TELEVISION

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

20p

OCTOBER 1973

EXTRA

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TELEVISION VOL 23 No 12 ISSUE 276

SERVICING·CONSTRUCTION·COLOUR·DEVELOPMENTS OCTOBER 1973

COLOUR FAULT FINDING

Now that colour television is a firmly established part of the British domestic scene, and the rental firms have trained their engineers to deal with the servicing problems, it is possible to stand back and take a look at the future from the service engineers' point of view.

The main point that strikes one is the question of servicing methods. It seems that the modern idea of a replacement printed board type of service operated by field "panel jockeys", backed by a second-line repair service at the works, is likely to fade out in favour of conventional on-site repairwork. There are several reasons for such a change, including the effect of VAT and the large investment that would be required to finance stocks of replacement modules for an ever increasing number of different chassis. It also seems that panel replacement can often involve additional setting-up work in order to get the replacement to operate satisfactorily with the rest of the receiver.

Followers of the TELEVISION Colour Receiver project will appreciate this latter point. Component tolerances, especially in semiconductors, can lead to the situation where the performance of one receiver differs notably from that of another of the same type. The problem is more acute with home-built receivers since the quality control and standardisation in manufacturing techniques found in a factory are not of course possible with "one-off" construction. It has also to be remembered that even highly automated assembly lines produce their share of "rogue sets".

It is only to be expected therefore that problems requiring some experience and knowledge to enable them to be sorted out can arise in constructors' sets. In this issue test figures and key waveforms for the Colour Receiver are given to help in this respect, while last month a detailed fault-finding guide to the i.f. strip was published (though you are advised to leave well alone if you have had your strip aligned by the Alignment Service). It is possible that minor amendments to individual sets will be needed to bring them into line, while the effects of different reception conditions have also of course to be taken into account.

Our centre pages this month feature a special colour television fault-finding chart which will be useful in tackling a wide variety of receivers, both commercial and home-built. This is the first time that a television magazine has provided such a service and we feel sure that readers will find the chart particularly useful to hang on their workshop wall.

M. A. COLWELL—*Editor*

THIS MONTH

THE NEXT ISSUE DATED NOVEMBER WILL BE PUBLISHED OCTOBER 22

Hold-over: We regret that due to shortage of space in this issue we have had to hold the next instalment of "Renovating the Rentals", covering the decoder circuits in the Philips G6 colour chassis, until the next issue.

TELETOPICS

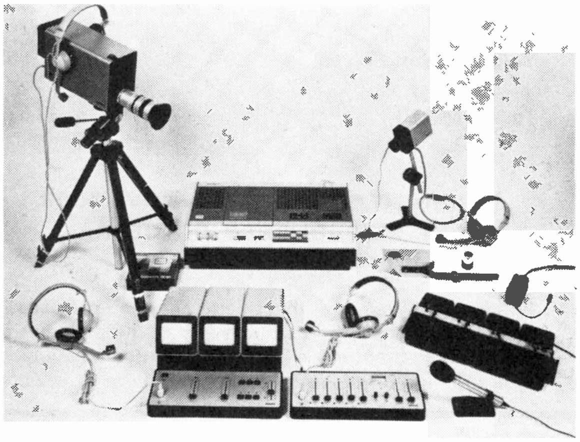
VCR AND MINI-STUDIO FROM PYE

Pye have announced two interesting new Philips products, the video cassette recorder type N1520 which can be used with a camera, and a group of items under the name "Mini-Studio" which provide a complete ready-to-use CCTV system for educational, industrial and amateur entertainment purposes.

The cassette recorder is fully compatible with all Philips video recorders and is in line with other continental brands. Attempts are being made to secure a common standard for operation and compatibility among most major continental countries under the I.E.C. classification, and to extend this to include Japanese equipment. We understand that the DIN European VCR standard is now established, with half-inch tape used.

The trend seems to be to omit u.h.f. or v.h.f. tuning circuits and provide facilities to record direct from the video signal stage. This enables the recorder to be connected to one common socket on television receivers or camera equipment, for use in studios as well as in the home.

The N1520 is classified as a "professional" recorder mainly for studio work and costs £750. It will take a European Standard video cassette that carries the VCR logo. This particular model does have an r.f. modulator so that recordings can also be played via a domestic receiver's aerial socket. Two-track dubbing and editing is provided so that it can be usefully employed in preparing educational or industrial training programmes in conjunction with the "Mini-Studio" equipment. It is designed to CCIR standards and the colour processing is to the PAL system.



The complete Mini-Studio, together with (centre rear) a Philips N1520 video cassette recorder.

The video socket takes a nominal 1V peak-to-peak input at 75Ω and chroma signals of 300mV peak-to-peak. The output is at the same level, but the chroma is at 270mV. Full details and technical specification can be obtained from Philips.

The "Mini-Studio" equipment shown in the accompanying photograph can be set up for use in 30 minutes by teenage children or adults, providing an inexpensive CCTV system for less than £1,500 (basic price excluding tax). It can be used with a videotape recorder—which costs from £150 extra—or for "live" performances. The equipment includes two cameras—one with electronic viewfinder—and various lenses (including zoom and standard microscopy), tripods, headsets, telecine, mounting rack with three 10cm monitors and a control unit (see below), microphone and audio mixer. The system can be used for example with a bench microscope, with class demonstrations carried out using large screen monitors.

The system conforms to CCIR waveforms. The control unit enables simple effects to be carried out: faders are provided so that when switching from one camera to another the picture from the first gradually dissolves into the picture from the second, while both horizontal and vertical wipes can be achieved and by combining them the picture from one camera can be made to appear as a corner insert. The audio mixer will cater for five channels, three for microphones. The vision mixer is three channel with mixing of two pictures, the third showing the output picture. The equipment is being handled by the Business Communications division of Pye.

FUTURE UK TV SERVICES

The Television Advisory Committee to the Minister of Posts and Telecommunications has now published the technical reports on which its recent recommendations were based. The committee recommends 1980 as the target date for the closure of the v.h.f. 405-line service. The v.h.f. bands could then be replanned, amongst the possibilities being a "maximum coverage" TV service consisting of either two programmes reaching 85 per cent of the population or a single programme using six channels to reach 99 per cent of the population, a "local" service to provide a large number of small population groups with their own TV programmes, extension of f.m. broadcasting or the mobile radio allocation or a combination of these various options.

On the subject of satellite TV transmissions in Band VI (11·7-12·5GHz) the committee says that four or five national programme channels would be a feasible proposition in the early 1980s. Individual aerial/converter assemblies for such a service would probably be more expensive than setting up communal reception/distribution systems.

NEW VCR RANGE

The American owned International Video Corporation is introducing in the UK its VCR100 series one-inch videotape cartridge recorders which are aimed at the professional studio market. The VCR101C offers recording and playback in monochrome and colour (PAL or SECAM colour systems) while the VCR111C is a playback only version. The cartridge contains a single 8in. NAB reel of tape, making the machines compatible with IVC reel-to-reel recorders. The tape is automatically threaded and anchored to the take-up reel in the machine.

There are two audio channels, with the option of a.g.c. One channel can be recorded after the rest of the tape has been recorded. Cartridges are available with 1, ½ or ¼-hour tape playing times and cost £25 each. At the end of rewinding the cartridge is automatically ejected clear of the mechanical drive. One particularly interesting feature is the ability to delay the display of the recorded picture so that picture disturbance due to sync searching after switch-on does not appear on the screen. These machines are not compatible with European VCR types. An editing version will be made available at a later date.

SOLID-STATE SENSOR

Fairchild have introduced in the US a 500-element charge-coupled device for imaging—we take this to mean that it is a solid-state sensor giving a video output signal. Applications include slow-scan TV, document reading and optical character recognition. This is understood to be the first charge-coupled device to be brought to the market—the one-off price is quoted as $1200.

TRANSMITTER OPENINGS

The following relay stations are now in operation:
Luton: BBC-1 channel 55, BBC-2 channel 62. Receiving aerial group C.
Hastings: BBC-1 channel 22, BBC-2 channel 25. Receiving aerial group A.
Weymouth: BBC-1 channel 40, BBC-2 channel 46. Receiving aerial group B.

The transmissions from these stations are vertically polarised.

AERIAL NOTES

We have received from R. Smith Aerials (98 Ash Road, Luton, LU2 9AX) a copy of the catalogue of their extraordinarily comprehensive range of TV and FM aerials and fittings. There are numerous wideband and fringe u.h.f. designs, the Zodiac range for example featuring a full-wave dipole, quadruple directors mounted on twin beams and an angled reflector. Wideband u.h.f. aerial kits are available for use with touring caravans, UK maps and charts being supplied with each kit. The catalogue contains helpful advice on aerial selection and use, including guidance on obtaining reception from two or more u.h.f. transmitters.

The new IVC VCR100 series of video recorders combines the user convenience of cartridge loading—insert a cartridge, close the lid and press a button—with the quality obtained by using a 1in. tape format as in conventional IVC studio-type recorders. Marketed in England and Wales by Bell & Howell A-V Ltd.

A new TV aerial system consisting of a 92-element lightweight beam, remote tuned masthead aerial amplifier plus optional aerial rotator unit is being introduced by Uni-Com Electronics Ltd. (36 Clarges Street, London, W1) for use in fringe areas or for receiving extra channels. Field tests have been carried out by Alpine Aerials who will be undertaking installations in London and the Home Counties.

LARGER TRINITRON

Sony have announced in Tokyo the successful development of a 27in. version of their Trinitron colour tube. The new version has a 114° deflection angle. Sony are at present selling Trinitron colour sets in the US in three sizes ranging from 5in. to 17in.

TRADE NOTES

The latest trade figures available, for May this year, show that at a time when there is said to be a build up of stocks of TV sets in the distribution pipeline imports continued to rise. Of 252,000 colour sets delivered to the trade in May (more than twice the number of monochrome sets delivered) some 29% (72,000) were imported. Taking the first five months of the year imports accounted for almost 25% of colour set deliveries in the UK. UK setmakers have now approached the Japanese television industry through BREMA requesting a cut in imports to half the current level. It seems however that recent currency realignments have already made the UK industry more competitive, while it is understood that output has now increased to a level sufficient to meet current demand. Thorn are continuing with their expansion programme, having recently acquired a new plant in Hull where subassemblies for their colour receiver plant at Bradford will be made.

ELECTROKIT'S NEW ADDRESS

Electrokit have moved to new premises at 8 Cullen Way, London, NW10.

110° COLOUR THE NEW RRI CHASSIS

T. JOHN

We were pleased to accept an invitation recently to attend one of the series of servicing seminars being held by Rank Radio International to introduce to the trade and servicing organisations the new Bush/ Murphy 110° colour chassis. It is a welcome thing indeed to see the trouble to which RRI are going to familiarise the trade with the technical details and servicing aspects of this new chassis in good time.

The chassis itself is a masterpiece in respect of making everything easy to get at. The whole thing can be dismantled into its component parts within a matter of minutes through a simple process of unscrewing, unclipping and unplugging. The aim has not been to divide the chassis into large numbers of separate, detachable panels but instead to group circuits logically and make them accessible for repair with the absolute minimum of fuss.

The first thing that struck us on examining the set was the absence of a degaussing shield, the degaussing coils resting against the rear of the tube bowl. Perhaps this had been left off in the interests of making everything readily visible for demonstration purposes? Not so however: the degaussing shield in the c.r.t. (Mullard) being used is actually built into the tube.

The tube of course is the key factor in the new chassis. RRI have decided to use the thick-neck rather than the thin-neck type of 110° tube, with Mullard Phase II circuitry. The following reasons were given for deciding upon the thick-neck tube: better purity which is more easily obtained; higher light output which is more even over the screen area; less subject to magnetic effects; requires less scan power than a thin-neck tube. To clarify this latter point, the line scan power required by both types of tube is much the same: the field scan power required with a thick-neck tube however is less than that required with a thin-neck tube using a toroidal deflection yoke.

RRI emphasise that no completely new techniques have been adopted and indeed much of the new chassis will be familiar to those acquainted with previous RBM chassis. Nevertheless modifications have been introduced and general updating undertaken while there are of course new field and line output stages, convergence and pincushion distortion correction circuits.

A varicap tuner operated by a touch-sensitive tuning unit (of the type described in our April issue —pages 250-251—this year) is used. The i.f. panel is very similar to that used in the RRI A816 monochrome chassis (Bush TV309 series), with three i.c.s. The signal passes first to a BF240 transistor which acts as i.f. preamplifier then via the response shaping circuits to the i.f. amplifier i.c. (type SC9504P) which incorporates a line-gated sync-tip a.g.c. circuit and also provides an a.g.c. output for the tuner unit. This is followed by a further i.c. (type SC9503P) which acts as a low-level synchronous detector and video preamplifier. The 6MHz sound signal also derived from this i.c. is applied to the third i.c. (type TBA750) which provides intercarrier sound amplification, limiting, detection and audio preamplification.

The audio output stage consists of a single BD181 transistor in a class A circuit, giving an output of 2W. The quality of the audio obtained from this stage is excellent and an external loudspeaker socket is provided. This is arranged so that the plug can be inserted either to operate the extension speaker only or both the external and internal speakers. The audio output transistor is protected against flashovers by connecting a v.d.r. (type E299DD/P336) between its collector and chassis.

The a.f.c. circuit along with the luminance, decoder and RGB output stages are all mounted on the main signal panel. The decoder follows previous RBM practice with most of the signal processing and detection carried out by two i.c.s (which are now unpluggable) and a passive subcarrier regenerator employed. A modification here however is the inclusion of a circuit to prevent a spurious subcarrier developed by noisy low-level signals on monochrome reaching the chrominance synchronous demodulators in the second i.c.

A new contrast control circuit, now linked to the colour control so that the two track together from the signal point of view, is used in the luminance channel. This is shown in Fig. 1. The arrangement is based on the four diodes 3D6-3D9. 3D7 and 3D6 form a shunt path for the signal to chassis via 3C24 while 3D8 and 3D9 form a series path to the base of 3VT4. Adjustment of the contrast control varies the diode biasing and thus the impedances of the two paths. As the contrast control is moved to provide a more positive potential 3D8 and 3D9 con-

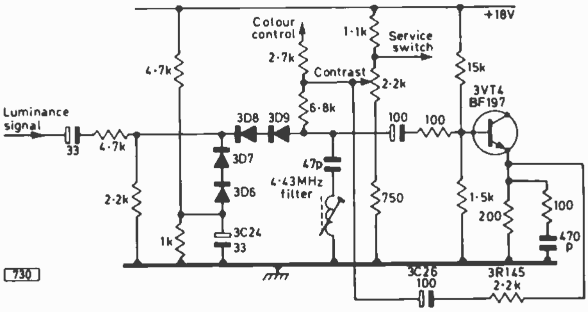


Fig. 1: Contrast control circuit. 3C26 and 3R145 form an anti-bounce network to prevent picture disturbance with rapid operation of the contrast control.

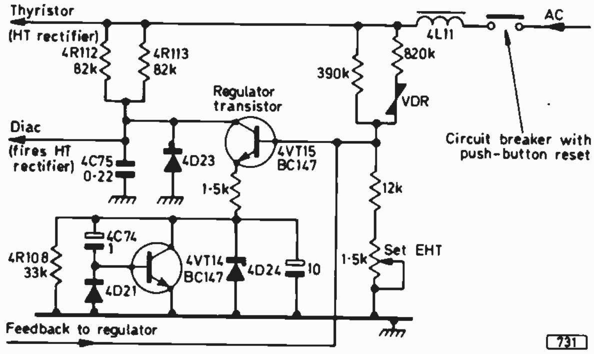
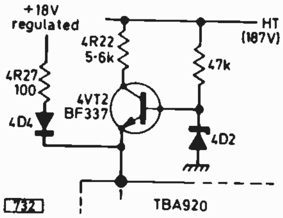


Fig. 2: Slow-start system in the power supply circuit.

duct more while 3D7 and 3D6 conduct less and vice versa.

The stabilised power supply circuit uses a thyristor and is basically the same as the circuit previously employed. Some detailed improvements have been added however including the use of a substantial choke in series with the thyristor to limit the peak repetitive current and a "slow-start" circuit to limit the initial switch-on current surge. The latter arrangement is shown in Fig. 2. 4C75 charges via 4R112 and 4R113 until the breakover voltage of the diac which fires the thyristor is reached, the charging of 4C75 being controlled by the action of the regulating transistor 4VT15. 4VT14 which provides the slow-start action is connected across the zener diode 4D24. When 4VT14 is conducting (at switch on) 4D24 is shorted and 4VT15 conducts heavily, delaying the charging of 4C75 and thus the triggering of the diac and thyristor. 4C74 is completely discharged on switching on so that a heavy current

Fig. 3: Line oscillator (TBA920) starter circuit: the supply to the TBA920 is from the h.t. line via 4VT2 until the line output stage comes into operation and the l.t. supply appears.



flows into it via 4VT14 base. As 4C74 charges so 4VT14 cuts off and the circuit then reverts to normal operation. On switching off 4C74 discharges via 4R108.

Another power supply modification is a circuit breaker with push-button reset. This removes the power to the receiver when the e.h.t. exceeds 28.5kV. More about this later.

A TBA920 i.c. is used as sync separator and line generator, with an external noise-canceller transistor in the input circuit of the sync separator section. The l.t. supplies are all derived from the line output stage in this chassis so the problem arises of how to start the line generator in the i.c. before the line output stage comes into operation. This is done by the line oscillator starter shown in Fig. 3. On switch on 4VT2 conducts heavily, providing the supply to the i.c. (pin 1) via 4R22 from the main h.t. line. Once the line output stage comes into operation the supply to the i.c. is via 4R27 and 4D4, the positive voltage at 4VT2 emitter then cutting it off. Zener diode 4D2 ensures that the reverse base/emitter voltage of 4VT2 is not exceeded.

The line output stage is shown in simplified form in Fig. 4. A single line output transistor (type 2SC1172E) is used, with the scan coils driven from

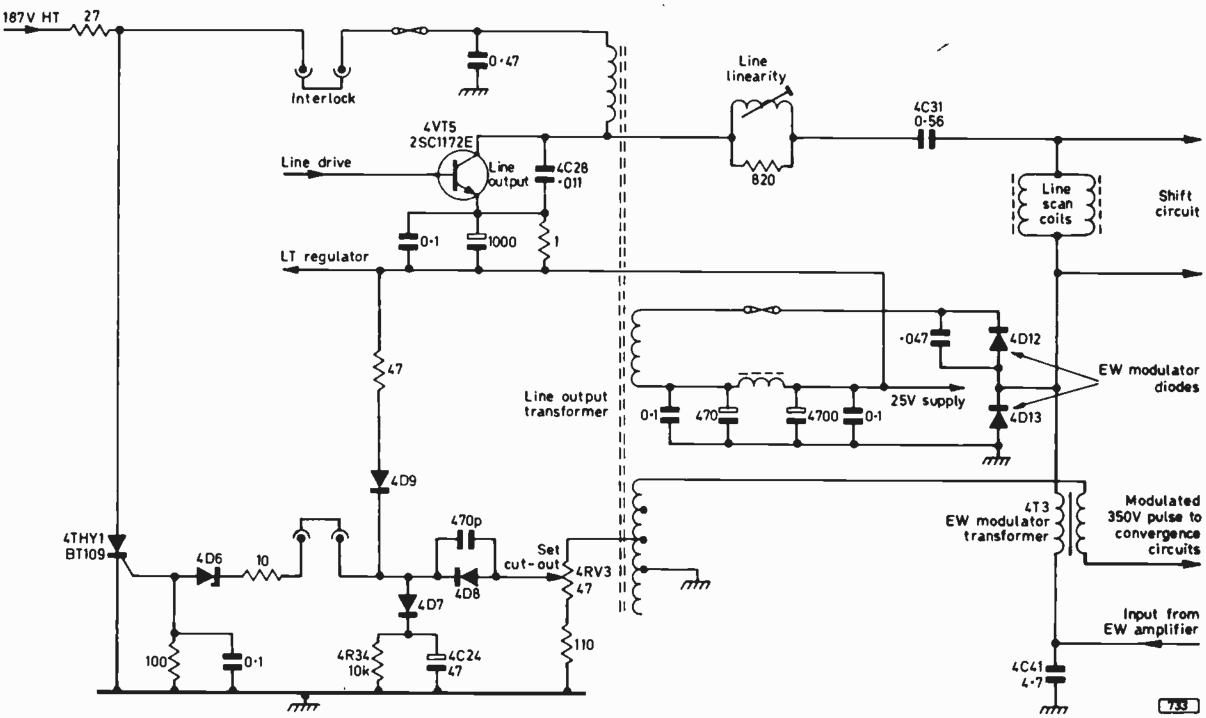


Fig. 4: Simplified circuit of the line output stage, showing the EW pincushion correction arrangements and the overvoltage protection system. The EW modulator diodes also provide the 25V supply.

its collector (via the linearity control and S-correction capacitor). The line output transformer is used primarily to tune the flyback pulse. Overvoltage protection is provided by the circuit consisting of 4RV3, 4D8, 4D6, the thyristor 4THY1 and associated components, switching off the receiver in the event of the line output transistor collector voltage rising by more than 25%. The set cut-out voltage control (4RV3) is adjusted to ensure that 4THY1 fires if the e.h.t. rises 25%. During normal operation the voltage produced by the protection rectifier 4D8 is lower than the zener voltage of 4D6, thus holding off the voltage from 4THY1 gate. Should the voltage produced by 4D8 exceed 4D6 zener voltage however 4THY1 fires and the contact breaker in the power supply (Fig. 2) opens interrupting the supply to the receiver. In addition 4D9 operates the protection circuit in the event of an excess voltage appearing on the l.t. supply. 4D7, 4R34 and 4C24 provide a transient overvoltage limiter to prevent the circuit breaker coming into operation in the event of a c.r.t. flashover.

The only thing the field timebase has in common with that used in the 90° RBM single-standard chassis is the use of a silicon-controlled switch as the field oscillator. In this new circuit the s.c.s. directly controls the discharge of the capacitor which generates the field scan waveform. The waveform produced by this capacitor is first amplified by a transistor stage whose gain, and hence the height, is controlled by variable emitter negative feedback. This is followed by a three-stage direct-coupled class A amplifier using a BD183 output transistor, with choke coupling to the scan coils.

Pincushion & Convergence Circuits

This brings us to the circuit features specifically new to 110° operation, the new pincushion distortion correction and convergence arrangements. It seems that a lot of development work has gone into these over the last couple of years as a result of which they are not nearly as complex as we had at one time been led to expect. In fact RRI say that convergence is easier to adjust than in their 90° chassis, with less interaction between the controls.

Getting a good linear display is important with a colour set and we were particularly impressed with the crosshatch pattern the receivers on show displayed. Separate North/South (top and bottom) and East/West (picture sides) pincushion correction is employed. Fig. 5 is included to help clarify what is involved here. To overcome pincushion distortion at the top and bottom of the display the field deflection current must be increased at the centre of each line in the upper and lower portions of the raster. This is done by superimposing small line-frequency currents on the field deflection current. A transductor is used for this purpose and operates on the same lines as the transductor used in 90° chassis for pincushion distortion correction. In addition a second harmonic component is added to straighten the lines at the top.

To correct pincushion distortion at the sides the line scan amplitude must be reduced at the start and finish of each field scan period. To achieve this the line amplitude has to be varied parabolically at the field rate. This is done by injecting a field-rate parabolic waveform in series with the line scan coils. A variable (by means of the E/W amplitude and keystone controls) combination of field-frequency parabolic and sawtooth waveforms is applied via a three-stage E/W correction waveform amplifier to the primary of the E/W modulator transformer 4T3 which is in series (see Fig. 4) with the line scan coils. The width control sets the bias applied to the E/W amplifier: in this way the line scan amplitude is varied linearly across the field scan.

