MAY 1982

RADIO & ELECTRONICS WORLD

ISSN 0262–2572

AUSTRALIA $1 85c
CANADA $2 95c
EIRE £1·04p
NEW ZEALAND $2 20c

70p

Getting to grips with Logic Analysers

UOSAT Monitor

THE UK'S LOWEST COST FULL SPEC NICAD BATTERIES READER OFFER

JRC'S NRD515 HF Receiver unravelled

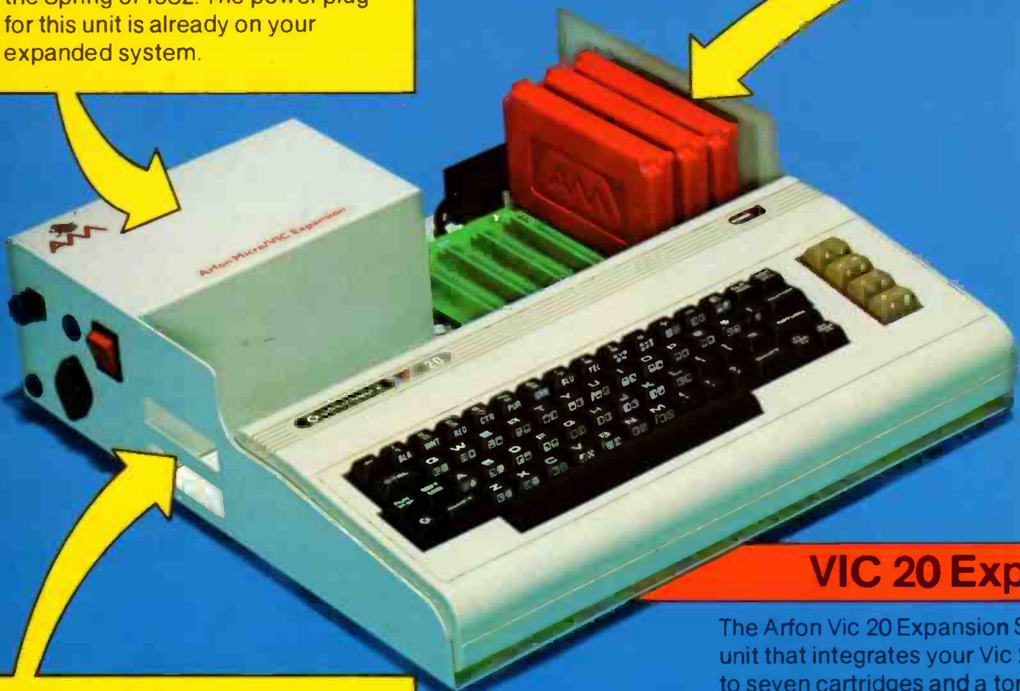
Thandar TA2080 Reviewed
Low Cost UOSAT Doppler Tracking Monitor
Video Recorders: Who Does What
Low Cost Radio Control

In-Car Computer
PH Meter
Databriefs: AM/FM Tuner
Balanced Mixer & Linear IF System

EXPAND YOUR VIC

OFFICIALLY APPROVED BY COMMODORE

From £85 plus VAT.



ARFON PRINTER

A low cost stand alone printer which will be almost essential for your larger programs will be launched in the Spring of 1982. The power plug for this unit is already on your expanded system.

EXPANDABLE TO 7 CARTRIDGES

You will now be able to use up to seven cartridges to expand from your basic Vic 20. These can include RAM memory expansion up to nearly 30K of usable memory, ROM cartridges with packaged programs, user expansion cartridges, printer software, disc software, RS232, IEEE interface, line expansion firmware and many others – besides of course all your games cartridges.

ARFON EXPANSION MEMORY

Immediately available from Arfon in cartridge are 3K RAM +2 sockets, 8K RAM, 16K RAM, 8K ROM, 16K ROM. Also a basic Vic simulator cartridge to allow tape and cartridge use without altering the system.

INTERFACES

Slots have been left to allow normal use of the cassette socket, disc socket etc., which will still run normally with your expanded system.

VIC 20 Expansion System

The Arfon Vic 20 Expansion System is a finished metal cased unit that integrates your Vic 20 with an expansion board for up to seven cartridges and a toroidal power supply (fully enclosed) to give you sufficient power for any expansion and also to power the Arfon Vic Printer. Your Vic and its screen modulator are incorporated into the expansion system to produce one unit and there is an optional lid that covers the expansion area and allows your T.V. to sit on top. Access to the various input sockets on your basic Vic 20 is not restricted while it is in the expansion unit.

Stocks are available now through your own Vic Dealer.

I would like to be included on your mailing list.

Name ____________________

Address ____________________

____

Send to:
Arfon Microelectronics Ltd.,
Cibyn Ind. Estate,
Caernarfon, Gwynedd,
N. Wales.

Arfon Micro

AM

R&EW

MAY 1982

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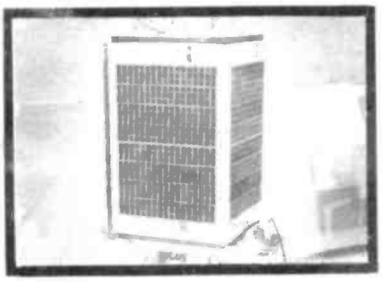

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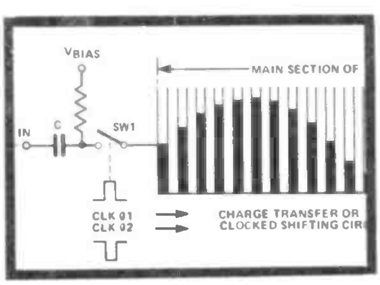


News

DUE TO PRODUCTION DIFFICULTIES THE VIDEO RECORDER FEATURE MENTIONED ON THE FRONT COVER HAS HAD TO BE HELD OVER UNTIL NEXT MONTH.

ICOM

TRIED, TESTED AND TRUSTED

IC-720A
Possibly the best choice in HF. £883.inc.

The main problem that the amateur of today has to deal with is deciding just which rig out of the many excellent products available he is going to choose. Technology is advancing at such a rapid rate and getting so sophisticated that many cannot hope to keep up. Some go too far!

Perhaps one way of dealing with the problem is to look at just what each model offers in its basic form without having to lay out even more hard earned cash on "extras". The IC-720A scores very highly when looked at in this light. How many of its competitors have two VFOs as standard or a memory which can be recalled, even when on a different band to the one in use, and result in instant retuning AND BANDCHANGING of the transceiver? How many include a really excellent general coverage receiver covering all the way from 100kHz to 30MHz (with provision to transmit there also if you have the correct licence)? How many need no tuning or loading whatsoever and take great care of your PA, should you have a rotten antenna, by cutting the power back to the safe level? How many have an automatic RIT which cancels itself when the main tuning dial is moved? How many will run full power out for long periods without getting hot enough to boil an egg? How many have band data output to automatically change bands on a solid state linear AND an automatic antenna tuner unit when you are able to add these to your station?

Well you will have to do quite a bit of hunting through the pages of this magazine to find anything to approach the IC-720A. It may be just a little more expensive than some of the others – but when you remember just how good it is, and of course the excellent reputation for keeping their secondhand value you will see why your choice will have to be an IC-720A!

IC-PS15 Mains PSU £99

IC-2E £159.inc.
IC-4E £199.inc.
The World's most popular portables

Nearly everybody has an IC2E – the most popular amateur transceiver in the world – now there is the 70 cm version which is every bit as good and takes the same accessories. Check the features.

Fully synthesized – Covering 144 – 145.995 in 400 5KHz steps. (430-439.999 4E)
Power output – 1.5W with the 9v. rechargeable battery pack as supplied – but lower or higher output available with the optional 6v or 12v packs. Rapid slide-on changing facility.
BNC antenna output socket – 50 ohms for connecting to another antenna or use the Rubber Duck supplied (flexible ¼ λ whip – 4E)
Send/battery indicator – Lights during transmit but when battery power falls below 6v it does not light, indicating the need for a recharge.
Frequency selection – by thumbwheel switches, indicating the frequency. 5KHz switch – adds 5KHz to the indicated frequency.
Duplex simplex Switch – gives simplex or plus 600KHz or minus 600KHz transmit (1·6MHz and listen input on 4E)
Hi-Low switch – reduces power output from 1.5W to 150mW reducing battery drain.
External microphone jack – if you do not wish to use the built-in electret condenser mic an optional microphone speaker with PTT control can be used. Useful for pocket operation.
External speaker jack – for speaker or earphone. This little beauty is supplied ready to go complete with nicad battery pack, charger, rubber duck.

A full range of accessories in stock.

		£ p
ICML1	10W mobile booster for IC2E	49 00
BP5	11 volt battery pack	30 00
BP4	Empty battery case for 6 x AA cells	5 80
BP3	Standard battery pack	17 70
BP2	6 volt pack	22 00
BC30	Base charger for above	39 00
BC25	Mains charger as supplied	4 25
DQ1	12 volt adapter pack	8 40
HM9	Speaker microphone	12 00
CP1	Mobile charging lead	3 20
IC 1 2 3	cases	each 3 60

All prices include VAT

The IC4E is going to revolutionise 70 CM!

ICOM

Free carriage on direct sales – call us.

Remember we also stock Yaesu, Jaybeam, Datong, Welz, G-Whip, Western, TAL, Bearcat, RSGB Publications.

Please note: Access/Barclaycard owners – goods must be sent to address registered with credit card company.

170 for further details

IC-290E £366, IC-490E £445.inc.
Multimode mobiles
290E-144-146 MHz, 490E-430-440 MHz
The best pair since Erica's!

IOW RF ouput on SSB, CW and FM. Standard and non-standard repeater shifts. 5 memories and priority channel.

Memory scan and band scan, controlled at front panel or microphone. Two VFO's LED S-meter 25KHz and 1KHz on FM-1KHz and 100KHz tuning steps on SSB. Instant listen input for repeaters.

IC-730 **The best for mobile or economy base station**
£586.inc.

ICOM's answer to your HF mobile problems – the IC-730. This new 80m-10m, 8 band transceiver offers 100W output on SSB, AM and CW. Outstanding receiver performance is achieved by an up-conversion system using a high IF of 39MHz offering excellent image and IF interference rejection, high sensitivity and above all, wide dynamic range. Built in Pass Band Shift allows you to continuously adjust the centre frequency of the IF pass band virtually eliminating close channel interference. Dual VFO's with 10Hz and 1KHz steps allows effortless tuning and what's more a memory is provided for one channel per band. Further convenience circuits are provided such as Noise Blanker, Vox, CW Monitor, APC and SWR Detector to name a few. A built in Speech Processor boosts talk power on transmit and a switchable RF Pre-Amp is a boon on todays crowded bands. Full metering WWV reception and connections for transverter and linear control almost completes the IC-730's impressive facilities.

IC-251 £499.inc.
IC-451 £630.inc.
Great Base Stations

ICOM produce a perfect trio in the UHF base station range, ranging from 6 Meters through 2 Meters to 70 cms. Unfortunately you are not able to benefit from the 6m product in this country, but you CAN own the IC-251E for your 2 Meter station and the 451E for 70 cms.

Both are really well designed and engineered multi-mode transceivers capable of being operated from either the mains or a 12 volt supply. Both contain such exciting features as scan facilities, automatic selection of the correct repeater shift for the band concerned, full normal and reverse repeater operation, tuning rate selection according to the mode in use. VOX on SSB continuous power adjustment capability on FM and 3 memory channels. Of course they are both fitted with a crystal controlled tone burst and have twin VFO's as have most of ICOM's fully synthesized transceivers.

IC-24G
Low-priced mobile
£169.inc.

The famous IC-240 has been improved, given a face lift and renamed the IC-24G. Many thousands of 240's are in use, and its popularity is due in part to simplicity of operation, high receiver sensitivity and superb audio on TX and RX. The new IC-24G has these and other features. Full 80 channels (at 25kHz spacing) are available and readout is by channel number – selected by easy to operate press button thumbwheel switches. This readout can clearly be seen in the brightest of sunlight. Duplex and reverse duplex is provided along with a 12½ KHz upshift, should the new channel spacing be necessary.

IC-25E
The Tiny Tiger
£259.inc.

Amazingly small, yet very sensitive. Two VFO's, five memories, priority channel, full duplex and reverse. LED S-meter. 25KHz or 5KHz step tuning. Same multi-scanning functions as the 290 from mic or front panel. All in all the best 2M FM mobile ICOM have ever made.

NEW!
Tono Theta 9000E
£650.inc.

A highly sophisticated and amazingly improved Theta-7000E, is the Microprocessor-Controlled Communications Terminal which features completely automatic Send/Receive of Morse Code (CW), Baudot Code (RTTY) and ASCII.

An added feature of the Theta-9000E is that a WORD PROCESSOR is now built in the super unit!!
This saves a tremendous amount of time when preparing documents and letters.

In addition, a high-speed Send/Receive of graphic patterns drawn by a light pen on a CRT Display can be easily operated.

By introducing these exciting developments to the amateur radio world, Theta-9000E could build a strong reputation for up-to-date performance.

Battery-Backed-Up memory, which was one of the most popular characteristics of Theta-7000E, has been enhanced by a dramatic expansion to 256 characters by 7 channels.

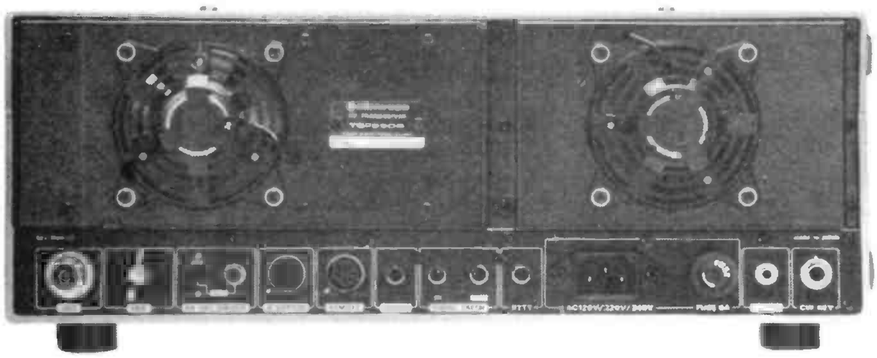
Large Capacity Display Memory can cover up to 14,000 characters and Screen Format contains 80 characters/line by 24 lines. The easy-to-use, multi-application, remarkable Theta-9000E provides all the features you could desire! Why not send for details?

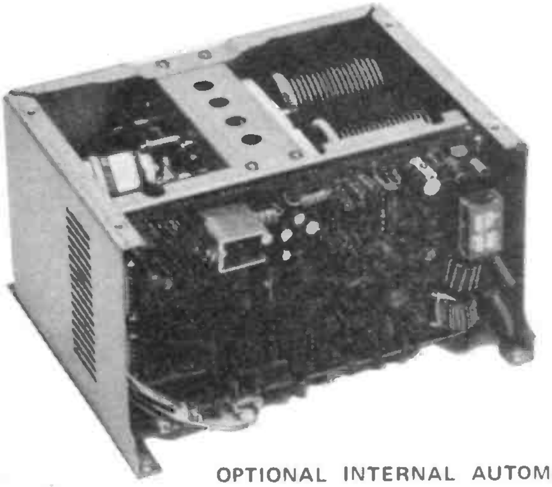
Thanet Electronics

143 Reculver Road, Beltinge, Herne Bay, Kent. Telephone (02273) 63859

Agents (phone first – all evening weekends only, except Scotland)
Scotland – Jack GM8 GEC 031 657-2430 (daytime)
031 665-2420 (evenings)
Midlands – Tony G8AVH 021 329-2305
Wales – Tony GW3 FKO 0874 2772 or 0874 3992
North West – Gordon G3LEQ Knutsford (0565) 4040 ansaphone available

the rig worth waiting for





OPTIONAL INTERNAL AUTOMATIC TUNING UNIT

191 for further details

With the advent of amateur band transceivers/ general coverage receivers in one package, the question all the inquiring Trio owners asked was "when will Trio produce their answer/ equivalent to the FT-one?" We are delighted to say that it's here right now and, if previous experience is anything to go by, Trio have got it right first time (as always).

The basic package is apparently straightforward. The TS930S is all solid state, gives 120W out from transistors run from a 28V supply for "better than the rest" linearity; covers all amateur bands and general coverage from 150 kHz to 30 MHz; uses a built in power supply; has digital readout; has twin VFO and multi-channel memory facilities and so on and so on.

What makes the TS930S stand out from the rest is, once again, the Trio attention to detail. I have always said, Trio design their equipment to be used by the average amateur, whereas some rigs look like the control panels for the space shuttle. The acid test is to sit down in front of the TS930S and compare it IN USE to anything else. Notice how the RF and AF gain controls are together, as are the mic gain and carrier level controls.

Need the variable bandwidth? Trio have come up with the most versatile system ever, with completely independent adjustments for the upper and lower sides of the filter passband, so you can have any bandwidth you like anywhere around the signal you want — think about it.

Now switch on and operate on 14 MHz. So simple, just touch the button marked 14. Need to go to 21? Just push the button marked 21. Compare that to some rigs which need four hands and a degree in computing science to even get switched on!

What about general coverage? Equally simple using the 1 MHz step buttons. If you are on 14 MHz and you need to listen to the 15 MHz broadcast band just touch the 1 MHz UP button and there you are. Keep going and you step right through the spectrum in 1 MHz bands.

Now just mention some of the other features, look at the display which is bright white on a black background. Frequency readout is to 100 Hz whilst the synthesiser tunes in 10 Hz steps for true "VFO feel". Also included in the display are an analogue dial and the RIT offset in KHz away from dial frequency.

The memory facilities not only remember frequency but also mode in use, and because of the operating simplicity of the TS930S, you don't have to fill the memories with the amateur bands. RF speech processing is fitted together with tunable audio filtering and full break in keying for the real CW operator. The noise blanker system has switchable gate times to cope with not only impulse noise but also the infamous "woodpecker" and it works.

Finally, there is provision for fitting internally a fully automatic aerial tuner for the amateur bands.

Alan, just back from Tokyo where he tried out the 930, is walking about in a daze muttering, "I've got to have the first one." Judging by his impressions of the rig, it's simply fabulous and we can't wait. By the time you read this, we should have them on show (and in use), so come, see, try out the new leader in HF rigs. The family is now completed from TS130 TS130S/V through TS530S, TS830S to the amazing TS930S. There is now a rig to suit everyone in the Trio range.

FOR FULL DETAILS ON THE NEW RIG WORTH WAITING FOR WRITE IN MARKING YOUR ENQUIRY "REW" OR BETTER STILL TELEPHONE:

LOWE electronics

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Comment

Expanding to meet your needs

R&EW's original aim of providing one magazine for all persons engaged in the 'doing' end of electronics is enabling us to produce 'prime' features ranging across a broad spectrum of interest. It has also led to an evolution in the production process whereby we need to have specific editors responsible for specific topics. Please check the credits alongside, and direct correspondence to the appropriate name.

Responding to your reactions

You may have noticed that we changed the format of the reader response card last issue — as the numbers of respondants has increased by around 400% since last December, we have found it necessary to 'tune' the system somewhat. As each issue goes out, we are getting a broader base of readership, so whilst some of you may find radio topics tiresome, and others feel the same about the computing features, we are seeking to obtain your overall impression based on the entire issue.

The numbers to circle for your overall impression rating are:

Excellent	1
Good	2
Average	3
Bad (write and tell us what we're doing wrong)	4

Help found

As you may have noticed, we filled our editorial vacancy immediately the job was announced. In view of the enormous variety and interest in such work, it's not surprising that we had many other applications as well — we'd like to be able to take on some more staff, but economics preclude further hirings for the time being.

It pays to advertise

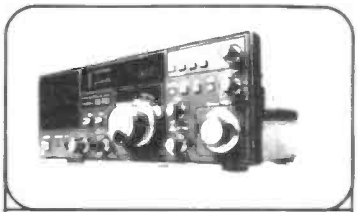
When the editorial aspects of **R&EW** had got under control once again, we turned our attention to the problems of trying to get on top of the mountains of enquiries and orders from the catalogue and Project Packs enterprise. After a few weeks of drawing nothing but blanks and disinterested personnel from the local Job Centre services, a simple advert in the local paper produced an avalanche of applicants seeking any type of work we had to offer — and we have been able to select from a wide range of eager applicants.

All this seems to indicate that despite a change of name, the 'Labour Exchange' is still having a hard time shaking off its old image amongst the keener elements of the working population. Either that, or it simply isn't doing its **own** job.

You may all take pride in having helped contribute towards solving the Nation's most pressing problem in one of the best possible ways: by supporting a private enterprise that is not subsidized by public funds, nor owned by overseas interests. That the enterprise is engaged upon a basically creative and productive 'product' in the only major area of commercial and industrial growth is an added bonus.

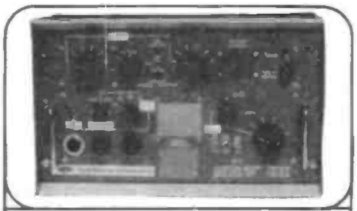
Tell us all about it

If you, or your company, is involved in the electronics business, then please make sure that copies of any press releases, news items etc. are sent to **R&EW**. We are also looking to establish overseas news contributors, and would be pleased to hear from anyone able to act as an overseas correspondent for **R&EW**.



HF RECEIVERS

FRG7700; 0.15-30 MHz, continuous coverage AM/SSB/CW/FM. (Memory option) £329 inc.

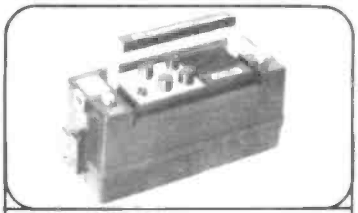


MARINE MF

Voyager, 5 channel, 1.6-4.2 MHz, 20W PEP. Auto alarm 2182 etc, to MPT 1271 £495 + VAT.

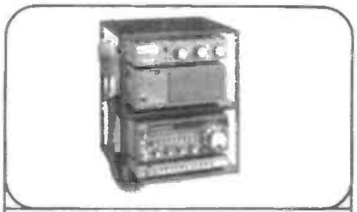
HF TRANSCEIVERS

FT–ONE 0.15-30 MHz Rx, 1.5-30 MHz Tx, AM/SSB/CW/FSK/FM 100W £1,295 inc.



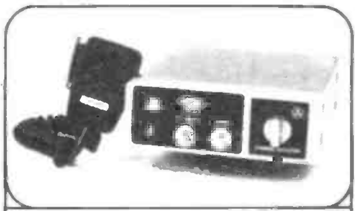
HF SSB PORTABLES

JSB–20. 4 channel 3-9 MHz. 10W PEP Options of 3 antennas, 4 power supplies.



"HAM" TRANSCEIVERS

FT707 10-80m, 100W PEP, SSB/AM/CW, Variable IF bandwidth, Digital £569 inc.

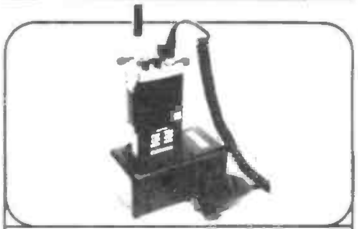


CITIZENS BAND

OSCAR–ONE; 27 MHz, 40 channel, 4W, Delta tune, channel 9, to MPT 1320 £85 inc.

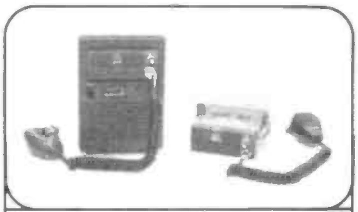
2 METER MULTIMODES

FT480R Synthesized 25/12½/1 kHz on FM 1kHz 100/10Hz SSB, 10W PEP, £379 inc.



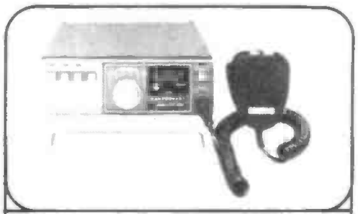
MARINE VHF

MARINER 6 channel, 1 watt handheld. c/w 6,8,16 etc. to MPT 1251 £175 inc.



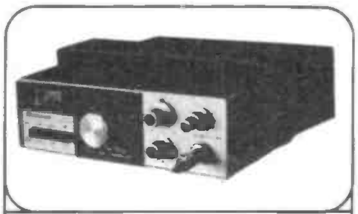
PRIVATE MOBILE RADIO

COMPACT 10W, single channel mobile, Highband, to MPT1301. Unit cost £250 + VAT.



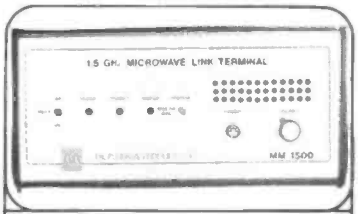
70cms FM EQUIPMENT

FT720RU 10W, 25 kHz synthesized remotable and dual band possibilities £265 inc



70cms SSB TRANSCEIVERS

KLM Jumbo, 432-432.48 MHz USB/LSB 10W PEP Auto scan, etc. £129 inc.



MICROWAVE LINKS

Full duplex, single channel, 1.5 GHz, 4W, 230/24V, 19" rack, to MPT 1401.

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Buckley	Howarth	GW3TMP	(0244) 549563
Swansea	Peter	GW8EBB	(0792) 872525
Jersey	Geoff	GJ4ICD	(0534) 26788

177 for further details

NEW PRODUCTS

Dial-a-Chip

Mostek have announced a new family of repertory dialer chips designed for use with both traditional electromechanical exchanges and new multi-frequency electronic systems.

Each member of the family contains on board RAM to store up to ten 16-digit numbers, including last number dialed.

The MK5173 is the basic IC and contains a complete loop disconnect dialer plus memory in a 16 pin package. Fabricated in CMOS and consuming only 100 uA the device can easily be powered from the line to which it is connected.

Mostek (UK) Ltd
Masons House,
1 Valley Drive,
Kingsbury Road,
London NW9

circle no 15

Aqua Starcom

Frank Cody Electronics Ltd have announced the addition of the AQUA STARCOM range of hand held, portable, radio telephones, to their range of communications equipment.

Suitable for use in all types of weather the unit will enable the professional user to have an efficient two-way communications system.

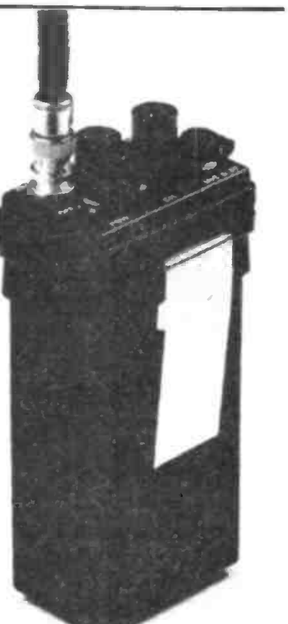
Suitable for use in the marine environment, the Aqua Starcom model HE900 has been type approved by the Home Office. The HE900 has 4 channels, a frequency range from 156 MHz to 165 MHz and a power output of 1 watt. The power for the unit is provided by an internal ni-cad battery pack which is rechargeable. There is an external speaker/microphone with a mylar diaphram and like the unit is also water resistant. The set comes complete with a helical aerial.

Designed to be hard wearing and to withstand the roughest conditions the HE900 should be particularly useful to coastguards, marina operators, harbour authorities, ferry marshalls and for those involved in the loading and unloading of cargos. 'On board' frequencies can be fitted to the set. For complete flexibility there is an optional belt hook clip. The HE900 will be priced at around £325.

A comprehensive range of accessories are available including a leatherette carrying case, desk charger, multi-way charger, a variety of speaker microphones, a CTCSS tone module and a whip antenna.

Further details from:
Frank Cody Electronics,
Star House,
Gresham Road
Staines,
Middlesex TW18 2AN

circle no 16



Speechless

An Enhanced Audio Recognizer from Watkins-Johnson in the USA has simplified the task of using ATE (Automatic Test Equipment). The Audio Recognizer allows 'hands off' control of the ATE station, simplifying its use and speeding up of the testing process.

Voice input is via a directional microphone and the systems memory is adequate for a vocabulary of 160 words. The units accuracy provides a 98% consistent recognition maintained with up to a 75 dB background noise level.

Further details of the WJ-1500-88 from
Watkins-Johnson Company
ATE Applications Engineering
2525 North First Street,
San Jose
CA 95131, USA

circle no 17

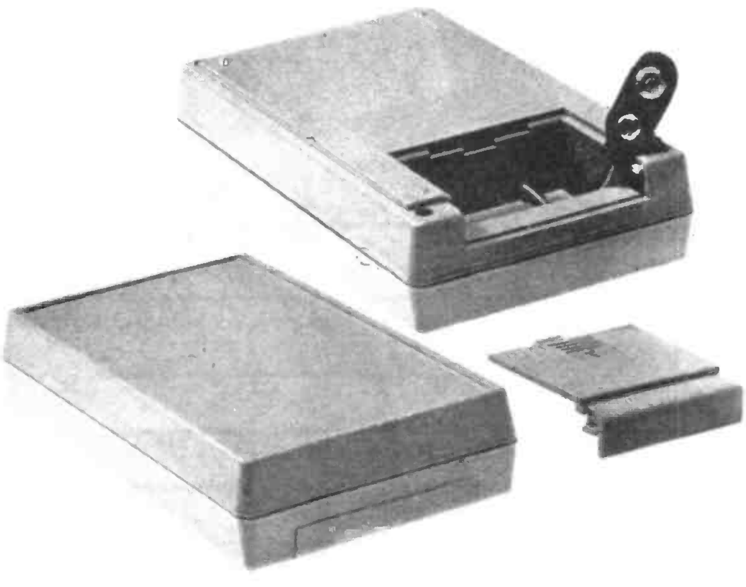
Box with Battery

OK Tool's Pac Tec HP series of boxes are now available with a battery compartment for 9V batteries. Designated the HP-BAT-9V, the enclosure has a removable battery 'hatch' in its back panel, together with a battery clip and lead.

Measuring 1.12" x 3.60" x 5.75" the case is available in four colours with a range of options that include belt-clips, shoulder straps and wrist straps.

OK Machine & Tool
Dutton Lane,
Eastleigh,
Hants SO5 4AA

circle no 18



Quality Print — Budget Price

The T/Printer from Datarite Terminals, is a low cost, fully fledged RO daisy wheel printer that can also be used as a self-correcting typewriter.

Based on the Olivetti Praxis 35 the printer should appeal to the small office and home computer user wanting letter quality print from their system.

The T/Printer 35 takes paper up to 12 inches wide and uses the standard Olivetti 100 character typewheels. These include characters not usually found on computer printers including many numerical functions. The printer can be set for 10, 12 or 15 characters per inch, a feature usually found only on much more expensive terminals.

Print speed is about 120 words per minute.

The T/Printer is available with Centronics parallel or RS-232 serial interfaces. Prices start at around £475.

Datarite Terminal Ltd
Caldare House,
144-146 High Road,
Chadwell Heath,
Essex RM6 6NT

circle no 19

Back-to-Back

Motorola have introduced two dual-LED optocouples which should find application in telecommunications systems where they will facilitate detection of a ring signal while providing isolation from the ring lines.

The devices (HIIAA1 and HIIAA2) consist of two gallium-arsenide infra-red LEDs connected in inverse parallel, optically coupled to a single silicon photo transistor.

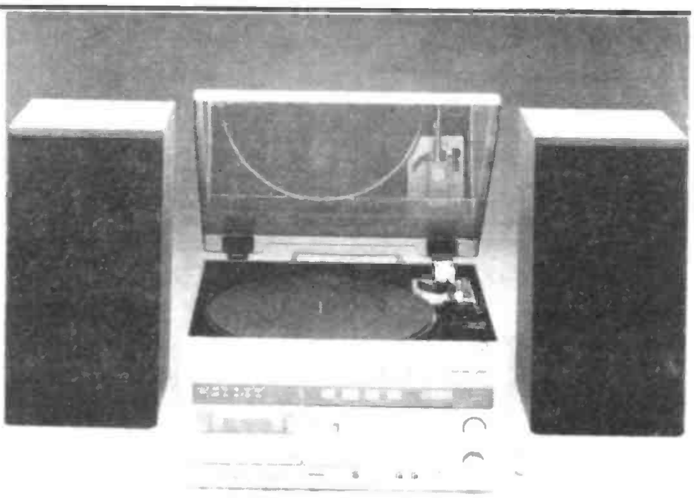
circle no 20

Small

Hitachi's new music centre is described as space saving — it measures 39cm x 40cm x 20cm high and in that space manages to cram a 2 x 20W amplifier, MW/LW/FM tuner, record deck and cassette recorder.

The receiver section boasts digital tuning and 5 FM pre-sets, the cassette deck features Dolby noise reduction and solenoid control of transport. The record deck has a repeat play facility — in short the system is all singing, all dancing.

In case you are wondering where such mundane things as the volume, balance, tone controls are, Hitachi have hidden them away behind the flap on the front panel.



Smaller

The RX-1950 'personal Hi-Fi' from panasonic manages to cram an AM/FM radio and high quality cassette player into the pocket sized package that has become familiar over the past year.

The model features a stereo FM section, metal tape compatibility and comes complete with case and a branching adaptor for another set of headphones — stereo made for two.

Smallest

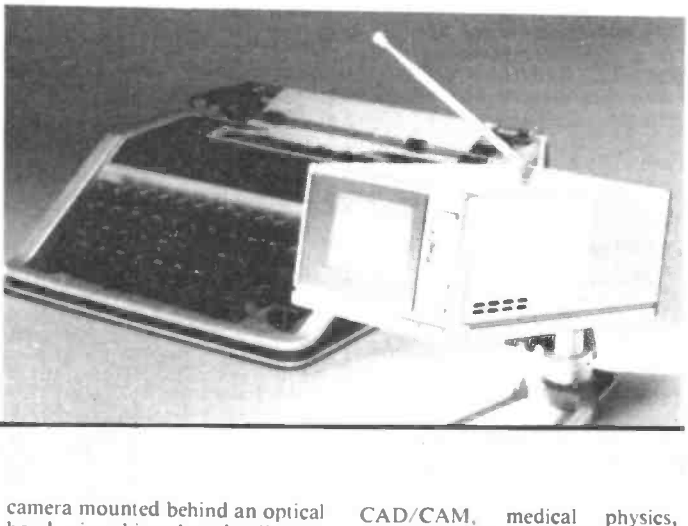
Matsushita in Japan have come up with the smallest (115mm x 86mm x 232mm) lightest (1.5kg) and least power hungry (9.5W power consumption) colour TV yet. The 3" TV operates on AC mains, car batteries or on an optional rechargeable battery pack.

The model features video input/output terminals making it ideal for use with portable TV cameras and VTR equipment as well as plain enjoyment (?) of TV programmes out of doors.

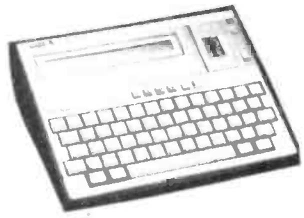
The price should be around the £200 mark when it reaches these shores later in the year.

For further information contact
National Panasonic
300/318 Bath Road,
Slough SL1 6JB

circle no 22



Sony Typecorder



Sony's new typecorder has been available in the US for a while now, so we were pleasantly surprised to be able to get a sneak preview when Sherry Smythe of the US publishing group Wayne Green Inc., dropped in to pay us a visit with one of these in her bag.

The Typecorder is a completely portable keyboard/LCD/microcassette recorder, designed for the busy executive/writer who 'gets around'. The device includes a stenography function as well, whereby keying a single letter followed by the 'steno' function calls up a complete word (or suffix) from a list of the most common words in the English language, greatly speeding the rate at which an experienced user can type — up to the point at which dictation can be directly transcribed.

Four AA Ma-Alkaline batteries last around 5 hours, with various AC and DC power adapter options.

The text is down loaded onto cassette after first entering via the 40 character single line liquid crystal display, which includes a page and line number indication. A single cassette stores up to 120 pages of text, or it can be used as a regular dictaphone if required.

The text can be transmitted via a telephone coupler, or it can be played directly to a printer, telex punch — you name it.

Incidently, the Sony coupler has not yet gone through the full Modem approval procedure, so we subsequently learnt that we were being a shade naughty. Judging by the success of the mission, there were no ill effects.

Sony plan to market the device in the UK in mid-1982. Prices are still to be fixed, but if you should find yourself in the US $1400 will get you the basic unit. The Modem looks expensive by comparison at around $500, and printer interfaces are as yet unknown quantities. Our thanks to Kevin Melia at Sony UK who helped with the info, and who does a much better job on PR than the persons responsible for other product divisions at Sony UK. Watch this space for a salutory tale about our experiences with an ICE2001.

circle no 24

Screen to Slide

The GDS-1700 proves an inexpensive and easy to use means of producing 35mm slides and prints from display screens.

The unit features a Nikon F3 camera mounted behind an optical hood, pivot-hinged to the display. Camera operation may be controlled by a computer through a camera interface unit.

Application areas include CAD/CAM, medical physics, radar as well as more general scientific uses.

Graphic Display Systems
76 Hemingford Road,
Cambridge CB1 3BZ

circle no 23

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30,24,20,15,12,2 Amp	£4.84
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24V 100mA	£1.00
24V 250mA	£1.50
25V+6.2V Sec 1.6 Amp	£1.90
30,24,20,15,12,2 Amp	£7.96
9-0-9V 2 Amp	£4.70
12V 2 Amp	£4.84
20-0-20V 2 Amp	£6.98
30-0-30V 2 Amp	£7.96
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AB19 12 x 8 x 3in. (304.8 x 203.2 x 76.2mm)	£3.04

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RB5 11 x 7.50 x 4.50in (279.4 x 190.5 x 114.3mm)	£3.98

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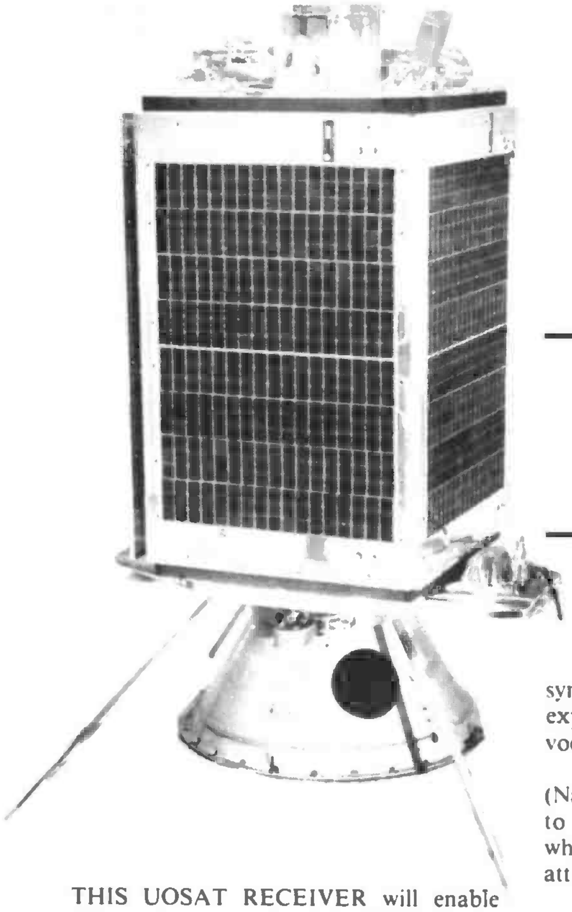
183 for further details



UOSAT RECEIVER

A doppler-tracking ground station receiver for the reception of UOSAT telemetry on VHF.

Graham Leighton.

THIS UOSAT RECEIVER will enable information transmitted by UOSAT, the 'educational' spacecraft successfully launched early last October, to be received using a simple pair of crossed-dipoles as the antenna. It can also be used to monitor other fixed channels in the 2m band - or with a change of helical filter and oscillator chain, services in the PMR band and thereabouts.

The launch of this satellite in the OSCAR series was designed to stimulate a greater practical interest in space science amongst schools, colleges and universities. The **R&EW** receiver provides a low cost means of reception of the satellite's VHF telemetry (or UHF beacon, using a converter) which can then be analysed to provide a host of data on the spacecraft's performance and behaviour.

The spacecraft carries a number of experiments intended for scientific research. These include a series of radio beacons, two particle counters to provide information on solar activity and a magnetometer for measuring the earth's magnetic field.

One experiment which should be of special interest is an earth - pointing camera covering a 300 square mile area. The image sensor is a CCD device, and once formed, the image is stored in one of UOSAT's on-board computers prior to transmission.

The pictures will have a resolution of about 2km, and will show 16 grey levels, with land features and land/sea boundaries enhanced. You won't be able to spot the flies on the dustbin, but you will be able to distinguish land and sea masses quite easily.

Also of note is an on-board speech synthesiser which will 'speak' telemetry, experimental data and 'news' using a vocabulary of about 150 words.

The 2m band signals are NBFM (Narrow Band FM), circularly polarised to overcome aerial alignment problems which could arise with varying spacecraft attitudes.

Recorded progress reports detailing the current status of UOSAT together with information on its orbit are available on Guildford (0483) 61202.

The **R&EW** UOSAT receiver is a six channel crystal controlled design. An AFC facility is available on two channels, since the doppler frequency shift on the 2 meter beacon is about +/-3 kHz which will cause a significant degradation to the signal if a fixed frequency receiver is used. The AFC range is just sufficient to cope with the +/-15 kHz doppler shift found on the 70cm beacon. A suitable low noise 70cm converter was described in reference (5).

The low noise figure and high gain of the 3SK88 RF and mixer stages are exploited to give the receiver a sensitivity exceeding 0.15uV (-124dBm) for 12dB SINAD. The heart of the receiver is an MC3359/ULN3859 IF IC which is a tidied-up and slightly improved version of the MC3357. The use of this IC simplifies the design of the IF considerably, and helps achieve the overall excellent price/performance of the unit.

A nine times multiplication is used in the local oscillator chain to give the required range from the VXO - which also means that a readily available crystal may be used.

VARIOUS VERSIONS

There are several options available to the constructor, which improve the performance - but as always there is a price to pay. A two pole helical filter may be substituted for C1, C2, L1. This reduces the susceptibility of the receiver to out-of-band signals, increasing the image rejection from 55dB to 75dB.

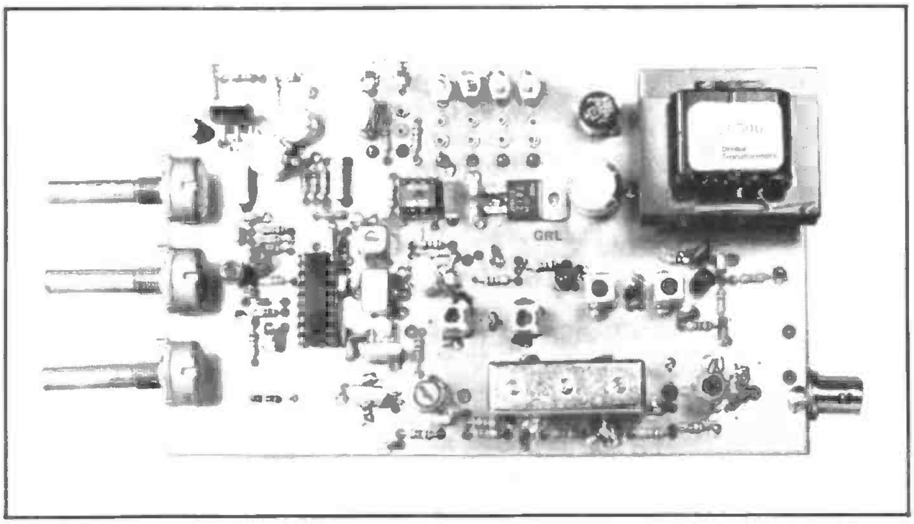


Figure 1: Prototype UOSAT Receiver PCB.

UOSAT RX CIRCUIT DESCRIPTION

RF STAGES

The RF and mixer stages, Q1 and Q2 are similar to the well tried 2m converter design described in Ref (1), except that the local oscillator is injected to the the source of the mixer. This method produces a more stable mixer with improved intermodulation characteristics.

IF SECTION

The drain of Q2 is tuned to 10.7 MHz by T1, which also matches the mixer to the crystal filter. The output of the filter is the same impedance as that found at the input to IC1 (pin 18). The high sensitivity and impedance at this point (about 5uV for 12dB SINAD and 3k respectively) may be demonstrated by the ready reception of short wave signals if you place your finger near pin 18.

The double balanced mixer converts the 10.7 MHz signal to the second IF at 455 kHz. A Colpitts oscillator is provided in IC1, which in this case is crystal controlled by X7.

The output at pin 3 has a 1k8 impedance which matches directly to a ceramic filter. Most of the gain of the IC is at 455 kHz in the limiting amplifier, and the input to this stage is also matched to the filter impedance. The amplitude - limited FM signal is demodulated using a quadrature detector, and the recovered audio is filtered by R12, C23, C24 and C26 to give the desired response. Unfiltered audio is fed to a bandpass filter formed by an inverting op-amp at pins 12/13 and R11, R8, C15, C16. Any noise above the normal audio range, present in the absence of signal, is selected, amplified and then detected by the combination of D1 and C14. The squelch sensitivity is adjusted by varying the bias fed via R9 to the squelch detector input. A level of 0V7 at pin 14 will activate the squelch detector causing pin 15 to be open circuit and pin 16 to be grounded via pin 17. The receiver is muted by shorting the audio at the top of RV4.

The ubiquitous TDA2002 is used as the audio power amplifier

AFC AND LOCAL OSCILLATOR

About +2dBm is required at 133.3 to 135.3 MHz as local oscillator. Q3 forms a Colpitts oscillator at about 14 MHz. The frequencies of the crystals are trimmed either manually (by C34-37) or by the AFC voltage via D2 and D3. The third harmonic of the crystal frequency is selected by T3 and T4. Q4 triples again and its output is tuned by T5 at the L0 frequency. T6 forms the rest of the filter and matches the output to Q2.

A high multiplication factor is needed to allow sufficient range to be extracted from the VXO. Despite the nine times multiplication, the output at T6 is very clean because of the use of double tuned filters T3/T4 and T5/6.

The AFC voltage derived from pin 11 of IC1 is scaled by IC3 and added to an offset which is set by adjusting RV2 — this allows the receive centre frequency to be adjusted. Manual tuning is available if the input of IC3 (pin 2) is connected to a fixed bias source which is set by RV3.

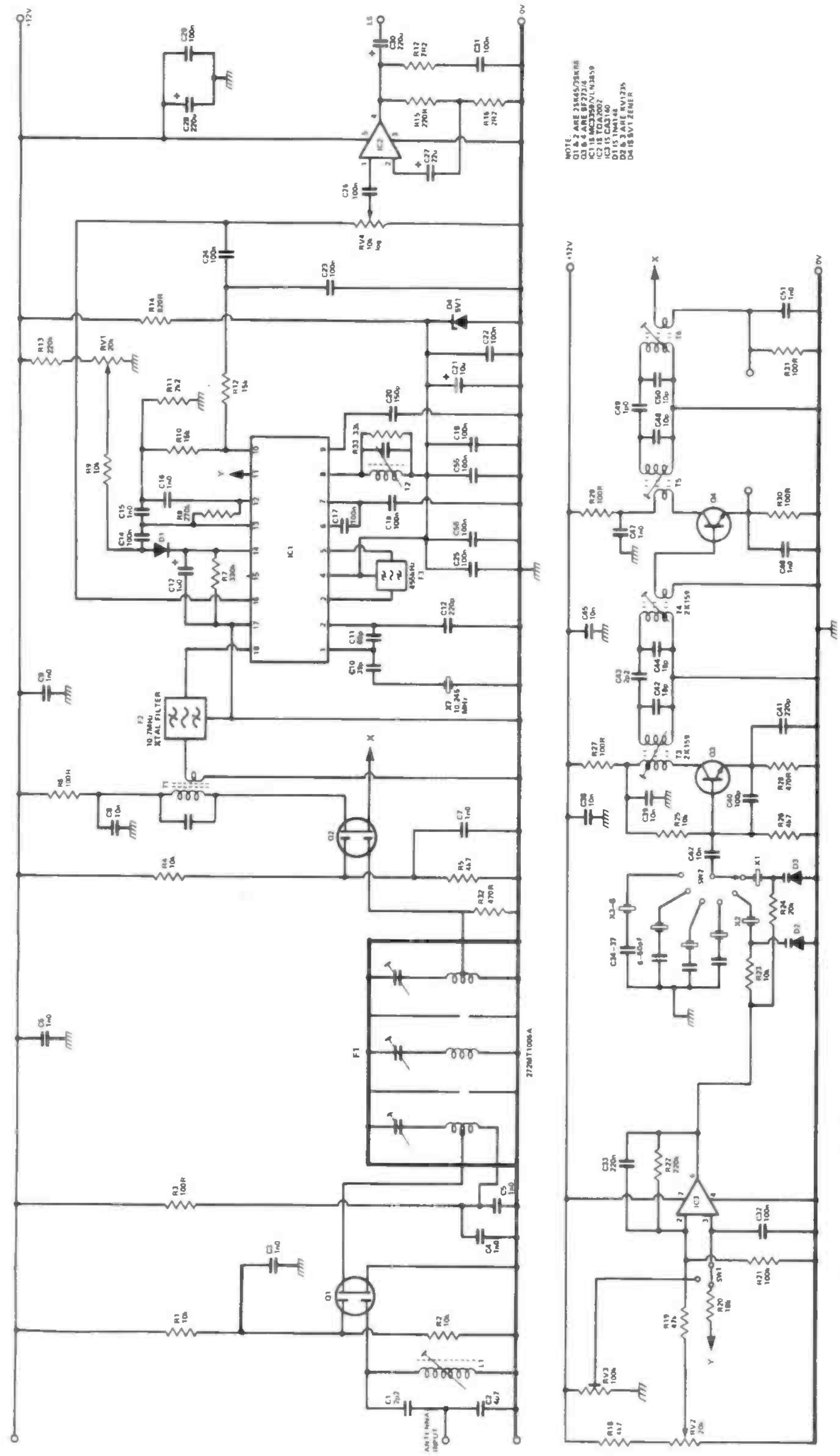


Figure 2: Receiver Circuit Diagram.

