APRIL 1982

ISSN 0262–2572

RADIO & ELECTRONICS WORLD

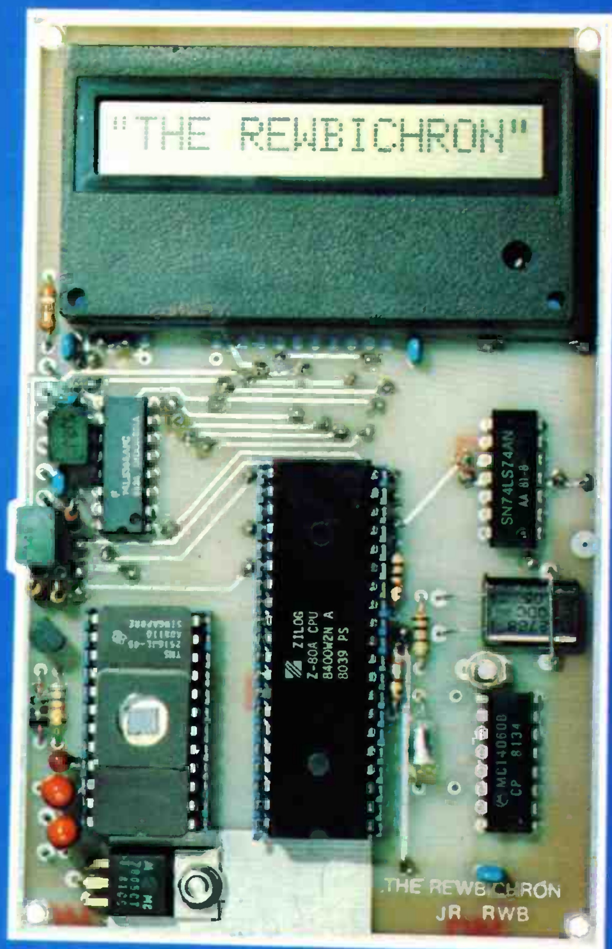
70p

Projects

MSF Clock
Radiation Monitor
Key-Pad Lock
2M Preamp

Reviews

C58 Transceiver
Vic 20
Levell TG301



Features

CB Radio Reviewed
ASCII LCD Display
Metal Detectors in Medicine
Z8 Computing Board

"Give me one good reason why I should choose a VIC 20 home computer."

1. VIC is outstanding value for money. No other colour home computer can give so much for under £200.

2. Total standard memory 25K made up of 20K ROM and 5K RAM.

3. Fully expandable to 32K of user RAM.

4. Microsoft Basic interpreter as standard.

5. Accessible machine language as standard.

6. Connects direct to monitor or standard television.

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9. All colours directly controllable from the keyboard.

10. 62 predefined graphic characters direct from the keyboard.

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15. Automatic repeat on cursor function keys.

16. User-definable input/output port.

17. Machine bus port for memory expansion and ROM software.

18. Standard interfaces for hardware peripherals.

19. VIC 20 is truly expandable into a highly sophisticated computer system with a comprehensive list of accessories (see panel below).

20. Full range of software for home, education, business and entertainment on disk, cassette and cartridge.

21. Books, manuals and learning aids from Teach Yourself Basic to the VIC programmers' reference guide (a must for advanced programmers).

22. Full support for VIC owners – their own magazine 'VIC Computing' as well as a national network of VIC user groups.

23. National dealer network providing full service and support to VIC owners.

24. Expertise and experience – Commodore are world leaders in microcomputer and silicon chip technology.

25. Commodore is the leading supplier of micro-computers in the UK to business, schools, industry and the home.

26. VIC 20 is the best-selling colour home computer in the UK.

How many reasons was it you wanted?

Accessories include:

- Cassette tape unit.
- Single drive 5¼" floppy disk unit (170 K bytes capacity).
- 80-column dot matrix printer.
- 3K, 8K and 16K RAM expansion cartridges.
- Programming aid packs; machine code monitor cartridge, programmers' aid cartridge, high resolution graphics cartridge.
- Plug-in conversion box for a full 32K, 40-column x 25 lines VIC including Prestel compatability.
- Prestel/Tantel interface package.
- RS 232C communication cartridge.
- Memory expansion board
- IEEE/488 interface cartridge.
- Joysticks, light pens, paddles and motor controllers.

commodore

VIC 20

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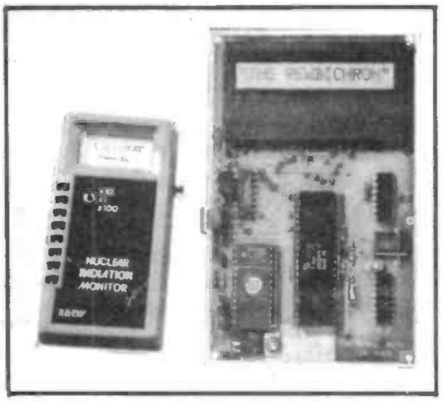
FOR MORE INFORMATION ON THE VIC 20, TELEPHONE OR WRITE TO: COMMODORE INFORMATION CENTRE, BAKER STREET, HIGH WYCOMBE, BUCKS, OR TEL: SLOUGH 79292.



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RADIO & ELECTRONICS WORLD

Volume 1. No.7*
APRIL 1982

Projects

Reviews

News

Features

Information

BACK ISSUES: Don't forget, back issues, of R&EW can be obtained from our subscription department at 95p each, inc postage. Use the reply paid card/order form or send a cheque/PO.

TECHNICAL QUERIES: While we always try to help readers in difficulties with **R&EW** projects, we cannot offer advice on modifications to our designs, nor on non-**R&EW** projects or products. Telephoned queries will only be accepted between 2.00-5.30pm on Thursdays. Written queries MUST contain a stamped self-addressed envelope and must deal with only one project.

*The best explanation for there being two 'No.7' issues will receive the three issues numbered '8'.

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
DC1	12 volt adapter pack	8 40
HM9	Speaker microphone	12 00
CP1	Mobile charging lead	3 20
IC123	cases each	3 60

All prices include VAT

The IC4E is going to revolutionise 70 CM!

ICOM

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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.

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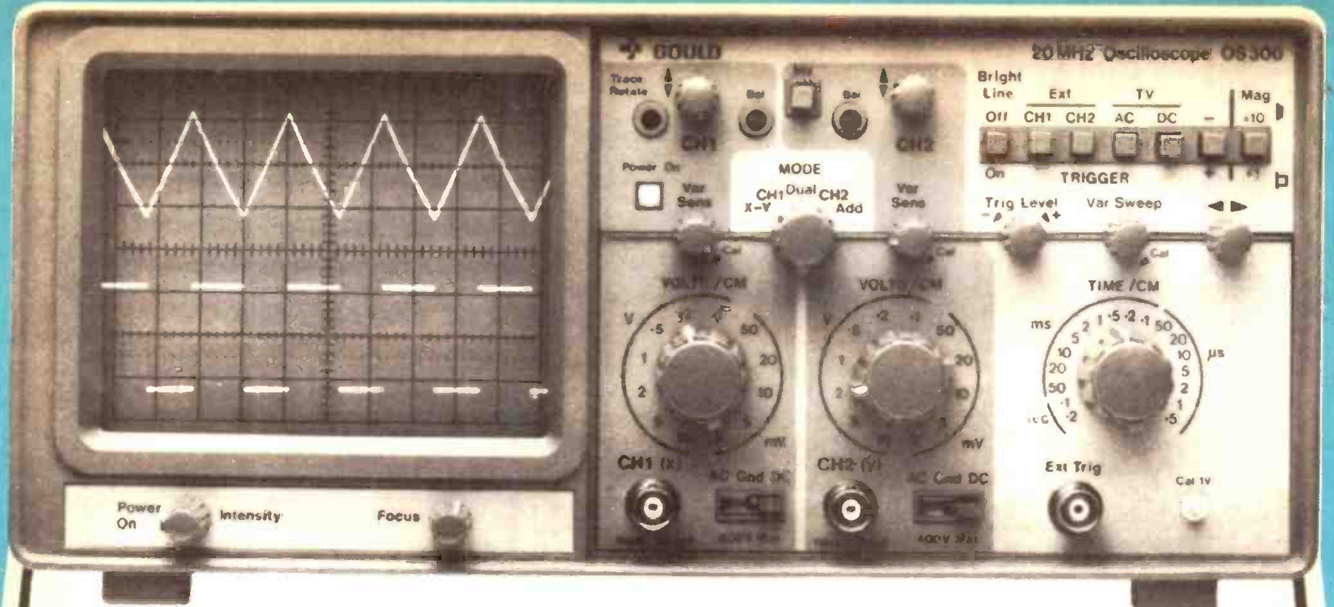
GOULD OSCILLOSCOPES SET A HIGHER STANDARD



The new Gould OS300 Dual Trace 20MHz 'Scope

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MYERS ELECTRONICS, 12 HARPER STREET, LEEDS LS2 7EA.
Telephone Leeds 452045.

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EDITORIAL

Another R&EW Triumph!

Regular readers of this column will recall from our February edition that we were on the look-out for someone "keen on radio/electronics and tolerably literate", to join our editorial team. Well, we've had a bit of a triumph here, because within a week of that issue hitting the bookstalls we had a call from Gary Evans (yes, THE Gary Evans), who just happens to be one of the finest technical journalists/design engineers around, and is also widely regarded as one of the UK's leading computing experts.

When Gary arrived at our offices we pulled a rather dirty trick on him. We took him out for a slap-up meal, plied him with plenty of booze (in the best journalistic tradition) and then, when he wasn't quite sure what day of the week it was, conned him into signing a contract to join us as our Assistant Editor. Sneaky?

A Touch of History

Gary has had a rather interesting career. In the mid 1970's he joined the editorial staff of Electronics Today International (ETI) magazine, which was then (and still is) one of the best technical journals around. Within a couple of years he became Projects Editor of ETI. In 1979 he became the first Editor of Computing Today, which at that time also showed great promise of eventually becoming a good magazine.

And then, at the ripe old age of twenty-four, Gary suddenly developed a severe case of itchy feet, coupled with an inexplicable feeling that life was 'passing him by'. So he resigned from the publishing world and promptly set off on a journey that can aptly be described as "Evans' Travels", which lasted for the next three years.

Gary's travels took him round the world several times. He stopped off in the States for a while, to give the Americans some help with their space programme. He paused in Australia for a few months, to do a little gold prospecting. He got shot at in Angola. He occasionally returned to the UK where, amongst other things, he at one stage worked on a hush-hush defence contract, and on another, drove a bus for Cardiff Council.

Back to the Present

That brings us back to the present time and Gary has already settled comfortably into his new 'Assist, Ed' chair at the **R&EW** offices. We are sure that his publishing expertise will be a great asset. Mind you, we are aware that there is a risk of him trying to pass on some BAD publishing habits, so we've warned him that we will NOT be publishing pictures of Chieftain tanks, Spitfire fighters or Wellington bombers in OUR electronics magazine!

Inflation Strikes Again

To allow for the increased postal costs resulting from the increased magazine weight, we have increased our subscription fee by 50 pence (to £10) as from this issue.

The latest news on the 'subscriptions' front is that we hope to be increasing the size of of **R&EW** by ANOTHER sixteen pages in the near future (probably about June or July), and when that happens, we may have to increase the subscriptions fee by quite a large amount. So, if you dive in fast, you can beat inflation by taking out a subscription now, before the proposed new costs come into effect.

Practising what you preach

The Sony 'Typecorder' personifies the year of 'Information Technology'. It is significant that **R&EW** should be experimenting with this communication medium to bring our readers closer to the very latest innovations and the means of expediting the written word - if ever there was a publication at the heart of information technology, the **R&EW** is surely it (or should that read 'IT' ?).

It is also significant that the other 'end' of the first transatlantic 'Typecorder' conversation should be one of Wayne Green's publications: in a world of anonymous publishers, Wayne is still very much an innovator and individualist who is prepared to speak/write his mind. We like to think that Wayne is one of the more interesting alternatives to the 'reader fodder' churned out by the major publishing groups on both sides of the Atlantic.

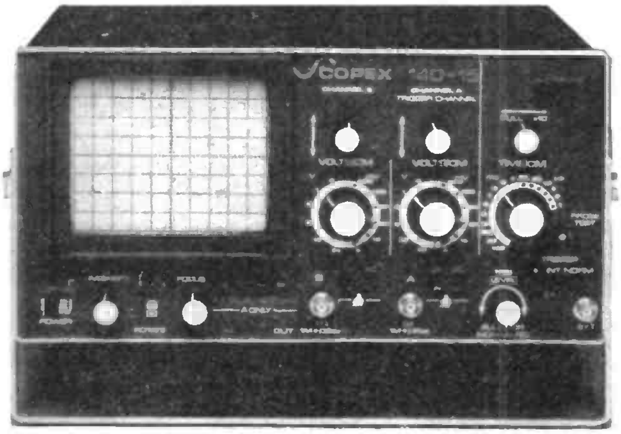
A myriad of solutions looking for problems.

Now that **R&EW** Z.8 development system has been unleashed, we are beginning to provide a programmer's eye view of its capabilities. We have been enormously encouraged by the enthusiastic reception from industry and educationalists, and feel that many people have recognized the system for what it is: the first *easily* programmable on-chip Microcomputer solution in the world. We are grateful to Zilog for their assistance and ecouragement in getting this project under way.

Whilst we are compiling a series of projects based on dedicated applications of the system, we are very anxious that our readers should put forward some of their own ideas and programmes. We are offering free development boards (as well as standard author's rates) for published applications - so don't forget to write.

Ray Marston.

NEW PRODUCTS



Increased Scope

The 14D15 is the latest addition to the Scopex range of oscilloscopes. Evolved from the popular 14D10 series the new 'scope is a 15 MHz dual trace model incorporating push button X—Y, add and invert facilities, probe compensation and an active TV sync separator as standard features.

The 14D15 costs £250 + VAT a price that includes two probes and carriage to anywhere in the UK mainland.

Scopex Instruments Ltd,
Pixmore Avenue,
Letchworth,
Herts SG6 1JJ. *No. 260*

Apple Plug-In Modules

The North West Instrument Systems Model 85 is a fully programmable digital memory oscilloscope unit retailing at $995. The two channel 50 MHz instrument with disk storage (operating software is contained on a single 5¼ inch minifloppy) occupies two peripheral slots on the Apple II.

The unit comprises of two PCBs enclosed within a metal case and the entire module barring the two probes, fits within the Apple.

Input signals are sampled by a high speed sample and hold circuit before A-D (8 bit) conversion. Waveforms may be stored in disk memory for later display or use in extensive calculations.

The Model 85's vertical gain, sweep speed, trigger level and other functions are all programmable.

Excellent sensitivity and accurate time base and vertical scale calibration, amongst other features, mean that the device in conjunction with an Apple II computer can meet the demands of high-performance signal acquisition instruments, at a far lower cost.

The US price is $995, UK shipping charges, taxes etc. will be extra. Details from:

Northwest Instrument Systems Inc.
PO Box 1309,
Beaverton,
OR 97075
USA *No. 249*

Filter Range

A new range of filters and CB accessories has been recently launched by AKD. The range, called the 'Blackline' series comprises a car FM radio booster, CB notch filter for TV or car, CB FM radio booster with combined CB notch filter, high pass filter for UHF TV and a CB signal booster for receive. All carry a 2 year guarantee.

Armstrong Kirkwood Dev.,
10 Willow Green,
Grahame Park Estate,
Hendon NW9 5GP.
Tel: 01-205-4704. *No. 261*

New Spec. PPMs

Surrey Electronics, long known for their range of meters and PPM drive units, have just released a new specification sheet. One of the products described is the PPM3 drive circuit.

The PPM3 is intended for monitoring unbalanced signal lines although the addition of a 1:1 transformer will provide a balanced input. Three non-interactive 20 turn presets for zero, FSD and gain adjustments are provided together with a sealed single turn preset for precise setting at mark 1.50. The boards maintain a flat frequency response and do not suffer from loss of accuracy or zero drift even in high radio frequency fields. Each board can drive two meter movements. The spec. sheet provides details of Ernest Turner meters.

The Ernest Turner range of meters provide movements with well defined ballistics, a feature that is essential if transient signals are to be accurately displayed. The meters, available as single movements (in three sizes) or twin versions, may be illuminated with festoon lamps.

The PPM3 costs £45 as a ready built unit, £28 as a kit. Ernest Turner meters cost from £25.

Surrey Electronics,
The Forge,
Lucks Green,
Cranleigh,
Surrey. *No. 253*

Meter Range

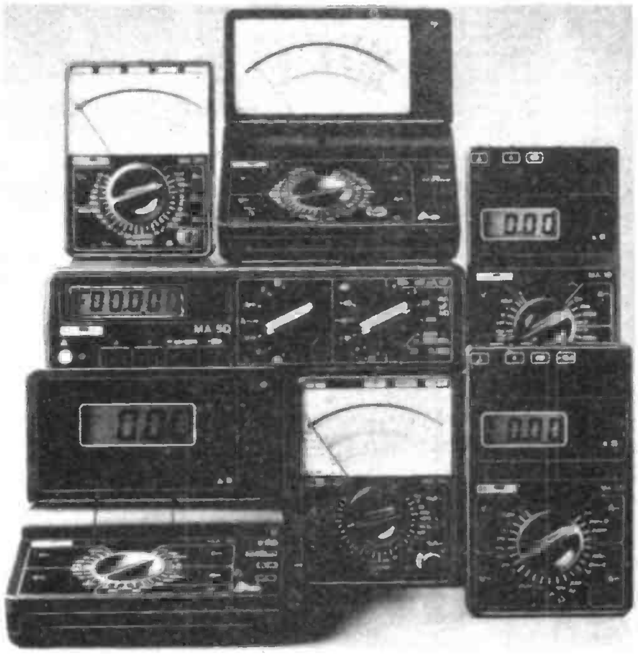
A range of multimeters manufactured by the BBC (that's the Brown Boveri Corporation) is now available from the House of Instruments. The range comprises three digital and three analogue types all featuring a large clear display. The meters are supplied complete with batteries, test leads and most with a carrying case.

The MA 1D and MA 2D are 3½ digit LCD hand held meters with the MA 1H and MA 2H as their lower priced equivalents.

The MA 3D and MA 3E are designed with the display, digital or analogue, forming an integral part of the meters case lid. This allows the display angle to be adjusted to suit any application and means that, when closed, the model forms its own robust carrying case.

Also in the range is the MA 5D bench model featuring a 4½ digit display with, as well as the usual voltage/current etc. ranges, the ability to measure capacitance.

Quiswood Ltd,
30 Lancaster Road,
St Albans,
Herts AL1 4ET *No. 248*



The Interfaker

In theory all datacomms devices should be plug compatible but as we know this is often far from true in practice. The Interfaker from Modular Technology will help find out why machines aren't talking to each other and will enable lines to be patched so that they do.

The module plugs into the system bus and a row of DIL switches allows each line to be broken and in conjunction with the built in logic probe allows the state of each to be investigated. A patch panel and jump leads allow lines to be rerouted when what's what and where it should go is sorted out.

The unit is powered by a single 9V battery and features a charger jack to facilitate the use of Ni-cads.

Modular Technology, *No. 252*
PO Box 117,
Watford,
Herts WD1 4PD Tel: 01-421-0626

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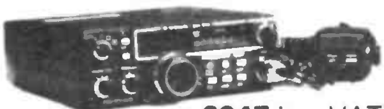


£247 inc. VAT

TRIO		£	Carr.
TS830S	160-10m Transceiver 9 Bands	694.00	(—)
VFO230	Digital V.F.O. with Memories	216.00	(2.00)
AT230	All Band ATU/Power Meter	119.00	(2.00)
SP230	External Speaker Unit	34.96	(1.50)
DFC230	Dig. Frequency Remote Controller	179.00	(1.50)
YK88C	500Hz CW Filter	29.60	(0.50)
YK88CN	270Hz CW Filter	32.66	(0.50)
TS130S	8 Band 200W Pep Transceiver	525.00	(—)
TS130V	8 Band 20W Pep Transceiver	446.00	(—)
VFO120	External V.F.O.	85.00	(1.50)
TL120	200W Pep Linear for TS120V	144.00	(1.50)
MB100	Mobile Mount for TS130/120	17.00	(1.50)
SP120	Base Station External Speaker	23.00	(1.50)
AT130	100W Antenna Tuner	79.00	(1.50)
PS20	AC Power Supply – TS130V	49.46	(2.50)
PS30	AC Power Supply – TS130S	86.50	(5.00)
MA5	5 Band Mobile Aerial System	86.00	(5.00)
MC50	Dual Impeadance Desk Microphone	25.76	(1.50)
MC35S	Fist Microphone 50K ohm IMP	13.80	(0.75)
MC30S	Fist Microphone 500 ohm IMP	13.80	(0.75)
LF30A	HF Low Pass Filter 1kW	17.90	(0.75)
TR9000	2M Synthesised Multimode	389.00	(—)
BO9	Base Plinth for TR9000	34.90	(1.50)
TR7800	2M Synthesised FM Mobile 25W	284.00	(—)
TR7730	2M Synthesised FM Compact Mobile 25W	247.00	(—)
TR2300	2M Synthesised FM Portable	166.00	(—)
VB2300	10W Amplifier for TR2300	58.00	(1.50)
MB2	Mobile Mount for TR2300	17.71	(1.50)
RA1	Flexible Rubber Antenna for TR2300	6.90	(0.50)
TR2400	2M FM Synthesised Handheld	198.00	(—)
SMC24	External Speaker/Microphone for 2400	13.40	(1.00)
ST1	Base Stand and Quick Charger	46.00	(1.50)
BC5	12V Quick Charger	18.40	(1.00)
SC3	Soft Carrying Case Plus Belt Hook	11.50	(0.50)
PB24	Spare Battery Pack and Charger Lead	15.87	(0.75)
TR8400	70cm FM Synthesised Mobile Transceiver	334.00	(—)
PS10	Base Station Power Supply for 8400	64.00	(2.00)
TR9500	70cm Synthesised Multimode	449.00	(—)
R1000	Synthesised 200KHz-30MHz Receiver	297.00	(—)
SP100	External Speaker Unit	26.90	(1.50)
HC10	Digital Station World Time Clock	58.80	(1.50)
HS5	Deluxe Headphones	21.85	(0.75)
HS4	Economy Headphones	10.36	(0.75)
SP40	Mobile External Speaker	12.40	(1.50)

ICOM			
IC730	HF Mobile Transceiver 8 Band	586.00	(—)
IC720A	HF Transceiver & Gen. Cov. Receiver	883.00	(—)
PS15	Power Supply for 720A	99.00	(3.00)
IC251E	2M Multimode Base Station	499.00	(—)
IC25E	2M Synthesised Compact 25W Mobile	269.00	(—)
IC290E	2M Multimode Mobile	366.00	(—)
IC2E	2M FM Synthesised Handheld	169.00	(—)
IC L1/2/3	Soft Cases	3.50	(0.50)
IC HM9	Speaker/Microphone	12.00	(0.75)
IC BC30	230V AC Base Charger and Hod	39.00	(1.50)
IC BC25	230V AC Trickle Charger	4.26	(0.75)
IC CP1	Car Charging Lead	3.20	(0.50)
IC BP2	6V Nicad Pack for IC2E	22.00	(1.00)
IC BP3	9V Nicad Pack for IC2E	17.70	(1.00)
IC BP4	Empty Case for 6 x AA Nicads	5.80	(0.75)
IC BP5	11.5V Nicad Pack for IC2E	30.50	(1.00)
IC DC1	12V Adaptor Pack for IC2E	8.40	(0.75)
IC ML1	10W Booster	49.00	(1.00)

TV INTERFERENCE AIDS

Ferrite Rings 1½" dia. per pair	0.80	(0.20)
Toroid Filter TV Down Lead	2.00	(0.50)
Low Pass Filter LP30 100W	3.95	(0.50)
Trio Low Pass Filter LF30A 1kW	17.90	(0.75)
Yaesu Low Pass Filter FF501DX 1kW	22.25	(0.75)
HP4A High Pass Filter TV Down Lead	5.95	(—)

ANTENNA BITS

H1-Q Balun 1:1 5kW pep (PL259 Fitting)	9.95	(0.75)
T Piece Polyprop Dipole Centre	1.00	(0.20)
Ceramic Strain Insulators	0.40	(0.10)
Small Egg Insulators	0.40	(0.10)
Large Egg Insulators	0.50	(0.10)
75 ohm Twin Feeder – Light Duty-Per Meter	0.16	(0.02)
300 ohm Twin Feeder – Per Meter	0.14	(0.02)
URM67 Low Loss 50 ohm Coax-Per Meter	0.60	(0.20)
UR76 50 ohm Coax-Per Meter	0.26	(0.05)

Please send total postage indicated. Any excess will be refunded.

MICROWAVE MODULES			
MMT144/28	2M Transverter for HF Rig	99.00	(—)
MMT432/28S	70cm Transverter for HF Rig	149.00	(—)
MMT432/144R	70cm Transverter for 2M Rig	184.00	(—)
MMT70/28	4M Transverter for HF Rig	115.00	(—)
MMT70/144	4M Transverter for 2M Rig	115.00	(—)
MMT1296/144	23cm Transverter for 2M Rig	184.00	(—)
MML144/25	2M 25W Linear Amp (3W I/P)	59.00	(—)
MML144/40	2M 40W Linear Amp (10W I/P)	77.00	(—)
MML144/100S	2M 100W Linear Amp (10W I/P)	129.00	(—)
MML432/20	70cm 20W Linear Amp (3W I/P)	77.00	(—)
MML432/50	70cm 50W Linear Amp (10W I/P)	119.00	(—)
MML432/100	70cm 100W Linear Amp Meter	228.64	(—)
MM2000	RTTY to TV Converter	169.00	(—)
MM4000	RTTY Transceiver	269.00	(—)
MMC50/28	6M Converter to HF Rig	27.90	(—)
MMC70/28	4M Converter to HF Rig	27.90	(—)
MMC144/28	2M Converter to HF Rig	27.90	(—)
MMC432/28S	70cm Converter to HF Rig	34.90	(—)
MMC432/144S	70cm Converter to 2M Rig	34.90	(—)
MMC435/600	70cm ATV Converter	27.90	(—)
MMK1296/144	23cm Converter to 2M Rig	59.80	(—)
MMD050/500	500MHz Digital Frequency Meter	69.00	(—)
MMD600P	600MHz Prescaler	23.00	(—)
MMDP1	Frequency Counter Probe	11.50	(—)
MMA28	10M Preamp	14.95	(—)
MMA144V	2M RF Switched Preamp	34.90	(—)
MMF144	2M Band Pass Filter	9.90	(—)
MMF432	70cm Band Pass Filter	9.90	(—)
MMS1	The Morse Talker	115.00	(—)

DATONG PRODUCTS			
PC1	General Coverage Converter HF on 2M Rig	120.75	(—)
VLF	Very Low Frequency Converter	25.30	(—)
FL1	Frequency Agile Audio Filter	67.85	(—)
FL2	Multi-mode Audio Filter	89.70	(—)
ASP/B	Auto RF Speech Clipper (Trio Plug)	79.35	(—)
ASP A	Auto RF Speech Clippers (Yaesu Plug)	79.35	(—)
D75	Manually controlled RF Speech Clipper	56.35	(—)
RFC/M	RF Speech Clipper Module	26.45	(—)
D70	Morse Tutor	49.45	(—)

AD270	Indoor Active Dipole Antenna	37.95	(—)
AD370	Outdoor Active Dipole Antenna	51.75	(—)
MPU1	Mains Power Unit	6.90	(—)

MORSE EQUIPMENT			
MK704	Squeeze Paddle	10.50	(0.50)
HK707	Up/Down Key	10.50	(0.50)
HK704	Deluxe Up/Down Key	14.50	(0.50)
EKM1A	Practise Oscillator	8.75	(0.50)
EK121	Elbug	29.95	(0.50)
EKM 12A	Matching Side Tone Monitor	10.95	(0.50)
EK150	Electronic Keyer	74.00	(—)

ROTATORS			
KR250	Kenpro Lightweight 1-1½" mast	44.95	(2.00)
Hirschman	RO250 VHF Rotor	49.95	(2.00)
9502B	Colorotor (Med. VHF)	49.95	(2.00)
KR400RC	Kenpro (HF) Complete with Lower Clamps	99.95	(2.50)
KR600RC	Kenpro (Med HF) Complete with Lower Clamps	139.95	(3.00)

DESK MICROPHONES

SHURE 444D Dual Impeadance	29.95	(1.50)
SHURE 526T Mk II Power Microphone	39.95	(1.50)
ADONIS AM502 Compression Mic 1 O/P	39.00	(—)
ADONIS AM601 Compression Mic + Meter 1 O/P	49.00	(—)
ADONIS AM 802 Compression Mic + Meter 3 O/P	59.00	(—)

MOBILE SAFETY MICROPHONES

ADONIS AM 202S Clip-on	20.95	(—)
ADONIS AM 202F Swan Neck + Up/Down Buttons	30.00	(—)
ADONIS AM 202H Head Band + Up/Down Buttons	30.95	(—)
DAIWA RM940 Infra Red Link	45.00	(0.75)

HAND MICROPHONES

T.A. 600 Fist Mic.	4.95	(0.50)
Power Mic. Wide Impeadance	9.95	(0.75)
TRIO MC30/35 600/50K IMP	13.80	(0.75)
YAESU YE7A/YD846 600/50K IMP	5.75	(0.75)
SHURE 201 High IMP. Quality Mic.	14.50	(0.75)

TEST EQUIPMENT

Drae VHF Wavemeter 130-450MHz	24.95	(—)
FXI Wavemeter 250MHz MAX	33.00	(0.75)
DM81 Trio Dip Meter	60.00	(0.75)
MMD50/500 Microwave Modules Frequency Counter	69.00	(0.75)

YAESU			
FT902DM	160-10m 9 Band Transceiver	885.00	(—)
FC902	All Band A.T.U.	135.00	(1.50)
SP901	External Speaker	31.00	(1.50)
FT101Z	160-10m 9 Band Transceiver (FM)	590.00	(—)
FT101ZD	160-10m 9 Band Transceiver (FM) Digital R.O.	665.00	(—)
DCT101Z	DC/DC Power Pack	42.55	(1.50)
FAN101Z	Cooling Fan for 101Z/ZD	13.80	(0.75)
FT707	8 Band Transceiver 200W Pep	569.00	(—)
FT707S	8 Band Transceiver 20W pep	485.00	(—)
FP707	Matching Power Supply	125.00	(5.00)
FTV707R(2)	Transverter – 2M	198.00	(—)
FV707DM	Digital V.F.O.	186.00	(—)
FC707	Matching A.T.U./Power Meter	85.00	(1.00)
MR7	Metal Rack for FT707	15.70	(1.00)
MMB2	Mobile Mounting Bracket for FT707	16.10	(1.00)
FRG7	General Coverage Receiver	189.00	(—)
FRG7700	200KHz-30MHz Gen. Coverage Receiver	329.00	(—)
FRG7700M	As above but with Memories	409.00	(—)
FRT7700	Antenna Tuning Unit	37.00	(1.00)
FT208R	2M FM Synthesised Handheld	209.00	(—)
FT708R	70cm FM Synthesised Handheld	219.00	(—)
NC7	Base Trickle Charger	26.85	(1.30)
NC8	Base Fast/Trickle Charger	44.10	(1.50)
NC9C	Compact Trickle Charger	8.00	(0.75)
FBA2	Battery Sleeve for use with NC7/8	3.05	(0.50)
FNB2	Spare Battery Pack	17.25	(0.75)
PA3	12V DC Adaptor	13.40	(0.75)
FT480R	2M Synthesised Multimode	379.00	(—)
FT780R	70cm Synthesised Multimode (1.6MHz Shift)	459.00	(—)
FP80	Matching 230V AC Power Supply	63.00	(1.50)

• AS REVIEWED •

FT290R	2M Portable Synthesised Multimode	249.00

MM811	Mobile Mounting Bracket	22.25	(1.00)
CSC1	Soft Carrying Case	3.45	(0.75)
NC11C	240V AC Trickle Charger	8.00	(0.75)
FL2010	Matching 10W Linear	64.40	(1.20)
Nicads	2.2 AMP HR Nicads Each	2.50	(—)
FL2100Z	160-10m 1200 Watt Linear	425.00	(5.00)
FF501DX	H.F. Low Pass Filter 1kW	23.00	(0.75)
FSP1	Mobile External Speaker 8 ohm 6W	9.95	(0.75)
YH55	Headphones 8 ohm	10.00	(0.75)
YH77	Lightweight Headphones 8 ohm	10.00	(0.75)
QTR24D	World Clock (Quartz)	28.00	(0.75)
YM24A	Speaker/Mic 207/208/708	16.85	(0.75)
YD148	Stand Microphone Dual IMP 4 Pin Plug	21.10	(1.50)
YM34	As 148 but 8 Pin Plug	21.45	(1.50)
YM38	As 34 but up/down Scan Buttons	22.60	(1.50)

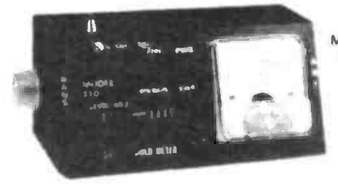
FDK VHF/UHF EQUIPMENT			
Multi 700EX	2M FM Synthesised 25W Mobile	199.00	(—)
Multi 750E	2M Multimode Mobile	289.00	(—)
Expander	70cm Transverter for M750E	219.00	(—)

STANDARD VHF/UHF			
C78	70cm FM Portable	219.00	(—)
CPB78	10W Matching Linear	67.50	(1.50)
C58	2M Multimode Portable	239.00	(—)
CPB58	25W Matching Linear	79.50	(1.50)
CM8	Mobile Bracket	19.96	(1.00)
CL8	Soft Carrying Case	6.95	(0.75)
C12/230	Charger	7.59	(0.75)

DRAE POWER SUPPLIES

All with Over-Volts – Current Limit and Thermal Protection

4 AMP	27.95	(1.50)	12 AMP	69.00	(2.00)
6 AMP	44.95	(2.00)	24 AMP	99.00	(3.00)



MODEL 110

SWR – POWER METER			
Model 110	H.F./2M Calibrated Power Reading	11.50	(0.50)
SWR25	H.F./2M Twin Meter	11.50	(0.50)
UH74	2M/70	14.30	(0.50)
WELZ SP15M	H.F./2M 200W	29.00	(0.75)
WELZ SP200	H.F./2M	59.00	(0.75)
WELZ SP300	H.F./2M/70	79.00	(0.75)
WELZ SP400	2M/70	59.00	(0.75)
DAIWA SW110A	H.F./2M	36.00	(—)
DAIWA CN620A	H.F./2M Cross Pointers	52.80	(—)
DAIWA CN630	2M/70 Cross Pointers	71.00	(—)

DUMMY LOADS			
DL30	PL259 30W MAX	5.00	(0.50)
DL60	PL259 60W MAX	8.80	(0.70)
DL60	N TYPE 60W MAX	16.50	(0.70)
DL600	SO239 600W MAX	29.95	(1.50)
DL1000	SO239 1000W MAX	39.95	(1.50)

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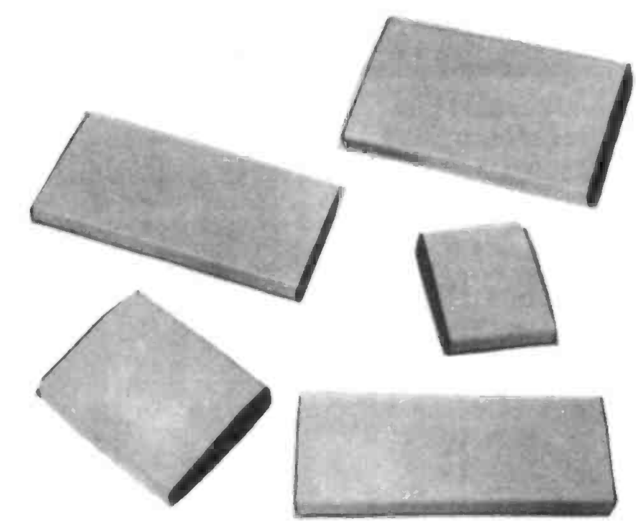
203 for further details

NEW PRODUCTS



BOSS Boxes

The new range of two piece aluminium boxes from BOSS should prove ideal for designs that incorporate keyboards, meters or switches. Ranging in size from 178 x 210mm to 483 x 261mm with an overall height of 51mm, the sloping front design permits comfortable operation of switches etc. with excellent display visibility.
BOSS Industrial Mouldings Ltd,
James Carter Road,
Mildenhall,
Suffolk IP28 7DE. *No. 258*

New Power Supplies

A range of 22 power supply units providing outputs from 8V at 2A5 to 350V at 0A2 has been introduced by Telonic Berkeley. The Kikusui models offer control of output voltage (from 0V) via two controls giving fine and coarse adjustment together with continuous control of current from 10% to 100% of rated value, thus the devices may be operated in a constant voltage or constant current mode. Voltage and current levels are displayed on separate meters.

The modules may be used in series to provide higher output voltages or in parallel to increase the available current. In the latter mode a simple link between units enables both to be controlled by one unit.

The units may be rack mounted, a standard 19" rack accepting up to five modules.

Any enquiries to Bob Lovell at:
Telonic Berkeley (UK) Ltd,
2 Castle Hill Terrace,
Maidenhead,
Berkshire. *No. 254*

New Large ROMs

Hitachi — the innovative technology people — have announced two new large capacity memory ICs fabricated in low power CMOS technology.

The largest is a 256K mask programmable ROM organised as 64K x 4 or 32K x 8 and should prove useful in such applications as speech synthesis and character generation.

The other device is a 128K byte organized ROM which achieves a maximum access time of 250 nS, fast for this size of memory.

Both the HN61256 and HN613129P operate from a single 5V supply and consume very little in the way of watts.
Hitachi UK Ltd,
Hitec House,
221-225 Station Road,
Harrow, Middx.
Tel: 01-861 1414. *No. 256*

Ambit's quarterly

The third of Ambit's 'price on the page' quarterly catalogues (The Spring Edition) features the wide variety of components featured in the past with the important addition of a range of ferrites selected for the RF design engineer. These include parts for HF broadband RF amplifiers, Balun designs, Chokes etc.

A cross reference chart will soon follow, enabling bemused engineers to compare the apparently random nature of different manufacturer's nomenclature.
Ambit International,
200 North Service Road,
Brentwood,
Essex. *No. 250*

Microwave Modules

The new 1 500 MHz Link Terminal from Microwave Modules Ltd is intended for point-to-point operation replacing or supplementing telephone lines and may be used in conjunction with VHF or UHF mobile radio systems.

The equipment has an RF output of four watts and features excellent receiver sensitivity. A choice of AC mains or 24V DC powered versions is available and modular construction facilitates field servicing.
Micro Wave Modules Ltd,
Brookfield Drive,
Aintree,
Liverpool, L9 7AN.
No. 259

Latest Catalogue

The latest catalogue from Harris Electronics details the large and varied range of testmeters stocked by the company.

In addition to the usual multimeters the company stock such items as Insulation Testers, electronic thermometers and 'clamp testers'.

Well worth a browse.
Harris Electronics,
138 Gray's Inn Road,
London WC1X 8AX
Telephone 01-837 7937 *No. 251*

Workstation News

The Telpro multipurpose work station is designed to hold PCBs of up to 175mm in its standard position and can be extended to cope with boards of up to 280mm. It can accommodate oval or odd shaped PCBs while connectors, switches and other components can be held with adaptor plates supplied.

The workstation provides a 360 degree rotation and allows both working height and angle to be adjusted. Component trays are incorporated into the die cast base of the unit.

The price £32.50 from:
Electronic Hobbies Ltd,
17 Roxwell Road,
Chelmsford,
Essex CM1 2LY. *No. 255*

Transformers Galore

ILP have increased their range of toroidal transformers and can now offer 98 different types. These range from 30VA to 625VA with each transformer available with 110V, 220V or 240V primary windings.
ILP Electronics Ltd,
Graham Bell House,
Roper Close,
Canterbury,
Kent CT2 7EP. *No. 257*

Step-by-step fully illustrated assembly and fitting instructions are included together with circuit descriptions. Highest quality components are used throughout.

Sparkrite

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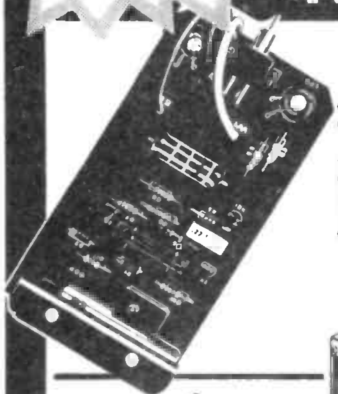
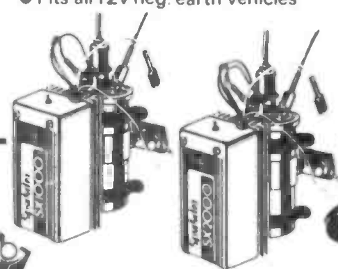
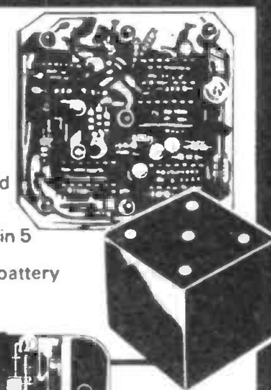
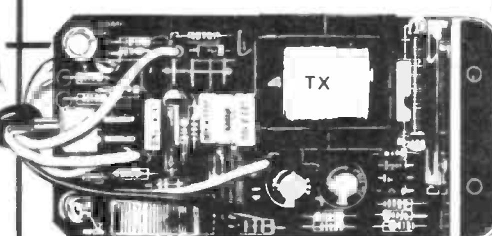


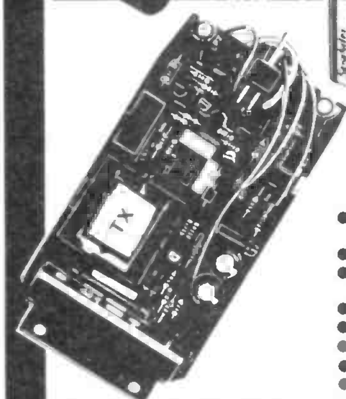
SX1000
Electronic Ignition
- Inductive Discharge
- Extended coil energy storage circuit
- Contact breaker driven
- Three position changeover switch
- Over 65 components to assemble
- Patented clip-to-coil fitting
- Fits all 12v neg. earth vehicles



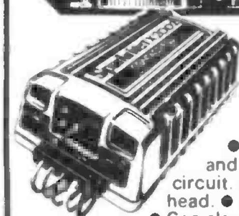
MAGIDICE
Electronic Dice
- Not an auto item but great fun for the family
- Total random selection
- Triggered by waving of hand over dice
- Bleeps and flashes during a 4 second tumble sequence
- Throw displayed for 10 seconds
- Auto display of last throw 1 second in 5
- Muting and Off switch on base
- Hours of continuous use from PP7 battery
- Over 100 components to assemble



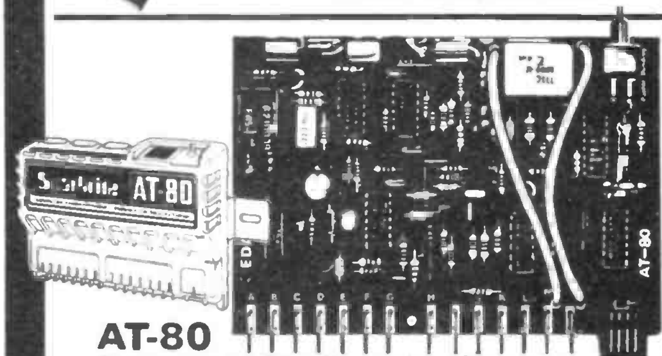




SX2000
Electronic Ignition
- The brandleading system on the market today
- Unique Reactive Discharge
- Combined Inductive and Capacitive Discharge
- Contact breaker driven
- Three position changeover switch
- Over 130 components to assemble
- Patented clip-to-coil fitting
- Fits all 12v neg. earth vehicles

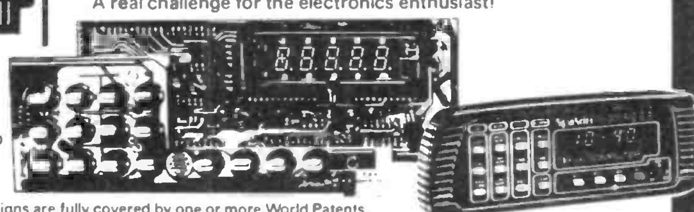


TX2002
Electronic Ignition
● The ultimate system ● Switchable contactless. ● Three position switch with Auxiliary back-up inductive circuit. ● Reactive Discharge. Combined capacitive and inductive. ● Extended coil energy storage circuit. ● Magnetic contactless distributor trigger-head. ● Distributor triggerhead adaptors included. ● Can also be triggered by existing contact breakers. ● Die cast waterproof case with clip-to-coil fitting ● Fits majority of 4 and 6 cylinder 12v neg. earth vehicles. ● Over 150 components to assemble



VOYAGER Car Drive Computer
● A most sophisticated accessory. ● Utilises a single chip mask programmed microprocessor incorporating a unique programme designed by EDA Sparkrite Ltd. ● Affords 12 functions centred on Fuel, Speed, Distance and Time. ● Visual and Audible alarms warning of Excess Speed, Frost/Ice, Lights-left-on. ● Facility to operate LOG and TRIP functions independently or synchronously. ● Large 10mm high 400ft-L fluorescent display with auto intensity. ● Unique speed and fuel transducers giving a programmed accuracy of + or − 1%. ● Large LOG & TRIP memories. 2,000 miles. 180 gallons. 100 hours. ● Full Imperial and Metric calibrations. ● Over 300 components to assemble. A real challenge for the electronics enthusiast!

AT-80
Electronic Car Security System
- Arms doors, boot, bonnet and has security loop to protect fog/spot lamps, radio/tape, CB equipment
- Programmable personal code entry system
- Armed and disarmed from outside vehicle using a special magnetic key fob against a windscreen sensor pad adhered to the inside of the screen ● Fits all 12V neg earth vehicles
- Over 250 components to assemble



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EDA SPARKRITE LIMITED 82 Bath Street, Walsall, West Midlands, WS1 3DE England. Tel: (0922) 614791

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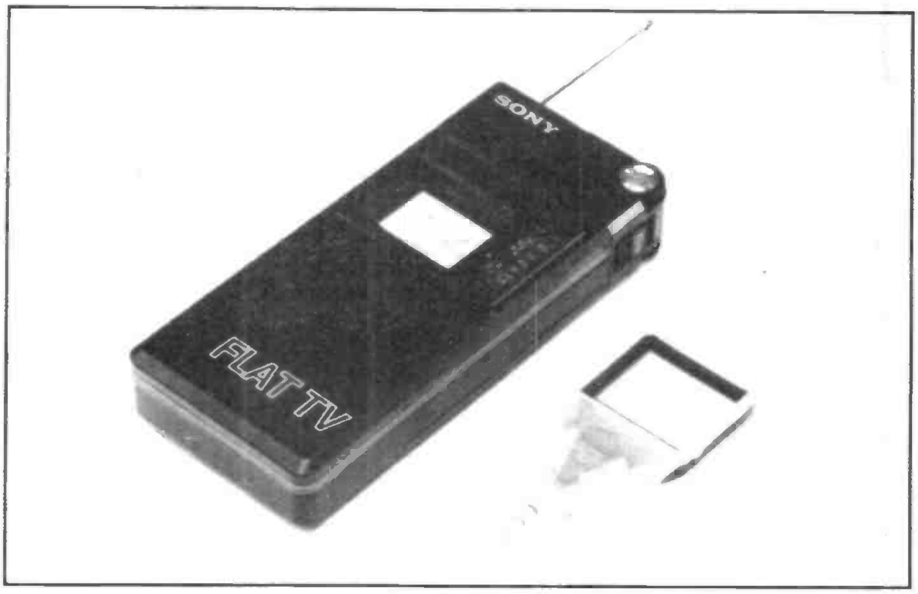
NEWS.



2" Flat Screen TV from Sony

Sony look like being first home in the race to mass produce a flat TV. The FD 200 is only 87 x 198 x 33mm with the tube itself measuring 16.5 x 55 x 133mm.

The tube is constructed in a "paddle like" form and unlike conventional tubes has the electron gun parallel to the screen.

Electrostatic deflection is used for vertical deflection while an electromagnetic system, in conjunction with two internal ferrite plates, is used for horizontal deflection. Automatic focusing in the vertical direction is used to maintain a sharp image over the screen.

Sony have developed a new glass manufacturing process enabling them to produce the tube with the high degree of precision required.

Apart from the small size of the tube Sony have managed to keep the size of the FD200 down by, amongst other things, using a miniaturized flyback transformer, a thin deflection yoke and the extensive use of ICs.

The TV may be powered from its own internal batteries, from the mains or a car battery. With an optional battery pack it will operate for 8.5 hours continuously or for 39 hours on sound only.

The TV has a built in rod antenna and can tune over both the VHF and UHF bands.

The set retails in Japan for 54 000 yen, that's about £125, as yet there are no details of a UK launch date.

The All Electronics Show: Don't miss it!!

The inimitable Evan Steadman and his AES bandwaggon draw up at the new Barbican venue for the electronics event of the year from April 20th to 22nd inclusive. Radio and Electronics World will be there on stand 565, Hall B Lower.

Get to our stand first, and you can pick up a candid digest of the best events and things to see in the show without the usual trudge around the trivia (unless you like that sort of thing, of course)

By way of a little encouragement, anyone seen wandering around the show wearing an REW tie may be approached and find a £5 voucher thrust in hand. £10 if the said person can also produce a copy of the current **R&EW**. Lose £10 if you produce a copy of another electronics magazine by mistake.

The All Electronics Show is probably the premier UK event for components and design engineers: if past form is anything to go by, it's not the place for production engineers (Internepcon), and it's not quite the place for test equipment freaks (Testmex) — but for a general sweep of component manufacturers and suppliers, there isn't anything to match it.

We would not recommend it to purely 'hobbyist' readers, since some of the less enlightened exhibitors tend to give anyone without a professional visiting card the bums' rush — should you be so bold as to approach them for information. It helps to engage the attention of some exhibitors if you have a current financial statement together with your company's balance sheet.

Rumours that Mr Steadman will be holding a competition to guess the weight of his wallet at the end of the show are entirely malicious and without foundation.

Electronics retailers: Share in R&EW's success

The **R&EW** 'Project Pack' and 'Databrief' PCB concept has caught on more rapidly and widely than we had imagined. The volume of orders has forced us to examine our approach to the whole question of marketing through this medium.

We have received a number of enquiries from retail shops wanting to stock both **R&EW** and the Project Packs series of kits — so we are inviting applications from retailers wishing to stock Project Packs for supply 'over the counter', so that we can consider establishng a network of authorised dealers both in the UK and overseas.

We shall be rationing dealerships by area, and whilst appointments will be made in order of application — we will need to be satisfied that a retailer is prepared to give a reasonable supporting service before referring back to the **R&EW** service department. Lists of authorised dealers will be published in **R&EW** — and they will then be assured of a monthly rush of customers to pick up the latest issue and kits!

Free Components?

Remember the first issue of **R&EW**? It's nearly a collector's item these days, and perhaps it's now pertinent to remind readers with ideas and the patience to turn them into feature articles, projects etc., that we pay plenty for good material. Apart from a page rate of around £50, we are also uniquely positioned to provide advice, assistance and even technical support for innovative ideas and projects.

Plus we refund the cost of the parts used, and generally bend over backwards to help you develop your own skills and aptitudes. However, we are not an adjunct to the state educational system, and must ration our resources to reasonably novel subjects. This does not always mean 'never seen before topics', but probably just a new and a better technological solution.

We are particularly anxious to support the more advanced and ambitious projects that arise from time to time in secondary schools, colleges and universities. Virtually every electronics undergraduate has to undertake a project in the final year, and we have yet to hear from more than a handful with sufficient enterprise to incorporate this with our scheme — both to earn a few bob to help eke out the inadequate grants, and to help disseminate their efforts to an appreciative audience. Get off your backsides and apply for a sponsorship form (SAE please).

■ **R&EW**

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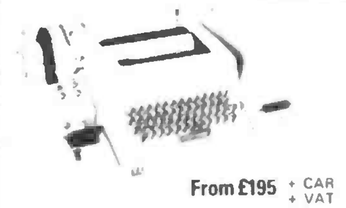

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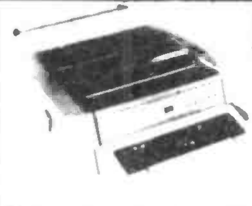

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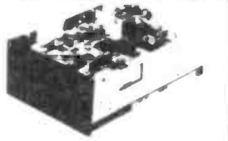

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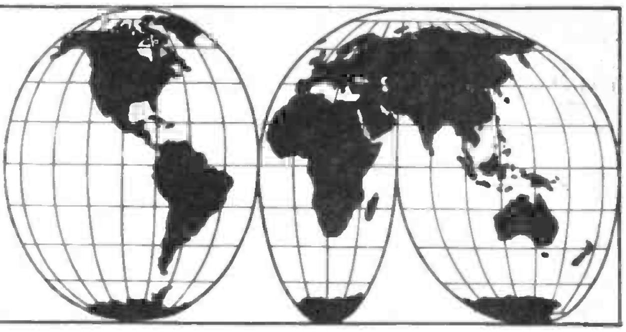

Frank A. Baldwin

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

By the time this article appears in print, the season for reception of the African Continent will just about be commencing for listeners here in the U.K. Coinciding with this period of maximum possibility with respect to hearing the Dark Continent will be that it will also be applicable to Latin America -but more of the latter next month.

Africa

Although many African stations may be heard on the 60 and 90 metre bands throughout the year, it is during our summer months that the best chance of receiving some of the lower powered transmitters becomes apparent, the stronger stations likewise exhibiting better signals here in Britain. Past experience has shown that the early evenings provide the optimum chance of successful reception.

One of the features of African stations is that most of them have programmes using European languages, being formerly colonial territories. English, French and Portuguese languages are commonly heard but there is also a wealth of native vernaculars to contend with, Kenya for instance coping with Swahili and seven vernaculars in addition to English and even Hindustani.

African music is distinctive to say the least, the drums predominate with their throbbing rhythms but over this back ground one will often hear the superimposed native instrumental music, lilting, rising and falling in intensity but at all times aurally colourful.

The folk songs of the Dark Continent are just as exhilarating as the music, often composed - no pun intended - of a lead singer with the refrain followed by a chorus of many voices rendering a repeated chant.

All in all, an exciting prospect for the evenings ahead. Africa I presume?

Around the Dial

Spain

Madrid on **11840** at 1952, station identification followed by a Spanish language lesson in the English programme for Europe, scheduled on this channel from 1910 to 2010.

Romania

Bucharest on **7195** at 1957, when radiating a programme entitled Radio Forum which was all about the peace movement of Romania youth; this during the English transmission to Europe and timed from 1930 to 2030.

Vatican City

Vatican on **11700** at 2055 when featuring a talk on wartime policies in an English programme directed to Central and East Africa, scheduled from 2045 to 2100.

Albania

Radio Tirana on the out-of-band frequency of **16230** at 1154, OM (Old Man = male announcer) with the Chinese programme for China - where else? Albanian music and songs also being included in this transmission, timed from 1100 to 1200 on this channel.

Radio Tirana on **9480** at 1835, OM with a news commentary in the English programme for European consumption and scheduled from 1830 to 1900.

Sweden

Stockholm on **6065** at 1850, OM with the English programme for Europe and Africa, timed from 1830 to 1900 this included a feature about Welsh pops apparently ignored in London but much appreciated on the Continent - at least according to the commentator.

Finland

Helsinki on **15265** at 0910, YL (Young Lady = female announcer) regaling listeners with a Finnish fairy story in an English programme for Europe, the Far East and the Pacific, scheduled on Sundays only from 0800 to 0925. Needless to say they lived happily ever after!

Switzerland

Berne on **15305** at 0924 when radiating a discussion about local radio in Switzerland during the English transmission for Australia, the Far East and South Asia and scheduled from 0900 to 0930.

Portugal

Lisbon on **21640** at 0929, OM's with a discussion during the Portuguese programme for Timor, Macao and Australia, scheduled from 0900 to 1100 but sometimes extended beyond the closing time.

East Germany

"Radio Berlin International" on **21575** at 0945, OM with station identification followed by a newscast at the commencement of the programme in English intended for the Far East and timed from 0945 to 1030

Norway

Oslo on **25730** at 1208, YL and OM with comments on European affairs during the English programme for Europe, the Far East, the Pacific, South and South East Asia and scheduled from 1200 to 1230 Sundays only.

West Germany

Cologne on **21465** at 1223, YL with a comment of world affairs during the English programme for South East Asia, scheduled from 1215 to 1300 at this spot on the dial.

Austria

Vienna on **9770** at 1230, OM with station identification and comments on the local weather in the English transmission for Europe, North America, South East Asia and Australia, scheduled from 1230 to 1300.

Sri Lanka

SLBC (Sri Lanka Broadcasting Corporation) Ceylon on **11800** at 1927, OM with a song in Sinhala, YL with announcements in the same language then some local-type music in the Sinhala programme for Africa and the Middle East, scheduled from 1915 to 1930.

Gabon

Moyabi on **11755** at 0610, "Africa Number One" with announcements in French, African drums and music. This one can also be heard during the evenings on **4811**.

Israel

Jerusalem on **9815** at 2020, YL with news for local affairs in the English programme for Europe, North America and Africa and scheduled from 2000 to 2030 on this channel.

Madagascar

Radio Nederlands Relay on **15220** at 1829, OM with station identification proir to the start of the English programme intended for Africa and timed from 1830 to 1920. The following items included a programme review, a newscast of world events and a news comment feature. Also logged in paralled on **6020** also from Madagascar.

Philippines

FEBC (Far East Broadcasting Company) Manila on **9715** at 1328, OM with a programme in Chinese (Mandarin is scheduled but I don't know the difference). It sounded like a phone-in programme to me. The Mandarin programme is scheduled from 1230 to 1600.

Guyana

"Action Radio" Georgetown on **5950** at 0710, OM with cricket results from Australia complete with an Austalian accent, OM with announcements in English, drums interval signal followed by OM with a promo (advertisement) in English. This is a 10 kW transmitter, the published schedule being from 1100 to 0250 so either this was an extended transmission or the schedule has been altered -probably the latter.

China

Being an inveterate China Watcher I often pay a visit to the many places on the dial where broadcasts from this country may be logged. Not only do I enjoy their classical music I also gain a sense of achievement in managing to list some of the regional stations in my log.

Radio Peking on **5075** at 2112, YL with songs in Domestic Service 2, scheduled here from 2100 to 0030.

Radio Peking on **5860** at 2052, YL with songs in Domestic Service 1, on this frequency from 2000 to 0100 and also logged in parallel on **6665**.

Radio Peking on **4884** at 1621, OM with the Russian programme timed from 1500 to 1600. The Mongolian transmission is timed from 1400 to 1455, all in the Foreign Service.

Radio Peking on **6860** at 2120, YL and OM with the English programme for Europe, scheduled from 2100 to 2200. It was all about Chinese social affairs, the birth control programme, the anti-smoking campaign and even Chinese butterflies! Certainly most informative and intertaining. It is amazing just how much information one can pick up on the short waves, much of it never appearing in the press.

Radio Peking on **6955** at 1145, Chinese classical music , OM with the Korean programme, scheduled from 1100 to 1500.

Radio Peking on **9880** at 1150, Chinese light music in the Burmese transmission timed from 1130 to 1200.

Radio Peking on **11445** at 1152, YL with the Tagalog programme for the Philippines, scheduled from 1130 to 1200.

Radio Peking on **11600** at 0948, OM with the English programme directed to Australia and New Zealand and scheduled from 0930 to 1030 - all about the armed forces of Vietnam.

Radio Peking on **9860** at 1125, local-style music, YL with the Esperanto programme for Japan and Korea, scheduled from 1100 to 1130.

Radio Peking on **17680** at 1122, YL with announcements and Indonesian recorded music in the Indonesian programmes, scheduled from 1030 to 1130.

Radio Peking on **11375** at 1259, 'East is Red' on chimes at opening of the Uigher programme in the National Minorities Service, the Uigher transmission being timed from 1300 to 1355 on this frequency.