The convergence circuits (Fig. 6) merit full description, being the first for use with 110° tubes that we have seen used by a UK setmaker. First, horizontal (line) convergence. Both the red/green and blue horizontal convergence circuits are shunt fed from the line output transformer, the convergence correction voltage waveform being modulated by the field scan (by 4T3) to give increased deflection sensitivity at the corners of the display. The operation of these circuits is based on double integration. The field-modulated line flyback waveform is first integrated by the primary windings of the red/green (5T1) and blue (5T2) amplitude transformers. Thus a substantially sawtooth waveform flows in these transformers. The second integration is performed by the horizontal convergence coils 7L9, 7L10 and 7L11 themselves. Resistors 5R2 and 5R3 provide tilt in the red/green circuit while 5R6 and 5RV3 provide tilt in the blue circuit. Diodes 5D1 and 5D2 across the red and green coils provide clamping so that static convergence is not disturbed when dynamic convergence adjustments are being made. Clamping is not required in the blue circuit: 5D3 across the blue tilt control provides waveform shaping, not clamping. The red/green differential amplitude coil 5L3 with 5R4, 5C3, 5RV1 and 5C6 form a damped resonant circuit to help shape the waveform. The coarse tilt facility is incorporated as part of each amplitude transformer to enable additional pulse voltage to be added if necessary at the bottom end of the convergence coils, giving coarse adjustment to the resistive tilt controls.

The blue lateral coils 7L7 and 7L8 require sawtooth and parabolic currents of either polarity. These are obtained from ±60V pulses derived from the line output transformer. These pulses are applied to 5L1 and 5L2. 5L1 integrates the pulses and feeds sawtooth current to the blue lateral coils, the polarity of the current being determined by the setting of the core. Adjustment of 5L1 also alters the amplitude of the current. 5L2 in conjunction with 5C1 and 5R1 supply parabolic current to the blue lateral coils, adjusting 5L2 core altering the polarity and amplitude of the current.

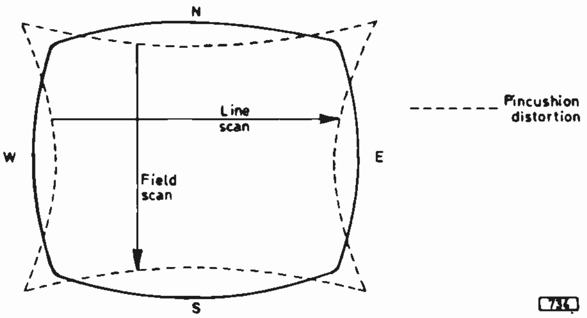


Fig. 5: Illustrating the pincushion distortion correction required.

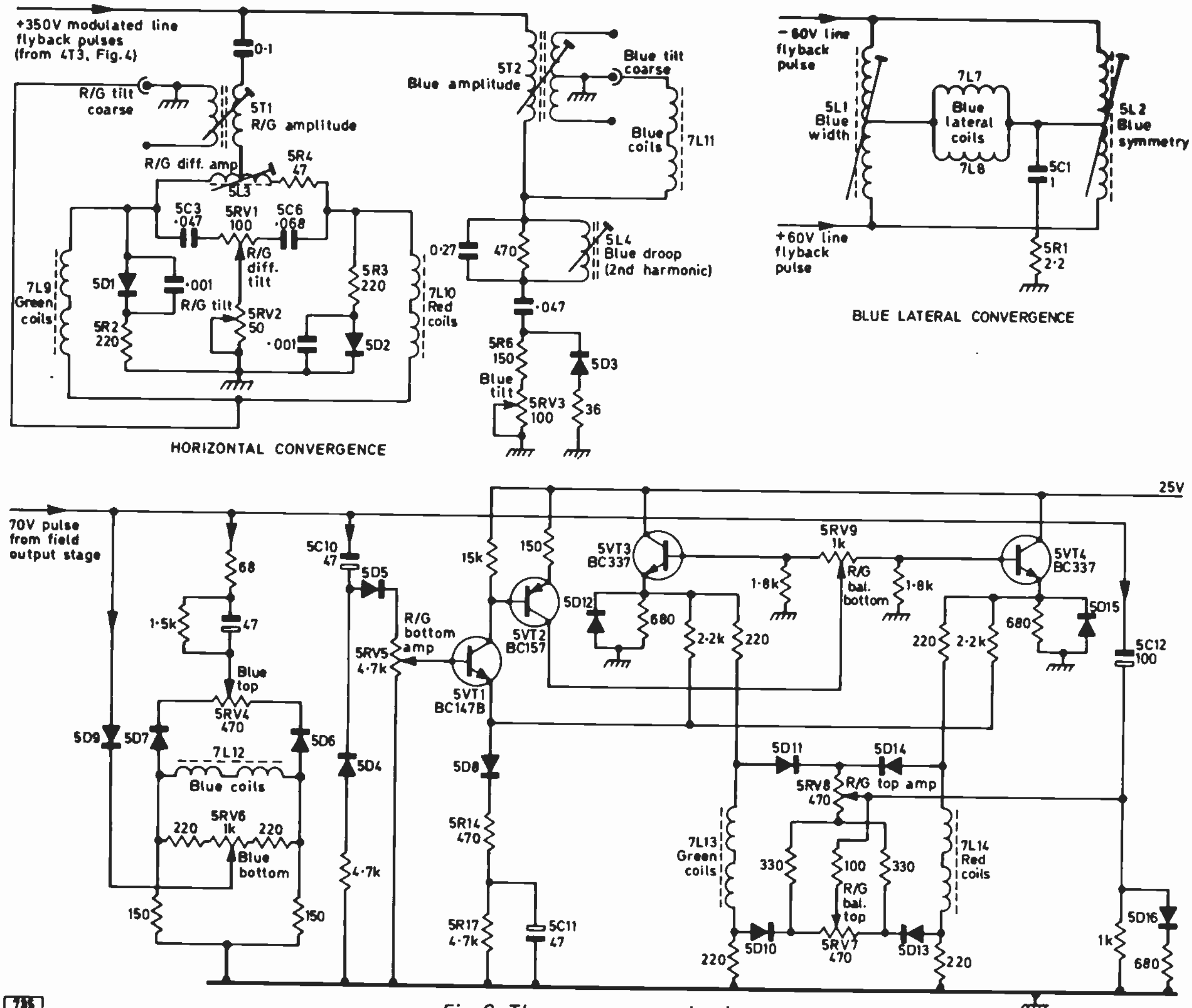


Fig. 6: The convergence circuits.

For red/green vertical (field) convergence a voltage derived from the field output transformer is applied to the red/green vertical convergence circuit in two ways. For the first half of the scan it is fed via 5C12 direct to the matrixing network (5RV8, etc.). During the second half of the scan it is fed via 5C10 to the clipper diodes 5D4, 5D5 and then to the base of 5VT1. The components in the emitter circuit of this stage provide shaping. 5VT2 inverts the resultant waveform and drives the symmetrical pair of emitter-followers 5VT3 and 5VT4. Diodes 5D12 and 5D15 bypass the field flyback pulses to chassis. The setting of the R/G bottom balance control 5RV9 in the base circuit of the emitter-followers interacts with the R/G top controls in their emitter circuits, though the opposite does not occur: for this reason vertical convergence at the bottom of the display is adjusted first followed by adjustment to the top part of the display.

The blue vertical convergence coils may require current of either polarity. This is provided by applying drive to each end of the coils (7L12). Again the bottom control affects convergence at the top so that the bottom is adjusted first followed by correction at the top of the display.

A service switch is provided to assist when making grey-scale and purity adjustments. In the down position a blank raster is obtained to enable purity adjustments to be carried out. In the up position a collapsed raster (horizontal line) is produced which can then be resolved into its R, G and B components to enable the tube first anode controls to be accurately adjusted.

This is the first UK produced 110° colour chassis for which detailed information has been released. The initial production models we examined gave good performance and the chassis is likely to be with us for some years. It will be interesting to compare this chassis with the TCE (BRC) 4000 and the Philips, Pye 110° chassis—due for release shortly—when details of these other new chassis become available. One thing the RRI chassis does prove: the vast complexities that had been forecast with 110° operation have been overcome, undoubtedly as a result of the development work that has been steadily going on during the last couple of years. ■

VARICAP TUNING SYSTEM

ROGER BUNNY

As regular readers will know the author has been active in the field of long-distance television reception for some years. Earlier this year I spent some time reviewing receiving equipment with a view to completely changing the system I was using. Quite by chance supplies of v.h.f. and u.h.f. varicap tuners became readily available so I decided to adopt these for the new receiving system. The initial prototype tried out gave most encouraging results and following this a design was evolved on the basis of which a further six units were made—four for v.h.f. and two for u.h.f.

These units have now been in operation for some time and have proved most reliable. There have been no problems save for that of accurately locating channel settings. Several new receivers have also been brought into use, adapted for being fed from the varicap units. Details of the modifications made to these receivers for long-distance reception will be given in a separate article in a later issue.

The v.h.f. and u.h.f. tuners used were obtained from Manor Supplies. The u.h.f. one is the Mullard ELC1043 for which a data sheet can be obtained from Mullard Ltd. A 12V supply, a tuning voltage variable over the range 0.3-28V and a variable positive voltage for gain control (a.g.c.) are all that is needed to operate the unit. Connections are shown in Fig. 1.

The v.h.f. tuner is a Philips unit and the only information I was able to obtain on it was that available from Manor Supplies. The supply circuit for it was designed on the assumption that its requirements were very similar to those of the Mullard type ELC1042. The connections are shown in Fig. 2—note that these are not quite the same as for the ELC1042. The only additional requirement for the v.h.f. unit is a 12V feed to provide Band I/III switching.

Further information on varicap tuners and their use is given in the following issues of TELEVISION: November 1971, October 1972, May 1973.

Circuit Details

The circuit (see Fig. 3) adopted to provide the power supplies is quite simple. An inexpensive Eagle mains transformer was available with two secondaries which when connected in phase provide an 0-48V winding. This is eminently suitable for giving the 30V required for the tuning line. A bridge rectifier (D1-D4) is used with the output taken via R1 to a split feeding the tuning voltage section and the 12V supply section. The latter is self-explanatory apart possibly for SW2 and R13: these are fitted on the v.h.f. units and serve to stabilise the current through the zener diode D5 on Band I, the current flow to chassis via R13 preventing the current through the zener rising alarmingly (the 12V Band switching supply at approximately 12mA is required on Band III only).

The maximum output obtained from the tuning voltage side of the circuit is 30V. The feed here is via the emitter-follower Trl (BFX85) with its associated components. The zener diode D6 holds Trl base at a constant voltage, the 6.8kΩ resistor R5 setting the zener current flow to chassis—in this case approximately 4mA. The use of this emitter-follower rather than a straight zener diode reduces the a.c. ripple to an absolute minimum and allows dissipation to occur in the regulator itself rather than in the zener diode—this in turn gives better overall voltage stability with variations in temperature. The value of C6 could in practice be reduced to 1,000μF if space in the box used to house the unit is limited.

Tuning

Tuning is carried out by means of the two carbon potentiometers VR2 and VR3. Since the graph of frequency change/tuning voltage (see Fig. 5) is not linear the use of a logarithmic potentiometer for coarse tuning is suggested in the interests of obtaining a more linear scale across the face of the meter when tuning. On the six units I constructed originally however linear potentiometers were used and al-

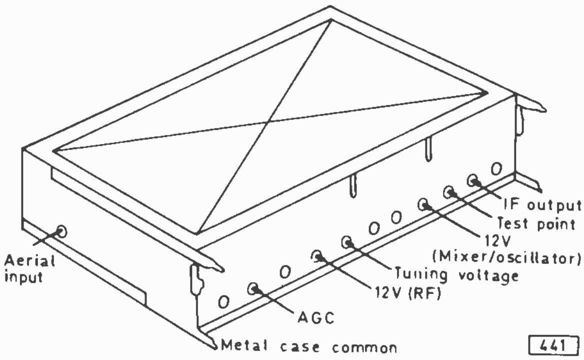


Fig. 1: ELC1043 u.h.f. tuner pin connections.

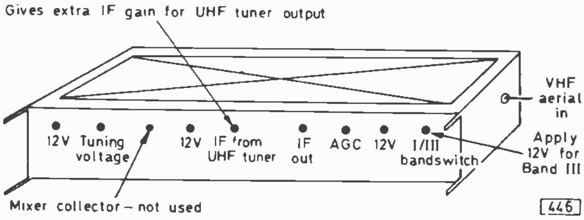


Fig. 2: Pin connections of the Philips v.h.f. varicap tuner available from Manor Supplies.

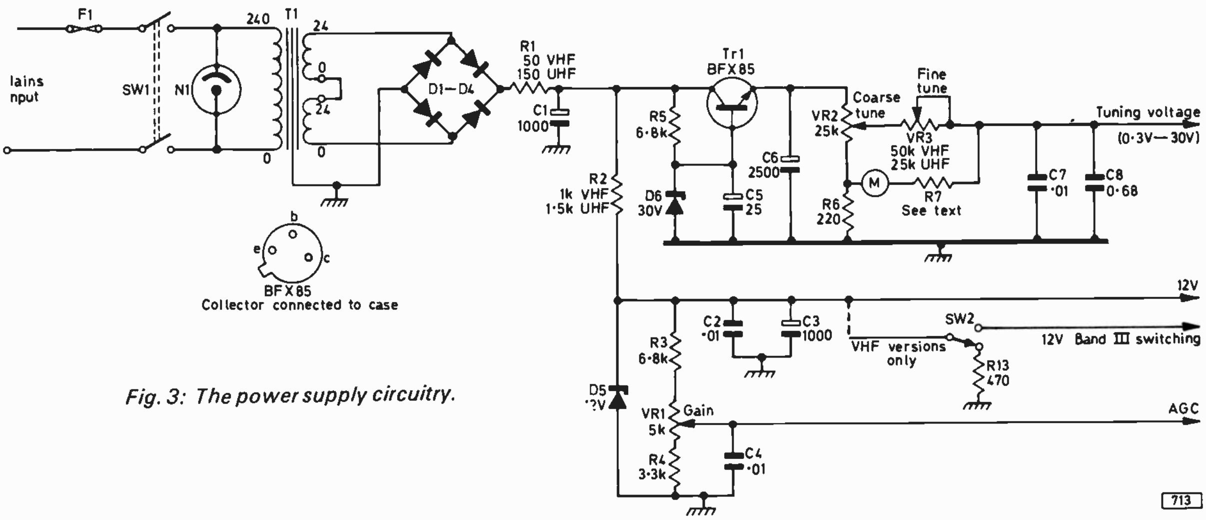
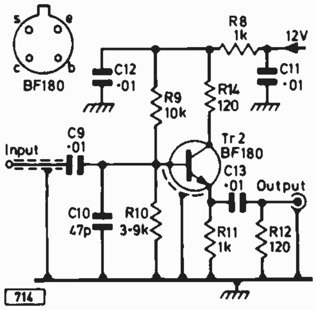


Fig. 3: The power supply circuitry.



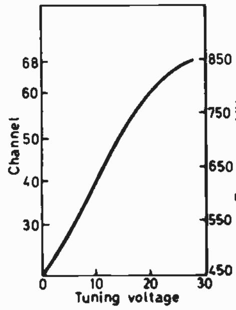


Fig. 4 (left): Emitter-follower used at the output.

Fig. 5 (right): Tuning voltage plotted against channel setting with a vision i.f. of 39.5 MHz—Mullard ELC1043 u.h.f. varicap tuner.

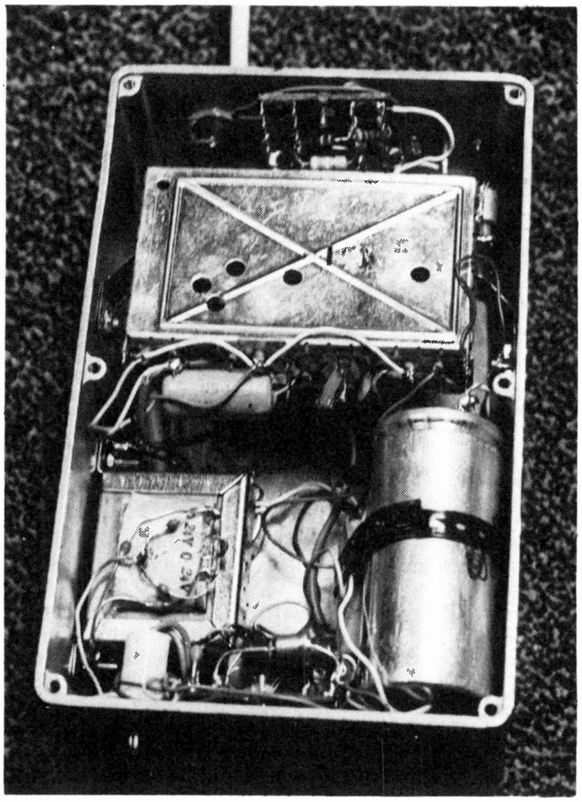
though scale cramping is evident with these the large meters employed allow great accuracy in tuning adjustments and ease in locating channels. This meter is an attractive 50μA movement of some 4in. width and fits extremely well into the Eddystone diecast box used.

Resistor R7 in series with the meter consists in fact of several resistors, the exact value being selected so as to give full scale deflection with a tuning voltage of 30V. In practice different values were used for each unit constructed. As a basis however fit a 470kΩ resistor as standard and then insert extra resistors as necessary to get the correct operating point. F.S.D. should be found with 470kΩ plus another series value between 82kΩ and 130kΩ. In all cases no more than three resistors were needed. A small adjustable (skeleton preset) resistor could of course be used to set the exact value but in the interests of long term stability and freedom from any slight tendency for the preset to move the use of separate fixed resistors is recommended.

The 0.68μF capacitor C8 fitted actually at the input connection on the tuner itself is essential since hum may be noticed without it. In addition a small 0.01μF ceramic capacitor is fitted across each of the input supply connections on the tuner body for absolute stability.

R1	150Ω* 5W W.W.	R5	6·8kΩ 2W	R9	10kΩ ½W	R12	120Ω ¼W
R2	1·5kΩ* 5W W.W.	R6	220Ω ½W	R10	3·9kΩ ½W	R13	470Ω 5W W.W.
R3	6·8kΩ ½W	R7	See text	R11	1kΩ ½W	R14	120Ω ½W
R4	3·3kΩ ½W	R8	1kΩ ½W				*R1 50Ω, R2 1kΩ, VR3 50kΩ for v.h.f. tuner.
10% carbon unless otherwise indicated.							
C1	1000µF 70V	C5	25µF 50V	C8	0·68µF 150V	C11	0·01µF 150V
C2	0·01µF 150V	C6	2500µF 50V	C9	0·01µF 150V	C12	0·01µF 150V
C3	1000µF 25V	C7	0·01µF 150V	C10	47pF 150V	C13	0·01µF 150V
C4	0·01µF 150V						
All small-value capacitors ceramic.							
VR1	5kΩ lin.	D1–D4	100V p.i.v., 1A	Tr1	BFX85		
VR2	25kΩ log.	D5	12V 1·5W zener	Tr2	BF180		
VR3	25kΩ* lin.	D6	30V 1·5W zener				
F1	Miniature fuseholder (RS)	M	50µA f.s.d. 4″ meter (Adastra T41)	SW1	DPST toggle (RS)	T1	0–240V pri.; 2×0–24V sec. (Eagle MT100)
		N1	Mains neon (RS)	SW2	Miniature SPDT toggle (RS)		

Eddystone diecast box (6357P, 7¼″×4½″×3″); 18-way miniature tagstrip; two coaxial sockets (Belling-Lee); 1 miniature mains input plug and socket (RS); knobs, etc.



Internal view showing constructional details.

To avoid detuning the i.f. output feed if varying lengths of coaxial feeder are used a simple emitter-follower stage (Fig. 4) using a BF180 is included between the varicap tuner i.f. output and the actual i.f. output socket of the tuning unit. This allows the varicap tuner i.f. output to be peaked exactly.

The values of R1 and R2 vary depending on whether the unit is for u.h.f. or v.h.f. use. The differences are because of the extra current required by the Band switching diodes in the v.h.f. version.

Construction

No problems should arise with the physical construction of such units, apart possibly from being able to incorporate the large smoothing electrolytics. In the units I constructed C1, C3 and C6 were strapped together using polythene cable strapping and then bolted against the wall of the box by passing a 6BA bolt through one of the holes in the strapping. The various components associated with the power supplies were mounted on half an 18-way miniature tagstrip which is mounted in turn on the inside of the front cover of the box. The other half of the tagstrip was used for the emitter-follower stage and the meter f.s.d. setting resistors. This tagstrip section is mounted on the inside of the rear wall of the box.

Commence construction by fitting the potentiometers and then working outwards. Fit the meter second to last and finally mount the tuner over this prior to wiring it into circuit. When working with the meter fitted it is advisable to tape some form of protective material over the meter face to avoid scratches etc. Prewire the tagstrips, with all components fitted, before mounting them in the box—the flying leads required for connecting to the main components should also be prefitted.

As brackets or other mechanical adornments are not supplied with the tuners a method of mounting them in the diecast box must be devised. The easiest solution is to cut two strips of tin, drilled to take a 4BA bolt at one end, the other end being soldered to the body of the tuner. This operation should be done carefully since an iron of at least 60W is needed to effect good jointing. Once soldered the strips (solder a similar strip on the other side of the tuner) can be adjusted to contact the walls of the box and an appropriate hole drilled in the box side. It is a wise move to solder a 4BA nut on to the tin strip to obviate problems later when mounting the tuner in the unit—one less hand then being required to bolt the tuner in place. Alternative layouts and mounting arrangements will undoubtedly suggest themselves to the constructor but these notes and the accompanying photograph show how the author tackled the problem.

For aerial isolation purposes a 470pF 750V working capacitor should be inserted in series at the point where the aerial input enters the wall of the unit.

Operation

Provided care has been taken over construction the unit should work immediately it is switched on! In my case one didn't, the BFX85 immediately blowing its base open-circuit. The fault was traced to a bead of solder beneath the slider connection of the main tuning potentiometer contacting to chassis (this couldn't be observed visually).

The value of 50kΩ for the fine tuning potentiometer is suitable for v.h.f. although even a 100kΩ one could be fitted. Whilst tuning over Band I the coarse tuning potentiometer should prove sufficiently accurate on its own since a tuning spread of only 30MHz is required. The fine tuning potentiometer is of greater help when tuning in Band III, the rough frequency being set with the coarse tuner and the fine tuner then being used to sweep to the exact frequency. I found however that even in Band III the coarse control is sufficiently accurate by itself. The fine tuning control comes into its own at u.h.f. where it is particularly helpful for sweeping to channels adjacent to strong local signals. A weak signal is often received at a dip in the i.f. response and the fine tuning control is particularly useful for finding this. The fine tuning potentiometer has a range of just over one channel at the l.f. end of the u.h.f. band—from about channel E23. Its range gradually extends at increasing frequencies until at the h.f. end it is possible to sweep three channels.

The stability of the units is good, there being no detectable drift after the initial warm up. I normally allow 25 seconds for warming up, this being the period during which the high-value electrolytics charge. The circuit then operates normally.

If any problem is experienced in obtaining the 4in. Adastra meters or RS components these can be obtained from Ian C. Beckett, 6 Bridge Street, Buckingham. An s.a.e. should be included with the list of requirements.

