MARCH 1982

ISSN 0262–2572

RADIO & ELECTRONICS WORLD

70p

PROJECTS

Car Anti-Theft System
23cm Converter
Z-8 Computing Board

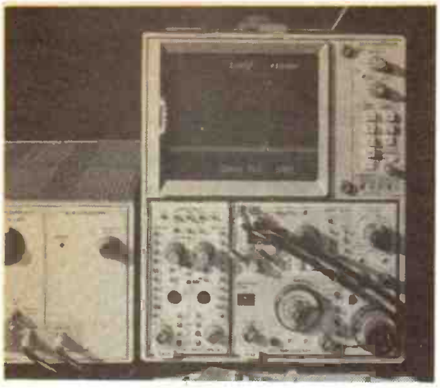
REVIEWS

M40FM CB Rig
SC110 2" Scope
Sinadder 3

FEATURES

4017B Applications
Satellite TV Broadcasting

OVER 60 CIRCUITS!
16 EXTRA PAGES



Published by Broadercasting Ltd., 117a High Street, Brentwood, Essex. R&EW is published monthly, on the first Thursday of each month.

RADIO & ELECTRONICS WORLD

Volume 1. No.7.

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.

Publisher
William Poel
Editor
Ray Marston
Technical editor
Stephen C. Taylor
B.Sc. A.M.I.E.E.
Practical features editor
Roger Ray
Production editor
Jack Burrows
Art/Production Manager
Patrick Haylock
Art Editor
Sally Bennett
Editorial Secretary
Kim Mitchell
Computing Consultant
Jonathan C. Burchell
RF Consultant
Timothy Edwards
Editorial Offices
117a High Street Brentwood
Essex CM14 4SG
telephone (0277) 213819
Advertisement Manager
Bob Kennedy
Hillcroft House 16 The Avenue
Highams Park London E4 9LD
telephone 01-531-7621
Subscription Manager
Owen Rundle
45 Yeading Ave, Rayners Lane
Harrow, Middx HA2 9RL
telephone 01-868-4854
Published by
Broadercasting Limited
Distributed by
SM Distribution Ltd
16/18 Trinity Gardens
London SW9 8DX
telephone 01-274-8611
Printed by
LSG Printers Lincoln
Photosetting by
Delafield Reprographic Service
481 Ongar Road
Brentwood Essex
Subscriptions
Rates for 12 months
U.K. £10.00
Overseas £11.00
Holland Electronics
Postbus 377, 2300 AJ LEIDON
Tel: 071-144988

MicroValue

MONEY SAVERS

with the exclusive MicroValue 12 Months Warranty*

New CP/M System based on Gemini Multiboard

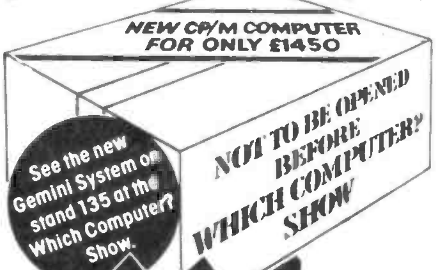
Gemini Microcomputers is launching at Which Computer? Show a new system based around its successful MultiBoard range, and MicroValue dealers will have first deliveries in February. It will have:

HARDWARE

- Twin Z80A CP/M System
- 64K Dynamic RAM
- 700K Disk Storage (Formatted)
- 80 x 25 Screen Format
- Inverse Video
- Prog. Character Generator
- 160 x 75 Pixel Graphics
- Centronics Parallel I/O
- RS232 I/O
- Light pen interface
- 59-Key ASCII Keyboard

SOFTWARE

- Full 64K CP/M 2.2 with screen edit facility
- Comal-80 structured BASIC
- GEM-ZAP Assembler/Editor
- GEM-PEN Text editor
- GEM-DE BUG debugging software



MicroValue price **£1,450** + VAT

MicroValue Exclusive

80 × 25 Video for Nascom

Nascom owners can now have a professional 80 × 25 Video display by using the Gemini G812 Intelligent Video Card with onboard Z80A. This card does not occupy system memory space and provides over 50 user controllable functions including prog character set, fully compatible with Gemini G805 and G815/809 Disk Systems. Built and tested.

£140 + VAT

MicroValue Exclusive

NEW

I/O Board for Nascom & Gemini Multiboard Systems

Quantum I/O

The new Quantum Micros I/O board takes the unique approach to the problems of interfacing your Nascom or Gemini Multiboard to external devices. This 80 Bus and Nasbus compatible card is supplied fully built, populated and tested and includes three Z80 PIOs, a CTC and a Real Time Clock with battery back-up. In addition, a range of "daughter" boards that attach straight to the I/O board are under development catering for a wide variety of interfacing requirements.

Quantum I/O board MicroValue price – **£140** + VAT

Prototyping daughter board MicroValue price – **£20** + VAT

IEEE-488

The EV Computers' IEEE-488 card is an 80 Bus and Nasbus compatible card designed to fully implement all IEEE-488 interface functions. This built and tested card gives the user a very cost effective and versatile method of controlling any equipment fitted with a standard IEEE-488 or GPIB interface.

MicroValue introductory price

£140 + VAT

MicroValue Exclusive

New Software for Nascom Systems

POLYDOS 1 A disk operating system for use with Nascom 1 or 2 and Gemini G805 Disk Systems. An incomparable and extremely well presented DOS that includes an editor and assembler and adds disk commands to the Nascom BASIC MicroValue price **£90** + **VAT**

MATHSPAK Double precision maths package on tape MicroValue price **£13** + **VAT**

MATHSPAK Handler Used in conjunction with MATHSPAK MicroValue price **£9.95** + **VAT**

Command Extender For use with MATHSPAK it extends BASIC's reserve word list MicroValue price **£9.95** + **VAT**

Logic Soft Relocater An integrated assembler and disassembler package which allows disassembly and reassembly from anywhere on the memory map MicroValue price **£13** + **VAT**

SAVE MORE MONEY

Standard Firmware for Nascom at Reduced prices

NASPEN	RRP £30	VAT	MicroValue price £20 + VAT
Nas-Sys 3	RRP £25	VAT	MicroValue price £20 + VAT
NasDis D-Bug (EPROM)	RRF £50	VAT	MicroValue price £30 + VAT
NasDis D-Bug (TAPE)	RRP £40	VAT	MicroValue price £20 + VAT
Imprint	RRP £30	VAT	MicroValue pnce £20 + VAT
Bits & PCs Prog Aid	£28	VAT	MicroValue pnce £20 + VAT

*MicroValue Warranty

All products, except kits and Nascom Imp. sold by MicroValue dealers are supplied with 12 months warranty and will be replaced or repaired by any dealer (even if you didn't buy it from him) in the group in the event of faulty manufacture.

YOUR LOCAL MICROVALUE DEALER

All the products on these two pages are available while stocks last from the MicroValue dealers listed on right (Mail order enquiries should telephone for delivery dates and post and packing costs.) Access and Barclaycard welcome

BITS & PC'S
4 Westgate, Wetherby, W. Yorks.
Tel: (0937) 63774.

ELECTROVALUE LTD.
700 Burnage Lane, Burnage, Manchester M19 1NA.
Tel: (061) 431 4866.

28 St Judes, Englefield Green, Egham, Surrey TW20 0HB.
Tel: (0784) 33603. Tlx: 264475.

SKYTRONICS,
2 North Road, The Park, Nottingham.
Tel: (0602) 45053/45215

TARGET ELECTRONICS
16 Cherry Lane, Bristol BS1 3NG.
Tel: (0272) 421196.

INTERFACE COMPONENTS LTD.
Oakfield Corner, Sycamore Road, Amersham, Bucks.
Tel: (02403) 22307. Tlx: 837788.

HENRY'S RADIO
404 Edgware Road, London W2.
Tel: (01) 402 6822.
Tlx: 262284 (quote ref: 1400).

LEEDS COMPUTER CENTRE,
62 The Balcony, Merrion Centre, Leeds.
Tel: (0532) 458877

MicroValue

MONEY SAVERS

with the exclusive MicroValue 12 Months Warranty*

MicroValue Exclusive

MV1 - a Z80 computer

SAVE £107.50

The MV1 computer kit uses the ubiquitous Nascom 1 Pcb and the Z80 CPU. Interfaces are included for television, printer and cassette. 2K memory, Gemini power supply (drives up to 3 extra boards). Cherry full ASCII keyboard and Quantum Graphics are also included. Available with either an ASCII version of the Nas-Sys 3 monitor, or a Tiny BASIC. MV1 is expandable to Gemini 80-BUS specification.

MicroValue price **£105** + VAT

MicroValue Exclusive

MicroValue's 'Nascom Special'

SAVE OVER £65

We've put together a microcomputer kit containing the Nascom 2, Nas-Sys 3, Graphics ROM, Bits & PC's programmers aid, Gemini 3 APSU, 16K RAM Board and mini motherboard. The result is a powerful micro using market proven boards and components.

RRP OVER £405 + VAT

£340 + VAT

MicroValue Exclusive

SHARP MZ80K with Super Graphics

SAVE £200!

The 48K RAM System is offered at a rock bottom price with the Quantum Micros Hi Res Graphics which gives resolution down to a single dot and high res. plotting. Characters are user definable and the pixel characters actually *join*. Five free games packages are included too!

RRP £645 + VAT

MicroValue price

£445 + VAT

SHARP

48K MZ 80K

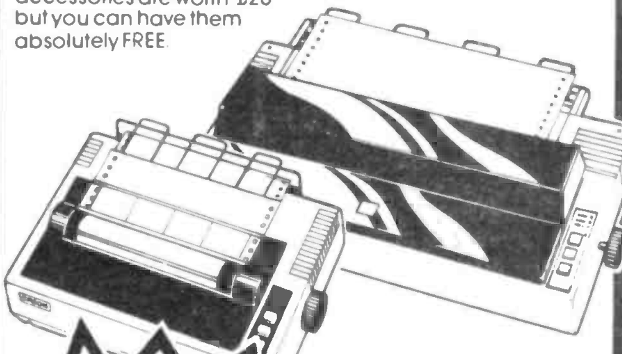
RRP £460 + VAT

MicroValue price **£345** + VAT

£30 worth of accessories FREE with every Epson Printer

	MicroValue price
Epson MX80T	£359 + VAT
Epson MX80FT1	£399 + VAT
Epson MX80FT2	£465 + VAT
Epson MX100	£575 + VAT

Buy one of the above Epsons from MicroValue and we'll give you a Pack of Fanfold paper, Interfacing Document and Connecting Cord for Multiboard or Nascom. The accessories are worth £20 but you can have them absolutely FREE.



Cheapest Printer in the UK!

Nascom IMP + Graphics Only £199 + VAT

SAVE £156

MicroValue has slashed the price of the 80cps, 80 column IMP dot matrix printer. And added Imprint's high res. graphics and double width character option. IMP has bi-directional printing and friction/tractor feed.

RRP £355 + VAT

MicroValue price

£199 + VAT

Subject to only 6 months' warranty

NASBUS Compatible DOUBLE DENSITY Disk System - Available Ex Stock

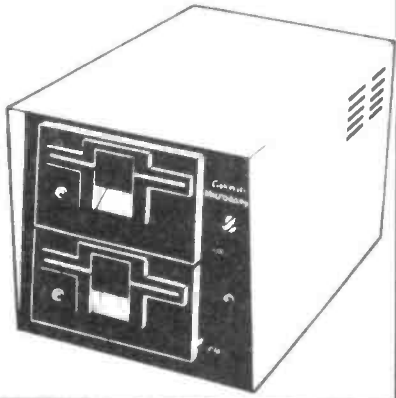
With hundreds in daily use the Gemini Disk system is now the standard for Nascom and Gemini Multiboard systems. Single or twin drive configurations are available, giving 350K storage per drive. The CP/M 2.2 package supplied supports on-screen editing with either the normal Nascom or Gemini IVC screens, parallel or serial printers, and auto single-double density selection. An optional alternative to CP/M is available for Nascom owners wishing to support existing software. Called POLYDOS 2 it includes an editor and assembler and extends the Nascom BASIC to include disk commands.

Single drive system (G809, G815/1)
£450 + VAT

Double drive system (G809, G815/2)
£675 + VAT

CP/M 2.2 package (G513)
£100 + VAT

Polydos 2
£90 + VAT



114 for further details.

G4JDT HARVEY

EAST LONDON HAM STORE

G8NKV DAVE

H. LEXTON LIMITED

191 FRANCIS ROAD LEYTON E.10
TEL 01-558 0854 TELEX 8953609 LEXTON G

RADIO & ELECTRONIC ENGINEERS — ENGINEERS ALWAYS AVAILABLE ON THE PREMISES

MAIN (UK) SERVICE CONTRACTOR TO HITACHI SALES (UK) LTD

EXCLUSIVE TO US IN THE UK. 1kW input 600W ssb 350FM 2MTR LINEAR!!

BUILT-IN POWER SUPPLY, ELECTRONIC WARM UP, VARIABLE INPUT ATTENUATOR. ADAPTS EXCITERS FROM 2W-25W. RADIAL BLOWER. LED's FOR READY, TX, OVERLOAD, PTT & RF VOX with VARIABLE DELAY CHOICE OF EIMAC TUBES. 4×150A OR 4C×250B OR 4C×250R. ELECTRONIC PLATE CURRENT FUSE – NO THERMAL DAMAGE OF P.A. TUBE POSSIBLE. SIZE: H.88mm, W.318mm, D.375mm. FROM £460.00.

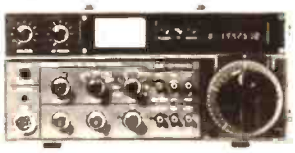
D 70C	70cms.	10W in – 200W out	£489
D 200S	2mtr.	1kW p.e.p. ssb. (600W FM)	£599
D 200	2mtr.	500W p.e.p. ssb. (350W FM)	£499
D 200C	2mtr.	1300W p.e.p. ssb. (150W FM)	£300

All these linears have adjustable inputs and outputs and they are all fully protected.
ALSO AVAILABLE:- 18db Gasfet masthead preamplifier which suits the output of these linears and which is also powered by them via the antenna co-ax.

ICOM ACCESSORIES

BP5 11V Pack	£30.50
BP4 Empty case for 6XAA	£ 5.80
BP3 STO Pack	£15.50
BP2 6V Pack	£22.00
BC3 Base Charger	£37.00
DC1 12V adaptor	£ 8.40
WM9 Mic speaker	£12.00
¼ wave 2E whip	£6.50
CP1 Mobile Charging load	£ 3.20
LC1/2/3 Cases	£ 3.50

ICOM MULTIMODES



IC251 2m	£495.00
IC451 70cm	£599.00
IC260 2m	£299.00
IC290 2m	£379.00

ICOM FM MOBILES PORTABLES

IC2E FM 2m £169.00
IC202 SSB £169.00
IC402 70cm £242.00
All accessories available – see below
IC25E
25W FM Mobile £259.00

ICOM 720A G/C

IC720A 200W	£889.00
PS15 Power Supply	£99.00
PS20 P/S with speaker	£125.00
IC730 200W	£586.00
IC2KL 500W linear	£883.00
IC2KLPS Power supply	£211.00

OUR CASH DISCOUNT TERMS ARE SECOND TO NONE

YAESU/SOMMERKAMP

FT1 Latest HF	£1295
FT9020M YAESU	P.O.A.
FT9020M SOKO	£935
Full Specification Model	
FT1012DFM	P.O.A.
FT1012DAM	P.O.A.
FT2772D SOKO	
FULL SPEC. A.M.	£671
FT2772D FM	
FULL SPEC. SOKO	£753
FT707 100W	£569
FC707 ATU	£85
FP707 PSU IN SPEAKER	£125
FTU707DM VFO	£203
FT707+FP707+FC707	
ALL IN PRICE	£720
FT767DX SOKO	P.O.A.

All accessories available for Yaesu/Sommerkamp

YAESU/SOMMERKAMP PORTABLES/MOBILES

FT 480R MULTIMODE VHF
FT 290R PORTABLE
FT 208R PORTABLE VHF
FT 708 PORTABLE UHF
+ACCESSORIES

JAYBEAM ANTENNAS

8Y 2M 8E Yagi	£14.50
10Y 2M 10E Yagi	£31.00
PBM 10/2M 10E Parabean	£36.80
5XY/2M x 5E Yagi	£22.75
8XY/2M x 8E Yagi	£28.40
X6/2M/X12/70cm 2MTR x 70cm x Yagi	£38.50

& MANY OTHERS!!

TRIO/KENWOOD

TS830S HF Transceiver	£680.00
TS130S HF Transceiver	£530.00
TR8400 UHF Mobile	£320.00
TR9500 UHF Multimode	£445.00
TR7800 VHF mobile	£268.00
TR7850 HP FM 2m	£310.00
TR7730 2m FM	£245.00
TR9000	£370.00

Many Trio/Kenwood accessories available

MICROWAVE MODULES

MMA 144V 2m preamp	£ 34.90
MML 144/25 RF amp	£ 59.00
MML 144/40	£ 77.00
MML 144/100S new with preamp	£129.95
MMT 432/144 2-70 transverter	£184.00
MMT 28/144 10m transv.	£ 99.00
(MM4000 RTTY with keyboard	£299.00)

STANDARD

C8800 2mtr mobile	£252.00
C7800 70cm mobile	£270.00
C78 70cm portable	£219.00
C58 2mtr portable	£239.00
CMB8 mobile mount C58/C78	£ 19.95
CPB58 2mtr 25W linear	£ 79.95
CPB78 70cm 10W linear	£ 67.50
CLC8 carry case C58/78	£ 6.95
C12/230 Charger	£ 7.75
ADONIS MICS IN STOCK	
202S Flexible neck with control box	£ 23.00

ROTATORS ETC

DIAWA	
DR7600X	£135.00
DR7600R	£144.00
DR7500R	£105.00
KENPRO KR250	£ 44.00
KR400RC	£ 90.80
HAM IV	£189.00
CHANNEL MASTER	£ 42.00
CN620 1-8 150MHz Pwr/swr	£ 52.00
CN2002 2-5kW PEP auto ATU	£190.00
AR40	£ 65.55
9502B	£ 50.00

CARRIAGE FREE!

SWAN/CUBIC

102BX 235W+PS5	£800.00
103BX WARC 235W	£1000.00
PS6 Power Supply	£145.00
150MX Digital	£561.00
15002 Linear	£406.00
ST2A ATU	TBA
ST3A ATU	TBA
HF Mobile ant	£80.00

CUSHCRAFT AMATEUR ANTENNA

HF. A3 20/15/10 3 ele beam 8bD	£165.00
ATV3 20, 15, 10 Trapped vertical	£38.30
ATV5 10.15.20.40.80 Trapped vertical	£83.69
214B 14 ele boomer 15.2db	£55.77
ARX 2 Ringo Ranger 6dB vertical	£27.86
CS100 Speaker	£12.50
A144-44 ele Yagi	£18.25
A144-77 ele Yagi	£22.82
A144-1111 ele Yagi	£28.94
ARX2B Ringo Mk11	£32.29
ARB2K Conversion kit RINGO Mkl to Ringo MkII	£14.18

FULL RANGE IN STOCK
SAE CATALOGUE
144 - 10T - Yagi / 144 - 20T - Yagi } OSCAR
For vertical and horizontal Oscar specials

SPECIAL OFFER!
10M-80M Trapped Vertical
KB105 £77.00

RECEIVERS ALL ON SPECIAL OFFER – P.O.A.

R1000	Kenwood
FRG7700	Yaesu
FRG7700	Memory
IC2001L	Sony
SEARCH II	2 metre

ALL POA ARE ON SPECIAL OFFER. PHONE HOT LINE ★ 01-556 1415 ★

Also in stock – D.N.T. range of CB Transceivers. Specialist in-car fitting service if required.

We offer FM Conversion to your ICOM IC720 or 720A and YAESU FT707 – please phone for details. *STOP PRESS! NOW ALSO FOR FT107 & 901.*

ALL ACCESSORIES AVAILABLE – PLUGS SKTS CO-AX 2MTR COLINEAR £31.50, 70CM COLINEAR £31.50

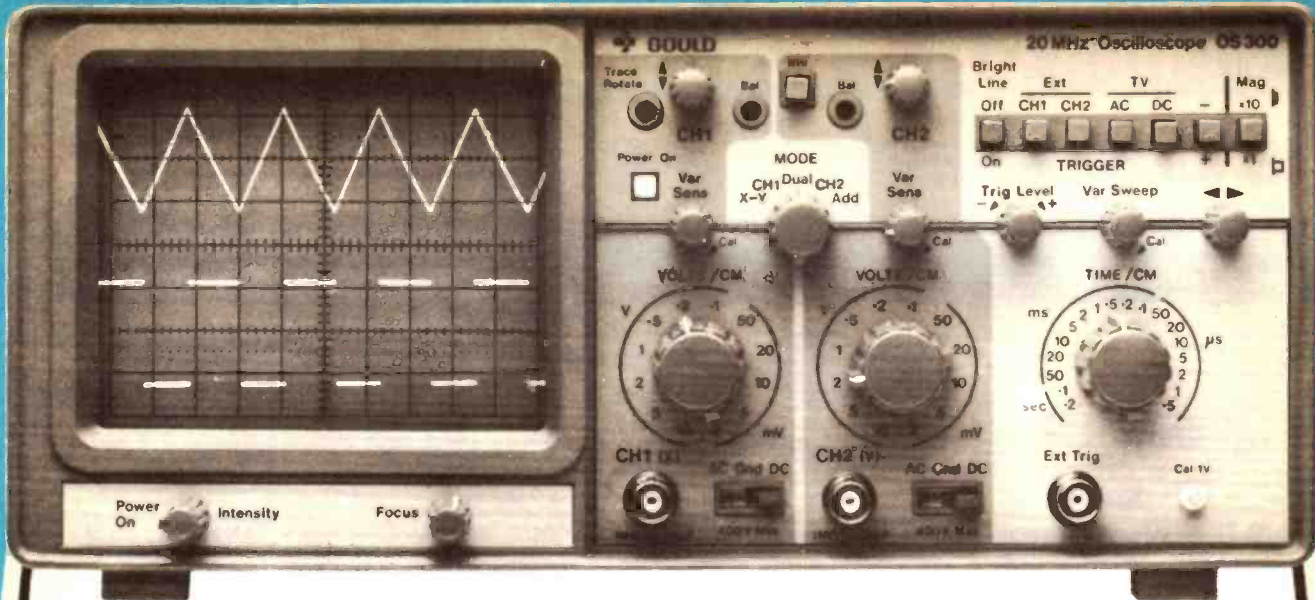
Access

PRICES INCLUDE VAT AT THE PRESENT RATE OF 15%
OPEN MON–FRIDAY 9:00–5.30. SATURDAY 10:00–3:00. INSTANT HP FACILITY AVAILABLE
EASY ACCESS M2–M11–M1 NORTH CIRCULAR ROAD–EASY PARKING

BARCLAYCARD VISA

99 for further details

GOULD OSCILLOSCOPES SET A HIGHER STANDARD



The new Gould OS300 Dual Trace 20MHz 'Scope

A tough, professional instrument you can trust – at a price you can afford! ★ Max. sensitivity 2mV/cm. ★ Stepped and continuously variable attenuator and timebase controls. ★ D.C. coupled triggering and "active" T.V. sync separator. ★ 'Add' and 'Invert' for differential measurements. ★ X-Y facility. Built to do more – safely, reliably and for longer.

Ask for our 8-page data sheet for full details and applications information.

GOULD
Electronics & Electrical Products

Gould Instruments Division
Roebuck Road, Hainault, Ilford, Essex IG6 3UE.
Telephone: 01-500 1000. Telex: 263785

10619

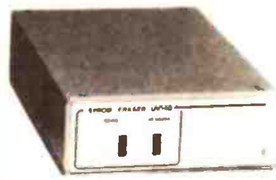
41 for further details

EP4000 EPROM EMULATOR PROGRAMMER

- •COPY/PROGRAMME/EMULATE 2704/2708/2716(3)/2508/2758/2516/2716/2532/2732 EPROMS
- •4k x 8 STATIC RAM
- •VIDEO O/P AND 8 DIGIT LED DISPLAY
- •EMULATES SIMPLY AT THE PUSH OF A KEY
- •POWERFUL EDITING FACILITIES
- •COMPREHENSIVE IN/OUT (RS232, TTL, 20MA LOOP, PARALLEL, DMA). AS STANDARD
- •2764 ADAPTOR NOW AVAILABLE
- •EP4000 EX-STOCK AT £545 + VAT + £12 DELIVERY.

P4000 EPROM PRODUCTION PROGRAMMER

- •PROGRAMME UP TO 8 EPROMS SIMULTANEOUSLY
- •COVERS SAME EPROMS AS EP4000
- •POWERED DOWN SOCKETS
- •INDEPENDENT BLANK CHECK/VERIFY/PROGRAM MODES
- •SIMPLE TO USE WITH MODE PASS/FAIL LEDS
- •EX-STOCK AT £545 + VAT + £12 DELIVERY



UV141 BENCH TOP
UV140 EPROM ERASERS

- •TWO UNITS WITH 14 EPROM CAPACITY
- •SAFETY INTERLOCKED
- •ELECTRONIC TIMER (UV141)
- •UV141 EX-STOCK AT £78 + VAT
- •UV140 EX-STOCK AT £61.50 + VAT

GP INDUSTRIAL ELECTRONICS LTD
UNIT 6, TOTNES INDUSTRIAL ESTATE
TOTNES, DEVON TQ9 5XL Tel: (0803) 863360 Telex: 42596

GP

28 for further details

EDITORIAL

It's getting bigger!

Have you noticed that this months edition of **R&EW** is bigger than previous issues? Not more expensive, mind you, but physically BIGGER. It's got sixteen extra pages, giving it a total of seventy-six editorial plus thirty-six ads pages, all for a mere 70 pence. And, you may care to notice, those extra pages are not provided simply on a 'one issue only' basis, but are intended to be a permanent feature of all future editions of the magazine.

How, you might wonder (politely stifling a yawn), can **R&EW** perform such miracles when most other 'electronics' journals are getting smaller and costing more? The answer to that burning question is all to do with reader responses and cash flows. Most of the profit from the magazine comes from subscription returns, kit and book sales and direct sales revenue. These profits are presently pretty good, and **R&EW**'s policy is to simply plough ALL profits straight back into the magazine until it reaches the '200 page super-mag' standard that we are aiming at. With your help, we may reach that standard within eighteen months, so let's see how you can influence 'our' progress.

Subscriptions

Subscription returns provide the magazine with a rock-solid financial base. Each time that we gain another thousand subscribers, we can afford to add another couple of pages to the magazine. So, if you want to have a really big influence on the way that **R&EW** grows, take out a subscription. Details are given on page 73.

Readers gain a lot by becoming subscribers. They have the magazine delivered to their door every month, at a price that is inflation-proofed for a full year. They get preferential treatment through the reader's enquiry service, and are eligible for membership of 'Data Club', and are entitled to special discounts on many of our catalogue items. It's a good deal for the subscriber, good business for us, and good news for all **R&EW** readers.

Books and Kits

Radio & Electronics World gets a lot of its working revenue from the sales of books and 'project packs'. Our book service is intended to complement the contents of **R&EW**, by providing in-depth coverage of specialised subjects. Our constantly expanding book range is carefully selected and vetted, and is actually stocked at our offices. We are pleased to be able to say that order processing and despatch is running very smoothly.

'Project Packs' are a mixture of good and bad news. **R&EW** projects are being received with even greater enthusiasm than expected, and the huge extra work volume brought about by the demand for our kits has, frankly, knocked us sideways. The situation was not helped by the usual seasonal pile-ups around Christmas time, nor by the failure of one of our Oriental suppliers to meet his contractual obligations.

Customer satisfaction with the service was, until very recently, running at 97%, a very poor figure. Users of the service will thus be pleased to know that this part of the business is now being re-organized: Customer satisfaction should be virtually 100% by the time you read this (if it is not, write directly to yours truly, with full details, and the Dr Martins' will be duly swung.

Our computer printouts show that 1.43% of our total readership is now using our books/kits service. As already mentioned, profits from the service are presently ploughed back into the magazine, helping to consistently improve the quality (and size) of the journal.

Direct sales

R&EW carries a far heavier financial 'overhead' burden than any other electronics magazine, due to the high cost of our laboratory facilities (three times higher than our nearest competitor) and rather high production costs. Consequently, we actually show a financial loss on the present direct sales figure (we need direct sales of 55 000 to break even), so the magazine is effectively subsidised by the books/kits and subscription services.

The 'break even' figure of 55 000 copies probably needs a bit more explaining. It is the figure at which the revenue from direct sales and advertising will balance our total expenses at our NEW 'plus sixteen pages' size, and will be the point at which we will add ANOTHER sixteen pages to the magazine! We'll stay in that vicious circle until we reach our '200 page super-mag' target size!

How can you help us reach that target figure? Simply make sure that all your friends and associates know about **R&EW**, and encourage them to buy it rather than just photocopy the best bits (which is naughty anyway).

Reader Response Cards

The results of ALL returned reader response cards are computer processed, giving us a precise monthly analysis of your 'ratings' of the features in each issue: This information is used in planning future editions. Readers do not like articles that are written in long-winded, rambling or "I'm-the-author-and-aren't-I-wonderful" styles (we've published a couple of those). They don't want constructional articles that run on for several months, are not keen on super-heavy projects, and feel insulted when project write-ups give excessively detailed constructional information.

Readers seemingly prefer medium-cost projects that are fully described in a single issue, love occasional 'quickie' projects, and like projects to be cost-effective when compared to their commercial equivalents. Above all, readers seem to like state-of-the-art 'information' and 'application' features such as Data Brief and PLL Frequency Synthesis, etc.

So, one final way you can influence the future of Radio & Electronics World, at zero cost to yourself, is to occasionally complete our 'response' card and send it to us. And if you feel like adding a few scathing comments, go ahead, but keep them clean and constructive.

Ray Marston.

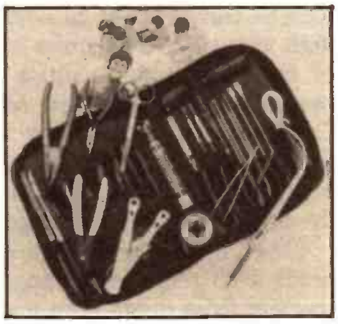
NEW PRODUCTS

Tool Wallets

£13.50 inc VAT and postage buys you the ideal assortment of small handtools to tuck away for the inevitable time when you find that someone has raided all the useful items from you 'big' toolkit. Included are:
Snipe nose pliers, side cutters, a pair of pozidrive-type cross head screwdrivers with 00 and 0 tips, and standard blade screwdrivers with 1/8" and 3/32" tips, and a pair of stainless steel tweezers ideal for 'heatsinking' delicate components during soldering.

£35.59 inc., buys a complete serviceman's selection, including soldering iron, desolder braid, pliers, cutters, strippers, craft knife, adjusting tools - most of the things you need to fix the average electronic consumer product, barring the universal 5 pound lump hammer.

£1 sent to *Toolmail, Parkwood Industrial Estate, Sutton Road, Maidstone, Kent, ME15 9LZ* will bring you the complete catalogue which contains a very wide range of standard tools for DIY and craft hobbies.



CMOS 8 bit MCU

Hitachi have released details of their new HD6301, which is fully upwards code compatible with the HD6801 (all the 6801 instructions plus some extras), and provides 4k of ROM, 128 bytes of RAM, 29 I/O lines, a 16 bit timer and serial communications interface on-chip.

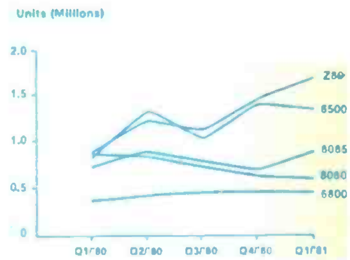
The delights of CMOS are apparent in the wide voltage range (3-7V), and power consumption of 30 mA (active), 3 mA (sleep -leaving timing and SCI going), and 0.3 mA (power down).

4 bit CMOS micros have been nearly monopolized by the Japanese for some time now, so it now looks as if 8 bit MPUs are under siege. Details from: *Hitachi Uk Ltd., Hitec House, 221-223 Station Road, Harrow, Middlesex, HA1 5EX.*

Z80 Sales

The attached graph shows the results of a recent Dataquest survey on 8-bit micros. The versatility of the Z80 processor (which R&EW will again demonstrate next month, in our MSF time code receiver system) has led to sales exceeding 1.7 million units in the first quarter of 1981.

Of this, Zilog have a 65% share, nearly four times that of the next nearest source.



CW crib for TRS80

Helping to undermine the utility of the morse test for HF radio amateurs yet again, MFJ Enterprises now offer a complete morse transceiver package for minimum 16 K Model I and III TRS80 (and Video Genie) users. The system enables the screen to display received messages, together with the contents of the transmit buffer, and the ten programmable message index. 3295 characters of text buffering are available. Speed adjusts from 12 WPM to 55 WPM (automatic selection up to 100 WPM on receive).

All interface parts are supplied, and no modifications to either rig or computer are required. The interface features an ANL, 5 pole active bandpass filter, lowpass post-detection filter and a tracking comparator. On the transmit side, the interface will key virtually any transmitter.

The programme is supplied on cassette, and is disk compatible. Priced at US $99.95, plus $4 (US domestic) shipping and handling, the UK shipping charge will probably be around $15. Futher details from: *MFJ Enterprises, P O Box 494, Starkville, Mississippi MS39762, USA.*

RFI-shield coating

Aptly named RFI Shielding Ltd., have introduced a new acrylic coating material which can be applied to non-conductive materials to provide them with RF integrity and anti static properties. Conductocoat 981 is a liquid that can be painted, sprayed, dip coated or roller coated.

When applied to wood or plastic at a thickness of 0.05mm, surface resistivity drops to 0.5 ohms per square (a non-dimensional system whereby resistivity is specified) -causing 30 dB or better shielding up to 30 MHz, and 60 dB on up to 1 GHz. Additional coats do not affect performance, and may harm physical characteristics. Room temperature or oven curing is permissable.

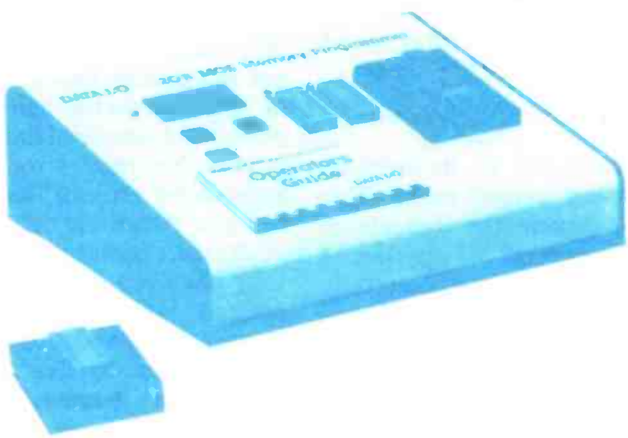
It is available in tins ranging from 25 litres to a 'sampler' size of 250ml. The price works out at around £5 per litre at the 5 litre level - and you can have any colour you like - so long as it's black. *RFI Shielding, Warner Drive, Springwood Industrial Estate, Rayne Road, Braintree, Essex. CM7 7YW.*

PROM Programmer

Microsystem Services of High Wycombe have introduced the Model 20B NMOS PROM programmer, which also handles most of the Intel microprocessors that have on board EPROM. A master EPROM can be used as the basis for copying, or data can be downloaded into RAM via an RS232 communication facility at between 110 and 9600 baud. There are 6 data formats available to suit most development systems and peripherals. Various fail-safe and self-checking modes keep the programmer under control.

Microsystem Services have also published a very useful cross reference chart for PROM and logic array programming. The chart is used to select the correct 'personality' module, socket adapters etc. for each particular device to be programmed on the PROM programmers supplied by Microsystem Services.

The chart lists the array size and organization of the device, the technology, pin count, type numbes etc - and is available free from. *Microsystem Services, Duke Street, High Wycombe, Bucks.*

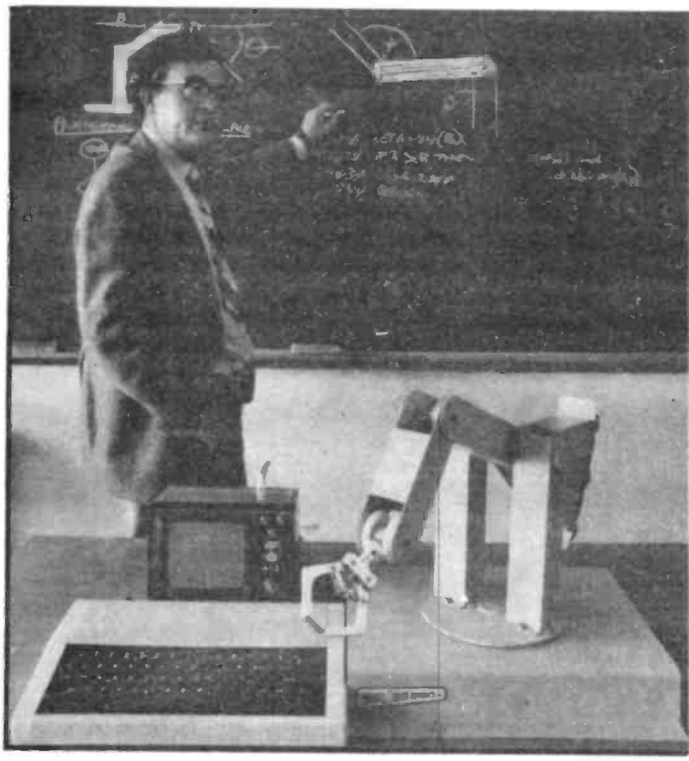


Log Periodic Antenna

Watkins Johnson's new WJ-8344 log periodic 1.0 to 18.0 GHz antenna should put the finishing touches to any misconceptions that you might have had about the theory of log periodic antennas *(see photos)*. However, the device is not a single element placed along the middle of a cheese wedge of 'log period antenna material' - but closer examination of the photo reveals printed elements lurking in the surface in a typical log periodic manner.

VSWR is 2.5:1 over the band, and gain ranges from 5 dB to 8 dB depending on frequency. The antenna weighs less than 4 ounces, and is suited to applications including surveillance, RFI, and point-to-point communications. *Watkins-Johnson UK Ltd., Shirley Ave., Windsor, Berks.*

NEW PRODUCTS



Robot Arm

Sands-Whitely Research have announced a 'pick-and-place' mechanism known as the Small Arm Robot. As you can see from the picture, the arm is very much aimed at the educational and instructional user, where the more enlightened institutions should find the price of £500'ish + VAT is acceptable.

The arm has a reach of 0.45m, and can lift 250gm in the 25mm 'jaws'. The arm will pivot through 360 degrees, with shoulder and elbow movement of 180 degrees. Control is achieved down a Centronics 8 bit parallel bus, using the specially designed interface card supplied in the unit. As well as all the 'usual' small computers, the arm can be interfaced to the **R&EW** Z-8 controller MCU, and we hope to report on this in due course. *Sands-Whitely Research and Development Ltd, Cambridge Road, Orwell, Royston, Herts.*

Power MOSFET

Hitachi presents the 2SK351 for switching applications (80nS) involving lots of volts. AC line voltages of more than 200v are specifically mentioned. The device is described as a 125 W, 800 V, 5 A MOSFET.

The high voltage was achieved by computer-aided structural analysis to yield the optimum uniformity of electric field distribution throughout the chip. Let's hope that these devices are more readily available than the 2SK318 100 W VHF power MOSFETs we ordered a while ago....

Further details from: *Hitachi UK Ltd., Hitec House, 221-223 Station road, Harrow, Middlesex HA1 5EX*

8 bit MPU + EPROM

Latest offering in the combined MPU and EPROM stakes comes from Motorola. The MC68705U3 comprises: CPU, clock, 3776 bytes of EPROM, 112 bytes of RAM, bootstrap ROM, 24 lines of I/O, and an 8 bit timer with 7 bit prescaler, plus zero crossing detection on interrupt input. The device emulates the CM6805U2.

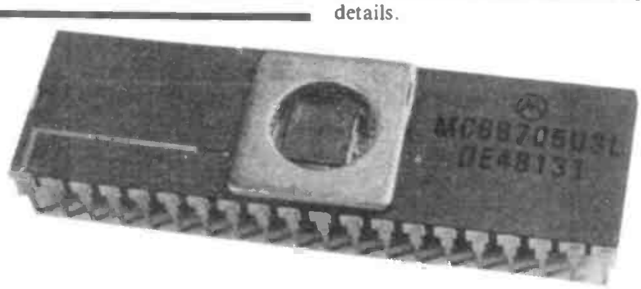
The Domestic price is around £40 in 1000's, get in touch with your local Motorola distributor for details.

Sharp hand-held computer

Sharp's PC-1500 hand-held computer contains a 16 K BASIC and 3.5 K of CMOS RAM, with the option of another 4 K bytes for an extra £70. Thirty-six square millimetres of silicon contain the custom CMOS 8-bit processor and display controller. A 770 nS cycle time ensures higher-than-average speed of execution, enabling the software to be expanded to handle 2-letter variables and two dimensional arrays. A real-time clock is built in, and can be used in programmes.

String variables, Boolean operations, a real typewriter layout QWERTY keyboard, numeric keypad, tri-function keys and a host of other functions makes the asking price (in Japan) of £277 look very reasonable.

The optional £231 printer is a drum X-Y plotter, with red, green and blue ballpoint. It should be available in the UK by the time you read this, although the price was not available at the time of asking.



Video Disc System

Sharp Corp. of Japan - who owe their name to the ever-sharp pencil that started the firm - have taken writing technology a stage further with their new video disk system that is capable of writing using the thermomagnetic effect. The recording medium is a terbium-dysprosium-iron 5" disk (similar to a standard floppy), with a claimed capacity of 200 M bytes.

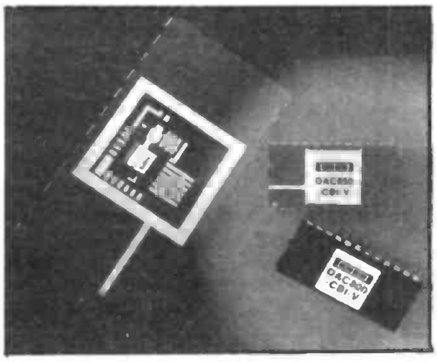
The estimated time of implementation of this new technology is given as 'within two years' -although the consumer implications of the process are yet to be explored.

NEWS

MC74HC let loose

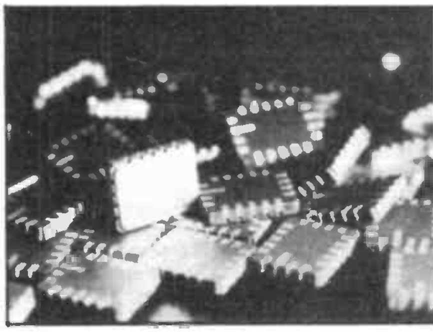
Following hard on the heels of National, Motorola are now regaling all who ask with their literature on the new family of high speed CMOS devices. The introduction schedule shows some interesting devices for the first quarter of '82, including the 74HC-74, -165, -373, -374, -4020, -4040, -4060, -4511, -4543 and many others - which might just be available by the time you read this. Contact National and/or Motorola sources for details.

DAC corner



Burr-Brown have announced two new 12 bit DACs covering the industrial (DAC850) and military (DAC851) temperature range. The maximum linearity error is E/—0.5 LSB, with guaranteed monotonicity. Both voltage and current output versions are available. Settling time for the current output versions is under 40nSec.

National Semiconductor also pitch in with some new 12 bit DACs in the DAC1285A series - this time featuring 300nSec current mode settling times. Various temperature ranges are catered for, 0.5 LSB error etc.



Leadless Wonders

Celdis advise us that they can now supply MOSTEK leadless chip carrier ROMs, RAMs and EPROMs. For those of you with the necessary machinery to develop and use these devices, the uniform chip carrier packages permit higher density layouts, and higher operating speeds as a result of the reduced lead lengths.

Bigger and better

Charles River Data Systems of Natick, Mass., USA have announced what they claim is the world's first 32 bit super micro, based on the 68000, and running UNIX compatible UNOS. Billed as a PDP11 and Nova eater, the Universe 68 computer is a multi user, multi processing system with 16M-byte address capability, and support for up to 34 users (initially).

The basic 68/10 system sports serial ports, one parallel port, 256k-bytes of main memory, 8M-byte Winchester and floppy backup. $18 500 puts you in line for one. The 68/80 comes with a few extras, and an 80M-byte cartridge disk drive for $38 500. Board set configurations are also available.

IBM PC - "Alive and Well"

After the flurry of excitement at the introduction of the 16 bit IBM personal computer in the USA, UK readers might be forgiven for wondering whatever happened. After all, IBM UK are remaining utterly uncommittal on UK introduction schedules.

However, US interest is booming, and other small/personal computer suppliers are reported to be getting just a shade jittery.

For whom the cash register tolls

Chubb Cash, whose UK manufacturing operations have all but ceased, now report they are trading profitably with a range of machines built in Japan - to their exclusive design. UK manufacturing fell into something of a classical high technology trap, when their advanced design called for products based on technology that was not fully 'productionized'. Ah so.

Licensed to print money

Thomas De La Rue Ltd, who are literally licensed to print money for the UK and many overseas governments, have recently acquired Rockwell International's Printrak product range. The current range is based on computerized recognition of human fingerprints, and there is some speculation if this system cannot be fairly readily adapted for banknote forgery detection.

One size suits all

Micro Data Systems (apparently another member of the Thurlby fold) offer the exceptionally compact D350 autoranging 3.5 digit multimeter for just £69 + VAT. This ICM7106 beater uses a single 64 pin CMOS flatpack device that does everything but put the cat out and operate the 20A shunt.

Ken's finger in the dyke

Ubiquitous Minister for Information Technology, Kenneth Baker, has announced a government sponsored scheme to set up Information Technology Centres (ITECs) to be operated jointly under the control of the DoI and Manpower Services Commission. The scheme is intended to help ease the accute embarrassment of the government over youth unemployment statics, and help provide some production line fodder for the electronics industry.

Sponsorship ("active participation, not just cash") from local industry is also being sought, which some industrialists regard as a bit of cheek when the state educational system itself is largely to blame for the paucity of trained personnel in this field. One of the first centres is scheduled for Dundee, where both Timex and NCR are poised to provide employment for successful trainees.

Editorial Note. Since the appointment of Kenneth Baker to the specially created post of MIT, there has been a flurry of activity in government circles to try and help resuscitate the electronics business outside the cosier 'recognized' circles of aerospace and defence. Whilst those who accuse the government of 'too little, too late' are condemned as churlish and ungrateful, secondary education facilities in the UK still lag well behind most of Europe and the Western World.

SEMICONDUCTOR NEWS.

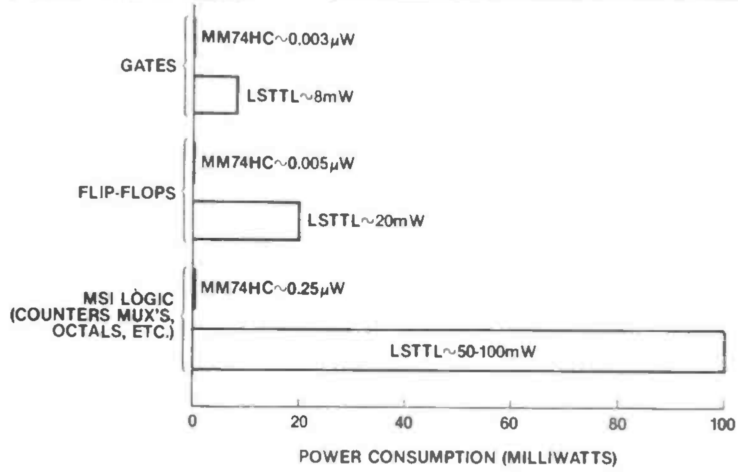


Figure 3a: System power vs frequency, MM74HC vs LSTTL.

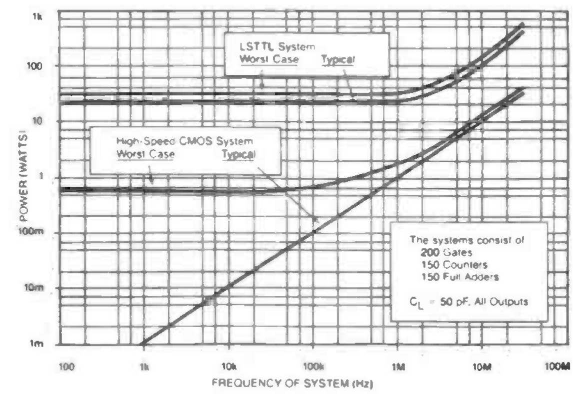


Figure 3b: Highspeed CMOS (HCMOS) vs LSTTL quiescent power consumption.

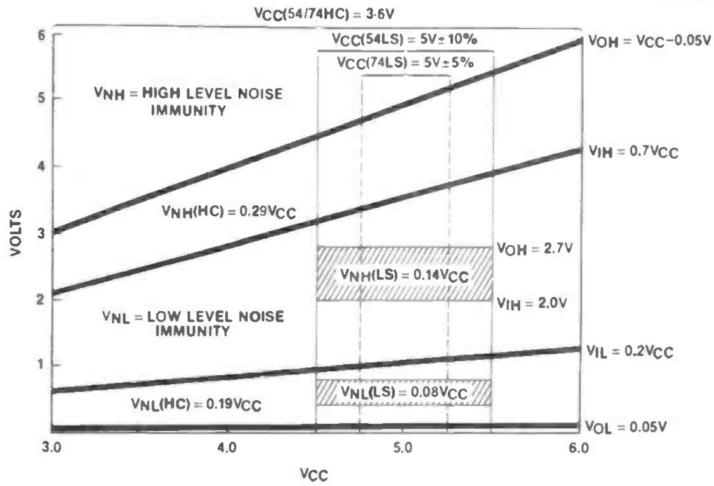


Figure 4: Comparison of MM74HC and LS input and output voltages and power supply range.

spurious triggering due to the difficulty of decoupling in the right places is one of the main features of debugging the first hardware. Not only does 74HCMOS have a higher impedance supply (ie less capacitance required to decouple the glitches) - the noise immunity *(Fig4)* is far better anyway.

In other words, if the gate is buried deep inside an array there is far less chance of noise propagated down the power line from adjacent switching actions and causing spurious operation.

You've got to admire their source.

Figure 5a illustrates an interesting comparison of the current source and sink capabilities of 74HCMOS. It's looking worse for LPS all the time. *Fig 5b* gives the output sink characteristics all the way down to zero output voltage (ie outside the acceptable logic levels), and *Fig 5c* illustrates the superior source capability of 74HCMOS.

74HCMOS is not designed to be driven directly from TTL. The reasons are primarily loss of noise immunity (by a factor of 2-3 times), and the additional power consumed in the buffer stage - together with speed degradation from the additional logic. And most significantly - the 74HC family will be a complete family, and not simply a few selected functions. In fact, both National and Motorola are aiming to have over 100 parts on offer by the end of 1982 - so who needs TTL drive compatibility? Maybe there's also a little bit of arm twisting in there somewhere....

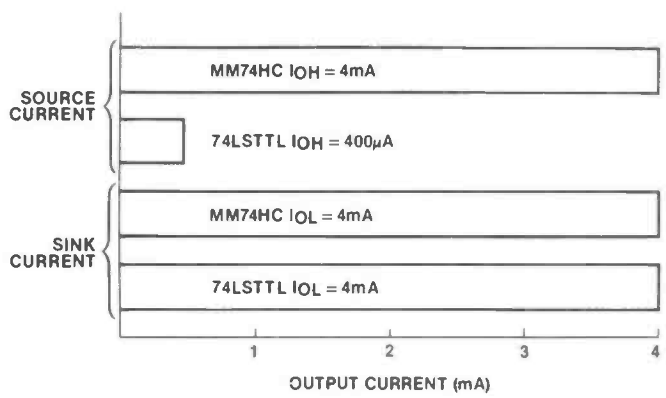


Figure 5a: Comparison of MM74HC and LSTTL specified standard output currents (V_{CC} = 4.5 to 5.5 V).

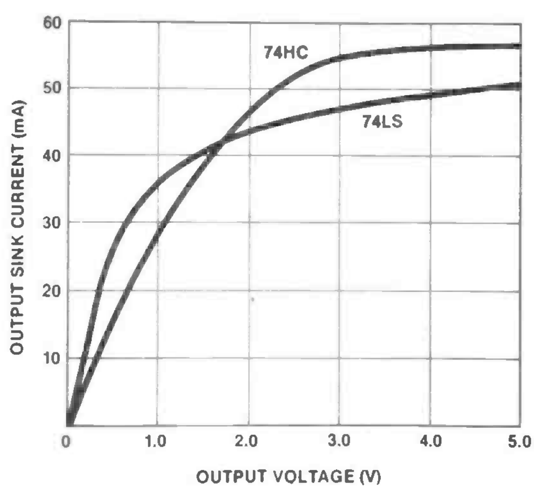


Figure 5b: Output sink current vs output voltage for 74HC and 74LS.

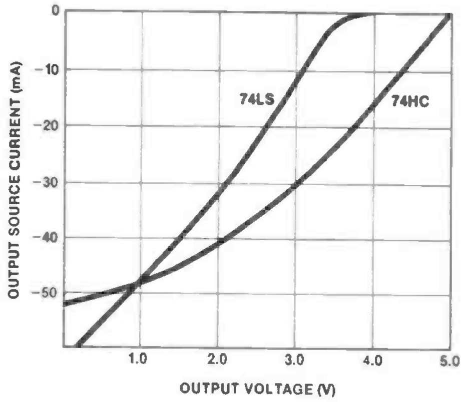


Figure 5c: Output source current vs output voltage for 74HC and 74LS.

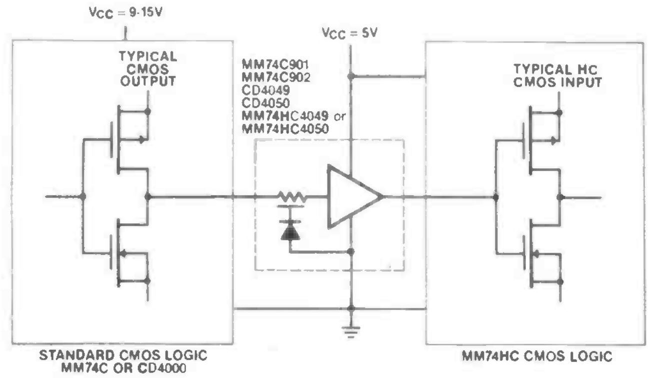


Figure 6a: Interfacing high voltage CD4000 or 74C to 74HC.

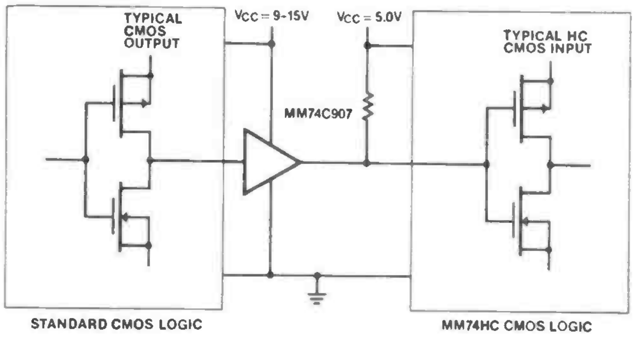


Figure 6b: Interfacing higher voltage CD4000 or 74C to 74HC.

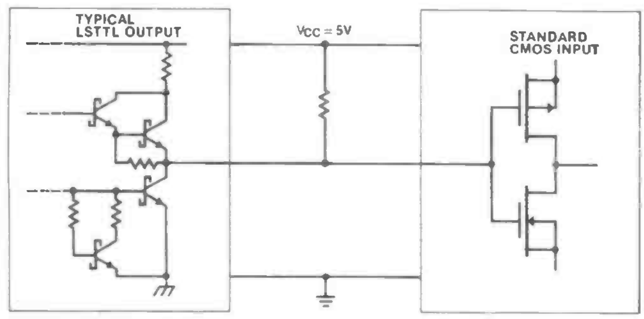


Figure 6c: Interfacing LSTTL outputs to standard CMOS inputs using a pull-up resistor.

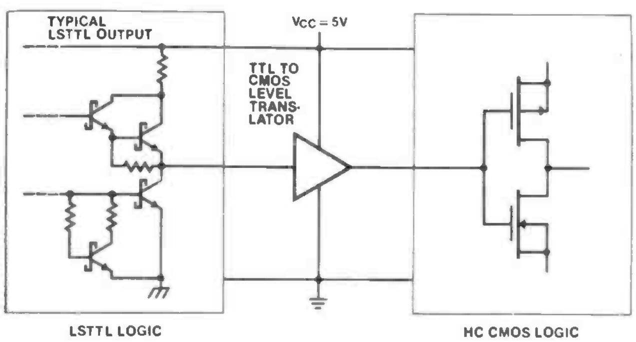


Figure 6d: Interfacing LSTTL outputs to HC CMOS logic inputs.

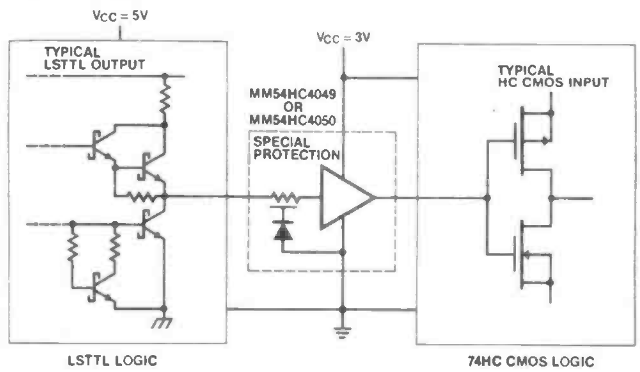


Figure 6e: LSTTL to CMOS down conversion using MM54HC4049 and MM54HC4050.

The possible input interface options are listed in *Fig 6a-e*. Remember that 74HC drives LS directly.

A Word from Motorola.

Motorola seem just a shade irked at National's pre-emptive strike with their grand 74HC launch. After all, the second sourcing agreement that they have with National is at a profound level indeed. No 'photocopies' here - but a direct exchange of digital plotter information for the fabrication of masks.

Motorola appear to have their design centre in Austin (Texas) for this particular range, although there is very heavy involvement with their UK factory in Scotland. Motorola aims to be turning out designs around twice as fast as National in the first year - although both sources should be offering parts simultaneously.

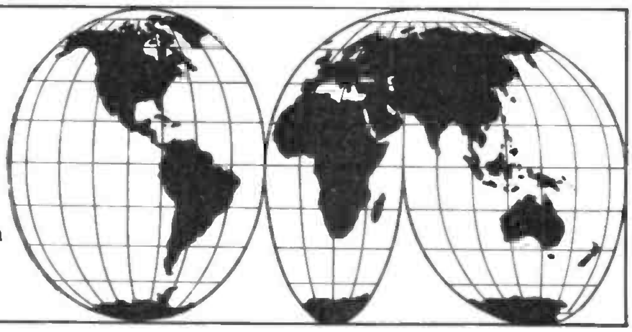
One project engineer was very enthusiastic about the project, with tales of typical speeds well in excess of the minimum on the spec sheet. Like National, Motorola see this new family overtaking LPS TTL sooner rather than later.

Like National again, there was a good deal of stalling on the question of pricing. But since these devices are being made on the most modern lines with 5" wafers - with a die size a good deal smaller than standard LPS and CMOS, it must be concluded that there is a considerable cost saving for the manufacturer.

National hinted that introductory pricing would be around 15% higher than LPS - which seems fair enough in view of the system savings, and the fact that a good deal of money has been spent in establishing the technology. In view of the built-in ability of 74HC to slash prices when the time is right, manufacturers of LPS - and the newer versions, such as Fairchild's FAST, and Texas' ALS - must be viewing the whole situation with a certain amount of alarm. ■ R & EW

Your Reactions.........	Circle No.
Immediately Applicable	282
Useful & Informative	283
Not Applicable	284
Comments	285

SHORT WAVE NEWS FOR DX LISTENERS



Frank A. Baldwin

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

China

Radio Peking on **10245** at 2039, Chinese classical music in Domestic Service 1, scheduled on this channel from 2000 to 2400.

Radio Peking on **4883** at 1530, YL with announcements and songs in the Russian programme radiated from 1500 to 1600. The Foreign Service in Mongolian is timed on this frequency from 1400 to 1455.

Radio Peking on **9440** at 2036, OM with a newscast of world affairs during the English programme directed to North and West Africa and scheduled from 2030 to 2130.

Radio Peking on **7935** at 2039, Chinese music in typical style in Domestic Service on this frequency from 2000 to 0110.

Radio Peking on **4905** at 1530, Chinese orchestral music, YL announcer in Domestic Service 1, on this channel from 2000 to 2300 and from 1100 to 1735.

Nei Menggu PBS on 7300 at 1405, OM and YL with sound effects - presumably a drama -interspersed with short bursts of local-type music (Nei Menggu equals Inner Monglia). Schedule on this channel unknown but probably closes around 1530, other channels being timed from 2130 to 0540 and from 0930 to 1530 (Saturdays and Sundays until 1550).

Yunnan PBS (People's Broadcasting Station) Kunming on **4760**, Chinese orchestral music, YL announcer. This transmitter is scheduled from 2150 to 0100 and from 0250 to 0600 (Tuesdays and Saturdays to 0800).

Urumqi, Xinjiang on **4735** at 1530, YL in vernacular - the Uigher programme is scheduled at this time. Transmission times are from 2300 to 0320, 0330 to 0700 and from 1045 to 1730.

Tibet

Xizang (Lhasa) on **4750** at 0031, OM with a talk in either Chinese or Tibetan - I couldn't tell the difference!

AROUND THE DIAL

For those who tune around the dial or slide along the scales or just simply watch the changing digits, the following stations may be of some interest - or at least some of them. Why not adjust the receiver to:

South Africa

Johannesburg on **25790** at 1306, OM with a programme entitled "Roundabout", all about South African sporting events and results in the English programme intended for Central, East and West Africa, Europe and the Middle East and scheduled from 1300 through to 1600.

I never did get to Jo'burg but I graced my presence on Durban for a while and spent many 'tickeys' (similar to the old 6d piece) visiting the hinterland Zulu kraals -especially those in the Valley of a Thousand Hills. Apart from feeding the wild monkeys with bananas, smoking the local brand of cigarettes was the main occupation. Officially termed 'Cape to Cairo' they were commonly called 'Camel to Consumer' but I found them excellent cigarettes - whatever the origin!

Finland

Helsinki on **11755** at 1941, OM (Old Man equals male announcer) with the English programme for Europe, it was all about the Finnish presidential election procedure and very interesting at that - it really is surprising just how much information one can acquire by listening on the short waves. I had thought about applying for membership of the College of Useless Knowledge but on second thoughts would find myself disqualified for retaining some that is useful.

Libya

Tripoli on **17930** at 1954, OM in Arabic with a talk about world affairs from their viewpoint. Also logged on a different occasion at 2003 when a speech was constantly interrupted by shouts of "Arabia, Arabia" from the audience. When I was in Libya...

Vatican City

Vatican on **9645** at 2045, OM with station identification at the end of the English programme beamed to the UK and Eire and timed from 2030 to 2045 on this frequency.

Spain

Madrid on **9765** at 2049, OM with a programme all about a furniture exhibition held in Valencia. All this in the English programme for the UK and Europe and radiated from 2010 to 2110. The address is Radio Exterior de Espana, PO Box 150.039, Madrid 24.

East Germany

"Radio Berlin International", Berlin on **7185** at 1820, OM with the English programme forEurope, scheduled from 1815 to 1900, during which we - Sooty the cat and I - heard all about current rural life in the GDR.

Grenada

"Radio Free Grenada" on **15105** at 2107, OM with a talk in English followed by a programme of local pops in the English programme for the UK and Europe, being scheduled from 1945 to 2115. Off at 2115 after announcements and the address (PO Box 34, Morne Rouge, St George's, Grenada) and without any National Anthem.

Australia

Melbourne on **11905** at 2159, 'Waltzing Matilda', station identification and announcements in English at the commencement of the (announced) Indonesian programme for South and South East Asia.

Melbourne on **17795** at 1932, a programme of recorded pops with announcements in English in a programme for the Pacific Area scheduled from 1800 to 2400 on this frequency and just audible via the short route Asia and the USSR.

Melbourne on **11820** at 0708, a programme of recorded UK pops then the announcement in English "... Papua and New Guinea Service" at 0710. This is the English Service to Papua/New Guinea and the Pacific Islands, scheduled from 0700 to 0845 on this channel.

Melbourne on **9570** at 0720, OM and YL with news comment - all about the anti-piracy patrols in the Gulf of Siam where apparently the pirates prey on the Vietnamese refugee boat people. The English programme for Europe on this frequency is timed from 0700 to 0900.

In response to a reader request, I recently conducted a survey of the Radio Australia channels from 0658 through to 0758. On this particular Sunday morning the following results were obtained.

Melbourne on **11740** at 0658, OM announcements, time-check, 0600 YL with newscast, a good signal on a reasonably clear channel; on **9570** at 0612, OM with news commentary, good clear signal on a clear frequency - this one is favourite if you want to listen to Australia; **15240** at 0604, YL with the news, poor channel and almost useless unless you have a 1.2 kHz selectivity position - and even then it is not so good; **17725** and **17870** at 0610 are both useless; **21680** at 0758, OM with announcements, time-check at 0800 and a newscast on a very good channel at this time; **15115** YL with news just audible at 0802; **11725, 17870** and **15230** all checked as useless for UK reception at this time. According to their schedule, all of these channels are in use at the stated times but they could well have been modified between the printing of the schedule and the above survey. Conclusion - go for **9570** or **21680**.

George Hewlett of Torquay, an old timer SWL and an official monitor for Radio Australia reminds me that good pointers to possible reception of Melbourne are the Australian time and frequency transmissions, these being VNG on **4500, 7500** and **12000**. George informs me that the **12000** transmission is audible nearly every day in spite of a Russian station on the same channel, although all I could hear around 1100 one morning was the USSR station. Also according to GH the **7500** channel can be heard in the mornings but can suffer from CW (Morse) interference. The **4500** frequency is mainly an evening reception possibility but also sometimes in the mornings, in which case it can serve as a guide to logging VLM4 Brisbane on **4920** (schedule 1900 to 1402 with a power of 10 kW).

United Arab Emirates

Dubai on **17710** at 1947, Arabic music, YL with song in Arabic in the External Service to Europe and Africa, scheduled from 1730 to 2050 on this channel and in parallel on **15320** and on **17865**. The best channel is **17710**. Also logged on **21700** at 1048, OM in English with a programme all about the seasons and weather in the surrounding desert in the English transmission timed from 1000 to 1050. A programme in Arabic followed at 1051, all this being the English/Arabic Service scheduled from 0415 to 1700. The announced address for reports was given as Dubai Radio, PO Box 1695, Dubai. If you have never sailed up the Persian Gulf past Dubai and the coast of the UAE then you have been lucky - much of me trickled over the side from the pools of perspiration at my feet -the SS Takliwa did not boast of an air-conditioning system! And as for the Shatt-al-Arab...

Japan

Tokyo on **21610** at 0800, OM with the station identification and a newscast all about local events -including details of trade between Japan and the EEC. All in the English programme for Europe and scheduled from 0800 to 0830.

Philippines

AFRTS (American Forces Radio and TV Service) Tinang on **2600** at 1249, OM with a talk in English about the American recession, the schedule being from 0800 to 1700 and from 2130 to 0330, the power being just 35 kW.

New Zealand

Wellington on **15485** at 0750, of all things "The Archers" - it seems the Pacific Area is also involved in the goings-on at Ambridge - which is why I have mentioned this station and this channel in two issues running. As fellow sufferers I thought you might be interested!

USA

VOA (Voice of America) Greenville on **15205** at 1918, OM with a review of current economic events in the USA and their probable results in the English programme for the Middle East, scheduled from 1500 to 2200 on this channel.

India

AIR (All India Radio) Delhi on **9665** at 2012, OM with a news commentary in the English programme for North and West Africa, the UK and West Europe, scheduled from 1945 to 2045 to these target areas.

AIR Delhi on **3365** at 1625, when radiating a programme of Indian music, albeit through a mass of commercial interference but nevertheless identifiable - just!

AIR Delhi on **17875** at 1040, YL with songs in Hindi and some local-style music in the English (confusing isn't it) programme for North East Asia and Australasia, timed from 1000 to 1100.

AIR Hyderabad on **4800** at 1606, local-style music and songs in the schedule 0025 to 0215, 1200 to 1740 (variable to 1840 at times) with English newscasts at 1230 and 1530. The power is 10 kW, this being a Regional transmitter with programmes for local consumption.

For reports on the **9665** and **17875** transmissions the address is The Director, External Services Division, All India Radio, PO Box 500, New Delhi.

Vietnam

Hanoi on **6426** at 2107, OM and YL with the Chinese programme for the Far East, scheduled from 2100 to 2200. If you are interested, the English programme for Europe may be heard on **15010** from 2030 to 2130.

Burma

BBS (Burma Broadcasting Service) Rangoon on **4725** at 1508, YL with a talk in (presumably) a Burmese vernacular. The schedule is from 1030 to 1445 but can vary seasonally to closing at 1545. The power is 50 kW.

Kashmir

Azad Kashmir (Free Kashmir) Trarkhel on **4980** at 1535, OM in vernacular - either Urdu or Kashmiri, I wouldn't know the difference - in the schedule 1410 to 1800. This one relays Radio Pakistan in addition to local programmes. The interminable signing-off anthem must be heard to be believed - it goes on and on. The territory is in dispute with India which maintains a station in Jammu - also in Kashmir.

Angola

Luanda on **4820** at 1910, OM and YL alternate with announcements in Portuguese followed by a programme of music Latin American style. Radio Nacional is scheduled from 0400 to 0800 and from 1500 to 2400, the power is 10 kW.

Benin

Cotonou on **4870** at 0600, African drums, OM station identification in French then OM in vernacular with, presumably, a newscast. This is the Home Service which operates from 0400 (Saturdays from 0550) to 0800 and from 1300 (Saturdays from 1100) to 2400 weekdays. Sundays from 0600 through to 2400 with an English newscast at 1900 and 2100. The power is 30 kW.

Mali

Bomako on **4837** at 2032, OM with a talk in French heard with some difficulty under CW interference. Radio Mali is scheduled from 0600 to 0800 weekdays and from 1800 to 2400 daily. An English programme is radiated from 1820 to 1900 on Saturdays. The power is 18 kW and the frequency can vary slightly from the listed **4838**.

Zambia

ZBS Lusaka on **4910** at 1833, YL with a talk in vernacular in the Home Service which is scheduled from 0350 to 0530 and from 1530 to 2105 (Fridays and Saturdays until 2200). The power is 50 kW and Lusaka is listed on **4911**.