PLA (People's Liberation Army) Fuzhou, Fujian on **3400** 1606, OM and YL alternate in Chinese, the schedule is from 1000 to 1730.

Urumqi, Xinjiang on **4500** at 1615, OM and YL in Chinese in the Home Service, this particular transmission being from 1045 to 1730.

Wuhan, Hubei on **3940** at 2201, OM in Chinese during the transmission period 2100 to 0100.

Xining, Qinghai on **3950** at 1512, Chinese classical music, YL with announcements and off at the end of the 0950 to 1520 scheduled period.

Kunming, Yunnan on **4760** at 1458, YL with songs in Chinese during the period 0920 to 1600.

Xizang, Tibet on **4750** at 1524, deep-toned gongs and pipe music in the 1000 to 1545 transmission. (Xizang = Lhasa). Well worth hearing if you can get under the surrounding commercial interference.

India

AIR (All India Radio) Delhi on **3905** at 1855, songs and music in the Foreign Service, scheduled here from 1745 to 1945. There is a Home Service transmission on this channel from 1210 to 1310 in English. The power is 100 kW.

AIR Delhi on **3925** at 1514, OM in Hindi in the Home Service operating on this frequency from 1330 to 1600 and from 1730 to 1740 (Tuesday, Saturday and Sunday also from 1600 to 1730). There are newscasts in English at 1530 and 1730. The power is 10 kW.

AIR Delhi on **3365** at 1526, YL with the Delhi A programme, scheduled here from 0025 to 0230 (November to February 2300 to 0300) and from 1230 to 1740 (November to February from 1030 to 1740). The power is 10 kW.

AIR Kurseong on **3355** at 1525, YL with announcements in vernacular followed by OM with a newscast in English at 1530. Kurseong is on the air from 0030 to 0400 and from 1230 to 1740. The power is 10 kW.

Pakistan

Karachi on **17640** at 1138, YL announcer, OM song in Burmese in the programme directed to Burma and scheduled from 1100 to 1200.

Nepal

Radio Nepal, Kathmandu on **3425** at 1520, OM with announcements in Nepali, OM with songs in the local style, all in the Home Service which is on the air from 0200 to 0350 (Saturday until 0450), from 0720 to 1020, from 1150 to 1435 and from 1520 to 1720. There is an External Service in English on this channel timed from 1435 to 1520 -I just missed it! The power is 100 kW and the address for reports is Department of Broadcasting, H.M. Government of Nepal, P.O. Box 634, Singha Durbar Kathmandu.

Mongolia

Ulan Bator on **4762** at 2205, OM and YL alternate with a newscast in Mongolian - what else! - after opening transmission at 2202. Also logged in parallel on **5053**, this latter channel providing the best reception at this time. The schedule is from 2200 to 0100 and from 1050 to 1500 but in my experience they nearly always open slightly later than 2200 and the **4762** frequency is variable at times. The power 50 kW.

Indonesia

RRI (Radio Republik Indonesia) Ujung Pandany on **4719** at 1520, OM in Indonesian just prior to the sign-off. The schedule is from 0800 to 1530 and the power is 50 kW. Ujung Pandang is in Propinsi (Province) Sulawesi (Celebes) Selatan and the local time is 8 hours ahead of GMT (GMT + 8).

RRI Medan on **4764** at 1539, OM with announcements, YL with songs, music in the local style. This is Medan 1 which operates from 2300 to 0300 and from 0900 to 1700. Medan is located in Propinsi Sumatera (Sumatra) Utara and is GMT + 7. The power is 50 kW, the address being Jin Letkol Martinus Lubis 5, Medan, Sumatera Utara, The Martinus Lubis part reminds me of Imperial Rome - or perhaps it is that those of us who 'follow the Legions' recall overmuch about the II Legio Augusta, the IX Legio Hispana or even the XX Legio Valeria - after all, they invaded Britannia!

RRI Palembang on **4855** at 1547, local orchestral music, YL with songs. This one operated from 2200 to 0115 (Sunday until 0700) and from 0900 to 1600. The power is 10 kW, the address being Jin Merdeka 2, Palembang, Sumatera Selatan.

Your Reactions.........	Circle No.
Immediately Applicable	13
Useful & Informative	14
Not Applicable	15
Comments	16

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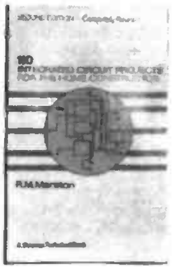


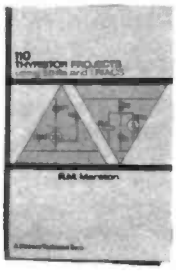
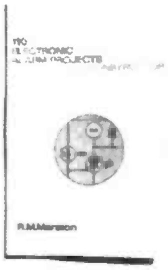


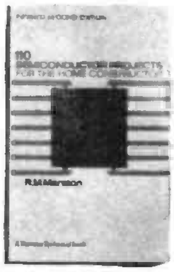

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BOOKS OF THE MONTH

ADVANCED COMPUTER DESIGN

By J K Iliffe

1982; 469 pages; 160 x 235mm; Hardback **£18.95**

The author of this book, a lecturer on computer studies at Queen Mary College, University of London, has divided the subject into three main categories. The first section deals with encoding and execution of problem-orientated or high-level programming languages. The second section discusses the provision of high-speed operations on numeric and non-numeric data. The third section deals with the reduction and containment of programming costs.

The first chapter discusses the choice of topics and also explains the notations used throughout the book. Most chapters conclude with suggestions for further reading and a number of them also include questions by which the reader can test his understanding of the matter he has read. There are also some exercises with solutions given in the book's Appendices.

In all, there are 19 chapters enabling the author to deal with the subject in considerable depth.

THE ATARI ASSEMBLER

By Don and Kurt Inman

1981; 270 pages; 150 x 230mm; Paperback **£9.70**

As more and more people acquire their own microcomputer they will want to make the most of them. After having mastered BASIC language an assembler is the next logical step.

The authors have in this book provided simple, detailed directions for using the Atari Assembler Cartridge and give fundamental information on programming in assembly language. The book is primarily intended for the beginner at assembly language programming who already has some knowledge of BASIC language programming.

The method used is by a series of detailed steps for using the assembler, and to assist in easier understanding there are more than 80 diagrams and illustrations. With the exception of the first and last chapters, all chapters conclude with a summary of what has been covered in the text, plus questions and their answers.

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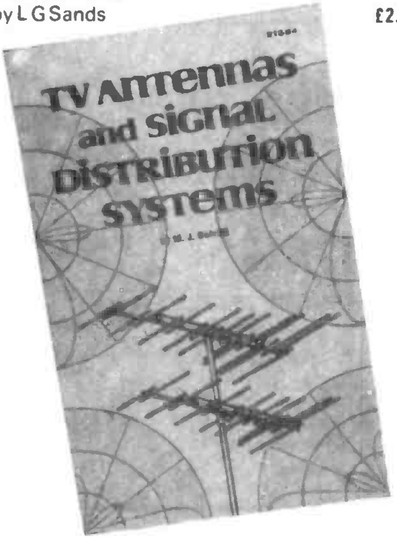

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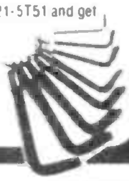

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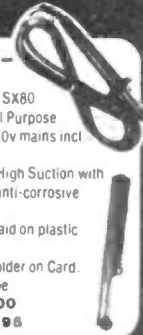

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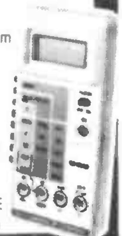

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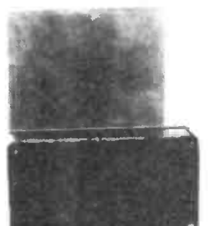

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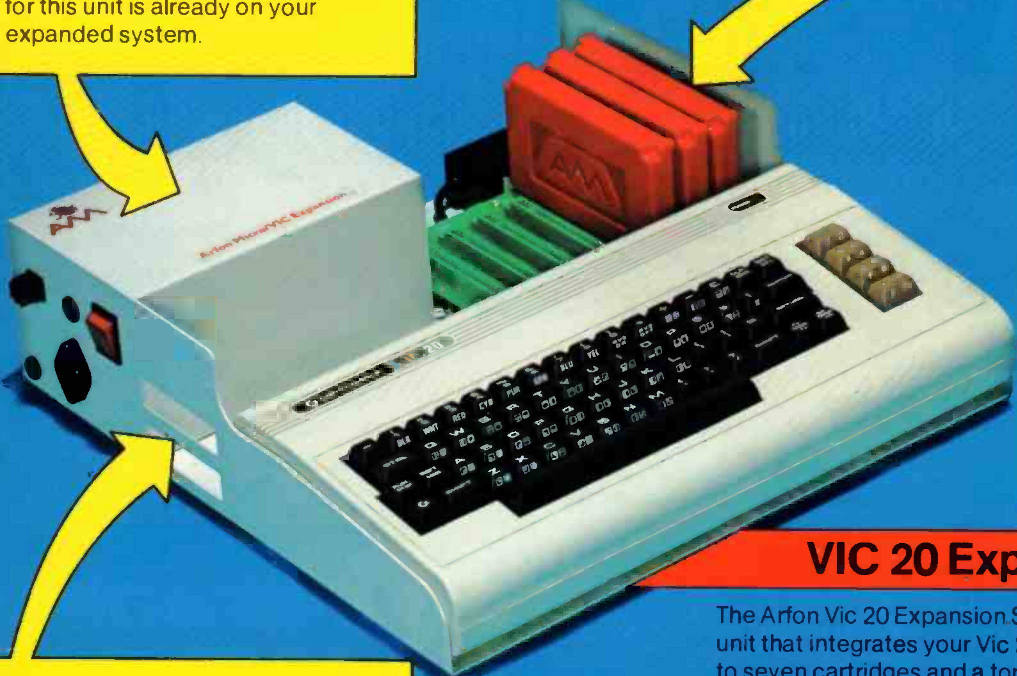

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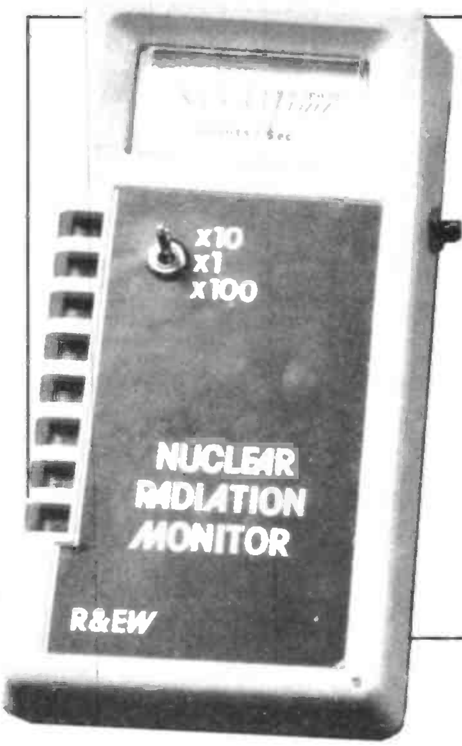

R&EW Project Pack Price See Page 86

RADIATION MONITOR

R&EW present a hand held instrument for the detection of gamma radiation which should prove a must in many areas of industry and research.

Design by Roger Ray and J Camm.

THE **R&EW** HAND HELD Radiation Meter will detect gamma radiation, producing an audible click for each quantum of radiation received while producing a display of counts/second on a meter. The instrument is of medium sensitivity allowing its use with radiation levels between 1mr/h (1 milli-roentgenper hour) and 1r/h (1 roentgenper hour). Its upper limit may be extended if required by adding extra ranges to the instrument.

The unit will find applications in schools, hospitals, power stations and in many other areas using radioactive materials. Many branches of industry use such materials to, for example, measure the speed of flow of various liquids. In paper mills the thickness of the 'liquid' paper is accurately measured by monitoring the absorbtion of Beta particles by the paper.

AFTER THE BOMB...

A nuclear radiation monitor is likely to be a very valuable asset to the survivor of a nuclear war. The levels of radiation in such an environment are likely to be much higher than that measured with the **R&EW** monitor. It is possible to extend the ranges on this monitor, but it would require calibrating against a known source to give meaningful readings. The ZP1310 GM-tube has been used up to around 300 rads/h in commercial instruments.

Where high levels of radiation are concerned it is useful to be able to use the detector remote from the hand-held monitor. The GM tube and its associated resistors together with the emitter follower Q3 can be mounted remote from the monitor, and connected via 4-core cable. The low output impedance of the emitter follower allows cable tens of metres long to be used before serious attenuation of the output pulse occurs. Information on the effect of nuclear radiation and on surviving a nuclear war can be found in Ref. 4

CIRCUIT DESCRIPTION

The main component of the **R&EW** radiation monitor is the Geiger-Muller tube. The ZP1310 type used, requires an EHT voltage of 575 volts (see ZP1310 data). To obtain this high voltage from a 9 volt supply an inverter is required. An oscillator block (TBP-23) intended for supplying record bias in tape recorders is used as the inverter.

The oscillator block consists of a 100 kHz push-pull oscillator driving a toroidal transformer. This steps up the AC voltage to about 150V. To obtain the EHT voltage required (570V), a voltage quadrupler comprising D1-4 and C1-4 is used. This rectifies the AC voltage output from the oscillator block, and gives a four times voltage multiplication. Because the oscillator is operating at a frequency of 100 kHz small value, and hence small size capacitors can be used for C1-4. Resistors R1 and R2 comprise the anode load for the tube, two resistors are used due to the high voltage involved and the requirement for low capacity between anode and supply.

A regulator is used to provide a constant voltage for the oscillator block under varying battery conditions. The regulator consists of Q1 and Q2 and its associated components. This circuit will work with a voltage drop of only 100 mV across the pass transistor Q1. Thus it still regulates with an input voltage below 8 volts, and then tracks the supply with an output 100 mV below the input. D5 gives the regulator short circuit protection, taking the base of Q2 low if the output is shorted.

When the GM tube receives a quantum of energy, ionization of the gas occurs and as a result of avalanche, spreads through-out the volume of the tube. The ensuing current pulse produces a fast rising voltage pulse in the cathode resistor R3. This pulse in coupled to the base of the emitter follower Q3, which presents a high impedance to the tube to prevent loading effects. D8 is normally reverse biased, and is included to prevent more than 5V7 being applied to the base of Q3. The low impedance output from this stage is coupled to Q4 by C8, output can also be taken from this point to drive external counting circuitry. Q4 amplifies the pulse to drive the input of IC1. C9 together with R11 gives some degree of pulse stretching, ensuring IC1 is reliably triggered. IC1 is a CMOS version of the ubiquitous 555 timer. In this configuration it is used as a frequency to voltage converter. A duty cycle of less than 50% is used to ensure linear operation. A negative going pulse on pin 2 of IC1 triggers its internal monostable, giving a pulse of fixed width. These pulse drive a 200 uA meter through RV1, as the pulse height and width are constant the meter reading is proportional to input frequency. The resistor connecting pins 6, 7 of IC1 to the supply rail controls the timing (output pulse width) of the ICM 7555. S2 selects the resistor used for rangesof 10, 100 and 1 000 counts/second. C11 provides meter damping required at low counts/second. The output of IC1 is also connected to a piezoelectric transducer to give an audible click for each count. A 78L05 regulator (IC2) gives a constant 5 volt supply for the counting part of the circuit.

UNITS OF RADIATION

There are a number of units used to measure radiation which vary in definition. The unit of exposure to X-ray or gamma radiation is the ROENTGEN, named after the discoverer of X-rays. A Roentgen is defined as the radiation which will produce 2.08 x 10^9 ion pairs in a cubic centimeter of dry air.

1 Roentgen = 1r = 1000mr

Absorbed radiation dose is measured in rads (Roentgen absorbed dose). A rad is defined as the dose of radiation which imparts 10^{-5} joules of energy per gramme of matter. This may appear somewhat confusing, but fortunately for X-rays and gamma radiation: 1 Roentgen = 1 rad. The new unit which is now used for radiation dose is the Gray (Gy) it is equal to 100 rads.

The **R&EW** radiation monitor is calibrated in Counts/second (CPS). This means that the rate of ionising events detected by the GM tube is displayed on

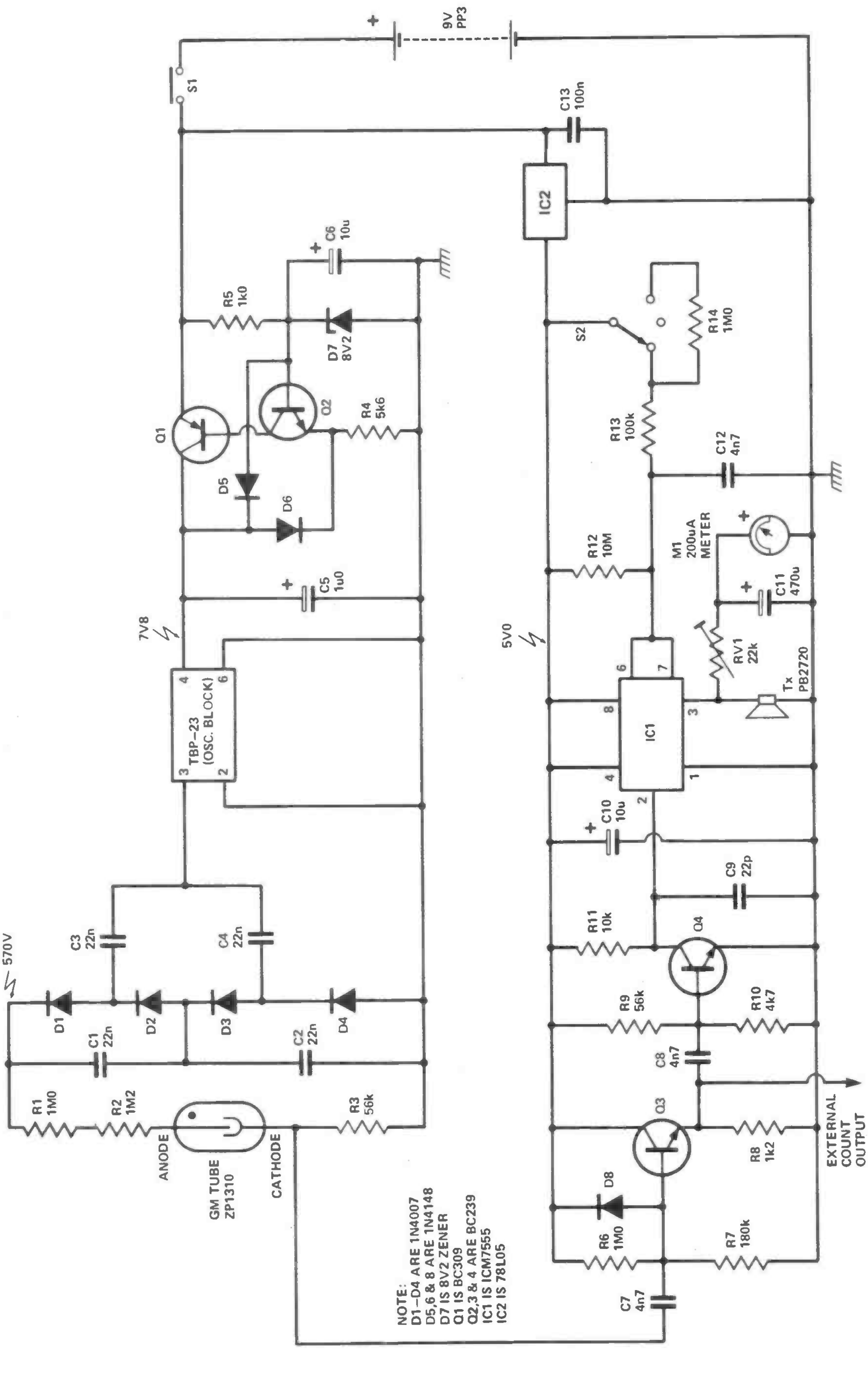

Figure 1: Full circuit diagram of the R&EW Radiation Monitor.

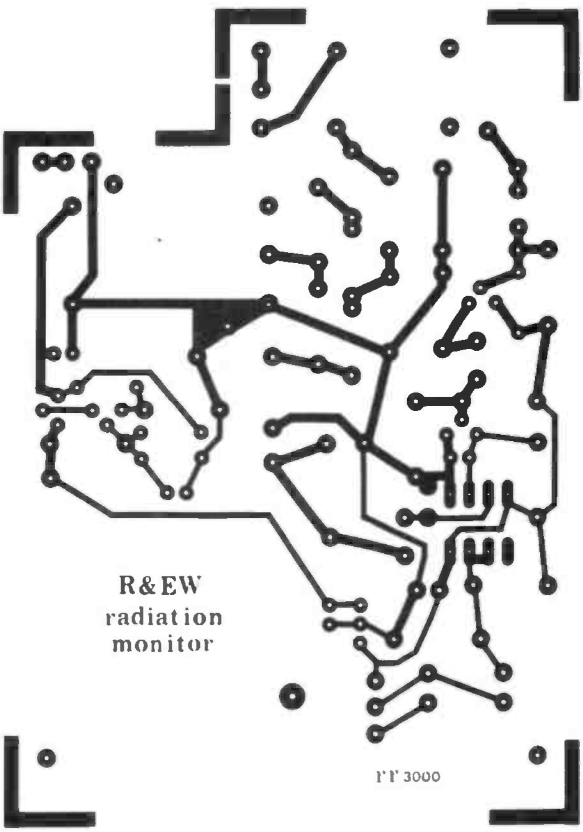

Figure 2: The PBC foil pattern of the Radiation Monitor.

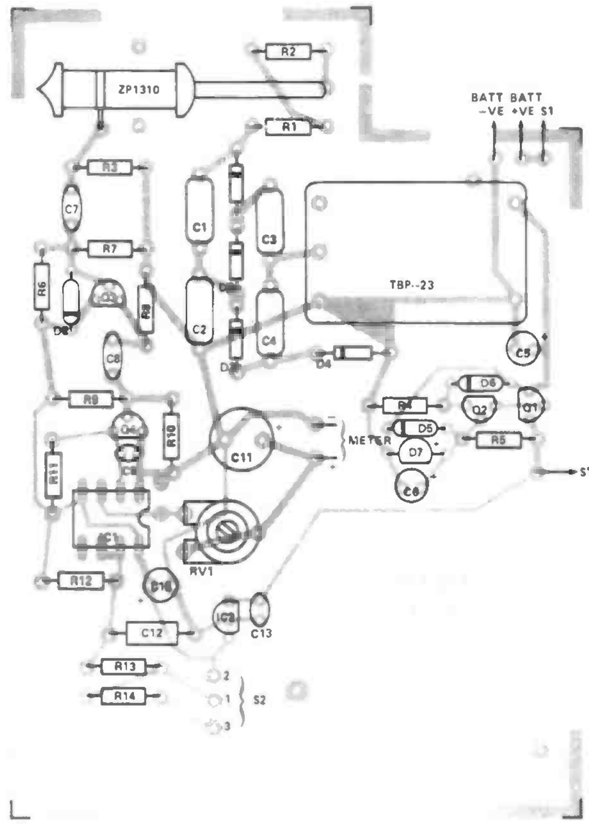

Figure 3: The Radiation Monitor's component overlay.

the meter, each individual event being counted. This calibration is independent of the type of GM tube used. To convert counts/sec to Roentgens/hour for the ZP1310 refer to *Fig 8*. This shows a typical graph of count rate against dose rate, measured with a Colbult 60 source. GM-tubes may vary +/—10% from this typical curve, which is measured using sophisticated scaling equipment. In practice the smaller pulses may be missed as the frequency of events increase, therefore this graph should only be taken as a guide especially outside its linear region.

CONSTRUCTION

A single sided PCB etched as shown in *Fig 2* is used to construct this project. Assemble the resistors, capacitors, IC socket, diodes and transistors in that order. Now solder in IC2 (taking care to get it the right way around) and the oscillator block. Do not connect the GM tube at this stage. Solder in pieces of insulated wire of sufficient length, to connect to the switches and the meter. Leads from the piezoelectric transducer are soldered on the track side of the board, one lead to pin 3 of IC1 the other to the earth track. The assembled PCB should be tested before it is fitted into the case or the GM tube connected. Connect up the meter and switches and insert IC1. Make a visual check that the assembled PCB agrees with the layout of *Fig 3* and set RV1 to mid-position.

A battery or 9 volt power supply can now be connected to check that the circuit is working. Measure the voltage on pin 4 of the TBP-23 it should be 7V8 +/—0V2. Next measure the EHT voltage at the junction of C1 and D1, it should be between 550 and 600 volts. A high impedance meter must be used for this measurement (e.g. AVO 8 on 2500V range) a meter with a lower impedance (50 M) will give an artificially low reading. Most digital voltmeters are unsuitable for this measurement without an EHT probe as they usually have only a 10 M input impedance. If a suitable multimeter is not available, the range of a low cost meter can be extended by using a suitable series resistor. A 500V, 20k/V instrument would read 0-2500 volts, 50 M impedance with a well insulated 40 M series resistor (4 x 10M)

Test that IC2 is regulating by measuring the voltage on pin 4 of IC1. It should be 5V0 +/—0V2. Set S2 to the 100 cps (x10) range (R14 in circuit). If a pulse generator is available connect it across R7 set to 100 Hz narrow pulses 1 volt peak and adjust RV1 so that the meter reads 10 (10 x 10 = 100 Hz). A function generator with a squarewave output may be used in the same way.

If all is well the GM tube can now be connected. A short piece of wire is soldered between the anode connector and the PCB, and the tube carefully pushed into the pin. The cathode strap can now be soldered to the board, and the tube held in place with a tie-wrap (take care not to apply any pressure to the tube). The meter is glued into the lid of the Sabtronics case, in the aperture provided. The push-button switch is fitted in the side of the case, and S2 into a hole in the front panel. The assembled board can now be fitted after the battery connector is threaded through the hole into the battery compartment. The case is then screwed together to complete the construction.

MEASURING RADIATION

To use the instrument, select the lower range and depress S1. In normal conditions after a few seconds a click will be heard, and the meter will give a single flick. This is due to background, which is a combination of cosmic and environmental radiation and spontaneous discharges in the GM tube. Checking for this background is the simplest way of making sure the monitor is working. If the monitor is placed near a source emitting gamma rays

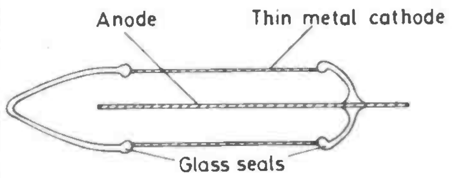

Figure 4: Construction of a miniature GM tube.

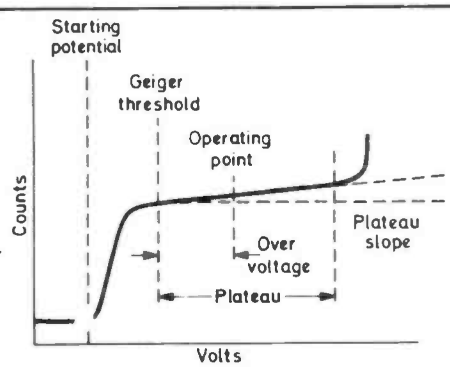

Figure 5: Characteristic curve of a GM tube.

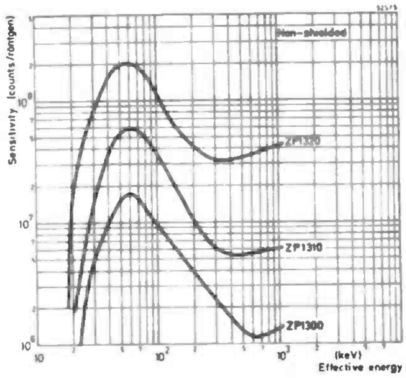

Figure 6: Sensitivity to gamma radiation for three non-shielded tube types as a function of gamma energy.

GM TUBE OPERATION

A Geiger-Muller (GM) tube consists of two electrodes mounted in a gas filled envelope. The configuration of the tube, gas pressure and working voltage are chosen so that an ionising event will result in a single discharge. The construction of a miniature GM tube is shown in *Fig 4*. Tubes for different applications vary in size and shape, but all work in a similar way.

When a particle (alpha or beta) or quantum of energy (gamma) enters a GM tube, ionisation of the gas occurs in the wake of the particle, and as a result of avalanche, spreads throughout the volume of the tube. This is in effect a current pulse in the tube which in turn produces a voltage pulse with a fast rise time in the series resistors connecting the tube to the supply. It is this pulse that is detected by the counting circuitry, and then displayed audibly or visually. The energy contained in the pulse is derived from the energy stored in the self-capacitance of the tube. After the pulse has been produced the capacitance of the tube is discharged and the gas deionised. A halogen gas included with the main gas acts as a quenching agent to speed up the deionisation process. The tube is now recharged through its anode register.

The characteristic curve of a Geiger-Muller tube is shown in *Fig 5*. Operation is normally in the plateau or Geiger region, where avalanche can occur, and the count rate is relatively constant with applied volts.

Gamma radiation is highly penetrating, and is detected when it causes electrons to be ejected from the inner surface of the cathode tube. Gamma tubes are most sensitive when the radiation is at right angles to the axis of the tube. The sensitivity of this type of tube varies with the energy of the radiation, as shown in *Fig 6*. This variation is not critical for many applications, but can be corrected using an external filter if required.

ZP1310 DATA

Optimum Operating Voltage	575V
Threshold voltage (max)	500V
Plateau length	150V
Starting potential	< 380V
Plateau slope	0.15
Anode-Cathode Capacitance	1.0pF
Dead time (575V)	<15uS
Background*	< 2 counts/min

*shielded with 50mm lead and 3mm aluminium

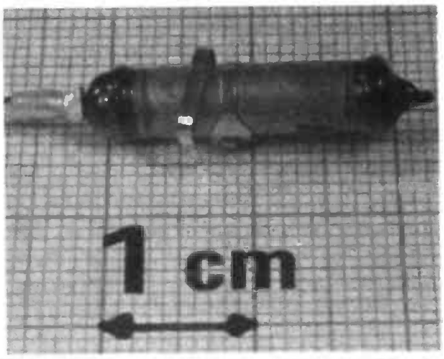

Figure 8: Photograph of the ZP1310 GM tube. This is the most expensive single item in the Radiation Monitor and although fairly robust, care should be taken when mounting the tube on the PCB.

a higher reading, depending on the level, will be displayed on the meter, and a greater frequency of clicks heard. You may well have a gamma source in your 'junk box' without realising it. Many war time meters and instruments were coated with luminous paint that is quite a potent emitter of radiation. The pointer from such an instrument gave more than 100 CPS when placed near the monitor.

SPECIFICATIONS
Size: 170mm x 86mm x 44mm
Supply: 9V PP3 (P)
Current: 12 mA typ.
Radiation: GAMMA
Ranges: 0-10, 100, 1000 C.P.S.

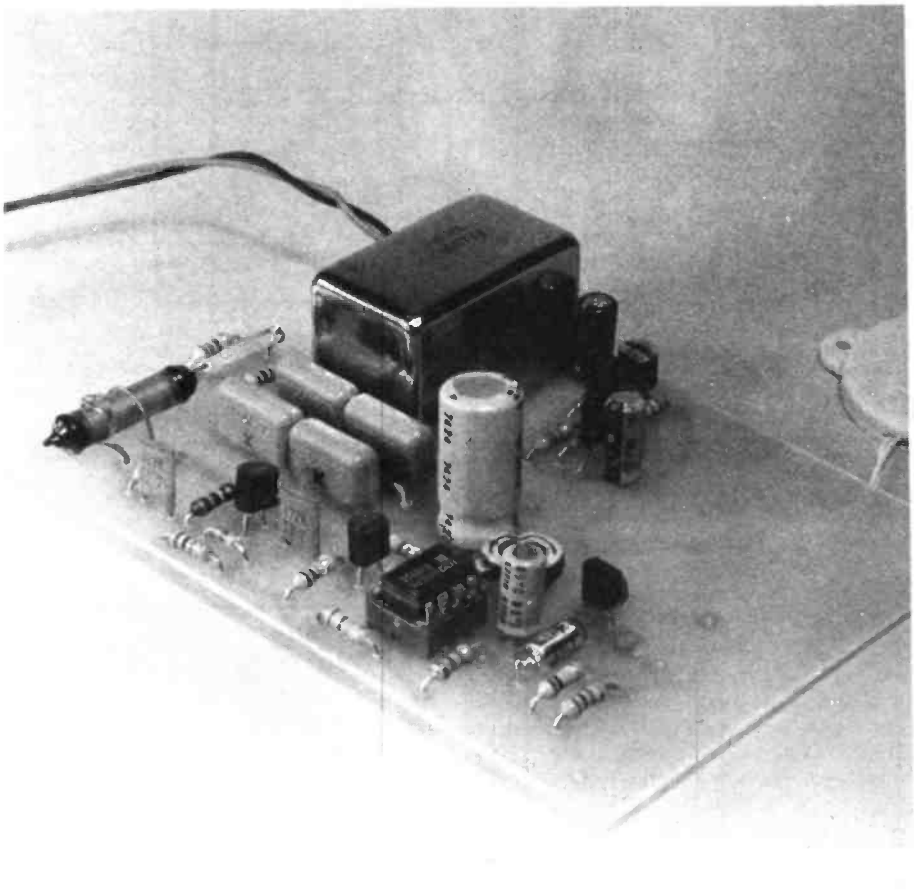

Figure 7: The assembled Radiation Monitor PCB.

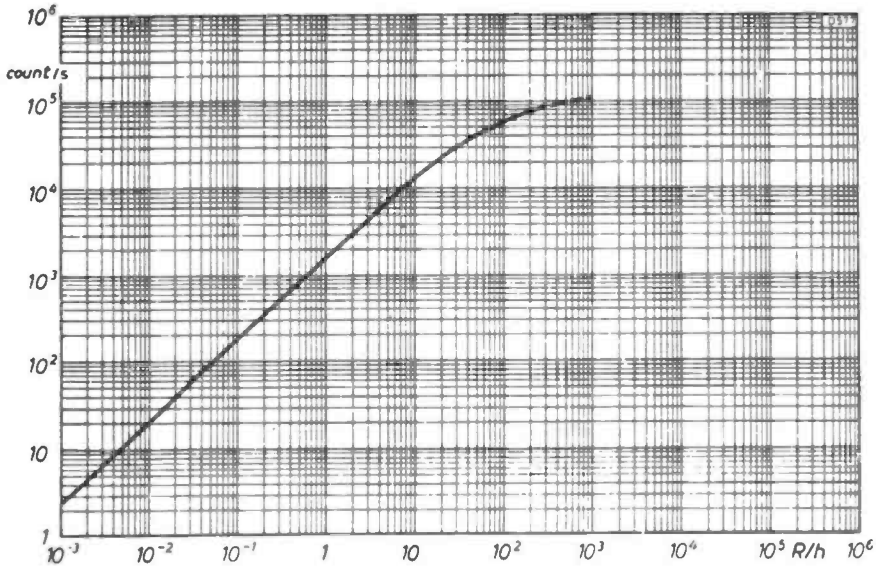

Figure 9: Chart to convert counts/second to Roentgens/hour for the ZP1310.

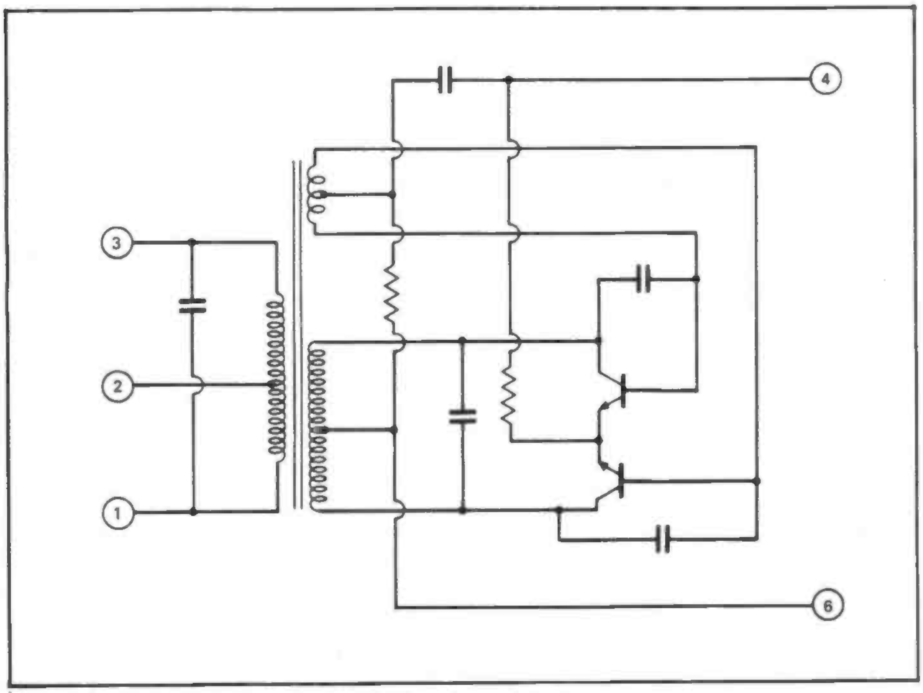

Figure 10: Circuit diagram of the TBP-23 oscillator block.

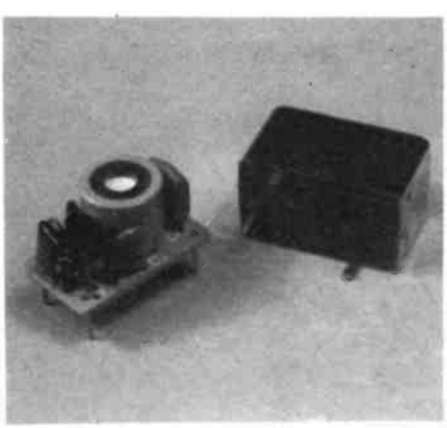

Figure 11: An internal view of the oscillator block..

REFERENCES

(1) Mullard Technical Information (40), Geiger-Muller tubes 1977.
(2) Mullard technical handbook, Book 2 Part 2 1977 Valves and Tubes.
(3) Toko datasheet. Oscillator block for stereo tape recorders 1977.
(4) Surviving Doomsday, C. Bruce Sibley. 1977.
(5) **R&EW** Vol 1, No. 1, What to do if the Bomb Drops, J Camm. 1981.

COMPONENTS LIST

Resistors (¼W 5%)	
R1,6,14	1M0
R2	1M2
R3,9	56k
R4	5k6
R5	1k
R7	180k
R8	1k2
R10	4k7
R11	10k
R12	10M
R13	100k
VR1	22k preset
Capacitors	
C1,2,3,4	22n 400V
C5	1u0 35V electrolytic
C6,10	10u 16V electrolytic
C7,8	4n7 ceramic
C9	22p ceramic
C11	470u 6V3 electrolytic
C12	4n7 polystyrene
C13	100n monolithic
Semiconductors	
D1,2,3,4	1N4007
D5,6,8	1N4148
D7	8V2 zener
Q1	BC309
Q2,3,4	BC239
IC1	ICM7555
IC2	78L05
Miscellaneous	
S1	Push to make switch
S2	3 position miniature toggle switch
ZP1310 GM Tube	
TBP-23 Toko oscillator block	
8 pin IC socket	
200uA meter 920 series	
PP3 battery connector	
PB2720 piezoelectric transducer	
PCB	
Sabtronics hand-held case	

WORDS OF CAUTION

The GM tube is by far the most expensive single item in the **R&EW** radiation monitor although the tube used in this project is relatively robust, a few simple rules must be exercised in its handling.

1. Do not drop it or apply undue pressure to the body of the tube -the glass seals may break!
2. Do not solder directly to, or bend the anode pin.
3. Do not reduce the value of R1 and R2, and keep the stray capacitance between anode and cathode or anode and supply to a minimum.

The EHT supply for the tube is around 600 volts, and although the available current is very low it can give quite a jolt so take care! Finally the dangers of nuclear radiation cannot be overstated. Anyone with access to radioactive sources, should be familiar with the necessary precautions. ■ R & EW

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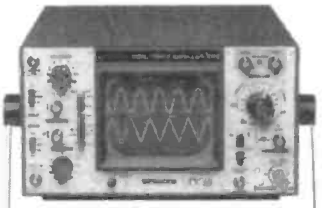

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LBO 513	10 MHz	5 mV/1 mV	Single Trace	5"	
LBO 514	10 MHz	5 mV/1 mV	Dual Trace	5"	
LBO 552A	10 MHz	20 mV	Dual Trace	5"	Stereo Scope
LBO 506A	15 MHz	10 mV	Dual Trace	5"	
LBO 507A	20 MHz	10 mV	Single Trace	5"	
NEW LBO 515B	30 MHz	5 mV	Dual Trace	4.5"	Sweep Delay
LBO 520A	35 MHz	5 mV	Dual Trace	5.5"	
NEW LBO 517	50 MHz	5 mV/1 mV	Quad Trace	6"	Sweep Delay

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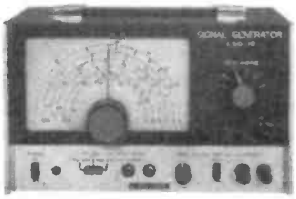

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C58 2m transceiver

The Standard C58 is the 'alternative' to the Yaesu/Sommerkamp FT290R (reviewed in R&EW last November) - with this in mind, we now look into the C58 and see what it has to offer.

Pros and Cons

The C58 is a multimode transportable transceiver for the 144-146 (or 148 MHz) amateur communications band. It is just a shade smaller than the FT290R - mainly as a result of the use of AA size NiCads (the FT290R uses C cells). You can see from the *photos* that the oriental shoe-horn has been hard at it once again.

The C58 uses a mask programmed TMS1000 MPU (TMS1300 TMS1024 expander) to control the multiplicity of functions - the FT290R adopts a similar technique with a Hitachi 4 bit 'presser'that does nearly the same with slightly more style.

Apart from the lower 1 watt power output (FT290R boasts 2.5 W at 12 volts), the C58 uses its memory facilities in a slightly different way, the main advantage being that you can 'QSY' from the memory channel using the incremental tuning controls - the FT290R cannot. On with the C58:

Figure 1 outlines the block system of the C58, which reveals quite a number of mixing operations in the path between synthesiser and antenna.

Knobs for all reasons

The front panel buttons of the C58 are nearly as confusing to those too eager to read the handbook as those of the Yaesu rig. The rotary controls are straight forward enough; the memory function are those which need a little description.

The C58 memory is basically 5 channels, recalling by sequential stabbing of the 'RCL' button. Pressing 'CCL' loads the memory into the working 'register', from which the user may then tune as required (the QSY function mentioned above). Whilst the memory does not recall mode selection, the memory indicator number flashes if the operating mode is not the same as when the memory was loaded.

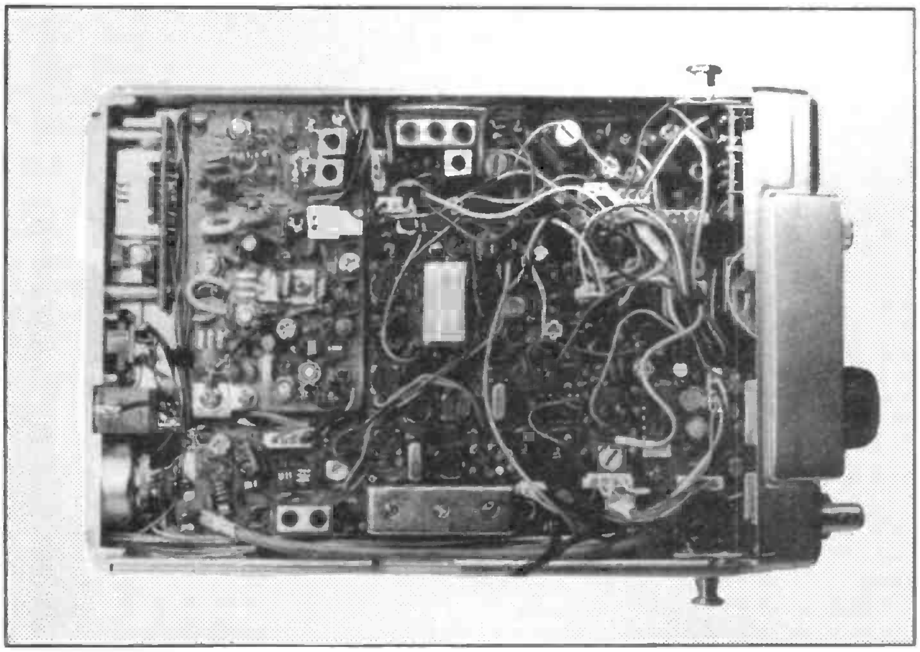
The step size of the synthesiser is similarly programmed by repetitive prodding the "STEP" button - and 100 Hz is available off FM as well as CW/SSB, without the contortions of switching the mode around as with the FT290. To make up for the lack of LCD space, various dots appear in various corners of the display to indicate even numbers of MHz, 100 Hz offsets etc. Confused? You won't be after you've read the book, but don't expect to pick up the operation without first reading the handbook. The original 5/25 kHz and 1 kHz/100 Hz steps have been supplemented by a 12.5/1 kHz option with internal switch.

Scanning is tolerably well thought out. The C58 offers a MHz-at-a-time scan, thereby avoiding the problems of piling into the inevitable beacon signal as the FT290 runs through the entire span of the set every time. Step sizes are selected as above. The memory scan skips channels encoded for SSB whilst the mode selected is FM (and vice versa). The big gripe from FT290R fans will be that scanning cannot be initiated from the mic switch.

RIT on the C58 is easier to drive than the clarifier function of the FT290R, but is not accessible via the mic controls. The fact that the RIT can accidentally be overlooked on the C58 whilst it automatically resets after retuning on the FT290R, is a plus for FT290.

Inside the Receiver (PHOTO)

The C58 instruction book is an example to any equipment manufacturer. As with so many Japanese manufacturers, you feel



Internal view of the top-side of the C58.

you could almost go out and set up in competition making C58's with the wealth of information supplied. Using the book as the guide, we'll take a look around the circuit *(Fig 2)* and see how it's all done.

The first point of note is the use of a JFET for the RF stage. In fact JFETs are used in many places where perhaps we become accustomed to seeing dual gate MOSFETs. It is perhaps worth remembering that earlier JFETs exhibit a lower noise figure than the earlier MOSFETs -although the more recent dual gate MOSFETs have just about overhauled the JFETs.

A common source JFET amplifier can also take a good deal of taming, since the configuration of the single-ended common source amplifier is only a fraction of a picofarad away from being an oscillator. The C58 uses what appears to be a 2-pole helical resonator (LR01 on the diagram) at the input, but our TOKO reference books shows this is a double tuned 7 mm bandpass filter. The output of the RF stage is certainly via a 3 chamber helical filter (similar to the one used on the **R&EW** 2 m converter in October 81), and thence via the dual gate MOSFET mixer down to 10.7 MHz and the first roofing filter - FR02.

On FM, the MC3357 takes over, and regular **R&EW** readers will now be beginning to know this device like an old friend. The conversion from 10.7 MHz to 455 kHz is carried out on-board with the 10.245 MHz crystal, and a pair of Murata CFU455F (NTK LFB) series ceramic filters (12 kHz BW) shape the passband. The muting arrangement uses the MC3357's internal noise amplifier output and a voltage doubler detector - and like the FT290R, this can suffer from thermal drift when set 'acutely'. Pin 14 of the IF IC is OC when the mute is 'shut', so the anode of diode QR40 is pulled high, and QR40 is forward biased to turn off the audio amplifier at pin 8.

The SSB section ploughs on at 10.7 MHz, using diode switch QR30/31 and QR42 (implying that QR42 was perhaps an afterthought?) to permit the filter to be used for both transmit and receiver. This gate also doubles up as the noise blanker, which is effective only on SSB operation. The SSB IF stage QR04 is quaintly described as a 'Younger Amp (SSB TX)', presumably a dictionary translation problem of 'pre-amp'. LR06 whisks away the TX signal to the balanced mixer in the transmit 10.7 MHz to 145 MHz up-converter.

The noise blanker is becoming obligatory on all SSB gear these days, and the unit used in the C58 is a tidy example of the genre. It has been pulled out and enlarged in *Fig 3*, since some readers may feel daring enough to have a go and retrofit it to some of the older gear that is not blessed with such a thing. It is

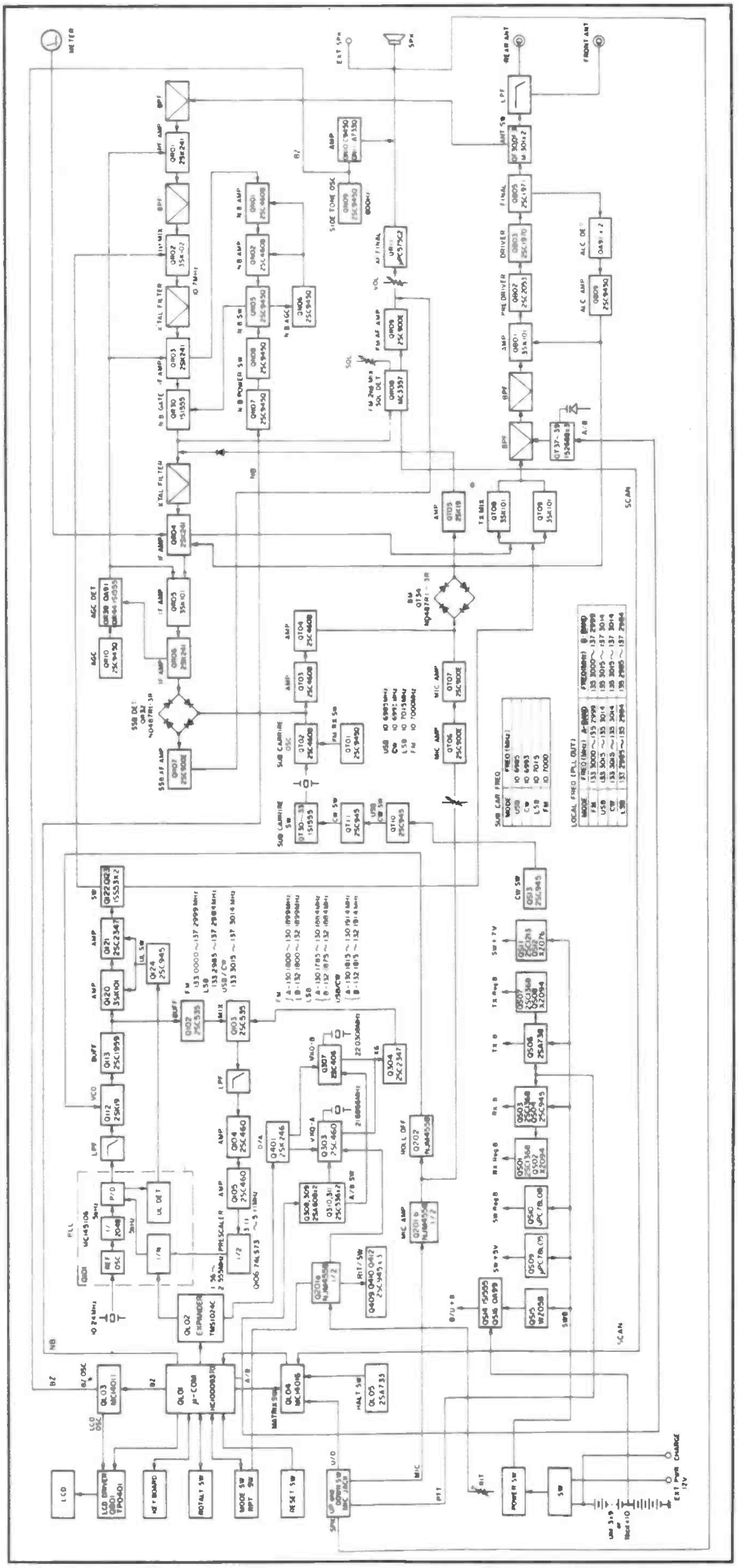
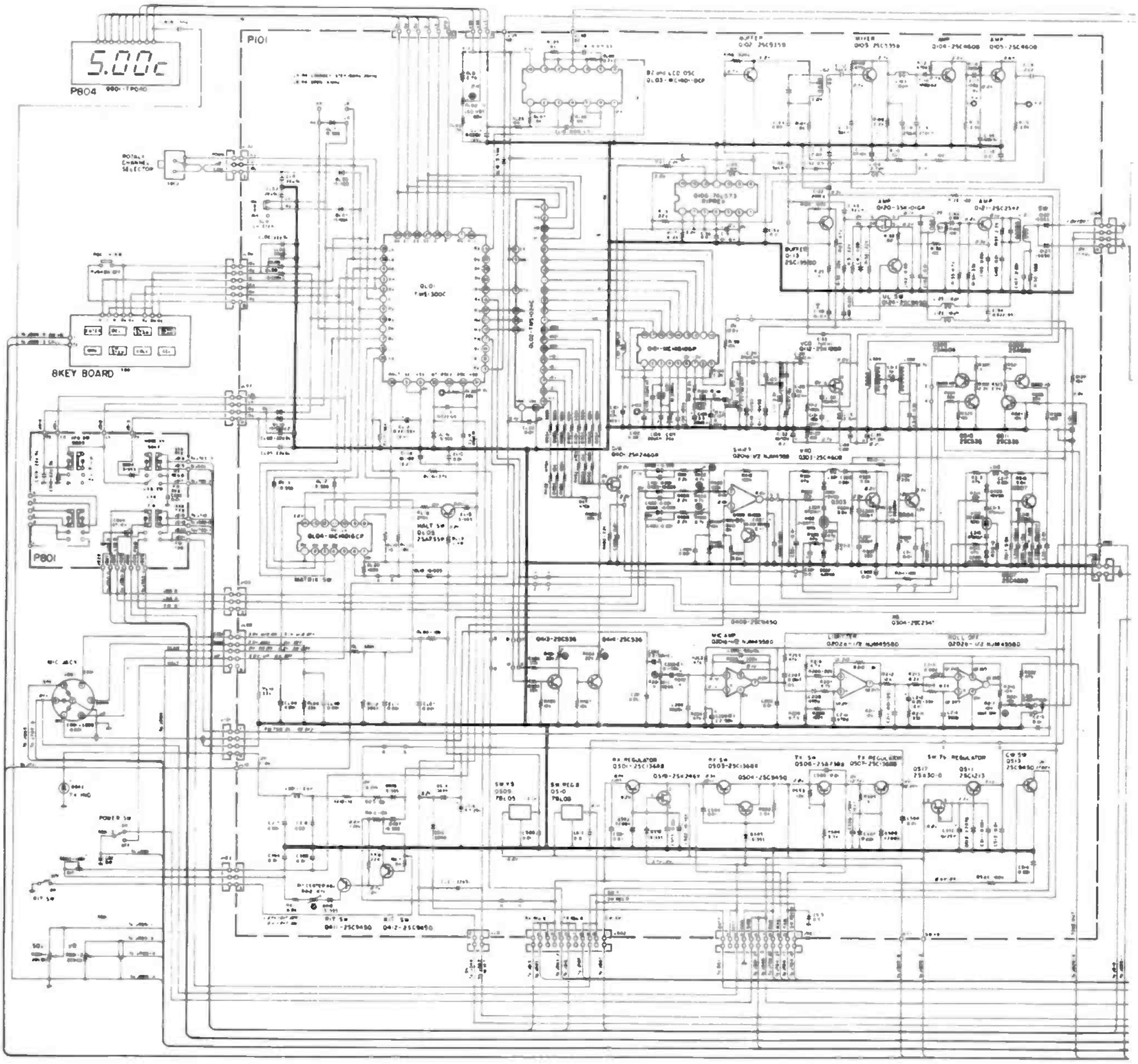


Figure 1: Block diagram of the C58 circuitry.