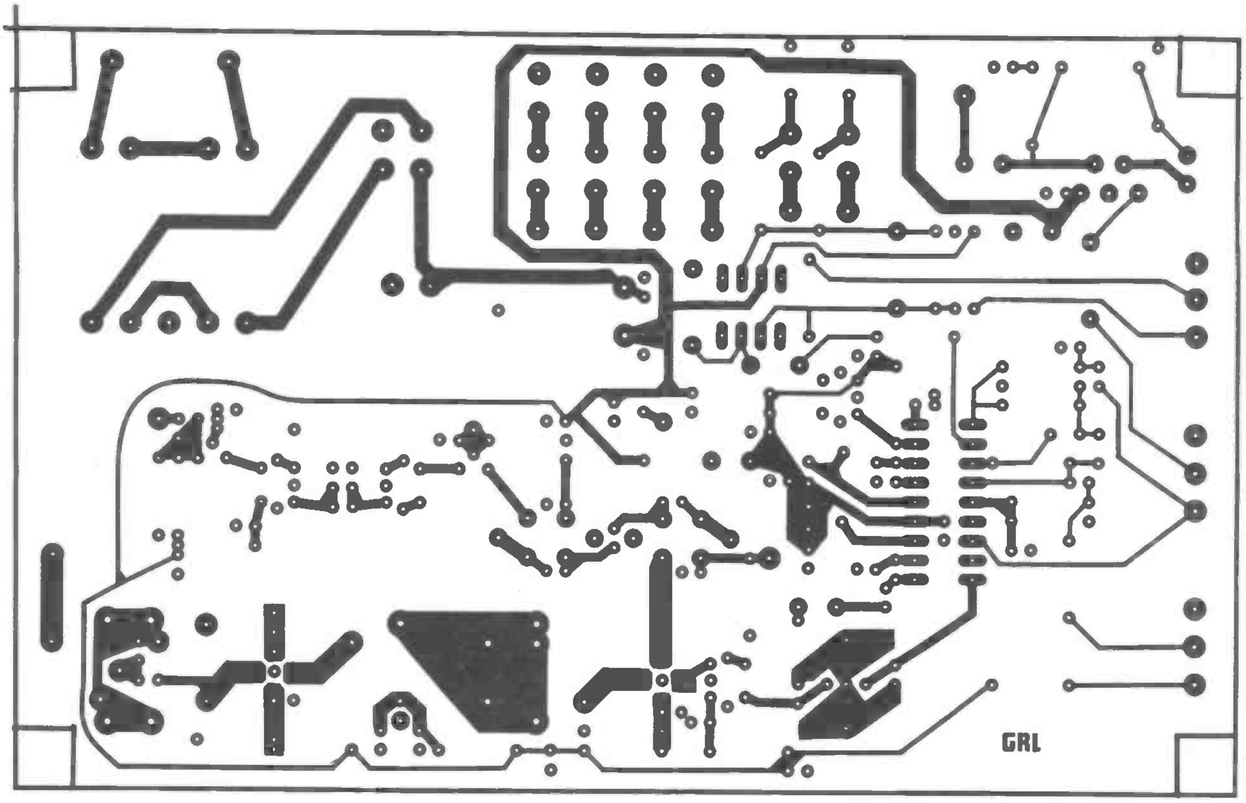


Figure 3: PCB Foil Pattern, Track Side.

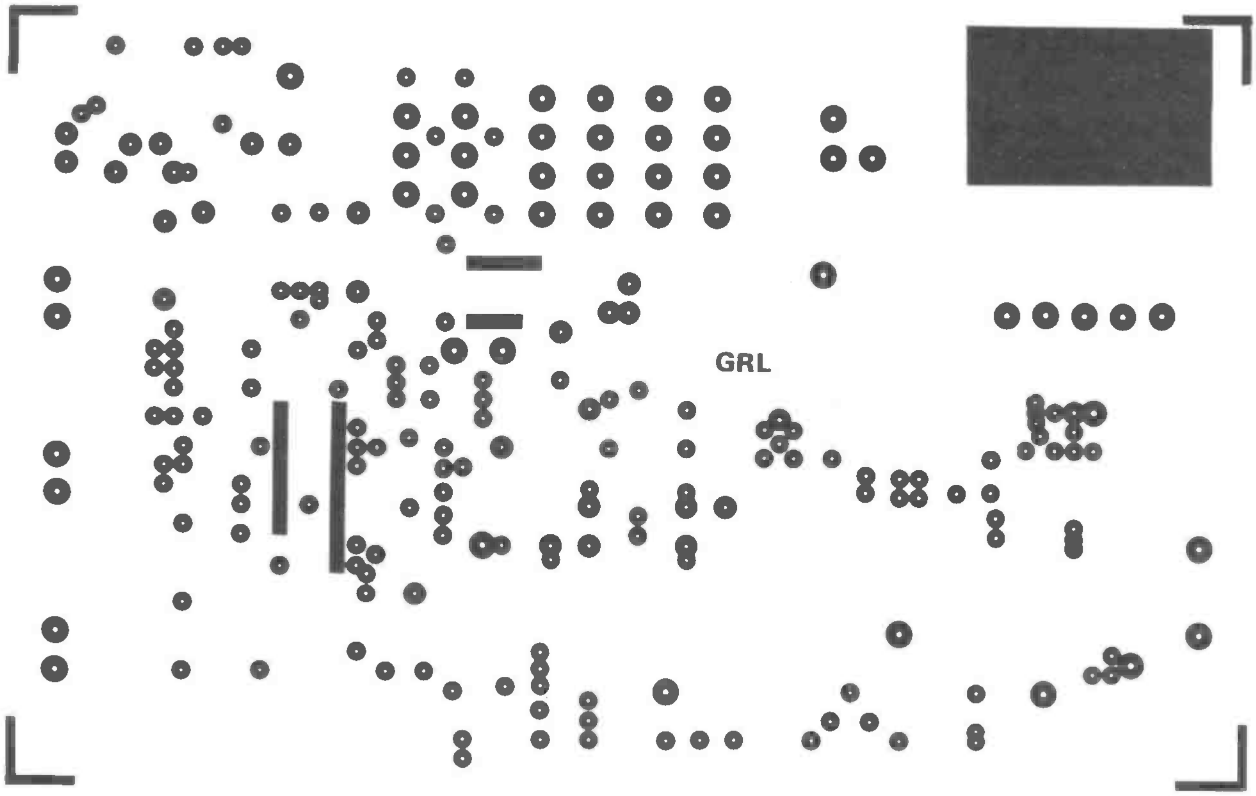


Figure 4: PCB Foil Pattern, Component Side.

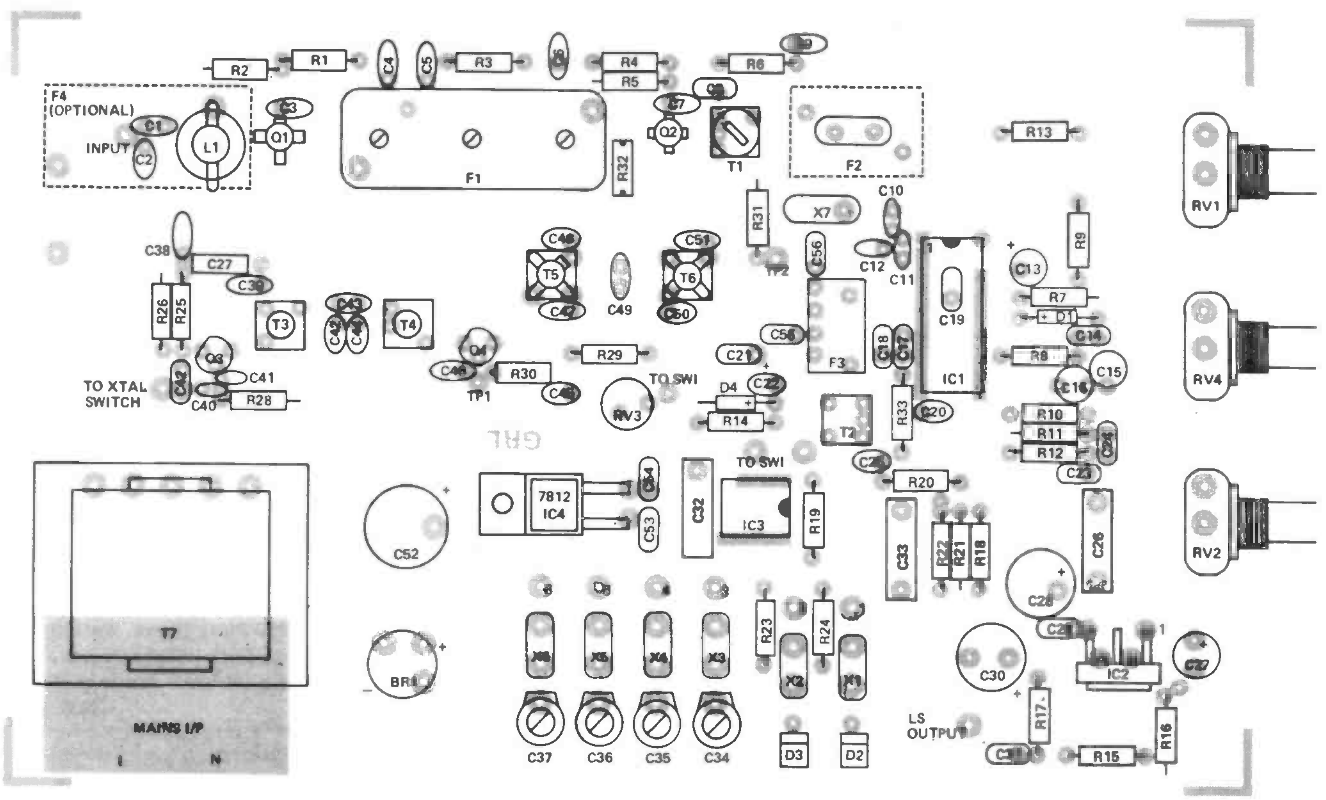


Figure 5: Component Overlay.

COMPONENTS LIST

Resistors	
R1,2,4,9,23,24,25	10k
R3,6,27,29,30,31	100R
R5,26,18	4k7
R7	330k
R8	270k
R10,12	15k
R11	2k2
R13,22	220k
R14	820R
R15	220R
R16,17	2R2
R19	47k
R20	18k
R21	100k
R28,32	470R
R33	33k
Potentiometers	
RV1,2	20k lin
RV3	100k min preset
RV4	10k log
Capacitors	
C1,43	2p2 ceramic
C2	4p7 ceramic
C3-7,9,46,47,51	1n0 ceramic
C8,38,39,45	10n ceramic
C10	39p ceramic
C11	68p ceramic
C12,41	220p ceramic
C13	1u0 16V tantalum
C14,17,18,19,22,25 23,24,29,31,55,56	100n monolythic
C15	1n0 polystyrene
C20	150p ceramic
C21	10u 16V electrolytic
C26,32	100n polystyrene
C27	22u 16V electrolytic
C28,30	220u 16V electrolytic
C33	220u 16V electrolytic
C34,35,36,37	9-50p ceramic trimmer
C40	100p ceramic
C42,44	18p ceramic
48,50	10p cermamic
C49	1p0 ceramic
Semiconductors	
Q1,2	3SK45/3SK88
Q3,4	BF273/BF274
IC1	MC3359/U-LN3859
IC2	TDA2002
IC3	CA3140
D1	1N4148
D2,3	BB109
D4	5V1 400mW zener
Coils	
L1	S18 green (5.5 turns)
T1	119LC30099N
T2	LPCS 4200
T3,4	113CN2K159
T5	200058 (4.25/.25 turns)
T6	200027 (4.25/2.25 turns)
Miscellaneous	
F1	272 MT1006A
F2	10.7 MHz 10M15A or 10M15D
F3	455 kHz LFH 12S-SLFD-12
X1-6	as required
X7	10.245 MHz
IC sockets, crystal pin sockets, BNC socket, PCB, Case, etc.	
POWER SUPPLY	
C53,54	1n0 monolythic
C52	470u 16V electrolytic
BR1	W005 bridge rectifier
T7	3VA 6+6V transformer
IC4	7812

Both of the IF filters may be upgraded. If an 8 pole 10.7 MHz filter is used, the rejection of in-band interference, mainly caused by blocking in IC1 , is reduced along with adjacent channel rejection. A lower cost SLF-D12 ceramic filter at 455 kHz improves only the adjacent channel rejection. There is no point in using both upgraded filters together.

If more channels are required it should be a simple matter to increase the number of positions on SW2 and include another PCB with more crystals and trimmers.

ASSEMBLY

Assembly of the PCB is straightforward, but it helps if the following few notes are adhered to.

All components that require an earth connection should be soldered to the top of the board. The earth leads on IC1 and IC3's sockets are bent outwards before soldering. If an SLF-D type filter is used, its earth connectors are made likewise.

F1, T1/3/4 connections and the earth leads of C42/44/48/50 should be soldered top and bottom. Q1 source and the earth track under F2 should be connected through the PCB to the earth plane. C19 must be fitted before IC1's socket.

When handling the PCB during initial testing, beware of the mains voltages present around T7. ▶

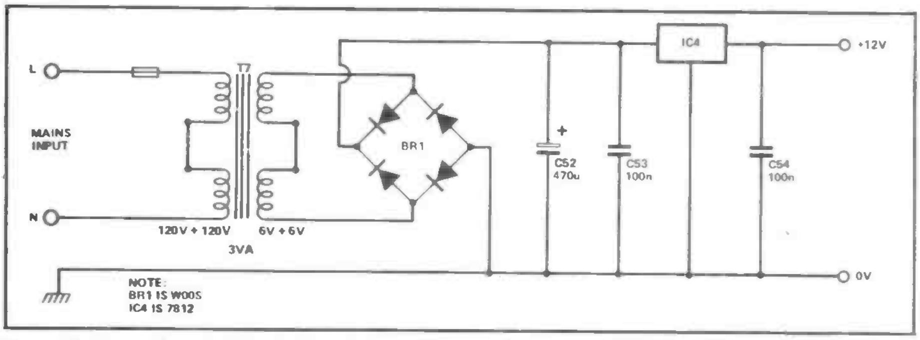


Figure 6: Power Supply Circuit Diagram.

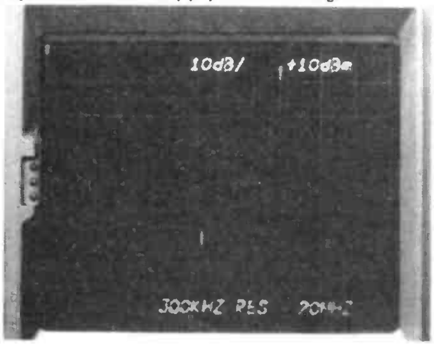


Figure 7: Local oscillator output spectrum, vertical 10dB/div; Horizontal 20MHz/div; Centre Frequency 100MHz.

TESTING

Remove IC1 and IC3 from their sockets. Connect the power, (whether mains or 12V) and check the supply voltages. Check the audio amplifier operation by applying a signal to pin 1 of IC2 (finger or signal generator). Fit a crystal in channel 3, set T3 and T4 cores level with the can top, and monitor the voltage on Q4 emitter, TP1, tuning T3 and T4 for maximum reading.

Monitor TP2 and tune T5/T6. Retune T3 and T4 for maximum. Switch the supply off, insert IC1 and switch on again. Set the mute fully anticlockwise. Using either a signal generator or strong local signal, tune T2, T1, and C1 for best signal - to - noise ratio. If a signal generator is available, inject signal at 10.7 MHz to pin 18 of IC1 and set the voltage on pin 11 to about 2.8V by tuning T2. Without a signal generator, the descriminator may be set up by tuning T2 as before, but with no signal input to the receiver.

Inserting IC3 activates the AFC to channels 1 and 2. RV2 provides coarse tuning for these channels. With SW1 set to manual - and RV2 to centre of its travel - adjust RV3 to give about 5V at pin 6 of IC3. This sets the manual tuning range.

Although F1 is supplied fully aligned, it may require some minor adjustment to take account of circuit variations. When the receiver has been tuned as above, it is a good idea to slightly retune L1, F1, T1 and T6 for best signal - to - noise.

References:

1. **Timothy Edwards, A state of the art 2m Receiving Converter, R&EW October 1981.**
2. **Peter Whatley, Motorola Inc, FM Receiver Mixes High Gain with Low Power, Electronics June 2nd 1981.**
3. **MC3359 Data Sheet, Motorola Inc.**
4. **ULN3859 Data Sheet, Sprague**
5. **Leighton G.R., 70cm to 2m and TV converter, R&EW January 1982.**

■ **R & EW**

Your Reactions.........	Circle No.
Excellent - will make one	51
Interesting - might make one	52
Seen Better	53
Comments	54

NRD515 HF RECEIVER REVIEW

With R1000/FRG7700 at the £300 mark, we see what Japan Radio Co's NRD515 offers for an extra £600.

The NRD 515 Receiver complete with memory unit NDH 515 & speaker NVA 515.

YOUR FIRST IMPRESSION of the NRD515 will, on opening the box, be that it seems rather more substantial than the photographs might suggest. The 515 is not a pretty or stylish receiver, but a purposeful and austere instrument much in the mold of the Drake series. Indeed, the cosmetics of the R1000 and FRG7700 are far more alluring at first glance. Non-radio persons asked to judge which of the three was the most valuable invariably pick the FRG7700.

However, in this business, appearances can be very deceptive indeed, and the NRD is certainly a cut above the 'enthusiast' class receiver, as a quick glance inside will reveal. The NRD is a commercial quality receiver - despite the extensive use of phono plugs and sockets for internal screened connections. Despite the fact that phono's have been demonstrated to be 'good to 500 MHz', they do not instil confidence - but better than the open pin connectors of the cheaper receivers.

The large tuning dial spins freely on the NRD515 - always a nice touch, and a foretaste of the covert technical merit that lurks within this sheep's attire.

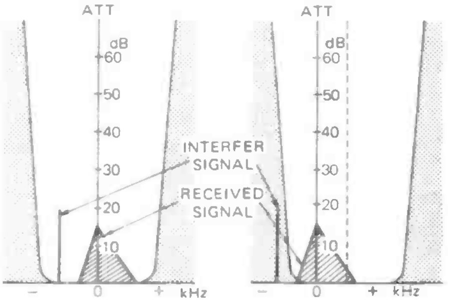
Spot the differences

The NRD515 avoids the compromises of the cheaper receivers of this type, and synthesises down to the nearest 100 Hz. There is no messing around with VCOs to interpolate the 1 MHz steps, and the smooth synthesiser tunes at the rate of 10 kHz per revolution, with a fast up/down switch conveniently located by the operator's index finger.

The synthesiser also rolls 'over and under' at the end of the 1 MHz bandspread, so that the MHz change in a continuous 0-30 MHz range. However, an adjustment to the MHz selector switch overrides the tuning thus set.

Pass band tuning is also provided (IF shift), *Fig 1* illustrates the action of this control which is basically to shift the IF response away from unwanted signals, but without modifying the response in any way. The MW is blessed with a real double tuned preselector that is automatically switched in by signals from the synthesiers. The other two receivers offer dire warning messages about the dangers of intermodulation and overload from local MW transmissions. Admittedly the problem of local MW transmissions is severe outside the USA - but this feature helps illustrate the consideration that went into the design. Either that or the fact that NRD couldn't bring themselves to use a 'real' high level mixer! (Perish the thought!)

The NRD515 is also complemented by a matching transmitter - the NSD505. **(R&EW** readers may be interested to learn we have started work on a companion transmitter for the R1000/FRG7700 series - no planned publication date yet.)

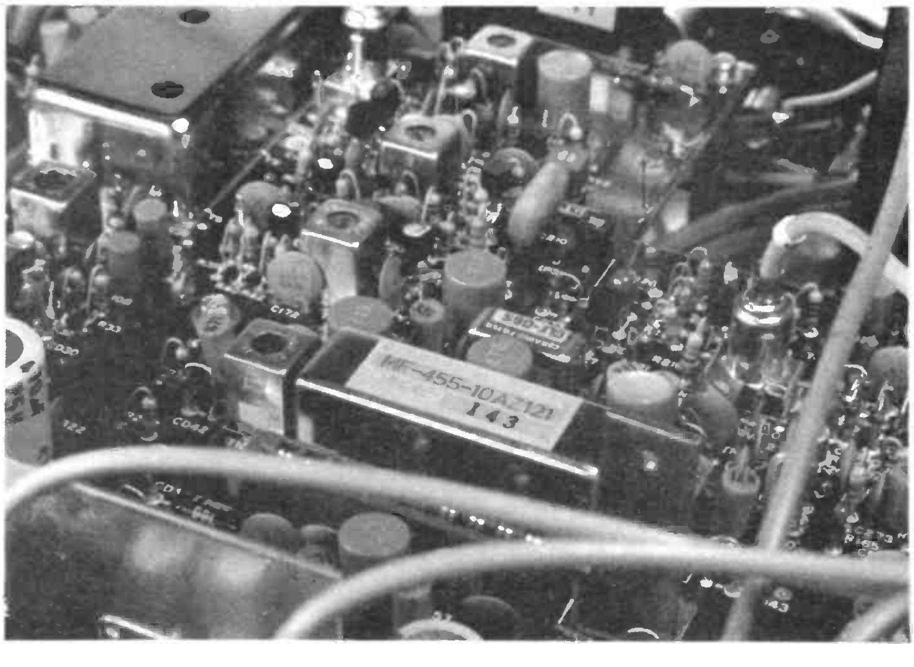


PBT control set at mid position — With PBT control turned clockwise from mid position

Figure 1: Pass Band Tuning.

Block details (Fig 4)

The block diagram of *Fig 4* reveals a similar arrangement to the 'other two' -except that the NRD uses a first filter frequency of 70.455 kHz. This certainly removes the image a little further away than with a 48 MHz IF - and perhaps it also helps to avoid problems that might arise from an image falling in Band II (88-109 MHz). With a first IF of 48 MHz, when tuned to 20 MHz, the image falls on 88 MHz.



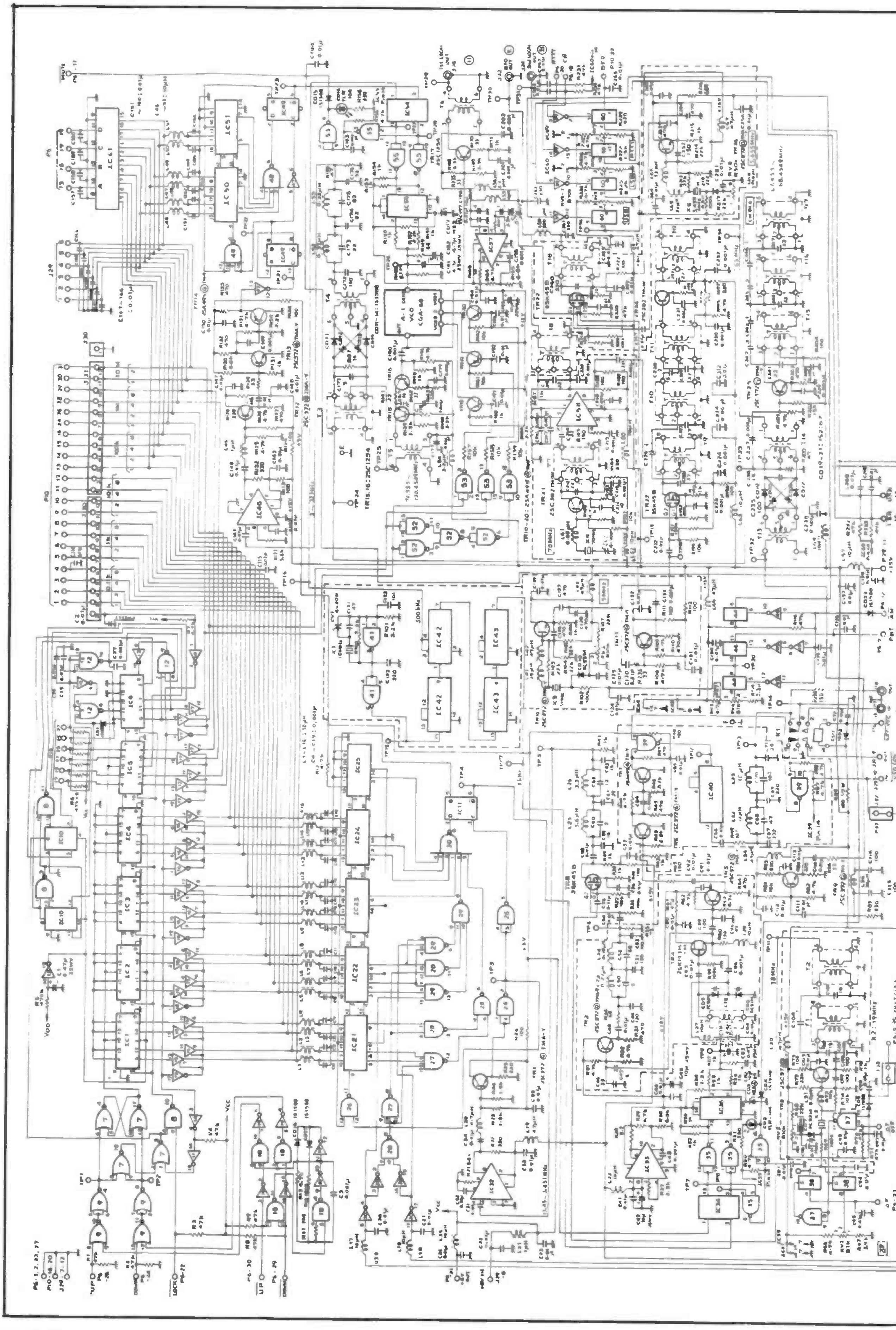


Figure 3: Circuit diagram of the synthesizer

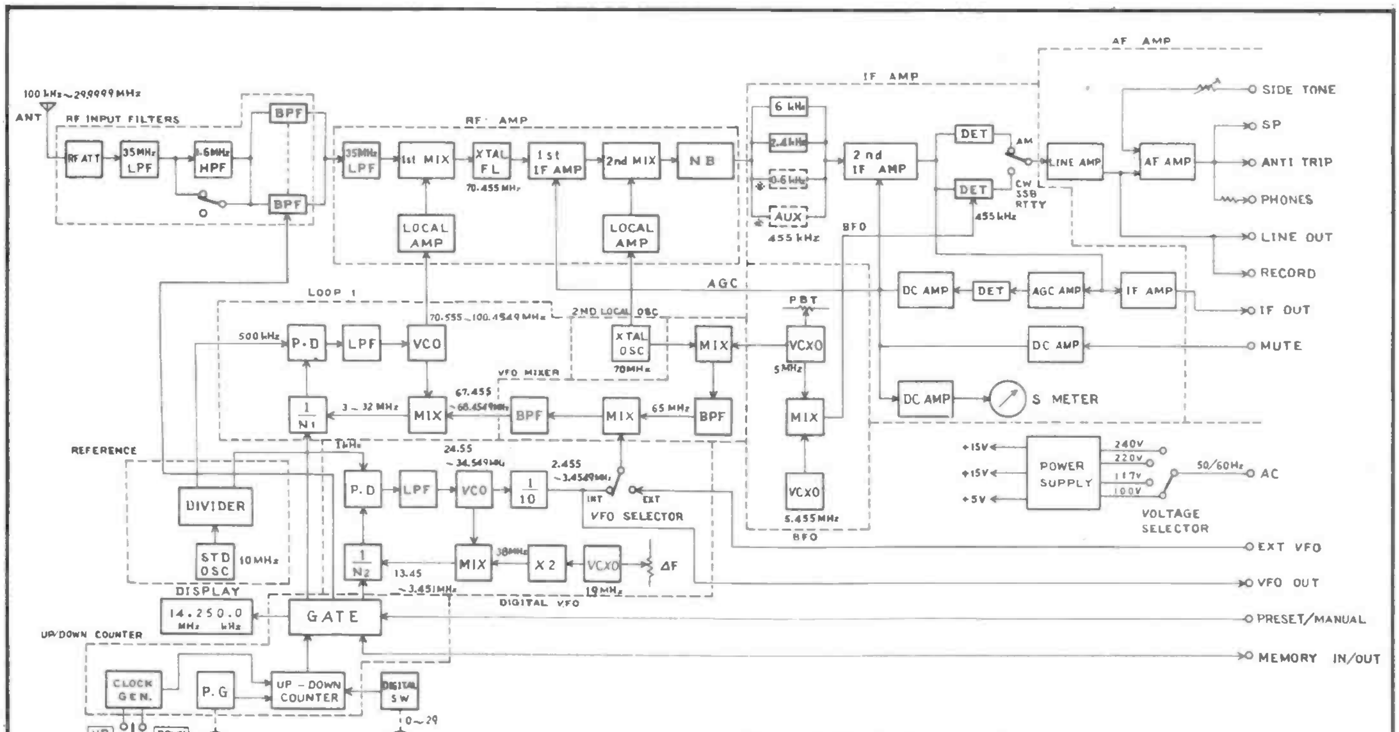


Figure 4: Block diagram of the receiver

It must be said that we have not yet noticed the problem (except with the lid off on the FRG7700) - but the US and many other countries are far more liberally supplied with VHF local radio transmitters that could conceivably make this problem a good deal more serious.

Only two IF filters are supplied as standard - the 6 kHz one is a CLFD6 from NTK (about the best in 455 kHz ceramic ladder filters - see *Fig 5*), the SSB filter from Kokusai is an MF45510AZ121, which offers a rather smoother performance than the ceramic alternatives which do not quite match the environmental performance of a receiver in this class.

The noise blanker earns its keep (more later), and there are many professional touches - such as the buffered IF output (for NBFM detectors and the like), external VFO option with internal VFO output - plus the memory facility. Since the NRD515 synthesises down to the last 100 Hz, there is vastly less entailed in this memory than with the Yaesu FRG7700 version. The memory is thus basically some battery backed-up static RAM, and the daring may have some additional ideas on how to remotely control the NRD down the BCD bus.

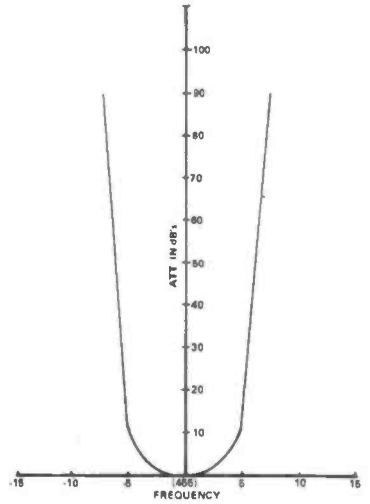


Figure 5 :Response of a|445KHZ ceramic ladder filter

The circuits : Receiver (Fig 6)

On first glance, the NRD receive signal processing circuit looks the same as that of the R1000 and FRG7700. Refer back to the December issue of **R&EW** (pp 50/51) and you will see that there are in fact several subtle differences. From the antenna socket, the NRD515 first remembers to provide clamping diodes to try and catch overloads on the antenna before harm is done. The 10 dB and 20 dB attenuators are relay activated -which in view of the physical layout of the set is about the only way to do it, if switching diodes are to be ruled out. In view of the fact that use of the attenuator implies that a very high level of signal is present, this is understandable.

Note the next part of the circuit is a 35 MHz low pass filter - Messrs Yaesu and Trio apply this further on in their designs, but placing it up front does help prevent strange things happening in the presence of strong VHF transmissions - and also shortens the amount of PC track available from which such unwanted signals can reradiate themselves. With a first IF at 70 MHz, when tuned to 30 MHz, the VCO runs at 100 MHz - placing the potential image at 170 MHz - in the middle of a densely populated mobile radio band. As mentioned, this is arguably a better solution than the 48 MHz IF, since power levels involved in PMR should not approach those of band 2 transmission. A 1.6 MHz high pass filter is selected internally (by relays again) to prevent volts of local MW transmitter from upsetting the front end. Such are the problems of local MW transmitters in the US, that the diode switching of the octave filter network can be modulated by the local community station.

Octave selection

The filter array of the NRD employs the third of the three classic configurations -constant-K pi and T sections of highpass and lowpass in the R1000, constant-K pi section bandpass in the FRG7700 - and now the dreaded M-derived pi and T section in the NRD515. The next person to design an HF receiver of this type will doubtless have to face up to the inevitability of being accused of plaguerisation.

The responses of these filters are illustrated in the *photographs* — which apart from a few lumps (which should not be as a result of the measurement technique: 50 ohms tracking generator input at antenna socket, 1M FET probe at TP3) — are quite respectable. There were some traces of VHF leakthrough, but not enough to cause concern.

The 600 kHz LPF allows coverage

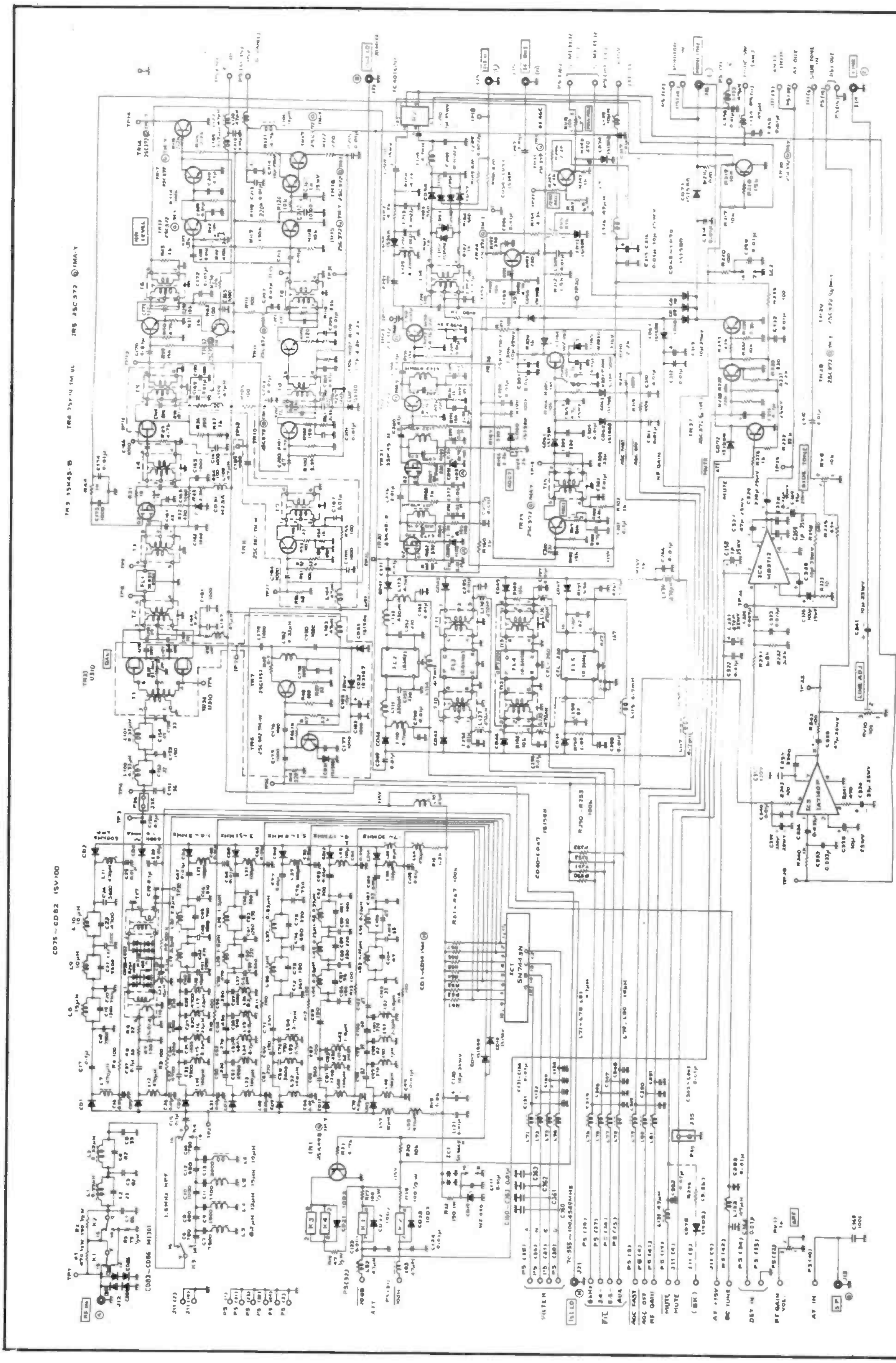
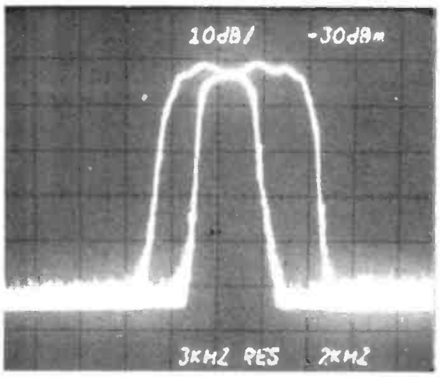
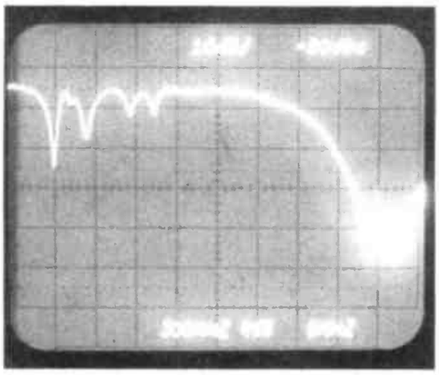
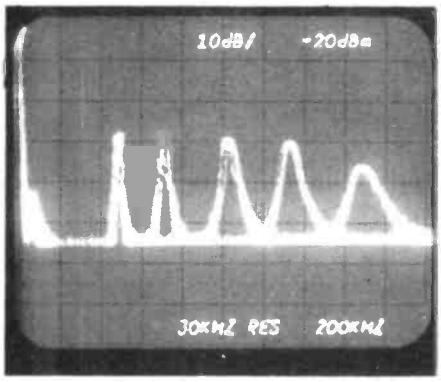


Figure 6: The receiver sections circuit diagram

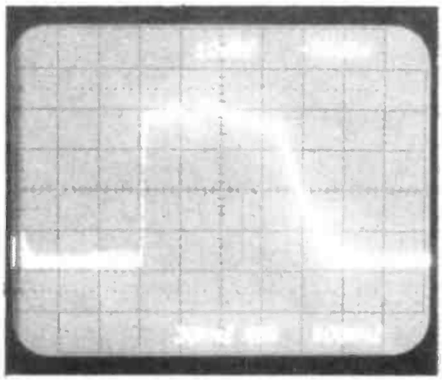


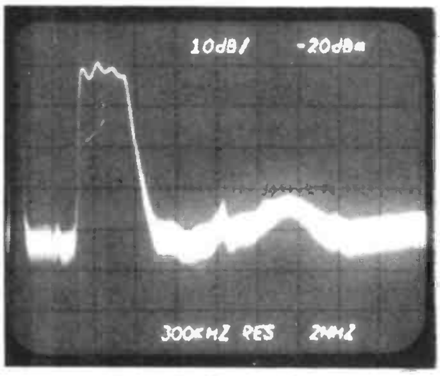
2nd IF filter bandpass


The overall LPF at the input

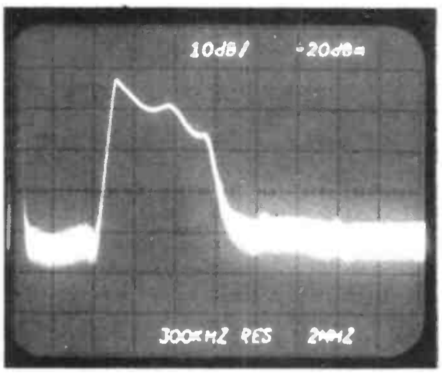


MW preselector at 5 spot frequencies

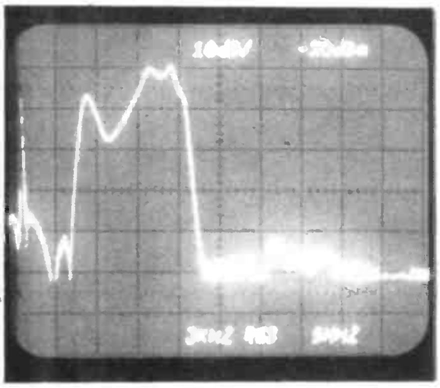

1.6 to 3MHz octave filter

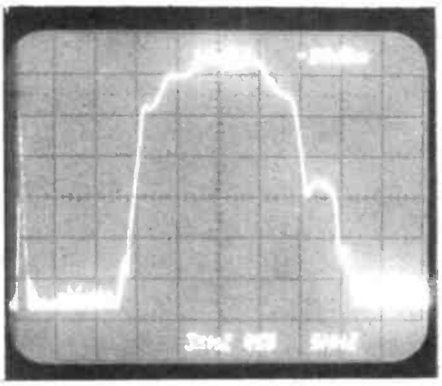


3 to 5.1MHz BPF



5.1 to 9MHz BPF (+ slope)


9 to 17MHz BPF (+ lumps)


17 to 30MHz BPF

down to around 7 kHz (the limiting factor being the first IF filter bandwidth). All the usual datum transmissions - such as MSF at 16 kHz and 60 kHz were duly noted.

The MW filtering arrangements deserve special comment, as you can see from the analyser traces, a genuine double tuned bandpass preselector has been used. the Nipponese fear of the enormity of MW signals knows no bounds.

This preselector is automatically selected between 600 kHz and 1.6 MHz — and note the use of bottom inductance coupling to avoid the problems of the change in coupling ratio associated with capacitance coupling as the ratio of the tuning capacitor and coupling capacity change dramatically from one end of the band to the other.

The remaining filters are much as expected - and then another couple of sections of 35 MHz LPF before the most interesting feature of all - no RF stage! What? How dare they! Most receivers dutifully concede to the widespread desire for enormously sensitive HF receivers with pointlessly low noise figures, with an RF amplifier (or two). The NRD515 takes an unfussed view of this, and proceeds directly into a balanced mixer comprising a pair of J310 FETs. With the signal on the gates, and the LO injection at a relatively high level on the source, good conversion gain is maintained together with good overload performance. Whilst we weren't able to match the IM performance measured by 'QST' — it was nevertheless very good. Interestingly, it compares to the projected IM performance of the R1000 minus the RF gain stage.

The first LO is buffered and amplified close by the first mixer in TR7 — TR6 forms part of an ALC loop that controls the amplitude of the LO fed to the mixer. A neat touch this, and one to bear in mind.

The first filter of the NRD515 is a classic *(Photo)*. No trace of anything nasty here, so next through the IF stage TR3, and thence to the second mixer - a single ended JFET. Which all goes to prove that good signal performance can be extracted from some unlikely circuits — and that double balanced mixers are not always essential.

Perhaps the 15V rail helps maintain strong signal behaviour as does source injection, but so far we have got as far as the FRG7700 with superior performance and three fewer transistors.

Blankety blank

Noise blankers are now ubiquitous in HF equipment, so this example will be used for a better appreciation of the subject. The NRD515 samples its noise just after the first stage of 455 kHz amplification (TR5 - wot no AGC?). Incidentally, R259 damping T6 looks suspiciously like a last minute effort to tame a common emitter amplifier with tuned input/output and no neutralization. (I too have trod that path.)

In the noise blanker, TRs 10 and 11 provide a 455 kHz side chain amplifier with TRs 15, 16 and 17 forming an AGC detector to track the average signal level, and thus prevent the circuit from responding to signal modulation peaks. The noise pulses are routed via the trigger circuit formed by TR12 and TR13 — causing TR14 to switch the IF signal path to ground, and TR32 (another late entry by the sound of it) to clamp TR5's emitter to the positive supply and thus turn it off for a maximum period determined by R114 and C210. The various waveforms are illustrated in the *Photographs* from a Tek 7616 four beam storage oscilloscope, clearly showing the input noise pulse (bottom trace), then blanking gate pulse as viewed on the base of TR14, then the 455 kHz IF measured at TP13 - and finally the top trace of the IF envelope after amplification at TP17. The before and after effects of the noise blanker are quite evident.

In view of the fact that noise blankers are virtually always designed only to operate from a fairly specific noise waveform (usually optimised for car ignition) perhaps there is some scope for 'getting at' the gate times to provide an adjustable blanking period. However, we didn't wish to incur the wrath of Lowe Electronics by redesigning a £900 receiver for them, so we left this alone - but maybe we will revisit our R1000 with a view to trying out these ideas before we finalise the concepts of **R&EW** HF communications receiver.

455 kHz and on

The IF filter switching is simple enough -but the way in which the 6 kHz filter is matched into the circuit is worth remembering. NRD provide an option socket for plugging in two additional IF filters — a 600 Hz (CW) mechanical filter is available from Kokusai — or a 300 Hz crystal filter from a number of sources. Of course, the user may choose to fit what he wants here, and a 10 or 12 kHz filter for NBFM might be used.

The IF stages use a pair of dual gate MOSFETs with the source 'held up' on what appear to be zener diodes to ensure a good range of control on gate 2, without driving the AGC negative. In fact, AGC only appears on TR3, TR20 and TR21 — another lesson in concise circuit design for those of us who sprinkle the AGC around like confetti.

TR25 drives the AGC detector stage, and TR26 drives the AGC around the circuit, with its gate being used for time constant programming. The NRD515 provides the facility of being able to switch off the AGC altogether, which is useful in DF applications and when sweeping the RF and IF responses.

The NRD uses the classic form of RF gain control, where turning down the gain compensates the S meter reading. The meter is driven from the AGC line by TR31, whose emitter nominally backs off the positive voltage through the meter so as to remain 'nulled' with no signal present. As the AGC voltage decreases with increasing signal, so the emitter voltage drops allowing additional current through the S meter. By controlling this AGC voltage directly with the RF gain control, the S meter responds accordingly. So an S9 signal remains at S9, regardless of the RF gain setting.

The product detector uses a diode ring in the familiar form — and switching between the AM and SSB detectors is achieved by an analogue switch IC2 (4016). The rest of the receiver board contains many neat and thoughtful inclusions - sidetone, line output etc.

The synthesiser (Fig 5): Digital VFO

As can be seen from the *Photographs*, the synthesiser is not to be taken lightly. You will need to refer back to the block diagram to keep your bearings when trying to delve into its workings.

Starting at the top left of the circuit, (*Fig 3*) you will find the shaftencoder and fast up/down driver circuitry - remember that, you'll need it when you start building the **R&EW** HF receiver. This loads data into up/down counter IC1-6.

In the centre of the diagram IC41 drives the references dividers - IC42 provides 500 kHz for loop 1, and IC43 drives the 1 kHz reference for the digital VFO. Follow the 1 kHz output around to the digital VFO section (bottom left). IC34 (11C44) is a phase detector, whose output feeds an interesting filter arrangement using an analogue switch - presumably for voltage translation via IC33, a 723 regulator device operating at 12V output. The output of IC34 is monitored for any loss of lock, whereupon CD (a LED) lights up.

The VCO covers 24.55 to 34.549 MHz - one of the buffered output chains (TR5, 6 and 7) leads to IC40, for decade division down to the interpolation range of

2.4550-3.4549 MHz — thus deriving the 100 Hz steps without the bother of 100 Hz time constants in the loop filtering.

The other output goes via TR2 through a low pass filter to be mixed in TR3 with the 38 MHz from the delta tune VCXO, TR8 (Bottom left of the circuit). The product of this (13.45-3.451 MHz) goes via another LPF for amplification in IC, through IC32 and TR1 for conversion to logic levels, thence to be gated in IC31 (74LS74) under control from the main synthesiser logic.

The first LO

The part of the block diagram labelled 'loop one' is to be found on the top right of the diagram. Starting with the phase detector again, IC54 operates with one input from the 500 kHz reference line, and the other from the MHz information gating from the synthesiser. The output again uses the interesting loop filter technique with the 4016, controlling a circuit block simply marked VCO -containing three VCOs covering the 70.555-100.4594 range. The appropriate VCO is selected by gating driven from the 10's of MHz setting information lines from IC6.

TR15 and TR16 buffer this into a balanced diode mixer formed by CDs11 to 14, with the other input being 67.455 to 68.459 MHz — derived from the digital VFO, via a mix with 65 MHz in the other diode mixer (CD19/22) — just right of bottom centre.

The result is a 3-32 MHz signal (after lowpass filtering) which disappears back up through another MC1350 amplifier, to be halved and gated via IC49 into the phase detector of IC54 as the other 500 kHz signal.

The rest

If you are still with us this far, then the remainder of the circuit is quite simple. The second LO is a 70 MHz crystal oscillator, located just lower right of the diagram centre, this is then mixed down with the VCXO of the pass band tuning system to the 65 MHz used in loop one. The same 5 MHz is used to mix against the BFO VCXO at 5.455 MHz, so that the BFO is shifted the same amount as the first oscillator to provide the tracking effect of the PBT. Analogue switch IC60 selects the appropriate mode to provide the correct offset for the BFO VCXO.

The data for the displays is reading off the programming lines (on P10) in standard BCD. Thus only a standard BCD to 7 segment driver is required — and the display creates no multiplexing problems. The display is not a frequency count (as per R1000 and FRG7700) but a reading of the programming data and as such relies on the loop being locked up for accuracy.

Parameter	Manufacturers Spec			Test Results	
		SSB	AM	SSB	AM
Sensitivity	1.6-30MHz	<.5uV	<2uV	<.4uV	<1.6uV
	100kHz-1.6MHz	<2uV	<6uV	<1.6uV	<5uV
Image Rejection	>70dB			90dB	
IF Rejection	70.455MHz	>70dB		>90dB	
	455kHz	>70dB		>92dB	
		6dB Down	60dB Down	6dB Down	60dB Down
Selectivity	6kHz	>4kHz	<10kHz		
	2.4kHz	>2kHz	<6kHz		
IMD Rejection				86dB	
Blocking				100dB rel 1uV at 15MHz ± 50kHz	
				80dB rel 1uV at 15MHz ± 25kHz	
Spurious Responses (NB. These are below the level of antenna noise)					
Internally generated spurious at every 500kHz and 1MHz					
1MHz Spurious	1MHz equivalent to	0.4uV			
	2-4MHz equivalent to	.05uV			
	5-19MHz equivalent to	.05-.2uV			
	20-30MHz equivalent to	0.3uV			
500kHz Spurious	2-17MHz	>12dB Sinad			
	17-30MHz	>6dB Sinad			
Spurious also noted at several other frequencies on every MHz band e.g. .772MHz.					

Table 1.

Points of interest

Apart from the interesting low pass filter design, note how JRC have used 723 voltage regulators nearby each critical voltage source in the circuit. Note too the way in which 100 Hz is derived without the usual loop time constant problems.

The way in which the synthesiser operates is an excellent example to any aspiring receiver designer - for it is probably one of the last examples of a purely parallel control we are likely to see in this complexity. Serial control and the MPU will almost certainly occupy subsequent generations of designs.

Conclusions:

The NRD515 is a delight to operate. It is well made in a 'professional style', and despite one or two niggles over the use of phono connectors, the receiver has class. The functions and facilities are well thought out. It is certainly a cut above the R1000 and FRG7700, although we found more than an acceptable number of birdies in our tests (see results in *Table 1*).

It is questionable that many enthusiasts will think it worth twice the price of an FRG7700 with memory option and the enterprising FRG owner could probably bring an FRG7700 up to NRD standards for less than £200.

