

FEBRUARY 1984

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# TELEVISION

SERVICING-VIDEO-CONSTRUCTION-DEVELOPMENTS

**INTO THE 90s  
WITH NEON TESTER**

**EXTRA  
PAGES**



**LOPT TESTER**  
**THORN 1500 OVERHAUL**  
**THE CASE OF THE CURIOUS COSSOR**  
**SERVICING THE TANDBERG CTV3**  
**TEST REPORT: AVO 2001 DMM**  
**VCR CLINC • TV FAULT REPORTS**

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Z9	100 mixed Miniature Ceramic and Plate caps	£1.50	Z28	20 General Purpose Germanium Diodes	£1.00	Z52	Decca "Bradford" Control Knobs Black and Chrome. $\frac{1}{4}$ " Shaft	8 for £1.00
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(Z14A)	200 Transistors as above but including power types like BD131, 2N3055, AC128, BFY50 etc.	£9.95	Z34	6 x Miniature "Press to Make" Switches, Red Knob	£1.00	Z58	22 Pin DIL I.C. Sockets	10 for £1.00
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1µf 350v	10 for £1.00
2.2µf 63v	20 for £1.00
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10µf 25v	20 for £1.00
22µf 16v	20 for £1.00
100µf 25v	20 for £1.20
160µf 25v*	20 for £1.50
330µf 25v	10 for £1.00
400µf 40v*	8 for £1.00
470µf 25v	10 for £1.00
470µf 35v	8 for £1.00
1000µf 35v	6 for £1.00
1000µf 40v*	5 for £1

\*Axial. All others are Radial.

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50µf 250v (3 pin)	50p
100µf 350v	80p
2000µf 100v	£1.00
1000µf 100v	60p
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2,200µf 63v	70p
3,500µf 35v	50p
220µf 400v ITT/RBM	£1.00
6,800µf 70v	£1.00
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 Further Discount on large quantities

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 10 of each £6.60  
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 10 of one value £1.00  
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 20 x 1N4005 £1.50  
 100 for £5.00  
 20 x 1N4148 £1.00  
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 12 x BY127 £1.00  
 8 x BY255 (3A 1,300V) £1.00  
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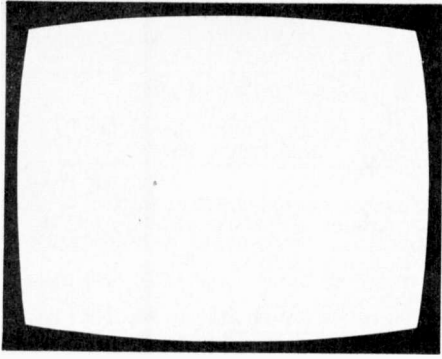
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# TELEVISION

February  
1984

Vol. 34, No. 4  
Issue 400

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## QUERIES

We regret that we cannot answer technical queries over the telephone nor supply service sheets. We will endeavour to assist readers who have queries relating to articles published in *Television*, but we cannot offer advice on modifications to our published designs nor comment on alternative ways of using them. All correspondents expecting a reply should enclose a stamped addressed envelope. Requests for advice on dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Service Bureau". Send to the address given above (see "correspondence").

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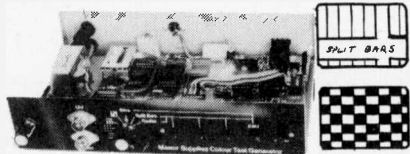
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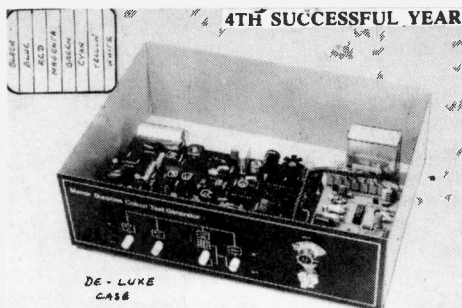
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SPECIAL TEST REPORT TELEVISION DEC. 1982

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 MONO PORTABLE TV, SMALL SCREEN MONITOR  
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#### SPECIAL OFFER

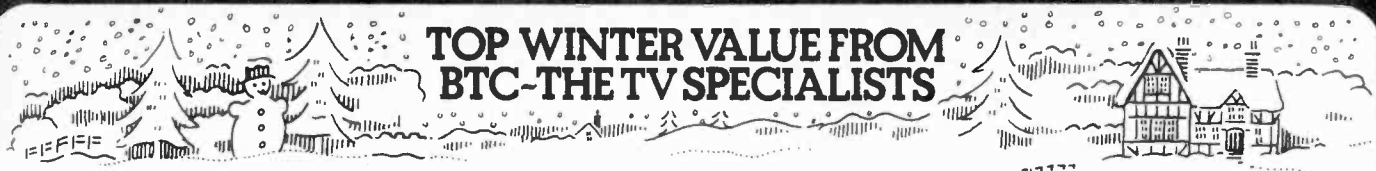
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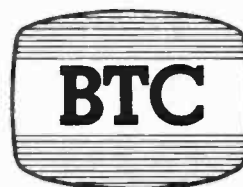
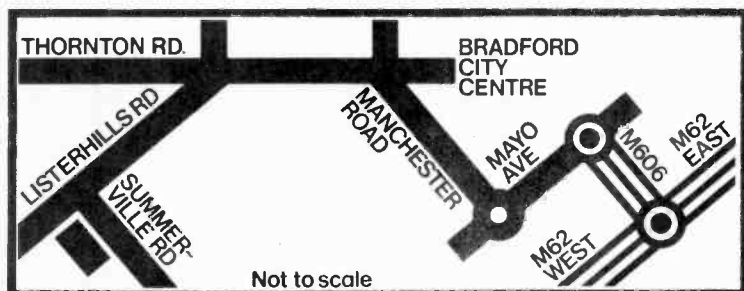
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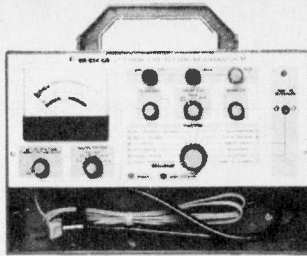
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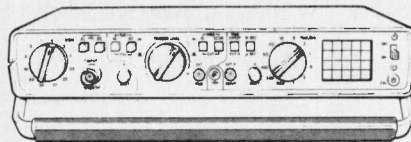
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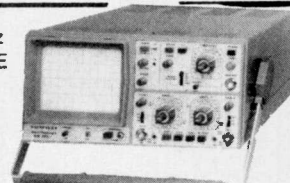
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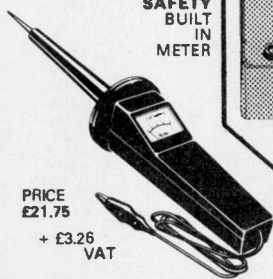


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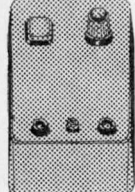
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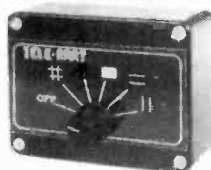
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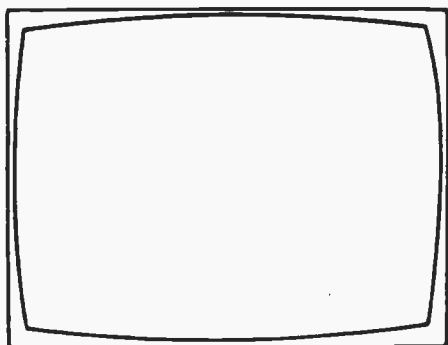
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# TELEVISION

## The Problem of Satellite TV

It's important to distinguish between two aspects of satellite TV. First, DBS can provide extra channels and a wide coverage. Secondly, the technology that it requires represents an important advance in TV engineering, offering manufacturing and employment opportunities. The fact is that we don't in the UK at present need the extra channels or the wide coverage: Channel 4 is still a delicate newcomer financially, and our present terrestrial network provides virtually saturation coverage. On the other hand we could do with the business opportunities, and it would be a disadvantage not to play a part in the next stage of TV development. This unresolved dilemma seems to get more awkward by the day. How do you go about raising the money to provide an unwanted service in order to keep abreast of the technology?

A couple of months ago we commented on the government's lack of a policy for broadcasting. It's almost eerie to compare the sense of urgency the government showed over the idea of establishing cable TV in the UK with the present dithering over satellite TV. The key to the difference is the fact that it was promised cable TV with no call on public funds, while the more expensive business of launching satellites raises much more difficult financial problems. What the government seems to be saying is that satellite TV is indeed a good thing, and that that being so there should be plenty of backers. It doesn't want to get involved itself in providing finance, and when one considers some of the ways in which public funds have gone into questionable projects in the past such caution is understandable.

But let's take a look at what's going on in that other island state. The Japanese National Space Development Agency is about to launch the BS2a satellite. It has two transponders which will be used by NHK, the Japanese equivalent of the BBC. Most of the £176 million cost of BS2a is being borne by NHK. A back-up, BS2b, will be launched next year, to be followed in 1987 by the three-channel BS3 for which fourteen groups have so far applied to run the channels. Well, Japanese TV is not all that good, so extra channels may be welcome, while the geography makes terrestrial coverage more awkward than in the UK. That apart however, one can see who intends to wrap up the market for domestic satellite TV equipment. Unless, dare one say it, we in the UK manage to isolate ourselves by doing a sort of 405 with MAC-C.

The last few weeks have seen extraordinary disarray on the DBS front in the UK. The BBC, charged with starting the first two DBS channels in 1986, has obviously felt itself to be in an intolerable situation. It hasn't the money to fund a programme whose financial prospects are highly doubtful. The BBC seemed to be on the verge of shelving its DBS efforts, but on December 15th the board of governors decided, without much evident enthusiasm, against this course. An announcement commented upon the "great difficulties which remain to be overcome by the BBC, industry and others in establishing a viable DBS service", concluding that the BBC "should continue to explore all possibilities." Prior to that, Unisat, the consortium building the satellites for BBC use, had threatened to stop work on them unless financial guarantees were forthcoming. Mullard's managing director Ivor Cohen had appealed to the government to bring together those involved in DBS in the UK to ensure that it takes off: Mr. Cohen commented that the government "did it for teletext and should do it for satellite TV." And Sir Anthony Part, chairman of the government committee on technical standards for DBS, had appealed for all sides involved to get together to find a way ahead.

One of the more surprising aspects of all this has been the BBC's attempt to find a private sector partner to share the risks of a DBS service. The BBC held talks with Thorn-EMI, who understandably were reluctant to get involved. As a further possibility the government has suggested that the BBC and the IBA should try to establish a joint venture instead of setting up competing DBS services as originally envisaged. A plausible idea maybe, but surely the whole idea of having two broadcasting authorities is that they should operate independently?

The technically sound idea that the UK should use the MAC-C system for its DBS transmissions seems to have added to the problems. Despite the EBU's enthusiasm for the system, no one else seems to want to adopt it at present. It raises interesting cost versus technology questions. Whilst MAC is undoubtedly an excellent system, it does mean a more complex receiver, one that can store and rearrange each TV line. This involves a cost penalty which is difficult to assess. What one can say is that time and again in the TV field cheap but cheerful engineering solutions have, with a little development, proved to be acceptable in practice. For the moment however the hope that MAC-C will find acceptance outside the UK has brought everything to a standstill here. You can't start to design receivers or the chips for use in them until a decision has been made on the transmission standard.

For the present, Europe seems to be loosing out in the DBS race. US and Japanese satellites are already going up whilst we in the UK struggle with the problems outlined above and the continentals debate similar difficulties. The French and W. German governments had planned to have a DBS service in operation by the end of 1986. As a result of doubts about the costs involved, the French government recently decided to set up a working party to reconsider the plan. It's likely that a scaled down French/W. German/Luxembourg service may be adopted as a compromise.

The problems raised by DBS are not simple, and it would not be fair to complain too strongly about the present state of indecision. When all is said and done however it's likely that the economic benefits of DBS will be reaped elsewhere.

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### TELETOPICS

This feature will be resumed next month. The main news items recently relate to changes of company ownership. Philips, with a consortium of banks, plans to take over Grundig on April 1st. The move will require W. German Federal Cartels Office approval. Philips at present owns 24.5 per cent of Grundig. Finland's largest privately owned company Nokia, which has interests in forest products, plastics, metals and electronics, is to acquire majority holdings in Luxor and Salora.

### FRONT COVER

Our front cover photo this month shows one of the current range of Harrison Bros petal dishes, with mount, feedhorn and LNA/downconverter. Details can be obtained from Harrison Bros, 22 Milton Road, Westcliffe-on-Sea, Essex SS0 7JX.

# Servicing the Tandberg CTV3 Chassis

Peter H. Dolman, T.Eng. (C.E.I.)

The Tandberg CTV3 was the last true Tandberg chassis to be released in the UK – the later CTV4 was fitted with a chassis produced by W. German setmaker Loewe Opta. The CTV3 is an accessible, solid-state chassis designed to drive 22 and 26in. 20AX tubes. Most of the faults likely to be encountered are simple ones that are quick and cheap to put right. The high standard of performance makes these sets ideal for second-hand sale or rental purposes. This article is intended to serve as a time-saving fault and overhaul guide – also to introduce a chassis that may well be unfamiliar to some engineers. Fig. 1 shows the basic physical layout.

## Timebase/Power Supply Panel

There are two main panels, the signals one on the left and the timebase/power supply panel on the right. We'll first briefly outline what's on the latter. The series chopper circuit (see Fig. 2) is of discrete component design using a BU126 as the chopper transistor. It's on a plug-in subpanel and provides three outputs: 160V for the line output stage, 230V for the RGB output stages and 24V for the sound channel. The circuit runs synchronously with the line output stage in order to ensure that high-energy switching transients are coincident in time with the line flyback, thus preventing the appearance of power supply radiation interference effects on the screen. The line output stage is conventional, using a BU208 line output transistor which receives its base drive from the tertiary winding on the driver transformer in the chopper circuit. Over-voltage protection is provided by means of a crowbar circuit which fires to prevent operation should the 160V rail rise to 180V – the crowbar thyristor and its series current limiting resistor short out the 160V rail in this event.

The c.r.t. heater and the l.t. supplies are derived from windings on the line output transformer. EW correction is provided by a conventional diode modulator circuit driven by a Darlington power transistor (Q530). Only width and pincushion adjustments are incorporated, the once familiar keystone control being omitted as with so many modern designs (unfortunately!). NS correction is taken care of by the precise shaping of the ferrite core used in the deflection yoke (standard 20AX practice, converting an otherwise barrel-shaped error to a generally acceptable "moustache" shape). On large-screen receivers however, particularly up-market or export models, additional correction may be provided. So in some versions of the CTV3 you may find a small PCB plugged into the deflection yoke.

The line sync and line oscillator circuits are contained in our old and trusted friend the TBA920, which features horizontal phase control (R519) as the sole means of line shift, for reliability reasons. The set is VCR compatible – a useful sales point to make! Composite sync is fed to the discrete component field timebase which is mounted on a small subpanel. A good standard of stability and linearity is achieved, the output stage employing a complementary pair of Darlington transistors (Q605/6) in a class B push-pull configuration. No field shift control is considered

necessary due to the tube's tight beam landing specification.

A third subpanel on the timebase/power supply board provides dynamic convergence correction.

## The Signals Panel

Now over to the left, to the signals panel. The u.h.f. input at the aerial socket is fed to a U322 varicap tuner. This is the sister of the familiar U321 but has opposite sense a.g.c. control requirements. The i.f. output is fed via the LC selectivity circuits to a TDA2541 amplifier/demodulator i.c. which provides outputs to the three-chip decoder and the sound channel.

The decoder employs a TDA2560 for Y/C signal processing, a TDA2522 chroma demodulator and a TBA530 for matrixing. The c.r.t. cathodes are driven by three complementary-symmetry class AB RGB output stages.

The 12V supply for the i.f. strip and the decoder is derived from the line output transformer via a three-transistor series regulator circuit. Beam limiting is accomplished by a two-transistor circuit that backs off both the brightness and contrast levels at a predetermined threshold to protect the tube and line output stage. There's a picture sharpness switch that operates by modifying the response of the luminance amplifier within the TDA2560.

The sound channel consists of a TBA120U intercarrier sound i.c. and a TDA2610 amplifier/output device, all mounted on a plug-in subpanel. There's a Baxandall tone control circuit (bass and treble controls in a feedback loop), necessitating an extra single transistor stage which is mounted near the front controls. The sound quality is of a high standard, and isolated loudspeaker and headphone sockets are provided.

## Fault Finding

Experience of these delightful receivers shows that almost all common faults can be swiftly remedied by intelligent use of a soldering iron! It's advisable to run through the following problem areas as a matter of course in order to ensure stable performance and good long-term reliability.

Most no sound/raster faults can easily be dealt with by careful examination of the plug-in power supply edge connector P110. Pin 9 is the favourite for dry-joints, but if in doubt resolder all nine joints, preferably removing the old solder and applying new – also be certain to check the appropriate connections on the mother board, together with the condition of the plug/socket itself. Inspect the area around R752 and make good any suspect joints before returning the board to its holder. A fairly common failure on the main board is that of the mains bridge rectifier's reservoir capacitor C726 (220 $\mu$ F, 350V). It can be responsible for severe hum bars, often intermittent in nature.

Intermittent line collapse should direct attention to the scan-correction capacitor C532 (0.91 $\mu$ F). It may be going open-circuit or, more likely, is dry-jointed. If the trouble is intermittent squealing from the line timebase area, seal



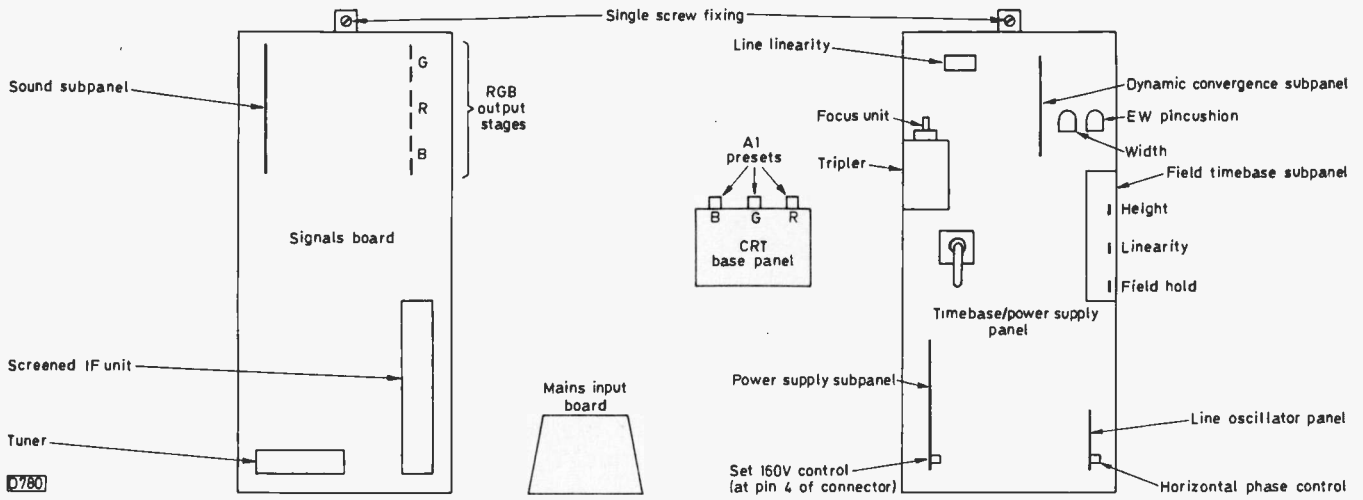


Fig. 1: Physical layout of the Tandberg CTV3 chassis.

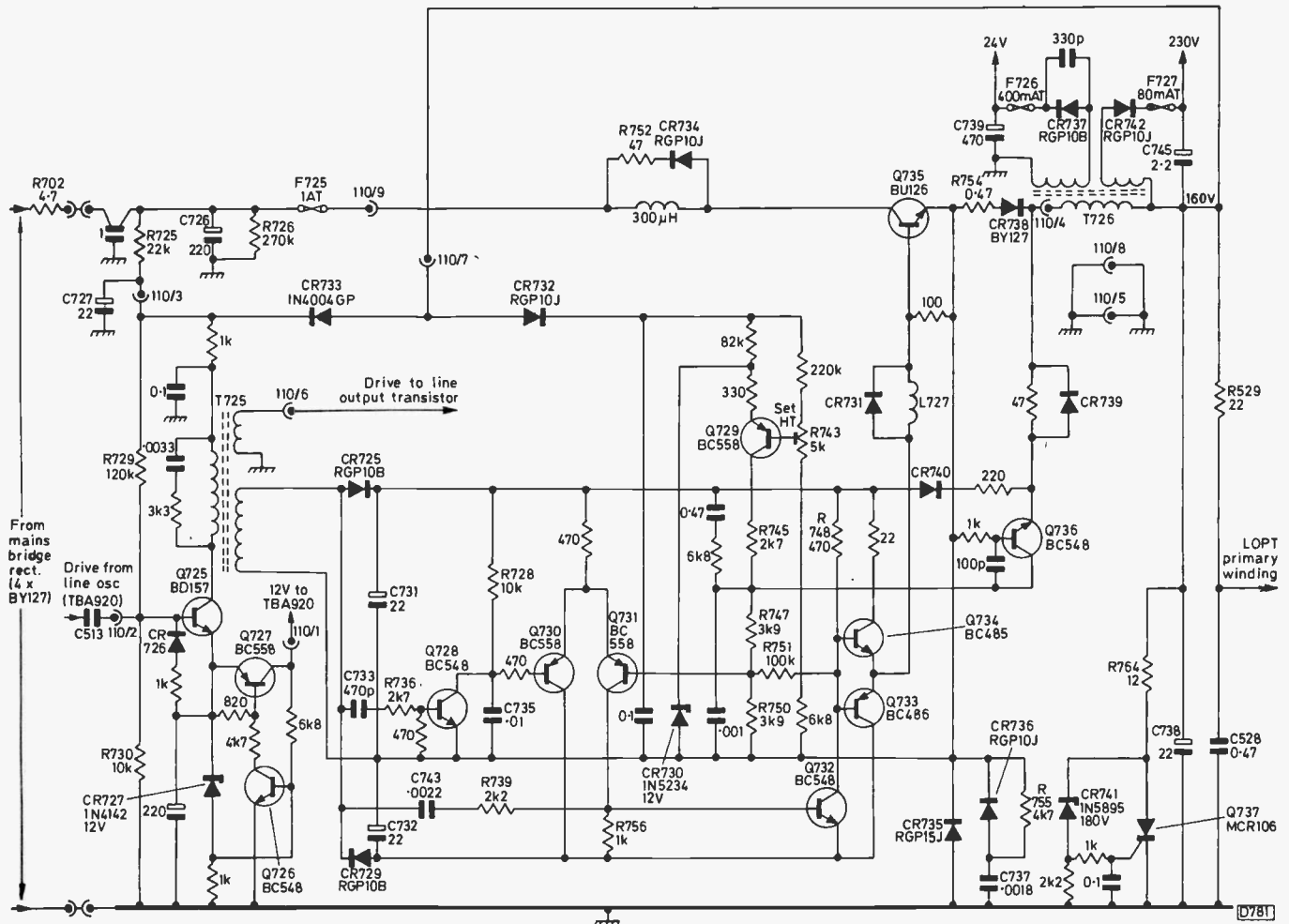


Fig. 2: The chopper power supply circuit used in the Tandberg CTV3 chassis. Transistor Q725 receives its input from the line oscillator (TBA920) and drives both the BU208 line output transistor and the chopper drive/control circuit. At switch on, R725 provides a start-up supply to get things going. The sync/line oscillator chip receives its supply from the emitter of Q725, via Q727, at all times. R728/C735/Q728 generate a sawtooth waveform at the base of Q730 which, with Q731, form a pulse width modulator that produces a variable mark-space ratio squarewave across R756 to drive Q732/3/4. R751 provides positive feedback. When Q733 conducts, the chopper transistor Q735 switches off. When Q733 switches off, Q734 and Q735 conduct. T726 is the chopper transformer and CR735 the efficiency diode. CR736/R755/C737 form a snubber circuit to protect Q735. The 160V produced across C738 by the chopper is sensed by Q729, which adjusts the d.c. voltage at the base of Q731 to vary the mark space ratio of the chopper drive waveform. Over-voltage protection is provided by the crowbar thyristor Q737: in the event of the chopper output rising to 180V, zener diode CR741 conducts and Q737 fires, short-circuiting the 160V line. Excess current protection is provided by Q736: if the voltage across R754 exceeds 0.7V, Q736 conducts to alter the d.c. conditions at the base of Q731. To prevent Q735 conducting continuously under low mains voltage/heavy load conditions, with a consequent sudden sharp rise in output voltage, C743/R739 feed a short pulse to the base of Q732 to ensure that Q735 always switches off for a minimum period during each cycle of operation. All diodes are type 1N4148 unless otherwise indicated.

the line linearity coil L527 with RS printed circuit lacquer (stock no. 554-989), avoiding nearby heat-producing components.

In the event of random width variations, check the line output stage h.t. supply decoupler C528 (0.47 $\mu$ F) for dry-joints. If this is not the cause, suspect the Darlington EW driver transistor's plug-in connections (Q530). If in doubt, dispense with the plug-in facility and hard wire. On rare occasions the transistor itself can become mechanically intermittent, making it look as though there's a dry-joint present when there isn't. Replace with a BD699.

Always inspect the plug-in dynamic convergence correction panel for signs of overheating. In particular check the condition of the edge connector: I prefer to remove the plug and socket connectors and wire this panel into the main board directly to ensure a perfect connection. Arcing here can cause a real mess! It's also prudent to remove the few on-panel stand-up power resistors, scrape off the leadouts, then resolder them in place.

Just about every failure I've had in the field timebase has been due to... you've guessed it, dry-joints, again often associated with edge connector trouble. Resoldering and pin cleaning is usually sufficient to clear up the problem. This plug-in unit is a little inaccessible, being "wrapped around" by the output pair's heatsink. The latter can be temporarily removed to give access to the print side of the panel for speedy fault location, but the output pair are likely to object if the set is operated in this condition for more than a couple of minutes.

When setting up the field timebase, the presets have to

be adjusted through small holes in the surrounding metal-work. The need here is for a reasonable degree of surgical dexterity and an insulated adjusting tool – never use a non-insulated type, as the end result is likely to be tragic rather than exquisite!

Failures on the signals board are rare and normally call for replacement of the tuner or the appropriate i.c. The only common (and sometimes devious) problem is caused by incorrect biasing of one of the RGB output stages. This generally gives rise to the appearance of flyback lines at low brightness levels, the colour of the lines indicating which stage is in trouble. Almost certainly the culprit will be the 220k $\Omega$  resistor from the base of the upper transistor in the appropriate output stage to chassis (R192/212/232). It's best to replace all three resistors for good measure.

## In Conclusion

Well, that's it. Hardly worth an article do I hear you say? Maybe, but look at it this way: should you encounter one of these sets on a late afternoon call, you're now sure to be able to carry out a 100 per cent successful repair and arrive home in time to see the news – provided you don't run out of solder.

Spares are available from Tandberg UK Ltd., Revie Road, Elland Road, Leeds LS11 8JG. Tandberg also supply parts for the CTV1 and CTV2: for CTV4 spares, apply to Loewe Opta agents HRS Electronic Components Ltd., Brasshouse Passage, Birmingham B1 2HR.

# Simple LOPT Tester

Jim Littler

There are a few line output transformers one keeps in stock due to their known tendency to fail. What does one do about the many other types? It's handy to be able to check them before sending off for a replacement, and for this purpose the tester described below was designed. It's simple and in practice works very well.

## Circuit Operation

The circuit is shown in Fig. 1. Multivibrator Tr1, Tr2 generates a 28kHz squarewave output which is converted to a low impedance (600 $\Omega$ ) by the emitter-follower Tr3. The output from the emitter-follower drives the primary winding of the line output transformer in place of the line output transistor or valve, causing the transformer to ring.

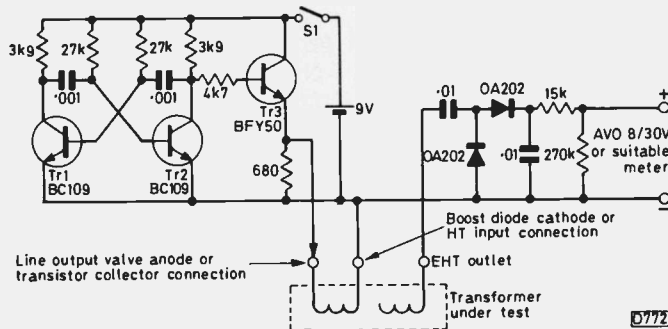


Fig. 1: LOPT tester circuit and connections.

The output from the e.h.t. overwinding is taken to a diode probe which uses a voltage doubling rectifier to produce approximately 30V at the output terminals – assuming that the line output transformer is a good one. Shorted turns in the transformer will reduce the output to around 3V.

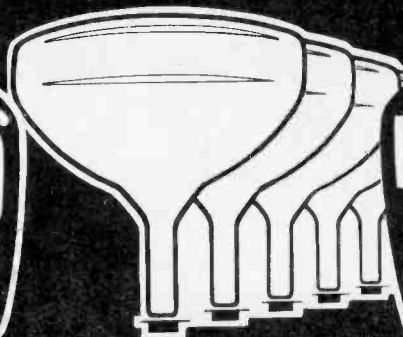
## Use

A suitable meter could be fitted into the case to make the unit completely self-contained. The prototype is used with an AVO Model 8 on the 30V range however. It has been found to give reliable tests with monochrome and colour receiver line output transformers, both in and out of circuit. Note however that any defective component in the line output stage will result in a low-voltage reading if the transformer is tested in situ. Typical readings with known good transformers are shown in Table 1. They were obtained using a 9V supply.

