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VERSATILE INTEGRATED COMMUNICATIONS BUILDING BLOCKS

THE COMPLETE ELECTRONICS AND COMMUNICATIONS MAGAZINE

D71699

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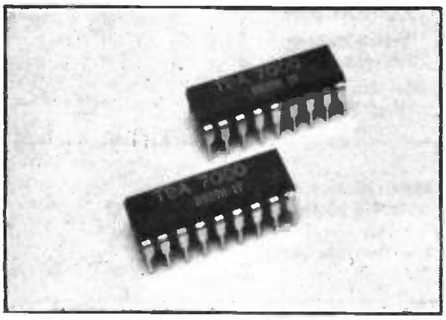
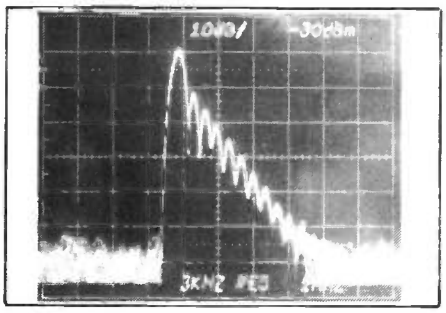
RADIO & ELECTRONICS WORLD

OCTOBER 1983





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Spectrum Analysis Made Easy
The most recent updates on past issues
We will be publishing these **Next Month**.

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COMMENT

New Technology — the ultimate quack remedy for ailing economies?

There's an old Chinese curse, the essence of which is 'May you live in interesting times'. Not quite as obvious as some of the more familiar Anglo-Saxon offerings, but as far as inscrutability goes, it doesn't require much thought to abstract the essence of the malice. Anyone engaged in the electronics, computing and communications worlds understands the meaning of this curse only too well.

Gone are the days when one product churned through the factory untouched and unmodified for ten years at a time. Now we would be lucky if it achieved more than 2–3 years of life, and then it would probably have seen a series of midstream revisions, because the original development was telescoped into a dangerously short space of time in order to 'catch the market'.

So interesting are these times that the heart of high technology itself – Silicon Valley – is beginning to see mass layoffs. Computer Guru Adam Osborne has actually carried out the old joke about the microchip manufacturer moving into smaller premises because business was booming, by citing the greatly improved efficiency of assembly of his new Executive computer as the main reason for shutting down one plant and laying off the workforce.

This is just one very visible example of the simple fact that the parameters currently ordering the way that business and politicians presently view the industrial world are as out of date as a parliament where the administrators waste much of their time debating a foregone conclusion, and then vote on it by physically walking through division lobbies. It's understandably hard to be convinced that such people should be charged with the direction of a nation's livelihood.

So far, no politician has come up with a convincing argument as to why Information Technology should make any impact whatsoever on the 'structural' unemployment problem of the West. And exporting IT to the underdeveloped nations has simply increased aspirations amongst poor nations to a level that cannot possibly be met from the world's resources. One tractor effectively unemploys maybe four or five labourers – certainly progress towards the Western ideal, but hardly appropriate. 'Ignorance is bliss' is a useful analogue to the Chinese curse cited above.

The cost of long term 'structural' unemployment to a nation is quite staggering. Apart from the direct costs of unemployment, the cost in terms of lost taxation on real income, lost 'cashflow' in the gross national product, lost creativity and diminished creation of wealth is a national loss of incalculable proportions. The solutions are certainly not simple, but one thing now seems definite; the application of New Technology as understood by politicians and major industrialists is certainly no cure at all.

We'd like to hear from readers with suggestions as to how they would employ technology to increase the sum total of human happiness – starting with their home country. The rules are simple: show how to create wealth and employment in a 'market' environment using new technology as a catalyst. Be as outrageous as you like – propose income and import controls, control of the media and locking up politicians – if that's what it takes!

Even if we can only publish one suggestion, this looks like being one more than anyone has to work with at present.

Arcom Control Systems has asked us to emphasise that the Z8000 development board being offered as the prize in our Zilog Competition is an ARC 8000 board, designed and produced by Arcom Control Systems. We apologise for giving the impression that Zilog was responsible for the development of this board.

BULLETIN BOARD

Nota Bene

This month we offer some Japanese thoughts on where their Electric Measuring Instrument Industry is going, based on an article in the July 1983 issue of the Japanese Electric Measuring Instrument Manufacturers' Association (JEMIMA)'s newsletter.

Electric measuring instruments are believed to make a continuous and indispensable contribution towards modernising 'fundamental industrial foundations'. In other words, the developments that have been seen in the technology of these instruments have brought important savings in all resources – energy, manpower and materials – through the advent of more efficient equipment, improved production techniques, higher quality products and more advanced systems, to name but a few. However, the world recession that followed the second oil crisis in 1979 (the first was in 1973) has had its effects even on the fortunes of JEMIMA's members, because there was a distinct slackening particularly of private sector demand. But the most important concern is the future, something that is very difficult to assess.

The 1982 fiscal year saw the first single figure percentage increase (4.2%) in this element of Japanese industry since 1976 and trends so far suggest a still lower figure in 1983 (3%). Because of their dominance in volume terms, these figures reflect the fortunes of sales of process measuring and control instrumentation and of other test and measuring instrumentation, with the former down 1.6% and the latter up 9.2%. Indeed these figures themselves tell an important story, for the decline in process equipment reflects to a great extent the way the Japanese Government attempted to stimulate the economy in 1981 by bringing forward various public works orders – for example, replacing water service installations and automating office systems. Since '90% dissemination' of water services has now been achieved, this particular market for process instrumentation is likely to level off mid-term. The test and measurement field, on the other hand, has been moving forward in 'leaps and bounds' as the new 'space-age' technology – fibre optics, ultrasonic devices, Josephson junctions, IR image sensors, etc, etc – makes its presence felt. There are high hopes that such advanced technology projects as the Information Network System (INS) will demand similarly advanced test and measurement instrumentation. Other areas in which an expansion in demand is expected are optoelectronics, 'personal-use wireless apparatus' and a wide range of GPIB-based automatic measuring equipment.

The message that JEMIMA reads in all the information at its disposal is one of growth in all areas from 1984 on, with test and measurement equipment reaching double-figured growth and becoming the biggest sector of the market (a position presently held by process control and measuring equipment). In other words, the Association expects a 'healthy future' for its members, despite the current period of low growth and business conditions worldwide remaining 'chronically depressed'.

Further developments in optical communications

Following on from last year's demonstration of unamplified transmission of signal over more than 100km of optical fibre cable, John Midwinter's team at British Telecom Research Laboratories at Martlesham Heath now expects that, in future, repeaters could be placed as much as 400km apart – simply through developing means of making the glass used even purer. British Telecom, you may remember, is scheduled to have installed a network of some 26,000km of optical fibre cables by mid-1985.

The initial success came with the development, not only of a method for producing very fine and very pure glass fibres, but also of an improved jointing technique (leading to fewer losses there and for its developers – Ron Smith and his colleagues at the Wembley section of British Telecom – a £1000 top prize in BT's recent 'Fit for Purpose' competition) and of a highly pure light source that has a frequency stability of better than one part in 10^9. Moreover the improved signal quality that resulted both from the improved characteristics of the light source and its monomode transmission along the optical fibre led in turn to improved receiver technology because it was new feasible to design an optical heterodyne receiver. Such a receiver is the direct equivalent of that used in most radios: a second laser beam is mixed with the incoming signal and it is the resulting beat or intermediate frequency (IF) signal that is detected. Such a device has 30–100 times the sensitivity of other optical receivers.

The very latest research in this area at BTRL is looking at possible 'infra-red' glasses from which to make the fibres, because it is expected that their attenuation would be just 0.01dB/km rather than the present 0.2dB/km – and that would extend the range ten-fold.

In all this, it is pleasing to remember that optical communications is a field in which Britain is in advance of both the Americans and the Japanese.

Electronic ordeals

Data Dynamics circulated a press release after one of its ZIP printers suffered an 'involuntary heat test'. The picture below shows its appearance once the flames, that had extensively damaged its transit box and packing, had been put out. The manufacturer's pleasure resulted, not only from the way its claim that the metal case of the printer would stand up well to rough industrial usage, but also from the fact that, once it had cooled down, the printer was found to be in perfect working order.

The other 'ordeal' that we report here was very much more intentional. Part of the testing on one of Beckman's heavy duty HD100 multimeters included it being frozen into a block of ice and then dumped on the floor of a sauna in Finland, the ice melting away on the sauna stones. Beckman, of course, was happy to report that all its functions were still functioning after this 'masochistic' treatment.

Computer ordeals

The recent London Computer Marathon, held on 10th–17th August, was seen by its sponsor – Micro Networks – to be the first serious performance test on the reliability of 16-bit microcomputers. The idea was that the 'runners' would work non-stop, 24 hours a day for seven days, running a special program over and over again. This program was designed by the Marathon's referees – Colin Barker, the Editor of *Which Computer?* and Cindy Mills, the Editor of *Personal Computer News* – and the aim was to test the most vulnerable aspects of those 16-bit micros. The floppy disk drives are a particular concern in this respect as excessive head pressure or overheated disk drives will ultimately lead to breakdowns caused by worn out or buckled diskettes. The results were expected to be very valuable to potential users of the machine.

All the manufacturers of single-user 16-bit micros were invited to participate but, in the event, there were just 11 runners – two LSI M4's; two IBM PC's; one Comart CP1000; two Samurai S-16's; two Olivetti M20's; and two Wang PC's. As can be seen from the table below, six machines survived the week without any breakdowns including both Olivetti M20's and both Samurai S-16's – which must have pleased the sponsor as Micro Networks is the UK distributor for the latter micro. The IBM PC's, however, had a rather less happy time with one suffering a faulty disk drive right at the start and the other experiencing a software fault, but one that didn't prevent it from running for the length of the competition. These were, by the way, entered by a dealer and not by IBM itself.

The detailed report of the judges isn't available at the time of going to press, but perhaps the most interesting feature of the initial results is the great disparity between the number of times the program was completed by the Wang and the LSI machines and those achieved by the other machines. Other points to note are that the disks themselves stood up well to the treatment and that there was no noticeable difference in the performance of 8" and 5¼" disks.

London Computer Marathon : Results

Entry	Machine	Iterations of prog	Breakdowns	Temp °C max/min
1	LSI M4	980	0	33/30
2	LSI M4	967	2	33/32
3	IBM PC	127	74	40/38
4	IBM PC	0	2	-
5	Comart CP1000	96	3	30/29
6	Samurai	277	0	33/29
7	Samurai	277	0	35/29
8	Olivetti M20	141	0	40/30
9	Olivetti M20	142	0	36/30
10	Wang PC	1192	10	31/29
11	Wang PC	1191	0	30/28

Launch of a Tandy club

Following the UK launch of Tandy's new Model 100 microcomputer on 4th July 1983 (reviewed in *R&EW* August '83 p46), John Noyce of Remsoft came up with the idea of forming a Users Club dedicated to the Model 100. His reasoning was that the new machine was so different from earlier Tandy products that all users will greatly benefit from such a means of information exchange. Moreover, the discussions that ensue could well lead to the machine's capabilities being used to the full.

At present there is an annual subscription of £12 for members of the user club (payable to 'Remsoft'), while a quarterly newsletter is planned and a discount scheme for software envisaged. The address to which to send subscriptions, SAE's for further details and contributions to the newsletter (preferably on tape cassette using the text editor) is Remsoft, 18 George Street, Brighton BN2 1RH (Tel: 0273 602354).

★ ★ Company News ★ ★

Data Beta has been appointed sole UK distributor for **Zeltex**. The latter firm specialises in packaged electronic circuits – in particular high-speed, high-precision digital-to-analogue and analogue-to-digital convertors, but also a variety of high-speed data acquisition systems and such specialised analogue circuits as isolation amplifiers and sample-and-hold amplifiers. But perhaps Zeltax is best known for its high-speed frequency domain multiplexing (FDM) products that are used by telecommunications companies worldwide. By this arrangement, Data Beta supplements its planned range of digital filters and may even be able to market these in the States.

Digital Equipment Corporation has signed an agreement with **Trilogy** whereby DEC acquires an option on the latter's advanced semiconductor technology. In particular, DEC will be aiding Trilogy in setting up a new manufacturing facility in California which will ultimately devote some of its capacity to supplying DEC with semiconductors based on the new high-performance, ultrareliable Triology technology. This technology is seen as a breakthrough in circuit integration and packaging.

DEC is also at the heart of **Compass Peripheral's** recent appointments as franchised distributor for both **Bubble-tec** and **Imperial Technology**. Compass was set up to specialise in very high performance disk-based mass storage devices for DEC equipment. So far its range has been limited to mechanically driven Winchester and floppy disk systems: the arrangements with the American firms mean that Compass will now be able to supply the DEC-compatible add-in bubble memory boards for use where there are environmental constraints and MegaRam solid-state mass storage systems. The latter are mounted on a 7" chassis accommodating up to 32Mbytes and look like a conventional rotating disk to the computer.

Decade Computers is also a DEC specialist with products including the full range of VAX, UNIBUS and Q-Bus compatible pheripherals. This company has recently also become a franchised distributor for **National Semiconductor's** range of DEC compatible memory boards which can be used with all three systems. Previously it could only supply memory boards for VAX computers.

Motorola is to phase out five members of its MC12000 series of MECL phase locked loop devices. These are: the MC12000 digital mixer/translator; the MC12002 analogue mixer; the MC12012 dual modulus pre-scaler; the MIC12020 IF offset controller; and the MC12021 IF offset programmer. Motorola has had limited customer demand for these devices but the planned programme of 'business as usual' for the rest of 1983 and 'lifetime buy-out' orders up to June 1984 (for delivery by December 1984) should give customers time to adjust.

Burr-Brown has acquired the outstanding shares in **Applied Micro Technology**, a Tucson-based supplier of STD bus circuit cards, I/O control systems and peripheral controllers. Not only will these complement Burr-Brown's activity with Multibus-based cards but this development means that Burr-Brown has effectively cornered the process control and energy management markets, as it is also a leading supplier of high-performance data acquisition components for conditioning and conversion of analogue signals.

Brabury, a well established broadcast manufacturing and engineering supplies company that specialises in TV studio equipment and outside broadcast vehicles, has become a distributor of **Isle Communications Electronics'** colour TV monitors. The latter include the MCM series of professional monitors which are said to be the most cost-effective units of this type presently available.

BUSINESS DIARY

Tandy UK comes out...

WHICH personal computer manufacturer also retails them direct to the public? Which personal computer manufacturer produces machines for which the upward compatibility of software to new models is (nearly) the most important sales feature? Which personal computer manufacturer has a turnover in excess of a billion pounds?

I would be reasonably surprised if many of you actually knew that the answer is the Tandy Corporation of Fort Worth, Texas. In a business where hype and hot air are not notable by their absence, Tandy is notable by its absence from the minds and lips of the UK computing press. But it looks as if America's hi-tech retailing answer to its national psychological need to 'institutionalise' businesses (to the point at which an oblique reference dropped by Johnny Carson is instantly picked up by anyone and everyone) has grasped the need to raise its profile in the UK. And the moment it chose was the launch on one of the most significant advances in the Adam Osborne theory of computer retailing yet to manifest itself.

Adam Osborne (of Osborne 1 fame), you will recall, suggested that leading edge excitement and uncharted computing territory is not quite where it's at when it comes to serving the needs of the computer user. Tried and trusted technology, with a dose of basic starter software has been the basis for the sound success of the Desktop Computer business. 'Desktop' seems to have evolved as the generic term for personal computers that are 'complete', and things that require hooking up to a TV set come under the classification of 'home' computers. And in this field, just about anything goes — much to the relief of innovators like Sinclair.

Nowhere is this principle better displayed than in the Tandy range, which is unexciting by the standards of the computer press, but phenomenally successful in the USA. The fact that Tandy usually has the product widely available when it's announced also seems to pique the UK punditry who get a lot of snappy copy from 'will they/won't they' shenanigans about Sinclair, Acorn *et alia*. The new machines all use the boring old Z80 (or the 80C85, as Zilog's promised CMOS Z80 isn't ready yet, but OKI's 80C85 is).

The body politic

Tandy UK has apparently been doing a little soul searching lately, since the recent press launch was originally scheduled for a select band of national media operatives, without inviting the computer press. In the event the doors were thrown open to a much broader section of the media, and Tandy put together a presentation that was a declaration of intent to try harder to get to the hearts and minds of the press rather than wait for someone like Michael Parkinson to confirm its position in National Life by dropping the occasional reference to his local Tandy store.

The relative independence of Tandy's thinking is well illustrated by the fact that the UK HQ is situated in Walsall, West Midlands. This smacks of selection by rational consideration of the logistics of strategic placement with respect to markets rather than any desire to be where it's at. This also illustrates an important piece of basic Tandy philosophy, namely that Tandy runs by its own rules, and is rarely influenced by outside considerations. Its executives seem only very grudgingly to concede the existence of Life Beyond the Corporation, and even in the white hot heat of the computer technological revolution, it gets results like 10% *net* profit on a $2 billion turnover.

The corporate video presentation at the outset of this rather unusual 'coming out' made a couple of claims that would have added a good few inches onto Pinnochio's

Tandy's new low-priced pocket computer – the PC-4.

Tandy's new TRS-80 Model 12 business micro.

nose. The glossy commentary voice swept over the question of manufacturing by claiming that all Tandy computer products were made by Tandy in the USA, and only the most naive of observers would have swallowed that whole. However, I'm prepared to believe that a good many of the Tandy oppos actually don't know any better themselves. Ignorance can be blissful in this game, although I cannot imagine that more detail on the subject could either embarrass or harm Tandy whose corporate success is largely in distribution, marketing and support. The US punter is perhaps slightly more sensitive than us Brits who are pleasantly astonished to discover that anything at all is still made here.

The wonder of Tandy

The star of the show, the delightful Model 100, is made for Tandy and NEC (who call its version a PC8201) by Kyocera — who make anything from replacement ceramic hip joints to cordless telephones and teacups. The new Model 4 is made in France by Matra Tandy (51% Matra), and the PC4 mini portable shown here looks a touch like a Casio machine, wouldn't you say?

The wonder of Tandy is that all that really doesn't matter. The fact is that here is technology being marketed by a very professional distribution network, operating on sound business principles. The computer sales network of Tandy extends to some 300 outlets in the UK, made up of 235 Tandy owned and operated stores (they do not operate a franchise scheme in the UK). Of these, 25 are computer centres specialising in computer products and support, which includes a full time 'education director'. Support is very much the mainstay of Tandy computer philosophy, and its 400 US computer centres are complemented by 275 repair facilities and total on-site service if required.

The remaining 60 or so outlets in the UK are appointed dealers, who operate according to a regular format. Franchising is perhaps not in the blood of the British retailing trade — or perhaps there isn't enough money around to make the franchise concept viable in a land where overheads for prime trading sites are possibly 2 or 3 times the 'real' costs of operating in the US.

The UK MD, John Sayers, declared that profitable growth and not market share was Tandy's main objective. John Sayers' background as an accountant was well in evidence as he illustrated this philosophy with an enviable precis of the corporate balance sheet, and a hint of $2.5 billion turnover for the 82/83 year, which ended on 30th June.

57% gross margin on that sort of turnover is a lot of money, much of which is spent in support services including a whopping £200,000,000 on advertising. It also explains one of the problems behind Tandy's relatively slow progress in the UK: relatively high prices. UK computer consumers would rather pay less for distinctly more basic or speculative machinery and support, so it remains to be seen whether the EECness of the Model 4 at £1500'ish for the twin disk version can carry a sufficient advantage. In terms of a BBC Model B with twin disks and monitor, it should be a force to be reckoned with.

But no colour? Well, apart from the fact that most low cost monitors (i.e. domestic TVs) produce colour displays that are fit only to promote migraines, the diversity among international standards is bad news, and I don't know about you, but an 80 column display is a far more useful thing than a breathtaking capacity for Space Invaders.

The software available is really the thing. At a rough guess, there must be twice as much available for a Tandy machine than for anything else. Only when Acorn User magazine gets near the 450 pages plus level occupied by the leading independent Tandy user monthly (Wayne Green's '80 Micro') will anyone at Fort Worth get worked up about competition from the Fens.

And how about taking the BBC model B you bought in Stoke Poges into a dealer in Kuala Lumpur and expecting it to be fixed? Tandy philosophy says that this is not a problem, and explains that this is one reason why Tandy is not keen to see non-standard hardware modifications — nor anything else that happens to stray beyond corporate policy. For some this policy implies a distinctly menacing 'big brother' complex, and the lack of subtlety with which it has been known to be explained at times has not helped either. But one thing is certain, when the anticipated Armageddon arrives for the microcomputer business and the market shakes down to the 'four or five mainstream sources' that pundits have predicted, then Tandy will have booked its ticket. Despite all the euphoria, I wouldn't put money on many of the present UK manufacturers surviving such a holocaust.

■ R&EW

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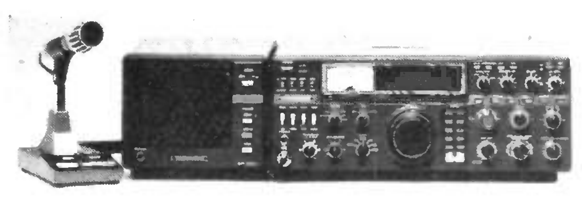
1239	FP-700 PSU for FT-77	£105.00
	FC-700 ATU for FT-77/707	£ 80.00
1240	FV-707DM Scanning VFO for FT-77/707	£160.00
1243	SP-980 Speaker for FT-980	£ 50.00
1246	FL-2100Z HF 1200W linear	£450.00
1247	FT-980 Transceiver/Gen. Cov. Rcvr.	£1090.00
1248	FRG-7700 Gen. Cov. Receiver	£319.00
	FRG-7700M As above with memory	£379.00
1254	FRT-7700 ATU for FRG-7700	£ 39.00
1255	FRA-7700 Active antenna for FRG-7700	£ 36.00
1257	FRV-7700D Converter 118/130, 140/150 & 70/80	£ 75.00
1263	FV-101 Remote VFO for FT-101Z	£109.00
1265	FT-1 Transceiver 150kHz-30MHz	£1350.00
1274	FAN B Fan for FT-101Z series	£ 13.00
1275	DC Unit 12V PSU for FT-101Z	£ 44.00

ACCESSORIES

1208	YE-7A Hand mic for FT-101	£ 6.50
1213	QTR-24D 24hr quartz clock	£29.00
1214	YM-35 Hand scanning mic.	£14.35
1215	YM-36 Noise cancelling mic.	£13.95
1216	YH-55 Lightweight headphones	£ 9.50
1221	YD-148 Desk Mic.	£ 21.00
1353	YM-38 Desk scanning mic.	£ 25.50

from the KENWOOD stable for...
the discerning DX-operator ... or ... DX-SWL

... the TS-930s, £1199 *... and ...* *R-1000 £279*



Since, at 'WESTERN', we sell both Yaesu and Kenwood, we do not try to push a prospective purchaser into a particular brand of equipment ... we have no 'axe to grind' one way or the other. Our M.D. (He's spoilt! He just takes home what he fancies for a trial evaluation!) thought he'd try the top of ranges FT-1 and TS-930S. He promptly brought the FT-1 back to the stock-room (Mr. Hasegawa, please note!). Then he took the FT-102. He hitched the FT-102 and TS-930S up together but brought the FT-102 back. Said he'd got too old and lazy to bother with controls like PA Tune, PA Load, Pre-selection tuning, when the TS-930S does the same job with less knobs. He's grown to like the 930S so much he hasn't tried it against the Yaesu FT-980 — although no doubt it's only a matter of time (The FT-102 is back in the demonstration room!). The 'Noise Blanker' really cuts old 'Woody Woodpecker' down to size! UA's will have to find something new to annoy a TS-930S owner.

How often have you found a rare DX-station only to discover he has a good pile-up too! With the '930' you just press 'M In' and store his frequency in the memory and carry on tuning round on QSO elsewhere. Then to come back smack onto the rare DX you just select 'Memory' instead of the VFO, and up pops your DX station. Since there are 8 Memory channels there are more than enough for anyone!

The R-1000 is an un-cluttered simple to use and excellent general coverage receiver. It brings the world to your fingertips in seconds. With its PLL synthesised receiver you get excellent stability and accuracy.

Features are: ★ Covers 200kHz to 30MHz continuously ★ 30 1MHz bands ★ Noise Blanker ★ Terminal for external tape recorder ★ Built-in 12 hr. quartz digital clock with auto-timer facility to switch 'On' at pre-determined time. ★ 'S' meter with 'dimmer' control to panel lighting. ★ Built-in 4" speaker ★ Built-in attenuator to prevent overloading ★ Digital readout to 1kHz and analogue dial.

REW TEL

For those of you who aren't users, a chance to savour some of the traffic on the REWTEL Bulletin Board.

ANOTHER MAPLIN MODEM

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%                                                            %%
%%   YET ANOTHER                                              %%
%%                                                            %%
%%   MM      MM   AAAA   PPPPPPPP  LL        IIIIII NNN    NN %%
%%   MMM    MMM  AA  AA  PP      PP LL          II   NNNN   NN %%
%%   MM M M MM AA    AA PP      PP LL          II   NN NN  NN %%
%%   MM   M  MM AAAAAAAA PPPPPPPP  LL          II   NN  NN NN %%
%%   MM      MM AA    AA PP        LL          II   NN   NNNN %%
%%   MM      MM AA    AA PP        LLLLLLLL IIIIII NN    NNN  %%
%%                                                            %%
%%                MODEM  GOES INTO ACTION !                   %%
%%                                                            %%
%%                                                            %%
%%              GREETINGS FROM  MARK SPACE    22 JUL 1983     %%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

TO FEMALE LONELY HEARTS FROM VIC

HI! I WAS SITTING HERE TAPPING AWAY AT 4AM, AND IT SUDDENLY DAWNED ON ME, AS TO WHAT ON EARTH I WAS DOING. I DO NOT SLEEP VERY MUCH; PLAYING WITH COMPUTERS HELPS TO PASS THE NIGHT. I THOUGHT IT MIGHT BE BOTH NOVEL AND POSSIBLY FRUITFUL TO USE THE BULLETIN BOARD AS A TIMEOUT-TYPE LONELY HEARTS! I'M 34, SINGLE, LOOKING FOR SOMEONE TO SHARE INTERESTS LIKE THEATER, BRIDGE, CHESS, MUSIC, ETC,ETC. AS YOU'LL BE READING THIS WE SHARE AN INTEREST IN COMPUTERS, BUT NOT TO THE EXCLUSION OF ALL ELSE.

PLEASE REPLY TO VIC OF NORTHOLT, AND WE'LL GET IN CONTACT.

NEWS ABOUT TBBS LONDON BULLETIN BOARD

**** TBBS LONDON ***London Local Bulletin Board.

Is pleased to announce that it is back in action from August 1st. 1983. The Telephone Number is (01)-348-9400

The System Hours will be:-
09:00 to 01:00 CCITT v.21 (European) 300 Baud
01:00 to 07:00 Bell 103 (U.S.A.) 300 Baud.

The system will answer you on your first call. New users should note that certain areas can only be accessed by registered users. Full details can be found on the board. Facilities include:- User Groups for different machine types Games, Puzzles, Downloading of Software etc. Please do not use the previously published phone numoer.The Correct number is that given above (01)-348-9400

BBC MICRO USERS SOUTH WALES

To all BBC Users in the South Wales Area. Anyone using a BBC micro to access REWTEL, PRESTEL or any similar type of public database please get in touch to swap experiences problems etc. At the moment I use a BBC Model B with a borrowed Modem to access the 300 baud networks. I'd like to get a decent direct coupled modem to make life easier.
Will be at the Acorn User show this coming Saturday. Anyone interested in discussing ways of accessing networks via BBC micros how about by the Bar - opposite stand 9 - at about 12.00. Heaven knows how to recognise each other. Look for the drunken trio (or more)

Regards,

John Williams, Pete Hodges (and others)

TO DOUBLE DEEDMAN RE TANGERINES

Dear Doug,

Some of us have been using Tangerines since REWTEL started!!!!!!

I am using the TUG 80 column card for adecent display.

Give me a ring on 061-747-3459 if you like.

Andy Michael.

1/8/83

THANKYOU

Many thanks for all your useful tips - you seem to have become REWTEL's resident expert. Keep it up.

JAJ

WHAT ABOUT TELESOFTWARE

Hello REWTEL Operator,

I've recently started accessing REWTEL with a R&EW modem connected to a BBC Model B with Shugart SA200 disc (100K). I have written terminal software which allows me receive and store ASCII files on disc, such as REWTEL pages. I can also transmit ASCII files directly from disc. This bulletin was written on a BBC micro fitted with Wordwise, saved to disc, and then transmitted while I was connected to REWTEL.

The transfers are initiated when the terminal software receives previously unused CTRL codes. I'm sure I could use the sytem to send or receive programs as long as they are in ASCII format, easy on the BBC micro, so how about some software on REWTEL to download eh?

Calum Steen

REPLY TO CALUM

Hello there,

No problem with your first message. My inputs work under interrupt and can receive at full 300 BAUD. You tend to send lines that are too long, however, and I miss the ends. This was a problem in your second message.

How would you like us to publish your BBC micro software in R&EW so everyone else can use it ?

At the moment I have no time to experiment with the telesoftware potential of REWTEL, but why not send me a proposal for a telesoftware transfer arrangement between two BBC micros with modems. (Yes, I Know the R&EW modem is originate only but nothing is perfect is it ??)
rgds. Roland Perry REWTEL ED.

FROM RIK

I am so far very impressed with this system; would suggest a little more data, easily accessed, for first-time users like me. (Modem 'tuned up' this very night. And 16-line pages are a bit difficult with a TRS-80 £100... but never mind. Must get the Big System up ASAP. Would like to see a way of contacting other current users in real time (like Compuserve's 'CB mode') and way of seeing who's online. Keep up the good work, tho'...Popping up again soon.
RIK- Studio Sound magazine. 'Bye...

SOUTHEND COMPUTER CLUB INFORMATION

SOUTHEND COMPUTER CLUB

MEETS EVERY MONDAY EVENING AT THE ESPLANADE PUBLIC HOUSE SOUTHEND SEA FRONT 7PM TILL 10:30PM

ALL TYPES OF COMPUTER WELCOME

QUESTION TO DBM GOLFBALL PRINTER USES

Does anyone out there know if it is possible to get IBM compatible golfballs which have line graphic characters on them suitable for constructing forms i.e. vertical lines, horizontal lines, crossovers, corners etc. I cannot believe that such a golfball does not exist. Please leave any answers addressed to JAJ.

Thankyou

JAJ

COMMUNICATIONS BUILDING BLOCKS

ICs for communications are virtually 'building blocks' in their own right. By selecting the right peripheral components and standards for interconnection, *R&EW* is establishing a 'library of sub-sections for communications designers. This month: mixers, selectivity, IF amplification and detection.

Most designs that are based on ICs are very easily 'departmentalised' into specific sub-sections based on the functions provided by the IC in question. Radio circuitry is well suited to the 'mix'n'match' approach of fitting together an array of function blocks, so here we go with a series of such blocks based around ICs from manufacturers such as Plessey, TOKO, Hitachi, Sprague, Telefunken etc.

Several of the function blocks will also double up in instrumentation applications: devices such as spectrum analysers and signal generators are based on abstracts of receiver designs.

The building blocks planned in this series will allow designs for all types receiver to be assembled: from simple direct conversion receivers, through broadcast MF and HF to multimode UHF systems, maybe also with the facility for computer control. We shall be revisiting some past designs that have appeared in *R&EW* and adapting them into this format, as well as including many new and previously unpublished circuits and ideas.

On with the show!

This month we offer the heart of an AM or SSB receiver – two balanced mixers, an AGC controlled IF and various options for selectivity contained within the TOKO KB4412 and KB4413. In all, a matched set of functions that also incorporates an effective ANL, signal level metering and a carrier level derived mute signal.

The KB4412-based IF board does not include an on-board first oscillator, which must therefore be chosen to suit the required frequency coverage. Reference to the internal layout of the KB4412 (*Figure 1*) shows that the mixer input on pin 1 is an internally biased transistor base at the lower end of a 'transistor tree' double balanced mixer stage (Q10 to Q17). The device is not specifically frequency limited, and has worked to

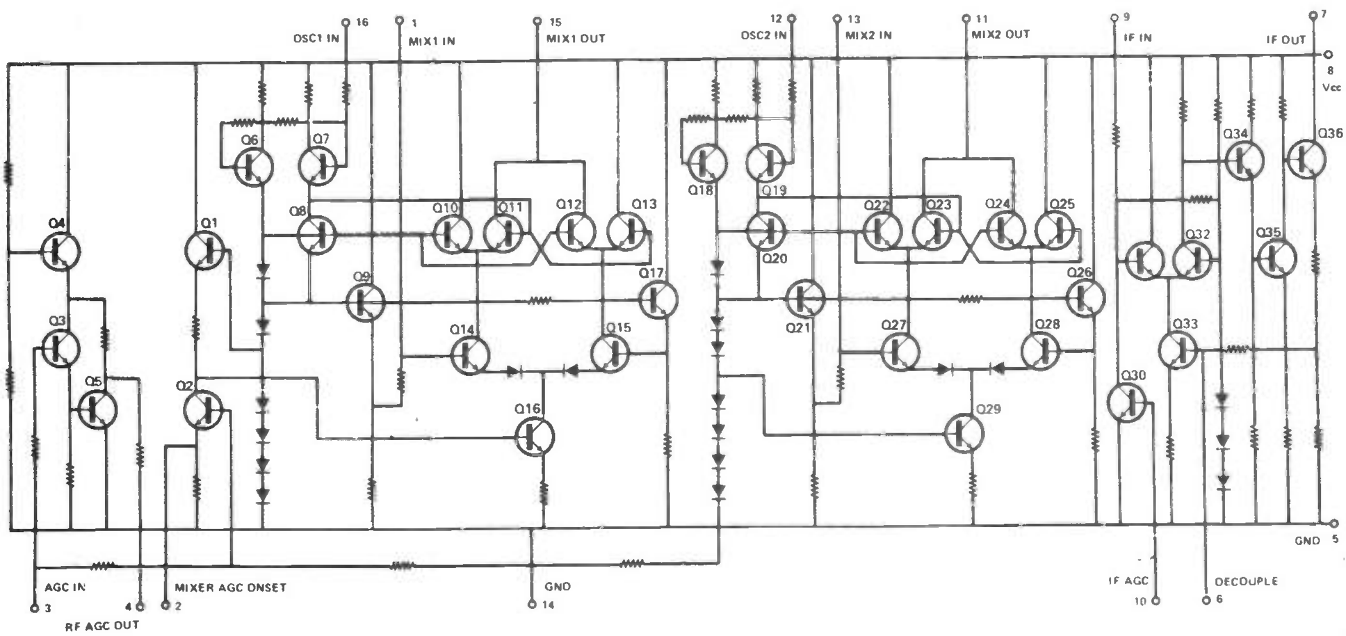


Figure 1: Inside the KB4412

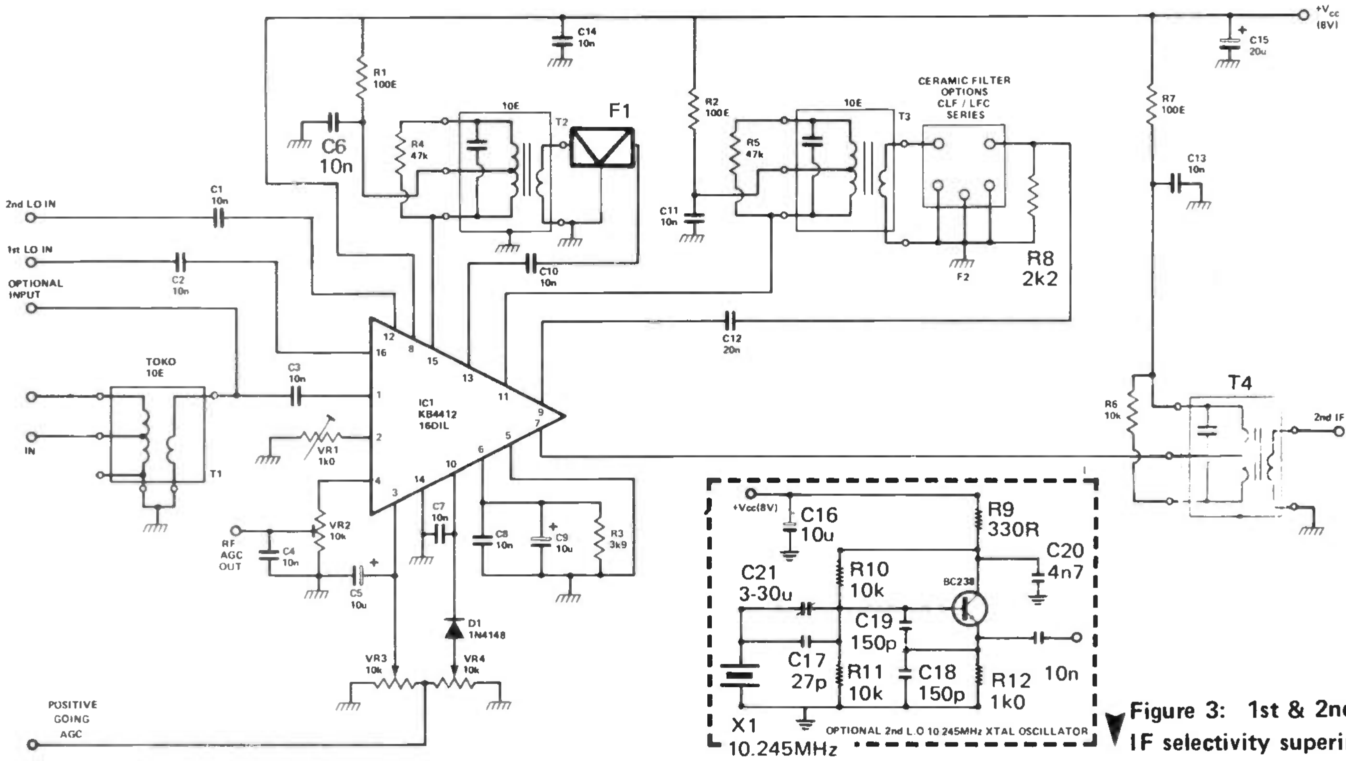
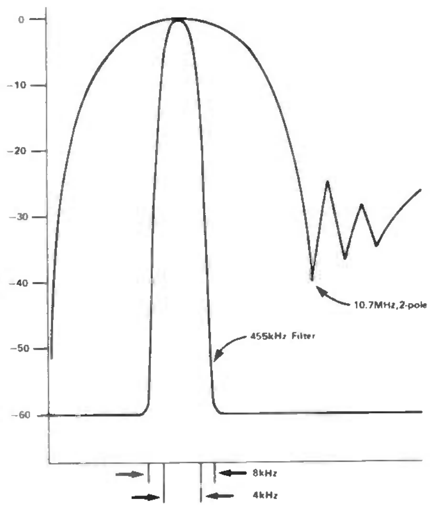


Figure 2: The IF circuit, (inset- the 2nd LO)

Figure 3: 1st & 2nd IF selectivity superimposed



beyond 70MHz in test fixtures. The input noise figure of the mixer is not specified, but should not be a problem at HF where a figure of 10dB is unlikely to restrict receiver performance.

The oscillator should be fed to pin 16 at 100mVRMS, and the choice of frequency is open to the designer's choice. It is possible to configure the IF for various IF frequencies (theoretically as high as 45MHz, when the oscillator injection would be 45MHz + 455kHz, assuming a 455kHz main IF). In the circuit example shown here, 10.7MHz has been selected as being rather easier to work with in terms of filters and overall stability. It also happens that there's a handy LCD DFM module that offers 1kHz resolution with a +10.7MHz offset, the DFM177.

To tune the LF – HF bands (with a small hole in coverage at 10.7MHz, determined by the filter characteristics), the oscillator injection should be between 10.7MHz (corresponding to an RF input of DC – of which more later) and 40.7MHz (30MHz RF). There is a considerable advantage in going this way, since the range from 10.7MHz–40.7MHz can be covered in as few as two ranges of a VFO: 10.7–24MHz and 24–40.7MHz, for example.

If a 455kHz IF is used, then the oscillator tunes from 455kHz to 30.455MHz, and this would take a minimum of five switched ranges, without worrying too much about the image response when going much above 5MHz.

The downside of this approach is that it is going to be rather more difficult to obtain adequate stability where the LC ratio of the oscillator tuned circuit is so critical: i.e. there's precious little residual capacity when such a wide ranging oscillator is tuned to 40.7MHz, making the circuit susceptible to minor changes in capacity. These may arise from thermal drift of the tuning element or mechanical shock, for example, a compromise is available through using an extra range of oscillator, which makes adequate stability attainable rather than academic:

10.7MHz – 20MHz
20MHz – 30MHz
30MHz – 40.7MHz

Oscillators for HF receivers is a vast subject for another instalment of this series, so we'll leave them to consider the next stage in the featured module (*Figure 2*). No gain is provided on-board at the first IF frequency; instead the next stage is another DBM (identical to the first section just described).

In the described application, this mixer takes the 10.7MHz first IF and mixes it with a 10.245MHz (or 11.115MHz) crystal oscillator to provide an output at 455kHz, where lurks the majority of the circuit's selectivity and a gain controllable IF amplification stage from Q30 to Q36. The IF filter can be chosen from a wide range of different types within the NTK/Murata ranges to suit the mode of operation required. The effect of the selectivity of this stage is compared with that of the 10.7MHz 2-pole filter in *Figure 3*.

As mentioned earlier, the lowest frequency that can be effectively tuned by this module is limited by the first filter bandwidth. The receiver will be progressively desensitised as the local oscillator signal slides down the edge of the filter until it swamps the subsequent stages. If the first filter has a bandwidth of 3kHz, and a shape factor of 2:1 (6/60dB), then there's a good chance of hearing signals at 4kHz or thereabout. With the relatively broad 10.7MHz 2-pole, the lowest frequency attainable will be of the order of 20kHz. Some examples have been able to tune to 16kHz at reduced sensitivity.

Since the output of this module is undemodulated IF, it's worth noting that it's possible to reconvert to 10.7MHz, and shift the 10.245MHz 2nd LO to provide a pass band tuning effect... in which case the first IF filter should be uprated to an 8-pole response to provide a suitable shape factor for the PBT to work against (see the feature on passband tuning in the July *R&EW*). However, don't forget you will then have to reconvert to 10.7MHz before proceeding.

AGC action

AGC works in the positive-going direction. As you can see from the internal layout of the KB4412 (*Figure 1*), the AGC input at pin 3 operates on the base of Q3 to provide a degree of delay before the output to RF stage (pin 4) begins to move. The same AGC input controls the gain of the first mixer via Q2.

The emitter resistor of Q2 is made accessible on pin 2 so that the stage may be optimised with an external trimmer resistor. IF AGC at pin 10 is simple enough to follow – Q30 merely pulls down the bias (and the input signal) on Q31. Note that both the RF/Mixer and IF AGC are trimmable to optimise the operating points in a given application. The initial setting is with both presets set with their wipers to ground for maximum gain. First the IF, then the RF preset should be set to hold the S/N ratio at approximately 40dB.

Detection and AGC

The second building block is based on the companion device to the KB4412 – the KB4413. *Figure 4* shows the internal diagram of this device along with the block function layout. In this application, we are concentrating on the performance at 455kHz, but tests at *R&EW* have shown that the device operates to beyond 30MHz without loss of performance.

The AM input at pin 14 is envelope detected by an emitter follower (Q2). The IF signal is decoupled to ground at pin 13, and pin 16 provides access to the AGC system for fixing the time constant, since the DC level at the emitter of pin 2 is an ideal reference for the incoming signal level. The capacitors used at pin 16 can be switched to provide fast or slow AGC action, although for a 'hang' AGC system for SSB, it is necessary to adopt a more sophisticated quick charge/slow discharge circuit.

The ANL facility of this device is very well developed. (See elsewhere in this issue for a description of ANL

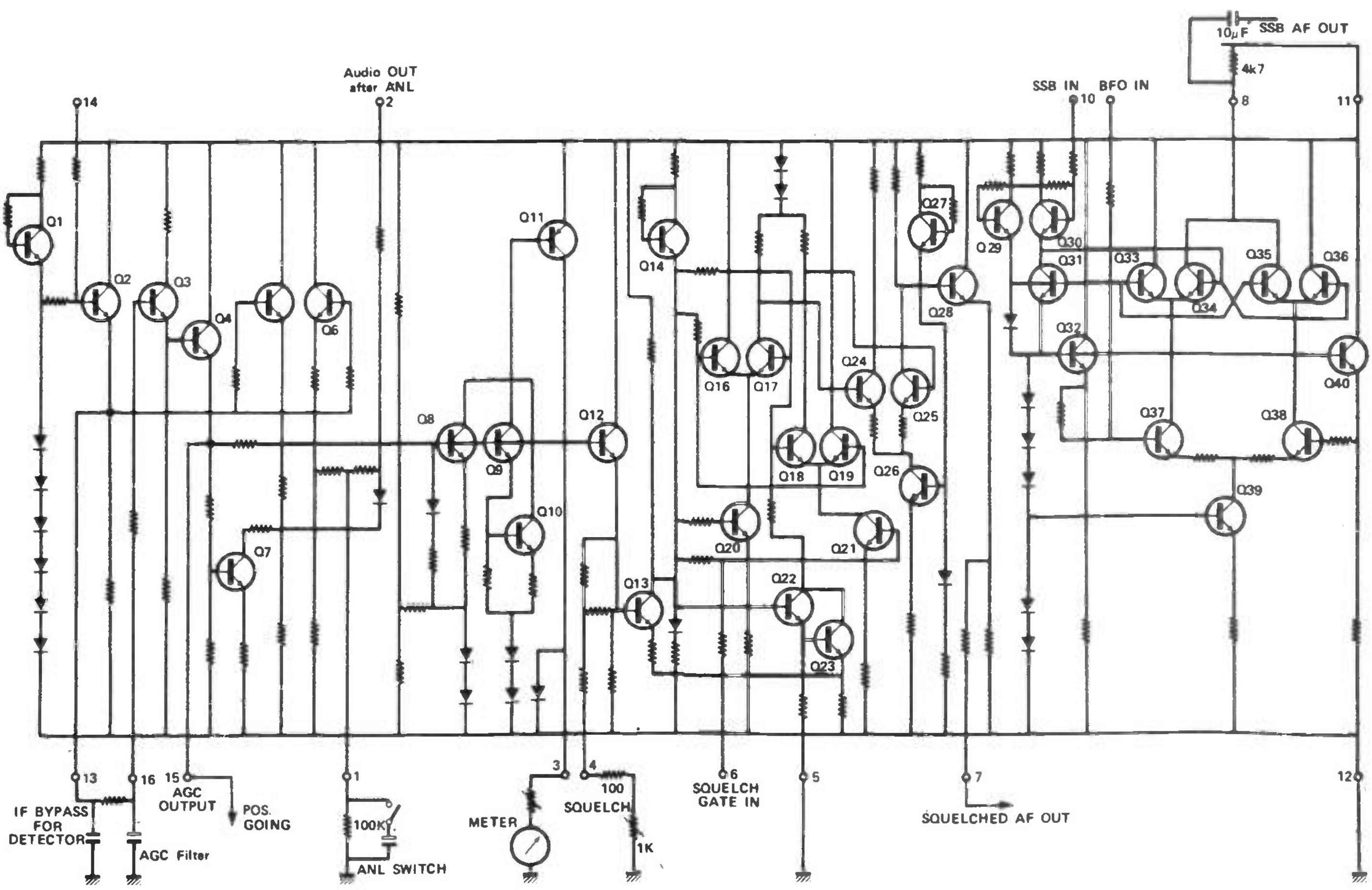


Figure 4a: Inside the KB4413

principles). Q5 and Q6 form a symmetrical stage that is biased from the DC level of the detector, and fed directly with the audio. Q3 and Q4 drive the positive going AGC line to pin 15, and the signal from the emitter of Q4 is also internally routed to the signal metering and squelch circuit from Q8 to Q13. Q7 provides the 'averaging' reference for the diode clipper action. ANL action is initiated by switching the time-constant capacitor into circuit at pin 1.

