ETI for Electronics & Computing Enthusiasts

Electronics Today INTERNATIONAL

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MM70924

July 1982

Heath Computer Review
Step-by-Step Instructions

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NEW COMPUTERS IN STOCK

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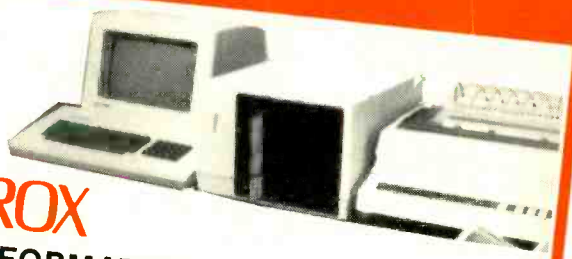
Exceltronix
Components & Computing Inc.



XEROX

820 INFORMATION PROCESSOR

This extremely versatile system can not only be a powerful CP/M based computer, but it can also be a low cost word processing system. Its standard features include: dual 5¼ inch disk drives (8" drives optional); CP/M operating system; 80 by 24 display screen; Z80 microprocessor; 64K RAM; 2 serial ports; 2 parallel ports; and "ETHERNET" compatability. Also available is a 40 cps daisywheel printer.

820—1 with 5¼" disc drive (no printer **$4395**
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If you buy the Xerox System you get a 20% discount off our regular MX100 Printer (one only)

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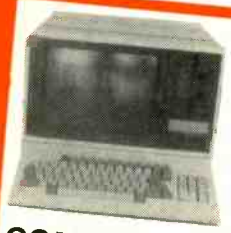

SANYO COMPUTER

We, at EXCELTRONIX, are very pleased to introduce the SANYO FDS-1000 computer system. This remarkable system has a Z80A CPU with 64K RAM, an ASCII keyboard with 5 programmable function keys, an 80 x 25 green phosphor CRT display, and a 5¼" double-sided double-density disk drive all in one attractive package. The CP/M operating system is also included with the system for the price of just **$2725.00 SPECIAL**

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The Zenith Z89 and Z90 are complete, personal microcomputers consisting of computer, keyboard, and video terminal in a single, compact unit. These computers feature up to 64K RAM, an 80 by 24, green phosphor CRT, 3 serial I/O ports, special graphics symbols for business users, an optional floppy disk drive, with either the CP/M or HDOS operating systems and wide software support. These superb all-in-one computers are priced as follows:

SYSTEM NAME	MEMORY SIZE	FLOPPY DRIVE?	PRICE
Z89-0	48K	NO	$2895.00
Z89-1	48K	YES	3375.00 (includes CP/M or HDOS)
Z90-0	64K	NO	3350.00
Z90-1	64K	YES	3650.00 (includes CP/M or HDOS)

APPLE II™ + w/48K RAM $1795.00

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New—Multiflex 16K Ram Card for the apple
SPECIAL **$99.00** fully assembled and tested.

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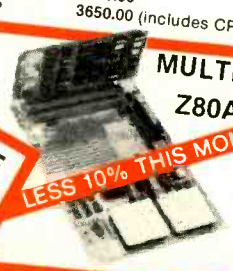

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LESS 10% THIS MONTH SPECIAL
$375.00 in kit form
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master charge

FOR ORDERING INFORMATION SEE OPPOSITE PAGE.

CHARGEX

If we run out of stock on any of these items at the time of your order, our super-fast service will rush the items to you as soon as humanly possible.

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Components & Computing Inc.

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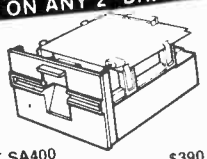

SHUGART SA400 (5¼", SS)	$390.00
SHUGART SA450 (5¼", DS)	549.00
SHUGART SA801 (8", SS)	689.00
SHUGART SA851 (8", DS)	950.00
CDC 9406 8" DOUBLE DENSITY DD SPECIAL PRICE	649.00

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BEST PRICES ON HAMEG SCOPES

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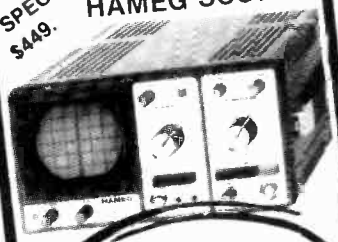

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NOVATION APPLE CAT II	569.00
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1802	13.50
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1853	1.95

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8085 CPU	8.95
8155	10.70
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8214	4.50
8216	2.39
8224	3.90
8226	2.85
8228	5.00
8251	6.45
8253	8.95
8255	6.55
8257	8.95
8259	8.99
8279	11.75

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ETI

The Magazine for Electronics & Computing Enthusiasts

JULY 1982 Vol. 6 No.7

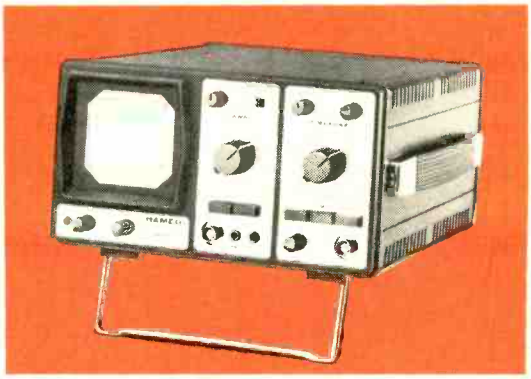
ISSN 0703-8984

Member ABC Audit Bureau of Circulations

Features

Projects

Our Cover: High technology is found in the modern office on practically every desk. Seen here are the 3M Fax machine, Xerox 820 computer, 3M Whisper Writer terminal, and the Bell Displayphone. Also this month, the *Sticks* drum box to derange all in hearing distance.
Photo by Steve Rimmer.



Columns, News and Information

ADVERTISERS' INDEX

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Previous issues of ETI Canada are available direct from our offices for $3.00 each; please specify by month, not by feature you require. See order card for issues available.

We can supply photocopies of any article published in ETI Canada; the charge is $2.00 per article, regardless of length. Please specify both issue and article.

COMPONENT NOTATION AND UNITS
We normally specify components using an international standard. Many readers will be unfamiliar with this but it's simple, less likely to lead to error and will be widely used everywhere sooner or later. ETI has opted for sooner!
Firstly decimal points are dropped and substituted with the multiplier: thus 4.7uF is written 4u7. Capacitors also use the multiplier nano (one nanofarad is 1000pF). Thus 0.1uF is 100nF, 5600pF is 5n6. Other examples are 5.6pF = 5p6 and 0.5pF = 0p5.
Resistors are treated similarly: 1.8Mohms is 1M8, 56kohms is the same, 4.7kohms is 4k7, 100ohms is 100R and 5.6ohms is 5R6.

PCB SUPPLIERS
ETI magazine does NOT supply PCBs or kits but we do issue manufacturing permits for companies to manufacture boards and kits to our designs. Contact the following companies when ordering boards.

Please note we do not keep track of what is available from who so please don't contact us for information on PCBs and kits. Similarly do not ask PCB suppliers for help with projects.

K.S.K. Associates, P.O. Box 54, Morriston, Ont. N0B 2C0.
BR Electronics, P.O. Box 6326F, Hamilton, Ont., L9C 6L9.
Wentworth Electronics, R.R.No.1, Waterdown, Ont., L0R 2H0.
Danocinths Inc., P.O. Box 261, Westland MI 48185, USA.
Arkon Electronics Ltd., 409 Queen Street W., Toronto, Ont., M5V 2A5.
Beyer & Martin Electronic Ltd., 2 Jodi Ave., Unit C, Downsview, Ontario M3N 1H1.
Spectrum Electronics, Box 4166, Stn 'D', Hamilton, Ontario L8V 4L5.
Dacor Limited, P.O. Box 683, Station Q, Toronto, M4T 2N5.

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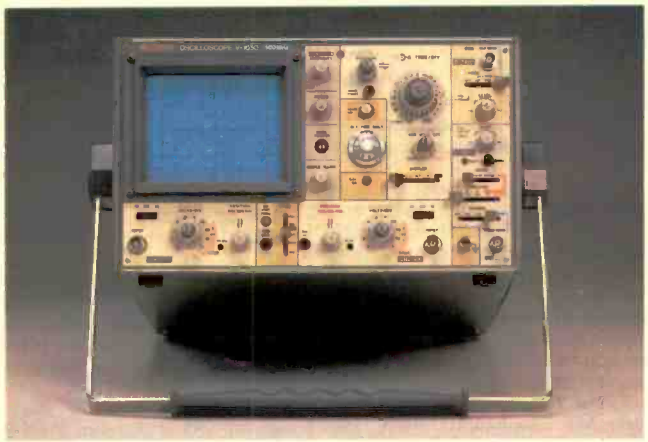

V-1050 100MHz QUAD-TRACE DELAYED SWEEP

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V-352 35MHz DUAL-TRACE

V-202 20MHz DUAL-TRACE

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V-151B 15MHz SINGLE-TRACE

NEW PRODUCTS

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- Small size, light weight
- Battery powered
- Easy to use

V-509 50MHz DUAL-TRACE DELAYED SWEEP
215(W)×110(H)×350(D)mm, 5kg

V-209 20MHz DUAL-TRACE
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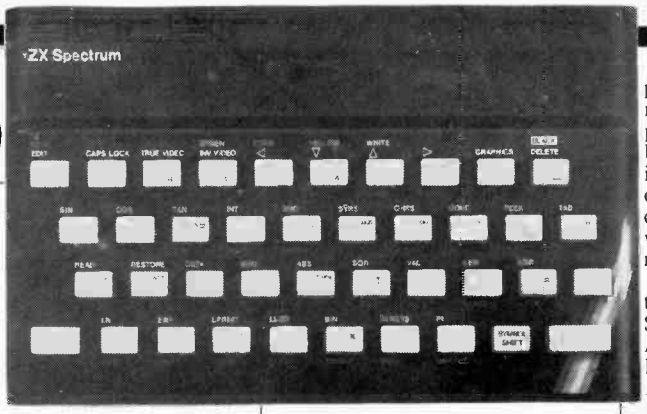
News

New Sinclair Computer



You'd think Sinclair would be lying back exhausted by the runaway success of the ZX81, with sales of 400,000 units since the launch in Britain in April 1981. Not so; they're about to launch the ZX Spectrum, initially only in Britain. North American deliveries are not expected until the end of the year.

The basic Spectrum comes with 16K of RAM (and a UK price converting to $285); a 48K version ($400) will be launched at the same time. The Spectrum incorporates full colour, high resolution graphics and sound. The keyboard is similar to that on a calculator.

A revolutionary new disk system is also expected soon, a 'micro-floppy' with 100K capacity a price tag rumoured to be under $150!

Sinclair is keenly aware of the delivery problems caused by massive demand on the ZX81 and hope to overcome this problem on the Spectrum.

Sinclair has also come to an agreement recently with Timex to distribute the computers in North America; the two companies have been in close alliance for some time as the ZX81 and the Spectrum are both manufactured in Timex's Scottish plant.

The price of the ZX81 has been reduced recently due to the economies of scale of the huge production runs.

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EDITORIAL QUERIES
Written queries can only be answered when accompanied by a self-addressed, stamped envelope. These must relate to recent articles and not involve the staff in any research. Mark such letters ETI-Query. We cannot answer telephone queries.

New Inmarsat Aids Shipping

Ships and oil rigs over more than a third of the globe have substantially improved communications through a new maritime satellite brought into service at midnight (UK time) on Saturday (May 1).

The satellite, MARECS-A, was launched by the European Space Agency and is being leased to the International Maritime Satellite Organization (INMARSAT).

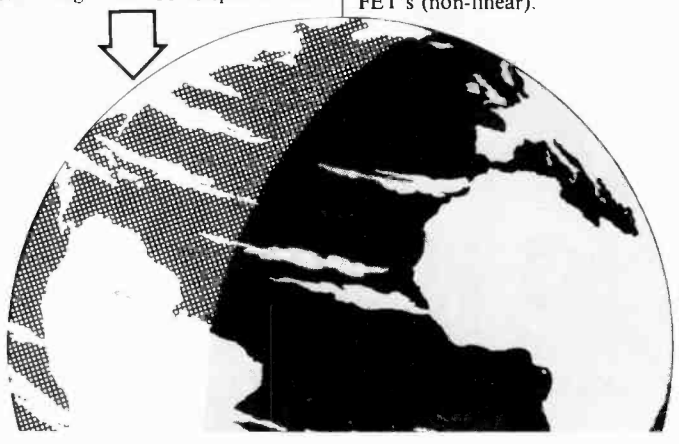
From its geostationary position in space over the Atlantic Ocean, MARECS can "see" an area extending from the Eastern Pacific to the Indian Ocean and from Greenland to Antarctica.

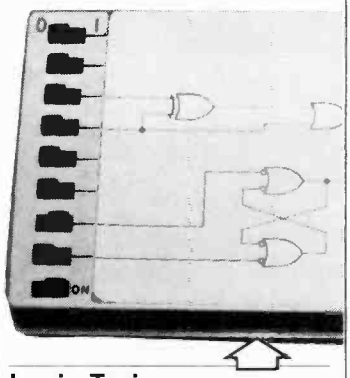
Two more satellites planned this year will complete INMARSAT's new-generation space segment, to take over from the existing MARISAT satellites. A second MARECS is due to go into orbit over the Pacific, and an American INTELSAT V, with a maritime communications package providing about 30 telephone circuits, will be located over the Indian Ocean. INMARSAT will lease capacity on another three INTELSAT V satellites as spares-in-orbit.

Over 1100 vessels, ranging from yachts to supertankers and oil rigs, are now equipped for INMARSAT communications and the number is rising rapidly.

The number of coast earth stations in the INMARSAT system also is increasing. There are five at present, and another 14 are planned by 1984.

For further information contact: Ms. Stephanie Collins, INMARSAT Public Relations Office, 01-720-2266.





Logic Trainer

Sterling Enterprises has introduced the Broder Logic Trainer Model 100 into Canada.

The Broder Logic Trainer has significantly reduced the training time required to learn how gates and flip-flops function in circuits. Now a new training package has been added to include relay logic, diodes, bipolar transistors, and FET's (non-linear).

The student solves the trainer problems by correctly manipulating the 8 switches that provide inputs to the circuit problems. A solved problem will result in the designated display bar being on. The problems are related to circuits used in communications, word processing, automatic machinery, etc.

For more information, contact Diane Dixon, Sales Manager, Sterling Enterprises, 14 Randy Avenue, Orangeville, Ontario L9W 2A1 (519) 941-5375.

New Commodore Products

Commodore International announced at the Hanover Fair, West Germany two exciting new products to add to its second generation of systems, the Commodore CBM II and the Commodore PET II.

The CBM II, offering 256-750K memory, to be priced under $3,300, and the PET II offering 128-256K, to be priced at under $1,500 will both be available in Canada late in 1982.

Specifications for the standard CBM II include: 256K RAM (expandable onboard to 256K, plus over 512K additional external memory), 40K ROM, 80 x 25 monochrome display, detachable keyboard; adjustable tilt-and-swivel video display and two integral high speed disk drives.

For further information, contact James J. Dionne, Vice-President, Systems Division, Commodore Business Machines Limited, 3370 Pharmacy Avenue, Agincourt, Ontario M1W 2K4. (416) 499-4292.

Terminal

Zenith Data Systems, a division of Heath Company, has introduced a personal information terminal for the emerging information access market.

Developed to meet the needs of new information services which are providing businesses with information from data banks, electronic mail, news, communications, funds transfer and access to the power of a large computer, the new Zenith terminal connects to telephone lines with a modular connector and is capable of automatically dialing, gaining access to a computer and requesting information, features missing in conventional terminals.

The ZT-1 terminal has a suggested retail price of $995. The ZT-1 includes an auto-dial modem, which can also be used as an automatic dialer for voice calls.

Zenith Data Systems microcomputer products are available from authorized Zenith Data Systems dealers nation-wide and from Heathkit Computer and Electronic Centres in Vancouver, Calgary, Edmonton, Winnipeg, Mississauga, Ottawa and Montreal.

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A powerful microcomputer with a full standard 53 key typewriter style keyboard and built-in cassette recorder for use in entering and storing programs. Utilizing the versatile Intel 8080A micro processor, the Interact computer has 16K of RAM and 2K of ROM at its disposal. Output is in color on your own TV screen. Sound is also generated through your TV set and can consist of exhilarating computer beeps or two full octaves of music. This is truly a powerful computer capable of developing and handling a variety of programs, and with available software provides true educational stimulus (examples: Star Track, Chess, Concentration, etc.). The Interact computer offers the ideal opportunity to learn BASIC, the most popular computer language for small business and hobbyists, and with the use of the 84 page manual, you learn at your own pace.

INSTALLATION: Attach to antenna terminals of your color TV set and plug into 120 VAC wall outlet. Computer includes built-in RF modulator. FCC approved and UL and CSA listed.

PROGRAMING: Most Micro-computers start you off with an abbreviated 4K BASIC, and then later you have to relearn the more powerful language. Since this computer has 16K of RAM, we start you with Level II Microsoft 4.7 BASIC. BASIC is the most popular Micro-computer language using commands that are words we are ordinarily used to; such as, PRINT, NEW, GOTO (For go to), END, COLOR, JOY, INPUT, etc. To help you learn programing we have included an 84 page instruction manual, plus a 20 page book of program examples.

RCA COSMAC VIP

Authorized distributor for RCA, COSMAC VIP

New! VP 111 Microcomputer ... $139.50
Assembled* and tested.

Features
- RCA 1802 Microprocessor
- 1K Bytes static RAM
Expandable on-board to 4K
Expandable to 32K Bytes total
- 512 Byte ROM operating system
- CHIP-8 interpretive language or machine language programmable
- Hexidecimal keypad
- Audio tone generator
- Single 5-volt operation
- Video output to monitor or modulator
- Cassette interface—100 Bytes/sec
- Instruction Manual with 5 video game listings, schematics, CHIP-8, much more

Ideal for low-cost control applications
Expandable to full VIP capability with VP-114 Kit

*User need only connect cables (included) a 5-volt power supply and speaker

What can you honestly expect from an interactive data terminal that costs only $475.95

Well, to begin with, color graphics.
RCA's VP-3301 has unique color-locking circuitry that gives you sharp, jitter-free color graphics and rainbow-free characters.

Plus much more: Microprocessor control. Resident and programmable character set. Reverse video. State-of-the-art LSI video control. 20 and 40 character formats. RS232C and 20 mA current loop. Six baud rates. Eight data formats. ASCII encoding. Light-touch flexible-membrane key switches for reliability and long life. CMOS circuitry and a spill-proof, dust-proof keyboard for hostile environments.

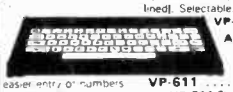
The VP-3301 can be used with a 525-line color or monochrome monitor or a standard TV set through an RF modulator.** It serves a wide variety of industrial, educational, business and individual applications including communication with time sharing and data base networks such as those provided by Dow Jones News/Retrieval Service, CompuServe and Source.

All this—for the low price of **$475.95**. And it's made by RCA.

VP—3501 Videotex Data Terminal
For time sharing applications via telephone. Connects to standard TV set for display. Built-in 300 baud direct connect modem, includes: numeric keypad, color graphics, tone and noise generator, RF and video/audio outputs, expansion interface, resident and user-definable character sets, cursor control, reverse video, plus many other features. (Includes connecting cables.)

VP—3303 Interactive Data Terminal (RF & Video/Audio)
General purpose terminal. Similar to the VP-3501. Does not include modem or numeric keypad. Six switch selectable baud rates to 19.2k. RS-232C and 20 mA current loop interfaces.

Educational and Entertaining



ASCII Keyboard Fully encoded, 128-character ASCII alphanumeric keyboard, 58 light touch keys (2 user defined). Selectable Upper-Case-Only
VP-601 ..... **$109.75**

ASCII/Numeric Keyboard ASCII Keyboard identical to VP-601 plus 16 key numeric entry keyboard for easier entry of numbers
VP-611 ..... **$149.75**

Cable: ASCII Keyboards to VP-711 Flat ribbon cable, 24 in. length for connecting VP-601 or VP-611 and VP-711. Includes matching connector on both ends.
VP-620 ..... **$27.50**

Cable: ASCII Keyboards Flat ribbon cable, 36 in. length with mating connector for VP-601 or VP-611 Keyboards. Other end is unterminated.
VP-623 ..... **$27.50**

RCA PRICE LIST

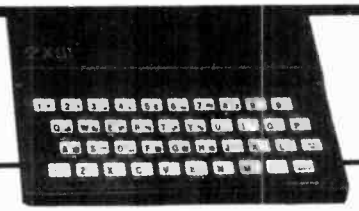
58-Key Typewriter Format for Alphanumeric Entry

VP-601 - 8-bit parallel output	$109.75
VP-606 - Asynchronous serial output	139.75

58-Key Typewriter Format Plus Separate 16-Key Calculator-Type Keypad for Fast Numeric Entry

VP-611 - 8-bit parallel output	$149.75
VP-616 - Asynchronous serial output	159.87
VP-3301 - Video output & built in audio	475.95
VP-3303 - Connects directly to TV set	498.95
VP-3501 - With built in modem & RF modulator	549.95

Sinclair ZX81 Computer
ASSEMBLED $185.95
Kit $149.95



The ZX81's advanced capability.
The ZX81 uses the same fast microprocessor (Z80A), 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, or to select a program off a cassette through the keyboard.

New, improved specification.
*Unique 'one-touch' key word entry: eliminates a great deal of tiresome typing. Key words (PRINT, LIST, RUN, 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 numeric arrays. *Up to 26 FOR/NEXT loops. *Randomize function. *Programmable in machine code. *Cassette LOAD and SAVE with named programs. *1K-byte RAM expandable to 16K. *Full editing facilities. *Able to drive the new Sinclair ZX Printer (to be available shortly).

If you own a ZX80...
The new 8K BASIC ROM as used in the ZX81 is available as a drop-in replacement chip. (Complete with new keyboard template and operating manual). With the exception of animated graphics, all the advanced features of the ZX81 are now available on your ZX80 — including the ability to drive the Sinclair ZX Printer.

16K Memory Expansion Kit (No P.C. Board) $89.95

Sinclair's new 8K Extended Basic offers features found only on computers costing three or four times as much. *Continuous display, including moving graphics. *Multi-dimensional string and numerical arrays. *Math and scientific functions accurate to 8 decimals. *Unique one touch entry of "key words" (i.e. basic and system commands). *Automatic syntax error detection. *Randomize function. *Built-in interface for ZX Printer. *Connects to standard TV and cassette recorder. *164 page manual included. *Power supply (9V at 650 ma) optional for $14.95. *1K of memory is included. *Easy-to-build.

ZX81 Printer $169.95

Designed exclusively for use with the ZX81 (and ZX80 with 8K basic ROM), the printer offers full alphanumerics and highly sophisticated graphics. COPY command prints out exactly what is on screen. At last you can have a hard copy of your program listing and results. Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch. Connects to rear of ZX81 — using a stackable connector so you can use a RAM pack as well. A 65 ft paper roll, instructions included. Requires 9 volts, 1.2 amp power supply (option extra).

64K $249.95

MEMOTECH 64K MEMOPAK
The Memopak is a 64K RAM pack which extends the memory of the ZX81 by a further 56K. Designed to be in the price range expected by Sinclair owners. Plugs directly into the back of the ZX81 and does not inhibit the use of the printer or other add-on boards. There is no need for additional power supply or cables. The Memopack together with the ZX81 gives a full 64K, which is neither switched nor paged, and is directly addressable. The unit is user transparent, and accepts such basic commands such as 10DIM A(9000).
With the Memopak extension the ZX81 is transformed into a powerful computer, suitable for business, leisure and educational use, at a fraction of the cost of comparable systems.

Machine Language Software

ZXAS Machine Code Assembler. A full specification Z80 assembler. Standard mnenonics are written directly into your BASIC program. **$13.95**
ZXDB Disassembler/Debugger. Perfect complement to ZXAS, also provides single step, string search, block transfer, hex loader. **$13.95**

Hardware

ZX81 Assembled	$185.95
ZX81 Kit	149.95
ZX Printer	169.95
64 K-RAM	249.95
16K RAM	169.95
16K RAM Kit	89.95
Power Supply (for ZX81 + 16k memory)	14.95

Software

Multifile Data Storage System	$39.95
Dictator	19.95
Constellation	19.95
ZX Chess	29.95
Star Trek	13.95
Vu-Calc	29.95
Viewtext	19.95

Books

Not only 30 programs for the ZX81 — $16.95
Understanding your ZX81 ROM —23.95
Getting acquainted with your ZX81 — 16.95
The explorers guide to the ZX81 — 16.95
The gateway guide for the ZX81 & ZX80 — 16.95
Mastering machine code on your ZX81 — 24.95
The ZX81 pocketbook — 16.95

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Circle No.6 on Reader Service Card.

Circle No.9 on Reader Service Card.

New SW Frequency Directory

Perhaps the most exhaustive directory of agencies and frequencies using the HF spectrum ever published has been announced by Grove Enterprises.

A sample of the listings include:

US Air Force (SAC, TAC, MAC, NORAD, MAG, ARRS, Command Control, CAP); US Navy (Nuclear subs, missile ranges, tactical callsigns, AUTEC, Rescue); US Coast Guard (Ice Patrol, air to ground, ship to shore, emergency); US Army (National Guard, Reserves, Corps of Engineers); Foreign military (Great Britain, New Zealand, Australia, Cuba); Department of Energy (Nuclear transport, nuclear storage); US Federal Emergency Management Administration, US State Department and Embassies; Spy numbers schedules (the most complete list ever published); drug smuggling networks, mysterious beacons, pirate and clandestine broadcasters, International Red Cross; aircraft (international en-route, foreign, flight testing, ARINC); point to point telephone, NASA (Cape Kennedy, White Sands, Edwards AFB, shuttle nets, tracking); Marine (ocean vessels, coastal stations, Great Lakes, inland rivers, weather); radioteletype frequencies, facsimile frequencies, international assignments, callsigns.

For further information write Grove Enterprises, 140 Dog Branch Road, Brasstown, NC 28902.

Printer

E.S.S.N.A. Limited announces a new letter quality printer, the Daisywriter TM 1000.

The Daisywriter TM 1000 features print wheel cassettes that are operator changeable. The print wheel cassettes are available in 75 different character sets and in 12 languages (including French).

The Daisywriter TM 1000 has been engineered for high reliability (2500 hr. MTBF) and is easily and quickly serviced. It's modular construction allows for on site maintenance. All parts are designed for self testing.

For more information, contact M. LaPalme, E.S.S.N.A. Limited, 21 Progress Court, Scarborough, Ontario M1G 3L4. (416) 431-5588.

Miniature Fiber Optic Link

A new Miniature Fiber Optic Logic Link, HFBR—0200, a DC to 5 MBaud data link for distances up to 1200 metres, has been added to HP's family of fiber-optic products.

HP's Miniature Fiber Optic Logic Link components present a flexible and comprehensive packaging concept to the OEM designer. The HFBR-1201 transmitter and HFBR-2201 receiver are among the smallest available today. The shielded, mounted, connectored package is only 7.8 mm (0.312 inches) in height, conforming with the height limitation of conductive components used in PC boards on 0.50-inch card centers.

The HFBR-0200 kit, which includes transmitter, receiver, mounting hardware and 10 metres of cable, sells for $227.82 per kit in quantities up to nine. It is available now at Hewlett-Packard authorized components distributors.

For more information, contact Inquiries Manager, Hewlett-Packard (Canada) Ltd., 6877 Goreway Drive, Mississauga, Ontario L4V 1M8.

Subminiature LED

A series of new subminiature LED lamp arrays featuring intensity-matched color arrays in five different lengths has been added to the family of subminiature lamps available from Hewlett-Packard (Canada) Ltd.

The HLMP-6200 and HLMP-6X50 series arrays consist of several subminiature lamps molded as a single strip. Array lengths of three, four, five, six and eight elements are available in red, high efficiency red, yellow and green.

For more information, contact Inquiries Manager, Hewlett-Packard (Canada) Ltd., 6877 Goreway Drive, Mississauga, Ontario L4V 1M8.

Also....

The first metric guide for electronic and radiological applications is available from EEMAC. Contents include: Recommendation on use of units; SI Units; Principle Reference Sources. For a copy send $6.00 (all inclusive) to Metric Practice Guide, EEMAC, 1 Yonge St, Suite 1608, Toronto, Ont., M5E 1R1.

●

A new version of computer timesharing is taking off in California: renting time on personal computers installed at your local library. The most successful company in the field, Micro Timesharing has coin-operated Apple II computers in four libraries but another 170 on the waiting list. Software for tax preparation, home budgeting, small business finance and word processing is available.