Table 1: Test readings

Transformer	In situ	Out of circuit
ITT CVC25	32V	—
Thorn 1500 (jellypot)	15.5V	12.7V
Thorn 9000	25V	—
Philips G8	25V	38V
Thorn 3000 (e.h.t. transformer)	24V	—
Decca Bradford	28V	—





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# Songs My Grandad Taught Me

Les Lawry-Johns

My memory for day-to-day things gets worse and worse. "That set of mine you repaired yesterday. There's just one little thing . . ." I can't remember doing their set or what was wrong with it, and unless I look it up in the book I just have to stand there for a while until the memory comes flooding back. "Here's the fiver I owe you for the job you did for me last week." "Oh, yes. Thank you very much." I'd completely forgotten. What would I do without H.B. to remind me about such things? So it's not really that I forget, it's just that the recall chip doesn't function until jogged. Probably a dry-joint somewhere.

I can remember my earliest years however. I can remember laying in a cot, watching the family eat and crying for some. Then my mother saying "look at him thinking he can eat our food". Also being pushed in a pram by my grandmother who told me she'd take me to the police station if I cried. But most of all I recall my grandad playing his concertina and singing his songs about the Crimea and the Balaclava Charge (the Light Brigade).

Mind you it wasn't all honey. Oh no. I was once supposed to be asleep when my grandparents were engaged in running Aunt Lil down into the ground. Half way through the tirade I woke up. My grandad noticed and immediately accused me of spying - "I'll cut his liver out" he bawled, reaching for one of his many walking sticks (the one with the dagger at the end). Grandma tried to cool him down. "Yes" he said, "I was only agreeing with you like I always do. Didn't say a word against her. I'll be glad to get back on board again, I swear I will."

"Play us a tune before you go" I asked. So out came the concertina and Grandma vanished into the kitchen to put the stew pot on. She made lovely stew, with dumplings. Mum couldn't quite get the same taste. Grandad started with a swinging rendition of The Bells, followed by a funny song I never really understood.

"I went into the butcher's and stole a leg of suet,  
Singing bullyah, bullyah bay.

I stuck it in me boot and didn't mean to do it,  
Singing bullyah, bullyah bay."

I clapped that then asked for my favourite.

"Bayonets charging bombs and mortar,  
Dying groans from every quarter,  
Down the Valley of Death the gallant charge was made,  
By the lion hearted heroes of the Light Brigade."

There was a lot more to it, something about the artillery thundered and someone had blundered, but I can't quite put it into context. Even for this my memory's not what it was.

I can still remember the first article I wrote for the magazine some thirty years ago however. About the HMV 1807 (I think). I followed this with one on the 1805 and earlier models. There's a resistor that goes high in the, let's see now, which circuit was it?

Some years later I met Johnny Logan, the one-armed engineer. Quite a character - happy to handle large sets and run over roofs putting aerials up. He gave me many a hint, like smearing custard over the centre spindle of BSR

record decks to prevent them running rough. Only kidding. He told me how to handle women, and shortly after I got divorced. He's up north now. Stay there John, I've been happy for twenty years or so now. H.B. says that if you phone us at 11 p.m. any more she'll smear custard on your centre spindle . . .

## The Pye 725

A friend (was) of mine brought in this Ekco CT822/1 - the Pye chassis with the vertical panels. The complaint was that the colour went on channel change or on sudden bright scenes. So I brought the hairdryer into play and when it was directed at the TBA540 the colour went.

"No bother Mr. Lupton" I said, changing the chip. The colour then stayed - until next day.

I checked this, that and the other, finally ending up at the TBA540 again. I put in another and the colour stayed for two days.

"It goes grainy as well now" said Mr. Lupton.

So I took out the i.f. gain/filter unit and resoldered all the suspect contacts.

The next day it was back. "Colour's gone again." He looked sort of tense, but only when he tried to smile.

This time the TBA540 said it wasn't guilty, but when the freezer was applied to the TBA560 the colour went off. In went another and we kept the set on test for a couple of days. Lovely. Three days later it was back again.

"It's gone grainy again." To cut a long story short, I changed the i.f. gain/filter unit and the tuner. And still it came back. Trying to see through the tears, I removed the filter unit and resoldered all the suspects as usual. The dry-joint was on the coupling capacitor C117, not on a coil as I'd thought. So far it's not come back, and Mr. Lupton did manage a smile as he went out with it. Funny how sets you know so well can give you so much heartache. Funny how quickly you forget it when the next one comes along.

## The Quad

A couple of weeks ago this chappie brought in a Quad amplifier. The little stereo solid-state one with 2N3055 output transistors and vertical plug-in audio panels. He said it worked for a short time then cut out. It worked for me all day, so I told him to check the rest of his set-up. "You mean the tuner?" he asked. He didn't use a record turntable or tape deck.

So he brought in the tuner, which was also a Quad. This time with valves in it. Sticking a signal tracer on the output, I found that it worked perfectly for some fifteen seconds then cut out, leaving a trace of background noise. There were a couple of 6BA6 i.f. bottles, a couple of 6AL5s, a 12AT7 (there should be two) and an ECC81 (equivalent) in the other 12AT7 position. I wondered where to start, then decided that I didn't have much choice - I could lay my hands on the 6AL5s (EB91s) but didn't suspect them, and wasn't keen on searching for 6BA6s because I was sure the last went years ago. So I looked hard at the ECC81. I felt sure I had one somewhere (out of an old VC3?) but I couldn't be sure where. I

knew that an ECC83 isn't far out and had plenty of these – for amplifiers and things. So I fitted one and the radio stayed on.

He said it sounded a little distorted (as it would through a signal tracer, for heaven's sake). So I stuck in an ECC82. He said it sounded better, daft bugger. The customer is always right however (never) and off he went quite happily. In fact an ECC82 was the same as fitting a 12AU7 in place of a 12AT7, way out. But he was convinced it sounded better.

### **The Table Lighter**

There were two sets on the bench. One had to be close at hand because it was on soak test and when things did happen they happened suddenly and horrifically. The other was a routine selector change (round for square) on a CVC9. In walked a tiny old lady of about eighty five. She plonked a coffee percolator and a table cigarette lighter in front of me.

"I want a yard of cable put on this, and a different screw put in the bottom of this because the proper screws won't go in."

I started to let rip and then shut up. There was

something about the old girl I liked. I tipped out a tub of small screws and found one that fitted the thread. She took it from me, pushed a flint up against the spring inside and tried to fit the screw. It slipped, and the flint shot out across the shop to heaven knows where. "Now look what you've done" she scolded.

I opened a draw and found one of my own flints. Took the lighter and pushed the flint up inside. Held the screw and tightened it. Flick the top. No flick. Of course not, the spring instead of the flint was hard up against the wheel. I unscrewed it and the flint flew into the CVC9. After a time I found it and removed the spring from the lighter. When correctly assembled the original screw fitted nicely and the lighter worked. She took it without saying a word and put it into her bag. "Just a yard of cable fitted to this plug and a mains plug at the other end." By this time other customers had arrived to consult the oracle and were smiling broadly at the antics.

"Pop back later dear. I'll fit the cable as soon as I get a chance."

"All right then. No one wants to work these days. I'll give you an hour, no more."

And off she went. A small figure with enormous presence.

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# **The Case of the Curious Cossor**

**Chas E. Miller**

As with so many once famous names in the domestic radio/TV field, that of A.C. Cossor is now a distant memory. Yet at one time it was a market leader, with radio and TV sets and the valves to go in them. Cossor were pioneers in the use of printed circuits and were one of the first firms to introduce a transistor portable radio receiver. The firm was started in the twenties as a valve manufacturer, but soon moved into the radio receiver field as well. Older readers will doubtless recall their famous kits which were sold under the Melody Maker name. Throughout the thirties the firm also produced ready made receivers. These were of generally rugged construction, but relied on t.r.f. circuitry long after most other makers had virtually abandoned it. Cossor called their t.r.f. sets Super-Ferrodynes, which no doubt sounded good in the advertisements. They also made some pieces of test equipment that were quite sophisticated by the standards of the day: the present writer still has and uses a 1937 wobulator which, so far as I know, has had but one capacitor replaced and retains the original valves.

Just before and during the second world war Cossor were involved in the production of radar equipment. At the end of hostilities domestic radio receivers reappeared, to be followed shortly after by a series of television sets. The example we're going to examine, the 901, was really a pre-war design. It illustrates perfectly the "sledge-hammer to crack a walnut" approach that characterised so many of the sets of the late thirties through to the early fifties, employing as it did a total of 28 valves, three of which were used for ordinary radio reception, and a Cossor 85K c.r.t. The tube was of interest in being one of the first to be fitted with an ion trap magnet (Cossor patented). Apart from that it was a round, 15in. type with a triode gun and a four-clip base. The use of an ion trap became the normal practice, to avoid ion burn of the phosphor screen, in the days before aluminized screens.

The vision and sound receiver sections were completely separate, each having its own input socket. These were fed by a splitting arrangement built into the main aerial panel, which also incorporated a simple attenuator for use in areas of high signal strength.

True to their belief in t.r.f. circuits, Cossor chose this type of vision receiver. It employed no fewer than four r.f. amplifiers. These used 63SPT pentodes, the Cossor equivalent of the more famous (notorious?) Mullard EF50. Detection was carried out by a single thermionic diode, type SD6, which was peculiar to Cossor. It had the B7G "button" base. Four more of these valves were used as sound and vision interference limiters and for line and field sync separation. Fig. 1 shows the video circuitry.

The video amplifier stage used another Cossor special, the 61SPT. It was a powerful, octal-based r.f. pentode capable of several watts anode dissipation. Note the overall low value of the anode load resistance. This valve had what must have been the most expensive screen grid feed resistor ever – a 6V6G beam tetrode which was used as a constant-current source. The video signal was d.c. coupled from the anode of the 61SPT to the c.r.t.'s grid, and the tube's cathode was connected to one side of the heater supply. Thus the latter, which was also common to the vision interference limiter and sync separator diodes, had to be maintained at well above chassis potential to provide the necessary tube bias. In fact with the brightness control set to minimum the heaters were at 390V, which probably gave more than one engineer a nasty little shock! A similar idea was used for the sound interference limiter diode, which had one side of its own special heater supply connected to the sound unit's h.t. line.

If these points suggest that the power supply was somewhat out of the ordinary, you're right! There were no fewer than eight heater supply windings on the power pack's three mains transformers. In addition to the oddi-

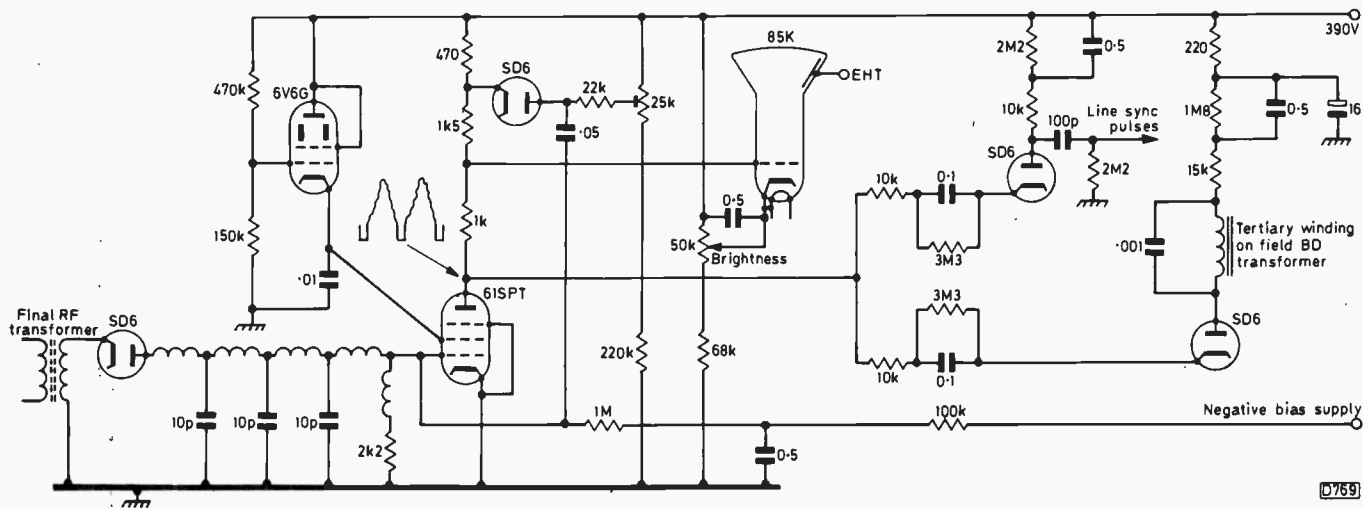


Fig. 1: The video and sync separator circuits used in the Cossor Model 901. A 6V6 was used to provide the video output valve with a stable screen grid supply. Separate diodes were used in the line and field sync separator stages.

ties so far mentioned, there was a hefty 6.3V supply for the majority of the other sound and vision valves while the 185BT line output valve required a heater supply of 0.45A at 18V. Lord knows why they decided to lumber themselves with this valve, but having taken the decision they used two of them, each with its own heater winding.

### The Timebases

Whilst the receiver, sync and power supply arrangements were quite complex, the timebases themselves were relatively simple. The field timebase used an OM4 double-diode triode as a blocking oscillator (the transformer had a tertiary winding for sync purposes) followed by a 6V6G output valve which was a.c. coupled (with an 8 $\mu$ F electrolytic) to the high-impedance field scan coils. On the line side an OM6 pentode (equivalent to the EF39) followed the diode sync separator as a pulse amplifier. Another OM4 (EBC33) was used in conjunction with the 185BT line output valve in quite an advanced configuration for its time, since the two valves acted as a self-oscillating multivibrator-type timebase.

### EHT Generator

Now comes a very crafty bit of work! Pulses from the anode of the line oscillator triode were taken to the grid of the second 185BT (see Fig. 2). When this valve switched off after the pulse, the giant r.f. choke in its anode circuit rang, producing a high-voltage oscillation. The initial positive-going excursion was rectified by the SU2150 which produced an e.h.t. of approximately 10kV. Naturally the SU2150 had to have its own highly insulated heater winding. This idea was dropped in the following

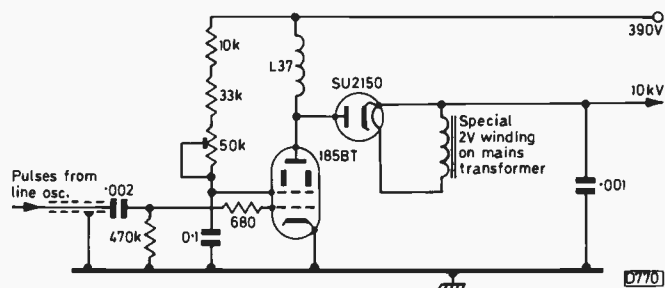


Fig. 2: The ringing-choke e.h.t. generator circuit.

Model 902 (which was similar in other respects) in favour of a straightforward high-voltage winding on the single mains transformer.

### TV Sound

For television sound a conventional radio-type superhet circuit was used. It employed the same range of valves as in the radio unit itself – OM10 frequency changer, OM6 i.f. amplifier and OM4 detector. The triode and one of the diode sections of the OM4 weren't used, though there was the previously mentioned SD6 sound interference limiter diode. The i.f. was 2.2MHz, which meant that the local oscillator had to operate at 39.3MHz (for Channel 1). To allow for the possibility of oscillator drift, a manual tuning control was provided. The detected output was passed to the equivalent OM4 in the radio section and then to the shared 6V6G output pentode. The triode audio amplifier incorporated a switched tone control giving five levels of bass/treble cut.

### The Cossor Approach

From the servicing point of view the 901 was probably a bit of a pig. It had a deep main chassis which would have made the components beneath hard to distinguish, while most of those on top were obscured by the tube. Nevertheless Cossor did make an effort to help servicemen by publishing a comprehensive valve voltage and resistance table. Having the correct resistance reading to chassis at every valve pin must have simplified fault-finding in many cases.

As so often seemed to happen in the vintage years, the "improvements" incorporated in subsequent models were of questionable value. Having fitted a permanent magnet focus unit in the 901, Cossor later reverted to the tiresome electromagnetic type that seemed to need adjustment half a dozen times during the course of an evening's viewing. Later came the neither one thing nor the other type of power supply, with a mains transformer for the heaters but the h.t. derived directly from the mains.

Despite their association with domestic radio and TV from an early stage, and many pioneering efforts, Cossor decided to pull out of this market in the late fifties. For a while badge-engineered Philips sets carried on the name, but it finally faded from the scene in the mid-sixties. Thus another household name entered limbo.

# VCR Clinic

*Reports from Steve Beeching, T.Eng. (C.E.I.),  
Derek Snelling, Mike Sarre, Mike Phelan,  
Mick Dutton and Les Harris*

## Ferguson 3V30

The trouble with a Ferguson 3V30 occurred, or so I'm led to believe, whilst the owner was away on holiday. The report was of f.m. modulator overloading – the symptom shows up as a bluish tint on peak whites, such as foreheads etc., though the replay signal level was perfectly o.k. The nature of the problem was confirmed by checking the signal level at the video output socket, suitably terminated at  $75\Omega$  of course. On record the luminance signal is passed through an a.g.c. circuit (amongst other things) prior to the f.m. modulator, and it seemed reasonable to suspect trouble in this department. Why make our initial check at the video output socket? Well, in the E-E mode the luminance output is tapped from the gain-controlled amplifier, so a fault here would affect both the recording and the E-E levels.

The HA11738 i.c. in which the a.g.c. circuitry is incorporated seemed a likely suspect, but replacing it didn't cure the trouble. At one point I began to suspect that the phantom twiddler had been at it – the E-E signal level could be varied but couldn't be lowered to a reasonable value. The a.g.c. loop involves quite a lot of circuitry. The luminance signal first enters at pin 26 of the i.c., where it passes through the gain-controlled amplifier. It passes out at pin 24 and returns to pin 13 after filtering. It comes out again at pin 14 and is then capacitively coupled to pin 28. It's at this point that the a.g.c. detector enters the scene, which means that the output from the gain-controlled amplifier depends on the signal level at pin 28. In this instance there was plenty of signal at pin 14 but not a lot at pin 28, indicating that the coupling capacitor C239 wasn't doing its job. It's a  $1\mu\text{F}$ , 50V electrolytic. S.B.

## Hitachi VCRs

Hitachis have predominated this month. First there was a VT8300 with the complaint of squeaking and distortion on sound, a common enough fault caused by the audio/control head vibrating. The head's number, 671, confirmed that it was one of the faulty ones – this one even obliged by vibrating whilst we were looking at it. Unfortunately the machine came back a week later with the same complaint. This time the fault took two days to show up. It seemed to be the same, but the vibration was now coming from the supply tape guide – replacing this item cleared the fault. There is of course no way in which you can convince the customer that there were two separate faults. After all the symptoms were the same.

Next came a VT8000 with no record. It was quickly established that there were no sound and vision in the E-E mode and no channel lights, though playback was not affected. The tuner and i.f. strip are powered by a 12V line that's present in all modes except playback, i.e. the "not-playback" 12V line. A quick check showed that this was missing, due to R069 ( $1.5\text{k}\Omega$ , 0.5W) in the "not-playback" 12V regulator circuit on the syscon panel being open-circuit.

The complaint with a VT11 was that it was noisy. This turned out to be the capstan motor knocking. The replacements from Hitachi are the ones for the VT17. Whether this is because they're better, or they are all that Hitachi

have got at the moment, I don't know.

I've finally had an Hitachi with a faulty bulb – a VT8300. This prevents the machine working of course and also makes the stop light flash. As this is supposed to indicate damp in the machine, our initial diagnosis was somewhat uncertain. However I'll know next time. I'll also start carrying an Hitachi bulb around with me. D.S.

## Spills

A word on liquids spilt into VCRs. We've just had in an Hitachi VT9500 that had obviously had something spilt into it a couple of months previously. Three boards showed signs of corrosion. Two could be cleaned with Servisol and methylated spirit. The third, the clock-timer board, proved to be more difficult and the i.c. had to be replaced. The VCR was then running very fast and a new motor was required. The internal PG coils in the old one had gone short-circuit and liquid had clearly got into it. The point is this. Whenever we get a case of liquid spilt into a VCR, be it water, orange juice or whatever, it seems to be several weeks or months before we see the machine. By that time corrosion has set in and started to cause problems. The owners spill something in, let it dry, then try it out. It usually works, so they forget it. But it's when the initial accident occurs that the machine should be stripped down and cleaned to prevent corrosion setting in. Whether our efforts with the VT9500 will prove successful or not in the long run I don't know – we haven't caught one as early as this before. D.S.

## Video Disc Players

We've recently taken delivery of some Hitachi video disc players. They raise a couple of interesting points. First, most TV sets have only one channel position modified for video use. If the customer has a VCR and a disc player, this means that they will both have to be tuned to the same channel, e.g. ch. 36. This in turn raises the problem of beat patterning if you want to record from the disc to the VCR via the r.f. lead. Yes, I know it's illegal, but you'll get customers who will want to do it. Secondly there's the problem of the order in which to connect them up, i.e. aerial-disc-VCR-TV or aerial-VCR-disc-TV. Hitachi make recommendations on this subject, but it's bound to affect the signal available. One can foresee problems, in particular with teletext sets. And what if the customer also has a home computer tuned to the same channel? I can see life getting rather complicated in future. D.S.

## Sanyo VTC5600P

The problem with this machine was no playback of its own recordings – the picture would show only when the machine was in one of the "trick" modes. Prerecorded tapes played back all right. I suspected a control pulse problem. There were off-tape control pulses with a prerecorded tape, but not with a tape the machine had recorded itself. So I put the machine into record and checked for pulses at the control head. None. Check back through transistor Q406 to the CX186 drum servo i.c. Still



nothing. Then back to servo board II where I came to the switching chip Q1315. The reference signal went in at pin 8 but didn't emerge at pin 9. Next check the switching voltage (pin 6) which was o.k. The i.c. is a CD4066B/TC4069UBP and the next step was to fit a replacement. This made matters worse! The switching voltage now stayed at 11V...

After considering the problem I decided to take an i.c. out of a stock machine. This cured the fault, leaving me with the simple task of ordering a replacement. We then had three more machines with defective TC4069UBP chips. The replacements from Sanyo were also dud. After three attempts and a couple of phone calls we managed to get some working i.c.s. So beware, even a new TC4069 may be faulty. **M.S.**

### **Panasonic NV333**

One of these machines would intermittently go from record or playback to rewind. We suspected the rewind sensor circuit (as good a place as any to start!). The output (3V nominal) from the supply reel phototransistor appears at pin 1 of P6010 on the system control panel and goes from there to pin 10 of the operational amplifier IC6004. The output at pin 13 should be 0V, but rose to approximately 0.5V in the fault condition. On checking at the other input, pin 11, we found a dry-joint where an additional ceramic capacitor had been added (across pins 10-11). This was pulling the connection of R6042 to pin 11 away from the print, as a result of which the voltage at this pin rose, activating the rewind mode. **M.S.**

### **Sanyo VTC5600P**

The problem we had on this machine was loss of colour in the E-E mode a few minutes after switching on – there was slight chroma in a vertical band at the centre of the screen, reminiscent of the magic-line tuning in earlier Panasonic colour sets. Checks at the input and output of the video panel confirmed that the colour was being deleted here. Whilst tracing through the signal path we noticed that the pilot burst cleaning pulse, which is applied to pin 6 of i.c. Q111, seemed to have grown an extra hump – just after the negative-going cleaning pulse itself. The pulse comes from the switching transistor Q177, and on fitting a replacement the fault had been cleared. It seems that this transistor must have been producing a back-e.m.f. when warm. **M.S.**

### **Ferguson 3V00**

One wouldn't think that a Ferguson 3V00 would cause us any headaches now, but this one did! The picture wavered from side to side, with displaced chroma, on all tapes. Pinch wheel we thought. It was well worn, but a new one didn't cure things. So we checked the spring pressure – o.k.

The tape was passing the control head smoothly, so we next went through the servo setting up procedure, including a ripple check on both motors. Everything perfect, but the fault still there. We noticed however that the capstan trapezoid waveform was not as stable as it might be – the length of the flat top portion was varying ever so slightly. To eliminate the servo, another panel was tried. Yes, the fault was a mechanical one.

We checked the capstan and relay spindles for freedom and truth, and all the belts – everything ran freely. Despair began to set in, so we lit our pipe and sat watching the

wretched machine. It was noticed that the entry guide roller was not entering the V block correctly. This alone would not cause the fault, but a closer look showed that someone had had a pair of pliers on the top of the roller. Replacing it cleared the fault. When we examined the roller we found that it was bent, the bend being on the part inside the plastic section. As a result the latter couldn't turn freely and was tight once during each revolution. We live and learn! **M.P.**

### **ITT VR580**

The complaint with this machine was that the tape would lace up but a few seconds after going into the play mode the tape would unthread again. We've had troubles with the opto-couplers used in these machines in the past, so we decided to check their outputs, starting with the wind tacho pulses generated by the opto-coupler fitted to the wind motor. A scope probe connected to pin 14 of the motor control module showed that these pulses were missing. We next lifted the mechanism into its service position to check the d.c. conditions at the opto-coupler. The voltage across the infra-red diode was nearly 8V, so the diode was clearly open-circuit. Replacing this cured the trouble. **M.D.**

### **Toshiba V8600B**

The customer's complaint was that the VCR wouldn't record. On trying it out sure enough there was no picture, just noise. With the cabinet top and bottom removed the machine recorded all right however, and no amount of tapping or pressing on the video board would instigate the fault. So we reassembled the machine and tried again. No recording! We eventually discovered that the fault could be made to come and go (monitoring the record r.f. output) by pressing the right-hand side of the case bottom: R365 at pin 15 of IC401 on the video board was being short-circuited by a PCB support lug. Filing this down cured the trouble. **L.H.**

### **GEC V4000**

This machine was brought into the workshop with the complaint that the cassette was stuck inside. On removing the top cover I discovered that the VCR was in the unthreaded state though the tape had been pulled out of the cassette. When the rewind button was pressed the reel motor ran but the left-hand reel didn't rotate. Pressing the fast forward button got the tape back into the cassette which could then be ejected. The cause of the problem was now clear – half the contents of a packet of salted peanuts were clustered around the left-hand spool carrier. **L.H.**

### **Blaupunkt TRV211 (Panasonic)**

This machine had had water spilt into it (they keep doing it to me!) and had been sent to another branch where the engineer had cleaned the servo board and replaced some components. When the machine was plugged in, the head drum ran all the time. The trouble was traced to leakage across the drum switching transistor Q6002 – cleaning the print side of the board cured the fault. The VCR was then tried out and was found to work in all modes except eject. We found that the eject switch measured about 40k $\Omega$  when pressed! **L.H.**

# Into the 90s with Neon Tester

Harold Peters

Any mum who took her lad along to the local Odeon to get him apprenticed as a projectionist twenty five years ago would have been out of her mind. The "pictures", she would have realised, had run their course and TV had taken over. Could today's mum be as ill advised to take her lad along to the local TV repair man to learn a trade that will last him into the nineties?

Receiver reliability has taken a massive step forward in recent times, and the amount of servicing required is falling to a corresponding extent. Nevertheless power is still consumed and heat generated, the odd transistor still goes short-circuit, and dry-joints continue to lurk in sets. Someone's going to have to continue the tradition, and they'll probably have to be able to handle VCRs as well. That means the ability to think about a wider range of symptoms, with causes both electronic and mechanical. Many of you have already reached this stage of course.

## In Retrospect

Since I started to write for this magazine two and a half decades ago phenomenal changes have occurred. Colour has come, the valve has all but gone, semiconductor devices of increasing complexity have arrived and the price of a 12in. monochrome set has dropped from one month's pay to two days' earnings. The magazine has changed too. Back in 1958 it cost 1/3d and was smaller: the title was prefixed "Practical". In today's changed world it goes without saying that most of us have to go about our affairs in a practical way most of the time. If there's still a division between types of people, it's not between the practical and non-practical so much as between analogue and digital types, so far as electronics are concerned at any rate.

## Prospects

Your scribe was on the point of deciding that there was little left to write about for analogue types when a visit to "Cable 83" at Wembley, in the hope of finding out all about satellite TV, caused him to change his mind. The place was full of bright young men who had never held a screwdriver and whose interest centred more on interactive terminals, data readouts and pence per hour than what happens if you clip out C47. Hope was immediately rekindled. It became clear that there will be plenty for us analogue types to do in the foreseeable future even if we don't get deeply into the digital stuff. Provided we keep clear of the things that aren't going to catch on anyway, it won't matter that C47 is no longer there to clip out. One thing we shall certainly become is "hook-up fixers", with the ability born of experience to put together the "black boxes" of the technological age and make the system work.

My personal view is that many of the wonders we shall be offered will fall by the wayside due to high cost, low entertainment/use value, or because they are not "user friendly". It seems that the man in the street hates having to press more than one button to get what he's after. Prestel is probably an example of something that's too

involved, too expensive, and on offer before it's generally needed. In the UK cable TV is coming after the VCR, the reverse of what happened in the States. Even if it does take root in certain areas, it will be a specialised branch of the trade - you will be either in it up to the neck or not at all.

So what will we be doing? TV servicing routines are already changing. Keeping sets out of the workshop by panel swapping is becoming a thing of the past. With a colour set's main chassis already reduced in size to that of a 1978 monochrome chassis we now need to be able to fault-find down to individual component level or bring the set in. The "dead" chassis that enables you to connect earthed equipment, like video feeds, is becoming more common. So too are connection sockets at the back for what broadcasters call baseband, Europeans CVBS (combined vision, blanking and sync) and you and I know as plain video. The most elaborate of these is the SCART socket, which was described last month (see page 132).

