TELEVISION

20p

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

JUNE 1972

COLOUR i.f. STRIP

also:

TRANSISTOR SYNC CIRCUITS

COLOUR SET RENOVATIONS

C & L IN SERVICING

TELEVISION

SERVICING·CONSTRUCTION·COLOUR·DEVELOPMENTS

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VHF RUNDOWN?

IT IS said that religious leaders should not involve themselves in politics. Likewise it could be said that engineers should not involve themselves with morals. But a questionable attitude seems to have developed of late amongst the UK broadcasting authorities regarding the 405-line service.

At the International Broadcasting Convention in London in 1970 the Chief Engineer of the Independent Television Authority expressed what he described as a "personal opinion" that 405-line broadcasting would be required to continue on the v.h.f. bands until about "1990." That would appear to us to be a reasonable period, giving the broadcasting authorities a very generous length of time to build up the u.h.f. network to give at least equal coverage to that at present provided on v.h.f. It would also seem acceptable in that by then the last single-standard 405-line receivers would have expended their useful life and the owners would have moved on to u.h.f. in monochrome or colour.

What to our way of thinking is unacceptable is any policy that might deliberately drive viewers on to u.h.f. by indicating or seeming to indicate that the 405-line service is relatively poor. This unfortunately seems to be happening. A large number of v.h.f. transmitting stations are radiating inferior quality pictures, not because of the link quality to the transmitter site nor because of the transmitter itself (although some are hanging on only because of the admirable work being put in by station engineers) but due to lack of alignment of the line-store standards converters. If this is an engineering problem it should have been solved. We would accept that the engineering implementation of the line-store converter design is not what it could have been. Both the BBC and the ITA have developed digital converters but things have been strangely quiet on this front of late. Is it maybe that the Authorities have weighed up new converter costs against length of service time and come up with the "leave it as it is" answer? Or is it (heaven forbid) a policy decision to let the 405-line network deteriorate slowly but decisively until the eye-strained public clamours for 625-line television?

Both the BBC and the ITA have a duty to keep the v.h.f. network continuing at the best possible quality for as long as the Government decides.

W. N. STEVENS, *Editor*

THIS MONTH

THE NEXT ISSUE DATED JULY WILL BE PUBLISHED JUNE 19

Colour Receiver : There has been a far greater response than was anticipated and in consequence there have been delays in meeting some orders: we hope readers will bear patiently with us all.

TELETOPICS

LINE OUTPUT STAGE DEVELOPMENTS

It looks as if single-transistor line output stages for large-screen monochrome receivers may become common before long. Mullard have published details of an experimental design using a single BU105 transistor line output stage operating from a 150V h.t. supply for use with 20 and 24in. tubes. An interesting feature is the absence of an efficiency diode: the BU105 acts as a bidirectional switch, providing its own efficiency diode action. The 500V tube first anode and focus supply is provided by a BY184 silicon rectifier which rectifies the flyback pulses whilst an e.h.t. overwinding feeds a further silicon rectifier, type BY185, which provides an e.h.t. of 18kV.

It also seems that single silicon e.h.t. rectifiers are about to become common. An e.h.t. silicon diode family has been developed by Brown Boveri. Advantages in the use of silicon rectifiers as opposed to selenium types for this application are the lower loss (smaller forward voltage drop), smaller dimensions and increased stability.

VIDEOCASSETTES

The hectic development of videocassette systems continues unabated while the first production models are beginning to appear. In Europe the Philips VCR machine is now in production and Philips are talking about producing a "five-figure number" this year. In the USA Avco's Cartrivision colour record/playback videocassette machines are now in production and Avco have announced that their Cartrivision system is to be incorporated in combination colour set/VCRs later this year—the US West Coast setmaker Teledyne Packard Bell is expected to introduce the first such sets at around $1,000 and it is understood that Admiral, DuMont, Emerson and others plan to enter this market soon. The Philips and Cartrivision systems both use ½in. tape. Sony meanwhile have announced that their U-matic videocassette system, which uses ¾in. tape, is NTSC/CCIR compatible, giving programme compatibility between the NTSC area (USA and Japan) and Western Europe. Sony say their U-matic system will become available in European markets some time during early 1973: clearly they are concentrating on the USA first. At the recent VIDCA gathering in Cannes National Panasonic showed a ½in. videorecorder which is expected to be available next year in the £350-500 price range. Vidicord showed a prototype of their new colour teleplayer type OR1 which is scheduled for release next year at around £400: this machine uses 8mm. film as the storage medium in conjunction with a flying-spot scanner. RCA, whose holographic videoplayer system is still several years off, have announced that they too plan to enter the magnetic tape videoplayer market: they expect to have a colour player for the consumer market in the USA by 1973 at a price claimed to be below any current competition and say that agreement has been reached with other US companies to market the system, which will use ¾in. tape.

CABLE TV

Our leader last month commented on the resurgence of interest in cable TV systems. Things could go far and fast if proposals put forward by Robert W. Galvin, chairman of Motorola, in the USA came to be adopted. Mr. Galvin has suggested no less than that most or all TV in the States should be switched over to cable, with possibly just some off-air broadcasting via satellites in rural areas. The idea would be for television to be just one of many services available via a broadband cable. Mr. Galvin comments that in changing over the opportunity could be taken to adopt new TV standards—he suggests an 800 or 1,000 line picture, making possible three by four foot displays without visible line structure.

Meanwhile in the UK a two-way "communication main" to include TV and radio services is to be a feature of the new city of Milton Keynes in North Buckinghamshire and it is planned that by Spring next year 2,000 houses will already have been connected to the system. The network is designed to provide initially conventional telephone, radio and TV services but is capable of handling such future services as remote meter reading, computer links and viewphones. The service uses a specially designed twin cable consisting of an orthodox telephone pair together with a coaxial cable for the TV and v.h.f. radio signals, and will be laid in trenches alongside the other utility services. The u.h.f. TV signals will be translated to non-standard channels in the v.h.f. band for distribution along the main "highway" cables: street cabinets containing frequency translators will then shift the 625-line signals back to u.h.f. for distribution along local lines to individual households so that standard TV sets can be used. The "head-end" of the system will be at the local telephone exchange which will receive the radio and TV signals off-air, amplify, clean up and frequency change them as necessary and reassemble them for transmission into the cable network. The whole point about this sort of thing is what sort of service can be provided at what sort of charge? And of course privacy: a future Minister of Posts and Telecommunications could become a very powerful figure! Of one thing there is no doubt: cable does give the possibility of far greater choice to the individual viewer.

CONSTRUCTORS' 625-LINE RECEIVER

For those of you who want to further improve the performance of the popular Constructors' 625-line Receiver we plan to publish shortly some additional modifications—giving what Keith Cummins tells us will be the de luxe version. These improvements include a sinewave line oscillator stage and a stabilised power supply circuit. For the benefit of more recent readers we shall be repeating the entire circuit, including the fast-acting a.g.c. system that was the last modification. Manor Supplies still have the main parts and C. G. James Electronics (Staines Road, Feltham, Middlesex) tell us they can still supply the chassis, at £6·88 including post and packing, with a two weeks' delivery time.

MORE TV ICs

Mullard have announced a further three new i.c.s for use in television sets. First an intercarrier sound i.c., type TBA480, which will drive a triode-pentode, transistor or i.c. audio section. This i.c. is already in use in recent GEC-Sobell single-standard monochrome sets. Secondly a sophisticated line oscillator i.c., type TBA920, which incorporates a sync separator, noise gate, line oscillator with phase bridge, flywheel time-constant switching, automatic phase control between the line flyback pulses and oscillator and an output stage designed for fast edge-switching of the line driver transistor. The third i.c., type TCA270, is the largest linear circuit developed so far in the Mullard range and consists of a synchronous video detector, video amplifier, white spot inverter, buffer stages, a.g.c. and a.f.c. circuits.

CHANGES OF ADDRESS

Labgear have changed their address which is now: Labgear Ltd., Abbey Walk, Cambridge CB1 2RQ, telephone 0223 66521.
The Head and Commercial Offices of Thorn Radio Valves and Tubes Ltd. are now located at the Company's Brimsdown site. Address: Mollison Avenue, Brimsdown, Enfield, Middlesex EN3 7NS, telephone 01-804 1201.

TRADE NEWS

Four new colour sets have been added to the Pye/Ekco range, all fitted with the group's new 697 chassis which features an improved sound channel and new varicap tuner. The **Pye** addition is Model CT203 at £308·96, fitted with a 26in. tube. The three **Ekco** models, CT252 and CT253 at £289 and the CT254 at £302, are all fitted with 22in. tubes and feature slider volume, brightness, contrast, colour and tone controls.

The new BRC solid-state chassis which will be used in the Company's mains/battery portables is the 1590.

The BRC 8000 colour chassis is used in a new colour set released by **Alba,** Model TC1717. This receiver is fitted with a 17in. tube and the suggested price is "under £190".

A group of former Teleton executives have founded Interconti Electronics to import audio and TV products from **Siemens** in Germany and **Admiral** in the USA. They plan to import some 6,000 26in. Siemens colour sets and a quantity of 14in. Admiral colour sets made in Taiwan this year. Next year they plan to import German sets fitted with 110° narrow-neck tubes and they forecast that they will be importing Siemens videocassette players (to the Philips VCR standard) within eighteen months.

Following a six months' test run **Indesit** has decided that its Italian sets should be marketed in the UK on a national basis. A 24in. model and a 12in. mains/battery portable are expected to be shown at the London Radio/TV Trade Shows (May 21-25th).

UK setmakers worried by the threat of Japanese colour sets flooding the market are once again seeking a meeting with the Department of Trade and Industry in the hope of getting quotas introduced. The import of Japanese colour sets rose from 27 in 1970, worth £2,834, to 43,783 worth over £3·5 million in 1971. At the same time however John Bowes, chairman of the British Radio Cabinet Manufacturers Association, said at the Association's annual dinner that British colour TV production was currently competitive with that of any country in the world. We can believe this. UK setmakers have little to complain about, considering the way in which the market has opened up for them. Their only real problem is to produce enough sets. A little competition in a seller's market is no bad thing.

According to the latest BREMA figures 116,000 colour and 147,000 monochrome sets were delivered to the UK market during January. Colour sets are thus rapidly moving towards half the total market.

LATEST RELAY SERVICES

The following BBC and ITA relay services are now in operation:
Kidderminster, BBC-1, channel 64, Aerial group C.
Saddleworth, BBC-1, channel 52, Aerial group E.
Windermere, BBC-2, channel 44, Aerial group B.
Mynydd Machen, BBC-Wales, channel 33, also BBC-2, channel 26, Aerial group A.
Bath, BBC-2, channel 28, Aerial group A.
Hertford, ITV London, channel 61, Aerial group C.
Guildford, ITV London, channel 43, Aerial group B.
Hemel Hempstead, ITV London, channel 41, Aerial group B.
All transmissions are vertically polarised.

NEW GENERAL-PURPOSE CCTV CAMERA

A new general-purpose closed-circuit TV camera incorporating an intrinsically weatherproof casing and other features to simplify operation, installation and maintenance has been introduced by EMI for educational, commercial and industrial use. Known as the Surveyor, the camera will operate on 625 or 525 lines and provides comprehensive operating facilities including remote operation and good low-light performance. The camera costs around £300 including the tube and has been developed by EMI's Sound and Vision Equipment Division at Hayes, Middlesex. An electrostatic vidicon pick-up tube—type 9745 or equivalent—is used to eliminate the need for deflection coils and thus simplify maintenance and tube replacement.

LETTERS

EKCO MODEL T221

Although nearly twenty years old now we find that these sets are still capable of giving good service with practically no maintenance. Recently however two failed within a short time, the symptoms being normal sound but poor picture and sync. After trying the usual possible cures without success we found by chance that a normal picture could be restored by decoupling the 5kΩ a.g.c. preset with a 2μF 250V electrolytic. This preset control is mounted at the front of the i.f. strip chassis, beside the tuner. The cure worked on both sets.—**D. V. Bridger** (*Tunbridge Wells*).

GEC MODEL 2048

We were getting a very odd picture on a single-standard GEC Model 2048. The trouble seemed to be some form of overloading as disconnecting the aerial produced a slight improvement. The synchronisation was affected, giving a rather ragged picture. The usual procedures for overloading trouble failed to improve matters and as the base voltage of the controlled i.f. stage was excessive—4V instead of about 1·6V—attention was turned to the a.g.c. circuit (Fig. 1). It was eventually found that the 160μF capacitor C108 was open-circuit.—**G. Hardcastle** (*London, S.W.18*).

RECEIVING CONTINENTAL SOUND

Your DX-TV readers may be interested in the method I have been successfully using to receive the 5·5MHz intercarrier sound signal used with most West European television transmissions. The circuit (Fig. 2) consists of a simple 0·5MHz oscillator using a 470kHz i.f. coil retuned to 500kHz obtained from an old Japanese transistor radio and a cheap silicon transistor. The output is capacitively coupled from the collector of the transistor and fed via a resistor to the input circuit of the intercarrier amplifier. The set I have been using this with is a Philips T-Vette transistor portable and the circuitry around the 6MHz take-off point is shown in Fig. 3. The point to which the 0·5MHz signal is applied does not seem to be very critical so long as some 0·5MHz signal appears in the primary of the 6MHz take-off transformer. Points A, B, C and D have been tried, point D being perhaps marginally better in giving a small improvement in keeping the 0·5MHz signal out of the vision channel. The system appears to be quite uncritical in setting-up and operation. It was made, connected and found to work on Norwegian television in Band III with no test equipment other than the set itself to check that oscillation was taking place. It was subsequently found, by finding the second harmonic in the medium waveband, to have been working at 570kHz and was reset to 500kHz. The 100kΩ resistor was selected quite arbitrarily to keep the 0·5MHz signal out of the vision channel and could probably be increased to reduce the loading effect on the intercarrier circuit. Spurious shortwave response if present could be reduced by mounting the resistor close to the existing circuitry and then taking a lead to a separate circuit board on which the oscillator is mounted.

The system works by mixing 0·5MHz with the 5·5MHz CCIR intercarrier signal which has come through the i.f. amplifier in the normal way, producing 5, 5·5 and 6MHz intercarriers at the take-off transformer. It would presumably also work on the OIRT standard, producing 6, 6·5 and 7MHz intercarriers, there still being sufficient i.f. bandwidth.

The system has been tried on Band III tropospheric signals from Norway, Denmark and West Germany and has given long-term viewing and sound for several hours' duration and at times with domestic broadcast quality. The method would appear to be suitable for adaptation to other sets, though it is possibly an advantage to have a set with separate vision and intercarrier detectors in order to keep the extra signals produced out of the vision channel. The 5·5 and 6·5MHz signals do not of course improve normal reception so the oscillator has to be switched out then. I hope this idea will be of interest to those wishing to receive DX vision and sound on UK-produced sets.—**Ronald Exeter** (*North Berwick*).

CONSTRUCTORS' 625-LINE IF STRIP

I have constructed the single-standard 625-line i.f. strip design you published in the July 1971 issue and get excellent results. However in case other constructors make the same mistake that I did perhaps you could emphasise that the i.c. shown in Fig. 6 is, as you state in the text but I overlooked, shown upside down, i.e. with its case in contact with the metal chassis.—**E. Poole** (*Leicester*).

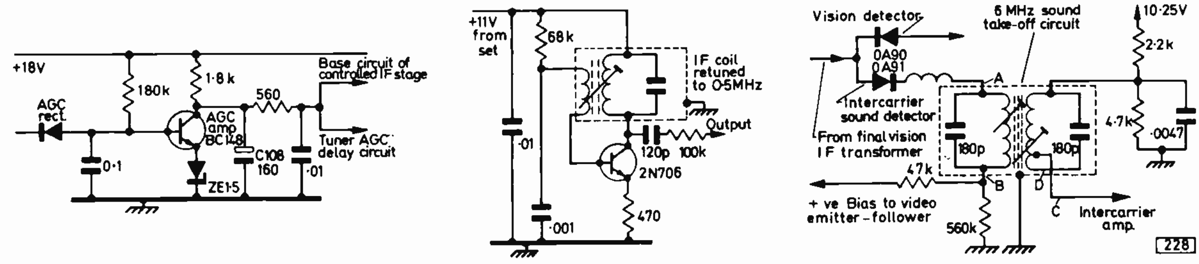


Fig. 1 (left): The a.g.c. circuit used in the GEC-Sobell 2048-1048 series. Fig. 2 (centre): The 0·5MHz oscillator circuit suggested by Ronald Exeter for the reception of CCIR sound signals. Fig. 3 (right): Philips T-Vette sound take-off circuitry to which the 0·5MHz signals were applied.

The largest selection

BRAND NEW FULLY GUARANTEED DEVICES

AC107	15p
AC113	20p
AC115	23p
AC125	17p
AC126	17p
AC127	17p
AC128	17p
AC141K	17p
AC142K	17p
AC151	15p
AC154	15p
AC155	17p
AC156	17p
AC157	17p
AC165	17p
AC166	17p
AC167	20p
AC168	20p
AC169	14p
AC176	23p
AC177	20p
AC187	30p
AC188	30p
ACY17	25p
ACY18	20p
ACY19	22p
ACY20	20p
ACY21	20p
ACY22	19p
ACY27	18p
ACY28	19p
ACY29	30p
ACY30	25p
ACY31	25p
ACY34	18p
ACY35	18p
ACY36	30p
ACY40	15p
ACY41	18p
ACY44	35p
AD140	40p
AD142	40p
AD149	43p
AD161	35p
AD162	35p
AD161/ 162(MP)	63p
ADT140	50p
ADZ11	£2
ADZ12	£2·10
AF114	17p

AF115	17p
AF116	17p
AF117	17p
AF118	30p
AF124	21p
AF125	20p
AF126	20p
AF127	20p
AF139	33p
AF178	50p
AF179	50p
AF180	50p
AF191	50p
AF186	45p
AF239	37p
AFZ11	37p
AFZ12	45p
AL102	85p
AL103	85p
ASY26	25p
ASY27	30p
ASY28	25p
ASY29	25p
ASY50	25p
ASY51	25p
ASY52	25p
ASY54	25p
ASY55	25p
ASY56	25p
ASY57	25p
ASY58	25p
ASY58	25p
ASZ21	40p
BC107	10p
BC108	10p
BC109	11p
BC113	25p
BC114	30p
BC115	30p
BC116	35p
BC117	35p
BC118	25p
BC119	45p
BC125	35p
BC126	35p
BC132	25p
BC134	30p
BC135	30p
BC136	30p
BC137	35p
BC139	45p

BC140	35p
BC141	35p
BC142	45p
BC143	40p
BC145	45p
BC147	17p
BC148	12p
BC149	17p
BC150	17p
BC151	20p
BC152	17p
BC153	27p
BC154	30p
BC157	20p
BC158	17p
BC159	20p
BC167	13p
BC168	13p
BC169	13p
BC170	12p
BC171	13p
BC172	13p
BC173	13p
BC174	13p
BC175	22p
BC177	17p
BC178	17p
BC179	17p
BC180	20p
BC181	22p
BC182	10p
BC182L	10p
BC183	10p
BC183L	10p
BC184	13p
BC184L	13p
BC186	27p
BC187	27p
BC207	11p
BC209	11p
BC209	11p
BC212L	11p
BC213L	11p
BC213L	11p
BC214L	12p
BC225	25p
BC226	35p
BC317	12p
BC318	12p
BC319	12p
BCY30	20p

BCY31	22p
BCY32	25p
BCY33	17p
BCY34	20p
BCY70	17p
BCY71	30p
BCY72	15p
BCZ11	20p
BD121	85p
BD123	85p
BD124	75p
BD131	80p
BD132	80p
BDY20	£1
BF115	22p
BF117	45p
BF118	60p
BF119	70p
BF152	35p
BF153	35p
BF154	35p
BF157	45p
BF158	25p
BF159	30p
BF160	30p
BF162	30p
BF163	35p
BF164	35p
BF165	35p
BF167	22p
BF173	22p
BF176	35p
BF177	35p
BF178	45p
BF179	50p
BF180	30p
BF181	30p
BF182	30p
BF183	30p
BF184	25p
BF185	30p
BF188	30p
BF194	23p
BF195	24p
BF196	30p
BF197	35p
BF200	45p
BF222	80p
BF257	35p
BF270	25p
BF271	17p

BF272	80p
BF273	30p
BF274	30p
BF308	35p
BF309	37p
BF316	75p
BFW10	55p
BFX29	27p
BFX84	20p
BFX85	27p
BFX86	22p
BFX87	25p
BFX88	22p
BFY50	20p
BFY51	20p
BFY52	20p
BFY53	17p
BSX19	15p
BSX20	15p
BSY25	15p
BSY26	15p
BSY27	15p
BSY28	15p
BSY29	15p
BSY38	15p
BSY39	15p
BSY40	30p
BSY41	35p
BSY95	12p
BSY95A	12p
BU105	£3·90
C111E	60p
C400	30p
C407	25p
C424	17p
C425	40p
C426	30p
C428	20p
C441	27p
C442	35p
C444	37p
C450	17p
C720	12p
C722	25p
C740	25p
C742	17p
C744	17p
C760	17p
C762	17p
C764	60p
EC401	15p

EC403	15p
GET880	27p
MAT100	15p
MAT101	17p
MAT120	15p
MAT121	17p
MPF102	43p
MPF105	43p
OC19	30p
OC20	50p
OC22	30p
OC23	33p
OC24	45p
OC25	25p
OC26	25p
OC28	40p
OC29	40p
OC35	33p
OC36	40p
OC41	20p
OC42	22p
OC44	15p
OC45	12p
OC70	15p
OC71	9p
OC72	12p
OC74	12p
OC75	15p
OC76	15p
OC77	25p
OC81	15p
OC81D	15p
OC82	15p
OC82D	15p
OC83	20p
OC84	20p
OC139	15p
OC140	17p
OC170	15p
OC171	15p
OC200	25p
OC201	27p
OC202	27p
OC203	25p
OC204	25p
OC205	35p
OC309	35p
P346A	17p
P397	45p
OCP71	43p
ORP12	43p

ORP60	40p
ORP61	40p
ST140	12p
ST141	17p
TIS43	40p
UT46	27p
V405A	25p
V410A	45p
2G301	19p
2G302	19p
2G303	19p
2G304	20p
2G306	35p
2G308	35p
2G309	35p
2G339	17p
2G339A	15p
2G344	15p
2G345	15p
2G371	13p
2G371B	10p
2G374	17p
2G377	27p
2G378	15p
2G382	15p
2G401	30p
2G414	30p
2G417	25p
2N388	30p
2N388A	50p
2N404	22p
2N404A	30p
2N524	55p
2N527	60p
2N696	12p
2N697	15p
2N698	24p
2N699	55p
2N706	7p
2N706A	8p
2N708	12p
1N709	45p
2N711	40p
2Nu17	42p
2N718	24p
2N718A	50p
2N726	27p
2N727	27p
2N743	17p
2N744	17p
2N914	17p

2N918	30p
2N929	22p
2N930	25p
2N1131	20p
2N1132	22p
2N1302	17p
2N1303	17p
2N1304	20p
2N1305	20p
2N1306	22p
2N1307	22p
2N1308	27p
2N1309	27p
2N1613	17p
2N1711	20p
2N1889	35p
2N1890	45p
2N1893	37p
2N2160	60p
2N2147	75p
2N2148	60p
2N2192	30p
2N2193	30p
2N2194	27p
2N2217	20p
2N2218	25p
2N2219	27p
2N2220	22p
2N2221	22p
2N2222	27p
2N2368	17p
2N2369	15p
2N2369A	15p
2N2411	50p
2N2412	50p
2N2616	55p
2N2711	22p
2N2712	22p
2N2714	25p

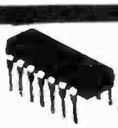
2N2714	25p
2N2904	25p
2N2904A	30p
2N2905	25p
2N2905A	30p
2N2906	25p
2N2906A	27p
2N2907	25p
2N2907A	30p
2N2923	13p
2N2924	13p
2N2925	13p
2N2926 (G)	12p
2N2926 (Y)	11p
2N2926 (O)	10p
2N3010	80p
2N3011	20p
2N3053	20p
2N3054	50p
2N3055	63p
2N3391	17p
2N3391A	20p
2N3392	17p
2N3393	15p
2N3394	15p
2N3395	20p
2N3402	22p
2N3403	22p
2N3404	32p
2N3405	45p
2N3414	20p
2N3415	20p
2N3417	37p
2N3525	74p
2N3702	12p
2N3703	12p

