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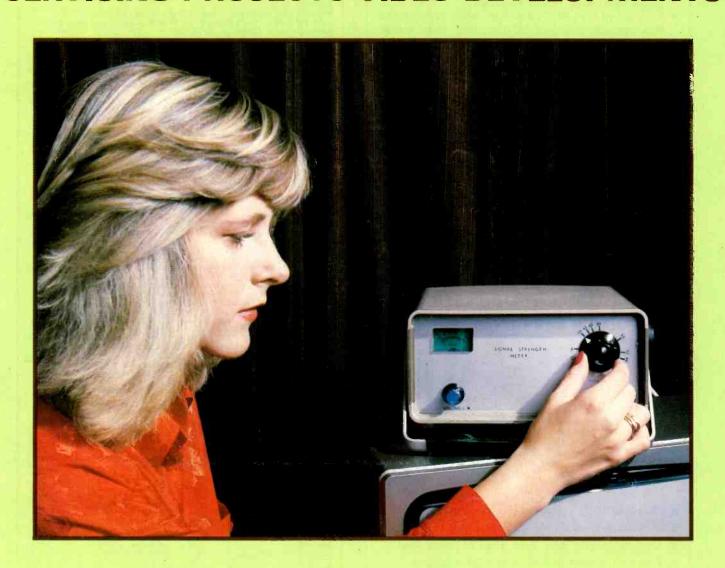
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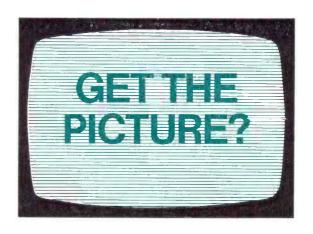
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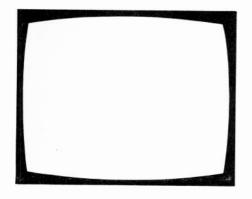
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- Wag's Wireless Les Lawry-Johns Wag had a problem with his son's stereo, then along comes an old girl who couldn't sleep a wink all night. Problem sets and problem people.
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- Teletopics
- Spectrum-monitor Interface Follow-up John de Rivaz, B.Sc. (Eng.)
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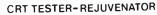
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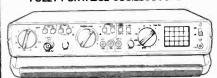


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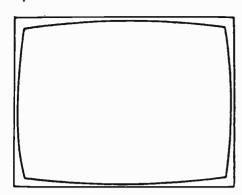
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CORRECTIONS

We seem to have been plagued by inadvertent errors in recent issues. Please note the following corrections:

- (1) September issue, page 627, An Approach to Adding Teletext, Fig. 3. R11 should have been shown connected to the 12V rail, not the 5V rail.
- (2) October issue, page 701, Line Selector Unit. R5 was omitted from the circuit (Fig. 2). It's connected between the emitter of Tr1 and chassis.
- (3) October issue, page 684, The Lid off Microcomputers. In discussing corrupt link addresses it was stated that the line will be shown as a string of capital zeros. This should have said a string of capital Us.
- (4) November issue, page 24, The Lid off Microcomputers Fig. 1. The polarity of the boost reservoir capacitor was shown incorrectly, i.e. reversed.

TELEWISIOM

Can Technology be Sold?

Back in 1975 Philips and Mullard introduced the 20AX tube. Do you remember the 20AX girl? And the extensive advertising campaign that accompanied the launch of 20AX? We didn't get such a thing when 30AX came along, and we probably won't now that that 45AX (see Teletopics) is here. This raises an interesting question. Mullard obviously felt that it was worth running an advertising campaign for their advanced technology back in 1975, but come 1985 it's not considered to be worthwhile. Why?

Presumably Mullard no longer feel that the technology within a TV set is by way of being a sales feature. This despite the fact that 45AX is noticeably different at a glance. There are of course other flat, square tubes, and no setmaker is going to be without models fitted with such tubes in his range. The new look may well be an important consideration when someone decides to buy a new set. But how decisive will it be? And will it initiate a surge of sales as customers feel that they must have the latest technology in their homes?

There are of course those who must have the newest and latest. Trendsetters they're called. But by and large this is not the way in which the British public goes about making its buying decisions. You'd almost think that TV is not high technology at all: it tends to be regarded and sold just like any other item, say cans of beans, with the emphasis always very much on price. It was Sir Jack Cohen, founder of Tesco, who summed up this sales approach with the immortal words "pile 'em high and sell 'em cheap". This has indeed worked well for many retailers of domestic electronics goods. But it has added to the public's tendency to regard TV as a sort of background item – something that's just there, switched on without a thought as to the technological wonders that lie behind the switch. True, it may have remote control, or teletext, as obviously advanced features. But so long as Coronation Street etc. come on at the appropriate times does anyone care all that much?

Has the industry lost out to some extent in this respect? The fact is of course that TV chassis are indeed much of a muchness. Some may be particularly well laid out, others may have some quirky bits of circuitry, but such things make negligible difference to what's seen in the average living room. More important, in terms of reliable long-term performance, is component specification – generous ratings and care over heat considerations. But these don't show up initially and can hardly be demonstrated in the showroom. Inside the set there'll be a tuner and tube that's common to any number of makes and models and a selection of i.c.s that probably owes more to the time at which the design was finalised than anything else. Apart from the optional extras one telly is much like any other and the public seems to realise this.

One factor that's led to a certain amount of discussion in recent times is the sales environment. Stacking the brown and white goods up in great big displays hardly contributes to an impression of technical excellence. Perhaps the camera shop – one thinks of Dixons of course – with all its gadgetry is a more sympathetic environment in which to emphasize the technological aspects of TV. That may well be, and perhaps the up-market sets with all the trimmings – satellite ready and so on – could more easily be plugged in such a setting. But the fact is that the shop with the technological look still has to compete with the shop that stacks the TVs next to the washing machines – and Dixons are as price competitive as anyone else.

Dixons are as price competitive as anyone else.

Shop aura is indeed a strange thing. Why not put the TV sets next to the fridges and freezers? After all you go to an electrical shop to buy electrical goods, and to make a TV set or a microwave oven work you plug it into the mains. But what a difference when you go into a large store and find the TVs discreetly displayed on the first floor next to the pianos while the dishwashers and vacuum cleaners are relegated to the basement! Psychology there: the TV set is to sit in the living room while the tumble drier resides in the kitchen. Which is all very well but hardly applicable to the high street shops competing hotly with each other. There are also the back street shops where the TV sets nestle with bikes and batteries (well sometimes, anyway!) – the sets are the same though you're more likely to be given the offer of a secondhand one.

Advertising that emphasizes the technological aspect of television is not entirely lacking. ITT for example have made much of their digital TV chassis, while others are putting the emphasis on satellite reception. Is it too late to try to sell TV as high technology? To encourage the public to see TV in the same light as radar and avionics, with which TV does of course have links? I'd say that it would be hard indeed to change the ingrained habits of the British public and to give TV a new image. TV is likely to retain for the foreseeable future its rather anonymous image as something you buy cheaply plug in and forget

cheaply, plug in and forget.

Might UK setmakers have done better to have dwelt on TV technology, as for example was once common in Germany? The overriding factor here is the power of the large retailers – particularly since the ending of retail price maintenance many years ago now. In most UK markets it's the large retail organisations that call the tune and set the scene – Sir Jack and his opposite numbers in other fields. The emphasis here is on turnover rather than the finer features of the goods. This is something we have to live with – and something that's been of great benefit to the public. Unfortunately it doesn't exactly encourage a sales pitch based on emphasizing high technology. Even if the emphasis could be shifted one wonders whether the public would respond: it seems to

take technology for granted today.

TV Fault Finding

Reports from Philip Blundell, Eng. Tech., Hugh MacMullen, Brian Renforth, Steve Illidge and Paul Hardy

Körting Mariner PC1 (10 Chassis)

These colour portables seem to have an appetite for TDA1170S field timebase chips. This one had burnt out its tripler as well! On powering up via the variac we found that the self-oscillating chopper power supply didn't begin to regulate with a 110V input as it should – in fact it wasn't dropping the mains voltage at all. This turned out to be due to D622 (BA157) being open-circuit.

P.B.

ITT CVC1210/CVC1215 Chassis

For a dead set with a buzzing power supply, check R744 (145V feed to the line driver transformer) for being open-circuit. It should be replaced with a modified $1k\Omega$ type (3154-09-05) as it's a safety component. You'll probably also find that R503 in the line scan circuit has been overheating – ITT recommend that this resistor be removed.

ITT CVC20/CVC30 Series

With reference to Ray Dunleavy's letter (October issue, we've also had the problem of blown field output transistors every month or so with the CVC20 chassis due to C21, and the blank raster problem with the CVC30 chassis due to R28 going open-circuit. Here are a couple more tips on the CVC30 chassis. Trips from cold, the fault clearing temporarily if the chassis is moved – replace the line hold control. Intermittent top foldover with R2021 on the field timebase module burning out – D10 (BY133) in the field output stage is going open-circuit intermittently.

National Panasonic TC42GA

The whole left-hand half of the picture was almost blacked out, though all voltages were correct and with a very bright scene the picture looked almost right. We discovered that there was ripple on the 220V line that supplies the colour-difference output stages, due to the relevant reservoir capacitor C514 (4.7μ F) being completely open-circuit – the supply is derived from the line driver transformer. **H.MacM.**

Panasonic U2 Chassis

There was complete loss of raster after three minutes, though the e.h.t. and all relevant voltages were correct. Although there was no luminance or chrominance a locked raster could be seen by advancing one of the first anode presets. We also noticed, before the picture disappeared, that there was rather severe top foldover. In view of the latter symptom the TDA1106 field timebase i.c. was replaced. This provided a complete cure – as a safety measure, the chip blanks the screen in the event of field collapse.

H.MacM.

Decca 100 Chassis

This 26in. set came in dead. Although the 3·15A mains fuse was o.k. the e.h.t. overwinding on the line output

transformer was burnt, the tripler was no good and the BU208A line output transistor was short-circuit. After replacing all these things a good picture was obtained – but with a quarter inch wide rope effect from the top to the bottom of the screen about two inches from the right-hand side. The plugs and sockets on the line output panel were, as usual, burnt but after wiring over and resoldering these the rope effect was still present. Scope checks then showed that everything was in order apart from an unusual kink in the waveform at the collector of the line driver transistor Tr304 (BF355). Replacing this transistor cured the effect.

Rank A816 Chassis

The problem with one of these sets (a 24in. Bush TV311) was lack of height with foldover – the picture occupied only one third of the screen. As the 23V supply to the field timebase was correct the d.c. coupled driver/output transistors 3VT11-14 were checked. It turned out that one of the output transistors, 3VT13 (BC287), was open-circuit collector-to-emitter.

Another of these sets came in with the no-results symptom due to 3R86 (150Ω) in the l.t. feed to the SN76533N sync separator/line generator i.c. being open-circuit. It's best to use a replacement rated at 1W.

In passing, though Rank boasted about this all-transistor chassis when it was introduced in the early seventies I think they'd have done better to stick to their hybrid chassis.

B.R.

Decca 80 Series Chassis

P.B.

The complaint with this set was that the picture suddenly went, leaving a thin vertical line at the centre of the screen. It's in fact a common fault with this chassis and can be caused by poor connections around the linearity or width coils or at the plugs on the line output panel. The scan correction capacitor C403 can produce the same symptom when open-circuit. Due to possible damage to the line output transformer and/or tripler it's essential to check for poor connections in this area whenever one of these sets comes in for service. The problem with this particular set turned out to be a bad joint at the linearity coil L401 – in fact it was virtually unsoldered from the panel. Resoldering restored a full raster.

B.R.

Hitachi NP6C Chassis

We've had a number of these sets with no sound or vision, or intermittent sound and vision. The problem is due to dry-joints on the high-wattage carbon resistors mounted on stems. Resoldering R933, R918, R928, R935 and especially R924 normally provides a cure.

S.I.

Panasonic U4 Chassis

One of these sets had no sound or picture, just a plain white raster. The fault was traced to peaking coil L102 on board B – it was open-circuit.

A fault that's occurred several times with this chassis is

a dry-joint at pin 5 of socket E6 (video input to the power supply/timebase panel). The symptoms are no sound and no sync.

The problem with a teletext version (Model TX-C21) was that after approximately a quarter of an hour the screen would go bright blue with flyback lines, then go off completely. The fault was traced to Q5010 (2SD637-QR) on the teletext panel.

Sony KV1810UB

Engineers must by now be quite familiar with the causes of GCS failure in these sets. I've found however that C605 (22μ F, 400V) on board PR can be responsible. It's well worth removing this capacitor to check its condition, i.e. look for leaking electrolyte. If you're at all suspicious, replace it.

Philips KT3 Chassis (Remote Control)

This colour portable would "change channel" – unfortunately the customer's description of the fault turned out to be less than adequate. After testing for a while it became apparent that with any even-numbered channel selected the set would eventually change to the odd-numbered channel immediately below, e.g. from channel 12 to channel 11. The channel number display at the front of the set wouldn't change however. This set had a TMS1000 microcomputer i.c. in the remote control department. The channel display and channel change circuits are driven by different ports in the i.c. Since the display didn't change in the fault condition the microcomputer chip wasn't necessarily to blame – in fact the fault was due to IC70

(40174). The least significant bit from IC70 was intermittently going to zero when it should have been a one – the channel change i.c.s then interpreted this as a channel change command. Fortunately the i.c. lives in a socket and is easy to change.

P.H.

Philips G9 Chassis

This set turned out to be a disaster – but you don't always know that to start with! The original fault was quickly cured by replacing C5138 (2,200µF, 63V) on the line scan panel and R3141 (39 Ω) on the signals panel – two common offenders. The resulting picture left much to be desired however - distinctly tubey! A quick check revealed that there was only 200V instead of over 1kV at the first anode controls. The 1kV supply reservoir capacitor C5157 was replaced but this made no difference. So N1, the 1kV supply connector, was disconnected to check whether the controls were loading the supply in some way. The resulting bang and flash was something to behold! Fuse FS5141, zener diode D8017 on the power supply panel and the field output transistors had to be replaced. With N1 reconnected the set worked but we still had low first anode voltages. Changing the tripler restored the supply. But the tripler wasn't faulty - someone had fitted the type used in the G8 chassis. Finally all three RGB output transistors had to be replaced as they were leaky (presumably due to overwork as a result of the low first anode supply). After resetting the video levels, the preset brightness and beam limiter controls a presentable picture was obtained. But what a job! Not having a clipper diode in it the G8's tripler can't provide a proper first anode supply for the G9.

The Story of G9AED

Lest we forget, 1985 saw the thirtieth anniversary of the start of commercial TV broadcasting in the UK. It's also thirty years since the conception of G9AED, a callsign once very familiar to TV dealers and enthusiasts. G9AED was the so-called pilot station for the new Band III network. It provided valuable help in getting the new services going successfully.

G9AED consisted of a mobile TV transmitter in a rather ungainly trailer which, along with an 85ft. mast, was towed to the sites of the new transmitters before they came on air. By radiating a test signal from the same site, albeit from a smaller aerial, dealers were able to demonstrate the new Band III sets and aerial riggers could install aerials ready for the start of the new programmes. This enterprising effort was provided not by the ITA (as it then was) but by Belling and Lee Ltd., who were then major manufacturers of TV aerials. A "Belling-Lee" mobile research unit used the signal for plotting coverage and for propagation tests. The ITA recognised the value of the service and during the following summer purchased the equipment from Belling and Lee.

The transmitter operated in the London area for six and a half months prior to the ITA opening on September 22nd, enabling over a quarter of a million aerials to be erected and aligned for the best signal and minimum ghosting. Belling and Lee considered the operation to be a worthwhile investment even though it helped their competitors as much as it did themselves. It provided

Andrew Emmerson, G8PTH

Britain's first ever TV commercial, a caption telling viewers that new high-power Band III transmissions would start soon – make sure your receiver and aerial are ready!

The 1kW transmissions were on the same channel as the regular ITA programmes that were to follow. They lasted for forty hours a week, from 9.30-12.30 a.m., 2-4.30 p.m. and 7.30-8.30 p.m. on weekdays and from 10-1 p.m. on Saturdays - but not on Sundays and Bank Holidays. A sound signal was generated and pictures were produced by two monoscope cameras. One was the "new transmissions" message and the other a special test card. This included a wavy line and contrasting panels with calibration in miles. The idea was that any ghost images caused by multipath reception would show up on the panels: the distance of the obstruction producing the reflection could then be estimated from the mile-marked scale. Contemporary articles show that ghosting was considered to be a major threat to good Band III reception. The test card also gave the sound and vision carrier frequencies being used and a national grid reference for the transmitter site.

Belling and Lee were proud of the fact that their mobile transmitter had been built in less than three months "in the true amateur spirit". It was allocated the special callsign G9AED, which they said stood for Aerial Development. It was in fact a normal G9 test and development call: as such calls are issued in strict sequence it was a matter of luck that the allocated letters made sense!

The amateur spirit was also reflected in the QSL cards that were issued for reception reports. Many of the reports probably came from amateurs, for although the transmissions were intended for the trade many TV enthusiasts used them for testing home-brew Band III converters – several designs had been published.

G9AED's test transmissions enabled Belling and Lee to publish maps showing where locked pictures had been received. It was pointed out that in view of the low height of the transmitting aerial and the low output power

reception of the ITA transmissions when they arrived could only be better.

Once commercial programme transmissions started at a site G9AED was moved to the next ITA transmitter site ready to perform the same role. Its usefulness would have been much reduced once the main stations had come into operation, and I've not been able to trace its final resting place. Its work was invaluable however and its picture is to be seen in several articles published in *Television* during 1955 and 1956.

Books

A Hardware Guide for the BBC Microcomputer by A.D. Derrick, B.Sc., D.S. Harding, B.Sc., S.D. Middleton and M.P. Smith, published by Wise-Owl Publications, Hull Innovation Centre, Guildhall Road, Hull, North Humberside HU1 1HJ at £13.45 including post and packing.

The electronics-orientated BBC/Acorn microcomputer user should find this a worthwhile publication to have available for reference. It comes with a loose-leaf circuit diagram and a complete circuit description. A study of the two leaves one in no doubt as to what does what in the machine.

In their preface the authors point out that the machine was originally designed by the BBC as an educational tool which can be expanded into a very sophisticated computer with powers rivalling those of present-day minicomputers. The guide provides information on many of the modifications, upgrades and circuit changes that can be carried out. It includes a comprehensive survey of the link modification system built into the machine and many hints and tips. An appendix reproduces data sheets for the main i.c.s used in the microcomputer – essential information for getting to grips with the detailed operation of the machine.

I found the book clearly laid out and easy to follow. The BBC machine is a lot more complicated than many of the microcomputers that arrived on the scene during the recent 'micro boom': this guide will enable the reader to get the maximum from the machine and will help those with servicing experience to deal with fault conditions – though access to the official diagnostic test equipment, a Progressive Establishment Tester (PET) or Final Inspection Tester (FIT), might be required to deal with the more obscure problems.

J.A.R.

Micro and Television Projects by Trevor Brown, published by BATC Publications, 14 Lilac Avenue, Leicester LE5 1FN at £3 plus 0.50p post and packing.

This book provides anyone thinking of setting up an ATV station with a great deal of practical information based on up-to-date technology. It's also worthwhile for those already active in the ATV field since it devotes much space to adapting and using a domestic microcomputer for TV purposes. Most of the information on microcomputer applications – including simple programs – relates to the Sinclair Spectrum, which is fair enough – we found the basic description of how this machine works extremely clear and to the point.

The microcomputer applications are quite sophisticated, but are mostly easy to build since PCBs are in many cases available from the BATC. Microcomputer

based projects include a user port, TV repeater arrangement, EPROM programmer and a picture freezer. A project called Teletron consists of a microcontroller (this differs from a microcomputer in using mainly PROM instead of RAM in the memory) which can be used for such purposes as a slow-scan test card or teletext generator – which brings us to a new version of teletext called Hamtext!

In all this is a very interesting book that's certainly value for money. Our only minor quibbles are about the rather eccentric diagram layout in chapter 4 and the fact that Fig. 2 on page 48 doesn't show quite all that the text suggests. In addition to the microcomputer based projects there's a sync and test pattern generator using the ZNA234 chip, an electronic caption writer, a simple video source switcher, a test card generator and both PAL and SECAM coders.

J.A.R.

Newnes Questions and Answers manuals, (a) Radio, (b) Television, both by Eugene Trundle, published by Newnes Technical Books (Borough Green, Sevenoaks, Kent TN15 8PH) at £2.95 each.

These books are intended as introductions to their subjects, taking the reader in easy to follow question and answer style from rock-bottom basics (what is an electron? in the case of the radio book) to quite sophisticated aspects of the subjects. It's amazing just how much can be got into a small book given a bit of careful planning. One strong point about both these books is that they are thoroughly up to date, bringing in CB radio in the case of the radio book and teletext, MAC and computer control in the television book. As a quick test we decided to ask the TV book how much memory was required to store a TV field – and it told us! These books are obviously not for those already clued up in the subjects, but can be recommended for anyone wishing to make a start. J.A.R.

Colour and Mono Television, Vol. 2 by K. J. Bohlman, published by Dickson Price Publishers Ltd., PO Box 88, Gravesend, Kent DA13 9PR at £8.95.

Volume 1, which we've not seen, dealt with tuners, i.f. stages, demodulation and the sound and video sections of monochrome and colour receivers. The present volume covers sync separation, timebases, display tubes, convergence and raster correction circuitry, power supplies, vision a.g.c., beam limiting and flyback suppression. It's quite a lot of book (over 225 pages) for the money and covers the subject matter thoroughly and clearly, with the emphasis on practical aspects - circuitry, current requirements, etc. We couldn't fault the book in any way in what it covers but were a little disappointed to find it not quite as up to date as one might expect: there's quite a lot on valve circuits and it would seem to cover the techniques used roughly up to the era of chassis such as the Philips J.A.R. G11 and Thorn 9000.

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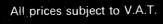
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Field Timebase Circuit Survey

Part 3: IC Field Timebases

S. W. Amos and E. Trundle

The previous two parts in this series illustrated the development of field timebases and showed how the need for increased output power and greater efficiency led to designs incorporating mid-point stabilisation, quiescent current stabilisation and so on. As a result, the original single valve output stage had by the 1970s developed into a complex driver/output stage arrangement using some six transistors and several diodes. It was inevitable that i.c.s would come to take over the various field timebase operations. During the last decade they've made steady progress in this area, to the point where a single chip with a modest heatsink can on its own drive the yoke of a large-screen, wide-angle colour tube. In this concluding instalment we'll examine the principles employed in i.c. field timebases and trace their evolution to date.

It's important to bear in mind that due to the frequencies involved an i.c. used for field deflection will have no internal reactive or frequency-determining elements. Thus waveshaping and timing must be provided by external components. Apart from the scan coils, these consist of resistive and capacitive elements. Internally a linear i.c. generally consists of a number of direct-coupled transistors plus some diodes and fixed resistors. For field deflection the transistors used are bipolar pnp and npn types arranged in any of the three possible basic transistor configurations (common-emitter/base/collector): with one notable exception, the output stages are of the class B type. The internal diodes may be conventional or zener types, used for voltage stabilisation, temperature compensation and voltage-dropping as well as in their basic role as unidirectional devices. As we shall see, the first circuits using i.c.s had to be adapted to the device itself: but, as dedicated i.c.s became available, the cart was put firmly behind the horse. As design and fabrication techniques improved, such functions as scan-correction, flyback boosting, thermal and output stage protection, flyback blanking and c.r.t. burn protection came to be

Contemporary field timebase i.c.s fall into two basic categories: those that incorporate a sawtooth generator and thus form a complete timebase, and those that act as a "power booster", intended for use with a separate timebase processor chip that performs the scan timing and waveform generating actions.

Use of Audio ICs

The first i.c.s that came to be used in field deflection circuits were basically low-power, class B chips intended for audio output applications. The similarity between audio and field output stages was touched on in Part 1 and designers of small-screen monochrome portables were quick to see the advantages of adopting these low-cost devices to drive the field scan coils. Typical of this approach was the use of a 14-pin i.c. capable of providing a 2-5W output from a $10 \cdot 8V$ supply to drive a $7 \cdot 5\Omega$, 10 mH yoke. With scanning currents of less than about 800 mA peak-to-peak, i.e. for use with a 90° small-screen tube

with a 20mm neck, the i.c. required no heatsink.

Fig. 1 shows an early-seventies design along these lines. The device used is a TBA641BX1 with an output capability of 4.5W and a built-in heatsink. Capacitor C1 is charged via R1 and the height control R2 from a 24V boost supply derived from the line output stage. The field oscillator acts as a switch to discharge C1 via D1. A linear ramp with a period of 20ms is thus presented to the i.c.'s non-inverting input (pin 7). The centre point of the chip's class B output stage is connected to pin 1, which drives the scan coils L1/2 via the large coupling capacitor C7. The bootstrap arrangement formed by C6 and R10 increases the output voltage swing and hence the maximum current flowing in the scan coils.

The current sampling resistor R9 (0.5Ω) develops across it a sawtooth voltage proportional to the scan current. Feedback from this point is taken to the i.c.'s inverting input (pin 8) via R8 and C3 which forms the series element of a differentiator. As the scan progresses, the voltage drop across C3 determines the curvature of the output current ramp: the smaller C3's value, the greater the ramp's curvature. There's also voltage feedback via the integrating network R4/R3/C2. The parabolic waveform developed across C2 forms the "grounding point" for C1, and as a result a variable curvature (governed by the setting of the linearity control R3) is given to the ramp applied to pin 7 of the i.c.

The network C5/R7, connected to pin 6 of the i.c, is known as a Bucherot cell: it ensures amplifier stability by curtailing the r.f. response. Such r.f. damping circuits are often found "holding down" i.c. amplifiers which have a high gain up to the r.f. spectrum.

Flyback Pulse Isolation

With some audio i.c.s there's a danger that the combination of the yoke's inductance and the supply voltage could produce a flyback pulse (across the scan coils) too high for the i.c.'s health and safety – the i.c. would have been designed to operate with the virtually resistive load presented by a moving-coil loudspeaker. Thus with a yoke inductance greater than about 10mH it was necessary to devise a means of diverting the flyback pulse away from

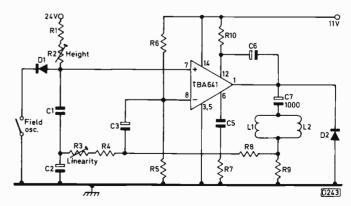


Fig. 1: Audio i.c. used as a field scan amplifier (Thorn 1612 chassis dating from about 1973).

the i.c. In Fig. 1 D2 clamps the negative-going pulse, preventing any excursion below chassis potential since this could cause breakdown or excessive dissipation in the i.c.

Fig. 2 shows a more elaborate approach to the problem of buffering the i.c.'s output stage during the flyback. As with the previous circuit, the chip's output voltage ramp (at pin 1) is positive-going during the forward scan, returning suddenly to chassis potential to initiate the flyback. In this circuit Tr1 and D1 are interposed between the i.c.'s output pin and the scan-coil load. During the first (negative) half of the forward scan period the scan current flows via D1: during the second (positive) half of the forward scan period the current flows via Tr1. When the flyback is inititiated by pin 1 of the i.c. falling to zero volts, the pnp transistor Tr1 is cut off. L1/2 then form a resonant circuit with C2, the negative-going flyback voltage pulse reverse biasing D1 and Tr1's collector-base junction. The i.c. is in this way isolated from the flyback action. Further oscillatory action is damped when D1 conducts again at the start of the next forward scanning stroke. In other respects this design is virtually the same as that shown in Fig. 1, with C3 and Bucherot cell C4/R4 to prevent r.f. instability.

Special-purpose ICs

The first dedicated field timebase i.c.s had output stages and feedback arrangements very similar to those already described. Again the intended application was the smallscreen monochrome portable, and the overriding aim was to reduce the peripheral component count. Fig. 3 shows such a circuit, with just a handful of non-critical passive components external to the i.c. The composite sync signal undergoes double integration by R1/C1/R2/C2 to separate the field sync pulses which are fed to the i.c. via C3. The time-constant network VR1/R3/C4 determines the oscillator timing, the ramp forming components being R5/VR2/ C6/C7. The sawtooth waveform generated at pin 4 is coupled by C5 to the non-inverting input of the class B power amplifier at pin 7. C8 couples the output to the yoke, which is returned to the positive supply line via the sampling resistor R7. C9 is a bootstrap capacitor and a.c. feedback is applied to the amplifier's inverting input via C10. The linearity control VR3 forms a variable integrator with R6 and C7 to superimpose an opposite-polarity integral on the input ramp waveform, slowing down the early part of the forward scan and increasing its rate-ofchange towards the end.

Enter the Flyback Generator

We have to use more bulky yokes with larger screen sets, the inductance of the scan coils increasing proportionally. Consider a yoke whose field coils have a resistance of 10Ω and an inductance of 20mH. During the forward scan the current rate-of-change is relatively slow and the load can be regarded as resistive. With a typical 2A peak-to-peak scan current a supply voltage of 20V is suitable. During the flyback however a complete current reversal must occur in the yoke within about 1ms. The yoke's time-constant is t = L/R = 0.02/10 = 2 ms, representing the time required for the current to reach 63 per cent of its final value when a d.c. voltage is suddenly applied. The "aiming current" here needs to be about 4A for the flyback to be completed in 1ms, and this implies (bearing in mind the yoke's 10Ω resistance) a supply voltage of around 40V. If we operate the output stage

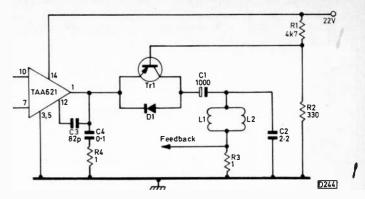


Fig. 2: Audio i.c. with flyback pulse isolating switch.