The author wishes to thank Barry Raynbird of Chandlers Ford for his assistance with this project. ■

Coping with ICs

PART 2

HAROLD PETERS

Intercarrier Sound ICs

All sound i.c.s are designed to give acceptable results at 4.5, 5.5 and 6.0MHz intercarrier frequencies. Most of them work equally well at 10.7MHz too. Alignment is straightforward. Tune the detector coil—be it a slope detector or quadrature coil—for maximum undistorted f.m. sound. The input circuit, which usually consists of a bandpass pair, is not easy to tune for maximum f.m. due to the limiting action of the i.c. It is best adjusted for minimum a.m. on a reduced signal.

TAA350: This is the original sound i.c. It is a simple limiter-amplifier using an external diode for slope detection. Some gave sibilants on sound, curable by biasing the detector diode on with a little d.c. or by reducing the *Q* of the detector coil. The latter course reduces output somewhat which is sparse enough at 200mV peak-to-peak. The TAA350 is no longer available: it has been replaced by the TAA350A which has its pins round thus:

TAA350 pin	=	TAA350A pin
1		8
2		9
3(E)		10(E)
4		1
5		2
6		3
7		4
8(N.C.)		5(N.C.)
9		6
10(N.C.)		7(N.C.)

TAA570: This is "almost" a TAA350 but has a built-in detector and audio amplifier. Its "works" were described and illustrated last month. Pin 4 can be used as remote volume control but usually isn't. Early TAA570s gave maximum volume with pin 4 shorted to chassis. Later ones reversed this, giving maximum volume with pin 4 open-circuit. These had an identifying white spot on the case. Later still the white spot was omitted. Moral: do not cut pin 4 off until you are sure which sort your set was wired for. Get some sound first. This i.c. can produce distortion when warm. Try retuning the quadrature coil, or reduce the pin 3 external load (nominally 4.7kΩ). Output about 1.5V p-p for 50kHz deviation.

TBA120: A 14-pin QUIL package widely used in Europe. Available in many brand names. A reliable i.c.

TBA480: This is a 16-pin QUIL replacement for the TAA570. A nice reliable i.c. with about 1.2V p-p output for 50kHz deviation.

TBA750: The current sound i.c. Capable of driving a pair of output transistors directly to get over 2W output. Reliable.

SAA570: Plessey version of the TAA570. Interchangeable.

Zener ICs

Zener i.c.s are two-legged devices designed to stabilise the 30V line used for channel selection with varicap tuners. Most brands come in three voltage selections: 31-32V, 32-34V and 34-35V. This need not concern you unless you live in an area where the u.h.f. channels are 60 or higher: some tuners need the higher voltage selection to give adequate tuning at this end of the u.h.f. band.

TAA550: This is metal cased with the case at 30V. So if you feel like fitting a heatsink ensure that it is isolated from chassis. The voltage ranges are denoted by a coloured dot: red low, yellow medium, green high. These seldom go short-circuit, but can be blown open-circuit by 30V line surges. The symptoms are peculiar, being akin to a.g.c. lockout. On closer observation the tuning is seen to vary with picture content.

SN76550: Texas version of above with similar colour dot coding. Pin 2 may need removing on some sets.

ZTK33: A similar device from ITT, with the voltage selection alphabetically coded—A low, B medium, C high.

ICs for the IF Strip

TCA270: An i.f. demodulator using synchronous detection and supplying positive- and negative-going outputs. The negative-going output usually goes to the sync separator whilst the positive-going one is used for luminance and chrominance outputs. Two a.g.c. voltages are available, with their crossover level adjustable, and a.f.c. control is provided for varicap tuners.

Alignment is by adjusting the "tank" circuit (the same as a quadrature coil in a sound i.c. circuit). It is set for best response with a squarewave modulated on to an i.f. carrier. Experience indicates that a broadcast test card may be good enough for the purpose, but since the tank coil and its neighbouring a.f.c. coil are interdependent no risks should be taken this early by inveterate twiddlers. E.H.T. flashovers can kill these i.c.s off (raster but no snow, faint hiss in loudspeaker). Replacement doesn't involve realignment.

MC1330P: I.F. demodulator (synchronous) plus video preamplifier from Motorola. Used by BRC, RBM, Decca. In 8-pin DIL pack. Provides negative- and positive-going video outputs, also a.f.c. output.

MC1352P: I.F. amplifier i.c. from Motorola incorporating its own gated a.g.c. system. For use in vision

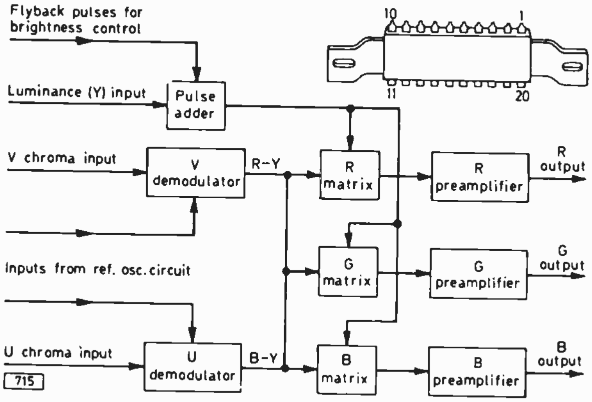


Fig. 1: Block diagram of the SL901 chrominance demodulator and matrixing i.c. used in Bush/Murphy models.

i.f. strips. In 14-pin DIL pack. Used in some chassis to partner the MC1330P.

Jungle ICs

Jungle i.c.s are so called because of their circuit complexity. They fulfil the functions of video pre-amplifier, noise limiter, sync separator, i.f. and tuner a.g.c. generator, line flywheel sync detector, field interlace detector and video blanking. It is possible for one section of these i.c.s to fail without stopping the rest.

TAA700: The first QUIL 16-pin package and the only one you cannot easily fit the wrong way round. Can be the cause of your field trouble; or can upset a.g.c. crossover if the two a.g.c. outlets short internally, giving more "snow" than usual. If pulses from the line timebase are missing the i.c. reverts to direct sync and ungated a.g.c.

TBA550: This is the zig-zag QUIL replacement for the TAA700. The pin numbering is identical and as some printed circuit boards are pierced to take either there is qualified interchangeability. The TBA550 is more liable to chassis current feedback, to the extent that the Pye group 169 chassis at the changeover to using this i.c. had to split the metalwork at the chassis to remove an earth loop.

SBA550: Plessey interchangeable version of the above. Pinning identical.

ICs for Colour Decoding

SL901: This Plessey i.c., widely used in RBM colour sets, has 20 pins and a heatsink that bolts to chassis for maximum dissipation. U (B−Y) and V (R−Y) signals from the decoder delay line circuit are synchronously demodulated in this i.c., matrixed to produce the G−Y signal and then further matrixed with the Y signal to give R, G and B drive outputs. See Fig. 1.

TBA500: Luminance amplifier, with black-level clamp and beam limiter control.

TBA510: Chrominance amplifier with burst blanking and separate burst output.

The above pair of i.c.s is found in imported sets. The TBA560 supersedes them, saving an i.c. at the expense of extra peripheral circuitry.

TBA520 and TBA990: These are colour demodulators of successive generations. They incorporate the PAL switch and synchronously demodulate the U and V

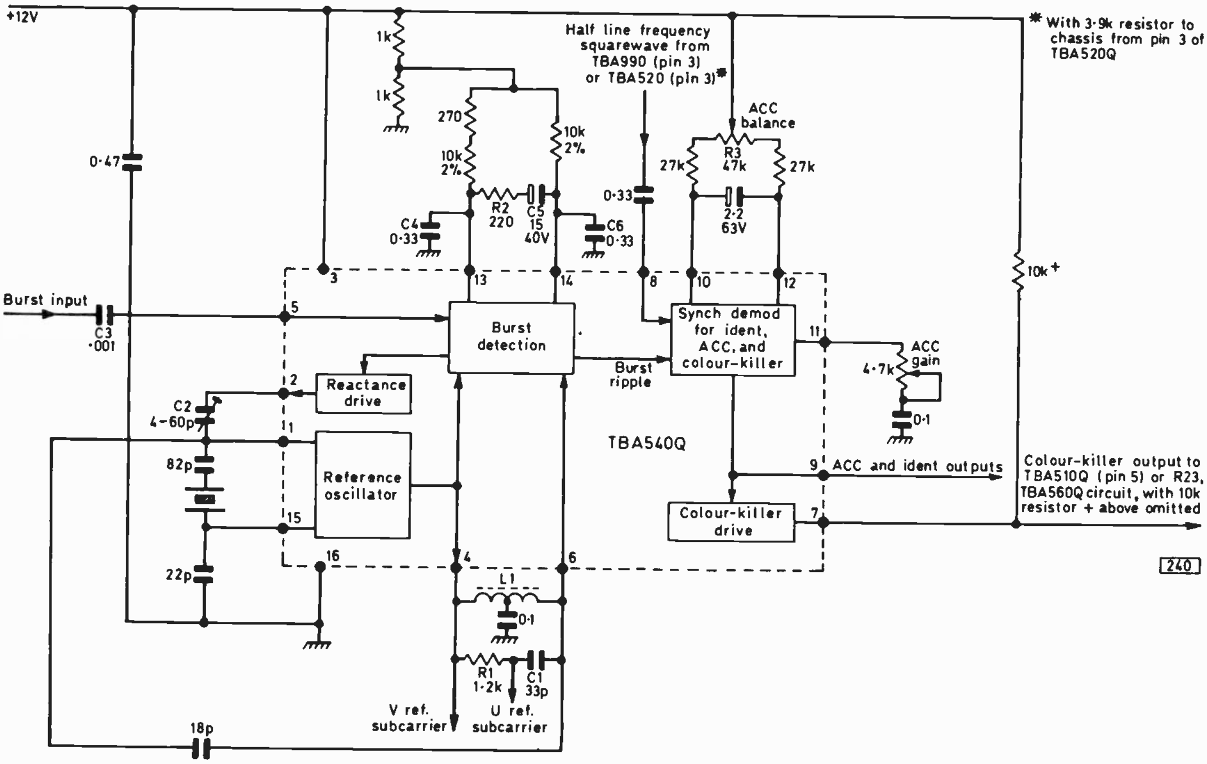


Fig. 2: Block diagram together with peripheral circuitry for the TBA540 decoder reference oscillator i.c.

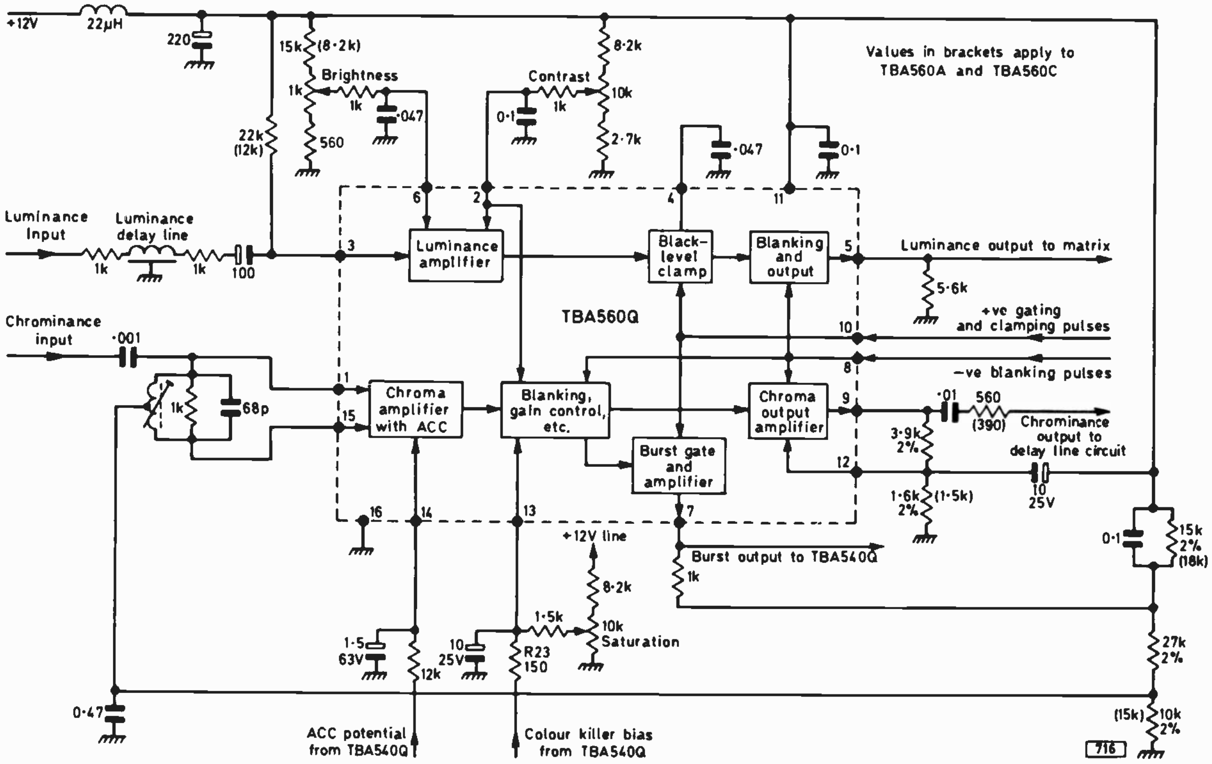


Fig. 3: Block diagram together with peripheral circuitry for the TBA560 series of chrominance i.c.s.

chrominance signals, at the same time matrixing G−Y from the resultant R−Y and B−Y outputs. The TBA520 works reliably in the Philips G8 chassis. The TBA990 is too young to have developed its character yet but has a very keen bistable which switches back at the least provocation, giving an asymmetric bistable output and shutting down the chrominance channel of the four i.c. decoder of which it usually forms part (more anon!).

TBA530: A simple matrixing i.c. It accepts R−Y, B−Y and G−Y outputs from a TBA990 or TBA520, adds Y and derives R, B and G outputs. The high gain per channel enables its performance to be linearised by feedback from the external output transistors. D.C. coupling is maintained throughout so that black-level clamping on each colour may be set right back at the demodulators.

TBA540: The reference combination for a decoder. It generates the 4.43MHz reference subcarrier and locks it to the burst of the incoming signal. The burst ripple produced in the i.c. is compared with a half line frequency squarewave from a TBA520 or TBA990 in a synchronous detector to produce a colour killer switch voltage and an excellent a.c.c. (automatic chrominance control) potential capable of holding the colour level over a 26dB range. This a.c.c. is fast acting and is capable of rapidly rising to a sufficiently high voltage when the detector is "out of step" to hold the bistable in the TBA520 or TBA990 for one line until it is in step again—this feature replaces the entire conventional ident circuit. Bad habits? Sometimes the odd i.c. will hang up at the end of a monochrome programme so that colour is not restored until 4 or 5 seconds late. Not as reliable as some other i.c.s. See Fig. 2.

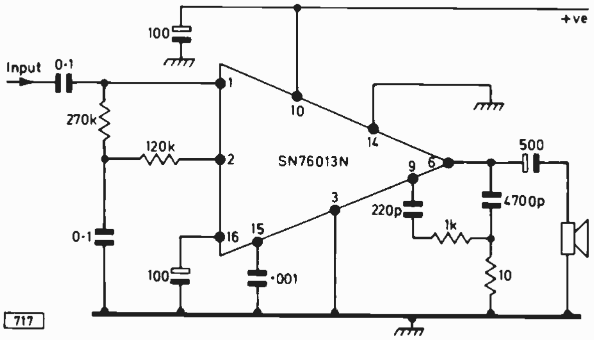


Fig. 4: Typical peripheral circuitry for the Texas SN76013N audio output i.c.

TBA560: A single i.c. to replace the TBA500 and TBA510. Extremely sensitive, needing only a few millivolts input for full output. Becoming obsolescent. See Fig. 3.

TBA560A, TBA560B and TBA560C: These improved versions of the TBA560 have the same pinning and general characteristics but need bias changes on some pins (see Fig. 3) to give the correct outputs. An improved a.c.c. range apparently alters the ratio of chrominance and luminance, but there is still adequate chrominance output to drive fully the following circuits. The TBA560A is an interim type while the TBA560B is customised for a European user: we shall probably encounter the TBA560C as the final development in use here. Although only just available the TBA560C appears to interchange with the A version without having to change circuit values.

—continued on page 555

FAULT FINDING GUIDE

7 John Law

TIMEBASES: PHILIPS 19TG158A SERIES

The sets in this series, sold mainly under the **Philips, Stella** and **Cossor** brand names, frequently appear in the workshop. Not, I hasten to say, because it is a bad chassis but because of the large number of sets sold. Far from being of poor design in fact the chassis has several unusual safety features. Apart from the usual fuse in the mains input circuit there is a 150mA fuse in the i.f., tuner and field timebase h.t. circuit and a 250mA fuse in the line timebase and sound h.t. circuit. In addition to these three fuses there are eight 1W drop-off resistors which are soldered to the underside of stand-off tags: should a fault cause excessive current through any of these resistors the solder will melt so that the resistor(s) concerned will drop from the tags thus breaking the circuit. This can prevent a serious printed panel burn-up. It also gives an immediate indication of the area of the fault.

The models in the series were fitted with 19 and 23in. tubes and originally the u.h.f. tuner was an optional extra. The common Philips Models 19TG158A, 19TG164A and 23TG164A, the Stella ST2029A and Cossor CT1974A have transistor u.h.f. tuners while the earlier Philips 19TG154A and 19TG156A together with the Stella ST2123A, ST2113A, ST1093A, ST1099A and ST2149A have valve u.h.f. tuners.

When the cabinet back is removed right- and left-hand printed panels mounted vertically in a metal frame are revealed. The space between the panels is occupied by the mains dropper sections at the top, the c.r.t. base below and a box below that secured to the bottom of the metal frame and containing the line output valve and transformer, boost diode and e.h.t. rectifier. Each panel has a system switch mounted vertically on it. The right-hand panel contains the i.f. and video valves and components while the left-hand panel is the timebase section. The tuner units are fitted to the left of the chassis frame with the knobs protruding through the front of the cabinet. Below the knobs are the system change buttons.

This article is concerned with fault finding in the field and line timebases. The circuit of these is shown in Fig. 1 while Fig. 2 shows the layout of the timebase panel. There are four valves on the panel, an ECC82 at the top, another ECC82 below it, an ECL80 below that and at the bottom a PCL85.

The pentode section (V401b) of the ECL80 is the sync separator. From the anode of this valve line sync pulses are fed to the grid of the line sync pulse amplifier/inverter triode V403a through R401/C401 and R403. The field sync pulses are integrated through R446 and C433 and applied to V401a grid. V401a in conjuction with the triode section of the PCL85 forms the field multivibrator, the cross-coupling capacitors being C430 on one side and C432/C431 on the other. The field charging capacitor C429 charges via R438 and the height control R439 to give the forward scanning stroke and is discharged via V402a when this valve conducts briefly once each multivibrator cycle to give the flyback stroke. The field signal thus produced drives the field output pentode V402b which in turn feeds the field scan coils via the field output transformer L106/7.

Returning to the line timebase, positive going sync pulses are fed from the anode of V403a via C402 to the anode of V403b the flywheel sync phase comparator valve. Reference pulses from the line output transformer are fed via C404 and the integrating network R410/C403 to V403b grid. The resultant d.c. potential at V403b anode is filtered and used to control the line oscillator. This consists of another double-triode multivibrator, V404 (the other ECC82). The cross-coupling capacitors here are C407 and C408. The control voltage from the flywheel sync circuit controls the time-constant of V404a grid circuit—this is basically set by the hold controls. Note that the drive voltage applied via C410 to the control grid of the line output valve is taken from the anode of the a section of V404. The line output stage itself is conventional, with V500 (PL36) the line output valve, V501 (PY800) the boost diode and V502 (DY87) the e.h.t. rectifier. The boost capacitance consists of the two capacitors C415 and C416 connected in parallel. It will be seen that there are no flywheel line sync discriminator diodes, their function being performed by V403b: this valve has proved more reliable than the usual diodes but can nevertheless cause weak or complete loss of line sync.

Fault tracing and component replacement on this chassis is not difficult: the removal of two bolts at the top of the metal frame gives access to the rear of the panels while clips above the panels release them to the extent of the leads. The box containing the line output transformer and associated valves can be taken out complete after two bolts at the bottom of the frame have been removed. The only problem is to ensure that the print behind the upright panels is clean and free from dust so that it will solder well: a toothbrush with some Thawpit together with a dentists's mirror are useful for cleaning and inspecting completed joints.

The drop-off resistors are a great help in locating

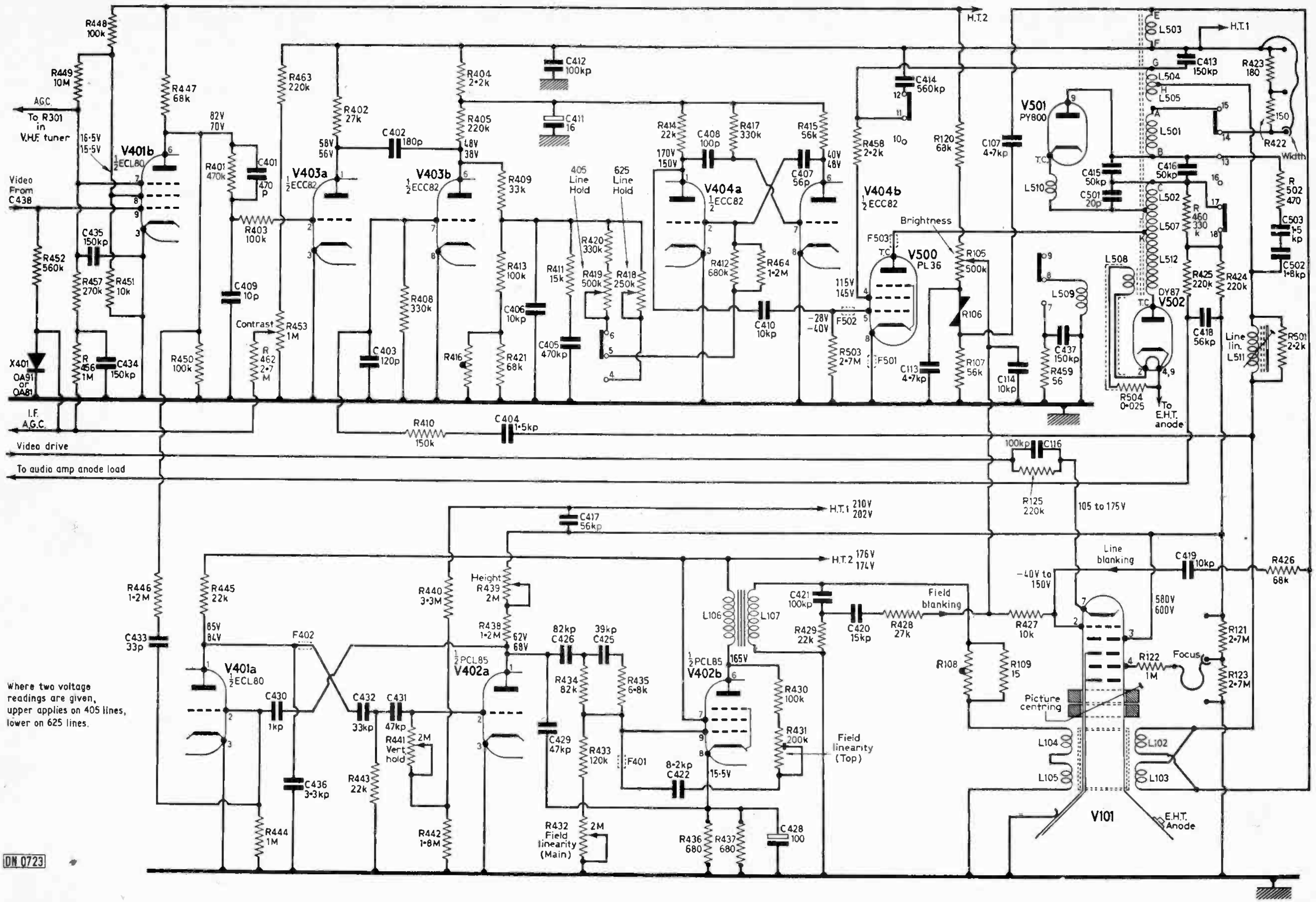


Fig. 1: Timebase circuits used in the Philips 19TG158A series. Switches in 405-line position. Voltages measured with 100kΩ/V meter

a faulty circuit. Their functions are as follows:

R200 (470Ω) is in the h.t. feed to the u.h.f. tuner.
R201 and R201a (both 3.3kΩ) in parallel are in the feed to the v.h.f. tuner.
R223 (390Ω) forms part of the sound output pentode cathode resistance.
R254 and R255 (both 3.9kΩ) in parallel feed h.t. to the video output pentode (PL83).
R436 and R437 (both 680Ω) in parallel comprise the field output pentode cathode resistance.