2N3704	15p
2N3705	12p
2N3706	12p
2N3707	13p
2N3708	8p
2N3709	8p
2N3710	10p
2N3711	10p
2N3819	40p
2N3820	£1
2N3903	25p
2N3904	27p
2N3905	25p
2N3906	27p
2N4058	15p
2N4059	10p
2N4060	12p
2N4061	12p
2N4062	12p
2N5172	12p
2N5459	43p
2S034	75p
2S301	50p
2S302A	45p
2S302	45p
2S303	60p
2S304	£1·10
2S305	£1
2S306	£1·10
2S307	£1·10
2S321	60p
2S322	50p
2S322A	45p
2S323	60p
2S324	£1·20
2S325	£1·20
2S326	£1·20
2S327	£1·20

DIODES & RECTIFIERS

AA119	8p	BY130	15p	OA10	22p
AA120	8p	BYZ10	35p	OA47	7p
BA116	22p	BYZ11	32p	OA70	7p
BA126	22p	BYZ12	30p	OA79	8p
BY100	15p	BYZ13	25p	OA81	7p
BY101	12p	BYZ16	35p	OA85	7p
BY105	15p	BYZ17	35p	OA90	6p
BY114	12p	BYZ18	30p	OA91	7p
BY126	15p	BYZ19	25p	OA95	7p
BY127	17p	OA5	17p	OA200	6p

74 Series T.T.L. I.C-s



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BP01 = SN7401	0·15	0·14	0·12
BP02 = SN7402	0·15	0·14	0·12
BP03 = SN7403	0·15	0·14	0·12
BP04 = SN7404	0·15	0·14	0·12
BP05 = SN7406	0·15	0·14	0·12
BP07 = SN7407	0·18	0·17	0·16
BP08 = SN7408	0·18	0·17	0·16
BP09 = SN7409	0·18	0·17	0·16
BP10 = SN7410	0·15	0·14	0·12
BP13 = SN7413	0·29	0·26	0·24
BP16 = SN7416	0·43	0·40	0·38
BP17 = SN7417	0·43	0·40	0·38
BP20 = SN7420	0·15	0·14	0·12
BP30 = SN7430	0·15	0·14	0·12
BP40 = SN7440	0·15	0·14	0·12
BP41 = SN7441	0·67	0·64	0·58
BP42 = SN7442	0·67	0·64	0·58
BP43 = SN7443	1·95	1·85	1·75
BP44 = SN7444	1·95	1·85	1·75
BP45 = SN7445	1·95	1·85	1·75
BP46 = SN7446	0·97	0·94	0·88
BP47 = SN7447	0·97	0·94	0·88
BP48 = SN7448	0·97	0·94	0·88
BP50 = SN7450	0·15	0·14	0·12

BI-PAK Order No.	Price and qty. prices 1-24 £p	25-99 £p	100 up £p
BP51 = SN7451	0·15	0·14	0·12
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BP54 = SN7454	0·15	0·14	0·12
BP60 = SN7460	0·15	0·14	0·12
BP70 = SN7470	0·29	0·26	0·24
BP72 = SN7472	0·29	0·26	0·24
BP73 = SN7473	0·37	0·35	0·32
BP74 = SN7474	0·37	0·35	0·32
BP75 = SN7475	0·47	0·45	0·42
BP76 = SN7476	0·43	0·40	0·38
BP80 = SN7480	0·67	0·64	0·58
BP81 = SN7481	0·97	0·94	0·88
BP82 = SN7482	0·97	0·94	0·88
BP83 = SN7483	1·10	1·05	0·95
BP86 = SN7486	0·32	0·30	0·28
BP90 = SN7490	0·67	0·64	0·58
BP91 = SN7491AN	0·87	0·84	0·78
BP92 = SN7492	0·67	0·64	0·58
BP93 = SN7493	0·67	0·64	0·58
BP94 = SN7494	0·77	0·74	0·68
BP95 = SN7495	0·77	0·74	0·68
BP96 = SN7496	0·77	0·74	0·68
BP100 = SN74100	1·75	1·65	1·55
BP104 = SN74104	0·97	0·94	0·88
BP105 = SN74105	0·97	0·94	0·88

BP107 = SN74107	0·40	0·38	0·36
BP110 = SN74110	0·55	0·53	0·50
BP111 = SN74111	1·25	1·15	1·00
BP118 = SN74118	1·00	0·95	0·90
BP119 = SN74119	1·35	1·25	1·10
BP121 = SN74121	0·67	0·64	0·58
BP141 = SN74141	0·67	0·64	0·58
BP145 = SN74145	1·50	1·40	1·30
BP150 = SN74150	1·80	1·70	1·60
BP151 = SN74151	1·00	0·95	0·90
BP153 = SN74153	1·20	1·10	0·95
BP154 = SN74154	1·80	1·70	1·60
BP155 = SN74155	1·40	1·30	1·20
BP156 = SN74156	1·40	1·30	1·20
BP160 = SN74160	1·80	1·70	1·60

BP161 = SN74161	1·80	1·70	1·60
BP164 = SN74164	2·00	1·90	1·80
BP165 = SN74165	2·00	1·90	1·80
BP181 = SN74181	2·75	2·60	2·40
BP182 = SN74182	0·97	0·94	0·88
BP190 = SN74190	3·50	3·25	3·00
BP191 = SN74191	3·50	3·25	3·00
BP192 = SN74192	2·10	1·95	1·75
BP193 = SN74193	2·10	1·95	1·75
BP195 = SN74195	1·10	1·05	0·95
BP196 = SN74196	1·80	1·70	1·60
BP197 = SN74197	1·80	1·70	1·60
BP198 = SN74198	5·50	5·00	4·00
BP199 = SN74199	5·50	5·00	4·00

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Workshop HINTS

by VIVIAN CAPEL

THIS month we will describe a few hints that can be useful in dealing with mechanical troubles.

Springs

Most mechanisms incorporate coil springs in one form or another for various functions. They can be of the compression type which are wound with spaces between adjacent turns and are intended to be squeezed under pressure: when released they expand to their original form. The mounting springs under record-player turntable units are examples of this type. Alternatively the spring can be of the expanding variety. The coils are wound closely together with adjacent turns touching. The applied tension tends to pull them apart and they exert a contracting force to counteract this and pull the linked components together. In the majority of applications this type is used.

Springs often become damaged by being over-stretched, or the end loop breaks. More frequently the spring simply becomes detached and disappears. Thus the engineer is faced with the task of finding and fitting a replacement. While it is possible to apply to the makers of the equipment for the right spring this involves delay and of course there is always the problem of identifying the right one out of the many used in the particular mechanism. For this reason many engineers find it more convenient to make their own replacements.

Making a Coil Spring

The operation is quite simple, the equipment needed being a wheelbrace, vice, selection of long screwdrivers with varying diameter shanks and a supply of piano wire of various gauges. The wheelbrace is mounted horizontally in the vice with the wheel uppermost and a screwdriver chosen and inserted into the chuck with the blade foremost. This serves as a mandrel on which the spring can be wound. Because a spring expands slightly in diameter after it is wound the diameter of the screwdriver shank should be a little less than the required inside diameter of the spring.

One end of the piano wire should be inserted in the chuck and secured to prevent it coming free. The wheel is then slowly turned and the wire taken up around the screwdriver shank. Keep the wire taut and pull it backward (see Fig. 1) toward the chuck at an angle which keeps the adjacent turns together but does not make a turn ride over the top of its predecessor. When the spring has reached the required length cut the wire and remove the spring and screwdriver from the chuck.

As an aid in determining the size of the spring required—especially if the original is lost and there is no pattern to make a comparison with—here are a few observations on the characteristics of coil springs as determined by their dimensions.

Properties of Coil Springs

There are two main properties of a spring, the length to which it can be expanded in comparison to its closed length and its tension or strength in the expanded state.

If a coil spring is expanded too far its coils will not return to their original position and the spring is said to be stretched. The amount that a spring can be expanded without becoming stretched is governed by the number of turns and the diameter. The greater the number of turns the less each one has to deviate from its resting position for the complete spring to reach a particular length. Also the greater the diameter the smaller the strain and therefore the more the spring can be expanded.

The strength of a spring is related to the gauge of wire and the diameter. A heavy gauge will obviously give greater tension than a lighter one but also a spring with a large diameter will exert less force than a smaller one because as we have seen there is less strain when it is expanded. More force is exerted when the spring is well expanded than when it is nearly closed.

If therefore we need a spring that is strong and will stretch a long way we need a large number of turns but not so many that the spring is too long in its closed position. It needs to be of fairly large diameter but as this will make it weaker we must compensate by using a heavy gauge of wire. A weak spring with a long stretch is easily made with thinner wire and a large diameter while a strong spring with a short stretch need have few turns and small diameter. So the various factors are interdependent and although spring design can be quite an exact art—by varying the various parameters—something suitable for the job can usually be made up by judicously estimating the size from the foregoing principles.

If a spring has become stretched nothing can be done to restore it by squeezing it up as it has now become a compression spring and the expanded state is its normal one. Rather than winding a completely new spring however the old one can be unwound on a wheelbrace—by reversing the winding process—and then rewound tightly. Proper unwinding is essential, not just pulling the spring out straight, because this will produce kinks.

Leaf Springs

From coil springs we turn to leaf springs. These are used as contacts in tuner units and are also currently used in the press-button channel selector of the Philips colour TV range. To make a positive contact the leaf spring must be tensioned just right. In the case of the turret tuner the leaf must be so sprung that the contacting stud moves it about a tenth of an inch away from the resting position. If as sometimes happens contact is made without much movement of the leaf there will be little if any pressure and the contact will very likely be intermittent. If on the other hand the leaf is adjusted too far forward it may be caught by the edge of the coil biscuit and crumpled when the turret is rotated.

How to Adjust Leaf Springs

When a leaf spring contact is adjusted by bending it will always spring back some way from its new to its old position. To allow for this it must be bent a little beyond the required position so that when it comes to rest it will be about right.

The next problem is how to do the bending. I have had a small tool for bending leaf-spring contacts in my trimming-tool kit since the days when radios used this type of switch for wavechanging. With the coming of rotary-wafer switches it fell into disuse but found a new lease of usefulness with TV tuner turrets and other modern leaf switches. It consists (see Fig. 2) of a cranked metal rod with a handle, the open end being slotted for a short way. The leaf is inserted in the slot and the rod then turned to gently bend the leaf in the required direction. The principle of the tool is quite simple and obvious and no doubt something of a similar nature could be made up in the workshop. Sawing a slot in a metal rod is not too easy but with a fine new blade and some care it can be done using an ordinary hacksaw.

Leaf-contact switches such as those used in the Philips tuner push-button unit already mentioned are not quite so easy to deal with as the turret tuner because with the latter the turret can be turned to an empty position or the coil biscuits removed so that the leaf can be adjusted while not in actual contact. In the other case the two leaves are bearing directly against each other so that it is not easy to judge whether the correct tension exists or not. The best thing to do (see Fig. 3) is to ease one leaf back (do not bend it) to see how far its partner travels to its rest position. If the movement is limited or non-existent the leaf needs bending forward. The same thing can then be done with the other one. This will ensure that both leaves exert pressure against each other when the switch is in the closed position. Bending should always be done from the base of the leaf not part-way up (see Fig. 4) so that the contact surfaces meet at the correct angle. Also the leaf will then be sprung over its whole length.

Screw Threads

It is often necessary to saw off a screw or a length of screwed-rod that is too long. In the process of cutting the threaded portion it frequently happens that the bottom thread is burred over or flattened so that it is difficult if not impossible to fit the screw into position—or the nut to the end of the screw as the case may be. The simple solution to this problem is to fit a nut to the thread *before* cutting it. Then when the excess portion is cut away the nut can be unscrewed: if any burring has taken place the threads of the nut will straighten out the screw thread and enable it to be started. It is easier to force a nut over the damaged portion of thread from a good section rather than to try to start it from the damaged end.

If a nut has not been fitted before cutting the only other alternative is to touch the end of the screw on to the grindstone. This will remove the burred thread and present a clean undamaged portion at the end.

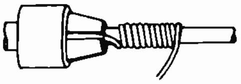


Fig. 1

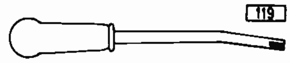


Fig. 2

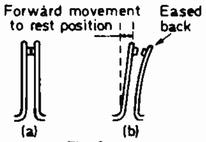


Fig. 3

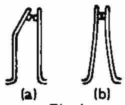


Fig. 4

Fig. 5

Fig. 1: Using a wheelbrace to wind a spring. The end is anchored securely in the chuck and the wire kept taught and pulled backwards to ensure close turns.

Fig. 2: This tool for adjusting leaf springs consists of a cranked rod slotted at one end.

Fig. 3: To check the tension of a pair of leaf-spring contacts (a) ease one backwards as shown at (b): the partnering contact should spring forward to its rest position. Repeat the process with the opposite contact.

Fig. 4: Incorrect way (a) to bend a leaf contact—part way up. The springs should be bent from the base as shown at (b) above.

Fig. 5: Control spindle end finished on a grindstone after cutting: the rough-sawn end is ground flat and the edges chamfered off.

A further hint concerning screw threads is rather obvious although it is surprising how often it is not carried out. When cutting a screw or screwed-rod or carrying out any other work the screw is usually held by a bench vice to permit both hands to be free for the task required. If the threads are given only gentle pressure in a steel vice they will, being soft metal, suffer damage. A carpenter's vice with wooden clamp plates is rather more gentle but damage could still result if it is tightened up. In any case few radio and TV workshops are equipped with this sort of vice. The remedy is very simple: wind some rag around the screw before putting it in the vice and do not over tighten. The screw will be held firmly enough for most operations and the thread will not suffer at all. Paper or preferably cardboard can be used if a piece of rag is not to hand but there is a strong chance that the threads will cut through the paper when pressure is applied and so will be gripped by the steel jaws. Most workshops can produce an old duster (or should be able to) which will perform the necessary function of protecting the threads.

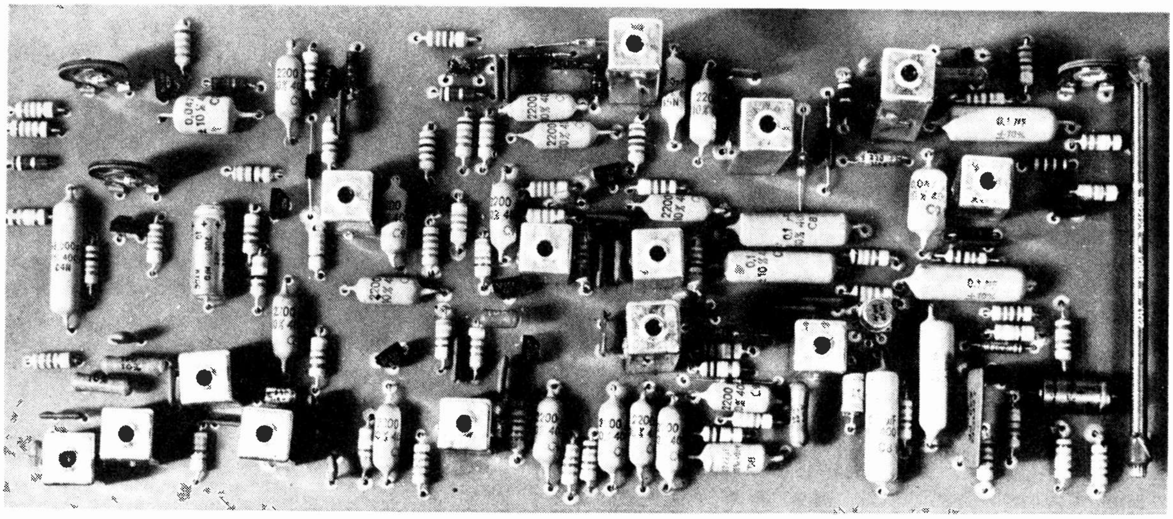
Driving Nails In

While we are on the subject of screws a hint on its more humble relative the nail would not be amiss. It is perhaps not very often that nails are used in the TV workshop but the odd occasion does arise. A detached ledge in a cabinet for example may need pinning and glueing and there may be further needs with cabinet work.

As most amateur woodworkers will have experienced, driving in a nail or panel pin sometimes results in the wood splitting at the point of entry. There is a tip to reduce this possibility that was passed on to me many years ago by a coffinmaker! I have used it on many occasions since with success. The nail is first of all blunted by holding it head down on

—continued on page 371

THE 'TELEVISION' COLOUR RECEIVER PART 3
COLOUR IF STRIP



THE i.f. module in our colour receiver contains not only the i.f. amplifier and its associated chroma/sound and luminance detectors but also the sound intercarrier amplifier and f.m. detector, the a.f.c. detector, the a.g.c. circuits for i.f. amplifier and tuner gain control, the controlled chroma amplifier stage, and the luminance delay line circuit and output phase splitter.

The outputs from the module are all intended as direct feeds to other circuit boards: the sound output direct to the audio amplifier module, the chroma output straight into the PAL-D decoder, the luminance output direct to the colour matrixing circuitry and a second feed to the sync separator on the timebase module, the a.f.c. outputs to the tuner.

General Requirements

As is well known the standard intermediate frequencies for UK 625-line working are 39·5MHz vision carrier and 33·5MHz sound carrier. With the chroma subcarrier at 4·43MHz from the vision carrier the subcarrier at intermediate frequency is 35·066MHz.

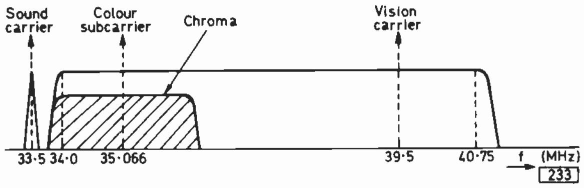


Fig. 1: The i.f. signal distribution (note that the actual transmitted signal is reversed—the sound carrier is at vision carrier plus 6MHz: reversal occurs as the result of the action of the mixer stage in the tuner).

The relative distribution of these signals is shown in Fig. 1. Vestigial-sideband transmission is used, with the chrominance information carried in the single-sideband section of the composite video signal. The low-frequency luminance signal components—around the vision carrier—are transmitted double-sideband. As a result of these two facts detection distortion which we will mention later can arise.

Sound-Chroma Beat

Any non-linear stage—whether the non-linearity is due to a transistor or diode—will act as a mixer circuit. If we present to such a non-linear circuit a signal composed of the combined sound and vision passband of Fig. 1 we will produce not only the original signals but also a number of other, mixed signals—the so-called *intermodulation distortion products*. The principal products will be the largest consistently repeated signals. This usually means that the varying picture content frequencies can be neglected so that the only product of any significance falling *inside* the passband is the chroma/sound beat of 6 – 4·43MHz, i.e. about 1·57MHz.

The formation of such a product would give the visual appearance of r.f. patterning on the picture at this frequency and because the sound frequency is varying with the modulation level (f.m.) the distortion would appear as "sound-on-vision". Once this distortion product has been produced on the luminance signal it is impractical to remove it using a narrow-band filter as this would substantially affect the rest of the luminance signals.

We cannot hope to make the i.f. amplifier stages perfectly linear so this problem will arise unless we

Table 1: Components List

Component—Pack 4

D101	OA90	Tr110	BF194	C116	6·8pF	C133	68nF	C149	100nF
D102	OA90	Tr111	BF194	C117	2·2nF	C134	125µF	C150	100nF
D103	OA90	C101	120pF	C118	3·3pF	C135	680pF	C151	47µF
D104	AA119	C102	33pF	C119	2·2nF	C136	2·2µF	C152	100nF
D105	AA119	C103	39pF	C120	2·2pF	C137	10pF	C153	39pF
D106	BZY88-	C104	150pF	C121	47pF	C138	5pF	C154	56pF
	C7V5	C105	150pF	C122	120pF	C139	3·3pF	C155	150pF
		C106	120pF	C123	2·2nF	C140	2·2nF	C156	22nF
Tr101	BF196	C107	33pF	C124	2·2nF	C141	180pF	C157	1nF
Tr102	BF197	C108	220pF	C125	2·2nF	C142	220pF	C158	2·2nF
Tr103	BF194	C109	22pF	C126	47pF*	C143	180pF	C159	2·2nF
Tr104	BF197	C110	120pF	C127	5pF	C144	100nF	C160	27pF
Tr105	BF194	C111	2·2nF	C128	6·8pF	C145	68pF	C161	120pF
Tr106	BC148	C112	2·2nF	C129	47nF	C146	47nF	C162	18pF
Tr107	BC148	C113	33pF	C130	2·2nF	C147	100nF	C163	2·2nF
Tr108	BC158	C114	56pF	C131	200µF	C148	100nF	C164	2·2nF
Tr109	BF194	C115	2·2nF	C132	2·2nF				

Capacitors 2·2pF up to 68pF are mica; 120, 150, 180 and 220pF are ceramic; 680pF is mica; 1nF to 100nF are C296, 400V polyester; electrolytics 2·2 µF 16V, 47µF 6·3V, 125µF 16V, 200µF 10V.
* C126 is part of Pack 6, not Pack 4: it is shown here to complete the components list.

R101	270Ω	R115	100Ω	R128	82Ω	R141	560Ω	R153	1·5kΩ
R102	3·3kΩ	R116	470Ω	R129	470Ω	R142	1·8kΩ	R154	5·6kΩ
R103	390Ω	R117	3·9kΩ	R130	1·2kΩ	R143	220Ω	R155	680Ω
R104	1·5kΩ	R118	18kΩ	R131	470Ω	R144	39kΩ	R156	5·6kΩ
R105	820Ω	R119	1kΩ	R132	3·9kΩ	R145	3·9kΩ	R157	3·3kΩ
R106	1·2kΩ	R120	1kΩ	R133	1kΩ	R146	120Ω	R158	10kΩ
R107	4·7kΩ	R121	470Ω		(preset)	R147	56Ω	R159	220Ω
R108	6·8kΩ	R122	1kΩ	R134	2·7kΩ	R148	220kΩ	R160	5·6kΩ
R109	6·8kΩ	R123	18kΩ	R135	12kΩ	R149	100kΩ	R161	4·7kΩ
R110	560Ω	R124	2·2kΩ	R136	1·5kΩ		(preset)	R162	1·2kΩ
R111	10kΩ	R125	1kΩ	R137	390Ω	R150	47kΩ	R163	100Ω
R112	820Ω		(preset)	R138	1·2kΩ	R151	390kΩ	R164	100kΩ
R113	2·2kΩ	R126	33kΩ	R139	18kΩ	R152	1kΩ	R165	100kΩ
R114	8·2kΩ	R127	39Ω	R140	8·2kΩ				

Resistors are all ½W 5%. Presets are all 0·3W, vertical mounting.

IC101 TAA350

Component—Pack 5

Delay Line, DL101 600ns, $Zo=1k\Omega$. 3 FX1242 Ferroxcube formers (for L113, L119, L120).

Component—Pack 6

1 set of ready-wound coils together with cans and cores *or* 1 kit of parts including wire lengths for winding coils (for all coils except L113, L119, L120). Includes C126.

Miscellaneous

Printed circuit board.

Component—Pack Suppliers

No. 4 A. Marshall & Son Ltd., 28 Cricklewood Broadway, London, NW2.
Cost: £7·50 including postage.

No. 5 Forgestone Components, Low Street, Ketteringham, Wymondham, Norfolk.
Cost: £1·35 including postage.

No. 6 P & R Windings, Industrial Estate, Happaway Road, Barton, Torquay, South Devon.
Cost: ready-wound set £5·20 including postage
kit of pieces £2·75 including postage
Both include C126.

Printed Circuit Board (TV IF 1)
E. J. Papworth & Son Ltd., 80 Merton High Street, London, SW19.
Cost: £2·32 including postage.

Readers should order components from the suppliers as "Component-Pack No. . . ." for the TELEVISION Colour Receiver Project. For Component-Pack No. 6 it should also be noted on the order whether the ready-wound or the kit is required. Any enquiries regarding the supply of individual components should be addressed directly to the suppliers.

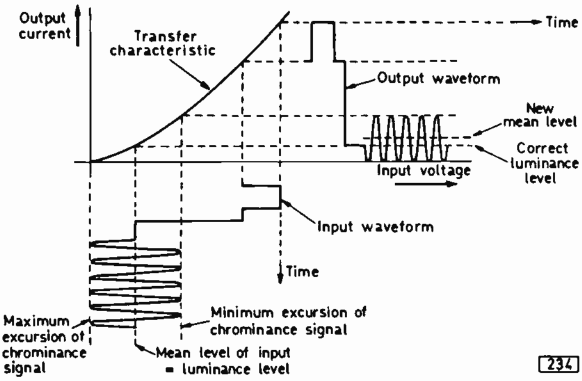


Fig. 2: With a common luminance and chrominance signal detector the non-linear transfer characteristic of the diode produces the form of distortion shown here.