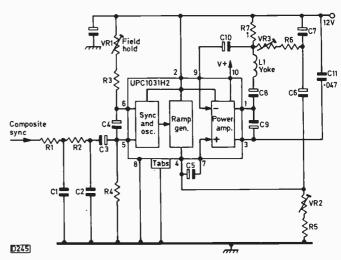


Fig. 3: Complete field timebase in a single NEC i.c. The voltage applied to pin 10 defines the flyback clamping level: the flyback time, depending on yoke characteristics, can be adjusted by varying this voltage.

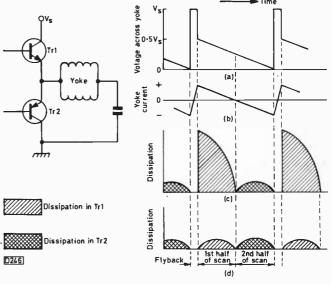


Fig. 4: Power dissipation in a class B field output stage: (a) shows the voltage waveform across the scan coils and (b) the current flowing in them. The shaded areas in (c) indicate the energy dissipation in the output transistors Tr1/Tr2, with Tr1 absorbing the difference between the applied and the required voltage for much of the time. The low and equally-distributed dissipation when a flyback booster is used is shown at (d).

from a 40V supply however the difference between this and the 20V level suited to the forward scan must, during the first half of the forward scan, be absorbed by the upper transistor of the class B output pair (see Fig. 4).

The "flyback generator", or "flyback booster", was developed to overcome this problem. Fig. 5 shows the principle of operation. During the 19ms forward scan period the i.c.'s output stage is supplied from the 20V line via D1. C1 charges to 20V via D1 and R1. At the end of the forward scan the voltage at pin 4 of the i.c. will have fallen to about 2.7V, the saturation voltage of Tr2. To initiate the flyback Tr2 is abruptly turned off while Tr1 simultaneously turns on. When, as a result, the voltage at pin 4 rises to 20V the flyback generator comes into operation. This acts as a switch, linking pins 2 and 3 with the result that +20V appears at the negative plate of C1. Since C1 is too large to change its charge rapidly its stored voltage is added to the newly present 20V so that the cathode of D1 is at 40V. Thus D1 switches off and the output stage supply is doubled. This occurs only during the flyback period and is what's required to smartly reverse the current in the scan coils - and the direction of the magnetic field they produce. C1 plainly loses charge during its 1ms stint of duty: this is replenished during the following forward scan period. The waveforms shown in Fig. 5 further illustrate the circuit's operation. In theory the use of this technique should reduce the power dissipation in the i.c. by 80 per cent: in practice a very worthwhile reduction of about 65 per cent is achieved.

The flyback booster technique was not unknown in discrete transistor field output stage circuits, being used for example in the Bang and Olufsen 3400 series chassis to drive the field deflection coils of a 110° delta-gun tube. Not all modern TV sets call for the use of this principle: much depends on the L/R ratio of the scan coils, the available supply voltage and the deflection current required. This latter is in turn related to the diameter of the tube's neck, the deflection angle and the e.h.t. voltage – a high e.h.t. voltage "stiffens" the electron beam.

Direct Yoke Drive

The field section of the 30AX deflection yoke has a resistance of 6.2Ω , an inductance of 10mH and requires a scan current of 2.1A peak-to-peak. This gives a timeconstant of 0.01/6.2 = 1.2ms, which is within the capability of an i.c. without a special flyback booster circuit. Fig. 6 shows the arrangement of the Mullard TDA2652 which is designed to drive the 30AX yoke directly. Two techniques are used here to minimise the power dissipation in the i.c. First, the parallel combination of C2, D1 in series with the supply to the i.c. provides a tuned flyback period which increases the flyback voltage and enables a lower supply voltage to be used. Secondly, due to the relatively low value of the supply decoupling capacitor C1 (220 μ F) and the high value of the filter resistor R1 (22 Ω) a large fieldrate ripple is present at the anode of D1. This reduces the average voltage supplied to the i.c., and hence its dissipation, without significantly affecting the voltage present during the flyback. It's interesting to compare the dissipation and supply voltage with this i.c. (4.4W and 35V respectively) with the relevant figures for a similar chip equipped with a flyback booster used to drive the same yoke (4W and 26V).

Power Boosting

It's only comparatively recently that i.c.s capable of driving large-screen, wide-angle tubes unaided have been developed. For some years it was necessary to add a discrete component class B (or occasionally class A, using

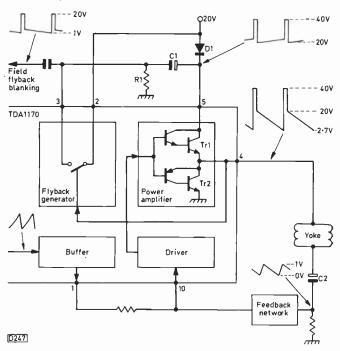


Fig. 5: Flyback booster principle.

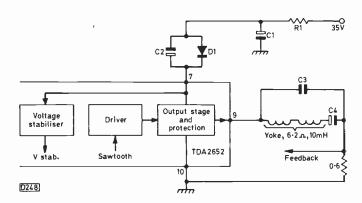


Fig. 6: High efficiency without a booster. C3 has counterparts in other circuits: it shunts away line flyback pulses, preventing these upsetting the interlacing via the feedback circuit.

two npn transistors) output stage to act as a current amplifier, especially where low-efficiency yokes like the early PIL toroidal types were used. Devices such as the TDA1170, TDA1270 and TDA1044 were used in this way and Fig. 7 shows a typical arrangement. The i.c. produces a negative-going ramp at its output pin 4. At the beginning of the forward scan Tr1 turns on, its emitter current flowing via R7, C5 and the scan coils. The first part of the forward scan is produced in this way. At the half-way point there's a period during which neither Tr1 nor Tr2 is conductive - their bases are directly coupled and there's no quiescent current. Since the base-emitter threshold of each output transistor is 0.6V, the "gap" in their conduction lasts for about 1.2V of the output ramp during the centre section of the scan. During this short period the yoke's power requirement is very small - it's passing through the zero current point: the small current required is supplied by the i.c. via R6. Crossover distortion is thus minimised, with the aid of feedback to pins 10 and 11 of the i.c. Tr2 takes control of the scan current during the second half of the forward scan.

Another way of looking at this arrangement is as a "current-dumping" circuit, a system much used in audio power amplifiers. The i.c. can be regarded as driving the yoke directly (via R6) for small signal currents, with the

current-dumping transistors Tr1 and Tr2 assisting for large signal currents.

There's no flyback booster in the arrangement shown in Fig. 7: the circuit drives a 20AX yoke from a 35V supply. This implies that the dissipation in Tr1 is large (refer back to Fig. 4). In later circuit designs flyback booster equipped chips were used: Fig. 8(a) shows a circuit using the technique previously described; in Fig. 8(b) an emitter-follower transistor (Tr1) is added.

HF Damping

Earlier (see Fig. 1) we encountered the Bucheron cell, an *RC* network used to limit an amplifier's r.f. gain. The *RC* combination R1/C1 connected between pins 4 and 11 of the TDA1170 i.c. shown in Fig. 9 provides a frequency-selective negative feedback path around the output stage, introducing an h.f. roll-off to prevent parasitic r.f. oscillation. Since the i.c.'s scan-coil load is inductive its impedance rises with frequency: this too could lead to instability where the amplifier has significant h.f. gain. The Zobel network R3/C3 is included to prevent this: it has the effect of equalising the load impedance to ensure stable operation at all frequencies.

Waveform Shaping

Some more sophisticated i.c.s incorporate special circuits over and above the feedback/linearity shaping arrangements already described. In Part 2 we saw how scan correction was provided in the sawtooth generating section of a discrete transistor field timebase. Fig. 10 shows how the same function was achieved in i.c. technology in a mid-seventies design (the TDA1044) that also incorporated a flyback booster and a 2A output stage.

Before we embark on a description of some of this i.c.'s internal circuitry a couple of terms require explanation. A constant-current source is one that drives a fixed, preset current through a load whose resistance is subject to change. It usually consists of a transistor with a fixed emitter resistor and a stabilised base voltage: the collector current depends on these factors and not on the load resistance – provided the latter is not so high that it limits the current available from the supply. A constant charging current provides a perfectly linear voltage ramp across a capacitor. An image circuit is one that provides a current (or voltage) mirrored about a V or I axis. Thus the image of a current flowing to the supply line is an equal current flowing via the earth line. Similarly the image of a negative voltage with respect to the supply line voltage is an equal voltage above ground potential.

In Fig. 10 R9/R10/Tr12 provide a fixed, temperature-compensated bias for the base of Tr9: the value of its emitter resistor Rt, which provides timing, thus determines Tr9's constant collector current. Charging capacitor Ct is in effect charged by Tr9's collector current, but to avoid the need to refer it to the supply voltage the image circuit Tr10/11/8 is used to generate across Ct a ramp that rises from chassis potential. When the voltage across Ct reaches a certain level a threshold detector in the i.c. switches Tr13 on, rapidly discharging Ct to initiate the flyback. Thus a single capacitor is used to set the field oscillator frequency and to generate the ramp, a useful feature that obviates the need for the separate oscillator timing and ramp generating capacitors used in earlier designs. The sawtooth generated across Ct is buffered by the Darlington pair Tr6/7 to provide a low-impedance

source for general use within the chip.

The scan-correction operation is carried out by the circuitry to the left. The sawtooth waveform is applied to the bases of the npn transistor Tr1 and the pnp transistor Tr2. Tr1 conducts only during the second half of the forward scan while Tr2 conducts only during the first half of the scan. The point at which they start to conduct depends on their emitter bias, i.e. the voltage at pin 1 of the i.c.: their degree of conduction thereafter depends on the current applied, i.e. the value of the series resistor Rkr. Tr2's collector current is imaged by Tr3 and Tr4 and added to Tr1's collector current before being applied to the tap on R6/7, the constant-current image transistor Tr8's emitter resistor. Conduction of either Tr1 or Tr2 thus reduces Ct's charging current, with the effect that the ramp is flattened. By varying the voltage at pin 1 and the value of the series resistor we can introduce the degree of scan-correction required for different types of picture tube.

For all its sophistication the TDA1044, being a massproduced device, is not expensive. It has been used in sets ranging from low-cost monochrome portables, e.g. the Bush BM6530, to full-specification colour sets, e.g. the Thorn TX10 chassis (in conjunction with an output power booster).

Before we leave this chip a note on its noise-immunity circuit. A hold-off circuit is incorporated to prevent premature triggering of the flyback by noise or interference spikes. This uses a level detector to examine the amplitude of the field ramp, whose period in the freerunning state is set at about 21ms by Ct/Rt. Only when the ramp is nearing completion does the level detector open the sync enabling gate to allow the sync pulse through to the base of Tr13.

Class D Operation

One theme in the evolution of field timebase design has been power consumption. Very early circuits operated under class A conditions, with more energy dissipated in the amplifier than in the load. The move to class B circuits made for greater efficiency, but still with considerable power loss in the output devices. Except in a batteryoperated set the odd few watts absorbed by the field output stage are not significant in terms of running costs, but the reliability of electronic equipment depends very much on its operating temperature, both locally (at semiconductor junctions) and generally, in terms of the temperature within the cabinet and the extremes of the temperature cycling to which the electronic and mechanical components are subjected. It's well known that class D operation, in which the active devices have only two operating states, on and off, is theoretically capable of very high efficiency. This principle was used by Mullard in a field timebase i.c. released in 1976 - the TDA2600. It represented a radical departure from conventional practice, and was used in the Pye/Philips G11 chassis to drive the yoke of a 20AX tube.

If we feed a square-wave input to an integrating circuit the energy available at the output will be proportional to the ratio of the square wave's on to off times (the markspace ratio). If, over the 20ms field scan period, we apply a square wave of steadily increasing mark-space ratio to an integrator and scan yoke the current flowing in the scan-coil load will increase in a linear manner – see waveforms (d) and (f) in Fig. 11, where an *LC* integrator is shown. At the end of the forward scan the input

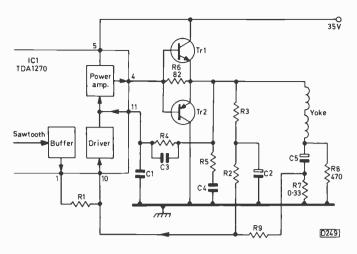


Fig. 7: Use of a boost circuit where the deflection yoke has a high energy requirement.

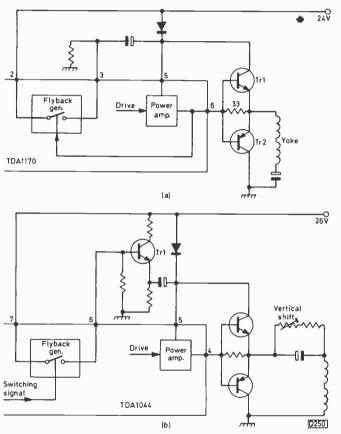


Fig. 8: Application of flyback boosters: (a) as used in the Bang and Olufsen 8800 series; (b) as used in the Thorn TX10 chassis.

waveform suddenly reverts to narrow pulses, whereupon the current flowing in the yoke reverses to give the flyback. At any instant the output transistors within the chip are either on or off, and in neither state do they dissipate much power.

It's not practical to generate the drive pulse train required by direct means, especially as linearity and scan correction have to be applied – these call for additional, adjustable variation of the mark-space ratio during the forward scan. The technique used to produce the variable mark-space ratio pulse train is to incorporate within the chip a pulse-width modulator. This consists of a differential amplifier whose output state depends on the instantaneous level of the waveforms applied to its two inputs: these are an internally generated 150kHz triangular wave –

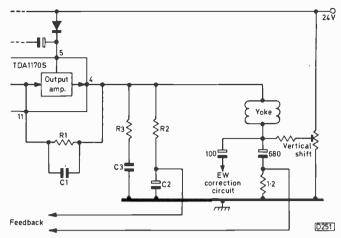


Fig. 9: Use of RC networks to prevent h.f. instability.

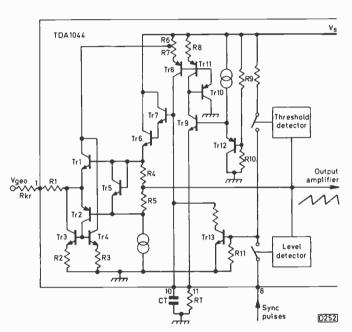


Fig. 10: Geometric correction of the scan waveform: part of the TDA1044's internal circuit.

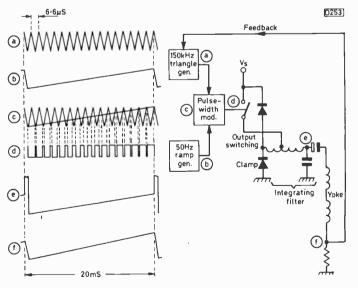


Fig. 11: Operation of the Class D field timebase.

waveform (a) – and a 20ms sawtooth that's produced by a conventional *RC* network – waveform (b). Whenever the ramp input voltage exceeds the level of the triangular waveform the amplifier's output goes high, linking, via the

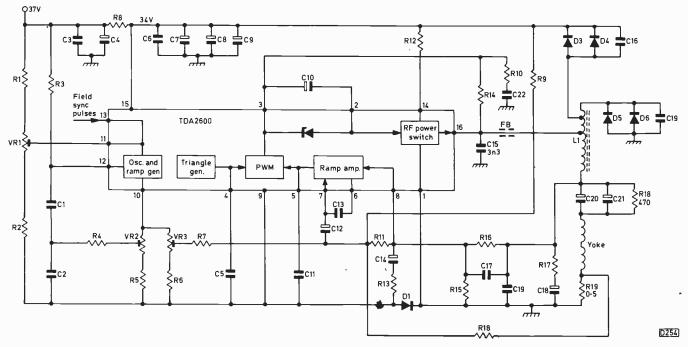


Fig. 12: Class D field timebase circuit used in the Philips G11 chassis. It produces a falling current ramp through the scan coils (compare with Fig. 11).

output stage, the integrator's input to the supply voltage. As the ramp builds up it slices the triangular waveform at progressively higher levels, thus generating the required advancing mark-space ratio waveform.

The circuit used in the G11 chassis is shown in Fig. 12. The ramp is produced by C1/2 which charge via R3, with VR1 providing ramp timing. VR2 is the linearity control and VR3 the height control. The ramp and feedback signals are coupled to pin 7 of the i.c. by C12. After internal buffering the ramp is applied to the pulse-width modulator whose output is coupled to the r.f. output switching transistors by C10.

The output at pin 16 is fed to the integrating filter consisting of L1 and C19: the filter's time-constant is long enough to "lose" the 150kHz square wave while having little effect on the shape of the 20ms current ramp that flows in the scan coils. Clamp diodes D3/4 and D5/6 prevent voltage spikes appearing at the i.c.'s output (pin

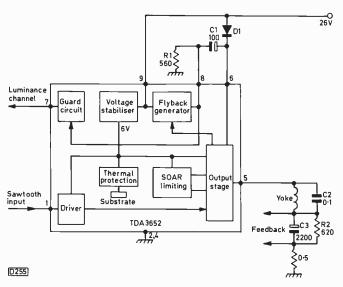


Fig. 13: The latest generation of field output i.c.s use a class B output stage with a flyback booster and incorporate sophisticated protection circuits.

16) while overshoots at the filter's output are damped by R17/C18. Many of the chip's peripheral components are present to provide suppression of spurious high-order components of the 150kHz switching frequency. In this connection diode D1 deserves special mention: it isolates the early stages of the i.c. from earth to prevent crosstalk from the power output switching, providing a "clean earth" at its anode.

Direct yoke drive makes heavy demands on the supply rail. It's heavily decoupled at 50Hz by C7/8/9 and at 150kHz by C6. To counteract the small remaining ripple a sample is fed to the ramp coupling circuit via R9, where it has an "equal and opposite" cancelling effect.

The TDA2600 and its host chassis, the G11, seem to have represented both the debut and the finale of the class D field timebase technique, at least in consumer market TV sets. The heatsink that surmounts the TDA2600 is comparable in size to those fitted to its class B counterparts, and the need for a special wound component, along with the apparently embarrassing presence of the r.f. square wave (whose penetrating ability has been suggested above), seem to have led to abandonment of the technique. It's reliability has not in practice been of the best.

Contemporary Field ICs

The current trend is towards higher output power using class B output stages in conjunction with a flyback generator. Modern devices like the TDA3652 can supply a scan current of 3A peak-to-peak without the need for a power output booster. Fig. 13 shows a typical modern field amplifier i.c. with some of its peripheral components. A 3V peak-to-peak sawtooth, generated by another i.c., is applied to pin 1. The driver stage is powered from an internal voltage stabiliser that provides a 6V line. The output stage consists of two complementary Darlington pairs operated in class B, each with a maximum operating current of 1.5A. They are protected against excessive dissipation by a thermal sensing bridge circuit on the crystal substrate. If its temperature exceeds 150°, the

Darlingtons' base currents are limited to reduce the total dissipation. Further protection is provided by a SOAR (Safe Operational Area) limiting circuit that monitors the voltage drop across the aluminium emitter leads of the output transistors: if the collector-emitter voltage of either Darlington pair increases beyond a certain threshold the base current (and hence the collector current) of that pair is automatically reduced. The working point of the output transistors is thus maintained within the permitted Ic/Vce boundary (SOAR) at all times.

Guard Circuit

Another modern feature is the guard circuit that provides an output at pin 7. This output is d.c. coupled to the luminance section and provides a tube bias-off voltage when no scan current flows at output pin 5. In some i.c. designs the field flyback blanking pulses are also delivered to the guard pin and take the same route to the tube which is thus protected against screen burn in the event of scan failure.

Picture Shift

Picture shift facilities are seldom required with modern colour tubes whose production tolerances are such that with zero d.c. in the yoke the raster displacement from central should be small enough (±3mm) for all but the most critical of applications. If necessary a variable d.c. yoke bias current can be derived from a potentiometer. In the circuits we've been discussing however the average yoke current is not zero because the scanning current is not perfectly balanced about the zero line. The field scan current is exponential in shape, the resulting asymmetry of the upper and lower halves of the waveform giving a slight downwards displacement to the raster. Compensation is provided in Fig. 13 by R2 which provides a d.c. path across the coupling capacitor C3: R18 in Fig. 12 and R8 in Fig. 7 serve the same purpose – in Fig. 8(b) a variable shift control is provided in this position. Some i.c.s have provision for altering the output stage's mid-point voltage by means of a low-current external potentiometer. This works in conjunction with a fixed bleed resistor across the scan coupling capacitor or a potential divider feeding the "outer" end of the yoke in a d.c. bridge configuration.

Height Stabilisation

In the early days, particularly in the valve era, the scan coils were outside any feedback loop. Since they are wound with copper wire, which has a positive temperature coefficient, the scan current decreases as the operating temperature of the coils rises. Compensation was provided by including a thermistor in series with the coils. In modern transistor and i.c. designs the need for this is obviated by including the coils in a negative feedback loop. In some circuits the sampling resistor in series with the coils is used as a height control, the output from the slider being applied as negative feedback to the inverting input of the power amplifier within the i.c. In this case the input ramp is of fixed amplitude.

Acknowledgements

In conclusion the authors would like to express their thanks to Thorn EMI Ferguson and Mullard Ltd. for the provision of much useful information.

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Wag's Wireless

Les Lawry-Johns

Wag's a well known local waterside figure and has been for many years. He's been a customer of mine for nearly as long. Last week something that threatened this longstanding relationship occurred. He brought in his son's music centre, a Ferguson Studio 6.

His son lives down in Sussex (I think) and being very busy he didn't have time to bring it in himself. So Wag went off to collect it, leaving behind the speakers since they weren't suspect. There were complaints about the main amplifier, the cassette and the record deck. So I spent a few hours sorting it out, replacing the output transistors, their emitter resistors and a few other odds and ends. Fitting the test speakers proved that the work had been done well, but it was left on test for some time just in case. Some days later Wag called to collect it, settled the bill and departed in his usual high spirits.

Wag's Return

The next day he was back. "It doesn't work Lawry, and that's going to upset my son. Didn't you test it?"

"Yes Wag, I tested it for hours. I'll test it again now." So saying I plugged it in and fitted the test speakers. The radio boomed out loud and clear and Wag's face became worried.

"What's them things?" he said, pointing to my test

speakers. "They're the speakers, Wag. It won't talk without

"I haven't got things like that."

"No Wag, you left them in Sussex, so you can't test the machine till everything's connected together again. What

"I just plugged it in at home and it didn't work at all, but my record player works without those things."

"That's because they're built into your record player, Wag. This hi-fi has spacially distributed sound from separate stereo speakers, see?'

So Wag went off, feeling a bit foolish - like I do several

times a day.

l Never Slept a Wink

A chap carried in a Bush T20. He was followed by an elderly lady who looked a trifle unhappy. He put the set on the bench and retreated. The lady advanced.

"This set was in here three months ago and it went wrong again at teatime yesterday. I couldn't stop worrying all evening and couldn't sleep at all last night. It's not right that it should go wrong so soon after being serviced. I've a good mind to complain to Radio Kent about it.'

She was so busy complaining she didn't notice that I'd removed the rear cover and checked one or two points. I quickly replaced the 1Ω resistor (5R8) in the line output transistor's base circuit and refitted the rear cover.

"Well now madam" I said politely, "let's see what's caused you so much sorrow." I plugged it in and switched on. Up came the sound and a few seconds later a good

picture appeared. "Now then, what would you like me to do?"

She stared at it transfixed. "I lay awake all night worrying about it and the moment I get it here it's all right. What's wrong? Will it go again? How do I know it won't go off again tonight? What have you got to say about it?'

"I think it wanted a ride in the car. If it goes again take

it for a ride then straight back home again.

"I haven't got a car. My son-in-law brought it down for me because I was so worried. I just couldn't sleep. I've nothing else."

I felt a bit sorry and decided to tell her the truth. "While you were telling me your problems I managed to find out what was wrong and put it right. So you can sleep in peace tonight."

"But how do I know it won't go wrong again? I can't

stand another night like last night.

So I took the back off again and examined the scan plug socket which showed some signs of distress. I made that good and checked around the other weak spots on the T20. Everything seemed to be all right so I refitted the back and pronounced everything to be in order.

"I hope it is. Do I owe you anything?"

"I'm afraid so dear. You girls have to pay for my services.'

At this point Honey Bunch appeared, towed by Zeb. The old girl screamed.

"Take that dog away. My mother was scratched by an Alsatian once and the scar didn't heal till the dog died."

The old girl called her son-in-law and off they went, vowing not to return to such an unruly place.

New Chassis

I must admit that some of the newer models in the Ferguson and Decca ranges worry me and probably will do for a while - until I get used to their habits. It was the same some years ago when I sold a customer a Philips G6 rather than a G8, because the latter set was new to me and I was afraid of it whereas the G6 had lovely things like valves in it, things I was at home with. Sounds silly, doesn't it? That particular G6 ended up with a tripler in place of the e.h.t. overwinding and valve rectifier. Why? Economy, that's why. The family I'd sold it to fell on hard times and couldn't afford a new transformer. It still gives a good picture. The G8 and G11 are now old friends to me, but I can't say the same about the G9. This one still worries me a bit. As for the Ferguson TX10, who would have thought the line output transistor is actually the chopper when he first opened one up? Once I'd got used to the layout they just had to alter it to confuse me. Only the siting of the focus unit convinced me that I was still dealing with a TX10. I must get out the books and bring myself up to date.

GEC 20AX Chassis

This set really had me going. The tripler had decided to burst out of its confinement: the makers had decided to pass a cableform against the bottom corner of the tripler and this is where the insulation breakdown had occurred. It had been allowed to go on arcing for some time before the owners had switched off, so arcing had also taken place over on the chroma panel. In this chassis the group of chroma panels used in the C2110 series was replaced by a single panel and this had taken the brunt of the arcing. Having replaced the tripler I switched on to see what damage had been done.

The screen was a lovely bright blue, the brightness control having no effect. I removed the blue connection plug from the top of the board and some red and green showed with chroma only, turning to a blank screen when the colour control was turned down. Considerable time had to be spent checking voltages, i.c.s, transistors etc. before an acceptable picture was eventually obtained. I'd have given my left arm for a replacement panel but no one seemed to have one locally. Working through the panel was agony – and all because a cableform had been tied up close to the tripler's bottom corner.

Bookie's Lair

Do you remember me telling you about my bookie friend who lives in a back-to-front house? You go up the drive, through the garage, ring the bell on the kitchen door, go through the kitchen into the hall then into the lounge where you can look out over the front garden and the swimming pool which is normally empty of water. This room contains many items including a bar and a 26in. Dynatron with the Pye 731 chassis, the rear cover being held by ten thousand screws. A door leads from this lounge to another one that also overlooks the front garden. It contains another 26in. Dynatron, this time with a Philips VCR in the top. So the rear cover is held on by fifteen thousand screws. The chassis is the same (nearly) as the one in the set in the other room. I've looked after these two monsters for many years and of late John's been asking me about fitting up-to-date receivers in the handsome cabinets. I've avoided this exercise on the grounds that I'm no carpenter and might damage the woodwork. Apparently he's made other enquiries and been told that a 26in. Sony would fit in snugly. My reply to this idea was

"Bugger you mate. If you have Sony sets fitted let them that fits 'em look after them. Not me. I shall not darken your door again."

So the Pye interiors stay inside the cabinets and the sets still perform.

The Hitachi Portable

What's all this about? Well, John suddenly appeared with a Hitachi colour portable which had the annoying fault of intermittent severe top compression that completely ruined the horse racing (office set). As he brought it into the shop I said I'd have a quick look but wouldn't dwell too long on it as these sets frighten me.

I soon found a small daughter board that held the field output stage and discovered that if this was moved to port the raster remained steady. If it was moved to starboard the compression proceeded apace. I didn't like the look of the items on the board so, being the fool that I am, I fitted a wire and spring to hold the board hard to port. It seemed perfectly all right to me so he took it and paid for my highly technical expertise.

The next day he was back. "In the middle of the 3.30" snarled John.

So out came the offending board (soldered in not plugged) and all the connections on it were carefully resoldered (though none looked suspicious). Refitting the board proved that the operation had been successful and John's office is now at peace. Long may it continue. Still, it could have been a TX10 . . .

next month in

TELEVISION

RECENT DECCA-TATUNG CHASSIS

In late 1981 Ray Wilkinson provided a detailed account of the Decca 120/130 series chassis and the reasons for adopting the circuitry it used. Time and the technology don't stand still and the current range of Decca-Tatung chassis differ in many respects while retaining the single, compact PCB approach. Ray Wilkinson brings us up to date on the 140, 145, 150, 160 and 165 series chassis.

● SERVICING THE MULLARD/PHILIPS TELETEXT DECODER

Mike Phelan starts a new series, this time on teletext equipped sets. The series will describe the operation of teletext decoders and explain how to go about fault finding. Mike comments that the diagnosis of faults is very easy since the decoder, being a digital device, tends to produce a screen display showing the precise nature of whatever ails it. The teletext version of the Philips G11 chassis is taken as the basic example – many of these sets are now available from disposal warehouses at reasonable prices.

• THE N. AMERICAN TV SCENE

Keith Cummins spent several weeks recently in Canada and the USA. We asked him to take a look at the TV scene over there: his report brings out the many differences in the approach to providing TV services in N. America compared to the arrangements we're used to in the UK.

MORE ON THE HYBRIDS

S. Simon with further guidance on quick checks for defective hybrid receivers. This time notes on the Pye 697 and Thorn 1500 chassis.

COMMISSIONING SMATV SYSTEMS

As a follow up to his recent article on TVRO installations Geoff Lewis reports on small master aerial systems.

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Teletopics

ENTER 45AX

1975 saw the introduction of the Philips/Mullard 20AX tube and 1978 the advent of the 30AX tube. Now in 1985 comes the 45AX, another major step forward in tube design. The 45AX range is of the new flatter, squarer screen type (see June issue, page 448). The particular significance of the 45AX range is that it comprises both 90° and 110° types in sizes from 14 to 26in., with both flatter and squarer screens. There are also two neck diameters, narrow (29mm) and mini (22.5mm). The complete range is as follows:

36, 41 and 51cm. (14, 16 and 20in. approximately) 90°

tubes with mini necks for use in economy sets.

