". 18". 19		ECF82	88 PC900	80 PL95	1.00	Decca CS1730/3, C		£3.68	Pye 731/25		£5.40	G.E.C. 2110 Philips GB		£8.59 £9.00
22"	£30.00 £34.00	ECH81 ECH84	1 04 PCC84 1.13 PCC85	70 PL504 85 PL508	1 32 1 43	Decca 1910 Bradfor 2213	d	£5.92	Rank BM A823/2179 Rank BM A823 A/V		£5.78 £6.89	Pye 691/693 Pye 697		11.00
25", 26" 26" 110°	£36 00		2.39	Decca 30		£5.92	Reddifusion MK1		£6.04	Pye 731		14.00 10.15		
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	ECF86 78 PCC805 1.40 PY33		61							Thorn 8000	£	£9 00		
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20"	£55.00	EF184 EH90	68 PCF802 1.02 PCF805	86 UCLB2 1.63 UCLB3	84 94	Philips 210/5051		55	4 7k, 6 8k		17	18 Ele UHF. A-B-C		£2.63
22" 25"	£45.00 £55.00	EL34	1.63 PCF806	1.30 UL84	1.02	Philips G8 5081 Philips G8 5083		32 51	10k 7 watt 1 shm-4.7	kohm	22 14	2 Ele. F.M 3 Ele FM		£4.28 £5.78
26"	£57.00	EL81 EL84	86 PCF8D8 68 PCH2DD	1.63 U26 1.45 U191	1 30 95	Pye 725		48	5.6k-12k		15	6 Ft Mast	£	£1.16
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AC127	22 BC109C	11 BC212	9 BD115	30 BF167		24 BFT42	28 i	BU407	£1 25 2N3706	10		6016/	TBA120B £1	1.30
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AD143	82 BC159	10 BC252B	12 BD144	£1.20 BF198		10 BR100	17	R254D	£2 80 Type	Price (p)	SL917	B £6.25		1.58
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AF127 AF139	32 BC171B	10 BC301	28 BD 204	84 BF241		15 BT108		TIP32C	42 BA154 46 BA155	6	SN760			1.99
AF 239	42 BC172 45 BC172A	9 BC303 10 BC307	28 BD 222 10 BD 225	46 BF257 47 BF258		28 BT116 25 BU104		TIP41C TIP42C	47 BA156	15	SN760 SN760			11.99
AL102 AL103	£2 00 BC172B £2 00 BC172C	10 BC307A 10 BC327	10 BD232	45 BF259		26 BU105	£1 25	TIP47 TIP2955	70 BAX13 90 BAX16	4 5	SN761	10N 89		£1.20 £1.25
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AU113 BC107	£1 49 BC174B 11 BC182	10 BC337 9 BC338	11 BD235 9 BD236	31 BF274 31 BF336		13 BU108 36 BU124	£1.80 £1.30	(SEP3055) TIS91	63 BB105G 21 BY126	30 10	SN762 SN765			£1.60 £1.99
BC107A	12 BC182LB	10 BC461	30 BD237	31 BF337		30 BU126	£149	TV106/02	£1.20 BY127	11	SN765	33N £1.30	TDA2030 £2	2.80
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Studio 80 Project: Video Camera

Part 1 Malcolm Burrell

THE aim of this project has been to provide for constructors a simple, easy-to-build monochrome camera design, at low cost and using readily available components. The vidicon tube used is a 2/3in. type, and the whole unit is contained in a Vero box measuring $205 \times 110 \times 140$ mm. The camera is self-contained but can also be synchronised with other video sources. It can be mains or battery operated. Simple mixer and effects generator units have also been produced, and will be featured in the magazine at a later date. Together, the units provide a low-cost video studio system which we've called "Studio 80". The camera can resolve about 4MHz.

To simplify the design, i.c.s have been used wherever possible. Though this is not the first camera I've built, it nevertheless took me many months to try out various possible circuit arrangements and to evolve the final circuit with the performance optimised and the bugs ironed out.

Design

The starting point for the present design was a circuit suggested by Siemens. Many of the components used in this turned out to be difficult to obtain however, while it soon became clear that the use of alternative circuits for some operations would considerably reduce the cost of the camera. Only a small part of the camera remains reasonably faithful to the Siemens circuit — the video amplifier and the TDA1170 field timebase. The use of a TBA920 as the line oscillator was initially considered, but a simple 7400 NAND gate i.c. offered a cheaper and simpler solution.

The design of the power supply presents a number of difficulties. The tube requires a heater current of 100mA at 6.3V, and to this must be added the power consumption of

the timebases, the video amplifier and the sync circuits. This brings the total up to about 600mA, and means that a substantial mains transformer is required. All transformers produce a magnetic field of course, but the problem with a camera is that the transformer is inevitably in close proximity to the tube and is likely to cause hum bars on the scans. The solution adopted to overcome this problem will be discussed later.

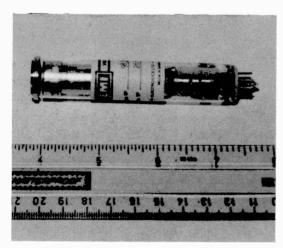
A block diagram of the camera is shown in Fig. 3.

The line output stage is quite conventional, with a choke as the load. It can be driven directly by the 7400 i.c., dispensing with the need for a discrete driver stage. To obtain the supplies required by the tube, the line output stage choke was initially arranged as a transformer. Due to the high winding ratios required however few turns could be comfortably accommodated – though the circuit did work. The main problem was that to obtain sufficient horizontal scan the stage was worked hard, the linearity was poor and even a microampere of beam current severely damped its operation. The solution was either to use a bigger, better transformer or separate line output and h.t. generator stages. The latter course was adopted.

The TDA1170 provides a straightforward field timebase. The only difference between its use here and in a TV set is that the flyback diode at pin 5 is unnecessary due to the very much lower deflection current required with a vidicon tube.

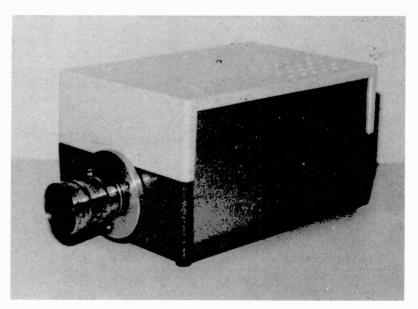
The video section consists of a couple of transistors in the head amplifier, with a f.e.t. as the first stage, followed by TBA500P and CA3046 i.c.s. The front end must be screened to prevent stray r.f. pickup.

The sync pulse generator circuit used is very similar to that featured in the August 1979 issue of *Television*. A 555 timer i.c. is used as the basic oscillator, with the component



The EMI 2/3in. vidicon used in the prototype camera.

The first prototype camera, which is fitted with a surplus lens.



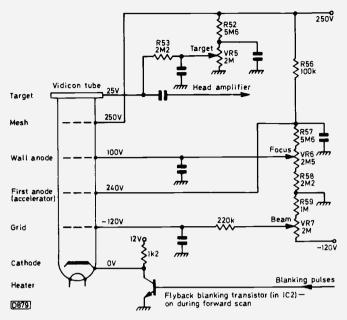


Fig. 1: Supplies to the vidicon tube.

values used selected to ensure that it switches states during the line blanking interval. This has been done because in the form initially tried the switching action produced a spike on the supply lines. This was amplified by the video amplifier, producing a vertical line near the centre of the picture. The field drive pulses are obtained from the oscillator section of the TDA1170 i.c.

The number of presets used has been minimised to simplify matters. Their functions will be described when we come to the setting up procedure. Those in the timebases operate in similar ways to normal TV receiver timebase controls. Note however that their effects when observed on a monitor screen are the opposite to what you might expect – for example increasing the line scan amplitude makes the picture smaller.

Case

Most of the project cabinets currently available are unfortunately the wrong shape for camera use. The plastic Vero box type 203 was selected because the 65mm diameter C lens mount can be mounted on the lower half of the shell with little overlap on to the top half. A plastic case is also easier to drill than a metal one — in fact the large hole required for the lens mount aperture can be made with a hot soldering iron, since the mount will mask the ragged edges.

Operating the Vidicon

From what has been said so far it will be apparent that there's much in common between a television camera and receiver. For those not familiar with the vidicon tube, the following notes on its operation are included.

The tube used is the latest 18mm (2/3in.) type with a separate mesh connection. Fig. 1 shows the supplies for the various electrodes. The electron gun is broadly similar to that employed in a display c.r.t., but the beam from the cathode scans a photosensitive target instead of a fluorescent screen. Coils around the tube deflect the beam horizontally and vertically. As the beam scans the target, a minute current proportional to the illumination focused on the faceplate flows from the target connection. This is amplified and then mixed with the blanking and sync pulses. The composite video signal thus obtained can be fed to a monitor or to a u.h.f. modulator for feeding to the aerial socket of a standard TV receiver.

The target consists of a layer of photoconductive material with a thin, transparent layer of conductive tin oxide at the front. The target connection is made to the tin oxide layer. The resistance of the photoconductive layer decreases when light is focused on to it. The resistance is still very high — of the order of tens of megohms when brightly illuminated. The action is basically that of discharging a capacitor, with the photoconductive layer forming the dielectric and the tin oxide layer and electron beam the two plates of the capacitor. The beam current discharges the capacitance it sees at each point on the target, and since this capacitance is proportional to the scene illumination a video signal is produced at the target connection.

Between the cathode and the target are four electrodes. The grid and first anode perform the same functions as in a c.r.t. The wall anode is used for electrical focusing, and nearest the target is the mesh. This is exactly what it says — a very fine mesh through which the electron beam passes to reach the target.

The mesh is responsible for making the spot size as small as possible in order to obtain the sharpest focus. In older vidicons the mesh was internally connected to the wall anode, but better results are obtained by operating it at a higher voltage, as here.

The definition of the picture is determined by the tube's operating voltages, the bandwidth of the video amplifier, the scene illumination and the quality of the optical lens used. The high-impedance supplies for the vidicon are obtained from the separate h.t. generator stage TR4. This operates like a line output stage, with a transformer feeding a pulse to a voltage-doubling rectifier circuit. A separate winding feeds a single rectifier diode to obtain a negative voltage of around -120V. Off load, the doubler circuit would produce some 900V. This voltage would fluctuate considerably with variations in beam current however, so a VDR is used to provide a stabilised 250V supply. This is a good practical level since although 700V or so would give fractionally better definition, higher working voltage capacitors would

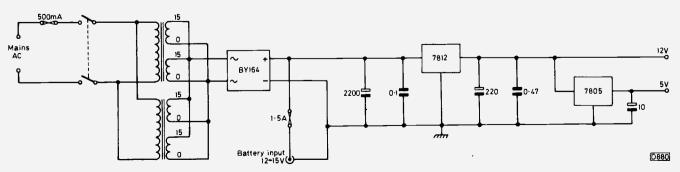


Fig. 2: Power supply circuit. A separate generator stage provides the positive and negative h.t. supplies.

be needed for smoothing while a more efficient transformer than could be accommodated on the little pot core used would be required.

The beam control VR7 performs a similar function to a brightness control with a normal TV tube, though the effects on the viewed picture are not the same – it produces a negative picture at some part along its range. R56 applies h.t. to the first anode and R57 supplies the focus control. The target requires a bias of around 25V, which is derived from the h.t. line via R52 and the target control VR5. R53 feeding the target is in fact the load resistor across which the vidicon's output signal is developed.

The vidicon's cathode is returned to chassis via a transistor in the CA3046 video amplifier/mixing i.c. This transistor is used for flyback blanking, being switched off during the line and field flyback intervals. The vidicon's cathode is then at 12V, cutting off the beam.

Power Supply Circuit

The power supply circuit is shown in Fig. 2. As mentioned earlier, the mains transformer presents something of a problem. A large transformer could be accommodated in the case, but even with careful orientation magnetically introduced hum on the scans would not be completely removed. Instead, two smaller 6VA units are connected in parallel. After rectification this combination feeds a 7812 12V regulator which in turn drives the 7805

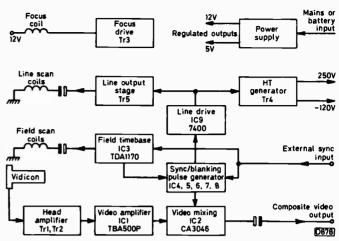


Fig. 3: Block diagram of the camera.

5V regulator. All earth returns should be made to a single earthing tag bolted to the 7812. Only the 7812 needs a heatsink – the 7805 and the transistors remains cool in free air.

Earth loops must be avoided. Whilst they are unlikely to cause hum, they will cause striations and possibly instability.

The complete circuit will be given next month. Printed circuit boards prepared by the magazine are undergoing evaluation.

Servicing The Indesit T12S

John Law

THE original version of the Indesit 12in. mains-battery portable, the T12LGB, was covered in the November 1976 issue of this magazine. Since then the BEAB approved T12SGB version has appeared. It's a much simpler set, making greater use of i.c.s. The i.f. strip consists of a TBA440C i.c. with a BF194 preamplifier stage, while a TBA950 takes care of the sync and line oscillator departments. For the field oscillator, there's a simple unijunction transistor circuit. The most important section from the servicing point of view, the combined line output/power supply arrangement, remains much as in the earlier set however, with the distinctive pump transistor arrangement. The sound side is also similar to the earlier set, consisting of a TBA120B intercarrier sound i.c. followed by a TAA611B audio amplifier/output i.c. The video output transistor is a BF257.

These popular little sets are easily identified by their orange or white plastic cases and absence of protruding knobs at the front or side.

The earlier version was prone to failure of the transistors used in the field output stage (AC141K and AC142K), and the recommendation was to replace them with silicon transistors of a higher power rating, for example types BC286 and BC287 as used in the T12SGB. The large heat shield plate to which the earlier transistors were bolted is discarded in the later version, in which each output transistor has its own top-hat heatsink.

The appearance of the two models is very similar, but

while the T12LGB has a rotary tuner with a side-mounted tuning knob the T12SGB has a four-button selector unit mounted at the top of the case and a varicap tuner within.

Different Panels

The simplified circuitry used in the T12SGB means that there's better spacing on the large printed panel which, as before, fills the whole area of the cabinet. The components have been renumbered and repositioned, and to further complicate matters three different print layouts have been used. When ordering service sheets from Indesit therefore be sure to quote all the information given on the back of the set. Circuits and spares are available from Indesit Ltd., 292 Streatham High Road, London SW16.

Access

Because of the lightness and flexibility of the plastic case, these sets have a reputation for being awkward to dismantle and put together again. A little care is usually all that's necessary. The cabinet splits neatly into front and back halves, with the c.r.t., speaker and push-button block secured to the front section: the rear section is simply an empty shell. Since the soft plastic is easily marked, it's advisable to lay the set on a soft surface before opening the case.

To gain access, remove the two Phillips screws from the

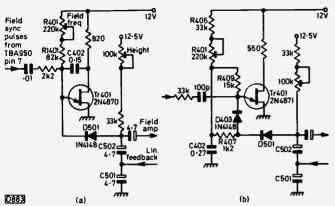


Fig. 1: Contrasting unijunction transistor field oscillator circuits used in the T12S. (a) Miller type, with the timing capacitor C402 connected between the emitter and B2 connections of TR401. When TR401 conducts, C402 charges negatively on its left-hand plate. The charge leaks away via R1401 and R401, and when TR401's emitter is sufficiently positive it switches on again, charging C402 and discharging C501/2 via D501. Positive-going field sync pulses synchronise the action. (b) Alternative version, with a 2N4871 transistor and simple RC timing circuit. This time C402 charges via R401/6 when TR401 is off. When TR401 switches on, C402 and the field charging capacitors C501/2 are discharged.

bottom of the set with it laying face downwards. Lift the bottom up and out towards the top until the positioning lugs lift free of the two holes in the top of the case. The back will then come clear, exposing the green printed panel which is attached to the front half of the case by two top screws and two more at the bottom. With these removed, raise the set upright and ease the panel from the case. A word of warning: removing the panel leaves the set front heavy so that it can topple forwards, with some risk of damage to the neck of the c.r.t. To guard against this, place a weight of some sort on the bottom of the cabinet as the panel is withdrawn. Take care when passing the tube base through the round hole in the panel. One inch diameter tube necks are delicate, and replacement tubes are expensive.

There are separate supply leads for mains or battery operation.

Power Supply Operation

Difficulty in servicing these sets is usually due to lack of understanding of how the power supply circuit works. Since the majority of failures occur in this area, it's worth giving a brief outline of the way in which the various supplies are obtained.

On mains operation the a.c. from the on/off switch is passed to the rectifier diode D902 via the $5\cdot 1\,\Omega$ surge limiter resistor R904. The rectifier produces around 315V across its reservoir capacitors C905/6, which are connected in series. There follows a 250mA fuse (F902) and smoothing filter (R908/C908). R908 is a 17W, dropper type resistor, mounted on a heatsink attached to the aerial panel. The d.c. is now down to 230V, and is fed via the fusible $27\,\Omega$ resistor R907 to the collector of the pump transistor TR902, type BU104 or BU134.

The pump transistor provides a switch-mode action, being switched on briefly once each line by the flyback pulse. When it's switched on, energy is fed into the line output transformer T402, which thus acts as the switch-mode reservoir. Note that TR902 is used as a voltage dropper rather than as a regulator. When it switches on, its emitter is connected to pin 1 of the line output transformer via D907. The switch-on pulse is provided by winding 3-2. TR902 switches off at the end of the flyback pulse, when

the efficiency diode D401 begins to conduct in the normal manner to provide the first half of the line scan. It also charges C909 to produce the 17V supply for the line driver and output stages. The 15.5V supply for the field timebase and the 12V supply for most of the rest of the circuitry are derived from this 17V supply.

The basic purpose of TR902 then is to obtain an l.t. supply from the mains without the need for a separate mains transformer. The "pumping" action of TR902 in building up the 17V supply accounts for the term "pump transistor". The h.t. supplies required for the tube and the video output stage are derived from the line output transformer in the usual manner.

Stabilisation is still required of course, to avoid changes in picture size with mains voltage or load variations. This is achieved downstream by the shunt regulator transistor TR901, which produces the stabilised 12V rail in conjunction with R903 and also provides overall stabilisation. Variations in the 12V supply are sensed by R901 and applied to the base of TR901 which, being connected in the common-emitter mode, produces an inverse effect at its collector to compensate.

The pumping action can't start until the line output stage comes into operation of course. This is the reason for the series-connected reservoir capacitors and the series-connected resistors R905/6 in parallel with them. At switch on some 6V is developed at the junction of these components. This is fed via D904 to the line oscillator and via D905 to the line driver and output stages, and is enough to get things going. Once the 17V supply has been built up, D904/5 are reverse biased and isolate the start-up circuit. D903 operates the other way round, being reverse biased at switch on to prevent the start-up supply being loaded down by the rest of the set.

The pump circuit plays no part on battery operation, when the 12V d.c. supply is fed to pin 5 of the line output transformer via D908 which acts as the boost diode. D907 then isolates the pump circuit.

There are a lot of diodes in the line output/power supply section, but their functions should now be fairly clear. An appreciation of which does what can save a lot of time when looking for the cause of a power failure.

Common Faults

Fuse failure is the first thing to look for when a breakdown occurs. We've already mentioned the 250mA h.t. fuse F902. There's also a mains fuse, F901, which is rated at 2.5A. F902 is a quick-blow type and F901 an antisurge type. When one of the fuses has blown, examine it to see whether there are signs of burning. If the glass is clear the fuse may simply have died of old age, and replacing it may well clear the fault. If the glass is black however there's been a heavy overload and further checks must be made. Two immediate suspects are TR902 and C908. If the capacitor is faulty, check R908 since the short may have burnt out its wire. F902 is likely to be the burnt fuse in either of these events. A fault likely to burn out F901 is a short in the mains filter capacitor C902 - this can shatter F901. In this event check that the contacts of the on/off switch have not been damaged, and that the surge limiter resistor R904 is intact (note that it's a fusible type in some sets).

The mains rectifier D902 is another item that can break down for no apparent reason. If it goes open-circuit it will die quietly: if it goes short-circuit its passing can be noisy, with F901 shattered – you'll find it black or maybe broken in two.