If there is excessive current in the PCL85 pentode section, as a result of an interelectrode short for example, R436/7 will be over-run melting the solder so that they fall to the floor of the cabinet. Their presence there immediately indicates a fault in the field timebase therefore. Before resoldering any of the drop-off resistors it is essential to find and clear the fault. If the resistors are discoloured or have changed value fit new ones.

From the above it will be obvious that the first step in fault location on this chassis should be inspection of all the drop-off resistors. If all are in position check the three fuses. The 1.5A mains fuse FS100 is beside the voltage adjustment panel and protects the heaters, the h.t. rectifier and main smoothing electrolytics. Failure of the 250mA fuse FS202 located at the top right-hand corner of the i.f. panel will leave the heaters alight but no sound or vision since it controls the h.t. supply to the line timebase and the audio amplifier (V203 triode section). Any momentary arcing in the boost diode or line output valve will blow it. The 150mA fuse FS201 is located on the left of the i.f. panel and controls the power supply to the field timebase, the i.f. stages and the tuner units.

In dealing with field timebase troubles the valves should always be the first suspects. Remember that in this chassis there are two valves involved, the triode section of an ECL80 as well as the usual PCL85.

The field output transformer can cause a number of faults in this chassis. One is slight foldover at the top of the picture with the BBC-1 test pulse in the field blanking interval visible on the screen: in some cases the foldover is steady, in other cases intermittent. Low field amplitude with good linearity has also been traced to the field output transformer, as has creeping at the top of the raster with a 3in. gap at the bottom. The defective transformer cannot be repaired, replacement is the only answer.

In cases of low height however, first replace the PCL85 then check the value of the 1.2MΩ resistor R438 in series with the height control. This increases in value over a period of time to give lack of height.

Bottom cramping may be due to loss of capacitance in the pentode cathode decoupling electrolytic C428 (100μF). Similar symptoms are caused by failure of C422 (0.0082μF) in the linearity feedback network or C426 (0.082μF) in the coupling circuit.

Loss of height with low brightness has been traced to C417 (0.056μF) and R424 (220kΩ) which smooth the boost feed to the height control.

Poor linearity should lead to a check of the components in the linearity circuits (anode to grid and grid to chassis of the PCL85), particularly the miniature preset potentiometers (R431 and R432)—dead spots and breaks in the tracks of these components account for many linearity faults.

Complete field collapse (horizontal white line) may be caused by failure of the field multivibrator. After checking the valves check the cross-coupling capacitors. A break in the track of the field hold control potentiometer R441 will also cause this fault.

Spasmodic height variation can be difficult to trace. Valves and potentiometer tracks should be checked first and if cleared individual components on the printed panel measured for value changes and prodded for dry-joints or internal breaks until the offending item shows up. Don't forget C421 (0.1μF) across the secondary of the field output transformer and R108/R109 which are in series with the field coils.

Loss of width is a common complaint and is usually cured by replacing the PL36 line output valve. It can also be caused by loss of emission in the PY800 boost diode.

If the line cannot be locked and the hold control is at one end of its track change over the two ECC82 valves at the top of the printed panel. This will often effect a cure as the line oscillator ECC82 (V404) operates under more stringent conditions than the line sync ECC82 (V403): replacement of the V404 ECC82 is of course the long term solution in this case. If the fault is confined to 405-line operation check the value of R420 (330kΩ) in series with the 405 line hold control. Another cause of lack of line locking is change of value of R402 (27kΩ). A case of ragged verticals developing some time after switching on was traced to the v.d.r. R416 being faulty—as a check it can be replaced by a 100kΩ resistor.

Loss of line drive to the PL36 can be caused by R420 going open-circuit. An open-circuit R417 (330kΩ) will also kill the drive voltage. This is the grid return resistor of V404b and is taken to the h.t. line instead of to chassis. A decrease in its value will give weak line hold with the control at one end of its track: the clue to this fault is a drop in V404b anode voltage of about 10V.

If the line oscillator goes out of lock when changing channels inspect and clean the system switch—poor contacts can give this symptom.

If there is no raster but the drive voltage is present at the PL36 grid the cause may be failure of the screen grid resistor R458 (2.2kΩ). If this component is OK however remove the top cap of the PY800 boost diode: if this results in an increase in the timebase whistle first suspect the boost capacitors C415 and C416. Then suspect the line output transformer which unfortunately often proves to be the faulty component in this chassis.

Should a picture of low brightness level balloon and disappear when the brightness control is turned up the cause is probably the e.h.t. rectifier V502 (DY87). There is however a resistor (R504) in series with its heater. This can increase in value, lowering the heater voltage and giving the same symptoms. Its value is 0.025Ω and a replacement must come from the manufacturers. The layout of the line output section box is shown in Fig. 3.

One case where repair of the line output transformer was possible occurred with the complaint of normal picture on 625-line operation but no results on 405 lines. The customer had forgotten to mention that there was no sound either. A voltage check soon revealed that there was no h.t. voltage at the anode of the PY800 boost diode. The supply on this system is via the width resistors R423 and R422, contacts

—*continued on page 557*

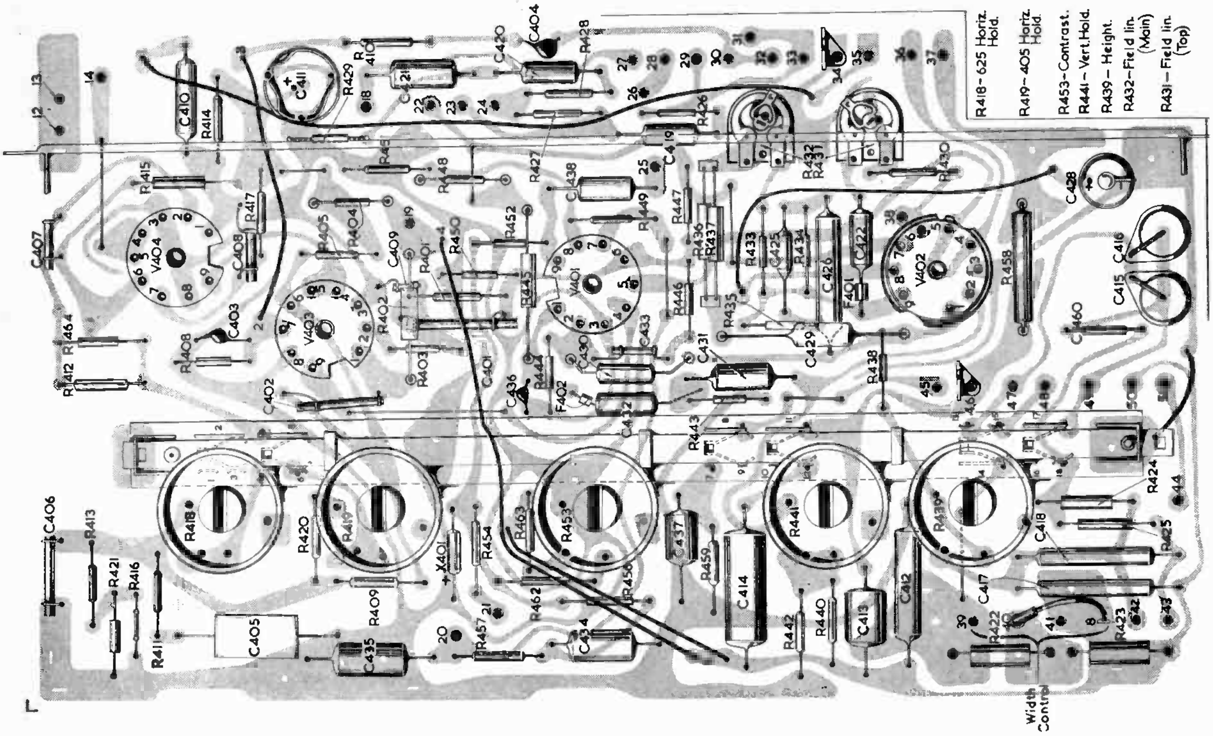
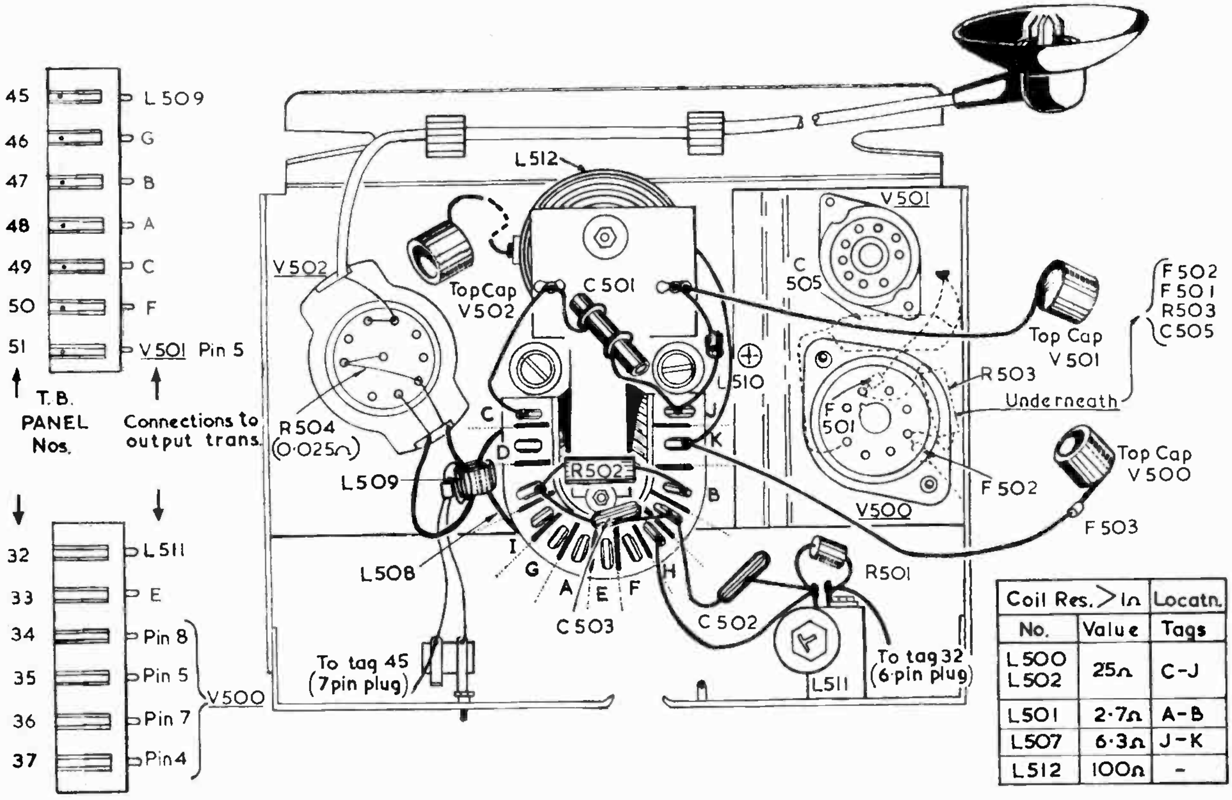


Fig. 2: Layout of the timebase printed panel, viewed from the component side.



Coil Res. > 1Ω		Locatn.
No.	Value	Tags
L500 L502	25Ω	C-J
L501	2·7Ω	A-B
L507	6·3Ω	J-K
L512	100Ω	-

Fig. 3: Physical layout of the line output stage. When replacing the line output transformer clear the tags then unsolder the heater wires from V502 holder, accessible after prising out the top moulding. Coil d.c. resistances given where greater than 1Ω.

LONG-DISTANCE TELEVISION

ROGER BUNNEY

SPORADIC E picked up towards the end of July following what had become a rather depressing lull. Indeed there were several really sustained and intense openings with long-skip signals and what was a most welcome visitor here—Danmarks Radio early on the 26th on channels E3 and E4. A fire destroyed the Copenhagen ch. E4 transmitters recently but within a fortnight Marconis had installed replacement units with normal service resumed. A number of mysteries have arisen and will be dealt with later. First however the log:

1/7/73—CST (Czechoslovakia) ch. R1 MS (Meteor Scatter); BRT (Belgium) E8, E10—both trops (tropospherics).
2/7/73—DFF (East Germany) E4; TVP (Poland) R1—both MS; also improved trops (u.h.f.).
3/7/73—WG (West Germany) E2—MS; NOS (Holland) E4—trops.
5/7/73—TSS (USSR) R1, R2—SpE; NOS E4—trops.
6/7/73—TSS R1—SpE; CST R1—MS.
7/7/73—TSS R1; MT (Hungary) R2; RAI (Italy) IA twice, IB; JRT (Yugoslavia) E3, E4; TVE (Spain) E2; plus unidentified signals —all SpE.
8/7/73—TSS R1; MT R1; CST R1; RAI IA; JRT E3 twice, E4 twice; *Albania* IC—all SpE.
9/7/73—DFF E4—MS; TSS R1—SpE; also improved tropospherics into ORTF (France u.h.f.).
10/7/73—DFF E4—MS.
11/7/73—DFF E4—MS; TSS R1, R2; RAI IA—both SpE; also SpE mystery pattern on ch. E2—see later!
13/7/73—TSS R1; TVP R1, 2, 3—all SpE.
14/7/73—TVP R1; CST R1; SR (Sweden) E2, 4; NRK (Norway) E2—all SpE.
15/7/73—CST R1; RAI IB—all MS; NOS E4—trops.
16/7/73—CST R1—MS.
17/7/73—DFF E4; CST R1—both MS.
18/7/73—TSS R1, 2; TVP R1, 2; DFF E3, 4; JRT E4—all SpE.
19/7/73—TSS R1, 2; DFF E4; SR E2 twice, E3 twice, E4; ORF (Austria) E2a; TVE E2, 3, 4; RTP (Portugal) E2—all SpE.
21/7/73—DFF E4; CST R1; WG E2—all MS; JRT E3, 4; TVE E2, 3, 4—all SpE.
22/7/73—CST R1; RAI IB—both MS.
23/7/73—CST R1; SR E2—both MS.
24/7/73—DFF E4—MS.
25/7/73—TSS R1, R2 twice; TVP R1, 2; CST R1; MT R1; SR E2, 3, 4; NRK E3; WG E2; ORTF (France) F2—all SpE; DFF E4 —MS.
26/7/73—TSS R1 twice; R2; CST R1; TVP R2; DFF E3, 4; ORF E2a; DR (Denmark) E3, 4— all SpE; NOS E4—trops.
27/7/73—DFF E4—MS.
28/7/73—DFF E4—MS; CST R1—SpE, R2—MS; WG E2—MS.

More aerial activities at this end! On the 22nd the total aerial structure was removed and an extra 10ft of lattice fitted, lifting the mast itself to 40ft. Unfortunately, due to the late arrival of a new type of u.h.f. aerial the "normal" aerials are at the time of writing out of service. A two-element Tru-match type wideband Band I array is in use facing East at 44ft. I shall be reporting on the performance of the new u.h.f. structure in due course.

Mystery Corner!

We would appreciate any suggestions and comments on the following points which have given rise to considerable speculation. A Dutch report indicates that a version of the checkerboard pattern with much smaller squares is in use on ch. E3, source unknown. It appears that Albania is using a form of small chessboard as well since Garry Smith (Derby) reports reception of this pattern on ch. IC. Garry also comments on variations of the Czechoslovakian CS U 01 pattern, with circles omitted and floating with various TSS programmes and test cards.

Older enthusiasts will recall the crosshatch/grid pattern once used by TVE. Both Graham Deaves and Ryn Muntjewerff (Holland) noted this pattern—consisting of 5 x 5 squares—from the East on ch. E2 at 0700 GMT on July 11th. For my part this signal appeared to be a long-skip one—resembling a tropospheric signal, noisy with slow fading. It came from a roughly Easterly direction and faded at 0730 with no indication of its origin. To confuse matters further George Sharples (Malta) has also seen this pattern on ch. E3.

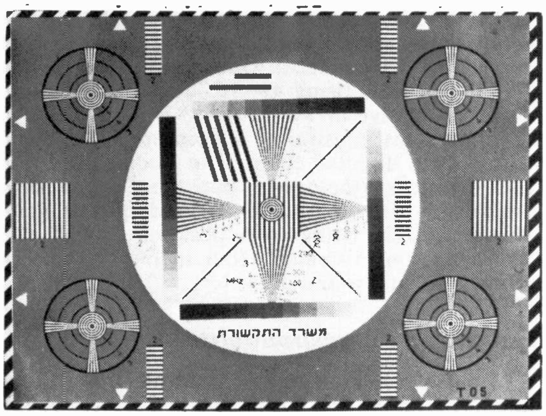
The Finnish Fubk pattern has been noted—in fact we have an excellent photograph taken by Dieter Scheiba—carrying the identification "CNCT YLE". We are waiting news from Finland as to the purpose of this extra identification.

Finally from David Griffin via Graham Deaves (both from the Norwich area) comes a photograph showing the normal T05 Telefunken card but with an identification consisting of three very small symbols/letters immediately above the circle while below the circle are six equally small letters which resemble "CANALT"—I suspect this is "CANAL?". Channel E4 on May 26th last was the important date for this mystery—at 1520 GMT. My log indicates that the JRT/MT direction was active at the time.

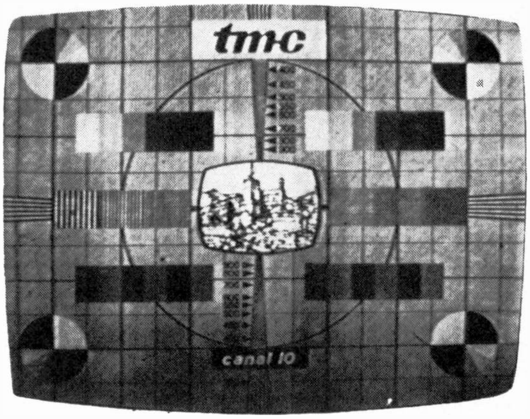
PM5544 Round-up

The PM5544 test card is so widely used at present —according to the Europese Testbeeldjagers Rumania is also now using it—that to clarify the situation we are including the following list of users. At the time of writing it is reasonably accurate but the

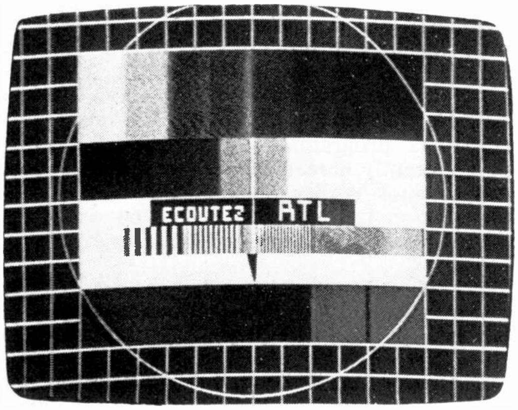
DATA PANEL 27 – 2nd series



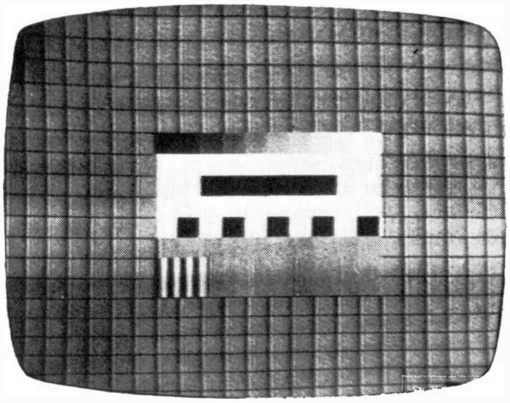
Test card used by Israel.



New Tele Monte Carlo test card.



New Tele Luxembourg test card.



New USSR test pattern.

Photographs this month courtesy Michele Dolci, Dieter Scheiba and Ryn Muntjewerff

situation seems to change daily!

RTE (Eire), carries the identification "RTE".

BRT/RTB (Belgium), carries the identification either "BRT" or "RTB".

DR (Denmark). Identification "DR Danmarks Radio".

NRK (Norway). Identification "Norge Televerket".

SR (Sweden). Identification "SR1" or "SR2", plus "Sverige".

ORF (Austria). Identification "ORF" and either "FS1" or "FS2".

JRT (Yugoslavia). Identification "JRT Zagreb" or "JRT LJNA".

TVR (Rumania). Identification "TVR".

MT (Hungary). No identification.

NOS (Holland)—experimental transmissions only from the Lopik transmitter.

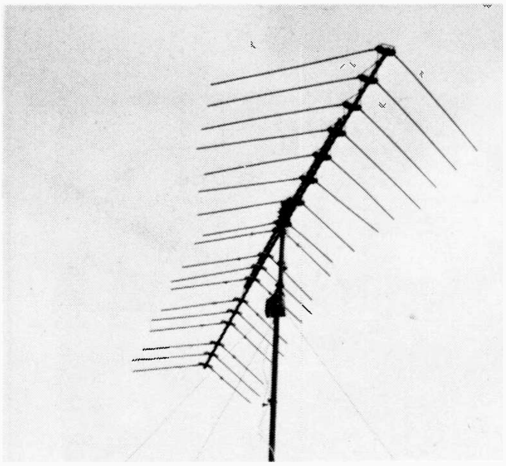
This list is provided by courtesy of the Europese Testbeeldjagers (Oudelandseweg 56, Ouddorp 3348 (ZH NL), Holland). The club incidentally is becoming quite large and with this so are the news items increasing—all too important in active SpE conditions. Enquiries to the club for sample bulletins should be accompanied by two international reply coupons.

News

West Germany: As from July 1st AFN Frankfurt (American Forces Network) has taken over responsibility for the forces TV from the US Army at Wiesbaden. We understand that Siemens have received an order for the supply of 56 transmitters for the AFRTS Network in West Germany. AFN has been in operation some 30 years.

Nigeria: New transmitters under construction: Kaduna ch.E10, Kano ch.E2, Enugu chs.E3/4 (this station was received in the UK on its old ch.E2 shortly before the Biafran War), and finally Port Harcourt ch.E5.

Iraq: Pye TVT are to supply six transmitters to the Ministry of Information for the expansion of television in the South of the country. These will be located at Sammawa, Amarah and Basrah and use



Wideband log-periodic aerial (Bands I and III) used by Robert Fitzjohn at Yaba, Nigeria.

pairs of 10kW transmitters with 1,000ft. masts.

Poland: The first network (TVP-1) is to be expanded to cover 95% of the population by 1978, using mainly v.h.f. transmitters with local relays where necessary. The second network (TVP-2) will be expanded through main u.h.f. transmitters with low-power v.h.f. relays where necessary—all towns will have their own low-power relays by 1974 (40% coverage). Between 1976-1980 the high-power transmitter network will expand to give 95% coverage. In 1974 Poland will take into service a terrestrial station to operate with the Orbita satellite network, giving the ability to participate in long-distance television programme exchanges with other Intervision countries. There is also mention of "The third television programme," an international version of the first programme but assumed to be for external use and not to be transmitted in Poland.