51cm. 90° tube with narrow neck for optimum screen performance.

51, 59 and 66cm. (20, 23 and 26in. approximately) 110° tubes with narrow necks for use in sets with fuller specifications

In addition to the extermal features there are significant internal improvements. These include the use of a low-wattage cathode to give a faster, more stable picture at switch on and a new shadowmask support system with reduced thermal inertia.

Mullard point out that when deciding on the parameters for the range key glass dimensions had already been established in Japan for 14-20in. tubes with 90° deflection. These dimensions were adopted in the interests of compatibility and interchangeability. For the larger tube sizes with 110° deflection however Philips have decided upon their own parameters since there are no established dimensions in the Far East. These tubes have slimmer outlines that are better suited to the push-through presentation favoured in Europe. Note that the tube sizes quoted follow the new international system, being based on the phosphor diagonal rather than the overall glass screen diagonal.

The 51cm., 90° narrow-neck tube is already in production at Mullard's Durham plant: the minineck version will go into production there next year. The 110° tubes are being produced at Philips' plants in Germany (Aachen) and France (Dreux). The small-screen sizes will go into

production next year at Lebring, Austria.

The first thing that has to be decided in tube design is the neck diameter, since this determines everything else. A narrow neck reduces the deflection power required but poses design problems with respect to colour purity and beam focusing. A large neck implies greater convergence errors. As mentioned above the standard narrow and mini neck diameters have been adopted for the 45AX range. The guns used in 45AX tubes need to be physically smaller than in previous tubes while giving an equivalent or better spot performance. To this end a novel approach has been adopted in the design of the triode section, giving what Mullard call an "aberration reduced triode": the electron optics of the individual guns in the assembly "overlap" to reduce the aberration effects associated with small guns.

Smaller guns mean smaller cathodes, and usually a smaller area contributing to the total beam current. In order to maintain good life performance at higher current densities a new high-technology cathode assembly is used

in 45AX tubes. Normal cathode construction starts with spot welding the cap to the barrel. Subsequent preparation has to be a compromise for the best treatment of each part. The 45AX's 0.65W cathode is built up from two separate pieces joined by laser welding: only through laser welding can the minute parts be connected without risk to the prepared coatings. Since the cathode coating can be optimised without fear of damage, its potential activity in the finished tube is greatly increased. The temperature at which it is run can thus be reduced, extending tube life. The new 0.65W cathode runs 15°C cooler than earlier types while retaining greater activity.

As with the 30AX tube, the gun contains a magnetic ring that's factory premagnetised to provide static convergence. This is the first time the technique has been used

with 90° tubes

Traditionally shadowmasks have been suspended near the centre points of their sides, though theory would suggest that corner suspension would result in a more stable assembly. Flattening the glass screen calls for a flatter shadowmask of course, but a flat mask is more prone to bulge and bow, with impurity effects, as the electron beam heats it to the normal running temperature. The bimetal compensators used in previous tubes need spot-welding to a strong shadowmask surround or "ring" - a lightweight ring would buckle and destroy the colour purity. The corner suspension system used in the 45AX tube involves no ring and no twisting motion: the four corner brackets simply swing the mask towards and away from the screen as it heats and cools. The precise extent of the movement at any temperature (beam current) is defined by the mechanical dimensions of the brackets.

A bismuth coating is applied to the mask to improve its heat dissipation properties. The lightweight mask assembly is fastened to its support pins after the phosphor screen has been laid – laser welding is used to avoid

damaging the phosphors.

The design features so far mentioned are used in each of the tubes in the 45AX range, though their implementation varies with different tube types. The scan coils have to be designed specifically for each tube type however and there are noticeable differences between those for the 90° and 110° versions of the tube. The self-converging feature of all the tubes needs to be especially powerful with the 110° versions: to achieve this, precision double saddle windings are used in conjunction with the pin-shooting technique pioneered in the 30AX tube.

The yokes for 90° 45AX tubes employ the more usual saddle-toroidal winding arrangement with pin-shooting retained for the line windings. This helps to achieve the high level of raster shape accuracy necessary with a flat, square tube, where the slightest picture distortion is easily spotted. In addition to being fully self-converging the 90° tubes require no raster shape correction circuitry: the

square picture is designed in.

RENTAL SCENE

In a recent report entitled "The Television Rental Industry" stockbrokers Fielding, Newsome-Smith point out that the industry will remain substantial for many years despite a continuing, gradual decline of the rental habit. Turnover is likely to remain at some £1b annually, at 1985 prices, over the next decade. The total number of subscribers has been falling at roughly five per cent a year – from 11·75 million in 1978 to about 8·9 million at present. The report mentions that the disconnection rate for VCRs is high – about 33 per cent during the first year. It suggests that the

larger concerns in the industry – Thorn EMI, Granada and Electronic Rentals (Visionhire) – may well increase their share of the market. Two recent takeovers confirm the view. Telefusion, with 250,000 rentals plus the Connect retail chain, has been taken over by Electronic Rentals while Telebank (STC) with 130,000 rentals has been taken over by Granada. ERG's deal with Telefusion has created a substantial service operation, with an annual turnover of some £4m, carrying out work for third parties including Boots and local electricity boards.

VIDEO DISC SYSTEMS

JVC has unveiled in Japan a 3-D version of its VHD video disc system and expects to have this on sale by the end of next year. One of the problems will be software, since programmes have to be shot using a dual-camera arrangement. The viewer has to wear special liquid-crystal filter spectacles developed by Sharp: these are switched electronically, obscuring the vision of each eye alternately in synchronism with the field scanning.

Further details of Hitachi's record (once only)/playback disc system, mentioned briefly last month, have been released. The system is intended primarily for still picture storage, having a playing time of only sixteen seconds for a moving display. The machine (Model VIR1000) is available in an NTSC version only and has a port for direct connection to a microcomputer.

MINI TVs

Casio's Model TV21 2in. monochrome pocket TV set is now on sale in the UK with a suggested retail price of £99.95. It employs a liquid crystal display with a "solar projection" arrangement and has auto-tune channel change plus brightness and volume controls. The earphone cable is also the aerial and the set, weighing just seven ounces, operates with two standard AA size batteries. For further details apply to Casio Electronics Co. Ltd., Unit 6, 1000 North Circular Road, London NW2 7JD (01-450 9131). At the recent Osaka Electronics Exhibition Casio showed two colour versions which are now on sale in Japan at £200 and £230. Citizen and Sanyo also showed pocket receivers using colour LCDs. Sanyo's set has a 4 × 3in. display with 384 × 216 pixels, weighs 1.5kg and has a consumption fo 4.9W.

DON'T USE A BU208!

When in doubt many engineers tend to use a BU208 as a replacement line output transistor. Thorn point out that this is not a suitable replacement for use in their 1615 series large-screen monochrome chassis. A BU205 was selected during development of the chassis and this is what should be used – a BU208 generally fails after a few weeks. Exact replacements are often important in the line output transistor position.

TRADE SCENE

Colour receiver sales in the UK increased by 4.6 per cent during the second quarter of the year. There's been a reversal of the trend of the last couple of years, with sales of large-screen sets rising by 9.3 per cent while sales of small screen sets fell by 1.8 per cent. Deliveries to the trade were down 11.2 per cent overall during the quarter, large-screen CTV deliveries falling by 5 per cent to 353,000 while small-screen CTV deliveries fell by 18 per cent to 274,000. Imports have fallen, with UK production accouniting for 78 per cent of large screen sets and 56 per

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cent of small-screen sets. VCR deliveries fell by one per cent to 232,000 while home computer deliveries fell by 53 per cent to 203,000.

A recent report by Mintel Publications (KAE House, 7 Arundel Street, London WC2R 3DR) on the £2.6b UK leisure electronics market suggests that the outlook is for substantial but uneven growth. By 1984 44 per cent of UK homes are expected to have a microcomputer and 48 per cent a VCR - these estimates compare with 1984 figures of 23 and 35 per cent respectively. Some £250m worth of home computers were sold in 1984. Mintel suggests that there will be a fall to £100m in 1989, a drop of 60 per cent. The market is becoming software led however – sales of software are expected to rise by 125 per cent to £270m in 1989 while sales of peripherals should rise by 275 per cent to £300m, resulting in an overall increase in the home computer market of 48 per cent, up from £450m in 1984 to £670m in 1989. Mintel sees much the same story in the video market, while CTV sales should climb 44 per cent from £528m in 1984 to £760m in 1989 with increasing numbers of households having two or more sets.

For the first time since 1976 Japanese VCR exports recorded a decline in August – a one per cent year-on-year fall compared to August 1984. Production continued to increase however. It seems that Japanese manufacturers are going though a tough period – both Hitachi and JVC recently announced sharp declines in first half profits (in Hitachi's case the main problem was a substantial drop in sales of semiconductor devices). JVC's 37·2 per cent profit drop is largely attributed to softer VCR prices, with tough competition in a shrinking market. JVC plans to launch a range of high-resolution VCRs during the next

half year but the profit contribution from this won't show

through until the following financial year.

According to a recent Screen Digest report more than half the world's households (473 million) now have a least one TV set. In the USA, General Electric has announced its withdrawal from TV receiver production. In future it will sell sets manufactured by Matsushita (Panasonic). GE's consumer electronics business general manager Jacques A. Robinson commented that the move will give GE "the advantage of Matsushita's leadership in cost and engineering technology". Matsushita is expected to build up deliveries of CTVs to GE from its US plant outside Chicago to over 500,000 sets annually. This will probably give Matsushita leadership of the US TV market. GE will continue to produce colour tubes.

CD PLAYER TRAINING COURSES

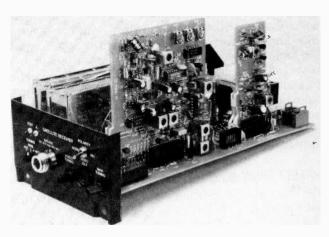
Starting in December, Ferguson will be holding a series of two-day training courses on the mechanics and electronics used in the CD01/CD02 disc players. These courses, dealing with theory and principles, fault diagnosis, repair and maintenance, are being held at both the Edmonton and Chadderton dealer training schools. At the end of the course a delegate should be competent to deal with all field problems that might affect Ferguson disc players and will have an adequate background to assimilate changes/ enhancements that may be introduced in later, more sophisticated models. The charge for the course is £34.50 (including VAT) per delegate - lunch is provided on both days, also refreshments in the morning and afternoon. Any bona fide professional engineer interested should apply to Frank Pack, Thorn EMI Ferguson Ltd., PO Box 121, Lea Valley Trading Estate, Angel Road, London N18 3BP.

SATELLITE TV

The official European Telecommunications Satellite Organisation Eutelsat, of which the posts and telecommunications authorities of 25 European countries are members, is studying the feasibility of moving into the DBS field. The idea is to pool European resources and establish a satellite TV broadcasting system that would provide 18 channels from two orbiting satellites (with a third held in reserve) covering most of Western Europe. The organisation believes that a pan-European system would avoid costly duplication and be the most economical way of establishing DBS services in Europe. The Department of Trade and Industry has approached Eutelsat expressing interest in the proposals as a possible means of starting UK DBS services.

Meanwhile in Luxembourg the Societe Européene des Satellites (SES), a company set up earlier this year, has announced that it's to buy a 16-channel satellite from RCA and will be taking an option on a second one. A launch date in early 1987 is suggested for the first satellite, which will be used for TV transmissions. It seems that SES is unwilling to comment further at present on its plans.

Luxor (UK) Ltd. have released two satellite TV receiving systems which will enable viewers to receive pictures from the Intelsat and Eutelsat satellites. Dennis Swannack, Luxor (UK) Ltd.'s managing director, comments that "we have been highly encouraged by the initial response to the two new systems, which we believe to be a business proposition for domestic, commercial and educational users who wish to receive satellite television pro-



The indoor receiver unit with the Luxor 2000 satellite TV receiving system, shown above, is designed as a module to fit into the SX9 chassis.

grammes." System 2000 is for use with Luxor's SX9 chassis: it includes a satellite receiver module that slots into the SX9. System 3000 is intended for use with previous Luxor models and other makes of receivers.

System 2000 includes a 1.25m glassfibre reinforced parabolic dish with a flame-deposited aluminium reflective surface and a white weatherproof coating. This is used with a Cassegrain feed system and an 11GHz low-noise amplifier-converter with a noise figure of better than 3.25dB and an i.f. output of 950-1,750MHz. Features of the indoor receiver unit include manual tuning or automatic tuning via the television set's self-seek system, remote control via the normal TV handset, a video output for feeding to a VCR, a programmable two-channel sound system, and video polarity switching. The receiver module was provided for in the design of the SX9 chassis, so that when fitted there are no external cables or peripheral equipment. System 2000 comes with a bracket and clamp for mounting on a 50mm tube for wall fixing. A price of around £900 plus VAT is suggested.

System 3000 includes the same dish and head assembly but has a separate receiver with a u.h.f. modulator whose output is fed to the TV set's aerial input socket. Features of the receiver include: infra-red remote control; four sound system which is mono/stereo switchable; Dolby noise reduction; wide or narrow audio bandwidth; built-in signal strength meter; two-speed frequency scanning; video and audio outputs; video polarity switching; and ready for polar rotor and aerial actuator drive connections. The suggested price is around £1,100 plus VAT.

For further details apply to Luxor (UK) Ltd., 87-89 Farnham Road, Slough, Berkshire SL1 4UL.

Philips have announced that they will have available an adaptor for reception of DBS signals using the MAC standard by early 1987. The adaptor will feed a conventional TV set and together with an outdoor parabolic dish aerial will constitute a complete TVRO system. Work on the design and production preparation of i.c.s for use in the adaptor is at present being carried out. With the introduction of this advanced adaptor Philips will be contemplating a gradual conversion to future high-definition TV. The design conforms to the full specification MAC standard agreed between the EBU and the European Electronics Industry last February and already offers a wide range of new possibilities in this respect. In particular the adaptor will continue to be suitable for use should a different aspect ratio be adopted in the future. There's also the possibility of using a key for pay-TV or for broadcasts for closed viewing circles.

Astec, who are well known for their u.h.f. modulators. have introduced a range of modules to provide a satellite TV receiver unit, i.e. the indoor bit. The AT1000 series tuner units have an input bandwidth of 950-1,450MHz and a 612MHz i.f. output: the conversion gain is 30dB with a noise figure of 6dB. Frequency conversion options range from a low-cost, high-performance voltage-controlled oscillator arrangement through a module with ÷256 prescaler to a unit with an integral phase-locked loop. These modules all use high-side mixing and are available with single or dual inputs. Demodulator unit AT3010 employs a SAWF to select the 612MHz input and provides a composite baseband output. Module AT1020 provides an i.f. gain of 40dB and the a.g.c. and low-noise converter control voltages. For further details apply to Astec Europe Ltd., 16 Albury Close, Reading, Berkshire RG3 1BD.

IN BRIEF

The first ever demonstrations of the IBA's enhanced C-MAC wide-screen, higher resolution TV system over an operational satellite link were given at the Royal Television Society's Cambridge Convention last September . . . The eleventh International Broadcasting Convention (IBC 86) will be held at Brighton on September 19-23rd 1986 . . . New workshops for the repair and calibration of electrical and electronic test equipment, from Avometers to oscilloscopes, have been opened by John Firth Instruments Ltd., Beech House, Hob Hey Lane, Culcheth,

Warrington, Cheshire WA3 4NY - apply to Customer Service Dept. The workshops complement the company's sales and distribution operations. A test equipment showroom, in which examples of veteran and vintage makes and models will be displayed alongside the very latest instruments, is to be opened. JFI would be interested in hearing from anyone who has vintage equipment for sale or loan or has anything available in the way of "test equipment trivia" that would add interest to the collection . . . British Telecom's 60,000 Prestel customers can now send telexes anywhere in the world, and receive them, over Prestel's Telex Link . . . The BBC is to set up a data transmission system called Datacast that uses spare teletext capacity. The data transmission rate will be 12 kilobits a second and the data will be delivered all over the UK. The aim is to provide a fast, scrambled information service for business and industrial subscribers, avoiding the cost of telephone lines. It will be run by the Corporation's commercial arm, BBC Enterprises.

PUBLICATIONS

A new catalogue, dated 1985-6, has been published by East Cornwall Components, 119 High Street, Wem, Shropshire SY4 5TT (0939 32689). East Cornwall Components now carry a very extensive range of items with delivery generally by return of post.

Publication by Newnes-Butterworths of the second edition of Steve Beeching's VCR servicing book has been delayed – it's understood that the new edition will be available in about a month's time.

Spectrum-monitor Interface Follow-up

John de Rivaz, B.Sc. (Eng.)

My article in the July 1984 issue described a Spectrum-monitor interfacing circuit, i.e. a YUV/RGB adaptor. Many readers have built this circuit and several have written to us about difficulties they've experienced. These notes are intended to help such readers.

The circuit was originally used with a Ramtek monitor obtained from Opus Supplies. This particular monitor is no longer available but I see no reason why the circuit shouldn't work with other monitors. It does of course use an SL901B i.c. in a way the manufacturers didn't intend, and it's possible that there are chip design variations that can cause problems.

The level of the V input signals at pins 19 and 20 of the i.c. is very low. This is because of the high gain of the following stages within the i.c. To test the circuit, check that the two transistors (Tr7/8) that drive these pins are both npn devices and that they are correctly connected. There should be square waves at their bases while the V signal should be present at their emitters. It should also be visible at the junctions between the balance control and the two $1.5 \mathrm{k}\Omega$ emitter resistors. Check through the circuitry that recovers the ident signal, referring to the original article, and ensure that it's working properly.

The Spectrum's output, in terms of brightness, is low for colour 1 (blue) and high for colour 7 (white). This means that red, which is colour 2, is also rather low. This has given some readers problems and I've advised altering the gain of the three channels in the monitor to suit.

Sync pulses are still present at the outputs of the

adaptor circuit. These can be sliced off using diodes. I've in fact now done this in order to make the RGB input to the monitor compatible with that from a QL microcomputer. Alternatively the monitor's amplifiers can be biased back to cut off the sync pulses. There's a control for this purpose in the Ramtek monitor.

The blue and red levels obtained from the adaptor are low but I've found them to be perfectly satisfactory. The problem is that the adaptor circuit renders the colours exactly as the Spectrum initially generates them, whereas when the colours are passed through the PAL converter (which is bypassed by the adaptor) deliberate distortion of the levels is introduced in order to produce brighter, more garish colours. This effect could be recreated by altering the gain of the three channels, but this would mean either adding attenuators and making the monitor provide the additional gain or alternatively building 20MHz bandwidth amplifiers for each of the three channels. This approach may give problems with grey-scale tracking with regard to the Spectrum's two brightness levels.

I've found that a resistor of $10k\Omega$ or thereabouts between the SL901B's demodulator bias pin 3 and the positive rail reduces the green output and increases the red and blue outputs. Unfortunately this impairs the i.c.'s stability, though this effect may not be noticeable.

There's scope for further experimentation with this application of the SL901B i.c. Readers are invited to do so and to share their conclusions with other readers through the pages of the magazine.

Electron Test Pattern Program

Andrew J. Heron

Whenever I consider buying a test pattern generator I'm deterred only by the cost. So, looking at a beastly micro lying idle, I though who not use it for a worthwhile purpose? The following program has been written for the Acorn Electron, but should also work on the BBC micro: I must stress however that it has not been tested on the BBC machine.

The program will produce the following test patterns on any 625-line TV set or monitor: (1) plain raster in a choice of eight colours; (2) colour bars; (3) split bars; (4) horizontal bars; (5) vertical bars; (6) crosshatch; (7) dots; (8) chequerboard; (9) centre circle. One disadvantage of the program compared with a conventional test pattern generator output is that the displays don't cover the whole raster. This is because the micro displays both text and graphics in a "window" which reduces the horizontal dimension to 83 per cent of the raster and the vertical dimension to 95 per cent – the 4:3 aspect ratio is also lost. This shouldn't be of great significance however, especially as most convergence adjustments are ideal around the centre. A sound signal is not available since the sound produced by the micro goes to the internal speaker and the cassette recorder connector, not the modulator.

Use

Some notes on the use of the program, which is loaded by typing LOAD"TSTGEN" or CH.". The operator is prompted to select a colour for the chequerboard and circle patterns. 1 = red, 2 = green, 3 = yellow, 4 = blue, 5 = magenta, 6 = cyan, 7 = white. The colour is selected by pressing the appropriate number, then the return key. The colour for the plain part of the display must next be selected. This is done in the same way. Then, after pressing the return key, the plain raster will be displayed in the selected colour.

The next pattern (colour bars) is obtained by pressing the space bar. The following pattern is obtained in the same manner, in the sequence (1) - (9) given above. After displaying the circle pattern, pressing the space bar will return the program to the stage where the colours are selected. The colours can then be changed. At this point the operating procedure repeats.

While any of patterns (1) – (8) are displayed on the screen the circle can be superimposed by pressing the shift key – this brings up the circle in the colour selected. If the space bar is pressed at this point the program again returns to the point where the colours can be changed.

The program should be self-explanatory. The following points are worth noting however. (1) The return key must be pressed after entering the colour number. (2) If a number greater than 7 is entered for the colours you'll be prompted to make another entry. (3) If the split bars are being displayed and you want a plain raster for example it's quicker to press the shift key to display the circle rather than to work through the remainder of the patterns. Then press the space bar and select the plain raster colour. (4) If you require only the standard patterns (those for which you don't select a colour), press the return key twice when prompted to select a colour. This will bring up the colour selectable patterns in black.

Editorial note: It seems that lines 1960-2030 of the following program may require some modification to produce a circle suitable for linearity setting up (see letters in the September issue, pages 612 and 614, on BBC microcomputer programs). We are looking into this.

Program

10 MODE 2

```
20 VDU 23; 82 02; 0; 0; 0;
 30 COLOUR 134: CLS
 40 COLOUR 0
 50 PRINT TAB (7, 8); "TEST"
 60 PRINT TAB (6,12); "PATTERN"
 70 PRINT TAB (5, 16); "GENERATOR"
 80 COLOUR 4
 90 PRINT TAB (3, 24); "By A. J. Heron"
100 \text{ TIME} = 0
110 REPEAT UNTIL TIME = 200
120 COLOUR 4: CLS
130 PRINT TAB (4, 8); "THE PROGRAM"
140 PRINT TAB (4, 12); "DISPLAYS THE"
150 PRINT TAB (3, 16); "FOLLOWING TEST"
160 PRINT TAB (6, 20); "PATTERNS"
170 \text{ TIME} = 0
180 REPEAT UNTIL TIME = 500
190 COLOUR 135: CLS
200 COLOUR 1: PRINT TAB (3, 4); "PLAIN RASTER"
210 COLOUR 2: PRINT TAB (3, 6); "COLOUR BARS"
220 COLOUR 3: PRINT TAB (3, 8); "SPLIT BARS"
230 COLOUR 4: PRINT TAB (3, 10); "HORIZONTAL BARS"
240 COLOUR 5: PRINT TAB (3, 12); "VERTICAL BARS" 250 COLOUR 6: PRINT TAB (3, 14); "CROSSHATCH" 260 COLOUR 1: PRINT TAB (3, 16); "DOTS"
270 COLOUR 2: PRINT TAB (3, 18); "CHEQUERBOARD"
280 COLOUR 3: PRINT TAB (3, 20); "CENTRE CIRCLE"
290 COLOUR 8: PRINT TAB (2, 28); "PRESS SPACE BAR"
300 IF INKEY (-99) THEN 320
310 GOTO 300
320 CLS
330 COLOUR 128: CLS
340 COLOUR 3: PRINT TAB (2, 4); "THE PATTERNS ARE"
350 PRINT TAB (2, 7); "DISPLAYED IN THAT"
360 PRINT TAB (7, 10); "ORDER"
370 PRINT TAB (2, 14); "AT ANY TIME THE"
380 PRINT TAB (2, 16); "NEXT PATTERN IS"
390 PRINT TAB (0, 18); "OBTAINED BY PRESSING"
400 PRINT TAB (3, 20); "THE SPACE BAR"
410 COLOUR 8: PRINT TAB (2, 28); "PRESS SPACE BAR"
420 IF INKEY (-99) THEN 440
430 GOTO 420
450 COLOUR 5: PRINT TAB (4, 6); "AT ANY TIME A"
460 PRINT TAB (4, 9); "CIRCLE MAY BE"
470 PRINT TAB (2, 12); "DISPLAYED WITH THE"
480 PRINT TAB (2, 15); "PRESENT PATTERN BY"
490 PRINT TAB (4, 18); "PRESSING THE"
500 PRINT TAB (5, 22); "SHIFT KEY"
510 COLOUR 8: PRINT TAB (2, 28); "PRESS SPACE BAR"
520 IF INKEY (-99) THEN 550
540 GOTO 520
550 CLS
 560 COLOUR 6: PRINT TAB (4, 6); "YOU CAN SET"
570 PRINT TAB (3, 9); "THE COLOUR OF"
580 PRINT TAB (5, 12); "THE CIRCLE"
590 PRINT TAB (8, 15); "AND"
```

```
600 PRINT TAB (2, 18); "THE CHEQUERBOARD"
                                                          1350 MOVE X, 0
 610 PRINT TAB (6, 21); "PATTERNS"
                                                          1360 DRAW X, 1024
 620 COLOUR 8: PRINT TAB (2, 28); "PRESS SPACE BAR"
                                                          1370 NEXT X
 630 IN INKEY (-99) THEN 650
                                                          1380 VDU 7
 640 GOTO 630
                                                          1390 IF INKEY (-99) THEN 1430
 650 CLS: CLG: COLOUR 128
                                                          1400 IF INKEY (-1) THEN 1960
 660 COLOUR 8: PRINT TAB (0, 1); "CIRCLE/
                                                          1410 GOTO 1390
     CHEQUERBOARD"
                                                          1420 REM CROSSHATCH
 670 PRINT TAB (6, 2); "COLOUR"
                                                          1430 FOR Y = 100 TO 1024 STEP 100
 680 COLOUR 1: PRINT TAB (4, 6); "1.. RED"
                                                          1440 MOVE 0, Y
 690 COLOUR 2: PRINT TAB (4, 8); "2.. GREEN"
                                                          1450 DRAW 1280, Y
 700 COLOUR 3: PRINT TAB (4, 10); "3.. YELLOW"
                                                         1460 NEXT Y
 710 COLOUR 4: PRINT TAB (4, 12); "4.. BLUE"
                                                          1470 VDU 7
                                                         1480 IF INKEY (-99) THEN 1520
1490 IF INKEY (-1) THEN 1960
 720 COLOUR 5: PRINT TAB (4, 14); "5.. MAGENTA"
 730 COLOUR 6: PRINT TAB (4, 16); "6.. CYAN" 740 COLOUR 7: PRINT TAB (4, 18); "7.. WHITE"
                                                         1500 GOTO 1480
 750 COLOUR 8: PRINT TAB (4, 22); "ENTER COLOUR"
                                                         1510 REM DOTS
 760 VDU7
                                                         1520 CLS: VDU 23,225,0,0,0,16,0,0,0,0
                                                         1530 FOR Y = 0 TO 31 STEP 2
 770 COLOUR 7: PRINT TAB (0, 28): INPUT G
 780 IF G > 7 THEN CLS: GOTO 660
                                                          1540 FOR X = 0 TO 19
 790 *FX11. 0
                                                         1550 PRINT TAB (X, Y); "."
 810 REM PLAIN RASTER
                                                          1560 NEXT X
 820 CLS
                                                         1570 NEXT Y
 830 COLOUR 7: PRINT TAB (4, 8); "ENTER RASTER"
                                                         1580 VDU 7
 840 PRINT TAB (7, 10); "COLOUR"
                                                         1590 IF INKEY (-99) THEN 1640
                                                         1600 IF INKEY (-1) THEN 1960
 850 VDU 7
 860 PRINT TAB (0, 28): INPUT C
                                                         1610 GOTO 1590
 870 IF C > 7 THEN 820
                                                         1620 REM CHEQUERBOARD
 890 COLOUR 128+C: CLS
                                                          1640 CLS: VDU 23,224,255,255,255,255,255,255,255
                                                         1650 COLOUR G
 900 VDU 7
 910 IF INKEY (-99) THEN 940
                                                         1660 D = 0
 920 IF INKEY (-1) THEN 1960
                                                         1670 Y = 0
 930 GOTO 910
                                                         1680 N = 0
 940 COLOUR 128: CLS
                                                         1690 GOSUB 1770
 950 REM COLOUR BARS
                                                         1700 GOSUB 1840
 960 N = 0
                                                         1710 N = N+1
 970 FOR X = 0 TO 1280 STEP 160
                                                         1720 D = D+1
 980 IF N = 8 THEN 1080
                                                         1730 IF D = 50 THEN 1910
 990 READ B
                                                         1740 IF N = 5 THEN Y = Y+3
                                                         1750 IF N = 5 THEN 1680
1000 GCOL 0, B
1010 MOVE X, 0
                                                         1760 GOTO 1690
1020 MOVE 1280, 0: PLOT 85, 1280, 1024
                                                         1770 READ X%
1030 MOVE X, 0
                                                         1780 DATA 0,4,8,12,16,2,6,10,14,18
                                                         1790 DATA 0,4,8,12,16,2,6,10,14,18
1040 MOVE X, 1024: PLOT 85, 1280, 1024
1050 DATA 7,3,6,2,5,1,4,0
                                                         1800 DATA 0,4,8,12,16,2,6,10,14,18
1060 N = N+1
                                                         1810 DATA 0,4,8,12,16,2,6,10,14,18
                                                         1820 DATA 0,4,8,12,16,2,6,10,14,18
1070 NEXT
1080 VDU 7
                                                          1830 RETURN
1090 IF INKEY (-99) THEN 1130
                                                         1840 PRINT TAB (X%, Y); CHR$ (224)
                                                         1850 PRINT TAB (X%+1, Y); CHR$ (224)
1100 IF INKEY (-1) THEN 1960
1110 GOTO 1090
                                                         1860 PRINT TAB (X%, Y+1); CHR$ (224)
                                                         1870 PRINT TAB (X%+1, Y+1); CHR$ (224)
1880 PRINT TAB (X%, Y+2); CHR$ (224)
1120 REM SPLIT BARS
1130 MOVE 0, 341
                                                         1890 PRINT TAB (X%+1, Y+2); CHR$ (224)
1140 GCOL 0, 7
1150 MOVE 1280, 682: PLOT 85, 1280, 341
                                                         1900 RETURN
1160 MOVE 1280, 682: MOVE 0, 682: PLOT 85, 0, 341
                                                         1910 VDU 7
1170 VDU 7
                                                         1920 IF INKEY (-99) THEN: CLS: GOTO 1960
1180 IF INKEY (-99) THEN 1220
                                                         1930 IF INKEY (-1) THEN 1960
1190 IF INKEY (-1) THEN 1960
                                                         1940 GOTO 1920
1200 GOTO 1180
                                                         1950 REM CIRCLE
1210 REM HORIZONTAL BARS
                                                          1960 R = 300
                                                         1970 GCOL 0, G
1220 CLS
1230 GCOL 0, 7
                                                         1980 MOVE 640, 512
                                                         1990 FOR A = -180 TO 180 STEP 10
1240 FOR Y = 100 TO 1024 STEP 100
1250 MOVE 0, Y
                                                         2000 X = COS (RAD(A))*R
1260 DRAW 1280, Y
                                                         2010 Y = SQR (ABS(R*R)-(X*X))
1270 NEXT Y
                                                         2020 MOVE 640, 512
1280 VDU 7
                                                         2030 IF A < 0 PLOT 85, X + 640, Y+512 ELSE PLOT 85,
                                                               X+640, 512-Y
1290 IF INKEY (-99) THEN 1330
1300 IF INKEY (-1) THEN 1960
                                                         2040 NEXT A
1310 GOTO 1290
                                                         2050 VDU 7
1320 REM VERTICAL BARS
                                                         2060 RESTORE
                                                         2070 IF INKEY (-99) THEN 650
1330 CLS
1340 FOR X = 1 TO 1280 STEP 100
                                                         2080 GOTO 2070
```

Letters

ALL ABOUT CONTEC SETS

In reply to your request (October issue, page 677) for information on Contec colour sets, these were imported and sold by Dixons shops for some three years until last Christmas or thereabouts. They were made by a firm called Cony in Hong Kong and seem to give good results and reliable service. There are three basic models as follows: (1) A 14in. transportable, Model 8135, with a half-mains chassis and a series switch-mode power supply. This was probably the best of the three. There are very few common faults apart from the two $330k\Omega$ start-up resistors and the tuner (MCES can repair these). It does however have a tendency towards dry-joints and enormous cracks in the print, especially if mishandled – check around the line output transformer.