For the professional user, the NRD515 will probably be the best choice, but it would have been a far more clear cut decision if the price was only £200-£300 less.

■ R & EW

Your Reactions..........	Circle No.
Immediately Interesting	47
Possible application	48
Not interested in this topic	49
Bad feature/space waster	50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CB

R&EW 40-CHANNEL CB RIG.

The final part of our CB Rig details setting up instructions plus details of a 'mod' to improve blocking.

Setting up

The following details are broadly applicable to the alignment of any similar type of transceiver equipment. You will need a multimeter, 2A/12V power supply (preferably with current limiting, although immunity to RF is more important), an RF power meter, an oscilloscope, a 50 ohm dummy load, 30 MHz frequency counter and a deviation meter. (The deviation meter described in last October's **R&EW** is suitable for this purpose).

A spectrum analyser (or a friend with one) will help a great deal, although the set has been designed to be sufficiently 'foolproof' as to fail to operate when outside the permitted range.

1. Switch on and check for current consumption. In the CB mode, the display will light up, and the total current consumption is around 500 mA — with around 120 mA going into the TDA2002 even under quiescent conditions. With the mute control fully anticlockwise, you should already hear the characteristic FM 'hiss' in the loudspeaker.
2. Master Crystal oscillator:
Adjust the trimming capacitor on the PLL crystal for 10.24046 MHz at pin 26 of IC3.
3. 2nd mixer LO:
Tune T8 to provide maximum signal at pin 1 of IC1. (Screw core down approx 1 to 2 turns.) If you do not have a means of checking the amplitude of the signal, wait until a signal is being received before fine tuning for maximum sensitivity.
4. Adjust the VCO:
Set T4 so that the lock detector (pin 27 IC3) remains high at all positions of the channel selector switch during transmit (remember to fit dummy load). Measure the VCO tuning voltage at the phase detector output filter, and adjust RV7 for minimum difference in tuning voltage when switching between transmit and receive. Check that the loop remains in lock at all positions of the selector switch in both transmit and receive.
5. The receiver detector:
Tune the detector IFT, T9, so that the DC output on pin 9 of IC1 is sitting at mid rail voltage.
6. Course IFT tune:
Adjust the filter matching transformer, T3, for maximum audio output.
7. 1st mixer output (10.695 MHz IF):
Apply 10.695 MHz (modulated with 1.5 kHz deviation at 1 kHz if available) to the gate of Q2 (via 10pF capacitor) and adjust T2 for maximum output (best S/N).
8. The RF bandpass filter:
Apply a 27.79125 MHz FM (Ch 20) signal at the RF input of the set, select channel 20, tune T1 and T5 for maximum output, corresponding to best signal to noise.
9. Repeat items 5-8 for best results, until approx 0.3 uV sensitivity is achieved.
10. Transit alignment:
FIT DUMMY LOAD, switch to full output. Press mic PTT, tune all RF stage transformers starting at the output of the double stage (T6) for maximum current consumption — or best RF output if an indication is available. Repeat until 4W RF output is available (44V pp across the 50 ohm load). The VCO frequency at the output is nulled by accurate adjustment of R6/T10.
11. Modulation:
Set mic gain control to maximum. Set VR5 so that a loud whistle into the mic just causes clipping at D12/D13. It will probably be necessary to switch to low power to prevent oscilloscope overload with RF.
12. Set maximum deviation:
Adjust VR6 so that clipping at D12/D13 corresponds to approx 2 kHz deviation overall. This adjustment can only satisfactorily be made using a calibrated modulation meter.

Unless you are completely confident of your skills, you should get your finalised set checked out by a competent CB dealer with service facilities.

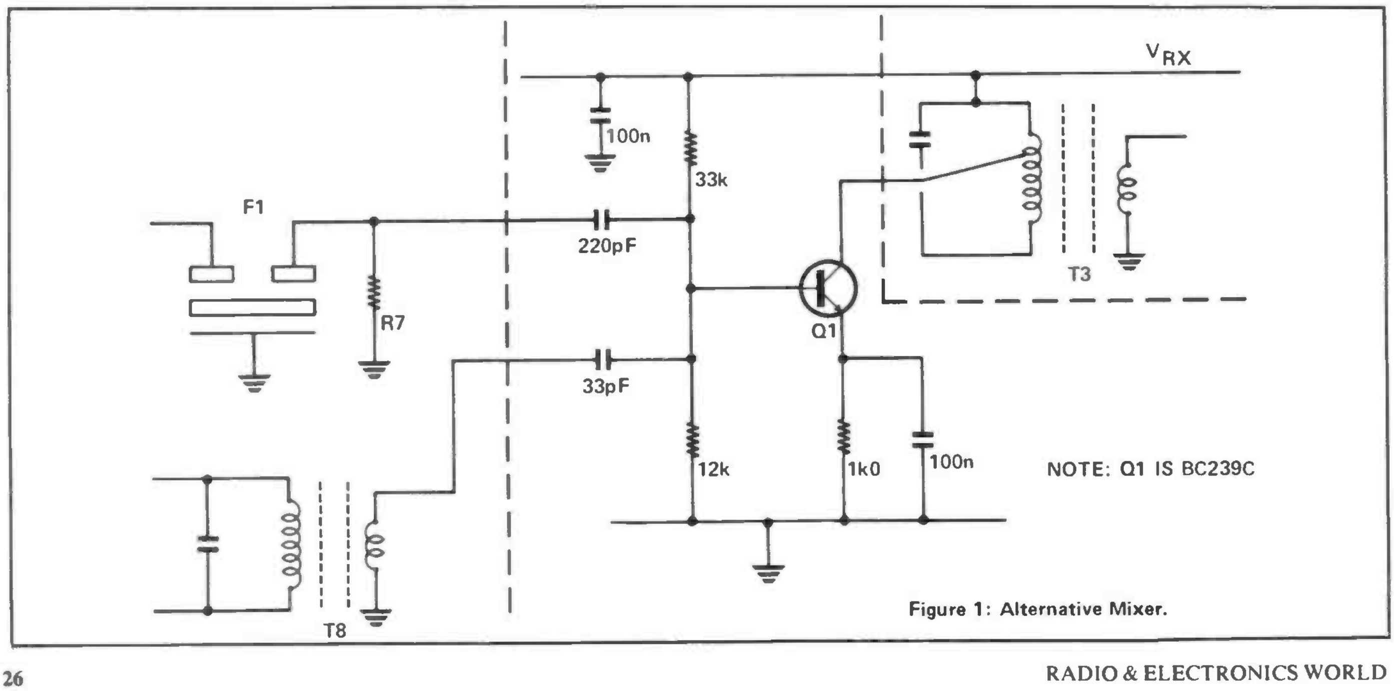


Figure 1: Alternative Mixer.

COMPONENTS LIST

Preset Resistors	
VR1,4	50k Preset
VR2	1k Pot
VR3	47k log + switch
VR5	1k Preset
VR6	4k7 Preset
VR7	10k Preset
VR8	500R Preset
VR9	10k Pot
VR10	1k Pot
Transistors	
Q1,2,4	2SK55
Q3,9-16	BC239
Q5,6	KT5011
Q7	(2SC2028) 2SC495
Q8	(2SC2029) 2SC1306
Filters	
FL1	10M15A 10.7 MHz
FL2	LF-B6/CFU455H
FL3	CFM2 455D
XL1	10.240 MHz 30pF parallel
RF/IF Transformers	
T4,T1,T5,T6, T7,T10	199CCA127
T2,T8	30099
T3,T9	LLC4828
Diodes	
D1,4,5,6,9,12,13, 14,15,D17-27,D29	IN4148
D2	IN5402
D3	6V8 Zenner
D8	BB204
D9	BB109
D11	9V1 Zenner
Integrated Circuits	
IC1	MC3357P
IC2	TDA2002
IC3	MC145151P
Inductors	
L1	T106-26 80 turns 0.56mm
L2	7.50 t 5mm id 0.8mm wire
L3	9.50 t 5mm id 0.8mm wire
L4	7.50 + 5mm did 0.8mm
L5	S18 Green 5.5t
L6	100uH
L7	3t FX1115 ferrite bead 0.25mm
L8	16 turns on 4mm former
L9	S18 Orange 3.50t
La	3t FX1115 ferrite bead 0.25mm
Capacitors	
C1,3,20,26,28,30,42,48,49,59,64	100n
C2,11,80,86,CE	150pF
C4	5p6
C5	220p
C6,12,13,19,27	Not used
C7	27p
C8	2p2
C9,23,24,40,50,65 93,94,CA	1n0
C14,25,51,71,72,74,75, 76,77,79,83,88,89, 17,31,61,69	10n
C15,17,31,61, 68,69	68p
C18	1n0 (ceramic)
C21,22	470p
C29	10p
C32,82,87	1u 35V
C33	220u 16V
C34	47u 3V
C35	220n 35V
C36	100u 16V
C37	220n 35V
C38	4u7 16V
C41	47u 16V
C43	10u 16V
C44	off PCB
C45	off PCB
C47	22u 10V
C52	2n2
C55	33p
C56	50pF trimmer
C57	3p3
C58,62	47p
C60	22n
C63	1u tant
C66	390p
C67	39p
C70	220n
C73	18p
C78	220p
C90	10n
C91	1uF
C95	2200 16V
Resistors (.25 W 5%)	
R1,10	2k2
R2	560R
R3,4,8,9,13,15,74	47k
R5	27R
R6	270R
R7	330R (ceramic filter version only)
R11	680k
R12	18k
R14	33k
R16	1k8
R17,44	47R
R18	220R
R19,20	2R2
R21	330k
R22	2k2
R23	15R
R24,25	Not used
R26	3k3
R27	560R
R28,29,72	100k
R30,31	15k
R32,66	270R
R33	22k
R34	27k
R35	180R
R36,70	470R
R37-39	68k
R40	6k8
R41,50,71	4k7
R42	47R
R43	12R
R45	100R
R46	39k
R47,48	12k
R49	150R 2W
R51	22k
R52-65	680R
R67	100R
R68	1k2
R69	2k7
R73	10k

Circuit Diagram — Amendments

There were one or two anomolies in the circuit diagram we published last month. Starting on page 49, the source resistor of Q1 is R5 (27R). C91 was missed out it is a 1u0 capacitor between the junction of R71 and the Mute Control (VR9). Q3 is a BC239 its supply rail is VRX which is decoupled by a 10n capacitor C31. Onto page 50 the loop filter is incorrect, there should be a 22k resistor (R33) between C63 (1u0) and ground. Finally the unlabelled 100k base biasing resistor on Q12 between base and supply is R28.

Bleed-over.... Call the Rig Doctor

The most common complaint amongst CBer's is that of bleed-over or adjacent channel interference. More usually the problem is one of blocking, caused by strong signals well outside the passband of the 455 kHz filter which provides the selectivity between one channel and the next. Blocking effects are particularly noticable in rigs using the MC3357 or its ilk. A dramatic improvement is effected by using a 2-pole crystal filter with a 15 kHz bandwidth centred on 10.7 MHz. The usual filter fitted is a 10.7 MHz ceramic filter 180 kHz wide. Ideally the replacement filter should be centred on 10.695 MHz with a 8 kHz bandwidth.

The improvement provided by the 2-pole crystal filter shows that the limitation to blocking performance is within the MC3357 integrated circuit itself and not in the RF stages/ first mixer as is generally assumed. Looking more closely into the operation of the MC3357, the problem appears to be in the 10.695/455 mixer. Taking this mixer in isolation its limiting level has been shown to be very low.

Fortunately in the **R&EW** CB rig, as with many others it is relatively easy to replace the mixer in the MC3357 by an external transistor or FET mixer. / shows the additional components required on the **R&EW** CB receiver for a simple transistor mixer. This is not to say the 10.695 MHz crystal filter is not now required as this still provides worthwhile improvement to blocking performance as well as a reduction in noise bandwidth.

Improving the 455 kHz filter generally only improves the interference from the channels immediately adjacent to the one being received. Using a filter narrower than 6 kHz in this position causes more problems than it cures, due to additional distortion on wide or slightly off channel transmission. The combination of the CFM2445C and LFB6 filters in the **R&EW** CB rig already well caters for adjacent channel rejection. ■ **R & EW**

Your Reactions.........	Circle No.
Excellent - will make one	9
Interesting - might make one	10
Seen Better	11
Comments	12

READERS LETTERS

Facts and opinions; Yours and Ours

We hope to use this letter page as a forum for reactions on a wide range of subjects, from those specific to R&EW through to the role of electronics in the 'real world'.

FRG7700 versus R1000

Dear REW,

Your excellent and informative article on the FRG7700 and R1000 was of particular interest to me as an owner of the FRG7700. However, the 3rd order IMD figures are not quite consistent through the series — can you clarify?

Also, as both receivers use FET's in the RF and mixer stages, they are more prone to 2nd order IMD, or plain 'mixing' effects. The 2nd order figures would be very revealing, since below 500 kHz, the 2nd order products make the set almost unusable without an ATU.

For example, Radio One on 1089 kHz beats with Langenberg on 1593 to produce a product at 503 kHz, and this carries on right down to zero fequency. Also, I get a continuous interferring signal above 16 MHz when using a long wire antenna without a tuner — is this IF breakthrough or continuous beat IMD?

J A Dyer
Somerset

REW:

Ahem, the results were altered as we adopted our standard test procedure format as set out in the January issue. The final figures appearing in that issue were derived from the test procedures published therein.

You raise a very sound point on IMD, and most users of the R1000 and FRG7700 will have discovered the same as yourself when using long wire antennas. The R1000 attenuates frequencies in this range anyway, since 1uV sensitivity in the MW is quite pointless, and only exaggerates the IMD unnecessarily.

This also illustrates the efficacy of using a loop or tuned ferrite rod antenna for MW DX listening, the directivity of such a system can reduce co-channel as well as IM interference — only the very best mixers can cope with the unattenuated signal levels that abound on the end of a long wire after dark.

Open All Hours

Dear REW:

Your idea of a register of businesses willing to assist outside 'normal' hours strikes a chord very dear to my heart. I have recently been invited to make submissions to my local authority who are currently studying the question of out-of-hours trading with particular reference to Sunday trading.

This company opens late for the sale of components, amateur radio gear, test gear etc. on Wednesdays and Fridays (10pm) and the 'phone is manned until 10pm most evenings - thereafter by an answering machine.

If you are thinking of starting a campaign to change the archaic trading laws of this country, more strength to your arm!

P J Gillen
Communications and Engineering Services Ltd
297 Bramford Road Ipswich IP1 4AT
(0473) 462173

REW:

The law only really interferes with Sunday trading activities — there is a lot that can be done by staggering weekday opening hours, and using Mon-Sat more intelligently without the need for an Act of Parliament.

R1000 AGC response

Dear REW,

Your report on the R1000's 'reluctance' AGC is an understatement. The World Radio and TV Handbook report on the R1000 cites this as a major criticism, and they give the following cure.

Reduce C2 to 1uF — on my circuit diagram, C2 is shown on the mode switches, but in my set it appears to be C138, located on the main PCB. The two pin socket on the PCB marked 'AGA/AGB' can be disconnected to speed things up further by leaving C138 completely out of the circuit during AM reception.

C127 and R226 also slow up the AGC response, and in my set I have cut these out completely, and can now tune the band without the effect of strong signals masking weaker ones.

P A Davies, C Eng
Cheshire

REW:

Thanks for the hint. There is some danger that LF response will be lost if you go the whole hog with C127 and R226 — so perhaps a switch could be used instead. The redundant dimmer switch used in the FM mod discussed in the feature might also serve for this function?

More FRG7700 mods...

Dear REW,

Further to the modifications already mentioned for our version of the FRG7700, we have recently included two additional items:

1) Local oscillator hum sidebands cut from −20 to −45dB with additional supply filtering.
2) FM de-emphasis reduced to 100uSec from the original 500uSec

Trevor Brook
Surrey Electronics

A letter from the colonies...

Dear REW:

First the good news:
Congratulations on the first three issues of R&EW, they are superior to most hobby periodicals available here — I hope you can keep it up.

Now for the bad news, there are some 750 radio amateurs in Toronto, 7500 CBers, n000 engineers — and about 24 copies of R&EW on sale through the local W H Smith stores. The odds of me getting one are thus around 333:1!

A friend of mine asked if he could borrow an issue to copy an article, but I advised that that was against copyright law, and that he would have to apply for permission to make a photocopy.

And by the way, the colour of the lettering on the December cover is atrocious — greem lettering on a reddish background. And when I write greem, I mean greem!

R B Young
Toronto

REW:

It's good to hear from overseas readers — and your letter illustrates a useful point about becoming a subscriber. The rate of £11 is excellent value — and from what we are told, less than the cost of the issue on the bookstall in many cases. You are assured of a copy, even when the temperature plunges to minus 50 degrees, as it is won't do in your neck of the woods.

Thanks for pointing out the copyright position to your friend. Hopefully we now contain so much indispensable information that it is cheaper to buy a copy than try and photocopy the material anyway.

What we want...

Dear REW,

I have one or two suggestions for projects/features for R&EW — some of which have never appeared in any other magazine, and some of which need to update previously published designs:
100W 2 metre linear amplifier
1kW HF amplifier
2-10 meter transverter
Fast and slow scan TV

I don't think any magazine has ever covered these subjects, and I and many other think it's about time someone did.

J S Goodier
Cheshire

...a 459MHz RC system, and an HF communications receiver...

T A Lloyd
Berks

...a 2m transceiver

C J Soundy
Somerset

...more practical MPU hardware and interface info

B Heath
Nottingham

...a feature on spectrum analysers, and maybe a project on same?

F J Cronby
Cheshire

...tight leather trousers and warm custard

M DeSade
France
(How did that get in here??)

...more beginners features

A Moody
Co Durham

...fewer typographical mistakes

Anon.

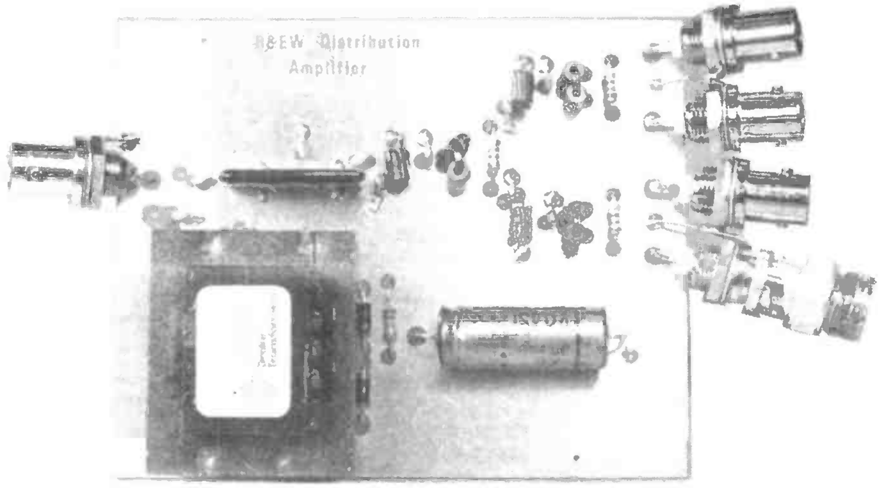
...more Data Brief features
...a cross between an ICF2001 and a Drake R7

B MacMurray
NI

REW:

It is very helpful to receive letters from readers with suggestions for forthcoming projects and features. When we have gathered together a complete list of possible items, we will publish it and ask you to 'vote' via the response card. Only Radio and Electronics World can do this, because it is reached by the parts other magazines don't get to hear about.

TV DISTRIBUTION AMPLIFIER



Allows one aerial to provide signals for up to four TVs or video recorders without degrading S/N ratios.

Design by Roger Ray.

PROVIDING SIGNALS for second TVs, video recorders, etc. From one aerial can lead to a degradation of the S/N ratio of the system if a passive splitter is used. The inclusion of a thin film amplifier in the **R&EW** splitter means that its four isolated outputs give a signal that is 10 dB up on the input - overcoming the S/N problem.

Although primarily intended for VHF and UHF TV, the unit is wide band (5-900 MHz), allowing its use at other frequencies. This versatility can, in some instances, be a drawback. If, for example, very strong band II FM signals exist a trap may be necessary to 'notch' these out even though the IC amplifier exhibits very low intermodulation distortion.

In cases where it is simply required to split the signal path into two, just one of the passive splitters could be used, e.g. C6,7 L3,4 and R3. A bit of careful surgery on the PCB would give you three '3 dB' splitters, an amplifier and PSU should you require it!

The distribution amplifier may be used in conjunction with the **R&EW** masthead pre-amplifier published in our January issue - in this case the DC power for the masthead amplifier will be provided via the co-ax link between the two units.

CONSTRUCTION

The first task in constructing this project is to wind the coils L1-6. The winding details are clearly shown in *Fig 4*. L1,3,5 are made by winding four turns of 0.25mm wire on the ferrite bead starting at **a** and finishing at **b** (tap), a further turn is then wound through the bead finishing at **c**. L2,4,6 are made by threading a turn of 0.56mm wire through two beads starting at **d** and ending at **e**, and then another turn starting at **e** and ending at **f**. The coil winding is a lot more difficult to explain than to do!

Tin the ends of the windings by applying a hot soldering iron and a small amount of solder.

The coils can now be assembled on the PCB, the leads marked **a** are soldered to the top earth plane. The small letters on the overlay **Fig 3** show the correct orientation of the coils.

The other components are assembled next, leaving T1 and IC1 until last. The earth ends of capacitors C4-10 are soldered to the top earth plane. Make the through-board links A-E with tinned copper wire and solder into position.

The pin out of IC1 ensures it is inserted the correct way around in the board.

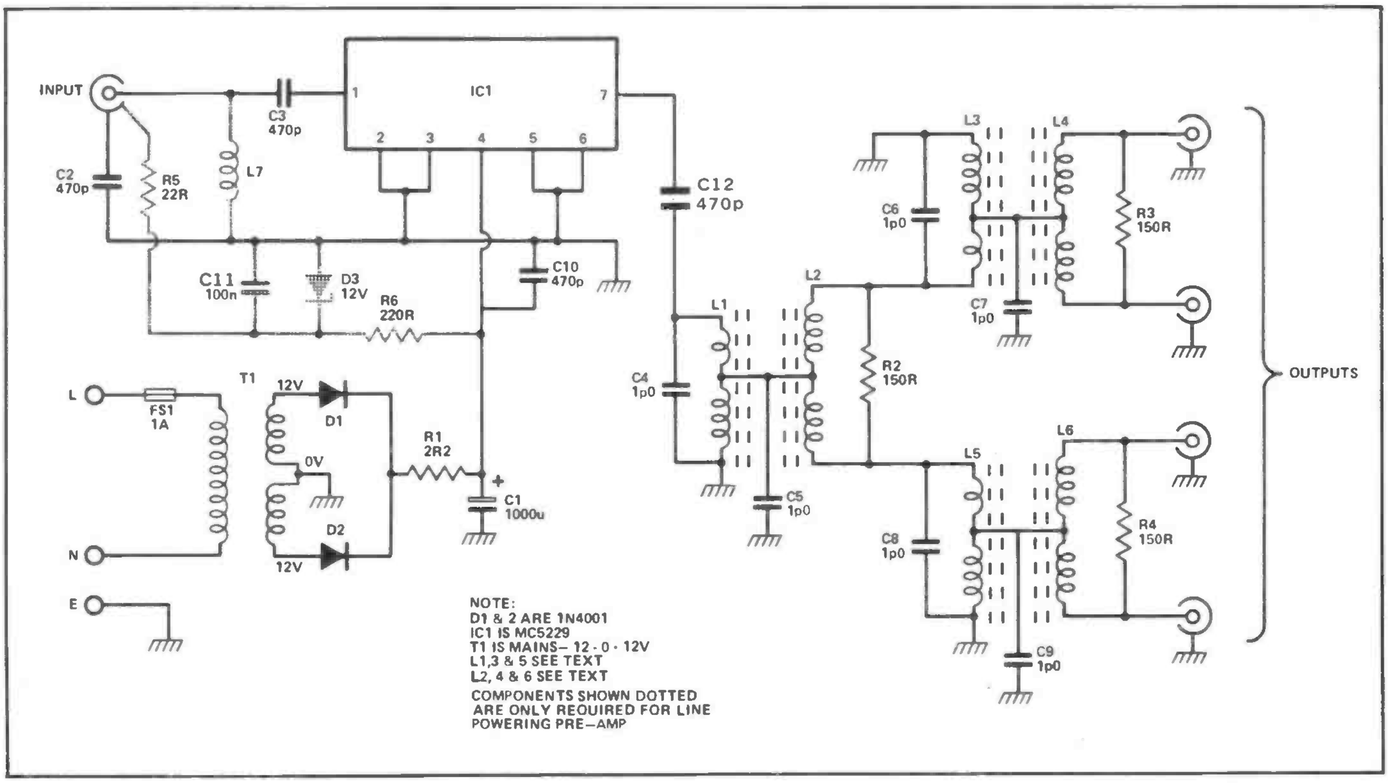


Figure 1: The complete circuit diagram, components shown dotted are only required if the unit is used in conjunction with the R&EW Masthead Amp.

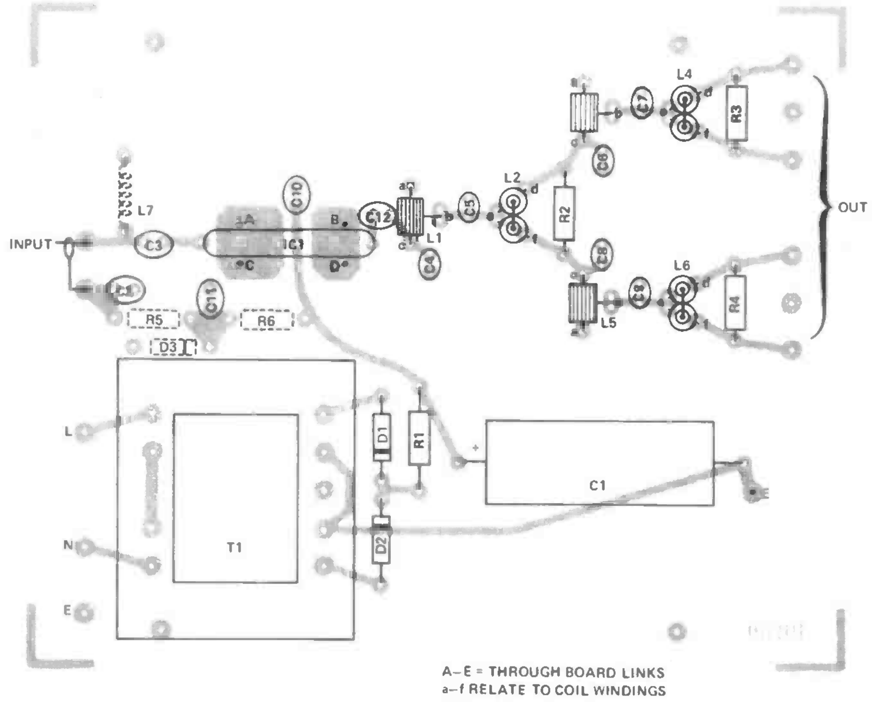


Figure 2: Component overlay of the distribution amplifier.

Parts List

Resistors	
All 5% 1/4 W	
R1	2R2
R2,3,4	150R
R5	22R *
R6	220R *
Capacitors	
C1	1000u 25V
C2,3,10,12	470p ceramic
C4,5,6,7,8,9	1p ceramic
C11	100n monolithic *
Semiconductors	
D1,2	IN4001
D3	12V zener *
IC1	MC5229
Inductors	
L1,3,5	4+1 turn 0.25mm insulated copper wire on FX1242 ferrite bead.
L2,4,6	1+1 turn 0.56mm insulated copper wire on 2 x FX1242 ferrite beads
T1	Mains, 12-0-12V 3VA PCB mounting
Miscellaneous Case	
5 TV co-ax sockets	
1A fuse & holder	
Case	

Note. * Components thus marked are only required for line powering the R&EW TV pre-amplifier if desired.

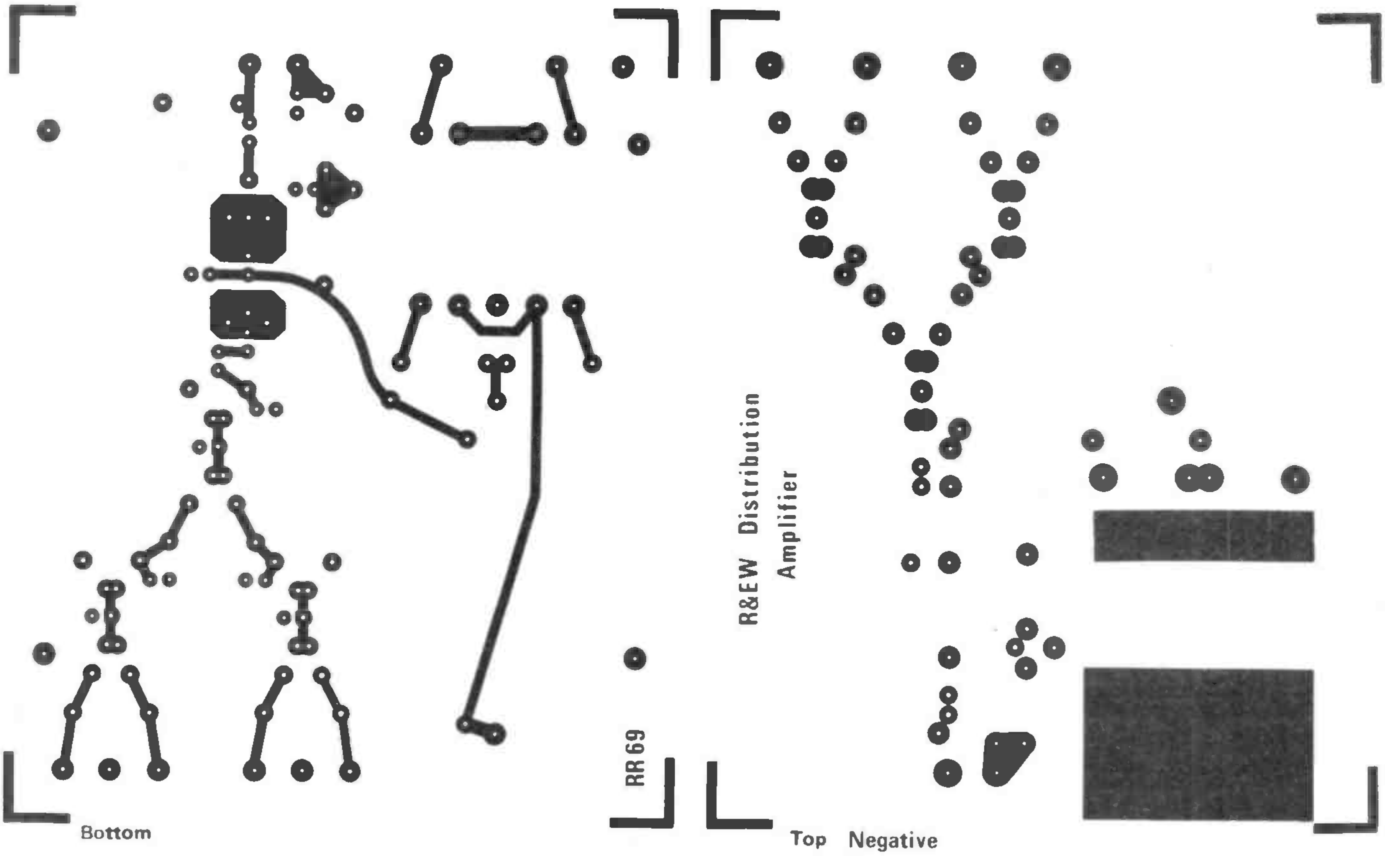


Figure 3: Foil pattern for the projects PCB.

TV DISTRIBUTION AMPLIFIER

SPECIFICATION OF THE MC5229 at 25°C

SYMBOL	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
I_{CC}	Operating Current at V_{CC} = +17V	mA	38	41	46
G	Gain at f = 30 ~ 900MHz, Z_{out} = 75Ω	dB	17	17.5	18
ΔG	Gain Flatness at f = 30 ~ 900MHz, Z_{out} = 75Ω	dB		±0.8	±1.2
RL_{in}	Input Return Loss at f = 30 ~ 900MHz, Z_{out} = 75Ω	dB	7.5		
RL_{out}	Output Return Loss at f = 30 ~ 900MHz, Z_{out} = 75Ω	dB	7.5		
I_{SO}	Isolation, f = 30 ~ 900MHz	dB	25		
NF	Noise Figure, f = 30 ~ 900MHz	dB		5.0	6.5
IM_2	2nd Order Intermodulation Distortion at f_1 = 90MHz, f_2 = 100MHz, $f = f_1 + f_2$, V_{out} = 100dBμV	dB	–50	–55	
IM_3	3rd Order Intermodulation Distortion at f_1 = 200MHz, f_2 = 210MHz, $f = 2f_2 - f_1$, V_{out} = 100dBμV f_1 = 700MHz, f_2 = 750MHz, $f = 2f_2 - f_1$, V_{out} = 100dBμV	dB dB	–60	–65 –55	
P_{out}	Output Power at 1dB Compression, f = 500MHz, Z_{out} = 50Ω	dBm		10	

CIRCUIT DESCRIPTION

This circuit consists of two major elements, a thin film hybrid amplifier (IC1) and a hybrid two-port signal splitter (L1,L2,R2 etc).

The hybrid amplifier type MC5229 from NEC provides a minimum gain of 17 dB with a low distortion output capability in excess of 100 mV. The main purpose of this amplifier is to provide sufficent gain so that the losses through the splitter network, do not serously degrade the signal/noise ratio. The amplifier itself has a noise figure of 5 dB which is significantly less than most UHF TV tuners.

IC1 requires a supply of 17 volts DC, this is provided by a conventional power supply comprising T1,D1,D2, and C1. T1 steps the mains voltage down to 12 volts. D1 and D2 together provide full wave rectification their combined output being smoothed by C1. R1 is included to provide surge current limitation.

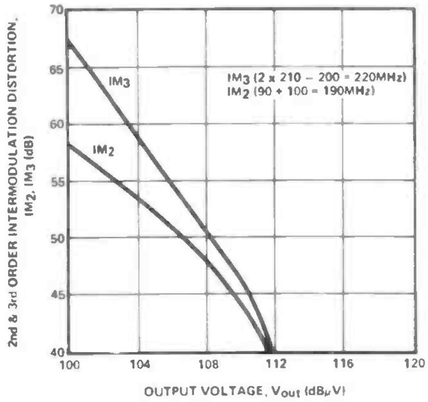
The amplified signal output on pin 7 of IC1 is directly connected to the first '3 dB' hybrid splitter comprised of L1,L2 and R2. L1 provides the correct impedance transformation to drive L2 which gives an equal split to each output port. The value of R2 is made twice the characteristic impedance, as is common with most two port splitters. C4 and C5 are frequency correction capacitors used to improve the response above 500 MHz. The theoretical 3 dB power split is nearer 4 dB in the UHF band due to losses in L1 and L2.

The other two splitters are identical to the first giving a total of four outputs.

The components R5,R6,C11,D3 and L7 provide zener stabilised DC power for the **R&EW** masthead preamp (via the co-ax cable), L7 completing the DC path yet looking like an open circuit to the UHF signal at the input.

Lengths of tinned copper wire should be soldered into the board in the four output positions and the two earth connections between them, similar lengths of wire are used for the input and input earth connections. Connect the mains lead earth to the connection marked E on the board and connect the mains neutral to the connection marked N. A short length of brown wire is connected to the position marked L.

Visually check all components are soldered in position, with the exception of those shown dotted on the overlay (unless they are required to line power the **R&EW** masthead pre-amp).



Typical 2nd & 3rd order intermodulation distortion at V_{CC} = +17V.

The assembled board can now be fitted into the case, using 3mm screws with 6mm spacers under the board. Connect the mains live connection to one side of the fuse holder, and the brown wire from the board to the other. Ensure mains connections to the fuse are adequately insulated with either a plastic 'boot' or tape.

The co-ax sockets are mounted on the case using suitable fixing screws, the connections from the board being made to them using the shortest possible length of wire. (Note. If components are fitted for line powering a pre-amp, the input socket must be an insulated type).

TESTING AND USING

The only testing required is to plug the unit in and try it. For the cautious a check that the voltage across C1 is approximately 17 volts will show the mains fuse is fitted and all is well. In use the outputs can be taken to wall outlets or left as lengths of co-ax. Ideally unused outputs should be terminated in 75R (ie a 75R resistor soldered inside a co-ax plug). In practice this is not too important unless the response flatness is a requisite, although if reflections are a problem this is where to look. Reflection may manifest themselves as ghosting on a TV picture.

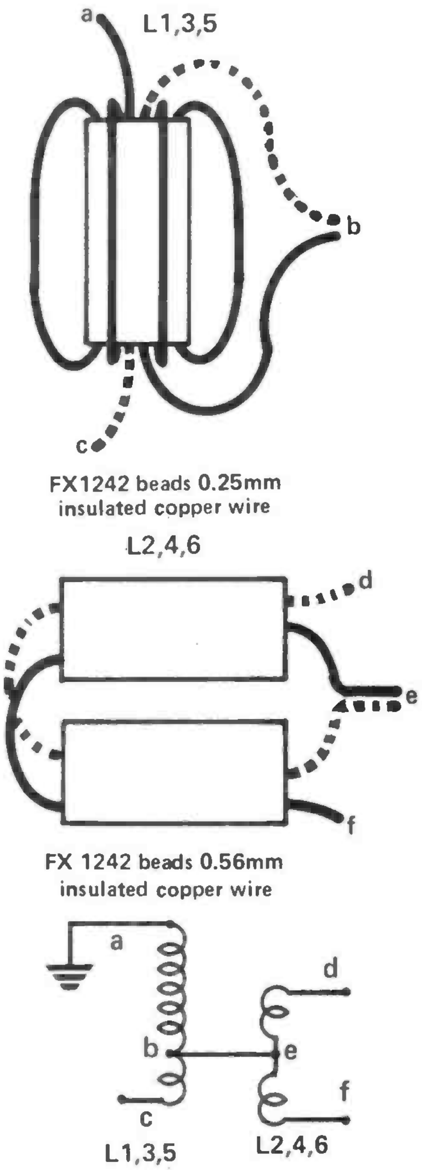


Figure 4: Coil winding details.

Specification

Number of Outputs	4
UHF Gain at each output port	9 dB min
UHF response (470-860 MHz)	+/— 1 dB
Overall frequency response	5-900 MHz
Input match (typ)	10 dB RLR (2:1 VSWR)
Ouput match (typ)	15 dB RLR (1.5:1 VSWR)
Isolation between outputs	15 dB min

References: Ray,R Masthead TV Amplifier **R&EW** January 1982.

■ R & EW

Your Reactions.........	Circle No.
Excellent - will make one	25
Interesting - might make one	26
Seen Better	27
Comments	28

CASIO FX-9000P COMPUTER REVIEW

Gary Evans puts Casio's entry to the microcomputer market place through its paces.

Our thanks go to Tempus for the loan of the mini printer used in this review.

CASIO, THE CALCULATOR PEOPLE, have entered the microcomputer market — slightly later than most of their rivals — with the FX-9000P desk top computer. Now the term desk top computer can cover a multitude of sins, from word processors with a few inbuilt maths facilities to souped up TV games with a BASIC cartridge. The FX-9000P, however, can best be thought of as a 'super calculator' — not surprising considering its pedigree.

The machine's most likely applications will be in scientific and engineering establishments where its good points will make it a valuable asset and its bad will, in the main, be overlooked.

The FX-9000P combines a QUERTY keyboard with separate numeric pad and assorted control keys, a 5" VDU, four expansion module slots (hidden behind a hinged cover) plus various I/O sockets in a compact, tidy package.

HARDWARE: FIRST THE KEYBOARD

The keyboard brings back memories of the early Commodore PETs, being more calculator than typewriter like in feel, belying the impression given by first appearances. The calculator theme is further reinforced by the fact that there are no lower case characters available, shift giving shortform BASIC commands and single key entry of standard maths functions.

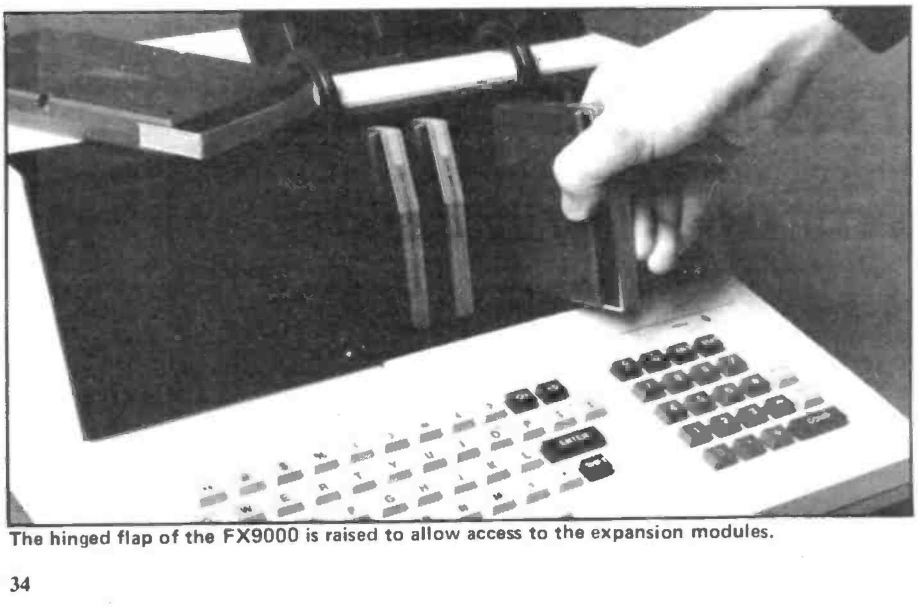
Also available directly are such commonly found maths symbols as <>=# etc.

A separate keyboard is used for numeric entries and has associated with it special function keys such as COMP - to allow direct calculations without the need for PRINT statements — and STAT — to facilitate the use of the FX-9000P's repertoire of statistical routines.

THE VDU

The display produced by the VDU is a pleasant green, the brightness and contrast of which can be adjusted by controls at the rear of the machine. Its format is 32 x 16 characters and the upper case display produced is clear and sharp.

In graphics mode the screen is configured as 22 x 127 pixels, an organization that unfortunately means that not all of the screen can be accessed when in this mode.



The hinged flap of the FX9000 is raised to allow access to the expansion modules.

THE EXPANSION MODULES

The expansion modules of the FX-9000P reveal an interesting design philosophy on the part of Casio, namely CMOS memory modules designed to provide mass storage. On board the machine has 12K or ROM (operating system + CA-BASIC) and 4K of NMOS RAM, the addition of expansion modules allows this memory to be supplemented in a variety of different ways.

Three different types of module are available. The 16K RAM NMOS module provides a large chunk of extra memory and in use must occupy the left most expansion slot (1). The 12K ROM module allows additional firmware to be added to the 12K resident system — this type of module must occupy slot 4. The third type of expansion memory incorporates 4K of CMOS RAM.

The CMOS modules have a built-in battery backup and the low power consumption associated with CMOS memories means that data can be retained for up to three years.

The implication is that Casio see these modules as forming the mass storage medium for the computer. They certainly do provide a reliable, transportable storage system offering an access time far superior to tape or even disk. Our only reservations are the cost (figures indicate about £50 for 4K) and the structure of software involved in their use — of which more later.

The modules are plastic boxes and look much like TV. game cartridges with an integral handle at the front with an edge connector at the rear.

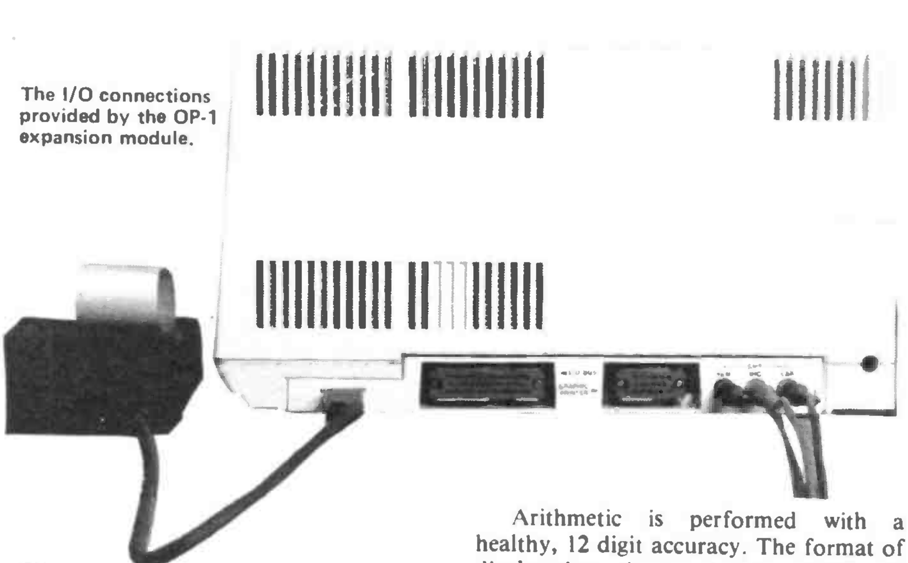
THE CPU

The processor on which the FX-9000P is based is described as being Z-80 compatible — no more detail than that is forthcoming from Casio.

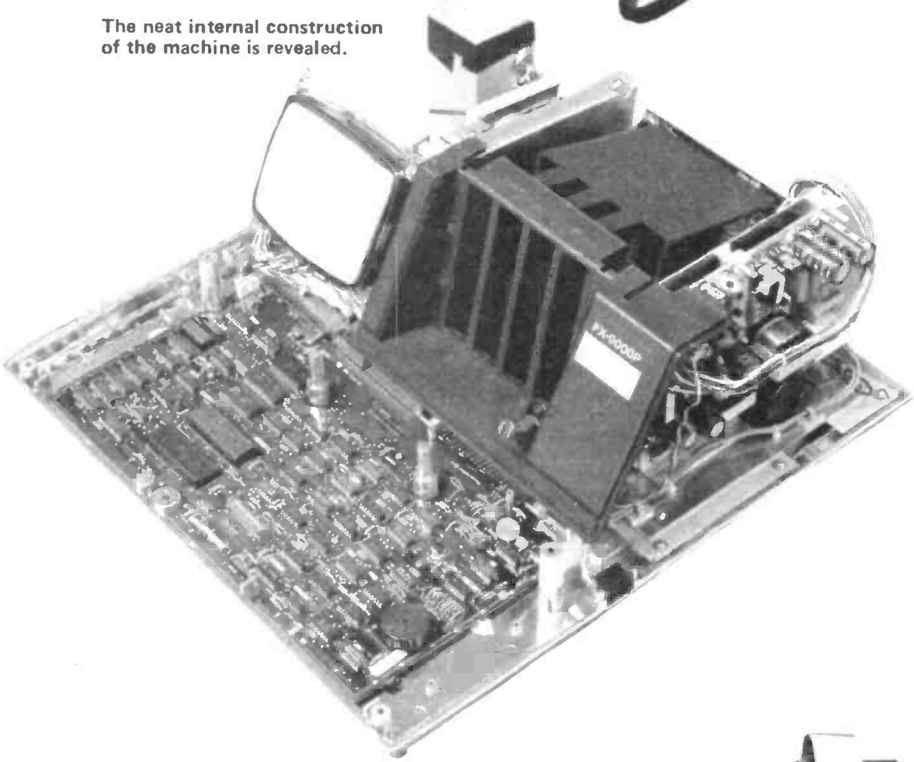
INPUT/OUTPUT

I/O connections to the machine are made via numerous sockets on the OP1 expansion module. This is described as an optional extra, but as I/O without this expansion would not be possible, it should be considered an essential part of the basic package. The OP1's buss connector provides disk, RS232 et al I/O, a mini printer socket will drive Casio's own printer. The graphic printer output will connect to the Epsom MX-82 while the three phono sockets provide tape in, tape out and tape deck remote control lines.

The OP1 also includes a real time clock with battery back-up — it is accessible from BASIC — and three independent alarms utilising a built-in bleeper.



The I/O connections provided by the OP-1 expansion module.



The neat internal construction of the machine is revealed.

SOFTWARE: CA-BASIC

The version of BASIC resident in the FX9000P is Casio's own CA-BASIC. It provides 120 instructions including a full range of trigonometric functions as well as more esoteric hyperbolic, factorial and permutation facilities. It does not, however, provide any CALL or USR command and no hint of machine code operation was given in the manual.

Arithmetic is performed with a healthy, 12 digit accuracy. The format of displayed results can be controlled and formatted from BASIC.

Variable names can be either a single letter or letter plus one digit. Manipulation of one and two dimensional numeric arrays as well as string arrays is catered for.

Memory can be partitioned into ten program areas (P0-P9), selected from the front panel keys (shift numeric). This allows ten programs to be stored, each capable of being executed by a single keystroke.

The FX-9000P is slow at executing programs when compared to other machines performing similar tasks. In its 'super calculator' role however, it offers a great improvement in execution time over conventional programmable calculators.

The cassette deck is controlled by familiar commands such as SAVE, LOAD etc. Also provided are commands to allow the 'screen memory' contents to be saved.

Password protection of files is possible to prevent loading or editing of files by unauthorised users.

The FX9000P with mini printer and cassette recorder attached. Cassette data transfer is 300 BPS Kansas City format.

MOVING DISPLAY

When it comes to displaying data in a graphical form the FX-9000P has some powerful commands to aid the user. The DRAW command, for example, when followed by an argument describing the apexes of a triangle will be all that is required to produce the shape. Similarly, QUAD (argument) will produce a rectangle — both can be 'undrawn' by commands (CDRAW, CQUAD).

Graph axes can be set up with a single command (INIT) while co-ordinates calculated within programs can be scaled to fit the range set up by INIT.

A number of functions allow characters to be 'put to' or 'fetched' from specific areas of the screen making it relatively easy to manipulate the display to produce, for example, animated displays on a static background.

The drawing speed of commands such as QUAD and DRAW is impressive and is faster than can be achieved in many other BASICs limited to a plot function.