Wideband UHF Aerials

Until quite recently the wideband u.h.f. aerial tended to be a low-gain log-periodic array (wideband in this context is coverage of the whole u.h.f. TV spectrum, Bands IV and V). Examples of such aerials are the J Beam Log-beam and the Antiference Troubleshooter. The situation is changing however. Wolsey now market an array which consists basically of four stacked bowtie dipoles. This gives coverage over the whole band with a gain/bandwidth characteristic as shown in Fig. 1. A number of enthusiasts have reported highly on this array which has a reasonable gain for its size, averaging 3dB up over the best log-periodics. A higher performance array is the Fuba XC391D a photograph of which was featured in the February 1973 column. The

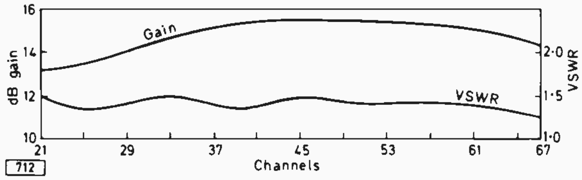


Fig. 1: Gain and VSWR characteristics of the Wolsey "Colour King" wideband u.h.f. aerial.

gain of this rises from 10.5dB at ch.E21 to 16dB at ch.E60. Within the last few days a most comprehensive list of u.h.f. arrays has arrived from R. Smith Aerials of Luton. Of particular note are the ranges of wideband u.h.f. aerials. The ZE range comprises four arrays with varying gains, the highest being that of the ZE30 which has a quoted gain of 14.5dB at E21 rising to 16.8dB at E68. A much more impressive array (visually) is used in the main Z range. This consists of a twin-boom arrangement with a twin director chain. The Zodiac 30 array has 118 directors (these are not the X-type director assemblies but separate units) and quoted gains of 15.9dB at E21 rising to a peak of 21.0dB at E68. The arrays in this range (four in fact) have a maximum gain at around E54.

From Our Correspondents . . .

Michele Dolci (Italy) confirms that Libya is operating on ch. E4. Trop signals have been received in Southern Italy by an enthusiast at Catania. The station appears to be a low-power one. There is no further news about the Tele Monte Carlo u.h.f. transmitter but a new test card is in use on v.h.f. and is included in our Data Panel this month.

Jordan "went colour" on April 27th. George Sharples tells us he has noted this country using the PM5540 test card on ch.E3. The card preceded educational programmes—during which commercials are apparently screened! Whilst on the subject of Jordan Derek Waller of Consett has received written confirmation from Jordan Television confirming his reception earlier this season—our congratulations on this.

Ryn Muntjewerff (Holland) has sent us details of a new wideband array now available in Holland and intended for TV-DXing! It is a log-periodic array covering 47-88MHz (ch.E2-IC), with eight active dipoles and one director. The length is approximately 12ft. and the aerial is for use with 300Ω balanced feeder. Ryn reports excellent results with this aerial, including strong Albanian signals on various occasions. Further information on this array can be obtained from: Benelux DX Club, Margon B.V., Eindhoven, Holland.

Robert Fitzjohn who is at present on leave in the UK from Nigeria has sent a long letter describing the exotic DX in that part of the world. There are many channels available but "it's a gamble most nights"! Apart from various locals up to about 250 miles he can view Accra ch.E4 when Ibadan leaves the air at 2200 (Accra is −1 hour GMT) and farther afield Lome, Togo on ch.K8 with 819 lines can be received (this is not listed in the 1973 WRTVHB). Signals in the area generally vary according to local weather conditions (at the time of writing it's the "rainy season"). The Fernando Poo transmitter (programmes in Spanish) can—weather permitting—be received on occasions on either ch.E11/12.

Neil Breward of Stoke-on-Trent comments that things have been really buzzing using our wideband dipole and a modified Bush receiver. A very comprehensive log shows that he received as many stations during 20 days in May as he did throughout 1972! Finally L. Allsopp (Cardiff) has forwarded a detailed log including unusually short-skip signals: he has noted the BBC-1 Scottish service with local news—the signal was typical Sporadic E with ghosting and rapid fading.

BASIC COLOUR FAULTS GUIDE

SPECIAL SUPPLEMENT TO 'TELEVISION' OCTOBER 1973

IN this special colour supplement we show some of the faults peculiar to colour sets, using off-screen photographs for easy recognition. These were taken from a standard British-made PAL receiver fitted with a shadowmask tube. Picture faults which are common to colour and monochrome sets, such as those affecting height, width, linearity, focus, brightness or resolution are not shown.

PURITY

The neck of a shadowmask tube contains three independent electron guns whose beams must each pass through the shadowmask to reach only the red, blue or green phosphor dots respectively, so that each gun scans a raster of one primary colour with no **impurity** or tainting with another colour. If a purity error is present, objects will change colour as they move across the screen and a monochrome picture will contain tinted areas. Purity errors are most visible on the red raster and therefore purity is checked by switching off the green and blue guns so that only a red raster is seen. Most sets are equipped with gun cutoff switches for this purpose; on a few (e.g. Decca CTV25) the guns can only be cut off by backing off the A1 (background colour) presets. Photo 1 shows a red raster with typical purity errors showing.

CURE: Loosen the wingnuts on the scan coil assembly and slide the coils towards the tube flare. Adjust the **purity rings** (these are two ring magnets on the tube neck, rearward of the convergence assembly. They can be adjusted to aid or oppose each other and produce a magnetic field across the tube neck at any angle) for pure red at the **centre** of the screen. A magnifying glass can be used to check that no green or blue phosphor dots are illuminated here. Now bring the scan coils rearward until the screen is uniformly red as in Photo 2. If necessary retrim the purity rings to remove any remaining purity errors in the corners. Now switch on the blue and green guns singly to check that there are no purity errors in these colours either. If pure rasters cannot be obtained the shadowmask has probably become magnetised and requires degaussing; check whether the set's automatic degaussing circuit has failed.

With all three guns switched on, a colour set should provide a good quality picture on a monochrome transmission. The grey tones in the picture should have neutral colour. If there is any overall colour tint the grey scale adjustment procedure recommended by the manufacturer should be carried out.

CONVERGENCE

There should be virtually no coloured fringes visible on the edges of objects. Presence of these means the three primary-colour rasters are not exactly converged (registered) together. There are two sets of convergence controls, for **static** and **dynamic** convergence.

Coloured fringes over the **entire** picture as shown in Photo 3 are cured by adjusting the static convergence controls on the tube neck. These are three circular magnets which provide radial shift of the red, blue and green rasters respectively, plus a fourth **blue lateral** control for sideways movement of the blue raster. Set these static controls for correct registration at the **centre** of the screen. The cross at the centre of Test Card F is a useful aid for this. Recheck purity after static convergence adjustments.

Even with good static convergence, fringes may be visible in parts of the picture away from the centre as in Photo 4. This is cured by careful setting up of the dynamic convergence controls. A crosshatch pattern generator should be used for these critical adjustments. Failing this it is just possible to use a test card but it is humanly impossible to set up dynamic convergence on an ordinary picture. The skill of achieving a good result is only learnt by practice—a useful hint is to turn each control slightly **less** than appears to be called for at any stage of the process.

MISSING COLOURS

Complete absence of one of the three rasters leaves a picture of the complementary colour, e.g. no red raster leaves a cyan picture, Photo 5, no green raster leaves a magenta picture, Photo 6, and no blue raster leaves a yellow picture (not shown). The cause of the fault might be:-

A beam cutoff switch at 'off', or
Extreme mis-setting of the grey scale controls, or
Incorrect A1 voltage
Incorrect cathode voltage } at the faulty gun, or
Incorrect grid voltage
Internal failure of the tube.

On a receiver with primary-colour drive to the tube cathodes the fault is very likely to lie in the relevant colour output stage.

COLOUR DECODER

A block diagram of the decoder used in PAL receivers is shown. A crystal-controlled reference oscillator (4·43 MHz approx.) feeds two synchronous demodulators which detect the two colour-difference signals R-Y and B-Y present in the composite colour signal. Subsequently G-Y is obtained by electrical summing of these two. The reference oscillator must run in phase with the modulating oscillator at the colour transmitter. To ensure this a **'burst'** of about 10 cycles of 4·43 MHz is included for reference immediately after the line sync pulse on colour transmissions.

However, the special feature of the bursts in the PAL system is that on successive lines they are alternately 45° phase-advanced and 45° phase-retarded. Since the oscillator control voltage is smoothed the phase-lock loop does not attempt to follow these alternations and the oscillator runs at the average phase of the bursts. The burst phase alternations do cause the phase discriminator output to contain an a.c. component of half line frequency i.e. 7·8 kHz. This is amplified by a 7·8 kHz tuned amplifier and is a vital signal known as the **'ident'**; it serves two purposes:-

BASIC COLOU

1. Impure Red Raster

2. Pure Red Raster

3. Poor Static Convergence

4. Poor Dynamic Convergence

5. No Red Raster

6. No Green Raster

R FAULTS GUIDE

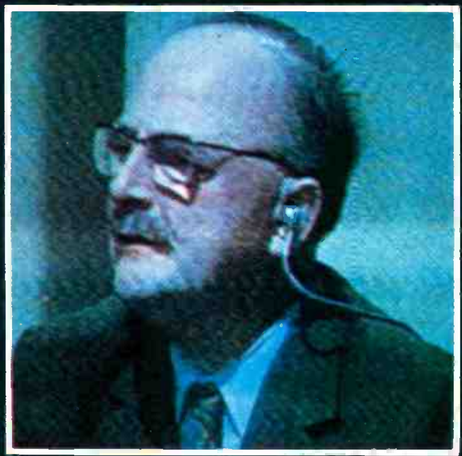
7. Reference Oscillator not locked

8. Pal Switch out of Phase

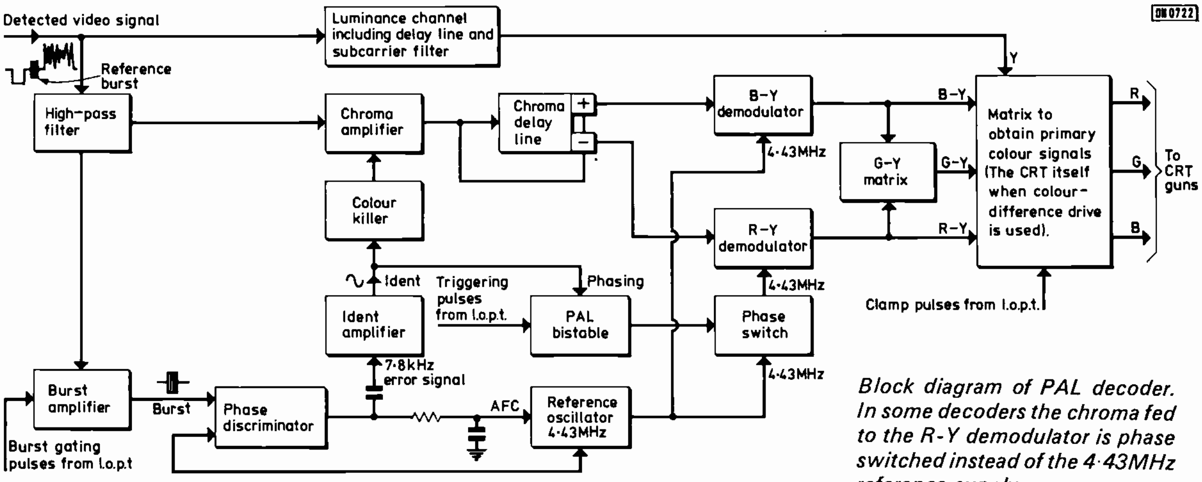
9. Dry-joint on Luminance Delay Line

10. Hanover Blinds

11. Blinds removed - Compare with 10



12. Sound/Chrominance Beat Patterning



Block diagram of PAL decoder. In some decoders the chroma fed to the R-Y demodulator is phase switched instead of the 4·43MHz reference supply.

(a). It establishes the correct operating phase for the PAL bistable. This is a multivibrator which is clocked (reversed) by line pulses to run at half line frequency and operates a phase reversing switch in the reference oscillation supply to the R-Y demodulator. This arrangement is necessary because the R-Y phase is reversed at the transmitter on successive lines; without 'ident' the PAL bistable cannot 'know' in which of its two phases to start.

(b). It disables the **'colour killer'.** Since ident is derived from burst, absence of ident normally means the transmission is monochrome whereupon the colour killer removes forward bias from a transistor in the chroma amplifier so that no unpleasant coloured 'noise' reaches the tube.

DECODER FAULTS

Many decoder faults upset the ident so that the **colour killer** operates. Therefore if a set shows a monochrome picture when the programme is known to be in colour (and the set is correctly tuned) the first step should be to artificially disable the colour killer so that the state of the decoder can be diagnosed from the screen. Ways of disabling the colour killer vary; usually a 10 kΩ resistor fitted with crocodile clips can be connected from the transistor supply rail to the base of the killer-controlled transistor to provide operating bias.

Failure of the reference oscillator to lock to the burst frequency appears as horizontal bands of colour across the screen, Photo 7. The more bands there are, the further off frequency is the oscillator.

CURE: Carefully adjust the oscillator frequency to see if it can be brought into lock to give correct colours. If the oscillator can be brought close to the correct frequency but does not lock, suspect a fault in the burst amplifier or phase discriminator. If the burst is completely lost the colour is likely to 'run through' the picture so fast it can hardly be seen. An oscilloscope is needed to check such points as the burst gate pulse timing and the burst amplifier tuning.

If the PAL bistable runs in the wrong phase, R-Y is incorrectly demodulated and the colours are wrong—in particular, faces are bright green! See Photo 8.

CURE: Interrupt the signal several times to see if the bistable phasing is sometimes correct or permanently wrong. If sometimes correct, the bistable is not receiving ident phasing and therefore has a 50/50 chance of starting correctly. Check the discriminator balance, ident amplifier and bistable phasing diode. If the bistable phase is permanently incorrect the ident amplifier is likely to be off tune.

HANOVER BLINDS

The purpose of alternating the R-Y signal phase on alternate lines is to cancel out phase errors in the signal path. In all British-made PAL sets a one-line (64 micro-second) delay is used to separate the R-Y and B-Y (not alternated) signals before demodulation. The delayed and undelayed chroma signals are summed to obtain B-Y and differenced to obtain R-Y. Accurate separation is only possible if both the amplitude-balance and the phase trim presets associated with the delay are set correctly; if there is any error there will be a difference in colour between adjacent lines—the so-called **'Hanover blind'** effect, see Photo 10. In coloured areas of the picture, pairs of lines appear to crawl upward.

CURE is to trim the chroma delay presets for minimum blinds, preferably viewing a colour bar pattern, to obtain the satisfactory result in Photo 11.

A fault which can be mistaken for very severe Hanover blinds occurs if the PAL bistable sticks in one state; then there is virtually no colour on alternate lines. Often the trouble lies in the line pulse feed to the bistable.

LUMINANCE DELAY

This is a much briefer (some 0·6 microseconds) delay which is fitted in the luminance channel to compensate for the time taken by chroma to pass through the narrow-band-width chroma circuits and thereby ensure exact horizontal registration of colour and luminance. There is no adjustment on the luminance delay and any chroma/luminance registration error is most likely to be caused by mistuning of the chroma amplifier. Luminance delay lines often suffer from dry joints causing a characteristic double-edging effect on the luminance signal (monochrome picture), the colour being unaffected, Photo 9.

SOUND CHROMA BEATS

The sound carrier is spaced 6 MHz from the vision carrier while the chroma subcarrier is spaced 4·43 MHz from it. Therefore there is a possible beat frequency inside the video range (1·5 MHz approx.) which could be generated by interference between sound and chroma. The i.f. strip response is carefully shaped to minimise this possibility. However severe misalignment or simple mistuning of the receiver can cause 1·5 MHz patterning on the coloured parts of the picture—see Photo 12.

The off-air colour photographs and material for this Supplement were provided by Caleb Bradley B.Sc.

SERVICING television receivers

L. LAWRY-JOHNS

ITT/KB VC200 CHASSIS

MODELS fitted with this chassis include the **KB** SV042, SV043, SV048, SV049, SV054, SV142, SV143, SV148, SV149 and SV154 and the **RGD** SV237 and SV337. It is a single-standard chassis designed to receive u.h.f. signals in Bands IV and V.

Servicing Facilities

Servicing facilities include a swing-down main board. This is held in the up position by two nylon catches which are moved outward to allow the chassis to pivot on its lower hinges. Similar nylon clips hold the tuner unit in position, so access to all parts likely to require attention is simple.

Tuner Units

One of two types of tuner unit may be found fitted—a UTA106 or a UTA108. In both the r.f. amplifier is a BF180 and the mixer/oscillator a BF181. The BF180 is the more likely one to fail, causing very poor reception marked by excessive grain. The BF181 tends to stop oscillating resulting in complete loss of signals; sometimes this initially affects one part of the band more than another (BBC-2 OK but no ITV for example). Transistor replacement is quite straightforward but requires a delicate touch to avoid moving other components—this would disturb the tuning.

Always check the transistor supply voltages before dismantling the tuner. The voltage at the 50μF decoupler should be 12V. If this is absent check back to the 20V line—R158, R160, D9 etc. The 20V supply is derived from the line output transformer so it isn't much good looking for voltages if there is a fault which affects the line output stage.

Mechanical Troubles

There are a couple of mechanical faults that can occur with these tuners. The UTA106 (Philips) tuner can develop poor reset accuracy due to the gear wheel at the end of the tuning capacitor shaft being loose—while the grub screw appears to be tight the screw does not mate with the shaft due to the fixing screw not bottoming on the shaft as a result of insufficient clearance in the grub screw hole. Remove the gear wheel and clear the hole so that the screw can move freely. Frequency drift and low gain with the UTA108 (Hopt) tuner can be caused by the brass collars fixing the lecher lines to the ceramic pillars developing a hairline crack—the ceramic pillars also support the tuning gang stators. Carefully inspect all the tuner sections and solder where necessary. This trouble could unfortunately make it necessary to have the tuner unit realigned.

Power Supplies

The forest of wire-wound resistors on the left side need sorting out in order to appreciate what doesn't work when one of them becomes open-circuit or overheats to denote trouble in a particular part of the receiver.

The mains supply is taken direct to the on/off switch, then neutral goes to chassis while live passes to a 1A delay fuse. When the fuse really shatters ("we heard a pop and everything went off"), disconnect C93, check for shorts and fit a new fuse. If the fuse holds fit a new capacitor in the C93 position, observing the a.c. voltage rating which is 300V—or 1kV d.c. From the fuse the supply is taken to R108. This leads a hard life and it is hardly surprising that it frequently fails and the set stops functioning. It is the surge limiter for both the h.t. and the heater diodes and gets a little hot under the collar therefore. R108 has a value of 20Ω and is rated at 17W (minimum).

The supply then splits up to feed the h.t. rectifier D3 and the heater circuit rectifier D4. The output from D4 is negative and feeds the ballast resistors R105 and R109 (each 108Ω) and the valve and tube heaters. The output of the h.t. rectifier feeds the various h.t. supply lines via a number of resistors each with its own smoothing capacitor. For example R102 feeds the audio output stage, smoothed by C83, whilst R103 feeds the field output stage, smoothed by C85. Hence either of these two circuits can cease to function while the rest of the set continues to work happily. The rest of the h.t. current has to pass through R106 however so that nothing can work if this becomes open-circuit despite the fact that h.t. is maintained to the field and sound output stages. Failure of one or more sections of the receiver is often due to one of these smoothing resistors being open-circuit, the precise one to check depending upon the symptoms.

R102 can overheat and damage the board if the PCL86 audio valve is faulty and passes excessive current: in later models R102 is mounted 15mm. off the board to prevent this.

Grid CRT Modulation

Probably the most interesting thing about this chassis is the fact that the c.r.t. is grid modulated.

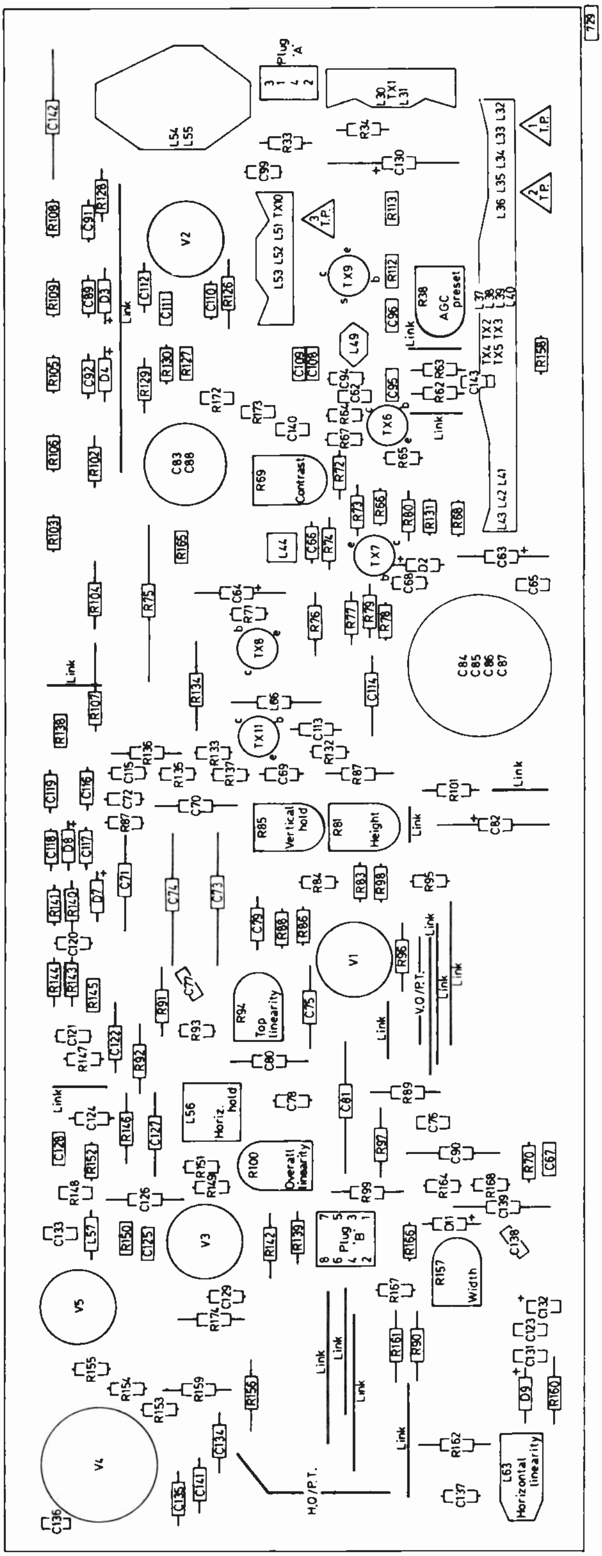


Fig. 1: Main printed board (component side).

The almost universal practice of modulating the c.r.t. cathode is adopted to take advantage of the fact that the act of reducing the cathode voltage has the same effect as increasing the grid voltage *and* the first anode voltage together by the same amount, thereby gaining a little bonus when compared to swinging the grid voltage which of course leaves the voltage difference between the cathode and first anode steady. Thus when grid modulation is employed (as in colour-difference circuits) extra drive is required to produce the same contrast. There is a compensation with grid modulation however since peak white is obtained when the video amplifier is passing least current, and this you might think would result in a long and energetic life for the video output transistor. The BF119 has a habit however of becoming open-circuit, leaving a well lit screen but with no picture on it. This normally occurs when the receiver has been on for some time and the temperature in the cabinet has had time to rise.