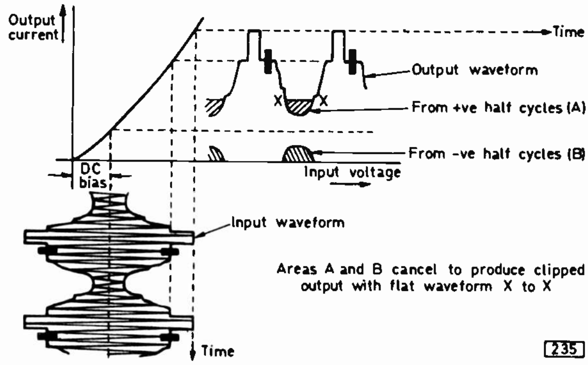


Fig. 3: This shows why applying d.c. bias to a common luminance/chrominance detector diode will not give a linear detection characteristic.

make the level of one of the offending carriers very low in comparison to the other. The chrominance components cannot be treated in this way because of the physical difficulties in achieving gain reduction of the chrominance without affecting the luminance into which it is slotted and also because heavy reduction in the chrominance signal level with subsequent amplification after detection will produce a totally unacceptable signal-to-noise ratio. It is therefore the sound signal which is subjected to the heavy attenuation necessary and because of the protection afforded by the use of f.m. the noise performance of the sound channel is not all that critical.

Reducing Sound-Chroma Beats

Some reduction of the sound/chroma beat is already afforded in transmission. First because the sound centre frequency is slightly offset from 6MHz to a frequency which has been quantatively found to reduce the magnitude of the beat product for low frequency and low level a.f. modulation—the exact intercarrier frequency is in fact 5·9996MHz. Also because the sound carrier power is one fifth that of the peak sync power: the reason for this is historic—with the positive modulation used on 405 lines it can be shown that a sound signal of one fifth peak white power gives on average a sound signal which just becomes of unacceptable quality when moving away from the transmitter at the same point that the picture quality also becomes just unacceptable. (The same reasoning applied to the choice of the picture/sync ratio of 7/3). With negative picture modulation and frequency modulated sound the same conditions do not really apply and on the Continent a sound/vision ratio of 1/10 is in general use.

It is now generally accepted that the sensitivity of the i.f. amplifier must be at least 40dB poorer at sound than that at chroma to reduce the beat signal to undetectable proportions.

Overall Gain

The overall gain of a receiver from aerial input terminal to luminance detector load must be such as to make it usable under the worst signal conditions acceptable for normal field strengths. This can be taken as requiring a transfer of 15μV of signal at the 75Ω aerial input of the tuner to a luminance output of about 2V into its 3·9kΩ load. This is a power transfer of 3pW to about 1mW which is some 86dB. Allowing for aerial input mismatches of perhaps 3dB and tuner to i.f. amplifier mismatching of the same order the total gain of the tuner plus i.f. amplifier must be some 92dB. The average u.h.f. tuner gain is about 20dB so that the i.f. amplifier must have a power gain of about 72dB.

The circuit must also be expected to operate without overload at input levels of about 2mV into the 75Ω aerial terminal. This can be calculated in the same way to show that the gain control range required (to be provided by the a.g.c. system) must be about 45dB. Such a large range is generally obtained by using two controlled stages, either both in the i.f. amplifier or one in the i.f. amplifier and the other in the tuner. The latter arrangement is more practical to engineer, minimising the disturbances to the frequency response caused by i.f. amplifier gain control. It is also better to prevent overload in the tuner's r.f. amplifier stage.

Group Delay

Any electronic circuit offers a certain delay to the signals presented to it: typically this is only 1-2ns for a single transistor amplifier but in bandwidth-restricted circuitry other effects have to be taken into account. These mainly result from changes in delay at particular frequencies. The error between any two frequencies is known as the *group delay*. Its effect, if present on picture, is to deregister information that should occur at the same time instant so that for example a high-frequency edge has its various frequency components displayed at different instances of time giving unwanted edge distortions. The most noticeable errors are rapid changes of group delay occurring around the vision carrier and of necessity these are minimised in the design of the frequency-selective circuits.

Unfortunately this inevitably means that—unless relatively complex correction is made using phase equalisers—there will be a larger error around the subcarrier intermediate frequency. The resultant group delay on the luminance information around this frequency is subjectively less visible than that at the lower luminance frequencies. However the basic difference in delays between the low-frequency luminance information and the chrominance information must be corrected to prevent the display of the luminance and chrominance information on the screen being in error—giving the appearance of an overall convergence error. The necessary correction can easily be introduced in the luminance channel by using a suitable fixed delay line and this must also compensate for the tuner group delay and the frequency restriction present in the decoder and the colour-difference signal detectors. This is a subject we hope to go into in greater detail in a separate article later on. The overall result with the circuits we are using is the need for a luminance delay line with a delay of the order of 600ns. The accuracy need not be too high particularly as ±100ns variations can be expected in the chrominance-luminance delays from different u.h.f. transmitting stations.

Detector Distortions

Because of the non-linear "bottom end" transfer characteristic of a semiconductor diode (see Fig. 2) the relative amplitudes of peak video information (at around white level or high-saturation, high-luminance level) are transferred incorrectly. The most noticeable error is in the mean level of a chrominance signal which does not give the expected luminance level (Fig. 2). As can be seen the transfer characteristic causes the mean level of the chrominance signal to effectively reduce towards black. This is a form of subcarrier rectification. The difference between the new mean level and the correct luminance level amounts to the degree of rectification and gives an effective increase in saturation and decrease in brightness. In broadcast circles the effect is more commonly known as chominance-luminance crosstalk because one signal is directly affecting the other.

The effect could be reduced by biasing the semiconductor detector so as not to use the bottom end of its characteristic but this is of no practical use because the other half of the r.f. envelope will then be conducted through the diode as well (Fig. 3) giving cancellation of all high level signals!

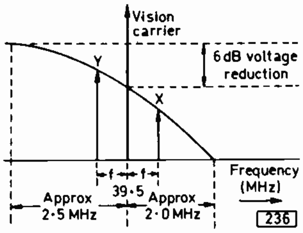
The solution is to use separate detectors for luminance and chrominance and to adjust the levels applied to each so that the non-linearity on one signal balances that on the other. The general result is then an overall non-linearity which is less noticeable than the chrominance-luminance crosstalk. With careful choice of detector diode types the overall non-linearity should be no worse than 5%.

A further effect arising from the detection of a vestigial-sideband transmission is known as *quadrature distortion*. This is a relatively complex effect which again we hope to discuss in a future article in TELEVISION. We must note here however that the result is an effective change in the relative amplitudes of the luminance and chrominance signals. Again this can be considerably reduced by using carefully selected signal levels and separate detectors. It can be completely eliminated however only by using synchronous detection.

IF Passband and Rejection Frequencies

We have already noted the reduction of sensitivity of at least 40dB required at the sound i.f. compared to the chrominance in order to reduce the sound/chroma intermodulation distortion product to minimal proportions. The other requirements are a flat fre-

Fig. 4: The low-frequency video information is derived from both sidebands.



quency response across the video passband and the rejection of specific frequencies that might be present in the amplifier.

The passband requirement is obvious over most of the frequency range and it is interesting to note that with delay-line PAL small errors at the chroma end result only in saturation errors and not the basic colour-difference signal errors that occur with the NTSC system.

Around the vision carrier we have a specific problem which has to be taken into account. Because of the vestigial-sideband transmission system we have double the required signal level around the carrier point: if we allowed all the information to pass we would have a frequency response inbalance with relatively less high-frequency content. It is not possible to make an economic filter that cuts off precisely at the vision carrier and has low group delay—if it were this would be done at the transmitter! Also the vision carrier must be maintained in the interests of detection.

The answer is to derive half the required energy at the vision carrier from one sideband and half from the other with a gradual reduction in the content from the vestigial sideband at the higher frequencies. The idea is sketched in Fig. 4. The response at the vision carrier must therefore be at −6dB (i.e. half voltage). At frequency f from the carrier some of the energy will be derived from the i.f. upper sideband at X and part from the i.f. lower sideband at Y. The resultant obtained in this way at any video frequency is the same as having a flat passband out to the vision carrier with a sudden cut-off at this point. Obviously the slope of the line passing through the −6dB vision carrier point must be correct for this effect to be accurate.

The rejection frequencies in the i.f. passband are those due to adjacent channel transmissions. The principal ones (Fig. 5) are the adjacent channel vision (X) at 31·5MHz (39·5−8), the adjacent channel sound (Y) at 41·5MHz (33·5+8) and the adjacent channel subcarrier (Z) at 43·066MHz (35·066+8). Rejection of the latter can be done in conjunction with general rejection of all Band I pickup from about 43MHz upwards. All other adjacent channel components

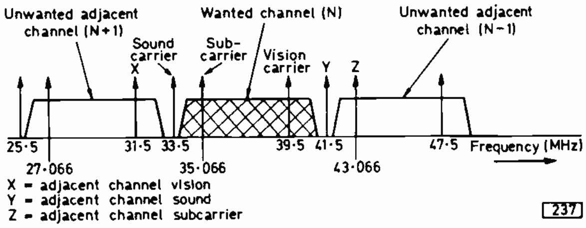


Fig. 5: The principle adjacent channel signals at i.f. Note reversal of the channel numbers because of the tuner mixing process.

should fall outside the general passband response of the i.f. amplifier which to be reasonably flat over the principal video range would without rejectors have to offer some gain over the range 30-45MHz.

Tuned Circuit Techniques

Many of the requirements of a modern single-standard monochrome i.f. amplifier are synonymous with quality colour performance. With valve amplifiers and dual-standard techniques the required stability was difficult to achieve adequately, group delay considerations were all but neglected and general linearity was poor. With modern transistor circuitry less frequency response compensation is required and this results in tuned circuits of relatively lower Q factors. In addition the relatively lower input and output impedances of transistors enable capacitive coupling to be successfully employed in the majority of cases. Absolute impedance matching between two stages can generally be achieved by tapping part of the tuned circuit load of the first stage.

Impedance Matching

Figure 6 shows the principle involved. The first stage shown in (a) has a collector tuned circuit with all three elements in parallel—tuning inductance (L) and capacitance (C) and damping resistance (R). A coupling capacitor Cc of a suitably high value to offer negligible reactance at the i.f. range (say 4nF for 1Ω reactance at 40MHz) feeds the amplified signal to the second stage. However to match the output impedance of the first stage into the input impedance of the next necessitates the use of a small LC matching section between the coupling component and the base of the second stage.

Figure 6(b) shows the same circuit as in (a) but here the tuning capacitance is in an alternative position —down to chassis. The chassis and the supply rail are the same signal point (because of the low reactance of the decoupling capacitor) so the circuits are electrically identical. A coupling capacitor and impedance matching network are still needed.

The circuit shown in Fig. 6 (c) dispenses with the coupling component and matching network by splitting the tuning capacitance C into C' and C''. The total series capacitance must still equal C so as to maintain resonance in the tuned circuit (i.e. $C = C'\,C''/C'+C''$) but by selecting the ratio in which we make the split we can accurately match the output impedance of the first stage into the input impedance of the next. There is now no requirement for a separate coupling capacitor because this function is provided by C'. The impedance transfer ratio needed is of the order of 10 or 20:1 in most cases.

Input Filters

The complete circuit of the i.f. module is shown in Fig. 7. The input from the tuner is at point 2B. As with the majority of tuner applications it is convenient to be able to use coaxial cable to connect the tuner to the amplifier, with the tuner output circuit being in the form of the primary of a bandpass filter. For the secondary of the bandpass filter within the i.f. amplifier it is convenient to introduce the necessary sound attenuation at 33·5MHz. The tuned circuit which provides this attenuation consists of the series rejector C102/L101 and to give correct impedance matching the parallel capacitor C101 is also introduced, reducing the input impedance towards 75Ω. The attenuation required from the trap is high and its Q must therefore be high.

The adjacent sound trap for 41·5MHz is next in the feed path. This consists basically of the parallel resonant circuit—of quite high Q—L102/C103/C104/C105. Because of the frequency proximity of the vision carrier and the vestigial sideband the filter is made with some phase compensation using the split capacitance balance form shown with resistance compensation (R101). This cannot give perfect group delay equalisation—that could only be provided by a completely reactive bridged-T filter offering no frequency/attenuation characteristics—but the compenpensated section in bridged form is an economic compromise.

A similar compromise is made in the following pi-section filter which shapes the upper part of the vestigial sideband roll-off, beginning from the region around the vision carrier. The reactive elements C106 and L103 are in the form of a half-section low-pass filter with resistance matching (R102) immunising its effects from the next rejector. Only a simple half-section filter is needed because of the relatively slow roll-off required. Because of some assistance in the rate of roll-off from the preceding adjacent channel sound rejector the −3dB point of this low-pass filter is set at just above the vision carrier and its effects on group delay are minimal in that region.

The final rejector is formed by L104/C108/C109 and is tuned to the adjacent channel vision frequency of 31·5MHz. Group delay requirements are not so severe at this end of the band—remote from the vision carrier—but the capacitance is again split to give impedance matching into the first transistor stage.

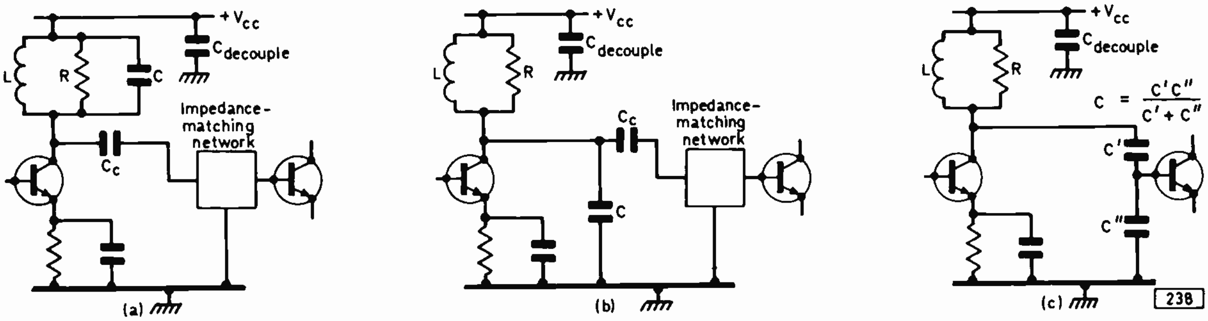


Fig. 6: Impedance matching by using tapped tuned circuit capacitance (d.c. biasing arrangements not shown).

The overall result of the input filter sections is to give *all* the required rejections needed so as to allow simple, relatively broadband amplification within the following transistor stages: as a result of the rejection requirements an overall input Q factor of around 10 is offered to the signals, giving reasonable definition to the overall band of frequencies to be amplified.

Amplifier Stages

The first stage (using Tr101) is the gain-controlled stage. The transistor must therefore be primarily capable of handling forward a.g.c. control with as little as possible disruption to the frequency response characteristics with gain changes. The BF196 is a relatively low-noise transistor developed for this purpose and to reduce input admittance effects still further the input capacitance to the stage is swamped by the shunt capacitor C110. Small changes in the characteristics of the BF196 with bias changes therefore have proportionately less effect on the frequency response although this will not be completely true at the extremes of the gain range. Also the basic h.f. loss introduced by C110 must be made good later.

The bias for Tr101 from the a.g.c. amplifier (Tr107) will be discussed later. Tr101 is connected in the common-emitter mode with its emitter held at a positive potential by the potential divider R106/R103 so allowing the a.g.c. circuits to operate the control of Tr101 over a linear range of the transistor's input characteristics.

The collector load is the relatively low-Q tuned circuit formed by L105 and C113/C114 with R104 (1·5kΩ) damping the Q down to about 7. R105 is a supply dropper resistor and is decoupled by C112. The tuned circuit is set to midband (36·5MHz). The impedance matching into Tr102 is decided by the ratio of C114 and C113—the technique we have already discussed.

Tr102 and Tr103 form a cascode pair. This arrangement is used to get sufficient gain to avoid a fourth i.f. amplifier stage. The same number of transistors is used but there is a saving in tuned circuits and interstage matching losses and a probable increase in overall stability. Because of the need for a.g.c. at the input the cascode stage cannot be used for the first stage.

As with any cascode arrangement the lower device acts only as an impedance converter to provide the ideal operating current for the upper device. With transistors this means a common-emitter stage working into a grounded-base stage. The overall gain will be approximately the product of the individual device gains whilst the noise performance of the stage will depend on the lower device. In this particular application noise performance is relatively unimportant because the noise level has been determined in the tuner and the first stage. The main consideration in choosing a transistor for the bottom section of the cascode stage is that it should be able to supply sufficient current to the upper section at a low impedance. To maximise the overall gain of the stage the input and output impedances should be high. These conditions are best met with a BF197 at the input. The upper transistor should be capable of meeting the matching requirements whilst having as high an $h$fe as possible: the BF194 is ideal.

The emitter bias resistor R110 of Tr102 is fully decoupled by C115 while a bias of about +5V for its base is provided by R109/R108/R107. It is usual for the bias of the upper device in a cascode stage to be at about half the supply rail voltage. In this case the effective supply rail is 20V minus the bias on Tr102 —i.e. about 15V. The bias for Tr103 base is therefore set at half this voltage difference plus the value of Tr102 bias—i.e. approx. 7·5+5=12·5V with respect to chassis. This is provided by the same bias chain R109/R108/R107 and the computed value of R108 necessary to give the correct bias (6·8kΩ) also isolates the signal on Tr102 base sufficiently from Tr103. The upper transistor is of course operated in grounded-base configuration, its base being decoupled by C117 at the signal frequency.

To prevent possible feedback due to strays and the loop created by Tr102 and Tr103 through the bias network the junction of Tr102 collector and Tr103 emitter is decoupled to any high-frequency oscillation by C116. Because this is a low-impedance signal point the effect of this capacitor on the signal is very small.

Detector Driver

The cascode stage requires a high load impedance while the output stage that it will drive (Tr104) needs a low input impedance. These two requirements are not reconcilable in a single tuned circuit coupling (such as that used between Tr101 and Tr102) because the high transfer ratio of impedance (about 1000:1) would demand the use of too high a Q while maintaining adequate bandwidth. The problem is overcome by using a bandpass coupled pair of tuned circuits.

The primary of this bandpass pair is formed by L106 and C118 with R111 damping the Q to about 16. The bottom coupling capacitor C120 leads the signal to the secondary formed by L107/C121/C122 with the ratio of C121 and C122 being used to precisely match into Tr104. The secondary is heavily damped to give a Q of about 8. The tuning frequencies at the primary and secondary (which are physically separate but electrically coupled by C120) are such as to set the vision carrier to around the −6dB point (L106) and to adjust the flatness of the overall passband (L107).

Bias of about 4V for Tr104 base is set by R114/R113 and again the emitter bias resistor is completely decoupled (C123). The BF197 used for this position is designed for such output stages where the load is fairly high-impedance and the current requirements are dictated by the available power. The output coupling must be broadband so as to be able to adequately supply both the luminance and chrominance/sound detectors. A single tuned circuit is therefore used with the luminance detector (D101) being the more important and highest level feed. L109 is therefore bifilar wound with L108 which is damped to a Q of about 4 by R115. The resonance conditions are provided by the self-capacitance of the bifilar windings. Additional sound rejection at 33·5MHz is provided by the tuned circuit L111/C126 which also helps to maximise the energy around that frequency passing from the very loosely coupled winding L110 to the chroma/sound detector.

The luminance detector diode D101 is connected so as to give a positive-going signal with the sync pulses representing maximum output. R.F. filtering is provided by C127/L112/C128/L113 and the detector load of 3·9kΩ is R117. The detected signal of about 4V then passes to the base of Tr105. This point must be d.c. biased so the earthy ends of C127/C128 and R117 cannot be taken by d.c. connection to chassis and to prevent the bias network R118/R119 becoming part of the detector load the common point is decoupled by C125. This arrangement puts a very small forward bias on D101 but only corresponding to the residual carrier level and therefore not causing any peak signal distortion.

We will return to the other outputs from the i.f. amplifier chain after describing the luminance and a.g.c. circuitry on the module.

Luminance Channel

The luminance detector output at the base of Tr105 is amplified with unity gain (see later) to drive the 600ns luminance delay line DL101. The line used is an air-cored type with distributed capacitance along its length. This has been found to give the most acceptable delay characteristics with the minimum effects on the bandwidth of the luminance signal. The characteristic impedance of the line is 1kΩ and it must be terminated in this value at both ends to prevent reflections and therefore possible ringing on the picture. The driven end is terminated directly by the 1kΩ resistor R120 whilst the output end is terminated by R138 (1·2kΩ) in parallel with the bias resistors and the input impedance of the next stage so as to bring this also to 1kΩ.

R138 is effectively in parallel with R120 because of the d.c. conduction of the delay line so the total collector resistance of Tr105 is approaching 500Ω. In a transistor amplifier where the emitter resistance is undecoupled (R121 here) the gain is approximately the ratio of the collector to the emitter resistances. Thus in this case the gain of Tr105 is nearly unity (as mentioned earlier) and the stage is operating as a phase splitter with roughly equal amplitude outputs at its collector and emitter. There is actually a small gain at the collector circuit: this is only about 1·3dB and matches the average insertion loss of the delay line.

A notch filter (L114 and C137 with the damping resistor R137) tuned to 4·43MHz is connected across the input of the delay line to remove the majority of the chrominance signal within the luminance passband. This is necessary in a colour receiver in order to avoid objectionable crawling of subcarrier across the similar frequency shadowmask tube aperture holes and saturation distortion due to further subcarrier rectification.

The luminance signal is a.c. coupled to Tr109 base through C134. The base bias for Tr109 is provided by R139/R140 and is about 6V. Tr109 acts as a second phase splitter with outputs of about 4V peak.

The collector signal is taken to the sync separator from 2N. Because of the stray capacitance in the emitter circuit some h.f. boost occurs and this is corrected by the h.f. decoupling provided by C135.

The signal at Tr109 emitter is developed across a constant resistance R143 plus R142 in parallel with the contrast control R602. The amount of signal tapped off by the slider of R602 does not therefore affect the current conditions of Tr109 and the output at 2N therefore remains isolated and at constant amplitude.

The emitter output impedance is low enough to allow the use of coaxial cable from 2E to the luminance input point on the matrix and colour-amplifier module. With movement of the slider of R602 not only does the signal level at 2E vary but the d.c. potential also varies over a range of about +3·5 to +11V. This potential is coupled through R144 to connection point 2M which goes to the saturation voltage line in the decoder. As the contrast setting is increased the d.c. voltage feed increases and raises the saturation of the display in proportion: this eases user adjustment of the receiver. The decoupling capacitor C136 prevents luminance signal reaching the chrominance path in the decoder.

Automatic Gain Control

One advantage of negative picture modulation is that the peak power received from a u.h.f. television transmitter is represented on a regular once-per-line basis by the tips of line sync pulses. Efficient automatic gain control (a.g.c.) systems depend on monitoring a particular waveform point—such as the sync tips or the sync back porch—when the signal is at a known reference level. Mean-level systems which were the general rule in the past are inefficient and lead to amplitude distortions that are relatively unacceptable in a monochrome receiver and totally unacceptable in a colour receiver. With the repetitive sync tip level representing peak signal we have the ideal reference.

The a.g.c. output requirements are determined by the controlled transistors. The majority of the control is applied to the i.f. amplifier input stage (Tr101). When the maximum reduction in gain is required control must also be applied to the r.f. stage where the signal input would otherwise be large enough to overload the r.f. amplifier and mixer. Control must not be given over to the tuner too early otherwise the signal-to-noise performance will suffer.

The BF196 transistor Tr101 needs a low-impedance a.g.c. circuit. The range of control for the transistor is already set by the emitter biasing potential but the minimum base voltage (maximum gain) and the degree of bottoming permitted (minimum gain) determine the limits of the control range. With this particular transistor rather more than 45dB of gain control can be obtained when it is operated over a current range of about 4 to 10mA.

AGC Action

The sync pulses comprise the maximum positive-going signal swing of the output at the emitter of the phase splitter Tr105. This signal is d.c. coupled through R122 to the base of Tr106. The base bias of this transistor is set—when Tr105 is conducting—by the potential divider R120/R138/R121 to about 10V. Tr106 acts as a peak detector, conducting only when the voltage at its base exceeds that set by the potential divider consisting of the a.g.c. threshold control R125 and R124 at its emitter. As can be seen from the component values the threshold voltage may be between 0 and about +6V.