Metering circuitry is largely self-explanatory, being derived from the AGC voltage after smoothing. Squelch threshold is set externally at pin 4 by setting the operating point of Q13 to activate the gate trigger formed by Q13/Q22/Q33. The gate circuit operates via a series of differential amplifier pairs, the signal path being: Q21 → Q18 → Q25 → Q28. The switching path is via Q22 pulling down Q18, Q16 and Q24. A convoluted circuit to achieve noise-free audio switching.

The SSB demodulator is another double balanced mixer (virtually identical to those in the KB4412). The IF signal should remain coupled to the AM detector input to retain the meter functions etc. Juggling time constants may provide a suitable compromise to permit the AGC and squelch to remain operative. The audio input to the gate should be switched to the SSB detector output.

The application PCB includes two BFOs – one for USB injection, one for LSB injection. These are simple enough Colpitts circuits, switched by grounding the respective emitters. It is not part of the philosophy of this series that delicate elements like 'hot' RF points in resonant circuits in oscillators should be put in jeopardy by switching.

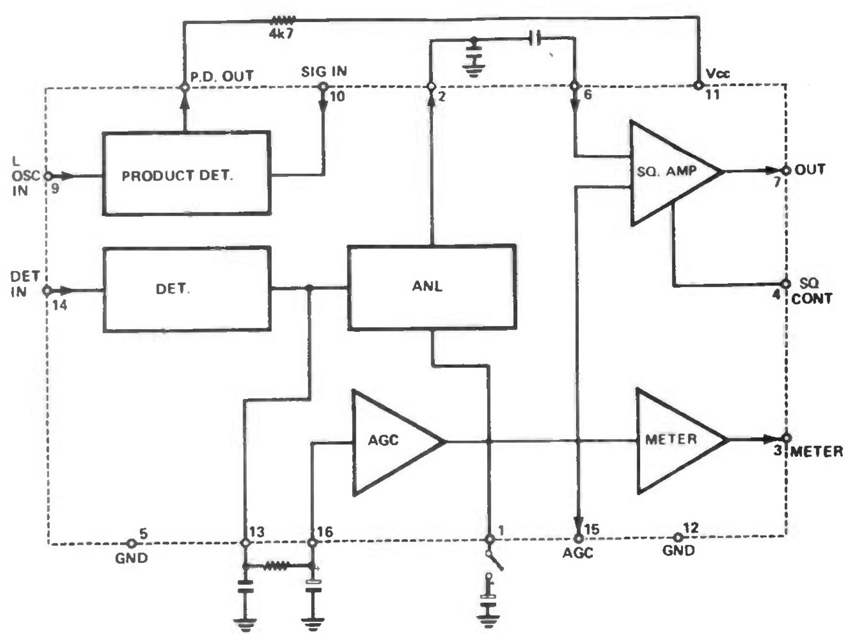
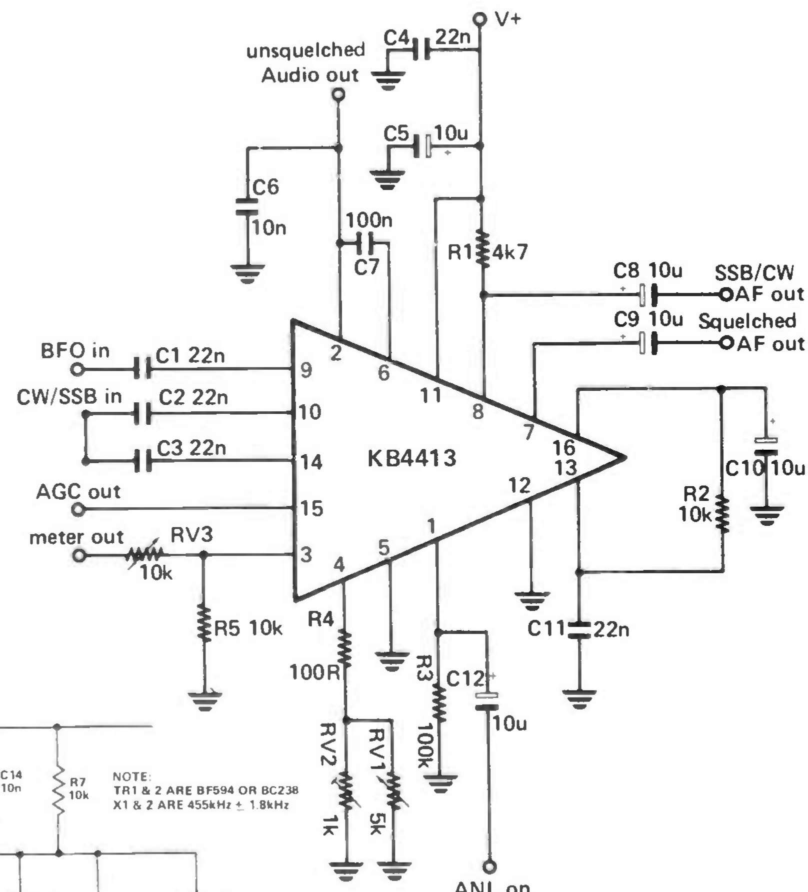
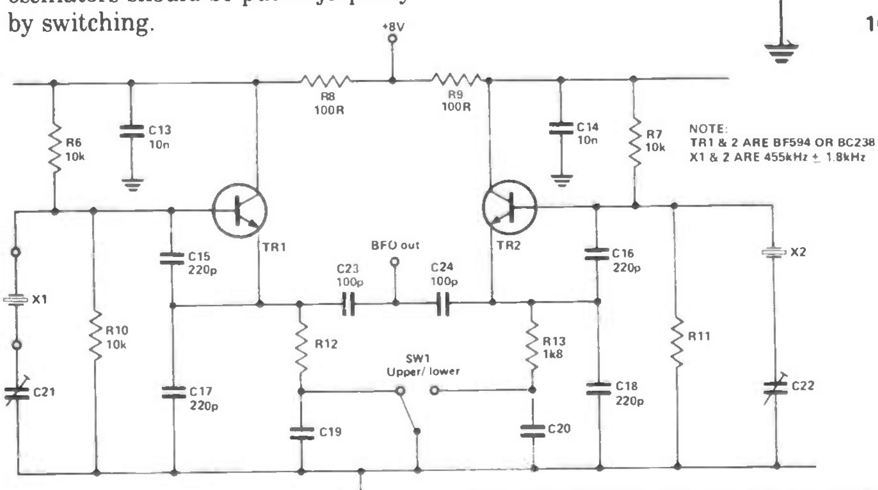


Figure 4b: KB4413 block functions





The twin BFO's. X1 and X2 are CRM455 resonators

Construction and Testing

The PCB foil and overlays (*Figure 5*) should provide all the necessary information for construction. A standard-size board has been evolved that we will endeavour to stick to for other elements of this series.

Testing can be accomplished by the experienced 'wet' finger, but a simple signal generator (GDO) will help a lot. The IF module relies on being provided with a local oscillator input – and as yet, we have not defined one in the series, although there are plenty of circuits published to be getting on with in the meantime.

It's simpler to check the IF board after the detector board has been run up and verified; so start by attaching an audio amplifier to the output of the detector board and applying 8V. Place a signal generator (or the aforementioned wet finger) on the signal input, set the module to AM, and turn the squelch preset to present minimum resistance at pin 4, but leave the 'fine' panel control set midway so that when the coarse preset is set (after the IF module has been aligned), there will be a suitable working range of control.

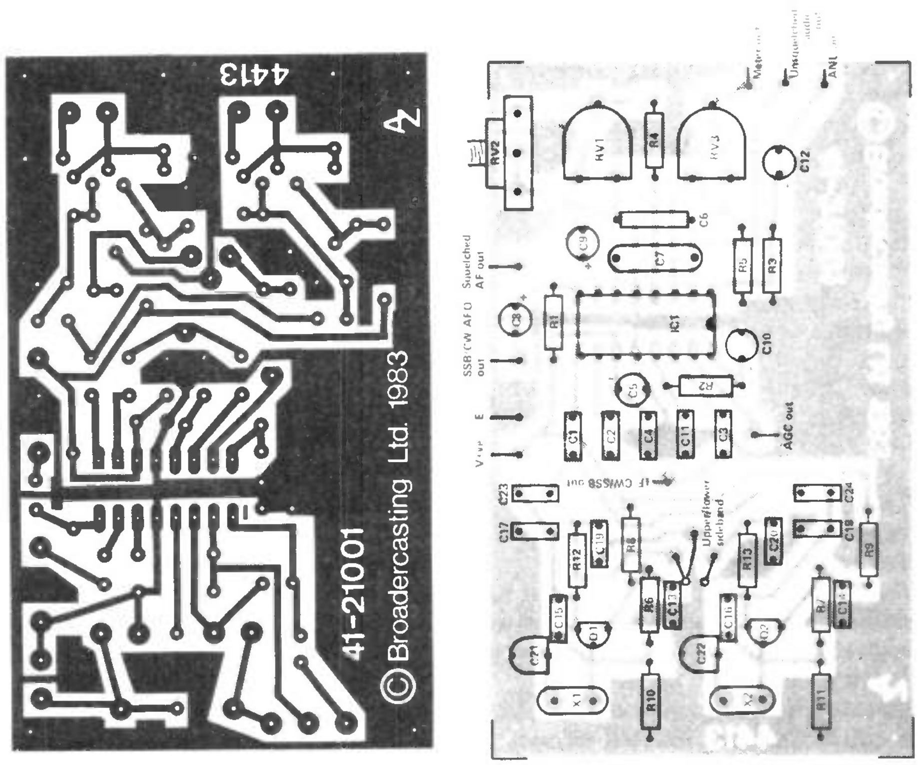
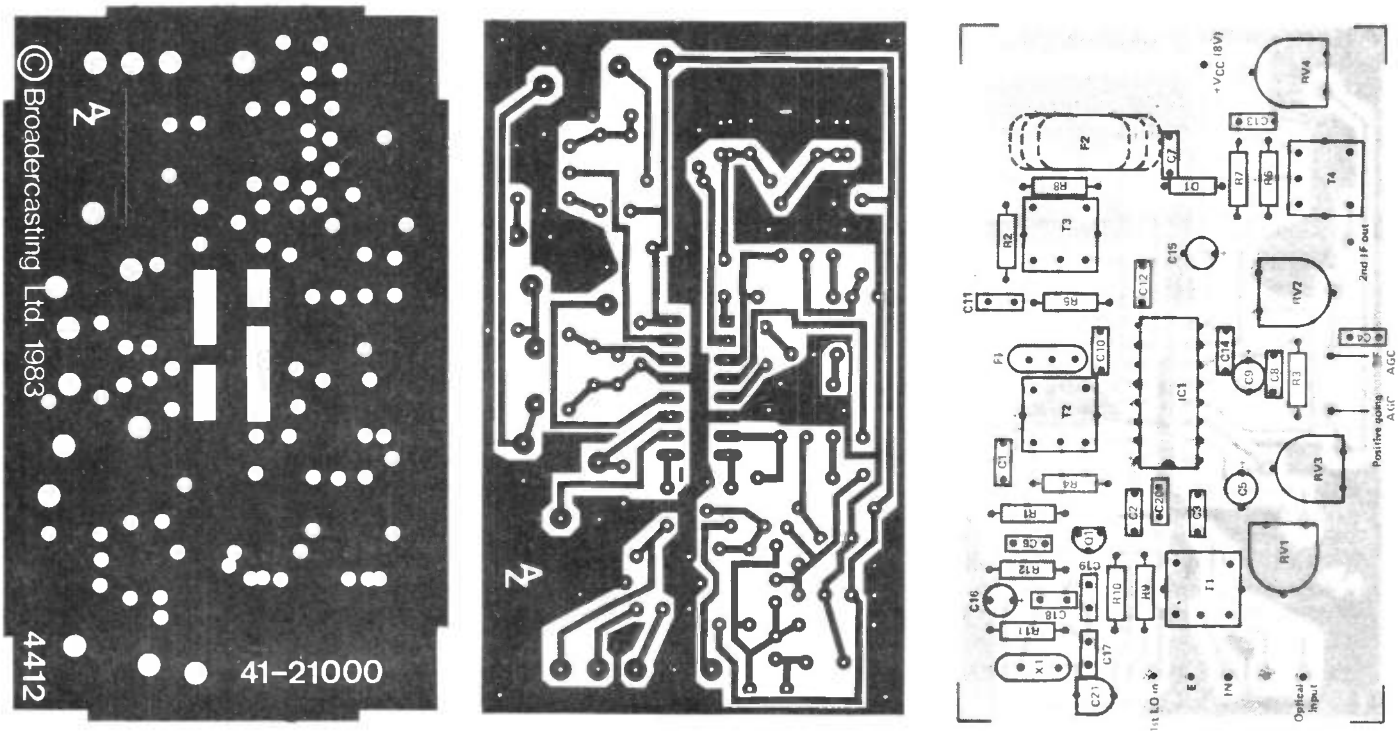


Figure 5: KB4413 Detector block PC foil and overlay

KB4412 IF/mixer stage earthplane, foil and overlay



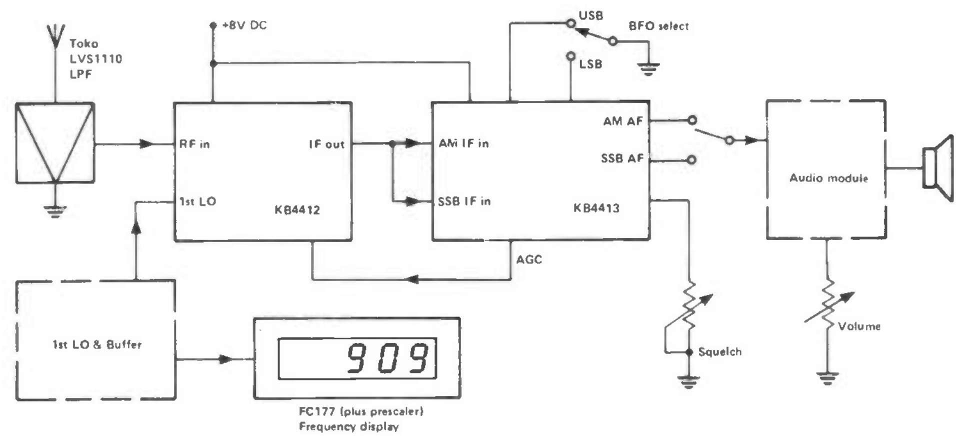


Figure 6: The start of a system of building blocks

Remember that this board is essentially 'untuned' and virtually any input frequency from an AM signal generator up to 70MHz will be demodulated. As long as you have an indication that signals are progressing to the audio output, connect the output of the IF module, and connect the AGC lines. Set the AGC presets to the RF and IF midway.

Power up with 8V, and it should be possible to hear 'noise' in the audio output. Turn the IF AGC preset to maximise the noise (the preset wiper should be grounded). Place either the 455kHz signal (or your previously calibrated moist finger) on pin 11, and adjust T3 and then T4 for maximum noise. It is possible that with the IF in maximum gain configuration, peaking T4 will cause oscillation to occur; if so, advance the AGC preset until it stops.

Move your signal generator to pin 15, and inject 10.7MHz (your finger should be sufficiently wideband to work here too), and peak T2. Place a couple of feet of wire on the untuned input to the first mixer, and by injecting a signal at the first LO input and you should be able to tune signals that are ±10.7MHz of the oscillator injection frequency.

If you have chosen to use the low pass filter technique, then injecting (10.7+.909)MHz should readily tune in Radio 2. If you have no selectivity installed yet, then you may also hear the corresponding 'oscillator low' RF signal at (10.7+10.7+0.909)MHz – if there's one around.

Before the AGC can be properly established, it's going to be necessary to add an RF stage and some selectivity – plus an oscillator. Next month we'll deal with a simple front-end system that permits tuning from 15kHz to 5MHz in a single range.

Systems

Now we have two building blocks in the series, it's time to set out the first (of many) possible configurations. The block diagram of *Figure 6* sets out the basic interconnections and switching, and includes in outline some of the other modules planned in this series.

The building block concept is essentially for experimenters, so feel free to adapt and modify. One of the more straightforward and direct options is to precede the input stage with a block lowpass filter (TOKO LVS series), and then no further RF selectivity is necessary to tune from DC (with the proviso outlined earlier) to the upper limit set by the filter stage. But it's a good idea to include a series trap at 10.7MHz in view of the activity in the mid-HF spectrum.

■ R&EW

Noise Blanking

Virtually all modern HF receivers sport noise blanker facilities: here William Poel discusses the parentage and the development of the techniques.

ANL

Before the noise blanker, there was the automatic noise limiter. Calling it an 'automatic noise limiter' is actually rather overdoing things, since it is hard to conceive of a practical system that isn't automatic. An operator is hardly likely to sit there waiting for a noise spike before pressing a button marked 'Manual Noise Limiter'. However.....

The principle of operation is that the noise spikes are clipped after the signal has been detected. Most implementations of this concept average the incoming audio level and set the threshold of the limiter accordingly – see *Figure 1* – so maybe this is the facet referred to 'automatic'. This basic idea may be thought of as the reverse of that used in several forms of radio control detector where only signals that exceed the

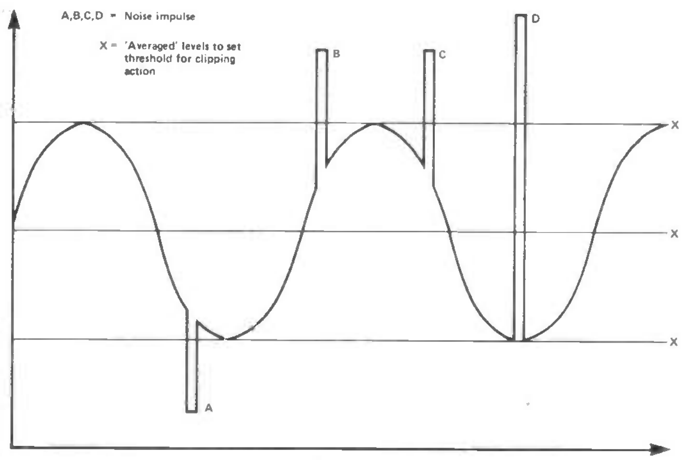


Fig 1a

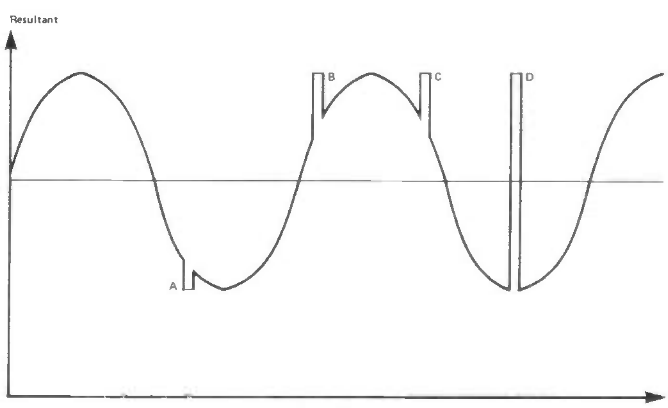


Fig 1b

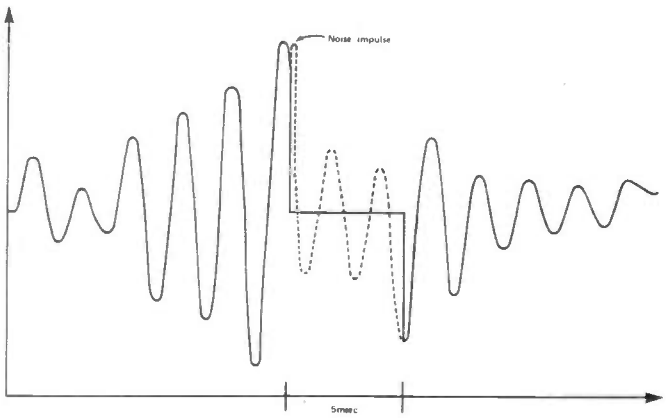


Fig 1c

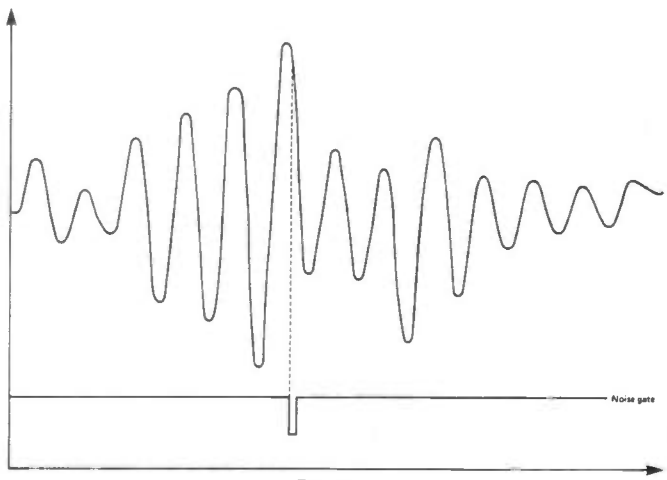


Fig 1d

Figure 1: a) ANL operation illustrated on a sine wave. b) The resultant amplitude is limited but pulse D is still a very substantial 'error' and will be clearly audible. c) Audio Noise Blanking at work on a speech waveform — the gap in the audio appears as a result of blanking the stretched pulse. d) The same RF interference pulse removed prior to filtering.

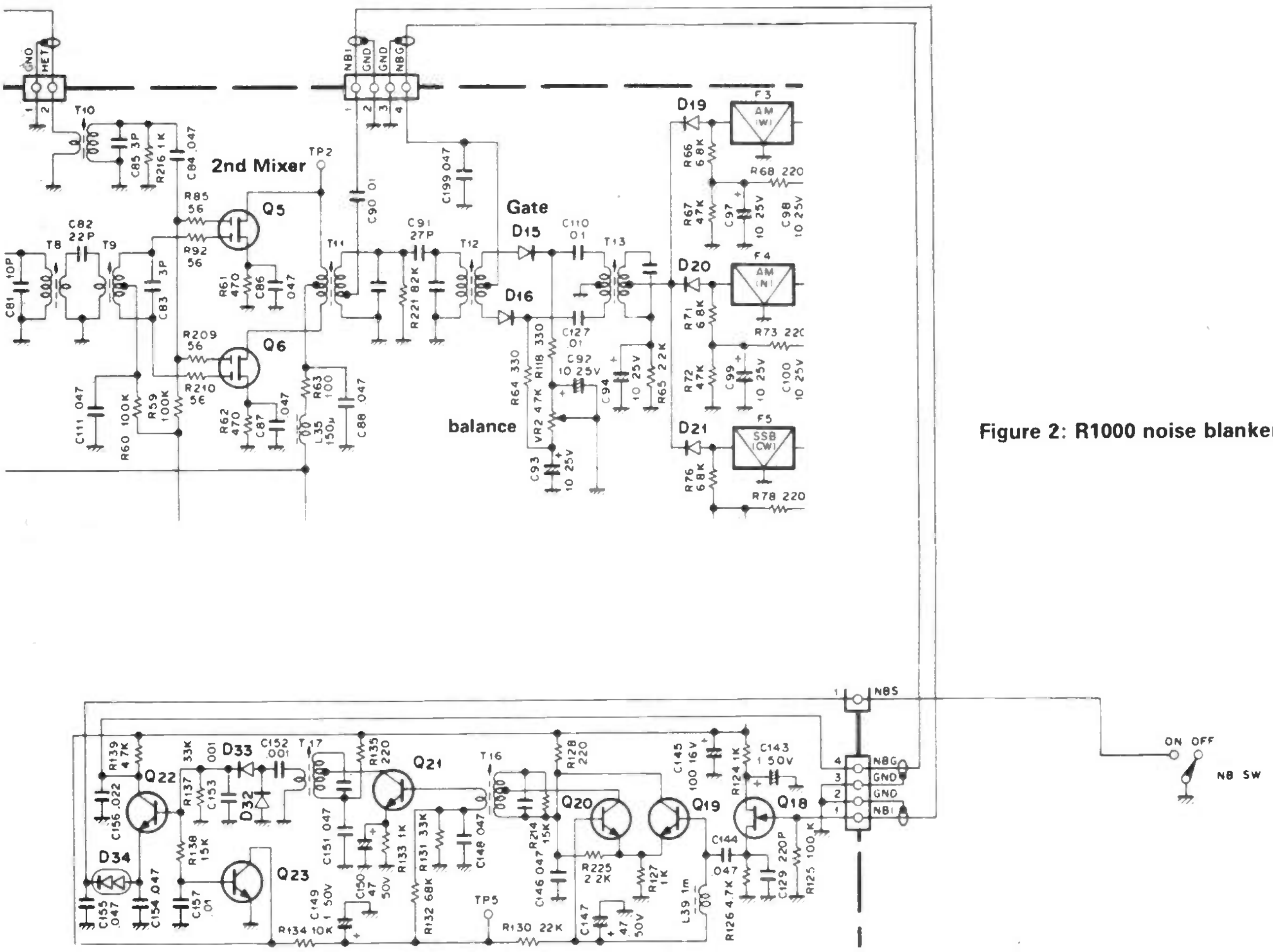


Figure 2: R1000 noise blanker circuitry.

'averaged' threshold are permitted to pass to the PWM (pulse width modulation) decoding circuitry. Perhaps the 'manual' version of this noise limiter would be one in which the operator has to set the limiter threshold by hand – but the writer has yet to encounter such a technique in practice.

The Good Old Days

In the days of the Trio 9R59DE and its ilk, any ANL was most frequently tested by reference to the LORAN navigation beacon that wallowed in the middle of the 160m amateur band. Modern amateurs who have not experienced the delights of this cross between an eternal electronic raspberry and high speed 'woodpecker' probably never will, because they are unlikely to find such a direct test of noise limiter/blanker facilities on the modern HF bands. Some people have even been known to try to generate local interference sources to convince themselves of the efficacy of this function button on their new toys. However, taking the supression components from a small DC mini-drill can provide the right sort of RFI if you are not unfortunate enough to have neighbours who already delight in this practice.

The ANL operates regardless of the frequency and nature of the impulse interference, but by acting after main receiver selectivity, interference pulses that start out as brief period impulses are stretched as they pass through the subsequent narrow filters.

A fast edged pulse passing through a narrow filter can only do so according to the rules that determine the relationship between bandwidth and the rate of change of amplitude through the filter. Without going into the finer points of Fourier series, fast pulses take up relatively more spectrum space than slow ones – the same principle applies to sidebands in AM telephony.

If the filter is being activated by a pulse whose edge is faster than the filter's bandwidth can handle, the pulse will be stretched across the filter. In a multipole filter, the effect results in the noise pulse being passed from one pole to the next before the preceding pole has had time to build and decay in an 'orderly' manner.

The classic demonstration of this effect occurs when the filter in a spectrum analyser is swept at a rate that exceeds the filter spec. The photographs (*Photos 1–2*) taken from the screen of the analyser (a Tek 7L12 with Butterworth filters: never mind the group delay, feel the shape factor) provide an ideal demonstration.

Most HF receiver filters are going to be based on Butterworth passbands, so this illustration can be

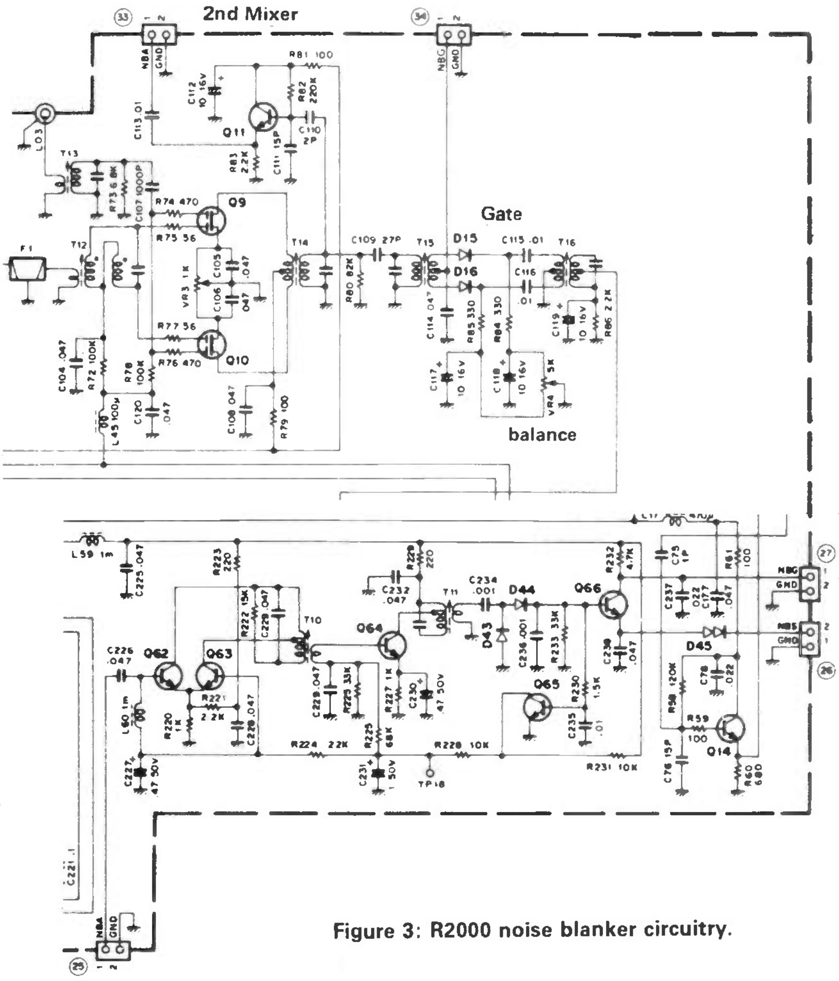


Figure 3: R2000 noise blanker circuitry.

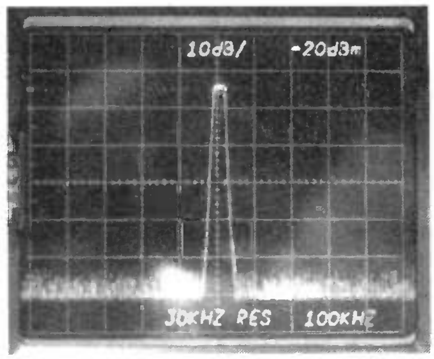


Photo 1: Response of filter under normal condition.

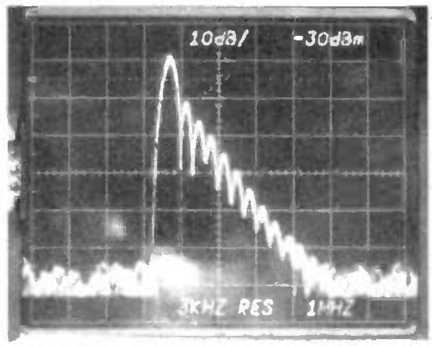


Photo 2: Spectrum analyser is used to demonstrate the effect of a filter being activated by a pulse with a rise time greater than the filter bandwidth can handle.

directly extrapolated to the condition present when a narrow spike traverses an IF filter, and re-emerges slower and fatter at the far end.

Opening the Gate

The noise pulse can be removed after detection by gating – but a 10 microsecond pulse stretched to 5 milliseconds can leave a detectable hole in the audio (*Figure 1c*). Furthermore, for the best results, the positioning of the blanking pulse needs to be set up using a delay line.

The solution at IF is simple. If the narrow noise pulse can be removed before it gets to the narrow filter (as in *Figure 1d*), then the gap in the detected audio is imperceptible – and just as importantly, there is no effect on the AGC system of the receiver.

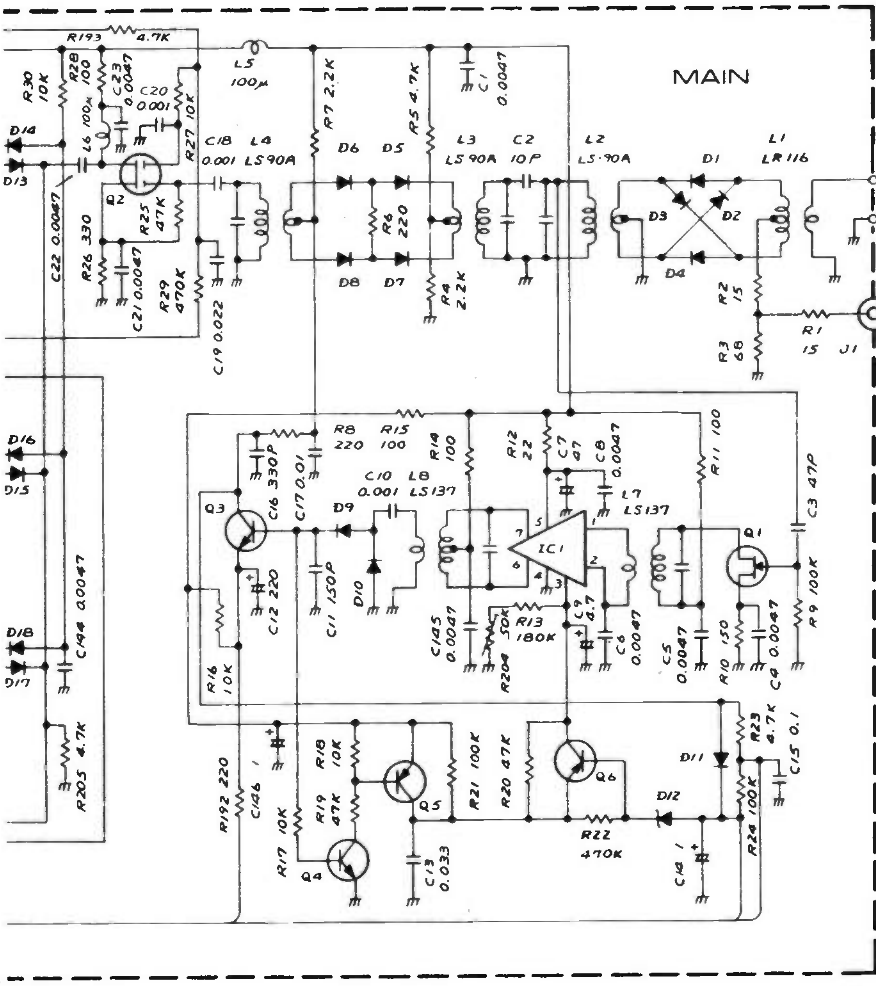
No self respecting HF receiver fails to include this facility these days, and the circuits from the R1000, R2000, IC R70 and NRD515 are illustrated in *Figures 2,3,4 and 5* respectively. The photographic illustrations (*Photos 1&2*) are from the NRD515 review published a while back, along with previously unpublished views of noise in an IC R70 environment.

Taking the R70 application as the theme of this sermon, refer to *Figure 4*. The noise blanker is made up of a completely self contained AM receiver sub-system starting at Q1. The input to Q1 is reasonably wideband, since it has only passed through the main 70MHz roofing filter of the receiver before being reconverted back down to 9MHz for IF processing. IC1 is a linear gain block (TA7124P), driving a voltage doubling detector stage that switches Q3. The emitter of Q3 is the element of the circuit used by the panel switching: grounding the end that disappears off down the cable loom activates the action of the noise blanker.

The R70 is blessed with a facility for 'narrow' or 'wide' blanking pulses. In our tests we were unable to detect any effective difference between these two modes, the only visible difference being that the 'wide' mode delayed the trailing edge of the blanking pulse somewhat, without actually affecting the gating time. Selection of this 'longer' monostable time period is effected by leaving R24 unshorted.

Q4, and 6 provide the local AGC that 'averages' (much as the ANL averaging circuit works) to ensure that the blanker is fired only on noise impulses, rather than on any input level that is generally of a high amplitude. When the blanker is gating, the AGC is modified to prevent the 'local' receiver circuit from being unduly influenced by the effect noise pulses.

You can see from the photos of the 'scope traces (*Photos 3–8*) that the noise blanker generates fast pulses, so the LC supply decoupling (L5C1) is evidence that the ▶



designer has discovered (like we all do) that an undecoupled noise blanker can actually introduce more noise than it removes. The emitter of Q3 is also heavily decoupled via C12, since this comparatively long lead would provide an excellent additional noise source if given the chance.

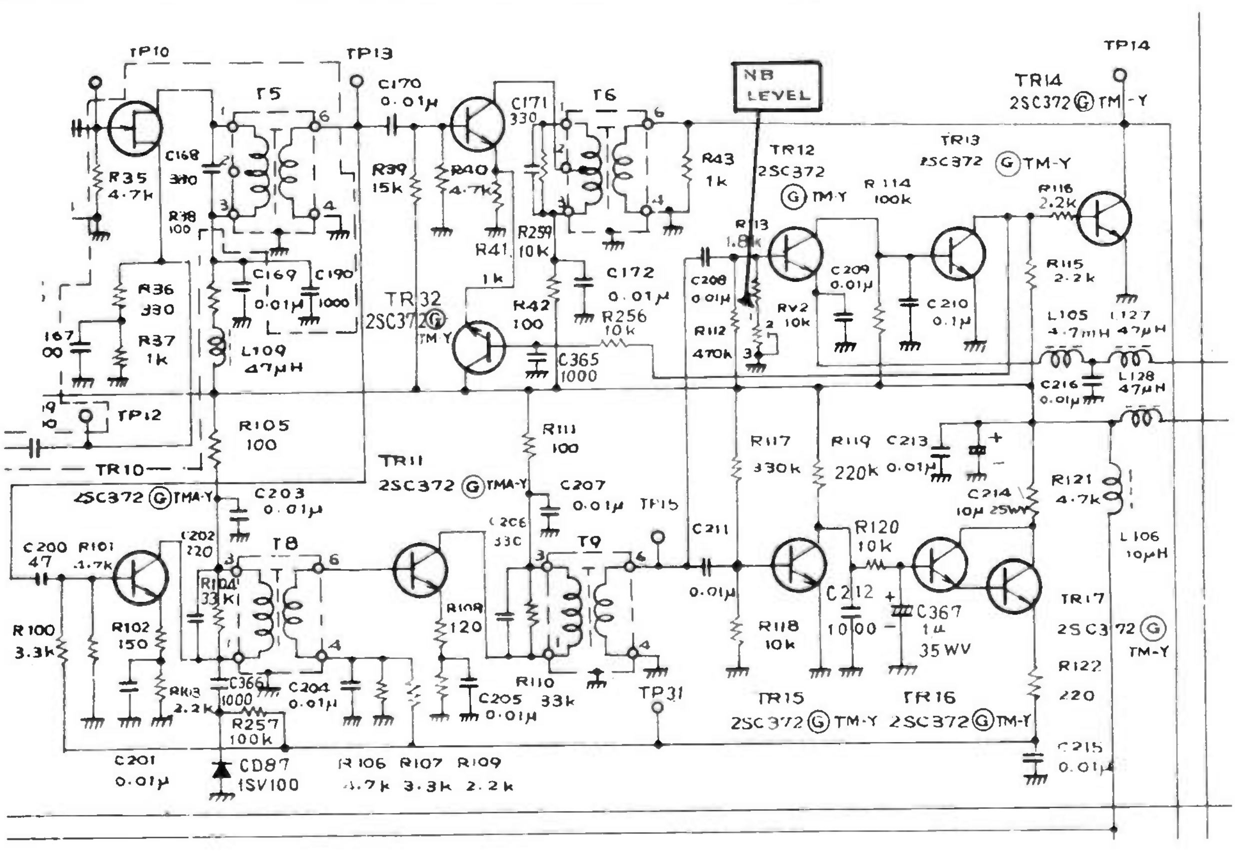
The Gate

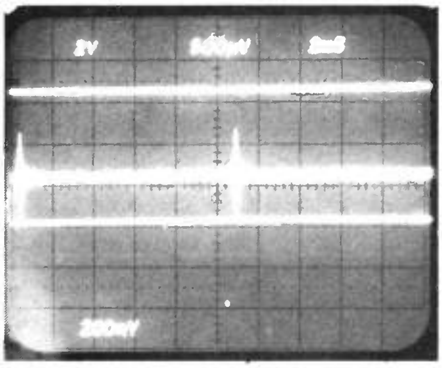
The RF gate circuit employs a straightforward balanced diode switch (D5—D8). The switch is normally forward biased, but when the collector of Q3 pulls low, the circuit is reverse biased and the diodes cease to conduct. Common low capacity switching diodes (BA244's, for example) provide adequate isolation without resorting to the more esoteric PIN devices.

The NRD515 rather inelegantly shorts the IF signal to ground to achieve the blanking gate, but the R1000 and R2000 use a similar balanced diode gate, with provision to trim the balance using a preset.

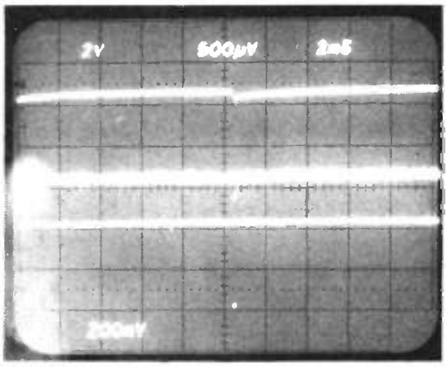
◀ **Figure 4: IC R70 noise blanker circuitry.**

▼ **Figure 5: NRD515 noise blanker circuitry.**

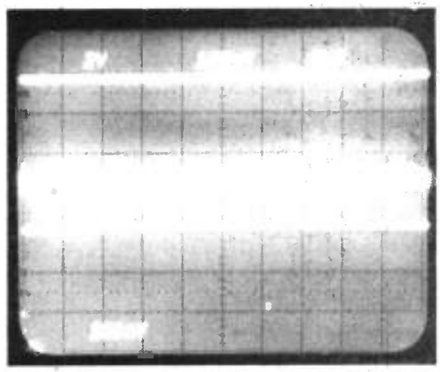




3a: Before

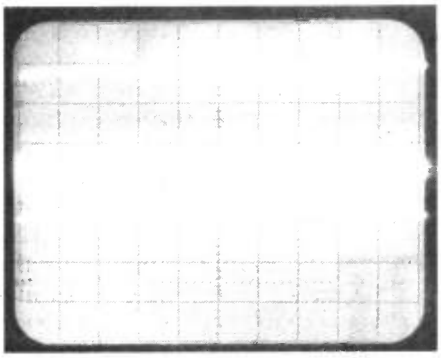


3b: After

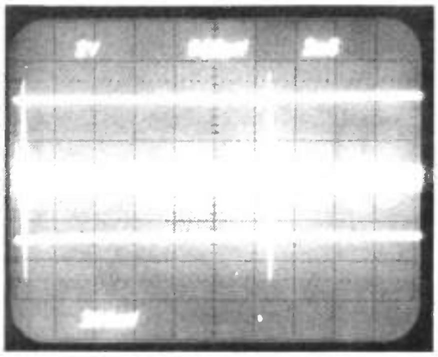


4a: Before

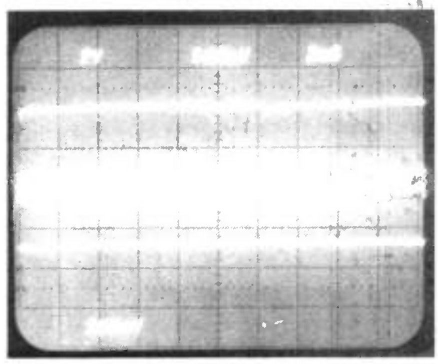
4b: After



5a: Before



5b: After



Top = noise blanker gating signal
Middle = actual noise pulse after IF filter
Lower = actual noise impulse fed to the receiver input

The R70 in action

The photos taken from the R70(*Photos 3–8*)illustrate the benefits of correct noise blanking. It must be said that a noise blanker monostable is only 'adjustable' within narrow limits, and for a properly programmable width blanking pulse, a LPSTTL monostable should be used. Beware of taking the timing to a panel control, by the way, or all sorts of hash may be radiated.

Most wideband impulsive noise is sufficiently narrow that a fixed narrow blanking timing can trap the effect. It is in the nature of fast pulse edges to be brief in the first place, since more leisurely pulses will not radiate harmonics into the RF spectrum anyway.

Delay Lines

In RF noise blanking, it should not be necessary to worry about delaying the IF signal while the blanker makes up its mind. However in audio circuitry (notably click removal from scratched records), the blanking processor will frequently want to wait to see just how long the interfering noise pulse is before deciding the timing of the noise gates – hence a delay is required and this is conveniently available from one of an increasing number of acoustic delay devices.

In the RF application, it may well be useful to shut the noise gate a fraction before the impulse arrives, and it is worth remembering that signals can readily be delayed by using bandpass filters – but that's a case of catch 22, because the moment you use a filter to slow the passage of the noise pulse, it's been stretched again.

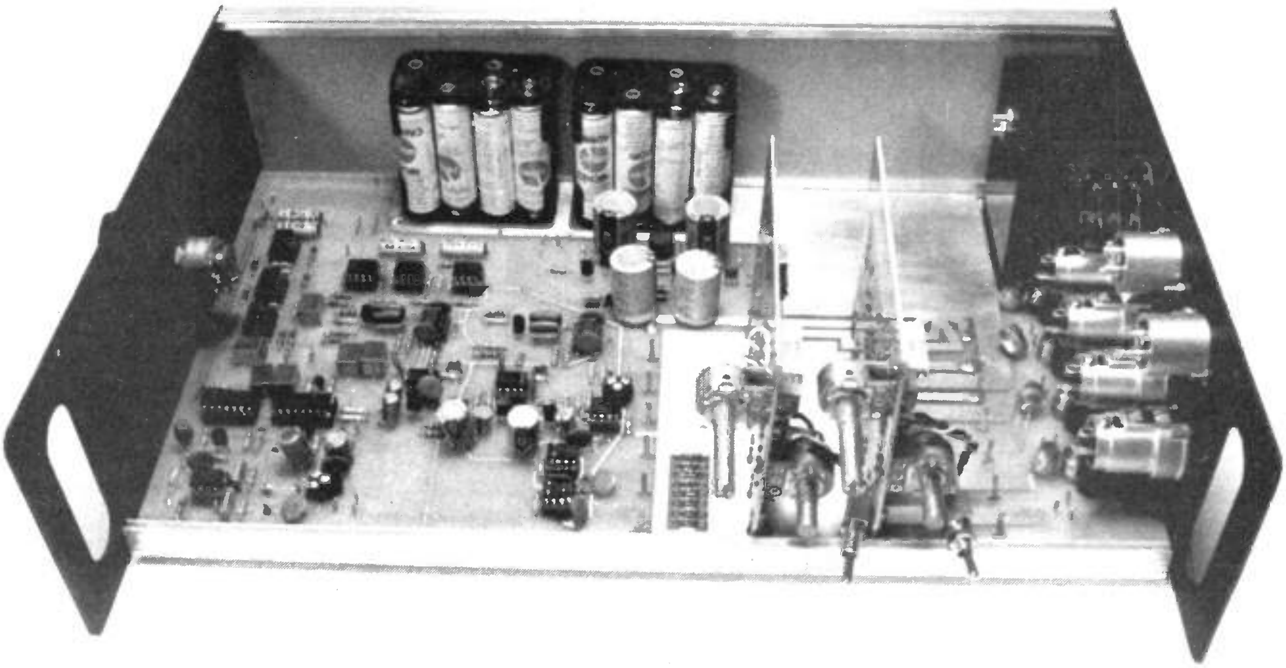
Other techniques

A couple of years back, a technique was described in *RadCom* (the RSGB members' magazine) using a similar form of local receiver impulse detection, but using the output to sidestep the main receiver's local oscillator for the period of the blanking pulse, to a point where the circuitry was sufficiently detuned as to be insensitive. In an add-on noise blanker application, this may be less cruel to a receiver than hacking a way into the signal path to install a noise gate, and a brief experiment with a varicap switched across the tank circuit wouldn't be too time consuming.