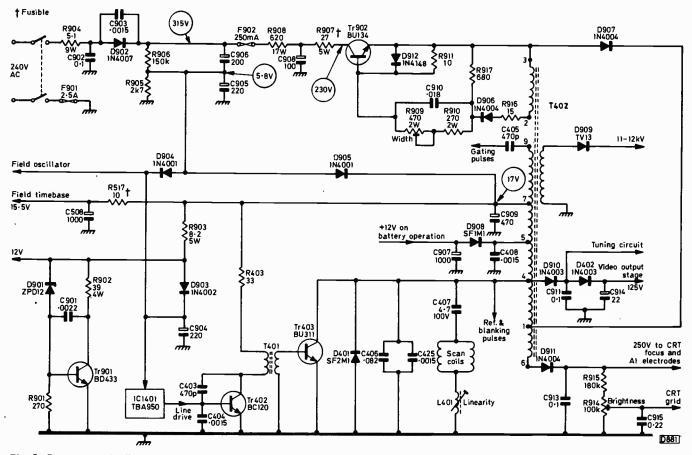


Fig. 2: Power supply, line output and line driver stage circuitry. See Fig. 3 for alterations that may be found in some sets. R903 is 8.2Ω with c.r.t. type A31-120W and 7.5Ω with c.r.t. type A31-410W.

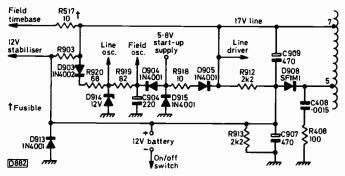


Fig. 3: Alternative power supply arrangements used in some sets. At switch on, D904/5 provide the start-up feeds, D903 being reverse biased. Once the 17V supply is established, D903 switches on and D904/5 switch off. Note that the link between D913/R903 and the junction of R913/C907 etc. is made on battery operation only.

R908 in the smoothing circuit leads a fairly hard life, and can go open-circuit to give the no results on mains symptom. It usually fails without warning, from old age.

The electrolytics in the mains supply circuit give rise to a certain amount of trouble. The usual fault is C906 or C908 drying up. This results in a small picture following a slow start up, with the 12V line down to 7-8V.

The zener diode D901 which provides the reference voltage for the shunt stabiliser can fail, and this is often accompanied by failure of the stabiliser transistor. Voltage checks will soon show whether the fault is in this area.

Diode Checks

The various diodes can be easily checked with an Avo on the Ohms range. With the black lead to the anode and the red lead to the cathode, a reading of around $1k\,\Omega$ should be obtained. Reversing the leads should give a higher reading if the diode is in good condition. A truer reading will be obtained if one end of the diode is disconnected. Since diodes are cheap, it's quicker to replace any that seem doubtful. If a replacement diode is not to hand, examine the suspect one under a good light. If the surface is cracked or the white lettering or positive ring at one end is discoloured, the diode is probably faulty.

Transistor Alternatives

A BU104, BD253, BU134 or BU111Y can be used in the TR902 position. The shunt stabiliser can be a BC302 or BD433. The line output transistor TR403 can be a BU311, BU312 or BU109, and the driver transistor TR402 a BC120, BC140-10 or BC302-5.

Sensitivity

The original T12LGB performed best when used with a suitable aerial. The T12SGB will usually give excellent results using just its ring aerial.

An Odd Fault

Finally, a set that had received DIY attention came our way. You're unlikely to get this, but the results are interesting. The fault was a very small picture, and it transpired that the line and field scan coil leads had been interchanged. The leads to the line coils are colour coded black and white and plug on to pins 41-2 on the panel: the leads to the field coils are colour coded red and white and go to pins 51-2.

All on a Quiet Afternoon

Les Lawry-Johns

WE'VE been a bit slack lately, and business hasn't been too good either. I'm always a bit suspicious when it's too quiet though. It always seems to herald the approach of a hurricane. This started on the stroke of midday, when Miss Pocock phoned to say that her colour set was changing colour, Miss Fox phoned to say that her black and white set was going grey, and Anna Logg popped in to say that her father's set was all green. "All right" I said to one and all. "I'll call this afternoon and you'll all be o.k. by teatime."

A Jowett Van

At ten past twelve there was a clattering noise outside and a 1934 Jowett van (two cylinder horizontally opposed engine) pulled on to the forecourt, attracting more attention than our window has for the last ten years.

I helped the owner extract the large Dynatron (still on it's legs) from the rear of the van after he'd unroped it. The castors rolled quite easily on the wood plank floor, and it was soon in the shop where it was found to be suffering from the usual Pye hybrid ailments too mundane to mention.

It was not the set which caused the trouble. It was the little van with its large wire spoked wheels attracting so many people that other vehicles could not get on the forecourt. I hurriedly completed the repair to the Dynatron and back it went into the little square van with its number plate on the top.

Off it clattered, to the disappointment of the crowd which quickly dispersed to allow Derek to bring in his 3500 Ultra, Mr. Deadman to bring in his 24in. monochrome set which needed a new tube, and Geoffrey to bring in his Telpro. I told them all to come back at five o'clock, as the repairs would all be done by teatime.

I was about to start on the first one when a lady came in with a Decca portable (MS1212).

"I want you to tell me how much it will cost and what is wrong before you do it."

So I whipped out the eight screws and lowered the back. When I plugged the set in the screen lit up and there was a faint hum from the speaker. It was a fair bet that the MC1330 detector chip was at fault.

Talking Chip

"If this thing with eight legs talks to you in foreign languages when you touch it, the voices will be saying that the repair will cost about eight quid give or take a bit allowing for the exchange rate in Tokyo."

"You mean the set will tell us how much the repair will cost?"

"It's the latest thing in silicon chips, but it talks in every language other than English you see."

"Lets see what it says then." I could see she was dubious. So I touched the output pin with the tweezers and the speaker burst into life with various voices as predicted but unfortunately someone was also reading the world news in English, which upset my little game. Just to be sure of the diagnosis I touched the input pin. It was dead, though my claim that it could also estimate its own repair didn't hold water.

"How much then?"

"Eight pounds twenty one including VAT."

Enter the Audiophiles

So we replaced the chip and started to put the new tube in the monochrome Ferguson set, or rather to take the old tube out. Just as all the bits were cluttering up the bench the audiophiles arrived.

"Have you a lead with a 5-pin plug at one end and four plugs at the other?"

I showed him a 5-pin DIN to 4 phonos.

"No it's not like that. Look, I'll draw it for you."

"Sorry sir, they don't make them with wander plugs on the ends."

"Can you make one up for me?"

"Which pins do you want the plugs to connect to, apart from pin 2?"

"All of them."

"Sorry sir. Try the shop down the road."

The next one to come along put me right off.

"Are you Mr. Littlejohn?"

I knew at once I didn't like him.

"You could say that. What can I do for you?"

"I've this Ferguson Studio 6 music centre. There's nothing wrong with it and it won't take you a jiffy to fix. It's just that the v.h.f. wanders off after about half an hour and there's some distortion on one channel after about two hours. I don't mind paying a couple of quid for your trouble."

"Thirty."

"How much? You must be joking."

"Thirty, and if you like to bring it back this time next month I'll see if I can fit it in."

"**** you. I'll take it somewhere else or do it myself."

And off he went whilst we concentrated on the tube change.

The job completed we then polished off the Telpro which wanted only a new boost reservoir capacitor and a fuse.

The 3500 proved to be more of a headache, requiring a tripler and an e.h.t. transformer. The rippled picture then obtained and the squeaking noise proclaimed that the core had dropped out of L502 during the tussle, suspicion centring upon the cat who had been heard playing with something that rolled. It was finally found under the Telpro. I suddenly remembered Miss Pocock etc. Time was slipping by. Teatime I'd promised.

Out Amongst the Femmes

Now think. Anna Logg's father had gone green. We'd sold him a new Ultra three years back. An 8800. Probably a shorted green output transistor. Make sure we've some BF337s in the box. Miss Pocock had merely said changing colour. Pye hybrid, probably the CDA panel. Take a spare one just in case. Miss Fox was going grey. Decca monochrome set. Probably the tube, possibly the PFL200, so check to see that we have one.

Off we drove, glad of the chance to get some fresh air. Bowling along with the window down. Who wants to smoke? Throw cigarette end out of window and wind blows it back in again. Where has it gone? Can't stop here. Pull over when we can. Feel a pleasant warmth on inside of thigh, suddenly becoming an agony. Hole in trousers and blister on thigh. Seat covering singed. Press on, the customers await your expertise.

Miss Fox had left the door open, as she was largely confined to a chair with arthritis (she had arthritis, not the chair). Having exchanged pleasantries we got down to work. Off came the rear cover whilst we waited for the valves to warm up. On came a grey picture, but the raster was bright enough. Not the tube. Note the effect of the contrast control. Working, but it couldn't put much black and white into the picture.

Pull out the PFL200. Didn't seem to want to come out. Eventually it did, but being in two halves the new one went in to stay.

"How's that Miss Fox?"

"There's a nice white line down the middle."

Now if there's one thing these sets suffer from it's dryjoints under the line output stage, leading to the scan coils. What with all the pulling that had been required to remove the PFL200, it was hardly surprising that one (dry-joint) should show up. So out came the main panel and sure enough there was a hole where a lead connection should have been. This done, we put the panel back and refitted the rear clips. The picture was now quite nice, so we put the back on – with all the screws along the top, at the sides and across the bottom.

"Nice and quiet around here Miss Fox."

"Have you turned the volume down then Mr. Johns?"

"No er, I don't think . . ."

Out came all the screws.

"What's that you're saying Mr. Johns?"

"Not a lot Miss Fox."

Naturally when I'd upended the panel to solder the underside I'd pulled off a speaker lead and hadn't noticed it.

"Oh that's better Mr. Johns, I'm so pleased to have it going again. Do I owe you anything?"

"Not a lot Miss Fox."

Rush off to next call, as it was now past four o'clock. Drive straight across crossroads as I was on the main road, only to realise that the vehicle coming from the right wasn't stopping either. Some fool had been up all night painting a roundabout which of course gave the other fellow priority. You just can't rely on anything being the same for two minutes nowadays.

Changing Colours

Miss Pocock threw the key out of the window as she has arthritis almost as bad as Miss Fox.

"Hallo Miss Pocock, how's the legs today?"

Fancy me asking Laura Lovitt a question like that . . .

"The colour keeps changing. One minute it's a nice colour, then it goes all red."

The CDA panel was the obvious place at which to start. We turned it over, expecting to find some nice cracks that could be bridged with nice bits of wire. There were no cracks, the supply to the red output stage being intact.

Back went the CDA panel. We watched the picture for some time. Then suddenly it went red, in a way which meant that there was a high voltage on the grid of the red gun. This in turn meant that the triode of the PCL84 wasn't passing current. A new PCL84 seemed to restore order, and another simple job was done. Refit back cover and prepare to leave. Screen went red.

Remove rear cover. Check valve base, but all contacts

seemed good. Rocking the valve produced the fault however, so it appeared that there was an intermittent open-circuit inside the base.

I didn't feel inclined to change the valve base at this time of the afternoon, so I fitted the solid-state replacement panel and promised to return with the original the following day.

A Question of Ethics

Anna Logg's father (I always forget his name but I can't forget hers) lives on the fourth floor of a large block of flats. It's no joke collecting or delivering a set there because of the large number of twin doors — quite apart from the lift. When I arrived Anna let me in. Her father was having one of his bad turns, with his distressing lung condition which makes you feel bad just to look at him fighting for breath. He has oxygen equipment by his chair, and that's all that can be done.

The set was on when I got there, and seemed perfectly alright for a time. Then the screen flashed bright green. I immediately accused the green output transistor at the top of the signals panel of playing about. A meter check showed that the output voltage occasionally dropped to a low figure.

To clear the tube of suspicion I removed the fly lead. The voltage at the signals panel them remained steady, falling only when the tube lead was reconnected. Oh dear. A heater-cathode short in the tube was all we needed. Although the tube was insured for four years, it isn't funny having to implement this. I toyed with the alternatives. Disconnect the heater from earth and tie it to the green cathode instead via a suitable resistor? But if the short still occurs the green will smear across the screen. Fitting an isolating transformer would restore almost normal working, and this is what we do if the tube is not insured. This tube was insured however, and the old boy was entitled to a new one.

"The tube's at fault and will have to be replaced" I told them. "I'll bring over a loan set while we're waiting for the replacement."

"I don't want a loan set. I've never borrowed anything in my life."

Anna looked resigned. "He's like that. He depends on the TV as he can't get out, but he won't accept one which isn't his – even from us. He's a cantankerous old bugger, aren't you dad?"

This was an unexpected snag. Since Thorn take at least a month to replace a faulty tube (counting the transport there and back, which accounts for a few days), the stubborn old chap was going to be lonely for several weeks unless we told a white lie. So we lugged our test gear down to the van, then came back for the set – fortunately having Anna to open the doors for us. Back at the shop we whipped out the tube, and within half an hour it was on its way to Edmonton via UK roadlines (carriage £5.38), albeit in a Mullard box since we didn't have a Thorn one. We then nipped back to the shop and fitted a Thorn New Life tube which we had in stock, and decided to take the set back to him the next day in case he disbelieved that the correct replacement could have been obtained so quickly.

When we took the set back the old chap was very pleased.

"They're very good at implementing their guarantees, aren't they? I think I'll write and thank them."

I charged him a fiver and he said I'd earnt that for all the lugging about.

I wonder what would have happened it he'd been one of those clever people who buy their sets from a discount warehouse? No doubt he would still have found a kindly soul who would have done exactly the same as I had.

Note for Thorn. Isn't it possible to speed things up a bit? Say by having spare tubes at local branches so that they can be dispatched the same day. After all a dealer isn't going to go to all the trouble of taking a tube out and

sending it back if it isn't faulty. And again, we do go to a lot of inconvenience in implementing your set guarantees without recourse to you at all. Do you want a list?

Your good name is being upheld by our unpaid efforts. What about a bit of cooperation in keeping the customers happy?

Letters

REBUILT TUBES

In talking about rebuilt tubes (June issue) Les Lawry-Johns comments that he's "probably got it all wrong", which invites replies. May I therefore say that the symptoms Les has been unfortunate enough to experience are typical of tubes that haven't been properly evacuated. Les mentions that at least one of the sources he's tried uses hot pumping. But this isn't the whole secret. In my experience, excellence of the pumping system, combined with high temperature, are the essentials for proper tube evacuation.

Les questions the ageing process. I can say without fear of correction that a cathode properly converted from the metallic carbonates with which it is initially coated becomes a metallic oxide coating which, in a vacuum, will remain stable. The oxide coated cathode will change only if there's some other factor at work — and in the tubes he describes this other factor is almost certainly gas present due to inadequate pumping. The measures Les has been obliged to adopt are in fact not reageing but acceleration of the gas absorption by the getter.

There are approximately seventy companies engaged in the business of tube rebuilding in the UK, and I'm sure that the reputable majority of them will agree that Les has been singularly unfortunate. Anyone experiencing the sort of problems that Les describes should return the tube as unsatisfactory and ask for his money back.

T.W. Smith, C.Eng., M.J.E.R.E.,

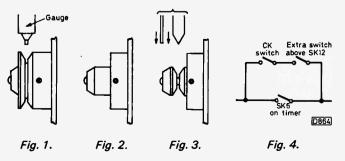
Managing Director, Display Electronics,

96-100 Waterloo Road, Uxbridge Middx.

VCR SPEED CONVERSION

G. Beard's article on VCR speed conversion in the July issue was excellent. For those who wish to double the playing time but don't require the machine to be compatible with the N1700 standard however there's a simpler approach. The only part that has to be purchased is an N1700 head drum – the extra servo head, new audio/sync head and centreless grinding of the capstan are not required. This is how I modified my N1500 machine – the job took a couple of hours and was well worth while.

The N1700 head drum was first fitted, giving a tremendous improvement in picture quality and much more positive adjustment of the tracking control (due to the



slanted heads). The motor pulley was then removed, and a gauge was turned up to fit the groove (see Fig. 1). A piece of quarter-inch mild steel was then chucked up, projecting $\frac{3}{4}$ in. from the chuck, and carefully turned down until the motor pulley was a tight fit (this is essential if it's to run true). The pulley was next clamped on tight and turned down to 0.505in. (Fig. 2). You'll find that the cone-shaped end of the pulley is just under 0.5in., which is a useful guide. With alternate use of a 90° V tool and a narrow parting tool made from a hacksaw blade, the groove was turned until the gauge fitted perfectly (see Fig. 3). The pulley was then replaced and all the drives cleaned. No adjustment was necessary, but an 0.1μ F capacitor was connected across SK401 3-5 to correct for loss of audio h.f.

The timer was modified as suggested in the October 1978 issue, page 646 (not page 64 as stated). Another way of doing this is to fit a switch above SK12, which closes when the machine laces up, shorting out the timer switch SK6, so that when the latter opens after an hour the tape runs to the end, the auto-stop then operating. For short-period recording, this can be disabled by using the CK switch, which is not used usually, so that the timer's switch off facility is used (see Fig. 4).

So there you are: if you don't want to be able to replay prerecorded tapes or tapes from N1700 machines the modification for double playing time is quite simple.

Mike Phelan.

Holmfirth, W. Yorks.

VIDEO POLARITY

Other readers may be interested in the problem that confronted us recently and the way in which we managed to resolve it. The set, a "Continental Edison" monochrome receiver, was brought to us with the complaint that "it wasn't working". The symptoms however were a negative picture and loss of both line and field sync, with normal sound.

After some investigation, we found that the set was intended for use with positive instead of negative vision modulation. The video channel consists (see Fig. 5) of a detector diode followed by a couple of emitter-followers and then the output transistor. The second emitter-follower provides two outputs, one to the output stage and the other. from its collector, to the sync circuit. Our first thought was simply to reverse the detector diode, but this was not successful as the video signal's d.c. component cut off the first transistor. Our second approach to the problem, transposing the video and sync outputs from the second stage, was more successful. This produced a normal, positive picture, but the sync locking was still unstable. We tried to improve the sync by taking the sync feed from the output stage instead of the second stage, but while this improved the sync locking it made the picture worse - the distorted frequency response produced smeary vision.

We finally decided to try to get the signal polarity right by modifying the first video stage – by taking the output from the collector instead of the emitter of the first transistor (see Fig. 6). This was most successful, and gave a better quality picture than some comparable, unmodified

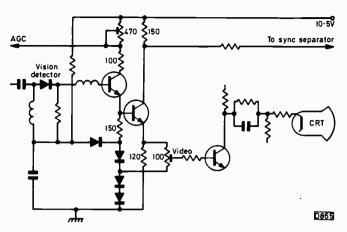


Fig. 5: Circuit of the original video channel.

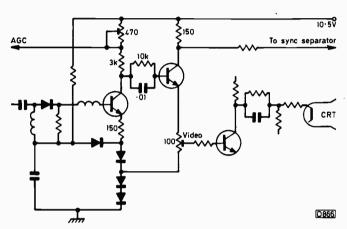


Fig. 6: After modification to cater for negative-going vision.

sets. The most suitable value for the first stage's collector load resistor was found to be $3k\Omega$. The interstage coupling is via a $10k\Omega$ resistor in parallel with an 0.01μ F capacitor, and the second transistor's emitter load resistance was increased by removing the 120Ω resistor previously fitted here.

Dr. Karailiev.

Senior Lecturer, College of Science and Technology, Port Harcourt, Nigeria.

PROJECTION TV

Vivian Capel's article on vintage projection TV systems (June issue) reminded me of things I'd almost forgotten. At the time, I was fortunate in attending a one-day course on projection sets, with particular attention to the Schmidt optical system, run by Philips/Mullard engineers at their Birmingham depot. Whilst the article covers the system very well, I was given the following instructions on resetting the corrector lens. This, as you say, is very important.

At the centre of the lens there's engraved a circle with a V inside it. This is used for setting up. While the c.r.t. and the scan assembly are still removed, pull back from inside the unit the rubber tube mask. With an external light shining through the lens one will then, on looking through the lens at an angle, see an inverted reflection of the V on the corrector lens. By sliding the lens in various directions, it's possible to make the point of the reflected, inverted V touch the point of real V, thus forming an X. The lens is then correctly set and the fixing clamps can be tightened. This method is accurate and dispenses with the need to use L-shaped jigs. R.A. Cotterill.

Christchurch, Dorset.

next month in

SERVICING THE DECCA 80/88/100 CHASSIS

We've looked at these sets before, but that was when they were still quite new. Various stock faults and problems have since come to light, and this is the main theme of our treatment this time. It's based on experience gained with a large number of these sets out on rental.