If the complaint then is that the set performs well for a time and then loses the picture, leaving the screen well lit and the sound normal, it is quite reasonable to check the c.r.t. gid (pin 2) voltage: if this is about 200V suspect the BF119 and check it in the usual way. Suitable replacements are the BF179 or BF257. If the BF119's base voltage is below its correct working figure of 3-4V however the transistor is in order and the reason for this low voltage should be investigated.

The video output transistor is driven by an emitter-follower (BC172B), the signals developed across the emitter resistor R67 of this stage being applied to the contrast control, to R66 (a.g.c. generator input) and to R131 (sync separator input). This transistor (TX6) appears to be quite reliable.

The positive-going signals from the detector diode D1 are fed to the base of TX6 and via C95 to the sound channel.

Effect of IF Instability

At this point let us consider something which could well occur and which could be confusing. The fact that the writer has not encountered it so far doesn't mean that no one else has or will. The well known effect of oscillation in the i.f. stages, due say to an open-circuit decoupling capacitor, usually causes loss of sound and a brilliantly lit screen as the video stage is then overloaded: it is this latter condition which normally provides the clue and leads us hot foot on the trail of instability. Now spare a thought for what happens when an overlarge signal arrives at the video stage of a receiver in which the c.r.t. is grid modulated. The heavy signal drives the video amplifier into maximum current causing a large voltage drop across its load resistor (R75 here). The c.r.t. is therefore cut off as its grid voltage is low, and we are left with a blank screen instead of a bright white one to call attention to the instability. The v.d.r. R173 will prevent too much overloading of the video stage but the tube will still be cut off if the contrast and brilliance are left at their normal working settings.

Other Video Effects

The BF119 can cause a black "curtaining" effect which depends on the picture content and the contrast control setting, extending from the left-hand side of the screen to the centre. A replacement BF119 may cure the fault: alternatively its bias resistor R79

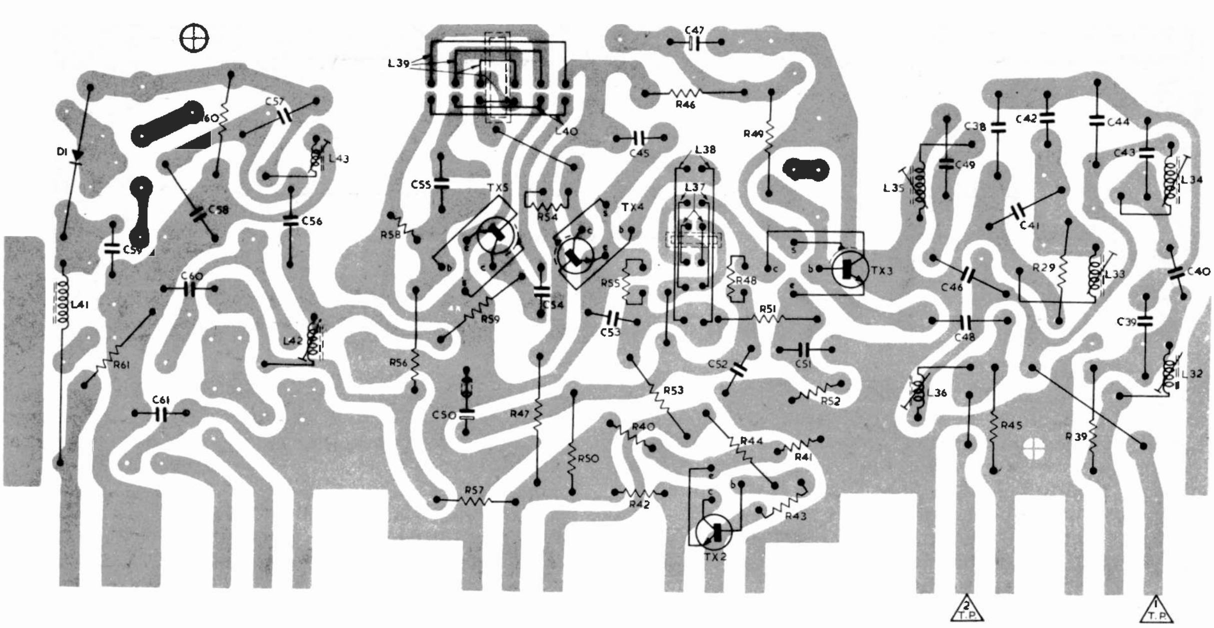


Fig. 2: Layout of the vision i.f. board—viewed from the print side.

can be increased from 100Ω to 120Ω. Do not make this value change unless this particular fault is present.

If the video drive is insufficient R63 may be reduced from 510Ω to 390Ω (5%). Change R161 to 1MΩ and R165 to 100kΩ.

IF Stages

As far as the vision i.f. transistors TX4 and TX5 are concerned there are unfortunately no emitter resistors across which to make convenient voltage measurements: voltage checks must be made in the collector circuits therefore where a higher voltage than specified indicates that the transistor concerned is not passing enough current either because its base voltage is too low or because the transistor is faulty.

In the case of TX5 the resistor across which a voltage check can be made is R57 (about 5V drop).

In the case of TX4 the voltage check should be made across R47 (about 10V allowing for signal fluctuations). Now the voltage across R47 has a profound effect on the gain of the i.f. strip since it controls the base bias applied to the first vision i.f. transistor TX3 and hence its gain. The a.g.c. potential is derived from TX7 which operates in a fairly conventional way: it is switched on once each line by a differentiated flyback pulse from the line output transformer applied to its collector via C65 and D2, the extent to which it conducts each time depending on the amplitude of the video waveform applied to its base. As a result a negative charge proportional to the signal black level is established on C65 and filtered by R68/C63. This a.g.c. potential is applied to the base of TX4 which in addition to providing i.f. amplification acts as a d.c. amplifier/inverter producing a forward gain control potential across R47 to set the i.f. gain as we have seen. It is also applied to the a.g.c. inverter stage TX2 which produces the forward a.g.c. applied to the tuner unit. The level of the a.g.c. to the tuner is preset by R38.

CONTINUED WITH FULL CIRCUIT NEXT MONTH

COPING WITH ICs

—continued from page 545

Other ICs for TV

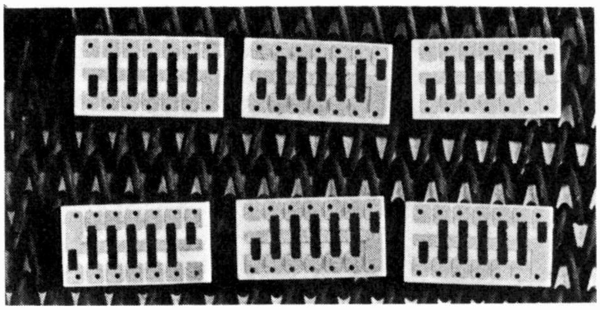
TBA570: Line oscillator used in continental sets, with d.c. control of sync and frequency.
TBA920: As the TBA570 but improved and with integral sync separator. A novel feature is its flywheel sync circuit with two-speed locking. A fast-acting frequency discriminator pulls the oscillator in from a wide range of mistuning. Once within frequency the fast-acting detector is replaced by a slow-acting phase discriminator which gives very clean verticals and a good steady sync. Provision is made so that by shorting down one pin the slow-acting circuit can be inhibited for VTR working.
SN76533N: Line oscillator plus sync separator from Texas, offering similar facilities to the TBA920.
SN76013N: This 4W Texas i.c. is an audio output device with integral fan-shaped heatsink. Known colloquially as the "Flying Fin". Its gain and tonal range are adjustable by the addition of external components to the bias and feedback network on pin 2. Although the pins are conventionally numbered 1-16, pins 4, 5, 12 and 13 are missing. Peculiarities are a characteristic "plop" on switch-on, a hiss or crackle at zero volume and a variable quiescent current of typically 15-30mA. See Fig. 4.

These then are the main i.c.s in current TV use today. Our next instalment—"Four in a Box"—describes the latest four i.c. decoder using devices we have mentioned above. This decoder can be fairly described as a small printed circuit board with an i.c. in every corner, each pointing to its companion and saying "it's him!"

TO BE CONTINUED

THICK-FILM CIRCUITS FOR TV

Keith Pitt B Sc



IN addition to silicon monolithic integrated circuits another technology new to television is beginning to take its place in our receivers, that of thick films. Although we will only meet this development in the form of modules of unfamiliar shapes it is of interest to know a little about it and what it can do.

Thick films got their name by contrast with thin films which are evaporated metal and metal alloy conductors and resistors. While these evaporated films are about 10 nanometres thick (0.4 microinches) thick films are between 10 and 35 micrometres (0.0005-0.0015in.) thick. They are made by first screen printing a paste on to a ceramic base or substrate and then converting the print into a glaze by firing under controlled conditions in a moving belt furnace at between 750 and 1000 deg C. Resistive, conducting and insulating glazes may be made in this way. (Dielectric films for capacitors are also possible but it is usually cheaper and easier to use miniature discrete components). Transistors and other components can be added either in a packaged form or as a chip.

Thick-film Technology

The printed glaze technology used for thick films has been borrowed partly from the artist and partly from china and porcelain manufacturers. The circuit required is first converted into a suitable layout—partitioned into layers of conductors, resistors and, if necessary, dielectrics for crossovers. Each layer is accurately dimensioned at ten times full size and then reduced photographically. A stainless steel stencil screen is used for all the stages.

A print of the pattern in the correct ink (or paste) is then transferred to an alumina substrate by means of a rubber squeegee. This is next dried in an infra-red oven to remove the solvents. At this stage the substrate may be fired immediately or alternatively taken back to the printing stage to print a second or even a third layer before firing. Generally the complete pattern of conductors and possibly cross-overs is fired prior to printing the resistors. The conductors—usually a solderable mixture of silver and palladium—are fired in a cycle lasting about ten to twenty minutes with a peak at about 850 deg C. The resistive material is a mixture of precious metal oxides fired over a carefully controlled schedule taking about an hour with its peak close to 780 deg C.

The value of resistors produced from a particular paste depends on its chemical composition; by varying this a whole range of resistance from a few ohms to many megohms can be made. The process does not produce resistors right on target—they lie within a broad tolerance band. Fortunately however they can be adjusted quickly and cheaply to within one or two per cent of the target value. Two techniques are used: first, abrading away parts of the resistor track by firing a jet of fine abrasive particles at it; secondly, cutting away part of the area by means of a laser beam. Both methods raise the resistance from the as-fired value. Lasers involve a large capital outlay but have been brought into operation recently mainly for the benefit of the television industry. The unit cost of a resistor adjusted in value this way is very low due to the fantastic speed of the computer controlled operation.

Once the resistor values have been adjusted and the thick-film network has passed electrical and optical tests it is ready for the final stages. Normally for the television industry any components or leads connected directly to a thick-film network will be soldered in place. Although there are special miniature transistors and capacitors available for use with thick-film assemblies it has been found that in practice their use makes thick films economically uncompetitive. As a result a compromise is made between space and cost saving, specially cheap versions of standard components being used instead. For one particular application a new minimum price ceramic capacitor was developed in order to remain competitive; each of the new components provided a price reduction of about five times compared with the standard types without significant loss of performance.

After device and lead attachment the completed thick-film module is resin dipped. Many of the modules in use in television sets are similar in format to those shown in Fig. 1 in which all the leads project from one side of the body and the package is mounted vertically and soldered into a printed circuit board—this is sometimes known as the single-in-line package.

Applications

For about four years several setmakers have been using multimillion quantities of discrete power resistors in thick-film form. These have values ranging from 0.1Ω to 56kΩ, dissipate up to 3W and have the pluggable tag harness which is the preferred terminal arrangement for the consumer industry. Subsequently the use of individual thick-film resistors was supplemented by networks of six resistors mounted on heatsinks for use as the red, blue and

The heading photograph at the top of the page shows thick-film resistor patterns emerging from a belt furnace after processing. These resistors are for providing bias on computer logic lines. Courtesy Middlesex Polytechnic.

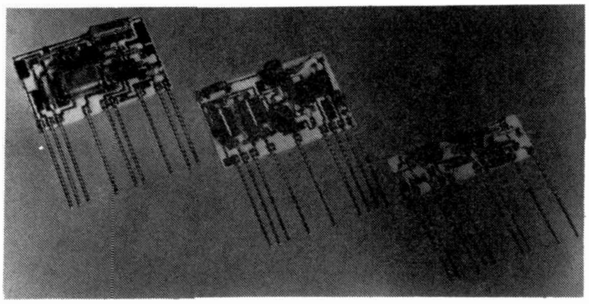


Fig. 1: Thick-film hybrid circuits for use in colour TV receivers. Courtesy Erie Electronics Ltd.

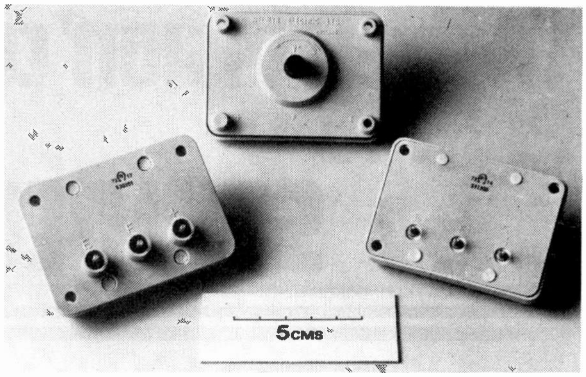


Fig. 2: High-voltage thick-film focus modules for use in colour TV sets. The circuit provides automatics focus voltage correction for wide variations in mains voltage. Courtesy Welwyn Electric Ltd.

green output stage video loads (see cover photograph last month), the complete assembly dissipating 7.5W. The better thermal tracking of these resistor networks gives improved grey-scale tracking and consequently better colour reproduction.

From these the applications spread to high-value/high-voltage resistors including focus potentiometers. A thick-film glaze forms an ideal potentiometer track and a number of standard products have evolved in this field. Fig. 2 shows one commercially available range of thick-film focus assemblies for use in colour receivers. This has now become a standard line marketed by several thick-film manufacturers and has gained wide acceptance. Other applications in the potentiometer field are for field shift, line hold and shift and convergence circuitry.

More ambitiously a number of hybrid circuits have been developed for the television market. A hybrid circuit consists of a thick-film substrate with additional surface-mounted components. These assemblies are only acceptable of course if economically compatible with standard techniques. Improved reliability compared to conventional methods is another prime requirement, especially since over 60% of colour receivers are rented rather than bought. These requirements have been met and several hybrid modules are incorporated in the latest sets.

One of the first modules to appear was a field oscillator circuit; this was closely followed by a convergence system and circuitry designed for 110° tubes. Thorn Consumer Electronics (previously BRC) have been in the forefront of the application of thick films to consumer equipment as readers of TELEVISION will have observed—see recently reported news items. Even more recently AB Microelectronics have produced a thick-film varicap television tuner unit. This is typical of the new applications which are on their way to the market.

These examples show how the conventional component manufacturers have adapted themselves to take advantage of a newly developed technology in order to keep up with the demands of the electronics industry. Not only have thick films become widespread in television and radio, they are also beginning to spread rapidly into the automotive market.

Traditional resistor manufacturers such as Erie Electronics, Welwyn Electric and others have taken the initiative in developing thick films and applying them over a wide range of product fields. The number of television applications should continue to increase in the future. The only aspect which is not favourable is that faulty modules cannot be repaired—even in the factory—and represent a relatively high throw-away value compared with discrete components. They are easy to remove and replace however and do not therefore present any major servicing snags.

Current development work suggests that thick films will have wide applications in the r.f. field, including u.h.f., and it is possible that wired TV distribution systems will become one of the next big users. ■

FAULT FINDING GUIDE

—continued from pages 548/9

15 and 14 on the system switch and winding L501 on the line output transformer. Close inspection eventually showed that the lead-out wire from L501 had broken away from its tag. The broken lead was soldered to the tag and this restored normal working. The loss of sound was due to no h.t. voltage being available from the boost line to feed the triode section of the PCL83 audio valve—the feed is via R460, R425 and the triode anode load resistor R257 (2.7MΩ).

If the brightness control will not blank out the raster completely check the brightness control resistance chain—R120 (68kΩ), the brightness control itself (R105 500kΩ), the v.d.r. R106 and R107 (56kΩ) to chassis. Any change in resistance values here will upset the balance. Replace any resistor whose value has changed—check the v.d.r. by substitution.

The design of this chassis with its drop-off resistors and three fuses encourages a systematic approach to servicing. Remember that five minutes' close physical inspection of the printed panel for hair-cracks, dry-joints, discoloured resistors, leaking electrolytic capacitors, corroded valve bases and even the tell-tale white top of a cracked valve can save hours of plodding work with a meter.

When you make a soldered joint on the dark, rear side of the panel check it twice—and then again, preferably with a good light and a dentist's mirror—to ensure that it is a good, clean firm joint.

NEXT: BRC 1400 CHASSIS

THE 'TELEVISION' COLOUR RECEIVER PART 18
SERVICE DATA

THE voltage data given this month for the main modules in the colour receiver should with the key waveforms shown in Figs. 1 and 2 go a long way towards sorting out any servicing problems. Data for the i.f. module was given in R. Fisher's article last month. The use of the information given depends—as with all servicing data—on the set-up conditions and the instruments employed. This should be clearly understood when you come to interpret the results you obtain from checks on your receiver.

Test Conditions

The voltage readings given are the averages of those obtained from three receivers—the prototype and two constructors' models: they are the closest that we can give at this moment as being "norms". The meter used for all the measurements was a Philips 50kΩ/V "Multitester". Meters providing a greater loading (e.g. 20kΩ/V) and those with a different meter protection system will inevitably give different readings at particular points—notably at the transistor base and emitter connections. All this is to be expected: remember that in any fault-finding procedure using voltage checks one is looking for a similar—or dissimilar—conduction state and that normally the degree of conduction is more important than the precise voltage.

All voltage measurements were taken with a mains input of 240V. Where only one voltage is given for a particular point this is the voltage under normal operating conditions, with the receiver correctly set up and a 95% colour bar input. Where two voltages are given the second is the normal signal voltage and the first the no-signal voltage obtained with no r.f. input to the receiver and the saturation, contrast and brightness controls reduced to zero.

Waveforms

The waveforms shown (Fig. 1 and 2) are practical ones—not idealised—and were also obtained with a 95% colour bar input and with the receiver adjusted for a normal display. The possibilities of video signal level variations are geater than with simple voltage measurements because the former depend much more on the quality of the signal, the way in which the receiver has been set up and the drive levels required for the particular colour tube being used. The instrument used for monitoring the waveforms shown were taken using a Tektronix 7704A with 7A19, 7B92 and P6006 × 10 probe.

Waveforms have not been given for the convergence circuitry. The waveforms and d.c. potentials here have in our experience been found to be of little value in fault-finding and indeed may be downright confusing. If readers prove to have any real difficulty in this area we will examine it more closely however.

VOLTAGE MEASUREMENTS

Decoder

Tr 1	base	1·53V 1·31V
	emitter	0·85V 0·63V
	collector	14·2V 13·4V
Tr 2	base	0V
	emitter	0·02V
	collector	16·8V 16·3V
Tr 3	base	0·18V
	emitter	0·12V
	collector	4·3V 4·9V
Tr 4	base	3·45V 3·35V
	emitter	3·15V 3·05V
	collector	14·8V 14·7V
Tr 5	base	5·15V 5·1V
	emitter	4·65V 4·55V
	collector	15·1V 14·9V
Tr 6	base	3·6V 3·4V
	emitter	3·05V 2·95V
	collector	18·2V 17·6V

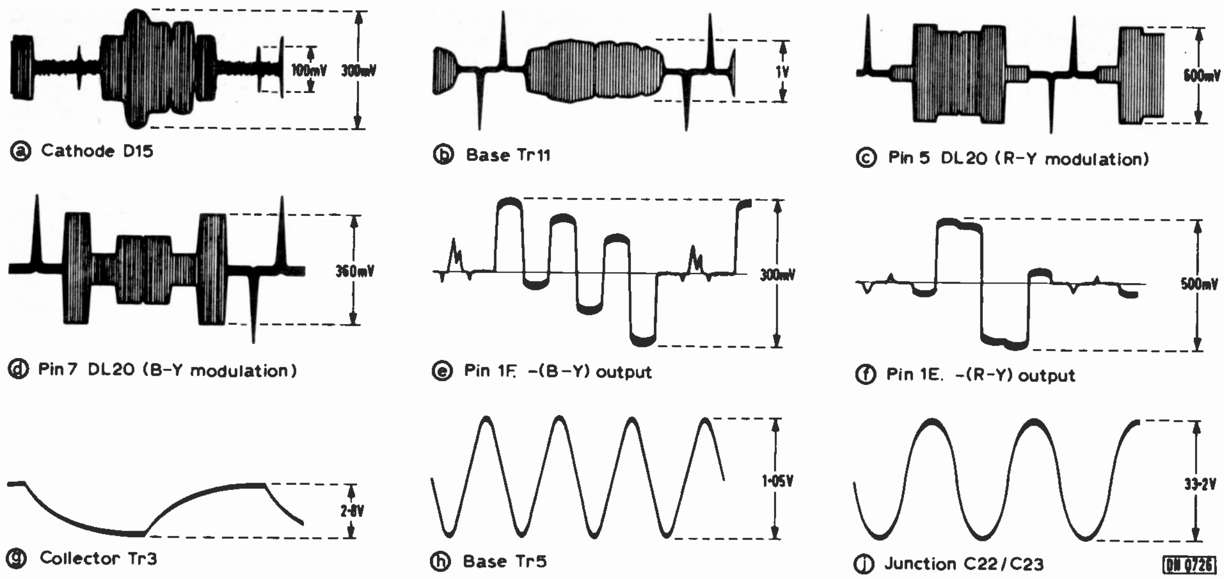


Fig. 1: Key decoder module waveforms.

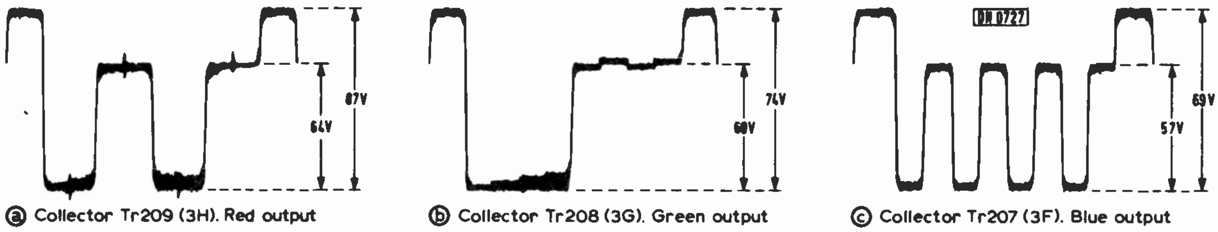


Fig. 2: RGB module waveforms.