Ghana

GBC Accra on a measured **4914.5** at 1830, OM with a newscast in English after a previous programme in vernacular. This is the GBC-1 programme in English and vernaculars and scheduled from 0530 to 0800 and from 1200 to 2305 (Sundays from 0650 through to 2300). The power is 10 kW.

■ R & EW

Your Reactions	Circle No.		Circle No.
Immediately Applicable	270	Not Applicable	272
Useful & Informative	271	Comments	273

R&EW BOOK SERVICE

Use the reply paid coupon for ordering.

BOOK OF THE MONTH

ELECTRONIC TEST EQUIPMENT
Operation and Applications
Edited by A M Rudkin
316 pages; 150 x 234mm; Hardback

This book is written by a team of specialist contributors and edited by A M Rudkin, Product Manager at Marconi Instruments. It covers a wide range of test equipment from Audio Oscillators to Spectrum Analysers. Each chapter gives an insight into the design principles and operation of the different types of equipment. The book is well layed out with clear diagrams and easy-to-follow drawings. Just enough information is given to help select suitable test equipment and have a basic understanding of how it works. Detailed operational information is not included, as there is insufficient space when covering such a large field of equipment. The final chapter is devoted to the use of microprocessors in the control of programmable and automatic test instruments.

Published by Granada Publishing.

BEGINNERS HANDBOOK OF AMATEUR RADIO
By C Laster
1979; 384 pages; 135 x 215mm; Paperback
£9.70

Designed for either the classroom or individual study, this handbook takes the beginner in amateur radio through the license preparation and study phase, and into the operation of a novice amateur radio station. Subjects discussed include the history of amateur radio; learning the International Morse Code; passing FCC license examinations; radio communication theory; principles of electricity and magnetism; theory and practical aspects of vacuum tubes, transistors, amplifiers, oscillators, transmitters, receivers, transmission lines, and antennas; amateur radio practices and operating procedures; typical GCC exam questions and a sample novice class theory examination.

CIRCUIT DESIGN PROGRAMS FOR THE TRS-80
By H M Berlin
1980; 144 pages; 135 x 215mm; Paperback
£10.15

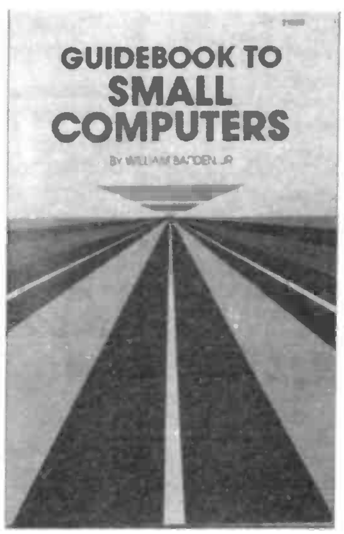
This book is written for the reader with an understanding of Level II BASIC. It features a variety of useful programs that will enable the user to solve a myriad of problems such as rms and average values, periodic waveform, inverse Laplace, Fourier, design of matching pads, attenuators, active filters, heatsinks, integrated circuit timer, zener diode regulator, and bipolar transistor circuits. The programs are designed to be used with the Radio Shack TRS-80 systems, having Level II BASIC and at least 16k of RAM. However, many run on inexpensive 'personal-type' digital computers.

INTRODUCTION TO MICROCOMPUTERS FOR THE HAM SHACK
By H L Helms Jnr
1979; 96 pages; 135 x 215mm; Paperback
£4.15

The author introduces the reader to the dawning era of 'computercations' or the widespread introduction of computer technology into electronic communications. By reading this book, the reader can take the first step toward the application of microcomputers to amateur radio.

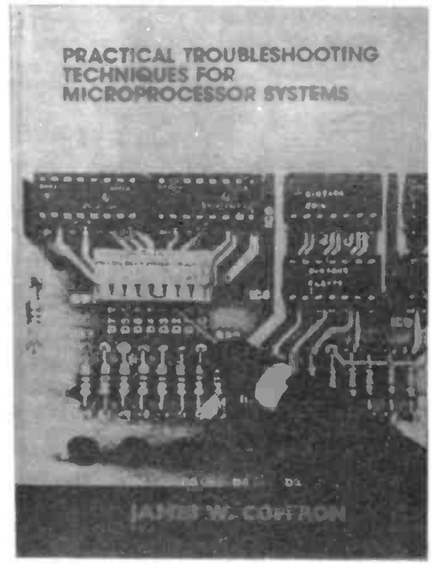
GUIDEBOOK TO SMALL COMPUTERS
By W Barden Jnr
1980; 128 pages; 135 x 215mm; Paperback
£4.85

If you are contemplating buying a small computer system for your home or office, or business, this book can save you time and trouble. It contains all the information necessary for a prospective buyer to make an intelligent selection of a small system. The first chapter is a general introduction to small computers and presents the fundamentals of hardware and software. The remaining chapters feature a survey of 21 currently popular systems and are illustrated with photographs, drawings, and charts. A handy directory of small computer manufacturers concludes the book.



PRACTICAL TROUBLESHOOTING TECHNIQUES FOR MICROPROCESSOR SYSTEMS
By James Coffron
1981; 256 pages; 160 x 235mm; Hardback
£14.95

Written for the engineer or technician who uses microprocessor systems, this book is a collection of different troubleshooting techniques. The text is hardware orientated to meet the needs of practical troubleshooters and others who will deal with microprocessors in a real world context. The author describes troubleshooting techniques for 8-bit microprocessors and covers circuits utilizing the 8080, 8085, Z80 and 6800.



* * * * * * * *

A selection of books available from R&EW.

RADIO BOOKS

AMATEUR ANTENNA TESTS AND MEASUREMENT
by H D Hooton — £6.95

CB RADIO CONSTRUCTION PROJECTS
by Len Buckwalter — £2.75

FERROMAGNETIC CORE DESIGN
by M F Doug DeMaw — £16.45

MICROWAVE DEVICES AND CIRCUITS
by Prof S Liao — £24.70

MICROWAVE THEORY AND APPLICATIONS
by S F Adam — £17.95

PRACTICAL RF COMMUNICATIONS DATA FOR ENGINEERS AND TECHNICIANS
by M F Doug DeMaw — £6.95

QUESTIONS AND ANSWERS ABOUT CB OPERATIONS
by L G Sands — £2.65

TV ANTENNAS AND SIGNAL DISTRIBUTION SYSTEMS
by M J Salvati — £7.65

GENERAL BOOKS

ABCs OF INTEGRATED CIRCUITS
by R P Turner £4.15

ACTIVE FILTER COOKBOOK
by Don Lancaster £10.45

ANALOG I/O DESIGN AQUISITION: CONVERSION: RECOVERY
by P H Garrett £16.45

BEGINNER'S HANDBOOK OF IC PROJECTS
by D L Heiserman £9.70

BUILDING AND INSTALLING ELECTRONIC INTRUSION ALARMS
by J E Cunningham £4.55

CMOS COOKBOOK
by Don Lancaster £9.05

DESIGN OF OP-AMP CIRCUITS - with experiments
by H M Berlin £7.65

DESIGN OF PHASE-LOCKED LOOP CIRCUITS - with experiments
by H M Berlin £7.65

DESIGN OF VMOS CIRCUITS - with experiments
by R T Stone £8.35

DIGITAL LOGIC DESIGN AND APPLICATIONS
by L B McCurdy et al £9.70

EFFECTIVELY USING THE OSCILLOSCOPE
by R G Middleton £6.95

HOW TO BUILD A FLYING SAUCER
by T B Pawlicki £4.45

HOW TO BUILD YOUR OWN STEREO SPEAKER
by Christopher Robin £5.20

INTEGRATED CIRCUIT PROJECTS
by R P Turner £4.55

LOGIC AND MEMORY EXPERIMENTS USING TTL BOOK 1
by D G Larsen & P R Rony £8.35

LOGIC AND MEMORY EXPERIMENTS USING TTL BOOK 2
by D G Larsen & P R Rony £9.05

99 PRACTICAL ELECTRONIC PROJECTS (2nd Edition)
by Herbert Friedman £4.15

ONE EVENING ELECTRONIC PROJECTS
by Calvin R Graf £4.55

OP AMP HANDBOOK
by F W Hughes £16.45

OPERATIONAL AMPLIFIER CHARACTERISTICS AND APPLICATIONS
by R G Irvine £18.70

PRACTICAL LOW-COST IC PROJECTS (2nd Edition)
by Herbert Friedman £4.15

SECURITY ELECTRONICS (2nd Edition)
by J E Cunningham £5.25

SON OF CHEAP VIDEO
by Don Lancaster £6.95

SCRS & RELATED THYRISTOR DEVICES
by C Laster £9.05

TTL COOKBOOK
by D Lancaster £8.35

THE 555 TIMER APPLICATIONS SOURCEBOOK - with experiments
by H M Berlin £5.25

UNIQUE ELECTRONIC WEATHER PROJECTS
by Tom Fox £6.25

COMPUTER BOOKS

THE ADA PROGRAMMING LANGUAGE
by J C Pyle £8.95

APPLE BASIC FOR BUSINESS FOR APPLE II
by A J Parker et al £11.20

THE ARCHITECTURE OF CONCURRENT PROGRAMS
by P B Hansen £19.45

BASIC BUSINESS SOFTWARE
by E G Brooner £8.35

CALCULATOR CLOUT – PROGRAMMING METHODS FOR YOUR PROGRAMMABLE
by M D Weir £6.70

CIRCUIT DESIGN PROGRAMS FOR THE TRS-80
by Howard M Berlin £10.15

COMPUTER GRAPHICS PRIMER
by M Waite £10.45

COMPUTER LANGUAGE REFERENCE GUIDE
by Harry L Helms £5.55

CP/M PRIMER
by S Murtha & M Waite £10.45

CRASH COURSE IN MICROCOMPUTERS
by Louis E Frenzel £13.95

DIGITAL CIRCUITS AND MICROCOMPUTERS
by D E Johnson et al £9.50

DIGITAL CONTROL USING MICROPROCESSORS
by P Katz £16.95

EXPERIMENTS IN ARTIFICIAL INTELLIGENCE
by J Krutch £6.25

GUIDEBOOK TO SMALL COMPUTERS
by W Barden Jnr. £4.85

HEXADECIMAL CHRONICLES
by D Lancaster £12.55

HOW TO DBUG YOUR PERSONAL COMPUTER
by J Huffman £5.95

HOW TO PROGRAM AND INTERFACE THE 6800
by A C Staugaard Jnr £11.15

HOW TO TROUBLESHOOT AND REPAIR MICROCOMPUTERS
by John D Lenk £5.95

INTRODUCTION TO MICRO-COMPUTERS FOR THE HAM SHACK
by Harry L Helms £4.15

LOGIC DESIGN OF COMPUTERS
by M P Chinitz £11.15

MICROCOMPUTER DICTIONARY
by C J Sippl £11.15

MICROCOMPUTER INTERFACING WITH THE 8255 PPI CHIP
by P F Goldsbrough £6.95

MICROPROCESSOR SOFTWARE, PROGRAM CONCEPTS AND TECHNIQUES
by G A Streitmatter £14.20

MINICOMPUTER IN ON-LINE SYSTEMS
by M Healey et al £17.20

MOSTLY BASIC: APPLE II
by H Berenbon £7.65

MOSTLY BASIC: PET
by H Berenbon £9.05

MOSTLY BASIC: TRS-80
by H Berenbon £9.05

PET BASIC: TRAINING YOUR PET COMPUTER
by R Zamora et al £9.70

PET PERSONAL COMPUTER FOR BEGINNERS
by S Dunn £4.95

PRACTICAL HARDWARE DETAILS OF Z-80, 8080, 8085 & 6800 MICROCOMPUTER SYSTEMS
by J W Coffron £16.45

PRACTICAL TROUBLESHOOTING TECHNIQUES FOR MICROPROCESSOR SYSTEMS
by J W Coffron £14.95

A PRIMER ON PASCAL
by R Conway et al £9.70

PROGRAMMING AND INTERFACING THE 6502 - WITH EXPERIMENTS
by Marvin L De Jong £11.15

THE S100 AND OTHER MICRO BUSES
by E C Poe & J C Goodwin £6.95

SMALL BUSINESS COMPUTER SYSTEMS
by P J Best £8.40

SOFTWARE MAINTENANCE GUIDEBOOK
by R L Glass & R A Noiseux £16.45

STRUCTURED COBOL, A PRAGMATIC APPROACH
by R T Grauer & M A Crawford £13.45

SYSTEMS PROGRAMMER'S PROBLEM SOLVER
by W S Mosteller £14.20

TELEMATIC SOCIETY: A CHALLENGE FOR TOMORROW
by J Martin £9.70

THE 8080 A BUGBOOK
by Peter R Rony £9.05

TRS-80 ASSEMBLY LANGUAGE
by H S Howe £7.45

TRS-80 INTERFACING BOOK 1
by Jonathan A Titus, Christopher Titus & David G Larsen £7.65

TRS-80 INTERFACING BOOK 2
As for Book 1 £8.35

USING THE UNIX SYSTEM
by R Gauthier £14.20

VIDEO/COMPUTERS, HOW TO SELECT, MIX AND OPERATE PERSONAL COMPUTERS & HOME VIDEO SYSTEMS
by C J Sippl & F Dahl £5.95

Z-80 MICROCOMPUTER DESIGN PROJECTS
by W Barden Jnr £9.75

6502 SOFTWARE DESIGN
by Leo Scanlon £9.05

6809 MICROCOMPUTER PROGRAMMING AND INTERFACING - with experiments
by A C Staugaard £10.45

NEW TITLES

APPLESOFT LANGUAGE
by B D & G H Blackwood £7.65

BASIC ELECTRICITY/ELECTRONICS Vol 3 Understanding Electronic Circuits 2nd Edition
by Training & Retraining Inc £9.70

HANDBOOK OF SEMI-CONDUCTOR MEMORIES
by M M Cirovic £16.45

INTIMATE INSTRUCTIONS IN INTEGER BASIC
by B D & G H Blackwood £5.55

PRINCIPLES OF BIO-MEDICAL INSTRUMENTATION & MONITORING
by R J Traister £18.70

THE 68000: PRINCIPLES AND PROGRAMMING
by L J Scanlon £10.45

8085A COOKBOOK
by Titus £9.75

Make all cheques/postal orders payable (in sterling only!) to R&EW Book Service. Orders should be sent to R&EW Book Service, 200 North Service Road, Brentwood, Essex CM14 4SG. Note: All prices exclusive of postage and packing please add 75p for first book ordered, plus 25p for each additional title on same order.

107 for further details

The Sensation of the Japanese Music Fair

Designed by a genius, controlled by a computer, programmed by a laser, played by amateurs professionally and by professionals superbly.

THE NEW CASIOTONE 701

"... what is going to become THE instrument of 1982... probably the best instructive keybo= ard I have come across. But it is also a top line musical instrument capable of satisfying even the most proficient musician.... I suggest you place your orders now." (Keyboard & Music Player.)

"... opens up home music making for all the family... one of the most advanced music teaching aids so far developed... this instrument is going to be one of the biggest best sellers of 1982." (Electronics & Music Maker.)

Complete Programmable Polyphonic Keyboard (RRP £555)

ONLY £495

* Input an entire piece of music, specially scored in bar code and read by a light pen attached to the instrument.
* Alternatively, program your own melodies, chords and tempo, from the keyboard, into the extensive memory, (up to 5 minutes playing or more) with full editing facilities.
* 3-WAY PLAYBACK
  1) Automatic playback of the entire piece; melody, chord, bass and rhythm with arpeggio. Follow the melody as it plays via lamps above each individual key.
  2) Manual melody playing, guided by the keyboard lamps, with automatic bass and rhythm accompaniment.
  3) ONE KEY PLAY facility, allows the melody line to be played, simply by stroking one key. Non-players can become Instant Musicians!
* The 5 octave, 8-note polyphonic keyboard can be split into 2 and 3 octaves and a different voice can be selected for the accompaniment
* 20 "breathtakingly clear and bright" pre-set instruments and voices.
* 3-way chord section:- Fingered, Memory and Casiochord auto accompaniment.
* 16 rhythm accompaniments with 'fill-in' variation and two percussion effect buttons. Start/Stop, Synchro', Tempo and Balance controls.
* Variable Vibrato and Sustain. Output jack. Foot pedal input jacks. Music book. AC only. Optional extras: Foot pedals, Hard case.

CREDIT. 0% Interest, third deposit, 12 monthly repayments. (Not MT-31, MT-40, or VL-1) or reduced rates for longer periods.
INTEREST. (0%) on ACCESS, B'CARD or VISA for first 6 months, for any keyboard purchase over £90.

NEW PORTABLE KEYBOARDS

Casiotone MT-40

(RRP £125)
AN INCREDIBLE £99

* 8-note polyphonic playing of this 37 key, 3 octave keyboard.
* 15 key bass keyboard with automatic synchronised bass function.
* 22 lively and realistic built-in instrument sounds and voices.
* 6 built-in auto rhythms, with dual "Fill-in" rhythmic interludes.
* Sustain, Vibrato and Pitch controls. Line out and Headphone jacks.
* Integral amplifier and speaker. Battery powered, or optional AC adaptor.

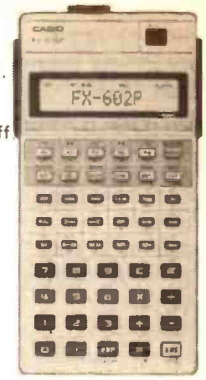
Dims: 61.6x584x178mm (2-7/16x23x7"). Weight: 2.2kg (4.9lb.)

Casiotone MT-31 (RRP £79) ONLY £69

Similar to the MT-40 but without the rhythm box, bass and auto functions. Dimensions:

OTHER CASIOTONES:
CT-101 £195. CT-202 £275. CT-403£275. VL-TONE £35.95.
Lists on request.

WE WILL BEAT ANY LOWER ADVERTISED PRICE BY 5% providing the advertiser has stocks. We regret that free offers are excluded when price beating.



World's Fastest Programmable? FX-602P

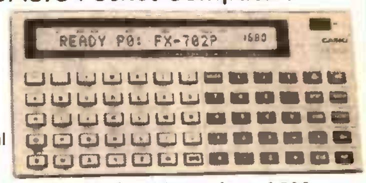
* LCD alpha/numeric (dot matrix) scrolling display.
* Variable input from 32 program steps with 88 memories, to 512 steps with 22 memories.
* Memory and program retention when switched off.
* Up to 10 pairs unconditional jumps (GOTO)
* Conditional jumps and count jumps. Indirect addressing. Manual jump.
* Up to 9 subroutes, up to 9 levels.
* 50 scientific functions, all usable in programs.
* PAM (Algebraic) with 33 brackets at 11 levels.
* Program and data storage on cassette tape using optional FA-2 remote control adaptor, £19.95.
* Compatible with the FX-501P and FX-502P.
* 9.6 x 71 x 141.2mm. 100g.

ONLY £74.95 (RRP £84.95)

Plus FREE MiCROL Professional Programming pack* (RRP £9.95)

FX-3600P. 38 program steps, 7 memories. Integrals & Regression. **£22.95**

World's Most Powerful BASIC Pocket Computer?



CASIO FX-702P

(RRP £134.95)

ONLY £119.95

Plus FREE MiCROL Professional Programming Pack (RRP £9.95)

Alpha/numeric dot matrix scrolling LCD. Variable input from 1680 steps. 26 memories, to 80 steps. 226 memories, all retained when switched off. Up to 10 programs. Subroutines; 10 levels. FOR:NEXT looping: 8 levels. Debugging and Editing. 55 built-in functions, including Regression and Correlation, all usable in programs. Program/Data storage on cassette via optional FA-2 adaptor (£19.95). Auto Power Off. 17x165x82mm. 176g.

NEW CASIO FP-10 MINI PRINTER

(RRP £49.95)

AN INCREDIBLE

£44.95

Plus FREE Pack worth £5.00

Compatible with the FX-501P, FX-502P, FX-601P, FX-602P and FX-702P. Manual and program results printout. Memory and program listing.

Electric discharge printer gives a remarkably legible 5x7 dot matrix printout of 20 characters per line. Stores up to 30 characters with printout over 1½ lines, with overload symbol. Fast 2 lines per second print speed. Aluminised paper rolls are approx 2,500 lines (30 feet) long and cost £2.50 per pack of 5. FP-10 connects directly to the calculator or via FA-2 remote control cassette interface. Four AA batteries will print approx 6,000-9,600 lines. Rechargeable pack, NP-4M prints approx 13,000 lines, £6.90). AC adaptor, AD-4150, recharges NP-4M in situ, (£5). Dims: 43.5H x 157.5W x 82.5D (1¾ x 6¼ x 3¼") Weight 372g. (13.1oz), incl. batteries.

MiCROL PROCOS Professional Computing Solutions on cassette. Save up to 90% of programming time with this electronic equivalent of pen and paper. 'Visicalc-type' system. Answer 'what if' questions & analyse trends. £24.95

Discounts on software when you purchase your hardware from us.

World's Most Versatile Alarm Chronograph Watch AX-210

10 alternative displays: over 60 functions. LCD ANALOG display of time plus: DIGITAL display of: Time (12 or 24 hr); Calendar; Full month calendar (this month and next month); dual time (12 or 24 hr); Alarm time; Professional 1/100 second stopwatch with laps, etc. Hourly time signal. Alarm - electronic buzzer or 3 selectable melodies. Rapid forward/backward setting. 9.4 x 35.4 x 36mm.

(RRP £34.95) **ONLY £29.95**

PRICE includes VAT and P&P. Send your company order, cheque, PO or phone your Access/B'card

Catalogue on request 14p stamp appreciated.

TEMPUS

LEADING CASIO SPECIALISTS
Dept REW
164/167 East Road, Cambridge CB1 1DB
Telephone 0223 312866

27 for further details

CLASSIFIED ADS

REPAIR THAT OLD BLACK AND WHITE TV

with the aid of the best seller

"TV FAULT FINDING"

(more than 200,000 copies sold)

5th Edition
Edited by J R Davies
132 pages

Over 100 illustrations, including 60 photographs of a television screen after the appropriate faults have been deliberately introduced.

Comprehensive Fault Finding Guide cross-referenced to methods of fault rectification described at greater length in the text.

Price ONLY £1.50 (inc P&P)

Make remittance payable to:
RADIO & ELECTRONICS WORLD DATA PUBLICATIONS
45 Yeading Avenue,
Rayners Lane,
Harrow, Middlesex HA2 9RL

NATIONAL PANASONIC STEREO CASSETTE DECK, auto stop. Model RS260 USD. With Howland West Audio Stereo headphone, C1S-500. £50.00 ONO. Box No REW11.

TR2300. 2m FM transportable, with case and 10W booster amp., 'rubber duck'... £170 ONO. Phone (0277) 822720. G3XDG.

OFFERS FOR TAPLIN TWIN MODEL DIESEL ENGINE. 10cc, with silencer, fuel tank and prop shaft coupling for 4BA thread. Suit model R C boat around 48in. LOA. Box No REW12.

T&J ELECTRONIC COMPONENTS. Quality components, competitive prices. Send 45p cheque or postal order for illustrated catalogue, 98 Burrow Road, Chigwell, Essex IG7 4BH.

TANDY DX-200 SW RECEIVER. Fitted with Ambit DFM1 frequency meter/timer. £195 ONO. Casio FX-501P programmable calculator £40. Tel: 031-228-1432.

VLF CONVERTER. 10-500kHz. Palomar Engineers, £45 ONO. Box No REW13.

SERVICE FACILITY OFFERED. For amateur pmr CB equipment. Quotes given. Modifications also carried out. DHK Electronic Services. Phone 061-439-2377.

ICOM IC202 144MHz SSB TRANSCEIVER, as new, £85. Ohio superboard computer. Cased, PSU, 8k, 48 x 32 display, cegmon, new basic 1 + 3, 300/1200 baud (software selectable), exmon, assembler. £160 ONO Tel: Durham 711855.

FOR SALE: AM/FM Multi purpose signal generator. 10-440 MHz. Valve model AN USM-16 with transformer. £125. including carriage. N Dobson, 19 Romney Drive, Carrville, Durham DH1 1LS.

FOR SALE: 2 Meter Converter, Telford Communications, G8AEV. £12. 29.5 MHz pre-amplifier, Telford Communications £10. Box No REW14.

SEMITRON CRICKLADE LTD. Offer a range of zener, rectifier and avalanche diodes as surplus stock. Power rating 400mW to 25W. Each mixed packet has approximate retail value of £30 and is available at £5.50, including postage. All devices fully tested to original specifications. Orders above £20 value postage free. Cash with order please. Buy prime quality product direct from the manufacturer at a fraction of its true value. Semitron Cricklade Ltd, Dept X1, Cricklade, Swindon, Wilts.

KW2000A AC PSU £190. TR2200GX with VB-2200GX and mobile mount £95. Heathkit GR78 £85. HW7 with PSU £48. HW17 with FM unit £40. Eddystone 680X with Panadaptor £260. Phone: 01-237-4604.

BI-KITS STEREO AMPLIFIER CHASSIS, cabinet, and two 7 inch speaker kits to match. £20 ONO. Box No REW15.

1920's ONWARD VALVES. Wireless lists 25p. 100 mixed diodes £1. 1000's modern components lists. 25p. Sole Electronics, REW37 Stanley Street, Ormskirk, Lancs, L39 2DH.

AUTO ELECTRICAL KITS. Interior light delay - adjustable 12-20 seconds. Fits inside headlining. £3.25 incl. Lights-on alarm - self cancelling. No more flat batteries! £3.95 incl. All parts and pcb supplied. Micha Design, Gt Missenden, Bucks HP16 9PW.

POWER TRANSFORMER & RECTIFIER BARGAINS. 30-150 amps, various voltages, list: R Neville, Green Lane, Ellisfield, Nr Basingstoke, Hants.

MASTER OSCILLATOR, M1-19467-A. £10.00 plus carriage. Box No REW16.

WANTED: SX200N VHF/UHF scanning receiver. Also GDX2 Discone antenna. G4DBL. Telephone: Winchester 880120.

SONY ICF-2001 RECEIVER and Power Unit. One month old. Perfect. £135 inclusive. 0742-369116 (Sheffield)

AUTOMATIC MORSE DECODER. Low cost easy build 9V circuit. Accepts audio input or practice key. Gives continuous readout on 12 character alphanumeric display. Send £3.95 plus large SAE for fully detailed 17-page construction manual. Parts and pcb available, N MacRitchie (Micros), 100 Drakies Avenue, Inverness IV2 3SD.

FREE CATALOGUE. Everything for microcomputer users. Telephone Croydon Computer Centre. 29A Brigstock Road, Thornton Heath, Surrey, 01-689-1280.

FRG7 for sale as new plus joystick. ATU £150 ONO. 33 Luscombe Close, Caversham, Reading RD4 0LJ.

ZX81 Sinclair built. As new condition £50. Tel: Hornchurch 48434 after 6pm.

PRE-PACKED, screws, nuts, washers, solder tags, studding. Send for price list. A1 Sales (RE) PO Box 402, London SW6 6LU.

GLASS LAMINATE, single sided. Assorted sizes. £1.30 sq ft. Post 30p sq ft. D Chadwick, 5 Halifax Crescent, Liverpool L23 1TH.

CLASSIFIED ADS

UPDATE YOUR FT207. Nine page modification pamphlet, auto tone burst, listen on input, band coverage, full step by step instructions. £2 plus SAE to: K Jackson, 21 Elson Road, Gosport, Hants.

NEW 1982 ACE COMPONENT CATALOGUE. Let your problems be our business. Be certain; have your components delivered quickly and efficiently and get that project working. Send 30p NOW for the easy to use 1982 Catalogue to: Ace Mailtronix, Dept REW3A, Commercial Street, Batley, West Yorks WF17 5HJ.

QSLs letterheads, general offset up to A3 size. A/W, camera facilities - SAE details to Box REW9.

THE RADIO AMATEUR INVALID & BLIND CLUB is a well established Society providing facilities for the physically handicapped to enjoy the hobby of Amateur Radio. Please become a supporter of this worthy cause. Details from the Hon Secretary, Mrs F E Wolley, 9 Rannoch Court, Adelaide Road, Surbiton, Surrey KT6 4TE.

INTERESTED IN RTTY? You should find the **RTTY Journal** of interest. Published in California, USA, it gives a wide outlook on the current RTTY scene. RTTY-DX; DXCC Honour Roll; VHF RTTY News; and up to date technical articles are included. Specimen copies 35p from The Subscription Manager, RTTY Journal, 21 Romany Road, Oulton Broad, Lowestoft, Suffolk NR32 3PJ.

INTERESTED IN OSCAR? Then join AMSAT-UK. Newsletters, OSCAR NEWS Journal, prediction charts etc. Details of membership from: Ron Broadbent, G3AAJ, 94 Herongate Road, Wanstead Park, London E12 5EQ.

TR7800 as new in original packing, £225 ONO. Microwave modules 70cm transverter MMT 432/28-S £100. Modular electronics 70cm pre-amp £10. Smith, Raven Avenue, Tibshelf, Derbyshire. Tel: Ripley 874768.

YAESU MUSEN Communications Receiver FRG-7, as new. Sale due to bereavement. £120. Tel: 01-997-5296 after 6.30pm.

JOIN THE INTERNATIONAL SW LEAGUE. Free services to members including QSL Bureau, Amateur and Broadcast Translation, Technical and Identification Dept, - both Broadcast and Fixed Station, DX Certificates, contests and activities for the SWL and transmitting members. Monthly magazine *Monitor* containing articles of general interest to Broadcast and Amateur SWLs, Transmitter Section and League affairs, etc. League supplies such as badges, headed notepaper and envelopes, QSL cards, etc. are available at reasonable cost. Send for league particulars. Membership including monthly magazine etc., £9.00 per annum UK overseas rates on request, Secretary, Grove Road, Lydney, Glos GL15 5JE.

FOR REPAIRS to Multimeters insulation, continuity and general purpose test equipment, phone G Butcher, Harlow (0279) 419118 (Daytime) and 39516 after 6pm.

AR88D COMMUNICATIONS RECEIVER working order £35. Oscilloscope Cossor 1035 double beam £15. Marconi valve Voltmeter TF899. Manuals. B H Dicker, East Meon, Petersfield, Hants. Tel East Mean 391.

SMALL ADVERTISEMENTS

Advertisements must be prepaid and all copy must be received by the 4th of the month for insertion in the following month's issue.

The Publishers cannot be held liable in any way for printing errors or omissions, nor can they accept responsibility for the **bona fides** of Advertisers.

Where advertisements offer any equipment of a transmitting nature, readers are reminded that a licence is normally required. Replies to Box Numbers should be addressed to: Box No..., **Radio & Electronics World, 45 Yeading Avenue, Rayners Lane, Harrow, Middlesex**

CLASSIFIED ADVERTISEMENT ORDER FORM — PLEASE COMPLETE BELOW

Write Your Ad. Below In the boxes - one word per box please. Underline words required in Bold type. Your name, address, and/or telephone number, if to appear, must be included in the boxes and must be paid for. Telephone numbers count as two words. Please use BLOCK CAPITALS.

—Advertisements are accepted on the understanding that the details stated comply with the conditions of the Trade Description Act,1968.
—Whilst every care is taken to ensure accuracy, we do not accept liability for inaccuracies should they occur
—Cancellations must be notified by telephone or in writing by the 6th of the month preceding publication.

			£2.00
£2.04	£2.16	£2.28	£2.40
£2.52	£2.64	£2.76	£2.88
£3.00	£3.12	£3.24	£3.36
£3.48	£3.60	£3.72	£3.84
£3.96	£4.08	£4.20	£4.32

RATES
All cheques should be made payable to Radio & Electronics World.

12p per word - minimum charge £2.00

Tick this box if you require a box number charged at 30p ☐

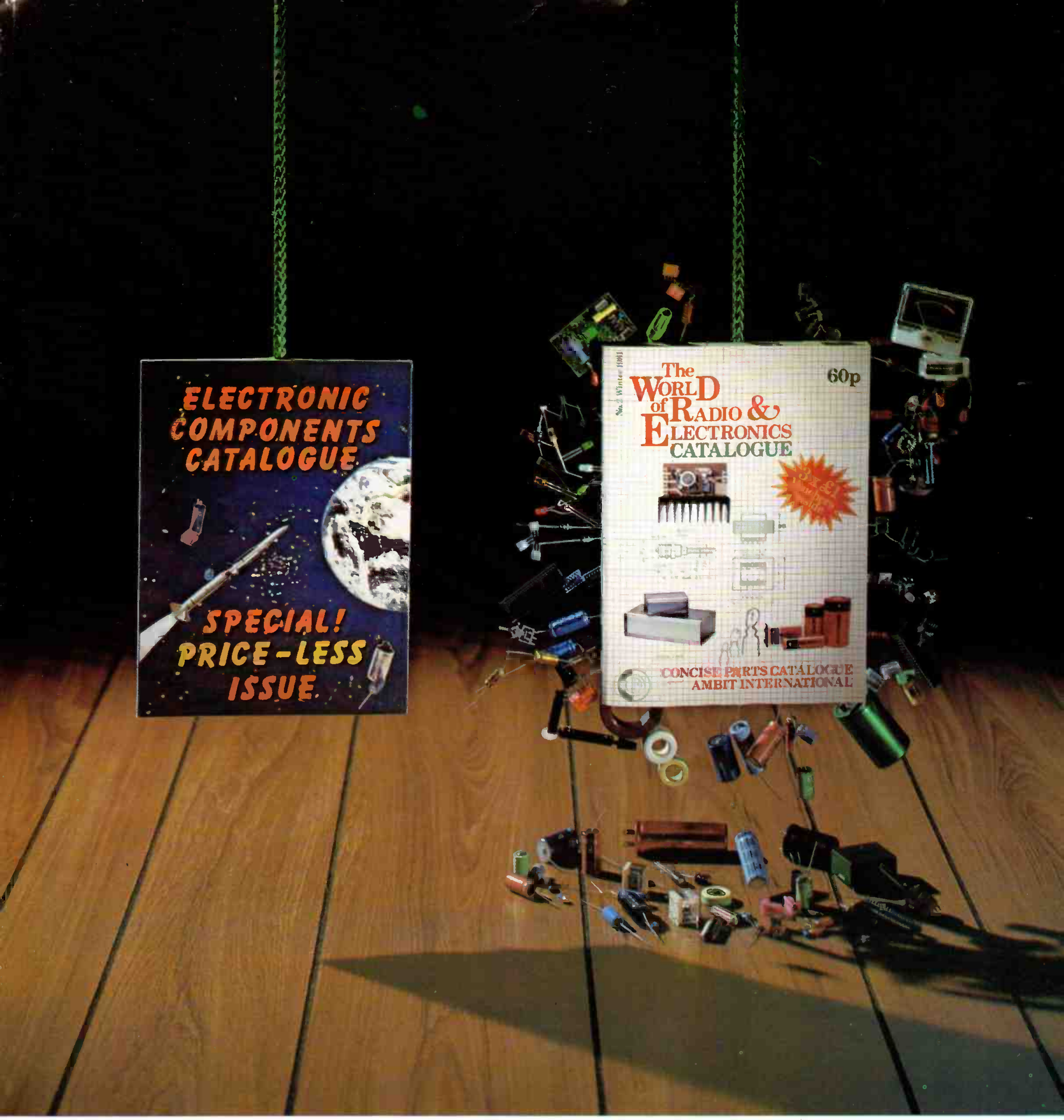
I enclose remittance of £ : p

NAME .... ADDRESS ....

.... POSTCODE ....

Post your completed form to RADIO & ELECTRONICS WORLD, Classified Ads., 45, Yeading Avenue, Rayners Lane HARROW, Middlesex.

ADVERTISERS' INDEX


ELECTRONIC COMPONENTS CATALOGUE
SPECIAL! PRICE-LESS ISSUE
The WORLD of RADIO & ELECTRONICS CATALOGUE
60p
CONCISE PARTS CATALOGUE
AMBIT INTERNATIONAL

Some of the TELOMAN PRODUCTS RANGE

NEW PRODUCTS

£43·70 inc VAT

SIZE TL100 19"x 14"x 6"

TL99 17"x 12" x 6" £39.90

THE **TL100** HAS BEEN DESIGNED FOR THE PROFESSIONAL ELECTRONICS, TV OR INSTRUMENT TECHNICIAN WHO NEEDS TO CARRY A LARGE NUMBER OF SPECIALIST TOOLS. CONSTRUCTED FROM HARD WEARING ABS WITH STRONG ALUMINIUM FRAMES, TWIN HANDLES AND TOGGLE LOCKS. A MOULDED TRAY IN THE BASE, A COMPREHENSIVE 2 SIDED TOOL PALLET THAT IS REVERSIBLE WITH SPACE FOR OVER 40 TOOLS. THERE IS SPACE FOR DOCUMENTS AND A HEAT SINK FOR A HOT SOLDERING IRON TO PREVENT ANY DAMAGE BEING CAUSED.
ALSO AVAILABLE IS THE **TL99** WHICH IS A SMALLER VERSION OF THE **TL100.**

TLW4 TOOLWALLET MEASURES 11"x14"x2½" WHEN CLOSED. MADE FROM REINFORCED PVC WITH A HEAVY DUTY INDUSTRIAL ZIP.

TOOL PALLET FOR SPANNERS (PRICES ON APPLICATION)

TOOLROLL £8.95 inc. VAT P&P £1.00
MEASURES 23"x13" WHEN OPEN. MADE FROM PVC. IT CAN HOLD UP TO 30 TOOLS AND HAS 3 POCKETS.

SALES PRESENTERS £7.48 inc. VAT P&P £1.50
IT CONTAINS 3 DOCUMENT POCKETS 4 RING BINDER BOARD CLIP WITH QUICK RELEASE **SIZE A4**

£13·75 inc VAT P&P £1.50.

***DISCOUNT STRUCTURE FOR MULTIPLE USERS ONLY**
***CUSTOM MADE TOOL PALLETS (ONLY FOR LONG RUNS) TOOLS WILL BE REQUIRED FOR MEASURING BUT WILL BE RETURNED.**

Mail Order

Please send

Enclosed my cheque £ .

TL 100/ TL99 P&P £2.60 extra)

Name

Company

Address

Tools NOT included. British made.
Money back guarantee. Allow 7-21 days for delivery. **REW/3**

TELOMAN GUARANTEE 2 YR

TLW4

Teloman Products Ltd
'Wychwood' 2 Abbots Ripton Rd, Sapley, Cambs. PE17 2LA
Tel: (0480) 65534

Z-8 PROGRAM DEVELOPMENT BOARD

Take advantage of the fact that R&EW is able to leapfrog over all other published designs with the 'state of the art' in microcomputer boards: This month Jonathan C Burchell looks at the construction of the Z-8 board, and the combined power supply unit and cassette interface.

CONSTRUCTION OF THE Z-8 board is relatively easy - despite the complexity of the circuit, by using the double sided, PTH (plated through hole) PCB. The component positions are also silk-screened onto the board - so you've got no excuses for getting it wrong!

The fine track used on the PCB (12.5 thou), together with the need for a plated through hole board means that we have not published the artwork for the PCB. Readers are strongly advised to use the **R&EW** 'Project Pack' board, any other method of construction is not recommended, and will probably lead to frustration and failure. The original prototype was wire wrapped on a piece of perf board (see last month's illustration), and the fact that it worked 'nearly' first time is as much a tribute to author's lucky rabbit's foot as it is to scientific planning and execution.

The use of a plated through hole PCB means that components need only be soldered on the underside of the board. The connection to the tracks on the top surface has been made by the PCB process.

Assembly

First locate and solder in place all the IC sockets. The **R&EW** kit contains sockets for all IC's and we recommend their use. Next, the remaining 'discrete' components may be fitted. When fitting the reset switch, a small blob of glue between the switch and the PCB provides an extra degree of rigidity.

The EPROM programming supply resistor, R31, becomes quite hot during programming, and for this reason a high wattage device is used. Make sure to mount it slightly clear of the board so that air can circulate freely around it.

When fitting the indirect edge connector take special care to ensure that all of the connector pins are well seated in the board before beginning to solder them in. Once the construction of the Z-8 board is complete give it a thorough visual inspection for missed and badly soldered connections. Although the tracks are very close the solder resist mask present on both sides of the board should prevent any bridging problems. Do not fit the IC's yet, place the board to one side and construct and test the cassette interface.

PSU

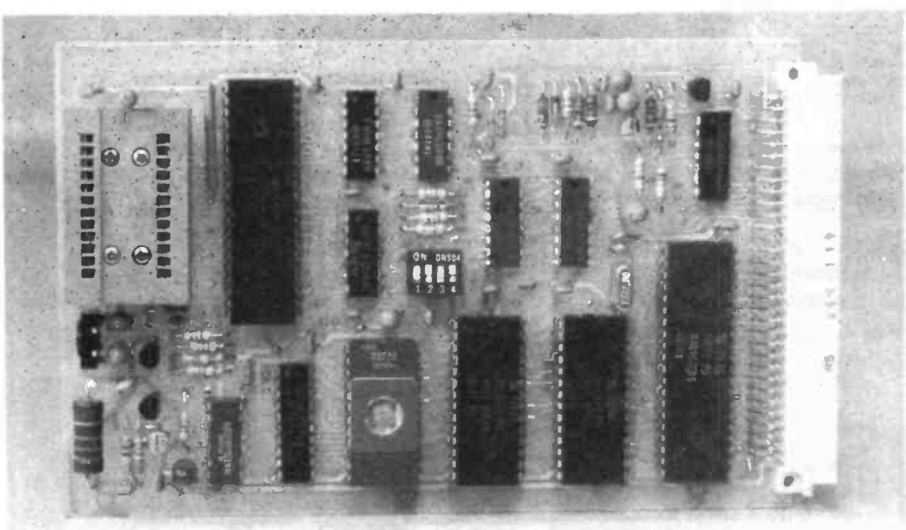
The Z-8 card needs to be supplied with 5 volts at 800 mA, +12 volts and —12 volts at 20 mA, and 25 volts at 30 mA for EPROM programming. The power supply shown in *Fig 4* provides these voltages. A 12—0—12V mains transformer is used to provide plus and minus 15 VDC supplies, which are then regulated to provide the 12 volt and 5 volt rails.

Resistor R1 is used as a voltage dropper to provide some reduction in the power dissipated in the regulator. NB The regulator must be mounted on a heatsink.

The +25 volt supply is provided by the voltage doubler network of C18, D1, D2, C14 this generates about 35 volts, which is then regulated by a 78L24 regulator. The output of this 24V regulator is raised slightly by a diode placed in the earth lead of the regulator IC. The original unit used an LED as this provided a convenient "ON" indicator as well.

Connections from the PSU to the Z-8 board are made via a 10 way 0.1" molex connector, two pins of which are cut away to provide positive keying. Thus hopefully preventing an expensive and embarrassing accident.

The cassette interface is very simple, and is only designed for low speed (110 baud) work. A later article will describe a 4800 baud interface based on manchester encode/decode techniques.



Photograph of Z-8 PCB.

Cassette interface

The interface is based around the versatile Signetics NE567 phase locked loop tone decoder, which will accept an audio input from 50 mV to 2 volts. Whenever a tone of the same frequency as the VCO of the 567 is present at the input to the 567, the output of the decoder will go LOW.

A digital "0" is recorded on the tape as a burst of tone, a "1" as silence. On playback, the 567 will alternatively detect or not detect the tone. The system shows moderate tolerance to noise dropouts and the other failings that cheap cassette recorders are prone to exhibit. Speed tolerance is provided by the ability of the phase locked loop to track an input signal within 15% of the nominal centre frequency of it's VCO; further tolerance to speed variations is provided by the use of a UART to generate and decode the data stream.

The recording tone is generated by the 567 VCO, the square wave present on pin 5 is shaped via R3, C26 and R2, C23. The shaped waveform is passed to the audio input of a cassette tape recorder. This tone is turned on and off by Q1, which is controlled by the data stream from the Z-8 card.

Construction and testing of the PSU and cassette interface

Construction should take place by following the overlay diagram of *Fig 6*, which details the component layout. Do not forget to fit the LED, or the 25 volt supply will not work correctly.

Take care when working on the PSU. Live mains are present around the transformer. We want to retain all our readers!

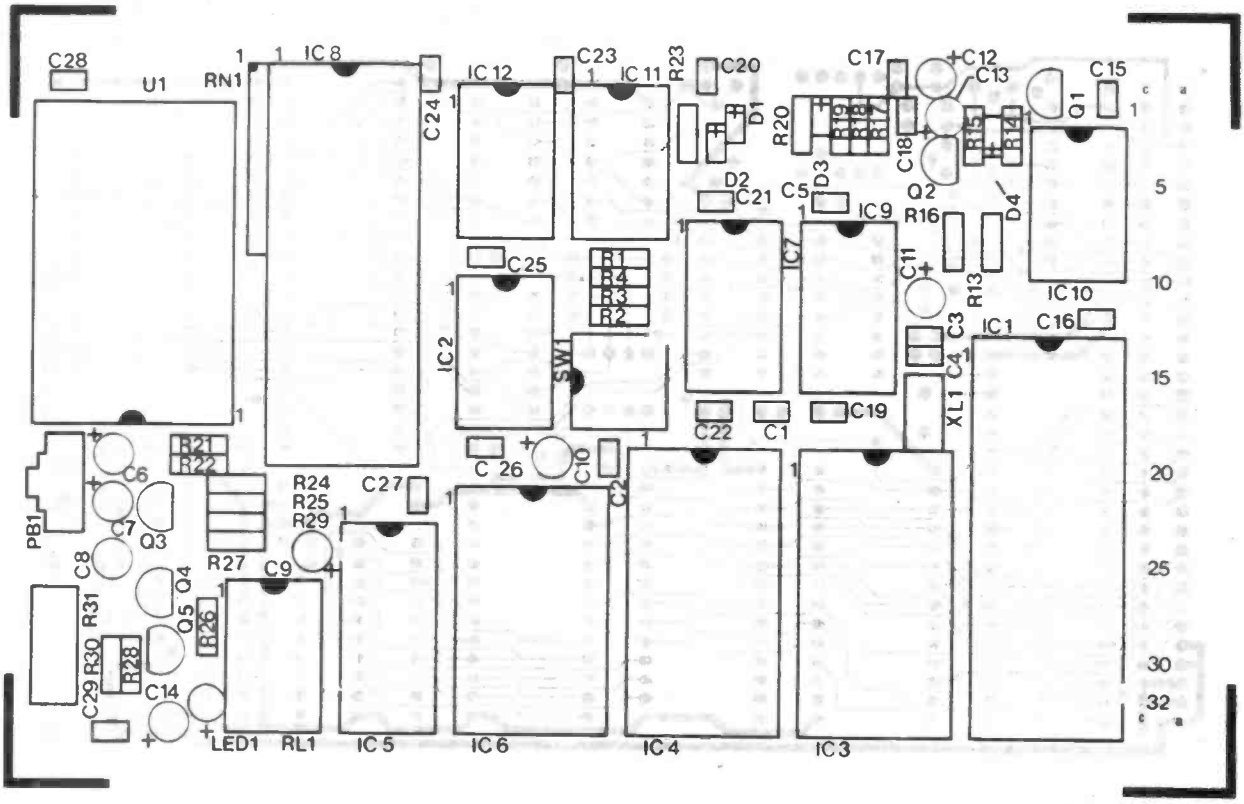


Figure 1: Z-8 Board component overlay.

The PSU should be built into a verocase as shown, as this gives further protection from accidental encounters with 240V AC. Remember to drill some holes into the box lid to provide adequate ventilation, and to terminate the mains lead securely at some point, to prevent the possibility of lead fracture or damage from stress on the power cord.

When constructed and checked carefully, the unit should be connected to the mains and turned on. Test the voltages on the Molex pin connector for correct value and polarity. When checking a PSU, it is wise to load the output with a resistor when monitoring the voltage, which will help to detect a number of problems which can be hidden under no-load conditions.

Assuming all is well, the cassette interface may be tested. Connect a DIN lead from the socket on the board to your cassette recorder, and turn the PSU on. Record for about 10 seconds. On playback a tone around 3 kHz should be heard. If the output of the 567 (pin 8) is monitored it should be high most of the time, going low whenever the tone is present. Altering the volume control when the tone is present will cause the output of the 567 to fluctuate. The volume control should be set half way between the point at which the output of the 567 goes low, and stays low, and maximum volume of the tape recorder.

Insert an unconnected jack plug into the ear, or the auxiliary speaker socket of the tape recorder in order to mute the

Z-8 BOARD PARTS LIST

Resistors	
RN1	4k7 x 8 SIL resistor
R1,2,3,4,15,17, 18,20,24,25,27, 30	4k7, 0.25W
R5,6,7,8,9,10, 11,12	equals RN1
R13,25,29	47k, 0.25W
R14	100k, 0.25W
R16	330, 0.25W
R19	1k, 0.25W
R21,23,26	470, 0.25W
R22	180, 0.25W
R28	27k, 0.25W
R31	330, 2.5W
Capacitors	
C1,2,5,15,16, 17,18,19,20,21, 22,23,24,25,26 27,28,29	0.1u mono
C3,4	22pF plate
C6,9,10,11,12,13	22uF 16V tant
C14	4.7uF 35V tant
Semiconductors	
IC1	Z8671
IC2,10	74LS125
IC3,4	Z6132-6
IC5	74LS373
IC6	2732 EPROM
IC7,9	74LS138
IC8	8255
Q1,3,4	BC237
Q2,5	BC307
D1,2,4	1N4148
D3	6V8 zener
Miscellaneous	
XTAL1	7.3728 MHz
RL1	5V reed relay DIL
LED1	red LED
PB1	Reset switch
SW1	4 way DIP

Figure 2: Z-8 Board parts list.

PIN NO.	ROW A	ROW C	PIN NO.	ROW A	ROW C
1	GND	GND	18	R/$\overline{W}$	$P2_5$
2	GND	GND	19	$\overline{AS}$	$P2_4$
3	−12	+12	20	$P3_5$	$P2_3$
4	−12	+12	21		$P2_2$
5		AUX SER IN	22	A_1/D_1	$P2_1$
6		TTL SER IN	23	A_0/D_0	$P2_0$
7			24	A_7/D_7	$P3_3$
8	A_{12}	TTL SER OUT	25	A_6/D_6	$P3_4$
9	A_{13}	AUX SER OUT	26	A_5/D_5	A_8
10	A_{15}	A_{14}	27	A_{10}	A_9
11	RS232 OUT	RS232 IN	28	A_{11}	A_4/D_4
12			29	+25 V	A_3/D_3
13			30	+25 V	A_2/D_2
14		$P3_6$	31	+5 V	+5 V
15		$P3_1$	32	+5 V	+5 V
16	$\overline{RESET}$	$P2_7$			
17	$\overline{DS}$	$P2_6$			

PIN ASSIGNMENTS FOR 64 WAY INDIRECT EDGE CONNECTOR

Figure 3: Z-8 Board connector identification.

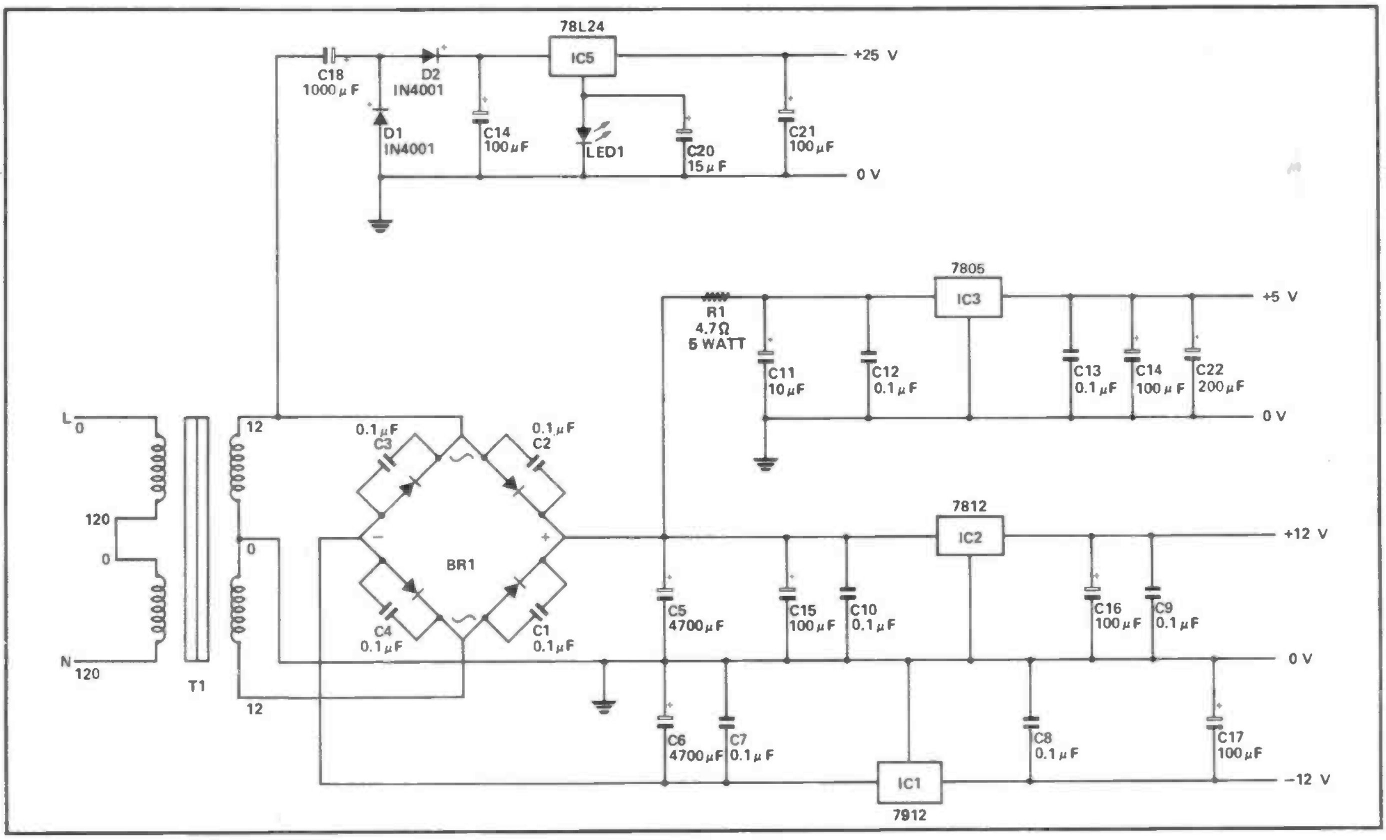
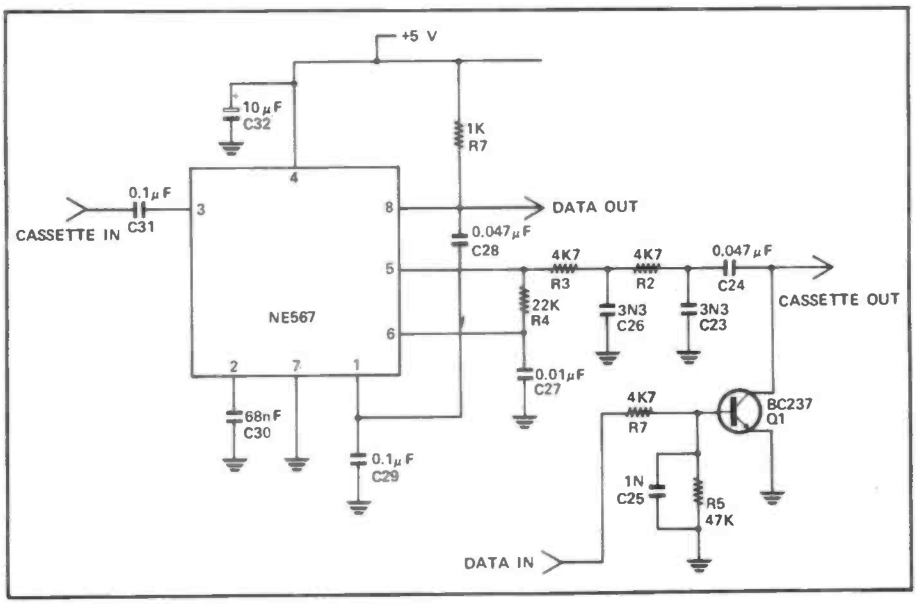


Figure 4: Z-8 PSU and cassette interface circuit diagram.



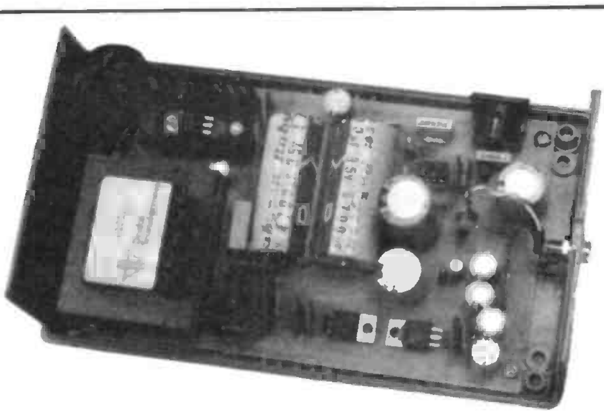


Figure 8: Photograph of Z-8 PSU and cassette interface.

COMPONENTS LIST
for Z-8 PSU & cassette interface

Resistors	
R1	4.7k 5W
R2,R3,R6	4.7k 0.25W
R4	22k 0.25W
R5	47k 0.25W
R7	1k 0.25W
Capacitors	
C1,2,3,4,5,6, 7,8,9,10,12, 13,29	0.1uF 50V Disc
C5,6	35V 4700uF
C11	10uF 35V
C14,15,16,17,21	100uF 25V
C18	1000uF 25V
C19	1000uF 63V
C20	15uF 16V
C22	200uF 16V
C23,26	3n3 plate
C24	0.047 polyester
C25	1nF plate
C27	0.01uF 50V Disc
C28	0.047uF Disc
C30	68nF polyester
C31	0.1uF polyester
C32	10uF 16V tant.
IC1	7912
IC2	7812
IC3	7805
IC4	NE567
IC5	78L21
Q1	BC237
BR1	6A 200V
LED1	Red LED
T1	PCB mounting type P1212 12VA 12-0-12
D1, D2	IN4001

10 way molex plug and socket
5 way DIN socket

Figure 7.

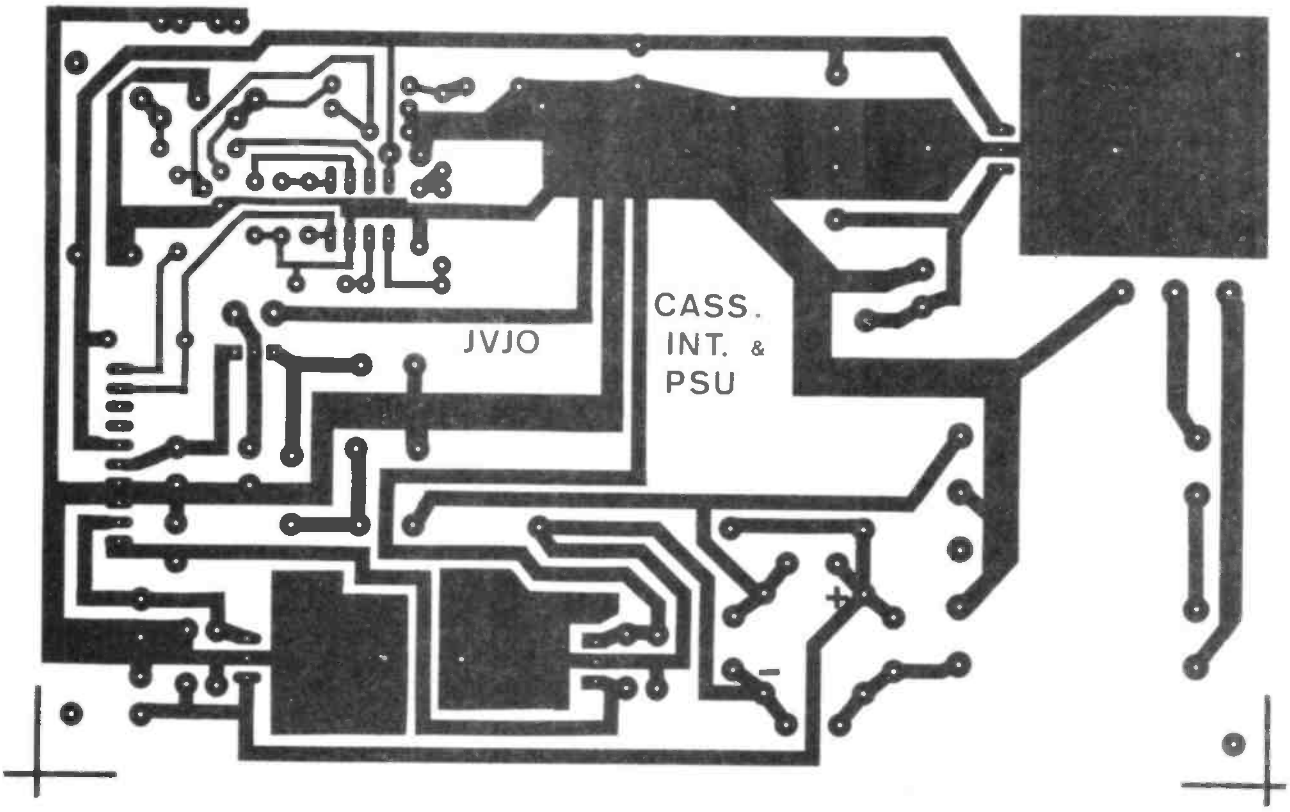


Figure 5: Z-8 PSU and cassette interface PCB track.

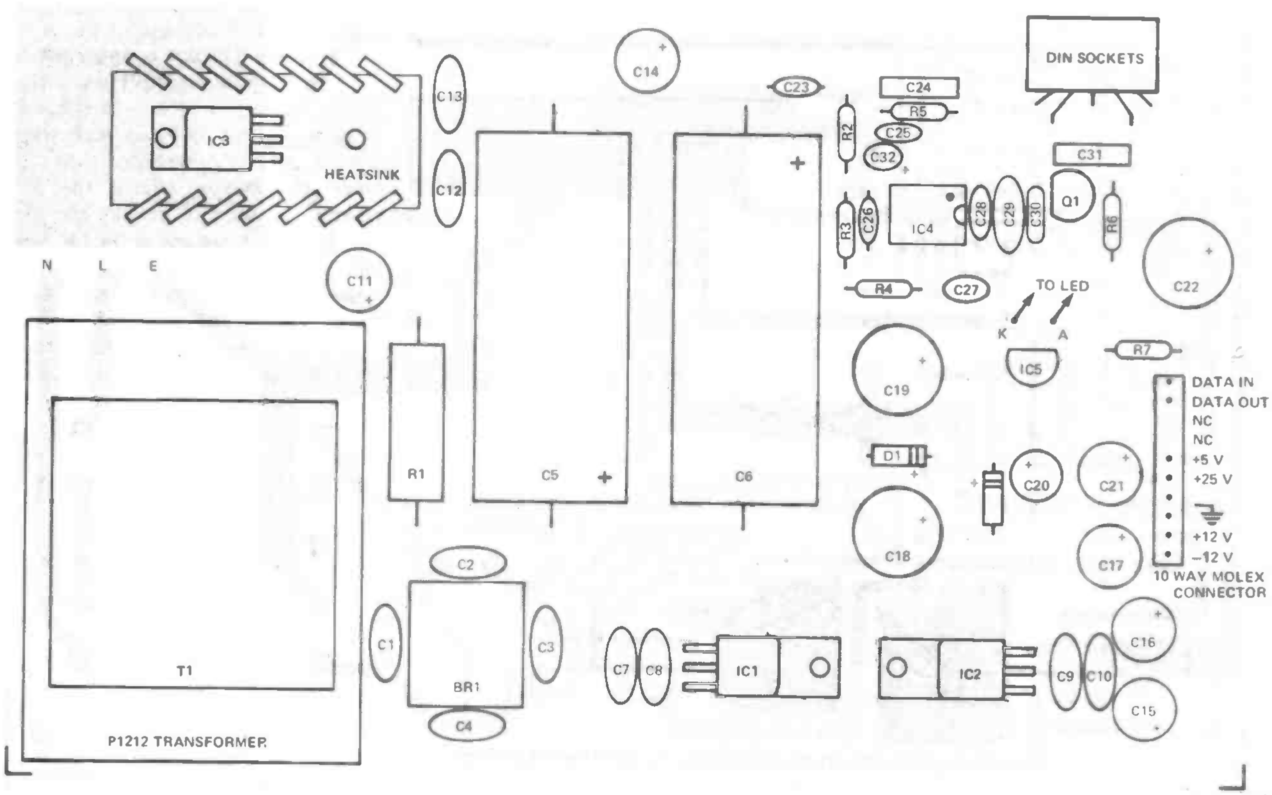


Figure 6: Z-8 PSU and cassette interface component overlay.

TERMINAL SPEED SETTING

SWITCH	1	2	3	4	BAUD RATE
	OFF	OFF	X	ON	110
	ON	ON	X	ON	150
	OFF	OFF	X	OFF	300
	ON	OFF	X	OFF	1200
	ON	OFF	X	ON	2400
	OFF	ON	X	OFF	4800
	OFF	ON	X	ON	9600
	ON	ON	X	OFF	19200

X = DON'T CARE

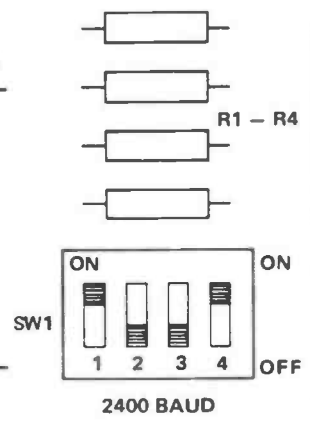


Figure 9: Z-8 Board terminal speed settings.

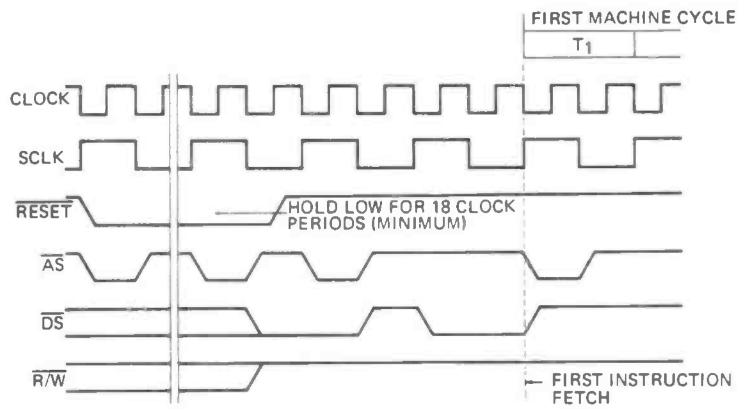


Figure 10: Z-8 Reset timing diagram.

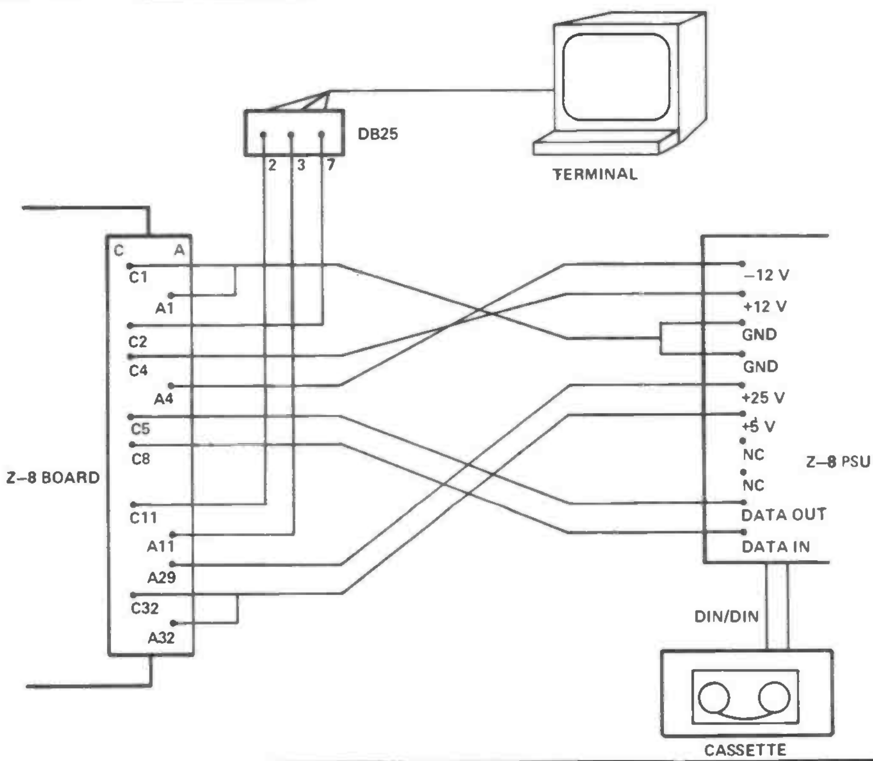


Figure 11: Z-8 Board, PSU and terminal interconnections.

loudspeaker, and prevent premature deafness. Next record the tone again, but whilst the recorder is running, connect and disconnect the far end of R7 to plus 5 volts a few times. On playback, tone and no-tone bursts should be present, the 567 output going high during the no-tone, and low during the tone periods.

Those of you with access to oscilloscopes and test generators should know how to apply them to this test procedure without additional prompting.

Putting it all together

Having made a working PSU and Cassette interface, it is now time to check out the operation of the Z-8 board. RESIST the temptation to simply connect it all up and see if it works. Any mistake is certain to be expensive, and difficult to rectify. If you follow the procedure outlined below, any errors should be detected before damage results.

Making up the cable from the PSU and cassette interface to the Z-8 development board 'indirect' edge connector socket. The connections on the socket should be sleeved to prevent possible short circuits. Also connect up the RS232 terminal you are going to use to the edge connector. *Figs 3 & 10* should be consulted.

Fresh Underwear Time begins here:

Connect up the power supply and Z-8 board. Do not fit any of the ICs into the Z-8 board. Do not connect the terminal. Turn the power supply on with a meter connected across the +5V rail. Check this comes up to voltage and stays there. Repeat this procedure with the other power supplies. Check the 5V power supply at each IC socket also check that +12 volts is present at the far end of R17, —12V at the far end of R18 and +25V at the junction of Q5 and R30. Check with the multimeter that the terminal data I/O lines are connected at the correct points on the edge connector. It is particularly important to take care here, as the RS232 signals are of much greater amplitude than the TTL signals on the rest of the edge connector and will almost certainly harm one or more of the ICs. (The voice of experience.)