CCD CAMERAS

Steady progress is being made in the development of small TV cameras using solid-state image sensors (charge-coupled devices) in place of camera tubes. David Matthewson reviews the present state of the art, with particular reference to Sony's recently announced prototype "video movie" unit.

TUNING TROUBLES

Troubles with tuning and tuners account for quite a lot of service time, though little practical information is available on the subject. S. Simon provides guidance on how to deal with common problems that arise with various types of tuning arrangements, from mechanical methods to touchsensitive systems.

VIDEO NOTEBOOK

Steve Beeching uses various faults experienced with VCRs to illustrate practical VCR fault-finding techniques.

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Vintage TV: The HMV Model 901

David Looser

No fewer than nine manufacturers exhibited receivers for the BBC's new high-definition TV service at the 1936 Radiolympia. The service was due to begin that November. Amongst the exhibitors of course were EMI, who had developed the 405-line all-electronic system which, along with Baird's 240-line system, was to be used by the BBC (the two systems were used alternately during the initial trial period). EMI exhibited two receivers under each of their brand names — HMV and Marconiphone. The HMV sets were the 901 and the 900. The latter incorporated an all-wave sound receiver. The corresponding Marconiphone sets were the 701 and 702. All four receivers employed the same basic electronics, the differences being confined mainly to the cabinets and the sound receivers.

About a year ago I was offered an HMV Model 901 which was virtually complete but had not been used for some time and was showing signs of deterioration.

Basic Features

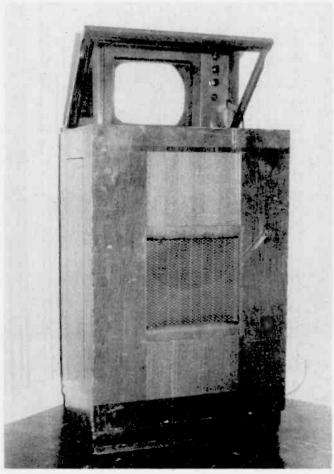
The 901 has a 12in. c.r.t. which is mounted vertically in a

substantial (and heavy) wooden cabinet, the picture being viewed via a mirror fitted to the inside of the cabinet's lid. This arrangement was quite common with sets of the period. It was done because of the length of the narrowangle deflection tubes then in use. The Emiscope 6/6 12in. tube used in the 901 is about 2ft. long: mounting it horizontally would not be exactly convenient.

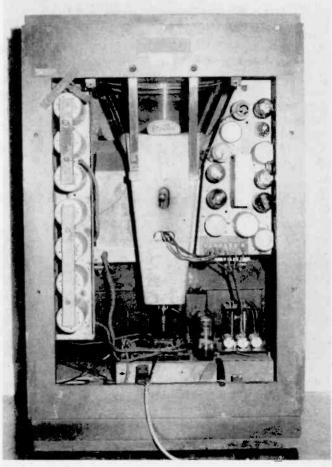
The electronics used in the 901 are on four steel chassis as follows:

- (1) The t.r.f. vision receiver, which is mounted vertically down the right-hand side of the cabinet.
- (2) The superhet sound receiver, which is mounted across the front of the cabinet.
- (3) The timebase chassis (or synchronising unit as EMI called it) on the left-hand side of the cabinet.
- (4) The power supply unit, which is mounted at the bottom of the cabinet.

The accompanying photograph shows the innards with the back removed. The tube, centre, was a remarkable device, with a hexode gun structure, electrostatic focusing and a peculiar seven-pin base.



TV 1936 style, with viewing via a mirror. The cabinet is typical of EMI's radiograms of the period, and the 10 \times 6in. ellipitcal speaker can certainly give decent audio. Thirteen controls are grouped around the c.r.t. faceplate.



Inside the 901, with the tube in its cradle at the centre, the t.r.f. vision receiver unit at the left, the timebase unit at the right and the power supply unit at the bottom. The sound receiver is at the front of the cabinet.

Thirteen front panel controls are grouped around the tube face. They include an r.f. sensitivity control (there was no a.g.c. in those days), the 240/405-line system switch, and a lot of what would nowadays be relegated to internal presets – for example line hold, linearity and width etc. In fact there's only one internal preset control – the sync separator bias adjustment.

Restoration

I decided to restore this receiver to working order, and EMI were able to sell me a photocopy of the original service manual — not bad for a set that had been obsolete for 40 years!

As a first step the set was dismantled and cleaned. Not surprisingly, the innards were filthy. Whilst doing this I checked around for damage, broken components, etc.

Power Supply

The power supply unit was obviously the thing to start on first, with its two separate mains isolating transformers for the h.t. and e.h.t. supplies. The h.t. transformer was o.k., as were the twin U12 h.t. rectifiers. The three reservoir/smoothing electrolytics showed excessive leakage however. They weren't the originals, so I had no hesitation about replacing them with modern equivalents.

Vision and Sound Receivers

With the h.t. and l.t. supplies available, it was time to test the sound and vision receivers. The sound receiver is a conventional four-valve superhet (X41, VMP4G, MHD4, N41 valves) whose circuit was typical of the standard broadcast receivers of the period. It works at the single frequency of 41.5MHz of course. The local oscillator can be fine tuned from the front panel to accommodate drift, the i.f. being 1.5MHz. The only problem with this unit was an intermittently open-circuit primary in one of the i.f. transformers. After this was rewound and realigned, the unit functioned perfectly. The vision receiver was even less trouble — in fact it worked without any attention at all. It

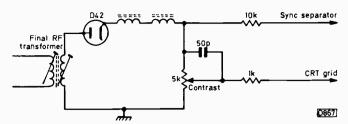


Fig. 1: The video signal is fed to the grid of the c.r.t. via the contrast control, with no video-frequency amplification.

consists of six r.f. amplifier stages (five MSP4s and an MSP41), followed by a D42 detector which feeds the c.r.t. grid without any video amplification at all. A high-level contrast control is included between the detector and the c.r.t. grid (see Fig. 1). Since the video signal is d.c. coupled to the c.r.t. and there's no a.g.c., the true black level is displayed, something that few modern monochrome sets seem capable of doing.

Timebases

The timebase unit employs separate sync separator valves (two more MSP4s) for the line and field sync. The grids and cathodes are connected in parallel, but the anodes are kept separate to feed the respective timebases. The sync feed to the field oscillator includes a D42 interlace diode. Both timebases employ conventional blocking oscillator circuits, but there's a curious extra valve in the line timebase (see Fig. 2). This valve, an MH4 triode, is referred to as a "compensator valve" and was apparently necessary because in the Baird 240-line system the line sync pulses' were suppressed during the field sync pulse. It presumably improved the basic frequency stability of the timebase: anyway, it was omitted from the later 405-line only versions of the receiver. The line and field output stages are similar, both employing an N41 output pentode, transformer coupled to the scan coils. Without the need to generate the e.h.t., the line output stage is delightfully simple.

The timebase unit had suffered rather more than the receiver units. Most of the electrolytics and some of the

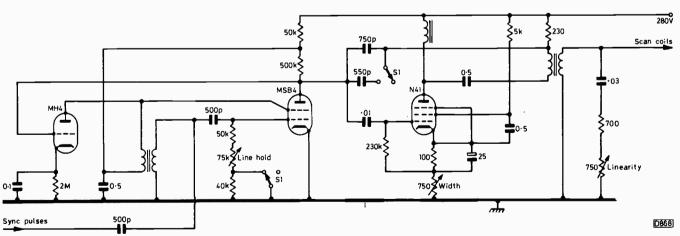


Fig. 2: The grandad of all line timebase circuits? Well one of them, anyway, used in the HMV Model 901 of 1936. It's interesting that the charging capacitors (750pF and 550pF, switched for 240/405-line operation – switch S1 is shown in the 405-line position) are charged negatively by the MSB4 blocking oscillator valve during the flyback, Miller style, discharging to h.t. via the 500kΩ and 50kΩ resistors to drive the N41 output valve progressively harder on during the forward scan. The output valve is a.c. coupled to the output transformer – as in most hybrid colour sets of the 1967-9 era. The tetrode blocking oscillator circuit is conventional, with feedback between its screen and control grids via the blocking oscillator transformer, but what does the MH4 triode do? EMI called it a "compensator valve", and apparently included it to compensate for the fact that in the Baird 240-line system the line sync pulses were not present during the field sync period. It would seem to work as follows. You'll notice that the positive-going line drive waveform is applied to its control grid, as well as to the N41's control grid. At some point therefore it will conduct, its anode current flowing via the primary winding of the blocking oscillator transformer to ensure that the blocking oscillator valve switches on at the right time.

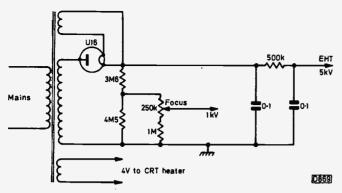


Fig. 3: E.H.T. from the mains, with a pi filter network. The bleed resistance chain ensures good regulation and provides a tap for the focus voltage. Note that this type of e.h.t. system can be lethal.

resistors had to be replaced, and in addition the 240/405-line system switch had at some time in the past been removed, leaving a bird's nest of the wiring that had previously gone to it. For the present I've tidied this wiring up, but I've not entirely given up hope of obtaining a replacement switch and restoring the set to dual-standard operation.

The Tube

All that now remained before I could attempt to get a picture was to refit the tube and get some e.h.t. The tube has a number of odd features. For example, although the diameter of the neck is quite large (about 2in.), it reduces considerably a few inches from the bulb, the scan coils sitting over this reduced diameter portion. The idea was

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obviously to improve the tube's deflection sensitivity (it also stops the scan coils sliding down the neck), but it means that the coils have to be assembled on to the neck of the tube – a fiddly job that was not helped by my being worried about putting stress on the tube's glass at its weakest point. The c.r.t. merely rests in position inside the cabinet, in a metal cradle which occupies the centre of the cabinet – it can be clearly seen in the accompanying photo.

E.H.T. Supply

The e.h.t. supply (see Fig. 3) turned out to be a bit of a problem. The output from the high-voltage secondary winding of the e.h.t. transformer is rectified by a U16 valve and smoothed by a pi-section filter. A bleeder network $(3.6 M\,\Omega)$ plus $4.5 M\,\Omega$) across the reservoir capacitor ensures that both capacitors are discharged when the set is switched off, and also ensures good e.h.t. regulation by swamping the c.r.t.'s beam current. A tapping feeds the tube's first anode via the focus control. Note that e.h.t. supplies of this type are *lethal*, and should be treated with respect.

The transformer showed considerable signs of overheating, and I was not surprised to find that it suffered from shorted turns. I put it aside for rewinding therefore and set about devising a temporary supply. A surplus e.h.t. transformer rated at 20mA, 3.7kV was obtained and this, after rectification, produced a nice 5kV for the final anode. With a separate transformer for the tube's 4V heater supply, and a BY476 silicon diode as the e.h.t. rectifier, I was ready to try the set out.

Moment of Truth!

With everything assembled, I switched on. After about 30 seconds I was rewarded with sound and line whistle, so I gingerly turned up the brightness control. This produced a dim raster, and adjustment of the other controls then turned this into a recognisable TV picture. My triumph was short lived however, for after a few minutes the picture disappeared to the accompaniment of crackling sounds from the power supply chassis — one of the e.h.t. capacitors had decided to go short-circuit. A replacement was obtained from the remains of an early post-war (but still mains e.h.t.) TV set, and in this form the 901 has been functioning ever since.

Performance

It must be admitted that the picture is extremely dim by modern standards. How much of this can be laid at the door of the elderly tube is difficult to say. The presence of an ion burn in the centre of the screen suggests that the tube had been in use for a not inconsiderable number of hours. The focus and scanning geometry are nothing to write home about either, but the correct black level presentation and excellent e.h.t. regulation are plus points. The sound is very good, certainly better than the majority of modern sets. It's helped by having 4.5 W of audio driving a $10 \times 6 \text{in}$. speaker mounted in a decent timber cabinet. The effect is marred however by the 10 kHz whistle from the line timebase.

An HMV 901 would have set you back 95gns in 1936, the equivalent in modern terms to about £1,500. For this you'd have been able to watch up to two hours of TV a day (but not on Sundays). Is it surprising therefore that a year after the start of the service only some 1,000 sets had been sold to the public, while correspondents to Wireless World were complaining that TV was a flop?

Bionic Alternatives

Eugene Trundle

BACK in June 1979 we reported on some solid-state replacement modules introduced for use with the Pye hybrid colour chassis. Amongst these was a CDA panel produced by LEDCo. Another panel for the same purpose was sent us for testing not long since, manufactured this time by DR Developments of Melton Mowbray. The original Pye valved CDA panel simply cooked itself up, so that most of the originals are now in dire need of pensioning off.

The DR panel differs from the LEDCo one in several respects. The main differences are as follows. First, instead of using feedback clamps, the DR Developments panel uses driven clamps of a similar design to those in the original panel (see Fig. 1). Secondly, the time-constant of the field flyback blanking pulse in the DR Developments design has been increased in order to suppress the teletext lines at the top of the screen. The panel is again a direct plug-in replacement, with a minimum of presets, designed to be fully compatible with the existing circuitry in the Pye chassis.

In the DR Developments panel there are fourteen transistors in a circuit that's not far removed from the original Pye one. There's provision for setting the green and blue colour-difference signal levels, and these are the only presets necessary or provided.

The valid comment made by Alan Pemberton (Letters, September 1979) regarding the adverse effect of the LEDCo panel on the black-level performance of the luminance channel also applies to the DR Developments design, since the black-level clamp again looks into a low impedance which drastically shortens the time-constant of the clamp components in the Pye brightness circuit. The answer to this would perhaps be to massively increase the value of the coupling capacitor C39 (0.22μ F, on the i.f. panel), or to use a high-impedance f.e.t. circuit as the first luminance stage on the CDA panel. Neither of these alternatives is attractive, the former since it would involve

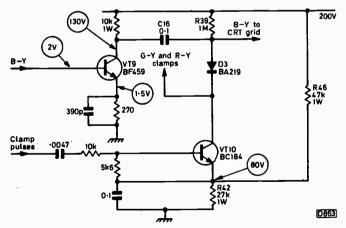


Fig. 1: The driven clamp circuit used in the DR Developments solid-state CDA replacement panel. Transistor VT10 drives D3 and the other two clamp diodes. When VT10 and the clamp diodes switch on, C16 and the corresponding coupling capacitors in the other colour-difference signal channels are returned to the clamp potential at the junction R46/R42. Thus VT10 and three diodes replace the three clamp triodes used in the original Pye circuit.

the repairer in delving into another panel, the latter because it would involve extra circuitry and, due to f.e.t. spreads, extra presets.

We fitted the DR Developments CDA panel in a suitable receiver and ran it on soak test. The picture, assessed subjectively, was as good as that given by one of the original hybrid panels when in good condition, and the factory settings of the G-Y and B-Y presets were correct. The teletext/VITS blanking arrangement worked well, and would no doubt be a great boon in cases where the c.r.t. suffers from the "halo effect" produced by secondary emission. We found that the flyback blanking was quite adequate with our test sample, and that the luminance output transistor was driven fully to cut off during the line and field flyback blanking periods.

We feel that the driven clamps used in the colourdifference output stages are not quite as effective as feedback clamps: this was noticed on a reasonably good tube — we were unable to lay our hands on a set with a gassy tube to check this point fully.

The ballast resistor used to replace the valve heaters in the original hybrid design consists of two $100\,\Omega$, 11W resistors each dissipating 10W and mounted close together just 13mm from the surface of the panel. There are several other hot little resistors, one or two of which are operated close to their maximum ratings: all of these are mounted close to the panel. This means that the panel is likely to suffer in the long run from the effects of overheating — though by then the set would probably have reached the end of its useful life.

The DR panel has a plus point in its teletext blanking, but we cannot see any reason to give preference to the design in other respects. The picture is perfectly satisfactory, but there is the concern one feels about the long-term effects of the rating and mounting of some of the resistors on the panel.

IF MODULES

The Pye hybrids were eventually replaced by a range of solid-state sets which were covered in these pages in some detail by Mike Phelan (see the September-November 1979 issues). One problem that assails these sets concerns the i.f. module. It's been mentioned on various occasions, and can be summed up as double-sided print, bad joints and trousered capacitors. To overcome this difficulty, both DR and LEDCo have introduced replacement panels.

At this point we must comment that we've never experienced any problems with repairing the offending Pye panel using the means advocated by Mike on page 642 of the October 1979 issue. Perhaps regular readers will recall the Trundle mean streak — make do and mend is better than cough up and send! For those who don't want to get involved in this type of repair however the replacement modules do offer a most adequate substitute.

We had one of each type for review, the LEDCo 915 module and the DR "IF Gain Module". Both use a single-sided panel, with more robust print tracks than the Pye original, and both up-date the circuitry by using a Plessey SW150 SAWF to form the i.f. passband.

LEDCo have opted for a low component count of 24 by using a single transistor to drive the SAWF whose output feeds the differential inputs of an 8-pin MC1349 i.f. amplifier chip. A.G.C. is applied to the chip.

DR Developments on the other hand use a circuit which follows the original design more closely — apart from the use of a SAWF that is. There are three transistors, the first driving the SAWF and the other two providing the gain thereafter, the first of these being gain controlled. The component count is 32.

The relative merits of these two approaches to the problem are not really important, since both give excellent performance and neither is likely to break down. If they should, normal diagnostic and repair methods can be used — a circuit diagram comes with each module.

On test, both modules worked very well, giving results comparable to a very well aligned conventional coil strip. We suspect that the performance obtained from the set once the module has been fitted depends more on the alignment of the vision detector coil, the luminance channel frequency response and the condition of the c.r.t. than on the replacement module's i.f. response. Thus any small differences in the performance of the modules is likely to be masked.

Neither module requires any adjustment, neither does the

set into which the module is fitted. We would not hesitate recommending either module to anyone who cannot or doesn't want to repair the original Pye panel.

PRICE AND AVAILABILITY

The LEDCo 915 module is available from LEDCo, 21 Clifford Road, South Norwood, London SE25 5JJ at £11.45. The DR Developments CDA panel is available at £19 and the IF Gain module at £9.50 from Lloyd Electronics, 63 North Parade, Grantham, Lincs. All prices include VAT and post/packing, and quantity discounts are available.

DR Developments have recently added to their range a replacement power supply panel for the Rank A823 solid-state colour chassis. The Rank panel is another one that tended to suffer from burn ups, mainly due in this case to the VA1104 surge limiting thermistor. To overcome this particular problem, DR Developments use a slow-start arrangement. For further details, see *Teletopics*, July 1980, page 482. The panel is available from Lloyd Electronics at £17.50. We hope to try one out in due course. The replacement panel strikes us as a sound idea since a defective Rank power supply panel can affect the adjacent decoder panel, leading to quite an expensive repair bill.

VCR No-colour Faults

Steve Beeching, T.Eng. (C.E.I.)

FROM time to time one is going to meet a Betamax or VHS machine with the no colour fault. Before diving in with the soldering iron to change the colour chip, read on.

Colour signal processing takes place during record and replay in these VCRs, so any number of discrepancies in these circuits can cause loss of colour. In previous issues (see the May and June issues this year) I described the colour record/replay systems used in these machines. The purpose of the present article is to deal in greater detail with a part of the system that's caused some problems. The specific circuitry described is that used in the Sony Betamax VCR — the Sanyo and Toshiba versions are the same however.

Colour Processing System

Fig. 1 shows a block diagram of the system, with the colour subcarrier recovery arrangement operating in the replay mode. The off-tape colour signal, with a 685kHz or 689kHz subcarrier on alternate tracks, is mixed with 5.119MHz or 5.123MHz carriers (these frequencies have been rounded off to simplify matters), the resulting difference signal being the required 4.43MHz one. The 5.119MHz and 5.123MHz carriers are obtained from the 4.43MHz signal provided by a crystal oscillator after adding 685kHz or 689kHz, the latter two signals being obtained from a phase-locked loop which is locked to the replayed line sync pulses. It's the phase-locked loop that's our main concern here.

The loop contains a variable-frequency oscillator (VFO) whose output is divided by eight to give 685kHz or 689kHz. The oscillator's output has to be switched at 25Hz, i.e. track-by-track. The reference for this switching is a pulse obtained from a pick-up coil mounted near the head

assembly. The pulses are delayed and then applied to a flip-flop. This produces a 25Hz squarewave that controls the switching. I've called this V/2, i.e. half field rate. The other input to the phase-locked loop consists of line pulses (fh). In the record mode these are obtained from the video input signal; on playback they are obtained from the replayed video signal.