●

DEC (Digital Equipment Corp.) have entered the personal computer market with three models in the $5000 - $7000 range. Known as the Rainbow 100, DECmate II and Professional, the models will be available here in the fall.

●

Career counselling will be available on Telidon in 70 schools, 20 youth employment centres and 10 public areas in Ontario in September courtesy of TV Ontario, the province's educational TV network.

●

ETCO has just published a 'wholesale-by-mail' catalogue available to genuine dealers. ETCO Electronics, Dealer Division, P.O. Box 840, Champlain, N.Y. 12919. (514) 342-1555.

●

Prices of video recorders could fall later this year due to overproduction. With increasing capacity in Japan and European production lines coming on stream, worldwide production could be 14 million in 1982 — however the market has been estimated at only 12 million.

●

Canada's Spar Aerospace has won a $130 million contract for Brazil's first two telecommunication's satellites; these will be launched by Ariane Space, a European company, in late 1984.

●

The largest commercial communcations satellite contract ever has gone to Hughes Aircraft Co. The contract is to build five Intelsat VI models and is worth $700 million; there are also options for 11 more. Each Intelsat VI will carry 33,000 telephone calls and four TV channels.

●

A patent has just been granted for a new solar cell which has a 40% efficiency — more than twice as good as present types. It was developed at the IBM Watson Research Centre in the US.

The Ethernet communications network pioneered by Xerox has received the backing of Mitel with the announcement that their new PABX will be made compatible with it. Ethernet is a coax cable system known as a local area network; these networks help in providing high capacity data links over small areas, such as an office complex.

●

Electrohome has entered the field of servicing home computers, VCR's, Telidon receivers and other high technology equipment. The new operation known as Aabex Electronic Services will eventually replace the 26 Service Electrohome centres.

●

The Quebec Government plans $1 billion spending during the next four years for a programme that will concentrate on high technology in the Province. The programme is known as 'Le Virage Technologie"

●

Sharp Electronics of Canada have introduced a talking photocopier: if there's a misfeeding problem, for example, the machine will tell you how to correct it.

●

The University of Lethbridge is using a computer to codify and produce a Blackfoot-English dictionary. There are about 8,000 Blackfoot Indians in Southern Alberta and the dictionary is intended for use in reservation classrooms.

●

Satellite Television Corporation, a subsidiary of COMSAT, is planning to offer US consumers three channels of pay-TV, without advertising, beamed by satellite to individual homes. A 1986 start-up date is expected.

●

Epitek of Kanata, Ontario have commenced a major expansion of their production facilities in Ogdensburg, N.Y. The facility will handle work on their reflow hybrid chips and SIP resistor networks.

●

The Canadian Information Processing Society has prepared a booklet "A Buyers Guide to small Business Computers"; it includes a detailed checklist to help avoiding errors when considering a purchase. Copies are $2.50 and are available from CIPS, 243 College Street, 5th Floor, Toronto, Ont., M5T 2Y1.

●

Within a week of the Falklands Island situation starting, a video game was being offered on British Telecom's Prestel Service to its 16,000 subscribers. The game simulates a British Submarine trying to sink the Argentine navy.

●

ETI

Electronic office

Technology has been sneaking up on the work place of late. . . the time may come when you'll need a degree to operate the phones, as Roger Allan observes.

CANADIAN OFFICE operations cost between 30 and 60 billion dollars a year. Two thirds of total office costs are communication oriented with about 93% of those costs directly attributable to labour.

It has been calculated in the United States that the number of documents handled by the average office worker is increasing at the rate of two file drawers, or 4,000 documents, a year. There is no reason to believe that figures are too different in Canada.

Productivity of office workers in the 1960's increased only some 4%.

It is in these figures that the rationale, even the survival necessity, for corporate involvement in electronic offices is to be found. For with the rapidly increasing generation of data and information, corporate finances become strained very rapidly. Why there should be such an increase in information flow over the past decade or so is a socio-economic-technical question derived in part from the realignment of corporations' methods of doing business and the rise, in Marshall McLuhan's phrase, of the global or electronic village. Its intricacies need not concern us.

But there are immediate consequences. Hans Brune, head of the Department of Communications Office Communications Systems Program has been quoted as saying that business executives are "drowning in paper . . . it appears that the paper offices of today are unmanageable in terms of cost, performance and timeliness."

As such, the office systems used until the mid-seventies have had to change simply by virtue of economic realities and despite some worker attempts to stymie technological innovation. Fortunately, the electronic revolution has succeeded, to date at least, in keeping abreast of the corporate necessities for information collecting, storage, production, processing and communication by means of the micro chip and ancillary devices. It has been calculated that the computer customarily found on the desk of a secretary in an 'electronic office' performs the same function as one in a room 40 by 20 feet two decades ago. An analogous reduction in the price of sirloin steak would currently have it marketed at the price of 3 cents per pound.

Such technological change does not come cheap. In North America it is calculated that the electronic devices found in the modern office represent some 4 billion dollars in annual sales, a figure that is bound to rise. This represents a marked change from past decades when office improvements (primarily the purchase of adding machines and typewriters) represented only some 10% of the investment ratio of such sectors as agricultural manufacturing. Nowadays, the figures are roughly comparable, percentage wise, to total business investment. This is not really surprising since, in the words of Hans Brune, the office has become the nerve centre of the modern economy, "a battlefield, where fortunes are made and lost. It is also a mundane place where paper is pushed, accounts are kept, invoices and pay cheques are prepared," and executives are quite capable of reading balance sheets.

The CWP

The nerve centre of any electronic office is the communicating word processor, or CWP. It is analogous to having a huge team of human clerks, secretaries and

Displayphone

A voice/data communications telephone, the Displayphone (left), manufactured by Northern Telecom, provides an integration of voice and data in a single unit. All necessary components, including display, telephone, keyboard (in a pullout drawer) and a data modem are packaged into a single desktop unit. The system will support concurrent operation of most of its features on voice or data calls, while also providing simultaneous voice and data communications. Two telephone lines are used for voice and data while two display pages, one for phone and other features, one for data, are standard, with the user selecting and viewing either page without altering the contents or disrupting the services performed on the other. The system's keyboard features five key positions: display on the screen indicating the function of each key at any given time. Menus, which are also displayed on the screen, offer a selection of the various services or functions that can be performed by the system, while a keyboard allows the unit to be used as a computer terminal. The device can operate as a regular telephone for manually dialed numbers, while a dialing system allows the origination of calls without lifting the handset. A personal phone directory for the selection and automatic dialing of 81 prestored numbers is also built in.

Electronic Typewriter

The IBM Electronic Typewriter 75 is a combination of electronics with IBM single element typewriter technology. It has a 15,500 character storage capacity shared between two memory elements; document and phrase storage. In document storage, the typewriter temporarily stores entire documents for later revision, while the phrase storage capacity stores frequently used phrases, sentences or paragraphs totalling 7,500 characters in ninety-nine storage areas. Its electronics permit 'editing' by way of a five key control panel, electronic column layout which permits tabs to be automatically set and columns aligned without any 'figuring' by the typist and electronic number alignment which positions the carrier for alignment of statistical columns. Format storage capability permits margins and tabs for four frequently used formats to be stored without affecting the memory capability of document or phrase storage.

researchers all in one device. A CWP can distribute among many persons articles, manuscripts and reports, permitting them to be revised by multiple editors. Information can be called up from data bases anywhere in the world (there are currently over 700 of them in the United States). Words, sentences and paragraphs can be inserted, deleted or transposed at the push of a button. It can be connected to a high speed printer such that data, when all the editing has been done, can be turned into hard copy.

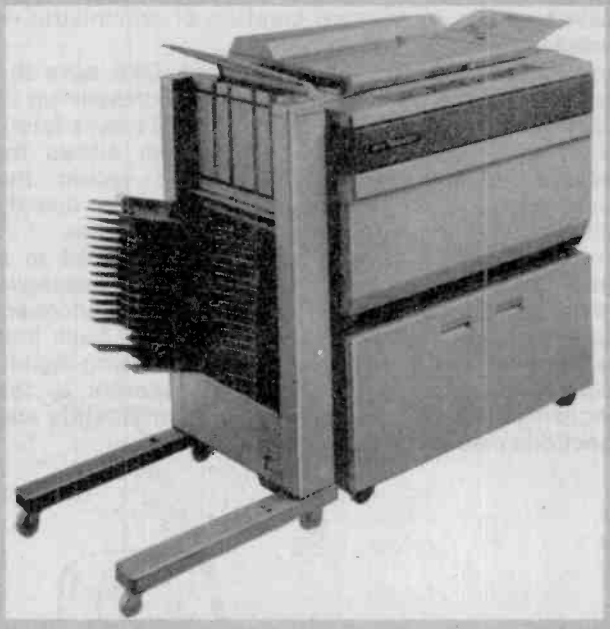
Initially, at least when first introduced into an office, these machines are used by secretaries and clerks. Later, either when executives overcome an apparent inbred fear of manipulating a keyboard or when the current crop of school leavers with an inbred hands-on experience in computers reach the market place in large numbers, then this type of device will be used by more senior managers. One of the prime characteristics of a contemporary CWP is that it is 'user friendly'.

Not only can these CWP's communicate with each other but, by connecting into mainframe computers, are capable of bringing to bear the full weight of computer technology to small workstations operating for a brief duration.

For instance, by loading the mainframe with the appropriate program a business executive, using his desk top video console, can create financial projections utilizing a large number of variables. Once he has determined what the expected financial outlook for the company is, he can then institute changes in variables (such as a delay in spare parts procurement, or a trucking strike of three days duration a month from now) and, almost instantly, determine what effect this will have on the company's finances. Theoretically, this permits the business executive to produce financial and operating forecasts with an accuracy far in excess of current systems, at a fraction of both the time and cost compared to customary pencil and paper forecasting methods.

The Telephone

While CWP's are all well and good, they are dependent on copy transmission and number crunching via the mainframe computer or at the workstation, and as such



Office Copier

The Canon NP-400F is representative of the current generation of desktop fixed platen copiers for small and medium business use. While it has the standard copier features, double bin paper feeding, copying speed of 40 a minute, multiple copies up to 99, it also features enlarge and reduce modes. The reduce mode permits reductions of 75% and 64%. It will permit something the size of a computer printout to be reduced to the size of a standard business letter, thereby saving storage and mailing costs. The enlarge mode permits originals to be enlarged up to 127%. This permits map sections, detailed drawings and legal fine print to be enlarged for study purposes. Originals may be sheets or books.

do not take into account the enormous amount of information exchange that takes place within an office between people.

Recent studies indicate that 70 percent of all telephone calls never reach the desired party on the initial attempt. Financially, if a secretary were detailed to undertake the telephone calls and failed to reach the desired party, spending an average of fifteen minutes a day in the process, the cost to the company will be in the order of $1400 a year in wasted costs (salary, heat, light, rent, etc).

This 'telephone tag' has a further expensive element. Studies indicate that some 50 percent of all interoffice telephone calls actually consist of one-way information, requiring no interaction. These calls merely distribute or request information, but are often not completed.

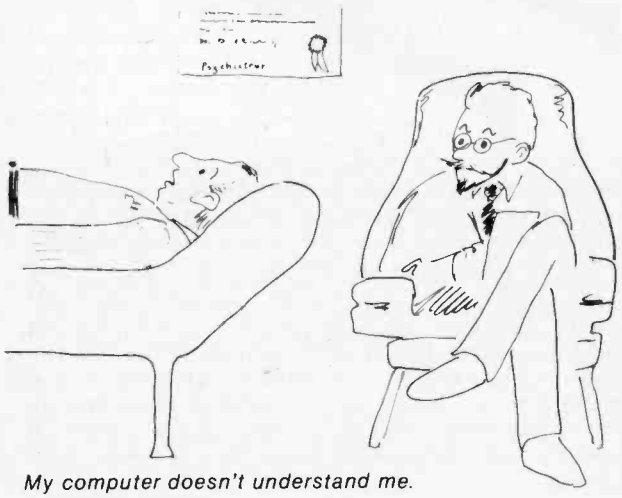
DVE

In the integrated office, there are a number of ways to get around this problem, the state of the art being the Digital Voice Exchange System (DVE).

In a typical system, such as the one manufactured by Wang, the office worker utilizes a standard Touch-Tone. The user simply calls into the DVE system and is requested to enter an identification number and optional password. The DVE logically guides the user with a series of voice prompts. The DVE notifies the user of awaiting messages and prompts for selection of a mailbox review, Voicegram creation or administrative functions.

If Voicegram creation is selected, DVE asks the user to enter the desired address (or addresses up to 256) and the day/time of delivery (up to 31 days later). Following Voicegram entry, the system allows for message review with the option to record the Voicegram prior to sending. Each user may specify mailbox or telephone receipt of their Voicegrams.

DVE Voicegrams are recorded and stored in a digital format on disk. When the user reviews messages within an audio mailbox, the DVE performs a random access. This digital code is then transformed back into analog speech which is played back. The analog-digital-analog conversion is completely transparent to the user, with the original voice quality, identification and inflections preserved.



My computer doesn't understand me.

Facsimile Communication System

A facsimile communication system consists of three parts: a telephone system, the facsimile terminal and an interface between the facsimile terminal and the telephone system. The facsimile terminal is similar to a photocopier except that the copy is produced at a remote location. The terminal scans the surface of a document and converts the image into an electronic signal that is transmitted via the telephone system to the receiving unit. The receiving device converts the signal into an exact replica of the original and produces a print. Most facsimile terminals can both send and receive documents and some can perform both functions simultaneously. Top of the line models can telephone the number of the receiving station, answer the phone at the receiving location, feed the document into the sending unit and transmit it, verify reception at the receiving unit and make a print and terminate the telephone call. The business advantages of such a system are that they can combine the immediacy of telephone communication with the hard copy delivery capability of the mail. The 3M 9136 Facsimile Transceiver shown here can also communicate with analog and digital machines and is capable of transmitting a standard business letter anywhere in the world in about a minute.

Electronic Funds Transfer

In 1975 the Federal government issued a Blue Book policy statement, "Toward an Electronic Payments System." It contained a vision of nationwide electronic funds transfer (EFT) systems that would reduce the use of cheques by transferring electronically debits and credits between bank accounts.

While the policy statement primarily concerned itself with retail selling (the automatic debiting of an individual's account when he purchased a shirt, for instance) there are future applications in the electronic office, particularly recurrent fixed amount payments. These might include the payment of mortgages, electricity and water bills, loan payments and so on. Banks have already instituted, over the past few years, the first elements of EFT systems by their use of automatic tellers and in-house customer loan debits. Their reasoning is that they cannot afford to continue subsidizing the processing cost of personal cheques. Currently, bank customers pay about half the 65 cents it costs to process a cheque. If the true cost of a cheque is charged, it will become much cheaper for consumers to use debit payment services than to write cheques. Until this happens, there will be no market for wide-scale point of sale payment systems.

However, as the cost of cheque processing continues to rise, the likelihood of passing the true cost of cheques onto the user increases. As such, industry spokesmen believe that that portion of the office, customarily known as accounts, currently involving large numbers of staff who manually open payment letters and enter the data into computers will gradually die out.

Corporately, the integration of the office with other offices is somewhat more complex, if only by virtue of the sheer volume of data that must be transmitted.

Whisper Writer

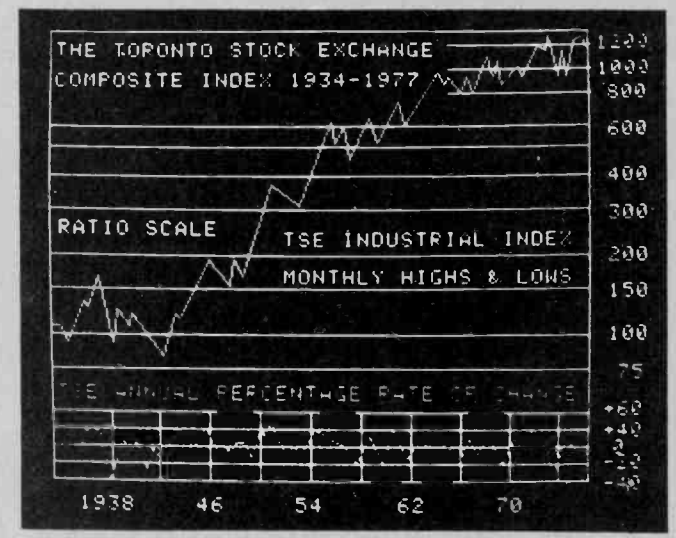
Communication with remote databases and access to the TWX/Telex network is possible over ordinary telephone lines using a portable printing terminal such as the 3M "Whisper Writer". The desktop teleprinter employs thermal printing for quiet operation. An acoustic coupler allows travelling executives to use the unit anywhere there is power and a telephone. Designed in a modular system, it can be used alone as a receive only terminal or with an optional automatic line selector for TWX reception. Addition of an intelligent keyboard provides full communication capability in a unit the size of a small typewriter for two-way correspondence as well as remote database accessing, timesharing and computer electronic mail applications. Up to three typed pages may be stored in the keyboard's 4,000 character memory, allowing messages to be edited before transmission.

Printing Calculator

The Canon Canola SP1260-D is a twelve digit desktop printing and display calculator with a live memory. Beside the normal calculator functions, it is equipped with a random access memory that stores up to 128 data items with basic function signs and a voice synthesizer to call out data entries and results. The voice synthesizer is available in English, French and German. Two switches control the speed and volume of the sound verification. The display panel is a fluorescent multi-numeric design and the printing mechanism is the high speed non-impact, silent, 3½ line per second type. The calculator can also automatically produce any number of duplicate printouts.

Communication Networks

For the fullest integration, common user communication networks would have to be created. Currently, Trans Canada Telephone System's (TCTS) Datapac and CNCP's Infoswitch packet switching systems can be used to create closed common user networks which would meet the Blue Book guidelines. A unified network is not yet available because Datapac and Infoswitch are not interconnected at the network level. Since the two networks both use the same protocol, there are no major technical barriers to interconnection. The reason why there is no interconnection is that the two carriers do not *want* to interconnect, believing that if a universal interconnected system went down it would have major economic ramifications. As such, the companies believe that two separate systems would be a better structure. If and when such problems are sorted out, the integrated office would be capable of reaching its fullest fruition; being totally integrated with all elements of the economy, and wired to all individuals' personal bank accounts.



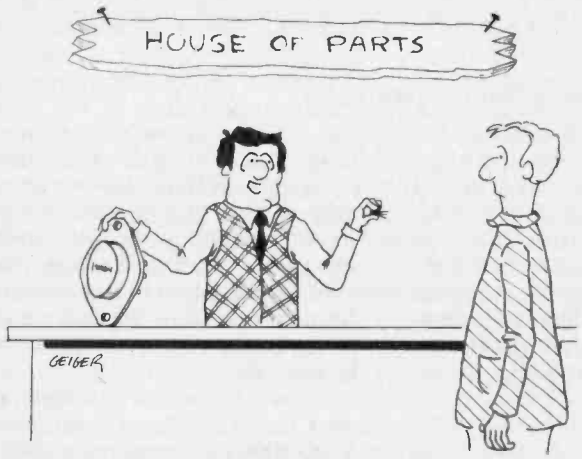
Telidon

Designed by researchers at the Canadian Department of Communications and manufactured by private corporations, Telidon is a graphics communications system which enables text and high-quality animated images to be transmitted directly to television sets in homes and offices. There are three basic modes of operation. Videotex is an interactive system in which the viewer, by means of a telephone line or two-way cable, calls up information for display on a modified television set. Using a keyboard or keypad, the viewer can retrieve information from remote computer data bases. The data base, or electronic library, has the potential to store millions of pages of information. The Telidon 'page' is what appears on the screen. Teletext is operated by a simple key pad that resembles a pocket calculator. In this mode, viewers receive text and graphics on an ordinary television receiver equipped with a decoder. The decoder enables the TV to receive pages of information broadcast on the vertical blanking interval of a television transmission. Information of general interest is continually updated and rebroadcast every few minutes, while special interest programs can be scheduled to arrive at specific times. The audio-visual mode requires specially designed terminals with extra computer memory which permits high-resolution graphics and text to be used, and can be accompanied by sound tracks as well as permitting displays to be stored in the terminal for later re-use.

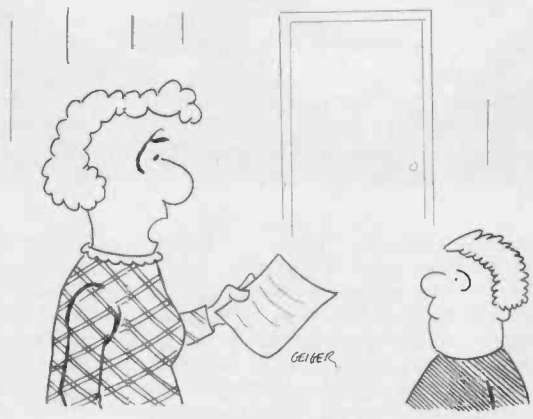
There is little doubt that the continued integration of the office will affect the five million Canadians, representing some 40 percent of the workforce, involved in clerical and executive positions. What the actual effect of the new technology will be is uncertain. There has been a series of debates as to whether there will be a net increase or decrease in jobs. American and Japanese studies tend to demonstrate that, while there will be short term dislocations, the net effect will be minimal; on the other hand studies tend to predict that millions will be thrown out of work.

It is perhaps not surprising that most knowledgeable observers have concluded that as yet the impact of the integrated office is unknown.

ETI



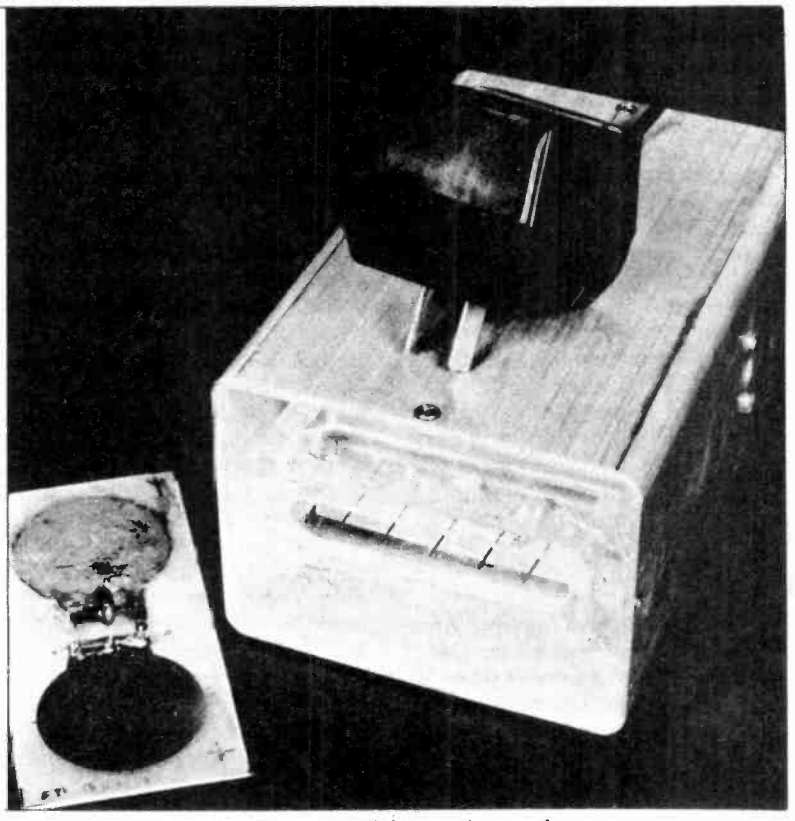
Here's the transistor you wanted — you have your choice of case styles.



I think your father's been working with computers for too long. He left a message that says if I am late, then store dinner in fridge. Else go to oven and heat dinner. end."

Negative Ion Generator

For those experimenters who just have to find out for themselves what the subject is all about, this negative ion generator should provide a good basis for experiment. Design by Jonathan Scott, Development by Graeme Teesdale



Our unit can be powered from 12 VDC or a plug pack.

THE RISE in popularity of negative ion generators, the claims made for them, and the attention they have received in newspapers and magazines recently has undoubtedly intrigued many readers with a technical background or interest, as evidenced by the deluge of letters and phone calls we've received in recent months requesting information and project material to be presented in ETI.

As the electronics associated with a negative ion generator are relatively simple, generally employing readily available components, this article describes how to build a unit that can be used as the basis for experiment. The cost of commercial units, at least in part, is justified by the design and construction of the emitting head, which requires somewhat more specialised parts and construction than are available to the average constructor in order to work efficiently.

All the present negative ion generator designs that we have examined operate on the 'corona discharge' principle. This requires relatively high voltages, around 2.5 kV to 3 kV. In AC operated units this is usually obtained by a voltage-multiplier rectifier operated direct from the 120 VAC line. While this is economical and efficient and, in an assembled plastic box, fairly safe, it is not at all safe for anyone without a great deal of experience to tinker with on the workbench or kitchen table, etc. With this in mind, we have designed our unit to work from a 12-15 volt supply, employing a dc-to-ac inverter and voltage-multiplier rectifier, giving a relatively safe high tension voltage to operate the emitting head. This has the added advantage that it is portable and can be used in a car or run by a plug pack from the wall. In addition, we have kept in mind that many of the victims of electrocution each year are people who should have known better. Our project design was partly motivated by the desire to avoid the necessity of having to replace design staff, who are hard to come by, expensive and cannot run the risk of being zapped like the occasional 20^{c} transistor! Prime motivation behind the design was to avoid losing readers, though.

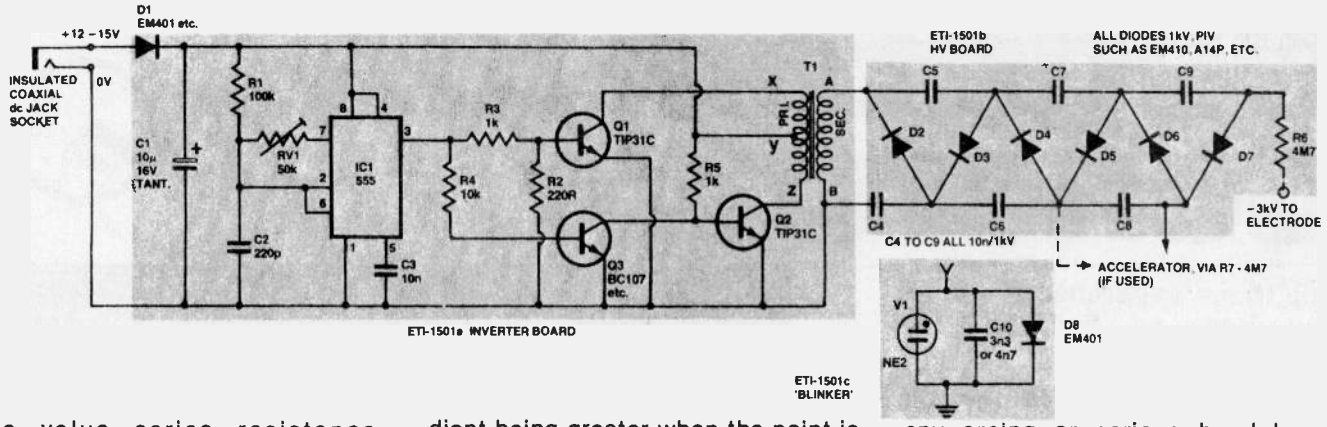
Circuit design

The negative ion generator electronics can be separated into three components: an oscillator, a driver and step-up transformer comprising the dc-to-ac inverter, and the voltage-multiplier rectifier.

A 555 timer IC (IC1) is arranged as an astable multivibrator. A trimpot is included in one of the timing inputs (pin 7) to allow adjustment of the mark-to-space ratio of the output to ensure equal drive to the two driver transistors, Q1 and Q2. These two transistors alternately switch current through the primary of transformer T1. As both Q1 and Q2 are NPN transistors, one has to receive an inverted drive signal so that it is off when the other transistor is on and vice versa. Thus Q3 is employed to invert the drive to Q2.

Transformer T1 steps up the drive applied to its primary, providing a 500-600V peak-to-peak output at the secondary (depending on the supply voltage).

As about 3 kV DC is required to operate the emitter head, a Cockcroft-Walton voltage multiplier circuit is employed, multiplying the secondary voltage of T1 six times. A



large value series resistance, together with the inherently poor regulation of the rectifier circuit, ensures that the output short-circuit current is very low to reduce shock hazards.

To enable you to test the operation of this unit a 'blinker' has been provided. This simply consists of two large 'pads' on a piece of pc board with a diode, capacitor and neon connected between them. With the pad to which the diode cathode connects held with your thumb, the other pad acts as an 'antenna' or 'collector' when held in front of the emitter head of any negative ion generator.

As charge builds up on the antenna pad, the capacitor will charge up. When this reaches a voltage that exceeds the breakdown voltage of the neon, the neon will conduct briefly while the capacitor discharges and you will see a flash. The charge will build up again and the whole process will be repeated.