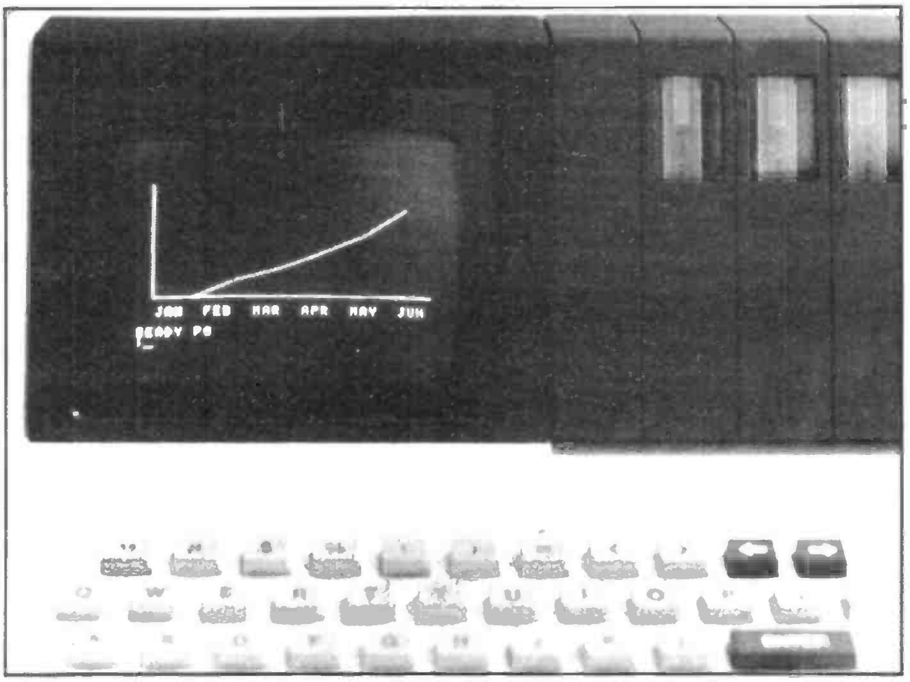
We would also have liked to have seen a 'FILL' command whereby selected blocks could have been filled in to highlight various areas of the display.

RAM FILES

Now as promised more on the use of the CMOS RAM files.

These form a very useful form of mass storage providing fast access to a variety of user programs. However, until their use is mastered, they can provide a few headaches.

Seven RAM files can be set up on the machine with the command RFILE n (n equals 1 to 7). These are in 4K blocks from the top of available memory down. On the review machine, top of memory was an 8K ROM cartridge (files 7 and 6 — 8K ROM block). The next two 4K blocks were each a CMOS RAM pac (files 4 and 5) The rest of memory being 16K NMOS RAM.

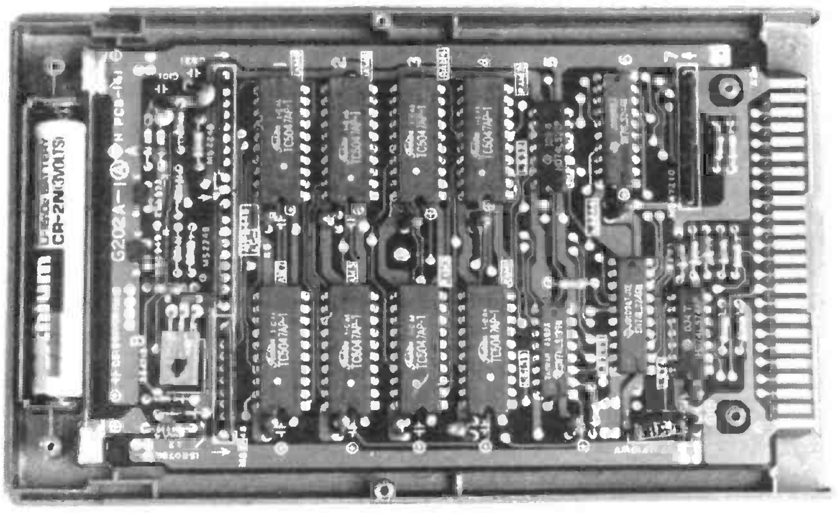


The powerful commands for producing graphical displays are demonstrated in this simple program.

Thus on our machine, only files 4 and 5 could be used as non-volatile storage. Different combinations of modules will mean that file numbers will have different characteristics.

The nature of any particular file is not signalled to the user, neither is information as to whether a transfer has been successful or not.

Once the system has been mastered it provides a valuable form of storage, but initially a bit of care and patience will be required.


An internal shot of a CMOS memory module showing the battery that provides storage for up to three years.

MANUAL OPERATION

Two manuals are supplied, one an operating handbook, the other a description of the CA-BASIC. Both suffer from an annoyingly poor translation which at times makes comprehension extremely difficult.

Between them however they should provide a moderately experienced programmer with an idea of what is required to perform different tasks, the finer points best being sorted out by hands-on experience at the keyboard.

FOR THE FUTURE

Expansions planned include disk drive units — most welcome, and RS232 interface board and presumably additional ROM packages.

ROUNDING UP

It is perhaps unfair to call the FX-9000P an upmarket programmable calculator as it is faster, more powerful and offers a far superior display to any such machine but it is in the upper end of this market that the machine will find its niche.

If the price is right, the FX-9000P should find a home in many establishments where the recession means that budgets will not stretch to the likes of Hewlett-Packard's HP-85.

A machine that will perform admirably in the design office/laboratory but would be misplaced on the secretary's desk or in the home. ■ R & EW

Your Reactions.........	Circle No.
Immediately Applicable	35
Useful & Informative	36
Not Applicable	37

R&EW Data Brief

ULN 2240

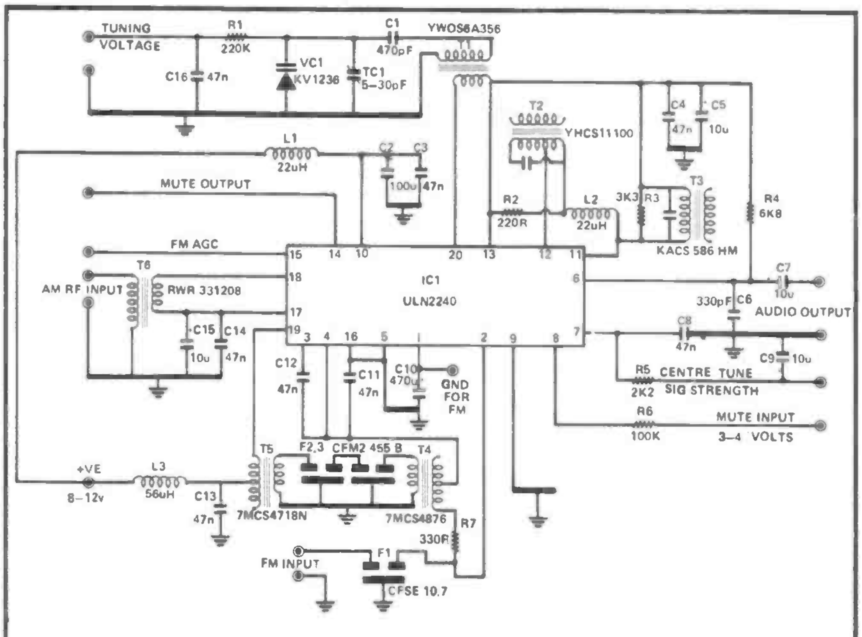
A COMPREHENSIVE AM/FM/SSB SIGNAL PROCESSING SYSTEM

ULN2240 AM/FM tuner system

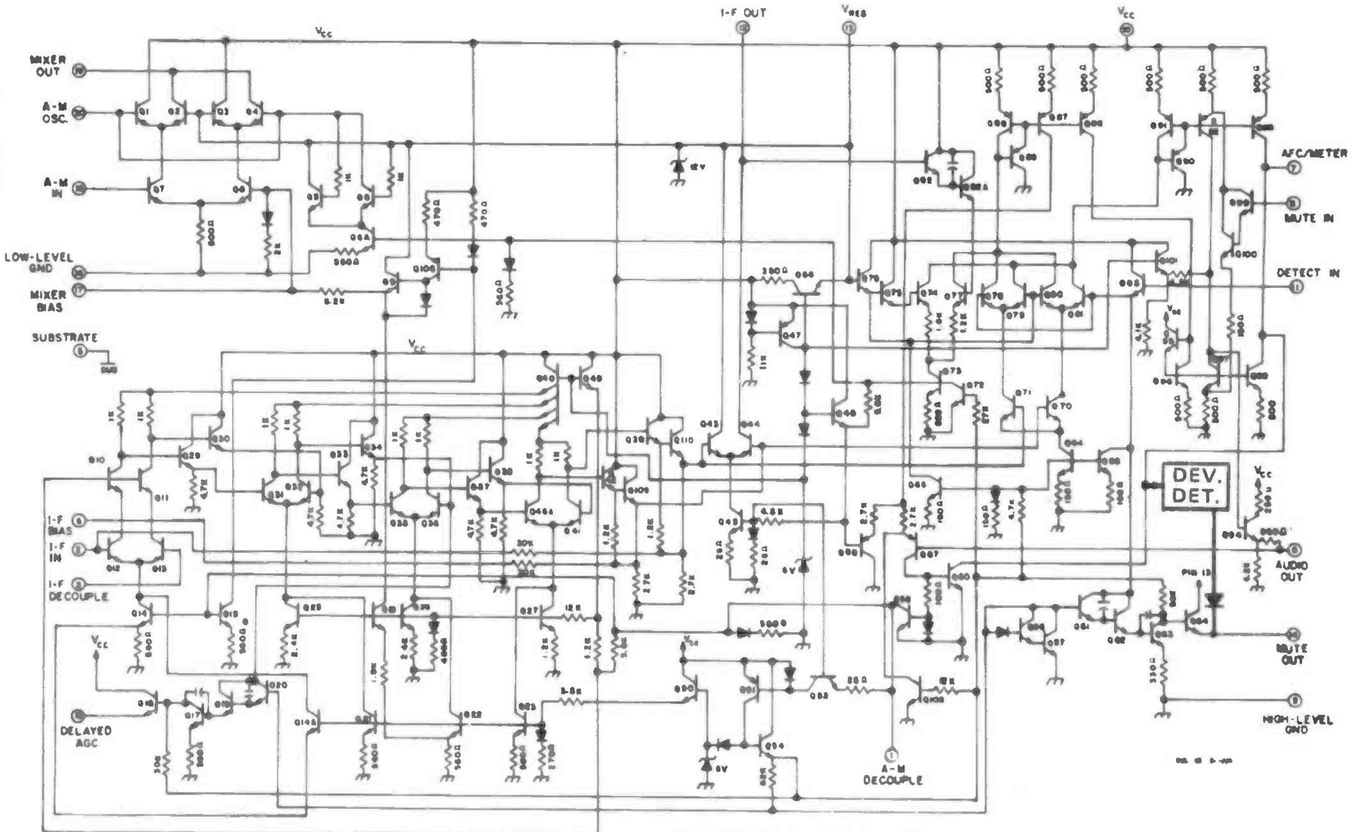
The ULN2240 is an extremely comprehensive signal processing system for use in all types of radio communication system. It contains a complete single conversion AM receiver, with balanced mixer, single terminal oscillator, IF amplifier, AGC and low level linear peak detector, together with a comprehensive low noise FM IF system with deviation (detune) muting, signal level muting, AGC output and tuning meter information. The ULN2240 is a derivative of the ULN2242A, being the same except for the inclusion of deviation muting and an improved S/N ratio on FM.

The AM section of the device provides an exceptionally sensitive receiver that will operate from DC to around 50 MHz - made all the more simple by the single terminal oscillator connection. The AGC effect on the on-chip oscillator precludes satisfactory communications quality SSB much above 10 MHz, although with an external oscillator the performance is not impaired in any way.

In FM mode, the device can be used for either wideband broadcast or narrowband communications, with a noise-cum-signal level squelch being supplemented by a deviation mute circuit that operates in much the same way as that found in the KB4420, CA3189E families.



TEST AND APPLICATION CIRCUIT

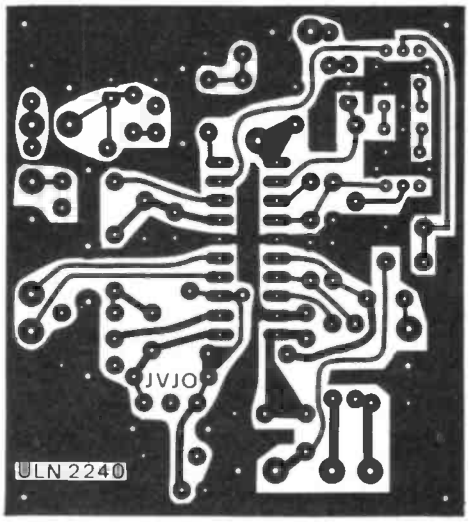


INTERNAL CIRCUIT DIAGRAM

ELECTRICAL CHARACTERISTICS at $T_A = +25°C$, $V_{CC} = 12.8$ V

Characteristic	Symbol	Test Pin	Test Conditions	Limits Min.	Typ.	Max.	Units
Operating Voltage Range	V_{CC}	10		10	12.8	16	V
Differential Audio Output	V_{out}	6	See Note 1	—	—	±3.0	dB
Audio Output Voltage	V_6	6	No Signal	—	5.8	—	V
Regulator Output Voltage	V_{REG}	13	No Signal	—	6.4	—	V
Avail. Reg. Output Current	I_{REG}	13		2.0	—	—	mA
F-M MODE: f_o = 10.7 MHz, f_m = 400 Hz, Δf = ±75 kHz, V_{in} = 10 mVrms, Non-Muted (unless otherwise specified)							
Input Limiting Threshold	V_{TH}	2		—	12	25	µV
Recovered Audio	V_{out}	6		350	425	600	mV
Output Distortion	THD	6		—	0.3	0.7	%
Output Noise	S + N/N	6		74	80	—	dB
A-M Rejection	AMR	12	See Note 2	45	>55	—	dB
Mute	ΔV_{out}	6	$V_{in} = V_{TH}$ + 10 dB, max. mute	—	—	−1.0	dB
			$V_{in} = V_{TH}$ − 6 dB, max. mute	−45	—	—	dB
AFC Output Voltage	V_{afc}	7		220	—	500	mV
I-F Input Voltage	V_2	2	No Signal	—	3.5	—	V
Mute Output Voltage	V_{14}	14	No Signal	3.6	4.2	—	V
AGC Output Voltage	V_{15}	15	No Signal	4.2	4.8	5.5	V
			V_{in} = 10 mVrms	—	—	0.5	V
Mute Output Current	I_{14}	14	No Signal	0.5	—	—	mA
Avail. AGC Output Current	I_{15}	15	No Signal	1.0	—	—	mA
Supply Current	I_{CC}		No Signal	—	23	35	mA
A-M MODE: f_o = 1 MHz, f_{if} = 455 kHz, f_m = 400 Hz, 30% A-M, V_{in} = 1.0 mVrms (unless otherwise specified)							
Sensitivity	V_{in}	18	V_{out} = 50 mVrms	—	5.0	8.5	µV
Usable Sensitivity		18	20 dB S+N/N	—	6.0	—	µV
Recovered Audio	V_{out}	6	80% A-M	250	325	500	mV
Input Overload	V_{in}	18	80% A-M, THD = 10%	25	50	—	mV
A-M Decoupling Voltage	V_1	1	No Signal	—	1.0	—	V
I-F Input Voltage	V_2	2	No Signal	—	3.7	—	V
Mute Output Voltage	V_{14}	14	No Signal	—	—	0.5	V
AGC Output Voltage	V_{15}	15	No Signal	—	—	0.5	V
A-M Input Voltage	V_{17}	17	No Signal	1.6	1.8	2.1	V
Supply Current	I_{CC}		No Signal	—	16	30	mA

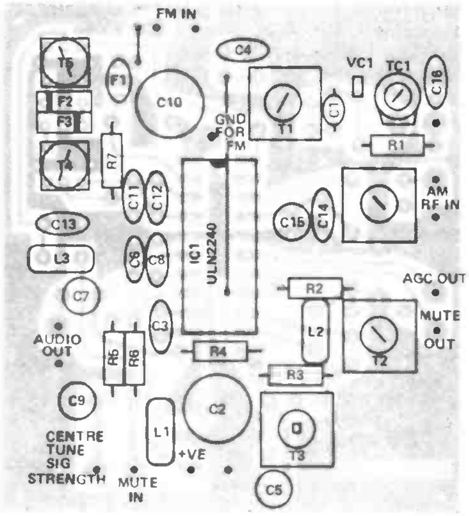
Notes: 1. Differential Audio Output is specified as 20 log $\frac{V_{out} \text{ for } 10 \text{ mV F-M } V_{in}}{V_{out} \text{ for } 1.0 \text{ mV A-M } V_{in}}$ 2. Amplitude Modulation Rejection is specified as 20 log $\frac{V_{out} \text{ for } 100\% \text{ F-M } V_{in}}{V_{out} \text{ for } 30\% \text{ A-M } V_{in}}$



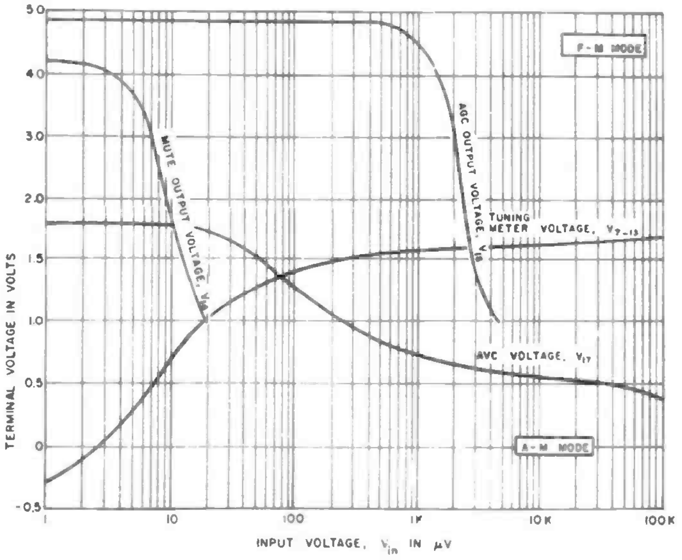
Test circuit PC foil

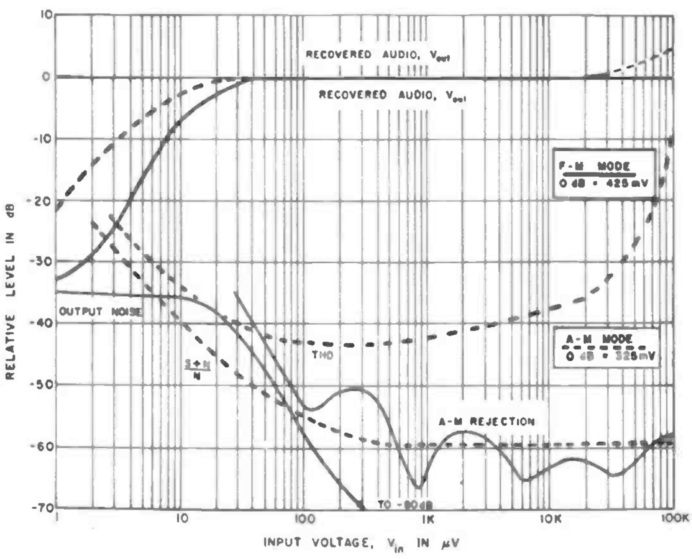
SMALL-SIGNAL A-C CHARACTERISTICS at $T_A = +25°C$

Characteristic	Symbol	Test Pin	Test Conditions	Limits Min.	Typ.	Max.	Units
I-F Input Capacitance	C_2	2		—	6.0	—	pF
I-F Output Resistance	R_{12}	12		—	250	—	kΩ
I-F Output Capacitance	C_{12}	12		—	2.5	—	pF
Audio Output Impedance	Z_6	6		—	350	—	kΩ
F-M MODE: f_o = 10.7 MHz							
I-F Input Resistance	R_2	2		—	10	—	kΩ
I-F Transconductance	g_m	2-12		—	8.0	—	mho
Detector Input Resistance	R_{11}	11		—	100	—	kΩ
Detector Input Capacitance	C_{11}	11		—	1.5	—	pF
A-M MODE: f_o = 1 MHz, f_{if} = 455 kHz							
A-M Input Resistance	R_{18}	18		—	5.0	—	kΩ
A-M Input Capacitance	C_{18}	18		—	20	—	pF
Mixer Transconductance	g_m	18-19		—	15	—	mmho
Mixer Output Resistance	R_{19}	19		—	500	—	kΩ
Mixer Output Capacitance	C_{19}	19		—	5.0	—	pF
I-F Input Resistance	R_2	2		—	15	—	kΩ
I-F Transconductance	g_m	2-12		—	160	—	mmho
Detector Input Resistance	R_{11}	11		—	250	—	kΩ
Detector Input Capacitance	C_{11}	11		—	1.0	—	pF



Component overlay





OSCAR ONE REVIEW

SMC have taken the daring plunge of being the first major Amateur Radio equipment importer to have their monica stuck on a CB. What have they let themselves (and us) in for?? William Poel finds out.

For R&EW Test Specification see April 1982 issue.

IN VIEW OF THE surprisingly pre-amptive and stuffy views held by many diehard radio amateurs and the RSGB on the subject of CB enthusiasm, SMC have apparently taken their life in their hands by becoming inexorably entwined in the CB business with what appears to be an exclusive design of their own. (If you know better, then write and tell me.)

When you're about number 60 on the scene, it pays to have something novel to use as a promotional aid - and SMC has managed to overcome a move in the direction of the 'Poserphone' (a magnificent phrase coined by Graham Baskerville to denote rigs with more knobs and chrome than sense) - and instead decided to ride on the back of a thoroughly good specification.

ENGLISH SPOKEN

An otherwise excellent handbook, (one suspects at least edited by an English person) is let down by a few phrases that would do Leonard Sachs proud, and have the audience gasping in wonderment as the technologicalness of it all.

Hang on to your chequebook too, for scarcely a page turns by without the appearance of an SMC part number denoting some wonderous accessory that is available to cure all ills from warts to ignition interference. In fact, the handbook is so good in many respects that it will doubtless save SMC many wasted hours trying to explain the wonders of installing and operating a mobile radio to the unitiated CBers.

HOW DOES IT DO?

Like most sets seen to date, the specification is a reprint of the basic requirements of MPT1320. The fact that MPT1320 is no guide to the actual worth of a set gives us some scope for comment here - the spec. merely ensures that a CB transmitter causes as few problems as possible to other more deserving users of the airwaves as possible. It could have crystal set receivers - and some may think that their sets already do possess such things.

The receiver performance is outstanding, on a par with the **R&EW** rig in fact. The uncluttered appearance is thanks to a communications engineer's appreciation that knobs and buttons do not (necessarily) a fine wireless make, so the controls *(Fig 1)* have been restrained to those that actually do something.

The standard of construction is however not so good being fairly typical of the Taiwan/Korean sets we have seen.

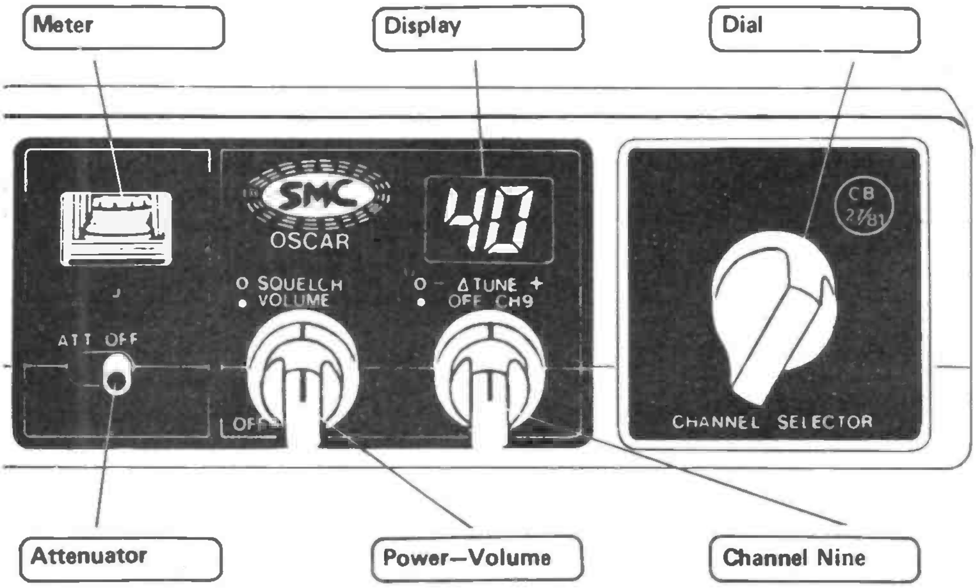
■ **R&EW**

CIRCUIT DESCRIPTION

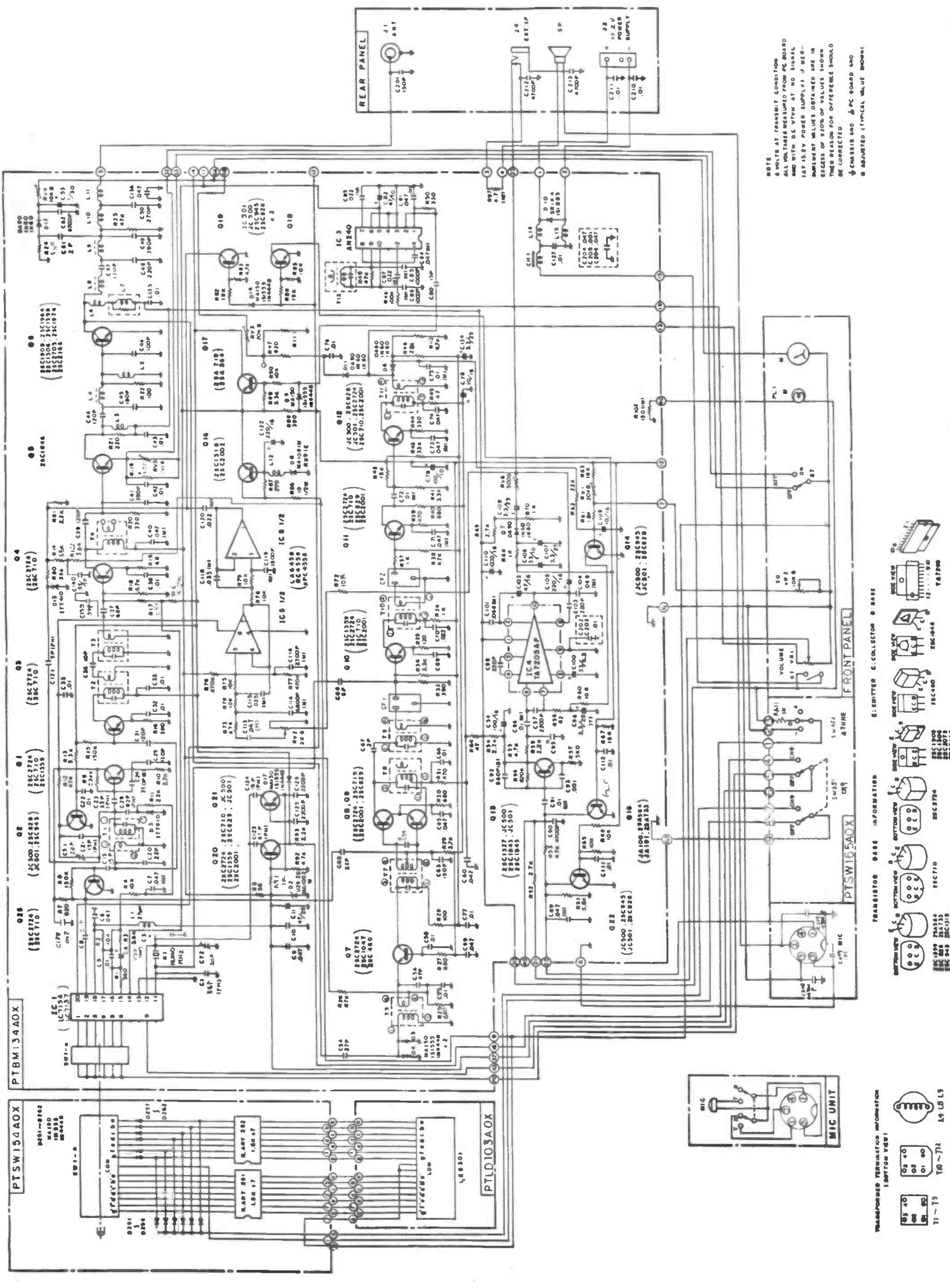
The circuit *(Fig 2)* reveals a balanced bipolar mixer stage (Q8/9) in an otherwise conventional receiver circuit. AGC remains from what appears to be an AM heritage around D6, a separate quadarature FM limiter and detector stage is tacked on (IC3) at the end. The bandpass pair at the mixer output (T8/T9) must make a contribution towards the set's excellent performance, and one wonders what else might happen if CF1 is replaced with a monolithic dual crystal filter -the mod that turned the DNT receiver from awful into quite good.

The PLL system uses the LC7137 PLL from Sanyo, with Q20 and Q21 performing the task of 'delta tune' a function which ought to be rendered completely pointless if all sets actually meet the spec for frequency accuracy. However, all sets do not, and the function can occasionally be shown to justify its presence. The use of unloaded collectors in the switch transistors leaves a shade to be desired, since the transistor's own capacity may drift significantly when used this way. The author has occasionally noted some strange effects with this type of switch -possibly as a result of the RF signal rectifying in the collector/base junction.

The transmitter modulator uses a genuine AGC circuit, with the entire output IC being used to generate the feedback control (shades of AM again). The output is then limited and filtered in IC5, before application to a separate modulator varicap, D13. The VCO (Q1) is tuned by D3, with Q2 providing transmit/receive buffering capacitance to reduce the tuning voltage transition. Q3 doubles, and Q4/5/6 raise the steam up to 4 watts for the antenna. Q17 provides the bulk of the T/R switching function, with odd bits of housekeeping dotted around to keep things in order.



Your Reactions.........	Circle No.
Immediately Applicable	31
Useful & Informative	32
Not Applicable	33
Comments	34


REAR PANEL
FRONT PANEL
MIC UNIT
PTBM134AOX
PTSW154AOX
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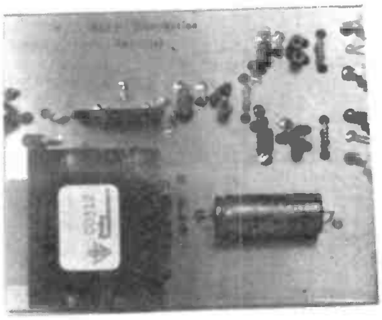

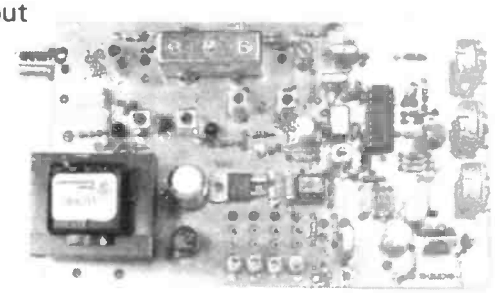

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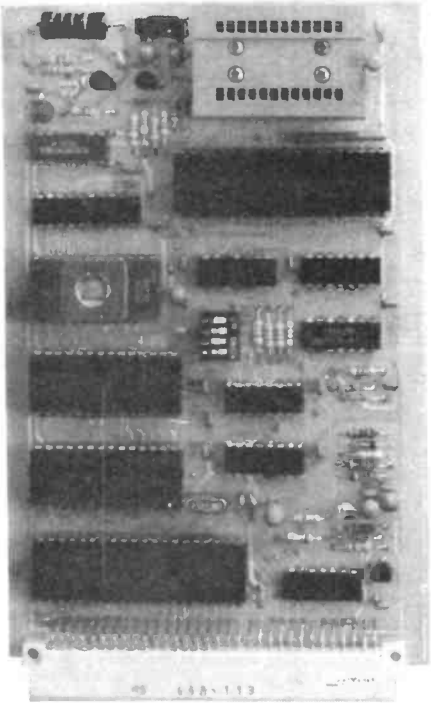

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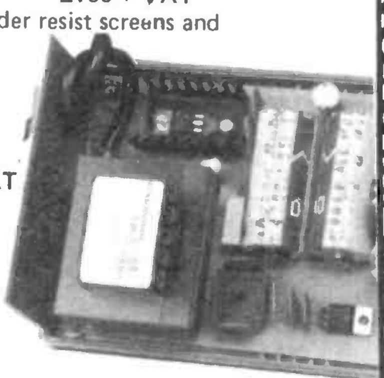

R&EW Z-8 Datapack, approximately 100 pages. £10 inc. P&P refundable against purchase of the computer Kit.

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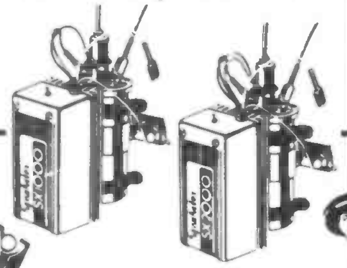

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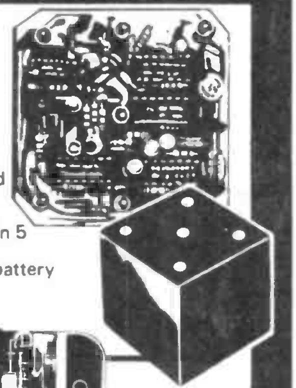

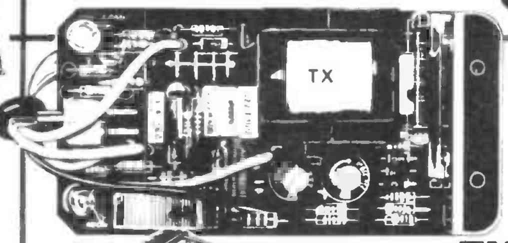

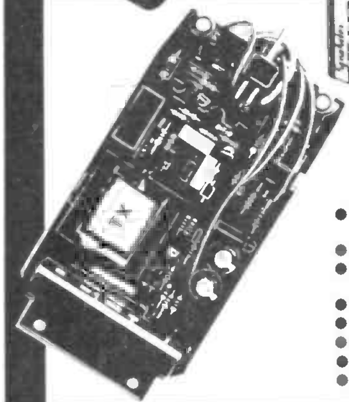

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- Unique Reactive Discharge
- Combined Inductive and Capacitive Discharge
- Contact breaker driven
- Three position changeover switch
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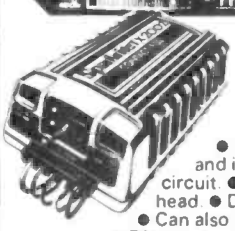
- Fits all 12v neg. earth vehicles



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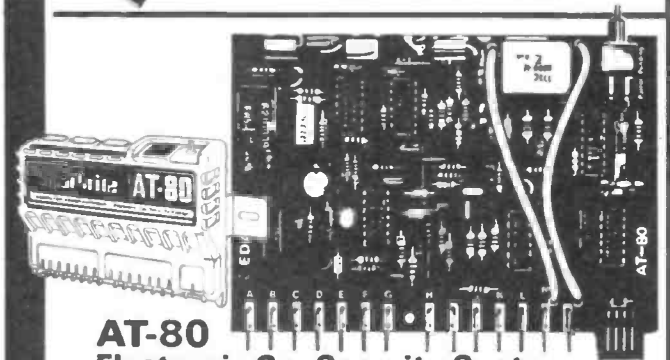

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- Over 250 components to assemble

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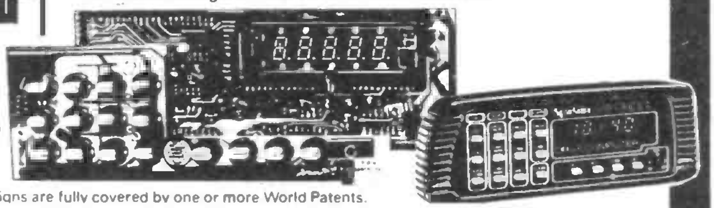

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All the fun of the fair.

COMPUTING NEWS

Gary Evans visits Microsystems '82 and reports on a forthcoming attraction.

THE DIVERSE RANGE of products grouped together under the banner of the microprocessor gives rise to an equally large variety of exhibitions/shows/fairs offering manufacturer's a chance to show off their wares. It would be a full time job to attend all such events and it is therefore necessary for the potential visitor, be they amateur or professional — engineer or businessman, to sift through the publicity surrounding forthcoming attractions in order to decide whether it will be worth their while attending.

This may not be as easy as it sounds as many exhibition organizers seem to lose sight of their 'audience' and attempt to cram as much under one roof as is humanly possible; everything, ZX81 add ons to multi talented, mega buck word processors. Microsystems '82 did not fall into this trap, it being aimed squarely at the professional — although the odd space invader crept in, we're all human afterall (except the invaders of course).

The organisers of Microsystems are old hands at the game, the event being one of the longest established micro shows. This years event at the traditional venue of the West Centre Hotel, tucked away behind Earls Court, was held between the 24th and 26th of February. The first day saw some 1 100 people through the (figurative) turnstiles and a brisk level of activity was evident at most stands.

As usual, a number of manufacturers chose the event to launch either new products or additions to existing ranges which ensured that everybody had a chance to look at something new.

In the space of a page it is not possible to mention each and every company present, instead just a few 'highlights'.

YEARS AHEAD WITH SCHH....

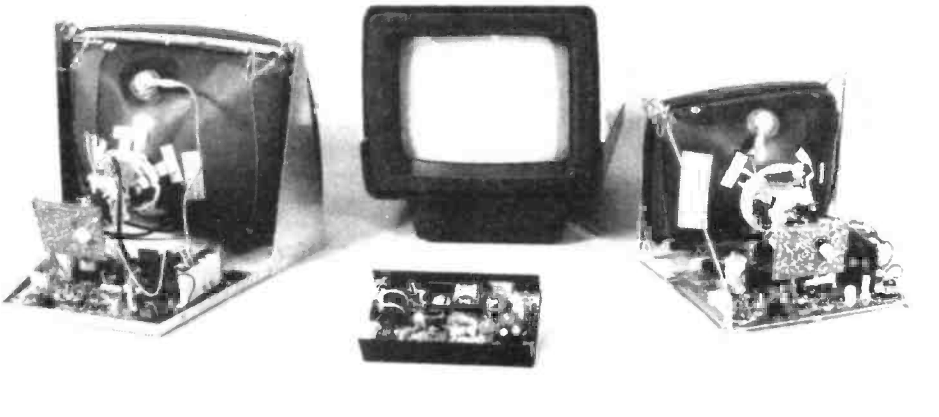
The Philips stand offered a chance to see their updated PMDS (Philips Microcomputer Development System) extended to support 16 bit microprocessors as well as, at the other end of the scale, the PM 4300. This is a low cost prototyping/debugging system for developing small/medium scale micro systems.

Featuring Hex keypad, 16 character - 14 segment alpha numeric display, breadboard area, I/O etc. A useful feature of this system is a plug-in MPU personality module.

Moving on to the development of large scale systems, the latest in the Tektronix 8500 series — the 8560 — is designed to facilitate the team-orientated approach. Also on show from Tektronix was 308 data analyser, the 7D02 logic analyser (for use with 7000 series 'scopes) and the 834 data communications tester.

Microvitec were showing their range of Low Complexity Colour Displays (LCCD). These are a range of high definition display systems produced at a price that is competitive with standard TV sets. The LCCDs should find a ready market in industrial/educational organizations where funds are limited, prohibiting the purchase of expensive monitors, yet where the limited bandwidth of a 'modulated' production TV does not give the required performance.

The BBC chose a microvitec LCCD as the display for their computer in the computer programme series.



Microvitec at Microsystems '82. Low Complexity Colour Displays.
Left: 20" frame only version: 14" structural—foam case: 14" frame only.

TIME GENTLEMEN PLEASE

Just three of the companies represented at Microsystems '82 and we'll have to call it a day, but I hope you have caught the flavour of the event.

The next fair of note is The Computer Fair at Earl's Court from April 23-25th. This is a more 'down market' affair — that's not meant to be degrading — with the accent more on the amateur side of things.

The Computer Fair should prove to be a good day out for the more technology aware family and should not be as risky to life and limb as the more traditional outing to Chelsea Football Ground just up the road.

● ● ● ● ● ● ● ● ● ● ● ●

Calculated Slump

Production of calculators in Japan was only 50 million units last year, still enough to go a few times round the world if laid end to end but not quite as much as the 60 million produced in 1980.

The reason for this slump, competition from Hong Kong Taiwan and Korea - now where have we heard that before?

Prize Draw

The shortage of talented personnel has prompted at least one company to offer prizes to any of its employees who refers a friend for any job appearing on their notice boards.

If the friend gets an interview, the employee gets a tee shirt. If he manages to get the job and sticks a probation period, the employee has his name put down for a star prize draw, the star prize in question being a DeLorean sports car. Luckily the car has already been bought and is safely at company HQ in Canada.

Now history has a habit of repeating itself. In the fifties a similar idea by another company resulted in a near disaster when it caused such a slump in recruitment that it nearly killed off the organization. The prize then a Ford Edzel.

■ R & EW

Your Reactions.........	Circle No.
Immediately Applicable	59
Useful & Informative	60
Not Applicable	61
Comments	62

VOYAGER CAR COMPUTER

Make driving safer and more economical with our In-Car-Computer featuring 12 functions centred on Fuel, Speed, Distance, and Time. Design by EDA Sparkrite.

THE VOYAGER DRIVE COMPUTER is a highly sophisticated system that monitors and displays, at the touch of a button, all the information regarding car performance and road conditions a motorist could need. By slightly modifying driving style according to data on instantaneous fuel use, it should be possible to make considerable savings over a period of time while the ice warning feature will make driving safer.

The Voyager is a state-of-the-art design being based on a microprocessor with on-board RAM and mask programmed ROM.

ENJOY THE TRIP

A unique feature is the ability of the Voyager to act as 'four computers in one'. Thus while an immediate display of essential information can be obtained the log and trip computers continue to receive data. These may be operated synchronously or independently, thus permitting a number of short trips to be recorded individually, while computing fuel consumption over much longer periods.

The Voyager also doubles as an in-car clock.

The Voyager may be fitted to any petrol driven car or van except for those fitted with fuel injection. The reason that the unit cannot be used with injection systems, or with diesel or LPG engines is that the fuel sensor is not designed for use with high pressure systems.

The black injection moulded case and attention to the details of construction mean that the Voyager looks at home amongst the sleekest of instrument panels.

The Voyager is available as a complete kit and we would recommend that the project be built from this as it includes everything down to the last nut and bolt and ensures that the finished article looks professional in appearance.

CONSTRUCTION AND CORRECTION

The kit is supplied with complete constructional and installation instructions which will enable any reasonably experienced constructor to achieve a high standard of finish.

Connecting the Voyager to the vehicles electrical system is straightforward and should not take long. To fit on the fuel and distance sensors is a little more time consuming although again a straightforward enough job adequately covered in the kit instructions.

When installation is complete, the Voyager display should remain blank until the ignition is switched on when, if all is well, the word CAL will appear. Press clear and the display should change to CAL — —.

To set the time enter **time now** followed by **set** then **slow** to advance the minutes and **fast** to set the hours. A dot on the right hand side of the display will indicate PM. When the correct time is displayed, pressing any of the function buttons will start the clock.

If you over shoot, press **clear** and start again.

Once the time is set, turn the ignition off where upon the display should 'freeze' for about six seconds before switching off.

After about a minute, switch the ignition back on, and check that the time has been updated. Pressing **(trip) time** at this stage should display the total time that the Voyager has been connected to the ignition circuit.

COMMENCING CALIBRATION

To calibrate the fuel sensor enter **cons now** followed by **cal** then **fast** and **slow** until the display reads 161. This is an approximate calibration figure as a basis for the rest of the procedure. Note that when displaying fuel consumption (log or now) the Voyager will produce a bar on the left hand side of the display.

Now fill the vehicle's tank to the brim, making sure that there is no air in the fuel system and that it is on level ground. Then clear the log computer by pressing **fuel, set, clear.**

Drive until about five gallons of fuel have been used, this need not be done at one time and other Voyager functions may be used in the meantime providing the log computer is not cleared. Fill the tank again and note the exact amount required to do so.

Make sure the slide switch is in the appropriate position (gallons or litres), input the amount by entering **fuel, cal** then **fast** and **slow**. Once again press **clear** if you over shoot.

Pressing **cons now, cal** will display your calibration number, make a note of this as it will make recalibration (necessary if the vehicle's battery is disconnected) easier.

Press any function button to enter the calibration number.

The distance and speed calibration is carried out in a similar manner. To start -press **(trip) dist, set, clear.**Then drive for a known distance (about 10 miles). The vehicle odometer should be sufficently accurate for the purpose of recording distance. Once again ensure the slide switch is in the appropriate position (miles or kilometers) then enter the distance travelled by pressing **(trip) dist, cal** and **fast** or **slow**.

Speed now followed by **cal** will display the speed calibration number, make a note of it.

Pressing any one of the function buttons will enter the figure.

ALARMING SPEED

To set the speed alarms, enter **(alarm) speed** when the Voyager will display zero (or two speeds displayed alternately for two seconds).

Press **set** to 'freeze' the display then **clear** the display and **fast** and **slow** to enter the required speed e.g. 30 mph.

Now press **(alarm) speed** again to revert to the alternating display. 'Freeze' the other speed by the use of **set** and calibrate the other speed (e.g. 70 mph) as before.

To set the time alarm press **(alarm) time, set** then **fast** and **slow** to obtain the required time.

The lights alarm can be tested by switching the ignition off while the side lights are on.

ICE WARNING

To test the ice warning unit press the test button when the Voyager should display the word ICE and produce a chime. Releasing the button will display 'no ICE' (assuming the sensor is at a temperature above 0°C). This display will be retained for two seconds before the previous function is returned to.

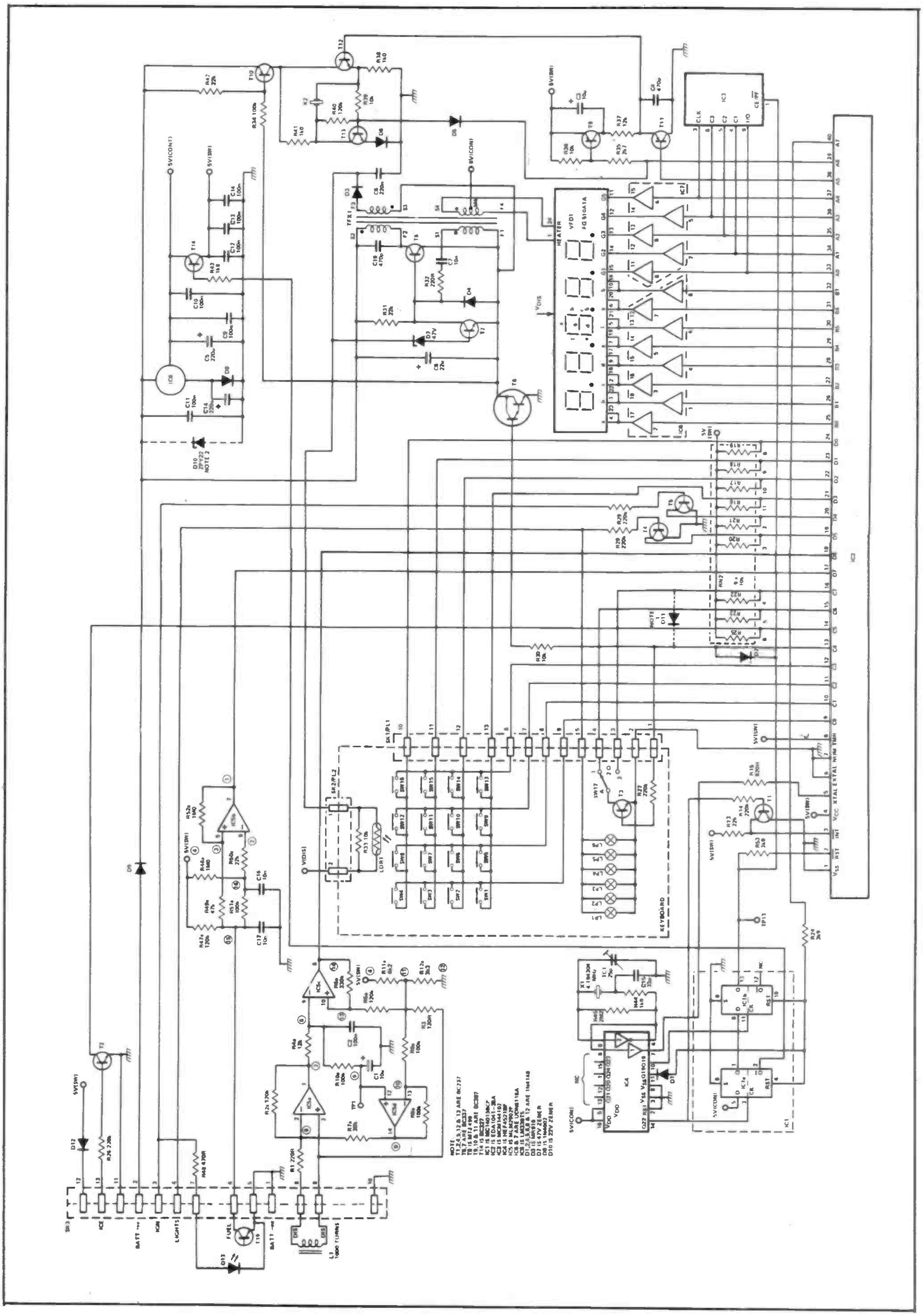


Figure 1: Complete Circuit Diagram of the Voyager's main board. Note resistors with the suffix 'a' are within the DIL resistor network RN1.

VOYAGER CAR COMPUTER

TIME ALARM
The Time Alarm operates as an alarm clock even if the ignition is off. Stop the alarm by pressing any button for two seconds, or it will continue for 1 minute. **Set clear** when not required.

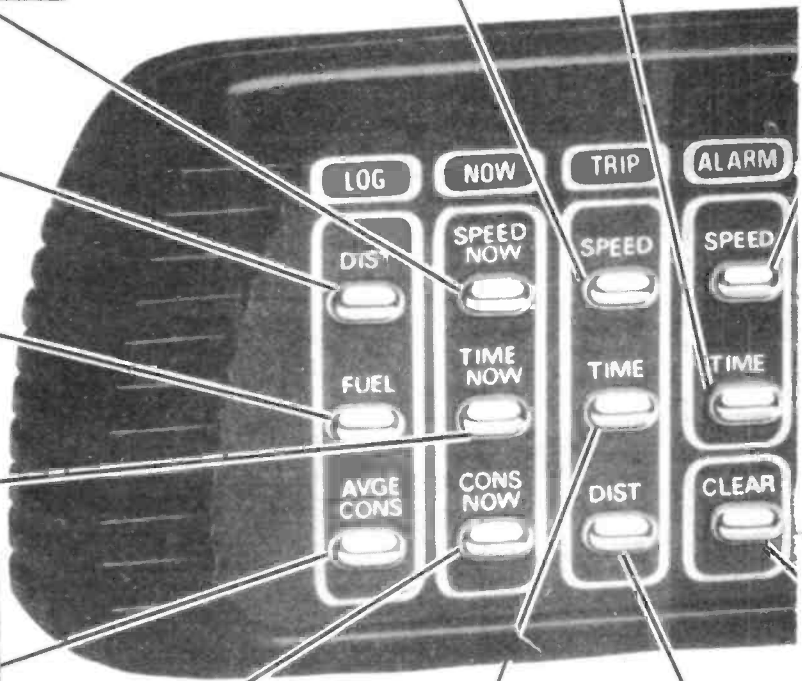
TRIP SPEED
Average speed over the trip, computed continuously. 0.1 mph or kph.