C58 2m transceiver

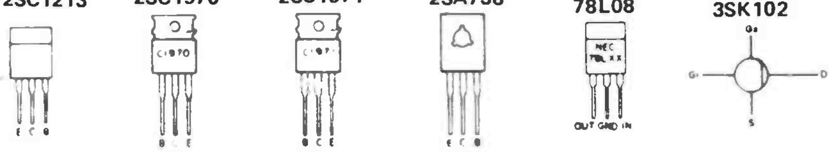


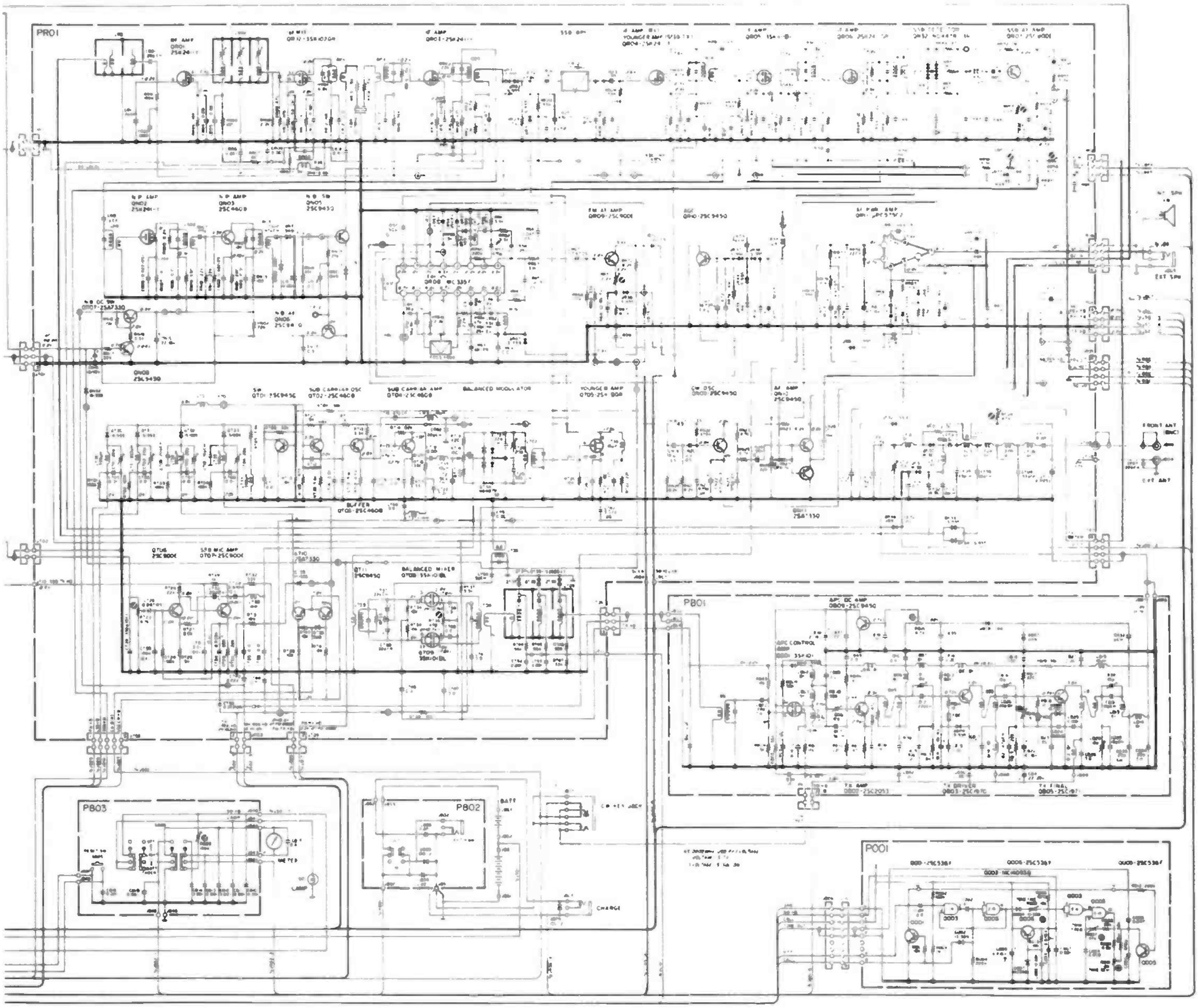
BOTTOM VIEW

2SA733 2SC900 2SC945 2SC1959 2SC2347	2SC2053	2SK19	2SK30 2SK246

SIDE VIEW

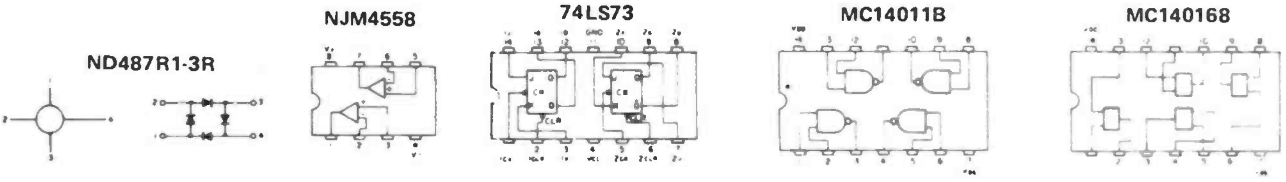
2SC460 2SC535 2SC1213	2SC1970	2SC1971	2SC1368 2SA738	78L05 78L08	3SK101 3SK102



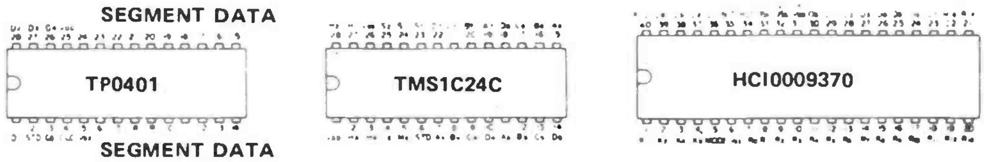


TOP VIEW

ND487R1-3R NJM4558 74LS73 MC14011B MC140168



SEGMENT DATA



SEGMENT DATA

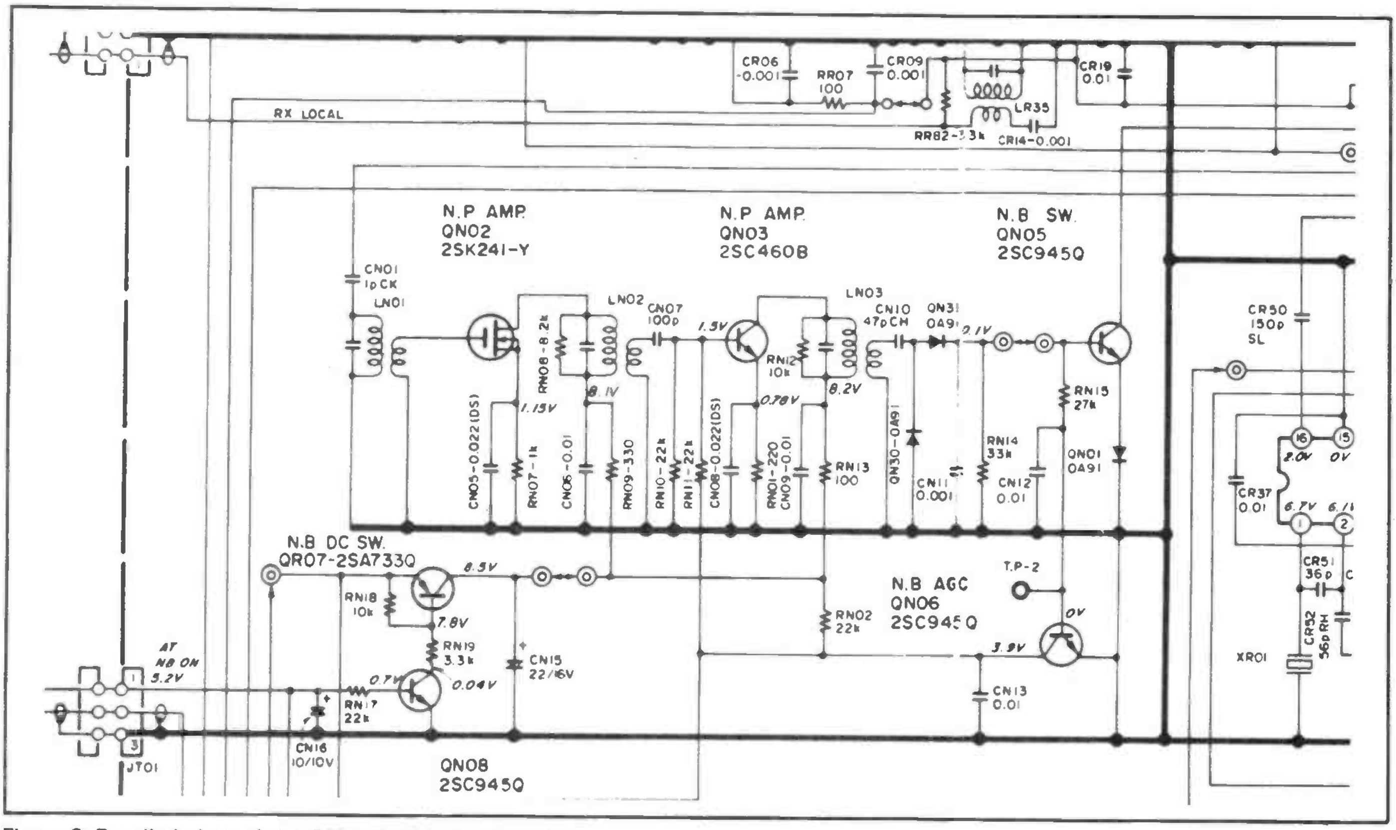


Figure 3: Detailed view of the C58 noise blanker circuitry.

essentially a loosely tuned amplifier before the main selectivity, with a simple peak detector and an AGC system that is fast enough to ensure that the blanker gate does not shut on modulation peak -but is slow enough to permit noise spikes through to shut QN05, and thereby the diode switch preceeding the main filter.

Two further stages of IF amplification (QR05 and QR06) conclude the SSB receiver amplification, with a diode-based product detector at the far end. AGC from QR10 is signal-derived by sniffing some IF from LR07, via CR36. If your magnifying glass is up to it, this stage actually provides a very interesting and economical SSB AGC system is a single device. The IF signal is rectified with fast attack by QR's 37,39 and 44 - with diode QR38 providing a slow decay for the CR71 time constant.

The S meter is derived from the AGC characteristic, using the source current of QR05 as the reference. This gives the range of S meter a little more meaning than those systems which employ the rectified output of an early IF stage. However, the size of the actual meter renders any meaningful interpretation rather unlikely.

The Transmitter : FM

ON FM, the mic signal proceeds through amplification (Q201b), limiting (Q202a) and low pass filtering (Q202b) via the deviation control, R217, to the FM varicap Q211. The VCO is running at the required frequency (minus 10.7 MHz), so this is then mixed in QT08/QT09 with 10.7 MHz from the carrier oscillator QT02, and the result is carefully filtered LT05. Not a triple tuned helical filter, but a bandpass filter block with varicap 'tracking' of the band selected. Band A is 144 - 145.9999 MHz, and B is 146-147.999 MHz. Yes, the C58 covers those naughty bits of the spectrumwhich the Home Office would rather you didn't use for passing the time of day.

Two VCXOs are used (one for band A and one for band B) to provide the interpolation of the 100 Hz steps. Like the FT290, this interpolation results from a D/A output from the MPU to control a varicap on the VCXO, and this is thus not directly synthesised. This is where the numbers around the synthesiser start to get confusing, so refer back to the block diagram *(Fig 1)* for a refresher on the mix down process.

The output linear amplifier uses a dual gate MOSFET at the input, which in conjunction with QB09, provides automatic output level control (APC). This is simply brought about by rectifying a small part of the output in QB07 and QB08, and driving QB09 on the gate of the MOSFET. RB20 is thus the preset that determines the output power.

The Transmitter : SSB

The mic amplifier stage Q201b is used on SSB, but then the signal branches to QT06/7 which provide a degree of speech processing. It is interesting to see that Standard bother to treat the audio differently in this way, and this gives a great deal of confidence in their attention to detail. The audio from this stage is fed to a balanced diode modulator (QT34) where 10.7 MHz DSB results on the far side.

Another 'Younger Amp' then drives this through the 10.7 MHz SSB crystal filter before it is coupled into the up-mixer via LT03. The SSB signal then passes through the output stage as previously described for the FM section.

Note that RF01 provides a relatively high impedance DC signal (2k7) on the antenna socket during transmit. This signal can be used to switch a subsequent linear amplifier (the **R&EW** 2m PA?) in the same way as the FT290R.

Tone Burst

The C58 tone burst is a fascinating little thing. It has been expanded from the main circuit in *Fig 4* for your edification.

It works in two ways via the PTT switch - push the PTT once, and the input on pin 1 of Q0003 drops momentarily, causing the output of the gate to rise (NAND). The input to the next section also rises, causing the output to drop - and the input on pins 12/13 drops, but not far enough to activate the toneburst formed by the final section of Q003.

Press the PTT twice in quick succession and pins 12/13 drop to the point at which the output flips up and activates the tone burst oscillator. Pins

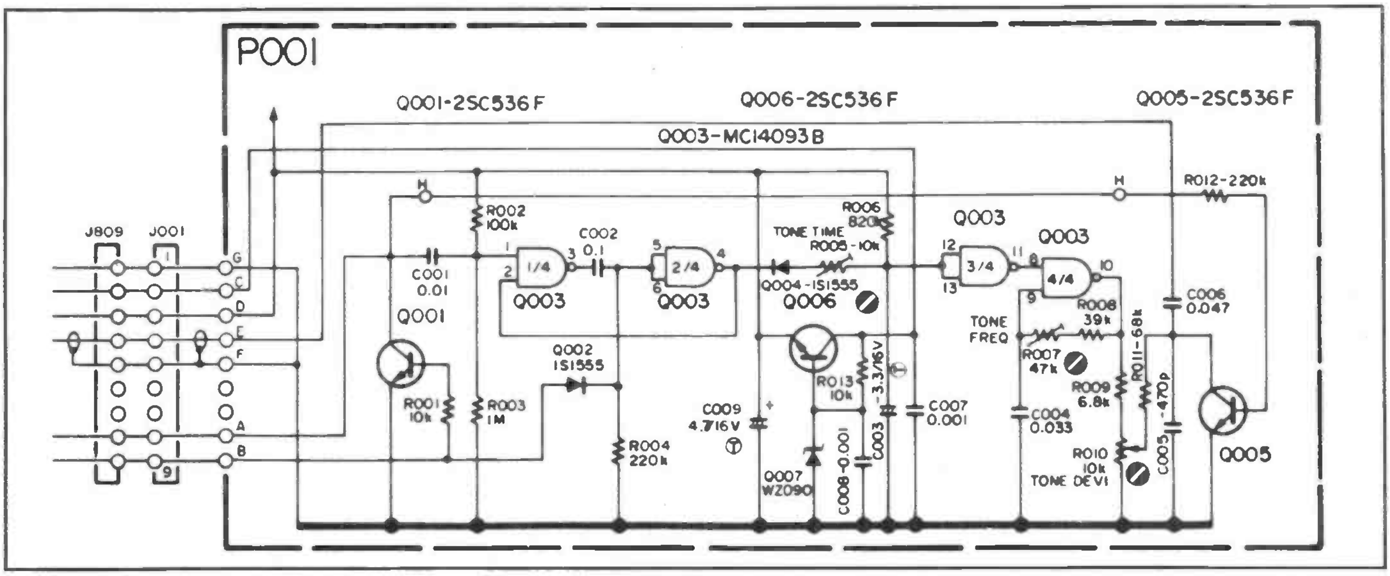


Figure 4: C58 tone burst circuitry.

12/13 gradually recharge via the R006/C003 time constant, leaving the tone running for around 800 mSec.

Alternatively, you can press the call button, and bleep away to your heart's content....

The Rest

The PLL device was described in some detail in connection with a DNT CB rig in the March issue. We won't bother to reiterate all that here, apart from adding a bit about the way the D/A code operates. The basic step size of the synthesiser is 10 kHz, so the VCXO must interpolate the intermediate 100 Hz steps -which it does by varying one of the two VCXOs by +/- 1.5 kHz.

Disregarding the intermediate stages, 9.9 kHz in 100 Hz increments is 99 levels, and this is achieved with the ladder resistor network fed from a BCD 00-99 output (not an R/2R network) on QL02. The voltage is summed at the gate of the FET, Q401, and thence from its source to the varicaps. This process relies upon the linearity of the VCXO over this comparitively narrow range.

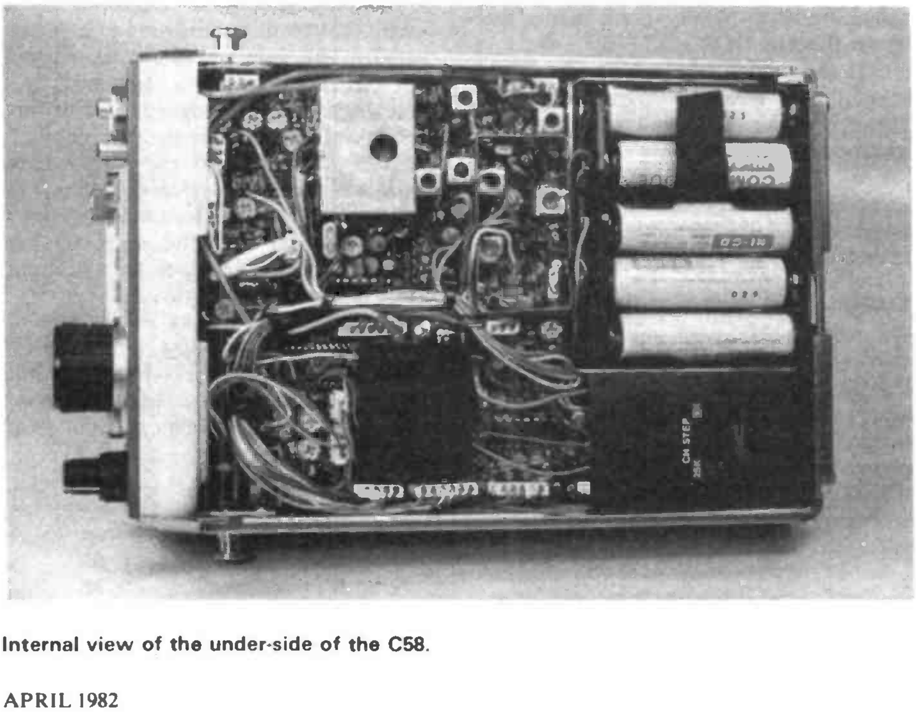
The shift circuit based on the op amp (Q201) provides the USB and LSB offsets of 1.5 kHz - as well as the RIT function. Q409 turns on during tansmit to disable the RIT function.

In use

The C58 is a bit of an anomoloy - it is too big to be carried in the pocket, yet too small (in terms of power output) for mobile use. It is ideal for occasional transportable use, but even on receive standby is consumes 90 mA from its stack of AA's - rising to 600 mA on transmit. It's easy to see why the FT290R chose C cells.

This aside, operation is quite simple. The tuning knob feels as if it is about to fall off (don't worry, that's quite normal), and the lack of station search from the microphone is a nuisance - but the rest of the rig is unobtrusive and efficient.

The C58's BNC antenna connector knocks spots off the FT290R's dreadful telescopic alternative, and the RIT is easier to use than the clarifier on the FT290R. The battery check/lamp function on the rear panel might have been better off where the noise blanker switch resides on the front. There seems little reason to turn the noise blanker off.



Internal view of the under-side of the C58.

Construction

The packing density of the C58 is about as complex as anything is likely to get before the advent of thick film technology. No-one in their right mind (outside Japan) would attempt to make a rig as complex as the C58 for around £250 retail.

Service accessibility is adequate, and several of the components used are old friends from the TOKO and ALPS ranges, implying a high standard of components - which is matched by a high standard of contruction. However, the average radio amateur is not advised to look further inside than the battery compartment.

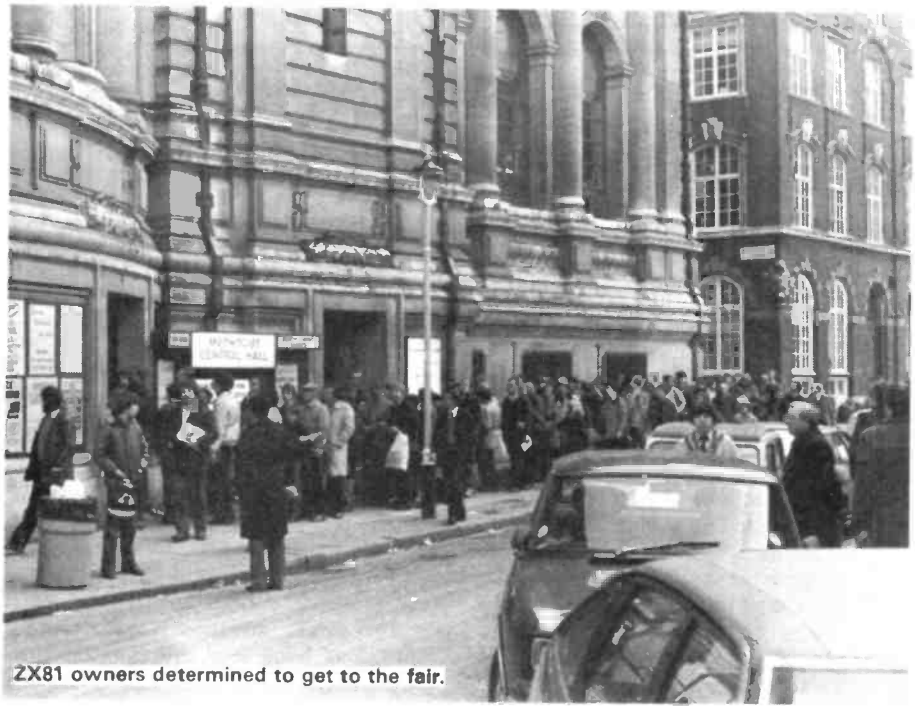
■ R & EW

Your Reactions.........	Circle No.
Immediately Applicable	21
Useful & Informative	22
Not Applicable	23
Comments	24

This month the second ZX81 fair and a new 'copycat' computer from Commodore.

Gary Evans reports....

COMPUTING NEWS



ZX81 owners determined to get to the fair.

THERE CAN BE NO DOUBT that uncle Clive and his merry men at Sinclair have discovered the proverbial license to print money with their ZX81. The thriving software and hardware 'add—on' market for this machine features a mass of products from manufacturers large and small covering the length and brea dth of these isles. The second ZX Microfair at the Central Hall Westminster in late January, brought together most of these products and was an event many ZX owners were determined not to miss.

The queue to get inside the hall would have done justice to a Rolling Stones/ Barry Manilow/Led Zep (delete as appropriate) concert.

Judging by the variety of accents to be heard, the London venue didn't deter those North of Watford from 'away daying' it to the show. Quite a cosmopolitan gathering.

The event might have benefited from being held over two or three days, however another fair is to take place on May 1st, so perhaps those of you who didn't fancy the queue can try again then. **R&EW** certainly shall as this time round we only managed a brief glimpse at most of the stands.

From what we did see, the most evident hardware 'add-ons' were upgraded keyboards to replace the 'touch me at your peril' sensitive keyboard that adorns the standard ZX81. Some of the keyboards looked very nice indeed, many available with an optional case to accommodate the ZX board plus various expansion modules. The other obvious best seller in the hardware line was memory to supplement the meagre ration of the standard machine. A brisk trade in edge connectors was also apparent, presumably for the do-it-yourselfer's.

On the software side the range of products to be seen was vast. The ever present space invaders shared stands with payroll packages (how much does a space invader earn?) and educational programs. The ingenuity shown by many companies has to be admired with most programs squeezing every byte of performance out of the Sinclair 8K ROM.

At all stands, help, advice and information was freely available with Tim Hartnell of the ZX80 and 81 Users Club having a particularly busy time.

All in all a successful day with something for every ZX81 owner, lets just hope that next time its slightly, less crowded.

Computing With Auntie

After all the fuss about which machine the BBC should choose for their Computer Programme series, quite a few harsh words flying around Cambridge over that one, it seems ironic that the BBC have chosen to present the subject in such a way that the type of machine you possess will do nothing to add to or detract from participation in the program. The general overview of the subject that the program presents is far from the nuts and bolts, hands on, down to earth approach that many people were awaiting.

The BBC computer is good value for money, and while the series and the distinction of being Auntie's computer will give an undoubted boost to sales, the machine would have sold well without this kudos and there can be little but crocodile tears from the other contender in the battle.

Commodore 'Copycat'

The Hanover fair in April should see the launch of a new personal computer from Commodore, and could mark a new trend in the pattern of marketing machines. The model 64 is a 'copy-cat' computer, the cat in question being the Apple II.

The machine will run Apple software entered from the keyboard or loaded from disc but will cost less than half the price of the Apple. It brings back memories of the early exercises carried out by our Oriental friends in the Hi-Fi and photographic markets, and indeed the Model 64 has surprised many people who had expected copy-cats from Japan to be the first to reach the market.

The Commodore machine allows the MPU to be replaced, thus exchange the 6502 for a Z80 and you have a Tandy clone, for an 8088 for an IBM look alike.

This approach gives users access to a wide range of software at little or no cost.

Patching It Up

If you have ever tried connecting up a system that features hardware of assorted pedigree you won't need me to tell you that all notions of a standard bus structure are soon consigned to write only memory. That data line stays at an obstinate 5V while one of the supply lines appears to have a great deal of ripple. The problems of breaking into lines to trace/ identify signals and the necessary rerouting can, and often does, take up many hours of frustrating work.

A device that has saved us here at **R&EW** a lot of these problems is mentioned on the New Products page this month. The Interfaker certainly is a good idea, why hasn't someone thought of it before.

Your Reactions.........	Circle No.
Immediately Applicable	84
Useful & Informative	85
Not Applicable	86
Comments	87

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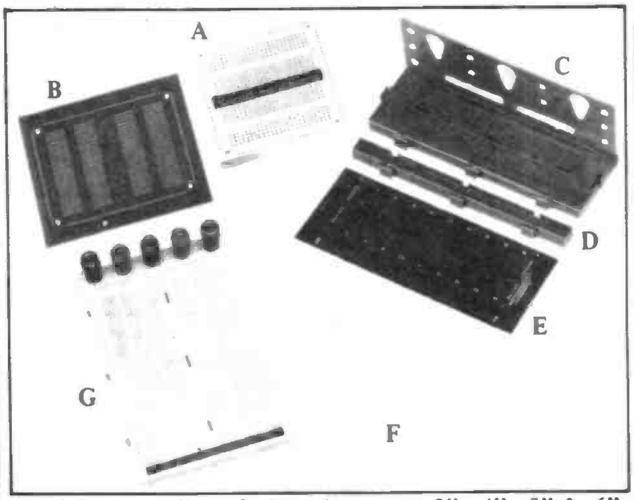

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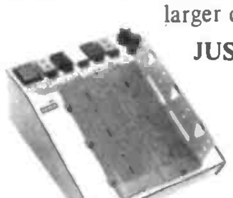

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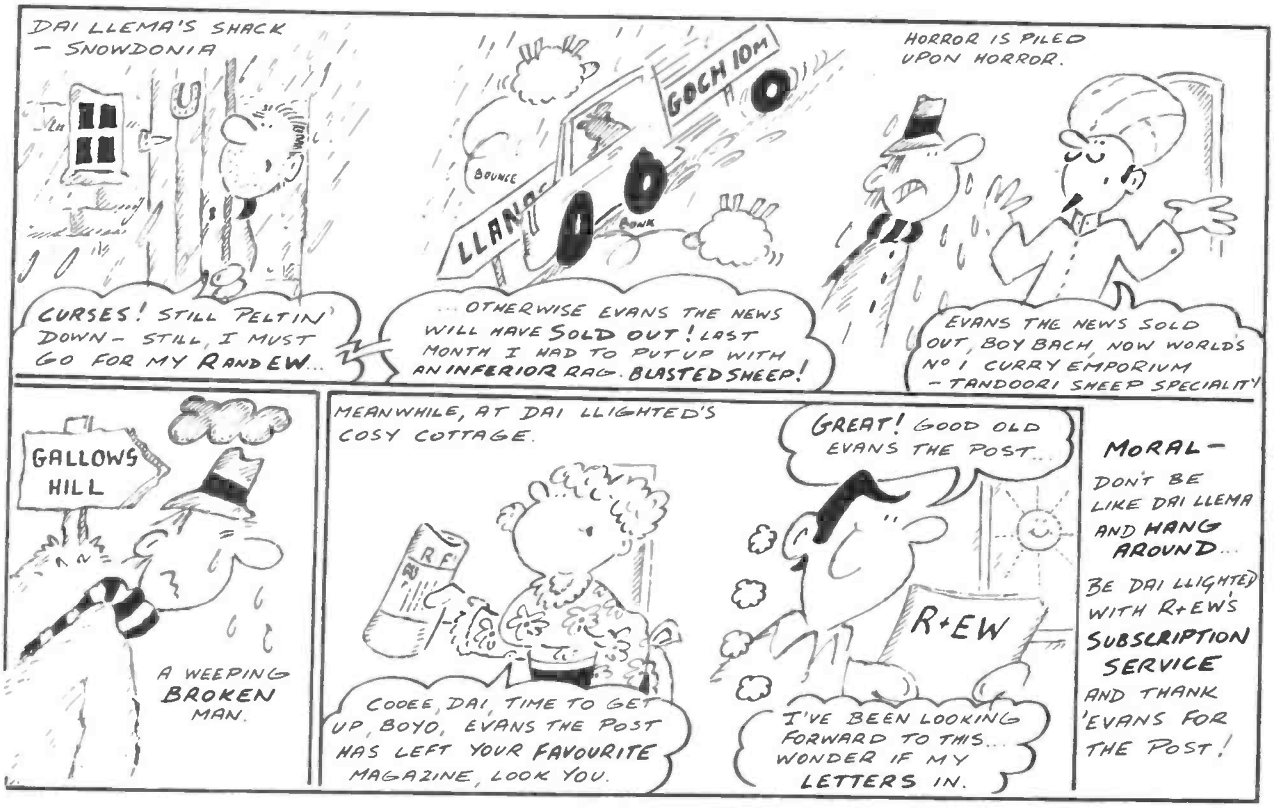

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Bipolar linear IC for voice processing. Balanced input/high gain/AGC/limiter.

DATABRIEF - KB4417 speech processor device

The KB4417 provides all the functions of a communications voice processor from microphone input. AGC and limiting are provided, together with an overmodulation clamp used in the event of excessive modulation peaks reaching the output. The input circuit is designed for optional balanced microphone inputs, with a fully balanced stage built around Q3 to Q8. If used in single ended mode, the unused input should be returned to AC ground via approx 10 uF.

This stage provides a substantial voltage gain from a low output dynamic mic (typically around 1 mV), which appears at pin 15, the output of the buffer stage Q15. This is then capacitively coupled to a further buffer at pin 14, formed by Q16/Q17 to preset a low impedance to the gain control detector, Q18. The AGC signal is then routed internally to Q9, with the time constant being determined by the RC network on pin 11.

The limiter stage (input at pin 4) compresses the speech waveform so that excessive modulation peaks are avoided - and this stage also incorporates an external overmodulation control via pin 6. This operates by going positive to turn Q27 into a clamp on the emitters of Q25/Q26, thus restricting the output to Q28. Transmit/receive switching via pin 5 is effected by taking the pin high to completely disable the output from the limiter stage by the action of Q24 completely clamping the base of Q25 to ground, thus switching it off.

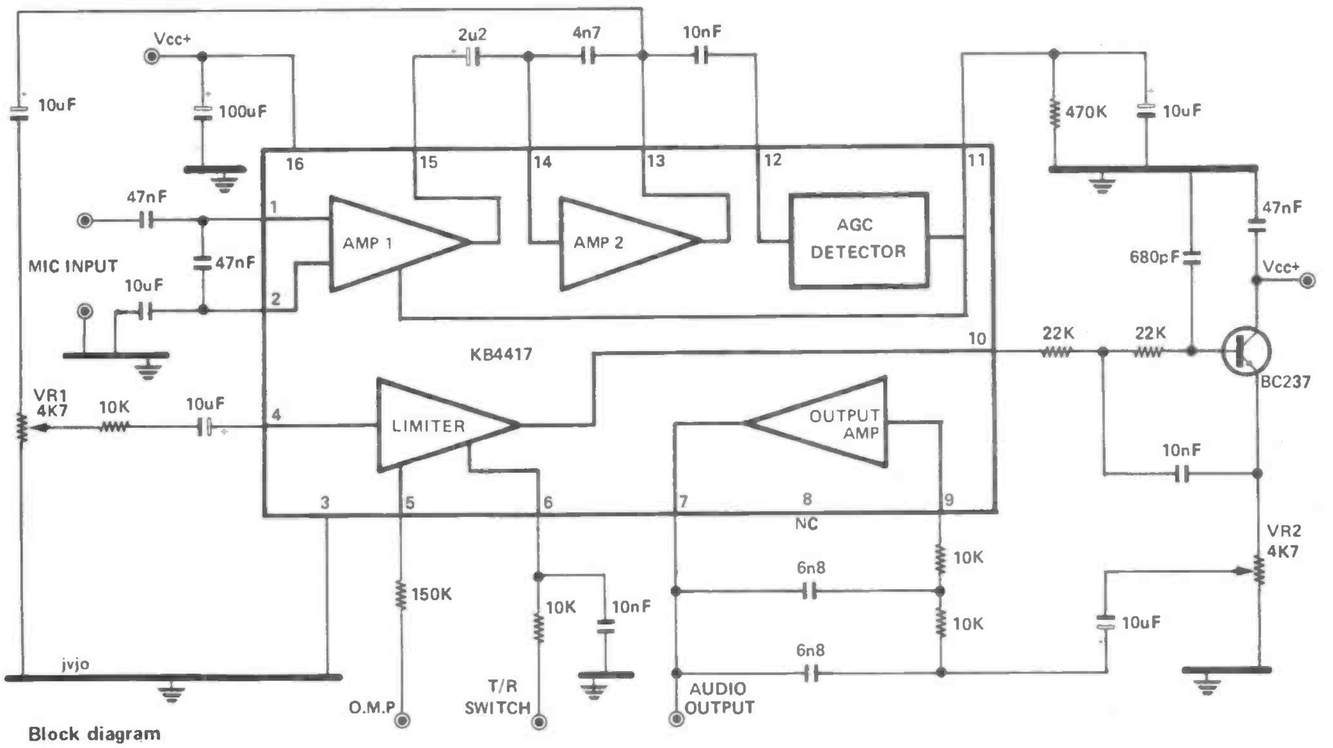
MAXIMUM RATINGS

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

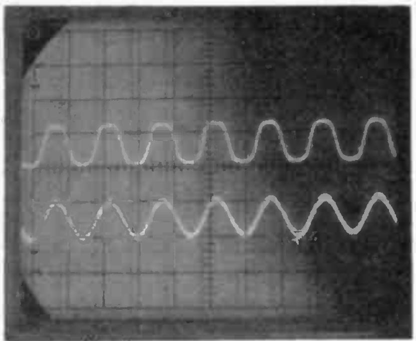
	Pin	Pin	
AMC IN	1	16	V_{CC}
AMC IN	2	15	AMC AMP_1OUT
GND	3	14	AMP_2 IN
LIMIT IN	4	13	AMC OUT
TRSW	5	12	AMC DET IN
OMP IN	6	11	CR TIME CONST.
AMP OUT	7	10	LIMIT OUT
NC	8	9	AMP IN

ELECTRICAL CHARACTERISTICS

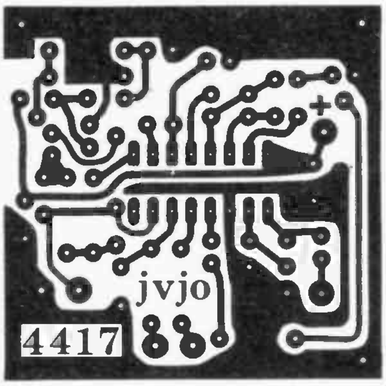
ITEM	NOTATION	MIN.	TYP.	MAX.	CONDITION
Current Consumption	I_Q		15mA		At no Signal
Microphone Amplifier					
Input Impedance	Z_{in}		600Ω		
Output Impedance	Z_{out}		1KΩ		
Output Voltage, (1)	V_o		260mV		MIC input: 1mV
Output Voltage, (2)	V_o		420mV		MIC input: 3mV
Distortion	T.H.D.		1%		MIC input: 3mV
Signal - Noise Ratio	S/N		55dB		
Limiter					
Input Impedance	Z_{in}		5KΩ		
Output Impedance	Z_{out}		1KΩ		
Distortion	T.H.D.		3%		Limiter Input: 3mV
Signal - Noise Ratio	S/N				
Limiting		80%			Reduction at 40mV input, relative to 400 mV - 100%
Amplifier					
Input Impedance	Z_{in}		5KΩ		
Output Impedance	Z_{out}		1KΩ		
Gain	G		30dB		
Distortion	T.H.D.		0.8%		Input - 10mV, 1kHz



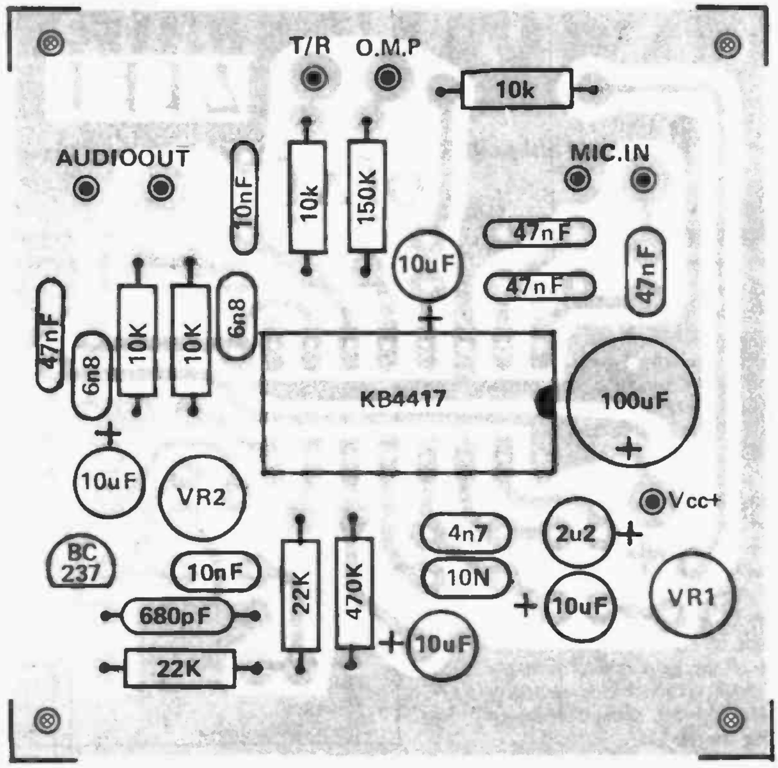
Block diagram



Lower: Sine input.
Upper: Output from limiter after filtering.



PCB foil



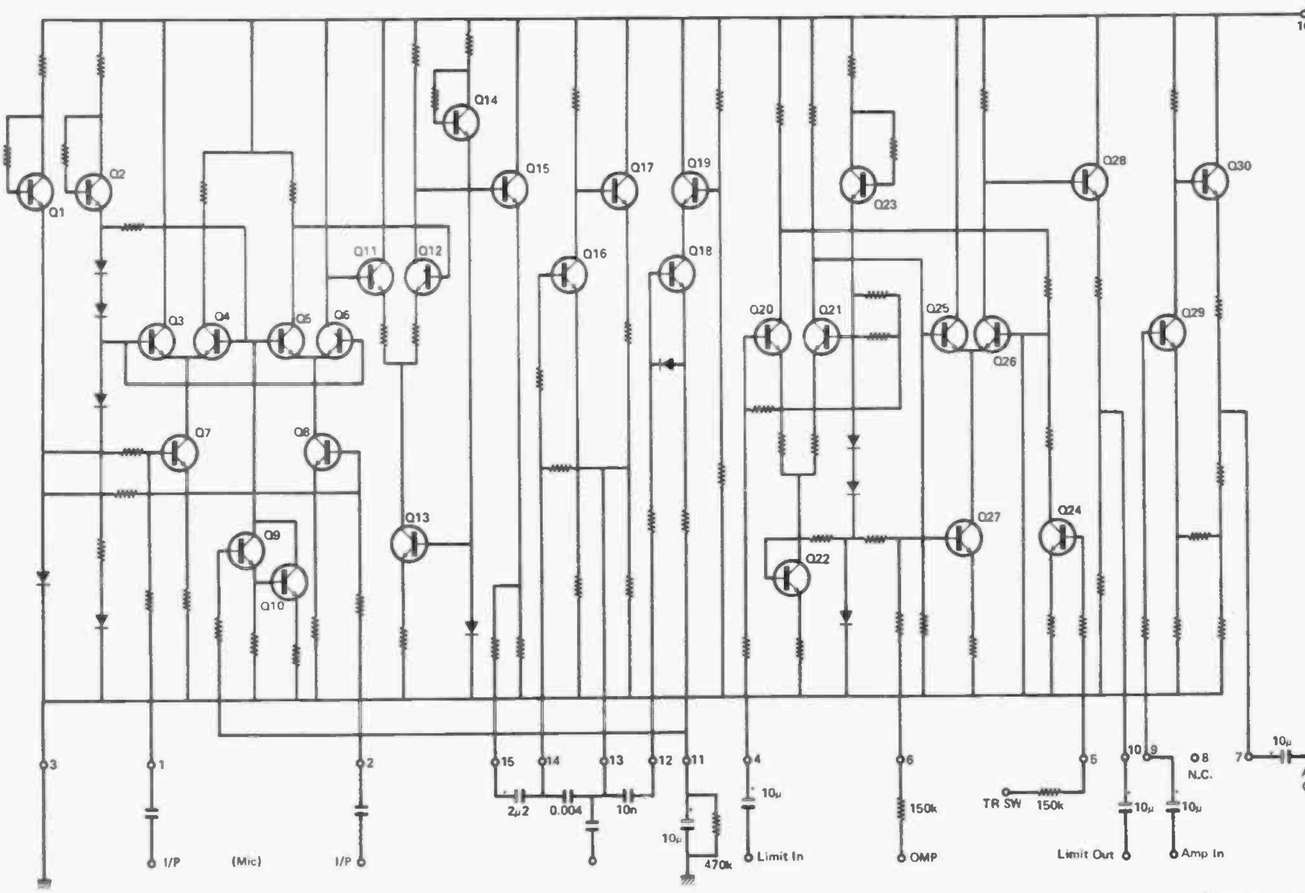
PCB overlay

Notes

Amp 1 clips at 2V PP O/P at pin 15. 50mV in 1V out.

Set VR1 with sinewave so that when AGC comes in, limiter does not quite start to clip output.

VR2 sets output voltage.



Internal circuit diagram

■ R & EW

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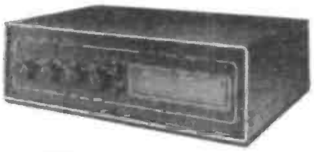

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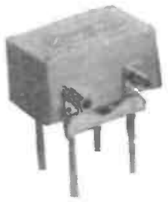

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FT1012DFM	POA
FT1012DAM	POA
FT1012AM	POA
FT1012FM	POA
PT707	POA
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FT1012DFM SOM/CAMP Full spec.	POA
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MBM48/70cm	48 element Multibeam	31.00 (3.00)
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8XY/70cm	Crossed 8 element yagi	36.80 (4.50)
PMH2/70cm	2 way phasing harness	9.20 (1.00)
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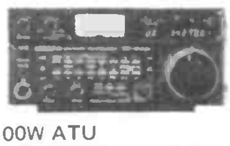

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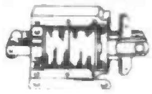

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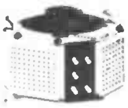

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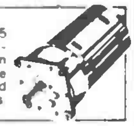
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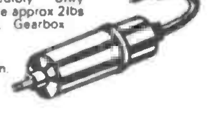
3-9v. D.C. operation, speed 2-6 R.P.M. Current consumption incredibly only **2-5 M. A.** Ratio 1670-1. Torque approx 2lbs inch plus. Motor – German. Gearbox Swiss.
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Shaft L. 5 mm. Shaft Dia. 2 mm.
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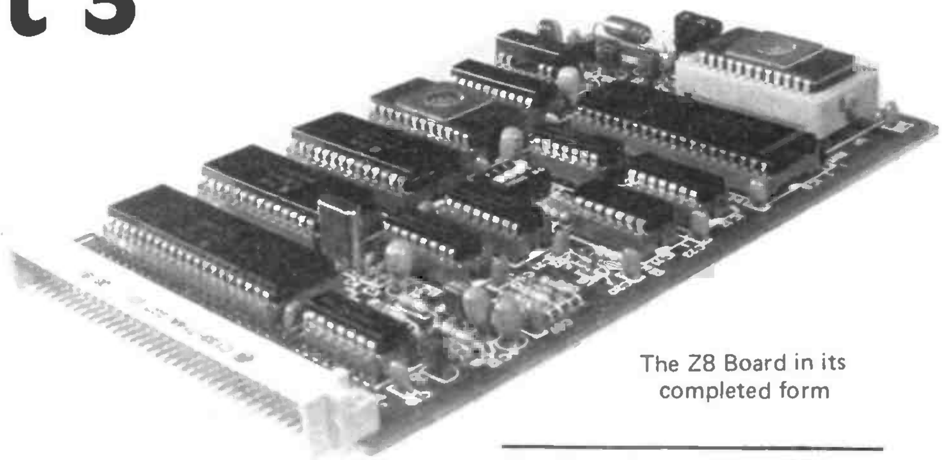
Z-8 DEVELOPMENT SYSTEM, Pt 3

In this concluding part of the Z-8 development board series we take a look at the "programmers view" of the Z-8 board, and reveal the facilities offered by the "Utilities ROM".



The Z8 Board in its completed form

See Page 86 For Price Details

SYSTEM MEMORY MAP

Figure 1 details the system memory map, locations O-FF hexadecimal are internal to the Z-8671. Locations 0,1,2,3 are the Z-8 I/O ports and in particular the Z-8 I/O ports 2&3 will be used in most Z-8 to outside world interfaces. (See the ASCII LCD display article). Memory locations 4 to 127 are general purpose Z-8 registers and are used by the BASIC interpreter for expression evaluation, and as pointers to the start of the program in main memory, etc. A more detailed explanation of the register usage is found in the BASIC/DEBUG language manual.

In a completely RAMLESS system these registers are also used for the storage of the current values of the VARIABLES A-Z, the input line buffer, and the GOSUB stack. The GOSUB stack overlays the top of the VARIABLE storage area, and therefore only the safety of the variables A-M can be guaranteed in a Z-8 design with no external RAM.

Registers 240-255 define the various operating modes of the Z-8 I/O registers and internal counter timers. *Fig 2* shows these registers and the effects of setting individual bits within them. Whilst we do not have the space to discuss the exact effect of each operation, *Fig 2* should provide a comprehensive view of the flexibility and configurability of the Z-8 design.

Memory locations 1000-2FFF hex are occupied by the two Z6132 RAM chips, providing 8K bytes of RAM for program development. RAM can be expanded externally up to a limit of AFFF hexadecimal.

Memory loctions B000-BFFF hex are occupied by a single 2732 type EPROM. This holds the Utility software, which at the moment occupies only about 2K bytes. The remaining 2K is thus free for further developments. This may include software to download, or upload BASIC programs from the serial data link or perhaps even a Z-8 Assembler program.

Memory locations COOO-CFFF contain the control registers of the single 8255 used for EPROM programming. The address bus is not fully decoded and the addresses COOO-COO3 repeat throughout the entire 4K byte block.

Any read or write to memory locations DOOO to DFFF hex will cause the input and output of the UART to be switched away from the terminal, and directed to the TTL 741s 125 buffers. This feature may be used to debug hardware dependant on the serial data link, without having to constantly plug and unplug the terminal. A single line of BASIC is used at the start of the program to switch the data stream over, and a single line at the end of the program restores the data stream back to the terminal. This feature is also made use of by the cassette interface. Any read or write to memory locations EOOO-EFFF hex will restore the serial data stream to the RS232 drivers and the terminal. Pressing the reset button will also have the same effect.

Any Read of locations FOOO-FFFF hex will enable the current value of the BAUD rate switches onto the data bus, the switches are only read after a reset, and only bit 0,1, & 2 are used. Thus the port may be used as a general input port at other times.

MEMORY ADDRESS	
0000H	Z–8 I/O PORT
0001H	Z–8 I/O PORT 1
0002H	Z–8 I/O PORT 2
0003H	Z–8 I/O PORT 3
0004 – 007FH	Z–8 GENERAL PURPOSE REGISTERS
0080 – 00FFH	Z–8 CONTROL REGISTERS
1000 – 2FFFH	8K BYTES OF RAM
B000 – BFFFH	UTILITY EPROM
C000H	8225 PORT A
C001H	8225 PORT B
C002H	8225 PORT C
C003H	8225 MODE CONTROL REGISTER
D000 – DFFFH	LATCH TO SWITCH SERIAL DATASTREAM
E000 – EFFFH	LATCH TO RESTORE SERIAL DATA STREAM
F000 – FFFFH	BAUD RATE SWITCHES

Figure 1: System memory map.

WRITING AND MAINTAINING PROGRAMS

Z-8 BASIC is very similar to most other BASICS. However, it is completely under the programmers control as to where his program is stored in memory by the interpreter. This makes it easy to have several different programs in the computer at once and to switch at will between them.

The word (two bytes) stored in register R8 of the Z8671 defines the memory location which is to be used as the start of

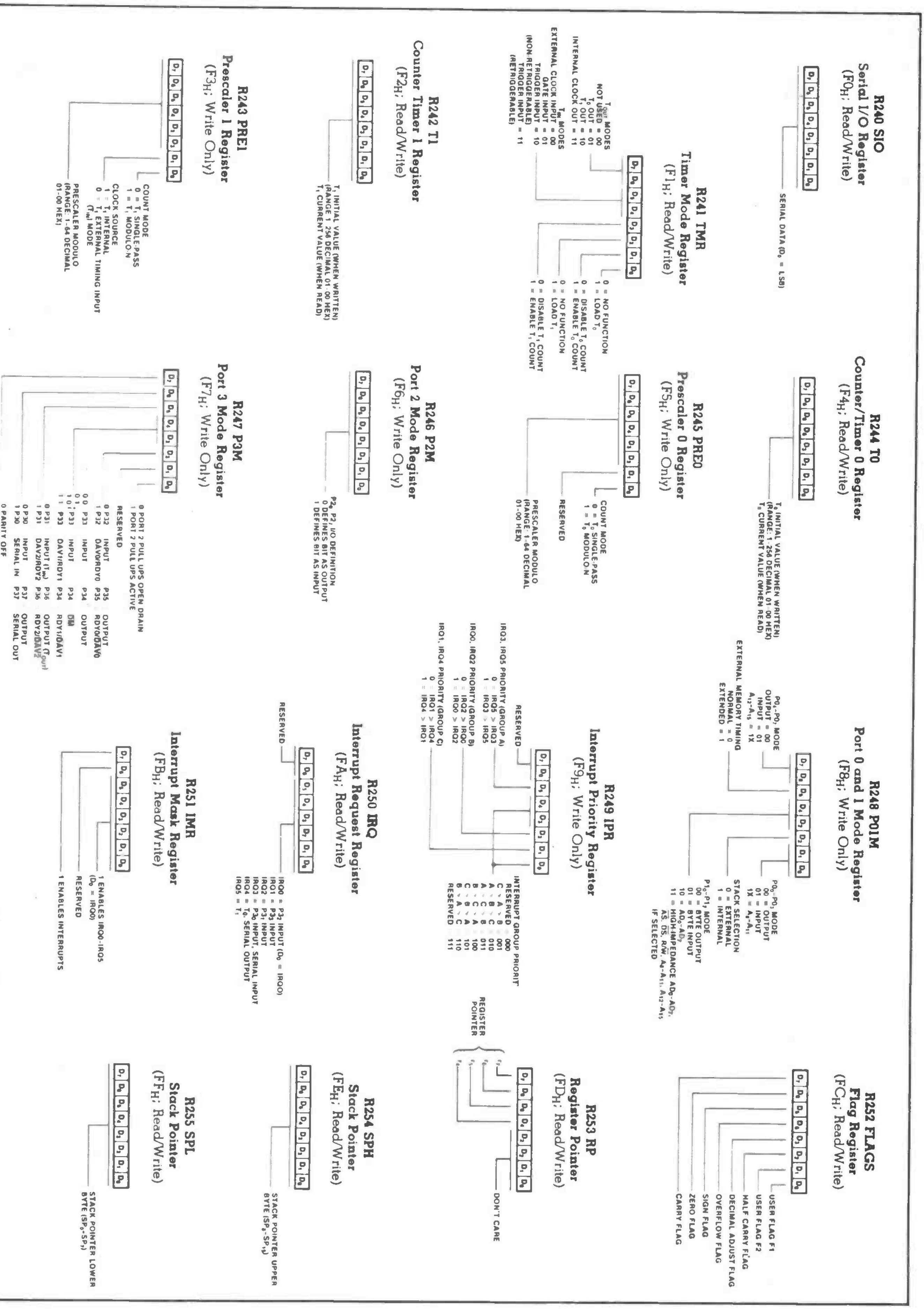


Figure 2: Control registers.

the program entry. It is thus possible to start entering a program at say 2000 hex simply by typing:

∧ 8 = %2000 <Return>
NEW <Return>

The first line assigns the value 2000 hex to the word at location 8, the second command initialises various pointers which depend on the value currently held in register 8.

To change to entering a new program it is only necessary to type:

∧ 8 = %(NEWPROG) <Return>
NEW <Return>

N.B. The syntax of (NEWPROG) means the value of the starting address of the new program.

The previous program will not be destroyed unless the new program memory space overlaps it. To return to the previous program it is necessary to find out the end address in memory of that program, and to do this a utility provided in the utility EPROM is used (see 'Using The Utilities'). Then the following is typed:

∧ 8 = %(End of prog) <Return>
NEW <Return>
∧ 8 = %2000 <Return>

This procedure insures that the BASIC interpreter is correctly set up for further edits and code entry to the previous program.

Lines of code are stored in memory without keyword compression and in pure ASCII, apart from the line number, and end of line markers. The line number is stored as a sixteen bit binary number, and the end of a line is marked by a zero byte. The end of a program is marked by the illegal line number of 65535, FFFF hex. *Fig 3* shows an example of a small program and its representation in memory.

```
10 I=5
20 PRINT "WELCOME TO BASIC/DEBUG"
30 I=I-1: IF I
40 STOP

00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00   *................*
00 00 00 00  00 00 00 00  00 00 00 C0  00 00 00 00   *................*
00 0A 49 3D  35 00 00 14  50 52 49 4E  54 20 22 57   *..I=5...PRINT "W*
45 4C 43 4F  4D 45 20 54  4F 20 5A 38  20 42 41 53   *ELCOME TO Z8 BAS*
49 43 2F 44  45 42 55 47  22 00 00 1E  49 3D 49 2D   *IC/DEBUG"...I=I-*
31 3A 20 49  46 20 49 3E  30 20 47 4F  54 4F 20 32   *1: IF I>0 GOTO 2*
30 00 00 28  53 54 4F 50  00 FF FF 00  00 00 0C 00   *0..(STOP........*
00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00   *................*
```

Figure 3: A small program and its representation in memory.

THE EPROM PROGRAMMER

Software provided in the utility EPROM provides for the transfer of RAM to EPROM and also EPROM to RAM. The hardware of the EPROM programmer is relatively simple. An 8255 PPI is used in its mode zero interface mode. It appears to the Z-8 as four memory locations, location C000 is used to read or write data to the EPROM, locations C001 & Bits 0-3 of C0002 allow the outputing of the desired address to the EPROM, whilst location C003 is the Control register of the 8255 and allows the setting up of the PPI operating mode. Bit 4 of the C002 location is used to control a small relay which allows the EPROM programming socket to be completely powered down, making it safe to remove and insert EPROMS without having to completely powerdown the whole of the Z-8 computer.

Bits 5 & 6 of C002 are used to provide the programming waveform to the EPROM, which is detailed in *Fig 4*. The 50 mS delay involved is generated in software by performing a timewasting addition and subtraction routine.

The hardware and software is configured to correctly program and read 2732 type EPROMS. It is possible by a simple lead scrambler to accommodate a 2716 type EPROM, and bit 8 of C002 is available on the PCB to be used in conjunction with a lead scrambler for the programming of 2764 type EPROMs.

The 8255 may also be used as a further I/O port. The nature of the Z-8 to 8255 interface is rather diferent in timing to the standard 8080 to 8255 interface, it has been found that some makes of 8255 do not perform reliably, if at all. In view of this we recommend that only National Semiconductor devices are used, as these would appear to perform without problem. Also the 8255 has so far only been tested in the simple MODE 0 (See 8255 PPI data sheet) interface operation, required for EPROM programming.Thus no guarantee is given about the success of other modes of usage, until further experiments have been carried out.

THE UTILITIES

The 2732 EPROM at BOOO hex contains various useful routines to aid in the maintenance of programs and the production of EPROMs; a full listing is included with every EPROM. All of the utility software apart from the Cassette routines are written in BASIC and thus provide an ideal opportunity to study some real Tiny BASIC code. It is hoped to provide increasingly better versions of the monitor as time and authors allow; anyone writing a better version of the current monitor is invited to submit it for evaluation to us here at **R&EW**.

The utilities currently provided are:

RAM to EPROM: This program transfers the data between <RAM START ADDRESS> to <RAM STOP ADDRESS> into an EPROM starting at <EPROM START ADDRESS>. The software allows for partial EPROM programming and updating.

EPROM to RAM: This program transfers data from <EPROM START

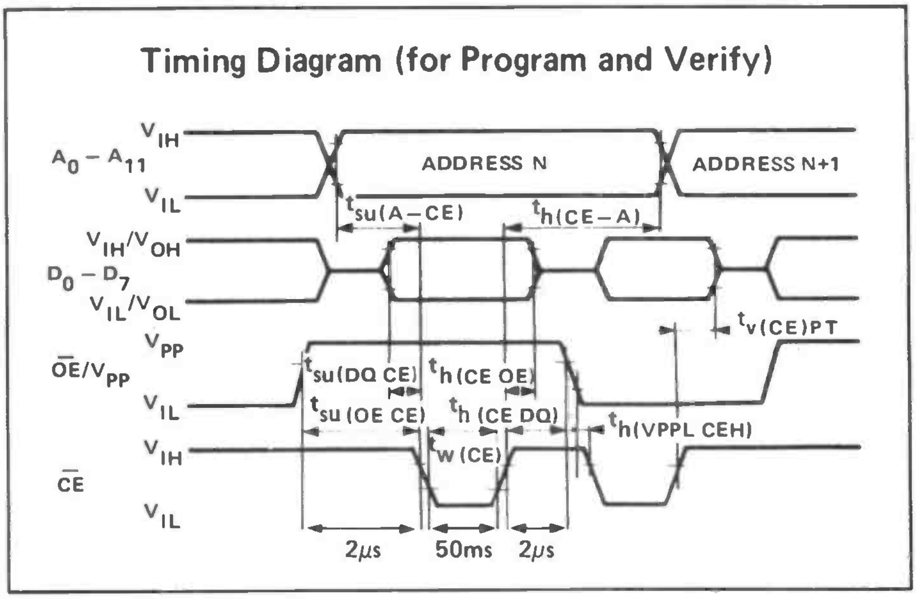


Figure 4: 2732 EPROM programming waveform

ADDRESS (hex)	(decimal)	CONTENTS
F0-FF	240-255	Z8671 control registers. See map for RAM system.
80-EF	128-239	No registers are implemented at these addresses.
68-7F		The Expression Evaluation stack grows from 7F (hex) down, and the line buffer grows from 68 (hex) up.
40-67	64-103	GOSUB stack; grows down.
40-55	64-85	Area shared by variables M-Z and GOSUB stack. Variables are destroyed if stack grows into this range.
22-55	34-85	Variables A through Z.
21	33	Free register, available for USR subroutine.
20	32	Print column counter, contains current cursor location.
1F	31	Internal variable. Do not modify.
1E	30	Basic/Debug uses as scratch. USR subroutine may use, but cannot save values here.
1C-1D	28-29	Pointer to constant block.
18-1B	24-27	Internal variables. Do not modify.
16-17	22-23	Current line number.
14-15	20-21	Second argument in three argument USR subroutine call.
12-13	18-19	Last argument and result in USR subroutine call.
10-11	16-17	Basic/Debug uses as scratch. USR subroutine may use, but can not save values here.
0E-0F	14-15	Pointer to next character to be used in input buffer.
0C-0D	12-13	Pointer to the end of the line buffer. R12 defines the page containing the variables, and so contains 00 to indicate the registers.
0A-0B	10-11	Pointer to bottom of GOSUB stack. Initialized to 68 (hex).
08-09	8-9	Pointer to start of Basic program. This address will be in external ROM, usually 1020 (hex) for auto-start up.
06-07	6-7	Pointer to top of GOSUB stack. Since stack is in registers, 00 will be in R6 and the register number in R7.
04-05	4-5	Free register. Available for USR subroutines.
00-03	0-3	Z8671 I/O ports.

Figure 5: Register deployment in RAMless Z8 system

ADDRESS> to <EPROM STOP ADDRESS> to RAM, starting at <RAM START ADDRESS>. Programs already in EPROM can be loaded back into memory for modification and execution.

RAMMOVER: This program moves a block of RAM starting at <RAM START ADDRESS> and ending at <RAM END ADDRESS> to a new location starting at <NEW START ADDRESS>. The move is performed from the highest address first and thus allows large blocks to be moved by small amounts.

RAMDUMP: This program provides a formatted hex and ASCII dump of memory starting at <RAM START ADDRESS> and ending at <RAM END ADDRESS>.

RAMCHANGE: This program allows memory, starting at location <RAM START ADDRESS> to be examined and changed if desired.

CASSETTE WRITE: Dumps the contents of memory from <RAM START ADDRESS> to <RAM END ADDRESS> to the cassette interface via the auxillary serial I/O port.

CASSETTE READ: Takes the data from cassette and write it into memory starting at <RAM START ADDRESS>.

All of the above programs are self explanatory in use and accept the inputting of data in either DECIMAL or HEXADECIMAL form, if prefixed by the % operator.

The UTILITIES are executed simply by typing:

```
^8=%B000      <Return>
RUN           <Return>
```

FURTHER Z-8 DEVELOPMENTS

We will be continuing to support our commitment to the Z-8, with the publication of a minimum chip Z-8 design, and a number of interesting Z-8 based designs, details of which will appear in the next few months. In the meantime, any budding authors with good ideas are invited to drop us a line and sound us out. You never know we may just give you the bits to get the project under way!

Finally I should like to acknowledge the immense amount of help and support offered to us by Zilog UK in the planning and "hand holding" stages of this project. Particularly Mike Quee and Brian Jasper who made it all possible. NB. Z-8 is the registered trade mark of ZILOG INC.

■ R & EW

Your Reactions.........	Circle No.
Excellent - will make one	147
Interesting - might make one	148
Seen Better	149
Comments	150

METAL DETECTORS IN MEDICINE

Metal Detectors have been in use by the medical profession for over a hundred years. Richard Turner describes their history, and introduces a revolutionary new British design, in the next few pages.

AS A RESULT OF THE attempted assassination of America's 20th President, James Garfield, in July 1881, Alexander Graham Bell built an instrument for locating bullets and other metal objects buried in the human body. His design was based on the Induction Balance (IB) principle (see *Fig 1*) developed by Professor David Edward Hughes and demonstrated to the Royal Society in London two years previously. Initial laboratory tests showed that the Bell Bullet Probe could detect a pistol bullet buried four inches deep in the carcass of a dead cow, kindly loaned by the local butcher.

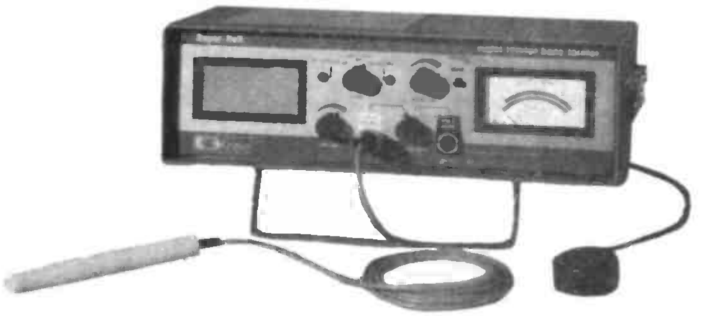
With the permission of the attending physicians, Bell performed a test on the wounded President, but the experiment was unfortunately marred by the metal springs in the patient's mattress.