A fault in this circuitry can cause no colour recording or no colour on replay. Whenever you encounter the no colour fault, first establish whether the trouble is on record or playback – by playing a known good tape.

Circuit Action

As with any loop system, the story has to be picked up somewhere. The VFO can be considered as the system's clock, so we'll call its output the clock pulse output. This is as good a point as any at which to start. Fig. 2 shows the relevant circuitry in greater detail while Fig. 3 shows the various pulse waveforms.

Say the clock is running at 5.48MHz. Its output, suitably squared, is being counted by IC8. Fig. 3 picks up the count at 321. Two outputs (÷4 and ÷8) are combined in the nand gate IC11/1 with the V/2 signal which is in its high state. The output at pin 6 is high unless all three inputs to the gate are high, when the output goes low. The ÷8 output from IC8 also goes to gate IC11/2, where it's combined with the output from IC11/1, giving the CK input to IC9/1 – a gated bistable. A rising edge at the CK input plus the appropriate state at the D input initiates reset of IC8's count. The ÷8 output from IC8 is in addition fed to the ÷44 counter in IC12 to give a line rate output we'll call f'h. This is compared with fh in the a.f.c. i.c. (IC6), whose output controls the frequency of the VFO. Note that after a count

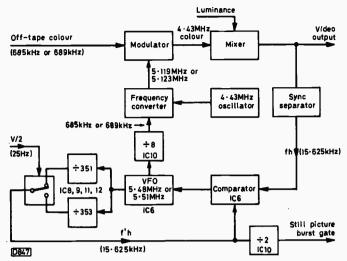


Fig. 1: Block diagram of the colour signal processing system used in Betamax VCRs. The recorded colour subcarrier is at 685 or 689kHz on alternate tracks. This is mixed with a 5.119 or 5.123MHz carrier in a balanced modulator to produce the 4.43MHz colour signal required for playback. A rather elaborate system, including a phase-locked loop, is used to produce the 5.119 or 5.123MHz carrier (see text). Missing signals anywhere in this area will lead to loss of colour.

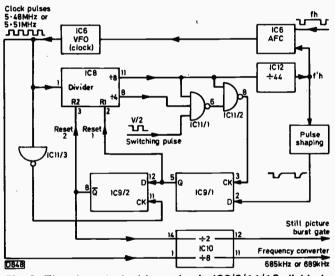


Fig. 2: The phase-locked loop circuit. IC8/9/11/12 divide by 351 or 353 on alternate tracks.

of 351 f'h will be slightly ahead of fh, while after a count of 353 f'h will be slightly later than fh. The error signal applied to the VFO thus varies, with the result that the VFO gives the 5.48MHz and 5.51MHz outputs required.

A pulse shaper puts a slope on the trailing edge of f'h. This is important! Compare (Fig. 3) the two inputs to bistable IC9/1, CK and D (f'h). After f'h sends the D input low, the next rising edge at the CK input triggers the bistable provided the trailing edge at D has risen high enough.

The output from IC9/1 is the "reset 1" input to IC8 (pin 2). IC8 requires both its reset inputs to be high before it responds. Therefore the output from IC9/1 is also fed to the D input of bistable IC9/2, whose CK input consists of the clock pulses after inversion by IC11/3. The action of this second bistable is similar to that of the first. Reset 1 at pin 12 sends the D input low, and the next rising edge at the CK input triggers it. This corresponds to a count of 328. When reset 1 ends, input D goes high again and the next clock pulse resets IC9/2. This gives the "reset 2" output, which is shifted by a clock pulse interval and inverted by

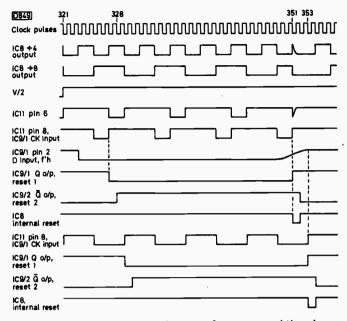


Fig. 3: Timing chart – the pulse waveforms around the phase-locked loop. Note that the shape of the waveform at pin 8 of IC11 depends on whether the V/2 signal is high or low.

being taken from the Q output.

All this activity is required to provide IC8 with two reset inputs that are coincidentally high for only one clock pulse period. This resets IC8 at the count of 351. To count 353, the V/2 input must be low, holding gate IC11/1 off. The output at pin 6 is then high, the second gate acting as an inverter. The CK input to the first bistable is thus an inverted version of the +8 signal. The D input to IC9/1 is as before, but this time the rising edge that initiates reset occurs two clock periods later, i.e. at a count of 353.

The output for the colour carrier frequency conversion stage is not taken from within the loop. Instead, the clock pulses are taken to a separate $\div 8$ counter in IC10 – probably because the $\div 8$ output from IC8 is already driving three inputs and is thus well loaded. IC10 also has a $\div 2$ counter which is fed from IC9/2. This is simply a convenient way of picking off line rate pulses for the still picture circuit.

Faults

Faults we've had in this part of the VCR have been absent line (fh) and V/2 pulses, mainly because of dislodged plugs and sockets. A more complex problem arose when bistable 1 (IC9/1) went intermittent, as a result of which the whole loop failed because IC8 was being held reset. It was difficult to decide where the fault was, but eventually a check revealed that both the Q and Q outputs of IC9/1 (pins 5 and 6) were high. Replacing IC9 cured the fault.

A few tricks can be used to check parts of the loop. The V/2 input can be kept in the high state by earthing the base of Q38 or in the low state by earthing the collector of Q38. A frequency counter can then be used to measure the count. Another point is that a dual-beam scope can be used to see and compare the CK and D inputs to IC9/1. This enables you to see the points on the sloping, trailing edge of the D input at which the reset edges occur. The display is difficult to lock and is confusing without inhibiting the V/2 input.

I'm not going to pretend that fault-finding in this area is easy. The service manuals are not too clear, and contain errors. I hope this article has provided some insight into what goes on however.

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PAL

Components for TV

Part 4

Harold Peters

WE said at the outset that we wouldn't go into valves and semiconductor devices. There's one point worth making however — the use of semiconductor devices to replace valves, for example the "solid-state PL802". This is quite a good way of keeping an otherwise good elderly set going. Similarly, it's perfectly in order to replace indicator lamps with LEDs.

If, after what has been said in previous instalments, the reason for the use of a particular item in a set is still obscure, you may find the answer by measuring its dissipation in use and comparing this with the component's specification. One reason for the success of our oriental friends is the way they design their sets to run well within the ratings of the components and the board material used. As a rough guide, if a component is operated at just over half its maximum rating (or less) it will have a long life. A 63V capacitor operated at 50V has only 13V in hand for flashovers, surges and so on. Resistors that dissipate watts warm the inside of the rest of the set, while hot coils invite shorted turns by raising the temperature of the insulating varnish to near melting point.

Some of the worst problems arise from the use of underrated semiconductor devices - an inheritance maybe from the days of valves, which are relatively tolerant of overloads etc. Data books often quote transistor dissipation at a typical junction temperature - typical because it's almost impossible to measure. The nearest you can get to the junction is in the flat type of output transistor, where the metal disc that presses against the heatsink is connected directly to the substrate and is at a temperature only 2° different from the junction. If a thermocouple is inserted here, theory and practice can be brought together. What if you find that things aren't as you expected? This could mean that allowance has not been made for a complex timebase waveform sitting on top of the d.c. bias. Another possibility, especially with small transistors that feel much hotter than you would expect, is that they are very close to a large dissipator of power. There's not much that the user can do of course, other than to ensure that there's adequate ventilation. Removing the back is not to be recommended, since apart from the danger the back has holes that provide a chimney effect to aid the ventilation.

DELAY LINES

Back to our passive components then. Colour sets incorporate two different sorts of delay lines. The luminance delay line is used to compensate for the different bandwidths of the luminance and chrominance channels, while the chrominance delay line delays the chroma signal for one whole line to enable the PAL-D decoding process to be undertaken.

Luminance Delay Lines

Luminance delay lines usually have a delay time of about 400nS (0.4μ S), and behave like a bit of coaxial cable. Provided it's correctly terminated, the delay line will delay all frequencies presented to it equally. Until the advent of the lumped inductance line, which has only just appeared,

the form taken by the luminance delay line has consisted of a winding, with many turns of thin wire, over a foil covered with a pattern of metallic patches. The biggest of these – the middle one – is connected to chassis. Electronically the line looks like an infinite number of coils connected to an infinite number of capacitors (see Fig. 21).

The line should be terminated at each end with its own characteristic impedance — usually of the order of $1\cdot 5k\Omega$. It seldom is in practice, because the devices on each side are usually i.c.s which have somewhat flexible input and output impedances. The delay can be varied to suit the circuit by varying the number of turns of wire used for the winding. Changes of up to 100nS can be made in this way without altering the line's other characteristics unduly. Most luminance delay lines attenuate the higher frequencies, and it's common practice to build compensation into the end of the winding — a few turns are deliberately carried on past the end of the foil, giving an h.f. lift to compensate for the losses in the line.

The two most common failures are the coil going open-circuit (the wire is only 0.05mm), or the pin to the PCB becoming dry-jointed. Both faults give loss of luminance with the colour maintained. The open-circuit in the coil usually occurs at a termination, and you can afford to lose a turn or two in order to repair it. If a double luminance image appears, the foil has become disconnected from chassis.

The delay time can be checked using the full field pulse and bar test signal that's radiated daily before the start of all BBC transmissions. Override the colour killer and check the chroma/luminance pulse just to the left of screen centre — to see that the blue-green coloured signal fits fairly well over the grey luminance pulse.

Chroma Delay Lines

To delay the chroma signal for exactly one line, it's converted from an electrical to an ultrasonic signal, sent down an "echo chamber", picked up 64μ S later and converted back into an electrical signal (see Fig. 22). To start with heavy lumps of glass were used. You need a 160mm length of glass (about 7in.) to delay an ultrasonic pulse for 64μ S. The conversion is done by a pair of transducers mounted at the same end of the line: this permits a reflecting surface at exactly the right distance away to be ground at the other end while measuring the line under signal conditions. All the other surfaces of these early lines were made crinkly to disperse spurious reflections.

Modern chroma delay lines – commonly known as billiard table lines – use a multiple reflection path to enable the 160mm to be folded up. These are "guided lines", with the vertical component of the ultrasonic wave concentrated, headlamp style, straight down the plane of the line. They are very thin therefore, about 0-8mm (160/283-5mm for pedants). To absorb stray reflections, pillars of epoxy resin are printed on to the flat glass surfaces at points outside the beam. You can make your own pillars by dropping blobs of solder or flux on to the line – even sticky fingers provide good attenuation.

To say that the delay is $64\mu S$ is not exactly true. Unless

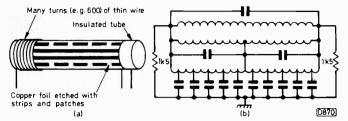


Fig. 21: (a) Luminance delay line, conventional construction; (b) equivalent circuit. The line is equivalent to an infinite number of tuned circuits, behaving in a similar manner to a long length of coaxial cable though with a higher impedance. Altering the number of turns varies the delay time.

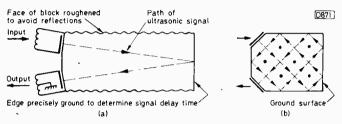


Fig. 22: (a) Early type of chroma delay line. (b) Current "billiard table" type of chroma delay line. Despite the reduced size, the path length is the same. Efficiency is improved by making the glass one cycle thick and placing epoxy pillars "off beam" to absorb stray reflections.

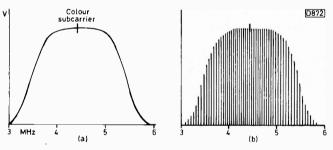


Fig. 23: (a) Chroma delay line frequency response, with direct signal path added. (b) The same swept slowly – the output undulates as the direct and the delayed signals add and subtract with change of phase. For this reason the chroma delay line with its associated circuitry is often called a "comb filter".

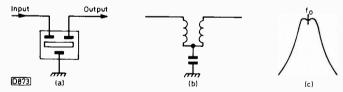


Fig. 24: Ceramic filter. (a) Usual symbol. (b) Equivalent circuit. (c) Frequency response.

it's a Secam line that is. Secam uses f.m. colour, and relies on sidebands far away from the subcarrier, so its delay lines need to have a good bandwidth. The broadest bandwidth lines are picked for Secam, and we get the rest for PAL. Because of the half-line, quarter-field offset employed in the PAL system to make the subcarrier dots crawl diagonally across the raster to reduce their visibility on monochrome sets, the PAL subcarrier is not an exact multiple of the line frequency. The delay line has to provide an output that's in phase with the direct signal, and this means that the delay time is actually 63.943 µS. Small coils are provided at each end to provide a fine trim so that the delay is exactly right.

When this condition is met, raising the applied subcarrier frequency by one cycle (Hz) will result in the output dropping from maximum, through zero to negative, then

back again through zero to maximum. You can see this if you look at a colour bar display with an unlocked reference oscillator. Red changes to green and back a number of times, with bands of no colour in between. This action goes on right through the sidebands, and if viewed on a slow sweep looks like a series of teeth (see Fig. 23).

CRYSTALS

A quartz slice cut and ground in a certain way and then sandwiched between two electrodes behaves like a very high inductance in series with a very small capacitor. It can be made to oscillate at a fixed frequency determined by the grinding process therefore. This provides a very stable oscillator which can be varied only very incrementally by means of a small adjustable padding capacitor. A varicap diode can be used.

Such crystals are used in the colour decoder's reference oscillator stage — at either 4.43MHz or, more recently, 8.86MHz, i.e. twice the subcarrier frequency. The latter enables a very accurate 90° phase shift to be achieved by simply dividing the output by two. A 6MHz crystal is used in teletext decoders, to provide the dot rate generator from which all characters and the line and field pulses are derived by dividing down.

CERAMIC FILTERS

A similar device is the ceramic filter. These are piezoelectric devices that resonate or "twist" – just like a record pickup of the same type – with the applied a.c. They are usually drawn as a pair of mutually coupled resonant circuits (see Fig. 24). The input signal twists the ceramic, the twist inducing a secondary voltage in the output plate. The resultant characteristic is like that of a bandpass tuned circuit.

The main application is as the 6MHz input circuit in the intercarrier sound channel. More recently the sound discriminator's quadrature coil has sometimes been replaced by a ceramic filter. While the 6MHz input filter is a symmetrical device capable of working both ways round, the discriminator filter needs a phase reversal to give the correct S curve. One section of the device is reversed with respect to the other therefore, the device being polarised.

SURFACE ACOUSTIC WAVE FILTERS

You can combine the principles of all the above mentioned devices into a unit with an encapsulation no bigger than an output transistor to obtain a device that will provide all the i.f. shaping required in the receiver. This is the surface acoustic wave filter, which we'll mention only briefly since detailed consideration has been given to it in these pages before (see for example pages 645-9, October 1976). When one of these devices is used to replace the discrete component filter unit, it's necessary to arrange the i.f. strip as follows. An i.f. preamplifier is needed to counter the SAWF's insertion loss, which is fairly high. The SAWF should be followed by a synchronous demodulator (exalted carrier or quasi-synchronous type, as used in most recent TV designs). And the earth path layout recommendations should be followed, otherwise funny effects can occur.

A properly designed SAWF circuit has a superior group delay characteristic compared to the equivalent discrete coil arrangement, but in bulk production this superiority can be easily negated as a result of production spreads. This makes the hand-aligned coil strip as capable of giving a regular result.

Service Notebook

George Wilding

Poor Vertical Linearity

The fault on a Pye hybrid colour set was poor vertical linearity – the base of the raster being somewhat cramped and the top unduly extended. The field timebase panel in these sets gives little trouble, field collapse usually being due to the absence of one of the three l.t. supplies to the panel. Our first step was to adjust the two linearity presets to see what effect they had. RV24, which sets the output stage mid-point voltage, had considerable effect, but RV23, the feedback linearity control, produced no effect at all. It seemed then that RV23 was probably dry-joined or had a break at one end of its track. At this point however the field linearity suddenly righted itself, and careful examination around RV23 showed that the $15\,\Omega$ resistor (R261) in series with it was of the type that has circular end caps, one of which was only loosely attached.

Replacing R261 and readjusting the presets restored perfect field linearity, but good focus overall was difficult to obtain. Examination of the screen showed this to be due to bad flaring by the green gun. Usually of course it's the red and blue guns that first show this symptom when a tube ages.

Low LT

The complaint with a Thorn portable fitted with the 1590 chassis was "no results". On switching on we found that there was a pronounced grating noise from the speaker as the volume control was advanced, but nothing else. It seemed likely that the l.t. voltage was low. The input to the series voltage regulator transistor was found to be correct at about 12.5V, but the output at its collector was only about 5.5V. Both the transistor and its $10\,\Omega$ shunt resistor were running warmer than usual, so clearly there was a partial short across the l.t. rail.

Inspection showed that the boost diode was very discoloured, indicating a fault in the line output stage. Now the reservoir capacitors for the rectifiers fed from the line output transformer often give trouble in these sets, but both were cool and with perfect casings. The next likelihood was the line output transistor itself, and on isolating its emitter and base connections a severe collector-base leak was discovered. Replacing the transistor and boost diode restored normal results.

No Colour

There was an excellent monochrome picture on an ITT colour set fitted with the CVC5 chassis – but total absence of colour. Now in any colour set the first step when confronted with this symptom should be to override the colour killer. The easiest way of doing this in the CVC5 chassis is to connect a $10 \, \mathrm{k} \, \Omega$ or $12 \, \mathrm{k} \, \Omega$ resistor between the positive side of C152 (8 μ F), which decouples the supply to the chroma amplifiers, and the positive side of C162 (4·7 μ F), which smooths the colour-killer bias applied to the base of the delay line driver transistor T29d. These capacitors are quite close to one another, and are easily bridged with a suitable resistor. The result was fairly strong colour, though of incorrect hue and with Hanover bars. The

fact that the colour was locked however showed that the burst and reference oscillator circuits were working correctly, whilst the presence of colour proved that the chrominance channel was operational. Clearly the fault was in the colour-killer department.

A somewhat unusual arrangement is used in these sets. The colour-killer turn-on voltage is obtained from the collector of one of the transistors in the bistable circuit. The bistable trigger pulses are removed on monochrome, but on colour the bistable starts (or should start) switching and the resultant squarewave at the collector of one of the transistors is smoothed and used as the colour turn-on bias. A voltage check at the collector of one of the transistors showed that the bistable circuit was not switching despite a colour signal being present. A check on the transistors then showed that one (T36d) had an open-circuit base-emitter junction. A replacement restored the colour, and after slight adjustment of the static convergence magnets a first class picture was obtained.

A Frustrating Experience

Sometimes the simplest of faults can be the most frustrating to cure. For example, we were called to see a hybrid Pye colour receiver with the complaint "bad colour". This was due to one or more dry-joints around the green PCL84 colour-difference output valve — pressure on the panel in the valve's vicinity would cure the complaint. Suddenly however all the valve heaters went out, though the sound remained.

When this happens in a hybrid colour set of any kind the first suspect is always the PY500 boost diode. In view of the suspected dry-joints on the CDA panel however we decided to check the heater chain on this first. It turned out to be continuous, so clearly the fault was on the large power supply/line timebase panel where the other three valves, plus the diode dropper, the thermistor and the dropper resistor, are mounted. The heat from the thermistor and the 22Ω dropper resistor (R303) often causes bad connections on the board, though none were apparent this time and the components were intact.

The problem was eventually traced to a very bad contact at pin 5 of the PY500's valveholder - though not without difficulty since there are slight differences between the course of the heater supply in earlier and later versions of the chassis and we didn't have all the circuits to hand. What proved the point was that pushing the PY500 over to one side would restore heater continuity. You sometimes get dry-joints at the base of this and the PL509 due to heat, but this time the soldering was still perfect. The problem was that the spring-like contact for pin 5 of the PY500 had become widened: with care, we managed to close it up, using the large, strong needle we carry with us for this purpose. Prior to making tests to discover the cause of the poor colour we'd had to turn the cabinet of this large 26in. model around, and this had apparently been enough to loosen the PY500 just that little bit more in its holder.

