PRACTICAL

TELEVISION

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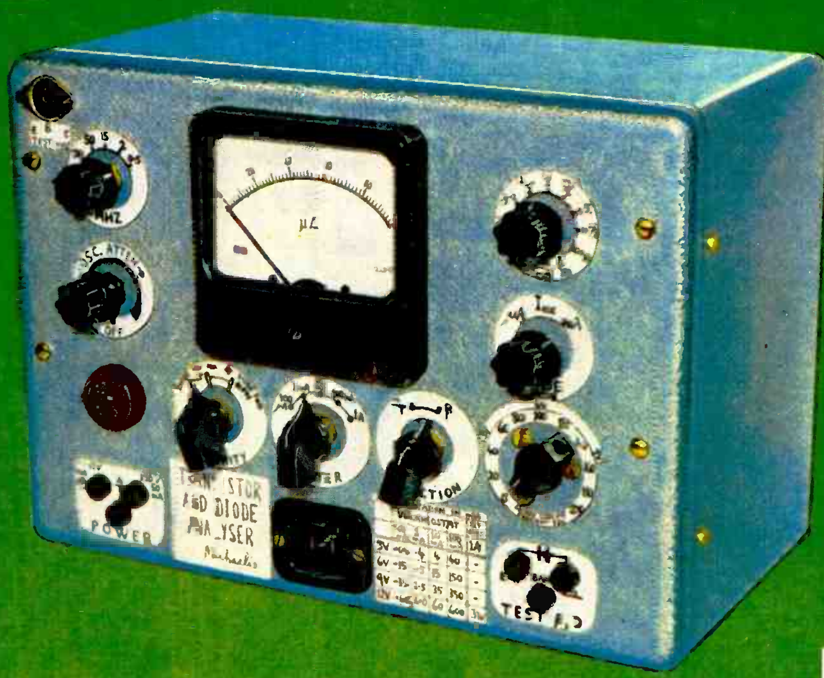
OCTOBER 1969

TRANSISTOR AND DIODE ANALYSER



also: HEAT PROBLEMS IN TV RECEIVERS

PRACTICAL
TELEVISION

VOL 20 No 1
ISSUE 229

OCTOBER 1969

EARLY WARNING NEEDED!

There are various stages in the design of a TV set. First a performance specification must be drawn up. Then a basic design capable of providing this performance built. This has next to go through a metamorphosis that changes it from a laboratory hook-up into a practical proposition for the mass-assembly line. And of course at about this stage field testing must be undertaken to find out what unforeseen snags occur when the set is in actual use.

There is a feeling that this latter process—and the radio and TV industry are certainly not alone in this respect—is inadequately undertaken, leading to those well known faults that bedevil early production models. Commercial pressure is of course strong at this time: a model cannot be left too long in the development stage prior to being marketed lest competitors snatch the advantage of introducing something that pips you to the post.

Where our readers come in—since so many are concerned with service work of one kind or another—is that they very often have to bear the brunt of this difficulty—sorting out the snags that irate customers find in their brand-new up-to-the-minute receivers. Is there anything that can be done to help?

Commercial secrecy is understandable but we feel that insufficient is done to prepare the service trade for the problems that eventually get landed in its lap. This is especially true at the present time when with the trade reeling from the problems of the introduction of colour TV we are about to be faced with i.c.s. and a host of new devices and techniques. Practical TV will as always do its best to prepare its readers for what is to come. But we all depend on the willingness of those who are at work on the next generation of headaches to be forthcoming. It helps everyone in the long run for as much information on what's going on to be available at the earliest opportunity.

W. N. STEVENS, *Editor.*

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TELETOPICS

ACTIVE RECEIVING AERIALS NOW SUCCESSFULLY TESTED

A new receiving aerial with active elements for 100-156MHz has been devised by Rohde & Schwarz together with the Electronics Department of the Technical University of Munich (Director Prof. H. H. Meinke). All measurements and tests carried out so far have given very good results and have proved the outstanding advantages of this type of aerial. Featuring low noise, low cross-modulation, immunity to lightning and other environmental influences and remarkable compactness these aerials are intended at present for use in air-traffic control. In the centre below a circular plate of 30cm. diameter a transistor amplifier is housed in a metal cylinder and connected to the top plate via a series resonant circuit with a very low series capacitance. The top

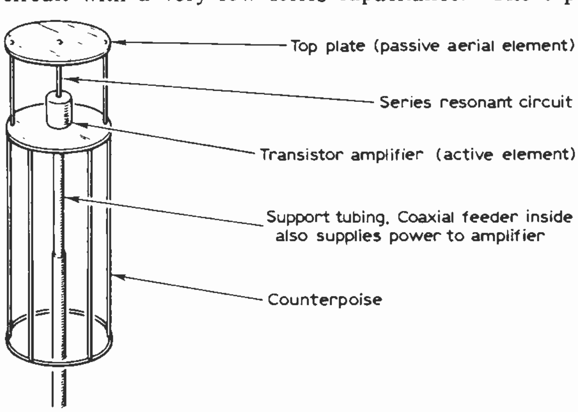


plate is supported by two outer metal rods which at the same time are used for connection to earth and are permanently connected to the basket-shaped counterpoise. The supply voltage is applied to the transistor amplifier via a coaxial cable run through the support tubing; this cable is also used for the trans mission of the received and the amplified r.f. signals.

Electrically the antenna is a high capacitive-loaded double-folded monopole. The passive antenna portion (top plate) is designed so that the antenna itself acts as a bandpass filter in the operating frequency range, obviating the need for filters between the passive portion of the antenna and the amplifier. This bandpass filter heavily suppresses mixture products and cross-modulation by frequencies outside the operating frequency range. The arrangement of the active element (transistor amplifier) permits optimum matching to the antenna with the noise figure being at a minimum.

The small active antenna Type HA 430/141 boosts the received r.f. signals with only a small rise in noise temperature. Even in the case of long high-loss cables between the antenna and the receiver the good receiving characteristics are not affected due to the amplification of the transistor.—Aveley Electric Ltd., South Ockendon, Essex.

TELETON CCTV EQUIPMENT

A compact low-cost CCTV system with numerous applications is expected to be available from Teleton in October. The camera will cost £54.17.6d, and camera with monitor and five lenses from standard to telephoto £148.5.0d. The unit can be used with its own 9in. monitor or connected to any domestic TV set. The camera has transistorised circuitry and a vidicon tube. Teleton Electro (Distributors) Co. Ltd., Teleton House, Robjohns Road, Widford, Chelmsford, Essex.

SOLDERING-IRON STAND

Available from Light Soldering Developments Ltd. of 28, Sydenham Road, Croydon CR9 2LL is the Liteguard soldering iron bench stand, designed to hold safely a hot soldering iron. Both element and bit are shielded and the stand may be vertically or horizontally mounted. The Liteguard is designed to protect the iron as well as the user and sells at 25s.

LATEST TV SETS

The main news this month is the announcement by Thorn/BRC of the first sets fitted with the new Thorn 3000 single-standard colour chassis. 19in. and 25in. models will be available in the **Ferguson, HMV** and **Ultra** ranges with prices ranging from £235.10.0d. for the 19in. Ferguson 3703 table model to £302 for the de-luxe 25in. **HMV** console Model 2705. In the **Marconiphone** range are the 19in. Model 4703 at £235.10.0d. and the 25in. Model 4705 at £296.10.0d. Like the dual-standard 2000 chassis, the 3000 chassis is fully solid-state throughout and uses modular construction with plug-in printed boards. The new chassis results in colour sets closely comparable in size to current monochrome ones and not appreciably heavier. Other new sets from the Thorn group this month are the **Marconiphone** 17in. portable Model 4661 (price to be announced) and 24in. Model 4659 at £84.12.0d. Both these models are fitted with the 1400 dual-standard chassis.

From the Pye group there is the **Invicta** 20in. Model 7354 at £79.10.0d, fitted with the dual-standard hybrid 368 chassis.

The "Trendy Set" announced by **Sanyo** is a battery/mains single-standard portable model fitted with a 10in. picture tube. Price is yet to be fixed but should be less than £70. Model number is 10-T120(U).

BEULAH CCTV MONITOR

To meet the demand for a low-priced CCTV and studio monitor Beulah Electronics have introduced Model 1100. The monitor is transistorised with a sealed-face 11in. c.r.t. and is designed for stacking so that a number of units will occupy minimum space. Termination of coaxial is switched and a black-level clamp circuit can be supplied as an optional extra. The unit operates on 625 lines with a bandwidth of 5MHz (+3dB) and is priced at £120.

Also available from Beulah Electronics Ltd. (126, Hamilton Road, West Norwood, London, S.E.27) is a booklet on their CCTV and videotape equipment for industrial training.

REDIFFUSION REMOTE PROGRAMME SELECTION SYSTEM

Rediffusion have now fully developed and tested in use the whole range of cables and equipment required—except the remotely-operated programme selection switches—for their proposed remote programme selection system on h.f. CATV (wired television distribution) mentioned in our report from Montreux in the August issue. The idea is to provide each receiver with its individual connection to a central programme exchange where a wide choice of programmes will be available. These are all received on the same channel and are selected by the subscriber by means of a telephone-type dial in the home acting on a rotary selection switch in the exchange. Once installed therefore the subscriber network needs no further modification however extensive the choice of programmes becomes. For use with a standard TV set the signal is fed via an inverter unit for frequency conversion containing a single transistor and three diodes.

The programme selection switches have now completed their development in the laboratory and a small-scale remote selection system is being installed in TV studios at Teddington.

BRC EXTEND LARGEST TV PLANT

A 73,000 sq. ft. extension to the BRC Ultra factory at Gosport has now been opened. The Gosport plant is claimed to be the most modern and largest in Europe and produces the entire brand range of Thorn/BRC monochrome receivers. In addition to production of Ferguson, HMV, Marconiphone and Ultra models sets are produced for the Thorn rental organisations Radio Rentals, DER and Multibroadcast.

Starting with design and development, the factory makes its own chassis and most of the components. One set is completed every 10 seconds and the new extension will provide additional capacity of 15,000 sets per week.

The factory is at present concentrating on the production of the forthcoming 1500 single-standard monochrome chassis, which is so compact that its electronic parts are reduced to almost transistor portable dimensions.

RANK CCTV OFF-AIR RECEIVER

The Broadcast Division of Rank Precision Industries Ltd., announce a new off-air television receiver which has been designed as an addition to closed-circuit television installations. The receiver enables r.f. television programmes to be viewed on video monitors a large number of which can be fed from the one source. The receiver will be found to satisfy the majority of requirements where a good-quality video and sound signal is required from off-air sources. Rank Precision Industries Ltd., Bessemer Road, Welwyn Garden City, Herts.

BBC-2 COVERAGE EXTENDED

The **Skipton** relay station was brought into operation on July 21st on channel 45 with vertical polarisation. Use a Group B aerial directed towards the site about 5 miles west of the town centre. The other channels assigned to the station are 39, 42 and 49.

Transmissions from the **Angus** station started on July 28th on channel 63 with horizontal polarisation. Use a Group C aerial. The other channels assigned to the station are 53, 57 and 60.

The **Darwen** Lancashire relay station came into operation on August 25th on channel 45 with vertical polarisation. Use a Group B aerial. The other three channels assigned to the station are 39, 42 and 49.

Planning permission has now been obtained to go ahead with the 700ft. **Emley Moor** mast to take over from the temporary 300ft. mast. It is hoped to have the mast with its aerials in operation by the end of November.

A BBC-2 transmitting station is being built at **Bilsdale West Moor** in the North Riding and should be ready for service this autumn. BBC-1 in colour on u.h.f. will be added in about a year's time.

A BBC-2 relay station at **Keighley** is nearing completion.

REDIFFUSION MARKET IVC EQUIPMENT

Colour videotape recorders and cameras made by International Video Corporation are now being marketed by Rediffusion for colour CCTV use. The IVC 600 and 800 series recorders have been developed for colour working and use helical scan with "Alpha" wrap, a tape wrap arrangement which gives nearly 100% head-to-tape contact. Three vidicon tubes are used in the 100 series colour cameras. Rediffusion Central Services Ltd., Carlton House, Lower Regent Street, London, S.W.1.

TRANSISTORS IN TIMEBASES

3 LINE OSCILLATORS

H. W. HELLYER

IN THE days when we were learning about radio and television fault diagnosis our mentors used to tell us we would make quicker progress by going backwards. They meant of course that the easiest way to fault-find is to sample signals at the output end and work back towards the source. In looking at television timebases, and in particular those few to date that employ transistors, we may find it helpful to follow a similar procedure. Last month we took a brief look at line output stages and compared one or two older types with up-to-date circuits. Before we can usefully discuss field timebase circuits and cover the rather different colour television configuration we should go back to the pulse production and shaping sections and consider some of the limitations here.

We have already noted the difficulty imposed by transistor characteristics upon switching circuits (see Part 1, August 1969 PRACTICAL TELEVISION) and will show in this article how some of the problems are overcome or, in some cases, avoided.

BASIC REQUIREMENTS

Line oscillators are a special case and merit a separate study. The multivibrator can be disregarded; even in valved circuits improved frequency control with sinewave and blocking oscillators make these a prime choice and, as we shall show later, the silicon-controlled switch is likely to supersede them eventually. Where transistor designs are under consideration the blocking oscillator has other advantages besides the ease of frequency control. These are (a) the fast switching times that can be gained and (b) the low output impedance.

Flywheel synchronisation is standard practice and several different types of phase detector are in use. Direct synchronisation is not really feasible with transistorised designs because, as discussed last month, a large flyback ratio is employed to get maximum deflection energy without excessive peak collector voltages. With a large flyback ratio the flyback time is greater than the blanking interval in the transmitted waveform and if direct sync were used the line timebase scan would commence too late. With transistors, too, the added problem of hole storage has to be taken into account. There will be a couple of microseconds delay between the initiation of the synchronising pulse and the line output transistor switch-off. So flywheel synchronisation is imperative for transistorised designs.

BLOCKING OSCILLATOR

The blocking oscillator used in transistorised timebases is basically the same as its valved counterpart. A simple example with a single *RC* time-constant network is shown in Fig. 1. A negative triggering pulse at the base of Tr1 or a positive pulse at the collector will cause the base to become slightly negative with respect to the emitter (using a pnp configuration) and as collector current then flows through the primary winding of the transformer T1 the base voltage becomes more negative and the transistor eventually bottoms.

The total current is limited by the collector winding and the load. The collector waveform has a step, as shown in Fig. 2, due to the effect of the base feedback winding and the load of the succeeding (driver) stage. After this, as would be expected from the application of a constant voltage across an inductance, the current rises linearly. The constant voltage is produced by the action of the feedback

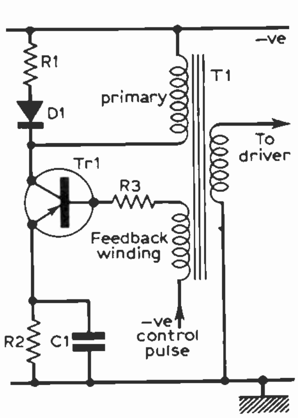
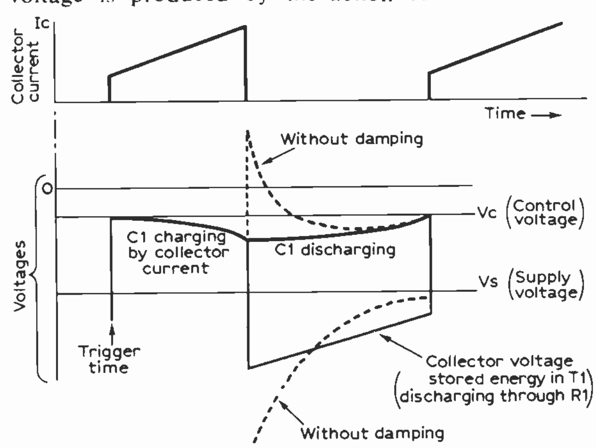


Fig. 1 (left): Simple transistor blocking oscillator circuit. When Tr1 is triggered into conduction rising collector current drives the base more negative via the feedback winding on T1. C1 charges during this period. When Tr1 bottoms, the field in T1 collapses and the base is then driven hard off so that the circuit blocks. C1 then discharges.

Fig. 2 (right): Waveforms showing the action of the blocking oscillator circuit.



winding and the collector current goes on rising until the transistor bottoms. Base current then ceases, the transistor comes out of the bottomed condition and the circuit blocks.

The voltage in the feedback winding collapses in sympathy with the primary voltage and as there is a large amount of feedback the switching action is rapid. The duration of the off or blocked condition is determined by R2 and C1, the latter being charged by the flow of emitter current during conduction. C1 discharges through R2 when the transistor is blocked, sending the emitter toward chassis potential. Figure 2 shows the sequence and also shows the way that this change of emitter voltage is interrupted by the potential of the base input, i.e. the sync pulse which initiates conduction once more.

If the incoming pulse is too large and C1 too small there will be a large emitter swing which reduces the power drive to the next stage and limits the frequency control achieved by the incoming sync pulse. The opposite condition, of a small sync pulse and a large capacitance, makes the timing very touchy both for variations in supply voltage and temperature.

When the transistor switches off, a voltage spike is developed by the energy in the transformer inductance. We cannot use it in the way we use the collapsing pulse in line output stages, so R1, D1 damp it out. The dotted line in Fig. 2 shows what the curve would look like without these components.

FLYWHEEL LINE SYNC

Before going on to give practical examples it would be advisable to say a few words about flywheel synchronisation, reactance and phase detectors: we can conveniently chop off our circuits at the line output driver but it is almost impossible to disentangle the oscillator from its regulated triggering.

The basic flywheel circuit design will be familiar to most readers: Fig. 3 shows the block diagram. The operation depends on the phase shift caused when the oscillator runs off-true being detected and converted to a control potential to correct the errant oscillator.

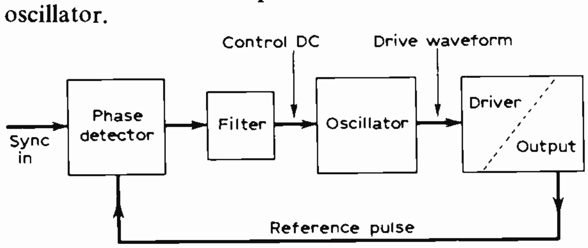


Fig. 3: Block diagram of the basic flywheel synchronisation system. The phase detector provides the correction signal while the time-constant of the filter gives the flywheel effect. The reference pulse may be taken from the oscillator but is generally derived from the output stage as shown here.

Like all servo control systems it has its own in-built error. There will be a difference between the free-running oscilator frequency and the synchronised frequency and a permanent phase shift which will depend on the control sensitivity of the oscillator as well as the output from the phase detector. This last should be independent of the supply voltage and signal variations, and the pull-in range has to be fairly wide to overcome changes due to mains supply frequency difference from transmitted frequency locks. To get the best anti-noise condition plus reasonable independence from supply rail variations a fairly sensitive phase detector is needed.

PHASE DETECTOR CIRCUITS

The reference signal to the phase detector could be a pair of sinewaves from a transformer, but this may be chucking away the advantages the use of the system is supposed to give us. If the reference pulses are shaped, greater sensitivity is gained. So a sawtooth reference waveform is more usual and the gating (sync) pulse is theoretically rectangular. A basic example is shown in Fig. 4, where the rectangular gating pulses are applied to the diode junction while the reference pulse from the oscillator or output stage comes in via an integrating network. The mean d.c. at the top of the upper diode depends on the phase difference between the two inputs and the greatest difference is on the part of the reference waveform with the steepest slope. The free-running frequency of the oscillator in this circuit is made to coincide with the locked frequency so that the steady-state output of the phase detector is then zero. The two load resistors across the diodes also act as a return path for capacitance charges in case the sync pulse is lost.

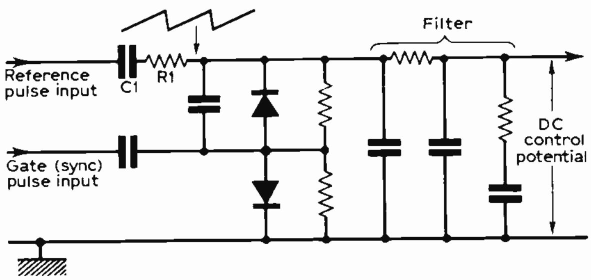


Fig. 4: A simple and very widely used circuit, the unbalanced phase detector. A typical flywheel filter is also shown. The resistor and capacitor in series introduce a slight phase shift to compensate for the basic response lag of the system.

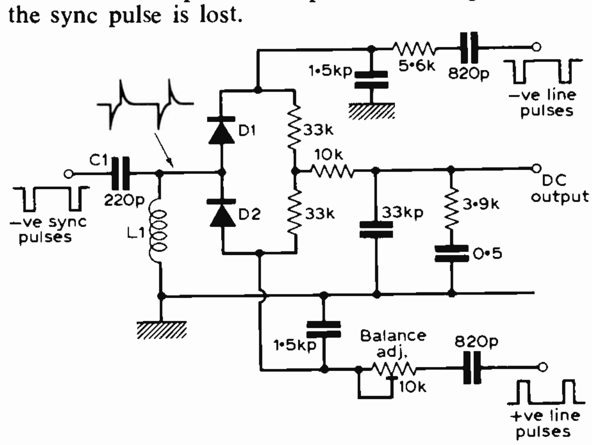


Fig. 5: A balanced phase detector circuit. This gives improved results but requires a pair of antiphase reference signals (or alternately antiphase sync pulses from a phase splitter stage).

The previous example was an unbalanced detector and this, though widely used, is not the best type. To gain even more independence of supply variations

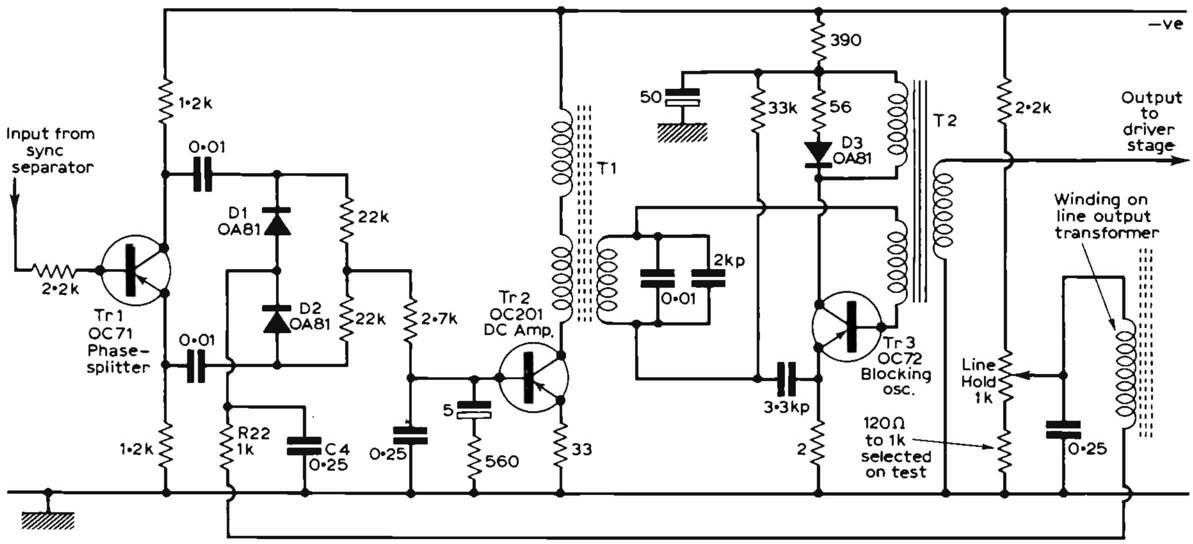


Fig. 6: The line generator circuit of one of the earliest all-transistor models, the Pye TT1. This uses a blocking oscillator with a balanced phase detector and d.c. amplifier in the flywheel sync circuit.

balanced phase detectors may be used as shown in Fig. 5. Both diodes conduct in the same direction, with line flyback pulses of opposite polarity fed to the top and bottom of the circuit while the sync pulses are differentiated by C1 and L1 to produce the reference waveform.