If the luminance signal level from the detector is small Tr106 will be cut-off. The a.g.c. amplifier Tr107 however is self-biased to conduct by the values of R127 and R126 which make its base more positive than its emitter. The voltage at the junction of R131 and R129—which is the a.g.c. potential—is determined by resistors R130/R129/R128/R127 (giving

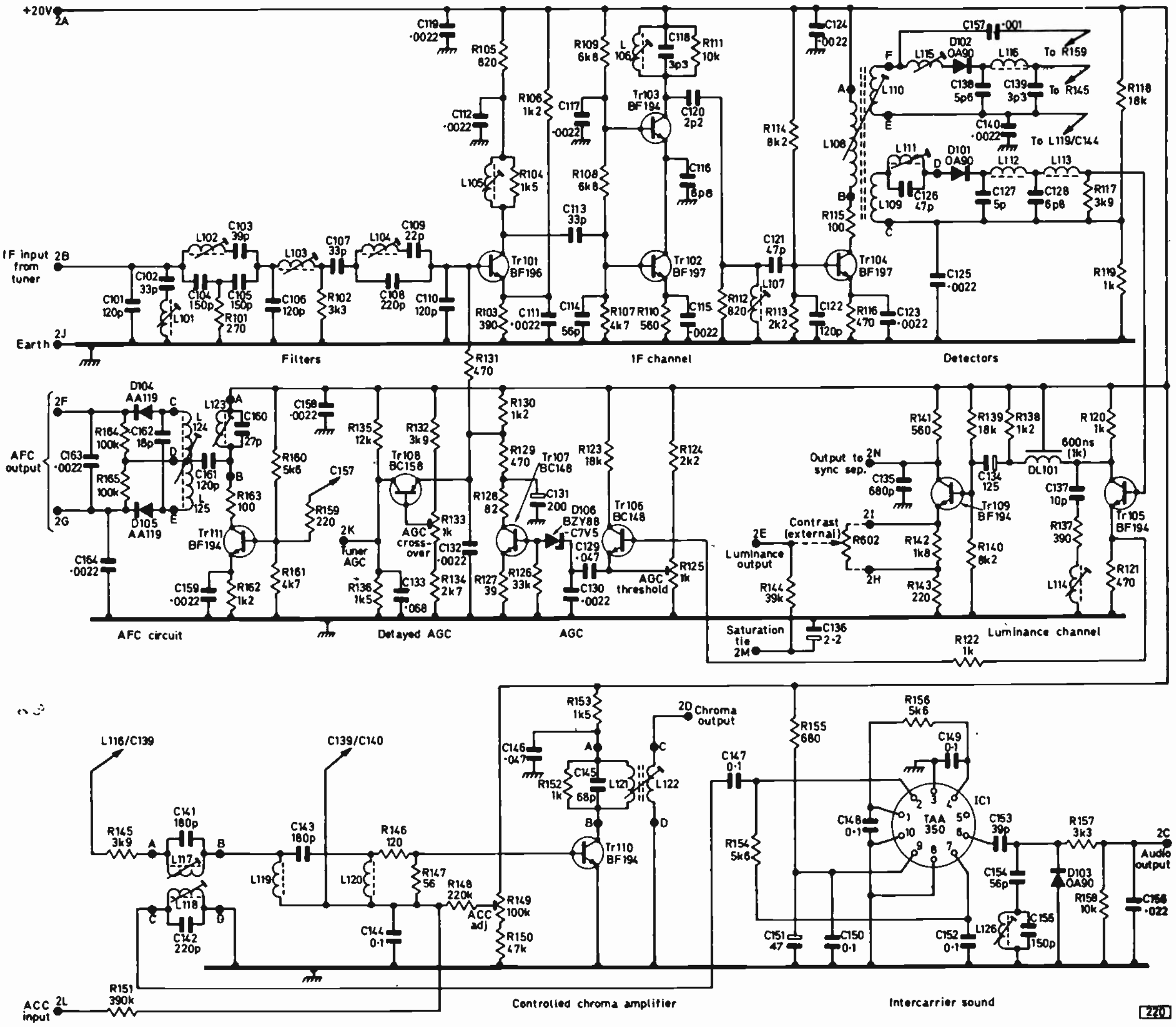


Fig. 7: Complete circuit diagram of the i.f. strip for the Television colour receiver. The strip incorporates the luminance channel, the a.g.c. circuits, the a.f.c. circuit, the intercarrier sound channel and the first chrominance amplifier. C138 may be 5pF.

about +6V). This potential applied to the base of Tr101 gives maximum gain from this stage. At the same time the potential at the base of Tr107 charges C130 and C129, conduction being through the zener diode D106.

When the luminance signal level increases sufficiently to bias Tr106 on pulses of current will be passed by this transistor during the line sync periods. These will continue to be positive-going at the emitter of Tr106 due to emitter-follower action and discharge C129 and then charge it in the reverse direction thereby reducing the potential at the base of Tr107 so that it turns off. The a.g.c. control potential at the junction R130/R131 in consequence rises towards the rail potential—the limit of this rise being set when D106 ceases to conduct to limit the voltage change that can occur at Tr107 base. As the a.g.c. control potential rises this is communicated via R131 to the base of Tr101 whose stage gain will begin to fall. The value of R131 is chosen for minimum effect on the frequency response of the first i.f. stage.

Before the zener's 7·5V changeover point is reached the i.f. amplifier will have been pulled back to minimum gain. Tr108 is set to conduct at this point by the correct adjustment of R133 in the potential divider chain R132/R133/R134. The current supplied by the emitter circuit flows through R136, increasing the potential across this resistor from the nominal 2V established by the potential divider R135/R136. Current will be passed in this way because of the larger value of the collector resistor R135 compared to the emitter resistor R130. The increase in voltage at point 2K is taken to the forward a.g.c. controlled r.f. amplifier in the tuner to reduce its gain.

The changeover from i.f. amplifier only to r.f. and i.f. amplifier gain control is set by R133 which is known as the a.g.c. crossover control. Changeover is always smoothly affected because conduction of Tr108 causes not only forward gain control of the tuner but also the creation of a conducting diode path from its emitter to its base. This acts as a clamp diode maintaining the i.f. control voltage more or less constant as soon as tuner control begins.

C132 decouples any i.f. signal in the a.g.c. circuit, preventing its feedback to the tuner; C131 decouples the peak sync pulses conducted by Tr106 and Tr107 to prevent them passing into the i.f. amplifier or affecting the conduction of Tr108; C133 decouples r.f. from the tuner control point.

Sound/Chrominance Feeds

As noted earlier the coupling which takes the chroma and sound signals from the i.f. amplifier is very loose. The signal level at L110 is therefore low but is such as to minimise the chrominance/luminance crosstalk already discussed.

The signals pass through a 39·5MHz luminance rejector formed by L115 with its own self-capacitance. D102 is the chroma/sound detector diode and r.f. filtering is provided by C138/L116/C139. The signal levels are further attenuated by R145 (3·9kΩ) to limit the production of chroma/sound beats due to the non-linearity of the detector diode.

The 6MHz intercarrier component is coupled off through a double-tuned circuit of which L117/C141 forms the primary and L118/C142 the secondary. Both sides are tuned to 6MHz and the Q is relatively high so that chrominance information does not get into the intercarrier channel. The 6MHz signal is coupled off through C147 to the input point (pin 2) on the intercarrier sound limiter/amplifier integrated circuit IC101 (IC1 in Fig. 7).

Chrominance Amplifier

The chrominance signal—now minus the intercarrier sound—continues through C143 which is the series arm of a high-pass filter formed by L119/C143/L120 to prevent any chroma/sound beat present passing any further—i.e. it is tuned to 1·57MHz. The load for the chroma detection is provided by R146 and R147. This low value of load is necessary because of the relatively high circuit capacitances—it will be remembered that the 3dB detection bandwidth is defined as $1/2\pi RC$. With a large value of capacitance in series with the signal (C143=180pF) the detector load has to be less than about 180Ω in order to get a 3dB bandwidth higher than 6MHz. This frequency guarantees that the chrominance sidebands are unaffected.

The chrominance signal drives Tr110 which is in the common-emitter configuration. The bias is supplied from the potential divider R149/R150 through R148 and R147 and because of this the earthy side of the detector rail from L110 is not chassis connected but is decoupled for i.f. (C140) and chroma (C144). Variations in bias can be set up by R149.

Tr110 is the automatic chrominance controlled (a.c.c.) stage. At point 2L a negative bias proportional to the level of the burst signal in the decoder reference chain tends to reduce the bias set up by R149. If the burst signal level in the decoder is high 2L becomes more negative and the gain of Tr110 is reduced. This system maintains the chrominance signal level at the output of this module to within 1·5dB for up to 12dB variation in the input level due to fine tuning errors, propagation and aircraft-flutter effects, so maintaining correct saturation from the decoder. The burst is used as the reference level because while picture information varies the burst amplitude is held to close tolerances at the transmitter.

The collector circuit of Tr110 consists of a transformer coupled output—L121/L122—with the primary tuned to 4·43MHz and damped by R152. The nominal chrominance input to the base of Tr110 is 10mV peak-to-peak and the burst amplitude at the output point 2D is about 100mV. The damping of the primary is such as to give a Q factor of about 2—not high enough to affect the chrominance sidebands put high enough to reject some of the out-of-band noise signals.

Intercarrier Sound IC

The 6MHz load for the intercarrier sound path from the detector output is provided by the input conductance of the TAA350 (400μmhos≡2·5kΩ). The intercarrier level into that load is about 2mV. The TAA350 was chosen because it has been found that for the home constructor it is the least critical in circuit arrangements while offering a good a.m. rejection (40dB) for the input level used and an audio output level after detection of about 24mV which is ideal for directly driving an integrated output amplifier. The TAA350 internal circuit arrangement consists of four long-tailed pair amplifiers with constant-current drive to the emitters.

The TAA350 is designed to operate from a 6V supply rail so with our +20V rail a voltage dropper is required (R155) and this must be adequately decoupled (C150 and C151). Decoupled feedback is applied from a low-level output point at pin 7 through R154 to the input at pin 2. The complementary input at pin 1 is a.c. earthed (through C148) and d.c. feedback is applied to this pin from the low-level complementary output (pin 4). Pin 3 is both substrate and envelope earth. The main output is from pin 6 and the complementary output at pin 5 is left open-circuit. (All these complementary inputs and outputs relate to the use of long-tailed pair circuits within the i.c.) The amplified and limited f.m. signal is coupled via C153 to the slope detector which consists of the high-Q tuned circuit C154/L126/C155 (Q=80) and the detector diode D103.

FM Detector

Any f.m. detector must convert the signal frequency variations into amplitude variations which can then be conventionally detected. The slope detector is the simplest possible of these systems but it can only be used when—as in this case—the f.m. signal is already well limited. The idea is that the high-Q tuned circuit is tuned to the edge of the f.m. band—say to 6·15MHz. The signals—centred of course on 6MHz—are below this frequency and will thus be lying on the slope of the high-Q frequency/impedance characteristic of the circuit. At different frequencies the tuned circuit path will offer different impedances so that the output signal will consist of amplitude variations proportional to the difference between the actual signal frequency and the tuned circuit resonant frequency. These amplitude variations are detected by the diode D103 and the audio output is coupled through a simple r.f. filter circuit R157/R158/C156.

Note that the resonant circuit of the slope detector *cannot* be set to the centre frequency of the f.m. signal: if it is there will be equal amplitude variations for equal frequency swings above and below the centre frequency and the signals will cancel on detection.

In fact to align this detector all that need be done is to tune L126 for maximum audio output.

The output impedance of the audio signal at 2C is about 4·7kΩ. When loaded with about 4·7kΩ the correct 50μs de-emphasis time-constant is obtained with C156 as the shunt element.

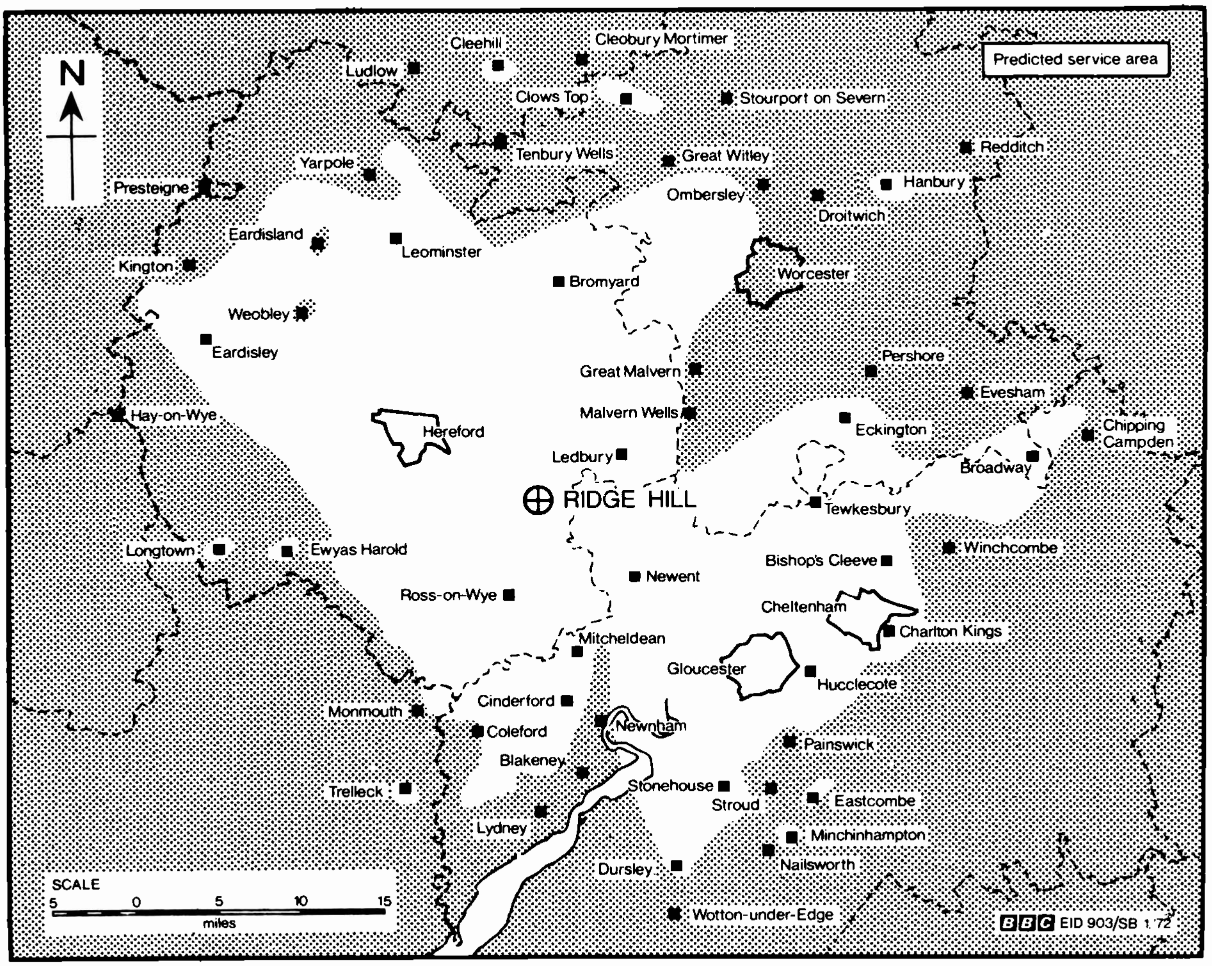
Automatic Frequency Control

An automatic frequency control (a.f.c.) circuit is used to detect tuning errors and to provide a d.c. correction voltage for the tuner to change its oscillator frequency. For this purpose the vision carrier i.f. is the only consistent signal. The small level of vision carrier i.f. across L110 is rejected by the self-resonant coil L115 and fed via C157 to the amplifier stage Tr111. R159 is included to limit the loading on the main signal paths. The collector load of Tr111 is the primary of a discriminator transformer tuned by C160 to the vision carrier i.f. (39·5MHz). The secondary is connected as a Foster-Seeley discriminator with a long time-constant loading on each side (100kΩ resistors R164 and R165 with 2·2nF capacitor C163). This prevents d.c. output changes with short-term freqency variations (e.g. low-frequency video signals) or amplitude variations. The d.c. output from 2F with respect to the earthy discriminator output point 2G is taken off to the tuner where its application depends on the make and type of tuner used. Changes in vision carrier i.f. due to mistuning or frequency drifts cause movements from zero d.c. across 2F/2G. L124 and L125 are adjusted to give the correct zero condition while L123 peaks the effects for vision carrier input.

Whither Now?

The i.f. module contains a lot of circuitry as we have seen. Next month we will put all this together using the same system that we employed for the decoder module. In preparation for building the reader can order the relevant components and the printed circuit board from the suppliers listed in Table 1, using the instructions given. Printed circuit board details will be given next month for those making their own and of course coil winding data will be given for the wind-it-yourselves brigade.

Next month: Soldering irons on for the great i.f. assembly!



The expected area of the **Ridge Hill** *u.h.f. services is indicated by the unshaded part of the above map. Channels are BBC-1 22, ITV 25, BBC-2 28, fourth 32. Polarisation is horizontal, receiving aerial group A, maximum e.r.p. 100kW. Map courtesy BBC Engineering Information Service.*

C & L IN TV SERVICING

K. J. YOUNG

CAPACITORS are frequently the cause of faults in television sets. The qualities of importance are the capacitance, the dielectric loss at the frequency concerned and the d.c. leakage at the operating direct voltage, the relative importance of these depending on the function fulfilled by a particular capacitor.

Types of Capacitors

Reservoir, smoothing and decoupling capacitors must present a sufficiently low impedance at the frequency to be bypassed, i.e. they must have adequate capacitance, but precise value is not critical. Some d.c. leakage can usually be tolerated provided this does not lead to appreciable temperature rise. A simple test for suspected loss of capacitance is to add another capacitor temporarily in parallel. To test for leakage it is necessary to disconnect or use a "tong-test" milliammeter (starting on a high range).

Tuning capacitors and trimmers are air-spaced or have low-loss insulation such as mica. Precise capacitance value is vital and low loss factor and high leakage resistance essential.

With coupling capacitors, including isolating ceramics, the precise capacitance value is not vital but high leakage resistance is important as otherwise the bias on the following stage may be disturbed with risk of valve or transistor failure. Safety is also involved with aerial isolation ceramics as any low-resistance connection to an a.c./d.c. chassis is dangerous.

For pulse-shaping circuits timing capacitors are used: exact capacitance value and freedom from appreciable leakage are usually important especially if the associated resistor of the *CR* network is of high value.

Any replacement pulse ceramics in line timebase circuits must be of the same or higher peak rating, e.g. 8 or 12kV, and in some cases the capacitance value is also fairly critical.

Test Equipment

It is often debated how much test gear is worth acquiring beyond the essential multirange meter; also whether it is cheaper to rely on a good stock of replacements. The cost of time as well as the equipment needs to be considered. In my view a reasonably good oscilloscope is well justified as this makes it possible in most cases to locate the approximate point in the circuit at which the waveform or signal first departs from its correct shape or amplitude. There are limitations to its use, e.g. high-voltage areas, while frequency response is another barrier. Y bandwidths of 4·5MHz are now common in reasonably priced scopes however and these save much time in i.f. alignment when used in conjunction with a wobbulator. An oscilloscope can also serve as a bridge detector.

Capacitor Testers

The crude form of capacitance meter is of little use but a capacitance bridge is well worth having. A particularly good design by Nelson-Jones (*Wireless World* December 1968) incorporated a 1in. c.r.t. and catered also for inductance but not for electrolytics. There are many bridges on the market, ranging from the Nombrex and Heathkit to more expensive ones. The Marconi TF2700 includes provision for polarising voltage which is important for electrolytics. The bridge with inductively-coupled ratio arms pioneered by Blumlein has particular advantages and some data has been issued by Wayne Kerr. With some bridges a separate leakage tester is necessary and the cheaper ones have other limitations such as lack of provision for polarising voltage for electrolytics. Nevertheless even the simplest capacitance bridge is an asset. Since few leakage testers cater for voltages beyond 1kV it is more important to have a stock of replacements for capacitors, chiefly pulse ceramics, beyond this rating. Care is needed with leakage testing because of the charge held after completion of the test: this should be discharged not with a screwdriver but by connecting a 10kΩ 25W resistor for (for large values) ten seconds.

Inductors

Little trouble usually arises with inductors. D.C. resistance figures are useful but do not give the complete picture. An inductance bridge or *Q* meter can often be done without except for diagnosing shorted turns. These are most liable to occur in the line output transformer as this component is highly stressed. A resistance reading will not reveal this fault owing to the small difference caused by contact between adjacent windings. Shorted turns however reduce the *Q* and introduce losses.

To reduce the heat dissipation associated with resistors an auto-transformer may be used to supply the heater chain and h.t. smoothing chokes are common. Failure here is unlikely.

An excessive temperature rise noted after the set has been switched off and the voltages safely discharged is a simple warning of trouble in the line or field output transformer. Heat-sensitive paint, a dab of which changes colour at a defined temperature, is useful. For repairing minor cracks in insulation silicone or other compound providing good insulation and thermal stability can be used.

Tuned Circuits

With tuning coils and transformers the most troublesome items are ferrite and iron-dust cores and

—*continued on page 361*

SERVICING television receivers

L. LAWRY-JOHNS

PHILIPS 19TG108U SERIES—cont.

Line Output Stage

Until very recently the line output stage in these models has been reasonably trouble free—apart from the occasional valve failure, PY81 sparking over etc. Of late however we have noticed an increasing tendency for the line output transformer to short between the windings, leading of course to non-operation, no e.h.t. and perhaps some overheating in the PL81 and PY81. Some line whistle may be heard with an intermittent spluttering noise issuing from the line output transformer. The routine tests such as removing the top cap of the PY81 to check the boost line capacitor should be made (just in case) but in most instances the transformer will be found at fault. Change the PY81 in all cases as arcing in this can produce a very similar effect although the arcing may not be observable.

Line Oscillator Troubles

The line oscillator stage often gives trouble, the symptom being a mass of lines which rotation of the line hold control will not clear. Whilst this could be due to the ECL80 valve (V611) or an associated component (R615 for example, a 680kΩ resistor which is wrongly marked R613 on some circuits), we have generally found the vision interference limiter control R600 next to the hold control and connected to it to be at fault. As in most situations limiting is not required the connection can be broken: this allows the video amplifier to operate without any suppression being applied to the suppressor grid and removes the damping effect of a faulty control on the line hold circuit.

General Line Faults

Most of the other line timebase faults such as lack of width, poor e.h.t. regulation and non-operation can be cleared by valve changing (always noting the effect of removing the top cap of the EY86 to prove the possibility of this valve being internally shorted).

Less Common Faults

No Sound: On occasions this fault is not due to a defective PCL83 stage, audio tests proving that this stage is humming away quite nicely when a screwdriver is applied to pin 2. In this event the EBF89 (V104) may be found not functioning. Although not so prone to do this as the earlier EBF80, it can still cause trouble on occasions. The EF85 (V103) is not at fault nearly so often. Check voltages in both stages and R103 when the fault is elusive.

Poor Sync: When difficulty is experienced in locking the picture both vertically and horizontally check V413 and the resistors R407 and R408 as these tend to change value. Also check the electrolytic capacitors in the video amplifier circuit. Either C601 or C603 can dry up causing loss of sync more than loss of contrast (as the low-frequency sync pulses are more subject to the negative feedback present when the electrolytics lose capacitance).

Poor Contrast and Sync: If valves and voltages are up to standard and the above mentioned capacitors check out the front-to-back resistance of the OA70 vision detector diode (X218) should be checked. An ohmmeter check at pin 2 of V608 (the video amplifier) should show approximately the following: negative probe to chassis, positive to pin 2, about 500Ω; positive probe to chassis, negative to pin 2, about 5000Ω. This takes into consideration R215 and R214. If the reading is the same both ways—either low or high—the diode is faulty.

Undulating Picture: If the picture is inclined to produce the symptoms of seasickness, waving sideways and expanding and contracting up and down, the chassis will have to be removed and the main electrolytics C708-C709 replaced. These are in the large can clipped approximately under the tuner unit. This should not be confused with the latter symptom (up and down) only which can be due to poor insulation between the heater and cathode of the PCL82 (V414) field output valve (it is much easier to check the PCL82 than the electrolytics).

Vertical Hold: If the control is at one end of its travel check the resistors R416 and R417. The relationship between these two resistors determines the control setting and R417 tends to change value.

Bottom Compression: If the height is reduced but vastly more so at the bottom check C408 which tends to dry up after a few years' use. Also check the value of R421, the PCL82 and the smaller components (C411 etc.).