(2) A 14in. transportable with remote control, Model 3732, which is basically the same as the 8135 except that a single start-up resistor replaces the two $330k\Omega$ resistors.

(3) A 20in. receiver, Model 8250, which has an isolated chassis and a parallel switch-mode power supply, also remote control (clips into the front). There are two common faults. First the single $150k\Omega$ start-up resistor (for a change!). Secondly a defective TA7609 line/field generator i.c. which can be responsible for funny line tearing to ripply pictures to faults that appear to be a.f.c./a.g.c. related – so replace the TA7609 first. Oddly the same i.c. is used in all three models but gives trouble only in the 20in. sets.

Service information for these sets can be obtained from: Mastercare, 653 London Road, High Wycombe, Bucks HP11 1EH (0494 21200).

Spares should be ordered from Mastercare Components, Halifax Road, Cressex Industrial Estate, High Wycombe, Bucks HP12 3UB (0494 33311).

In passing, while the remote control units are different they will operate either set, also some Sony models (and vice versa).

Stephen Denning, Oldfield Park, Bath.

Editorial note: Our thanks to several readers who answered our appeal for help, including B. Sharp, Stephen Howe, L. Bailey, A. Brown and Dave Mackrill. Manuals and spares are also available from Dixon's Service Division, Commerce House, Cartwright Road, Stevenage, Herts SG1 4QD (0438 314371).

Several readers have written to us for a source of spares for **York** TV sets. These are available from Tech-Semco, 176-188 Acre Lane, Brixton, London SW2 5UL (01 733 5588) who tell us that they also stock spares for **Crown, Ingersoll, NEC, Silver, Cap Ten and Murphy** (post Rank production and not VCRs) sets.

HEATSINK ARRANGEMENTS

In the October issue Larry Ingram comments on the way in which the i.c. heatsinks are fitted in various Grundig field timebase modules and suggests that it would be "good practice" to correct the gap between the heatsink and the i.c. body. Heatsinking of the i.c. in this arrangement is accomplished by thermal conduction via the i.c.'s

connection fins which are soldered to the PCB and to the heatsink: the gap between the heatsink and the body of the i.c. is deliberately left to avoid returning the heat to the i.c. There's no evidence that sitting the heatsink on the i.c. will damage it, but as this is not what's intended it's best to leave things as they are.

Steve Beeching, T. Eng., Newark, Notts.

THE G11's HT RESERVOIR CAPACITOR

I was interested to read Alan Turner's letter (November issue, page 28) on the continuing saga of the $470\mu F$ h.t. reservoir capacitors used in the Philips G11 chassis. As an independent wholesaler we are only too well aware of the problem and have been for some years. We also supply the blue LCR type, but the ones we supply have the word "welded" clearly stamped on the casing.

I'd like to point out that a high percentage of substandard components are dumped on the surplus market to be off-loaded at so-called special prices by the less worthy "independent wholesalers". The moral is: it pays to know your supplier!

Bryan Tuckfield, Sales Manager, Willow Vale Electronics Ltd., Reading, Berks.

SOLDERING IRONS AND UNUSUAL FAULTS

Your test report (October) on the Miniscope soldering iron reminds me of a similar type of soldering iron that was used in 1955 when building the prototype of the Ferranti Pegasus computer at the Ferranti computer laboratory in Portland Place, London. These irons had a short bit, about 3/8 in. in diameter, and were very useful when soldering connections to the heater bus bars as a lot of heat in a small area was needed. If the switch was held down for longer than a few seconds with the bit in free air it quickly glowed red – this feature was often used for lighting cigarettes, much to the annoyance of the person using the iron since the bit had to be cleaned and retinned.

Another popular prank was to unplug the supply transformer whilst the iron was in use: as the bit cooled rapidly this usually resulted in the iron being firmly soldered to the bus bar.

Whilst writing, you might be interested in some unusual faults that could occur in most types of equipment.

A Tektronix oscilloscope had an intermittent fault – the trace often became very distorted. With the timebase switched off and no input, the usually finely focused spot looked like three question marks joined together. The fault could sometimes be cleared by pressing on the power supply panel or any of the components on it, but a close inspection and prodding didn't reveal anything amiss. Though dry-joints aren't common in Tektronix scopes we decided to resolder all the connections on the board. After this the fault was no longer intermittent - it was permanent! Another close inspection, using a watchmaker's eyeglass, revealed a small line at the end of a small high-stability resistor - it looked like a crack in the paint. The resistance was measured and the component was found to be open-circuit, though it had previously measured correctly at 270Ω . Resoldering the connections had evidently moved the cracked resistor sufficiently for it to go open-circuit and reveal the crack. Heating the solder to remove the resistor allowed the end to drop off completely. The resistor was connected in the base circuit of a regulator transistor, in series with a 220pF capacitor. It seems that the stabiliser oscillated when the resistor went open-ciruit.

The power supplies were all wrong in another Tektronix scope: it seemed that two supply lines were shorting. All the components and wiring in the relevant area were tested, and nothing wrong could be found with the printed conductors. It was eventually discovered that the short was through the epoxy glass board to a conductor running on the other side of the double-sided printed board. As it was impossible even to see the reverse side of the printed circuit without a major strip down normal working was restored by isolating the small part of the print that was faulty and mounting the two or three small components concerned above the board.

A Gould OS255 double-beam scope had traces that bent downwards at the ends: when shifted to the bottom of the screen they bent up at the ends with a kink in the middle. In this type of scope the brightness and focus controls are at the rear with long steel rods running under the tube to the knobs at the front. These rods had become magnetised: a metal strip supporting the chassis, which runs alongside the tube, and even the metal strip in the carrying handle had also become magnetised. Demagnetising these parts restored a straight trace.

L. Bailey, Carnforth, Lancs.

TIPS ON SINCLAIR MICROS

Following Sinclair's recent price cut I decided to obtain a QL and to connect both this and my Spectrum to the same monitor. I set up a relay to switch between the two feeds but found that the output from my YUV/RGB adaptor (Television, July 1984) didn't match the QL's RGB output. The problem was due to d.c. levels on the outputs and was dealt with by fitting 1N918 (or similar) silicon diodes in series with each output from the YUV/ RGB unit, with $1k\Omega$ resistors to chassis (see Fig. 1), the outputs being taken from across the resistors. Three diodes in series were used in the R and B feeds and six in the G feed. This restored compatibility between the two sets of signals. Otherwise, the monitor's d.c. level controls would have needed adjustment depending on which computer was in use. As the Spectrum has a large border and the QL none, the changeover relay contacts also adjust the width and height by switching in additional resistors.

A useful tip for connecting to the QL's serial port is to use a six-way BT connector (e.g. Cirkit, 97p) instead of buying Sinclair's £15 lead – a bit has to be sculpted off one side to get past the ribs in the QL to prevent its use. If you



Fig. 1: Spectrum YUV/RGB adaptor modification.

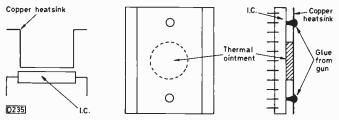


Fig. 2: Adding a heatsink to the Spectrum's ULA i.c.

have a Spectrum with interface 1 and a parallel port you can use it as a serial-to-parallel converter to print from the QL. This saves an additional £40 or so for a new QL serial/parallel adaptor.

Cirkit also sell an eight-pin DIN plug that can be used for the monitor connector to the QL, at 69p against Sinclair's £8 for a monitor lead: the DIN however needs two pins bending slightly for it to fit.

An intermittent fault on the Spectrum was traced to heating of the ULA i.c. Even stroking the i.c. with a finger would remove the fault, so a heatsink was made from copper sheet (see Fig. 2). It was U-shaped, the sides being as long as possible consistent with the space available. It was sanded flat on a belt sander and two holes were drilled at either end. Some thermal contact ointment was smeared in the middle and it was then placed on the i.c.: two blobs on the two holes from glue gun fixed it to the i.c. This procedure cleared the fault, which is just as well as there's no free market in these chips and a replacement would have involved the delay and expense of sending the whole computer back to Sinclair.

John de Rivaz, B.Sc. (Eng.), Truro, Cornwall.

THE SONY KV1810UB

I've now successfully converted several Sony KV1810s to use a BU208 in the line output stage following articles in *Television*. It then occurred to me that it might be possible to use the BTW58-1300R gate-controlled switch, which is available from RS for £2·34 plus VAT (catalogue no. 262-753). This device is rated at 1,300V 6·5A peak, which is a little too critical for line output stage use. It goes a treat in the power supply however and is easy to fit.

My thanks to all those contributors who've made me less wary of Sony sets through their well written articles. *Bob McClenning*,

Tacolneston, Norwich.

TOSHIBA C2095B

The problem with this set, used in conjunction with a T534B remote-control transmitter unit, was that the working range of the remote control unit gradually decreased until it would work only within a foot of the set. The cause of the trouble was found be to the $1,000\mu F$, 16V decoupling capacitor C3 within the handset.

Stephen Howe,

Broughton, South Humberside.

A SAFETY HAZARD

We have received several sets fitted with the new basic Pye/Philips A2 chassis (e.g. Models 2060 and 2600) ahead of the relevant service information. Be warned! The chassis resembles the CTX but is half dead and half live—the live section is the power supply, which is in the corner farthest from the aerial socket. The live area isn't marked in any way and extends to the front half of the divided heatsink. Despite the fact that we were warned about this by a technical rep. one of my colleagues has suffered a severe shock from accidentally touching his hand across both halves of the heatsink while fault finding. It's something that's all too easy to do.

H. Peters,

R. C. Snelling Ltd., Blofield, Norfolk.

	ECC	NO	MIC	: DE	EVIC	CES,	P) E	OX	22	8.	TE	LF	ORI) TF	2 8	QP	
16181 16182	1.04 1.04	2SC1124 2SC1151A	1.26 4.72	2SD348 2SD350	16.13 5.20	AN5435 AN5610	3.08 7.43	BC186 BC187	0.27 0.25	BD222 BD225	-,	0.49 E	8F195 8F196	0.14 0.17	BSR59 BSS38	1.29 0.59	BZX79 RANGE BZY88 RANGE	0.10
16334 16335 16446	0.51 0.80 0.98	2SC1152 2SC1162 2SC1172	4.68 1.05	2SD350A 2SD353 2SD389	2.29 / 7.50 /	AN5612 AN5613 AN6320N	3.41	BC204 BC207 BC212	0.16 0.14 0.11	BD229		1.05 E	3F197 3F198 3F199	0.16 0.17 0.17	BSTBD140G BSTC0146 BSTC0246	2.48	C106D C1129 CA1310E	0.46 0.58 2.70
16600 16799	1.38 2.88	2SC1172Y 2SC1195	2.20 3.26	2SD401 2SD551	3.55 2.42	AN6326 AN6342	3.98 1.61	BC212B BC212L	0.20 0.10	BD232 BD234		0.50 E 0.42 E	3F200 3F216	0.37 0.36	BSTC0233 BSTC1233	6.12 4.34	CA3044 CA3046	3.50 2.06
16801 16802	0.54 1.14	2SC1213 2SC1226 2SC1306	1.46	2SD588A 2SD600 2SD621	3.25	AN6344 AN6363 AN6551		BC212LB BC213 BC213L	0.20 0.10 0.10	BD238		0.45 E	3F218 3F222 3F224	0.36 0.55 0.17	BSTC3146 BSTCC0143 BSTC0643	3.07	CA3060 CA3065 CA3089	1.65 1.29 0.83
16803 16905 17074	5.30 0.86 9.30	2SC1307 2SC1316	1.98	2SD636 2SD657	0.40 2.80	AN6552 AN7115	0.68 2.52	BC213LB BC214	0.19 0.10	BD240 BD241		0.37 E 0.39 E	3F237 3F2 40	0.65 0.17	BSV57B BSW68	3.49 0.60	CA3089E CA3090	1.43 1.38
17127 1N4001	3.51 0.06	2SC1364 2SC1383	1.20	2SD679 2SD731	2.11	AN7145 AN7146 AN7150	2.80 9.90 2.45	BC214L BC214LB BC225	0.1- 0.2- 0.4	BD243		0.50	3F241 3F244 3F2 4 5A	0.17 0.57 0.37	BSX19 BSX20 BSX21	0.34	CA3094 CA3131EM CAH76023N	2.20 3.12 6.60
1N4002 1N4003 1N4004	0.06 0.06 0.04	2SC1398 2SC1410 2SC1413	2.39	2SD787E 2SD811 2SD823	5.54	AN7151 AN7156	2.26 2.78	BC237 BC238	0.1 0.1	BD244 BD244A		0.51 E 0.85 E	3F255 3F256	0.20 0.28	BSY52 BSY79	0.50 0.51	CBF16848N-07 CD4001	1.56 0.38
1N4005 1N4006	80.0 80.0	2SC1505 2SC1578 2SC1617	1.00 8.74 3.89	2SD856 2SD869 2SD898B	7.17	AN7158 AN7218 AP58076	6.75 1.64 4.68	BC238A BC239 BC239B	0.1 0.1 0.2	BD246C		0.89	BF256LC BF257 BF258	0.42 0.34 0.36	BT100A BT106 BT108	1.61 1.18 1.45	CD4002 CD4008 CD4011	0.27 1.06 0.29
1N4007 1N4148 1N4448	0.07 0.04 0.05	2SC1670 2SC1678	3.13 1.98	40408 40594	0.50 1.53	AS560S AU113	1.58 2.97	BC251A BC252	0.1 0.1	BD278A BD317		0.80 I 2.60 I	BF259 BF262	0.34 0.57	BT109 BT112	1.45 2.48	CD4012 CD4013	0.24 0.47
1N5401 1N5402 1N5403	0.14 0.15 0.16	2SC1810 2SC1815 2SC1829	1.70 0.66 2.22	40595 40636 40871	1.43	AY105K AY106 BA130	2.08 1.09 0.14	BC258 BC261A BC262	0.2 0.2 0.2	BD375		0.42	BF263 BF264 BF271	0.57 0.37 0.34	BT113 BT116 BT119	2.48 1.20 1.76	CD4016 CD4017 CD4020	0.45 0.82 1.23
1N5404 1N5408	0.15 0.35	2SC1855 2SC1875	1.88 4.77	40872 60857	1.53 1.21	BA1310 BA1320	1.98 1.38	BC287 BC294	0.5 0.5	BD379 BD380		0.76	BF273 BF274	0.20	BT120 BT121 BT122	2.17 2.48 2.48	CD4021 CD4023 CD4025	0.39 0.28 0.64
1N914 1S44 1S5012A	0.04 0.09 0.81	2SC1891 2SC1893 2SC1929	3.69 3.02 2.25	74LS30 7805 TO-220 7805 TD-3	0.63	BA1330 BA145 BA148 DIOD	2.75 0.19 0.33	BC301 BC302 BC303	0.4 0.5 1.0	BD412		6.27	BF324 BF336 BF337	0.23 0.33 0.36	BT123 BT125	1.98 2.48	CD4028 CD4047	0.84 1.06
1S921 2N1302	0.10 0.27	2SC1942 2SC1945	5.70 4.53	7806 7808	0.73 2.39	BA154 BA156	0.40 0.05	BC307 BC307A	0.1 0.1	BD434		0.49	BF338 BF355	0.40 0.49	BT126 BT128 BT128P	2.48 2.48 3.07	CD4049 CD4050 CD4052	0.46 0.55 0.75
2N1303 2N2218 2N2219A	0.38 0.42 0.40	2SC1953 2SC1957 2SC1959	1.93 0.95 0.31	7812 TO-3 7812 TO-220 7815	1,16	BA157 BA159 BA182	0.22 0.12 0.19	BC308 BC308A BC309	0.1 0.1 0.1	BD436		0.60	BF362 BF363 BF371	0.66 0.60 0.50	TBA970 BT151-800R	3.06 1.15	CD4053 CD4069	0.80 0.29
2N2222 2N2646	0.38 0.80	2SC1962 2SC1969	1.93 2.92	7818 7824	0.70 0.64	BA222 BA284/2	1.66 0.17	BC317A BC327	0.1 0.1	BD438 BD441		1.42	BF391 BF393	0.25 1.59	BT151 500R BTT6018	1.38 2.42 2.51	CD4081 CD4093 CD4511	0.35 0.72 1.10
2N2904 2N2905 2N2906	0.36 0.43 0.38	2SC1985 2SC1983 TF 2SC2009	1.75 7.00 0.34	AC107 AC117 AC123K	0.43	BA301 BA302 BA311	0.87 1.24 1.32	BC328 BC337 BC338	0.1 0.0 0.1	BD507		0.60	BF417 BF418 BF422	0.84 1.87 0.29	BTT6218 BTT8024 BTT8124	4.43 4.89	CP5521 CV12E	17.83 3.07
2N3053 2N3054	0.27 0.99	2SC2029 2SC2027	2.33 1.42	AC128 AC138	0.34	BA312 BA313	0.97 0.76	BC360 BC368	0.3 0.2	BD518		1.50	BF423 BF435	0.29 0.54	BTT8214 BTT8224	5.99 2.97	CX034 CX095D	11.83 3.14
2N3055 2N3055H 2N3442	0.61 0.85 1.16	2SC2028 2SC2057 2SC2073	2.11 1.18 1.54	AC141 AC142K AC151	0.43	BA317 BA318 BA328	0.04 0.09 4.77	BC440 BC441 BC454	1.0 0.4 0.3	4 BD529		1.32 1.10	BF450 BF451 BF457	0.35 0.29 0.41	BU105 BU106 BU108	1.50 2.48 1.50	CX104 CX108 CX109	9.64 8.16 7.86
2N3702 2N3703	0.14 0.14	2SC2078 2SC2091	2.39 1.30	AC153 AC176	0.30	BA333 BA401	1.37 0.64 2.92	BC455 BC460	0.3 0.4	2 BD534		0.53	BF458 BF459 BF460	0.39 0.52 1.56	BU109 BU110 BU111Y	2.25 5.69 4.16	CX121 CX130 CX131	11.83 4.35 11.83
2N3704 2N3705 2N3706	0.14 0.14 0.14	2SC2122A 2SC2141 2SC2166	5.12 1.86 1.98	AC179 AC183 AC187	0.28 0.72 0.39	BA511 (IC) BA521 BA524	2.02 8.94	BC461 BC462 BC463	0.4 0.3 0.6	BD536		0.61 0.74	BF469 BF470	0.31 0.55	BU124 BU126	1.38 0.90	CX134 CX136	11.04 11.49
2N3707 2N3711	0.16 0.11	2SC2216 2SC2233	0.69 2.20	AC187K AC188	0.43 0.37	BA526 BA532	7.98 2.67	BC464 BC465	0.6 0.6 0.3	4 BD544B		0.83	BF471 BF472 BF479	0.31 0.33 0.61	BU134S BU204 BU205	4.57 1.58 1.08	CX137 CX139 CX157	11.83 11.83 4.84
2N3771 2N3772 2N3773	2.04 1.71 2.29	2SC2271 2SC2278 2SC2314	4.01 1:14 0.87	AC188-01 AC188K AC193K	0.44 0.43 0.65	BA536 BA6304A BA843	3.44 2.92 3.96	BC477 BC478 BC479	0.3	2 BD590 1 BD598		1.17 1.25	BF480 BF491	0.60 0.32	BU206 BU207	1.27 1.65	CX158 CX170	4.10 7.62
2N3819 2N3823	0.41 1.17	2SC2335 2SC2526	10.41 1.87 1.26	AC194K AD140 AD145	0.65 1.06 1.60	BAV18 BAV19 BAV20	0.21 0.11 0.11	BC532 BC546 BC547	0.1 0.1 0.1	7 BD679		0.57	BF495 BF506 BF509	0.64 0.43 0.41	BU208 BU208/02 BU208A	1.12 1.97 1.12	CX177 CX506 CX507	6.75 9.33 7.62
2N3904 2N3908 2N4101	0.62 0.62 1.33	2SC2570	2.39 1.05	AD149 AD161	0.90 0.56	BAV21 BAX12	0.34 0.11	BC548 BC549	0.°	0 BD681 0 BD695		1.48 2.30	BF523 BF594	0.20 0.27	BU208D BU209	1.95 1.93	CX755 CX758	12.95 7.62
2N4240 2N4444	3.30 0.90	2SC2578 2SC264A	6.75 4.82 1.99	AD162 AD262 AF114	0.45 1.05 2.47	BAX13 BAX16 BB119	0.11 0.11 0.17	BC550 BC556 BC557	0.º 0.º 0.º	6 BD697		3.60	BF595 BF596 BF597	0.27 0.18 0.27	BU226 BU312 BU326	2.45 2.38 2.00	01693 DEC1 DEC2	2.59 2.20 2.20
2N4914 2N5064 2N5293	0.72 0.71 0.50	2SC2728 2SC2785	0.95 0.75	AF115 AF117	1.24 0.50	BC107 BC107B	0.13 0.11	BC558 BC559	0.° 0.°	0 BD699 0 BD700		3.49 3.70	BF617 BF618	1.05 1.05	BU326A BU326S	2.20 2.20	E1222 E5024	0.40 0.28
2N5294 2N5296	0.50 0.49	2SC373	1.40 1.16 1.33	AF118 AF127 AF139	1.20 0.50 0.53	BC108 BC106B BC109	0.15 0.15 0.12	BC560C BC635 BC636	0. 0. 0.	6 BD707		3.70 1.06 1.12	BF694 BF757 BF758	0.22 0.59 0.65	BU406 BU407 BU407D	1.49 0.82 1.00	E5386 E5529 E8021	0.25 0.25 1.29
2N5297 2N5298 2N5490	0.50 0.61 1.49	2SC388 2SC394V	0.50 0.81	AF178 AF179	1.45 0.55	BC109B BC113	0.15 0.14	BC637	0.	4 BD710 0 BD807		0.80 0.34	BF759 BF760	0.47 0.65	BU412 BU426	5.29 1.90	E9003 E9005	0.46 0.50
2N5496 2N6107	0.59 0.59 1.58	2SC41 2SC458 2SC495	2.19 0.34 0.92	AF180 AF181 AF182	0.55 0.53 0.55	BC116A BC119 BC126	0.25 0.36 0.20	BC639 BC640 BC879	0. 0. 0.	10 BD809 14 BD810 19 BD879		0.75 0.69 0.74	BF870 BF871	0.75 0.30 1.81	BU426A BU500 BU508A	1.67 1.95 1.89	ESM432C ESM532C ESM632C	4.60 4.60 4.60
2N6109 2N6122 2N6130 2N6133	1.36 1.76 0.72 1.25 0.73 0.73	2SC508 2SC515A 2SC536 2SC537	3.70 1.85	AF186 AF239	0.53 0.53	BC132 BC135	0.14 0.14	BC880 BCX32	0.1 0. 0.	BD880 BD895		0.79 2.31	BF900 BF959	0.83 0.42	BU526 BU608D	2.02 1.57	ESM732C ETTR6016	4.60 2.65
2N6133 2N6178 2N6180 2N696 [†]	1.25 0.73 0.73	2SC536 2SC537 2SC568	0.29 0.54 3.69	AF279 AL100 AL102	0.88 4.03 5.69	BC138 BC139	0.18 0.34 0.28	BCX34 BCX37	0. 0. 0. 0. 0.	0 BD901 7 BD902		2.31 2.48 0.79 0.84 1.26 1.26 1.75	BFR39 BFR52	0.44 0.50	BU826A BUV46	0.94 1.63 3.53 1.24 3.06 1.39 0.95 0.13	FT3055 GF758	5.78 1.16 0.84
2N698	0.43 0.43	2SC605L 2SC620	1.16 1.46	AI 103	5.69 2.68 1.36	BC140 BC141	0.45 0.34	BCY70 BCY71	0. 0.	BDV64B		1.26 1.26	BFR62 BFR79	0.50 0.29	BUV84 BUW81A	1.24 3.06	GF759 GF761	1.13 1.20 1.82
2N707 2SA1027 2SA1076	0.43 R 0.45 1.96	1 250684	1.23 4.40 1.65	AL113 AN115 AN155 AN206	3.98 1.89 2.58	BC142 BC143 BC147	0.34 0.33 0.08	BD115 BD116	0. 0. 0. 0.	6 BDX53 70 BDX53A		1.75 1.25 4.93	BFR86 BFR89	1.08 1.63	BUX84 BY126	0.95 0.13	HA11211 HA11215	2.53 5.06
2SA329 2SA351	0.40 1.17	2SC685A 2SC693	2.89 0.63 0.69	AN208	3.55 2.28 2.26	BC147A BC148	0.12 0.13 0.13	BC638 BC639 BC639 BC889 BC889 BCX32 BCX33 BCX37 BCY70 BCY71 BCY71 BC115 BD116 BD124 BD131 BD131	+KIT 0. 0.	BDX53B BDX54B		4.93 3.35 2.61 1.96	BFT41 BFT42	1.81 0.83 0.42 0.69 0.44 0.50 0.50 0.29 0.50 1.08 1.63 0.30 0.43	BY127 BY133 BY164	0.13 0.11 0.47	HA11223W HA11225	0.00 4.29 8.71
2SA489 2SA490 2SA493	1.17 1.67 1.05	2SC717 2SC717 2SC734	1.20 1.43 1.16	AN214 AN214Q AN231 AN234 AN236	2.40	BC148C BC149	0.11 0.11	BD 133	0.	12 BDX63A 53 BDX64A		1.96 2.61	BFT84 BFW10	0.40 0.60 0.34	BY176 BY179	1.52 1.42	HA11229 HA11235	2.88 2.48
2SA628 2SA637	1.14 1.46	2SC735 2SC782	2 47	AN234 AN236	5.92 3.33 6.79	BC149B BC153 BC154	0.13 0.14 0.14	BD135 BD136 BD137	0. 0. 0.	6 BDX65A 6 BDX76 8 BDX70	1	2.61 0.59 1.21	BFX29 BFX30 BFX84	0.34 0.65 0.37	BY184 BY187	1.05 0.47 0.77	HA1124 HA11244 HΔ1125	5.25 2.82 4.29
2SA673 2SA683 2SA684	1.27 1.61 1.33	2SC806 2SC814	1.27 11.29 1.39 0.28	AN239 AN240P	5.88 1.72	BC157 BC158	0.14 0.10	BD138 BD139	0. 0 .	6 BDY62/0 34 BDY81)1	4.62 1.18	BFX85 BFX87	0.41 0.55	BY189 BY198 BY201/2	1.76 1.62 1.50	HA11251 HA1137W	4.47 2.87
2SA748 2SA818 2SA835	1.00 1.83	2 2SC828 2 2SC867A 2SC876	0.28 3.04 n.se	AN241 AN245 AN247P	5.88 1.72 1.71 4.49 4.22	BC116A BC119 BC126 BC135 BC135 BC137 BC138 BC139 BC149 BC141 BC142 BC143 BC147 BC147A BC147A BC147B BC148B BC148B BC149B BC149B BC153 BC153 BC153 BC153 BC153 BC154 BC153 BC154 BC155 BC156 BC165 BC16	0.16 0.40 0.28	BD140 BD144 BD150	0. 1. 0.	37 BF115 43 BF117 75 BF118		0.40 0.66 0.67	BF762 BF870 BF871 BF909 BF959 BFR59 BFR52 BFR62 BFR62 BFR79 BFR81 BFR81 BF124 BF144 BF144 BF145 BF145 BF145 BF145 BF145 BF146 BF146 BF147 BF148 BF148 BF148 BF149	0.34 0.44 0.32	BY203/20 BY206	0.41 0.17	ESM432C ESM532C ESM532C ESM532C ESM532C ESM532C ESM532C ETTR6016 FND500 FT3055 GF758 GF758 GF759 GF759 HA11211 HA11211 HA11225 HA11225 HA11225 HA11229 HA11225 HA11235 HA1124 HA1124 HA11251 HA11251 HA1137W HA1137W HA1137W HA1138 HA1141 HA1144 HA1150 HA1160 HA1160 HA1160 HA1160 HA1160 HA1166 HA1166 HA1166 HA1166 HA1166	5.03 5.65 5.65
2SA940 2SA951	2.50 1.81 1.20	1 2SC901 6 2SC926A	3.04 0.96 4.55 1.42 0.54 4.13	AN252 AN253	2.57 2.97	BC167 BC168	0.36 0.36	BD157 BD159	0	57 BF121 53 BF123		0.25 0.13	BFY52 BFY90	0.27 0.61	BY208 BY210-400	0.22 0.46 0.18	HA1144 HA1156	7.87 1.16
2SA966- 2SB325 2SB375	Y 1.10 3.81 3.81	6 2SC930 7 2SC935 7 2SC936	0.54 4.13 5.25	AN262 AN272 AN281	1.98 7.92 6.53	BC170 BC171	0.16 0.16 0.11	BD163 BD165	0	60 BF127 71 BF137 62 BF152		0.13 0.29 0.31	BR100 BR101	2.20 0.22 0.70	BY210-600 BY210-800 BY223	0.27 0.34 0.85 0.99	HA1160 HA1166X	9.00 3.80 5.36
2SB400 2SB407	0.44 3.24	0 2SC937 4 2SC940	5.25 3.58 4.68	AN295 AN301	5 52	BC172 BC172B	0.10 0.27	BD166 BD168	0	42 BF153 73 BF154		0.31 0.58 0.26	BR101 BR103 BR88B	0.66	BY224-400 BY225-100	0.99 1.13	HA1166 HA1167	1.55 5.36
2SB411 2SB511 2SB54	3.3 2.5 1.3	0 2SC982 0 2SD1051 9 2SD1128	0.70 0.75 2.25	AN302 AN303 AN305	5.55 3.99 4.39 8.88	BC174B BC177	0.17 0.27 0.20	BD177 BD179	0	43 BF157 43 BF158 49 BF159		0.33 0.18 0.18	BRC116 BRC1330	00 0.97 0.67 1,76	BY226 BY227 BY228	0.25 0.49 0.60	HA11713 HA11714	20.16 8.13 7.76
2SB56 2SB618/	1.3 2.8 2.2	0 2SD1138 2 2SD1265	0.94 0.76	AN313 AN315	3.41 2.46 5.53	BC178 BC179	0.26 0.26	BD135 BD136 BD137 BD138 BD139 BD144 BD150 BD159 BD160 BD165 BD165 BD166 BD168 BD165 BD168 BD177 BD177 BD177 BD181 BD182 BD183 BD183 BD183 BD183 BD183 BD183	0	99 BF167		0.31 0.38	BRC4443	2.01 1.02	BY255 BY298	1.07 0.20	HA11713 HA11714 HA11714 HA11715 HA11724 HA11725 HA11738 HA1180 HA1192 HA1196	8.13 8.13
2SB681 2SB695 2SB75	3.9 1.9 1.0	6 2SD1398 8 2SD1453 4 2SD198	2.25 0.75 3.87	AN316 AN318 AN320	6.20 5.47	BC182 BC182 BC182B	0.09 0.11 0.26	BD184 BD187	1	99 BF173 21 BF177 53 BF178		0.34 0.55 0.40	BRC5296 BRC6109	1.02 0.77 0.83	BYW56 BYX10	0.60 0.34 0.29	HA11725 HA11738	22.25 18.26 22.25
2SB861 2SC1034	0.8 6.7	5 2SD234 2SD235	0.49 0.60	AN331 AN337	4.59 5.37 1.17	BC182L BC182LB	0.10 0.14	BD189 BD190	0	69 BF179 69 BF180		0.36 0.36	BRC82 BRC83	1.08	BYX55-350 BYX55-600	0.53 0.15	HA1180 HA1192	5.15 0.00
2SC1050 2SC1061 2SC1096 2SC1104	5.0	6 2SD257 6 2SD291 6 2SD292	0.75 2.25 0.94 0.76 2.25 0.75 3.87 0.49 0.60 2.94 2.94 2.59	AN238 AN249 AN240P AN241 AN245 AN247 AN253 AN262 AN272 AN281 AN281 AN301 AN302 AN302 AN305 AN305 AN316 AN316 AN316 AN320 AN320 AN327 AN331 AN305	1.17 5.98 1.75	BC169C BC170 BC171 BC172 BC172B BC173B BC174B BC177 BC178 BC182 BC182 BC182 BC182 BC182L BC182L BC183L BC183L BC183L BC183LB BC183LB BC183LB BC183LB	0.10 0.11 0.26	BD202 BD203	0	Section Sect		0.32 0.34 0.39	BR88B BRC-M-3 BRC116 BRC1300 BRC300 BRC4443 BRC4444 BRC5296 BRC6109 BRC82 BRC83 BRC84 BRC84 BRX449 BRY39 BRY55	2.08 0.60 0.53	BYX71-600 BYX71-350	GE 0.18 1.25 0.72	HA1196 HA12005 IN HA1203	7.43 9.00 1.72
2501106	4.5	8 2SD313 4 2SD315	2.94	AN5111 AN5132	2.92 4.39	BC184 BC184L	0.13 0.14	BUZUI	0	79 BF185		0.43 0.39	BRY55 BRY56	0.69 0.67	BYX94	0.14	HA1306 HA1308	2.26 6.95 2.18
2SC1114	6.7 OU DON'T	SEE IT U	0.91 ISTED AS	AN5250 K FOR QU	2.89 JOTE. GI	BC184LB VE MAKE I	0.26 MODEL			23 BF194 MEMBER	R TO	0.14 ADD 0		0.50 ST & HA		1.20 DD 15%		