Nothing much else has appeared on this theme since that time, but it may provide some extra food for thought for those readers who are proposing to delve into their receivers to combat that unwanted affliction of the HF bands. It isn't obvious what happens to a synthesised LO in these circumstances, but it may be that the blanking gate pulse is suficiently narrow not to fluster a PLL time constant.

■ R&EW

NEXT INSTALMENT: *Squelch systems*



The Four-Channel Audio Mixer — Part II

Further details of the Multi-Option Professional Mixer from our audio designer, David Strange.

Last month we looked at the overall design strategy and the circuit operation of this stereo mixer: this month we look at its detailed construction. The order of construction I would suggest – and so the order taken here – is first to build the four input amplifiers and to follow this by the main mixer PCB. The input amplifiers are daughter boards and plug vertically into the main PCB.

As much as possible has been soldered directly into the PCBs to cut down on point-to-point wiring and so it is important, particularly with the front panel, that the drilling instructions are followed with great precision to ensure proper alignment of components with holes. The side panels are less of a problem in this respect and so these have been left to the preference of the constructor within the constraints imposed by components.

Another general point to note is that 1mm solder pins should be used as the termination point wherever wires leave or enter the PCBs and, once the wire has been attached, neoprene sleeving should be slid over the joint to give good mechanical stability. The same procedure should also be adopted on all potentiometer and switch tags when terminating to wires. It is also good professional practice to insert resistors with the tolerance bands oriented in the same direction for neatness and ease of checking prior to switch on.

Finally – before launching into the constructional details – I should admit that some component values have been modified in the course of the mixer's development. The values I would now recommend are those given in the parts list presented on p.33.

Input Amplifiers

Constructing the input amplifiers is a job done in quadruplicate – starting with four PCBs, the foil pattern for which is shown in *Figure 1* (with the component overlay in *Figure 2*).

Start by inserting the three 1mm PC pins for the termination of SW1 and then insert the seven AMP sockets along the bottom edge (component side of the board). The next component to consider is RV3. This is soldered copper side of the board and when inserting it you should ensure that the tracks are not shorted by the shoulders on its pins. The shoulders may be bent at right angles out of harm's way or cut off completely. The constructor will find that a very slim soldering iron is needed to complete the insertion of RV3 successfully.

From now on, it's fairly plain sailing with only component orientation to worry about. But do ensure that RV2 is pushed fully into the board so that the proper alignment is achieved with the front panel. SW1 should be fitted with flying leads, approximately 20mm in length, terminated to the 1mm pins previously inserted.

Main Motherboard

The foil patterns and component overlay for the main motherboard are shown in *Figures 3 and 4* (pages 26–29, 30–31), respectively.

As one can see, a fair number of links through the board from the bottom track to the top track are required, but their locations are a little difficult to discover without reference to components. It is therefore better to leave the linking through until the construction is under way: then each link can be formed as its location is found. However, I would recommend taking care to prevent link points being cut off or hidden by components (and thus difficult to solder).

As with the input boards, the first items to insert should be the pins – starting with the 1mm PC pins and followed by the AMP pins, which are inserted component side into the board.

The IC sockets should be next as these provide a good reference point for other locations. Then begin inserting other components, starting with the lowest such as resistors and diodes and working up to the tallest – like capacitors. Keep aware of any component leads that require both sides to be soldered to the board.

When the board is completely filled, such controls as SW2, RV8, SW4, SW3 and RV4 should be attached to their flying leads and the leads soldered to the board. Keep the flying leads as short as is reasonably possible, considering each control's eventual location within the casing. The various in/out leads can also be attached to the board but these can be left as tails until the board is cased, when they will be made off to their sockets. Attach the battery clips, and screw the battery holders to the rear of the board. Care should be taken that the metal parts of the holders, which may be live, are not shorted by the screws and the PCB – plastic screws or adhesive pads may be your best option here.

The Meter

The next item to consider is the meter as this requires some modification. The meter was chosen for its scale clarity and quality but, in common with most VU meters, it incorporates a rectifier that is not required in our application. It is therefore necessary to remove the internal rectifier and wire the meter terminals directly to the meter coil. This is done by first lying the meter on its face and easing sideways the two soft plastic wedges that are located where the clear plastic face meets the black plastic body. Once the wedges have been slid sideways, they should be completely removed and placed carefully to one side. The face may then be prised off, after the two brass screws in the back of the barrel have been removed.

The movement can now be gently brought forward from the barrel and the two diodes and resistors removed – of course, taking great care not to damage either the very fragile movement or the needle. The leads should now be soldered directly to the terminals. Once this has been done,

continued p.32

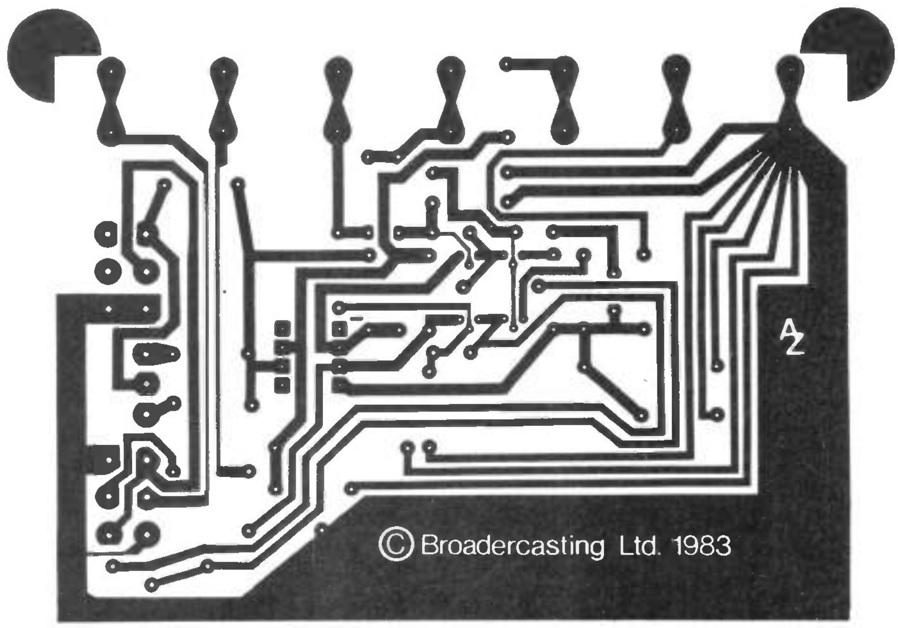


Figure 1: Foil pattern for input amplifier PCB.

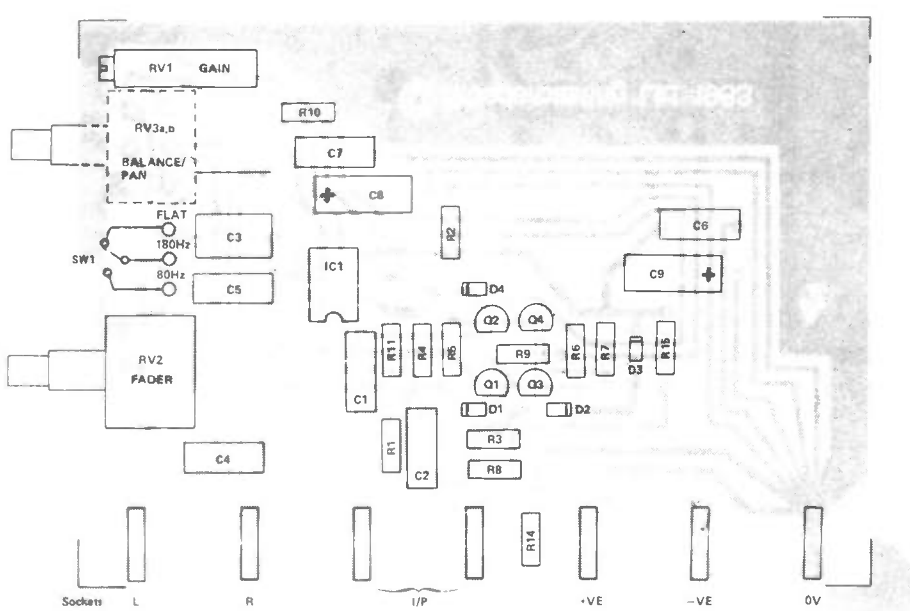


Figure 2: Component overlay for input amplifier.

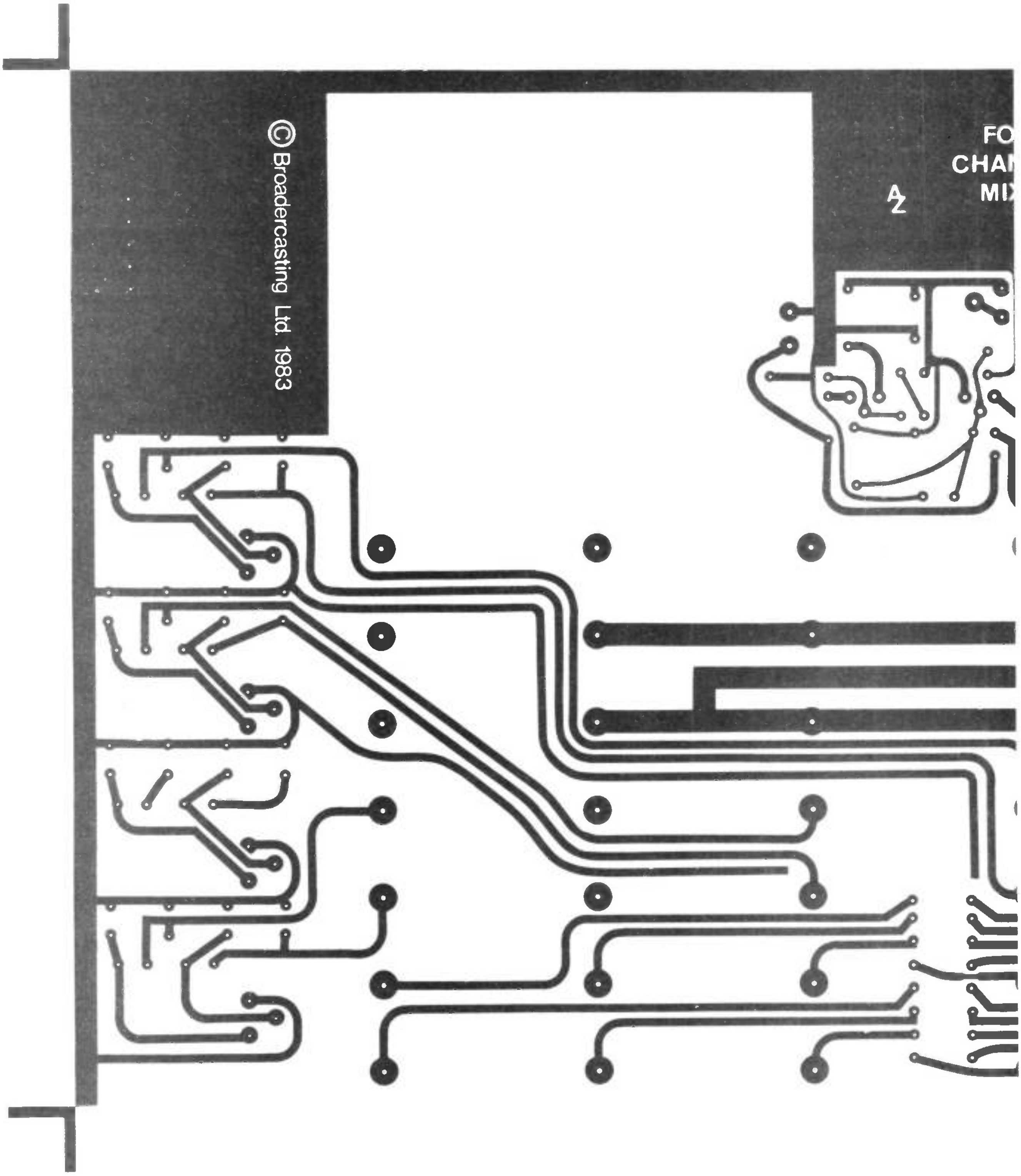
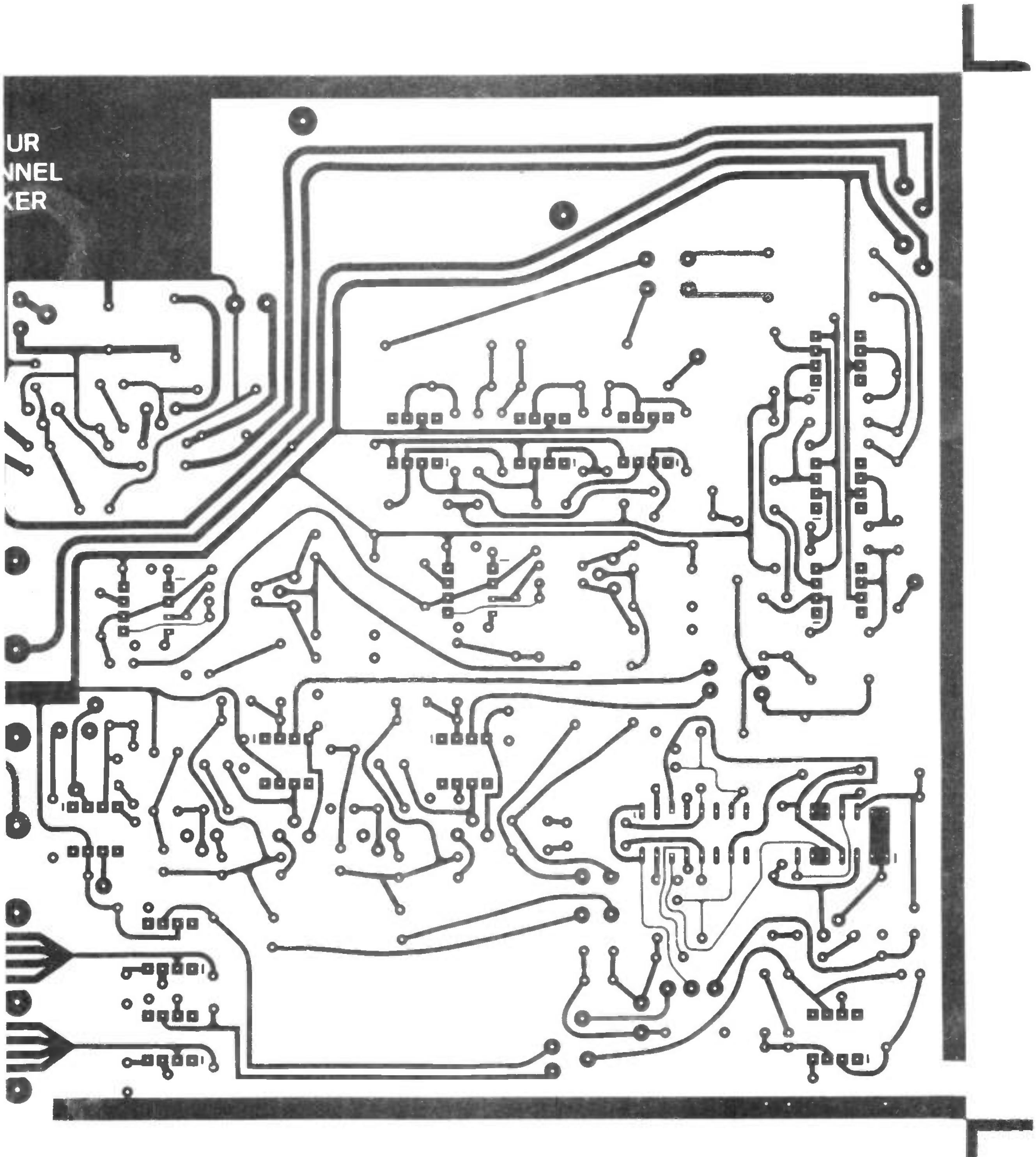


Figure 3a: PCB foil pattern for main motherboard. Bottom plane.


UR
NNEL
KER

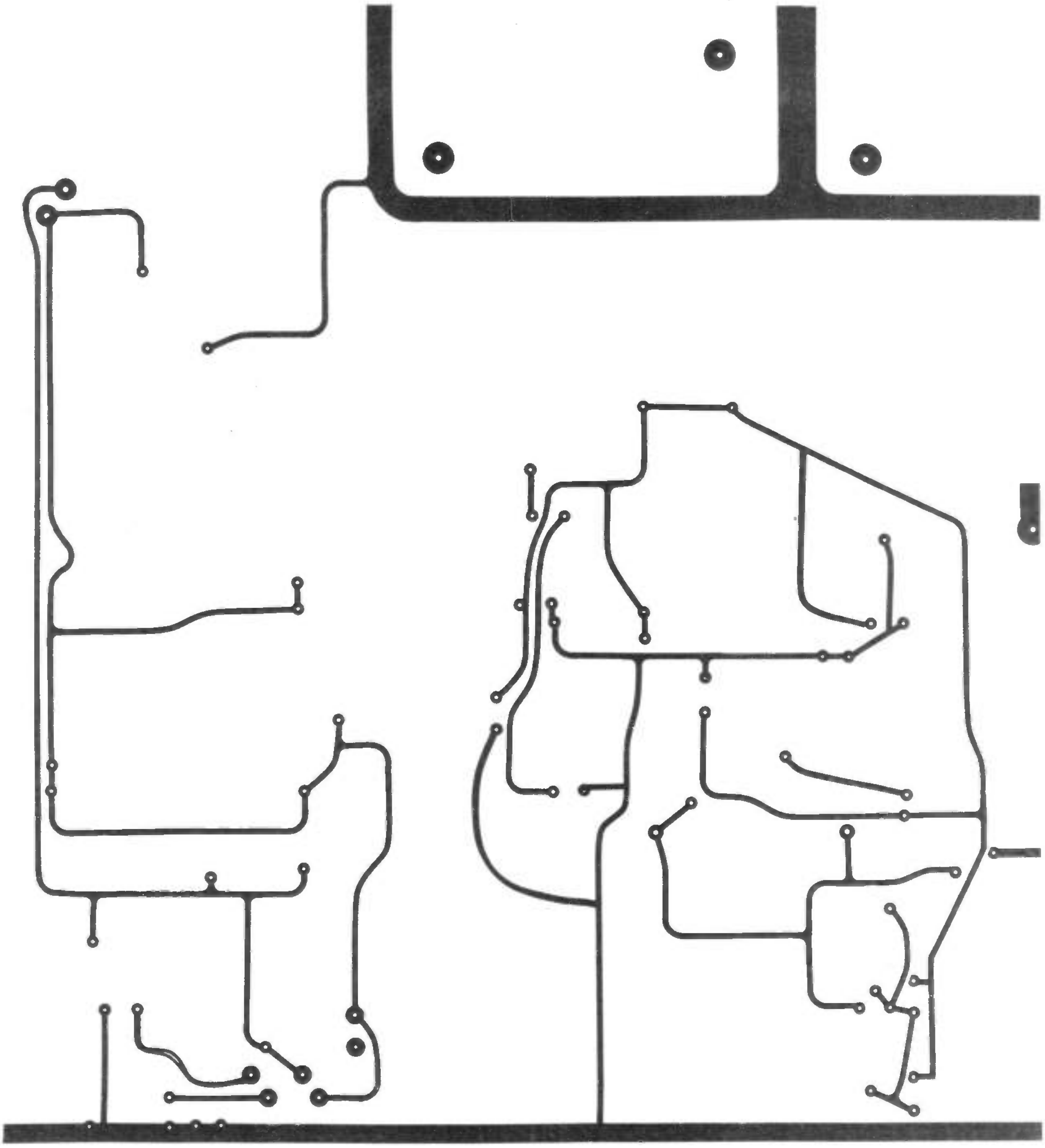
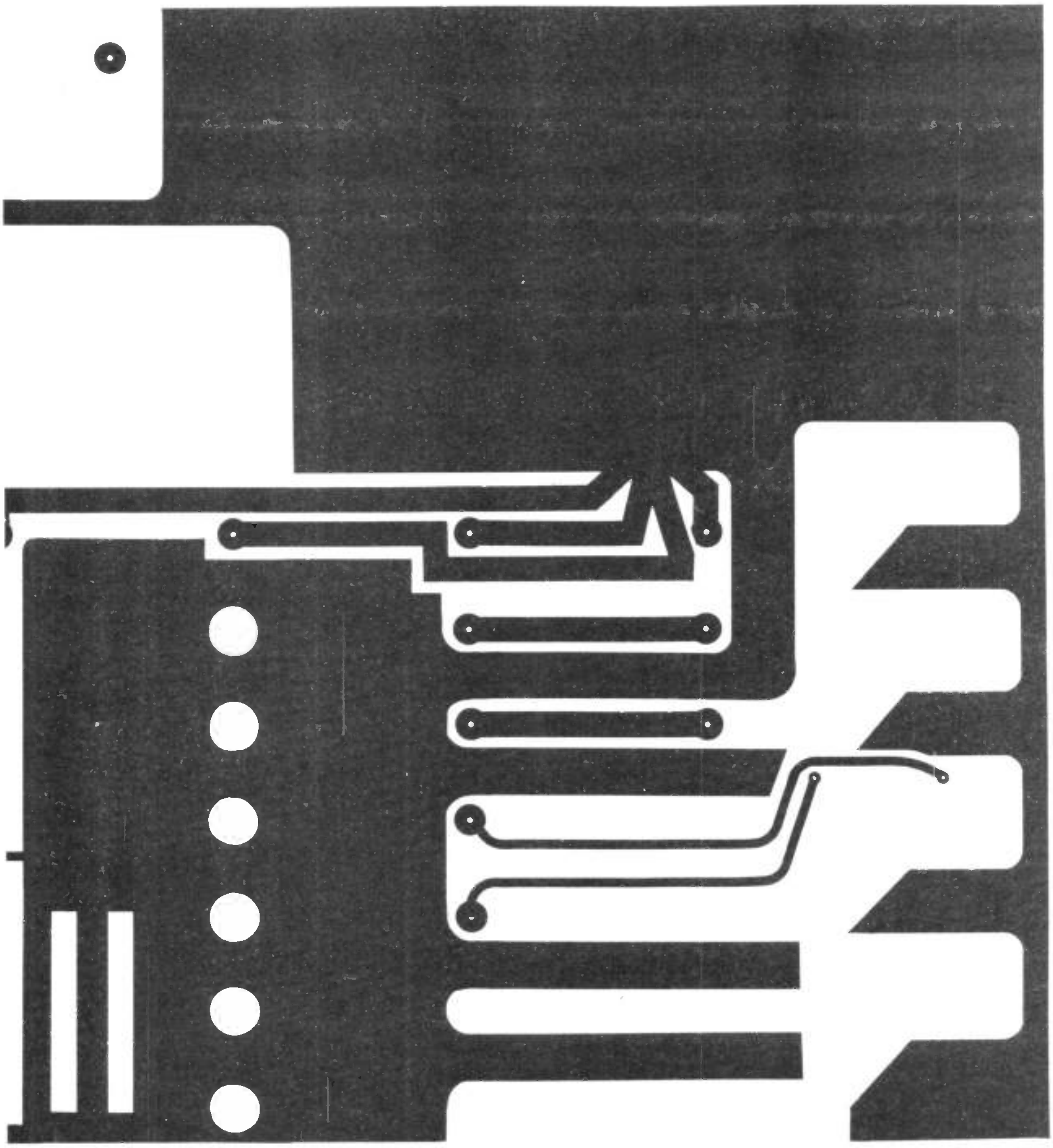


Figure 3b: PCB foil pattern for main motherboard. Top plane.



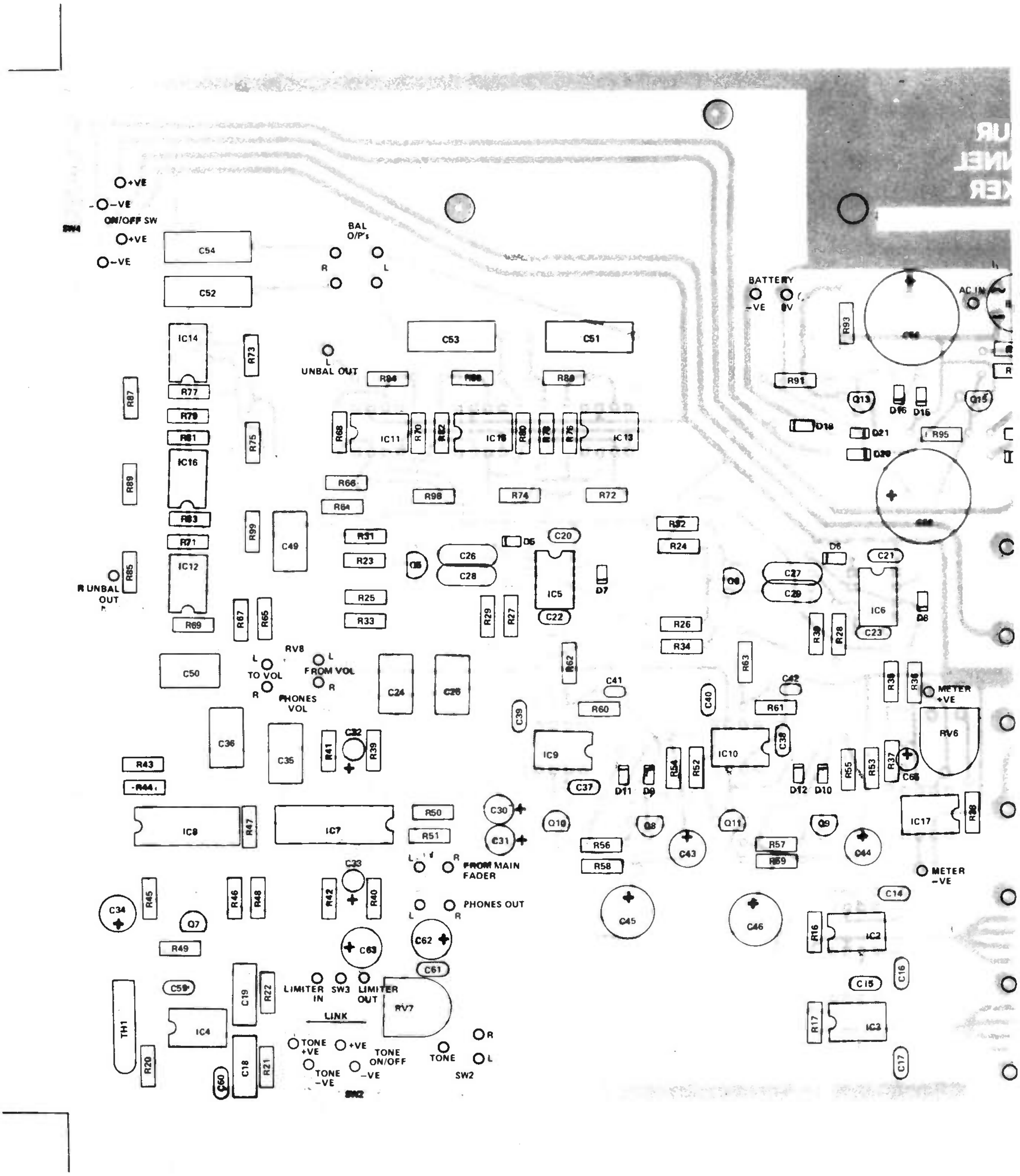


Figure 4: Mixer motherboard component overlay.

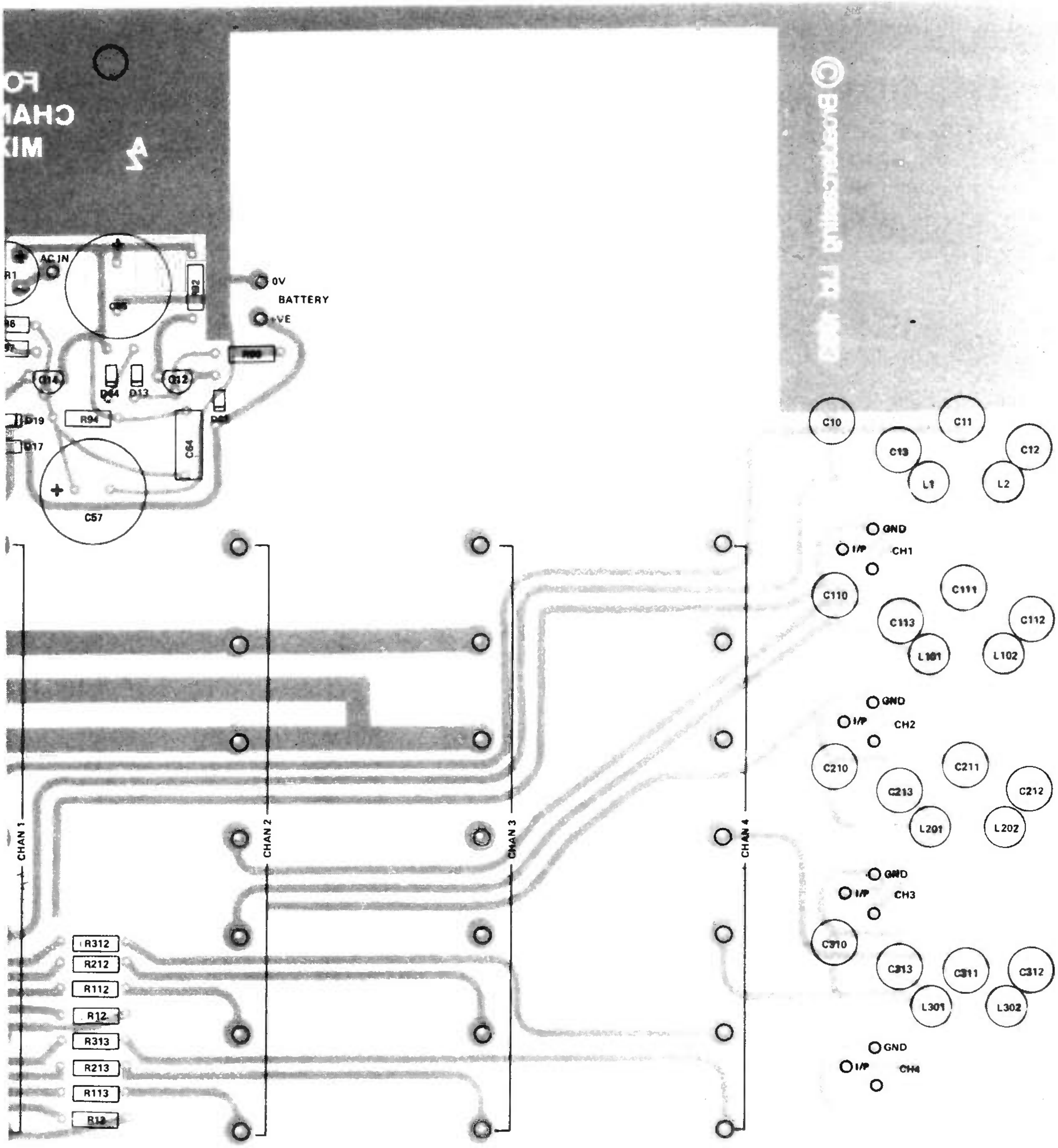
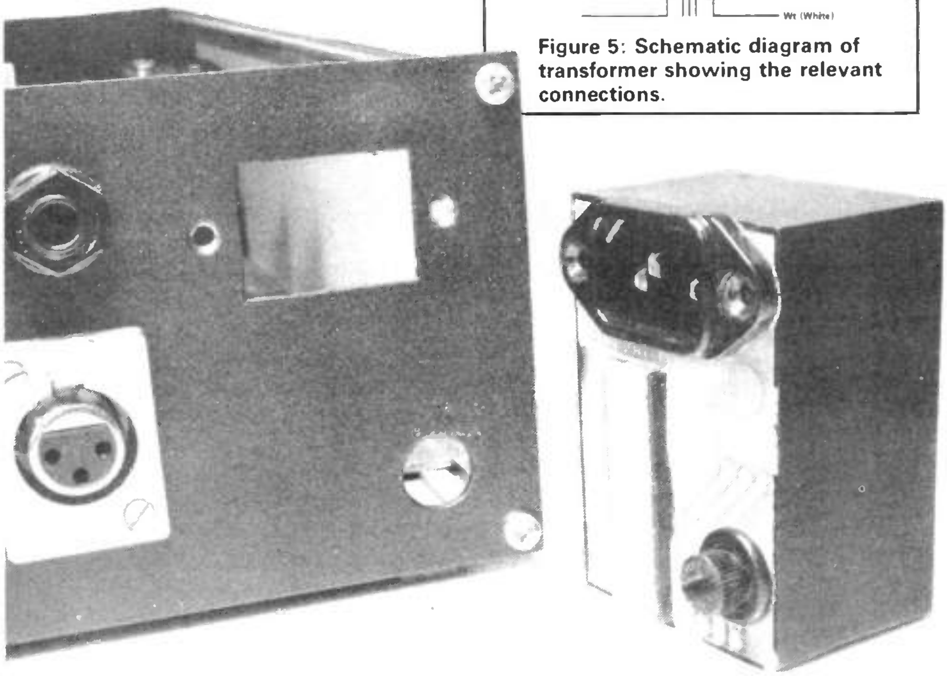

AC IN
0V
BATTERY
+VE
R94
D13
D19
D17
C64
C57
C10
C11
C13
C12
L1
L2
GND
I/P
CH1
C110
C111
C113
C112
L101
L102
GND
I/P
CH2
C210
C211
C213
C212
L201
L202
GND
I/P
CH3
C310
C313
C311
C312
L301
L302
GND
I/P
CH4
CHAN 1
CHAN 2
CHAN 3
CHAN 4
R312
R212
R112
R12
R313
R213
R113
R13

Photo 1: The transformer, its connections and its place on the side panel.



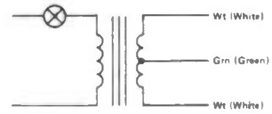


Figure 5: Schematic diagram of transformer showing the relevant connections.

the meter can be reassembled, with the wedges once again holding the front on.

Initial Testing

First solder the meter onto its flying leads and also temporarily connect the transformer unit (pictured in *Photo 1* and shown schematically in *Figure 5*) onto its leads. Ensure that the meter is properly mechanically zeroed; if not, adjust by means of the plastic screw to its rear.

With none of the ICs already inserted in their sockets, apply mains power to the transformer and check that the power supply is giving a smooth DC output of ±10 to ±12V. Note: C64 has been incorporated to increase the stability of the power supply and it is an addition to the circuit published last month. It has been placed in parallel with R94.

One terminal of each battery pack should now be connected and an ammeter put between the unconnected terminal and the charger circuit to establish that the proper charging current of about 14mA is flowing. The batteries should now be unclipped prior to subsequent testing in case a fault condition exists which could cause high currents to flow from the batteries.

The first section of the mixer to get working is the oscillator and so IC4 should be inserted; if all is well, a 1kHz tone will be produced when SW2 is switched to the appropriate setting.

Moving on a stage, IC8 and IC7 can now be inserted and a tone detected on both C35 and C36 when the master fader is opened. By plugging in IC5, IC6 and IC17 the meter is brought to life and it should be adjusted by RV6 so that 0VU is indicated when the limiter just begins to operate. This is set up by placing an AC voltmeter between either C35 or C36 and ground, followed by adjusting the master fader so that it is impossible to increase the signal on one of the capacitors any further (ensure SW3 is in the limiter position). This is the point at which to set RV6 so that the VU reads 0VU.

Insert the headphone amplifier ICs – IC9 and IC10 – and establish that each channel is functioning and that the volume control RV8 is effective. The output amplifiers should also be equipped with their ICs and these confirmed to be working, before inserting the mixing amplifiers IC2 and IC3 and a channel amplifier

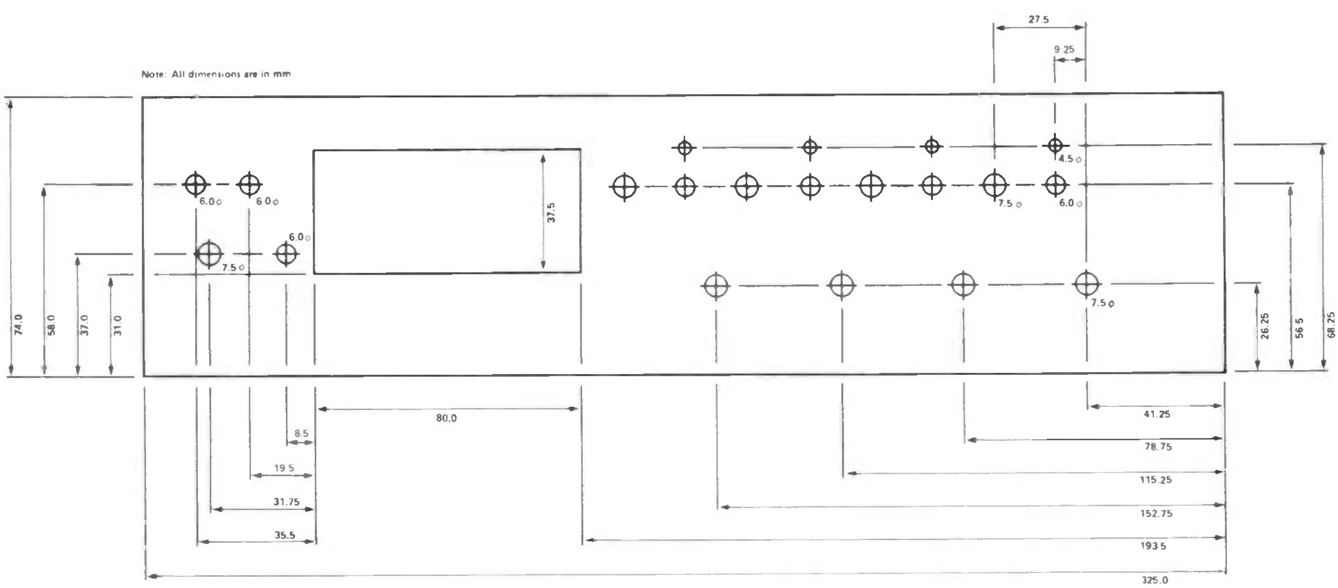


Figure 6: Front panel piercing instructions. Note that the phono jack socket has been moved to the side panel.

daughter board.

With the mixer now fully equipped, switch off the tone (with SW2): the channel amplifier may now be tested. Set the channel fader fully clockwise and ensure the pan potentiometer is central. Connect a microphone and wind the gain preset on the amplifier whilst monitoring the output of the mixer.

Having thus established that the whole mixer is functioning, RV7 should now be adjusted until no change in level is heard when the limiter switch SW3 is operated. We are now ready to get the mixer into its case.

The Case

As I emphasised before, the front panel must be drilled very accurately in accordance with the drilling instructions given in *Figure 6* so that the controls align properly. Note that the master fader and headphone jack socket are mounted on the left hand side panel and the input/output sockets on the right hand panel.

There are a number of points to note when placing the completed boards in the case. Firstly a nut is required both back and front of the panel where the channel faders and pan potentiometers pass through the front panel – for fixing. In addition, a small bite must be taken out of the channel board PCB on the lower front corner to clear the guide rail of the case. Lastly, the main PCB requires some spacing away from the floor of the case.

My final point concerns the transformer and its positioning. If it is envisaged that the mixer will always be used on batteries, then the encapsulated transformer unit can simply be fitted inside the case. However, the transformer does radiate some hum and so, if mains operation is required, the transformer unit should be positioned remotely in a separate plastic box: this will much improve the noise figures!

Next month, in the final part of this constructional project, we shall be presenting details of the mixer's performance – its full specification and noise figures.

■ R&EW

PARTS LIST

Resistors

all ¼W 5% unless otherwise specified

R1,101,201,301	1k2
R2,102,202,302,3,103 203,303,10,110,210,310 11,111,211,311	100k 2%
R4,104,204,304,5,105, 205,305	12k 2%
R6,106,206,306,7,107, 207,307,49	2k2
R8,108,208,308,66,67,70,71	15k
R9,109,209,309	100R
R12,112,212,312,13,113,213, 313,43,44,45,46,64,65,68,69, 72,73,74,75	10k
R14,114,214,314,15,115,215, 315,92,93	47R
R16,17,41,42	100k
R20	1k
R21,22,62,63	1k5
R23,24	82k
R25,26,27,28,29,30,48,50,51,96,97	33k
R31,32,33,34	3k3
R35,36,52,53	1k8
R37	1M2
R39,40	2M2
R47	180k
R54,55	4k7
R56,57,58,59,84,85,86,87,88,89	33R
R60,61	820R
R76,77,78,79,80,81,82,83	22k
R38,90,91	6k8
R94,95	2k7
R98,99	120R
THI	R53

Potentiometers

RV1,101,201,301	200k 12.5mm 20T horizontal preset
RV2,102,202,302	5k log dual gang 41 click pot
RV3,103,203,303	10k log/antilog balance pot with centre click
RV4,8	10k log dual gang 41 click pot
RV6	5k 10mm horizontal preset
RV7	10k 10mm horizontal preset

Capacitors

C1,101,201,301,2,102 202,302	470n polycarbonate siemens
C3,103,203,303,24,25 35,36,49,50	1µmetalised polyester layer siemens
C4,104,204,304,5,105,205 305,6,106,206,306 7,107,207,307,64	100n metalised polyester layer siemens
C8,108,208,308,9,109 209,309	47µ 16V axial electrolytic
C10,110,210,310,11, 111,211,311,12,112, 212,312,13,113, 213,313	2n7 polystyrene axial
C14,15,16,17,20,21, 22,23,37,38,39, 40,59,60,61	10n disc ceramic
C18,19	10n metalised polyester layer siemens
C26,27,28,29	100n polycarbonate siemens
C30,31	1µ 10V radial electrolytic
C32,33,65	1µ 10V tantalum
C34	22µ 25V tantalum
C41,42	39p ceramic
C43,44	33µ 16V radial electrolytic
C45,46	220µ 25V radial electrolytic
C47,48	1µ 10V radial electrolytic
C51,52,53,54	1µ bipolar axial
C55,56	2200µ 16V radial electrolytic
C57,58	1000µ 16V radial electrolytic
C62,63	100µ 10V radial electrolytic

Inductors

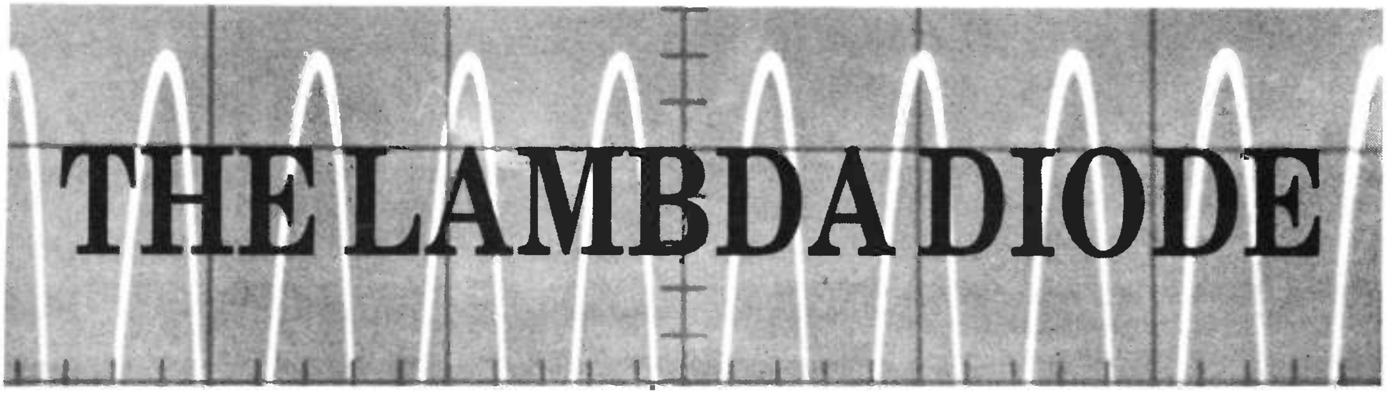
L1,101,201,301,2, 102,202,302	8.2mH 8RB

Semiconductors

Q1,101,201,301,2,102,202, 302,3,103,203,303,4, 104,204,304,5,6	BC239
Q7	BC307
Q8,9,13	BC182
Q10,11,12	BC212
Q14	BC337
Q15	BC327
D1,101,201,301,2,102,202,302, 3,103,203,303,4,104,204 304,5,6,7,8,9,10,11,12, 13,14,15,16,21,22,	IN4148
D17,18,19,20	IN4001
BR1	W005
IC1,101,201,301,2,3,9, 10,11,12,17	LF351
IC4,13,14,15,16	741
IC5,6	LF353
IC7	NE570
IC8	LM339

Miscellaneous

SW1,101,201,301 - single pole double throw centre off miniature toggle.
SW2 - 4-pole double throw min toggle.
SW3 - single pole double throw min toggle.
SW4 - double pole on/off toggle.
IC sockets - 18 off 8 pin, 1 off 14pin, 1 off 16pin.
3 pin XLR chassis socket 4 off.
3 pin XLR chassis plug 2 off.
Stereo ¼ inch jack socket 2 off.
IEC mains connector with fuse
1 Encapsulated transformer unit. EX3H case, knobs. VU meter (Sifam) AL22 with bezel etc. 28 AMP sockets. 28 AMP pins. 50 1mm PC pins. 2 NiCad battery packs 16AA size NiCad rechargeable. 2 Battery holders. 2 PP3 type battery terminal clips.



James S B Dick considers the workings of the Lambda diode and in doing so takes a look at negative resistance.

The concept of resistance is omnipresent in electronics — only a few materials loose their resistance at very low temperatures. Apart from these superconductors, all devices produce a voltage drop across them when they pass current. The resistance concept is quantified as Ohm's Law.

Resistance — Static and Dynamic

Ohm's Law, as it is taught, is simple: to determine the resistance of a component, apply a voltage across it and measure the current passed (*Figure 1*). The voltage (in volts) divided by the current (in amps) defines the component's resistance (in ohms). This is true of linear devices — the resistor, for instance. Double the applied voltage and the current is doubled also: the 'voltage-divided-by-current' value stays constant, so the current is said to be a linear function of the applied voltage.

However, this is not always the case. Moreover, non-linear devices do not have to be esoteric — the common light bulb is an example of such a device. *Figure 2* shows a typical voltage/current plot for a light bulb and it can be seen that as the voltage applied increases, the current taken is less than that predicted from the first few measurements. Another example is the silicon diode: until there is a voltage of 700mV across the diode, little current is taken.

The resistance calculated by the application of Ohm's Law depends on the voltage applied where these non-linear devices are concerned, but it is known as the static resistance (the applied voltage being held steady). Another quantity — the dynamic resistance — is used to describe how the characteristics of the device change with varying (i.e. dynamic) voltage.

The dynamic resistance is defined as the change in voltage divided by the corresponding change in current and is represented in a voltage/current plot by the reciprocal of the gradient of the curve. With linear devices, the gradient (i.e. dynamic resistance) is constant but with a non-linear device the dynamic resistance is a function of the applied voltage. The diode of *Figure 2* has a high dynamic resistance until the knee in the curve is reached.

If the voltage/current plots are done for a number of devices, some exhibit slopes which have a negative gradient. This phenomenon is known as negative dynamic resistance — although the word dynamic is often omitted. The device still has a normal, positive static resistance but the negative gradient on the graph means that if the voltage applied is increased, the current actually decreases instead of increasing. *Figure 3* shows the voltage/current diagrams (called 'characteristic curves') for two negative resistance devices — the tunnel diode and the so-called Lambda diode. The Lambda diode has the JFET configuration shown in *Figure 9* and is only a pseudo diode.

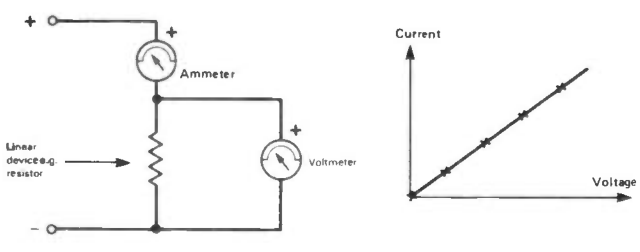


Figure 1: Ohm's Law measurement for a linear device. The gradient of the graph is the reciprocal of resistance.