Turn off, and connect a terminal. Switch the power back on with the terminal in full duplex mode, and a wire link bridging pins 2 to 6 of IC10. Any characters typed at the keyboard should appear on the screen. This confirms correct operation of the RS232 driver and receiver circuitry.

Turn off.

Fit all the TTL ICs and IC1. Set the correct baud rate onto the dip switches. Switch the power back on, and if all is OK the following message should appear on the terminal.

26! at 65022
:

This is an error message from BASIC saying that it cannot find either RAM or a programme to run. The colon is the BASIC prompt. Without RAM the BASIC will only execute commands entered in the immediate mode; for instance typing:

:PRINT "HI" (cr)
(cr means carriage return)

..should cause the word 'HI' to be printed on the terminal. If an error message did not appear on the terminal, press the reset switch PB1. If nothing happens then check the baud rate switch settings. These switches are only read when the system is reset, so press PB1 every time they are altered. Incorrect characters on the screen is a sign of mismatched baud rates. Check for crystal activity at pins 2 and 3 of IC1. Check that pin 6 of IC1 goes high each time PB1 is passed. If not, check out the reset circuitry. Further clues as to the correct operation of the Z-8671 are given in the reset timing diagram of *Fig 10*.

When debugging any logic based system, check all signal lines. Any lines stuck permanently high or low can easily be spotted. If a signal line is changing, but not between a true high (greater than 3.4 volts) and low (less than 0.8 volts) suspect that two outputs may be shorted together.

Once you have the board working, switch off again and plug in the two RAM chips, IC4 and IC3. The Z-8 will work with either one present, but to enable full development to take place both must be used. When using just one, it is not necessary to change any on board links or switches as the Z-8671 automatically 'measures' and locates RAM on 'power-up'.

Getting going

On switching on the : prompt, without any message should appear.

Type at the terminal:

:PRINTHEX (Λ8)
1000

An answer of 1000 should appear, assuming both chips are used. This is a pointer to the first memory location of IC3 and the first location which will be used by BASIC.

Now type...

:PRINTHEX (Λ12)
2F77

This is the top of the GOSUB stack, and is of course located in IC4.

The utility EPROM and the 8255 may now be plugged in. There will be more information on the utilities next month. Meantime however, full documentation is included with the kit or built units. Note that all ICs on the Z-8 board point the same way, except for EPROMs in the EPROM programming socket. These must be placed the opposite way round.

You may now proceed to familiarize yourselves with Z-8 BASIC. Next month we will look a the facilities of the UTILITY EPROM, and Z-8 programming in general. If you have made the **R&EW** kit, using the sockets provided and you cannot get it going, then the **R&EW** lab will try and fix it. The cost will be £20 plus parts if necessary. We cannot extend this offer to kits constructed without sockets or using anything but the genuine PTH board.

ADDRESS (hex)	CONTENTS
yyF1 - yyFF	Unused.
yy68 - yyF0	Input line buffer, used for editing in immediate mode and user response to IN or INPUT request in run mode.
yy56 - yy67	Unused.
yy54 - yy55	Storage for variable Z.
yy52 - yy53	Storage for variable Y.
. . .	
yy22 - yy21	Storage for variable A.
yy20	Base of GOSUB stack. Stack grows down to lower memory addresses, and may extend until it reaches the top of the user's Basic/Debug program.

Table 1: Storage Location in the Top Page of RAM.

ADDRESS (hex)	CONTENTS (hex)	DESCRIPTION
R0E-0F => (R14-R15)	yy68 to yyF0	Next value to be used from line buffer. INPUT command resets to the beginning of the buffer; IN uses all values in the buffer before resetting.
R0C-0D => (R12-R13)	yy68 to yyF0	Last character entered in line buffer. Backspace subtracts one from this pointer; escape resets it to the beginning of the buffer. R12 is the page number for variables and the input buffer.
R0A-0B => (R10-R11)	yy20	Top of user memory, high boundary of GOSUB stack. Initially set to yy20 of high page of RAM.
R06-07 =>	moves down from yy20	Low boundary and top of GOSUB stack.
R04-05 =>	moves up from xx00	High boundary of user program plus stack reserve.
R08-09 =>	xx00	Bottom of user memory; first line of user program.

Table 2: Z-8 BASIC Memory and Pointers.

Next month

Utilities and programming techniques are covered, and we invite readers to enter our 'win a Z-8 system' applications ideas competition. □ **R & EW**

Your Reactions.........	Circle No.
Excellent - will make one	160
Interesting - might make one	161
Seen Better	162
Comments	163

Catronics

Your one-stop shopping centre for complete equipment from 'Trio' and 'Philips', accessories from 'Jaybeam' and 'Microwave Modules', components, kits and the 'Video Genie' Microcomputer system.

Now available from Catronics — REAL Value-for-Money in Microcomputers

video genie system

Advanced features are:

1. Built-in TV interface, the user's TV set may be used as the display terminal, thus saving money.
2. Main Control Unit contains the CPU plus.
   (i) 51 key typewriter keyboard, with 10 key rollover.
   (ii) High quality cassette recorder, enables recording and playback of programs, data and the use of pre-recorded tapes.
3. Built-in audio cassette interface for connecting another cassette recorder to serve as cheap and compact storage for large amounts of data on tapes.
4. 16k user RAM included, expandable to 48k.
5. Fully TRS 80 level II software compatible so a huge range of software is already available.
6. Full 12k Microsoft BASIC in ROM.
7. Full expansion capability to Discs and Printer, a small system with big possibilities.
8. Self-contained, all in one attractive case.
9. The system uses the powerful Z80 processor.

Our Special Price only £344.00inc. VAT.

Full range of supporting programs and accessories available, including Amateur Radio packages

New RTTY Terminal Unit /Program for Computers	Fabulous new program now available to send and receive RTTY. Complete with Receive Terminal Unit and Transmit AFSK on PCB assy. Suitable for Video Genie and TRS80 computers: CT600 price £121.90.

APPROVED TRIO DEALER

Why not pay us a personal visit? CATRONICS are 300 years from Wallington Railway Station (London Bridge or Victoria). Frequent buses from Croydon and Sutton. Three large car parks within 100 yards. Hire purchase facilities available on equipment. Credit Cards accepted. Mail orders are normally dealt with on day of receipt. All our prices INCLUDE VAT.

BARCLAYCARD VISA — ACCESS

Catronics Ltd., Dept. 241 Communications House, 20 Wallington Square, Wallington, Surrey SM6 8RG
Tel: 01-669 6700. Shop/Showroom open Mon to Fri 9am to 5.30pm. Closed for lunch 12.45 to 1.45pm. Sat 9am to 12.45pm.

293 for further details.

Sowter Transformers

With 40 years' experience in the design and manufacture of several hundred thousand tranformers we can supply

AUDIO FREQUENCY TRÁNSFORMERS OF EVERY TYPE

YOU NAME IT! WE MAKE IT!

Telex: 987703 SOWTER

OUR RANGE INCLUDES:

Microphone transformers (all types), Microphone Splitter/Combiner transformers, Input and Output transformers, Direct Injection transformers for Guitars, Multi-Secondary output transformers, Bridging transformers, Line transformers, Line transformers to G.P.O. Isolating Test Specification, Tapped impedance matching transformers, Gramophone Pickup transformers, Audio Mixing Desk transformers (all types), Miniature transformers, Microminiature transformers for PCB mounting, Experimental transformers, Ultra low frequency transformers, Ultra linear and other transformers for Transistor and Valve Amplifiers up to 500 watts, Inductive Loop transformers, Smoothing Chokes, Filter, Inductors, Amplifier to 100 volt line transformers (from a few watts up to 1,000 watts), 100 volt line transformers to speakers, Speaker matching transformers (all powers), Column Loudspeaker transformers up to 300 watts or more.

We can design for RECORDING QUALITY, STUDIO QUALITY, HI-FI QUALITY OR P.A. QUALITY. OUR PRICES ARE HIGHLY COMPETITIVE AND WE SUPPLY LARGE OR SMALL QUANTITIES AND EVEN SINGLE TRANSFORMERS. Many standard types are in stock and normal despatch times are short and sensible.

OUR CLIENTS COVER A LARGE NUMBER OF BROADCASTING AUTHORITIES, MIXING DESK MANUFACTURERS, RECORDING STUDIOS, HI-FI ENTHUSIASTS, BAND GROUPS AND PUBLIC ADDRESS FIRMS. Export is a speciality and we have overseas clients in the COMMONWEALTH, EEC, USA, MIDDLE EAST, etc. Send for our questionnaire which, when completed, enables us to post quotations by return.

E. A. Sowter Ltd.

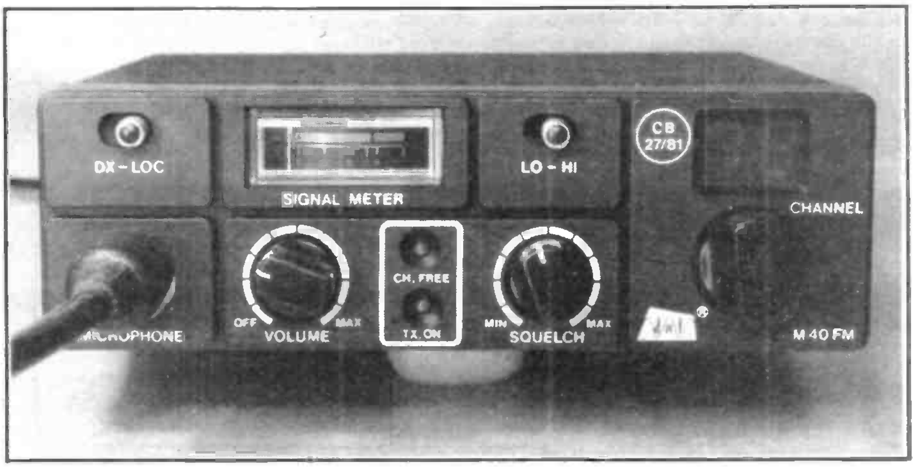
Manufacturers and Designers

E. A. SOWTER LTD. (Established 1941), Reg. No. England 303990
The Boat Yard, Cullingham Road, Ipswich IP1 2EG, Suffolk, P.O. Box 36, Ipswich IP1 2EL, England
Phone: 0473 52794 & 0473 219390

29 for further details

M40FM CB rig from DNT.

Fresh from the shelves of H Lexton, we see if this Hong Kong-made CB rig matches the high standards set by the Jap-made gear.



Was that 10-4, or 4-10?

DNT, LCL and several other names adorn the front panel of this quite neatly conceived CB radio. The original company behind the brand is in fact a West German manufacturer who found the low costs of Hong Kong a temptation that could not be matched even by the ruthless efficiency of the Fatherland's industrial machine.

The other popular CB rig from the last outpost of the British Empire comes in under the Binatone brand - and our first encounter with an example of one of those shockers is largely unprintable. The DNT rig is neatly presented in a tidy box - the panel is subdued and functional, although the doubts raised by the presence of the RF gain control were to some extent justified - as we shall see.

Opening up the rig and peering inside *(PHOTO)* revealed the usual Hong Kong assembly techniques. They take a shotgun, fill it with components, and fire it at the PCB before flow soldering. Damn cunning, these Chinese.

Euro influence.

The DNT shows distinct signs of its European origins. The 5 pin DIN plug on the microphone is a bit of a giveaway - and the fact that there is no trace of chrome on the front panel is a blessed relief from most of the rest of the market.

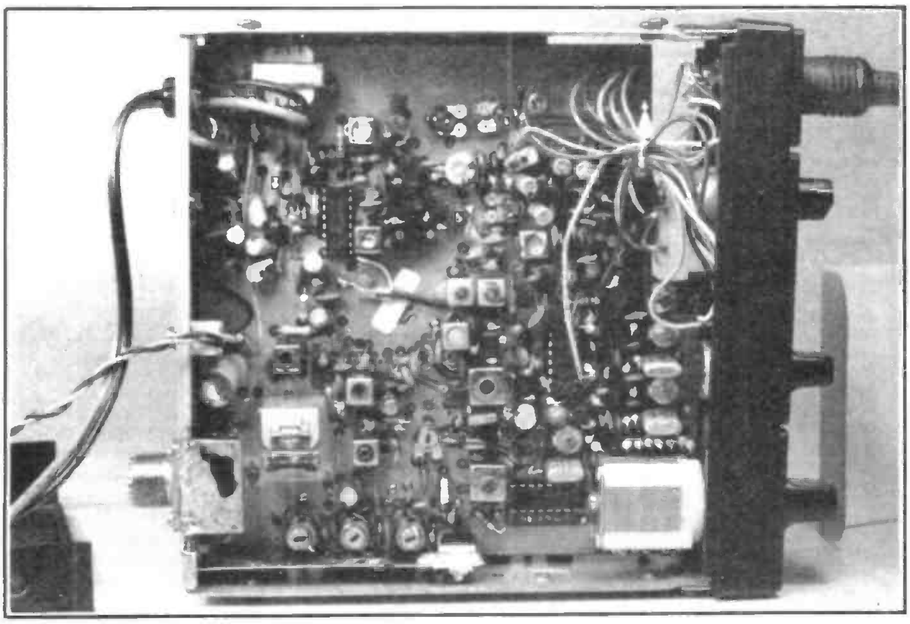
The block diagram and circuit *(Fig 1 and 2)* do not include as much oriental influence as most rigs - and this is one of the few UK spec transceivers that does not use the Sanyo LC7137 PLL (featured in the January Databrief). Instead, a standard Motorola PLL synthesiser device is used in conjunction with a few crystals to provide the prescribed mixture.

The LM383 in the audio stage is National Semiconductor's answer to the TDA2002 (a very Euro device) - and a 3N201 is certainly not found in many oriental designs.

The circuit - first the PLL.

The best place to start is where the frequencies are generated. The MC145106 is not the most modern of solutions -indeed it was virtually abandoned by CB manufacturers for the US market 4 years ago with the advent of the 7120 and 7130 devices from Sanyo. Nevertheless, the device in the set we saw bore the time code '8132', which would indicate 1981, week 32 manufacture.

In view of the possible stranglehold that Sanyo hold on the production of CB (thanks to their near monopoly supply of the 7137), perhaps this isn't such a bad move. The 'usual' application is shown in *Fig 3*. Being essentially a low speed CMOS



Inside the rig

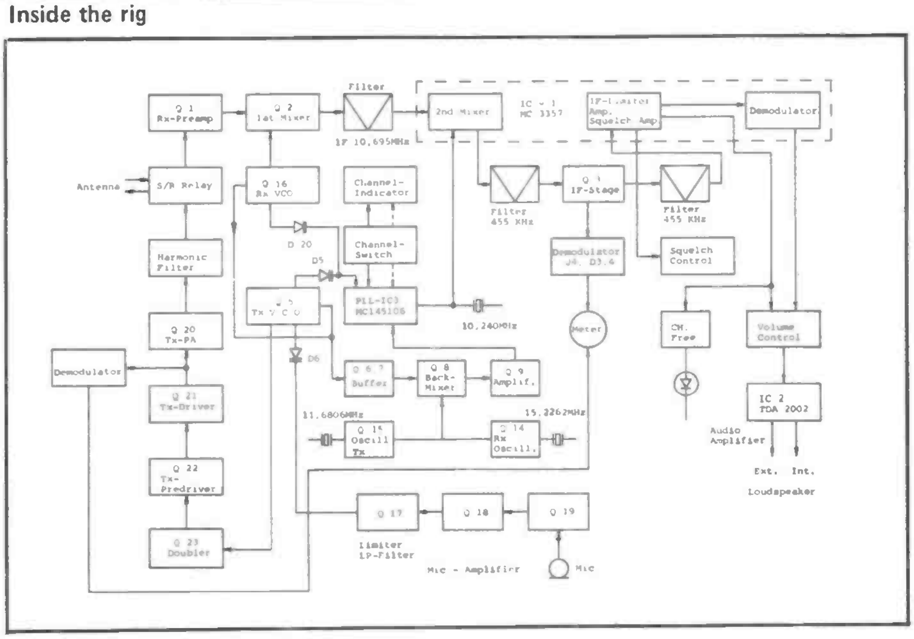


Figure 1: Block diagram of the M40FM.

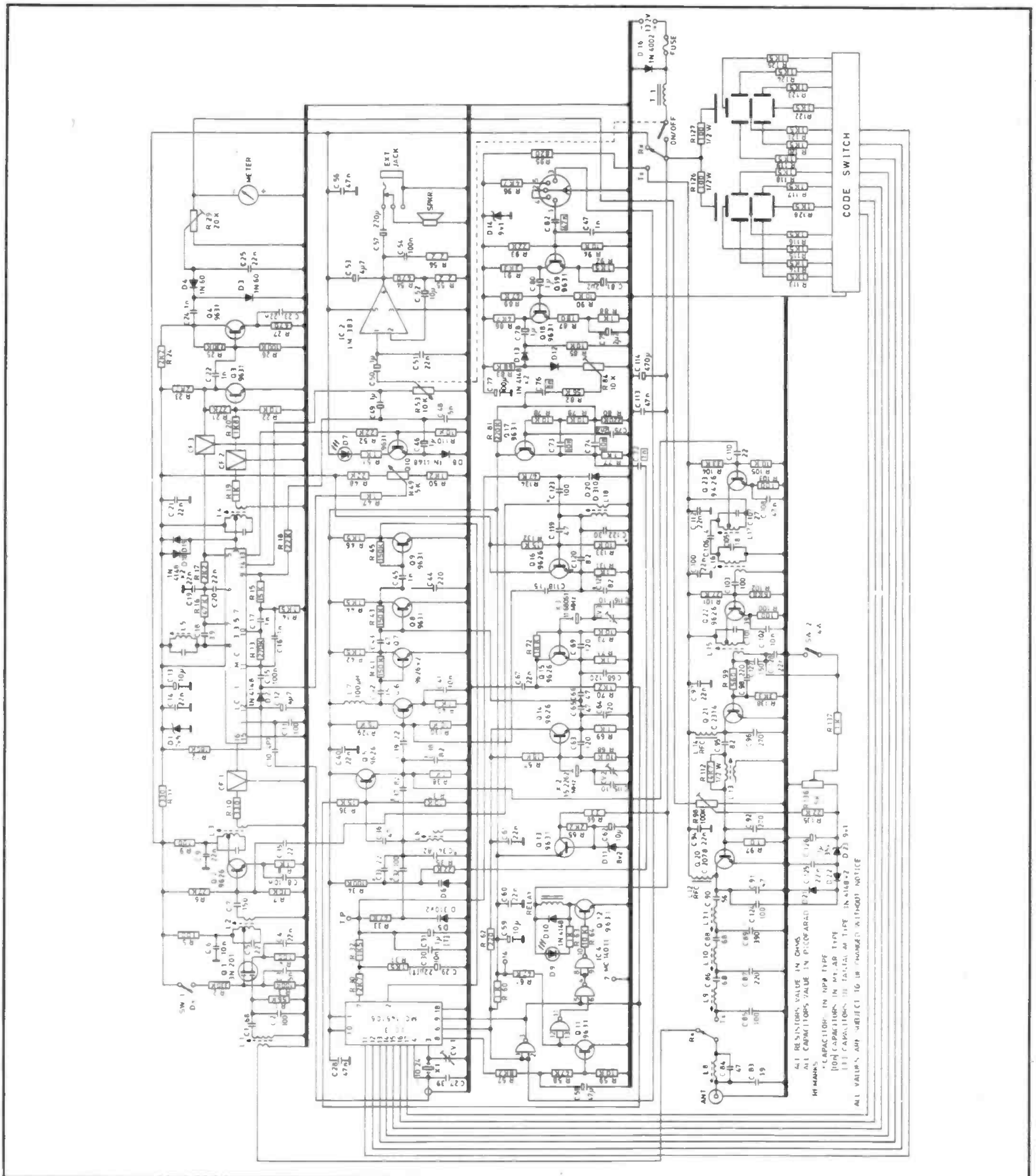


Figure 2: Full circuit diagram of the M40FM.

device, the MC145106 operates to only 4-5 MHz and must be used in a mixer configuration.

Prescaling is hardly ever found in this type of equipment, with mixing being the favourite means of achieving the necessary output frequency. The 9 stage binary programmable counter has maximum count of 511 (1 less than you might expect) - so with a reference frequency of 5 kHz (as determined by the 10.24 MHz crystal used), the 10 kHz UK channel spacing can be achieved.

In order to provide enough scope for linear narrow band FM, the synthesiser is programmed to generate 13.800625 MHz (half channel 1 frequency on 27.60125 MHz), and it does this by mixing the VCO in Q8 with 11.68061MHz from a crystal oscillator : result 2.120025 MHz. In view of the limited range of 'N' counter, it must be assumed that this corresponds to a division of 434 - with channel 30 on 27.90125 producing a 2.270025 MHz mixing product, division ratio 454.

If you work these out in reverse, the

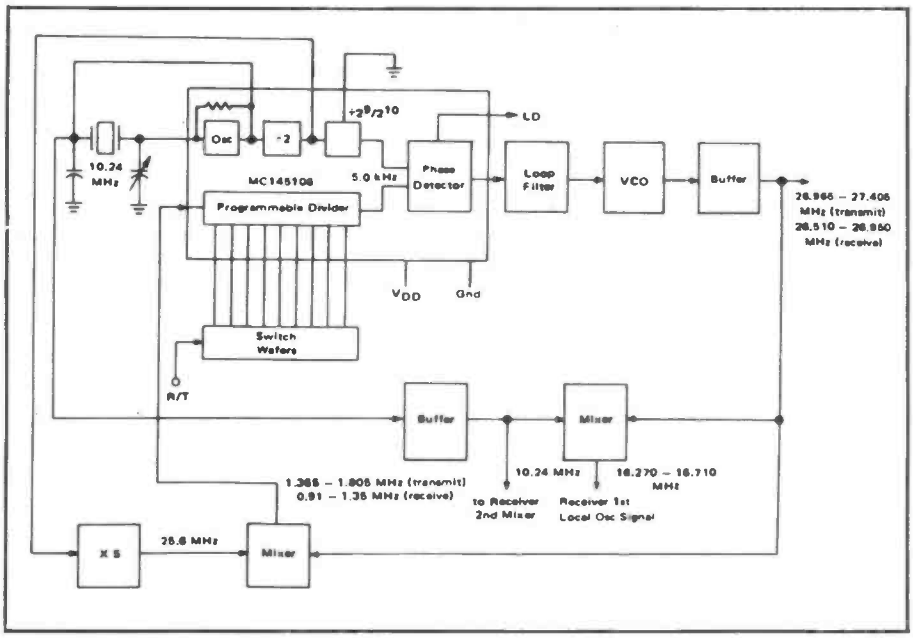


Figure 3: MC145106 application circuit.

results are not perfect to the nearest Hz, so it must be assumed that the crystals are trimmed onto the exact channel.

The receiver does the same trick, except allowing for a 10.695 kHz IF offset, with oscillator injection of the LF side. The synthesiser thinks it's looking at the range 1.68-1.88 MHz (10 kHz steps this time, although still with the 5 kHz reference).

Next the receiver.

The receiver is a strange thing. A delightfully sensitive stage is followed by a bipolar mixer of really quite indescribably bad performance. How this came about, heaven only knows. The rest of the receiver is excellent, showing off the advantages of true noise muting in a purpose made device. There is little RF selectivity in this design - in view of the tendency of the mixer to overload, the more the better, perhaps.

Roofing selectivity is provided by CF1 (a ceramic filter) - and then the MC3357 takes over and does a very thorough job of the second conversion, limiting and detection. The main channel selectivity is provided by a pair of Murata CFU455G filters - with a nominal bandwidth of 8 kHz (typically 10 kHz) these might be just a shade on the wide side in view of their shape factors. However, the extra bandwidth helped reception of those naughty folk who had obviously found the deviation preset inside their rigs, and given it a tweak to sound louder.

Signal metering is provided by taking some signal from the IF pre-stage (Q3) and rectifying it. Not the greatest of meter dynamic ranges, since no AGC or log detection is used - see the results table for the number. The squelch output (pin 14) clamps the volume control to ground, and this is supplemented by the effect of the scan control on pin 14, which turns on Q10 when the mute is shut to light the 'channel free' lamp. This may seem rather obvious at first - but in sets where Secall or sub audio signalling is used (and there's plenty of room in this case for another PCB), it is necessary to establish that the channel is unoccupied before calling. Indeed, the 'channel free' signal may be used to inhibit transmission.

However, when Q10 is turned on D8 acts as an effective audio shunt to ground via C46. Belt and braces muting ensues. The audio output is loud and quite adequate.

Then the transmitter.

Straightforward stuff here. Q23 acts as a doubler amplifier, with L16 and L17 providing a bandpass filter to keep out the (approx) 13.4 MHz. The remaining stages amplify to 4 W output - although there is an interesting piece in the 10 dB attenuated output. This is achieved by sniffing signal through C125, rectifying it and applying it to an ALC circuit whose level is set by R136. This voltage is also used to drive the output 'meter' circuit via R98. The ALC is applied to the base of Q21, and simply bypassed when 4 W is required.

The output is applied to an antenna relay (not quite sure why they bother at this low power level) via a low pass filter which is beginning to look familiar in all UK spec rigs.

Pre-emphasis isn't obvious in the audio stages - although C76/R82 might arguably pass as some form of treble enhancement. The clipping stage uses D12 and D13 in a conventional diode limiter, and resulting splatter is mopped up by the low pass filter formed on Q17.

Results.

Well, the receiver works very nicely when the going is not too awkward, but it blocks horribly at the first sign of strong signals, and shows some rather indifferent 3rd order IMD behaviour. (See results *Table 1*). On-the-air tests show the device to behave well otherwise.

The mixer should be readily modified with a FET or a MOSFET by a keen radio enthusiast, since the rest of the receiver is one of the better conceived ideas we have seen. Certainly the muting works effectively in the midst of the miscellaneous junk cluttering the UK CB allocation.

The transmitter audio is not particularly crisp (a lack of correctly defined pre-emphasis) - but apart from that, there are no particularly bad habits to report, and on the whole, the rig is simple and effecient in operation.

The results of our various tests are tabulated in *Table 1*.

R&EW Test Results

MUS	CH1	CH40	
Dx	0.16 uV	0.16 uV	
Local	0.5 uV	0.5 uV	
S9 on meter			
Dx		0.6 uV	
Local		6.0 uV	
Adjacent Channel		48 dB	
IMD		36 dB	
Blocking		79 dB	
Spurious			
50 dB		27.97 MHz	Tests
rejection		27.84 MHz	carried
		27.73 MHz	out on
		27.56 MHz	Channel
60 dB		27.66 MHz	19
		27.62 MHz	
		27.90 MHz	
		27.92 MHz	
		28.00 MHz	

Note: 'Birdie' on CH2 at equivalent level of 0.2 uV

TX O/P	CH40	CH1
	3.5 W	3.4 W

All spurious 80 dB
Deviation +/— 1.6 kHz
Supply Voltage 13.2 V

Table 1: R&EW test results.

Conclusions.

A sound basic rig - once the receiver mixer is swapped for something like a 3SK88/3SK45 etc. It is relatively easy to 'get at' - and you might like to note that the use of MC145106 PLL device allows a much easier modification to the 10 m amateur band than most other rigs with the LC7137.

■ R & EW

Your Reactions.........	Circle No.
Immediately Applicable	286
Useful & Informative	287
Not Applicable	288
Comments	289

R&EW Data Brief

MC145151

A high speed CMOS synthesiser development system.

General.

The MC145151 represents another example of silicon gate CMOS at work. Motorola have always been strong in RF and frequency synthesis technology, so the versatility of this family of devices owes much to experience. Other members of the family contain dual modulus prescalar controllers and serial data latching. The MC145151 featured here is the ideal 'development' tool for the hardware of such systems.

Figure 1 details of the internal layout of this device, which contains all the elements of a complete synthesiser (bar the VCO), and *Table 1* covers the electrical characteristics - which remain essentially the same for other family members.

The reference oscillator is controlled with a three bit code *(Table 2)* to suit a wide variety of crystals and reference frequencies. The main programmable counter inputs (logic '1' when high or OC due to internal pullups) can be instructed (14 bit binary) to divide from 3 to 16383 - and transmit/receive offset of 856 is added when pin 21 is low.

This can be used with 25 kHz channel spacing and 21.4 MHz filtering in UHF transceivers - or with 12.5 kHz channel spacing and 10.7 MHz filtering for HF/VHF applications. Alternatively the transmit and receive data may be loaded separately. The output of the N counter is available at pin 10 for use during development - this is very useful during development, since the actual division can be checked against that predicted, or can be used in another loop system entirely.

The phase detector outputs are shown in *Fig 2*. Either the tristate or double-ended phase detectors can be used with the filters of *Fig 3*. Simple non-critical applications can start the basic approach of *Fig 3a & 3b* - although when the reference frequency becomes less than 1% of the VCO frequency, *Fig 3c* is obligatory. Much depends on the VCO, of course, and readers are referred to 'Design of Phase Locked Loop Circuits' by Howard Berlin (**R&EW Book Service**) for all you need to know about applying this form of phase detector.

Pin 28 pulses low when unlocked, and remains 'High' when the loop is locked.

RA0, RA1, RA2 (Pins 5, 6, and 7) —

These three inputs establish a code defining one of eight possible divide values for the total reference divider, as defined by the table below:

Reference Address Code			Total Divide Value
RA2	RA1	RA0	
0	0	0	8
0	0	1	128
0	1	0	256
0	1	1	512
1	0	0	1024
1	0	1	2048
1	1	0	2410
1	1	1	8192

Table 2: The reference oscillator is controlled by a 3-bit code.

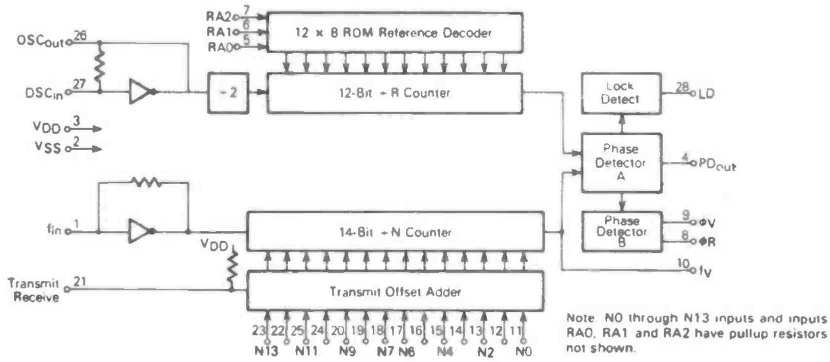


Figure 1: Internal layout of the MC145151.

ELECTRICAL CHARACTERISTICS

Characteristic		Symbol	VDD	T_{Low} Min	T_{Low} Max	25°C Min	25°C Typ	25°C Max	T_{High} Min	T_{High} Max	Units
Power Supply Voltage Range		V_{DD}	–	3	9	3	–	9	3	9	Vdc
Output Voltage, $V_{in} = V_{DD}$ or 0	0 Level	V_{OL}	3	–	0.05	–	0	0.05	–	0.05	Vdc
			5	–	0.05	–	0	0.05	–	0.05	
			9	–	0.05	–	0	0.05	–	0.05	
$V_{in} = 0$ or V_{DD}	1 Level	V_{OH}	3	2.95	–	2.95	3	–	2.95	–	
			5	4.95	–	4.95	5	–	4.95	–	
			9	8.95	–	8.95	9	–	8.95	–	
Input Voltage, $V_O = 2.5$ or 0.5	0 Level	V_{IL}	3	–	0.9	–	1.35	0.9	–	0.9	Vdc
$V_O = 4.5$ or 0.5			5	–	1.5	–	2.75	1.5	–	1.5	
$V_O = 8.5$ or 1.5			9	–	2.7	–	4.05	2.7	–	2.7	
$V_O = 0.5$ or 2.5	1 Level	V_{IH}	3	2.10	–	2.10	1.65	–	2.10	–	
$V_O = 0.5$ or 4.5			5	3.5	–	3.5	2.75	–	3.5	–	
$V_O = 1.5$ or 8.5			9	6.3	–	6.3	4.95	–	6.3	–	
Output Current, $V_{OH} = 2.7$	Source	I_{OH}	3	−0.44	–	−0.35	−0.66	–	−0.22	–	mAdc
$V_{OH} = 4.6$			5	−0.64	–	−0.51	−0.88	–	−0.36	–	
$V_{CH} = 8.5$			9	−1.3	–	−1.0	−1.3	–	−0.7	–	
$V_{OL} = 0.3$	Sink	I_{OL}	3	0.44	–	0.35	0.66	–	0.22	–	
$V_{OL} = 0.4$			5	0.64	–	0.51	0.88	–	0.36	–	
$V_{OL} = 0.5$			9	1.3	–	1.0	1.3	–	0.7	–	
Input Current	Other Inputs	I_{IL}	9	–	−60	–	−25	−50	–	−35	µAdc
	f_{in}, OSC_{in}		9	–	±15	–	±5	±10	–	±8	
	f_{in}, OSC_{in}	I_{IH}	9	–	±15	–	±5	±10	–	±8	
	Other Inputs		9	–	±0.3	–	±0.00001	±0.1	–	±1.0	
Input Capacitance		C_{in}	3-9	–	10	–	6	10	–	10	pF
Output Capacitance		C_{out}	3-9	–	10	–	6	10	–	10	pF
Quiescent Current		I_{DD}	3	–	800	–	200	800	–	1600	µAdc
			5	–	1200	–	300	1200	–	2400	
			9	–	1600	–	400	1600	–	3200	
Three-State Leakage Current	PD_{out}	I_L	9	–	±0.1	–	±0.0001	±0.1	–	±3.0	µAdc

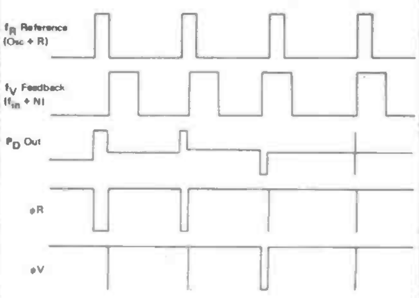
NOTE: $T_{low} = -40°C$
$T_{high} = 85°C$

SWITCHING CHARACTERISTICS ($T_A = 25°C$, $C_L = 50$ pF)

Characteristic	Symbol	V_{DD}	Min	Typ	Max	Units
Output Rise Time	t_{TLH}	3	–	100	200	ns
		5	–	50	100	
		9	–	40	80	
Output Fall Time	t_{THL}	3	–	100	200	ns
		5	–	50	100	
		9	–	40	80	
Output Pulse Width, ϕ_R, ϕ_V with f_R in Phase with f_V	$t_{WH(\phi)}$	3	70	120	170	ns
		5	50	100	150	
		9	30	80	130	
Input Rise and Fall Times, OSC_{in}, f_{in}	t_{TLH}, t_{THL}	3	–	–	5	µs
		5	–	–	4	
		9	–	–	2	
Input Pulse Width, OSC_{in}, f_{in}	t_W	3	40	30	–	ns
		5	35	20	–	
		9	25	15	–	

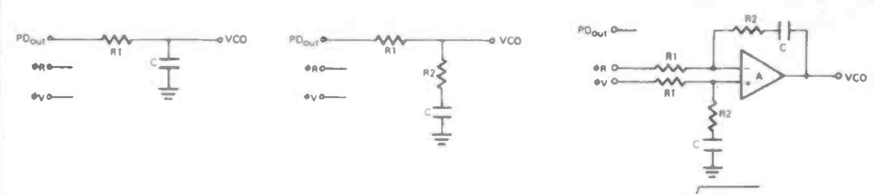
Characteristic		Symbol	VDD	T_{low} Min	T_{low} Max	25°C Min	25°C Typ	25°C Max	T_{high} Min	T_{high} Max	Units
Operating Frequency OSC_{in}	Input = SQ Wave $V_{DD} - V_{SS}$	f_{max}	3	–	17	–	27	14	–	12	MHz
			5	–	33	–	56	27	–	21	
			9	–	35	–	65	35	–	33	
	Input = Sin Wave 500 mV ptp	f_{max}	3	–	11	–	21	10	–	9	MHz
			5	–	20	–	34	17	–	15	
			9	–	17	–	34	17	–	15	
Operating Frequency	f_{in} Input = SQ Wave $V_{DD} - V_{SS}$	f_{max}	3	–	9	–	15	8	–	7	MHz
			5	–	19	–	30	15	–	15	
			9	–	31	–	52	26	–	22	
	Input = Sin Wave 500 mV ptp	f_{max}	3	–	10	–	15	7	–	6	MHz
			5	–	18	–	31	15	–	15	
			9	–	21	–	31	15	–	15	

Table 1: Electrical characteristics of the MC145151.



NOTE: The P_D output state is equal to either V_{DD} or V_{SS} when active. When not active, the output is high impedance and the voltage at that pin is determined by the low pass filter capacitor.

Figure 2: Phase detector output waveforms.



$$\omega_N = \sqrt{\frac{K_\phi K_{VCO}}{NR1C}} \qquad \zeta = 1/2\ \omega_N\ (N/K_\phi K_{VCO}) \qquad F(s) = \frac{1}{R1CS + 1}$$

$$\omega_N = \sqrt{\frac{K_\phi K_{VCO}}{NC(R1 + R2)}} \qquad \zeta = 1/2\ \omega_N\ (R2C + N/K_\phi K_{VCO}) \qquad F(s) = \frac{R2CS + 1}{S(R1C + R2C) + 1}$$

$$\omega_N = \sqrt{\frac{K_\phi K_{VCO}}{NCR1}} \qquad \zeta = \frac{\omega_N R2C}{2}$$

Assuming gain A is very large, then:

$$F(s) = \frac{R2CS + 1}{R1CS}$$

NOTE: Sometimes R1 is split into two series resistors each R1 ÷ 2. A capacitor C_C is then placed from the midpoint to ground to further filter φV and φR. The value for C_C should be such that the corner frequency of this network does not significantly affect ω_N.

DEFINITIONS: N = Total Division Ratio in feedback loop
$K_\phi = V_{DD}/4\pi$ for PD_{out}
$K_\phi = V_{DD}/2\pi$ for φV and φR
$K_{VCO} = \frac{2\pi \Delta f_{VCO}}{\Delta V_{VCO}}$
for a typical design $\omega_N \cong 2\pi/10\ f_r$ (at phase detector input)
$\zeta \cong 1$

Figure 3: Phase Locked Loop - Low Pass Filter design.

DATABRIEF applications circuit (Figure 4).

This PCB has been designed as a 'synthetic crystal' for designers wanting to be able to generate a crystal-accurate frequency 'off the shelf' using just a few stock values: e.g. 10.695 MHz required - so use an 8.192 MHz crystal and program RA0-RA2 all high (open circuit). The 'N' counter is loaded with 10695:

(The technique is simple - write out a 14 bit line, and simply subtract the highest permissible 'bit' from the required number:
10695-8192 = 2503 : '1'
2503-4096 doesn't '0'
2503-2048 = 455 : '1'
etc.

Then set up the DIP switches (0 is ground) on the PCB. The VCO and filter time constants are calculated from standard formulae.

The circuit of *Fig 4* covers approx 3-6 MHz in 10 kHz steps, although the PCB can be populated with the appropriate coil/capacitor/crystal combinations to cover anything up to 40 or 50 MHz. Since no minimum frequency is specified, it must be assumed that the same board can be used to synthesise low frequency signals too - the VCO will not be able to range very widely, but will be good enough to stabilize a 19 kHz oscillator for example

The ICL8038 can be used for wider ranging applications, and we hope to report on these soon.

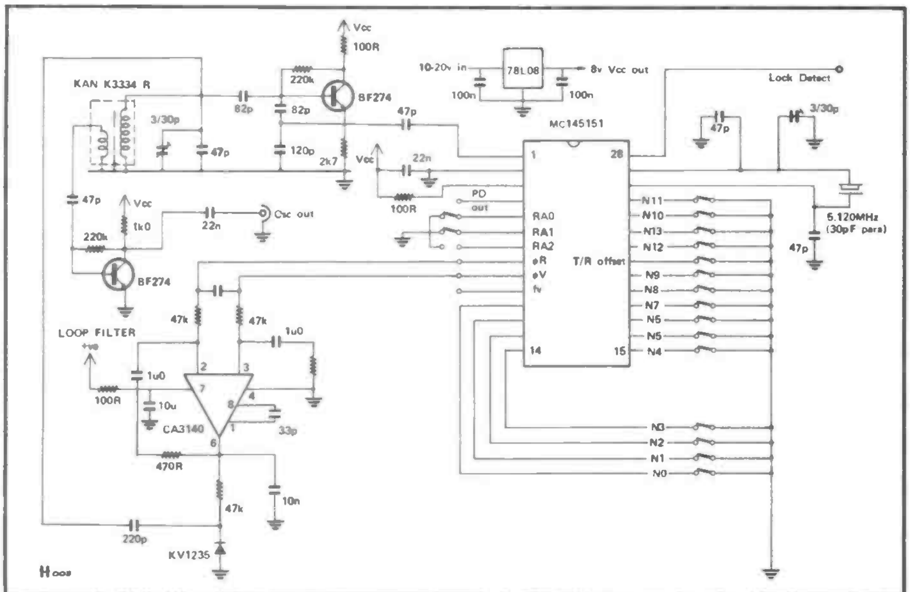
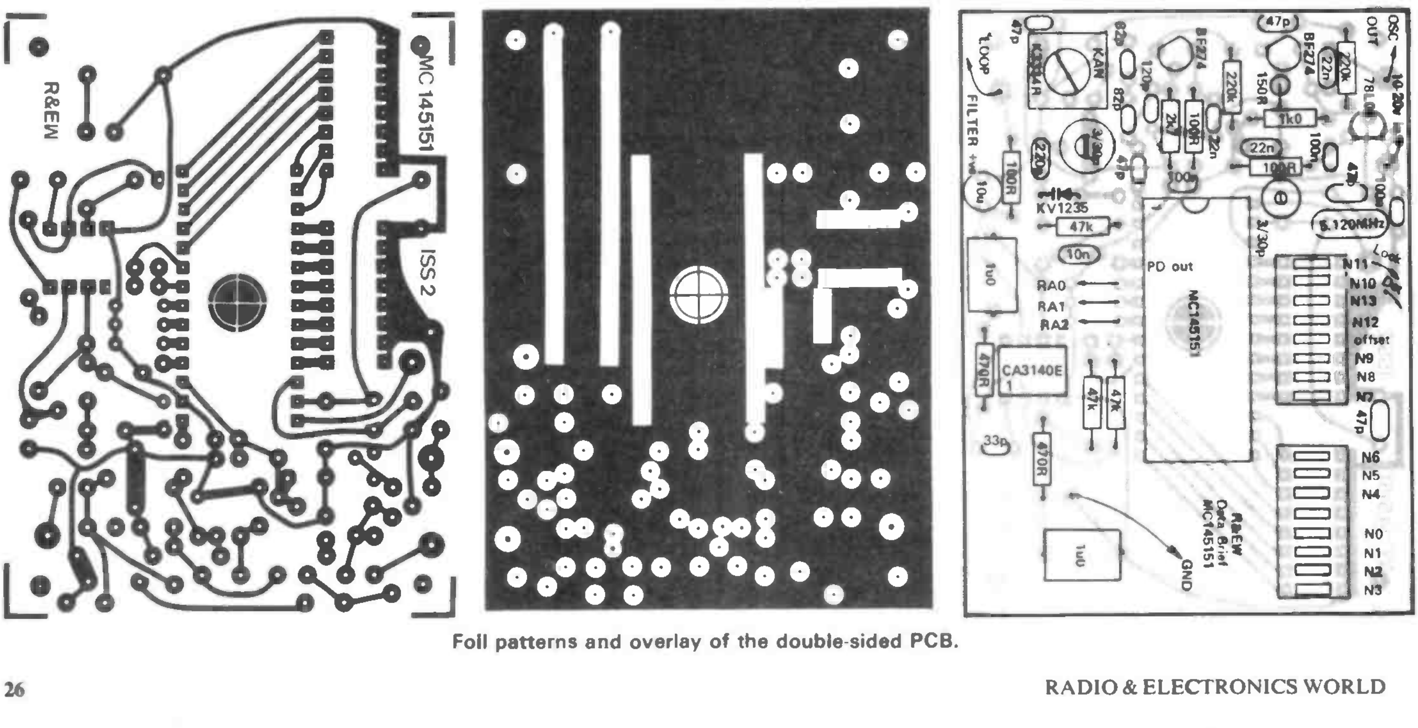


Figure 4: MC145151 'synthetic crystal' application circuit.

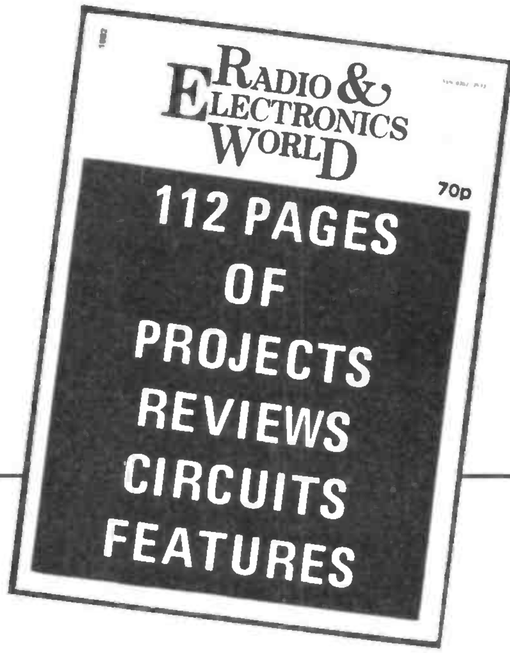


Foil patterns and overlay of the double-sided PCB.

COMING NEXT MONTH IN THE

APRIL ISSUE OF R&EW

THE BEST VALUE FOR MONEY ELECTRONICS MAGAZINE AVAILABLE



GREAT PROJECTS, including:

GAMMA RADIATION MONITOR

This small, modestly priced battery-powered unit gives audio/visual readouts of low-level gamma and high-level beta radiation. Analogue count indications (up to 1000/sec) are given on an inexpensive moving-coil meter, and the instrument is housed in an attractive case. Designed in our own laboratory by the ubiquitous Roger Ray, this is an absolute 'must' project for all serious experiments and would-be physicists.

MSF TIME-CODE RECEIVER/CLOCK

The ultimate timepiece! This microprocessor-controlled 'clock' is radio-linked to the atomic standard at the National Physical Laboratory. It gives a continuous readout of time, day, date and month on a dot-matrix LCD display, and its accuracy NEVER varies by more than one second (unless, of course, the World blows up, in which case - who cares?).

KEY-PAD SECURITY LOCK

This incredibly inexpensive piece of state-of-the-art electronics will be hated by all housebreakers. The device accept a four-decade code (of your own choice) that is punched in via a 10-button keypad, and incorporates an anti-tamper feature. It can be used as a stand-alone security lock, or can be used to supplement your existing Yale or other latch.

2 METRE PRE—AMP

Another high-performance pre-amp from the mystical workshop of our tame RF-wizard, Timothy Edwards. Need we say more? You know it must be good!

PLUS:

Software and programming information on our superb Z-8 COMPUTING SYSTEM, with lots of 'applications' tips.

plus REVIEWS OF

The VIC20 Computer from Commodore
The VIC20 Expansion System from Arfon
A new FUNCTION GENERATOR from Levell
The C58 Transceiver from Standard

Radio & Electronics World disappears from book stalls *fast*. Make sure you get your copy by placing a regular order with your Newsagent. Just fill in this coupon and hand it to him?
NEWSAGENT: Please reserve me a copy of the APRIL '82 RADIO & ELECTRONICS WORLD

Name ....

Address ....

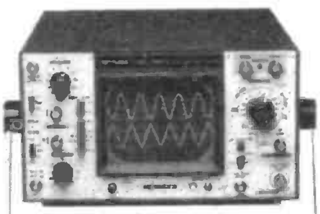
R&EW

The full range of Leader Test Equipment, the first choice of engineers around the world, is now available in the U.K.

Leader products, with a long history of high reliability, back by a 1-year warranty, are engineered and built to the most rigid standards, and incorporate the latest technology. A complete technical and service facility is provided in the U.K. by Thandar Electronic Ltd

OSCILLOSCOPES

4-50MHz Oscilloscopes with more performance and reliability for less cost. The Leader range of oscilloscopes includes 14 models, single and dual trace, for bench or field use. All models offer comprehensive triggering controls, TTL compatible Z-AXIS modulation and convenient colour-keyed front panel layout. Probes are included with each model.



LB0508A OSCILLOSCOPE

With 20MHz bandwidth and 10mV input sensitivity on a 5" screen this universal oscilloscope is suitable for a wide range of applications

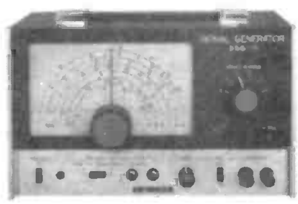
- •5" Dual trace
- •DC-20 MHz bandwidth (vert amp)
- •10mV Sensitivity
- •Sweep mode: chop - ALT, CH1, CH2, X-Y
- •Synchronisation: Auto, Norm, TV, Int., Ext., +, -
- •Timebase Sweep Speeds: 0.5µs/cm – 200 ms/cm
- •X5 Magnification (max speed 100ns/cm)

LBO 310A	4 MHz	20 mV	Single Trace	3"	
LBO 301	8 MHz	10 mV	Single Trace	3"	
LBO 308A	20 MHz	2mV	Dual Trace	3.5"	Mains/Battery
LBO 510A	4 MHz	20 mV	Single Trace	5"	
LBO 512A	10 MHz	10 mV	Single Trace	5"	
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

Thandar Electronics Ltd. reserve the right to alter prices and specifications on Leader equipment without prior notice.

RADIO/CB/TV TEST

CRT Testers · Pattern Generators · Signal Generators · Antenna Impedance Meters · RF Power Meters · C.B. Signal Generators · Stereo Signal Generators · Dip Meters · SWR/Wattmeters



LSG16 SIGNAL GENERATORS

A compact R.F. generator ideally suited to checking alignment of AM/FM and T.V. receivers.
- •Frequency Range 100 KHz – 100 MHZ
- •Frequency accuracy ± 1.5%
- •Crystal Oscillator 1-15 MHz
- •Modulation Internal 1kHz for A.M.
- •Output Voltage 0.1Vrms or higher to 100 MHz

GENERAL TEST

Function Generators · Transistor Checkers · LCR Bridges · Power supplies · Millivoltmeters · Curve Tracers · Home Appliance Testers

LHM 80A H.V. METERED PROBE

- •Input Impedance 20K Ω per volt
- •Range 40K Volts
- •Accuracy ± 3% Full Scale

LDP 076 LOGIC PROBE

Fast servicing and analysis of digital circuits
- •Imput Impedance > 10M Ω
- •Frequency Range DC to 50 MHz
- •Minimum Pulse Width 10nsec

AUDIO TEST

Audio Generators · Frequency Response Recorders · Audio Systems Analyzers · Wow & Flutter Meters · Speaker Analyzers · Audio Testers · Distortion Meters · Attenuators

LFR5600A FREQUENCY RESPONSE RECORDER

Designed to graphically record wow and flutter, drift, voltage, temperature and frequency response of Audio equipment.
- •Frequency Range 20 Hz - 30 KHz
- •Variable chart speed
- •Voltage range 0.1V, 10V
- •Sweep Oscillator •Pilot Signal •Cartridge pen
- •Metered, swept frequency input/output voltage

LEADER

For full technical details together with price list please contact.

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

249 for further details

PLL FREQUENCY SYNTHESIS Pt.3

Ian Campbell concludes his fascinating 'PLL' feature by delving into the secrets of synthesiser interfacing and control.

In the first two parts of this series we looked at the operating principles and detailed inticacies of Phase Locked Loop frequency synthesisers. In the next few pages we conclude the series by showing how the external world interfaces with the synthesiser and tells it what frequency to operate at.

TELLING THE SYNTHESISER WHAT TO DO.

Just how one goes about telling the PLL chip of a synthesiser what division ratio is required, so that the correct frequency is obtained, depends on which family the PLL falls into.

There are two basic types of chip, one which accepts the programming information in serial form (no confusion with Cornflakes here please), and the other which has a parallel data input.

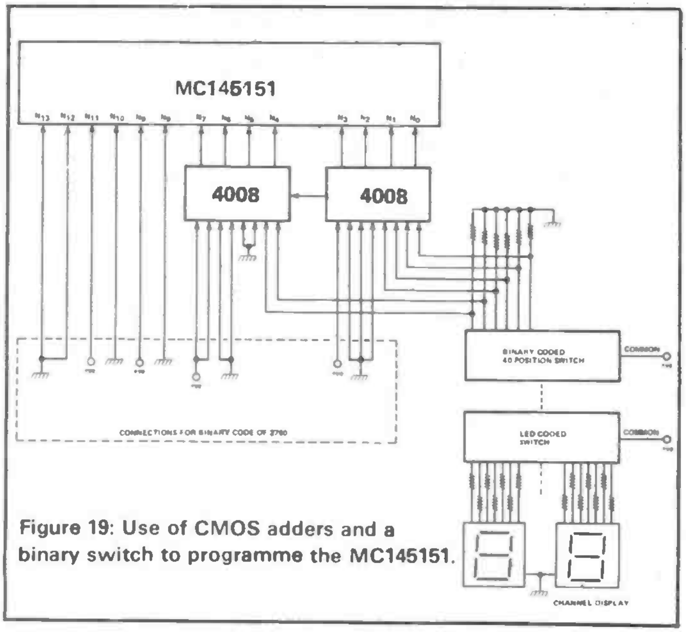


Figure 19: Use of CMOS adders and a binary switch to programme the MC145151.

PARALLEL DATA SYNTHESISERS.

A quick glance back to *Fig 8* in part *1* (January issue) will reveal that the programme input lines to the divide-by-N programmable counter may be connected directly to BCD thumbwheel switches. This method has been used in a few commercial 2 m band radios including the ICOM IC2E recently reviewed in **R&EW**. It is not commonly found, primarily because it does not look very nice and it is clumsy.

A simple yet somewhat better approach is to use a rotary BCD switch which is internally constructed in such a way that BCD data appears on its outputs. These devices are manufactured by companies such as Alps and come in a variety of shapes, sizes and descriptions.

The Motorola MC145151 PLL chip requires binary coded data on its fourteen input lines and may be programmed very simply using such a switch as shown in *Fig 18*.

Binary coded switches which are commonly available have up to 12 bits of information and 80 positions, coding from decimal 0 to 79. If this number is suitable for controlling the 'N' counter, all is well but what happens if it is not? A common programming example is where the division numbers required are incremented by one, starting from a fixed number, e.g. imagine the required frequency range from our MC145151 is 27.660 MHz to 27.99 MHz and the channel spacing is 10 kHz. This requires the 'N' counter to go from 2760 to 2799 with increments of one. Examination of *Fig 19* will reveal the method for accomplishing this rather simple task.

The MSB (Most Significent Bits) of the basic division number, 2760, are presented to the MC145151 and the LSB (Least Significant Bits) are passed into two CMOS 4008 4-Bit full adders. Also sent to the adders is a binary code from a 40-position binary coded switch. The 4008's add up the LSB of the 2760 and whatever binary number is passed to them from the switch and present that to the MC145151. If channel indication is also required then the switch may have a second wafer programmed in LED 7-segment code which will drive two LED displays directly. See, it really is simple isn't it?

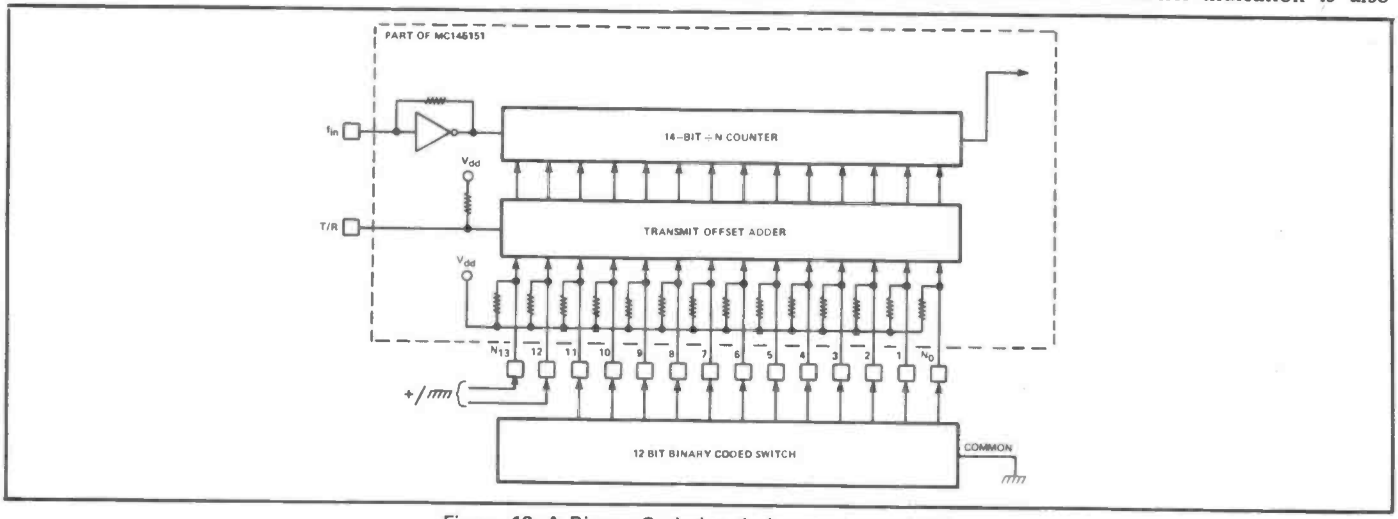


Figure 18: A Binary Coded switch-programmed PLL.

SIMPLE SOLUTIONS.

Just as simple is the solution to the problem of channel or frequency requirements which exceed the capacity of a switch. At first this may seem impossible but a quick look at *Fig 20a* and all will become clear. ▶

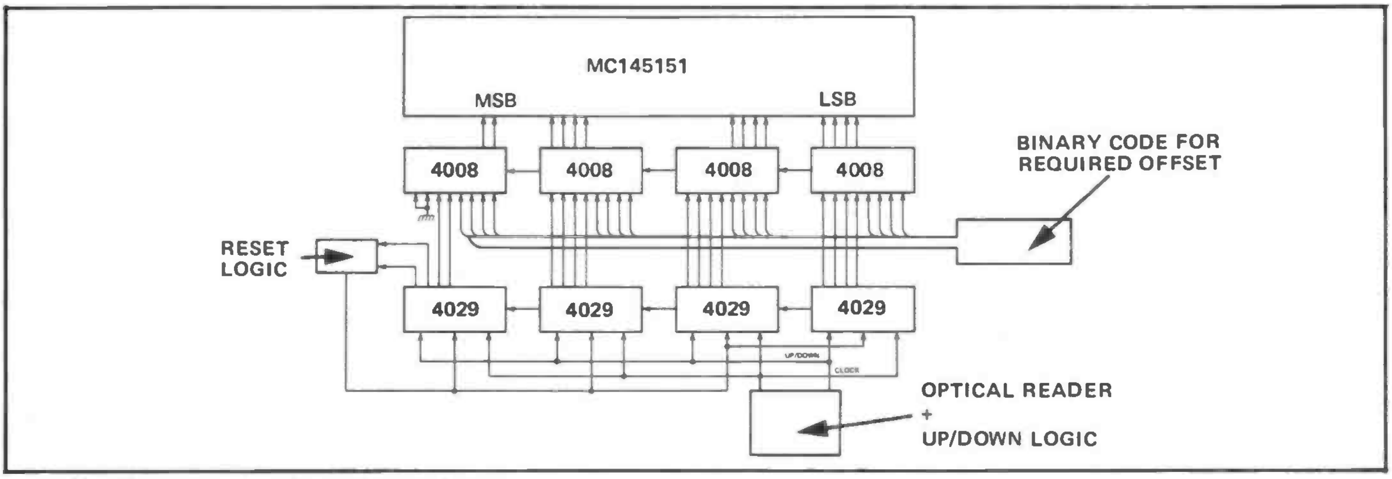


Figure 20a: Binary programming without switches.

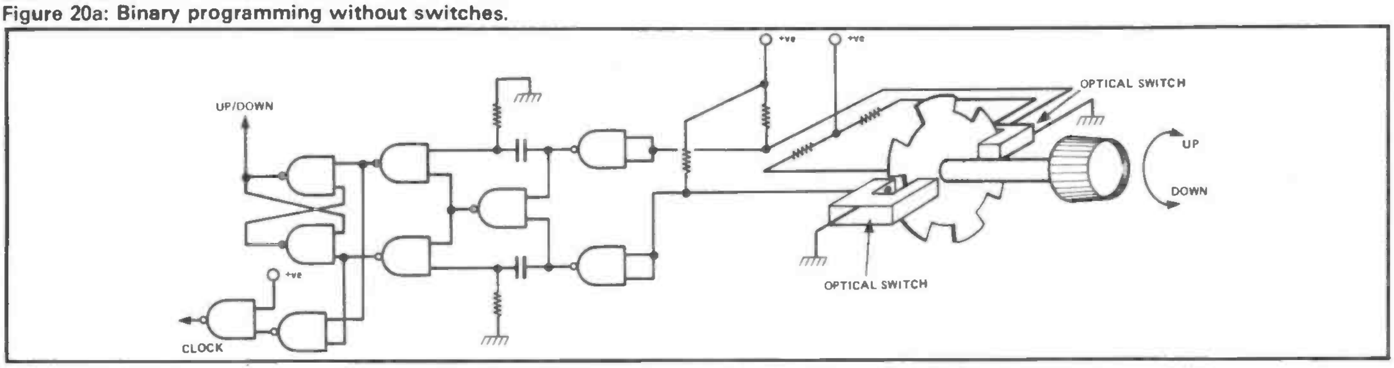


Figure 20b: Optical reader and up/down logic.

The 4008 adders can be used this time to add up the basic division number (offset code) together with a binary number produced by a set of CMOS 4029 up/down counters.

The clock and up/down instructions for the 4029's can be provided by a slotted disc which is rotated between two optoswitches set just a little less than 180° apart. The pulses produced by the optoswitches, when the disc is turned *(see Fig 20b)*, are decoded for this task by as little as nine NAND gates, four resistors and two capacitors.

Since there is no limit to the capacity of the system, except the range of the 4029 counters, the binary numbers available can go from 0 to 16383.

Now what happens if we have to cater for a lazy radio operator who prefers pressing buttons to twiddling knobs? Again the answer is not difficult. With four CMOS chips *(Fig 21)* in place of the optical reader and decoder of *Fig 20b* we can debounce the switch contacts; provide up/down control signals; make clock signal for the counters and even use the squelch line from the receiver to stop the clock and hence the scan on receipt of a signal. If some 4029's, wired to count in BCD, are connected to the clock and up/down lines, they will count in unison with the synthesiser controlling the 4029's and their outputs may be decoded and used to drive on LED channel display.

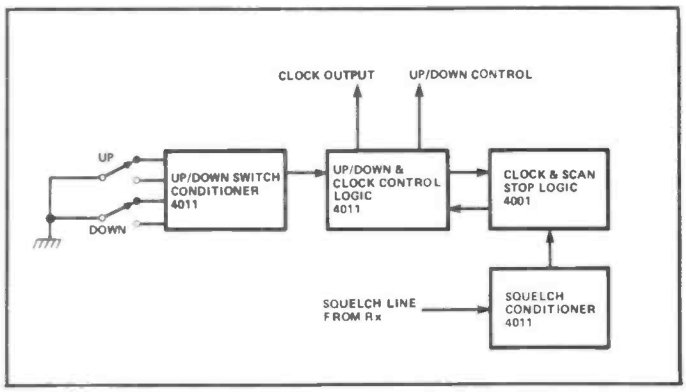


Figure 21: Digital scanning control circuits.

DIFFICULT PROBLEMS.

What do we do to programme our synthesiser if the division numbers are not regularly incremented by one, or are a peculiar combination of numbers?

If the number of channels required is small then a diode programmed ROM may be made (a rather laborious business) and inserted between the PLL chip and a simple multiposition switch, as shown in *Fig 22*. Position 1 of the switch gives a binary code of 10101001111111, which makes the 'N' counter of the MC145151 divide by 10879, and position 2 represents a division by 5219. The internal pull-up resistors on the input lines of the chip provide the ones and zeros and are obtained when diodes pull to ground via the switch.

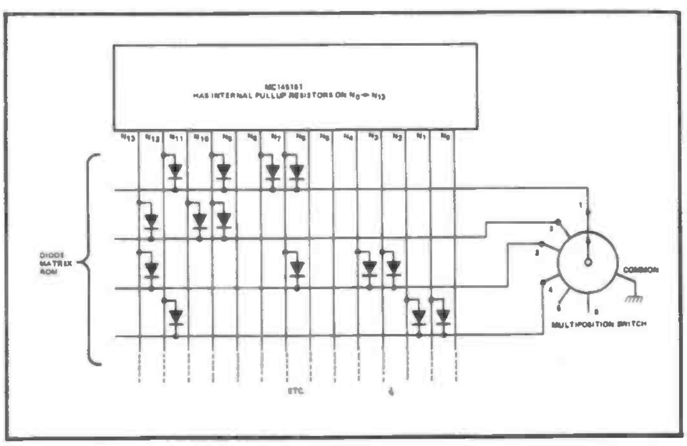


Figure 22: Diode matrix programming.

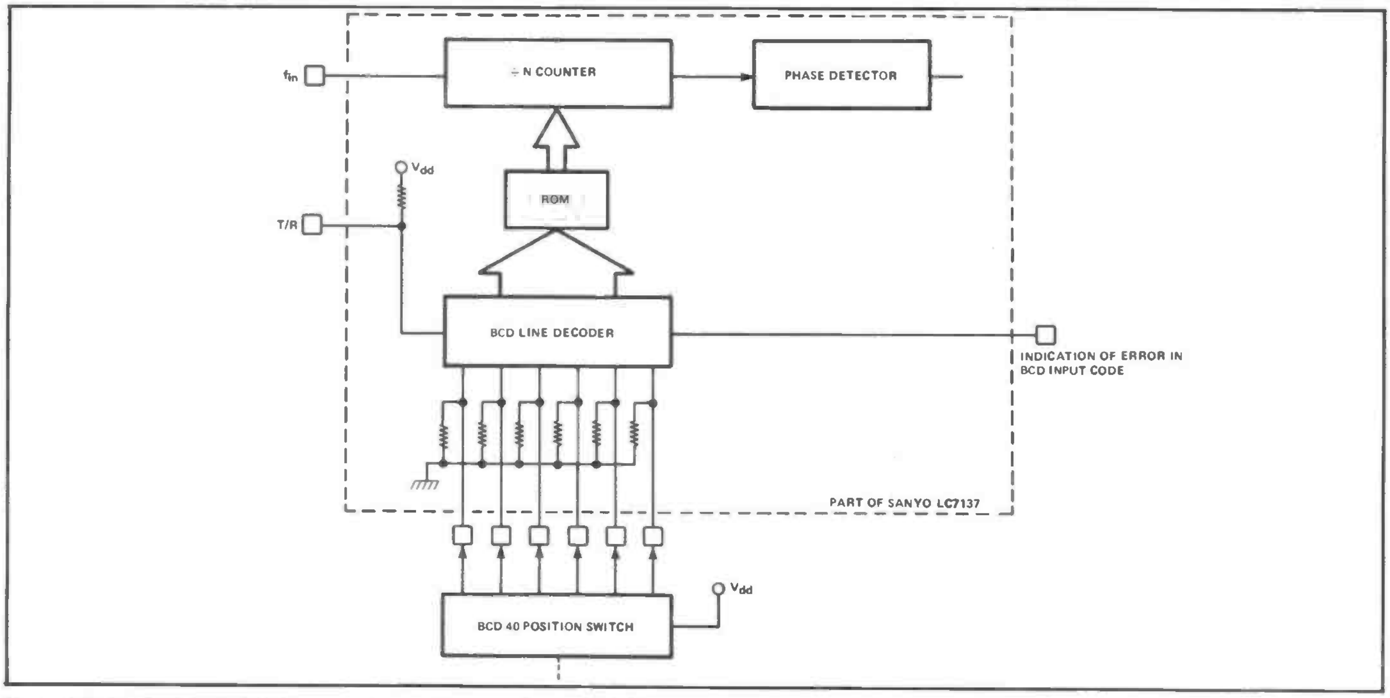


Figure 23: SANYO LC7137 PLL, showing on-chip dedicated ROM.

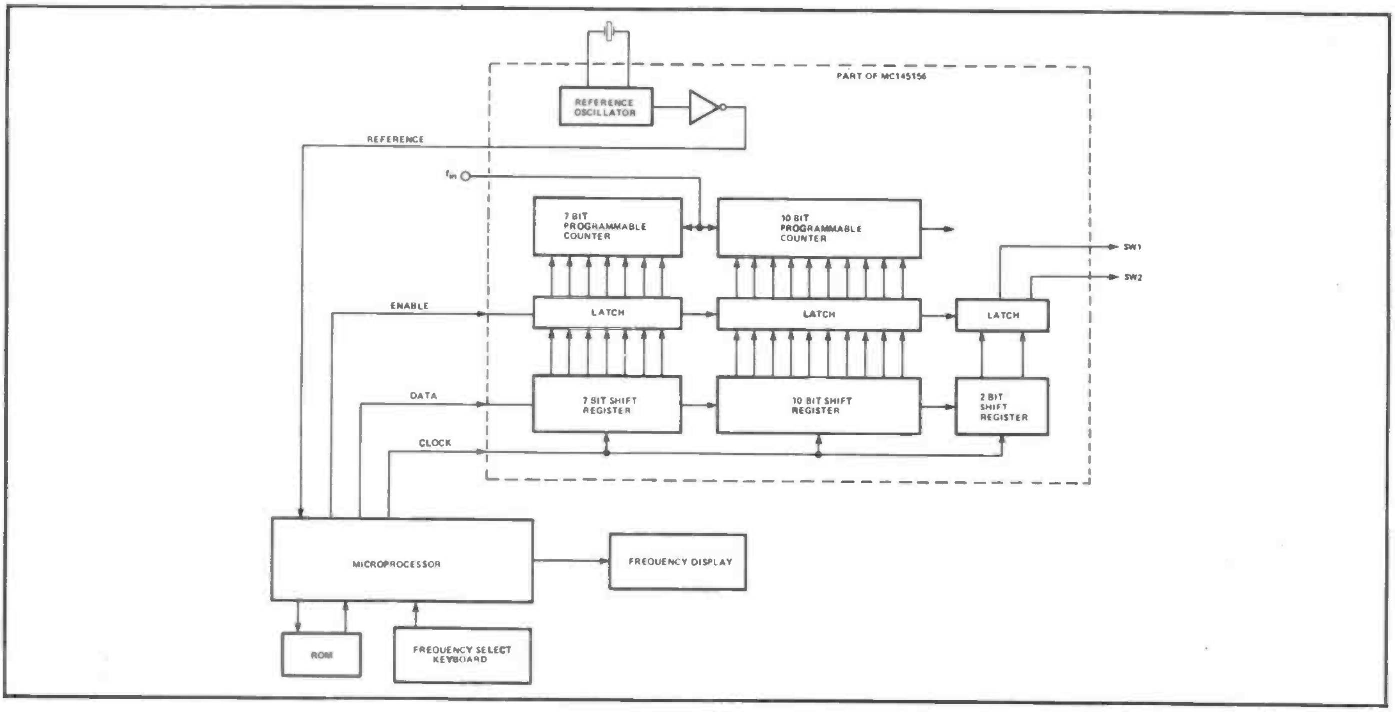


Figure 24: Microprocessor-controlled serial data input PLL.