SPEED NOW
Instantaneous speed from second to second as you drive 1 mph or 1kph.

LOG DIST
Distance travelled since the Log computer was last reset. 0.1 miles or kilometers. (Over 2,000 miles of memory)

LOG FUEL
Fuel used since the Log computer was last reset. 0.05 gallons or 0.1 litres (Up to 180 gallons).

TIME NOW
Time of day in hours and minutes. 12 hour format with decimal point on the right hand side to indicate PM.
Operates as a stop watch if you set it to zero.



LOG AVGE CONS
Average fuel consumption since the Log computer was last reset. 0.1 mpg or 0.1 miles per litre or 0.1 litres per 100 kilometers.
A bar at the left hand end of the display denotes a fuel consumption reading.

CONS NOW
Instantaneous fuel consumption from second to second as you drive. 1 mpg or 0.1 miles per litre of 0.1 litres per 100 kilometers.

TRIP TIME
Elapsed time since the Trip computer was last reset. Stops automaticlly when the ignition is switched off. Reads minutes and seconds for the first hour like a stopwatch and thereafter reads hours and minutes (Up to 100 hours).
Can also be operated as a split lap timer, freezing the time with the SET button but then continuing.

TRIP DIST
Distance travelled computer was last or kilometers.

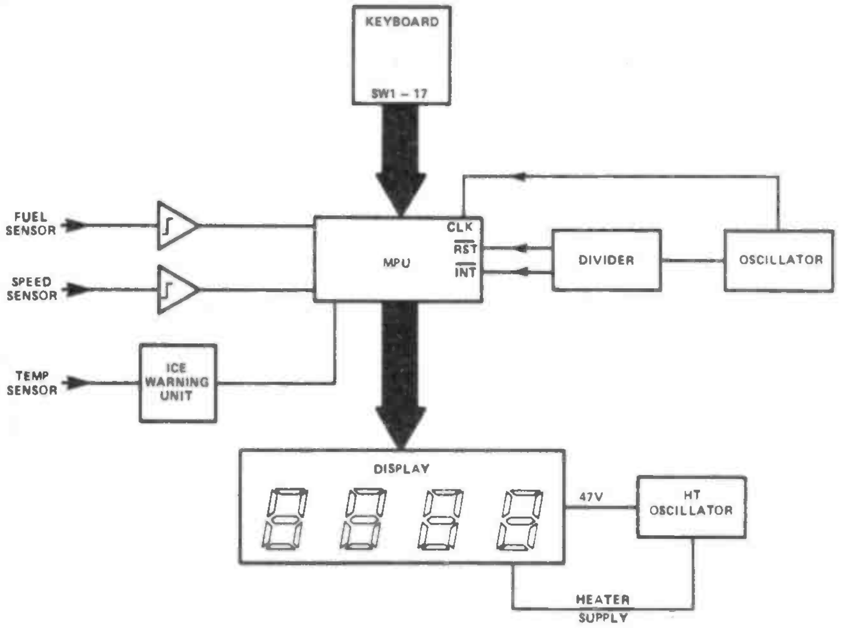


Figure 2: Block Diagram of the Voyager.

CIRCUIT DESCRIPTION

The circuit of the voyager drive computer is centred on the N-MOS 8 bit MPU IC2. The other parts of the circuit are concerned with collecting and processing information from the fuel and distance sensors, the keyboard, the vehicle ignition and lights circuits, the ice warning detector and with displaying the data derived from these inputs on a fluorescent display. A power supply, crystal oscillator and audio amplifier complete the Voyager circuit.

DISTANCE SENSOR

The distance sensor is formed by coil L1 which generates a signal the frequency of which corresponds to the peaks in magnetic flux caused by the rotating magnets on the vehicle drive shaft.

SPEED ALARM

Two programmable speeds, displayed for alternate two seconds. A high note chime sounds when you exceed an alarm speed and a low note chime sounds as you drop back through the chosen alarm speed.

Actual speed is displayed as the chime sounds can be temporarily silenced by pressing **alarm speed clear** and restored again without having to re-programme by pressing **alarm speed** again.

DISPLAY

(Vacuum Fluorescent) 5 digits 0.4 inches (10mm) high. Many instruments have only 4 digits or have only 0.3 inch displays.

Light Sensor controls display -brightens automatically.

Not only Metric and Imperial conversion, but also a third position to accommodate the combination of miles and litres.

Straightforward calibration method for all makes of vehicle with a simple method for recalibration should the need ever arise e.g. after the vehicle battery has been disconnected.

Single step or auto-increment setting buttons.

LIGHTS ALARM

A six second alarm sounds if you leave your lights on when you turn the ignition off. Press any button to stop the alarm.

ICE ALARM

The Ice Alarm displays 'ICE' or 'no ICE' as the outside temperature changes around freezing point and operates a high or low note chime.

It also alerts the driver each time the ignition is switched on if the weather conditions are icy.

The Ice Alarm can also be interrogated by pressing the **alarm time** button. If it is icy the work ICE will be displayed before the alarm time.

since the Trip reset 0.1 miles

RESET

Dist set clear resets to zero the appropriate computer according to which DIST button is pressed. The two button **SET CLEAR** sequence avoids accidentally resetting the computer.

Log and Trip computers can be reset together by holding the clear button down for at least three seconds at the end of the reset sequence.

With the ignition off the Voyager cannot be re-calibrated or reset, so it cannot be changed by the children if they are left in the car.

11 Function buttons and 5 Setting buttons.

Button operation confirmed by buzzer and tactile feel.

Invalid button sequence indicated by displaying "Error".

Panel illuminated at night.

The Voyager can be read even when stationary with the ignition turned off. Pressing any function button will "wake up" the computer for six seconds to display whatever is required. Press twice to display both alarm speeds.

This signal is amplified by IC5a and fed to the Schmitt trigger formed by IC5c, the hysteresis of this section being defined by R5 and R6. The output of IC5c now consists of a series of 'digital' pulses and is input to the MPU on pin 18.

The voltage at the junction of R10 and C1 is the mean output of IC5a, the function of IC5d being to maintain this at the reference voltage set at the junction of R11 and R12 (about 1/3 supply).

FUEL FLOW

The fuel flow sensor consists of a infra red LED and photo transistor, the light path between them being interrupted by a rotating element as fuel flows through the sensor.

Power to the LED is taken from the ignition line via R48.

The photo transistor's output is applied to a Schmitt trigger (IC5b) whose non-inverting input is biased to the average value of the input (voltage at junction of R51 and C16) plus an offset (R46). The offset is approximately two times the hysterisis of the stage (defined by R49 and R52).

KEYBOARD

SW1 - SW16 form a 4 x 4 array that is periodically strobed by the MPU. Debouncing of the keys is performed by the software of the system which also ignores multiple key closures, only the first key pressed and last released having any effect.

SW17 selects either MPG, KPL or MPL.

IGNITION AND LIGHTS

The IGN line is buffered by T5 and input to the MPU at pin 20.

The lights line powers the panel lights of the Voyager and signals its state to the MPU via T4.

If the lights are on and ignition off, the MPU will generate an alarm signal.

DISPLAY

The display requires an HT supply of about 47 V and this is produced by the self oscillating invertor (TFX1, T6, R31, R32, C7, C19 and D4). The AC output from the oscillator is rectified and smoothed by D3 and C8 while D7 and T7 regulate the supply, T7 removing the drive to T6 if the output rises above 47 V.

The HT supply is fed to the display via the parallel combination of R33 and LDR1 which form the brightness control.

A secondary winding of TFX1 provides a low voltage AC supply for the display's heater.

The oscillator is powered from the 12 V unswitched line and T8 enables the MPU to switch the display on and off by a control signal on pin 13.

The digit and segment drives are provided by the MPU under software control and are buffered by ICs 6 and 7.

CHIMES

The chime circuit consists of T9,11,12 & 13 with associated components. With MPU's pin 39 held low, T9 is turned on discharging C3 and turning off T13. A square wave signal at pin 38 of the MPU will, via T11 and T12 produce a similar signal across X2.

When IC2 pin 39 is high, T13 will act as an inverting amplifier, driving X2 with a much larger differential signal. However, T9 is now turned off and C3 is free to charge causing the available voltage swing at T11 emitter to fall and thus the amplitued of the signal across X2 to die away.

Power to the chime circuit is derived from the unswitched 12 V line via T10 which removes the supply when the circuit is in the standby mode.

POWER SUPPLY

The 12 V battery line is fed to a three terminal voltage regulator IC8, the output of which forms the 5 V continuous supply. The 5 V switched line is taken from the collector of the T14, the supply being on when IC1a's Q is low (normal mode) and off when the IC's output is high (standby mode).

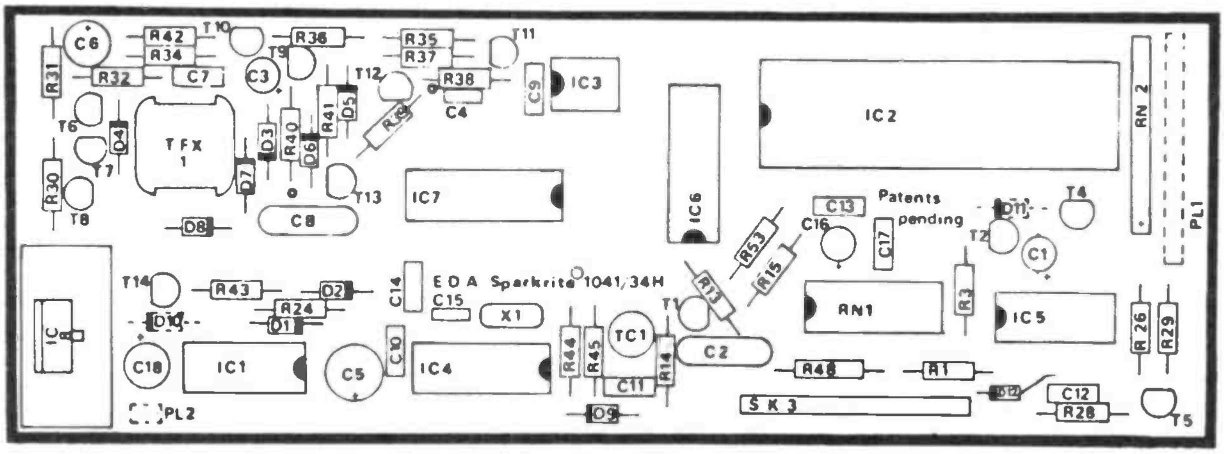
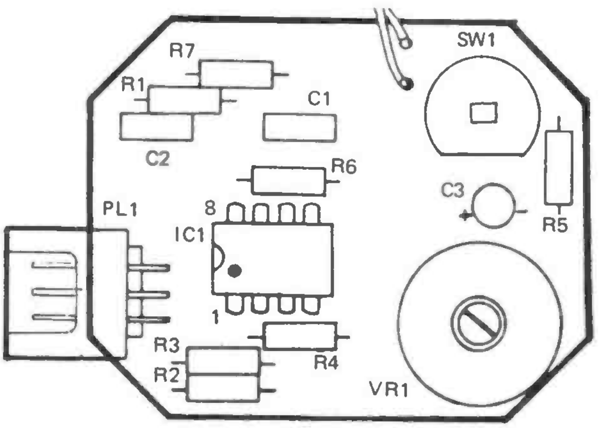
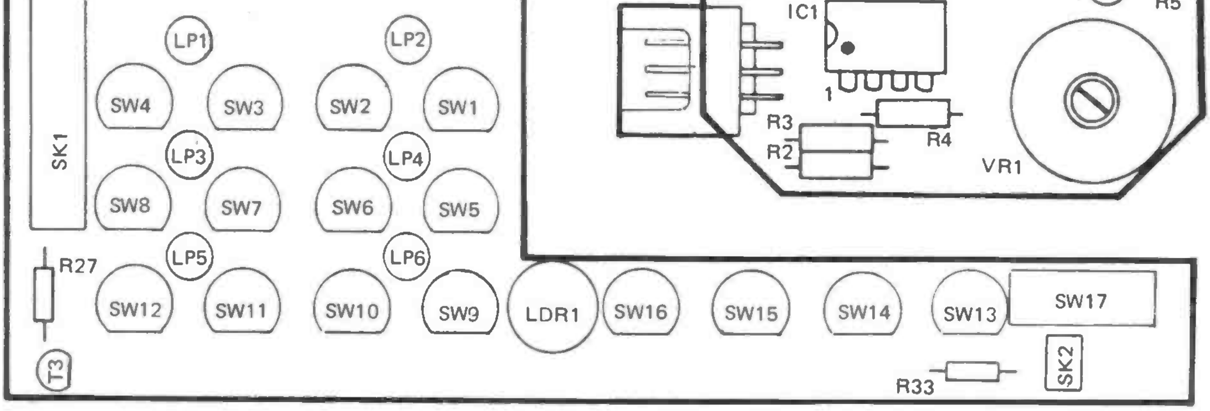


Figure 3: (Above) Shows the main board's component overlay.
Figure 4: (Right) The overlay for the Ice Warning System.
Figure 5: The layout of the Keyboard PCB.





SYSTEM OSCILLATOR

Crystal X1, the invertors in IC4 and associated components form an oscillator which provides the MPU clock signal.

Other sections of IC4 together with IC1 form a divider chain to provide the RST and INT signals, the RST line being buffered by T1.

STANDBY MODE

In order to reduce current consumption when not in use, the Voyager detects the ignition off condition and, after a delay of six seconds, removes power from most of the circuit.

Power is still applied to the clock and divider circuits and these arrange for power to be applied to the MPU periodically. During this time the time of day memory is updated and the keyboard scanned to determine whether a key has been pressed.

The other section of the circuit continually supplied with power is IC3. This is a CMOS RAM which consumes negligible power. When the MPU goes into standby mode, the data in all its registers is 'dumped' to this memory before power is removed.

ICE WARNING UNIT

The temperature sensor (thermistor TDR1) and R1 form a potential divider, with the value of R1 selected such that over the temperature range of interest (0—4°C) the voltage at its junction if approximately midway between the supply rails. This voltage is fed via the low pass filter formed by R7, C1 to the non-inverting input of IC1a (the filter provides a degree of immunity from the 'noisy' electrical environment of a car).

C3 is included to slow down the response of the unit, to eliminate relatively rapid temperature variations about the switching point.

The voltage at the inverting input of IC1a is derived from the network R2, VR1 and R5 - the difference between this and the voltage derived from the potential divider is amplified 10 times by the IC.

This amplified voltage is fed to the Schmitt trigger formed by IC1b. This has been designed to provide a hysterisis of about 3°C.

The test button pulls the inverting inputs of the ICs to ground simulating the 'ice' condition.

The circuit is powered from the main board, C2 providing decoupling of the supply.

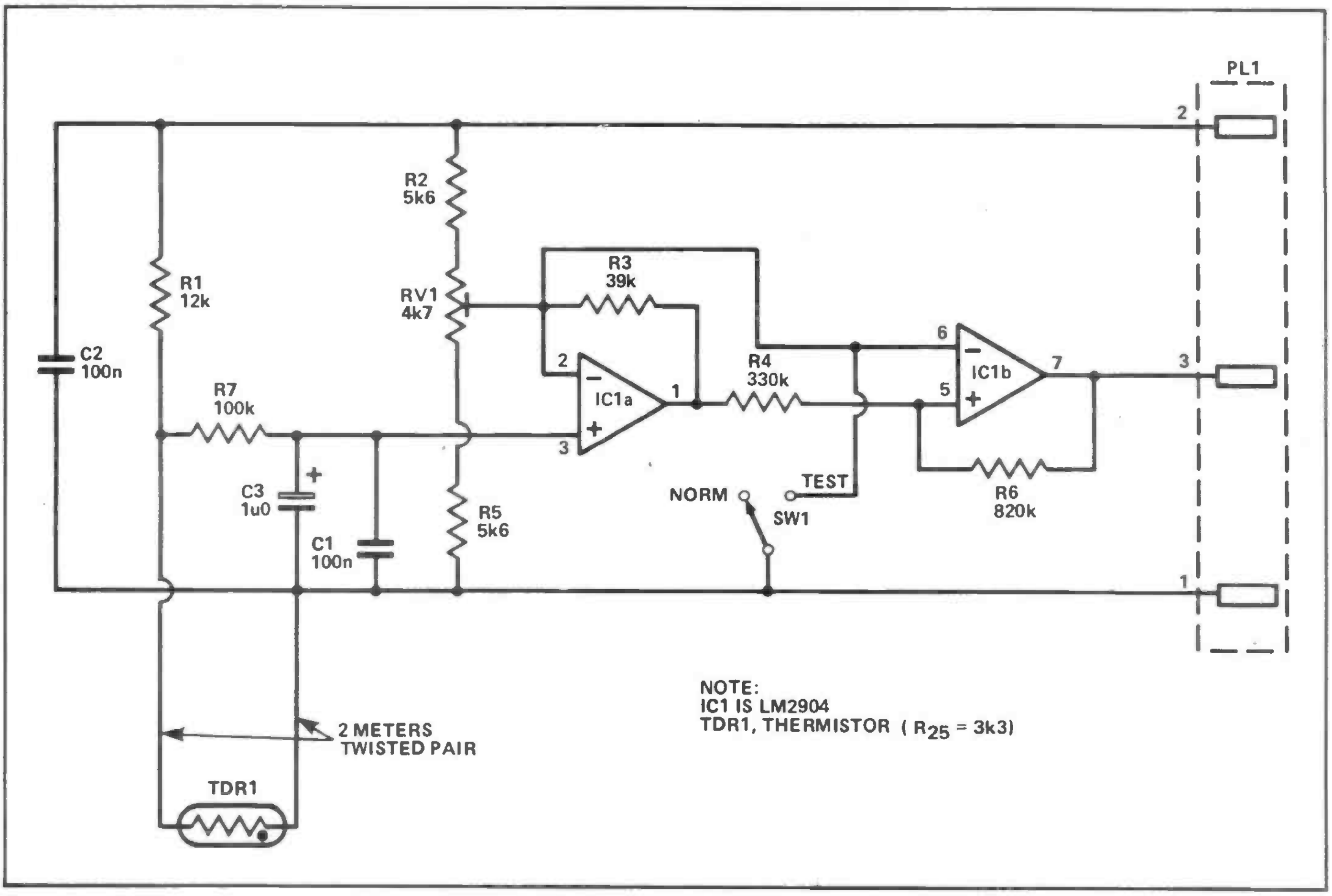


Figure 6: The Circuit Diagram of the Remote Ice Warning System.

PARTS LIST

Resistors (all .25 W 5%)

R1,32	220R
R3	120R
R13,31,42	22k
R14,26,27,28,29	220k
R15	820R
R24,53	3k9
R30,33,36,39	10k
R34	100k
R35	2k7
R37	12k
R38,41,44	1k0
R40	120k
R43	1k8
R45	2M2
R48	470R

Note R2, 4-12, 46,47 and 49-52 are within RN1 while R16-23 & R25 are within RN2.

Capacitors

C1	10u 10V tantalum
C2	100n polyester
C3	10u 16V electrolytic
C4	470p ceramic
C5,18	220u 10V electrolytic
C6	22u 25V electrolytic
C7,16,17	10n ceramic
C8	220n polyester
C9-14	100n ceramic
C15	33p +/— 2% ceramic

Semiconductors

D1,2,4,5,6,8,12	1N4148
D3	MR816
D7	47V 1W3 Zener
D9	1N4002
D10	22V 1W3 Zener
T1,2,4,5,12,13	BC237
T6,7	BC337
T8	MTJ499
T9,10,11	BC307
T14	BC327
IC1	4013
IC2	EDA1041-28A
IC3	MCM144102
IC4	4521
IC5	MLM2902P
IC6,7	UDN6118A
IC8	LM330T5

Switches

SW1-16	Push to Make
SW7	SPDT slide

Miscellaneous

TFX1	Transformer
X1	4.194 MHz crystal
X2	piezoceramic sounder
TC1	trimming capacitor
LDR1	ORP12
LP1-6	28 V 40 mA bulb

PCB, connectors, hook up wire, cast etc.,

Remote Ice Warning Parts List.

Resistors (all .25W 5%)

R1	12k
R2,5	5k6
R3	39k
R4	330k
R6	820k
R7	100k
RV1	4k7 preset

Capacitors

C1,2	100n ceramic
C3	1u0 electrolytic

Semiconductors

IC1	MLM2904P

Miscellaneous

SW1	push-to-make
TDR1	thermistor assembly
PL1	three way connector

PCB, hook up wire, case etc.

A complete kit of parts for the Voyager is available from EDA Sparkrite at 82 Bath Street, Walsall, West Midlands — The Price: **£59.95 incl.**

Your Reactions.........	Circle No.
Excellent - will make one	55
Interesting - might make one	56
Seen Better	57
Comments	58

TV SATELLITE BROADCASTING

Designing Receivers

The rush into what many manufacturers see as being the consumer phenomena of the second half of the eighties has already spawned a rush of designers from companies associated with the Microwave business in an attempt to catch the designer's eye at an early stage.

THE FIRST THING to establish when considering the hardware design is the noise budget of the system -in other words, the exact nature of the signal in the ether as it lands in the dish, so that antenna gains, preamp noise etc can be established. A typical analysis works like this:

Noise power (Pn) in a given bandwidth (B) = kTB (k is Boltzman's constant)

The required power at the antenna is going to be the noise power, Pn, plus enough to exceed the FM threshold (10 dB) and about 2 dB for misc. losses and errors. With Pn at -129.7 dBW (disregarding the receiver noise factor for a moment), and the input at -102 dBW, the 12 dB used by the threshold and 'safety margin', leaves 15.7 dB to work with. The propagation path losses might reach 6 dB under severe weather conditions, so that leaves 9.7 dB for the noise figure. Knock off another 2.7 dB for contingencies, and 7 dB is spare for the receiver noise factor.

A quick look at the data sheets for microwave GaAsFETs is in order here, NEC's NE218 shows 2.8 dB at 12 GHz (with 7 dB gain), and the NE700 2.3 dB NF with 9 dB gain. It looks as if we're in business - and in fact, as you will see, an LNA (Low Noise Amplifier) isn't actually an essential part of the system if you can be confident of pinpoint alignment of everything else.

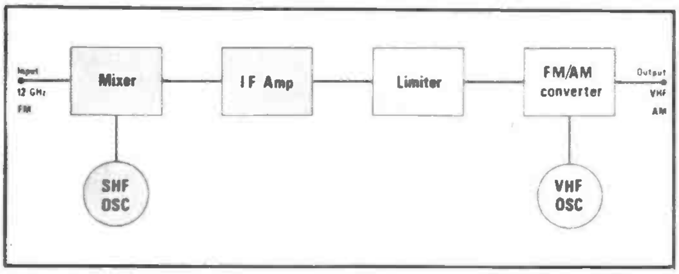


Figure 1: Block outline of an experimental 12 GHz satellite front end with a view to producing a low cost approach.

ANTENNA GAIN AND NOISE TEMPERATURE

G/T is an expression for gain over noise temperature in dB. It is the ratio of the antenna gain to the sum of the antenna noise temperature and preamp (LNA) noise temperature. So, G/T is a general figure of merit that can be balanced by improving either one of the components (more gain, worse temperature and vice versa).

For DBS, Pat Hawker (ref 1) suggests that G/T of 6 dB is good enough for fringe reception - which amounts to a 1m dish, with 8 dB receiver noise figure. In view of the NF's of commercially available devices, it seems that the DBS receiver is going to be relatively simple to achieve. The calculations are based on figures that will yield a picture S/N of around 37 dB, which is better than most 'occasionally aligned' TV sets are likely to be able to resolve anyway.

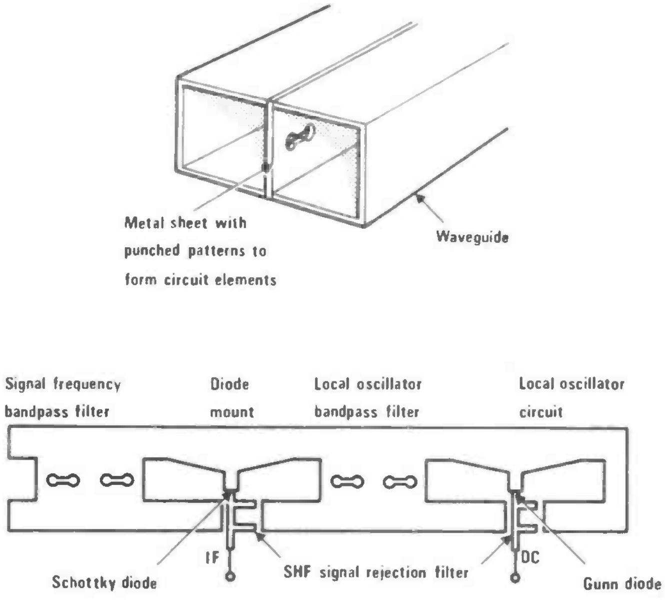


Figure 2: Details of a 12GHz converter with planar circuit.

HARDWARE SOLUTIONS

A design developed by NHK Technical Research Labortories in Japan looks like a very smart implementation of the mathematical precision of microwaves, for the tuned elements are either pressed or chemically etched and fitted into a section of waveguide, allowing for straightforward mass production. A carefully tweaked unit is claimed to have a 4.5 dB noise figure, with 3.4 dB conversion loss - inside the noise budget without an LNA.

A more conventional approach is shown in *Fig 3* - the double superhet, and *Fig 4* illustrates a technique being used in several of the UK TVRO equipments, where signal conversion is used, relying on the attenuation due to opposite polarization effects, and the use of tracking PLL detectors that help reject the unwanted image signal. Discrimination due to across polarization is a fairly delicate thing, being highly dependent on the deviation from the boresight position *Fig 6*. The image reject mixer is an interesting development in its own right, and although the author has not seen much evidence of its use below UHF, it seems worthy of a closer look at HF where it would be easier to achieve the matching and balance required for correct operation anyway. Any takers?

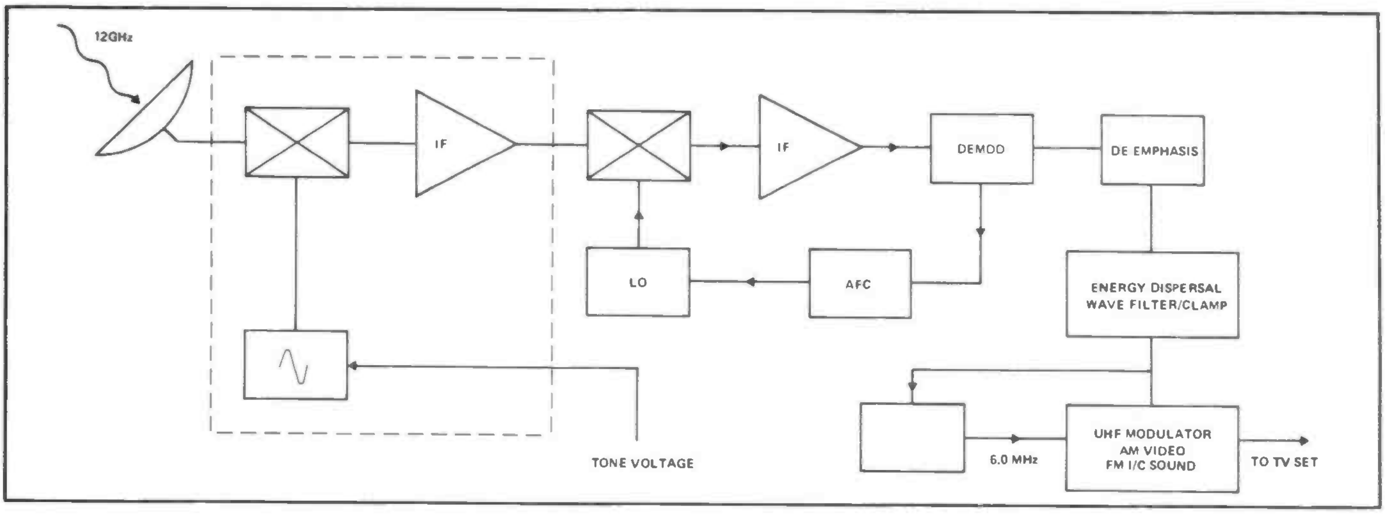


Figure 3: Block diagram of a conventional satellite receiver.

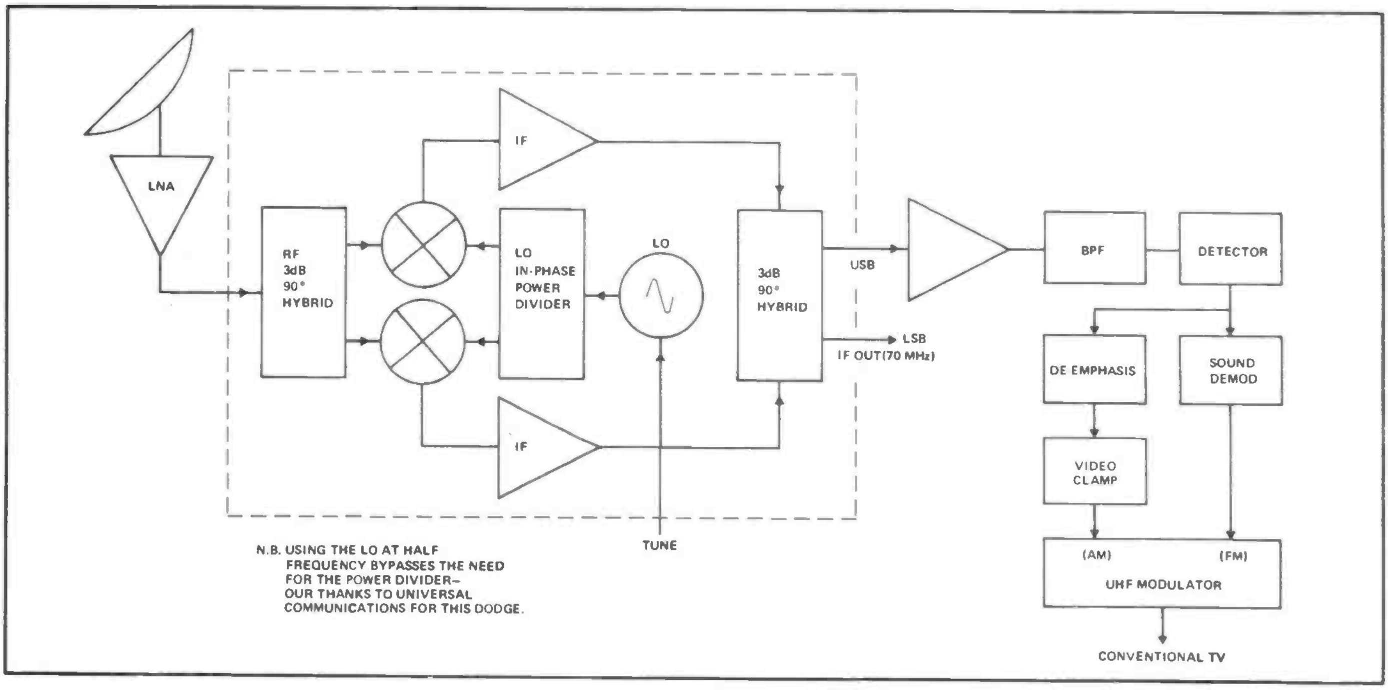


Figure 4: Use of an image rejection mixer for single conversion techniques.

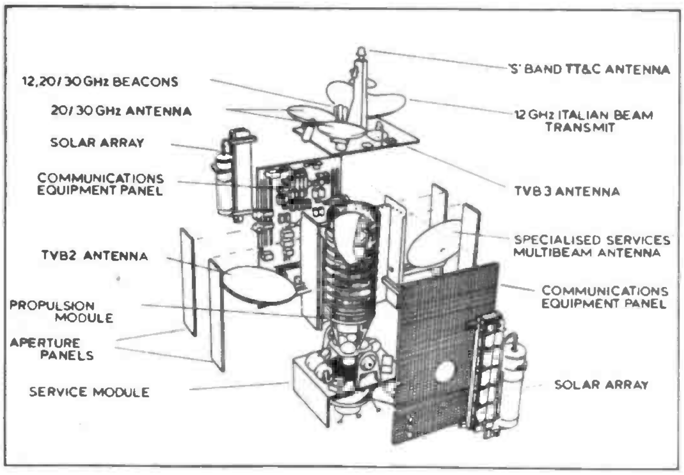


Figure 5: L—SAT 1 configuration.

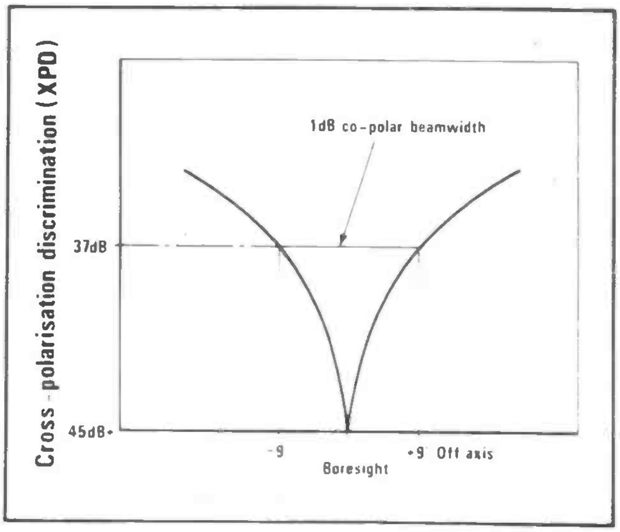


Figure 6: The polarisation discrimination of a satellite receiving aerial decreases rapidly away from its centre bore-sight direction.

PROPOSED BROADCAST SATELLITE PARAMETERS FOR THE FREQUENCY BAND 11·7–12·5 GHz

Type of modulation	fm	
Number of lines	625	
Sound sub-carrier frequency	6 MHz	
Peak-peak deviation	13·3 MHz	
Peak deviation of sound sub-carrier	50 kHz	
Receiver equivalent rectangular noise bandwidth	27 MHz	
Angle of elevation	15°	40°
Luminance signal—unweighted noise for 99% of worst month	34 dB	33 dB
Sound signal to weighted noise ratio for 99% of worst month	51 dB	50 dB

Table 1.

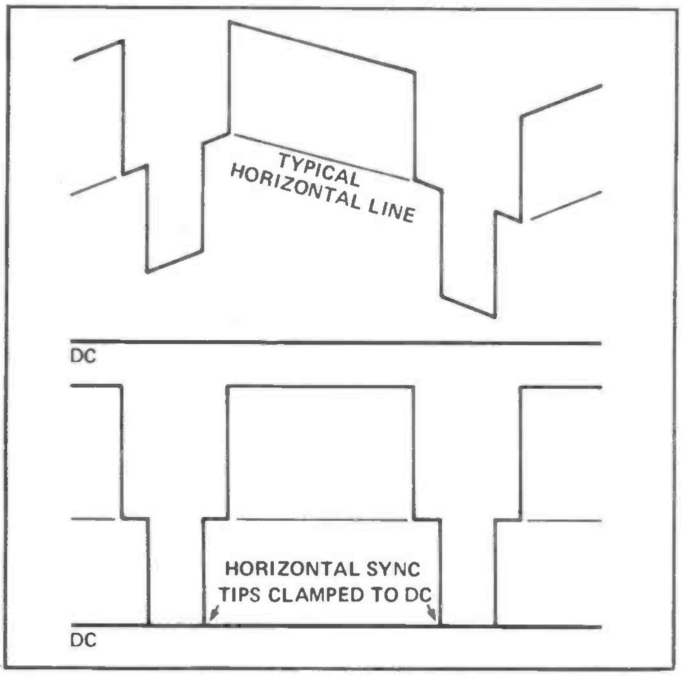


Figure 7a: (TOP) Video demodulator output showing video riding on energy dispersal wave;
Figure 7b: (LOWER) Energy dispersal wave eliminated by DC clamp.

Harmonic mixers (as used in the **R&EW** 23cms converter, March 82) are also being evaluated for use in the first mixer, although there do not yet appear to have been any offers of practical 12 GHz receivers using these techniques.

Note the video clamp that is used to eliminate the energy dispersal wave proposed to keep DBS out of terrestial microwave link systems. You may recall that this is a low frequency triangle wave used to provide a 600 kHz deviation LF signal to spread the energy around and avoid the possibility of concentrating it a narrow band ground based telecommunication channel. *Fig 7* illustrates its action.

PRACTICALITIES

As you can see, once the 12 GHz can be got down to a manageable IF, then we are into the realms of the enthusiast constructor. 70 MHz holds no fears for the **R&EW** reader - although the population of the various VHF bands does mean that you are going to need to screen the equipment very carefully to aviod interference from PMR and the like. Maybe an IF in the 220-250 MHz region would be a better idea, since there isn't a lot doing in that band at present. (One of the reasons why UK CB campaigners with foresight campaigned for the adoption of the 230 MHz band.) We are keen to hear from any of our readers who are either engaged in DBS already, or who are keen to investigate the possibilities in conjunction with our sponsored project scheme.

As mentioned last month, there's enough going out on OTS to make a start seem worthwhile now, although the real thing is a few years away. *Table 1* list the operational parameters for European DBS - so we can start designing with confidence.

Current information indicates that a 11.786 GHz beacon is continuously transmitting to assist in propagation experiments (and also establishing the complexity of setting up DBS from a consumer standpoint).

TABLE SHOWING CORRESPONDENCE BETWEEN CHANNEL NUMBERS AND ASSIGNED FREQUENCIES FOR THE 12 GHz SATELLITE BROADCASTING BAND

CHANNEL NO.	ASSIGNED FREQUENCY (MHz)	CHANNEL NO.	ASSIGNED FREQUENCY (MHz)
1	11 727·48	21	12 111·08
2	11 746·66	22	12 130·26
3	11 765·84	23	12 149·44
4	11 785·02	24	12 168·62
5	11 804·20	25	12 187·80
6	11 823·38	26	12 206·98
7	11 842·56	27	12 226·16
8	11 861·74	28	12 245·34
9	11 880·92	29	12 264·52
10	11 900·10	30	12 283·70
11	11 919·28	31	12 302·88
12	11 938·46	32	12 322·06
13	11 957·64	33	12 341·24
14	11 976·82	34	12 360·42
15	11 996·00	35	12 379·60
16	12 015·18	36	12 398·78
17	12 034·36	37	12 417·96
18	12 053·54	38	12 437·14
19	12 072·72	39	12 456·32
20	12 091·90	40	12 475·50

Note: UK channels are 4, 8, 12, 16 & 20, orbit position 31°W, polarisation left hand circular.

Table 2.

SATELLITE TV NEWS

Those wishing to get in on the ground floor should check out a copy of a new magazine called 'Satellite TV News'. Although bearing the mark of a Euro edition of an American publication, it promises to provide the best informed and brightest coverage of the subject. Full marks for getting in first.

An annual sub is £15 for 12 issues, and anyone likely to become involved in the consumer end of the business will find STN invaluable. The address is 41/71 Derby Road, Heanor, Derbyshire, DE7 9BR.

Reference: IBA Technical review No.11.

■ **R & EW**

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144·4 (433·2)	b	c	b	e	e	b	e	e	e	e	e
144·800	e	e	e	e	e	c	c	c	e	c	e
144·825	e	e	e	e	e	e	e	e	e	e	e
144·850	e	e	e	e	e	e	e	e	e	e	e
145·000/R0T	a	c	a	c	c	b	e	b	e	a	c
145·025/R1T	a	c	a	e	e	b	e	b	e	e	e
145·050/R2T	a	c	a	e	e	b	e	b	e	e	e
145·075/R3T	a	c	a	e	e	b	e	b	e	e	e
145·100/R4T	a	c	a	e	e	b	e	b	e	e	e
145·125/R5T	a	c	a	e	e	b	e	b	e	e	e
145·150/R6T	a	c	a	e	e	b	e	b	e	e	e
145·175/R7T	a	c	a	e	e	b	e	b	e	e	e
145·200/R8R	a	c	a	e	e	b	b	b	a	e	c
145·300/S12	e	e	e	e	e	e	e	e	e	e	e
145·350/S14	e	e	e	e	e	e	e	e	e	e	e
145·400/S16	e	e	e	e	e	e	e	e	e	e	e
145·425/S17	e	e	e	e	e	e	e	e	e	e	e
145·450/S18	a	e	a	e	e	b	b	b	a	a	e
145·475/S19	a	e	a	e	e	b	b	b	a	a	e
145·500/S20	a	c	a	c	c	b	b	b	a	a	c
145·525/S21	a	c	a	c	c	b	b	b	a	a	c
145·550/S22	a	c	a	c	c	b	b	b	a	a	c
145·575/S23	a	c	a	c	c	b	b	b	a	a	c
145·600/R0R	a	c	a	c	c	e	b	b	a	a	c
145·625/R1R	e	e	e	c	c	e	b	e	a	a	c
145·650/R2R	e	e	e	c	c	e	b	e	a	a	c
145·675/R3R	e	e	e	c	c	e	b	e	a	a	c
145·700/R4R	e	e	e	c	c	e	b	e	a	a	c
145·725/R5R	e	e	e	e	c	e	b	e	a	a	c
145·750/R6R	e	e	e	c	c	e	b	e	a	a	c
145·775/R7R	e	e	e	e	c	e	b	e	a	a	c
145·800/R8R	a	c	a	c	c	b	b	b	a	a	e
145·950/S38	a	e	e	c	e	e	e	e	a	e	e

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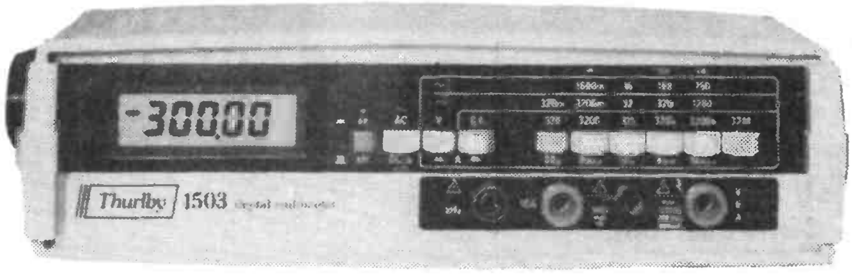

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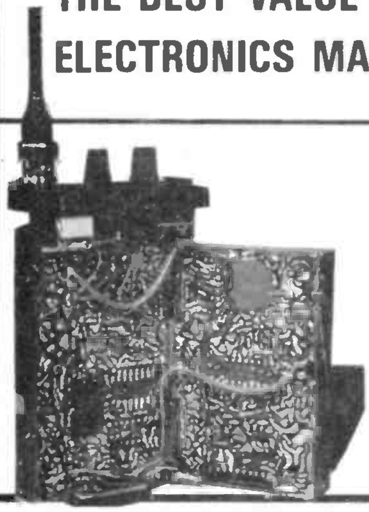
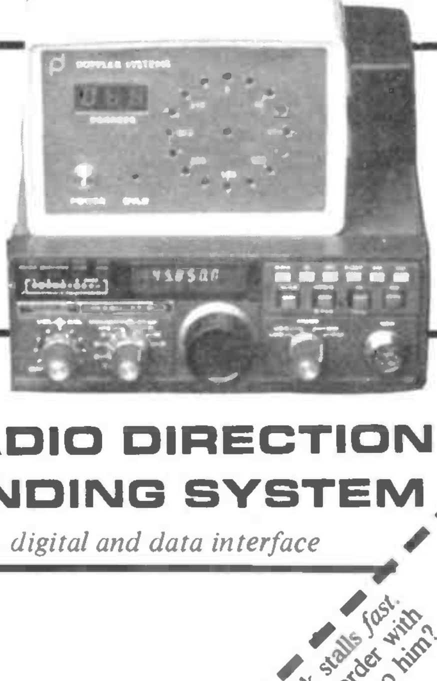
RADIO CONTROL


Inside ICOM's IC4 70cm handheld


The long arm of the law reaches out to apprehend a prototype of the R&EW RC system

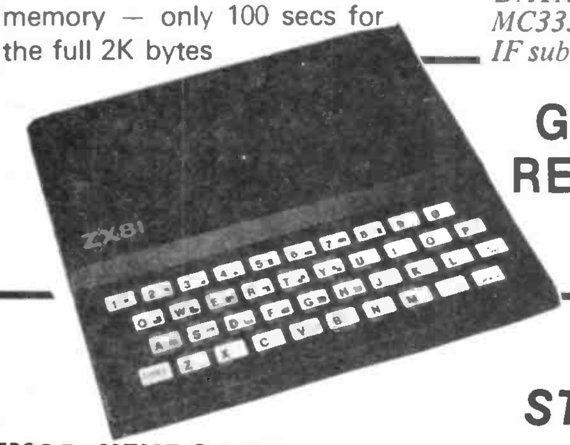
ZX81 EPROM PROGRAMMER
Allows single rail 2716 EPROMs to be loaded from any part of the ZX81's memory — only 100 secs for the full 2K bytes

DATABRIEF - *featuring the MC3359/ULN3859 NBFM IF subsystem and detector*



GENIE II REVIEWED

RADIO DIRECTION FINDING SYSTEM
LED, digital and data interface



ZX81 KEYBOARD
A 'Qauntum Jump' above the standard keyboard in terms of performance — constructed using a novel 'two PCB' solution to the problems of forming a keyboard matrix on a single board — cheaper than through hole plating without the need for numerous wire links.

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R&EW

DIGITAL pH METER

An accurate and robust unit that offers the performance of commercial instruments costing four or five times as much! Design by P.D. Coker, B.S.c, Ph.D. and M.C. Polgreen, B.S.c.

IN MANY AREAS of science and technology, the accurate measurement of acidity or alkalinity is of considerable importance.

The **R&EW** pH meter has been designed primarily for educational applications - in particular, chemical or biological studies, but its accuracy and usefulness will find applications in many other areas such as horticulture, photographic processing (or even in home brewing) where an accurate indication of acidity is required. It is robust and easy to construct from readily available components.

Historical Note

Until relatively recently, the majority of pH meters used to perform this function were either very expensive, fragile or both. They used analogue meters to display the reading, these being rather delicate and offering an accuracy of +/— 2% at best, compared with the +/— 0.15% accuracy offered by most digital panel meters.

Many portable meters suffer from instability and a number have no form of temperature compensation; these typically offer a resolution of +/— 0.1 units which is satisfactory for rough work but useless for more precise applications.

Development Stages

During the development of this meter, it was intended to eliminate as many of the less desirable features of analogue meters as possible, consistent with reasonable ease of construction and cost. A digital display was considered essential and the Ambit DVM176 ditial panel meter was selected in view of its low current consumption, compactness and its ability to work satisfactorily at battery voltages down to about 7V0. The DVM176 uses a liquid crystal display with 0.5" digits and has a typical current consumption of 2 mA; the display is 3½ digits and is easily legible.

Some form of amplification of the minute electrical output of the pH probe is essential and in the past this was achieved by the use of electrometer valves such as the ME1400 series which were both expensive and delicate. Several manufacturers now produce MOS—FET operational amplifiers and the RCA CA3140 was selected in view of its high performance and low cost. Its input impedance is very high (10^{12}Ohms) and matches the output impedance of most pH probes quite well.

The digital panel meter (DPM) has a stable 100 mV reference and an equally stable offset voltage can be provided for buffer control by the use of ZN423 voltage references. The circuit was designed to provide an indication of pH with an accuracy of at least 0.05 units with general purpose electrodes or 0.01 units with high quality electrodes.

WHAT IS 'pH'?

In scientific terms, the degree of acidity (or alkalinity) of a solution is expressed in pH units. pH is defined as:

$pH = -\log_{10}(H^+)$ where(H^+) is the concentration of hydrogen ions in the solution.

Water (H_2O) molecules have a tendency to break up (dissociate), producing hydrogen ions (H^+) and hydroxyl ions (OH^-); the process is reversible.

$H_2O \quad H^+ + OH^-$

Under equilibrium conditions, the concentrations of H^+ and OH^- ions are both equal to 10^{-7} moles per litre in the case of pure water and the pH of the water is 7. Addition of an acid to water increases the number of H^+ ions since acids also dissociate; for example, hydrochloric acid (HCl) breaks down in solution to give H^+ ions and Cl^- (chloride ions).

$HCl \quad H^+ + Cl^-$

and the pH of the solution will be less than 7. Dissolving an alkali such as caustic soda (Sodium hydroxide, NaOH) in water produces a solution in which OH^- ions are much more abundant than H^+ ions and the pH of the solution will be greater than 7.

$NaOH \quad Na^+ + OH^-$

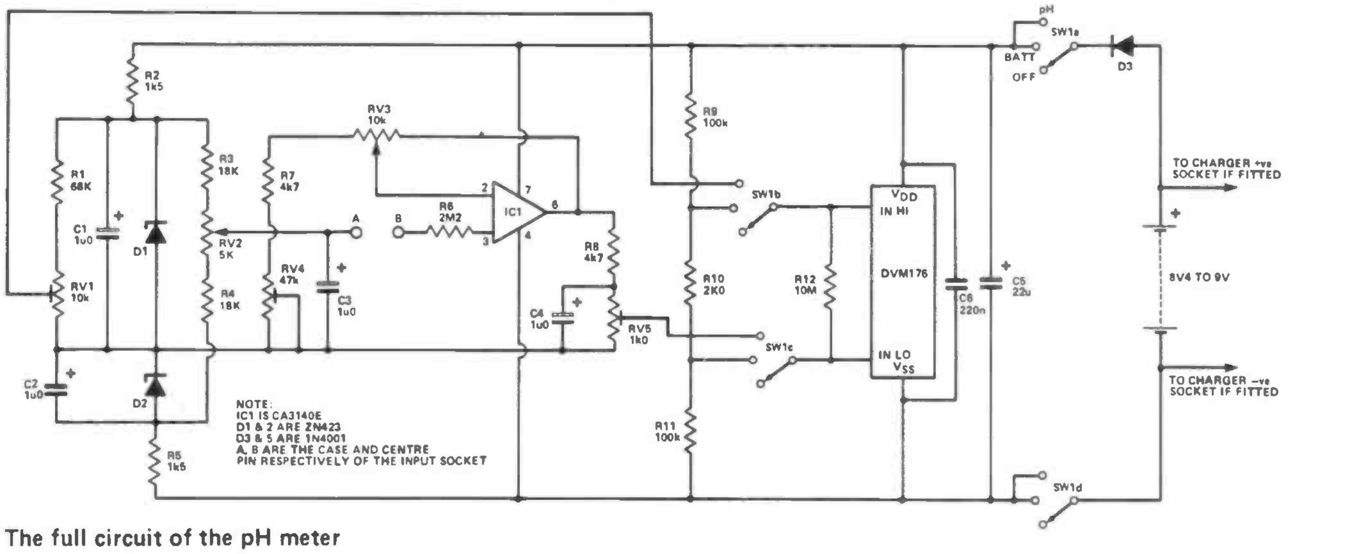
The pH scale extends from 0 to 14 and a solution with a pH of 7, which is neither acid nor alkaline in reaction is termed 'neutral'; acidic solutions have a pH less than 7 and alkaline solutions, greater than 7. The scale is calculated using base 10 logarithms so each 1.0 fall in pH corresponds to a 10-fold increase in the number of hydrogen ions and a similar decrease in the number of hydroxyl ions. The pH scale only applies to solutions in water and it is not possible, for example, to measure the pH of petrol or cooking oil.