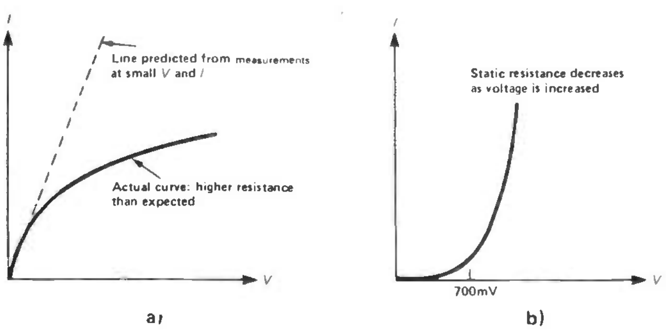


Figure 2: Voltage/current graphs of two non-linear devices. a) Filament bulb; b) Silicon diode.

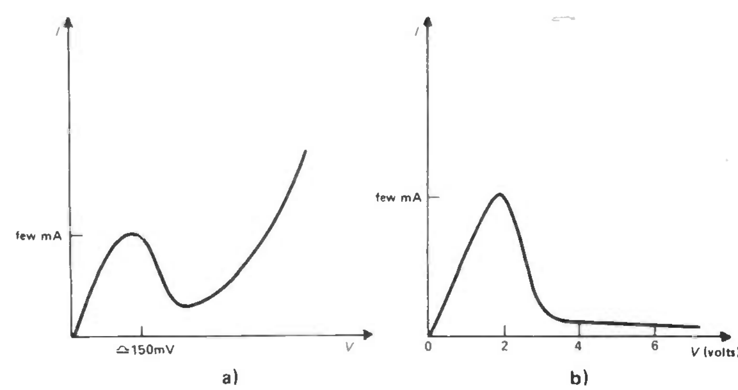


Figure 3: Voltage/current graphs of two negative resistance devices. a) Tunnel diode; b) Lamdba diode.

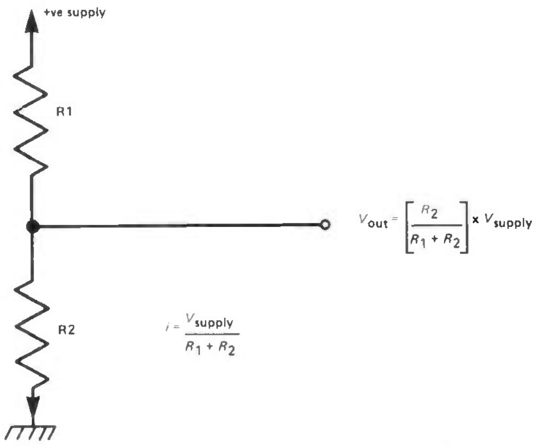


Figure 4: Potential divider incorporating linear devices.

The solid-state physics required to understand the detailed workings of these devices is fairly complex and, as it is not required for operational use, will not be gone into here.

Load Lines

When any electrical circuit is switched on, it will come to a point of equilibrium (with the exception of oscillators, of course!). The simple two-resistor circuit in *Figure 4* will settle down to act as a potential divider with the voltages and current shown. The equilibrium point is easily determined by Ohm's Law. However, how can the equilibrium point be found when a non-linear device is used? If R2 is replaced by a diode, determining the current and voltage through the two devices is more easily done by solving graphically.

First, the characteristic curve of the non-linear device is drawn and then the range of voltages and currents possible for the resistance is superimposed. Since the resistor is a linear device, the range of possible values is represented by a straight line defined by point A where the voltage across the device is at a maximum (i.e. the supply voltage), and point B where the current is at a maximum (i.e. the supply voltage divided by the resistance) — see *Figure 5*. The equilibrium point is the point of intersection of these two curves. Note that the line A–B is not the characteristic curve of the resistor.

In general, the line representing the supply-voltage/resistor combination can intersect the characteristic curve of the negative resistance device in one of three ways. These correspond to different modes of device operation, and are illustrated in *Figure 6*.

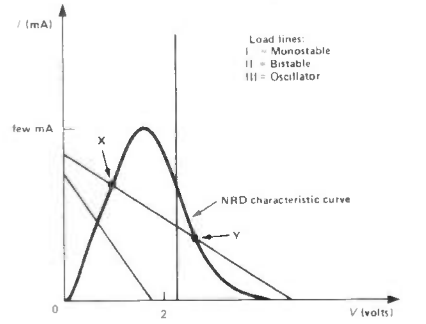


Figure 6: The different modes of operation available through biasing a negative resistance device.

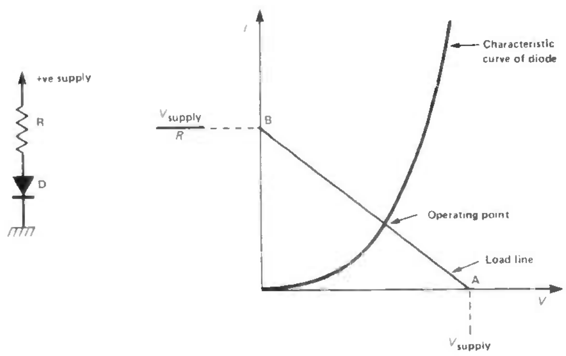


Figure 5: Determining the operating point of a resistor/diode circuit.

Monostable

Line I has only one solution — an equilibrium point on a section of the curve where the device has a positive dynamic resistance. If the voltage to the device is perturbed, for example, by applying a pulse, the operating conditions will be shifted from the equilibrium point but, because stability is sought, they will soon return to it. If an inductor is placed in series with the device, the return to stability is delayed and the circuit acts as a pulse lengthener — the task of the classical monostable.

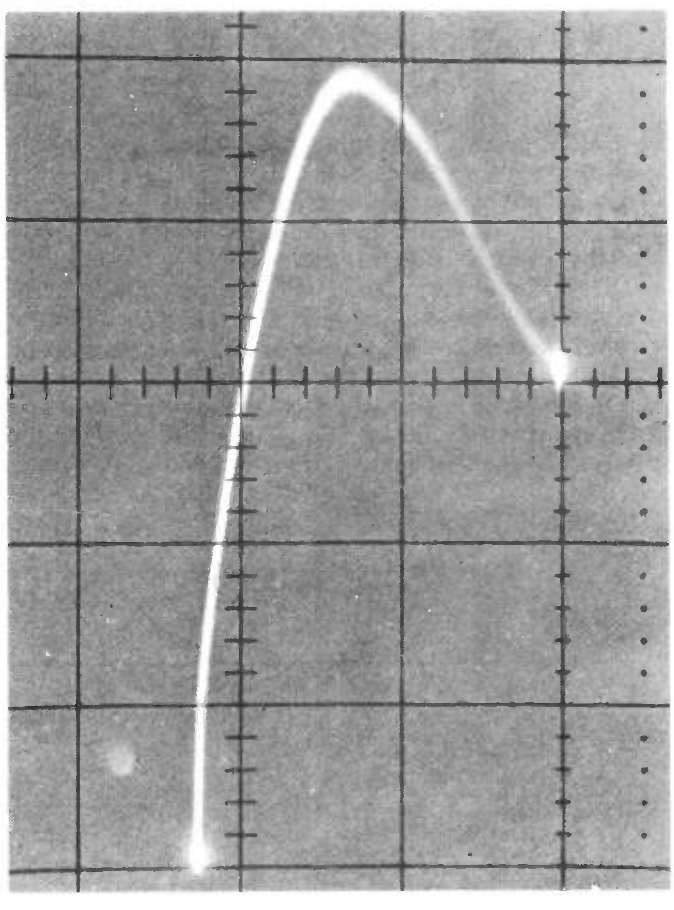


Photo 1: Oscillograph of Lambda Diode characteristic curve as obtained from a curve tracer. 1mA/division in *y*; 2V/division in *x*

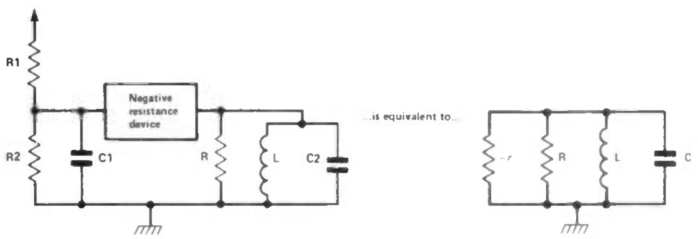


Figure 7: Simple negative resistance oscillator and equivalent AC circuit.

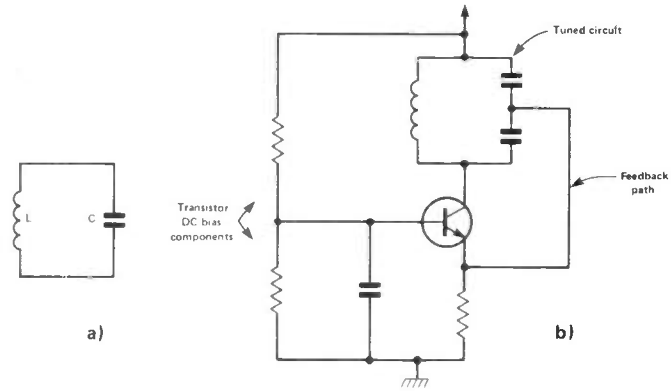


Figure 8: Oscillator circuits. a) Simple L-C resonator; b) Colpitts oscillator.

Bistable

Line II in *Figure 6* has two equilibrium points and bistable action occurs. If the circuit is at point X, it may be jolted into stability at point Y by applying a positive pulse via a capacitor; a negative pulse will reverse this action. Note that the bistable latches — i.e. the ouput holds the state that was initiated by the last pulse.

The circuit shown in *Figure 9* operates in this fashion.

Oscillator

Line III represents a stable sine-wave oscillator and such oscillators are important circuit building blocks — particularly in music synthesisers, telecommunications and analogue computing.

The simplest method of producing a sine wave is to let a parallel inductor–capacitor (L C) circuit, such as that in *Figure 8*, 'ring' at its natural frequency. The circuit shown might be made to ring by the application of a short pulse. The amplitude of the induced oscillations will decrease because energy is lost in the resistances of the inductor, capacitor and connecting wires; any power transferred to other circuits will also cause energy loss.

The oscillations can be maintained by replacing the lost energy. This is done, for example, in the Colpitts oscillator circuit shown in *Figure 8*, where feedback to sustain oscillation is provided between the emitter of the transistor and the capacitive divider in the collector circuit. An alternative method is to null out the effect of the positive resistance in the L C circuit by adding a 'negative' resistor. *Figure 7* shows a negative resistance device biased by R1, R2 and C1. The tuned circuit has a resistive loss *R* represented on the equivalent AC circuit by R. If the power supply is ignored and a negative resistance is connected in parallel with R, L and C, then the load on the tuned circuit is:

$$1/R_{load} = 1/R + 1/(-r)$$

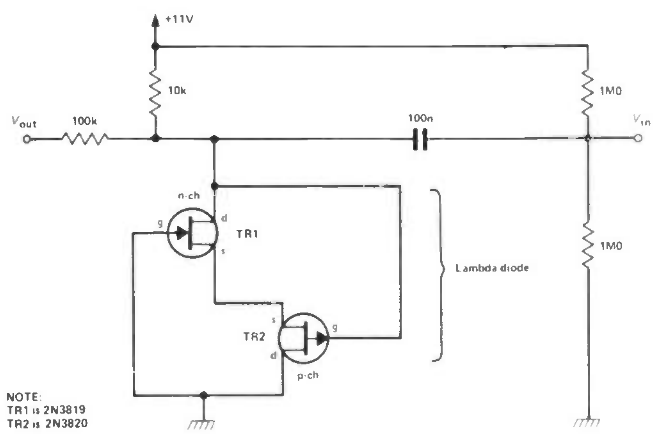
If *r* is made equal in amplitude to *R*, R_{load} becomes infinite — so the tuned circuit is not damped. To take advantage of this circuit configuration, the negative resistance device has to be biased by Line III in *Figure 6*, so that the point of equilibrium is on a negative gradient.

Applications

Tunnel diodes are not readily available and tend to be expensive. This is because a high level of 'doping' is required in the semiconductor to obtain the shallow depletion layer necessary for the tunnel effect.

However, a negative resistance device can be synthesised from two junction field effect transistors (JFETs) — one n-channel and one p-channel. The configuration shown in *Figure 9* is known as a Lambda diode because its characteristic curve resembles the capital Greek letter Lambda (see *Figure 3*).

The circuits involving the diode shown in *Figures 9, 10, 11* illustrate its use in two different modes. *Figure 9*



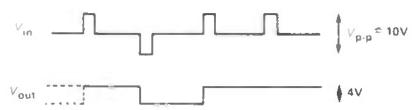


Figure 9: Lambda diode bistable circuit, together with its idealised input/output characteristics.

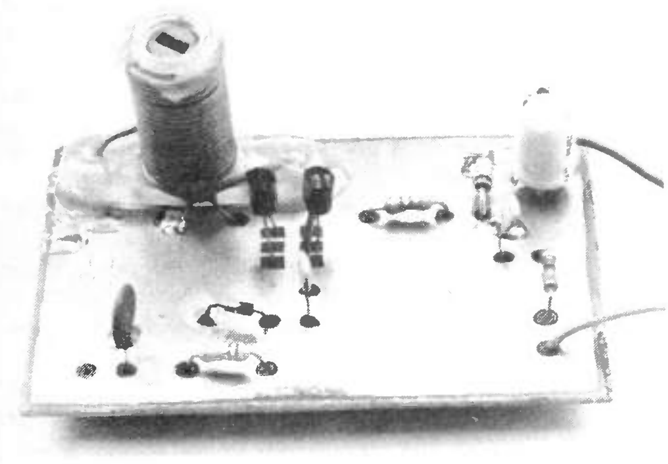


Photo 2: 15MHz variable frequency oscillator (VFO) incorporating a Lambda Diode

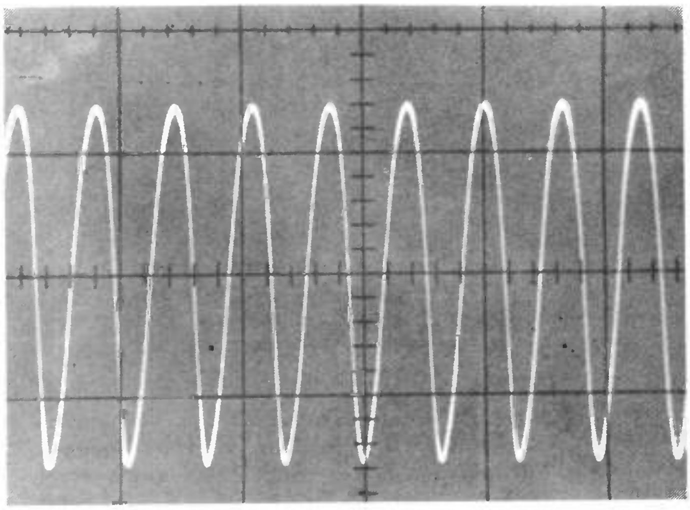


Photo 3: Oscillograph of VFO output. 100nsec/div in *x*; 0.2 volts/div in *y*.

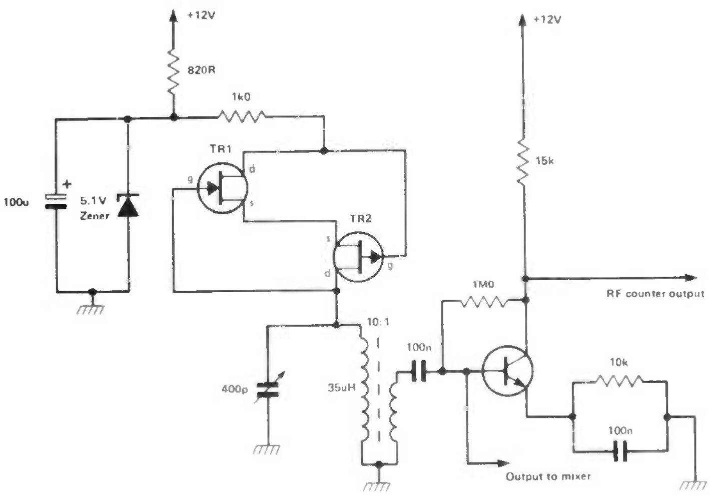


Figure 10: Lambda diode variable frequency oscillator. The range of frequencies produced by this circuit is 1.3–3.0MHz.

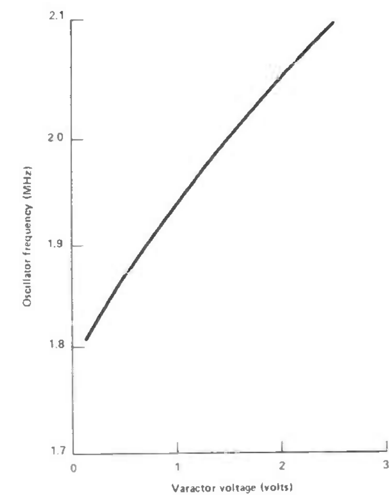


Figure 12: Voltage/frequency relation for a varactor controlled oscillator.

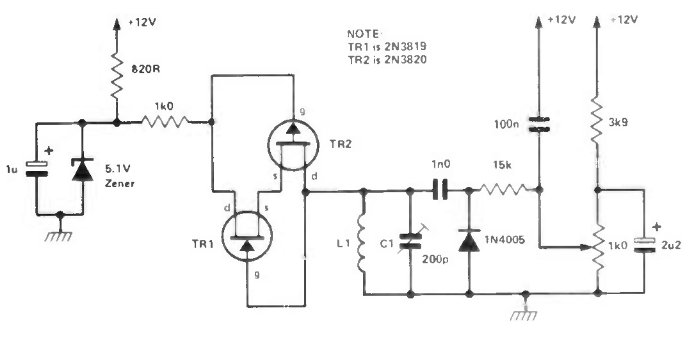


Figure 11: Varactor controlled oscillator incorporating a Lambda diode.

is a simple bistable circuit while the last two are oscillators, *Figure 11* showing an oscillator with voltage control of frequency performed by the varactor action of a reverse-biased rectifier diode. Stability is a feature of both: typical drift rates are under 100Hz per hour with a switch-on drift of (approximately) 200Hz.

In all these oscillator circuits, the amplitude of oscillation is high (±2V in the case of *Figure 10*). The amplitude of the sine wave is closely linked to the voltage of the supply, modulation of which allows a simple amplitude-modulated frequency source to be obtained. Because the peak current passed by the diode is only a few milliamps, Lambda diodes are ideal as frequency sources in battery powered equipment.

■ R&EW

A Guide to High Frequency Coils

Many types of coil feature in high frequency work, varying in shape, in structure and in application. This guide to HF coils draws closely on a summary of their structure and characteristics recently prepared by a leading manufacturer — TOKO

High and low frequency coils differ not only in their usable frequency range (though the boundary between them is not clearly defined) but also in their design concept. For example:

1) Low frequency coils (or transformers) are designed for 'ideal' conditions, i.e. few extraneous losses brought about by external factors: such conditions do not prevail in HF work.
2) High frequency coils are, in general, designed for use in tuned (resonant) circuits.
3) High frequency coils are, in general, equipped with means of adjustment.
4) High frequency coils are used at frequencies above 10kHz.
5) The upper inductance limit of high frequency coils is about 10mH.
6) High frequency coils are used in 'signal', rather than 'power', applications.

Another point to note is that high frequency coils are referred to in the market as coils, transformers or inductors, without any distinction being made. There seems to be no standardisation of dimensions or values, either locally or internationally, and this should be borne in mind while reading this article. Moreover, it should also be remembered that much of what follows applies to TOKO coils, most of which are small in size and are all primarily signal processing types.

Coil constants

The most instructive way of looking at any coil is from its two-terminal representation, the equivalent circuit for which is shown in two forms in *Figure 1*. The inductive component is the main element, but the inherent resistance (representing loss) and the distributed capacitance cannot be neglected.

The formulae involved in transforming between the two equivalent circuits are as follows:

$$R_{PL} = \frac{R_{SL}^2 + w^2 L_S^2}{R_{SL}} \; ; \; L_P = \frac{R_{SL}^2 + w^2 L_S^2}{w^2 L_S} \qquad (1)$$

with equivalent expressions for R_{PC} and C_P ($w = 2\pi f$). Putting $Q_L = wL_S/R_{SL}$ and $Q_C = 1/wC_S R_{SC}$, then:

$$R_{PL} = R_{SL}\,(1 + Q_L^2) \; ; \; L_P = L_S\,(1/Q_L^2 + 1) \qquad (2)$$

In general, $Q_L \gg 1$, therefore:

$$R_{PL} \simeq R_{SL}.Q_L^2 \; ; \; L_P \simeq L_S \qquad (3)$$

Similarly:

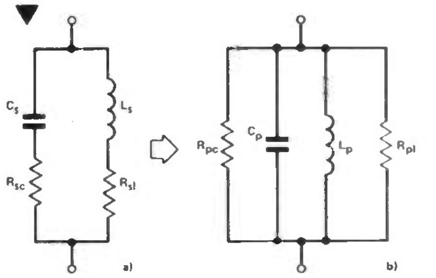
$$R_{PC} \simeq R_{SC}.Q_C^2 \; ; \; C_P \simeq C_S \qquad (4)$$

The equivalent circuit shown in *Figure 2* is derived from equations 3 and 4, with $L = L_p \simeq L_S$; $C = C_p \simeq C_S$; $1/R = (R_{PC} + R_{PL})/R_{PC}\,R_{PL}$. The latter are known as the three coil constants.

Note that the resistances (representing losses) in the inductance and the distributed capacitance have been treated separately when it is not possible to deduce the separate values of R_{PC} and R_{PL} from two-terminal information. In other words, one is forced to use their combined value. However, this is no real problem in circuit analysis as typically $R_{SC} = 0$ and $R_{PC} = \infty$ (infinity), and so the relation $R = R_P$ is generally used.

It is also interesting to note that the above analysis can be applied directly to a tuning circuit, through representing the tuning capacitance by C_S and the resistance of the tuning capacitor by R_{SC}.

Figure 1: Equivalent circuits for a coil (in the two-terminal representation). a) Series; b) Parallel.



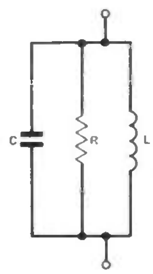


Figure 2: Equivalent circuit based on the coil constants.

The other factor to consider in connection with any coil is its 'quality', or figure of merit, $Q = R/wL$ (in the terminology of *Figure 2*) $= R_L/X_L$, where X_L is the inductive reactance of the coil. However, the appropriate value of Q in any situation will depend on the intended use of the coil: it is not correct to assess the applicability of a coil merely on the basis of Q alone. Instead, the Q value should be thought of simply as a loss factor and the quality of the coil should be assessed on the basis of the stability of the three constants to changes in its environment, such as heat, humidity, vibration and shock.

Coils as filters

A coil serves as the functional element in most filters, and filters can be classified into four forms. These are shown in *Figure 3*, the shaded areas representing the pass band(s).

Lowpass filters do not find many applications, except in multiplex stereo circuits, and the same can be said of highpass filters, especially in relation to radio and TV circuits. Bandpass filters, on the other hand, are most widely used in signal-selection circuits, such as those relating to antenna input, high frequency amplifiers and intermediate frequency transformers (IFTs) for AM and FM radios, and in picture and sound amplifiers. These devices are mainly single- or double-tuned filters, although triple- (or more) tuned types ('staggered tuning') are sometimes used. The band elimination filter, or trap coil circuit, is used in TV receiver circuits to suppress unwanted signal.

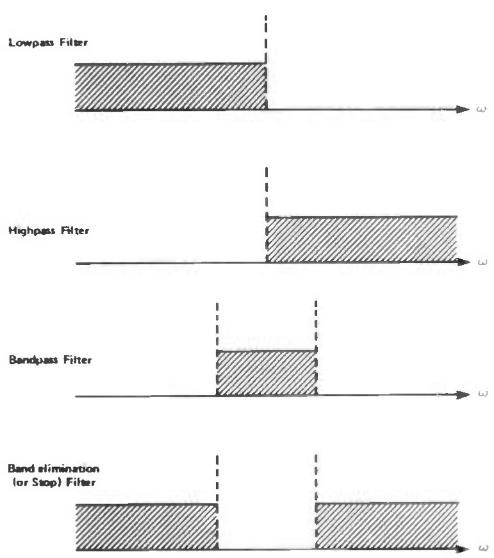


Figure 3: Classification of filters.

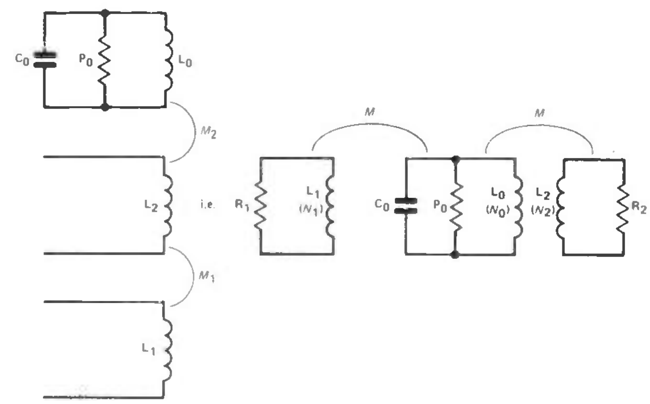


Figure 4: Equivalent circuit for a single-tuned band filter.

Single-tuned band filters

A single-tuned band filter, the equivalent circuit for which is shown in *Figure 4*, has windings for input, tuning and output. When the degree of coupling between L_0, L_1 and L_2 is unity – i.e. $M_1/L_1L_2 = M_2/L_2L_0 = 1$ – the equivalent circuit can be converted to the form shown in *Figure 5*. In fact this is true of most of the coils presently in use. The analysis of the latter circuit proceeds as follows.

The admittance Y is given by:

$$Y = G + jwC + \frac{1}{jwL} \tag{5}$$

$$= G\left[1 + j\left[\frac{wC}{G} - \frac{1}{GwL}\right]\right] \tag{6}$$

$$= \left[1 + j\left[\frac{w_0C}{G}\,\frac{w}{w_0} - \frac{1}{w_0LG}\,\frac{w_0}{w}\right]\right] \tag{7}$$

where $w_0 = 1/\sqrt{LC}$. Putting $w_0C/G = 1/w_0LG = Q$ and $F = w/w_0 - w_0/w$, we get:

$$Y = G\,(1+jFQ) = G\,(1+jx) \tag{8}$$

where $x = FQ$. And, if Y_0 represents the admittance at the tuned frequency w_0, we obtain:

$$Y/Y_0 = 1+jx \tag{9}$$

as $Y_0 = G$. This equation gives the ratio of the admittance at any frequency w to that at the tuned frequency w_0. Moreover, as the voltage $V = I/Y$ (where I is the current):

$$V/V_0 = 1/(1+jx) \tag{10}$$

where V_0 is the voltage at w_0.

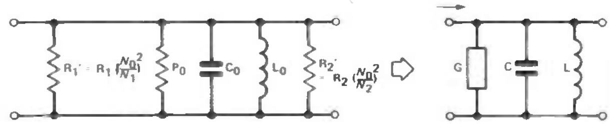


Figure 5: Equivalent circuit for a single-tuned band filter when the degree of coupling is unity. $L = L_0$; $C = C_0$; $G = 1/P_0 + 1/R_1 + 1/R_2$.

The latter equation is used to derive the coil's amplitude–frequency characteristic (shown in *Figure 6*), while the phase-angle–frequency characteristic (shown in *Figure 7*) is obtained from the relation $Q = \tan^{-1} x$.

A special case of particular interest is that when $x = 1$: putting $F = w/w_0 - w_0/w \approx 2\Delta f/w_0$ ($\Delta f = w - w_0$), the case $x = 1$ implies $Q = w_0/2\Delta f$ and $V/V_0 = 1/(1+j) = 1/\sqrt{2} = 3\text{dB}$. This relation between Q and the 3dB bandwidth is often used in connection with single-tuned band filters. Moreover, when $x = 1$, the phase angle is 45° ($\tan^{-1} 1$) and the real and imaginary parts of Y become equal. For these reasons, the $x = 1$ characteristic is often used.

Turning our consideration to losses in these filters, and putting $G_a = 1/R_1$, $G_L = 1/R_2$ and $G_u = 1/P_0$ in *Figure 5*, we see that the effective power from the source is:

$$P_{av} = I^2/4G_a \qquad (11)$$

and the power dissipated in the load is:

$$P_L = \left[\frac{IG_L}{G_a + G_u + G_L}\right]^2 \cdot \frac{1}{G_L} \qquad (12)$$

The power efficiency is thus:

$$\eta = \frac{P_L}{P_{av}} = \frac{4G_aG_L}{(G_a + G_u + G_L)^2} \qquad (13)$$

The Q at loaded condition is given by:

$$Q_L = \frac{w_0 C}{G_a + G_u + G_L} \qquad (14)$$

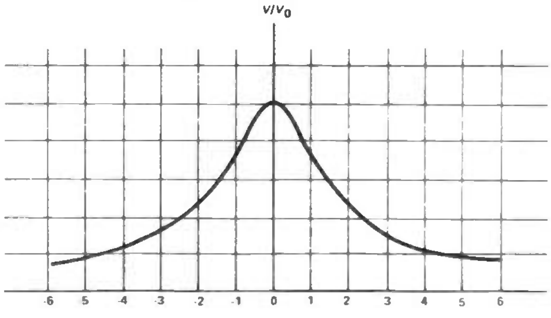


Figure 6: Amplitude–frequency characteristic for a single-tuned band filter.

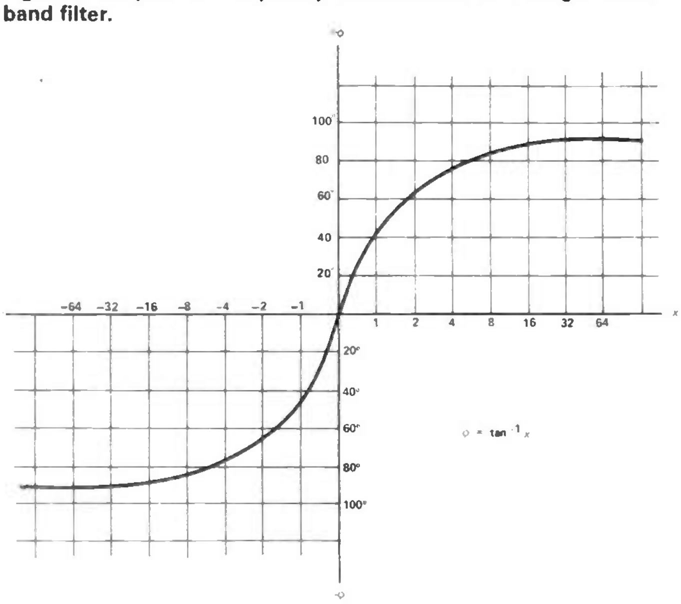


Figure 7: Phase angle–frequency characteristic for a single-tuned band filter.

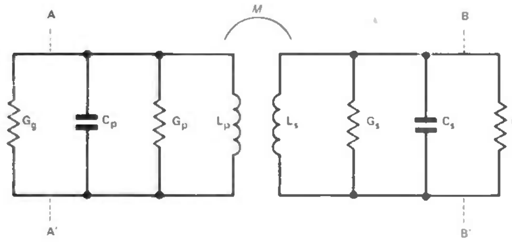


Figure 8: Equivalent circuit for a double-tuned band filter.

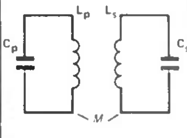
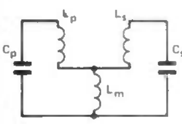
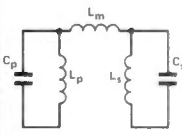
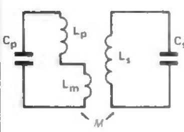
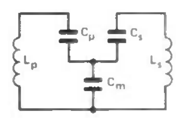
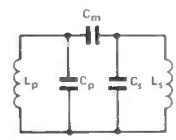
Type of Coupling	Method of coupling	Calculation of K
Indirect inductive		$K = \frac{M}{\sqrt{L_p L_s}}$
Inductive T		$K = \frac{L_m}{\sqrt{(L_p+L_m)(L_s+L_m)}}$
Inductive pi (π)		$K = \sqrt{\frac{L_p \cdot L_s}{(L_p+L_m)(L_s+L_m)}}$
Inductive L		$K = K_D\sqrt{\frac{L_m}{L_p+L_m}}$ ($K_D = \frac{M}{\sqrt{L_s+L_m}}$)
Capacitive T		$K = \sqrt{\frac{C_p C_s}{(C_p+C_m)(C_s+C_m)}}$
Capacitive pi (π)		$K = \frac{C_m}{\sqrt{(C_p+C_m)(C_s+C_m)}}$

Table 1: Coupling coefficient for different types of coupling between the primary and secondary tuned circuits.

while the Q at unloaded condition is:

$$Q_u = w_0 C/G_u \qquad (15)$$

Thus by letting:

$$a = \frac{Q_u}{Q_L} = \frac{G_a + G_u + G_L}{G_u} \qquad (16)$$

and substituting in equation 13, we have:

$$\eta = \frac{4G_aG_L}{(G_a + G_L)^2}\left[1 - \frac{1}{a}\right]^2 \qquad (17)$$

$$= \frac{4M}{(1 + M)^2}\left[1 - \frac{1}{a}\right]^2 \qquad (18)$$

where M is G_L/G_a – *NOT* the mutual inductance.

When $M = 1$, the value of the first term is unity and the coil is matched. This term is thus seen to reflect the degree of matching while the second term gives the loss resistance due to the coil itself.

Double-tuned band filters

The theory of double-tuned band filters, in which two tuned circuits are mutually coupled (see the equivalent circuit in *Figure 8*), is covered in many engineering textbooks. It is more appropriate here to look at their operation in a more simplified manner and to use graphs to show the response, impedance and phase characteristics. In what follows, the nomenclature S is used for $K\sqrt{Q_{L1}\,Q_{L2}} = Kq$ (where K represents the coupling coefficient between the primary and secondary tuned circuits) in order to simplify the discussion. Values of K for a number of configurations are given in *Table 1*.

If Z_i is the (input) impedance looking right from A–A′ and Z_o is the (output) impedance looking left from B–B′ then:

$$Z_i = m.{}^{1}\!/_{G_P}\ ;\ Z_o = m.{}^{1}\!/_{G_S} \qquad (19)$$

The value of m depends on the value of S and is shown in *Figure 10*. The points to note are that:

1) when $S=0$, $m = 1$ and Z_i and Z_o are equivalent to the reasonant impedance $1/G$ of the primary and secondary sides, respectively;
2) when $S = 1$, the amplitude has a flat-topped characteristic (see *Figure 9*) but Z_i and Z_o indicate double peak characteristics.
3) Z_i and Z_o exhibit a slight asymmetry with respect to the central frequency w_0.

The ratio of the power consumed in the load P_L to the effective power supplied by the source P_{av} is given by:

$$\frac{P_L}{P_{av}} = \left[1 - \frac{Q_{L1}}{Q_{U2}}\right]\left[1 - \frac{Q_{L2}}{Q_{U1}}\right]\frac{4S^2}{(1+S^2)^2}\;\frac{(1+S)^2}{(1+S^2)^2 - 2(S^2-b/2)(qF)^2 + (qF)^4} \qquad (20)$$

where $Q_{L1} = w_0\,C_p/(G_g+G_p)$; $Q_{u1} = w_oC_p/G_p$; $Q_{L2} = w_oC_S/(G_L + G_S)$; $Q_{u2} = w_oC_S/G_S$; $b = (Q_{L2}/Q_{L2})$; and $F = (w/w_o) - (w_o/w) \simeq 2\,\Delta f/w_o$.

When $Q_{L1} = Q_{L2}$, obviously $b = 2$ and equation 20 may be simplified. The result may be plotted as functions of S and qF, and this has been done in *Figure 9* which presents the amplitude–frequency characteristic in the form of the relation between qF and the power ratio.

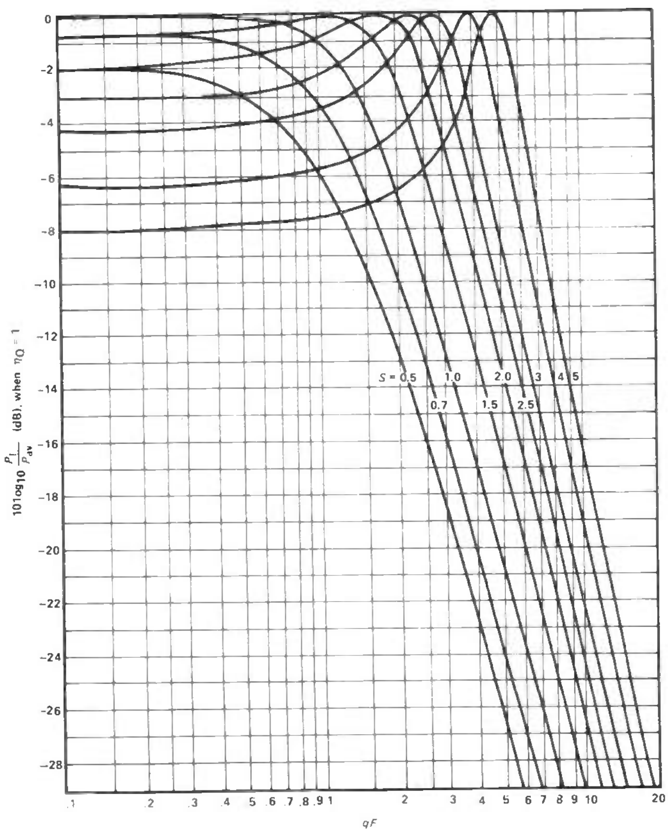


Figure 9: Relationship between *qF* and the power ratio.

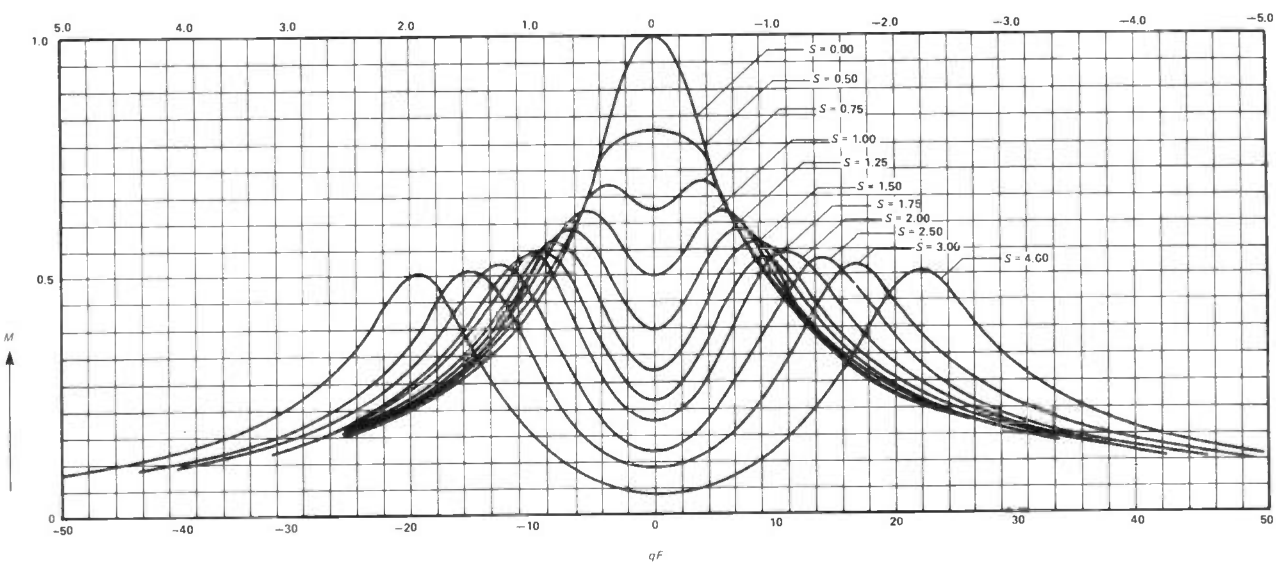


Figure 10: Relationship between *qF*,*m* and *S*.

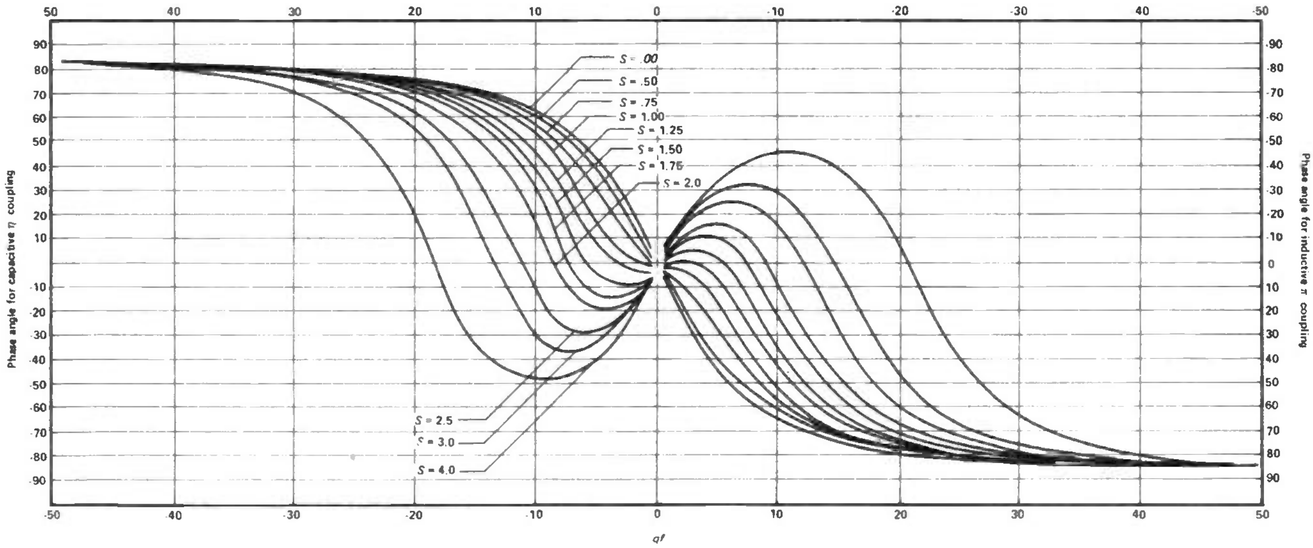


Figure 11: Relationship between *qF* and phase angle.

From the curves, it may be seen that:

$S<1$ corresponds to an undercoupled condition and a single peak.
$S=1$ corresponds to a critically coupled condition and a relatively flat curve.
$S<1$ corresponds to overcoupling and a double peak.

The losses in the coils are seen to have three possible sources. η_Q is used to represent those due to resistance in the coils, η_S for those related to the Kq product (S) and η_w for those due to detuning – and they are related to the first two terms, the third term and the fourth term of equation 20, respectively. The equations are:

$$\eta_Q = \left[1 - \frac{Q_{L1}}{Q_{u1}}\right]\left[\frac{1 - Q_{U2}}{Q_{u2}}\right] \quad (21)$$

$$\eta_S = \frac{4S^2}{(1+S^2)^2} \quad (22)$$

$$\eta_w = \frac{(1+S^2)}{(1+S)^2 - 2(S^2 - b/2)(qF)^2 + (qF)^4} \quad (23)$$

Note that equation 21 is equivalent to the second term of equation 18 and that the curves shown in *Figure 9* are for $\eta_Q = 1$.

The phase angle-frequency characteristic for these devices is illustrated in *Figure 11*.

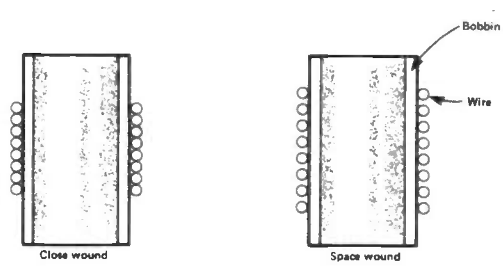


Figure 12: Single layer solenoids. a) Close wound; b) Space wound.

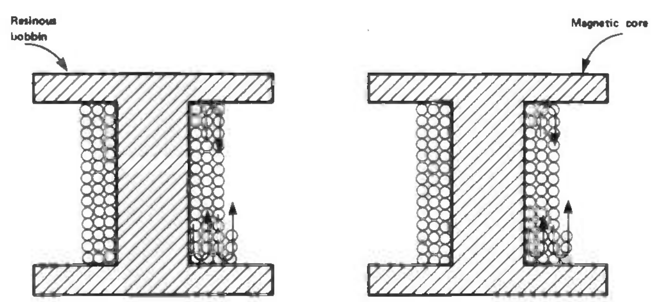


Figure 13: Multilayer solenoids. The arrows indicate the order of the turns.

Winding Structure

The characteristics of a coil largely depend on the type of winding employed. At present, several winding structures are used, including single layer solenoid, multilayer solenoid, single spiral, multispiral, 'honeycomb' (or universal) and bank wound. In all cases, it is important that the coils are wound neatly and with low distributed capacitance.

Single layer solenoid: Historically, this is one of the oldest forms — simple in structure and with an

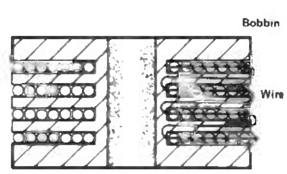


Figure 14: Multisection spiral coil. The arrows indicate the order of the turns.

inductance that can be calculated. There are essentially two types — close wound and space wound (see *Figure 12*). However the space factor is bad and so this type of winding is only used when a low inductance is required.

Multilayer solenoid: For a given inductance, this has a better space factor than its single layer counterpart and indeed the coil size can be quite small. This type of winding is to be found in low frequency transformers, choke coils, power transformers etc. However a certain amount of difficulty will be experienced when it is used for high frequency coils, especially if fine wire is required, because some slippage can be expected to occur which will have a detrimental effect on the orderliness of the winding.

In most of these coils, the bobbin is either spool shaped or it has flanges. The coupling coefficient is close to unity and the inductance is approximately proportional to the square of the number of turns in the winding. Some typical multilayer solenoids are shown in *Figure 13*.

Single section spiral winding: Once again there are two possible structures: in one the wire is wound into a flat helix and held in place either in a slot or between two insulating plates; in the other, the wire is wound on a special bobbin around which are special slots to accommodate the wire. The latter permits very neat winding and excellent performance is achieved: moreover, the same principle is used for multiple spiral windings.

Another version has the 'coil' printed on a flat plate by etching the latter. However the resulting 'wire' is flat, degrading Q, and the space factor is bad. Thus, this type does not seem to have much application.

Multisection spiral winding: In practice, the bobbin for this type of winding incorporates a number of narrow slots, which enable it to be wound very neatly and high coil performance is achieved. A typical coil of this type is shown in cross section in *Figure 14*.

'Honeycomb' or universal winding: This is a multilayer form *without* the shortcomings of multilayer solenoids. However, it has a greatly reduced winding efficiency (from the view of the time element) and so it is only really suited to applications in which the space factor and high inductance are important. Thus, this type is widely used in long-wave equipment (i.e. operating at relatively low radio frequencies) and in TV deflection circuits.

Bank winding: This is, in effect, a combination of the multilayer solenoid and the spiral type. Low distributed capacitance is a feature of bank winding but, on the other hand, the winding efficiency is even lower than that of the honeycomb type. This type of winding is typically employed in bar and rod antenna coils.

This guide continues next month with discussion of the magnetic core structures employed in high frequency coils, the materials used both for those and the windings, and a common method of measuring the characteristics of high frequency coils.