Line Scan Problems

The complaint from the owner of a set fitted with the Thorn 3000 chassis was that the picture width had decreased gradually over a period of a few weeks, so that there was now a considerable gap at each side. Furthermore, all vertical outlines had a "corrugated" appearance. The first obvious step was to check the h.t. voltage, which turned out to be correct, while the main electrolytics, which tend to dry up or even go open-circuit in older versions of these sets, appeared to be in order. Attention was turned to the line timebase panel therefore, and on removing this we noticed

that L502, in the h.t. feed to the line driver and output stages, had no core – in fact the core had fallen out on to the decoder panel beneath. Replacing the core, this time with a little locking compound, plus a little adjustment, restored a full sized picture free from vertical irregularities.

No Results

We were called to see a dual-standard hybrid GEC colour set with the fault "no results" - due to a blown mains fuse. Now it takes a fairly heavy direct or indirect short to blow this fuse on any type of set, so it was prudent to check the main possibilities before changing the fuse and switching on. The first step was to check the mains filter capacitor, which seemed to be in order, so we went on to check from the top cap (cathode) of the boost rectifier to chassis. Not surprisingly, with the meter on the ohms range we obtained a leakage reading – of a little over $2k\Omega$ in fact. Now the main possibilities when you get a leakage reading from this point to chassis are: (1) a heater-cathode short in the boost rectifier; (2) a leaky or short-circuit pulse capacitor providing line output transformer third or fifth-harmonic tuning; (3) a short from the primary winding of the line output transformer to the earthed frame or an earthed secondary winding; or (4) a short-circuit boost capacitor where this is returned to chassis rather than the h.t. line. Though extremely rare, another possibility is an internal short in the line output valve, between the anode and an earthed electrode.

Our next move was to disconnect both valve top cap connectors, thus eliminating the two valves from the search. The leakage reading remained, and the odds were that the boost capacitor was in order — when it does break down, unfortunately quite often, it usually goes dead short. The reading from the PY500's top cap to chassis would then be low, certainly not as high as $2k\Omega$. Similarly, when a line output transformer's insulation breaks down it usually does so completely — especially in colour sets. So the prime suspect was a harmonic tuning capacitor. These don't usually go short-circuit suddenly, but progressively increase their leakage as the leakage current increases their temperature, in a cumulative manner. Often the first sign is decreasing width, plus a faint burning smell, before the viewer switches off or the fuse blows.

We couldn't see any ceramic pulse capacitors until the small earthing plate behind the valves was removed. We then discovered C83 (200pF), which was blackened on one side and cracked in two almost as soon as it was touched. On replacing it and switching on, a good picture was obtained, and despite the heavy overload current before the fuse blew the PY500 seemed to be o.k. — as always we gave it a tap or two to see whether there were any internal sparks.

Had there been no leakage from the PY500's top cap to chassis, the next step would have been a check on the h.t. supply.

Problems on a 1500

"The height keeps altering" said the voice on the phone. "Sometimes the screen is full, and at other times there's a black band at the top and bottom, varying spasmodically at times." The set was fitted with the Thorn 1500 chassis, and the trouble could have been due to several causes. The main thing however is to see the extent to which the linearity is affected when the height is reduced.

Fortunately the picture height was at about minimum when we called and, being more compressed at the top than at the bottom, it was clear that the fault was in the output rather than the oscillator part of the field timebase. Not

unexpectedly, a new PCL805 valve made no difference, so the next move was simply to hold a $100 \mu F$ test electrolytic between the pentode cathode pin and chassis. This cured the trouble, indicating the need to replace the decoupling capacitor here (C79, $160 \mu F$).

After doing this, we noticed that the focus was poor, the control having no effect. This fault is quite common on these sets after they've had a few years' use, and is usually due to $R120 \ (1.5 M\Omega)$ in the feed to the focus control going open-circuit. The surprising thing is that the owners seldom complain about the poor definition — possibly because the resistor progressively goes higher in value before finally succumbing.

Awful Picture

The picture displayed by a Pye colour set fitted with the 697 hybrid chassis was over-bright and bleary, with severe smearing. When the test card appeared, the h.f. definition was so poor that the 2MHz grating could hardly be resolved. Since the timebase locking was perfect and optimum picture quality coincided with maximum sound, there was almost certainly a fault in the luminance channel rather than i.f. misalignment – the i.f. bandwidth needs to be in excess of 2.5MHz to preserve the shape of the field sync pulse in particular, a response markedly less than this invariably producing weak field lock.

The brightness control acts on the PL802 luminance output pentode's control grid circuit, and though working to some extent could not reduce the brightness level to normal. The luminance output stage was strongly suspect therefore, the symptoms suggesting that the value of the anode load resistor had markedly increased. This would reduce the video bandwidth, while the resultant low anode voltage would produce excessive brightness.

The anode circuit consists of a peaking coil (L50) with parallel damping resistor (R355, $10k\Omega$), the load resistor itself (R354, $2.7k\Omega$), and R353 (680 Ω) to the h.t. line, decoupled by C352 ($32\mu F$) – the latter network increases the l.f. gain. Our first suspicion was that L50 was open-circuit, thus adding $10k\Omega$ to the value of the total load resistance. The continuity of L50 was o.k. however, and the trouble turned out to be that R354 was open-circuit – at least, that's how it read on our meter. Presumably the PL802 had been kept operational due to the h.t. connection to its anode via the c.r.t.'s cathode drive controls. Anyway, replacing R354 restored a good picture with normal brightness control action.

Two Quickies

A couple of quickies. No results but all valves glowing on the Decca Bradford hybrid colour chassis is almost always due to the h.t. rectifier's surge limiting resistor R603 (3.9\Omega) going open-circuit. It's mounted across the power supply panel, which must be removed to make repairs — after removing the vertical timebase panel. As everything plugs in, this can be done quite quickly — but remember the long flying lead from the timebase panel to the sync pin on the main board.

Secondly, intermittent loss of picture and sound on the Pye 725/731/etc. solid-state chassis, accompanied by severe sparking from the power supply panel at the bottom right-hand side of the cabinet (and soon resulting in permanent loss of sound and raster) is often caused by bad contact and arcing between one or other of the two lugs between the mains input choke L909 and the printed wiring. Scrape away any carbonisation on the panel before resoldering the lug to a jump lead.

Long-distance Television

Roger Bunney

SPORADIC E reception continued well into July. There were some quite dramatic openings, giving many enthusiasts the sight of really exotic signals. Of particular interest is the number of sightings of Arab signals on channels E2, 3 and 4 — more on this later. My own activities have been somewhat irregular this month as a result of a week's holiday with the family at Swanage, atop the cliffs (using a 5in. Panasonic portable!) followed on my return by a severe bout of tonsilitis. The latter unfortunately coincided with a period (the 23rd-25th) during which an excellent tropospheric opening seemed to be developing. On recovering I was rewarded with an afternoon SpE spell which produced RTVE (Spain) and RTP (Portugal). This was on the 30th. The log for the period is as follows then:

4/7/80 TSS (USSR) ch. R1; TVP (Poland) R1, 2; MTV (Hungary) R1; NRK (Norway) E2, 3, 4; SR (Sweden) E2 twice, E3.

7/7/80 An evening SpE opening produced many East European and Scandinavian programmes.

8/7/80 SR E2; TSS R1.

9/7/80 TSS R1, 2.

10/7/80 TSS R1, 2, 3, 4; TVP R1, 2, 3; CST (Czechoslovakia) R1; SR E3; NRK E2; RAI (Italy) IA, B; RTVE E2, 3, 4; RTP E2, 3; plus many unidentified signals.

This was an interesting day. Though at work for most of the time, reports suggest that conditions were excellent all day. Before 0900 I had RAI IA, B and JTV (Jordan) E3. During the evening, from 1830, TSS R1, 2; RTVE E2, 3, 4; RAI IA; SR E2, 3, 4; NRK E2, 3, 4; and RUV (Iceland) E4 were received. At 2120, system M (525-line) signals were noted here on ch. A2 – see later.

13-20/7/80 On holiday at Swanage, using the 5in. Panasonic portable reviewed last month. Reception of sorts was obtained at the clifftop flat with a 12ft. wire. In view of the signal from Rowridge, a ch. B3 sound notch filter would have helped. The best logging was YLE (Finland) E2 on the 18th. Other countries received during the week were TSS, TVP, CST, MTV, RTVE, RTP and SR on chs. E2, R1 and R2. There was tropospheric reception from TDF (France) at u.h.f. on the evening of the 16th – fantastic signal levels, but dead channels the following day.

20-23/7/80 Nightly reception from Scandinavia on chs. E2, 3, 4.

23-24/7/80 On both mornings from 0750 onwards MTV-1 was present at high signal levels on chs. R1 and R2.

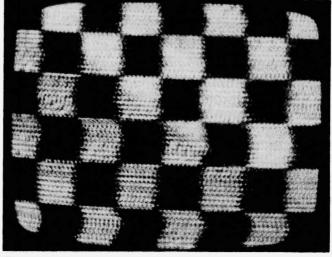
30/7/80 RTVE E2; RTP E2, 3.

The most dramatic and unusual logging was on July 11th, with system M ch. A2 vision and sound from 2120-2300 BST. At the start SR was fading out on ch. E3. The new signal was seen floating over ch. E3 but was clearly unsynchronised. After adjusting the sync, an image that was obviously on ch. A2 was obtained (last winter's F2

experiences confirmed that!), while the matching sound channel produced suitably accented audio. Unfortunately the signal was mainly at noise level, with occasional lifts to give recognisable images - apparently puppets/Muppets, a rapidly upwards moving rolling caption at 2159, another at 2202, and people talking, but all too vague to be able to identify anything positively. A margarine commercial was noted however. The signals faded at 2300, with very spaced out fades up from the noise. Sound was monitored on the above mentioned portable, and this was perhaps of greater help than the visual displays. I assume that the signal arrived via a double-hop path (RUV ch. E4 had been seen earlier), similar to the reception in late July 1978 when both ch. A2 and A3 signals were seen - the WTFL saga, which eventually turned out to be reception from CKCW-TV Moncton. I hastily phoned strategically placed DXers when the signal was noted, but mine seems to have been the only logging. Did anyone else see it?

Many letters have arrived reporting other signals during the period, and the Arab content is most interesting. JTV was present on the 13th, 15th and 17th, and on the 15th Hugh Cocks sighted colour bars on ch. E2 at 1800 followed by a flag at 1830 (approximately twelve horizontal stripes, with the pole on the right-hand side, on a grey background) then the station opening and a programme with French spoken sound, similar to TF-1. Hugh suspects that this was Lebanon. He also noted a mystery Arab signal on ch. E2 during the mid-afternoon of the 20th – suspected Dubai. On the 21st, Hugh had Albania ch. IC at 2115.

Ray Davies presided over a mini-DX-TV convention, which included several Dutch friends, at his Norwich location during the 11-13th. For once such a gathering actually witnessed DX signals in profusion! Of particular interest was Gwelo, Zimbabwe ch. E2, received via TE on both the 12th and 13th at 1750-1805, and Ray's reception of Syrian sound on ch. E4 between 1800-1900 on the 14th. Ray also reports excellent u.h.f. tropospheric reception during the 21-26th, peaking on the 24th when Band III transmitters were received as well. Tropospheric



The mystery ch. E3 chessboard pattern, phographed by Keith Hamer. It's thought to be from an Italian "free" station.

propagation was present again on the evening of the 22nd, with Switzerland, Spain and RTE (Eire).

In all then an excellent and varied month.

Several enthusiasts have reported seeing a small black chessboard pattern on ch. E3. It's thought to come from an Italian "free" TV transmitter. The only clue to date is the caption "TV Nocoj" that followed the fade out of the chessboard – this was seen by Mark Baldwin (Rugby) on July 7th at 1900 BST. The photograph shown was taken by Keith Harmer (Derby) 45 minutes after Mark's logging!

Mike Allmark has sent in a detailed letter describing his envious reception in Leeds. He specifically mentions the ch. E4 reception with Arab content that's been seen elsewhere, and wonders whether it's Syria or Lebanon. The situation in the latter country is as hazy as ever, though it's understood that the ch. E2 and E4 transmitters are now either in operation or about to be put "on air", with plans to increase powers.

News Items

West Germany: An agreement with France has now been signed giving the go-ahead for the satellite TV project—with two satellites transmitting at 12GHz to domestic terminals. The service is expected to start in 1983-4. The Steinkimmen ch. E2 NDR-1 transmitter closed down on July 1st.

Poland: A newly opened studio centre enables Szczecin to produce its own programmes as an opt-out from the main TVP-1 service.

Italy: We now have a more detailed list of some of the "free" stations transmitting in Bands I/II:

Ch. IA: TV NCT (Nord Centre Television); Tele Spazio Campano (at Sante Agato Dei Goti).

Ch. IB: Tele Trieste Mia (Trieste); Telespazio Quadrifonic (Rome); Tele Bari (Bari); Teleradio San Marco (San Marco); Radio Sud Television Video Fatamorgana; TVC4 Mori (in Cagliari, Sardinia); T.O. Sardegna (in Sassari, Sardinia); Teleor (in Oristano, Sardinia).

Ch. IC: Tele Sud Italia; Radio TV Atri.

Our thanks to Brian Fitch and Keith Harmer for this information. Given the right SpE conditions, reception of all these stations is possible in the UK. Note that NCT transmits on ch. E3, not ch. IA as Italian listings suggest.

UK: The IBA's latest Pocket Guide to Transmitting Stations (dated June 1980) has been issued and includes dates for the first 405-line transmitter closures. It's available free from IBA Engineering Information, Crawley Court, Winchester, Hants SO21 2QA.

From our Correspondents . . .

Graeme Wilson (Middlesborough) is using a much modified Thorn 1500 chassis, with selectivity switching by means of three input selectivity modules from the Bush TV161 series connected in cascade and adjusted to give a 2MHz vision bandpass. Despite the cascade connection, the insertion loss is low. He's also experimented with replacing the BF196 in the Philips G8 selectivity module, using a BF256 f.e.t. The advantage is improved noise performance, but mismatching lowers the gain. Graeme would be interested in hearing of anyone else's efforts along these lines. He also uses switching to operate the tuner and i.f. strip only, extracting the sound from an emitter-follower after the volume control. The idea is to provide signal monitoring without running the power consuming sections of the set. The video is fed into a small audio

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Optimax 14 (FM)	Band 11 W/B	14	£57.50	£48.88
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amplifier/power supply (which also powers the signal circuits), and if signal activity is detected the whole unit is run up.

Alister Pink (Ilkeston) has received excellent ch. E2 signals from RTVE Madrid using a Ferguson 3787 colour portable fed from a Band II f.m. array, while a London enthusiast has received Band I SpE signals using a Wolsey Colour King u.h.f. array... Any other unusual aerials in use?

On July 7th Arthur Milliken noted the RETMA test card on ch. R2. Any ideas? The time was 1100 BST. Bulgaria maybe? Arthur did well in logging Izana (Canaries) at 1245 and Amman (Jordan) at 1805 on the 13th, both on ch. E2 – obviously a good day!

Brian Fitch (Scarborough) mentions receiving the SABC overseas programme at just below ch. R2. Assuming that this isn't some form of amplifier cross-modulation, I would suspect that this must be due to third harmonic radiation. The time was 1755 GMT, and at this time the SA European Service uses a northerly beam at 21.535 or 21.695MHz. Since Band I isn't used in SA, no harmonic interference would be noticed there. It's a good pointer for TE propagation!

Wenlock Burton (Melbourne) reports receiving mystery u.h.f. (ch. 34) signals in his area – source unknown, and officially there are no such transmissions!

Geoff Perrin is really pulling in the signals on his 50ft. mast in Oman. He's had signals from Italy to the north west, from deep into Russia, from India in the east and unknown sources. He's also been seeing a mystery ch. E4 Arab signal from just west of north at his location 90kms north of Salalah in Oman. Apparently the Bahrain E4 news announcer has a logo that resembles the London Transport symbol at the upper right-hand side. Pakistan is received on a fairly regular basis (PM5544 test pattern with "PAKISTAN" and "TELEVISION" identifications and a digital clock across the centre), and he's received Bombay once. Iran ch. E8 uses the Fubk test card (it seems reasonable to assume that all the other NIRT stations use it as well) with both Arab and English identifications in the central black portion.

New Antiference Export Aerials

Antiference Ltd. (Bicester Road, Aylesbury, Bucks) have introduced two new ultra-wideband v.h.f./u.h.f. TV aerial systems intended for the export market. The MHX3510 provides a gain of 4dB in Band I, 6-9dB in Band III and 10-13dB over the ch. 21-48 spectrum. The MHX355 is a compact version for local service areas, providing a gain of 3dB in Band I, 5dB in Band III and 10dB at u.h.f. Though such systems are not ideal for DX use, it's interesting to see Antiference extending their range.

Whistling Colour Sets

Derek Snelling

THE problem of ear-splitting whistles from the backs of colour sets has always been with us. Over the last couple of years however, with the new generation of 110° sets, it's reached almost epidemic proportions.

The whistling is caused by the vibration of coils, chokes or transformers (and in older sets valves) at line frequency. Whether you hear the whistle depends to some extent on how old you are. At over 50 it begins to fade away, but your pet dog will suffer.

To cure the problem means preventing the offending component from vibrating. First however you have to locate the part. Unfortunately the fault is nearly always temperature dependent, occuring either when the set is first switched on, then fading away, or starting after the set has been on for a few hours. The reason for this is that expansion and contraction of the various parts affects their ability to vibrate. If you have the back off the set and it's whistling away, finding the offending part is a matter of lightly pressing the coils and transformers in turn. When you reach the culprit, the whistle will either disappear or change dramatically. Don't limit your search to the line output panel or area - many modern sets use a switchedmode or chopper power supply operating at line frequency, so this should also be checked. Don't forget the line output and boost valves in older sets.

Cures

The cure depends on which part is causing the fault. With valves, replacement is the only cure. Note that a new valve will sometimes whistle for the first few hours, then settle down. You may not be able to put up with it that long however. With transformers, the two halves of the core are usually held together by a clamp: slight tightening of the

nuts can provide a cure, but be careful not to overtighten them as this may crack the core. Coils and chokes don't usually have a clamp. A cure for these components is to spray the coil with a liquid plastic such as Servisol Plasti-Seal or Radiospares Anti Corona spray. Both of these sprays are designed to prevent arcing in e.h.t. circuits and thus have excellent insulation properties. They are best applied in two or three coats — if the coil is left in circuit, take care not to spray any preset controls. Another word of warning: these sprays give off a flammable vapour whilst drying, so don't switch on for about ten minutes after spraying.

Hints

If you have trouble in locating the faulty part, try tapping likely coils and transformers. If one whistles, however briefly, then that's probably the culprit. A few common offenders are: The line linearity coil (it's on the convergence panel) in the Philips/Pye G11 chassis; the raster correction transductor in hybrid ITT colour sets; the line linearity coil in the Rank T20A chassis; the line output stage valves and transformer in the Decca series 10 and 30 hybrid colour chassis; and the line driver transformer (despite a plastic sleeve) in the Decca 80/100 solid-state colour chassis.

One final point. I came across one set where the whistle was due to an electronic rather than a mechanical fault. The set was fitted with the ITT CVC20 chassis, and the whistle came from the chopper transformer in the power supply. Changing this had no effect however. ITT were contacted, and pointed out that the fault can be caused by the generation of unwanted harmonics in the power supply as a result of one or other of the small electrolytics being faulty.

The Philips Projection TV System

Harold Peters

In the early 50s projection TV receivers were quite common. Recent vintage TV articles in this magazine have outlined the basic techniques then employed, including the Schmidt optical system. In more recent times a number of Japanese colour projection systems have gone on sale in the UK. One of the latest colour projection systems to be introduced comes from Philips. It's being produced in quantity at the Philips Lowestoft plant, mainly for mainland Europe but also for the UK.

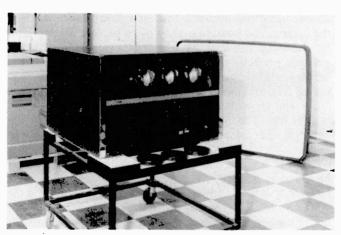
The set is in two parts. First a 60in. aluminised plastic moulded screen which can be either wall mounted or free-standing. And secondly the optical-electronic unit. This is housed in a low trolley that doubles as a coffee table. There are three single-colour 6in. c.r.t.s, each of which is linked to three specially constructed TV-Proclar lens assemblies.

So far as the user is concerned, setting up is simply a matter of positioning the trolley so that the centre lens touches a cord stretched to it from the screen corners.