Construction

The component overlay for the pH meter is shown in *Fig 3*. The majority of components are mounted on a glass-fibre printed circuit board and wires from panel controls and the DPM are connected to PCB pins. SRBP circuit board has inferior insulation characteristics and should not be used. IC1 is mounted last of all, in a good quality socket and the usual precautions against static electricity should be taken. Tantalum capacitors do not always have a clear indication of polarity and this should be checked carefully.

The board should be carefully checked after soldering and then all surplus flux removed with a solvent such as methylated spirits and a stiff brush.

The DPM module has a number of terminals which need to be connected as in *Fig 2*. A 10M resistor (R12) is connected across the INHI and INLO terminals and ▶



The full circuit of the pH meter

CIRCUIT DESCRIPTION

The output from a glass/calomel combination electrode is amplified by IC1 and displayed on the DPM. Most pH electrodes are designed to give zero output at pH 7 and a DPM offset facility is provided by VR1 which taps off a portion of the supply voltage and permits operation without offset-null compensation on IC1. Buffer adjustment is made using VR2 (a 10-turn potentiometer) which utilizes a part of the stable 2V45 supply from D1,2.

Since pH is temperature dependent, compensation is provided by the inclusion of RV3 in the feedback loop of IC1; RV4 provides coarse temperature setting during calibration. The output of IC1 is attenuated by VR5 which is required in order to set the range of the meter during calibration.

In order to reduce leakage currents to the minimum, tantalum bead capacitors are used and all resistors should be at least 5% tolerance; accuracy will be improved if 2% tolerance components are available. Variable resistors (VR1,4 and 5) should be cermet types and VR2 is a wirewound component.

The input socket and probe connector are BNC 50 ohm types which have superior insulation and corrosion resistance compared with the more conventional aluminium co-axial types. After construction and calibration, the circuit board and components are lightly sprayed with a silicone water repellent, such as is used for proofing tents and anoraks.

COMPONENTS

Resistors (0.25W 5%)

R1	68k
R2,5	1k5
R3,4	18k
R6	2M2
R7,8	4k7
R9,11	100k
R10	2k0 or 2 x 1k in series
R12	10M (10%)

Variable Resistors

RV1	10k multiturn preset .75" long
RV2	5k B ALPS VM10
RV3	10k B ALPS VM10
RV4	47k cermet preset
RV5	1k cermet preset

Capacitors

C1,2,3	1u0 16V Tantalum
C4	10u 16V tantalum
C5	22u 16V tantalum

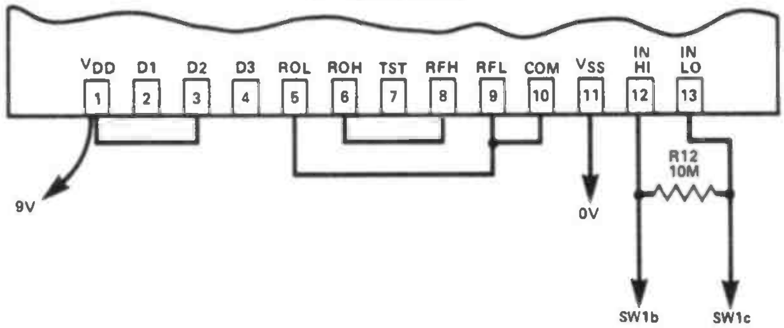
Semiconductors

IC1	CA3140E
D1,2	ZN423

Miscellaneous

S1 4 pole 3 way rotary wafer
DVM176 (Ambit)
PCB
50Ω BNC Socket
Knobs
Sabtronics hand-held case
PPe battery connector
8 pin IC socket.

DVM176 CONNECTIONS



the supply terminals V_{DD} and V_{SS} have a 22 u tantalum capacitor connected across them; the positive end of the capacitor is adjacent to the V_{DD} terminal.

If the final calibration is carried out with reasonable care, the meter will indicate pH values with high accuracy. In use, the accuracy depends mainly on the type and condition of the electrode system; the prototype has been tested with a number of glass/calomel combination electrodes and gives satisfactory results with most types when they are clean and properly maintained. Some cheap electrodes have poor linearity of output with changing pH and these will not be suitable for critical work. Manufacturers generally issue maintenance notes but these are frequently mislaid and the following points may be of interest to people who are unfamiliar with the subject:

1: Electrodes should be kept moist either by immersing the tip in de-ionised or distilled water, or by replacing the end cap over the electrode tip, when it is not in use.

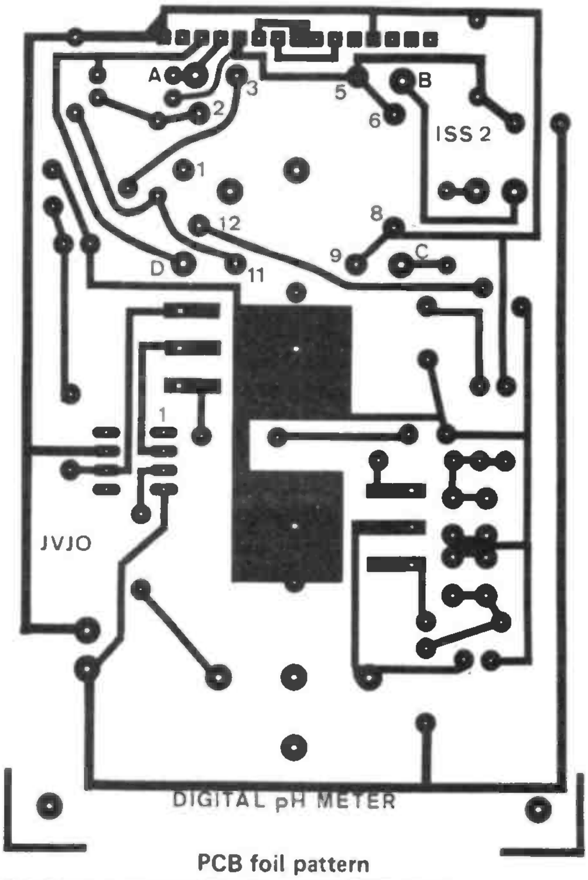
2: The electrode should be rinsed between measurements, in water and any dirt or contaminant carefully removed either with water from a wash bottle or with damp tissue.

3: Dry or maltreated electrodes can usually be renovated by soaking the tip in dilute hydrochloric acid for 1 or 2 days, follwed by thorough rinsing in distilled water. Organic deposits can be removed by wiping with a suitable solvent (acetone or alcohol).

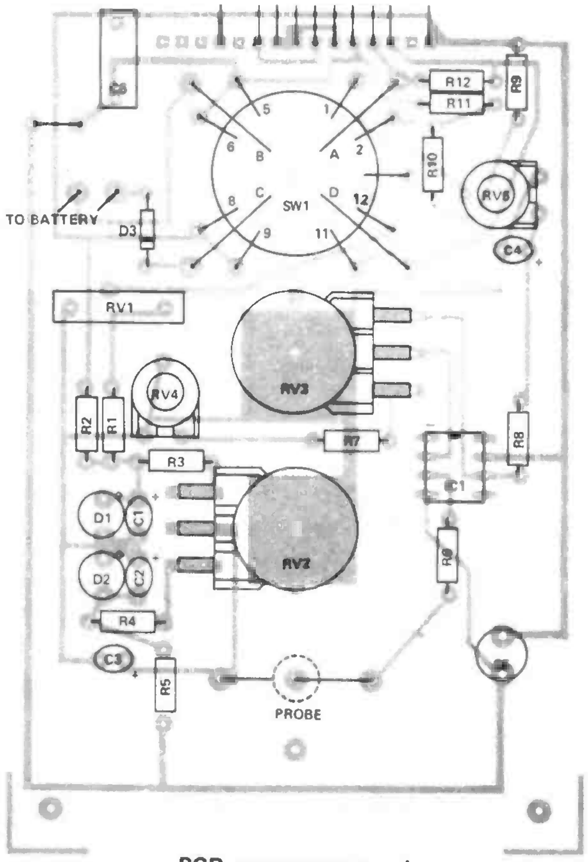
4: The electrode filling will need topping up from time to time with saturated potassium cholride solution, although modern electrodes tend to use a potassium chloride gel which normally needs no maintenance.

CALIBRATION

Before the meter is calibrated, the electrode should be checked and serviced



PCB foil pattern



PCB component overlay

as necessary. Fresh buffer solutions of known pH should also be prepared from commercially available powders or tablets; for the initial calibration, 3 solutions are recommended with values of about pH 4,7 and 9. The exact value at the ambient temperature which is stated on the container should be used, and the buffer solutions should be maintained reasonably close to this temperature. The 'keeping' qualities of buffer solutions vary and it is false economy to use solutions which are more than a few weeks old. The following calibration procedure is recommended.

1: Short circuit the input socket and set all preset potentiometers to mid position (RV1,4,5).

2: Battery indication: should be correct to 100 mV

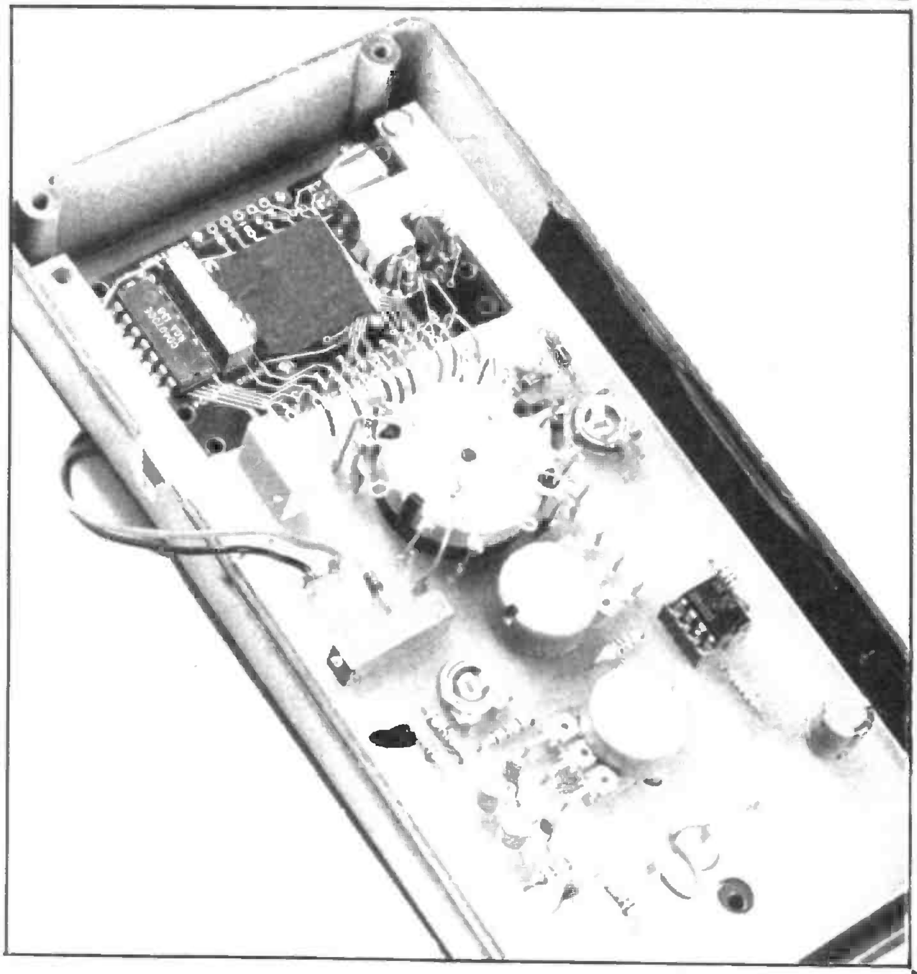
3: Temperature compensation:
Turn S1 to 'pH' and set the DPM offset (RV1) to give an indication of 0.00 on the DPM; RV5 is set to maximum output and RV3 (temperature compensation) to 50°C (maximum)

i) Adjust buffer control (RV2) so that the DPM reads *either* + *or* — 2.00.

ii) Set RV3 to 0°C (Minimum) and adjust coarse temperature compensation (RV4) so that the DPM indicates + or — 2.38.

iii) Reset RV3 to 50°C; if the DPM does not indicate + or — 2.00 repeat steps i-iii.

4: DPM offset (for most types of electrodes with an E_0 of 7.00): Adjust RV2 so that the display indicates 0.00; sweep RV3 from 0° to 50°. The display



Continued on Page 74 ▶

A DAY AT THE RACES

Evan Steadman's inimitable publicity machine drew up at the nearly complete Barbican centre on Feb 24th to preview some of the delights awaiting the visitors to his All Electronics extravaganza in April.

The event got off to an inauspicious start with the tickets being clearly printed 'Tuesday February 24th' - although, as usual, ES turned this to his advantage by a subsequent update mailing that 'fixed' the event inexorably in the minds of the recipients.

The press conference proper was a breathless affair, with exhibitors being batched up starting-stall fashion to rush their particular piece of momentous news past the assembled throng.

Fawlty Towers

In fact, the Barbican Centre was in a state of incompletion that would have done an emerging Mediterranean seaside resort proud. Until Her Majesty the Queen opened the Barbican amidst a huge amount of publicity (did you see it on BBC2 on March 3rd?) - the entire complex was being painted, plastered and looked after by a bunch of uniformed security men, the like of which the writer has seldom seen outside the USA.

Evan Steadman managed to gloss over these small problems with his accustomed flair, displaying not a little of the skill that he has acquired as the most visible 'Front Man' in the electronics business.

During lunch, ES was overheard to say that it was his aim to see the premier Euro Electronics Show held in Europe, and that if he was introduced to anyone whose intention it was to upstage this effort, then the man was as good as done for. Show organisers from Paris, Dusseldorf and Berlin take note...

Is there life after lunch??

A parade of slightly nervous presenters combatted the nerve wracking environment of an illuminated lectern in a dimmed presentation theatre/cinema, with the battalions of the press eagerly scribbling down their notes in the first five rows. As it happened, the press did its usual thing, and all but dispersed after the free lunch had been dished out.

Your scribe stayed until (nearly) the bitter end when I counted about 3 others remaining. It's a wonder why PR operations bother to expect anyone from the media to hang around after the booze has run out. Maybe an intravenous drip of Mouton Rothschild should have been arranged for the lecture hall.

Most of the presenters were visibly nervous of this ordeal by lectern and

dimmed lighting. Upon the stroke of three minutes, ES provided a merciful release by virtue of a timed alarm bell - but it was only by then that most presenters had got into their stride anyway. Such is the fickleness of a production line press conference.

Your scribe was only present in time for the afternoon festivities (Yes, I just made it in time for lunch, thank you). Of the afternoon session, the **R&EW** award for prepared and concise presentations goes to Helen Hutt of precision Metal Depositors Ltd. The only member of the 'opposite' to be present, and the only person describing themself as a company publicity manager. The training showed.

Transradio made an interesting announcement of a coax stripping handtool, and BNC crimptool system -but most of the other presentations failed to reveal much that an avid follower of the electronic press would not have already known. Nevertheless, as usual **R&EW** knows better, and there are going to be several stands of enormous interest (apart from ours; 565 Hall B lower). The multicolour XY drum plotter from ALPS on the Armon Products stand (211) will be quite a crowd puller. Wireless World has a huge double stand (732/733: in fact, it's so large it's downright vulgar!) - watch out WW, we've got some Big Sums lined up for the next issue!

The R&EW Show Guide

As mentioned last month, **R&EW** will be publishing a candid visitor's guide to supplement the official Show Guide. Make a beeline for stand 565 and read it before you start. Evan Steadman has kindly agreed to supply complimentary tickets to any **R&EW** reader who wishes to attend the event - just send in an SAE marked AES ticket. With 450 stands sold, it's up to all of us to establish the AES as the premier event in the UK, and hope that the creation of such a focal point will help deter others for dispersing the exhibitors' energies too widely throughout other events of this type.

Another R&EW contest!

In a moment of weakness (just after lunch), Mr Steadman kindly agreed to permit us to use the enclosed 'photo' in another caption contest. The brief is simple, either send your suggestions to us by mail, or bring them to the stand at the AES (April 20-22nd inclusive). The winner will be announced in the June issue (appearing May) - deadline April 23rd.

Here's one to be getting on with:
"No wonder **R&EW** cannot afford better halftone reproduction, you should see what I just took off them for their stand at the AES!"

Seriously, Evan, it's cheap at half the price (?).

NEWS BACKGROUND

Busby In Spare

British Aerospace, Marconi and British Telecom plan to form a joint company, United Satellites, to provide Britain's first national broadcasting and telecommunications satellite system.

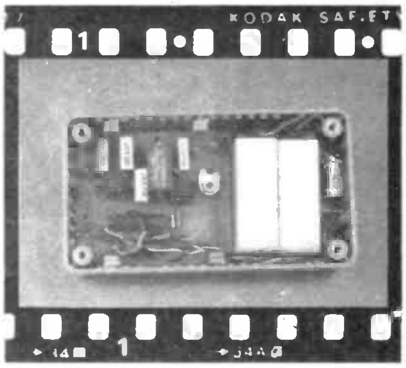
Welcoming the Home Secretary's recent announcement of the Government's policy on direct broadcasting by satellite in Britain, British Aerospace, Marconi and British Telecom confirmed that they were planning a British satellite system to provide facilities for direct broadcasting and telecommunications services from the mid-1980s.

The three companies have already investigated potential markets, and also the technical and operational means to meet broadcasting and telecommunications requirements in both the short and long term.

In the next phase, the three companies, will be having further discussions with the broadcasting organisations to define technical requirements and the terms on which they will be able to offer satellite capacity for direct broadcasting television services. The requirements for satellite telecommunications services will also be finally agreed with British Telecom.

Through their collaboration the three parties propose to become the suppliers of the first British national system for direct broadcasting and telecommunications services by satellite, as well as promoting British satellite systems and services successfully in expanding world markets.

CIRCUIT BLOCKS



A new R&EW feature that presents tried and tested building blocks from our lab. This month IR Link and a fast Ni-Cad Charger.

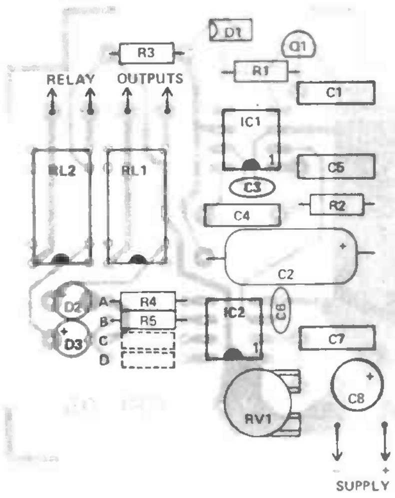
Originally intended as a remote camera trigger, the system described will find many other uses. The receiver, though basically two channel, may be extended (without much effort) to 16 channels. The transmitter, as described, is four channel but may be extended to 32 channels. The range available is in excess of 30m - but this depends on ambient light conditions.

CONSTRUCTION TESTING

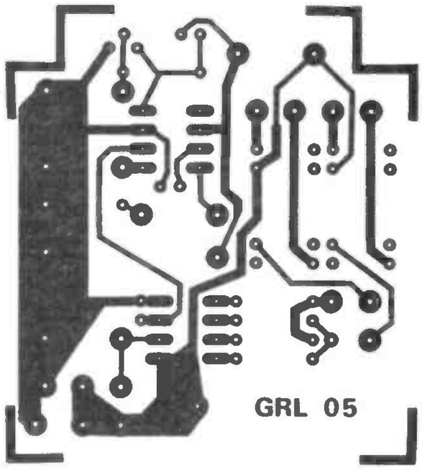
The only thing to note during the assembly of the transmitter board is that the switches are soldered to the track side of the PCB.

Set RV1 on the receiver to its mid position, and connect the supply. Connect the battery to the transmitter and operate a switch; adjust RV1 and the transmitter until the receiver responds. Slowly increase the range and readjust RV1 to attain the maximum.

Due to the very high gain of the SL480 care must be taken to avoid stray pickup if using an external supply.



Receiver PCB overlay



Receiver PCB foil

CIRCUIT DESCRIPTION

THE TRANSMITTER

IC1 is a device specifically designed for remote control applications. It is capable of producing 32 discrete codes, although in our application only four of these are used.

The method of transmission is Pulse Position Modulation, where the device transmits each code word as a group of six pulses. The interval between each pulse determining whether an '1' or 'O' is transmitted.

RV1 and C1 set the PPM rate - and in order to conserve battery life, this should be as slow as possible, consistent with adequate response time at the receiver.

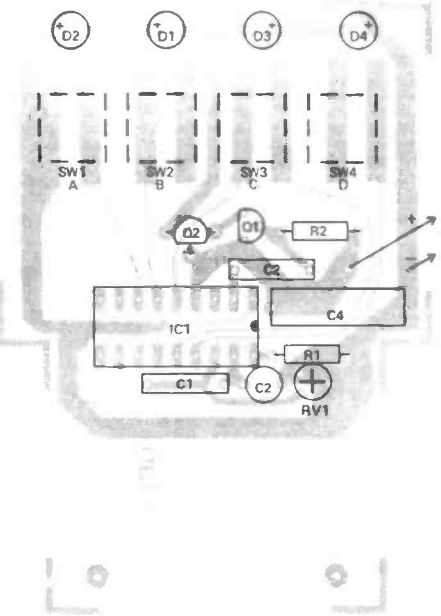
The two-transistor amplifier formed by Q1 and Q2 provides very narrow high current pulses to the IR diodes D1-D4. This prolongs battery life and allows the LEDs to work at a higher light output efficiency.

THE RECEIVER

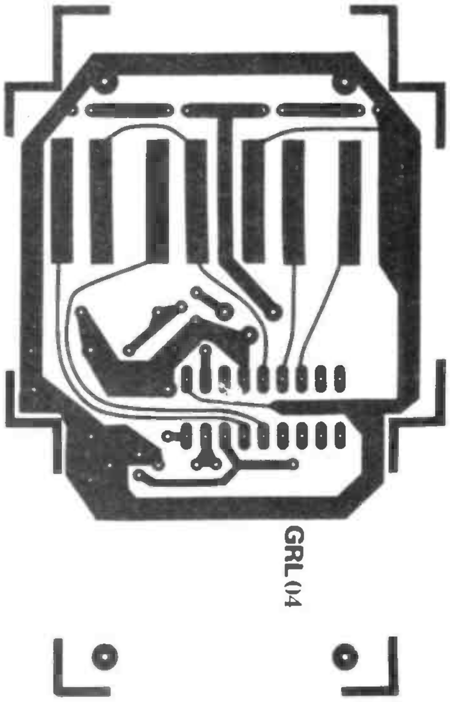
The receiver consists of an IR pulse pre-amplifier and a decoder IC.

The receiving diode is biased by transistor Q1 and associated components, compensating for diode leakage currents and allowing the receiver to be used in high ambient light conditions. The other components associated with IC1 provide decoupling of AC signals.

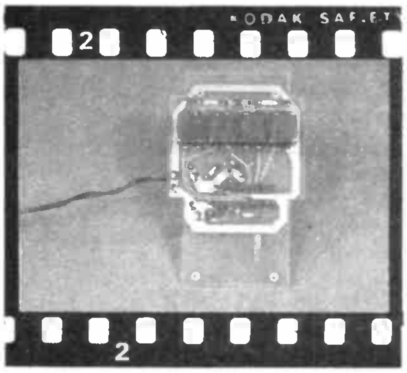
The output of IC1 is fed to the decoder IC2. The on-chip oscillator of this IC must be adjusted to coincide with the PPM rate of the transmitter - accomplished by varying RV1. Depending on the code received by IC2, one of the outputs (A-D) will go high, these are used to drive the relay and LED via a current limiting resistor.

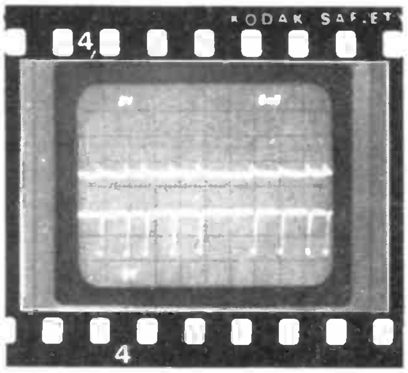


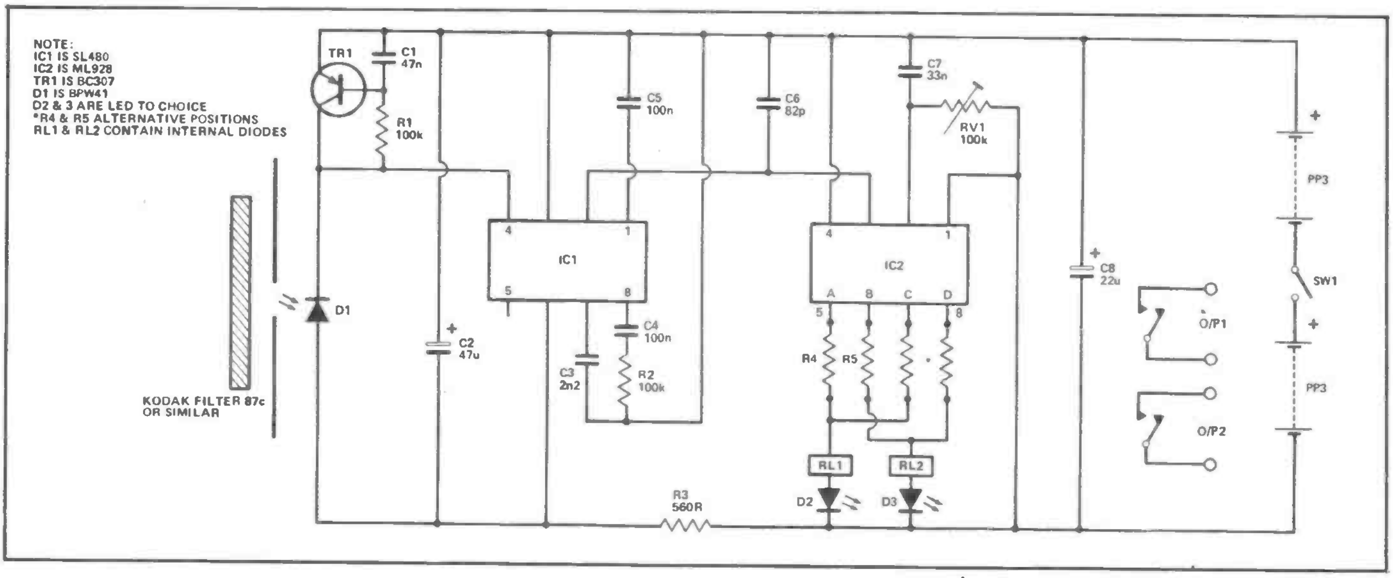
Transmitter PCB overlay

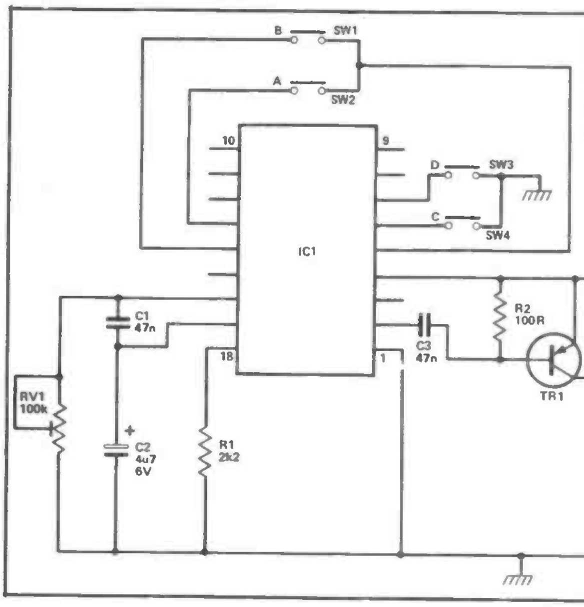


Transmitter PCB foil









Circuit diagram of the IR transmitter only four of the possible 32 codes are used, selected by switches A, B, C and D.

▲ The receiver circuit diagram, R4 and R5 may be connected to any of the outputs A-D to correspond with the switch option selected on the transmitter.

1 A view of the infra red receiver

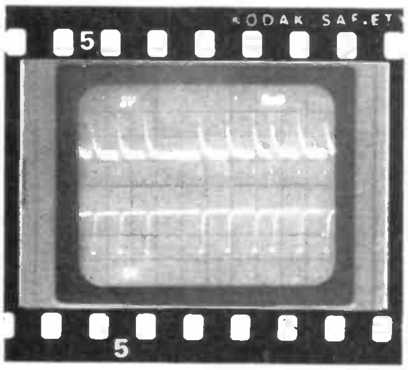
2 The IR transmitter board, the push switches are mounted on the underside of this board.

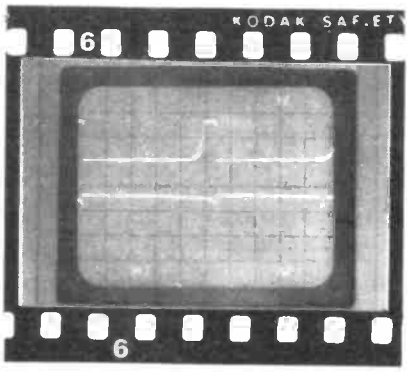
4 Photo showing the SL480 output Pin 2 (upper trace) and the SL490 output Pin 2 — weak signal conditions.

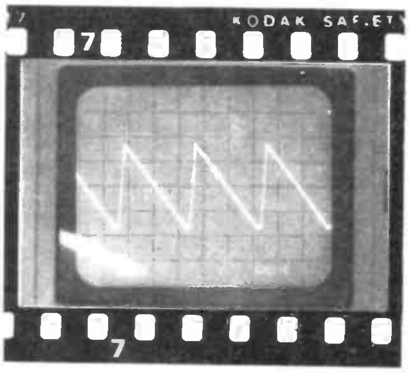
5 Same as above but under strong signal conditions.

6 Top trace shows pulse outputs to LEDs while lower shows drive pulses from SL490 — this illustrates the action of the pulse shaping network C3, R2.

7 Shows the output of the ML926 2 (oscillator pin).







CIRCUIT BLOCKS

Fast charge for NICADs — Richard Collins

Most modern Nicads are designed for 'fast charging' — i.e. charging at up to 0.5 to 2 times the nominal capacity of the cell. In the interests of safety, you must check that the cell you are about to charge in this brutish fashion has a vent to allow gas to expand and escape, and is recognized by the manufacturer for this mode of charge cycling, or else...

The cell should be fully discharged down to around 0V6, then the charger shown here can be used to speed up the charging period of a C cell (1.2Ah), from the trickle rate of around 12 hours, to 2 hours. It is not permissible to trickle charge at much more than 10% of the nominal cell capacity, so the timer is an essential feature. People with nerves of steel have been known to charge them in 5 minutes from a car battery, but that is strictly for the reckless.

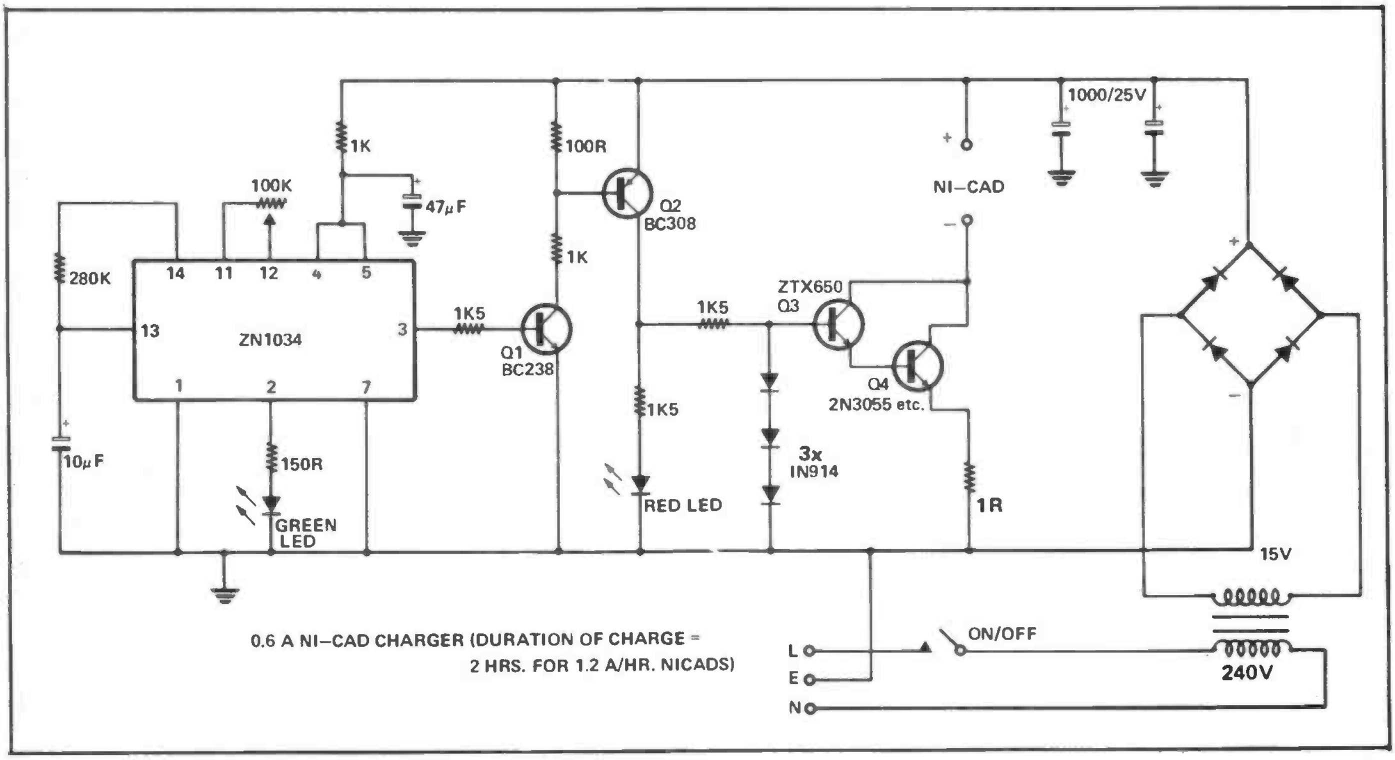
The basis of the timing cycle is provided by the ZN1034 timer, which is a very much more accurate (and, sad to say, costly) version of a 555, however, the accuracy is worth the cost here. This is set to the desired period (2 hours) — with the current being set by the constant current configuration around Q3 and Q4. The three diodes on the base of Q3 set the potential at the emitter of Q4 to a constant 0V6 (the diode 'drop' voltage, taking into account the junctions of Q3 and Q4 'en route'), so the current through Q4 is simply 0.6V/Re. If Re is 1R (as here), then the current is 600mA.

The maximum number of cells that can be charged depends on the supply voltage, as long as the maximum 'charged' potential of the battery is below supply voltage less 0V6, then the circuit will charge them up. During charging a red LED indicates the state of play, and when the cycle is complete, the green LED on the ZN1034 gives the all clear.

The circuit is supremely tolerant to the transistor types used, as long as they are silicon, the correct polarity and Q4 can handle the power required of it.

■ R & EW

Your Reactions..........	Circle No.
Immediately Interesting	5
Possible application	6
Not interested in this topic	7
Bad feature/space waster	8



0.6 A NI–CAD CHARGER (DURATION OF CHARGE = 2 HRS. FOR 1.2 A/HR. NICADS)

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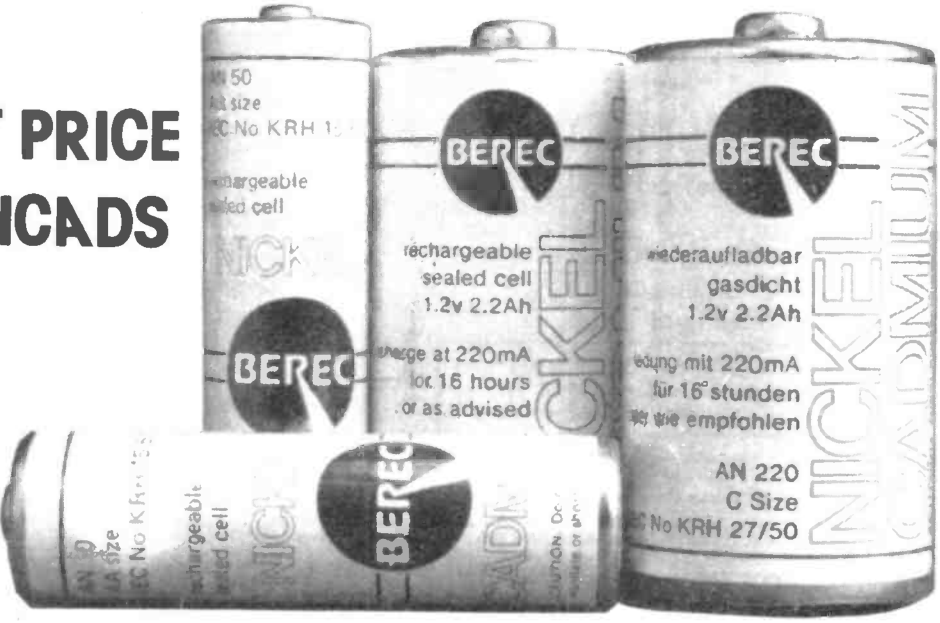

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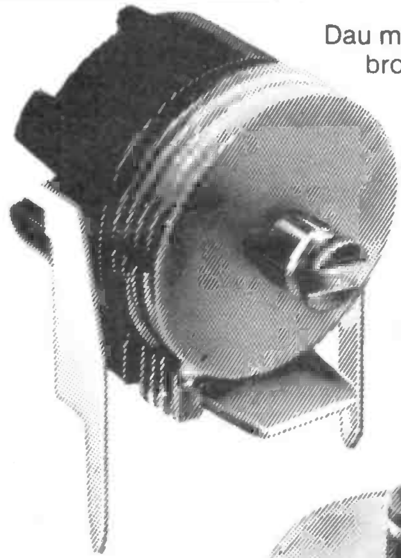

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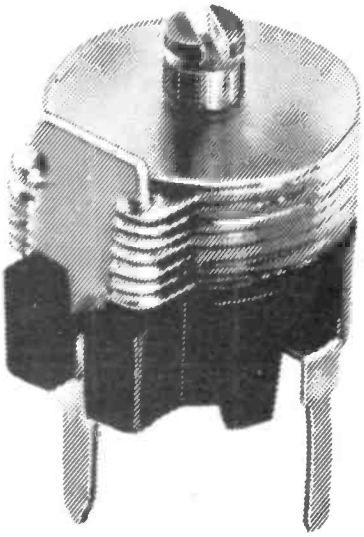

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R&EW Data Brief

KB4412

DATABRIEF - KB4412 Communications IF/mixer system

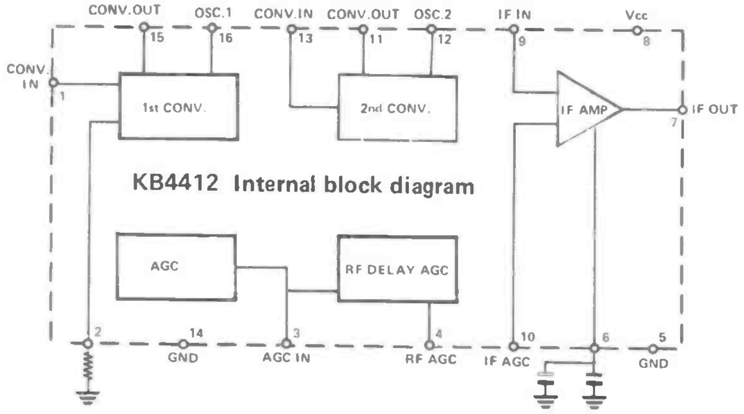
The KB4412 comprises a pair of high frequency double balanced mixers with excellent high level performance, and a gain controlled IF system for use at 455 kHz (or 10.7 MHz with care in layout).

The AGC action is delayed by feeding positive-going AGC (from a KB4413 for example) into pin 3, with the RF stage AGC at pin 4 being delayed by the setting of the preset and inverted by Q5 to provide the more conventional negative-going AGC for MOSFET stages etc. AGC to the mixer is controlled by the preset on pin 2 (in parallel with Q2's emitter resistor). The setting of this preset, controls the current through the first mixer together with the AGC line.

The oscillator feed to both mixers (pins 12 and 16) is buffered and fed to the bases of the transistor tree double balanced mixer (Q10-Q15, Q22-Q28), with the signal input being fed in at the mixer emitters to provide switching action and good overload characteristics.

The IF amplifier is a differential stage around Q31 and Q32, where AGC is effected by simply pulling the base of Q31 to ground in Q30. Pin 6 by-passes the bias to the input stage, with Q34-Q36 forming a futher gain stage with DC stabilization through Q33. The output at pin 7 is an open collector, which is terminated in a tuned circuit at the IF frequency.

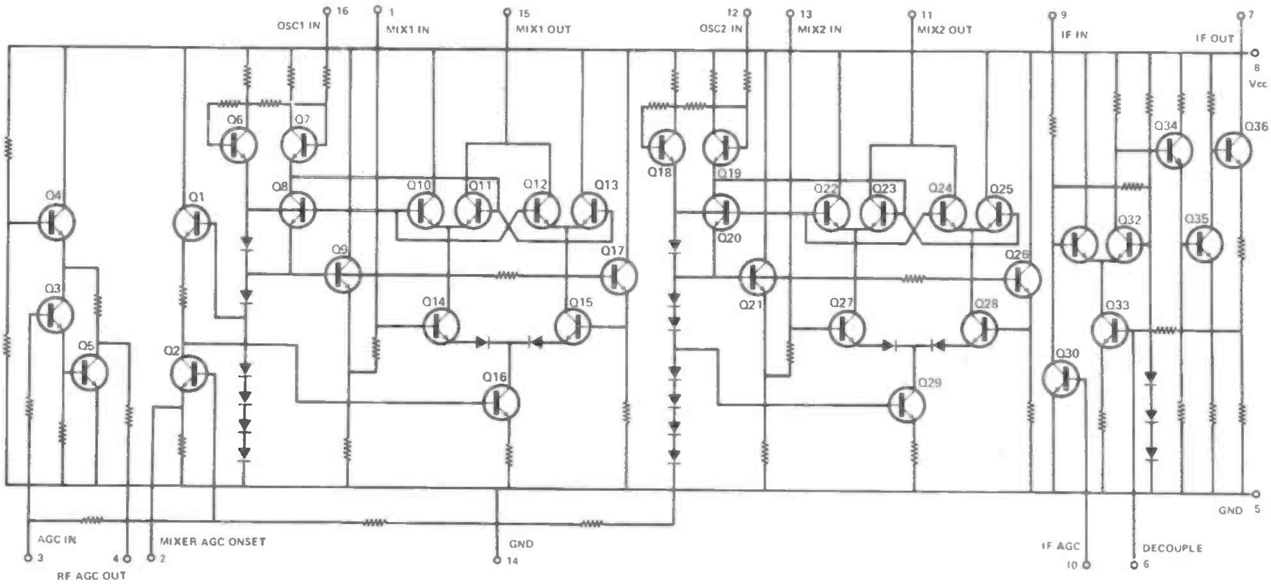
ITEM	NOTATION	RATING(max).
Supply Voltage	V_{CC}	16V
Power Consumption	P_T	500mW
Operating Temp.	T_{opr}	−25° to +60° C
Storage Temp.	T_{stg}	−30° to +125° C

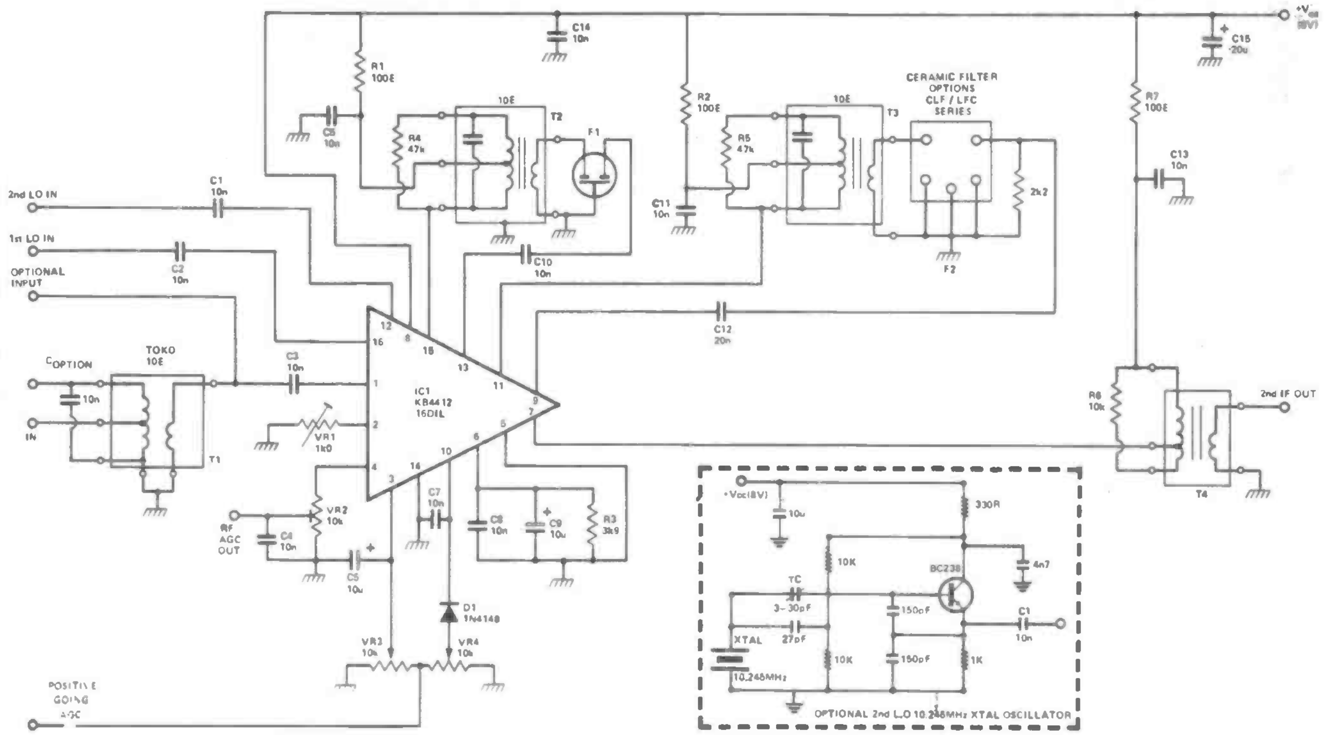


KB4412 Internal block diagram

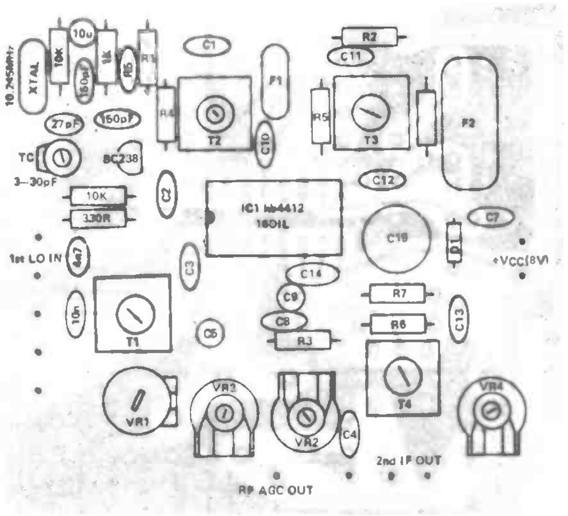
ITEM	NOTATION	MIN.	TYP.	MAX.	UNIT	CONDITION
Current Consumption	I_Q		15		mA	At no signal.
Mixer 1 Gain	G_1	15	20		dB	27MHz input; oscillator, 16MHz; injection voltage, 100mVp-p, at full gain.
Mixer 2 Gain	G_2	15	20		dB	11MHz input, oscillator, 10.5MHz; injection voltage, 100mVp-p, at full gain.
Amplifier Gain	G_3	50	55		dB	455kHz input, at full gain.