■ R&EW

DESIGNER'S UPDATE

Michael Graham looks at a new single-chip micro controller that is the first device of its type to be truly suitable for one-off applications

Regular readers of *R&EW* will be familiar with Zilog's Z8 micro controller and its associated hardware. Motorola's new 68705 series of devices has an appeal that will be immediately apparent to those of you that have been following the development of the Z8.

The first thing to note about the controller is that it is available at realistic prices in one-off quantities (look out for the basic devices at around the £20—£25 mark). There have been controllers available at this price for some time, though: what is it that makes the 68705 so different?

The difference lies in the fact that the hardware necessary to program the devices can be built for as little as £5. And the reason that the hardware is so cheap to implement lies in the programming approach adopted by Motorola. The idea is that software is developed and debugged in an industry standard EPROM and then copied into the equivalent area of the target 68705. Control of the copying process is undertaken by software that is part of the 68705's firmware.

Low cost and ease of programming are just two of the attractions of this series of devices. Another major plus point is that the instruction set of the micro controllers is very similar to that of the 6800. Anyone with experience of programming a 6800 — and there must be many such people — will have little difficulty in adapting to the 68705.

Many variants

The full range comprises over 17 different devices but, to provide some idea of their capabilities, we'll focus

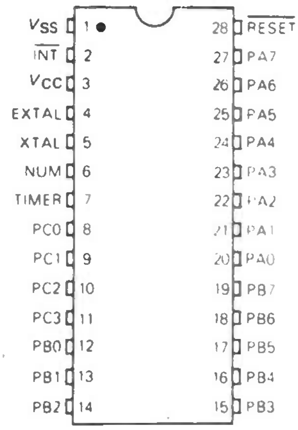


Figure 1: Pin assignments.

HARDWARE FEATURES

- 8-bit architecture
- 64 bytes of RAM
- Memory mapped I/O
- 1796-bytes of user ROM
- 20 TTL/CMOS compatible bidirectional I/O lines (8 lines of which are LED compatible)
- On-chip clock generator
- Self-check mode
- Zero crossing detection
- Master reset
- Complete development system support on EXORciser
- 5V single supply

SOFTWARE FEATURES

- Similar to M6800 family
- Byte efficient instruction set
- Easy to program
- True bit manipulation
- Bit test and branch instruction
- Versatile interrupt handling
- Versatile index register
- Powerful indexed addressing for tables
- Full set of conditional branches
- Memory usable as register/flags
- Single instruction memory examine/change
- 10 powerful addressing modes
- All addressing modes apply to ROM, RAM and I/O

USER SELECTABLE OPTIONS

- Internal 8-bit timer with selectable clock source (external timer input or internal machine clock)
- Timer prescaler option (7 bits 2^7)
- 8-bidirectional I/O lines with TTL or TTL/CMOS interface option
- Crystal or low-cost resistor oscillator option
- Low voltage inhibit option
- Vectored interrupts: timer, software and external

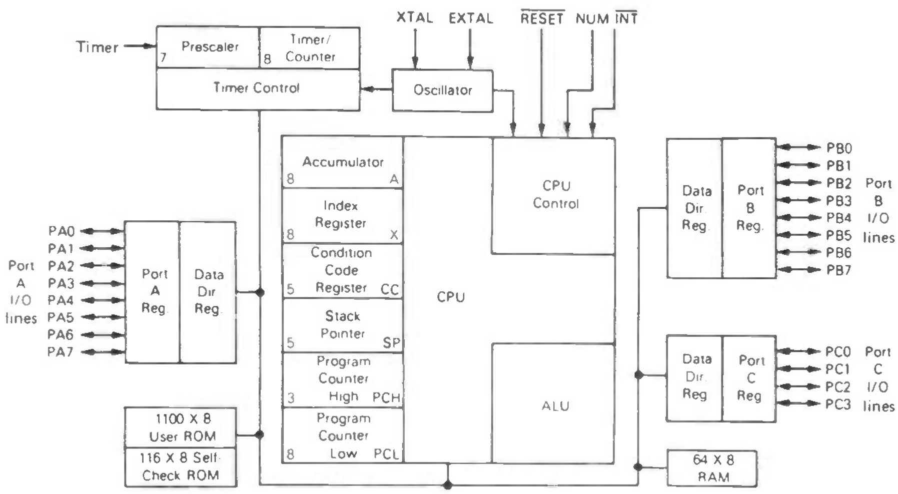


Figure 2: MC6805P2 HMOS microcomputer block diagram.

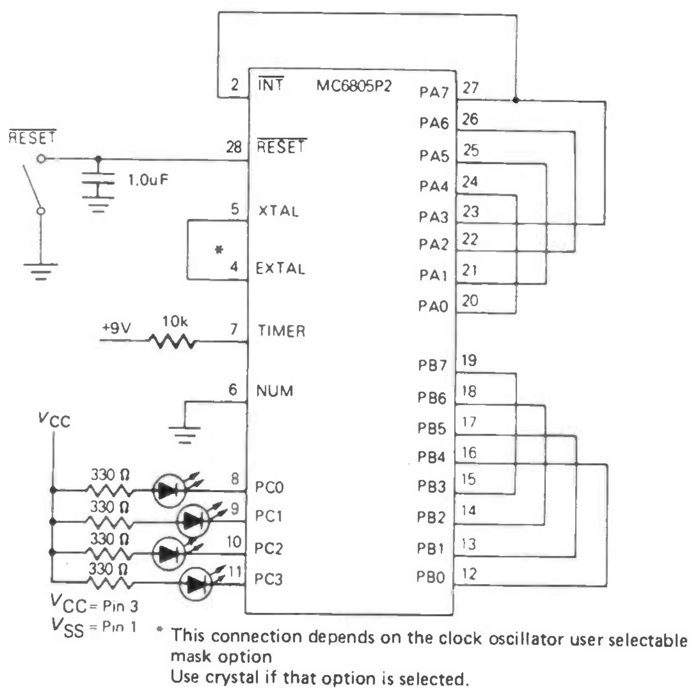


Figure 3: Self-check connections.

on one of the lower-cost 24-pin variants — the 6805P6. The list of the software and hardware highlights offered by the device given here shows some of the options that are selectable by the user, while *Figures 1 and 2* respectively show the pinout for the IC and the block diagram of the various control registers and memories provided by the chip.

From these diagrams it can be seen that the micro controller has been designed with its role in life very much in mind. Control devices often have limited amounts of memory available and thus the 68705 series has been designed for byte-efficient program storage. Attention has been paid to the addressing modes of the controller, including an indexed mode that makes it straightforward to incorporate conversion or jump tables within a program.

Add these features to the fact that the software is, by and large, that of the 6800 MPU and it is easy to realise just how attractive the MCU is in control applications.

The Hardware

In any application, very little in the way of external hardware is required: in addition the devices all have a very powerful built-in test function. *Figure 3* shows the test set up and,

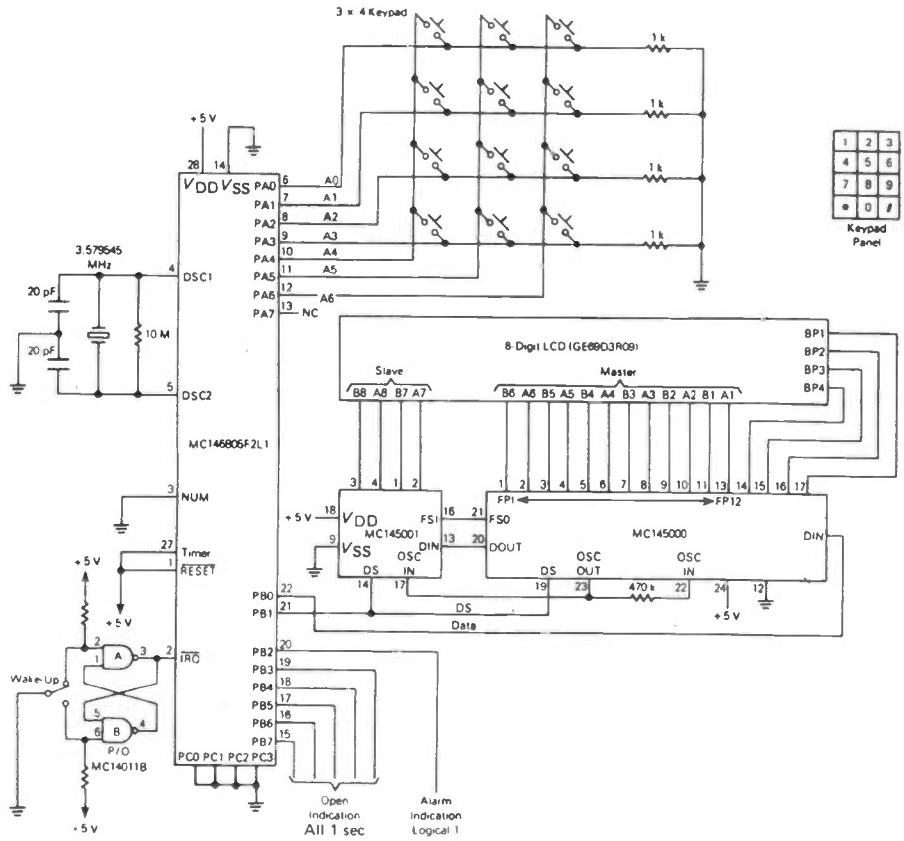


Figure 4: Digital lock system schematic diagram.

when used in this configuration, a healthy device will cycle port 3's bit 3 at a rate of 7Hz. Moreover, taking the timer input high will exercise all of the RAM, ROM, Interrupts and I/O.

In the space we have available here it is not possible to do justice to the many features of the 68705. If you would like to find out more about this series of devices, the best way to do so is to track down a copy of the user manual. This is published in the UK by Prentice-Hall. (For the record, the book's exact title is *M6805 HMOS M146805 Cmos Family.)*

Finally just a brief look at a circuit that demonstrates some of the power of the 68705 series. *Figure 4* shows the complete circuit diagram of a keyless lock. All the keyboard scanning and display drive is part of the 6805's firmware and Motorola has made a complete listing of these routines available so that users may easily adapt them to their own requirements.

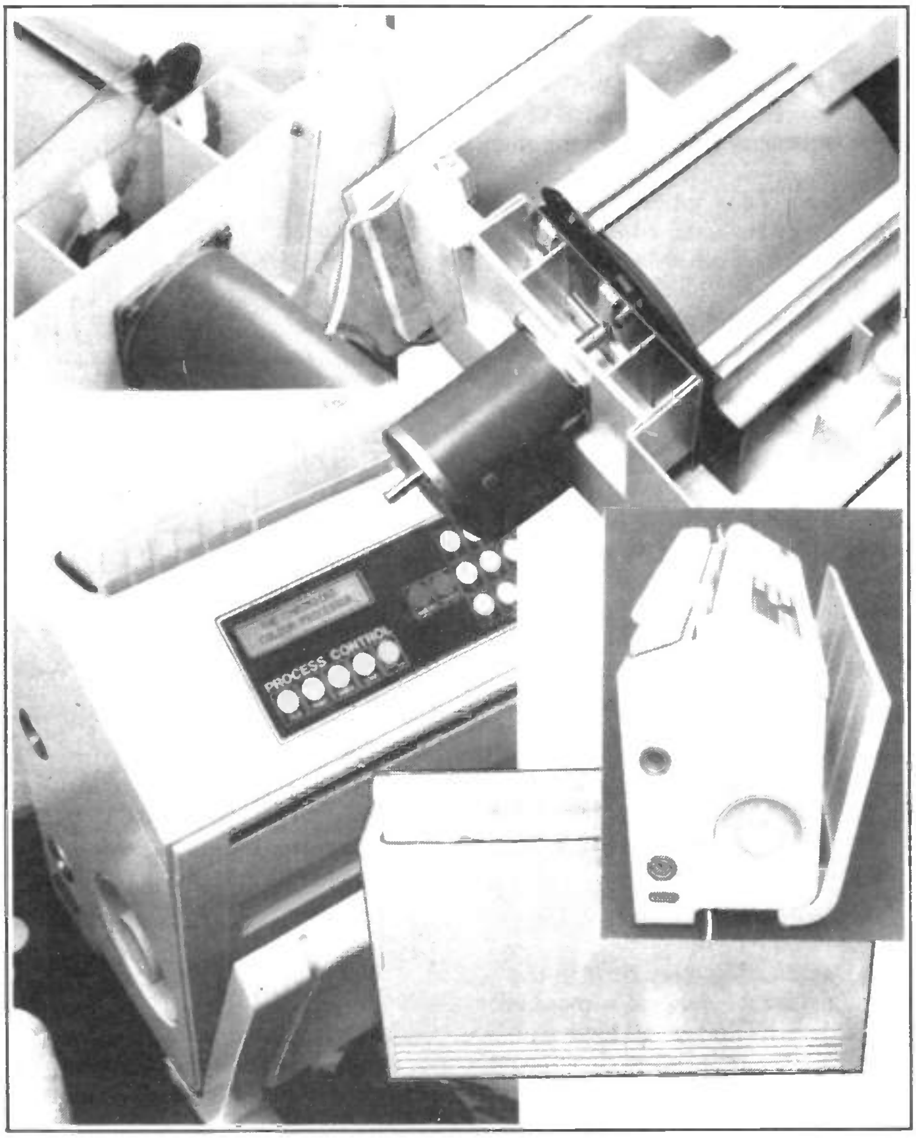
■ R&EW

THE CHROMICRO
A Colour Photographic Processor Controlled by a Z8.

About 18 months ago, when *R&EW* first brought out the Z8 development system, we offered to support anyone who had a good Z8 applications project. This is the story of one such project — how Bill Evans, a design engineering student doing a Master's degree at the Royal College of Art and Imperial College of Science and Technology, invented a new colour processor controlled by a Z8.

Before you design something you have to have a need to fulfil. My chosen problem was to try to come up with a newer, cheaper way of automating home colour photographic processing. Taking the pictures is fun, but as anybody who has endured the pleasures of sitting on the edge of the bath manoeuvring silly little tanks around in a bath full of tepid water and pouring lethal, highly corrosive chemicals into tiny funnels will know, colour processing is an ideal candidate for automation. Of course, there are big automatic machines around but they cost £3–4000 and are steam driven, usually under hardwired logic or electromechanical control. Through utilising more modern technology I hoped to come up with a cheaper but equally versatile machine for processing prints, slides and negatives — aimed at professional, semi-professional, or institutional users and, of course, the odd eccentric wealthy amateur.

The Z8 development system seemed ideal for this project, mostly because the Z8671 is a control oriented chip with up to 32 lines of I/O. Its TINY BASIC meant that an electronics illiterate like myself need not worry too much about machine code programming and the supporting minimum chip system was ideal for popping into the final model.



The birth of a prototype

Colour processing is quite simple in theory. In total darkness you load a fragile material — either prints (which are often as large as 10" × 8" but can easily be up to 20" × 16") or films (which are long and thin) — into a drum. You then apply highly corrosive chemicals and water to its surface at a precise temperature (around 30°C) for a precise time. Prints are usually developed in up to three chemicals plus wash but slides require four solutions in sequence. Prints may take 5–8 minutes; slides up to 35 minutes.

The system diagram displayed in *Figure 1* illustrates the complexity any automated system must have. Precise temperature and time control is easy with a microprocessor, but what about handling the material and applying these chemicals in sequence? Most of the design effort was thus placed in coming up with new ways of manipulating the materials which would make life easier for the user.

I started building prototypes to test new processing principles about a year ago. The first attempt (pictured in *Photo 1*) was rather complicated. It was constructed from converted pieces of photographic equipment, apart from a plastic garden hose spray attachment and a lot of sheet black plastic (polystyrene), simply cut with a Stanley knife and cemented together.

This prototype tested the rotating spray principle. A print was loaded into the tall vertical drum and a rotating spray head driven by a little permanent magnet DC motor fitted on top. The spray covered the print surface with the chemicals which were collected in the box-like sump underneath to be returned to the pump.

The prototype worked, but it was far too complicated. The spray head with its rotating seal and the pump would all be very costly to manufacture and, although the system would be easy to control, it would not be very flexible for the user as a different drum would be needed for different sized prints and films.

The next prototype (illustrated in *Photo 2*) was a rather radical overreaction to the first. This was a gravity fed device, as I was trying to produce something much more simple. The print was just sandwiched between two sheets of dimpled stainless steel and a small header tank fed the chemicals evenly across the surface of the print. This method was not at all a success — the prints were unevenly developed. This taught me that I needed some sort of compromise between the complexity of the first prototype and the simplicity of the second.

As yet none of these prototypes had much control equipment. It did not seem appropriate to waste time hooking up gear when my 10-bit digital control devices would

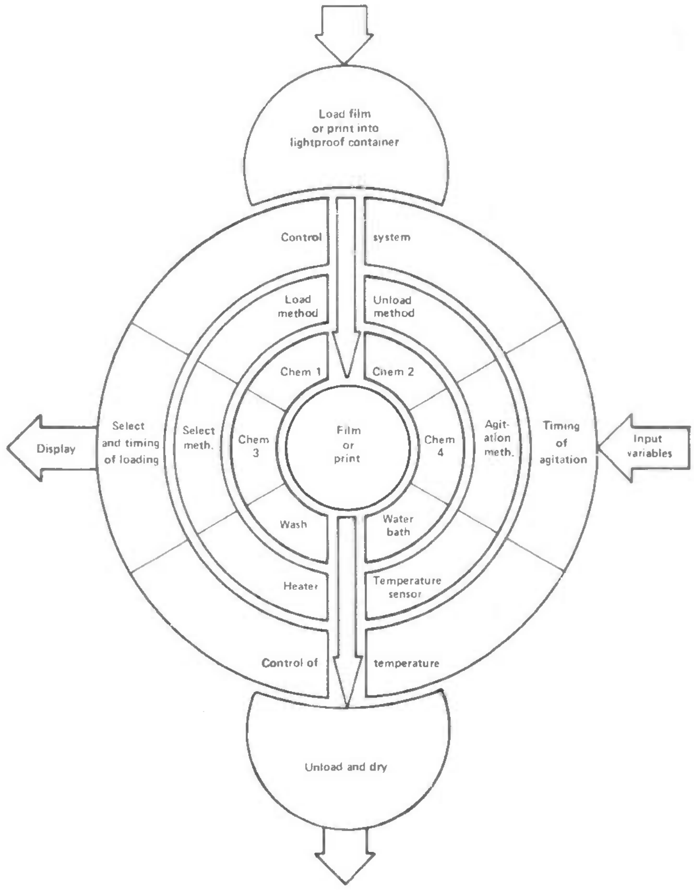


Figure 1: The system diagram.

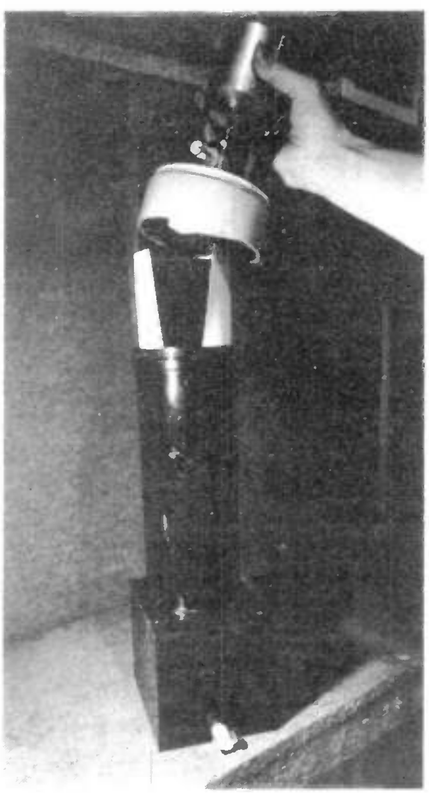


Photo 1: Loading the first prototype.

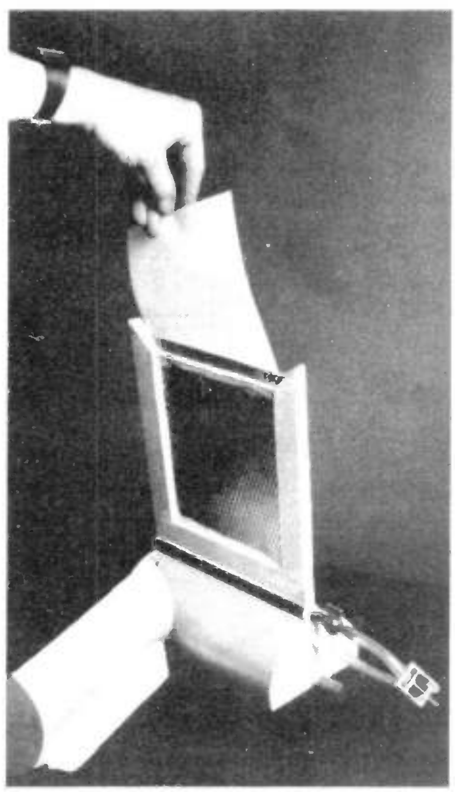


Photo 2: Loading the second — gravity fed — device.

suffice. However, this was not true of my final prototype.

For my third and final prototype, I learnt from my previous attempts and built a much more sophisticated and instrumented rig. In this, instead of trying to re-invent the wheel, as in my earlier attempts, I looked at automating a more traditional approach — the drum and trough principle.

Onset of sophistication

The photographs and diagrams of *Photo 3, Figures 2,3* show the basic washing machine principle. A plain drum, driven by a stepper motor, rotates in a light tight trough into which the processing chemicals are dropped by gravity and drain likewise through a solenoid operated stop cock. The prints are fixed to the surface of the drum, emulsion side out, and are dunked through the chemicals once each revolution. The stepper motor was chosen for its good high-torque low-speed characteristics, together with its facilities for variable speed and easy microprocessor interfacing. The water bath was temperature controlled by a combination of immersion heater and bimetallic thermostat.

The drum presented a 20″ × 24″ surface onto which any combination of print sizes could be fitted (e.g. six 10″ × 8″ or two 12″ × 16″ etc.). If I could come up with a flexible system for loading prints onto this drum and could take advantage of the processing power of a microprocessor, an easy to use, economic machine could be produced.

I came up with the idea of using a sort of carrier blanket under which the prints would be gripped. If I could find a porous material that would allow the chemicals to flow through onto the surface of the print, then I would have the basis of a new flexible system. One could envisage a production machine which had in effect a porous conveyor belt which would lightly pinch the print and take it through the trough of chemicals. This type of system would be impossible without the programmability of a microprocessor control system. The microprocessor could be made to look after formatting all the different size prints onto the surface of this conveyor, in particular ensuring that no overlaps occurred and that it was not overfilled.

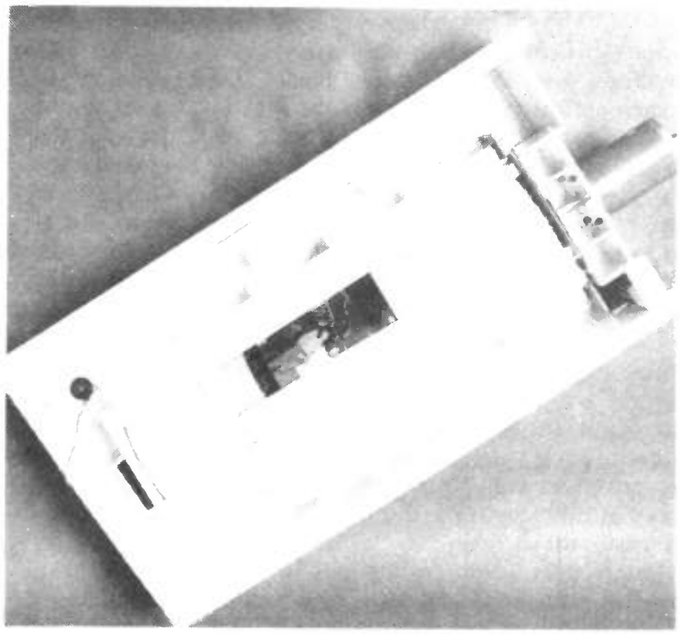


Photo 3: The third prototype.

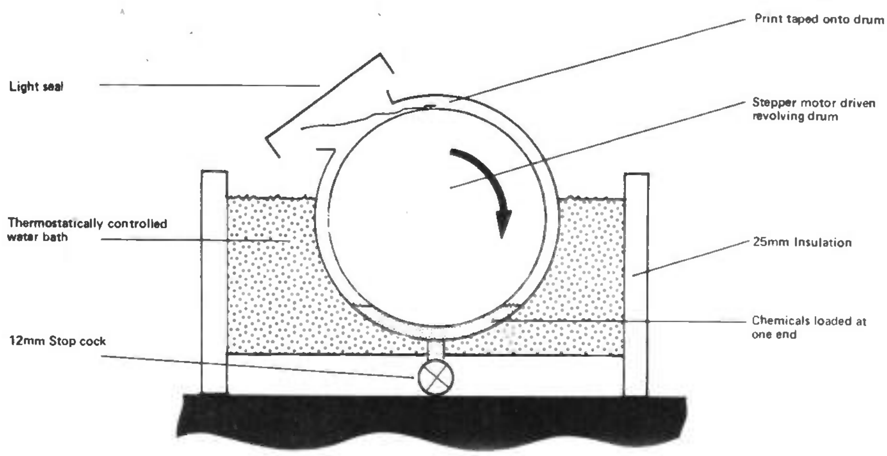


Figure 2: Side view of drum and trough.

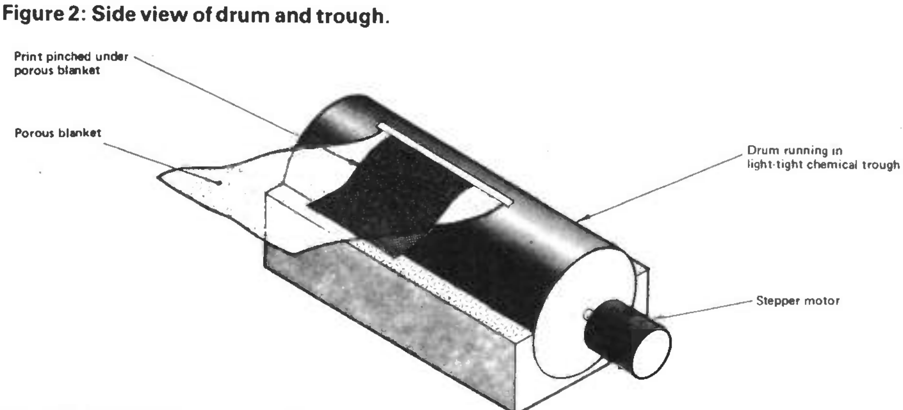


Figure 3: Blanket transport principle.

The tests on this prototype were very successful. I found two porous blanket materials which allowed the photochemicals through to develop the prints correctly. They were a special filter foam with open cells and a screen mesh, the latter being a polyester mesh used by the silk screen printing industry to control the flow of ink onto paper or cloth. I was now in a position to make up a model to show how such a photo processor would look and work if it went into proper production. Only some features of the model would work as there is a limit to what you can do in a year, even with the help of *R&EW*!

Design concept

The exploded view and photographs (*Figure 4, Photos 4–8*) show how the final product is intended to look. To run the machine, the user would first program it so that the

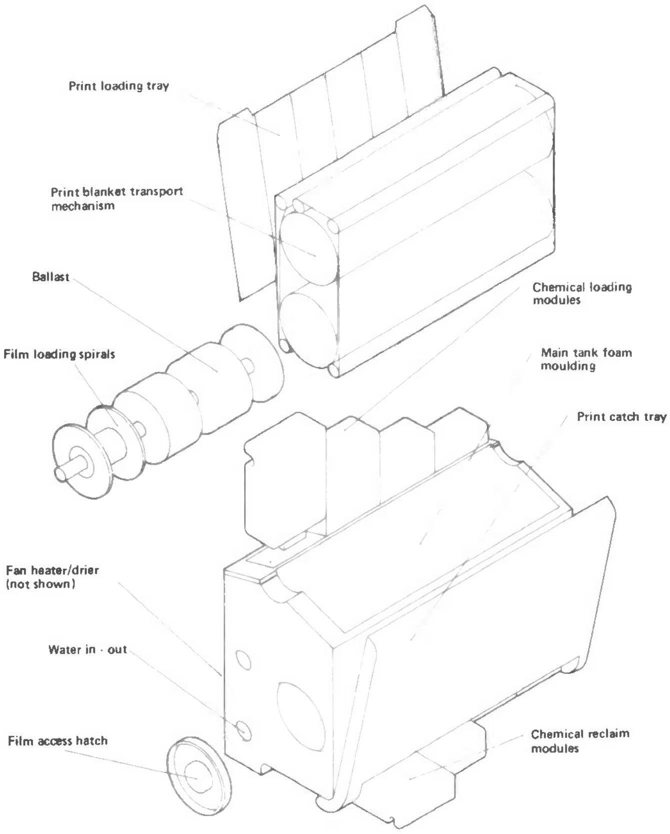


Figure 4: Component layout — exploded view.

microprocessor knew what chemicals to expect, the length and temperature of development and what size of prints were to be loaded. The prints would then be placed on the loading tray against their appropriate register. When the load button was pressed, the rollers and the blanket would pick up the leading edge of the print and start to suck it into the machine. The stepper motor in the upper roller would then 'step' the print in far enough to leave it in the correct position on the blanket to accept a second batch of prints. The cycle would then be repeated, the user being prompted by the liquid crystal display to load up the prints correctly until the machine was full.

The processing cycle begins with the prints rotating at about 40rpm, pinched lightly by the porous 'conveyor belt'. Once per revolution, the prints go through the trough and are immersed in chemical. The chemicals are dropped in by AC solenoid pinch valves, chosen because they are cheap and have no moving parts that could come in contact with the strong photochemicals. Pinch valves also allow the chemicals to drain, at the end of each development stage, into reclaim packs which are identical to the loading packs. At the end of the cycle, the stepper reverses and, by the simple principle of leading and trailing edges, the print exits past a hot air drier and into the front print catch tray.

Films would be processed in a similar way, except they would be loaded into conventional spirals. These would sit in the same trough, but a greater volume of chemical would be added to half immerse them. The same stepper motor would then agitite them backwards and forwards

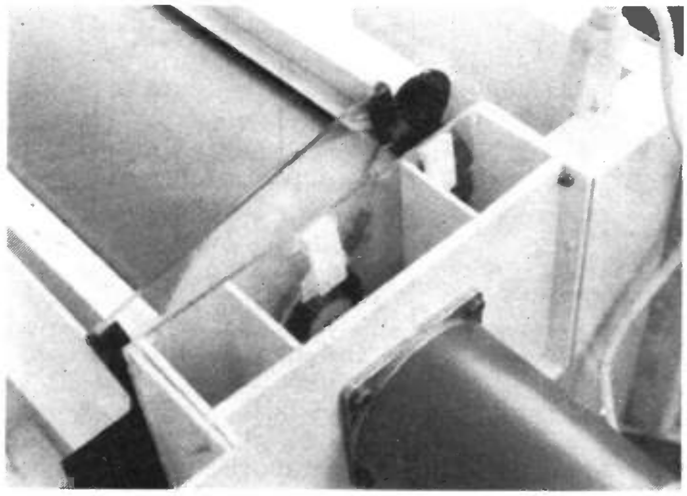


Photo 4: End view of third prototype, showing trough and stepper motor.

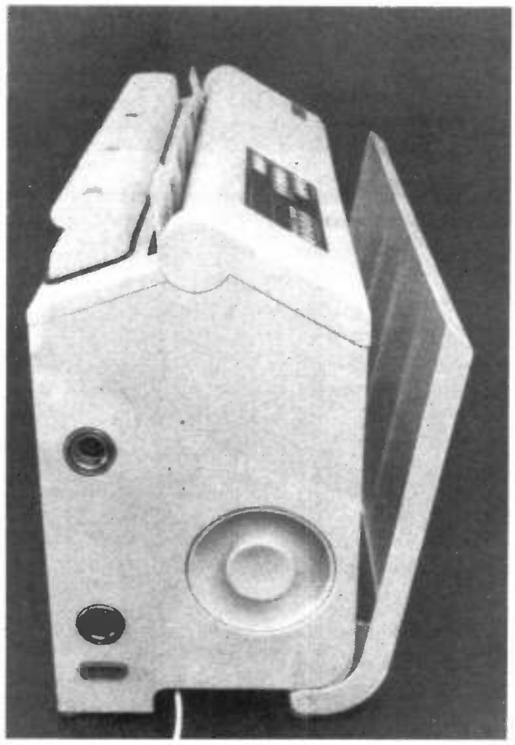


Photo 5: End view of third prototype, showing trough, stepper motor and immersion heater.

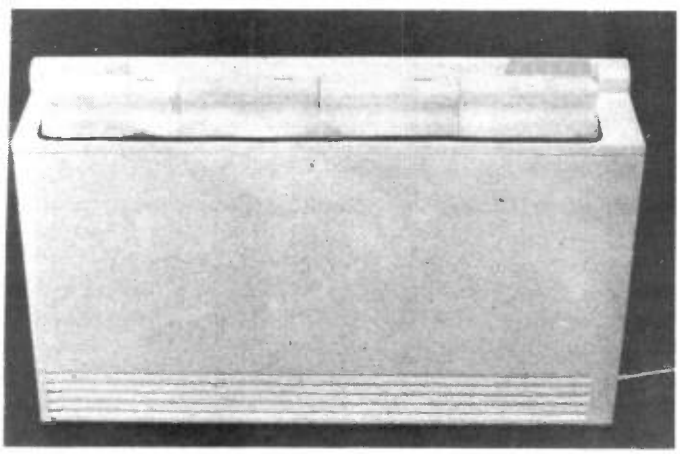


Photo 6: Rear view of processor, showing vents for the fan heater. ▶

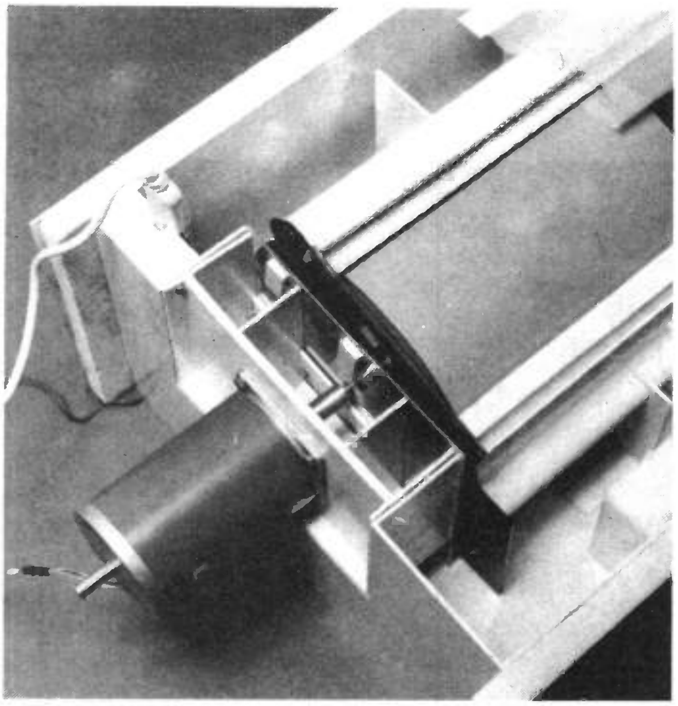


Photo 7: End view of processor, showing chemical pack above, film access hatch and print catch tray.

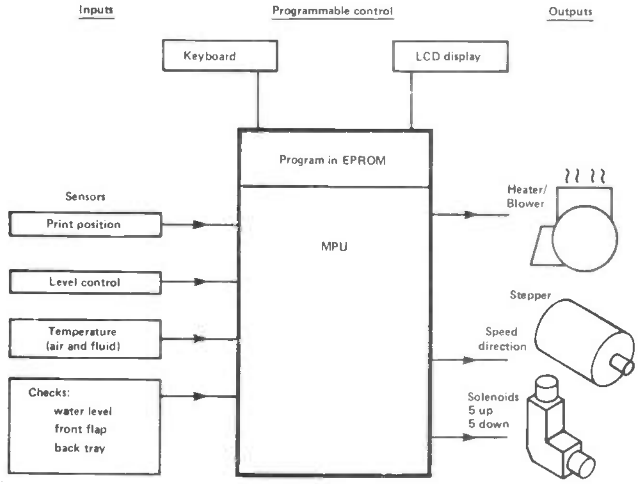


Figure 5: The control system.

until the cycle of chemicals and wash water were complete.

The machine is primarily designed to be easy to use. The chemically resistant keyboard and display are backlit for darkroom work and positioned for maximum clarity. The top and bottom chemical packs can be swapped over at the end of the cycle for a re-run with the microprocessor keeping track of the chemical utilisation and increasing development times as the chemicals become depleted. The compactness of the machine would make it easy to store, end up if required. The elimination of expensive lifting mechanisms, costly pumps and fiddly clips and frames to suit different print sizes all help to lower the final production costs.

The technology

Let us take a more detailed look at the electronic and mechanical interfaces that make the whole thing possible. This is summarised in *Figure 5* which is a schematic diagram of the control system.

Input: Once the operating conditions have been established, either as a set of unique times and temperatures or through following standard routines recalled from the computer's memory, data must be collected for the control software to act upon. These are provided by a range of sensors. For example: the signal from two adjacent mercury felt switches, AND-gated to an input port, is to be used to ensure that the machine is only operated when it is level to within $\pm 3°$. Another important train of information is that from the sensors which sample the air and chemical temperatures at approximately 0.5Hz. These sensors are to be encapsulated solid state devices to simplify their interfacing with the Z8. Other inputs include those from microswitches that monitor the correct positioning of chemical packs, print racks and wash water levels.

One input of particular interest is that from a simple IR phototransistor detector on the drier side of the exit rollers. This is used in the feedback mechanism that controls the blanket speed during the print eject part of

Photo 8: The production model.

the cycle. In the commercial systems I mentioned earlier, blanket transport is usually under open loop control. This is adequate for loading and agitation but reliance on open loop stepper control at the start of the drier sequence could lead to problems: hence the use of feedback to detect exact print positions.

Output: As *Figure 5* suggests, the outputs are to the stepper motor, to the drier/heater fan and heating elements, and to the solenoid pinch valves which, as I outlined earlier, are used to select the chemicals.

The stepper will be controlled by software through pulses giving direction of rotation and speed, while a hardwired logic stepper motor interface will be incorporated to free the microprocessor from the task of switching the different phases of the motor. In terms of the actual devices to be used, the Sprague UCN 4202A stepper motor translator/driver is reckoned to meet the requirements — though, in fact, an earlier prototype used an Astrosyn 001 drive card, which is more expensive but will look after the acceleration ramps without demanding special software.

The drier does not require such sophisticated control as its size and performance can be accurately matched to the machine, the insulation and the operating temperature range. Two levels of heat are required and two levels of fan speed, both of which could be selected by switching in and out either multiple arrays of heater wires or different windings of the motor. Such arrangements and the sampling rate of 0.5Hz are adequate because the temperature control is only critical to ±5°C for drying and ±0.25°C for development. Other advantages of this method are that:

1) Cheaper AC fan motors with multiple windings may be used, obviating the need for costly DC pulse width modulation (PWM) control systems.

2) Cheaper, simpler gates may be used, with the minimum of logic external to the microprocessor, because the current is either fully ON or fully OFF over a relatively long time span (1 sec).

The system

The diagram in *Figure 6* shows in a simplistic way how the software of the control system would function.

The microprocessor looks first at the level switches and will not go on to ask the user for processing information until the machine has been correctly levelled. The user then inputs process data, prompted by the microprocessor (see *Figure 7*). Timers, internal to the microprocessor, look after the sequence of chemicals, whilst subroutines under interrupt control check the temperature and compensate as necessary. The correct blanket speed to suit the material being processed is determined by the pulse frequency to the stepper. After wet processing is complete, the software reverses the direction of rotation of the blanket and looks for the photodetector sensing a print. The drier subroutine ensures the correct air temperature and print speed for the material being processed.

During the last part of the drying cycle, the microprocessor looks at the machine temperature and will start a fan blowing cold air over the machine to lower

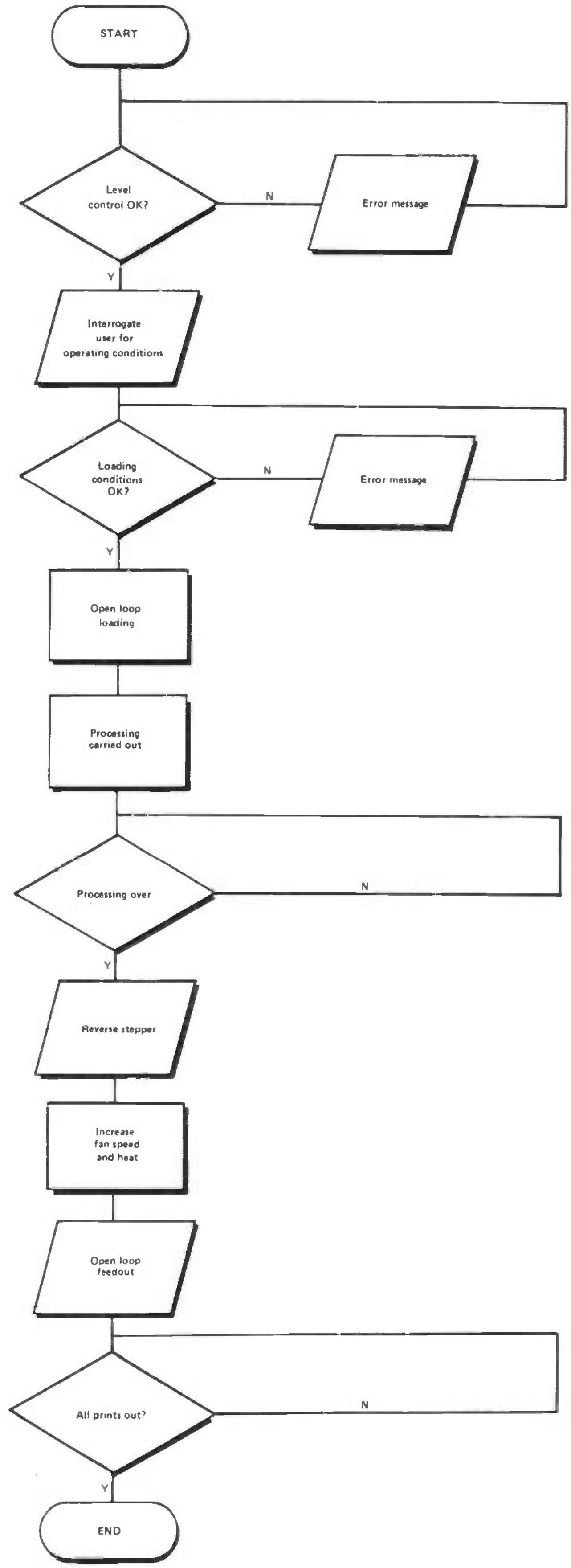


Figure 6: System flow diagram.

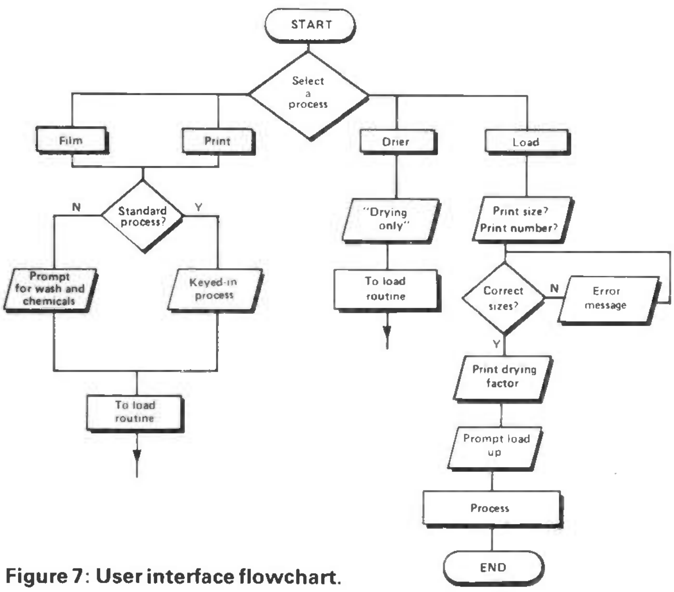


Figure 7: User interface flowchart.

it to nearer the normal development temperature range. This is to prepare the machine for immediate re-use if desired.

The user interface

Practical considerations carried a great deal of weight in the design of this interface. A membrane type keyboard was chosen because its polycarbonate overlay shows a high degree of chemical resistance and because this eased the task of making the assembly waterproof. It was also decided that feedback to the operator would be in two parts: firstly, through a tactile and audible click on the switches and secondly through an LCD display. All of these facilities would be backlit in the appropriate safelight colours. The keyboard–microprocessor–LCD interface shown schematically in *Figure 8* was realised on the production version block model.

It was decided to decode the 21-switch keyboard into serial ASCII data to ease the microprocessor interfacing requirements. A serial keyboard decoder was used for this. The particular device I used has since been made obsolete and I cannot track down a single chip package which does the same job. I would now use an ordinary ASCII keyboard encoder and a universal asynchronous receiver/transmitter (UART) to convert the eight parallel bits to serial to feed into the Z8 via P_{30}. Data from the keyboard is then acted upon by the microprocessor which outputs programming and process information to the 20×2 (20 characters × 2 lines) LCD module. The interface for the module is very simple, because the $\overline{WR}$ (*write*) and $\overline{RDY}$ (*ready*) timing conditions are met by the Z8 handshake on P_{31} ($\overline{DAV2}$, *data available*) and P_{36} ($\overline{RDY2}$).

The output of text to the parallel port of the microprocessor is achieved by software. This requires a machine code routine to change the output of the TINY BASIC print command from the microprocessor serial output port (P_{37}) to the 8-bit parallel port (P_2). The source code prior to assembly is listed in *Figure 9* for the Z8-TBDS.

The version for the minimum chip system actually in the model is considerably shorter as there is no need to look for the ESCAPE character or send the PRINT command to the serial port as well. This routine could also be used to put a parallel printer onto the Z8-TBDS as any PRINT or LIST command would be sent to P_2 as well as to the serial port.

The LCD, an EPSON EA-Y20025AZ, did require a clock in the range 500kHz to 2MHz to enable it. The system clock of the Z8 (4MHz with an 8MHz crystal) can be placed onto P_{36} which is unfortunately one of the handshake lines. So a simple CMOS ocsillator (shown in *Figure 10*) was built using three gates of a Quad NAND Schmitt trigger (4093B), three gates being the minimum number to use to get a cleanish square wave out.

The block model pictured here (*Photo 8*) has a live keyboard and display to demonstrate how the system would look to a user. The software, which is written in TINY BASIC, goes through a routine set of questions or displays the standard processes available.