Total Field Collapse

The field coils are inclined on occasions to become open-circuit leaving of course a white line across the centre of the screen. When this symptom presents

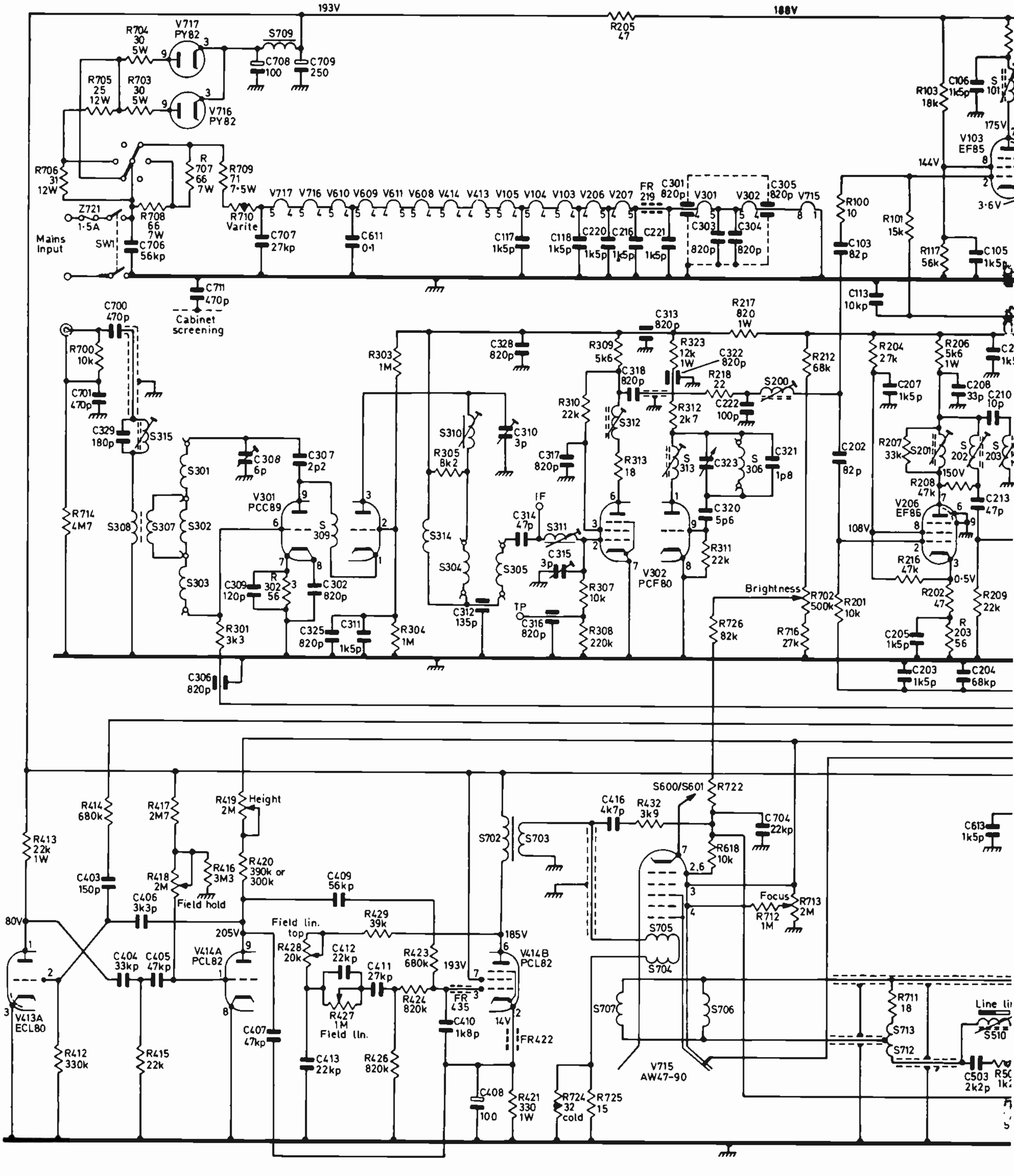
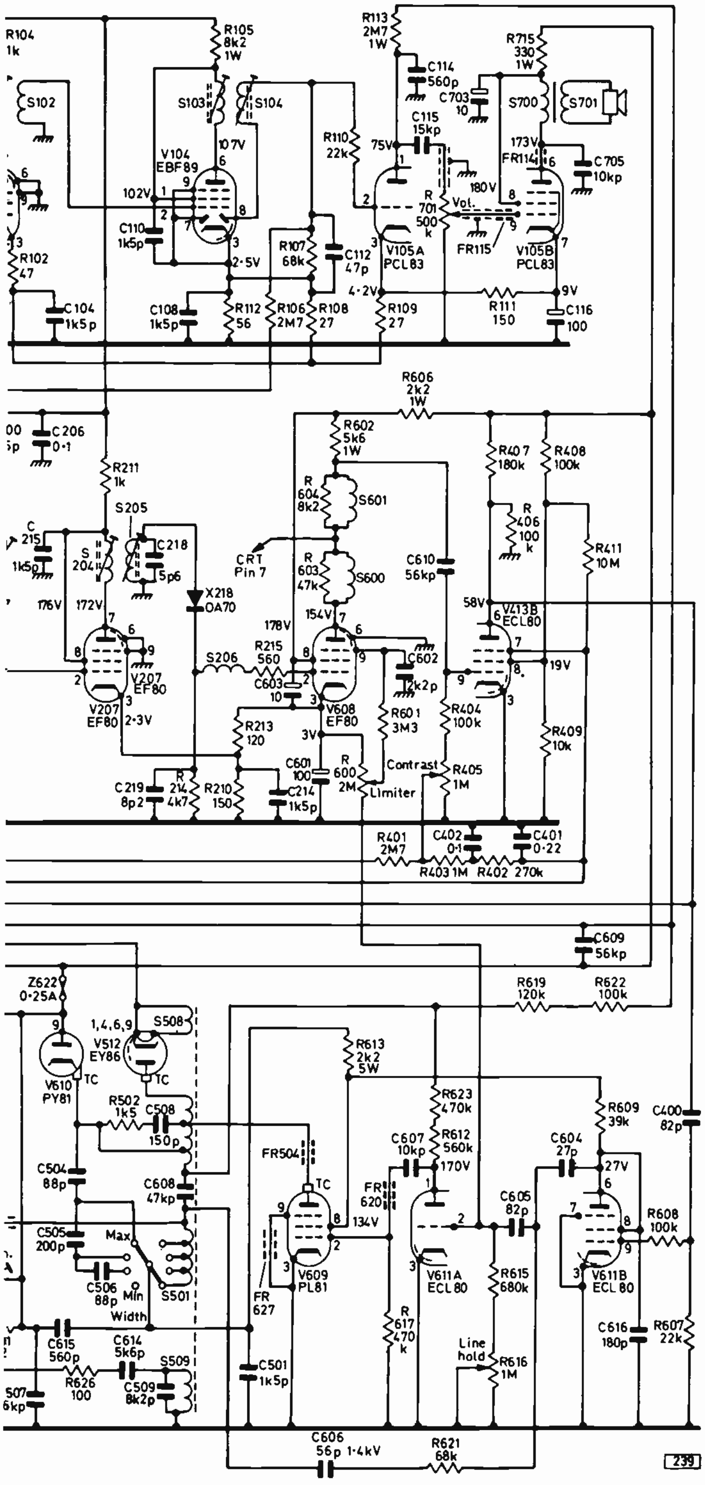


Fig. 3: Circuit diagram, Philips Model 19TG108U. Voltages shown measured using a 20,000 Ω/V meter.

itself the drill is to check the upper left PCL82 and ECL80, their valve base voltages and the more common points, briefly shorting pin 3 to pin 4 to put an a.c. voltage on the output pentode grid to see if the raster opens out. If it does the fault is in the oscillator stage, if it doesn't the fault is in the output circuit. If the pin 6 voltage is present (meaning that the output transformer is intact) and the cathode voltage at pin 2 is about right (14V) it is fair to suspect the scan coils and to disconnect one end to check their continuity.



If they are indeed open-circuit there is little which can be done in the way of repair. A replacement set of coils does not have to be exactly the same type so long as they are Philips ones and of the correct deflection angle.

Suspected Tube

It is surprising how often one can be fooled into suspecting that the tube is losing emission when the culprit proves to be the video amplifier valve (which is d.c. coupled to the tube in this circuit). Whilst an EF80 can last indefinitely in an i.f. stage the role of video amplifier involves large current swings which weaken its cathode emission more rapidly. As its emission falls the anode voltage rises to limit the brilliance and the valve cannot handle the positive drive at its grid. This leads to a negative picture which suggests at first sight that the tube is weakening. So the moral is to change the video amplifier valve before hastily condemning the tube.

It must be expected however that the time will come when the tube will be found to be at fault either through loss of emission or through a partially shorted heater which has the same effect except that a sharp tap or two on the tube neck may clear the short for a period (however limited) and restore an almost normal picture.

C and L IN TV SERVICING

—*continued from page 358*

brass tuning rods. An adequate stock of spares of all sizes should be held together with a good selection of trimming tools. Even then it is sometimes necessary to make a special one which is time consuming. Ferrite and dust-iron cores increase the inductance while a brass rod reduces it: this is sometimes useful as a temporary means of slightly increasing or reducing the inductance of a coil.

Coil formers are often mechanically weak and may have only a rudimentary thread which can be damaged by over use or if the slug cracks. It may be necessary to renew both the former and the winding and for this purpose an inductance bridge of *Q* meter is really needed. Alternatively if the diameter, number of turns and arrangement of the original winding are carefully noted a simple resonance test can be made with the associated capacitor using a signal generator and signal tracer or oscilloscope.

Watch out for open-circuit connections to the printed coils now commonly used. Removal of a coil from a printed board can be troublesome and for this purpose it is useful to have a jig so that all the soldered joints can be heated simultaneously.

Inductance Bridges

Inductance bridges can be bought as separate instruments or as part of a universal bridge. For very modest outlay and maximum versatility when used infrequently however the simplest approach is to set up a breadboard with plug-in or terminal connections so that a de Sauty connection for capacitance and either a Maxwell or Hay connection for inductance (see Nelson-Jones, *Wireless World* December 1968) can be hooked up as required. This raises no stray capacitance problems provided a reasonably low frequency is used. An oscilloscope or signal tracer can be used as the detector. All the items can be battery powered (except the scope the case of which is earthed). For all bridge and *Q* measurements the component under test should be removed from the circuit. With transformers the core can be left bolted to the chassis provided all the leads are disconnected.

COLOUR RECEIVER CIRCUITS

PAL V SWITCH AND IDENT CIRCUITS

GORDON J. KING

AT the transmitter the U and V signals modulate separate subcarriers. The two sets of signals are then added to form the chrominance signal. The U subcarrier remains of constant phase but the V subcarrier is inverted, i.e., phase shifted by 180°, on alternate lines. This V signal phase inversion on alternate lines is made use of in the chrominance delay line circuitry in the receiver to cancel certain types of phase error that can occur in the transmission path and to separate the U and V components of the chrominance signal so that when the delay line circuitry is correctly aligned only U signal is fed to the U synchronous demodulator and only V signal to the V synchronous demodulator. The V signal output from the delay line circuit is still alternating by 180° on alternate lines however and it is clearly necessary to remove this characteristic of the V signal. This operation is undertaken by the PAL V switch in the decoder. The switch inverts on alternate lines either the V signal itself or the V reference signal fed to the V synchronous demodulator—both approaches are widely used. Thus the V signal alternations carried out at the transmitter on alternate lines are reversed so that we get at the output of the V signal synchronous demodulator the signal originally created at the camera control unit. Inverting the V chroma signal or the V reference signal on alternate lines has exactly the same result.

Now one important operation in a PAL receiver is to identify which set of lines carries the inverted V signal. The circuitry which does this is called the ident circuit. Our subject this month then is PAL V switching and the way in which the V switch is controlled by the ident circuit so that the V signal alternations at the transmitter and receiver are synchronised.

There is no difficulty in getting either the V signal or the V demodulator reference signal to alternate in phase by 180° line by line. A bistable circuit (a type of multivibrator circuit with two stable states) or similar device switched between its two stable states by line flyback pulses provides the required drive to activate the actual PAL switch which is often a pair of diodes operating in conjunction with a phase reversing transformer system. Our February 1972 instalment introduced the V switch and showed a typical circuit (Fig. 5).

Swinging Bursts

V switch synchronising or V line phase identification is built into the PAL system in the form of the swinging bursts. These burst signal phase swings are, as past instalments have shown, related directly to the phase alternations of the V chroma signal, and produce at the phase detector in the reference signal control circuit half line frequency components (about 7·8kHz)—at half line frequency because the burst phase is the same every other line. For example, on one line it is +45°, on the next −45°, on the next +45° and so on relative to the −U chroma axis. After processing these 7·8kHz components give rise to a 7·8kHz sinewave signal called the ident signal which is fed to the bistable to ensure that it operates the PAL switch in correct synchronism. This is done as the ident signal aids the bistable line by line switching when it is in correct synchronism but makes the bistable miss a count when there is initial lack of synchronism.

Representative Circuit

A good example of the type of circuit under discussion is the Pye 691 circuit section shown in Fig. 1. Here VT22 and VT23 are the bistable transistors, D28 and D29 are the PAL switch diodes and T15 is the reference signal phase alternating transformer.

The reference signal gets to the V detector through C150, C147, T15, either diode D28 or D29 depending on which one is conducting at the time, T14, the filter L33 and the current limiting resistors R176/R179. The filter removes the 7·8kHz switching component.

To complete the picture the reference signal feed to the U detector is via C150, the 90° phase shift network C148, C149 and R178, and then T16. The phase shift network introduces the required quadrature phase shift (90°) between the reference signals applied to the two chroma detectors, the trimmer enabling accurate phase adjustment to be made.

The Bistable Circuit

Now to the bistable. In one stable state VT22 is conducting while VT23 is cut off; in the other VT23 is conducting while VT22 is cut off. The collector of the transistor which is conducting is at virtually chassis potential (since the emitters are connected direct to chassis) while that of the transistor which is off is at the positive rail potential of +15V. Thus on one line the collector of VT22 is positive while that of VT23 is at chassis potential and on the next line the collector of VT22 is at chassis potential while that of VT23 is positive. These conditions alternate line by line as the line flyback trigger pulses switch the bistable from one state to the other, producing antiphase squarewave outputs at the two collectors to drive the PAL V switch.

The PAL V Switch

The anodes of the two PAL switch diodes are returned to the positive potential at the junction of the potential divider R171/R175 which is connected between the l.t. rail and chassis. Diode conduction only occurs however when its anode is more positive

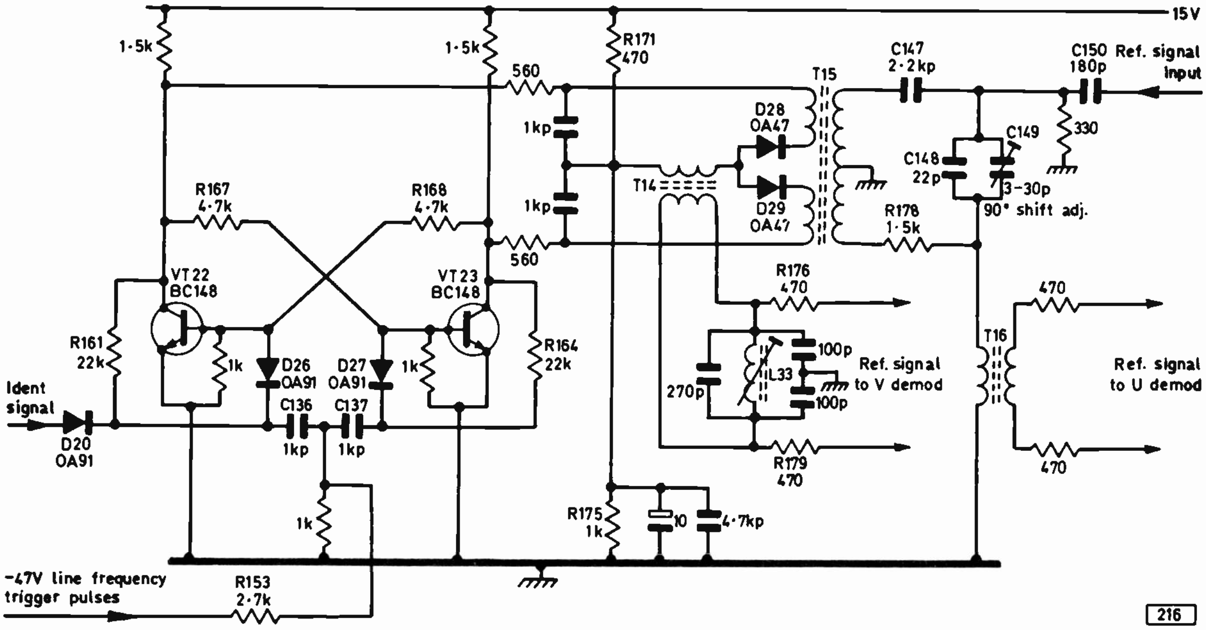


Fig. 1: Typical PAL V switch circuit (T15 with D28 and D29) and its controlling bistable circuit (VT22 and VT23) which provides antiphase squarewave outputs to switch the diodes D28 and D29 alternately on and off. In this circuit (Pye 691 chassis) it is the reference signal to the V demodulator that is switched line by line.

than its cathode: this happens at D28 when VT22 is on and at D29 when VT23 is on. Thus on one picture line the reference signal passes through D28 and T14 to the V detector and on the next line through D29 and T14. Now diodes D28 and D29 are fed by the top and bottom secondary windings respectively on T15. As there is 180° phase reversal between these secondary windings the required V reference signal phase alternations are carried out—basically under the control of the bistable line by line switching.

Bistable Circuit Operation

This brings us to the bistable itself. As we have already said, the circuit has two stable states and will change from one to the other only when a trigger pulse is applied. In Fig. 1 the triggering pulses at line frequency are applied to the bases of the transistors through C136/C137 and diodes D26/D27. Let us see the basic action without diodes D26/D27. If VT22 is conducting and VT23 is cut off a negative-going trigger pulse will switch VT22 off—since to be conducting its base must be biased positively. When VT22 is switched off by the trigger pulse its collector swings positive, thereby taking VT23 base positive via the coupling resistor R167. This switches VT23 on and as its collector voltage falls to chassis potential VT22 is held cut off due to the coupling resistor R168. The circuit then remains in this state until the next trigger pulse arrives which this time switches VT23 off. Each time the switching action is rapid.

Now a fundamental feature of the bistable circuit action is that *one* complete switching cycle requires *two* input pulses. For example, to switch VT22 off requires one pulse and to get it to conduct again requires a further pulse. This means that the pulse repetition frequency of the output at either collector is half that of the input.

Diodes D26/D27 with R161 and R164 improve the speed and reliability of the switching action. The diodes are biased by the transistor collector potentials. Thus when VT22 is conducting D26 is held just conducting while at this time VT23 is cut off and so is D27 by the positive potential at its cathode reflected via R164 from VT23 collector. Thus the next negative input pulse fed to the circuit finds itself confronted by one diode which is conducting and another which is cut off. It naturally passes via the conducting diode D26 to VT22 base to switch this transistor off. The time-constants of R161/C136 and R164/C137 are equal and arranged so that the appropriate diode remains conducting for the appropriate length of time. For effective switching the time-constants need to be around five times the trigger pulse width.

Synchronising the Bistable

We have seen then one method of operating a PAL V switch line by line so as to phase alternate the reference signal applied to the V detector. What about the synchronising? Without this the PAL switch could be happily switching in opposite phase to the switching at the transmitter. This is where the ident signal comes in. The positive-going half-cycles of this pass through diode D20 to the junction of D26 and C136. If the bistable is switching in synchronism with the V chroma phase alternations the ident signal has no influence on the switching.

If however the switching is in error when the circuit comes into operation the positive half cycle of ident signal will prevent the negative trigger pulse switching VT22 off so that the circuit does not switch till the next trigger pulse arrives after which it will continue switching in correct synchronism. The important thing about the ident signal is that it is at half line frequency and over-rides the circuit switching when this is incorrect.

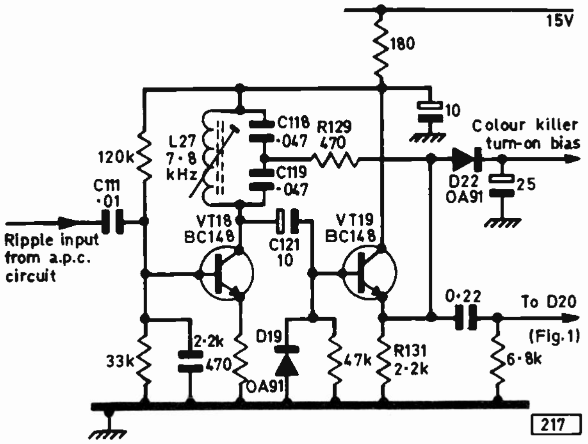


Fig. 2: The V switching must be synchronised and for this purpose the ident circuit shown here (Pye 691 chassis) generates a 7·8kHz sinewave from the phase swings of the transmitted burst signal.

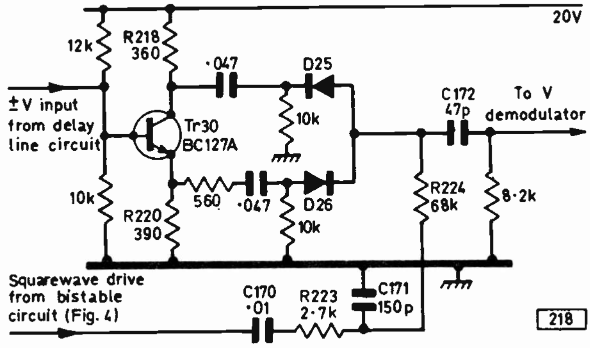


Fig. 3: The PAL V switch used in the ITT-KB CVC5 chassis uses a pair of switching diodes (D25 and D26) in conjunction with a transistor phase splitter (Tr30). In this chassis it is the signal feed to the V demodulator that is inverted on alternate lines.

Ident Circuit

The stage which generates the ident signal in the Pye Group 691 chassis is shown in Fig. 2. The swinging bursts produce a squarewave signal at approximately 7·8kHz at the a.p.c. phase detector. This signal is passed via a d.c. amplifier and the coupling capacitor C111 to VT18 base. The collector of this transistor is tuned to 7·8kHz by L27/C118/C119. As a result a 7·8kHz sinewave—the ident signal—appears at VT18 collector and is passed to the base of VT19, arranged as an emitter-follower, through C121. Since VT19 has no fixed bias it would be non-conducting. On a colour transmission however the bursts give rise as we have seen to a 7·8kHz sinewave output at VT18 collector. This signal is rectified by diode D19 and the resulting bias switches VT19 on. The 7·8kHz signal thus appears at its emitter. Controlled positive feedback is introduced by the coupling from VT19 emitter via R129 back to the 7·8kHz tuned circuit and this results in a large-amplitude 7·8kHz signal at VT19 emitter. This signal is fed to the bistable through D20 (Fig. 1). It is also fed to the colour killer rectifier D22 which produces a positive d.c. bias to switch on the colour killer controlled stage in the chroma channel.

A Different Approach

The circuitry we have been describing is reliable and widely used. There are however many other ways of carrying out PAL V switching. To conclude this month we will look at the system used in the ITT-KB CVC5 chassis. This is an example where the V signal itself instead of the V reference signal is switched before application to the V synchronous demodulator. The V switch, which this time uses no wound components, is shown in Fig. 3. The ±V

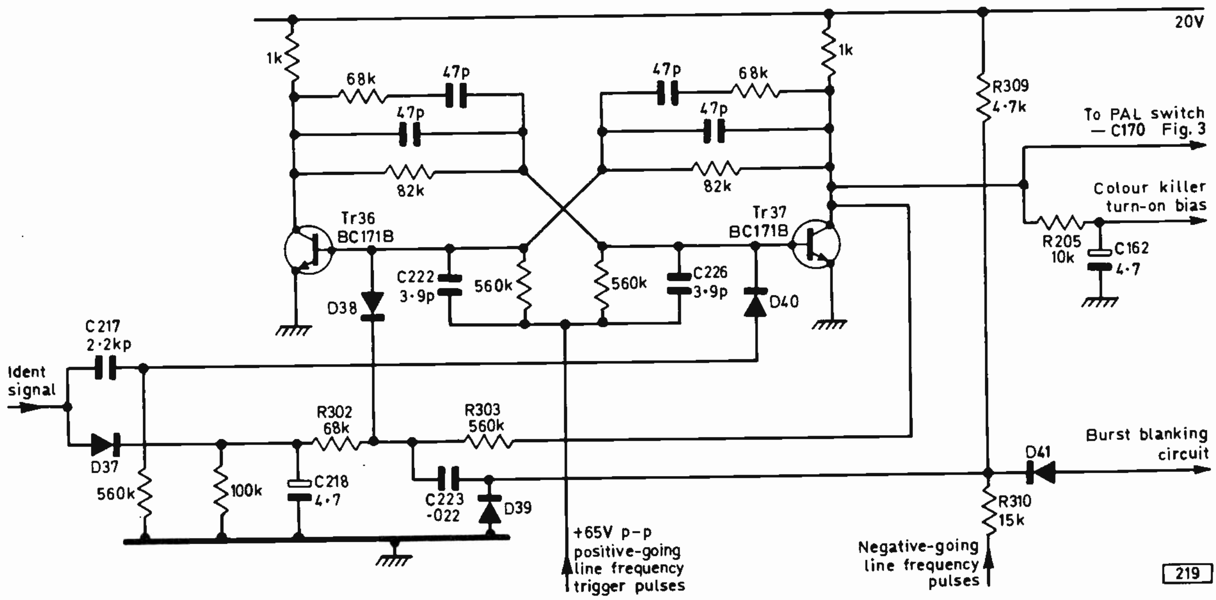


Fig. 4: The bistable circuit used in the ITT-KB chassis also provides the colour killer turn-on bias to bring the chrominance channel into conduction on a colour signal.

signal from the delay line circuit is fed to the base of Tr30 which is arranged as a phase splitter. Thus the signal at Tr30 collector is 180° out of phase with the signal at its emitter. Consequently to provide PAL switching a pair of diodes—D25 and D26—are used to select the signals at the collector and emitter of Tr30 on alternate lines for feeding to the V synchronous demodulator. Once again a bistable circuit is used to control the switching of the diodes. As the diodes are connected back to back (D25 anode to D26 cathode) the squarewave output fed from the bistable circuit via C170, R223 and R224 to the junction of the diodes switches them on and off alternately. The demodulator circuits were described in *Colour Receiver Insight* in the March issue. C172 removes the squarewave switching component from the signal feed to the V synchronous demodulator.