REPRESENTATIVE CIRCUITS

As a practical example of reasonable simplicity (Fig. 6) we will resort again to the Pye Model TT1 which has already featured in previous articles. Consideration of the whole line oscillator, phase discriminator and flywheel circuit in detail will help lay the ground for when we come to later types. In this circuit a blocking oscillator of very similar design to the one already discussed is used, but with a lower-value emitter resistor because the base-emitter voltage is here more dependent on the transformer-fed base circuit. T1 is a special component with a ferrite core, saturated by d.c. through the primary windings to reduce the inductance. A sinusoidal ringing voltage is produced by base current flowing in the tuned ciruit which consists of the third winding on T1 and the associated capacitors, and this tuned circuit determines the oscillator frequency. Transformer T1 is really a form of coupled controlled inductance, making the timing circuit insensitive to h.t. voltage changes. The oscillator output is fed to the output pair of transistors via an OC23 driver stage. The output stage was described in Part 2 last month.

A balanced phase detector is employed and the sync pulses are used for gating, negative-going pulses being derived from the collector of the phase splitter stage and positive-going pulses from its emitter. A

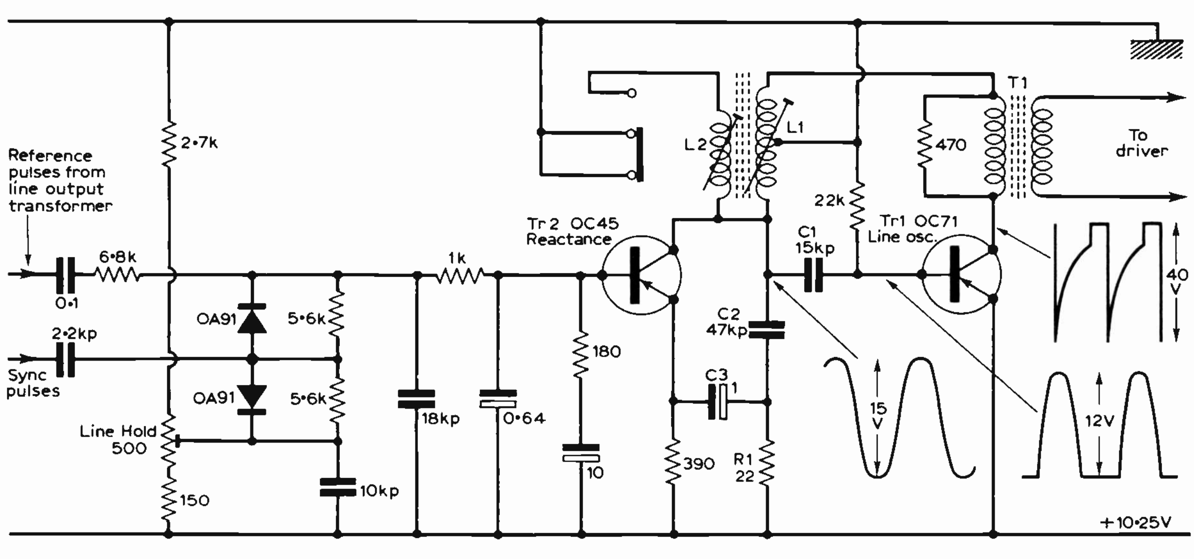


Fig. 7: The line generator circuit of the Philips all-transistor T-Vette portable uses a sinewave oscillator. This type of oscillator must be controlled by a variable reactance stage which adjusts the tuning.

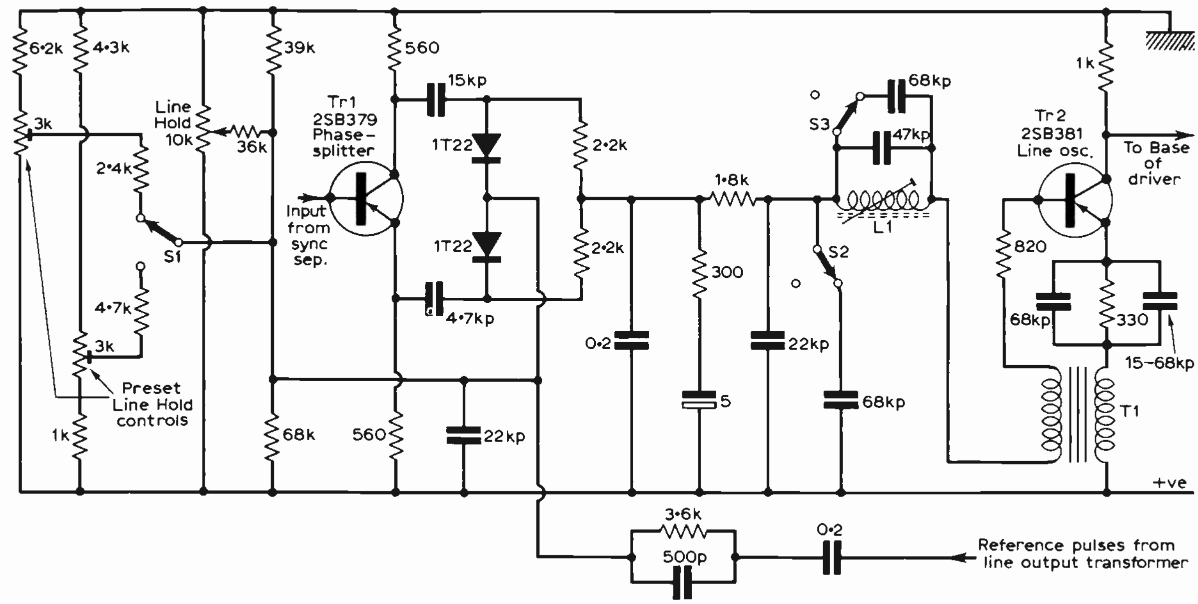


Fig. 8: The line generator circuit used in the Sony Model TV306-UB. This uses a blocking oscillator (Tr2) and as in Fig. 6 a tuned circuit is used to apply the flywheel sync to the oscillator.

winding on the line output transformer provides the reference waveform, which is integrated by C4 and R22, the other end of the winding being given a reference potential from the line hold control. Thus opposite polarity signals are fed from the phase splitter stage to the two sides of the diode automatic frequency control discriminator and compared with the incoming sawtooth. The result of this is the generation of a phase-dependent d.c. output which is filtered by the usual flywheel network and applied to the base of the OC201 d.c. amplifier whose collector current passes through the pair of windings comprising T1 primary. The permeability of the core of this transformer is determined by Tr2 collector current, and as the blocking oscillator feedback tuned circuit is linked to this the frequency of the oscillator is closely controlled.

An example of the use of a sinewave oscillator as line generator is to be found in the Philips T-Vette portable model, the relevant circuit being shown in Fig. 7. Feedback is from the collector of Tr1 to its base via L1 and C1, with L2 in parallel with L1 to alter the frequency on 625 lines. The tuning capacitor is C2, and a quadrature signal is developed across R1 and fed via C3 to Tr2 emitter. The other input to Tr2, the reactance stage, is to the base from

—continued on page 41

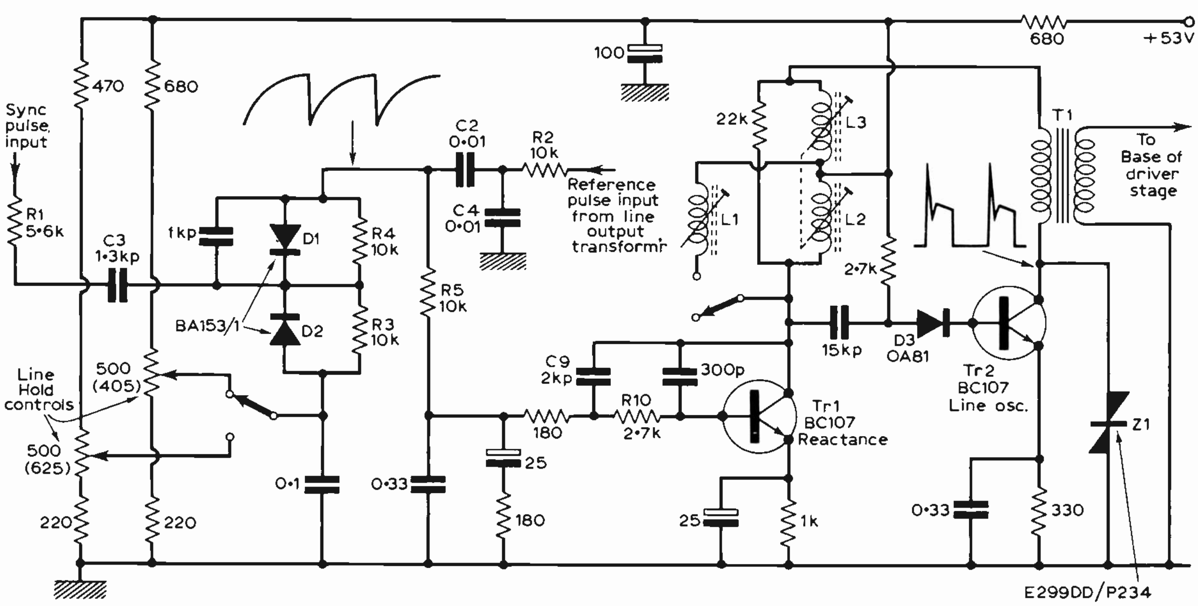


Fig. 9: The line generator circuit used in the Thorn/BRC 2000 all-transistor colour receiver chassis. The basic arrangement is very similar to Fig. 7 but here the variable reactance is capacitive.

CHARLES RAFAREL

DX TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

WE started the 1969 SpE season with a burst of glory in May but June showed some decline and this downward trend in my opinion and that of other DXers appears to have continued. Still I think we should be grateful for the openings we have had and there is still a lot of the 1969 season to come. There also seems to be some drop in results in comparison with July 1968. August 1968 was not good for SpE either, so we had all better really concentrate with our DXing if we want to be successful!

Fortunately there have been some quite good Tropospheric openings, particularly about the 27th July when the French came in well in all bands. Things were not quite good enough however for more distant DX except for Belgium E2 on the 28th which is quite rare here!

Now for the log for the period 1st to 31st July 1969:—

1/7/69 W. Germany E4, Italy IB.
2/7/69 W. Germany E4, Portugal E2 and E3, Spain E2, E3 and E4 and 2nd Chain Santiago E2.
3/7/69 USSR R1, Italy IB, Sweden E2.
4/7/69 W. Germany E4, Italy IA, Yugoslavia E4. Poland R1 and R2.
5/7/69 Spain E3 and E4, W. Germany E2, Sweden E2.
7/7/69 USSR R1, Czechoslovakia R1, Poland R2, Norway E2.
8/7/69 Poland R1.
9/7/69 Sweden E2.
10/7/69 Spain E3.
11/7/69 Czechoslovakia R1, Poland R1, Spain E2, E3 and E4.
12/7/69 USSR R1.
15/7/69 Poland R1, Spain E3.
16/7/69 USSR R1, Czechoslovakia R2, Norway E2 and E3, Sweden E2, E3 and E4, Iceland E4 (see news below).
17/7/69 W. Germany E4.
18/7/69 Poland R1, USSR R1 and many USSR forward scatter network stations on 38 to 40 MHz.
19/7/69 Yugoslavia E4.
20/7/69 USSR R1 and R2, Poland R1, Hungary R1, Sweden E2, E3 and E4, Spain E2 and E3, also USSR forward scatter network as above.
21/7/69 Yugoslavia E4.
22/7/69 Poland R1, Czechoslovakia R1, EBU test card on R1 (see remarks in last month's notes), Italy IA.
24/7/69 Sweden E2 and E4, Denmark E3 and E4 (unusual—not seen in 1968—Fyn and Copenhagen both very good).
25/7/69 Poland R1, Spain E3 and E4.
26/7/69 USSR R1, Poland R1 and R2, Czechoslovakia R1 and R2, Austria E2a, W. Germany E2 and E4, Italy IB, Yugoslavia E4, Spain E2, E3 and E4.
28/7/69 Czechoslovakia R1, Norway E2.

NEWS AND REPORTS

We have some news about BRT/RTB Belgium from A. F. Reekie of Brussels. The following u.h.f. stations went into service in February/March 1969:

Genk (20km. NW of Maastricht) Ch. 44 200kW hor.
Rivière (15km. S of Namur) Ch. 52 200kW hor.
Oostvleteren (5km. NW of Ypres) Ch. 49 20kW vert.
Froidment (10km. from Tournai) Ch. 57 20kW vert.

The code system is designated as code H, which is the same as code G, i.e. negative image and f.m. sound, except that the bandwidth is 500kHz wider. The intention is to use the system for PAL colour transmission. The existing Band I/III positive transmissions with a.m. sound will ultimately be converted to negative image with f.m. sound at 5·5MHz separation. The timing of the change will be determined partly by the decisions of France and Luxembourg on their existing 819-line systems. This could mean that these will change to 625-line negative with f.m. sound. The 819-line RTB transmissions finally ended in mid-February 1969, following rare periods of radiation of 819-line test cards for adjustment purposes.

In passing he mentions that the cost of the EBU station list is now 200 Belgian francs, i.e. approx. £2 by International Money order to EBU, Brussels (for those DXers who want a copy).

I saw Iceland E4 again on 16/7/69. The test card appeared at 14.15 when suddenly before our very eyes it slowly moved diagonally up right and off the screen. This was followed by an Apollo 11 relay!—all very peculiar!

We have a mystery from Alan Pemberton of Sheffield. He has been quoting an EIRJ caption and I thought that this could have been Polish on R2, but now he says he has a photo of the following caption from the same station "Vabariiklik Raamatukaubastu Soovitab". The double vowels in this tongue-twister look like Finnish to me, but please has any one got any constructive suggestions.

We have a nice batch of readers' reports this month—many thanks to you all. We choose the following cross-section for the moment.

Colour DX reports continue to arrive. The latest are from M. J. Dalby of Stroud with W. Germany E2, E3 and E4 in colour on his Bush CTV167 25in. set. Monochrome gave him Norway E2, Spain E2 and E3, France F2 (a new for him) and Poland R1.

P. Beard of Folkestone has a first for us by

—continued on page 41

INSIDE tv TODAY

PART 20 M. D. BENEDICT

TV NEWS-2

WITHIN the vast monolith of the BBC, the News Division described in the last part in this series works smoothly with other programmes, in particular *24 Hours*. Film is occasionally run from the Palace into Studio E, the *24 Hours* studio, and the Central London news studios at College Mews and Portland Place are frequently used when time does not allow a trip to Lime Grove. Regional programmes also frequently use news facilities as a reciprocal arrangement for services to news division. ITN however is a completely separate organisation, independent of all the ITV companies and responsible to its own Board of Directors, who are representatives for each of the programme companies, and to the ITA.

Independent Television News

At present housed in the top floors of Television House in Kingsway, London, ITN is much more compact than BBC News but with less air time to fill. Details differ from the BBC arrangements, particularly the equipment, but organisationally and operationally ITN is similar to the BBC if a little more efficient.

Technical equipment for the single studio with its four Marconi image orthicon cameras includes three telecine channels, three videotape recorders, standards converters and—the usual heart of a studio system—the Central Apparatus Room (c.a.r.). Incoming lines direct from Museum telephone exchange and television switching centre connect the c.a.r. with the rest of the Independent Television network. As well as the normal pulse generators, line selectors, test card and station ident generators, c.a.r. is equipped with several stabilising amplifiers so that outgoing and incoming signal levels can be adjusted operationally. Bad signals are tidied up by sync pulse regeneration and black levels can be altered by a lift control.

Adjacent to the c.a.r. is the gallery with the vision mixer panel and the banks of monitors. Behind the control desk in a separate room is the sound control area. In the studio next door are the four cameras and a large-screen projection television called an Eidophor, used in the newscaster's set for the *News at Ten* programme. A complicated technique of writing in an oil film with an electron beam causes the film to distort, controlling the light reflected from a very bright xenon light source. In this way a picture bright enough to be viewed on a back-projection screen can be achieved. Any source can be fed to the Eidophor, allowing the newscaster to introduce a film with the opening in the background. Camera sources can provide captions or photos as an alternative backing. BBC-2's *Newsroom* uses back-projection from a special slide scanner but not using a projection television arrangement, even though colour versions of the Eidophor are available.

Telecine

Telecine signals are fed direct to the vision mixer from the three channels, though each channel uses two projectors multiplexed into each camera. As with BBC news, Pye vidicon channels are used. One man operates the three control desks but he only has the job of controlling levels and running the film on cue. Loading and recueing the film after each sequence is the responsibility of a projectionist who is also occupied in the review theatres, except for rehearsals and transmissions.

Sync sound is run from sepmag reproducers but these are not locked to the respective projectors until the required sequence is ready to run. BBC practice is to splice blank film between the sepmag sequences so that once a reel is locked to its track at the start of the first sequence it should remain in sync wherever the mute or commag stories are spliced in that reel. Less dubbing is undertaken at ITN as the sound gallery is used for this purpose. It is not practice to completely dub a film, as does BBC News, but rather to use sync sound such as speech and mix in effects of all kinds direct from the grams when on the air. Each telecine channel feeds the vision mixer and sound desk directly, as do each of the three videotape recorders.

Videotape Recording

Three TR22 v.t.r.s are installed, modified by RCA so that the servos control the tape while a fast genlock is taking place. In operation signals are always replayed synchronously either by using pixlock or if that fails by c.a.r. genlocking to the pictures as soon as they stabilise. In fact only one channel of the vision mixer will work non-synchronously so that both videotapes and outside broadcasts are almost always synchronous, unlike BBC practice.

To improve picture quality "drop-out compensators" are fitted to each videotape recorder. When the signal level of the tape drops below a certain level an electronic switch is operated and the signal is taken from a delay line so that the previous line is repeated. Hence the unpleasant black or white flashes which often occur with poor or damaged videotapes are eliminated. As a bonus stability is improved as sync pulses are never damaged during drop-out, and edits are replayed better as damage to the tape caused during editing has little or no effect. Considerably more physical editing is undertaken with a special editing block featuring electronic indication of the control track and edit pulse position and vacuum clamping of the tape, reducing the time taken to complete an edit very considerably.

Standards Conversion

Standards convertors are installed at ITN both for news purposes and for general use by any programme company. Two of the all-electronic line-store converters designed by the BBC and built under licence by Pye are used for 625- to 405-line conversion. Two optical converters are used to convert the American 525-line, 60Hz pictures to the 405-line standard. Only the complex all-electronic field-store converters as recently built by the BBC can handle a change in field rates as well as converting colour pictures, but these are not yet commercially available so the old technique of optical conversion is still used at ITN.

News frequently uses standards conversion for material from abroad, in particular that from America coming via Early Bird. As BBC News will be moving to the Television Centre at a future date its exceedingly complex field-store converter has not been installed at Alexandra Palace but at the Television Centre, in the standards converter area. So lines to and from the Television Centre are booked for any material on 525 lines. As such converters will soon become available commercially from Rank Cintel, no doubt ITN will install such equipment at their new studio centre.

Regional News

In spite of ITN being a separate company all the programme companies work closely with it and each uses the other's facilities. In particular regional companies assist ITN by organising filming in their areas as well as transmitting the edited film to be videotape recorded at ITN, just as the BBC's regional centres work with Alexandra Palace. Outside broadcast facilities are also provided by the local programme contractors. When a story is used in this way the contractor is credited by the newscaster. Another organisation associated with ITN is a commercial film-processing laboratory, Humphries, who run the processing equipment at ITN.

ITN Coverage

Day-to-day coverage by ITN is very similar to the BBC's coverage, which is not very surprising considering that they are trying to do the same job. Details do however differ; for example one of the qualifications for an ITN newscaster, as they are described, is journalistic experience. Newscasters are required to write a proportion of the news and so have an expert knowledge of journalism, while the BBC newsreaders are only employed to read the news. ITN believes that a newscaster has more authority due to this background—BBC-2's *Newsroom* also uses recognised reporters to read and prepare the bulletins in the same way as the ITN newscasters, giving support to this point of view. ITN is located close to Fleet Street and this geographical advantage is often used when experts are brought direct to ITN's studio and photographs can be rushed direct from the photograph agencies which are mostly located in the vicinity.

A sophisticated teleprompting technique aids the newscaster. This uses a closed-circuit television system with a monitor fixed to the camera and pointing at the ceiling. A sheet of glass in front of the lens reflects this and the camera views a narrow sheet of paper with the script typed out, page by page, rather like the roll of paper used on the BBC's teleprompter. The newscaster reads the script across the lens and the operator simply removes any pages of script that are dropped, while the BBC operator has to wind through such stories as fast as she can. Aiding the director is the telecine technique of rolling mute film from the first frame, the vision mixer taking telecine when the initial flickering ceases, about a second after the cue. Sound film is run from a figure six on the leader, giving a five second run up.

Since each editor has his own opinion regarding the importance of news events quite large variations of coverage can and do occur. On one very unpleasant winters day a viewer with two television sets might have noticed the following events on the 6 o'clock news on each channel:

BBC-1	*ITN*
Russian Cosmonaut	Fog and Ice—accidents on motorways
Flu—cases reported in Wolverhampton	Fog and Ice—map of affected areas
Commonwealth Conference	Fog and Ice—accident in Hayes, Kent
Fog—map	Commonwealth Conference with outside broadcast
Fog—Hayes	Russian Cosmonaut
Fog — motorways and Yorkshire A1 crashes	US Campus sit-in
Polish spy for Britain shot	Flu
Kray Twins court proceedings	Milan air crash
Harley Street demolitions	Smugglers' boat
Milan air crash	Kray twins—court proceedings
Rolls-Royce dismissals	Cut price A.A. insurance
Sirhan trial starts	1 sq. ft. land plots sold to Americans.
Highland Fling exhibition starts	

Both bulletins ran for around eight minutes. Although the really important events were agreed, different priorities were assigned to each. Minor stories differed considerably but the editor in both cases had rounded off the news with a lighthearted item.

Getting the News

How did these items reach the screens? Items like the Commonwealth Conference, the Kray court case and the start of the Sirhan court case are known from previous events leading up to them, and along with other arranged occurrences like the press conferences to announce the Highland Fling exhibition, the A.A. Insurance scheme and probably the land plots story, which was probably a smart Public Relations Officer obtaining coverage for his organisation, these form the items for the news diary. Background information on the subject of a press conference is issued to reporters, editors, and anyone else who may be interested in the form of a press release. Hence some of the stories which interest the editor can be covered first thing with a reasonable certainty of the forming of a story. An embargo is placed on each press report to stop anyone jumping the gun and publishing the story before anyone else. Any questions and interviews with people involved with a story can take place at the press conference.

The BBC headline was the Russian cosmonauts. During the day pictures were transmitted to the Russian people showing the launch, then came later pictures from Soyuz V, the space craft launched with three men on board. Intervision, the BBC's eastern equivalent to Eurovision, relayed these pictures to all Communist and east European countries and these were picked up by Austrian television and recorded there, as well as distributing the signal to all interested countries. A videotape recorder recorded the signals and both BBC and ITN undertook some editing to bring together the launch and later pictures.

ITN used a physical cutting of the video tape so that only one machine was used, but the BBC edited the story electronically on to a second machine. ITN used their science correspondent to comment on the event as well as finishing off with a report on what the cosmonauts might be expected to do. At 5.00 p.m. the Eurovision circuits were set up for the usual news exchange. A filmed story concerning the crashed BUA Trident at Milan Airport was transmitted via Brussels to both BBC and ITN. A "dope sheet" giving details of the crash was as usual sent along the sound circuits to help in the preparation of scripts. As a considerable amount of material was sent BBC and ITN subeditors were able to select a different part of the story for transmission.