Bell continued his experiments to improve the bullet detector. In the course of this work he invented another metal-detecting device, known as the Telephonic Probe. This was a very simple unit, consisting of a silver plate and a fine needle connected to a telephone: The patient's body effectively formed a galvanic battery, with the bullet forming one pole and the silver plate the other. When the needle contacted the bullet a click could be heard in the telephone.

Following the death of the President, the American medical profession showed no further interest in the Bell device. Further development work continued in England, however, and the Telephonic Probe was further improved by British surgeons Sir James Mackenzie Davidson and Sir Frederick Treves. It subsequently helped save the lives of thousands of wounded soldiers during the Boer War (1899-1902) and the Great War of 1914-18. The Induction Balance instrument, meantime, went into manufacture with Groves Instrument Makers, and is recorded to have been successfully used at a London hospital on 13th March 1887 to locate a broken needle in the thumb of a patient.

WORLD WAR 2

In the second year of World War 2, further developments took place, more or less simultaneously, in England, Germany and the USA. The Germans claimed to have invented a medical metal detector at about the same time as a British device was developed at the Barnato Joel Laboratories. An American detector came



The Roper-Hall locator, with one probe attached.

somewhat later and is known to have been used at Pearl Harbour, for locating shrapnel in victims of the attack.

The American instrument was manufactured by Waugh Laboratories of New York and was known as the 'Berman' detector, after its designer, Samuel Berman. The design was basically an electronic version of Alexander Graham Bell's IB device of 1881. The old interrupter was replaced by a high frequency oscillator, and the humble telephone was replaced by a valve amplifier driving an output transducer. The British and German detectors operated on the Beat Frequency Oscillator (BFO) principle at VHF.

The Berman detector dominated the post-war medical scene for many years, until new designs from Keeler Optical and the Burdick Corporation became available. Keeler's 'Balanced Coil' detector was designed by Bruce Goring Kerr and was manufactured by his company exclusively for Keeler Optical Products Ltd., a company renowned for their medical and optical equipment. Burdick Corporation's detector was designed by Warren S Gilson and operated on the BFO principle at 5.5 MHz.

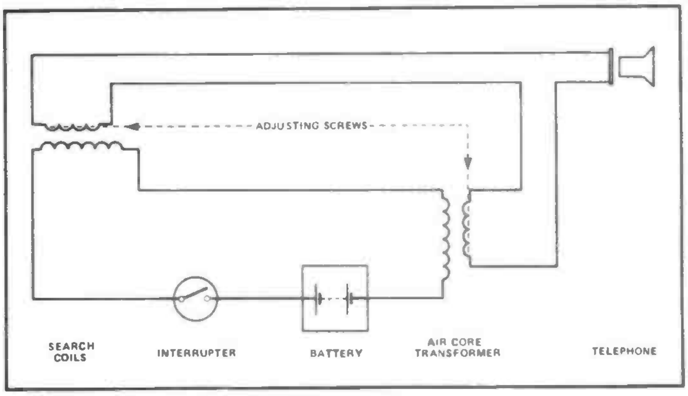


Figure 1: Basic circuit of A G Bell's Induction Balance metal detector of 1881.

NEW TECHNOLOGY

Goring Kerr Ltd., Windsor-based manufacturers of professional and industrial metal detectors, have recently completed a three year R & D project that has culminated in the development of a new and highly sophisticated type of metal detector for use by the medical profession. The new instrument has been developed in co-operation with the Department of Health, with Mr M J Roper-Hall (consultant Opthalmologist to the Queen Elizabeth and the Birmingham & Midland eye hospitals) acting as medical adviser, and is known as the Roper-Hall locator.

The Roper-Hall locator enables the user to find and identify different types of metal (ferrous or non-ferrous, or a combination of the two) by audible tones. Ferrous objects produce a continuous tone, non-ferrous a pulsed tone. The instrument operates at VLF and incorporates automatic drift stabilization circuitry, to ensure hassle-free operation.

The new detector consists of a small portable unit and a set of probes, plus accessories. The instrument's front panel has only five manual controls, these being the FUNCTION switch, SENSITIVITY and VOLUME controls, a PROBE SELECTION switch and sensitivity RESET button. The unit stabilizes within ten seconds of switch-on. Two different probes can be connected to the unit simultaneously; thus, a general search can be carried out with the long-range probe and, when contamination has been detected, the precise location can be determined by the short or the side-sensing probe. Audio-visual indication of the presence of metal is given via a loudspeaker and a moving-coil meter. The unit

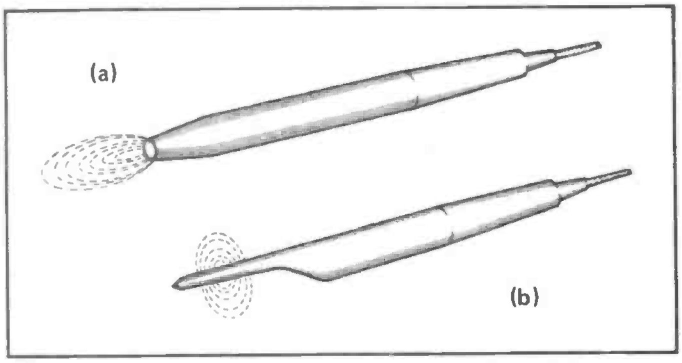


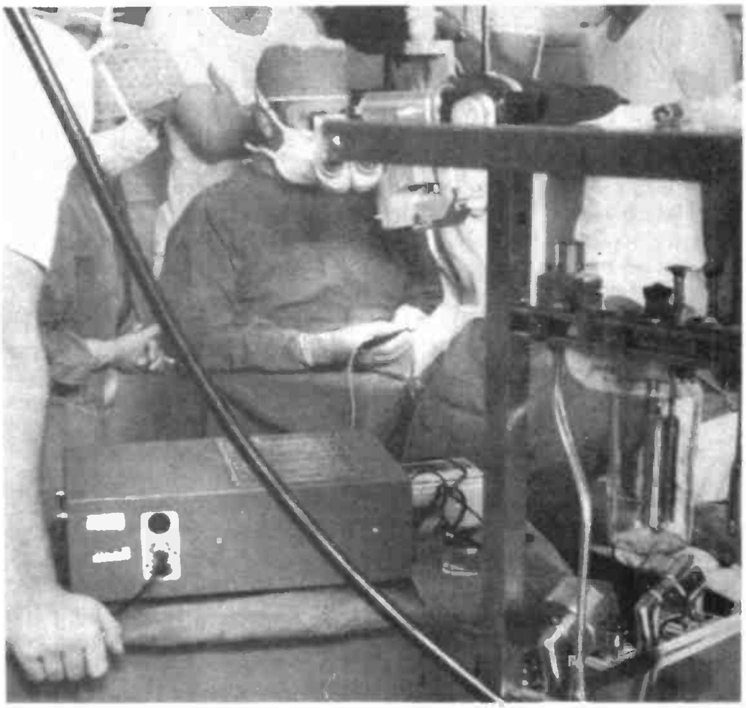
Figure 2: The magnetic field patterns of the probes of the Roper-Hall locator. (a) side-sensing probe, (b) end-sensing probe.

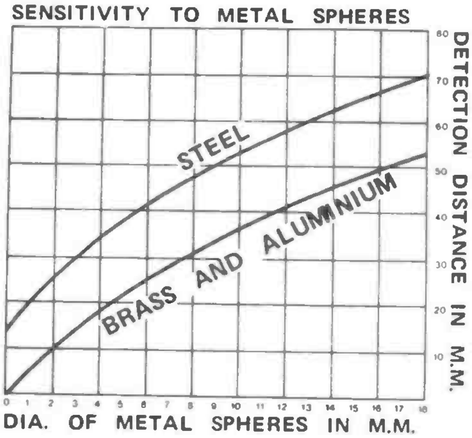
is battery powered, giving 18 hours of continuous operation per charge.

Three probes are supplied with the instrument. Two of these are end-sensitive types. The third probe is side-sensitive and is meant to be inserted right into a wound or incision to precisely locate small particles of metal. *Fig 2* shows the field patterns of the two basic types of probe, and *Fig 3* shows the sensitivity graphs of all three probes. Note that the long-range probe can detect a 1mm diameter piece of steel at a range of 20mm.

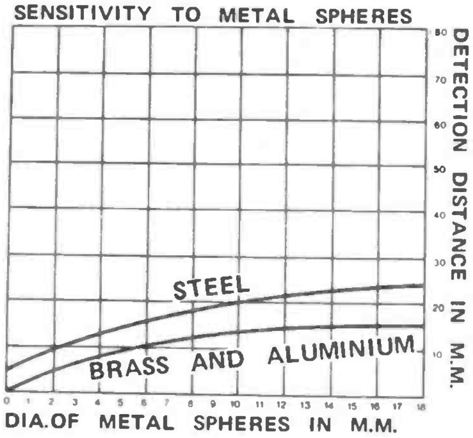
Accessories supplied with the Roper-Hall locator include a 'remote' meter, which can be placed close to (or on top of) the

Mr M J Roper-Hall using the locator during an operation at the Birmingham & Midland eye hospital.

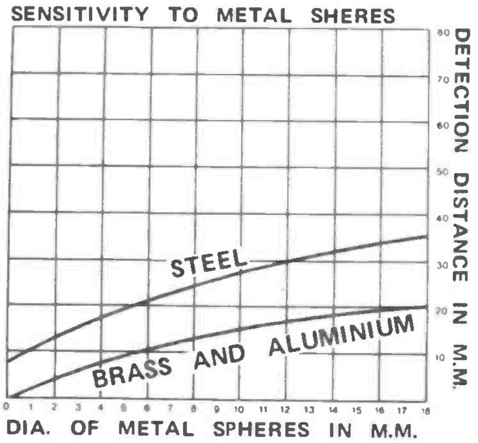




LONG RANGE PROBE



CLOSE RANGE SIDE SENSITIVE PROBE



CLOSE RANGE END SENSITIVE PROBE

Figure 3: Sensitivity graphs of the three Roper-Hall probes.

body of the patient when a delicate search is being made, and a foot switch which can be used to give a rapid reset of sensitivity. These accessories enable the doctor/surgeon to give maximum concentration to the search of the patient's body,with a minimum of distraction.

APPLICATIONS

Pieces of metal enter the human body in a variety of ways and from a variety of sources. High velocity bullets often fragment after entering the body, becoming difficult to locate. Shot-gun injuries present similar problems. Psychiatric patients sometimes inflict self-injury by burying needles in themselves or swallowing small pieces of razor blades etc. Small children are particularly vulnerable to unlikely-sounding injuries. Eye injuries in adults are often inflicted by small pieces of flying metal, such as flakes of steel from chisels, etc.

One of the most disturbing sources of 'stray' metal is the medical profession itself. Medical Defence Union reports indicate that many patients have ended operations with surgical instruments sewn up inside them. Back in 1962 there were 40 cases reported in the UK. By 1979 the figure had risen to 120.

In most instances, preliminary searches for metal are carried out by X-Rays. This technique is not always practical, however, particularly in the case of eye injuries, where a metal flake may actually 'swim' in the liquid of the eye and change its position as the patient moves. Similarly, fragmented pieces of metal may actually be 'mobile' in the body of a live patient, in which case the X-Ray plate only shows where the particle was at the time the X-Ray was taken, not where it is at the moment that the surgeon wants to operate.

Once a piece of metal has been located inside a patient's body, it can be removed by the doctor or surgeon. If the metal is non-ferrous, it usually has to be removed byconventional 'cut and sew' surgical methods. The Roper-Hall locator is particularly helpful here, as the front- and side-sensing probes can be used to indicate precise points at which a new cut should be made.

If a piece of ferrous or partly-ferrous metal is lodged inside the patients body, it can often be removed with a powerful electro-magnet, without the need for conventional surgery. A very thin steel probe is inserted into the body of the patient via the original course of the entry of the object, until contact is made. A large electro-magnet - which can be up to one metre in diameter - is then placed over the patient and switched on. The resulting powerful magnetic field is effectively concentrated via the steel probe, enabling the offending metal object to be withdrawn via its original course of entry and eliminating the need for cutting. The Roper-Hall locator's ability to identify the nature of metals is of great value to the surgeon, simplifying his task of opting for 'conventional' or electro-magnetic extraction techniques.

MILITARY APPLICATIONS

The Roper-Hall locator is well suited for military use in battlefield surgery. The unit is fully portable and carries operating instructions on the upper surface, enabling surgeons to quickly familiarize themselves with its operation. Disposable sheaths are supplied with the instrument, for fitting over the probes and leads, enabling sterile conditions to be maintained with minimal effort and thereby facilitating a rapid turn round of casualties under arduous battlefield conditions.

The Roper-Hall device is manufactured by Keller Optical Products Ltd., of Windsor, and is probably the most sophisticated 'medical' metal detector in the world today. And, by jove, its one hundred percent British!

Acknowledgement:

The author thanks Keeler Optical Products Ltd for the provision of photographs and for the demonstration of the Roper-Hall Locator.

References:

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■ R & EW

Your Reactions

	Circle No.		Circle No.
Immediately Applicable	9	Not Applicable	11
Useful & Informative	10	Comments	12

R&EW Data Brief

KB 4413

DATABRIEF - KB4413 Communications detector system

The KB4413 is a unique IC that combines an AM peak detector, a balanced product detector for SSB (although usable as an RF/IF mixer in its own right), AGC and meter detector/drivers, a carrier derived squelch and an effective peak limiter for automatic noise limiting.

The IF signal for AM detection is fed to the base of Q2 which operates as a simple peak detector, with IF signal decoupled via pin 13. The detected DC level is then fed to the AGC amplifier, after removing the audio with the capacitor at pin 16. The positive going AGC signal appears at pin 15, and is also fed along to the signal meter driver (Q8-Q11) and the carrier level squelch.

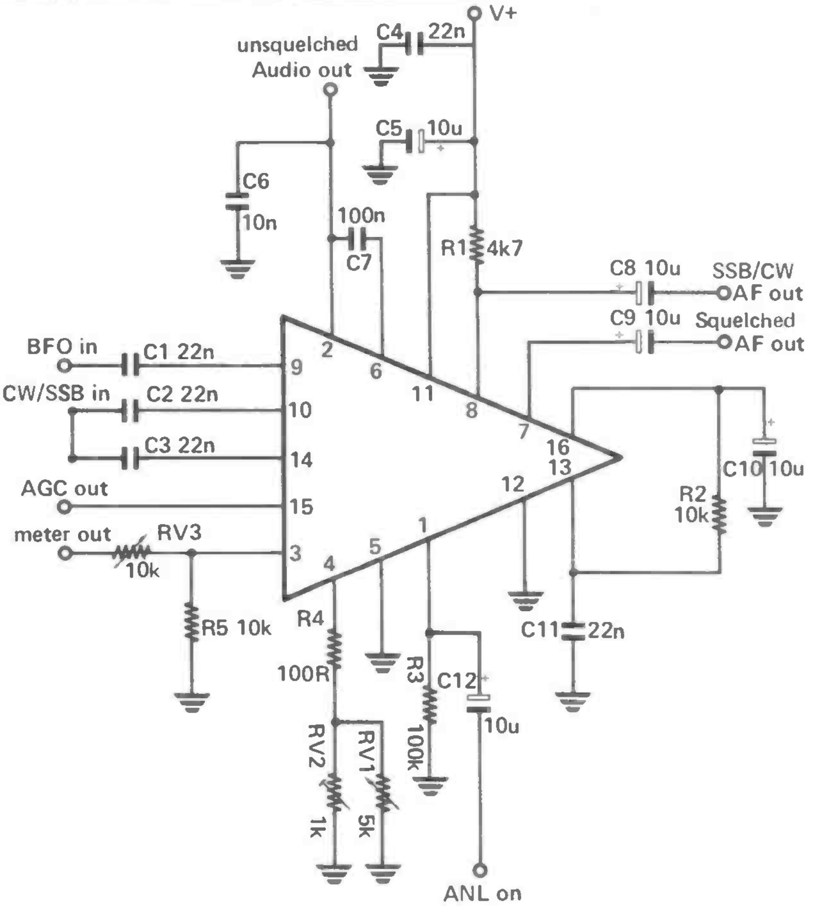
The squelch circuit level is set by the preset at pin 4, which adjusts the threshold for the schmitt trigger formed by Q22/Q23. The actual squelch audio gate is a derivative of a balanced mixer (Q16-Q21) which provides noiseless switching of the audio signal fed in at pin 6 after emerging from the ANL at pin 2. The bases of Q17/Q18 are fed by the switching signal derived from the trigger, allowing the audio signal at the bases of Q16 and Q19 to pass through to the collectors of Q17/Q18 where the differential amplifier formed by Q24 and Q25 feeds the 'squelch' audio onto the next stage via the buffer preceding pin 7.

The audio fed to the differential amplifier around Q5 and Q6 is optionally clipped by D7 when the capacitor is switched in across pin 1. The ANL is provided with carrier-derived AGC via Q4/Q7 to stabilize the correct operating point and prevent clipping on signal peaks. The result appears at pin 2.

The final stage provides the balanced mixer/product detector. This is a classic configuration that will be recognized by communications engineers, where one signal is fed to the bases of the transistor tree, and the other is used to 'switch' the emitters. The product is taken at pin 8, which can be either a resistor or tuned circuit.

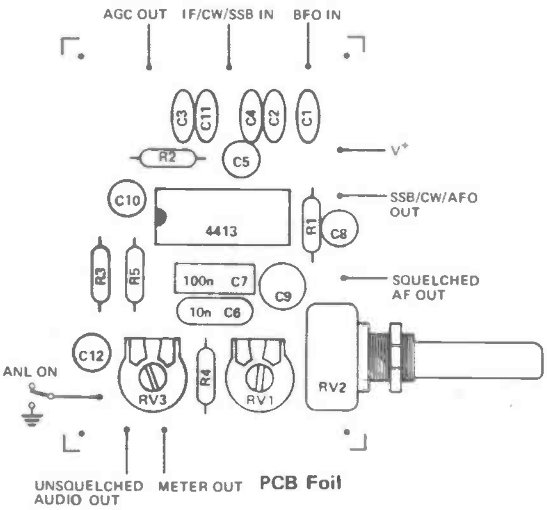
ELECTRICAL CHARACTERISTICS T_a = 25 C, V_{cc} = 8V, f = 455kHz

Item	Notation	Min.	Typ.	Max.	Condition
Current Consumption	I_Q		13mA		At no signal
Detector Output, I	V_o		30mV		Input: 100d Bu
Detector Output, II	V_o		110mV		110d Bu
Signal-Noise Ratio	S/N	50dB			100d Bu at 30% mod.
Distortion, I	T.H.D.		0.5%		110d Bu
Distortion, II	T.H.D.		1%		110d Bu 80% mod.

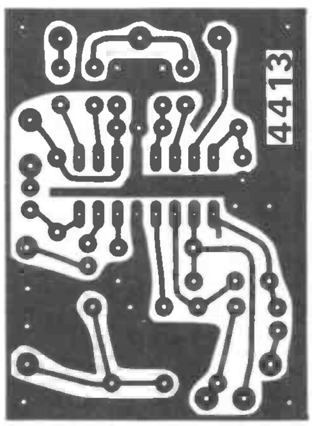


MAXIMUM RATINGS

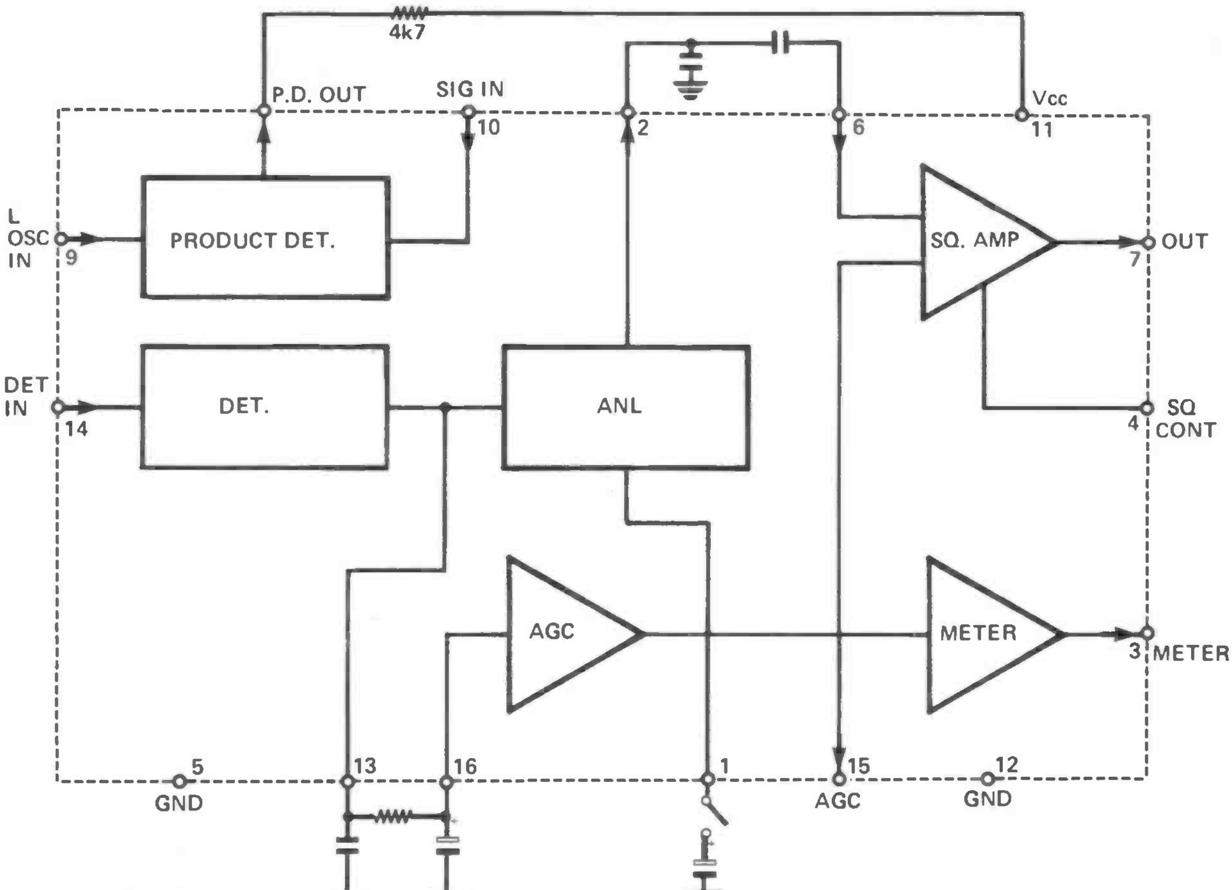
ITEM	NOTATION	RATING (max.)
Supply Voltage	V_{CC}	16V
Power Consumption	P_T	500mV
Operating Temp.	T_{opr}	−25° to +60° C
Storage Temp.	T_{stg}	−30° to +125° C



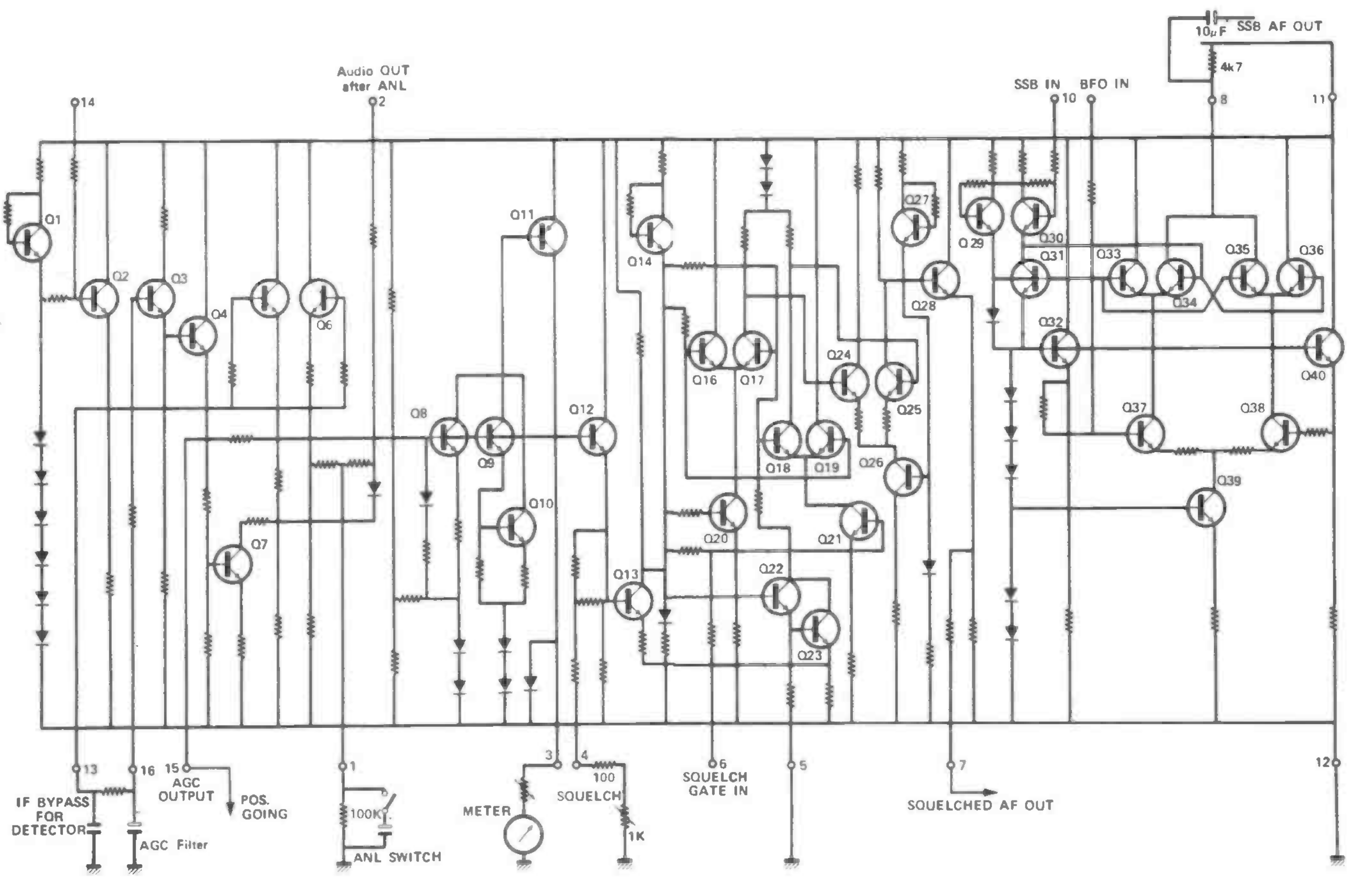
PCB Foil



PCB Overlay



Block diagram



Internal circuit diagram

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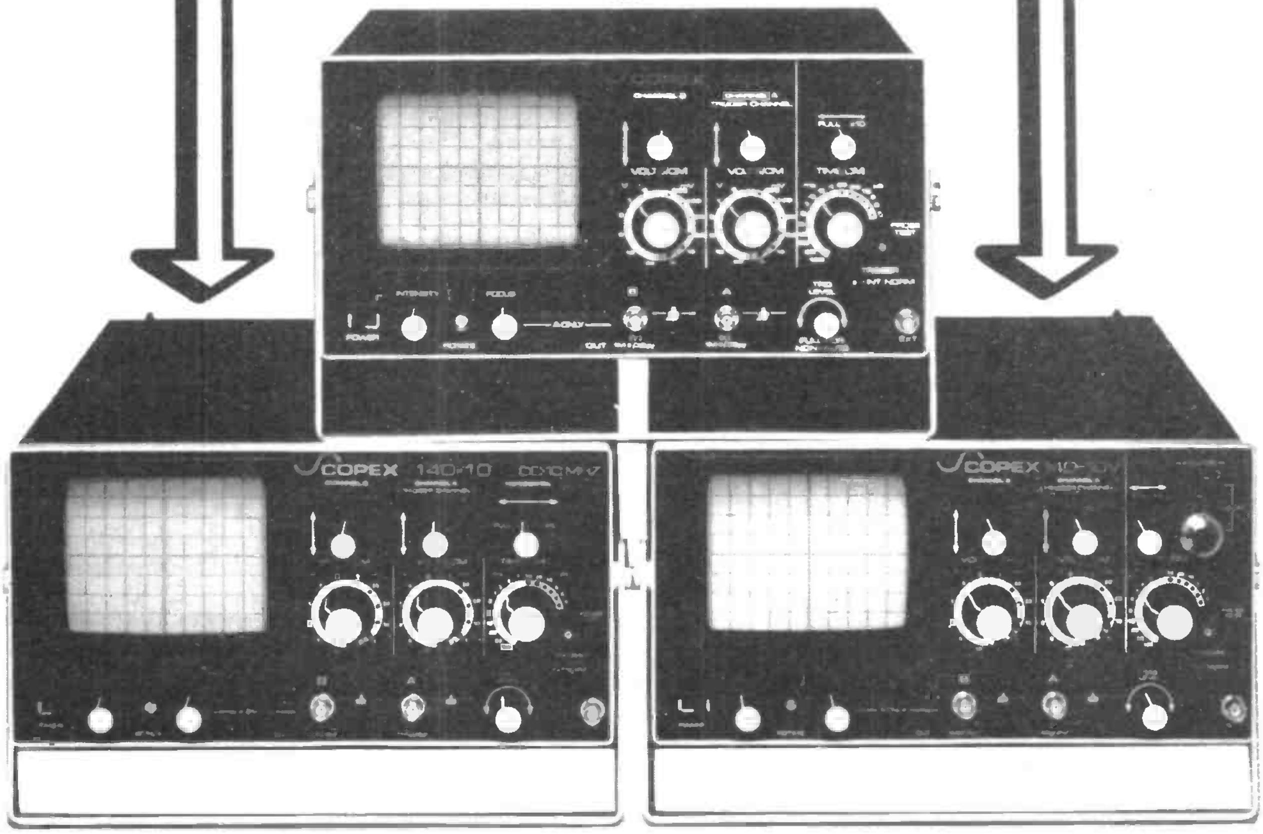
Spoilt for choice

14D-10
2mV/cm at 10MHz

14D-15
15MHz
Active TV sync.

14D-10V
Line selector
Active TV sync.
2mV/cm at 10MHz



Scopex Instruments now offer you an unrivalled choice of oscilloscopes at under £300.

The straightforward and successful 14D10 with a sensitivity of 2mV/cm at 10MHz on both channels at £240 + VAT. The new 14D15 15MHz dual trace 5mV/cm with active TV sync separator at £250 + VAT and the sophisticated 14D10V 10MHz dual trace 2mV/cm active TV sync. separator and line selector at £290 + VAT.
All these above prices include two probes, mains plug and carriage U.K. mainland.
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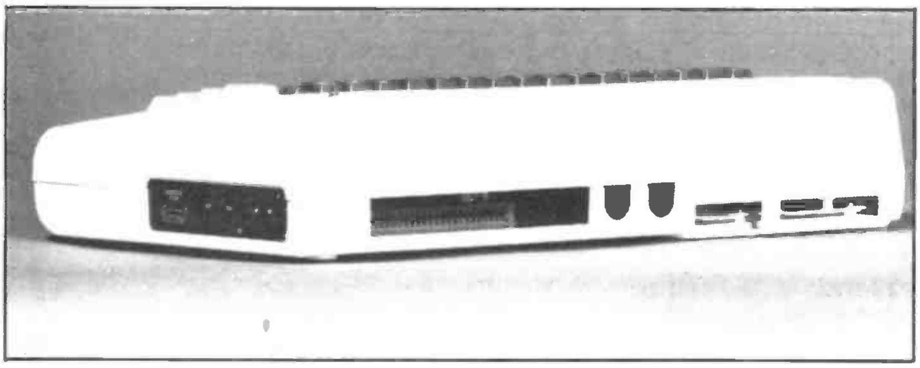
VIC—20 COMPUTER REVIEW

The Commodore VIC-20 is a full-blown computer that provides colour Video and programmable sounds at a rock-bottom price. How good is it? Ashley Grant gives his opinion in the next couple of pages.

The VIC-20 is a consumer-orientated computer system that, when coupled up to an ordinary domestic colour TV set, can produce multi-colour displays & complex sound effects of the owner's (programmer's) choice. The system can be used as a conventional 'home' computer or as a TV games machine - using games cartridges and 'joy stick' accessories. The outstanding feature of the VIC-20 is its price - well under £200 for the basic system: as a computer, the VIC-20 is comparable with the TRS-80 and the Atari 400, which cost two or three times as much.

The VIC-20 is produced by Commodore, the makers of the Pet computer, and has many similarities with its illustrious forebear. It uses the same version of the Basic language as the Pet, so is very easy to program, even for the 'first time' computer operator. It has a full-size typewriter-style multi-function keyboard that is almost identical to that of the Pet, the keys being legended with both alpha-numerics and the graphic character set. The VIC-20 even uses the same basic microprocessor as the Pet (the 6502), but uses a high-speed version of the device and runs at twice the Pet's speed. It performs nine-digit full floating-point mathematical operations, as a standard feature.

Detailed view of the keyboard.



Rear view of the VIC-20 showing the user sockets.

The basic version of the VIC-20 is supplied with 5 K of RAM, with 1.4 K used to store system variables, cassette buffer and screen memory, and the remaining 3.6 K available to the user for Basic programs. Plug-in cartridges are available which allow the user memory area to be expanded to 29.5 K.

Programs can be stored using a Pet-type cassette deck, which plugs into a suitable socket on the VIC-20. Only a single deck can be accommodated, so file updating must be done in memory. Control commands are SAVE, VERIFY and LOAD. A low-cost single-disc drive and a dot-matrix printer are also being produced.

When you buy a VIC-20, you get the basic machine plus a separate power supply unit and a separate TV-modulator, plus instruction manuals, all wrapped up in an attractive box. The machine-PSU-modulator combination is rather messy when hooked together, and can not really be described as 'portable' - this is our only real criticism of the system. The instruction manual supplied with the machine is better than any past efforts of Commodore, but still rates as pretty awful - why *do* computer manufacturers find it impossible to produce good manuals?

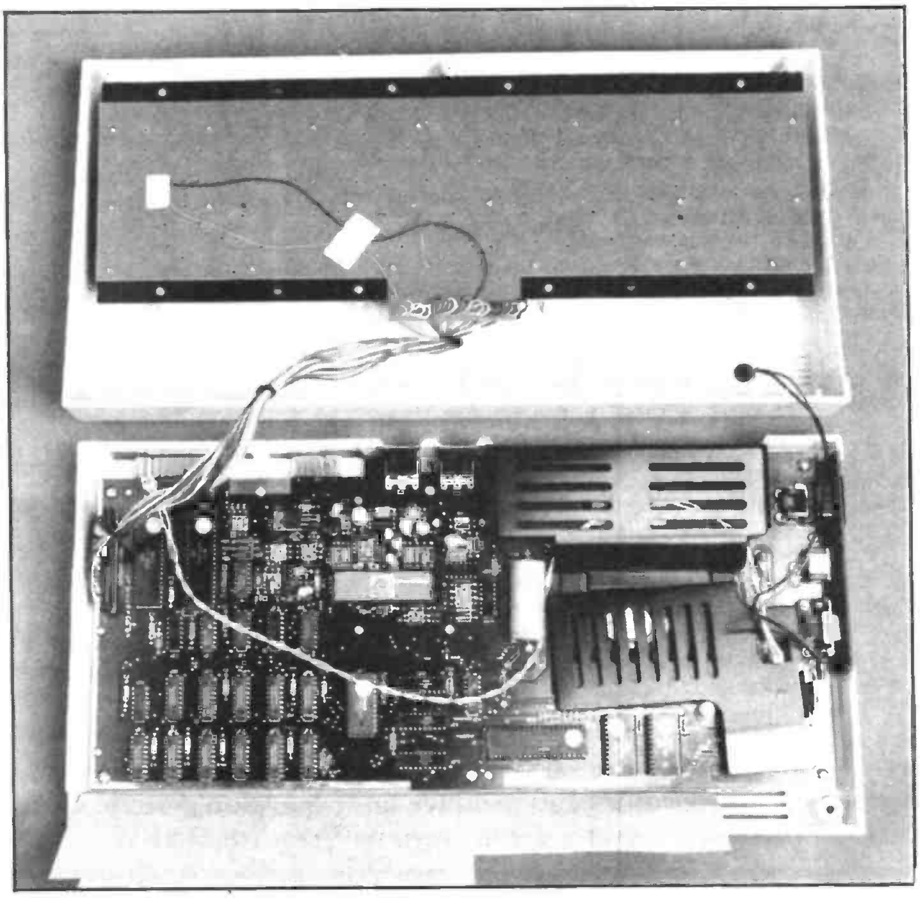
On the Screen

One of the outstanding features of the VIC-20 is its coloured video display, which is controlled by a 6561 Visual Interface Chip (VIC) and is entirely under the programmer's control, giving great flexibility in formatting and choice of displays. Three display modes are available; text, multi-colour, and high resolution. The display is memory-mapped giving, in the text mode, 23 lines of 22 characters (506 characters total), enabling the programmer to easily place a character in any desired position on the screen. When writing programs, a line can have an effective length of 88 characters, spaced over four lines of the screen.

The display appears as a coloured border surrounding a coloured background on which the desired characters are displayed. In text mode, each character can be in any one of 8 colours, the background can be any of 16 colours, and the border can be any of 8 colours, giving a total of 255 useful colour combinations.

In the 'multi-colour' mode, the screen has a plotting resolution of 88 x 160, achieved by breaking each character space into an 8 x 4 matrix of plotable points, each of which can be in any one of four colours selected by the programmer.

In the 'high resolution' mode, the screen has a plotting resolution of 176 x 160, achieved by breaking each character space into an 8 x 8 matrix of plotable points, each of which can be in either of two designated colours.



Internal view of the VIC-20

In the Ears

Another outstanding feature of the VIC-20 is its programmable sound generator system (also controlled by the 6561), which outputs sound to the audio channel of the TV set. The system comprises three independent tone generators and one white-noise generator. The outputs of the four generators are mixed and fed to a volume-control system before being fed to the TV set. Each generator can span a 3-octave range in 127 descrete steps, and 16 sound levels are available. The generators and the sound-level control can be accessed/controlled via simple POKE commands.

The sound generator facility is quite flexible, enabling complex sound effects and music to be created. It can even be used to make the VIC-20 function as a simple 'keyboard' musical instrument; using software to control sound evelope shapes, the VIC-20 can be made to sound like a piano, organ, harpsicord, or virtually any instrument of your choice.

More - More

The 6561 VIC is a busy little piece of silicon which, as well as controlling the video and audio aspects of the VIC-20 , also provides some useful I/O functions, such as enabling a light pen to be used to provide interactive graphics and rotary paddles and joysticks to be used in 'game' programs, etc. Suitable 'add-ons' are available.

The VIC-20 also incorporates a couple of 6522 I/O chips, one of which controls the programmable user port which gives an 8-line I/O with two hand-shakes. This useful little bonus enables the owner to use the VIC-20 for controlling external devices such as motors, lights, heaters, train sets, etc.

An RS232 port is also incorporated in the VIC-20 and is designed for eventual use with a MODEM, enabling the computer to communicate via the telephone lines. It can even communicate with **R&EW**'s Z-8 computer. Very exciting.

Conclusions

The VIC-20 is an excellent machine. It is delightfully easy to 'drive', its graphics are superb, and its sound facility is very good. My major gripe, concerns the use of the separate PSU and TV-modulator, which results in a system that looks messy and is not transportable. The instruction manual is also pretty useless, but that comment applies to ALL computing manuals that have so far fallen into my sticky little hands.

The only other gripe is really a 'state-of-the-art' thing about the user-available RAM which, in the VIC-20, pans out at 3.6 K, a figure not dissimilar to that available in many other computers. Put in perspective, 3.6 K of RAM will barely hold two pages of text from a novel, or one page of **R&EW**. Not exactly a 'gigantic' figure, and even 64 K of RAM would, in this context, hold only an eighth of the magazine!

The point of this gripe is that, no matter how many 'K' of RAM you buy in a 1982 computer system, you are almost certain to find that figure quite laughable (Ha Ha) by 1987, just as the Sinclair Mk 14 is already regarded as 'faintly amusing'. In other words, computers, like cars, have a high degree of built-in obsolescence. For my money, however, the VIC-20 is the least obsolescent computer presently available, and when I say "for my money", I mean it, because I've just bought one!

R & EW

Your Reactions.........	Circle No.
Immediately Applicable	17
Useful & Informative	18
Not Applicable	19
Comments	20

'VIC-20 EXPANSION SYSTEM' REVIEW

OUR ONLY REAL CRITICISM of the VIC-20 computer is that it has very limited user-available RAM, and that the computer/PSU/TV-modulator combination is untidy and not conveniently portable. Arfon Microelectronics Ltd have now designed an expansion unit that overcomes all of these problems and enables the computer to accept up to seven plug-in expansion cartridges (RAMs, ROMs, etc.), enabling the VIC-20's full capability of 29.5 K of user-available RAM to be utilised.

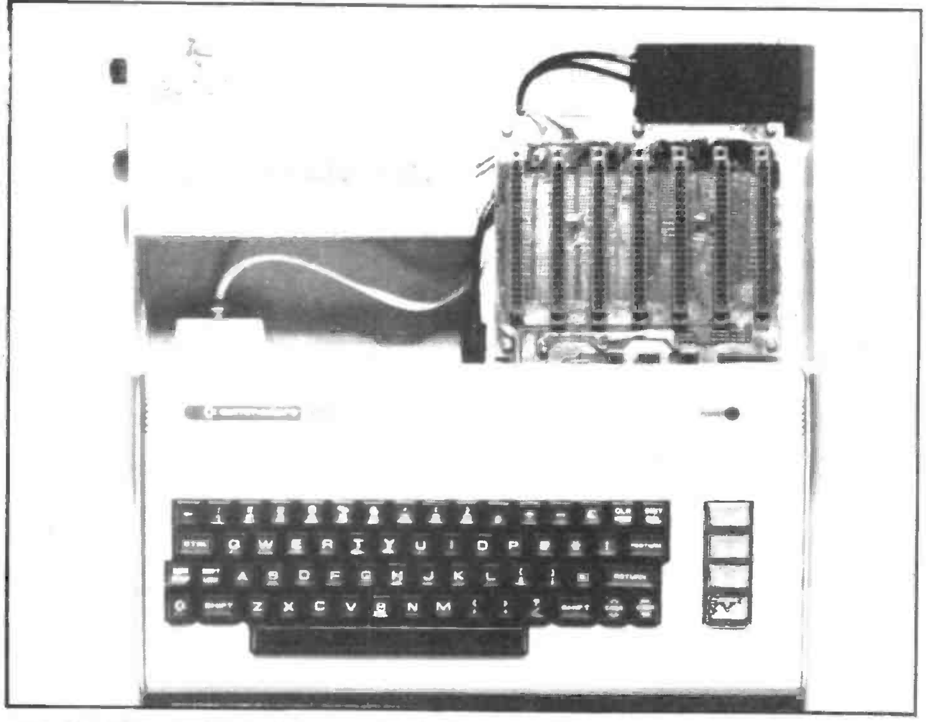
The Arfon expansion unit consists of a high quality, rigidly constructed aluminium shell, housing a heavy duty power supply and an expansion mother-board (which accepts up to seven vertically-mounted cartridges). The VIC-20 is fitted into the expansion unit by simply placing it into the front of the 'tray' and pushing it back until its rear-mounted expansion socket engages with the edge connections of the motherboard. The tightly-fitting sides of the tray then hold the VIC-20 firmly in place.

The VIC-20 expansion unit, with lid in place and used as a TV/monitor platform.

Arfon Microelectronics Ltd produce an 'expansion system' and a range of RAM cartridges for the VIC-20 computer. Ashley Grant reviews them for R&EW.

The expansion unit has an aluminium bracket fitted in its rear section, designed to hold the VICs TV-modulator, and the built-in heavy duty power supply replaces the VICs existing PSU. Thus, the expansion unit turns the VIC-20 system into a tidy and easily-portable computing package. The package is turned ON OFF via a switch (mounted on the left hand side of the expansion system) that is independent of the VIC's own on/off switch but enables its indicator light to function in the normal way.

An optional lid is available for the system, and gives comfortable clearance of the expansion cartridges when they are fitted in place. The lid is very robust and can serve as a TV/monitor platform.



The VIC-20 and TV modulator mounted in the expansion unit.

The built-in power supply produces outputs of 5V and 8.5V at 3 Amps rating, to power the VIC-20 and all expansion cartridges. A 24 V rail is also provided (to a socket at the rear of the unit), and is specifically intended to power a VIC-20 printer that is under development by Arfon.

Our overall impression of the Expansion System is very favourable. The design is well thought out and implemented, and represents good value for money at its recommended retail price of £85 plus VAT.

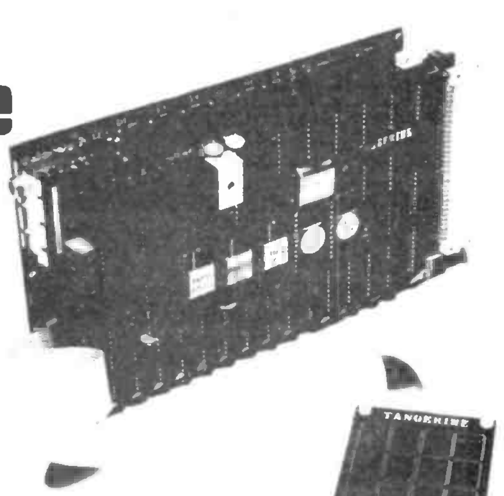
Expansion Cartridges

Arfon presently produce a range of 3K, 8K and 16K RAM expansion cartridges which will plug directly into the VIC-20's expansion socket or into the motherboard sockets of the expansion system. The units are well constructed and attractively packaged. Recommended retail prices are £26 for the 3K cartridge, and £39 and £65 for the 8K and 16K packages respectively.

Arfon plan to increase the cartridge range throughout 1982, and have plans to produce RS232, user port, expansion speech, music, disc controller and dedicated ROM packages. We hope to review these items when they appear.

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

Step by step with the computer system designed for tomorrow.



Microtan 65

£79·00 +VAT Ready Built

£69·00 +VAT Kit

- ★ 6502 Microprocessor
- ★ 2K Monitor TANBUG
- ★ Intelligent socket accepts keypad or full ASCII Keyboard
- ★ Chunky Graphics and Lower Case Options
- ★ Connects to unmodified B/W or Colour TV

For the first time buyer or experienced user, Microtan 65 is a superb route into personal computing. If you are looking for a sophisticated machine with the capability of expansion into a professional system, then this is the computer for you. Step by step with the computer system designed for tomorrow. . . .

6502 Microprocessor

Probably the most popular CPU (central processing unit) for personal computers, having a powerful instruction set and architecture.

2K Monitor TANBUG

The built-in 'mind' of the machine. TANBUG controls all system functions and gives comprehensive machine-code facilities. Functions include:- set and clear breakpoints, single step through program, execute program, copy block of memory, modify memory locations and much more.

Intelligent keyboard socket

For absolute beginners we can supply an easy to use 20-way Hex keypad: for the more experienced user there is a full typewriter style ASCII keyboard. Either way, Microtan will work out exactly which type you are using and act appropriately.

Chunky Graphics Options

For drawing simple lines and graphs, or for animated games, Chunky Graphics is a low cost answer. This set of chips plug into the Microtan board and allow graphics to be built up on the screen at a resolution of 64 rows by 64 columns.

Lower Case Option

To extend the character set to 128 characters, allows for real descenders on lower case characters and a set of extra symbols and characters for simple graphics.

Microtan Accessories

20-way Hex keypad MPS 1 Basic power supply

Aerial connector lead

Full ASCII Keyboard MPS 2 Full system power supply

Mini — motherboard

Microtan is available ready-built or as a kit. We recommend that you should have some soldering experience before attempting the Microtan Kit, although if you do run into problems you can make use of our "Get you Going" service (telephone for details).

TANEX

- ★ 7K Static Ram
- ★ 10K Microsoft Basic
- ★ 32 Parallel I/O lines
- ★ 1 Serial I/O port
- ★ XBUG
- ★ Cassette Interface

The first step in expanding your system. Tanex provides the extra facilities necessary for the serious programmer. Memory expansion: Tanex has provisions for up to 7K of static RAM and up to 14K of EPROM using 2716 or 2732 chips.

XBUG and BASIC

XBUG is a 2K extension to TANBUG that contains a mnemonic assembler and disassembler and cassette firmware running at 300 Baud CUTS standard or high speed 2400 Baud Tangerine standard with 6 character filenames. Tangerine have taken out a full O.E.M. licence for Microsoft BASIC, the microcomputer industry standard, this is a full feature implementation with interrupt and machine code handling, and a superb program editor.

Both XBUG and BASIC plug directly into Tanex and are supplied with comprehensive user manuals.

Parallel I/O

When fully expanded Tanex includes two V.I.A.s (Versatile Interface Adaptors) which implement the cassette interface and the parallel I/O ports. Software in TANBUG V2.3 enables you to plug in and use a Centronics type printer.

Serial I/O

Also on the expanded board is a serial I/O port that can be used to interface RS232 or 20Ma loop terminals or VDU's, again all controlled by TANBUG V2.3.

To complete Tanex, a comprehensive user guide is supplied which contains full constructional details. This manual is also available separately.

Tanex (Min Config) Kit £50.95 inc VAT and P & P
Tanex (Min Config) Assembled £62.45 inc VAT and P & P
Expanded Tanex Kit £104.66 inc VAT and P & P
Expanded Tanex Assembled £116.16 inc VAT and P & P

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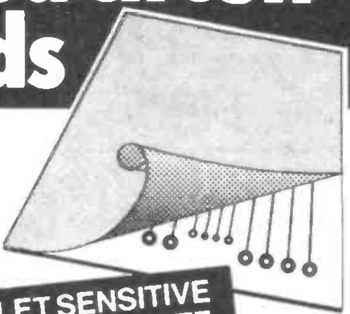

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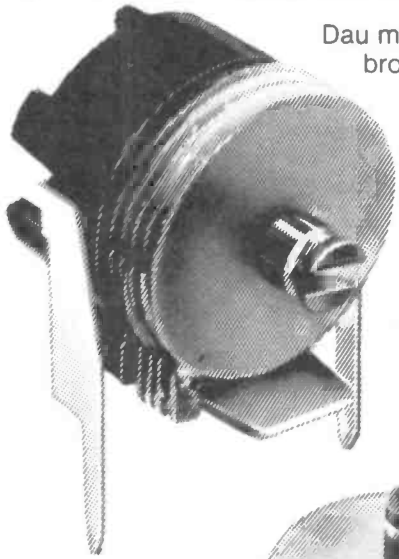

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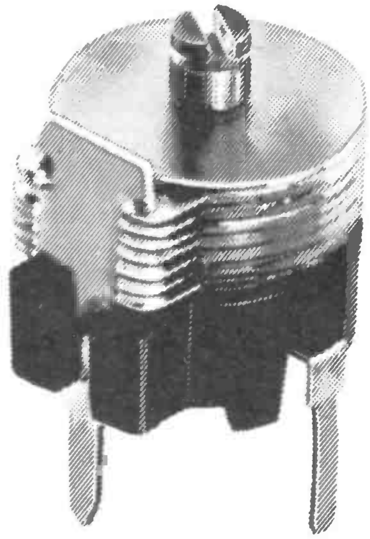

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CB

R&EW 40-CHANNEL CB RIG.

After the introductory aspects of the first two parts, we provide full circuit and constructional details of the basic transceiver in one hit. Hold tight....

Tailored responses

One of the more helpful aspects of our tight production schedules - and the fact that we have an extensive in-house engineering facility - is the fact that reader comments can be assimilated very quickly. Reaction to the idea of **R&EW** getting into CB was predictably mixed, the shutters came down on the mental processes, and the opinions flowed forth from one or two die-hard members of the amateur radio fraternity who have always regarded CB as something nasty and distasteful.

The fact that many readers in the London area will have heard more bad language and operating procedure in 10 minutes spent listening to a well known 2 m amateur repeater, than in 10 hours on the 27 MHz does not cut any ice.

However, one objective comment from Jeff Harris, G3LWM (of JH Associates, neons and panel lamps to the gentry) made us all feel very smug, since his request that the **R&EW** CB rig should be made easily convertible to the growing 10 m amateur FM band was immediately instigated, thanks to the adoption of the MC145151 universal PLL synthesiser described in one of last month's databriefs. This request was a good deal easier to comply with than one suggestion from 'disgusted of Cheltenham' that would have required major surgery, and won us an entry in the Guiness Book of World Records....

The rig described here is the basis for a future series of articles that will cover communication accessories and modifications that are going to be applicable to any two-way radio system -CB, Amateur - and even PMR, bearing in mind the restrictions placed by official regulations on such things. The basic rig is cheap in this 'knocked down' form, easily accessed and understood by a comparative novice - and above all, it ought to be easy to 'get going'!

Ten league boots

The 'level I' block diagram is shown in *Fig 1*. The rig 'breaks down' in several discrete sections - PLL, receiver, transmitter and mic amplifier - and if you cast your minds back over some of the circuits you have seen for other CB rigs, you will see that this is a fine example of a purpose-built design that has taken advantage of the 'state-of-the-art' and leapfrogged the technology of most current CB designs in one bound.

Starting at the receiver antenna input, a low noise JFET common source input stage is preceded by the antenna filter, and the obligatory diode clamp. The low transmitted power enables switching complexity to be kept to a minimum, although the need to switch the power around the rest of circuit means that there are various 'housekeeping' switching transistors to switch the supply for the appropriate PLL selector matrix switch, and mute the audio during transmit.

The Receiver (fig two)

The RF stage input is tapped from the antenna filter network to provide minimum interference with the transmitted signal, where the impedance is high enough to permit coupling using a relatively small capacitor. The input to the RF stage FET gate is clamped using a pair of back-to-back diodes. The device itself is a 2SK55 from Hitachi, which although not as well known as some FETs, provides lower noise and better overall performance than devices costing twice as much.

Coupling to the mixer uses a classic top-coupled bandpass pair onto the gate of another 2SK55 used as a mixer with local oscillator injection at the source. Insertion of the LO at this point requires good isolation from the VCO tuned circuit, since strong signals will make their presence felt at the source - and the direct coupling to the secondary of the VCO coil as used in the first prototype exhibited extreme distress when tested under overload conditions. In other words, the VCO was effectively turned off when a strong signal appeared!

The output from the mixer is matched to the 10.7 MHz ceramic roofing filter, whose prime function is to provide image rejection (10.7 MHz - 910 kHz) - not channel selectivity as such. A 2 pole crystal filter may be used instead, although the improvement will only be noticed under extreme conditions. The MC3357 IF mixer is fed from the oscillator on the main sythesiser device with 10.24 MHz, bypassing the internal colpitts oscillator. The IF output at 455 kHz then passes to an interesting filter combination, first described in conjunction with the RCM&E FM radio control system published a year or two ago. The filter comprises a TOKO CFM2455 C (or D) followed by a NTK LFB6 ceramic filter.

The mechanically coupled TOKO filter possesses exceptionally good band reject characteristics and the ceramic ladder filter of the LFB6 possesses good 'close in' bandpass characteristics - so the net result is a very low cost filter with good bandpass, and good band reject. The actual passband width is nominally 6 kHz, typically 7 kHz or so to allow room for some of the less accurate transmissions that regrettably seem to be around - notably from

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R&EW 40-CHANNEL CB RIG.

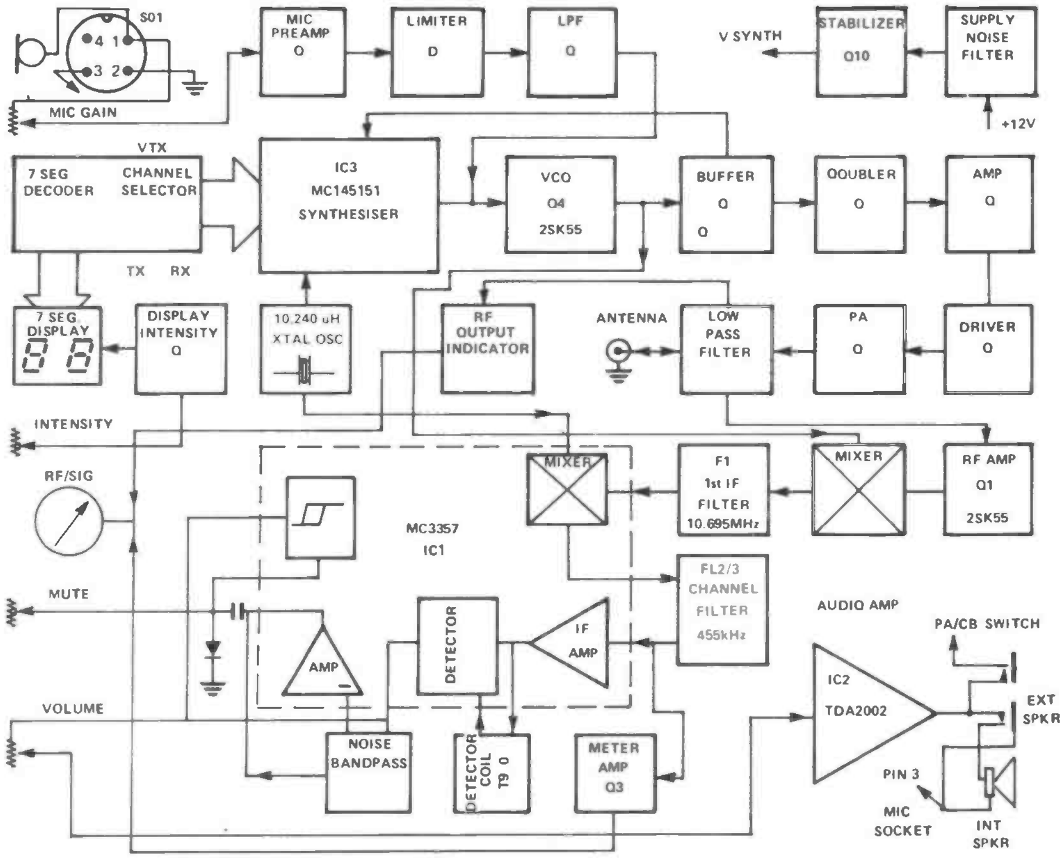


Figure 1:
Block diagram of CB Rig.

'multimode' rigs without MPT1320 approval.

The mute circuit on the IF strip operates by selectively amplifying noise from the demodulator output - pin 10 is in fact an inverting op-amp intput, with the output at pin 11, so R10-12 and C21/C22 form a bandpass filter centred around 9 kHz to be well clear of the speech band. D4 rectifies this noise component and feeds it via R9 to the Schmidtt trigger in IC1. The variable mute control establishes the actual operating point of the trigger circuit, and it must be noted that the voltage feeding the mute control pot should be as stable as possible. The trigger output at pin 14 goes low when the mute is triggered by noise, and pin 13 simply provides an inverted output of the same signal.

The noise mute operates very effectively, with far greater discrimination against sideband than carrier-level-referred muting systems. However, noise mute can be triggered by signals that are off frequency and enthusiastically modulated - since if the signal instantaneously deviates outside the IF passband, a noise burst will occur that provides sufficient output at D4 to cause the mute to chatter on modulation peaks.

This arrangement will be supplemented in a later instalment by an additional circuit that is specifically designed to blank noise of this type without completely silencing the receiver audio stage.

Signal metering is provided by Q3, which is coupled into the IF filter output, simply driving a voltage doubler detector stage to detect the signal meter. This aspect of the circuit leaves most people (including me) rather cold, since although the RF power indication on transmits serves to show that something is in fact happening, this function on receive is generally quite pointless. Nevertheless, a planned add-on will turn the meter into a signal/noise reading system, offering a far more useful indication of received transmission quality.

The audio stage, IC2, uses a TDA2002 in its usual capacitor coupled form to provide plenty of drive for the on-board speaker - and around 4/5 W for an external PA speaker. Beware the laws regulating the rampant and indiscriminate use of PA systems in public places.

The PLL system (fig 4)

The MC145151 featured in last month's databrief, so the description of this circuit will relate strictly to its application here. The first version of the set used the VCO at the TX output frequency, taking advantage of the frequency range of the PLL, and the simplicity of the programming. However, the VCO runs 10.695 MHz away from the TX frequency when receiving, and the leap from one extreme of its tuning range to the other led to problems in obtaining a reliable lockup. In other words, the loop time constant was a compromise between fast lockup and low noise.