## Video Input

Until such sockets become commonplace it will pay to become adept at fitting your own for customers who want to feed signals into their TV sets. Naturally the chassis must first be isolated, but modern sets consume so little power that a small isolator can usually be fitted inside without causing impurity. The standard video output signals produced by VCRs, games, computers etc. are of 1V peak-to-peak at 75Ω. If you look into the unterminated socket with a scope however you will usually see 2V peak-to-peak. Within a TV set, the output from the video detector is usually 2.4V peak-to-peak. So the 1V external signal needs amplifying. A practical circuit that fits on to a small piece of Veroboard is shown in Fig. 1. The network to which the anode of the d.c. restorer diode is connected simulates the pedestal normally found at the output of a synchronous demodulator. If you get clipping or crushing, replace the network with a 2kΩ-4.7kΩ potentiometer and adjust for optimum results. If the gain is insufficient, increase the value of R1. It may be possible to use the unterminated 2V peak-to-peak signal if the two units are interconnected by a very short lead and there's no ringing.

A sophisticated "extra" would be to arrange for the set's remote control to switch to video automatically, or to do it by the VCR button. This can be done quite simply by making use of the switching used to speed up the flywheel line sync time-constant in the VCR position to actuate an HEF4053 two-way video switching i.c. as shown in Fig. 2. Only one of the switches in the i.c. is needed for video switching, so you've three left for other purposes such as sound switching and lighting LED indicators. Note that the HEF4053, which is used in the colour decoder of Pye/Philips teletext sets, is a MOS device.

## Multi-standard Operation

Multi-standard sets are becoming more common with the international exchange of tapes and the interest in satellite TV. They must have switchable polarity at the

vision detector, a sound section capable of handling a.m. or f.m. signals at four different carrier frequencies, and some means of decoding the three main colour systems. If you're content with monochrome reception all three systems are to a degree compatible, provided you adjust the field hold and height on a UK set for 525-line/60Hz field rate signals. Colour decoders that sort out PAL and SECAM already exist and more are on the way. Most of us have been used to the idea of PAL-only working for so long that a bit of information on the other two systems may not come amiss at this point.

The chrominance subcarriers in the SECAM system – one for each colour-difference signal – are frequency modulated but remain in the area of 4.5MHz. Saturation is represented by frequency deviation. The two colour-difference signals Dr (red) and Db (blue) are transmitted on alternate lines, the decoder demodulators receiving their inputs directly and via a 64µsec delay line on alternate lines. Synchronised switching is required to ensure that the demodulators receive the correct signals.

Since the subcarrier is present throughout the line there's no need for a crystal oscillator in the receiver. As with f.m. sound, pre-emphasis is applied at the transmitter and de-emphasis at the receiver. There's a choice of ident signals, either an extended burst of Dr or Db during the back porch period or ten lines of triangular subcarrier, alternately Dr and Db, during the field blanking period. The unmodulated subcarrier present in monochrome parts of the picture shows as a "fuzzy" trace on oscilloscope waveforms.

The NTSC system (USA, Japan, etc.) has a similar line frequency to ours but runs at 60 fields per second. The line period differs therefore and the vision bandwidth is narrower. The suppressed chrominance subcarrier is phase/amplitude modulated as in PAL, but without the phase change on alternate lines. The subcarrier frequency is around 3.58MHz, with a 9Hz burst on the back porch.

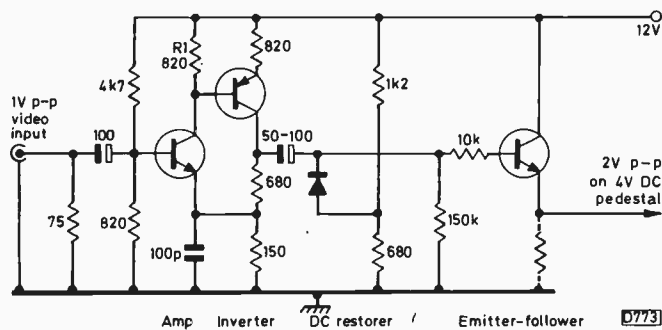


Fig. 1: Video amplifier to lift a 1V video input signal to a simulated detector output on a d.c. pedestal.

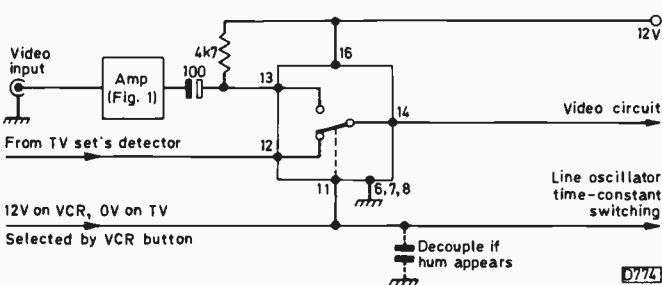


Fig. 2: Electronic video/TV switching using the voltage at the VCR button. If the amplifier is incorporated the input components (100µF and 4.7k) are not required. If extra switches in the i.c. are to be used, link pins 9, 10 and 11 as required.

The colour-difference signals are known as I and Q, have different bandwidths and the phase axes differ with respect to PAL.

Examining the line sync period enables you to identify the colour system: a still burst is NTSC, a twinkling (swinging) burst is PAL, and if the whole back porch is full of subcarrier, it's SECAM.

## COMPATIBILITY

In our future role as experts at putting black boxes together and leaving a working system we're bound to come across some units that refuse to work with certain others. You'll be aware of various TV set/VCR problems by now, but it's worth dwelling on this for a moment.

### TV/VCR Combinations

Interposing a VCR between the aerial and a TV set produces some form of compatibility problem in ten per cent of installations. Some dealers will only supply VCRs to customers who already have TV sets from them so that they can tackle the problem from both ends. It's a fact of life that some TV sets just don't like some VCRs, but by playing general post with them they'll all end up working perfectly. The Americans call problems "opportunities", so in their terms here are four main opportunities to get your teeth into.

First, the aerial circuit. A TV set's first tuned circuit is up on the chimney: it forms a bandpass circuit with the tuner unit's input lecher line, the coaxial cable providing bottom-capacitance coupling. Even without the complication of a VCR this lot can give trouble – like one channel being snowy while the others are good. The aerial is seldom 75Ω over its entire bandwidth, being inductive at the higher channels and capacitive at the lower ones. Sharp corners and staples can prevent the coaxial cable being 75Ω all the way down. In the set, the tuner and aerial isolator combination need to be exceptionally well designed to appear resistive over the whole band. Sooner or later combinations of these tolerance errors will produce a high-Q rejector circuit slap bang on the channel you want to watch. By interposing a VCR you double the bandpass circuitry and introduce splitting, amplification and combining as well. So anything can happen and maybe will.

Most VCRs provide unity gain (or slightly less) on the through channels but add 3 to 6dB of noise. If you've below 1mV of signal before the VCR is interposed, you'll begin to notice noise on the through channels when it's been fitted. The effect varies between makes: the only one the writer's seen to clean up a picture is an Hitachi machine. The ch. 36 signal from the VCR is added at between 1.5mV and 3mV on Japanese machines, at up to 10mV with Philips V2000 series machines. It would appear that VCR manufacturers seldom test their products on other brands of TV sets.

If you happen to get a problem of this sort, resistive damping sometimes helps – but you've got to have a good signal in the first place.

Secondly there's the problem of non-vestigial sidebands: VCRs all provide a double-sideband output on their own channel, i.e. the vision passband is ±5.5MHz of the vision carrier, with the 6MHz sound turning up at both sides. It's possible to tune the TV set's VCR channel to either of these two sidebands, only one of which gives correct operation. On the wrong one the a.f.c. will probably work in the wrong direction, tending to reject the signal on

channel change. If both the TV set and the VCR are correctly aligned, there should be no noticeable impairment due to the presence of a double-sideband signal. The VCR's performance can be readily checked in this respect by feeding its output into a teletext receiver and checking the text performance in the E-to-E mode. The performance should be as good as with a direct signal. Whilst on this subject, you're bound to be asked why a VCR won't record teletext: it's much easier to say that the data occurs during the head switching time than to go into details about bandwidth limitations.

Thirdly a.f.c.: with a.f.c. in both the VCR and the TV set it's possible that the two systems may interact. A.F.C. in anything works properly only when the a.f.c. coil and the vision detector coil are both tuned to exactly the same frequency (39.5MHz). In addition, the channel tuning should be set correctly with the set at running temperature. Otherwise the a.f.c. is permanently pulling the tuning in, and because it can never pull the signal back to 39.5MHz there is always a degree of mistuning.

An example of this type of problem is to be found in the Pye/Philips G11 chassis, where an extremely wide a.f.c. that's enabled only in the presence of a field sync pulse (to prevent lockout due to the adjacent sound) is used. For some reason interaction with the a.g.c. occurs if the tuner a.g.c. reservoir capacitor C5010 (150 $\mu$ F) dries up. Replacing this capacitor, which is beside the selectivity/gain module, is the first move when incompatibility is experienced with a G11.

Finally there's the question of modulation levels. The r.f. modulator is a weak part of the average VCR: if it's not set correctly there can be buzz, sync crushing, or crushing of white/yellow/cyan. Even when an oscilloscope applied to the set's vision detector shows an apparently standard waveform it probably isn't, due to an excess of residual carrier left in the modulation (see Fig. 3). Its effect is to raise the whole signal on to a d.c. pedestal at detection, giving rise to any of the defects mentioned above plus different brightness, contrast and colour levels depending on the way the set derives its a.g.c. and a.c.c. potentials.

Most modulators have two adjustments, video amplitude and bias. These should be set as laid down in the manual, or failing that by using a scope to monitor the set's detector output. An ideal waveform to use in the Ch. 4 test pattern. First draw this on the scope face at line rate, using a felt tip or chinagraph, whilst watching the direct signal. Then pass the signal through the machine in the E-to-E mode, using the video and bias controls to get the same result. There may be a third adjustment on the

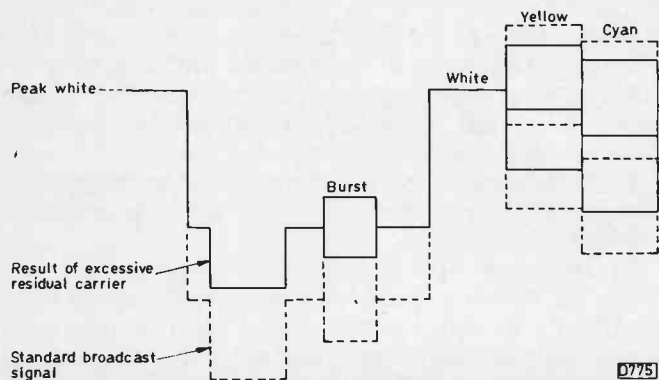


Fig. 3: The effect of too much residual carrier on a demodulated signal from a VCR. Note the reduced burst amplitude, different black level and yellow/cyan bar crushing.

modulator to mix in the sound: increasing the setting will introduce sound/colour beat patterns while reducing it will produce buzz.

From all this you will see that it's much easier to feed the video signal in at "baseband", as described earlier.

### Video-video Interfacing

Only an ostrich would pretend that video to video copying doesn't go on. Doing it through the aerial socket often results in patterning as both machines will have left the factory tuned to ch. 36. The simple answer is to detune the master VCR through the little hole hidden somewhere in the casing. Having done this you must then check that you've not spoilt any of the broadcast channels. Once again, using baseband video and sound gives better results: every time reprocessing occurs, something is lost.

### System Compatibility

Engineers are frequently asked about the compatibility of tapes from other countries. Generally speaking, exchanges of PAL tapes bring no problems, and provided you're satisfied with monochrome PAL/SECAM exchanges are straightforward. Swapping across the Atlantic is not on however: PAL and NTSC don't mix, mainly due to the different field rates. Bringing in VCRs from abroad can also be a problem, even if the machine is a PAL one. There are specialist firms that do conversions at a price – a possible opportunity for the more enterprising amongst you!

### Computers and Games

Much of the foregoing also applies to computers, video games, etc. If at all possible, interfacing at baseband will give a less tiring picture to the eyes, by virtue of the characters' verticals being "spot width" and therefore only just able to get through the modulation system with a bit of ringing. On the current Pye/Philips KT3 chassis portables the sync module has been modified for improved VCR etc. performance: early panels used a TDA2571Q i.c. while later ones use a TDA2571AQ, TDA3571Q or TDA3571AQ, all of which give better performance with VCRs, computers, etc.

The supply of cassette recorders for use with computers is another source of trouble. Naturally the one specified by the computer manufacturer is best, especially if it can be keyboard controlled, but in other cases the writer finds that the cheaper recorders preserve the data better than hi-fi units.

### VCR/Hi-fi Interfacing

When it comes to VCR/hi-fi interfacing you can score a point. All that's required is to connect a lead from the VCR's audio output socket to both channels of the hi-fi unit's auxiliary input (or whatever). You can then: listen on phones to one channel whilst the rest watch another; monitor a programme you're taping whilst watching another; use the hi-fi to enhance the sound quality; record TV music with better quality than the VCR gives. Note that the compact cassette tape speed is twice as fast. Regrettably Pye/Philips V2000 series machines at present don't have an audio output socket (though an adaptor can be added at extra cost) and turn off after three minutes if no wheels go round.



If from all this you can foresee yourself being kept busy without having to "go digital", read on: the best is yet to come!

## SATELLITE TV

A crossover point in the economics of television transmission has now been reached. It's cheaper to put up a satellite to broadcast direct to homes than to construct a network of ground stations. The reception technology involved may be unfamiliar, but is fairly conventional and will suit us analogue types down to the ground – literally. There has already been much in the magazine on this subject, but let's just summarise the basic facts. Communications satellites are in a common orbit at 22,500 miles above the equator. Because they travel at the same angular velocity as we do they appear to be stationary. In practice they wobble a bit. The Russian ones wobble more than the American ones because their launch site is farther away, so that they have to be brought in as it were from the side. There are two basic s.h.f. broadcast bands, C (4GHz) and Ku (12GHz). The BBC transmissions will be in the latter band, on chs. 4 (11.78502GHz) and 16 (12.01518GHz), from a satellite 31°W of south and about 25° above the horizon. You can check where to put the dish by observing where sunlight falls at 3 p.m. BST in mid-October – you will see that it need not be on the roof.

You will have to wait until 1986 or so to pick up these transmissions, so if you're keen enough to want to get some experience in the meantime the satellite to go for is the Russian Gorizont 4 which operates in band C. Reverting to the BBC's 12GHz satellite, you will notice that 31°W is just off the coast of Brazil, which may seem a rum place for a transmitter beamed at us. Twice a year however the shadow of the earth eclipses the satellite for up to an hour, cutting off its solar power. The position 31°W of the receiving country ensures that the eclipse occurs well after midnight so that it never interferes with peak viewing hours.

The predicted field strength for the whole of the UK is -103dB (W/m<sup>2</sup>), which is incredibly low. Expressed in words, it's one five thousandth of a microwatt per square metre of free air. "Bound to be snowy" you'll say. Strangely enough, nice clean pictures are expected using a dish of no more than 3ft diameter. This is in part due to the use of f.m. for the modulation, and to the ability of modern amplifiers to provide up to 40dB of gain without adding more than a few dB of their own noise.

The initial electronics are up at the dish and consist of a low-noise amplifier and down-converter, the latter providing an output at around 900MHz for feeding to the indoor unit. The latter converts to a final i.f. of around 70MHz – our conventional 39.5MHz won't do because a bandwidth of 27MHz is required. This signal is demodulated to provide baseband video plus detected sound. A modulator can be used to provide a standard u.h.f. output, or the VCR can be used. There may be a sync output and a choice of a.f. outputs, with and without de-emphasis. The use of the MAC system will introduce added complication.

### Going for Gorizont

We'll assume you're going to try 4GHz reception. The hardest thing is to get the first picture. Consider the variables that must be right before anything comes through at all. (1) Dish elevation – how high you point it. The accuracy needed at 4GHz is 1° (0.5° at 12GHz). Press

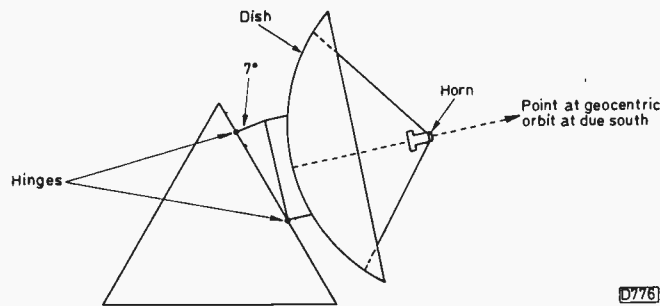


Fig. 4: Dish with polar mount. As the dish is panned on its hinges, offset by 7°, it tracks the orbital path right down to the horizon both ways.

on the side of a working dish and you lose the picture. (2) Dish azimuth – how far round from south. Same accuracy as for elevation required. (3) Dish focus. The signal pick-up feedhorn must be at the dish's focal point, where a clamp is usually provided. There are some two inches of adjustment: tolerance on weak signals is about half an inch up or down. (4) Polarization: the feedhorn must be in the correct plane of the received signal – at 90° out there's an absolute null. (5) Finally of course the receiver must be tuned to the required channel.

### Dishes

Gorizont 4 transmits a strong, conventional SECAM signal. You'll need a dish of about 6ft diameter. Ideally the base on which this is mounted should consist of level concrete inset with bolts, but railway sleepers will do instead. Mounts come with two kinds of adjustment, either simple worm screws for azimuth and elevation or polar. The former work like a camera tripod and are the simplest to use – they are all you require if you don't intend to start DXing once the novelty of Gorizont has worn off. With a polar mount (see Fig. 4) the dish is offset from its elevation hinge by a 7° "cheese", mounted thin end downwards. The dish must first be pointed exactly due south with the azimuth control at zero or mid-position, the whole array being inclined towards the elevation of the geostationary orbit at 0°. Once this has been done with precision, the azimuth adjustment will swing the dish around to track the geostationary orbit right down to the horizon.

It's now clear why the 7° cheese is there. The geostationary orbit, being over the equator, appears to recede at our latitude as it approaches the horizon. Due to the earth's noise, don't expect good results close to the horizon. When the 12GHz pictures come, the transmission "boresight" will be close to Morecombe Bay – the BBC expect noise-free reception within 300 miles of this using a 2ft dish. You'll need a wider dish if you expect to pick up the other channels assigned to this orbital position (Iceland, Ireland, Spain and Portugal). Also if you want to watch the French, Benelux, Swiss and W. German signals at 19°W – choose between one steerable dish or two separate ones pointing in different directions.

Having expensive equipment at ground level is a security risk incidentally, as we found to our cost. An anti-theft device is advised, especially to pioneers.

### Head End

The signal is picked up by a metal probe in the waveguide feeder. A screw may be present for tuning/matching. There are three conventional ways of conveying

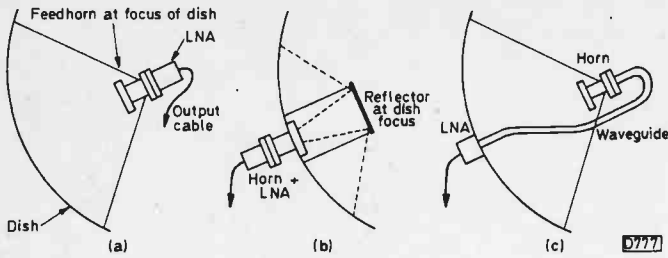


Fig. 5: Three methods of transferring the signal from the dish to the LNA. (a) LNA with feedhorn at the focus of the dish. (b) Cassegrain system with reflector. (c) Shepherd's crook waveguide, the preferred solution with current 12GHz equipment.

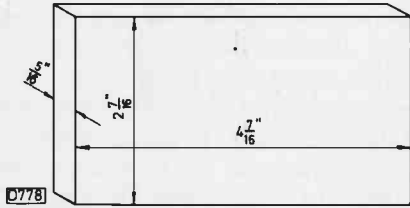


Fig. 6: PTFE block depolarizer. Being a soft plastic, the PTFE can be wedged into the feedhorn and should be pushed right home to the rectangular opening. Efficiency is proportional to thickness, but if it's too thick it will cover too much of the feedhorn opening.

the signal to and focusing it on the probe (see Fig. 5). The most common one for use at 4GHz is a feedhorn placed at the focus of the dish: the low-noise amplifier is bolted to the rear of the feedhorn. The cosiest place for the LNA is behind the dish however. The signal can be reflected there by an electronic lens placed at the dish's focal point - this is called a Cassegrain aerial. Alternatively the signal can be conveyed to the back of the dish by means of a waveguide that looks like a shepherd's crook. The feedhorn - or scalar horn - has a series of concentric rings at the input: its mode of operation can be likened to that of a u.h.f. Yagi aerial, the rings collecting the signal and passing it to the horn opening and thence to the probe.

### Depolarizer

As with other TV signals those from space are polarized, permitting co-channel operation. Most of the signals are circularly polarized, with the spin in one or the other direction, right- or left-hand. A circular feedhorn picks up both, and half (3dB in watts) the incoming signal will be lost whatever you do by way of positioning. What you need is a depolarizer, which rotates one component of the signal through 90° and adds it to the other, restoring the full available field strength at the probe. Depolarizers are carefully dimensioned sheets of high permittivity material such as PTFE (see Fig. 6) placed at the mouth of the feedhorn at 45° to the vertical (not the diagonal) of the

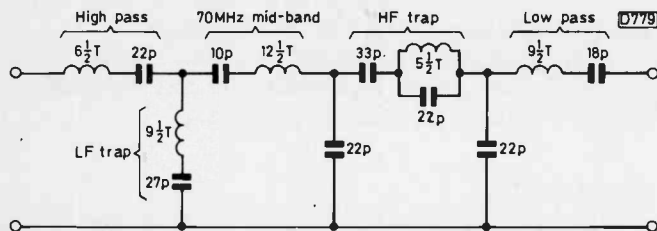


Fig. 7: The Tay Howard filter commonly found in 4GHz receivers of US or Japanese origin.

opening. Looking into the horn, the top of the depolarizer should be at the right for right-hand circular polarization and at the left for left-hand polarization.

### Practical Tips

To get the elevation right without an inclinometer, use a protractor nailed to a long straight edge with a plumb line dropped from its axis. With the straight edge laid through the feedhorn clamp and the hole in the centre of the dish, the elevation can be adjusted to within 1°.

To find south, use the sun at mid-day (1 p.m. BST), adding four minutes of time for every degree west of Greenwich or subtracting four minutes for every degree east, e.g. Portsmouth 12:04, Colchester 11:56. Use the pole star at night.

Beware of the capture effect. This characteristic of f.m. causes the signal to vanish suddenly during adjustment, not to return when you put everything back as it was. Change channels sharply and you should get the original picture back.

Advertisers tend to call their dishes 4GHz or 12GHz types. They are in fact aperiodic, receiving all frequencies. The degree of manufacturing precision has to be four times more accurate at 12GHz than 4GHz however. A 4GHz dish should be usable at 12GHz with some loss of efficiency.

### Electronics

Most of the low-noise amplifiers at present available come from the USA or Japan. They are watertight, sealed and tuned, and contain gallium arsenide f.e.t.s which don't like being bumped. The d.c. supply comes up the coaxial feeder, masthead amplifier style. Because the coaxial feeder is stiff and heavy, make sure you don't loosen the connector when twisting the feedhorn for polarization/focus adjustment or swinging the dish. Waterproof the joint during the assembly stage. Scalar feedhorns bolt on to the accompanying LNA through the holes provided - use them all and don't drill any more. Keep the cable from the LNA to the downconverter as short as possible, while allowing for the dish to be swung. If you buy an LNA and downconverter as a package complete with linking cable, use the length provided - like as not it's been matched to provide a bandpass tuned coupling between the two boxes.

LNAs are specified by gain in dB and noise in degrees Kelvin. Gains are typically 40-50dB while noise figures vary from mediocre at 160°K to incredibly good at 80°K. To convert °K to dB,  $dB = 10 \log (^{\circ}K/290) + 1$ .

There are two points of interest in satellite TV receiver units. The first is the very common use of the "Tay Howard" filter to provide 70MHz i.f. bandpass shaping. Fig. 7 shows the circuit and what tunes to what, since you may want to realign such a filter for Gorizont reception. Broadening the bandwidth improves the picture quality and reduces "sparklies" (those twinkling tails seen on VCRs in trouble) while narrowing the bandwidth reduces the noise.

Secondly there's the business of the dispersal signal added to prevent excessive field strength at any one frequency (to minimise interference with terrestrial microwave links). It shows up as a pulsing effect on weak signals. With Gorizont the dispersal signal shifts the carrier in a triangular fashion at 2.5Hz, with a deviation up to 2MHz. To improve reception, study the a.f.c. circuitry to

see if the decoupling can be reduced to speed up the response time without causing hum bars etc.

### Scrambling

The Gorizont transmissions are a suitable starting point because the signal is a conventional SECAM one that can even provide a good monochrome picture on a PAL set. Most other satellites carry commercial programmes, so scrambling is used to reduce pirating. Various techniques are possible. For example the sound may be converted to digital form and slotted in to replace the line sync pulse. As a result you can't resolve either the sound or the vision on an ordinary set. The sound digits may be further shuffled around, and random delays introduced in the line sync pulse start time. The sound on Gorizont is pretty dreadful when received without expansion, due to the use of compression. The way to deal with this was described by Nick Harrold in the December issue.

### MAC-C

When it comes to UK 12GHz transmissions, the suggested MAC coding system itself acts as a form of scrambling. Each TV line with MAC (Multiplexed Analogue Components) consists of a line sync word followed by a clamping period, 20 $\mu$ sec of chrominance information, then 40 $\mu$ sec of luminance information. Due to this compression of the chrominance and luminance information, the signals will have to be stored, stretched and delayed, something which will call for special purpose i.c.s. The advantages of the system are: (1) No cross-colour effects. (2) Improved definition. The absence of a subcarrier trap permits a full luminance bandwidth of 5.5MHz, while a full 1.3MHz chrominance bandwidth is possible without crushing the upper sideband as happens now. (3) Extra circuitry can be added to get rid of various disturbing effects, e.g. the luminance signal components beating with the line, field and subcarrier frequencies to produce flicker, patterns and a pronounced line structure. Removing such defects is particularly important when a large-screen projection set is being used.

The variant MAC-C is suggested for adding the sound. This permits up to eight high-quality sound channels to replace the line sync word. Instead of the latter, there would be a digital signal of the order of 200 bits per blanking period, with modulation in the form of phase shift keying. The eight quality channels that this would provide could cater for all the stereo and multilingual requirements foreseen.

### Opportunities

Entrepreneurs amongst you will have realised by now that there are plenty of opportunities ahead to produce bits and pieces to help satellite TV along, like expanders for Gorizont sound. Also required will be some form of field strength indicator for use beside the dish to show not only signal amplitude but also channel. A spectrum analyser is ideal, but is hardly the sort of thing to grace a muddy lawn on a wet day. You may find you have to erect a dish the day before the set arrives. Another requirement is a device for focusing and polarizing the feedhorn without your body casting a huge shadow over one third of the dish.

All in all there will be plenty to keep us analogue types busy for a long time to come.

# next month in

# TELEVISION

## ● THE CED DISC SYSTEM

The CED video disc system was launched in the UK last October. More and more players are appearing as production builds up. The basic CED technique is ingenious. During recording, the composite video signal is applied to an f.m. modulator whose output is stored on the disc in the form of capacitance variations along the track. During replay, the capacitance variations form part of a u.h.f. resonant circuit which is coupled to a second resonant circuit driven by a fixed frequency oscillator. An a.m. detector coupled to these circuits provides an f.m. output that follows the disc modulation. This is demodulated, processed and then remodulated to provide a signal for feeding to the set's aerial socket. The sound signal is recorded and played back in a similar fashion. Next month we'll take a look at the basic techniques and the players now available.

## ● SERVICING THE SONY KV1400UB

David Botto provides a step-by-step fault-finding guide for this popular 14in. colour portable.

## ● A QUESTION OF BLACK LEVEL

A black level signal is a considerable asset when making video programmes – the black level can be used to make tidy edits and at the start of the tape where wear and dropouts mainly occur. Malcolm Burrell describes a simple, two-i.c. black-level generator.

## ● SERVICING FEATURES

Our usual servicing features including VCR Clinic and TV Fault Report.

## ● DX SIGNAL DETECTOR/ALARM

This circuit is able to detect very weak TV signals, providing an audible indication when a signal is present. Two phase-locked loops are used, acting as a narrow-band filter to detect the line-frequency component of the received signal.

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# Test Report: AVO 2001 Digital Multimeter

Eugene Trundle

In the field of test meters, AVO is probably the most widely known and respected name. The analogue AVO Model 8 and its derivatives are almost legendary: it's been an industry standard for years. With this sort of reputation to keep up, any new instrument the company introduces needs to be good. I was very interested therefore to have the opportunity to test and report on the AVO 2001 digital multimeter.

It's a pocket-sized, battery-operated meter with an LCD (reflective) display, housed in a very tough moulded plastic case. There are but two, thumb-operated controls, a slider switch for function selection and a second one for range selection. The display panel gives a  $3\frac{1}{2}$  digit (maximum 1999) readout and indicates the unit of measurement (e.g. V, k $\Omega$  or mA) plus negative, a.c. and overload as necessary. There's also a low-battery indication.

An audio bleeper is provided for "eyes-off" continuity checking and to warn of invalid switch settings. There are three input sockets - common negative plus separate positive sockets for the voltage and current ranges. These take the standard AVO shrouded connectors, and a wide variety of probes and connectors is available, including high-voltage, r.f. and temperature-measuring types.

The instrument is designed to be hand-held or free-standing on the bench, the versatile support stand offering three positions: folded away; meter propped at about 30°; or fully opened to form a loop so that the meter can be hung from a convenient hook. Power comes from an internal PP3 battery whose life is about 400 operating hours.