E	CC	IONO	MIC	C D	EVI	CES.	P	O B	OX	228,	T	ELF	ORI) TI	F2 8	BQP	
HA1338 HA1339 HA1342	7.50 2.33 2.65	M1130 M191 M193	5.35 6.32 18.55	NE646N NE650N NE654BN	2.98 4.34 4.18	SAS560 SAS560S SAS560T	1.85 1.65 5.42	SN76620 SN76622 SN76623	2.59 1.65 0.69	TA7109 TA7120P TA7122B/P	3.71 0.64 0.92	TC4053BP TCA150 TCA160B	4.34 1.79 1.79	TDA2611AQ TDA2612Q TDA2620	2.98 4.68 1.96	TIP30C TIP31A TIP31B	0.40 0.34 0.38
HA1350 HA1365 HA1366WR	3.27 4.02 1.86	M51102L M5115P M51231P	6.35 5.24 3.04	NP1106 0A200 0A202	5.61 0.11 0.11	SAS570 SAS570S SAS570T	1.78 2.61 5.42	SN76630 SN76640 SN76651	2.55 4.24 1.49	TA7124P TA7130P TA7136AP	2.34 1.27 1.27	TCA270Q TCA270S TCA270SQ	1.71 2.15 1.65	TDA2630 TDA2631 TDA2640	1.96 2.73 2.59	TIP31C TIP32B TIP32C	0.50 0.69 0.40
HA1367 HA1368 HA1368R	4.32 1.90 2.45	M5124P M5134-9341 M51394P	4.82 4.13 11.97	OA47 OA90 OA91	0.14 0.08 0.09	SAS580 SAS5800 SAS590	2.85 2.89 2.85	SN76660N SN76665N SN76666N	2.48 1.49 1.41	TA7137P TA7141AP TA7146P	0.98 3.87 4.23	TCA290A TCA420A TCA440	2.39 2.16 1.93	TDA2643 TDA2651 TDA2652	12.12 2.95 6.95	TIP33C TIP34 TIP41A	0.80 1.18 0.49
HA1370 HA1374 HA1374A	3.71 8.80 8.80	M5142P M5143P M5144P	5.49 7.33 3.77	0A95 0C28 0C29	0.09 2.52 2.15	SAS5900 SAS660 SAS6600	2.56 2.97 1.33	SN76705N SN76707N SN76709	1.34 4.39 5.12	TA7148P TA7149P TA7161P	1.67 3.26 5.45	TCA4500A TCA530 TCA640	2.15 2.16 10.26	TDA2653 TDA2654 TDA2655B	5.65 4.73 5.44	TIP41B TIP41C TIP42A	0.31 0.45 0.49
HA1377 HA1389	3.96 2.39	M51513L M51515BL	2.55 3.23 3.95	0C35 0C36 0C44	1.06 1.28 0.35	SAS660S SAS6610 SAS670	1.33 1.33 3.96	SN76709N SN76730 SN76810N	5.45 5.36 0.60	TA7162P TA7169 TA7171P	2.59 9.54 2.79	TCA650 TCA660B TCA730	2.04 3.30 3.81	TDA2660 TDA2661 TDA2670	2.47 2.47 2.48	TIP42B TIP42C TIP47	0.79 0.53 0.65
HA1389R HA1392 HA1394	2.05 3.90 3.95	M51516L M51517L M5152L	3.71 2.88	0C45* 0C75	0.18 0.44	SAS6700 SAS670S	1.33 1.33	SN76920N SN94041 SN94042	2.90 5.54 4.35	TA7172P TA7176P TA7193AP	1.41 2.48 6.67	TCA740 TCA750 TCA800	2.48 2.25 5.95	TDA2670A TDA2680 TDA2690A	1.94 3.20 2.65	TIP48 TIP49 TIP55A	0.92 3.61 3.65
HA1397 HA1398 HA1406	3.76 3.98 2.07	M51522 M5191P M5192	5.39 4.94 2.20	ON188 ON236 OT112	1.87 1.06 1.08	SAS6710 SAS6800 SAS6810	1.33 2.53 1.43	SP8385 STA441C	0.55 2.75 5.54	TA7193P TA7201P	7.26 2.71 2.47	TCA830S TCA900	5.95 2.38 2.04	TDA2780AQ TDA2790Q TDA2791		TIS43 TIS90 TIS91	1.34 0.28 0.29
HA1452 HA17723 HBF4030AF	1.63 5.94 2.48	M5194AP M53273P M53274P	5.74 1.02 1.33	OT121 PD144 PT2014	1.32 2.24 3.04	SBA550B SBA750 SC9488P	2.15 1.61 2.09	STK0029 STK0039 STK0050	5.35 7.67	TA7202P TA7203P TA7204P	2.18 2.16	TCA910 TCA940E	1.65 2.93 3.89	TDA2795 TDA3000T TDA3030A	2.78 2.55 11.49	TMS1000NL TMS3748HS TMS4116	11.86 16.13 2.06
HD38750A53 HD4480 HD44801A05	8.71 17.16 17.49	MA06 MA8001 MB3705	1.07 0.82 1.81	PT5006 PT6042 R1038	2.48 1.79 2.19	SC9503 SC9504P SC9511P	1.65 1.95 2.09	STK0059 STK0080 STK011	7.13 9.16 3.96	TA7205 TA7206P TA7207P	1.38 6.25 3.34	TCE330 TCE527 TCE82	1.86 1.08	TDA3190 TDA3300B	2.68 6.47	TV106 TY6010B U05G	1.76 2.97 1.14
HEF4001P HEF4001BP HEF4011	0.67 0.67 0.29	MB3712 MB3713 MB3730	1.85 1.69 3.25	R1039 R2008B R2009	2.19 1.33 1.98	SCR957 SG264A SG608	1.33 5.26 5.26	STK013 STK014 STK015	9.25 8.84 7.75	TA7208P TA7210P TA7214P	2.15 3.58 3.63	TCE83 TCE84 TCEP100Q	1.08 1.08 10.25	TDA3500 TDA3501 TDA3506	4.25 7.25 9.98	U143M U37003	3.08 0.49
HEF4528 HM6231 HM6232	0.00 9.81 8.89	MC13002 MC1303P MC1307P	6.22 2.16 1.92	R2001B R2029 R2030	1.33 1.33 1.33	SG613 SG629 SG6533	8.75 8.27 10.31	STK016 STK022 STK025	6.91 5.25 12.50	TA7215P TA7217AP TA7222	2.58 1.37 1.95	TCEP100 TD190 TD3F700H	9.61 0.95 6.60	TDA3510 TDA3520 TDA3521	6.55 9.71 13.39	UA723CA UA758PC UA783P3C	5.53 5.29 3.38
HM9102 HM9104 HM9105	3.22 3.24 3.24	MC1310P MC1327P MC1330P	1.30 1.33 1.69	R2257 R2265 R2305	2.38 1.49 1.18	SI-1125HD SI1125H SKE2F 1/04	13.86 7.50 1.39	STK040 STK043 STK054	8.70 10.48 7.13	TA7227P TA7229P TA7233P	2.81 4.45 3.67	TD3F800H TD3F800R TD3F900H	4.96 3.66 4.16	TDA3540 TDA3560 TDA3561	2.98 5.00 6.50	UAA170 UAA180 ULN2165	2.31 2.36 1.49
HT4207 ITT2003 K174YP	17.16 0.22 3.46	MC1349P MC1350P MC1351P	0.99 1.21 1.33	R2306 R2322 R2323	1.36 0.59 0.76	SKE2G 2/04 SKE2G 3/04 SKE4F 1/02	0.95 0.99 1.39	STK070 STK077 STK078	22.31 7.67 8.52	TA7240AP TA7245P TA7314	7.83 7.50 5.94	TDA1003A TDA1005A TDA1006A	1.79 2.22 1.69	TDA3561A TDA3571A TDA3571Q	7.50 6.24 2.83	ULN2204 ULN2216F UPC1009C	7.70 2.15 6.32
KA2101 KC581C KC582C	2.92 6.32 3.97	MC1352P MC1357P MC1358P	1.12 2.15 1.30	R2348 R2354A R2354B	2.01 2.01 2.01	SKE4F 1/06 SKE4F 2/06 SKE4F 2/08	0.73 0.85 0.86	STK082 STK086 STK2101	11.86 13.59 6.32	TA7325P TA7609 TA7676P	1.15 3.17 2.81	TDA1010 TDA1011 TDA1028	1.15 2.40 2.45	TDA3576 TDA3590 TDA3590B	7.09 6.79 1.54	UPC1001H UPC1026C UPC1028H	2.75 1.24 2.00
KC583C L129V L200CV	5.54 0.25 1.69	MC14001 MC14013 MC14016CP	2.40 0.41 0.84	R2441 R2443 R2461	0.49 0.88 1.50	SKE4F 2/10 SKE4G 2/02 SKE5F 3/10	1.24 0.96 1.60	STK2110 STK2230 STK415	7.33 7.70 7.70	TAA300 TAA310A TAA320A	2.97 1.16 1.27	TDA1029 TDA1035T TDA1034B	4.89 2.55 2.42	TDA4050A TDA4180P TDA4260	3.47 1.92 1.54	UPC1020H UPC1025H UPC1032H	2.77 2.90 0.62
LA1111AP LA1201 LA1210	0.88 1.02 1.56	MC14011 MC14025 MC14049UBC	0.26 0.60 0.58	R2477 R2501 R2540	1.02 1.28 1.98	SL1310 SL1327E SL1430	3.14 1.33 1.39	STK433 STK435 STK436	4.95 5.94 7.21	TAA350A TAA435 TAA550	0.80 1.82 0.37	TDA1037 TDA1037D TDA1041	2.95 3.25 2.16	TDA4280 TDA4290 TDA440	7.20 4.47 4.90	UPC1030H UPC1031H UPC1031H2	2 <i>.27</i> 4.50 6.00
LA1230 LA1320 LA1352	2.87 2.87 1.54	MC1438R MC14493P MC14556BCP	1.05 2.82 3.47	R2540X R2615 RC4195NB	3.30 0.67 2.16	SL1430T SL1432 SL414	2.31 2.25 3.69	STK437 STK439 STK441	7.80 8.31 11.28	TAA570 TAA611B12 TAA621AX1	1.74 1.30 2.00	TDA1044 TDA1047 TDA1054M	2.62 4.10 1.21	TDA4400 TDA4420 TDA4422	2.27 3.95 8.32	UPC1154H UPC1156H UPC1185H	1.93 2.96 2.94
LA1357N LA1363 LA1364	11.07 6.21 3.02	MC1712 MC7724CP MC7818C	3.88 3.49 2.18	RCA16083 RCA16029 RCA16334	5.30 2.01 1.02	SL432A SL437 SL439	3.44 7.43 2.48	STK443 STK459 STK460	10.29 9.40 10.75	TAA640 TAA661B TAA700	4.24 1.00 2.59	TDA1059B TDA1060 TDA1082	0.80 2.59 3.06	TDA4430 TDA4431 TDA4432	4.78 2.27 2.27	UPC1182H UPC1186H UPC1181H	1.82 1.05 1.25
LA1365J LA1378 LA1385	3.44 6.52 1.94	MC7824CP MC78M12	4.68 0.83	RCA16335 RCA16600	1.36 1.38 2.38	SL480 SL490 SL901B	3.14 2.37 8.32	STK461 STK463 STK465	9.68 11.53 10.31	TAA840 TAA930 TAA970	2.50 4.87 2.83	TDA1104 TDA1151 TDA1170	5.61 1.17 2.37	TDA4400 TDA4600 TDA4610	2.87 2.84 3.11	UPC1213C UPC1217C UPC1212C	0.99 2.47 1.72
LA1387 LA3155 LA3300	7.60 1.25 1.54	MC78M24 MCR100 MCR101	0.94 0.38 0.67	RCA16799 RCA16801 RCA16802	0.95 1.08	SL917B SL918A SN16861N-07	11.96 9.07 2.72	STK466 STR441 STR453	11.77 9.45 8.16	TAD100 TAG232-600 TAG626-600	2.52 0.73 1.06	TDA1170S TDA1180 TDA1190	3.25 3.25 2.11	TDA4620 TDA5500 TDA5700	4.46 2.73 2.31	UPC1351C UPC1353 UPC1350C	1.81 7.85 1.07
LA3301 LA3350 LA3361	1.41 1.43 1.23	MCR106/5 MCR220/7 ME0402	1.57 2.28 0.17	RCA17028 RCA17074 RCA17376	2.48 6.60 1.58	SN16880N SN16965 SN16966N	3.63 8.95 10.25	STR6020 T6007V T6007	8.31 0.95 0.62	TBA120 TBA120A TBA120AS	1.05 1.05 1.24	TDA1190Z TDA1200A TDA1220	2.48 1.43 1.95	TDA9400 TDA9403 TDA9503	2.92 5.15 2.92	UPC1355C UPC1362 UPC1365	2.13 7.75 7.10
LA4030P LA4031P LA4032P	4.20 3.20 2.35	ME0404 ME0404/2 ME0411	0.26 0.47 0.28	RCA60857 RGP10 RT402	4.95 0.50 1.58	SN29715N SN29716N SN29717N	6.04 3.66 7.19	T6016 T6017 T6018V	0.40 0.72 0.72	TBA120S TBA120SB TBA120T	1.05 1.05 0.95	TDA1230 TDA1235 TDA1270	3.23 3.88 3.76	TDA9513 TE527 TE538	5.44 1.38 0.40	UPC1366 UPC1360C UPC1458	7.14 4.51 8.66
LA4050P LA4051P LA4100	1.57 1.79 1.25	ME0412 ME4102 ME5458	0.24 0.50 10.02	RT905A S0280 S0281	2.38 2.14 2.14	SN29722 SN29723AN SN29744N	11.95 7.65 2.29 1.38	T6021 T6022V T6026	0.40 3.92 0.98	TBA120U TBA1440 TBA1440G	2.50 2.03 7.20	TDA1327A TDA1327B TDA1330	1.50 1.82 1.76	TE626 TEA1002 TEA1009	1.49 3.47 1.86	UPC2022 UPC30C UPC32C	1.48 2.51 4.94
LA4101 LA4102 LA4112	1.30 2.81 4.83	ME6002 ME6102 ME8001	0.26 0.28 0.29	S1299 S175 S2062D	4.74 31.48 2.07	SN29764AN SN29767 SN29770BN	4.98 4.24	T6027 T6028V T6029V	0.81 0.39 4.86	TBA1441 TBA240A TBA395	1.62 3.99 1.10	TDA1365 TDA1412 TDA1420	6.99 1.05 1.52	TEA1020SP TEA1087 TIC106C		UPC41C UPC554C UPC558C	4.10 1.85 4.04
LA4125 LA4138 LA4140	2.25 3.38 1.15	MED411 MJ2501 MJ2955	0.75 3.30 0.99	S2800 S2800D S2802	7.73 5.54 3.47	SN29771BN SN29772BN SN29773	4.93 4.91 2.51	T6032V T6033V	0.98 0.60	TBA3950 TBA396 TBA400	1.10 0.80 2.39	TDA1470 TDA1512 TDA1670	2.90 2.89 4.48	TIC106M TIC116 TIC44	0.77 2.07 0.72	UPC566H UPC572 UPC575C2	2.95 3.87 2.40
LA4192 LA4220 LA4400	3.65 1.62 2.25	MJ3000 MJ3001 MJ3028	2.37 1.69 2.65	S3702S S3703F S3707	5.21 5.21 4.32	SN29770AN SN29791 SN29845	2.25 1.67 2.36	T6035V T6036 T6037	0.73 0.67 2.11	TBA440P TBA480	2.45 1.57 1.30	TDA1770 TDA1905 TDA1908	6.85 1.76 3.20	TIC45 TIC47 TIP120	0.77 0.77 1.06	UPC576H UPC577H UPC587C2	2.58 0.76 1.34
LA4420 LA4422 LA4430	1.72 1.72 1.47	MJ481 MJ802 MJE2955	1.53 5.45 1.89	S40W S551 S552	10.89 4.54 4.54	SN29848 SN29861 SN29862	1.66 2.29 2.29	T6041V T6044V T6045 T6049	0.73 0.95 1.20	TBA480Q TBA510 TBA520 TBA520Q	1.37 1.84 1.68	TDA1940 TDA1950 TDA2002	1.95 3.80 0.90	TIP110 TIP112 TIP117	0.53 0.88 0.95	UPC592H UPD1514C UPX27C	1.13 8.32 2.18
LA4460 LA4461 LA4520	2.32 2.95 2.15	MJE3055 MJE340 MJE520	1.65 0.49 0.49	S6080B S6087AR SAA1020	8.80 4.90 4.76	SN72709 SN75110N SN76001ANQ	0.44 0.83 1.65	T6052V T6058 T6059	1.45 0.87 0.59 1.16	TBA530 TBA5300 TBA540	1.30 1.30 1.15	TDA2003 TDA2004 TDA2006	1.75 2.27 1.55	TIP120 TIP121 TIP126	0.55 0.87 0.73	X0022CE X0035TA X0056CE	4.04 5.11 5.11
LA5112N LA7020 LA7025	2.65 7.33 8.05	ML231 ML232B ML237B	0.99 2.15 2.51	SAA1021 SAA1024 SAA1025	4.76 2.81 4.40	SN76003N SN76013ND SN76013N SN76013NDG	5.54 2.48 3.99 8.90	T8001V T9003V T9005V	1.20 0.95 2.38	TBA540Q TBA550 TBA550Q	1.15 4.50 4.50	TDA2010 TDA2020 TDA2030	1.85 2.77 1.99	TIP127 TIP2955 TIP29A	1.43 0.86 0.46	X0062CE X0065CE X0096CE	6.52 4.78 4.29
LA7027 LA7800 LA7801	9.35 2.65 4.15	ML238 ML741CS ML923	5.77 0.59 3.30	SAA1050 SAA1051 SAA1061	4.16 5.83 3.61 4.86	SN76023N SN76023ND SN76023ND SN76033N	2.59 3.50 2.68	T9010V T9011V T9013V	0.62 0.49 7.96	TBA560C TBA560CQ TBA570	1.40 1.60 1.60	TDA2140 TDA2150 TDA2151	1.59 6.20 1.93	TIP29B TIP29C TIP3055	0.63 0.40 0.60	X0109CE X1074AF XC9494P	9.90 7.00 1.33
LB1274 LC4011B LD3120	3.08 1.24 1.13	ML0926 MM5314N MM5316N	3.58 4.02 3.96	SAA1075 SAA1082 SAA1121	8.85 4.43	SN76105N SN76110N	0.54 0.90	T9014V T9016 T9034V	1.68 1.02 1.38	TBA570A TBA570Q TBA625A	1.71 1.35 2.17	TDA2160 TDA2161 TDA2190	4.01 1.85 3.43	TIP30A TIP30B	0.41 0.70	Y730 Y969	0.05
LM1011N LM1017N LM1111	3.46 3.41 4.29	MM5318N MM5369N MM5387AA/N	3.11 2.01 1 16.20 6.49	SAA1124 SAA1130 SAA1174 SAA1250	3.25 4.99 7.77 3.96	SN76115AN SN76131 SN76226DN SN76227N	1.61 1.92 1.98 0.75	T9035V T9038V T9051	1.39 9.42 4,29	TBA625B TBA625C TBA641BX1	2.17 2.17 1.89	TDA2520 TDA2521 TDA2522	2.37 3.71 1.50			ble with	
LM1303P/N LM1310P/N LM1877	1.65 1.38 10.92	MM5841N MP8112 MP8113	1.49 1.49	SAA1251 SAA5000	4.98 4.02 5.39	SN76228N SN76231 SN76242	3.27 2.55 5.23	T9053V T9054V T9057V	1.40 0.75 0.70	TBA641A12 TBA651 TBA673	4.13 1.76 2.45	TDA2523 TDA2524 TDA2525	3.13 4.50 3.90	1		nse 9″ × answeri	
LM3065N LM317CKC LM339N	0.85 1.38 0.80	MP8512 MPF256C MPS6570 MPSA42	1.57 0.60 0.48 0.65	SAA5010 SAA5012 SAA5020 SAA5030	5.39 4.50 5.78 8.25	SN76242 SN76243 SN76322 SN76360	5.23 2.77 2.17	T9063V TA5814 TA7020P	3.24 1.49 4.80	TBA7000 TBA720 TBA730	2.00 2.50 2.14	TDA2530 TDA2532 TDA2533	2.70 2.50 2.30		nachine	available ours	
LM3407 LM340T5 LM340T12	1.42 0.83 0.64	MPSA42 MPSA56 MPSA92	0.85 0.27 0.45 0.86	SAA5040A SAA5050	16.23 7.74 1.98	SN76390 SN76396 SN76510N	3.08 2.90 1.05	TA7027 TA7050 TA7051	4.80 1.74 1.74	TBA750Q TBA760 TBA780	2.90 1.71 1.65	TDA2540 TDA2541 TDA25450	2.15 2.48 5.94		0902 -	712083	
LM340T5 LM342N LM342P 12V	0.83 0.62 1.62	MPSU05 MPSU10 MPSU55	1.56 0.99	SAA661B SAA700 SAB1009B SAB1046P	3.30 4.99 4.03	SN76532N SN76533N SN76530P	0.91 2.47 1.57	TA7060AP TA7061AP TA7069	0.71 1.27 3.13	TBA800 TBA810AS TBA810S	1.08 1.00 1.61	TDA25700 TDA2571A TDA2575A	2.17 3.66 0.50			ess and aycard	
LM342P 15V LM342P 5V LM348N	1.62 2.15	MR510	0.60 1.33 0.67	SAB3011 SAB3012 SAB3013	4.03 7.34 5.88 5.61	SN76546N SN76540N SN76540N	3.47 1.98 1.98	TA7070P TA7071 TA7072P	3.13 1.68 3.69 2.57	TBA820M TBA890 TBA900	0.82 1.61 2.48	TDA2576A TDA2577 TDA2581	2.85 3.70 1.69		custo	omers	
LM380N LM384N01 LM567CN	2.80 3.25 1.43		0.21 0.51 0.51	SAB3021 SAB3022B SAB3023B	7.90 13.58 12.30	SN76544 SN76546 SN76549	2.89 1.65 2.59	TA7073P TA7074P TA7076P	5.86 1.98 7.50	TBA920 TBA9200 TBA940	1.89 2.31 1.87	TDA2582 TDA2590 TDA2591	2.18 2.50 2.50		DOST	ueries by only	1.
LM8360 LM8361	1.82 3.22 2.97	MVS460-02 NE555	0.34 0.61 0.38	SAB3024 SAB3209	6.36 5.23 3.49	SN76550 SN76551 SN76570	0.37 1.49 3.08	TA7089M TA7089P TA7092P	1.56 1.50 6.84	TBA950 TBA970 TBA9700	1.55 1.79 3.28	TDA25910 TDA2593 TDA2594	0.83 2.47 3.08	Plea	se ask fo	f 100+ per r special qu ovt. Instituti	ote.
LM8361 M1024 M1025	3.57 2.81 5.17		0.95 3.48 1.33	SAB3210 SAF1031 SAF1039 SAS5010	2.53 3.35 8.39	SN76600 SN7660N SN76611	1.21 0.00 2.59	TA7093P TA7102P TA7108P	3.99 5.88 1.61	TBA990 TBA9900 TBA231	1.82 1.68 2.57	TDA2600 TDA2610 TDA2611A	5.50 2.79 1.25		ls, Nation	als etc., acc cial order.	
M1124 REGIS1	2.80 TEREC	OFFICE	3.35 THE :								231	, IUNDIIN	123	•	All g	oods should be d	lelivered lays.