The BBC's coverage of the Commonwealth Conference included the use of a small o.b. unit rigged to allow an interview in a studio setting or a report from a camera with the reporter standing in front of Marlborough House. ITN also used a similar set-up provided by Thames Television who also used it for reports into their *Today* programme. Unlike BBC News ITN does not have its own o.b. unit but pays for facilities provided by the local programme contractors. Depending on the "state of play" at the o.b. the report may be recorded or may be broadcast live, but interviews are almost always recorded as are the arrivals and departures of important personalities.

Reporting the Fog

Fog causing accidents is not news but on the scale of this day's events it rapidly became obvious that something out of the ordinary was taking place. Besides monitoring the police radio transmissions and other emergency services, which give a good indication of what is happening, the police were using the BBC's Monitoring Unit and transmitting messages on the radio to warn drivers of motorway closures which were forced by the number of crashed cars littering the motorways. Wire services filled the teleprinters with details of the story as it unfolded and as units become available from earlier jobs they were despatched to the scene of accidents, to the headquarters of the Herefordshire police and to any other places that the editor considered would add to the story.

Camera Units and Stringers

On days like these the film operations team are hard pushed to keep enough cameramen in the right place without losing some of the action at other events. In spite of the o.b. unit at Marlborough House a mute camera unit would be held in readiness to provide colour coverage and to cover arrivals and any other incidents demanding flexibility of action or movement or requiring too much editing to be covered with o.b. and videotape techniques. BBC-2 prefers the film story as it is in colour but this does not stop the *Newsroom* editor using a monochrome interview if it is of news value.

As news of the crashes came in the BBC Leeds newsroom was alerted and the editor of the local news programme, sensing a local news story at least, sent a stringer (freelance cameraman) based in Doncaster to the scene of the crashes on the A1 (M) Doncaster bypass. As he was on his way the Editor of the national news decided to use the story and extra instructions were sent to the cameraman by radiotelephone. Almost at the same time the ITN editor contacted Yorkshire Television asking for coverage of the same accidents. As the stringer was the only cameraman in the Doncaster area his home was contacted and he was asked to cover the events for ITN as well as for the BBC. As he would have worked for both ITN and BBC News before the different requirements of each organisation would be well known to him.

ITN wanted an on-the-spot report and pictures of the crashes. A Yorkshire Television reporter made her way to rendezvous with the stringer. At the scene the stringer started shooting colour stock on his mute Bell and Howell while his assistant and sound recordist loaded the Auricon with colour stripe stock which was used to shoot crashes and an account from a driver of one of the lorries involved. As Yorkshire Television is fully equipped for colour the stringer used colour stock in his Arriflex to shoot an interview with the Yorkshire reporter, followed by her report. ITN and other ITV companies usually prefer sound on ¼in. tape with pilot-tone so the Arriflex would be used for this. Finally coverage for the local news was filmed using the Auricon loaded with black-and-white magnetic-striped stock.

Getting the Report to the Studio

After each organisation's material had been completed dispatch riders met the cameraman and rushed the film (and tapes) to the labs or regional centre. As the deadlines for each organisation vary—the colour stock was processed at Alexandra Palace and had to be flown to London—the cameraman arranged his assignments to meet these requirements rather than following the principle of first come first served, although if assignments clashed it would be a different matter altogether. In London it is comparatively unusual to use a stringer, let alone to find a case where the stringer can cover the story for both BBC and ITN, but this does occur in regional areas where news cameramen are few and far between and the man on the spot may be two to four hours ahead of a unit sent from base.

Three sets of film left the scene of the accident and while the BBC story was being processed before being edited the second set was being edited at Yorkshire Television's centre at Leeds. At the same time the BBC's local news story was processed and edited in a hurry as the story was to form the main feature of the local news that evening and a follow-up may have been required. Instructions were passed to the stringer to stand by in case more filming was required—an interview with the spokesman for the motorway authorities or the police for example.

Long before the BBC's film arrived at Alexandra Palace the ITN's story had been cut by a Yorkshire Television film editor, in consultation with the ITN subeditor and editor. Lines were booked from Leeds to ITN and a time agreed for transferring the complete story to ITN's videotape recorder. After dubbing a commentary from a Yorkshire Television news studio in Leeds the story was safely in London. Unfortunately the commentary was not needed for the 6 o'clock transmission as only the first 19 seconds of the story were used and this required a shorter commentary from the ITN newscaster who linked the story with film of the other accidents on the other motorways. However the complete item was shown on *News at Ten.*

London-based units were rushed to the accident area at the southern end of the M1, one from ITN and one from BBC News, whilst each organisation diverted one of the cameramen to Hayes after covering a news conference. No great rush was necessary as the film operations organisers realised that with such a crash the van would be removed long before a unit could reach the scene and only shots of the road at the scene of the accident would be of use. However follow-up enquiry at the local borough council was envisaged by ITN and a reporter sent to the area, but this was dropped and the reporter and camera unit recalled.

Deploying Film Units

During the day news of the proposals to demolish part of Harley Street and to rebuild it was reported by the wire services. As this redevelopment had been expected it came as no great surprise to the editors, but a unit was sent by the BBC along with a reporter to film the street and its consulting rooms before the reporter interviewed some of the doctors concerned as well as the owners of the property. Similarly a unit was sent to the Rolls-Royce factory where workers were being laid off, as well as to Dover where a boat used by smugglers had been captured, to the Highland Fling exhibition and to Stratford-on-Avon where the American tourists had bought their foot square land plots. Several other stories were covered but turned out less interesting than hoped, so never made the bulletins.

As no cameras are ever allowed in court both ITN and BBC covered the trial of the Kray brothers by each sending a reporter who sat in the courtroom along with other newspaper reporters. After the adjournment both reporters returned to their studios and recorded a report "to camera". Library film of the area where the events were alleged to have taken place was used.

News from Abroad

Students occupying the campus of their university and the first day of the trial of Sirhan Sirhan, Robert Kennedy's assassin, were just two of the stories offered to BBC and ITN by various organisations like UPITN and Visnews. ITN decided to take the story and with a slight re-editing of the film supplied and a script written from information supplied with the film completed the story. Most material from abroad, except reports by British reporters from obvious trouble-spots such as Vietnam and the Middle East, is distributed by such organisations. The cost of world-wide coverage would be prohibitive for any one organisation so a great deal of sharing of facilities by syndication takes place.

Preparing the News

Other stories coming in off the wire services included the shooting of a Polish man alleged to be a British spy. A photograph was available from a news photographic agency and copies were sent to both BBC and ITN, the BBC using theirs. As these photographs, films and other materials came in the various subeditors and film editors checked the stories, wrote the scripts and edited the film whilst graphics artists made maps showing the areas affected by the fog and ice as well as maps of roads affected and the streets around the Hayes crash. Making up these maps is simplified by using a large selection of basic maps on to which the relevant details are added. Photographs are also mounted by graphics artists, who add any details that may be missing on the original photograph or remove those which might be distracting to the viewer. Having made the captions the BBC graphics artists mount them between two sheets of perspex and fix these with a clip, allowing the whole assembly to be loaded into the caption scanner without damage.

Timing the Bulletin

Long before all this material was ready, before some material was even in the building, the editors will have made an estimation of the duration of each story, and with the provisional running order will have worked out a duration for the complete bulletin. Initially a considerable over-run would have been allowed, but as items come in and are completed more accurate estimates are made and approximate running times given to stories to be edited. When the bulletin goes into the gallery the script may run between 10 to 30 per cent over duration and during the rehearsal the editors will drop several stories, consulting with the production secretary regarding the duration of each story as rehearsed.

When accurate overall running times are needed, for example when a party political broadcast follows, the script will be written with several "cutables." Small stories of two or three sentences are placed last in the bulletin and the newsreader reads as many of these as time allows, stopping when he sees that he is out of time. In this way an experienced newsreader can come out accurately to within a couple of seconds. ITN is always required to come out on time so that the end music is of fixed length and is started exactly on time to end correctly. When the

—*continued on page 20*

VIVIAN CAPEL

HEAT PROBLEMS in TV RECEIVERS

HIGH temperature has long been acknowledged as one of the major factors governing the reliability of television receiving equipment.

The life expectancy of a variety of components is reduced as the temperature is increased and it is frequently found in the workshop that intermittent faults will simply not show themselves when the set is run minus its back. Conversely such faults can often be quickly provoked by draping a blanket over the back of the cabinet to cut off all ventilation. The reason for this is the basic physical law that metal expands when heated and contracts when cooled. By this means a fault can be produced or a dormant fault condition be made active.

Faults caused by heat

Let us look first at faults directly attributable to heat. Modern valves have electrode spacings that are much closer than their predecessors. This is especially the case with frame-grid valves where the grid-cathode spacing is particularly small. When such valves are operated within their specified temperatures expansion of the electrodes should have little effect. However if the temperature is greater than the permitted maximum then deformation of the electrode can occur which can give rise to a leak to an adjacent one. Excessive temperature at the cathode can cause flaking of the active cathode material, resulting in loss of emission and the danger of electrode leaks from the loose flakes. Gas too can be liberated leading to a "soft" valve, although care in the selection and treatment of materials during manufacture has made this comparatively rare in modern valves.

Printed circuits can suffer not so much from a steady high temperature as from repeated heating and cooling. When the thin copper print is subjected to this it expands and contracts and being bonded to the supporting panel this produces stresses. Eventually metal fatigue sets in and a hair-line crack appears.

Trouble can also arise in components where materials with different rates of expansion are in close contact. Wire-ended components such as resistors and capacitors may suffer from this, poor contact resulting from the expansion or contraction of the wire-end with the material of the component. Some early all-glass valves were prone to crack across the base due to the expansion of the valve pins set in the glass. Now however the metal pins and the glass are carefully selected to have the same rate of expansion.

Dormant faults

Cases where heat causes the activation of a dormant fault are also very common. Capacitors may have a weak area in their insulation, or an irregularity in the surface of the foil may cause a partial penetration through the insulation. Expansion caused by heat may complete the penetration, causing a leak. Where the capacitor is being used with high or pulse voltages a breakdown of insulation can quickly occur in any weak area, and expansion of the foil due to heat will accelerate it further.

When serious overheating occurs carbon resistors tend to decrease in value. If they are carrying h.t. current in a low impedance circuit a heavier current will flow causing a further decrease in resistance eventually resulting in a burnt-out resistor.

Another example of the dormant fault is where plastic-covered wiring is pinched or stretched across a sharp edge. There are numerous cases of faults showing up after the set has thoroughly warmed up that have been traced to penetration of wiring insulation in this manner. When switched off a recovery seems to take place and the short clears, only to reappear next time the set is switched on and warmed up.

Dormant faults also abound in printed circuits, in addition to the fatigue effect previously mentioned. Breaks or cracks that exist either through fatigue or faulty manufacture are in most cases temperature conscious, either healing or parting as the temperature rises. Excess solder that partially shorts over to an adjacent portion of the print is another source of this type of fault. Sometimes a thin layer of flux may be all that separates adjacent conductors so that when the temperature rises the flux softens and the metal expands, the result being a short-circuit.

Dry-joints could also be described as dormant faults. These range from soldered joints on either print or wired connections where the solder has not taken on one or both of the conductors due to the presence of dirt, grease or excess flux, to connections that missed the solder completely during manufacture. In such cases there being just a doubtful mechanical contact between the conductors means that heat will frequently affect such joints.

Field-scan shrinkage

Another effect of heat which was common on many older receivers was that of field-scan shrinkage. After the set had been switched on for about half an hour the bottom of the picture would creep up until a large gap was left which having reached a certain size would remain constant until the set was switched off.

A check of the output valve, bias resistor and bypass capacitor would reveal no fault. In fact there seemed no cure and the only course was to overscan the tube when cold so that when shrinkage occurred the mask would just about be filled.

The main cause of this trouble was found to be the output transformer and scan coils, particularly the latter. Heat caused the d.c. resistance of the windings to increase. Here again is another basic physical law, that the resistance of most metals increases with temperature. Although small, the resistance increase was sufficient to reduce the scanning current enough to produce the effect described. While nothing can be done to alter this basic law, modern practice is to include a thermistor somewhere in the field circuit. These devices decrease their resistance with rise in temperature so that some degree of compensation is achieved.

Reducing heat

It is obvious from the problems so far considered that temperature increases should be kept to the minimum. Manufacturers have endeavoured to do this in design, especially of recent years, and some of these ideas can be copied by home experimenters and constructors. The approach to the problem has been along two paths, first to reduce the amount of heat actually generated and secondly to remove the heat that is produced as quickly as possible and to keep it away from particularly vulnerable parts of the circuit.

In the former approach comes the substitution of transistors for valves. So far these have not made a major contribution to the cooler chassis because the big heat producers, the output valves, remain. Transistors are used mainly in tuners and i.f. circuits. Even so some reduction of heat is welcome and is valuable when combined with other heat-reducing measures.

Mains dropper

One of the greatest single sources of heat in the television receiver is the mains dropper. When used on the highest mains voltage tapping anything up to 90V may have to be dropped. With an 0·3A heater chain this would mean around 25-30W, all of which is dissipated in the form of heat. Thus if this component can be dispensed with a major reduction in temperature can be brought about. Apart from early parallel-fed heater models the mains dropper has reigned supreme for many years. Recently however growing appreciation of the need to keep temperature as low as possible has led manufacturers to look for alternative means of providing the correct heater supply.

Using a silicon rectifier

One ingenious method in use is to connect a silicon rectifier in series with the heaters in place of the dropper. As this conducts only on alternate half-cycles power to the heater chain is reduced without wasteful and heat-producing dissipation. There are dangers here though; these rectifiers are prone to developing short-circuits which if undetected means that the heaters will be subject to prolonged overload. Safety measures are possible, however. In one chassis the sync separator screen grid is fed from a point in the heater chain. Thus if the rectifier goes short-circuit the a.c. on the heater line results in loss of sync which prevents the set being used until the fault is rectified.

This series rectifier technique can easily be adopted by the home experimenter. The main ballast section of the dropper is disconnected and the rectifier wired in its place. A check that the correct voltage is present across the valve heaters should then be made. To do this a measurement should be taken across the heater of a valve for which the heater voltage is known. As moving-coil instruments measure r.m.s. voltage and being half-wave rectified the voltage on the heater line after this modification is not r.m.s. it is better to use a moving-iron meter if one is available. Should the voltage prove to be too high one or more of the lower-value sections of the dropper included for mains voltage adjustment can be included in the circuit.

Safety precautions

As a safety precaution two rectifiers could be wired in series as the possibility of both going short-circuit would be far less than a single one doing so. As the series resistance of the rectifier in the forward conducting state is very low the extra one would have no effect on the power supplied to the chain. Since these rectifiers are now cheap this method is simple and economic. However as it is not impossible for both to develop a fault it is not 100% reliable.

Another simple arrangement (see Fig. 1) is to connect a capacitor (C1) and diode (D2) from the heater pin to the grid of the audio output valve. The heater rectifier D1 should be connected so that the heater chain is positive and the diode D2 so as to conduct on negative half-cycles (normally suppressed). The capacitor C1 blocks any positive voltage reaching the grid through leakage in the diode D2. Should the heater rectifier go short-circuit a.c. will appear on the heater line and will be applied via capacitor C1 to the diode D2 which will rectify it and feed a negative voltage to the grid thereby cutting off the valve. Thus the symptom of no sound will warn of a fault.

Using an autotransformer

A more conventional means of dispensing with the mains dropper is used in some models. This is to use an autotransformer instead (Fig. 2). Because

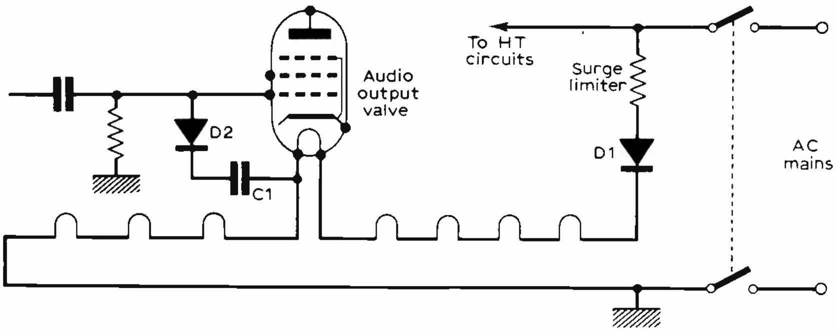


Fig. 1: Heater chain fed via a silicon rectifier (D1). The protection circuit consists of D2 and C1 from the audio output valve heater to its grid: in the event of D1 going short-circuit a.c. rectified by D2 will drive the valve's grid negative cutting it off and killing the sound.

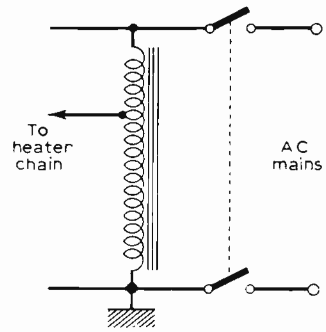


Fig. 2: Heater chain fed by an autotransformer. A compact unit is possible due to the single winding.

of the single winding this component does not have to be large and existing sets could be quite cheaply modified to use this component. A number of firms will make up transformers to customers' specifications. All that is needed is to add up the total heater voltages of all the valves in the chain and to specify a transformer for the local mains voltage with a tapping at the required voltage for the chain. Heater current will have to be quoted, too. When connecting to the mains input circuit make sure to avoid the mistake made by many in the days of fitting tube boost transformers: wire to the *set* side of the switch, not to the mains side, otherwise the heaters will be on all the time the set is plugged into the mains supply.

HT rectifiers

A major source of heat in older sets is the h.t. rectifier as is indicated by the condition of the cooling fins of the selenium variety. Nearly all modern sets use the silicon types mentioned before, and this is a worthwhile modification to make. Do not wire the silicon directly across the old one as is sometimes done, using the tags for support, as this increases the unreliability hazard. Selenium rectifiers were prone to leak to chassis and if left in circuit could still do so. If anchoring points are not available fit a tag strip. And remember to include a 25Ω 5W resistor in series with the rectifier as a surge limiter.

Replacing valve rectifiers

Valve rectifiers can also be replaced by wiring the silicon rectifier across the valve base, anode to cathode; surge limiters are likely already to be included. A resistor will also be needed to replace the rectifier heater; the value of this must be calculated from Ohm's law according to the rating of the rectifier heater. Keep this resistor physically away from the rectifier as the heat generated by it may damage the rectifier. If a heater chain modification is being carried out as well and a transformer being fitted just short out the rectifier heater pins and deduct its voltage from the total. Note that some older sets may be used to the gradual build-up of h.t. that occurs with a valve rectifier, so that a silicon rectifier with its low forward resistance on switching on may affect the life of h.t. components and timebase valves. A thermistor, type VA1026 or VA1015 for example, in series with the silicon rectifier will overcome this problem.

Removing heat

So much for reducing the causes of heat, but what about removing the heat that is inevitably generated away from vulnerable components?

Where mains droppers are used there is a growing tendency to mount them at the top of the chassis. Heat rises, so in this position it goes out through the top ventilation holes without affecting other components. One maker once mounted the dropper vertically with a long tube through the middle: convection air currents started by the heat caused an upward airflow in the tube which cooled the dropper and conveyed the heat to the top of the receiver. It acted in fact as a chimney.

Valve heat

Valves are the other source of heat which can cause deterioration in other parts as well as in the valves themselves. One maker used to fit cooling fins to the PL81 line output valve. These were simply constructed of four slotted rectangles of metal that were painted with a matt black finish: con-

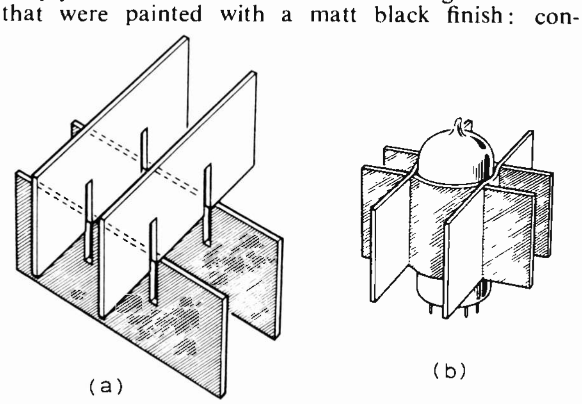


Fig. 3: (a) Four metal strips slotted ready for assembling to make valve cooling fins. (b) Fins assembled and fitted to a valve

struction is shown in Fig. 3. The dimensions are such that when the sections are slotted together they will make a tight fit on the standard valve

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waveforms in COLOUR receivers PART 4

GORDON J. KING

So FAR we have concentrated on the colour transmitting end of the chain, studying the primary-colour signals obtained from the camera, the colour-difference signals produced by the matrix, the V and U signals which are "weighted" versions of the R−Y and B−Y signals in the PAL system, and the colour bursts. We have seen that the monochrome signal in a colour transmission is called the Y signal and that this provides the picture fine detail, the colour being introduced in less detail as we shall see later.

Composite Colour Signal

This multiplicity of signals is often referred to as the *composite colour signal*. It includes the line and field sync pulses and the various blanking intervals which are common to monochrome transmissions. The Y signal and the sync and blanking components are virtually identical to those of a monochrome transmission because a colour signal is expected to activate a black-and-white set while conversely a colour set is expected to be able to produce a black-and-white picture from a monochrome transmission. This is termed compatibility.

The composite colour signal thus modulates the carrier wave in the same way as a 625-line black-and-white signal with negative-going picture modulation. The sound signal is frequency-modulated, as in a monochrome system, and the receiver adopts the intercarrier technique for extracting the sound signal.

We must now move from the transmitter and consider the receiver, leaving for the moment the propagation medium between the transmitter and receiver—although this can influence colour more than monochrome as we shall see. The colouring information is multiplexed with the Y signal in such a way that the composite signal does not need any more channel width than a 625-line monochrome signal, one of the outstanding features of contemporary colour systems.

Importance of Phase

This means that the front-end of the receiver can be the same as a monochrome one provided the composite signal sidebands are allowed to pass through without undue attenuation or phase displacement. In practice phase problems are more critical in colour than monochrome and for this reason the front-end stages of a colour set are generally more exactingly designed—allowing for more accurate alignment and filtering—than those of a monochrome set. Phase effects in monochrome yield the well known symptoms of ringing, black-after-white, white-after-black, smearing and so forth. In colour they can change the hues, affect colour registration, delete the colours or impair the saturation as well as giving the monochrome symptoms.

Figure 1 shows the spectrum expansion of a 625-line monochrome signal at (a) and the same signal with the colour multiplex at (b). The theoretical expansion of the monochrome or Y signal is from d.c. to about 5.5MHz (to −3dB or half power), while as (b) reveals the colouring information spreads out to just over 1MHz (relative to the −3dB points) on each side of the chroma subcarrier which is placed at about 4.43MHz in the spectrum. The shaded portion of the signal at (b) represents the energy of the colouring information.