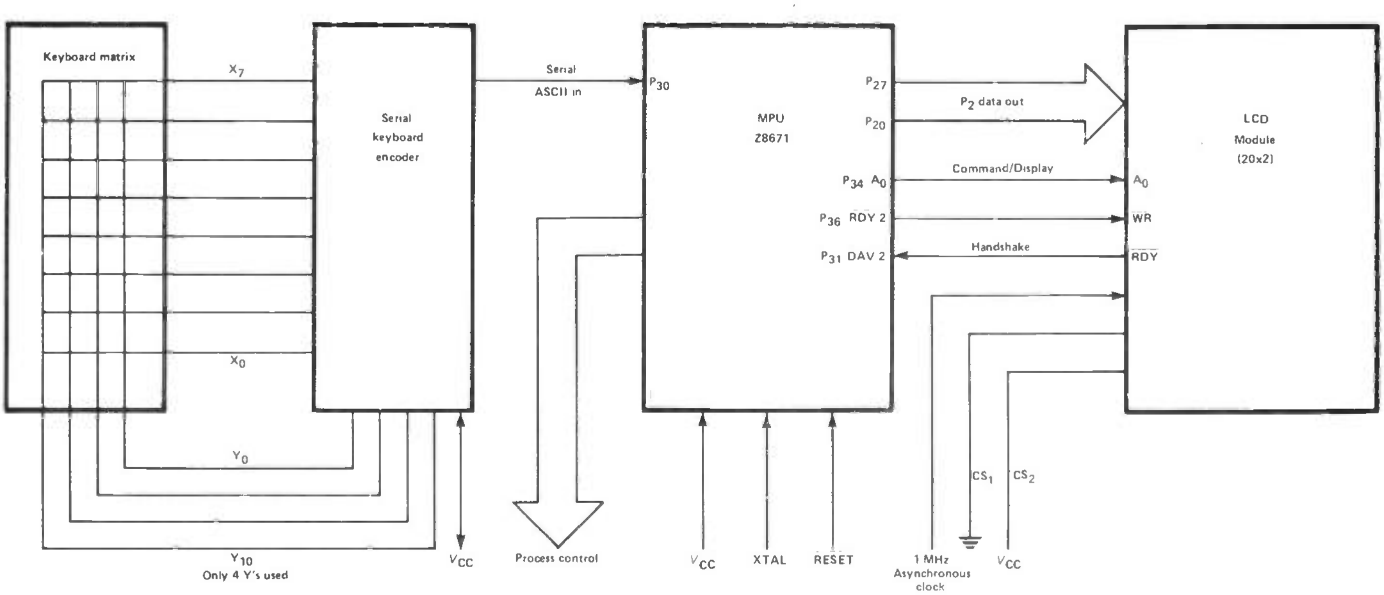


Figure 8: Block circuit diagram of keyboard, Z8 and LCD interface.

```
1F80                    ORG     %1F80
1F80 70FD       INIT    PUSH    RP                      ;SAVE REGISTER POINTER
1F82 3120               SRP     £32
1F84 1C06               LD      R1,     £6              ;BYTE COUNTER
1F86 2C10               LD      R2,     £%10
1F88 3C12               LD      R3,     £%12            ;1012H NOW IN R2,R3
1F8A 4C8D               LD      R4,     £%8D
1F8C B0E5               CLR     R5                      ;JP 005AH IN R4-R6
1F8E 6C5A               LD      R6,     £%5A
1F90 7C8D               LD      R7,     £%8D
1F92 8C1F               LD      R8,     £HI PRINT       ;JP PRINT IN R7-R9
1F94 9CAA               LD      R9,     £LO PRINT
1F96 AC24               LD      R10,    £36             ;R10 POINTS TO RR2
1F98 D3A2       COPY    LDCI    @RR2,   @R10            ;COPY R4-R9 TO MEMORY
1F9A 1AFC               DJNZ    R1,     COPY            ;  POINTED TO BY RR2
1F9C 50FD               POP     RP
1F9E B0F6               CLR     P2M                     ;PORT 2 TO ALL OUTPUTS
1FA0 B003               CLR     3                       ;RESET CONTROL BITS
1FA2 E6F761             LD      P3M,    £%61            ;SET UP PORTS 2 & 3

                *       ENABLE EXTERNAL I/O DRIVERS

1FA5 8F                 DI
1FA6 E6FB08             LD      IMR,    £8
1FA9 AF                 RET

                *       ROUTINE USED BY BASIC TO PRINT ON LCD DISPLAY. RELOCATABLE.

1FAA 56FCFE     PRINT   AND     FLAGS,  £%FE            ;RESET ESCAPE FLAG
1FAD E41302             LD      2,      19              ;TRANSFER DATA
1FB0 E4F010             LD      16,     SIO             ;GET SERIAL INPUT
1FB3 56107F             AND     16,     £%7F            ;STRIP PARITY
1FB6 A6101B             CP      16,     £%1B            ;ESCAPE CODE ?
1FB9 EB03               JR      NZ,     DONE            ;IF NOT JUMP
1FBB 46FC01             OR      FLAGS,  £1              ;SET ESCAPE FLAG
1FBE 8D006C     DONE    JP      %006C                   ;RETURN TO BASIC

                *       DISABLE EXTERNAL I/O DRIVERS

1FC1 8F         DISABLE DI
1FC2 E6FB80             LD      IMR,    £%80
1FC5 AF                 RET

1FC6
```

Figure 9: Source code for Z8-TBDS

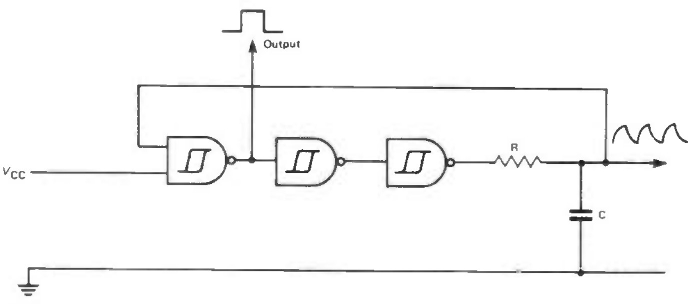


Figure 10: Quad NAND Schmitt trigger oscillator used as the clock source for the LCD module.

Towards production

Since finishing this project some interest has been shown in the product by photographic equipment manufacturers. They are most interested in the user convenience and the programmability of the machine. One of the problems of automatic photo-processors is that the market is relatively small, so production volume is low. Fifty machines a year would be good business for one small company and this is precisely where the Z8 comes into its own as a development device. The ease of transferring the programme from the Z8-TBDS to the low cost Z8- MCS (£30ish in these volumes) make it a practical proposition on a relatively small scale. The on-chip TINY BASIC also proved very useful as the program for this processor would include a fair amount of text manipulation which is easy in BASIC. The other control functions could be carried out in machine code. The TINY BASIC makes jumping back and forth between machine code subroutines and BASIC very simple — using the GO @ (memory location) or USR functions. Another reason why I am a Z8 convert is that, should the demand for such a product pick up, the chip is designed for easy transfer to the 'mask programmed' state suitable for higher volume production.

The type of keyboard used is also viable in low production volumes. The prototype board was made for me by Thorn-EMI Panelgraphic and they talk in terms of approximately £1 per key all inclusive for a 20–30 key board in volumes as low as 25 per annum.

What is more, what started life as a Z8 applications project for *R&EW* may end up in your shops — you never know!

Acknowledgment

As a footnote to this project I would like to thank Chris Honey at *R&EW* for the software support and for writing the machine code routine shown here, and Jonathan Burchell for his moral, technical and financial support throughout this project.

■ R&EW

One Night's Work

Two approaches to toneburst developed by Stephen Ibbs from our series of designs that can be built and tested all in one evening.

Amateurs who, like me, enjoy modifying old rigs, rather than buying black boxes, invariably at some time need a toneburst circuit, and many designs are now available, ranging from simple manually-timed R C oscillators to automatic, crystal controlled IC designs. Two alternative ideas are presented here, both generating the desired 1750Hz and both involving a device being used in an unusual way.

1) **Manually timed:** The LM3909 is a well known IC, designed to be a very low power 'battery-on' indicator. However, by using the circuit in *Figure 1*, it can be made to act as an audio oscillator, the frequency of which is adjustable via RV1. The problem with this IC is that it likes to operate at 1.5V – not your normal rig supply voltage! – so some sort of cheap regulation is needed. It is perhaps not well known that an LED will drop approx 1.5V across it when lit. So all we need is a suitable current limit resistor (R2) to prevent the LED from blowing up and we have, not only our regulator, but also a visual indication that power is being applied to the toneburst circuit.

2) **Automatically timed:** The standard automatic toneburst circuit is a 7.168MHz crystal feeding either a 4020 or 4060 ripple binary counter. But these crystals are expensive (about £2.50), so this design (*Figure 2*) uses a 455kHz resonator (approx 45p). The transistor oscillator circuit with the specified capacitors should pull the frequency down to 448kHz (which is 1750Hz × 256). This signal is fed into the 4020 where it is divided by 256, with the output being taken from pin 13. C5 and R3 provide the timing network (with a time constant of approx 0.5sec) and RV1 controls the deviation level.

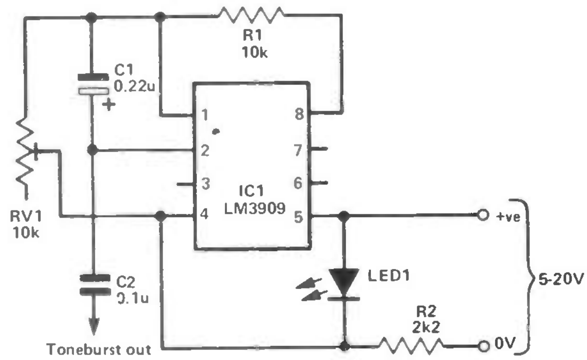


Figure 1: Manually timed toneburst circuit.

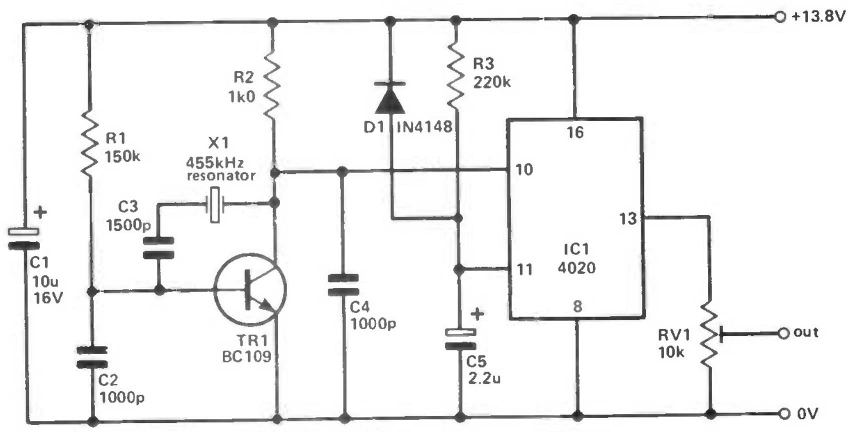


Figure 2: Automatically timed toneburst circuit.

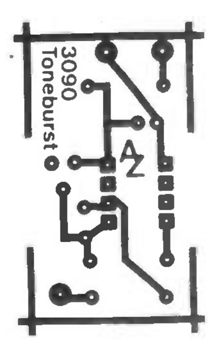


Figure 3: PCB for LM3909-based toneburst.

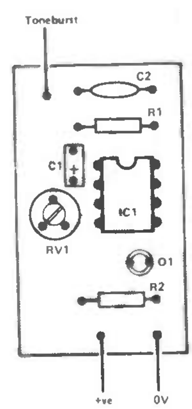
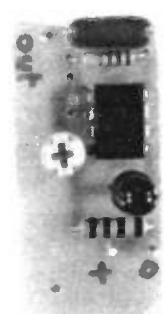
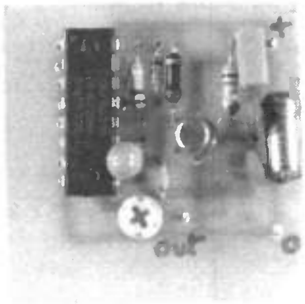


Figure 4: Component overlay for LM3909-based toneburst.





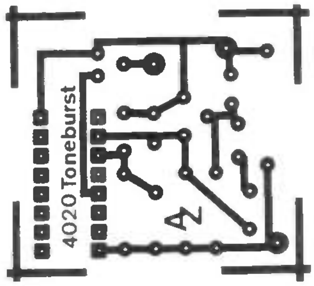


Figure 5: PCB for 4020-based toneburst.

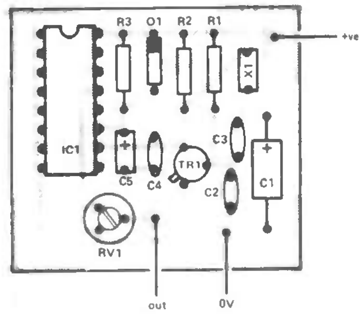


Figure 6: Component overlay for 4020-based toneburst.

Construction

While veroboard can be used with care, PCBs are easier and designs for these are given in *Figures 3–6*. When mounting the components, check that they are the correct way round! After inspecting for solder splashes etc, switch on and check that 1750Hz comes out of the outputs. Depending on the rig, a resistor may be needed in the 3909 output to reduce the level.

A 4060 has most of the oscillator built into it, but it was without much enthusiasm that I tried putting this ripple counter into the circuit because I thought the *Q* would not be sufficient for the internal oscillator to work... but it did, and it consequently produces a simpler circuit. However the combined cost is probably still more than that of the 4020 circuit described here; moreover the 4020 is more common. (A circuit for a toneburst generator that does use the 4060 is, in fact, included in the article on PF70 conversion on page 64.)

Acknowledgement

My thanks to Mike G6JKF and Hugh G85XL for their help.

■ R&EW

Timeplex — for tomorrow's video

We present details of a proposed system for encoding video signals that would be independent of the transmission standard. It was demonstrated to the public in Japan on 12th July 1983 by Thomson-Brandt, a firm specialising in consumer R&D.

Video recorders suffer from jitter and frequency drift, while the recordings themselves are often marred by dropout and time base errors. Thus the advent of a system for encoding video signals of whatever type that can also compensate for all such errors upon decoding is welcome indeed. The Timeplex System for recording onto and playback from a 8mm video recorder that has been developed by Thomson-Brandt is said to do precisely that.

Its secret

The Timplex System operates by compressing digitally the colour difference signals within the video signal with respect to the time base and transmitting the resulting data sequentially during the horizontal blanking period that coincides with flyback between screen lines. Such processing naturally draws on RAM control, as does the decoding part of the operation — particularly that involved in compensating for dropout. The kind of processing involved is indicated by *Figures 1 and 2* which

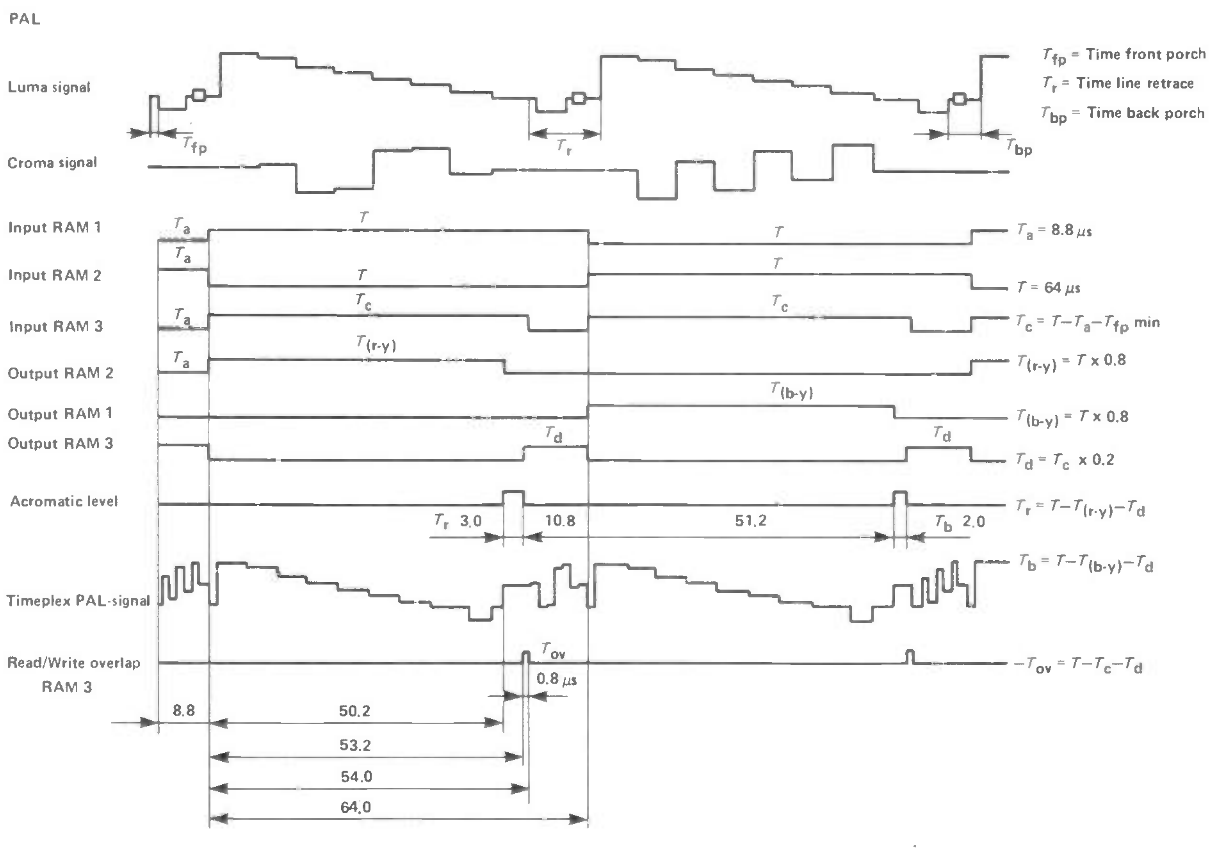


Figure 1: Detailed pulse diagram of Timeplex TV-multistandard — PAL I

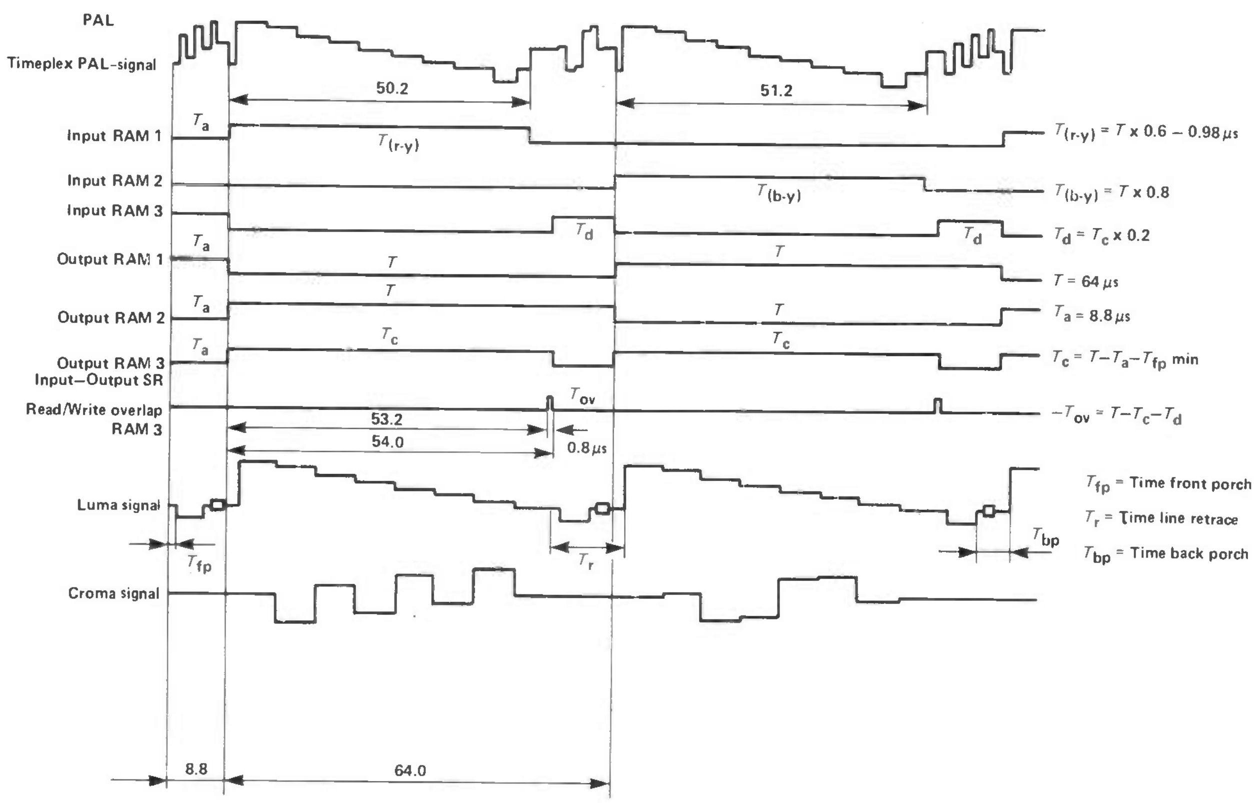


Figure 2: Detailed pulse diagram of Timeplex TV-multistandard — PAL II

show typical luma and croma signals within the PAL I and II colour systems, respectively, and their relation to the various RAM inputs and outputs and to the final Timeplex PAL signal.

It will be observed that Timeplex draws directly on the base band signals — the ones that carry the essential picture information — and it is believed to be the first system to take this approach. In doing so, it immediately becomes very attractive for recording straight from camera, as Timeplex operates directly on the signals generated by the camera.

But perhaps the most attractive feature of the Timeplex System is the way it is totally independent of the local TV standard and so should find application all around the world. This is a result of the way the internal timing is referred to the horizontal line frequency of the input with the aid of a phase locked loop. It means that any frequency shift is automatically followed and thus it is of no matter whether the signal to be reproduced is 50 or 60Hz or 525 or 625-line.

Similarly, the system is able to process video signals whatever colour standard has been applied, whether it be PAL — as used in most Western European countries, or SECAM — as used in the USSR and France, or the American NTSC. (We gave details of which station uses which system in a table of Euro-broadcast TV services in our August 1983 issue.)

The other advantages of Timeplex are as follows:

1) There is a single common FM carrier for all the video signals, making for minimum intermodulation.

2) The luminance (brightness level) has a negligible effect on the chrominance (colour balance).

3) The horizontal line noise that is created by fluctuations in the gap between the head and the tape is

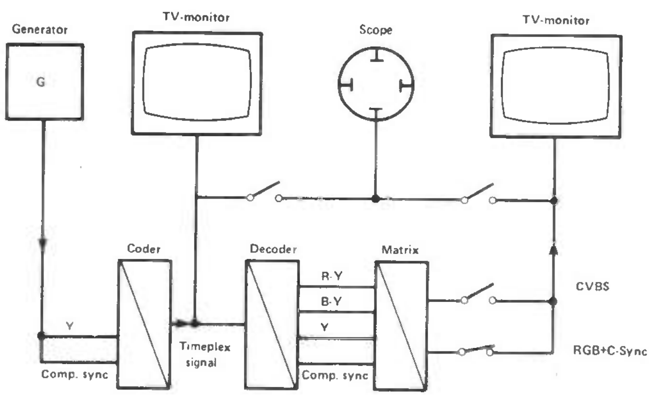


Figure 3: System resolution in feedthrough mode.

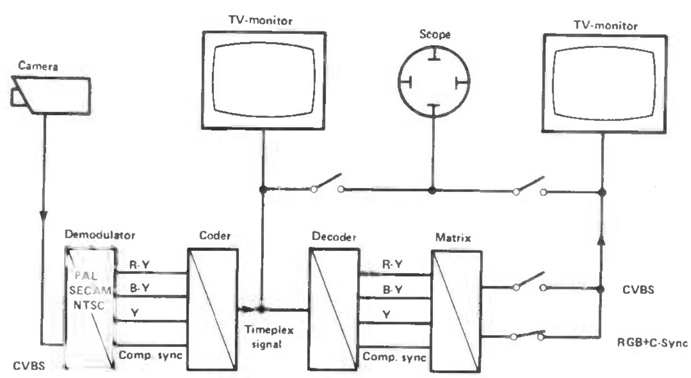


Figure 4: Line picture quality in feedthrough mode.

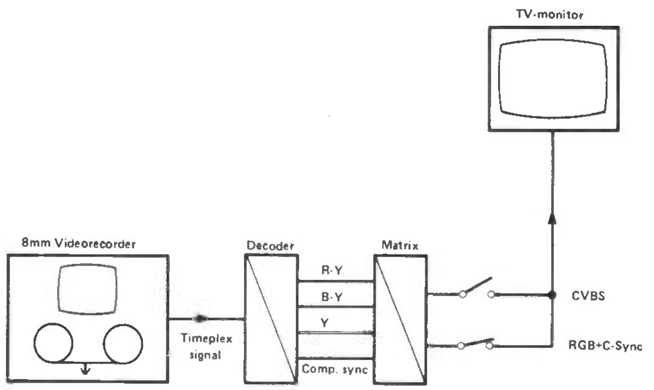


Figure 5: Line picture play back.

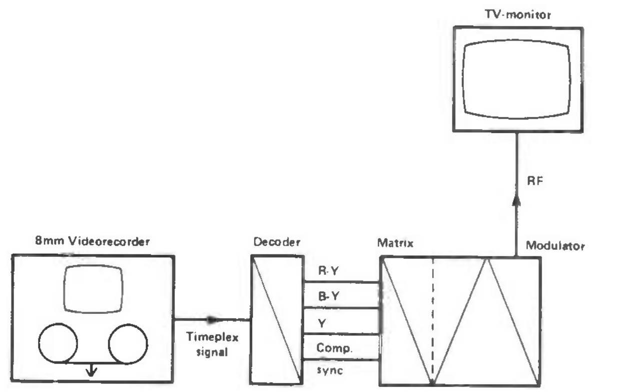


Figure 6: Line picture play back with RF-modulator.

suppressed. (The effect is, by the way, very noticeable on the majority of home video systems, which use the 'colour-under' system.)

4) The system offers very high resolution — higher than that offered by current TV transmissions.

In practice

The demonstration in July was aimed at showing the range of ways in which Timeplex can be incorporated within video processing, both in feedthrough mode and in playback. These are shown schematically in *Figures 3–8.* Certain similarities are readily observed in the set-ups depicted because, of course, the roles of the coder and the decoder matrix do not vary. The coder produces the desired compressed video signal, while the decoder first converts the incoming signal to colour-difference signals and then reconverts the latter to RGB or composite video (CVBS) signals in its second matrix. Note that the compressed video signal may itself be displayed on a TV monitor.

In feedthrough mode (*Figures 3 and 4*), coder and decoder are directly coupled. In fact, the only difference between the two arrangements shown is that the former demonstrates the basic operation of the Timeplex System, while the latter considers the path taken from a camera delivering live pictures in the form of a CVBS signal. In this second case, the camera signal has first to go through a demodulator to produce the desired colour difference signals, whereas the generator used in the demonstration automatically delivers RGB and composite sync signals. This generator was also able to test Timeplex's ability to compensate for frequency shifts through its facility for producing a variable video signal frequency.

Figures 5 and 6 shown in diagrammatic form the process of live picture playback, while *Figures 7 and 8* illustrate the overall route taken between camera and display. In all cases the output from the 8mm video recorder passes straight to the decoder. Of particular note here are the cases illustrated in *Figures 6 and 8* which refer to the use of a normal domestic TV as the display medium, rather than any TV monitor that can accept either CVBS or RGB signals direct. The RF modulator incorporated in these arrangements modifies the CVBS signal output from the decoder matrix.

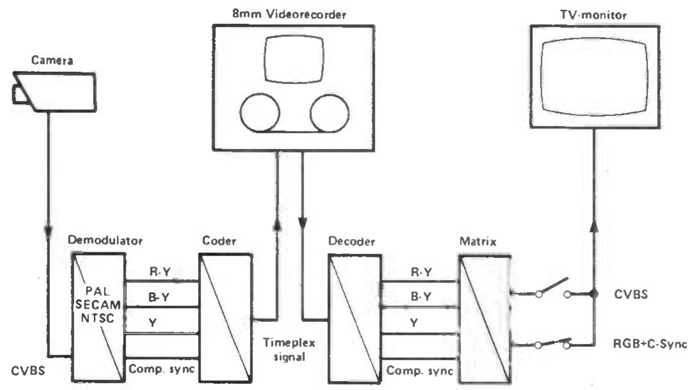


Figure 7: Picture quality of Timeplex in combination with 8mm video recorder.

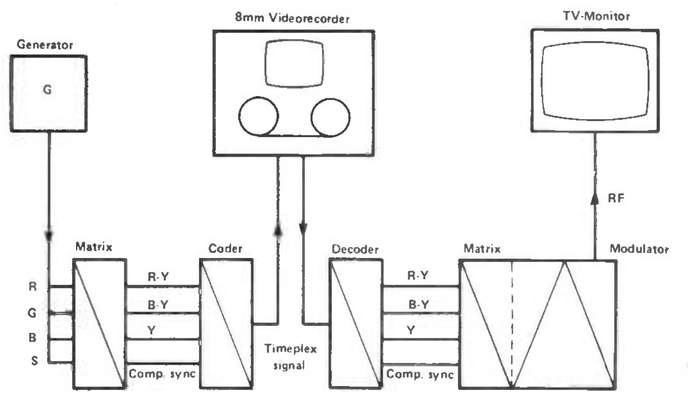
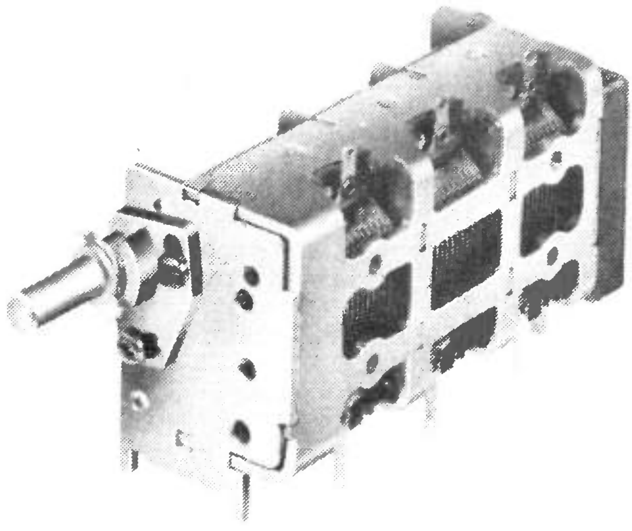


Figure 8: Picture quality of Timeplex in combination with 8mm video recorder and RF-modulator.

On reflection

The Timeplex System has evidently been designed with an eye to the future and to suit a range of consumer requirements. It must surely represent a real alternative to the existing 'colour-under' system. Moreover the speed of the signal processing employed here is sufficiently high to contemplate using it on satellite transmissions.

■ R&EW



On The Right Track?

Rod Greenaway takes a brief look at the ways in which radio designers have been trying to get around the problems posed by keeping local oscillators and RF tuned circuits apart by just the right amount.

ANYONE who has whiled away the hours either trying to calculate the formulae for accurate tracking of multiply-ganged tuned circuits in superhet radio receivers has probably longed for the advent of the 'broadband' systems currently favoured in modern HF receiver designs. Equally, anyone who has been left to fiddle with the practical adjustments involved in making the RF and oscillator circuits track to maintain optimum performance will probably readily agree that anything that reduces alignment to a couple of non-iterative tweaks is a Good Thing.

The 'iterative' adjustment is one where a subsequent adjustment requires that the alignment process returns to the first adjustment to re-tweak, then back and forth again until the best compromise is available across the band. It is the bane of the perfectionist, since true perfection is very rarely achieved (see *Figure 1*).

There have been several approaches to designing a way around track-tuning, with direct conversion SSB techniques being one which seems to achieve the most perennial recognition. Most of you reading this will probably have looked at such circuits, and a good many of you will also have had a dabble at putting these ideas into practice. As suppliers of such devices as coils and IF filters will grudgingly concede, such solutions can be depressingly effective in amateur communications in particular. The widespread use of noise blanking techniques in HF SSB communications arises from the effect of the narrow IF stretching the initially brief pulse into the more disruptive waveform that emerges after filtering.

But the concept of direct conversion is limited to SSB, and whilst this is certainly the most popular point to point communications medium, AM and FM are not yet relegated to the point where a serious receiver system can afford to ignore them.

The first clues on the activities going on to try to achieve a form of IF-less FM receiver appeared in patents 1 530 602 and 1 363 396 filed by STC and the Singer Company respectively. The latter firm being engaged in a variety of high technology activities particularly in conjunction with US defence work that should not be mistaken for sewing machines.

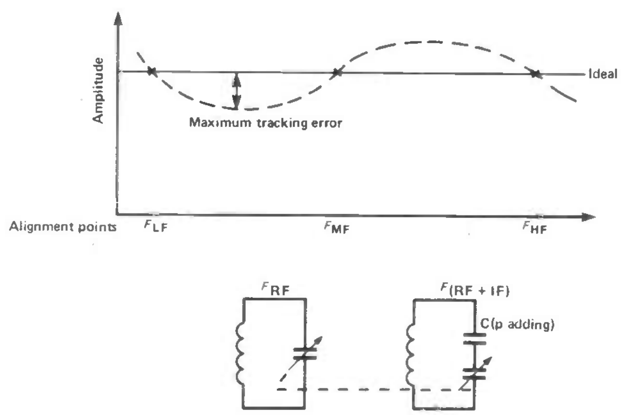


Figure 1: The classic '3 point tracking' compromise for making the best of the inevitable difference between the resonant frequencies of an antenna and an oscillator coil.

The STC patent relates specifically to a design of FM demodulator without coils that does not suffer the same compromises as PLL systems at the extremes of performance required in communication systems. But if you think that the language of legal documents and parliamentary legislation takes some beating, try this for size:

"According to the invention there is provided a demodulator for frequency modulated signals comprising local oscillator means for providing first and second signals in phase quadrature at the centre frequency of the frequency modulated signal, first and ▶

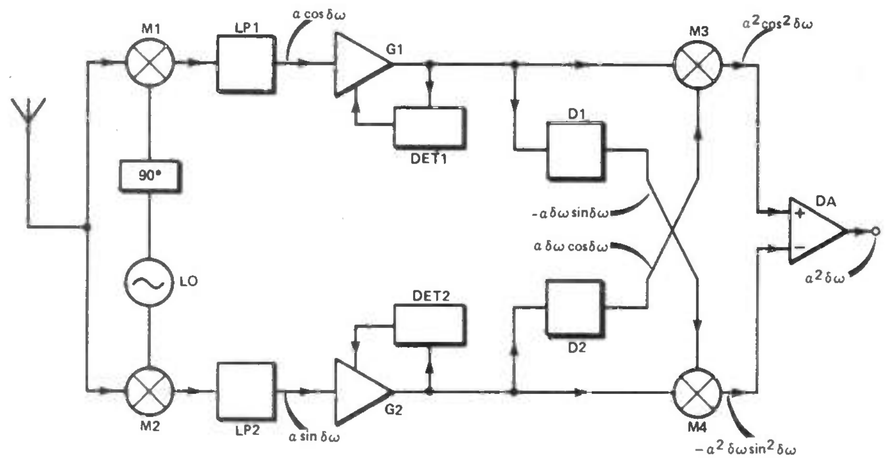


Figure 2: STC's suggested approach to coil-less FM radio.

second mixing means for respectively mixing the frequency modulated signal with the first and with the second local oscillator signal, means for low pass filtering each of the outputs of the first and second mixing means, means for amplifying each of the outputs of the low pass filtering means to a constant level, means for differentiating each of the outputs of the amplifying means, means for coupling the output of each differentiating means and the input of the other differentiating means to a multiplying means, and means responsive to the difference between the outputs of the said multiplying means to provide a demodulated audio signal."

Pretty meaningful stuff, eh? Perhaps another example of a profession that seeks to protect its own interests by a seemingly pointless smokescreen of jargon. It certainly doesn't seem to have a lot in common with the language of us communicators as heard on 2m; can you imagine saying: 'What means have you got for amplifying the means with which you are modulating the phase of your carrier means, old man?' Come to think of it, maybe it wouldn't be worse than the average conversation on that band anyway.....

Check out the schematic diagram of *Figure 2* as a means to short circuit the gobbledygook, and you will see an appealing and elegant concept that relies on a neat mathematical expression for the results. By combining the two FM signals that result from differentiation after synchronous demodulation in two mixers fed in quadrature from a single local oscillator, the intermediate algebraic results cancel at the final subtractor leaving the signal that is proportional to the incoming signal's deviation.

The Singer patent says essentially the same thing, except that the application referred to is a microwave aircraft landing system. Since Singer appear to have the lead on STC by 3 years, it's surprising that the STC application wasn't challenged — but patents and patent laws are curious things. It's also highly likely that some knowledgable reader will be able to cite some reference to a 1950's issue of the RSGB 'Bulletin' wherein exactly this concept was discussed and documented using ECC81 valves, thereby making all subsequent attempts to patent it a nonsense. Electronics is like that.

Simply Years Ahead

Never one to be left out of this leading edge stuff, the mighty Philips organisation has been one of a number of IC fabricators to develop ideas along these lines with the idea of realising an IC solution. Plessey seem to have such a device as well, lurking within the new Multitone paging receiver system, although Peter Chadwick is yet to furnish *R&EW* with evidence of this unit.

The TDA7000 (*Figure 3*) promises another route to FM

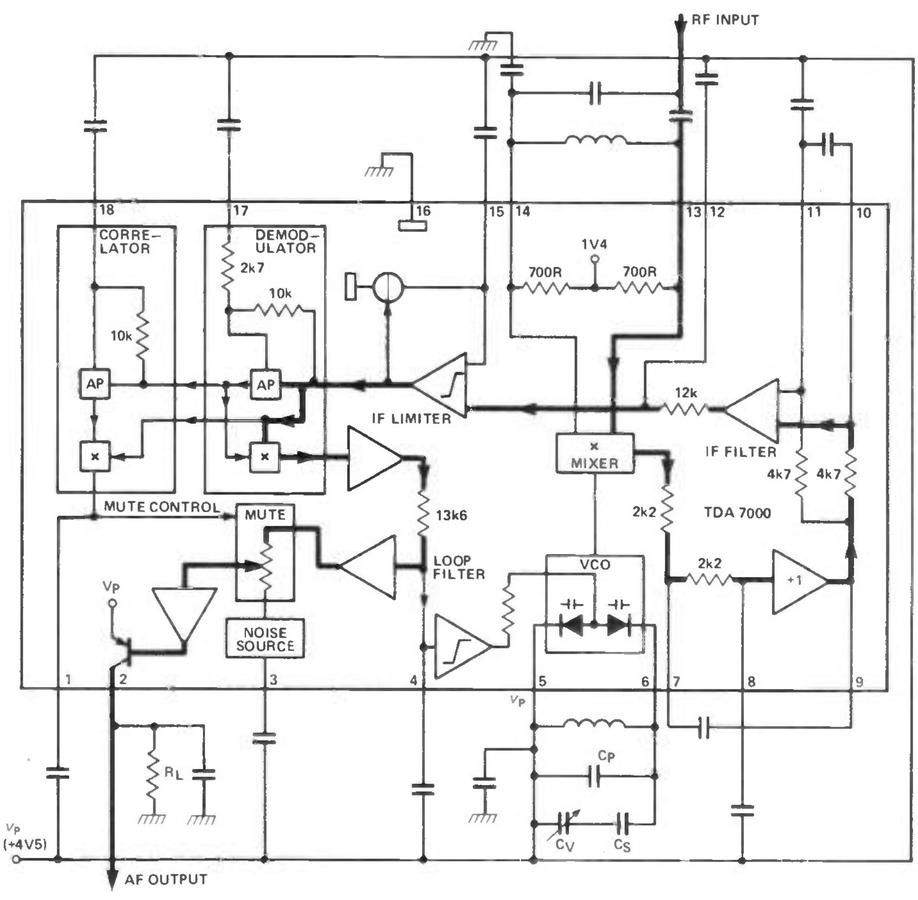
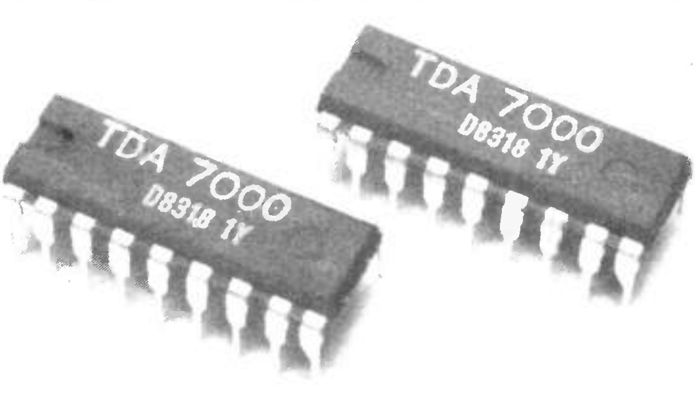


Figure 3: Inside and outside the TDA7000.

reception without track-tuning, which is best used in conjunction with a system containing a 70kHz IF. The rather scant information thus far provided by Mullard, who has yet to convince us it is willing to either supply or support the device, make it difficult to assess further claims. However it is safe to say that the device is capable of resolving signals of the order of $1\mu V$ and that it is capable of handling up to 100mV of RF without fretting too much, although this assumption is made on the basis of an extrapolation of available data rather than firm information.

If you're wondering how to handle 75kHz deviation with a 70kHz IF, then the answer appears to be that the local oscillator is encouraged to track the modulation to a limited extent in a frequency locked loop, thus providing negative feedback. Image rejection would appear to be brought about by the circuit's correlation facility, where it chooses to mute the image signal that doesn't respond favourably to AFC treatment. Such an approach begs all sorts of questions about exactly how it will behave on the air that can only really be satisfied with a good hands-on fiddle.

The TDA7000 is not proposed as a stereo system: one wonders what the frequency locked loop does for phase response anyway. But as a 2.7–10V supply at 8mA, it's a cheap and efficient way to get FM reception in the minimum of space. Before you ask, it's currently specified between 1.5 and 110MHz, so 2m isn't on,



although it could serve in IF applications if the output at reduced deviation is adequate.

The experimentally inclined among you will see for yourselves how reducing the necessary IF bandwidth for FM can be brought about by taking the time constant (filter) off the AFC in the FM receiver front end. It seems as if this could provide an interesting area for investigating further to see if it offers a viable means for getting 10kHz deviation through filters designed for 12.5kHz channelling. An analysis of the concept could provide any maths fans reading this with a lot of scope for development. Any takers?

■ R&EW

NOTES FROM THE PAST

The use of PCBs within electronic equipment is standard practice these days. Thirty years ago, however, people were just beginning to contemplate their manufacture, as revealed by 'Recorder' from 1961.

A minor revolution has taken place in the manufacture of domestic radio and television receivers over the last eight or nine years. Unlike many of the revolutions which occur these days, this one has been relatively bloodless. Whenever skirmishes have taken place they have been entirely verbal in character, consisting mainly of propaganda by some set manufacturers and of indignant counterblasts from service engineers.

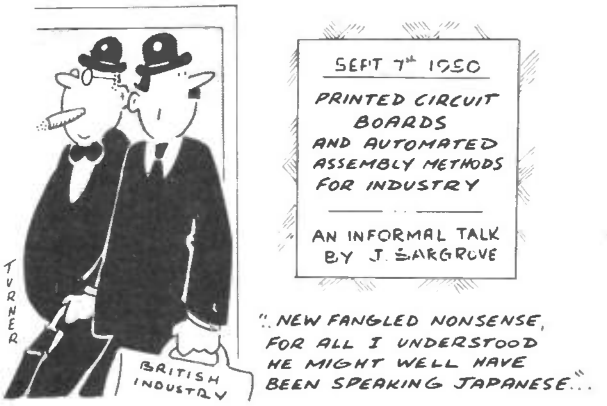
The revolution referred to is the replacement of hand-wired chassis by printed circuit boards. The changeover is now virtually complete, and printed circuit receivers are currently accepted in the domestic electronics field as being reasonably reliable and capable of service, bearing in mind the new techniques involved.

How It Started

It was in 1947 that John Sargrove, in this country, proposed the advantages of printed circuit manufacture. John Sargrove also developed a complete automated plant for manufacturing sound receivers, descriptions of this plant and the processes involved being given in the technical press at that time. For some reason, interest in the plant died away, despite the potential advantages it offered in so far as the saving of direct assembly labour was concerned.

Interest in printed circuits themselves did not, however, die, and research on materials and techniques continued. I would guess that it was around 1952 or so that the first trickle of printed circuit assemblies into domestic radio and television receivers commenced. The first boards consisted of small sub-assemblies, such as printed IF filters and the like, these gradually increasing in size and detail as time went by.

The major changeover to printed circuits took place in 1955 to 1958. During this time *complete* printed circuit chassis appeared, and manufacturers found themselves closer to the dream wherein a whole production line of factory operators fitting and soldering components could be replaced by a super-machine which automatically inserted the components into a printed circuit, and then soldered all the joints underneath in one fell swoop. Unfortunately, automated production did not advance as rapidly as had been hoped and there tended to be initial snags, particularly where automatic soldering was concerned. On a conventional production line each joint is made with a normal soldering iron, and it is an almost unconscious human reaction to lightly rub a joint with the bit whilst solder is being applied.



The rubbing breaks through the oxides on the surface of the connecting wire and gives good thermal contact to the joint. With automatic soldering there is no similar abrasive action, because the boards are dip-soldered or passed over a 'wave' of molten solder. The consequence was that, in some cases in the earlier days, component lead-outs which soldered perfectly on a hand production line obstinately refused to 'wet' at all when passed through the automatic process. As a result there would be blobby and unsatisfactory joints, joints which had obviously not 'taken' and, worst of all, joints which *looked* all right but in which the lead-out wire was surrounded by solder without being 'wetted' by it.

About this time service engineers began to object strongly to printed circuit boards, their main complaint being against some of the more complex boards used in television receivers. The objections were raised partly because some of the initial designs were flimsy and difficult to get at, and partly because the manufacturing quality of some of the assembled boards was significantly lower than the hand-wired versions the engineers had grown used to handling. Such objections were valid, and were not eased by statements from some manufacturers that the new printed circuit receivers were as easy, if not *easier*, to service than their hand-wired predecessors!.

Over the last few years further development seems to have made complete printed circuit chassis much more acceptable to the service engineer. Automatic soldering problems should now be almost completely cleared up. Also, many printed circuit boards now carry component identification and other servicing aids to overcome the disadvantage inherent in an assembly where the components are on one side and the connections on the other. And so the printed circuit is now with us, and has become an accepted part of the domestic radio and television scene.

PF70 CONVERSION

Stephen Ibbs describes another 70cm conversion

Anyone looking inside a PF70 will be startled to see the component density and construction technique — at least 17 PCBs! Despite this, the unit divides into relatively straightforward sections.

The PF70 is a three channel, hand-held transceiver, with a separate microphone/speaker operating either in the T band (405–440MHz) or the U band (440–470MHz). Most units coming onto the amateur market are U band, known as 'PF2UB Bodyworn'. These operate from a 15V high-power NiCad battery and are capable of at least 500mW output.

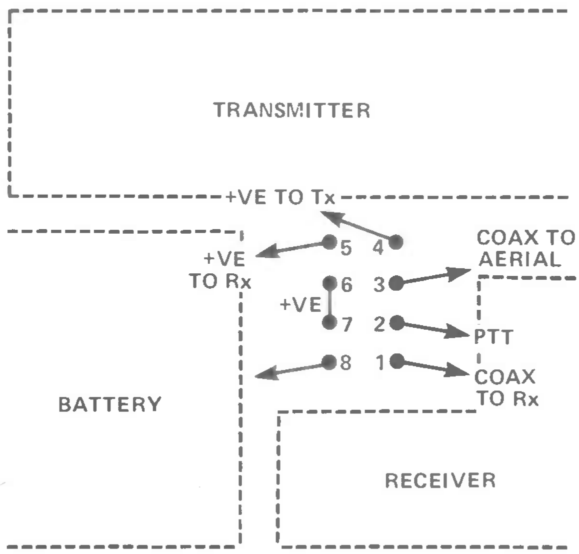


Figure 1: Connections from the relay (looking from PCB side).

Where To Begin

Undo the five case screws, lift off the top and, if you can see a big brass block just above the battery compartment, it means the unit does not have a pre-amp. You must remove the block and replace it with a pre-amp (more details later). Unsolder the aerial lead and the aerial socket, and all other retaining nuts to the various controls. Disconnect the battery leads and the unit should now come out of the case. Remove the retaining nuts around the channel switch and the receiver screening will lift off, revealing the crystal holders. The three Tx positions are nearest the volume control end and the Rx nearest the battery compartment. Insert the appropriate crystals, but before replacing the can, check to see if a small piece of wire is connected to the small PCB beside the Rx crystals. If there isn't, solder one to the free end of the 680Ω resistor. This is useful when tuning the receiver. Replace the screen, ensuring that the lead pokes through one of the trimming holes. Reconnect the aerial socket temporarily and connect either a dummy load via an SWR bridge, or a terminated power meter. Attach a power supply via a current meter (100mA range initially, followed by 500mA), switch on, and press the PTT button. Tune the four coils (marked 1—4 in *Figure 1*) in the 1st and 2nd multiplier stages for maximum current drain. There should now be some signs of life in the meter. Adjust the rest of the trimmers for maximum RF out. If the trimming tool contains any metal, release the PTT button each time before inserting or removing the tool to make sure it does not short on anything. It is wise to re-trim everything at least twice, because the components are interdependent. It should be possible to get at least 500mW out. If the output remains low, remove the PA screening can. The four separate stages, 3rd multiplier, driver, PA, and filter will become obvious. Each stage is capacitively coupled to the next and by moving the tapping point on the coil it is possible to increase the power.