Servicing the NordMende FC25 Chassis

Pete Saunders

Foreign TV sets first started to come into the UK in large quantities in the early seventies. One foreign manufacturer who supplied sets to a number of rental companies at that time was NordMende of W. Germany. They were predominantly large-screen sets fitted with the FC25 chassis, which was designed to drive a 110°, delta-gun tube. Although the sets are now about ten years old they still have quite a modern appearance, with touch tuning and slider controls.

The chassis is split into two main sections. The vertically mounted section on the left-hand side contains the tuner, i.f. strip, colour decoder and audio amplifier. It's easy to remove by unscrewing two large winged bolts: it can then be hung on two screws set into the side of the cabinet for servicing. The front panel, which incorporates the touchtuning assembly and slider controls, is also secured by two winged nuts and is equally accessible. The horizontal chassis contains the power supply and the line and field timebases: it slides out on metal runners and can be tilted at 90° or 45° leaving both sides free for servicing. The convergence panel is hinged centrally to the top of the cabinet and can be swung up for access.

Power Supply Arrangements

The power supply (see Fig. 1) is fairly straightforward in design and produces stabilised 210V and 185V outputs. Various other supplies are obtained from the line output stage.

The mains input goes via filter choke L531 and the surge limiter R532 to diode D532 and the regulating thyristor D538 which produces 210V d.c. across the reservoir capacitor C539. This voltage depends on the thyristor's firing point, which is controlled by the trigger transistor T501. When the set is switched on D531 rectifies the a.c. fed to its anode via R531, producing about 10V d.c. across C540. This is applied as bias to the emitter of T501 which produces a pulse waveform at its collector to fire D538. As a result some 60V is developed across C539. This voltage appears at the cathode of zener diode D543 which comes into operation, increasing the voltage at the emitter of T501 to 33V. The bias applied to T501 is thus increased, advancing the thyristor's firing point to produce 210V across C539. We thus have a soft-start action.

T501's base samples the mains input and the h.t., via R534, R537 adjusting the output voltage for 185V. An active filter circuit employing D559, T505 and T506 is used to reduce the hum content to an acceptable level. Some models have an over-voltage subpanel fitted.

The other main supplies in the set are a 28.5V line which is produced in the conventional manner by the action of the EW diode modulator, a 26.5V line (U2) which is obtained from the 28.5V line via an RC filter, and an 11.5V rail (U3) which is obtained from the U2 line via a simple series regulator circuit employing T203 (BC140). Fig. 2 shows the l.t. supply arrangements. The tuning voltage is derived from the U1 rail, and the RGB output stages are fed from the U4 supply via an RC filter. In later models fuse V410 (2AT) is included in the 28.5V line and fuse V415 (2AT) is present in the heater supply

which includes a rectifier circuit D417 (BY196)/C417 $(1,000\mu\text{F})$. The 12V supply for the line oscillator panel is obtained from the U1 supply via R401 (3·3k Ω , 9W) with stabilisation by D590 – R401 is the centre one of the three stand-up wirewound resistors directly behind the first anode supply presets on the bottom chassis.

Dealing with a Dead Set

I always make a point of isolating the line output stage by simply disconnecting plug three on the bottom chassis. If you have no h.t., low h.t or mains fuse blowing with plug three out the fault is almost certainly in the power supply. The thyristor D538 can go short-circuit to blow the fuse: I've used the good old BT106 or BT116 as a replacement for the original BSTC type and have had no failures. T506 and C539 can also go short-circuit. A point to note is that a short-circuit on the U1 rail may not always blow the fuse. If the mains fuse is intact and there's no h.t. it's still worth checking for a short-circuit across the U1 rail. If the U1 rail comes up when plug three is disconnected the fault is in the line output stage.

If the U1 rail isn't present when plug three has been disconnected, first check whether the surge limiter resistor R532 (2.5Ω , 27W) is open-circuit. It's the smaller of the two green power resistors mounted vertically on the bottom chassis. Also check the top section R539 (15 Ω , 15W) of the fusible green power resistor (R539/R404). Still no joy? Then check, by substitution if necessary, T501 (use a BC187), T505 (BC174), D543 (ZTK33) and R531 (27k Ω , 2W). I've had these components measure o.k. but fail under load. Still dead? Measure D531 and D533 (1N4148). A scope check is very useful here. Fig. 3(a) shows the waveform that should be present at the junction of R531/D531/D533 and Fig. 3(b) the waveform that should be present at the collector of T501.

Incorrect HT

Excessive h.t. is normally caused by D543. Low h.t. (60V) will be the result when R542 goes open-circuit. Low h.t. together with "motor boating" signifies a very loaded U1 rail. Disconnecting plug three will usually return the U1 supply to normal. If the power supply is still not operating correctly, unplug the overvoltage trip panel near the smoothing block: if the U1 supply returns to normal you've a faulty trip panel. The panel has been removed on many of the sets we've encountered.

Line Timebase Faults

If the U1 rail is being pulled down or the fuse blows and the power supply is not at fault, inspect the condition of the BU208 line output transistor's mica washer. If this is in order, disconnect the tripler. The tripler and the line output transformer both fail occasionally. Before suspecting them however remove the horizontal shift transformer U416: this often has short-circuit turns or shorts to the core. The set will work with U416 disconnected but the line shift control will be inoperative.

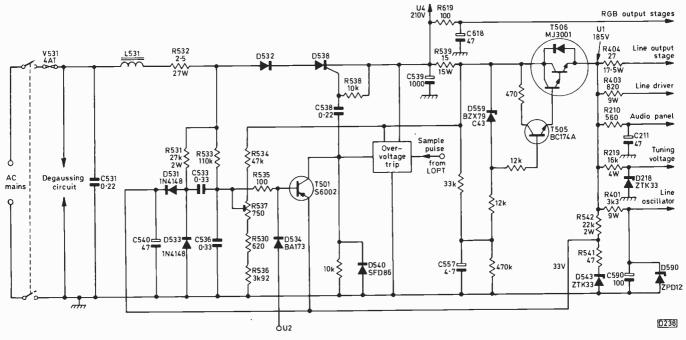


Fig. 7: The regulated power supply circuit used in the NordMende FC25 chassis. R403 and R404 are fusible resistors.

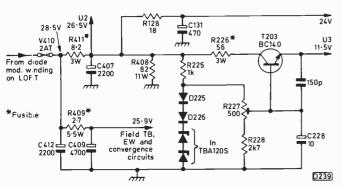


Fig. 2: L.T. supply arrangements.



Fig. 3: Waveform at the junction of D531/R531 (a) and at the collector of T501 (b).

The dead set symptom will be present when R401, the $3.3 k\Omega$ stand-up flame proof resistor on the bottom chassis, is open-circuit since the line oscillator will be inoperative. I've experienced no trouble with the line driver stage but focus problems are fairly common – usually caused by R416 (11M Ω) which is connected between the tripler and the focus control. It changes value and quite often has a burn mark around it. The focus control itself (R418, 12M Ω) causes intermittent focus trouble. R413 (47M Ω) and R421 (33M Ω) are also worth checking. I've found the tripler to be a not so common cause of focus problems. On occasions R416 goes completely opencircuit, the result being no brightness at all.

Width faults are fairly common. The usual causes of reduced width are the EW modulator driver transistor T410 (BD234) going open-circuit or C415 (0:047 μ F) leaky. If the problem is not due to either of these check whether the flyback tuning capacitor C408 (0:0091 μ F, 1.5kV) is open-circuit. If T410 repeatedly fails replace

C415. Excessive width is the result of T410 or one of the MR854 EW modulator diodes D414/5 going short-circuit – BYX71-600 diodes tend to be more reliable.

The EW modulator diodes can also go open-circuit. As a result the U2 voltage falls and there's a blank raster, no sound, lack of height and no channel indicators.

R525 (150k Ω) high-resistance or open-circuit causes flyback lines – it's in series with the first anode controls.

Field Faults

A class A field output stage with a single SM5 transistor (T406) is used. It doesn't usually cause field collapse but can cause height variations during warm up. Use a 2N3055 for replacement purposes. The driver transistor T405 (BC237) going short-circuit is the usual cause of field collapse – with T406 overheating. Poor field linearity is not uncommon: if T406 is not the cause check the field charging capacitors C443 (3.3μ F) and C442 (4.7μ F) by substitution. If you're faced with two or four inches of field scan, then R469 (1.5Ω) is open-circuit.

Now to some less common faults connected with the field timebase. If the picture drops half way down the screen check the field scan coupling capacitor C471 (1,000 μ F). If a set suffers from field jitter after changing channels, fit a 1N4148 diode in series with the base of T406 (cathode to the junction of the base and C447) – if this hasn't already been done. Field collapse or roll when changing channels or when the aerial is unplugged occurs when C433 (0·1 μ F) is open-circuit. Field jitter on ch. 1 only? Check C431 (470pF) and C432 (0·0047 μ F) in the field sync pulse integrating circuit.

The IF Strip

The i.f. strip is housed in a plug-in module and is extremely reliable. The only fault I've encountered here was intermittent loss of picture due to a dry-joint on one of the chokes. Note that removing the i.f. screening can causes detuning and consequent loss of signals: the d.c. conditions can still be used as a fault guide however and

soldering a 6-8pF capacitor across L119 will give a reasonable picture for test purposes.

The Decoder

The decoder is part of the vertical chassis and is of the well-known Philips/Mullard four-chip type (TBA520/530/540/560C) – the TBA540 reference oscillator i.c. and its associated components are on a small plug-in subpanel. It's important to make sure that the decoder is fitted with a TBA560C and not a TBA560 otherwise you'll be involved with a curious colour fault – the symptom is that the red output fades and goes spotty when the colour control is turned up. Remember that man-made faults can be the worst to trace!

No colour and the brightness control inoperative is caused by the small choke L313 going open-circuit. Intermittent grey-scale flashing is a common fault on these sets. There are several causes: the BF458 RGB output transistors, the TBA530 matrixing i.c. (IC302) and the 100Ω presets R393/R396/R397. If the fault appears to be on the c.r.t. base however change the c.r.t. socket. I've found that this is a very common fault and that soldering or tightening the socket never seems to work. You can use the base from a Pye 725 series chassis as it's of the same type.

For critical colour tuning check for dry-joints on the burst phase coil L328. Dry-joints also appear on the luminance delay line V322 and the tuner mounting where it solders directly on to the main panel. Chroma breakthrough on monochrome transmissions is usually caused by the TBA540 chip on the subpanel.

Here's a quick way of isolating a no-colour fault on these sets. Measure the voltage at TP42 on the subpanel: it should be 1.1V on a colour and 4V on a monochrome transmission. If you've no colour and 1·1V at TP42, check the colour slider control. If it's faulty replacement means changing all six slider controls as they are contained in a plastic housing – a bit of a tedious job. If the colour slider control is o.k., suspect that the TBA560C i.c. is not producing a chroma output. If there's 4V at TP42 this means there's no burst ripple present. Override the colour-killer by shorting TP31-32 (just below the TBA560C). If there's still no colour, very weak colour or out-of-phase colour, suspect oscillator failure, possibly the TBA540. If there is colour but just out of lock there's no burst or a fault in the a.p.c. loop: replacing the TBA540 seems to cure most of these problems. The ident is incorrect if the voltage at TP42 is 10V: I've found the cause to be the TBA520 i.c. (IC304). If there's only 0.2V at TP42 the bistable has packed up, probably due to the TBA520 again though C384 (0.33 μ F) on the subpanel can go open-circuit.

Having said all this, colour faults are not that common and the decoder is pretty reliable.

Sound Circuits

Crackling sound is usally due to a noisy volume control or the BD129 audio output transistor. This operates under class A conditions and runs pretty hot. Some sets are fitted with an alternative sound panel using a four-transistor circuit with class B output stage. This is more reliable.

The BD129 can also cause no sound. I've also been plagued by intermittent loss of sound: very frustrating since the fault can cure itself for several hours or days in

some cases. First check for dry-joints on the sound output panel and the plugs and sockets relating to the sound circuit. If this fails to find the cause of the problem check the condition of the screened lead to the volume control: replace it if in doubt.

Intercarrier sound buzz and/or distortion can be due to the quadrature coil F180 being off-tune or its parallel tuning capacitor C178 $(0.001\mu\text{F})$ having changed value.

Convergence Faults

If you get any kind of convergence trouble check carefully for cracks in the central area of the panel. For red and green verticals bowing and won't set up, check C804 ($2\cdot2\mu\text{F}$) then T801 (BC237) and T802 (BC307). The only other convergence fault I've encountered is blue droop on horizontals due to potentiometer R863 (250 Ω) going open-circuit: this results in R865 (18 Ω) burning up and D863 (1N4148) going open-circuit since these items are connected in parallel with R866/R863.

Tuning Troubles

In common with many continental sets you may find twin v.h.f./u.h.f. tuners soldered into a plug-in panel mounted on the vertical chassis. Removal is very easy. The u.h.f. tuner sometimes goes low gain but the most common tuner fault is patterning on channel one only. This is due to a touch-tuning fault causing the v.h.f. tuner to remain on and interfere with the u.h.f. tuner. The easiest course is to open-circuit the supply to the v.h.f. tuner by breaking the relevant print leading to the back of the tuner panel.

There's no a.f.c. on these sets, the tuner being very stable. Tuning drift is more likely to be due to the TAA550 33V stabiliser i.c. or zener diode DB30 (ZPD13) on the touch-tune oscillator panel, though the tuner can be the cause of the problem.

Now for a more obscure fault – where the picture drifts off tune when the brightness or contrast control is operated. Check D218 (TAA550/ZTK33) as before then suspect the 33V zener diode D543 in the power supply.

The eight-channel touch-tuning was quite advanced for its time. There are three small plug-in modules behind the touch-tuning board. Two of them contain an SAS560 and an SAS570 respectively for electronic channel selection. The third panel contains an oscillator which puts a 70V peak-to-peak sinewave voltage on the touch plates. Channel selection is achieved by touching one of the plates, thereby momentarily interrupting the oscillator voltage on that plate. This causes the SAS560 or SAS570 to latch to that particular channel.

Faults to look for on these three modules are as follows: Blank raster, no sound and no channel indicators, oscillator transistor TB22 (BC212) open-circuit or shorted turns on the oscillator coil LB22.

Touch tuning sticks on one channel, random channel changing or several channel indicators lit up, suspect the SAS560 or SAS570 i.c.

All eight channel indicators lit up, change CB23 (10μ F) on the oscillator panel.

It's important when working on the touch tuner not to operate the set with any of the following items out of circuit: D218, the tuner panel, and plug X1 (adjacent to the tuner). To do so will usually result in the destruction of the SAS560 or SAS570. In other words this is the result if either the 24V or 33V rail goes missing.

If R128 (18 Ω) on the vertical chassis burns or has burnt up the 24V rail has suffered a short-circuit: DB30 on the oscillator panel is probably short-circuit – watch out that D218, the SAS560 and the SAS570 have not been damaged.

Less Common Faults

Finally a few not so common faults we've had.

Bright raster with flyback lines, no picture but the audio circuit is working, make sure that the U3 (11.5V) rail is present: R226 (56 Ω fusible) just above the i.f. can trips open; other causes are C352 (0.1 μ F) at pin 8 of the TBA530 short-circuit or R619 (100 Ω) which supplies the RGB output stages open-circuit.

A very loud buzzing noise like a demented bumble bee will be due to the mains input choke L531 on the horizontal chassis: it can affect the picture, causing hum on the field.

Finally, to remove residual hum on the supply to the RGB output stages C618 was increased in value from $4.7\mu\text{F}$ to $47\mu\text{F}$ and L618 was replaced by a 100Ω resistor (R619) – these changes are included in Fig. 1.

In Conclusion

So there you have it. A set which after careful attention will give years of trouble-free service. Note that the F IV and FC1 25-T chassis are very similar. The latter is modified in the convergence section to operate with an inline gun tube. The tripler is of the universal type and line output transformers can be obtained from Tidman Mail Order Ltd., 236 Sandycombe Road, Richmond, Surrey. Spares can be ordered through the present UK NordMende agents Hayden Laboratories Ltd., Chiltern Hill, Chalfont St. Peter, Bucks SL9 9UG. (0753 88847).

Desoldering Iron Test Report

Eugene Trundle

Ever since there have been printed-circuit boards there's been the difficulty of removing components from them, especially when these are multi-legged devices. A great variety of desoldering aids has appeared over the years, working on several different principles with varying degrees of success. There was an aspirated soldering iron with rubber pipes and tubes leading off to compressors or pumps; also big, sizzling, branding-iron style bits designed for the removal of particular components, typically a 16pin DIL chip; hollow "poking tubes" made of solderrepellent metal; hand-held solder-sippers with a pretty blue or green finish, working like a spring-loaded bicycle pump in reverse; resin-impregnated copper braid with (hopefully!) a thirst for liquid solder; heat guns which do the necessary by means of a searing-hot stream of air; and so on. Enquiries around our workshop indicate that braid is the current favourite, after long dalliance with the handpump system - the latter's nozzle tends to wear and clogging is something of a handicap.

The Doranuro SA-6

The Doranuro SA-6 electric desoldering iron is a new tool that combines two older ideas. Superficially it looks like a conventional and rather chubby soldering iron. In fact it has a hollow nozzle in place of the bit and a spring-loaded plunger pump in the hollowed out handle section. The business end is kept hot by a 30W heating element, and the pump assembly clicks out for easy cleaning or replacement. The iron is 26cm (10½in.) long and weighs 113gms (4oz). It's made in Taiwan by OK Industries Inc. (glorious name!) and comes with a choice of two nozzle sizes, 1.5 or 1.7mm, and three element voltages, 230, 115 or 24V. The one I had for test was the standard Model SA-6-230 with 1.5mm nozzle and UK mains input.

Operation

Operation is straightforward. You prime the plunger, make sure the nozzle is tinned, then push it over the wire component leg to be desoldered. Press the button and the plunger flies backwards, sucking molten solder up the

hollow nozzle and into the vacuum chamber where it gathers on the face of the piston for later removal. The desoldering operation can be performed with one hand, particularly when working on a horizontal board at table level

On Test

How did it work? I used it on a great variety of jobs over a period of weeks and found that, like the curate's egg, it was good in parts. My first problem was a physical one – what to do with it between sips of solder? There's no stand available from the distributors as yet and its 7cm of shimmering barrel is a bit difficult to stow safely on the bench.

For most desoldering work on PCBs I found that the instrument worked well. By its nature it's best with "pinned" components. It's very good indeed for the removal of line output transformers, conventional i.c. packages and transistors, provided the iron can be positioned at 90° to the board. One of its strongest points is its ability to deal with double-sided PCB joints, where a pin can usually be fully released so long as a reasonably airtight butt joint can be achieved between the nozzle and the panel – and a good heat transfer to the pin established.

There were none of the clogging and jamming problems to which manual solder pumps are so prone, probably because the nozzle and airway are in this case so hot. There was no need to use the declogging wire supplied, and the recovered solder that built up in a conical heap at the front of the piston was easy to remove – at long intervals, because there's plenty of room to accommodate the solder.

There were several desoldering jobs that the SA-6 couldn't cope with easily. For example the wide tags on some large electrolytics, and "heat-spreader" i.c. connections; also the "edge-on" solder joints with Hitachi tuners and ITT and Grundig i.f. modules; and various interboard links. Difficulty was also experienced with very small multipinned i.c. packages such as the syscon chips in the Sony F1 VCR, and with surface-mounted components in

the very latest equipment. I don't mean to slate the instrument – it will effectively deal with say 80 per cent of the desoldering jobs likely to be encountered.

It has to be said however that a fresh length of good desoldering braid, in conjunction with a very hot conventional iron, can in my experience cope with virtually anything. Since the braid has to be kept on hand to deal with the awkward jobs mentioned above I found myself inclined to pick it up for every job, especially when use of the sucking iron meant either keeping it hot, throbbing and idle most of the time or plugging it in and waiting for two or three minutes until it reached working temperature.

Given a straight choice I'd plump for braid, but having seen and tried this instrument I'd very much welcome it alongside as a useful addition to the armoury. Where double-sided print and plated-through holes are likely to be encountered it would soon save its very modest cost of £16 in terms of time and frustration alone! Spare nozzles are available at £2.35 each.

Source

The iron is distributed by Enfield Transformers Ltd., 7 Centenary Estate, Jeffreys Road, Enfield, Middlesex EN3 7UF (phone 01-805 5438 or 01-805 6078).

Signal Strength Meter

Jeff Allan

A signal strength meter is invaluable for ascertaining TV signal levels – it's also useful for showing the customer why the picture is "snowy on TV". Such meters don't appear to be generally available, though Manor Supplies do one in kit form. I decided to see what I could do by way of making my own.

Basic Arrangement

For simplicity and to save on cost and time I decided to use a ready-made tuner/i.f. strip assembly. It so happens that we've recently been scrapping a number of GEC C2110 series colour sets that had previously been out on rental. They are getting to be a bit unreliable - customers have come to expect a higher degree of reliability than two or so breakdowns a year. The tuner/i.f. panel used in this chassis turned out to be a good choice for use in a signal strength meter. The only additional circuitry required (see Fig. 1) is that to provide the necessary voltage supplies and to drive the meter. This circuitry can be built on a piece of Veroboard. Telepanels (52 Mount Pleasant Road, Chigwell, Essex, telephone 01-729 0506) can provide the tuner/i.f. panel at £10 plus £1.50 post and packing. As I used a scrap panel I decided to incorporate in the meter the small sound sub-panel that's mounted on the main i.f. panel. The sound panel is available from Telepanels for an extra £5.

Accuracy

The accuracy of the signal strength meter obviously isn't going to be up to the standard of something for which you'd have to pay ten times more, but it gives a perfectly satisfactory meter-scale reading of 0-5. In addition the panels provide composite video and audio outputs which can be taken off via phono sockets.

Circuit Details

The unit is powered by twelve HP7 batteries which supply the 12V regulator with 18V. The 7812 regulator i.c. converts this to a stable 12V output. LED D4 provides power-on indication and also indicates when the batteries need changing – it goes out when the battery voltage drops to 13.5V.

The 555 timer chip IC1 is connected as a free-running

oscillator whose output at pin 3 is used to drive Tr2. This transistor is switched on and off, producing at its collector voltage peaks which are rectified by D3/C2, with smoothing by R7/C3, to give the 33V tuning supply required. Note that coil L1 and Tr2 are critical components: the types specified in the components list must be used.

Tr1 is connected as a shunt regulator, setting the point at which the meter responds to weak signals.

Construction

Assemble the power supply/meter drive circuits on a piece of Veroboard. Fig. 2 shows the arrangement of the GEC tuner/IF panel, with the sound sub-panel in place. The composite video output is present at pin 2 of plug PL13. This can be taken via screened lead to a phono output socket, with the braid connected to pin 1 of PL13. The audio output is taken from pin 8 of IC181 on the small, vertical sound sub-panel (assuming that IC181 is a TBA800 – take the output from pin 1 when IC181 is an SN76013ND07). The audio is controlled by VR2 which acts on the TBA120SQ intercarrier sound chip IC180. A speaker can be driven from pins 2 and 3 of plug PL9. I found it convenient to mount the aerial input and the output sockets and speaker on the rear panel of the signal strength meter.

The positive terminal of the signal-level indicator meter M1 is connected to pin 4 of the TCA270Q detector chip IC102: the other terminal goes to preset P1.

VR1, VR2 and M1 are mounted on the front panel.

The project can be housed in the box of your choice. I used a BICC-Vero Hi-Style instrument case measuring 220 × 105 × 230mm. This is available from Verospeed (Stansted Road, Boyatt Wood, Eastleigh, Hants SO5 4ZY) under code no. 75-2443A. At the time of writing the price is £21-98 inclusive of post and packing but not VAT (at 15 per cent). This case has the advantage of being fitted with a handle/tilt foot that can be locked in several positions. Those who are proficient at woodwork could use a wooden box with lid.

Setting Up

Before switching on, adjust the a.g.c. delay preset P102 on the i.f. panel fully anticlockwise. The LED should light when the unit is switched on. With a loudspeaker con-

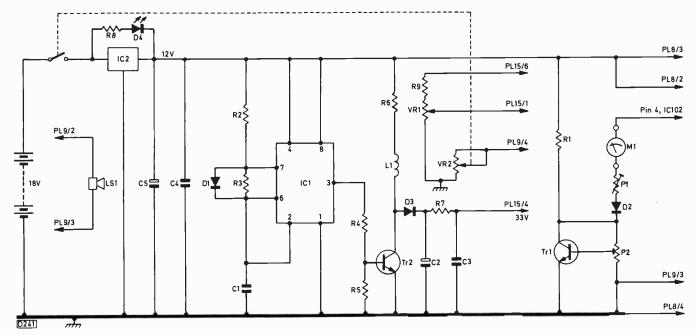


Fig. 1: Circuit of the signal strength meter.

nected, noise should be heard when the volume control is turned up. Plug in an aerial and tune VR1 until a station is heard. If the meter's needle is off the scale, adjust P1 to bring the needle back on to the scale.

Adjust P2 for 2V at the collector of Tr1 then tune the signal strength meter to the strongest station available. Adjust P1 so that M1 reads maximum deflection. Next unplug the aerial from the meter and plug it into a colour set. Attenuate the signal until the picture is just acceptable. Now reconnect the aerial to the signal strength meter and note the reading on the scale. Ideally, it should give a mid-scale reading. If not, i.e. if it reads say too high,

★ Components Resistors:									
	•	R1	4k7						
R2 4k7									
R3 47k									
Capacitors: R4 1k									
C1	4700p polystyrene	R5	330						
C2	1μ 63V electrolytic	R6	2.2						
C3,4	0·1μ 250V mylar	R7	1k						
C5	100µ 25V electrolytic	R8	330						
		P1	47k						
Semio	onductor devices:	P2	4k7						
D1,2	1N4148	VR1	100k						
D3	1N4002	VR2	4k7						
D4	LED		1/4W. P1,2						
Tr1 BC107 subminiature									
Tr2 TIP41A presets. VR1,2									
IC1 555 linear pots									
IC2	7812	VR1 v	vith switch						
Miscellaneous: M1 Maplin LB80B 250μA f.s.d. meter L1 Maplin WH47B 1mH choke LS1 20Ω 70mm speaker Tuner/i.f. panel, case, knobs, sockets, 10346 Veroboard, holder for 12 HP7 batteries.									

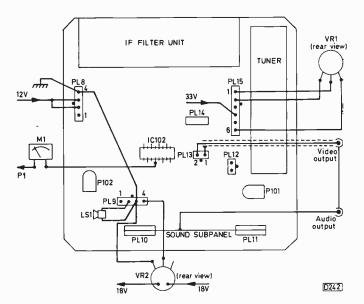


Fig. 2: Connections to the i.f./tuner panel.

readjust P2 for a slightly higher voltage (e.g. 2.5V) at the collector of Tr1 then readjust P1 so that the meter's needle doesn't go off scale with strong signals.

Calibrating VR1 so that the control is near the end of its travel when channel 68 is tuned in might call for the addition of a resistor in the R9 position. Use a suitable value up to $47k\Omega$.

Use

With experience you will get to know what reading on the scale 0-5 constitutes a good, bad or reasonable signal level.

The meter's consumption when in use is high – 170mA! This is mainly due to the tuner/i.f. panel. It shouldn't be a problem if you remember this point.

When armed with this signal strength meter you'll have some authority when you tell a customer that the poor picture on his colour set is due to a poor aerial – after all the signal strength meter can't lie, can it?!

VCR Clinic

Reports from Mick Dutton, Steve Illidge, Steve Beeching, T.Eng. and Eugene Trundle

Panasonic NV333

This machine would replay prerecorded tapes in colour but wouldn't record in colour. Waveform checks in the colour recording circuits revealed that chroma was present as far as the low-pass filter (TP8003) though very little arrived at the input (pin 8) to the record amplifier in IC8001. The voltage at this pin was found to be high: it's linked to the colour-killer stage in IC8003 by D8005 (MA165) which turned out to be leaky.

M.D.

Panasonic NV370

Noisy sound in record was the problem with this new machine. The sound processing is all done within a single i.c. while a second chip (IC4001, type TA7355P) provides switching between record and playback. It was this second i.c. that proved to be defective. It's worth noting that this machine also appears under the Philips and Pye labels.

M.D.

Salora SV8200

The problem with this machine, which is basically the Mitsubishi HS303, was no colour in record or playback. Since there was no sign of a 625kHz signal IC6A0 (HA11741) was first suspected. A replacement was fitted before we discovered that pin 15 was at 0V instead of 3.2V due to C6D1 $(0.22\mu F)$ being short-circuit.

Sony SLF1

I've had considerable problems with a Sony SLF1 portable recorder. It's been to another dealer and also to a Sony service depot in northern climes where "no fault found" was reported. The customer was doing his nut as the fault was very obvious – severe herringbone patterning in areas of saturated colour. We first checked the luminance and chrominance drive levels, which were correct: there then followed several weeks of trying various things. The record amplifier was replaced in case there was crossmodulation between the two carriers, the video heads also in case they were out of specification or something else was amiss. A set of heads sent to us by Sony as underguarantee replacements were themselves faulty, or at least one tip was. As with the previous repairers I was getting nowhere fast, except that the fault was established to be on record. The record drive figures are given as luminance $300\text{mV} \pm 20\text{mV}$ at the slider of RV18 and chrominance $260\text{mV} \pm 20\text{mV}$ at the collector of Q5. By trial and error the patterning was reduced to a reasonable level with the luminance drive at about 450mV, just before the video heads saturated, and the chrominance at about 200mV.

Unfortunately before the customer could collect the machine I had powering-up problems due to C231 on the TTF1 tuner unit failing to provide IC231 with a reset pulse.

S.B.