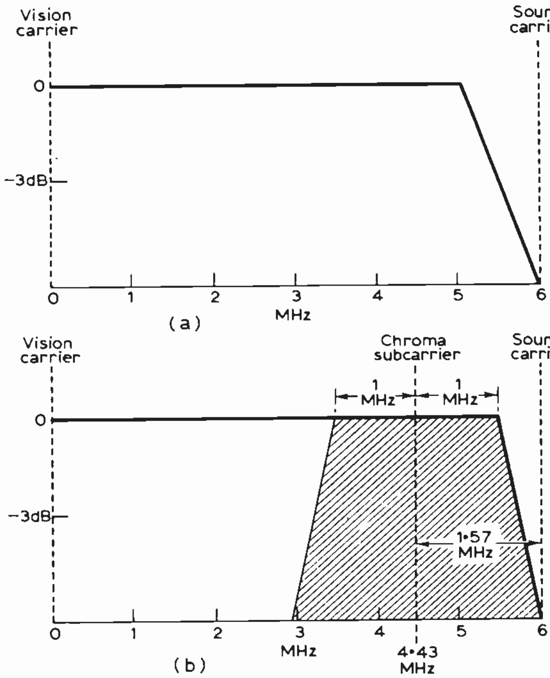


Fig. 1: Vision signal bandwidths, (a) 625-line monochrome and (b) 625-line colour. Note in (b) the position of the chroma subcarrier and the extent to which its upper and lower sidebands spread into the Y-signal area.

IF Response Parameters

It must be borne in mind that channels like this will eventually occur side-by-side so that the response characteristics of the set must take them into account as well as the signals of the channel to which the set is tuned. This is necessary to avoid adjacent channel interference problems. Figure 2 gives an impression of the i.f. response parameters of a colour

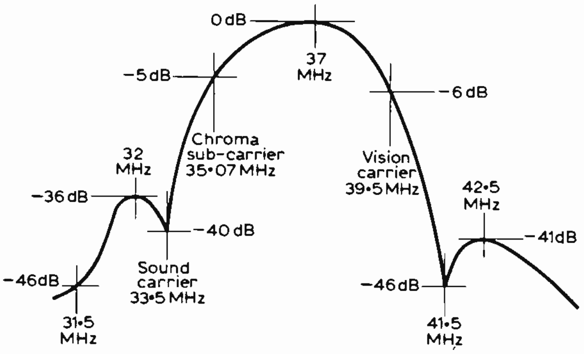


Fig. 2: Response characteristics of a colour set, showing the main carrier frequencies (at i.f.) and the frequencies of the rejectors and their attenuation values. These are explained in the text.

set. The points of the three main carriers—sound, chroma and vision—are indicated, as also are the points corresponding to the rejector frequencies which are necessary to keep out the adjacent unwanted signals. A rejector tuned to 31.5MHz is for adjacent channel vision while that at 41.5MHz is for Channel 1 sound (in this dual-standard era) and adjacent channel sound.

It will be necessary for us to refer to various beat signals that the rejectors are designed to handle in one way or another as we go along, but for now let us assume that the front-end stages of the set—which is correctly aligned—are carrying composite colour signal. One line of such signal might appear like that shown in Fig. 3, which identifies the various

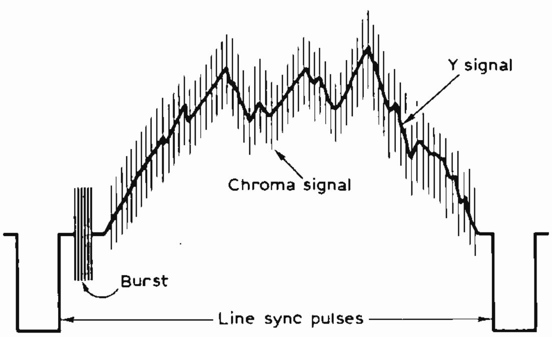


Fig. 3: One line of colour signal, showing how the chroma information appears on the Y information (see also Fig. 5).

components. In particular notice how the chroma signal is superimposed on the Y or luminance signal. The Y signal carries the wideband picture detail and if a composite signal like this is applied to a monochrome set the vision detector would process only the luminance signal to give a black-and-white display. Nevertheless the chroma signal would still be present across the vision detector load and if we connected a scope here we would be able to resolve the 4.43MHz subcarrier components.

It will be recalled that the V and U modulators at the transmitter deliver sidebands of the colouring information only when a colour scene is being picked up by the camera. This is because the subcarrier proper is suppressed by the nature of the subchannel modulation. Thus with no colour there are no subcarrier components and the more colour in the scene (i.e. the greater the saturation) the greater the amplitude of the subcarrier components. These components will always be focused on 4·43 MHz, so that even though the subcarrier proper is suppressed at the transmitter components *at subcarrier frequency* will appear across the detector load when a monochrome set receives a colour signal. Since the subcarrier is suppressed at the transmitter I not uncommonly find that some students of colour television are surprised to learn that subcarrier components do exist in the composite signal—extra to the bursts. Indeed the shading either side of the Y signal in Fig. 3 constitutes sinewave components at the subcarrier frequency.

Dot Pattern

Many readers will remember the dot-pattern that used to plague some early monochrome sets. This effect became progressively more apparent as the definition of sets improved over the years and was caused by a difference-frequency due to beats of the 405-line vision and sound carriers—the difference being exactly 3·5 MHz set by the parameters of the 405-line signal (e.g. 38·15 MHz (sound i.f.) minus 34·65 MHz (vision i.f.) equals 3·5 MHz). Sets having video responses bordering on this frequency thus produced interference consisting of a display of very small dots all over the picture. This was—and still is—easily cured by a 3·5 MHz rejector located in the video amplifier valve cathode.

With colour we have a similar state of affairs but this time at the higher definition of the 625-line system. As we have seen a monochrome set will produce the Y signal across its detector load *plus* a 4·43 MHz subcarrier component. This means that a 4·43 MHz beat occurs between the vision carrier and the chroma subcarrier components and this obviously gets into the video amplifier and appears to the picture tube as high-definition picture signal. Again the effect is that of a multiplicity of dots all over the picture.

Subcarrier Frequency

In practice the effect is mild since the subcarrier proper is suppressed—it would be much worse if it were not suppressed. However the effect is present but it is significantly minimised by the choice of the subcarrier's frequency. The actual subcarrier frequency is 4·43361875 MHz which ensures that the interference signals in adjacent lines and in consecutive fields oppose each other, a technique that results in the least subjective disturbance to the viewer so far as the dot-pattern is concerned.

Signal Interleaving

The chroma information can be added to the basic monochrome (Y) signal because there are gaps in the energy distribution of the Y signal due to the picture being formed by line-by-line scanning. Thus the main energy of the "detail" (Y) part of the picture is focused into relatively narrow bands geared to multiples of the line-scan frequency. This leaves low-energy gaps in between and in these gaps the chroma information is generated. Again the choice of the subcarrier frequency determines the correct interleaving of the chroma and monochrome information and by using the frequency just mentioned the effect shown in Fig. 4 is made possible.

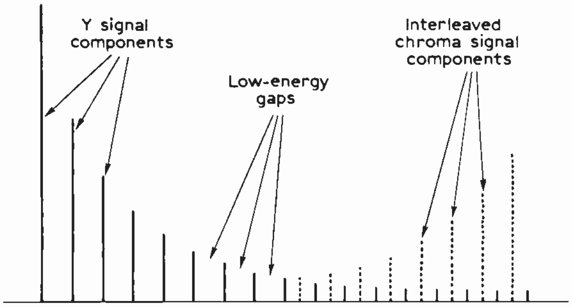


Fig. 4: How the chroma-signal components are arranged to interleave in the low-energy gaps present in the Y-signal bandwidth due to the fact that the picture is composed of a series of scan lines.

Chroma Bandwidth

It can thus be seen how the chroma information can be transmitted within the bandwidth normally occupied by the monochrome signal. However we should have noticed a factor of the composite signal that seems out of line with the requirements of high-definition television; namely the relatively narrow chroma signal bandwidth. In Fig. 1(b) this is shown as ±1 MHz, yet we know that for good-quality monochrome reproduction a bandwidth of around 5 MHz on the 625-line standard is essential. Why, then, can we get away with a mere 1 MHz for the chroma signal?

Colour Detail

The answer is that the human eye is unable to distinguish fine detail in colour alone. In colour TV therefore we secure the detail of the picture by the high-definition luminance signal and "paint in" roughly the colour by means of a low-definition chroma signal. There is no point in transmitting and processing a lot of information that we are unable subjectively to appreciate! White light is composed of red, green and blue light and it requires such a mixture of light for us to resolve maximum detail. Try threading a needle in saturated light of one colour for instance!

This characteristic of the human eye also makes the shadowmask tube a viable proposition, for if we could discern detail in colour we would see the red, green and blue dots which form the phosphor-dot triads on the screen instead of a specific single colour (per picture element) which is the result of the eyes integrating the three small dots of colour.

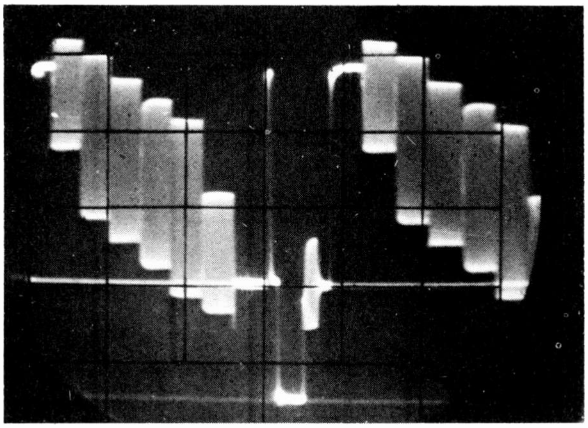


Fig. 5: The sort of signal that would appear across the vision detector load when the set is receiving a standard colour-bar test pattern input.

Chroma Modulation

At this point mention must be made of the nature of the chroma modulation. Double-sideband modulation is here adopted as distinct from the vestigial-sideband modulation of the composite signal upon the main carrier. This is why we have upper and lower sidebands spreading out on both sides of the chroma subcarrier to process a signal of a bandwidth little more than 1MHz. This factor assumes a greater importance later when we investigate the signals in the receiver's chroma channel, so it is just as well to keep it in mind.

After this stage-setting we are in a good position to trace the signals from the vision detector through the various channels of the colour receiver, and this we shall commence doing next month. The oscillogram in Fig. 5 shows the type of signal that appears across the detector load. This shows almost two lines of the colour test-bar signal, with the line sync pulse and associated colour burst between. Remember that this is called the composite colour signal.

CONTINUED NEXT MONTH

INSIDE TV TODAY

—continued from page 14

newscaster bids his good evening the sound mixer simply fades up the remaining music.

After the Bulletin

Even after transmissions work continues as there are always further bulletins to prepare, stories to re-edit and for some of the engineers a bulletin on the other channel to transmit, whilst the studio staff may have to make recordings of interviews or reports involving complex film sequences which are better prerecorded. Only after the last bulletin can most of the staff go home.

After the last bulletin of the day all film is collected and sent to the film library where it is classified by subject (heavily cross-referenced) and by the date. Many stories can subsequently be illustrated by reference to this material. In fact a fair proportion of all film shot by the BBC is distributed abroad by Visnews, who take copies of stories that may be of interest abroad. UPITN operate in the same way with ITN material.

Whatever happens however one thing is certain—news will be transmitted on the next day and seven days a week, 52 weeks a year! In this respect news is like television in general, with thousands of hours of programmes being broadcast every year on three channels. In spite of the tremendous amount of material and effort spent on it the home viewer pays only a very small licence fee, receiving in return one of the best television services in the world, whichever channel is selected. ■

SERVICING television receivers

L. LAWRY-JOHNS

STC VC11 PORTABLE CHASSIS

EMPLOYING the STC VC11 chassis, the KB KV003, RGD RV203 and Regentone TV403 are lightweight dual-standard portable models with a very compact layout and an 11in. tube (TSD217 or TSD282).

The cabinet is secured by four screws, two at the top front and two underneath the bottom front. Once these are removed, the side u.h.f. knobs pulled off and the aerial plugs removed at the back the set can be placed front down on a soft surface and the cabinet lifted off. This exposes the chassis which consists of a horizontal member carrying the sound and vision i.f. strips up to the video amplifier and audio output stages and also the line oscillator stage which uses flywheel sync. The vertical chassis is hinged and carries the line output, sync separator and field timebase stages.

To swing this latter unit down it is necessary to rotate the v.h.f. channel selector to reveal the fixing screw in the shank (this is uppermost when channel 1 is selected); the fine tuner is then rotated so that the gap coincides with the screw. Remove both knobs and the two screws to the right of the tuner. A further three screws are located one on the left near the u.h.f. tuner and two on the right, one at the top and one at the bottom.

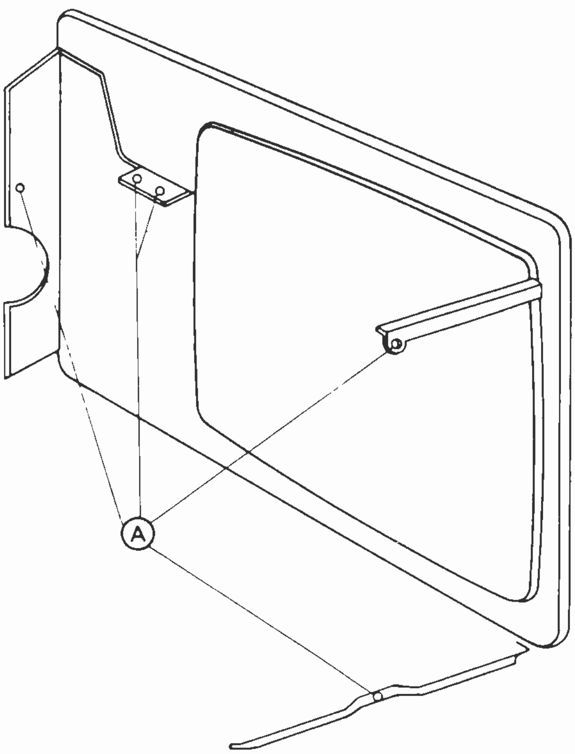


Fig. 1: Positions of the five screws that can be removed in order to lower the hinged vertical chassis.

Tube Replacement

The original type of tube fitted was a TSD217. Later models used at TSD282 T-band type. This latter type should be used for replacement. When fitting a TSD282 delete the BA115 (D10), replace C150 and R170 with a wire link and change R171 to 330kΩ. No implosion guard is required. The front fixing screws of the cabinet must not be allowed to come into contact with the tube tensioning band. Insulate the band in the vicinity of the screws to prevent this happening. The band must contact to chassis and this contact must be good. Crackling on sound can often be traced to a poor contact on this band.

Common Faults

The v.h.f. tuner (Philips) often gives trouble and for more complete details of this unit readers are referred to the servicing articles in the December

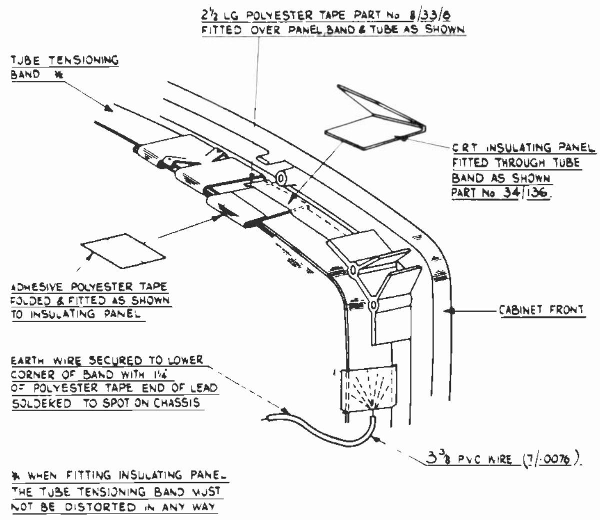
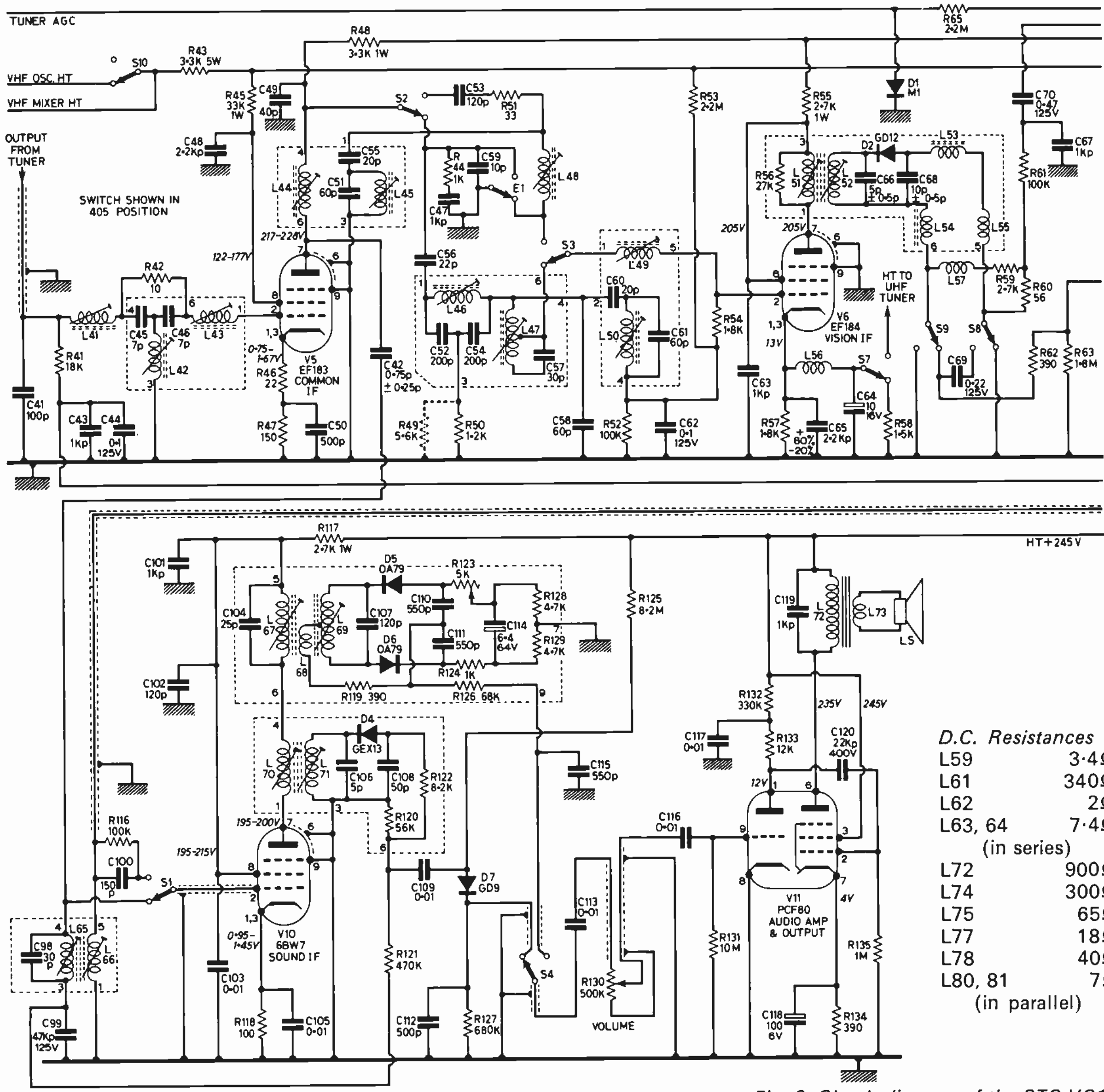


Fig. 2: Fitting an insulating panel with a T-band tube—see Tube Replacement. The earth wire to the tension band must be taped into position as shown here and not soldered as the heat would distort the band.



D.C. Resistances

L59	3·4Ω
L61	340Ω
L62	2Ω
L63, 64 (in series)	7·4Ω
L72	900Ω
L74	300Ω
L75	65Ω
L77	18Ω
L78	40Ω
L80, 81 (in parallel)	7Ω

Fig. 3: Circuit diagram of the STC VC11

and January (last) issues. Apart from poor switch contact which only demands cleaning the turret studs, the main trouble occurs when the plastic core of the fine tuner assembly breaks. The use of a hot Allen key to push out the broken core can save a great deal of time and patience.

Other v.h.f. tuner faults may concern faulty valves, resistors changing value (check R4, R6 and R8) and an open-circuit i.f. output coil (L10). The aerial socket may require its contacts resoldered from time to time particularly if an external aerial with heavy coaxial cable is used.

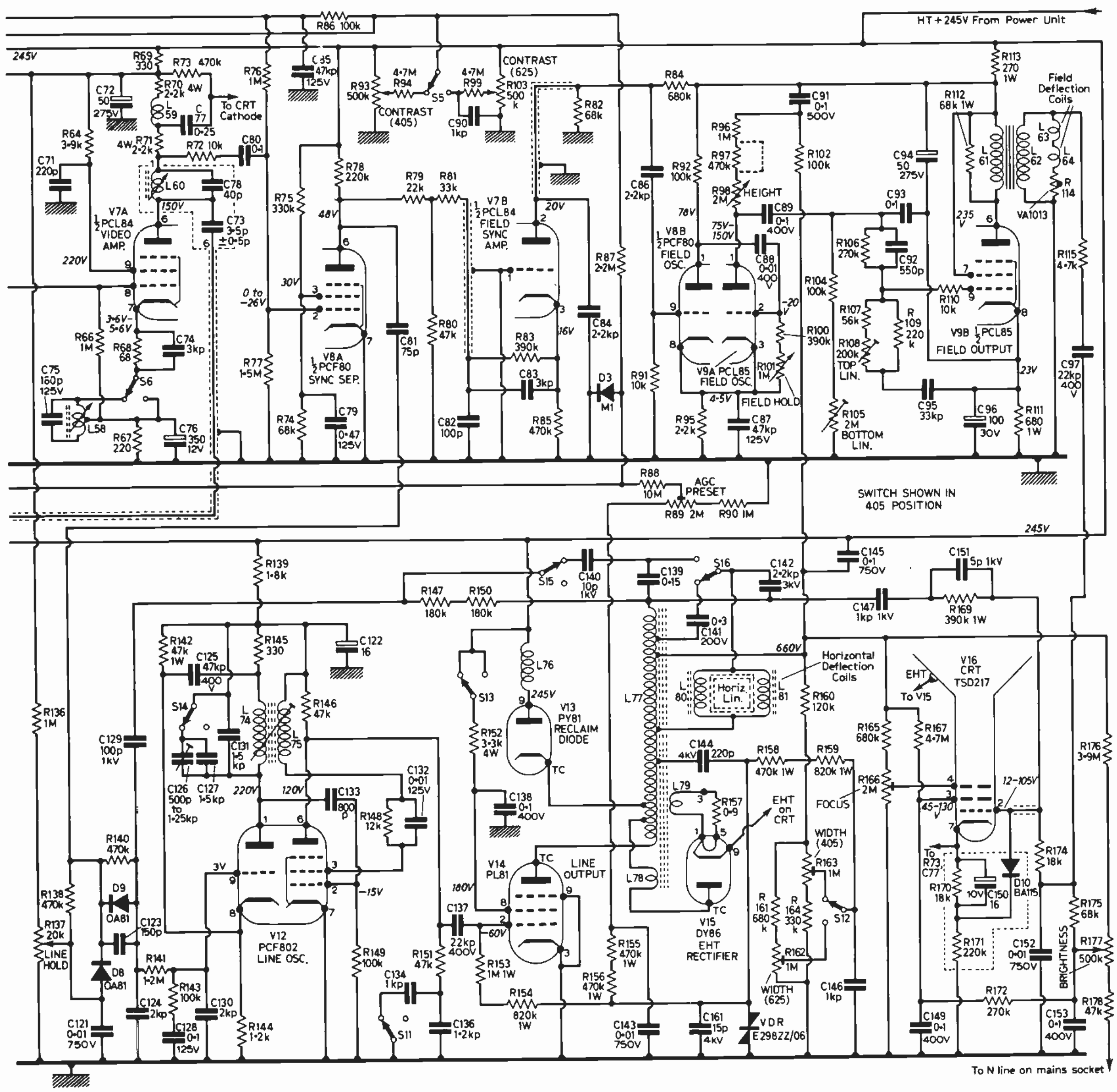
The u.h.f. tuner, which may be one of two types, Bird or Telefunken, does not give much trouble (this is the writer's experience; it may not be yours) apart from dry-soldered joints which may cause intermittent fading and improper contact on the aerial input socket.