The Receiver

It is extremely useful to be able to disable the squelch on any rig, and it also helps the alignment of the receiver. Since the PTT button on the main unit is rarely used (except to tune up the Tx initially as mentioned above), it can be converted to a 'squelch defeat' button. This is done by removing the switch lead *not* connected to earth and replacing it with a lead from the base of Q22 on the squelch board. This is the board close to the side, lying behind the

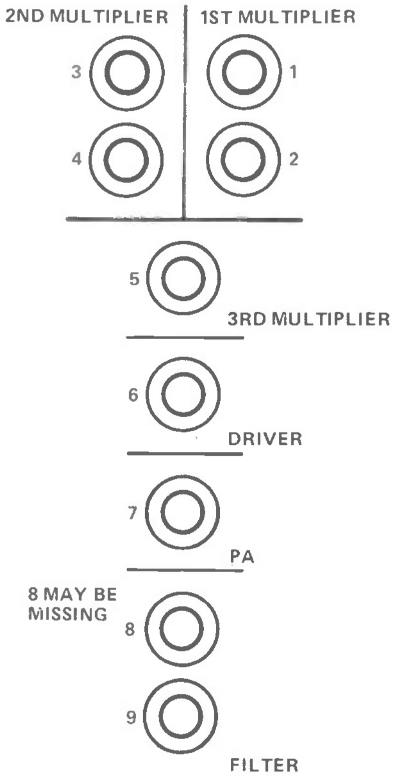


Figure 2: The transmitter tuning coils.

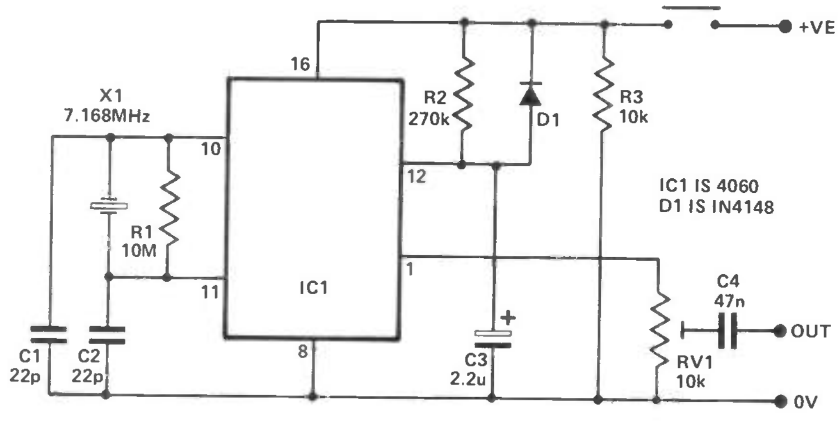


Figure 3: Circuit for the toneburst generator.

audio amp board (which has the volume control leads attached to it). The base is connected to the only 100k resistor on the board, the other end of the resistor being connected to earth.

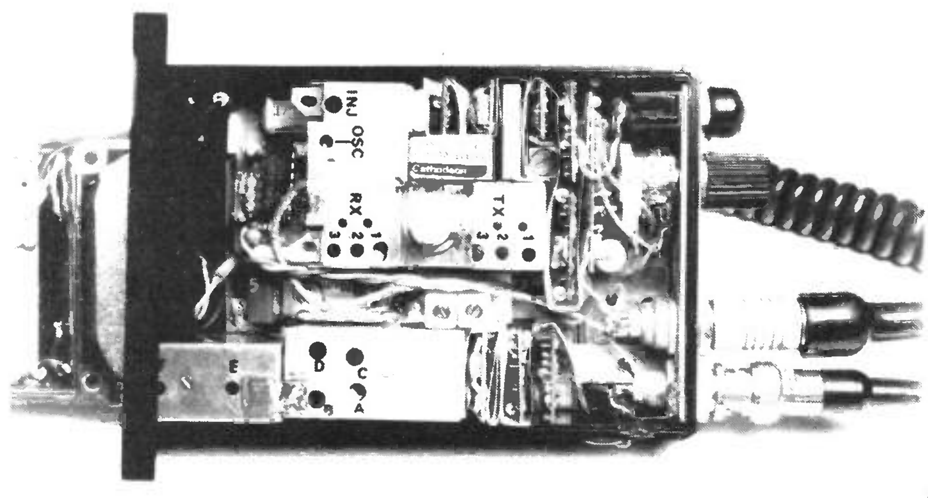
Remove the brass helical coils block, noting the input and output connections, and join the two together. Attach a 10V meter to the small insulated test lead mentioned earlier (black probe to earth), connect the power supply leads, switch on and disable the squelch. If all is well, something should be heard from the speaker. Adjust coil L3 (very close to the test lead) for maximum 'dip' in the voltage reading (approx 5V). Feed in a signal, preferably from a signal generator via a variable attenuator, and adjust the crystal coil and the capacitor C2 (close to L3) for the best quieting signal. Check the setting of L3 with an incoming signal. L4 (close to the volume control) is the deviation coil, and if it needs adjustment, do it carefully.

By now, the receiver should be working, but you will probably be disappointed by the poor sensitivity. It is recommended that a pre-amp be fitted — either the Pye board AT27632, if you can find one, or the *R&EW* 70cm pre-amp. The latter fits beautifully between the transmitter and receiver motherboards, and takes its supply from the relay (pin 5, *Figure 2*). Attach the earth to the screening can. Retrim as per the pre-amp and check the adjustments of the PF70 trimmers.

You should now have a working PF70, but before putting it back in the case you might consider adding a toneburst. The following circuit (adapted from the Nov '82 issue of *PW*) will fit into the space vacated by the brass block. It is crystal controlled and automatically lasts for approx 0.5sec. A pushbutton can be mounted in the mic/speaker assembly because there should be two spare terminals on the socket and plug. Connect either one of the socket terminals to the regulated 10V supply. The other terminal is connected to the +ve in on the toneburst board. Pull the rubber boot back from the mic plug and undo the plug retaining nut. You should find two leads cut short (normally blue and green). Solder tiny pieces of tin plated wire to the two spare terminals and, using heat-shrinking, connect them to the blue and green leads. Put the plug back together. Next, drill a small hole in the top corner of the mic/speaker body to accept a sub-miniature push-to-make switch. Extend the leads, again using heat-shrinking, and connect them. Now when the transmit button is pressed, and the toneburst switch activated, the toneburst should operate for about 0.5sec. The audio output is soldered to the socket terminal that is linked to the audio amp board, and the deviation preset adjusted to give a satisfactory output.

The final modification is to change the aerial socket to a BNC, and this is done by careful filing of the aluminium strip mounting bracket (which should be cleaned) and the plastic body.

Don't try to drill it out. The photograph shows the author's



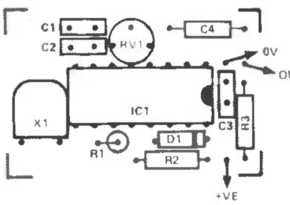


Figure 4: Component placing on the tone-burst board.

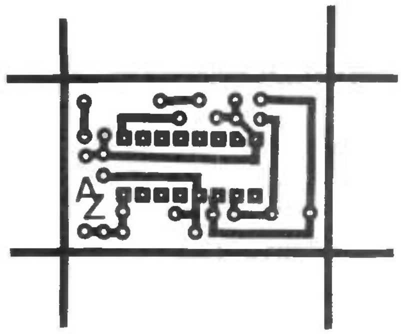


Figure 5: The toneburst PCB foil pattern.

modified rig with a home-made 70cm helical aerial. This took about ten minutes to make, using a length of 18SWG enamelled wire with 20 turns (close wound) on a 4.5mm former. Leave enough wire to solder it to a BNC plug, and clip off the remainder. Clean the tail-end with wire wool or fine glass paper, solder to the BNC pin, and connect the plug together, filling it with epoxy resin to stop the wire moving around and possibly rubbing on the earthed body. The coil is then stretched out to a length of 7cm. The prototype was sheathed in black heatshrink and performs as well as the commercial helicals available at over £5. The whole unit can now be bolted together, and with a couple of repeater channels and SU8 it is invaluable. If you want greater power try the Wood and Douglas 70PA/FM10 which will deliver 10 watts, and has a switched pre-amp built in.

Further Modifications

It has been noted that the two weakest features of the PF70 are the mic/speaker socket and plug arrangement, and the quality of the received audio. With care these can both be improved and, for readers willing to experiment, the following suggestions are given. (Note: not shown in the photograph.)

Mic/speaker plug and socket: Pye used a 5-pin locking plug arrangement and the most common fault with this is that the earth connection breaks, resulting in annoying intermittents. Readers who fit the toneburst will certainly discover how 'fiddly' the whole system is. Experiments were carried out on how matters could be improved and eventually it was realised that a complete replacement was the best answer. Owners of the Yaesu FT708R will know what a nice plug/socket assembly it has, and one was tried in the PF70. The pin-out of the Pye socket is shown in *Figure 6* and it doesn't matter in what order these are re-sited on the new socket, as long as the necessary interconnections, e.g. PTT to earth on Tx etc, are made.

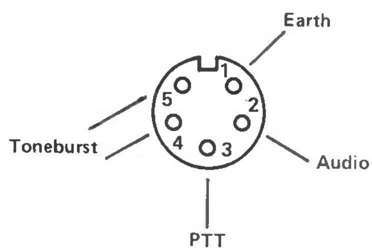


Figure 6: Pin connections for the mic/ speaker plug.

The Yaesu socket fitted perfectly on one unit, but the hole was slightly large on another and needed a washer (cannibalised from a BNC washer). The new arrangement has the advantage of a screw lock and an extra pin, so that if a 6-core microphone lead were used, a spare wire would be available at the mic/ speaker end for other purposes. For example, if a second miniature pushbutton were installed in the mic/ speaker unit, the spare wire could be used to operate the squelch — in turn making the pushbutton on the main body redundant, which could therefore be replaced by, say, an external power socket to run the PF70 from a regulated power supply or one's car battery. Though the nominal supply voltage is 15V it will operate at 12 - 13.8V, albeit at reduced power. There is of course no reason why any other mic socket can't be used as long as it fits and has the required number of pins.

Receiver audio: The circuit for the audio amp is shown in *Figure 7*, with the output coming via C7 to the speaker, and the audio in from the microphone (in fact the same speaker) going via C8 and R15 to the first Tx audio board. If the line could be interrupted at point X, the input and output could be split to provide audio output for another speaker, separate from the speaker/mic. It is, in fact, quite easy to lift the top of C7. This can now be connected to a 3.5 min jack socket mounted in the space on the front panel (already partly drilled out by Pye). Use a socket with the longest possible thread, because it only just reaches through the panel. This should be wired so that C7 and C8 are normally connected together, but, when a plug is inserted, this connection is broken and C7 feeds the external speaker. The other speaker wire should be connected to earth. This modification in the author's experience greatly improves the received audio, particularly when the rig is used mobile.

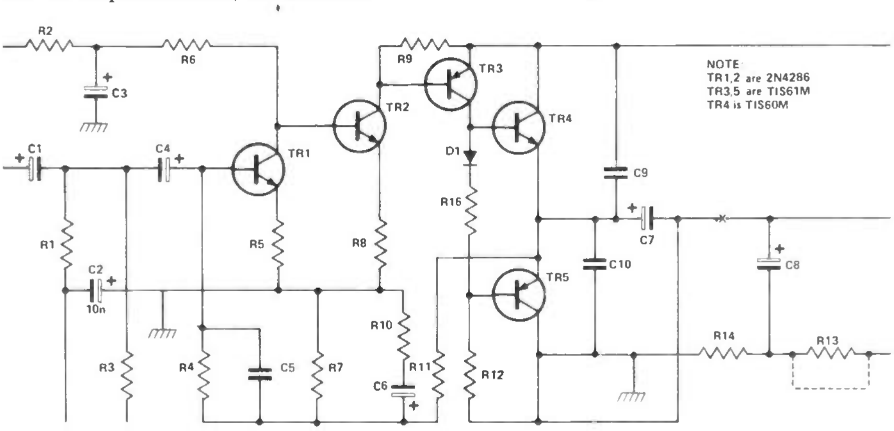


Figure 7: Circuit diagram for the audio amplifier.

Acknowledgement

The author had the valuable assistance of M Lowe G6JKF in developing these further modifications to the PF70.

■ R&EW

R&EW Data Brief

μPC1037H

NEC μPC1037H:

A double balanced modulator

Observers of Japanese radio equipment who are daring enough to delve inside will immediately recognise the μPC1037H. It's mainly to be found inside mixer synthesiser systems (commonly in CB equipment), but also in SSB demodulators and DSB modulators. At a 1000-off price of about 30p, it is a lot cheaper than an SL1640, but so far it only appears to be sourced in the UK as a CB spare, and so is appropriately 'marked up'.

The internal circuit shown below is the familiar transistor tree, although one of the outputs is available as an open emitter (Q6) in a true emitter–follower configuration, which makes matching to any subsequent filter stage a more predictable task than in most cases. The standard output at pin 2 presents itself at 350Ω impedance (presumably the value of R4).

The upper frequency limit of the device is not specified, although operation to 30MHz is assured.

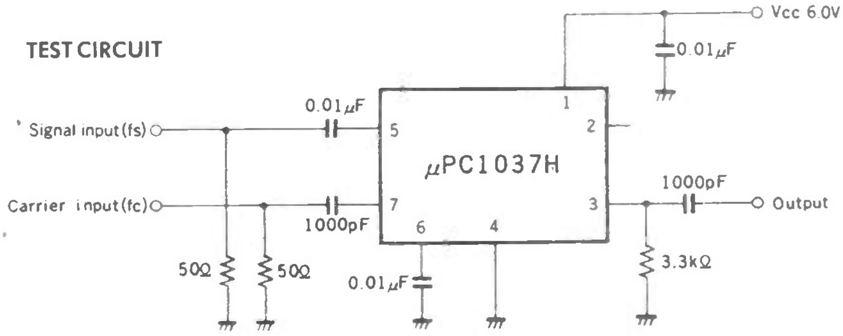
ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

Supply Voltage	V_{CC}	9.0	V
Package Dissipation (Ta = 75°C)	P_D	270	mW
Operating Temperature	T_{opt}	-30 to +75	°C
Storage Temperature	T_{stg}	-40 to +125	°C

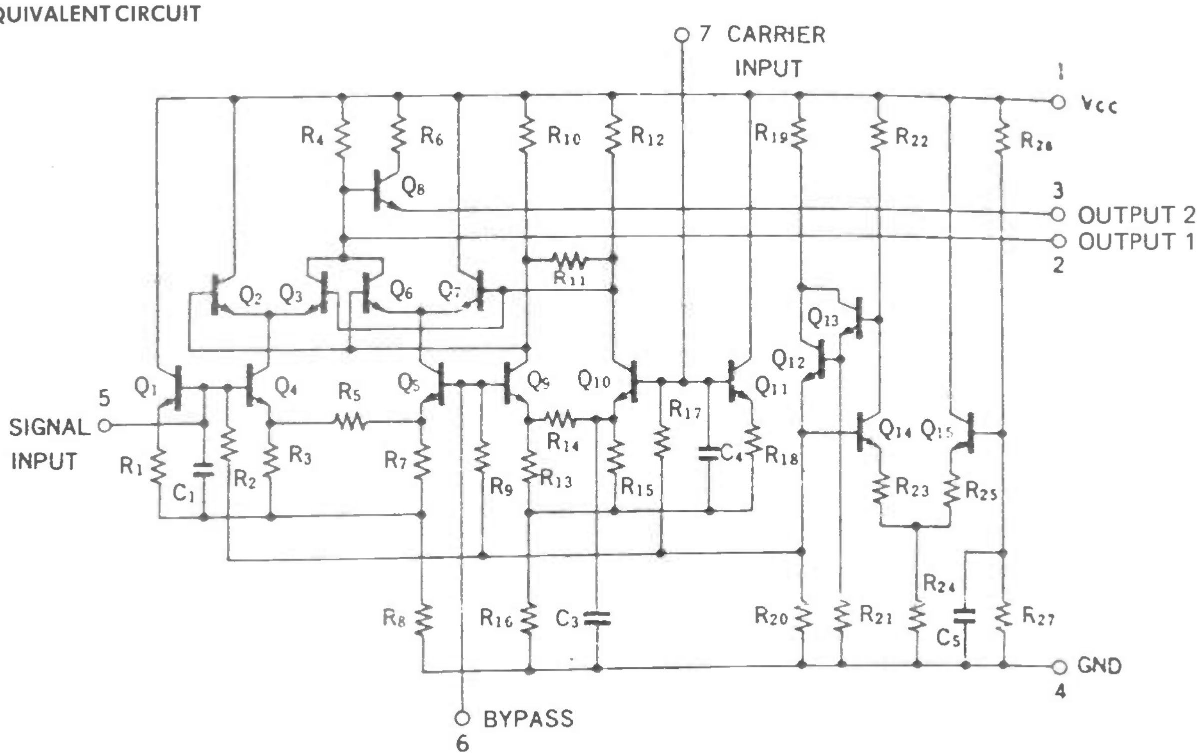
RECOMMENDED CONDITIONS (Ta = 25°C)

Operating Supply Voltage	6.0	V
Supply Voltage Range	5.0 to 7.0	V

TEST CIRCUIT

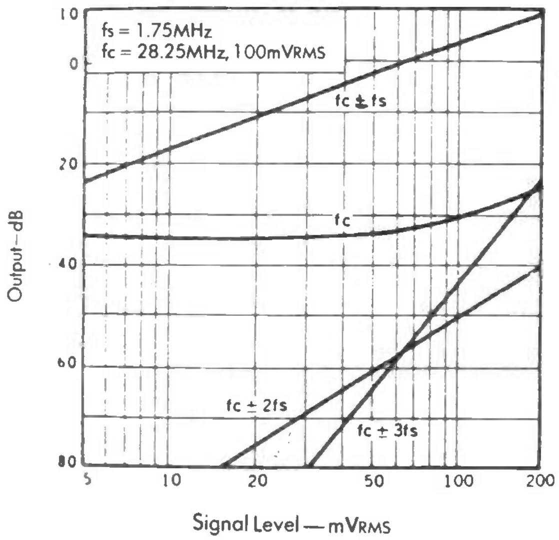


EQUIVALENT CIRCUIT

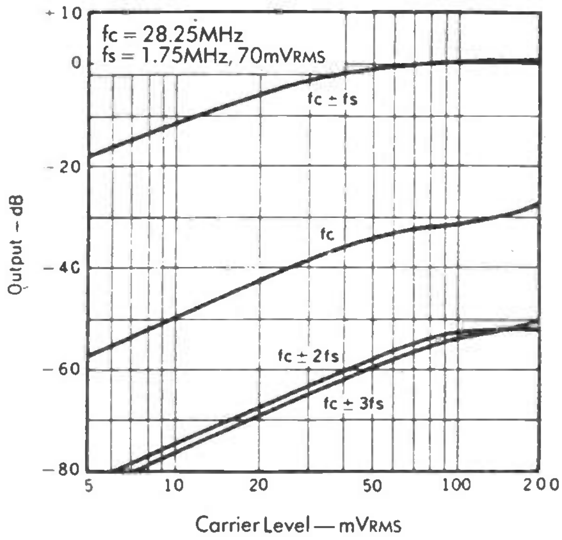


TYPICAL CHARACTERISTICS (Ta = 25°C)

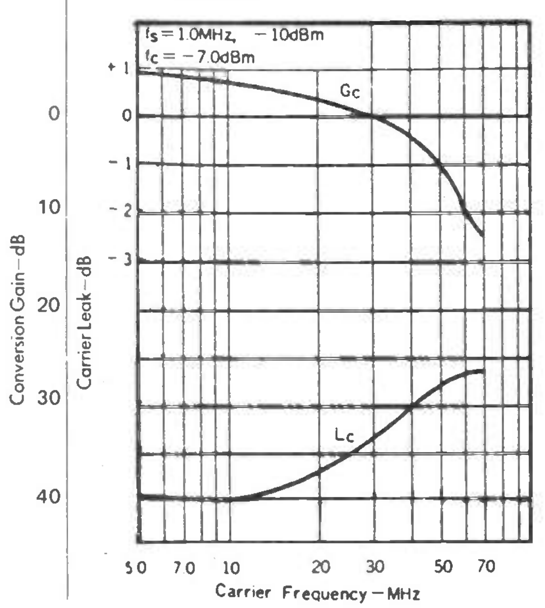
OUTPUT vs. SIGNAL LEVEL



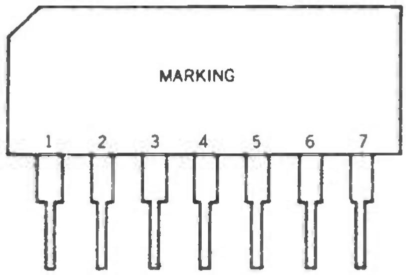
OUTPUT vs. CARRIER LEVEL



CONVERSION GAIN, CARRIER LEAK vs. FREQUENCY



CONNECTION DIAGRAM



Pin No.	Electrical Connection
1	Vcc
2	OUTPUT 1
3	OUTPUT 2
4	GND
5	SIGNAL INPUT
6	BYPASS
7	CARRIER INPUT

ELECTRICAL CHARACTERISTICS (Ta = 25°C, Vcc = 6.0V)

Characteristic	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Quiescent current consumption	I_{CC}		12	16	mA	
Conversion gain	G_c	−2	0	+2	dB	Signal: 70mVRMS 1.75MHz
Signal leak (*1)	L_s		−32	−20	dB	Carrier: 100mVRMS 28.25MHz
Carrier leak (*2)	L_c		−32	−20	dB	Output: 30MHz
Intermodulation products	IMD		−45	−35	dB	(*3)
Signal input impedance	Z_{si}		500//9		Ω//pF	
Carrier input impedance	Z_{ci}		1000//9		Ω//pF	
Output impedance	Z_{O1}		350//7		Ω//pF	

(*1) $L_s = \dfrac{\text{Signal output (1.75MHz)}}{\text{Desired sideband output (30MHz)}}$

(*2) $L_c = \dfrac{\text{Carrier output (28.25MHz)}}{\text{Desired sideband output (30MHz)}}$

(*3) Signal 1: 42.5mVRMS 1.75MHz
Signal 2: 42.5mVRMS 2.00MHz
Carrier: 100mVRMS 28.25MHz
Output: 27.75MHz

VSC-1000

A Variable Speech Control Cassette Recorder from Tandy, reviewed here by Chris Anstey

A new piece of equipment aimed at the consumer market has recently been brought to our attention. The unit has all the normal facilities one would expect in a portable cassette recorder but it also has two extra controls – a variable speed control that allows the tape to be run at between 0.8 and 2× standard speed, and a pitch control that can 'correct' the pitch even when the tape is being played at 2× normal playing speed, thereby eliminating the familiar 'chipmunk' effect of a speeded-up tape. These controls can be adjusted in parallel or they may be moved independently of each other and so can be used to produce some interesting (if not always enjoyable!) 'distortions' of both speech and music.

A User's Comments...

In 'normal' use, with the speed and pitch controls switched out, speech reproduced by the recorder is pleasantly clear and sharp. But music suffers somewhat as a result of the restricted dynamic range and apparent weighting of the frequency response towards the human speech range of 100–400Hz. It is however no worse in this regard than most portable recorders employing smallish speakers.

The unit is supplied with a demonstration cassette which is designed to show the variable speed and pitch controls to best advantage. At double normal speed but without adjusting the pitch control, it is almost impossible to understand what the recorded voice is saying; moving the pitch control to compensate produces a clearly understandable (if a little bubbly) tone at normal pitch.

According to the demonstration tape, the main use for this recorder is for decreasing the time taken to listen to 'teaching' cassettes and talking books. Normal reading speed is quoted as being approximately 1.7× talking speed and the idea is to present oral information at the same speed. The demonstration tape makes a couple of claims about its efficacy in this regard, citing the grades and study times of students at an American University and the performance of trainees within a 'major retail chain'.

Other uses may be found in correcting the pitch distortion sometimes associated with long distance radio communications or in slowing down such 'difficult to understand' recordings as foreign language tapes. One could also consider its application with an eye to phone bills: one can imagine sending phoned orders to answering machines at up to double speed – but don't expect any thanks from the invoice typist at the other end!

...and Conclusions

To sum up, this recorder is certainly more than just a toy: it does have some worthwhile applications at least as far as speech is concerned – I cannot recommend the effect it has on music to any music lover!

It is well built and packaged and with a retail price of just less than £90 I would expect it to find a ready market.

■ R&EW

The recorder is available from a number of Tandy shops. Our thanks go to Peterborough Electronics for the loan of a unit.

SPECIFICATIONS(Typical)

Power Requirements	
AC:	120V, 60 Hz (220/240V, 50 Hz for the units purchased in Europe and Australia.)
DC:	9V (6 type C Batteries)
External:	DC9V Jack (center terminal negative)
Tape	Cassette tape
Tape Speed	1-7/8 ips (4.75 cm/s)
VSC Speed Range	0.8 – 2 x NORMAL SPEED
VSC Pitch Correction Range	1 – 2 x NORMAL SPEED
Wow and Flutter	1-7/8 ips (4.75 cm/s)
Recording Time (Playing Time)	60 minutes (Using C-60)
Fast Forward/Rewind Time	110 sec (C-60)
Recording System	AC bias
Erasing System	DC erase
Track System	Monaural dual track
Speaker	3" Permanent magnet, dynamic type
Audio Output	1.2 WATTS (Max.)
Frequency Range	
VSC off	100 – 8000 Hz
VSC on	400 – 4000 Hz
Input Impedance	
MICROPHONE:	22 k ohm
AUX:	330 k ohm
Output Load Impedance	EXT.SP: 8 ohm HEADPHONES: 8 ohm
Microphone	Built-in condenser microphone
Dimensions	2-3/8" x 9-27/32" x 6-13/16" [60(H) x 250(W) x 173(D) mm]
Weight	2 lbs. 14 oz. (1.3 kg)

The Yaesu FT-77

An all solid state HF transceiver, reviewed here by John Mills.

The recent introduction of Yaesu's FT-77 HF transceiver has set a new milestone in economy HF operation, whether used mobile or in a base station. In designing the FT-77, Yaesu has made good use of the CAD/CAM (Computer aided design and manufacture) facilities now available to provide a practical, no frills approach for both the newcomer and the established mobile operator. Full SSB and CW operation are provided for all the amateur bands between 3.5 and 30MHz (including WARC), while a 600/1300Hz CW position and FM operation represent further options available to the user. Nominal output power is 100 watts pep (85W 10m) or 50 watts when used in FM mode.

Yaesu claims that CAD/CAM makes for high levels of reliability in the smallest possible space, while using automatic (robot) parts insertion and soldering considerably improves quality control and so helps to keep down the final cost to the amateur.

Also of note are some not immediately obvious features that the FT-77 has. These include dual selectable noise blankers, self-contained SWR metering and the options of a 25kHz marker unit, a fixed frequency crystal, a digital scanning VFO and memory (FV-700DM), a VHF/UHF transverter (FTV-700) and a FC-700 antenna tuner.

Control considerations

The front panel is well laid out and provides rotary controls for mode selection (LSB, USB, CW-W, CW-N, FM), AF gain, squelch (only operates on FM mode), mic gain/drive and band selection. The FT-77 uses a normal capacitor-tuned VFO, but the tuning knob has a noticeably 'sluggish' feel to it. The extra friction has presumably been incorporated deliberately to reduce any drift or jitter whilst in mobile use. A small amount of backlash is discernable mechanically, but this does not appear to alter the received frequency. A clarifier is also provided with a rotary control: this is enabled by a push switch and a LED next to the tuning dial indicates when this function has been selected. The control varies the Rx frequency through approximately ±2.5kHz.

All other controls are grouped neatly in a row and provide the following operations:

1) **RF att:** This inserts a 20dB

attenuator in series with the receiver input to prevent strong signal overload. A red LED indicator to the left of the turning dial shows whenever this is enabled.
2) **Noise Blanker:** This activates the automatic RF noise blanker. The latter has either a wide or a narrow pulse width, selected by a slide switch under the top cabinet access panel.
3) **AGC:** This control selects either slow or fast AGC time constants.
4) **Fix:** This switch is used to select fixed frequency operation when the option of crystal control is taken up. When 'Fix' is selected, the VFO is disabled and the digital display indicates a small 'F' on the left of the readout.
5) **Mark:** This switch instigates 25kHz CW markers throughout the range if the optional marker unit has been installed.

Facilities

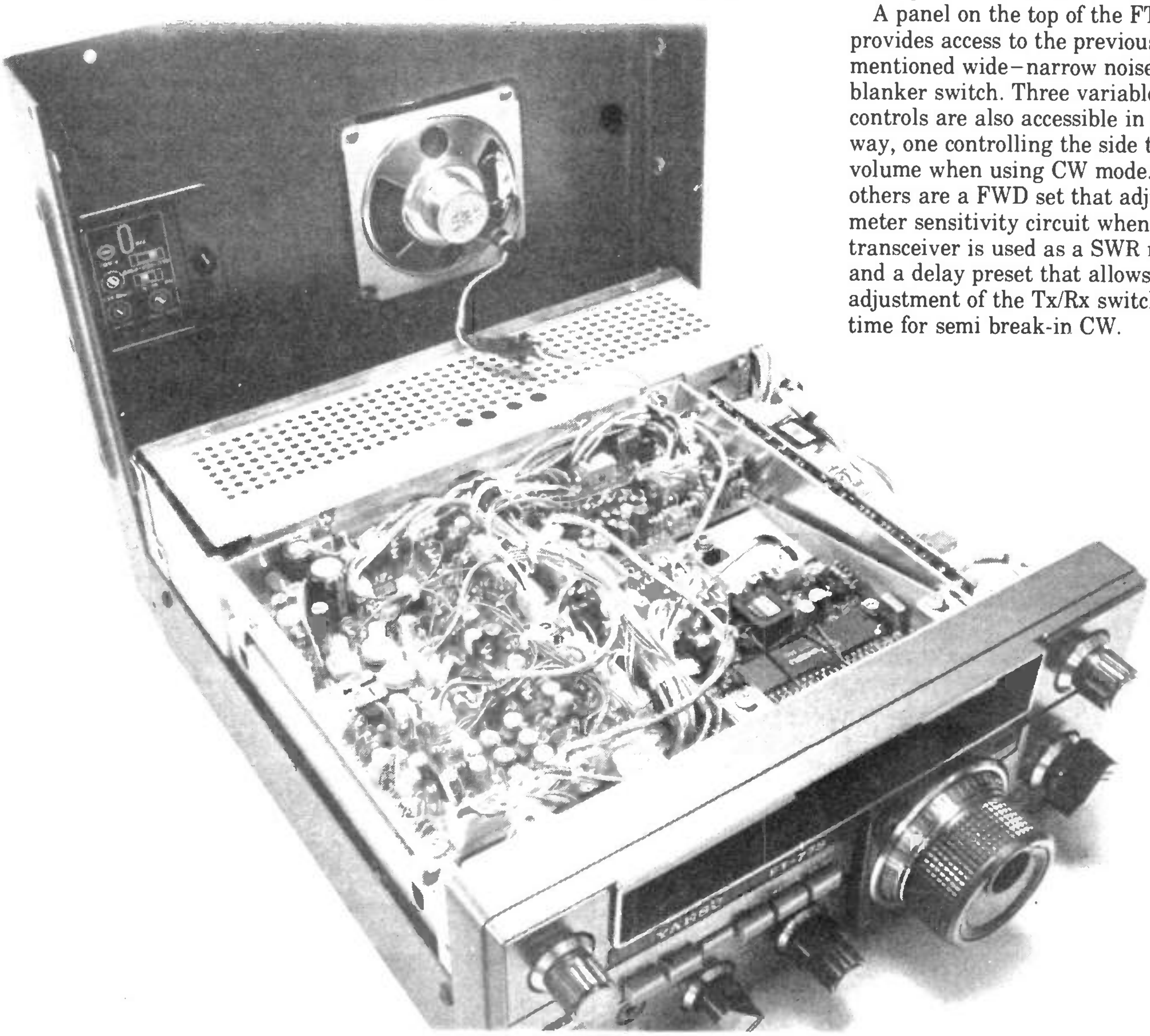
Facilities for headphones are provided via a 1/4″ socket, while a constant level (70mV$_{RMS}$) audio output suitable for a tape recorder is available by way of a 3.5mm jack socket. The mic connector will accommodate a wide range of Yaesu microphones including ones with UP/DOWN frequency control buttons, a facility that is particularly valuable when the FT-77 is used with the optional digital VFO unit. The desire to offer the user such a choice is presumably the reason that most HF transceivers are now sold without microphones.

A fluorescent frequency display presents the operating frequency to the nearest 100Hz. To the left of the display, annunciators indicate when use is being made of an external VFO (VFO−B) or fixed frequency operation (F). In all cases, the displayed frequency is that of the carrier (or suppressed carrier), and so the display will always be correct whichever operating mode is selected.

The only complaint here concerns the brightness of the display. No facility is provided to dim this during night operation and the display tends to light up the surrounding area. It is possible that the LSI chip used has facilities for auto-dimming at night, but this point has yet to be investigated.

Comprehensive metering is provided, the meter indicating signal strengths from S1 to S9 + 60dB on receive, while either automatic limit control (ALC), relative forward power (FWD), or reflected power (REF) may be chosen for display during transmission. These are selected via a three-position switch.

A panel on the top of the FT-77 provides access to the previously mentioned wide−narrow noise blanker switch. Three variable preset controls are also accessible in this way, one controlling the side tone volume when using CW mode. The others are a FWD set that adjusts the meter sensitivity circuit when the transceiver is used as a SWR monitor and a delay preset that allows adjustment of the Tx/Rx switching time for semi break-in CW.



The fixed frequency crystal holder is also under the top access panel, and this is provided with a preset trimmer to allow accurate frequency selection. It should be noted that the fixed frequency crystal is selected within the VFO range of 5–5.5MHz and therefore provides a spot frequency in each band that is selected.

The rear of the FT-77 is mainly taken up by the 100W power amp module but Yaesu has also found space for all the sockets required to feed the various optional add-on units. There are phono sockets to provide low level RF output (200mV, 50Ω) and 8VDC, and three DIN sockets that provide for the various switching functions required when used with linears, phone patch, up/down scanning, PTT, etc. In addition, external speaker and CW key jack sockets have been provided, with antenna input via a SO239 socket and DC via the usual 4-pin connector.

SPECIFICATIONS

Frequency coverage:
All amateur bands between 3.5 and 29.9MHz, including the three WARC bands.

Operating modes:
A3J (LSB/USB), A1 (CW)
F3 (FM) optional.

Power requirements:
13.5VDC; 1A receive, 20A transmit

Size:
240(W)×95(H)×300(D)mm, including heat sink.

Weight:
6kg (13.2lb)

TRANSMITTER

Power input:
240WDC for nominal 100W output (85W on 10 metre band)

Spurious radiation:
Less than −40dB

Carrier suppression:
Better than 40dB

Unwanted sideband suppression:
Better than 50dB (8W/1kHz modulation)

Audio response:
350–2700Hz (@−6dB)

Stability:
Less than 300Hz drift during the first 30 minutes after a 10 minute warmup; less than 100Hz every 30 minutes thereafter.

Microphone input impedance:
500–600Ω

RECEIVER

Circuit type:
Single conversion superheterodyne (double conversion for FM, when installed).

Intermediate frequency:
8987.5kHz (plus 455kHz for FM)

Sensitivity:
0.3μV for 10dB S+N/N (SSB and CW-W)
0.15μV for 10dB S+N/N (with CW-N option)
0.7μV for 12dB SINAD (FM, with FM option).

Image rejection:
More than 70dB

IF rejection:
More than 50dB

Selectivity (@ −6/−60dB):
2.4/5kHz for SSB, CW-W
600/1300Hz with CW-N option
12/24kHz with FM Unit option

Audio output:
3W (4Ω internal speaker, @10% THD)

External speaker impedance:
4–16Ω

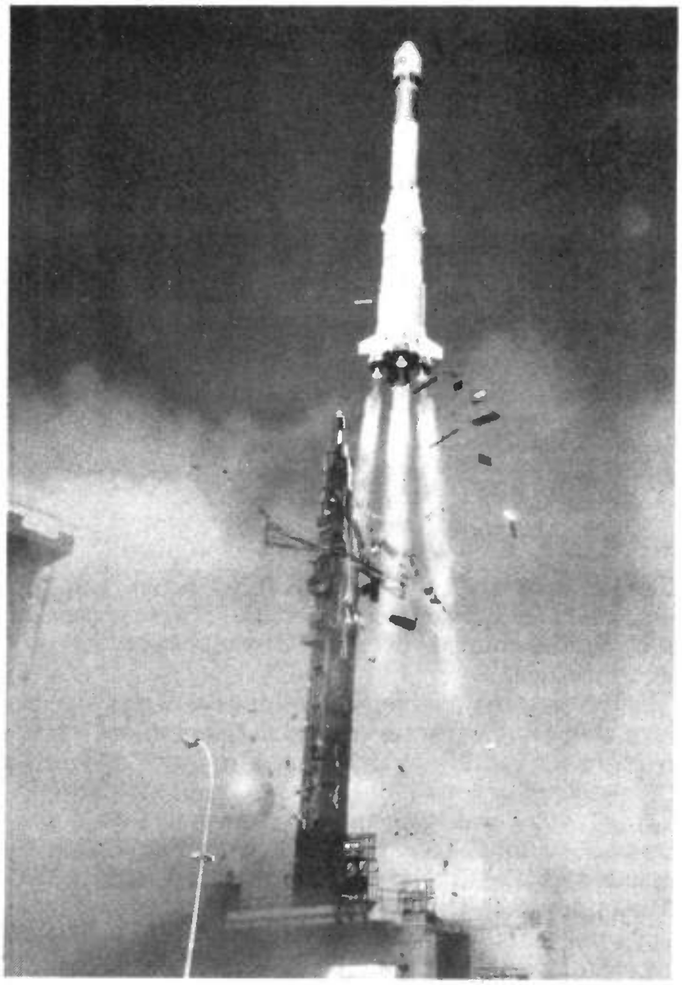
In operation

The FT-77 is very easy to set up. Of the QSO's made, all reports indicated good speech quality and excellent stability during extended operation. However, two criticisms must be made overall, one being the high brightness of the display mentioned earlier and the other that, at least as far as the reviewer is concerned, the positioning of the FWD/REF switch under the top access panel is a bit of a nuisance. Obviously, its position is not of concern if it is operated into a fixed 50Ω antenna; however, many operators do have various tunable systems requiring the SWR to be reset during a change of band. A small point perhaps, but niggling none the less.

The compact size of the FT-77 should allow it to be fitted to most cars and the host of accessories will enable it to serve as a base as well. All in all this transceiver is very good value for money — and well worth the appellation 'thrifty' that Yaesu gives it in the excellent handbook supplied with the unit.

■ R&EW

Thanks go to SMC for the loan of the review model.



Ariane 6 takes off for a successful launch of ESC-1 and amateur radio satellite AMSAT Phase 3B.

AMATEUR RADIO WORLD

Compiled by Arthur C Gee, G2UK

The great event, for which radio amateurs worldwide with an interest in amateur radio satellites have been waiting, eventually took place on 16th June. The European launcher Ariane L6 successfully placed its dual payload – the European Communications Satellite ECS 1 and the radio-amateur satellite AMSAT Phase 3B, –, into a geostationary transfer orbit 17 minutes after lift-off.

However, it soon became apparent that all was not exactly as anticipated with Phase 3. As seems inevitable in radio-amateur circles on such occasions as this, rumour-mongers had a field day! Once again they filled the air with 'doom and gloom'! Phase 3 was said to be in the wrong orbit; to be at an unfavourable attitude for its solar panels to get enough sunlight to charge the batteries; to be in an apogee which subjected it to the severe effects of van Allen Belt radiation; and to be in such a low perigee that atmospheric drag would soon bring it down to earth. Subsequent difficulties with the kick motor gave rise to the rumour that unused fuel still aboard would cause rapid and severe corrosion! And so it went on!

These rumours were eventually put to rest by an official announcement which gave as factual an account as it was possible to determine. It seems that following the ejection of the satellites from the launcher, excess oxygen was dumped from the third stage of the rocket, which resulted in an unexpected acceleration of that stage. This 'bumped' Phase 3, causing some damage to one aerial, and threw the satellite off its intended course. This necessitated an unscheduled firing of the kick motor to bring it back to its intended orbit. This used up some fuel intended for getting the satellite into its planned final orbit, so its present orbit must be its permanent one. This is not quite so satisfactory as the planned one, but it is not all that different from that intended and, at the time of writing, everything seems to be going nicely. 'All's well that ends well', as they say!

My other satellite news is that OSCAR 8 must now be regarded as non-functional, having at last suffered the same fate as earlier satellites – battery failure. The Russian RS6 has also been 'somewhat irregular' at times, so there may be problems with that too. UOSAT is going well and the CCD camera may be switched on shortly to a predetermined schedule, if enough folk are interested in it. The pictures are not so good as was hoped, but, for experimental purposes, they may be fed back into the satellite for retransmission.

An interesting new beacon has appeared in the 10MHz band. It is on 10.144MHz and is located at Norden, Germany (QRA Locator DN37g). It is installed at Norddeich Radio, one of the ten coastal radio stations of the Federal Republic of Germany and the call sign is DK0WCY. The beacon is the contribution of German radio amateurs and DARC to the World Communications Year activities and is intended to serve as an aurora indicator. Whenever aurora propagation is detected on VHF in northern Germany, the beacon will respond by sending an appropriate message. It is hoped ultimately to record geomagnetic field activity, and to calculate *K* readings and transmit these values continuously.

The beacon also provides a good check on 10MHz band conditions which are very variable. Some DX is to be heard and worked but, for the most part, propagation conditions give only 'local' QSO's. The 10MHz band has recently been released in Japan, New Zealand, Australia, Malaysia, The Philippines and Papua New Guinea, so there should be plenty of opportunity for some good DX QSO's if conditions are suitable.

Meanwhile, a great furore has arisen over the curtailing of the VHF/UHF amateur band allocations for radio amateurs in Belgium by the Government departments concerned. This has been done without consultation with the radio amateur organisations and in the face of recently established international agreements. So much opposition has been raised to this apparently high-handed action, that the date of its coming into force has been delayed for further consideration.

My final piece of news is that routine station logs will no longer be needed in the USA for amateur radio stations if FCC proposals are carried through. This particular proposal is contained in PR Docket 82-726 and marks a general trend towards 'deregulation'. Station logs may be required for certain specified non-routine operations but the traditional amateur radio station log need no longer be kept. We suspect, however, that most radio amateurs will continue to keep some record of their QSO's for their own personal interest. ■ R&EW

ATV On the Air

PRESENTED BY

ANDY EMMERSON, G8PTH

One of the things I have to keep in mind when writing this column is that it appears a month or so later – and being topical in advance is very difficult! Today's hot news items can be pretty stale by the time they appear in print...

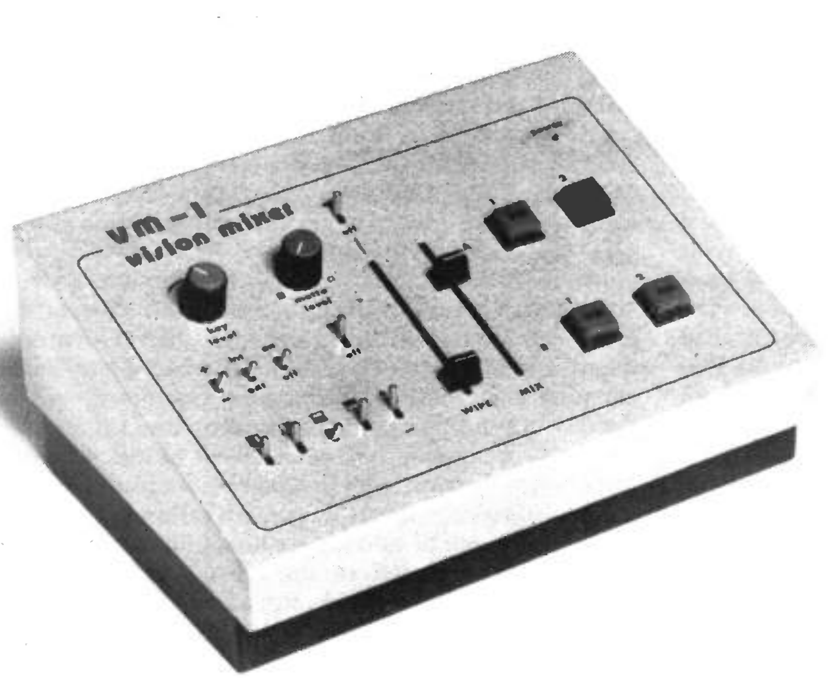
However, let me start by being 'a bit previous' with news of a day out to interest all TVers. The date is 20th November (put it in your diary now) and the event is a TV extravaganza organised jointly by Q Studios and the British Amateur TV Club (BATC). Activities will include demonstrations of video and 24-track sound recording, a full lecture programme and equipment displays. Club video shows, snacks and an all-day bar complete the attractions. And if you insist on parting with money, some well known firms associated with amateur television, satellite reception and aerials will be there to help you do this.

The location is Queniborough, near Leicester, and a talk-in will be arranged for people coming by car, while for those coming by train, a taxi service will be arranged from London Road station. Full details will be given in the next issue of CQ-TV, the BATC's journal. You can also ring Paul Elliott on Leicester (0533) 553293 (daytime) or 606986 (evenings). Even if it seems a long way off, book the date now!

By the time you read this the summer will probably be but a memory, but for several it will be enhanced by the excellent lift conditions experienced in June and July. The weekend of 18th/19th June was kind to John Wood G3YQC who managed to work several Dutch and German stations from his Rugby location. Callsigns included PE1DWQ (Netherlands), DC0BW and DF2BY (West Germany). DL1YAQ managed to transmit all the way from Germany on just 6W! And 14th July was good for John Stopford G8UWS in Folkestone who worked ON1AHT, ON1AGC, ON6PD, ON7ZR and ON7CI (all Belgian) and F6GOZ in France.

Whilst working the DX was good for these Belgians, they also had some rather less attractive developments to face, which should put our 70cm losses to PMR and MOULD in perspective. As Arthur Gee hints in his report on the Amateur Radio World this month, there are moves in Belgium to bar amateur radio operation between 430 and 434MHz, and also to bar 23 and 13cm. (Currently ATV is not permitted on 23/24cm and the power limit on 23 is a pathetic 500mW.) In Germany, the prospects are no better with the desire to remove amateurs from the 23cm band and to ban normal ATV on 70cm. At the moment these are only proposals, but they should not be regarded as merely hearsay: I have them in black and white from the German ATV club.

What is the implication of all this? Well, for a start we shall have to gird up our loins and prepare to defend our 'rights' in this country. The radio spectrum is a valuable resource and our UHF amateur allocations (all of which are shared) are seen as hopelessly underutilised by other factions who are short of space. Thus we have already lost parts of 70cm to PMR, Syledis and MOULD in the UK and we are liable to find more high-power aircraft



The VM-1 video mixer and effects unit from Video City Productions would be a superb addition to the more sophisticated ATV studio. If you make your video hobby pay for itself with weddings and the like, this might be something to put on your shopping list. (Further information on 01-637 1608).

radar stations on 23cm. Unfortunately the amateur lobby is not as well represented in Government circles here as in, say, the United States and it is up to us to inform non-amateur radio interests of the value of our work and our right to a small share of the spectrum.