The 'blinker' thus provides a crude measure of the ion production of the generator being tested. The closer the blinker is held to the emitter head, the faster it will flash. Alternatively, if held a fixed distance from the emitter heads of different air ionisers in turn, the one in front of which it blinks fastest will have the greater ion output.

Design of the emitter head

The object of the emitter head is to take in the HT, in our case about 3 kV, and produce a stream of negative ions flowing forwards into the room in which the generator is placed. The ions are produced by a very intense field gradient, which is induced by the high voltage and the geometry of the head assembly. This ion flow is a corona wind. It is a basic principle of electro-static physics that the field gradient is stronger in the immediate vicinity of a point projection, the gradient being greater when the point is sharper. So most ion generators employ some combination of sharp projections and high voltage. A number of other matters affect the choice of head geometry. firstly, the design should expel the ion stream away from itself to allow more ions to be emitted. Secondly, it should achieve its aim with a minimum of ozone production. Thirdly, it should employ points made of a hard metal to resist cathode stripping and hold their edge, without being too hard to work or too expensive or exotic to get easily. We will briefly discuss these aims and the relevant principles behind their realisation, then give you a couple of examples to act as a guide for experimentation.

If the point is spaced well away from other parts of the unit the ions will naturally repel themselves away from the region of emission. However, if the point or points are partially enclosed in the case of the device there may need to be either a chimney-shaped assembly around the emitters or some sort of accelerator electrodes to help eject the ions from the emitter head.

Wherever there is ion production there will be ozone production. Ozone, 0_3, is a product of higher energy activity than is necessary for mere ion production. It is a corrosive as well as a strong antibacterial agent, and is poisonous in sufficient concentration. About 0.025 to 0.05 parts per million (ppm) is recognised as a safe level. Ozone is what you smell after there has been arcing, such as in a motor commutator; an acrid, coppery smell, distinctly metallic. It is produced in some quantity in all ion generators, though some are so well designed that it is negligible. In order to keep it to a minimum, as low a voltage as possible should be used. Our project has been designed to give the lowest voltage compatible with adequate ion production. The design should be such as not to allow any arcing or serious breakdown. This is really only likely if you try using an "accelerator", as there will be no metal in close proximity to the emitter otherwise.

The best metal for the points which is easily obtainable is steel, preferably stainless. This is hard enough to hold an edge, and will resist the effects of cathode stripping. The latter is undesirable both because the fine point will be eroded away, and also because the heavy metal ions which are ejected are undesirable agents in the air we breathe (stick to getting your minerals from cornflakes).

PARTS LIST

Resistors (all ½W, 5%)

R1	100k
R2	220R
R3,5	1k
R4	10k
R6,7	4M7
RV1	50k

Capacitors

C1	10u/16V tantalum
C2	220p ceramic
C3	10n greencap
C4 to C9	10n/1kV ceramic
C10	3n3 or 4n7 greencap

Semiconductors

D1,8	EM401 or similar
D2 to D7	1 kV PIV diodes.
IC1	NE555
Q1,2	TIP31C
Q3	2N3904

Miscellaneous

Three pc boards; T1 — FX2242 potcore and former; coaxial dc jack socket; 9 V 200 mA or 300 mA plug pack (if required); V1 — NE2 70 V neon; piece of plexiglass about 100 x 100 mm, 5 mm thick; five needles; about 80-100mm of 6mm diameter thin-walled brass tubing; case; nuts, bolts etc.

HOW IT WORKS

One board contains a dc-to-ac inverter, a second board a high voltage multiplier rectifier and a third a 'blinker' test unit.

The dc-to-ac inverter on the first board consists of a 555 astable multivibrator, the output of which is used to drive two transistors operated in push-pull, the collectors of which switch current through each side of the transformer (T1) primary in turn. Diode D1 prevents any damage from a supply connected with reverse polarity. Capacitor C1 is a bypass. IC1 oscillates at around 25 kHz, determined by R1 and C2. The exact frequency is unimportant. The mark-to-space ratio of the output of IC1 (via pin 3) may be adjusted by RV1, which is connected in series with pin 7 of IC1.

The output of IC1 drives the base of Q1 directly, via R3 and R2. Q1 turns on when the output of IC1 goes high. Resistor R3 is there principally to limit the base current supplied to Q1, while R2 serves to discharge the base-emitter junction capacitance so that Q1 turns off quickly when the output of IC3 goes low.

When pin 3 of IC1 goes high, Q3 also turns on, preventing Q2 from turning on. When pin 3 of IC1 goes low, Q1 and Q3 turn off and Q2 will turn on as base bias will be supplied via R5.

Thus current is alternately switched through each side of the primary of T1. The secondary provides a voltage step-up of 25:1. If the supply voltage is 12 VDC, then the peak-to-peak output from the secondary of T1 will be 600V. The voltage-multiplier rectifier employs the well-known Cockcroft-Walton circuit, where the output of each successive half-wave rectifier is connected in series with the previous one. This circuit provides a multiplication of six times. Thus, with a 12 VDC supply, the output will be about -3.6 kV. With a 10 VDC supply (as can be obtained from a 9 VDC plug pack), about -3 kV is obtained. An output for an 'accelerator' is provided.

The high voltage output to the emitter head is taken via a 4M7 resistor to ensure that only low short-circuit current occurs if the emitter head is accidentally contacted or excessively humid air causes 'flashover' from the emitter.

The blinker is simply a crude relaxation oscillator. When a charge builds up on the 'antenna' pad, it will charge C10. When the voltage on C10 reaches the breakdown voltage of the neon, V1 (about 70V), the neon will conduct. This will discharge the capacitor, the voltage across it falling until it reaches the extinguishing voltage of the neon (about 30-40V), which will then cease conducting. While the neon conducts, it will emit light, but as it discharges C10 fairly rapidly, all you will see is a brief flash from the neon. Diode D8 ensures only negative charges operate the blinker.

When the neon ceases conducting the charge on C10 will build up again and the whole process will be repeated.

Fig. 1 shows the emitter head assembly of our prototype. The plastic we used was clear plexiglass, but this is purely to show you what is inside the gizmo. We recommend some aesthetic colour for your version if you use plexiglass. There was found to be no need of an accelerator as the points actually protrude beyond the slot in the face-plate. If they are to be recessed an accelerator may be necessary, as the ions soon collect on the plastic parts and build up a field, inhibiting further ionisation or ejection. There is no shock hazard as the unit is not line powered and there is a very large series resistance between the points and the multiplier output. At most, there results something between a nip and a tickle if you touch the emitter points. The points are steel needles soldered to a brass rod; the needles are probably sharp enough normally, but we struck them against a fine whetstone to sharpen them further. This enhances ion production a little.

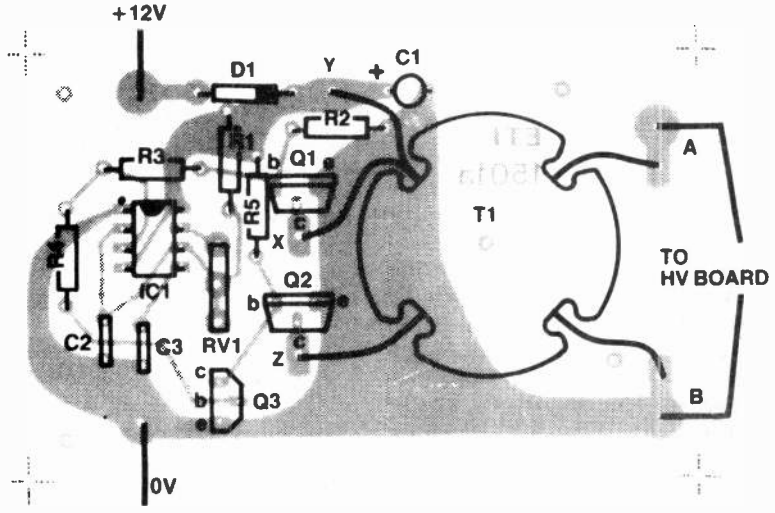


Fig. 2 shows one commercial unit's layout. It employs an accelerator and points of phosphor-bronze. It has a similar voltage potential to ours, but is physically smaller, due to custom plastic components. The points are partially recessed. This unit derives the HT directly from the line.

Suitable steel needles can be obtained from your family sewing drawer! Failing that, any sewing accessories supplier can help you.

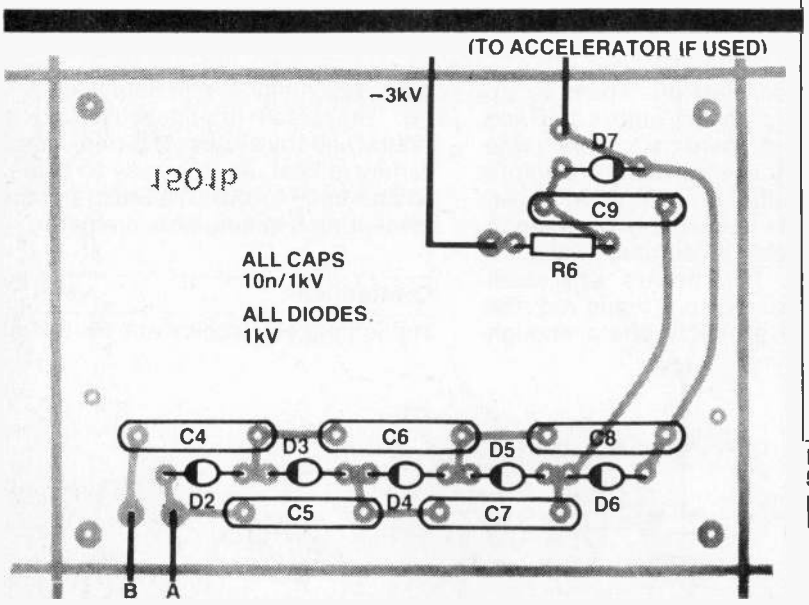
The brass tubing you'll find in hobby and toy stores. The thin-walled variety is best, as it is easy to solder to and easy to cut. We used a piece measuring 6 mm outside diameter.

Contruction

The ioniser electronics are contained on two circuit boards. The first contains oscillator, driver and transformer, while the second contains the high voltage rectifier. We housed both of these in a small box, the emitter head being designed to fit in one end.

First stage of construction is to assemble the components on the pc boards. Commence with the inverter board. Insert the resistors, capacitors, IC and transistors before assembling the transformer to it. As usual, take care with the orientation of the diode, IC1 and the transistors. Next, wind the transformer, details

The high voltage board.



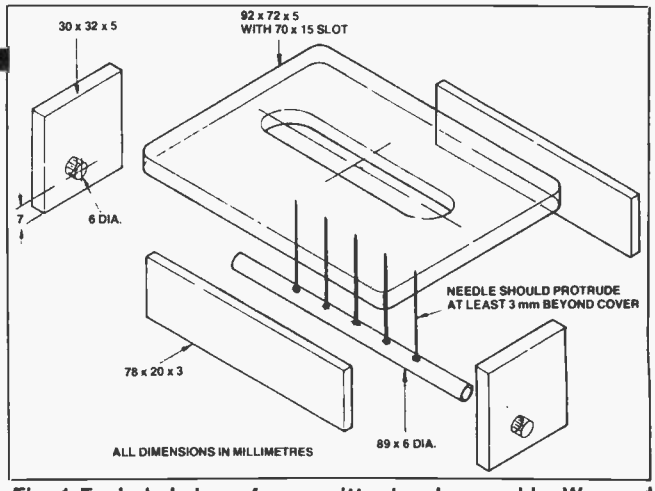


Fig. 1 Exploded view of our emitter head assembly. We used 5mm and 3mm thick plastic, but it could all be made from 5mm plastic. The two pictures below show the completed head. Brass tubing supports the needles, which are soldered to it.

are given in the box. The transformer employs a potcore and this can be held on to the pc board with a nylon bolt; do not use a metal bolt. Cut the transformer coil wires to length, scrape off the insulation and solder them in place. The TIP31C transistors, Q1 and Q2, do not actually require any heatsink, though they do get warm in operation.

The high voltage board may be assembled next. Take care with the orientation of the diodes. Stand the capacitors erect on the board so that they do not touch each other or you may have arc-over problems between these components.

Mount the appropriate components on the 'blinker' board next, as you'll need this for a testing aid. It is important to watch the diode polarity here. The cathode of the diode goes to the pad marked with the 'ground' symbol. Note that the components are mounted on the copper side.

The emitter head is constructed from clear plexiglass and its assembly is detailed in Fig. 1. We mounted our high voltage board on the rear of the emitter, gluing it in place with a little epoxy cement. This allows a short lead between the rectifier output and the brass tube supporting the needle points of the emitter.

A short lengthof twisted pair hookup cable links the rectifier input (A and B) to the inverter board. This board we mounted on the end plate of the box using four nuts and bolts and short spacers.

The DC input socket we mounted on one side of the box, as can be seen from the photographs. Exactly how the dc coaxial jack socket is wired will depend on how your plug pack output plug is wired. Some have the outer connector connected to positive, while others have it connected to the negative. Watch the wiring of this socket if you plan to operate your unit in a vehicle. The outer connector is electrically connected to the socket's mounting and this automatically connects the case to that side of the supply. If your plug pack has the outer of its DC connector connected to positive then you will not be able to operate your ioniser project in a vehicle that has the battery negative connected to the vehicle chassis without running the risk of shorting the supply if the ioniser's case comes in contact with vehicle ground.

With everything assembled, you can proceed to test it.

Getting It Going

You will need a multimeter and a supply of between 9 and 14 VDC. It would be handy, but not essential, to have a high vltage probe for your multimeter, having an impedance of 10M or more.

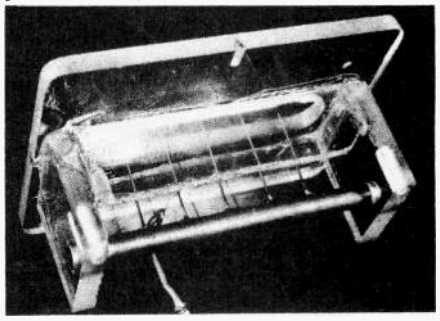
If you do not have a high voltage range on your multimeter to enable you to measure voltages greater than 3 kV, switch it to the current range to read 300 mA full scale or more, and connect it in series with the dc supply input.

Switch the supply on and, assuming all is well, adjust RV1 on the inverter board for minimum current. This could be between about 220-280 mA.

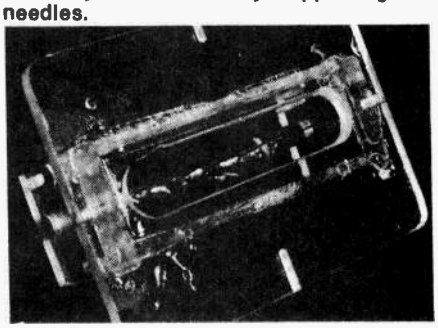
Alternatively, measure the rectifier output (at the anode of D7) and adjust RV1 for maximum output. With a supply rail of 10V, you should get around 3 kV; at 14 V, a little over 4 kV.

Run the unit for a few minutes, then switch off, discharge the rectifier capacitors and feel Q1 and Q2. One should not be markedly hotter than the other, otherwise you have adjusted RV1 incorrectly or you have a fault; most likely a transistor inserted incorrectly or a dry joint between the output of IC1 (pin 3) and the bases of Q1, Q2 or Q3.

Having confirmed everything works as it should, and having adjusted RV1, assemble it all into the



Rear view of our emitter head, showing general construction of the plexiglass 'chimney' and assembly supporting the needles.



Front view of our emitter head, showing the slot and positioning of the needles. Note that the needles protrude about 3 mm beyond the front face.

Fig. 2 Picture of a commercial air ioniser's emitter head, showing construction.

Continued on page 20

ETI next month

30 Years of Canadian TV

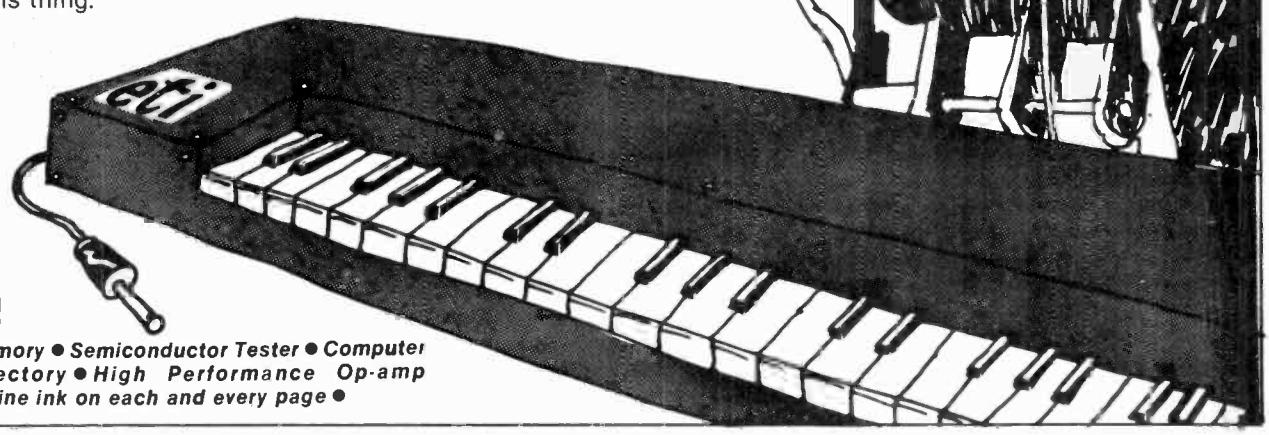
Once, long ago, there was no TV in Canada, and there was nothing to do at night but sit home and watch the radio. A look at the developements of the ensuing years, next month. Stay tuned.

I-Ching Computer

Next month, we present a project to electronically throw the I-Ching (you weren't sure you even wanted to do it by hand, were you?). We also present an article explaining what the I-Ching is, so you can show off to your friends.

Synthesizer

Strike up an oscillator, sound the random noise source; next month, we begin with the first modules of the ETI studio synthesizer. If you've always wanted to play piano and couldn't, we guarantee you'll sound just as bad on this thing.



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● Light Memory ● Semiconductor Tester ● Computer Store Directory ● High Performance Op-amp IC's ● Genuine ink on each and every page ●

Continued from page 18

case and you can check its operation with the blinker.

Turn the ioniser on and grasp the blinker so that your thumb is in good contact with the pad marked by the 'ground' symbol. Hold the blinker such that the 'antenna' pad is about 10 mm in front of the emitter. You should be able to count around one blink per second if all is well and this is a good 'bench mark' for successful operation when you experiment with different head designs and geometries.

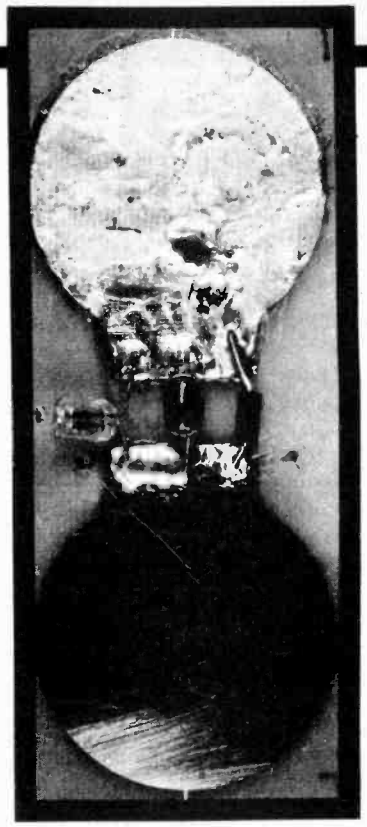
Notes

This project shows but one way to construct a negative ion generator and the electronics can readily serve as the basis for experimenting with different designs. Higher voltages are unnecessary, are not usual in commercial designs and can lead to problems with ozone generation, breakdown, etc. A connection is available on the high voltage board for supplying an 'accelerator' on an emitter head. It should be connected via a 4M7, ½W resistor. The accelerator voltage could be tapped off lower down the rectifier chain if desired; we suggest at the junction of C6 and C8.

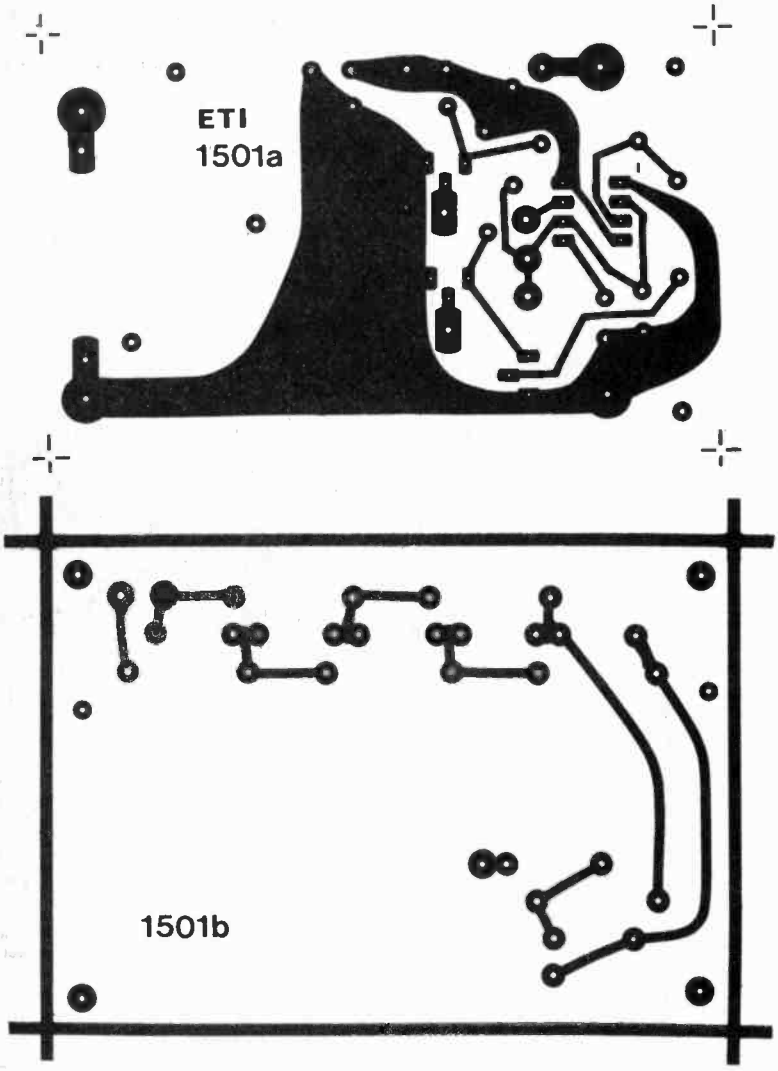
The high voltage board may be mounted separate to the emitter head and four bolt-hole positions are provided on the board.

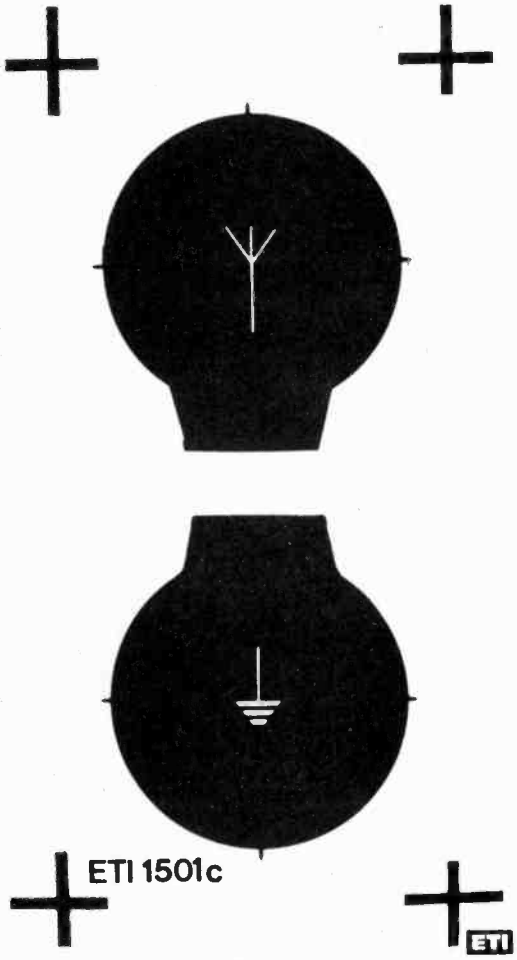
The exact values of capacitors C4 to C9 on the high voltage board are not important and may be any value between about 1n and 22n or so, but should not be lower than 1n. The voltage rating of these capacitors should not be less than 1000 volts.

The DC supply should not be greater than 15 volts, otherwise insulation breakdown within the transformer may be experienced. Likewise, more turns should not be wound on the secondary of T1 or you may experience insulation breakdown.

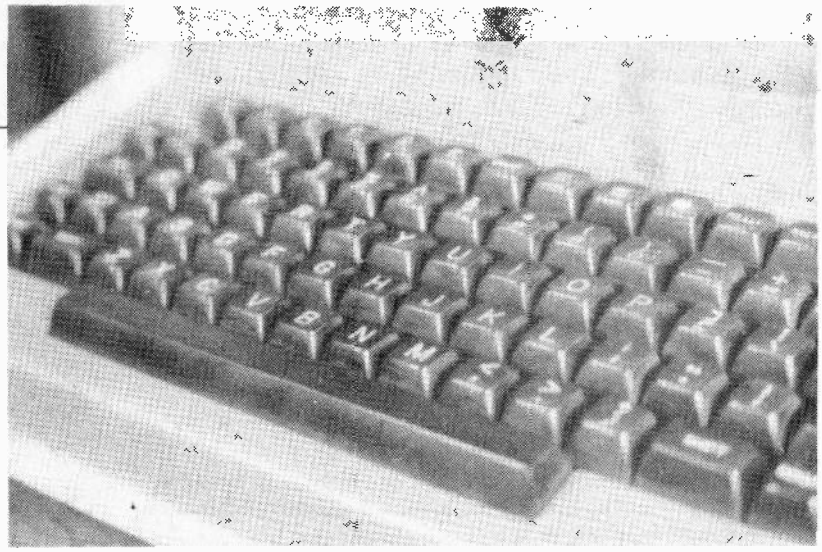


Our 'blinker'. Components are positioned as per the circuit diagram. Cathode of D8 is at the bottom.





Heath Computer Review



The Heath computer: a small but powerful 8080 based system for home or the rigors of high finance, by Steve Rimmer.

THIS MONTH, we're going to peer inside yet another computer, to wit, the Heath/Zenith H-89. Bigger than a breadbox *and* line powered (no need to cart for 678 D cells every time you want to run something), the H-89 is a really nice system for either the fairly well to do home user or for a small business. The basic big grey box as it comes out of the carton is a one piece affair, with a keyboard, a 80 X 24 character screen using green phosphor and one double sided, double density 5¼ inch disk drive, all together in one case with no cables betwixt. Associated with it is a two volume set of documentation for the HDOS disk operating system, plus a very detailed hardware manual and complete schematic.

The 8080 based Z-89-81, with 48K of RAM, one disk and three serial ports is $3995.00. The software, with the DOS, DEBUG, EDIT, ASM assembler and BASIC files, is $195.00.

CP/M, plus a vast and even increasing range of more specialized software is also available for the H-89.

Into the Fray

The first thing one gets to do following the unpacking and subsequent plugging in of the H-89 is to thoroughly check it out. The HDOS operating system includes several routines for exercising the disk drives and making sure the numbers are cool. All told, it takes a couple of hours to get the works going. This is, admittedly, a downer, since one invariably wants to have a quick compute when one first gets one's system up, but it does permit the user to keep track of the running of the disk drives, making them the butt of considerably less suspicion later on.

Upon powering up, the first thing the computer says is "beep", audibly, followed by "H:", vidibly (or whatever). This is a prompt from the boot ROM. If you type "B", it will type "oot", and the game commences. The disk whirrs, and, upon hitting the space bar, we get:

ACTION (BOOT)

The option in the brackets is usually the default, selected by a carriage return. Booting causes a message to show up, "HDOS VERSION 2.0", asks you for the date, insists upon knowing the date if you are reluctant at first, and, eventually, wends its way into HDOS proper. The functional HDOS prompt is "►".

One of the immediately unusual things about the HDOS structure is in the way it handles typos and the rubbing out thereof. It is usually the case that one types on the screen, DELETEing as needed, and the machine sucks the whole line into its input buffer when it senses a carriage return come down. With the Heath, however, it appears that one types directly into the buffer. Thus, if you hit a wrong character, upon mashing the delete key, the last entry into the buffer is read back out onto the screen. Thus, if one were to type the word "WOMBAT", and then choose to unWOMBAT it, the screen would show

WOMBATTABMOW

It works, of course; it just wants some getting used to.