Poor Brilliance

A very frequently encountered fault is low brilliance, the picture being all soot and very little whitewash. This is invariably due to a resistor going high in the feed to pin 3 (first anode) of the tube base. Check R167 4·7MΩ (or 4M7 if you like it better that way). R176 could cause similar effects but it doesn't seem to.

Valve Heaters Inoperative

The resistor R173, 56Ω, 6W wire wound seems to become open-circuit regularly. This causes complete failure of the heater chain. It is located near the top centre of the vertical chassis under a heat shield. This is the only heater circuit dropper, the rest of the voltage being lost by the half-wave rectification action of D11 (BY100).



chassis used in 11-in. portable models.

Distorted Sound

Distorted sound on the 405 standard usually points to a fault in the noise limiter stage. R125 8·2MΩ has a tendency to go high causing severe clipping which shows as distortion especially on a strong signal (not high volume level but high aerial signal!).

The causes of distortion on the 625 standard are different. Usually in these models poor BBC-2 sound is due to incorrect i.f. alignment and slight adjustment to L67, L69 restores reasonable quality. R123 on the other side of the coil can is provided to balance out any buzz which persists when the receiver is correctly tuned.

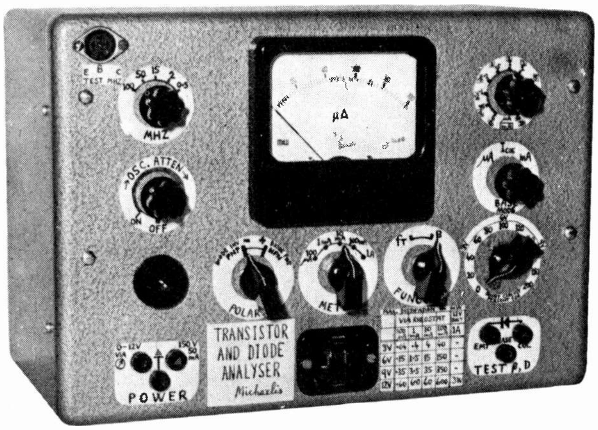
Whilst we never recommend readers to tamper with the i.f. alignment, in some cases a slight adjustment to a particular coil core is better than trying to replace the small capacitors which are wired across most coils. A slight change in the value of one or more capacitors is enough to spoil the reproduction in the 625 sound i.f. stages. Having said this however we hasten to urge readers not to interfere with any coil cores unless they know the exact function of that coil, they have the alignment data and are in possession of a signal generator (at least).

Line Timebase Faults

Apart from line oscillator h.t. supply failure, which we will deal with next month, common line timebase faults are lack of width and no line sync. The former is usually due to a low-emission PL81 but the width circuit should be checked.

Resistors R158, R159 and R160 should be checked, also the v.d.r. and R153, R154 if necessary.

CONTINUED NEXT MONTH



TRANSIST DIODE AN

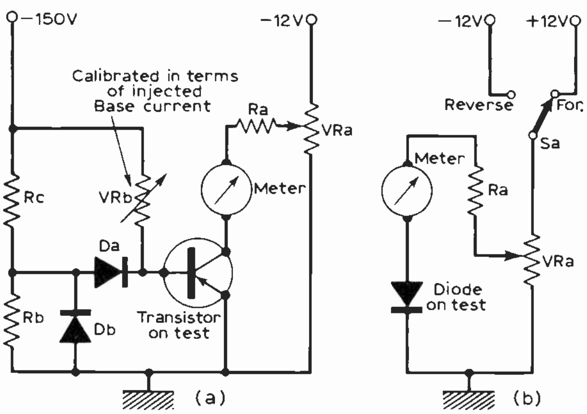
PART 1

THIS instrument has been named an analyser because ordinary testing of transistors and diodes whose basic characteristics are known is only one of the facilities it provides. The design is such that even an unmarked transistor whose connections, type and purpose are not known and for which no data sheets are available can be systematically analysed in order to determine all information required for experimental purposes. A later part will present detailed instructions for carrying out this process and at an early stage of this procedure it will emerge whether the transistor is intact or defective.

It is not even necessary to know in advance whether the device is pnp or npn, silicon or germanium. This will also emerge in the course of analysis. In fact *nothing at all* need be known in advance about the transistor one desires to analyse. Thus this instrument is the ideal tool for getting all those unknown, unmarked transistors from the bottom of your junk box back into service as well as for making better use of the many bargain offers of transistors specified as "unmarked, untested, for experiments". In this sense the transistor analyser will rapidly pay for itself.

The analyser is also well suited for workshops where it can be used by those with various degrees of proficiency since it cannot be damaged by incorrect settings with respect to the transistor being tested. The transistor may be destroyed by wrong settings but is never endangered if the systematic instructions to be given are followed carefully and correctly.

We make no apology for introducing simplified parameter terminology because our aim is to permit the quickest possible *practical* use of a transistor without introducing baffling theoretical parameters and their complex algebra. Thus this project is suitable even for relative beginners.



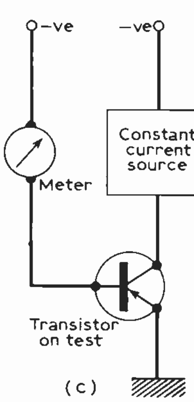


Fig. 1: (a) Basic circuit of the arrangement used for testing current gain (β) and differential current gain (βd). A full account of the circuit and the reasons for its adoption are given in the text. (b) For diode testing the basic circuit is used but only the collector and emitter connections are employed. (c) An alternative widely used circuit for testing β, with a constant-current source—see text.

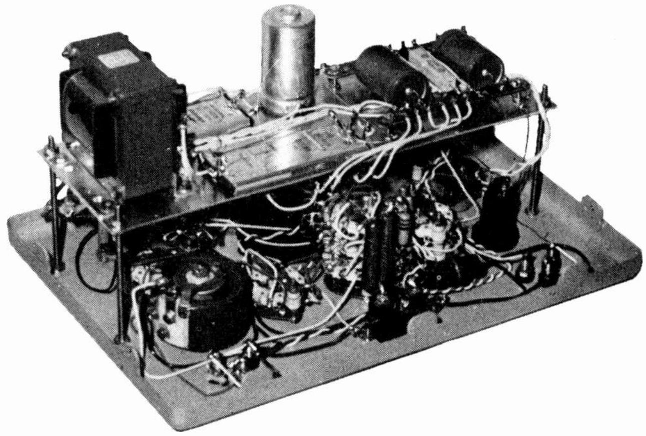
BASIC PRINCIPLE

Figure 1(a) shows the circuit principle adopted for determining the amplifying capabilities of a transistor. The relevant parameter is called the current gain, beta (β). It is the ratio of collector current (or change of this) to the base current (or change) needed to produce this collector current (or change). We speak of the *integral current gain* (β) when taking the ratio of the *total* currents at any operating point, and of the *differential current gain* (βd) when taking the ratio of the current *changes*. The same basic circuit (Fig. 1(a)) is suitable for measuring both β and βd.

An adjustable voltage tapped off by the control VRa is applied via resistor Ra and the meter to the collector of the transistor on test, whose emitter is grounded. Calibrated base drive current is injected via VRb. The injected base current is clearly set by VRb because this control has a very high value and is connected to a high source voltage in relation

OR AND
ALYSER

MARTIN L. MICHAELIS, M.A.



diodes for testing npn transistors. This polarity switch also plays an important role in the systematic procedure for determining the electrode connections of an unknown transistor and whether it is a pnp or an npn type.

to which any working voltage drop between base and emitter of the transistor on test is negligible.

METER RANGES

Collector currents may range from 1μA to 1A during testing so it is necessary to use a 100μA f.s.d. meter movement on which 1μA can still be read off with reasonable accuracy and the presence of a fraction of a microamp collector current is still visible as a distinct movement of the pointer. About 0·25μA is the minimum current discernible in this manner and whenever we speak of zero collector current in this article we mean any value less than about 0·25μA. We need five decimally graded ranges to cover all encountered collector currents up to 1A. The lowest range giving 100μA f.s.d. is provided by the unshunted meter, whilst the meter is shunted to give 1, 10, 100mA and 1A f.s.d. respectively in the other ranges.

The range switch also selects a different value of Ra in Fig. 1(a) for each range such that the short-circuit current when the collector is connected to chassis is just full scale when VRa is set exactly midway; thus the short-circuit current is twice the full-scale value of the selected meter range when VRa is turned to maximum and the full supply voltage is then applied to Ra. No settings of the controls or external connections can therefore ever lead to more than twice full-scale deflection meter current and the meter requires no further protection.

VRa has a scale graduated linearly from zero to 200% full-scale deflection, serving an important function in the testing procedure. The described arrangement not only protects the meter but also prevents inadvertent current runaway and thus safeguards the transistor being tested.

POLARITY

Figure 1(a) is drawn for testing pnp transistors. A pnp/npn polarity switch is provided in the full circuit to change over to positive supply voltages and to reverse the connections of the meter and the safety

TESTING DIODES

Figure 1(b) shows the basic circuit employed for testing diodes. This is simply Fig. 1(a) but omitting the base drive section on the left. The diode to be tested is connected to the collector and emitter sockets of the transistor test connections, leaving the base socket blank. The diode anode is always connected to the collector socket and the diode symbol is marked accordingly between the collector and emitter sockets on the front panel.

To test any diode first decide the value of forward current to be applied as test current, select the lowest meter range containing this desired current value and set VRa to the position of this current in this range. Set the polarity switch to the npn position, which is always the setting for diode forward current, and the meter should read the preselected current or some value reasonably close to it. If the meter shows no reading the diode is open-circuit, assuming it has been connected the right way round.

Now move the polarity switch to the pnp setting, which serves to test diode reverse voltage. The meter reading should drop to zero or to some value very much smaller than previously. If the meter reading remains unchanged the diode has a short-circuit fault. To read the reverse current switch progressively down to lower meter ranges until a satisfactory reading is obtained. Good silicon diodes usually do not give any reading even in the 100μA meter range because their reverse current is virtually zero.

The choice of forward test current may be made according to physical appearance if more specific test data are lacking. Point-contact diodes used for r.f. signal rectification may be tested at 1 to 5mA, junction diodes for general purpose electronics at 10 to 25mA, small-power rectifiers at 100mA and large-power rectifiers at 1A.

CONSTANT-CURRENT SOURCE

Figure 1(c) shows an alternative circuit arrangement found in many transistor testers. Here a constant-current source (a special electronic current

★ components list

Resistors:

R1	330Ω 5W
R2	2Ω* 5W
R3	33Ω* 5W
R4	390Ω* 1W
R5	3·9kΩ*
R6	39kΩ*
R7	27kΩ* 1W
R8	2·2kΩ
R9	220Ω
R10	0·23Ω resistance wire*
R11	2·3Ω*
R12	23·6Ω*
R13	260Ω*
R14	200MΩ (nine 22MΩ resistors in series)
R15	100MΩ (ten 10MΩ resistors in series)
R16	50MΩ (or top five 10MΩ of R15)
R17	20MΩ (or top two 10MΩ of R15)
R18	10MΩ (or top 10MΩ of R15)
R19	5MΩ (two 10MΩ in parallel or selected low 5·6MΩ resistor)
R20	30MΩ (two 15MΩ in series)
R21	20MΩ (two 10MΩ in series)
R22	15MΩ
R23	7·5MΩ (two 15MΩ in parallel)
R24	3MΩ (two 1·5MΩ in series)
R25	1·5MΩ
R26	750kΩ (two 1·5MΩ in parallel)
R27	300kΩ (two 150kΩ in series)
R28	150 kΩ
R29	75kΩ (two 150kΩ in parallel)
R30	30kΩ 1W (two 15kΩ ½W in series)
R31	20kΩ 1W (two 10kΩ ½W in series)
R32	15kΩ* 2W
R33	5·6kΩ* 5W
R34	27kΩ
R35	33kΩ
R36	1kΩ
R37	100Ω
R38	1kΩ
R39	100Ω
R40	47Ω 1W

All ½W 10% carbon unless otherwise indicated.

* Value used on prototype: may need adjustment.

VR1	40Ω 5W linear w.w. (use 50Ω if not available)
VR2	25kΩ log. with double-pole mains switch (S1)

Diodes:

D1	Selenium bridge 12v a.c., 1A d.c.
D2	Selenium bridge 100-250v a.c., 50-100mA d.c.
D3-D6	Small silicon diodes, 25mA, 25v p.i.v., e.g. BAY21
D7, D8	Small silicon diodes, 250v p.i.v., reverse current less than 0·2μA at 200v reverse voltage, e.g. S36
D9	Small signal diode which will rectify up to well over 100MHz, e.g. OA257
D10	4·5v, 100mA zener
D11	4·5v, 100mA zener

Capacitors:

C1	1000μF 25v El.
C2	50μF 250v El.
C3	50μF 250v El.
C4	560pF†
C5	4700pF†
C6	0·01μF 250v
C7	0·01μF 250v
C8	0·01μF 250v

C′ a-e and C″ a-e. See Table 1, 500v ceramic

† Over 25v; insulation 1000MΩ or better.

Miscellaneous:

S1	On VR1
S2	4-pole changeover (1 wafer)
S3	6-pole 5-way (3 wafers each 2-pole 5-way)
S4	8-pole changeover (2 wafers each 4-pole changeover)
S5	1-pole 3-way (1 wafer)
S6	2-pole 11-way (2 wafers each 1-pole 11-way)
S7	4-pole 5-way (2 wafers each 2-pole 5-way)

One pole on each wafer used for switching, other pole for tie-points.

Sk1	Panel-mounting mains input
Sk2	Three insulated wanderplug sockets
Sk3	Three insulated wanderplug sockets
Sk4	Standard tape recorder 3-pole audio input socket
F1	1A
LP1	Panel-mounting neon pilot lamp (mains voltage)
M1	100μA f.s.d. moving-coil meter. Resistance approximately 2337Ω

Wire, solder, tags, material for cabinet, etc.

stabiliser circuit) forces a definite collector current and the meter is connected in the base circuit to read the base current automatically drawn to give the forced collector current. This arrangement possesses two great advantages. First the constant-current source tends to run the transistor at the lowest collector voltage for which that current can be drawn, i.e. the transistor is automatically held on the knee of its characteristic and power dissipation is thus minimised so that conditions are not critical regarding transistor power ratings. Secondly if the meter range switch is combined with the current-selector switching of the constant-current source the meter can be calibrated directly in β.

ADVANTAGES OF CIRCUIT ADOPTED

However the arrangement also has so many disadvantages that it was rejected in favour of the adopted arrangement of Fig. 1(a). The outlay in parts for a constant-current collector source switchable to sufficient current values to cover the full required range yet spaced closely enough to permit determinations of βd as well tends to be prohibitive. Then it is not permissible to use a high supply voltage with large resistors as a simple constant-current source in the collector circuit: electronic current stabilisers operating with low supply voltages would be needed. The need for both polarities would further complicate the issue. The constant-current collector source without a meter is not usable as it stands for diode testing as well, and it is altogether less satisfactory for using the diode test function to determine the connections of an unknown transistor. Finally the most serious disadvantage of all, and the one which chiefly decided the issue to reject this arrangement and use the Fig. 1(a) principle instead, is that a prohibitively expensive meter would be required in the base circuit because base currents to be measured are smaller than collector currents by a factor equal to the current gain. As we shall see later in this series some common transistors provide large current gains even with only a few μA collector current for which the base current is only a few nanoamperes. Thus a 1μA f.s.d. meter would be necessary in the arrangement of Fig. 1(c), which in

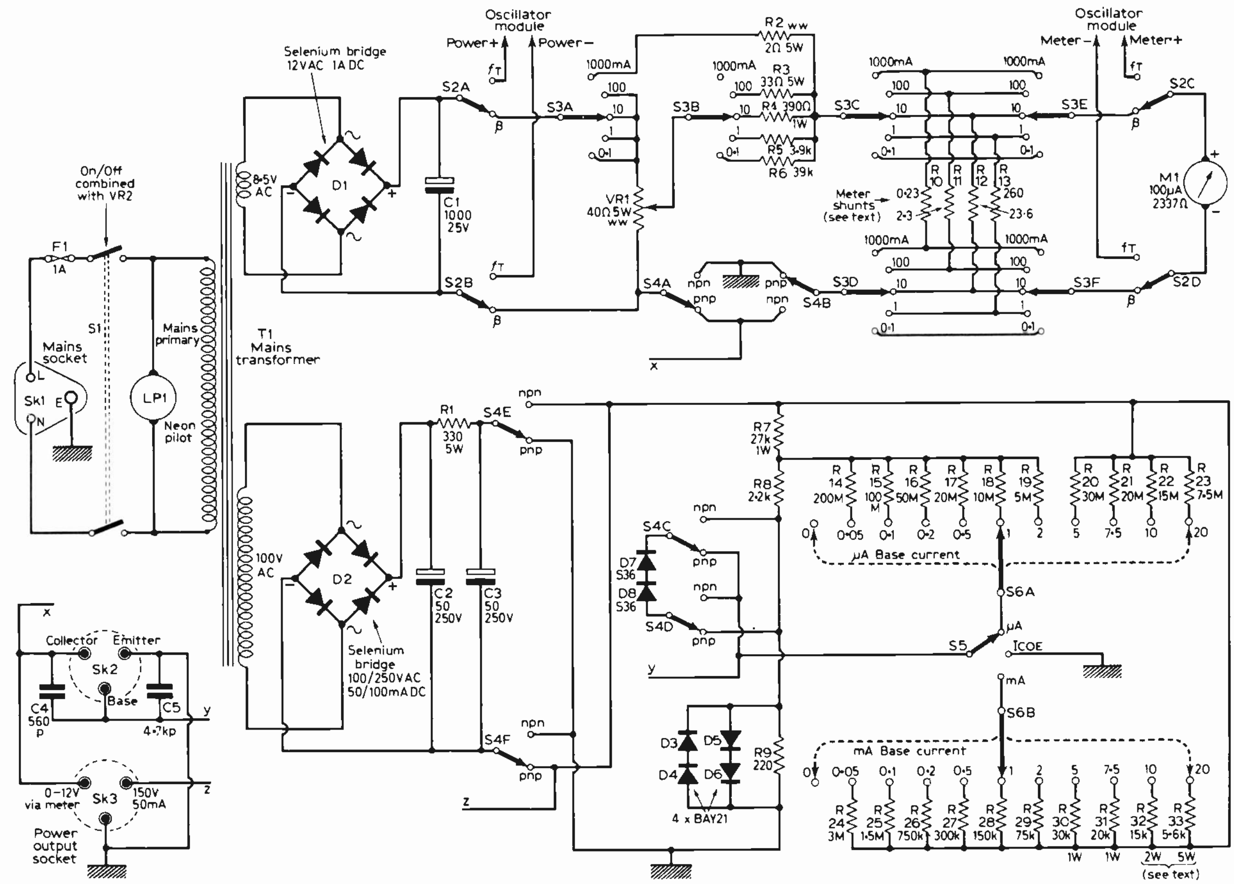


Fig. 2: Circuit diagram of the power supplies and arrangements for checking gain.

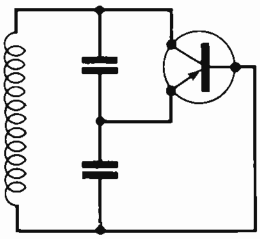
practice would imply the need for an electronic amplifier driving an ordinary meter. In summary the chief objection to Fig. 1(c) is its prohibitive cost in a properly versatile circuit design.

SAFETY MEASURES

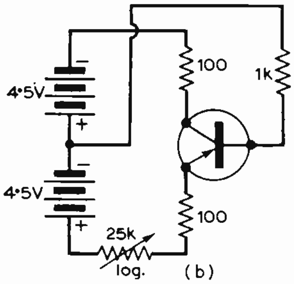
Without the safety components Rb, Rc, Da and Db in Fig. 1(a) there would be a serious risk of destroying the transistor if the polarity switch is set to npn when a pnp transistor is connected or vice versa, because no base current could then flow so that the base-emitter reverse voltage would rise to the full 150V source voltage, leading to inevitable breakdown. To remove this danger the voltage divider Rc, Rb has been provided to bias the anode of the safety diode Da with about 1V reverse bias. The anode and cathode of the safety diode are both returned to the same supply voltage, and when the latter is changed in polarity with the pnp/npn switch other contacts of the same switch also reverse the safety diode Da. Thus the actual voltage between the base and emitter sockets can never rise to greater than 1·3V in the selected polarity before Da switches on and takes the full current through VRb. If the polarity switch is set incorrectly therefore the transistor merely sees a base cut-off potential of 1·3V which is harmless.

The maximum base drive current normally required for testing and here provided via VRb is 20mA. In the event of wrong polarity or a disconnected transistor this current must flow through Da and Rb and if it is not to cause a significant rise of base socket potential (remember that many transistors will not tolerate more than 4V reverse base voltage) the current through the voltage divider Rc, Rb would have to be large compared to 20mA. This would demand an uneconomical drain on the 150V supply. To avoid this the current through the voltage divider has been made only about 5mA and the diode Db shunted across Rb. As soon as the current arriving through Da becomes comparable to 5mA, according to the setting of VRb, the voltage drop across Rb increases by the few hundred mV needed to reach the threshold of Db which then takes over all further current. Db must also be reversed when the source voltage polarity is reversed, but here it suffices to connect two diodes in anti-parallel which is cheaper than using one diode with switch contacts.

The characteristics of Db are not critical but Da must be a type with extremely low leakage current. Otherwise when VRb is set to the lowest base drive currents provided, around 50nA, the safety diode Da would present an indeterminate shunt and the actual base drive current reaching the transistor becomes ambiguous. No commonly available diode satisfies this requirement in the forward cut-off region between zero and the silicon threshold, the forward leakage current here being appreciable in



(a)
Schematic circuit
of RF oscillator
(see text)



(b)
Schematic circuit
of oscillator
DC conditions
(see text)

Fig. 3 (above): The basic oscillator circuit used for the transition frequency test.

Note that S7 must be a ceramic or good paxolin type switch.

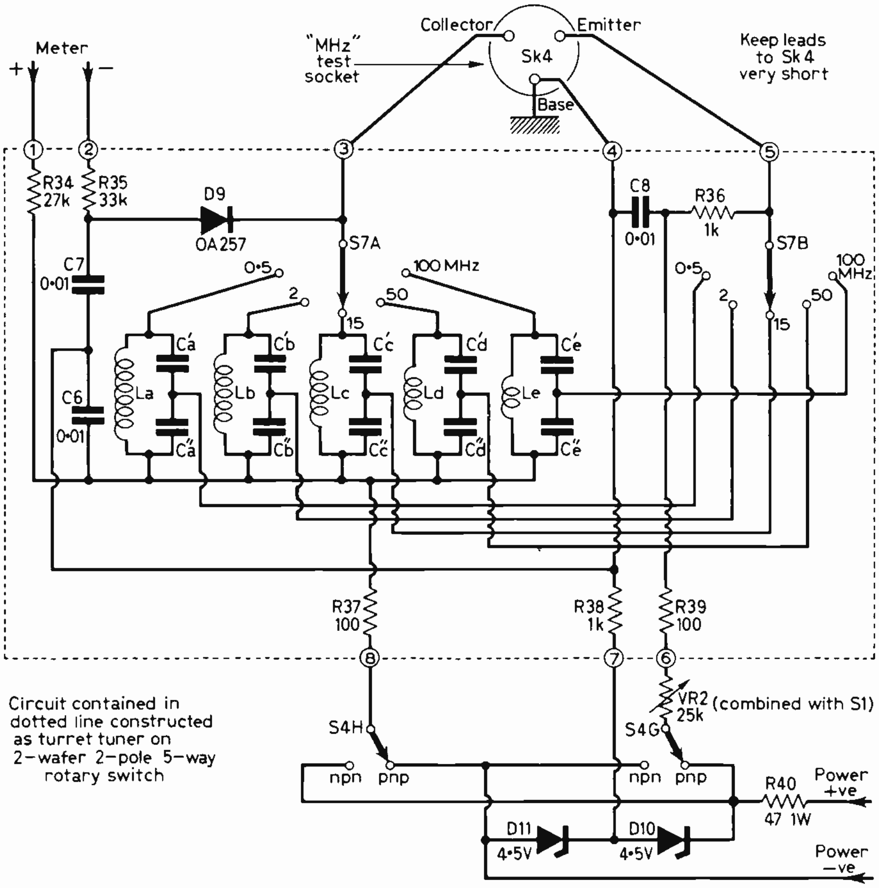


Fig. 4: Circuit diagram of the oscillator module used for the f_T test.

relation to the minimum current injected via VRb. Thus it is not satisfactory to connect two or three diodes between base socket and chassis to give a total silicon threshold nominally greater than the maximum required base-to-emitter working potential. It is essential to use the biasing arrangement of Fig. 1(a) to hold Da at a definite reverse voltage.