A somewhat more sophisticated example of the use of a ROM for programming a PLL is found in the SANYO LC7137 *(Fig 23)*. This is a dedicated PLL chip programmed for use in the UK CB market. The ROM is on the chip together with a BCD decoder. The user presents the lines to the IC with BCD data from a 40-position switch, and the BCD decoder selects which of the 40 channels the data corresponds to. This approach is absolutely ideal for the person who wishes to use the PLL IC for only one particular purpose, since the device is very compact compared with an external diode-programmed ROM. It does mean however, that the IC cannot be used in any other application, since tampering with the ROM is impossible. It should be noted that the programming situation is just a little more complex than is shown, since a binary 1 or 0 on the T/R line switches a different part of the ROM into operation. The two parts correspond to transmit and receive frequencies. There is also an error detector which signals if a BCD input has taken place that does not call up a memory location. Clever people these Japanese!

SIGNAL DATA SYNTHESISERS.

Although ideal for the amateur enthusiast there is a big drawback to parallel programming. That is the plethora of interconnections between the PLL chip and the programming source e.g. the Motorola MC145151 has 14 pins dedicated to the function.

This is overcome in the serial data input PLL, where each bit of data is sequentially presented to the PLL chip and then locked into its appropriate parallel position by a combination of shift registers and latches. *Figure 24* shows the Motorola MC145156, which is a serial data input device, and it will be seen that only three pins are involved with data transfer. ▶

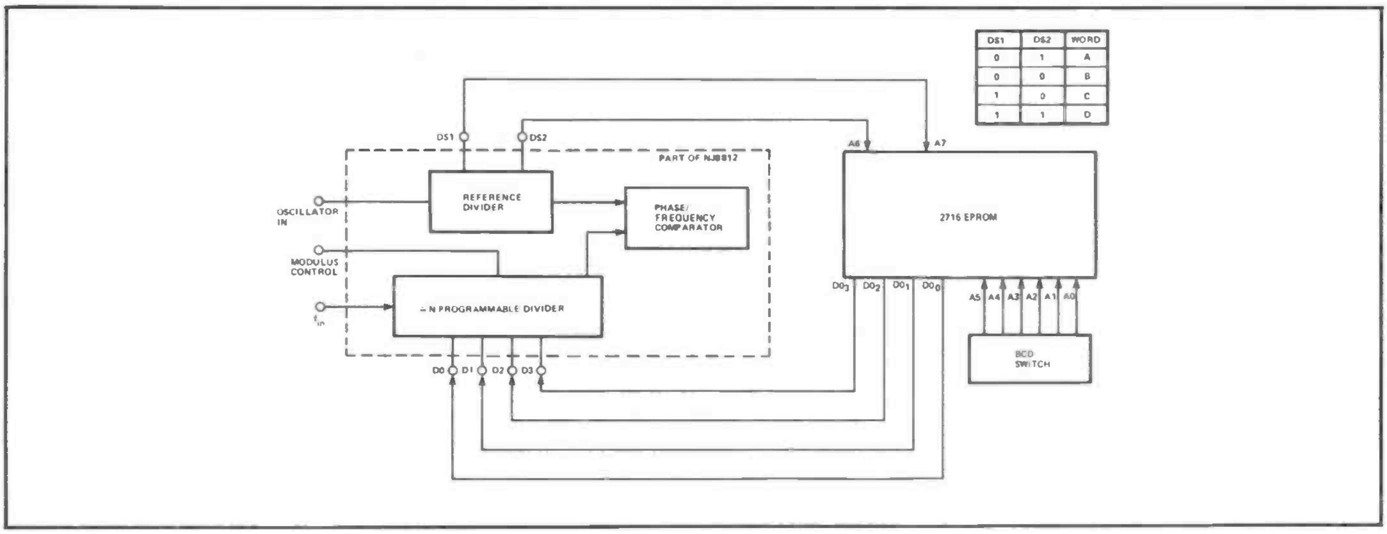


Figure 25: ROM-controlled serial data input PLL controller.

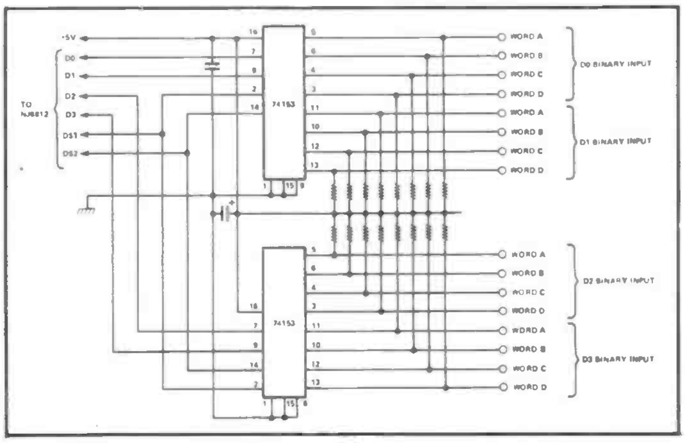


Figure 26: Parallel-to-serial data converter for NJ8812.

The data for programming has, of course, got to come from somewhere. In fact the usual method is to have a ROM suitably programmed to provide the necessary binary or BCD data for the PLL together with BCD for channel display. The ROM also has programming data which allows a microprocessor to carry out the functions of a dedicated controller. The ROM is accessed for its information by the Microprocessor according to data received by it from the user. It then tells the PLL to zip about all over the place at the whim of the button pusher, displaying what channel or frequency it is on while doing so.

The presentation of bits of information to the PLL chip naturally must be orderly and correctly sequenced. The timing of this, as far as the MC145156 is concerned, comes from the crystal used to generate the PLL reference frequency. It clocks the MPU to provide, out of the ROM, the correct binary coded data stream which moves through the shift registers. When all the 19 bits of information have been entered, the enable line latches this data, now in parallel form in the chip, into the programmable dividers, and any new information for frequency or channel change can be clocked into the shift registers.

As far as the amateur experimenter is concerned this type of synthesiser approach is fraught with problems and it is much easier to programme in parallel fashion. For the large scale manufacturer, however, the advantages of serial programmed synthesisers are obvious. The MPU can do a variety of tasks apart from just controlling the frequency of the PLL. It can tell the time, switch the receiver on and off, mute between stations, remember your favourite stations, scan the band looking for and stopping on signals, in fact there is an endless list of sales gimmick possibilities.

THE PLESSEY WAY.

A circuit, from Plessey Semiconductors, which is somewhat of a halfway house between the serial and parallel format is the NJ8812. It is a MOS integrated circuit that contains decoding and controlling circuitry, including modulus control, for frequency synthesisers.

The device is microprocessor compatible, but what is even better is that it interfaces directly with ROMS, PROMS and EPROMS. A glance at *Fig 25* shows it connected to a 2716 EPROM.

A little note on what goes on inside will make its operation clear. The device needs to be presented with four 4-Bit binary words, which we can call A,B,C and D. These have to be sequentially clocked into the programmable divider, via pins D_0 to D_3, starting with A. Clocking is done, at a rate of 1.2 kHz, by the states of the data select outputs DS1 and DS2. These outputs are controlled by the on chip divider chain which provides the reference frequency for the phase/frequency comparator. The words A to B are loaded when DS1 and DS2 change state according to the Table in *Fig 25*. The trick in this application is that a BCD switch is used to provide some of the information as to which lines in the EPROM are to be addressed and the rest is provided by the DS1 and DS2 outputs. This means that each time the combination of data select outputs changes, so a different memory location is written onto the EPROM's data out (DO_0 to DO_3) lines and thus provides, sequentially, the binary 4-Bit words for the programmable counter. The BCD switch is used to allocate the channels for the equipment using the synthesiser. The only problem here is programming the EPROM correctly.

The NJ8812 and its sister device the NJ8811 may be converted to parallel data input, which is good news for the experimenter. This is quite simple if two TTL 74153 dual 4-input multiplexers. are used as in *Fig 26*.

A LAST WORD.

For the experimenter, or the poor man, single pole single throw switches on the input lines of a parallel format PLL does the job, but just see how slow it is to change frequency!

■ R & EW

Your Reactions

	Circle No.		Circle No.
Immediately Applicable	274	Not Applicable	276
Useful & Informative	275	Comments	277

Thandar SC110 2 inch 'Scope

At £130 plus VAT, the Thandar SC110 is probably the lowest-cost oscilloscope on the market: It is also one of (if not THE) smallest.

THANDAR ELECTRONICS are the 'lot' who took over the test equipment side of the original Sinclair Radionics operation when 'Uncle Clive' (as he is becoming ever-more-widely known in the business) starting putting computers in black Tupperware boxes.

Present-day Thandar is concentrating efforts on test equipment, with all reference to Sinclair now absent. As well as their own home-grown gear, they handle the 'Leader' range of test equipment, which includes one (if not the only) of the few low cost RF signal generators for the hobbyist - the popular LSG-16.

The early Thandar products were real triumphs of ingenuity - who would ever have dreamed of putting a 200 MHz 8-digit frequency meter inside a variant of a box originally designed for a calculator - and producing an exceptionally effective product into the bargain?

Think Small

An oscilloscope with a 2" tube sounds just a shade unreal - a bit like a Z80 BASIC computer with a flat mylar qwerty keyboard that sells for under £70 - and we all know what happened to *that* particular device, which is now racing past the 250,000 unit mark.

Rumor has it that the product was born from a need to shift some of the stocks of the tubes that had been custom designed for the ill-fated miniature TV set - but the scope has long since established itself in its own right, since like the ZX81 alluded to above, the SC110 is completely out on its own in the market. There are other portable oscilloscopes, but not the sort you would really want to carry up a telegraph pole - or tuck in a tool kit as a regular piece of portable gear.

The two inch screen of the SC110 is a good deal more useful and versatile than you might imagine. For roughly 50% duty cycle waveforms, the SC110 screen shows a single period at roughly the same size where many users of larger format oscilloscopes would display two or three periods. Assuming the waveform is regular, no additional information is conveyed, however many periods you look at.

The 10 MHz bandwidth is complemented by a 100 nSec/div timebase - and the whole package thus performs a versatile

TECHNICAL SPECIFICATION

Physical Details

Dimensions:-	10" x 5.8" x<2" (255 x 148 x<50 mm)
Weight:-	<2 lbs (900grms)
Operating temperature range:-	0°C – 40°C

Calibrator

Square wave output of amplitude 1 volt pk-pk ± 5%.
Frequency 1kHz ± 30%

Power Requirements

4V to 10V D.C. via disposable cells, rechargeable cells, or A.C. adaptor.

Typical Power Consumption:

Bright Line - 900mW
10MHz – 1300mW
Economy – 350mW

Current Consumption at 5V

Economy – 80mA max
Bright Line – 210mA max
10MHz, 1 div sine wave – 300mA max

Triggering Circuit

Source:-	Internal or external switchable
Coupling:-	A.C., D.C., TV Frame, or TV Line filtering.
Level:-	Continuously variable over waveform
Slope:-	+ or – selectable on level control.
Sensitivity:-	Less than 1 div. for internal trigger Less than 1 volt for external trigger

Modes:-

a) Bright line
Timebase free runs until synchronised by trigger circuit.

b) Trigger:
Timebase reset with display blanked until sweep initiated by trigger circuit.

c) Economy:
Instrument switches to a power saving mode with display blanked until timebase is started by trigger circuit.

d) External:
As for Bright Line but with external trigger input.

Display

Screen dimensions:-	32mmx26mm
Graticule divisions:-	5 horizontalx4 vertical (6mm)
Phosphor:-	Blue-white, medium persistence
External Adjustments:-	Intensity, Focus, Trace Rotate

Vertical Deflection (Y input)

Bandwidth:-	D.C. to 10MHz ± 3dB at 1 div.
Coupling:-	Switchable D.C., A.C. or ground A.C. coupling – 3dB at 2Hz
Sensitivity:-	10mV/div to 50V/div in 12 ranges Calibrational accuracy ± 3%
Input impedance:-	1MΩ in parallel with 47pF.
Maximum input:-	350V (D.C. + peak A.C.) provided D.C. component does not exceed 250V.

Horizontal Deflection (X Input) – switch selectable

Bandwidth:-	D.C. to 2MHz ± 6dB
Coupling:-	D.C.
Sensitivity:-	Approximately 0.5 volts/div.
Input impedance:-	1MΩ in parallel with 10pF
Maximum input:-	2.5 volts, protected to 250 r.m.s. 50/60Hz

Timebase – switch selectable

Sweep times:-	0.1μ secs/div to 0.5 secs/div in 21 ranges Calibrational accuracy ± 3% for 0.2μ secs/div to 0.5 secs/div ranges; ± 10% for 0.1μ secs/div.

Technical Specifications of the SC110.

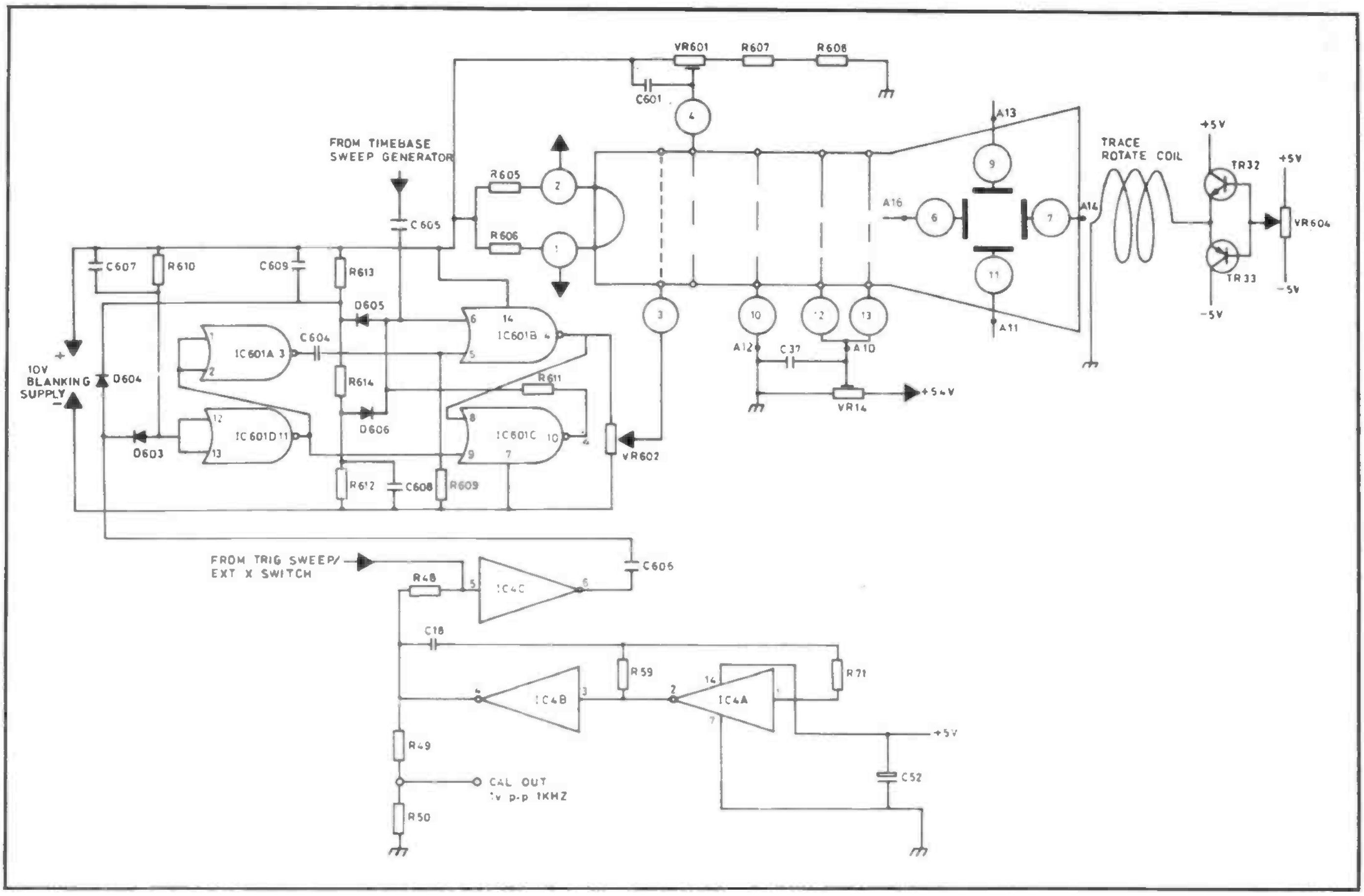


Figure 1: Tube driving and blanket circuitry of the SC110 'scope.

and useful number of functions, both as a low cost 'beginners' instrument, and as a serviceman's aid. Quantitative measurements can be made, although the SC110 is more at home performing basic qualitative tasks-like checking through an audio amplifier to see where the HF rolloff occurs, or where the clipping starts.

Inside the manual

Apart from the user instructions supplied with the device, a service manual is available that describes the 'scope in a good degree of detail. The SC110 manual is a particularly good example of 'how it works' for those interested in delving deeper into the workings of oscilloscopes.

Apart from the fact that it is written by someone whose native tongue is English - the SC110 is simple enough to illustrate the operation of an oscilloscope without getting bogged down in the finer points. We don't have space to reproduce too much detail here, so the section we have chosen is the tube drive circuit, since this provides a concise illustration of a practical flyback blanking circuit.

Driving and blanking (Fig 1)

The tube cathode voltage of —540V forms the reference rail for the flyback blanking circuit around IC601. IC601B and IC601C form a simple set-reset flip-flop that switches the tube grid via the intensity control, VR602. The input to this flip-flop is controlled from the timebase generator via C605. (D605/D606 and associated resistors clamp this between the IC supply rails).

In triggered sweep mode, IC4C input is grounded, thus leaving the input to inverter IC601D high, and the pin 9 input of IC601C low.

Pin 5 of IC601B is held low - so the negative going timebase pulse on the other input sets the output of the FF high, and the trace appears. At the end of the sweep, the timebase pulse is positive going, thus resetting the FF and blanking the trace during the flyback operation.

With an external X input, IC4C input is not grounded, and the output from the calibrations oscillator formed by IC4A and IC4B arrives at the DC clamp (D603/D604), driving IC601D's input low, and the FF output high. Simply grounding the input to IC4C again does not reset the FF - so IC601A inverts this negative going pulse from IC601D to provide a reset pulse for the FF.

Trace rotation is performed by driving current through TR32/TR33 and the trace rotation coil fitted on the tube neck. Focus and astigamatism (dot 'roundness') are electrostatic controls, handled by VR601 and VR14 respectively.

Conclusions

The small screen is fine for most audio and RF (below 10 MHz) waveforms where a single period can be displayed with adequate resolution, but it is not well suited to viewing digital pulse trains. The controls are easy to use and the facilities provided (see table) match up to those of many much larger bench models.

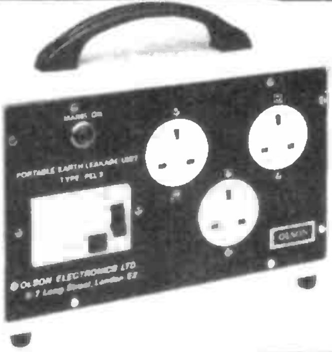
Power from the 'C' cell battery pack (mains adapter optional) can be conserved by switching to an economy mode, and with operation from 4-10 V DC, a surprisingly long period of use is available between charges.

At £139 (+VAT), the SC110 is the cheapest portable 10 MHz oscilloscope by a long, long way. However, in the £200 - £300 region, there are several offerings with dual trace and 20 MHz + operation, so weigh up your requirements carefully before making a decision. Even when you graduate to a bench stacked high with Tektronix 7000 series, you will probably find that the SC110 provides a unique degree of versatility that will keep it in frequent use. ■ R&EW

Your Reactions.........	Circle No.
Immediately Applicable	176
Useful & Informative	177
Not Applicable	178
Comments	179

PORTABLE MAINS DISTRIBUTION NOW WITH EARTH LEAKAGE

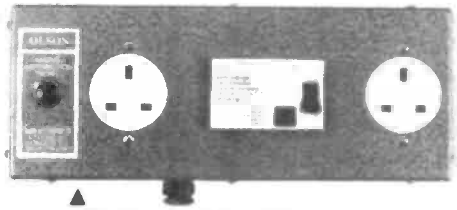
OLSON



◀ Portable unit with earth leakage

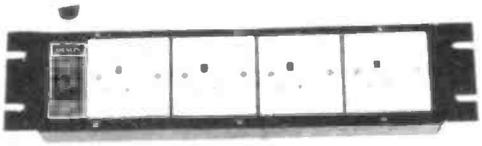
Type PEL 3

£59 + £2 pp + VAT



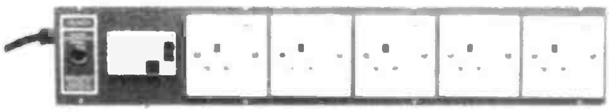
▲ Wall unit with earth leakage

Type WEL2 £48
+ pp £2 + VAT



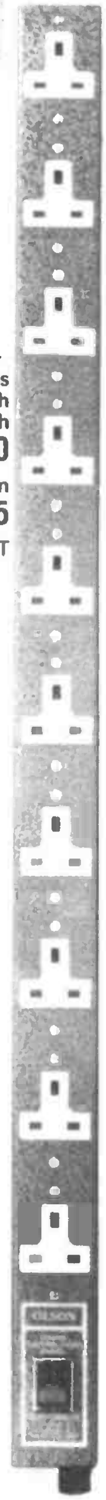
▲ 3½″ × 19″ Rack Mounting

Type 13A/4SW/R
£23.65 + pp £1.25 + VAT



▲ Bench unit with earth leakage

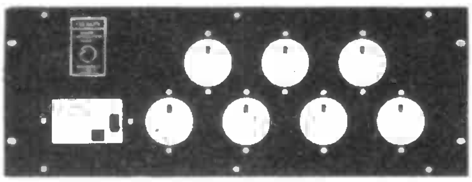
Type BEL5SW
£55 + pp £2 + VAT



▶ Internal Power for racks 8 types from 3-10 sockets. All fitted with illuminated switch

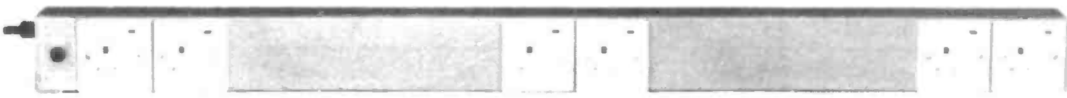
NEW!

Type T13A/10
50mm × 890mm
£34.25
+ £2 pp & VAT



◀ 7″ × 19″ rack mounting with earth leakage

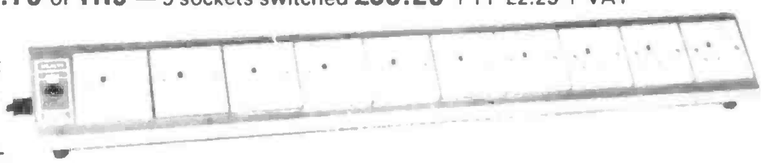
Type REL 7
£69 + pp £2 + VAT



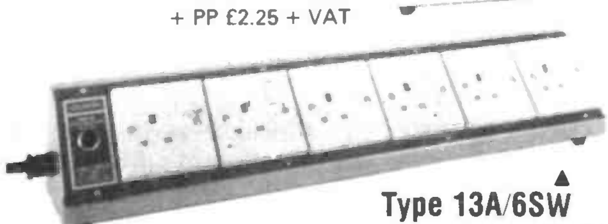
▲ 4 feet LG. 30 amp total load Instant Trunking System for Wall or Bench Mounting

TR6 — 6 sockets switched **£29.70** or **TR9** — 9 sockets switched **£35.20** + PP £2.25 + VAT

10 sockets switched in sloping box ▶



Type 13A/10SW £36.30
+ PP £2.25 + VAT

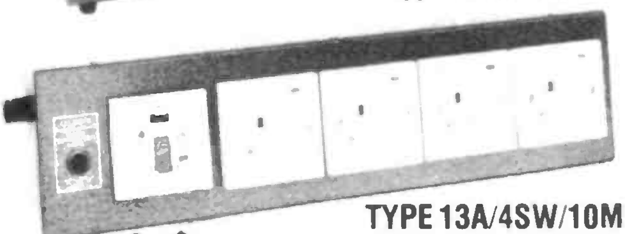


▲ **Type 13A/6SW**

Type		Price	PP
13A/4	not switched	£17.00	£1.25
13A/6	not switched	£20.60	£1.25
13A/4SW	switched	£20.35	£1.25
13A/6SW	switched	£23.65	£1.25

ALL PRICES PLUS VAT

These four types in sloping or flat boxes



TYPE 13A/4SW/10M
10mA earth leakage UNIT
NEW!
£68.00
+ £2 pp & VAT

● All units are in metal boxes complete with 6ft cable and 13 amp fused plug, ready for use. Only MK sockets and plugs are used. Trade counter open 9-5 Mon.-Fri.

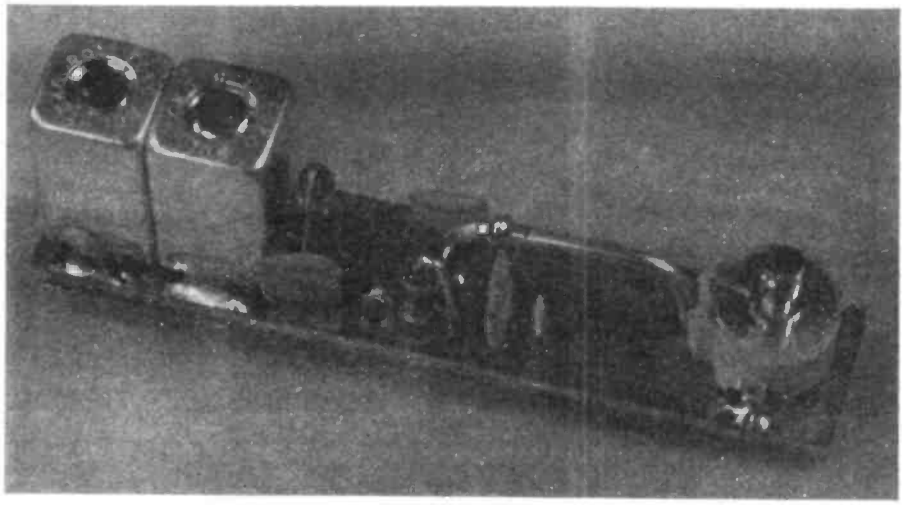
OLSON Electronics Ltd. FACTORY NO. 8, 5-7 LONG STREET LONDON E2 8HJ Tel: 01-739 2343

113 for further details.

HIGH PERFORMANCE 70cm PRE-AMP

R&EW Project Pack
£3.90 + VAT (£4.48) P&P 50p per order.

Up-grade your receiver with this excellent little unit. Designed by Timothy Edwards, its performance is (naturally) first class, and its building cost shockingly low.



DOES YOUR LOCAL REPEATER go down into noise when you drive through valleys? Can you tell the talk from the flutter when you drive through trees? Are you really sure that your receiver is as sensitive as it ought to be? The answer to these questions is not '42', but **R&EW's** easily built high-performance 70cm pre-amplifier.

The new pre-amp has small dimensions but gives a big performance. It is built on a double-sided PCB that measures a mere 50mm x 10mm, and gives a useful gain of 13 dB, with a 3 dB bandwidth of 20 MHz and noise figure of less than 2.0 dB. The unit is small enough to be built into virtually any existing receiver, does not require the use of test gear when setting up, and gives a performance that is at least as good as that of any commercially available pre-amp.

Put into perspective, these performance figures mean that if your existing receiver has a sensitivity of 1.0 uV (typical of many modern sets), its sensitivity will rise to 0.15 uV when fitted with the new pre-amp, with a corresponding increase in useful communication range. Not bad for a circuit with a total kit price of under a fiver!

CIRCUIT DESCRIPTION

The pre-amp is designed around a single BFR91 transistor, which has a very low noise figure and high margin of stability at 70cm (470 MHz). The transistor is used in the common emitter mode and biased at a collector current of 5 mA via R1-R2. At this bias level the BFR91 has input and output impedances that are very close to 50 ohms. Supply line decoupling is provided via C4 and C5.

The inductively tapped L1 and C1 input network provides a virtually loss-free match between the aerial and Q1 and gives plenty of out of band rejection (particularly to 2 metre signals). Q1 output is DC blocked by C3 and fed into Toko helical resonator L2, which is tuned by brass slugs and which provides a 50 ohm output. This resonator gives excellent out of band rejection, as shown by the spectrum analyser photographs. The overall gain of the pre-amp is about 13 dB (photo' 1), the 3 dB bandwidth is 20 MHz (photo' 2), and the out-of-band rejection is in excess of 35 dB (photo' 3).

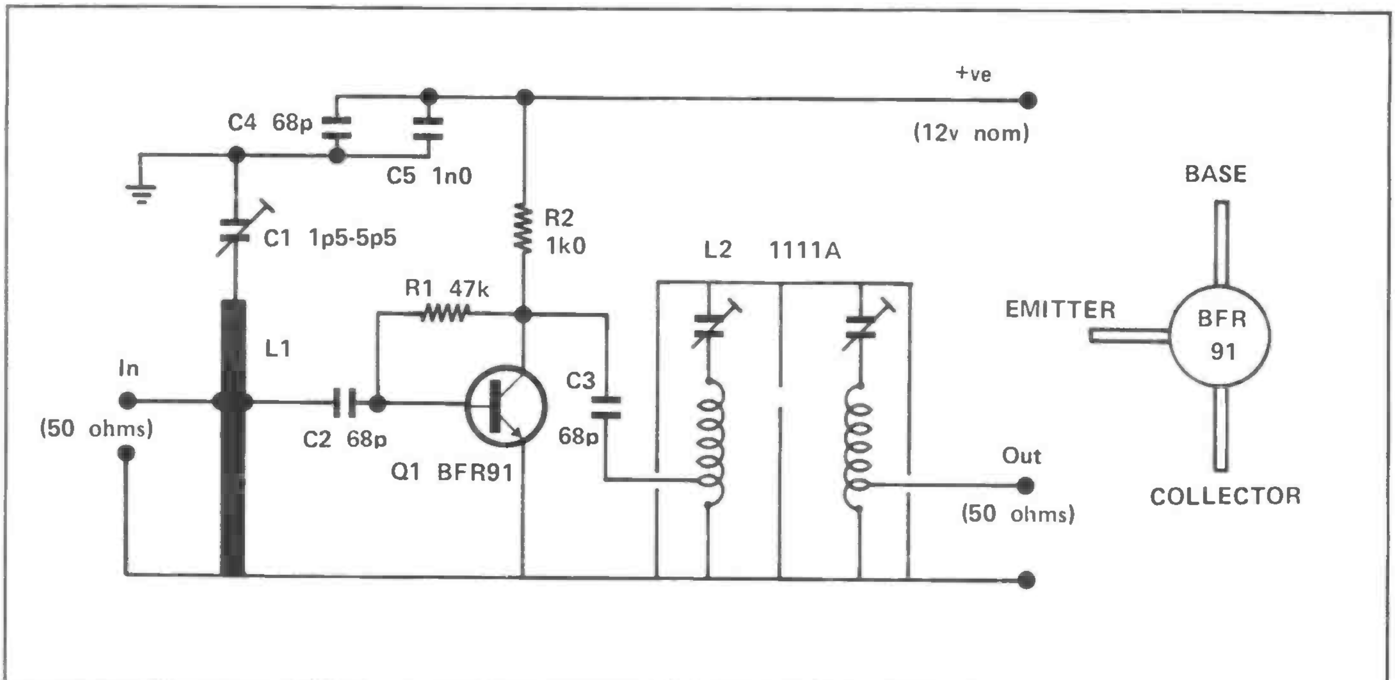
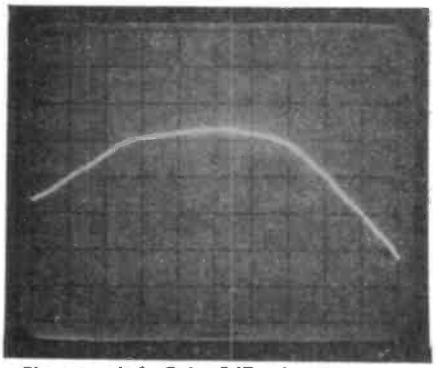
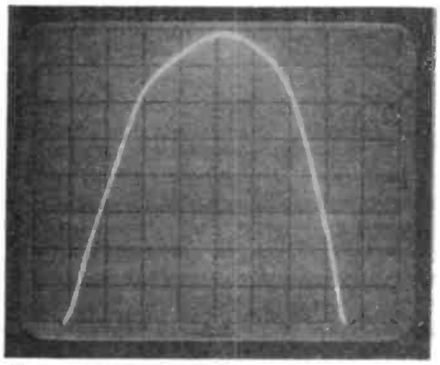


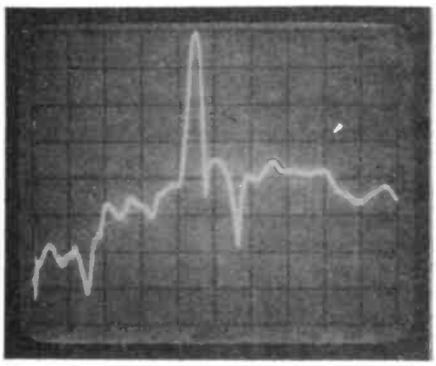
Figure 1: Circuit diagram of the 70cm pre-amp.



Photograph 1: Gain. 0dB gain set to +40dB on analyser scale. Vertical scale 10dB/division. Horizontal scale 5MHz division. 410 - 460MHz centred on 435MHz. This shows a gain of +13dB at 435MHz.



Photograph 2: Bandwidth. Vertical scale 2dB/division. Horizontal scale 5MHz/ division. 410 - 460MHz centred on 435MHz. This shows a 3dB bandwidth of 20MHz.



Photograph 3: Ultimate rejection. Vertical scale 10dB/division. Horizontal scale 100MHz/division. 0-1 GHz. Centred on 500MHz. This shows an ultimate rejection in excess of 35dB.

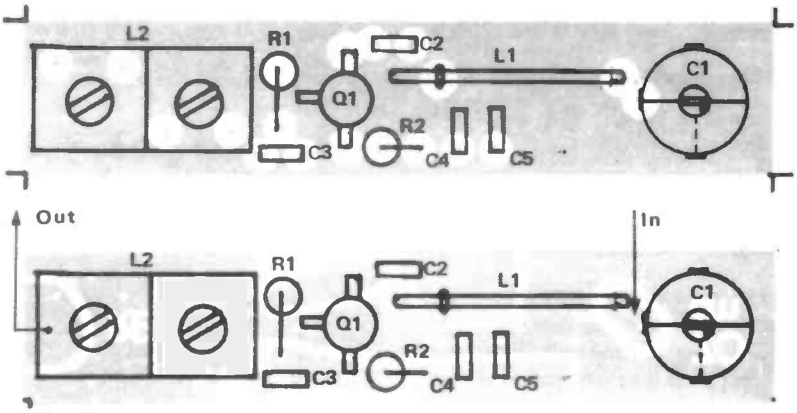


Figure 2: Component Overlay (Twice size) showing (A) Top track view and (B) track viewed through the topside.

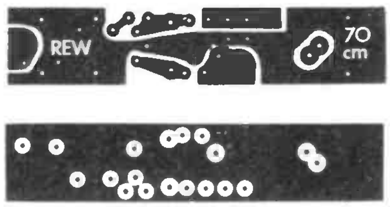


Figure 3: Foil patterns for the double-sided PCB.

SPECIFICATION

3dB bandwidth	20 MHz
Noise figure	Less than 2.0dB
Gain	13dB
1dB compression	—3dBm (0.5mW)
Saturated output	—2dBm (0.7mW)
Supply voltage	8-16V (nominally 12V)
Supply current	4-6mA at 12V
I/P & O/P impedance	50 ohms
Size	50mm x 10mm x 17mm

Construction and Alignment

Using the parts placement guide, fit Q 1 first and solder the middle lead which is the emitter both to the top and bottom track on the printed circuit board. Next fit the helical resonator, and solder all four of its can legs both to the *top and bottom* of the PCB. The rest of the components can now be fitted in any order, noting that C 1, the variable trimmer, must have its two outside legs soldered to both the top and bottom of the PCB. Use a small iron and clean off the flux residue after completion.

Do not install the pre-amp in any lead or equipment where transmitter power is likely to be present. Connect the pre-amp between the aerial changeover relay on the equipment and the receiver front end, and having located this cable, cut it and connect the pre-amp as shown in the component placement diagram, ensuring that the input coax comes from the aerial changeover relay and the output coax goes to the receiver.

Preset C 1 to the middle of its range and connect the supply to the pre-amp. If all is well it will be drawing approximately 5 mA. Tune to a weak noisy signal and adjust C 1 for minimum background noise, do not tune for maximum signal strength meter reading as this will **not** produce the minimum noise figure and hence the maximum signal-to-noise from weak signals. It may be possible (although unlikely) to squeeze an extra ounce of performance by very **slightly** tuning the two brass slugs in the helical resonator. The pre-amp has sufficient bandwidth to cover all applications including amateur TV use (but more about this exciting development later).

COMPONENTS LIST

Resistors

R1 47k CR25
R2 1k CR25

Capacitors

C1 1.5-5.5pF variable
C2 68p plate ceramic
C3 68p plate ceramic
C4 68p plate ceramic
C5 1n0 plate ceramic
Q1 BFR91
L1 15mm x 5mm x 0.5mm silver plated wire
L2 252MN 1111A/7HW
Double sided printed circuit board (available from R&EW)

Conclusions

The performance of the pre-amp is at least as good as that of any commercially available unit and it is so small that it will fit almost anywhere.

The spectrum analyser photographs were taken with a Hewlett Packard Spectrum Analyser with its matching Tracking Generator and photographed with a Polaroid camera. Signal-to-noise measurements were performed using an Adret synthesised signal generator and a Sinadder 3 automatic SINAD meter (see this month's review).

■ R & EW

Your Reactions.........	Circle No.
Excellent - will make one	278
Interesting - might make one	279
Seen Better	280
Comments	281

R&EW Data Brief

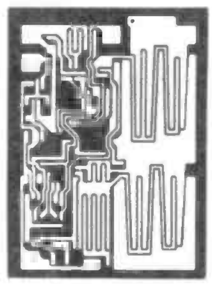
ULN 2283B

DATABRIEF — ULN2283B low power audio amplifier

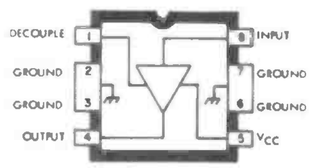
The ULN2283B is a very versatile low cost audio amplifier suited to most applications where up to one watt of audio is required. The very wide operating voltage range suits it to battery operation, where a 6 V battery source results in less than 8 mA quiescent current. The actual output for a given supply voltage is shown overleaf.

There are few problems associated with the ULN2283B, but care must be excercised to ensure that adequate supply decoupling is provided for the associated circuitry as a result of the peak supply drain from the class-B output stage. The lower the loudspeaker impedance, the greater the current peaks - so always use the highest impedance speaker that is consistant with the desired audio level. A 16 ohm speaker usually provides the same subjective results as a 4 ohm speaker - with a lower current consumption, and fewer problems arising from the peak supply demands of the circuit.

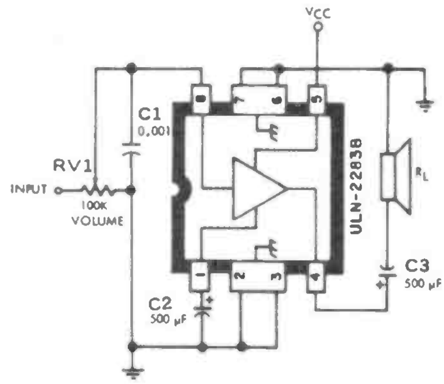
The internal circuit closely resembles that of the audio stage in the ULN2204 combined AM/FM/AF radio IC.



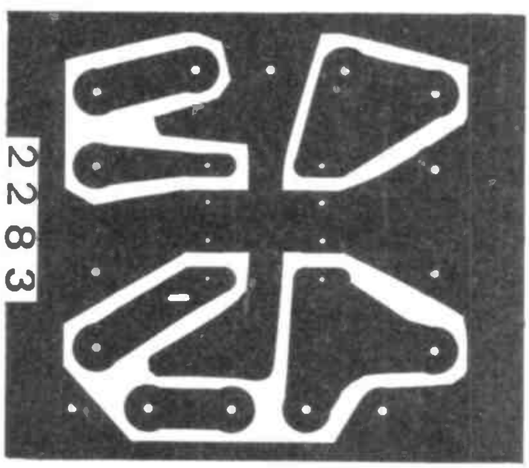
CHIP MASK



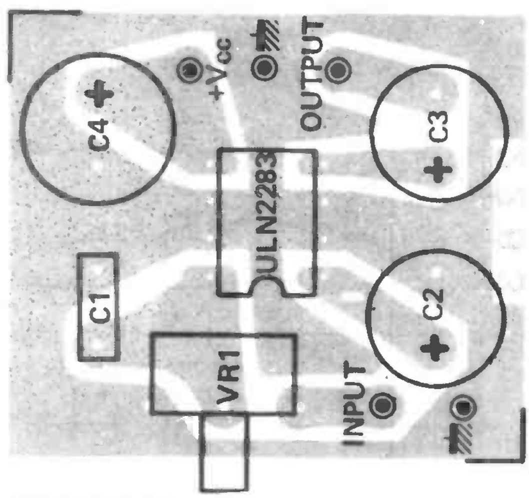
OUTLINE



TEST CIRCUIT



P C B Foil (shown X2)

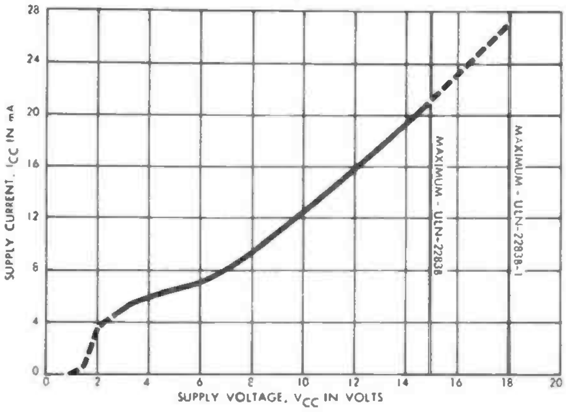


P C B Overlay (shown X2)

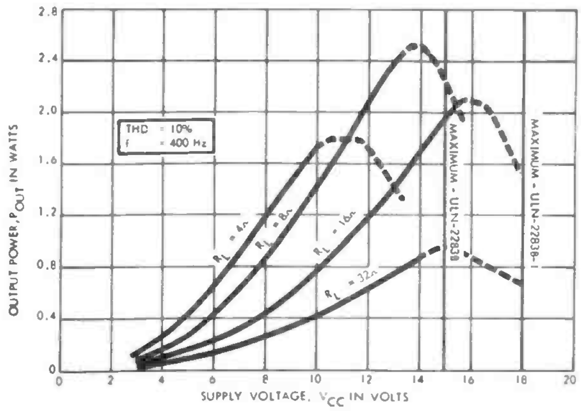
ELECTRICAL CHARACTERISTICS at $T_A = +25°C$, $f_{in} = 400$ Hz

Characteristic	Symbol	Test Conditions	Limits Min.	Limits Typ.	Limits Max.	Units
Supply Voltage Range	V_{CC}		3.0	—	15	V
Quiescent Supply Current	I_{CC}	$V_{CC} = 6.0$ V	—	7.0	—	mA
		$V_{CC} = 12$ V	—	16	25	mA
Voltage Gain	A_e	$P_{OUT} = 0$ W	39	42	46	dB
Audio Power Output	P_{OUT}	$V_{CC} = 6.0$ V, $R_L = 8\ \Omega$, THD = 10%	250	350	—	mW
		$V_{CC} = 9.0$ V, $R_L = 8\ \Omega$, THD = 10%	800	1140	—	mW
		$V_{CC} = 12$ V, $R_L = 16\ \Omega$, THD = 10%	800	1200	—	mW
Input Resistance	R_{IN}	Pin 8	—	250	—	kΩ
Power Supply Rejection	PSRR	$C_D = 500\ \mu F$, $f_{ripple} = 120$ Hz	28	34	—	dB

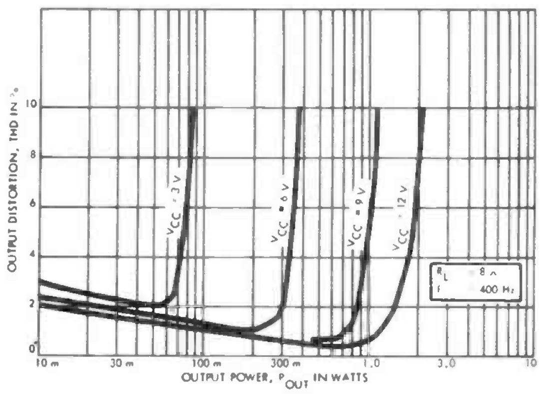
TYPICAL CHARACTERISTICS



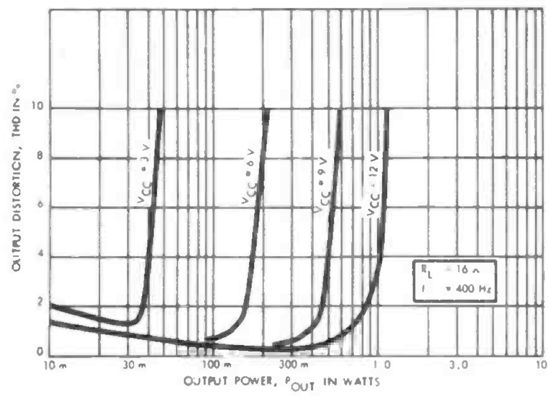
SUPPLY CURRENT



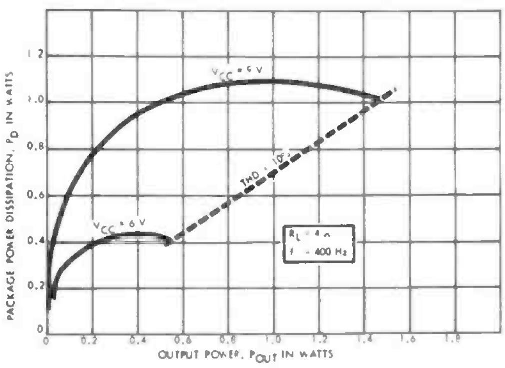
OUTPUT POWER



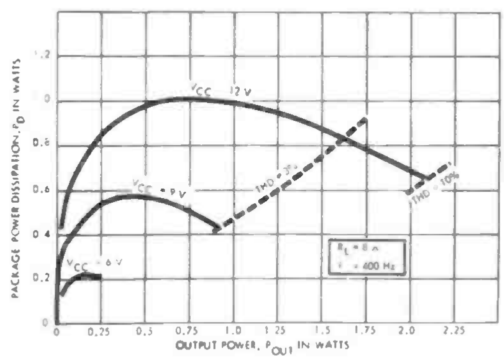
DISTORTION



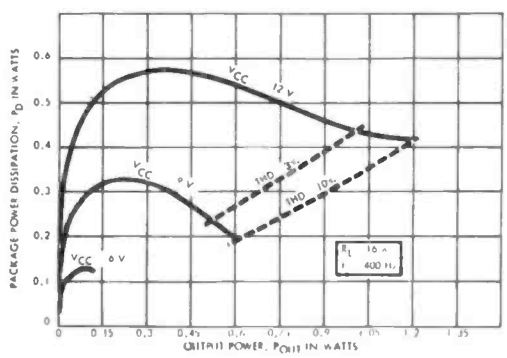
DISTORTION



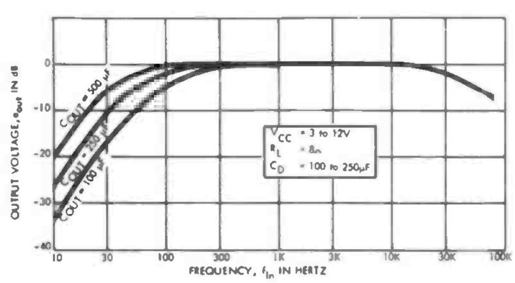
POWER DISSIPATION



POWER DISSIPATION

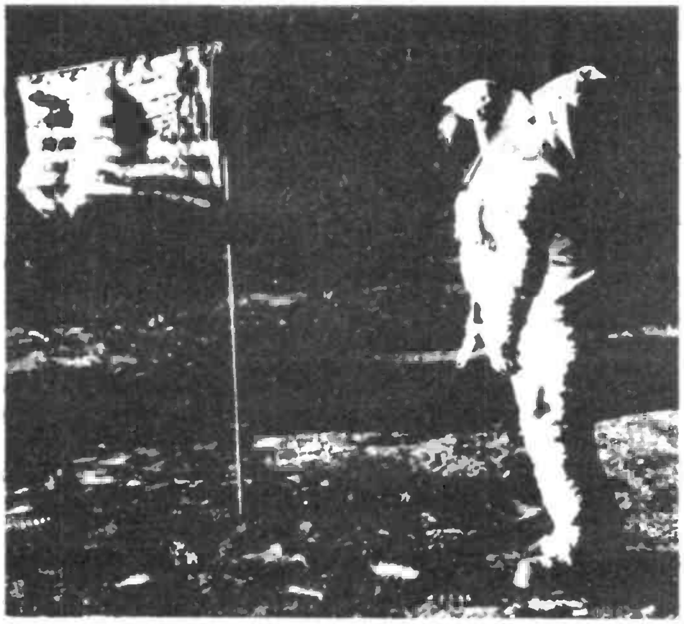


POWER DISSIPATION



FREQUENCY RESPONSE

■ R & EW



R&EW COMPETITION RESULTS

We ran a number of 'reader's competitions' in the October and December issues of R&EW. Prizes ranged from a £10 voucher to a CB900 CB rig. All entries have now been judged. Here are the results.

The 'Win a CB Rig' Competition

The 'spot the balls up' CB competition in the December **R&EW** (page 91) brought forth a flood of entries from eagle-eyed readers, all keen to win a free CB rig. There were two 'classic' errors in the circuit diagram, but also another 5 or so more subtle errors. In fact, there were so many really observant readers that we award the following the title of 'honorary **R&EW** proof readers':

B Robinson	Lancs
P M Rowlem	London
S Allbutt	Kent
A J page	Birmingham
K Lockstone	Middlesex
C P Orrey	Lincs
P Green	Yorks
S Allison	Yorks
M Turff	Avon
G M Jones	Liverpool
R Humphrey	Oxon
R C S Withers	W Midlands
D Bobbett	Essex
S R Ring	Hants
C Marshall	Oxon
P Matthews	Sussex
R J Hall	Warwick
M Renshaw	Merseyside
P R Jackman	Hants
P D Mason	Surrey
B Strutt	Essex

The circuit diagram errors were:

1) Pin 4 of the mic socket (PTT) is permanently earthed, and should go to the slider of the Roger Bleep on/off switch.
2) C116 and D20 form a neat short circuit from the HT rail to earth.

And now for the others that were spotted:

3) The PA/CB switchover wiring is garbled, resulting in various anomolies including the absence of mic input in PA mode.
4) Q4 collector effectively grounds the 2nd LO injection.
5) Pin 2 of U3 is shorted to ground, instead of via a capacitor.
6) The pinout diagram of the LA6458D puts pins 5 and 8 back to front.
7) Pins 18 and 20 on the synthesiser chip were shorted, instead of being connected via 10k.
8) No earth return for the LED channel readout.

The winner is J D Woodward of Somerset, who spotted the two basic blunders, as well as the largest number of 'others' - coupled with suggestions concerning selective calling that we hope to bring you in due course. Thanks to all those who participated, we don't have space for printing the corrected diagram, but if you would like one, then please send us an SAE.

In view of the great popularity of this competition, we shall be running similar competitions from time to time in **R&EW**.

The Grand Space Invaders Contest (October '81)

Well, it's good to see that **R&EW** readers have a keenly developed sense of humour. One wag even managed to point out that the judging was scheduled for September 30th - before the 'publication date' of the issue!!

Lots of good ones, so here they come:

"Now we've conquered space, let's sort out time travel for **R&EW** readers..."
Anon

"Be careful Joe, that's the last golf ball"
A E Stewart

"Looks like a hole in one, Al"
M R Josey

"Now I can bring the dog next trip"
D Imison

"Dammit Fortesque, I said bring the Union Jack"
T L Beckham

"Gee, they disguise their CB antennas here too"
N Henderson

"Ma would love it here, everything dries so fast"
K V Perry

And in reverse order eht srenniw:

"These bus services are getting worse"
E Ball

"This is the last time I go on a mystery tour"
T E Stewart

Congratulations - a free 12 month sub tc **R&EW** is on the way.

The Transistor Design Competition (October '81 Issue)

Perhaps the fact that a certain 'wireless' magazine recently found space to reminisce over valves is indicative of a certain reluctance amongst readers to enter the silicon age and put aside thermionic emissions. Judging from the scant entry to this competition, we might have done better to pin a pair of ECC81's to the front cover.

Our thanks to those of you who did manage to put in an entry and particularly to Bill Wilson of Aberdeen, whose late arrival in the shape of a novel transistor GDO carried off first prize. The two runners up were E G Cawkwell of Aylesbury, and George Short of Croydon.

We will be publishing their entries in due course - other entrants may also be contacted with a view to using their offerings as 'quick-circuits'.

SINADDER 3

Test Gear Review

Lyons Instruments produce this invaluable piece of 'radio measuring' equipment, which functions as both an automatic SINAD Meter and an AC Voltmeter.

RECEIVER SENSITIVITY IS expressed as an RF input level required to produce a given signal-to-noise ratio, or more accurately, a SINAD ratio. The word SINAD is an acronym of SIgnal Noise And Distortion. The SINADDER 3 is an instrument that automatically gives a reading of SINAD in decibels (dB) when connected to a receiver under test. Expressed mathematically,

$$\text{SINAD} = \frac{(\text{Signal voltage} + \text{noise} + \text{distortion})}{(\text{Noise} + \text{Distortion})}$$

This ratio is usually expressed in decibels as:

$$\text{SINAD (dB)} = 20 \log_{10}\left(\frac{S + N + D}{N + D}\right)$$

To measure the SINAD ratio of a receiver, the receiver's audio output is connected to a matched load, across which the SINAD meter is connected. A signal generator on the required frequency, modulated with a 1 kHz audio signal, is connected to the input of the receiver. Using a SINADDER, the SINAD ratio is displayed directly on a meter calibrated in decibels.

Putting the Instrument to Use

When the SINADDER arrived in the **R&EW** laboratory it was immediately put to good use, measuring the sensitivity of several communication receivers. It proved very simple to use - in fact it took longer to fit the mains plug on the instrument that to take the required measurements. The SINADDER is fitted with a screened input lead terminated in crocodile clips. These can be clipped to the speaker connections, or to a resistive load (of suitable wattage for the receiver's output power) connected to the receiver's ancillary AF output. A resistive load is certainly preferable, as a watt or more of 1 kHz tone coming from the receiver's loudspeaker is not particularly pleasant. When used in this way the SINADDER 3 scores over its predecessor (S-101 SINADDER) by providing an internal audio amplifier and speaker, together with a front panel volume control. This allows the signal to be monitored when required, without touching the receiver's volume control.

To measure SINAD ratio the signal generator connected to the receiver's input is required to be modulated with an accurate 1 kHz tone. If the modulation is not exactly 1 kHz, the SINADDER displays a worse reading than the true one. The SINADDER 3 has a built-in accurate 1 kHz oscillator, with a variable-amplitude output on the front panel. This 1 kHz signal is then connected to the 'external modulation' input of the signal generator. Unfortunately, using a Radiometer M527 signal generator, the output level was not sufficient to give more than 10% modulation. With more modern signal generators, though, the 1 kHz tone output is adequate.

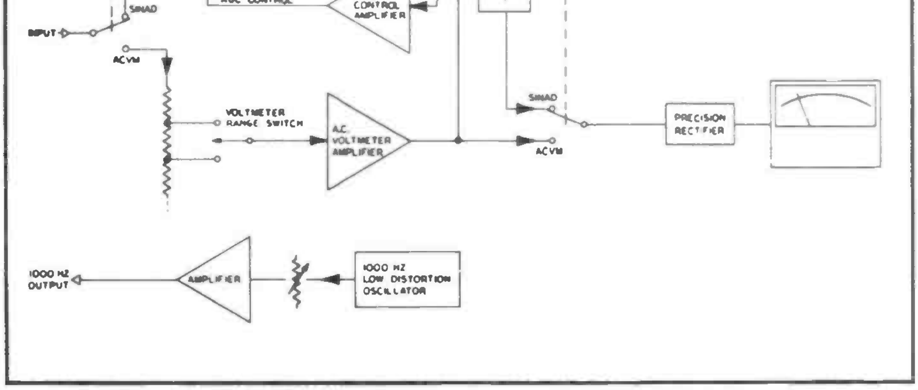


Figure 1: SINADDER 3 Block Diagram

Inside the Covers

The Block diagram of the instrument is shown in *Fig 1*. When being used as an AC voltmeter the three switches are in the ACVM position. The input AC coupled to a nine-position potential divider range switch. The signal is then amplified and then rectified to drive the meter.

When switched to SINAD the input signal is connected to a gain-controlled amplifier stage. AGC is provided to give a constant output for input level variations from 20 mV to 10 V RMS. This output

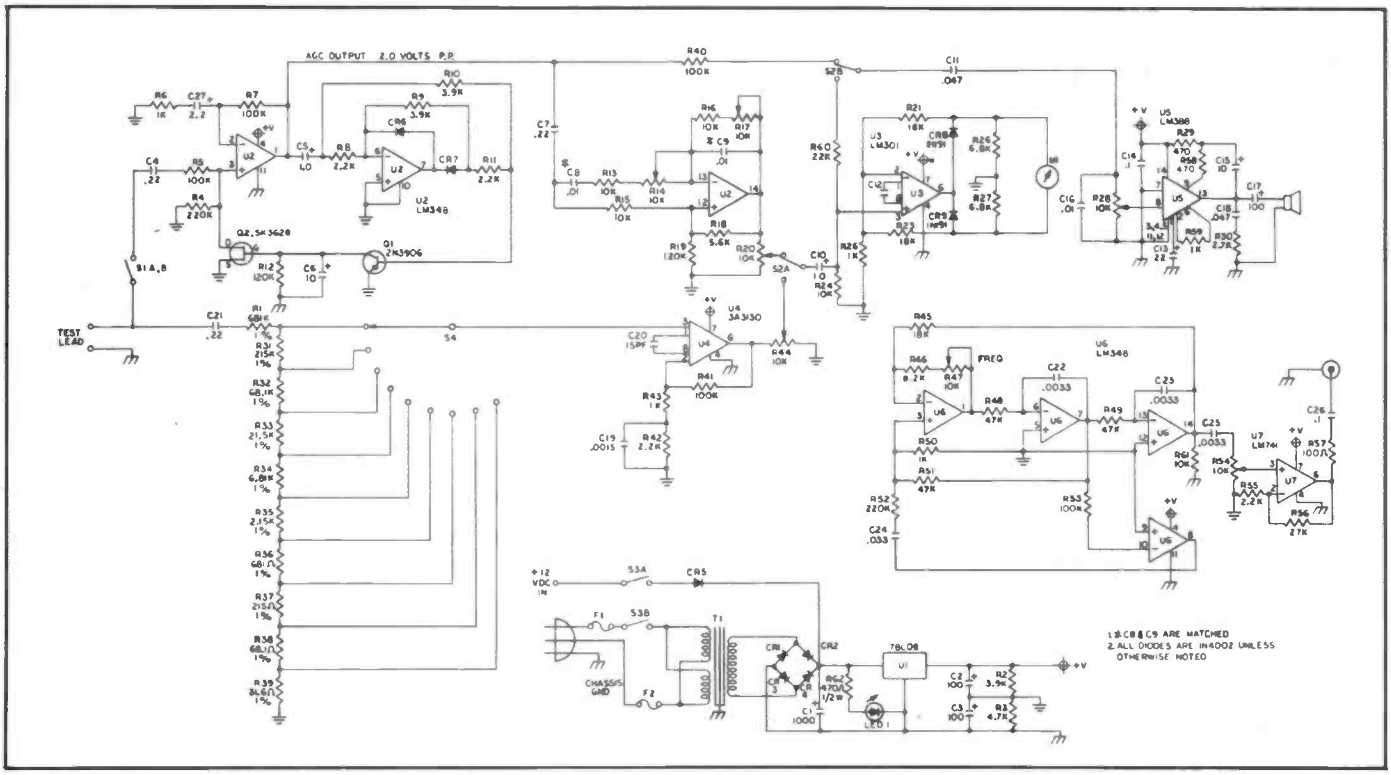
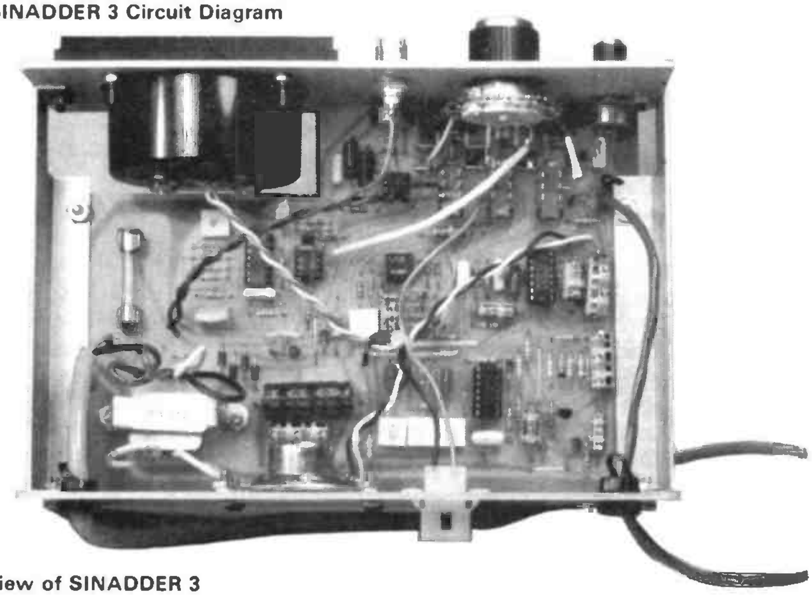


Figure 2: SINADDER 3 Circuit Diagram



Internal view of SINADDER 3

Specifications:

Panel Controls:	push-push power switch; push/AC VOLTS — push/SINAD switch; rotary AC VOLTS range switch; 1 kHz tone output level control; internal speaker level control.
Input:	permanently affixed shielded test cable w/miniclips.
SINADDER Input Level:	20 mV to 10 VRMS.
SINADDER Input Impedance:	100 kΩ.
SINADDER Accuracy:	± 1 dB.
AC Voltmeter Ranges:	Nine: 10 mV, 30 mV, 100 mV, 300 mV, 1 V, 3 V, 10 V, 30 V, 100 V.
AC Voltmeter Input Impedance:	1 Megohm.
AC Voltmeter Accuracy:	± 3% of full scale, ± 0·25 dB 100 Hz - 20 kHz.
Audio Amplifier:	in SINADDER mode, AGC controlled constant volume to internal speaker. in VOLTMETER mode, range switch and front panel pot control volume.
Internal Tone:	1000 Hz ± 1 Hz. 1·5 VRMS into 500 ohm load. Front panel controlled.
Power:	115/230 VAC Strap selectable 50/60 Hz ± 15%. 13·5 VDC ± 15%.
Size:	8·75" W × 3·25" H × 7" D **Net Weight:** 3¼ lb.

then passes through a very sharp 1 kHz notch filter. This removes the 1 kHz tone, leaving only the Noise and Distortion components of the signal. These components are amplified and rectified by a precision average value rectifier circuit and used to drive the meter.

The internal audio amplifier and speaker together with the 1 kHz oscillator can be used in either the AC voltmeter or SINAD modes.

Conclusions

The SINADDER 3 is a well made instrument that greatly simplifies the measurement of SINAD ratio. In operation it meets all of its quoted specifications and is extremely easy to use. The only possible improvements to the instrument would be an indicator to show when the input level is too low, and some expansion of the SINAD scale. The scale is relatively cramped around the most used 12 dB mark and expansion to 30 or more dB for ultimate SINAD measurement could be useful.

It is definitely an instrument that, once used, is difficult to do without. The SINADDER 3 is available from Lyons Instruments Ltd of Hoddesdon, Hertfordshire.

■ R & EW

Your Reactions.........	Circle No.
Immediately Applicable	164
Useful & Informative	165
Not Applicable	166
Comments	167

Sinclair ZX81 Personal Comp
the heart of a system that grows with you.

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. Not surprisingly, over 50,000 were sold.

In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

Today, the Sinclair ZX81 is the heart of a computer system. You can add 16-times more memory with the ZX RAM pack. The ZX Printer offers an unbeatable combination of performance and price. And the ZX Software library is growing every day.

Lower price: higher capability
With the ZX81, it's still very simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, *and* to drive the new ZX Printer.

New BASIC manual

Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.

Kit: £49.95

Higher specification, lower price – how's it done?
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

New, improved specification
- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function – useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer.
- Advanced 4-chip design: micro-processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.

Built: £69.95

Kit or built – it's up to you!
You'll be surprised how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.

uter-

Available now- the ZX Printer for only £49.95

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alphanumerics *and* highly sophisticated graphics.

A special feature is COPY, which prints out exactly what is on the whole TV screen without the need for further intructions.

At last you can have a hard copy of your program listings – particularly useful when writing or editing programs.

And of course you can print out your results for permanent records or sending to a friend.

Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your computer – using a stackable connector so you *can* plug in a RAM pack as well. A roll of paper (65 ft long x 4 in wide) is supplied, along with full instructions.

16K-byte RAM pack for massive add-on memory.

Designed as a complete module to fit your Sinclair ZX80 or ZX81, the RAM pack simply plugs into the existing expansion port at the rear of the computer to multiply your data/program storage by 16!

Use it for long and complex programs or as a personal database. Yet it costs as little as half the price of competitive additional memory.

With the RAM pack, you can also run some of the more sophisticated ZX Software – the Business & Household management systems for example.

How to order your ZX81

BY PHONE – Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day.

BY FREEPOST – use the no-stamp-needed coupon below. You can pay by cheque, postal order, Access, Barclaycard or Trustcard.

EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

To: Sinclair Research Ltd, FREEPOST 7, Cambridge, CB2 1YY. **Order**

Qty	Item	Code	Item price £	Total £
	Sinclair ZX81 Personal Computer kit(s). Price includes ZX81 BASIC manual, excludes mains adaptor.	12	49.95	
	Ready-assembled Sinclair ZX81 Personal Computer(s). Price includes ZX81 BASIC manual and mains adaptor.	11	69.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	10	8.95	
	16K-BYTE RAM pack.	18	49.95	
	Sinclair ZX Printer.	27	49.95	
	8K BASIC ROM to fit ZX80.	17	19.95	
	Post and Packing.			2.95

☐ Please tick if you require a VAT receipt — TOTAL £ ______

*I enclose a cheque/postal order payable to Sinclair Research Ltd. for £ ______

*Please charge to my Access/Barclaycard/Trustcard account no.

*Please delete/complete as applicable.

Please print

Name: Mr/Mrs/Miss

Address:

FREEPOST – no stamp needed. Offer applies to UK only. REW 03

sinclair ZX81

6 Kings Parade, Cambridge, Cambs., CB2 1SN. Tel: (0276) 66104 & 21282.

HAVE YOU MISSED AN EARLIER EDITION OF R&EW?

Packed full of excellent Projects, Reviews and Features, a few copies of Britains newest and most innovative Radio/Electronics magazine are still available —

CONTENTS FROM PAST ISSUES OF R&EW

PROJECTS

Talking Clock	(Oct. '81)
VHF (2 metre) Converter	(Oct. '81)
27MHz FM Deviation Meter	(Oct. '81)
300 Watt Hi-Fi System	(Oct, Nov, Dec. '81)
AM/FM Radio	(Oct, Nov. '81)
60kHz 'Time' Receiver	(Oct. '81)
70cm Converter	(Nov. '81)
8-Digit DFM	(Nov, Dec. '81, Jan. '82)
Simple DVM	(Nov. '81)
Modulation Meter	(Nov. Dec. '81)
RS232 ADA Converter	(Dec. '81)
2 Metre PA	(Dec. '81)
Logic Probe	(Dec. '81)
3½ Digit DMM	(Jan. '82)
70cm-2m/TV Converter	(Jan. '82)
TV Mast-Head Amplifier	(Jan. '82)
Z-8 Computing System	(Feb. '82)
TV Pattern Generator	(Feb. '82)
40-Channel CB Rig	(Feb. '82)
TV Antenna Selector	(Feb. '82)

REVIEWS

Philips PM2521 DMM	(Oct. Nov.'81)
BBC Microcomputer	(Oct. '81)
IC2 Transceiver	(Oct. '81)
Sinclair ZX-81	(Oct. '81)
FT290R Transceiver	(Nov. '81)
Tektronix 60 MHz 'Scope	(Nov. '81)
Acorn Atom	(Nov. '81)
FRS7700 & R1000 Receivers	(Dec. '81, Jan, Feb. '82)
Amstrad CB Rig	(Dec. '81)
Power Meter Duo	(Dec. '81)
TR4122B Spectrum Analyser	(Dec. '81)
Marconi 2019 Signal Generator	(Feb. '82)
Thurlby 4¾-digit DMM	(Feb. '82)

FEATURES

50 Transistor Circuits	(Oct. '81)
Using UARTs	(Dec. '81, Jan. '82)
The Hall Effect	(Dec. '81)
Data File	(Dec. '81, Jan, Feb. '82)
Using the RS232 ADA	(Jan. '82)
Helical Filters	(Jan. '82)
PLL Frequency Synthesis	(Jan, Feb. '82)

Back issues of R&EW cost 95p each, including postage. Use the reply paid card/order form or send a cheque/P.O. to:—
R&EW Back Numbers, 45 Yeading Avenue, Rayners Lane, Harrow, Middlesex HA2 9RL

CB

R&EW 40-CHANNEL CB RIG.