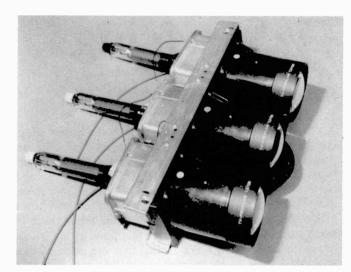
The Electronics

The electronic chassis is an adapted version of the standard K12Z direct-view chassis, with the three thick-film RGB output stages mounted on the three separate c.r.t. bases. There's adequate drive, and because of the narrow deflection angle of the three projection tubes the chassis has sufficient scanning power too.

Extra convergence is necessary, for as well as the three beams having to converge at the screen horizontally they also point slightly upwards. The convergence drill is quite straightforward however. Since there are three separate tubes, the effect of moving say red upwards does not, as with a delta-gun, direct-viewed c.r.t., displace green sideways. There's no elaborate gun switching either: you simply cover up the lens of the colour not required.



A complete set, with its screen, ready for packing.



The three tubes/lens assemblies before being cased.

The e.h.t. produced by the chassis is split three ways in a jelly-pot that contains the final e.h.t. smoothing capacitance – the tubes don't have the "Aquadag capacitance" of direct-viewed types.

A novel protection circuit has been devised to ensure that the tube screens aren't burnt by failure of any of the six scanning circuits or failure of any of the supplies. It blacks out the relevant c.r.t., at its cathode, as soon as a fault occurs. If the fault is transient, the picture slowly fades back in again from black level, but if the fault persists for longer than two-three seconds the set automatically switches to standby (i.e. the remote control "off"), making human intervention necessary.

Remote Control System

The remote control system used, called "Long", is inherited from the parent K12Z chassis. It has coloured bar tuning facilities on the screen for all the analogue controls (volume, bass, treble, brightness and colour) as well as for station tuning. The automatic contrast control system adjusts to compensate for the ambient lighting level.

The user has a choice of 29 programmable programme selections. These are stored in a memory when first set up. A small on-board calculator type battery, which is recharged when the set is running, keeps the memory going for up to three months between use of the set. Button 29 adjusts the time-constant for VCR use, while button 27 can be used for station hunting with the armchair handset. The same memory stores the users' preferences for the analogue settings mentioned above: they can be recalled instantly by pressing the "granny button".

The remote control system uses infra-red radiation, which is reflected from the screen to a receiver mounted alongside the projection lenses. In the same way, the twinspeaker hi-fi sound is beamed from the reflex enclosure in the "coffee table" towards the screen to prevent "disembodied sound" effects.

And it's UK Made!

In these troubled times, it's interesting and reassuring to note that the set is made in the UK for export to continental Europe, and that the design work for the electronic sections not part of the basic K12Z chassis was done in the UK.

Photographs courtesy Philips Electrical Ltd.

TV Servicing

S. Simon

A COUPLE of months ago we described the power supply circuit used in the Thorn 8000 (and related) chassis, and considered the servicing aspects. In response to a request from an avid reader and acquaintance, we're now going to have a general look at the run of the mill problems presented by these sets. As he said, it's nice to know how to tackle the power unit, but what happens when the tuner won't tune properly, or the picture is grainy, or the colours are completely wrong? We replied that the point of these articles has been to get the theory right first and then to see how it applied in servicing various makes and models. To this he countered that he'd prefer to have a practical run down model by model, so that he could quickly refer to a particular issue when a particular set came his way.

Well, we've come a long way since this beginners series started in the October 1977 issue. If you've followed us this far, you can't really be a beginner any more, can you? We hope not, anyway. Also, in recent issues we've dealt with some techniques that would hardly be the sort of thing a beginner would dabble with — the switch-mode power supply used in the Thorn 3000/3500 chassis for example.

So we'll drop the "beginners" bit from now on, and concentrate instead on giving practical notes and guidance on particular chassis. We hope readers will find this slightly changed approach acceptable.

Tuner Troubles

We thought that the mechanical aspects of the "1500" type tuner used in the 8000 chassis were by now well known and didn't need further explanation. Not so apparently.

There are two main defects that occur with this tuner. One is fairly obvious and doesn't need to be dwelt upon too much. The buttons push a bar which rotates the tuning spindle. This rotates the moving vanes of the various sections of the tuning capacitor so that as they close into mesh with the fixed vanes the tuning frequency falls — to channel 21 when the vanes are fully closed. When half open, the capacitors should tune to say channel 40, and when fully open to channel 68. It's quite common for the bar to be pulled away from the arms by the spring tension over a period. Before this obvious defect occurs, the bar can become loose on one side, making accurate tuning difficult.

It's not sufficient in this latter event to blob some solder on the loose side and return it to service. The bar should be completely removed, noting which side is presented to the push buttons — you'd be surprised at the number of tuners we find with the bar reversed, so that the ends of the buttons foul the edges of the bar. Having removed the bar, clean the ends and tin them. Repeat with the swing arms. Then refit the bar, close the arms over it, and solder the outside and top, leaving no solder on the inside to impede the button pistons. Note that if the bar is not straight the capacitor vanes will have differing travel and the result will be a grainy picture.

All this is straightforward and presents little difficulty. The second defect is not so obvious. The complaint may well be that the tuning is not accurate, and that some channels are completely unobtainable. This is due to the earthing springs not making good contact between the rotor

and the bulkhead or body of the tuner. A certain amount of grease is applied during manufacture, and this eventually hardens, preventing contact instead of enhancing it. While the application of grease solvent may help matters, it's preferable to remove the leaves individually, using a fairly heavy soldering iron. Clean them and the rotor, slightly bend the leaves, and refit them carefully. Do this and you won't have to buy a new tuner.

Plug/socket Problem

It's extremely common on these models to find that the picture suddenly becomes grainy, with perhaps loss of colour. While this can be due to many things, for example a faulty aerial socket (or plug, lead or aerial), or perhaps the r.f. transistor in the tuner, very often it's due to nothing more than poor contact in the i.f. input plug and socket on the lower left side of the combined i.f./decoder board (it's called the signals panel). This is the plug from the tuner unit, with a bared section of the braiding under a clip. Early attention to this small point can save a lot of trouble.

Colour Faults

If the picture is well contrasted and clean, but has no colour content although the control has been advanced and the tuner's buttons have been set correctly, it's likely that the burst gating pulses are not reaching the decoder. These come from the timebase panel (right-hand side), and the feed resistor R404 (33k Ω) at the bottom left may well be found open-circuit.

As these sets get a few years over their heads, the faults commonly encountered may not necessarily be due to the usual well-known stock causes. In many cases for example you'll find that one of the small electrolytics is the cause of a fault that in most of the sets serviced a year or two ago would probably have been due to a faulty 4.43MHz crystal or field-effect transistor (VT110, type BF256LC) in the reference oscillator control loop. In fact we have to be cautious about trotting out "stock causes" when dealing with sets that are more than a few years old.

Much time can be saved by closely examining the ends of small electrolytics for signs of deterioration, replacing those with even the slightest suspicion about them. Whilst voltage checks will often reveal a leaky electrolytic, and shunting a similar value one across a suspect will provide a check for the open-circuit condition, they often become intermittently defective and can lead one a merry dance. Quite often they perform perfectly until subjected to the slightest vibration, which leads one to suspect a faulty lead connection (which indeed it is, internally) or a dry-joint elsewhere on the panel.

By and large the decoder section of the signals panel is trouble free. The main troubles occur where the heat is – up amongst the colour drive components at the top of the panel.

Once in a while one of the RGB output transistors may be found to be defective, causing excess of one colour if it has gone short-circuit or absence of that colour if it has gone open-circuit. These transistors are only occasionally at fault however. When they are, use BF337s for replacement purposes as these seem to be more reliable than the original types fitted.

More often the trouble (if it's on this panel at all) will be due to dry-joints or cracks which have developed over the years and which may not be obvious at first sight. If in any doubt, use your ohmmeter to prove the continuity of a track or joint.

In many cases where the trouble is the absence or partial absence of one colour the c.r.t.'s cathode voltages (i.e. the outputs from the collectors of the RGB output transistors at the top of the panel) will be found to be roughly equal, the trouble instead being due to low first anode voltage on the gun concerned.

The three first anode presets are the three controls mounted on the left-hand side of the tube base. They are skeleton presets with a value of $2M\Omega$. They often develop a dud spot which turns into a burnt crack across the track. Don't try to repair the control, as this will only lead to further trouble. A similar fault occurs with the focus control used on the original 8000 version of the chassis — it's at the top right-hand side of the tube base.

The Tube

If the original tube is still fitted, you can't expect it to give equal emission from all three guns. Indeed this could well be the cause of the apparent lack of one of the primary colours. Whilst the effect can be masked to some extent by resetting the drive presets on the signals panel and the c.r.t. first anode presets on the tube base, this is rarely satisfactory. Depending on the circumstances, the tube should either be reactivated or replaced. Readers' attention is drawn to the comments on regunned tubes in recent issues.

Low tube emission may not show up as the absence of one or more primary colour: the effect may instead be one of flaring as soon as the brightness, colour or contrast is advanced to an acceptable level.

Main Chassis Assembly

The main chassis assembly is secured by two screws at the bottom and one at the top strut. When these have been removed, the chassis can be slid out on the lower nylon runners sufficiently to gain access to most parts and to allow the right-hand side timebase panel to be lowered. There are swing catches at the front and rear.

The field timebase (oscillator, driver and output transistors) occupies the centre to the top of the panel, the line oscillator, flywheel sync and line driver stages being on the right-hand side from the centre to the bottom, with the line output pulse feeds etc. at the bottom left. The rest of the left-hand side is taken up by the preset controls, which are clearly labelled. These directions are when viewing from the print side of the panel.

Field Timebase

The faults on this panel are mainly confined to the field timebase, and there's no regular pattern apart from a tendency for dry-joints, mainly around the output section, where careful observation or perhaps vibration will locate the point where the soldering is poor. Voltage checks may well show a correct reading at one end of an apparently good track but not at the other. If this is so a lead should be jumped across the relevant points rather than trying to resolder the suspect area.

Apart from poor connections, it's the field output transistors that, normally running warm as they do, are the items most likely to be at fault. The supply line is 45V

positive, so the collector of the npn output transistor VT410 should be at this voltage while the collector of the pnp output transistor VT411 should be at chassis potential. Thus the emitters provide a convenient test point (TP25) for checking that both transistors are drawing roughly the same current. Taking into account the emitter resistors, a voltage of 24V at TP25 is acceptable. If this voltage is correct, the output transistors are not the cause of the field collapse (horizontal white line) condition. This of course leaves 1,001 other possibilities. A pair of high-resistance headphones or a signal tracer with its own built-in loudspeaker is a handy way of proving that the field oscillator is working and that the driver is driving. Experimenting with these two aids on a working set will illustrate the kind of buzz to expect. We say this because much time can be lost searching around in the field timebase when the trouble may (for example) be in the field balance control R460 which is between TP25 and the field scan coils.

Line Timebase

Intermittent loss of line hold is a frequent complaint on these sets, and as with other faults the cause is often one of the small electrolytics dotted around both the timebase and the signals panel. There are four of them (C412, C414, C423 and C427), all $10\mu F$, 25V, in the line oscillator/driver stages. If the culprit can't be readily spotted, save time by replacing all four.

The line driver transistor (VT402, MJE340 or equivalent) works from the 120V line. It often becomes faulty, leading to no line drive, no e.h.t., etc. It's situated on the lower right-hand side of the panel. If h.t. is present at the line output transformer but the output stage isn't working, spare a thought for the driver. If it has gone short-circuit, R729 on the power supply panel may well be found open-circuit.

The drive from VT402 is taken via a two-pin plug at the bottom centre of the timebase panel to the almost centrally mounted line output transistor. This is on its own large heatsink, insulated from the main frame. The 8000 chassis uses a very simple line output circuit with very few components on the transistor's base assembly. The transistor itself (VT401) is a BU105/02. The 8500 chassis uses a BDX32 (2SC1172B) line output transistor, with additional components on its base panel. While the whole heatsink assembly can be interchanged, a BDX32 cannot be fitted in place of a BU105/02 without adding the extra diode and choke etc.

In the event of trouble being experienced in the line output stage, particularly if overloading is in evidence, the first move should be to remove the e.h.t. connection plug from the socket on the transformer's overwinding. If the stage then springs to life, the e.h.t. rectifier is suspect. This is often because the plastic housing is leaking to chassis. Mounting it differently sometimes overcomes the problem.

This type of plastic insulation breakdown can sometimes affect the 8500 (on) chassis, where the focus unit is bolted to the right-hand side of the chassis frame. Having mentioned the focus unit on the 8500 etc. chassis, we must also mention the tendency of the 100k Ω resistor (R609) on the tube base to change value, casting suspicion on the focus unit when in fact this is not responsible at all.

So there we are my friend. Combine these notes with what we said in the August issue on the power supply etc. and you have an idea of the troubles you can expect on the 8000s, 8500s and other relatives that might come your way.

New CTV Signals Board

Part 2

Luke Theodossiou

LAST month we dealt with the basic signals board itself. In this concluding instalment we'll look first at the tuner and i.f. module. Before doing so, there's one modification to the details given last month. We've found this modification worthwhile, but it was too late to take it into account last month. It concerns the zener diode D8.

The ideal voltage at the emitters of Tr7, 8 and 9 is around 2.4V, but the lowest voltage commonly available zener diode is a 2.7V type, which we used in our prototype. Unfortunately this voltage difference is sufficient to produce a change in the black level when the gain controls are adjusted. It was decided therefore to use a LED instead – as in the Thorn TX10 chassis. A LED's "on" voltage is quite constant over a reasonable range of currents, but a more important advantage is that the temperature drift is comparable to that of a silicon transistor. The recommended LED is the RS Components type 586–447. Its cathode (identified by a tiny notch on the body) should be connected to chassis.

The Tuner Unit

The Telefunken tuner unit used is interesting in having a dual-gate MOSFET input stage. The a.g.c. is applied to one gate while the r.f. signal is applied to the other.

IF Module

As in the previous signals board, the i.f. module is a ready-built, prealigned unit which readers can purchase from the source shown in the components list. This policy has been adopted due to the difficulty in ensuring consistent results when strips are set up by individual constructors. Especially where it's intended to use the receiver for teletext reception, very accurate alignment is essential.

Fig. 1 shows a block diagram of the i.f. unit. The i.f.

output from the tuner is connected to a coupling circuit inside the module. This produces the correct bandpass response for optimum gain and selectivity. The signal is then passed to a 26dB broadband amplifier which is contained in an SL1431 i.c. It next goes to a surface acoustic wave filter which neatly tailors the i.f. response to the UK channel bandwidth requirements. The SL1431 also detects the amplified signal, generating an a.g.c. signal to control the gain of the tuner. The a.g.c. take-over point can be adjusted by means of the preset inside the module. This should not require adjustment under normal circumstances.

The output from the SAWF passes to a TDA2540 (or TDA2541) i.c. which carries out further i.f. amplification, signal detection, internal a.g.c. and the production of an a.f.c. signal. The latter is brought out at pin 3 and is added to the tuning voltage to counter tuning drift.

The video output from the i.c. is split into two paths. The first one goes to a ceramic 6MHz filter to extract the intercarrier sound signal; the other passes via a 6MHz trap which removes the sound signal from the video and sync feed. The latter signal is taken to a phase-splitter which produces negative- and positive-going outputs. The positive-going output is available at full amplitude (for teletext etc.) and also attenuated to 1V peak-peak for feeding to the decoder section of the panel.

The 6MHz signal is amplified and demodulated by the TBA120U i.c., which also incorporates an electronic volume control circuit.

Construction

The print pattern of the signals panel is shown in Fig. 3—the board can be purchased from Readers' PCB Services in the usual way. Fig. 2 shows the component layout.

The 7812 regulator and TDA2006V audio i.c. are mounted on a common heatsink which is fixed to the board

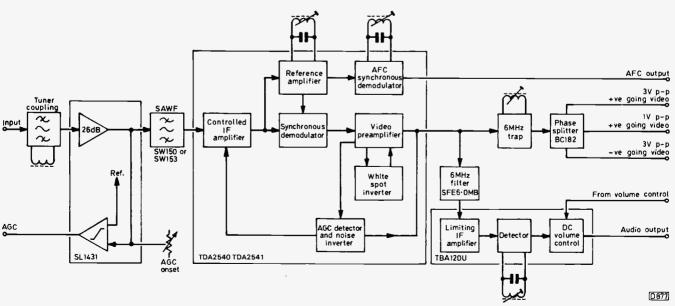


Fig. 1: Block diagram of the i.f. module.

★ Components list

Resis	tors:	R16	390Ω	R32	680Ω
R1	47k	R17	120k	R33	22k*
R2	68Ω	R18	47k	R34	22k*
R3	4k7	R19	10k	R35	22k*
R4	47k	R20	68k	R36	47k*
R5	47k	R21	47k	R37	47k*
R6	1Ω	R22	15k	R38	47k*
R7	1k	R23	68Ω	R39	1k
R8	1 k	R24	68Ω	R40	1k
R9	1k	R25	68Ω	R41	1 k
R10	1 k	R26	68Ω	R42	1k
R11	68k	R27	2k2	R43	1k
R12	47k	R28	2k2	R44	1 k
R13	15k	R29	2k2	R45	1k
R14	1k	R30	680Ω	R46	33k 2W
R15	390Ω	R31	680Ω		

All $\frac{1}{4}$ W 5% carbon film resistors unless otherwise indicated. $\frac{1}{4}$ W thick-film metal glaze resistors, 2% tolerance.

Presets:

VR1 10k VR2 1k VR3 1k VR4 1k VR5 1k 470Ω VR₆ VR7 470Ω VR8 470Ω

Horizontal mounting presets. VR1 standard, VR2-8 miniature.

Semiconductor devices:

7812 IC2 TDA2006V or TDA2030V IC3 TDA3560 Tr1-6 BF458 BC182L Tr7-9 **TAA550** D1 D2-7 1N4148 **RS** Components **D8** type 586-447

Capacitors:

C1-2

C3

C4

C5 220µ 40V pluggable electrolytic C6 100n ceramic disc C7 100n Siemens polyester 470μ 16V pluggable electrolytic **C8** C9 10p ceramic plate C10 100n Siemens polyester C11 120p ceramic plate C12 10n ceramic plate C13 100n Siemens polyester C14 2µ2 63V pluggable electrolytic C15 100n Siemens polyester C16 330n Siemens polyester C17 2-22p trimmer C18 330n Siemens polyester C19 2µ2 63V pluggable electrolytic C20-22 100n Siemens polyester 10μ 16V pluggable electrolytic C23 C24-25 10n ceramic plate C26-28 100n Siemens polyester C29-30 2µ2 63V pluggable electrolytic C31 10n ceramic plate C32 100n 250V Siemens polyester C33 10µ 16V pluggable electrolytic

100n ceramic disc

220µ 16V pluggable electrolytic

2µ2 63V pluggable electrolytic

Miscellaneous:

Tuner Telefunken type 204
IF module Reference no. 39-13-09
L1 00D0-914-001
L2 PC501-L602
XL1 8-8MHz crystal

The above are available from TW Electronics, Kennet Building, Wotton Hill, Newbury, Berks, RG15 9UJ. The tuner is £10.50, if the i.f. module £19.50, the crystal £1.10 and the coils £0.60 (total for both). Prices include VAT and post/packing.

DL1 Orega TLC1392 DL2 Sylvania SDL445

Heatsink for IC1-2 is 50mm length (i.e. half) of RS

Components type 401-497 Molex 0.2in. pitch p.c.b. pins.

Note: The preset contrast control VR1 is adjusted in conjunction with the black-level controls. After the grey-scale has been set up, adjust VR2 for minimum Hanover blinds with colour bars or a test card displayed. The chroma delay line's input and output coils should not normally require adjustment.

by two 4BA self-tapping screws. Apart from this, construction is very straightforward and should present no difficulties. We suggest that the aerial connecting cable is soldered directly to the connector A holes on the board rather than using the Molex type connector we normally specify.

The first thing to connect is a nice, thick earth cable from the *underside* of the signals board at connector D3. Take this back to the power supply. The remaining connections are as follows:

- A1 Aerial earth.
- A2 Aerial input.
- B1 33V supply to tuning potentiometers.
- B2 Connection to volume control wiper.