## Brief Specification

Here's an abridged specification:

**Voltage ranges:** 0.2V, 2V, 20V, 200V and 1kV, a.c. and d.c. Accuracy 1% on the a.c. ranges, 0.25% on the d.c. ranges.

**Current ranges:** 0.2mA, 2mA, 20mA, 200mA, 2A and 10A, a.c. and d.c. Accuracy 1.5% on the a.c. ranges, 0.75% on the d.c. ranges.

**Resistance ranges:** 200 $\Omega$ , 2k $\Omega$ , 20k $\Omega$ , 200k $\Omega$ , 2M $\Omega$ , 20M $\Omega$ . Accuracy 0.25%—2% on the 20M $\Omega$  range.

**Continuity facility:** 0-2k $\Omega$  indicated; audible bleep with resistances less than about 900 $\Omega$ .

**Diode test:** 2V available at prods when open-circuit. Maximum current 300 $\mu$ A. Audible bleep indication of good diode. Junction voltage indicated on display.

## On Test

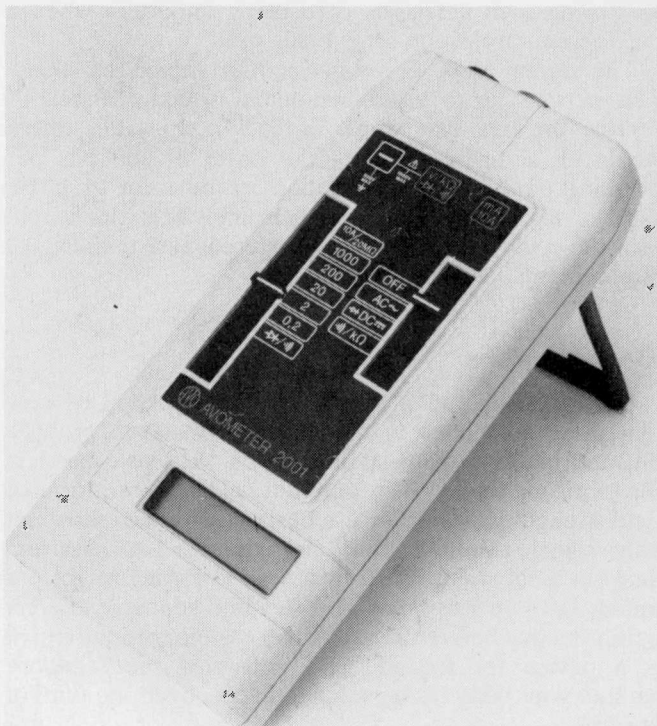
I use an AVO 8 for everyday servicing, calling on more exotic test meters only when great accuracy or a high input impedance is required. These occasions are surprisingly few, in spite of all the high-technology equipment that comes my way for repair and servicing. It was quite hard to kick the habit of using the AVO 8 so as to give its digital brother a fair trial, and there were times when I had

to revert to the familiar dial and pointer due to the *fruit machine effect*. This, for those who've not met it, is a characteristic of digital test instruments when measuring a varying quantity. It takes the form of an eye-boggling, ever-changing readout that's difficult to interpret. The AVO 2001 has an integration time of 100msec for the input signal: this goes a long way to suppressing the effects of 50Hz ripple, the most usual cause of the effect.

I found the instrument easy to use, and the display is visible over a reasonably wide angle. One of the accessories supplied is a rigid, direct-entry prod which when fitted to the input socket (top centre of the case) in effect turns the whole meter into a hand-held probe (you can't do that with an AVO 8!). The idea is that you clip the end of the negative lead to chassis (if the equipment being serviced has a chassis) or common negative, then go hunting with the meter/probe assembly. I found that this works very well with voltage and continuity measurements and helped me to concentrate on the diagnosis rather than the test gear. Digital multimeters such as this are virtually impervious to overloads, a useful feature when one is waving the prod around in the average power supply circuit or video output stage. Show me an analogue meter that would shrug off a full mains voltage application when switched to 200mV f.s.d.!

I used the audible indications less. Audible continuity checking is fair enough in principle, but when you're looking for hairline cracks in a printed panel for example there may be less than 900 $\Omega$  across the break due to parallel paths: I'd have been happier with an upper limit of 9 $\Omega$  (or even 0.9 $\Omega$ !) for full confidence in this approach. The diode test facility was also of little use to me: many a troublesome diode will upset the circuit operation due to slight reverse leakage - an out-of-circuit reverse resistance check on the 20M $\Omega$  range is the only test that will root out this sort of thing.

Full marks to AVO for the ergonomic design of the instrument. The slide switches are carefully placed to fall under the thumb when the meter is hand held, and the display readout is offset to the right to prevent its being



The AVO 2001 digital multimeter.



obscured under these conditions. The non-slip feet have enough friction when the meter is lying on the bench, even on a polished surface, to permit one-hand operation of the switches. Small points maybe, but indicative of the careful thought that went into the design.

After several weeks' use, during which I found that the meter was capable of doing all that its specification claims, I dismantled it to take a look at the innards. There are fourteen i.c.s mounted on two boards, plus a sprinkling of diodes and transistors. Most of the i.c.s are simple operational amplifiers and logic gates, the magic being done inside a 40-pin l.s.i. chip that functions as an A-D converter and display driver. I was particularly interested in the slide switches as these are the only wearable parts. They certainly look up to AVO standards. Further assurance on the reliability front is given by the parts list,

servicing instructions and factory repair facilities set out in the instruction book.

At the end of its stint in the workshop and the field the meter looked decidedly grubby! Its ivory colour and textured surface finish were largely responsible for this.

### Verdict

In conclusion, I was impressed with this digital multimeter and feel that its features are well suited to current needs and for the foreseeable future. There are certainly cheaper (and superficially similar) digital multimeters around, but pedigree costs money – and if AVO's traditional hardware is anything to go by, the 2001 will still be working when the others have fallen by the wayside. The trade price of the 2001 is £85.40 plus VAT.

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# Starting a TV Servicing Business

Tony Thompson

Why go to all the trouble of starting your own business? Let's consider some of the reasons. Perhaps you're tired of the daily rental round and feel the need to spread your wings – it's a common enough feeling amongst TV engineers, who tend to be a restless breed. Or maybe the recognition you'd expected from your employer never materialised. Then unemployment, unwanted and depressing, might persuade you to launch out on your own. Certainly there's much satisfaction to be gained from being your own boss and giving form and purpose to your ambitions. Becoming self-sufficient is no easy feat to perform however, and is even less easy to maintain. If the challenge appeals to you, or you simply like to plan your battles on a paper, read on.

### Where to Begin

You must first consider your own capabilities. Do you have the knowledge and the confidence to set up a servicing business? The answer is not simple. The more you know about the subject, the more pitfalls you'll anticipate: it's all too easy to conclude that the effort is hardly worthwhile. It's sometimes a case of fools rushing in where angels fear to tread. Luck sometimes favours fools – but only those who are prepared to learn from their mistakes. And you'll make plenty of those.

It's far from being simply a matter of having technical expertise. The person already in the trade has an advantage over the most enthusiastic and gifted amateur however, since his day-to-day experience will have provided him with a great deal of practical know-how – about sets and chassis, fault-finding and servicing techniques, also business procedures, ways of handling customers, addresses for spares, trade contacts, selling methods and so on. This kind of first-hand experience is valuable, but no one should despair if they don't have it, though it goes without saying that you've got to be technically competent to stand a chance of success.

Read everything you can on television matters. Much knowledge can be gained from reading, but practice is the real name of the game: if you're outside the trade, try getting some inside experience first. You can approach local firms to offer your services – help on Saturdays is often welcome, and you could become a valued stand-by

in the event of staff illness, holidays, and during rush periods. The answer may be "no", but you won't be shot on the spot – so don't be nervous about asking. If you're seen to be keen, and perhaps willing to help out for a bit in exchange for practical experience, you may be pleasantly surprised. It's always worth a try.

Assuming that you have the ability and a modest amount of money to start up with, what next?

One thing I firmly believe is that servicing information is absolutely essential. It has been said that in the days B.C. (before colour) there lived service engineers who were giants amongst men – they possessed the ability to repair any make of set without recourse to a service manual. Perhaps. But was every repair 100 per cent effective? In any case things have been very different since the advent of colour and the use of a wide variety of solid-state circuit techniques. The wet finger in the wind and a fist full of dropper sections will no longer suffice.

Technical change is still with us, with new i.c.s, new types of power supplies and so on being continually introduced. The only way to deal with this situation is to obtain knowledge. Most manufacturers, sadly not all, will supply service manuals if you ask for pro-forma invoices, stating what you want clearly. Trade knowledge of a wider kind is available through subscribing to a trade magazine, though you'll have to prove that you're a bona fide trader. You might also consider the annual *Radio and Television Servicing* books – you can probably take a look at them in your local library. You're a reader of *Television* of course! Buying a collection of manuals can be an expensive business: note the more common chassis and make a start with these.

### The Business-like Approach

Presumably you intend to work from home, at least initially. This poses certain problems, some of which I touched upon in an earlier article (TV Rentals, June 1983). More on this later.

You're going to need trade headings, if only to obtain those trade magazines or obtain an account with a good supplier. It goes deeper than that however: it shows the public that you are serious about your operation, not just another cowboy attempting to earn easy money. Your

headings and business cards are your public face: it's vital that the impression you give is a favourable one. Don't print your own: leave the John Bull printing outfit on the shelf and invest in smart headings etc. printed on good quality paper by a professional printer. Get quotes first, comparing like with like: offset may be more expensive than letterpress for very small quantities, but usually has the edge in appearance (many small jobbing printers use their type stock until the wear becomes noticeable). Don't forget the billheads, or in this case you could have a rubber stamp made up and stamp duplicate receipt books yourself.

You must have a reliable vehicle, be it a van or an estate car. Estate cars are probably the thing for part timers, and you should be able to obtain a tax allowance for the use of the vehicle, to cover both daily running costs and the expense of keeping it roadworthy. Talking of taxes, have a word with a sympathetic accountant. If you can find one by recommendation so much the better. You'll feel more confident with the backing of professional advice – and the last thing you want is money problems when your hands are full with the difficulties of getting the business started. Remember that whenever you sell or rent a set, if this is part of your business you must obtain a licence from the Office of Fair Trading.

VAT is unlikely to rear its ugly head to start with. It's prudent to discuss this with your friendly accountant however – it is surprising how quickly your turnover can rise to VATable levels.

### **Obtaining and Stocking Spares**

Spares are fundamental of course and you'll want an account with a supplier. You can try to convince him how sound you are, but if he has any sense he'll supply only for cash till he gets to know you. After you've been trading for a few months he'll probably unbend and you'll have a source of the most often needed components at the end of the telephone. You'll need more than one account, and it makes sound business sense as well as being morally fair to keep your accounts paid on time. If you neglect this you may find references hard to come by when you need them most. Or you may get bad references, which are a setback for a trader in his early stages.

Alternatively you can obtain much of what you require by post from advertisers in this and other magazines. If my own experience is any guide, you'll find little to complain about. In the main they're prompt and courteous and their spares are offered at prices that bear very favourable comparison with those of many major wholesale suppliers. Once they know you, many of these advertisers will consider opening a monthly account or supply you on a "phone for spares" basis.

What to stock is something of an imponderable. I know the spares I use most frequently, but to list these, chassis by chassis, would take another article. Your experience will tell you what's required. Draft your stock list under two headings, essential and desirable. Bear in mind that whilst keeping a customer waiting is undesirable, keeping shelves full of expensive spares that don't move for years on end is far worse.

What you consider essential will depend on your approach: if you intend to specialise in one or two well-known makes of TV sets, as some do very successfully, your needs will differ considerably from those of a repairman servicing items as diverse as say music centres, hi-fi, CB radio, in-car entertainment equipment and every known make of colour and monochrome set. Whatever

you decide to stock, always have a couple of universal e.h.t. trays handy and don't be without semiconductor equivalent charts.

### **Test Equipment and Tools**

A good multimeter is the first essential for day-to-day field servicing – a sensitivity of 20k $\Omega$ /V gives good enough accuracy for most purposes. It's a good idea to provide the meter with extra protection – mine resides in a dense foam lined compartment within the tool box. The alternative to a cheap and cheerful one is an AVO or similar quality instrument. The AVO is renowned for its reliability and strength and possesses really effective overload protection. If you want a higher sensitivity you'll need to think about a solid-state meter, probably with a digital readout.

The next most important tool is the soldering iron. The type to use is very much a matter of personal preference. I use a standard 25W mains-powered model with no frills such as temperature control. It takes time to warm up, and tends to lose heat rather too quickly when soldering heavier metal areas such as the bars in Thorn tuners or the joints between chassis frame and printed panels in ITT sets. But its simplicity makes for ruggedness. The one I use has lasted for years, even with the same bit (a worthwhile tip: before you use a new iron, remove the bit and smear heatsink compound on the shaft – this will help prevent seizure of the bit in its socket during use. Use thick white compound, not silicone). When the time comes for renewal however I'll be looking for a low-voltage, transformer-isolated model, one without earthing to the iron casing. Weller make such a model, designed to allow the iron metalwork to come into contact with voltages without damage. The quick-heat solder gun might appeal to you on safety grounds and for speed, but bear in mind the weight you'll have in your hand when using this tool: also the shape tends to be bulky and awkward to fit in the limited space in a toolbox.

I don't normally take an oscilloscope on outside work unless I've good reason to think I may need it. This item resides on the shelf above the bench. These are expensive, delicate tools that are hardly suited to the rough and tumble of outside servicing. They are too easily broken when you take a corner a shade too fast and you've forgotten to store your tools etc. safely because, as usual, you were in a rush and it was raining. As a self-employed person you have to buy your own test equipment, a fact that tends to make you rather wary of the prospect of picking up bits of shattered c.r.t. glass from the spare wheel storage compartment . . .

You'll need the usual range of hand tools of course – wire strippers, radio and standard pliers, crosspoint and standard screwdrivers, etc. The tools I find most useful are my set of metric and BA nut spanners (don't buy the type with one handle and umpteen replaceable shafts – they're time wasting and tend to be inefficient), and the double-ended trimming tool, plastic handled with wide and narrow flat brass blades. Aerosols should include your tin of switch cleaner (not CTC which is toxic-fumed and can damage plastics and carbon tracks beyond any hope of salvage), freezer for heat-sensitive faults, and either a tube or spray of silicone grease, which is ideal for clearing arcing problems around e.h.t. caps and high-voltage areas etc. A small hairdryer will also help with heat-sensitive problems.

You may want a stabilised power supply in the workshop, especially if you intend to service car radios and

cassette players. If it's variable, so much the better. These can be made quite easily, and if you have access to the RS catalogue you'll find several suitable integrated devices to make matters simpler still. I find that I rarely use a signal generator these days, but it's invaluable when needed.

The potential video engineer could easily be confused by the amount of apparently essential gear available: frequency counters, test cassettes, a host of special manufacturers' jigs and tools, etc. The best advice I can give is to build up slowly. Money is hard earned, so don't let it stand idly on a shelf in the form of some instrument a salesman has convinced you is essential. Maybe it is – but you'd do best to find out for yourself.

## **Getting Business**

I've put forward some of my ideas about advertising in previous articles. No business can succeed without work, and continuous work is best. Word of mouth recommendation is a valuable form of free advertising and is something you earn through your attitude to your customers and the standard of your work. But it's too slow to yield a return unaided – you've got to attract customers positively if you are to get going.

Working from home has its drawbacks. First, some people need more than a little convincing that they are dealing with a professional if the credibility that a shop or trade address bestows is not available. You will also attract those who want something done dirt cheap. Paradoxically, they tend to be ultra-critical of the finished result. It's also worth bearing in mind that you are expecting people to entrust to your care something they usually regard as a valuable family asset. It's for this reason that confidence builders, such as mention in your advertisements of any trade qualifications you happen to have, can do wonders in allaying doubts and help in drawing customers to your door.

If you envisage problems should too many people decide to come to your door, stress the "I'll come to you" aspect of your service. Many people prefer this for convenience and because they can see, or think they can, what they're paying for. It's likely however that a large percentage of your repairs will be of the take back variety, since faults are tending to become more and more complex and elusive. Less and less nowadays do I come across the genuine dead set, no raster, no sound, line across the screen type of fault that was once the staple diet.

On advertising I'll repeat what I've said before. Local newspaper advertising is expensive though effective. Unless you can run to front page display advertisements, the door-to-door delivery of an attractively produced leaflet is more likely to produce a worthwhile return for your limited funds. The PO will undertake such deliveries at a price, and you can even select your areas – if, for example, you feel that a particular housing estate is unlikely to be fruitful, you can choose to miss it. They'll even miss certain streets if you ask nicely. This is the most expensive may of leafleting, but it's guaranteed. Enquire at your local post office or write for details to your nearest main post office. A cheaper way is to enlist the services of the Scouts, or find distributors through the yellow pages and classified advertisements in local papers. The most economical method of all is to do it yourself: at least you know they've been delivered.

Local newsagents will usually display a postcard-sized advertisement for a modest charge: this won't set your telephone afire with calls, but it all helps. Do make a neat

job of the lettering, or have the card printed. Hand-scribbled cards look amateurish, the one thing you must avoid.

## **Hints and Tips**

This article, as with previous ones, has been written from experience. I'd like to round off with some general hints to help anyone trying to make a go of things in the present difficult times. Note however that you're reading my personal opinions and, like almost everyone I know, I'm fallible!

First, don't take on VCR servicing unless you are absolutely certain of your ground and have access to service information and the correct spares. I service only the makes I sell. The design and construction of certain cheap machines leaves a little to be desired. Best leave these repairs to the original suppliers, whoever and wherever they are. There's also the problem of so-called "grey imports", machines that have come into the country other than through the manufacturer's normal channels of distribution. Some sharpies offer such machines at attractive prices, but disappear before service under warranty is required. The makers won't entertain repairs to such machines: this is when the unfortunate purchaser, seeking an economical repair, turns up on your doorstep. So be warned.

Watch out too for the dreaded bodger. He's always with us. You know the kind of thing – the customer tells you that his next door neighbour has had a look at the set (he fixes fruit machines and used to work on tanks in the army, so he's o.k.), says there's not much wrong but that he's too busy/doesn't have the parts. So you take the back off, or it falls off because there are no fixing screws, and inside are wrong fuses or no fuses, wired across fuses or countless other horrors. I've had motors wired the wrong way round on cassette decks, silver paper fuses, completely wrong type valves fitted, thermal cut-out resistors wired across and many, many another atrocity. Sets of this type can represent both a challenge and a considerable waste of time. They are unlikely to make you rich, or even to cover the cost of the time it will take you to sort them out. Nowadays I simply take a look, then refuse to touch them.

Don't undercharge for your work. If it's good, and you've confidence in your repairs, it's worth a fair rate. You'll gain little in the long run by doing cut-price bodes. This brings me nicely to my final point. Don't be a cowboy. Strive to do a thorough and professional repair, one at least as good as the general condition and age of the set will allow. It makes sound financial sense in the long run. In this business it's all too easy to get a bad name – and conversely it's difficult to get and keep a good one. People remember the last time the telly went wrong, especially if it was just after they'd been charged, however reasonably, for a repair. Don't use second-hand valves or components. Don't fit over-rated fuses, or wire-wrap bits of droppers as bridges. Do it right. It'll pay, eventually. And keep a sense of proportion. However good you are, you can't win every time and must learn to cut your losses on the banger you mistakenly accepted for repair or the quote you gave in all good faith only to find you were miles out – on the wrong side. Honesty is sure to loose you the odd customer now and then. If you charge a fair rate for a fair repair however your reputation will build up. Then, with a bit of allowance for luck, your business will become established.

# Is Moonbounce DX-TV Possible?

Dr. S. C. Giess

For many years radio amateurs have made contact across continental distances at both v.h.f. and u.h.f. by bouncing signals off the moon. This moonbounce, or eme (earth-moon-earth) as it's sometimes known, is a demanding technique: since the signal path is long at some 750,000km, the received signal strengths are low. So amateurs normally use all the transmitter output power they can legally employ to feed large aerial arrays, with sensitive receivers and narrow-band modes of operation – usually morse, occasionally s.s.b. All in all it's a challenging technique.

Reading about amateur radio moonbounce led me to consider whether it would be possible to detect TV signals from distant transmitters by using the same principle. My conclusion is that it may indeed be possible to do this, and experiments are being undertaken to see whether it's feasible in practice. The present article compares the radio amateur situation with the problems a TV-DXer faces, and introduces aspects of the topic special to DX-TV.

## Time Window

The basic situation is shown in Fig. 1. It will be appreciated first that the moon must be above the horizon at both the transmitter and the receiver for the method to work! This puts limits on what signals can be received at any specific time. If the intention is to try to pick up signals from a particular terrestrial region, the time window must be calculated.

Radio amateurs usually employ rotatable transmitter/receiver aerial systems, and can therefore follow the path of the moon while it's above the horizon. Their time window for communication to a given region may thus be several hours wide. Unfortunately, while a DX-TV enthusiast may have a rotatable receiving aerial, the transmitting station aerial is fixed, with its power beamed towards the local horizon. It follows that the only time when the moon will have any signals to reflect is when it is just rising or setting at the transmitter location. So the TV-DXer has a much narrower time window to receive signals from a particular region.

We can estimate the duration of this time window: if the transmitter aerial has a vertical beam width of say  $10^\circ$  then, since the earth rotates through  $360^\circ$  in 24 hours, the moon will pass through the beam in approximately 40 minutes. The exact time to attempt reception can be calculated precisely on a home computer, using a knowledge of spherical trigonometry coupled with the orbit of

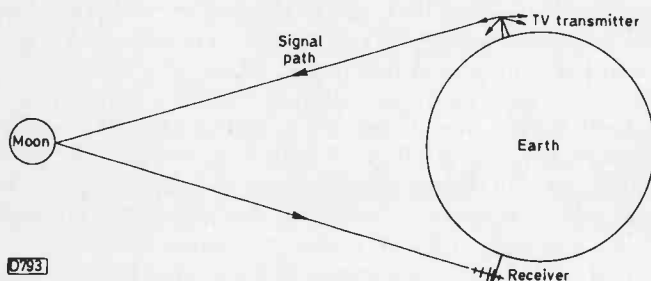


Fig. 1: Signal path for moonbounce reception.

the moon. You may however, like the writer, prefer to visualise the situation with the aid of a humble globe and an orange, using the moon rise/set tables given in reference 1.

## Ham Transmissions

Radio amateurs have achieved moonbounce contacts in several bands, namely 144MHz, 435MHz and, for region 2 amateurs in the Americas, 220MHz. In the Americas amateurs can use transmitter powers of around 1kW to feed the aerial system. The aerial systems employed are usually stacked Yagi arrays: I've read of arrays consisting of 24 13-element Yagis and 8 18-element Yagis for 144MHz use. If a 13-element Yagi has a typical gain of some 11dBd (dB with respect to a half-wave dipole) and an 18-element Yagi a gain of some 13dBd, then these large arrays have gains of approximately 25 and 22dBd respectively. Aerial phasing losses would reduce the gain figures by 1-2dB. Nevertheless the effective radiated power (transmitter power  $\times$  directional aerial gain) of these amateur systems is of the order of 100kW at 144MHz, which is comparable with the e.r.p. of a typical main Band I/III TV transmitter.

## What could be Detected?

Because of the low signal-to-noise ratio we can, as with amateur radio practice, detect signals only when using a narrow-band receiving system. This means that the only aspect of the TV signal that could be detected is the field scan modulation – the field buzz.

As the 50Hz buzz of a 625-line system carries no identification, it would be more convincing in Europe to detect 525-line transmissions with their 60Hz field buzz. Since there is very little by way of 525-line broadcasting in Europe (only some low-power AFRTS outlets), the signals would have come from the Americas. By the same reasoning, American enthusiasts would try to detect 50Hz buzz received in the opposite direction.

## Channels to Try

Two channels have advantages, channel A2 (55.25MHz vision) in Band I and channel A7 (175.25MHz vision) in Band III. As these vision carrier frequencies are the same as for channels E3 and E5 respectively, it's possible to align the moonbounce system by taking advantage of meteor scatter or aircraft bounce propagation from distant European transmitters. In the UK we can also use the channel B6 sound carrier with 1MHz offset for this alignment – until the closedown of the 405-line system.

There is a disadvantage in using channel A2 in that multi-hop sporadic E or F2 propagation occasionally brings American signals to Europe on this channel. Care would have to be taken to check the directions of any channel A2 signals to avoid ambiguity. This might be done by seeing if the signal fades when the receiving array is not pointed at the moon.

As well as these alignment advantages, the use of the

lowest channels in each band maximises the power fed to the receiver, thus giving the best signal-to-noise ratio. This is because the effective collecting area of an aerial is proportional to its gain multiplied by wavelength squared – so for a given aerial with a fixed number of elements and thus gain, the collecting area is greatest with the longest wavelength.

### The Signal-to-noise Problem

We can obviously detect these TV carrier signals only when their received power exceeds the background noise. This background noise has several components: receiver noise, galaxy and universe radiation (the cosmic background), solar radiation, and unwanted signals picked up due to receiver imperfections, i.e. non-perfect i.f. passband performance, non-zero image rejection, and cross-modulation caused by strong out-of-band signals overloading the r.f. and mixer stages.

If we can arrange (1) that the receiver's noise figure is low and that its other imperfections are minimised by the judicious use of front-end filters, and (2) that the effect of the sun is made negligible by conducting the experiment after the sun has set at the receiving location so as to eliminate any solar radiation picked up by the aerial side lobes, also choosing the time of the month to minimise reflected solar radiation, we are left with the cosmic background as the ultimate background noise. In order to assess its importance, we need to consider the power available to the receiver for a moonbounce signal and then compare this with the cosmic background.

### Received Signal Strengths

To calculate the power of a signal that's been reflected by the moon, a modification of the radar equation is used, as follows:

$$P_r = P_t \times (A/4\pi R^2) \times (1/4\pi R^2) \times (G\lambda^2/4\pi)$$

where  $P_r$  is the power at the receiver,  $P_t$  is the transmitter's effective radiated power,  $A$  is the moon's equivalent scattering cross-sectional area,  $R$  is the distance between the moon and the earth,  $G$  is the receiving aerial's directional gain, and  $\lambda$  the wavelength. Note that  $G\lambda^2/4\pi$  is the receiving aerial's collecting area.

Now for a sphere of diameter  $d$  and having a perfectly conducting surface,  $A$  is  $\pi d^2/4$  if  $d$  is much greater than the wavelength. Since the moon has a non-conducting surface that's rough on a scale roughly equal to wavelength,  $A = A$  (perfect sphere)  $\times L_s$ , where  $L_s$  is the scattering loss. For the moon  $L_s$  is 0.05 in the frequency range 50-

**Table 1**

Frequency (MHz)	Power at receiver (dBW)
55.25	-181
145	-178
175.25	-186 (a)
175.25	-180 (b)

**Table 2**

Channel	Frequency (MHz)	Aerial gain* (dBi)	Array
A2/E3	55.25	14	4 3-el Yagi
Radio amateur	144.6	25	24 13-el Yagi
A7/E5	175.25	19 (a)	4 11-el Yagi
A7/E5	175.25	25 (b)	24 13-el Yagi

\*A half-wave dipole has a gain of 2dBi.

**Table 3**

Frequency (MHz)	Power dBW/Hz	Direction
55.25	-193	Galactic pole
55.25	-185	Galactic equator
175.25	-204	Galactic pole
175.25	-193	Galactic equator

200MHz (see reference 2), i.e. the reflected power is 0.05 times the incident power. Taking  $R$  to be 384,000km and  $d$  3,476km, the values of  $P_r$  shown in Table 1 are obtained with the receiving aerials listed in Table 2.

For comparison, the signal strength for a good TV picture is roughly 1mV r.m.s. at a tuner's 75Ω input, a power of some -80dBW.

A 24 13-element Yagi array at 175.25MHz provides equal gain to a radio amateur array at 144MHz – but you'd probably need the resources of a club to afford it. The 55.25MHz and 175.25MHz quad aerial arrays are proposed by the writer for a DXer working alone.

### Cosmic Noise

Radio astronomers have found that the strength of the cosmic background noise depends on both frequency and the direction in the sky (see Table 3). The highest background power comes from the galactic equator – the Milky Way – so it's desirable to carry out experimental reception when the moon is not in line of sight of the Milky Way. The figures quoted in Table 3 (from reference 3) for the strength of this noise are spectral powers: this means that the total power the receiver possesses is the spectral power multiplied by the bandwidth. For instance, a receiver with a 1kHz bandwidth would receive a power of -163dBW at 55.25MHz from an aerial pointing at the galactic pole, the corresponding power at 144MHz being -174dBW. A comparison with the estimated wanted signal power for amateur reception at 144MHz, -178dBW, shows why moonbounce requires narrow-band operation – any wideband signal would be lost in the cosmic noise.

A comparison of the expected TV signal strengths for channel A2 (-181dBW) and channel A7 (-186dBW) with the background noise levels of -163dBW and -174dBW respectively with a 1kHz bandwidth indicates that TV-DX for a solo operator is a more difficult proposition than amateur radio communication done with club resources. A study of the *World Radio Handbook* however shows that there are at least three channel A2 system M transmitters in the Americas with transmitter e.r.p.s in excess of 100kW – one is quoted as 900kW – while there are ten channel A7 transmitters with e.r.p.s in excess of 150kW, four being over 300kW. This means that the estimates of wanted signal power listed in Table 1 may be somewhat pessimistic, in which case there's a reasonable chance that a solo TV-DXer will be able to detect these signals.

The writer hopes to report on practical details and findings at a later date.

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- (2) M.I. Skolnik, *Introduction to Radar Systems*, McGraw-Hill. Page 604, 1962 edition.
- (3) J.D. Kraus, *Radio Astronomy*, McGraw-Hill. Page 237, 1966 edition.



# Confrontation with a Sanyo

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

I'm often asked how and where I start when VCR fault-finding. The answer is that I rely on experience and an awareness of the video signal processing that takes place in the machine. Here is an example of a fault that took two-three hours to sort out, the VCR in question being a Sanyo VTC5300. It turned out to be a design problem for which Sanyo have modifications, but I didn't know this until a couple of days later. Let's start at the beginning.