Following last month's discussion of some of the basic principles to be considered when designing CB, this month's thrilling instalment reveals that 'we are not alone'. We also have some good news - and some bad news, read on....

The price of perfection

When we were fishing around for ideas for presenting the **R&EW** CB rig, several things had to be taken into account - not the least of which were the problems associated with a previously published design for a CB transceiver. CB is manufactured to a closely regulated set of specifications, and inviting hobbyist to make a piece of gear that has the potential - if incorrectly adjusted - to obliterate emergency communications systems is not considered a particularaly good idea.

The next problem was the presentation of the hardware. With sleek and slick rigs available, we didn't want the **R&EW** transceiver to look like a home made compromise if it could possibly be avoided. 'Avoidance' boils down to a plastic injection moulding at around £4 000 for the tooling, and a commitment to use a ton or so of the end-project. Plus the metal work, 'special' items etc. All in all, a very tall order for a relatively small market.

And perhaps the most insurmountable problem of all is the fact that as the CB sales slump leads to price cutting and dumping, the amortized cost for the stylish box and trimmings could cost more than a complete rig. Ahem.

The Good News

While mulling over these problems, we learned about a UK firm who were being brave enough to arrange to manufacture a rig entirely in this country. Not only is this newsworthy in itself, but we immediately asked if we could 'share' the hardware to present the **R&EW** CB rig *(PHOTO)*.

As it happens, we discovered that the design of the basic transceiver itself was very much along the lines that were proposed for the **R&EW** transceiver. We had originally intended to use the Sanyo LC7137 PLL synthesiser device, but recently we have been slightly concerned over the late delivery. Whilst on the other hand, the MC145151 (see the Databrief elsewhere in this issue) has been steadily rising in our estimation - and what's more, they seem to exist in adequate numbers and Motorola have been most helpful after a period of badgering.

The use of the more universally programmable MC145151 also permits a much simpler conversion of the basic design to suit frequencies outside the CB band - specifically for use with 10m NBFM - or how about channellized NBFM on 160m? Five watts on 80m can also span over 200 miles under the right conditions.

The rig is in fact being manufactured by Mega Electronics, and we are now able to make the 'made in England' hardware available for the **R&EW** rig - as well as for many other potential projects that can be fitted into such a case. But this still leaves the question of unskilled manufacture of a set that is supposed to conform to the standards of MPT1320.

More Good News

So we have come up with what we think could be an ideal compromise. The Mega rig will be made available in both complete and 'knocked down' versions, and we shall describe the circuit, operation and testing to provide a thorough understanding and working knowledge of the rig. To ensure that the transceivers cause as little trouble as possible, the 'kit' versions will be available with circuit boards that are fully assembled and flow soldered - we appreciate that there will be those amongst you who like to do things from scratch, but there will be plenty of work in assembling the unit into the case, and then subsequently fitting on the extras, which is where we propose to concentrate the **R&EW** effort.

The case of the Mega rig has enough spare room to accommodate all of the proposed add-ons such as selective calling - in fact, there is even space for a stack of 'C' size NiCad batteries on one of the lid halves, so turning the set into a transportable unit. The set can work from 10V, so there is enough room to charge the batteries from a vehicle supply.

There's even room for a 934 MHz section, and there appears to be nothing in the licence about not using 934 MHz/27 MHz duplex. A low power 934 MHz fixed channel transceiver could possibly act as a radio mic - there is a lot

(NB The use of any type of radio transmitting apparatus is regulated by the Home Office, and except in the case of certain types of 27 MHz radio control equipment, requires specific licencing. A CB licence costs £10 and is available from a Post Office.)

R&EW 40-CHANNEL CB RIG.

of scope for thought and originality.

The block diagram circuit of the Mega rig (*Fig 1*) is more basic than the proposed 'all singing and dancing' version of the **R&EW CB**, so we shall be concentrating on the many peripheral 'add-ons' and modifications that will bring it into line with the philosophy of part one of this feature - but moreover, these peripherals will then be generally applicable to other sets. Feedback from readers reveal that most who want a CB have already got one, and they tend to agree with the problems we identified in part one - but understandably enough, they don't want to junk the set before even the guarantee has run out.

The not so good news

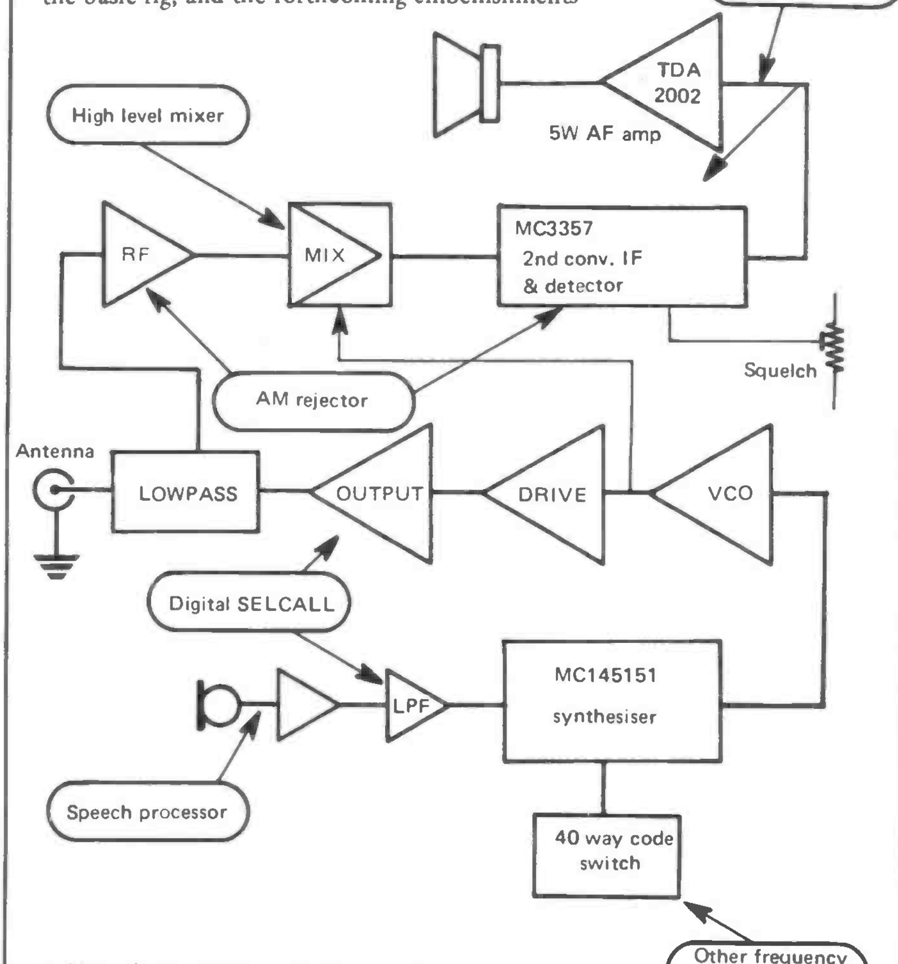
As a result of the appalling weather around Christmas and the New Year, progress on the production trimming of the basic design has been held up. In view of the possibly alarming consequencies of 'another' UK specification CB transceiver that is 'published in haste', we have decided to hold the publication of the full circuit and constructional details until next month (Contrary to the assertions made by our Editor in last month's carry-over, I shall not be eating my fur lined boots just yet).

So this month we take a closer look at the question of speech processing for the transmitter - which is another one of those areas where too many commercial rigs do not appear to be paying enough attention. The number of 'power mics' available to the followers of CB bears witness to the fact that enough users are disenchanted with the basic rigs to want to go out and spend a few more pounds in the hope of performing a silk purse conversion.

Say "Arrrrrlow"

The specification for UK CB states that maximum deviation is 2.5 kHz, nominally 1.5 kHz. The method of determining this

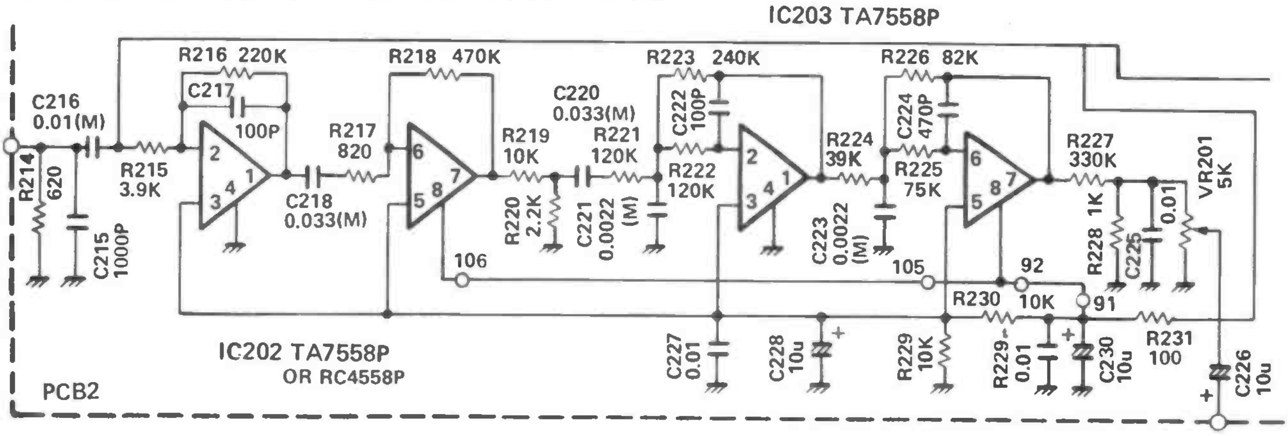
The 'Rig' and the options.......
the basic rig, and the forthcoming embellishments



- Nicad/low power audio transportable conversion
- SELCALL and sub-audio tone systems
- Audio noise blanking, AM rejector system
- Mic processing systems, audio and RF clippers
- Conversions to other frequencies in HF (legal!)
- Auto break-in for radio/tape players
- Scanning, priority channels

Figure 1: Block diagram of the basic rig with options indicated in the oval 'boxes'.

Figure 2: Typical oriental mic pre-amp, limiter and low pass filter stage.



is to first establish a 1.5 kHz deviation input level, and then increase this by 20 dB - and swing the frequency from 300 Hz to 3 kHz. Now 20 dB is 100 times, so if 2 mV gives 1.5 kHz, 200 mV must be limited to 2.5 kHz.

The solution adopted by many rigs is to simply drive the first stage of the mic preamplifier into severe clipping by banging the output from an op-amp hard against the supply rails, and then removing the resulting harmonics in an active low pass filter as shown in *Fig 2*. (Refer to our December CB rig test for more details of such circuitry.)

The results of this are adequate for the purpose of complying with the spec - but they leave a lot to be desired in use. For example, although speech will be clipped to provide 'talk power', pauses in the speech are likely to be filled in with miscellaneous road and background noises - since using the example outlined above, the happy breaker can produce 200 mV output from his microphone, but the gasps for breath need only produce 2 mV from the microphone for 60% of maximum deviation to be used in transmitting the heavy breathing.

Some designs make provision for pre-emphasis in the modulator, to help spread the speech energy more evenly by emphasizing higher frequencies, at the rate of 6 dB/octave. The result produces a characteristic which is approximately the inverse of the audio engineers 'A' weighting curve - where the idea is to concentrate sound energy in the most perceptible band of frequencies for the purpose of assessing noise levels.

The system works well on FM broadcasting, where the modulation levels are generally well below 50% (most of the time) - but in a communications system with only a narrow available deviation, clipping usually sets in and evens out the energy dispersal using 'brute force' techniques.

ALC to the rescue

Automatic Level Control (ALC), Voice Operated Gain Control (VOGAD), call it what you will, has one purpose - namely to try and provide a constant audio output level (without clipping) over a wide range of input levels. In this way, the maximum speech effectiveness is retained, but the time constant of the gain control is set so that small pauses in the speech are not immediately filled in with background noises as the amplifier's gain remains suppressed awaiting the next speech input.

Plessey's SL6270 mic preamplifier IC (*Fig 3*) provides a constant output from 3 to 100 mV input without clipping and the associated problems of harmonics and intermodulation distortion. This device effectively combines the earlier SL630/SL620 pair in a single package, although purists might like to consider using an SL1621 audio derived AGC generator

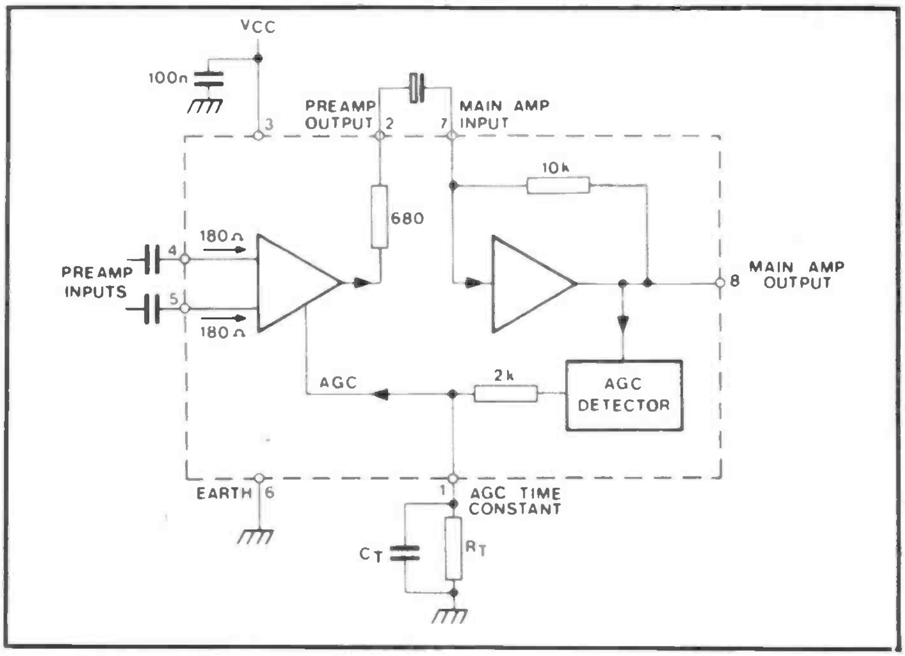


Figure 3a: SL6270 mic pre-amp system.

with its uniquely programmable fast attack/slow decay system.

ALC is provided in some rigs - SMC's new 'Oscar' is one, and here the ALC is derived from the audio amplifier IC. D7 rectifies the audio, with RV6 determining the operating point Q18 is then used to clamp the microphone input to ground, with C106/C107 and R68 determining the time constant of the system. Q22 is there to clamp the mic circuitry 'off' during receive.

Incidentally, the loudspeaker is muted during transmit by simply removing the earth return via the PTT switch. Virtually all CB rigs route the loudspeaker connection through the mic connection, since this then enables a telephone handset to be fitted, complete with remote speaker option switching. The fact that the loudspeaker output is available here may also be used in selective calling systems.

Another (low cost) IC solution is offered by the SGS TDA1054 preamplifier device (*Fig 4*). Although originally conceived for applications in cassette recorders, this device has proven itself versatile as a transmitter mic amplifier in the circuit of *Fig 5*.

Finally in this review of practical speech processing techniques, we give you the TOKO KB4417. This device is the subject of a forthcoming **R&EW** Databrief, so we will not delve too deeply here.

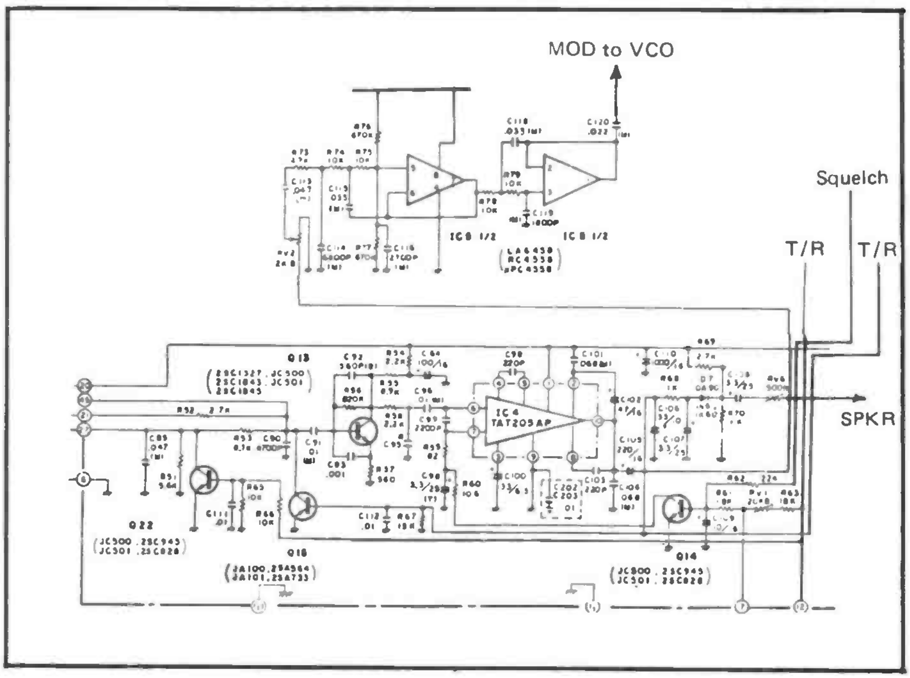


Figure 3b: SMC's OSCAR transceiver mic amplifier system.

R&EW 40-CHANNEL CB RIG.

The circuit of *Fig 6* shows that, as usual, the TOKO device manages to pack in more functions for your money, including an AGC section, clipper, transmit muting, overmodulation shut down (OMP) and a further section for filtering applications.

Conclusions

There's a lot more to designing an effective speech amplifier circuit than simply clipping and filtering. If all rigs had decent ALC input stages, then

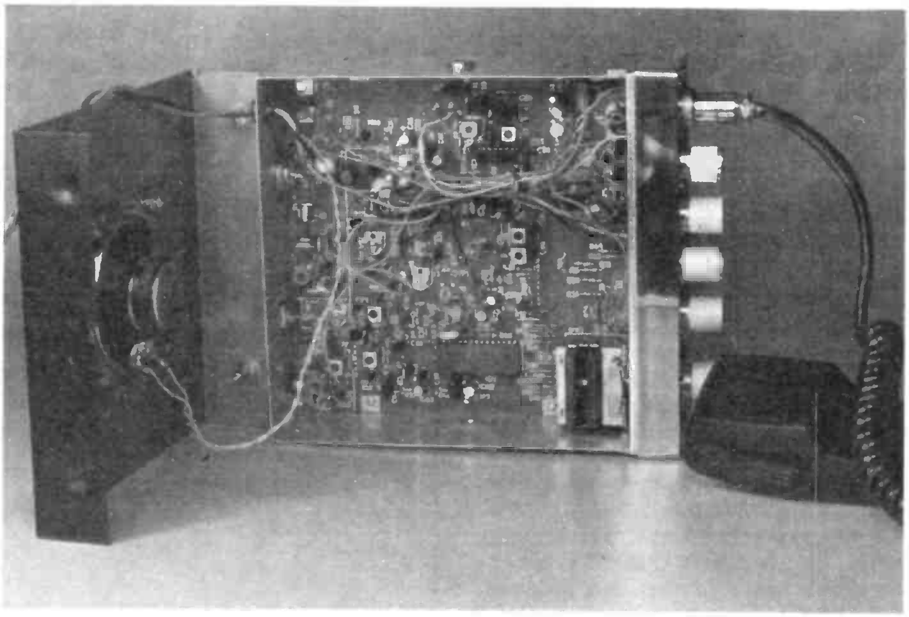
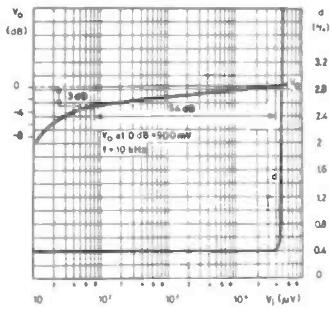
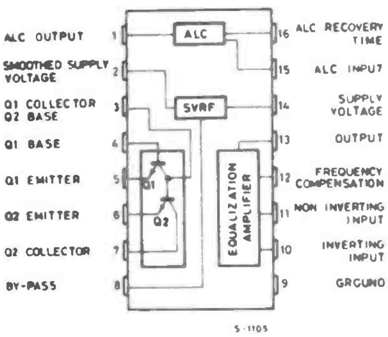


Figure 4: Internal layout of the TDA1054 AGC mic pre-amp.





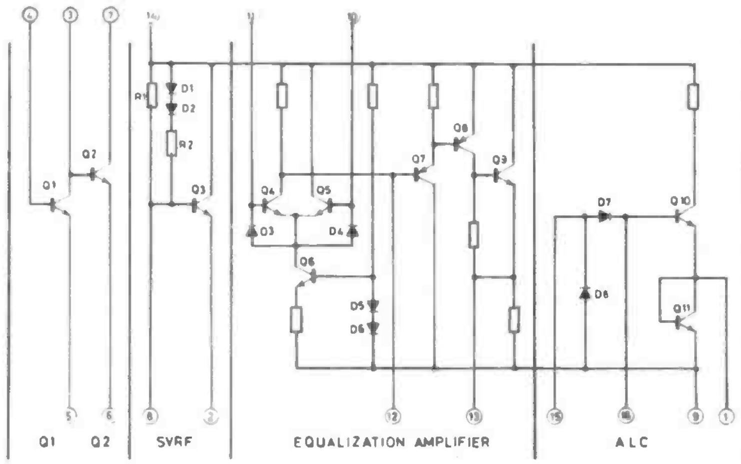
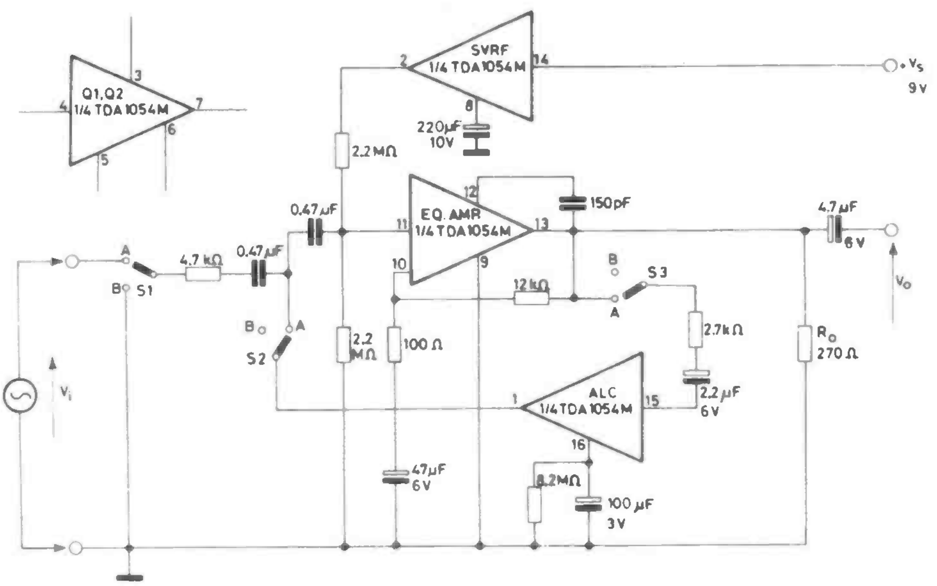


Figure 5.

TDA1054 Test Circuit.



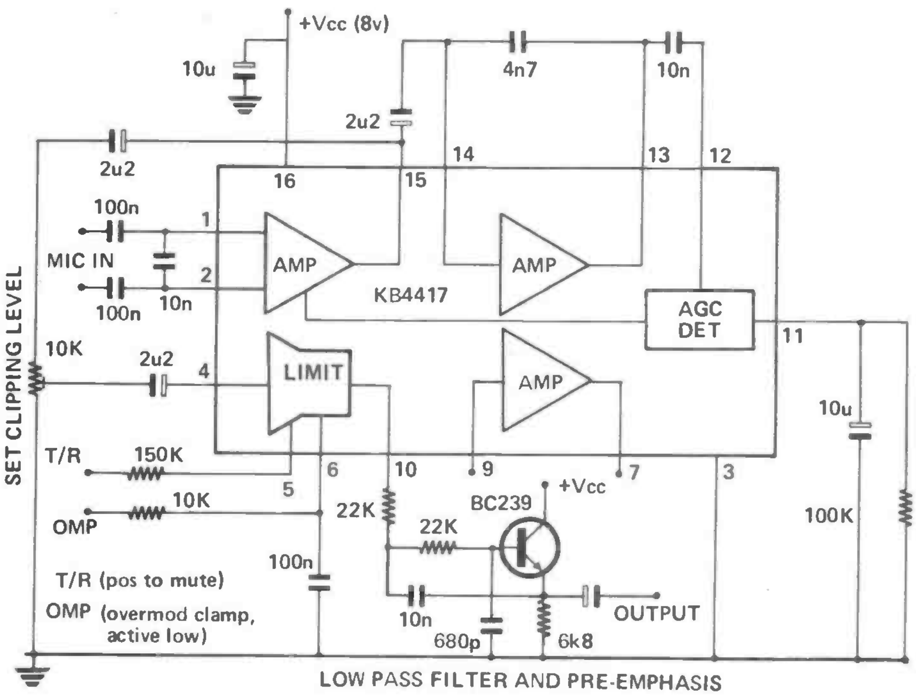


Figure 6: KB4417 in a comprehensive speech processor.

manufacturers of 'power mics' (ugh) would be out of business. A few simple tests will reveal that a decent modulation system can do as much for the usable range of most sets as an extra 3 dB of transmitted power.

No mention has been made of the need to avoid RFI in audio stages - the practical implementation of any transmitter speech amplifier must take into account adequate decoupling of RF from sensitive sections of the circuit. Most sets will rattle when shaken - not as a result of any loose screws, but due to the liberal use of ferrite beads. AM sets are certainly more prone to this problem, but FM is by no means immune, so watch out.

Next Month

Blizzards permitting, we shall be analysing the basic circuit in detail, together with assembly and alignment considerations. Hardware will be available, so your affair with CB can begin in earnest.

□ R & EW

Your Reactions.........	Circle No.
Excellent - will make one	180
Interesting - might make one	181
Seen Better	182
Comments	183

BI-PAK BARGAINS

5T21 **SCREWDRIVER SET**
6 precision screwdrivers in hinged plastic case. Sizes: – 0.8, 1.4, 2, 2.4, 2.9 and 3.8mm **£1.75**

5T31 **NUT DRIVER SET**
5 precision nut drivers in hinged plastic case. With turning rod
Sizes: – 3, 3.5, 4, 4.5 and 5mm **£1.75**

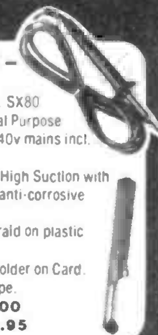
5T41 **TOOL SET**
5 precision instruments in hinged plastic case. Crosspoint (Phillips) screwdrivers: – H 0 and H 1 Hex key wrenches: – 1.5, 2 and 2.5mm **£1.75**

5T51 **WRENCH SET**
5 precision wrenches in hinged plastic case. Sizes: – 4, 4.5, 5, 5.5 and 6mm **£1.75**

BUY ALL FOUR SETS, 5T21-5T51 and get **HEX KEY SET FREE**
HEX KEY SET ON RING.
Sizes: 1.5, 2, 2.5, 3, 4, 5, 5.5 and 6mm.
Made of hardened steel
HX/1 **£1.25**

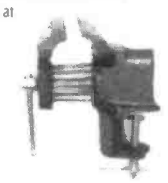
BI-PAK PCB ETCHANT AND DRILL KIT

Complete PCB Kit comprises
1 Expo Mini Drill 10,000RPM 12v DC incl 3 collets & 1 x 1mm Twist bit.
1 Sheet PCB Transfers 210mm x 150mm.
1 Etch Resist Pen
1 ½lb pack FERRIC CHLORIDE crystals.
3 sheets copper clad board
2 sheets Fibreglass copper clad board.
Full instructions for making your own PCB boards.
Retail Value over **£15.00**
OUR BI-PAK SPECIAL KIT PRICE **£9.75**
ORDER NO. SX81



BI-PAK SOLDER – DESOLDER KIT

Kit comprises ORDER NO. SX80
1 High Quality 40 watt General Purpose Lightweight Soldering Iron 240v mains incl. 3/16" (4.7mm) bit.
1 Quality Desoldering pump. High Suction with automatic ejection. Knurled, anti-corrosive casing and teflon nozzle.
1.5 metres of De-soldering braid on plastic dispenser.
2 yds (1.83m) Resin Cored Solder on Card.
1 Heat Shunt tool tweezer Type.
Total Retail Value over **£12.00**
OUR SPECIAL KIT PRICE **£8.95**



MINI VICE

This small cast iron quality made vice will clamp on to any bench or table having a max thickness of 1⅛". The 2½" jaws open to max of 1⅞". Approx size 80 x 120 x 66mm
Bi-Pak's Mini Vice at a Mini Price only
£2.
ORDER NO. SX82

The Third and Fourth Hand...

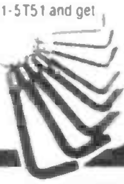
.... you always need but have never got "until now"
This helpful unit with Rod mounted horizontally on Heavy Base, Crocodile clips attached to rod ends. Six ball & socket joints give infinite variation and positions through 360° also available attached to Rod a 2½ diam magnifier giving 2.5 x magnification. Helping hand unit available with or without magnifier
Our Price with magnifier as illustrated ORDER NO. T402 **£5.50**
Without magnifier ORDER NO. T400 **£4.75**

BRAND NEW LCD DISPLAY MULTITESTER.

RE 188m
LCD 10 MEGOHM INPUT IMPEDANCE
•3½ digit •16 ranges plus hFE test facility for PNP and NPN transistors •Auto zero, auto polarity •Single-handed, pushbutton operation •Over range indication •12.5mm (½-inch) large LCD readout •Diode check •Fuse circuit protection •Test leads, battery and instructions included.

Max indication	1999 or – 1999
Polarity indication	Negative only. Positive readings appear without + sign.
Input impedance	10 Megohms
Zero adjust	Automatic
Sampling time	250 milliseconds
Temperature range	– 5°C to 50°C
Power Supply	1 x PP3 or equivalent 9V battery
Consumption	20mW
Size	155 x 88 x 31mm

RANGES
DC Voltage 0-200mV. 0-2-20-200-1000V. Acc: 0.8%
AC Voltage 0-200-1000V
Acc. 1.2% DC Current 0-200uA. 0-2-20-200mA. 0-10 A. Acc: 1.2%
Resistance 0-2-20-200K ohms. 0-2 Megohms. Acc: 1%
BI-PAK VERY LOWEST POSS PRICE **£35.00** each



EXPERIMENTOR BOXES – ALUMINIUM – PLASTIC

ALUMINIUM BOXES

Made with Bright Aluminium folded construction with deep lid and screws

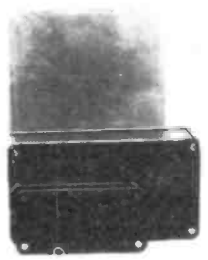
SIZE " L	W	H	Order No.	Price
5¼	2¼	1½	159	**83p**
4	2¼	1½	161	**83p**
4	2½	2	163	**83p**
3	2	1	164	**57p**
8	6	3	166	**£1.68**
6	4	2	167	**£1.12**

Plastic Boxes

Coloured Black. Close fitting
Flanged Lid. fixing screws into brass bushes

SIZE L	W	H	Order No	Price
4	2	1	141	**£1.00**
4¾	2½	1½	143	**£1.30**
6	3¼	2	144	**£1.50**
Plastic as above but with aluminium top panel				
4	2¾	1	146	**£1.40**
Plastic sloping front				
5½	4¼	2¼ slope to 1½	148	**£2.14**

All measurements for boxes are shown in inches. L = Length. W = Width. H = Height



MW398 NI-CAD CHARGER

Universal Ni-Cad battery charger. All plastic case with lift up lid. Charge/Test switch. LED indicators at each of the five charging points.

Charges: –	Power: –
PP3 (9V)	220-240V AC
U12 (1.5V penlite)	Dims: –
U11 (1.5V "C")	210 x 100 x 50mm
U2 (1.5V "D")	**£6.95**

POWER SUPPLY OUR PRICE £3.25

Power supply fits directly into 13 amp socket. Fused for safety. Polarity reversing socket. Voltage switch. Lead with multi plug.
Input: – 240V AC. 50HZ Output: –3. 4.5. 6. 7.5. 9 & 12V DC Rating: – 300 ma MW88

"IRRESISTABLE RESISTOR BARGAINS"

Pak No.	Qty*	Description	Price
SX10	400	Mixed "All Type" Resistors	£1
SX11	400	Pre-formed ¼-½ watt Carbon Resistors	£1
SX12	200	⅛ watt Carbon Resistors	£1
SX13	200	¼ watt Carbon Resistors	£1
SX14	150	½ watt Resistors 22 ohm-2m2 Mixed	£1
SX15	100	1 and 2 watt Resistors 22 ohm-2m2 Mixed	£1

Paks SX12-15 contain a range of Carbon Film Resistors of assorted values from 22 ohms to 2 2 meg. Save pounds on these resistor paks and have a full range to cover your projects.
*Quantities approximate. count by weight

"CAPABLE CAPACITOR PAKS"

Pak No.	Qty*	Description	Price
SX16	250	Capacitors Mixed Types	£1
SX17	200	Ceramic Capacitors Miniature Mixed	£1
SX18	100	Mixed Ceramics 1pf-5 pf	£1
SX19	100	Mixed Ceramics 68pf-0.5mf	£1
SX20	100	Assorted Polyester/Polystyrene Capacitors	£1
SX21	60	Mixed C280 type capacitors metal foil	£1
SX22	100	Electrolytics, all sorts	£1
SX23	50	Quality Electrolytics 50-1000mf	£1
SX24	20	Tantalum Beads, mixed	£1

Quantities approximate. count by weight.

AUDIO PLUGS, SOCKETS AND ACCESSORIES

25 pieces of Audio Plugs, Sockets and Connectors to include DIN 180°-240° Inline 3-6 Pin. Speakers, Phono Jack, Stereo and Mono, etc. etc. Valued at well over £3 normal. Order No SX25 Our Price £1 50 per pak Guaranteed to save you money

SX26 3 Prs of 6 pin 240° DIN Plugs and Chassis Sockets 50p
SX38 100 Silicon NPN Transistors—all perfect. Coded mixed types with data and eqvt. sheet. No rejects. Real value £2.50
SX39 100 Silicon PNP Transistors—all perfect. Coded mixed types with data and eqvt. sheet. No rejects. Fantastic value. £2.50

TRIACS — PLASTIC

4 AMP — 400v — T0202 — TAG 136G.

1 OFF	10 OFF	50 OFF	100 OFF
40p	£3.75	£17.50	£30.00
8 AMP 400v — T0220 — TAG 425			
60p	£5.75	£27.50	£50.00

Everyday Electronics

Teach-in '81
Kit 1 £15.65 (Kits 1 & 2 combined
Kit 2 £ 8.94 price £23.00)

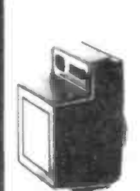
All prices include V.A.T. & postage.

IC SOCKETS

The lowest price ever.

The more you buy the cheaper they come!

Pin	10 off	50 off	100 off
8	75p	£3.00	£5
14	80p	£3.25	£5.50
16	80p	£3.25	£5.50



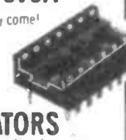
VOLTAGE REGULATORS T0220

Positive +	Negative +
7805 — 50p	7905 — 55p
7812 — 50p	7912 — 55p
7815 — 50p	7915 — 55p
7824 — 50p	7924 — 55p

(please state voltage required)

Other types: LM340K — 6 volt — 18 volt — 24 volt.
T03 — **40p**. UA723 — 14 pin DIL — **40p**

Guarantee Satisfaction or your money back has always been BI-PAK's GUARANTEE and it still is. All these Sale items are in stock in quantity and we will despatch the same day as your order is received



MOTOROLA PIEZO ELECTRIC TWEETER

Maximum Ratings:
25 volts rms which is equal to:
200 watts across 4 ohms
100 watts across 8 ohms
50 watts across 16 ohms
BI-PAK SPECIAL OFFER PRICE **£4.65**
ORDER NO. 1907

DOME TWEETER

Dome tweeter for systems up to 50w.
Impedance: 8 ohms
Frequency Response: 2000-20,000Hz
Dims. 98mm diam. x 31mm deep
Our Price **£2.85** DMT200

BI-PAK's COMPLETELY NEW CATALOGUE

Completely re-designed. Full of the type of components you require, plus some very interesting ones you will soon be using and of course, the largest range of semiconductors for the Amateur and Professional you could hope to find.

There are no wasted pages of useless information so often included in Catalogues published nowadays, just solid facts i.e. price, description and individual features of what we have available. But remember, Bi-Pak's policy has always been to sell quality components at competitive prices and **THAT WE STILL DO.**

BI-PAK'S COMPLETELY **NEW** CATALOGUE is now available to you. You will be amazed how much you can save when you shop for Electronic Components with a Bi-Pak Catalogue. Have one by you all the time—it pays to buy BI-PAK

To receive your copy send **75p** plus 25p p&p

BI-PAK

Send your orders to Dept BI-PAK PO BOX 6 WARE HERTS.
SHOP AT 3 BALDOCK ST. WARE HERTS.
TERMS, CASH WITH ORDER, SAME DAY DESPATCH, ACCESS, BARCLAYCARD ALSO ACCEPTED. TEL (0920) 3182. GIRO 388 7006
ADD 15% VAT AND 50p PER ORDER POSTAGE AND PACKING

Use your credit card. Ring us on Ware 3182 NOW and get your order even faster. Goods normally sent 2nd Class Mail.
Remember you must add VAT at 15% to your order Total. Postage add 50p per Total order

17 for further details

APPLICATIONS FILE: CD4017B

The CD4017B counter/divider is one of the most popular of all CMOS chips. In this special feature, Ray Marston explains the basic characteristics of the device and shows 27 practical ways of using it.

THE CD4017B IS DESCRIBED in manufacturer's leaflets as 'a CMOS decade counter/divider with ten decoded outputs'. This simple description in fact belittles the full capabilities of the device, because those 'ten decoded outputs' can in practice be used to do a whole host of useful things. The ten outputs are so arranged that, when the chip is fed with a suitable clock signal, they sequentially switch high on the arrival of each new clock pulse, only one output being high at any moment of time. Each output is capable of sinking or sourcing a current of several milliamps.

Thus, the decoded outputs of the CD4017B can be used to directly drive a bank of LEDs to make attractive visual 'sequencing' displays, or to sequentially switch audio tone generators to produce special sound effects or create musical rythms, etc. Alternatively, outputs can be coupled back to the device's control terminals to make the IC count to, or divide by, any number from 2 to 9 and then either stop or recycle. Numbers of 4017s can readily be cascaded to give either multi-decade division or to make counters with any desired number of decoded outputs. Let's take a closer look at the device.

CD4017B BASICS.

Figure 1 shows the outline and pin designations and the functional diagram of the CD4017B, while *Fig 2* shows the basic timing diagram, of the device, which incorporates a 5-stage Johnson counter. The device has CLOCK, RESET AND INHIBIT input terminals and ten DECODED and one CARRY output.

The counters are advanced one step at each positive transition of the CLOCK input signal when the CLOCK INHIBIT and RESET terminals are both low. Nine of the ten decoded outputs are low, with the remaining output high, at any given time. The outputs go high sequentially, in phase with the CLOCK signal, with the selected output remaining high for one full clock cycle. An additional CARRY OUT signal completes one cycle for every ten CLOCK input cycles, and can be used to ripple-clock additional 4017's in multi-decade counting applications.

The 4017 counting cycle can be inhibited by setting the CLOCK INHIBIT terminal high. A high signal on the RESET terminal clears the counters to ZERO and sets the 'O' output terminal high. All unused inputs must be tied low or high, as appropriate. The CD4017B can be powered from any DC supply in the 3 V to 18 V range; the IC consumes a typical quiescent current of less than one microamp. The CLOCK signal must have a rise time less than 15 uS; the maximum usable clock frequency is typically 5 MHz.

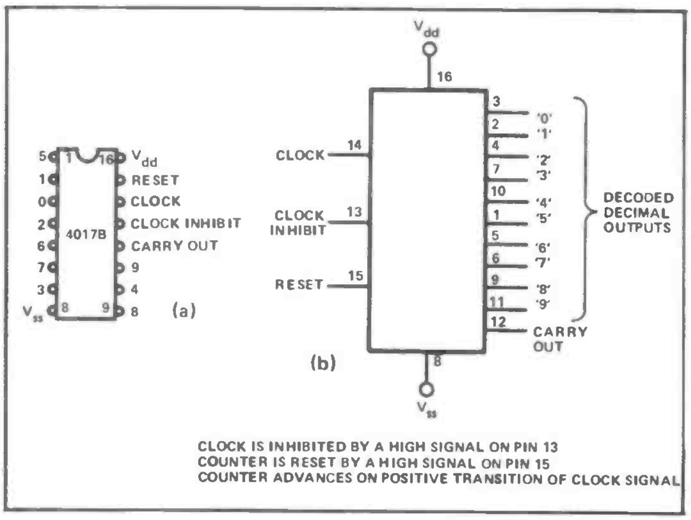


Figure 1a: Outline and pin designation of the CD4017B.
Figure 1b: Functional diagram and data for the CD4017B.

PRACTICAL DIVIDER CIRCUITS.

The CD4017B is a very versatile counter/divider and can readily be made to divide by any desired whole number. The easiest way to use the device is as a decade divider, as shown in *Fig 3*. Here, the output signal has a frequency 1/10th of that of the input clock signal. We've shown a 555 astable as the 'clock' generator, but any other clock generator can be used, the only requirement being

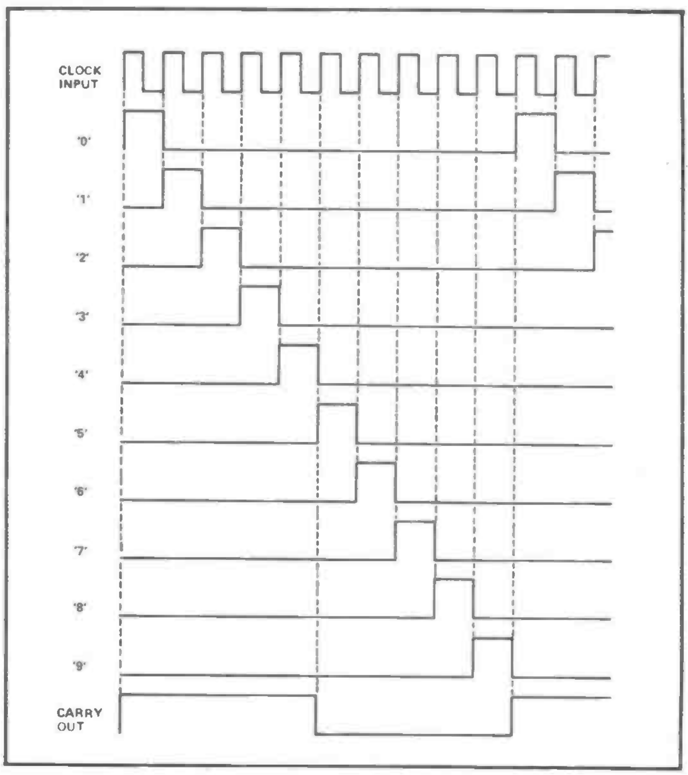


Figure 2: Waveform timing diagram of the CD4017B, with it's RESET and CLOCK INHIBIT terminals grounded.

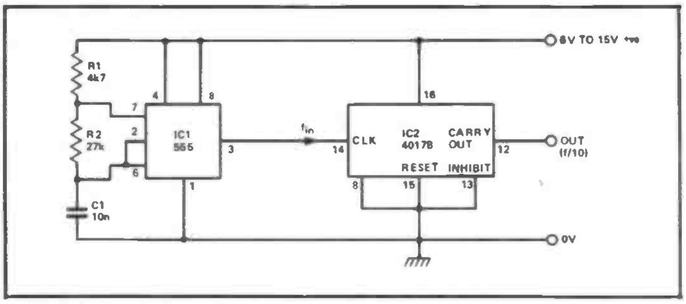


Figure 3: The simplest application of a 4017 is as a decode divider. IC1 is a 555 astable 'clock' generator.

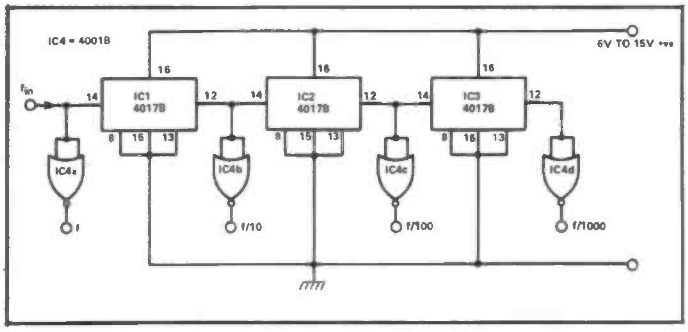


Figure 4: Any number of 4017s can be cascaded to make a multi-decode divider. If the outputs are to be externally loaded, they should be buffered, as shown here.

that the clock signal should transition fully between the logic 'O' and logic '1' states, and must have a rise time less than 15 uS.

Any number of 4017B stages can be cascaded to give multi-decade division. *Fig 4* shows the circuit of a 3-decade divider that generates outputs of 1/10th, 1/100th and 1/1000th of the clock frequency. Note that the four outputs are buffered via simple CMOS inverters (made from 4001 gates), to ensure that output loading does not degrade the rise-times of the clock signals.

Figure 5 shows how to connect the 4017B so that it stops operating after completing a pre-determined counting sequence. In the diagram, the counter is set to stop when its clock inhibit terminal is driven high by the '9' output, but the counter can in fact be inhibited via any one of the 4017's decoded output terminal. The count sequence can be restarted by pressing reset button PB1.

Figure 6 shows one way of connecting a 4017 as a divide-by-N (N = 2 to 9) counter with N decoded outputs. The circuit is set to divide by 5 with the connections shown. The circuit operation here is such that the Nth output of the counter momentarily goes high on the positive transition of the Nth clock pulse and causes the IC1a-IC1b flip-flop to change state and apply a reset command to pin 15 of the 4017, which in turn causes its 'O' output to go high and feed a low signal to one terminal of NOR gate IC1c: When the negative transition of the Nth clock pulse arrives, it places a low signal on the remaining terminal of the IC1c NOR gate, which therefore feeds a high signal to IC1a and causes the flip-flop to again change state and remove the reset command from pin 15 of the 4017. The 4017 is then free to count again on the arrival of the next clock pulse.

Figure 7 shows an alternative way of obtaining divide-by-N operation. Here, the Nth output (the 5th in this diagram) momentarily goes high on the arrival of the positive transition of the Nth clock pulse and causes the IC1a-IC1b monostable to generate a 15 uS pulse that immediately resets the counter to the 'O' or empty state, ready for the arrival of the positive transition of the next clock pulse: This circuit is of particular value in multi-IC 4017 divider applications. In practice, the monostable pulse duration must be less than the clock period interval, so the *Fig 7* circuit will only work at clock frequencies up to about 60 kHz. At higher frequencies the pulse period must be reduced.

Note in the *Figs 6 and 7* circuits that the counter can be made to divide by any number N by simply taking the 'free' terminal of the circuit's multi-vibrator to the Nth output terminal of the counter.

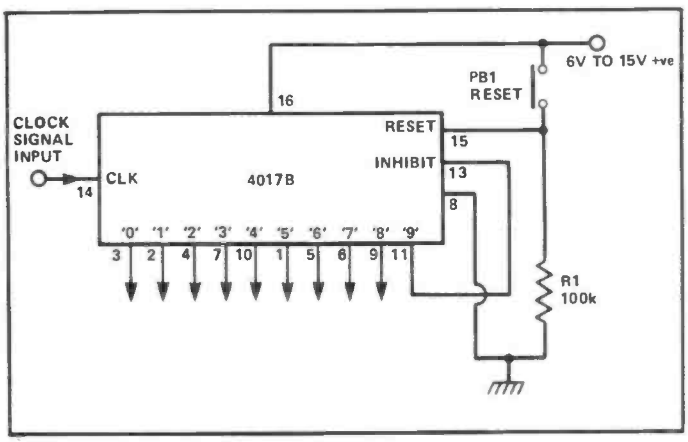


Figure 5: Method of connecting the 4017B for sequence-and-stop operation. The counter stops when it's CLOCK INHIBIT terminal is driven high by the '9' output. The count sequence can be restarted by pressing the RESET button.

GREATER-THAN-10 STAGE COUNTER/DECODER CIRCUITS.

The most important feature of the 4017B is the fact that it provides up to ten fully decoded outputs, making the IC ideal for use in a whole range of 'sequencer' applications. Often, however, ten stages of counting/decoding aren't enough for a particular task and in such cases it is a fairly simple matter to interconnect a number of 4017 ICs to obtain any required total of decoded output stages.

Figure 8 shows how to interconnect a pair of 4017's to make a 10- to 17-stage counter/decoder; the circuit is shown set for divide-by-17 operation. Circuit operation is as follows.

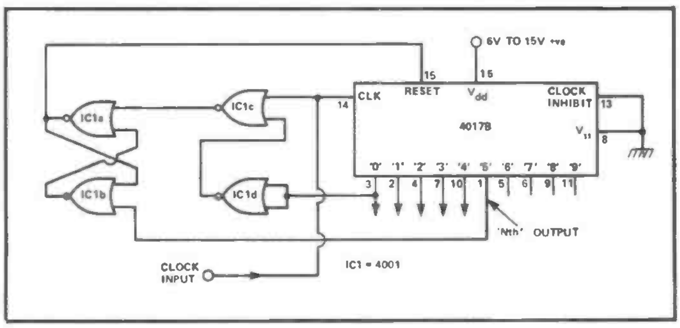


Figure 6: A Divide-by-N (N=2 to 9) counter with N decoded outputs. the circuit is set to divide-by-5 with the connections shown.

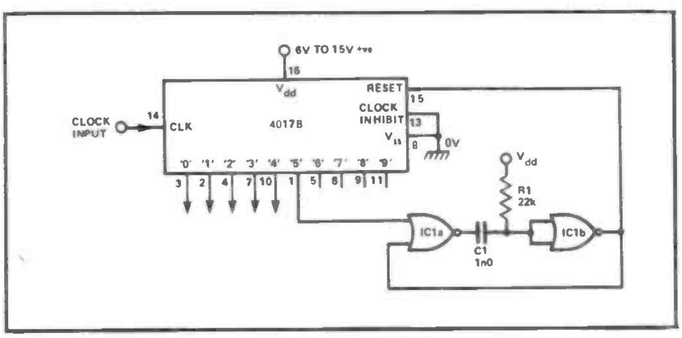


Figure 7: An alternative divide-by-N counter. The circuit is set to divide-by-5 with the connections shown.

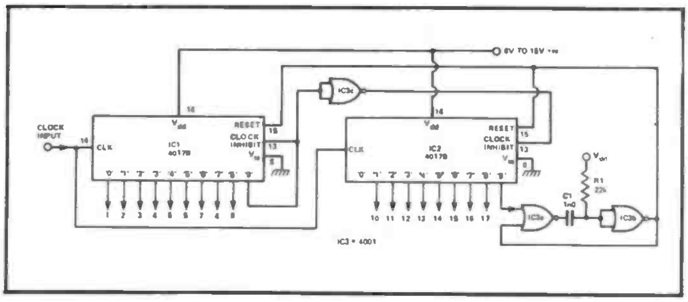


Figure 8: A 10- to 17-stage counter/decoder, set for divide-by-17 operation.

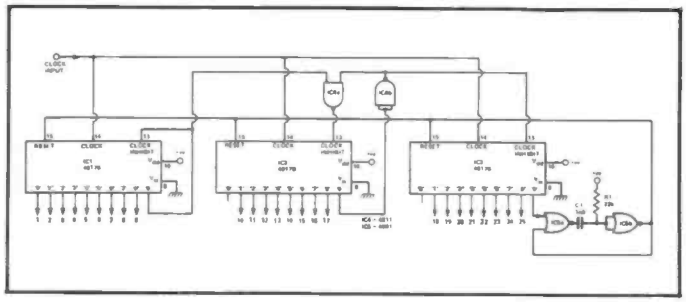


Figure 9: An 18- to 25-stage counter/decoder, set for divide-by-25 operation.

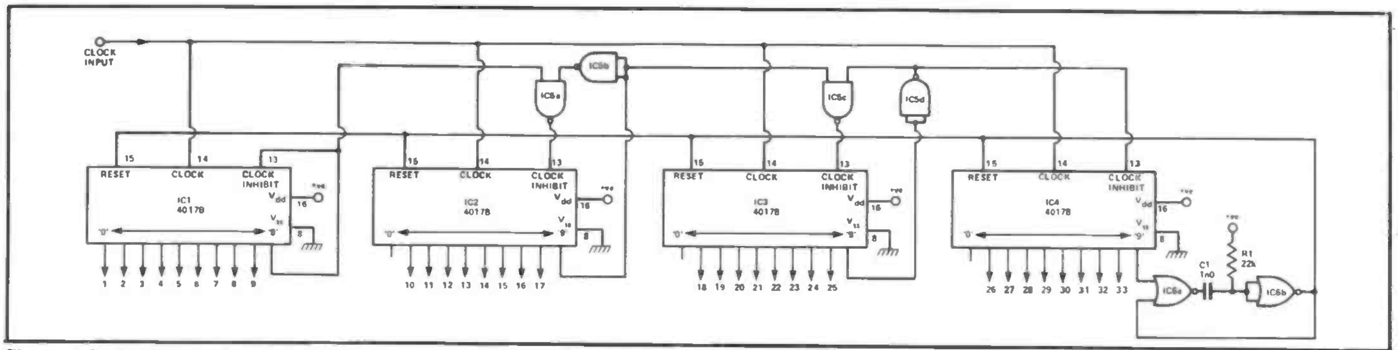


Figure 10: A 26- to 33-stage counter/decoder, set for divide-by-33 operation.

The CLOCK input signal is parallel-fed to IC1 and IC2. When, however, the count is below 9, the '9' output of IC1 is low and causes the CLOCK INHIBIT terminal of IC2 to be set high via IC3c, so IC2 is not influenced by the clock signals. As soon as the 9th clock pulse arrives the '9' output of IC1 goes high and inhibits IC1 from further clocking action and simultaneously drives the clock inhibit terminal of IC2 low via IC2c and enables IC2 to respond to subsequent clock signals. Eventually, on the arrival of the 17th clock pulse, the '9' output of IC2 goes momentarily high and triggers the IC3a-IC3b 15 uS monostable, which resets both counters to their empty or 'O' states. The counting sequence then repeats.

Note that the '9' output of IC1 and the 'O' and '9' outputs of IC2 are 'lost' in the counting action, so the circuit provides a maximum of 17 usable counter/decoder stages. The circuit can be made to count by any number in the range 10 to 17 by connecting the 'free' input terminal of IC3a to the appropriate output terminal of IC2.

Figure 9 shows the connections for making an 18 to 25-stage counter/decoder from three 4017's. In this case IC3 is inhibited via IC4b and the low output '9' of IC2, and IC2 is inhibited via IC4a and the low output '9' of IC1, up to the 9th clock pulse. IC1 is inhibited via it's high '9' output, and IC2, between the 10th and 17th clock pulses. Finally, IC1 is inhibited via it's high '9' output, and IC2 is inhibited via the high '9' outputs of IC1 and IC2 via IC4c between the 18th and 25th clock pulses, and the entire circuit is reset to the 'O' state via the IC5a-IC5b monostable on the 25th-plus-one clock pulse.

Note in *Fig 9* that the 1st counter gives nine useful outputs and that all succeeding stages give eight useful outputs. The basic *Fig 9* circuit can be expanded to incorporate any number of 4017 stages by simply adding slightly modified IC2-IC5a-IC4b stages between IC1 and the final two stages of the system, as shown in the 26- to 33-stage counter/decoder circuit of *Fig 10.*

Figure 11 shows an alternative way of using 4017's to obtain large numbers of counter/divider stages. The technique

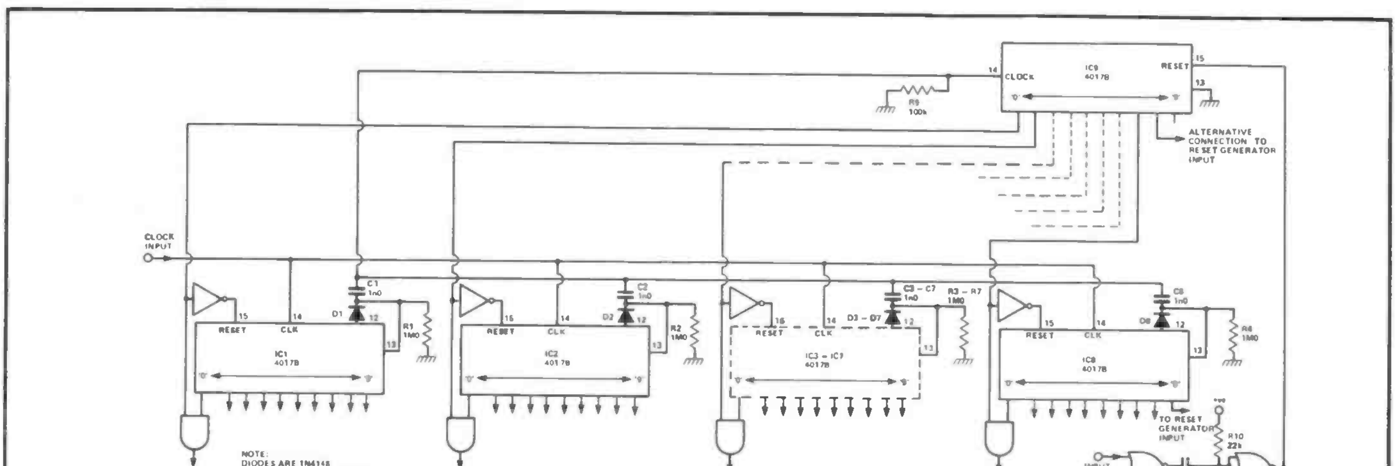


Figure 11: A 79- on 80-stage counter/decoder. The circuit gives 79-stage operation when the reset generator is fed from the '9' output of IC8, on 80-stage operation when fed from the '9' output of IC9.

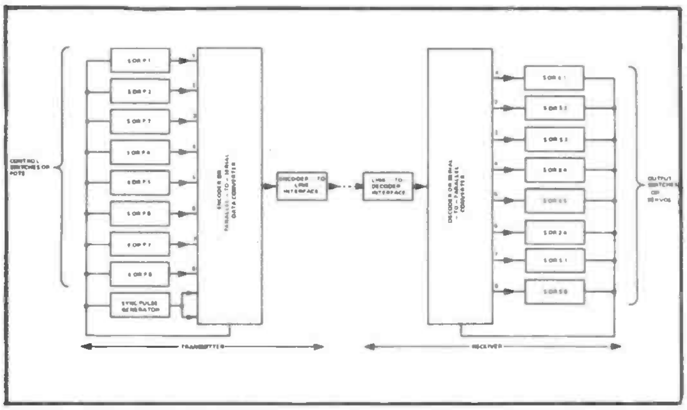


Figure 12: The basic block diagram of a simultaneous 8-channel remote control system.

illustrated here is cost-effective on counts exceeding 43 or so, and the diagram in fact shows the connections for making a 79- or 80-stage counter/decoder. IC9 is used to multiplex the IC1 to IC8 4017 stages and is clocked via the pin-12 CARRY OUT signal of each succeeding counter stage via diode-resistor-capacitor discriminator/differentiator networks.

The basic *Fig 11* circuit can be used to give any number of decoded output stages up to a maximum of 99 by using appropriate numbers of 4017 counter stages and by feeding the input pin of the reset generator from the appropriate counter output terminals. The circuit counts in decade numbers when the reset pulse is derived from IC9, or in discrete numbers when fed from outputs of the other counters.

SIMULTANEOUS MULTI-CHANNEL REMOTE CONTROL SYSTEMS.

Simultaneous multi-channel remote control systems, giving either fully proportional or simple ON/OFF action (or a combination of the two) are widely used by the model 'plane, boat and car fraternities'. The 4017B is ideally suited for use in such systems, since the systems rely on a basic 'sequencing' action; let's see how.

BASIC PRINCIPLES.

Figure 12 shows the basic block diagram of a typical 8-channel remote control system. In the transmitter, eight manually-actuated pots (in a proportional system) or switches (in an ON/OFF system) are sequentially sampled at a fixed rate by an ENCODER circuit, which at each sample point generates a pulse with a width proportional to the state of the device being tested. The output of the encoder consists of a repeating series of 'frames' of eight width-controlled pulses followed by a synchronisation pulse, all presented in serial form.

Typically, in an 8-channel proportional system, the width of the controlled pulses may be variable from 0.5 mS to 1.5 mS (depending on the setting of individual control pots), the sync pulse width may be 3 mS, the sample period 2 ms, and the frame width 20 mS.

The serial output of the encoder is coupled via a suitable 'link' to the input of a DECODER circuit that is located in the remote receiver. The 'link' may take the simple form of two wires (or only one if a ground return is used), or the more complex form of a modulated radio, ultrasonic or infra-red signal. The decoder circuit detects the sync pulse in each frame, and then counts the individual controlled pulses in the frame and routes each one to its own output terminal, where it may be fed to an electronic switch or a servo-mechanism which will reconstruct the original mechanical control movement that took place at the transmitter.

The 'hearts' of the remote control system described above are the encoder and the decoder. The basic control system is highly versatile; in ON/OFF applications, for example, the outputs can

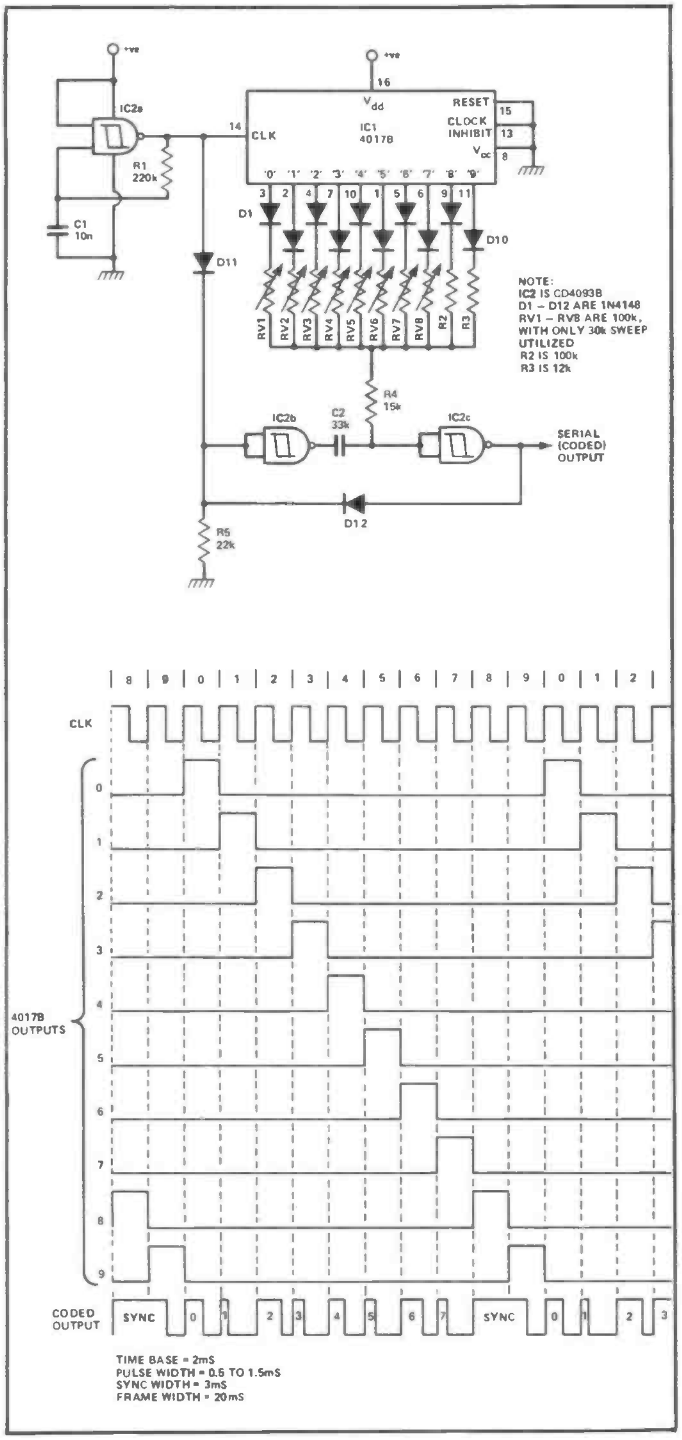


Figure 13: Practical circuit and waveforms of a simultaneous 8-channel proportional control encoder.

easily be decoded to give non-simultaneous on/off control of up to 256 devices from the 8-channel system.

AN 8-CHANNEL PROPORTIONAL CONTROL ENCODER.

Figure 13 shows the practical circuit and waveforms of a 4017-based 8-channel encoder for use in simultaneous control systems. IC2a is a 500 Hz (2 mS) astable multivibrator that simultaneously feeds clock pulses to the input of the 4017 and trigger signals to the input of the IC2b-IC2c monostable multivibrator. In any given clock cycle, the period of the monostable is determined by C2-R4 and by the resistance value in

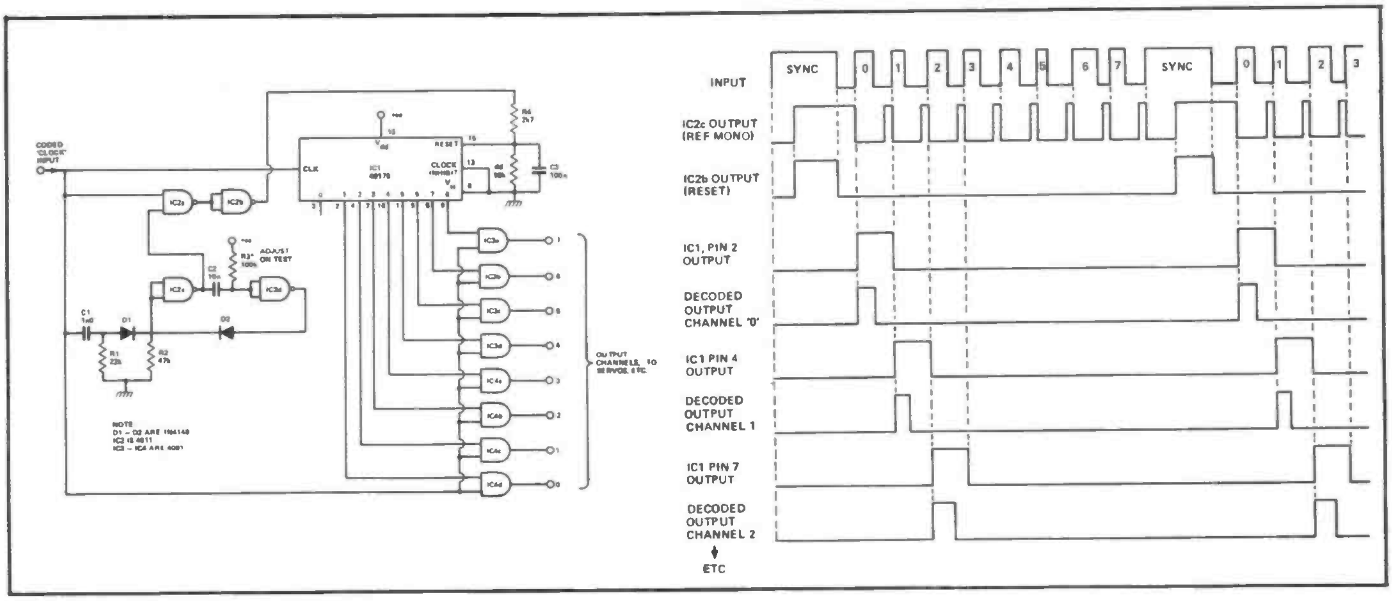


Figure 14: Practical circuit and waveforms of a simultaneous 8-channel proportional control decoder.

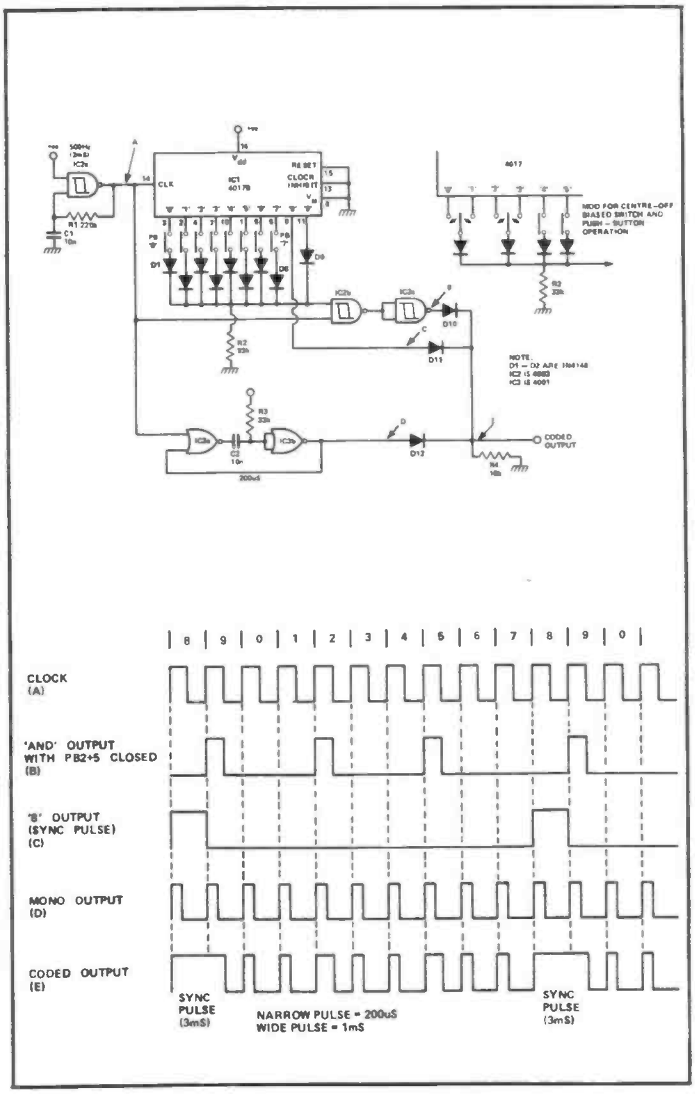


Figure 15: Circuit and waveforms of a simultaneous 8-channel ON/OFF control encoder.

series with the relevant 'high' output of the 4017. In clock cycles 'O' to '7' the pulse widths are determined by the settings of RV1 to RV8 respectively. In the '8' clock cycle the pulse has a width equal to the clock cycle period (2 mS), and in the '9' clock cycle the pulse is fixed at about 1 mS, thus giving a composite 3 mS sync pulse from the 8th and 9th cycles. The system is designed to give a fixed 20 mS frame width.