Other control things that are available at the keyboard are CTRL-D, exit back to HDOS, CTRL-G, make the computer beep (oh, gee),CTRL-U, ignore an entry, CTRL-Z, hit this twice and break out of low level hang ups, and SHIFT RESET, which forces a reboot. This whole writhing mess offers one quite a lot in terms of interrupt capability, which is quite desirable . . . oh, the pain of having an un-backed up machine code program crash.

In order to get something useful up and running, there are several things one must undertake before actually having a jolly compute. The first is to back up the software. This means, first off, formatting a blank disk with the INIT routine, and then doing BACKUP. After this, you are supposed to run something called TEST17 . . . which, among other things, trashes the disk and requires that it be INITed all over again. This, however, brings beneficent karma down on the disk drive, so it's probably worthwhile.

Once all the bowings and scrapings are over with, the appropriate bit of software can be transferred from the source disk to an INITed duplicate disk. Depending upon what you're doing at the time, you might want BASIC, EDIT, etc. . . we'll get to these presently. The ONECOPY instruction is useful for duplicating disks.

Software

The software which one would normally get with the system is the

HDOS itself, DBUG,EDIT,ASM and "Extended Benton Harbor BASIC", the latter of which has the added feature of being slightly pompous sounding and making you feel clever. There are tons more stuff available, which we didn't get a chance to look at, however, it's all specialized, and, whatever you do wind up buying, you're still probably going to get these routines. A brief scan, then.

First thing in the book after the introductories and the bits you naturally skip over (some day someone's going to write the first chapter of a manual in Sanskrit to *prove* nobody reads them) is DBUG. DBUG is a glorified monitor routine for coping with machine language programs. Commodore users may be familiar with TIM or SUPERMON, which are similar. The features of DBUG are:

- Display memory location contents.
- Change memory location contents.
- Display 8080 register contents.
- Change 8080 register contents.
- Execute a program.
- Single step through a program.
- Install breakpoints.
- Load programs from a device (e.g., the disk)
- Dump programs to a device.

The display of DBUG can be set to run in several modes, including characters, decimal and weird split octal.

The features of DBUG aren't too hard to get used to if you've already had to puzzle through a monitor some time in the past. To display a range of RAM contents, one simply enters the first and last addresses, and, yes, thar she blows, numbers everywhere. Typing an "=" permits altering a byte.

8080 registers can be peered at either collectively, by typing CTRL-R, or one at a time by entering "REG" (as opposed to unleaded premium, perhaps), and then the name of the desired register. Once again, the mighty "=" allows changing the registers.

STEP would, as one might have imagined, be the single step actuator. One can specify the step increment (up to 255), and the starting address. The STEP, of course, allows one to run a program one instruction at a time to watch what it does at each turn.

Breakpoints are also useful in debugging a program, as they cause the thing to halt when one is reached. Thus, for example, if one wanted to see whether a certain subroutine were being called, one could stick a breakpoint in it; the program would stop if it hit it. DBUG has an eight entry breakpoint table. Breakpoints can be cleared individually, or breakpoint genocide can be undertaken, wiping them all out in one fell swoop.

GO executes a program at the address specified, or wherever the program counter is if one is not. EXEC does the same thing, but includes the breakpoints.

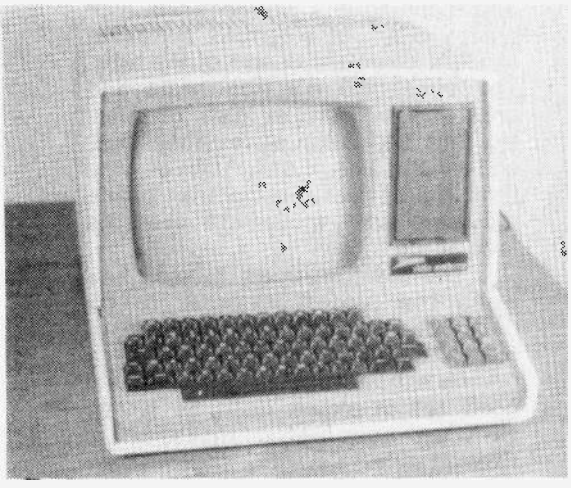
DBUG has a moderate amount of low level command syntax checking, and will do some error messages if you tell it to do something impossible or rude.

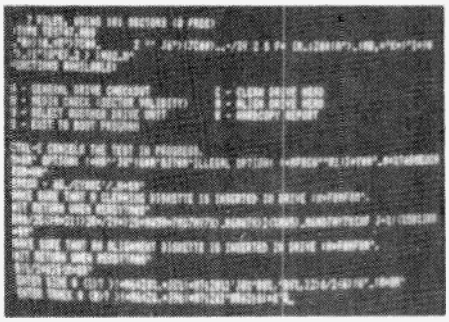
EDITing

The EDIT text editor is a general purpose text creation thing. Text can be text (I suppose this goes without saying), making the H-89 into a moderately poor man's word processor, BASIC programming, assembler mnemonics, etc. The EDIT occupies some 12K of RAM, with whatever is left over being the text buffer.

The text can contain all the printable ASCII characters, forming both printable and non-printable words, depending upon the bent of your mind. Control characters, with the exception of CTRL-I and CTRL-L, are uncool.

There are two modes for EDIT, these being the Text mode and the Command mode. The former is passing simple; type your brains out and your deathless prose winds up in the buffer. CTRL-C goes into the command mode. This is, of necessity (all that documentation has to have words on it, after all) a bit more complex.





Without doing a Reader's Digest trip on the manual, the Command mode allows one to modify the text in the buffer. The features are changing characters, changing lines, replacing old strings with new strings, deleting lines, inserting text, printing the buffer and, when you're really fried and want to trash the lot, blitz, which kills all the buffer contents.

Further commands are available for the expected I/O, as one would expect.

ASseMbler

We're going to be quite brief with the assembler, as it's profoundly involved, and the prospective user will want to have a proper dig through the documentation before even imagining he or she comprehends it. However, let it be known to all mankind and yourself as well that the software is straight forward, the documentation understandable, and the little fidgety programs I wrote with it worked.

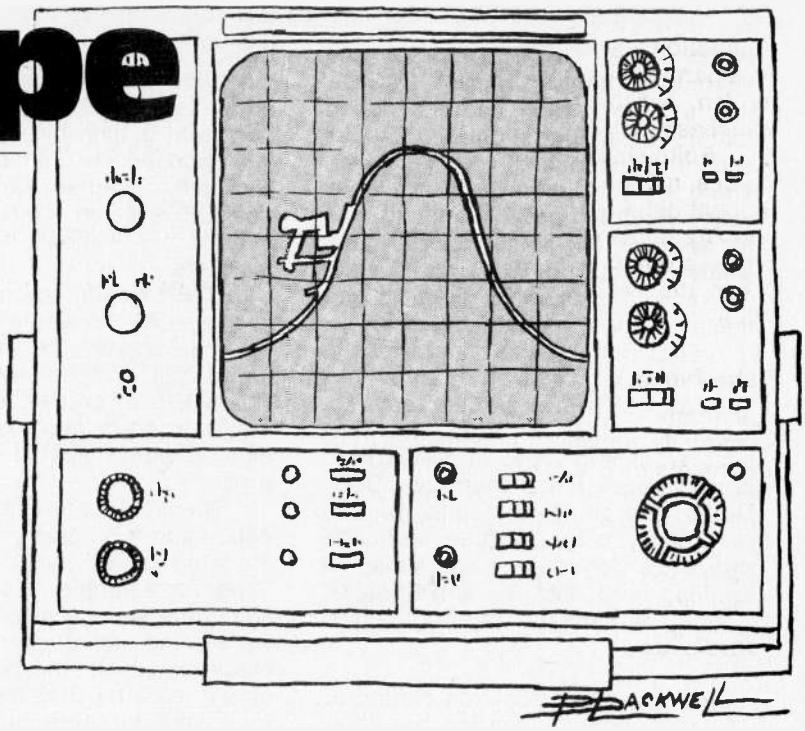
The part that makes explaining the assembler impractical in this space is that it requires a decent explanation of 8080 machine code instructions first. . . another time, mayhaps. However, for those not familiar with assemblers, we shall venture forth into their function a bit.

If you have a computer with a monitor, all you can do is to change bits in RAM. This makes writing machine code programs very tedious indeed, because you have to devise the architecture, look up all the codes, figure out the branches and jumps, and then enter it. Insert or delete one measly byte somewhere along the line and most of the branches and jumps require recalculation. Mondo drag.

The ASM allows you to write a program in 8080 machine language mnemonics. Acorn ATOM users will be familiar with this sort of trip for the 6502 processor. This is actually just text which the ASM routine then translates into bytes. After it's been

Continued on page 36

The Scope



There's no substitute for 'looking inside' a circuit when you really want to know what's going on. The oscilloscope must surely be the most versatile electronic instrument even invented. Les Bell and Roger Harrison take you on a guided tour.

ONE OF THE BIGGEST barriers people face when they take up electronics is cultivating the ability to visualise what is happening in a circuit. It is fairly easy to work out the DC conditions in a circuit, but electronic circuits are generally dynamic in nature; that is, the voltages and currents in a circuit change according to an applied signal or function of the particular circuit (as in amplifiers and oscillators, respectively).

The problem is, you can't see what's happening! The "good books" may tell you what happens ideally, but the real world is very often quite different.

What's needed is some kind of window into the circuit to enable you to see what's happening, to get that intuitive feel which will make understanding that much easier. The window is, of course, the oscilloscope. Without it, the circuit designer may very well be blinded.

Oscilloscope Basics

The heart of a Cathode Ray Oscilloscope (CRO) is the cathode ray tube (Fig. 1). It consists of an evacuated tubular glass envelope, flared at one end. In the tubular portion, or the neck, is an "electron gun". This generates a narrow, focused beam of fast-moving electrons which are directed towards the flared end, past a set of parallel plates (the deflection plates), the large end of the tube being covered in a special coating (on the inside) called the 'phosphor'. When the electrons strike the phosphor, it emits light ('fluoresces') and you see a spot. Spot deflection is achieved by varying the electrostatic field between the deflection plates. Some CRTs use electromagnetic coils around the neck of the tube for spot deflection (TV tubes for example)

The electron gun contains a heated cathode (K) which boils off electrons. These are attracted to an anode (A_1) which is very much more positive than the cathode by at least several thousand volts. As they accelerate towards the anode, the electrons pass through a control grid (G), which is a cap of metal around the cathode and somewhat negative with respect to it. This electrode is used to control the brightness of the spot. If the negative potential on G (with respect to K) is increased, fewer electrons will pass and the spot brightness will decrease, and vice-versa.

Between the control grid and the focusing grid there may be a second grid, the screen grid, which is usually around 300 V positive. Following the focusing anode (A_1) there is usually a second anode (A_2). Voltage on the final anode is very high; usually several thousand kV. Alternatively, between the control grid and the second anode, there may be an Accelerator electrode (sometimes called a 'pre-accelerator') at the full final anode voltage. This arrangement consitutes a focusing scheme called an 'einzel lens'. Varying the potential between K and A_1 will vary the spot size. This is used to focus the spot.

The result of all this accelerating and focusing is a well-focused, high energy beam of electrons travelling straight down the centre of the tube. To deflect the electron beam and create a display, a pair of electrostatic deflection plates are provided for each axis (X and Y). An electric field will deflect the electron beam, providing spot movement over the face of the tube.

The electron beam passes between the plates in order to be deflected, but after the first set of plates the beam can be anywhere in quite a large area. This means the second set of plates must be larger, with an associated increase in capacitance. Usually, the vertical

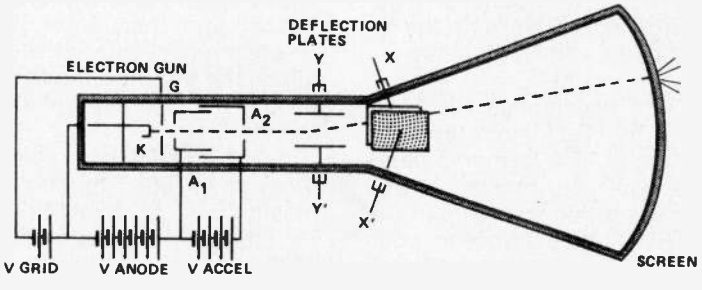


Fig. 1 The internal structure of a typical cathode ray tube.

deflection plates come first, since the Y channels require greater bandwidth, while the X channel or timebase requires a lower bandwidth.

Following the deflection electrodes, many electrostatic CRTs have a post-deflection accelerator which usually takes the form of a graphite spiral around the envelope funnel between the neck and the face of the tube.

Tube Types

Electrostatic deflection types are commonly employed in measuring instruments as they offer much greater bandwidth operation than magnetic deflection tubes, which are principally limited by yoke inductance. On the other hand, electrostatic deflection tubes are limited to beam deflection angles less than 20% off axis while electromagnetic systems can achieve a maximum deflection of ±55°. This is why oscilloscope tubes (electrostatic types) are so much slimmer than TV tubes (which use magnetic deflection) of similar length.

Some demonstration and teaching oscilloscopes use standard TV tubes with magnetic deflection. While the display is much larger than a standard oscilloscope, the bandwidth limitations allow them to display only signals generally less than 100 kHz. Oscilloscopes using electrostatic CR tubes may have bandwidths of 10 MHz commonly, and up to 100 MHz without using special techniques.

The general purpose of an oscilloscope is to examine voltages (or sometimes currents) as they change with time. There are other modes of operation, but as this is the fundamental one, let's start with it.

In order to display a waveform that is varying with time, we must draw the spot across the face of the tube, from left to right, return to the starting point and repeat. To do all this, the voltage impressed on the X deflection plates is increased at a linear rate with time, to draw the spot from left to right, then reduced to zero (or the starting voltage) suddenly to return the spot to the starting point, and so on. This establishes a 'time base' as the spot takes a known amount of time to travel from left to right across the screen.

At the same time, the waveform to be examined (suitably amplified) is applied to the Y deflection plates. The spot will then trace out a graph of the waveform on the CR tube screen as shown in Fig. 2.

If the time taken for the spot to travel across the screen has a definite relationship to the frequency of the waveform being examined and if the start of the trace (at the left-hand side) is arranged to commence at some definite point on the waveform (i.e., synchronised), then a stable trace will result on the screen.

For example, say we wish to display two cycles of a 60 Hz voltage. The horizontal deflection, or timebase, would have to sweep the spot from left to right in the length of time it takes to complete two cycles at 60 Hz; 33.2mS. The timebase would make 30 sweeps per second, that is, it would be running at 30 Hz.

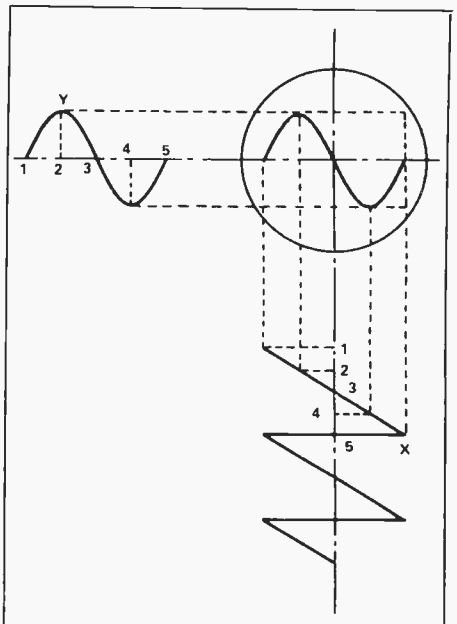


Fig. 2 Showing how the deflection waveforms applied to the X and Y plates of a cathode ray tube cause the electron beam spot to trace out a faithful replica of the Y-input waveform.

In a practical oscilloscope, during the return sweep of the X deflection (the flyback), the electron beam of the CR tube is turned off, or 'blanked', so that it is not displayed: otherwise the resultant squiggle would become confused with the desired display!

The signal applied to the X deflection plates of the CR tube is often referred to as the 'sweep', although the term 'timebase' is generally more common.

Oscilloscope manufacturers include a 'graticule' on the screen of their instruments as a convenient reference enabling quite accurate time and amplitude measurements to be made. The graticule may be a transparent plastic cover placed over the CR tube face, scored with grid lines at convenient intervals (generally 10mm) or, as in the more expensive types, it may be scanned directly on the face of the CR tube during manufacture. The latter provides a more accurate reference than having a separate external graticule.

The general form of most general-purpose oscilloscopes is shown in Fig. 3. As you can see, there are four basic components: the Cathode Ray Tube, the Vertical Circuits, the Horizontal Timebase Circuits and the Power Supplies.

The Timebase and X Amp

So that waveforms of widely varying frequencies can be displayed, the timebase must be variable over a very wide frequency range. Accordingly, oscilloscopes are made with the timebase range switched at convenient increments. The actual ranges included on an instrument depend on the applications for which it is intended, but typically the minimum sweep rate may be 20s for a full sweep (generally 2 s/division) ranging up to a maximum of 1 us for a full sweep (0.1 us/division). The range steps generally go in intervals of 5, 2, 1. A vernier control is always provided so that a display may be varied for some convenient purpose.

The timebase generator provides a 'sawtooth' waveform (that's what it resembles) for the X deflection. This is amplified and applied to the X plates of the CRT. The width of the timebase deflection on the CRT depends on the amplitude of the sweep waveform. Thus a width control may be provided by having a potentiometer to control the gain of the X amp. A DC voltage or bias applied to the X plates will determine the horizontal position of the trace on the CRT face. Thus, a potentiometer to vary the DC bias on the X plates is provided as a horizontal position control.

So that the timebase generator may by synchronised to the waveform being examined (to provide a stable trace as explained previously), a trigger circuit is included. The timebase may be triggered internally by sampling some of the signal going to the Y deflection plates or from an external signal. This is very convenient in particular applications which are explained later.

For some particular applications (phase measurement, frequency comparison) a sawtooth sweep is undesirable for X deflection, so that direct access to the X amp is required. For this purpose the input of the X amp can be switched to a front panel socket generally marked "horizontal input" or an abbreviation of the same.

The Vertical Or Y Amp

The signals one may wish to examine might range from microvolts to hundreds of volts! The lower level signals will require amplification (as the deflection voltages required may be tens of hundreds of volts), the higher level signals will require attenuation. Accordingly, a sensitivity switch is provided ahead of a high gain, low distortion amplifier; the Y amplifier.

The most sensitive range of common oscilloscopes is typically 5 mV to 10 mV per centimetre (one graticule division). More expensive types may have a maximum sensitivity as high as 10 uV/cm. The insensitive end of the range will generally be around 50 V/cm for run-of-the-mill CROs, but special instruments (e.g., those used for electrical supply applications) provide for levels as much as ten times higher. As with the timebase range control, sensitivity steps are generally 5, 2, 1 intervals. A vernier sensitivity control is provided for convenience.

The bandwidth of the Y amp is an important factor in the selection and application of an oscilloscope. A general purpose instrument may have a bandwidth extending from DC to 10 MHz or 15 MHz. Inexpensive units may only extend to 3 MHz. Magnetic deflection units (generally for demonstration or teaching applications) may only reach 20-50 kHz, a few struggling as high as 100 kHz. High quality instruments ($$$$!) may have bandwidths as great as 350 MHz. Special instruments, using sampling techniques, may reach 1 GHz (1000 MHz!).

To examine AC waveforms superimposed on a DC voltage, the Y amp must be AC-coupled. Accordingly, a switch is provided that inserts a capacitor in series with the input.

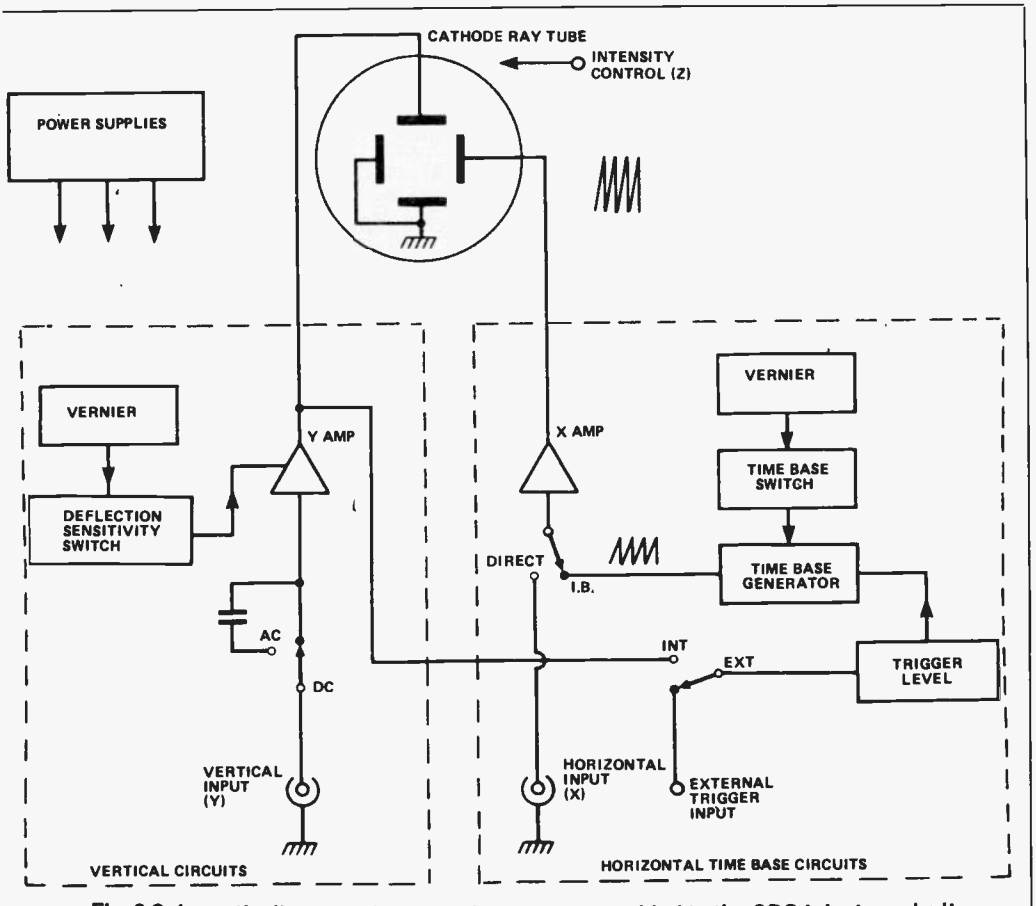


Fig. 3 Schematic diagram of essential sub-systems added to the CRO tube to make it a measuring instrument.

The range of input sensitivity may be extended by the use of probes which can provide such facilities as very high voltage attenuation and increased input impedance.

The vertical position of the trace is determined by a DC bias applied to the Y plates of the CRT, in the same manner as for the X plates.

The Z Input

If 'Y' represents the vertical axis and 'X' represents the horizontal (time) axis, then what on earth is the 'Z' axis?

The only thing left to vary on a CRT display, after moving the spot vertically and horizontally, is the intensity of the spot. Accordingly, most CROs will include a Z input. In general, this allows for blanking and brightening of the display or for marking particular types of measurements.

That completes the description of your basic oscilloscope.

Dual-Trace Operation

It is often helpful to be able to display two waveforms at the same time; for example, to measure the phase change on a signal pasing through an amplifier stage. This can be achieved in two different ways.

One can simply build two completely separate guns and two sets of deflection plates into a single CRT envelope. These dual-beam CRTs are complex and expensive, and they require two completely separate sets of drive amplifiers; more expense.

The alternative used in most modern dual-beam scopes is dual-trace operation in which a single-beam tube is used to display two traces by switching between them. Two methods of beam-switching are used; one can either switch between traces at the end of each sweep, which is suitable for high-frequency waveforms, or at lower frequencies one can switch alternately between the waveforms as the sweep progresses across the display. The first method is called alternate trace, the second is chopped trace operation.

These basic principles apply to all oscilloscopes, except some types which are intended for specialised applications. Of course, oscilloscopes are more complex then this in practice. Perhaps the best way to see some of the more sophisticated facilities is through the controls on the front panel of an oscilloscope of medium complexity.

Choosing (Not Using) A Scope

There comes a time in every young man's life when he can't figure out what on earth the circuit's doing, so he decides to buy an oscilloscope. Of course, everyone has different requirements; digital circuitry, RF, high fidelity, process control, computer equipment. . . these applications all have widely varying characteristics, so what should one look for when evaluating the performance of a CRO?

The most obvious consideration is bandwidth. The bandwidth of a general purpose oscilloscope is the frequency at which the total gain of the oscilloscope is 3 dB down on its mid-band performance. There are several limitations on the bandwidth of an oscilloscope, ranging from the bandwidth of the amplifier stages themselves to the time which the electron beam takes to pass between the deflection plates and the amount of energy required to make the phosphor glow. For example, if the input waveform goes through a complete cycle during the time that an electron is passing between the plates, then the deflections will average out, giving a net deflection of zero!

In the DC mode, there is no problem with low frequencies right down to DC, particularly when using long-persistence phosphors. The bandwidth figure given in specifications is therefore the upper frequency limit of the scope.

Closely related to bandwidth is the risetime of the scope. This is the time taken for an input square (really square) wave edge to go from 10% to 90% of its value on the screen. Unfortunately, on high performance CROs, this is well nigh impossible to measure. It is usually calculated from the bandwidth instead, using the formula:

$$\tau = 0.35/BW$$

The vertical amplifier system of a scope should ideally have a risetime five or more times faster than the risetime of the fastest signal it is intended to examine. In this case risetimes measured on the scope will have less than 2% error.

It is generally important to get the highest bandwidth and fastest risetime your money will allow. When examining a square wave signal, for example, Fourier analysis tells us that the square wave is actually composed of a series of harmonics of the fundamental frequency.

If the vertical amplifier and tube of a scope lop off the fifth and higher harmonics, the square wave will be noticeably rounded. In this case, risetime measurements will be virtually meaningless.

Glitches in digital circuitry will virtually disappear on a narrow bandwidth CRO rendering it almost useless for digital troubleshooting. Thus, although you may be working with quite slow logic, a high speed scope is still very useful. For a typical hobbyist with no specific requirements or interests, a 15 MHz oscilloscope would probably be ideal.

Probes

A point to watch for, particularly with high frequency scopes is the selection of suitable probes. The capacitance of the probe leads can severely limit the bandwidth of an instrument so it is essential to use the appropriate probes.

Most oscilloscopes have an input resistance of 1M0 and x1 probes will give this resistance at the probe tip plus a capacitance which is in parallel with the scope input capacitance (usually around 20-30pF). For higher input resistance, x10 probes are available. They include a 9M0 resistor, thus raising the input resistance to 10M.

Probes require compensation for capacitance effects which limit their bandwidth. For very wide bandwidth operation, complex compensation networks may be used. Typical probe circuits are illustrated in Fig. 4.

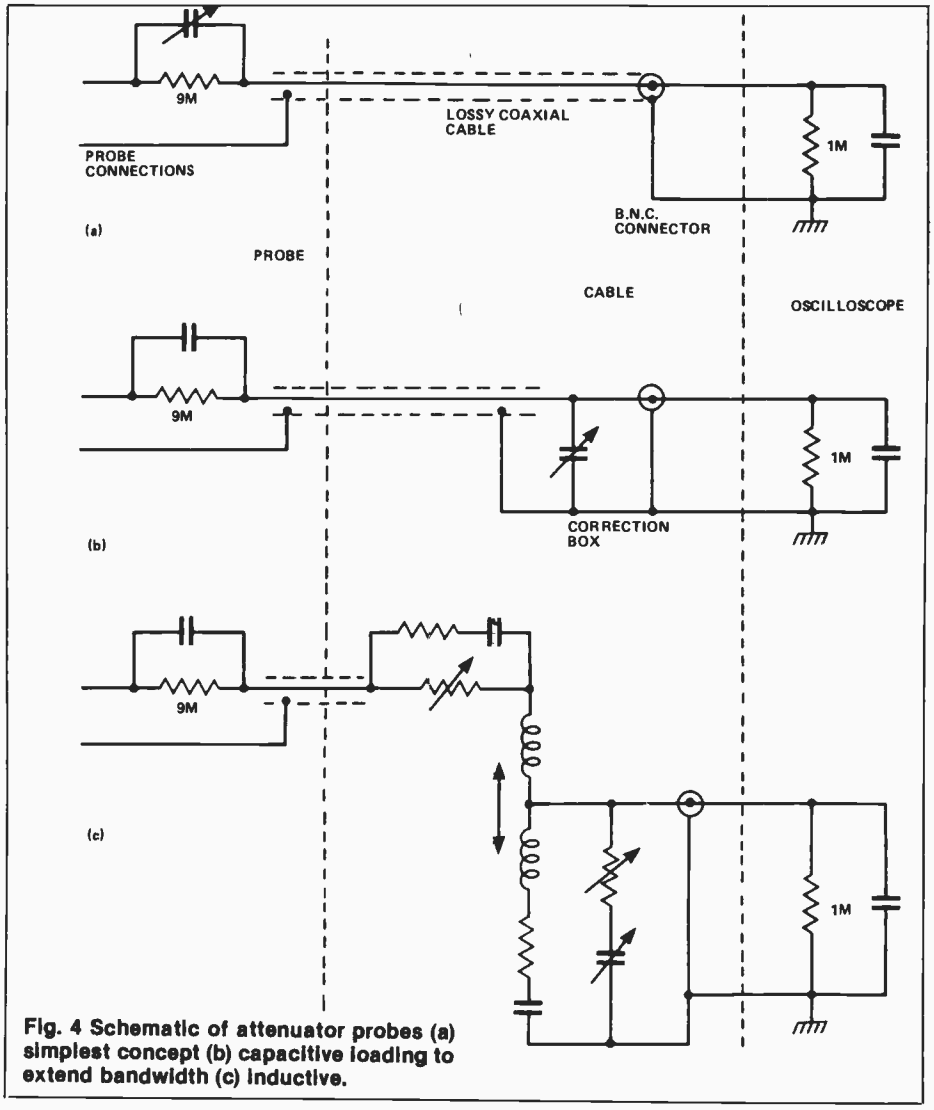


Fig. 4 Schematic of attenuator probes (a) simplest concept (b) capacitive loading to extend bandwidth (c) inductive.