ANTI-PARASITIC CAPACITORS

It is essential to avoid parasitic oscillation when measuring β and βd under d.c. conditions otherwise readings will be false. High-gain transistors may oscillate on odd inductive loops of the connecting wires and distributed stray capacitances, usually in the v.h.f. range. To prevent this trouble a capacitor is introduced as shunt between base and emitter, another capacitor provides negative feedback between collector and base, and the collector-to-emitter capacitance giving positive feedback is not augmented above the inevitable strays. Provided short external test leads are used, or preferably the transistor is inserted directly into the test sockets, parasitic oscillation is unlikely under these conditions and has never been encountered during exhaustive field tests of the design.

But note that the anti-parasitic arrangements introduce considerable capacitance between base and emitter so that without the safety diode Da the transistor would be in danger even when the polarity switch is set correctly. The base capacitor would charge to 150V whenever there is a momentary poor contact at the base and as soon as base contact was restored the capacitor would discharge with a large surge through the base. Even though the chief resulting danger from a massive collector current surge is removed by Ra, the base-emitter junction could nevertheless be burnt out directly. This danger is also completely avoided by the safety diode because it prevents the base capacitor charging up to appreciable potentials.

OPERATING FREQUENCY TESTS

The measurements of β and βd made in the arrangement of Fig. 1(a) under static d.c. conditions are valid for a.c. signals up to a certain frequency above which β and βd drop drastically below the d.c. values. Textbooks define a so-called transition frequency determined by the transit time of charges through the transistor and at which β has dropped to unity so that current gain has just vanished at this point. Various sophisticated methods are available for measuring the transition frequency of a transistor, one of the best being to observe the flank distortion of an accurate squarewave on a suitably calibrated oscilloscope. This would demand an unjustified outlay in accurate squarewave generators and wideband oscilloscope circuitry if v.h.f. transistors are to be covered too, so this approach

Table 1; Tuned circuit data for oscillator module

Nominal frequency	C′	C″	L (approx.)	L turns	L wire type†	L core type
0·5MHz	400pF	5000pF	300μH	155 turns on 6 mm. diameter former	0·2 mm. diameter (36 swg). Pile 10 mm. long	Ferrite screw slug approx. 14 mm. × 5 mm. diameter
2MHz	100pF	1250pF	75μH	75 turns on 6 mm. diameter former	0·2 mm. diameter (36 swg). Pile 10 mm. long	Ferrite screw slug as above
15MHz	100pF	1000pF	2·5μH	13 turns on 7·5 mm. diameter former	0·4 mm. diameter (28 swg). Single-layer close-wound	Ferrite screw slug as above
50MHz	27pF	47pF	0·6μH	9 turns 7·5 mm. diameter self-supporting	1 mm. diameter (18 swg) close-wound	—
100MHz	1pF*	3pF*	0·2μH*	7 turns 4 mm. diameter self-supporting	1 mm. diameter (18 swg) close-wound	—

* Stray *C* of switch and wiring and *L* of wiring comparable: bend Le and/or modify values of C′e and C″e to obtain 100MHz (check with grid-dip meter, wavemeter or by reception of top end of v.h.f./f.m. broadcast band).
† Enamelled copper wire.

Specified data is not critical since frequencies need only be approximate. Wind coils with nearest available materials or according to μH values given with any other material if inductance measuring equipment is available. Finally if grid-dip meter or wavemeter is available select C′ and C″ to produce exact nominal frequencies (this is not essential).

was rejected for the present instrument. However some facility for practical assessment of the maximum usable operating frequency of a transistor is essential because this forms one of the chief criteria for allocating an initially unknown transistor to its correct usage.

A simple principle is to test whether the transistor will oscillate at progressively higher frequencies, thus determining the limiting frequency at which oscillation fails. This does not measure the transition frequency but for ordinary practical work we are not interested in this but rather in the maximum usable frequency, which the oscillation test assesses directly.

OSCILLATOR DESIGN

The principle that if a transistor will oscillate at a given frequency it will also function satisfactorily in any other circuit up to that frequency, whereas if it will not oscillate at a given frequency it cannot be used for any other purpose at that frequency either, is not wholly valid according to the advanced physics of transistors, but in a suitable oscillator circuit it may be used as a very good approximation for obtaining practical guidance concerning the maximum frequency at which the transistor will operate satisfactorily. The problem is to devise an oscillator arrangement in which the oscillation criterion is strongly dependent on the transition frequency of the transistor and is as little as possible affected by other parameters such as operating point, input/output mode, L/C-ratio of tuned circuits, loading on tuned circuits, geometric dimensions of transistor, polarity of transistor etc.

The Colpitts oscillator circuit shown in basic schematic form in Fig. 3(a) was found to meet these requirements best of all, when used in conjunction with a d.c. set-up as sketched in Fig. 3(b). This arrangement obviates the distinction between grounded-base and grounded-emitter modes in that though it is essentially a grounded-base circuit the feedback is so heavy that oscillation is ensured if oscillation is possible at all with a given transistor.

FREQUENCY RANGE

The arrangement of Fig. 3(b) permits change of operating point through a large range with a single logarithmic potentiometer in a manner satisfactory for any transistor from small milliwatt types to large power types without endangering either. The potentiometer has been termed the *oscillator attenuator* control and placed on the front panel for interpolation between the five provided spot frequencies. Thus ten categories are distinguishable, sufficient to obtain a very good indication of the uses to which an unknown transistor may be put. Further checks are then quickest in an actual circuit. The ten frequency classes are tabulated together with full practical instructions in the final instalment of this series giving the systematic procedure for analysing a completely unknown transistor.

DETECTION

This method of frequency assessment also enables a very simple yet highly satisfactory oscillation detection arrangement to be used. A meter and diode in series are simply connected across the coil of the tuned circuit in Fig. 3(a). Since the coil has a very low resistance no significant d.c. voltage

—*continued on page 34*

getting COLOUR on your BLACK-&-WHITE set

T. JOHN REPORTS

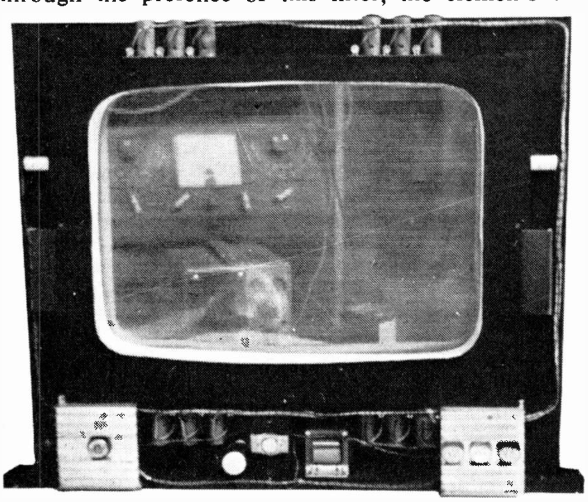
WITH the addition of a converter and a colour-filter optical system you will soon be able to view colour TV on your black-and-white set. The converter and optical system are to be made available shortly in kit form and have been developed by inventor Edward Jaggers, B.Sc. We understand that the price will be £35-40. Photographs of the colour pictures produced by this system indicate that very acceptable results can be obtained.

Field Sequential System

The system is based on the field sequential principle, i.e. alternate fields are displayed in red, green and blue. To do this the picture tube is driven by R, G and B signals on alternate fields while red, green and blue optical filters in front of the screen are switched in synchronism field-by-field. Thus we get approximately 17 blue, 17 red and 17 green fields per second and these are integrated by the eye to give an overall colour picture.

Optical Filter Unit

The optical system differs from previous systems of this type in using switched colour filters instead of a large and cumbersome colour-sector disc. The filter elements are horizontally positioned in a simple unit which is placed in front of the set, a prototype version being shown in the accompanying photograph. Very little loss of definition is caused through the presence of this filter, the elements of which are produced to an accuracy of 0·0002in. from high-stability plastic film. Flicker is normally a problem with this type of system but is reduced to an absolute minimum by an anti-flicker device consisting of a series of sublimitive light sources that are also switched by the decoder. Light-dependent resistors in an automatic control circuit maintain the position of the filter elements accurately.



The optical filter unit, viewed from the set side. The six transducers at the top and bottom control the filter elements which, as can be seen, cause little loss of definition.

Filter Movement

Movement of the filter elements is effected by transducers which are controlled by field-frequency squarewave signals, the noise level of the transducers being kept to a low level by using a special method of suspension.

Colour Transmissions

As readers will know the colour transmissions are compatible, which means that a monochrome set will receive them but produce only a monochrome picture display, not having the extra circuitry required to process the chroma component of the composite transmitted signal. This means that on BBC-2, and on BBC-1 and ITA before long, you will be actually receiving colour transmissions even though you only get a black-and-white picture.

Converter Circuitry

The extra circuitry required to obtain the red, green and blue signals to drive the picture tube on alternate fields is contained in the converter unit the operation of which is roughly indicated in block schematic form in Fig. 1. The converter is connected between the final i.f. amplifier in the receiver and the video amplifier. The i.f. signal is first demodulated to obtain the luminance, chroma and sound signals. The combined luminance/chroma signal is then fed to a preamplifier from which the chroma signal is taken off and fed to the decoder.

Decoder

The decoder is simplified since it only has to produce one signal at a time, R—Y, G—Y or B—Y, instead of all three. Thus a single synchronous demodulator is used, the phase of the reference signal applied to it being shifted field-by-field so that it demodulates R—Y, G—Y and B—Y in field sequence. The sequential demodulated colour-difference output is then fed to a luminance/colour-difference adder stage so that sequential red, green and blue signals are obtained to drive the video amplifier stage in the set.

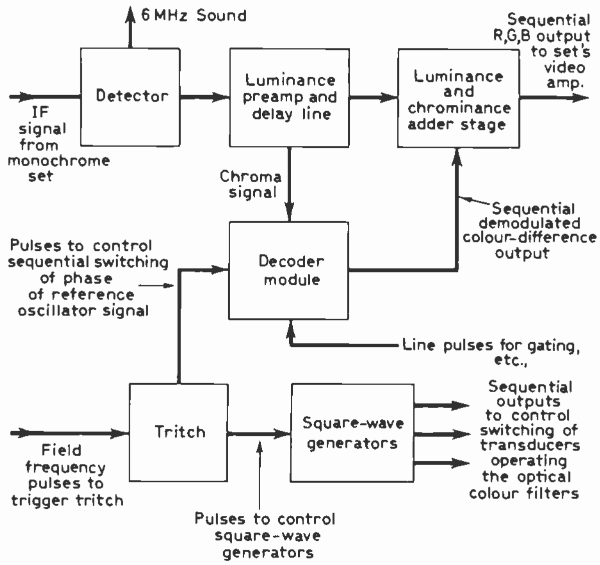


Fig. 1: Block diagram showing the "electronics" of the Jaggers colour TV system for converting a monochrome set to field sequential colour operation in conjunction with a switched colour optical filter. The signal from the receiver is taken off at the final i.f. stage, fed to the converter and returned to the video amplifier as a demodulated sequential R, G, B signal.

Tritch

The field sequential switching is controlled by a tritch circuit which is very similar to the design featured in the February issue of PRACTICAL TELEVISION this year. This is driven by field blanking pulses obtained from the set and delivers two outputs, one to control the phase shifting of the reference oscillator signal in the decoder and the other to control a group of three squarewave generators which in turn control the transducers that operate the filter elements in the optical unit.

Installation

The black-and-white set will need very little alteration. Plug-in adaptors are used to feed the i.f. to the converter and the R, G and B signals to the set's video amplifier. Pulse feeds from both the field and line timebases are taken from the scan coils in the set, an isolating network being incorporated in the converter. These connections are all colour coded and no harm can come to the unit if they are by accident connected incorrectly—only a collection of rather weird colours!

The receiver that has been used in demonstrations is a Philips G19T211A, but many other sets have been used with good results, mostly only requiring a "tweek" of the first i.f. in order to bring in the chroma subcarrier.

Sizes

The unit is to be manufactured in one size, large enough for a standard 23 in. model, masks being supplied to blank off unwanted areas in smaller sets. ■

UNDERNEATH THE DIPOLE

MOONSHINE is the name given in the USA to illicit whisky, "the *hard* stuff". The *soft* landing on the moon was certainly not moonshine. Its reflections will continue for weeks following the greatest physical step forward made by Commander Neil Armstrong when he placed his foot on the moon. Its implications will accelerate technical progress in a thousand fields, many quite unconnected with outer space.

OUT OF CHAOS

The transmissions to Britain of the Apollo event were not confined solely to British sound and television broadcasting activities. London became a kind of "clearing house" for Europe and, I believe, other continents in the easterly direction. Large space and much equipment at the BBC was occupied with monitoring, videotaping and film transfer facilities of the event for Fleet Street and foreign journalists plus TV executives and film editors. The same kind of Tower of Babel chaos took place at Independent Television News but in both cases splendid results were achieved.

That hopeful old show business saying "*It'll be All Right on the Night*" was often a consolation after a terrible dress rehearsal of a theatrical show but was not necessary at line-ups at either the BBC or ITN where editors, producers and technical crews are accustomed to a time scale down to the last second and where patching in television sources and complicated vision mixing and title overlays are everyday exercises. Cinema newsreels obtained much material from the BBC and/or ITN and there was a great volume of videotape transferred to 35mm. and 16mm. film by Technicolor, Colour Film Services, TV Recordings and Visnews. This world coverage for cinema, educational institutions, closed circuit and home movies must amount to millions of feet of film.

BLUEBELLS OF ENGLAND

Old steam locomotives were a big holiday attraction this year, especially the narrow-gauge lines of Wales; but the old standard-gauge Bluebell Railway and the reopened Dart Valley line have had a successful season with thousands of holiday makers and television companies filming or taping their activities. The "free commercials" given by all channels on their magazine programmes must have helped a lot.

Power boat racing, motor racing, horse racing and show jumping all play their part. Specially noteworthy was the Royal International Horse Show. Pity the series of shows was confined to the "old-fashioned" black-and-white BBC-1, about to add colour. The BBC should remember that the success of the Technicolor colour film system was mainly due to the attractive appearance of chestnut and dun-coloured horses in Western cowboy films and especially to the piebald and skewbald foals which appealed to children of every age.

STADIUM LIGHTING FOR TV

This year the lighting at night of the International Horse Show at Wembley must have posed many technical problems, mainly because of the large space devoted to hurdles, jumps and other obstructions. It would be possible to illuminate the large area like daylight if there was a large enough power source, enough lamps, enough electricians and enough places in which to use the lamps in the right way. This of course means that the lamps have to be controlled from a central point by communication or by remote control, with complete collaboration with the BBC lighting supervisors and technical men controlling the camera control units and TV racks. Just how many "brute" carbon-arc lamps (225A d.c.) plus 5 and 2kW tungsten-halogen luminaires were used is not clear to me at the moment as I was at the receiving-set end. But the result was one of the best (if not the best) night presentations of a horse jumping show, which the BBC credited to Alan Mouncer and Roy Norton for television "presentation". Dorian Williams gave perfect commentaries on the event and David Coleman's talk with Ted Edgar, the winner of the George V Gold Cup Championship on Uncle Max, was a classic interview.

TECHNICAL COLLABORATION

The British Broadcasting Corporation is a large and complex body undertaking a wide range of activities but naturally some of the detailed operations are subcontracted such as the lighting for the Royal International Horse Show. This was a good example of technical collaboration and was carried out by the Lee Electric organisation, built up by two likeable brothers Ben and John Lee. Very practical men, "blooded" in the tough field of big film spectaculars, they know that everything has got to be "spot on" on the night.

Lee Electric Ltd. are one of several companies who provide lighting equipment on hire for outside television broadcasts as well as for film locations. This lighting equipment is also needed for day work as "filler" light. Shooting films in strong sunlight often requires powerful artificial light sources or strong reflectors. Reflectors are economical of course but it is sometimes difficult to pick up sunlight from the right direction.

Strand Electric, Berkey Electric and Mole Richardson are also engaged in the specialised lighting field, covering everything including mobile generators (which have to be silenced) and spotlights capable of following rapidly moving objects (such as horses at a show jumping event) with accuracy. Berkey are developing a follow-spot

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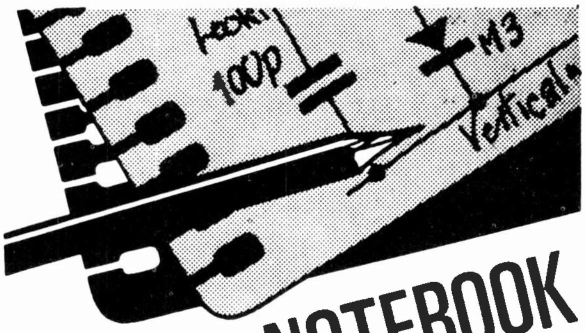

SERVICE NOTEBOOK

G. R. WILDING

Curved Raster Edges

A VERY annoying fault which crops up periodically is a raster with curved sides, resulting in all verticals being similarly curved. The cause can be inadequate h.t. smoothing in the line timebase circuit, heater-cathode leakage in a line timebase valve, an a.f.c. discriminator defect, displaced scan coils or even maladjusted raster correction magnets.

In some models reduction in value of one of the main h.t. smoothing capacitors can produce the effect without any noticeable increase in speaker hum level and without any hum bar. The best check is simply to parallel another electrolytic across each one. It is never necessary to use a check capacitor of equal size to the suspect—the effect of shunting a 50 or 64 μF capacitor across a reduced value 200 μF one will always be sufficient to indicate whether the latter has partially dried up.

To avoid damage to the rectifier it is best to connect the check capacitor across a main electrolytic before switching the set on so that it can charge up normally. On then "stabbing" it across suspects only small surges will be caused. If a completely uncharged capacitor is on the other hand connected across a reservoir capacitor when the set is working a hefty surge that does no good to rectifier or capacitor can occur.

In our particular receiver, an Ultra Bermuda, all electrolytics were in order and all valves were good including the EF80 d.c. amplifier which boosts the output potential from the a.f.c. discriminator to the 30FL14 line generator. The main curve in the verticals was towards the raster top, and although line lock was positive there was a tendency towards tremor in the top castellations.

This strongly suggested impaired sync action somewhere so following the line of greatest probability we checked the dual-diode unit mounted on the discriminator subchassis. This proved perfect and voltages to the EF80—strapped as a triode—were as specified so it appeared that we had a component defect in the circuit, probably a capacitor since none of the resistors was the slightest bit discoloured. (Usually we find that resistors that look all right are all right.)

We then paralled a replacement across the first capacitor suspect, the 50pF capacitor linking the sync separator output to the junction of the dual-diode unit, and immediately the raster edge improved although there still remained a depression towards the centre of the left-hand side. As the right-hand side was normal we tried readjusting the left-hand pincushion correction magnet and with only slight bending of the retaining strip were able to iron this out too.

Usually the setting of these magnets as made by the manufacturers cannot be improved, but as the PY800 had been replaced a short while ago it seemed that in doing so the setting of this particular magnet had been accidentally moved. These pincushion correction magnets offset the raster distortion unavoidably present in wide-angle tubes by pulling out the raster at the centre of each side and at the centre of the top and bottom. Their effect is more noticeable in the horizontal direction due to the screen's 5 : 4 aspect ratio.

Blank Raster

AN unmodulated but controllable raster with normal sound is a fairly frequent complaint and is usually caused by a video amplifier or detector stage fault rather than failure of a vision i.f. stage. Of course if brilliance level cannot be reduced from peak this will almost certainly be caused by a grid-to-cathode short-circuit in the tube. In receivers where the video amplifier anode is directly coupled to the c.r.t. cathode—almost universal practice in 405-only models—ability to control raster brilliance implies that the c.r.t. cathode voltage and therefore the video anode voltage are about normal. This in turn means that the video amplifier anode and screen voltages are near normal and the cathode resistor intact, thus permitting the valve to pass normal current.

Absence of screen modulation in such cases is therefore due to lack of grid input to the video amplifier valve. Sometimes a short-circuit develops in the video amplifier cathode decoupling capacitor and though this would result in only a very weak sort of picture there would always be some background modulation present. Lack of real picture results because without grid bias the positive-going detector output merely draws grid current and the resulting high anode current differs little whatever the instantaneous signal value.

However with a.c. coupling from the video pentode to the c.r.t. as is used in so many receivers today ability to control brilliance gives no information about the video stage—it could be cut-off or passing saturation current. These points were brought to mind when servicing a modern Ekco receiver with a.c. video coupling which had a completely blank but controllable raster.

The first automatic action was to replace the PCL84 video amplifier. There was no effect, but as the screen feed resistor and associated resistors were all at normal temperature it was safe to assume that the valve was operative, passing about normal current but receiving no input. The detector diode then became prime suspect so we removed the PCL84 before making a resistance test on the diode "in situ". As in many receivers, on 405 the vision diode is directly coupled to the video grid and it is good policy to remove the valve for two reasons. First it makes positive identification of the control grid valveholder connection so much easier. And secondly an ohmmeter reading can be obtained through the cathode-to-grid conductance of a warm valve when the meter battery polarity makes the grid positive to chassis.

In this receiver we found a complete short from the control grid connection of the valveholder to chassis with the ohmmeter both ways, and though this could be caused by a short-circuit miniature i.f. decoupler or shorting lead from the i.f. transformer the odds were overwhelmingly for a faulty vision diode. After unsoldering one end for a final check we confirmed that the diode was defective, replaced it and switched the set on for a test run. Incidentally vision diodes are always mounted inside the last i.f. transformer can because being non-linear devices if they pick up stray signals they will act as a form of frequency-changer and produce plus and minus frequencies that cause background patterning.

After a good run to check for field creep or other faults the set was considered OK. However the picture suddenly vanished, leaving a blank raster, while the smell of burning resistors became apparent. Investigation showed that the screen feed resistor of the PCL84 pentode was being over-run due to a screen-to-grid short-circuit in the valve. It now seemed probable that the cause of the original diode's failure was a momentary flashover inside the valve. On replacing the PCL84, the screen feed resistor and fitting a new diode reception was again normal.

When vision diodes are directly coupled to video pentodes and develop a complete short-circuit it pays also to replace the valve in case a flashover was the cause of the diode's failure. When diodes go high-resistance on the other hand the usual cause is simply age. When replacing diodes that are completely short- or open-circuit and there is no polarity indication the only sure way of determining which way round the replacement should go is to lightly solder it in and note results. When diodes go high-resistance however there will invariably be a noticeable difference in their forward and reverse resistances which will indicate how the replacement should be fitted.