Note that, in conformance with normal practice, only one third (or less) of the sweep ranges of RV1 to RV8 are utilized. In practice, component values may have to be altered slightly to give precise ranges of coded output pulse widths.

AN 8-CHANNEL PROPORTIONAL CONTROL DENCODER.

Figure 14 shows the circuit and waveforms of a decoder for use with the above system. The incomming 'coded' waveform is fed simultaneously to the clock terminal of the 4017 and to the trigger terminal (via C1-R1-D1) of the IC2c-IC2d monostable. IC2 of this monostable produces a negative-going pulse with a period slightly less than the 2 mS clock period (about 1.8 mS), and this negative pulse is ANDed with the positive clock signal by IC2a and IC2b to produce a RESET output signal from the 3 mS input sync pulse, but not from the 'control' pulses, which all have periods significantly less than the 1.8 mS reference value. Note that the value of R3 may have to be adjusted on test to set the correct reference period.

Outputs 1 to 8 of the 4017 are sequentially ANDed with the coded clock signal once the counter has been reset by the sync pulse, so that each individual code pulse is routed to its own designated output terminal or channel. The individual outputs which take the form of 0.5 mS or 1.5 mS pulses with repetition periods of 20 mS, can then be fed to suitable servos, etc., to convert the pulses into proportional mechanical movements.

AN 8-CHANNEL SIMULTANEOUS ON/OFF ENCODER.

Multi-channel simultaneous on/off coder/decoder systems are technically no easier to implement than full proportional systems. In fact they are often more difficult. *Fig 15* shows a practical example of a simultaneous 8-channel on/off control encoder.

Here, astable multi IC2a simultaneously feeds 500 Hz clock signal to the 4017, to the IC3a-IC3b 200 uS monostable, and to one input terminal of the IC2b-IC2c AND gate. The other input of the AND gate is sequentially taken from the '0' to '7' outputs of the 4017 via any of the PB0 to PB7 switches that are closed. ▶

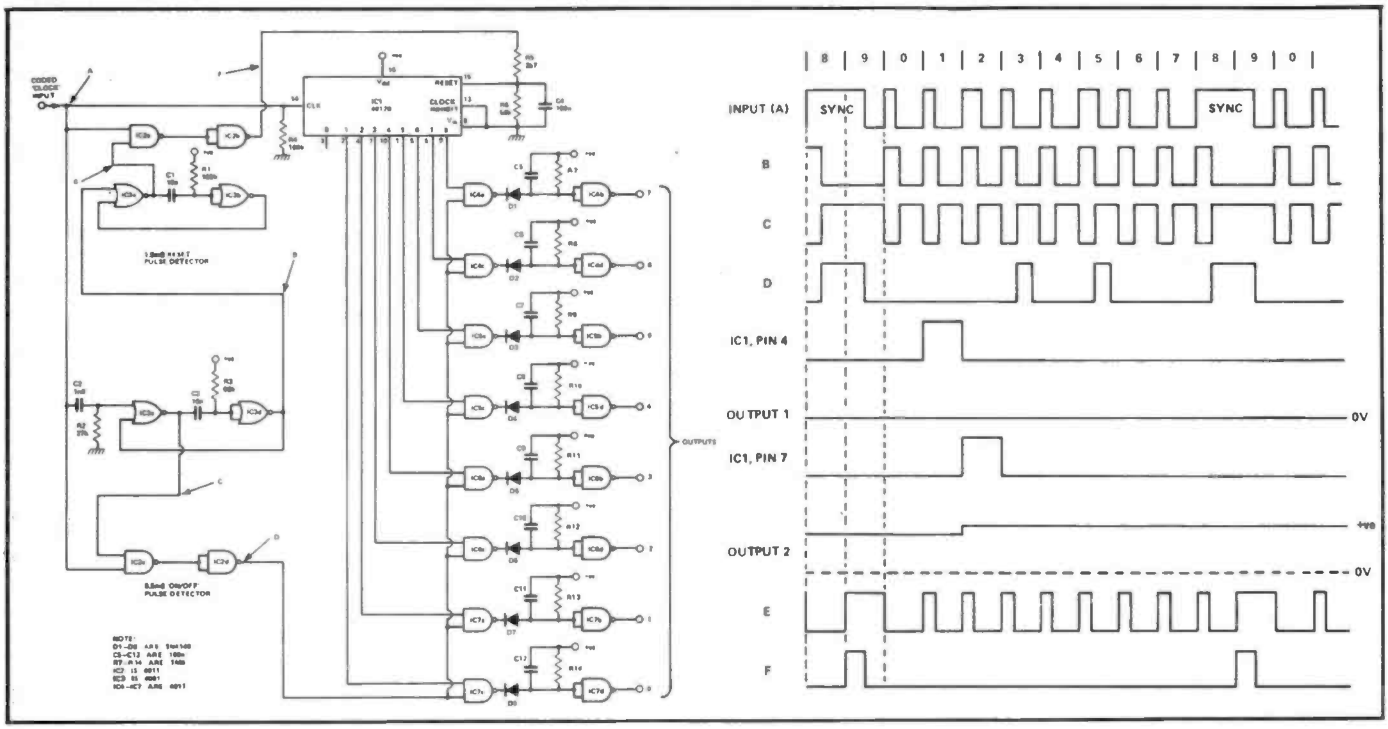


Figure 16: Circuit and waveforms of a simultaneous 8-channel ON/OFF decoder.

and directly from the '9' output. The outputs of the AND gate and the 200 uS mono, plus the direct '8' output of the 4017, are all ORed to produce the final serial-coded output across R4.

The final output waveform comprises 200 uS pulses and 1 mS pulses to represent OFF or ON switch states respectively, plus a 3 mS sync pulse spanning the 8th and 9th clock cycles.

AN 8-CHANNEL SIMULTANEOUS ON/OFF DECODER.

Figure 16 shows a decoder circuit that is suitable for use with the above encoder. Here, the IC3a-IC3b-IC2a-IC2b network detects the input sync pulse and then resets the counter, and the IC3c-IC3d-IC2c-IC2d network detects 'wide' (1 mS) or 'on' code pulses and then ANDs the selected output of the 4017 via the IC4-IC7 array to produce a high potential on the appropriate output channel. Note that the purpose of the D-R-C network in each output channel is to convert a detected 'wide' pulse into a steady DC voltage that will remain high (or low) for greater than one frame period.

Note that the steady (non-pulsed) outputs of the eight channels of this system can readily be binary decoded to make a total of 256 non-simultaneous channels available.

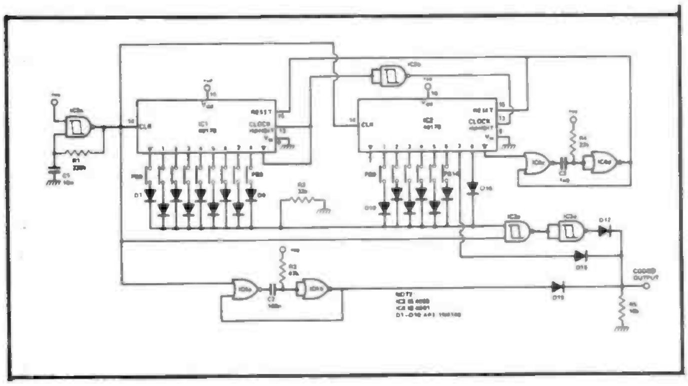


Figure 17: A simultaneous 15-channel ON/OFF encoder.

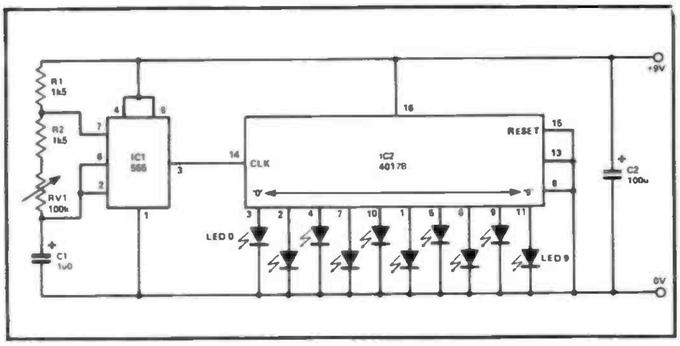


Figure 18: 10-LED chaser or sequencer. This circuit can be used with supply voltages up to only 9 volts, and produces a 'moving dot' display.

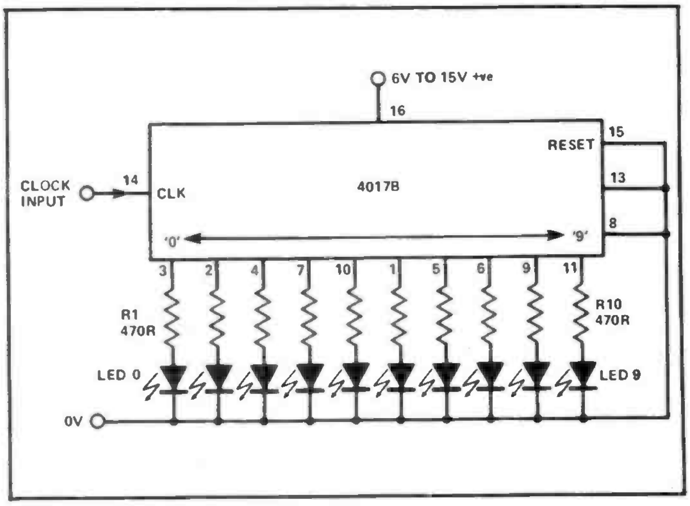


Figure 19: this version of the 10-LED chaser can be used with any supply up to 15 volts.

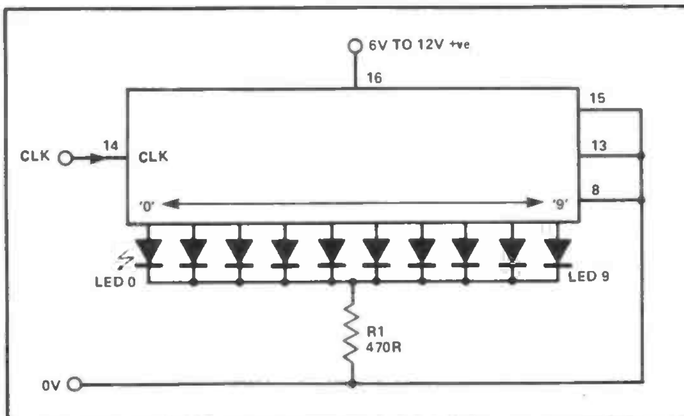


Figure 20a: This version of the chaser can be used with reasonable confidence up to 12 volts maximum.

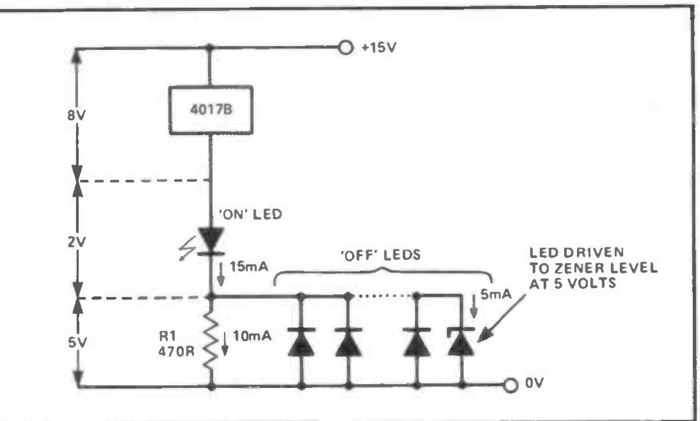


Figure 20b: Possible equivalent of the *Fig 20a* circuit when powered from a 15 volt supply.

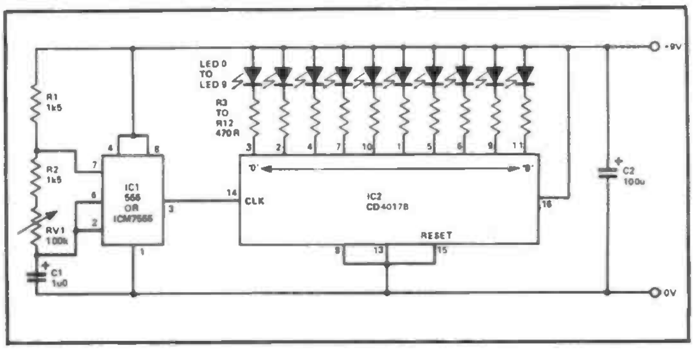


Figure 21: 10-LED 'moving hole' display.

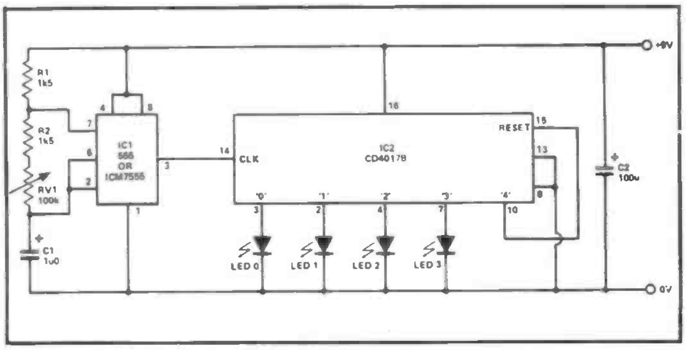


Figure 22: 4-LED continuous MOVING DOT display.

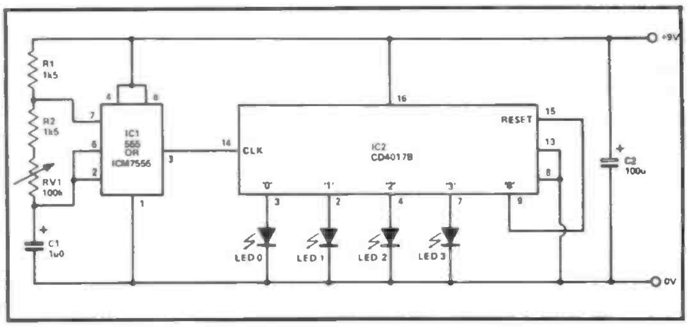


Figure 23: 4-LED intermittent MOVING DOT display with 50% blank period.

EXPANDED MULTI-CHANNEL CONTROL SYSTEMS.

It should be noted that each of the four coder/decoder circuits that we have looked at can easily be expanded to incorporate any desired number of channels (with appropriate increases in frame periods and miscellaneous timing component values) by simply using multi-stage 4017B counter networks (as described earlier) in place of the single counters shown in the existing circuits. *Fig 17*, for example, shows how a pair of 4017s can be used to make a simultaneous 15-channel on/off encoder.

LED CHASER / SEQUENCER CIRCUITS.

One of the most popular applications of the 4017B is as a LED chaser or sequencer, in which the IC drives an array of LEDs in such a way that individual LEDs or small groups of LEDs turn on and off in a pre-determined and repeating sequence, thereby producing a visually attractive display.

Figure 18 shows the practical circuit of a 10-LED chaser, in which IC1 is used as the clock generator. The action here is such that the display appears as a moving 'dot' which repeatedly sweeps from left (LED 0) to right (LED 9) in ten discrete steps as the 4017 outputs sequentially go high and turn the LEDs on. The LEDs do not, of course, have to be arranged in a straight line, they can, for example, be arranged as a circle, in which case the 'dot' will seem to rotate.

Note that the LEDs in the *Fig 18* circuit are not provided with current-limiting resistors, and that the circuit can safely be used with supply voltages up to only 9 volts. The decoded outputs of the 4017B provide inherent current-limiting under short circuit conditions: The manufacturers do not quote a maximum short-circuit current value, but practical experience indicates that currents of 10 - 15 mA are commonly available from the device. The maximum device dissipation-per-output-stage figure of 100 mW is quoted on some data sheets, indicating that a volt drop up to about 7 volts can safely be developed across a 4017B output stage under maximum-current conditions.

Thus, the LED chaser circuit of *Fig 18*, which has each LED connected directly between an output and ground, can safely be used up to maximum supply values of 9 volts (allowing for a 2 volt drop across an ON LED). At voltages greater than 9 volts, the circuit of *Fig 19*, which has a resistor wired in series with each LED, should be used. Note that the main purpose of these resistors is that of reducing the power dissipation of the 4017B.

A variant that is sometimes used is shown in *Fig 20a*, and can be used with reasonable confidence at supply levels up to 12 volts maximum. *Figure 20b* shows a possible equivalent of this circuit when it is powered from a 15 volt supply, and illustrates the defect of the design. The action of the 4017B is such that when a given LED is on, the anodes of all other LEDs are effectively grounded: R1 thus causes the OFF LEDs to be reverse biased. Because of the low reverse-voltage ratings of LEDs, it will often be found that one of the OFF LEDs will zener at about 5 volts, giving the results shown in the diagram and possibly causing a destructive power overload in one of the 4017B output stages. ▶

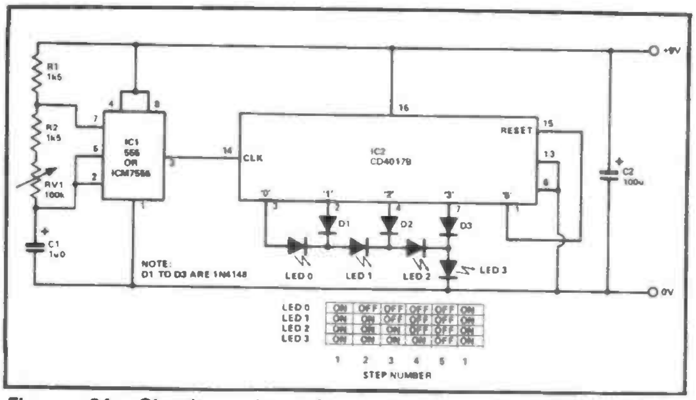


Figure 24: Circuit and performance table of 4-LED 5-step SEQUENTIAL TURN-OFF display.

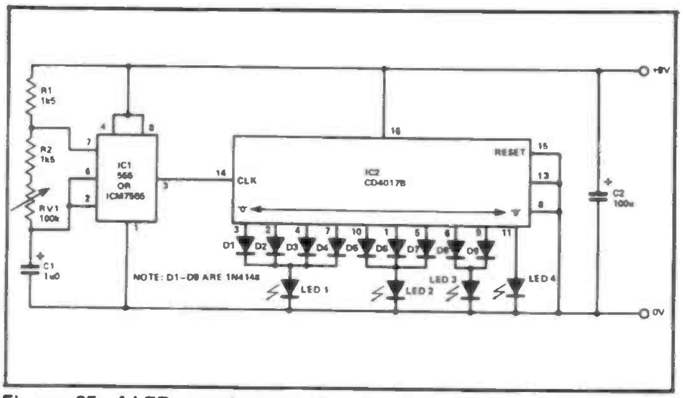


Figure 25: 4-LED continuous 'Accelerator' display, in which the pattern seems to accelerate from left to right continuously.

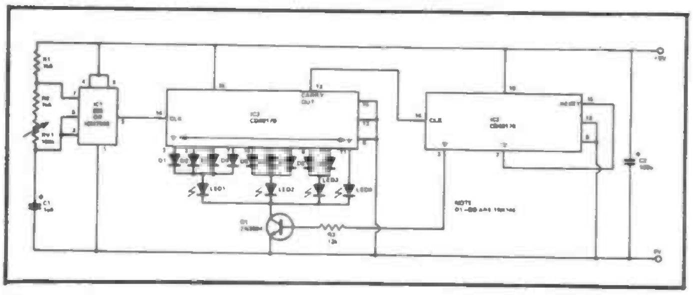


Figure 26: 4-LED intermittent 'Accelerator' display, in which 'acceleration' occurs for 10 clock steps in every 30.

ALTERNATIVE LED DISPLAYS.

The output stages of the 4017B can source or sink currents with equal ease. *Fig 21* shows how the IC can be used in the 'sink' mode to make a 'moving hole' display, in which nine of the ten LEDs are on at any given time, with single LEDs turning off sequentially. If the LEDs are arranged in the form of a circle, the circle seems to rotate. Note that, since all LEDs except one are on at any given time, all LEDs must be provided with current-limiting resistors, to keep the IC power dissipation within reasonable limits.

Moving dot displays are, in practice, far more popular than the moving hole types. Moving dot displays of the *Fig 18* type can be used with fewer than ten LEDs by simply omitting the unwanted LEDs, but in this case the dot will seem to move intermittently, or to 'scan', since the IC takes ten steps to completely sequence and all LEDs will therefore be off during the 'unwanted' steps.

If a continuously-moving less-than-10-LED display is required, this action can be obtained by connecting the first 'unused' output terminal of the 4017B to it's pin-15 RESET terminal, as shown (for example) in the 4-LED circuit of *Fig 22.* Alternatively, the circuit can be made to give an intermittent display with a controlled number of OFF steps by simply taking the appropriate one of the 'unwanted' outputs to the pin-15 RESET terminal. In *Fig 23*, for example, the LEDs 'display' for four steps and then 'blank' for four steps, after which the sequence repeats.

Figure 24 shows a rather unusual and very attractive 4-LED 5-Step sequencer, in which all four LEDs are initially on but then turn off one at a time until eventually (in the 5th step) all four LEDs are off; sequencing details are given in the table of *Fig 24.* Note that the LEDs are effectively wired in series and that the basic circuit can thus not be used to drive more than four LEDs.

Figure 25 shows another unusual and attractive LED display. In this case the 4017B runs through a 10-step sequence, with LED 1 on for steps '0' to '3', LED 2 on for steps '4' to '6', LED 3 for steps '7' and '8' and LED 4 on for step '9'. The consequence of this action is that the visual display seems to accelerate from LED 1 to LED 4, rather than sweep smoothly from one LED to the next. The acceleration action repeats continuously.

Figure 26 shows how the above circuit can be modified to give an intermittent display, in which the visual 'acceleration' action

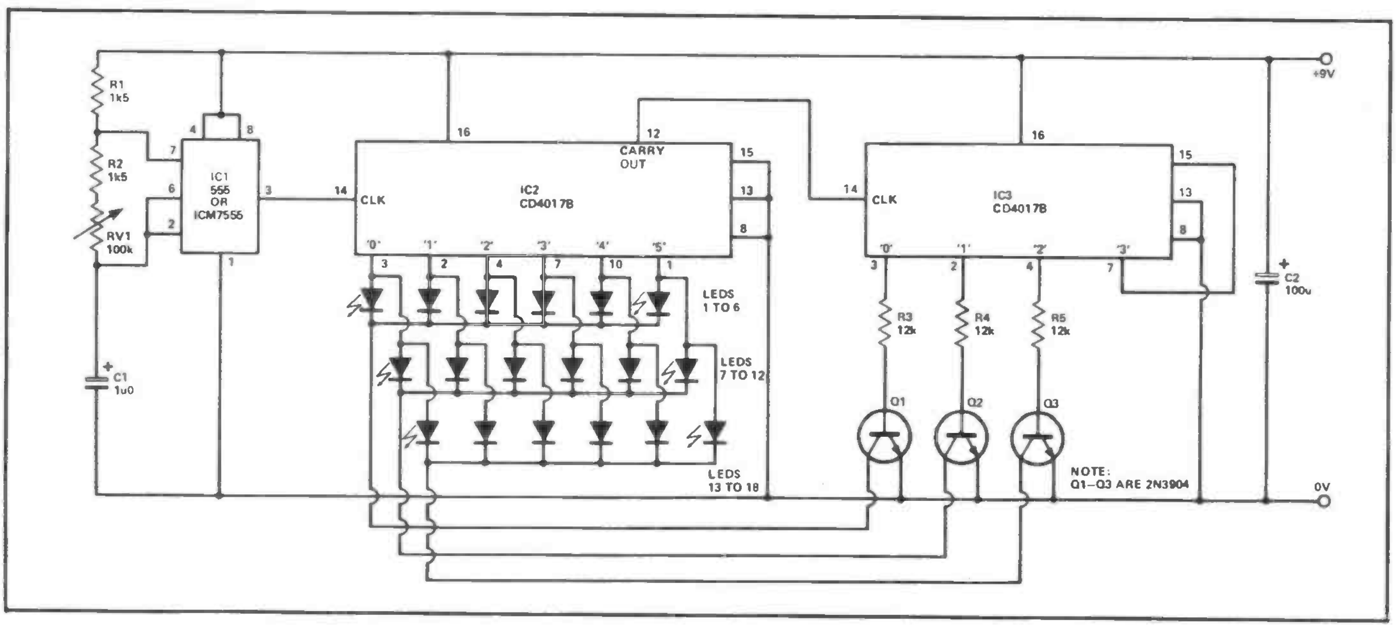


Figure 27: Multiplexed 6-LED by 3-Line moving-dot display in which the dot moves intermittently along the lines, one line at a time.

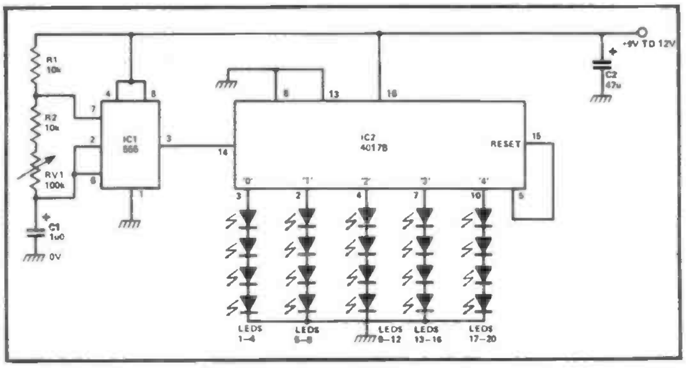


Figure 28: This 4-bank 5-step 20-LED chaser must be used with a supply voltage greater then 9 V

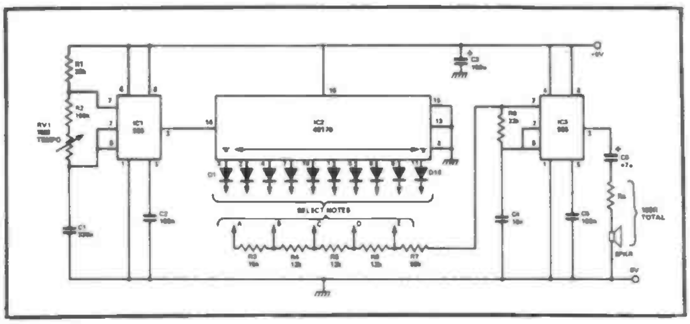


Figure 29: A 10-step 5-note musical sequencer.

Figure 30: 9-step 5-note musical doorbell.

occurs for 10 clock cycles but all LEDs then blank for the next 20 cycles, after which the action repeats. The action is as follows:

The 4017B has a CARRY OUT terminal at pin 12. When the IC is used in the divide-by-10 mode, as in *Figs 25 and 26*, the CARRY OUT terminal produces one output cycle each time the IC completes a decade count.

In *Fig 26* this signal is used to clock a second 4017B (IC3), which is connected in the divide-by-3 mode, with it's '0' output fed to gating transistor Q1. Consequently, for the first ten cycles of a sequence the '0' output of IC3 is high and Q1 is biased on, so IC2 acts in the manner already described for *Fig 25*, with it's LEDs turning on sequentially and passing current to ground via Q1. After the 10th clock pulse, however, the '0' output of IC3 goes low and turns Q1 off, so the LEDs no longer illuminate, even though IC2 continues to sequence, Eventually, after the 30th clock pulse, the '0' output of IC3 again goes high and turns Q1 on, enabling the display action to re-occur.

Figure 26 is a simple example of display 'multiplexing' in which IC3 and Q3 are used to enable or disable a bank of LEDs. *Fig 27* shows a further example of a multiplexing circuit, in which 3-lines of six intermittently-sequenced LEDs are sequentially enabled via IC3 and individual gating transistors, with only one line enabled at any one time. This basic circuit can in fact be expanded to control a 10-line (100 LEDs) matrix display.

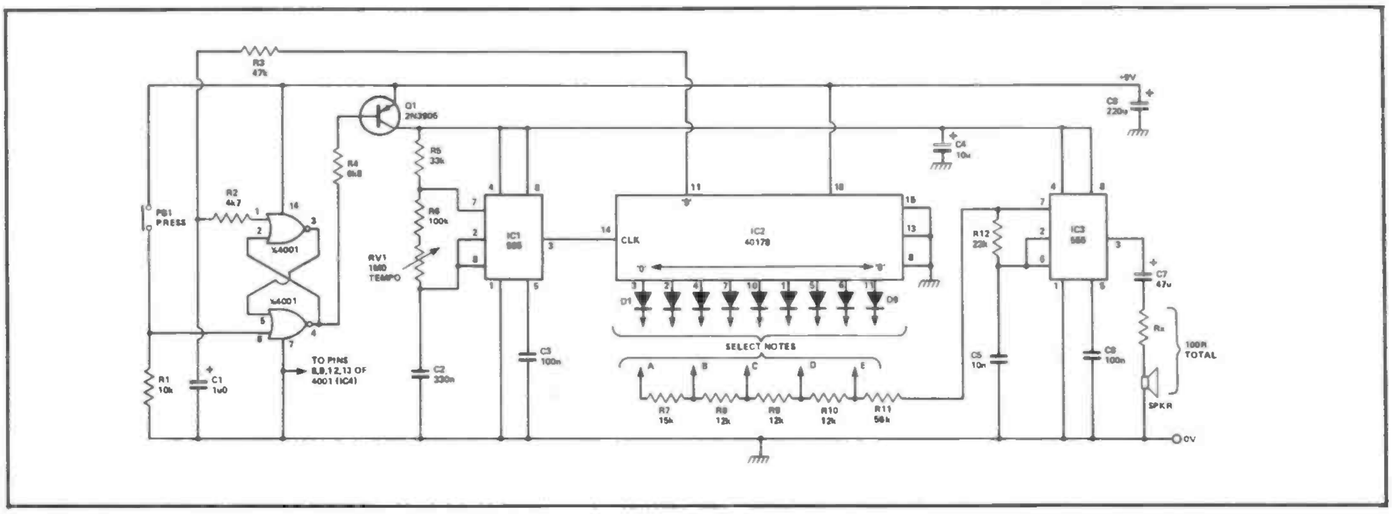
Finally, *Fig 28* shows the circuit of a 4-bank 5-step 20-LED chaser. Note that a bank of four LEDs is wired in series in each of the five used outputs of the 4017B, so four LEDs are illuminated at any given time. In practice, roughly 2 volts are dropped across each ON LED, giving a total drop of 8 volts across each ON bank, so the supply voltage must be greater than this value for the circuit to operate. A greater number of LEDs can be used in each bank if the supply voltage is suitably increased.

MUSICAL SEQUENCER CIRCUITS.

The decoded outputs of a clocked 4017B can readily be used to sequentially actuate tone generators or special sound effects circuits, etc., and thereby generate attractive or useful musical sounds. To wrap up this 4017B feature, *Figs 29 and 30* show a couple of practical applications of this type.

In the *Fig 29* circuit, IC1 is used to clock the 4017B, and the decoded outputs of the 4017B are used to sequentially actuate tone generator IC3 via diodes D1 to D10 and via note-selector pins A to E. Each time one of these pins is driven high, a tone is generated, each pin producing a different tone. Thus, by connecting appropriate output diodes to appropriate tone pins, the circuit can be 'programmed' to generate simple tunes and melodies with as many as 5-notes in a 10-step sequence.

Finally, *Fig 30* shows how the above circuit can be modified for use as a musical door bell. Here, when the circuit is in the



normal standby mode Q1 is cut off via the IC4 flip-flop and no power supply is connected to IC1 or IC3, so the circuit draws a standby current of only a couple of microamps. When PB1 is briefly closed, the flip-flop changes state, turning Q1 on and connecting power to IC1 and IC3 and thereby causing IC2 to initiate the pre-programmed 9-step melody: On the arrival of the 10th clock pulse from IC1, the '9' decoded output of IC2 goes high and feeds a reset signal to the IC4 flip-flop. If PB1 is open at this time, Q1 turns off and the circuit action is complete. If, on the other hand, PB1 is still closed the sequencing action will simply continuously repeat until PB1 is released.

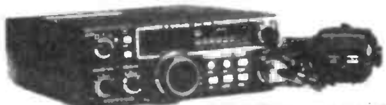
■ R & EW

Your Reactions	Circle No.		Circle No.
Immediately Applicable	262	Not Applicable	264
Useful & Informative	263	Comments	265

MAIL ORDER
THE EASY WAY – THE BREDHURST WAY
TO ORDER ANY OF THE ITEMS LISTED BELOW
SIMPLY WRITE ENCLOSING A CHEQUE OR
PHONE AND QUOTE YOUR CREDIT CARD NO.
– WE DO THE REST!

Bredhurst electronics

TS 7730



£247 inc. VAT

TRIO		£	Carr.
TS830S	160-10m Transceiver 9 Bands	694.00	(—)
VFO230	Digital V.F.O. with Memories	215.00	(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	445.00	(—)
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	49.45	(2.50)
PS30	AC Power Supply – TS130S	88.50	(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	13.00	(1.00)
ST1	Base Stand and Quick Charger	45.00	(1.50)
BC5	12V Quick Charger	18.40	(1.00)
SC3	Soft Carrying Case Plus Belt Hook	11.60	(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	10.35	(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	259.00	(—)
IC290E	2M Multimode Mobile	366.00	(—)
IC2E	2M FM Synthesised Handheld	169.00	(—)
IC L1/2/3	Soft Cases	3.60	(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	4.25	(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×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	23.00	(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	0.25	(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 (10W I/P)	228.84	(—)
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)
EKM1A	Matching Side Tone Monitor	10.95	(0.50)
EK150	Electronic Keyer		(—)

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	28.00	(0.75)
DM81 Trio Dip Meter	51.75	(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

MMB11	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	24.90	(1.50)

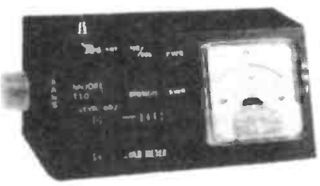
FDK VHF/UHF EQUIPMENT			
Multi 700EX	2M FM Synthesised 25W Mobile	199.00	(—)
Multi 750E	2M Multimode Mobile	289.00	(—)
Expander	70cm Transverter for M750E	219.00	(—)

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)
CMB	Mobile Bracket	19.95	(1.00)
CLB	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	13.95	(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	35.00	(—)
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)
DL50	N TYPE 60W MAX	16.50	(0.70)
DL150	PL259 150W MAX	14.95	(0.75)
DL600	SO239 600W MAX	29.95	(1.50)
DL1000	SO239 1000W MAX	39.95	(1.50)

MAIL ORDER
Mon-Sat. 9-12.30/1.30-5.30

All prices correct at time of going to press.

BREDHURST ELECTRONICS

RETAIL
Mon-Sat. 9-12.30/1.30-5.30

HIGH STREET, HANDCROSS, WEST SUSSEX. TEL. 0444 400786

115 for further details

IN—CAR SECURITY SYSTEM.

This sophisticated anti-theft project is armed/disarmed externally by using a special magnetic key fob to apply a security code to a sensor pad inside the windscreen. Design by EDA Sparkrite Ltd.

The in-car security project described in the next few pages is probably the most sophisticated system ever published in the UK. It gives full anti-theft protection to the vehicle and all internal/external accessories, is easy to build and fit, and is available as a complete and fully engineered kit from its designers, EDA Sparkrite Ltd., at a cost of £24.95. The system is known as the AT-80 and can be fitted to any vehicle having a 12 volt negative earth electrical system.

The outstanding feature of the AT-80 is its unique method of arming and disarming the alarm system. The owner is provided with a magnetic key fob which can be used from OUTSIDE the vehicle to apply a 4-bit security code to an adhesive sensor pad mounted INSIDE the windshield; the owner can easily pre-programme the system to accept any 4-bit code of his choice. The sensor pad also incorporates a 'code accept' lamp that illuminates each time a code bit is entered, but which does not indicate the 'correctness' of the total code entry.

Note that, although the system offers only sixteen possible code combinations, it still gives exceptionally good security: To enter the vehicle one must be carrying the correct car key and the magnetic fob, and must know the special 4-bit security code and how to feed it into the windscreen pad.

PROTECTION.

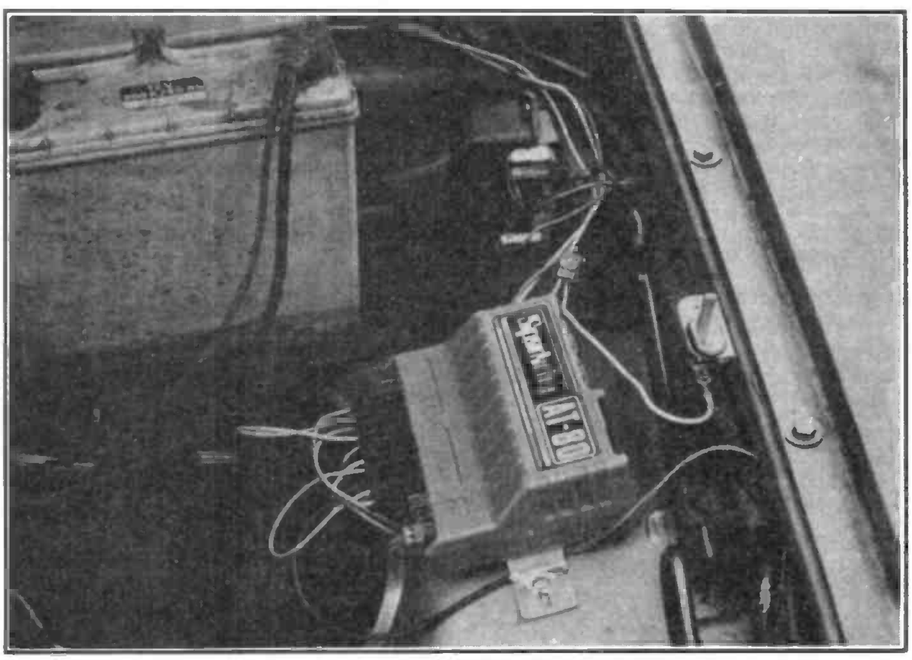
The main alarm unit is fed with 'trigger' signals from door switches, a bonnet switch, a boot switch, an accessory protection loop, and from the ignition system. If any attempt is made to enter the vehicle or open the boot or bonnet or to turn on the ignition (by switching or by 'hot wiring') when the AT-80 is armed, the alarm will activate, causing the horn and headlights to pulse for roughly one minute. If one of the 'trigger' signals remains active (e.g. a door remains open), the alarm will activate indefinitely, even when the one minute period has elapsed (this does not apply to the accessory protection loop). Closing the door again returns the AT-80 to the armed state. The ignition system is always disabled while the AT-80 is armed.

Protection of accessories such as spot lights or radio is performed by connecting a loop of wire to the main control unit and passing it through each accessory in turn, firmly fixing it inside each accessory without making an electrical connection to it. The end of the loop is then connected to a convenient earth on the vehicle. Breaking the loop at any point causes the alarm to sound for one minute and, if the system is not already armed, to become armed. If the wire loop becomes disconnected while the ignition is switched on, the alarm sounds for about five seconds but the AT-80 does not become armed and the ignition is not disabled.

ARMING/DISARMING

As already mentioned, the AT-80 can be armed and disarmed from outside the vehicle by using a special magnetic key fob to apply a security code to an adhesive sensor pad mounted inside the windscreen. This pad incorporates two reed relays and an indicator lamp, which briefly illuminates each time one or other of the reed relays is activated by the key fob. The key fob is powerful enough to penetrate even the thickest windscreen and the code is formed by the correct sequence of operations of the two reed relays. A 4-bit code is used to disable the system. This code is chosen and programmed by the owner and can be changed at any time whilst the system is disarmed.

To arm the system, the ignition must be turned off. Arming is achieved by simply applying the key fob to the sensor pad at least once, and the ignition system is immediately protected, but not the doors, etc. Thirty seconds later, the full protection comes into force. If the alarm is accidentally triggered, the one minute alarm period can be shortened by entering the correct disarm code, in which case the



The AT-80 installed under the bonnet, together with the bonnet switch.

CIRCUIT DESCRIPTION

The AT-80 system is armed/disarmed by a code applied to two reed relays (RD1-RD2) in the windscreen sensor pad, the code being applied via a magnetic key fob. The circuit of the complete system can be broken down into a number of 'blocks', these being the POWER SUPPLY (designed around transistors TR4-TR5), the CODE DETECTOR (IC2b-IC3b-IC3a-IC5-IC6-IC4b and TR6, plus TR2-TR3), the ALARM CONDITION DETECTOR (IC2a-IC2e-IC2f-IC1d-IC4a and IC1c), and the ALARM ACTIVATOR (IC1b-IC2d-IC1a and TR1).

THE POWER SUPPLY

All ICs in the system are powered from a 7 volt supply derived from Zener diode D11, which in turn is powered (from the 12 volt battery line) via constant-current generator TR4, which is active whenever TR5 is turned on. TR5 is turned off only when SW1a is set to the ARREST position and the output of IC2d is low; this condition does not occur in normal use.

THE CODE DETECTOR

Windscreen reed switches RD1 and RD2 are normally open but can be closed (via the windscreen) with a magnetic key fob that is supplied with the kit. These switches are biased via R31-D17-R39 so that two sets of signals are available across D17 - these signals being designated CLOCK and DATA. If either switch is closed, a CLOCK signal is generated, but a logic-0 DATA signal is generated only when RD2 is closed. Thus, a CLOCK pulse and logic-1 DATA is generated via RD1, and a CLOCK pulse a logic-0 DATA is generated via RD2. The signals are used to activate the code detector circuitry.

The clock signals are debounced and inverted via R28-C9-IC2b, 0Red with the output of the IC3c-IC3d ACCESSORY PROTECTION circuit (described later), and converted into a clean negative-going pulse via IC3b-IC2c. This pulse is NORed (IC3a) with the ignition line (via R19-R26-R25), and the resulting output signal (from pin 3 of IC3a) is fed to MODE switch SW1b and also, via transistors TR3 and TR2 to CODE ACCEPT lamp LP4 in the windscreen pad.

Up to this point, the overall action is such that, if the ignition is turned off (as when the owner is trying to enter the vehicle), a brief positive pulse appears at IC3a output each time a reed switch is closed, and this pulse briefly illuminated LP4, but if the ignition is turned on (as when driving), the pulse generating system is automatically disabled.

The CLOCK signals from IC3a and the DATA signals from D17 are fed to dual 4-bit shift register IC5 which has its outputs EX-ORed via IC6, then ORed via IC4b and used to drive ignition-disabling relay RL2 via Darlington transistor TR6. IC5 is automatically reset via C14-R42 when its supply is first connected. The output of IC4b (driving TR6) goes high when the codes in the two halves of IC5 do NOT coincide, and drives RL2 on ONLY when the ignition line is live. the overall action of the code detecting circuitry depends on the setting of MODE switch SW1, as follows.

When SW1 is the "Programme" position, identical CLOCK and DATA signals are fed to both halves of IC5. Consequently, both halves carry identical 4-bit codes, so the output of IC4b is low and TR6 (and IGNITION DISABLE relay RL2) is off. This is the mode that is used when the owner 'pre-programmes' the system with a code.

When SW1 is in the normal "on" (or "Arrest") position, CLOCK signals are fed only to IC5b. Consequently, IC5a permanently retains the owner's own pre-programmed code, but IC5b presents a code equal to the most recent four bits of DATA fed in from the windscreen pad. If these two sets of DATA coincide, IC4b output is low, the system is DISARMED, and the vehicle can be started, but if the DATA does not coincide IC4b output goes high (system ARMED) and disables the ignition (via RL2 and TR6) when it is turned on.

When the owner leaves his vehicle, the system will inevitable be DISARMED; the owner can then ARM the system by simply keying one or more 'bits' of DATA into the windscreen pad. To re-enter the vehicle, he must DISARM the system by keying the correct 4-bit code into the pad.

Note that the output of IC4b is inverted via IC2a and used to drive the ALARM CONDITION DETECTOR circuitry, which will now be described.

ALARM CONDITION DETECTOR

Under the ALARM condition, the lights and horn are pulsed on and off for about 60 seconds via the RL1-TR1-IC1a-IC1b-IC2d network, which is activated by a high pulse fed to pin 5 of IC1b, either from the Alarm Condition Detector circuitry or the Accessory Protection circuit. As far as the Alarm Condition Detector circuit is concerned, a high pulse can only be fed to pin 5 of IC1b by taking BOTH inputs (pins 8 and 9) of IC1c to logic-0.

Pin 9 of IC1c is controlled by the IC1d-IC2e-D3-C6, etc., circuitry, and can be pulled low by turning on the ignition or by pulling terminal 'H' (door switch, etc.) low. Pin 8 of IC1c is controlled by 'inhibit' circuitry IC4a-IC2f-C4-R11-R16-IC2a; the action here is that pin 8 is HIGH when the system is DISARMED, remains high for about 30 seconds after the system is first ARMED, but then falls to the low state.

Thus, the alarm system is disabled for 30 seconds after first being ARMED, giving the owner time to check that doors, etc., are properly closed, after which time it becomes fully enabled and will activate the alarm if the ignition is turned on or if any of the doors, etc., are opened.

ACCESSORY PROTECTION

Accessories are protected by a loop of wire connected between terminal 'I' and ground, the 'action' being such that the loop breaks if any accessory is stolen. The loop connects to IC3d-IC3c, which acts as a simple one-shot pulse generator, producing a single positive pulse at IC3c output if the loop breaks. This pulse triggers the ALARM ACTIVATOR circuit via D6, and simultaneously feeds a CLOCK pulse to the Code Detector circuitry via D10; if the ignition is turned off at this time and the system is not already armed, this pulse will arm the system and the alarm will activate for 60 seconds; if the ignition is turned on at the time that the loop breaks, the pulse will be blocked by IC3a and the system will not be armed, but the alarm will activate for about 5 seconds (determined by the action of D5 and IC2a).

ALARM ACTIVATOR

IC1a is cross-coupled with transistor TR1 so that the combination acts as a 2-second gated astable that turns on when a logic-0 input is applied to pin 2 of IC1a. When in the ON mode, the circuit alternately switches relay RL1 on for one second and off for one second, thereby pulsing the horn and lights.

The IC1-TR1 astable is gated via the IC1b-IC2d-C2, etc., circuit, which functions as a monstable multivibrator that is triggered by a logic-1 signal applied to pin 5 of IC1b. The mono can be triggered via either the Alarm Condition Detector or the Accessory Protection circuit, as already described, and when activated turns the RL1-driving astable on for a pre-set period.

If the system is ARMED when the mono is triggered, the mono operates with a time constant of about 60 seconds. If the system is DISARMED when the mono is triggered, the time constant is reduced to about 5 seconds by R6 shunting across R10. If the mono is activated by the opening of a car door, etc., when the system is armed, the alarm will continue to operate beyond the 60 second period if the door remains open.

COMPONENTS LIST

Resistors (¼W, 5%)

R1,29,32,36	33R
R2,22	1M0
R3,17	3M3
R4,5,7,12,13,21,25,41	10k
R6	330k
R8,11,24,28,30,34,37	47k
R9	4k7
R10	1M8
R14	27k
R15,35,38	22k
R16,19,42	680k
R18,20	180k
R23,26,27,40	100k
R31,39	3k3
R33	56R
R43	330R

Capacitors

C1,19	220n, 100V polyester
C2	47u 10V electrolytic (low leakage)
C3,5,6,7,8,9,10,11,13,14	100n 12V ceramic
C4,12	10u 16V electrolytic
C15,20	1n0 12V ceramic
C16	470p 12V ceramic
C17,18	47n 250V polyester

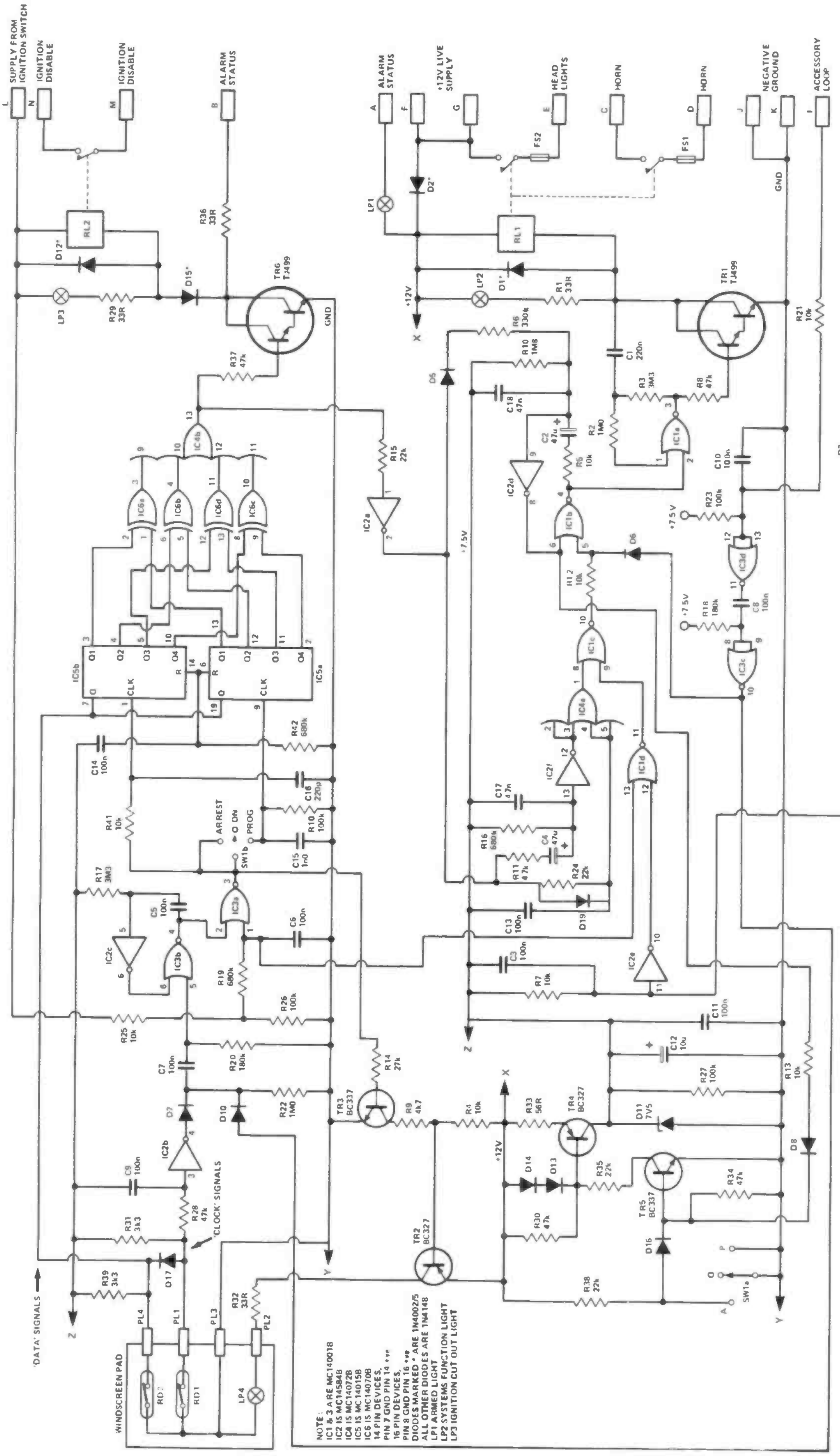
Semiconductors

D1,2,12,15,18	IN4002 or IN4005
D3,5-8,10,13,14,16,17,19	IN4148
D11	7V5 zener
TR1,6	TJ499
TR2	BC327
TR3,5	BC237 or BC337
TR4	BC307 or BC327
IC1,3	4001B
IC2	4584B
IC4	4072B
IC5	4015B
IC6	4070B

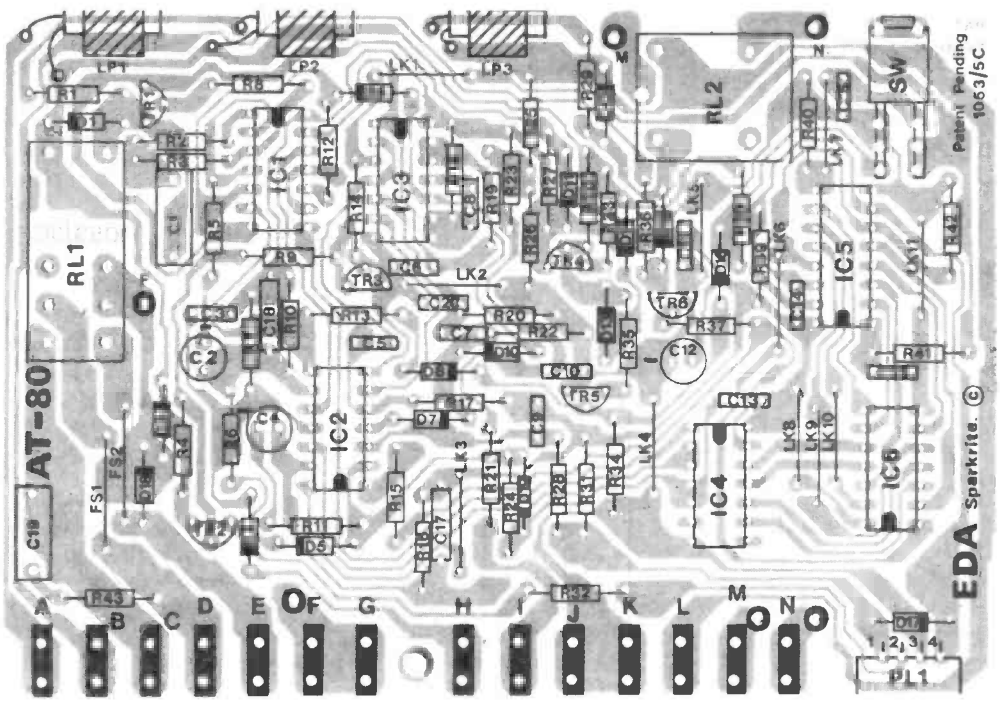
Miscellaneous

LP1,2,3	14V 80mA bulb
RL1	double-pole changeover relay
RL2	Single-pole changeover relay
SW1	DPDT switch with centre off

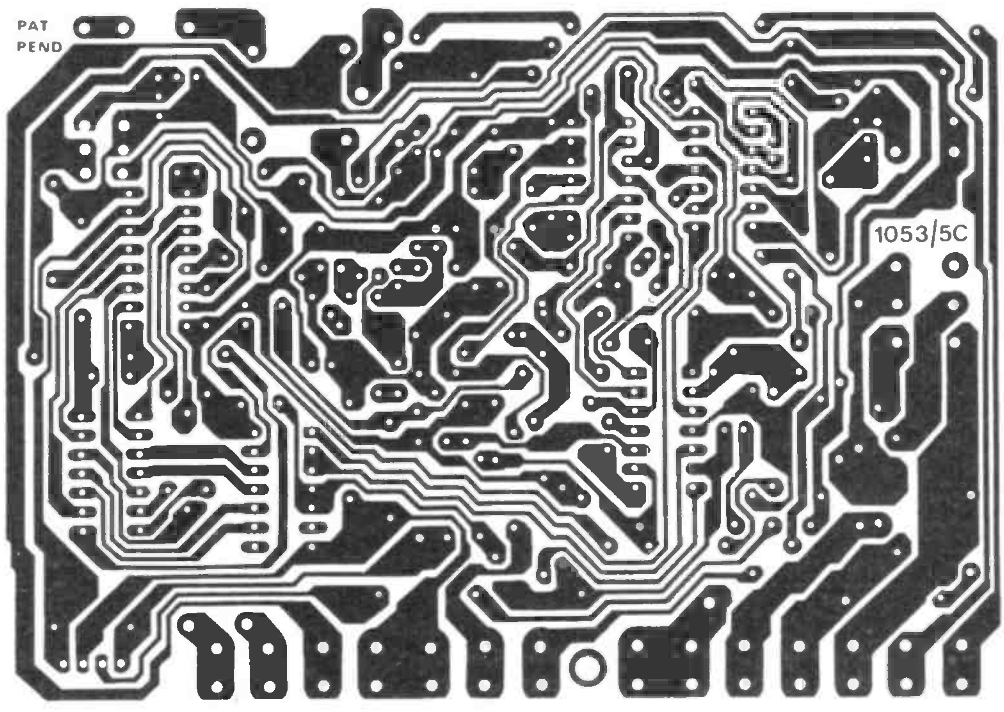
Moulded case, PCB, windscreen pad, magnetic key fob, etc.



Full circuit diagram of the AT-80 (Copyright EDA Sparkrite Ltd)



PCB OVERLAY



PCB FOIL

alarm continues to sound for about five seconds after disarming (to prevent the correct code being found by trial and error).

To disarm the system and allow entry to the vehicle, the correct 4-bit security code is simply entered, one bit at a time, into the sensor pad via the key fob. If an entry error is made, simply repeat bit-feeding until the correct entry is made. The system responds to only the last four bits of any entry.

CODE PROGRAMMING

The main alarm unit includes a number of function lights and a function-select switch that is marked ARREST, ON and PROG. To programme-in your own personal code, simply move the switch to the PROG position, key the desired code into the windscreen sensor pad, and then move the switch to the on position. Check that the 'ARMED' light is off. The system can then be armed in the normal way, by entering another code bit into the sensor pad. Note that the code will be lost if the vehicle battery is disconnected, and will have to be re-programmed when the battery is replaced.

CONSTRUCTION

The AT-80 is available as a complete kit from its designers, EDA Sparkrite Ltd. The kit is fully engineered and includes many items, such as the moulded case and the special sensor pad, etc., which even

The windscreen sensor pad

the most ardent DIY fanatic could not hope to imitate. For this project, therefore, the kit is absolutely essential.

The kit is supplied complete with excellent 'construction' and 'installation' instructions, so we won't bother to repeat much here. Construction consists of little more than soldering all the components to the high-quality glass fibre PCB, which has the overlay printed on its topside, and should take little more than one hour. The manual reproduces two versions of the overlay, one giving component values and the other giving component numbers. We found a few errors here, as follows:

C16 should be 470p, not 220p.
R24 should be 47k, not 22k.
D19 is not shown in the manual's overlays, nor on the circuit diagram.
C4 as supplied and shown in the manual's overlay, has a value of 10u, not 47u as shown in the components list and circuit diagram.

Other minor constructional points are that links MM, NN and FF mentioned in section 3(1) of the manual need to be cut to length to give neat results and that the completed PCB should be painted or dipped in polyurethane varnish, which (not surprisingly) is not supplied with the kit.

INSTALLATION

Installation of the system in the vehicle is technically easy, but time consuming (about three hours work), and the manual gives very explicit instructions. The system's main unit can be fitted under either the boot or bonnet, and the adhesive sensor pad is connected to it via a 4-way ribbon cable and plug and socket after being fixed to the front or rear window. Various leads go to the door switches, battery, ignition feed, horn and headlamps, etc. All necessary connecting blocks and terminals, etc., are supplied with the kit, which rates as possibly the best quality product that we have yet seen from a UK kit manufacturer. ■ R & EW

Your Reactions.........	Circle No.
Excellent - will make one	168
Interesting - might make one	169
Seen Better	170
Comments	171

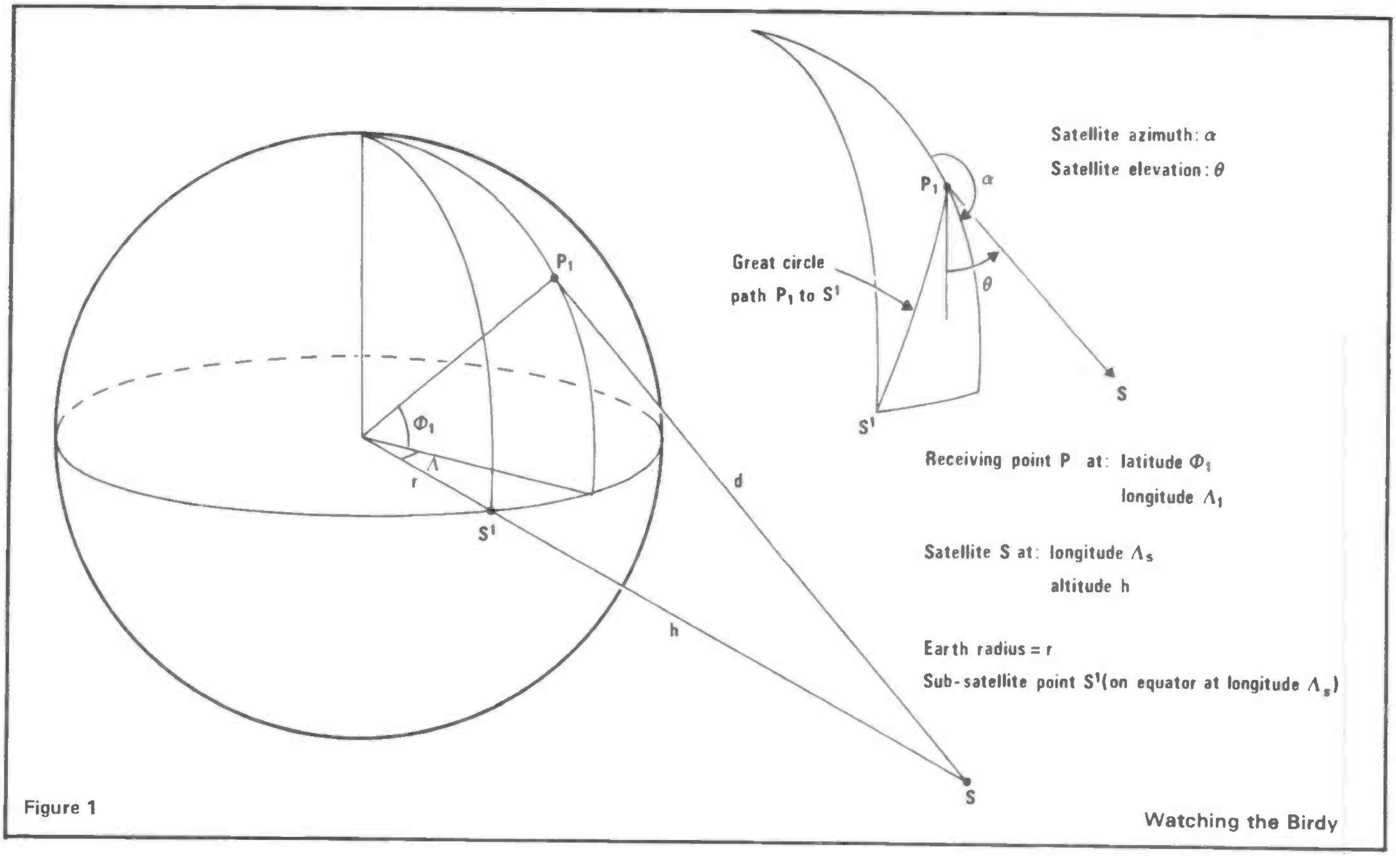


Figure 1

Watching the Birdy

TV SATELLITE BROADCASTING An Introduction

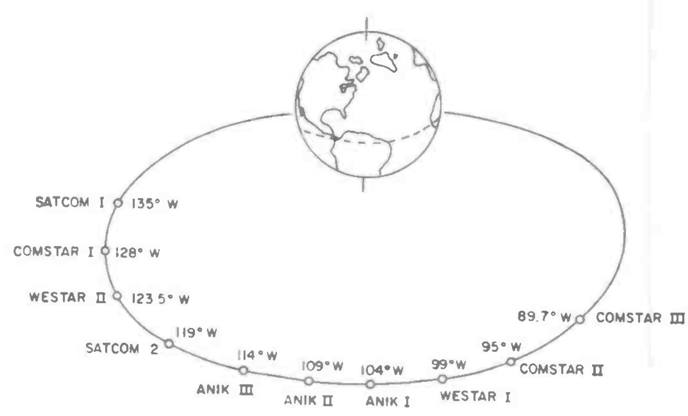
Whilst there is much fervour in the USA for this novel form of broadcasting, there are many misconceptions about how the US system relates to the plans for the 'DBS' (Direct Broadcast Satellite) - which is quite another thing. We reveal all in this new series.

STAR GAZING

TV satellite broadcasting in the USA has achieved the notable status of a 'craze', as backyards and front lawns across the nation are sprouting earth terminal dishes like mushrooms. Some rather garbled reports concerning the way this system has been conceived and operated have led to speculation that persons equipped with the right form of earth station receiver in the UK can intercept these broadcasts, and thereby enjoy some of the dazzling array of entertainment that is paraded in front of the insatiable gaze of our erstwhile colonial cousins.

Americans with $1 500 to spare, and somewhere to erect a dish can tune into the 4 GHz geostationary satellite network to receive the latest films, news, sport etc., on a coast-to-coast 24 hour network that makes our ground based broadcasting look positively tame. Witness the programme schedule shown in TABLE ONE. Notice how 'first run movies' crops up so consistently?

The Geostationary satellite is a whole lot easier to live with than the orbital variety that are occasionally available to radio amateurs. This is because the satellite remains fixed - and the receiver antenna may do likewise, without the huge additional cost and complexity of tracking the passage of the spacecraft.



North American TV Satellites

RCA SATCOM 1 (135°W)
Polarization: ODD–Vertical; EVEN–Horizontal

TR–1	Nickelodean–premium children's programming (6.8)
	ARTS (Alpha Repertory Television Service)–performing and cultural arts programming (6.8)
TR-2	PTL (People That Love)–religious (6.8)
TR–3	WGN-TV, Chicago–Midwest's Leading independent station (6.8)
TR–5	The Movie Channel–24 hr/day first-run movies (6.8)
TR–6	WTBS, Altanta–Ted Turner's Superstation
TR–7	ESPN (Entertainment & Sports Network)–24 hr/day sports (6.8)
TR–8	CBN (Christian Broadcasting Network)–religious (6.8)
TR–9	C-SPAN–live coverage from the House of Representatives (6.8)
	USA Network–professional sporting events, Calliope, and the English Channel (6.8)
	BET (Black Entertainment Network) (6.8)
TR–10	Showtime (West)–first-run movies, entertainment specials (6.8)
TR–11	MTV (Music Television)–Pop/Rock Video (5.8 & 6.62 stereo)
TR–12	Showtime (East)–first-run movies, entertainment specials (6.8)
TR–14	CNN (Cable News Network)–24 hr/day news (6.8)
TR–15	Occasional Transmission–sporting events, news & network feeds (6.8/6.2)
TR–16	Showtime (Spare)–occasional network remote and sports events feeds (6.8)
	AETN (American Educational Television Network) (6.8)
	CMN (Christian Media Network)–religious (6.8)
	NJT (National Jewish Television)–religious (6.8)
TR–17	WOR-TV, New York–the Big Apple's top independent station (6.8)
TR–18	Reuter's Monitor Service–commodity/stock market information (digital video)
	Galavision–in the best in Spanish-oriented programming (6.8)
TR–19	The Shopping Channel–Shop-at-home TV service (6.8)
	Spotlight–first-run movies (6.8)
TR–20	Home Box Office Cinemax (East)–time-structured HBO (6.8)
TR–21	HTN (Home Theatre Network)– quality P and PG movies (6.8)
	The Weather Channel (est. Spring 1982)
TR–22	HBO (Home Box Office) (West)– first-run movies, sports & entertainment specials (6.8)
	MSN (Modern Satellite Network)–general Entertainment (6.8)
	Beta–programming for women (est. 1-4-82)
TR–23	HBO Cinemax (West)–time-structured HBO (6.8)
TR–24	HBO (East)–first-run movies, sports & entertainment specials (6.8)

Audio Services on STACOM 1

TR–2	Satellite Radio Network (6.2)
TR–3	WFMT(FM), Chicago (5.8 stereo)
	Seeburg's "Lifestyle" Music (7.6)

COMSTAR 4 (127°W)
Polarization: EDD–Vertical; Even–Horizontal

TR–20	Occasional Transmissions–sporting events, news & network feeds (5.8)

WU WESTAR 2 (123.5°W)
Polarization: All Horizontal

TR–2(3)	Occasional Transmissions–sporting events, news & network feeds (6.2/6.8)
	Independent Network News (6.2)

RCA SATCOM 2 (119°W)
Polarization: ODD–Vertical: Even–Horizontal

TR–2	Occasional Transmissions–sporting events, news & network feeds (6.8)
TR–5	Occasional Transmissions–sporting events, news & network feeds (6.8)
TR–8	NBC Network Contract Channel–live/taped network feeds (6.8)
TR–9	American Forces Satellite Network–various network & independent programming (6.8)
TR–13	NASA Contract Channel (6.8)
TR–18	Occasional Transmissions–sporting events, news & network feeds (6.8)
TR–23	Alaska Satellite Television Project–various network & independent programming (5.8/6.8)

ANIK 2/3 (Canadian) (114°W)
Polarization: All Horizontal

TR–1(1)	BCTV (British Columbia Television), Vancouver, B.C.– British Columbia's leading independent station (6.8)
TR–3(5)	Daily Live Coverage of the Canadian House of Commons from Ottawa (with French translation) (6.8)
	CHLT–TV, Sherbrooke, Quebec–French language independent network (TVA) programming (6.8)
TR–4(7)	CHCH–TV, Hamilton, Ontario–Ontario's leading independent station (6.8)
TR–8(15)	Daily Live Coverage of the Canadian House of Commons from Ottawa (with French translation) (6.8)
	CHLT–TV, Sherbrooke, Quebec–French language independent network (TVA) programming (6.8)
TR–10(19)	CITV–TV, Edmonton, Alberta–Alberta's leading independent station (6.8)
TR–12(23)	Daily Live Coverage fo the Canadian House of Commons from Ottawa (standard English) (6.8)
	CTV North–various CTV network progrming (6.8)

ANIK B (Canadian) (109°W)
Polarization: All Horizontal

TR–4(7)	Occasional Transmissions–sporting events, news & network feeds (6.8)
TR–6(11)	CBC North–various CBC network programming (6.8)
TR–7(13)	Occasional Transmissions–sporting events, news & network feeds (6.8)
TR–8(15)	CBC (French Channel)– French language CBC programming (6.8)
TR–9(17)	CBC Occasional Transmissions (6.8)
TR–10(19)	CBC(English Channel-1)–English CBC programming (6.8)

Table 1: Programme schedules available to North American users.

BBC 10?

Geostationary satellites are placed some 22 300 miles up, to be precise. They are described as 'Geo' stationary, since although the satellite is still whizzing along quite frantically, it is fixed in relation to the earth's surface, i.e. it rotates at the same speed as the earth itself. (*Fig 1*).