Sensitivity and Accuracy

The sensitivity of an oscilloscope is usually expressed in mV/cm or

mV/div, and in general, a higher sensitivity scope is more useful than an insensitive one.

Accuracy, in the absolute sense, is probably less important than with other pieces of test equipment, as an oscilloscope is generally used for qualitative analysis. Most oscilloscopes have an accuracy of ±5%, but as one moves into a laboratory, as opposed to service/general purpose machines, ±3% accuracy is more common. It is tempting to suppose that by buying a more accurate oscilloscope, one could save money on other test equipment, but this is not the case. Modern digital test equipment is now quite cheap, while accurate oscilloscopes are not, even leaving aside the inconvenience of making measurements by counting divisions on the graticule.

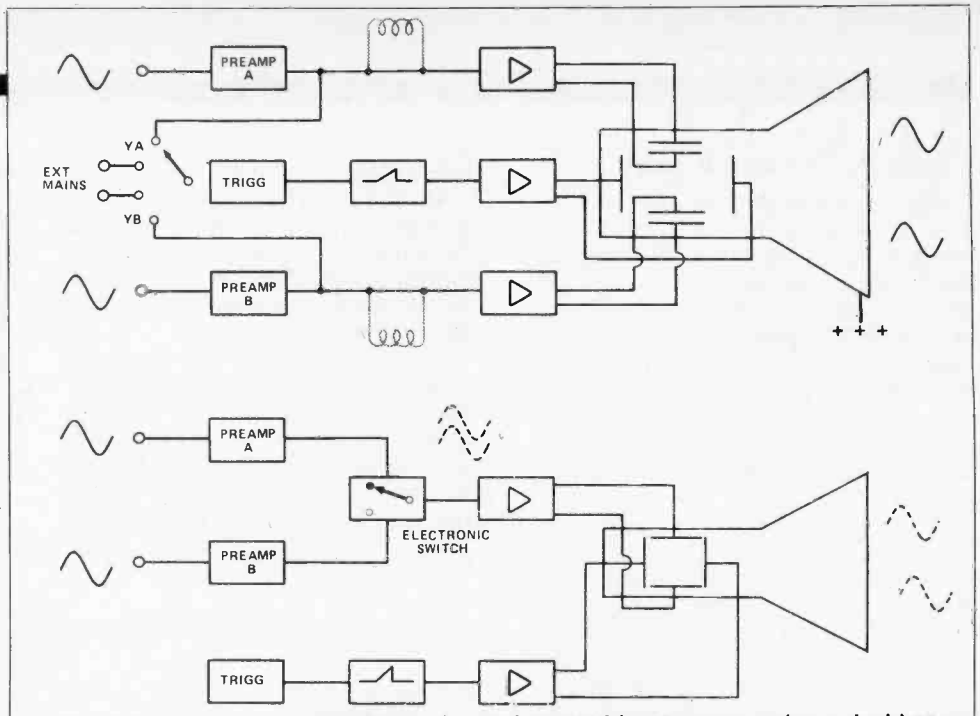


Fig. 5 Dual-trace oscilloscopes can be implemented in two ways: using a dual beam cathode ray tube or using a single beam tube and electronic switching of the trace. The block diagram at the top is of a Philips model 3232 and is typical of dual-beam types. The block diagram at the bottom shows the electronic switching techniques of obtaining dual-trace operation with a single beam cathode ray tube

Other Facilities

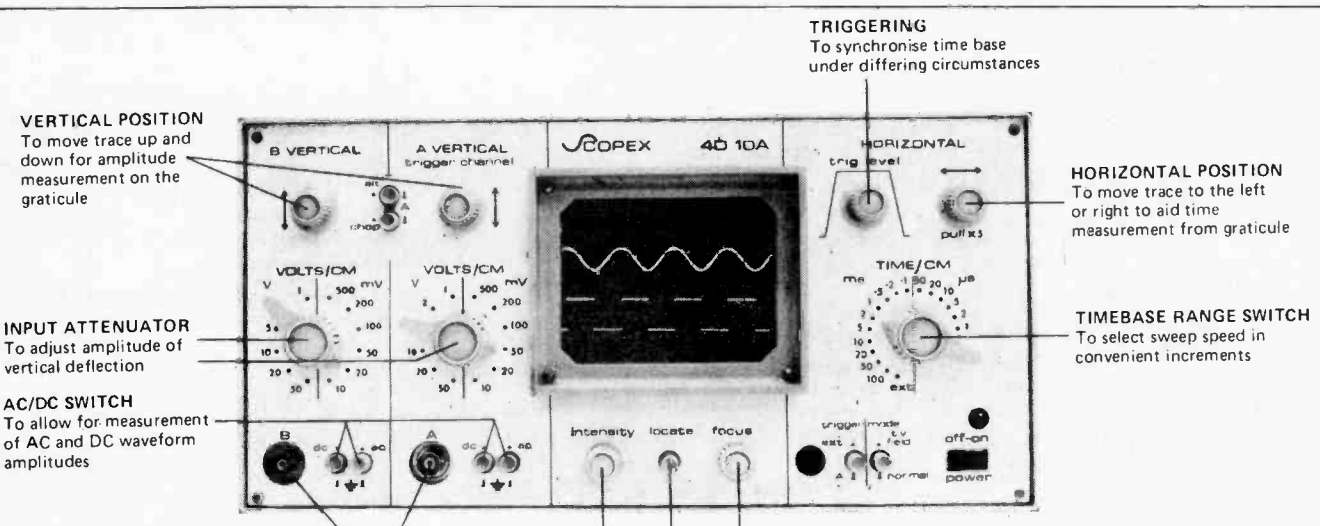
In deciding on an oscilloscope, several other factors ought to be taken into consideration. The obvious question is: will I need a dual-trace scope? There is very little to be said about this choice; you pays your money (as much as you can afford) and you takes your choice. Single-trace scopes are becoming quite rare beasties, in fact, as the dual-trace types are considerably more versatile.

The triggering facilities of a prospective purchase should also be carefully examined. It's probably true to say that poor triggering on a scope can render it the greatest bugbear of the user's life; virtually useless, in fact.

Unfortunately, there is no universal way to specify the triggering performance of an oscilloscope. It is best to arrange a demonstration, either by the dealer or by an associate or friend who has used the oscilloscope in question. In any case, it is generally wise to ask around for other users' impressions when considering such a major purchase.

A useful facility on some oscilloscopes is the provision of two timebases with delayed sweep facility. In this mode of operation, for the first timebase, the delaying sweep is triggered by the trigger circuitry, and continues for selected delay time. When this time is reached, the second timebase takes over (usually at a higher speed), providing accurate resolution of an event which can occur some time after the trigger event.

ETI



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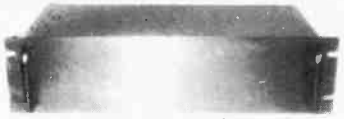

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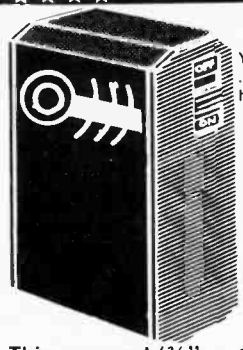

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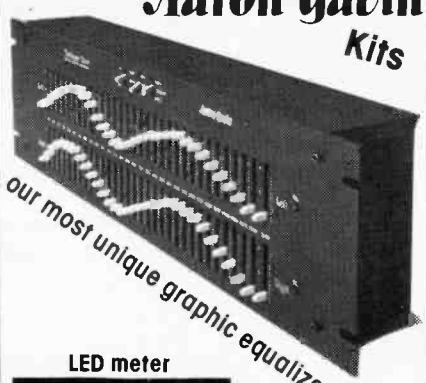

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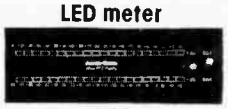

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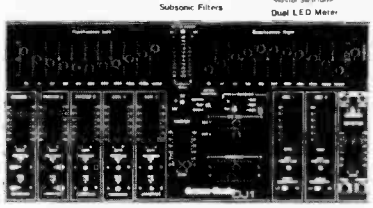

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Drum Box

Sticks is a small, self propelled drumming machine. . . just the thing for one man bands or aspiring rockers. Designed by Steve Rimmer

PLAYING ALONG with a rhythm box is very much like playing with a maniac. . . a drummer who refuses to deviate from what he's doing no matter where the music goes. One does not notice the subtle changes even a really bad drummer does until one gets in with a machine that does none at all. Still, for practicing, for doing lounge gigs, or for producing a few hundred feet of new wave, a synthetic drummer can find its uses. At the very least, it will produce some interesting noises when you get tired of your stereo.

"Sticks" is a moderately sophisticated drum box. It produces the sounds of five separate percussive instruments; bass drum, brushes, snare drum, conga and wood block. It can also generate these sounds in any of six switch selectable rhythms, to wit; rock, samba, bossa nova, waltz, slow rock and swing. The beat rate can be varied from rigor mortise to computer music. There is a built-in amp to drive the box's internal speaker, or, for recording applications, a phone plug stuck in the external signal jack will switch off the amp and divert the sound to external inputs.

The heart of Sticks is a National IC that generates the rhythm patterns: the MM5871N. This absolves the builder from a great deal of fiddling with discrete parts. This chip also contains an on-board clock generator. Another National IC, the MM5837N, contains a long shift register which generates psuedo-random noise to produce the brush and snare sounds. The rest of the chips are pretty common.

Construction

The two specialized chips are a bit scarce, and, to make sure that there are no problems in getting them, we've arranged to have them supplied to ETI readers by Altair Electronics. Further information can be located in the parts list.

The project is built in a Hammond case, as indicated in the parts list. Be aware that it *just* fits; if you elect to use this case, you will have to trim the PCB and bend or break off a protruding bit on SW1.

Once you have all the parts together, begin by stuffing the board. The jumpers and IC sockets go on first, followed by the passive components and semiconductors. If you elect to use the same case style as we did, cut its front panel and mount the pots, switch, phone jack and the speaker. We were unable to get a three inch speaker grill, and wound up using a piece of ¼ inch coarse screen over the speaker opening; this is more than adaquate to protect the cone. Continue with the fuse holder and switch cutout for the back panel, and drill a hole for the line cord grommet.

The power supply parts, being few in number, and simple, are bolted individually to the top of the case, rather than providing a separate PCB for them. It is essential that C22 and C23 be attached directly to the regulator pins; otherwise, the regulators tend to oscillate. If space gets to be tight, C23 can usually be reduced to about 10 nF with no ill effects.

There are quite a number of wires connecting the front panel to the PCB, so take some care in getting these right (especially the power leads). Lead dress isn't critical. It was our (terrifying) experience that reversing the power causes the transistors and the op amps to explode quite dramatically, but leaves the expensive chips untouched. Still, we recommend checking everything over a few times.

With the project completed, and the IC's plugged in, switch the power on. By adjusting the RATE and VOLUME controls, you should be able to get the sounds of five different bopping electronic drums. . . don't be surprised if they don't sound *exactly* like blocks, congas, etc. As drum synthesizers go, these are quite simple. The resulting beat, however, is rather pleasing, and should faintly resemble music.

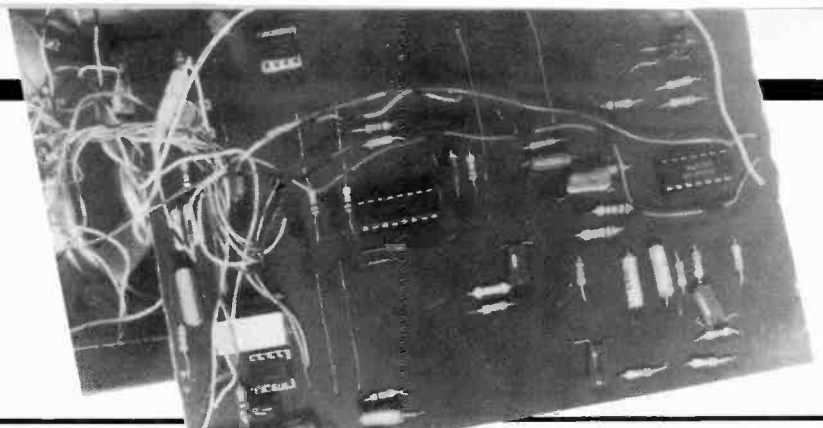
It is possible to get the box going and have one or two voices dead. If you suspect this of being the case, either 'scope the outputs of the suspected op amps (you may have to isolate them from the mixing bus by lifting their associated mixing resistors (R3, 6, 9, 12 and 17)), or disconnect all the known good voices from the bus (again by lifting resistors). These sound generators have proven suprisingly trouble free, and very stable over a long period of time.

Playing

There is nothing to set up for Sticks; it should go fine right off the bat. If you want to have one voice louder or softer than the others, adjust its associated mixing resistor by a few K. The amplifier picks up a bit of whine from the rhythm chip's clock, but this is usually not noticeable unless you turn up the volume full blast and the rate pot right down.

You are now ready to go out and drive people totally. . . *mad!*

PARTS LIST — DRUM BOX



Resistors (all ¼W, 5% unless otherwise noted)

R1	2k2
R2	2M2
R3	5k6
R4	6k2
R5	910R
R6,9,10,17	1k5
R7	1k
R8	6k8
R11	4M7
R12	2k7
R13,15,16	1M
R14	680R
R18	27k
R19,24	10k
R20	10k log pot
R21	10R
R22,23	220k
R25	33k
R26,27, 31,35,36	100k
R28	3k
R30	3k9
R32	200k
R33	1M linear pot
R34	120k

Capacitors (polystyrene, polyester or polycarbonate unless otherwise noted.)

C1,2	.047 uf
C3,4	.01 uf
C5,6,15	.022 uf
C7,8	.0082 uf
C9,10,18,19	.005 uf
C11	.22 uf
C12	1 uf
C13	.05 uf
C14	250 uf 25V electrolytic
C16,17, 22,23	.1 uf
C20,21	1500 uf, 25V electrolytic

Semiconductors

IC1	LM324
IC2	LF353N
IC3	LM386N
IC4	MM5871N*
IC5	MM5837N*
IC6	7812
IC7	7912
Q1,2	MPS6515
D1-4	50Volt, 1 Amp bridge
D5,6	1N4148

Miscellaneous

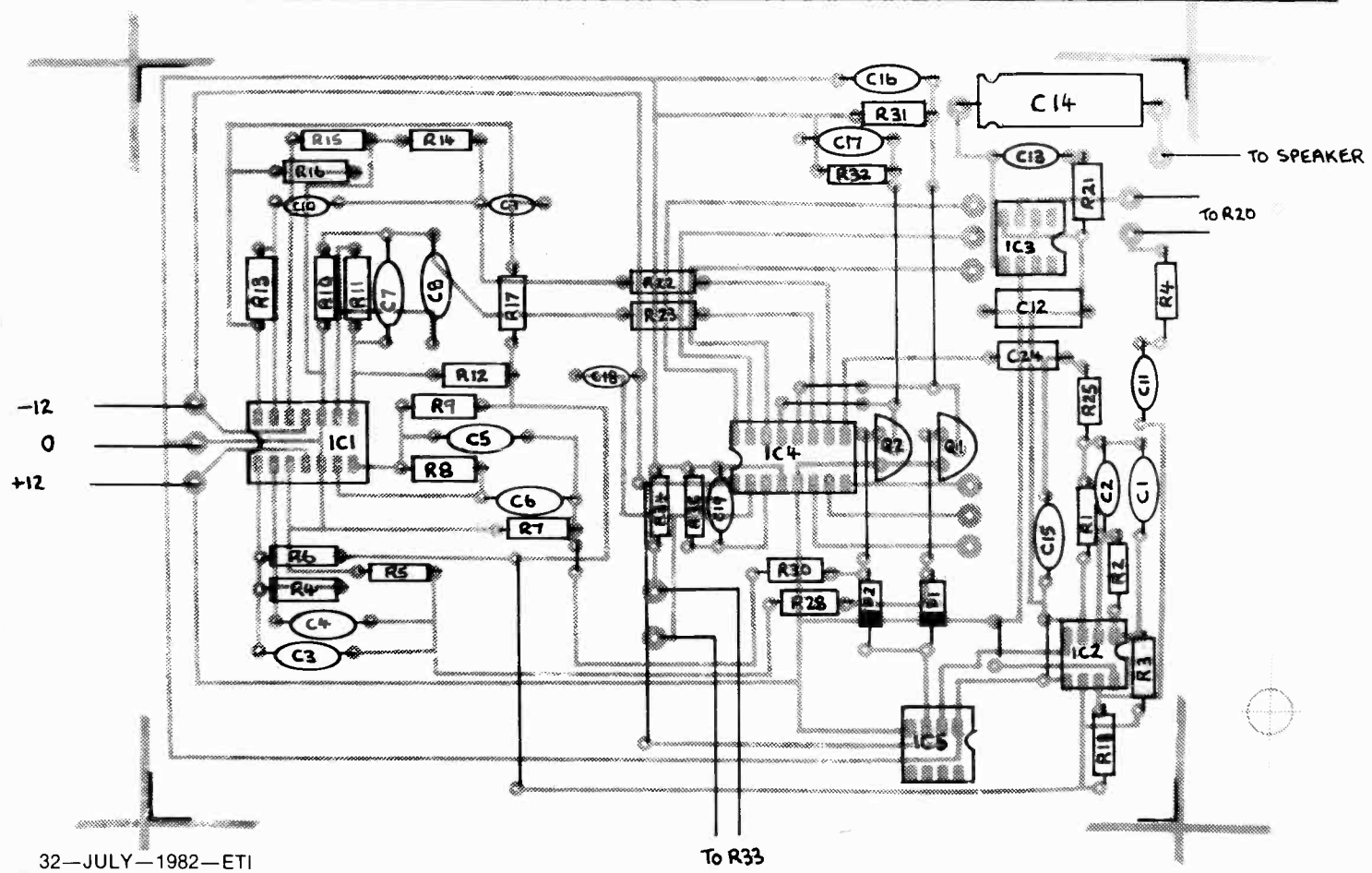
T1	30 VAC CT 500 mA
J1	Phone jack with N/C contact
SW1	1 pole, 6 pos (Switchcraft 90064B06 and 6 A650)
Speaker	3 inch, 8R

Case Hammond 1456 FE3 CBU and 1456 FE3 PBK line cord, power switch (Armaco SW113 or similar), hardware, etc.

***The two MOS chips, MM5871Nand MM5837N, are unusually hard to find. However, they are being supplied to ETI readers for tis project by:**

Altair Electronics Enterprises Ltd.
660 Progress Ave.,
Kingston, Ont.
K7M 4W9

Prices are $19.50 for the MM5871N and $4.50 for the MM5837N. Ontario residents please add 7% sales tax. Quantities are limited.



ETI SPECIALS

Electronic Circuit Design — $3.95
92 pages
A collection of major articles on various aspects of circuit design including CMOS, Audio Amplifiers, Power Supplies, SCR's, Op-Amps, Using the 3080 and Temperature Control. A large number of useful circuits are given but the emphasis is on guidance and how to tackle the design for yourself.

Hobby Projects — $3.95
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First published Summer 1980. Contains 25 straight-forward projects most of which have never appeared in the magazine including: Stereo Amp, Audio Mixer, Scratch and Rumble Filter, Equaliser, Constant Volume Amp, Graphic Effects Unit, Envelope Generator, White Noise Intercom, Drill Speed Controller, LED Tacho, Parking Meter Timer, Electronic Ohmmeter, Switch, Electronic Organ, Touch Receivers, Dice, Siren, Simple

Projects Book No. 2 — $3.95
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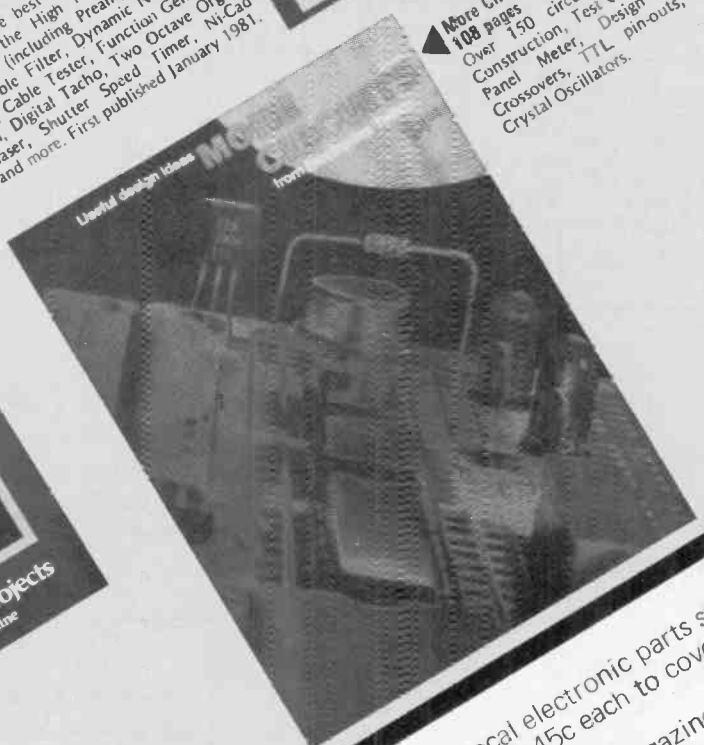
Contains 25 of the best projects from recent issues including the High Performance Series 4000 Amplifier (including Preamps and Power Supply), Rumble Filter, Dynamic Noise Filter, Logic Probe, Cable Tester, Function Generator, Rain Alarm, Digital Tacho, Two Octave Organ, Light Chaser, Shutter Speed Timer, Ni-Cad Charger and more. First published January 1981.



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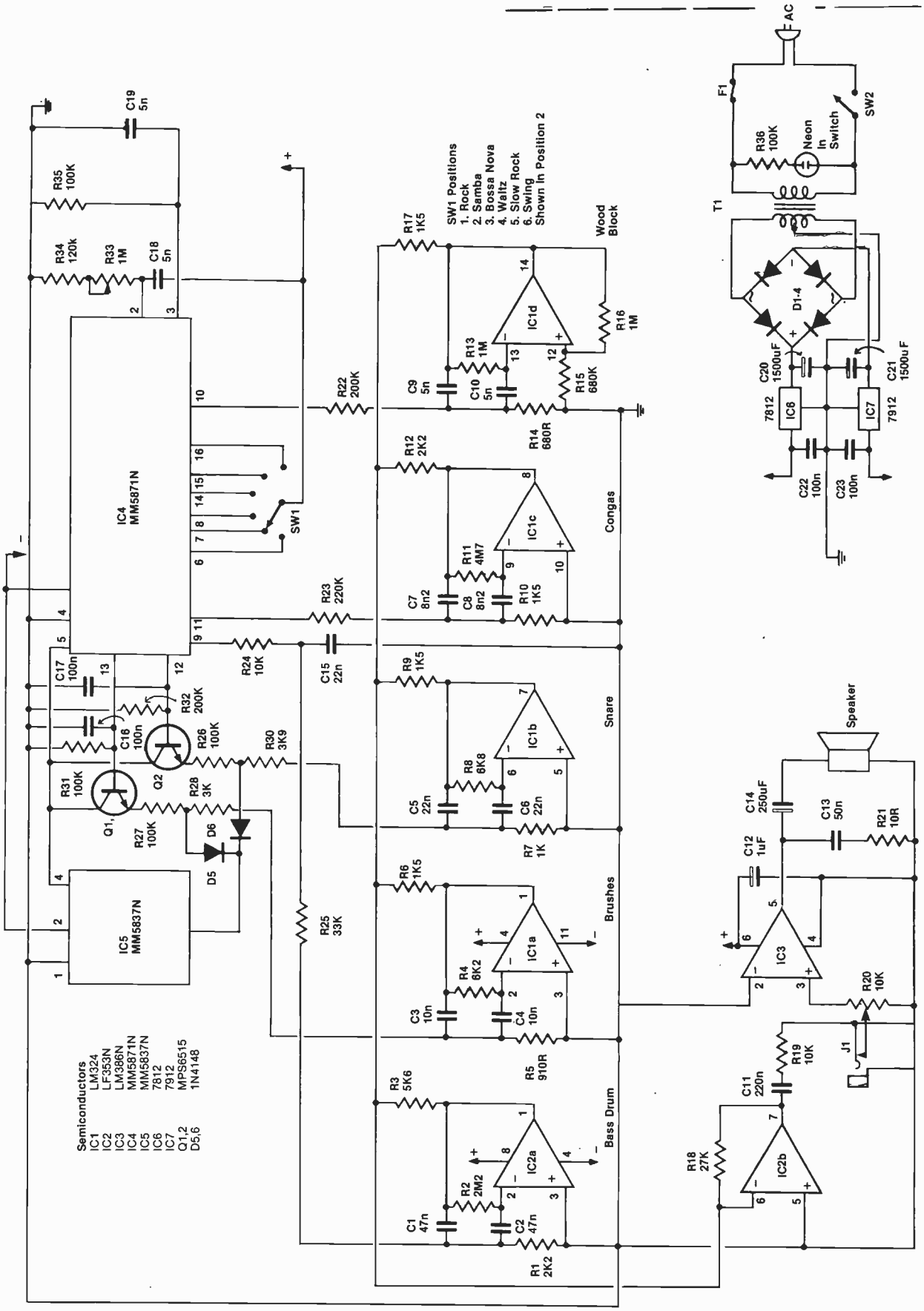
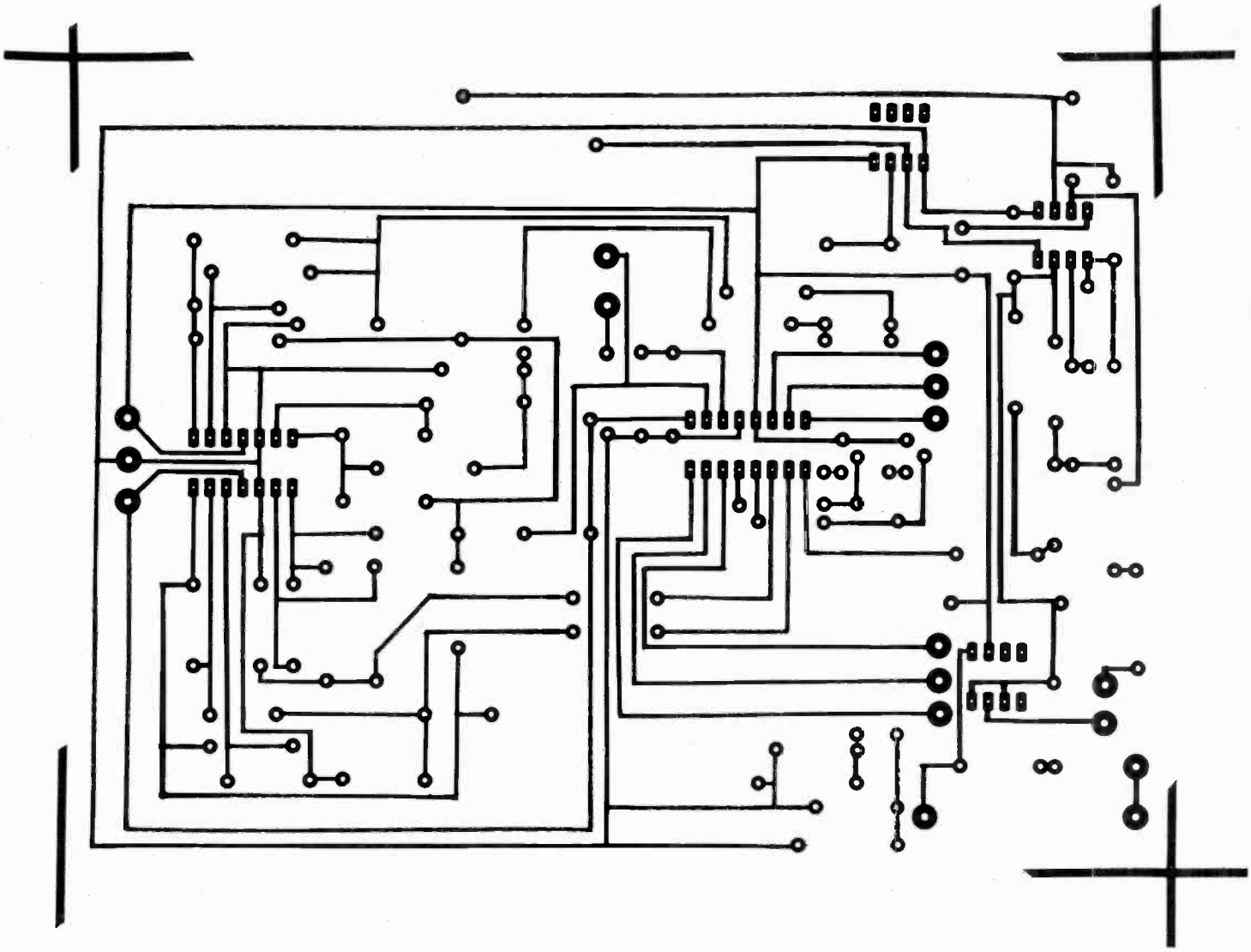