Boost Rail Short

THE fault was no results on a dual-standard Ferguson 23in. model. On removing the back the first thing we noticed was an open-circuit fusible resistor in the h.t. feed. We resoldered the clip, checked for an h.t. short and as none was present we switched on and awaited results. Within seconds the PY800 boost diode began glowing red hot and just before we hastily switched off faint and distorted sound began to get through.

In nine cases out of ten when a boost rectifier violently overheats the cause is an internal heater-cathode short-circuit, but in this instance the fact that sound was beginning to develop proved that a fair measure of heater current was being applied to the remaining valves. This was rather surprising as a complete heater-cathode short-circuit in this valve, being first in the heater chain, normally results in negligible heater current for the other valves. However although it appeared to be OK when tested as boost rectifiers are so susceptible to this fault we replaced it with another and switched on again. (Many heater-cathode short-circuits only develop on application of normal heater current and working voltage and seem all right when tested cold with an ohmmeter.)

The new rectifier soon began to glow red but this time we were able to notice that it spread out from the centre of the anode structure. This immediately proved that the cause was not a heater to cathode short-circuit as had been surmised but a short-circuit from the cathode circuit to chassis, and an ohmmeter check showed only about 150Ω from the rectifier's cathode (top cap) connection to chassis. The first possibility that came to mind was that the PL500 could have an internal anode-cathode short-circuit but on removing its top cap connection (anode) the short remained.

We were then faced with several alternatives—a capacitor short-circuiting from the boost rail to chassis, breakdown in insulation between a winding and the core of the line output transformer, or a short from the scan coil wiring to an earthed point The 150Ω short-circuit value rather suggested a winding insulation breakdown since most capacitors that break down due to applied voltage usually exhibit a near-zero resistive value. As the field scan coils in this model were chassis connected we removed both leads to the line scan coils in case they were shorting together.

The short-circuit persisted but on studying the circuit diagram we noticed that a 220pF, 8kV working capacitor was connected from a point on the line output transformer to chassis. On unsoldering one end we found that it had a resistance of close to 150Ω and on replacing it with another and reconnecting the scan coil leads normal reception was obtained.

TO BE CONTINUED

TRANSISTOR AND DIODE ANALYSER

—continued from page 29

drop can ever appear across it and accordingly the meter can never give a reading if the circuit is not oscillating, yet it must give a reading whenever the circuit is oscillating regardless of the frequency provided the diode can handle it.

The maximum possible amplitude of oscillation is the applied collector voltage and thus series resistors are included in the meter circuit to convert this into a voltmeter reading of full scale at just below the applied oscillator collector voltage. The same meter as for the β, βd tests is used but is switched over to the oscillator module by the f_T/β function selector switch so that the meter range switch is then out of circuit.

Exhaustive tests of this oscillator module have proved its practical reliability provided it is built strictly in accordance with the instructions and tuned circuit data detailed in this article. Checks made with a wide range of known transistors always gave assessments in close agreement with nominal operating frequency specifications in data tables.

COMPLETE THEORETICAL CIRCUIT

The complete circuit of the transistor and diode analyser shown in Fig. 2 and 4 can be readily understood in terms of the circuit principles described so far. We will cover those points of detail not yet dealt with next month.

TO BE CONTINUED

CHIPS WITH EVERYTHING

PART 2 E. J. HOARE

TOMORROW'S TV SETS

MANY people are hardly aware that chips exist. This is not really very surprising because up to the present time they have hardly begun to appear on the domestic scene. One interesting exception is the Rank-Bush-Murphy colour receiver that was announced late last year. Quite a large chip is used in this for colour-difference demodulation and RGB matrixing purposes, and this is a pointer to the new things around the corner.

The fact that a receiver has a single chip in it is quite unimportant in itself, but in the Bush case it has provided the designers with a useful technical solution to the problem of applying the technique of RGB drive, as distinct from colour-difference drive which most colour receivers use. RGB drive can be made to give more accurate matrixing of the luminance and colour-difference signals, but the problems of accurate tracking between the three output stages and of long-term stability are difficult to achieve using conventional components. It is not impossible, as Thorn have demonstrated, but the usual solution is plenty of negative feedback with heavy penalties in the form of added complexity and cost.

A chip can be designed to give good tracking of the three channels at a low level and also overcomes the cost and complexity problems. Just how good the long-term stability can be made remains to be seen. It poses considerable difficulties to the chip designer. So at present we can sum things up by saying that chips can occasionally present a useful technical answer to specific design problems but are not of any significance in terms of overall receiver performance, cost, servicability and so on. They can of course be used to give the advertising boys a field day!

Next Generation Receivers

Things begin to get a lot more interesting when we come to consider next generation receivers. If we think in terms of new designs of receivers which are likely to appear on the market during the next year to eighteen months we can expect to see some significant changes. It is difficult to predict exactly how many new chips will appear because this depends on how far afield the setmakers are prepared to go shopping and how long it takes to complete the design and proving of some of the chips that are being worked on at the moment. Also of course price will pay a crucial part. Very few setmakers will be prepared to build in extra chips if the overall receiver cost is higher. The marketplace is too competitive. On the other hand if chip prices break even with the cost of the equivalent conventional components, or better still show a saving, setmakers will build them into their new designs as soon as circumstances allow.

Next Uses of Chips

What sort of jobs can we expect to see chips doing during the period we are considering? At the present state of the art, and combining the resources of the various manufacturers, both American and British, we may well see some or all of the following circuits in chip form: intercarrier sound amplifiers and detector; a.f. and sound output; low-level video signal processing, a.g.c. and sync separator; a.f.c.; decoder circuits partly catered for with, perhaps, two chips, demodulator and RGB matrix.

This makes a total of seven possible uses in a single colour receiver, although we may see many more than seven different chips available to setmakers. The various manufacturers of semiconductors will presumably split up the circuitry in different ways and offer their own solutions. This means that in some cases it will not be practicable to combine chips from one source with some from another because they will not join up in a harmonious and economic marriage. On balance it does not seem likely that we shall see receivers with more than about three-five chips in them during this period. Now what are the implications?

Let us take performance first. These receivers are going to be single-standard models and due to this cause alone will show a marked improvement in picture quality. The main reason for this will be the better i.f. response that can be achieved if no compromises have to be made between 405- and 625-line operation. This will probably be the biggest factor of all. Finer line structure because all programmes are on 625 will also help. The reduced complexity and the absence of system switching will tend to reduce the number of faults and partial failures and so will contribute towards a higher standard of long-term picture quality.

If we add to this a modest improvement due to the use of chips it seems likely that next year's receivers are going to be significantly better than the ones we have at present. The improvement attributable to chips will probably lie more in consistency of performance and long life than in picture quality.

Now let us take another aspect. If a colour receiver has five chips—to take the extreme of our assessment—we can expect it to have 150-200 fewer components than the equivalent receiver designed entirely with conventional valves, transistors and passive components. This reduction is beginning to be really significant. Fewer components means improved reliability and also lower average temperature, which again gives better reliablity. There will also be easier access for servicing. The implications of chipping are beginning to show through.

Looking Ahead to 1975

When we look ahead to 1975 the fun really begins. Not many people are prepared to stick their

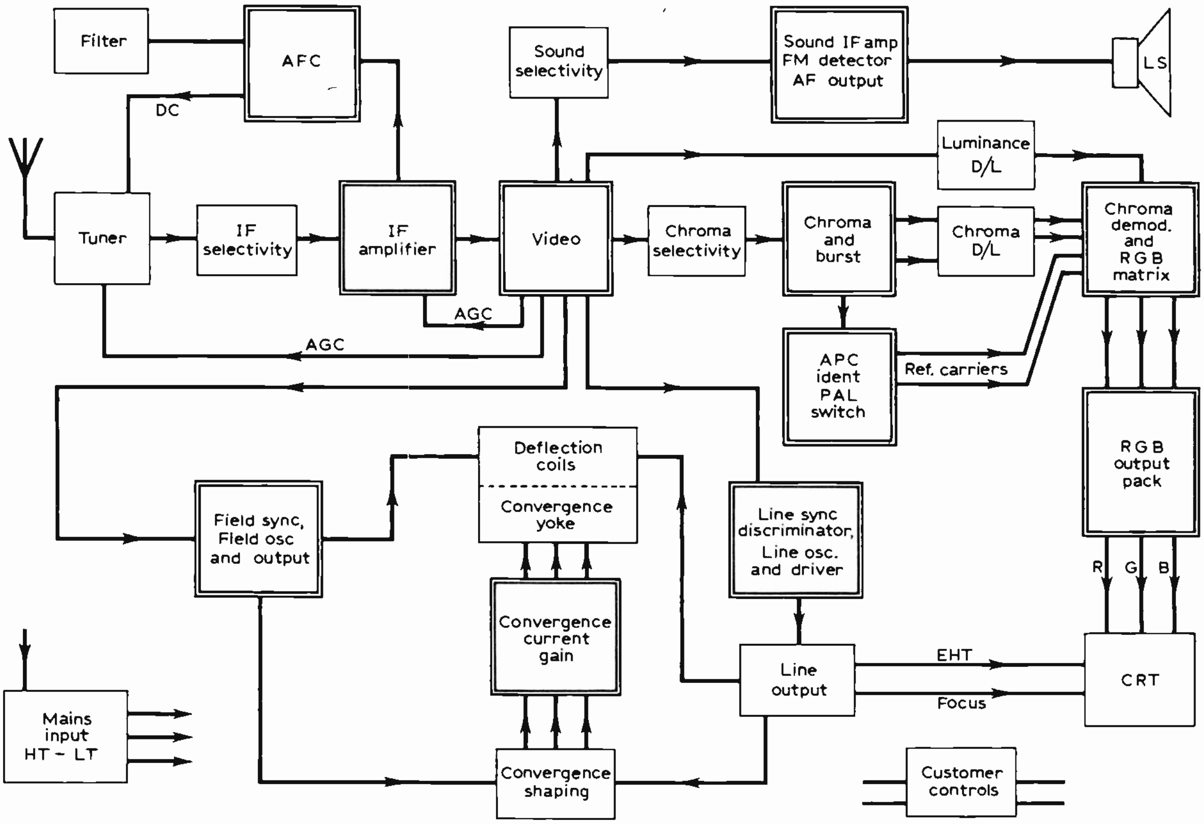

Fig. 6: Block diagram of a complete colour receiver as it may be in 1975—the blocks with a double outline are the sections that are in chip form. The set consists of eleven chips and output packages with their associated components; a few coil assemblies; a tuner unit; a deflection and convergence assembly; line output stage; loudspeaker; and customer controls. Some details such as c.r.t. electrode feeds have been omitted in the interests of clarity but the total number of conventional components needed is about one quarter of the number used in present-day designs.

necks out regarding the prospects six years ahead in an industry based on fast moving technology: still someone ought to do it, so let's hâve a go!

The crux of the matter is what sort of improvements we can expect in the art of designing and manufacturing chips, and trends in their prices and those of conventional components. From these factors will stem changes in receiver design and these will affect set manufacture, selling, servicing and customer satisfaction.

Chips are confined at present to small-signal, low-power, medium-frequency applications which do not need too many coils and capacitors. This will still be largely true in 1975, but not to the same extent because circuit techniques will have been devised to carry out the same circuit functions without using components which cannot be fabricated on a chip. Pulse techniques will be used more and more, and chips will be able to work quite happily at television i.f.s. It is safe to predict that a chip will have been devised to provide all the i.f. gain for a normal i.f. strip, and selectivity will be obtained from a single if complicated coil assembly between the tuner and the source of i.f. gain.

A.F. gain and sound output power will be available from a chip with a built-in heatsink, and this combined with another chip handling the inter-carrier sound amplification and f.m. detection processes will take care of the sound channel. It may be that both chips will be encapsulated in a common housing—it makes good sense.

For monochrome receivers a package will probably be available comprising a video output stage and heatsink, encapsulated with a chip providing video detection, a.g.c. sync separation etc. For colour receivers the output stage would have to be omitted and substituted by delay-line matching and a low-impedance blanked and clamped low-level video output.

Field sync clipper, field oscillator and output stage plus heatsink could form another chip, with suitable outputs for field blanking and convergence purposes. Similarly line sync clipper, flywheel sync discriminator, oscillator and line output driver stage could form another chip.

Colour Sets

Turning to the chrominance circuitry, all the normal decoder functions have to be covered, together with RGB matrixing with good d.c. coupling or keyed clamps. All this could be carried out with three chips, a PAL delay line and a few ordinary components. It is even possible that the delay line could be provided electronically by the "chain of buckets" principle. It seems unlikely that the three RGB output stages could be done in true chip form. It is more probable that three matched output transistors with built-on heatsinks will be encapsulated into one package.

There is not a great deal left now. A fairly conventional line output and e.h.t. stage will still be the order of the day unless anyone has a bright idea, because you cannot confine 25kV to a few millimetres, nor the large amounts of scanning energy.

A.F.C. will be in chip form of course, possibly combined with other functions. We now turn to convergence. This is not ideally suited to chippery because of the shaping needed for several current waveforms. However it seems possible in principle to do the shaping at a low energy level and then to provide current gain for the various outputs in a chip. Alternatively we may have single-gun colour c.r.t.s with a completely different set of problems and incorporating chips in their structure for the complicated beam-indexing functions needed.

1975 Receiver Complete

Having surveyed the likely progress of circuit technology we can now put it all together and see the result. Figure 6 shows our complete 1975 colour receiver. Impressive, isn't it? By present day standards it seems a trifle odd—even bewildering. And yet there is nothing impossible or even improbable about it. Just different. Large groups of circuits have been condensed into perfect examples of small electronic black boxes. Eleven of them surrounded by a few conventional components—all mounted on a single printed board of modest size. They are coupled to a line scanning and e.h.t. unit of normal form; a deflection and convergence yoke; a u.h.f. or v.h.f. tuner; a loudspeaker; and ordinary customer controls. The shape and size of the cabinet is governed entirely by styling considerations and is not in any way dependent upon the layout of the electronics—they are too compact.

So there is your 1975 receiver, complete. The next point, and a very important one, is what does it all mean to the designers, the receiver manufacturers, the service engineers and the customer?

Designing the 1975 Receiver

Just think for a moment about the problems of designing a 1975 receiver. You start off with a specification describing the performance, facilities, gimmicks, manufacturing, servicing and styling requirements. All these have probably been arrived at after a series of discussions between the heads of design, service, manufacturing and the commercial departments. Then the designers get down to work. What do they do?

Probably their first task is to go shopping for chips in order to get specifications for each one and firm cost quotations. With each chip they will receive detailed descriptions of the inputs required and the outputs available, together with a circuit diagram showing the external components and l.t. voltages which have to be connected to each one. If the chip is to operate correctly these instructions must be followed implicitly and there is very little scope for alterations.

On the basis of this information a circuit diagram can be drawn up showing each chip and its associated components. By the time they have all been joined together the colour receiver is nearly complete. True a line output and e.h.t. stage is still lacking, but a complete design can be obtained off the shelf, free of charge, from the component manufacturer. The tube maker too will willingly suggest appropriate circuits for the d.c. feeds to the shadow-mask c.r.t., and in any case these present very few problems. What else remains to be done apart from sweeping up a few loose ends and designing one or two selectivity units? The answer is very little.

Once the circuit diagram has been drawn and the component stocklist compiled the next job is to design a single printed board to hold the lot. The problems arising in any critical areas associated with the use of chips will have been identified and solved by the application laboratories of the chip makers. The printed pattern design needs care and skill but is basically a routine matter.

When some models have been made and field tested it is inevitable that a number of problems and deficiencies will be found. Again the chip makers will have to be consulted and most of the answers will be forthcoming in the course of a few weeks. Some changes and more field testing will follow and when this process has been repeated a few times the design will be complete. What a change from the complex design and development procedures of today!

Implications for the Designers

Some of the implications are obvious of course. The design teams which have been carefully built up by each setmaker over a period of years are going to play a much less important part. They will be allowed to run down and become about half their present size. The emphasis will be more and more on system engineering and less and less on circuit design: in other words some of the skilled circuit development engineers are going, temporarily, to be out of a job. Their work will retreat back into the hands of the people who make the chips—and doubtless the skilled engineers will follow it. This may mean moving house, and financially they may be at a disadvantage. So it is possible that chips will not be an entirely unmixed blessing. Spare a thought for the vanishing race of true TV development engineers who have served you well for a long time.

The Setmakers

The setmakers are in for a happier time. Gone will be the days of several printed panels with perhaps 100-300 components on each, and a complicated cable harness with all sorts of plugs and sockets. Much of the ironmongery will have gone too. Instead there will be a nice simple structure with a single printed panel and only a line scanning unit to remind them of the bad old days. The labour needed to assemble and test the complete receiver will be less than one third as much as was needed in 1969 and so the difficulties of recruiting enough labour will have largely disappeared. Think also of the saving in testgear, production line equipment, factory floor space, heating and lighting, production control staff, the purchasing of third party components, storage space and so on. The whole operation is going to become so nicely streamlined that only the biggest manufacturers need bother to try to stay in business.

Production and marketing will become so competitive, with all products basically alike, that it will be a case of expand or die. Inevitably a few will die.

Over the next few years it seems likely that at least two setmakers will merge or quietly fade away.

It is at first sight a curious anomaly that under these conditions it is quite common for small businesses to start up and flourish. They are able to cater for the odd few per cent of the market that wants something different and is prepared to pay for it. With chips available to all it may well be that one or two small companies will build TV receivers with specialised styling and a few distinctive features.

The Rental Trade

One thing is for sure—television receivers are going to last longer. Rental operators are going to have the choice of spreading the amortisation of the capital costs of a receiver over a longer period or of keeping them much as they are at present and making a modest but long-continuing profit on their older models. It will involve some nice sums for the accountants. These will be complicated by possible changes in social outlook which may well pour an ever increasing degree of scorn on any domestic product more than a few years old. Who can tell? If a receiver is capable of lasting for 10-12 years it will be vital to make the right assessments on matters such as these. The market place is too competitive to allow the careless operator a second chance.

The Private Buyer

The rental habit is strong in this country although almost unknown on the Continent where pride of ownership is still a very strong force. It is interesting to speculate whether the habit of buying, as opposed to renting, may tend to return if television receivers become substantially more reliable and even a little cheaper to buy. If a man hears from his friend that the new breed of chipped receivers hardly ever need servicing he may think twice about paying rental charges which over a long period of years add up to much more than the initial cost of buying a set.

This kind of situation will take a long time to develop, if indeed it ever does. Old habits die hard and it will be several years before sufficient experience has been gained for the average man in the street to begin to see clearly where his best interests lie. If he did decide to switch over to buying again, as opposed to renting, the very large rental industry with its network of service departments all over the country would take a nasty knock.

Service Organisations

If our forecasts are correct the 1975 receiver is going to pose some very different service problems compared with those with which we are familiar at present. Take an average colour receiver of today. It has a very large number of individual components scattered about over several printed board assemblies interconnected by a complicated jumble of leads. It has a mixture of valves and transistors and perhaps half a dozen separate h.t. lines.

When the service engineer is called in it is either to carry out routine adjustments such as purity, convergence or grey-scale tracking, or else to cure a specific and obvious fault such as no sound or vision. In the latter case a high degree of skill and experience is needed in order to diagnose the fault. Unless it happens to be a "standard" one with a known cause and cure it will be necessary to track it down stage by stage, and this may involve threading one's way up and down leads and along ill-defined paths of printed copper conductors. It can be a very tricky and time consuming process, although it is only fair to say that some receivers give very little trouble in this respect. In many cases the fault cannot easily be rectified in the customer's home and so the whole receiver has to be brought back to the workshop for more thorough investigation.

Partial Faults

There is another problem too. When the basic fault has been cured it is often found that there are other inadequacies also. The sound may be distorted, the field linearity poor, the line scan too short and so on. How much of this do you repair? If the receiver is owned by the customer and he is paying the bill the problem becomes even more acute. Do you repair all the faults and present him with a hefty bill that he does not understand, or do you leave the receiver in a state in which it is liable to fail again quite soon?

Servicing Chipped Receivers

Perhaps this seems to have been a digression from the problems of our 1975 receiver, but it is not. When we have a few chips and a double handful of ordinary components on a single printed circuit board constituting almost a complete colour receiver, the type and scale of service problems are going to be very different. With no valves, fewer leads and the single printed board readily detachable, the whole approach to TV servicing will change and this is going to be of vital interest to engineers and managers alike.

We have already pointed out that receivers are going to be a lot more reliable because of the great reduction in the numbers of components of all kinds and because a small number of chips is going to be more reliable than a large mixed bag of valves and transistors. The next point is that chips are going to provide a more consistent and stable performance so there will be fewer service calls to carry out routine adjustments. It is safe to assume that the service workload will be reduced considerably.

The second point to make is that receivers will very seldom need to be removed from the customer's home. Any ordinary fault will be cured by relatively unskilled operators who simply unplug the printed board or any minor subassembly and replace it with a service exchange unit. A fault-diagnosis sheet will make it easy to identify the offending unit. Each operator will be able to make many more calls per day than at present.

Next comes the problem of repairing the faulty unit. It seems likely that service departments will have three choices. They could either repair it themselves, send it back to the manufacturer or take it to a local trade service organisation. This part of the industry may expand considerably unless the setmakers provide a very good service in replacement panels. Small dealers will therefore be better off than they are at present—at least from the servicing angle.

Fault-finding

Service departments doing their own repair work will have to change their methods. To begin with a

CORRECTION:

CHIPS WITH EVERYTHING PART I

It is regretted that a printing error occurred in the first part of this article last month: the seventh line from the bottom of the left-hand column on page 534 should read "chip, with diodes, resistive tracks and interconnections".

certain amount of streamlining will be called for because there will be far fewer receivers cluttering up their workshops. Next they will have to provide a few guinea-pig receivers into which offending units can be plugged for easy diagnosis. The fault-finding procedure itself will be different also.

If you take a printed board with a number of chips mounted on it, together with their associated feed components, it will be possible to diagnose any fault by following a set routine of systematic checks and measurements. An engineer with very little experience but armed with a check list, a multirange meter and an oscilloscope will be able to find almost any fault in a very short time. This sort of approach is not practicable with conventional circuitry. The apparent disadvantage of having so many eggs in one basket becomes a positive advantage instead, because the comparatively high cost of a replacement chip will be more than offset by the saving in engineer's time. He will be able to handle a much larger number of receivers.

The other problem we mentioned, about partial faults which one never quite knows whether to repair or not, will also largely disappear. Chips are go/no-go devices and coupled with a very much smaller number of passive components we can expect a substantial drop in the number of these faults.

The Customer

The customer is, after all, the man who enables so many of us to earn our living, and it looks as though he is going to get a fair deal from chips. Not only will he get a small but worthwhile improvement in performance and a more reliable product, he can also expect a reduction in cost. This will not be dramatic but over a period of years the prices of television receivers can be expected to fall in comparison with other consumer durables which have not enjoyed the same kind of technological breakthrough. The longer useful life of our 1975 receiver will also help to encourage the second set market, to the benefit of all concerned.

The Quiet Revolution!

If you take any single facet of the television problems we have been discussing it hardly justifies this title. However when you add them all together and consider how they are going to affect designers, setmakers, rental operators and dealers, service engineers and customers it represents a very important change to a very large number of people. When the revolution is complete a number of designers will have changed jobs and moved house; one or two setmakers will have gone out of business; service engineers will have learnt new skills and will have new patterns of work; rental operators will have adjusted to new trading conditions; and the customer will have a cheaper and better product. ■

HEAT PROBLEMS IN TV RECEIVERS

—continued from page 17

envelope. These can be easily constructed and fitted to output valves. Care is needed with the line output valve not to initiate brushing from any sharp edges, and of course to ensure that there is no danger of short-circuiting anything nearby. There is perhaps less need of this with the larger, more modern PL36 and PL500 line output valve types, but other types can be given an improved life expectancy from this modification: sound, field and video output valves can be treated in this way as well as the line time-base valves.