The solution was to adopt a transmit VCO frequency of half the output frequency, as per the LC7137 PLL used in most imported sets. This device was described in some detail in a databrief (January issue of **R&EW**), and the division ratios discussed in connection with the ROM encoded LC7137 are exactly the same as those selected here. The MC145151 uses parallel binary coding rather than BCD channel coded selection, so the actual code switch is specifically designed for the task. The transmit/receive offset is built into the LC7137, and called up by simply activating a 'transmit/receive' function pin, which is not available in the required form here. The solution is to provide a separate code switch wafer to cover transmit and receive, using diode 'logic' to select the appropriate programme.

A 10.24 MHz crystal is used (divided to provide a 5 kHz reference), since this crystal can then also be used in the subsequent 10.695 MHz to 455 kHz conversion in IC1. In this way there is only one master 'clock' in the receiver, keeping spurii to a minimum.

The 'trimming' varicap, D8, is used to provide a step function in the VCO tuning

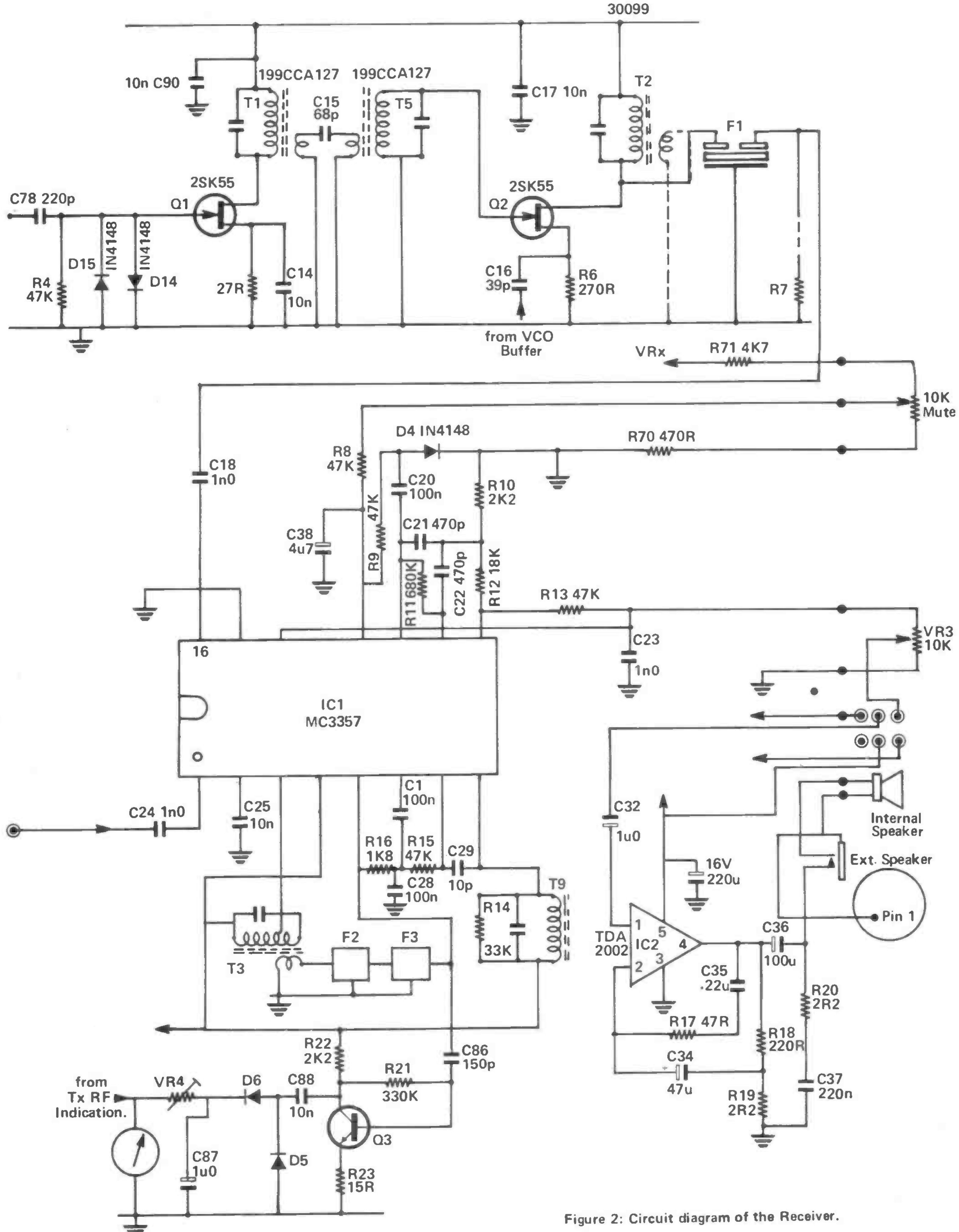


Figure 2: Circuit diagram of the Receiver.

R&EW 40-CHANNEL CB RIG.

between transmit and receive to ease the requirement on the loop VCO, by providing a course tuning effect. VR7 is used to set up D7 so that the VCO tuning voltage remains as nearly constant as possible when switching between transmit and receive on channel 21.

The VCO itself uses a 2SK55 in the inductive version of the capacity tapped colpitts circuit, feeding an emitter follower buffer that isolates the VCO from effects on the receiver mixer - and provides enough drive to the multiplier and transmitter chain.

The PLL also provides an out of lock pulse at pin 28, which is stretched into an adequate signal to clamp the transmitter and prevent unwanted emissions if the synthesiser should fail to lock for some reason.

The phase detector at pin 4 is the simpler option available on the MC145151, which is adequate in this relatively narrowband application. Last month's databrief applications PCB used a voltage translator op-amp filter with the double-ended phase detector; but this is an unecessary complication where the VCO voltage only moves by less than half the supply voltage to the MC145151.

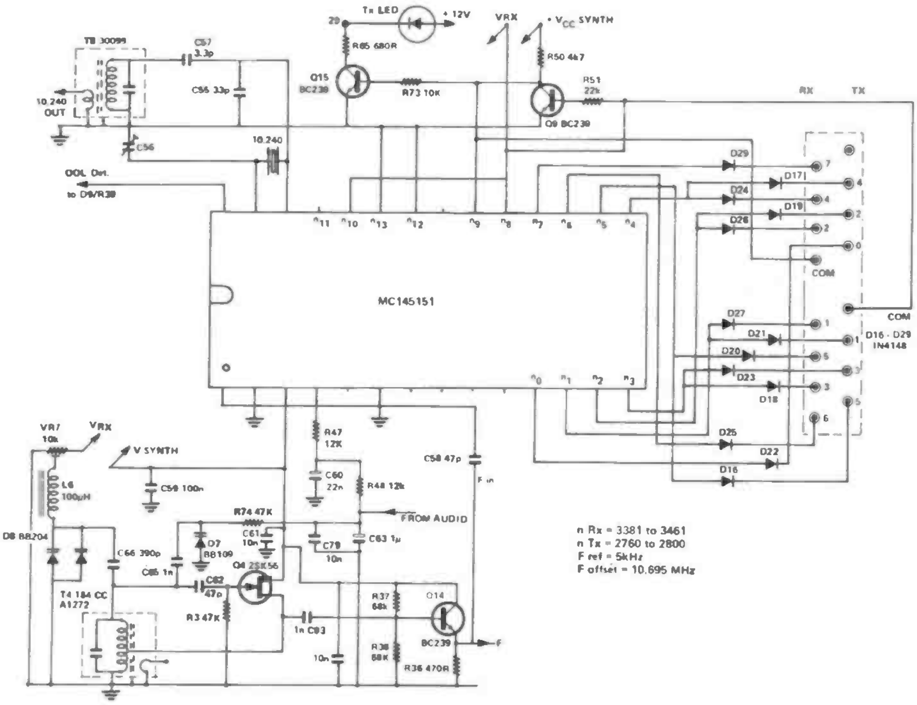
Modulation from the audio stage is fed directly to the loop filter.

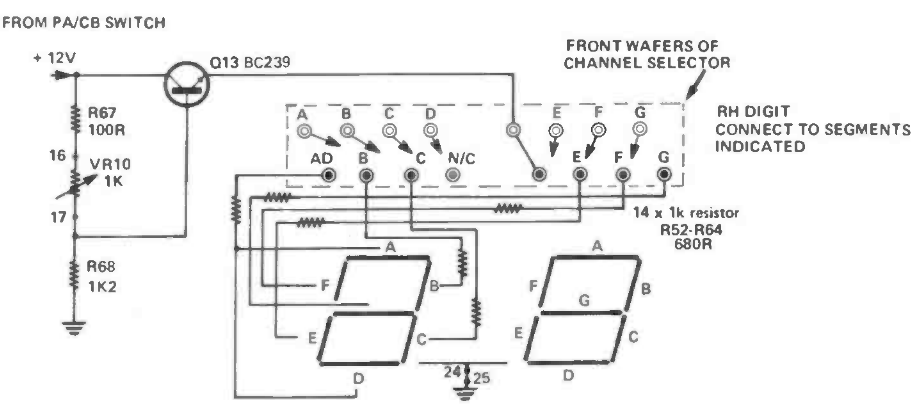
The behaviour of the loop can be seen from the *photos* of the tuning voltage step function, both from receive to transmit, and the worst case, from channel 1 to channel 40. The 100 mSec lockup is well up to spec.

Mic amp and filter (fig 5)

The mic amplifier is fed via the 'mic gain control' on the front panel - with VR5 used to set the minimum level of this adjustment. Choke/capacitor filtering at the socket removes RF that might otherwise overload the preamp device, Q11. The gain of this stage is quite sufficient to drive the diode limiter into hard clipping, which is subsequently cleaned up using TR12 in an active low pass filter arrangement. Trimpot VR6 establishes the maximum deviation level at the VCO, and this is set only after the limiter is being driven hard.

The circuit is surprisingly effective in spite of its simplicity, although there is room for a more sophisticated approach with AGC etc. A subsequent feature will provide details of improved 'talk power'. Although FM sets will tend to sound 'louder' if overdeviated, there comes a point where the receiver passband chops the signal unacceptably, so there is little point in exceeding the MPT1320 limit of 2.5 kHz deviation maximum. The best solution is try and maintain a high average deviation level through compression techniques.





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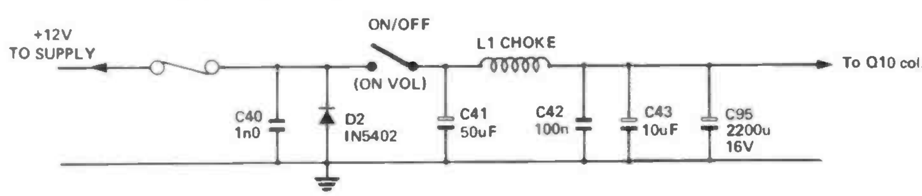
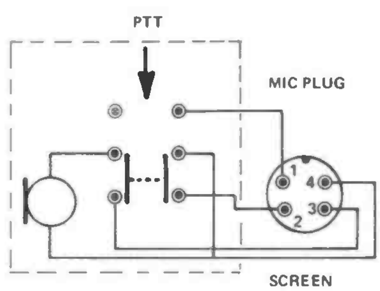
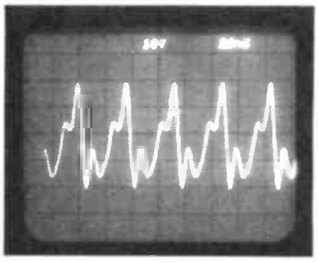


SUPPLY SWITCHING & FILTERING



CONNECTIONS TO MIC & PTT

Figure 4: Circuit diagram of the frequency synthesiser and channel display.



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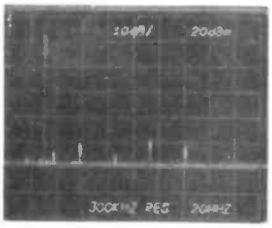

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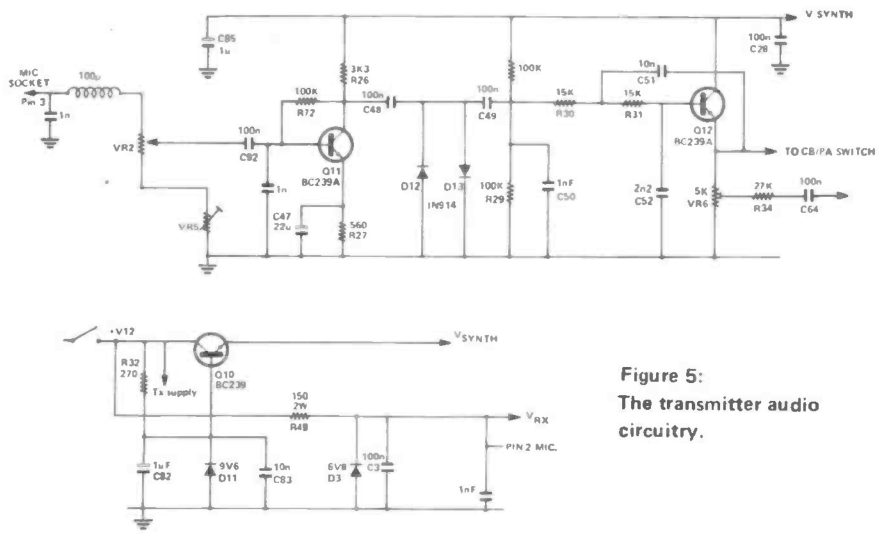
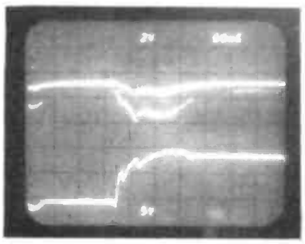


Figure 5: The transmitter audio circuitry.



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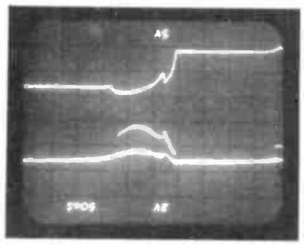

(D)

A) Waveform at the collector of the P.A. transistor Q8.

B) Output spectrum, carrier shown notched 28dB down.

C) Transmit/receiver lock–up.

D) Channel 1/40 lock–up.

The Transmitter (Fig 6)

The output from the VCO buffer is essentially at half the output frequency, so the first task of Q5 is to double this. Q5 is run in class C to provide a harmonic rich output, and the second harmonic is selected in the bandpass pair formed by Q6 and Q10. The coupling capacitor is selected to provide approximately 500 kHz bandwidth.

This bandpass filter must be maintained at a high Q to prevent unwanted signals creeping through, and it is important to tune this for minimum 13.5 MHz signal, as well as simply maximum output. The two conditions will coincide, so there is no trade off in output power by keeping it 'clean'.

The next stage base is fed from the OOL detector stage, which is basically a pulse stretcher designed to clamp the transistor when the loop is wandering around out of control. When all is well, Q6 provides considerable gain, with T7 tuning to the output frequency. The emitter of this stage acts as the switch point when receiving, since the HT is applied to the output stage at all times the set is on.

Q7 drives the PA through a series tuned network designed to use the input reactance of Q8 to best effect. The emitter of this stage provides a convenient location at which to apply the statutory 10 dB transmitter reduction, and VR9 is used to establish the exact operating point under 'low power' conditions.

The final stage is series-matched to the output low pass filter (as is customary in virtually all CB designs), with specific harmonic traps being included to steepen the low pass response of the filter. The spectrum analyser *photos* illustrate that the output spurii are below 75 dB, in accordance with the required specification. There should be no need to 'tweak' this filter in any way. The values chosen represent an utterly repeatable and reliable LPF.

A quick glance at the RF waveform at the collector of Q8 reveals a textbook class C amplifier, with copious amounts of 2nd and 3rd harmonic present. The filter is utterly essential. The tap for the RF power indicator is taken midway along the filter. This indication is not a measure of the transmitted power, but merely an indication that RF is present at the tapping point. SWR must be established separately using a specific SWR meter.

The receiver input is also taken along the filter stage — the relatively low impedance input to the FET yields better IM performance, which is usually the limiting factor in such equipment, since 0.1 uV sensitivity can be shown to be fairly academic. A 10 dB coaxial attenuator in line with the antenna input showed no audible degradation of performance under typical conditions, further highlighting the futility of bothering to indicate signal levels!

Construction

For the reasons stated, we will not be publishing 'basic' constructional information since this type of equipment is subject to specifications which cannot readily be checked by the 'home constructor'. However, preassembled and 'DC' tested PCBs are available, and this 'knocked' down version of the kit can be assembled with a high degree of probability that the set can be made to work 'first time', by following the outlined test procedures.

The main point of wishing to DIY is generally to learn better how a circuit works — indeed, circuits that are assembled 'parrot fashion' and work first time with no adjustment provide as much insight into the workings of electronics as a Rubik Cube. And the real learning with radio starts when you switch on and start to align the set — sorry if this approach has spared you the soporific pleasures of component insertion, and lead poisoning from solder fumes — but in view of the enormity of the indicated response to this project, we have saved all concerned from the tribulations associated with inexpertly assembled kits. Shortages in the kits themselves are readily apparent when supplied in this form.

Some kits may be supplied without the front panel control wiring to the board — and these will contain specific point-to-point instructions — the overlay details (*Fig 7*) will need to be referred to when establishing the points of adjustment.

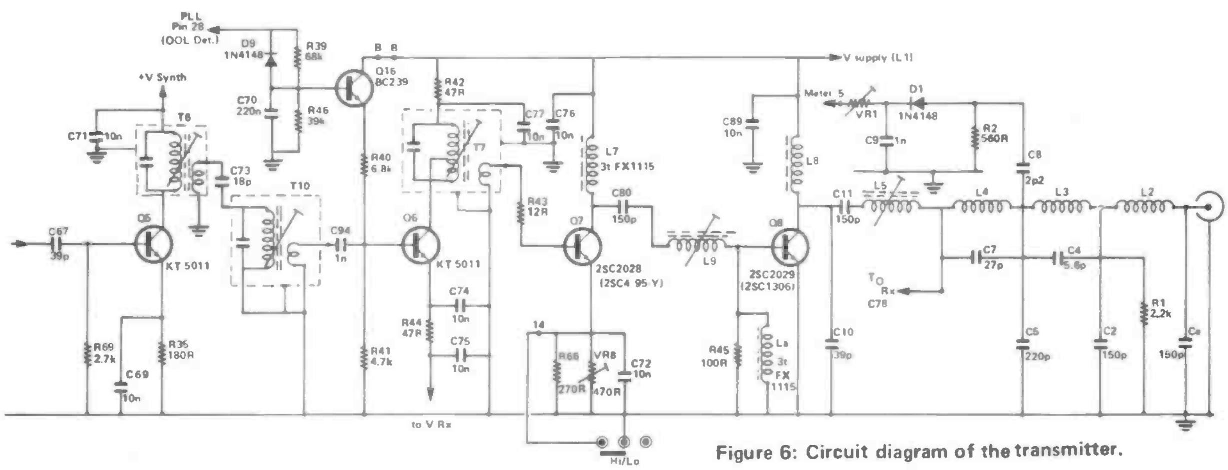

Figure 6: Circuit diagram of the transmitter.

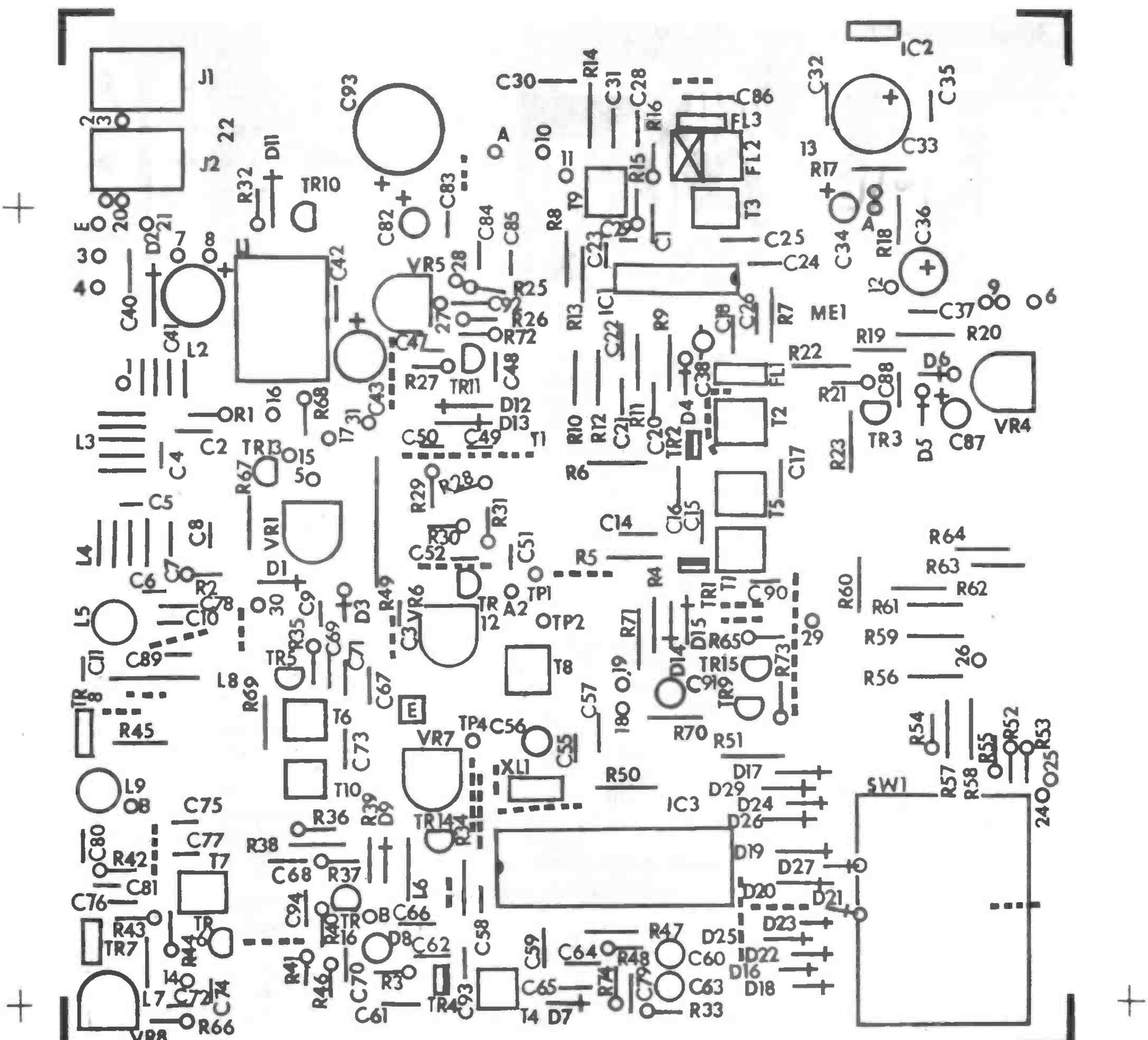

Figure 7.

Your Reactions.........	Circle No.		Circle No.
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Details of the setting up procedure, and adding some of the frilly selcall etc., is covered next month. For those of you who can't wait, an SAE will bring the latest information. □ R & EW

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AB13 5 x 4 x 2in. (152.4 x 101.6 x 50.8mm)	£1.38
AB14 7 x 5 x 2in. (177.8 x 127.0 x 50.8mm)	£1.64
AB15 8 x 6 x 3in. (203.2 x 152.4 x 76.2mm)	£1.98
AB16 10 x 7 x 3in. (254.0 x 177.8 x 76.2mm)	£2.70
AB17 10 x 4.50 x 3in. (254.0 x 114.3 x 76.2mm)	£2.28
AB18 12 x 5 x 3in. (304.8 x 127.0 x 76.2mm)	£2.52
AB19 12 x 8 x 3in. (304.8 x 203.2 x 76.2mm)	£3.04

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RB4 11 x 6 x 4in. (279.4 x 152.4 x 101.5mm)	£3.14
RB5 11 x 7.50 x 4.50in (279.4 x 190.5 x 114.3mm)	£3.98

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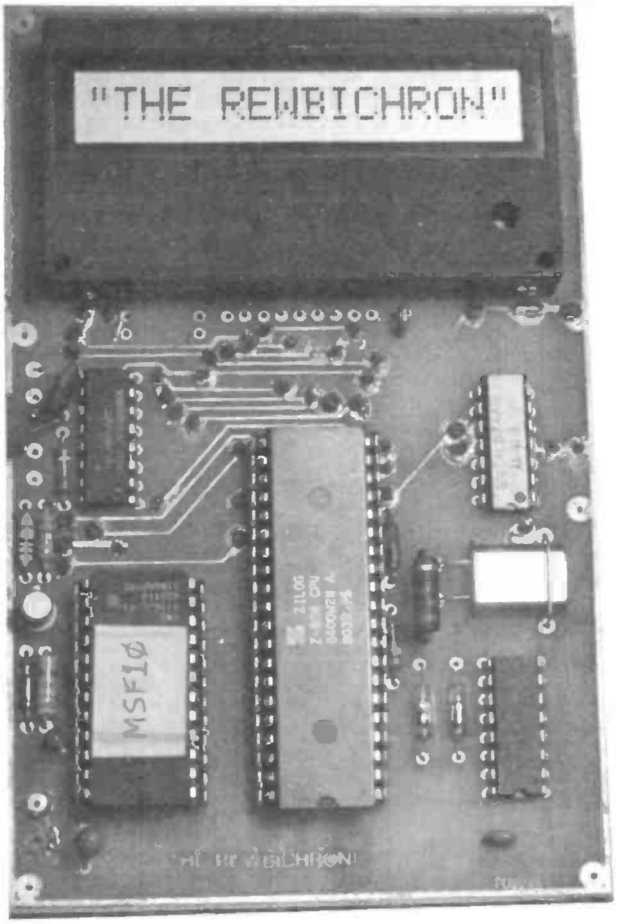


R&EW presents the ultimate timepiece! This microprocessor controlled clock is radio linked to the NPL time standard. It provides a display of time, day, date and month on a dot matrix LCD module and its accuracy never varies by more than one second.

Design by John Robinson, MA (CANTAB), G4AZX.

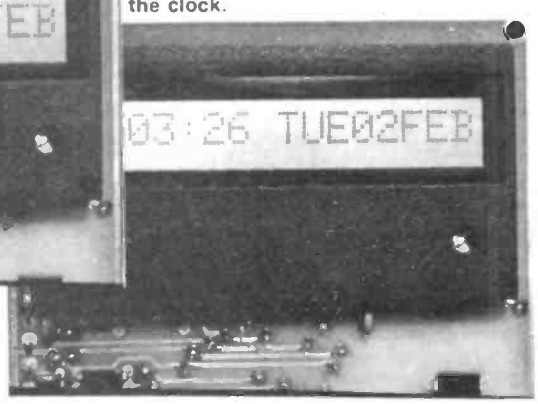
THE "REWBICHRON" MSF CLOCK

* 12 or 24 hour display format.
* Alphanumeric date display.
* Microprocessor based for low component count.
* Continues running if MSF fails or is lost.
* Excellent noise immunity.
* Data checked for validity and parity.

This is the message displayed while the first set of MSF data is being captured, this may take about a minute.

The normal (24 hour format) display of the clock.

This photo shows the alternative, 12 hour format, display obtained at the flick of a switch.



THE STATE—OF—THE—ART DIGITAL CLOCK

THE PROJECT DESCRIBED HERE receives highly accurate TIME/DATE signals from the 60 kHz MSF transmitter at Rugby, which in turn has its code signals locked to the atomic time standard at the national physical laboratory. The clock is microprocessor controlled and gives a readout of time, in 12 or 24 hour format, plus day, date and month in alphanumerics on a new dot matrix LCD display module.

The use of the Z80 microprocessor greatly reduces the total chip count of the project and at the same time provides the design with some unique features. Majority note pulse detection and a software phase locked loop result in excellent noise immunity. All MSF data is thoroughly checked for validity as well as parity, thus for example 31st NOV would not be accepted. The clock continues running even if MSF fails or is lost, using its own quartz crystal as a secondary standard. All these features yet the logic section of the clock (excluding the display module) contains a mere five ICs making construction straightforward.

WHAT IS MSF?

A standard Frequency transmitter (one of many) is located at Rugby. It radiates an accurate 60 kHz carrier, which is pulsed with binary data defining the time and date, as provided by the National Physical Laboratory (and therefore *accurate*).

The time is transmitted in two ways. The first, known as the "Fast Code", comprises a train of pulses lasting about 500 mSec. For some time, the Fast Code was the only date transmitted by MSF, with the individual seconds during the minute marked by short (100 msec) breaks in the carrier; the "sound" of these pulses will be familiar to anyone who has listened to other standard frequency transmitters on a communications receiver.

More recently, the "Slow Code" was added to the MSF transmissions. This operates by changing the seconds pulse length to 200 msec if a binary "1" data bit is being sent, or retaining the 100 msec length for a data "0"; in this way data is sent at the rate of 1 bit per second. The complete set of data, which includes the time, full date (day-of-week, day-of-month, month and year), BST marker bit and a fixed "Framing Pattern", is sent during each minute, and defines the *approaching* minute. This means that a timepiece can receive and check all the information at a leisurely pace, ready to display it at the start of the next minute.

In addition to the time information, the slow code contains the difference between British Standard Time and Universal Time, and 4 parity bits which enable single bit errors to be detected. All this data requires more than 60 bits, so certain 'seconds' pulses are modified to carry 2 bits, as in *Fig 1*. The 2 bits are known as First and Second Level Data.

Figure 2 summarises the position of all the slow code data within the minute. Each quantity (ie Hour, Minute) is coded

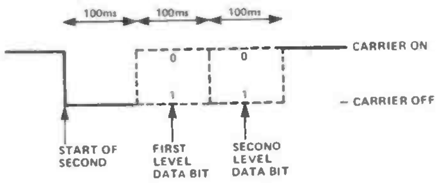


Figure 1: The data pattern each second

in Binary-coded-decimal (BCD) form, which simplifies the task of decoding and displaying it. The range of the digits, and therefore the number of bits allocated in the data, varies with the quantity; for instance, the top "hours" digit cannot be greater than 2 (2 bits) whereas the top "minutes" digit can go up to 5 (3 bits). The framing pattern is a set of 8 bits with fixed values as shown; the chosen pattern can never occur elsewhere in 8 consecutive bits of the data, and it therefore forms a unique marker which can be detected by the clock and used to lock its data recovery sequence.

A BASIC MSF CLOCK

Figure 3 is a block diagram showing the "bare minimum" requirements for an MSF clock, using conventional logic components (eg CMOS).

The 60 kHz receiver, which is similar to a normal longwave receiver but with fixed tuning and, preferably, a long AGC time constant, produces a logic signal showing the state of the carrier (on or off). Because the data is conveyed by the widths of the carrier pulses, a small amount of logic is needed to recover the binary data plus a 1 Hz clock signal which indicates when it is valid. A new data bit is loaded into the shift register each second, so that a complete set of data builds up during each minute (matching the pattern shown in *(Fig 2)*. The block marked FRAME DETECTOR is made up of an 8-input gate, with 2 inputs inverted, connected to 8 consecutive bits at the input end of the register. When the framing pattern reaches this detector, which will happen once per minute, all the data will have arrived at its correct position in the remainder of the register, and is clocked into the data latch and therefore the display. At the same time, the seconds counter is reset to zero. During the next minute, while a new set of data is arriving, the 1 Hz input clock drives the seconds counter, resulting in the 'seconds' display counting 0-59.

SOME IMPROVEMENTS

The simple clock just described will perform well, provided that a perfect signal is always received from MSF. Unfortunately, in the real world, the usual problems of radio reception (fading, interference etc.) mean that data errors occur - quite simply, a data "0" may be received where a data "1" was transmitted, or vice versa. In the simple clock, this may result in a wrong time being displayed, or in gibberish being displayed (due to "non-BCD" codes), or in no minute update due to the framing pattern being corrupted. Further, the pulses which clock the seconds counter may be irregular, resulting in an erratic seconds count.

Figure 4 incorporates several improvements to cure these problems. This design looks more like a conventional digital clock, with its own time counter driven by a 1 Hz crystal oscillator, but instead of a manual setting switch, the job of correcting the counter is performed by the MSF receiver and data shift register. If the parity checker is included (which requires the seond-level data to be detected) the system will be much more robust in the presence of noise. Parity checking involves counting the number of data "1" bits in the protected portion of data and the parity

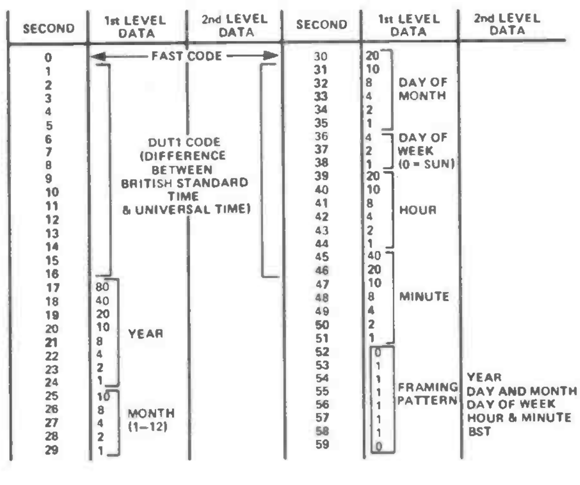


Figure 2: The position of slow code data within each minute.

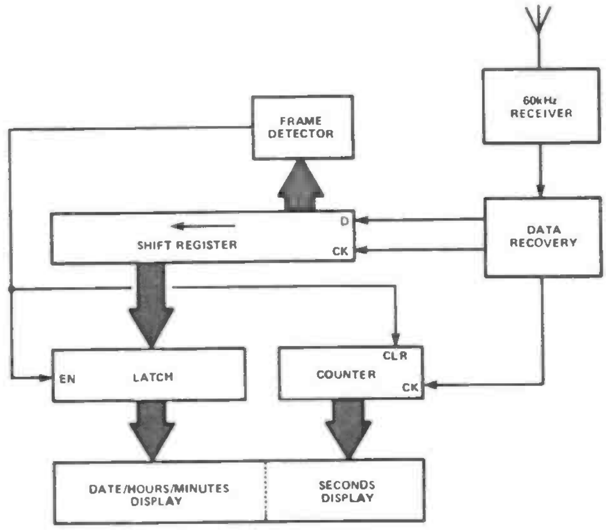


Figure 3: A "bare minimum" MSF clock.

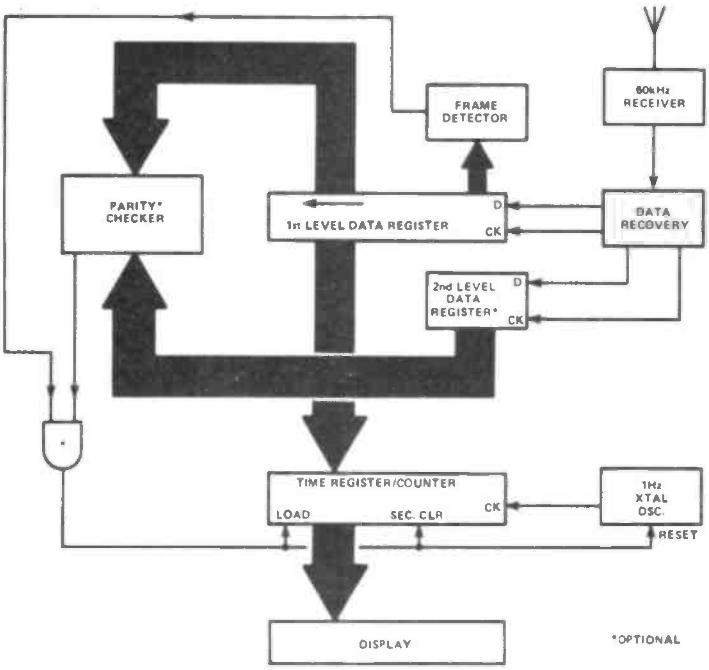


Figure 4: Improved MSF clock with "free-run" capability.

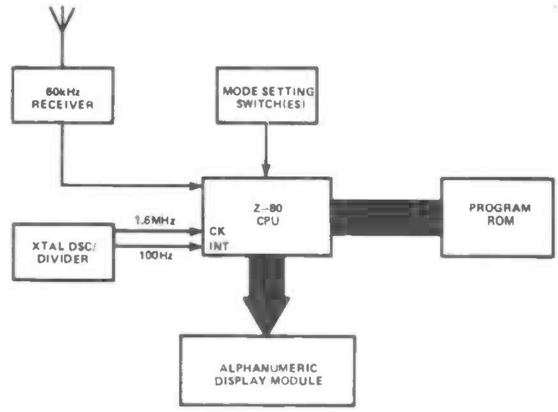


Figure 5: Block diagram of the "REWBICHRON". The use of a microprocessor to handle all the logic operations of the clock greatly reduces the complexity of the circuit — The "REWBICHRON' uses only 5 ICs on its main logic board.

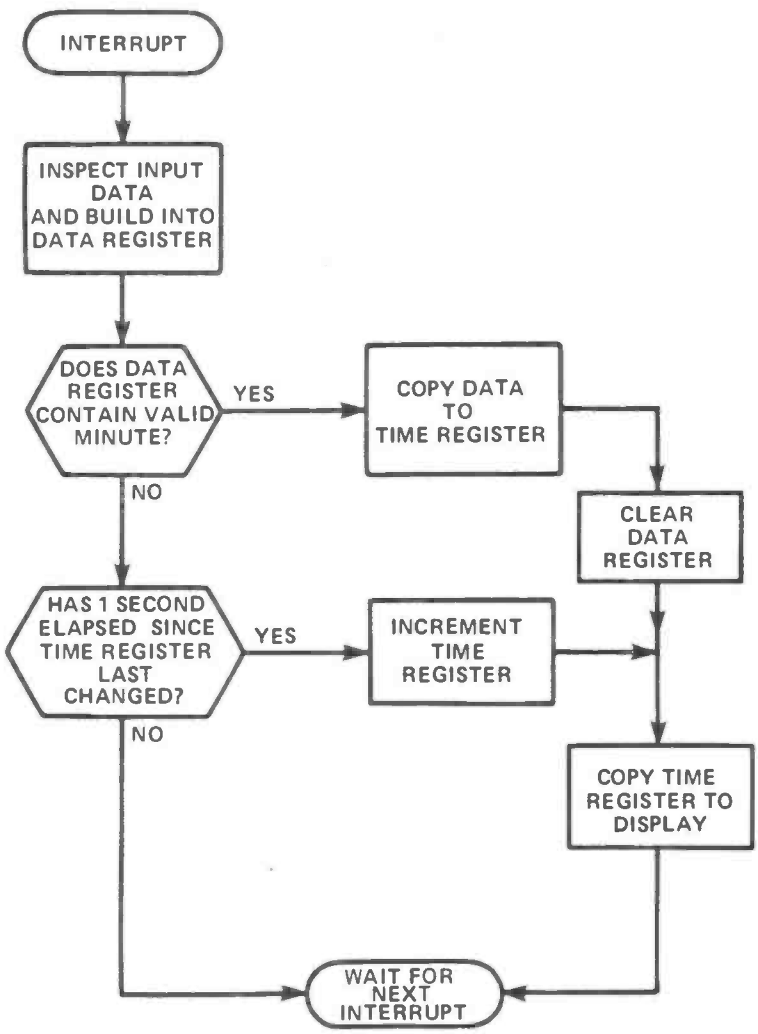


Figure 6: Outline of the REWBICHRON's software.

check bit together; if this number is not odd, then an error has occurred and the time will not be accepted to reset the counter.

PROCESSOR POWER

The "full facilities" clock can be - and has been - implemented with discrete logic ICs. Like early colour TV receivers and Teletext decoders, a huge board full of devices is needed. Unlike these examples, the data rate is sufficiently slow that a microprocessor can easily handle all the logic operations required - and also allows a few new ideas to be incorporated!

Even the block diagram becomes dramatically simplified, as shown in *Fig 5*. The use of an "intelligent" display module, the new PCIM200, means that the REWBICHRON uses only 5 ICs to handle all the processing between the receiver and the display.

CIRCUIT DESCRIPTION

The system uses a Z80 CPU, whose program is contained in a 2 K x 8 PROM. There are sufficient registers in the Z80 to avoid the need for any external RAM (although this is only just the case - at one point even the Refresh Register is used!).

TIMING

Referring to *Fig 7*, the master timing source is a crystal oscillator and divider (IC1 and IC2) starting at 3.2768 MHz. This frequency is divided by 2^{15} to give a squarewave at 100 Hz, which feeds the interrupt input of the CPU, and forms the main timing reference. The CPU clock frequency (1.638 MHz) is the highest submultiple of the crystal acceptable of the Z80, in order to maximise the amount of processing which can be done between interrupts.

IC2 serves not only as the last stage of clock and interrupt division, but also, being TTL, to provide an adequate current drive to the CPU clock pin; CMOS at 5 V simply can't cope with this much capacitance at high frequencies. R2 pulls the TTL logic "1" level up the +5 V required by the CPU.

DATA INPUT

IC5 provides a 6-bit input port to the CPU, of which only the bottom 2 bits are used by the "basic" version of the lock. MSF carrier logic, from the receiver head, is fed to bit 0, while bit 1 is driven by a logic signal from R7 and the 12/24 Hour switch. Note that the function of this switch is not in any way defined by the circuit hardware; its state is merely made available to the CPU. Likewise, the MSF data is not decoded outside the CPU, but is inspected periodically by the program, under interrupt timing control; the program must therefore make sense of the information in this form.

DISPLAY

The PCIM200 Display is an LCD Dot Matrix display module, which is particularly easy to interface to a microprocessor system. The module can store 32 characters, of which the "left-hand" 16 are displayed in a single row, using a 7 x 5 dot matrix to represent each character. The character set is based on ASCII codes, but excludes lower-case alphabetic symbols. A cursor (underline) row is also available in the display, together with powerful character addressing and string manipulation features, but these are not used in this application.

The module connects directly to an 8-bit processor bus, together with 3 control signals, MRD, MWR and CS. If CS and MWR are brought low simultaneously, the information on the bus is written to the module; this can be either, an ASCII character code or a control code for the module. Thus the module behaves rather like a RAM in WRITE mode, and is connected as the sole output port in this system.

CPU CONTROL

We now have a complete system with one memory device (the program ROM), one input port (IC5) and one output port (the display module). Because each of these devices has two gated "inhibit" inputs, interfacing to the Z80 is trivial - as the circuit shows, no external gating or address decoding is needed. The only special interfacing requirement is that the logic "1" levels to the display should be +5 V, for which the pull-up components R8, R9 and R10 are included.

POWER—UP RESET.

Any microprocessor system must include a means of resetting the CPU when power is first applied, This means that the CPU reset pin must be held low for a short time after the power rail has risen, and, incidentally, after the clock oscillator has started.

When power is applied, Q1 receives base current via C3 and R4, which holds its collector (the CPU reset pin) low. C3 then charges, on a time constant C3-R4, until Q1 is no longer held on by the falling base current. At this point the reset pulse ends, The purpose of D1 is to partially discharge C3 whenever the power rail dips, even by a small amount, so that a reset pulse is produced after any slight power interruption.

SOFTWARE OVERVIEW

The software of the MSF clock is stored in a 2716 EPROM. *Fig 6* is a simplified flow diagram and outlines the program's operation.

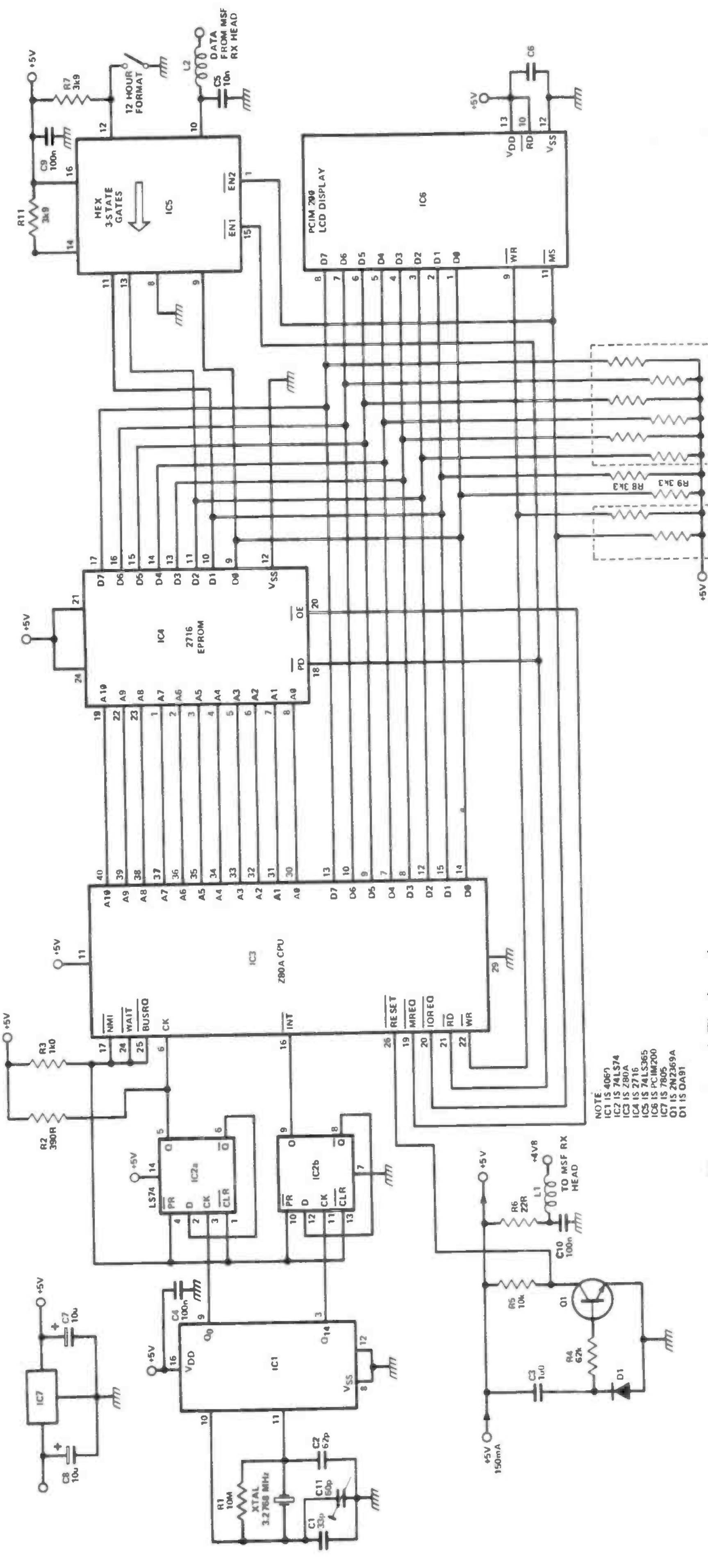


Figure 7: Circuit diagram of the REWBICHRON's logic board. The board is powered by a Sabtronics mains adaptor type BS-01.

CONSTRUCTION

The low component count of the design and the use of a double sided PCB make construction of the logic/display board quite straightforward. First insert all the pins linking the tracks on the top and bottom sides of the PCB. Next mount the rest of the logic board components and the IC sockets. Finally the display modules can be soldered into place. The ICs can now be placed in their respective sockets paying attention to orientation and ensuring that *all* of the pins are safely in the socket.

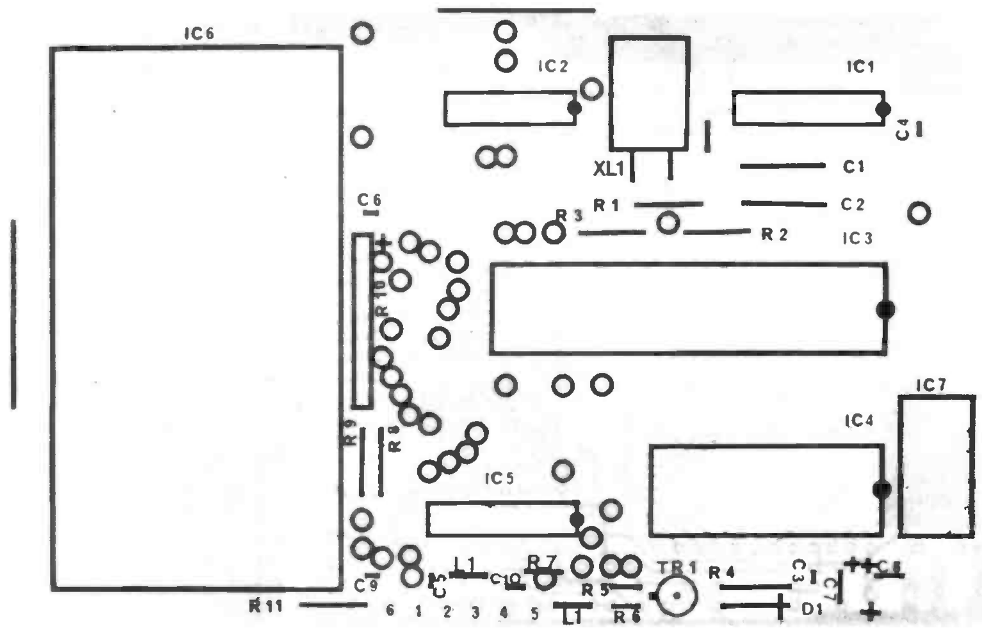


Figure 8: The overlay of the logic board, the PCB foil patterns are available from R&EW upon receipt of an SAE.

PARTS LIST (LOGIC DISPLAY BOARD)

Resistors (all .5W 5%)	
R1	10M
R2	390R
R3	1k0
R4	62k
R5	10k
R6	22R
R7,8,9,11	3k9
R10	8 x 3k9 SIL
Capacitors	
C1	33p ceramic
C2	62p ceramic
C3	1u0 16V tantalum
C4,6,9,10	100n monolithic
C5	10n monolithic
C7,8	10u 16V electrolytic
Semiconductors	
D1	0A91
Q1	BC238
IC1	4060
IC2	74LS74
IC3	Z80A
IC4	2716
IC5	74LS365
IC6	PCIM200
Inductors	
L1,2	15mH choke
Miscellaneous	
3.2768 MHz crystal	
PCB	
SPDT switch	
Sabtronics Mains Adaptor type BS-01	

THE RECEIVER HEAD

HEAD FOR RUGBY

The receiver head is based on the new ULN3859 NBFM subsystem. This device is a derivative of the popular MC3357 providing a specific de-emphasis/decoupling point (Pin 9) and AFC output (Pin). The '3859 works from 5V0 quite happily, and consumes only 3-4 mA in the process.

CONSTRUCTION

The R&EW receiver design offers repeatable results and is straightforward to set up. The PCB layout shown should be used in order to be certain of acceptable results and little in the way of constructional comment is required, except to say that the overlay shown should be carefully followed.

TESTING

The board can be tested quite easily and although it will help if you have access to a frequency counter and/or 60 kHz signal source it can be set up without the aid of any test gear.

The first thing to do is check your approximate orientation with respect to Rugby and get the antenna at a right angle. The beam width is narrow in such a high Q system and you will have to be within about 20-40 degrees to get a useful signal.

Next, set RV1 to maximum and, if you have a frequency counter, couple it to Pin 3 with about 100 pF and tune T1 for 515 kHz. Alternatively monitor the audio output with either a crystal earpiece or an audio amplifier with a high input impedance and listen for the characteristic 'chuffing' of the MSF 60 kHz signal. MSF is unmodulated - although a nearby TV set will give the impression of a 2.5 kHz signal when beating against MSF.

The discriminator is set up by adjusting the detector coil on Pin 8 until the voltage measured at Pin 11 is 2V5. This sets the discriminator in the middle of the S curve but for best results it is best to undo the core a shade further, causing the noise bursts in the carrier to become more rasping and definite.

When a pulsating burst is established, align the antenna for best results then adjust RV2 until the LED lights continuously. By turning RV2 just back from this position, you will reach a point where the LED flashes regularly at 1 Hz. If the LED does not give a solid on/off ratio readjust RV2 and the detector coil.

When setting up the receiver in its final location, it may be necessary to trim RV2 again for best results — the other RF adjustments should not be touched.

LEAD TO CONCLUSION

The receiver head is connected to the main system via a 3-way cable of up to 10 metres in length and should be kept away from any 'busy' electronics, including TVs and the main REW BICHRON system.

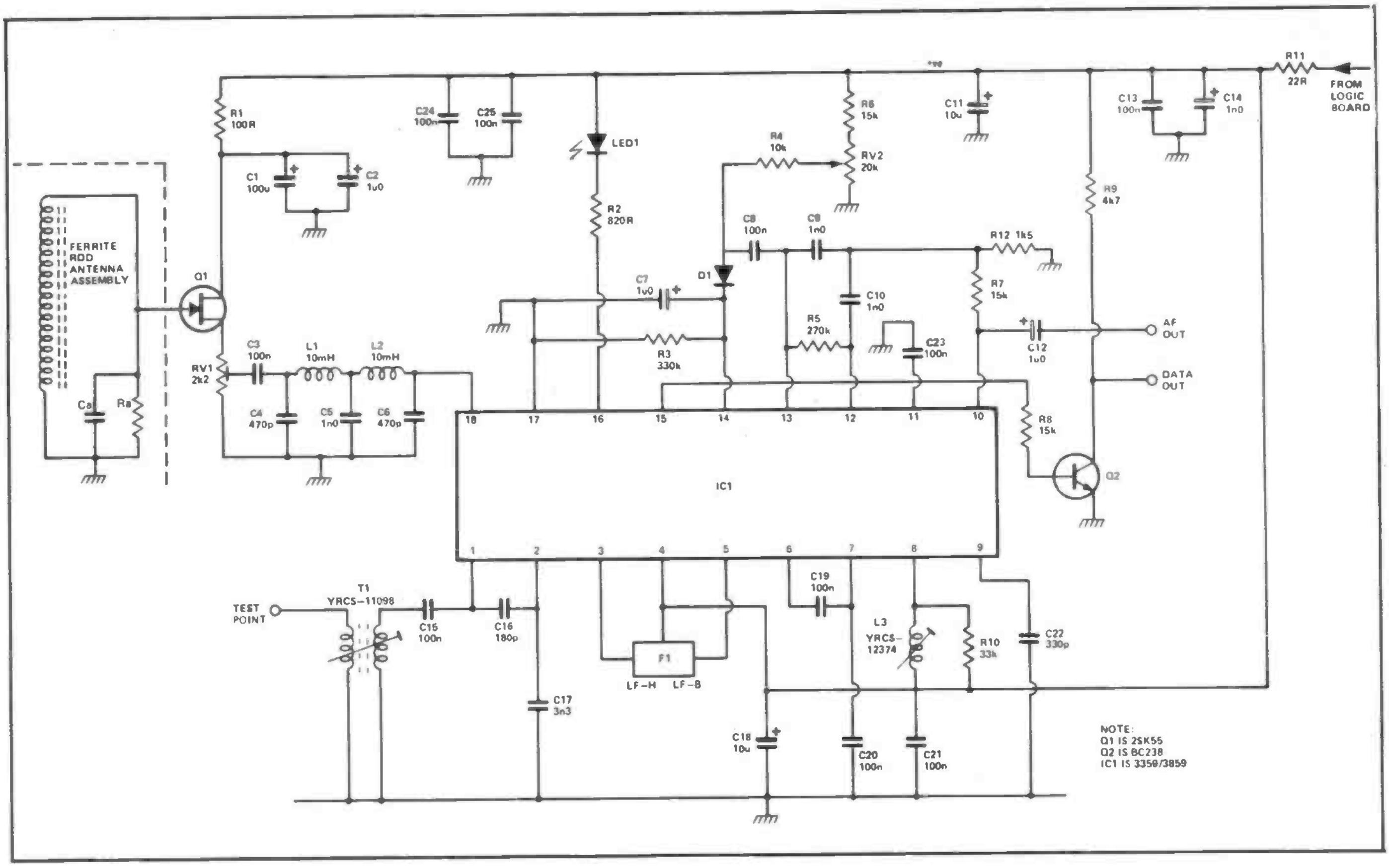


Figure 9: Circuit diagram of the 60 kHz receiver head. Ra and Ca are incorporated within the antenna assembly.

CIRCUIT DESCRIPTION

The signal from the antenna rod is fed to the rest of the circuit via the source follower Q1. This stage is used to keep the RF bandwidth as tight as possible, helping to reject some of the extraneous noises (such as TV timebase signals) that plague LF.

The low pass filter (C4, 5, 6 and L2, 3) on the input of IC1 is essential to keep out images from MW stations.

A Colpitts-style crystal oscillator is used with an external tuned circuit to provide the standard IF of 455 kHz with HF injection at 60 kHz.

The noise muting section of IC1 is used to provide carrier on/off indication, offering yet more noise immunity as noise received during the carrier off period is ignored completely. This approach also avoids the problems of AGC, since during periods of carrier, the limiting amplifier simply does its job and as long as there is enough signal to quiet the noise mute, AGC becomes irrelevant.

The noise mute operates using a bandpass active filter. (inverting input on Pin 12), whose centre frequency is set by C13, 14 and R5 together with internal resistors. The amplified noise is detected by D1, then fed to a Schmidt trigger (Pin 14).

The time constant of the mute action is set by C10 and the threshold of the Schmidt trigger by RV2.

The mute control, Pin 16, indicates the state of the received signal via LED1. The scan control, Pin 15, provides an inverted version of the required signal, which when inverted and level shifted by Q2 provides the data output to the logic and display board.

REW BICHRON PARTS LIST

Resistors (all ¼W 5%)

R1	100R
R2	820R
R3	330k
R4	10k
R5	270k
R6,7,8	15k
R9	4k7
R10	33k
R11	22R

Capacitors

C1	100u electrolytic
C2,14	1u0
C3,8,13,15,19,20,21,23,24,25	100n monolithic
C4,6	470p polystyrene
C5,9,10	1n0 monolithic
C7,12	1u0 electrolytic
C11,18	10u electrolytic
C16	180p ceramic
C17	3n3 ceramic
C22	150p ceramic

Semiconductors

IC1	3359/3859
Q1	2SK55
Q2	BC238
D1	IN914
D2	RED LED

Inductors

T1	YRCS-11098
L1,2	10mH
L3	YRCS-12374

Miscellaneous

Ferrite rod antenna assembly, PCB. LFH 8S

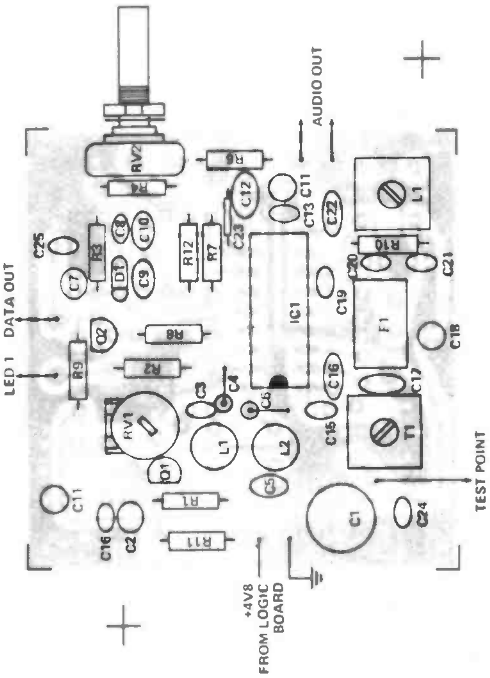


Figure 10: Component overlay of the receiver head.

■ R&EW

Your Reactions.........	Circle No.
Excellent - will make one	43
Interesting - might make one	44
Seen Better	45
Comments	46

ASCII LCD DISPLAY SYSTEM

The DM200 is a versatile 16 character alphanumeric dot matrix display system. In the next three pages we take a look at the facilities offered by this unique module.

A DREAM COME TRUE

Many items of instrumentation and electronic gadgetry would be much enhanced by an ability to provide real alpha-numeric prompts such as "SET OUTPUT VOLTAGE", or "INPUT OVERLOADED", etc. Until recently such facilities have been prohibitively costly. The only method of providing such a sophisticated level of display has been when the instrument already requires the cost and complexity of a visual display circuit, such as expensive oscilloscopes and logic analysers.

However, the availability of a new dot matrix display module changes all of this. It is now possible to incorporate full alpha-numeric prompting into any piece of electronic equipment from games to cars.