AC
F1
SW2
Neon In Switch
R36 100K
T1
D1-4
C20 1500uF
C21 1500uF
7812
IC6
IC7
7912
C22 100n
C23 100n
SW1 Positions
1. Rock
2. Samba
3. Bossa Nova
4. Waltz
5. Slow Rock
6. Swing
Shown in Position 2
Wood Block
Congas
Snare
Brushes
Bass Drum
Speaker
IC4 MM5871N
IC5 MM5837N
IC1a
IC1b
IC1c
IC1d
IC2a
IC2b
IC3
SW1
Q1
Q2
D5
D6
C19 5n
R35 100K
R34 120k
R33 1M
C18 5n
R17 1K5
R16 1M
R13 1M
R15 680K
C9 5n
C10 5n
R14 680R
R22 200K
R12 2K2
R11 4M7
C7 8n2
C8 8n2
R10 1K5
R23 220K
R24 10K
C15 22n
C17 100n
C16 100n
R32 200K
R26 100K
R30 3K9
R31 100K
R28 3K
R27 100K
R25 33K
R9 1K5
R8 6K8
C5 22n
C6 22n
R7 1K
R6 1K5
R4 6K2
C3 10n
C4 10n
R5 910R
R3 5K6
R2 2M2
C1 47n
C2 47n
R1 2K2
C14 250uF
C13 50n
R21 10R
C12 1uF
R20 10K
J1
R19 10K
C11 220n
R18 27K
Semiconductors
IC1 LM324
IC2 LF353N
IC3 LM386N
IC4 MM5871N
IC5 MM5837N
IC6 7812
IC7 7912
Q1,2 MPS6515
D5,6 1N4148



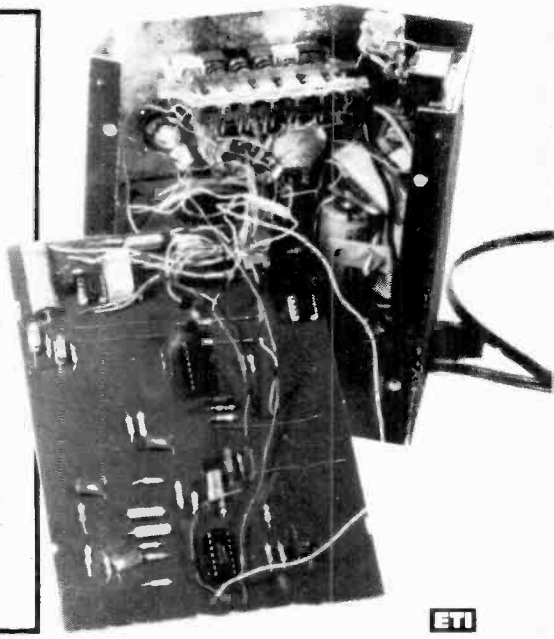
HOW IT WORKS

The heart of Sticks is IC4, the MM5871N, a large scale IC from National Semiconductor. It contains a pre-programmed Read Only Memory with the timing pulses for the various drums encoded as bit patterns. It also contains a clock and counter to sequentially play out the patterns. SW1 adds the most significant bit to the ROM address, selecting which of six possible "pages" of bit patterns will be played out. The chip outputs corresponding strings of bits from pins 9, 10, 11, 12 and 13.

The sound of a drum consists of what is called a damped sine wave, a sine wave which starts off at a high level and trails off to zero over a period of time. To reproduce a drum, as opposed to a chime, the damping must be quite heavy, i.e., the time that it takes for the tone to fade out should be very short. IC1 and IC2a form five twin T oscillators. However, in all cases, the positive feedback applied around the op amps is not quite sufficient to make them oscillate spontaneously, or to sustain oscillation for very long once it starts. They thus act as very high Q filters, which, if shocked by a pulse into their filter networks, will oscillate momentarily before dying out. This damped sine wave is an almost ideal percussion simulation.

In some drum sounds, there is a noticeable amount of white noise, as well as the damped sine wave. IC5 is a noise source chip, the output of which is gated by Q1 and Q2. The noise pulses themselves are sufficient to trigger their respective filters, and, at the same time, are filtered themselves so as to become part of the resultant sound.

R3, 6, 9, 12 and 17 mix the drum sounds onto a common bus, which is buffered by IC2b. IC3 is a 400 mW output stage, which will drive the internal speaker to quite a sufficient volume. C12, C13 and R21 must not be omitted, as they keep the IC from oscillating under some conditions.



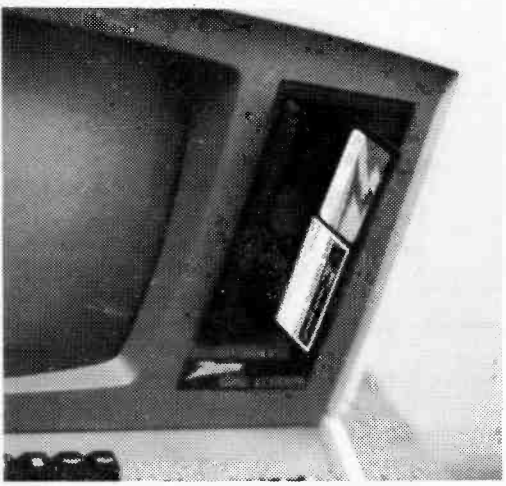
Continued from 23

translated, the text remains, so that it can be re-translated if changes are made. The program calculates all the branches and jumps, as well as selecting the appropriate codes.

This sort of thing almost makes ML programming tolerable.

BASIC BASIC BASIC BASIC

I don't know what makes Extended Benton Harbor BASIC extended: the



disk is still 5¼ inches across. However, that's what they say. . .

The BASIC is actually a BASIC compiler, which means that it assembles machine code routines in something like the way ASM puts together individual instructions, as opposed to the more familiar interpreter BASIC. This results in faster, more compact programs, but a compiler is not as much fun as an interpreter, as the syntax is testier, and there is a noticable compilation lag.

The Benton Harbor BASIC is not remarkably different from a middle of the road Microsoft BASIC. It has a few unique syntaxes, like FREEZE, which SAVEs a program and its variables, and SCRATCH, which kills the BASIC user areas.

This in *not* the BASIC for you if you enjoy writing complex "PRINT YOUR NAME" routines; using it does require no small end of understanding of BASIC beforehand. However, it is a powerful tool for the advanced programmer, and won't prove any problem at all if you've already put some wear on the keytops of your Apple.

One last thing about it. . . ultra splendid; English, yes, we said English, error messages.

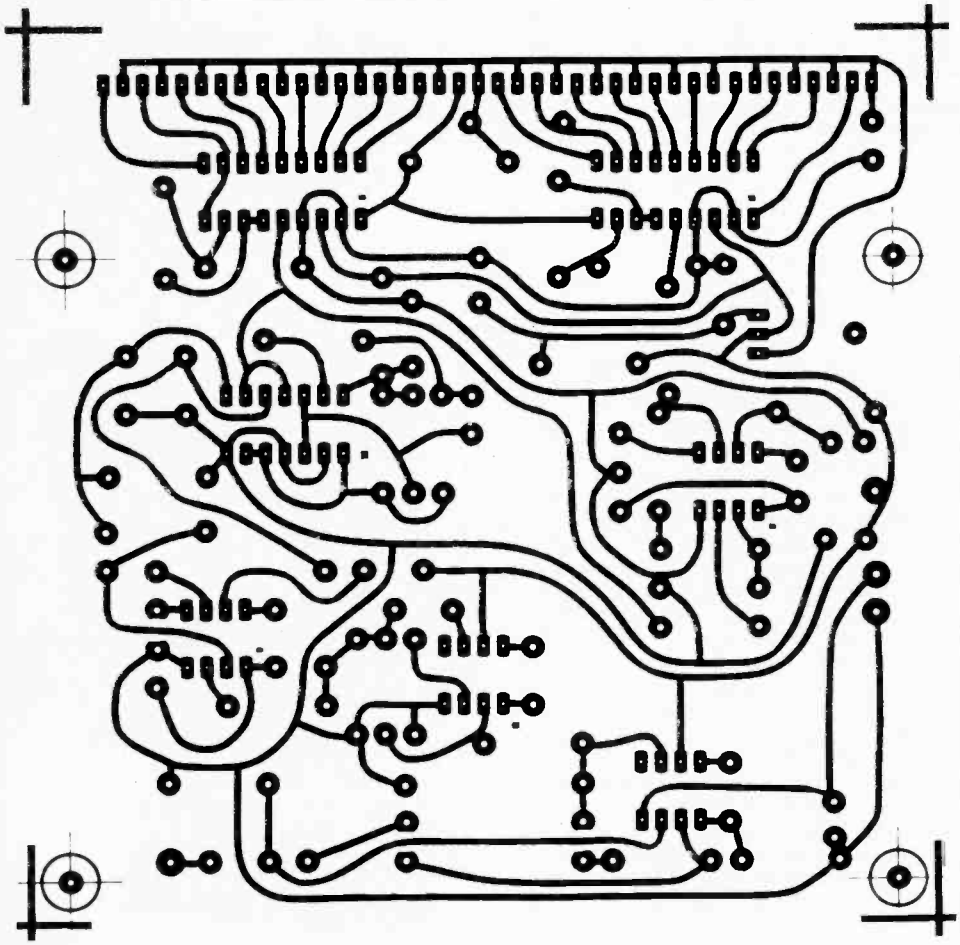
STOP. . . END. . . HALT. . . *TILT*

If you've grown weary of drawing airplanes in high resolution graphics, or if you want to write some serious software for a specific function, if you need a small business machine, or if you're just loaded and can't see your way clear to send all your surplus cash to my attention, you may be a candidate for the H-89. It's a good choice if you've outgrown your TRS-80 Model I and can't quite make the step up to a PDP-11.

All told, the physical construction of the machine is second to none, and the documentation. . . traditionally horrible for whatever computer you finally decide you want. . . is done in typical Heath style, understandable, detailed and with only a modicum of funny words. There are no resistor colour codes at the back, a bit strange, but its workmanship is cool.

Hey, Billy. . . the disks make ace frisbees. . .

ETI



Audio Level Display

May issue's audio level display project not only did away with VU meter needles; space considerations also forced us to make it temporarily PCBless. For those of our readers with bags of square LEDs just panting to get going on this project, well, wait no more . . . the board, in all its glory.

"I've checked, rechecked and triple checked this circuit and it should work! You electrons just aren't cooperating!!"

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Both the SINCLAIR ZX81 and the ACORN ATOM come complete with generous, informative manuals that take you from beginnings to advanced programming concepts. Both use standard televisions (colour or black and white) for display. Save your programs on a standard portable cassette recorder.

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The SINCLAIR ZX81 is the world's largest selling microcomputer: made in England, sales worldwide are now approaching 50,000 per month. Only by direct-to-user sales, has it been possible to offer so much computing power at only **$109.95!**

The ACORN ATOM is ideal for those who want a regular type-writer style keyboard, and a computer with extensive expansion capabilities. The ACORN ATOM can be converted to give a COLOUR DISPLAY (ideal for dynamic games), and is also ideal for business applications including word processing and bookkeeping.

So, if you have been wondering what all the fuss is about, wait no longer. Now you and your family can own your choice of two unique personal computers.

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Sinclair's new ZX81 personal computer is a tremendous advance over the highly successful ZX80. It offers far more computer capability, yet Gladstone Electronics is able to offer the ZX81 in kit form at **half the ZX80 price!**

How is it possible? Quite simply, by design. The ZX81 uses only 4 chips (as opposed to 21 in the original ZX80). The secret lies in the totally new Master chip. Designed by and custom-manufactured for Sinclair, this unique chip replaces 18 chips from the ZX80.

Easy-to-build Kit.
And because the chips have been reduced to only four, the kit is incredibly simple to build. A couple of hours work with a fine-tipped soldering iron and the ZX81 is ready to use.

The ZX81's advanced capability.
The ZX81 uses the same fast microprocessor (Z80A), 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, or to select a program off a cassette through the keyboard.

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Built:

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New, improved specification.

- Unique 'one-touch' key word entry: eliminates a great deal of tiresome typing. Key words (PRINT, LIST, RUN, etc.) have their own single-key entry.
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- Full editing facilities.
- Able to drive the new Sinclair ZX Printer

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If for any reason should you be unable to complete your ZX81 kit, you may return it with a cheque for $25.00, and it will be completed and returned to you.

If you own a ZX80 . . .
The new 8K BASIC ROM as used in the ZX81 is available as a drop-in replacement chip. (Complete with new keyboard template and operating manual). With the exception of animated graphics, all the advanced features of the ZX81 are now available on your ZX80 — including the ability to drive the Sinclair ZX Printer.

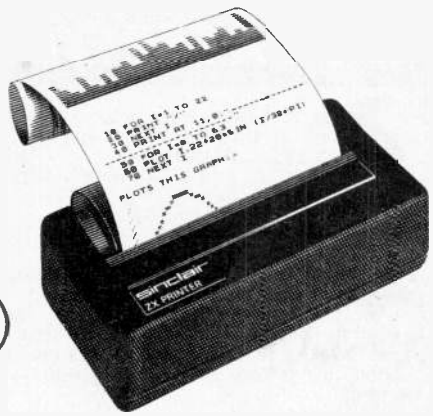
Expand your ZX81

NEW LOWER PRICE

16K—BYTE RAM PACK $99.95

The new RAM pack provides massive add-on memory in one complete module. Compatible with the ZX81 *and* the ZX80, it can be used for program storage or as a database. Yet it costs as little as half the price of competitive additional memory.

Measuring 3 in x 3 in x 1.25 in approx, the RAM pack plugs into the existing expansion port on the rear of the ZX81 and ZX80 via an edge connector. No additional power supply is needed.



$169.95 ZX Printer

Designed exclusively for use with the ZX81 (and ZX80 with 8K basic ROM), the printer offers full alphanumerics and highly sophisticated graphics. COPY command prints out exactly what is on screen. At last you can have a hard copy of your program listing and results. Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch. Connects to rear of ZX81 — using a stackable connector so you can use a RAM pack as well. A 65 ft paper roll, instructions included. Requires 9 volts, 1.2 amp power supply (option extra).

64K $249.95

MEMOTECH 64K MEMOPAK

The Memopak is a 64K RAM pack which extends the memory of the ZX81 by a further 56K. Designed to be in the price range expected by Sinclair owners. Plugs directly into the back of the ZX81 and does not inhibit the use of the printer or other add-on boards. There is no need for additional power supply or cables. The Memopack together with the ZX81 gives a full 64K, which is neither switched nor paged, and is directly addressable. The unit is user transparent, and accepts such basic commands such as 10DIM A(9000).
With the Memopak extension the ZX81 is transformed into a powerful computer, suitable for business, leisure and educational use, at a fraction of the cost of comparable systems.

Sinclair Price List

Sinclair ZX81 Computer Kit	$100.95
Sinclair ZX81 Computer Factory Assembled	$150.95
Sinclair 16K Memory Expansion	99.95
Memotech 64K Memory Unit for ZX81	249.95
ZX Printer	169.95
Power supply (for ZX81)	9.95
Power supply 1.2A (for ZX81, memory, printer)	29.95

Sinclair ZX81 Computer

Specification

Dimensions
Width 167 mm (6.32 in)
Depth 175 mm (6.80 in)
Height 40 mm (1.57 in)
Weight 350 gms (12.15 oz)

Microprocessor/Memory
Z80A 3.25 MHz clock
ROM: Containing 8K BASIC interpreter
RAM: 1K bytes internal, externally expandable to 16K bytes.

Keyboard
40 key touch-sensitive membrane. Using function mode and single press key-word system, this gives the equivalent of 91 keys and also graphics mode allows an additional 20 graphical and 54 inverse video characters to be entered directly.

Display
Requires an ordinary domestic black and white or colour TV. The aerial lead supplied connects the ZX81 to the TV aerial socket. The display is organised as 24 lines of 32 characters with black characters on a white background.

Two mode speeds
The ZX81 can operate in two software-selectable modes – FAST and NORMAL. FAST is ideal for really high-speed computing. In NORMAL mode however the ZX81 allows continuously moving, flicker-free animated displays.

Syntax check
The syntax of a line of program is checked on entry. A syntax error cursor marks the first place the syntax breaks down if there is an error. The syntax error cursor disappears when errors have been corrected. Only lines free from syntax errors will be entered into the program.

Graphics
Apart from the 20 graphics characters, space and its inverse, the display may also be divided into 64 x 44 pixels, each of which may be 'blacked' in or 'whited' out under program control.

Editing
A line editor allows you to edit any line of program or input, including program line numbers. Lines may be deleted, increased or decreased in size.

Programming
Programs can be entered via the keyboard or loaded from cassette. Programs and data can be saved onto cassette so that they are not lost when the ZX81 is turned off.

Arithmetic
Arithmetic operators +, −, x, ÷, exponentiate. Relational operators =, <>, >, <, <=, >=, may compare string and arithmetic variables to yield 0 (False) or 1 (True). Logical operators AND, OR, NOT yield boolean results.

Floating-point numbers
Numbers are stored in 5 bytes in floating-point binary form giving a range of $\pm 3 \times 10^{-39}$ to $\pm 7 \times 10^{38}$ accurate to 9½ decimal digits.

Scientific functions
Natural logs/antilogs; SIN, COS, TAN and their inverses; SQR; e^x.

Variables

Numerical:	any letter followed by alphanumerics
String:	A$ to Z$
FOR-NEXT loops:	A–Z (loops may be nested to any depth)
Numerical arrays:	A–Z
String arrays:	A$ to Z$

Arrays
Arrays may be multi-dimensional with subscripts starting at 1.

Printer
The 8K ROM will permit instructions (LPRINT, LLIST and COPY) to drive the new Sinclair ZX Printer.

Expression evaluator
The full expression evaluator is called whenever an expression, constant or variable is encountered during program execution. This powerful feature allows use of expressions in place of constants and is especially useful in GOTO, GOSUB etc.

Command mode
The ZX81 will execute statements immediately, enabling it to perform like a calculator.

Cassette interface
Works using most portable domestic cassette recorders. The transfer rate is 250 baud and uses a unique recording format not compatible with other systems. The ZX81 will save the data as well as the program to avoid the need to re-enter the data when the program is next loaded. (Programs are given names and the ZX81 will search through a tape for the required program). The cassette leads supplied have 3.5 mm jack plugs.

Expansion port
At the rear, this has the full data, address and control buses from the Z80A CPU as well as 0V, +5V, +9V, Ø and the memory select lines. These signals enable you to interface the ZX81 to the Sinclair 16K RAM pack and ZX printer.

Gladstone Electronics, 1736 Avenue Rd., Toronto, Ont. M5M 3Y7 (416) 787-1448

Sinclair ZX81 SOFTWARE

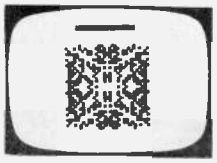
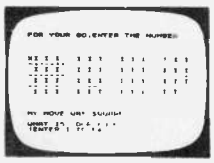
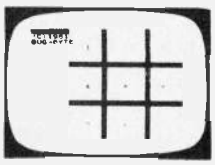
GAMES PACKS ON CASSETTE

1 for 1K ZX81 & 8K ROM ZX80. Eight fantastic programs for the unexpanded ZX81, including DIGICLOCK, 9-LIVES, REACTION TEST, GOBBLER and PATTERNS.
$12.95

2 for 16K ZX81. Four programs written in BASIC for the expanded ZX81. PONTOON, FRUIT MACHINE. OXO, and BIO— RHYTHMS.
$12.95

3 for 16K ZX81 and 8K ROM ZX80. Two programs for expanded ZX81 to keep you entertained for hours! 3-D OXO is written in machine code and is hard to beat. MARS RESCUE is a compulsive adventure game.
$12.95

4 for 16K ZX81. ZOMBIES — escape as they chase you around Zombie Island. Lure them into the pits, but don't fall in yourself. MOUNT MAYHEM — can you reach the 20,000 foot summit? Look out for Yetis and other hazards!
$12.95


EDUCATION

COMPUTER AID

GIVE YOUR CHILD THE COMPUTER ADVANTAGE!

- NO PROGRAMMING KNOWLEDGE NEEDED.
- CHILDREN WORK ON THEIR OWN.
- CHILDREN LEARN AT THEIR OWN SPEED.
- CHILDREN LEARN AT THEIR OWN LEVEL.
- FITS ANY TEXT BOOK BEING USED.
- EACH PROGRAM TEACHES AND DRILLS.
- COMPUTER GAMES ARE PART OF EACH LESSON.
- YOUR CHILD LEARNS AT HOME.
- EACH PROGRAM CONTAINS OVER 60 LESSONS ON 4 TAPES.

The COMPUTER—AID advantage!

These programs are self-teaching. and self-correcting. No adult involvement is required. The COMPUTER—AID programs build basic competency in addition, subtraction, multiplication, division and decimals. They're motivating. They are fun. They teach and reteach. They're automatic. They work!

MATH

What do you get?
1. A complete COMPUTER—AID math program on cassettes for your child including new and exciting COMPUTER—AID math games.
2. Paper and pencil tests like those your child does in school.
3. Printed explanations for the parent on how the program works. COMPUTER—AID Math is a home version of the same program being sold and used in schools throughout North America, specifically rewritten for the ZX81 computer!

COMPUTER—AID. programs are originated and written by Joseph R. Gladstone, who has 19 years experience in education, including 5 years as a senior administrator. His previous works have been published by SRA (subsidiary IBM), Holt Rinehart & Winston (subsidiary CBS), and MacMillan, and have covered language skills, reading, grammar, math, computational skills, word problems and phonics.

COMPUTER—AID programs will be available for language skills and reading in the near future.

COMPUTER AID

Programs currently available:

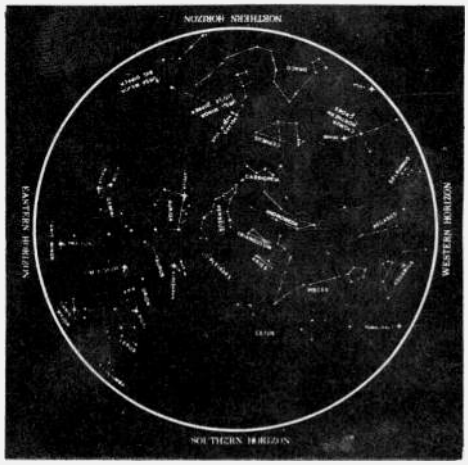
Program Title	Grade Covered	Available	Order Number
Addition & Subtraction 1 Over 60 lessons	1,2,3,	JUNE 1982	AS/1
Addition & Subtraction 2	3,4,5	JUNE	AS/2
Addition & Subtraction 3	6,7,8	JUNE	AS/3
Multiplication & Division 1	3,4,5	JULY	MD/1
Multiplication & Division 2	6,7,8	JULY	MD/2
Using Decimals 1	3,4,5	JULY	UD/1
Using Decimals 2	6,7,8	AUG	UD/2

$49.95

SPACE PACKS

CONSTELLATION

Turn your ZX81 into a telescope with this amazing 16K program. Produces a simulation of the night sky as seen from any position on Earth at any chosen time this century. You may point your telescope in any direction, move it up, down, left or right, zoom in or out. Stars may be displayed by magnitude or constellation
$19.95



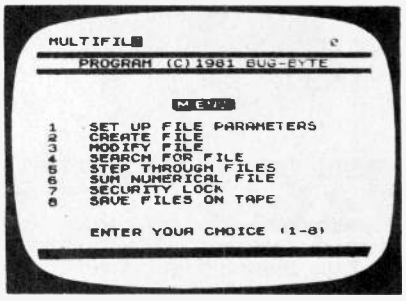
STAR TREK

The classic computer game in which you trek across the galaxy in search of Klingons to zap with your phasers and photon torpedoes. You have long and short range scanners to help you find them, Starbases to refuel your ship at and, of course, various witty comments from the crew. 16K.
$12.95

VU-CALC

VU-CALC
Answers those difficult "what if?" questions.
VU-CALC turns the ZX81 into an immensely powerful analysis chart. Constructs, generates and calculates large tables for such diverse applications as financial analysis, budget sheets and projections. VU-CALC enables your ZX81 to perform many simultaneous calculations that would have to be repetitively entered into a calculator.
VU-CALC is easy to understand and can be used immediately. The program is menu-driven and gives total flexibility in defining the parameters of the projections. You determine the number of columns and digits of accuracy you require. You decide the relationships between the columns and determine if calculations are made on a Relative or Absolute basis.
The ZX81/16K — VU-CALC combination turns a TV screen into a "window" on your most difficult financial and budgetary considerations. A must for the serious ZX81 user!

$29.95



ADVENTURE GAMES

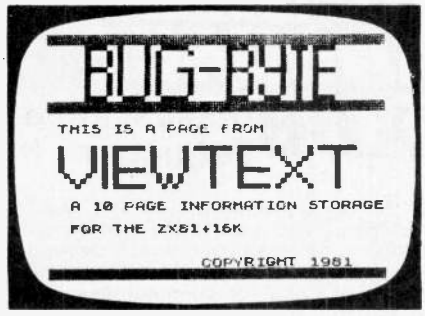
DAMSEL & the BEAST

A medieval game of concentration and suspense in which you, the intrepid hero, must wander in the darkness of the Beast's palace, find a Damsel hiding or imprisoned, kill the Beast, and then last but not least, lead her to the palace exit before she starves to death.
The graphics capability of the ZX81 is used to the full in constructing the elaborate palace of the Beast.
You have a choice of three levels of play: easy for the cautious, medium for the experienced, and difficult for the suicidal or fool-hardy!
Requires 16K ZX81.
$17.95

DICTATOR

Fantastic new adventure game for 16K (or greater) ZX81. You have just become 129th ruler of Ritimba with a single goal in mind: take full advantage of the situation for your own good. You have to deal with a handful of factions: unruly army, downtrodden peasants — but you have the secret police on your side.
It's only a game . . . but is it? In today's world, maybe Dictator is really a learning experience.
An entertaining and informative 8 page instruction manual is provided with Dictator. In addition to explaining how to play, a series of program notes gives the information you need to alter the various subroutines in the program to enhance or modify it. **$17.95**

VIEWTEXT



A ten page information display system for the 16K ZX81. Can display both text and graphics in any sequence with variable speed. Many applications including shop window displays, educations, animation, etc.
$17.95

INVADERS

Fast-moving, machine code version of the famous arcade game, for the 16K ZX81. Shields are provided to help protect you from the bombs of the marching aliens. Ten levels of play, from easy to suicidal. On screen scoring. Why settle for a lesser program when you can have "Invaders"? 16K.
$12.95

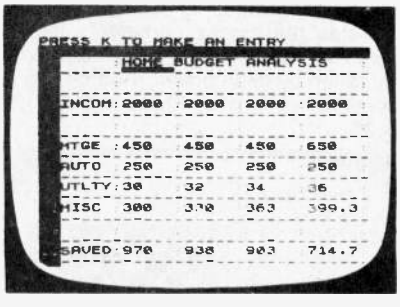
TWO FANTASY GAMES

Two exciting role-playing, adventure-style games which are played without detailed instructions. The computer describes your situation (often hopeless) and prompts you with questions to which you reply using plain English words. The ZX81 responds to your reply by describing the consequences (often dire) of your latest action and your new position.
You are deep in "Perilous Swamp", surrounded by dark reeds, deep stagnant pools and numerous pits and caves where creatures lurk. Your task is to rescue the princess, who has been captured by the evil wizard. You can fight, bribe, or run . . . just as in real life!
You have been marooned on "Sorcerer's Island" and must find your may off. Take care, however: the exit is guarded by a dreadful beast. The experience you gained in "Perilous Swamp" will help you escape.
For 16K ZX81 or ZX80/8K ROM
$17.95

MULTIFILE

Data Storage System
An amazingly versatile multi-purpose filing system for the 16K ZX81. The program is menu-driven, and number, size and headings of files are user-definable. Both string and numerical files are catered for. Files may be created, modified, replaced, and searched, and are protected by an ingenious foolproof security system. Output to the ZX printer is also provided. The program comes on cassette, together with three quality data cassettes for file storage, and comprehensive documentation, describing a host of applications for both business and personal use. Supplied in an attractive storage case. If your ZX81 is bored with playing games, then this program will give it plenty to think about!