JVC HR7700/Ferguson 3V23

The complaint was poor still and slow-motion pictures. This was a weird one. When still was selected the tape

sometimes carried on going: when it did respond it went to slow motion, with the picture covered in black spots each time the tape moved! The trouble was that the emitter-follower X21 was feeding oscillations to the motor drive amplifier, hence the spots. The cause? Well, in later production versions of these machines two fusible resistors, R38 and R39, were deleted and replaced with wire links. As a result C75 which decouples the 22V rail on the servo-1 panel was also removed. In this machine the capstan motor, while healthy, was putting spikes on to the 22V rail: these were returning via X21 as positive feedback. Simply replacing C75 cured the fault. Maybe the next one will be easy!

Sony SLC7

The fault here was intermittent poor recordings – it was another time-consuming job, until the fault put in an appearance. We then found that there were no syncs, just spikes – the picture was ragged to. The cause was poor contacts on the TV/camera selector switch.

S.B.

Mitsubishi HS303

The symptom with this machine was black lines overshooting from peak white areas of the picture. They were present only with the machine's own recordings. This was obviously a record fault, of the type normally associated with incorrect setting of the white/dark clip controls. We decided to look into this first and a quick scope check confirmed the diagnosis: adjusting the white clip control produced a cure. The customer had mentioned that the problem was intermittent however, so we left the machine recording. When the tape was played back we found that after about fifteen minutes the recordings had reverted to a similar white clip problem, only much more severe. IC2B0 (AN6310) which amongst other things contains the white/dark clip circuits was then replaced, providing a complete cure.

Guide Rollers

With VHS machines some very misleading symptoms can arise from the effects of what might be called "running faults" in the rotating tape guides at each end of the tape head wrap: lateral wobble and jitter on the picture; closely-spaced near sinusoidal ripples across the picture; booming effect on sound; and usually an acoustic noise from the afflicted guide itself, due to its "shuddering" rotary motion. Whilst almost any machine is vulnerable to this sort of thing we've found it to be most prevalent in JVC/Ferguson piano-key machines, Hitachi VT8000 series machines and Panasonic machines like the NV333. Why does the effect almost always disappear when the top cover is removed?

Panasonic NV366

"Poor picture after cue and review" said the job card. Sure enough there was a good picture in the normal playback and trick modes, but sometimes when reverting to playback from the search or pause mode the picture

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would give every indication of video head problems – flickering, snow and drop-outs. The cause of the problem was the video head switching relays RL3501 and RL3502 on the head amplifier board – a good tap on one or the other of them would clear the problem. Shades of Hitachi models in which sound head switching was done with latchety relays! If ever there was a graphic demonstration of the superiority of solid-state switches over mechanical types this must be it! Very low-level playback signals coming directly from a head are vulnerable indeed to the effects of contact resistance and noise.

JVC HRD120

One of the heads in this very new machine clogged before it got half way through a tape: the picture became progressively more snowy and flickery until it was virtually obliterated. Cleaning the heads provided a temporary cure but regardless of the type and state of the tape used the head clogging would again occur, within an hour at most. After checking the guides for cleanliness and any abrasiveness the head drum was condemned and changed. This cleared the problem.

JVC HR2200/Ferguson 3V24

This combination of a camera and an HR2200 VCR gave us pause . . . The problem was that the VCR would go into the pause mode by itself at random intervals during a recording session. Checks with another VCR proved that the camera was blameless.

Somehow X9, the first pause switch transistor in the VCR, was being made to conduct. With its base and

emitter leads firmly shorted it stayed off and the problem disappeared. A strange varying voltage was found at the base of X9, and at the "outer" end of the series resistor R40. What had happened was that the large "memory" capacitor C11 (3·3F, 1·6V – really a battery cell in disguise!) had gone bad and leaked on to the mechacon (front) panel. The gunge had embraced the control line print track from the camera socket and insidious leakage here was putting a varying voltage on to the pause line. The construction of this panel is such that much dismantling is required to gain access to C11.

JVC GXN70 Camera

We've had several of these cameras in the workshop recently – one with a broken handle pivot (no joke to replace!) and several with dry-joint problems on the Y-C processing board. This is a tightly-packed assembly with a high count of surface-mounted devices (SMDs). The joint problems seem to arise mainly in the luminance channel and can take some finding.

A recent case was a little more serious – no picture at all, but captions o.k. (this one has a built-in caption generator) and good sound. It took us longer than it should to discover that the line output stage was inoperative due to an open-circuit CP601 protection device. A milliammeter connected in its place registered around 400mA and there were strange noises coming from the mini-wound components in the line output stage. The 2SD781 line output transistor (Q602) turned out to be leaky, a replacement restoring normal operation with a current of about 180mA through CP601.

Long-distance Television

Roger Bunney

As September passes the evenings draw in and those hectic sporadic E openings have become but a memory of the recent, past season. There was some Sporadic E reception during September, but the persistent high-pressure systems, particularly towards the end of the month, boosted tropospheric reception. This month's SpE log is as follows:

7/9/85 TVE (Spain) ch. E2; RTP (Portugal) E2, 3; RAI (Italy) IA; unidentified signals on chs. R1 and 2.

9/9/85 NRK (Norway) E2-4; SR (Sweden) E3.

10/9/85 NRK E3.

11/9/85 TVE E2, 3; CST (Czechoslovakia) R1.

12/9/85 TVE E3; SR E3; NRK E3; RAI IA; TVP (Poland) R1.

13/9/85 ARD (W. Germany) E2.

14/9/85 ORF (Austria) E2a.

15/9/85 ARD E2; RAI IA, B; TVP R1, 2; TSS (USSR) R1, 2.

18/9/85 TVE E2; NRK E2.

19/9/85 RAI IA; DFF (E. Germany) E4.

20/9/85 TVE E2-4; ORF E4; ARD E2, 4; RAI IA; NCT (Italian private station) E3; +PTT (Switzerland) E3; DR (Denmark) E3; CST R1; TVP R1, 2.

22/9/85 TVE E2; NRK E3.

25/9/85 CST R1.

27/9/85 CST R1; DR E3; SR E3.

28/9/85 DR E3.

29/9/85 NRK E3; SR E3.

30/9/85 CST R1.

There were two main tropospheric openings during September – unfortunately neither coincided with the International ATV Contest on the 14/15th. The first occurred during the 7-12th, giving widespread reception of French signals in Band III and at u.h.f. throughout much of the UK, with W. German signals present in the Midlands and the southern UK. Unfortunately the opening never really intensified. Excellent reception of RTE (Eire) was maintained on a daily basis in the Midlands and along the east coast during the period. Along the south and south-west coasts excellent reception from a southerly direction was noted, with Swiss stations on chs. E31, 39 and 45 and Spanish signals from Zamora ch. E31, Gamoniteiro ch. E39 and Santiago ch. E45.

A short but intense opening on the 18th produced many

W. and E. German signals in the south, the Midlands and along the east coast. The main sustained high-pressure system arrived on the 24th and persisted into early October, unfortunately with a tendency to sea winds in the south. Thus really long-distance reception was not possible and the period was dominated by French v.h.f./ u.h.f. signals. W. German reception was confined to the 24th, 29th and 30th. There was some Dutch reception and conditions along land paths were slightly better, with various Czechoslovakian stations being noted at u.h.f. Despite auspicious weather conditions this year's September tropospheric reception proved to be a disappointment.

My thanks to Bill Cotteril (Tipton), Roger Pates (Nottingham), Iain Menzies (Aberdeen), Tim Anderson (St. Leonards), Dave Shirley (Hastings), Roger Fussell (Torpoint), Simon Hamer (Powys), Cyril Willis (Downham), Reg Roper (Torpoint) and Ryn Muntjewerff (Holland) for their reception reports. Dave Shirley also reports that from early October the non-scrambled Canal Plus times are: 1745-2035 Saturdays; 1225-1400 and 1745-2100 Sundays; 1230-1400 and 1745-2035 on Mondays, Tuesdays and Thursdays; 1230-1400 and 1745-2100 on Wednesdays and Fridays.

News Items

France/Switzerland: A new ch. E69 transmitter at La Dole is due to come into operation on November 30th with a service area covering a major section of France. Trials were carried out from 0800-2000 CET during September 7-20th with a test pattern and a series of test films. This is to be the first private TV channel intended for reception in France and will have programming biased towards films – it's intended to show up to 400 annually. Scrambling is to be used, with a month's access card costing 20 Swiss francs and initial decoder installation costing 150 Swiss francs. The new station is called Telecine: the PM5544 test pattern carries the identification "Telecine" at the top and "Chaine du Cine" at the bottom.

W. Germany: The two famous aerial companies Fuba and Hirschmann are to form a joint venture to produce and supply 12GHz DBS receiving equipment. It's expected that "realistically priced" equipment will become available later this year or early next year.

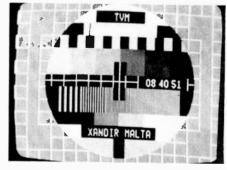
Sweden: The Horby ch. E2 SR-1 transmitter is to close on January 1st.

Iceland: A recently passed bill has broken the RUV monopoly, allowing commercially financed stations to be set up.

In brief: The Djibouti TV service now covers much of the country, using the SECAM system . . . The Yuri-2B satellite is to be launched early next year. It's claimed that







The international flavour of TV news links now available in Europe. Left: ABC news during the Lebanon hostages crisis. Centre: CBS news from Frankfurt – this is an Intelsat half transponder feed received via a 1-8m dish at Potters Bar! Right: The Tele Malta Corporation PM5544 test pattern, received by Mel Thurlbourn on ch. E10 at 10kW.

the overheating problem that led to the failure of two of the three travelling-wave tube amplifiers in the Yuri-2A satellite has been overcome . . . The DTI has given approval for the use of higher-powered cordless phones and more frequencies from 1988 . . . A new service, called channel TV5 or "Media TV", may be set up in S. Africa backed by newspaper interests. The u.h.f. transmissions would be scrambled, with a decoder charge of 36 Rand a month.

New EBU Listings

Holland: Soesterberg ch. E70, 20kW e.r.p. horizontal. This is an American Forces base transmitter operated by the AFRTS, using system M (525 lines). The ch. E70 vision carrier is at 867.25MHz and the sound carrier at 871.75MHz.

Rumania: Turnu Severin ch. R2, 15kW e.r.p. H; Dobrogea Sud ch. R3 15·5kW e.r.p. V; Bucuresti ch. R4 50kW e.r.p. H.

New VHF/UHF Scanner

Lowe Electronics Ltd. of Chesterfield Road, Matlock, Derbyshire DE4 5LE have introduced the AR2002 scanner, a replacement for the famed AR2001. The new scanner covers 25-55MHz and 800-1,300MHz and features wide/narrow band operation for either a.m. or f.m. reception: the 2001's membrane keyboard has been replaced with a positive button keyboard. Perhaps the most interesting feature is a tuning knob. The usual up and down scan buttons at times make for inconvenient manual tuning: the knob gives full coverage in segments relating to the bandwidth selected. The price is rather high at £375 including VAT, but as scanners go this one does represent good value. Send a stamped s.a.e. to Lowe for further details - supplies are expected by late December.

Correction

A couple of readers have pointed out that the clock photograph shown in the September issue (page 642) is the Jordanian, not the Syrian, clock.

New Mono Portable for DXers

Tandy are expected to have available shortly at £90 including VAT (catalogue number 16-9030) a 5in. monochrome portable with v.h.f./u.h.f. tuning and, apparently, system I, B/G and L capability.

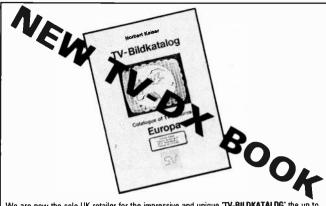
DTI Book

The DTI's new book How to improve Television and Radio Reception is intended as a guide to problems such as interference, ghosting etc. and includes a technical section with information on filters. Highly recommended - it's available free of charge from main post offices.

Penge Effect

Details of a mid-fifties phenomenon known as the Penge Effect (it was generally restricted to the London district of Penge) appeared in the technical press recently. I'd not heard of this before and have now obtained further information.

Until 1956 BBC Television was transmitted from Alexandra Palace. Most readers will be familiar with the famous lattice mast, which was equipped with two aerials arranged in an octagonal formation with eight end-fed dipoles and reflectors behind. The upper aerial was used for the vision signal and the lower one for sound. Subse-



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quently of course vision/sound diplexing combiners allowed both transmitter outputs to be fed to a common aerial. From 1956 Crystal Palace replaced Alexandra Palace, with an even more impressive self-supporting lattice mast. Initially two transmitter sets (a set had one vision and one sound transmitter) were operated in parallel, the output from each being fed to its own array on the mast. Penge lies at the bottom of the hill on which the Crystal Palace mast is sited and thus "looks up" at the

Due to the vertical separation of the two sets of aerials on the mast sharp nulls were produced in the vertical radiation pattern - where the two transmitted signals arrived out of phase there was partial or complete cancellation. The problem was very severe at Penge. It was eventually overcome by using a diplexing arrangement which combined the outputs from the two transmitters on to a common feeder, with splitting again at the roof of the transmitter and separate feeders to the aerials: phase correction was inserted into the transmitter system from reference information at the transmitter rooftop. I'd be pleased to hear from any readers who had experience of the Penge effect or who have any observations to make on the subject. Our thanks to Marconi Communication Systems for providing information.

Stereo Sound in the USA

The progress of stereo TV sound in the USA is slow, with many stations unwilling to adopt stereo, mainly on the grounds of cost. NBC is the only network at present supplying stereo programming: this is limited to a couple of light entertainment shows, certain weekend movies and

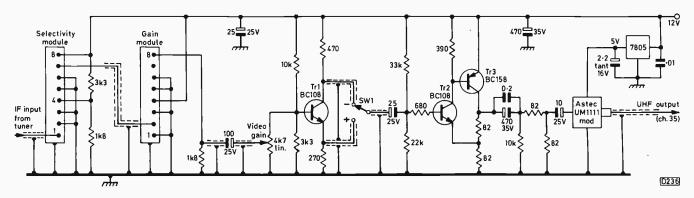


Fig. 1: DX i.f. circuit using G8 modules, with switching for negative or positive vision modulation. The Astec modulator provides an output for feeding to a standard system I receiver.

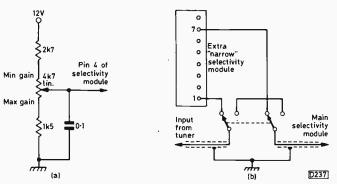


Fig. 2: (a) I.F. gain control circuit. (b) Adding an extra selectivity module with switching to provide narrow or wideband operation. Use a 2-pole, 2-way miniature toggle switch or pin-diode switching.

a few sporting events. Some 33 stations across the country are now transmitting stereo for part of the week, ranging from two hours (WPBT-TV Miami and KATU-TV Portland) to 66 hours (WVJV-TV Boston).

Versatile DX IF System

A query I often get is how to receive French TV pictures without investing in a system L receiver. The problem of course is that French TV transmissions use positive vision modulation while the rest of Europe uses negative vision modulation. It's at present cheap and simple to build a converter unit using the Philips G8 chassis U800 vision selectivity and U300 vision gain modules currently available from South West Aerials these are sold "as new, surplus stock". Fig. 1 shows the circuit devised for the purpose. Provision is not made for reception of the French 6.5MHz a.m. sound since DXers generally prefer to operate with reduced i.f. bandwidth in the interests of better selectivity and signal-to-noise performance. Versatility has been provided by including positive/negative video switching. When used with a varicap tuner, r.f., i.f. and video gain controls can be incorporated, giving a "communications receiver" approach. The demodulated video is amplified and applied to the cheapest Astec modulator available. The output from this, on channel 35, can be fed to the aerial input socket of a standard system I receiver.

No modification is necessary to the Philips modules, which are supplied with screening cans and connections via pins at one end. The output from the varicap tuner goes to pin 1 of the selectivity module, with appropriate connections to the other pins: the i.f. output at pin 7 goes to pin 2 of the gain module, which provides its output at pin 8. In the circuit shown a fixed voltage for maximum gain is applied to the selectivity module's a.g.c. pin (4). A

variable gain control could be used here, providing 3.5V for maximum gain and 8V for minimum gain. Alternatively a simple a.g.c. system could be used.

The output from the gain module is capacitively coupled to the slider of the video gain control which is incorporated in the base circuit of a simple phase inverter stage. Either positive- or negative-going video is selected by a single-pole, two-way miniature toggle switch – note that all feeds are via coaxial cable (due to the low impedances, the feeds can be up to 9in. long). The output from the phase splitter Tr1 goes to the video amplifier Tr2/3 and then to the modulator which produces a high-level output at its phono socket. The i.f. selectivity could be increased by inserting a second selectivity module. Provision should be made to switch this in or out of circuit, using a toggle or pin-diode switching, thus giving selection of narrow or wide i.f. bandwidth.

Alignment of the modules will be required. I've found that they are almost in tune and that only slight adjustment of the cores is necessary. Where a second selectivity module is added to give switched wide/narrow bandwidth this will need to be aligned to reduce the i.f. bandwidth. Once the main selectivity and gain modules have been peaked the additional narrow module can be switched into circuit and aligned for optimum signal resolution on a weak signal. You'll find that two of the four selectivity coil cores have a sharp response while the other two have a very flat response. Align the cores to the peak obtained nearest to the case of the modules, i.e. the outermost peaks. I would suggest applying a.g.c. to the main selectivity module and operating the narrow-band module at fixed gain.

The use of a Band I/III/u.h.f. varicap tuning system is assumed – a suitable circuit was given in the March 1982 issue of *Television*. Sendz Components have a selection of tuner units available.

Physical construction of the unit is not critical though it's sensible to minimise lead lengths. The prototype was constructed on Veroboard with the modules stacked on top of each other to give a very compact converter unit. The G8 chassis i.f. strip circuit was shown in the July 1978 issue of *Television*.

The overall cost is lowish – I'd expect the total for a case containing a power supply, tuner, G8 modules, modulator and a 4in. tuning meter to be not more than £20. There's at present no unit that provides the suggested features on the market. The constructor could of course consider adding a sound selectivity module (U500) to provide sound facilities, though this would necessitate operation in the wideband mode. Comments from constructors of this or alternative systems will be welcome.

Service Bureau

Requests for advice in dealing with servicing problems must be accompanied by a £1:50 cheque or postal order (made out to IPC Magazines Ltd.), the query coupon and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

HITACHI CPT1473

Field collapse was traced to failure of Q681. Since a 2SC1213A was not available I fitted a BC337, which appers to be an equivalent, but the BC337 failed after about four hours. All the voltages around Q681 and the STA441C field output i.c. are correct.

Q681 provides the flyback boost supply, conducting briefly but heavily for the 1msec duration of the flyback stroke to double the supply (in conjunction with D681 and C681). Because of its short duty-cycle, the usual transistor ratings quoted are not an accurate guide to suitability. Only the correct transistor should be used.

FERGUSON 3V00

New heads were fitted about a year ago. Since then the playback picture has gradually become marred by blue crosshatching – this occurs with both own recordings and prerecorded tapes. The crosshatching is present right across the screen and there are also three brighter vertical bars, one at each side and the other about a third from the left. A tape giving a blank raster results in the same symptoms.

Check the four screws that retain the pre-rec board behind the video heads – they must be tight and all screws must be in position. Try retuning the r.f. converter and the TV set to another channel. Note that you'll get this effect if the machine is too close to the TV set. The r.f. converter sometimes produces spurious beats.

TANDBERG CTV2 CHASSIS

There is momentary loss of sound and vision accompanied by a loud click from the rear of the set. This is usually accompanied by a change to channel one if the set is not already switched to this channel. Occasionally the picture becomes very snowy, correcting itself after about half a minute. There is also occasional complete loss of sound. This corrects itself after about five minutes – switching the set off and on again also restores the sound.

The click and loss of normal operation are likely to be due to a spark in the e.h.t. or focus areas. Carefully watch the set's interior in a blacked-out room: a spark may well appear at the e.h.t. tripler, c.r.t. bowl or focus spark gap – clean and/or replace as necessary. For the intermittent snow problem check for dry-joints or bad connections at the aerial socket, on the tuner panel and on the i.f. board before suspecting the tuner itself. Spasmodic loss of sound is a common problem with these sets. It can be due to bad jointing on the control panel but more often the plug/socket system that carries the audio between the main

panel and the front control panel is faulty. A sure cure is to remove the plugs and solder the leads direct to the print.

SHARP VC6300

The picture is all right and speech is normal most of the time. Any music appears to wail however. The motors and pulleys seem to be free enough.

This symptom is generally due to jitter in the rotational speed of the capstan motor. Clean and service the deck, then select record and adjust the capstan lock potentiometer R794 for zero voltage between TP713 and TP717 (this voltage should be 5V d.c. above chassis potential). If the fault persists and the peak-to-peak ripple voltage at TP721 (as observed on an oscilloscope) exceeds 500mV it's likely that the capstan motor is faulty.

HITACHI NP6C CHASSIS

There's intermittent loss of height on this set – about a quarter to half an inch at the top and bottom. Resetting the height control will restore a full picture but the fault returns. There's also a buzz that can't be tuned out by adjusting the tuning buttons – it doesn't seem to be present on all channels.

First check for dry-joints at the connections between the HM6231 field output module and the main PCB. If necessary check the field charging capacitor C603 ($10\mu F$) and the bootstrap capacitor C606 ($10\mu F$) by substitution. If the fault persists, replace the field output module. For the buzz, try careful adjustment of the sound detector coil I.405.

PHILIPS VR2021

The problem with this machine is a dot pattern on all coloured areas of the playback picture, also slight colouring and smearing of the Ch. 4 test pattern frequency gratings at around 4-4·5MHz. The dots seem to run diagonally through the colour: the patterning is not severe but is noticed by the customer. The problem has been lessened but not cured by reducing the chroma record current control setting. A replacement chroma module made no difference, and as the picture is perfectly all right when the incoming off-air signal is played through the video channel the i.f. module would seem to be o.k.

We've noticed this patterning on several of these machines. It seems to be due to a beat between the colour subcarrier and the four DTF frequencies. In a domestic setting the problem is usually made more acute by putting the VCR beneath the TV set, where a two-way interaction takes place. A mild steel plate under the set fixes the latter problem.

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TELEVISION DECEMBER 1985

SERIES REGULATOR TRANSISTORS

We repair a lot of monochrome portables and often find that the series regulator transistor requires replacement. The trouble is the large number of different types in use, often obscure devices in imported sets. Is there something that can be used as a general replacement?

We've found that provided they are properly heatsinked the TIP41 (npn) and TIP42 (pnp) can be used to replace almost any series regulator transistor in a monochrome portable set.

TEST CASE

276

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

Mrs. Tedham – everyone in the Service Department knows Mrs. Tedham. She's been with us for years, and at least one of our greying senior technicians remembers calling on her as a slip of a lad to twiddle all the vision i.f. transformers in her monochrome set in order to get as much gain as possible out of it in the face of the very low received signal strength. "Never mind the definition, let's have a bit of contrast" she'd say.

The years rolled on and Mrs. Tedham graduated to 625 lines then, in the fullness of time, to colour TV. The u.h.f. signal strength was not much greater than with the v.h.f. channels of yore, and they never got to the Montfield valley with a relay transmitter. Mrs. T. is fond of her telly, and to clarify as far as possible the doings of David Bellamy, Annie Sugden and the rest Ace Aerials (motto: We'll Top the Lot) had masterminded a massive installation. With scaffold poles, guylines and an Amplified Ultragain GXL Supersonic Mk V aerial they'd squeezed every microvolt possible from the scant field strength in the valley. In terms of pounds per microvolt it was the dearest in the patch . . .

The resulting pictures were just acceptable, though somewhat dependent on weather and season. When Mrs. T. came to enquire about VCRs our salesman had serious doubts. Could the signal strength justify four hundred and fifty pounds worth of VCR? The machine worked surprisingly well when it was demonstrated, and Mrs. T.'s firm opinion was that replay of its recordings gave better results than off-air reception – in terms of picture grain, anyway. Looking at the picture we had to agree. Perhaps this was a case of history repeating itself – lesser bandwidth, lower noise!

The VCR in question was an ITT VR3905 (Ferguson 3V35), a basic machine with infra-red remote control. The

Service Department's phone started to ring the day after it was installed! "Clocks keep flashing" – our intrepid field technician had to talk her out of a lifelong habit of switching everything off at the wall plugs whenever she went out. "Won't record" – use a cassette with a tab in it Mrs. T. And so on. Several complaints of snowy pictures were put down to the poor signal conditions at the site.

Finally we had to bring the machine into the workshop with an intermittent recording fault. It seemed that manually controlled recordings were all right but timer recordings were virtually unwatchable. The field technician had gone to considerable trouble on site, watching Mrs. T. go through the timer procedure, waiting for the VCR to perk up, and watching the programme in the E-E mode while the recording took place. Playback showed a good recording. Samples of previous recordings were shocking however – full of grain and snow, in fact quite useless.

Nothing showed up on a soak test of course. The machine was programmed and put into a corner each day but the recordings were perfect. The aerial socket and u.h.f. tuner were subjected to all kinds of indignities without detriment to the r.f. gain. Back it went to Montfield Vale, back it came to us. It's currently with Mrs. Tedham, and she and her VCR are in perfect harmony, nestling under their great landmark of an aerial mast. Timed recordings are fine – better in fact than live off-air programmes. So what was the problem? See next month.

ANSWER TO TEST CASE 275 - page 47 last month -

Last month's tale of woe concerned a troubled salesman and a Mitsubishi set with teletext and other features. Like many modern sets the CT2627TX has a sweep-tuning system, with the facility for automatic station tuning. When it's in the search mode the set should stop at each active broadcast channel and await instructions (manual mode) or commit the carrier frequency to memory for as many broadcasts as it can find (auto mode). This set was not stopping at any point though the signals were there to be had, and could be seen as bursts of unlocked lines at intervals during the sweep process. It was the unlocked condition of the displayed picture information that provided the clue. The attention that had been directed at the self-seek (ETS) board had all been futile, as the Real Technician at once realised.

The sweep tuning process, which consists basically of generating a long ramp voltage for the varicap tuner, comes to a halt when a time-coincidence between off-air sync pulses and the line flyback pulses is detected (in IC7202 on the ETS panel); that's to say, when the line timebase is locked to the incoming signal. For this to work the flywheel phase-locked loop has to get its act together quickly. If not the brakes in the sweep-seek department fail to come on and the search goes on and on.

So all R.T. did was to adjust the line hold control – VR502 on the main PCB. John then took the set back to the customer and completed the sale.