Tr 7	base	0V
		2·7V
	emitter	0·02V
		2·2V
	collector	18·3V
		18·2V
Tr 8	base	0·4V
	emitter	0V
	collector	5·5V
Tr 9	base	0·4V
	emitter	0V
	collector	5·3V
Tr 10	base	—1·4V
		4·8V
	emitter	0·02V
		3·9V
	collector	19·8V
		11·3V
Tr 11	base	6·7V
		6·2V
	emitter	6V
		5·45V
	collector	16·7V
		16·1V

RBG Module

Tr 201	base	0·9V
	emitter	0·23V
	collector	12·1V
Tr 202	base	0·85V
	emitter	0·15V
	collector	3·4V
Tr 203	base	0·85V
	emitter	0·15V
	collector	3·4V
Tr 204	base	3·3V
	emitter	2·6V
	collector	14·3V
Tr 205	base	3·3V
	emitter	2·6V
	collector	20V
Tr 206	base	3·5V
	emitter	2·8V
	collector	13·9V
Tr 207	base	2·6V
	emitter	2·1V
	collector	118V

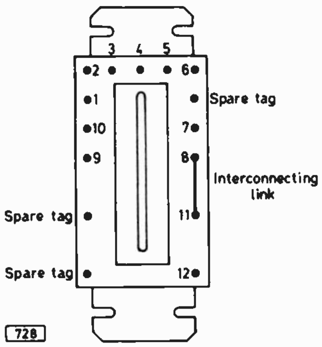


Fig. 3 (left): Tag connections to the line output transformer supplied by E. J. Papworth and Son Ltd. The −8V winding must be added—or see suggestion in column on right.

Tr 208	base	2·6V
	emitter	2·1V
	collector	118V
Tr 209	base	2·8V
	emitter	2·3V
	collector	109V

Timebase Module

D 303	cathode	0·05V
SCS 301	cathode	0·05V*
	cathode gate	0V*
	anode	4·1V*
	anode gate	6·2V*

*All voltage measurements on SCS 301 should be undertaken with great care. Meters of less than 20kΩ/V should not be used at all on the anode or anode gate whilst other meters should be connected before the receiver is powered. Do not jab the meter leads on to any pin of SCS 301 while the stage is powered.

Tr 301	base	0·9V
	emitter	0·4V
	collector	63V
Tr 302	base	0·05V
	emitter	0V
	collector	1·1V
Tr 303	base	1·1V
	emitter	1·3V
	collector	0V
Tr 304	base	1·25V
	emitter	0·7V
	collector	19·6V
Tr 305	base	20·9V
	emitter	20·2V
	collector	40V
V301	pin1—triode anode	225V
	pin 2—pentode grid	—55V
	pin 3—pentode screen	222V
	pin 6—pentode anode	173V
	pin 7—pentode cathode	0V
	pin 8—triode cathode	4·5V
V 302	pins 1, 8—grid	—76V
	pins 3, 6—screen	215V
	pin 9—cathode	2·2V

Power supplies

Some readers have expressed concern about the operating temperature of the mains transformer and have experienced difficulty in achieving the correct voltage and current ratings on load at the power supply output terminals. The manufacturers of the transformer supplied in Pack 18 have stated that "due to the excellence of the insulation these transformers are able to run safely up to 100°C". They state that even at 120°C they should still operate satisfactorily.

We have conducted further tests on samples and are of the opinion that as with most transformers running at high temperatures magnetic saturation can occur. There is also the possibility of poor regulation when used under heavy loading conditions. There are two possible solutions to such problems in this project:

(1) To remove some or all of the low-voltage loads and operate them from a separate additional transformer.

(2) To replace the transformer with one having a higher power rating—and inevitably of much greater cost.

The first suggestion can be carried out by using an additional transformer to supply the c.r.t. heaters with 6·3V at 0·9A.

A thermistor such as the VA1033 will provide some protection against a surge on switch on. The transformer can be a common 1A type or the special c.r.t. type (RS Components). A rectifier diode is not necessary of course in this case. In addition a 40V d.c. supply should be made available separately for the field timebase, requiring a 33V to 40V 1·5A to 2A transformer operating with R508, C507 and another 100V 2A bridge rectifier. Change FS503 to a 1A type after removing the field timebase feed from the original circuit. The 24V winding together with R516 and D505 could be used to supply −8V for the decoder panel in conjunction with an 8V zener diode connected across 6Q and 6C (cathode to chassis) plus C604. The VA1033 thermistor R517 is not necessary in this circuit.

If the h.t. voltage from the power supply is insufficient for correct operation of the boards on load the following suggestions can be tried: (1) In the case of the line timebase feed from 6G reduce R505 to 25Ω. (2) In the case of the feeds from 6H and 6I reduce R506 to 1kΩ.

Full details will be given next month in our new series *TELEVISION Colour Receiver Forum*. Constructors who have successfully completed the published receiver are invited to contribute brief details that could be helpful to other constructors. These will be carefully studied and we reserve the right to delete or amend any parts. Our aim is to provide a service to assist constructors who may be having difficulties.

"TELEVISION" COLOUR RECEIVER FAULT FINDING ADVISORY SERVICE

Adopt the following procedure:

(1) Complete the coupon, supplying complete fault symptoms and details of test measurements and/or oscilloscope traces that you have made and the results.

(2) Send your coupon and letter and two stamped self-addressed envelopes to: Fault Finding Advisory Service,

"Television", Fleetway House, Farringdon Street, London EC4A 4AD.

Letters will be dealt with in rotation and you should be prepared if there is a delay. If you have followed the instructions here you should receive an acknowledgement bearing a reference number which must be quoted in all further correspondence.

There may be occasions when an answer is best given by telephone, *but please do not ring us, we will ring you.* If you think that communication can be done better by telephone please write your evening/weekend telephone number in full on the coupon where stated. **Warning**: If we choose to telephone to help you or to ask for further information we may make a "transferred charges" call, i.e. at your expense. If you are not prepared to accept such a call do not enter your telephone number. It would be helpful if you have access at the time to details of your receiver. WE CANNOT ANSWER QUERIES BY TELEPHONE IN ANY OTHER WAY.

Note: The service is being made available in this form until November 30th 1973 only, at which time the situation will be reviewed in the light of experience.

Matters Arising

In the event of it being necessary to replace the horizontal shift potentiometer R354 a wire-wound type should be used.

Electrokit have moved to new premises at 8 Cullen Way, London NW10.

"TELEVISION" COLOUR RECEIVER PROJECT: FAULT FINDING ADVISORY SERVICE

Please complete the whole form in ink in capital letters, attach to your letter describing fault symptoms and send with TWO stamped self-addressed envelopes to: Fault Finding Advisory Service, "TELEVISION", Fleetway House, Farringdon Street, London EC4A 4AD.

NAME ....

ADDRESS ....

....

....

FOR OFFICE USE ONLY
1st Ref.

2nd Ref.

3rd Ref.

1st Ref. number.............................. (if known).

BRIEF FAULT SYMPTOMS (use additional paper if necessary):

TEST PROCEDURES CARRIED OUT:

PLEASE TELEPHONE ME BY TRANSFERRED CHARGE CALL DURING THE EVENING OR WEEKEND BETWEEN

(times)..............................ON TELEPHONE NUMBER..............................

I UNDERSTAND THAT THE PHONE CALL MAY BE CHARGED FROM CORNWALL OR LONDON. I HAVE READ AND UNDERSTOOD THE CONDITIONS OF THE ADVISORY SERVICE AS GIVEN IN THE AUGUST 1973 ISSUE OF "TELEVISION". I ALSO UNDERSTAND THAT THE MAGAZINE PUBLISHERS CANNOT BE HELD RESPONSIBLE FOR ANY LOSS OR DAMAGE TO THE COLOUR RECEIVER.

SIGNATURE..............................

DATE..............................

For Office use only.

DATE..............................

NAME..............................

REF ....

Dear Sir,

We acknowledge receipt of your form for the Fault Finding Advisory Service. This is being dealt with. Please quote the above reference number in all communications on the Colour Receiver Project.

Yours faithfully,
FOR TELEVISION MAGAZINE

WELL over half a million visitors were expected to pass through the doors of the Palace at the Funkturm, Berlin between August 31st and September 9th. The International Radio and Television Exhibition organised by AMK Berlin was in fact much more than just another exhibition: it was part of a large operation designed to show the world what Berlin has to offer. And of particular significance is that it celebrated the 50th anniversary of the commencement of broadcasting in Germany.

TELEVISION was privileged to visit many of the industry's Berlin based organisations recently, including the Sender Freies Berlin (SFB) broadcasting studios where automatic computer controlled television cameras and lighting equipment were demonstrated. SFB sends out television programmes on Channel 7 (v.h.f.) and Channel 39 (u.h.f.) in addition to three v.h.f. and two a.m. radio programmes.

Colour Sets

The colour television sets at the exhibition were overwhelmingly 110° types. It is interesting to contrast the German and UK television set markets. In the UK the custom of renting sets has assisted the rapid advance in the number of colour set installations. This has meant that in order to try to keep up with the escalating demand UK setmakers have concentrated to date on increasing production of their first single-standard chassis designed around 90° colour tubes. In Germany the vast majority of sets are sold individually and the emphasis has been much more on the luxury end of the market—the standard tube size is 26in. and touch-sensitive tuning, remote control and so on are common features. The result is that production has been lower in volume than in the UK though the introduction of new techniques, especially 110° designs, has been much more rapid.

There are two basic approaches to 110° scanning—the use of thick- or narrow-neck tubes. German production seems to be about 80% thick neck to 20% narrow neck. The thick-neck designs use valve, transistor or thyristor (see TELEVISION March 1972) line output stages; with thin-necked designs the thyristor line output stage is generally adopted.

Remote Control

Varicap tuners with touch-sensitive tuning arrangements are commonly used. The use of sensor systems makes it easy to introduce digital control techniques. For example ultrasonic remote control, a very popular feature in Germany, enables the brightness, colour intensity, volume and programme selection to be adjusted through switching in stages up or down under the control of the contact electrodes.

Audiovisual Switch

Many German colour sets are being sold as suitable for use with videotape machines. The main problem here is that of line synchronisation. For good off-air performance the line oscillator in a TV

The photograph used in our heading at the top of the column shows the SFB transmitting tower, Berlin.

The control console in the new SFB studios—the complex programmer is in the centre.

set should have a small pull-in range so that the noise immunity is good. With a narrow pull-in range however sets will not readily synchronise with the signal from a videotape machine. The answer is to widen the pull-in range by reducing the flywheel sync time-constant when operating with a videotape signal. Such sets are sold with an "AV" (audiovisual) switch on the user control panel to enable this to be done or with provision to add a switch for this purpose later on.

Video Recording

Videocassette and disc equipment has aroused a great deal of interest in the German market and several videocassette recorder/playback machines are already in production and on sale.

Seven German companies have introduced videocassette machines and some 40,000 machines are said to have been produced so far. Machines of this type were first shown as laboratory prototypes only two years ago at Berlin. Many of the machines shown had built-in tuners and timing switches. The system is capable of providing stereo sound but this has not so far been introduced.

TED Demonstration

Telefunken demonstrated the production version of the Teldec (Telefunken-Decca) videodisc system which is to be made available under the more affectionate name TED. An earlier version of this system was described in detail in the December 1971 issue of TELEVISION: at that time the 21cm. flexible disc with a groove concentration of 130 grooves per millimeter gave approximately five minutes' playing time of monochrome programme material. Since then colour has been added and the latest development is to increase the groove density to 280 grooves per millimeter to provide ten minutes' playing time per disc. The flexible disc is held against a pressure-sensitive transducer, which is held at a fixed height, by a cushion of air beneath the disc. The system uses frequency modulation for the recorded signal. Although the system is confined to playback only, its low cost is expected to make it an attractive commercial proposition. The colour picture quality that we could see was excellent and the demonstration showed how multiple-shape picture insets could be employed. Superimposition capabilities were also shown and a useful feature is the ability to provide short excerpt repeats and stills selected by the user.

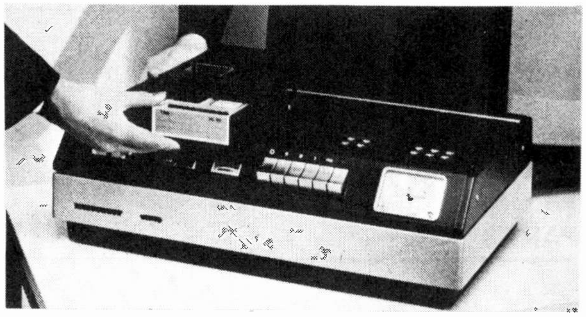
CCS System

A video recording system based on a Super-8 film scanner is being developed by NordMende and a small version was demonstrated. The intention is to go into production with this system early next year. NordMende call it the CCS (Colourvision Control Speed) system—since unlike cinema projection the film transport mechanism used in this system operates at a constant speed.

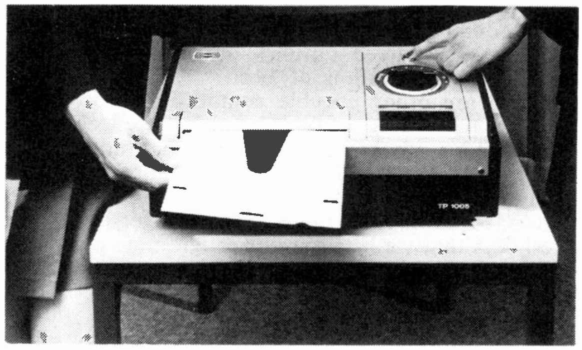
Organisation

The organisation behind the exhibition was of a very high standard—let's hope British exhibition organisers took some note of it. A new computerised information retrieval system based on the Siemens 4004//135F computer which is installed remotely at the Berlin Datel centre was used to help visitors find their way around the 23 halls and four pavilions. Two data terminals, screen viewers and printers were in operation at each of the three main entrances.

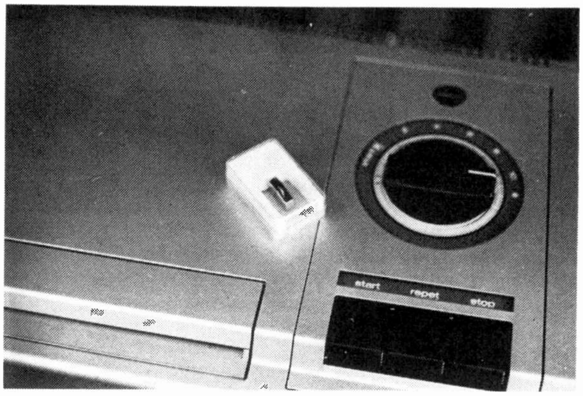
Full credit must go to AMK Berlin headed by Horst-Ludwig Stein the Managing Director and Wolfgang Nebe the Chairman of the Exhibition Committee. TELEVISION was represented in the Technical Press Section where visitors could see samples of recent work. ■



One of the videocassette tape recorders now in production in West Germany.



The Telefunken TP1005 "TED" videodisc player. The 21cm. disc in its sleeve is inserted in the slot at the front of the player. The only controls required for operation are the start, stop and repeat buttons.



This exclusive "Television" photograph shows a close-up view of the TED player with the pick-up cartridge in its box on top.

E. J. HOARE

receiver debugging

PART 3

IF AND VIDEO RESPONSES

A Television receiver's picture quality depends to a very large extent upon the response of its vision i.f. and video circuits. Any deficiencies in the design or alignment of the circuits will inevitably cause corresponding defects on the picture and these will show up as blurred outlines or multiple images—usually a combination of both.

There are other possible complications of course such as patterning caused by the presence of too much colour subcarrier at 4.43MHz or colour/sound beats at 1.57MHz. These can be dealt with fairly easily however as we shall see later. The main problem is to avoid the rings, smears, overshoots and preshoots that we listed in our programme of picture quality testing in an earlier series (see March 1973 issue).

If you look at even the best TV receivers you are likely to see traces of these defects. On bad receivers they are so obtrusive that however well designed the rest of the circuitry may be the picture is spoilt. There are obviously some fundamental problems involved in i.f. circuit design and in point of fact it is exceedingly difficult even to specify in proper engineering terms exactly what shape of response curves we want let alone how in practice to achieve them.

Since there is no short cut—no way of telling you just what i.f. and video responses to use in order to be sure of getting clean, sharp, picture detail—we shall have to try a different approach. Let us consider what sort of signal is present in the i.f. channel and what sort of distortion it is likely to suffer in its passage through several tuned circuits including a number of highly selective traps. Then perhaps we shall understand the nature of the problem a bit more clearly and see how to go about overcoming specific picture defects.

IF Sidebands

Suppose we take an item of picture detail consisting of a white line on a black blackground. The video information (drive to the c.r.t.) consists of a voltage that goes black-to-white-to-black, i.e. a squarewave in sympathy with the brightness of the image. See Fig. 1. The transition from black to white and back again is as nearly instantaneous as is possible in a television system and the edges of the squarewave are vertical. What sort of i.f. signal does this give rise to? For an answer we turn to the well known Fourier Analysis. We do not need to go into the details of this: put simply it says that any waveform can be made up by adding together a series of different sinewaves. These consist of a fundamental sinewave of a certain amplitude and frequency together with harmonics of this sinewave each having specific (clearly defined) amplitudes and phases.

Now this may sound a bit complicated but reference to Fig. 1 should dispel any mystery. It shows how a half cycle of sinewave can rapidly approach a squarewave shape by the addition of small amounts of only its third and fifth harmonics. To get a proper squarewave in television terms we need high-order harmonics in order to get the steep sides. And of course the frequency of the fundamental sinewave is that corresponding to a small part of one scanning line, i.e. a large multiple of 15,625Hz. The high-order harmonics will therefore extend out to about 5.25MHz. Thus the vision i.f. carrier at 39.5MHz has to be modulated with other sinewaves of many different amplitudes, frequencies and phases in order to convey accurately the picture information we require. This is a simplified explanation of "sidebands". In this case they extend from 39.5MHz−5.5MHz to 39.5MHz+1.25MHz, i.e. 34.0MHz to 40.75MHz, because the television signal is single sidebanded (SSB)—there is only a vestigial sideband on the upper side.

Referring to Fourier and his famous analysis again, the most important single point to emerge from our discussion so far and the waveforms shown in Fig.1 is this: we are interested in the amplitude and *phase* of each *component* of the i.f. signal in the i.f. passband; any distortion of the various signal components will alter the shape of the waveform produced at the vision detector.

Single-Sideband Operation

To make optimum use of the frequency spectrum available for television broadcasting a form of single-

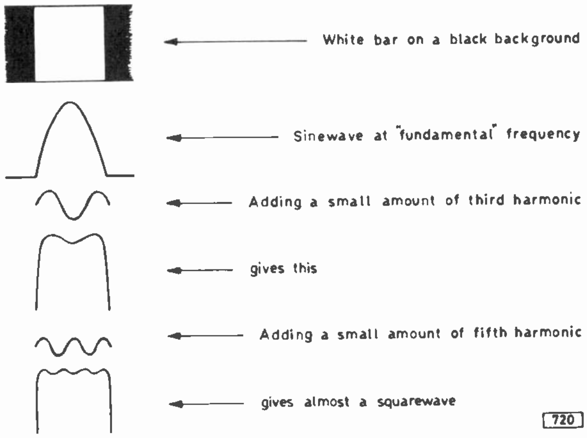


Fig. 1: A reasonable approximation to a squarewave (corresponding to a white bar on a black background) can be obtained by adding small amounts of third and fifth harmonic components to the fundamental sinewave.

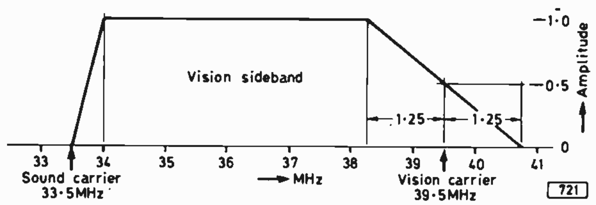


Fig. 2: The i.f. response of an "ideal" receiver matched to the vestigial sideband transmission. (Note that an amplitude of 0.5 = −6dB.)

sideband transmission is used. This is not true single-sideband operation because a vestigial sideband is present on the lower side (r.f.) or higher side (i.f.). Fig. 2 shows the i.f. response of an "ideal" receiver: the theory is that the response matches precisely the characteristics of the vestigial-sideband transmitted signal. Notice that the area of the ideal i.f. response above the vision carrier (the upper sideband) is equal to the area missing from the lower sideband: thus the overall response is equal to one complete full-amplitude sideband.

It is very difficult in practice to achieve this waveform shape exactly and it is rather doubtful whether it would give good picture quality anyway. In normal designs the i.f. response is nicely rounded, with the level at the vision carrier about 5 to 8dB below the peak of the response. It is a fairly good approximation to the ideal and avoids all sorts of circuit complexities and poor phase response which would be involved in any attempt to approach the ideal more closely.

This business of vestigial-sideband operation is rather unfortunate. You can see at once that the shape of the i.f. response is going to be critical in any quest for good picture quality. The part near the vision carrier must be shaped very carefully if a complete and undistorted sideband is to be obtained. If the slope and/or the level near the vision carrier are badly chosen there will be a bump or a dip in that part of the sideband corresponding to low video frequencies and the video response at the detector will be correspondingly distorted. A small dip is not too troublesome but a bump means that the circuits have too much response at low video frequencies and this will show up on the picture as a smear at the right-hand side of large black areas. (See Part 2 of the previous series, March 1973.)

This is the first clue in the process of hunting down the causes of poor picture responses. If you have a smear, check the slope of the i.f. response near the vision carrier. Try trimming the appropriate i.f. circuits in order to obtain a bit more attenuation at the carrier frequency. If 8dB of attenuation does not cure the trouble then either the slope of the response is wrong or else the video output circuit

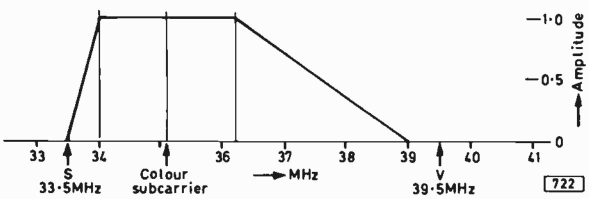


Fig. 3: The asymmetrical chrominance sidebands, shown at i.f.

has a poor amplitude response—more about that later. Meanwhile let us see what other factors govern the shape of the overall i.f. response before considering the distortions this tends to introduce.

Colour Subcarrier

The colour subcarrier has a centre frequency of 4.43MHz modulated on to the vision carrier, so the corresponding i.f. is 39.5−4.43=35.07MHz. The sidebands are fully maintained out to 5.5 and 3.13 MHz, i.e. 34.0 and 36.37MHz at i.f.—see Fig. 3. Now the sound carrier is at 6.0MHz, i.e. 33.5MHz i.f., so clearly we have a selectivity problem. There are two ways of extracting the colour subcarrier for feeding to the decoder. The best way and (as always) the more expensive is to use a separate chrominance detector with its own i.f. selectivity having a bandwidth of about 2.0MHz centred on 35.07MHz. It must have a high attenuation at the sound i.f. (33.5MHz) and preferably about −20dB at 37.3MHz to avoid luminance crosstalk. The response at the vision carrier must be maintained however in order to make detection possible. This approach involves some fairly clever filter circuits and is a rather complicated one.

A simple technique which is quite widely used employs a common detector for the sound, chrominance and luminance carriers. The response has to be attenuated in the region of the sound carrier, and in practice it is not very easy to avoid some attenuation at the colour subcarrier frequency also if a smooth response curve is to be achieved. Making a virtue of necessity it is usual to aim at an attenuation of 6dB. This produces quite a smooth chrominance response which can be compensated by an appropriate inverse slope at the input to the decoder to give an overall flat response.

The 6dB attenuation at the colour subcarrier frequency reduces the amount of 4.43MHz patterning which occurs in areas of the picture of high saturation. Most designers add a 4.43MHz filter in the luminance channel to reduce this patterning still further. A small loss of picture resolution is inevitable and a compromise has to be chosen according to individual preferences.

Sound Attenuation

It is essential to attenuate the amplitude of the sound carrier before the i.f. detector. The minimum amount of attenuation is determined by the need to ensure that the sound carrier is smaller than the space left by the minimum excursion (corresponding to peak white) of the vision carrier—see Fig. 1, page 444, August issue. If this is not the case the sound carrier will be severely amplitude modulated by the picture information. This produces a buzz on sound dependent upon picture content. Although f.m. sound limiters have a very good performance there is no point in asking them to achieve the impossible in removing large amounts of unnecessary amplitude modulation.