When you compare the costs of setting up a terrestial UHF TV transmitter network with the cost of 'installing' and operating a satellite, the enthusiastic might even argue that it would be cheaper for the broadcasting authorities to provide a ground terminal receiver to each TV licence holder, and to scrap the present Band 1, 3 and 5 transmitter network. Certainly, in the long term this might be more than just 'feasible', but downright 'viable'.

The actual costs of broadcasting via the link are minimal compared to the expense of a ground based transmitting network.

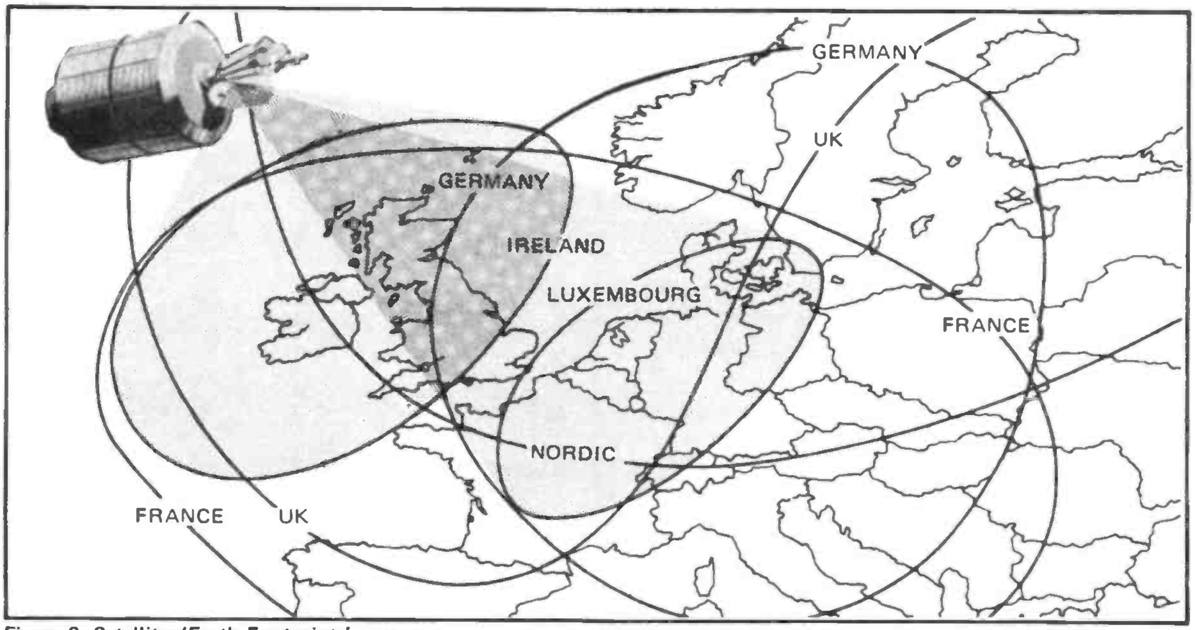


Figure 2: Satellite 'Earth Footprints'.

The position of a broadcasting satellite may be defined by its longitude, Λ_s, the other co-ordinates being determined by its geostationary orbit. A receiving station at longitude Λ_r and latitude ϕ_r will have azimuth, elevation and path length as follows:

(Refer to Figure 1).

Azimuth (°) = $\tan^{-1}(\tan\Lambda/\sin\phi_r) + 180°$ ETN
where $\Lambda = \Lambda_r - \Lambda_s$

Elevation (°) = $\tan^{-1}[(\cos\beta - \sigma)/\sin\beta]$
where σ = radius of earth/(radius of earth + height of satellite)

For a geostationary orbit this is a constant equal to 0·151 269 and

$$\beta = \cos^{-1}(\cos\phi_r \cos\Lambda)$$

Path length (km)

$$d = 35\,786\sqrt{[1 + 0{\cdot}419\,99(1 - \cos\beta)]}$$

The broadcast transmission beams up on the 5.9-6.4 GHz band from either a single ground terminal, or one located at each regional studio site. The satellite then 'transponds' the input signal to rebroadcast another frequency in the 4.5 GHz band (US cable vision system).

The BBC could conceivably run 10 channels in this way for the cost of the existing two. Granted, there would be a lot of repeats, but then again, things like the OU could be broadcast when there are people able to watch it.

DON'T BE FOOLED

The equipment required to handle the US system looks rather large - dishes tend to be a minimum of 10 feet across - and that presents severe wind loading problems. But the US system is NOT part of the proposed DBS programme, in fact, it was never intended that 'consumers' should be able to consume the output of the US satellite network.

The original STV idea was to feed cable vision networks from central distribution points, and thus provide a means of gathering revenues and protecting copyright. Thanks (?) to developments from the electronic warfare scene in microwave and millimetre wave technology - specifically the GAsFET and the microwave 'front-end on a chip', the cost of earth terminal hardware has been put within range of many enterprising Americans who now enjoy free access to the latest offerings of the cinema industry.

The fracas being kicked up by the US organizations interested in copyright protection of this material has led to some fairly staggering proposed penalties for big time 'pirates' - four years in jail and million dollar fines are being bandied about for the big time operators. And 'big time' means the fabled mobsters and 'operators' of US crime, not particularly nice people to do business with.

So, the size of a US consumer's satellite broadcasting groundstation is slightly misleading, for the satellites currently in use were never intended to transmit directly into the front room (via the dish in the back yard). Satellites intended for broadcast direct to your dish are designed with much higher effective radiated power (ERP), so that the European (and the American) DBS user will only need about a 3 foot dish.

You could still use a 10 foot dish as sported by the US 'interceptors', but the beam width at 12 GHz would be very, very narrow, and you might spend a long time 'sighting' the dish, only to find that even a moderate wind caused it to flap around unacceptably.

In Europe, all the UK can receive is some experimental test transmissions, an some occasional domestic Russian TV. Since the DBS system is being placed in the 12 GHz frequency band, equipment is presently both more costly and far less 'makable' by the enterprising home pirate than the 4.5 GHz band. When mass production starts, there is every possibility that the microwave 'IC' will have been perfected, and current estimates put an earth station receiver at about £300-500 by 1985.

R&EW will be bringing you gradually towards the magic 12 GHz band with a series of microwave projects, but be prepared to get your lathe and file kit, since so much of microwave engineering is based in precision metal engineering for waveguides, feeds, filters etc.

GOING WEST

DBS's are located several degrees west of the target areas, so that the solar power arrays remain illuminated by the sun during the peak evening broadcast times. A horn antenna (*Fig 2*) on the device directs a very specific 'beam' that illuminates a 'footprint' on the earth's surface which is otherwise known as the service area. Only very few householders in this service area will be unfortunate enough to find the DBS is out of sight, and UK readers may like to check that the proposed site at 31 degrees West is accessible. This means an elevation of 24 degrees around London, with extremes of 17 degrees in the Shetlands, and 27 degrees in the South West. An alignment accuracy of 0.5 degrees is necessary with a 3 foot dish.

Continued next month....

□ **R & EW**

Your Reactions

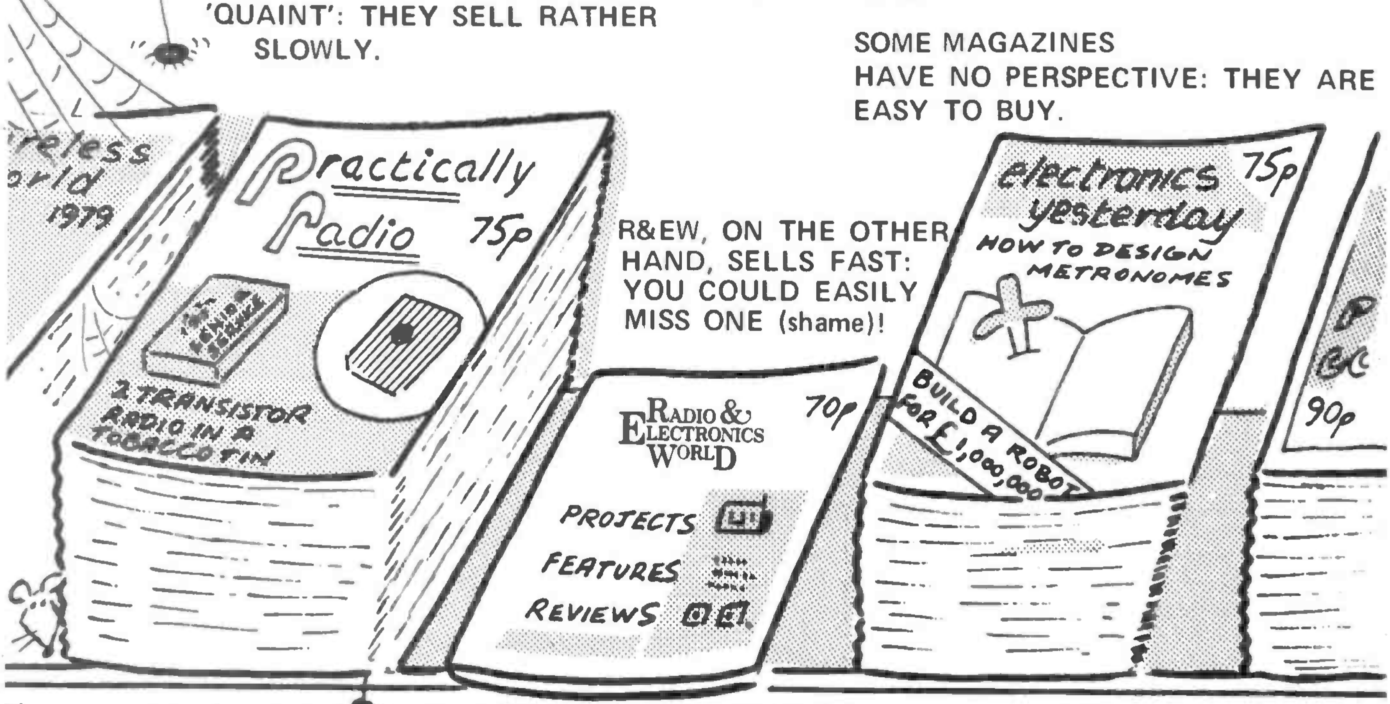
	Circle No.		Circle No.
Immediately Applicable	160	Not Applicable	162
Useful & Informative	161	Comments	163

SUBSCRIBE! FOR FIVE GOOD REASONS

WHEN YOU BECOME an R&EW subscriber, you gain a lot more than a mere assurance of 'getting it regularly'. Look at these five good reasons for taking out a subscription:

1. Subscribers have **R&EW** delivered to their door, every month for a year, with a guarentee against price rises.
2. Subscribers get 'restricted' information on limited special offers on components, books and equipment.
3. All **R&EW** subscibers are eligible for membership of our unique 'DATACLUB' service (see page 83 of the February issue), which entitles them to 24 PCB's a year and a special discount on components.
4. All **R&EW** subscribers are entitled to 'priority' treatment through our readers' enquiries service.
5. Subscribers automatically receive information 'up-date' sheets with their copy of the magazine. These sheets may contain details of 'mods' to past projects, details of last-minute special offers or late news about the contents of the magazine.

Why don't we supply this up-date sheet to all **R&EW** readers? Simple - the magazine leaves our hands and goes to the printers some 3-4 weeks before it hits the news stand. When you receive a subscription copy, however, your magazine is returned to our office, where it can receive an up-to-the-minute 'add-on' before being mailed direct to your home, So, subscribe!



If you want to be sure of getting **YOUR** copy of Britain's newest, most informative and innovative Radio/Electronics magazine, **PLAY SAFE! BECOME A SUBSCRIBER. Fill in the form below.**

SUBSCRIPTION ORDER FORM

I would like to subscribe to **Radio & Electronics World** for one year (12 issues). Please start my subscription from the ____________ issue.

SUBSCRIPTION RATE:
(tick as appropriate)
UK **£10.00 for 12 issues**
Overseas **£11.00 for 12 issues**

PAYMENT:
(Access/Barclaycard orders may be sent using reply-paid order card)
I enclose my (delete as necessary) Cheque/Postal Order/ International money order for £

Please use BLOCK CAPITALS and include postal codes.

Name (Mr/Mrs/Miss) ______________________________

Address: ______________________________

____

Signed: ______________________________ Date: ______________

Please send this order form, with your remittance, to Radio & Electronics World, Subscriptions Department, 45, Yeading Avenue, Rayners Lane, Harrow, Middlesex.

Using UARTs Part 3

In this concluding part of the series, our 'Mr Burchell' takes a look at the 8251, one of the most widely used microprocessor-compatible UARTs.

So far in this series we have looked at the class of UART devices used in hardwired discrete logic applications. This month we look at another class of UART's, those designed to interface directly with a computer and therefore under software control. Great care is taken by the manufacturer's of such devices to ensure that the electrical interface of the UART makes its internal registers appear just like any other memory location to the processor. By doing this they remove the need for special instructions (in the microprocessor's instruction set) just to talk to the UART. Instead, standard memory reference instructions such as 'store' and 'read' may be used. One of the best examples of a processor-compatible UART is the 8251, designed originally to be used with the 8080 series of microprocessors. The 8251 is found as the basis of the serial RS232 communications link in most 8080 and Z-80 designs.

THE 8251

The 8251 is in fact rather more than just a simple UART and it should properly be referred to as a USART (Universal Synchronous Asynchronous Receiver Transmitter), as it is capable of controlling not just asynchronous communications links but also those based upon synchronous protocols. As these are rather more complicated than asynchronous protocols, we shall leave them well alone for the time being.

I intend also to look only at the software aspects of using an 8251, as the particular hardware details are yery dependant upon the exact computer and microprocessor system being considered.

As can be seen from *Fig 1*, the 8251 appears to the programmer as four registers (memory locations), two read-only and two write-only. The first 'read' location contains data which has been transmitted to the 8251 and is known as the receive-register. The second read register contains status information for the programmer about the various UART operations which may be

Figure 1: 8255 Registers

Address	Read	Write
BASE	RECEIVER	TRANSMITTER
BASE+1	STATUS	COMMAND

taking place. The first write-address is known as the transmit register. It is into here that data to be transmitted is written. The second write register is known as the command register. Data written into this register defines the operating characteristics of the USART. The one exception to this is immediately after a power-on reset, when the first byte written to the command register is considered by the USART to be a mode control word, defining the mode (asynchronous or synchronous) in which the USART is to operate.

SOFTWARE REQUIREMENTS

In order to use the 8251 to communicate with the outside world, the mode of operation must first be defined (*see Fig 2*). This is done by writing the appropriate control word into the command register immediately after a system reset has taken place. This data word is known as the MODE control word. The various parameters which may be controlled by the mode control are:
The baud-rate factor; the number of clock cycles of the external baud rate clock which are to be considered as one bit time. In most systems this is set to 16; e.g. the external clock rate is divided by 16. The divide-by-one feature cannot be used unless it can be

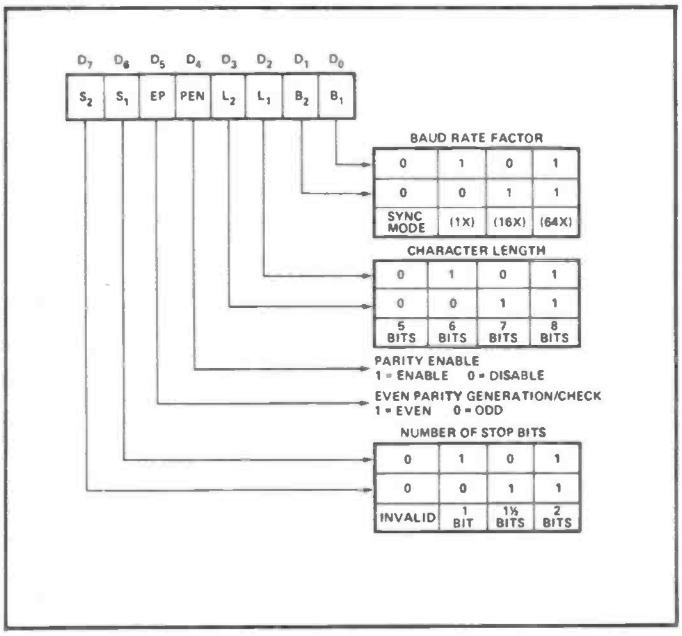


Figure 2: Mode Instruction Format, Asynchronous Mode.

guaranteed that serial data transitions take place synchronously with the local baud rate clock.
The character length. This is the number of data bits in the character. Various lengths from 5 to 8 bits per character may be selected. 5 data bits per word is of course the number most often used in RTTY systems.
Parity checking (or not) on received data.
The sense of the parity check generator, if it is enabled.
The number of stop bits in the data word. This only affects the number of stop bits appended to a transmitted character. The receiver logic only requires a single stop bit to correctly decode the data stream.

Any subsequent writes to the command register are interpreted as command instructions. The parameters controlled by the command byte are shown in *Fig 3*:
Bit 0 enables or disables the transmitter logic.
Bit 1 (when set) forces the output pin DTR to go low. This line, together with RTS, is used in implementing RS232 data links with full handshaking between both parties.
Bit 2, when set, enables the receive logic and parity checking. When not set the receiver will still receive characters, but the appropriate flags in the status register will not be set. When changing from disabled to enabled it is wise to discard any character in the input register, immediately after setting TxEN.
Bit 3. When set, the break character is sent by setting the Tx date pin of the 8251 low.
Bit 4, when set, resets any error conditions in the status register.
Bit 5, when set, forces the pin RTS low.

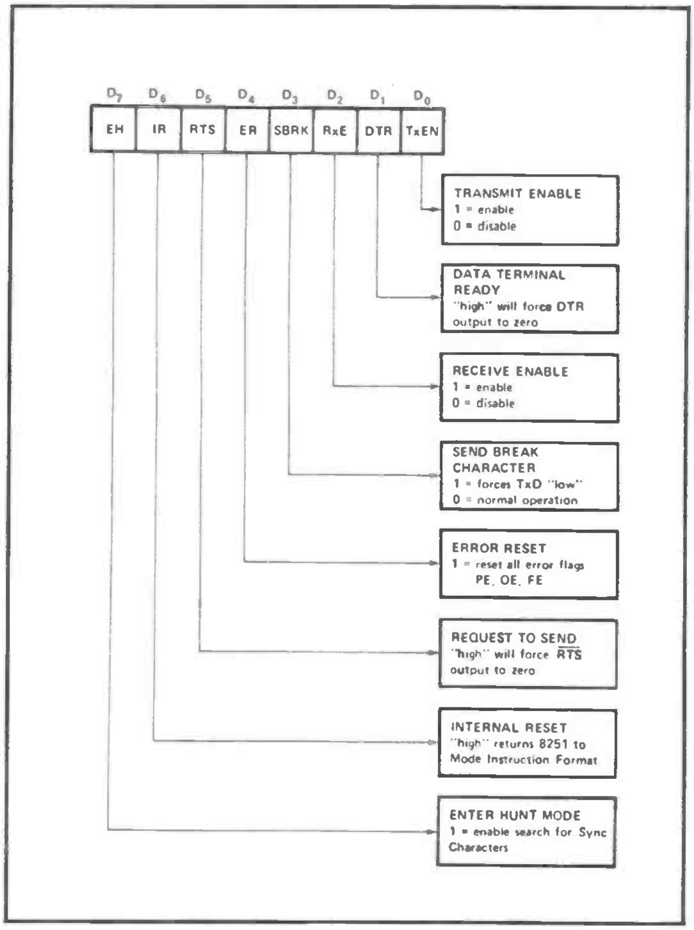


Figure 3: Command Instructions Format.

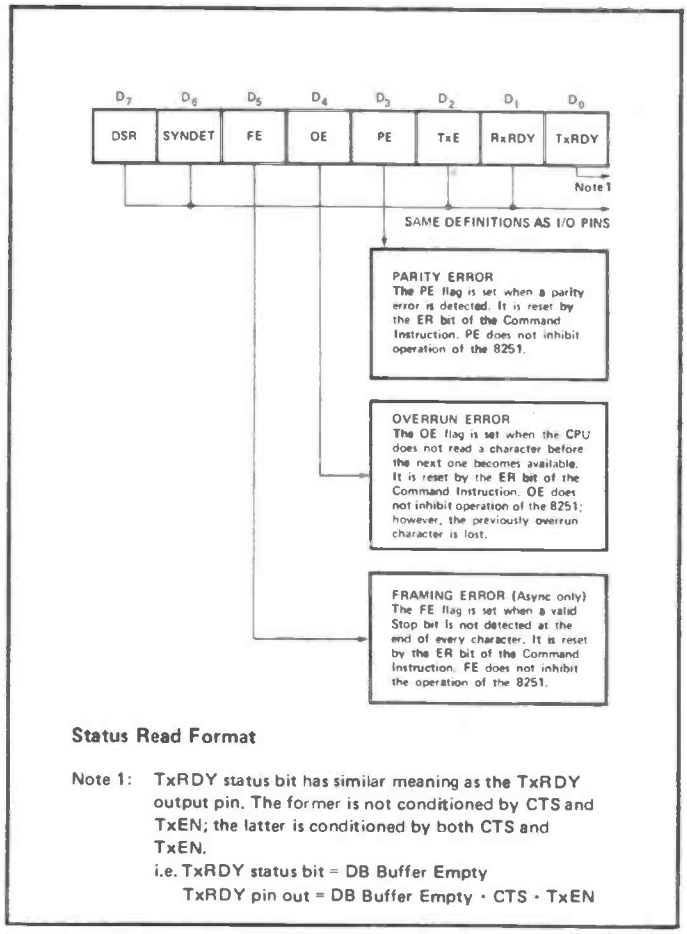


Figure 4: Status Register.

Bit 6 causes an internal reset of the 8251 to take place. The next byte must be written to the command register and is interpreted as mode data.

STATUS REGISTER

The status register (see *Fig 4*) provides feedback on the transmit and receiver logic of the USART, as follows:

Bits 3,4,5 provide information as to any error which may have been detected in the received data; these flags are reset by bit 4 in the command register.

Bit 1 provides status on the transmitter logic. When this bit is low a character to be transmitted may be loaded into the transmitter register. It returns low as soon as the character has passed from the transmitter register to the output register.

Bit 2, when set, indicates that a character has been received by the USART. This bit is automatically reset when the character is read from the receiver register.

ROUTINES

The software which follows enables the 8251 to establish a simple RS232 link. No handshaking is used and no error checking of the received data takes place. The baud rate 'divide' factor is set at 16. The actual baud rate is controlled by the frequency of the external baud rate clock.

The initialisation routine for most applications is as follows:

```
INIT    MVI,A CEH       Load A REG MODE word
        OUT BASE+1      output it to command reg
        MVI,A 27h       load A REG COMMAND word
        OUT BASE+1      output it to command reg
```

The first data byte configures the USART for asynchronous output with a baud rate clock divide factor of 16, an 8 bit character length, no parity bit and two stop bits. This is the standard format for 110 baud communication but it will work satisfactorily at higher baud rates. The extra stop bit will result in a 10% transmission speed reduction, and appears to the terminal as a brief mark condition between characters. The second data byte enables the transmitter and receiver to begin data transmission.

Receipt of a character is indicated by testing the status port.

```
INPUT   IN BASE+1       USART STATUS
        ANI 2           LOOK AT D1-RXRDY
        JZ INPUT        LOOP UNTIL TRUE
        IN BASE         READ DATA
```

Transmission of a character starts by testing the status port to see if the transmitter register is ready to receiver a character.

```
OU-
TPUT    IN BASE+1       USART STATUS
        ANI 1           LOOK AT DO-TXRDY
        JZ OUTPUT       LOOP UNTIL TRUE
        POP PSW         RETRIEVE DATA FROM
                        STACK
        OUT BASE        OUTPUT DATA
```

The simple examples above are presented in 8080 mnemonic code. However, they are sufficiently simple to be easily recoded into the native code of the processor concerned, if it is not 8080 based.

■ R & EW

Your Reactions	Circle No.		Circle No.
Immediately Applicable	172	Not Applicable	174
Useful & Informative	173	Comments	175

23cm / 2m or /10m CONVERTER

A new approach to microwave circuit design has produced this sophisticated, yet easily reproducable converter. Output is available on either 10 metres or 2 metres, depending on the crystal used in the oscillator.

Design by Roger Ray.

R&EW Project Packs:
PCB and all components including Xtal for 10 or 2 meters **£16.91 + VAT (£19.45)**

Design Philosophy

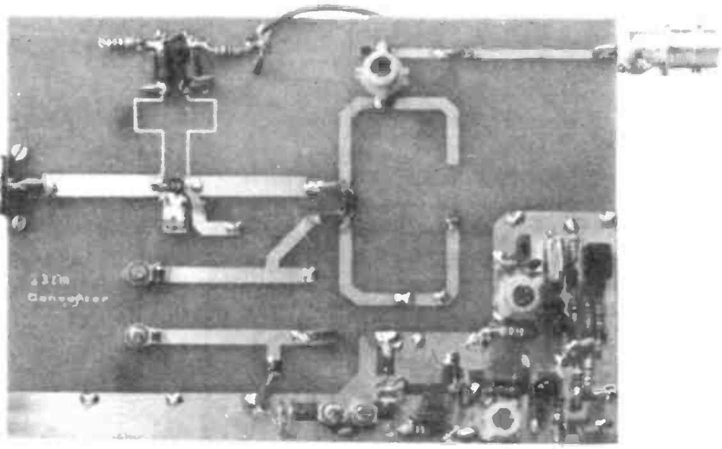
The 23cm amateur band extends from 1240 MHz to 1325 MHz, but the normal communication segment of the band is 1296-1298 MHz. **R&EW**'s new converter is intended for the communication segment, with an IF of 28-30 MHz or 144-146 MHz. Due to the wideband nature of its mixer, the converter can be used for other parts of the band by using the appropriate crystal, e.g., a 103.333 MHz crystal gives coverage of the satellite band (1260-1270 MHz), with an IF of 20-30 MHz.

The circuit elements of the RF amplifier and mixer are constructed using stripline technology on a fibre glass printed circuit board. This technique allows repeatable results to be obtained, giving only marginally higher losses than can be obtained using other methods of construction.

An anti-parallel diode mixer was chosen for the converter, as it offers several advantages over the usual hybrid ring mixer: Most important is that the local oscillator is half the frequency that would normally be used. This greatly simplifies the design of the multiplier stages, and allows a better filter to be constructed to suppress unwanted harmonics.

Construction

The printed circuit board is an integral part of the converter design. Nine micro-strip inductors are in fact printed on the board. If you are making your own PCB's use only 1.6mm thick fibre glass (G10) board, and follow the foil patterns carefully. With this project it is best to buy the PCB or complete kit from **R&EW**



CIRCUIT DESCRIPTION

Circuit elements for the RF amplifier and mixer are formed as strip lines on the PCB. A quarter-wave 32R transmission line noise - matches the NE21936 input impedance to 50R. The required source impedance for the transistor at 1.3 GHz is almost purely resistive, allowing this simple transformation to be used. L2 and L3 are quarter-wave biasing chokes for the transistor. Shorted line L4 provides an inductive impedance to cancel the capacitive reactance of the transistor. Another quarter-wave transmission line, L5, matches the real impedance at the collector of Q1 to 50R. An alternative to the use of L4 to cancel the capacitive reactance of Q1 would be to use a high quality trimmer at the mixer end of L5.

Zener diode biasing of Q1 allows R4 to set the collector current, which should be 5-6 mA. C3, mounted directly across the zener, stops it acting as a noise generator!

The mixer consists of L6, L7 and diodes D2 and D3. It is unconventional in operation, requiring a local oscillator at half the normal frequency. L6 is an open circuited half-wave line at signal frequency, the IF being taken from the low impedance point of this line (mid way along its length). L7 is a shorted half-wave at signal frequency (low impedance) but a shorted quarter-wave line at local oscillator frequency (high impedance). This gives good isolation between RF and L0 ports of the mixer. This type of mixer requires L0 injection at the correct level for optimum performance (approx 0dBm).

Crystal oscillator Q2 is identical to that used in the 70cm to 2m & TV converter (**R&EW** Jan '82) with the exception of DC switching. This oscillator uses 5th overtone crystals, and has proven to be exceptionally reliable in operation. Q3 forms an amplifier at crystal frequency, producing the required level to drive the X3 multiplier Q4. This multiplier drives a bandpass coupled filter to remove other harmonics of the crystal oscillator. The final X2 multiplier Q5 has its base tapped directly onto L13. Good final frequency filtering is provided by the widespaced tuned lines L14 and L15. As filtering is very good, C31 can be adjusted to give the required level into the mixer.

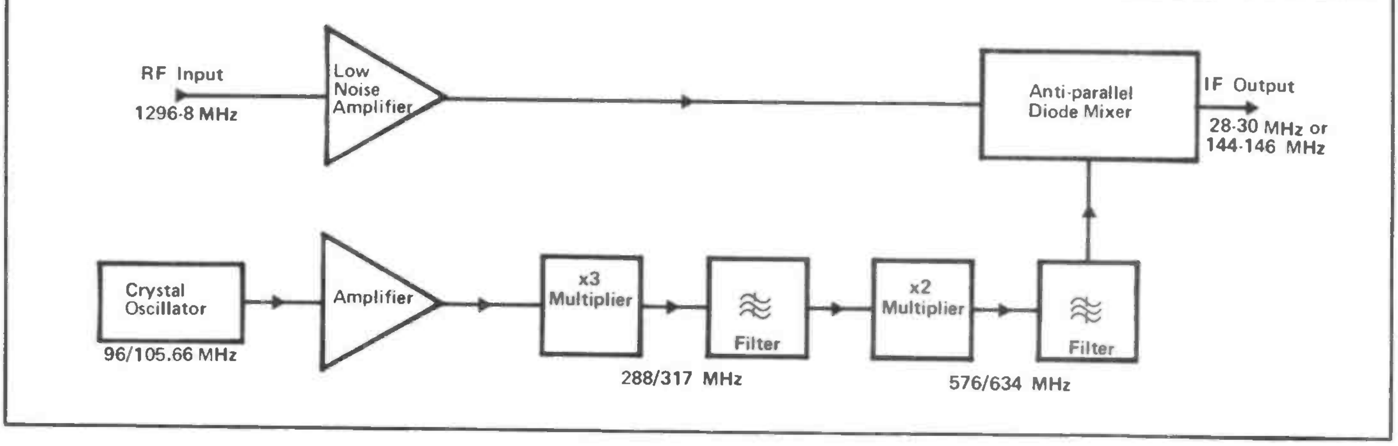


Figure 1: Block diagram of the converter.

23cm/2m or /10m CONVERTER

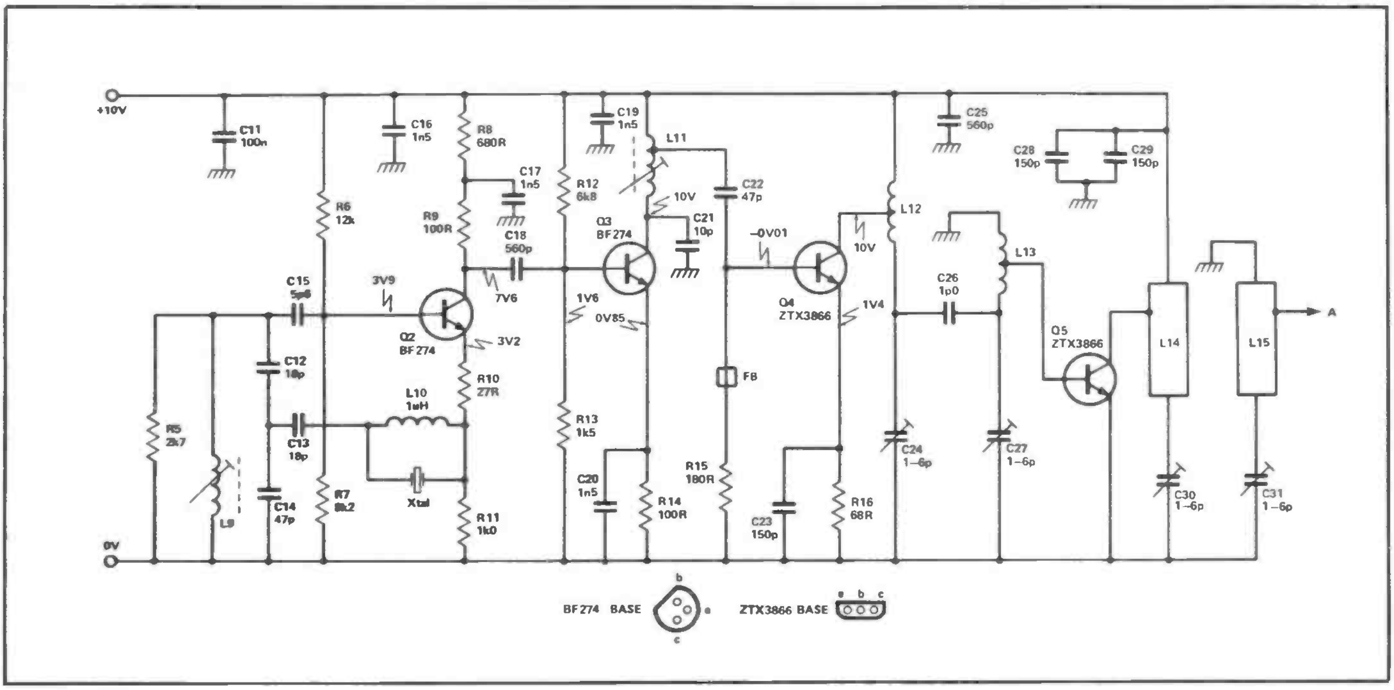


Figure 2a: The converter oscillator chain.

for reproducable results.

Start construction by making all the through board links, using 1mm diameter tinned copper wire, and soldering to both sides of the board. Assemble the resistors next, with the exception of R2,3 and 15. Where resistors connect to the earth plane, they should be soldered both top and bottom. R15 is soldered into place with a ferrite bead over one leg.

Capacitors are mounted with the shortest possible leads; this is very important if design parameters are to be met. Capacitors soldered to the top of the board (connecting to the microstrip elements and to the top earth plane), should have leads formed at right angles and then soldered into place. Again, absolute minimum lead length is essential.

After all the capacitors have been fitted, resistors R2 and R3 can be positioned. These are miniature 10R resistors which fit inside the FX1115 ferrite beads. Position the resistors in the centre of the ferrite beads, and bend the leads downward. Crop the leads off level with the outer edge of the beads, and solder the resistor/bead combination into place.

Wind coils L12 and L13 as shown in *Fig 3*, and solder them into the PCB. L12 is tapped half a turn from the cold (C25) end, using a similar piece of wire. Coil L11 is tapped 1.25 turns from the Q3 collector end. First solder L11 into the board, and then solder a piece of 22 SWG wire into the board for the tap. Bend and cut the wire so that it just touches L11 at the correct point. Solder the tap in position, using the minimum amount of heat, or the coil former will melt! The rest of the inductors should now be assembled.

Transistors Q2, 3 and 4 can now be inserted into the PCB; lead length should be approximately 3mm. Q5 has its emitter lead connected to the earth plane, and base-tapped half a turn up L13 (from the earth plane); it's collector is soldered to the adjacent stripline.

The RF amplifier transistor Q1 is positioned in the hole provided in the board, with writing upper-most. Carefully solder it into position; no lead length between the microstrip and transistor

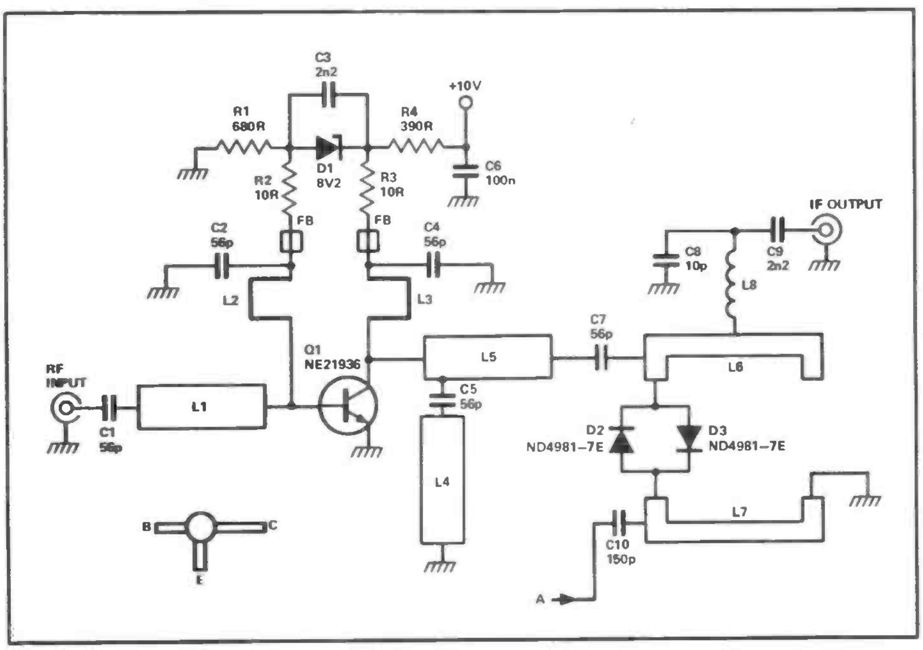


Figure 2b: The converter front-end and mixer.

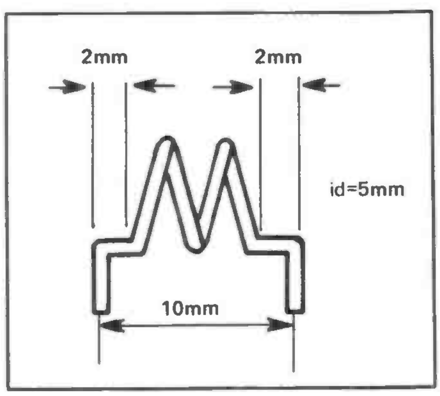


Figure 3: Winding details of L12 and L13.

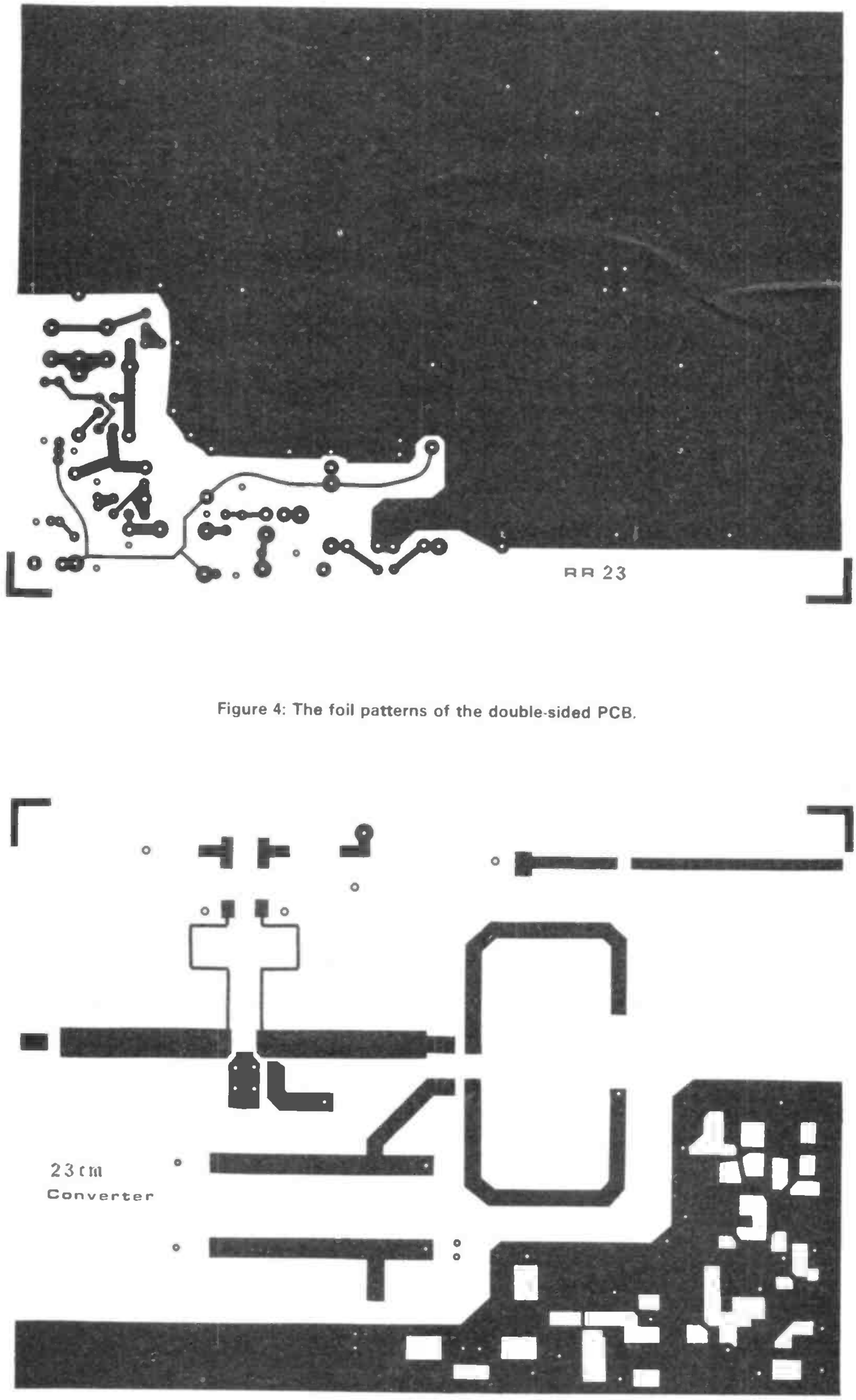


Figure 4: The foil patterns of the double-sided PCB.

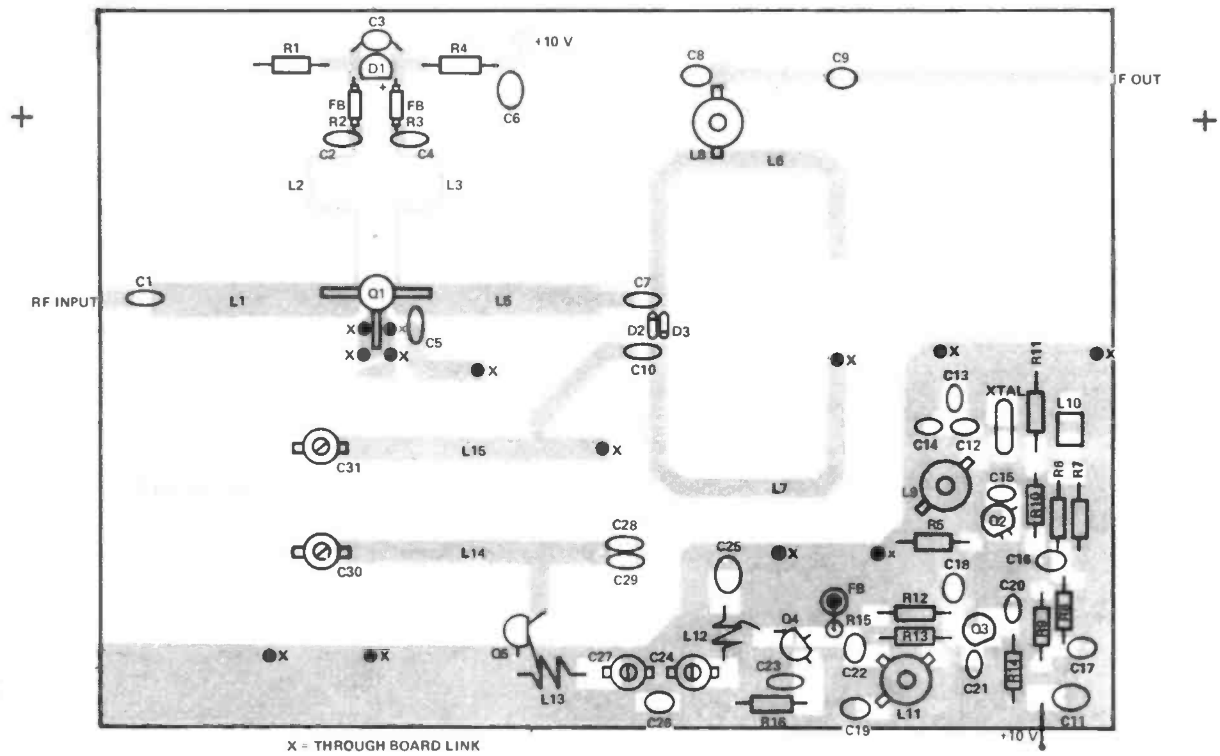


Figure 5: Component overlay.

body should be visible. Diodes D2 and D3 should, again, be assembled with minimum possible lead length; take care though not to bend the leads too close to the body of the diodes (or you might break the glass seal at the end of the diode). The remaining components (D1 and the crystal) can now be fitted.

Link the RF amplifier and oscillator supply connections with a piece of insulated wire, add the RF connectors, and you are ready for testing the converter. (Note that the input connector should be connected as close as possible to the board).

Test and Alignment

Visually check the completed board for wrongly orientated or missing components and faulty solder joints. Adjust the core of L9 to about 2mm from the top of the former for the 2 metre version, or level with the top for the 10 metre version. The core of L5 should be adjusted to be level with the top of its former. Set C24, 27, 30 and 31 to their mid positons (slot in line with the pins). Connect a 10V power supply to the converter (preferably with current limiting) and check that the current consumption is not excessive.

Connect a multimeter to the Q4 emitter end of R16, and adjust L9 until a reading is obtained. Adjust the core of L11 for a maximum reading. Using a diode probe connected to the multimeter (see *Fig 6*), connect the test probe to the tap on L13, and adjust C24 and C27 for maximum voltage. Move the probe to either end of C10 and adjust C30 and C31 for maximum voltage. Now re-peak the other cores and trimmers for maximum voltage at this point; the power should be around 1-2 mW. If a frequency counter is available, loosely couple it to L9 and

LIST OF OPERATIONAL 23cm BEACONS

Frequency	Call Sign	Location	QRA
1296.810 MHz	GB3NWK	North West Kent	AL51B
1296.830 MHz	GB3BPO	Martlesham Heath Suffolk	AM77J
1296.870 MHz	GB3AND	Andover, Hants	ZL63B
1296.890 MHz	GB3DUN	Dunstable Downs, Beds	ZL08E
1296.900 MHz	GB3IOW	St Catherines Hill, IOW	ZK34A
1296.910 MHz	GB3CLE	Clee Hills, Salop	YM48H
1296.930 MHz	GB3MLE	Emley Moor, Yorks	ZN32B
1296.990 MHz	GB3EDN	Edinburgh	YP04G

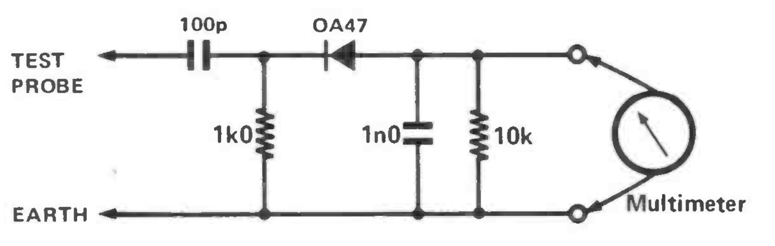


Figure 6: A diode probe for RF alignment.

SPECIFICATION

Freq. Coverage	1296-1298 MHz
IF Freq.	28-30 MHz or 144-148 MHz
Overall Gain/Loss	0dB
Noise Figure	5.5dB
Input Impedance	50 ohms
Supply Voltage	10V stabilized
Supply current	95mA nom

PARTS LIST

Resistors (All ¼W 5% unless otherwise stated)			
R1,8	680R	C16,17,19,20	1n5 ceramic
R2,3	10R 1/8W	C18,25	560p ceramic
R4	390R	C24,27,30,31	1-6p trimmer
R5	2k7	C26	1p0 ceramic
R6	12k	**Semiconductors**	
R7	8k2	Q1	NE21936
R9,14	100R	Q2,3	BF274
R10	27R	Q4,5	ZTX 3866
R11	1k0	D1	8V2 Zener
R12	6k8	D2,3	ND4981-7E or HP5082-2835
R13	1k5	**Inductors**	
R15	180R	L1,2,3,4,5,6, 7,14,15	PCB (see text)
R16	68R	L8,9,11	S18 4.5 yellow
Capacitors		L10	1uH choke
C1,2,4,5,7	56p ceramic	**Miscellaneous**	
C3,9	2n2 ceramic	Crystal	105.666MHz (28-30MHz IF)
C6,11	100n monolithic		96.000 MHz (144-145MHz IF)
C8,21	10p ceramic		
C10,23,28,29	150p ceramic		
C12,13	18p ceramic		
C14,22	47p ceramic	RF connectors	
C15	5p6 ceramic	PCB	

adjust the core of L9 for the exact crystal frequency. This completes the alignment of the oscillator section of the converter. Check that the collector voltage of Q1 is about 8 volts, and the converter is ready for operation.

With a suitable aerial connected to the converter find a local 23cm signal (a list of operational beacons is given at the end of this article), adjust C31 for maximum received signal. The core of L8 should be left in the centre of the coil for the 10 metre version and removed entirely for the 2 metre version.

Results

The first prototype converter was built in the **R&EW** Lab. A quad-loop aerial was connected to the input, and held in one hand. Both GB3DUN and GB3BPO were audible when the aerial was pointed in the right direction (a distance of over 40 and 50 miles respectively). This certainly proved the converter to be working, as an indoor aerial is hardly optimum at 1.3 GHz! The addition of a bandpass filter centred on 1297 MHz, with a two stage low noise pre-amplifier in front of it, showed that performance could be further improved. These can be added later if ultimate performance is required. The converter as it stands produces very acceptable results, performance being similar for both the 2m and 10m IF versions. ■ **R & EW**

References

1. NE219 transistor data. Nippon Electric Co Ltd 1979.
2. Hawker P. Technical Topics Radio Communication Feb 1979.
3. Leighton G. 70cm to 2m & TV converter **R&EW** Jan 1982.

Your Reactions.........	Circle No.
Excellent - will make one	121
Interesting - might make one	122
Seen Better	123
Comments	124

300 for further details

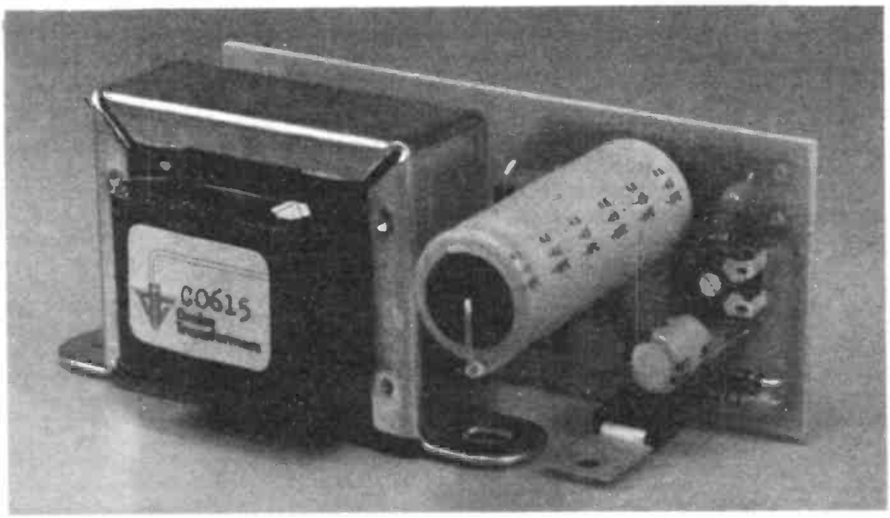
3 for further details

CONVERTER PSU

R&EW Project Packs
PCB Unit £7.46 + VAT (£8.58)
Boxed Unit £11.72 +VAT (£13.48)
P&P 50p per order.

This modest little power supply project can be used to drive one of R&EW's famous VHF converters - or to act as a general-purpose bench PSU.

Design by Graham Leighton.



THE POWER SUPPLY UNIT described here was originally designed for use with the 70cm/2m converter project described in the January issue of **R&EW**, and with the 23cm converter presented in this month's edition. The design is, however, reasonably versatile - it will supply up to half an amp of current at any pre-set voltage in the range 1.5 to 14V, with better than 1% regulation, and features automatic overload protection - so the project can in fact be used to power a wide variety of devices/projects.

The major part of the project, including the mains transformer, is housed on a single PCB measuring a mere 40mm x 100mm, giving the user the option of either building the resulting module into a piece of existing equipment or of fitting it into it's own box for use as a general-purpose PSU. In the latter case the PCB's pre-set pot (RPS1) can usefully be replaced by a panel-mounted pot of the same value, which can then be used as the SET VOLTS control.

CIRCUIT DESCRIPTION

The heart of the unit is IC1, a 3-terminal regulator chip with built-in electrical and thermal overload protection. The unregulated input to the IC is provided via mains transformer T1 and bridge rectifier D1-D4, and the output voltage of the regulator is determined by the ratios of R1—RPS1. The basic action of IC1 is such that its output pin takes up a value 1.25 volts higher than that on the ADJUST pin, which is connected to the R1-RPS1 junction.

When the RPS1 value is zero, the ADJUST pin is effectively at zero volts, so 1.25 volts appears across the unit's output terminals: When RPS1 is set to 2k2, the R1-RPS1 ratio is 10, so the output voltage increased to 10 x 1.25V, or 12.5 volts. The output voltage can thus be set via RPS1. Capacitors C3, C5 and C6 ensure a low-impedance output at all frequencies, and the LED gives a visual indication of the output state.

For a more complete description of 3-terminal regulator circuits, refer to 'Data File 1' in the December '81 issue of **R&EW**.

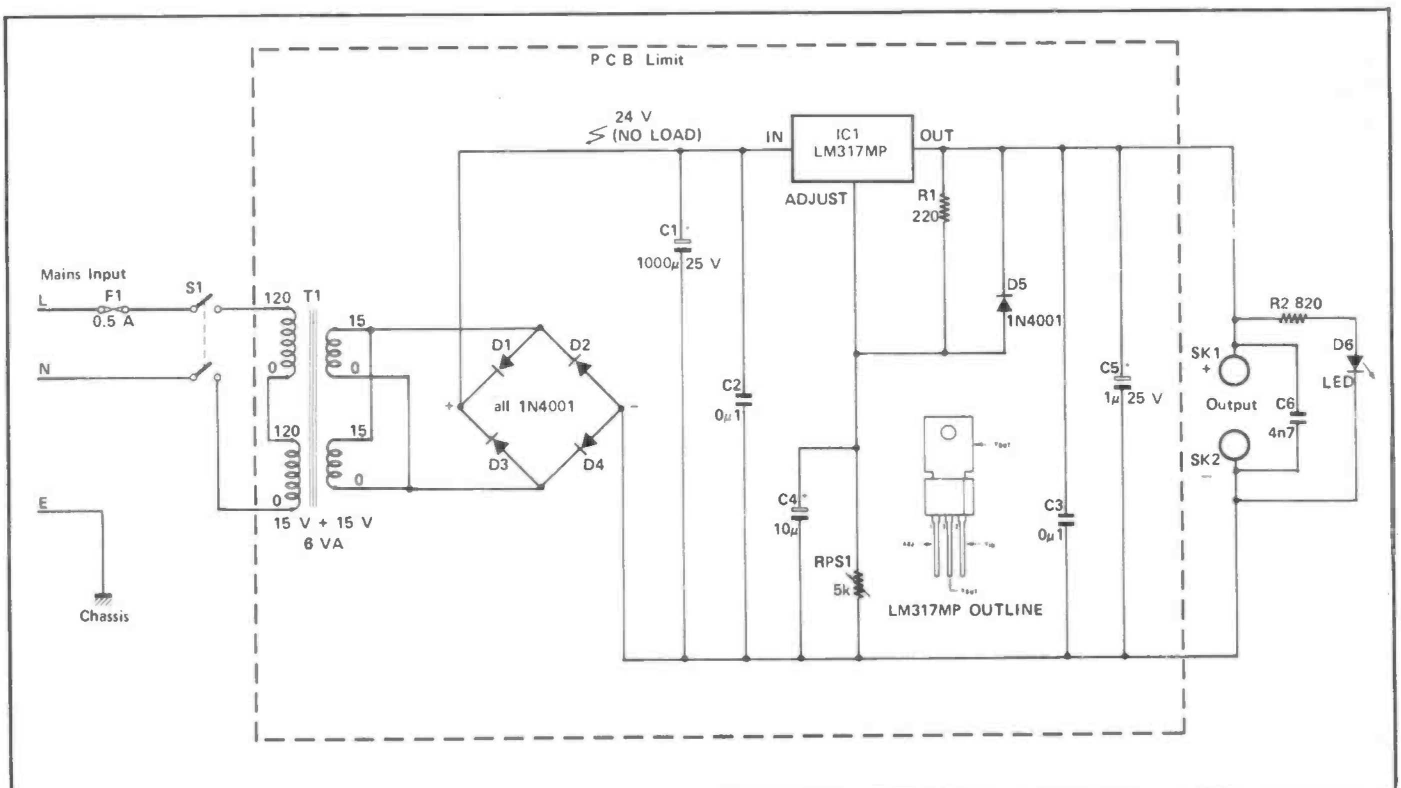


Figure 1: Circuit diagram of the Converter PSU.

Construction

Construction of the basic module should present very few problems, provided that care is taken to follow the PCB overlay and to observe the polarities of the semiconductors and the two electrolytic capacitors. Note that the transformer should be the last component fitted to the PCB.

If the module is to be built into a piece of existing equipment, note that the PCB is intended to be mounted vertically via the transformer tabs. Regulator IC1 must be provided with some form of heatsink (thermally connected to, but electrically isolated from, the IC tab - which also acts as the regulator's output terminal): In most instances the equipment itself can act as the heatsink, with insulation provided via the standard IC mounting kit.

If the project is to be used as a stand-alone unit, built into the **R&EW** project box, assemble the module and remaining hardware as shown in the photo's, using the box as the heatsink and fitting the IC with the usual insulated mounting kit. Ensure that the mains input is well insulated, and that the indicator LED is fitted in the correct polarity.

If the project is to be used as a general-purpose bench PSU, spanning 1.25 to 14 volts at 0-500mA, replace RPS1 with a panel-mounted 5k0 pot and build the module into a suitable case.

Testing

When construction is complete, double-check the assembly for component errors and solder bridges, etc., then set RPS1 to minimum value and switch on: The output voltage should be about 1.25 volts. Adjust RPS1 to give the required output voltage (it is possible to set the output above 14 volts, but the regulation will then suffer), then connect a suitable load in place and check that the regulation is satisfactory and that IC1 does not get excessively hot.

Note that the indicator LED will not illuminate at the minimum voltage setting, and that it's brightness increases in proportion to the output voltage.

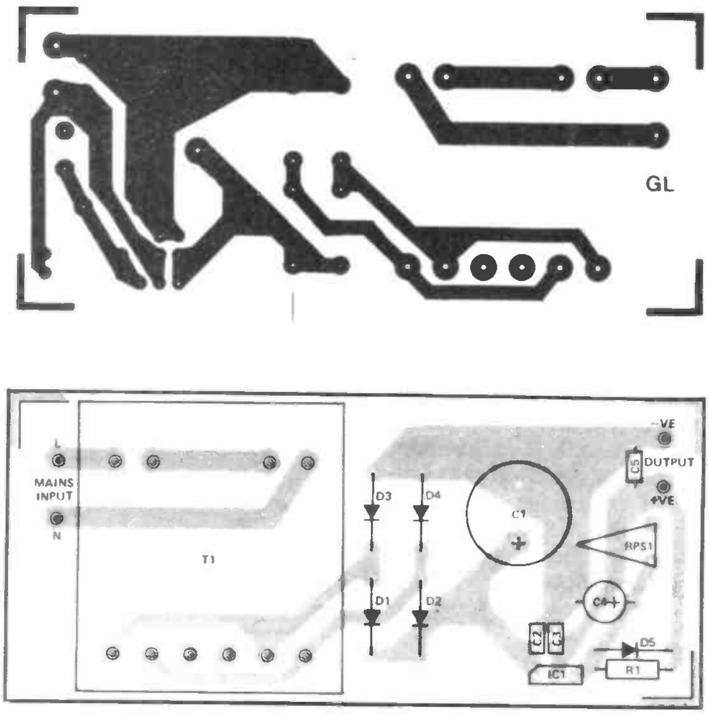


Figure 2: Foil pattern and overlay of the PSU.

SPECIFICATION

Mains input	220-250VAC
Output Voltage	1.25 to 14VDC
Output current	500mA max.
Regulation	Better than 1%
Size: PCB unit	45mm x 40mm x 100mm
Boxed unit	93mm x 45mm x 110mm (excluding connectors, etc)

COMPONENTS LIST

Resistors (.¼W, 5%)

R1	220R
R2	820R
RPS1	5k0 sub-min pre-set (horizontal mounting)

Capacitors

C1	1 000u 25V electrolytic
C2,3	100n monolithic ceramic
C4	10u 25V electrolytic
C5	1u0 25V tantalum
C6	4n7 miniature ceramic

Semiconductors

D1-D5	IN4001
D6	LED, in holder
IC1	LM317MP, with insulated mounting kit.

Miscellaneous

T1	6VA 15V + 15V transformer (stock No. 57-10013)
F1	0.5A 20mm fuse
S1	2-p 2-way miniature mains toggle
SK1	4mm socket, RED
SK2	4mm socket, BLACK
PCB	R&EW
Case	R&EW

20mm fuseholder and boot, mains cable, cable tie, set of stick-on feet for case.

■ R & EW

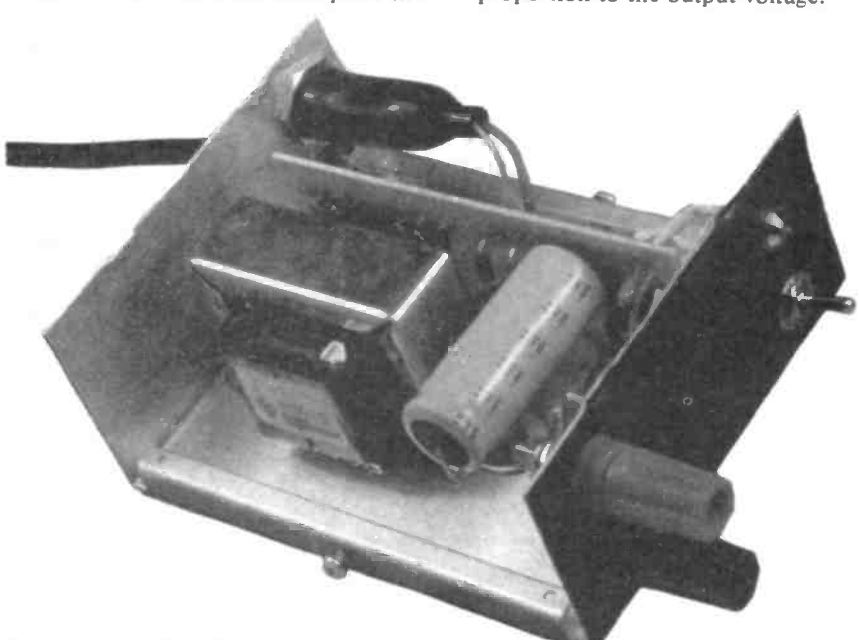


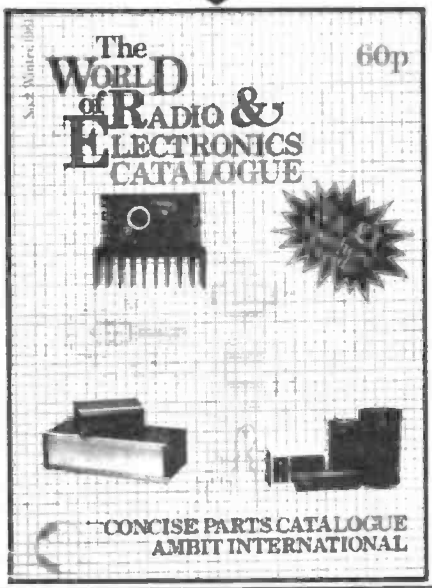
Figure 3: 'Boxed' version of the PSU.

Your Reactions.........	Circle No.
Excellent - will make one	266
Interesting - might make one	267
Seen Better	268
Comments	269

HOW TO SUCCEED IN THE ELECTRONICS BUSINESS:

INVEST 60p AND MAKE £2.40 net profit

Available at your newsagent or direct for 60p p&p inc



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

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

Prices shown exclude VAT. Postage 50p per order (UK). ACCESS/ BARCLAYCARD may be used with written or telephone orders - official MA details on application, and a special prize for those who read our ads carefully - a free 4 or 8MHz crystal with every CPU IC you buy - just clip out this paragraph and attach it to your order. E&OE.

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		
4027	0.26	4527	0.80		
4028	0.50	4528	0.85		
4029	0.55	4529	0.70		
4030	0.35	4531	0.85		
4035	0.67	4532	0.80		
4040	0.50	4534	4.00		
4042	0.50	4536	2.50		
4043	0.50	4538	0.85		
4043AE	0.93	4539	0.80		
4044	0.60	4543	0.80		
4046	0.60	4549	3.50		
4047	0.68	4553	2.70		
4049	0.24	4554	1.20		
4050	0.24	4555	0.35		
4051	0.55	4556	0.40		
4052	0.55	4557	2.30		
4053	0.55	4558	0.80		
4054	1.30	4559	3.50		
4055	1.30	4560	2.50		
4056	1.30	4561	1.00		
4059	5.75	4562	2.50		
4060	0.75	4566	1.20		
4063	1.15	4568	1.45		
4066	0.30	4569	1.70		
4067	4.30	4572	0.22		
4068	0.16	4580	3.25		
4069AE	0.14	4581	1.40		
4070	0.16	4582	0.70		
4071	0.16	4583	0.80		
4072	0.16	4584	0.27		
4073	0.16	4585	0.45		
4075	0.16	4702	4.50		
4076	0.55	4703	4.48		
		4704	4.24		

TTL N

7400N	0.10	7447N	0.62	74153N	0.55	74366N	0.85
7401N	0.10	7448N	0.56	74154N	0.55	74367N	0.85
7402N	0.20	7450	0.14	74155N	0.55	74368N	0.85
7403N	0.11	7451N	0.14	74156N	0.55	74390N	1.85
7404N	0.12	7453N	0.14	74157N	0.55	74393N	1.85
7405N	0.12	7454N	0.14	74159N	1.90	74490N	1.85
7406N	0.22	7460N	0.14	74160N	0.55		
7407N	0.22	7470N	0.28	74161N	0.55		
7408N	0.15	7472N	0.27	74162N	0.55		
7409N	0.15	7473N	0.28	74163N	0.55		
7410N	0.12	7474N	0.28	74164N	0.55		
7411N	0.18	7475N	0.35	74165N	0.55		
7412N	0.19	7476N	0.30	74166N	0.70		
7413N	0.27	7480N	0.26	74167N	1.25		
7414N	0.51	7481N	0.20	74170N	1.25		
7416N	0.27	7482N	0.75	74173N	1.10		
7417N	0.27	7485N	0.75	74174N	0.75		
7420N	0.13	7486N	0.24	74175N	0.75		
7421N	0.28	7489N	1.05	74176N	0.75		
7423N	0.22	7490N	0.30	74177N	0.75		
7425N	0.22	7491N	0.55	74178N	0.90		
7426N	0.22	7492N	0.35	74179N	1.35		
7427N	0.22	7493N	0.35	74180N	0.75		
7430N	0.13	7494N	0.70	74181N	1.22		
7432N	0.23	7495N	0.60	74182N	0.70		
7437N	0.22	7496N	0.45	74184N	1.20		
7438N	0.22	7497N	1.40	74185N	1.20		
7440N	0.14	74100	1.10	74188N	3.00		
7441N	0.54	74104	0.62	74190N	0.55		
7442N	0.42	74105	0.62	74191N	0.55		
7443N	0.62	74107	0.26	74192N	0.55		
7444N	0.62	74109N	0.35	74193N	0.55		
7445N	0.62	74110N	0.54	74194N	0.55		
7446N	0.62	74111N	0.68	74195N	0.55		
		74112N	1.70	74196N	0.55		
		74116N	1.98	74197N	0.55		
		74118N	0.85	74198N	0.85		
		74119N	1.20	74199N	1.00		
		74120N	0.95	74221N	1.00		
		74121N	0.34	74246N	1.50		
		74122N	0.34	74247N	1.51		
		74123N	0.40	74248N	1.89		
		74125N	0.40	74249N	0.11		
		74126N	0.40	74251N	1.05		
		74128N	0.65	74265N	0.66		
		74132N	0.50	74273N	2.67		
		74136N	0.65	74278N	2.49		
		74141N	0.45	74279N	0.89		
		74142N	1.85	74283N	1.30		
		74143N	2.50	74284N	3.50		
		74144N	2.50	74285N	3.50		
		74145N	0.75	74290N	1.00		
		74147N	1.50	74293N	1.05		
		74148N	1.09	74297N	2.36		
		74150N	0.79	74298N	1.85		
		74151N	0.55	74365N	0.85		

74LSN

74LS00N	0.10	74LS109N	0.20	74LS248N	1.35
74LS01N	0.10	74LS112N	0.20	74LS249N	1.35
74LS02N	0.11	74SL113N	0.20	74LS251N	0.35
74LS03N	0.11	74LS114N	0.19	74LS253N	0.35
74LS04N	0.14	74LS122N	0.35	74LS257N	0.40
74LS05N	0.13	74LS123N	0.35	74LS258N	0.37
74LS08N	0.12	74LS124N	1.80	74LS259N	0.60
74LS09N	0.12	74LS125N	0.24	74LS260N	0.50
74LS10N	0.12	74LS126N	0.24	74LS266N	0.22
74LS11N	0.12	74LS132N	0.42	74LS273N	0.70
74LS12N	0.12	74LS133N	0.24	74LS275N	3.20
74LS13N	0.20	74LS136N	0.20	74LS279N	0.35
74LS14N	0.30	74LS138N	0.30	74LS280N	2.50
74LS15N	0.12	74LS139N	0.30	74LS283N	0.42
74LS20N	0.12	74LS145N	1.20	74LS290N	0.50
74LS21N	0.12	74LS151N	0.30	74LS293N	0.40
74LS22N	0.12	74LS153N	0.27	74LS295N	1.50
74LS26N	0.14	74LS154N	0.99	74LS298N	0.76
74LS27N	0.12	74LS155N	0.35	74LS365N	0.32
74LS28N	0.15	74LS156N	0.37	74LS366N	0.34
74LS30N	0.12	74LS157N	0.30	74LS367N	0.32
74LS32N	0.12	74LS158N	0.30	74LS368N	0.35
74LS33N	0.15	74LS160N	0.37	74LS373N	0.70
74LS37N	0.15	74LS161N	0.37	74LS374N	0.70
74LS38N	0.14	74LS162N	0.37	74LS375N	0.40
74LS40N	0.13	74LS163N	0.37	74LS377N	0.85
74LS42N	0.30	74LS164N	0.40	74LS378N	0.65
74LS47N	0.35	74LS165N	0.60	74LS379N	0.60
74LS48N	0.45	74LS166N	0.80	74LS384N	2.50
74LS49N	0.55	74LS168N	0.70	74LS385N	2.05
74LS51N	0.13	74LS169N	0.85	74LS386N	0.29
74LS54N	0.14	74LS170N	0.90	74LS390N	0.68
74LS55N	0.14	74LS173N	0.60	74LS393N	0.61
74LS73N	0.21	74LS174N	0.40	74LS395N	2.10
74LS74N	0.16	74LS175N	0.40	74LS396N	1.99
74LS75N	0.22	74LS181N	1.05	74LS398N	2.75
74LS76N	0.20	74LS183N	1.75	74LS399N	2.30
74LS78N	0.19	74LS189N	1.28	74LS445N	1.40
74LS83N	0.40	74LS190N	0.45	74LS447N	1.95
74LS85N	0.60	74LS191N	0.45	74LS490N	1.10
74LS86N	0.14	74LS192N	0.45	74LS668N	1.05
74LS90N	0.32	74LS193N	0.42	74LS669N	1.05
74LS91N	0.28	74LS194N	0.35	74LS670N	1.70
74LS92N	0.31	74LS195N	0.35		
74LS93N	0.31	74LS196N	0.55		
74LS95N	0.40	74LS197N	0.80		
74LS96N	1.20	74LS200N	3.40		
74LS107N	0.25	74LS202N	3.45		
		74LS221N	0.50		
		74LS240N	0.80		
		74LS241N	0.80		
		74LS242N	0.70		
		74LS243N	0.70		
		74LS244N	0.80		
		74LS245N	0.80		
		74LS247N	1.35		

RAM

2102	1.70
2112	3.40
2114/2	1.49
4027	5.78
4116/2	1.59
4116/3	1.49
4864P	12.50
6116P-3	9.00
6116P-4	11.25
8264	12.50

74CXX

74C00	0.20
74C02	0.20
74C04	0.20
74C08	0.20
74C10	0.20
74C14	0.55
74C20	0.20
74C30	0.20
74C32	0.20
74C42	0.80
74C48	1.03
74C73	0.50
74C74	0.50
74C76	0.48
74C83	0.98
74C85	0.98
74C86	0.26
74C89	2.68
74C90	0.80
74C93	0.80
74C95	0.94
74C107	0.48
74C151	1.52
74C154	2.26
74C157	1.52
74C160	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

Processors 8080 series

8080AFC/2	£7.30
8212	2.30
8214	3.50
8216	1.95
8224	3.50
8251	6.21
8255	5.40

6800/6809

6800P	£2.90
68A00	4.25
68B00	4.65
6802	3.50
6809	£8.75
6810	1.25
68A10	1.85
68B10	2.04
6820	1.95
6821	1.25
68A21	2.10
68B21	2.25
6840	4.25
68A40	4.55
68B40	4.65
6850	1.50
68B50	2.13
6852	2.95
68A52	2.75
68B52	2.95
68488	5.25

Z80 series

Z80A	£3.75
Z80ADRT	7.50
Z80APIO	3.50
Z80ASIO/1	11.00
Z80ASIO/2	11.00
Z80ASIO/9	8.85
Z80CTC	4.00
Z80ACTC	4.50
Z8001	65.00

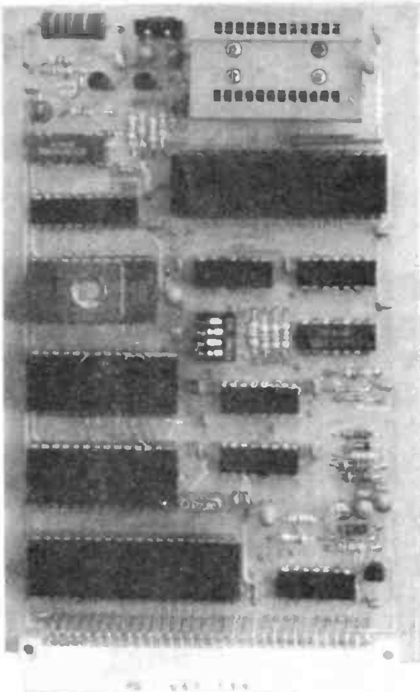
PROM

2708	2.00
2716	£3.00
2532	0A
2732	£4.00

TELEPHONE (STD 0277) 230909 TELEX 995194 AMBIT G POSTCODE CM14 4SG

AMBIT international 200 North Service Road, Brentwood, Essex

R&EWPROJECTPACKSR&EWPROJECTPACKSR&EWPRO



Z-8 BASIC DEVELOPMENT SYSTEM – The Computer

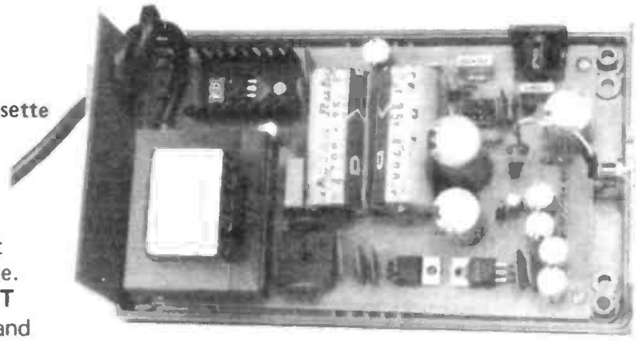
Complete Kit including all components, indirect edge connector socket, ZIF Programming Socket and 'Utility' EPROM.
£140 + VAT

Ready-Built Unit tested, complete with all connectors and 'Utility' EPROM. Delivery approx. 2 weeks. **£160 + VAT**

PCB only: fully plated through holes + solder resist screens and component overlay. **£15 + VAT**

RADIO & ELECTRONICS WORLD

PSU and Cassette Interface.