Andy said we had a problem. It was only a small problem because it occurred only every so often. The customer wasn't bothered about it except when he wanted to record war films. Well, all this was more than a body could stand. I just had to ask what the problem was. Later of course I regretted opening my mouth.

The complaint was that the picture went "funny" when loud sounds were replayed. Obviously the standard customer with a sharp mind and an acute sense of detail. The VTC5300 that confronted us was accompanied by one of the customer's tapes to illustrate the problem. Playing this did indeed reveal that there was some sort of fault whenever explosions occurred on the screen (it was a war film, not Andy having a party). The servo lost lock to the extent that the sound also varied in pitch. More to the point technically, a change in the video level from white to black appeared to contribute to the servo lock problem. Having had this sort of thing before, I knew that the cause of the problem would be somewhere in a sync separator circuit.

## AC Coupling

In order to illustrate the nature of the problem with which we were faced, it's necessary to understand a video signal's d.c. conditions before and after it has been passed through an electrolytic coupling capacitor. The demodulated off-air video signal in the VTC5300 passes from the i.f. strip via an emitter-follower stage. The relevant bit of circuitry is shown in Fig. 1: the emitter-follower drives a 470 $\mu$ F electrolytic loaded by a 75 $\Omega$  resistor. Since the video signal is non-symmetrical, the currents flowing into and out of C are also non-symmetrical, and a video signal containing a lot of peak white will produce a negative charge across R. As a result, the d.c. level upon which the

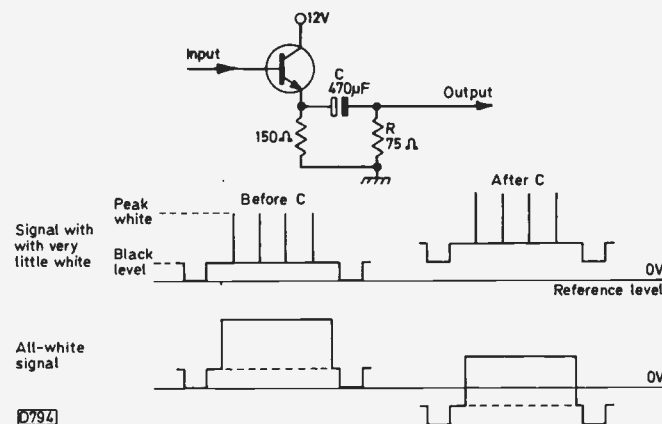


Fig. 1: Effect of a.c. coupling on a video signal.

video sits will be negative, with the sync pulses entirely below the zero reference level. A video signal with a continuously changing white content will float up and down with respect to the reference level after passing through the coupling capacitor.

Now if the reference level should be a sync separator's slice level, it's reasonable to assume that the use of capacitive coupling will result in problems, with the video signal contaminating the separated sync pulses to an extent dependent upon the white content of the signal, or alternatively loss of the sync pulses. A sync tip or black-level clamp circuit would stabilise the signal's d.c. condition, enabling a sync separator to function correctly independently of the signal's video content. The problem encountered in the Sanyo VTC5300 was of this nature.

## Relevant Circuitry

The relevant section of the VTC5300's circuit is shown in mainly block diagram form in Fig. 2. So that we could work with the fault symptoms continually present, the signal generator was arranged to switch from a full-white signal to one at black level. Initial tests indicated that loss of servo control in the record mode occurred when the signal changed from white to black.

The problem was not present when an external signal was fed into the machine, avoiding the capacitive coupling at the output of the i.f. strip. As a check, I inserted a capacitor in the signal generator coupling to simulate the off-air conditions. Considerable d.c. level changes were then noted across the 75 $\Omega$  resistor at the input to the a.g.c. loop. As a cross-check, the f.m. record drive and the E-E outputs were monitored. As expected, there was no change in the d.c. conditions at the drive to the f.m. modulator, due to the presence of the clamp (Q1039). The E-E output did show a change, but this was not as great as expected, probably due to the a.g.c. action. So we had a considerable change in the d.c. level of the signal at the input to the a.g.c. loop when we switched from white to black, but a much smaller shift at the output from the gain-controlled amplifier.

Very different results were noted when the situation at TP1239, the field sync pulse feed to the servo circuit, was checked. With a change from black level to white there was no problem. With a change from white to black about six field pulses went absent, accompanied by loss of drum servo lock. Having discovered what was going on, our next move was to trace the circuit operation back from TP1239.

## Evaluation

Q1239 is simply a pulse amplifier that's used to integrate out the line sync pulses. Q1238 separates the sync pulses from the composite video signal. Clearly a shift in the d.c. level of the video signal at the base of Q1238 will change its slicing level and cause sync separation problems. Q1238 is biased at its emitter so that it's off when the positive-going video signal is present but conducts on the negative-going sync pulses. Hence inverted sync pulses

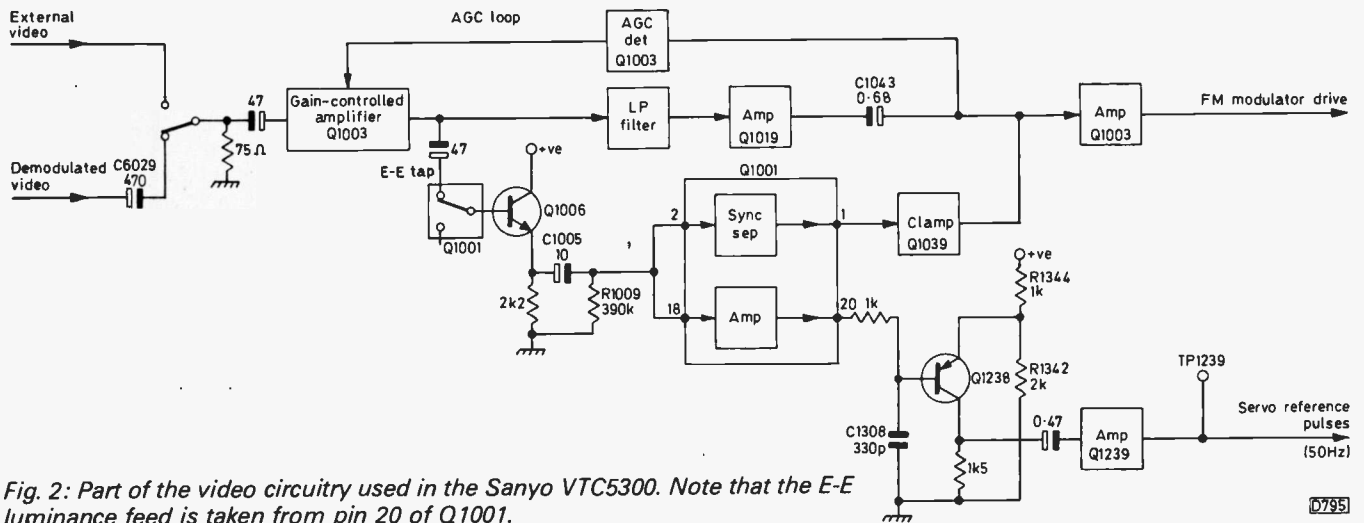


Fig. 2: Part of the video circuitry used in the Sanyo VTC5300. Note that the E-E luminance feed is taken from pin 20 of Q1001.

appear at its collector. If the d.c. level of the input signal drifts very far in the positive direction, the negative-going sync pulses won't be negative enough to switch Q1238 on, i.e. the slice level will be beneath the sync tips with no output from Q1238.

The action of Q1238/9 in producing field sync pulses was found to be a bit suspect. Q1238's slicing level is determined by the bias network R1342/4. The pulse output at the collector of Q1238 was found to be less well defined with a full-white video signal than with one at black level. This was due to that fact that with a full-white video signal the d.c. level of the signal at the base of Q1238 moved negatively. As a result, the signal slicing level was above black, with video information contaminating the sync output. The effect was to upset the sync pulse transitions, i.e. the timing capability. On a change from white to black however the signal level at the input to Q1238 moved positively then suddenly fell, the loss of sync occurring with this change.

Moving back to Q1006, we found that the signal at the base followed the level change monitored at the E-E output. We also discovered that the sync separator within i.c. Q1001 was affected by the level shifts, but not to the extent that Q1238 was.

Fig. 3 illustrates the comparison in d.c. level shifts at the base and emitter of Q1006 (E-E) and the input to Q1238 (across R1009). The level at the base of Q1006 shifted positively under the fault condition while the signal across R1009 moved positively and then, more rapidly, negatively. There was thus a hump in the response time of the d.c. shift at the base of Q1238, and it could be seen that this was where the field sync pulses were disappearing – the timing being around 200-300msec. Bear in mind that Q1006 is within the a.g.c. loop, and that the time-constant C1005/R1009 is contributing to the problem.

## Cures

I decided to shunt C1005 with a 100 $\mu$ F capacitor to increase the l.f. response at this point. The effect was dramatic. The whole a.g.c. loop started to oscillate at l.f., with the video signal yo-yoing up and down. This explained the hump as being the first part of a damped response: increasing the value of C1005 had obviously increased the l.f. loop gain.

Next I tried reducing the value of C1005 from 10 $\mu$ F to 4.7 $\mu$ F. On checking the result, I found that the outputs at TP1239 were o.k. with the video signal at black level and with peak white. On switching from white to black

however two-three field sync pulses were missing. An improvement on six pulses disappearing! A further reduction in the value of C1005 to 0.47 $\mu$ F stabilised the d.c. level very well, with no hump and no lost sync pulses when changing from white to black.

Forgetting the video signal for the moment, if you consider the d.c. voltage shift as a low-frequency step, i.e. a half cycle of l.f. signal, then reducing the value of the coupling capacitor will reduce the low-frequency response. In other words by careful selection of the value of the coupling capacitor the low-frequency response will be reduced and the d.c. shift removed. This would impair the l.f. response in a video signal path, but is acceptable where the signal is used only to drive a sync separator.

Having worked out that changing the value of C1005 to 0.47 $\mu$ F cured the problem I approached Sanyo. This revealed that there was a modification, which I tried bit by bit. (1) Reduce the value of R1009 to 150k $\Omega$ . This reduced the number of field sync pulses lost to about three instead of six. (2) Shunt C1308 with 1k $\Omega$ . This turns Q1238 further on and raises the slice level so that if the video signal moves positively the sync pulses remain within the slicing level. (3) Shunt R1344 with 47 $\mu$ F. This increases Q1238's a.c. gain, improving the shape of the pulses at its collector with a white signal. The Sanyo modification certainly works: though the field sync pulses at TP1239 show signal contamination this doesn't affect the servo action.

A third alternative is to change C1005 to 4.7 $\mu$ F and R1009 to 150k $\Omega$ . The d.c. shift with a video signal level change is then more stable and no changes to the sync separator circuit are necessary.

I was subsequently informed that an add-on i.c. modification can be carried out if the official Sanyo modification described above fails. I've not had the opportunity to try out my modification in these circumstances.

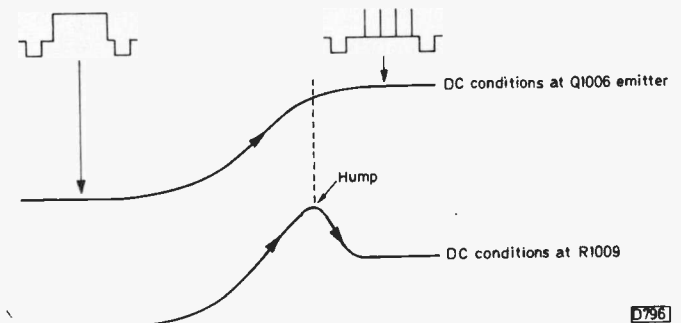


Fig. 3: The hump that caused the problem.

# TV Fault Finding

Reports from Richard Roscoe, Mick Dutton, John Coombes, Michael Brett, T.Eng. (C.E.I.) and George R. Wilding

## A Batch of ITTs

How often it's been remarked in these pages that faults tend to come in batches! We've recently been having a certain amount of trouble with ITT sets. The first was one of the many models using the CVC30/32 series chassis. It had teletext lines visible at the top of the picture and an intermittent tendency for the field scan to fold up and partially collapse. The latter was due to the usual dry-joint that occurs on the soldered connections to the field output transistors' heatsink. In addition to resoldering, we added a wire link from this point to chassis earth for good measure.

We were still left with the teletext lines however. This looked as though the flyback was too slow. Reducing the height put the teletext lines where they should have been, above the picture, but as the height was increased to normal again the teletext lines would fold over and sit at the top of the picture, annoyingly just visible. All the voltages and waveforms in the field timebase were o.k., and we were thoroughly baffled. At this point we had a spot of luck. As we reached across the back of the set to pick up something we knocked out the aerial lead. Glancing at the top of the screen as we replaced it, we noticed that there were prominent flyback lines along with the snow. These disappeared when the aerial was replaced, but the teletext dots remained. At last the symptoms made sense – there was no effective field flyback blanking! Tracing through with the scope, we found that the field flyback blanking waveform reached contact L1 of the plug in the decoder board socket but didn't manage to get on to the board itself. When we unplugged the decoder we found out why – when the decoder had been fitted the pin at L1 had not engaged properly and had bent over on itself. All we had to do was to straighten the pin carefully, plug in the decoder and switch on. The teletext had disappeared.

No sooner had we waved goodbye to that one than a CVC40 came along. It was completely dead. Not even the usual hrrmm-bonk of a tripping power supply. For reasons best known to themselves, ITT changed from a chip controlled chopper circuit to a discrete component circuit in the CVC40 chassis. The 300V supply produced by the mains bridge rectifier goes to the chopper transistor, the line oscillator and the chopper control circuit. The latter is on a small daughter board and it's here that the troubles usually begin, because the supply goes to several high-value, medium-wattage resistors. If the 300V supply is present where it should be and the line oscillator starts up, the likeliest culprit is one of these resistors. Lifting one end and checking each suspect's value directly may lack subtlety but is probably the quickest way of going about it. In this case R809, 220k $\Omega$ , was guilty, having gone completely open-circuit.

After this we had an old CVC9 that had given its owners a nasty fright. Foul smelling smoke had come from all round the control panel and the family had scattered in panic. Luckily the fuse had blown before too much damage was done, and once we'd replaced the infamous yellow mains filter capacitor and the mains fuse the set worked well.

The final set was a more modern one fitted with the

ITT80 chassis. It had gone dead after working normally until switched off. The power board was the earlier CVC820 (the modified CVC823 is fitted in later versions). Though there are differences between these two boards, both have a discrete component switch-mode power supply, and as with the CVC40 there are a couple of high-value resistors that are worth checking before anything else if the mains bridge rectifier is producing the correct 325V output. The first is the chopper driver transistor's base bias resistor R422 (820k $\Omega$ ) – R643 (1M $\Omega$ ) in the later version. The second is R405/R632 (820k $\Omega$ ) which provides a feed to the pulse-width modulator stage. With the set on the bench the culprit turned out to be R405.

R.R.

## Grundig CUC Series Chassis

We've had several faults on the various versions of the Grundig CUC series chassis: some have proved to be quite common, others less usual. First the power supply, which is of the Siemens self-oscillating type with a BU208A chopper transistor and TDA4600 control chip. If you find the 1.25AT fuse Si644 blown, either the mains bridge rectifier or more likely the chopper transistor T634 is short-circuit. In the latter event it's essential to change the drive coupling electrolytic C631 (100 $\mu$ F) as well. If you're lucky this will cure the problem, but be prepared to replace the TDA4600 plus D634 (1N4007) and R633 (27 $\Omega$ ) in the BU208A's base circuit if necessary.

No output from the power unit with the voltage at pin 1 of the TDA4600 low is caused by C642 (100 $\mu$ F) going short-circuit. This capacitor is not fitted in all sets and is not shown on all circuit diagrams, but it's advisable to fit one if you find it missing. It's connected between the junction of R641/2 and the negative side of the reservoir electrolytic C626. No output from the power supply can also be caused by a short-circuit on the secondary winding side of the chopper transformer – we've had D651 (BYV16), D656 (BYW76) and C652 (22 $\mu$ F) give this effect. A dead remote control set with the power supply lines established can be caused by transistor T2351 (BC337/25) being open-circuit and failing to operate the relay. Very low output on the +A rail (with the relay chattering in remote control sets) is caused by D633 (BYW32). This will probably measure all right, so it's best to check it by substitution. The +L (15V) line can be absent due to the regulator IC681 being open-circuit.

In 110° versions of the chassis the tube's heaters are a.c. coupled to the supply winding on the line output transformer by C704 (0.62 $\mu$ F). If this capacitor goes open-circuit there's sound but no raster with the tube heaters out.

Inability to tune in any station is the result when R330 (22k $\Omega$ , 2W) goes open-circuit, removing the 33V supply. A case of severe Hanover bars was traced to the printed track to the earth connection of the PAL matrixing transformer L381 being cracked. We've had two cases of a very faint blank raster with just a trace of picture information. The first was due to the safety resistor R524 (4.7 $\Omega$ ) which feeds line-frequency pulses to the beam limiter

circuit on the decoder panel going open-circuit. The second was due to the 4.7V zener diode D708 going short-circuit and removing the beam current sensing voltage obtained from the c.r.t.'s Aquadag coating. This diode is not present in all chassis.

Field collapse is usually due to the TDA1770 i.c. (IC2755), but make sure that C2764 (220 $\mu$ F) is not open-circuit as this will result in destruction of the new chip. The 6.8 $\Omega$  safety resistor R2761 will also have probably gone open-circuit and D2761 (SKE4G1/04) may be short-circuit. Note that the TDA1770 is used in the CUC95 chassis only.

Intermittent or no sound is usually due to the TDA1037 sound output i.c., but may also be caused by the TBA120T intercarrier sound chip in the tuner/i.f. can or dry-joints on the tuning panel.

M.D.

### Philips G11 Chassis

A Philips G11 fooled us recently. The fault was simply field collapse. As a matter of course we changed the h.t. reservoir capacitor C4029 (470 $\mu$ F) for the better blue type, replaced the TDA2600 field timebase chip, then checked and tightened the mains plug connections and the input fuse holders. When we switched on again there was, to our surprise and dismay, field collapse. Time to get out the meter. Instead of 19V at the output pin 16 there was nothing, though the 37V supply was reaching the i.c. via R2067. There were no shorts and the chip wasn't getting warm. Clearly something was missing. There's a feed to the chip's output stage via R2066 (1.5k $\Omega$ ) which turned out to be open-circuit. Ah well, we live and learn...

R.R.

### Philips G8 Chassis

We learnt something new the other day from a Philips G8 of all things – one of the later type with the sloping tuner buttons and the single i.f./decoder panel. The symptoms were such as we'd never seen before. The left-hand side of the screen was very dark, though the video information was just about discernible, while the right-hand side was completely white with prominent flyback lines. Since we'd been called out to the set and didn't have a scope with us the first step was to consider the symptoms carefully. They seemed to have something to do with the black-level clamping and/or flyback blanking, both of which are carried out in the TBA560CQ i.c. This is normally a very reliable chip however, so we decided to investigate further before changing it.

Pin 10 of the chip receives a line frequency pulse for gating etc. and the circuit said there should be a negative voltage present here. There wasn't. The trail back from pin 10 leads to a pulse shaping network which includes a 750k $\Omega$  biasing resistor (R3212) fed from the 205V rail. Such a value is high enough to be worth checking – and so it proved: R3212 was open-circuit! In went 470k $\Omega$  and 270k $\Omega$  in series, the best we could do on site, and up came a good, even picture.

R.R.

### Toshiba C1695B1

This set uses a rather complicated switch-on arrangement (see Fig. 1). The point to note is that the mains transformer derived l.t. supply must be established before the h.t. bridge rectifier can come into operation. In the event of failure to switch on, either at the receiver or via remote control, the first thing to check is the voltage at the emitter

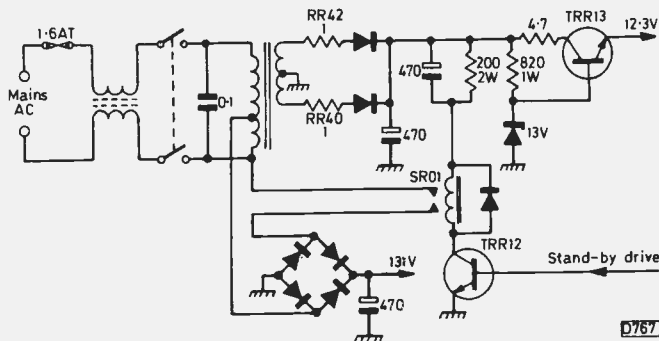


Fig. 1: Switch-on circuit used in the Toshiba Model C1695B1 (T24C chassis), with stand-by for remote control.

of the 12.3V regulator transistor TRR13 (TIP31A). If the voltage here is correct, suspect the relay driver transistor TRR12 (BC337). If this transistor is all right, check the SAB4209 remote control receiver i.c. (ICR01) by substitution.

If there's no voltage at the emitter of TRR13, check for 21V at its collector. If this voltage is present, suspect TRR13. If it's not present check the surge limiter resistors RR40 and RR42 (both 1 $\Omega$ ).

J.C.

### Ferguson 3752

A Ferguson 3752 came along recently with the fault intermittent field collapse. It's not a set we know too well, and when we took the back off we were surprised to see what looked like a version of the ubiquitous 8500/8800 series chassis. Surprised because field collapse is not a very common fault with these chassis, and even more rarely is it intermittent. Naturally the fault refused to appear until just before going home time. When it did we rapidly discovered that the 46V supply to the field timebase was missing.

In the 8500/8800 this comes from a mains transformer fed rectifier via R728, which is strapped across the pins of the smoothing can C714/5. Unfortunately we couldn't find these components – it was a case of mistaken identity. The chassis was actually the 9800, which has one or two important differences in the power supply arrangements. In particular, the 46V line is derived from a winding on the diode-split line output transformer, the relevant smoothing components being on the line output panel at the bottom of the chassis. We eventually found a classic dry-joint at pin 10 of plug 851 on this board – the pin that provides the field timebase with its 46V supply. Maybe it was a stock fault, the difficulties being of our own making.

R.R.

### Mitsubishi CT2207

In the event of field bounce with these sets, check that the tantalum electrolytic capacitor C403 is positioned the right way round – with the negative lead to pin 5 of the HA11414 timebase oscillator i.c.

J.C.

### Report from Israel

We've had some problems with the Philips G7000 video computer. The most common is failure of the action button – it's very weak and continually breaks. The best way to repair it is to dismantle the joystick box carefully and remove the button and its stem, then use a cyanoacrylate adhesive (RS Components 554-901 or Super-glue 3) to glue the two broken parts together. Observe

glue handling precautions and be careful not to get any on your hands or skin. Let the unit stand overnight to set, and be generous in applying the adhesive as this will help strengthen the button.

The second problem is the left/right-hand joystick not working or the characters sticking in the middle of the screen. The remedy is to change the 74LS365N six-bit tristate buffer IC677 (left) or IC658 (right). This device fails with some regularity and causes excessive loading on the multiplex data/address bus.

Failure of the tuner to reset to ch. 1 at switch on (ITT Studio Colour Model 1640, 5861-62-04 chassis) was cured by cleaning the tuner touch contacts with 96% alcohol. Failure of the remote control transmitter (Telecommander CMTC310) used with a Saba T5160 was cured by replacing the SAA1124 i.c.

Finally can anyone out there provide any information (circuit, diagram or manual) for a Pantronic CTV/radio/recorder combination?  
**M.B.**

### Rank T20A Chassis

Diagnosing field collapse can be tricky with these sets, since short-circuit field output transistors (4VT3/4) can cause the power supply to trip, giving the no results symptom. If the field output transistors are o.k., check the d.c. conditions around the field amplifier transistor 4VT1 (BC147B) and the driver transistor 4VT2 (BD510 or BC360) – the latter often goes short-circuit collector-ro-emitter.  
**J.C.**

### Sanyo CTP3106

In the event of no colour, check the voltages around the M51394P decoder i.c. (IC201). The first check should be at pin 2, which should vary between 0V and 8V with adjustment of the colour control. Secondly check for 9.2V at pin 4. If low or absent, check C202 (0.01 $\mu$ F). Pin 5 should also be at about 9V. If not check C204 (0.01 $\mu$ F). These checks enable most cases of no colour to be cleared.  
**J.C.**

### ITT CVC30 Chassis

A new Sony C6 VCR was delivered to the owner of an ITT set fitted with the CVC30 chassis and CMC60 remote control. When we tried to tune in the TV set we were unable to get the test signal. We were about to condemn the VCR when the customer mentioned that he'd been unable to obtain Channel Four. Now in his area the other three channels are above ch. 50, but Channel Four is on ch. 32. We removed the back of the set and checked the tuning supply to the tuner. The range was only 15-33V instead of 0-33V.

With the set in the workshop we noticed that the channel one tuning control produced the full tuning voltage range, but that if this control was set to give a high voltage output the other potentiometers couldn't be set to supply a lower voltage. The problem was traced to the isolating diode D16 being slightly leaky so that the channel one control was not isolated when other positions were selected.  
**M.D.**

### ITT CVC1200 Series Chassis

Lack of height on this chassis can be caused by the h.t. rail being set too low. This results in a low supply to the field timebase, since the 26V line is derived from a winding on

the line output transformer.

Inability to tune the set to a TV channel is usually the result of failure of the prescaler i.c. in the tuner/i.f. module. This i.c. divides the output from the local oscillator in the tuner to supply the SAA1174 i.c. on the tuning panel (frequency-synthesis tuning).

If the set is dead with the BU508A chopper transistor T713 short-circuit and the fuse blown, it's advisable to check that zener diode D702 is not open-circuit since this will result in destruction of a replacement BU508A.

If the TDA2653A field timebase i.c. fails, check that C411 (0.1 $\mu$ F) and R421 (3.9 $\Omega$ ) which damp the output are not open-circuit.  
**M.D.**

### Körting Hybrid Colour Chassis

The Körting hybrid colour sets are well made and reliable, probably the most common cause of trouble in older versions being the tripler. One of these sets gave us some puzzles recently however. It had been out of use for some time, and had then been brought along to see whether we could do anything with it, the complaint being a very blurred, faint picture.

On switching the set on we got a predominantly pale green blur, with some suggestion of movement behind. It looked as if the tube was in poor condition, but it was impossible to assess its condition until something approaching normal focus was obtained. The focus control is a 10M $\Omega$  rotary type, connected via high-value resistors between the tripler and chassis. The control's short, plastic spindle has a screwdriver slit at the top, but it could be budged only by gripping it with a pair of pliers. Rotation from one end to the other had zero effect on the focus level, so the associated high-value resistors came under suspicion. These were all o.k. however, though the focus voltage at pin 8 of the tube was only just over 2kV instead of some 4.5kV. A new tripler made no improvement, so we decided to check the voltages on the focus control carefully. To our surprise, the voltage at the slider was lower than that on the tag at the earthy side! Something had to be wrong inside the control, and on removing it and prising the cover off we found that the tip of the slider had split off, the voltage appearing at the slider coming via deteriorated insulation resistance – possibly due to excessive application of lubricant in a prior attempt to ease its operation.

A replacement control produced good focus, and we then found that the green was good, the red poor, and the blue zero. After making sure that the first anode switches were in the on position, and that the preset controls were fully advanced, we started to check the voltages at the tube base – or rather to compare the blue gun voltages with those of the red and green guns. These sets use colour-difference drive, and whilst the grid voltages were much the same the voltage at the blue cathode was well in excess of the 170V present at the red and green cathodes. The cathode drives come from the same source of course – the luminance emitter-follower T151, on the tube base. The only difference in the feeds consists of the usual series resistors for flashover protection, and it transpired that the one in the blue cathode feed (R173, 1.5k $\Omega$ ) was open-circuit, the voltage we'd measured being due to the meter's resistance providing a d.c. path for the blue gun's cathode current. Replacing this resistor and major adjustment of the presets produced a tolerable picture, but it was clear that a replacement tube would soon be necessary.  
**G.R.W.**



# Second-hand TVs: Thorn 1500 Chassis

Malcolm Burrell

Despite the booming sales of new TV receivers and VCRs, there still seems to be quite a demand for second-hand sets. A lot of those who have been renting decide that it's more economical to own a set rather than have to keep paying rent. If they can't afford a new set they may well be lured by an advertisement for reconditioned sets. The attitude is often that if the set lasts a year or so it will have paid for itself. We've found that those who buy such sets tend to be those who can't afford much else: sadly, I think that they're all too often exploited.

Reconditioned tends to suggest that a set has been restored to almost its original condition. That's likely to be wishful thinking, and it would probably be better to describe the sets as having been overhauled. Let's consider what can be done by way of overhauling the Thorn 1500 chassis. There are still lots of these hybrid, monochrome, single-standard sets around, though they are getting a bit long in the tooth now. They can still make an acceptable set for those wanting only monochrome and unable to afford much else however. What one has to do is to make as good a job as possible in carrying out the overhaul, without excessive expenditure on the one hand and running the risk of service calls within any guarantee period on the other. You should also bear in mind that the set will probably be used in far from ideal conditions – with a set-top aerial and kids changing channels all too frequently for example. So the last thing you want is an intermittent tuner and a hum bar to aggravate the matter.

It's not really worth fitting a new or reconditioned tube to such a set since this would add another £20 to the cost and the customer could go out and buy a monochrome portable for little more. If, like me, you tend to save exceptionally good tubes from scrapped sets, then you're well on the way. Remember that a lot of ex-rental sets get scrapped because someone takes the decision that they are passed it, even if a new tube was fitted only a week before. So you can strike lucky sometimes! Similarly a few desperate service calls usually precede the end of a set's rental life. During these calls new (foreign) valves may have been fitted – they may display the rental company logo, such as the Rediffusion sun or the Granada G.