$39.95



"Multifile . . . is a most versatile package with a good range of clear, menu-driven options. The files are not fixed, but user definable."
Your Computer Magazine, February 1982

ZX81 SOFTWARE

FLIGHT SIMULATION

for ZX81

FLIGHT SIMULATION is an exciting educative substantial software cassetie which mimics the piloting of an aircraft.

The screen displays cockpit navigational instruments and gauges in the lower half of the screen, together with the horizon formed by the sky and the ground through the windows of the cockpit in the top half of the screen. The ZX 81 pilot has instantaneous control of the plane through the keyboard including joystick (banking left and right, diving and climbing), engine power, flaps, undercarriage and the radio direction and navigational equipment locked onto different beacons. Changes in these controls immediately appear on different gauges, and the motion and altitude of the plane can be immediately "FELT" by observing the sky and grou nd through the windows. The "PILOT" can switch the screen to a navigational chart to examine where he is in relation to the different beacon and the runway. To land the "aeroplane" He must evaluate his position with the aid of the chart and the radio direction finding equipment. He must fly the plane on the proper course for approach to the runway and consider the plane in terms of altitude, speed, direction, distance etc., for the final approach.

If he is successful in his navigation, the display will change from a few miles out to a visual of the runway for final landing. The flashing lights along the runway are shown in full perspective according to the motion and precision of the "aeroplane" and come up to meet the plane as it lands. The software is a sophisticated machine code program in real time to give well nigh instantaneous response between the user control. The instrument panel and the outside world through the cockpit windows. It demonstrates the ZX 81 to its fullest possible power and simulates a twin engine aeroplane with a rapid motion in terms of banking, diving, etc. The flight stability of the aeroplane and the navigational position are continuously calculated and all the essential effects of flight such as stalling, lift with thrust, etc. are included.

16K $29.95

MACHINE LANGUAGE

ZXAS Assembler

Now you can use the full power of the Z80 microprocessor without having to laboriously POKE in instruction codes. This full specification Z80 assembler assembles all the standard Zilog mnemonics, which are simply written into REM statements (more than one per line is allowed) within your BASIC program. When assembled, the assembly listings, together with assembled codes and adresses, are displayed on the screen. The assembled code is executed by USR. The program occupies 5K, is situated at the top of the memory, and is protected from overwriting. This means that ZXAS may be used in conjunction with ZXDB (see below), providing an extremely powerful machine code system normally only found on very expensive computers.

The program is available for both the ZX81 and the 8K ROM ZX80, and in both cases, the 16K RAM pack is required. Despite the low price, ZXAS is a FULL-SPECIFICATION assembler, and is a must for all serious ZX users. Full documentation on how to use the assembler (including a list of the mnemonics) is supplied.

$12.95

".... the ZXAS is a quality piece of software that a serious programmer can use in the development of machine code software." **R. Bobak, Staatsburg, NY**

"ZXAS is a powerful ZX-81 assembler from Bug-Byte which occupies 5K. This superb product accepts the standard Zilog mnemonics with decimal or hexidecimal values."

Your Computer Magazine, February 1982

ZXDB Disassembler/ Debugger

The perfect complement to the ZXAS assembler, ZXDB is a complete combined machine code disassembler and debugging program. Like ZXAS, it is itself written in machine code for compactness, and may be used in conjunction with ZXAS, still leaving about 9K of memory for your own program.

Apart from the DIASSEMBLER, the program has features including SINGLE STEP, BLOCK SEARCH, TRANSFER AND FILL, HEX LOADER, REGISTER DISPLAY and more, all of which are executed by simple one key commands from the keyboard. All in all, an extremely powerful programming aid, well worth the money for the disassembler alone!

$12.95

Telephone Orders (416) 787-1448
Use Visa, MasterCard, American Express

BACKGAMMON

A great game — easy to learn, fast, exciting, a perfect blend of chance and skill. This high quality ZX81 Backgammon program uses fast and efficient machine code to choose its moves. Full feature game including graphics board, rolling dice, and doubling cube. You will need more than just luck to win!

Backgammon is a 3000 year old game of chance and skill for two people — or in this case between a computer and a person. This high quality program gives an excellent graphic representation of the board and pieces. Even if you are not familiar with the rules, you can learn as you play since the program will not let you make an illegal move (and will also tell you why a program is illegal) Side B contains a bonus: a simulation of a pair of Die. Why bother to roll when your ZX81 can do it for you?

16K

$19.95

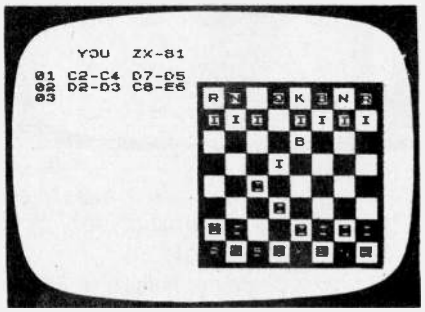
ZX 81 CHESS

Written in fast and efficient machine code, ZX81 Chess is hard to beat. You can choose from 6 levels of play: an average player will have difficulty with levels 2 or 3! ZX81 Chess gives you a graphic representation of a chess board using the standard A-H 1-8 notation system.

Your moves and the ZX81's are both displayed beside the board so you can easily follow the progression of the game. Castling and en passant are allowed, while illegal moves are rejected. You decide what colour to play. You may also set up the board as you wish, and change sides during the course of a game.

Side B contains Chess-Clock which simulates the clocks commonly used in chess tournaments to limit the amount of time taken by each player. Two clocks are displayed but only one runs at a time.

$29.95



The ZX81 Companion $13.95

The ZX81 Companion by Bob Maunder follows the same format as the popular **ZX80 Companion.** The book assists ZX81 users in four application areas: graphics, information retrieval, education and games. The book includes scores of fully documented listings of short routines as well as complete programs. For the serious user, the book also includes a disassembled listing of the ZX81 ROM Monitor.

Softbound, 5½x8", 132 pages.

Getting Acquainted With Your ZX81 $13.95

This book is aimed at helping the newcomer make most effective use of his ZX81. As you work your way through it your program library will grow (more than 70 programs) along with your understanding of Basic.

The book is chock full of games such as Checkers which draws the entire board on the screen. Other games include Alien Imploders, Blastermind, Moon Lander. Breakout. Digital Clock, Roller-Ball, Derby Day, and Star Burst.

But the book is not all games. It describes the use of PLOT and UNPLOT SCROLL arrays, TAB, PRINT AT, INKEYS, random numbers and PEEK and POKE, You'll find programs to print cascading sine waves, tables and graphs: to solve quadratic equations: to sort data: to compute interest and much more.

Softbound 5½x8", 120 pages

The Gateway Guide to the ZX81 and ZX80 $13.95

The Gateway Guide to the ZX81 and ZX80 by Mark Charlton contains more than 70 fully documented and expained programs for the ZX81 or 8K ZX80. The book is a "doing book" rather than a reading one and the author encourages the reader to try things out as he goes. The book starts at a low level and assumes the ZX80 or ZX81 is the reader's first computer. However by the end the reader will have become quite proficient.

The majority of programs in the books were written deliberately to make them easily convertible from machine to machine (ZX81, 4K ZX80 or 1K ZX80) so no matter which you have you'll find many programs which you can run right away.

The book describes each function and statement in turn, illustrates it in a demonstration routine or program and then combines it with previously discussed material.

Softbound 5½x8" 172 pages.

Computers For Kids, Sinclair Edition $6.95

Written expressly for youngsters ages 8 to 13, the book requires no previous knowledge of algebra, variables or computers. Armed with a ZX81 and this book, a child will be able to write programs in less than an hour. A section is included for parents and teachers.

The book starts with a patient explanation of how to use the Sinclair, graduates to flow charts, and simple print programs. The twelve easy-to-read chapters go through loops, graphics and show other programming concepts, and show in a painless way how to make the computer do what you want.

Dnald T. Piele, Professor of Mathematics at the University of Wisconsin-Parkside says, **"Computers For Kids** is the best material available for introducing students to their new computer. It is a perfect tool for teachers who are learning about computers and programming with their students. Highly recommended."

Softbound 8½x11" 56 pages

SYNC Magazine

Latest edition always on sale $3.95

SYNC, a bi-monthly magazine for users and prospective users of the Sinclair ZX80 computer has expanded its coverage to include the ZX81 as well.

Each issue of the magazine carries complete application programs, tips and techniques for more effective programming, hardware modifications and in-depth evaluations of software, peripherals and books.

Mastering Machine Code on Your ZX-81 $19.95

by Tony Baker

Until this comprehensive, yet easy-to-understand, handbook, there was virtually no material available about the ZX machine code. Using this guide you'll learn the ins and outs of ZX machine code translation. Discover the secrets of the ZX-81, and even see how to adapt the code to the ZX-80 machine. When you understand the language translations between BASIC and the ZX machine code, you'll enjoy the workings of your computer to the utmost!

ZX81 COMPLETE BASIC COURSE

44.95

At last, a comprehensive text for your Sinclair ZX81! The complete BASIC Course is a manual which will immediately become an indispensible work of reference for all your ZX81 programming.

Whether you have never done any programming or whether you are an experienced microcomputer user, the Complete BASIC Course will provide itself to you as an invaluable aid.

The Complete BASIC Course is designed to teach you to write and develop BASIC programs for the Sinclair ZX81 — no other books or aids are necessary. All is revealed in our easy step-by-step guide with programs and "test yourself" exercises all the way through.

As you become more proficient with computing, the Complete BASIC Course will continue to be an essential guide, giving you finger tip references, numerous advanced programming techniques and memory saving devices specifically for the Sinclair ZX81.

HOW TO WRITE PROGRAMS:

Even if the idea of writing programs is completely mystifying to you, the Complete BASIC Course will show you just how easy it is. In no time you will be able to write and enjoy complex programs for whatever use you desire.

Using the proven "TOP-DOWN" approach, the Complete BASIC Course will show you systematic and simple ways to write programs. Even experienced programmers will benefit from this Course, making programs easier to write and less prone to error!

BASIC Course Programs on Cassette $9.95

All major programs in the BASIC Course are available pre-recorded in this set of cassettes. This is a valuable adjunct to the Course, saving you time and effort.

NUMEROUS EXAMPLES:

Every concept, every function is fully described by simple programs that you can enter on your Sinclair ZX81 in minutes.

The Complete BASIC Course contains over 100 programs and examples! These programs illustrate the use and possibilities of the Sinclair ZX81:

- Home use
- Financial analysis and planning
- Educational applications
- Games
- Mathematical applications
- Displays of Artificial Intelligence

EVERY FUNCTION COVERED:

No matter what your application, what your confusion about any function, you will find it covered in the Complete BASIC Course

A full and detailed discussion is included of even traditionally taboo topics such as USR, PEEK and POKE.

A handy alphabetical summary section lists all functions, and provides a short description and example programs of all topics.

A PERMANENT WORK OF REFERENCE:

The Complete BASIC Course is an excellent reference work for experienced programmers (including tips on using special techniques) as well as a comprehensive step-by-step guide for complete beginners.

The Complete BASIC Course has over 240 pages filled with information in an attractive durable ring binder — this is a lay-flat work of reference that deserves a place next to every Sinclair ZX81 microcomputer.

49 Exploding Games for the ZX-81 $16.95

Edited by Tim Hartnell

Galactic Intruders, Breakout, Checkers, Death Maze, Star Trek, Smugglers Mold, and forty-three other favorites are all here, newly adapted especially for you and your new ZX-81 personal computer. This fascinating gamebook gives you programming instructions for all 49 marvelous games PLUS complete and easy-to-understand game rules. This wonderfully exciting playbook can be yours.

Machine Language Made Simple for your Sinclair $23.95

Learn how to program in the ZX81's own language, Z80 machine language, and get more power from your Sinclair: FASTER RUNNING PROGRAMS (typically 20 times faster than BASIC!), MORE PROGRAM IN LESS SPACE, and COMPLETE CONTROL!

Absolutely essential for the programmer that is interested in going beyond the confines of BASIC, and maximising the potential of the ZX81.

Understanding Your ZX81 ROM $23.95

In this book Dr. Logan gives a complete overview of Z80 machine language using the ZX81 monitor program as an example. Dr. Logan explains the structure of the ZX81 ROM, its peculiarities, and how you can use the ZX81 ROM routines for your own purposes.

A special section shows you how to use machine code routines in your own BASIC programs! Complete with example programs, reference tables, etc.

ZX81 ROM Disassembly *Part A $16.95

This is the book for the programmer that needs those complete answers about the ZX81 ROM.

Dr. Logan has examined all routines in the ROM and here he comments on each one. This book is a must for the experienced programmer.

Part A covers all ROM locations from OOOH to OF54H, and includes all functions except for the routines used in the floating point calculator. Part B (in preparation) covers locations OF55H to 1DFFH and includes all routines used in the ZX81 floating point calculator.

Part B - Covers Locations OF55H onwards. $16.95

Making the Most of Your ZX-81 $16.95

by Tim Hartnell

All new for you and your new ZX-81, this handbook focuses on the additional features of the ZX-81. You'll have new games and useful learning tricks, and you'll also see how to write programs that really work. It will guide you through start to finish, using each feature and function of your new ZX-81 personal home computer.

Not Only 30 Programs ZX81:1K $16.95

The ZX81/1K is more powerful than you ever imagined — this book of over 30 programs, all designed for the unexpanded ZX81/1K, will show you the amazing range of possibilities, from games, through to educational and mathematical applications, right through to exciting displays of 'Artificial Intelligence'.

Programs include Blackjack, Roulette, Star Wars, Breakout, Memory Left, Mini Adventure, 1K Draughts, all within 1K, and much, much more!!

Each program is explained, with programming hints throughout, including space saving techniques, PEEK and POKE explained, and more!!

The ZX-81 Pocket Book $16.95

by Trevor Toms

This handy new programming manual really gets you into ZX-81 functions. Don't just type someone else's programs . . . now you can create your own and understand why they work. It's fun to learn all about computing with the ZX-81 POCKET BOOK as a guide. You'll see what your new ZX-81 can do, and what extras will make it able to do even more . . . see how to use ZX-81 BASIC in the best ways . . . learn to avoid frustration and retyping with program and data file storage and retrieval techniques — and for ZX-80 owners, you'll learn how to convert your ZX-80 to the advanced ZX-81 capabilities. And there's so much more! This road map to the ZX-81 can be yours — it's worth every penny!

The Explorers' Guide to the ZX81

Programming Aids
Some Games and other novelties
Applications
Machine Language
Discovering the ROM
Hardware $12.95

Not intended as a beginner's guide to BASIC, or even an introduction to the ZX81. This book attempts to carry the reader on from where the ZX81 BASIC Manual leaves off by giving a variety of programs to run, and — more importantly — a wealth of detailed information about this computer and how to get the best out of it.

Programming aids include: saving memory space, DIM strings, converting to/from other BASICs, simulating DATA, READ, RESTORE statements.

Chapter 2 contains 23 programs including games, ROMtest, RAMtest, graphics, many of which are for 1K. Applications covered include standard deviation, ladder analysis for engineering, graph plotter, and personal bank account.

Machine language topics including a discussion of binary and hex numbering systems, using subroutines, and 4 incredible 1K progams.

ROM routines, ROM tables, load & save instructions, display file info, and keyboard scanning are all discussed in The Hardware chapter gives information on how to connect an external keyboard, connecting a monitor, hooking up a speaker for listening while saving or loading, and gives circuit diagrams of 1-4K RAM, 24 line I/O, 16K RAM, and more.

New! Acorn Atom Personal Computer

A PERSONAL COMPUTER DESIGNED WITH EXPANDABILITY IN MIND!

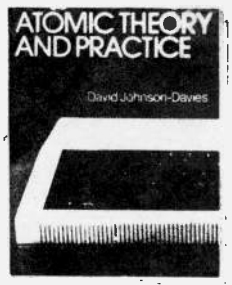
from only **$399.00**

fully assembled
*Complete with manual

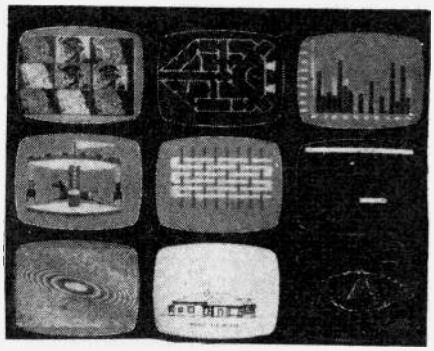
*Full-sized keyboard
*High resolution graphics
*Built-in sound
*Use with standard TV & cassette
*Excellent programme tapes available!

The Acorn Atom is a powerful, full facility computer at an extraordinary low price. It has a full size professional keyboard and a hardware/software combination of incredible power and versatility. And it's easy to use! Just connect directly to any domestic TV and you are ready to begin. (AC Adapter optional extra)

The Acorn ATOM is supplied with 2K of RAM (Random Access Memory) and 8K of ROM (Read Only Memory, or Operating System), but this can be boosted enormously. The standard computer has BASIC and ASSEMBLER (machine code) graphics and sound output, with direct cassette and TV interface. BASIC is the language used by ATOM: it is easy to learn. ACORN BASIC has all the normal functions you would expect plus many powerful extensions making it easier for you to operate and write your own programs!



FREE MANUAL
Free with every ATOM is a computer manual. The first section explains and teaches you BASIC, the language that most personal computers and the ATOM operate in. The instructions are simple and learning is a pleasure. You'll soon be writing your own programs. The second section is a reference section giving a full description of the ATOM's facilities and how to use them. Both sections are fully illustrated with sample programs.



"BASIC" ATOM 2K RAM 8K ROM Black & White **$399.95**
Save Even More on Expanded Acorn Atom: 12K RAM, 12K ROM Black & White **$525.00**
12K RAM 12K ROM Colour* **$599.95**

HOW YOUR ACORN ATOM GROWS

For learning purposes, the ACORN in its initial configuration is ideal. As your knowledge grows, you can increase the capacity of your ACORN! The **ATOM** is a computer built with future expandability in mind!
All of the upgrades listed can be performed by users with no electronics knowledge or experience.

Memory Expansion: Increases the RAM capacity (from 2K supplied) to 12K. The chips (2114s) simply plug into sockets on the main computer board. **$69.00**

Colour Board: An unbelievable feature! Convert your Acorn **ATOM** into a full colour computer for spectacular games, graphs, etc. Needs colour TV. **$79.00**

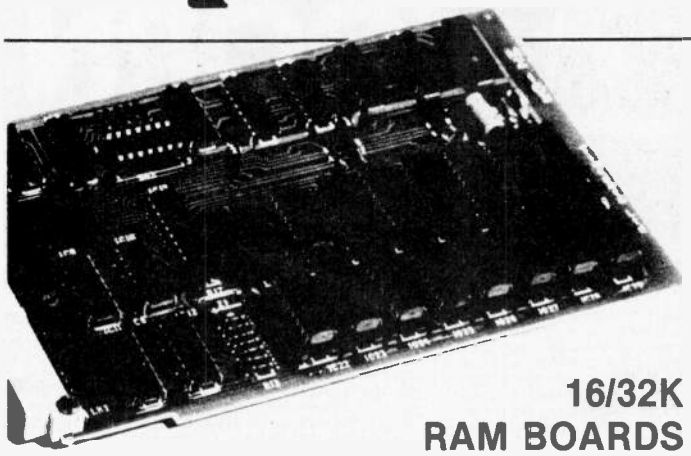
Floating point math chip. 10 digit accuracy **$69.00**
In the near future disk systems will be available for mass storage of information.

Power Supply (ac adaptor) **$35.00**

Available June 1982

GLADSTONE ELECTRONICS
1736 AVENUE RD., TORONTO, ONT., M5M 3Y7

Expand Your Atom!



16/32K RAM BOARDS

These boards have been designed especially to work with the Acorn Atom to expand the maximum RAM space from 12K to 28 or 38K bytes while retaining compatability with Atom software and hardware.
The addition of these boards make the Atom ideal for word processing and business applications where more RAM is required.
Dynamic memory IC's and a novel refresh circuit combine to give a reliable cool running board which can operate at the full 1MHz processor speed with safety. All data and address busses are fully buffered. Flexible addressing. The boards fit inside the Atom case.
The MP100 DC/DC power converter also mounts inside the Acorn case to provide the +12, +5V and −5V supplies required to power the MZ163 boards.
Full installation instructions are provided. Installation is available from our service department at reasonable cost.

MZ163 A 16K Built & tested. Fully socketed for later expansion if required. **$199.95**
MZ163 B 32K Built & tested. **279.95**
MP100 DC/DC Converter. **35.00**

Books About the Atom

Getting Acquainted with your Acorn ATOM $23.95
By Tim Hartnell and Trevor Sharples. Programs include Grand Prix, Life, Mordechai-Mind, Malachi, Craps and many many more.

One important chapter "Getting to grips with Assembler" tells you what Assembler is, how and where to use it, and how to make best use of the Assembler material in the Acorn manual. Other chapters cover arrays and strings, PEEK and POKE, mastering the graphics, and Atomic logic.

The ATOM Magic Book $19.95 * RECOMMENDED BY ACORN *
A 'must' for every Acorn Atom user, this book contains a wealth of games and other programs — plus much useful software and hardware information. Programs include a noisy and fast moving version of Breakout, and one which allows ATOM to store and play back speech.

Contents; Breakout. 3D Maze. Letters. Matches. Russian Roulette. Compart. Talkback. Moon Lander. Bouncing Ball. Patchwork. Bugrace. Space Battle. Hammurabi. Higher/Lower. Buzz-Word. Othello. Number Guessing. Hexpawn. Drive. Biorythm. Sums Tester. Scramble. Designs. Hunt the Wampus. Simon. Screens. Hangman. Programming Tips. Other BASICs. Tape Recording. 6522 VIA. 8255 PPI. Block 0 RAM. RAM Routines. VDU Codes.

ATOM BUSINESS **$23.95**
The ideal introduction to the use of the Acorn microcomputer for business uses. Each section contains a management summary, operating instructions, program notes, and source listings.
Programs include sales graph, sales record, nominal ledger, expense claims, budget factoring, lease or buy (discounted cash flow), standard deviation, queing simulation, label production and others.
This 110 page book is spiral bound for maximum convenience when using it with your ATOM
ATOM BUSINESS TAPE. All the programs from ATOM BUSINESS on cassette to save you the time and frustration of entering them by hand. **$29.95**

ATOMIC THEORY & PRACTICE. $14.95
The Atom's excellent operating and instruction manual, as supplied with the computer.

Acorn Atom
Technical Description

hardware

Memory: From 2K to 12K RAM on board (in steps of 1K) up to 40K including external memory. From 8K to 16K ROM (two 4K additions).
Processor: 6502 with 1 Mc/s clock.
Video Display Generator: 6847 generates video signals for 8 different modes including: high resolution graphics (256 x 192), Red, green, and blue graphics up to resolution of 128 x 192, and mixed ASCII characters and semi-graphics.
PIA: 8255 provides keyboard scan, cassette I/O, audio output, graphics control and user I/O.
VIA: 6522 provide two 8 bit + control I/O ports (one used for printer output) plus a wide range of serial I/O functions and dual timers.
Cassette Interface: CUTS 300 baud, involves minimum hardware (zero crossing detector input and output from timer) to allow user to redefine tape routine to virtually any speed or standard.
Loudspeaker: Driven from 8255 via buffer allowing software tone generation of any frequency.
B/W Video Output: To monitor.
UHF Modulator Output: Channel 36 domestic TV.
Bus Output: Fully buffered address and data bus plus internal connections for one Acorn Eurocard.
Power Requirement: Minimum system: 8 volts @ 800 mA (from ATOM power unit feeding internal regulator). Maximum system: 5V @ 1.8A from external regulator supply.

software

ATOM BASIC: • 32-bit arithmetic (± 2 000,000,000) • High speed execution • 43 standard and extended BASIC commands • Variable length strings (up to 256 characters) • String manipulation functions • 27 32-bit integer variables • 27 additional arrays • Random number function • PUT and GET bytes, words and strings to and from files • WAIT command for timing • DO-UNTIL construction • Commands may be abbreviated for economy • Multiple statements per line • Logical operators (AND, OR, EX-OR) • LINK to machine code routines • Numbers can be input and printed in hexadecimal • Symbolic labels for fast branches and subroutine calls • Powerful indirection operators (?,!) • Graphics facilities to draw points and lines • 16 PLOT commands, MOVE and DRAW.
ASSEMBLER: • Mnemonic Assembler for machine code programming • Formatted listing • Assembler and BASIC may be combined • Standard 6502 mnemonics • Provides symbols, automatic resolution of forward references • Macro-facilities • Breakpoints may be inserted for debugging.
VDU: • 32 characters x 16 lines • Inverted characters • Automatic scrolling • Paged/Non paged modes • All control codes can be generated • Screen editing.
Operating System: • CUTS cassette routines with checksum • Filenames up to 12 character • LOAD and SAVE BASIC and assembler programs or text files • Search (catalogue) routine • Software hook to optional disc drive and communication loop modules • Printer drive routines.
Optional Maths Software: • Floating point maths functions to 9 digit accuracy including arithmetic, trigonometric and hyperbolic functions.
Optional Communication Software: • Allows high speed bi-directional interface to other ATOMs or peripherals • Allows transfer of control or data to other modules in loop
Optional Utility ROM: • Such as the ONLIBASIC extension for real time control of laboratory experiments.

Telephone Orders (416) 787-1448

ATOMIC POWER FOR THE ACORN ATOM

ATOM FORTH Tape and book 49.00

ATOM FORTH is a complete implementation of the FORTH language for the fully expanded ATOM. The cassette contains:

The FORTH dictionary and compiler
The Tape Interface/Screen Editor.
The Graphics package
A high-resolution graphics demonstration.

FORTH's most distinctive feature is its extensibility. The basic unit is the 'word' — the programmer uses existing words to define his own which can then be used in further definitions. Words can be entered directly at the keyboard, allowing sections of a program under development to be tested individually. FORTH is a compiled language so programs run very fast (typically 5 times faster than BASIC).

In addition to a comprehensive set of arithmetic and stack operators, control transfer words, and defining words, ATOM FORTH includes the more advanced features for defining the actions of defining words themselves. This opens the door to 'meta-FORTH' and user-defined FORTH-based languages.

The Tape Interface and Screen Editor add words to the dictionary for manipulating files of source programs independently of ATOM BASIC. The Graphics include words for plotting black, white, and inverted points and lines in four modes. The demonstration program illustrates the use of recursion to draw a complex design with high-resolution graphics.

For instructions on using ATOM FORTH refer to the manual 'FORTH Theory and Practice' which gives a thorough introduction to FORTH programming and many practical examples. Manual $20.00

ADDRESS BOOK $29.00

Allows a file of up to 100 names, addresses, post codes, and telephone numbers to be built up and searched in a fast and convenient way. Options are selected from menus displayed by the program, and it allows all the entries to be printed out for mailing lists, etc.
Program 5K, graphics 6K.

UTILITY PACK 1: $29.00

DISASSEMBLER
A versatile disassembler which can list machine code in standard ATOM assembler form, or store the assembler text into memory so that it can be edited and reassembled with any starting address. Graphics 2K.

FAST COS
Speeds up program saving by modifying the ATOM's standard cassette-interface routines to operate at 1200 baud, or 4 times the standard speed. Program 1K.

RENUMBER
A fast renumber for BASIC or assembler programs, which gives a display of the line numbers for labelled lines. Program 1K.

SOFT VDU: $29.00

SOFT VDU
The soft VDU replaces the normal ATOM VDU, but provides 128 characters including upper and lower-case letters, and mathematical symbols. The characters can be mixed with high-resolution graphics, and the DESIGN program allows new characters, such as foreign letters, to be designed and added to the character set. Program 1.5K, graphics 6K.