At the same time, we ATVers must defend ourselves against other amateurs who support the mistaken belief that ATV is a greedy wideband mode and should be banned in favour of more spectrum-friendly modes. There is a myth, quite widely held, that a double sideband ATV signal occupies 6 to 8MHz of spectrum and effectively blocks up the whole 70cm band. Don't you believe it! In practical terms 90 per cent of the radiated energy is confined to 1MHz either side of the carrier, with the remainder of the power spread over the rest of the sidebands. ATV signals are generally radiated by technically more competent operators, using directional aerials, and the risk of harmful interference is very much reduced. The thoughtful ATV station operates high in the band (centred on 436 or 437MHz) and uses a bandpass filter, which minimises interference further. Tests made in Germany and the USA show that the use of horizontal polarisation can avoid interference with repeaters and minimise problems for satellite operators.

Why am I going on about this? Because in West Germany ATVers are already losing the battle. Shortly they will be forbidden to use normal wideband ATV in the 70cm band on Wednesdays ('Mode L Day' of the Phase 3 satellites) and within two years they will have to move off the band altogether. If 23cm is withdrawn as well, it makes for a pretty poor future for the Germans. The substitute offered to ATVers there is SATV, a sort of 'fast-scan, slow-scan TV'. SATV is in fact a narrowband 625-line system, with its video bandwidth restricted to 1MHz and on-carrier FM audio. Additional equipment is required to transmit and receive SATV, and it is not really compatible with the ATV operated in other countries.

SATV is obviously better than nothing, but I should hate to be forced to give up 'normal' ATV. If you think along the same lines as me, please take this article to heart and make sure it doesn't happen here. All we need is more understanding.

After all this preaching, let us get back to the technical topics with which we are more at home.

Several stations start off with a single camera, often an ex-surveillance job, and then expand to an electronic test card generator, such as Colin Edwards' design featured recently in *R&EW* (in fact I have just got one myself and I think it's excellent). Next comes a computer or a video recorder and the question asked is how can one superimpose and mix the pictures, so that graphics can be inlaid onto the other vision sources.

The simple solution is like 'crash editing' on VCRs – it doesn't work! Each vision source has its own timing system and if you try to superimpose one picture on another you get horrible tearing effects, since the signals are not synchronised together and the sync pulses are not occurring simultaneously. There is no easy answer and the various vision devices will have to be 'got at' and modified so that they will accept a uniform, external timing signal. This is fairly easy on most cameras, less easy on most computers and quite impossible on the average video recorder. Furthermore the syncs of a VCR are not that stable over any period of time anyway.

This tiger looks diffident because he has lost his superb colours. He belongs to G3YCV who transmits colour SSTV (slow scan TV) from Cliffsend on the Isle of Thanet.

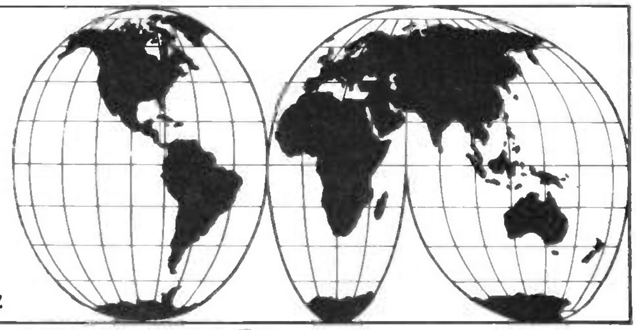
It will help if your camera is 'genlockable' – in other words, if it can be taken over by an external timing signal. Normally this would be a sync pulse generator (SPG) but a simple and acceptable solution would be to synchronise the camera to the VCR, computer or another camera instead. Some surveillance cameras come with a genlock option, for example Sony's small b/w home video camera and JVC's G-71 and S-100 colour cameras. Having locked one camera to the other video source you can set about building a vision mixer. (Appropriate circuits have appeared in CQ-TV recently.)

Alternatively, you can buy vision mixers. One of the lowest cost commercial units is the British-made VM-1 from Video City Productions in London. It is specially designed for use with two colour cameras or a combination of one camera and a VCR, one camera having to be capable of genlocking. The range of effects is quite amazing for such a small unit, including cuts, mixes and all combinations of horizontal and vertical wipes. There is also a drive output for black and white key cameras which can be used to 'key' (electronically cut) captions or to produce special shapes for effects. Fade and key levels are variable. A glance at the accompanying picture may give you a better idea of what it does. I haven't got my hands on one yet, but if it's as good as the company's Videomatte editing box it should be excellent. Price is not given: the first estimate was just below £200 but this may have changed.

That's it for this time – see you again next month and don't forget to write to me care of the Editor.

■ R&EW

SHORT WAVE NEWS FOR DX LISTENERS



by Frank A. Baldwin

All times in GMT, Bold figures indicate the frequency in kHz

Continuing our review of some of the Latin American stations that may be logged by listeners here in the UK during the present 'season', the country in focus this month is Peru. Those readers requiring information on the LA stations dealt with so far will need to order the last five issues from the R&EW Subscriptions Dept, 45 Yeading Avenue, Rayners Lane, Harrow, Middx HA2 9HL.

Peru conjures up in most minds the high Andean Altiplano, llamas, quipu and the Incas – an Indian nation which built a great empire with an advanced civilisation, only to be overthrown by the Conquistadors from Spain in 1533. Having set the scene and the era we come to the present day with details of the following difficult to receive Peruvian stations.

Radio Difusora San Martin in Tarapoto operates on **4810** with a 1kW transmitter, in the main from 0930 to 0430 (Sunday until 0300) but occasionally on a 24-hour schedule. Despite several attempts I have not yet succeeded in identifying this one although it has been reported by a few listeners in the UK.

Radio Amazonas, Iquitos, formerly identifying as Radio Samaren on **4815**, is now to be found on **5060**, where it is scheduled from 1100 to 0700 at 1kW. The difficulty with this one is that it is covered by Radio Dif. Nacional Progresso with its 20kW signal and 1000 to 0500 schedule. It also, however, has been logged by some UK DXers.

Then there is Radio Andahuaylas at 0.8kW which closes at 0300 but more often than not it is buried under Radio Valera in Venezuela with its 1kW transmitter. Nonetheless, I have seen this Peruvian reported by DXers in the SWL press during this very year. The channel is **4840** if you are interested.

In Huancavelica the local station is on the air from 1100 to 0500 with a power of 1kW. Radio Huancavelica has featured in several logs this year – including my own. The **4885** channel it uses is shared with a couple of Brazilians (although one of these is inactive at present) so you will need to tune to this frequency just prior to the closing time in order to obtain that vital station identification – unless of course you are able to differentiate between Spanish and Portuguese – the latter being used by the Brazilians.

Radio Ondas del Titicaca in Puno is nominally listed on **4920** but it is in fact on **4921** or sometimes **4922** with its 1kW transmitter operating from 0945 to 0300. This one is almost co-channel with the more powerful (10kW) Radio Quito in Ecuador (on **4920**) scheduled from 1000 to 0500. This is probably why I have never managed to log this Peruvian bearing the name of the highest lake in the world.

Radio Municipal in Abancay is on **4934** from 1100 to 0400 at 1kW but is very seldom reported, although the nearby Radio Tropical on **4935**, dealt with in a past issue, has proved relatively reliable here in these islands.

OAX71 Radio Madre de Dios in Puerto Maldonado operates on a variable **4951** from 1100 to 0230 with a 5kW transmitter and is therefore quite often logged by DXers.

Within the confines of Huancayo is Radio La Merced which is scheduled from 1100 to 0500 at 1kW on **4959** but also reported on **4960** whilst in Quillabamba is the 5kW OAX7Q Radio Quillabamba which is on the air from 1030 to 0300 (Sunday from 1100 to 0200) on **5025** where it is often reported dominating a channel shared with a Brazilian and a Colombian.

On **5035** there are no fewer than three Peruvian stations: OBF7X Radio Ayaviri scheduled from 1100 to 0400 at 1kW; Radio Ilo reportedly from 0400 to 0420 at 1kW and Radio Imagen from 1030 to 0500 also at 1kW. Of these, the first mentioned is that station most often logged and reported.

Radio Libertad in Junin is listed on **5040** where it operates irregularly, but when it is on the air it is timed from 1130 to 0630 and uses a 1kW transmitter.

OAX9L Radio Rioja is to be found on **5045** where it is scheduled from 1030 to 0400 although the latter can vary from 0300 on occasions. Listen after 0300 at which time the Brazilian Radio Cultura do Para at 10kW closes.

In the conclusion of the Latin American review next month, I will discuss a few Brazilians, Ecuadorians etc – having first tied a few knots in my quipu to remind me.

Around the dial

In which are listed the frequencies, the times and the programmes which will prove of some interest both to the short wave listener and to the DXer.

EUROPE

Albania

Tirana on **16230** at 1108, YL with a talk in the Chinese programme for China, scheduled from 1100 to 1200 on this out-of-band channel.

Belgium

Brussels on 17610 at 1442, OM with a talk about the Common Market in the English programme for North America and the Far East, on this channel from 1400 to 1445 but not on Saturday or Sunday.

Brussels on **17595** at 1058, chimes interval signal, then OM with station identification and the Dutch transmission for Africa, scheduled from 1100 to 1230 but not on Sunday.

Bulgaria

Sofia on **17825** at 1129, interval signal, YL with station identification 'Huna Sofia' at the start of the Arabic transmission for North Africa and the Middle East, timed from 1130 to 1230.

Czechoslavakia

Prague on **17840** at 0729, interval signal, 'pips' time-check at 0730, OM with station identification in English in the 'Asian and Pacific Service' and the programme in that language for Africa, the Far East, the Pacific and South Asia, scheduled from 0730 to 0800.

Poland

Warsaw on **7285** at 1838, YL presenting a news commentary in the English programme for Europe, timed from 1830 to 1900.

Warsaw on **9525** at 1835, YL with station identification and a newscast during the English transmission to Africa, scheduled from 1830 to 1900. Also on **9675** at 2020, OM and YL with a talk about local matters in an English programme for Africa, aired from 2000 to 2030.

Switzerland

Berne on **17830** at 0059, OM with station identification at the end of the Italian programme for South America, timed from 0030 to 0100. OM with identification and into a Spanish transmission for the same area and timed from 0100 to 0130. Also logged in parallel on **15305**.

AFRICA

Benin

ORTB (Office de Radiodiffusion et de Television du Benin), Parakou on **5025** at 1927, OM with a song in vernacular followed by OM with announcements in French. Also logged at 0453 the following day, this being a much better time for reception of this new regional transmitter.

Bonaire

Radio Netherlands Relay on **17605** at 2040, OM with a news review in the English programme for Central and West Africa, timed from 2030 to 2120.

Libya

Tripoli on **17930** at 1137, when radiating a programme of Arabic songs and music in the Domestic Service. Operating on this channel from 1100 to 1745.

Madagascar

Radio Netherlands Relay on **21480** at 1440, OM with YL and a news commentary in an English programme intended for the Far East, South Asia and timed from 1430 to 1520.

Morocco

Rabat on **17815** at 1141, YL with a song in Arabic complete with local-style orchestral backing in a Domestic Service relay which may be logged on this channel from 1100 to 1700.

Rabat on **17710** at 2040, OM announcer presenting local songs and music in a relay of the Domestic Service, on this frequency from 2000 to 2100.

Seychelles

Mahe on **15405** at 1158, OM with the Arabic programme for the Middle East and North Africa, YL with station identification, chimes time-check and off at 1200. The Arabic transmission is timed from 1100 to 1200.

South Africa

Johannesburg on **25790** at 1459, dance music in the 1950's style, time 'pips' at 1500, OM with announcements and the station identification during an English transmission beamed to Africa, Europe and the Middle East, scheduled from 1300 to 1600 on this channel.

Uganda

Soroti on **5027** at 0345, OM with a talk in Swahili in the National Programme which is on this channel from 0300 to 0545 Saturday and Sunday, from 1300 to 2100 weekdays, from 1400 (Sunday from 1430) to 2100 Saturday and Sunday. The power is 250kW.

AMERICAS

Antigua

Cologne Relay on **17795** at 2008, OM with a newscast in the German programme for Africa and Europe, timed from 2000 to 2200. Also logged on parallel in **17810** from Antigua and on **17860** from Cologne.

Brazil

ZYE368 Radio Nacional, Brasilia on **6065** at 0255, OM with a sporting commentary in Portuguese, all exciting stuff! This one operates from 0900 to 0300 with a power of 10kW.

Canada

Montreal on **17875** at 2028, OM with the English programme for Africa and Europe timed from 2000 to 2030. Closing announcements and then into the French programme at 2030. Also logged in parallel on **17820**. This programme Monday to Friday inclusive only.

Colombia

Radio Super in Medellin on **4875** at 0406, OM with a ballad in Spanish complete with guitar backing. This one operates on a 24-hour schedule and the power is 2kW.

Ecuador

HCJB ('Herald Christ Jesus Blessing'), Quito on **17790** at 2031, YL with station identification followed by OM with the French programme for Europe, scheduled from 2030 to 2100.

HCJB, Quito on **9715** at 0557, OM with station identification and announcements during an English transmission intended for North America and aired from 0500 to 0700.

Radio Luz y Vida, Loja on a measured **4851.7** at 0420, OM with a local pop song in Spanish. Sign-off was at 0430 without the National Anthem but after station identification and announcements by a YL.

Peru

If you are new to 60 metre band DXing, then probably the easiest Peruvian to log is Radio Atlantida in Iquitos from where it operates on **4790** with a 1kW transmitter. Logged recently at 0414 when radiating a programme of local pop music. The schedule of this one is from 1030 to 0500 (Sunday from 1130 to 0400).

Venezuela

YVTO Observatoria Naval Cagigal, Caracas on **6100** at 0054, second time pulses, OM with identification in Spanish at 0056. This is a time signal station with second pulses of 1kHz modulation with 0.1 seconds duration, each minute being marked by a 800Hz tone of 0.5 second duration. Each 30th second is omitted and a voice identification is made between the 52nd and 57th second of each minute. The power is 1kW on a 24-hour schedule. The address for reports (QSL's are issued) is Tecnico Encargado, Observatoria Naval Cagigal, Apt. 6745, Marina 69-DHN, Caracas 103.

Radio Frontera, San Antonio on **4760** at 0147, OM announcer presenting a programme of local pop records. This one operates from 1000 to 0300 with a power of 1kW.

ASIA

Bangladesh

Dacca on a measured **4879** at 0140, OM with some songs in Bengali complete with a backing of typical local-style music. This is the Home Service which is scheduled from 0000 to 0305 with a power of 100kW.

China

Radio Beijing on **17605** at 0915, OM in Chinese, musical interludes in a Domestic 1st Programme presentation. The 1st Programme is on this channel from 0300 through to 1000 (but not from 0600 to 0855 on Wednesdays). Also on **9860** at 1902, OM with news of local events in the English transmission to Europe, scheduled from 1900 to 2000.

Xizang PBS, Lhasa, Tibet on **4750** at 2310, OM with songs in Chinese. This section of the Chinese schedule is from 2230 to 0200 (Saturday until 0400).

India

AIR Delhi on **17705** at 0732, YL with a newscast, mainly about local affairs, in an English news slot timed from 0730 to 0740. Also on **17780** at 1155, YL with a song in Hindi during the Burmese transmission for South East Asia, scheduled from 1115 to 1215.

Japan

Tokyo on **17785** at 0800, interval signal (music box), YL with station identification in Japanese at the start of the programme in that language directed to the Americas, the Far East and Europe, timed from 0800 to 0830. Also on **17870** at 0815, OM with station identification, OM and YL with an English/ Japanese language lesson in the English programme for Europe, timed from 0800 to 0830. Also logged in parallel on **21610**, this being the better reception of the two channels at this particular time.

Pakistan

Karachi on **21802** at 1100, YL with station identification and a newscast in English read at slow speed, this being timed from 1100 to 1115.

The **6080** channel which I mentioned in the last issue as opening at 0100 is in fact Karachi with a programme in Hindi for South East Asia and scheduled from 0100 to 0215.

USSR

Moscow on **9800** at 0555, OM with a programme of jokes – judging by the frequent laughter – and songs in the Russian programmed 'All Union Radio' for European SSR, Armenian SSR, Azerbaijan SSR, Georgian SSR, the North Caucasas and the Lower Volga. On this channel 0400 to 1700. Also heard in parallel on **9775** where the programme is scheduled from 0000 to 1700.

AUSTRALASIA

Indonesia

RRI (Radio Republik Indonesia), Jakarta on **11790** at 1602, OM with quotations from the Holy Quran in the Arabic programme intended for the Middle East and scheduled from 1600 to 1700. Also logged in parallel in **15150**, the former channel being the best for UK listeners.

Australia

Melbourne on **17870** at 0722, OM with a talk on diet and health in the General Service English programme which is on this frequency from 0100 through to 0800. Also logged in parallel on **15240**.

Melbourne on **17795** at 0518, OM with a talk during the French transmission intended for Africa and the Pacific from 0500 to 0600.

Melbourne on **17725** at 0213, OM with a talk in English about local government in Australia, this transmission being intended for North America and the Pacific at the time reported.

CLANDESTINE

'Voice of the Sudanese Popular Revolution' on **17940** at 1619, OM with a talk in the Arabic programme, scheduled from 1330 to 1630. A rousing marching chorus at 1630 and carrier off at 1633.

Radio Bardai, Chad on **6009** at 1915, a few bars of pipe music, OM talk in vernacular 'Radio Bardai' or 'Chad National Radio, the Voice of Liberation' ('Radiodifusion Nationale Tchadienne, La Voix de la Liberation') claims to be located in Bardai which, on my globe, is shown as being located just south of the Libyan border in northern Chad. It operates, as far as I can tell, from 1800 to 2000.

Now Log This

In which are presented details of a station for your special interest. This month, try for an old 'friend' of mine – Radio Andina, Huancayo in Peru. It operates on **4996** from 1000 to a variable closing time around 0500. The power is 1kW and the voice transmission is apt to sound slightly low-pitched with a minimal echo-effect, probably because the studio is stone-walled. Best time to listen here in the UK is from 0400 onward. The address is OAZ4C Radio Andina, Cas. 40, Chilca, Huancayo, Peru. Let us hope the Shining Path underground organisation hasn't raided the station before this appears in print!

Now Hear This

Radio Candip (La Voix de Education et Development), Bunia in Zaire on a measured **5066** at 1827, YL with a song in vernacular then OM and YL alternately with announcements in French. This one operates Monday to Friday 0400 to 0730 and from 1500 to 1900 (Thursday and Friday to 1830); Saturday from 0400 to 0730 and from 1230 to 1730; Sunday from 1230 to 1835. The power is 1kW and the frequency varies from that given above to **5067**.

DX-TV Reception Reports

Complied by Keith Hamer & Garry Smith

Despite a slow start to the Sporadic-E season, reception during June exceeded all expectations. Reception occurred almost daily with signals from the south-east predominating. Several lucky enthusiasts in the UK witnessed multiple-hop SpE reception from African and Middle Eastern countries and we have even had a report of trans-Atlantic reception on 2nd July.

An excellent tropospheric lift on 18th and 19th June produced good quality pictures from West Germany, France and Belgium. There were many Continental amateur television (ATV) stations noted too and the night owls amongst us saw several strange signals during the early morning of the 19th.

Reception Pattern

A similar pattern of build-up in reception repeated itself on most days. RAI-Italy was usually the first visitor on channel IA with a blank raster, going on to the PM5544 test card at 0800. Television Espanola (TVE-Spain) was a typical lunchtime occurrence with regional test cards preceding programmes. Late afternoon often produced intense activity from the south-east with Albania (RTS) on channel IC making an appearance on several occasions. Yugoslavia (JRT) and Hungary (MTV) were also popular signals. The Rumanian Bucharest channel R2 outlet was frequently seen around 1740 BST using the EBU bar pattern with 'TVR' identification followed by its distinctive monochrome test card until the programme opening sequence at 1755 BST.

A few test card variations were noted during the month. TVE were seen on E4 using the GTE colour pattern (this was featured last month) with 'BARCELONA' at the bottom in lieu of 'tve 1'. Telewizja Polska (TVP-Poland) radiated the identification 'TVP NTD' on the 20th but subsequent sightings indicated a return to the usual dark PM5544 without any identification. Albania was noted on the 15th transmitting the PM5534 (the PM5544 with a digital clock insert) with 'RTSH' at the top and 'TV SHQIPTAR' in the lower rectangle. This was subsequently followed by the RTS identification caption at 1630 BST. The introduction of the PM5534 may herald the end of its unique monoscopic test cards — but that's progress!

Service Information

United Kingdom: BBC Trade Test Transmissions have now been totally replaced by sample pages of Ceefax. This means that the very familiar Colour Test Card 'F', which has been radiated almost daily since 1967, has finally been discontinued. There will be further details in next month's column.

Jordan: There is speculation that the channel E3 outlet operated by JTV is to be closed due to problems with co-channel interference in the Hashemite Kingdom. It is thought that the 104kW transmitter at Suweilih (which has provided DX-TV enthusiasts with 'exotic' reception in the past) will be replaced with a UHF outlet.

Hungary: There are several Russian relay transmitters in operation radiating material from TSS. At present all relays are in Band III and are low-power.

The above information was kindly supplied by Alexander Wiese (West Germany), Goesta van der Linden (Netherlands) and the BBC Engineering Information Department, London.

Reception Reports

Highlight of the month for Hugh Cocks (Robertsbridge, East Sussex) was the appearance of Dubai's 'square' PM5544 test card on channel E2 on 16th June, going on to programmes at 1100 BST. Nigeria and TVE-Canary Islands (both on channel E3) have been two other DX successes. Hugh also comments that SW harmonics from the south have spread as high as 55MHz. This phenomenon has occurred more times this year than in any other year.

Over in East Anglia, Clive Athowe (Blofield) saw NTV-Nigeria on channel E3 at 1300 BST on 11th June while Ray Davies (Happisburgh) watched a subtitled film during the early hours of the 19th on channel 35 from a Dutch pirate station.

The 20th was a memorable day for Leeds DXer Mike Allmark. At 1000 BST he saw TVE-Canary Islands on E3 radiating the test pattern which displayed the 'IZANA' transmitter identification while from the other direction he noted the Norwegian PM5534 with the inscription 'NORGE KAUTOKEINO'. The latter transmitter is situated some 200km inside the Arctic Circle. The 35W Radio Televisao Portuguesa (RTP) E4 relay was also noted. Later in the day, while RTS-Albania was received on channel IC (82.25MHz), Mike observed that the 2m amateur band was wide open to Malta and Sicily but a hopeful check on the lower Band III television channels E5 and E6 proved fruitless.

Cyril Willis (Little Downham, Cambs) had a field day with DX during the month. On the 16th Jordan was seen on test and an Arabic programme thought to be of Jordanian origin appeared on channel E3 on the 28th. Albania on IC and Rumania on R2 featured regularly in his log. On the 17th at 0330 (!) BST he found Band I jammed with Italian pirate FM stations. Another sleepless night rewarded him with similar reception on the 18th. On the following day, with the aid of a tropospheric lift, Cyril saw several Continental ATV stations. These included PE1GVS, PE1DWQ (in colour), PA2KIE, PE1HLR (150W), PE1DWA and PA3CHH from the Netherlands, DC0BV (Bremen), DDSSE, DL1YAQ from West Germany and ON58D from Belgium. Also of interest were British Forces Broadcasting Service (BFBS) relays from West Germany with noise-free colour and the American Forces Network test pattern on channel 26, the latter being 625-line, rather than the 525-line standard.

Simon Hamer (New Radnor, Powys) has been very active using a newly acquired MOSFET VHF tuner. Last May he saw Czechoslovakia with the 'CST-1 TV BRATISLAVA' PM5544 test card plus the EZ0-type with the identification 'RS-KH' on channel R1. On 3rd June he noted CST again (at 2045 BST) with a news programme identified by the initials 'tn' (an abbreviation for Televisni Noviny). Reception was on channel R2 (59.25MHz vision) whilst at the same time, but on channel E2, signals from TVE-Spain were observed. Obviously 12th June was a good day at Simon's location as he noted programmes from Italy, Poland, Spain and Rumania. Commercials from MTV-Hungary were positively identified on channel R1 by the advertisement spot called 'TV REKLAM'. Other noteworthy reception included the Italian pirate station NCT on IA/E3 and the 'RUV ISLAND' test card from Iceland on E4. Due to Simon's position at the foot of a range of hills he has had to wait two years to see any sign of RUV and he only succeeded this time by directing his array vertically rather than horizontally!

From Malta, we have received details of DX-TV reception by G Borg. Although a newcomer to the hobby he has noted programmes from DDR:F1 (East Germany) on E4 of exceptionally high quality. Also received on E4 during June was the French-

Figure 1: A unique monoscopic test card used by RTS-Albania.

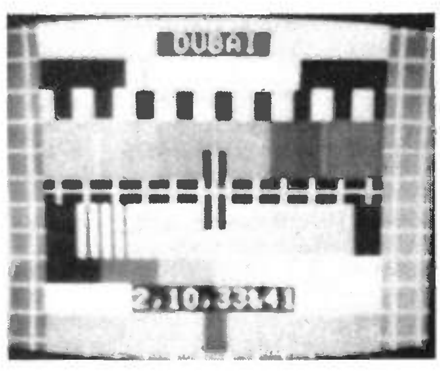


Figure 2: The 'square' PM5544 test card radiated by RCTV-Dubai which includes channel allocations.

language service in Switzerland using the '+PTT SSR 1' FuBK test card while, on UHF, a test card appeared from an Arabic country. We are eagerly awaiting the arrival of a photograph in an attempt to identify the station.

Robert Panknen (Murcia, Spain) has logged signals from many countries via SpE during the month. He has seen some BBC-1 transmissions from obsolescent 405-line transmitters in Band I. System A signals from the UK have also been received in Zimbabwe and South Africa. Incidentally, the British 405-line service is due to close down next year and during the interim period, to the delight of British DXers, many of the outlets will operate on reduced power.

From Rotterdam in the Netherlands, Goesta van der Linden has written with details of his DX-TV reception during June. On the 20th he noted Spanish test cards from Aitana, Santiago, Gamoniteiro and Barcelona plus sample pages from TVE's teletext service. The Norwegian PM5534 test card was seen from three NRK outlets (Melhus, Hemnes and Gamlesveten) and later in the day two Swedish transmitters were noted on E3 (Skoevde and Sveg). The Polish test card was received on channels R1 and R2 carrying the inscription 'TVP-NTD' from about 1215 BST. With the aid of enhanced tropospheric conditions, Goesta noted a variety of transmissions from outlets located in Belgium, Sweden, France, West Germany, East Germany and the UK.

Never Too Late

Although we are now into September, it isn't too late to try for DX-TV. Sporadic-E activity often continues into the Autumn but at a reduced level. A useful book for the TV-DXer has been published, called 'Long Distance Television for the Enthusiast' by R W Bunney. It's available at £1.95 (plus 40p P&P) from HS Publications, 7 Epping Close, Derby DE3 4HR.

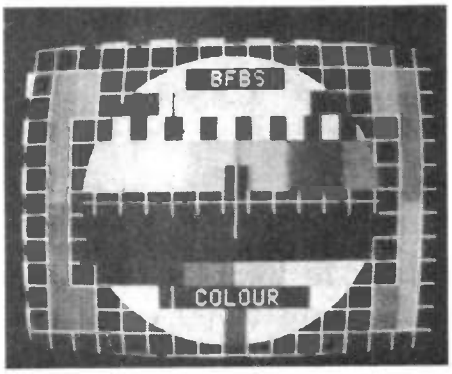


Figure 3: The standard PM5544 radiated by the BFBS in West Germany. Photo courtesy of Juergen Klassen (Berlin).

Figure 4: An unusual test card used by one of Italy's thriving pirate television stations.

Television Italiano Style

There are plans to close the Italian transmitters operating on channel IC (82.25MHz) very shortly. The only high-power outlet which can be received in the UK is Torino. Private mobile radio is to be permitted between 52MHz and 68MHz in areas where the TV services of RAI do not use Band I channels IA or IB. This could be the start of a gradual phasing-out of Bands I and III television in Italy.

Throughout the country, pirate television rules the airwaves with practically every available TV channel in use. Even the main police station in Milan has several illicit transmitting masts on top of the building! A form of 'squatters rights' situation has developed with pirate transmitters being left on the air 24 hours a day to prevent new stations from taking their frequencies. Many services are networked by several transmitters, each adding their own identification in the form of station logos in the corner of the screen. Services from other countries such as Tele-Monte-Carlo (Monaco) and TV-Koper Capodistria (Yugoslavia) are rebroadcast in the north of Italy, particularly in the Lombardy region. ■ R&EW

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Next Month

DESIGN FEATURES

Squelch systems
Two front-ends — More Communications Building Blocks
The structure of HF signal coils
Construction and alignment of the R&EW FM tunerset

REVIEWING:

- *New low cost DFMs, made in the UK — by Black Star*
- *Text and information manipulation with Personal Pearl*
- *The NE564 PLL Tone Decoder*

RADIO & ELECTRONICS WORLD

EXPANSION BUS

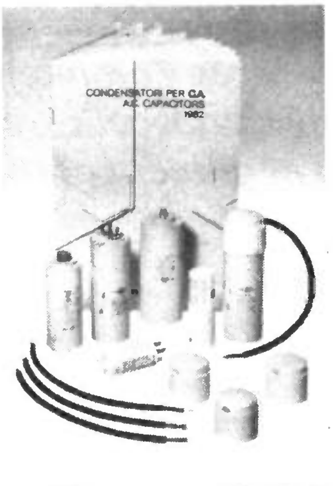
R&EW is establishing a regular feature series that looks into the huge industry that has grown up to support popular home computers — and which delivering some fascinating applications ad-ons, "go faster" accessories, and hardware that provides great scope for innovative enthusiasts. We evaluate and describe some of the more notable ideas that pass our way.

November Edition
On Sale
20th October

Please note that the Articles mentioned here are scheduled for the November issue but circumstances may dictate alterations to the final content of the magazine.

NEW PRODUCTS

Precision-made Capacitors



Ducati capacitors are precision-made devices for which a life of up to 30,000 hours is claimed. The range, which is being marketed in the UK by Hale Instruments (the sole importer), covers 2–60μF. In the 2–5μF range, there are no studs but the next range up includes a nylon M8 stud (complete with crinkle washer and nut) while the 16–60μF range incorporates a metal M8 stud. The insulating caps that cover the terminals are made of plastic.

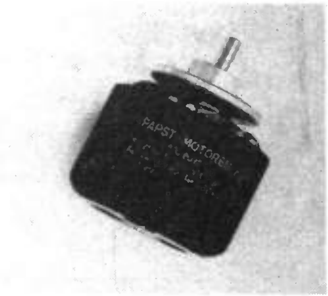
The capacitors have VDE approval and applications are envisaged in the manufacture of white goods, pump motors and general electrical appliances.

Hale Instruments Ltd
Manor House
Manor Road
Altrincham
Cheshire
WA15 9QX

AC Motors

The Papst range of AC motors covers a wide variety of both synchronous and non-synchronous devices. But perhaps of most interest are the 'unique' range of eddy current motors, which have the high starting torque characteristics of DC motors but the lower cost and longer operational life of AC devices.

The B195 is an example of this range, being an eddy current external rotor motor that operates from a 220V/50Hz supply and generates a torque of 11.3N cm at 600 rpm. A feature of its slotless external rotor is a lack of 'cogging' in the rotor movement, which ensures 'very smooth and quiet running with excellent speed stability'. Another member of the series is the B295, shown here.



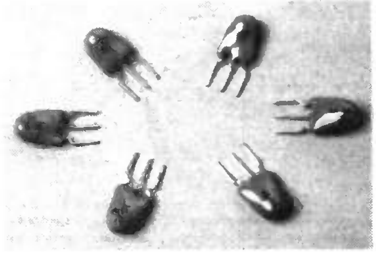
Papst Motors Ltd
East Portway
Andover
Hants
SP10 3RT

Novel capacitors

Sprague has developed a new range of capacitors that are impossible to insert backwards and will thus save both the time and the money wasted as a result of backward installation of standard two-lead capacitors. The secret is in the triple-lead construction of these new Tantalex (solid tantalum) capacitors, which have been designed with the complete range of consumer, commercial and industrial electronic equipment in mind. These Type 299D capacitors operate over a −55 to +85°C temperature range, or (with derating) to 125°C with two-thirds of the 85°C voltage. They are protected from moisture, mechanical damage and other environmental stress by a conformal coating of hard, flame-retardant resin.

Type 299D capacitors are available in four miniature case sizes with voltage ratings of 3–35VDC and capacitance values of 0.1–150μF. While the standard tolerance on the capacitance is ±20%, ±10% devices are available if required.

Sprague Electric (UK) Ltd
Salbrook Road
Salfords
Surrey
RH1 5DZ



Microwave Sweeper

Racal-Dana Instruments has announced the availability of a new range of microwave sweep oscillators covering the range 1–18.6GHz. The Model 928 range comprises six expandable instruments – the basic version covering 1–8GHz – that are fully GPIB controlled. Moreover programming the devices is simpler than you might expect because the GPIB mnemonics are in English.

The sweepers all have an interactive CRT on which all functional data (as well as warning and error messages) are displayed to allow rapid assessment of their operational status. This data can be stored in any one of nine non-volatile memories and it can be recalled by one keystroke, making it possible to treat each memory as a complete test function. An internal 70dB programmable step attenuator is an optional extra on all the models, and with this the dynamic power range becomes +7dBm to −72dBm in steps as small as 0.1dB.

The characteristics of the top-of-the-range model include precision levelling typically to within ±0.05dB over 1GHz frequency bands and power flatness to ±0.3dB over the entire 1–18.6GHz sweep range.

Racal-Dana Instruments Ltd
Duke Street
Windsor
Berks
SL4 1SB

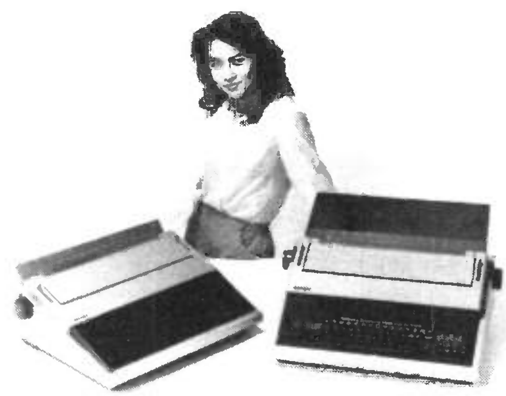
A Japanese handheld computer terminal

The Profort 801 is a tiny handheld computer terminal that has been developed in Japan by Intertek. This device is functionally equivalent to a standard VDU as far as any host computer is concerned as it has a full 128-line display memory (2048 characters), although only two lines of 16 characters can be displayed on its LCD screen at any time. Thus its use does not necessitate any software changes, although modification of the screen formatting procedures obviously wouldn't come amiss. However there are keys to allow the user to move the 'window' formed by the LCD display throughout the display memory.

Applications for the Profort 801 – which is available in the UK from Data Beta – are envisaged in field maintenance, testing and factory control when size and weight prove a problem, for this terminal only weighs 400g and will fit 'both large and small sized hands'. The terminal has 38 keys with which to generate the full ASCII character set and control codes, as well as some dedicated commands. The device also has an RS232 port that can operate at all standard speeds between 50 and 9600 baud, while 20mA current loop and TTL outputs can be supplied if required. In addition, the panel is electroluminescent and so can be switched on if the light level is too low.

Data Beta Ltd
23A Buckingham Avenue
Slough
Berks
SL1 4QA

NEW PRODUCTS



Electronic Typewriters

The KX-E701 and the KX-E708 represent the advent of Panasonic into the electronic typewriter market. Both feature a centralised control system with a master CPU and are thus able to offer such facilities as correction anywhere within the last 500 characters typed, simple relocation to the last typing position, three stored margin formats, automatic (i.e. electronically calculated and set) column layout; four-way centring; and expandable print – to name but a few. The KX-E701 (shown to the left) is seen as a standard electronic typewriter, though it comes with an impressive 1000 character phrase memory, allowing it to store addresses, salutations and other frequently used phrases. The KX-E708, however, is seen as a full feature display model designed to meet the needs of the automated office. It thus has such features as automatic text linking throughout its 8Kbyte memory (expandable to 32Kbyte) and multiple printout, as well as the various standard word processing functions.

The typewriters have already been shown in the States, but Panasonic does not plan to market them in the UK before mid-1984.

Panasonic Business Equipment (UK) Ltd
107-109 Whitby Road
Slough
Berks
SL1 3DR

For your EPROM

GP Industrial Electronics recently launched a new range of EPROM programming and emulation equipment that has been designed to cater for 'all the production and development requirements of engineers involved in microsystem design'. The range centres on three units – the EP-8000, the EP-4000 and the P-8000.

The first of these represents the top of the range and it has been specifically designed to both emulate and program all popular NMOS EPROMs, without needing any additional equipment such as personality cards because all the necessary software has been included and the device is able to configure itself 'automatically' to fit the selected EPROM. The EP-8000 also features enhanced video output (to allow the user to view the contents of any block of memory) and RS232 Intel ASCII-HEX and Motorola formats as standard. Data is loaded into its 8Kx8 static RAM from any of a pre-programmed EPROM, its own keypad, the serial and parallel ports and an audio cassette. The second device – the EP-4000 – is similar but smaller, being designed to work with EPROMs of up to 4Kx8.

While these two devices are designed for programming and microsystem development, the last unit – the P-8000 – has been designed purely for production programming. It can program up to eight devices simultaneously on a minimum programming cycle. Moreover it can be operated by semi-skilled personnel as it operates a 'simple to operate' menu system that is coupled to a self-test routine which can detect almost all operator and component errors.

GP Industrial Electronics
Unit E, Huxley Close
Newnham Industrial Estate
Plymouth
Devon
PL7 4JN

Automatic RF power meter

Marconi Instruments recently launched a new automatic RF power meter – the 6960 – which is said to provide 'sensitivity, speed, accuracy and ease of use for microwave engineering applications'. The 6960 is microprocessor-controlled and so offers such features as auto-range, auto-calibration, auto-zero, average time and power-up mode selection, power linearity correction and full GPIB compatibility, while novel aspects of the circuitry are said to have virtually eliminated zero drift and range errors, as well as providing self-checking and diagnostic facilities. The auto-calibration, by the way, is achieved by switching on a 50MHz power reference and adjusting the gain to suit the sensitivity of the sensor being used – in response to a single keystroke.

Other key features include response times down to 25msec (which is particularly important for GPIB operation) and an offset facility that allows high powers to be measured. The meter has an LCD module on which the power is displayed in either linear or logarithmic form, while relative measurements are shown when it is operating in dB REL mode. An analogue meter is also provided to aid fine tuning adjustment. The power range with the firm's 6910 RF power sensor is from –30dBm (1μW) to + 20dBm (100mW) over the frequency range 10MHz – 20GHz.

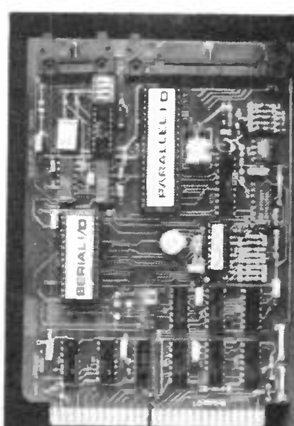
Marconi Instruments Ltd
Longacres
St Albans
Herts
AL4 0JN

Calendar clock card

Apoloco has produced a battery-powered calendar clock card as part of its FLEXSY S scientific/industrial microcomputer range. The clock gives 13 timer functions: tenths of seconds; seconds; tens ~~of se~~conds; minutes; tens of minutes; hours; tens of hours; day of week; unit of day; tens of days; months; tens of months; and automatic leap year calculations. It has been designed to STD bus standards and it incorporates both serial communication and parallel input/output facilities, the idea being to make it particularly attractive to users wanting to build STD-based systems for monitoring and process control applications, where unambiguous timing and dating of events is demanded.

The card's serial communication facilities are based on an RS232C interface with asynchronous operation up to 9600 baud and full duplex operation, while 16 unbuffered I/O ports can be switch selected to give various combinations of input and output. These parallel ports are compatible with buffered industrial I/O module racks that allow optical isolation, high power output and high voltage input.

Apoloco Ltd
90 King Street
Newcastle
Staffs
ST5 1JB



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007 SPY. Lets you stop and copy any Spectrum cassette. One cassette £3. Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs.

DIGITAL WATCH REPLACEMENT PARTS. Batteries, displays, backlights, etc. Also reports, publications, charts, S.A.E. for full list. Profords, Copners Drive, Holmer Green, Bucks. HP15 65GF.

RADIO AUSTRALIA, Peking, Canada, Voice of America. A Vega 206 (6 x SW/MW/LW) pulls these and dozens more. £23.45. Year's guarantee. Return despatch. Radiowatch, Building 109, Prestwick Airport, KA9 2RT.

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AUDIO JUMBLE (Bayswater). Including CYCLE JUMBLE/MUSIC JUMBLE. Once only secondhand bazaar, Saturday 8th October, 1 p.m. to 4.30 p.m. St James' Hall, Gloucester Terrace, London W2. (Near Lancaster Gate tube). Sell off your unwanted equipment – immediate stall bookings half-price!! S.A.E. to 67 Liverpool Road, London N1 ORH. (Phone; 01-837-7811).

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EVENTS: MOBILE RALLIES

September 17–18th	Great Home Entertainment Spectacular	Olympia	Montbuild Ltd 01-486 1951
September 18th	Peterborough R&ES Mobile Rally	Wirrina Sports Stadium, Peterborough	DT Wilson Peterborough 76238
September 20–22nd	Sensors and their Applications Conference and Exhibition	UMIST	Institute of Physics 01-235 6111
September 22–23rd	Seminar on Laser Technology	Tara Hotel, London	State of the Art Ltd 01-242 4045
September 24th	Ballymena & DARS 10th Annual Rally	Ballee High School	GI4HCN
September 25th	Harlow Mobile Rally	Harlow Sports Centre	G8FRG
September 25th	Welsh ARC	Oakdale Community College, Blackwood	RB Davies, GW3KYA
September 27th	Sound Broadcasting Equipment Show	Birmingham	Point Promotions Ltd 0734 53093
September 28–29th	Seminar on Integrated Digital Communications	Holiday Inn, Swiss Cottage	National Computing Centre 061-228 6333
Sept 29th–Oct 1st	Personal Computer World Show	Barbican Centre, London	Montbuild Ltd 01-486 1951
October 2nd	Great Lumley ARES Rally	Community Centre, Great Lumley	Ian Blackman, G4OGQ
October 4–7th	Design Engineering Show	National Exhibition Centre Birmingham	
October 6–8th	Amateur Radio Retailers Exhibition	Doncaster	Fred Hopewell, G4PGC
October 12th	Talk on Slow Scan Television	Lincoln	G4STO
October 15th	Midlands VHF Convention	BTT Training School, Stone	JPH Burden, G3UBX
October 15–18th	EI – GI Convention	Ballymascanlon	
October 18–20th	Computer Graphics '83	Wembley Conference Centre	Online Conferences Ltd, Northwood 28211
November 1st–3rd	Electronic Displays '83	Kensington Exhibition Centre	Network Exhibitions 0280 815226
November 9th	Talk on Aerials	Lincoln	G4STO
November 11th	Broadcasting: Marconi to Channel 4	Theobalds Park College, Waltham Cross	Ralph Barrett 01-845 6807
November 11–13th	Hometech '83	Bristol Exhibition Centre	Stephen Hybs, Bristol 292156

Also:
Microfair — Electronic aids for the Handicapped.
Sheffield 26–30th September; Coventry 3–7th October; London 24–28th October; Cardiff 31st October–4th November; Edinburgh 28th November–2nd December.
Info: Handicapped Persons Research Unit, Newcastle upon Tyne (0632) 664061

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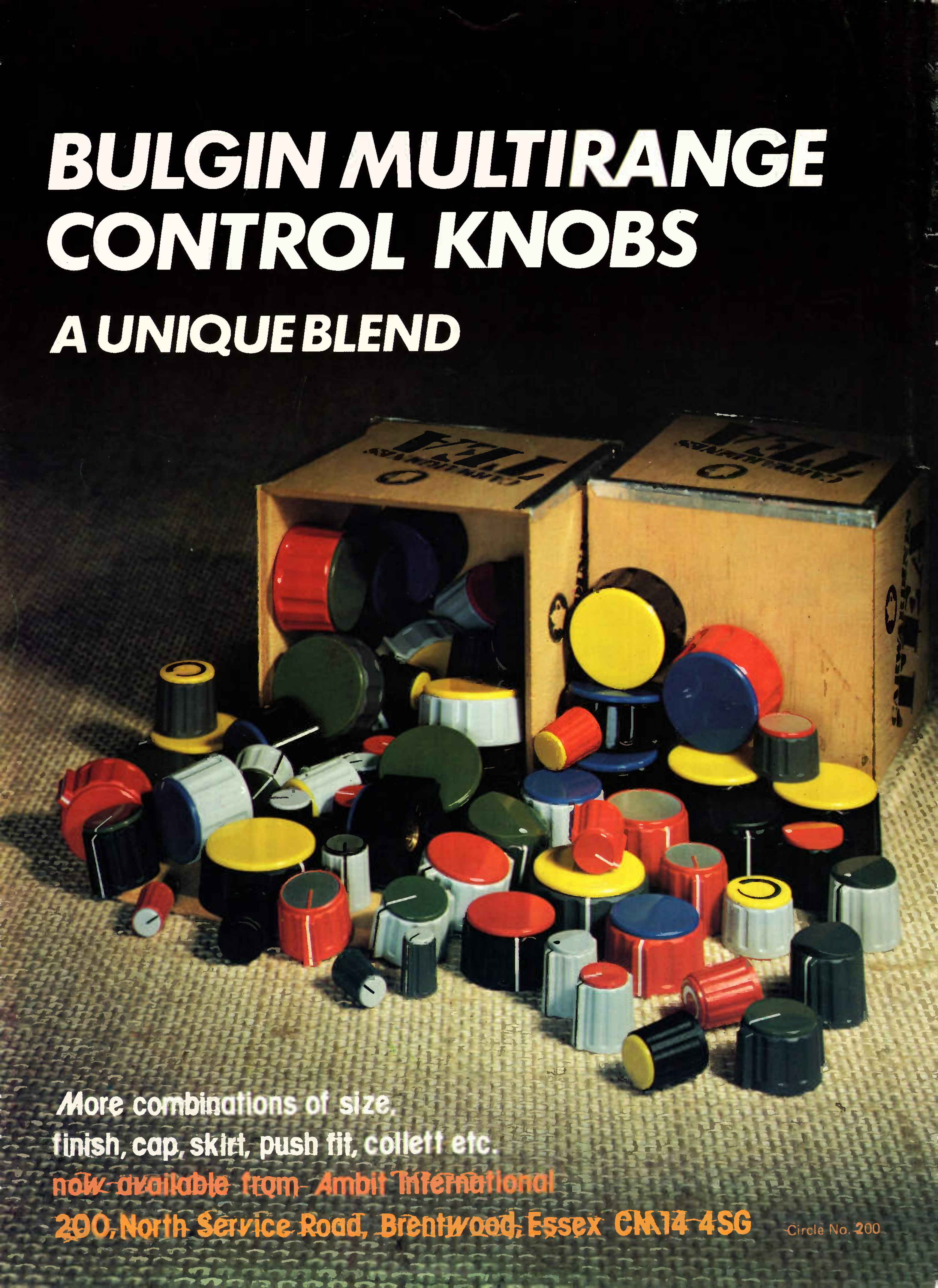
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