As many professional service engineers will affirm tuner valves account for a large proportion of valve failures. Here again heat is a big factor. These valves are housed in screening cans to avoid radiation effects and patterning but the shiny aluminium cans normally used reflect heat radiated out of the valve back into the electrode assembly. Although not handling heavy current like output valves, it will be found that tuner valves are very hot after a period of use.

From time to time cans have been found that have been finished with a black matt surface by the makers. These do not reflect the heat back, but absorb it and radiate it from the outside. Here then is a further modification that can easily be made: paint all screening cans with a black matt finish inside and out. If fins can be added to the can a further improvement in heat dissipation can be expected.

Ventilation

All this trouble to reduce set temperature can be completely nullified by thoughtless positioning and operation. Often one sees the top of the set adorned by a doily or cloth on which rests a lamp or vase. This is doubtless very charming, but the cloth usually falls down over the back thus covering the ventilation holes!

Ventilation holes are provided in the bottom of the cabinet, but these too can be smothered by standing the set on a thick cloth. Leg mounting is far better than table mounting because air can circulate through the bottom and cool the underchassis components.

Sets built into a shelf mounting arrangement may look neat and modern but free air circulation is again very much restricted. Ideally the receiver should be positioned a little way away from a wall—across a corner is quite suitable. It should be kept away from other heat sources such as open fires or radiators. Near a window is a good position as there are always cool downdraughts in this area of the room. These will be drawn into the lower ventilation apertures and sent up when they are heated through the set to be cooled on further contact with the window, thus a continual circulation will be maintained. However, summer sun shining through the window may make this position the worst one. Perhaps a change of position could be made according to season.

In conclusion remember: if you want to avoid frequent breakdowns, keep it cool! ■

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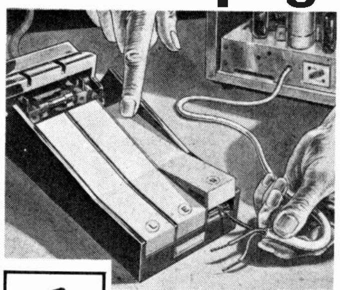

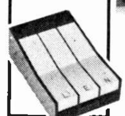

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UNDERNEATH THE DIPOLE

—continued from page 32

which includes a friction head mounting capable of being "panned" with a rifle-type sighting tube and a pan-handle tiller for the operator. Skill and artistry are needed in such handling, rather like the handling of a television camera. Yes: the focus of the profile aperture has to be variable, to cope with horses near as well as those at the other end of an arena.

LIGHTING CAMERAMEN BECOME FILM DIRECTORS

I will end this month with a reference to the background technical knowledge, experience and "know-how" which are necessary to achieve ultimate success in film or television production. In films successful directors and producers come into the business through many channels. The names of people like Jack Cardiff, Guy Green, Ronnie Neame, Pennington Richards, Peter Newbrook, Freddie Francis, Monty Berman and the late Roy Kellino come to mind, all fully aware of the fundamental technical problems of picture making having been lighting cameramen. Another source of film producers and directors is the cutting room, where the timing of cutting—the film equivalent of punctuation—is learnt.

Most scriptwriters seem to have grown up without any real knowledge of what can be done, what can't be done and, most important, what is the most economical way of telling the story from every angle of a production budget. Without turning a hair some scenarists will cheerfully write into a script "500 sailors jumped into the sea as the ship sank". All scriptwriters aren't technically ignorant of course: T. E. B. Clarke, who scripted most of the Ealing comedies, carefully studied all possible cost-cutting tricks.

Iconos

DX-TV

—continued from page 10

logging as I predicted one of the French low-power coastal stations, Boulogne Ch. 34. He also got Belgium Oostvleteren Ch. 49.

A new reporter to these columns is A. Pemberton of Sheffield (noted above). His June log is really excellent with nearly every country in Europe logged except perhaps Finland, Denmark and Rumania. He notes the confusion over Yugoslavia using RTV captions and Spain also doing so in connection with their advertisements. It is all too easy to be misled.

We have a further claimant for the new country Iceland E4. R. L. Yates of Moreton, Cheshire saw the test card on 31/5/69, 10/6/69 and 25/6/69 with his aerial to the NW. Our congratulations to him. Our old friend Doug Bowers of Saltash also got it on 26/6/69 at 21.00 to 21.45 and allowing for the time difference it looks like a transmission preceding the programme opening at 20.00 local time.

Another new DXer with a good start is B. Keady of Wakefield who saw the whole of the Apollo 11 programme via Spain Madrid E2 on 2/7/69.

TRANSISTORS IN TIMEBASES

—continued from page 9

the flywheel line sync discriminator stage. Tr2 acts as a variable inductive impedance to maintain correct oscillator frequency. Tr1 output is transformer coupled to the base of the driver stage by T1.

A conventional blocking oscillator is used by Sony in their Model TV306-UB. The basic circuit is very similar to the monitor television used in so many closed-circuit and videotape recording arrangements, and is extremely reliable. Figure 8 shows the circuit and as can be seen the blocking oscillator transformer T1 is connected between the emitter and base of the oscillator Tr2. The flywheel discriminator circuit is of the balanced variety already described, and the control potential is applied to the oscillator via a tuned circuit with L1 providing preset horizontal lock adjustment. On system change S1 selects different preset controls, S2 alters the time-constant of the oscillator and S3 adjusts the tuning of the tuned circuit.

To bring us right up-to-date, Fig. 9 shows the flywheel discriminator, reactance and line oscillator stages of the British Radio Corporation's 2000 colour television chassis. As can be seen, the arrangement is very similar to the T-Vette circuit we have already described. A Hartley oscillator (Tr2) is used, with L2 and L3 as oscillator coils for 405-line operation and L1 shunted across for 625-lines. An approximate squarewave output is obtained, D3 suppressing the negative half-cycles of the sinewave produced by the tuned circuit, and this is applied to the driver via transformer T1. The frequency of the oscillator is controlled by the variable reactance of Tr1 (capacitive reactance this time) which is virtually across the tuned circuit of Tr2. Again the hold controls set the d.c. reference for the discriminator.

Negative-going sync pulses are integrated by R1 and C3 and fed to the junction of diodes D1 and D2. The reference sawtooth is once more taken from the line output transformer, via the integrator R2, C4. The discriminator output is developed at the junction R4, R5 and fed via the usual filter to the base of Tr1. The quadrature waveform required by the reactance stage is obtained by feeding the sinewave to the base of Tr1 via the phase-change network C9, R10. This is arranged so that Tr1 base voltage leads its collector voltage by nearly 90 degrees; or to be more precise about the operation the collector *current* leads the *voltage* by the same amount. This causes Tr1 to behave as a variable capacitance.

There have been small modifications since the design was first marketed and one or two of these relate to the line stages. In particular the discriminator diodes may be different types, and then it will be found that the integrator capacitor C3 may be reduced in value. In some receivers this component has been as low as 680pF. However, the proof of the pudding is in the eating, as they say, and in this case we can reveal the "proof" in the fact that this circuit is used almost without modification in the just-released 3000 single-standard colour chassis.

The oscillograms in this section are of interest and are included in Fig. 9.

SERIES TO BE CONTINUED

YOUR PROBLEMS SOLVED

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply service data or provide instructions for modifying equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from page 45 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

FERRANTI T1002

I cannot obtain sufficient movement of the fine tuner to tune in BBC-1 properly. What can I adjust to remedy this and where is it situated?—A. McAllister (Glasgow, S.3).

First try a new 30C1 (PCF80) before adjusting the oscillator coil core. You will see a rubber stopper in the right side of the cabinet. With this removed a fine trimming tool can be inserted at a downward angle to adjust the core in the front side of the tuner.

STELLA ST2049A

This set suffered from field trouble then finally the safety resistors fell off. I replaced V403 and the resistors and the picture came back good and stable but now it is too narrow by about ½in. either side.—J. Wilkinson (Hampshire).

Check resistors R424, R426 and R427 together with R457. One or more of these has changed value.

SOBELL T24

The field keeps slipping with camera changes. After a short while it rights itself but I can rectify the fault with the field hold control which is far too critical.—R. Wood (Yorkshire).

Change the 0·003μF capacitor wired between pins 1 and 7 of the ECC82 (V11) valve base. If necessary also check the associated components.

BUSH TV85

There is no e.h.t. at the tube or EY86 cap. There is no line whistle. I have changed all the valves and the voltages on the PY81 are normal. The EY86 does not light up. The h.t. and sound are good and I have changed the boost capacitor.—J. Rearly (Kent).

Remove the top cap of the PY81. If the e.h.t. is partially restored the new 0·25μF boost capacitor is shorted due to inadequate voltage rating. If there is no difference, ensure that the coil on the top of the PL81 cap is intact, i.e. that the voltage at one end is also present at the top cap. Check the screen feed resistor (2·2kΩ) to pin 8 of the PL81—we assume that this does not light up.

PETO SCOTT TV239

The principal failures involve the PCL85 vertical output stage which frequently fails. I notice this valve heater flares brightly each time the set is switched on. The voltages are near the quoted values except at pin 9 which is often at an almost non-existent reading. I get frequent linearity troubles with almost constant vertical creep, expansion and contractions.

All the valves in the timebase panel are new and I note that there is only a trace of a.g.c. voltage to the r.f. valve (PCC89) and I get severe overloading on BBC-1 with an almost negative picture and distortion on sound at mid-volume and onwards. ITV is at the other end with a picture so weak it is difficult to see but sound comes through well except again that there is some volume distortion.—M. Varnals (Essex).

Ensure that the ECL80 sync separator/half field oscillator is in order. Check the 250μF electrolytic in the h.t. supply to the field stage. Check the voltage at the ECL80 suppressor grid which is applied to the tuner as delayed a.g.c. Some models did not use the specified 10MΩ resistor between the suppressor and screen grids. This results in cross-modulation on BBC-1 due to insufficient a.g.c. being applied to the tuner.

BUSH TV85

Reducing the volume also reduces the picture size and increasing the volume increases the picture size. The volume control seems to be in good condition, is not noisy and acts normally on volume.—J. Halfpenny (Birmingham).

We would advise you to replace the h.t. rectifier and if necessary the PCL82 audio output valve.

FERGUSON 3647

When the picture is switched to BBC-1 it shakes all the time giving a "watery" effect.—A. Howells (Wales).

If the aerial is in order and the other channels are also affected check the electrolytic capacitors (large round can with various colour tags), also the line sync stage. If other channels are not affected try using a more efficient aerial.

BAIRD 646

The slider that is used for picture height adjustment keeps burning out. I have replaced this component three times.—J. Howells (S. Wales).

If the vertical scan is normally unaffected we can see no reason at all why the height control fails—you mention the "slider", but we assume that you are referring to the control as a whole. You should make sure that the replacement is properly fitted and that the wiring insulation is in good condition.

FERGUSON 727T

A very faint picture was resolved by renewing the tuner valves. It remains fairly dark however even with the contrast and brilliance controls almost fully advanced.—T. Warren (Cumberland).

The tube is almost certainly at fault but you should check the tube base voltages and the video amplifier valve and components.

EKCO T344F

The set suddenly went off as if switched off, leaving no picture, raster or sound. Fuses and coax cable are OK and all the valves light up. I suspected the tuner and tried the r.f. amplifier V1 (30L15) and the frequency changer V2 (30C1) by substitution, but these are sound. I also replaced V14 (U26) in the e.h.t. to no avail. The heater of the c.r.t. lights up.—N. Pritchard (Cambridge).

You appear to have an h.t. failure. The most common cause of this is an open circuit 23Ω 5W wirewound surge limiter resistor connected to the anodes of the PY33 h.t. rectifier. This component is fixed between the anode pins of the valveholder and a small insulated pillar which comes through the adjacent chassis.

GEC 2081

This receiver gives a good picture on BBC-1 and BBC-2 but ITA has a build-up of heavy snow which suddenly clears after a few hours' viewing, but after a short while the snow effect builds up again—K. Holmes (Birmingham).

This symptom could either be caused by a fault in the tuner—a faulty valve, for example—or a bad aerial system. It is possible that the feeder is poorly connected to the dipole or diplexer if used. It would be a good idea to check the set on a friend's aerial before getting too involved with the circuits inside.

EKCO T443

With the brightness slightly advanced the flyback lines are clearly visible and appear brighter than the picture itself. I have noticed that the contrast makes only a slight difference to the highlights of the picture; although the contrast varies it is playing the part of the brightness control. I have changed the video valve and V16 and the voltages on the tube are all OK.—C. Ormsby (Staffordshire).

Your trouble could be in the cathode-ray tube itself or the vision detector diode. This latter is relatively inexpensive to replace and should be checked first.

PHILIPS 19TG170A

This set has recently failed due to a line drive fault. I have replaced the ECC82 valve and now the set works very well on 625-lines but not on 405-lines. The width on 405-lines is lacking about 1in. either side of the picture. The width control is at the extent of its travel. I have tried a new line output valve and new boost diode but to no avail.—D. Pearce (Kent).

This fault could be caused by a value change of the third harmonic tuning capacitor. Check this and also the S-correction capacitor in series with the line scan coils.

BUSH T57

The field on this set is down to 2in., slipping and rolling. I have changed the field output valve but no improvement has resulted. The tube appears to be low but before changing could you give me some advice on the field fault?—C. Walker (Derbyshire).

Before condemning the tube check the boost supply to pin 10. This supply also feeds the field oscillator and low voltage would cause both faults. Check the 2μF capacitor and the resistors in this circuit.

STELLA ST1007U

The picture has broken up into coarse white lines which increase in intensity as the line hold control is varied. These lines are about ⅛in. apart and at times break up into dashes. Occasionally a spark comes down the centre of the tube. In between the lines there is a faint picture content which is either one picture or two side by side with a black vertical band in the centre according to the line setting.—F. Edmonds (Dorset).

We advise you to try disconnecting the interference limiter control which often causes the trouble you describe. Also check the 330kΩ resistor from the line hold control to pin 2 of the ECL80. It may also be advisable to check the ECL80 itself.

KB WARDEN (VC1 Chassis)

The fault with this receiver is that the contrast is at maximum and will not reduce. Turning the contrast control makes no difference to the picture. I am using the 405-line system only.—J. Smith (Teesside).

You will have to check the a.g.c. circuit for shorts to chassis or a cancelling positive voltage. The latter would come from a faulty EF183 (i.f. amplifier) or PCC189 (tuner unit r.f. amplifier). If the valves are not at fault, check both M1 diodes (D10 and D11) and the capacitors in the a.g.c. line.

MURPHY V739

Spurious pulses sometimes cause the picture to divide vertically, bringing the outside edges to the centre. Correction takes place automatically after a small delay or another pulse. Both channels are affected.—A. Mowatt (Scotland).

A frequent cause of the trouble you describe is the connecting block of the line sync printed panel. We advise you to lift out the line sync panel, clean the contacts and ensure that the leaf contacts inside the connecting block are making good connection.

SOBELL SC370

When the Test Card is viewed the lines appear to be wavy and the picture is smeared with a greyish effect.

I have changed the video amplifier PCL84 and also the PL81, ECC82 and PCL85 without any improvement.—P. Wakefield (Essex).

The fault appears to be in the anode circuit of the PCL84. The load resistor is a 3·3kΩ resistor which is probably in order but in series with this is a choke across an 18kΩ resistor. This choke could well be open-circuit.

BUSH TV128

This set displays a minor fault which I think may be caused by hum in the sync system. The verticals about two-thirds up from the bottom are pulled back and forth to the left. This only happens on the BBC channel. The aerial to this set is also connected to a second set and as this fault doesn't appear on the second set I deduce that the aerial is not at fault. The ITV and BBC-2 channels are in order.

The set when switched on also causes interference on a mains radio located in another room.

It may be that there is more than one fault or that the same fault is responsible for the radio interference and the slight distortion of the BBC picture. —A. Logan (Ayrshire).

We do not suspect the set at all. Your description suggests that the aerial is at fault, receiving reflected signals, or that being connected to another cable the feeder is affected by standing waves. Have you tried it on a straight length of cable?

KB QVP20

There is sound-on-vision on BBC-1 only. The set is fitted with a turret tuner and as I have a Fireball tuner I wondered if this may be fitted to clear the fault.—A. Jones (London, S.E.1).

The trouble would appear to be due to an improperly set a.g.c. control. This control is mounted at the top of the upper printed circuit board, vertically above the tube, and controls the amount of a.g.c. applied to the tuner.

HMV 1826

This set has a very loud hum which only starts when the aerial is plugged in. I checked the i.f. and r.f. alignment, which is O.K. As the hum appears to be at about mains frequency I changed all the audio valves but without improvement. Fitting a new capacitor in parallel with the smoothing electrolytics has no effect Have you any suggestions?

There is also a series of bright specks and short lines on the screen. These are still there with the brightness turned right down and no picture visible. This also stops when the aerial is removed. The interference limiter does not affect this.—D. Moseley (Hanworth).

We suggest you check the tuner valves PCC84 and PCF80 by replacement. Also check the video amplifier PL83 and the associated resistors on the tag panel on top of the chassis.

PYE 11UF

This set suffers from bad sound distortion on both v.h.f. channels and BBC-2. Initially the sound is OK but after about ½ hour of viewing the fault appears. It is most noticeable on lower volume levels and can be tolerated for speech at normal listening levels. Music is however very uncomfortable to listen to.

As the fault is common to both frequency bands and a.m. and f.m. circuits it was assumed the trouble was after the sound detectors but valve changes made no improvement and component values seemed to check out OK.

An interference pattern can be seen on the screen at close examination but this is not visible normally. BBC-1 sound can be heard when switched to u.h.f. on the low frequency side of channel 33 but is not near the best tuning point for vision and sound BBC-2. These effects are not at all troublesome but may have a common source with the sound distortion.—V. Richmond (Surrey).

We advise you to check C56 (5000pF) and C57 (10,000pF) associated with the EH90 locked oscillator f.m. detector.

SOBELL T178

The primary cores of all the i.f. coils have been altered; the secondary cores have not been altered. I do not own a signal generator and would be obliged if you could advise how to correct these.— G. Lillyman (Sheffield).

Tune in a strong signal with a constant sound tuning note. Adjust i.f. cores for the best resolution and the sound rejector for minimum sound-on-vision. Check on a weak signal and adjust again except the rejector. Aim for the best resolution of the test card frequency bars at maximum sound signal.

BUSH TV99

When the set has warmed up the sound comes on perfetly but the screen is filled with raster and bright bands instead of a picture. The brilliance and contrast controls have no effect at all until the set has been operating for about 15 minutes. Also if after this time the neck of the tube is stroked with the handle of a screwdriver the picture appears but it goes again if the screwdriver is used in a similar manner. The screen again appears blank and very bright with flyback lines on it.

All the valves have been replaced and almost every resistor and capacitor has been shunted individually in the video amplifier PCF80 circuit without any success. I also suspect that there may be a heater-cathode short in the c.r.t.—A. Barry (London, S.W.17)

The tube is almost certainly faulty. The actual fault could be a grid-cathode short in which case both electrodes will record approximately the same voltage (about 100V). If however the cathode voltage is nil a heater-cathode short is more likely.

Applying a high pulse voltage between the grid and cathode of an otherwise disconnected tube base could clear the first fault. Fitting a 6·3V isolating transformer could clear the second.

PHILIPS 23TG170A

This set has lost width and no amount of adjustment makes any difference. The picture is now about ¼in. from the edge of the screen. I have replaced the PL500 and PY800 without any improvement being noted.

Also there is on BBC-2 very bad distortion on the sound.—J. Morris (Co. Durham).

Check the 8·2MΩ resistors and the v.d.r. in the width control circuit. Also check the 1·8MΩ resistor etc.

Make sure that there are no dry joints in the 625-line sound i.f. coils. Sometimes a gentle rocking of the coil cans will reveal which one is at fault.

STC VC11 CHASSIS

There is lack of brightness and the control has to be fully over to obtain a viewable picture. Recently the picture has reduced slightly in size giving a black band top and bottom.

Also the sound has failed on BBC-1 and ITV. Rotating the fine tuner has no effect on sound or picture—just a buzz that varies with the volume control setting. The sound on BBC-2 is perfect. —W. Cottrill (Surrey).

You should fit a new plastic tuning core in the fine tuner assembly of the v.h.f. tuner.

Check the resistors to pin 3 of the tube base (4·7MΩ etc.) which may require replacement to restore brilliance. Check boost line resistors to restore height (in the height control circuit).

BUSH TV138RU

What type of diode is used in the line sync circuit? I have replaced this with an ex-Government signal diode but now the line hold is far too critical.—J. Shore (Staffordshire).

There is not one diode in the line sync stage but two diodes comprising a *matched pair*. A matched pair must be fitted or the sync will be unbalanced. The original type fitted is M1S.

SOBELL ST288DS

The picture breaks up immediately after switching on. Adjustment of the line hold control and preset will hold the picture for about three hours after which it slips across and breaks up. After adjustment of the preset the picture remains good for the remainder of the evening's viewing.—K. Wright (Walsall).

Check R128 (400kΩ) and C120 (330pF). A hot soldering iron held near the suspect component will probably trigger off the fault.

QUERIES COUPON

This coupon is available until October 17, 1969, and must accompany all Queries sent in accordance with the notice on page 42.

PRACTICAL TELEVISION, OCTOBER 1969

TEST CASE 83

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.

? *AFTER running normally for an hour or so a Ferguson receiver would cut out on vision almost completely, leaving a mere trace of picture modulation and the sound unaffected. Tests were made of the EF80 i.f. valves and the PCL84 video valve without the trouble being found. Sockets of the valveholders were tightened and the valve pins thoroughly cleaned but the symptom still came on. The vision diode was eventually replaced with no difference in results but as it was thought that the trouble must have a video origin tests were made of the voltage at the cathode of the video valve. While the set was working correctly this was about 4V, rising sharply to about 10V when the fault appeared.*

What could have been responsible for this trouble? See next month's PRACTICAL TELEVISION *for the answer and for a further Test Case item.*

SOLUTION TO TEST CASE 82
Page 573 (last month)

Many readers will know by now that the "wave-motion" effect reported in Test Case 82 is the result of heavy residual hum in the vision channel and/or timebases, the field timebase being most vulnerable, and that it results from asynchronous field working at the station.

Since all the usual causes of high residual hum were examined without luck, special attention was directed to sources of hum emission and pickup in the field circuits and it was found that the wire in the heater circuit of the field output valve was extra long and was dressed very close to the control grid circuit of the field output valve. Repositioning this wire completely cleared the trouble.

It is noteworthy that the hum would probably not have been noticed on the picture with synchronous transmission—i.e. with the radiated field sync locked to the 50Hz mains—and this is true of many cases of "wave-motion" symptoms investigated. Asynchronous working demands more efficient smoothing and freedom from spurious hum pickup than hitherto.

Published approximately on the 22nd of each month by IPC Magazines Limited, Tower House, Southampton Street, London. W.C.2. Printed in England by Fleetway Printers, 17 Sumner Street, London, S.E.1. Sole Agents for Australia and New Zealand—Gordon and Gotch (A/sia) Ltd.; South Africa—Central News Agency Ltd.; Rhodesia, Malawi and Zambia—Kingstons Ltd.; East Africa—Stationery and Office Supplies Ltd. Subscription Rate (including postage): for one year to any part of the world, £2 1s. 0d. "Practical Television" is sold subject to the following conditions, namely, that it shall not, without the written consent of the Publishers first being 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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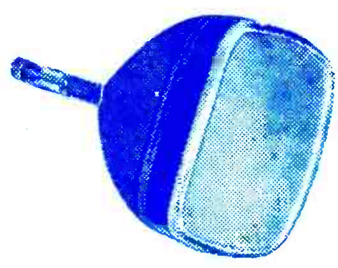

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