This consideration makes it desirable to attenuate the sound carrier by about 26dB relative to the peak of the response. This is adequate for monochrome receivers but for colour ones there is an additional requirement. The vision detector output will include a component produced by intermodulation between the sound and colour carriers, i.e. 6.0−4.43=1.57

MHz, and this produces very coarse patterning on the picture. On monochrome receivers it is not too obtrusive and a sound attenuation level of 26dB is acceptable from this point of view also. On colour pictures the pattern is particularly annoying and in order to reduce it to an acceptable level the sound attenuation should lie in the range 30-40dB.

Adjacent Channel Rejection

It is necessary to be able to operate receivers in areas where a programme is transmitted on an adjacent channel, i.e. one of the two channels next door to the one you want to receive. This situation is avoided in most areas by careful transmitter planning and location but it does exist in a few places. It is particularly likely to occur in areas of high ground or where a long sea path is present between an unwanted transmitter and the receiver—the sea allows good signal propagation, hence the trouble.

In order to prevent a sound or vision carrier from an adjacent channel breaking through into the wanted i.f. passband a high attenuation is necessary at intermediate frequencies corresponding to these carriers. To protect against the adjacent f.m. sound carrier an attenuation of about 40dB is desirable at 41.5MHz while to protect against the amplitude modulated adjacent vision carrier an attenuation of about 50dB at 31.5MHz is needed.

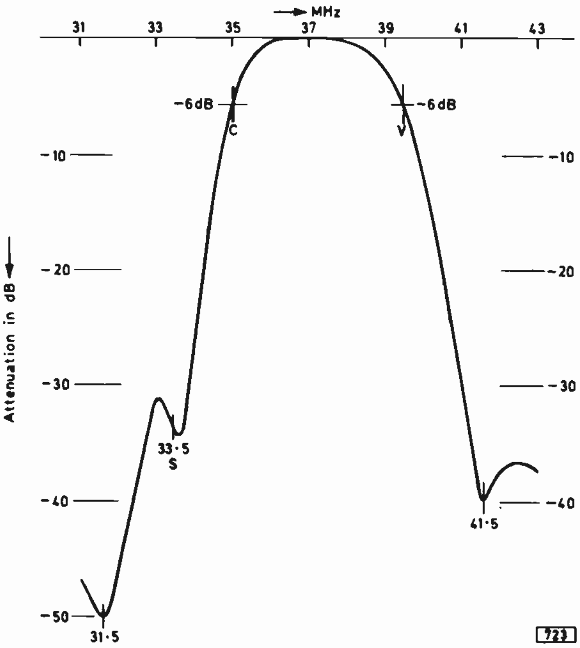


Fig. 4: A good i.f. response curve.

Overall Response Shape

There are a few other refinements which can be built into the specification of an overall i.f. response but apart from commenting upon the need to avoid "returns" of the response outside the band let us summarise the requirements discussed so far. Fig. 4 shows a typical overall i.f. response curve with the appropriate attenuation at each carrier frequency and a smooth shape.

The importance of a smooth shape is this: any sudden discontinuity in an i.f. response is associated with a phase change at the frequency concerned and this may cause a displacement of the Fourier components of the signal, and hence distortion, as we discussed earlier.

Having chosen a suitable overall i.f. response curve shape the question is—will this give a good picture? The answer depends to a large extent upon the "group delay" performance.

Group Delay Response

Any sinewave passing through a tuned circuit suffers a delay, the amount by which it is delayed depending upon the bandwidth of the circuit. A narrowband circuit causes more delay than a wideband one. Hence in colour receivers a delay line is provided in the wideband luminance channel so that the total luminance signal delay time is equal to that of the narrowband chrominance channel. This ensures that both the luminance and the chrominance information arrive at the c.r.t. screen at the same time and therefore register correctly.

Now if you feed an i.f. signal with all its sidebands at their various frequencies to an ill-designed i.f. strip you will be in trouble: different frequencies will suffer different delays. Thus information corresponding to a sharp black-to-white transition or step response entering such an i.f. strip would reach the detector spread out over a small period of time. The sharp transition thus becomes blurred. Sometimes the different frequencies are delayed in bunches and you then get overshoots.

A good i.f. strip is designed not to have constant phase angle characteristics but constant time delay instead, so that all frequencies are delayed by the same amount. They then all arrive at the detector at the correct instant in time. In practice it is almost impossible to achieve this over the whole i.f. passband but the best i.f. designs get near to it. They are said to have good "group delay" performance.

Fig. 5 shows a typical group delay curve for a complete i.f. strip. You will notice that at high video frequencies (34MHz) the time delay is 200nsec (0.2μsec) different from that at the carrier (which corresponds to 0Hz video). How important is this? Well a medium sized c.r.t. has a picture width of about 400mm. corresponding to a line scanning time of about 52μsec (flyback time is usually 12μsec giving 64μsec per line). So the picture displacement caused by 0.2μsec delay is 0.2/52 x 400=approximately 1.6mm. This can clearly not be ignored, but

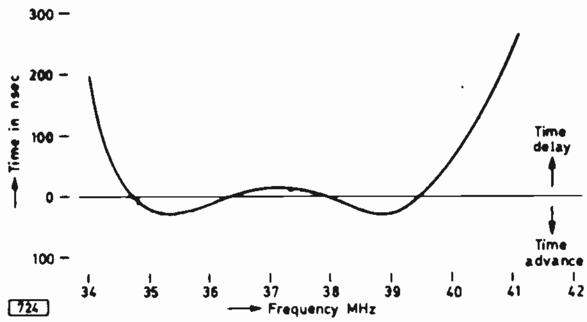


Fig. 5: A group delay curve for a complete i.f. strip.

since it occurs only at high video frequencies which cannot be properly displayed the effect on the picture will not be too serious.

Reducing IF Distortion

It is clear now that there are two fundamental requirements of any i.f. strip, bearing in mind the Fourier make-up of the signal. First each sideband component of the signal must reach .the detector at the correct *amplitude* in relation to all the other signal components; secondly it must reach the detector at the right *time*. Any failure to meet these two requirements will result in distortion of the detected video signal, causing rings, smears, overshoots or preshoots. Preshoots of course are caused by a time advance instead of a time delay relative to the carrier.

Now comes the important question—how do we avoid these amplitude and time distortions? There is unfortunately no way of giving a complete answer but we can at least explore a few useful do's and don'ts.

Fig. 4 showed a good basic overall i.f. response curve. Note the attenuation of 6dB at the vision carrier frequency and the smooth slope above and below this frequency. Attenuations of less than 6dB at this frequency usually give a smeary picture because there is too much l.f. response relative to the h.f. response at about 35MHz when the vestigial sideband is added to the main sideband. So here is our first point: if there are smears on the picture pay special attention to the i.f. alignment or circuit design where it affects the response in the region of the vision carrier. If adjacent channels are not present at your particular location the adjacent sound trap at 41.5MHz can be detuned upwards to give a smoother i.f. response curve.

Our next point concerns the response at the upper end of the video passband in the region of the colour subcarrier, i.e. video frequencies of 4-5MHz. The curve here (34.5-35.5MHz) must be smooth as shown in Fig. 6. It is better to sacrifice a little bandwidth and have a smooth curve than to have a wide bandwidth and a steep flank to the response.

A steep response near a trap frequency nearly always involves a sharp change of phase and hence a group delay (or time) error. This causes overshoots or rings.

By the same token we come to our third point. Any sudden discontinuity in the response curve means a phase change and hence a time error. Now the overall curve may look very nice, but if it is achieved by adding together the responses of two or three stages with one filling in the gaps in another

(a) The dotted response will give more bandwidth and more rings too!

(b) Avoid building up response curves by ill-matched stages.

Fig. 6: All response curves should be as smooth as possible.

you are asking for trouble. The amplitudes may add up nicely but the time errors will probably *not*. The curve of each individual stage in the i.f. strip should be as smooth as possible.

Ideal Design

The ideal design has quite a large number of separate i.f. stages, each one having a smooth response and contributing only a moderate amount of selectivity. The large amount of selectivity required overall is achieved by adding together the modest attenuations provided by each stage individually. Unfortunately this approach is too costly for commercial designs and really good picture quality is left in the hands of the amateur experimenter!

Retrimming

So if you have a receiver with bad i.f. distortion and the appropriate test gear try retrimming the i.f.s strictly to the maker's service data and see what improvement you can make. Then if you feel adventurous try retrimming individual circuits one at a time bearing in mind the principles we have discussed. Even small changes of trimming can have quite a significant effect on the picture. Go about things in a careful, systematic way and avoid the temptation to rush about with a screwdriver twiddling every core in sight.

A good technique is to note the adjustment of a circuit and then try the effect of a particular change of trimming. See what happens to the picture resolution and then retrim the circuit to its original condition. This process can be repeated on each tuned circuit in turn without any danger of getting the whole i.f. strip in a mess. The obvious warning of course is that if you are not equipped for the job or are not sure what you ought to be doing leave well alone: i.f. alignment is a tricky business.

Video Circuits

Not all picture resolution defects can be blamed on the i.f. strip. The video output stage can play an important part too. In fact an ill-designed circuit can cause most of the effects that we have been discussing in connection with the i.f. channel, but generally on a much reduced scale. (In general servicing work on old receivers however, ageing and value changes in the video circuits cause most trouble and should receive attention first.)

If the video channel bandwidth is too narrow there will be loss of resolution and you will not be able to see clearly the 4.5MHz frequency gratings of the standard test card. There is no excuse for transistor video output stages lacking in bandwidth but it is a fairly common occurrence with valve video output stages where the problems are rather more difficult. If you cannot get good resolution even when slightly overtuned check the video stage. Make sure that the lead to the c.r.t. is hanging loose and is not in a cable harness. The extra stray capacitance may be enough to lose some valuable bandwidth.

A drooping response as shown in Fig. 7(b) will cause moderate smearing unless it is compensated by too much h.f. response in the i.f. channel. A rising response—Fig. 7(c)—will tend to cause or accentuate overshoots and rings. This is partly be-

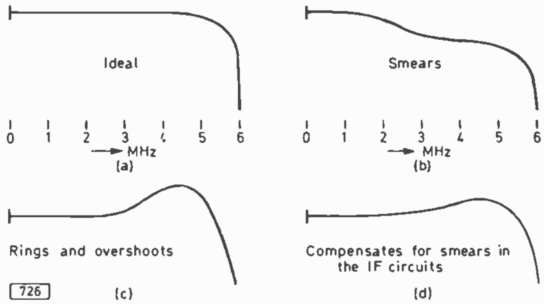


Fig. 7: The effects of different video responses.

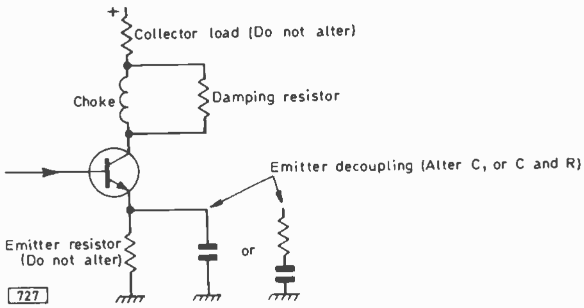


Fig. 8: The response of a video output stage can be modified by altering the damping of the peaking coil or the emitter decoupling.

cause the h.f. components of the signal are too large and partly because there will probably be a sharp fall-off at around 4-5MHz. The resultant abrupt phase changes will distort the time of arrival of the h.f. signal components which are responsible for the clean transitions from black to white and back again.

Adjusting the Video Response

Both these effects can be improved by altering the h.f. feedback of the output stage—see Fig. 8. Most designs have partial decoupling of the emitter or cathode by a capacitor of a few hundred picofarads. A larger capacitor, say increased in value by 50%, will give more h.f. gain by reducing the negative feedback at h.f. and will thus lift the response. A smaller value decoupling capacitor will result in the h.f. response falling. Similarly a choke of about 100μH with some parallel resistive damping will raise the h.f. response. Too much damping will reduct its effect: not enough damping may cause rings on the picture.

Remember also that too much capacitance or any high-impedance networks between the vision detector and the grid or base of the video output stage will cause loss of bandwidth, so keep an eye on both your circuit design and the physical layout. Keep leads short unless the circuit impedance is low.

As a final comment on i.f. and video problems we repeat the point made earlier. It is nearly always better to have a smooth and correct response with a small loss of bandwidth than to distort the signal in an attempt to achieve that last 0.5MHz. The improvement in picture resolution will be spoilt by the defects it introduces. Try retrimming for a good picture!

CONTINUED NEXT MONTH

YOUR PROBLEMS SOLVED

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BUSH TV56

I have modified this set for 625-line operation, using the surplus conversion unit featured in your November 1970 issue. The only modification I had to make in the line timebase was to fit a resistor in parallel with the line hold control—the timebase unit is otherwise as originally manufactured. Hum has since appeared on the raster, however, putting an S shape on the picture.—G. Hadfield (Baldock).

The h.t. supply to the line oscillator is decoupled by a 2μF electrolytic (C22). This and the main smoothing electrolytic (C33) in the supply to the timebases should be checked. The ECC83 line oscillator valve could well be at fault however.

KB SV148

When the picture first comes on it rolls downwards very fast. Then after two or three seconds it stops rolling leaving a third of the screen at the bottom blank. The picture then expands (after about three seconds) to normal. After operation for about an hour the picture is compressed at the bottom by about an inch. On examining a test card display the picture is seen to be compressed at the right-hand side by about an inch.—T. Conway (Cheam).

The rolling, etc., indicate that the PCL805 field timebase valve is in need of replacement. The right-hand side compression is a line timebase fault: the PL504 line output valve may be low emission or alternatively the line linearity and width controls may require careful setting up.

FERGUSON 3626

The main trouble with this set is field bounce. When the set is switched on the picture jumps up and down. If the hold control is adjusted the picture can be steadied somewhat so that it rolls up or down. After about an hour the jumping slows down and the picture then floats up and down. The second problem is about 1½in. of foldover at the bottom of the raster. The PCL85 field timebase valve and the 100μF output section cathode decoupler have been replaced without improving matters. Replacement main electrolytics and a new PFL200 video/sync valve have also been tried.—T. Jackson (Dulwich).

The trouble is in the field timebase circuit and the two faults may or may not be due to a common cause. The most likely cause of the trouble is that the operation of the timebase is being upset as a result of one of the linearity feedback capacitors being faulty. Check C90 (0.03μF) and C88 (0.01μF) therefore. The value of the cathode bias resistor R112 (360Ω) should also be checked. This should cure the foldover: if the jitter persists check the cross-coupling capacitor C79 (0.003μF) back to the triode, the sync pulse coupler C85 (0.001μF) and the output pentode grid leak resistor R106 (2.2MΩ). (BRC 900 chassis.)

GEC BT302

I have been reading your articles on servicing the GEC BT302 series in the January and February issues 1972. The value of the resistor (R105) in series with the field hold control is given as 330kΩ. Should this be 390kΩ?—T. Parkins (Liverpool).

We regret this slip: the value of R105 should be 390kΩ, not 330kΩ. The copy we had of this rather old circuit was not too clear. Fitting 330kΩ should however keep the field hold control within its range. The only other mistake we know of on this circuit is that the c.r.t. heater pins are shown in the heater circuit as 7 and 8 (as on the manufacturer's original): they should of course be 1 and 8 as shown at the c.r.t. base.

ULTRA 6627

The fault on this set appears only when it has warmed up. The picture then starts shaking horizontally. If the aerial is removed for about 15 minutes (with the set still working) then put back the picture is all right for a few minutes. Increasing the brightness speeds up the shaking. The e.h.t. tray and all valves in the line timebase have been replaced and all voltages are correct.—S. Greene (Filey).

It seems to us that your model is fitted with the version of the BRC 900 chassis that incorporates a flywheel sync circuit mounted on a small panel to the left of the line output section. The preset control on this panel often gives trouble as do the sync diodes. Check this area, if necessary using a cooling solution such as Freezit to locate the component at fault—or alternatively change this small panel.

GEC 2040

More often than not when the set is switched on the picture comes on in monochrome. The colour appears gradually two or three minutes later, first in horizontal bands which move up and down the screen, subsequently stabilising as the correct colours. The condition seems to be sensitive to ambient temperature. It is so erratic unfortunately that it is not possible to make voltage checks.—C. Pearson (London W4).

We suspect that the reference oscillator transistor TR328 or the emitter-follower TR329 is faulty or that there is a dry-joint in the reference oscillator subassembly (PC314). It is also possible that the zener diode D325 connected across the oscillator frequency control P302 is intermittent.

BUSH TV125

We are experiencing difficulty in obtaining even spacing of the raster lines, the top half of the raster being more expanded than the bottom. Adjusting the height and field linearity controls does not help matters. The field timebase valves have been replaced. Some foldover is produced at the top of the raster when the overall field linearity control is adjusted. Another fault is that when white lettering (captions etc.) come on the screen there is a loud buzzing noise.—P. Mutford (Bicester).

The field troubles suggest a fault in the linearity feedback network and the first suspects are 3C32 (0.1μF) and 3C26 (0.022μF). If replacing these does not help check the other capacitor in the loop, 3C27 (0.1μF). The buzz should be minimised by adjusting the a.g.c. delay control 2RV1. If not change the final i.f. amplifier valve 2V3 (EF80).

HMV 2643

The original complaint was no picture due to absence of e.h.t. A brand new 6/30L2 line oscillator valve cured that. Unfortunately however the line hold control has to reset about every ten minutes. The sync separator and video valves have been replaced, also the line hold control and its series resistors and the anode resistors in the line multivibrator circuit but with no improvement. I would welcome any comments you can make before I get involved in the flywheel sync circuit.—E. Leatherhead (Ipswich).

There is a bias stabilising resistor in the video amplifier circuit—R26 (39kΩ) from the screen grid to cathode. This nearly always changes value, making accurate line locking difficult. If changing this does not do the trick replace the flywheel sync diodes. These are encapsulated as a common block (type BA126) but a pair of BA144 or similar diodes can be used instead. (BRC 981 chassis.)

EKCO T526

This set has developed white bars down the left-hand side of the screen, gradually disappearing towards the centre—R. Gracehorn (Petersham).

The trouble is due to the line linearity coil ringing as a result of its damping resistor R159 changing value (correct value 1.5kΩ). Note that R159 is not mounted on the printed panel with the linearity coil L32, being on the line output transformer assembly instead. (Pye group 368 chassis.)

PHILIPS 19TG156A

The picture detail is good but lacking crispness, in other words generally grey, in spite of fitting a new c.r.t. The contrast control seems to be working correctly since it has a distinct effect on the picture. The i.f. and video output valves have been replaced, also the tuner valves. The sound and raster are correct. A new h.t. rectifier has been fitted.—T. Greyson (Wolverhampton).

The OA70 vision detector diode could be faulty and we suggest you check its front-to-back resistance. This can be done by switching to 405 lines and connecting an ohmmeter from chassis to pin 2 (grid) of the PL83 video ouput valve. With the leads one way round the reading should show virtually a dead short-circuit. Reverse the leads and the reading should be over 4kΩ. If these readings are obtained the diode is OK: if a reading of 4kΩ is obtained in both directions or a short is indicated in both directions the diode should be changed. Check the 250μF cathode decoupler in the video output stage as well.

BUSH TV108

The picture is perfect at times but then goes negative and dull. The e.h.t. is good and all valves have been checked.—O. Rowton (Hull).

We suspect that the c.r.t. has an intermittently faulty heater which is partially shorting at times. The normal voltage across the heater pins 1 and 8 should be about 6V but will drop to well below this when the short occurs. Sharply tapping the tube neck may clear the fault for a limited period.

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TELEVISION OCTOBER 1973

TEST CASE

130

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 Ferguson Model 3646 (BRC 1400 chassis) had the annoying symptom of line drift on both v.h.f. and u.h.f. The chassis employs a blocking oscillator type line generator controlled by a dual-diode flywheel sync discriminator via a d.c. amplifier. The latter stage consists of the triode section of a 30FL14 while the oscillator itself uses the triode section of a 30FL1.

The diodes and both valves were checked by substitution but the symptom remained and the line drift was significant after protracted periods of use. The anode voltage of the d.c. amplifier triode controls the oscillator frequency by adjusting the d.c. voltage at the grid of this stage. There are two series resistors in the feed, one of 2.2kΩ and the other 330kΩ. Both resistors were replaced to no avail.

Subsequent voltage tests at the anode and cathode of the d.c. amplifier gave readouts slightly greater than specified, the margin increasing with the operating time of the receiver. The conduction of the d.c. amplifier is varied by the discriminator output which is fed to its grid while its d.c. stability is established by a potential-divider network at its cathode.

What was the most likely cause of the trouble, bearing in mind that valve replacements failed to effect a cure? See next month's Television *for the solution and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 129

(Page 523 last month)

It will be recalled that the c.r.t. cathode voltage was abnormally low. As the c.r.t. cathode is d.c. coupled to the anode of the PFL200 video amplifier in this model the voltage there was low as well of course. This indicated excessive valve current which was subsequently confirmed when it was observed that the PFL200 screen grid resistors were overheating.

Insufficient grid bias is the usual cause of heavy current and as the PFL200 itself checked OK this possibility was next investigated. A voltage test at the cathode indicated something less than 1V, the correct figure being 6V. The cathode bias resistor is decoupled by an electrolytic capacitor and tests on this after disconnecting one end revealed that it was of low insulation, thus reducing the effective cathode circuit resistance.

Replacing the electrolytic completely cleared the trouble and eliminated the overheating in the screen grid circuit resistors. This is a typical case where incorrect video amplifier biasing results in incorrect c.r.t. operation, making it impossible to blank out the raster completely with the brightness control. Once the video amplifier valve in this type of circuit (d.c. coupled) has been checked—preferably by substitution—the next move should be a check of the valve biasing; and when an electrolytic capacitor is used for decoupling in the cathode circuit this should figure high on the testing list.

Published on approximately the 22nd of each month by IPC Magazines Limited, Fleetway House, Farringdon Street, London EC4A 4AD. Printed in England by Fleetway Printers, Crete Hall Road, Gravesend. Sole Agents for Australia and New Zealand—Gordon and Gotch (Asia) Ltd.; South Africa—Central News Agency Ltd. Publisher's subscription rate (including postage): for one year to any part of the world, £2.65. International Giro facilities Account No. 5122007. Please state reason for payment "message to payee". "Television" is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first having been given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, and that it shall not be lent, resold, hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

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CME2101, AW53-88, AW53-89, CRM211, CRM212, MW53-20, MW53-80, CME2104	21″	£8.66	65p	SUBJECT
CME2303, CME2301, AW59-90, AW59-91 A59-15W, CME2308	23″	£10.45	65p	VAT

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MW36/24 & 44	£5.23
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A47-11W & 26W	£9.35
A50-120W/CME2013	£11.55
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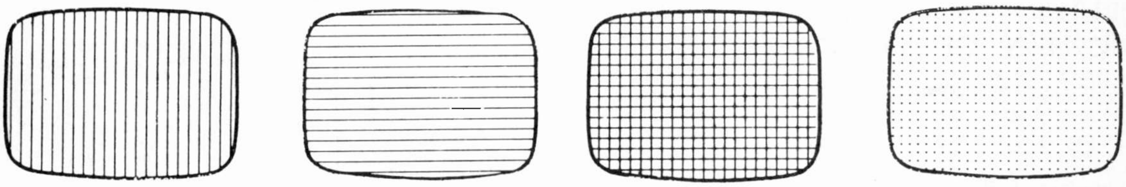

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