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3652 THORN 3K 3K5 EHT TX 3651 THORN 3K 3K5 6172 PHILIPS GB SPECIAL	8.95 2907 T3500 THICK FILM VID LOAD 8.96 4563 T38000 MAINS ON/OFF SW. 7.85 4412 T4000 FOCUS CONTROL UNIT	1.40 4334 GRUNDIG TELEPILOT 8 RCU 3.10 4357 KORTING 12 CHANNEL RCU 7.60 4358 KORTING 16 CHANNEL RCU	29.03 2983 PHILIPS G11 CVC32 B/CDIL 22.13 2984 PHILIPS G11 E/W CORR CDIL 22.50 2985 PHILIPS G11 FILTER CDIL	1.92 6039 T3V31 T/U LOAD/RING ASSY 2.73
2868 PHILIPS KT3	10.95 3273 T6818 220K BRIGHT CTRL 2909 T8500 FOCUS CONTROL UNIT	2.18 4380 PHILIPS G11 NDNTEXT RCU 2.56 4378 PHILIPS G11 T/TEXT 8CH RCU	19.29 2986 PHILIPS G11 FOCUS UNIT 20.78 2987 PHILIPS G11 G2 CONTROL ASSY	8.48 6044 T3V32 BDOSTER 32.37 7.98 6048 T3V32 CAPSTAN BELT 1.74
EHT TRAYS 5400 BG1895-641 5403 BG1897-642	7.50 2911 T8500 MAINS CHOKE	17.45 5409 PHILIPS G11 T/TEXT U/SONIC 12.75 5453 PHILIPS KT3 REMOTE RC4001	24.50 4575 PHILIPS G11 RNO SHAFT SH. 16.00 4576 PHILIPS G11 SQ SHAFT SWITCH	2.32 6053 T3V32 CASS MOTOR ASSY 9.45 2.32 6066 T3V32 LOADING GEAR ASSY 6.60
5404 BG2097-642/333 3663 DECCA 100	7.50 2910 T8500 PLASTIC CUT OUT 7.50 2918 T9000 FOCUS UNIT	3.72 4379 PHILIPS/PYE G11 2 FUNC RCU 3.95 4359 PHILIPS/PYE KT3/KT30	18.90 4645 PHILIPS G11 TDA2600 HOLDER 16.13 5284 PHILIPS G8 100K TUN P/SET	0.65 6068 T3V32 PINCH ROLLER ASSY 8.66 0.84 6071 T3V32 SERVICE MANUAL 18.50
3665 DECCA 1830 3662 OECCA 80	3.09 2919 T9000 OVER VOLT THICK FILM	1.65 4385 RBM 16CH NONTEXT RCU 3.95 4386 RBM 8CH NDNTEXT RCU 13.75 4387 RBM TEXT&V/DATA RCU	19:20 2977 PHILIPS G8 10K COLOUR CTRL 19:20 4525 PHILIPS G8 10K CON POT (550) 20:78 4524 PHILIPS G8 15R CON POT (550)	0.84 6071 T3V32 SERVICE MANUAL 18.50 0.98 6072 T3V32 SUPPALDG RING ASSY 2.50 0.87 6081 T3V32 UPPER DRUM ASSY 35.54 1.07 6085 T3V336 BRAKE PAD X2 0.67
3667 GEC 1028/CS108 3677 ITT CVC45	7.95 4982 T9600 0.33 2KV CAP 7.95 4982 T9600 0.37 2KV CAP	13.75 4387 RBM TEXT&V/DATA RCU 2.35 2980 REMOTE CTRL UNIT PHILIPS G9 17.65 4390 TCE 9000CHAS 2 FUNC RCU	20.78 4524 PHILIPS G8 15R CON POT (550) 8.97 2975 PHILIPS G8 2K2 BRIGHT CONTL 20.24 4526 PHILIPS G8 2H A1 POT (550)	0.85 6086 T3V35/6 BRAKE SHOE 0.67
3675 ITT CVC5/9 3678 KORTING HYBRID	7.95 2916 T9600 FOCUS UNIT	2.95 4396 TCE TX10(9653)+TEXT RCU 9.98 4400 TCE TX10(9670)+PREST RCU	20.78 4522 PHILIPS G8 5N1 1500V CAP. 20.78 4523 PHILIPS G8 5R CONV POT (550)	1.88 6090 T3V35/6 CAPSTAN MOTOR 23.91 6.64 6091 T3V35/6 CASSETTE MOTOR 6.93
3683 PHILIPS 550 GB 3681 PHILIPS 570 (5 LEAD) 3684 PHILIPS G9	9.00 2917 19600 SWITCH MUDE IX 1511 9.00 2917 19800 FOCUS UNIT 4429 19800 MAINS CHOKE	5.93 4397 TCE TX9/TX10 0.00 PUSH BUTTON UNITS	19.20 4858 PHILIPS G8 6×4" 7OR SPKR 2979 PHILIPS G8 EQUALIS, COIL	5.98 6103 T3V35/6 PINCH ROLLER 9.84 2.25 6105 T3V35 REMOTE CONTROL 19.43
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6p 6p 6p 6p 6p 6p 7p 7p 16p 18p	9p 9
BD537 BD538 BD675 BD676 BD677 BD678 BD679 BD680 BD681 BD682 BDX32 BDX32 BDX65 BDY92 BF180	BC337 BC338 BC557 BC733 BC733 BC744 BC746 BC741
38p 40p 40p 40p 38p 40p 40p 45p 45p 45p 100p 100p	6p 6
BFR79 BFR90 BFR91 BFX29 BFX84 BFX85 BFX87 BFX88 BFX88 BFY17 BFY18 BFY41 BFY50 BFY51	BF184 BF185 BF196 BF197 BF196 BF197 BF296 BF296 BF296 BF296 BF296 BF297 BF296 BF297 BF296 BF297 BF297 BF297 BF297 BF297 BF297 BF297 BF397
21p 25p 52p 99p 20p 20p 15p 15p 15p 40p 28p 40p 28p	20p
OC45 OC71 OC72 OC200 R2008B R2010B TAG4443 TAG4444 TIP29 TIP29A TIP29C TIP30 TIP30C TIP31A	BFY57 BFY64 BFY94 BFY96
50p 30p 50p 180p 100p 100p 76p 76p 15p 22p 25p 25p 30p 24p	100p 80p 100p 120p
ZTX326 ZTX500 ZTX501 ZTX501 ZTX502 ZTX503 ZTX504 ZTX550 2N.696 2N.697 2N.698 2N.706A 2N.706A 2N.708	TIP32A TIP32C TIP33 TIP34 TIP32C TIP33 TIP34 TIP41A
29p 13p 13p 18p 18p 25p 24p 22p 40p 45p 22p 22p 22p 22p 22p 22p 22p	24p 28p 50p 50p 50p 22p 25p 25p 25p 25p 25p 25p 25p 25p 25
BY133 BY164 BY176 BY179 BY182 BY184 BY187 BY196 BY206 BY207 BY208 BY210 BY223 BY225 BY225	2N.1131 2N.1132 2N.17132 2N.17101 2N.27101 2N.2101 2N.2102 2N.2102 2N.2202 2N.2203 2N.2203 2N.2203 2N.2203 2N.2203 2N.2203 2N.2203 2N.2203 2N.2203 2N.2203 2N.2203 2N.2203 2N.2203 2N.2203 2N.2
8p 40p 85p 32p 32p 32p 11p 11p 11p 18p 22p 72p 120p	28p 22p 24p 24p 24p 24p 24p 24p 24p 24p 24
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PC97 PCC85 PCF80 PCF200 PCF801 PCF802	p 7824 p 7825 p 7915 p 7916 p 7916 p 7917 p 7917 p 7917 p 7918 p
46p 50p 55p 180p 100p 42p 88p 110p 67p 115p 100p 54p 63p	C 520p 1190p 1190p 215p 670p 50p 50p 50p 50p 50p 40p 44p 44p 44p 44p 44p 43p 40p 43p 40p 43p 57p 57p 57p 57p 57p 57p 57p 57p 57p 57
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BA511A BA514	£1.80 HA11713 £1.75 HA11714	£6.00 LA7800 £5.75 LA7806	£1.95 STK5451 £2.50 STK5720	£6.75 UPC571 £6.80 UPC573C	£2.20 UPC1370C	£1.95 2SC945	20.35 2SJ50	€4.00		anese 1.6s. As we have imported
BA521	£1.75 HA11715	£6.25 LC7120	£3.50 STK5730	£6.75 UPC574J	£0.35 UPC1373H	£8.75 2SC1034	£3.75 2SK19	₹0.58		r 10 years. cking and then add 15% to total
BA527	£1.50 HA11716	26.25 LC7130	£3.50 TA7045M £3.75 TA7050P	21.30 UPC575C 20.80 UPC576H	£1.00 UPC1378H £1.75 UPC1382C	£1.95 2SC1061 £0.75 2SC1096	£0.95 2SK38A £9.60 2SK49	£2.70 £0.60	Callers by appointment: opening t	times 10am-5pm, Mon-Fri, 9-12 Sats
BA532 BA536	£1.50 HA11717 £2.25 HA11718	£6.25 LC7131 £4.75 LC7136	£2.75 TA7051P	£0.88 UPC577	£0.70 UPC1384C	£2.50 2SC1114	£3.50 2SK120	50.90	(closed B	ank Holidays).
BA612	£1.80 HA11724	£18.25 LC7137	£2.75 TA7054	£1.70 UPC580	£2,75 UPC1458C	£0.90 2SC1115	£3.75 2SK134	£4.00		
BA1310 BA1320	£1.75 HA11725 £1.25 HA11726	£16.00 M5106P £15.00 M5115P	£2.25 TA7063 £3.50 TA7066	£0.80 UPC585C £1.50 UPC592	£0.95 UPD277 £0.95 2SA103	£4.50 2SC1124 £0.60 2SC1162C	£0.80 25K135 £0.80 35K22	£4.00 £1.75		WIN. TELEPHONE DROER £5.00
BA1330	£1.75 HA11727	£9.50 M5134P	£2.75 TA7070P	£1.40 UPC595C	£1.70 2SA350	£0.60 2\$C11708	£2.95 3SK45	20.60	T DO	\A/EII
BA6304	£2.20 HA11736	£16.00 M5135P	£2.30 TA7072P	£1.20 UPC596	£1.50 2SA495	20.35 2SC1172 20.30 2SC1307	£2.75 3SK88 £1.25 TDA1515	£0.50 £4.30	1. PU	YY E L.L.,
CX0642 CX065B	£8.50 HA11745 £2.50 HA11747	£9.00 M5155 £9.50 M51513L	£1.50 TA7073 £1.50 TA7074P	£2.25 UPC1001H £1.95 UPC1009C	£2.00 2SA539 £1.20 2SA562	20.30 2SC1307 20.30 2SC1308	11.25 TDA1515 12.70 TDA2002	20.80	16 PARRING	WELL, STON GREEN,
CX0758	£2.20 HA11747ANT	£9.50 M51514AL	£1.75 TA7104P	£1.35 UPC1017G	£1.30 2SA634	£0.60 2SC1316	£2.95 TDA2003	£0.90	LONDON	I WO 41 C
CX095C CX100D	£2.80 HA11749 £5.75 HA11750	£4.50 M51515BL £5.00 M51516L	£2.50 TA7108 £2.50 TA7109	£1.50 UPC1018C £2.30 UPC1020	£0.95 2SA643 £1.75 2SA673	20.65 2SC1317 20.35 2SC1342	£0.30 TDA2004 £0.75 TDA2005	£2.20 £2.75	LUNDUR	1 W2 1LG
CX100D	£7.50 HA11753NT	£8.50 M51517L	£2.50 TA7119	£1.75 UPC1023H	£0.60 2SA684	£0.70 2SC1364	£0.40 TDA2006	£1.20	Tel: 01-723 924	6 (Answerphone)
CX130	£4.50 HA11758NT	£8.50 M51518L	£1.75 TA7120P	£0.50 UPC1025H	£2.30 2SA699A	£0.85 2SC1417	20.30 TDA2020 29.75 TDA2030	£1.40 £1.40	ITEMS DESPATOUE	D WITHIN 48 HOURS
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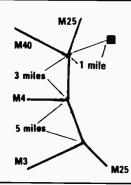
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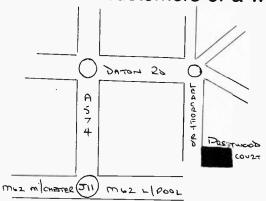
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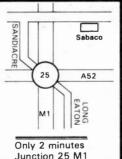
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Pye 731 3+56+27R	Rank T25LE Tripler £2.00 Rank HTCP A823 £3.50
Thom 50/17/1K5 \$1.00	1U 25 30K Rank £3.00
120/20/20/48/117 £1.00 270/10/6 for Thorn 4000 50p	G9 Philips £4.00
18/320/70/39 £1.10 Thorn 50-40R-1K5 50n	GEC 2110 £4.00 3500 Thorn £3.00
Ac Socket & Lead GEC, ITT, Philips, Pye 25p	9000 Thorn £5 9500 Thorn £4.50
7 x 3 % Thorn €1	2040 GEC
Thorn 1600-1700 £1.50 Rank Toshiba Tube Bases 30p	Universal Tripler £5.00 TVK 76/9 £3.00
Speakers	U8 £4.00
Pair 25 watt 4Ω speaker & tweeter in cabinet £15.00	CVC 825 ITT CVC 20/25/30/32 £3.50 Decca 80 100 £4.50
6×4 G11 25 ohm £1.00 5½×2½ 3 ohm £1.00	Grundig TVK 52 £2.50 11TBQ Pye 731 £3.00
5×3 80 ohm 70p 5×3 50 ohm 50p	D22 for Pye 18" colour portable £4.00
5×3 35 ohm 70p	LP 1193/63 £4.00
6×4 15 ohm £1.00 7×3 70 ohm £1.00	BG 100/41 £3,25 T/text ultrasonic ree'r panel £14.00
8×5 8 ohm 15 watt £2 8×5 8 ohm £1	Video cassette lamps on lead. 12-14V. 50p or 3 for £1.00
5×3 8 ohm 70p 7×3 16 ohm £1.00	20 for £5.00 200 for £25.00
5" dia 16 ohm £1.00	all I.C.'s + pots £4.00
6½" dia 4 ohm £1.50	G11 E.W. coils £4.00 G11 E.W. coils £1.00
2%4" dia 8 ohm 75n	for £1.00
3" dia 8 ohm 75p 41/2" sa 15 ohm 75n	G11 Scan Coils £5.00 G11 100K tuner pots 12 for £1
KT3 speaker K30 75p 3" dia 15 ohm 60p	KT3 IF panel £6.00 KT3 line OSC transformer £1
1690.5×3 12 ohm £1	KT3/K30 infra-red receiver
K45 Philip 15 ohm 75p K30 15 watt £1	head £1 K30 drawer unit with IC's
OF-550 KT3-K30 10p	(home) £10 K30 drawer unit with IC's
OF-513 correction 10n	(export) £10 (KT3 AE Sockets 50p
DIODES	KT3 receiver panel £8 . KT3 line driver transformer 50p
BY 126 BY 127 10p	Pye, K30, GEC, etc. Pre-mains stand-
BY 133 10p	by switch £1 Decca 80/100 IF panel £5
BY 134 10p BY 164 50p BY 176 25p	NPN PNP 80V 6 Amp TO66 O.P. Trans. pair 25p
BY 179 40p	5 button touch tuner BBC1/2 ITV1/2 video with ic SAS 560T/570T £7.00
BY 184 25p BY 187 10p	Control panel 5 sliders + mains lead £1.50
BY 190 40n	G118 touch button unit replaces old 6
BY 196 30p BY 198 10p BY 204/4 8p	P.B.U. £24 Tube base + base unit for 820 Euro
BY 206 8p	chassis £4.00 GEC Line O/P Trans. & Rec Stick for
BY 208/800 8p BY 210/400 5p	Portable £3.00
BY 210/800 10p BY 223 60p BY 224/600: 4.8A/600v bridge 50p	CVC 20/25/30/35/40 decoder panel £10 CVC 20/25/30/35/40 decoder panel (untested) £5
BY 226 15p	CVC 40/45 II- panel £5
BV 227	40K Transducer 50p PHILIPS NE511N £1.20
BY 229/4(0) 30p BY 237 5p BY 254 10p BY 255 30p	LM337M Reg. 30p 20 GEC Black Spark Gaps £1.00
BY 254 10p BY 255 30p	G11 Line Driver Transformer 35p KT3 Front Panel Control
BY 298 10p BY 299 10p	Assy. £2.50
BY 406 8p	BTW 30/50 50p TELETEX DECODER
BY 527 20p BY 407a 10p	L.C. SAA 5051 K30 L.C. SAA 5042
F 247 10p	[I.C. SAA 5030 [
XK 3102 50p	1.C. SAA 5020 etc. £8.00
International Rectifier EHT Diodes G7 6A/600V Stud Diodes 6A/1000V Stud Diodes 20p 20p	
6A/1000V Stud Diodes 20p	25A473 PNP C/P 10p

NEW 1617 THORN Chassis with	ICs & A	U113	68.00	Tube Thermpath 167	£1.00
30V Power Supply 500M/A 4×21 Pye 731 Power Panel	/4		£2.50 £13	Rank Secam Decoder Panel UHF	& VHF £13.00
6 Diode Universal Triplers			£4.00	NEW	
NEW PYE 725 line O/P panel with	h L.O.P.	T. & Tripler	£10.00	CRUNDIC SPARE PANE	LS
NEW GEC 20AX Power Supply Complete new GEC portable cha	assis M12	01H/M1501H with P.B.U /	£12.00	Set No. SC4127; SC4337; SC6217; GRUNDIG MODULE TYP	SC6237
v.can/LOPTI		The state of the s	£10	Tuner IF. AF TRX LOP, TP prear	mplifier.
Field + Jungle panel for GEC 3 GEC 2110 line panel with transfor GEC 2110 tuner unit + IF Panel	133/3135 ormer		£1.50 £7.00	Tuning board. Colour RGB. LED Deflection Board	Board,
GEC 2110 tuner unit + IF Panel			£12.00	From £3 to £8	
Pye/Chelsea Line op panel Pye 205 T/unit			£12.00 £3.90	Multi-Caps	
Pye 205 Line op panel			£7.50	4.700/75 6 amp Rip 350V 300M + 300M	£2.00 £1.00
Pye 713 IF panel and tuner Pye 713 Chroma			£7.00 £10.00	400V 400M 350V 400M	60p 60p
Pye/Chelsea Timebase panel with	LOPTI		£10.00	Thorn 3500	
Pye 731 Frame Panel Pye 731 Convergence Panel			£5.00 £5.00	175/100/100/350v KT3/200/25/25/385v	£1.00 £1.00
Pve 731 Chroma			£10.00	300+300+150+100+50MFD 350V	£2
Pye 731 IF panel + tuner Pye CDA/205 panel			£10.00 £6.00	47/220/350v	60p
GEC portable chassis + LOPII:	2114 New		£4.00	150/150/100/100/100/320v 2500/2500/63v	£2.00 50p
Thorn 1613/1713 chassis G9 Power Panel			9.75	150/200/200/300v	70p
Mono RANK Chassis 127A NEV	v		£6.00 £10.00	400/400/200v 300/100/100/16/275v	£1.70 £1.50
NEW G9 Frame Panel NEW G11 IF Panel			£10.00	100/200/325v 150/150/100/375v	40p £1.50
NEW MULLARD TELETE	X	3300/70	£10.00	300/300/100/32/32/300v	2.00
Panel 6101	£6.00	.1/100	5p	1500/2000/30v Jelly pot Thorn 00D4/013 150/150/100/100/320v	50p £3
G8 Tuner Unit + Panel G8 Power Supply	£4.00 £5.00	1/100 × 10 22/100	30p 10p	150/150/100/100/320v 100/350 + 300/200/100/16/275v	£2.00
G8 6 Sloping PBU	£8.00	4.7M/100	5p	1 225+25/380 GEC	£2.00 70p
G8 IF & Chroma G8 Chroma	£10.00 £3.00	470/100 2000/100	20p 70p	200/100/100/350v 500/500/25v	£1.50 50p
		4700/100	75p	150/150/100/300v 200/150/150/300v	75p
G11 IF Detector G11 Selector gain module	£3.00 £3	47/160 300 300/300V	10թ 80թ		1.00
Complete CVC 825 Chassis (both	1	800/160	50n	CVC 40/2 Chassis, new £30, comple	te with
panels) AEC V/Cap Resistor Unit UHF	£40.00 with IC	.1/250 Pulse 2,2 250v	5p 10p	intrfase panel	
SAS660 SAS670	£3.00	3n3/250 A.C.	10p	CVC 820 Line O/P Panel CVC20 Mains Panel	£3.00
Z714 RANK IF Panels 6MHz 1 SL437F	£3.00	.33/250V .39/250V	20p 15p	ITT 8 & 6 Push Button Unit	00.13
Z909B RANK IF Panels		4n7/250 tested 5KV	25p	CVC40/2 New Chroma Panel CMA 10	£10.00 £2.00
Export 5.5MHz 2 L.C.'s TBA1205B TCA2705Q	£2.50	.91/250 .91/400	35p 30p	CMA 11	£2.00
K35 IF	£6.00	22/250	15p	CMA 30 CMA 40	£2.00 £1.50
Z743 RANK IF Panel Export 5.5MHz 3 I.C.'s		47/250 100/250	10p 20p	CMC 10/2	£5.00
TBA750+SC9504P+		G11 470/250V	£1.75	CMC 16 CMC 38	£4.00 £8.00
SC9503P Pye G11 Front panel with transdu	£1.50	GEC600/250 700/250	60р £1	CMC 45	£1.50
pots, tuner pots, 6 pb switch+lea	d £5.00	300+300 MFD 350v	£1.00	CMC 47	£1.00 £15
Pye 6 button switch portable GEC V/cap VIIF/UHF tuner and	£1.00	800/250 32/300	40p	CMC 52 CMC 57	£6.00
sound O/P PC 706B3 (Export)	£12.00	4/350	20p 5p	CMC 58 CMC 59	00.83
GEC Line O/P PC 659B3	£6.00	8/350	8p	CMC 67	£8.00 £3.75
2110 GEC Power Panel GEC Power Supply (Export)	£8.00 £10.00	4.7M/350v 33/350	10p 20p	CMC 67/2	£4.00
G11 dynamic correction panel CVC 20 Front panel with sliders	£6	220/350	30p	CMC 68 CMD 12	£4.00 £10
mains input panel	±4	300/350 400/350	40p 50p	CMD 32	£5.00
CVC 40 PUSH BUTTON ASSY	with	10/375	10p	CMD 33 CMD 40	£5.00 £5.00
sliders: complete with lamp assy pots	£14	22/375 220/385	15p. 75p	CMD 41	£5.00
CVC9 slider pots panel	50p	330/385 CVC 820HT	60p	CMD 800 CME-25	£10.00 £2.00
CVC 5 Mains on/off + 5 pots Universal Focus. Fits Pye, Thorn	£2 and	0,1/400 KT3 E/W .39/400	15p 20p	CMF 26	£2.00
Decca Units.		.56K/400v	20p	CMF 40 CMH 10	£2.00 £1.50
T147 Rank tube base on panel Z718 Focus Unit	£1.00 £1.50	4700pf/400 .22/400	10p 10p	CMH 31	00.13
T20 Focus Unit	£1.00 75p	8/400 33/400	15p	CMK 12 (untested) CMK 30 (untested)	£4.00 £4.00
Large Type Decca Small	75p	400/400	20p 40p	CMN 20 CMN 21	£1.50 £1.50
KT3 Focus Unit K30 Focus Pot	75p 75p	394K/400V 220/450	20p 40p	CMN 40	£1.00
K30 Tube base on panel	£1.00	.47/500	25p	CMN 45 CMP 10	25p £2.00
TX10 Focus Units CVC 32 Focus Unit	£7.00 75p	0.1/600 0.1/1200V wire end	15p 20p	CMP 11	£4.00
Fedility Focus Unit 14R-14S	30p	0.1/450 A/C wire end	20p	CMP 40 CMS 11	£2.00 £2.00
3500 Thorn Focus Unit ITT Small for use with Split	£1.00	.047/600 0.047/1000	15թ 10թ	CMS 40	£2.00
Z718 Bush Focus	£2.00	0.01/1000	10p	CMU 12 CMU 14	£10.00 £8.00
Diode TV11	50p 50p	-0,1/1000 -47/1000v	10p 65p	CMU 30	£7.00
Remo TV12SP	50p	.47/250V A.C.	10p	CMU 45 CMZ 30	£7.00 £5.00
1600 Thorn EHT Rec and Lead TV13	50p 50p	.001K/1250 0.0047/1500	10p 10p	GMA 90	£5.00
TV14	50p	.005/1500	10p	GMC 120 GMR 64	£2.50 £5.00
TV18 TV20	60p £1.00	.0105/1500 1n8/1500	10p 15p	TMN 2	£2.00
TV45 Thorn 14/1500 rec stick	50p	2n0/1500	10p	VCA 20 VCA 21	£10.00
	5p	2n2/1500 .01/1600	15p 15p	VMC 26 VMC 34	£3.00
G7000 Philips Video Games Packs 11 types	£5	G11.8200/2KV	15p 20p	VMC 44 + 45	£5.00 £4.00
		0.1/2KV 10n/2KV	15p	VMC 51	£5.00
G11 drawer ASS 3 pots Mains sw and lead	£2.00	3n9/2KV 0.0015/2KV	15p 10p	Hand Sets G11 Ultrasonic Teletex Handset	£24.00
Line O/P panel GEC 2217/2218/2		5n2/2KV	10p	8 C.H. Ultrasonic GEC Full Remoti	e C2014H/
2214/2226/2227/2228	£10	6n2/2KV 2n0/2KV	15p 15p	New Replacement for G11 Ultrason	£15.00 sic Full
CLOCK DISPLAY		2n2/2KV 7500pf/2KV	15p	Remote	£12.00
4 SEG ACDM45	£1.00	3000PF/3000V	10p 10p	Thorn 4000 insert with 7 buttons Decca RC 11	£5.00 £14.00
4000 thick film	£2.00	4n7/2KV 8n2/2KV	15p 15p	Decca RC 11 Decca RC 12 G11 Infra-red full teletext	£14.00
		0.0082/2500	15p	Rank, Infra-red	£24.00 £10.00
4040 Clock	£1.00	150/3500 1800/4K·V	10p 5p	Dynatron-Full remote CTV 62, 63, 6 Hitachi infra red handset	64 £19.00 £18
7seg Red LED 2 digit LED 8.8	50p 50p	4.7nf/5KV	10p	Philips full remote KT3, 16C928/20C	934;
2 digit LED ÷1.8 with panel +	ЭФ	170/8KV 180/8KV	10p 10p	7228/7324; K12 26C 797/1ST 66K 18 G11, Full remote top button assy	26 £12.00 £12.00
MCI4511 4700/63	£1.00 £1.50	210/8KV	10p	G11, Full remote repair service (exc	hange
250/64	10p	1000/10KV .47/100V	10p 80p	unit) Philips infra red full remote 9 chann	£12.00 el for 60
CVC 20-25-30 Mains Switches Infra Red and Ultrasonic G11 Tel			75p	CP2605	6.63
RANK & ITT Mains Remote On-	Off Switc	h (720R)	£30 £1.50	Philips infra red full remote 12 chan CP2605	nel for 60 £12.00
RANK & ITT Mains Remote Swit RANK & ITT Remote Switch 280	tch 2865 o		£1.50	Philips Key Pad set KT3/K30	£3,00
G11 Mains Switch	o ouni		£1.50 50p	KT3/K30 T/Text KT3/K30 Full remote	£15.00 £15.00
4 amp Mains Switch GEC Mains Switch 4 amp			25p 30p	KT3 Power supply Hitachi 8 button unit with resistor u	£4.00
KT3 Mainswitch			£1.00	year mod.	£7.00
THORN Rotary Mains Switch G8 Mains Switch			50p 75p	GEC infra-red 2236-2026 GEC push pad hand set button blob	£4.00
Thyristor 600/4 amp C106/2	C 11 ~		24p	Pye & Philips handset KT3-K30 char	
G11 Preh Red LED P/Button for RANK TOSHIBA Transductors	PC-2011	inge	20p 50p	RC5150-RC5176-RC5171-RC5177. Special Price	£13.00
Mains Switch ITT Long Type Prin	it		75p	ITT Hand Set with TV-Teletex-VCF	£12.00
Mains Switch Philip Long Type T. Mains Switch GEC Long Type TA	AG		75p 75p	RC4001 Philips Tops for Teletext & Full	£17.00 Remote
Thorn 12 or 24 volt battery conve	rtor for p	ortable colour T/V	£6.00	KT3-K30	£9.75

Tuner Units V/Cap Rank VHF Z776T/Unit £6 V/Cap Rank VHF Z773T/Unit £5 NEW G8 Tuner V/Cap £5.50 ELC2(000 on Panel £2.50 GEC 6 Push Button Unit £6 DECCA 6 Push Button Unit £6 DECCA 6 Push Button Unit £6 ECC or Hitachi 6 push button unit 2110 Conversion £8 GEC 2110 V/Cap £3.75 ELC1043 (Ex Panel) £3.75 ELC1043 (Ex Panel) £3.75 ELC1042 (Ex Panel) £4.00 ELC2(000 £4.00 ELC2(000 NEW £10.00 GEC Tuner V/Cap Hitachi After 1979 ET548, ET547, ET546, ET541B £8.00 U322 (UHF) £5.00 U322 (UHF) £5.00 U317 (VHF) £5.00 U317 (VHF) £5.00 U311 UHF £7.00 UV. 411 Tuner £10.00 UV. 415 £7.00 UV. 417 £7.00 UV. 417 £7.00 Small V/Cap Missumi UHF £5.00 Small V/Cap Missumi UHF £5.00 NSF-UHF/VHF Varicap (old type) Mosfit UHF/VHF Varicap (old type) Mosfit UHF/VHF (new type) £8.00 Mosfit UHF/VHF (new type) £8.00 Mosfit UHF/VHF (new type) £8.00	SENDZ COMPONENTS 63 Bishopsteignton, Shoeburyness, ESSEX SS3 8AF SAME DAY SERVICE All items subject to availability. No Accounts : No Credit Cards Postal Order/Cheque with order Add 15% VAT, then £1 Postage Add Postage for overseas Callers: To shop at 212 London Rd., Southend. Tel. 0702-332992 Open 9-1/2.30-6. GVMT + school orders accepted on official headings add 10% handling charge. D.P.D.T. switch Black knob: Chassis or PCB mount 4p each or 40 for £1.00 ETTRE218 £1.50 ETTRE218 £	SAF1032p	SN76532N 50p SN76544N £2.00 SN76545 £3.00 SN76546 £1.00 SN76550 30p SN76552 30p SN76650 50p SN76650 50p SN76650 50p SN76660N 40p SN76660N 40p SN76660N 50p SN76660N 50p SN76660N 50p SN76660N 50p SN76660N 50p SN76670SN £1.00 SN76705N £1.00 SN76709N £1.00 SN76709N £1.00 SN76709N £1.00 UA783P3C 40p BT13810A 70p BT13810A 70p BT138410A 70p BT13840Q £1.50 TCA270 £1.00 TCA270 £1.00 TCA401 £1.00 TCA401 £1.00 TCA400 £1.00 TCA500 £1.00	MJE660 25p MJE661 25p MJE3055 £1.00 MJE2801 30p MJE2955 50p MJE13005 50p Sanikron Diode 30p Philips Cartridges GP412 £6.00 GP412/11 £6.00 GP406 £6.00 Transistors A1222 15p A1223 15p A1231 15p A131 15p A138 15p A
BF694 10p BC107 BF758 30p BC108 BF760 34p BC108 BF760 34p BC108 BF761 34p BC108 BF734 15p BC113 BF743 34p BC114 34p BC114 34p BC114 34p BC114 34p BC114 34p BC115 34p BC116 34p BC126 34p BC126 BFY50 25p BC139 BC126 BFY50 25p BC139 BC126 BFY90 25p BC139 BC126 BFY90 34p BC125 BC141 34p BC116 34p BC125 34p BC148 34p BC153 34p BC153 34p BC153 34p BC153 34p BC153 34p BC154 34p BC154 34p BC172 34p BC183 34p BC183 34p BC183 34p BC183 34p BC237 34p BC237	76 BD678 306 BT119 \$ \$ \$ 100 BD681 306 BT19 \$ \$ \$ 100 BD681 306 BT19 \$ \$ \$ 100 BD682 306 BT149 \$ \$ 100 BD682 306 BT149 \$ 100 BF819A 306 BT149 \$ 100 BF819A 306 BT149 \$ 100 BF871 306 BF871 307 BF871	TBA950 £1.50 TBA99WC TBA99WC TBA99WC TBA99WC TMS1000NL TMS199WC TMS199W0 TMS99W0 TMS99W0 TMS99W0 TMS99W0 TMS27WHG45 TMS27I6JL TMS3529 £1.00 TMS372UANS TMS4014 TV0 TWS99U2 TWS99U3 TWS99U2 TWS99U3 TWS	4.433-619 6MHz 8.867238 Large or small 50p each NEC 4730312 Line Tran Tripler in Case Antistatic Isolators Disc Type Black 10p I.C. Hol DIL – DIL 40 Pin × 4 21.00 42 Pin × 5 21.00 28 Pin × 5 80p 16 Pin × 10 70p 24 Pin × 5 75p 14 Pin × 5 75p 14 Pin × 10 70p	BD 5077 Sobp BD 5079 BD 5079 BD 5079 BD 5079 BD 50710 BD