Complete Kit including Case.
£26.50 + VAT
Ready-Built and Tested. **£33.00 + VAT**
PCB only. **£3.00 + VAT**

Z-8 Kit and PSU together; Ready-Built and Tested incuding Interconnect Cable.
£185 + VAT

Send your order to us at:
200, North Service Road, Brentwood.
Essex CM14 4SG
Postage and Packing 50p per order.

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

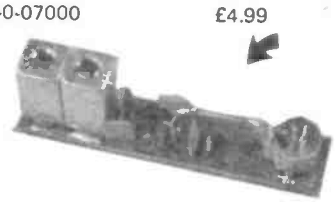
ECTPACKSR&EWPROJECTPACKSR&EWPROJECTPACKS

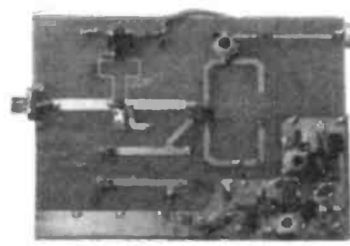
R&EWPROJECTPACKSR&EWPROJECTPACKSR&EWPRO

70cm PRE AMP

Low Noise 70cm Pre-Amp.
PCB and all Components.

Stock No.	Price inc. VAT
40-07000	£4.99





23cm CONVERTER

Low-noise Microwave Converter with 2m or 10m output. PCB and all components (no connectors). Xtal for 2 or 10m output.

Stock No		Price inc. VAT
40-23144	(2m)	£19.45
40-23028	(10m)	£19.45

RADIO & ELECTRONICS WORLD

Postage and Packing 50p per order.
Please allow 21 days for delivery.
200, North Service Road,
Brentwood,
Essex CM14 4SG

CONVERTER PSU

Versatile adjustable voltage power supply.
Spec:

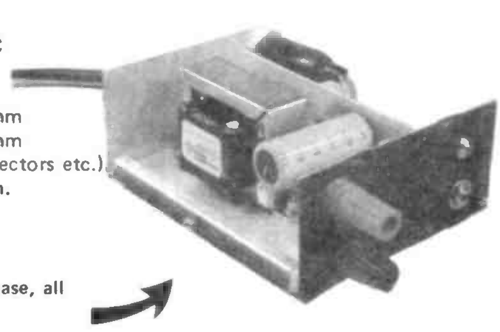
Manis input	220 - 250V AC
Output Voltage	1.25 to 14V DC
Output Current	500mA Max.
Regulation	Better than 1%
Size: PCB unit	45 x 40 x 100mm
Boxed unit	93 x 45 x 110mm (excluding connectors etc.)

PCB and all Components thereon.

Stock No.	Price inc. VAT
40-00140	**£8.58**

PCB, all components, undrilled case, all connectors, switch etc.

Stock No.	Price inc. VAT
40-00141	**£13.47**



ECTPACKSR&EWPROJECTPACKSR&EWPROJECTPACKS

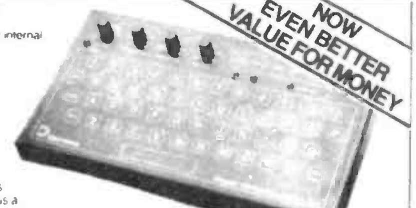
DATONG PRODUCTS

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)

NOW EVEN BETTER VALUE FOR MONEY



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

Model FL2

Model PC1

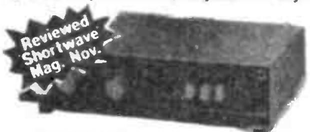
Model ASP

Reviewed '73 Mag. July'

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?

Reviewed Shortwave Mag. Nov.

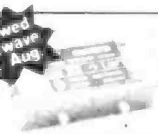


Model PC1

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.

Reviewed Shortwave Mag. Aug.



Model DC144/28

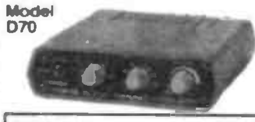
YET ANOTHER 2 METRE CONVERTER?

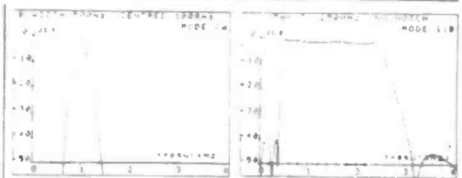
Yes but not just another. Model DC144/28 is designed to overcome the overload and spurious signal problems experienced by conventional converters. It uses a Schottky diode balanced mixer with about 7dbm of local oscillator drive. This, coupled with a 3SK88 r.f. amplifier, gives an excellent combination 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

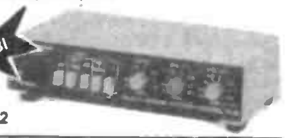
Have a look at these curves (and the others in our data sheet) and you will see why a U.S. reviewer commented that the FL2 is "incredible – it's like having a tunable crystal filter."*

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.

Reviewed CQ-DL Feb. 1981



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

DATONG ELECTRONICS LIMITED

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

46 for further details

NEWS BACKGROUND

Beware of the Technologist...

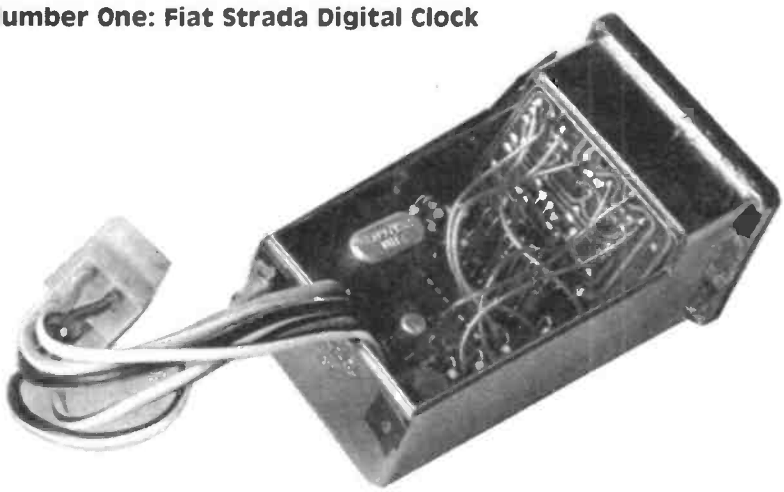
Forays by this column into the murky realms where technology and the layperson interface look like confirming every technologists' (that's you and me) fears that the public and its media are quite incapable of coming to terms with anything more complicated than changing a lightbulb.

Electronic Engineers are getting a bit of a reputation for being very tetchy about their status in a country largely owned and operated by products of the 'Arts'-oriented educational system. This concern occasionally borders on the paranoid, but as technology plunges headlong into the eighties, it is important that the issues surrounding the appreciation of 'science' by these persons of influence (who doubtless regard themselves as being somewhat above such mundane matters) are not clouded by pedantic squabbles amongst technologists.

There is more than a grain of truth in the feeling that scientists probably don't have the time to play at politics and the machinations of manipulating the 'system'. As soon as an engineer is elevated to managerial status, he quickly loses touch with the subject, unless he is particularly fortunate in having a competent supporting infrastructure that can handle the mechanics of management, leaving him to get on with the decisions and engineering.

Without further griping, we bring you two examples of where the technology is obviously way beyond the ken of those seeking to market it...

Case Number One: Fiat Strada Digital Clock



The simple four digit timepiece that resides in the fascia of the Fiat Strada costs £48.34. We'll leave a moment for that to sink in.

This particular fact came to light as a result of a 'friend' (who owns one of the said motor cars) being faced with a 3 digit version, where the leading digit was garbled. Garages are not famous for their perspicacity in matters electronic (many is the time the writer has been charged for a new set of points for his contactless ignition system) - and replacement was immediately advised as being the only course of action.

Well, at one off prices, the parts to make the clock (with the exception of the plastic mouldings, which are reusable anyway), cost about £7. At OEM price levels, it's about £3.30. No particularly high grade parts have been used - even the crystal is in a low cost epoxy sealed case.

Upon examination, the failure appears to stem from the clock IC (MM5378AA) causing one of the digit drive outputs to remain permanently on. Apart from the fact that such an arbitrary failure of a semiconductor part is rare anyway, the car was less than 10,000 miles old (although over 12 months old).

It is hard to imagine a possible failure mode instigated by the owner of the car, but when approached to verify the seemingly enormous bill for the job, Fiat UK remain adamant that this is the rate for the job.

"Swings and Roundabouts" were cited as one of the justifications for this high charge, so if any Fiat owners reading this should have cause to be pleasantly surprised by gaining on the 'roundabouts', we would be pleased to hear from them. Similarly, anyone being 'swung' by the big ends is invited to relate their tale.

Well, £48 probably is the rate for the job, but what a salutary lesson this is to us all concerning the basis on which the motor trade operates. We can immediately point to at least five multifunction clock modules that are available within the electronics business that retail one-off for less than £10.

Technology V. The People (Round Two)

Nikon

CAUTION

For flash photography, it is recommended that you use a Nikon dedicated electronic flash unit which operates with a low-voltage current. Use of any other flash which operates at high voltages may damage the camera's circuitry. Any damage caused by such use is not covered by the Nikon Warranty.

After one of the editorial Nikon 35mm cameras was half-inched, we bought a replacement in the shape of the new all electronic F3. This masterpiece of Japanese engineering came accompanied by a little piece of paper that fell out of the bag, bearing a warning that if any flashgun other than a Nikon speedlight (which, it is claimed, 'operates with a low-voltage current') was to be used, then be it on the head of the user if the F3 went bang. Well, our thief was inconsiderate enough to leave a Vivitar Autothyristor flashgun behind.

What, pray tell, is a 'low voltage current' anyway? Well, we measured the voltage at the output of the Vivitar and found it to be 270V. Not exactly low voltage - or was it? A phone call to Nikon revealed that the service department didn't know what constituted a 'low-voltage current' either - only that Nikon flashguns were OK - and they couldn't possibly comment on the use of any other flashgun with Nikon equipment - even when the voltage was supplied to them.

A subsequent letter from them was similarly non-commital, and contained the wonderful lines:

"Obviously cameras which contain a significant amount of electronics are almost certain to be damaged when

"I SHOULD HAVE KNOWN..'LOW VOLTAGE FLASH' NOT TO BE USED NEAR HIGH VOLTAGE BLONDE'..."

consistently subjected to such high voltages (300V), and so we must discourage their use."

There's no 'obviously' about it. Whilst some people at Nikon UK may well be having trouble getting past flash powder and into the 'silicon chip revolution', those of us who have coughed up the £70 odd for a flashgun find this type of gobbledegook warning a shade insulting and unhelpful. A brief glance through the sales literature makes no mention of the incompatibility of various flashguns, although it does make mention of various flash unit couplers and adapters for other flashguns.

It's a bit like Rolls-Royce advising owners only to turn the steering wheel whilst wearing a pair of Tibetan antelope-hide driving gloves - or they would not be held responsible for the consequences.

Well, we took fright, not wishing to risk an extremely expensive camera, and bought a Nikon-approved flashgun. At £65, this is a relatively cheap Nikon accessory - and as it happens, the superb results available via the 'through the lens' feedback path are far more consistent than have ever been possible using flashguns with simple reflective sensors.

However, it further highlights the need to spread a rudimentary appreciation of electronics amongst those actually responsible for supplying the products of the technology. Perhaps **R&EW** should instigate a 'rent-a-boffin' agency to supply members of the 'cognescenti' to organizations in dire need of their help.

We have a suspicion that there are enough instances like these to fill a book or two, and we will take great delight in relating the more classic examples in the hope that we might encourage some organizations into taking the appreciation of electronic technology a good deal more seriously.

British Aerospace get the rocket

1986 is at last slated for the first European DBS (see the feature elsewhere), and your own, your very own BA got the thick end of a thick contract worth over £100m to develop the works. The Arianne launcher is scheduled to place the machine in geostationary orbit, so let's hope that BA install garlic hardened devices in all critical locations...

"..COME ALONG, PERKINS, MEASURE IVAN'S INSIDE LEG..."

It's an ill wind...

President Reagan's roundabout knuckle wrapping exercising over the Polish situation once again offers a golden opportunity for European manufacturers of high technology products to step in and fill the breach. In view of the rumours that the Russians at least had the sensitivity to dress their troops in Polish uniforms this time, it seems only fair that the beleagured British clothing industry should be taking the measurements of a few Soviet divisions with a view to fitting them up with the uniforms of other nations.

"...AND IT'S 99% ACCURATE, PROVIDING YOU CAN TALK LIKE DONALD DUCK..."

Walls (and Computers) have ears

Anaheim California, home of Disneyworld, is also home to Interstate Electronics of California, who now offer a user programmable $100 dual LSI solution (1 000+ pricing) that will recognize a vocabulary of up to 100 words - with 99% accuracy.

Toshiba have been playing with consumer applications of their version of speech recognition technology for a while now, and this seems to be a way in for anyone with $100,000 to spend. Perhaps this offers an opportunity for Mrs. Whitehouse and her cohorts to monitor the output of all broadcast media simultaneously?

Philips goes GAA

Galium-Aluminium-Arsenide is the latest technology in lasar semiconductors to emerge from the Elcoma division of Philips.

The investment already made by the Dutch razor-to-lasar manufacturer in a series of products based on consumer applications of laser technology has produced a device that can even blast a 50mW pulse for the few nanoseconds it takes to record: a step towards the practical terabit optical data storage system threatened - and scoffed at - not so long ago.

Stereo on VHS?

Now that Japan and Germany are well into the concept of stereo TV, perhaps it is worth mentioning that many Japanese video recorders already include a stereo recording facility. One JVC model in the US is now offering the facility for pre-recorded tapes, and one supplier of such tapes is busily producing stereo VHS NTSC format cassettes, to be at the fore of the boom.

It is to be hoped that the general sound quality is being improved along the way, since most VCRs seem to rely upon the whirring of the heliscan head to help mask the fact that audio quality is in a class with a £5 transistor radio.

CB Slumping - Already!

After a commencement that can only be described as 'hasty', the state of the CB market is already beginning to slump. In fact, some sources claim that the expected grand boom never materialised at all.

The state of the CB market is reviewed in the next issue, and some salutary tales about the appalling quality and generally unseemly behaviour of the market will emerge.

And oh yes, tales of the impending legalization of AM FCC standard CB radio may be dismissed as circumstantial rumour and poppycock (C.R.A.P.). With the legalization of CB, it seems only reasonable to expect all those happy 'when will it be legal?' rumour mongers to be lost for something to do.

Told you so!

RCA reports only 30% of targeted sales for its US standard videodisk system during 1981. However, 90% of the 3m discs predicted have been sold (averaging at 18 per viewer). VCRs and satellite broadcasting have undoubtedly been the major cause of grief for RCA's plans - a situation which is not likely to change in RCA's favour.

NEWS BACKGROUND

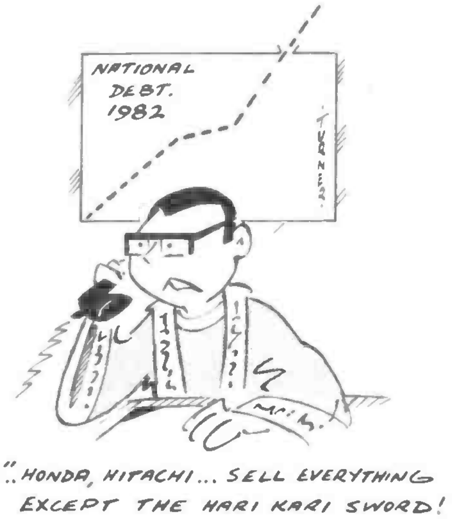
It's not cricket

In what can only be described as the opportunist publicity stunt of the year, a CB importer has offered to supply a free CB radio to each member of the English test team in India - if they win. Well, this got a plug for their name from one or two other journals, but they will have to do better than that if they want to see their names in **R&EW**.

It had to happen

AVX Ceramics - who hail from quaintly named 'Great Neck' in New York State (USA) - have got a step closer to the problems of keeping supply line noise out of dynamic memory systems. They can now place a chip capacitor on the lead frame, thus cutting out the inductance of the power leads from header to board.

All that now remains is for the ceramic package to be made from ferrite, and computer engineers will at last be able to keep their machine's thoughts to themselves.



Another one up for the Japs

The Japanese national debt is now bigger and better than ours. Strange though this may seem in view of their startling industrial eminence and apparent prosperity, it seems that the Japanese economic situation is quite critical. More news shortly, persons wishing to attend the liquidation sale should apply to Mr Zenko Suzuki, Tokyo, Japan.

The Bad News

ICL lost £49.8m last year, and spent £78.1m on plant closures last year. ICL chairman, Christopher Laidlaw further predicts a 'negative cash flow situation' will prevail for a while longer.

The Good News

By contrast to the above, the Midas touch seems untarnished at Plessey as the group edges towards a £100m profit on around £1000m turnover. (Not bad going in this day and age).

Ferranti produced £9.4m from a £143m turnover in the 6 months to September 30th 1981 - and the **R&EW** tea fund dipped from £1.86 to 34p, after rumours of a shortage on world sugar markets.

■ R & EW

ANY MAKE-UP OR COPY QUERIES CONTACT BOB KENNEDY 01-531 7621

Data File

No. 4

In this edition of 'Data File', Ray Marston shows how to use voltage comparator and 'window' circuits in practical applications.

THERE ARE MANY OCCASIONS in electronics when it is necessary to have a circuit that abruptly changes its output state when an input voltage, or a quantity that can be represented by a voltage (such as a current, resistance, temperature of light-level, etc.), goes above or below a pre-set reference value. Circuits that perform this basic function are known as voltage comparators.

Voltage comparators have plenty of practical applications apart from the obvious ones of over and under-voltage switches. They can readily be made to activate relays, alarms, and other mechanisms when load currents or temperatures or light levels go outside of, or come within, pre-set limits, and have a stack of domestic and industrial uses. We'll look at some practical circuits in the next few pages.

BASIC VOLTAGE COMPARATOR CIRCUITS.

The easiest way to make a voltage comparator is to use a CA3140 op-amp in one or other of the basic configurations shown in *Figs 1 and 2.* The 3140 op-amp has a typical basic (open-loop) low frequency voltage gain of about 100 dB, so its output can be shifted from the high to the low state (or vice versa) by shifting the input voltage a mere 100 uV or so above or below the reference voltage value. This particular op-amp can be powered from either single ended or split supply rails and provides an output that typically swings to within a couple of volts of its positive rail value or to within a few millivolts of its negative (or zero) supply rail value: Unlike many other op-amps, the 3140 can accept input voltages all the way down to the negative rail value.

The operation of the *Fig 1* circuit is very simple. A fixed reference voltage (Vref) is generated via R2 - ZD1 and is applied directly to the non-inverting input terminal (pin 3) of the op-amp, and the test or input voltage is applied to the inverting input terminal (pin 2) via current limiting resistor R1. When Vin is below Vref the op-amp output is driven high (to positive saturation), but when Vin is above Vref the output is driven low (to negative saturation) as shown in the diagram. The action of the circuit can be reversed, so that the op-amp output is normally low but goes high when Vin exceeds Vref, by simply transposing the pin 2 and pin 3 connections of the op-amp, as shown in *Fig 2.*

There are a few points worth noting about the basic single-supply *Fig 1* and *Fig 2* 3140 voltage comparator circuits. The first point is that the 'reference' voltage can be given any value from zero up to within 2 volts of the positive supply rail value, so either circuit can be made to trigger at any desired value between these limits by simply interposing a pre-set pot between a fixed voltage-reference source and the 'Vref' pin of the op-amp.

The second point to note is that the 'input' pin of the op-amp must be constrained to the range from zero voltage up to within 2 volts below the positive supply rail value. Thus, if you want the circuit to trigger at some high value of input voltage, this action can be obtained by feeding the input voltage to a simple potential divider before it reaches the actual input of the op-amp.

The final point to note about the basic voltage comparator circuits is that they give a non-regenerative switching action, so that the op-amp is driven into the linear (non-saturated) mode when the 'input' voltage is within a few tens of microvolts of Vref, and under this circumstance the op-amp output generates lots of spurious noise. In some applications this type of action may be unacceptable, in which case the problem can be overcome

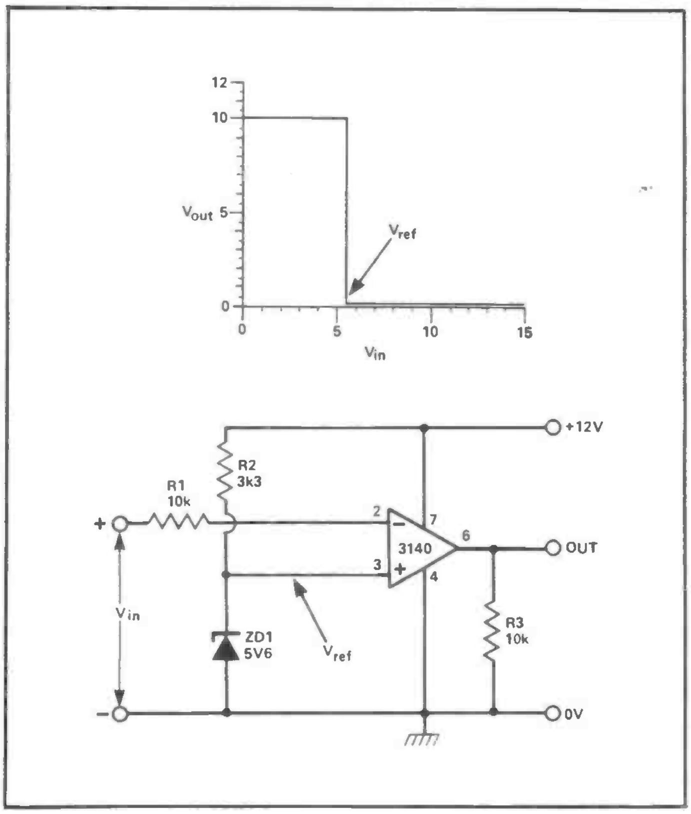


Figure 1: Basic op-amp comparator that functions as an under-voltage switch: The output is high when Vin is below Vref.

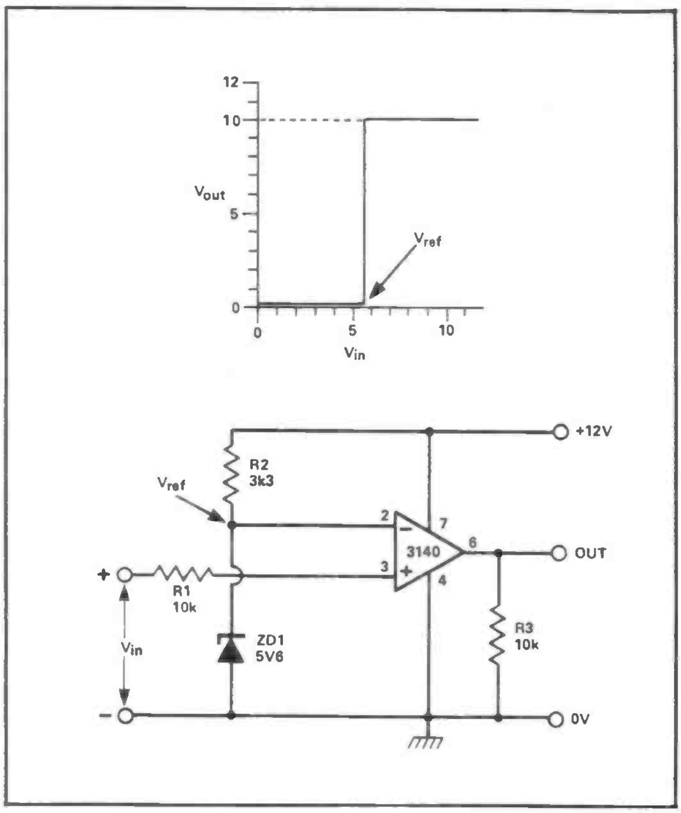


Figure 2: Alternative op-amp voltage comparator that functions as an over-voltage switch: The output is high when Vin is above Vref. ▶

by feeding a small part of the op-amp output voltage back to the non-inverting input terminal, so that a regenerative switching action is obtained: The feedback signal introduces a degree of hysteresis in the voltage switching levels, the degree of hysteresis being directly proportional to the amount of feedback.

SPECIAL VOLTAGE COMPARATOR CIRCUITS.

Figures 3 to 7 show how the three points mentioned above can be put to practical use to make various types of 'special' voltage comparator circuits; plenty of other variations are possible.

Figures 3 and 4 show how the basic comparator circuits can be modified to give variable-voltage switching by using a pre-set pot (RPS1) to set the desired 'reference' or trigger voltage at any value in the range 0-5V6, and to give regenerative ('noiseless') switching by feeding part of the op-amp output back to the non-inverting terminal via R3; note in the *Fig 4* circuit that the input terminal is terminated via R5, to ensure controlled hysteresis.

Figures 5 and 6 show examples of how the circuits can be modified to give high-value variable-voltage (0 - 130 V) triggering by interposing a simple potential divider (R2-R3) between the input signal and the input of the op-amp: The *Fig 5* circuit gives non-regenerative switching, while the *Fig 6* circuit gives regenerative switching.

Finally, *Fig 7* shows how the comparator can be used as a sensitive audio sine-square converter that can operate from input signal amplitudes as low as 10 mV peak-to-peak at 1 kHz and which produces decent square wave outputs from sine wave inputs with frequencies up to about 15 kHz. Input impedance is 100 k.

The operating theory of the *Fig 7* circuit is simple. Voltage divider R1-R2 and capacitor C2 apply a decoupled reference voltage to pin 2 of the op-amp and an almost identical voltage is applied to signal-input pin 3 via isolating resistor R3. When a sine

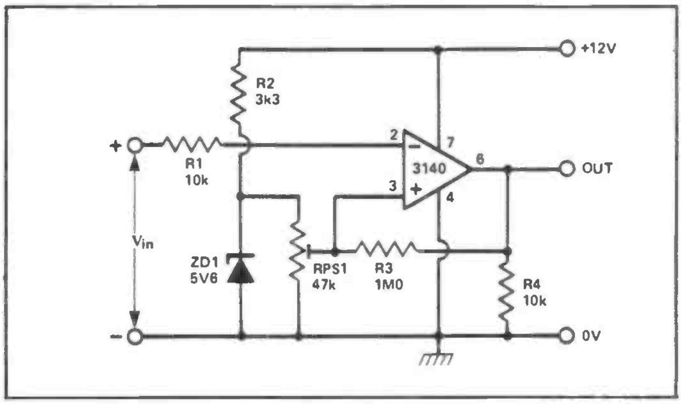


Figure 3: Variable under-voltage switch with regenerative feedback.

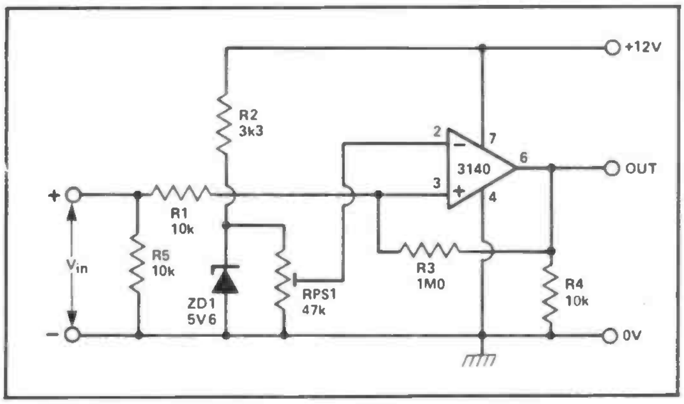


Figure 4: Variable over-voltage switch with regenerative feedback.

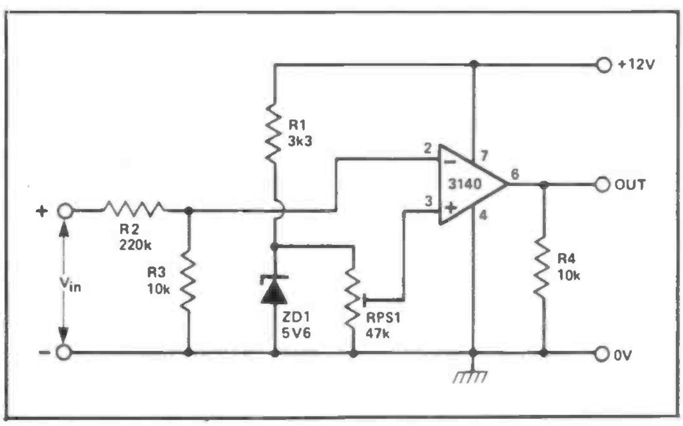


Figure 5: High-value (0-130 V) under-voltage switch.

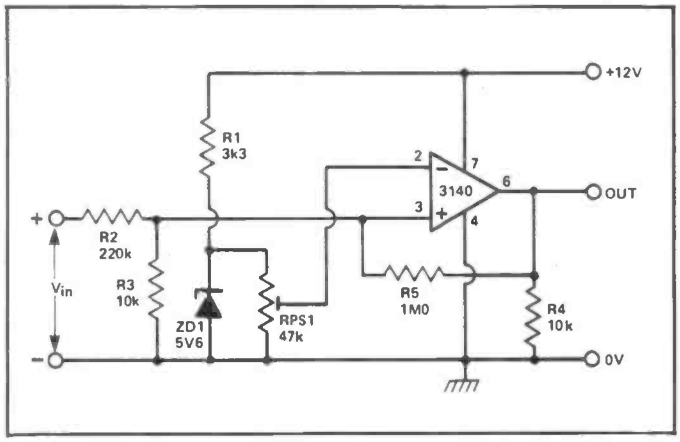


Figure 6: High-value (0-130 V) regenerative over-voltage switch.

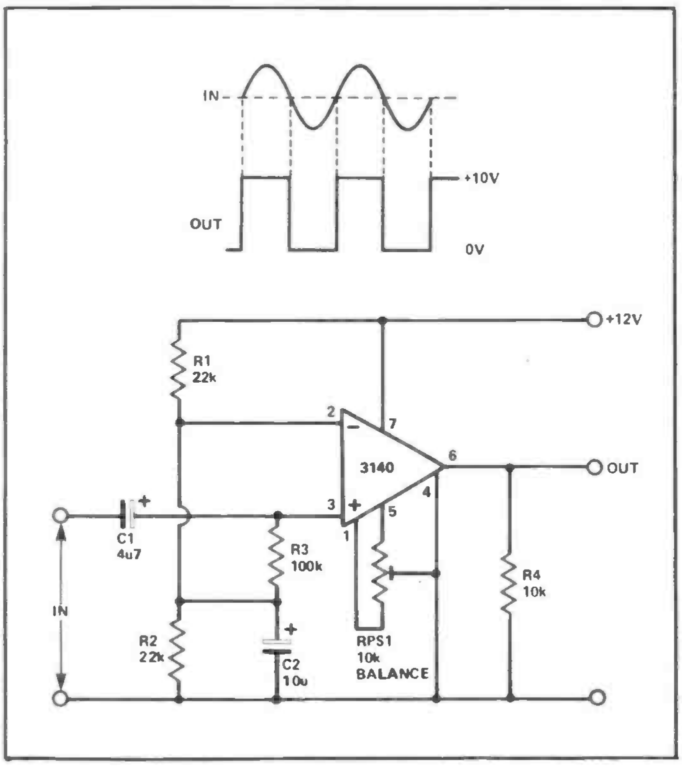


Figure 7: This sensitive sine-square converter needs only a few tens of mV of input signal and produces a decent square wave output up to about 15 kHz.

wave is fed to pin 3 via C1 it swings pin 3 about the pin 2 reference level, causing the op-amp output to transition at the 'zero voltage difference' cross-over points of the input waveform and produce a square wave output. Pre-set pot RPS1 is used to bias the op-amp so that its output is just pulled low with zero input signal applied, so that the circuit operates with maximum sensitivity and stability. Note that, because of the gain-bandwidth product characteristics of the op-amp, the circuit sensitivity decreases as the input frequency is increased.

WINDOW COMPARATORS.

The voltage comparator circuits that we've looked at so far give an output transition when the inputs go above or below a single reference voltage value. It's a fairly simple matter to interconnect a pair of voltage comparators so that an output transition is obtained when the inputs fall between, or go outside of, a PAIR of reference voltage levels. *Fig 8* shows the basic circuit configuration, which is generally known as a window comparator or discriminator.

The action of the *Fig 8* circuit is such that the output of the upper op-amp goes high when Vin exceeds the 6 volt V_U 'upper limit' reference value, and the output of the lower op-amp goes high when Vin falls below the 4 volts V_L 'lower limit' reference value. By feeding the outputs of the two op-amps to R4 via the D1-D2 diode OR gate we get the situation where the final output is low when Vin is within the limits set by V_U and V_L, but goes high whenever the input goes beyond these limits.

The action of the *Fig 8* circuit can be reversed, so that its output goes high only when the input voltage is within the 'window' limits, by taking the output signal via a simple inverter stage. Alternatively, the required action can be obtained by transposing the two reference voltages and taking the output via a diode AND gate, as shown in *Fig 9*.

Window discriminators can readily be made to activate from any parameter that can be turned into an analogue voltage, in the same way as a 'normal' voltage comparator can. They can thus be used to activate relays or alarms etc., whenever temperatures, voltages, currents or light levels, etc., go outside of pre-set limits. Let's look now at some examples of 'analogue-activated' comparator circuits.

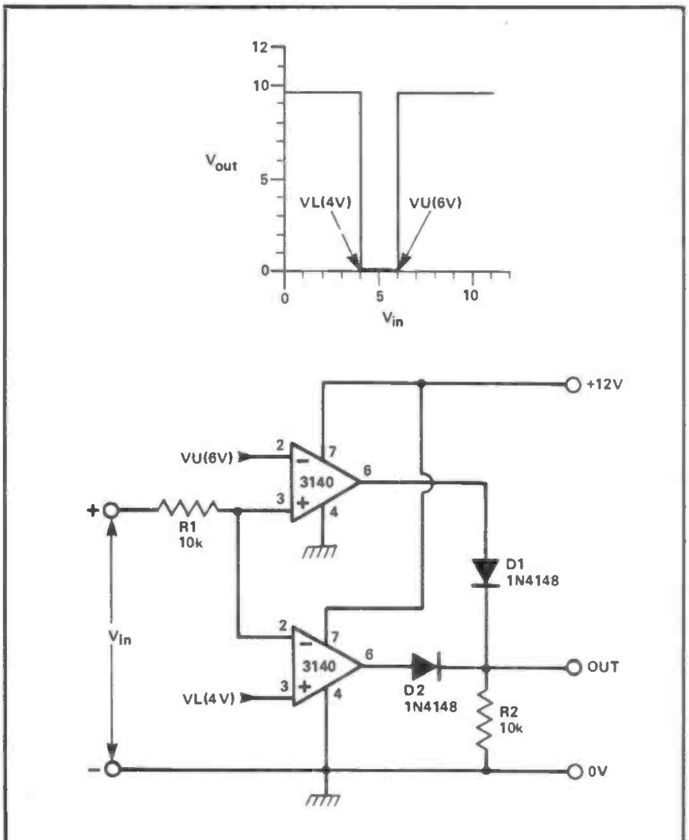


Figure 8: A voltage Window comparator or Discriminator. The output goes high when Vin goes outside of the V_L or V_U limits.

ANALOGUE—ACTIVATED COMPARATOR CIRCUITS.

Figure 10 shows how a comparator circuit can be made to function as an over-current switch that gives a high output when the load current exceeds a value pre-set via RPS1; the value of Rx is chosen so that it develops roughly 100 mV at the required trip current level. Thus a fixed half-supply 'reference' voltage is fed to pin 3 of the op-amp via R3-R4 and a similar but current-dependent voltage is fed to pin 2 via Rx-R1-RPS1-R2; in effect,

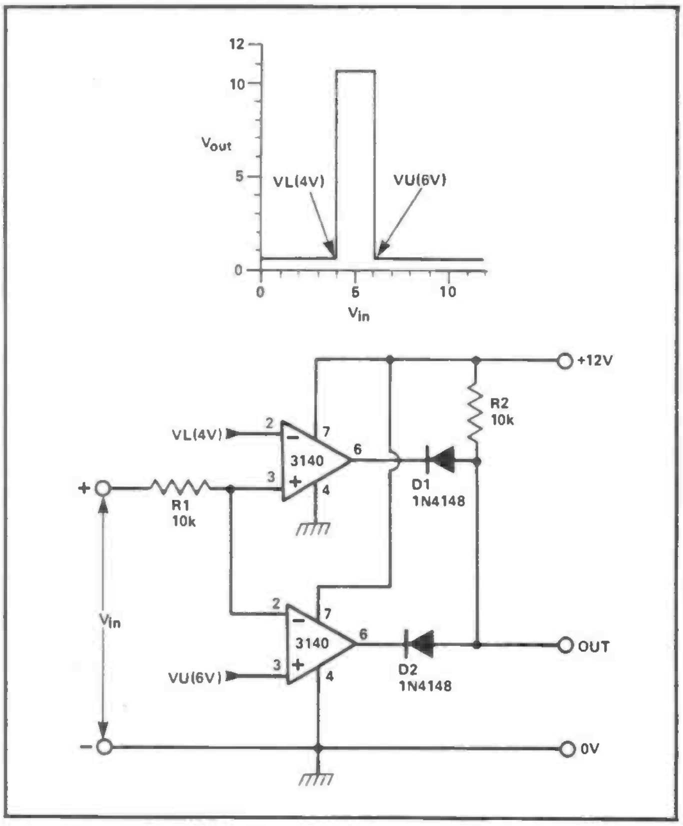


Figure 9: An alternative Window Discriminator in which the output goes high when Vin falls within the V_U and V_L limits.

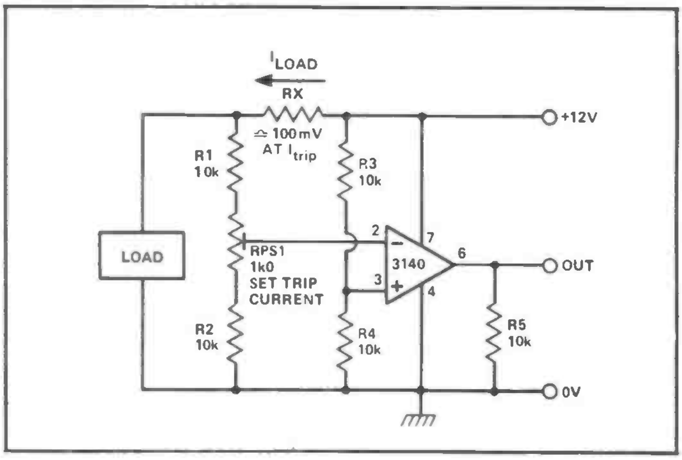


Figure 10: An over-current switch; the output goes high when the load current exceeds a pre-set value. The action can be reversed by transposing the pin 2 and 3 connections of the op-amp.

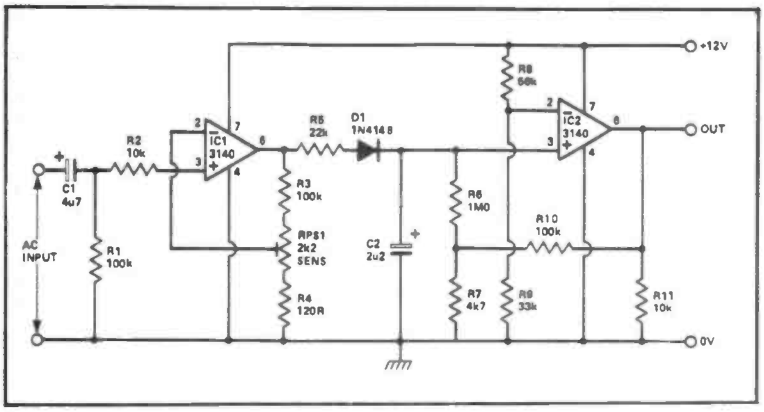


Figure 11: This AC over-voltage switch can be triggered by input signals in the range 6 mV to 111 mV peak.

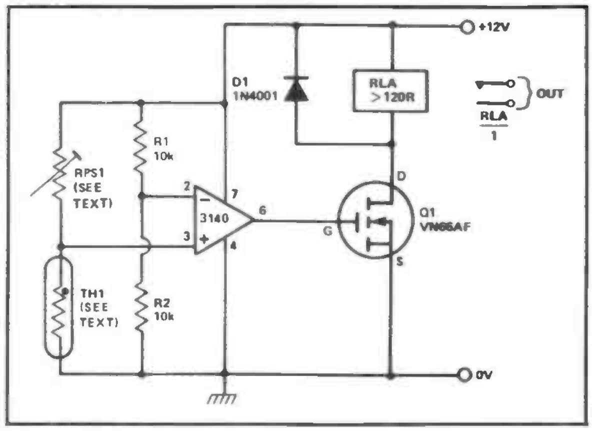


Figure 13: Precision under-temperature switch with VFET/relay output.

these two sets of components are configured as a Wheatstone bridge, with one side feeding pin 3 and the other side feeding pin 2, and the op-amp is used as a bridge-balance detector; consequently, the trip points of the circuit are not significantly influenced by supply voltage variations but are highly sensitive to load current variations.

Note that the action of the *Fig 10* circuit can be reversed, so that it functions as an undercurrent switch, by simply transposing the connection to pins 2 and 3 of the op-amp: The circuit can then be used as a lamp-or load-failure indicator in cars or in test gear, etc.

Figure 11 shows the circuit of a sensitive AC over-voltage switch, which gives a high output when the input signal exceeds a peak value (6 mV to111mV) pre-set via RPS1. The AC input signal is applied to the input of non-inverting variable gain amplifier IC1, which has its gain variable from x 45 to x 850 via RPS1. Note that the input of IC1 is DC-grounded via R1-R2, so the op-amp responds only to the positive half-cycles of the input signal. Consequently, the output of IC1 is an amplified but positively half-wave rectified version of the input signal, this signal is peak-detected via R5-D1-C2-R6-R7 and fed to the input of non-inverting voltage comparator IC2, which thus gives a positive output when the C2 voltage exceeds the value on the junction of R8-R9.

Figures 12 to 15 show a variety of ways of using comparator circuits as light - or temperature activated switches. All of these circuits use a light - or temperature-sensitive transducer (an LDR or cadmium sulphide photocell for light, or a negative-temperature-coefficient thermistor for temperature) as the sensing element and use the element as one arm of a Wheatstone bridge and use the op-amp as a simple bridge-balance detector, so that the 'trip' point of each circuit is independent of supply line variations: In all cases, the sensing element must have a resistance in the range 5k0 to 100k at the required 'trip' point and RPS1 is chosen to have the same resistance level.

The *Fig 12 to 15* circuits also show a variety of ways of using the output of the op-amp to activate a relay or to generate an acoustic alarm signal. Thus, the *Fig 12* over-temperature switch has a transistor-driven relay output, while the *Fig 13* under-temperature switch has a VFET-driven relay output. Similarly, the light-operated switch circuit of *Fig 14* generates a monotone alarm output signal in a small speaker, while the dark-operated switch of *Fig 15* generates a low power pulsed-tone signal in a small acoustic transducer.

MICRO-POWER OPERATION.

All of the 3140-based comparator circuits that we have looked at so far are continuously powered; they draw continuous currents of about 4 mA per op-amp and will thus flatten a PP9 supply battery in less than two days of continuous operation. These circuits are thus not well suited to battery operation in 'portable' applications. In practice, however, all of these circuits can easily be modified for long-life battery operation by using a micro-power 'sampling' technique; the principle can be explained with a simple example, as follows.

The *Fig 13* under-temperature switch circuit monitors temperature continuously and draws about 5 mA of quiescent current (with the relay off). In reality, however, temperature is a slowly-varying parameter and thus does not need to be monitored continuously; instead, it can be efficiently monitored by briefly 'inspecting' or 'sampling' it (by connecting the supply power and inspecting the op-amp output) only once every second or so; if the sample periods are very brief (say 300 uS) relative to the sampling interval (1 second), the MEAN current consumption of the monitor can be reduced by a factor equal to the interval/period ratio (e.g., by a factor of 3300) by using the sampling technique, so that, for example, the 5 mA consumption of the *Fig 13* circuit can be reduced to a MEAN value of a mere 1.6 uA, thus giving

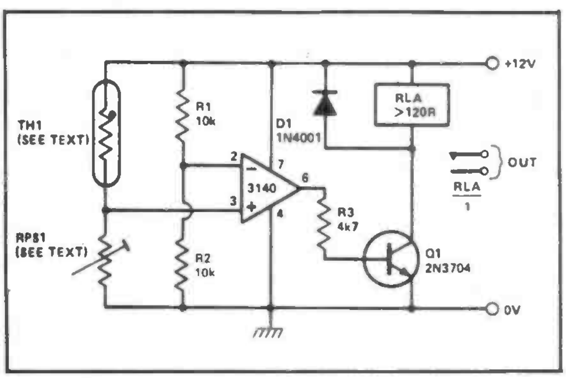


Figure 12: Precision over-temperature switch with transistor/relay output.

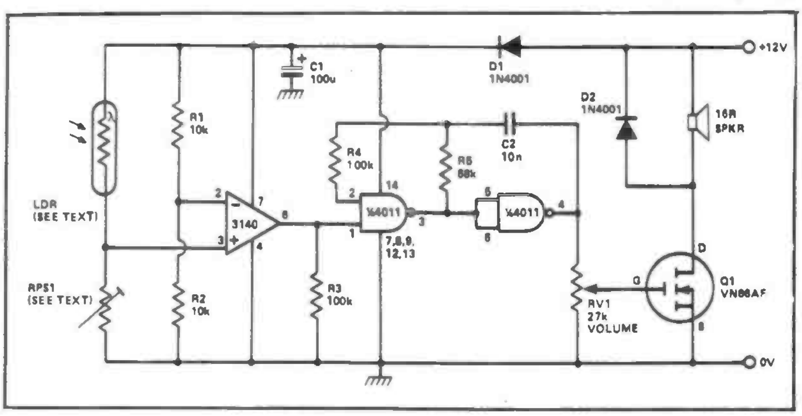


Figure 14: Light-operated switch with monotone alarm output.

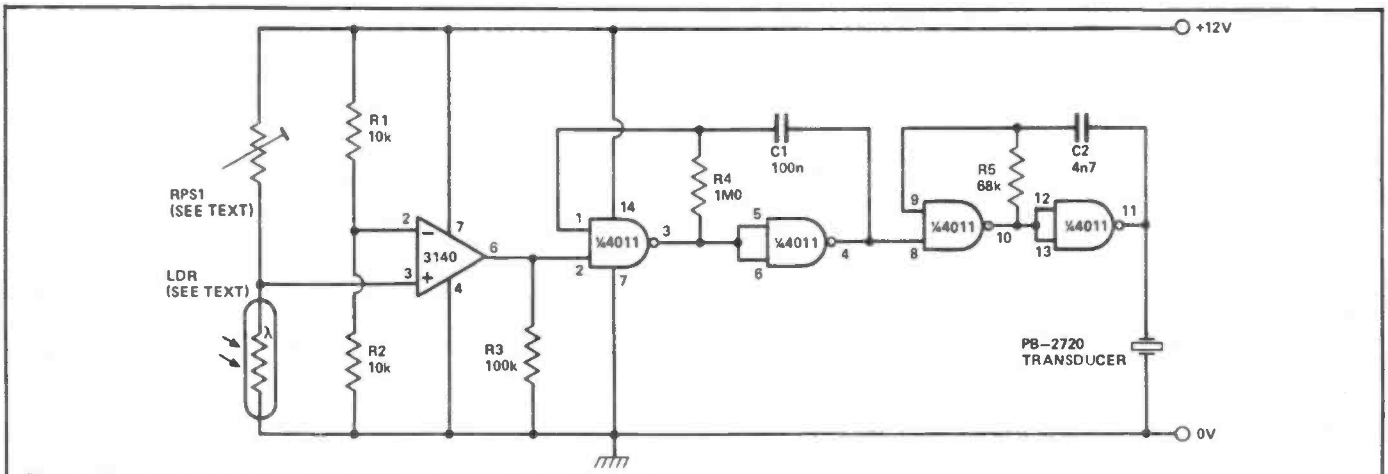


Figure 15: Dark-operated switch with low-power pulsed-tone output

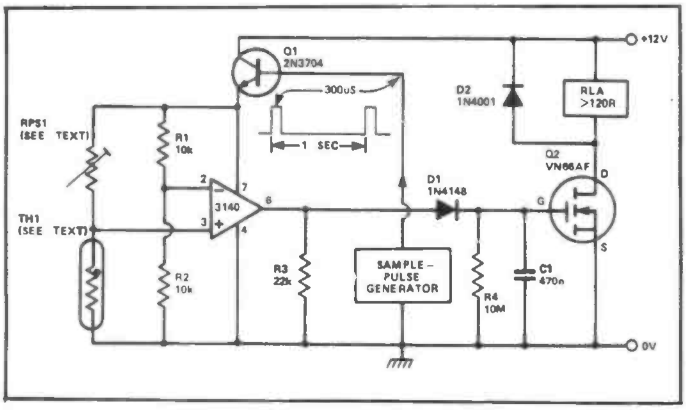


Figure 16: This micro-power or 'sampling' version of the *Fig 13* under-temperature switch draws a mean quiescent current of only a few micro-amps.

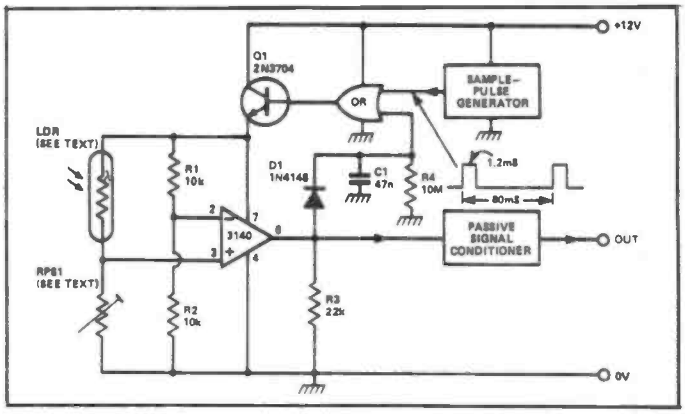


Figure 17: This coded-light-beam detector circuit uses a modified version of the micro-power 'sampling' technique.

years of continuous operation from a PP9 battery. The 'sampling' technique thus enables true micro-power monitor or comparator designs to be implemented.

Figure 16 shows the basic circuit of a 'micro-power' or sampling version of the *Fig 13* under-temperature switch, which operates the relay when the TH1 temperature falls below a pre-set value but which draws a mean quiescent current of only a few uA. The TH1-RPS1-R1-R2-IC1 monitor network is almost identical to that of *Fig 13*, but instead of being continuously powered it is powered via a 300 uS pulse just once every second via a sample-pulse generator and Q1. Note that the output if IC1 is fed to temporary 'memory' store R4-C1 via D1, and that the memory store operates the relay via VFET Q2.

Thus, if the TH1 temperature is outside of the trip level when the sample pulse arrives, IC1 output will remain low and no charge will be fed to C1 so Q2 and the relay will be off, but if the TH1 temperature is within the trip level when the sample pulse arrives the IC1 output will switch high for the duration of the pulse and thus rapidly charge C1 up via D1 and thence drive the relay on via Q2; the C1 charge will then easily hold the relay on until the arrival of the next sample pulse.

The *Fig 16* circuit, then, illustrates the basic principles of the micro-power sampling technique. In reality the sampling interval and pules-width used (and thus the reduction in mean power consumption) will depend on the specific application. If, for example, you wish to monitor transient changes in light or sound levels and know that these transients have minimum durations of 100 mS, you may have to use a 50 mS sampling interval and (say) a 500 uS sample pulse, in which case the mean consumption of your circuit will be reduced by a factor of 100.

In some cases you may have to slightly modify the operating principle of the sampling circuitry to give the desired micro-power operation. *Figure 17*, for example, shows how the principle may be adapted to make a coded-light-beam detector, in which the 'code' light signal is modulated at 1 kHz for a minimum durations of 100 mS. Thus, the sample-pulse generator is designed to produce a minimum pulse width of 1.2 mS so that it can 'capture' at least one full 1 kHz code cycle, and the sampling interval is set at 60 mS so that part of a tone burst will always be captured: The sampling circuitry thus gives a 50:1 reduction in monitor current consumption.

Thus, in the *Fig 17* circuit, the sample generator repeatedly feeds 1.2 mS 'inspection' pulses to the 3140 detector circuitry via one input of the OR gate and via Q1 to see if any trace of a coded signal exists: If no trace of a code signal is detected the output of the op-amp remains low and another sample pulse is applied 60 mS later, but if a trace of a code signal IS detected the output of the op-amp immediately switches high and the resulting pulse is 'captured' by C1 via D1 and applied to the remaining input of the OR gate, thereby temporarily applying FULL power to the 3140 circuitry so that the code signal can be properly inspected via the passive signal conditioning circuitry to see if it conforms to the specified 'code' characteristics.

Note that, for a sampling system to be truly efficient, the actual sample-pulse generator must itself consume negligible current and may thus have to be a non-standard design: We'll show some possible suitable circuits in next month's edition of 'Data File'. ■ R & EW

Your Reactions

	Circle No.		Circle No.
Immediately Applicable	258	**Not Applicable**	260
Useful & Informative	259	**Comments**	261

– FT290R–

MULTI MODE – MULTI ROLE
144MHz TRANSCEIVER
Only £249 including VAT

INC: 2 year guarantee
Free finance
Securicor delivery

SMC2.2C	NiCad cell, 2.2 A/hr, "C"	£2.70
NC11C	Slow Charger (180mA)	£8.05
SMC8C	Slow Charger (220mA)	£8.80
MMb 11	Mobile Mount	£22.25
CSC1	Soft carrying case	£3.45
FLC11	Leather heavy duty case	TBA
FL2010	Linear Amplifier 2m 10W	£64.40

MULTIMODE OPERATION
Never before possible from such a compact package, tru multimode - USB, LSB, CW & FM - operation for satellite or DX action, ragchewing on FM simplex, or even via a repeater (inbuilt ±600kHz shift and 1750Hz tone burst).

PROGRAMMABLE SYNTHESIZER
The optimum synthesizer steps for SSB/CW or FM operation by incorporating two synthesizer steps per mode: 100Hz or 1kHz per step on SSB and CW, and 12½kHz or 25kHz per step on FM. When changing modes from SSB/CW to FM, the FT290R is automatically set to the nearest standard channel on the start of scanning or tuning.

GENERAL
Frequency coverage:
144-146MHz
Modes of Operation:
SSB (USB,LSB), CW and FM
Synthesizer steps:
SSB/CW: 100Hz, 1kHz
FM: 12.5kHz, 25kHz
Power requirements:
8 x C size dry batteries
8 x C size Nicad cells
External: 8.5 - 15.2V DC
Memory backup: lithium cell
Current consumption:
70 mA on receive
800mA on transmit (2.5W RF, FM)
Dimensions:
58(H) x 150(W) x 195(D)mm, 1.3kg

DUAL VFO SYSTEM
The FT290R features a digitally synthesized dual VFO system which provides tremendous flexibility in day to day operation. For example, one VFO may be set up in the SSB portion of the band, and the other in the FM subband, for immediate QSY when changing modes.

TEN MEMORY CHANNELS
As many as ten frequencies may be stored into memory, for instant recall. The priority feature allows you to check a favourite frequency every few seconds, with automatic halting (FM mode) when the channel is clear or busy, as desired. Memory backup is provided by a built-in lithium cell, with an estimated lifetime of five years.

RECEIVER
Intermediate frequencies:
1st IF 10.81MHz (SSB & FM)
2nd IF 455kHz (FM only)
Sensitivity:
SSB/CW: 0.5uV for 20dB S/N
FM: 0.25uV for 12dB SINAD
Selectivity:
SSB/CW: 2.4kHz at 6dB down
4.1kHz at 60dB down
FM: 14kHz at 6dB down
25kHz at 60dB down
Image rejection:
Better than - 60dB
Audio output impedance:
8 ohms
Audio output:
1 watt @ 10% THD

CONVENIENT FEATURES
Among the many features adding to the convenience of the transceiver is a built-in telescoping antenna, a high-performance noise blanker, a high/low power switch, and a battery condition meter. A clarifier (off set tuning) allows you to follow unstable or Doppler-shifted signals.

LCD DISPLAY
A large, easy-to-read Liquid Crystal Display provides readout of the operating frequency, and an indication of a number of the control functions. The display highly readable under conditions of bright sunlight, is backed up by an illuminating lamp for night-time operation while portable or mobile.

TRANSMITTER
Power output:
2.5 watts at 12 volts
Carrier suppression:
Better than 40dB
Spurious radiation:
Better than 60dB
Unwanted sideband suppression:
Better than 40dB
Tone burst frequency:
1750Hz (other models)
Frequency response:
300-2700Hz (–6dB)
FM Deviation:
±5kHz (Max)
Microphone impedance:
600 ohms.

SOUTH MIDLAND COMMUNICATIONS LTD

S.M. House, Osborne Road, Totton, Southampton, SO4 4DN England.
Tel: Totton (0703) 867333. Telex: 477351 SMCOMM G. Telegram: "Aerial" Southampton.

Grimsby	Stoke-on-Trent	Leeds	Chesterfield	Woodhall Spa
SMC (Grimsby) 274A Freeman St Grimsby, Lincs	SMC (Stoke) 76 High St Talke Pits, Stoke	SMC (Leeds) 257 Otley Rd Leeds 16	SMC (Jack Tweedy) Ltd 102 High St New Whittington, Chesterfld	SMC (Jack Tweedy) Ltd 150 Horncastle Woodhall Spa, Lincs.
Grimsby (0472) 59388 9.30-6.00 Mon-Sat	Kidsgrove (07816) 72644 9.00-5.30 Mon-Sat	Leeds (0532) 782326 9.00-5.30 Mon-Sat	Chesterfield (0246) 453340 9.00-5.00 Tues-Sat	Woodhall Spa (0526) 52793 9.00-5.00 Tues-Sat

SMC AGENTS

Bangor	John	GI3KDR	(0247) 55162	Stourbridge	Brian	G3ZUL	(03843) 5917
Tandragee	Mervyn	GI3WWY	(0762) 840656	Redcar	Simon	G4EQS	(0642) 480808
Edinburgh	Jack	GM8GEC	(031665) 2420				
Buckley	Howarth	GW3TMP	(0244) 549563				
Swansea	Peter	GW8EBB	(0792) 872525				
Jersey	Geoff	GJ41CD	(0534) 26788				

26 for further details

SEMICONDUCTOR NEWS.

CMOS about to kill TTL?

In an (almost) ideal world, all logic would operate with Schottky speeds and drive capabilities, consuming CMOS power with CMOS noise immunity and CMOS power supply ranges. The decision to trade/off between CMOS convenience and Schottky power has been one of the design engineering problems of the 70's.

However, National and Motorola have just jointly introduced the CMOS logic family of the 80s, and as observers of progress in this industry might have expected, it is a CMOS process using silicon gate technology to achieve LPS TTL speed. **R&EW** brought you the news of the high speed CMOS families that Motorola had developed for frequency synthesisers - and now essentially the same techniques are about to revolutionize the rest of the CMOS logic world.

National have always been advocates of CMOS in TTL 'clothing' - 74C appeared about the same time as the rather more ubiquitous RCA 4000 series. For some reason - which still baffles many design engineers who occasionally rediscover the delights of the 74C family - 74C never really caught on, and CD4000 grew along with LPS TTL. It would be presumptive to suggest that this new family of 74HC (second sourced by Motorola) will do the trick and nail the 4000 series, since it seems more than likely that the 4000 series CMOS will be uprated with the new process before much longer. However, applications compatibility with LPS TTL is the thing.

P²CMOS.

The process is silicon gate complementary MOS. *Fig 1a* shows the classic metal gate CMOS structure (4000 series), *Fig 1b* shows the new P²CMOS structure - and the major difference - apart from gate material - is the absence of guard rings in the new structure. This saves a good deal of space, and as much as anything, it is this reduced chip size that contributes to the performance of the new devices.

Parasitic capacitances of the new devices are compared with the older technology in *Fig 2*. These are approximately halved - all of which helps reduce propagation delay to only 15 nSec.

Gate arrays will form a large slice of National's product range in 74 HCMOS. Due to the enormously high density proposed for these arrays - 2 K gates are planned to make their first appearance in June 1982 - new packaging technology is being exploited, with a tape assembly 132 pin ceramic package. 5K gate arrays are going to live in 172 pin 3 layer ceramic package.

This ultra high density packaging has been proposed now for some time - but due to the simple problems of getting the heat out of the more conventional high density logic arrays systems, these have not been practical concepts. High speed CMOS changes all this and *Fig 3a* shows you how. Note that the diagram illustrates a mix of gates and counters.

This is because, although CMOS loses some of its power advantages as the speed increases, only a few parts in a circuit will be operating at high speed at any one time. Quiescent state consumption is illustrated in *Fig 3b*.

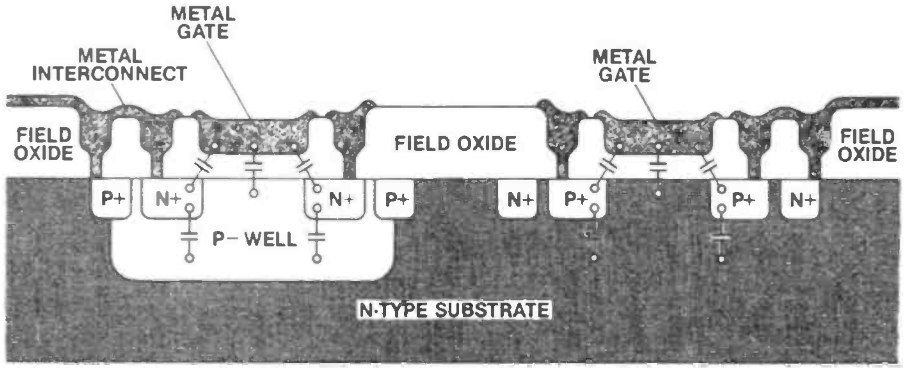


Figure 1a: Cross section of Metal Gate CMOS process, showing parasitic capacitances.

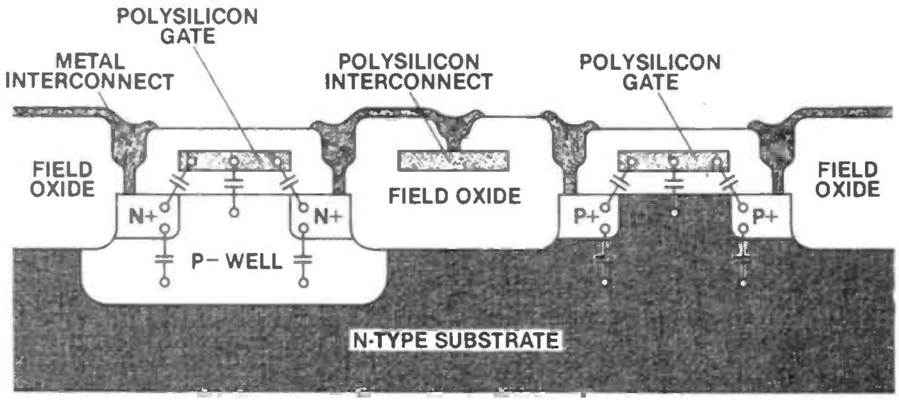


Figure 1b: Cross section of silicon Gate CMOS process, showing parasitic capacitances.

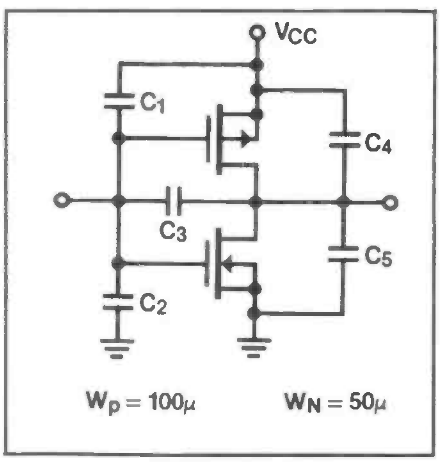


Figure 2: Parasitic capacitance comparison.

High Rise CMOS.

Populating a standard PCB with DIP packages is one thing - handling triple layer ceramic chip carriers is another. If the UK is not careful, the evolution of this technology into production systems will allow the US and Japan to gallop yet further ahead in microelectronic technologies. The only UK manufacturers likely to be able to fund the investment will be those engaged in aerospace/military programmes - which although better than nothing, could be a lot more hopeful. There is little doubt that the Japanese are adapting these technologies for consumer applications already.

Another consideration affecting vast gate arrays is the purity with which the power will arrive. LPS is not adequately immune to glitches on the power rails -and as most logic designers will testify,

	CD4000/MM74C	74HC
C_1	0.25pF	0.1pF
C_2	0.12pF	0.05pF
C_3	0.37pF	0.15pF
C_4	0.66pF	0.31pF
C_5	0.54pF	0.22pF

Table 1: Parasitic capacitance comparison. ▶