As in the previous circuit the switching must be at half line frequency rate (7·8kHz) and in this circuit is done by feeding the squarewave output from one of the bistable transistors to the junction of the two switching diodes. The bistable circuit is of course switched line by line by line frequency trigger pulses and is synchronised by the ident signal in the usual manner. The circuit of the bistable circuit is shown in Fig. 4. The trigger pulses are fed in via C222 and C226 while the ident signal is applied to Tr37 base through C217 and diode D40. The triggering pulses this time are positive-going and thus switch the transistor that is *off* in the bistable circuit *on* rather than, as in the previous Pye circuit, switching the transistor that is on off. Once again the positive half cycles of the ident signal are used. The latter immediately push Tr37 into conduction thereby ensuring immediate V switching synchronisation.

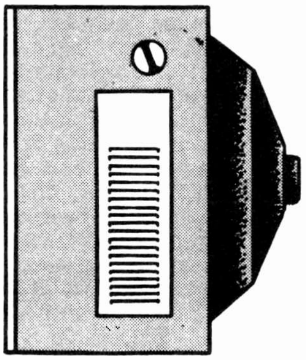
Colour Killer Action

The bistable circuit is also used—and in this respect is unique—to provide the colour killer action. This complicates the circuit somewhat! The inputs that control this action are negative-going line frequency pulses fed in via R310 and the ident signal which is rectified by D37 to provide a positive potential across C218. The negative-going pulses (which are also fed via D41 to the burst blanking circuit) have a positive d.c. component added via R309 and the negative tips are clipped by D39. They are then fed via C223 to the junction of R302 and R303. On colour a positive potential is present at this point as a result of the rectification of the ident signal. Thus D38 is reverse biased and prevents the negative tips of the pulses reaching the base of Tr36. On monochrome the positive potential is no longer present at the junction of R302 and R303 as there is no ident signal to rectify. D38 then passes the negative tips of the pulses to Tr36 base, cutting it off. Tr37 is held conducting and as C226 does not discharge it remains in this state. Consequently its collector voltage remains at chassis potential and there is no turn-on bias for the colour killer controlled stage in the chrominance channel. On colour the bistable is triggered on and off in the normal manner: the squarewave output at Tr37 collector is smoothed by R205 and C162 to provide the positive colour killer turn-on bias for the chrominance channel (see Fig. 1, page 221, March 1972).

We will conclude our coverage of PAL V switch/ident systems next month.

Renovating the RENTALS

CALEB BRADLEY B. Sc.



4 COLOUR SETS – INTRODUCTION

Back in Part 1 we hinted that ex-rental colour sets can now be bought. As yet the supply is merely a trickle however and most sets are snapped up by trade buyers at prices around £150 for a good 25in. model. The price of the set when new may have been over £320. This may appear rather a good bargain since one could not get a set much cheaper even by building it oneself—not considering the work needed to align it from scratch. (Let this not deter those proudly embarked on constructing the Television Colour Receiver—I speak only to the Few as slothful as myself!) But whether the buy is such a bargain depends on how competent one is to make any necessary repairs. In this part we shall reveal how one of these sets can be bought and how one should prepare in advance.

Based on my experience of reconditioning about two dozen ex-rental colour sets (so far) certain items of equipment can be regarded as *essential,* some others as *highly desirable* and a few as expensive luxuries. Certainly if you plan to sell the set the equipment needed to set it up perfectly should be at hand. Otherwise the profit may be eroded by costly call-backs—new viewers quickly get over their initial uncritical awe of the colour set. If on the other hand you are buying a single set for your own use you may be able to make do with less equipment. It is for example just possible to make all the adjustments needed using no more than an Avo and the transmitted test card.

Buying the Set

In terms of components-for-money a price of around £150 for an ex-rental colour set represents good value. The set was being rented until very recently and can therefore be assumed to have been 100% functional. Obviously it will not have been sold while still perfect so we can expect to find something wrong with it. In a surprising number of cases the "faults" amount to no more than cabinet scratches and a general need for adjustment. Where there is an electrical fault it is unusual to find more than one stage needing repair.

What the low price really signifies is that the state of the set is unknown. The seller listed at the end of the article issues a list of sets currently in stock with a brief description of each. Two typical offers might be:

Decca 25in. table model CTV25. Working wrong colours, scratches on side, fibre back torn. Price £160.

Philips 25in. model G25K500. Clean inside and out, tube neck broken. Price £148.

I suggest you ignore the electrical descriptions completely. They are based—as is stipulated—on no more than a cursory examination by the seller and in any case one should not buy an ex-rental colour set unless prepared to deal with any type of fault. Take the first offer for example: what does "working wrong colours" mean? It might be failure of the ident signal to phase the PAL bistable correctly (more of this later), or failure of a colour-difference signal stage, or no more than incorrect grey-scale adjustment—or it could be the tube. In fact almost any picture fault symptom *could* mean a faulty tube although in practice it rarely does (in the case of the Philips set there is not much doubt though!). This uncertainty, since the set must be bought "as-is" and is only returnable if found to be incomplete, is the real reason for the low price.

The price tends to reflect the state of the cabinet more than the electronics since this is more relevant to the reconditioned set's saleability. If you will accept a poor cabinet you may get a very low priced set. From the two samples given the author would choose the Philips as the better buy: a regunned 25in. tube can be had for less than £30 and the chances are that this is all the set needs.

Servicing Equipment Needed

A good multimeter is of course essential. Since it may have to be used on small-signal transistor stages it should have a good selection of low d.c. voltage ranges and at least 20,000Ω/V d.c. sensitivity. It should be capable of measuring boost h.t. voltages of about 800V. An internal d.c. blocking capacitor, as provided on many Japanese instruments, can make the meter useful in the absence of a 'scope for checking various high-level signals in the set, including ident, video and sync signals.

A reasonable oscilloscope is almost essential for

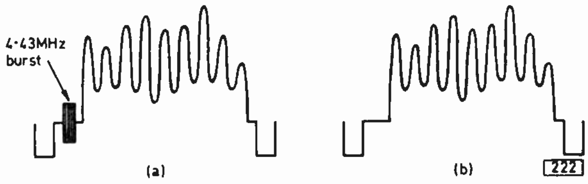


Fig. 1: The same composite video waveform at the video detector as displayed (a) by an oscilloscope with a 6MHz bandwidth, using a low-capacitance r.f. probe, and (b) by a cheap oscilloscope with a 3MHz bandwidth connected without a probe. Note the failure to resolve the 4·43MHz burst in (b).

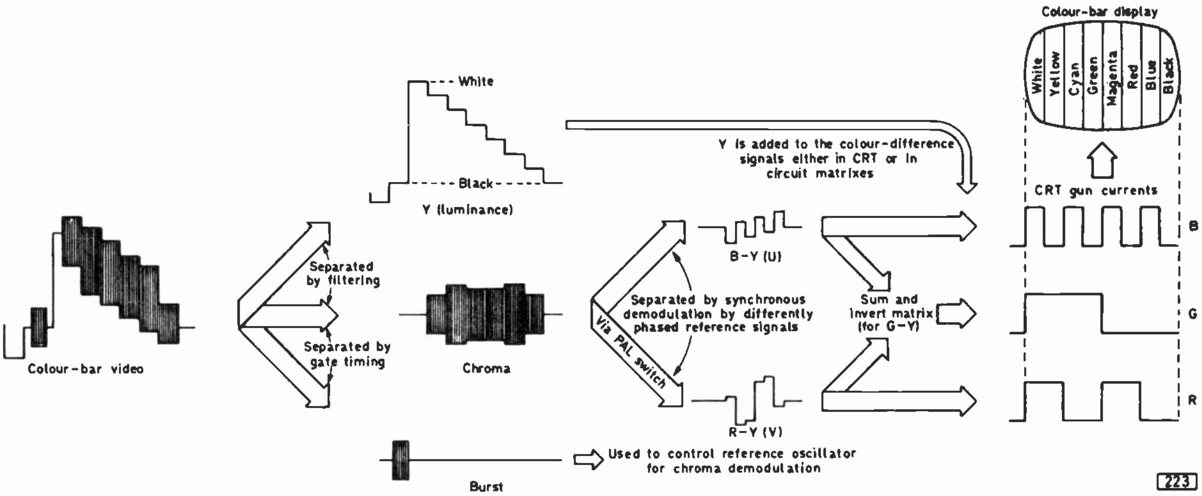
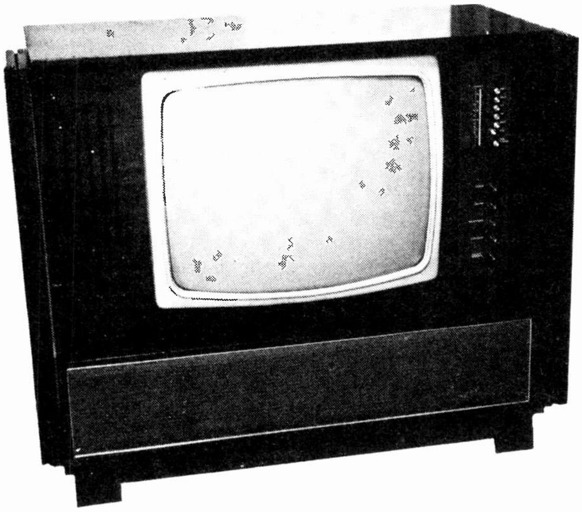


Fig. 2: Simplified representation of the processes in which the composite video signal is decoded to give a colour display. Factors glossed over here include the use of a delay line for initial U and V signal separation and the coefficients in the basic colour equations.

any decoder servicing. One with sufficient bandwidth to resolve the 4·43MHz burst in the composite video waveform is desirable but not absolutely essential since various clues can tell whether the burst is doing its job. For example if the picture has any colour content at all the reference oscillator must at least be trying to lock to the burst. Failing this if the next-to-finest test card grating (4·5MHz) can be resolved at all one can be confident that the i.f. strip has sufficient bandwidth to pass the chrominance signal so that the burst is probably present at the chrominance detector (which is separate from the luminance detector in many sets) even if the scope display is like Fig. 1(b).

It is an advantage if the scope has TV triggering facilities, i.e. has its own sync separator to give triggering at line or field frequency from a composite video waveform. Scopes without this facility can be used but the trigger level adjustment is very touchy. In this case it is worth connecting the external trigger terminal to the set's line or field oscillator to ensure consistent triggering at the required frequency. They will not provide this of course if the fault under investigation is in the sync circuits. When choosing a scope pay particular attention to the "feel" of the triggering controls in use: there are different personal preferences here. Availability of a good degree of X expansion is helpful when checking the shapes and timing of sync, burst gate and a.g.c. pulses.



A floor-standing Decca Model CTV25 dual-standard colour receiver. Some of these sets are now available on the ex-rental market.

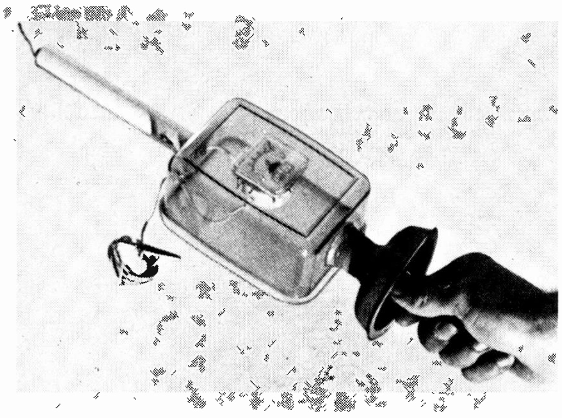
Colour Bars

When servicing the decoder it is useful to have a colour-bar signal whose progress can be followed through the set—see Fig. 2. Although a colour-bar generator is an expensive piece of equipment, definitely in the luxury extra class, this need not spell defeat because it is possible to use the colour bars at the top edge of the test card. Most scopes can be arranged to trigger from the field flyback and display just the top line or two of the picture. The display flickers somewhat compared with full-screen colour bars but this is no disadvantage.

It is unfortunate that on a correctly scanned picture of the test card the colour bars are mostly lost under the top edge of the screen. For final trimming of the R−Y, G−Y and B−Y channel gains (assuming colour-difference drive) use *one* vertical linearity or height control to bring the bars into the viewing area. Only one control should be used since this makes it easier to restore the original conditions—changes in height or linearity necessarily upset the convergence slightly. Trim the colour-difference gains until all bars look as they should. Hanover blinds should previously have been reduced to minimal level by adjustment of the delay line circuit.

An EHT Meter

An e.h.t. meter is a must. Unlike monochrome sets the e.h.t. voltage in a colour set must be set to a specified value—around 25kV. If the voltage is too low the picture focus will be poor and both the purity and convergence will be affected. Worse things happen if the set is run for long with too high e.h.t.: the overwind on the line output transformer may



This e.h.t. meter is safe, accurate and easy to make.

burn out, the c.r.t. may be damaged by excessive flashovers, and excessive X-rays may be liberated at the tube face. E.H.T. probes are available for use with standard multimeters but it is better to have a separate instrument. The Eagle KHP30 is a simple commercial model consisting of a well insulated probe with a meter built into the handle. A suitable instrument can however be made up very inexpensively and one used by the author is shown in the photograph.

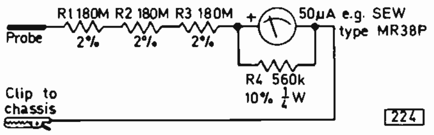


Fig. 3: Suggested e.h.t. meter circuit

The meter consists simply of a small 50μA panel meter with series resistors R1 to R3 (see circuit Fig. 3) to give 27kV full-scale deflection. A resistor R4 of 560kΩ or thereabouts is added across the meter as a precaution against corona in the movement if the coil should ever go open-circuit.

Constructing the Meter

Maximum insulation between the operator and the e.h.t. point is aimed at by the construction shown in Fig. 4. All the plastic parts were collected on a visit to Woolworths: the box is the smallest Airfix food container and the two plastic tubes come from two domestic sink plungers—the rubber sucker from one was used as a hand shield. Perhaps the appearance is strange but the obvious degree of insulation inspires confidence.

Resistors R1—R3 are Welwyn type F44F. These can be screwed together leaving no exposed edges to invite corona. Wipe the resistors and the inside of their tube with methylated spirits before assembling to remove traces of moisture and fingermarks. At the business end of the instrument a bolt holds R1 to the plastic cap (part of the sink plunger) and holds a piece of stiff heavy-gauge wire filed to a chisel end so that it can be slid under an e.h.t. connector cap. A nut and washer hold R3 to the box and a wire runs from under the washer to meter positive. Meter negative is connected via a flying lead and crocodile clip to the chassis of the set—this connection must never be forgotten. The plastic tubes are held to the box by liberal use of Araldite cement.

In use the meter is held *behind* the hand shield and the prod slid under the e.h.t. connector until actual contact with the metal clip inside is felt. This is important as otherwise corona can occur between the clip and the meter probe giving a falsely low reading.

The meter deflects by 46·3μA with 25kV e.h.t. and this value should be marked on the meter scale. Other kV readings can be found from:

voltage (kV)=meter reading (μA) ×0·54.

To make a proper job of it a new meter scale calibrated in kV could be drawn up but it is simpler just to mark off the existing scale in 5kV intervals. Since three 2% resistors in series should give somewhat better than 2% overall accuracy and the meter movement accuracy is about 2% the meter accuracy is better than plus or minus 1kV which is adequate.

As a side note it is in theory possible to adjust the e.h.t. of a set by monitoring only the voltage across the boost h.t. capacitor since this determines the flux in the output transformer core. I have never had much confidence in the accuracy of this method however and in any case it is necessary to know the exact working boost voltage for each model.

Another adjustment which should be made at the same time as setting the e.h.t.—since they interact—is that of the shunt stabiliser (most first-generation colour sets were fitted with one of these—type PD500) current. This is usually set to a maximum of 1·2mA with a black picture (obtained by turning down the contrast and brightness or by switching off the c.r.t. guns). The stabiliser valve itself is screened but the cathode is usually brought out to an accessible test point and then via a 1kΩ resistor to chassis. The current control must therefore be set for 1·2V at this point. Check the stabilising action by turning up the picture brightness and seeing the voltage fall. It should not drop below about 0·4V with normal brightness levels.

Demagnetising Coil

A demagnetising coil is only really needed when you find purity adjustment baulked by the shadow-mask having become too strongly magnetised for the

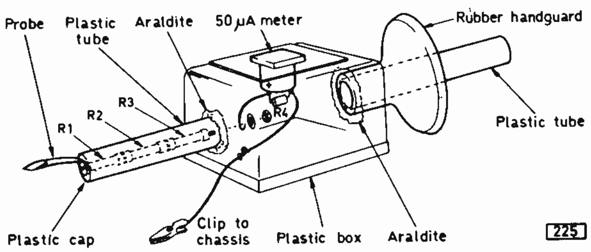
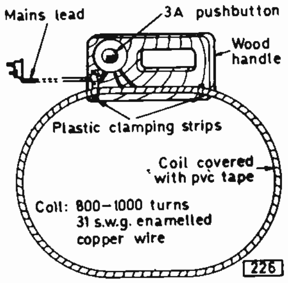


Fig. 4 (left): Construction of the e.h.t. meter. All the plastic parts were found during a visit to Woolworths.

Fig. 5 (right): Construction of the suggested demagnetising coil.



set's own demagnetising coil to cope. A small area can sometimes be cleared of magnetism by holding an "instant heat" mains solder gun close as these produce a strong a.c. field. It is however so simple to make up a demagnetising coil that there is no excuse for doing without one. Incidentally it is often called a "degaussing" coil which is rather a misleading name.

To make the coil wind 800 to 1000 turns of 31 s.w.g. enamelled copper wire in a 15in. diameter loop. Scrape enamel off the ends and solder to p.v.c. insulated flexible wires. Now insulate the coil and its connections thoroughly by wrapping with overlapping turns of p.v.c. adhesive tape, using three thicknesses of tape overall. Fix the loop to a piece of wood cut to form a handle (see Fig. 5) using *plastic* clamp strips, not metal. Connect the loop to a press switch rated at least 250V, 3A (low-voltage bell-pushes will not do). A spin-dryer lid switch might do if it has normally-open terminals. A double-pole switch is much preferred but if a single-pole switch is used it must switch the live side of the mains. Secure the mains carrying lead as shown.

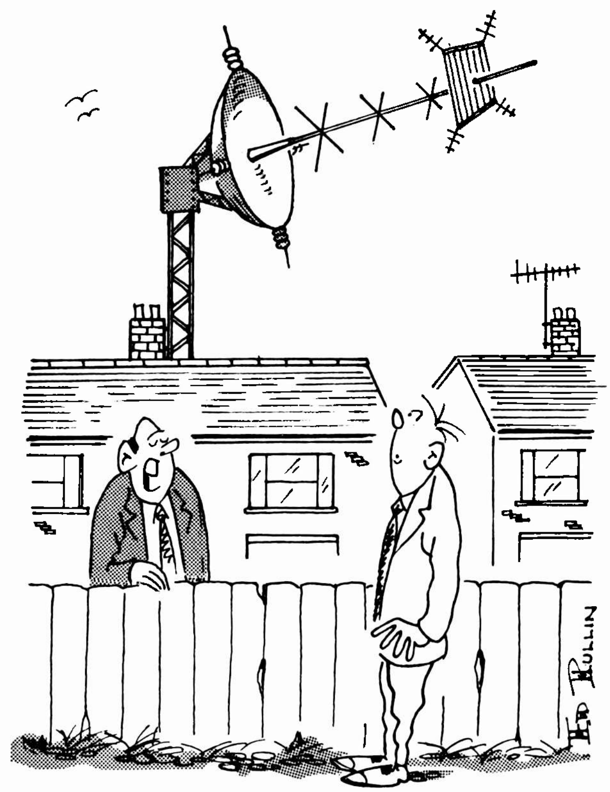
The set can be on while the coil is used—it makes no difference (the colour effects may amuse though!). Stand several yards from the set, hold down the push-button, walk up to the set and pass the coil over all parts of the tube face, walk away from the set and only then release the button. The coil should not be used for more than about a minute as it gets warm. It is sometimes suggested that the tube shield inside the set should be demagnetised by a similar process. The author does not agree as the shield is unlikely to need it and one may be dismayed afterwards to find that convergence has been lost due to the static convergence magnets being demagnetised as well!

Convergence

Static and dynamic convergence adjustments can only be done accurately using a crosshatch pattern generator, possibly with alternative dot pattern facility. Convergence adjustment on a test card alone is possible but it is hard to reach the high standard which should be aimed at. The new electronic test card occasionally transmitted is better for this as much of it is a crosshatch pattern anyway. There are various commercial crosshatch generators ranging from expensive ones which provide a modulated r.f. output which can be fed into the aerial socket or i.f. strip to simple ones using a few logic flatpaks to generate an artificial video signal, possibly without sync, which can be injected at the video amplifier grid (a circuit for one of these and details of its use will appear in a future issue).

Grey-scale Aids

Another instrument which might be regarded as a luxury but which I find invaluable is a grey-scale adjustment aid. This can take the form of a hand-held fluorescent tube of the correct colour temperature (e.g. the "Color-Trak") or a calibrated photoelectric meter (Megatron colour balance meter). Without these it is very hard to be certain whether the black and white picture is entirely free of colour bias in either the whites or dark greys, particularly when adjusting in a colourfully decorated room with lamp lighting.



"It's non-functional actually but it's certainly given the neighbours something to think about!"

Spares

Compared with the cost of the set it is relatively inexpensive to stock up with most of the spare parts commonly needed. The following list covers some of the parts which most often need replacement.

Fuses: A selection of standard 1¼in. type in the 500mA to 3A range. One can get through quite a few in tracking down an h.t. short and the temptation to use substitutes must be resisted.

Resistors: Line output valve screen feed resistors, typically 2·7kΩ 5W wirewound. A 27kΩ ¼W resistor is needed to disable the colour killer on Bush and Murphy dual-standard sets. Some sets including these often burn out their h.t. surge limiter resistors, typically about 10Ω 10W wirewound.

Potentiometers: Dynamic convergence circuits often blow their dear little potentiometers and a few 10Ω and 50Ω 3W wirewounds on hand will get those colour fringes cleared up quickly. On dual-standard sets there is the possibility of pinching a pot or two from the 405 convergence circuit.

Capacitors: A 2000μF 25V and a 200μF 250V (electrolytics) for h.t. ripple troubles, and a 0·01μF 250V capacitor for bridging across suspect decouplers.

Semiconductors: A BC109 often works wonders (except where a pnp type is needed) in all but i.f. and high-voltage stages. Have a spare reference oscillator transistor (depends on set but is BF184 for dual-standard Decca models)—they sometimes just refuse to oscillate for no apparent reason. Also some OA90 germanium diodes for the demodulator bridges and elsewhere in the decoder and a BA102 varactor diode for the reference oscillator circuit.