KB4412 Internal diagram



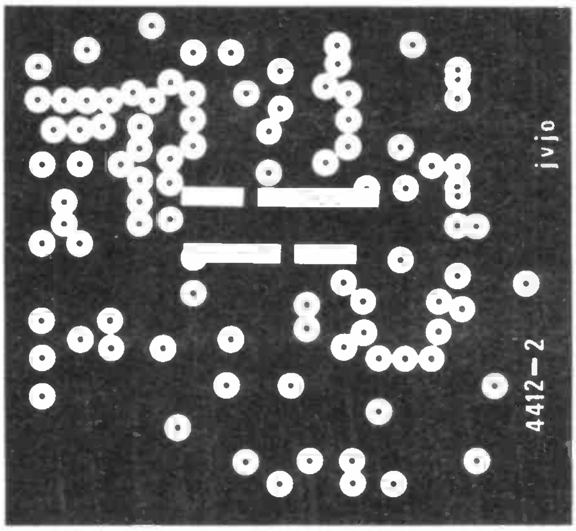


Application with dual conversion - inputs up to 40MHz can be used. Use the KB4413 detector system (see last month's databrief) for a complete AM/SSB system for LF/HF

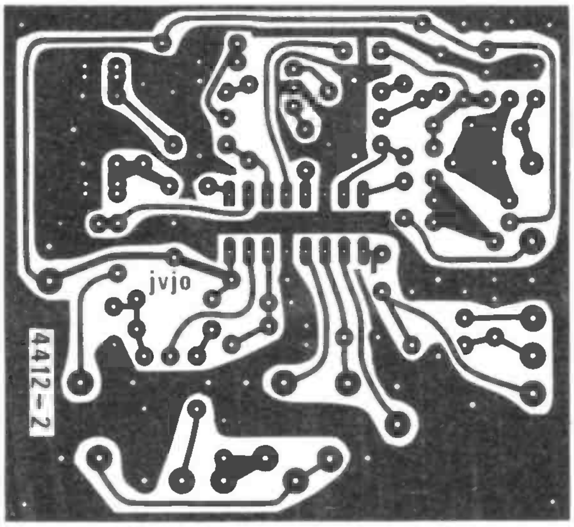


MIX_1 IN	1	16	OSC_1 IN
MIX_1 AGC CONT	2	15	MIX_1 OUT
AGC FEED	3	14	GND
RF AGC OUT	4	13	MIX_2 IN
GND	5	12	OSC_2 IN
PASS. C	6	11	MIX_2 OUT
IF OUT	7	10	IF AGC CONT.
V_{CC}	8	9	IF IN

PCB top earth plane



PCB foil side



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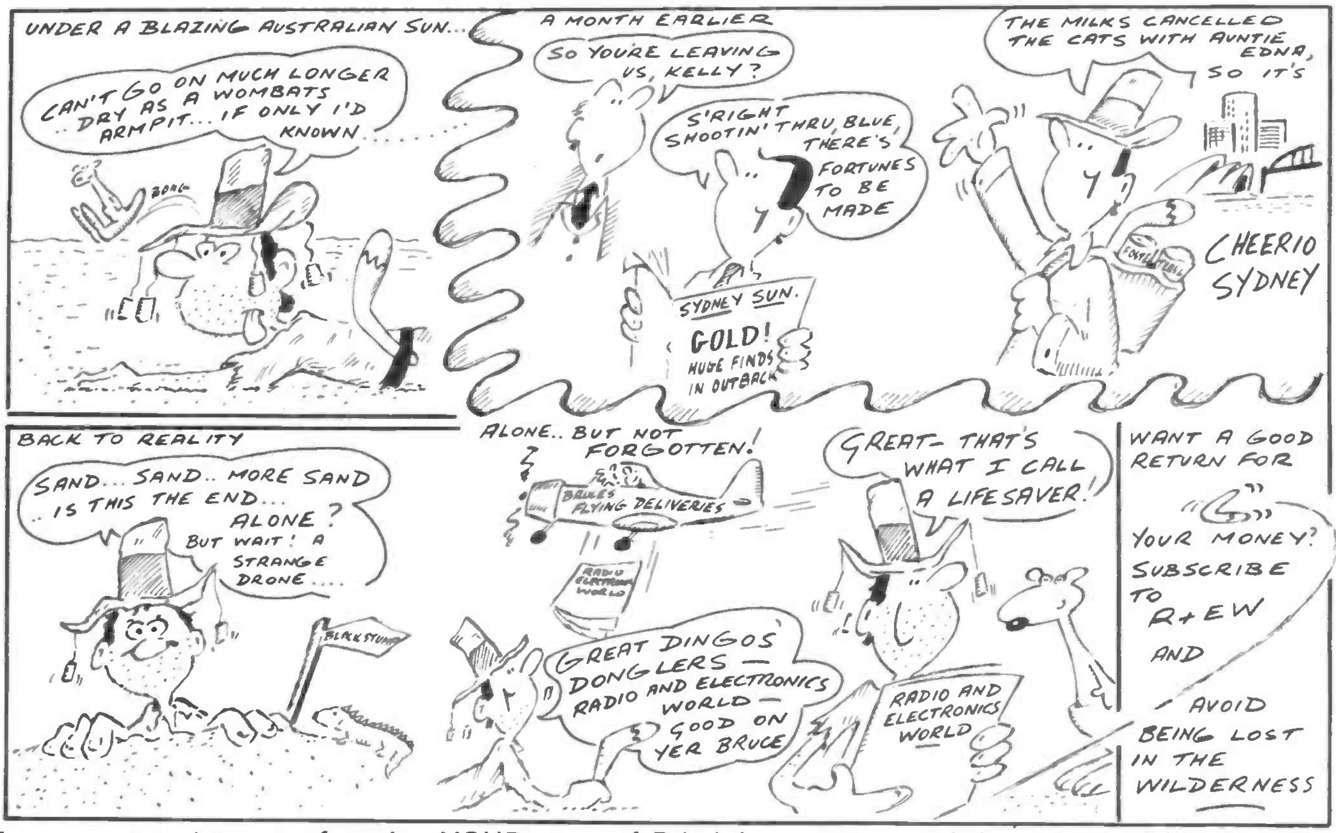

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◀ Continued from Page 61

should remain unchanged; if not, re-adjust and repeat the sweep. It may take several attempts to obtain an unchanging display although a tolerance of +/— 0.01 is allowable. Adjust RV1 to give a reading of 7.00 on the display.

5: pH calibrations:
Measure the temperature of the pH buffer solutions and set RV3 to this value. Remove the input short circuit and connect the pH probe.

i) Place the probe in the pH 7 buffer solution so that the sensistive tip is covered. Adjust RV2 (buffer control) so that the reading on the DPM corresponds to the calculated pH of the buffer at the ambient temperature (e.g. 6.88 at 20°C).

ii) Transfer the probe to the pH 9 buffer solution after rinsing with distilled water and adjust RV5 so that the DPM reading agrees with the calculated value (e.g. 9.22 at 20°C)

iii) Check the calibration with pH 4 buffer after rinsing the electrode. If the reading does not compare with the calculated value (e.g. 4.00 at 20°C) repeat steps i to

iv) Rinse the electrode and store moist or in distilled water.

Calibration should hold true for electrodes from the same batch but if another manufacturer's electrode is used, then recalibration will be needed for the highest accuracy.

The instrument may then be fixed in its case. Routine checking of the calibration can be achieved by the use of two buffer solutions. After the temperature compensation has been set, the DPM reading in one buffer solution is varied using the buffer control unit it agrees with the stated pH of the buffer solution. The setting thus achieved should hold good for the other buffer solution; if not, check the cleanliness of the electrode and the freshness of the buffer solutions before blaming the meter.

IN USE

A 9 volt PP3 battery should last for several months of intermittent use and if the voltage of the battery falls below 7, it should be replaced. A rechargeable battery should be given an overnight trickle-charge if its voltage falls below about 7.5. Corrosion of the input socket should not be a problem but it should be kept dry and clean.

The meter is stable and provided the electrode is not allowed to dry out, calibration, once performed, should be stisfactory when it is in frequent use.

Determination of the pHG of most liquids is straightforward but when pH measurements of soil or other abrasive material are contimplated, care must be taken since the tip of the electrode is easily damaged. Special soil probes are available but they tend to be expensive. The usual procedure is to make a suspension of soil in water (about 1 part of soil to 3 parts of water and to measure the pH of the super-natant liquid after 20 minutes or so. The electrode must be carefully washed after use. If the electrode is used with foodstuffs, it must be carefully cleaned with alcohol afterwards to remove any traces of oily contamination which will degrade its response. Surgary liquids should be removed by warm water for the same reason.

Most combination pH electrodes are safe to use in very hot water. The temperature range of this meter has been restricted since the range of 0° to 50°C was all that was needed and should prove to be adequate.

The protoype and several production models have been in daily use for 18 months and have been most satisfactory.

Reference

Golterman, H.L., Clymo, R.S. and Ohnstad, M.A.M. (1978) Methods for Physical and Chemical Ananlysis of Fresh Waters, Oxford, Blackwell Scientific Publications.

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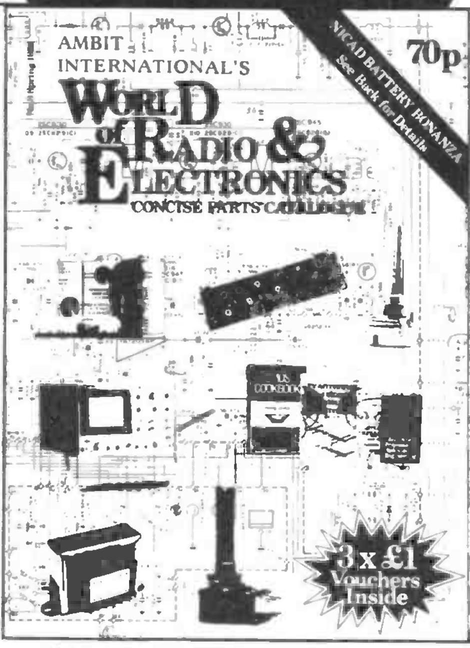

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74LS190N	0 45
74LS191N	0.45
74LS192N	0 45
74LS193N	0.42
74LS194N	0.35
74LS195N	0.35
74LS196N	0 55
74LS197N	0.60
74LS200N	3.40
74LS202N	3 45
74LS221N	0.50
74LS240N	0.80
74LS241N	0.80
74LS242N	0.70
74LS243N	0.70
74LS244N	0.60
74LS245N	0.80
74LS247N	1 35
74LS248N	1.35
74LS249N	1.35
74LS251N	0.35
74LS253N	0.35
74LS257N	0.40
74LS258N	0.37
74LS259N	0.60
74LS260N	0.50
74LS266N	0.22
74LS273N	0.70
74LS275N	3.20
74LS279N	0.35
74LS280N	2.50
74LS283N	0.42
74LS290N	0.50
74LS293N	0.40
74LS295N	1 50
74LS298N	0.76
74LS365N	0.32
74LS366N	0.34
74LS367N	0.32
74LS368N	0.35
74LS373N	0.70
74LS374N	0.70
74LS375N	0.40
74LS377N	0.85
74LS378N	0.85
74LS379N	0.60
74LS384N	2.50
74LS385N	2.05
74LS386N	0 29
74LS390N	0 68
74LS393N	0 61
74LS395N	2 10
74LS396N	1 99
74LS398N	2 75
74LS399N	2 30
74LS445N	1 40
74LS447N	1 95
74LS490N	1 10
74LS668N	1 05
74LS669N	1 05
74LS670N	1 70

RAM

2102	1 70
2112	3 40
2114 2	1 49
4027	5 78
4116 2	1 59
4116 3	1 49
4864P	12 50
6116P 3	9.00
6116P 4	11 25
8264	12 50

74CXX

74C00	0.20
74C02	0.20
74C04	0.20
74C08	0.20
74C10	0.20
74C14	0.55
74C20	0.20
74C30	0.20
74C32	0.20
74C42	0.80
74C48	1.03
74C73	0.50
74C74	0.50
74C76	0.48
74C83	0.98
74C85	0.98
74C86	0.26
74C89	2.68
74C90	0.80
74C93	0.80
74C95	0 94
74C107	0.48
74C151	1.52
74C154	2.26
74C157	1.52
74C160	1.05
74C161	1.05
74C162	1.05
74C163	1.05
74C164	0.80
74C165	0.84
74C173	0 72
74C174	1.05
74C175	1.05
74C192	1.08
74C193	1.08
74C195	1.08
74C200	4 52
74C221	1.06
74C901	0.38
74C902	0 38
74C903	0 38
74C904	0 38
74C905	5 64
74C906	0 38
74C907	0 38
74C908	0 84
74C909	1 52
74C910	3 62
74C914	0 86
74C918	0 98
74C925	4 32
74C926	4 32
74C927	4 32

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Data File No. 6

CCD analogue delay lines can be used to produce special audio effects such as echo, reverb, phasing, flanging, room expansion and predictive switching, etc.

Ray Marston explains how in the next few pages.

SOLID STATE DELAY LINES are widely used in modern music and audio systems. They can be used to produce popular effects such as echo, reverb, chorus, phasing, flanging etc., in music systems, 'rare' effects such as ambience synthesis or 'room expansion' in expensive Hi-Fi systems, and 'predictive' effects such as click/scratch elimination in record players or auto-switching in tape recorders, etc.

Two basic types of solid state-delay systems are available, analogue and digital. Digital delay systems tend to be more expensive and complex than analogue types, except where delay times are in excess of 250 mS, so we'll confine our present discussion to analogue systems only.

DELAY LINE BASICS

Modern solid state analogue delay lines come in integrated circuit form and are almost universally known as CCD (Charge Coupled Device) or 'Bucket-Brigade' delay lines. In essence, these devices contain a stack of analogue memory (sample-and-hold) cells or 'buckets' (usually 512, 1024 or 4096), all wired in series. Analogue input signals are applied at the front of the bucket 'chain', and the delayed output is taken from the chain's end.

Figure 1 illustrates the basic operating principle of an analogue delay line. Each bucket consists of a small capacitor and a tetrode MOSFET, and acts like a sample-and-hold stage. An electronic switch is placed at the front of the chain, which is externally biased to a preset voltage. Charges can be shifted down the chain, one step at a time, via an external 2-phase clock signal; one phase of the clock is also used to activate the input sampling switch. The operating sequence is as follows.

On the first clock half-cycle, each existing bucket charge is shifted backwards one step, to the next bucket in the chain, and a sample of the instantaneous input signal is fed to the first bucket via SW1, where it is 'stored' as an analogue charge. On the second half-cycle, each existing charge (including the input one) is transferred backwards another step, to the next bucket in the chain, but the input is NOT sampled via SW1. There is thus always an 'empty' bucket between each charged bucket in the chain. This double shifting process repeats on each clock cycle, with input samples repeatedly being taken and then clocked towards the back of the chain.

In the final section of the delay line, a short section of buckets is wired in parallel with, and fed from, the main delay line, but has one bucket more than the corresponding section of the main

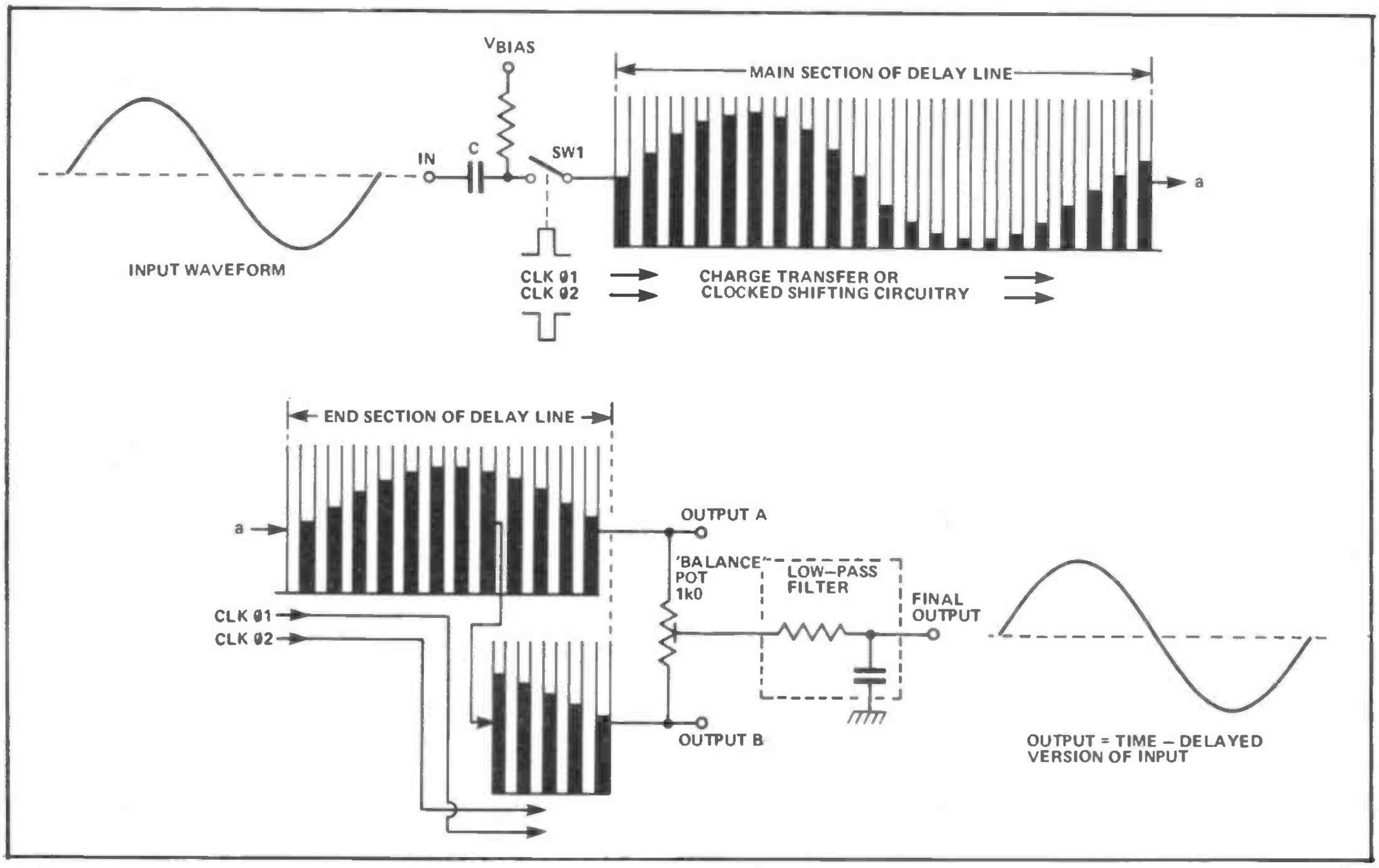


Figure 1: Basic operating principle of the 'Bucket Brigade' delay line. See text for explanation.

line and is clocked in anti-phase. The IC thus has two outputs which, when added together, effectively fill in the 'gaps' in the main delay line bucket chain. The outputs can be 'added' either by shorting them directly together or, preferably, by connecting them to a balance pot as shown in the diagram. The final output of the delay line is thus a quantised but time-delayed replica of the original input signal.

Figure 2 shows the essential 'usage' elements of an analogue delay line chip. The delay line MOSFETs use a tetrode structure, so the IC needs two supply lines (V_{DD} and V_{BB}), plus a ground connection. The input terminal must be biased into the linear mode by voltage V_{bias}. The two outputs of the device must be added together, as already described; in *Fig 2* we've shown addition by direct-shorting. Finally, the IC must be provided with a 2-phase clock signal, normally consisting of a pair of anti-phase square waves that switch fully between the V_{DD} and GND potentials.

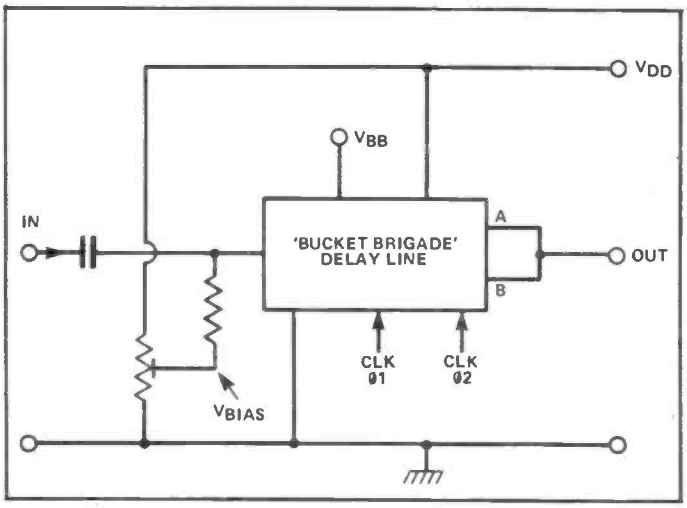


Figure 2: Essential 'usage' elements of an analogue delay line chip.

HOW MUCH DELAY?

We've already seen that the buckets of the analogue delay line are alternately 'empty' and 'charged', and that each complete clock cycle shifts a charge two stages along the bucket chain. Thus, the maximum number of samples taken by a line is equal to half the number of bucket stages (a 1024 stage line can take only 512 samples), and the actual time-delay available from a line is given by:

$$\text{Time Delay} = \frac{S \times p}{2} \text{ or } \frac{S}{2 \times f}$$

where S equals number of bucket stages, p equals clock period, and f equals clock frequency.

Thus, a 1024-stage line using a 10 kHz (100 uS) clock gives a delay of 51.2 mS. A 4096-stage line gives a 204.8 mS delay at the same clock frequency. This seems pretty good, but there are two major snags. The first is that the maximum useful signal frequency of the delay line is equal to one third of the clock frequency, so a delay line clocked at 10 kHz has a useful bandwidth of only 3.3 kHz.

The second snag concerns costs. Analogue delay lines are rather expensive. A 1024-stage line typically costs about £14, while a 4096-stage line costs about £28!

Figure 3 shows the block diagram of a basic, real-life, analogue delay line system. The input signal is applied to the input of the delay line via a low-pass filter which has a cut-off frequency that is one third (or less) of the operating frequency of the clock generator, and is used to overcome 'aliasing' or intermodulation problems. The output of the delay line is passed through a second low-pass filter, which also has a cut-off frequency one third (or less) of that of the clock and which serves the multiple purposes of rejecting clock break-through signals and integrating the delay line output pulses, so that the final analogue output signal is a faithful (but time-delayed) copy of the original input signal.

We'll take a closer look at some of the elements of the *Fig 3* circuit, and at some practical delay line chips, later in this article. In the meantime, let's digress slightly and look at the subject known as psycho-acoustics.

PSYCHO-ACOUSTICS

Many of the special effects that are obtainable with delay lines depend heavily on the human brain's idiosyncratic behaviour when interpreting sounds. Basically, the brain does not always perceive sounds as they truly are, but actually 'interprets' them so that they conform to a pre-conceived pattern. The brain can sometimes be tricked into mis-interpreting the sounds. The study of this particular subject is known as psycho-acoustics. Here are some psycho-acoustic 'laws' that are worth knowing:

1. If the ears receive two sounds that are identical in form but time-displaced by less than 10 mS, the brain integrates them and perceives them as a single (undisplaced) sound.
2. If the ears receive two sounds that are identical in form but time-displaced by 10-50 mS, the brain perceives them as two independent sounds but integrates their information content into a single easily recognisable pattern, with no loss of information fidelity.
3. If the ears receive two signals that are identical in form but time-displaced by greater than 50 mS, the brain perceives them as two independent sounds but may be unable to integrate them into a recognisable pattern.
4. If the ears receive two sounds that are identical in basic form but not in magnitude, and which are time-displaced by more than 10 mS, the brain interprets them as two sound sources (primary and secondary) and draws conclusions concerning (a) the location of the primary sound source and (b) the relative distances apart of the two sources.

Regarding 'location' identification, the brain identifies the first perceived signal as the prime sound source, even if its magnitude is substantially lower than that of the second perceived signal (the Hass effect). Delay lines can thus be used to trick the brain into wrongly identifying the location of a sound source.

Regarding 'distance' identification, the brain correlates distance and time-delay in terms of roughly 0.3 metres per

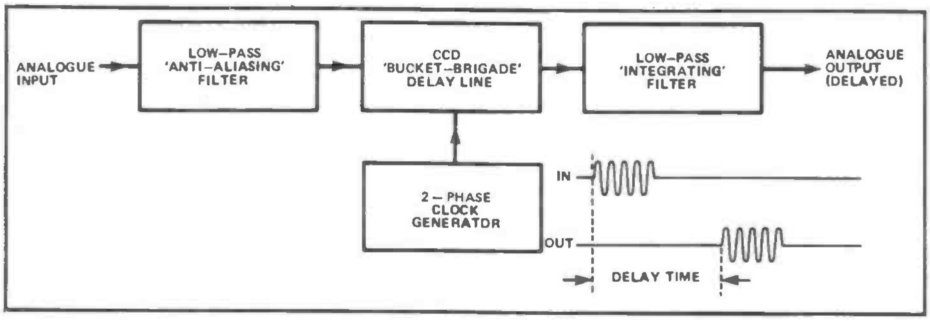


Figure 3: Block diagram of a basic analogue delay line system.

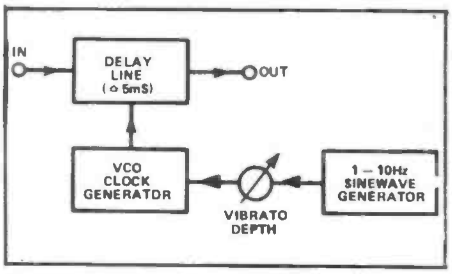


Figure 4: True vibrato circuit, which applies slow frequency modulation to all input signals.

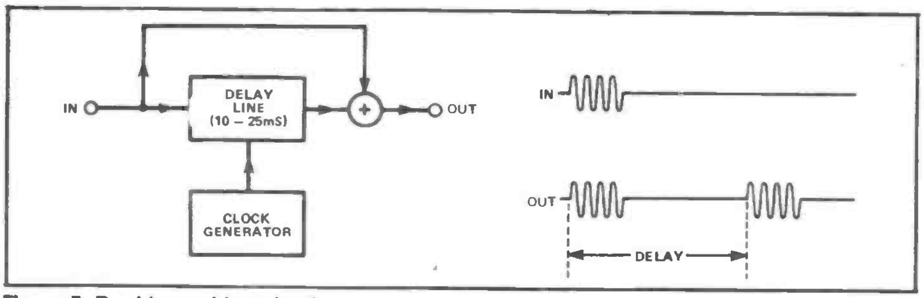


Figure 5: Double-tracking circuit.

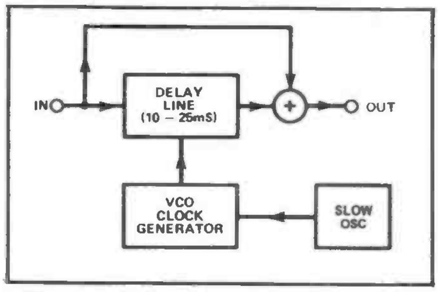


Figure 6: Auto-Double-Tracking (ADT) or mini-chorus circuit.

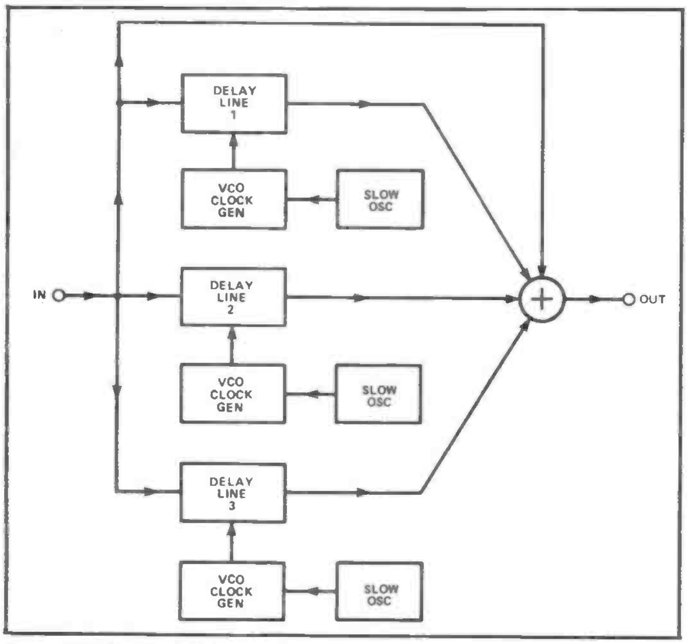


Figure 7: 'Chorus' generator.

millisecond of delay. Delay lines can thus be used to trick the brain about distance information.

5. The brain uses echo and reverberation (repeating echoes of diminishing amplitude) information to construct an image of environmental conditions, e.g., if echo times are 50 mS but reverb time is 2 seconds, the brain may interpret its environment as being a 50 ft cave or similar hard-faced structure, but if the reverberation time is only 150 mS it may interpret its environment as being a 50 ft wide softly-furnished room. Delay lines can thus be used to trick the brain into drawing false conclusions concerning its environment, as in ambience synthesisers or 'room expanders'.
6. The brain is highly sensitive to sudden (transients of millisecond duration) increases in sound intensity, such as clicks and scratches on discs, but is insensitive to transient decreases in intensity. Delay lines can be used to take advantage of this effect in record players, where they can be used (in conjunction with other circuitry) to effectively predict the arrival of a click/scratch and replace it with a neutral or negative transient.

DELAY LINE APPLICATIONS

SIMPLE MUSICAL EFFECTS

Figures 4 to 15 illustrate a variety of analogue delay line applications. In these diagrams we have, for the sake of simplicity, ignored the presence of the usual input/output low-pass filters. Let's start by looking at some simple musical effects circuits.

Figure 4 shows how the delay line can be used to apply vibrato (frequency modulation) to any input signal. The low-frequency sinewave generator modulates the clock generator frequency and thus causes the output signals to be similarly time-delay modulated. Simple.

Figure 5 shows the delay line used to give a double-tracking effect. The delay time is in the 'perceptible' range 10-25 mS, and the delayed and direct signals are added in an audio mixer to give the composite 'two signals' output shown in the diagram. If a solo singer's voice is played through the unit, it sounds like a pair of singers in very close harmony. Alternative names for this circuit are 'mini-echo' and 'micro-chorus'.

Figure 6 shows how the above circuit can be modified to act as an Auto-Double-Tracking (ADT) or mini-chorus unit. Clock signals are derived from a VCO that is modulated by a slow oscillator, so that the delay times slowly vary. The effect is that, when a solo singer's voice is played through the unit, it sounds like a pair of singers in loose or natural harmony.

Figure 7 shows how three ADT circuits can be wired together to make a 'chorus' machine. All three lines have slightly different delay times. The original input and the three delay signals are all added together, the net effect being that a solo singer sounds like a quartet, or a duet sounds like an octet, etc.

COMB FILTER CIRCUITS

Figure 8 shows a delay line used to make a comb filter. The direct and delayed signals are added together; signal components that are in-phase when added give an increased output signal amplitude, and those that are in anti-phase tend to self-cancel and give a reduced output level. Consequently, the frequency response shows a series of notches, the notch spacing being the reciprocal of the line delay time (1 kHz spacing at 1 mS delay, 250 Hz spacing at 4 mS delay. These phase-induced notches are typically only 20-30 dB deep.

The two most popular musical applications of the comb filter are in phasers and flangers. In the phaser (*Fig 9*) the notches are

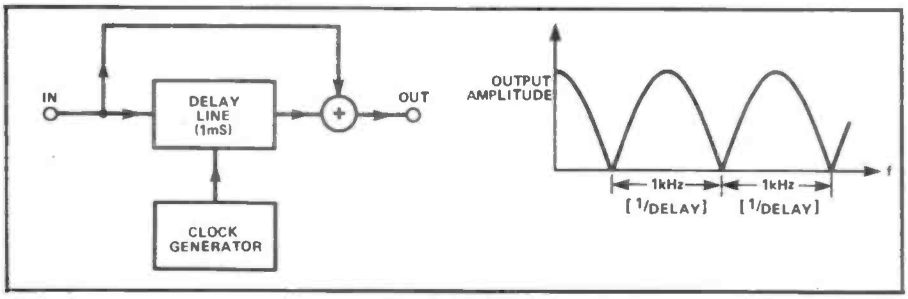


Figure 8: CCD comb filter. Notches are about 20-30 dB deep, 1 kHz apart.

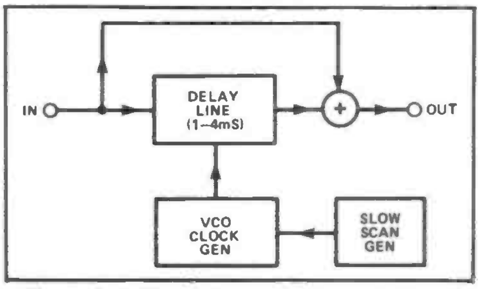


Figure 9: A Phaser is a variable comb filter, in which the notches are slowly swept up and down the audio band.

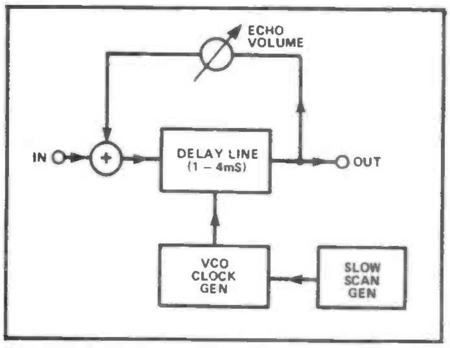


Figure 10: A flanger is a phaser with accentuated and variable notch depth.

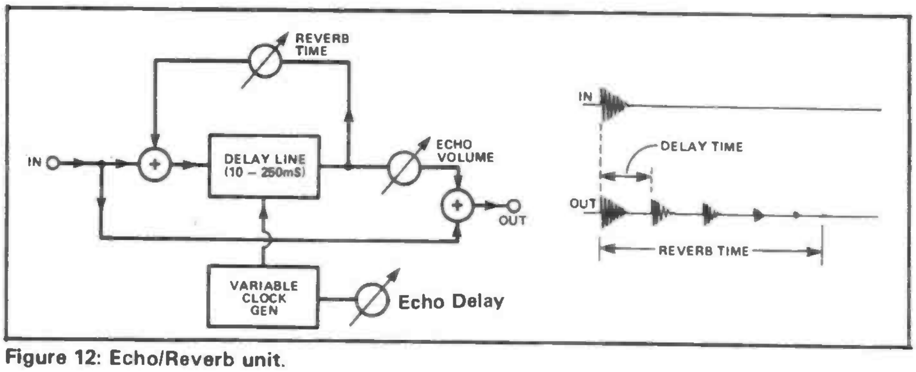


Figure 12: Echo/Reverb unit.

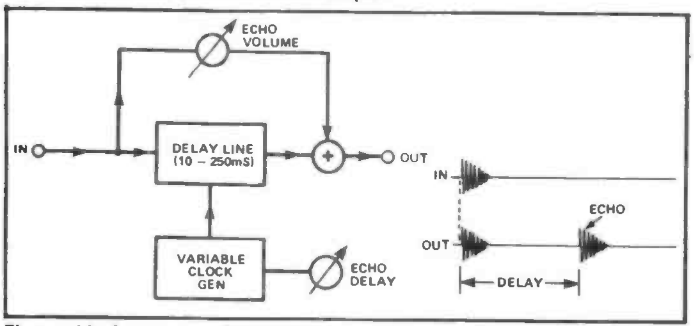


Figure 11: An echo unit.

simply swept slowly up and down the audio band via a slow-scan oscillator, introducing a pleasant acoustic effect on music signals.

The flanger circuit (*Fig 10*) differs from the phaser in that the mixer is placed ahead of the delay line and part of the delayed signal is fed back to one input of the mixer, so that in-phase signals add together regeneratively. Amplitudes of the peaks depends on the degree of feedback, and can be made very steep. These phase-induced peaks introduce very powerful acoustic effects as they are swept up and down through music signals via the slow-scan oscillator.

ECHO/REVERB CIRCUITS

Figure 11 shows the basic circuit of an echo unit. The delay (echo) may vary from 10 mS to 250 mS and is usually adjustable, as also is the echo amplitude. Note that this circuit produces only a single echo.

The echo/reverb circuit of *Fig 12* produces multiple or repeating echoes (reverberation). It uses two mixers, one ahead of the delay line and the other at the output. Part of the delay output is fed back to the input mixer, so that the circuit gives echoes of echoes of echoes, etc. The reverb time is defined as the time taken for the repeating echo to fall by 60 dB relative to the original input signal, and depends on the delay time and the overall attenuation of the feedback signals. Echo delay time, echo volume and reverb time are all independently variable.

Figure 13 shows the basic circuit of an ambience synthesiser or room expander. Here, the outputs of a conventional stereo Hi-Fi system are summed to give a mono image and the resulting signal is then passed to a pair of semi-independent reverb units (which produce repeating echoes but not the original signal). The reverb outputs are then summed and passed to a mono PA system and speaker, which is usually placed behind the listener. The system effectively synthesises the echo and reverb characteristics of a chamber of any desired size, so that the listener can be given the impression of sitting in a cathedral, concert hall, or small club house, etc., while in fact sitting in his own living room. Such units produce very impressive results.

There are lots of possible variations on the basic *Fig 13* circuit. In some cases the mono signal is derived by differencing (rather than summing) the stereo signals, thereby cancelling centre-stage signals and overcoming a rather disconcerting 'announcer-in-a-cave' effect that occurs in 'summing' systems. The number of delay (reverb) stages may vary from one in the cheapest units to four in the more expensive.

PREDICTIVE SWITCHING CIRCUITS

Delay lines are particularly useful in helping to solve 'predictive' or 'anticipatory' switching problems, in which a switching action is required to occur slightly BEFORE some random event occurs.

Suppose, for example, that you need to make recordings of random or intermittent sounds (thunder, speech, etc). To have the recorder running continuously would be inefficient and expensive, and it would not be practical to try activating the recorder automatically via a sound switch, since part of the sound will already have occurred by the time the recorder turns on.

Figure 14 shows the solution to this problem. The sound input activates a sound switch, which (because of mechanical inertia) turns the recorder's motor on within 20 mS or so. In the meantime, the sound travels through the 50 mS delay line towards the recorder's audio input terminal, so that the recorder has already been turned on for 30 mS by the time the first part of the sound reaches it. When the original sound ceases, the sound switch turns off, but the switch extender maintains the motor drive for another 100 mS or so, enabling the entire 'delayed' signal to be recorded.

Finally, to conclude this 'applications' section, *Fig 15* shows how 'predictive' switching can be used to help eliminate the

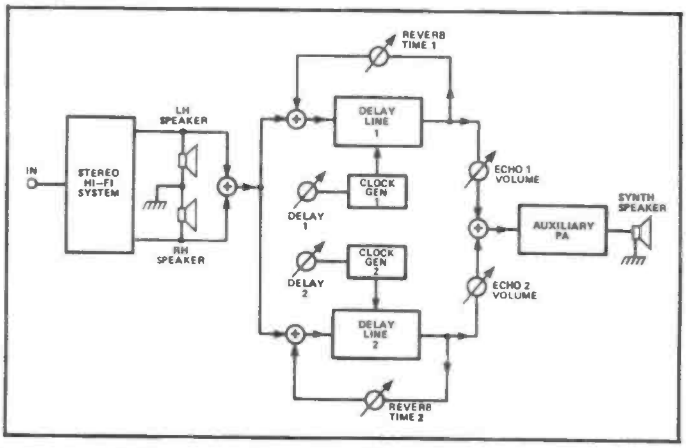


Figure 13: Ambience synthesiser or 'Room Expander'.

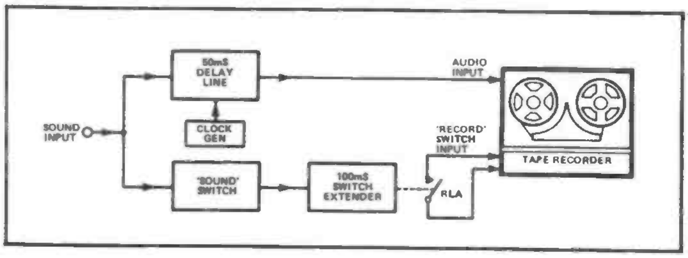


Figure 14: Automatic Tape Recorder with 'predictive' switching.

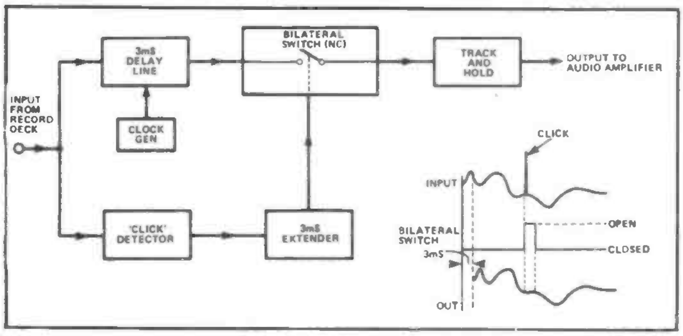


Figure 15: Record 'click' eliminator.

sounds of clicks and scratches from a record player. Such sounds can easily be detected by using stereo phase-comparison techniques.

In *Fig 15*, the disc signals are fed to the audio amplifier via a 3 mS delay line, a bilateral switch, and a track-and-hold circuit. Normally, the bilateral switch is closed, and the signal reaching the audio amplifier is a delayed but otherwise unmodified replica of the disc signal. When a click or scratch occurs on the disc, the detector/extender circuit opens the bilateral switch for a minimum of 3 mS, momentarily blanking the audio signal to the amplifier. Because of the presence of the delay line, the blanking period effectively straddles the 'click' period, enabling its sound effects to be completely eliminated from the system (see 'Psycho Acoustics').

PRACTICAL CIRCUITS

DEVICE No.	STAGES	SAMPLES	DELAY TIME, mS, vs CLOCK FREQUENCY	DELAY AT 7kHz BANDWIDTH	NOTES
TDA1022	512	256	256/f	12.8mS	VERY POPULAR LOW-COST DELAY LINE
SAD512	512	256	256/f	12.8mS	512 STAGE DELAY LINE (OBSOLESCENT)
SAD512D	512	256	256/2xf	12.8mS	BUILT-IN CLOCK DIVIDER USES SINGLE-PHASE CLOCK
SAD1024A	1024	512	2x 256/f	25.6mS	DUAL SAD512 DELAY LINE
SAD4096	4096	2048	8x 256/f	102.4mS	4096-STAGE DELAY LINE CLOCK-TERMINAL INPUT CAPACITANCE = 1000p

Figure 16: Basic details of five popular CCD delay lines.

DELAY LINES

Figure 16 shows basic details of five popular CCD delay lines. The TDA1022 and the SAD512 are general-purpose 512-stage delay lines requiring 2-phase clock inputs. They give 12.8 mS delay at 7 kHz bandwidth when driven at 20 kHz clock frequency.

The SAD512D is an 'updated' version of the SAD512, and incorporates built-in output drivers and a clock input divider. It requires a single-phase clock input.

The SAD1024A is a dual version of the SAD512. The two halves can be used independently, or can be wired in series to give a delay of 25.6 mS at 7 kHz bandwidth.

The SAD4096 gives a performance equal to eight SAD512s in series. It provides a delay of 102.4 mS at 7 kHz bandwidth, or 250 mS at 3 kHz bandwidth. The device requires a low impedance 2-phase clock drive, since its clock terminal input capacitance is about 1000 pF.

Figures 17 and 18 show a couple of practical delay line circuits, using TDA1022 and SAD512D devices. Both circuits use a preset to adjust the input DC bias so that symmetrical clipping occurs under over-drive conditions, and another pre-set to balance the two outputs for minimum clock breakthrough.

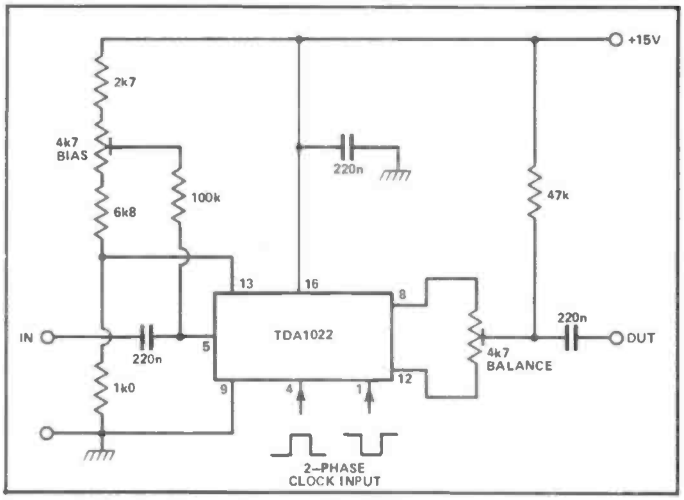


Figure 17: Delay line using the TDA1022.

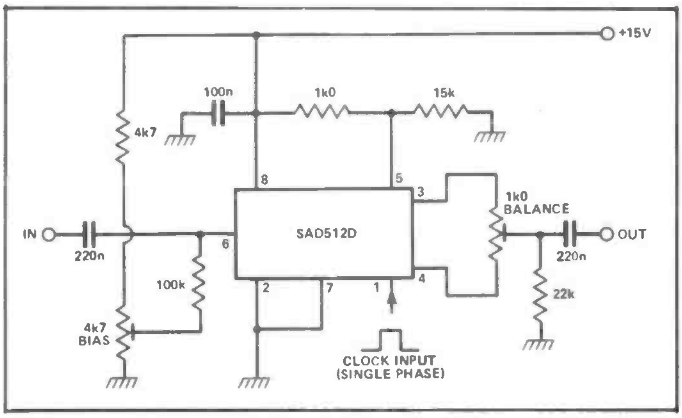


Figure 18: Delay line using the SAD512D

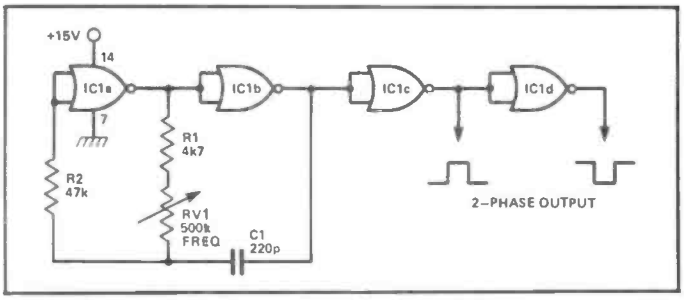


Figure 19: Variable-frequency general-purpose 2-phase CMOS clock generator.

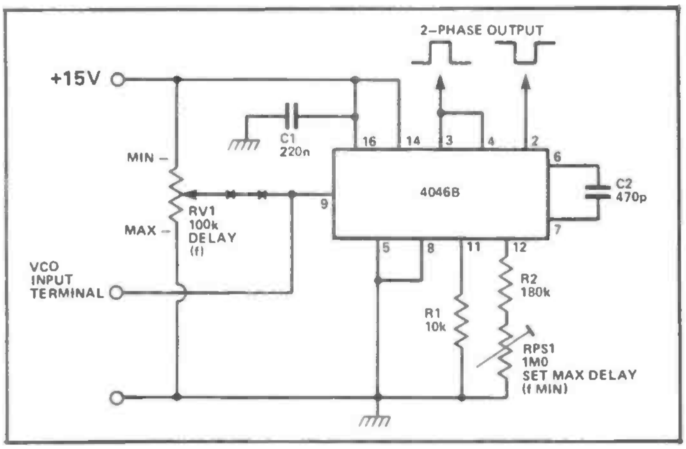


Figure 20: High-performance voltage-controlled 2-phase CMOS clock generator.

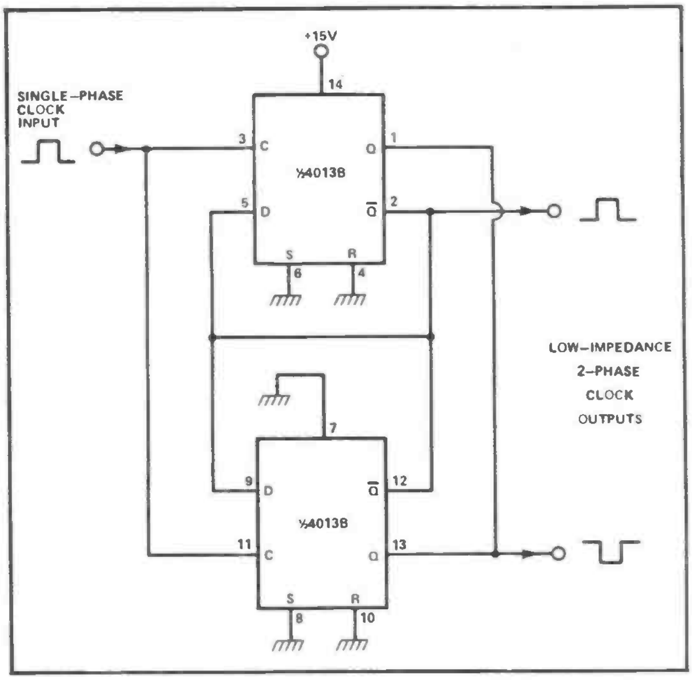


Figure 21: Single-phase to 2-phase converter, with low impedance output.

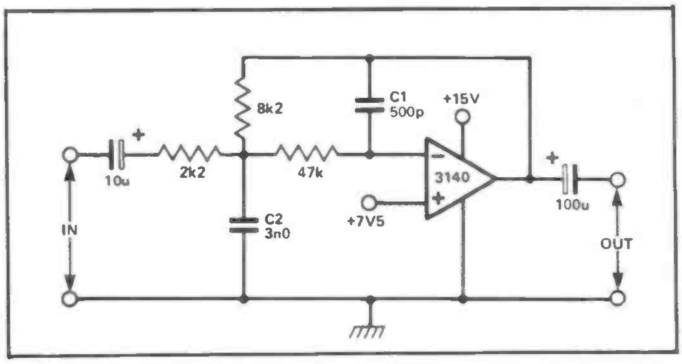


Figure 22: 25 kHz 2nd-order maximally-flat low-pass filter.

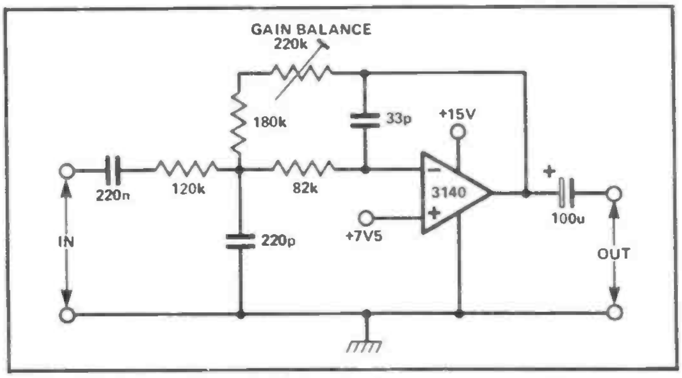


Figure 23: Adjustable-gain 2nd-order low-pass output filter.

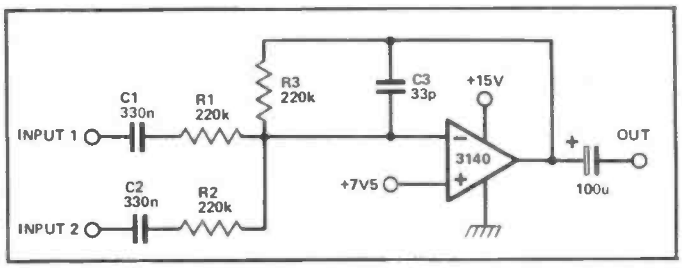


Figure 24: Combined 2-input mixer/1st-order low-pass filter.

CLOCK GENERATORS

The clock signals to a CCD delay line should be reasonably symmetrical, should have fairly fast rise and fall times, and should switch fully between the supply rail voltages. CMOS devices make ideal clock generators, and *Figs 19 to 21* show three practical circuits.

The general-purpose 2-phase generator of *Fig 19* is inexpensive and can be used in most applications where a fixed or manually-variable frequency is needed. The frequency can be swept over a 100:1 range via RV1, and the centre frequency can be altered by changing the C1 value.