THE DM200

The DM200 is a compact LCD display module not much bigger than a box of "Swan Vestas" (see *Fig 3*). The display consists of an array of sixteen, 5 x 7 character cells arranged in a single line (see *Fig 2*). In addition, an 8th row is available so as to provide cursor facilities when this option is selected. The display module operates from a standard 5 volt supply and consumes just 8 mA. The interface to the module, *Fig 5*, consists of eight bi-directional data lines, and the three controls lines: Chip Select, which when low selects the module for either a read or write operation; MRD, which when low with Chip Select places the module in a read mode, and MWR, which together with chip select allows data to be written into the display. The simplicity of the interface is a result of the incorporation of 3 Hughes LSI LCD display controllers within the module.

Figure 1 is a block diagram of the internal logic of the DM200. A small preset capacitor, adjustable from the front of the module, allows variation of the display viewing angle and contrast. Internal circuitry in the DM200 maintains constant display contrast despite variations in external temperatures, thus avoiding the well-known problems of LCD display systems subjected to a wide range of temperatures.

64 ASCII characters are displayed by the DM200 allowing complete lines of text, including punctuation, to be reproduced. Internally, the DM200 has a 32 character memory; thus, messages longer than the 16 display characters can be catered for. The display is completely self-refreshing and thus similar in concept to using a standard computer visual display unit. Data is written into the display simply by bringing Chip Select and MWR low together. The diagram of *Fig 4* shows the required timing for this event. The hexadecimal codes 20 to 5F cause the corresponding ASCII character to be stored into the display memory.

In addition, the characteristics of the display are fully programmable. The various codes acting upon it are detailed in *Table 1*. Various control codes allow the setting of such parameters as whether or not the display is blinking, the type of cursor, and the direction the cursor is incremented or decremented upon a character being written to the display. As well as being able to write to the display it is possible to read the current display status and current selected display parameters. The provision of shift and rotate instructions allow the full 32 character memory to be displayed without having to constantly update the contents of the display. In particular, the rotate instructions make it easy to provide the "Times Square" mode of operation.

When a new character is loaded into the display a "busy time" of 3.26 mS must be allowed to elapse before another character is written to the display. This wait period may be aborted by the reset instruction.

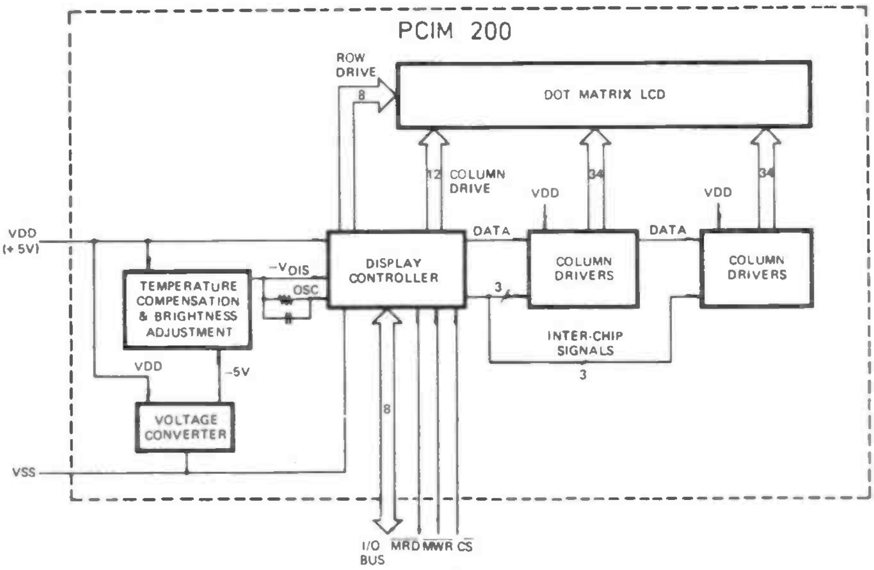


Figure 1: Block diagram of internal logic of DM200 display module.

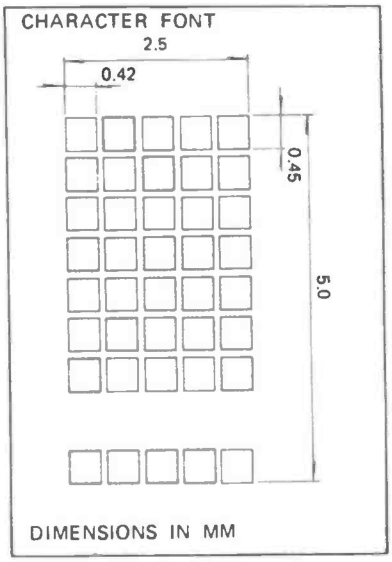


Figure 2: Single character position of LCD display.

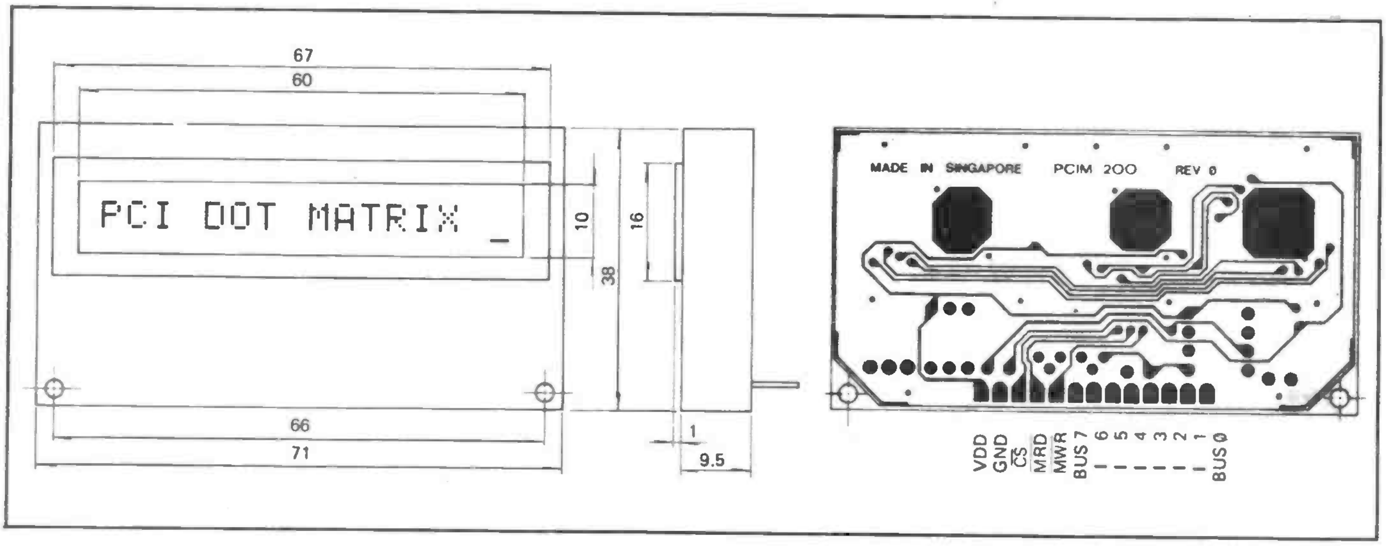


Figure 3: Dimensions and display connectors.

CONTROL CHARACTERS FOR THE DM200

Hex	ASCII	Effect
00	NUL	
01	SOH	Codes 0 to 1F change the Cursor location to an absolute address in the display memory. E.g. 00 positions cursor to position 1 in display memory.
1E	RS	
1F	VS	
20	SP	ASCII codes 20 through 5F cause the character corresponding to that code to be stored into the display memory the complete character set is reproduced below:
21	!	
41	A	!"#$%&'()*+,–./0123456789:;<=>?@ ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]∧–
5E		
5F	–	
60		Inhibits the cursor from blinking
61	a	Causes the cursor to blink at 1 Hz.
62	b	Inhibits the display from blinking.
63	c	Causes the entire display to blink at 1 Hz.
64	d	Inhibits the auto inc/dec feature.
65	e	Auto inc/dec. Causes the cursor to move by 1 for every character read or written to the display.
66	f	Used with auto dec. The cursor decreases by 1.
67	g	Used with auto inc. The cursor increases by 1.
68	h	Un blank display.
69	i	Blanks display, but does not destroy contents.
6A	j	Invisible cursor.
6B	k	Visible cursor. Cursor shows up.
6C	l	Cursor character is a filled block
6D	m	Cursor character is an underline on row 8
6E	n	Halt rapid load.
6F	o	Initiate rapid load see text.
70	p	Power up.
71	q	Power down, display blanks and power consumption is reduced to 4mA. Memory is maintained.
81		Get display control flags. The current settings of the display control flags are gated onto bus 0-7 as follows. 7 Busy; 6 Cursor Type; 5 Visible Cursor; 4 Blank Display; 3 Up/down; 2 Auto Inc/Dec; 1 Blink Display; 0 Blink Cursor
82		The current cursor location is gated onto Bus 0-7
84		The character at the current cursor location is gated onto bus 0-7
88		Decrement cursor by 1
89		Increment cursor position by 1
8A		Clear the display
8B		Reset busy, abort last character load
8C		Rotate display left, wrap-around occurs.
8D		Shift display left, characters fall off display.
8E		Rotate display right.
8F		Shift display right.

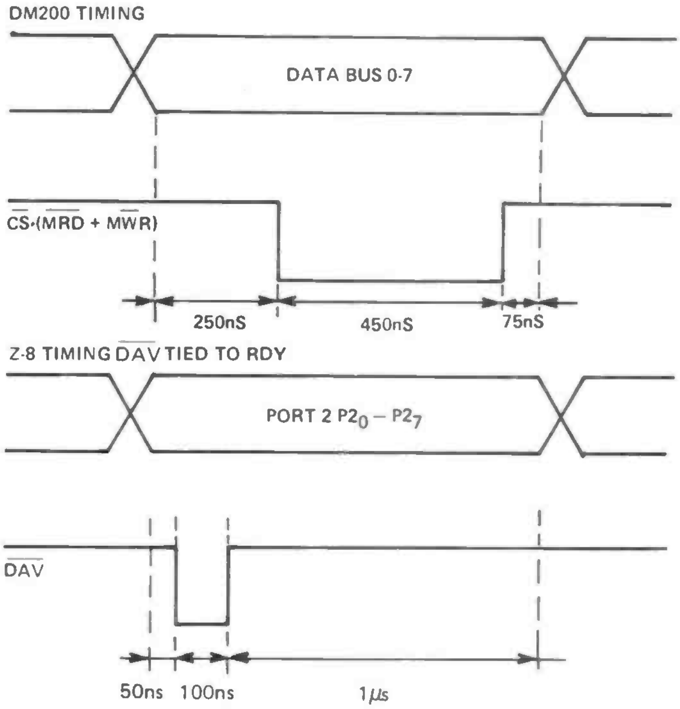
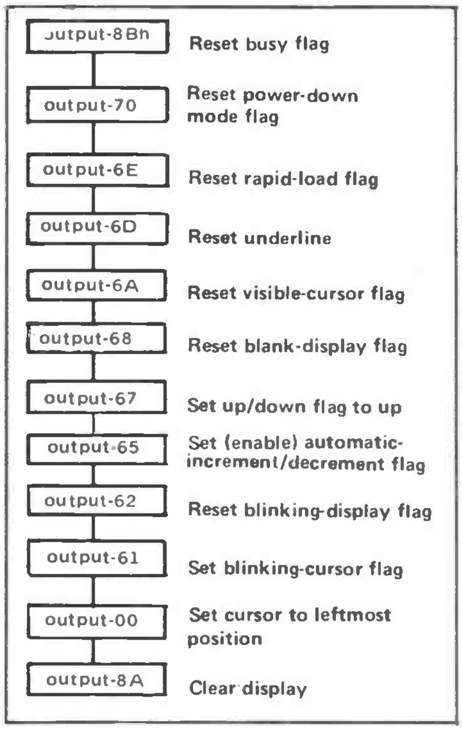


Figure 4: Module timing waveform.

There are two main methods for filling the display with information:

a) Select the display for auto increment or decrement of the cursor. Each character written to the display will now cause the cursor to move onto the next memory location (NB., wrap-around occurs at the end of display. In this mode the display memory may be thought of as a circular buffer).

b) Advantage may be taken of the rapid load instruction which, once issued, causes the display to blank and the oscillator to stop. 32 characters must now be sequentially presented to the display, and the rapid load mode terminated by the appropriate instruction. This method is faster than the cursor method but is only suitable when the messages to be displayed fit into a constant 32 character format.



An initialising sequence, performed after system power-up, will initialise everything, blank the cursor, and set it at the leftmost position. The display system will then be ready for character loading from left to right.

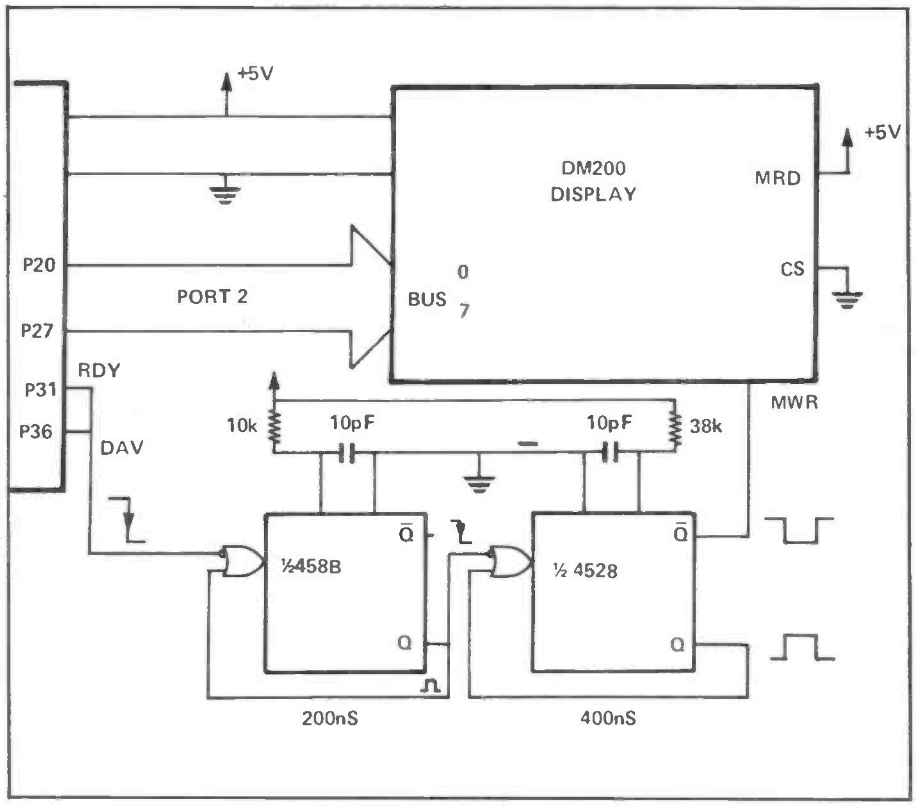


Figure 5: Z-8 to DM200 interface

A useful power down mode is provided which blanks the display but preserves the contents of the display memory and halves the power consumption.

When using the DM200, it should be remembered that the display does not power up in any particular state. It is necessary to go through the following procedure on power up:

1. Issue a RESET BUSY instruction.
2. Set all display parameters.
3. Issue a CLEAR instruction.

INTERFACING TO THE DM200

The MSF Clock project elsewhere in this issue shows quite clearly how simple a Z-80 to DM200 interface can be, and, as can be seen, the minimum of external hardware is required. *Fig 5* shows an interface from the **R&EW** Z-8 BASIC computer. The Z-8 port 2 lines are used for the data, and two of the lines of port 3 are set up to provide automatic strobing every time data is written into port 2. A CD4528 dual monostable is used between the strobe line from the Z-8 and the chip select line of the DM200 to ensure that the timing constraints are properly catered for. The program of *Fig 6* shows just how easy it is to control the DM200, and having first of all set up the display parameters allows any character typed at the terminal to be displayed on the DM200.

We hope to use the DM200 as the basis of a number of **R&EW** projects. In the meantime, if you wish to experiment further the DM200 is available from AMBIT INTERNATIONAL, 200 North Service Road, Brentwood.

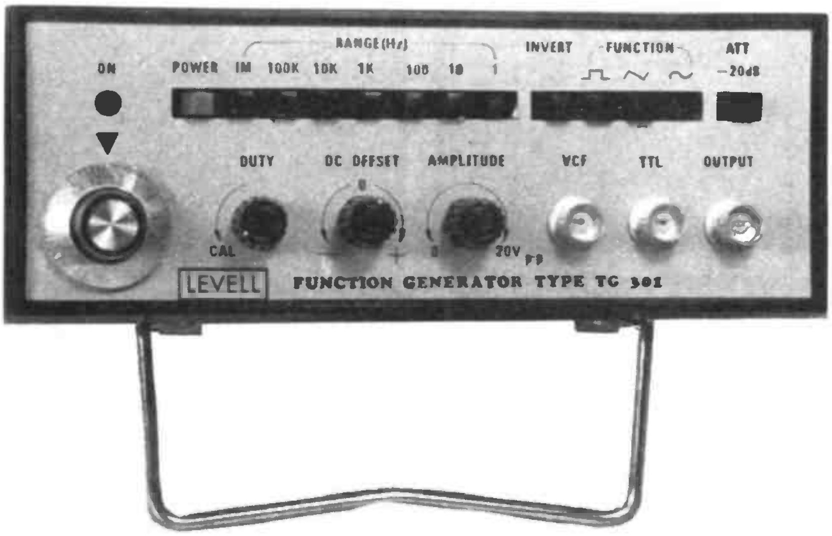
■ **R & EW**

Your Reactions	Circle No.		Circle No.
Immediately Applicable	80	Not Applicable	82
Useful & Informative	81	Comments	83

```
LIST
5 REM PROGRAM TO EXERCISE DISPLAY MODULE
10 REM SET UP Z-8 PORT 2 FOR AUTO-HANDSHAKE
20 @3=255:@246=0:@247=%61
25 REM SET UP DISPLAY PARAMETERS
30 @2=%70:@2=%6E:@2=%6A:@2=%68
40 @2=%67:@2=%62:@2=%61:@2=%64
42 REM CLEAR DISPLAY AND SET CURSOR
45 @2=%8A:@2=16
50 REM GET CHARACTER FROM TERMINAL
60 A=USR(%54)
65 REM OUTPUT IT TO DISPLAY
70 @2=A
72 REM SHIFT DISPLAY LEFT ONE CHARACTER
75 @2=%8D
80 GOTO 60
:
```

Figure 6: Program to display characters typed at a Z8's terminal on the DM200

LEVELL FUNCTION GENERATOR REVIEW



The Levell Electronics TG301 is a versatile function generator spanning 0.02 Hz to 2 MHz, but with a couple of hidden 'extras'...

Sad to say, there are few manufacturers of low cost 'general purpose' electronic test equipment — Thandar, Thurlby and Levell nearly amount to the entire industry. We are always delighted to hear of others, so if your company has been omitted, get in touch with your brochures etc., and maybe we can spread the word.

The Levell TG301 is a 'concise' piece of test equipment, reminiscent of the Thandar TG102 in many ways, with an extra decade at the LF end down to 0.02 Hz. The variable duty cycle feature of the TG301 is a useful facility for deriving ramp and pulse waveforms with a duty cycle of up to 15:1. The lack of calibration in this mode means that the output will probably have to be 'set up' using an oscilloscope — but nevertheless, as you can see from the photo's, the results are very good.

The ranges are set in the usual manner, with a calibrated knob and a range multiplier for the decades — the remaining controls are quite straightforward and self-explanatory.

The Circuit

The block diagram of the unit is shown in *Fig 1*. The basic waveform is derived from two constant current sources of opposite polarity that are alternately switched to charge and discharge a timing capacitor. This results in a triangular wave being generated at the current source diode switch, which is operated from a level detector that alternately connects and disconnects the current sources. A precision triangle-to-sine converter (*Fig 2*) then produces a very respectable sinewave, as you can see from the photos of the oscilloscope.

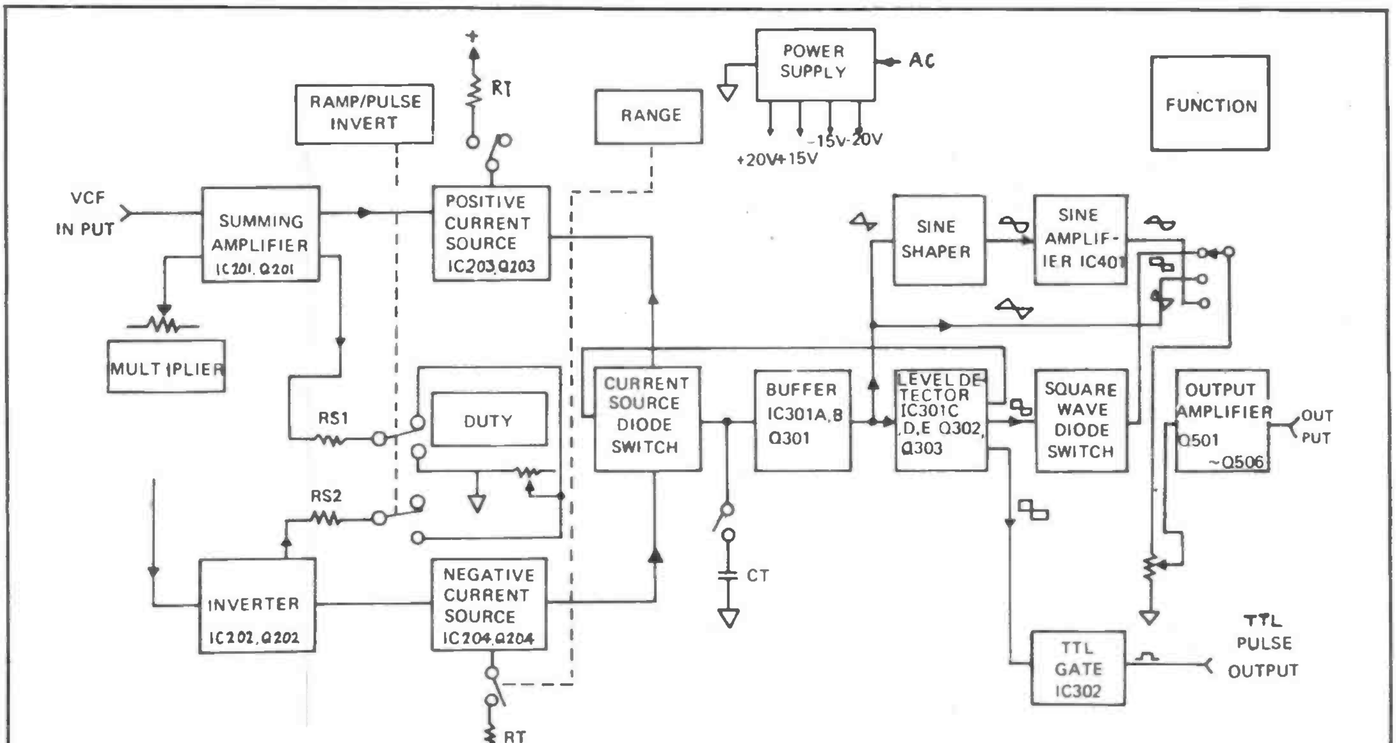
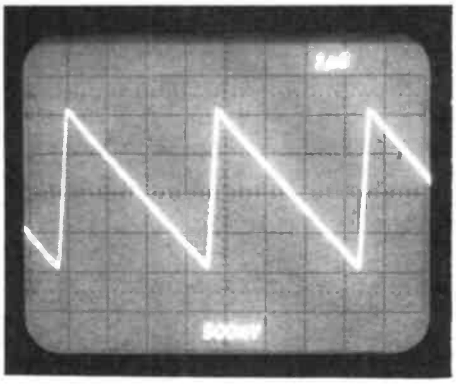
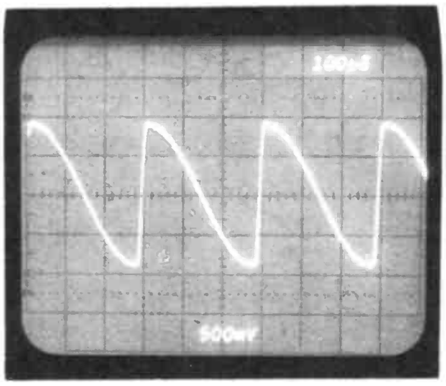


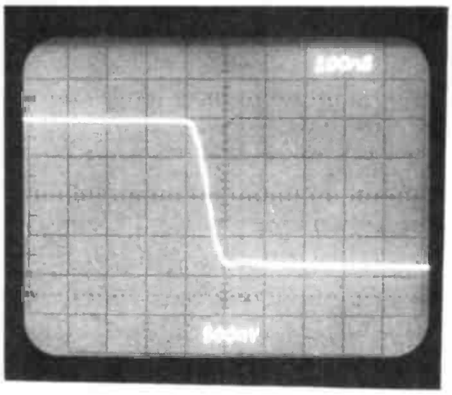
Figure 1: Block diagram of the TG301 circuit.



Triangle wave with reduced duty cycle to produce ramp.



Similarly a sinewave with reduced duty cycle



The trailing edge of a square wave in 'close-up'.

Levell were reluctant to let us use the full circuit, since it is an interesting approach that uses neither Exar not Intersil ICs to take a short cut, but like the Thurlby DMM reviewed a couple of months back, which performed the A D from first principles, the TG301 generates andshapeswaves using nothing but 'bare' transistors, op-amps and diodes. Brave stuff indeed.

The sinewave is excellent up to 200 kHz — and even beyond that, the remnants of its switching heritage are not as obtrusive as with other types of function generator costing a good deal more.

The duty cycle control operates by varying the amplitude of one of the current sources — and it is at this point that the invert function operates to reverse the sense of the output waveform. An externally applied sweep voltage of 10V p-p will sweep the output over a 1000:1 range (100:1 on the 0.02 Hz range).

The output amplifier is a complementary AB system that bears more than a passing resemblance to a Hi-Fi amplifier stage. Since the stage is designed to provide up to a watt or so, few op amp approaches would be viable — and certainly not many that would cope with 1W at 2 MHz.

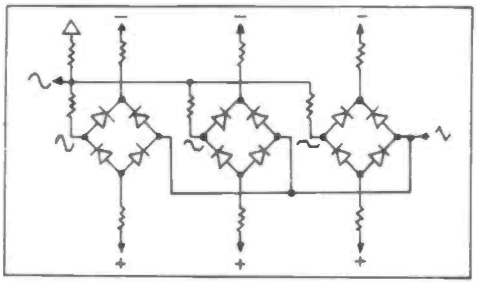
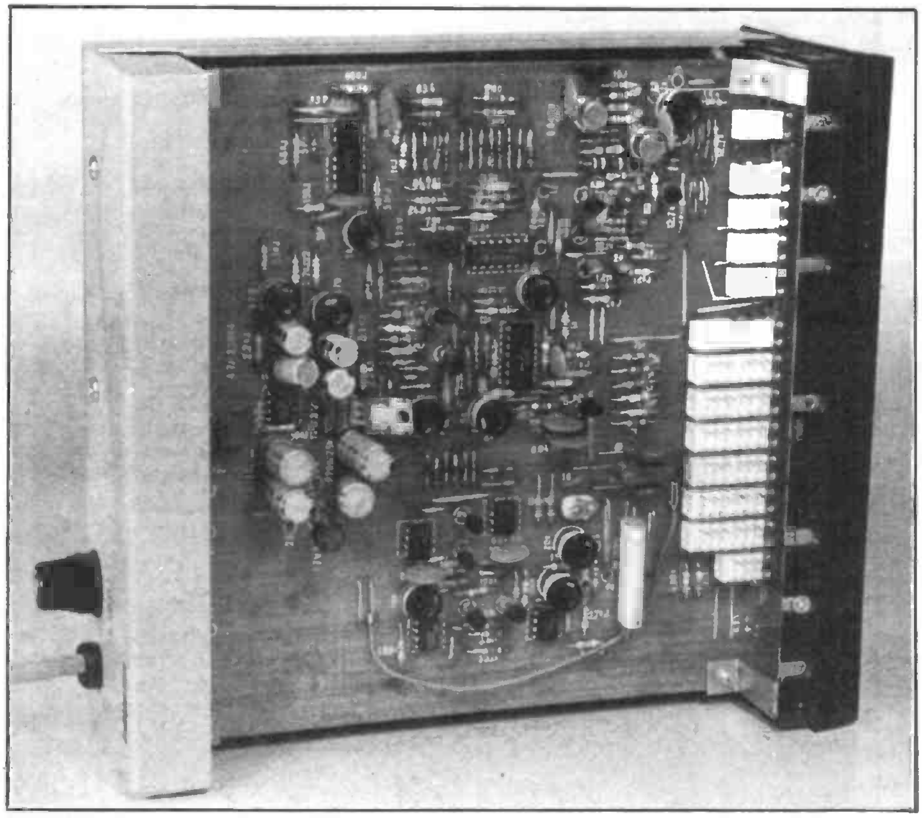


Figure 2: The TG301 triangle-to-sine converter circuit.

Presentation

The TG301 is 'functional' rather than stylish, and the internal construction (*photo*) could be similarly described. It is a shame that a little more imagination could not have gone into the design of the panel — but perhaps we are getting spoiled by the delightful aesthetics of Tektronik, HP and others who obviously have a team of industrial designers doing little else.



Internal construction of the TG301.

The handbook contains lots of useful information, but the layout and circuit diagram drawings would benefit enormously from a slightly more professional approach that would do justice to the undoubted competence of the product and its performance.

In common with other function generators in this class, the output attenuator control could be better. A switched —20 dB aids resolution at low levels, but a decently calibrated volts/millivolts attenuator would be a helpful feature. There are several sources of precision 'click stop' pots these days, and their implementation is quite simple.

The unit is supplied with two test leads — BNC/crock clip, 1 metre in length.

Conclusions

On the face of it, a function generator may seem to be a fairly standard thing. The TG301 has one or two 'hidden' features that have put it a jump ahead of its competitors. ■ R & EW

Your Reactions.........	Circle No.
Immediately Applicable	92
Useful & Informative	93
Not Applicable	94
Comments	95

194 for further details

195 for further details

TV SATELLITE BROADCASTING

European Background

Figure 1: The growth in size and capacity of the synchronous satellites used in the Intelsat system during the first decade of commercial operation.
Intelsat I had a diameter of 28·4 in. drum height 23·25 in weighed 150 lb at lift-off and 85 lb in orbit. No provision was made for multiple-access working.
Intelsat II had a diameter of 56 inches, drum height 26·5 in., weighed 357 lb at lift-off and 192 lb in orbit. Transponders permitted multiple-access working.
Intelsat III had a diameter of 56 in., overall height 78 in., weighed 632 lb at lift-off and 322 lb in orbit. The 10 720 solar cells provided about 130 watts of electrical power.
Intelsat IV had a diameter of 93·5 in., solar drum height of 9 ft 3 in., overall height 17 ft 6 in., weighed 2452 lb at lift-off and 1075 lb in orbit. Altogether some 50 000 solar cells provide sufficient power to permit an erp of about 1·9 kW for the 17° beam and 38 kW for the 4·5° beam (rf power about 80 W).

In the second of this series on Direct Broadcast Satellites, we look into what the future holds for the 12 GHz plan and set the scene for the technical onslaught....

WHERE TO LOOK

The World Administrative Radio Conference (WARC) is convened from time to time to decide upon an orderly and international approach to radio frequency allocations to users and countries throughout the world. We have WARC to thank for the relative order that exists in broadcasting today, although many countries continue to gripe about the size and nature of their allocations. So it was in 1977, when the question of Satellite TV Broadcasting arose.

Region 1 (Europe and Africa) were allocated the 11.7-12.5 GHz band, and just about everyone else got 11.7-12.5 GHz (Regions 2 and 3). And within this band, each country was allocated five of the 40 channels available, each spaced at 19.18 MHz (each of 27 MHz bandwidth, causing adjacent channel overlap - see later) using FM TV techniques, since they are more efficient than the present AM system used on terrestial networks - although bandwidth is somewhat greater. At 12 GHz, the bandwidth is not so much of a problem as in the confines of 500-850 MHz where country-wide networks must use a series of repeater stations within this band, and overlap between adjacent transmitters is a serious problem.

The UK was allocated channels 4, 8, 12, 16 and 20 - with other European countries having a similar distribution (n, n+4, n+8 etc). The actual orbital position was also 'fixed' at WARC - and the UK shares 31 degrees West (over the Atlantic, not far from the Eastern tip of Brazil) with Eire, Spain, Portugal and Iceland. At the time, it was not considered viable that the receiver antenna could be 'swung' (only in an arc, since all satellites are in equatorial orbit). However, it seems probable that the UK viewers with a slightly larger dish and a means of shifting it along the arc will also be able to enjoy the overspill from our European neighbours.

WHO NEEDS IT

DBS is going to be most attractive to those countries with populations spread widely cross a large area - and the educational experiment in India is perhaps the classic example that many people would already have heard about. Russia has also been making extensive use of DBS, although the 'Molniya' satellites forming their 'Orbita' system are in highly eliptical non-synchronous orbits to overcome the problems of reaching northern latitudes without the complications of fast tracking ground station antennas. The Russians have also been using TV satellite relays for some time now, with Statsionar 2 in the 4 GHz band -as well as some transmissions at the top end of Band V itself -which some of you may have noticed in the launch publicity surrounding London's 'Video Palace' enterprise - a case of jumping on the bandwaggon even before the axles are fitted!

Canada already enjoys most of the US DBS coverage, as well as the Canadian's own Anik series of satellites launched as long ago as February 1973. The Scandanavian countries (Norway, Sweden, Finland and Denmark) were intended to have coverage extending across their entire area. These relatively high lattitude countries are less ideal DBS candidates, since the angle of elevation for the antenna is going to be very low - leading to problems from relatively low level obstructions.

However, since the 1977 conference, opinions from the Scandanavian and Nordic countries (including Finland and Iceland) have diverged, and now most of the countries want to do their own thing once again.

MEANWHILE, BACK AT THE OTS....

The Orbital Test Satellite was launched by the European Space Agency in 1978 to verify some of the hypotheses surrounding proposals for future DBS plans. 3000 voice channels and 2 TV links have proven the viability of the general concept, and although the general experiment was scheduled to end by 1982, the life of the OTS is not over yet.

In a move which some ESA members considered was rather slick, British Telecom managed to rent one of the OTS TV channels - ostensibly for a direct link to Malta. Not so! After a period of being on the wrong end of European chicanery, the UK has bowled a superb googly, since the OTS channel has been sub-let to Satellite Television Ltd., who are a UK based company backed by substantial financial interests who have obviously seen the prospects for gettng into DBS as early as possible. Eutelsat gave their permission last September for the project to proceed.

STV can use the OTS footprint which extends from Helsinki to Tunisia - albeit at too low a power for the proposed DBS 1

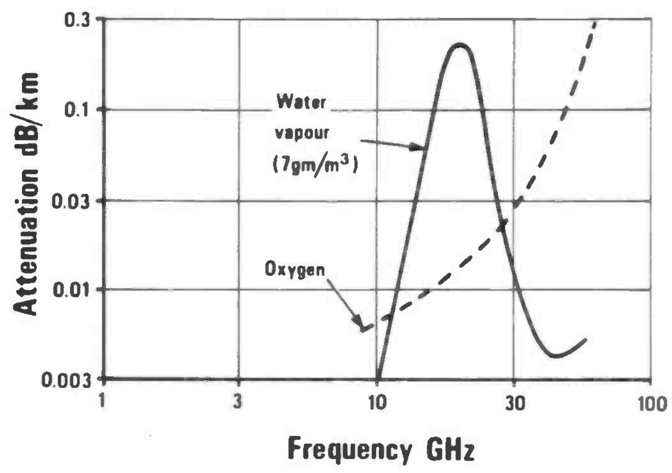


Figure 4: Attenuation of an shf radio wave, additional to the free-space attenuation due to the presence of water vapour and oxygen in the atmosphere. These curves relate to sea-level: and, at a height of 15-20 km attenuation is reduced to about one per cent of these figures.

metre dish antennas, with cable vision networks as their prime targets. However, the example of enterprising US interceptors probably means that a good number of viewers will be keen to start their affair with DBS as soon as possible. STV are also negotiating for space on one of the subsequent European Communications Satellites (5 going up between 1982 and 1992).

STV programming will include news, sport, weather, entertainment, films, and 'cultural' programmes, operating under the IBA code of practice with regard to both content of programmes and advertising. The whole show starts about now, with 1.5 hours a night, increasing to 6 hours, with 10 hours at weekends. £10 million has thus far been raised from the likes of Barclays and Guiness Mahon, and STV anticipate few problems in attracting as much additional finance as it requires.

MADE IN ENGLAND

The major contract (£150 m) for the production of the L-SAT for genuine DBS purposes, has been awarded to British Aerospace. L-SAT (Large-SATellite) has been commisioned by the ESA from its seven member countries (plus Canada), and will weigh around 2,300 kg, with a 3.5 kW solar cell array. Broadcasting should commence in 1986, although the pressure is on as France and Germany are proposing an 'experimental' DBS in 1984 as a result of a joint development programme they have undertaken.

CO—CHANNEL USERS

Despite the airy assumption that there are enough MHz around at 12 GHz to cater for anyone who wants a channel - there is not enough spectrum for the greedy broadcasters to use on an exclusive basis. Channel sharing is the thing, and the elegant solution is to send one transmission with vertical polarization, and one with horizontal. Terrestial transmissions suffer from a good deal of scrambling of polarization as a result of buildings, terrain etc., but signals from space obviously suffer no such obstruction, and discrimination from polarization is thus a viable solution.

The WARC conference established a criteria by which interference could be assessed by a factor known as the equivalent protection margin, which is simply the ratio of the wanted to unwanted signal - 31 dB for co-channel, and 15 dB for adjacent channel interference. Bearing in mind the fact that the transmissions are FM, these figures ensure a high standard of picture quality. The use of AM would have meant an additional 15-20 dB of 'protection' would have to be built into bandwidths and allocations to maintain the same picture quality - so FM actually conserves the spectrum, contradicting the apparent fact.

The band is also used by telephone microwave links, using relatively narrow channels, leading to the possibility of TV DBS having a concentration of high energy within these channels. So the DBS uses an energy dispersal technique with a low frequency triangular modulating waveform prior to vision modulation that results in 600 kHz deviation under 'no signal' conditions, thereby protecting the input of a 4 kHz telephone channel.

THE BASIC CONCEPTS OF 12 GHz TRANSMISSIONS

The US 4 GHz band suffers around 196 dB of attenuation in free space from the satellite to the ground station. This is bad enough - but at 12 GHz the attenuation is typically 206 dB. Add to this the effects of rain at around 1 dB per km, or cloud at 0.1 to 0.4 dB/km and the worst case could be as much as 212 dB. *(Fig 2)* Most calculations are based on attenuation of 206.5 dB for Europe, although higher latitudes will suffer correspondingly higher losses resulting from atmospheric attenuation effects - perhaps around 210 dB average. Depolarization resulting from atmospheric scatter is not considered likely to present the UK with much trouble.

Orbital errors cannot be overlooked either. An error of 70 feet in 22,300 miles would result in a drift of 0.1 degrees per year. Slightly eliptical orbits can be of the correct period, but can lead to a doppler frequency shift of 110 Hz, corresponding to a radius fluctuation of +/—23 miles. In order to maintain the precise position, small gas jets are fitted to the satellite for fine positional tuning. This consideration was once the main factor affecting the working life of a satellite, but the advent of the space shuttle means that these enormously expensive satellites can now be maintained and serviced in flight.

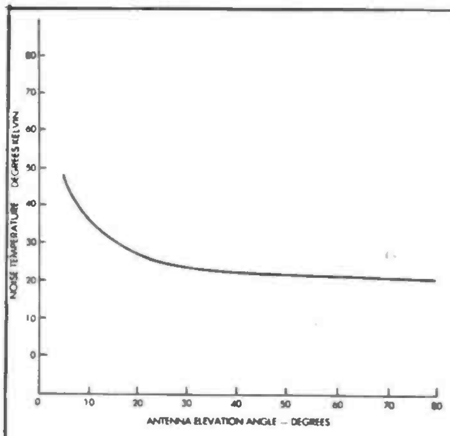


Figure 3: Even large dish antennas intercept terrestrial noise, but the noise level drops as the dish is tilted back from the horizon to the open sky.

	INTELSAT I	INTELSAT II	INTELSAT III	INTELSAT IV	INTELSAT IVA	INTELSAT V
First launching	1965	1967	1968	1971	1975	1979 (Estd)
DC power (watts)	33	75	125	450	600	1200
Total rf power (watts)	10	18	20	72	104	198·5
Transponders	2	1	2	12	20	27
Total usable bandwidth (MHz)	50	130	450	432	720	2241
Total two-way telephone channels (approx.)*	240	240	1200	4000	6000	12 000
Alternative TV facility (channels)*	1	1	4	12	20	40 50
Antenna beam(s)	11° x 360° centred + 7°	12° x 360° centred equator	1 Global beam 20° x 20°	1 Global beam 17° x 17° 2 spot beams 4·5° x 4·5°	1 Global beam 18° x 18° 2 hemi-beams 12° x 4°	1 Global beam 18° x 18° 2 hemi-beams 14° x 5° 2 zonal beams 9° x 3° 2 steerable spot beams for 11/14GHz East spot 3·2° x 1·8° West spot 1·6° x 1·6°

* Note that the capacity of a satellite varies according to the way it is used. Significant factors are the number and strength of the carriers; the type of modulation; the method of access; and the distribution of traffic on the various antenna beams, and the characteristics and requirements of the earth stations.
In mid-1977 the number of countries participating in INTELSAT was 95

TABLE 1: Technical details of the INTELSAT Satellites.

A Dish Antenna being elevated in the U.S.A.

The threshold effect of FM demands that the RF power should exceed the noise power by 10 dB (in the RF bandwidth) to produce a 'minimum acceptable signal'. At 12 GHz, the noise power is -122.7 dBW in a receiver with 7 dB noise figure, which means that the incoming signal must be at least 112.7 dBW, preferably 110.7 dBW to allow a 2 dB margin. DBS designers have also 'thrown in ' a further 9 dB to allow for path losses and miscellaneous attenuation across the service area of the beam, resulting in -101.7 dBW.

The video S/N for a 7 MHz peak deviation signal with 5 MHz bandwidth is 37 dB - which is the target set by the WARC and EBU standard - around a 90% perfect picture.

PRACTICAL ANTENNAS AND FRONT ENDS

Dishes of approx 1m diameter have been deemed as the practical maximum for the DBS network. The gain will be around 38 dB -and the beamwidth around 2 degrees. (Beamwidth = 75 x wavelength / D).

Now we start to worry about noise factors - and the preferred criteria in space communications is noise temperature, which equates to the popular noise figure (NF) designation according to:

290 degrees K = 3.0 dB
170 degrees K = 2.0 dB
75 degrees K = 1.0 dB

Figure 3 shows the effect of antenna elevation of terrestial noise pickup, so to apply this to a practical situation with 20 degrees of terrestial noise, and 3 K degrees of preamplifier noise, the noise power,
= KTB (K is Boltzman's Constant, B is the Bandwidth)
$= 1.38 \times 10^{-23} \times 3000° \times 30 \times 10^{6} =$
12.42×10^{-13}
convert to dBW (101 log Noise Power) = -119 dBW.

Next month.... ground station principles and design.

☐ R & EW

Your Reactions	Circle No.		Circle No.
Immediately Applicable	35	Not Applicable	37
Useful & Informative	36	Comments	38

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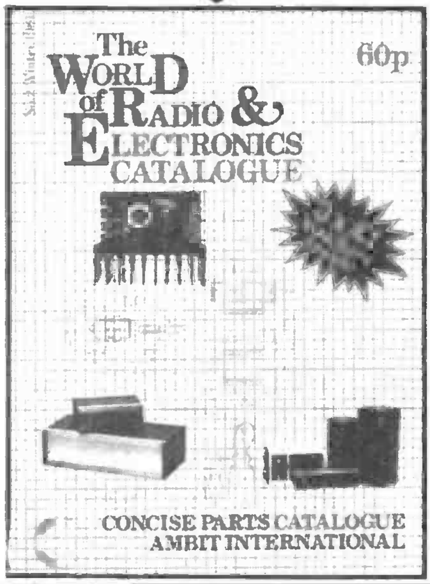

Buy Ambit's new concise component catalogue and get £1 vouchers. Use them for a £1 discount per £10 spent. But even without this, you will still find WR&E offers the low prices, fast service and technical support facility second to none. Here are some examples from the current issue:

I.C. SOCKETS

A range of high quality, low cost, low profile DIL sockets ideally suited for both the OEM and hobbyist. All types feature double sided phospher bronze contacts, tin-plated for low contact resistance.

8 x 0.3"	12p	22 x 0.3"	20p
14 x 0.3"	13p	22 x 0.4"	20p
16 x 0.3"	13p	24 x 0.6"	22p
18 x 0.3"	18p	28 x 0.6"	25p
20 x 0.3"	19p	40 x 0.6"	35p
20 x 0.4"	19p	42 x 0.6"	38p

DISCRETES

BC237	8p	BC556	12p		
BC238	8p	BC550	12p	2SK168	35p
ZTX238	9p	BC560	12p	J310	69p
BC239	8p	BC639	22p	J176	65p
BC307	8p	BC640	23p	40823	65p
BC308	8p	2SC1775A	22p	3SK45	49p
BC309	8p	2SA872A	18p	3SK51	54p
BC413	10p	2SD666A	30p	3SK60	58p
BC414	11p	2SB646A	30p	3SK88	99p
BC415	10p	2SD668A	30p	MEM680	75p
BC416	11p	2SB648A	40p	BF960	99p
BC546	12p	BF256	38p	BF961	70p
		2SK55	28p	BF963	99p

VOLTAGE REGULATORS

78XX1A TO-220 pos	0.58
79XX1A TO-220 neg	0.60
78G 1A TO-220 adj pos	1.10
78G 1A TO-3 adj pos	3.95
78H5A TO-3 5v pos	4.25
78H5A TO-3 12v pos	5.45
78HG5A TO-3 adj pos	7.45
79HG5A TO-3 adj neg	7.45
LM317.5A adj pos	1.30
LM337.5A adj neg	1.75
78S401.5A adj pos sw reg	1.20

XTALS

1MHz	3.00
3.2768MHz	2.00
4MHz	1.70
4.194MHz	1.70
4.43MHz	1.25
5MHz	2.00
6.5536MHz	2.00
7MHz	2.00
8MHz	2.00
9MHz	2.00
10MHz	2.00
11MHz	2.00

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CMOS

4000	0.11	4077	0.18	4705	4.24
4001	0.11	4078	0.18	4706	4.50
4002	0.12	4081	0.12	4720	4.00
4007	0.13	4082	0.18	4723	0.95
4008	0.50	4093	0.30	4724	0.95
4008AE	0.80	4099	0.80	4725	2.24
4009	0.25	4175	0.80	40014	0.54
4010	0.30	4502	0.60	40085	0.99
4011AE	0.24	4503	0.50	40098	0.54
4011	0.11	4506	0.70	40106	0.69
4013	0.25	4507	0.37	40160	1.05
4015	0.50	4508	1.50	40161	1.05
4016	0.22	4510	0.55	40162	1.05
4017	0.40	4511	0.45	40163	1.05
4019	0.38	4512	0.55	40174	1.05
4020	0.55	4514	1.25	40175	1.05
4021	0.55	4515	1.25	40192	1.08
4022	0.55	4516	0.80	40193	1.08
4023	0.15	4518	0.35	40194	1.08
4024	0.33	4520	0.60	40195	1.08
4025	0.15	4521	1.30		
4026	1.05	4522	0.89	**TTL**	**N**
4027	0.26	4527	0.80	7400N	0.10
4028	0.50	4528	0.85	7401N	0.10
4029	0.55	4529	0.70	7402N	0.20
4030	0.35	4531	0.85	7403N	0.11
4035	0.67	4532	0.80	7404N	0.12
4040	0.50	4534	4.00	7405N	0.12
4042	0.50	4536	2.50	7406N	0.22
4043	0.50	4538	0.85	7407N	0.22
4043AE	0.93	4539	0.80	7408N	0.15
4044	0.60	4543	0.80	7409N	0.15
4046	0.60	4549	3.50	7410N	0.12
4047	0.68	4553	2.70	7411N	0.18
4049	0.24	4554	1.20	7412N	0.19
4050	0.24	4555	0.35	7413N	0.27
4051	0.55	4556	0.40	7414N	0.51
4052	0.55	4557	2.30	7416N	0.27
4053	0.55	4558	0.80	7417N	0.27
4054	1.30	4559	3.50	7420N	0.13
4055	1.30	4560	2.50	7421N	0.28
4056	1.30	4551	1.00	7423N	0.22
4059	5.75	4562	2.50	7425N	0.22
4060	0.75	4566	1.20	7426N	0.22
4063	1.15	4568	1.45	7427N	0.22
4066	0.30	4569	1.70	7430N	0.13
4067	4.30	4572	0.22	7432N	0.23
4068	0.16	4580	3.25	7437N	0.22
4069AE	0.14	4581	1.40	7438N	0.22
4070	0.16	4582	0.70	7440N	0.14
4071	0.16	4583	0.80	7441N	0.54
4072	0.16	4584	0.27	7442N	0.42
4073	0.16	4585	0.45	7443N	0.62
4075	0.16	4702	4.50	7444N	0.62
4076	0.55	4703	4.48	7445N	0.62
		4704	4.24	7446N	0.62

7447N	0.62	74153N	0.55	74366N	0.85
7448N	0.56	74154N	0.55	74367N	0.85
7450	0.14	74155N	0.55	74368N	0.85
7451N	0.14	74156N	0.55	74390N	1.85
7453N	0.14	74157N	0.55	74393N	1.85
7454N	0.14	74159N	1.90	74490N	1.85
7460N	0.14	74160N	0.55	**74LSN**	
7470N	0.28	74161N	0.55	74LS00N	0.10
7472N	0.27	74162N	0.55	74LS01N	0.10
7473N	0.28	74163N	0.55	74LS02N	0.11
7474N	0.28	74164N	0.55	74LS03N	0.11
7475N	0.35	74165N	0.55	74LS04N	0.14
7476N	0.30	74166N	0.70	74LS05N	0.13
7480N	0.26	74167N	1.25	74LS08N	0.12
7481N	0.20	74170N	1.25	74LS09N	0.12
7482N	0.75	74173N	1.10	74LS10N	0.12
7485N	0.75	74174N	0.75	74LS11N	0.12
7486N	0.24	74175N	0.75	74LS12N	0.12
7489N	1.05	74176N	0.75	74LS13N	0.20
7490N	0.30	74177N	0.75	74LS14N	0.30
7491N	0.55	74178N	0.90	74LS15N	0.12
7492N	0.35	74179N	1.35	74LS20N	0.12
7493N	0.35	74180N	0.75	74LS21N	0.12
7494N	0.70	74181N	1.22	74LS22N	0.12
7495N	0.60	74182N	0.70	74LS26N	0.14
7496N	0.45	74184N	1.20	74LS27N	0.12
7497N	1.40	74185N	1.20	74LS28N	0.15
74100	1.10	74188N	3.00	74LS30N	0.12
74104	0.62	74190N	0.55	74LS32N	0.12
74105	0.62	74191N	0.55	74LS33N	0.15
74107	0.26	74192N	0.55	74LS37N	0.15
74109N	0.35	74193N	0.56	74LS38N	0.14
74110N	0.54	74194N	0.55	74LS40N	0.13
74111N	0.68	74195N	0.55	74LS42N	0.30
74112N	1.70	74196N	0.55	74LS47N	0.35
74116N	1.98	74197N	0.55	74LS48N	0.45
74118N	0.85	74198N	0.85	74LS49N	0.55
74119N	1.20	74199N	1.00	74LS51N	0.13
74120N	0.95	74221N	1.00	74LS54N	0.14
74121N	0.34	74246N	1.50	74LS55N	0.14
74122N	0.34	74247N	1.51	74LS73N	0.21
74123N	0.40	74248N	1.89	74LS74N	0.18
74125N	0.40	74249N	0.11	74LS75N	0.22
74126N	0.40	74251N	1.05	74LS76N	0.20
74128N	0.65	74265N	0.66	74LS78N	0.19
74132N	0.50	74273N	2.67	74LS83N	0.40
74136N	0.65	74278N	2.49	74LS85N	0.80
74141N	0.45	74279N	0.89	74LS86N	0.14
74142N	1.85	74283N	1.30	74LS90N	0.32
74143N	2.50	74284N	3.50	74LS91N	0.28
74144N	2.50	74285N	3.50	74LS92N	0.31
74145N	0.75	74290N	1.00	74LS93N	0.31
74147N	1.50	74293N	1.05	74LS95N	0.40
74148N	1.09	74297N	2.36	74LS96N	1.20
74150N	0.79	74298N	1.85	74LS107N	0.25
74151N	0.55	74365N	0.85		

74LS109N	0.20	74LS248N	1.35
74LS112N	0.20	74LS249N	1.35
74SL113N	0.20	74LS251N	0.35
74LS114N	0.19	74LS253N	0.35
74LS122N	0.35	74LS257N	0.40
74LS123N	0.35	74LS258N	0.37
74LS124N	1.80	74LS259N	0.60
74LS125N	0.24	74LS260N	0.50
74LS126N	0.24	74LS266N	0.22
74LS132N	0.42	74LS273N	0.70
74LS133N	0.24	74LS275N	3.20
74LS136N	0.20	74LS279N	0.35
74LS138N	0.30	74LS280N	2.50
74LS139N	0.30	74LS283N	0.42
74LS145N	1.20	74LS290N	0.50
74LS151N	0.30	74LS293N	0.40
74LS153N	0.27	74LS295N	1.50
74LS154N	0.99	74LS298N	0.76
74LS155N	0.35	74LS365N	0.32
74LS156N	0.37	74LS366N	0.34
74LS157N	0.30	74LS367N	0.32
74LS158N	0.30	74LS368N	0.35
74LS160N	0.37	74LS373N	0.70
74LS161N	0.37	74LS374N	0.70
74LS162N	0.37	74LS375N	0.40
74LS163N	0.37	74LS377N	0.85
74LS164N	0.40	74LS378N	0.65
74LS165N	0.80	74LS379N	0.60
74LS166N	0.80	74LS384N	2.50
74LS168N	0.70	74LS385N	2.05
74LS169N	0.85	74LS386N	0.29
74LS170N	0.90	74LS390N	0.68
74LS173N	0.80	74LS393N	0.61
74LS174N	0.40	74LS395N	2.10
74LS175N	0.40	74LS396N	1.99
74LS181N	1.05	74LS398N	2.75
74LS183N	1.75	74LS399N	2.30
74LS189N	1.28	74LS445N	1.40
74LS190N	0.45	74LS447N	1.95
74LS191N	0.45	74LS490N	1.10
74LS192N	0.45	74LS668N	1.05
74LS193N	0.42	74LS669N	1.05
74LS194N	0.35	74LS670N	1.70
74LS195N	0.35	**RAM**	
74LS196N	0.55	2102	1.70
74LS197N	0.60	2112	3.40
74LS200N	3.40	2114/2	1.49
74LS202N	3.45	4027	5.78
74LS221N	0.50	4116/2	1.59
74LS240N	0.80	4116/3	1.49
74LS241N	0.80	4864P	12.50
74LS242N	0.70	6116P-3	9.00
74LS243N	0.70	6116P-4	11.25
74LS244N	0.60	8264	12.50
74LS245N	0.80		
74LS247N	1.35		

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	0.80
74C161	0.80
74C162	0.80
74C163	0.80
74C164	0.80
74C165	0.84
74C173	0.72
74C174	0.72
74C175	0.72
74C192	0.80
74C193	0.80
74C195	0.80
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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6820	1.95
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68A21	2.10
68B21	2.26
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68A40	4.55
68B40	4.85
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68B50	2.13
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68B52	2.95
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Z80ASIO/2	11.00
Z80ASIO/9	9.95
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Z80ACTC	4.50
Z8001	65.00

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2716	£3.00
2532	OA
2732	£4.00

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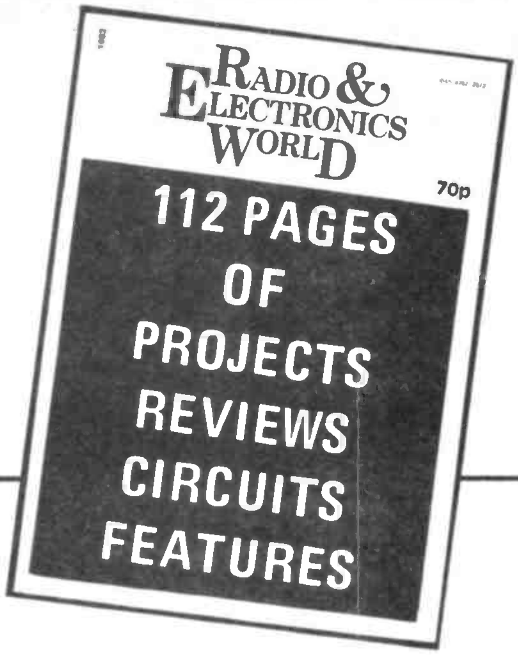

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This low-cost high-performance 'satellite' receiver incorporates a self-tracking oscillator system that eliminates carrier doppler-shift effects. Simple crossed dipoles can be used to pick up the satellite signals and feed them to our low-noise receiver unit, which has been specially designed for **R&EW** by Graham Leighton.

RADIO CONTROL TRANSMITTER

R&EW is designing a complete 'state-of-the-art' radio control system, including transmitter, receiver/decoder, fail-sale unit and high-power motor-driver unit, etc. Next month we describe the transmitter. It produces a 27 or 35 MHz FM carrier, generates 750 mW of RF output, and gives control of four analogue channels. Nice one!

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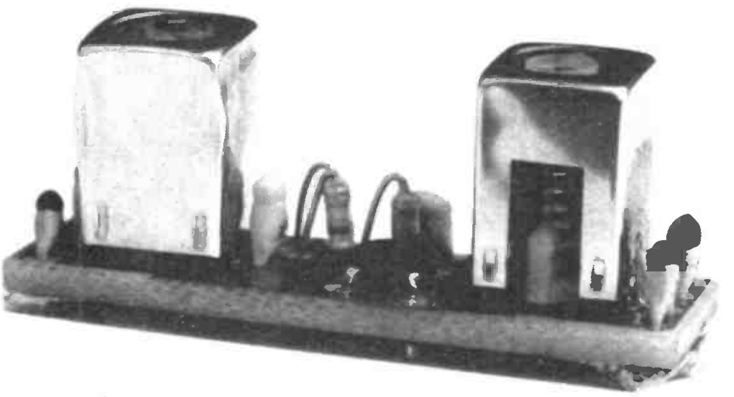


Improve the performance of your 2 M receiver with this high quality design from Timothy Edwards.

IF YOU ARE SENSITIVE to comments about your receiver's sensitivity this high quality pre-amp should silence the critics noise as well as your rig's

Many 2 M receivers and transceivers have 12 dB SINAD sensitivities of around 1.0 - 0.5 uV with some of the best available offering only 0.25 uV. Use of the **R&EW** pre-amp in a transceiver with a low loss changeover relay will typically produce 12 dB SINAD on an FM signal of less than 0.1 uV. Not bad when in practical terms a 12 dB SINAD roughly equates to a 5 and 5 signal.

The purist might suggest that fitting any pre-amp could degrade the intermod performance of a receiver. While this is the case in theory, in practice it has not caused any problems, although if one lives next to a Home Office or taxi transmitter a cautious approach should be taken. Crossmod and intermod in the pre-amp itself is very unlikely as the maximum output is only 65 mW.

CONSTRUCTION

Mount all the components, leaving the coils and cans until last. Note that the source leg of Q1 and the can legs of L1 and L2 are soldered on both sides of the PCB.