4·43MHz crystal: Sometimes these go open-circuit inside. Philips sets are easy here—the crystal can be unplugged in a trice.
Valves: The PL509 (line output) and PY500 (boost diode) are hard workers and are worth renewing whether they need it or not. Replace the GY501 (e.h.t. rectifier) if the e.h.t. is slow to come up or weak—the PD500 (e.h.t. shunt stabiliser) rarely fails. PCF802 and ECC82 (especially) for timebase oscillators. The PL508 (field output) rarely goes wrong. If replacing one colour-difference output valve (PCL84, or PCF200 in Philips sets) replace all three or the grey scale may be poor.
Blue-lateral coil assembly: Being (a) butterfingered and (b) always convinced that the blue verticals could be converged better if the wires to the blue-lateral assembly (clamped on the c.r.t. neck) are reversed the author usually manages to rip the tiny solder tags away from their fragile plastic mounting. It is a remarkable fact that this never happens when there is a spare coil at hand.

Receiving the Set

Having collected the set or had it delivered *first* take off the back and give it a thorough physical inspection. Remember that the tube may still have enough e.h.t. charge on it to give a nasty jolt if the e.h.t. connector or the shunt stabiliser top cap are touched. Search for such things as loose or non-mated connectors and flying leads, damaged or burnt components, track lifting from printed boards, missing valves, worn aerial connectors and (most revealing of all) for any signs of previous servicing work. A fault spotted at this stage can save hours of diagnosis later. Be especially suspicious about any stock faults known for the model.

Initial Examination

Without plugging the set into the mains supply, switch it on and check with an ohmmeter for zero resistance between the neutral pin of the mains plug and chassis, assuming it is a live chassis model as most are. Check that there is some resistance between the live pin and chassis until the set is switched off when it should become an open-circuit. This test makes sure that the live side of the switch is opening correctly (or has not been shorted across by some idiot as a makeshift repair). Otherwise the chassis will be lethally live when the set is switched off.

Finally make sure that all the screens around the line output section are correctly and securely bolted in place. Contrary to casual opinions sometimes heard the shunt stabiliser and e.h.t. rectifier *do* produce a harmful quantity of X-rays and the manufacturer's shields *do* contain virtually all the radiation quite safely, even when the stabiliser radiation is excessive due to maladjustment.

Switching On

Only now can the set be connected to the mains and switched on. If the audio stages are fully transistorised sound will come on immediately. If the line and field timebases, the tube and its electrode voltages are in order the line whistle and then a raster on the screen will be produced. If there is whistle but no screen illumination check that the cause is nothing as simple as the guns being switched off before checking out the e.h.t. and the supplies to the first anodes, grids and cathode. If the tuner, i.f. strip, detector and video output stage are in order a black-and-white picture should be forthcoming. If the set is a dual-standard one the tuner buttons may be set for a mixture of 405- and 625-line standards and u.h.f. and v.h.f. signal bands. Normally one will want to simplify the set to all-625 u.h.f. operation and this is done by mechanical adjustment of the tuner.

Check the black-and-white picture for shape, size, focus, resolution, uniformity of colour over the screen area (purity adjustments), neutral black, grey and white tones (grey-scale adjustments) and freedom from colour fringes on the edges of objects (convergence adjustments). All these will have to be put right before a good colour picture is possible.

See if areas of the picture which should be coloured become coloured as the colour intensity or saturation control is advanced. Any colour at all is reassuring since it means the reference oscillator is at least partially locking to the burst. If different colours flicker down the screen at a fast rate, or stabilise into bands, the reference oscillator is out of tune or only a fraction of the burst is getting through. The latter case, often due to mistiming of the burst gate pulse, can cause strange hue errors that possibly defy explanation.

Ident System

If faces are green sometimes and normal others the ident system is not doing its job of setting the PAL switch in the correct phase. The 7·8kHz (half line rate) ident signal is derived from the swinging ($\pm 45°$) burst signal. It is picked up in the reference oscillator phase control loop and amplified in a tuned stage to obtain a large-amplitude sinewave which is used to synchronise the PAL bistable circuit (via a diode) so that this drives the PAL switch in the correct phase. (An interesting variation occurs in some sets in which there is no bistable circuit and the ident signal is amplified sufficiently to drive the PAL switch directly.) Even the most humble scope can be used to pin down ident troubles.

No Colour

First try retuning, going into the sound-on-vision extreme in case the chrominance signal is being hidden by inadequate i.f. bandwidth. If this fails take steps to disable the colour-killer circuit as sometimes this is all that's faulty: in any case the screen will now show what the decoder is doing and serious servicing with the oscilloscope can begin.

Sources of Colour Sets

Unfortunately many suppliers open their doors only to the trade, although this situation may improve if there is sufficient private demand for "as-is" colour sets. The following seller however can be contacted for his current stock list although buyers will usually have to make their own collection by appointment: R–B Television, 82 North Lane, East Preston, Sussex.

Next month we look at the stock faults of a widely available dual-standard colour set rented by Granada.

WORKSHOP HINTS

—continued from page 347

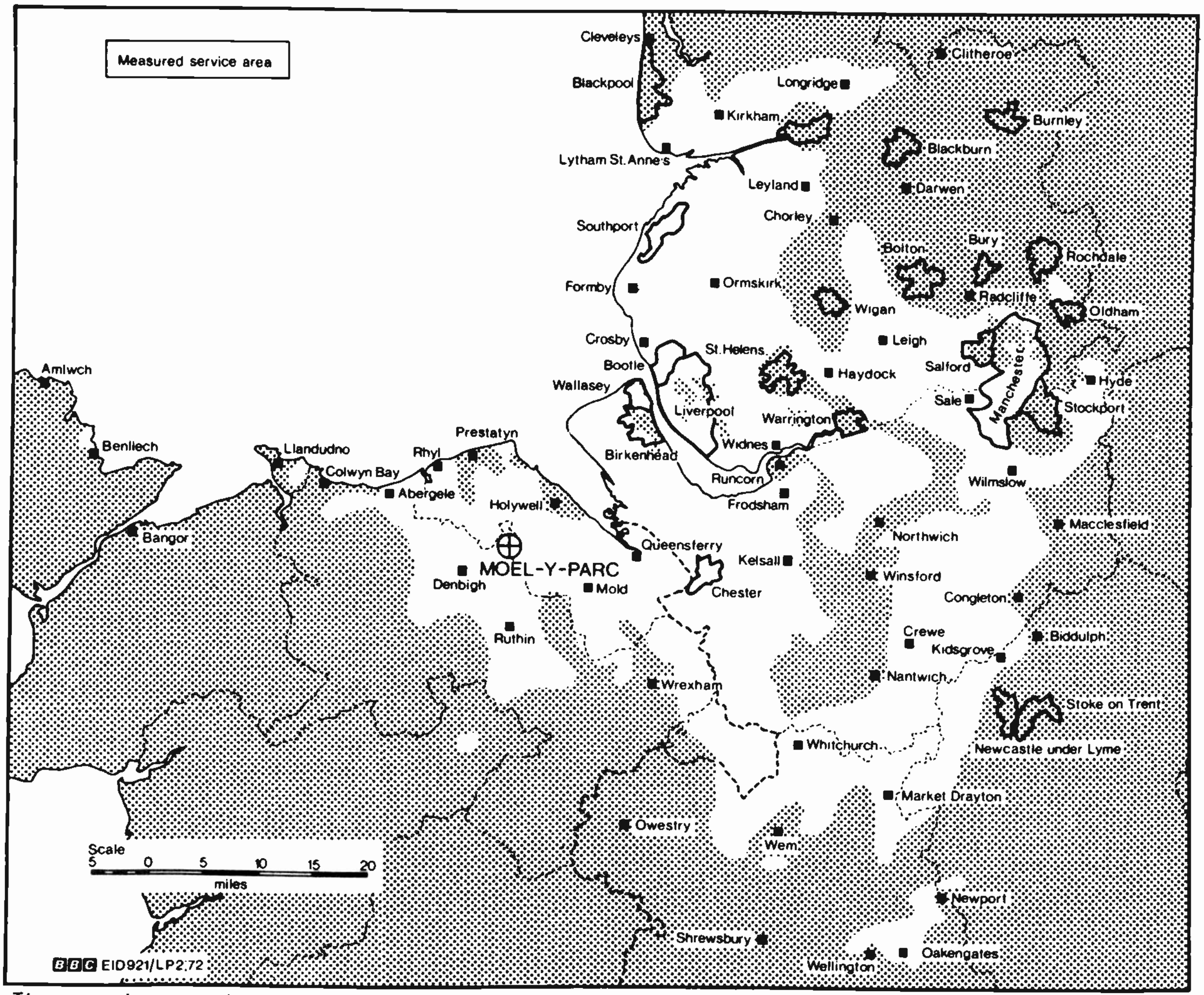
a hard surface (usually it must be metal) and delivering a sharp tap on the point with the hammer. This must not be too hard a blow otherwise the nail will be slightly bent which will actually increase the chances of splitting the wood. With a blunted end the nail can be driven into the wood without splitting it. The reason for this is that a normal sharp nail tends to force the wood fibres apart as it is driven wedge-like into the wood. When the nail is blunted it acts more like a punch, compressing or crushing the wood fibre ahead of it.

There must still be some taper on the front of the nail so it does not follow that in a tricky woodworking situation the best thing to do is to cut off the point altogether to give maximum protection against splitting. This taper ensures that the hole made for the nail is smaller than the body of the nail which follows it so that the nail is gripped firmly by the wood. So it can be seen that even with an apparently simple job such as driving a nail home there is more to the theory than meets the eye!

Control Spindles

Our final tip this time relates to control spindles. Unless the maker's replacement control or an equivalent is being fitted the spindle must be cut down to the length required for the particular job. Very often this is done with a hacksaw which leaves the spindle in rather a rough state. Once the control is fitted and an attempt made to replace the knob it is then found that the knob will not fit easily because of the burred over end. The next thing that is discovered is that it is difficult to file the end off without damaging the cabinet—and of course removing the control will mean a lot of extra work.

It is a good habit therefore always to clean off the cut spindle of any control before fitting it. This takes only a few seconds on the grindstone. First the spindle is applied with its end flat to the stone. Next the spindle is applied at an angle and slowly rotated so that the corner is taken off. The result is a professional looking finish and an easy to fit knob.



The approximate service area of the **Moel-Y-Parc** *u.h.f. station is shown by the unshaded parts of the above map. Channels: Fourth 42, BBC-2 45, ITV 49, BBC-Wales 52. Polarisation horizontal, receiving aerial group E, maximum e.r.p. 100kW. Map courtesy BBC Engineering Information Service.*

TRANSISTOR SYNC CIRCUITS

S. GEORGE

It is surprising what a wide variety of transistor sync separator circuits one encounters considering the basic simplicity of a sync separator stage. Current UK monochrome sets with a transistor sync separator generally use a single npn type operated from an h.t. rail of about 200V. Many imported sets however use a two-transistor arrangement, the first transistor —the sync separator proper—being a pnp type followed by an npn pulse amplifier which often acts as a phase splitter as well to drive a flywheel line sync discriminator circuit. A typical circuit, used in Hitachi mains/battery portables, is shown in Fig. 3 and will be described later. Before considering this let's see why pnp/npn two-stage combinations are so often found.

Sync Pulse Polarity

The c.r.t., to obtain greatest sensitivity, is almost always cathode driven. This means that its cathode will be at a considerable positive potential—with the grid less positive so that the tube is in effect negatively biased. As the positive potential at the cathode is increased so the bias increases until eventually beam current stops. This means that the polarity of the video drive must be such that the sync pulses are the most positive point of the video waveform. Then when the pulses arrive the c.r.t. cathode voltage is "below" the black level and the beam cuts off. With an npn video output transistor whose collector is fed from a positive rail—the usual arrangement—this means that the sync tips must be the most negative excursion of the waveform at its base. The transistor will then be cut off when the sync pulse arrives so that its collector voltage will rise to almost the full rail voltage and the tube cathode will be driven positively to cut off beam current. The sync pulse tips represent 100% modulation of the u.h.f. signal and as the stage preceding the video output transistor will be either the detector or an emitter-follower which will maintain the polarity of the detected signal it follows that the detector output must be negative-going with this arrangement.

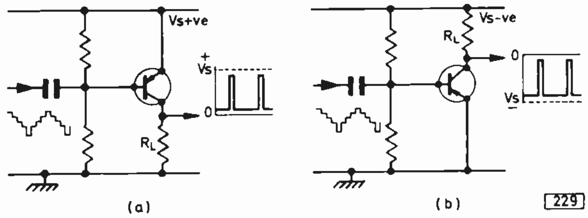


Fig. 1: A video signal with negative-going sync pulses is required to drive a pnp transistor used as a sync separator. Whether the transistor is fed from a positive or a negative rail we get an output consisting of positive-going sync pulses.

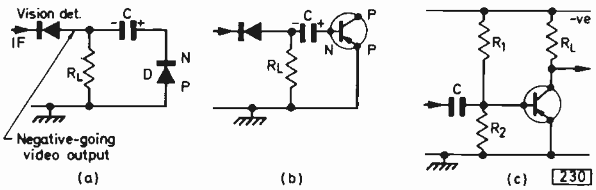


Fig. 2: Basic sync separator action. (a) Capacitor charged via diode D. (b) The np base-emitter junction of the transistor is equivalent to diode D in (a). (c) Basic pnp transistor sync separator circuit. The key to the operation of a transistor sync separator is the time-constant of its base circuit: this is arranged so that the transistor is cut off during the picture information but is driven into saturation by the sync pulses.

Sync Separator Drive

As well as being able to operate much better than valves as switches transistors also have the advantage of requiring a far smaller input to drive them from cut-off to saturation. Thus whereas a valve sync separator must be driven from the video output stage a transistor sync separator can be driven from the emitter-follower which is generally incorporated between the vision detector and the video output stage to reduce the loading on the detector. Taking the drive for the sync separator from the video emitter-follower also gives the advantage that the video output to the c.r.t. is no longer loaded by the input capacitance of the sync separator.

Output Pulses

The sync separator must be cut off during the picture information but driven into saturation when the sync pulse arrives. So if we have a video waveform in which for the reasons outlined above the sync pulses represent the most negative-going excursion this implies the use of a pnp sync separator transistor. Such a stage can be operated with the collector fed from a negative rail or with the emitter fed from a positive rail and the collector circuit returned to chassis. Either way as Fig. 1 shows we get a positive-going sync pulse from the stage. In (a) the transistor's collector will rest at almost chassis potential when it is cut off during picture information as there is then only a negligible leakage current flowing through the transistor and its load resistor. When however the transistor is driven to saturation by the sync pulse the collector voltage will rise to almost the supply rail potential as the collector-emitter voltage across a saturated transistor is only a fraction of a volt. With the arrangement shown in (b) the transistor's collector will rest at almost the negative rail voltage when the transistor is cut off during picture information but will rise to almost zero volts when the transistor

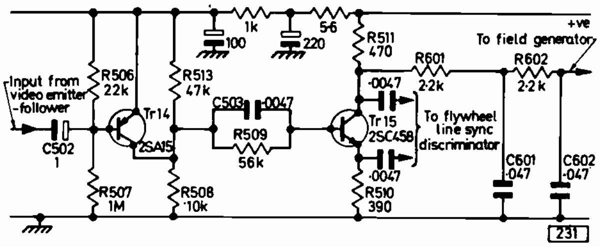


Fig. 3: The two-stage pnp-npn transistor sync separator circuit used in Hitachi mains/battery portables.

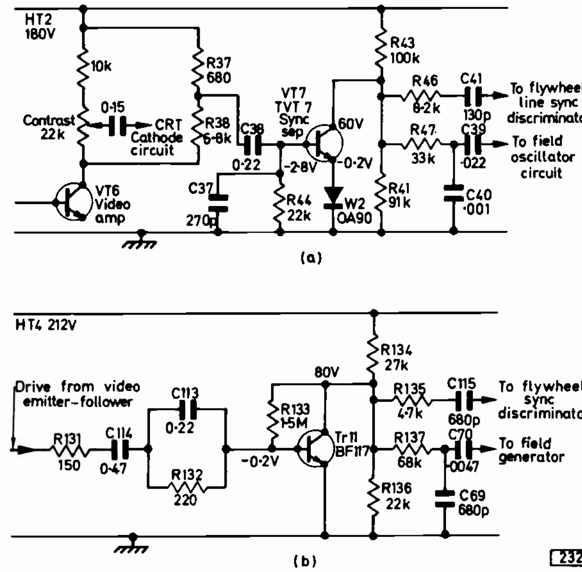


Fig. 4: Representative sync separator circuits used by UK setmakers, both with a single npn transistor. (a) From the BRC 1580 chassis. (b) From the ITT-KB VC200 chassis. The network C113, R132 in (b) is included to provide noise suppression so that the sync separator transistor is triggered on by a clean sync pulse.

conducts during the sync pulse periods. If these positive-going pulses are to receive further amplification this implies the use of an npn transistor in the following stage. Hence the common use of a pnp/npn combination in two-transistor sync circuits. Let's next take a closer look at how a sync separator is held cut-off by the video signal during the active, i.e. picture, line period.

Basic Sync Separator Action

The key to this is shown in Fig. 2. As shown at (a) the negative-going output from the vision detector charges the capacitor C via the diode D. The charge on the capacitor on the side connected to the cathode of the diode is positive. Consequently the diode is reverse biased and the capacitor holds its charge. At (b) a transistor is shown in place of the diode and as a result of the charge built up on the capacitor the transistor will be held cut off since its base-emitter junction is reverse biased. The basic sync separator circuit is shown at (c) and here a resistor R2 enables the charge on the capacitor to partially leak away between the sync pulses. By careful choice of capacitor and resistor values the transistor is held reverse biased to the required degree except during the sync pulse periods. When the sync pulse arrives a sudden negative spike is communicated to the base of the transistor which in consequence is driven into saturation. The flow of base current however restores the charge on the capacitor and the transistor cuts off. At the end of the sync pulse the transistor is once more cut off and is held in this condition by the charge on the capacitor until the next sync pulse arrives. In many circuits a high-value resistor—R1 here—is connected from the supply rail to the base of the transistor to slightly offset the mean bias and ensure that the transistor is fully driven into saturation by the sync pulses. In a valve sync separator stage the grid and cathode act as the diode charging the signal feed capacitor, anode current flowing only on arrival of a positive-going sync pulse.

Typical Two-stage Circuit

To return to the representative pnp/npn two-stage transistor sync circuit used in Hitachi 12 and 14in. mains/battery portables (and also the Elizabethan models which use the same chassis) shown in Fig. 3, Tr14 is the pnp sync separator transistor with the 1MΩ resistor R507 providing the marginal forward current feed to partially offset the self-developed reverse base bias of about 0·4V. R509/C503 provide the pulse feed to the npn pulse amplifier transistor Tr15 which develops equal amplitude but opposite phase outputs across its collector and emitter load resistors R511 and R510 to drive the flywheel line sync discriminator. A double integrator network R601/C601 and R602/C602 from the collector of Tr15 develops the field sync pulse.

Single-stage Circuits

Finally, a couple of UK monochrome chassis transistor sync separator circuits, that used in the BRC 1580 portable series chassis shown in Fig. 4(a) and that used in the ITT/KB VC200 chassis shown in Fig. 4 (b). The sync separator VT7 in (a) is an npn type fed from a 180V h.t. rail and receiving positive-going sync pulses from the potential divider R37/R38 which forms part of the collector load of the video amplifier VT6. R44 provides the discharge path for the coupler C38, a reverse bias of −2·6V being developed across the base-emitter junction of VT7. W2 provides junction protection since any excess bias will be developed across it rather than the base-emitter junction of the transistor. H.F. components are decoupled by C37 to prevent false triggering. 20V peak-peak sync pulses are developed at VT7 collector and are fed via R46/C41 to the flywheel line sync discriminator diodes and via the integrator R47/C40 to the field generator circuit. Just to show how varied things can be we have in the ITT/KB VC200 chassis a completely different set of conditions. Here the c.r.t. is grid driven by an npn video transistor. The sync pulses are thus negative-going at this point to blank the tube and this means that the output from the vision detector fed to the video output transistor via an emitter-follower is positive-going with the sync pulses the most positive signal excursions. The npn sync separator transistor Tr11 shown in Fig. 4(b) thus receives its drive from the emitter-follower and develops 90V peak-peak negative-going sync pulses at its collector. The negative bias developed at its base is partially offset by the positive feed via the 1·5MΩ resistor R133. ■

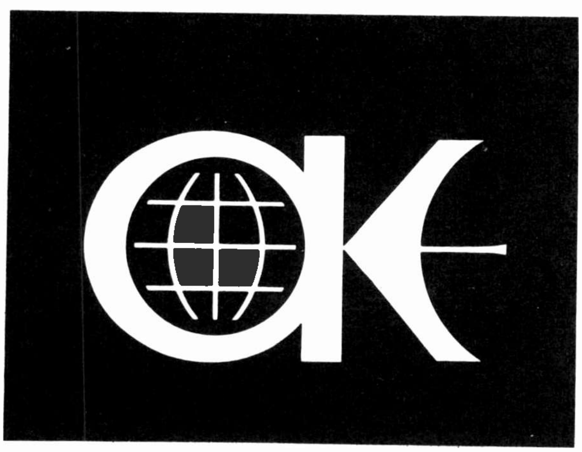
LONG-DISTANCE TELEVISION

ROGER BUNNEY

MARCH 1972 has given most enthusiasts something to talk about! The first three months of the year are usually quiet but 1972 is the exception; indeed this March we have had enhanced signal propagation of several types. In the United Kingdom and indeed Europe there was on March 6th a reasonably good Sporadic E opening (Sp.E) from the late afternoon until mid-evening. Signals were received from Central, Eastern and South Eastern Europe. Reports of reception in the UK range from Switzerland as short skip to the USSR as rather long skip and of course intermediate countries. In the middle part of the month virtually static high-pressure weather systems gave improved Tropospheric propagation (trops) with fair openings over several days. Generally the Belgian, Dutch and Northern German stations were favoured, at u.h.f. The peak conditions seem to have been about March 23rd: Graham Deaves at an extremely good location in East Anglia has reported signals on that day from as far as West Berlin on channels E33 and E39. Graham has also sighted a new test pattern being radiated by certain ORTF second chain transmitters and a sketch of this is included: as will be seen it resembles to some extent the well known EBU test pattern.

Sunspot activity—now on the downward side of the present cycle—has taken a sudden enthusiastic change with activity rising over the past few weeks. The mean averaged out value for February was 91—a peak occurred on February 22nd with a total of 161! It seems that conditions on the Sun were still producing high activity into March as exciting reception reports have since been received. One was from our contact—A. Papaeftychiou—in Cyprus who has received both Gwelo ch.E2 and Bulawayo ch.E3 in Rhodesia via the F2 (F2 layer reflection) and TE (Trans-Equatorial Skip) propagation modes. Indeed he tells us that conditions have been such to allow almost nightly reception of Gwelo ch.E2. A second letter arrived on March 14th telling us that the ch.E4 transmitter of Zaria, Radio Kaduna Television in Nigeria had been received twice—on March 11th and 13th. A note in this letter adds: "Gwelo comes in at any time just after sunset. Video varies: sometimes it is 'single-pathed'. As the night goes on the video gradually changes to a very fluttering signal."

My own log for the period does not reflect the improved tropospherics (nor indeed increased F2/TE, being too far North). However the temporary array was dismantled on the 26th and I now have a more substantial one.



Main news caption—Aktuelle Kamera—DFF Berlin. Courtesy OIRT Prague.

1/3/72	CST (Czechoslovakia) R1 (MS-meteor shower).
2/3/72	Switzerland E3 (MS).
3/3/72	NRK (Norway) E3 (MS).
4/3/72	SR (Sweden) E2 (MS).
6/3/72	NRK E3 (MS). A fairly good sporadic E opening occurred later in the day with MT (Hungary) R1; USSR R2; CST R1, R2; ORF (Austria) E2a; WG (West Germany) E2; plus various unidentified signals on channels E2, E3 and E4.
9/3/72	BRT (Belgium) E2 (trops).
10/3/72	SR E2; NRK E3 (both MS).
11/3/72	NRK E3; WG E2 (both MS); SR E2 (Sp.E).
12/3/72	NRK E2; SR E2 (both MS); NOS (Holland) E4 (trops).
13/3/72	SR E2 (MS); NOS E4 (trops).
14/3/72	CST R1; WG E2 (both MS).
15/3/72	NOS E4 (trops).
16/3/72	DFF (East Germany) E4; ORF E2a (both MS).
17/3/72	WG E2; SR E2 (both MS); NOS E4 (trops).
18/3/72	SR E4; ORF E2a (both MS); NOS E4 (trops).
20/3/72	WG E2; NRK E2 (both MS).
22/3/72	SR E2; WG E2 (both MS).
23/3/72	MT/TVP (Poland) Retma test card (Sp.E at 1311).
24/3/72	SR E2 (Sp.E).
25/3/72	SR E2 (MS); NOS E4 (trops).