- B3 12V supply to brightness and colour controls.
- B4 Tuning voltage from potentiometer bank.
- B5 Earth connection to tuning potentiometers.
- B6 Earch connection for volume, colour and brightness controls.
- C1 Green data input.
- C2 Blue data input.
- C3 Video output to options board.
- C4 Data switching signal.
- C5 Red data input.
- D1 To C1 on timebase board.
- D2 To C6 on timebase board.
- D3 To C2 on timebase board.
- D4 To C3 on timebase board. D5 To C7 on timebase board.

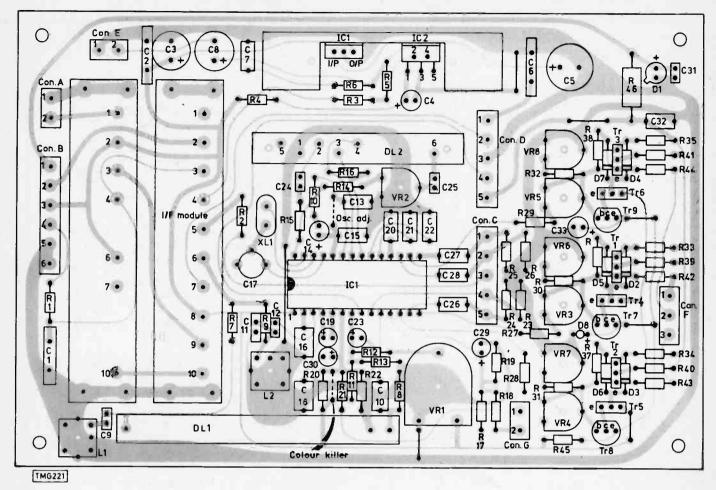


Fig. 2: Component layout.

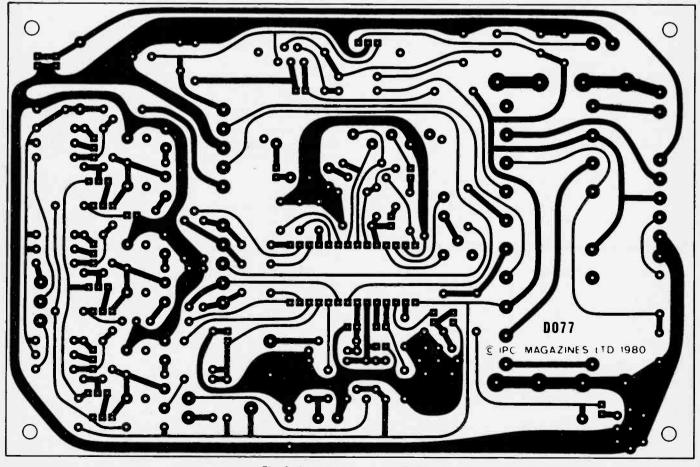


Fig. 3: Board print pattern. Full scale.

Note that connector C8 on the timebase board is not used with the new signals panel.

E1 Loudspeaker (only) earth connection.

E2 Loudspeaker.

F1 Green output to c.r.t.

F2 Blue output to c.r.t.

F3 Red output to c.r.t.

G1 To colour control wiper.

G2 To brightness control wiper.

Front Panel Controls

The front panel controls are wired up in much the same way as before. Connect the colour and brightness controls between earth and the 12V supply, with the wipers taken to the appropriate connector points on the signals board. The volume control's wiper and one end of its track are earthed, the other end of the track being returned to the signals board via a resistor of around $15 \,\mathrm{k}\,\Omega$. The optimum value is best found experimentally – the resistor adjusts the point at which the volume control begins to allow the sound to be heard. The easiest approach is to turn the volume control to its minimum volume setting, then increase the value of the

series resistor until a hint of sound is heard. Finally choose the nearest standard value below this. For those readers using remote control, the correct value is $10k \Omega$ – there's no need to select the resistor in this case.

Setting Up

Apply power and either tune to a station with a colour transmission or use a colour-bar generator. Ensure that a composite video signal of about 1V peak-peak is present at terminal 6 of the i.f. module (a scope is required for this of course).

(1) Connect scope to the junction of L2 and R9. Adjust L2 for maximum burst amplitude.

(2) Connect the scope to the junction of R7 and C9. Adjust L1 for minimum burst amplitude.

(3) Connect the two links shown on the circuit diagram. Adjust C17 slowly until a colour picture is obtained — with the colours just "running through". Disconnect the links.

(4) Adjust the black-level and grey-scale as described on page 425 of the June 1979 issue. VR3, VR4 and VR5 are the gain (highlight) controls while VR6, VR7 and VR8 are the black-level (lowlight) controls.■

Service Hints

Mike Dutton

The trouble with an elderly Dynatron hybrid colour set (Pye hybrid chassis) was no colour. The voltage at SK11 on the decoder panel (connection to the slider of the colour control) was found to be negative and didn't vary with adjustment of the control. The voltages at the colour control itself were correct however. When we came to trace the wiring back we discovered that it disappeared into the remote control cable. Disconnecting this restored colour, and on examination several of the wires were found to be broken and probably shorting intermittently inside the control head.

There was also excessive background blue which couldn't be removed by adjusting the blue first anode preset. The resistor (R464, $1\cdot 5M\,\Omega$) connected in series with the earthy side of this control had increased in value of course.

Lack of Width

The trouble with a Decca monochrome receiver (Model MS2400) was lack of width. The width control had very little effect, but all the components in this area were found to be o.k., while a new set of line timebase valves failed to produce any improvement. We decided to check the h.t. voltage, and found this some 40V on the low side, due it turned out to the reservoir capacitor being open-circuit. A replacement restored the width, and it's interesting that the only fault was the width problem – the sound was normal, and there was no ripple on the picture. The surge limiter resistor was getting hotter than usual however, due presumably to the increased ripple current flowing through it

Intermittent Sound

A friend of mine has a Teleton transportable CPL142 colour set. He complained that every now and then the

sound would just fade out. A tap on the cabinet would bring it back. I connected an Avo to the audio output stage's power supply and asked him to watch what happened when the sound next disappeared. A few days later he reported that the voltage dropped to zero when the fault occurred.

A separate full-wave rectifier, fed from a centre-tapped winding on the mains transformer, supplies the audio output stage. There are two fuses between the transformer and the rectifier diodes, and on close examination one of them (F704) was found to be quite loose in its holder. Prodding it would result in the sound gradually fading away as the reservoir capacitor discharged. My friend reported no further trouble after I'd tightened the fuseholder.

Faded Picture

The complaint with a Decca hybrid colour set (30 chassis) was that the picture had gradually faded until only a faint green outline could be seen. We switched on and measured the c.r.t. base voltages. First anodes quite normal, as were the cathodes. Adjusting the preset brightness control (c.r.t. grid bias) produced a slightly brighter picture, and by adjusting the first anode controls a reasonable grey scale was obtained. The picture was still very thin however, with a marked lack of contrast and no colour. Suspecting a decoder fault, the set was taken back to the workshop. A replacement panel failed to improve matters however, so a new i.f. panel was tried. This time we got a normal picture.

When a few voltage measurements were made with the original i.f. panel in place we discoverd that things were not at all right in the a.g.c. department. The voltage across the a.g.c. smoothing capacitor C60 (22 μ F) was nearer 8.5V than the usual 2.5V. Connecting a 1k Ω resistor across C60 restored the a.g.c. line to about the correct voltage, producing a normal picture and proving that the video detector etc. were o.k. So the fault had to be in the a.g.c. department, and each component was removed and checked. The culprit turned out to be C58 (0.01 μ F), which had a slight leak. This capacitor is the a.g.c. reservoir capacitor, connected between the collector of the peak detector transistor TR8 and chassis. After adjusting the set and turning the preset brightness control down again an excellent picture was obtained.

WITHOUT deflection, the tube's beam(s) would produce a stationary spot at the centre of the screen. For horizontal deflection, the beam must be swept to both the left and the right. The current through the line scan coils must flow in one direction to obtain travel to the right and in the opposite direction to obtain travel to the left. The current flowing in the primary winding of the line output transformer must likewise move in both directions during each scan.

Horizontal Scanning

Fig. 1 shows at (a) the basic transistor line output stage circuit and at (b) the horizontal deflection of the beam. The line output transistor Tr switches on towards the centre of the scan. Current then flows through the transistor and the line output transformer's primary winding. The output is coupled to the scan coils via C2, and the positive-going sawtooth drives the beam to the right-hand side of the screen. To initiate the flyback, the transistor is switched off. The tuning capacitor C1 and the line output transformer's primary winding then form a resonant circuit, and the wellknown flyback pulse appears at the collector of the line output transistor. As the pulse rises to its maximum value, the beam moves from the right-hand side of the screen back towards the centre. As the pulse then falls back to zero, with current reversal in the transformer/tuning capacitor, the beam is moved rapidly to the left-hand side of the screen. The circuit would then continue to oscillate, but when the voltage at the junction of the line output transformer's primary winding and the tuning capacitor tries to move negatively, the transistor's collector-base junction becomes forward biased. The transistor conducts in the reverse direction therefore, i.e. with current flow from the collector to the base. This damps the circuit, the current then flowing in the line output transformer's primary winding deflecting

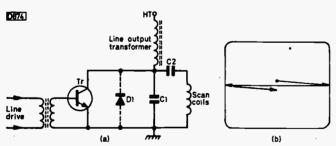


Fig. 1: (a) Basic transistor line output stage. (b) Horizontal deflection of the beam. When the line drive waveform switches the transistor on, current flows via the transistor and the primary winding of the line output transformer to the supply. The resultant sawtooth current flowing in the scan coils deflects the beam to the right-hand side of the screen. When the transistor is switched off to initiate the flyback, the tuning capacitor C1 and the circuit inductance comprise a resonant circuit. The resultant half-cycle of oscillation, with current reversal, deflects the beam back to the centre of the screen and then to the left-hand side. At the end of the halfcycle of oscillation, either the transistor or the shunt efficiency diode D1 conducts to damp the circuit, the current flow then deflecting the beam towards the centre of the screen to provide the first part of the horizontal scan. In practice the transistor is switched on about a third of the way through the forward scan.

the beam towards the centre of the screen to give the first part of the forward scan.

In a mains/battery portable, the supply line voltage is limited to 10V or so. The transistor's reverse collector-emitter voltage is then significant and would result in scan distortion at the left-hand side. A shunt efficiency diode (D1 in Fig. 1) is included therefore, providing the current path during the first part of the scan. In a valve line output stage, the reverse current path is provided by the boost diode.

Current flows in the transformer and in the scan coils in both directions therefore to give deflection to the right and to the left. Why then doesn't this problem seem to arise with a field output stage, since this must provide upwards and downwards movement of the beam?

Vertical Scanning

The answer to this is bound up with the very different nature of line and field output stages. The line output valve or transistor is used as a switch. When switched on, the current flowing through it increases linearly due to the highly inductive load provided by the line output transformer. If a d.c. voltage is applied across an inductor, the current flowing through it will rise in the same exponential manner that the voltage across a capacitor rises.

A field output stage acts as a sawtooth amplifier. Since the field frequency is in the ratio of 50/625 to the line frequency, the reactance of a given inductance at field frequency will be only 8% of what it offers at line frequency. The impedance of the output stage's load at 50Hz is in fact predominantly resistive.

The field output valve or transistor(s) is/are biased to a midway point. When the current increases above this point the beam moves one way, while when the current is reduced below the midway bias point the beam moves in the opposite direction. In a nutshell, reducing a current has the equivalent effect to reversing its direction of flow. Or, in other words, a current or voltage which is going say less positively can be regarded as moving negatively. This can be demonstrated by supplying sufficient d.c. to a meter to get a midway deflection of the needle: when the input is reduced, the needle moves backwards — in the same direction as if a small input of the opposite polarity had been applied. Thus a given current reduction can be considered as being the same as the addition of an opposite polarity feed of equivalent strength.

What about the field flyback? At the end of the forward field scan, i.e. with the beam at the bottom of the screen, the field output valve is cut off. The cessation of anode current flow produces a positive-going flyback pulse at the anode of the output valve, and the circuit is arranged so that during this period the beam is deflected back to the top of the screen. The precise action with transistor field output stages varies, since quite a variety of types of circuit are in use. Once again however the transistor conducting at the end of the forward scan is abruptly cut off, as a result of which current flow reversal occurs in the field scan circuit. In a two-transistor output circuit the upper transistor generally conducts in the reverse mode during this time.

Service Bureau

Requests for advice in dealing with servicing problems must be accompanied by a 75p postal order (made out to IPC Magazines Ltd.), the query coupon from page 683 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

RANK A823A CHASSIS

The fault on this set was a vertical blue band about a quarter of the way across the screen from the left-hand side, also occasional horizontal blue bands. The voltages around the SL917A i.c. on the decoder panel were measured as a first step, and were found to be as specified except for pin 5 which read 1.33V instead of 0.29V nominal. All the peripheral components seemed to be o.k., so a new chip was fitted. This made no difference. After some further checking, diode 3D1 in the feed to the burst gate pulse timing circuit was found to be leaky. Replacing this has produced a good picture, but the voltage at pin 5 of the i.c. is still 1.33V. Is this o.k.?

A circuit change in later versions of the panel has resulted in a higher voltage being specified at pin 5-1.5V nominal. Everything seems to be in order therefore. We'll make a note about 3D1 – this sort of fault is difficult to trace.

TELETON TVC14

This set initially suffered from a collection of faults. No e.h.t. was found to be due to an open-circuit heater in the 3AT2 e.h.t. rectifier - due in no small part to the supply bypassing the 2.2Ω series resistor, which was connected across two internally connected pins. Using a suitable base, wired correctly, a GY501 was brought into service and restored normal e.h.t. No colour was then overcome by slight adjustment of the colour killer control. The remaining problem is horizontal pulling accompanied by excessive width (one square on each side of the test card is missing). The pulling is not present when the set is first switched on (though there's excessive width), but gradually gets worse, distorting straight verticals badly. When the brightness is increased, they seem to straighten slightly. The main smoothing block has been replaced and the h.t. is about right.

The line oscillator consists of a cathode-coupled multivibrator using an 8FQ7 valve, and it's likely that replacing this will straighten the verticals. Note that in addition to the line hold potentiometer there's a stabilising coil, L701 – adjusting this might well help. For the width problem we suggest checking the resistors in the width circuit, in particular R719 $(2.2M\Omega)$. If you're unlucky, the line output transformer might be in need of replacement. The line drive at the control grid of the 31JS6A line output valve should be about -45V.

FOCUS FAULT

The trouble with this Autovox colour receiver is no focus—just a blurred picture. The e.h.t. is 23.5kV, and the tripler is supplying 8kV to the focus circuit. The high-value resistors

in the focus control network have been tested by substitution, but only $1.5 \,\mathrm{kV}$ can be obtained at the c.r.t. focus electrode and this cannot be increased. The fault was intermittent initially, the picture coming into focus after about half an hour, but is now permanent. The focus electrode is drawing about $750\,\mu$ A. Do you agree that the tube could be at fault?

Make sure that the 750μ A is disappearing into the c.r.t. and not through the focus spark gap due to leakage. If the tube is drawing 750μ A it's definitely faulty. The normal focus electrode current is less than 10μ A.

PHILIPS G8 CHASSIS

The trouble with this set is that the line oscillator coil L4501 has to be adjusted each evening when the set is first switched on. The line hold is then generally o.k. for the rest of the evening.

This sort of trouble is generally due to the 18V zener diode D4531 which stabilises the supply to the line oscillator. The diode goes open-circuit, producing line drift with the receiver settling down once adjusted. The same trouble can be caused by the 12V zener diode D2166 on the i.f. strip. If necessary check the voltages around the transistors TR4500 and TR4511 in the line oscillator circuit, and the electrolytics in this area. A less likely possibility is the TAA700 jungle i.c. on the i.f. panel, since this incorporates the flywheel line sync circuit.

KÖRTING HYBRID COLOUR CHASSIS

The initial fault was that the l.t. fuse had blown and the l.t. bridge rectifier was open-circuit. These items were replaced, and a check was made for shorts. The only part of the set where any faults were found was on the raster correction panel. R464, which is connected between the line windings on the transductor, was badly burnt and open-circuit, and the heat had scorched the transductor. R464 was replaced and the transductor checked for shorts between windings. It seems to be o.k., but I can't check for shorted turns. The set was then switched on and after adjusting the 24V regulator sound and a perfect picture were obtained. After about twenty minutes however the picture gradually got darker, the red became more saturated, and R464 started to overheat. The set was switched off, but nothing could be found wrong. Switch on again and the same results are obtained. Any suggestions?

It seems to us that the excessive current flowing through R464 is excessively loading the line output stage and the power supply generally. The main suspect must be the electrolytic C464, which provides a d.c. block between the line output stage and the raster correction circuit. It probably has a substantial leak. If C464 turns out to be o.k., the transductor is clearly suspect for shorted turns. As you say, this can't be tested for shorting turns.

PYE 697 CHASSIS

I'm having difficulty with the field hold on this set. The field won't lock and continually drifts. There's ample range of adjustment on the field hold control however — the picture can be made to roll up or down at varying speeds, but won't lock. A replacement field timebase panel has been tried, and the transistor, diodes and resistors in the sync separator circuit have all been checked.

The most common cause of this problem is a poor connection in the screened sync lead from PL4A on the i.f. panel to PL9 on the field timebase panel. Use of a scope should enable you to track down quickly the point where the sync pulses are failing.

PHILIPS 320 CHASSIS

The trouble is the presence of teletext lines about two-three inches from the top of the screen. They can be "lost" if the height is reduced by about a third.

This symptom is due to slow field flyback. It can be caused by shorting turns in the field deflection coils, but there are several other things to check – the driver and output transistors TR2506/7/8 for leakage, also the flyback pulse clipper diode D2509 and the scan coupling and bootstrap capacitors C2539/C2558.

GEC SERIES 1

There's a field hold fault on this set. Sometimes, especially when the set is cold, good lock can be obtained. When the set is warm however, also sometimes when cold, the setting of the hold control is very critical — and when lock has been obtained it's usually accompanied by field jitter. The hold control is not to one end but is in the centre of its travel. Turning the contrast up fully helps, but of course the picture can't be viewed. I've changed the field timebase and video/sync valves, and replaced the field sync pulse integrating capacitor. What next?

Try replacing the field sync pulse coupling capacitor C206 (500pF). If reducing the contrast improves matters, try very slight adjustment of the final i.f. coil L106. The vision detector diode D103 should also be checked.

PYE 697 CHASSIS

The first problem was that the shift choke burnt out. This turned out to be due to a short to earth on the track of the shift control — through the anchor lug soldered to the earth track. Now, with or without the shift components in circuit, there's a colour picture with a quarter inch foldover down the centre of the screen, from top to bottom. There's no loss of width, neither does the picture pull to one side. There's no overheating in the line output stage.

There are two main possibilities: either a hiccup in the line drive waveform, possibly due to one of the electrolytics (C214, C213 and C210) in the line oscillator circuit; or the boost capacitor C218 is faulty. An oscilloscope check at the control grid of the line output valve should sort this out.

ITT VC52 CHASSIS

The original fault condition was a loud hum when the picture was dark, the picture then going very black with the verticals etc. breaking up. Replacing most of the components in the a.g.c. circuit cured that, though there's still hum at normal contrast settings. It sounds like the result obtained when a station is turned off tune. What have I overlooked?

This type of i.f. overloading normally occurs only at abnormally high settings of the contrast control. We suggest you use an attenuator to reduce the signal from the aerial to the point where noise is just slightly noticeable, then advance the setting of the contrast control for a normal picture. If the fault persists, replace the i.f. coupling capacitor C44 (120pF) which could be slightly leaky.

PHILIPS G8 CHASSIS (550 SERIES)

After the set has been on for about an hour an intermittent green band appears across the screen, some four inches from the top. The fault does not occur when the set is operated with the rear cover removed, and disappears on turning down the colour control.

It appears that the bistable is running in the wrong phase

when the fault occurs. Check the tuning of the ident coil L205 (adjust for maximum output at the collector of Tr197). Then if necessary check the trigger pulse coupling capacitors C284/5 (0·01 μ F). Finally suspect the TBA520 chip. Use of a hair-dryer and freezer should help identify the culprit.

DECCA 30 SERIES CHASSIS

There's an odd fault on this set — a very bad flutter, similar to that caused by aircraft. It comes and goes erratically during the first hour, then goes completely when the set has thoroughly warmed up. It seems to be affected by camera changes and very contrasty scenes, and also darkens the picture. The set is otherwise excellent.