## Mechanical Problems

Most of the problems with a good bread-and-butter set can be divided into two categories, either electrical or presentation/mechanical. The latter might mean that the cabinet is rather battered. With a plastic cabinet you may find that the woodgrain finish has rubbed off in places – more as a result of transportation and storage than the previous user's use of polish. Such cabinets are easy to dismantle with a little time and trouble, and the fascia from one can be fitted to the reasonably good shell of another. Disposal of the rubbish isn't too difficult – a hammer will reduce a reject shell to manageable bits that can be put in a dustbin bag.

Avoid early 1500s with piano-key tuners. These are prone to reset problems. Whilst the cabinet is in pieces, look for trouble spots where control brackets and tuners are mounted in the cabinet. The plastic seems to undergo

something akin to metal fatigue (though not as much as with some other sets). So be prepared to drill holes and fit screws and spacers if necessary – or throw the thing away. There's nothing worse than selling a set one day and getting a call because "the tuner's gone inside" the next. Be careful over the safety aspects when fitting extra screws etc.

Don't forget the tuner. Failure to reset on some channels, usually the lower ones in group A, often indicates that the earthing strips on the tuning gang need removal, cleaning and replacement. Check that the operating bar is secure; most have at some time fallen off and been resoldered, but it's a good idea to do it again to be on the safe side.

## Preventive Maintenance

How much is your time worth? How much is customer good will worth? How much does petrol cost? Do you want the customer to buy his next set from you? These are the questions that have to be weighed against how much is spent on preventive maintenance.

You'll probably have dismantled the set for some kind of inspection if not for fault-finding. Apart from the usual valve faults there will probably be some potential problems lurking in a handful of deteriorating components. The sync separator valve's screen grid feed resistor R44 (47k $\Omega$ ) for example causes poor or no sync when it increases in value – replace it with a 1W type. That doesn't take long or cost much. Various hum problems can and do arise because of failing electrolytics. Check the three 12 $\mu$ F, 300V capacitors C38 (HT2 line smoothing), C68 (HT5 line smoothing) and C102 (HT3 line smoothing). I know that components of this type can be expensive, but let's say you're dealing with a number of these sets. In buying a bargain parcel of electrolytics you may well find half a dozen or so suitable ones. 22 $\mu$ F at 275V is quite suitable for replacement purposes. The parcel will also contain components you can use for other purposes – probably enough new bits for a couple of pounds to repair two or three of these sets. When you remove the old capacitors you may well find that they are swelling, leaking or about to part company with their end contacts. Aren't you glad you're doing this in the comfort of your workshop instead of a poorly lit corner of someone's living room on a dark winter evening?

The dropper resistor must be inspected of course. Has it been bridged? Is the substitute of the right value, especially if it's across the 148 $\Omega$  valve heater section? For about £1.50 you can get an exact replacement. It makes a much neater job and looks a lot better on a chassis that's had a few minutes spent dusting away ten years of dirt!

This brings us to another point. It's not really economical to spend hours polishing every component, though I've known many old-timers who do just this in their spare moments. A thorough clean with a vacuum cleaner and a wipe with a damp sponge inside the cabinet makes future servicing easier and more pleasant, apart from the fact that if you have to open the set in the customer's home for any reason it will look as though it's been overhauled.

One more point about cleanliness. It's always a good idea to sponge around the tube bowl. This makes it look better and removes the gunge that causes corona when damp. Give a final wipe with WD40: this helps to repel moisture and means that if you do store the overhauled set for a while it probably won't matter if it does get a little damp.

Whilst the set is dismantled, check whether the volume control is noisy. A quick squirt with switch cleaner and a touch of three-in-one oil makes a difference. Are the presets noisy? Similar attention to the contrast potentiometer works wonders, but the height and field linearity controls are best replaced if slightly dodgy. Pay particular attention to the width control R132 which burns up on a hot spot.

Is the mains lead in good condition and still of reasonable length? Does the mains switch feel as if it's about to give up the ghost or does it operate with a healthy click? Is the aerial socket loose? Is the e.h.t. tray firmly attached to the line output transformer?

These points can be minor irritants but affect reliability and presentation. It may seem to be a long list, but in practice a few seconds handling should make any of them obvious if in fact they're at fault. Some of them should be attended to anyway since they affect safety.

### Components to Check/Replace

In addition to the items mentioned so far, the following components are worth checking and replacing as necessary.

R38 47kΩ (video output transistor biasing); R40 2.2kΩ and R41 5.1kΩ (video output transistor load resistors);

R101/2 18kΩ (field oscillator cross-coupling); R103 300Ω (field output stage cathode bias); R120 1.5MΩ (focus supply); R123 330kΩ (height circuit feed).

C37 64μF (video coupling); C56 400μF (l.t. supply smoothing); C58 330μF (l.t. supply reservoir); C77 0.1μF (heater chain decoupling); C79 160μF (field output stage biasing); C82 0.1μF (c.r.t. first anode supply decoupling); C84 0.1μF (mains filter); C89 1μF (height supply decoupling); C90 0.1μF (line scan coupling); C97 220pF (boost rectifier decoupling). Also the line output stage harmonic tuning capacitor which is C95 (160pF) in smaller screen models and C113 (220pF) in larger screen models. C53 180pF (line oscillator charging circuit) can be responsible for tearing when leaky - this can be an intermittent symptom.

### Finishing Touches

When reassembling the set, pay attention to correct dressing of the leads away from hot components and points at high potentials. Remember to check the soldered joints around transformer tags and wirewound resistors as well as the valve holders.

Setting up on a test card should reveal any shortcomings. This should be followed by a soak test which should include some short bursts of operation, i.e. switch on from cold and note any height variation or slow heating valves. Listen to the sound occasionally at various volume levels to check for excessive intercarrier buzz, distortion, etc. This is often overlooked but may be all too noticeable in the comparative quiet of the customer's home.

Don't forget to give the cabinet a good polish, clean the

## TOP TWENTY T.V. SPARES

STOCK NO.	DESCRIPTION	PRICE
001 Philips G8 Loptx (Genuine Philips)	7.50	
002 Decca 30 series Loptx (Genuine Decca)	7.00	
003 Decca 100 series Loptx (Genuine Decca)	6.50	
004 ITT CVC 25/30/32 Loptx (Genuine ITT)	7.00	
005 Philips G9	7.50	
006 RRI T20	9.92	
007 RRI A823	7.00	
008 RRI Z718 18"	18.95	
009 RRI Z718 20"/26"	18.95	
010 RRI A774 Mono	10.87	
011 Thorn 1890/91	7.00	
012 Thorn 1615	6.50	
013 ITT CVC 45	6.50	
014 Phil TX Chass.	5.00	
015 RRI Ranger 1/2	5.00	
016 ITT CVC 5/9	5.00	
017 Philips E2 Chass.	5.00	
018 Thorn 9000/9002	8.50	
019 Thorn 9500/9600	8.50	
020 Polish 161 Mono Loptx	6.00	
021 Thorn 3500 Scan	4.50	
022 Thorn 8500	11.00	
023 Split Diode EHT Lead	1.35	
024 Thorn 1500 (5 Stick)	3.00	
025 Thorn 8000 Doubler	2.00	
026 Thorn 1400	2.00	
027 Philips G9	3.50	
028 ITT Universal	5.00	
029 5 x TV11 For PTV's	1.00	
030 3 x TV45	27.18	
031 REC	1.00	
032 ITT CVC 45	4.00	
033 TVK52 Continental	2.50	
034 RRI Z179	3.00	
035 Pye 691/697	3.50	
036 Pye CT200 4 Lead	3.50	
037 Pye CT200 5 Lead	4.50	
038 Korting Hybrid	5.00	
039 Grundig 3010/1500	3.00	
040 220/400 CVC	32-1.20	
041 200 + 300 Pye 691/697	2.00	
042 862/300 Philips G8	1.90	
043 175 + 100 + 100 Thorn	3500 1.50	
044 2000/100 Can	0.50	
045 470/250 Philips	G11 1.50	
046 400 + 400 Decca	30 2.50	
047 200 + 200 + 75 + 25	ITTS/9 1.50	
048 400/400V Thorn	9000 1.50	
049 200 + 220MF	16V Elect. 0.50	
050 933 10 x .047MF	400V Poly 0.50	
051 994 5 x 4.7MF/100V	C514 T3900 1.25	
052 995 5 x .0047/1500V	RRI A823 1.25	
053 996 5 x .91NF	Philips G11 2.25	
054 997 10 x .1/2000V	2.00	
055 998 5 x 1/250 Suppression	ITT 2.75	
056 Pye 713 4 Way	7.87	
057 Pye 715 6 Way	11.95	
058 Philips G8 (Square)	10.75	
059 Philips G8 (Sloping)	11.33	
060 Thorn 9000 6 Way	2.50	
061 Thorn 1615 4 Way	5.75	
062 Decca 6 Way	6.95	
063 Decca 4 Way	6.50	
064 GEC 2116 7 Tapered	6.95	
065 GEC 2116 7	7.95	
066 ITT CVC 5	9.25	
067 ITT CVC 8	11.45	
068 ITT 6 Way with V.C.R.	7.95	
069 R.R.I. A823 etc.	4 7.95	
070 124 Hitachi 4 Way	7.95	
071 125 R.R.I. T20 6 Way	8.95	
072 140 5 x TBA440	3.00	
073 141 5 x TBA120AS	1.80	
074 142 5 x TBA540	4.00	
075 143 5 x TBA540Q	4.00	
076 144 5 x TBA550Q	3.25	
077 145 5 x TBA560	3.50	
078 146 5 x TBA810S	3.00	
079 147 5 x TBA920Q	4.50	
080 148 5 x TBA950Q	3.25	
081 149 5 x TBA950Q	4.00	
082 150 5 x TBA530Q	4.25	
083 151 5 x TBA950	4.50	
084 155 5 x MC1327Q	2.50	
085 TDA1170	1.35	
086 TDA1190	1.90	
087 TDA1006A	1.45	
088 TDA1035	1.83	
089 TDA1044	2.23	
090 TDA1190	1.90	
091 TDA1412	0.90	
092 TDA2002	1.80	
093 TDA2020	2.50	
094 TDA2030	2.15	
095 TDA2523	2.35	
096 TDA2532	2.40	
097 TDA2540	1.65	
098 TDA2541	2.67	
099 TDA2560	3.28	
100 TDA2571	2.15	
101 TDA2591	0.98	
102 TDA2593	2.23	
103 TDA2600	4.00	
104 TDA2611	1.24	
105 TDA2640	2.35	
106 ETTR6016	2.28	
107 ETTR6016	2.28	
108 BT76018	2.28	
109 235 50 x BC213L	2.50	
110 250 10 x BD124	9.00	
111 270 10 x BU208A	8.50	
112 271 10 x BU208	7.50	
113 272 10 x BU326	10.00	
114 273 5 x BU205	2.50	
115 280 25 x 2N3055	7.50	
116 281 10 x 2N2905	(Equiv. BC161/203) 0.50	
117 335 50 x BY127	3.00	
118 350 5 x Thorn 1590/1	41 x 23 2.00	
119 357 Thorn	1590/1 2.00	
120 358 5 x Thorn 3500	200R Conv. Pot. 1.00	
121 359 5 x Thorn 3500	50R Conv. Pot. 1.00	
122 371 Pye 731 Thick Film	1.50	
123 371 Pye 731/731 Vis. Gain	Module 6.50	
124 372 Pye 731 3R3	50V Metal clad 1.29	
125 378 Grundig 5010/6010	Video Module 4.00	
126 384 5 x Philips G8/10R	384 5 x Philips G8 2.40	
127 385 5 x Philips G8	2.40	
128 386 5 x Philips G8 2k2 Lin.	Bright. 2.50	
129 387 5 x Philips G8 10k	Plug 1.70	
130 388 5 x Philips G8 47k	484 Focus Unit 1.20	
131 Log. Vol.	2.50	
132 389 Philips G8 Plastic	Mains Sw. 0.75	
133 390 Philips G8 Metal	Mains Sw. 1.23	
134 391 Philips G8 Line Eq/	Stor. Coil 2.25	
135 403 5 x RRI T20 C.R.T.	Base 4.35	
136 434 5 x Decca 30 2M	W/idth Slider 1.00	
137 435 10 x Decca 30 10R	Fusible 0.50	
138 436 5 x Decca 30 3R9	Modulohm 1.75	
139 437 Decca 30 47k	Vol. + Switch 1.25	
140 455 5 x 5R Universal	Conv. Pot. 1.00	
141 454 5 x 20R Universal	Conv. Pot. 1.00	
142 455 5 x 100R Universal	Conv. Pot. 1.00	
143 456 5 x 470R Universal	Conv. Pot. 1.00	
144 457 10 x 100k Tuner	Preset TCe etc. 3.00	
145 458 10 x 100k Tuner	Preset Philips G8 3.00	
146 459 ELC1043/05	Repaired Tuner 6.00	
147 460 ELC1043/06	Repaired Tuner 6.00	
148 461 U321 New Tuner	7.95	
149 462 U322 New Tuner	7.95	
150 469 Cut Out Metal	GEC 2100 1.00	
151 470 5 x GEC2100 3	Leg Thermistor 1.00	
152 479 5 x Gen. Purpose	Rotary Switch 3.60	
153 480 5 x Gen. Purpose	Push S.W. 3.75	
154 481 20 x neons	GEC etc. 2.25	
155 482 5 x Universal	Aerial Skt. 5.50	
156 483 10 x Metal	Coax Plug 1.70	
157 484 Focus Unit	T20 Type 1.25	
158 485 Focus Unit	Thorn 8500 Type 1.25	
159 291 5 x BT109	4.50	
160 293 5 x BT120	4.50	
161 496 TX10 Chass	Focus Unit 7.00	
162 089 10 x Anti Track	EHT Cap 2.00	

# QUICK SAVE T.V. SPARES

MUXTON HOUSE, MUXTON, TELFORD, SALOP.  
REG. OFFICE ONLY. CALLERS STRICTLY BY APPOINTMENT. PLEASE QUOTE STOCK NO.

control knobs and remove stubborn dirt around the screen. This makes a big difference and if you're charging a little more than the opposition is a good selling point – the hope and pray brigade won't bother, but you want your customers to come back.

One final point. If you can get some 13A mains plugs

(El cheapo will do) fit one to each set you sell, with the correct fuse. It means less time fiddling around pinching plugs off customers' irons etc., and it's preferable that if they do electrocute themselves by poking matchsticks in the wall sockets it won't be because of the set you sold them.

# Letters

## VIDEO HEAD CHECKERS

The Thandar video head tester reviewed in the November issue is not the only one available. We've been using a Panasonic tester for some time now. It's obviously designed to check Panasonic heads, but we've used it successfully on all the machines we handle, both VHS and Betamax types, with just one exception – the Ferguson 3292. The tester is simple to use – there's only one control, the on/off switch, and the meter has red, yellow and green segments. The Ferguson 3292 tends to give green readings even with worn out heads, but apart from this the tester has given us accurate faulty head diagnoses on Ferguson, Hitachi, Panasonic, Bush, Toshiba and Sanyo machines.

Dirt on the heads doesn't affect the result obtained, so if you get a red reading you can be confident that head cleaning will not provide a cure. When we first used the tester we found that some heads, particularly those used in the Toshiba V5470/Bush BV9600 and the Panasonic NV8600, gave faulty readings despite the fact that a perfectly acceptable picture was obtained after cleaning. A few weeks later however cleaning would again be necessary, even though the machines were not subjected to excessive use. Replacing the drum in each case cured the trouble, which was due to the fact that the heads were worn to the point where they had become excessively sensitive to dirt and would not bed into the tape as they should – a case of the tester knowing best!

All in all the Panasonic head checker is a useful device, the only drawbacks being the cost and the extremely short leads – the latter presumably for minimum effect on the inductance. Worth considering if you handle a lot of VCRs.

*Derek Snelling,  
Brownhills, Staffs.*

## G11 REMOTE CONTROL UNIT

Christmas brought the usual sort of problem when a friend managed to empty a glass of gin and tonic over the top of our Philips G11 full-function ultrasonic remote control unit. "No problem" I said, shaking it and giving it a dry with kitchen roll, "it'll be dry by morning". The following day I took the dried out unit from the top of the storage heater and tried it out. BBC-2 couldn't be selected, stand-by didn't operate, the channel 4 button selected channel 6 – oh dear!

I opened the battery compartment to check the battery. O.K. Next remove the screw inside the battery compartment, slide the two halves apart, and remove the PCB from the case. The board and the button panel are linked via a ribbon connector. Time to start thinking. Since some functions were working, the oscillator, the transducer and the driver stage were presumably in order. This left the chip and the front button panel. The chip looked dry, and I'd not data on it at the time, so I decided to examine the

button contacts. Bad news – a paxolin board is fixed to the bottom of the button panel with plastic rivets!

Some people might have decided at this point to give up and obtain a replacement – button panel or complete unit. Since the unit didn't work anyway, there was nothing to lose by further experiment. So after due consideration it was out with a sharp blade and off with the tops of the plastic rivets (there are hundreds of them!). They came off nicely. At this point I half expected to hear a sort of twanging sound, with the buttons going off in one direction and the board, springs and other bits flying off in the other. Not so. There's nothing nasty inside. When I removed the paxolin board I was confronted with three pieces of flimsy transparent plastic. The top piece (directly under the buttons) is etched with a circuit and sort of half bubble shapes that fall directly beneath each button. The circuit is etched on the underside. The next sheet is an insulator with holes where necessary. The bottom sheet has the contact circuit etched on the top side. It all functions like this: press down a button and the bubble on the top sheet is pressed flat through the hole in the middle sheet to make connection with the contacts on the bottom sheet, thus completing the circuit.

The problem with my unit was fairly obvious from the start: where the liquid had seeped between the sheets of plastic, the etched circuit seemed to have behaved like a blob of ink on a piece of blotting paper. There were all kinds of foreign bodies present as well. Time to get out my usual universal cleaner, methylated spirit. Check a corner of the plastic to ensure that (1) it doesn't melt and (2) the circuit is not removed. It seems to be o.k., but I didn't rub too hard, just in case.

Once everything was nice and clean I found that part of the circuit looked weak. As it's not possible to solder links on the flimsy plastic, I used a fine metallic marker pen to go over the doubtful bits. Reassemble and test: magic, everything is great! "What about those rivets?" I hear you ask. Well, a drop of epoxy resin (Devcon) on each protruding plastic stud, then hold the lot together with two bulldog clips until dry, and you're there.

Next Christmas my friends all get straws with their drinks!

*Andrew H. Sykes,  
Sutton, Surrey.*

## VIDEO MATTERS

With reference to the comment in Service Bureau last month on adapting the Pye 697 chassis for VCR use, the simplest and usually effective course is to reduce the value of C208 in the flywheel sync filter circuit to about a quarter of its original value, i.e. from  $1\mu\text{F}$  to say  $0.22\mu\text{F}$ .

The comments on battery charging in VCR Servicing (page 141) were not perhaps as clear as they should have been. The 3V25 is not switched off at the mains of course – you press the (tuner) off button on the front panel. The recorder should be in the stop mode with the power switch at off, i.e. released.

*Mike Phelan,  
Holmfirth, Yorks.*

# VCR Servicing

Part 25

Mike Phelan

The 3V24 portable VCR's mechacon panel uses a  $\mu$ PD553C-066 microcomputer i.c. This is the same chip as used in the 3V23 but with a different programme in its ROM – hence the suffix 066.

## The Mechacon Circuit

The mechacon circuit is much simpler than that used in the 3V23, even though the system incorporates a few extra features (see Fig. 109). There's the usual 400kHz ceramic resonator across pins 1 and 42 of the microcomputer i.c., a reset pulse applied to pin 7 sets all the registers in the i.c. to zero, while the supply pins are 21 and 41 (chassis). Pin 6 is not used and must therefore be connected to the positive rail. The inputs go to the A and B ports. The latter is used for the keyboard input – the control circuit consists of a simple diode matrix which is addressed by the three-bit I port (only nine of the twelve possible combinations are used). Put simply, pressing any key connects one of the address pins 30-32 to one of the input pins 37-40. The diodes in series with each switch are for isolation only.

This leaves us with the problem of getting all the other information the chip requires into the remaining four inputs A0-A3. For this purpose we again use those helpful items called data selectors, or if you like input expanders. There are two in this machine, IC1 and IC2 – both 4512s. They convert eight parallel inputs into an eight-bit

serial code. The I port that addresses the keyboard also addresses these two i.c.s.

In case the idea of these data selectors is still not clear, a brief recap and a glance at Fig. 110 should help – it's essential to understand how they work. Imagine the 4512 as a single-pole, eight-way switch. Any one of the inputs can be connected to the output line. The thing that determines which input is connected to the output is the three-bit address code – the bits come in on three lines and any one of these can be at either 0 or 1 (low or high). A little thought will show that there are eight possible combinations of 0 and 1. Fig. 110 indicates which address code connects which input to the output, which is known as Z.

How this is actually put into practice depends on the microcomputer chip that generates the addresses. In this case the addresses are not sent out in a fixed sequence, as might initially be assumed: different inputs are checked depending on the mode the machine is in – there would be little point in checking the after-load switch in the rewind or stop modes, or for reel rotation in pause, though things like battery low or lamp failure have to be checked in all modes.

As an example, pin 1 (D0) of IC1 is high until the after-load switch closes, but this fact is not passed on to the output unless all three address lines are at 0. If Z goes low when the address lines ABC are at 0, the microcomputer i.c. knows that the after-load switch has closed.

To return to the microcomputer i.c., inputs A0 and A1 receive the outputs from IC1 and IC2. The switches on the brake and pinch solenoids are directly linked to inputs A2 and A3. Looking at the outputs, C2 and C3 drive the loading motor (see Fig. 111). When C2 is high, X17 and X18 turn on, rotating the motor in the forward direction for loading. When C3 is high X16 and X19 turn on for unloading. Either operation normally takes about three

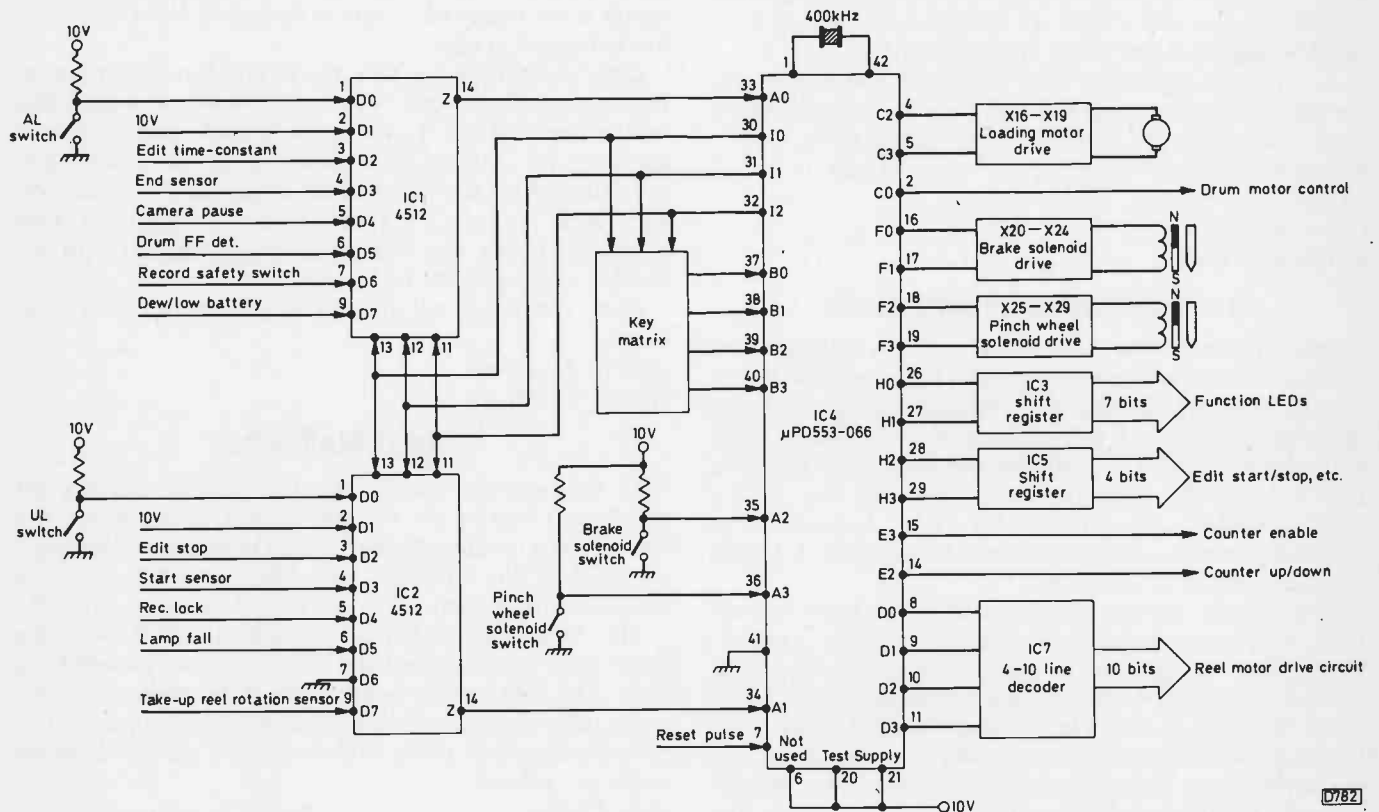


Fig. 109: The 3V24's mechacon system.

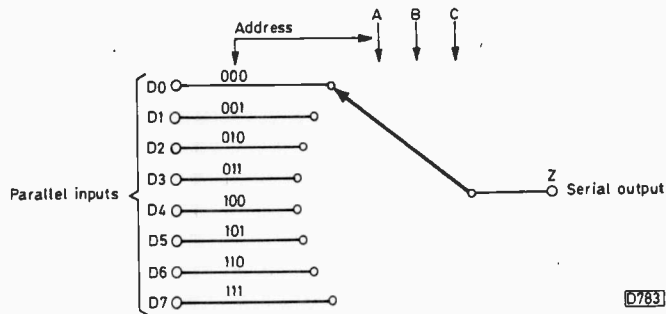


Fig. 110: Operation of the data selector i.c.s.

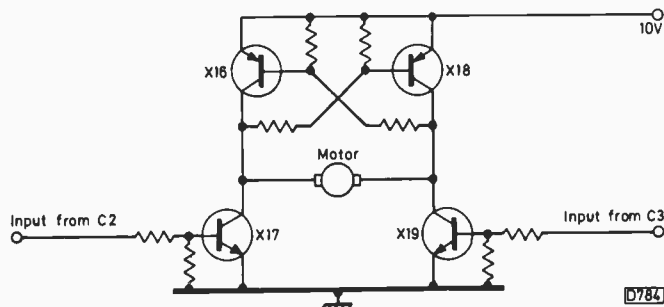


Fig. 111: Loading motor drive circuit.

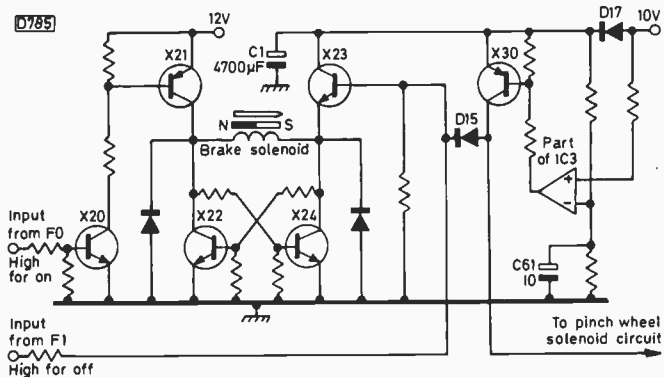


Fig. 112: Brake solenoid control circuit.

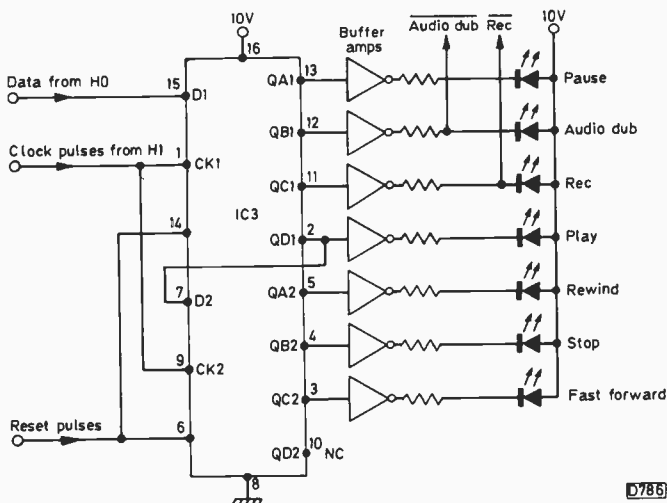


Fig. 113: Shift register for the function LEDs.

seconds and is terminated by the appropriate switch (AL or UL) closing. If this doesn't happen within six seconds the machine enters the alarm mode, i.e. the stop mode is selected, the function LEDs flash in rotation, and no commands are accepted. This will also happen if take-up spool rotation ceases, the drum flip-flop pulse is not

present, or the cassette lamp is open-circuit and the machine is switched on. To cancel the alarm mode the machine must be switched off and then on: if the fault condition is still present the alarm mode will be re-entered.

### Solenoid Control

Port F drives the two solenoids. As mentioned last month, the solenoids are of the permanent magnet type, requiring a 150msec pulse in either direction to move the plunger. The circuitry used is identical in both cases, so we'll show only one, that for the brake solenoid (Fig. 112). It's in the familiar bridge form, just like the drive for a reversible motor. The only point worth mentioning is that if the switch on the solenoid fails to change state within 2.5 seconds of solenoid operation (IC4 A2 input) the machine enters the alarm mode.