News Items

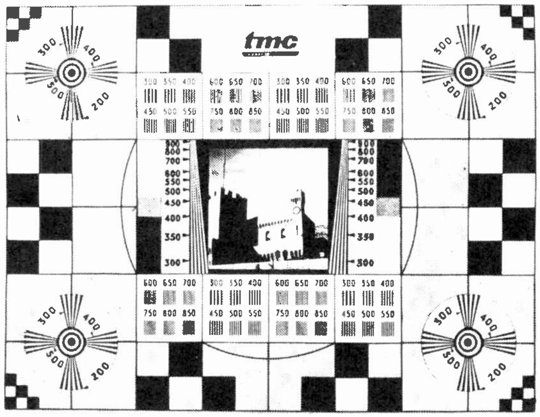
Switzerland: The Europese Testbeeldjagers Club of Holland advise us of two high-powered transmitters—TSI (Italian language network)—that are at present unlisted in the EBU station manual: La Dole ch.E34 400kW e.r.p. horizontal polarisation. St. Chrisona ch.E49 200kW e.r.p., horizontal polarisation. We understand that the new Swiss test card type YLE/SWF will be in use from about May 1972.

East Germany: The DFF (Deutscher Fernsehfunk) have issued a form of transmitter check list folder. Graham Deaves has kindly forwarded his copy from which we have extracted the following information on the u.h.f. network. DFF-1 First Programme Chain: Lobau ch.E27. DFF-2 Second Programme Chain: Leipzig ch.E22; Marlow ch.E24 vertical polarisation; Berlin ch.E27; Schwerin ch.E29; Dresden ch.E29; Dequede ch.E31; Inselsberg ch.E31; Brocken ch.E34. All transmissions except Marlow are horizontally polarised. Unfortunately no e.r.p. figures are given but as soon as we have a complete list this information will be featured. I have heard a rumour that a Band V DFF-2 transmitter is in operation on about ch.E42 and further information is being sought.

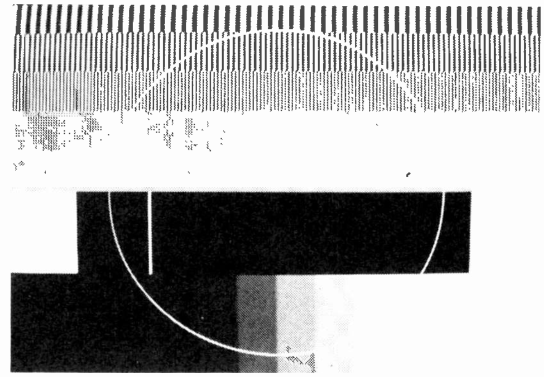
Eire: Last month we featured the RTE card, test card E shown earlier having been discontinued. We have just heard that RTE have introduced—from February 1st—a new colour test card. We will show this as soon as we receive a photograph.

Portugal: Keith Hamer tells us that RTP (Radiotelevisao Portuguesa) is using the RMA test card (see Data Panel 3). It is at present used on u.h.f. with the inscription RTP UHF at the lower centre frame. There is the possibility of

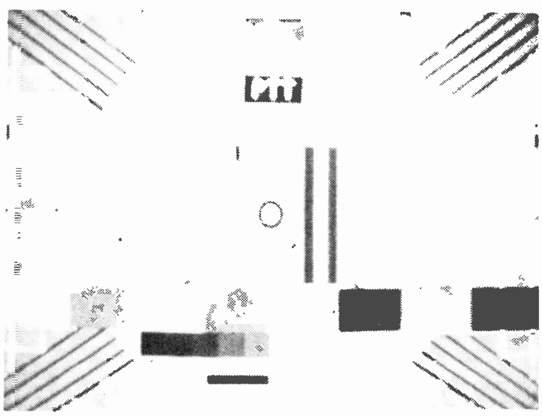
DATA PANEL II - 2nd series

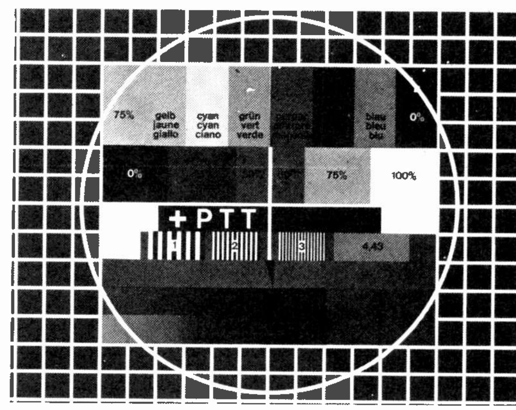


Monaco: Tele Monte-Carlo test card.

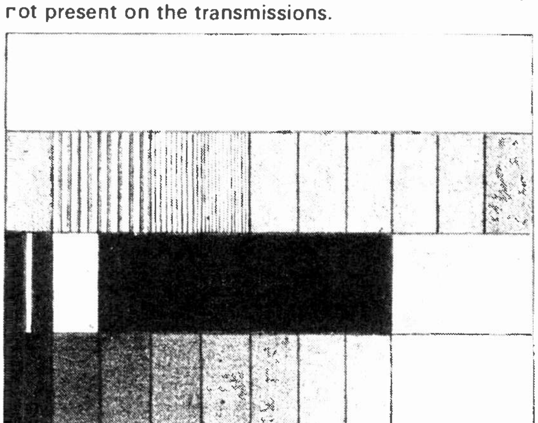


There are some variations to the basic EBU test pattern (see Data panel 1). A white (as above) or black circle may be included.

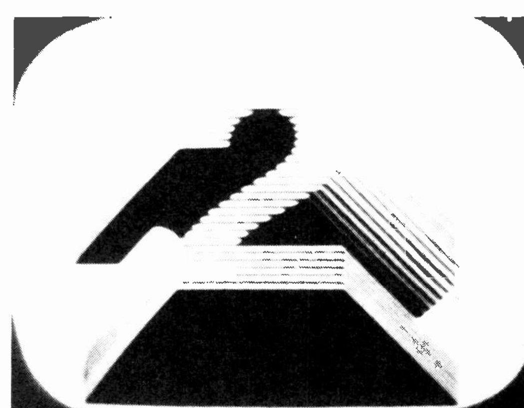




Switzerland: There are two test cards in use, type A as shown above left and type B, the familiar SWF electronic card, as shown above right. There are three networks: German, Schweizerische Radio und Fernsehgesellschaft (SRG); French, Société Suisse de Radiodiffusion et de Télévision (SSR); Italian, Televisione Svizzera Italiana (TSI). The A type test card carries an identification square as follows: B Bellerive studio for German language; L Lugano studio for Italian language; G Geneva studio for French language; Z Zurich studio; U Uetliberg transmitter; D La Dole transmitter; Q experimental transmission. The B type card carries the identification + PTT to the left and either SRG, SSR or TSI to the right. The other inscriptions on the card above are for technical guidance and are not present on the transmissions.



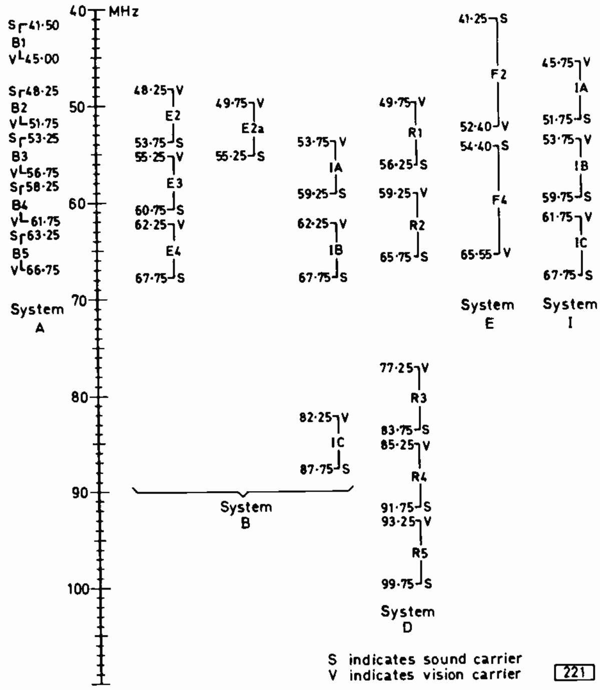
New ORTF pattern sketched by Graham Deaves. Photographs this month courtesy Garry Smith, Keith Hamer and Michele Dolci.



The new identification caption for Dutch networks indicates either 1st chain (figure 1) or 2nd chain (as above). Nederland is inscribed above the figure.

CHANNEL ALLOCATION CHART FOR THE EUROPEAN AREA

Bands I and II (TV)



System A: 405 lines, positive vision modulation, a.m. sound. (UK, Eire.)
System B: 625 lines, negative vision, f.m. sound. (Most of Western Europe, certain African and Middle Eastern countries.)
System C: 625 lines, positive vision, a.m. sound. (Belgium, with frequency allocations as for E2-4.)
System D: 819 lines, positive vision, a.m. sound. (France.)
System I: 625 lines, negative vision, f.m. sound.

course that this card could be used at times by their v.h.f. transmitters and this should be borne in mind if this card is noted on E channels.

Channel Allocation Chart

We have reduced the length of the column a little this month in order to feature a channel chart which will be of use in channel location—especially for the new enthusiast. The various British 405-line channels have been included to provide an accurate cross reference. An important point to remember is to allow for the sound-vision spacing. If you are using a modified 405-line receiver for example tuning to ch.E2 vision will give sound reception at 44·75MHz (ch.E2 48·25MHz vision minus 3·5MHz 405-line sound-vision spacing=44·75MHz). Consequently if you are within range of a ch.B1 transmitter the vision "buzz" can be used as a guide for ch.E2 vision. The same spacing applies for other channels as the receiver's i.f. is set.

From Our Correspondents . . .

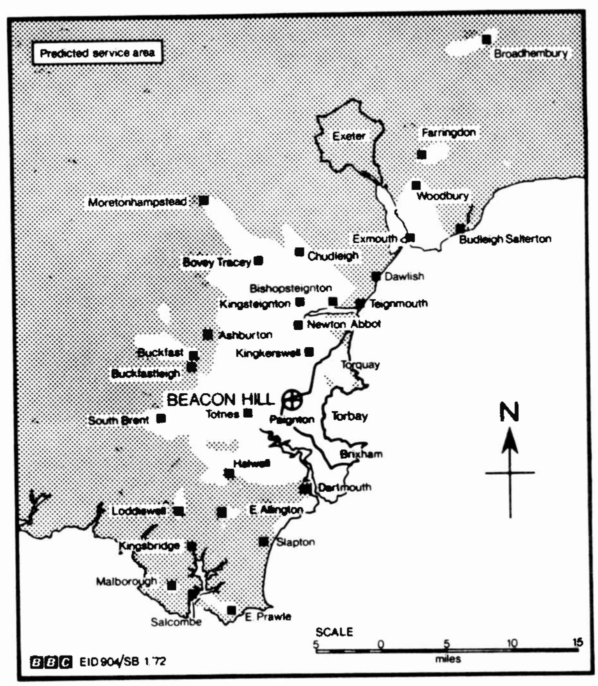
With thoughts of F2/TE reception in our minds it comes as little surprise to receive a few lines from George Sharples of Rabat, Malta. On March 18th he noted the checkerboard pattern on ch.E2 from 1330-1530. I feel that in view of the increased sunspot activity this could well have originated from Gwelo, Rhodesia—they use this pattern much of the time. The reception time confirms likely F2 propagation. We commented recently on the new transmitters being constructed in Greece—unfortunately for us in Band III!—and George has successfully received one on ch.E6. This is the first time to our knowledge that a Greek transmitter has been received at this distance and from our information it appears to be the one located at Pilion which recently increased its e.r.p. to 30kW. Located near the Agean Coast it operates on the EIRT Network—Hellenic National Broadcasting and Television Institute. The signals were noted from 1815-1900 local time on March 8th and there is no doubting the Greek lettering that George sketched for us! Changes have also been noted in the Libyan test card—once again the corner circles which apparently vary frequently. We hope to commence featuring the North African cards as soon as further and more detailed information is available.

David Bunyan of Sittingbourne, Kent has written detailing his reception from last October to the present. It seems from the list of transmitters received that this part of Kent is ideally located for tropospheric reception. Stations between ch.E21 and E62 have been received, some in colour. Antiference Hi-Gain u.h.f. arrays have been erected and by all accounts give extremely good performance. V.h.f. signals have also been around with West Germany received as far l.f. as ch.E2.

Clocks!

In a few columns' time the Intervision News captions will be complete. I am considering a short series on clocks used by the various broadcasters. Accordingly we would appreciate the loan of any *very good* photographs of clocks so that we can feature them for the benefit of all. We have good photographs of CST and DFF already.

BEACON HILL UHF SERVICES



The unshaded portion of the above map shows the expected service area. Channels: Fourth 53, BBC-1 57, ITV 60, BBC-2 63. Polarisation horizontal, receiving aerial group C, maximum e.r.f. 100kW. Map courtesy BBC Engineering Information Service.

YOUR PROBLEMS SOLVED

★ Requests for advice in dealing with servicing problems must be accompanied by a 10p postal order (made out to IPC Magazines Ltd.), the query coupon from page 379 and a stamped, addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets or answer queries over the telephone.

DEFIANT 900

The vision carrier suddenly appears on the sound and the picture also shakes—as with sound-on-vision. No adjustment to the controls however will remedy the fault which generally occurs soon after the set warms up. The fault is intermittent and more pronounced at some times than at others. It is present on both u.h.f. and v.h.f.—H. Chiltern (Nuneaton).

The EF183 common vision and sound i.f. amplifier 2V1 and the EF184 vision i.f. amplifier are suspect. If these are not at fault check the preset a.g.c. control 2RV1 and the three 0·47μF capacitors (2C3, 2C58 and 2C37) in the a.g.c. circuit.

McMICHAEL MT762

There is sound but no raster. The line timebase valves and the transformer have been replaced without bringing the raster back. When the e.h.t. lead is disconnected from the tube the timebase comes to life but goes dead again when it is reconnected.—T. Lamson (Malton).

If the line output stage is heavily damped when the e.h.t. lead is connected to the c.r.t. the EY86 e.h.t. rectifier is probably internally shorted. The only alternative is that the tube is drawing excess current which should be revealed by checking the voltages at pin 2 (grid) and 7 (cathode) of the tube base.

PHILIPS G23T210

The receiver came to us dead and was found to have a burnt out dropper. This was replaced and sound plus a good raster obtained, but no vision. The resistors in the feed to the i.f. strip, the vision detector diode and the video amplifier have been replaced, but still no vision.—R. Towers (Camberley).

If you are receiving u.h.f. sound all stages up to and including the video phase splitter T2188 must be operating. The fault would therefore be from the coupler (C2046) to the video valve PFL200 on. The voltages around the PFL200 should therefore be checked. If you are only receiving sound on v.h.f. the fault could be anywhere in the vision i.f. strip from T2187 on or in the video circuits. The only thing to do then is to make voltage checks to reveal the faulty stage.

GEC 2019DST

There is inadequate contrast even with the contrast control fully advanced—also the control is only operative on 625. There is a sound fault as well: a loud, high-pitched sound which over-rides any speech or music suddenly occurs and remains. It happens on all channels and can sometimes be cleared by rotating the fine tuner. All valves have been tested and found to be OK.—J. Tubman (Slough).

Insufficient contrast on this chassis is generally due to the 2·7MΩ resistor R52 which is in series with the slider of the contrast control going high-resistance. It is mounted on the nine-pin socket which terminates the leads from the control panel. The sound instability may be due to a faulty EF80 (V4) or PCL84 (V8) in the sound channel or a decoupling capacitor: in particular we suggest you replace C107 and C122 which decouple the supply to the screen grid (pin 8) of the EF80.

FERGUSON 406T

Although this set is old the picture is very clear. Recently however a linearity fault has developed at the top of the raster. The bottom of the picture is OK but there is a space at the top and below this the picture is cramped. The linearity controls will not open out the top of the picture.—F. Dixon (Oldham).

Top compression on this model is usually the result of the 470Ω field output valve cathode bias resistor increasing in value. Replace this then if necessary check the linearity controls and the associated components.

SOBELL T193

There are two pictures on the screen with a black bar about 2in. wide down the centre. If the line hold control is turned to nearly the end of its travel a full picture can just about be obtained but it keeps going back to the split picture.—R. Green (Worcester).

There is a coarse line hold control (P8) mounted behind the main control on the left-hand panel. Set the main control to approximately mid-travel then adjust P8 for a locked picture. If this does not do the trick replace the ECC82 line multivibrator (V11).

PYE RTL17

There is foldover at the bottom of the picture and partial cramping at the top. The height and linearity controls are at the limit of their travel, any movement of them merely reducing the size of the picture. The field timebase valves have been replaced and various components replaced without improving matters. The voltage at the anode of the triode section of the PCL82 is negligible although derived from the boost rail. The tube first anode voltage is also well down.—A. Saunders (Norwich).

The trouble is undoubtedly due to low boost voltage and we suspect a c.r.t. first anode leak. To check whether this is so disconnect the first anode lead: if there is a leak the full boost voltage should be restored by doing this.

BUSH TV76

It is impossible to get the line to lock on this set. The sync and line oscillator valves have been replaced, also the line hold control which was faulty. But no amount of adjustment of the main or preset line hold controls will lock the picture for more than a minute or so.—G. Summers (Glasgow).

We suggest you replace C31 which feeds reference pulses from the line output transformer to the flywheel sync circuit. This 0·005μF capacitor (1kV rating) is mounted on the tag strip below the flywheel sync discriminator diodes. Trace the lead from the diodes to the capacitor which is in series with two 47kΩ resistors.

EKCO T530

On switching on the picture and sound are good. After about ten minutes however a buzz on sound gradually comes through and gets louder as the set warms up—to a point where the sound distorts and is virtually blotted out. The trouble cannot be tuned out and the contrast control setting has no effect on it.—P. Ward (London, W.5).

The most likely cause of these symptoms is a heater-cathode leak in the PCL82 sound output valve which should therefore be replaced.

STELLA ST1007U

The set gives a good picture but there is vertical instability. This varies from complete lack of control to approximately mid-range stability. The trouble is almost always present. The only other trouble is the presence of transverse streaky black lines across the picture.—T. Royle (Coventry).

First check the value of the sync separator anode load resistor—this is R54 180kΩ wired to pin 6. Then check the valve—V13 ECL80. The electrolytics in the video amplifier circuit—C42 (100μF) and C76 (10μF)—should be checked for the streaking symptom.

INVICTA 538

There is lack of width on this 17in. set, the picture being in about three inches at each side. The screen grid voltage of the PL81 line output valve is low at about 120V (instead of 158V) and the boost voltage is also down.—C. Grant (London, S.E.26).

Replace the 2·2kΩ screen feed resistor (R75) in the line output valve circuit using a wire wound type for greater reliability.

GEC 2013

On switching on the picture and sound are normal and of good quality. After a while however the sound will roar out and the picture disappears. A series of dots on a dark background then appears on the screen instead, and often on varying the tuning a negative picture is obtained. By retuning and readjusting the line and field hold controls it is sometimes possible to get the picture back again after a few minutes, but the time varies up to an hour. When the picture is obtained again it remains until the set is switched off. The trouble occurs on all three channels. All likely valves have been replaced.—J. Dunwood (Gloucester).

The symptoms indicate a signal overload condition and that the fault is in the a.g.c. circuit. We suspect a leaky decoupling capacitor—either C68, C69 or C106 all of which are 0·22μF.

PHILIPS 11TG190AT

There is full scan and good picture and sound for about two hours with the set operating from the mains. Then the sound goes off and the raster becomes very dim and small, finally disappearing altogether although the timebase whistle can be heard. If the set is left for a few minutes and then switched on again the set works normally for about half an hour after which the fault conditions return. This does not happen when the set is operating from a battery.—J. Enright (Bolton).

It appears that the mains rectifier is failing. This consists of two bridge rectifier assemblies, type FSL2461A, wired in parallel.

McMICHAEL MP18

The sound is all right but the screen will not light up. The line timebase valves have been checked and the e.h.t. seems to be in order. On switching off at the set the screen lights up momentarily. The brightness control seems to be in order and the screen will light up if the tube grid and cathode are briefly shorted.—G. Down (Enfield).

You will have to check the tube base voltages. Pin 2 (grid) should vary from zero up to about 150V: check C124 (0·005μF) if the voltage remains at zero. The voltage at pin 7 (cathode) should be a little over 100V: if high check the PCL84 video amplifier valve which is d.c. coupled to the tube.

COSSOR CT1976

This set is fitted with the Philips Style 70 chassis and suffers from top compression. Disconnecting the linearity winding on the field output transformer stretches the centre of the picture to quite an extent. One of the things that is wrong is the cathode voltage of the PCL85, high at 20V.—J. Stuart (Rochdale).

As the cathode potential of the PCL85 is above normal first check that the bias resistance (R443+R444) measures 280Ω and that both resistors are present—one of them may have become detached or changed value as a result of excessive current. This may be due to a leaky coupling capacitor (C424) or faulty PCL85. It would be worth checking R448, the anode load of the EF80 section of the field oscillator, and R440 and C422 in the linearity feedback circuit. Unfortunately however the trouble could well be due to a faulty field output transformer.

PHILIPS 19TG155A

There is good sound and vision on 405 lines. On 625 however good sound or vision can be obtained but not together. Only poor sound and vision can be obtained together on 625.—G. Williams (Cardiff).

First check the aerial installation and make sure that the aerial is adequate. Then check the u.h.f. tuner unit valves. If necessary tune the 6MHz coil cores—L235, L201, L205, L206, L211 and L212—carefully with the tuner adjusted for best picture detail.

MARCONIPHONE 4621

When switched on there is sound but no picture or raster. If however the set is then switched on and off quickly the picture appears and the set operates normally—R. Pulson (Eastbourne).

It appears that the 6-30L2 line multivibrator valve is reluctant to oscillate. This could be due to the valve itself or to its h.t. feed resistor R46 (5·6kΩ) changing value.

BUSH TV135R

On 405 there is a good line whistle, raster and sound but no picture. On 625 there is just a raster with a dark patch in the centre. The PFL200 video valve has been replaced without making any difference.—P. Trafford (Stockton).

We are inclined to suspect the EF184 (2V3) which acts as vision only i.f. amplifier on 405 but vision and sound i.f. amplifier on 625. When this valve is faulty its anode/screen h.t. feed resistor 2R15 (3·3kΩ) is often damaged.

SWITCH-OFF SPOT ELIMINATION

The set is an HMV Model 2619 which has a very good picture—with plenty of brilliance and contrast control adjustment. The only thing that bothers me is a very brilliant spot which takes about 20 seconds to disappear after switching off.—E. Rosen (Romsey).

You will see that the earthy end of the brightness control is taken to chassis. If this is disconnected and wired instead to the neutral side of the on-off switch (the tag which is chassis connected only when the receiver is switched on) the residual spot will no longer linger provided the set is switched off with its on-off switch and not at the wall switch.

GEC 2001

The set operates all right on 405 but after about five minutes on 625 the picture becomes over bright. The PFL200 has been changed with no luck. — I. Evans (Brockley).

On 625 the PFL200 bias is determined by the ratio of R42 (1·2MΩ) to R43 (1·8MΩ). Replace R42 and try another PFL200 if necessary.

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TELEVISION JUNE 1972

TEST CASE

114

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

? A valve type Ferguson receiver exhibited severe horizontal instability over the whole picture, the raster appearing with extremely ragged vertical edges. This could neither be corrected nor altered significantly by adjusting the line hold control and no improvement was obtained by replacing the PCF80 and PL500 line timebase valves.

Oscillator circuit tests failed to reveal the cause of the trouble and attention was next directed to the line drive and the grid coupling to the line output valve. One test which can give an idea of the drive conditions is the presence of negative voltage at the control grid of the output valve. When this test was made the negative reading was found to be slightly higher than would normally be expected, but the main effect observed was that the picture immediately stabilised, though the horizontal scan amplitude was in error.

The set was a dual-standard model with the usual automatic line stabilising circuit. What was the most likely cause of this trouble and what was indicated by the stability resulting from the control grid test? See next month's TELEVISION *for the solution and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 113

Page 331 (last month)

One cause of the symptom referred to last month is interelectrode leakage in the picture tube (or "grid emission"). Another is incorrect biasing of the PFL200 video valve since the grid-cathode potential of the c.r.t. is partly determined by this.

After the more obvious tests described last month the knowledgeable technician would check the biasing circuit and it was here that the trouble was found. The lower cathode resistor is bypassed by a 320μF electrolytic which was a short-circuit! This of course increased the valve current, reducing the anode potential and thus the tube bias thereby making the picture excessively bright. The streaking on blacks was caused by the changed l.f. response conditions resulting from the fault.

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