This is unusual on the Decca chassis, and probably stems from instability in the a.g.c. circuit. We suggest you try heating/freezing the two transistors (TR8/9) and capacitors C58 ($0.01\mu\text{F}$) and C60 ($22\mu\text{F}$). Another possibility is trouble in the beam limiter circuit. Items to check here are the PL509's cathode components R467 and C434 ($100\mu\text{F}$), also the smoothing capacitor C69 ($50\mu\text{F}$).

PYE 169 CHASSIS

The trouble is loss of line hold — all I can get is wavy lines. I've changed the PCF802 line oscilator valve and some of the components in the flywheel line sync filter network but the trouble persists. I now suspect the a.g.c./sync/video jungle chip (TAA700). Is there anything else I should try before changing the i.c.?

There are several items to check before replacing the i.c. The first check should be of C49 ($16\mu F$), which smooths the h.t. supply to the line oscillator stage. If necessary, next check the capacitors in the line oscillator circuit – C67 (820pF), C64 ($0.001\mu F$) and C65 ($0.0033\mu F$). Also check the line oscillator coil itself – we assume you've tried adjusting it. If the coil is faulty, squeezing it will probably change the frequency.

BUSH TV300

The fault with this portable seems to be some sort of overloading. When it first started, a white smear or streaks, pulling over to the right, would appear after about half an hour. Eventually the whole screen would go white, with only the dark parts of the picture just visible. The fault now appears almost immediately after switching on. Adjusting the a.g.c. controls etc. makes no difference.

The problem is not unusual on this set and is usually due to one of the $1\mu F$ capacitors C519 and C520 that smooth the h.t. supply to the video output transistor. Replacements should be rated at 160V or more. Less likely culprits are the video output transistor itself (TR10, type 2SC1103) or its base signal coupling capacitor C226 (100 μF).

PHILIPS G6 S-S CHASSIS

The trouble is field jitter, triggered by any change of camera or picture content. I've changed all likely suspects in the field timebase, the PFL200 video/sync valve and the two 40μ F electrolytics in the a.g.c. circuit. The fault also seems to affect the verticals slightly.

Check by substitution C2047 ($12 \cdot 5 \mu F$), which decouples the video amplifier's screen grid, and the field sync pulse coupling resistor R2124 ($1 \cdot 5 M \Omega$). If the fault persists, check resistor values in the sync separator circuit – the screen grid feed resistor R2122 ($220k\Omega$) and grid resistors R2118 ($2 \cdot 2M \Omega$) and R2119 ($1M \Omega$) in particular.

THORN 8800 CHASSIS

There are foldover problems at the top of the screen. Over the top four inches there are faint lines and, more severe, the teletext lines. The latter occupy a depth of some two inches, an inch or so down from the top.

The problem is due to a slow field flyback. This is usually caused by leakage in the field output transistors, VT410 or VT411, or problems in either the driver transistor VT409 or C448 ($100\mu F$) which decouples the drain of the buffer amplifier transistor VT412. If you are unlucky, the field scan coils are faulty.

INDESIT T24EGB

There's an intermittent fault – ragged horizontal streaks to the right of white areas in the picture. The trouble seems to be triggered by changing channel, and can sometimes be cleared by repeated channel changes.

First note the effect of turning up the brightness. If this

makes the effect worse, suspect the e.h.t. pencil rectifier. If advancing the brightness control has no effect on the symptom the trouble would seem to be in the video output or driver stages. If the transistors (TR201 and TR205, types BC148B and BF178) and the peaking coil (L204) are in order, suspect C208 (220µF).

RANK A640 CHASSIS

The trouble with this set is false line lock, i.e. there's a vertical black line down the centre of the screen with half the picture on one side and half on the other side. Which components should I check?

On this chassis (Bush TV161 series) the problem is almost always due to failure of the flywheel sync diode block -3MR1-3, the small black block about half way up the right side of the timebase panel (the third diode is the field interlace diode). Separate BY206 diodes can be used, with a $15k\,\Omega$ resistor in series with each line sync diode.

TEST CASE

214

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.

VCR sales seem to be one of the few bright spots on the currently gloomy TV retailing scene. We now have a respectable number of them to look after, mainly on rental, and are of necessity learning the ropes as we go along. Experience bought dearly now will stand us in good stead in the future — provided we don't get too great a proliferation of models and tape formats.

Anyway, a recent case involving a JVC HR3660EK provided us with a bit of a puzzle. This is a VHS machine of course, and similar models are to be found in other ranges, such as Ferguson. It arrived in the workshop with the complaint that the picture was broken up, and on playing back a test tape bands of severe noise were observed at the top edge and over the bottom quarter of the screen, with the rest of the picture almost normal.

Routine checks were carried out on the servos, and all was found to be well here. The tracking control was also working. These parts of the circuit were exonerated therefore. The next suggestion was that the heads might be faulty or damaged, but close inspection revealed no defects – in fact the heads were undamaged and in good condition.

Several suggestions (not all of a technical nature!) were put forward and discarded, and finally the audio-cum-VCR man sent everyone away and decided to sort the trouble out himself, thank you! This he proceeded to do. Can you

suggest where the most likely source of the fault lay? All will be revealed next month.

SOLUTION TO TEST CASE 213

- page 620 last month -

We left our engineer last month faced with a puzzling case of a malfunctioning beam limiter in an ITT colour set (CVC20 chassis). The d.c. voltages measured at the base and emitter of the first transistor T1 suggested that it should have been turned off. Both transistors were conducting however — shorting the base-emitter junction of either of them removed the fault, restoring normal brightness and contrast levels.

Our intrepid engineer next hooked an oscilloscope across C7, which decouples T1's emitter, and was confronted with a messy line-rate waveform consisting mainly of damped oscillations from the line output transformer. The peak-to-peak amplitude of these oscillations was no less than 10V! Clearly T1's base-emitter junction was rectifying this waveform. This produced d.c. conditions suggesting that T1's base-emitter junction was reverse biased when in fact the transistor was conducting (remember the auto-bias operation of line output valves?).

The culprit was C7 of course. It was completely opencircuit, thus failing to iron out the waveform superimposed on the d.c. sample voltage obtained from the tripler.

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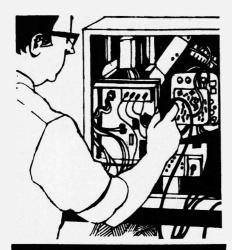
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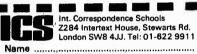
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	Olufsen, Grundig, Tandberg.	330/10V	47/40V		BD253/B	35p
NSF UHF VHF new AEG		5p each	47/63V	Speach /	BD124	£1.50
V/cap £3.50	Triplers GEC C2110 after 27/1/77 £3.50	 	22/2501/		BU105/04	£1.00
NSF UHF 1043/05		4700/40V	30p 33/350V	6p	BU204	40p
Removed from new	5 Diodes I.T.T. Earth Input Focus D.P. 25KV Tripler	1000/50V	10p 2000+20		AU113	£1.00
panels £3.75	& Anode Cap £2.00	220/63V	8p .01/1000		BU205	£1.00
TV PANELS	New (Silicon Diodes)	1500/40V	8p .047/1000		BU108	£1.00
ELC 2000 and IF and	G2100 GEC Tripler	470/63V	8p .47/1000	, -	BU208	50p
Chroma panel TV	TVM25 £2.00 THORN 3500	106/350V	20p .1/800V	\8p	BU500	£1.00
UHF/VHF chassis 5.5	THORN 3300 THORN 8500 Focus Unit	100/450V	40p .1/400V	Zb.	BU126	£1.00
mc/s front end £15.00	DECCA Focus Unit	220/450V	40p .0047/1,5		R2008B	£1.00
	(Large or small) £1.00 each	470/40V	8p 2N2/1,50		R2010B	£1.00
210PF/8KV 10p 330PF/8KV 10p	4 Push Button Units	8/350V	6p 1N8/1,50		BU208/02	£1.00
4.7NF5KV 10p	1400-1500 THORN £3.50 Used in G.E.C. T/V small	10/500V	10p .1/2000V		BU208A	£1,00
6200PF/2000V 10p	neon lamps	33/500V	·	00 63V 50p	₹T¥80	20p
180PF/6KV 10p	NE-2B6H-2 3p	33/450V	10p B9A Prin		BTY80	/ 20p
1000PF/10KV 10p 1000PF/12KV 10p	TCE527 20p	4700/25V	25p V/Holder			
1200PF/12KV 10p	TV 20 50p	4700/30V	25p PYE 697		BB 105 UHF	
270PF/8KV 10p	TV 18 EHT 40p	22/350V	6p (Long)	15p	BB 103 VHF	Varicap diodes 5p each
1800/4 Kv 5p	BYF3214 20KV Rectifier Sticks	ITT PT266	. 3W/12	THORN	THE TIMEP	UNIT & PANEL FOR
100 Mixed Diodes £1.00	(TV20 Type) 25p each			9000 SER		00.83
100 mixed 20mm Fuses £2.00	BYF3123 18KV		or Degause-		ORN 9000 FR	
300 Mixed condensers £1.50 300 Mixed resistors £1.50	Wire ends 25p	ing)	16-	ALSO IH	OKN 9000 FK	AME PANEL 29.00
300 Mixed resistors £1.50 30 Pre-Sets £0.50	BA 248 6p	Fits Most S		CVC9 I	ΓΤ Control	ITT Control Panel with
100 W/W Resistors £1.50	BSS 68 20p	PHILIPS	SNIPS CUT	Panel	£4.00	Mains Lead, 4 Slider
40 Mixed Pots £1.50	BYX55/350 1,6p BT106 S/Type 3,0p	MOST TH	INGS £1.50	CVC20 I	TT 6 Push	Pots Mains Filter £2.50
20 Slider Pots £1.00 10 Different Types	BT 106 S/Type 30p BT 106 95p			-3	nit & Input	3.5mm Jack Socket 7p
Mixed Electrolytics 150 £2.00	BT 116 95p	ELC 1043 AEC		Panel	£5.00	2200/40V 10p
Mixed Bulbs (15) 45p	BT 119 95p	MJE 1661	25p			Hitaahi 12// tuhas nau
CVC5 Panel with Pots	BT 109 70p	XTALS T/V 4.433.610KH	50p	PT3	4p	Hitachi 12" tubes new A31/300W £12:00
	BT 146/750V MULLARD	BYX 38/600		Thermistor	200+200+	A317300W 212.60
& Mains Switches 250K,	THYRISTOR 25p	BT138 Triacs		75+25 4 F	use Holder &/	5.5 MHz Filters 15p
100K, 423 500K £1.00 Triplers THORN 3000-3500	Thyristors 8A/800V 2N6399A 30p	RCA40506 T	Chyristors 50p		& Resistors	6 MHz Filters 25p
9000 £5.00 each	Thyristors 7A/400V	MJE 2955/15		ITT Panel	£1.50	D. 10 TED
	52600D 30 p	TIP 41A-42	pair 40 p	4700/25	10p	Red & green LEDs mixed 14 for £1.00
FRONT END FOR MUSIC CENTER	Y827 Diodes 30p	G11 Philips 1 PYE Thyristo			<u>-</u>	<u> </u>
VHF/M.W./L.W. Size 13"×3½	Bridge Rec	2N4444-0T1		Philips TV	IF Modules	8 × 3 Speaker
4 Push Button. Unit 7 Transistors.	B30C 600A6 12p B30C 500 12p	SP8385 Thor		38Mc/s fi	rst & second	80R or 50R 50p
V/Condenser, 10 Coils, Rod Aerial.	DE Solder Pumps £4.00	5 amp 300V		IF	£1.50 each	
I.C. Decoder CA758E. (No Power Supply and O/P Stage).	Philips T/Units UHF	SCR 957	65p	G9 PHILI	DC Tripler	G9 Seakers 70R £1.00
Circuit Supplied £6.00 (New)	New £2.00	BD561-2	pair 30p	Los Luiri	£3.75	
	New Circuit Supplied	BC365	10p	 		Speaker 5×3 35 ohm 75
O/P Stage for Music Center	UHF 8 C.H. Light action unit 4 I/C for V/cap tuning G.E.C.	10 Watt LP1 IF LP1170	173 £1.00 50p		l ceramics &	
PYE 731 6 Push Button Unit	C2001/C2201 £5.00	AM/FM T/U		plate conde	enser £1.00	Speaker 6×4 15 ohm
& 100KA Pots £3.00	4 Push Button T/Units	(Seconds)		THORN	Hearing Aid	£1.00
EHT Rectifier BY212 10p	UHF MULLARD £2.00	AT 1025/08 E			Ext. Loud-	Long Wires
3 OFF G770/HU37 EHT 10p	AE Isolating Sockets UHF	Tip P31 A/B		speaker	£2.00	Long Wires 300 Mixed Carbon Film
12KV 2 M/A Small 20p	& Lead PYE & THORN ITT 35p	New 10 Watt Mull	ard Amps £2,00	speaker		Resistors
EHT RECS	Transistor UHF Units with	DECCA-Brai	dford Tuner	Line O/P	Trans CVC20	5 of each type \(\frac{1}{4}\) Watt IR to
12KV 2 M/A Large 30p EHT RECS	AE Socket and Leads		v (4 push) £2.75	1	£5.00	2 Meg – ITT £1.50
EHT REC USED IN	GEC 2000 Rotary type NEW £2.00		5p BC207 5p			
THORN 1400.1500	NEW £2.00 UHF Aerial Socket and Leads	V	Sp BC463 5p	4		
Triplers (×80/150) 10p	PYE, ITT & THORN 35p	1			C.E.V	
CSD 118×MH Rec	Co.ax Plugs 12p	1		Α	JEI	NDZ
THORN 3500 10p 220M/450V THORN 50p	ITT Mains on/off switches	1		-		
700M/250V THORN 35p	Push-button 25p	I	Sp BC250 Sp/ Sp BC251 Sp /		MIDI	
175+100+100 350V	DP Push Button Switch ON/OFF 10p	1 '	Sp BC231 Sp	UU	IAIL	DNENTS
3500 THORN £1.90	Mains ON/OFF		5p BY298 12p			TEIGNTON,
400+400.350V DECCA 80p	Push Button T/V 20p			1		•
470+470.250V 40p	Mains ON/OFF	TIP29C 2	20p BD416 25p	_	SHOEBU	IRYNESS,
$\frac{100+200325V}{200+200+100+32350V}$ 40p	Rotary T/V 12½p	Bush Rank	5 push			•
$\frac{200+200+100+32\ 350V}{150+200+200.300V} \frac{\textbf{70p}}{\textbf{70p}}$	Main Dropper THORN	button unit f			E99EX	SS3 8AF
200+200+100 325V 60p	6R+1R+100R 35p Mains Droppers	V/cap	£2.50		Pag A	ffice Only.
731 PYE 600/300V	69R+161 PYE 40p	──	D. C	- [_	~
& BUSH 75p each	AD 161 AD 162 Pair 60p		urn Pots for	1 C	allers by ap	pointment only.
200+200 350V 60p	147+260 PYE 40p	V/Cap tunin			-	5% VAT.
400M 400V 400M 350V 50p	(731) 3R+56R+27R 50p	6 volt, 23 w	att Soldering			
800M 250V 30p	Plug and Sockets 3 & 6 Pin Printed Circuit Type pair 10p	Iron	£2.00		Add 50)p P. & P.
AE Power supplys 15V £1.00	4 push button unit (for Varicap	1000+2000m	/35V	A 44		all overseas parcels.
OEC Mains & Battery switch 30p	Tuning) 20K New 50p	V	25p	Add	hostage tor	an overseus parceis.
						

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		TBA651
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SAA 1024	£4.00	BTT822
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	20	BTT8224
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TBA120AS	30p	TBA396
TBA120B	30p	
TBA120S	30p	TAA550
TBA120SB	30p 30p	
TBA120U	30p	TAA570
TBA510	£1.00	
TRA 4800		TBA1441
TBA480Q	£1.00	TBA673
TBA520Q	£1.00	TCA640
i		TCA650
		TCA660
TBA550Q	£1.00	TC A740
		NPN TIP 1
TBA560CQ	£1.00	Darlington 2230
TBA750Q	£1.00	Thyristor 40506
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TBA 720A	£1.00	IS5030A IN3899
TBA810S	£1.00	BY 179 bridge
TBA890	£1.00	rectifier
TBA950	61.00	BU124 BU1377
IBA930	£1.00	BU326
		BU126
TBA990Q	£1.00	2N 3055
	£1.00	BD238
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TDA1170	£1.20	SN 76001 SN 76003
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TD + 37 40		SN76008KE
TDA2640	£1 each	

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TAA320A	50p	SN76546N	£1.00
CA270	50p	BSX20	5p
CA270EW	50p	R2603	50p
		BD136	-10p
BA651	80p	TBA800	40p
		BU126	
STT822	£1.00	NPN TIP 33B 10A/80V	
3TT8224	£1.00	BYF 3126 30KV stick of	30p diodes 50p
BA396	£1.00	3 Amp Diodes approx 1,200 ITT Bridge Rectifier C	7p 73 1½
AA550	20p	amps IN4003 IN4004	20p 5p 5p
AA570	£1.00	IN4005 IN4006 IN4007	5p 5p 5p
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CA650	£1.00	BT109	£1.00
CA660	£1.00		£1.00 £1.00
CA740	£1.00	2N6348	50p
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,	50p		10p
		3 amp Diodes 100V	7p
S5024A	50p	1 amp Bridges 100V 1 amp 400V	20p 20p
		3 amp Bridge	25p
55030A	50p	W005M Bridge	15p
N3899	50p	W04 Bridge	20p
		BY296	20р 7р
Y 179 bridge 800V/	l Amp	BY298 BY299	10p
ectifier	35p	BT146	10p 25p
U124	50p	BT 138 10/A	70p
U1377	60p	1600/volt 1 amp diodes	7p
U326	60p	1300/volt 1 amp diodes	7p
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N 3055 D 238	25p 20p	BD131	25p
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N76001	£1.00	· ·	r 40p
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N76227	50p	FT3055	26p
N76131	50p/	NPN-PNP 60V 5 amp 80	9W.
N76544N	£1.00	20p pair	
N76660 N76666	30p	GEC 8Ω speakers (Cost £10)	7 <u>0p</u>
AS560	50p £1.00	New (NSF/AEG)	
AS570	£1.00	UHF/VHF Varicap T/U	nits \ E 4.00
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N76532	50p	approx. 1,200 volts	7р
N76707N	50p		
N16964 N76018KE	50p £1.00	BY204/4	6р
N76008KE	£1.00	BY296 10p BY206 BY299 10p BY127	7р 10р

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Philips G11		MR508 3 amps/80	00V 12p
Thyristor		IN4006	5 p
BF240	5p	IN4007	5 p
BC546	5p	BY 210/400	5 p
BC 207	5p	BY210/800	10p
BC250	5р	BY176	50p
BC 251	5p	BY133	8 p
BC 308B	5p	BA159	7 p
BC139	5p	BY 184	25 p
BC 173 /	5p	BY 187/01 (EHT	
BC116	5p	Diode 11.5KV	
BF273	5p	2 M/A)	10p
BC174	5p		
BAV10	5 p	BC 147C	2N3566
BC238	5p	BC 148B	BF198
OA90 🛴	5p	BC 149C	BF274
Thermistors	ŀ	BC 195	BSY79
PTH451 A or B	20p	BC 108	BC 327
Thermistor		BC 109	BC213LA
nermistor PT37P	24	BC 107	BC212LT
F137F GEC4700M/25V	25p	BF 594	BF195
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Axle	15p	2N2222	BF 594
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BF127	20p	2SK 30A	BC454
BF 264	20p	BC 455	BC559
BF180	20p	BC 337	7p each
BF181	20p		
BF 182	20p	Small Red LEDs	5p
BF 200	20p	Type TLR 102	Jβ
BC 300	20p	ORP12	40p
BC 303	20p	BF355 300V	30p
BC350 \	20p		
BC 257	30p	BD681	25p
BF137	20p	BD228	25p
BF185	20p	BD207	30p
BC460 \	20p	20 small red LED	1.00
BC336	20p	2N6099	
BF157	20p		25p
E1222	20p	5 amp 300V	24
BFT43	20p	Thyristors	25p
TIP29A	20p	Pair TIP 41-42	50p
TIP30A	20p	4 Push button for	
TIP32	20p	v/cap with pots	50p each
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