SPECIFICATION

3 dB bandwidth	6.0 MHz
Noise figure	Less than 1.5 dB
Gain	22 dB
1 dB compression	+ 15 dBm (30mV) for −6dBm input
Saturated output	+ 18dBm (65mW)
Supply voltage	8 – 16V nominally 12V
Supply current	2 – 5mA nominally 3.5mA
Input & Output impedance	50R
Size	34mmx9mmx15mm

COMPONENTS LIST

RESISTORS (all 1/8 W)

R1	100K
R2	120K
R3	220R

CAPACITORS (All miniature plate ceramic)

C1	2p7
C2	6p8
C3	1n
C4	22p
C5	10p
C6	1n

SEMICONDUCTOR

Q1	3SK88

INDUCTOR

L1,L2	MC 108 7.5 turns Toko

MISCELLANEOUS

Coil cans	7mm Type
PCB	

CIRCUIT DESCRIPTION

The capacitively tapped tuned circuit C1, C2, L1 matches the 50R input to gate 1 of the MOSFET. With the values of C1 and C2 computed to give the correct impedance transformation, the noise figure was measured at 4-5 dB, this is to be expected as the optimum noise figure very rarely coincides with the best impedance or gain match. The values finally chosen consistently give noise figures less than 1.5 dB. The potential divider formed by R1 and R2 supplies approximately 5 volts to gate 2, which according to the NEC data sheet for Q1, gives the lowest noise figure and the highest gain. This was realised in practice. The 'source' of Q1 is taken straight to ground thereby eliminating any possible impedance that would be present in any parallel RC network.

The FET, a NEC 3SK88, is a 900 MHz device chosen because of its noise figure which is, at 144 MHz almost as low as that achievable. It is relatively cheap, shows no signs of instability and has proper gate protection, unlike some of the earlier BF 900 series.

The output network of C4, C5 and L2 was derived to match into 50R with a consistently adequate RF band width.

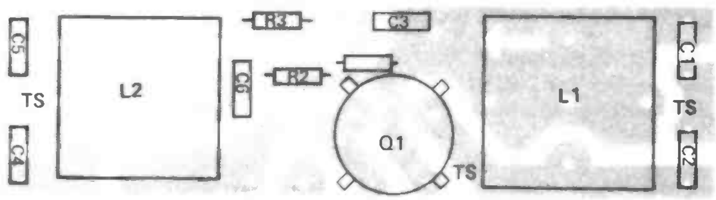


Figure 1: Component layout. The places worked (TS) must also be top soldered.

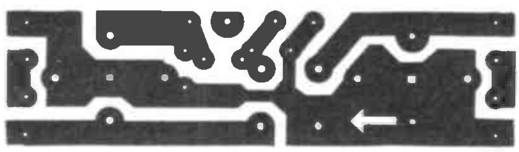


Figure 2a: Track side of PCB. The arrow indicates the direction of signal flow.

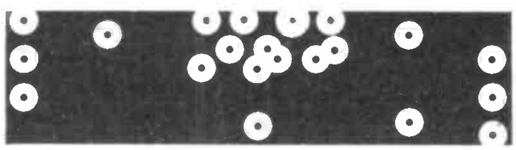


Figure 2b: PCB top pattern.

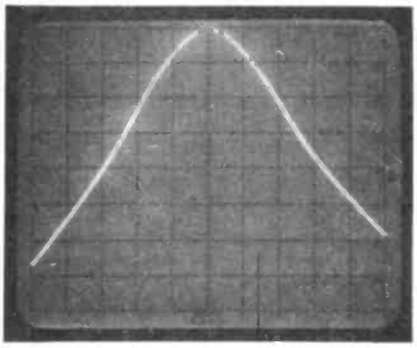


Figure 3a: Bandwidth: Vertical 2 dB/div, Horizontal 2dB/div, centered on 145 MHz.

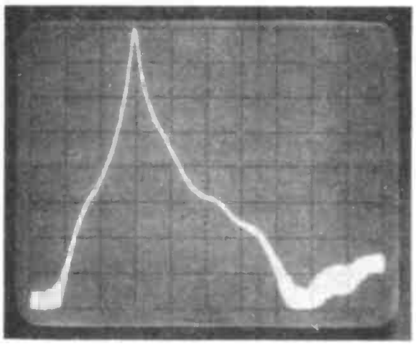


Figure 3b: Ultimate Rejection: Vertical 10dB/div, Horizontal dB/div (0-500 MHz).

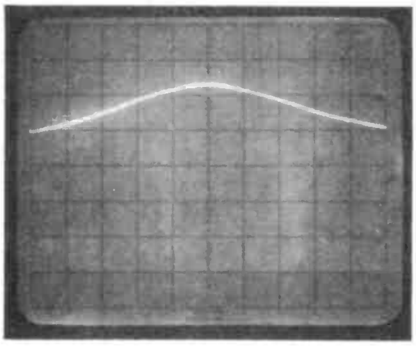


Figure 3c: Gain 0dB set to +40dB. Vertical 10dB/div, Horizontal 2 MHz/div, centered on 145 MHz.

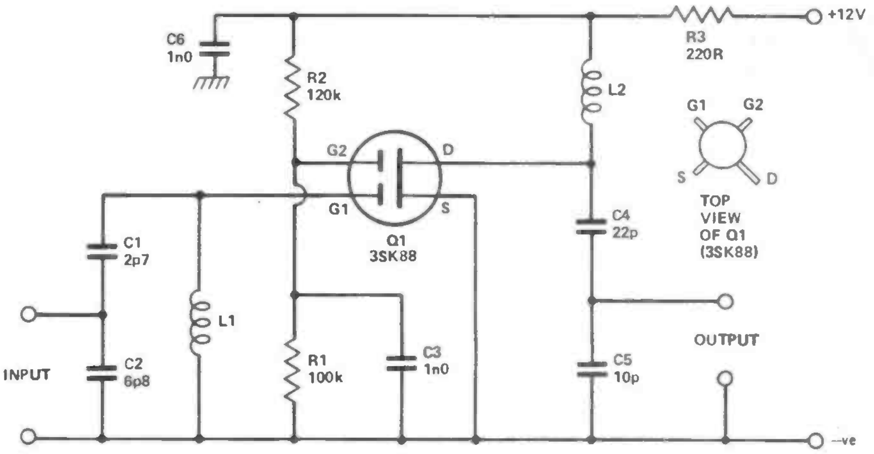


Figure 4: Circuit of the complete 2 metre pre-amp all the components are assembled onto a PCB less than 35mm x 10mm. Insert shows pin out of the 3SK88, the long lead corresponds to the drain.

To install the pre-amp first cut the co-ax cable to the receiver. Then carefully solder the co-ax going to the receiver to the track under C5, inner to the small track outer to the big track. The other cable is soldered under C2 in a similar fashion. As a guide the direction of signal flow is shown by an arrow on the track side of the PCB. Note that if the unit is to be used with a transceiver it must be connected between the aerial changeover relay and the receiver input. Don't try to transmit through it by putting it in the aerial lead. A suitable (less than 16 V) supply should be located within the receiver and taken to the track on the free end of R3.

ALIGNMENT

Pre-set the cores of L1 and L2 to be flush with the tops of their formers. If all is well at switch-on there will already be an improvement. Tune to a weak noisy signal and adjust L2 for maximum signal strength meter reading, or minimum background noise. Tune L1 for a dip in the noise of the same noisy signal, do not adjust L1 for maximum signal strength reading on a meter. The pre-amp has sufficient band width to cover all of 144-146 MHz for use in multimodes etc. Tuning the unit at 145 MHz will give very acceptable performance over the whole band.

Several of these pre-amps have been built and all have worked perfectly the first time. If however yours doesn't, check for approximately 5 V on gate 2 and approximately 0.75 V across R3 and, of course, any solder splashes.

CONCLUSION

The pre-amp should perform better than most commercially available models and will undoubtedly cost less.

The spectrum analyser photographs were taken with a Hewlett Packard Analyser with matching tracking generator to give a measured performance of 'wanted signal', band-width and 'out of band' response. It can be seen that the pre-amp provides useful extra rejection at 27 MHz.

■ R & EW

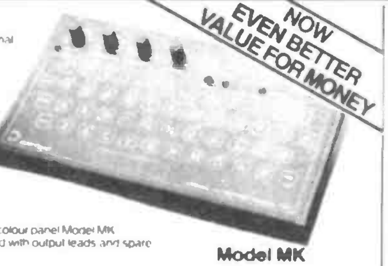
Your Reactions.........	Circle No.
Excellent - will make one	39
Interesting - might make one	40
Seen Better	41
Comments	42

DATONG PRODUCTS

DESIGNED BY ENTHUSIASTS FOR ENTHUSIASTS!

KEYBOARD MORSE SENDER – THE ULTIMATE KEYBOARD – CHECK THESE FEATURES

- CONVENIENCE no need for a power cable four internal pen cells last for 300 hours and give continuous memory back up
- EXCLUSIVE COLOUR CODED KEYBOARD DESIGN Separate key switches beneath a tough polycarbonate membrane combine excellent "feel" with a splash proof wipe-clean surface
- LAVISH MEMORY four 64-character memories with auto-repeat and programmable "pause" function, for all the routine sending
- BUFFER MEMORY ensures perfect sending despite less than perfect typing
- COMPREHENSIVE CHARACTER SET includes punctuation procedure signals accented letters. Plus a "merge" key for making any non-standard character
- BEAUTY AND STYLE only one inch thin and with four-colour panel Model MK looks every bit the thoroughbred it is. Model MK is supplied with output leads and spare connectors but without batteries (four HP7 pen cells)



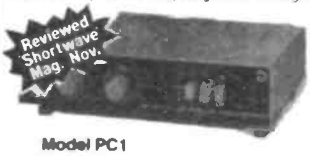
Model MK

MODEL ASP – THE "INTELLIGENT" RF CLIPPER

Model ASP modifies your speech signal direct from the microphone and makes it more effective at modulating your transmitter. The effect is as if the transmitter peak power were to increase by between two and three times. "Intelligent" means that unlike other speech processors Model ASP automatically senses your voice level and reacts accordingly to always maintain the degree of true r.f. clipping selected (in decibels) by the panel push-buttons. Special circuitry does this without the undesirable side effects of simple a.g.c. devices. Adding a Datong r.f. clipper to a normal SSB transmitter has a similar effect to adding a linear amplifier but without the high cost and risk of TVI

G8's – ARE YOU MISSING OUT?

Unless you can monitor the other bands you are missing a lot. If you have a 2 metre all-mode receiving set up, just add Model PC1 in series with its antenna and you have a superb general coverage receiver. What better way to listen in to all the non-VHF amateur bands, not to mention everything else from 60 kHz to 30 MHz? For sheer value for money there is no better way to get high performance general coverage reception. After all what a waste it is if your expensive 2 metre all-mode rig covers one band only?



Model PC1

ATTENTION VHF SCANNER OWNERS!

Did you know that Model PC1 will extend the coverage of your SX 200 type scanner to include all the long, medium and short wave bands as well? This is an excellent way to listen to your favourite short wave broadcast stations without the extra expense of a complete new receiver

Model DC144/28

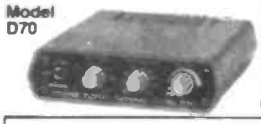
YET ANOTHER 2 METRE CONVERTER?

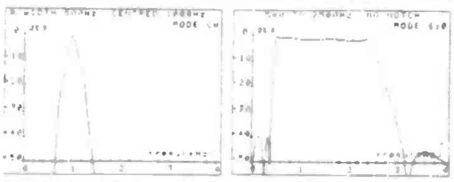
Yes but not just another. Model DC144/28 is designed to overcome the overload and spurious signal problems experienced by conventional converters. It uses a Schottky diode balanced mixer with about 7dbm of local oscillator drive. This, coupled with a 3SK88 r.f. amplifier, gives an excellent combination of low noise figure and strong signal handling capability. Its input and output gain controls also help you get the best out of your main receiver without flattening it with excessive gain.
Model DC144/28 is available either as a complete cased unit (die cast box, S0239 connectors) or as a ready built and tested PCB module

MODEL D70: THE GO-ANYWHERE MORSE CODE TRAINER

For building up your morse code reception speed there is no better method than the Datong "Morse Tutor".
You learn the code with the characters at normal speed but with an extra delay between each one. As you improve you reduce the "DELAY" control until, with it fully reduced, you find you are reading code at the chosen speed and with correct spacing.
An important feature is that the unit is completely portable. This allows you to practise wherever and whenever you find it most convenient. The all-CMOS design gives about 60 hours of practice from a lowcost PP3

Model D70





VARIABLE SELECTIVITY FOR ANY RECEIVER

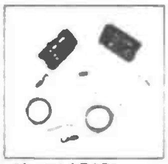
Have a look at these curves (and the others in our data sheet) and you will see why a U.S. reviewer commented that the FL2 is "incredible – it's like having a tunable crystal filter."*
With Model FL2 connected in series with your speaker you can wipe out off-tune "monkey chatter", unwanted tones and sundry "burbles" from SSB, while for CW the ultra-steep skirts allow you to use wider bandwidths for a given rejection of off-tune signals. This makes tuning easier and reduces listening fatigue.
Model FL2 costs little more than a single special accessory filter yet it offers better performance, extreme versatility, and can be used with any receiver.

*R. S. Dicks, 73 Magazine, July 1981 p 119.

Model FL2

MINIATURE RECEIVING ANTENNAS

If you don't have enough space to put up traditional receiving antennas, our active antennas are the answer. They need no tuning yet have constant sensitivity from 200 kHz to well over 30 MHz.
Results are quite comparable to full size conventional antennas but the space saving is enormous. The indoor version (AD270) is 3 metres long and the outdoor version (AD370) is 2 metres long.
A TV-type feeder cable of any reasonable length can be used yet because the antennas are balanced dipoles any interference picked up by the feeder is rejected.
Because of their wide frequency coverage Datong Active Antennas are ideal accessories for modern general coverage communications receivers.



Model AD270

Model AD370

PRICES: All prices include delivery in U.K. basic prices in £ are shown with VAT inclusive prices in brackets.

FL1	59.00 (67.85)	MPU	6.00 (6.90)
FL2	78.00 (89.70)	DC144/28	31.00 (35.65)
PC1	105.00 (120.75)	DC144/28 Module	25.00 (28.75)
ASP	69.00 (79.35)	Keyboard Morse Sender	112.20 (129.00)
VLF	22.00 (25.30)	RFA	25.50 (29.32)
D70	43.00 (49.45)	Codecall (Switched)	25.50 (29.32)
D75	49.00 (56.35)	Codecall (Linked)	24.00 (27.60)
RFC/M	23.00 (26.45)		
AD270	33.00 (37.95)		
AD370	45.00 (51.75)		
AD270 – MPU	37.00 (42.55)		
AD370 – MPU	49.00 (56.35)		

Products not shown in this advertisement

- Model Datest 1 Transistor Tester
- Model Datest 2 Transistor Tester
- RF Speech Processor Model D75
- Model RFC/MRF. Speech Processor PCB Module
- Model MPU Mains Power Unit
- Accessory Leads
- Model VLF
- Model FL1

ALL DATONG PRODUCTS ARE DESIGNED AND BUILT IN THE U.K.

NEW PRODUCTS PREVIEW

Available Shortly

MODEL DF1

Direction finder attachment for FM, VHF receivers/transceivers, gives directional readout on circle of LED's. Connects to loudspeaker and antenna jacks.

BROADBAND PREAMPLIFIER – MODEL RFA

- Wide bandwidth, 5 to 200 MHz, lets Model RFA replace a whole collection of single band amplifiers.
- Low noise figure, high intercept point (+ 25dbm), and moderate gain (9dbs) make Model RFA ideal for improving the sensitivity of HF and VHF transceivers, scanner receivers, PMR, marine VHF, without difficulties with overload.
- RF switched for convenient use with transceivers
- Solid construction (same die cast case as Models VLF and DC144/28) with S0239 connectors.

Price: £25.50 plus VAT (£29.32 total)
Expected Availability: early January.

"CODECALL" SELECTIVE CALLING DEVICE

The new Datong Codecall adds "selective call" to any radio voice channel. A single self-contained unit at each end of the link sends or receives a coded audio signal. When the correct code is received, the receiver bleeps loudly.
The only connection needed to a transceiver is to the external loudspeaker jack. Sending is via direct audio into the microphone.
"Codecall" allows totally silent stand-by operation yet with confidence that when that specific call comes, you won't miss it.
Over 4000 different codes can be selected by internal link or by three 16-way panel switches, depending on the model. This practically eliminates false alarms.
Full details free on request.
Availability: late January.
Price per unit: Link programmable £24.00 + VAT (£27.60)
Switch programmable £25.50 + VAT (£29.32)

Data sheets on any products available free on request – write to Dept REW

DATONG ELECTRONICS LIMITED
Spence Mills, Mill Lane, Bramley, Leeds LS13 3HE, England. Tel: (0532) 552461

199 for further details

THE R&EW 12-RIG CB REVIEW

CB has been 'legal' in the UK for six months, and the country is now pretty well flooded with home-grown and imported rigs. How good are they? Timothy Edwards reviews a dozen models and gives HIS views in this exclusive feature.

..ROUND THESE PARTS, SQUIRE, SQUELCH RANGE IS 'OW FAR COW DUNG COMES UP YOUR WELLIES..'

Some readers may question the need for CB. However, an incident that recently happened to the author reinforces beyond doubt the necessity for **everyone** to have a CB in their car. Early one dewy morning, whilst driving along the uncharted back roads of West Suffolk, the air in one of the rear tyres decided it would make one successful break for freedom. Pulling into the nearest piece of flat, wet grass, I was pleased that the spare tyre had recently been inflated. Nonchalantly, the car was jacked up and the offending wheel removed, but before the spare could be fitted there was a sickening 'thud' as the car slid off the jack and the exposed and vulnerable brakedrum buried itself in the mud. No problem, thought I, call for help on 2 metres.

Those of you who know West Suffolk might well realise that the amateur population is rather thin on the ground and, in a lot of cases, 2 metre repeater coverage is non-existent. A quick shout on the air proved this to be the case. Unfortunately, the local UHF Repeater (GB3WS) has just been closed down by the RSGB for some unexplained reasons, otherwise this would have been a lifeline of help.

During the cold one mile walk to the nearest house it was galling to remember that there are over ten times as many CBers as there are Radio Amateurs. Indeed, inside a three mile radius there were probably twenty CB operators who would have been only too glad to have come to my assistance. The next day I went to my local CB shop and bought what I was warmly told was the highest specification CB set on the market. Two hours later my laboratory had proved beyond all doubt that this was possibly the worst CB radio ever. Another 24 hours, and the dealer had returned 80 of these sets to the distributor for credit. There then followed an intensive flurry of activity whilst twelve CB radios were begged, borrowed and almost stolen to measure the most important parameters, the results being tabulated in this article.

With one exception, the transmitters of all sets performed perfectly adequately, generally meeting MPT1320. A few sets did not pass the transmitter noise sideband specification, but this is considered an unnecessarily high requirement and not relevant for 27 MHz use.

Test Procedures

The most important receiver parameters measured were sensitivity, adjacent channel selectivity, intermodulation and squelch adjustment range. It is rather unfortunate that the Home Office have decided to put no specifications at all on the receiver section, and some manufacturers have used this to their advantage in producing equipment which is far from satisfactory but nevertheless bearing the CB27/81 label. The illegal AM sets, of which there are many hundreds of thousands in use at the moment, have all had to pass the American FCC specifications, which require a fairly good standard of receiver. It is from this problem that the rumour, put around by some AM users, that the new FM system is not any good arises. The receivers of AM radios are generally far better than the UK-approved FM sets, and it is the intention of this review to reveal the appallingly bad receivers of some equipment available in this country. Due to the lack of a Home Office standard for 27 MHz receivers, the standard normally used for private mobile radios (MPT1301) was used.

The sensitivity was measured with 1.5 kHz deviation and a mod frequency of 1 kHz. A Sinadder 3 was connected to the loudspeaker terminals and the signal generator output reduced until a reading of 12 dB SINAD was obtained, the level necessary for adequate communication. For base station use a sensitivity of less than 0.20 uV is desirable, although in a mobile environment all of the sets tested would be satisfactory. Indeed, in the author's V8 Rover the ignition inter-

Equipment Type	Sensitivity for 12 dB SINAD	Selectivity dB	Intermod dB	Squelch Range
Amstrad CB901	0.13uV	60	60	0.07/23uV
Binatone 66	0.20uV	48	35	0.14/7.1
Cobra 210 XFM	0.28uV	65	44	0.22/31
Cybernet 2000	0.12uV	67	51	0.08/10
DNT M40 FM	0.12uV	43	23	N/A
Fidelity 1000 FM	0.12uV	45	31	0.40/1200
Havard 410T	0.45uV	0	30	N/A
Havard 420M	0.14uV	68	55	0.08/6.4
Sirtel Searcher	0.35uV	52	50	N/A
Uniden 200	0.12uV	70	63	0.28/1000
OSCAR (SMC)	0.09uV	74	70	0.06/160
Shogun	0.11	70	60	0.5/600

ference level is in excess of 1.0 uV, therefore any signals received below this level would not be copyable.

The selectivity was measured using the two signal generator method, whereby the two generators are connected together into a three port non-interactive combiner, the third port being connected to the receiver under test. One generator is set to frequency and its level adjusted until the receiver produces 12 dB SINAD, the other generator is moved one channel away (10 kHz), its modulation frequency adjusted to 400 Hz and then its level increased until the 12 dB SINAD level degrades to 6 dB. The difference between the two signal generator levels is then regarded as the adjacent channel selectivity. Without doubt this is a very important parameter and the higher the selectivity the better. If, for example, you are listening to a rather noisy signal on Channel 21 and the breaker half a mile down the road is operating on Channel 22, unless your adjacent channel selectivity is much better than 50 dB, the other breaker will certainly cause interference to your copy.

Intermodulation is a rather more complicated issue, but nevertheless extremely relevant in areas of high channel occupancy, and is basically a measure of the capability of the receiver to inhibit the generation of inband signals caused by the presence of two or more signals at unwanted frequencies. It is measured using two signal generators and a combiner as described before. The receiver for example is tuned to Channel 21, one generator is set to Channel 22 and is unmodulated and the second generator is tuned to Channel 23 and has modulation present. Both generators are set to the same RF level and then increased simultaneously until a signal of 12 dB SINAD is achieved. The difference between the level of the generators and the previously established level for 12 dB SINAD is defined as the intermodulation level. Using the DNT receiver with its intermodulation of only 23 dBs as an example, it can be seen that if you are listening on Channel 29 to a weak signal and there are signals on Channel 30 and 31, the two other signals need only be 23 dB higher in level than the one you are listening to, to cause total degradation of your copy. It is the author's opinion that a minimum intermod level should be 50 dB or greater. Unfortunately, only half of the sets measured met this requirement. It is interesting to note that every amateur 2 metre equipment measured in our laboratories has exceeded this level.

The squelch level is more important from the operator point of view, in that if the squelch is turned off there is an intolerably high noise level present with FM receivers. Obviously, on squelch threshold setting the receiver should open on a very weak signal. Unfortunately, this is not the case in some receivers. In VHF equipment it is desirable for the squelch to open at an RF level 6 dB lower than that required for 12 dB SINAD, but this did not occur in some of the receivers tested. One in particular required a level over 6 dB higher than 12 dB SINAD. With the squelch set to its 'tight' position or most insensitive point the receiver should only open on very strong signals. This is so that only very local signals will be heard. This should be at least 6 dB higher than the 12 dB SINAD level and all receivers met this requirement. Unfortunately, due to an administrative error, the squelch setting measurements were destroyed on some sets after they had been returned to their owners. These will be remeasured in the next CB Review, although they were all acceptable.

Sirtel Searcher

This model was the only one available on Day One of legal CB and, although of not very attractive appearance and slightly bulky, its performance is above average. The sensitivity of 0.35 uV may limit its application for base station use, though. Several are in use locally and are completely reliable.

DNT M40 FM

This was the most expensive equipment reviewed and had the worst receiver performance measured. The selectivity of 43 dB was considered inadequate and the intermod performance of 23 dB was thought to be very bad. A second sample was received for evaluation, but its performance was identical. The author cannot recommend this model.

Uniden 100

This model has one of the highest performance receivers yet measured, although its squelch performance at 0.28 uV may well limit its application to noisy mobile environments only.

Havard 410T

This was the only hand-held model tested and obviously had the wrong receiver filter fitted. This is rather strange and no explanation could be found for it. As it stands, this model cannot be recommended. As an experiment, a proper filter was fitted (a CFU455H): The sensitivity improved to 0.20 uV, adjacent channel improved to 45 dB, and the intermodulation remained the same. With fresh batteries this hand-held achieved an RF power output of 3 watts, which is excellent, and the audio quality via the built-in electric microphone, was one of the best heard.

Havard 420M

This model uses a modified Cybernet board and, all-round, its performance was excellent. This model can be thoroughly recommended.

Fidelity 1000 FM

The selectivity on this model was moderate and the intermod well below spec. This model showed its parentage as being a modified AM set, especially as its squelch required 0.40 uV to open, whereas its 12 dB SINAD figure was only 0.12 uV. The transmitter, although meeting MPT1320 specifications, had a peculiarly slow VOGAD action, and a shout into the microphone would momentarily produce in excess of 7 kHz deviation. Again, this model cannot be recommended.

Amstrad CB 901

This equipment was very nearly the best performing of the group, its technical performance being nearly beyond reproach and its general construction inspiring confidence in all those who used it. It is a pity though that Amstrad did not chose to make it a little smaller as it could easily have been.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

Sunrise Products "Shogun"

No doubt the best constructed set yet to pass through the portals of our lab. The standard of construction is very nearly up to 'PMR' (private mobile radio) standards, and well up with the best amateur communications equipment. This set does not appear to be from any of the usual 'stables', being of independent Japanese manufacture.

The Shogun is furnished with a selective call input/output socket, and this is soon going to become a very popular facility for the more serious CB users who 'use' the band. The Selcall unit is extra -but at least the fitting is straightforward enough. The low profile styling of the rig is neat and unobtrusive.

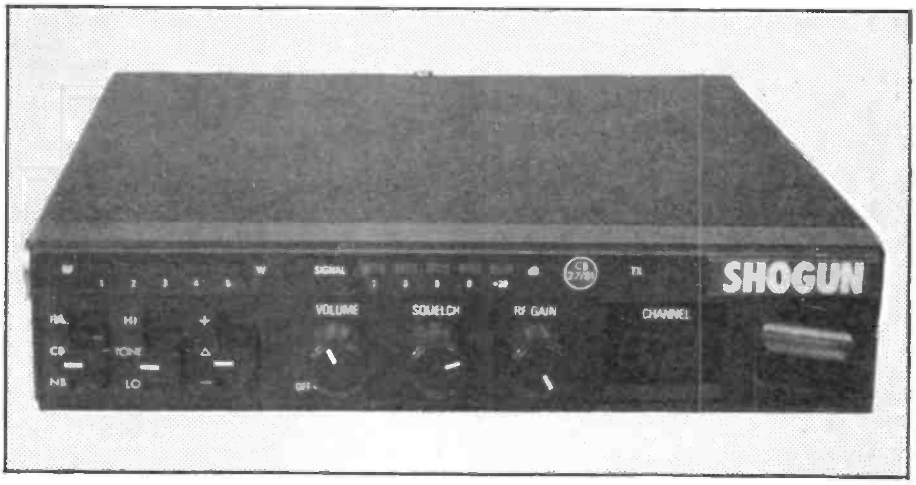
The Shogun also sports a unique facility amongst the sets tested here -namely a noise blanker, which is a true RF operated device switching the RF path before the main filter. As we are still to define our noise blanker test procedure, this unit was evaluated by inserting a 10 uSec pulse at 100 Hz repetition rate into the antenna feed (about the sort of rate from a noisy ignition system). The Shogun's blanker took it out of the audio by 20 dB or so - as long as the input signal was over 1 uV — and virtually anything you hear on the band will be.

Although at around £99 the Shogun isn't cheap, the quality of construction is impeccable, and thus this rig represents one of the best buys for the quality conscious and the 'serious' user.

SMC's "OSCAR"

Another rig that does not appear to emerge from one of the big stables is the "OSCAR", from South Midland Communications. SMC are well known for their activities in amateur radio (notably as importers of Yaesu equipment), so the Oscar might reasonably be expected to show off its heritage. Indeed, it was the best performer of the lot, even boasting a simple form of bipolar transistor balanced mixer, although its more subdued control panel will perhaps tend to conceal this from those CBers who associate performance with acres of chrome and liberal festooning with lamps and knobs. The country of origin is not apparent anywhere on the rig or the box, although it seems fair to assume that if it were made in Japan, it would have said so.

Nevertheless, the Oscar is soundly made, without quite the finesse of the Shogun.



▶

Cobra 210 XFM

Selectivity on this model was excellent although the intermod performance was not quite up to standard. Still, if you can find one at a reasonable price it probably represents a good buy.

Binatone Route 66

Although the adjacent channel selectivity on this model was nearly adequate the intermod performance was well below standard and therefore cannot be recommended.

Cybernet 2000

This model, being sold by Comet and other CB retailers, is identical to the 1000 except for three extra push buttons on the front panel. One of these is a DX local switch, which although desensitizing the receiver by 20 dB improved the intermod by another 10 dB, bringing it to 61 dB. In general, its receiver performance is truly excellent and, in particular, its incredibly tiny size makes it exceptionally useful in mobile applications. It is the only one the author deemed suitable for permanent fitting in his own car, and several other colleagues have come to the same conclusion. This model represents the best buy of the group.

Conclusions

No recommended retail prices have been included in this review, as regional fluctuations are so great as to make this nonsense. It would seem that only the Cybernet 1000 and 2000 are available all over the UK (via Comet distribution) and are at the moment the best buy. If size is not important then the Amstrad, which is also available from many retailers, would be the next recommended equipment.

Most of the sets tested had power outputs rather less than 4 watts. Some examples even dipped as low as 2.0 watts — although some sets can be tweaked to as much as 10W by some very simple twiddles (like shorting out an HT dropper resistor). This is of course not permitted by the spec., and in any case will probably lead to an untimely demise of the output and driver stages. Why the sets should all be so mean on the RF output is something of a mystery, and possibly contained in the clause of the specification covering the performance under extreme conditions. Now that we have acquired an Astell-Dutaform environmental test chamber (+200 to —50 degrees C), we will be able to put this theory properly to the test.

User tests showed that squelch sensitivity needed to be set to as much as 12 uV to simply cut out the average 'garbage' level on the band — indicating that some of the more esoteric sensitivities quoted herein are strictly for the lab. It is interesting to see just how little the average 'copy' is affected by applying a 10 dB attenuation to the receiver input — and this will then improve the perceived intermodulation performance by the same amount.

So there it is, everything you always wanted to know about CB sets but were afraid to ask, brought to you in yet another **R&EW** exclusive. Ignore the Busbys and the Bears, go out and get a seat cover and a rig and have a great time. 10—10 till we do it again, breaker break, we're gone, we're down.

Acknowledgements

The author gratefully acknowledges the help of James Harvey and many East Anglian breakers in the compilation of this review.

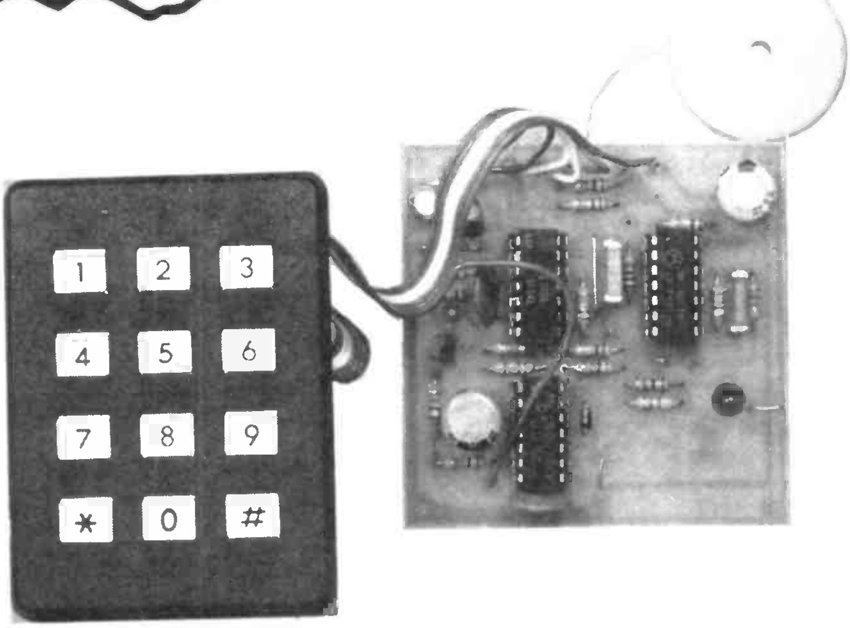
■ R & EW

Your Reactions.........	Circle No.
Immediately Applicable	47
Useful & Informative	48
Not Applicable	49
Comments	50

R & EW

KEY-PAD SECURITY LOCK

Protect your home or office with this 'smart' but inexpensive device. Activated by a 4-digit code fed in from a 12-button keypad, it triggers an alarm if fed with false signals. Design by Ray Marston. Development by Jake Oliver.



OUR KEY-PAD SECURITY LOCK PROJECT is specifically designed to give 'intrusion protection' to homes and offices, and is intended to activate an external alarm if a protected door is opened without first being rendered safe via the key-pad lock; the system is meant to give electronic back-up to existing Yale, etc., mechanical lock systems.

Our security lock consists of a 3-chip circuit and a 12-button keypad. The lock can be powered by any DC supply in the range 9 to 15 volts and consumes a mere 25 uA or so when in the 'OFF' or standby mode. The lock has a single output terminal (which is meant to be fed to an external alarm circuit), and the lock state is indicated by a LED. The lock is turned on and off by feeding in a 4-digit code from the keypad. If an incorrect code is fed in, an on-board low-power alarm activates roughly seven seconds after the feed-in, and then sounds for half a minute or so. The owner can select any 4-digit code of his choice, by suitably wiring the keypad.

Figure 1 shows the basic method of using the security lock to protect the home or office. The lock output is fed to the base of relay-activating transistor Q2 via a reed relay, and the relay contacts are used to self-latch the relay and turn on the alarm bell. The reed relay is sunk into the door frame and is held open (when the door is closed) via a magnet sunk into the door rim; the reed relay closes when the door is opened.

Thus, if the door is opened when the security lock is in the ON mode (output high), the external alarm bell will immediately activate and self-latch, and can then only be turned off again by breaking the supply to the relay. If, on the other hand, the security lock is in the OFF mode (output low) when the door is opened, the external alarm will not be activated.

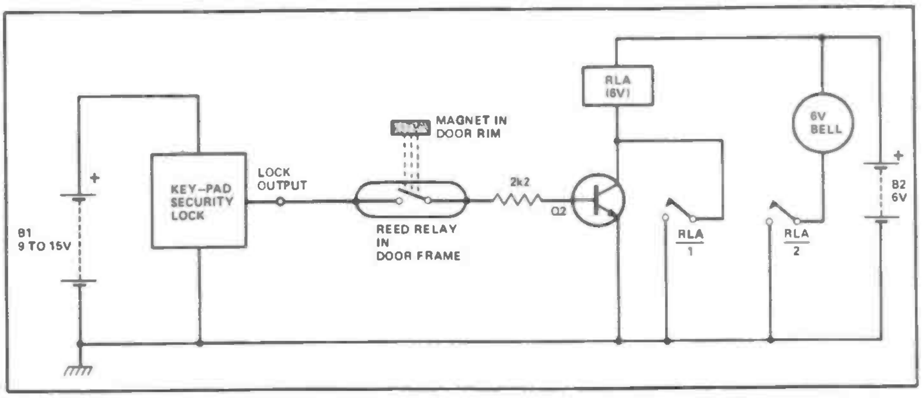


Figure 1: Basic method of using the security lock.

ANTI-TAMPER

The security lock is provided with an on-board low-power pulsed-tone alarm generator, and incorporates some rather cunning anti-tamper and time-delay circuitry. If, for example, a wrong code is fed into the lock, the on-board alarm will trigger, but not until several seconds AFTER the false entry has been made, thus ensuring that no clue is given concerning the number of the false-entry key.

Once the pulsed-tone alarm has triggered, it will continue to sound for about half a minute AFTER a false entry has been made, and thus continues to sound indefinitely if the key pad is repeatedly false operated. If the owner accidentally enters the wrong code or inadvertenty false-triggers the alarm, he can reset the alarm by operating a 'secret' keypad button for about five seconds, but if the wrong button is operated the alarm period will actually extend. The lock thus has excellent anti-tamper protection.

CODE SELECTION

The security lock is designed around a special purpose 'lock' IC (IC1 in *Fig 2*), which accepts inputs on pins 10 to 14; pin 10 is referred to as 'X' in *Fig 2*, and pins 11 to 14 are referred to as the 'A' to 'D' inputs. Inputs are applied from the positive supply line via the switches of the ▶

KEY-PAD SECURITY LOCK

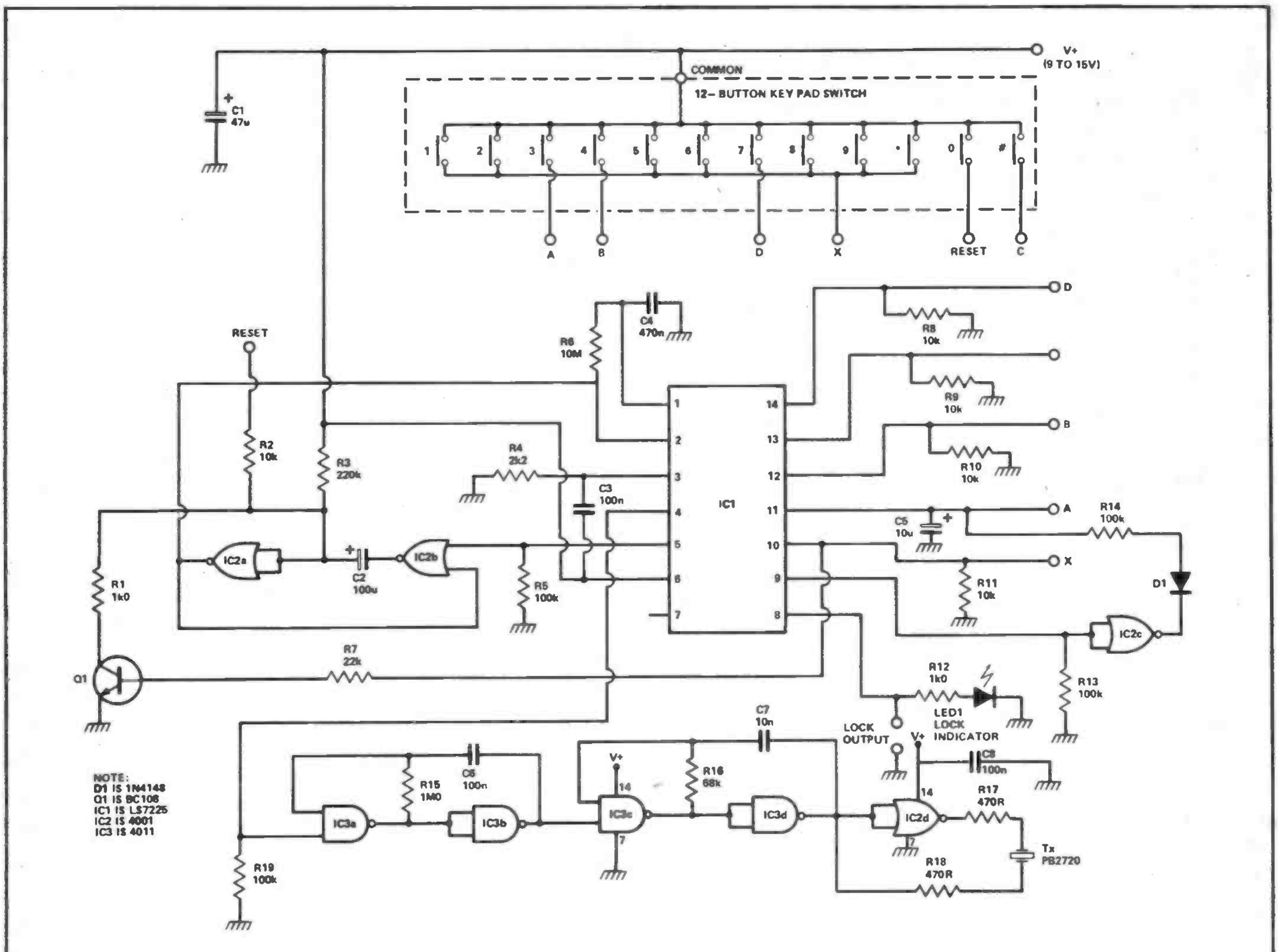


Figure 2: Key-pad security lock (switch shown set for: CODE = 34 # 7, RESET = 0).

CIRCUIT DESCRIPTION

THE BASIC CIRCUIT

The heart of the unit is IC1, an LS7225 'keyless lock' device. Pins 11 to 14 of this IC (designated 'A' to 'D' in *Fig 2*) accept inputs from the supply line via the key-pad switches and must be keyed in 'A-B-C-D' sequence for the lock to 'open'. Incorrect sequencing disables the lock and causes TAMPER output pin 5 to generate a 15 uS pulse. The sequence inputs can be disabled by taking pin 2 high. The IC has another input terminal at pin 10 ('X' in *Fig 2*), but any input applied here disables the lock and causes a 15 uS TAMPER pulse to be generated at pin 5.

Thus, the lock can be 'programmed by simply wiring four of the key-pad switches to the 'A' to 'D' inputs and all remaining switches (except the RESET switch, which can be any switch of the owner's choice) to input 'X'. Using our 12-button key-pad switch, almost six thousand 4-digit programming options are available. Capacitor C5 (connected to input 'A') determines the amount of time available in which to enter the keying code.

The basic IC has two lock outputs, one being available at pin 8 and the other at pin 9. The pin 9 output is a one-shot type which goes high as the last digit of the code is entered and remains high for the remainder of the C5 timing period. The pin 8 output is a bistable type which changes state each time a code sequence is correctly entered; thus, the code is entered once to turn this output ON (high), and again to turn the output OFF (low). Note that the basic action of the IC is such that new codes can not be entered until the preceeding C5 timing period has expired.

THE R&EW CIRCUIT

The LS7225 is not a particularly 'smart' IC, and in our version of the security lock we've added a few external frills, to give the project a truly sophisticated performance. Note first that we take the true output of the circuit from pin 8 of the IC, but that the pin 9 output is coupled back to C5 via R14-D1 and inverter IC2c, so that the C5 timing period automatically terminates within one second of completing a successful code entry, thus enabling the lock to be rapidly turned on and off.

Next, note that the TAMPER output (pin 5) is used to fire 30 second one-shot IC2a-IC2b whenever a false keyboard entry is made. The output of the one-shot is coupled directly to SEQUENCE DISABLE pin 2 of IC1, so that further keyboard entries are ignored, and is also coupled to pin 1 of the IC via time-delay network R6-C4. The IC incorporates a buffer stage between pins 1 and 4, and the circuit action is such that pin 4 goes high several seconds after the one-shot is activated and thence turns on the IC3-IC2a gated double-astable circuit, which produces a loud pulsed tone in the bridge-driven PB2720 acoustic transducer.

Finally, note that the timing period of the IC2a-IC2b one-shot can be controlled from the RESET button via R2 (giving a very short timing period) or from the 'X' buttons via R1-Q1-R27 (giving a fully extended timing period).

Thus, if a false entry is made from the key-pad, the on-board acoustic alarm will sound seven seconds AFTER the entry has been made, and will then sound for about half a minute UNLESS reset via the 'secret' RESET button; if an 'X' button is operated during this period, the alarm time will fully extend.

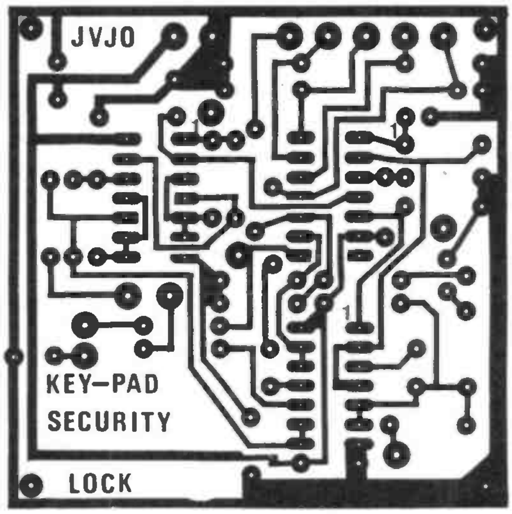


Figure 3: PCB foil pattern.

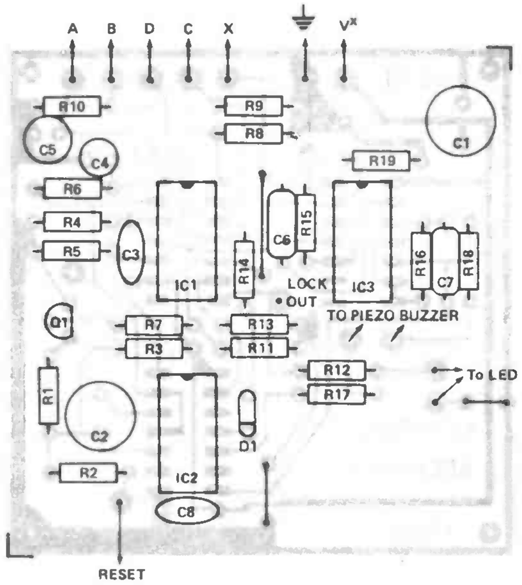


Figure 4: Component overlay.

12-button keypad. To open or close the lock, inputs must be fed to pins 11 to 14 in an 'A-B-C-D' sequence, and the owner can thus programme the lock to accept any code of his choice by simply wiring the selected code switches to the 'A' to 'D' inputs. Note that the 4-digit code numbers must be non-repeating, i.e., 2243 is not a valid code. Almost six thousand different valid codes can be programmed into the unit.

The lock's on-board pulsed-tone alarm activates if the A to D inputs of IC1 are operated out of sequence, or if the 'X' input is pulled high. All 'unused' outputs of the 12-button keypad (except the RESET output, which can be any switch of the owner's choice) should thus be taken to the 'X' terminal of IC1.

Once the owner's code has been programmed into the lock by hard-wiring the keypad switches, the procedure for operating the lock is as follows:

1. Punch in your 4-digit code, as slowly or as quickly as you like and check that the LOCK INDICATOR LED changes state as the last digit is entered, indicating that the lock is functioning correctly.
2. If the LOCK INDICATOR does NOT change state, hold down the chosen RESET button for several seconds, and repeat step (1).
3. Note that a pause of at least one second must be used between successive 'sequencing' (LOCK — UNLOCK) operations. If the on-board alarm is inadvertently triggered, simply hold down the RESET button until the alarm ceases (about 5 seconds).

COMPONENTS LIST

Resistors (¼W, 5%)

R1,12	1k0
R2,8,9,10,11	10k
R3	220k
R4	2k2
R5,13,14,19	100k
R6	10M
R7	22k
R15	1M0
R16	68k
R17,18	470R

Capacitors

C1	47u 25V electrolytic
C2	100u 16V electrolytic
C3	100n ceramic
C4	470n electrolytic
C5	10u 16V electrolytic
C6	100n polycarb
C7	10n polycarb
C8	100n ceramic

Semiconductors

D1	IN4148
LED1	Red LED
Q1	BC108
IC1	LS7225
IC2	4001B
IC3	4011B

Miscellaneous

PCB
PB2720 acoustic transducer
IC sockets (3 off) 14-pin
12-button key-pad switch, type KL0025
Veropins.

CONSTRUCTION

Construction of the unit should present no problems, as the PCB has provision for holding all components except the 12-button key-pad (which is connected to the PCB via Veropins). Start the construction by fitting the wire shorting links, then proceed as normal, fitting the IC holders last of all. The PB2720 transducer can either be mounted on the underside of the PCB or, more likely, can be remote-mounted next to the keypad, together with the LED. If you want to conserve power, wire a slide 'TEST' switch in series with the LED (mean current consumption will then be a mere 25 uA).

When construction is complete, fit the ICs into place, wire your code into the keypad (as already described), and connect the keypad to the PCB. Now connect the unit to a DC supply and give it a functional test. If the unit fails to work first time (very unlikely), use the 'Circuit Description' text as a troubleshooting guide.

In most practical applications, you'll probably find it best to mount the keypad, the PB2720 transducer and the LED on the outside of a protected door, and the rest of the circuitry on the inside. If you decide to use the unit in a car (as an anti-theft device), powered from the car's battery, take special precautions to decouple the unit's supply lines and protect them against transient over-voltages.

Your Reactions.........	Circle No.
Excellent - will make one	96
Interesting - might make one	97
Seen Better	98
Comments	99

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NEWS BACKGROUND

Is it time to give the Radio Amateur's 'Morse' test the old heave-ho, to make room for state-of-the-art communication techniques? William Poel expresses his views.

".. YOU'VE NO CHANCE, PAL, THE CORRECT KNOCK GOES THUMP, TAPTAP, THUMP..."

Coming out

Reader feedback indicates that a high proportion of **R&EW** readers are adherents to the amateur radio persuasion. In fact, we'll let you into a little secret, no less than five of the **R&EW** personnel are paid-up members of the fraternity. Furthermore, it's surprising to find just how many engineers engaged in the electronics profession are also radio amateurs - but many of them make the admission rather sheepishly, since amateur radio has been given such a dreadful image in this country over the years. (Tony Hancock et alia.)

Gatherings of radio amateurs frequently resemble meetings of Gay Liberation clubs, with participants confronting each other with the words: "I never knew **you** were one of us."

The condescending way in which the professional electronics press usually tend to look down upon the hobby as a quaint but irrelevant piece of nonsense, frequently gets die-hard radio amateurs leaping about in rage, reminding us of the contribution made by amateur radio to communications technology. Indeed, innovative ideas are really what amateur radio was originally all about (whatever happened?)

In view of the impact made by CB, it is perhaps an important time for amateur radio to try and establish a distinct and recognizable identity - or it will simply be lumped in with CB in the minds of the media, and 'Coming Out' will be all the more difficult and embarrassing.

Proud to be a Ham

The UK has always tended to regard technical pursuits as being just a shade gauche, and not quite the sort of thing you do if you can get a job at the Stock Exchange. Curiously enough, most other countries take their engineering a great deal more seriously, and afford engineers the status and salary of such professional people as doctors and accountants. This is the theme of many long drawn out debates inside the UK professional engineering bodies (who said 'clubs'?) which have regrettably failed to make any impact whatsoever on the situation.

As long as UK government action always seems to associate the socially disadvantaged with electronics (government sponsored training centres etc.), we face a continuing struggle. In view of this background, many British radio amateurs remain reticent about their hobby, and will only confess when pressed on the subject.

One person who isn't too reticent is American publisher Wayne Green, W3NSD/1. Many of you will probably have heard about his magazine '73' - it's refreshingly forthright and consistently interesting. Like **R&EW**, he isn't hidebound by the politics and constraints of an amorphous 'publishing house'. We get an 'exchange' copy at **R&EW**, but even if we didn't it's well worth the sub.

Wayne's number one hobby-horse is the promotion and recognition of amateur radio as a means of seeding interest in technology amongst the impressionable high school students in the US, leading to the increased numbers of engineers that every country seems to be short of -although precious few have any policies to encourage would-be technologists.

Morse and the Backwoodsmen

In a recent editorial, Wayne expressed some of his very interesting and controversial views on the amateur radio scene generally, and specifically singled out the strange anachronism of the morse test for particular ridicule. The masons have their funny rolled up trouser legs, and radio amateurs have the equally quaint requirement that a 12 words per minute morse test must be passed before an operator is deemed fit to invade frequencies below 144 MHz.

No-one but Wayne could possibly get away with writing a 6 page editorial in 4-column close set 8 point type, but Wayne's editorials are becoming something of an institution for readers of his various publications, and I always read them.

Apart from revealing plans that he has for combining microcomputing with amateur radio (more anon), Wayne went on to say of the requirement for morse code in amateur licences: ▶

NEWS BACKGROUND

If you have spent any time mixing with would-be hams, you know as well as I that our Morse-code requirement is probably the major single obstacle which has been keeping down our growth. Yes, I know that most old-time amateurs are fiercely adamant about keeping the code test. But as I mentioned in my report, it has been years since I have heard a new argument on the subject and the balance, as far as I can see, is towards making this a technical hobby instead of a skill hobby.

Some of the wheezes which come to mind are as follows:

1. *Code is a ham heritage.* So is QRM, but that's no reason to keep it. I am convinced that we will have more CW operators than ever if we make it a fun part of hamming instead of obligatory. Besides, with more and more operators using Morse keyboards, what do you mean by heritage? Those keyboards and Morse code readers are selling like crazy... if that tells you anything.

2. *Without the code test we'll be swamped with lousy operators.* Oh my goodness, since when did learning the code make anyone a good operator? If you want to hear really good operating, not the jamming and pileups we indulge in here, listen to the Japanese operators. They were taught how to operate by their clubs but had no code test.

3. *In emergencies, code can get through when phone can't, so everyone should know the code.* Well, that may have been true 50 years ago, but today most of your emergency traffic is on phone... and sideband gets through as well as CW almost anytime. In the future, we will be running most emergency traffic over high-speed digital networks, not on code or phone, anyway.

4. *CW rigs cost less than phone equipment, so by emphasizing code. we are enabling even the poor amateur to participate.* In the pre-war years we could buy this baggage. When Heath brought out the HW rigs, that argument went out the window... where it still lies... and that was about 20 years ago. Let's try to get out of the past.

5. *With the current exams made stupidly simple by cheat books such as the ARRL* Q & A Manual *and the Bash books, we have to have SOMETHING to keep everyone out.* I partially agree... but let's make it something better than the Morse-code test. Perhaps we could change to a licensing system whereby new amateurs would have to qualify before a club board, showing that they know the rules and are able to operate a ham station. We might make the technical exam less vulnerable to circumvention by League and Bash Q & A books.

6. *If we don't keep the code in the ham test, code will just die out.* As I said, I think that once it is made fun instead of punishment, we will find a new enthusiasm for the skill. Our clubs and publications can intensify this with contests, certificates, and articles on the subject.

7. *Just because the Japanese have had such incredible success merely by removing the code requirement is no reason why we have to imitate them.* Well, I believe in learning. When someone does something new and it is a success and what I'm doing is an obvious failure, it is time to re-evaluate and not let *Not Invented Here* stop me.

8. *I had to go through all that misery, so why should I want anyone to have it easier than I did?* Golly, I don't have any real answer to that bit of garbage.

9. *Suppose you are stuck in a life-and-death situation where all you have is a CW transmitter for communications?* Having been in just such a situation, and having used CW to save 85 lives, my answer is that the likelihood of such a situation occurring is so remote that I really wonder if it is worth sacrificing the technology of America on such a remote circumstance.

Yes, I know that there will be crowds of old-timers at Dayton looking for me with ropes, tar, and feathers. Well, I've leveled with you down through the years, never taking the easy way out. In this case, I think it is time... way past time, actually ... to get serious about revamping our ham exams and making our hobby a technical one rather than one limited mostly by an easily learned skill.

The recent *QST* polls showed that *QST* readers overwhelmingly are in favor of keeping the code requirement, so it's Wayne Green against the world again. *QST* has been pushing code for as long as I've been hamming—over 40 years. This got them into trouble in the late 40s when a large percentage of the amateurs deserted the League to go with the National Amateur Radio Council... a phone-oriented group which got us expanded phone frequencies on 75m, the 40m phone band, and more frequencies on 20m... over a lot of dead bodies. NARC, achieving its goals, went away.

So, if anyone has any other arguments which I have not enumerated, I'll be glad to publish them, along with my ripostes. Let's get this out in the open and fight fair on it... not let prejudices left over from 50 years ago continue to stop our growth. When I first got into amateur radio, there was still a lot of smoldering anger over being forced off spark. Then I watched the same thing happen with AM phone. I believe in being conservative, but there is such a thing as carrying it too far. If you disagree with me, I ask you to fight fair. If you agree with me, fight with me for the growth and health of the very best hobby ever invented.

Just ask for the tar remover when you need it, Wayne. The whole question of the code requirement ought to be up for examination in the light of new technological advances - almost any home computer can now be programmed to send and receive morse at 40 or 50 wpm. The new generations of Sharp hand-held computers should be capable of handling morse, and print out the received copy, so it isn't going to be long before a dedicated pocket-sized box is available to do it all for under £50. The morse test will be almost irrelevant as the operator's proficiency at the quickstep or foxtrot.

R&EW shares Wayne Green's views that the explosive growth of Amateur Radio in Japan has done nothing but good for that country and its amateur radio equipment industry, but they achieved it by ditching the archaic practice of morse, and concentrating on making sure that operators were technically proficient, and thus not likely to cause interference to other radio users - which is what the regulation of the use of the radio spectrum is all about.

Pass the tea, Fortescue

The UK Radio Amateur's Examination has become a bit of a farce. The technical proficiency implied in a 'pass' probably doesn't even extend to being able to wire up the mains plug of the Japanese transceiver that the newly licenced amateur is almost certain to buy. We suspect that this is another case of the HO's desire for a quiet life.

Few resources are set aside for the radio amateur population in the UK. In view of the small cost of a licence, there probably isn't enough left over after 'overheads' have been deducted to pay for a week's tea ration.

So we'll open the debate in the UK by suggesting:

1. Morse is scrapped, although amateurs sending it by hand must pass the present test, or proficient operators will be driven scatty.
2. The written examination should be made more complex.
3. A licence should be provisional for 12 months, not permitted to run more than 10W RF output on any band - although after 3 months he/she may opt to take a test involving setting up an HF transceiver, loading it into an antenna (after first wiring up the plug on the coax) and working a few stations under the direction of the examiner to get his proficiency certificate for 'full power'.

The final item would perhaps go some way to convincing operators that power is not the only answer to HF communication, and that skill, good antennas and 10W can do just as well, with less pollution of the airwaves, and less trouble for the neighbours. 200W through-line attenuators could form the basis of employment for British workers...

Any offers for alternative suggestions?

■ R & EW

Your Reactions.........	Circle No.
Immediately Applicable	1
Useful & Informative	2
Not Applicable	3
Comments	4

Data File No. 5

The 4007UB is the simplest but most versatile chip in the entire CMOS range. In this month's 'Data File', Ray Marston shows a stack of ways of using the device.

THE 4007UB IS THE SIMPLEST CHIP in the entire CMOS range. It contains little more than two pairs of complementary MOSFETs, plus a simple CMOS inverter stage: All of these elements are, however, independently accessible, enabling them to be configured in a wide variety of ways, thereby making the IC the most versatile in the entire CMOS range.

The 4007UB is an ideal device for demonstrating CMOS principles to students, technicians and engineers. It is sometimes known as the 'design-it-yourself' CMOS chip, and can readily be configured to act as a multiple digital inverter, NAND or NOR gate, transmission gate, or as a uniquely versatile 'micropower' linear amplifier, oscillator or multi-vibrator. We'll look at some practical examples of these applications later in this edition of 'Data File'. In the meantime, let's look at 4007UB basics.

4007UB BASICS: DIGITAL OPERATION

Figure 1a shows the functional diagram and pin numbering of the 4007UB, which contains two complementary pairs of independently-accessible MOSFETs, plus a third complementary MOSFET pair that is connected in the form of a standard CMOS inverter stage. Each of the three independent input terminals of the IC is internally connected to the standard CMOS protection network shown in *Fig 1b*. All MOSFETs in the 4007UB are enhancement-mode devices; Q1, Q3 and Q5 are p-channel MOSFETs. *Fig 1c* shows the terminal notations of the two MOSFET types; note that the B terminal represents the bulk substrate.

The term 'CMOS' actually stands for 'Complementary Metal Oxide Silicon field-effect transistors' and it is fair to say that all CMOS ICs are designed around the basic elements shown in *Fig 1*. It is thus worth getting a good basic understanding of these elements. Let's look first at the digital characteristics of the basic MOSFETs.

The input (gate) terminal of a MOSFET presents a near-infinite impedance, and the magnitude of an external voltage applied to the gate controls the magnitude of source-to-drain current flow. Basic characteristics of the enhancement mode n-channel MOSFET are that the source-to-drain path is open circuit when the gate is at the same potential as the source, but becomes a near short-circuit (a low value resistance) when the gate is heavily biased positive to the source. Thus, the n-channel MOSFET can be used as a digital inverter by wiring it as shown in *Fig 2*: With a logic 0 (zero volts) input the MOSFET is cut off and the output is at logic 1 (positive rail voltage), but with a logic 1 input the output is at logic 0.

Basic characteristics of the p-channel enchancement mode MOSFET are that the source-to-drain path is open when the gate is at the same potential as the source, but becomes a near-short when the gate is heavily biased NEGATIVE to the source. The p-channel MOSFET can thus be used as a digital inverter by wiring it as shown in *Fig 3*.