This leaves a slight problem. On the machines we've discussed previously, if the supply is interrupted all the solenoids are released. Being held by permanent magnets, those on the 3V24 are not – or wouldn't be without the aid of X30 and the associated components in the case of the brake solenoid circuit. It will be noted that the solenoid-off side of the circuit is connected to the 10V rail via D17, and that C1 will be charged to 10V. When the machine is switched off D17 is reverse biased, the 10V rail decaying while C1 maintains its charge. The non-inverting input of IC3 falls, as does its output, turning on X30, X23 and X22 to release the solenoid. C1 stores sufficient charge to enable this operation to be carried out – C61 ensures that IC3's inverting input remains stable despite the varying demand placed on C1 during solenoid release. The same thing is done in the pinch solenoid circuit.

### Shift Registers

IC4's H0 and H1 outputs drive the function LEDs via the shift register IC3 (4015). The reason for this is to be able to drive seven LEDs from two microcomputer i.c. outputs. If you're not familiar with shift registers and what they do, read on, referring to Fig. 113. A shift register is a sort of conveyor belt for logic ones and zeroes. Taking the upper half of the 4015, you'll see that there are four outputs, labelled QA1, QB1, QC1 and QD1. There are also two reset inputs, which are driven by the same pulse as the microcomputer i.c. at switch on: this sets all the outputs to 0 so that none of the LEDs are illuminated. The other inputs are marked data and clock. If a 1 is put on the D1 data input, the first clock pulse to arrive will have the effect of transferring it to QA1. The next clock pulse transfers it to QB1 and so on until it arrives at QD1 on the fourth clock pulse. In this application the QD1 output is linked to the second data input D2, so the fifth clock pulse pushes our 1 along to QA2. In effect then the device acts as an eight-stage register. All this assumes that D1 went to 0 before the arrival of the second clock pulse – otherwise a second 1 will be fed into the register. As a simple analogy of the action, imagine someone pushing boxes into a passage with eight windows, each box being a 0 or 1, each push a clock pulse. The item reaching QD2 at the eighth pulse/push is lost when the next clock pulse arrives – it falls off the end so to speak.

How is this used in the 3V24? Whenever a function is selected, assuming the machine accepts the command, the microcomputer's H1 output supplies eight clock pulses only while the H0 output supplies eight bits of data, only



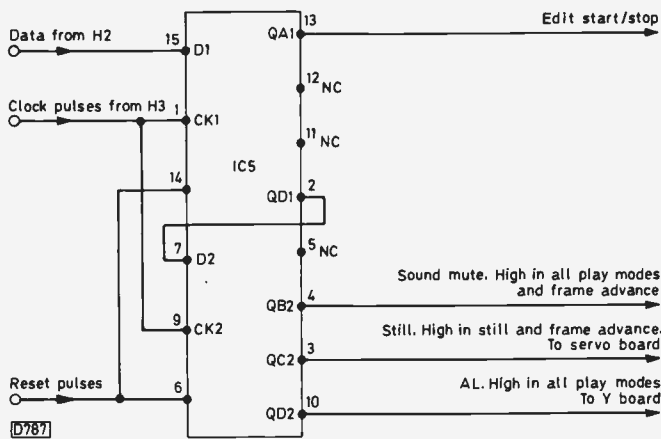


Fig. 114: The second shift register i.c.

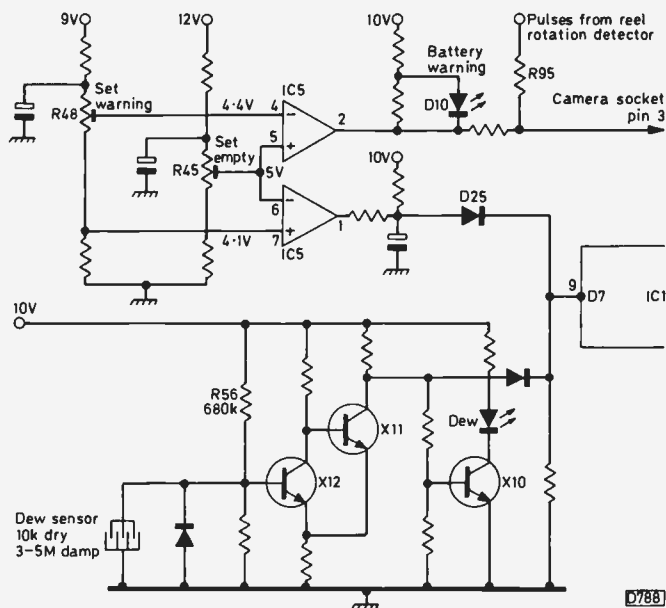


Fig. 115: Dew sensor and low-battery circuits.

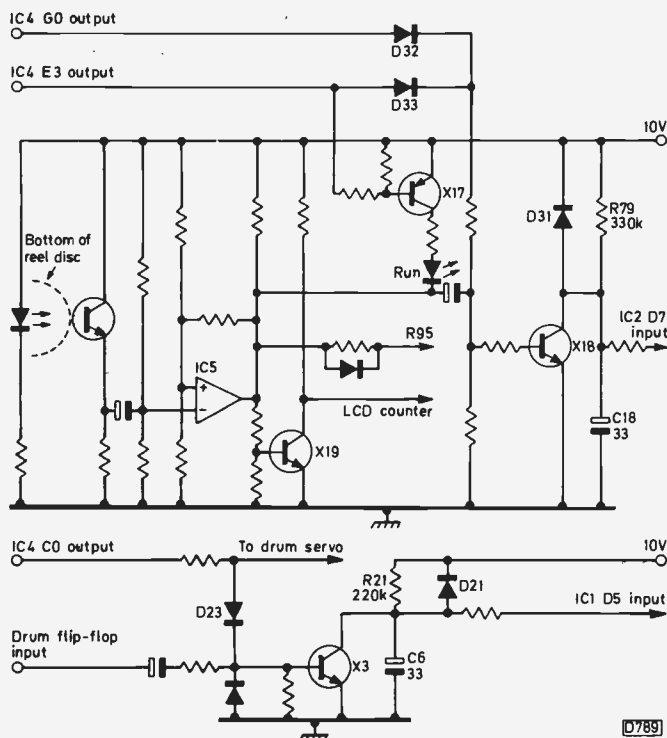


Fig. 116: Rotation detector arrangements.

one of which is a 1. For example, at switch on we are in the stop mode (unless rec-lock is selected). The 4015 will be reset so that all its outputs are at 0. The train of eight clock pulses then starts. When the third data bit arrives, H0 goes to 1 then back to 0. So the 1 enters the 4015 at the third clock pulse, the following five clock pulses moving it along to QB2 where it lights the stop LED. A similar process takes place when the other keys are pressed, the H0 data line being low except during one of the eight clock pulses. It's worth stressing that only one train of clock pulses and data bits arrives when a key is pressed, the 4015 storing the information it receives in this way until another eight bits arrive on selection of another function.

The microcomputer i.c.'s H2 and H3 outputs drive another 4015 in similar fashion (see Fig. 114). This works in exactly the same way as IC3, but only four outputs are used, all except one for status supply rails. We'll discuss the edit start/stop when we come to the servo's next month - the same applies to the microcomputer i.c.'s reel drive output (port D).

### Dew Sensor/Low Battery Circuits

Some further comment on the data selector inputs is required. IC1's D7 input (pin 9) receives dew sensor and low battery information - the circuit is shown in Fig. 115. Under normal conditions pin 2 of IC5 is high, so that D10 is not illuminated: pin 1 is low so that D25 is reverse biased. The voltages at pins 4 and 7 come from the 9V regulator and don't vary. The battery sensing operates in two stages. First, when the battery voltage falls to about 11V the voltage at pin 5 of IC5 falls below that at pin 4. Output pin 2 then goes low so that D10 comes on, also making pin 3 of the camera socket go low. If a Ferguson camera is in use, this lights the warning LED in the viewfinder - it flashes due to the pulses fed in via R95 from the reel rotation sensor circuit. If this warning is ignored and the battery voltage falls to 10.5V, the voltage at pin 6 of IC5 falls below 4.1V, pin 1 goes high, data input D7 goes high, the machine goes into the stop mode and no further commands are accepted.

The dew sensor circuit also feeds D7. The sensor is a special device whose resistance increases when it's damp (incredible but true!). It's mounted near the drum. Under damp conditions the dew LED will come on and commands will be inhibited via D7.

### Rotation Detector Circuits

The take-up reel rotation detector uses an LED and a phototransistor rather than a Hall effect i.c. as in the 3V00. The periphery of the reel disc has reflective segments that illuminate the phototransistor as the reel rotates (see Fig. 116). IC5 converts this to a squarewave which drives four things. First, the LCD counter. Secondly R95 in Fig. 115 to make the camera's battery warning LED flash. Thirdly the run LED, provided X17 has been turned on by output E3 of the microcomputer i.c. going low - the reason for this is that if the run LED was powered from the 10V rail direct it would have a fifty-fifty chance of being illuminated in the stop mode, depending on where the reel disc stopped. Fourthly, D31, R79, C18 and X18 form a reel disc rotation detector.

C18 charges via R79, but on every pulse X18 conducts to discharge it. If the take-up reel stops, C18 will charge in four-five seconds, D7 will go high and the microcomputer

i.c. will take the appropriate action – stop if in the fast forward or rewind modes, alarm if in the record, playback or audio dub modes. D31 discharges C18 at switch off. What about D32 and D33? Well, we don't want the rotation detector to function in the stop, pause or slow modes, or when loading/unloading. In fast search on the other hand the pulse repetition rate would be too high to ensure that C18 was discharged. As there's no convenient point that changes state on fast forward/rewind/playback/record only, we combine the outputs from E3 (high for load/unload/frame advance/pause/stop) and G0 (high for pause/slow/frame advance/fast forward search/rewind search): if either output goes high, X18 is turned on

continuously, inhibiting the rotation detector circuit.

The drum rotation detector works in exactly the same way, the alarm mode being entered when input D5 goes high. D5 is not addressed by the microcomputer in the fast forward/rewind/stop modes: output C0 is then high, so that X3 is switched on. This ensures that C6 is fully discharged when entering the play or record modes so that the full delay time is available, as in the reel rotation detector circuit.

### **Next Month**

Next month we'll consider the 3V24's servo system.

## **Bush Whacking**

**Bob Walker**

The era of solid-state colour started with the famed Thorn 2000 chassis. Shortly after came the Rank A823, which in various versions remained in production for several years. It's surprising how many of them are still giving good service. Some can still lead one a merry dance however, as this CTV1126 (A823AV) did.

At first sight the problem seemed simple enough. Don't they often? The VA1104 thermistor 8TH2, included to prevent destructive current surges at switch on, had fallen to bits. The power panel was scorched but not badly damaged. Replace, clean up and away we go. Christmas was only two days hence, so I thanked providence for the easy task and switched on. The screen flickered and went blank. There was 300V instead of 200V at the h.t. fuse, so I concluded that the mains rectifier/regulator thyristor 8THY1 had gone short-circuit. A replacement restored the correct 200V at 8F3, but the screen was still blank. Providence was not being so kind after all.

My previous acquaintance with the set was limited to a few brief glimpses of the picture before my friends, being very mannerly, switched it off whenever I called to see them. In fact all I knew was that it had four controls, four push-buttons, and was sadly deficient in reds. I could now add that the power supply was o.k., and that there was sound but no raster. At least the fault wasn't intermittent!

The set was wanted for Christmas, so there was no time to send off for a manual. I'd have to play it by ear. As a start the e.h.t. was checked. This was adequate so I moved over to the tube base. As expected, the red first anode voltage had been set much higher than the other two in an attempt to compensate for the lack of red. Apart from that however the c.r.t. voltages were quite normal. So something a little unusual was responsible.

Having recently come across a broken heater pin connection at the base of a monochrome tube, I decided to examine the A66-120X's pins carefully. Pin 9 (focus electrode) moved too freely, and after carefully removing the white plastic pin guide I found that the pin had broken off at the glass pinch. On with the goggles then and let battle commence to replace the 26in. tube single-handedly. A known good tube was fitted and, with hope that the red problem would also have been cured, I switched on. Still no results! On came the depression – how did I ever have the 22 carat brass neck to think I could tackle a strange colour set?

I'd enough time left to check up on some of the

previous articles in the magazine on this chassis and its habits, and in the June 1980 issue found reference to decoder faults arising from failure of that thermistor – the arcing tends to affect the SL901B chip. Not having the necessary extension leads for the decoder panel, I decided to remove it and carry out static tests on the two decoder chips with an 18V supply connected to pin 3Z1-6. This primitive idea worked quite well. The voltages around the SL917A were within the tolerances listed in an article in the March 1976 issue, but those around the SL901B weren't. Many of the pins registered 2.2V or thereabouts instead of a variety of readings from 5V to 12V. Evidently the SL901B had indeed been put out of action.

It's not easy to find a better soldering test than replacement of a 24-pin i.c., but a new one was eventually fitted without damaging the panel. On testing the panel as before the voltages were now found to be substantially correct: so back in it went, and after all the plug and socket connections had been checked the set was switched on. A picture at last – a good clear one, but in monochrome. Well, at least I'd got part of the way!

### **The Colour Problems**

Time for a little rational thought. First, the set had worked well enough, reds apart, until the breakdown. Secondly the power supplies were now all normal. Thirdly the chip I'd replaced is by no means the only thing that will affect the colour. Conclusion: nothing I'd done so far could account for the loss of colour, so something else had to be to blame.

Out with the decoder panel once more and on with the 18V supply. Check all voltages in the chrominance circuits. All normal except for 0V at the emitter and base of 3VT12 in the a.c.c. circuit. Change 3VT12, replace panel, switch on set, switch off a.f.c. and retune buttons (did I remember to do that before?) – at last there's the colour! Turn the saturation up a bit, increase the contrast – not bad at all. Now to improve the reds.

The grey-scale setting up procedure was followed through. No problems at all. The red drive control was then found to have little effect, so the following BC148 red driver transistor was removed and compared, on a tester with the BC148s in the other two channels. The gain was a good bit lower. Fit new BC148 and switch on. Red better, but still not as good as it could be.

At this point my friend's wife phoned to ask how I was getting along. Well, the red's always been weak and they're quite used to it – a little less at Christmas might even be a good thing! So the set was restored to the family circle, where it received rapturous acclaim. "Picture first class. Red better than ever before." Maybe, but it's one Bush that could do with a bit more whacking.

# Long-distance Television

Roger Bunney

The November/early December period was relatively active for DX-TV reception – so often the year-end conditions become really flat. To enter December with improving conditions is really good news at what's usually a bleak, cold and depressing time. The main news is of enhanced tropospheric reception, but sporadic E propagation was present on several days as follows:

- 8/11/83 RTVE (Spain) chs. E2, 3, 4; RTP (Portugal) E2; RAI (Italy) IA, IB; JRT (Yugoslavia) E3.
- 9/11/83 RTVE E2; TSS (USSR) R2.
- 13/11/83 TSS R1, 2; SR (Sweden) E2; RTVE E2; RTP E2.
- 14/11/83 SR E2; TSS R2.
- 17/11/83 TSS R1.
- 20/11/83 RAI IA; JRT E3, 4; TVR (Rumania) R2; TSS R1, 2.
- 22/11/83 RTVE E2; SR E2.

Unfortunately F2 reflection of Band I signals has been infrequent this year – during early November the m.u.f. reached only to the lower 40MHz spectrum. TE has been logged by those farther south in warmer climes, with southern European stations such as Madrid ch. E2 being received in S. Africa.

Meteor scatter propagation was particularly active during mid-November, following the Leonids meteor shower. There was a great number of signal "pings" on the 19/20th, throughout much of the day and evening. An auroral event was recorded in Aberdeen on the 17th, but had minimal effect in Band I.

Several tropospheric lifts were experienced during the period under review. Minor lifts occurred along the S.E./E. coasts and inland on the 19th and 23rd, the former with reception mainly from the S.E. and the latter from the east. Perhaps the most remarkable reception was of the Swiss channels E31 and 34 in Leeds on the 19th. The 23rd produced mainly W. German Band III/u.h.f. signals in the eastern UK.

The two main tropospheric events occurred on November 9-13th and December 1-5th. The former produced signals from W. Germany, the Low Countries and Luxembourg, with excellent noise-free colour from the German

networks on several days. The 12-13th also saw Swiss u.h.f. signals, though not at noise-free levels.

The most dramatic tropospheric opening occurred on the 1-5th, coinciding with an amateur TV contest on the 2-3rd. As a result amateur activity was at a high level, and here at Romsey the 144.75MHz calling frequency for amateur operation was at times jammed with UK and French stations. Over the 3-5th Cyril Willis (Ely) logged "loads" of UK ATV stations and several Dutch/Belgian ones, notably PAOHLA, PAOHUB and ON7PO, the latter noise free (P5 on the ATV scale). Apart from several French stations, the loggings at Romsey were from the Channel Islands in one direction and as far as N. Leicester in the other.

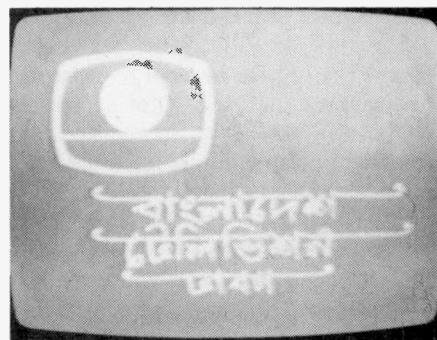
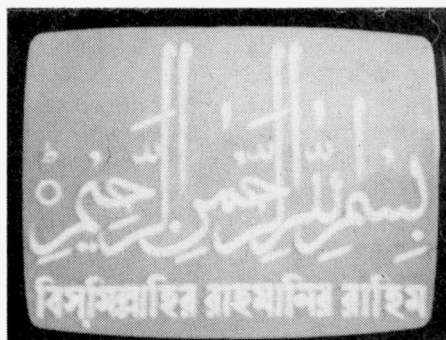
The broadcast bands were chaotic during this period, with repeated warnings about continental interference on both the BBC and ITV networks. The 1st started with strengthening TDF (French) u.h.f. signals, and by the 2nd most channels were jammed with signals from France, the Low Countries and both E. and W. Germany. DR (Denmark) and SR (Sweden) were received in East Anglia on the 2nd, in Band III and at u.h.f. The 3rd was particularly rewarding at Romsey, with virtually day-long reception of DR signals of very good quality on all Band III channels, E8 being the most spectacular. Strangely, whilst DR signals were so active there was minimal reception from W. Germany. Reception on the 4th extended to W. Germany, with a more comprehensive selection of W. German Band III/u.h.f. signals on the 5th. Unfortunately a front from the N.W. produced rain in central southern UK during the late afternoon on the 5th, terminating the excellent conditions. As I write however there's an overall high pressure system covering the UK and signs of improving W. European signals have already been noted.

In summary, a good month. The autumn of 1983 has certainly produced more than the usual number of tropospheric lifts. My thanks to the following for their reception reports: Hugh Cocks (E. Sussex), Cyril Willis (Ely), Iain Menzies (Aberdeen), Kevin Jackson (Leeds), Ian Johnson (Bromsgrove), John Tellick (Surbiton) and Gosta van der Linden (Holland).

## News Items

**Saudi Arabia:** A second network is now in operation, with Band III/u.h.f. transmitters (Damman ch. E29). The output is described as "international", for foreign workers, many programmes being in English with Arabic subtitles and a high proportion of feature films.

**W. Germany:** WDR-1 is to start transmitting in ch.E43 shortly, with Bonn ch. E5 and Koln ch. E11 closing down.



Left: Summertime SpE reception. TVP-1 (Poland) ch. R3 identification slide received in Aberdeen by Iain Menzies. Centre: The Koran, Television Bhaban (Bangladesh). Right: Television Bhaban identification slide. Photos Alexander Wiese.

**Eire:** Plans have been announced for the installation in the near future of a high-power RTE-2 transmitter at the Mt. Kippure site near Dublin.

**TV-DX Club:** The TVDX/RX group produces a newsletter approximately four times a year giving both technical and reception information. Particular emphasis is placed on technical standards and operation of the receiving installation. The cost of four issues is £2 in the UK, £3 overseas – a sample copy costs 50p (four 12½p stamps in the UK, four IRCs overseas). A beginners guide to TVDXing (with particular reference to the UK) is to be produced at 50p. Make cheques out to Dave Lauder, 18 Burnside Close, Barnet, Herts EN5 5LN.

**Satellites:** The TDRS-1 satellite is expected to be operational at 41°W early this summer, carrying a TV service with news. The signal strength should be sufficient to give acceptable pictures using a 6ft dish. Gorizont-5 at 53.3°E is currently transmitting 11.541GHz test signals in preparation for a DBS service. The New Zealand Post Office has prohibited the use of 4GHz terminals for the reception of signals from the Intelsat craft now carrying Australian programmes. A demonstration at Christchurch was terminated by the PO. The Indian National Satellite System will use INSAT-1 craft with telecommunications facilities in the 3.71-4.2GHz band and two high-power transponders for DBS reception in the 2.555-2.635GHz band.

### Satellite Signal Fading

A recent *Coops Satellite Digest* reports that a 4GHz operator in Demerara, Guyana has noted regular TV downlink signal fading at sunset. It had previously been thought that there would be no appreciable ionospheric effects at above 500MHz. The fading has been noted daily at between 2000-2100 local time, more westerly downlinks being affected from 2100-2200 at both high and low angles – one would expect low-angle signals to be affected more due to the longer ionospheric path. Perhaps other satellite enthusiasts could check on whether such fading is apparent at higher latitudes.

### From our Correspondents . . .

Mike Gaskin (Caterham) has recently moved to a new, high site where high-level signals from a variety of sources, including PMR and the local u.h.f. TV services, are present. To overcome the problems he's devised a new DX-TV receiver system (see Fig. 1). The unit is described as being experimental but nevertheless gives excellent results. The input is first converted to 38MHz by an ET021 tuner whose output is amplified by a narrow-band preamplifier using a 40763 MOSFET and bandpass filter. A Q multiplier provides variable selectivity – the effects are said to be dramatic! The amplified 38MHz signal is then mixed with the 106MHz output from a crystal oscillator to give a second i.f. of 68MHz. This is passed via a three-

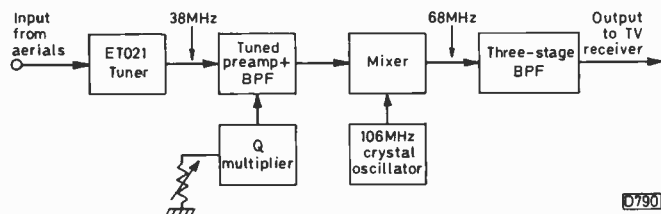


Fig. 1: Mike Gaskin's DX-TV receiver system, devised to overcome the problem of strong local signals.

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Wolsey Cosmovision – 1984 will see DBS-TV at 4GHz (USA TDRS at 41°W for Europe – early Summer) and 12GHz DBS-TV (Germany late Autumn). We will be supplying equipment for both bands. Watch this space for further details.  
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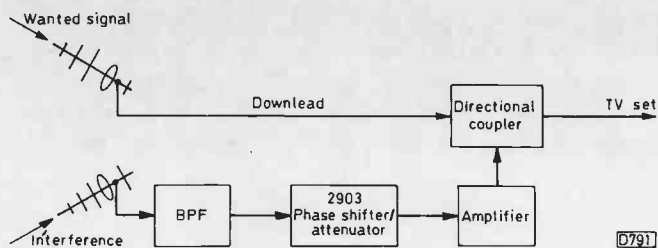


Fig. 2: Use of a Microwave Filter Company's 2903 unit for interference cancellation.

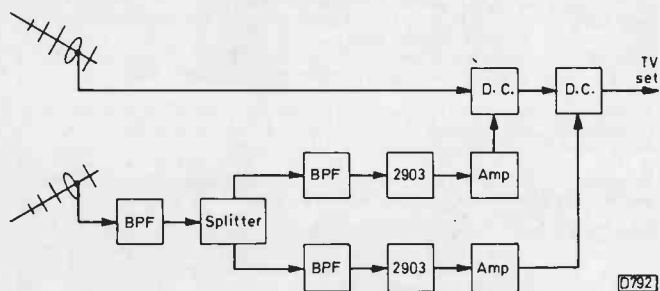


Fig. 3: More sophisticated system using separate channels for vision and sound signal interference elimination.

stage bandpass filter to the r.f. input of a JVC 3050 TV set tuned to the top end of Band I. Mike has also been using a Jaybeam 60-470MHz log-periodic aerial which he finds superior to the use of a Yagi due to the clean polar response and very effective reduction in pickup of the vertically-polarised PMR signals.

Mel Thurlbourne, who has previously been operational in the UK and Cyprus, is now DXing in the Falklands Islands. His receiver is a 16in. Argentinian set of ITT manufacture, designed for 625-line PAL N reception (3.58 instead of 4.43MHz colour subcarrier). It operates with system M channel allocations (lowest channel 54MHz) and is capable of modification for 525-line operation. Apparently there are quite a lot of Argentinian standard TV sets in the Falklands – they were imported for a service the Argentinians intended to establish and sold for £20 deposit plus monthly instalments. Recapture of the Islands put an end to the projected system N service. Mel found some brand new Band I, III and u.h.f. TV aerials on a floating hotel, but so far he's not seen any signals. There's been a report of Chilean TV being seen in the Port Stanley area however. We await Mel's next letter on DXing so far south with great interest.

## Interference

For some reason your scribe seems to be perpetually subject to interference of one form or another over the air waves. Recently a "ticking" was heard at one second intervals from Band I to Band III. My usual way of tracking down interference is to use a standard portable v.h.f. radio receiver with telescopic whip aerial – usually an f.m. radio, though multi-v.h.f. band units are preferred (Tandy Patrolman series etc.). A journey by foot in the immediate neighbourhood establishes where the interference is strongest: narrowing down the source should then be possible by reducing the aerial length. At this point I find it convenient to change over to a hand-held airband a.m. radio (Tandy offer cheap units which allow the telescopic aerial to be reduced to about 4in.). Using this method the ticking was traced to a specific point in a house – the cause turned out to be a central heating pump.

In the January 1981 issue I described a method of

interference cancellation by phase shifting and mixing the interference with the wanted signal plus interference. The technique gives interference reduction of some 40dB. The Microwave Filter Company Inc. of East Syracuse, N.Y. have a vast range of filters for use at 50MHz through to 4GHz. Of particular interest are the units that give phasing of unwanted signals so that, after mixing, only the wanted signal is left – such units are available for use in the US Low Band (Band I), Band II, High Band (Band III) and the u.h.f. bands. As Figs. 2 and 3 show, the idea is to use two aerials, one for the wanted signal and the other for the interference. The latter is passed via a bandpass filter (if necessary) to the phasing unit, which enables the phase and amplitude of the interfering signal to be adjusted relative to that arriving with the wanted signal. A directional coupler is then used to combine the two signals. The more elaborate system (Fig. 3) uses filtering to provide interference cancellation in both the sound and vision channels. To set up, the attenuation in the interference channel is set to minimum, the phase shift control is then adjusted for maximum interference reduction, finally the attenuation is increased for the same result. If there's insufficient range of control, a 10dB amplifier can be added in the interference channel. Several electronic phasers of the type described in the January 1981 issue have to my knowledge been built by enthusiasts suffering from interference problems and have generally proved to be effective.

NHK Tokyo designed a unit some years ago for anti-ghost use in built-up areas, again using two aerials and with a hybrid for combination. The output from the unit provided sum and difference signals, the latter being varicap diode tuned and coupled to the main signal path. Tuning was carried out at the receiver. According to Pat Hawker's Technical Topics column in *Radio Communication* (August 1982) the unit was never made available commercially.

I'd appreciate hearing from any readers who have had interference problems and have devised circuits to minimise the nuisance.

## Satellite Receiving Equipment

We have received details of a 2m dish system from SP Antenna Systems, 3 Woolpack Corner, Riddenden, Ashford, Kent TN27 8BU (0580 291090). The glass reinforced dishes have an f/d ratio of 0.45 and a claimed surface accuracy of  $\pm 0.5$ mm, making them suitable for both 4 and 12GHz operation. A pedestal type polar mount is available together with a feed support (to suit a Hugh Cocks' or other front end to order). The cost of the dish/mount is £421 plus VAT – with Hugh Cocks' electronics a 4GHz package works out at just over £800 and is said to be capable of providing locked video from the AFRTS downlink on the 1°W Intelsat. For further information send s.a.e. to the address above.

## 405 Help Wanted

Within twelve months we shall have lost forever the system A 405-line transmissions. Dave Hazell of 36 Park Road, Northleigh, Witney, Oxon OX8 6RX (0993 882238) has sent an appeal for any method of generating system A sound and vision signals for feeding his collection of 405-line receivers. If any reader has such a source – pattern generator, monoscope/electronic test pattern generator or whatever – we shall be pleased to hear.



# Service Bureau

*Requests for advice in dealing with servicing problems must be accompanied by a £1.00 postal order (made out to IPC Magazines Ltd.), the query coupon printed below 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.*

## TV/VCR COMPATIBILITY

The problem I have with a Sharp VC9300H VCR and a Philips G8 colour set is sound buzz in the E-to-E mode. I'm told that all G8s do this with Sharp VCRs. Is there anything that can be done?

This problem of buzzing is quite common and is not confined to Sharp VCRs and Philips G8s. Ferguson VCRs nearly always buzz with the Decca Bradford chassis for example. Neither the machine nor the TV set is faulty – it's a question of mismatch. We suggest you try the following courses, but emphasize that a complete cure may not be possible and that it may be necessary to settle for a compromise between picture quality and sound buzz. (1) Try an attenuator in the aerial and/or r.f. lead. (2) Try careful alignment of the 6MHz selectivity and discriminator circuits in the receiver. (3) Try turning down the TV set's tuner a.g.c. (4) Try *slight* adjustment of the TV set's a.f.c. circuit. (5) Try *slight* adjustment of the VCR's a.g.c. circuit. (6) Try *slight* adjustment of the VCR's E-E level control: this will have the effect of reducing the contrast of the E-E picture. Finally, you could try fitting a 6MHz ceramic filter in the receiver's sound circuit.