The high-performance 2-phase generator of *Fig 20* is based on the VCO section of a 4046B chip, and is useful in applications where the frequency needs to be swept over a very wide range, or needs to be voltage controlled. The frequency is controlled by the voltage on pin 9, being at maximum (min delay) when pin 9 is high, and minimum (max delay) when pin 9 is low. Maximum frequency is determined by the C2-R1 value, and minimum frequency by the value of C2 and the series values of R2-RPS1.

The *Fig 19 and 20* circuits can be used to directly clock all CCD delay lines except the SAD4096, which has a clock terminal capacitance of 1000 pF and needs low-impedance clock drive. The SAD4096 is best driven by the circuit shown in *Fig 21*, which uses the two halves of a 4013 divider wired in parallel to give the required low-impedance 2-phase output; the circuit is driven by a single-phase clock signal, which can be obtained from either of the *Fig 19* or 20 circuits.

FILTER CIRCUITS

In most applications, a low-pass filter must be inserted between the actual input signal and the input of the delay line, to prevent aliasing problems, and another in series with the output of the line, to provide clock-signal rejection and integration of the 'sample' signals. For maximum bandwidth, both filters usually have a cut-off frequency that is one third (or less) of the maximum used clock frequency; the input filter usually has a 1st-order or better response, and the output filter has a 2nd-order or better response.

Figure 22 shows the practical circuit of a 25 kHz 2nd-order low-pass filter with AC-coupled input and output. The non-inverting terminal of the op-amp is biased at half-supply volts, usually by a simple potential divider network. The cut-off frequency can be varied by giving C1 and C2 alternative values, but in the same ratio as shown in the diagram; e.g. cut-off can be reduced to 12.5 kHz by giving C1 and C2 values of 1n0 and 6n0 respectively.

All delay lines suffer from a certain amount of 'insertion' loss. Typically, if 100 mV is put in at the front of the delay line, only 70 mV or so appears at the output. Often, the output low-pass filter is given a degree of compensatory gain, to give zero overall signal loss. *Fig 23* shows such a circuit. This circuit has a nominal cut-off frequency of about 12 kHz, depending on the setting of the GAIN BALANCE control.

Finally, to complete this look at CCD delay line circuits, *Fig 24* shows how a 2-input unity-gain 'mixer' (adder) can also be made to act as a 1st-order low-pass filter by simply wiring a roll-off capacitor (C3) between the output and the inverting terminal of the op-amp. This type of circuit is often used at the front end of CCD flanger and reverberation designs.

■ R & EW

FOOTNOTE

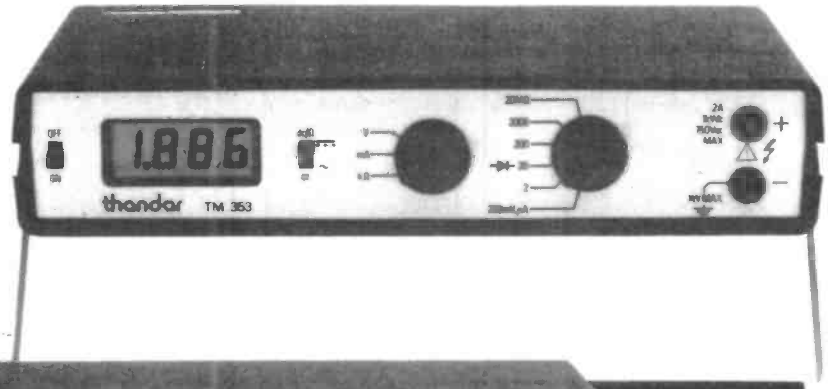
A limited range of CCD delay line ICs are available from Technomatic Ltd., 17 Burnley Road, London NW10.

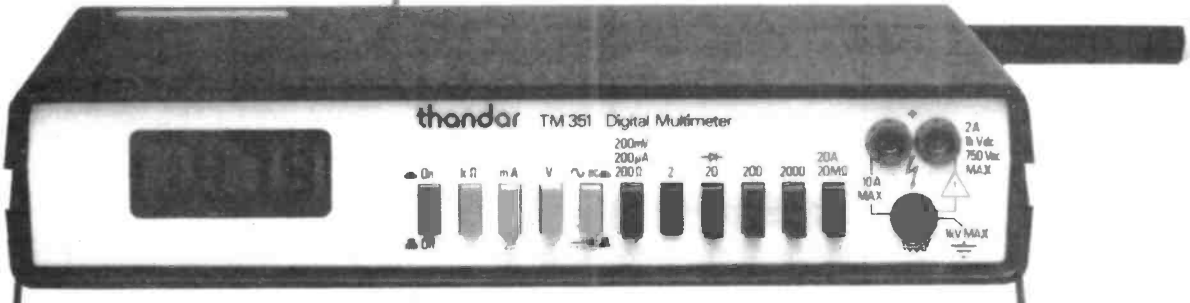
Your Reactions	Circle No.		Circle No.
Immediately Interesting	67	Not Interested in this Topic	69
Possible Application	68	Bad Feature/Space Waster	70

thandar MULTIMETERS

TM353 LCD 3½ DIGIT MULTIMETER

Laboratory quality bench/portable multimeter complete with ALKALINE batteries. Incorporating low power LSI circuitry giving 3000 hours battery life. AC and DC voltage 100μV to 1000V. AC and DC current 100na to 2A. Resistance 1Ω to 20MΩ plus diode test. Basic accuracy 0.25%. Size 255 x 150 x 50mm. Price £75.00 + VAT.





TM351 LCD 3½ DIGIT MULTIMETER

Laboratory quality bench/portable multimeter complete with ALKALINE batteries. Low power LSI circuitry giving up to 4000 hours battery life. AC and DC voltage 100μV to 1000V. AC and DC current 100na to 10A. Resistance 100mΩ to 20MΩ plus diode test. Basic accuracy 0.1%. Size 255 x 150 x 50mm. Price £99.00 + VAT.

TM354 LCD 3½ DIGIT HAND HELD MULTIMETER

High quality hand held multimeter using low power LSI circuitry giving 2000 hours battery life. DC voltage 1mV to 1000V. AC voltage 1V to 500V. DC current 1μA to 2A. Resistance 1Ω to 2MΩ. Basic accuracy 0.75%. Size 155 x 75 x 30mm. Price £39.00 + VAT.

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ELECTRONIC TEST & MEASUREMENT
London Road, St. Ives,
Huntingdon, Cambs PE17 4HJ
Tel: St. Ives (0480) 64646
Telex 32250

156 for further details

THANDAR TA2080 LOGIC ANALYSER

An 8 channel, 20 MHz design that, in Jonathan Burchell's view, provides an almost unbeatable price/performance ratio...

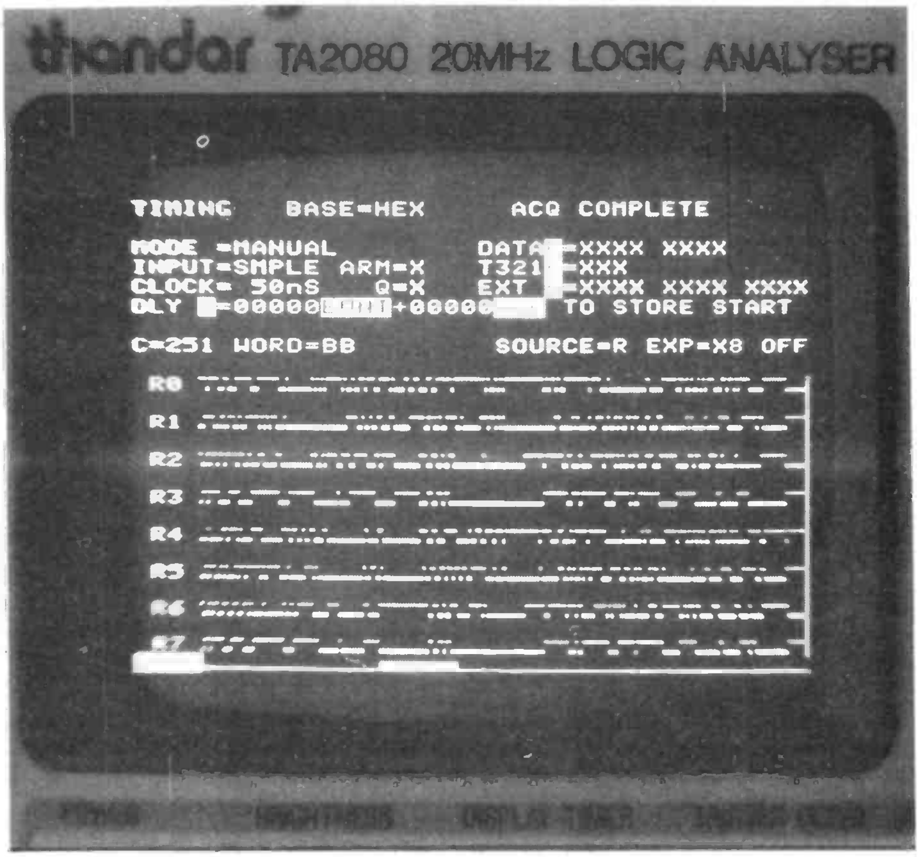


Photo 1: The analyser in the timing mode

LOGIC ANALYSERS ARE rapidly becoming an essential diagnostic tool for the computer engineer. The basic function of any analyser is to gather and display the relative logic states present on a data bus, and provide control facilities so that the engineer can home-in on selected sections of the data to check the accuracy of timing conditions, and simply to freeze the action for close inspection.

The Thandar instrument comprises a high speed data acquisition memory that is 252 samples 'deep', coupled to a display memory and a reference memory. Control of the analyser functions and keyboard is achieved with a Z80 MPU, providing straightforward control in conjunction with 6 lines of prompt information displayed at the top of the instrument's screen.

THE DISPLAY

The display may be operated in two modes: *timing* or *state*. In *timing* mode, the display (*Photo 1*) presents all 252 samples of memory in a timing diagram format, with expansions of x2, x4, and x8 available under keyboard command. The area to be expanded is selected by moving the white 'window' seen at the bottom of the display (using the cursor control on the keyboard - *photo 2*), to the desired section of the timing diagram.

An on-screen cursor facilitates quick analysis of an individual byte, by displaying the word value under the cursor's current position on the seventh line of the on-screen display - using the currently selected number base (hex, octal etc.).

The *state* display presents the contents of the memory in 24 byte blocks, in either binary plus ASCII, or hex plus octal plus ASCII - according to currently selected number base (*Photo 3*). The cursor control keys allow forward or backward movement through the memory; a 'wrap-around' facility on the display would have been helpful, since when the cursor is at one end of the data memory, it has to be moved all the way back again to get to the beginning. A 'word search' facility allows the display memory to be searched for occurrences of an eight-bit word entered via the keyboard.

The comparison mode provides an extremely useful diagnostic function, where the contents of the data memory are compared with the reference memory, and any differences are highlighted in inverse video. (*Photo 4*). The reference memory may be loaded either from the data memory, or from the front panel keyboard.

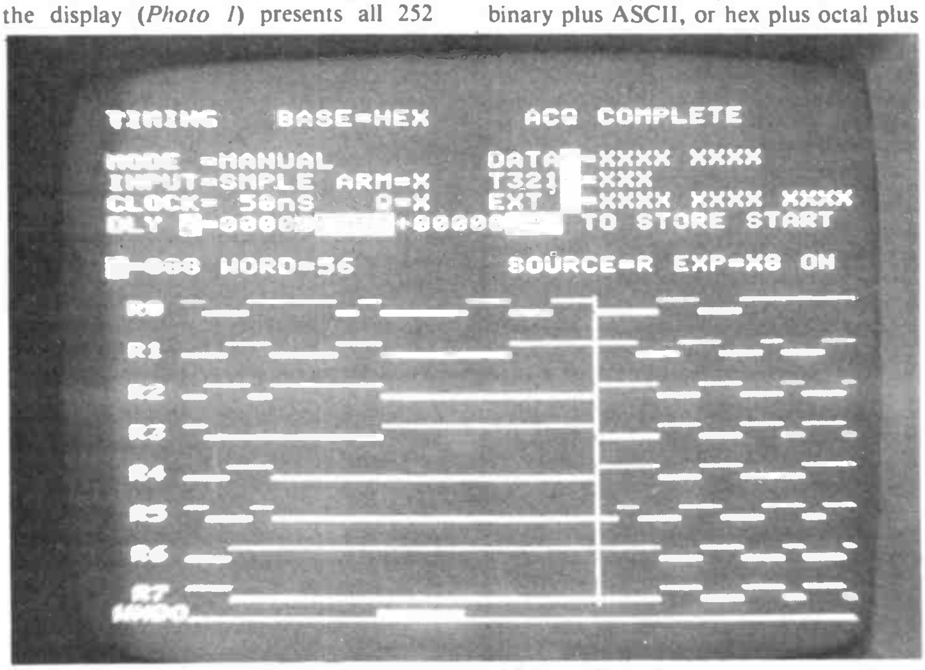


Photo 2: The window section of photo 1 expanded 8 times. Note the on-screen cursor, the display of the cursor location, and the its location value.

THE SIGNAL INPUTS

All the signal inputs to the analyser are conveyed via two connector pods. The actual method of connection to the device under examination is via flyng leads with miniature test probes, or via standard IC probe clips. Pod 1 includes the 8 data lines, the external clock line, and three triggers. Pod 2 gives a further 12 trigger inputs.

The input threshold is selected simul-.aneously for all inputs by a switch on the front panel. It can be either TTL level (1V4), or variable - in which case it can be adjusted from —10V to +10V, allowing the TA2080 to be used with other logic families. This feature may also be used to establish the output swing of various gates and drives, by moving the threshold until a point is reached where the analyser shows the outputs as being non-varying. ▶

TRIGGERING

An analyser is only as good as its triggering will allow it to be. The TA2080 scores well in this area, by providing a very powerful number of triggering modes. The unit may be set to trigger upon the 8 data inputs and 2 dual purpose inputs; one of these is a trigger and/or arm input, and the other is a trigger and/or clock qualifier input.

An additional 12 trigger inputs are provided if the external pod is connected. The trigger word can be set to any combination of 1's, 0's and Don't Cares. The trigger position is selected at either the start or the end of the store - in conjunction with a useful delay by event, and/or clock facility, this allows exactly the wanted information to be captured.

Data is sampled either in accordance with an internal clock, or an external clock. Two diffrent input modes are provided: in the *sample* mode, the data lines are sampled and stored only on the clock edges, while in the *latched* mode, all changes on the data lines are stored.

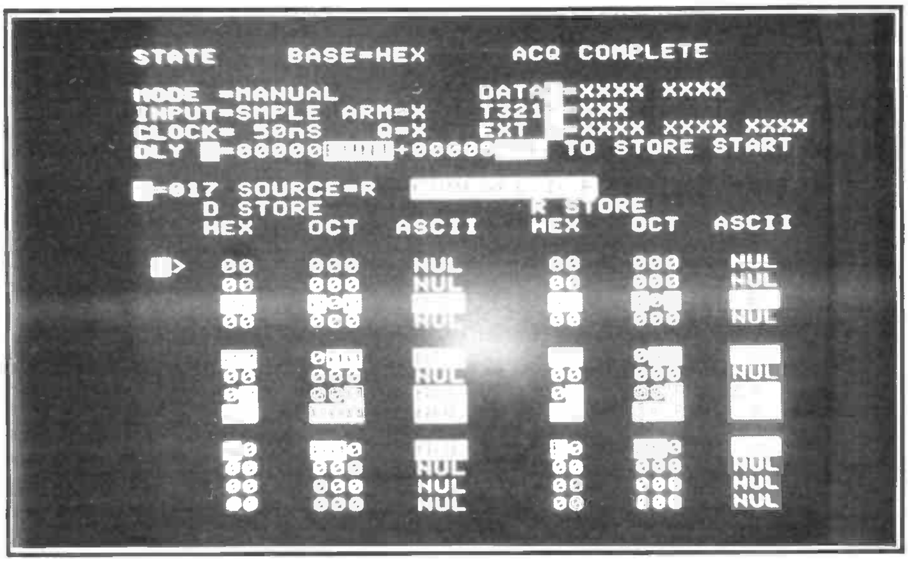


Photo 5: The compare mode, showing inequalities between the reference and data memory in inverse video.

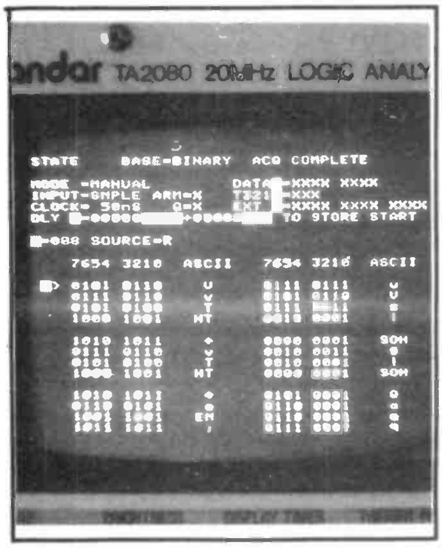


Photo 3: The analyser in the state mode - binary base.

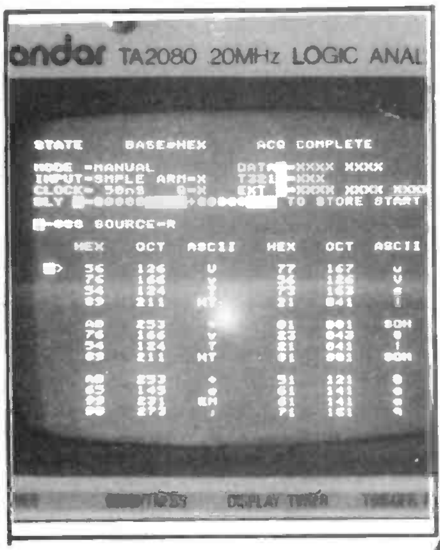


Photo 4: The same data as in photo 3, but this time with the base selected as HEX.

To check for glitches, it is necessary to take a sample in the *latch* mode, and one in the *sample* mode - and then compare them. Glitches down to 15 ns can be captured using this technique.

Another interesting feature of this analyser is the provision of a trigger filter. This is a variable control which selects the time that a valid trigger condition must be present before it will be recognised, thus helping prevent false triggering when the internal clock is being used.

ACQUISITIONS

Since the analyser can be used to try and record data in a vast number of different situations, it is important to have as many different acquisition modes as possible. The TA2080 can collect samples either automatically, at the rate set by the display timer, or in a number of different manual one-shot modes, including the powerful 'stop if data equals reference memory' and 'stop if data not equal to reference memory'.

Photo 6: A view inside the TA2080.

OVERALL IMPRESSIONS

The TA2080 is a neat and well thought out machine, as can be seen from the internal pictures. It is probably best suited to those needing to use an analyser to sort out small timing/logic problems, analysis of bus/micro problems - and for general debugging of logic boards.

One useful feature on the unit is the provision of a scope trigger facility, which triggers the oscilloscope trigger output when the analyser has detected the trigger word. It would be handy to be able to dump and load the reference store via a computer link, allowing several 'standard patterns' to be stored up and used later for comparison, and a form of signature analysis.

At just under £2000, the analyser is almost unbeatable on a price/performance ratio, and it is on this basis that Thandar expect to make their sales. The TA23080 provides an important alternative between the £500 overgrown logic probes, and the £10,000 all-singing-all-dancing machines from the Big Boys' toy rooms.

We were sufficiently impressedwith the TA2080 that we bought one for use in the R&EW laboratory, and shall be using it in the development of R&EW logic and MPU projects. You can't say fairer than that....

■ R & EW

Your Reactions.........	Circle No.
Immediately Applicable	127
Useful & Informative	128
Not Applicable	129
Comments	130

TA2080 SPECIFICATION

(All Specifications apply to TA2080 used with TA120P input pods)

SIGNAL INPUTS

Number
8 Data
13 Trigger
1 Clock
2 Dual purpose inputs: one trigger and/or arm and one trigger and/or clock qualifier.

Impedance
1MΩ in parallel with <12pF over the input range ±20V

Logic Threshold
Selectable between TTL (+1.4V) and Variable (−10V to +10V)

Maximum Input Voltage
±50V continuous

Hysteresis
100mV typical

Modes
Sample: Data stored is that prevailing at the active clock edge, provided that the specified set up and hold times are met.
Latch: As sample except, if any data transitions occur between successive active clock edges, the data stored at the second clock will be opposite to that stored at the first clock.

Data Skew
Typically better than 4ns between any two channels.

Minimum Pulse Width in Latch mode
15ns with 300mV threshold overdrive

CLOCK

Internal
Period selectable from 50ns (20MHz) to 250μs (4kHz) in a 1–2.5–5 sequence.
Crystal controlled.
Minimum pulse width to ensure sampling: one clock period + 25ns.

External
Frequency range DC to 20MHz
Minimum clock pulse width at threshold 23ns (high or low logic level)
Edge selectable to +ve or −ve
Data set up time to active clock edge 25ns min.
Data hold time after active clock edge 0ns min.

Qualifier
Selectable to qualify internal or external clock when high or low.
Set up time (true or false) to active clock edge 25ns min. Hold time after active clock edge 3ns min.

TRIGGER

Arming source
Selectable as internal (immediate on pressing the run key) or external +ve or −ve edge. No data will be recorded until the arm event has occured.
Delay from external arm 30ns max.

Trigger Word Recognition
Selectable to any combination (1, 0 or don't care) of 23 bits — 8 data and 15 trigger.
Trigger parameters may be entered in hex, octal or binary.

Trigger Position
Selectable to be at either start or end of store to enable post-trigger or pre-trigger data to be stored.

Trigger Hold Off Filter
Variable from 20ns to 500ns (asynchronous mode only).
In asynchronous mode triggering will occur when the selected combination of bits has been valid for a time greater than or equal to the setting of the trigger filter. In synchronous mode triggering will occur when the selected combination of bits is valid at the active clock edge, and the set up and hold time are satisfied.

Delay
Compound delay selectable as 0 to 59999 occurrences of the trigger word (events) followed by 0 to 59999 clocks.

Arm/Trigger Output
Rear panel BNC connector; TTL level. Negative edge at Arm followed by a +ve going pulse at each occurrence of the trigger event.
Delay from external arm event 50ns max.
Delay from trigger event async mode 60ns max.
Delay from trigger event sync mode 85ns max.

MEMORIES
Three memories are used to acquire, display and compare data.
Memory A. The high speed acquisition memory.
Memory D. The data memory.
Memory R. The reference memory.
All memories are 8 bits wide and 252 bytes deep. D is automatically loaded from A at the end of acquisition. R may be loaded from D or from the keyboard. The contents of either D or R may be displayed on the screen.

Reference Memory Operations
Stop if D = R. Repeat acquisitions are taken until the contents of D exactly match the data previously stored in R.
Stop if D ≠ R. Repeat acquisitions are taken until the contents of D do not exactly match the data previously stored in R.
Compare. 12 locations from D are compared on the screen with the corresponding 12 locations from R. The comparison starts at the current cursor position and differences are shown in reverse video.

DISPLAY

CRT
5" diagonal; high resolution. Display consists of 25 lines of 40 characters. Full ASCII character set including lower case and control characters. Acquisition parameters and system status permanently displayed in top 6 lines of screen.

Timing
All 252 memory locations displayed as waveforms indicating high and low logic levels. Expansions of x2, x4 and x8 available, the expanded portion being shown by a moveable window indicator. A movable cursor is provided, the position and word value of which is read out automatically.

State
24 sequential store locations are displayed starting from the current cursor position. The format is selectable as binary and ASCII or hex, octal and ASCII.
A word search facility is provided to allow any eight bit word to be quickly located in either D or R store.

GENERAL

Size
12 x 7 x 16½ inches (305 x 180 x 420mm) excluding handle.

Weight
20lb (9.1kg) including pods.

Supply
90–135V AC or 180–270 AC, switch selectable; 45–450Hz.

Operating Temperature Range
5°C – 40°C

Accessories
Two TA120P input pods
Instruction Manual
Mains lead
16, 28 and 40-way IC test clips
Accessory Carry Case

thandar
ELECTRONICS LTD
ELECTRONIC TEST & MEASUREMENT
London Road, St. Ives,
Huntingdon, Cambs PE17 4HJ.
Tel: St. Ives (0480) 64646 Telex 32250

Also available from the WR&E Catalogue.

NOTES FROM THE RADIO SHACK...

By Frank A. Baldwin

All times in GMT, bold figures indicate the frequency in kHz.

Radio 'Dx' listening is, for many, a source of great pleasure. By simply 'twiddling the dials' one can, from the comfort of an armchair, listen-in to every-day propaganda broadcasts from far-away lands that are racked by war or revolution, or to the happier broadcasting of less troubled nations.

If you own a decent 'amateur radio' receiver, the world becomes your oyster and you can, under the right conditions, listen to signals emmanating from any part of the globe. Hungary, the Philippines, Korea, Latin America and Australia are all a mere finger-touch away.

Of course, there is more to 'Dx' listening than simply tuning-in to 'every day' broadcasts, and most amateur radio enthusiasts have their own special areas of listening interest. For some, the 'amateur' bands offer the greatest pleasure, while for others, CB is THE thing. There are many other types of radio signal that can be picked up on a decent receiver, but to which it is illegal to listen in the UK without a special license, and we will not deal with such subjects in these pages.

Let's start this new series, then, by taking a quick look at the three 'legal' areas of listening interest.

AMATEUR BANDS

The Top Band, like all the other Amateur Bands, tends to be more exciting to me when diving under the surface to winkle out signals on the CW portions. The Donald Duck effects on the SSB sections somehow just don't appeal. To land the Dx you must first net the signal which, often as not, is mixed with others which are decidedly unwanted. Fishing around for an hour's session one evening, and an early morning period one Sunday, the following CW signals were hooked.

1800-2000 kHz

DJ2TI, DK5SO, DK 6AS, HB9NL, IR70NU, LA4O, OHONA, OK2BUX, OK2KZR, OL5BAH, OZ1LO, PA0DIN, PA0UU, RA1WCP, YU3EF, YU4FRS.

These were logged during the evening period, all between 1830 and 1850 kHz and from around 2030 GMT onward.

The early morning Sunday session produced the following CW signals, all between the 1805 to 1809 kHz trans-atlantic 'window'.

K1NBN, K4CNW, K4UEE, N1ACH, N4BP, N4IN, N4SU, N4WW, W1BB, W1CF, W1DEO, W1MX, W2FJ, WA2SPL and WB4UW.

All of which reminds me that many years ago I reported to a certain W3 the reception of his CW signals here in the East Anglian countryside early one Sunday morning. He had been very busy vainly calling several W6's, then apparently finally giving up in disgust. His letter to me was overflowing with gratitude to say the least - according to him I had saved his bacon down at his local club: they all reckoned his antenna (as he termed it) and his rig were NBG. He must have snorted with pride after that!

14000 - 14350 kHz

This was the only other Amateur Band I found the time to visit and then only for an hour early one evening. Twenty metres was for many years my favourite Dx hunting ground, albeit at the CW end. In the immediate post war years one was able to log some exotic stuff with comparative ease - but that was in the days before the Eastern Europeans flooded the market so to speak, when the C prefixed stations from China and the Su's from Egypt along with a lot more could be entered into the book, alas now now more.

I often wonder what became of my fellow enthusiasts in the Cairo Radio Club, in which city we used to meet twice a month towards the end of the SU period.

Enough of the nostalgia for the present, whilst I list the four calls I did manage to log. They were -HI3PC, PY4ADS, PY7HQ and, last but not least, VP9DR.

You will be reading more about Top Band capers and other band contortions next month.

BROADCAST BANDS

During the past month I have been locking on to various channels in attempts to identify several stations in response to a letter received from a Midlands reader. Great stuff this indentifiaction lark - provided the frequency given is within plus or minus 5 kHz and the time is GMT with some details such as interval signal or a time signal or language indication or a place-name or...

ETHIOPIA

"The Voice of Revolutionary Ethiopia" (that's what the man said) Addis Ababa on **9595** at 1900. After the interval signal a female announcer (YL) gave the station identification, this being followed by a male (OM) newsreader. The announced period of the English programme was from 1900 to 2000 and the target area South Africa. At 1909 drums were to the fore, then YL with a revolutionary rousing song, OM with identification again and then a news commentary.

This was a part of the ANC (African National Congress) programme but the station identification at 1926 was "Voice of Namibia", giving the address for reports as Programme Supervisor, Voice of Namibia, P.O. Box 1442, Addis Ababa. All of this according to my recorder -and I've played the tape through several times!

Whilst writing about African stations, I may as well continue with -

NIGERIA

Radio Kwara, Illorin on **7145** at 0605 - you'll have to get out of bed early for this one. OM with a newscast in English, mostly about local affairs. Illorin is located in Kwara State and is scheduled in English and local vernaculars from 0430 through to 2305.

MOZAMBIQUE

Maputo the captial, formerly Lourenco Marques, can be heard on **4925** with a little luck and the right conditions. Try around 2000 or so, logged here at 2010 with surprisingly little difficulty when a programme of choral folk songs was featured.

Mention of the South Atlantic reminds me of long summer days ploughing through this ocean standing up in the prow of the SS **Andes**, watching the flying fish scudder away ocean ahead only to plop back into the water some distance away. The crossing-the-line ceremony had been very amusing, fortunately I got a certificate without being lathered, shaved an uncermoniously dumped backwards into the swimming pool - I felt a bit of a fraud really - a certificate for nothing it seemed. After the delights (sic) of Sierra Leone, the prospect of more southern climes seemed attractive to say the least. The humid greenery of Freetown and locality - exotic as it was - was a bit much for my liking.

LIBERIA

ELWA ("Eternal Love Winning Africa") Monrovia may be heard on **4765** at 0656. Well, at least it is nearly an hour later than R. Kwara! A programme of UK made pops on records being followed at the time quoted with a newscast in English, mostly about African affairs. What about the eternal love etc? It is a cultural missionary service of the Sudan Interior Mission.

PHILIPPINES

FEBC (Far East Broadcasting Company) Manila on **9715** at 1310, OM and YL alternate with an English/Chinese language lesson in a programme directed to the mainland of China and scheduled from 1230 to 1615.

SPAIN

Madrid on **9765** at 1905, YL with "Press Review" followed by a weather report for Spanish regions - a lot better than we were sufferring at the time - all in the English programme for Europe, scheduled from 1900 to 2045.

Which brings to mind the times when I used to listen to the Falangist radio during the Spanish Civil War and even, on one occasion, managed to log a front line military transmitter sited somewhere in the vicinity of Burgos if I recall aright. I could even hear the lap, lap, lap of the hand generator. Following the war on a wall map issued by one of the British national dailies, complete with flags and pins - the map not the dailies - was quite a pastime in those days.

COLOMBIA

Radio Bucaramanga on **4845** at 0333, soft instrumental music with male chorus, all very dreamy stuff. It closed at 0357 with a choral rendition of the National Anthem.

SURINAM

SRS Paramaribo on **4850** at 0338, pop record, European-style, non-stop.

HUNGARY

Budapest on **11910** at 1030, YL with station identification and a newscast in the Enlgish programme for Australia, New Zealand and Japan. "Town and Gown", all about academic institutions in Hungary. The English programme is timed from 1030 to 1100.

TURKEY

Ankara on **9615** at 2115, YL with the English programme to Europe, all about Turkish scribes of old, long before the modern education system. The English transmission is scheduled from 2030 to 2130.

INDIA

If you would like to listen to a newscast from this country at a reasonable time - by that I mean not in the middle of the night - why not try **9950** at 1530 when both local and world news from AIR (All India Radio) Delhi may be logged. If you would care to test your gear and skill why not chase around for some of the parallel channels. Tune to **7280, 7412** and **10335** in rapid succession and see how you get on.

CITIZENS' BAND

What's this? CB! Well, why not -perhaps in the future no shack will be complete with out a rig and a twig.

Recently delving into the world of CB has brought quite a lot of pleasure, it all commenced with the acquisition of, firstly, a licence, then a rig followed, lastly by the erection of a twig. We are nothing if not legal so don't forget that small formality at the Post Office.

Having duly SWRed in the twig the next problem is the handle. What on earth does one use as a 'call-sign'. Listening to the locals prior to launching oneself into the C of CB does give one ideas. Around the immediate locality there are some colourful characters to say the least. Some I know personally and others only by listening on the various channels. All are undoubtedly good citizens. We have such handles as Speedy -he is one of the CB leaders, always ready to help another breaker solve his problems and also a first-aid practitioner of no mean repute; Nutmeg - and old submariner and the local firechief - much respected in the community. Then we have such handles as Storekeeper, Skylark, Chicken George, Tick-Tock, Tax Doger (he has my sympathy); Fisheye, Northern Lady; Ellapre (an Elvis Presley fan); Country Bumpkin, Star Bar and even Rubber Doll - oh dear!

With this gathering of enthusiasts, getting on the side and sliding into some of the conversations can be quite enlightening and not a little interesting. Some of the modulations are even educational. Just recently I have learned some facts about how and when to go fishing in the local river and other waterside localities; how and where to watch some wild life; local history galore not to mention the attributes and failing of various branded-name rigs and twigs.

Local clubs and gatherings are, apparently, a feature of the CBers life although I have'nt so far attended any. So - for all of us who have'nt yet had an eyeball over a few brown bottles at the local hotelry, we had better get on our skateboards and burn some rubber. Ten Ten till we do it again!

POSTSCRIPT

From this issue onwards, **R&EW** will be presenting regular 'amateur radio' features concerning band activities and general 'happenings' of interest on the airwaves. We invite contributions from interested parties. In the meantime, here is the news....

RALLY ROUND-UP

This month, the organizers of the Drayton Manor Mobile Rally are to be congratulated for their perspicacity in advising **R&EW** of the forthcoming event on April 25th, at Drayton Manor Park (A4091 near Tamworth, Staffs). Talk-in on 2m and 70cm, all the usual rally attractions plus 'side shows', refreshments, and Zoo (not squeakies in a cage, but monkeys and such like).

Forthcoming events: details nearer the time.

Lincoln Hanfest :	May 9th
Swindon Rally :	May 16th
East Suffolk :	May 30th

ORKNEY-CAITHNESS REPEATER GROUP

Plans to bring civilisation to North Britain, in the dubious shape of a 2m repeater, have been laid by the amateur community of those parts. GB3OC is scheduled to appear on Wideford Hill, near Kirkwall on mainland Orkney, and will serve stations on the North coast of Scotland, and Orkney. Donations and requests for further information (SAE please) to:
A.W. Wright GM3IBU,
18 Dundas Crescent, Kirkwall, Orkney.

MONDAY NIGHT IS RTTY NIGHT

The British Amateur Radio Teleprinter Group, herein after to be known as the BARTG, is endeavouring to establish Monday night as the main activity night for 2m operation.

RTTY fiends can also wallow in non-stop baudery from 0200 Saturday March 20th to 0200 Monday March 22nd in the BARTG HF Spring Contest. Details of this orgy of paper tape form HF contest supremo,
Ted Double, G8CDW,
89 Linden Gardens, Enfield, Middlesex, EN1 4DX.

A new VHF/UHF RTTY contest is due on 1800 Saturday April 3rd to 1200 Sunday 4th April, with 2m 70cm and 1296cm on offer. Take the LPF off your FT290 and do the lot in one go... G8APB, Chris Plummer, presides over this event, from 27a Thorn Lane, Four Marks, Nr Alton, Hants GU34 5XB.

GB3HB NEEDS YOUR HELP

The Mid-Cornwall 70cms repeater group are on the look out for subscribers to boost the flagging finances of this noble effort. Nigel Blackmore, G8ARH, at 10 Woodland Close, Lanivet, Bodmin PL30 5JF would appreciate any words of encouragement written on a £10 note (or two).

Your Reactions.........	Circle No.
Immediately Applicable	43
Useful & Informative	44
Not Applicable	45
Comments	46

DX-TV

Reception Reports

Compiled by Keith Hamer and Garry Smith.

AS THIS IS THE first article in our regular reception reports series, we will briefly explain, for the uninitiated, just what 'DX-TV' is. It is in fact a most interesting hobby in which enthusiasts around the world receive broadcast (as opposed to amateur) television transmissions from distant countries. During the summer months, British TV-DXers are able to receive signals from all over Europe, sometimes with good colour and clear sound. Normally, signals are received between May and September via the ionized "E" Layer located some 75 miles above the Earth. This mode of propagation is termed "Sporadic E" (abbreviated to Sp.E) and it is just that -sporadic. Reception from distant countries will be favoured while other countries will be either very weak or totally absent. Just as the enthusiast is about to take off-screen photographs for his personal records, the signal from, say, Portugal may well fade to be replaced by a bull fight from Spain or a news programme from Sweden!.

Until direct broadcasting by satellite arrives, reception from foreign countries will be the domain of DX-TV enthusiasts. This band of merry experimenters is fast-growing and there are now several books and publications available which deal with this fascinating subject. Readers to **R&EW** who would like to know more about DX-TV can write to the authors via the Editorial department.

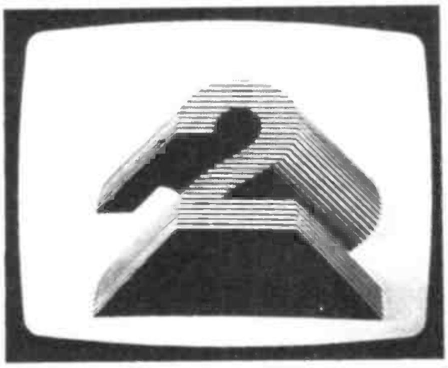
HOW IT WORKS

Apart from reception via Sp.E, signals can also arrive via tropospheric ducting (Trop), ionization of the F2-layer during sun-spot maxima (F2), trans-Equatorial skip (TE), lightning flashes, auroral reflections due to disturbances in the Earths's magnetic field (AB) and refelection from ionized trails caused by small meteors entering the Earth's atmosphere (MS, which is an abbreviation of Meteor Shower/Scatter).

Equipment for receiving distant signals does not have to be very elaborate. In fact good quality signals have been received from the USSR using nothing more than the most simple of aerials - a piece of wire. In order to cope with the various European transmission standards the television receiver must be either a modified UK set (modified from 405 lines VHF to 625 lines VHF and from the UK positive vision modulation system to the Continental negative vision system) or one of the several small-screen domestic receivers now available in high-street shops (such as the JVC CX-610 GB colour receiver, the Plustron CTV 55D colour set or the Plustron TVR 5D monochrome receiver).

WRITE TO US

TV-DXers are a friendly bunch (well, most) with a free-flow of information from enthusiasts throughout the world as we hope to show in this extravaganza each month. Off-screen photographs of test cards and captions will also be featured as an aid to signal identification so send your reports and photographs to us post-haste via **R&EW**: To induce you to contribute, we are holding a mini-competition - the one, and only, prize being a copy of the authors' book, "Guide To World-Wide Television Test Cards - Edition 2" which would normally set you back by £2.85. All you have to do is send in an interesting reception report together with good clear photographs of test cards or captions. The best entry (judged by yours truly) to be received within seven weeks of this article's publication will win. Entries from overseas will be most welcome. We would have liked the prize to be a three-week cruising holiday in the Caribbean, but we are in a recession after all! Now to the reception reports....

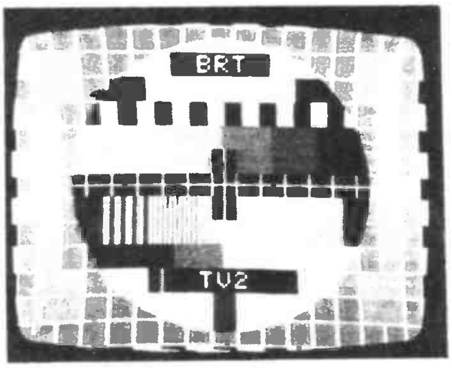


Dutch Second Network identification caption radiated by NOS.

From Czechoslovakia, Jaroslav Bohac has written with details of his recent reception via enhanced tropospheric conditions. Enthusiasts in the UK experienced extremely good conditions of January 13th and 14th with signals from West and East Germany, Belgium, France and the Netherlands due to an intense (1042 mb) high pressure system, or anti-cyclone, located over Eastern Europe. As the system moved eastwards the reception in the UK faded but on the 15th, it was Jaroslav's turn to receive some excellent signals including the West German transmitters of ZDF on channel E23 (from the transmitter at Hof) and E28 (Hofer Bogen), plus the ARD outlets on channel E42 (Bayerischer Rundfunk's third network from Regensburg), E51 (BR 3 -Spessart) and E43 (BR3 - Amberg). He also received the West German Suddeutscher Rundfunk (SDR-3) Trier transmitter on channel E48. East German (DDR:F) second network programmes on channel E34 from the Brocken tranmsitter were also received. We will be featuring some of Jaroslav's off-screen photographs next month.

Brian Renforth (Wiltshire) is logging some good DX signals with his Antiference 'Antrex' VHF Band I array plus an LP7 wideband Band III aerial (also Antiference) and a FUBA XC343 multiple director wideband Yagi UHF array which is positioned on a rotatable mast. At present, Brian is planning to replace the Band I aerial with a 3-element Telerection array and also the UHF beam by a Plemi 103-element type. With his present installation however, he is able to receive, on a regular basis, the following British regions: HTV Bristol (Mendip transmitter), HTV Cardiff (Wenvoe), TSW (Stockland Hill), TVS (Hannington) and Central Television (from the Oxford transmitter). When there is an improvement in trop, Brian can also receive Channel TV (Freemont Point), Anglia (Sudbury) and TVS South-East (Dover and Bluebell Hill transmitters). During the last Sp.E Season he received many European countries including Iceland (RUV), Finland (YLE) and Rumania (TVR). During the greatly enhanced trop 'opening' last January, strong signals from Sweden (SR) were logged from the UHF channel E30 outlet at Goteborg. The Philips PM5544 electronic test card was noted with the identification 'TV2' at the top and 'SVERIGE' at the bottom.

Finally this month, the extremely good trop opening noted here in the UK was also present in Australia (by sheer coincidence however). On January 14th Robert Copeman (Victoria) logged TNT 9 Launceston (Tasmania) which came in so strongly that it wiped out Robert's local station, GTV 9. It was the most spectacular trop opening that Robert has seen. Later in the month he logged three Australian channel 11 stations, namely ABGN 11 (Jerilderie, New South Wales), BTV 11 (Portland, Victoria) and the ABKT 11 station on King Island, Tasmania.



The Philips PM5544 electronic test card transmitted by BRT - Belgium's Flemish-language network. This was also received during the enhanced trop conditions of last January.

Your Reactions..........	Circle No.
Immediately Interesting	63
Possible application	64
Not interested in this topic	65
Bad feature/space waster	66

ELECTRONIC KITS

Velleman U.K. present their list of electronic kits together with prices which *include* V.A.T. and postage and packing. They are listed in "difficulty grades", for beginners *and* experienced kit-builders, with the lower skill level at 1, rising to 3. All include high-quality components, full instructions and technical data and come to you packaged in clear plastic boxes, ideal for component storage.

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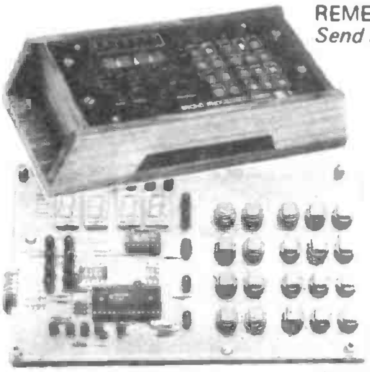
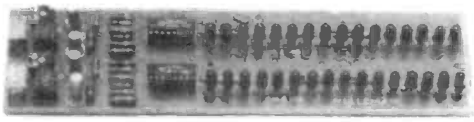
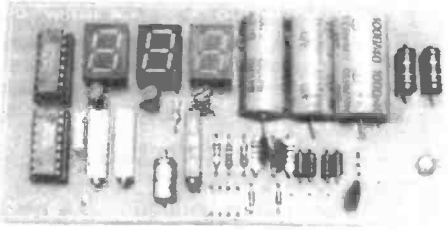


K1682

Wooden housing extra



K1798



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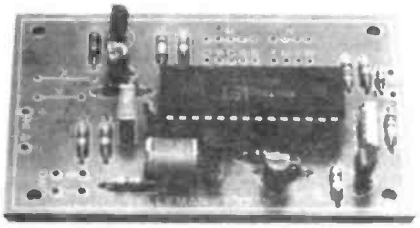

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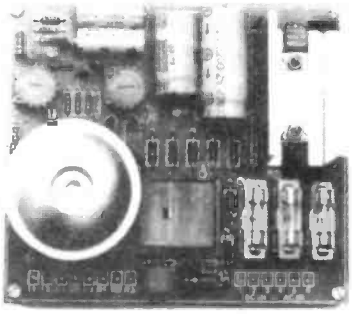

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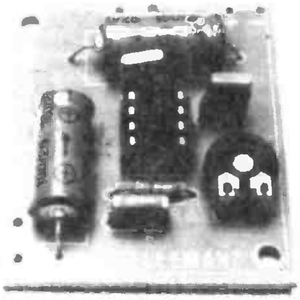

K2569

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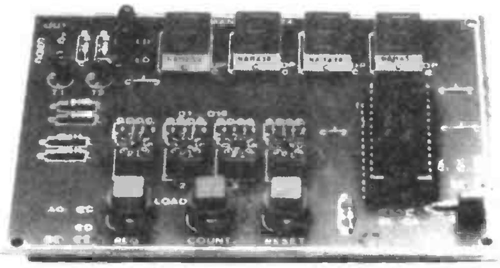

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Difficulty Grade: 2

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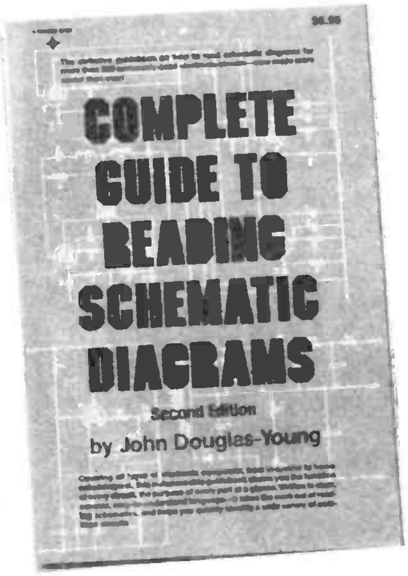
BOOKS OF THE MONTH

COMPLETE GUIDE TO READING SCHEMATIC DIAGRAMS

Second Edition by J Douglas-Young

303 pages; 150 x 230mm;
Spiral bound **£11.20**

This popular book is now in its second edition. With the rapid and far reaching developments in solid-state and integrated circuits the opportunity has been taken to include many important new circuits to add to the standard ones which are so essential.



The first chapter includes the Circuit Analyser, an important analytical tool that guides the reader to the part of the book containing specimen circuit diagrams and descriptions to compare with the circuit he is examining.

Subsequent chapters first give the basic circuit, with the distinctive features emphasised to enable to reader to identify it quickly e.g. whether it is an amplifier or an oscillator; a brief description of the circuit then follows. The reader is shown how to break the circuit down into subcircuits and the function of each component is explained and how a defect in it might affect its operation.

Finally there is a very comprehensive Appendix containing charts, conversion tables, equations, definitions and a complete listing of the new SI units of the metric system. The book as a whole forms a useful guide to troubleshooting.

DIGITAL LOGIC DESIGN AND APPLICATIONS

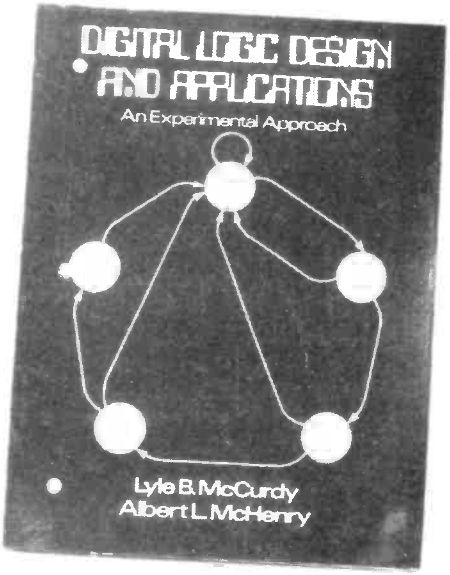
By L B McCurdy and A L McHenry

1981; 122 pages; 210 x 280mm;
Paperback **£9.70**

This is a laboratory manual which has been developed to provide experiments in applied logic network and design.

Altogether there are 22 experiments. Each one commences with an introductory paragraph which outlines the purpose of the experiment and this is followed by a brief introduction and a listing of the components used. The procedure of the experiment is then outlined.

To assist readers in demonstrating their understanding of the logic and or laboratory concepts, a number of questions have been included at the end of the analysis-type experiments.



The book is basically divided into four sections. The first section introduces the basic logic circuits using discrete components and develops their logical operations. The second section develops the theoretical and conceptual aspects of combinational logic design and application. The third introduces readers to basic flip-flop devices and their characteristics. The final section has been included to provide advanced level experiments in digital and analog-digital subsystem design.

The Appendix includes a most useful 5 page Formal Laboratory Report Writing Guide for the benefit of students and others.

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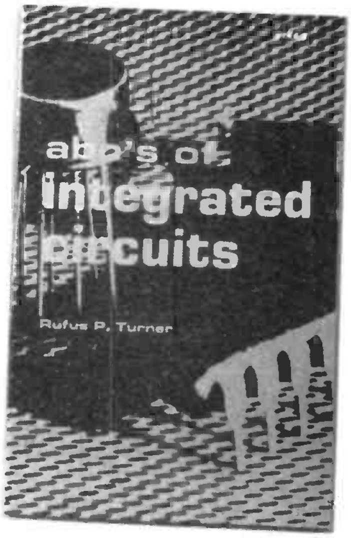

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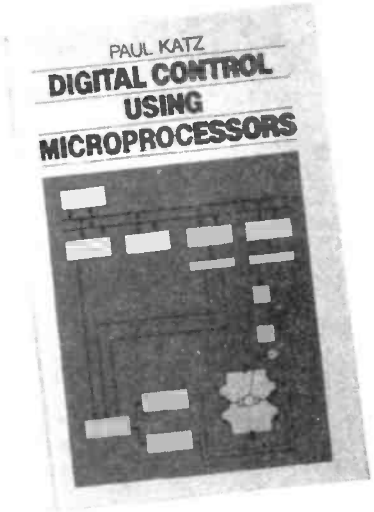

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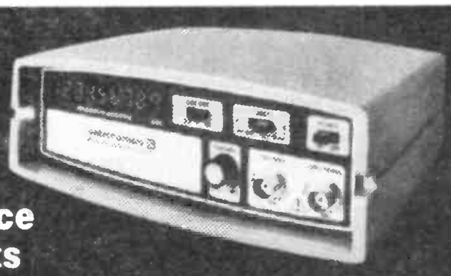

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