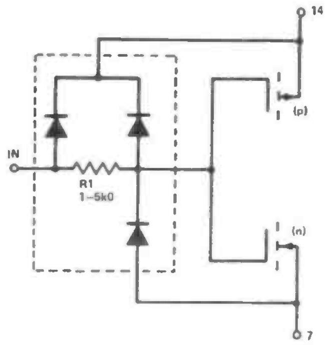


Figure 1b: Internal input-protection network (within dotted lines) on each input of the 4007 UB.

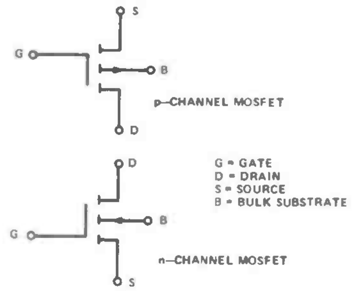


Figure 1c: MOSFET terminal notations

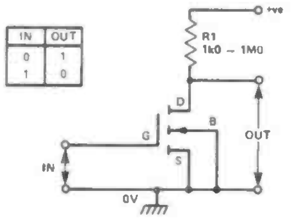


Figure 2: Digital inverter made from n-channel MOSFET.

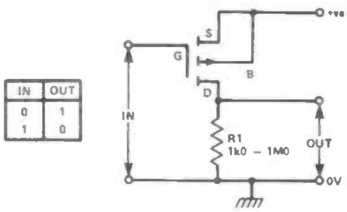


Figure 3: Digital inverter made from p-channel MOSFET.

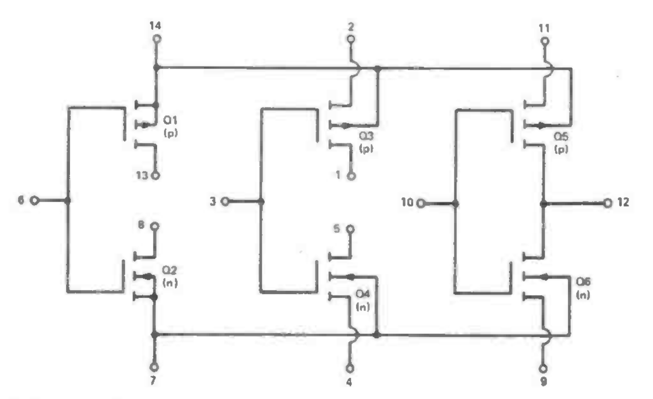


Figure 1a: Functional diagram of the 4007 UB dual CMOS pair plus inverter.

Note in the *Fig 2 and 3* inverter circuits that the ON currents of the MOSFETs are determined by the value of R1 and that these circuits draw a finite quiescent current when they are in one of their logic states. This snag can be overcome by connecting a complementary pair of MOSFETs in the standard CMOS inverter configuration shown in *Fig 4a*. Here, with a logic 0 input applied, Q1 is shorted, so the output is firmly tied to the logic 1 (positive rail) state, but Q2 is open and the inverter thus passes zero quiescent current via this transistor. With a logic 1 input applied, Q2 is shorted and the output is firmly tied to the logic 0 (zero volt) state, but Q1 is open and the circuit again passes zero quiescent current. This 'zero quiescent current' characteristic of the complementary MOSFET inverter is one of the most important features of the CMOS range of digital ICs, and the *Fig 4a* circuit forms the basis of almost the entire CMOS family. *Fig 4c* shows the standard symbol used to represent a CMOS inverter stage. Q5 and Q6 of the 4007UB are fixed-wired in this inverter configuration.

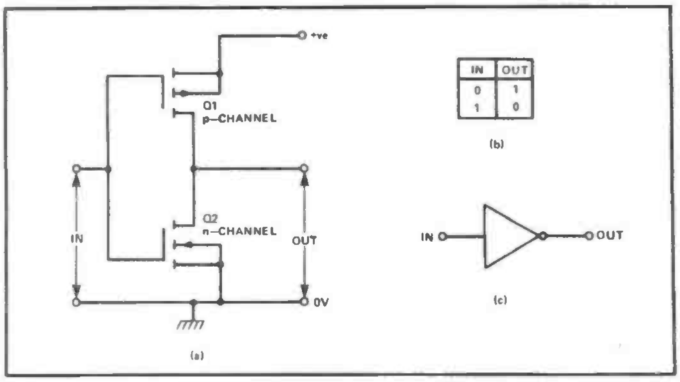


Figure 4: Circuit (a), truth table (b) and standard symbol (c) of the basic CMOS digital inverter.

4007UB BASICS: LINEAR OPERATION

To truly understand the operation and vaguaries of CMOS circuitry, it is essential to understand the linear characteristics of basic MOSFETs. *Fig 5* shows the typical gate-voltage to drain-current graph of an n-channel enhacement mode MOSFET.
Note that negligible drain current flows until the gate voltage rises to a 'threshold' value of about 1.5 to 2.5 volts, but that the drain current then increases almost linearly with further increases in the gate voltage.

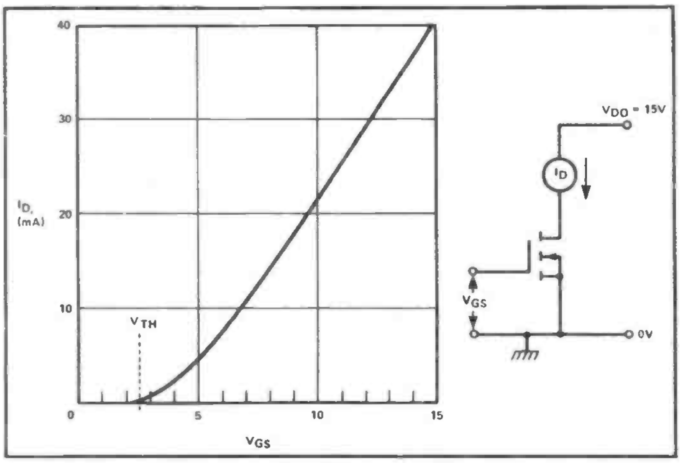


Figure 5: Typical gate-voltage to drain-current characteristics of an n-channel MOSFET.

Figure 6 shows how to connect an n-channel 4007 UB MOSFET as a linear inverting amplifier. R1 serves as the drain load of Q2 and R2-Rx bias the gate so that the device operates in the linear mode. The Rx value must be selected to give the desired quiescent drain voltage; the Rx value is normally in the range 18 k to 100 k. If you want the amplifier to give a very high input empedance, wire a 10 M isolating resistor between the R2-Rx junction and the gate of Q2, as shown in *Fig 6b*.

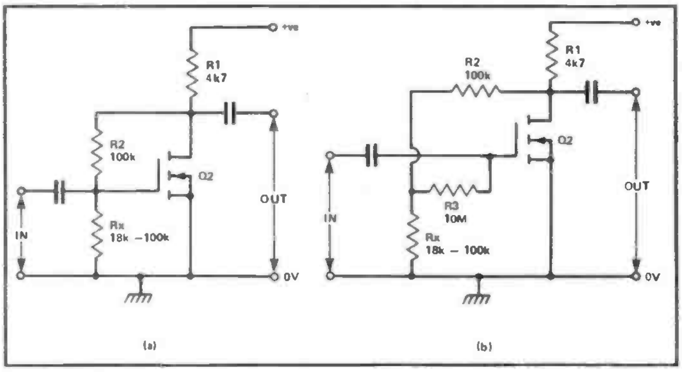


Figure 6: Methods of biasing an n-channel 4007 UB MOSFET for use as a linear inverting amplifier.

Figure 7 shows the typical I_D to V_{DS} characteristics of an n-channel MOSFET at various fixed values of gate-to-source voltage. Imagine here that, for each set of curves, V_{GS} is fixed at the V_{DD} voltage, but that the V_{DS} output voltage can be varied by altering the value of drain load R_L. The graph can be divided into two characteristic regions, as indicated by the dotted line, these being the triode region and the saturated region.

When the MOSFET is in the saturated region (with V_{DS} at some value in the nominal range 50% to 100% of V_{GS}) the drain acts like a constant current source, with its current value controlled by V_{GS}: A low V_{GS} value gives a low constant-current value, and a high V_{GS} value gives a high constant-current value. These saturated 'constant-current' characteristics provide CMOS with its short-circuit-proof feature and also determine its operating speed limits at different supply voltage values.

When the MOSFET is in the Triode region (with V_{DS} at some value in the nominal range 1% to 50% of V_{GS}) the drain acts like a voltage-controlled resistance, with the resistance value increasing approximately as the square of the V_{GS} value.

The p-channel MOSFET has an I_D to V_{DS} characteristics graph that is complementary to that of *Fig 7*. Consequently, the action of the standard CMOS inverter of *Fig 4* (which uses a complementary pair of MOSFETs) is such that its current-drive capability into an external load, and also its operating speed limits, increases in proportion to the supply rail voltage.

Figure 8 shows the typical voltage-transfer characteristics of the standard CMOS inverter at different supply voltage values. Note (on the 15 V V_{DD} line, for example) that the output voltage changes by only a small amount when the input voltage is shifted around the V_{DD} and OV levels, but that when V_{in} is biased at roughly half-supply volts a small change of input voltage causes a large change of output voltage: Typically, the inverter gives a voltage gain of about 30 dB when used with a 15 volt supply, or

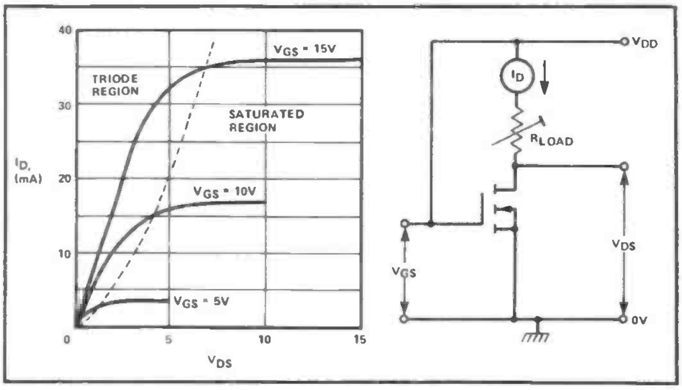


Figure 7: Typical I_D to V_{DS} characteristics of the n-channel MOSFET at various fixed values of V_{GS}.

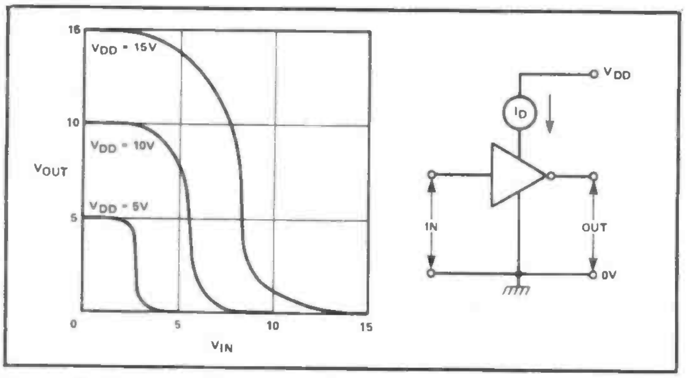


Figure 8: Typical voltage transfer characteristics of the 4007 UB simple CMOS inverter.

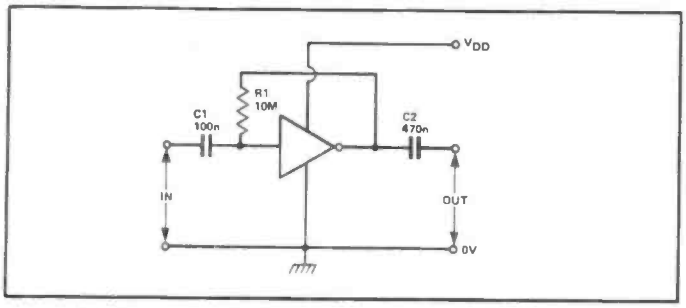


Figure 9: Method of biasing the simple CMOS inverter for linear operation. Typical gain and bandwidth performance figure are 30 dB and 2.5 MHz at 15 V supply, 40 dB and 710 kHz at 5 volts.

40 dB at 5 volts. *Fig 9* shows how to connect the CMOS inverter for use as a linear amplifier; the circuit has a typical bandwidth of 710 kHz at 5 volts supply, or 2.5 MHz at 15 volts.

Wiring three simple CMOS inverter stages in series *(Fig 10a)* gives the direct equivalent of a modern B-series 'buffered' inverter stage, which has the overall voltage transfer graph shown in *Fig 10b*. The B-series inverter typically gives about 70 dB of linear voltage gain, but tends to be grossly unstable when used in the linear mode.

Finally, *Fig 11* shows the drain-current transfer characteristics of the simple CMOS inverter. Note that the drain current is zero when the input is at zero or full supply volts, but rises to a maximum value (typically 0.5 mA at 5 volts supply, or 10.5 mA at 15 volts supply) when the input is at approximately half-supply volts, under which condition both MOSFETs of the inverter are biased on: In the 4007 UB, these ON currents can be reduced by wiring extra resistance in series with the source of each MOSFET of the CMOS inverter; we use this technique in the 'micropower' circuits shown later in this article.

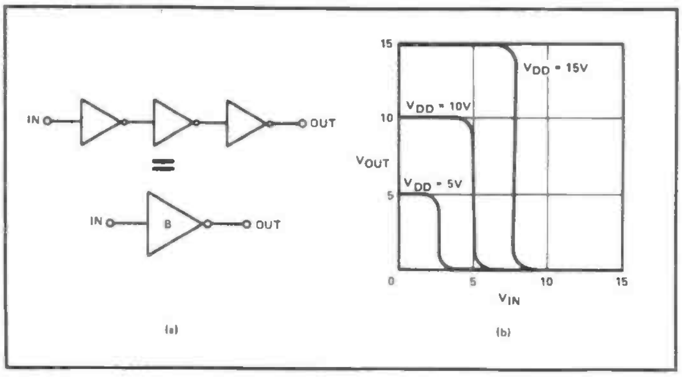


Figure 10: Wiring three simple CMOS inverters in series (a) gives the equivalent of a B-series 'buffered' CMOS inverter, which has the transfer characteristics shown if (b)

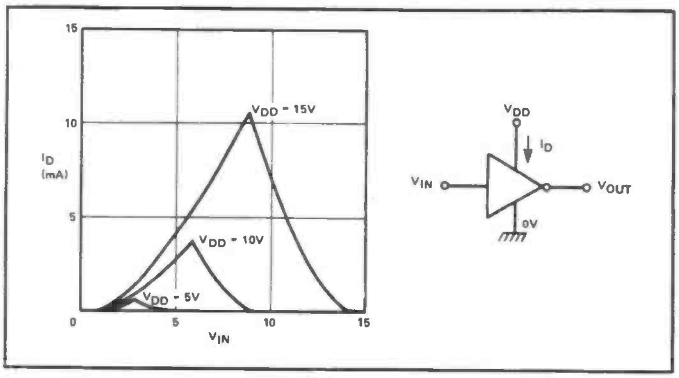


Figure 11: Drain-current transfer characteristics of the simple CMOS inverter.

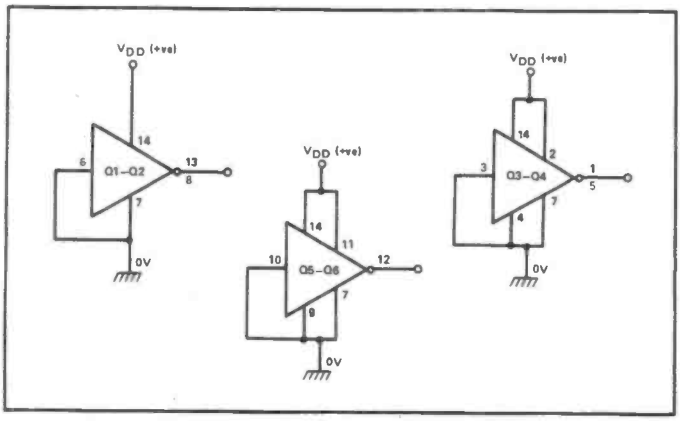


Figure 12: Individual 4007 UB complementary MOSFET pairs can be disabled by connecting them as CMOS inverters and grounding their inputs.

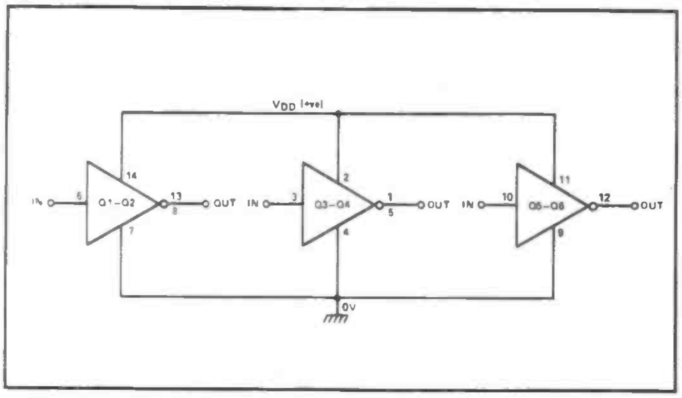


Figure 13: 4007 UB triple inverter.

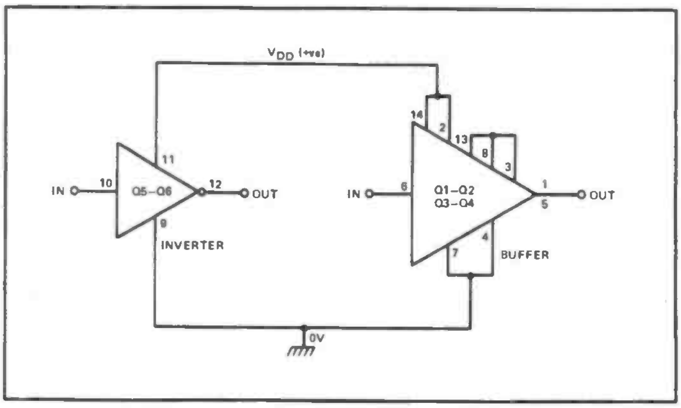


Figure 14: 4007 UB inverter plus non-inverting buffer.

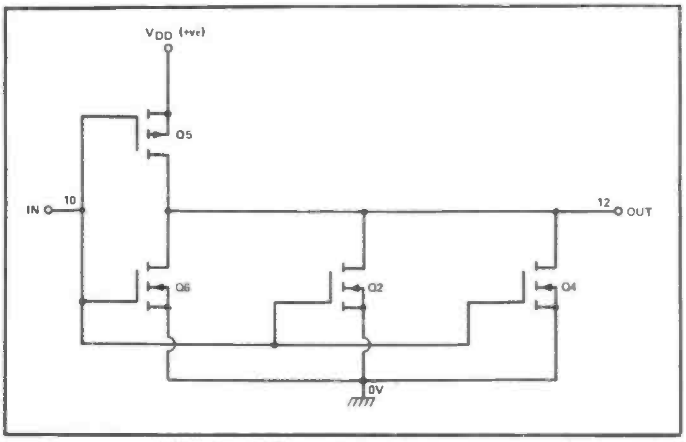


Figure 15: 4007 UB high sink-current inverter.

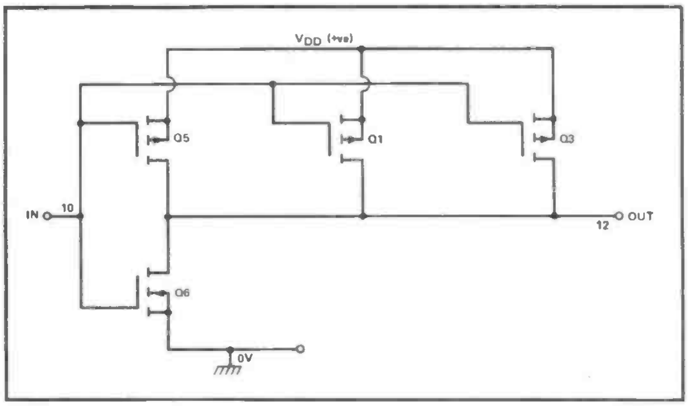


Figure 16: 4007 UB high source-current inverter.

USING THE 4007UB.

The usage rules of the 4007 UB are quite simple. In any specific applicaton, all unused elements of the device must be disabled. Complementary pairs of MOSFETs can be disabled by connecting them as standard CMOS inverters and tying their inputs to ground, as shown in *Fig 12.* Individual MOSFETs can be disabled by tying their source to their substrate (B) and leaving the drain open circuit.

In use, the input terminals must not be allowed to rise above V_{DD} (the supply voltage) or below V_{SS} (zero volts). To use an n-channel MOSFET, the source must be tied to V_{SS}, either directly or via a current-limiting resistor. To use a p-channel MOSFET the source must be tied to V_{DD}, either directly or via a current-limiting resistor.

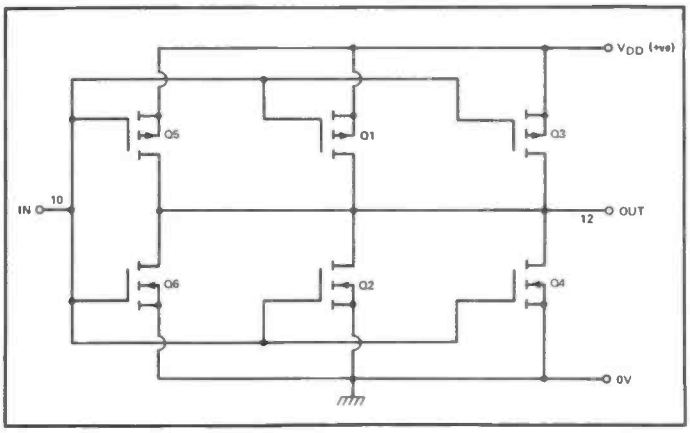
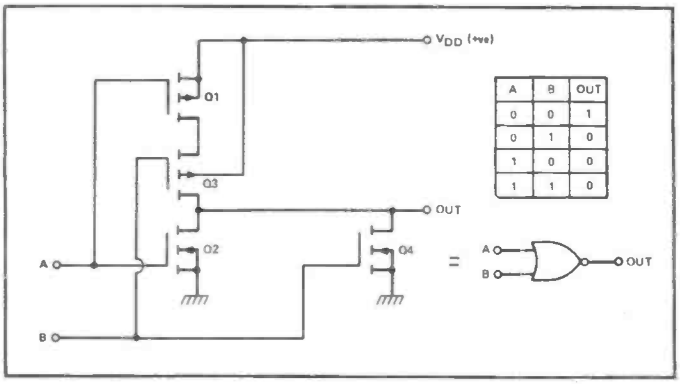


Figure 17: 4007 UB high-power inverter, with triple the sink-and source-current capability of a standard inverter.



A	B	OUT
0	0	1
0	1	0
1	0	0
1	1	0

Figure 18: 4007 UB 2-input NOR gate.

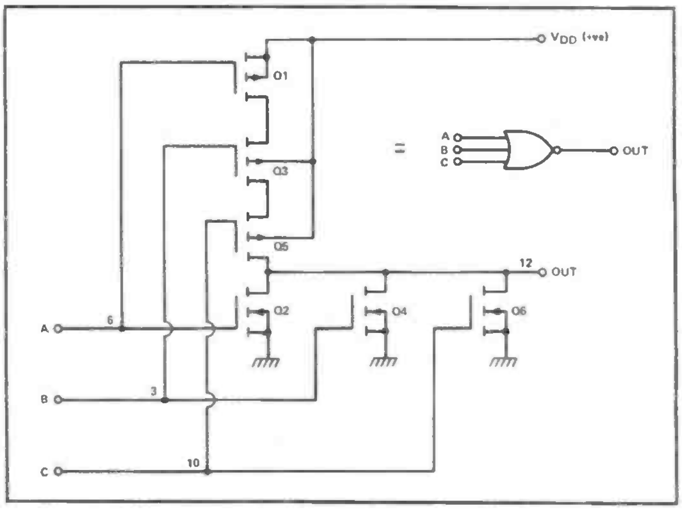
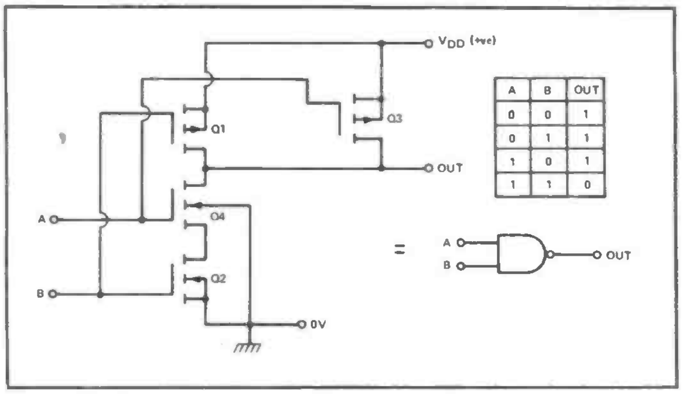


Figure 19: 4007 UB 3-input NOR gate.



A	B	OUT
0	0	1
0	1	1
1	0	1
1	1	0

Figure 20: 4007 UB 2-input NAND gate.

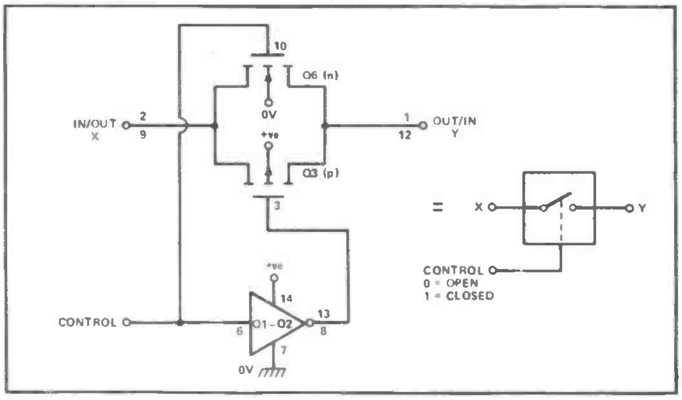


Figure 21: 4007 UB transmission gate or bilateral switch.

PRACTICAL 4007 UB CIRCUITS: DIGITAL.

The 4007 UB elements can be configured to act as any of a variety of standard digital circuits. *Fig 13* shows how to wire it as a triple inverter, using all three sets of complementary MOSFET pairs. *Fig 14* shows the connections for making an inverter plus non-inverting buffer; here, the Q1-Q2 and Q3-Q4 inverter stages are simply wired directly in series, to give an overall non-inverting action.

The maximum source (load-driving) and sink (load-absorbing) output currents of a simple CMOS inverter stage self-limit at 10 -20 mA as one or other of the output MOSFETs turns fully on. Higher sink currents can be obtained by simply wiring n-channel MOSFETs in parallel in the output stage: *Fig 15* shows how to wire the 4007 UB so that it acts as a high sink current inverter that will absorb triple the current of a normal inverter. Similarly, *Fig 16* shows how to wire the IC to act as a high source-current inverter, and *Fig 17* shows the connections for making a single inverter that will sink or source three times more current than a standard inverter stage.

The 4007 UB is a perfect device for demonstrating the basic principles of CMOS logic gates. *Fig 18* shows the basic connections for making a 2-input NOR gate. Note that the two n-channel MOSFETs are wired in parallel, so that either can pull the output to ground from a logic 1 input, and the two p-channel MOSFETs are wired in series so that both must turn on to pull the output high from a logic 0 input. The truth table shows the logic of the circuit. A 3-input NOR gate can be made by simply wiring three p-channel MOSFETs in series and three n-channel MOSFETs in parallel, as shown in *Fig 19*.

Figure 20 shows how to wire the 4007 UB as a 2-input NAND gate. In this case the two p-channel MOSFETs are wired in parallel and the two n-channel MOSFETs are wired in series. A 3-input NAND gate can be made by similarly wiring three p-channel MOSFETs in parallel and three n-channel MOSFETs in series.

Figure 21 shows the basic circuit for using the 4007 UB to make another important CMOS element, the so-called transmission gate or bilateral switch. This device acts like a near-perfect switch that can conduct signals in either direction and can be turned on (closed) by applying a logic 1 to the control terminal or turned off (open) via a logic 0 control signal. Here, an n-channel and a p-channel MOSFET are wired in parallel (source-to-source, drain-to-drain), but their gate signals are applied in anti-phase via the Q1-Q2 inverter. To turn the Q3-Q6 transmisson gate on (closed), Q6 gate is taken to logic 1 and Q3 gate to logic 0 via the inverter: To turn the switch off, the gate polarities are simply reversed.

The 4007 UB transmission gate has a near-infinite OFF resistance and an ON resistance of about 600 R. It can handle all signals between zero volts and the positive supply rail value. Note that, since the gate is bilateral, either of its terminals can function as input or output.

Finally, *Fig 22* shows how the 4007 UB can be wired as a dual transmission gate that functions like a single-pole double-throw (s.p.d.t.) switch. In this case the circuit uses two transmission

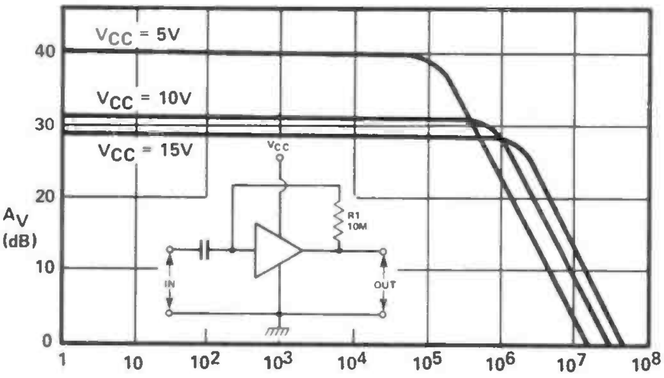


Figure 23: Typical Av and frequency characteristics of the linear-mode basic CMOS amplifier.

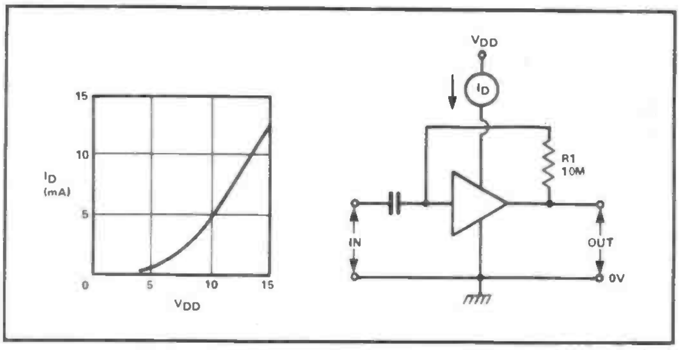


Figure 24: Typical I_D/V_{DD} characteristics of the linear-mode CMOS amplifier.

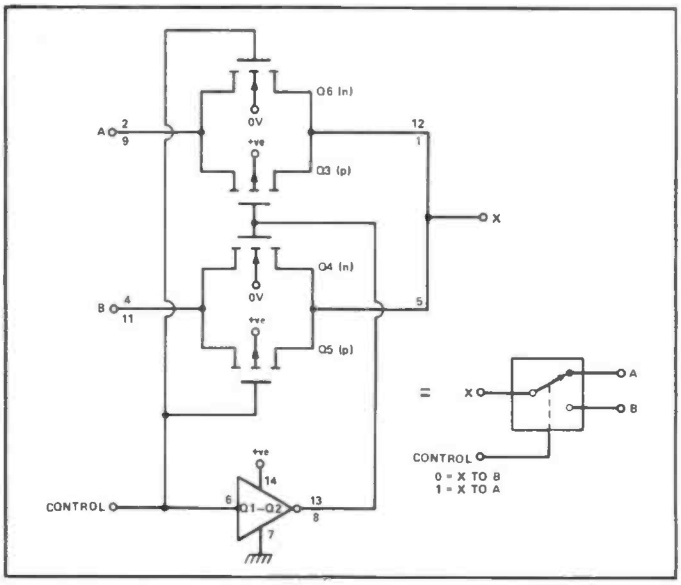


Figure 22: 4007 UB 2-way transmission gate.

R1	I_D	A_V (V_{OUT}/V_{IN})	UPPER 3dB BANDWIDTH
0	12.5mA	20	2.7MHz
100R	8.2mA	20	1.5MHz
560R	3.9mA	25	300kHz
1k0	2.5mA	30	150kHz
5k6	600uA	40	25kHz
10k	370uA	40	15kHz
100k	40uA	30	2kHz
1M0	4uA	10	1kHz

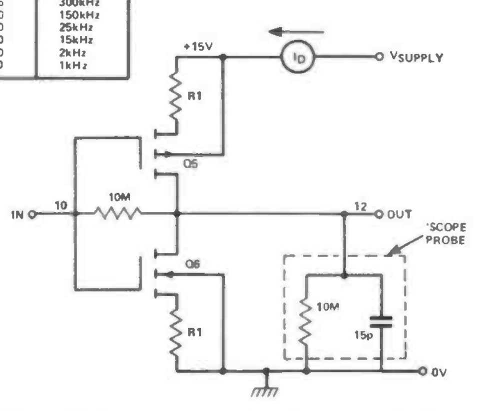


Figure 25: 'Micropower' 4007 UB CMOS linear amplifier, showing method of reducing I_D, with measured performance details.

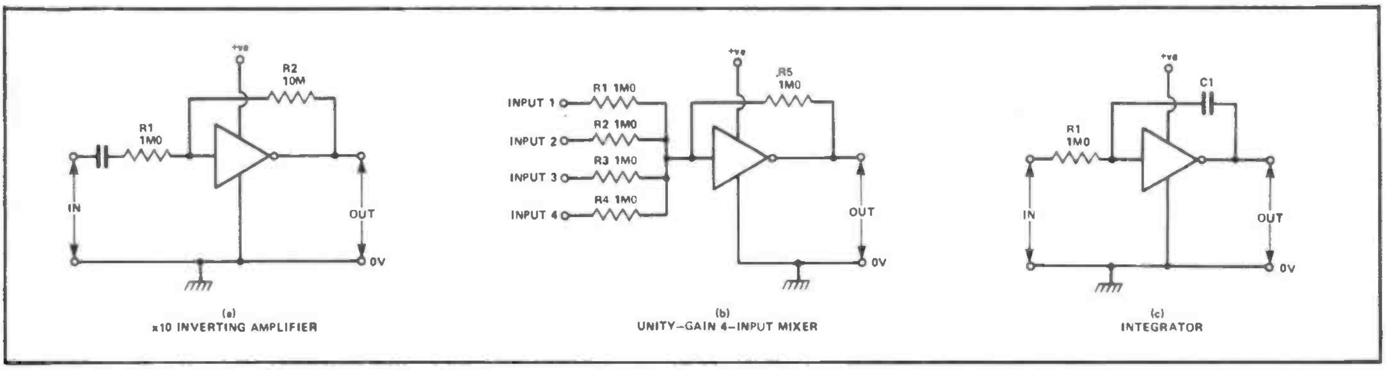


Figure 26: The CMOS amplifier can be used in a variety of linear inverting amplifier applications. Three typical examples are shown here.

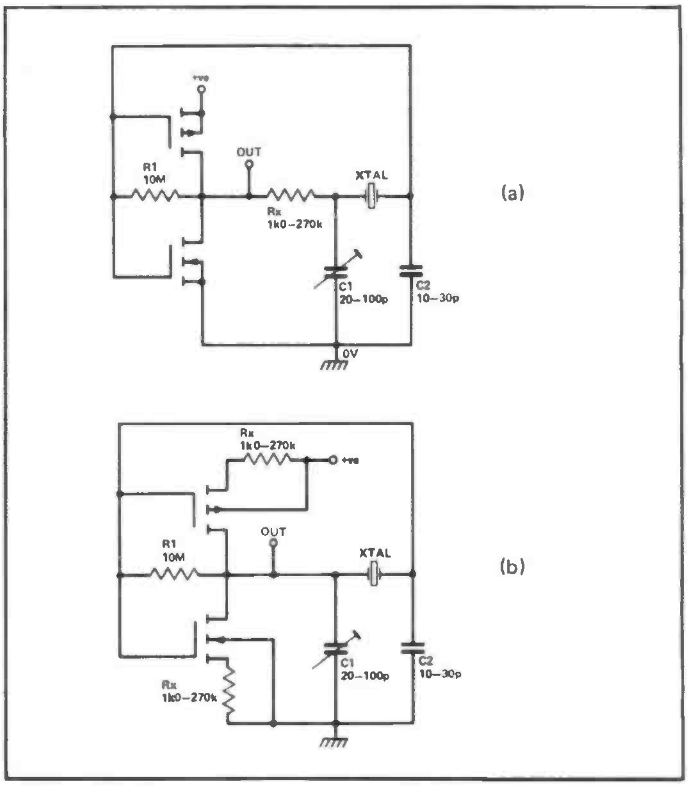


Figure 27: Crystal oscillator using (a) standard and (b) micropower 4007 UB CMOS linear inverter.

elements, but their control voltages are applied in anti-phase, so that one switch opens when the other closes, and vice versa; the 'X' sides of the two gates are shorted together, to give the desired s.p.d.t. action.

PRACTICAL 4007 UB CIRCUITS: LINEAR.

We've already seen in *Figs 6 and 9* that the basic 4007 UB MOSFETs and the CMOS inverter can be used as linear amplifiers. *Fig 23* shows the typical voltage gain and frequency characteristics of the linear CMOS inverter when operated from three alternative supply rail values: This graph assumes that the amplifier output is feeding into the high impedance of a 10M/15pF 'scope probe. The output impedance of the open-loop amplifier typically varies from 3k0 at 15 volts supply, to 5k0 at 10 volts, to 22k at 5 volts, and it is the product of the output impedance and output load capacitance that determines the bandwidth of the circuit; increasing the load capacitance or output impedance reduces the bandwidth.

As you would expect from the voltage transfer graph of *Fig 8*, the distortion characteristics of the CMOS linear amplifier are not particularly wonderful: Linearity is quite good from small-amplitude signals (output amplitudes up to 3 volts pk-to-pk with a 15 volt supply), but the distortion then increases progressively as the output approaches the upper and lower supply limits. Unlike a bipolar transistor circuit, the CMOS amplifier does not 'clip' excessive sine wave signals, but progessively rounds off their peaks.

Figure 24 shows the typical drain-current versus supply-voltage characteristics of the basic CMOS linear amplifier. Note that the supply current typically varies from 0.5 mA at 5 volts to 12.5 mA at 15 volts.

In many applications, the quiescent supply current of the 4007 UB CMOS amplifier can usefully be reduced, at the expense of reduced amplifier bandwidth, by wiring external resistors in series with the source terminals of the two MOSFETs of the CMOS stage, as shown in the 'micropower' circuit of *Fig 25*. This diagram also shows the effect that different resistors values have on the drain current, voltage gain and bandwidth of the amplifier when it is operated from a 15 volt supply and has its output feeding to a 10M/15pF 'scope probe.

It is very important to appreciate in the *Fig 25* circuit that these additional resistors add to the output impedance of the amplifier (the output impedance is roughly equal to the R1-Av product) and this impedance and the external load resistance/capacitance has a great effect on the overall gain and bandwidth of the circuit. When using 10 k values for R1, for example, if the load capacitance is increased to 50 pF the bandwidth falls to about 4 kHz, but if the capacitance is reduced to 5 pF the bandwidth increases to 45 kHz: Similarly, if the resistive load is reduced from 10 M to 10 k, the voltage gain falls to unity; for significant gain, the load resistance must be large relative to the output impedance of the amplifier.

The basic (unbiased) CMOS inverter stage has an input capacitance of about 5 pF and an input resistance of near-infinity. Thus, if the output of the *Fig 25* circuit is fed directly to such a load, it will show a voltage gain of about 30 and a bandwidth of 3 kHz when R1 has a value of 1M0; it will even give useful gain and bandwidth when R1 has a value of 10M, but will consume a quiescent current of only 0.4 uA!

The CMOS linear amplifier can be used, in either its standard or micropower forms, to make a variety of fixed-gain amplifiers, mixers, integrators, active filters and oscillators, etc. Three typical basic applications are shown in *Fig 26*.

A particularly attractive linear application is as a crystal oscillator, as shown in *Fig 27a*. Here, the CMOS amplifier is linearly biased via R1 and provides 180° phase shift, and the Rx-C1-XTAL-C2 pi-type crystal network provides an additional 180° of phase shift at the crystal resonant frequency, thereby causing the circuit to oscillate. If you simply want the crystal to provide a frequency accuracy within 0.1% or so, Rx can be replaced by a short and C1-C2 can be omitted: For ultra-high accuracy, the correct values of Rx-C1-C2 must be individually determined (Fig 27 shows the typical range of values). In micropower applications, Rx can be incorporated in the CMOS amplifier, as shown in *Fig 27b*. If desired, the output of the crystal oscillator can be fed directly to the input of an additional CMOS inverter stage, for improved waveform shape/amplitude. ▶

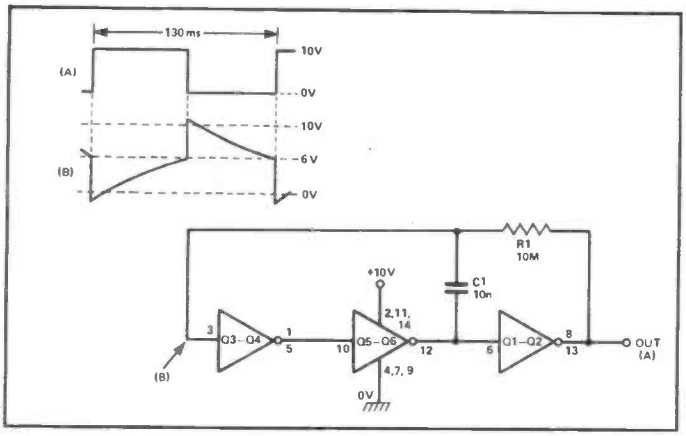


Figure 28: This 4007 UB ring-of-three astable consumes 280 uA at 6 V, 1.6 mA at 10V.

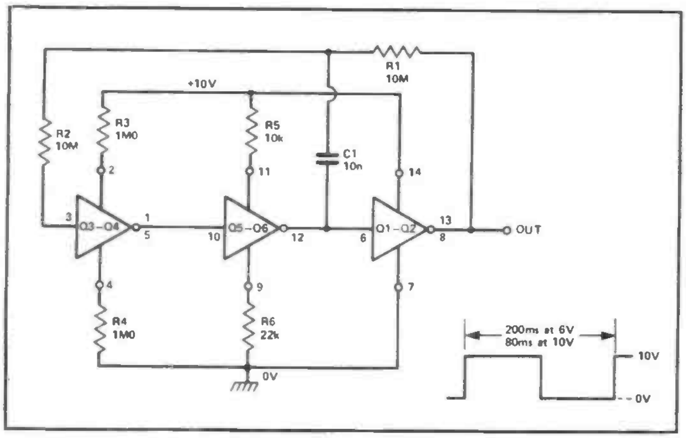


Figure 29: This micro-power ring-of-three symmetrical 4007 UB astable consumes 1.5 uA at 6 V, or 8 uA at 10 V.

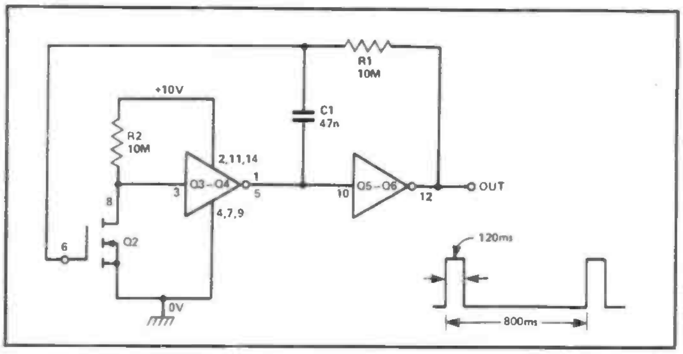


Figure 30: This 4007 UB asymmetrical ring-of-three astables consumes 2 uA at 6 V, 5 uA at 10 V.

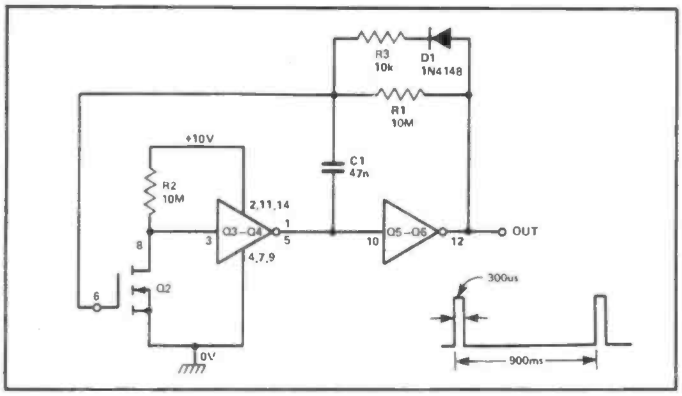
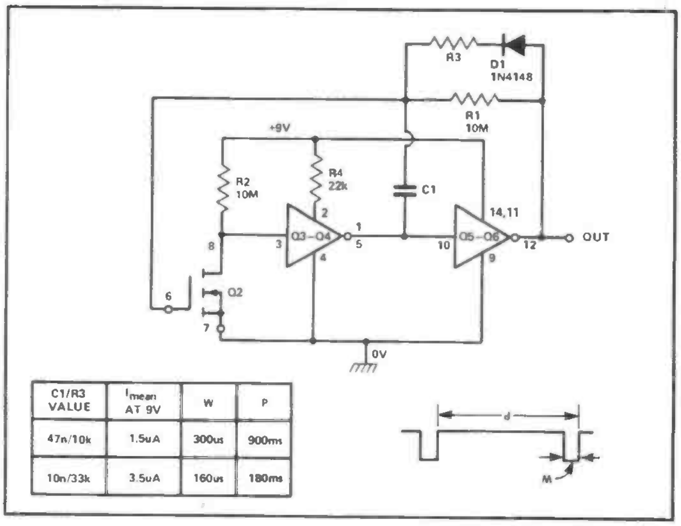


Figure 31: This dual time constant version of the 4007 UB astable generates a very narrow output pulse.



C1/R3 VALUE	I_{mean} AT 9V	W	P
47n/10k	1.5uA	300us	900ms
10n/33k	3.5uA	160us	180ms

Figure 32: This micro-power version of the 4007 UB dual-time-constant astable consumes absolutely minimal currents.

PRACTICAL 4007 UB CIRCUITS: ASTABLES.

One of the most useful applications of the 4007 UB is as a ring-of-three astable multivibrator: *Fig 28* shows the basic configuration of the circuit. Wave-form timing is controlled by the values of R1 and C1, and the output waveform (A) is approximately symmetrical. Note that for most of the waveform period the front-end (waveform B) part of the circuit operates in the linear mode, so the circuit consumes a significant running current.

In practice, the running current of the *Fig 28* 4007 UB astable circuit is far higher than that of an identically configured B-series 'buffered' CMOS chip such as the 4001 B, the comparative figure being 280 uA at 6 V and 1.6 mA at 10 V for the 4007 UB against 12 uA at 6 V and 75 uA at 10 V for the 4001 B. The 4007 UB circuit, however, has a far lower propagation delay than the 4001 B and typically has a maximum astable operating speed that is three times higher than that of the 4001 B.

The running current of the 4007 UB astable can be greatly reduced by operating its first two stages in the 'micropower' mode, as shown in *Fig 29*. This technique is of particular value in low-frequency operation, and the *Fig 29* circuit in fact consumes a mere 1.5 uA at 6 V or 8 uA at 10 V, these figures being far lower than those obtainable from any other IC in the CMOS range. The frequency stability of the *Fig 29* circuit is not, however, very good, the period varying from 200 mS at 6 V to 80 mS at 10 V.

Figure 30 shows how the 4007 UB can be configured as an asymmetrical ring-of-three astable. In this case the 'input' of the circuit is applied to n-channel MOSFET Q2. The circuit consumes 2 uA at 6 V or 5 uA at 10 V.

Figure 31 shows how the symmetry of the above circuit can be varied by shunting R1 with the D1-R3 network, so that the charge and discharge times of C1 are independently controlled. With the component values shown, the circuit produces a 300 uS pulse once every 900 mS and consumes a mere 2 uA at 6V or 4.5 uA at 10 V. Note that these characteristics are similar to those of the ideal 'sample-pulse generator' circuit that was mentioned at the end of 'Data File No 4'

Finally, to round off this edition of Data File, *Fig 32* shows how the current consumption of the above circuit can be even further reduced, by operating the Q3-Q4 CMOS inverter in the micro-power mode. The table gives details of circuit performance with alternative C1 and R3 values. This circuit will give years of continuous operation from a single battery supply. ■ R & EW

Your Reactions	Circle No.		Circle No.
Immediately Applicable	5	Not Applicable	7
Useful & Informative	6	Comments	8

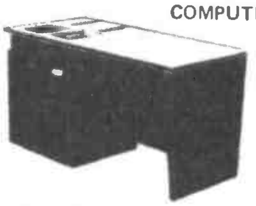
THIS MONTH'S NEW KITS

For the musically inclined	
Drum Synthesiser	£29.50
Mixer/Pre Amp	£16.00
Stylus Organ	£4.95
For the Service Engineer	
Micro Volt Multiplier	£3.95
Sign Wave Generator	£5.75
Linear Power Output Meter	£11.50
For the Ham or CB Enthusiast	
Aerial Rotator	£24.50
Aerial Direction Indicator	£5.90
For the Motorist	
Electronic Ignition Kit	£19.50
For all of you	
Electric Jigsaw Puzzle	£5.30
Blow Heater Kit	£6.45
And if you are having TV Interference Problems	
High-Pass Filter	£1.95
Low-Pass Filter	£3.45

UNIVAC KEYBOARD BARGAIN

Ideal for use with ZX80/81. Has 50 keys and many other parts for your spares box. Probably cost in excess of £100. In very good used condition — £13.50 + £2.00 post. Diagram showing how to connect to ZX80/81 — £2.00 extra.

COMPUTER DESK



Size approx. 4'x 2' x 2'6" high. These were made for hard work, the top being formica covered. Suitable for housing instruments or for use as office desks. Beautifully made, these cost over £100 each, our price only £11.50 each, however, you must arrange to collect.

EXTRACTOR FANS

Mains operated — ex. Computer.
5" Woods extractor £5.75 Post £1.00.
6" Woods extractor £6.90 Post £1.25
6" Plannair extractor £7.50 Post £1.00
4" x 4" Muffin 115v. £4.50 Post 50p.
4" x 4" Muffin 230v. £5.75 Post 50p.

INTERRUPTED BEAM

This kit enables you to make a switch that will trigger when a steady beam of infra red or ordinary light is broken. Main components — relay, photo transistor, resistors and caps, etc. Circuit diagram but no case. Price £2.30

INSTRUMENT BOX WITH KEY

Very strongly made (ply-wood sides with hard board top and bottom). This is black grained effect, vinyl covered, very pleasing appearance. Internal dimensions 12½" long, 4¾" wide, 6" deep. Ideal for carrying your multi range meter and small tools and for keeping them in a safe place. £2.30. Post paid if ordered with other goods, otherwise £1.00.

ROPE LIGHT

4 sets of coloured lamps in translucent plastic tube arranged to give the appearance of a running or travelling light. With variable speed control box, ideal for disco or shop window display. Complete, made up, ready to plug into mains. £36.00 + £2 post.

COMPUTER KEY SWITCHES (make your own keyboard)

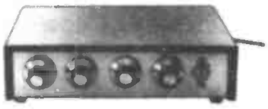
These are for making up on a p.c.b. and consist of a vertical mounting computer type reed switch, which makes circuit when a magnet passes over it. The magnet is located in the plastic plunger which in turn is depressed by a push rod, to which the legended top is fixed. These are made up in banks of 6, price £2.30 per bank of 6 (including tops)

OUR CAR STARTER AND CHARGER KIT has no doubt saved many motorists from embarrassment in an emergency you can start car off mains or bring your battery up to full charge in a couple of hours. The kit comprises: 250w mains transformer, two 10 amp bridge rectifiers, start/charge switch and full instructions. You can assemble this in the evening, box it up or leave it on the shelf in the garage, whichever suits you best. Price £11.50 + £2.50 post.

GPO HIGH GAIN AMP/SIGNAL TRACER. In case measuring only 5¼in x 3¼in x 1¼in is an extremely high gain (70dB) solid state amplifier designed for use as a signal tracer on GPO cables, etc. With a radio it functions very well as a signal tracer. By connecting a simple coil to the input socket a useful mains cable tracer can be made. Runs on standard 4½v battery and has input, output sockets and on-off volume control, mounted flush on the top. Many other uses include general purpose amp, cueing amp, etc. An absolute bargain at only £1.85. Suitable 80ohm earpiece 69p.

FREE OUR CURRENT BARGAIN LIST WILL BE ENCLOSED WITH ALL ORDERS.

3 CHANNEL SOUND TO LIGHT KIT



Complete kit of parts for a three-channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two-tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼" sockets and three panel mounting fuse holders provide thyristor protection. A four-pin plug and socket facilitate ease of connecting lamps. Special snip price is £14.95 in kit form or £25.00 assembled and tested.

MULLARD UNILEX

A mains operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost anyone. In easy to assemble modular form this should sell at about £30 — but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only £16.75 including VAT and post.
FREE GIFT — buy this month and you will receive a pair of Goodman's eliptical 8"x 5" speakers to match this amplifier.

THIS MONTH'S SNIP

POCKET AUDIO COMPONENT TESTER

With it you can quickly test diodes, rectifiers, transistors, capacitors, check wiring and p.c. boards for open circuits, find the anode and cathode of a diode or rectifier and whether a transistor is PNP or NPN, which are the base collector and emitter connections. Condensers, if bad, give a continuous signal, but if good, give intermittent signals of varying length depending on their value. The test current is very low (2uA) and the voltage only 1.4v, so it is also possible to check MOS devices, as well as sensitive transistors without fear of damaging them. The unit is supplied complete with internal battery, which should last many months.
Price £3.45p

THERMOSTAT ASSORTMENT

10 different thermostats. 7 bi-metal types and 3 liquid types. There are the current stats which will open the switch to protect devices against overload, short circuits, etc., or when fitted say in front of the element of a blow heater, the heat would trip the stat if the blower fuses; appliance stats, one for high temperatures, others adjustable over a range of temperatures which could include 0 — 100°C. There is also a thermostatic pod which can be immersed, an oven stat, a calibrated boiler stat, finally an ice stat which, fitted to our waterproof heater element, up in the loft could protect your pipes from freezing. Separately, these thermostats could cost around £15.00 — however, you can have the parcel for £2.50.

6 WAVEBAND SHORTWAVE RADIO KIT

Bandspread covering 13.5 to 32 metres. Based on circuit which appeared in a recent issue of Radio Constructor. Complete kit includes case materials, six transistors and diodes, condensers, resistors, inductors, switches, etc. Nothing else to buy if you have an amplifier to connect it to or a pair of high resistance headphones. Price £11.95.

MEDIUM & 2 SHORT WAVE CRYSTAL RADIO

All the parts to make up the beginner's model. Price £2.30. Crystal earpiece 65p. High resistance headphones (gives best results) £3.75. Kit includes chassis and front but not case.

TRANSMITTER SURVEILLANCE

Tiny, easily hidden but which will enable conversation to be picked up with FM radio. Can be made in a matchbox — all electronic parts and circuit. £2.30. (Not licenceable in the U.K.).

RADIO MIKE

Ideal for discos and garden parties, allows complete freedom of movement. Play through FM radio or tuner amp. £6.90 comp. kit. (Not licenceable in the U.K.).

RADIO STETHOSCOPE

Easy to fault find — start at the aerial and work towards the speaker — when signal stops you have found the fault. Complete kit £4.95.

MUGGER DETERRENT

A high-note beeper, push latching switch, plastic case and battery connector. Will scare away any villain and bring help. £2.50 complete kit.

POPULAR SNIP — STILL AVAILABLE

And it still carries a free gift of a desoldering pump, which we are currently selling at £6.35p. The snip is perhaps the most useful breakdown parcel we have ever offered. It is a parcel of 50 nearly all different computer panels containing parts which must have cost at least £500. On these boards you will find over 300 IC's. Over 300 diodes, over 200 transistors and several thousand other parts, resistors, condensors, multi-turn pots, recifiers, SCR, etc. etc. If you act promptly, you can have this parcel for only £8.50, which when you deduct the value of the desoldering pump, works out to just a little over 4p per panel. Surely this is a bargain you should not miss!
When ordering please add £2.50 post and £1.27 VAT.

BURGLAR ALARM CONTROL PANEL

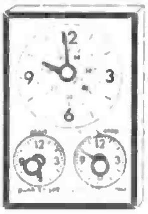
Contains labelled connection block, latching relay, test switch and removable key control switch. Simplifies the whole installation, all you have to do is to take wires to pressure pads and to alarm bell. Price £7.95, with complete diagram.

MINI MONO AMP on p.c.b., size 4" x 2" approx.

Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amplifier. Brand new, perfect condition, offered at the very low price of £1.15 each, or 10 for £10.00.

DELAY SWITCH

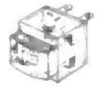
Mains operated — delay can be accurately set with pointers knob for periods of up to 2½hrs. 2 contacts suitable to switch 10 amps — second contact opens a few minutes after 1st contact. £1.95.



TIME SWITCH BARGAIN

Large clear mains frequency controlled clock, which will always show you the correct time + start and stop switches with dials. Complete with knobs. £2.50.

LEVEL METER

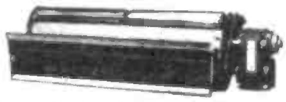


Size approximately ¾" square, scaled signal and power but cover easily removable for rescaling. Sensitivity 200 uA. 75p.

WATERPROOF HEATING WIRE

60 ohms per yard, this is a heating element wound on a fibre glass coil and then covered with p.v.c. Dozens of uses — around water pipes, under grow boxes in gloves and socks.

TANGENTIAL BLOW HEATER



2.5 Kw quiet, efficient instant heating from 230/240 volt mains. Kit consists of blower as illustrated, 2.5 Kw element, control switch and data all for £4.95. post £1.50.

12V SUBMERSIBLE PUMP

Just join it to your car battery, drop it into the liquid to be moved and up it comes, no messing about, no priming, etc. and you get a very good head. Suitable for water, paraffin and any non-explosive non-corrosive liquid. One use if you are a camper, make yourself a shower. Price: £8.50.

VENNER TIME SWITCH

Mains operated with 20 amp switch, one on and one off per 24 hrs. repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only £2.95. These are without case, but we can supply metal case with window £2.95.
Also available is adaptor kit to convert this into a normal 24hr. time switch but with the added advantage of up to 12 on/offs per 24hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is £2.30. Post any or all items £1.

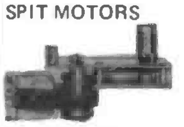
12V FLUORESCENT LIGHTING

For camping — car repairing — emergeny lighting from a 12v battery you can't beat fluorescent lighting. It will offer plenty of well distributed light and is economical. We offer an Inverter for 21" 13 watt miniature fluorescent tube. £3.45. (tube not supplied).

FIVE UNUSUAL SWITCHES

For inventors, experimenters, service engineers, students or in fact anyone interested in making electrical gadgets. The parcel contains: — delay switch — motor driven switch — two-way and off switch — polarity changing switch — and humidity switch. Our regular price for these switches bought separately is over £10, but this month you can have the 5 for £2.50.

SPIT MOTORS



These are powerful mains operated induction motors with gear box attached. The final shaft is a ⅛" rod with square hole, so you have alternative couplingmethods — final speed is approx. 5 revs/min, price £5.50. — Similar motors with final speeds of 80, 100, 160 & 200r.p.m. same price.

COMPONENT BOARD Ref. WO998

This is a modern fibreglass board which contains a multitude of very useful parts, most important of which are: 35 assorted diodes and rectifiers including 4 3amp 400v types (made up in a bridge) 8 transistors type BC 107 and 2 type BFY 51 electrolytic condensers. SCR ref 2N 5062, 25 Ouf 100v DC and 100uf 25v DC and over 100 other parts including variable, fixed and wire wound resistors, electrolytic and other condensers. A real snip at £1.15.

J. BULL (Electrical) Ltd.

(Dept. REW), 34 - 36 AMERICA LANE, HAYWARDS HEATH, SUSSEX RH16 3QU.

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