## THORN 8500 CHASSIS

There's a hum coming from the anti-surge coil L701 at the bottom left of the chassis. The hum is quite loud, and continuous. Is there anything that can be done apart from replacement? There is also loss of colour lock at switch on, normal colour appearing after about twenty minutes.

L701 is frequently responsible for a loud buzz on this chassis. It can sometimes be wedged or glued up (using white woodworking adhesive!), but often the only cure is replacement. Careful adjustment of the reference oscillator preset R163 on the signals panel should solve the colour problem.

## PHILIPS KT3 CHASSIS

One of these sets (16in.) is being used as a display for an Atari 800 computer. The problem is that the sound from the computer can't be tuned in correctly on any of the channels – the vision tunes in, and off-tuning the vision produces a low computer sound with a lot of background slush. There is also vision on sound buzz. Off-air reception is o.k. and the computer, which works all right on some other sets, has been checked.

You could have an early sound panel in the set, in which case it will be intolerant of transmissions that don't maintain the correct vision/sound ratio – TV games and computers seldom do. Check that C5161 (15pF) is fitted at the input of the sound panel, and try retuning the

detector circuit ceramic filter by reducing the value of C5175 – this was 120pF in early production but was reduced to 39pF. Note that with C5161 in circuit R5161 is connected between the junction of C5161/X5161 and chassis.

## THORN 1600 CHASSIS

There's sound and the c.r.t. heater is alright, but the picture consists of a dull, out of focus raster with modulation visible only in a dark room. The line oscillator voltages are correct but the driver transistor's collector voltage is wrong. Surprisingly, the line output stage is producing the correct 32V to feed to the shunt regulator circuit.

The incorrect driver transistor voltage suggests that the bias resistor R138 (470k $\Omega$ ) could have gone high in value. This will result in inefficient line output stage operation. Alternatively, check the scan-correction capacitor C136 and the e.h.t. stick rectifier W35. If all these items are in order and the line output transistor runs hot, it's possible that the line output transformer is faulty.

## PHILIPS G11 CHASSIS

This set is fitted with remote control. When the on-off switch is operated, the set goes into the standby mode and can be started only via the remote control unit.

This is a fairly common fault and is caused by failure of the small pair of contacts on the on-off switch – they should make a brief contact when the set is switched on to simulate the user selecting ch. 1. Check by touching a wire across the contacts with the set in the standby mode: it should then come on with ch. 1. Make sure you don't short across any of the mains contacts by mistake!

## TYNE MODEL 5224

This set has been restored to life by fitting a rewound line output transformer and replacing most of the transistors in the switch-mode power supply. The picture is quite good apart from a wrinkle that comes and goes about a third of the way across the picture. In addition the blue horizontal convergence is bad – o.k. at the centre of the screen but high at each side.

Since the chopper works at line rate, any ripple on the h.t. line will affect the line scan. Check the decouplers C348 (33 $\mu$ F) and C349 (0.1 $\mu$ F). If the problem persists, examine the line drive waveform – across R363 in the BU208's base circuit. If this differs markedly from that shown in the manual, check C347 (0.1 $\mu$ F) and D312 (1SX174) in the driver transformer circuit. If the poor blue convergence can't be cleared by adjusting P412 and L406, check the continuity of the 3W resistors R428 (2.2 $\Omega$ ) and R429 (27 $\Omega$ ) and if necessary the line section of the blue radial convergence unit.

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TELEVISION FEBRUARY 1984

### **THORN 9000 CHASSIS**

The fault is intermittent and often occurs on channel change. It consists of loss of line sync with a loud line whistle at the wrong speed, a fold in the middle of the raster and loss of colour. A normal picture is usually restored if the syclops circuit trips. The cause appears to be in the main syclops panel as replacing this clears the fault whilst replacement of the line oscillator and syclops control sections doesn't. The syclops transistor has been replaced.

Check thoroughly for dry-joints on the suspect panel – they are quite common in this chassis. If none can be found, another cause of the symptoms is a faulty diode. Check by substitution those in the syclops transistor's collector circuit – W702, W715 and W704. Also check the 90V line smoothing capacitor C715 (22 $\mu$ F).

### **MITSUBISHI CT200B**

Black vertical bars are present on pictures with a dark background. They are not present on a bright picture. The bars are thicker on the left-hand side of the raster, and decrease in depth towards the right-hand side.

We suggest you check R581 (220k $\Omega$ ) and C581 (0.01 $\mu$ F) which are connected in series with the primary winding of the e.h.t. transformer and are used to generate the beam limiting voltage. If necessary, check the flyback blanking stage, especially the diodes D620 and D621 and the electrolytics C6D3 and C6D4.

### **PHILIPS T8 CHASSIS**

The problem is sound but no raster, due to no e.h.t. The voltages around the BU407 line output transistor are all positive, instead of negative at the base and emitter, though the transistor itself appears to be o.k. The voltages in the power supply are higher than normal.

Loss of e.h.t. in these portables is usually due to a fault in the line oscillator unit or failure of the BC337 line driver transistor TS800. Possible but less likely is failure of the line output transformer. There are two i.c.s, type TBA240B and TBA720A, in the line oscillator unit. One of the i.c.s could be faulty, there could be a dry-joint or a defective resistor – check the pin voltages. Something to look out for is intermittent i.c. or transistor lead connections due to the set being moved around a lot.

### **DECCA 10/30 SERIES CHASSIS**

I've renovated a number of these sets and noticed a predominance of background green which is not due to incorrect grey scale setting – proved by turning down the colour control. I've tried panel swapping and setting up the panels according to the instructions in the manuals, but the fault remains.

It's a fact that some early types of discrete component decoder can suffer from this problem. Correct decoder alignment, particularly of the PAL demodulation phases, and the use of well-matched chroma detector diode pairs (D200/201 and D202/203 in the 10 series chassis), will go a long way to alleviate it.

### **TANDBERG CTV2-2 CHASSIS**

There were no results apart from the c.r.t. heaters and channel indicators glowing. On checking, the surge limiter resistor R981 and mains fuse S976 were found to be open-circuit, due to the chopper transistor Q977 and the 160V h.t. rectifier D985 being short-circuit. These items were all

replaced, but the only result is a whistling from the power supply panel. Thyristor Q976 appears to be short-circuit.

Q976, type BRY55 or MCR101, controls the switching of the chopper transistor. Replace it along with the voltage sensing transistor Q975. If the buzz from the chopper transformer persists, look for leakage or short-circuits in the line and field output stages.

### **THORN 1691 CHASSIS**

After about fifteen minutes the field scan collapses then opens out again to give a full raster. This sequence then continues. It's difficult to know where to start with the d.c. coupled field timebase.

We suggest you concentrate on the field amplifier stage, replacing first the electrolytic C106 (1 $\mu$ F) in the feedback loop, then if necessary the two diodes W19/W20 and the transistor VT20. A less likely possibility is that the scan coupling capacitor C107 (1,000 $\mu$ F) or one of the driver/output transistors VT21-24 is faulty.

### **HITACHI CNP190**

There's an irritating tuning fault on this set. When a button is selected and pressed the picture is all right initially but after a time the tuning appears to "jump" by a small amount, e.g. colour is lost. The problem occurs to a varying extent with all the buttons.

This type of fault is difficult to diagnose without an accurate digital voltmeter. Try disconnecting the tuning potentiometer bank and substituting a 47k $\Omega$  linear potentiometer, with its wiper to the varicap tuner's tuning pin. Adjust the preset to a local station and check for drift. If it occurs, change the 33V stabiliser i.c. (which is not shown on the circuit diagram) and try again. If drift still occurs, the ET512B tuner is suspect. If no drift is seen with the potentiometer in circuit, the four-button switch/tuning bank assembly is suspect.

### **RANK A774 CHASSIS**

After ten minutes the brightness level starts to vary. Quite often this stops after a while; but sometimes it continues all evening. There is also a difference in the brightness levels on different channels.

The cause of the trouble is likely to be in the a.g.c. circuit. We suggest you replace the two electrolytics 3C5 and 3C6 and diode 3D3 in the gate circuit, then set up the i.f. gain control 3RV2. If the flutter persists, the following modification may help: connect a 27k $\Omega$  resistor and an 0.1 $\mu$ F capacitor in series between the collector and base of the a.g.c. amplifier transistor 3VT2, then reset 3RV2.

### **THORN 8500 CHASSIS**

The thermal cutout operates as soon as the set is switched on, making it difficult to carry out any tests.

Proceed as follows. Disconnect the brown lead from the collector of the line output transistor to the line output transformer. If the fault persists, suspect the power supply rectifier/regulator thyristor W703 or the line driver transistor VT402. If not, reconnect the brown lead and pull out the line drive plug 20. If the fault is still present, check the line output transistor VT401. If not, suspect the following, given in order of likelihood: the e.h.t. rectifier unit W401; the shift choke L401; the efficiency diode W420; the first anode supply reservoir capacitor C401 (if short-circuit, R402 will probably be burnt); also check that the scan coil tags are not touching.

# TEST CASE

## 254

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

Amongst the many types of sets that come into the workshop, some are popular while others linger in the waiting repair section because the technicians tend to avoid them! This is sometimes a matter of sheer prejudice about a particular make, and we had better not go into details otherwise the correspondence page will be full of indignant letters. More often however a set is avoided because of the complaint noted, like "intermittently goes to stand-by", "tuning drift" and so on. Amongst such trying prospects, a set with the simple symptom of field collapse will soon find its way on to somebody's bench!

And so it did – a nice new colour portable, Doric Model CU36502D, fitted with the Rediffusion Mk. 5 chassis. True enough, there was no field scan. We turned down the brightness to prevent screen burn and had a close look at the chassis, scan coil connections and so on – such faults are very often caused by "sillies". Everything was intact, the scan yoke was plugged in, and there were no dry-joints or print cracks that we could see. There are two transistors in the class AB field output stage, Q501 and Q502 (see Fig. 1). These were checked in situ with the AVO on the ohms range, and as all seemed to be well we switched on again, taking care to keep the brightness setting low. The first check was for h.t. supply to the field output stage – the 73V line is derived from the line output transformer. All 73V were there, and were present at the collector of the upper transistor Q501.

In this chassis the field oscillator and driver, along with

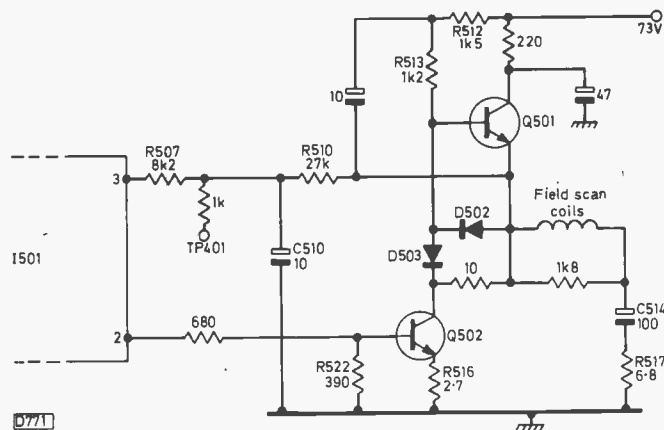


Fig. 1: Field output circuit, Rediffusion Mk. 5 chassis.

the line oscillator, are in a single IX0065CE chip (I501). So attention was turned to this area. The i.c. has separate supplies for the field and line timebase sections, and we found that the field oscillator/driver supply at pin 6 was present and correct at 11.7V. Was there field drive? A scope check at pin 2 proved that this was absent. No sawtooth, no anything. It's difficult (for us, anyway!) to know exactly what goes on inside an i.c., so we simply assumed that the field oscillator had stopped. After checking the continuity of the field hold and height control networks we sent off for a new i.c., under guarantee.

The replacement chip took some time to arrive, and by the time we came to fit it we'd forgotten the exact details of the fault. What was for sure however was that there was still no field scan! Consulting the circuit we discovered that field collapse can be induced by linking TP401 to chassis, so we checked for any shorts in this area. Nothing came to light, and having discovered that the chip's field output pin 2 was at zero volts we began to suspect the field output transistors. Removal for testing, then substitution, made no difference however, and as pin 3 (d.c. feedback) of the chip was at virtually zero voltage we began to suspect that we had somehow got another faulty i.c. Not so, as we subsequently discovered. With the knowledge that the chip was o.k., perhaps you will arrive at the answer long before it appears next month . . .

### ANSWER TO TEST CASE 253 – page 151 last month –

Last month's buzz word was JVC: if you recall, we described the antics of an HR4100EK portable VCR system in which off-air monitoring during a recording was badly marred by vision buzz though off-tape playback, whether the material was pre-recorded or self-recorded, was accompanied by a discernible but much less disturbing buzz level from the TV set. We felt that the tuner/timer section of the TU41 was exonerated because the recordings made through it were perfect. It appeared to be the source of the vision buzz whilst recording in the E-E mode however.

The trouble lay in the VCR itself in fact, specifically in the r.f. modulator department. For record monitoring, i.e. E-E operation, the VCR's audio and video signals are fed to its r.f. modulator. The 6MHz intercarrier sound generator coil was found to be the cause of all the trouble, as it was slightly off tune. To gain access to it whilst the modulator is operating requires removal of its screening "well" in the machine. When this has been removed and the module refitted, the sound coil can be adjusted for minimum buzz in the E-E mode. There is no circuit or component reference to the coil in the manual – the modulator (r.f. converter) is regarded as a black box.

Why the louder buzz in the E-E mode? With the VHS system, as with other domestic VCR formats, the off-tape luminance response is limited to about 3MHz: it's the h.f. video components and teletext pulses that cut most into the sound to cause video buzz, and these reach the modulator in the E-E mode.

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BU205	1.40					<b>PLEASE ADD 65 PENCE POST/ PACKING TO YOUR ORDER TOTAL AND THEN 15% VAT. GOODS ARE DESPATCHED BY RETURN AND SHOULD BE RECEIVED WITHIN 4 WORKING DAYS. THIS IS ONLY A FRACTION OF OUR RANGE, SEND 50 PENCE (REFUNDABLE WITH £5 ORDER) FOR OUR COMPREHENSIVE CATALOGUE. TRADE ACCOUNTS WELCOMED.</b>			
BU208	1.55								
BU208A	1.90								
BU208D	2.30								
BU326	1.80								
BU407	1.40								
BU426V	1.70								
BU526	1.62								
BUW81A	2.55								
E1222	0.35								
FT3055	0.65								
MJE340	0.50								
MJE520	0.45								
R2008B	1.70								
R2009	1.90								
R2010B	1.90								
R2028	1.90								
R2029	1.90								
R2030	1.90								
R2265	1.90								
R2305	0.65								
R2306	0.70								
R2322	0.70								
R2323	0.70								
R2354B	0.78								
R2396	0.80								
R2441	0.83								
R2461	2.00								
R2477	0.78								
R2501	2.00								
R2540	2.10								
SP8385	0.70								
T9011V	0.80								
T9016V	0.80								
T9035V	0.82								
T9038V	3.50								
TIP29	0.38								
<b>RESISTORS (CARBON)</b>		<b>VALVES</b>		<b>TUNERS</b>		<b>LINE OUTPUT TRANSFORMERS</b>			
½ Watt IRO to 10M (10 Pack) 0.18		30FL1 1.20		1043/05 7.95		Autovox 90° 9.75			
1 Watt 2R2 to 10M (10 Pack) 0.39		DY86 0.75		1043/06 7.95		Autovox 110° 9.75			
2 Watt 4R7 to 10M (10 Pack) 0.60		DY802 0.75		U321 7.25		Decca 1700 Mono 9.80			
		ECC82 0.75		U322 7.25		Decca 1830 9.80			
		PCF80 0.85		G8 11.75		Decca 2230 8.30			
<b>RESISTORS (WIREWOUND)</b>		PCF802 0.95				GEC 2110 9.50			
2½W OR22 to 10R 0.15		PCL82 0.85				GEC 20AX (diode split) 12.00			
5W OR47 to 6K8 0.15		PCL84 0.85				Grundig 1500 mono 13.70			
7W OR47 to 12K 0.15		PCL85 0.95				Grundig 5010 11.50			
11W OR1 to 18K 0.18		PCL86 0.95				ITT CVC5/8 10.25			
17W IRO to 6K8 0.24		PFL200 1.20				ITT CVC20 10.75			
		PL36 1.25				ITT CVC30 8.75			
<b>PRESETS</b>		PL504 1.40				ITT CVC45 9.75			
Horizontal and Vertical Standard and sub mid sizes 100R to 4M7 0.12		PL508 1.85				Indesit mono 10.75			
		PL509 5.10				Korting 90° 10.75			
		PY800 0.89				Korting 110° 12.50			
		PY500A 1.95				Philips 210 9.90			
						Philips G8 8.90			
						Philips G9 8.50			
						Philips G11 12.95			
						Philips K30 14.95			
						Philips KT3 7.95			
						Philips 570 9.50			
						PYE 691 P.C. 13.00			
						PYE 725 8.95			
						PYE 731 8.95			
						PYE 169 10.75			
						RRI 640/793 11.75			
						RRI 774 12.90			
						RRI 823 11.90			
						RRI T20 12.90			
						SABA 12.50			
						Skantic 12.50			
						Thorn 1500 20" 7.00			
						Thorn 1500 24" 7.00			
						Thorn 1591 10.50			
						Thorn 1615 10.00			
						Thorn 1690/1 8.75			
						Thorn 9000 10.90			
						Thorn 9600 10.00			
<b>SMOOTHING CAPACITORS</b>		<b>PUSH BUTTON UNITS</b>							
Decca 200/200/400/350V 2.70		Decca 30 4 way 6.80							
Decca 400/400 350V 2.90		Decca 30 6 way 7.80							
Decca 400/800 350V 2.90		GEC 2110 11.00							
Philips 600 300V 2.50		GEC 2112 12.95							
Philips 2200 63V 1.55		GEC 2136/7 8.90							
Philips 470 250V 2.00		GEC 2112 Conversion 13.00							
Philips (G9) 600 300V 2.80		Hitachi 190 4 way 8.95							
PYE 200/200/100/32 2.85		ITT CVC5 7 way 10.00							
PYE 600 300V 2.80		ITT CVC8/9 12.85							
RRI 2500/2500 30V 1.20		ITT CVC20/30 6 way 8.00							
RRI 220 400V 2.90		ITT CVC 25 6 way 8.50							
Thorn 150/160/100 300V 1.90		Philips 520 11.00							
Thorn 4700 25V 0.85		Philips 550 13.55							
Thorn 1000 70V 0.70		Philips G11 22.50							
Thorn 200/100/100 350V 2.85		PYE 713 4 way 8.70							
Thorn 175/100/100 400V 2.40		PYE 715 6 way 13.50							
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**Unmarked cabinets. Thorn 9000, 9200, 9600 Remote Control 20" - 22" BUSH T20s, T22s, T24s**

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18", 6 Button, Sliding Controls,  
Brilliant Condition. Good sellers as computer monitors

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THE ABOVE ARE WORKS MODIFIED FOR MOST PARTS OF THE WORLD VHF - UHF

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22"-26", could be mistaken for new

**All £49.00 each**

## **PYE 725**

20" unmarked cabinet

**£59 each**

*Minimum 5 sets*

*Prices subject to V.A.T.*

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CENTRE**

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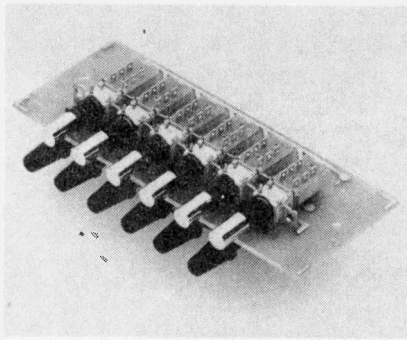
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(15 MINS PAST BRISTOL SOUTHWARD ON M5)

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6 way interlocked d.p. switch 100 K tuning potentiometers  
 Top quality through hole plated pcb  
 Dimensions: 5" by 2½" by 1"  
 Ideal for replacement when original parts are obsolete or unobtainable  
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**Quality, High Temperature Reprocessing**

Colour Tubes	One year guarantee (optional extension up to three years)	Two year guarantee (optional extension up to four years)
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90° up to 20"	£26	£29
90° up to 22"	£30	£33
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110° 26" (fast heat, narrow neck)	£33	£36
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Up to 22"	£38	£44
Up to 26"	£40	£46

Please add £12 plus VAT for optional guarantee on any type of colour tube.

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Your good, working tubes with scratches or small chips, can be **POLISHED** with our purpose built polishing equipment. Only £7 per tube.

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Your Local Tube Stockist:

- Well View, Southampton. Tel. 0703 331837.  
 Retach Ltd., Northwood, Middx. Tel. 9684-27019.  
 West One Distributors Ltd., Chesham, Buckinghamshire. Tel. 0494-778197.  
 Rushden Rentals Ltd., Rushden, Northants. Tel. 0933-314901.  
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Please note that we have no connections whatsoever with any other business having similar name to ours.

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**The Best Quality Sets Available Anywhere**

3500 Electronic 22"	£30
Bush Electronic	£15
GEC & Pye Hybrid	£5
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Decca Bradford	£10
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Also Philips G9, G11, ITT CVC 35, 45, 50, Thorn 9000, 9600, 9800, Bush T20.

**All sets complete with excellent cabinets Full spares back-up of tubes and panels – send for list Bulk terms to other wholesalers**



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**Some Inline sets also available**

I.E. ITT, C.V.C. 25 & 30  
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**All prices subject to availability of stock**

Quality discount available. Hundreds of sets to choose from.

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All prices subject to 15% VAT.

**500 various different T.V.'s arriving this month**

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Jap. sets from **£30.00**

*Special prices for quantity*

*9,000 sq. feet Warehouse*

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**SPECIAL OFFER THIS MONTH:-**

- ☆ Large quantity of 18" Decca PIL Tube 80 Series, all in good working order.
- ☆ Limited quantity of Toshiba Colour Portables.
- ☆ Used VHS, Beta, 2000 System Videos in excellent working order.
- ☆ Good selection of modern colour TV's.

**PLEASE PHONE FOR CURRENT STOCK POSITION  
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BRAND NEW TUBES AT CUT PRICES

A31-19W/20W.....	19.95	230DB4CT468.....	31.00
A31-120W/300W.....	17.95	240DB4/240AB4A.....	22.00
A31-410/510W.....	17.95	CT507 equiv.....	21.95
A34-100W/510W.....	18.50	310DGB4/DMB4.....	23.00
A34-514W.....	24.25	310EUB4.....	19.95
A38-160W/170W.....	17.50	310EUB4A.....	18.50
A44-120W/R.....	25.00	310EYB4.....	18.75
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A61-120W/R.....	21.00	310GNB4A.....	31.00
9AGP4.....	£21.82	310HCB4.....	31.00
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**Some Rebuilt Japanese & European Types Available from £14.00 +VAT £2.10**

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(NEW & MULLARD/THORN COLOREX)\*

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A47-342X.....	61.00	A63-120X.....	63.00
A47-343X.....	61.00	A66-120X.....	65.00
A49-191X.....	53.00	A66-140X/410X.....	70.50
A51-161X.....	70.00	A66-500X/510X.....	65.00
A51-220X.....	55.00	A67-120X.....	65.00
A51-500X/510X.....	64.50	A67-140X/200X.....	69.50
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\*Old Bulb Required for 110° Colorex\*

ADD 15% VAT TO ALL THE ABOVE PRICES.

Please allow 7 days for delivery

ALL TUBES TESTED BEFORE SALE & FULLY GUARANTEED

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IF Panel	1.75	2.50
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Twin Chip Decoder	10.50	

Also Philips G8, GEC S/S, Panels from £2.75  
NO VAT just add £1.50 p&p per 1 item & 75p per each additional item.

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Discount T.V. Services, "T.V. Panels", Unit 11,

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REPLACEMENT KIT (14 Pieces Boxed)	£ 8.25	V.A.T.

PLEASE ADD 15% V.A.T. PLUS P. & P. £1.50 PER ORDER  
OUR FULL CATALOGUE AVAILABLE ON REQUEST.

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Telephone Crewkerne (0460) 74321 Telex 46306 MONLTH G

# BI-PAK

## VALUE PACKS

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VP2	300	Carbon Resistors 1/2 Watt Pre-Formed	£1.00
VP3	200	1/2 Watt Min Carbon Resistors Mixed	£1.00
VP4	150	1/2 Watt Resistors 100 ohm - 1M Mixed	£1.00
VP5	200	Assorted Capacitors All Types	£1.00
VP6	200	Ceramic Caps Miniature - Mixed	£1.00
VP7	100	Mixed Ceramics Disc. 1pf - 56pf	£1.00
VP8	100	Mixed Ceramic Disc. 68pf - .015pf	£1.00
VP9	100	Assorted Polyester/Polystyrene Cpas	£1.00
VP10	60	C280 Type Caps Metal Foil Mixed	£1.00
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VP12	60	Bead Type Polystyrene Min Caps	£1.00
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A selection of large and small sized LED's in various shapes, sizes & colours, together with 7 Segment Displays both anode & cathode plus photo transistors, emitters and detectors. Cadmium Cell ORP12 and Germ. photo transistor OCP71 included. In all a total of 25 Opto pieces valued over £12 Normal Price.

Order No. VP57  
Our Super Value Price Just  
**£5.00**



## VALUE PACKS

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VP30	10	Ass. 10W Zener Diodes Mixed Vtts. Coded	£1.00
VP31	10	5 Amp SCR'S TO-66 50-400v Coded	£1.00
VP32	20	3 Amp SCR'S TO-66 Up To 400v Uncoded	£1.00
VP33	200	Sil. Diodes Switching Like IN4148 DO-35	£1.00
VP34	200	Sil. Diodes Gen. Purpose Like OA200/BAX13/15	£1.00
VP35	50	1 Amp IN4000 Series Sil. Diodes Uncoded All Good	£1.00
VP36	8	Bridge Rects. 4 x 1 Amp 4 x 2 Amp Mixed Vtts. Coded	£1.00
VP37	8	Black Instrument Type Knobs With Pointer 1/2 Std	£1.00
VP42	10	Black Heatsinks To Fit TO-3, TO-220 Ready Drilled	£1.00
VP43	4	Power-Fin Heatsinks 2 x TO-3 2 x TO-66 Size	£1.00
VP44	1	Large Power Heatsink 90 x 80 x 35 mm Drilled For Up To 4 TO-3 Devices	£1.00
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VP46	50	BC177/8 Type PNP Transistors Good Gen. Purpose Uncoded	£1.00
VP47	10	Silicon Power Trans. Similar 2N3055 Uncoded	£1.50

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Comprising 4 x 1/2 Amp rectifiers mounted on PCB.  
VRM - 150 vits  
IFM - 1.5 Amps

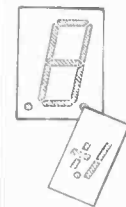
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10 off £1.00  
50 off £4.50  
100 off £7.50

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Red, Green, Yellow - 3/5/6 inch Mixed types and colours  
NUMERIC & OVERFLOW  
Common Anode/ Cathode. GaAsP/ GaP.

Brand New, Full Data incl.  
10 pieces (our mix) .....£4.00  
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VP40	30	Assorted 74 Series TTL I.C.'s Gates, Flip-Flops & M.S.I.'s + Data Book. All New, Normal Retail Value Over £6.00. Our Price	£2.50
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YOU MAY ORDER any ONE TYPE of the above CMOS at £2.00 per 25 pieces. ORDER AS VP41 + type number required.

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Comprises 2 standard screwdriver blades 5 & 7mm size. 2 cross point size 4 & 6. 1 Ratchet handle. 5-in-1 Kit £1.45 each. O/No 329B

## VALUE PACKS

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VP18	30	Metres PVC Covered Multi Strand Wire Mixed Colours	£1.00
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VP20	6	Rocker Switches 5 Amp 240v	£1.00
VP21	20	Pcs. 1 - 2 & 4 mm Plugs & Sockets Matching Sizes	£1.00
VP22	200	Sq. Inches Total, Copper Clad Board Mixed Sizes	£1.00

## VALUE PACKS

Pak No.	Qty	Description	Price
VP23	20	Assorted Slider Pots Mixed Values	£1.00
VP24	10	Slider Pots. 40 mm 22K 5 x Log 5 x Lin	£1.00
VP25	10	Slider Pots. 40 mm 47K 5 x Log 5 x Lin	£1.00
VP26	20	Small .125" Red LED'S	£1.00
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## TRANSISTOR CLEARANCE

All Sorts Transistors, A mixed Bag NPN-PNP Silicon & Germ. Mainly Uncoded You To Sort Pack Includes Instructions For Making Simple Transistor Tester. Super Value. Order No VP60 **£1.00**

Send your orders to Dept. T2  
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WARE HERTS



Use your credit card. Ring us on Ware 3182 NOW and get your order even faster. Goods normally sent 2nd Class MAIL. Remember you must add VAT at 19% to your total order. Postage add 75p per total order.

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**Special Clearance to trade**

G8, Philips from £8, Pye 205 from £5,  
GEC Hybrid from £5, Decca 1800 Series,  
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Buy T.V., tubes and spares free.

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**BEST QUALITY EX-RENTAL  
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**100's OF SETS  
ALWAYS IN STOCK –  
COMPETITIVE PRICES**

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(SUBJECT TO AVAILABILITY)

We also have PYE – DECCA –  
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**MANY – MANY – MORE!**

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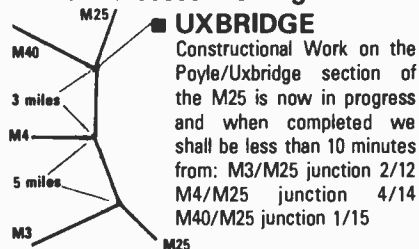
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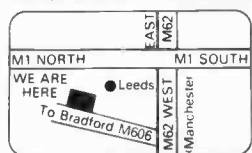
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