MATHS PACK 1: $29.00

PLOT
A versatile graph-plotting package for use in research, accounting, schools, and mathematics, or simply for amusement. Will draw a graph of a specified function, with automatic scaling if required, or a plot of coordinate data, connected by line segments or a smooth curve; a regression line can be fitted to data. Annotated axes are drawn if required. Program 5K, graphics 6K.

SIMULTANEOUS
Solves a set of simultaneous equations, with integer or real coefficients, by the rapid Gaussian-elimination technique. Program 2K, graphics ½K.

REGRESSION
Calculates the best-fitting straight line to a specified set of data points, gives the equation of the line, and the correlation coefficient of the fit. Program 2K, graphics ½K.

ATOM WORD TUTOR $29.00

ATOM WORD TUTOR consists of three versatile programs designed to aid the development of language abilities in children of primary school age. Each program is supplied with a sample database that provides the material for a full set of exercises, and the supervisor can enter further teaching material and build up libraries of databases on cassette. A simple, clear cursor method allows the pupil to answer the problems without typing. The names and scores of up to 16 pupils are recorded and can be viewed by the supervisor. Programs 5K, graphics 6K.

PAIRS
Words are presented with pairs of letters replaced by blanks. The pupil can choose from up to four possible pairs, only one of which completes each word.

RELATIONS
One of each pair of related words is displayed along with a linking phrase. The phrase is completed by adding the second word of the pair selected from the list on the screen.

SENTENCES
Each exercise shows a sentence with the words and punctuation marks randomly rearranged. The pupil must reconstruct the original sentence by selecting the items in the correct order.

INTRODUCTORY PACKAGE $59.95

A set of 4 cassettes containing programs designed to introduce you to the world of personal computing. Complete with a booklet giving full instructions on loading and running the programs - all you need is an Atom with at least 3K text-space.

Cassette 1 — Interactive Teaching
Step by step this tape teaches you to 'talk' to the Atom — no manuals or experience necessary. The display on the TV screen will tell you what the computer is doing, what you should do next, and even what you have done wrong.

Cassette 2 — Financial Planning
The MINICALC program will introduce you to the concepts of financial modelling that are widely used in business, and will prove invaluable for household budgeting.
SALES uses graphical techniques to chart sales over a 12-month period, with cumulative and 3-monthly averages.

Cassette 3 — Household
Programs for use in the home.
TBOOK is a computerised telephone-book, which can hold 95 names and telephone numbers for quick and easy access; these can be stored on cassette.
Learn to touch-type with TYPER, which gives you a carefully graded series of exercises which get harder as you improve; it includes a diagram of the keyboard so you do not have to look down at your hands.
Timing a series of actions is difficult, even with a stopwatch; TIMER will automatically organise the timing of a series of events, such as the stages in preparing a meal, display the current time and a countdown, and ring an alarm when each one is due.

Cassette 4 — Games
ATTACK — defend yourself from attack with a laser gun.
CONNECT4 — Play against the computer, or another player, to get 4 counters in a row.
BREAKOUT — Knock bricks from a wall with a bat and ball, and try to beat the high score.
MEMORY — For 1 to 4 players; the computer lays out 25 pairs of cards face-down, and you must remember where the pairs are.
MASTERMIND — Crack the computer's code in less than ten attempts.

747 Flight Simulation Program for the 12K Atom

Written for Bug-byte by a 747 pilot. Accurate simulation of a 747's cockpit display (airspeed, altitude, rate of climb, attitude, flaps, etc., and graphic display of horizontal situation and attitude); allows you to guide your craft to the landing strip. On making your final approach the display changes to a high-resolution 3D representation of the runway coming up to meet you. A real teat of skill. Finding the runway is quite a challenge — landing safety is even more difficult. If you succeed, you are awarded a skill rating and the chance to take off and try again.
REQUIRES FLOATING POINT ROM **PRICE ONLY $29.00**

SPACE PAK $24.95

Atom Invaders (12K, a.c, Gr. Mod4, sound)

Fast-moving, machine code version of the ever popular arcade game, which makes full use of the Atom's high resolution graphics.
All the expected features — one and two player versions, 3 different invader types in 11 x 5 formation, spinning flying saucer, single and double speed bombs, extra base for 1500 points, sound output, high score, etc. Probably the best version of the program available for the Atom, or any microcomputer. Compare the photograph and list of features with others available.

Galaxian (12K, basic, m/c, sound)

Swooping high-resolution aliens, realistic sound effects, high score etc. Another superb arcade game.

Star Trek (12K, basic & a.c, sound)

Go where no Atom owner has gone before, trekking across the galaxy, leaving a trail of zapped kilngons in your wake.
The program is a real time version, so if you delay too long in making command decisions, you'll probably live to regret it — if you survive, that is!
8 x 8 Galaxy, with 64 sectors in each quadrant. You have long range and short range scanners to search out Klingons, and Starbases to refuel at, a galaxy map to help you keep track of them and phasers and photon torpedos in your armoury.

Junior Games Pack $24.95

ATOM BREAKOUT (4K, a.c, Gr. Mod1, sound)
Fast-moving, highly addictive version of the popular arcade game. With high score, free ball for 500 points, ever advancing walls and sound output.
The aim of the game is to remove as many bricks as possible by hitting them with the bouncing ball. The "curved" edges of your bat will change the ball angle, making the game more challenging. The larger bricks score more points, but return the ball faster, so beware! Nine different skill levels are provided, from ridiculously easy to mind-blowingly impossible.

PINBALL (6K, a.c, Gr. Mod2, sound)
A computer simulation of a pinball table which is packed with features - opening and closing gates; tuneful, flashing bumpers; simulated gravity and a central trap. You have two bats in place of the more normal flippers, and five balls per game in which to attempt to beat the high score. A free ball can be won by lighting the eight letters and then getting the ball through the free ball gate.
The program has both one and two player versions of the game.

FRUIT MACHINE (8K, BASIC & a.c, Gr. Mod2, sound)
Another full-featured simulation. This time of a fruit machine, complete with HOLD and NUDGE facilities and spinning reels, with ten different symbols in a fixed order.
The program is written largely in BASIC, but with extensive machine code routines to produce fast-spinning reels and sound output.
Just as entertaining as a real fruit machine, but far cheaper in the long run.

ACORN CHESS The Program You've Been Waiting for!

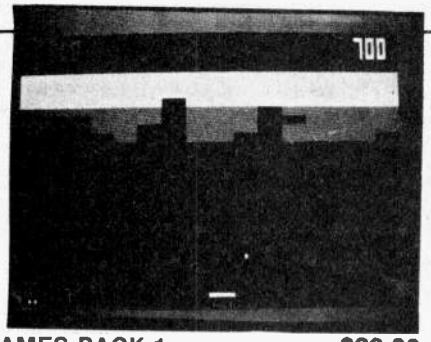
Fantastic machine code chess game for the 12K Atom. Features include: split screen (high res, + alphanumerics); many levels of play; castling and en passant; computer plays black or white.
Supplied on cassette with instructions **$29.00**

Gladstone's COMPUTER GRADE TAPES

Available in two lengths, 10 and 20 minutes, ideal for storing your computer programs. Take advantage of our quantity pricing and stock up!

	1 to 9	10-49	50-up
C10	2.29	2.05	1.72
20	2.79	2.49	2.09

Games For The Atom



GAMES PACK 1: $29.00

ASTEROIDS
Your space ship is encountering an asteroid storm; you must shoot the asteroids before they collide with your ship; but beware that large asteroids will break into smaller asteroids when hit. As in the popular pub version the game keeps a ladder of the ten best scores, together with the names of the scorers. Program 4K, graphics 6K.

SUB HUNT
You are in command of a destroyer tracking a submarine; knowing the submarine's course and position you must choose your course and speed to catch it. Program 1K, graphics ½K, needs floating-point.

BREAKOUT
Breakout is a version of the popular game in which you score points for knocking bricks from a wall. Balls can get trapped behind the wall and knock out a great many bricks. To add to the skill the balls undergo two changes of angle and speed, and when hitting a ball two angles of reflection are possible. The game keeps a record of the highest score. Program 3K, graphics 1-2K.

GAMES PACK 2: $29.00

DOGFIGHT
A two-player game in which each player controls a plane from the keyboard, and tries to shoot down the opponent without crashing into the stars. Each player has control of the direction of flight, a fire button, and an accelerate control. Program 4K graphics 6K.

MASTERMIND
Guess the computer's code before the computer guesses yours; a test of logical deduction and reasoning. Program 3K, graphics ½K.

ZOMBIE
Your plane has gone out of control and you are plummeting into the unknown. You land on Zombie island; your only hope of survival is to lure all the zombies into the swamp. In desperation you can try a jump into hyperspace! Program 3K, graphics ½K.

GAMES PACK 3: $29.00

RAT TRAP
Move your rat without colliding with the trails left by either rat; and entangle your opponent before he entangles you! With high-speed action-replay feature. Program 4K, graphics 5K.

LUNAR LANDER
Land a spacecraft on a lunar crater; instrument panel gives readout of altitude, velocity, fuel remaining, and drift velocity, and provides control over thrust and drift. Program 1K, graphics ½K.

BLACK BOX
Deduce the position of four invisible objects in the Black Box by firing rays at them and observing how they are reflected or absorbed. Program 3K, graphics ½K.

GAMES PACK 4: $29.00

STAR TREK
A full implementation of the now classic computer game in which you must rid the universe of Klingons. With short and long-range scans, galactic map, phasers, photon torpedoes, shields, etc. Program 5K, graphics 1K.

FOUR ROW
You and the computer take turns in placing marbles on the board, and the first to get a line of four marbles horizontally, vertically, or diagonally, wins. Program 5K, graphics 6K.

SPACE ATTACK
Earth is being invaded by hostile aliens; armed with a laser-gun you must repel the invasions and avoid being hit by the gunner ships. If you fail, the mother ship lands and the invaders take over. The game becomes progressively harder with each subsequent invasion; if you survive ten invasions the earth is saved! Program 3K, graphics 6K.

GAMES PACK 5: $29.00

INVADERS
The most popular video game, with invaders, flying saucers, shelters, and full sound effects, now available for the ATOM. Program 5K, graphics 6K.

WUMPUS
You are wandering in a network of caves inhabited by the Wumpus. Discover where he lurks and shoot him before he eats you; the pits and bats don't make things any easier. Program 2K, graphics ½K.

REVERSI
Reversi, also called Othello, is played with counters that are black on one side and white on the other; players take turns in placing and turning over counters, and the player with the most counters wins. Program 3K, graphics ½K.

GAMES PACK 6: $29.00

DODGEMS
Steer your car around the lanes, collecting points, but avoid the computer-controlled car which is programmed to collide with you. If you survive, the game gets faster. Program 4K, graphics 6K.

SIMON
Test your ability to remember a progressively longer sequence of lights and tones. With adjustable skill level. Program 2K, graphics 3K.

AMOEBA
Try and create the shapes devised by the computer; for up to 4 players. Program 3K, graphics 3K.

GAMES PACK 7: $29.00

GREEN THINGS
Your computer has just informed you that an alien lifeform has invaded your spacecraft; you only hope of survival is to discover a way of destroying the green things with the weapons available on the ship. Program 5K, graphics 2K.

BALLISTICS
A two-player game in which you take turns in firing shells at the other player, taking into account the wind and shape of the hill. Program 3K, graphics 6K, needs floating-point.

SNAKE
Grow yourself a snake by guiding it towards digits which it eats; but don't let it eat the walls, or itself. Program 2K, graphics ½K.

GAMES PACK 8: $29.00

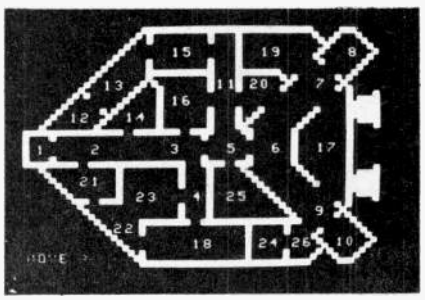
STARGATE
GOMOKU
ROBOTS

GAMES PACK 9: $29.00

SNAPPER
Guide the Snapper through the maze eating dots and avoiding the creatures from the cave. Before you can eat them you must eat a cross to become invulnerable. Later screenfuls have different mazes and faster creatures. Program 5K, graphic 3.

MINOTAUR
Wander in a three-dimensional labyrinth, and move the five gold bars from their treasure chests to the safe without being eaten by the hungry Minotaur. The audio minotaur detector warns you when he nearby, and a map, compass, compass, and marker crosses help you find your way through the passages of the labyrinth. Program 5K, graphics 6K.

BABIES
Use the trampoline to rescue babies that are falling from a burning building, by bouncing them to the safety of the right-hand side of the screen.
Program, 5K, graphics 3K.



GAMES PACK 10: $29.00

This pack includes video games such as Breakout and Squash, games of deduction such as Mastermind, and simulations such as Ski-Run and Track, all of which will run on an 8+2K ATOM.

BREAKOUT — Knock bricks from a wall and beat the high score.
HECTIC — Catch the blocks falling from the sky before they block your way.
MASTERMIND — Guess the computer's code in less than ten attempts.
SKI-RUN — Ski down a mountain, avoiding the trees, to the safety of a hut.
SNAKE — Guide your snake to feed it on digits, but avoid bumping into the edge!
TRACK — Drive along a race-track, avoiding the oncoming traffic.
SIMON — Test your memory with a series of letters provided by the computer.
SQUASH — Keep 15 balls in play in the squash court.
MOON — Land your module on the surface of the moon, controlling thrust and with a readout of height, velocity, and acceleration.
BOMBS-AWAY — Two players fire at each-other across a mountain.

ATOM ADVENTURES $29.00

ATOM ADVENTURES let you explore a fantasy world, with descriptions of the places you visit, the characters you encounter, and the objects you find in your quest for treasure. The pack consists of an Adventure program, and three different Adventure games:

DUNGEON
Search for treasure in a maze of interconnected caverns, tunnels, and caves, inhabited by friendly and unfriendly monsters. Win by finding treasure, and taking it to the Throne Room.

HOUSE
You start on the doorstep of a haunted house, in whose rooms lurk the ghosts of some familiar people. Find treasure and take it to the Grand Banqueting Hall to win the game.

INTERGALACTIC
You play the part of an intergalactic traveller in this mind-bogglingly wierd trip from Earth to the most distant parts of the galaxy. To win you must survive battles against the inhabitants of alien planets, and return home with treasure.
Program 5K, graphics 6K.

ATOM SYNTHESISER $29.00

The ATOM Synthesiser turns the ATOM into a programmable synthesiser, using the keyboard as a piano keyboard, with the ability to record, and edit four separate tunes, and play them through the internal speaker. As well as altering the tempo the notes can be played in four different voices which can be selected at any point in a tune. While a tune is being recorded, played or edited, the notes are displayed on musical staves.

Commands: Manual, Record, Play, Edit, Tempo, Save, Load.

ATOM Synthesiser comes complete with some demonstration tunes on cassette, including Variations on Bach's Toccata and Fugue, and "The Teddy-Bear's Picnic".
Program 5K, graphics 6K.

ATOM LIFE PACKAGE $29.00

The ATOM LIFE package is one of the fastest versions of Life available on any microcomputer, and will process a full 256 x 192 screen in less than 2 seconds, or a 128 x 64 screen in under ½ second. It uses the standard set of rules for survival and reproduction. These rules, though simple, give rise to a very complicated and fascinating selection of patterns. Some patterns are stable, others die out, some oscillate between different states, and some (such as the glider and the spaceship) move with successive generations.

A cursor-drawing system allows any shape to be drawn on the screen. The program comes complete with 7 programmed shapes, which can be called up in any part of the screen in any orientation. These shapes are:

Glider, small spaceship, flying machines, glider gun, queen bee, 15 cycle, and eater.

Complex patterns can be saved to cassette and reloaded, and 5 interesting patterns are provided with the program:

Newgun, two oscillators, a poisoned cell, and a grid pattern.

Utility ROMs for the ATOM

WORK PACK ROM: $75.00

A combined text editor and word processor ROM for the Acorn ATOM; needs 1K text memory and 6K graphics. The ATOM Work Pack is ideal for the preparation of leaflets, letters, booklets, and documents. Text can be edited, saved on cassette or disk, and printed out in any desired format. BASIC programs, and data created by programs, can also be edited. There is no limit to the size of document that can be created, as large documents can be broken into sections of the convenient size.

The Word Pack is supplied in a 4K ROM which simply plugs in to the ATOM's utility ROM socket. The ROM adds the commands EDIT and TEXT to the ATOM's command set, and these commands can be inserted in programs. The EDIT command enters the text editor/work processor. The TEXT command stores text to the editor's text area, so that output generated by programs, or by the LIST command, can subsequently be edited.

The Word Pack comes complete with a 16-page booklet giving full instructions, and examples of use.

Text Editor
The Text editor uses the ATOM's high-resolution screen to display the text, with full upper and lower case. Editing commands are all single keystrokes; they allow text to be added anywhere in the document, deleted, or moved, using a cursor to specify the required position. Any part of the document can be viewed, and the editor includes a 'find' command thus, for example, spelling mistakes can be corrected throughout the text with a single command.

Text-Editor Commands:
Insert after, insert before, copy text to buffer, end of text, delete, enter text, escape/delete mark, find (and replace), home cursor, insert character, next page, output to printer, previous page, quit to BASIC program, replace text, move to start, transfer text to buffer, where is end of text, exchange character, move to end, roll up one line, cursor to start of line, cursor to end of line, mark cursor position, load text file, save text file, execute COS/DOS command.

Word Processor
The processor commands can be inserted into the text to give great flexibility in how it is printed. Pages can be printed in any format, with optional page numbers, and sections can be justified as required. The processor caters for most makes of printer, and for single-sheet printing the processor can be made to wait for a keypress after each page.

Processor Commands:
Allow lines to be on the same page, allow new page, centre line, double-space lines, equal-position line numbers, indent, justify lines, keypress for new page, set lines per page, line one of document, margin, no justification, output character to printer, set page number, no page numbers, righ margin, single-space, temporary indent, width of page, exchange control character, comment line.

PROGRAM TEXT EDITOR (EDIT) and DEBUGGING AID (DEBUG) $69.95

EDIT and DEBUG are machine code routines which aid the user to write correct, efficient and structured programs at the keyboard. EDIT is a sophisticated program text editor, similar to editors available on more expensive machines than the Acorn Atom, which allows the user to make major alterations painlessly. DEBUG is primarily an aid to debugging machine code programs and includes a disassembler. The routines occupy 4K bytes of memory. May be used with or without floating point ROM. Includes 16-page instruction booklet.

EDIT COMMANDS

An	AUTO insert.
B	Go to BOTTOM of text
B=h	Set start of BUFFER space.
C/str1/str2/n	CHANGE n lines.
Dn	DELETE n lines
DM	DELETE MARKED text.
D.	DELETE all following text.
D=c	Set DELIMITER.
En	EXTRACT n lines to buffer
EM	EXTRACT MARKED text.
H/str/n	HUNT and list n lines.
In	INSERT from buffer with increment n.
Ln	LIST n lines.
L-n	LIST previous n lines.
LA	LIST AROUND.
LB	LIST BACK.
LF	LIST FORWARD.
LM	LIST MARKED text.
L.	LIST whole text.
L.n	LIST line with line number n.
M1	MARK text.
M2	
Nn.	Skip forward NEXT n lines.
N-n	Skip backwards n lines.
NEW	Start NEW text.
OLD	Back to OLD text.
On	Printer ON.
OFF	Printer OFF.
Q	QUIT EDIT.
Rn	RENUMBER with increment n.
Rn, m	RENUMBER from m with increment n.
Rn, m, F	FULL RENUMBER from m with increment n.
S/str1/str2/n	SUBSTITUTE n occurences in current line.
T	Go to TOP of text.
X	EXCHANGE primary and buffer text spaces.
Z	Store command line.
—	Invoke stored command line.
*	ADD to line. Operating system command.
XXYZ	Load XYZ.
XXYZ	Save XYZ.
?	Information.

DEBUG COMMANDS

A	Display/modify ACCUMULATOR image.
B	Display/modify BREAK point.
C	Disassemble (CRACK) from current byte.
D	DUMP memory from current byte.
F	Display/modify memory dump FORMAT.
G	Execute (GO) machine code from current byte.
M	Display/modify MEMORY locations.
ON	Printer on.
OFF	Printer off.
P	Display/modify PROCESSOR status register image.
Q	QUIT.
R	Display REGISTER images.
W	Display/modify current byte (WHERE).
X	Display/modify X register image.
Y	Display/modify Y register image.

Just typing RETURN repeats the previous command.

PROGRAMMER'S TOOL BOX $79.95

A packed 4K EPROM (fits Utility Socket) containing:
1200 BAUD CASSETTE OPERATING SYSTEM
Visible Load Routine

PLUS	*TRACE (X)	— controlled execution, line no. display
	*STEP	— single step execution
	FIND	— any string of chars. in program
	VAR	— list variables
	LVAR	— print variables
	AUTO X, Y	— automatic line numbering (any start, any step)
	RENUMBER X,Y	— any start, any step
	DELETE X to Y	— any range of line nos.
	HEX	— Hex and Ascii memory dump
	IHEX	— Hex Dump in instruction format

(*VIA chip required)

PLUS	**Additional BASIC statements**	
	READ, DATA & RESTORE	
	KEY X	— scans keyboard — input to variable
	INKEY SX	— scans keyboard — input to string variable
	IF...THEN ...ELSE... WHILE...END-WHILE CURSOR X, Y	— position cursor as required
	ON ERROR	
	BEEP X, Y	— sound a note — any duration, any pitch
	ZERO	—zeroes all basic variables
	POP	— close out sub-routine

WORKS WITH ANY MEMORY SIZE! GREATLY ENHANCES EXISTING ATOM FACILITIES DETAILED OPERATING INSTRUCTIONS SUPPLIED.

Turn your Acorn Atom into a Cost-Efficient Word Processing System!

The Centronics Model 739.
Here's proof that inexpensive doesn't have to mean incomplete. The Model 739 will perform just as dependably as the workhorse printers that have made Centronics the leader in printer performance. Look at the key features.

CORRESPONDENCE QUALITY—Clear characters, right justified, proportionally spaced for a custom quality printing.

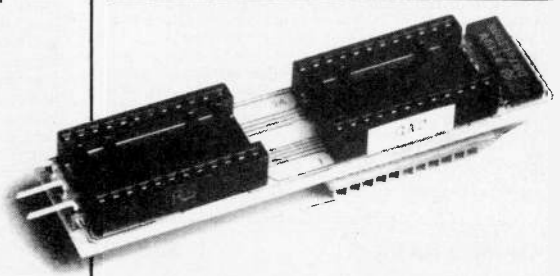
GRAPHICS—for business. Everything from bar charts and curves to illustrations.

3-WAY PAPER HANDLING—Cut sheet, roll, fan-folded forms.

$875.00

THE CENTRONICS 739.

Printer Interface and Cable for ATOM $59.95



GA2 Adapter Enables Use of TWO Utility ROMS!

The ATOM is fitted with single extra utility socket. The GA2 adapter shown here enables the user who wants more from his ATOM to utilize two utility ROMS with the flip of a switch.
For word processing applications, for example, the fast COS (cassette operating system) of the Programmers Tool Box may be used to save text created with the Word Pack ROM. This saves a substantial amount of time in loading and saving GA2 Adapter.

$45.00

INSTANT ROM ™

ROM/EPROM Emulators

A NEW MICROSYSTEM PROGRAMMING AID

- Plug-in replacement for all popular ROMs and EPROMs
- Instantly programmed at normal system speed
- No erasure required before re-programming
- Contains CMOS RAM with battery back-up
- Retains data for up to 10 years
- No limit to number of programming cycles
- 24-pin ROM/EPROM pin-out — fits into standard socket
- Available as 2K x 8, 4K x 8, and 8K x 8 modules
- Removable — easily copied in an EPROM Copier

'Instant Rom' ROM/EPROM EMULATORS are new programming aids for Microcomputer development. They contain CMOS RAM and, in 'standby' mode, can retain data for up to 10 years, powered by a built-in lithium cell.
Data or programs are written to INSTANT ROM (using an additional 'Write' signal) at normal system speed in your Development System. It is used like RAM.

When the Write signal is removed the device becomes, effectively, a ROM. When the power is switched off, data is retained.
Data (even a single byte) can be re-written by re-connecting the 'Write' signal. There is no need to erase the old data. There is no limit to the number of times that INSTANT ROM can be re-programmed.

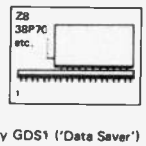
INSTANT ROM can save a lot of time.
Bugs can be corrected immediately, without the need to erase and re-program EPROMs. INSTANT ROM can be used for long periods; when the program is finally 'bug-free' an EPROM can be programmed.

INSTANT ROM plugs directly into 24-pin ROM/EPROM sockets, and is available as a replacement for all commonly used ROMs and EPROMs — 2316/2516/2716 (2K devices), 2332/2532/2732 devices (4K), and 2364/68764 (8K devices).
The lithium cell needs no re-charging.

APPLICATIONS

Program Development
At the development stage, systems can be 'up-and-running' and independent of the Development System without the need to burn EPROMs.
An INSTANT ROM can be unplugged and used as a Master ROM in an EPROM copier. It can be used for long periods of time in a system, even permanently if necessary; but corrections can be made instantly.

One-chip Systems
One-chip Microcomputers with 'piggy-back' EPROM sockets can use INSTANT ROM, as can those with on-chip Basic or other interpreters. A complete working system can be produced literally in minutes.



Non-volatile RAM
INSTANT ROM can be used to save data generated during a program. Accessory GDS1 ('Data Saver') may be used to detect power supply failure in advance, and produce an interrupt which will initiate a 'data-saving' routine.

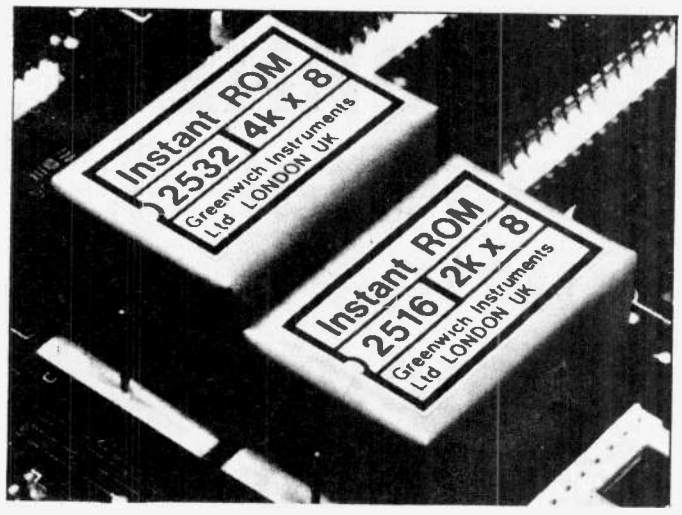
Character Generators
INSTANT ROM is very useful for developing Character Generators for printers and VDUs. The results can be observed, and further changes made, immediately. INSTANT ROM may also be useful in the development of Speech Synthesis ROMs.

Data Logging
INSTANT ROM can be used in remote data-logging applications. Data can be accumulated over many months; the INSTANT ROM can then be removed, plugged into a suitable Microcomputer, and analysed very quickly.

Logic Prototyping
By suitable programming, any combination of signals on the address lines can produce any combination of signals on the 8 data outputs. Complex logic can be simulated.

Signal Generation
INSTANT ROM, plus a binary counter and clock, can be used as an 8-channel programmable pulse generator. By adding an 8-bit D/A, any waveform can be generated with 8-bit resolution.

Personal Computers
INSTANT ROM has found many uses in this field. ROM-based Basic and other languages can be improved and extended with great convenience, security programs can be quickly written and debugged, and operating systems can be easily modified for turnkey operation.

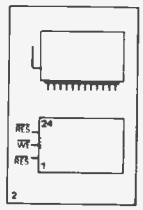


SPECIFICATION

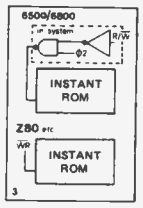
All types are for use on SINGLE RAIL 5-volt systems only:

GR2516. . .2 Kbytes. . .replaces 2316 ROM/2516 EPROM	$109.00
GR2716. . .2 Kbytes. . .replaces 2716 EPROM	$109.00
GR2532. . .4 Kbytes. . .replaces 2332 ROM/2532 EPROM	$157.00
GR2732. . .4 Kbytes. . .replaces 2732 EPROM	$157.00
GR2364. . .8 Kbytes. . .replaces 2364 ROM/*68764 EPROM	$269.00

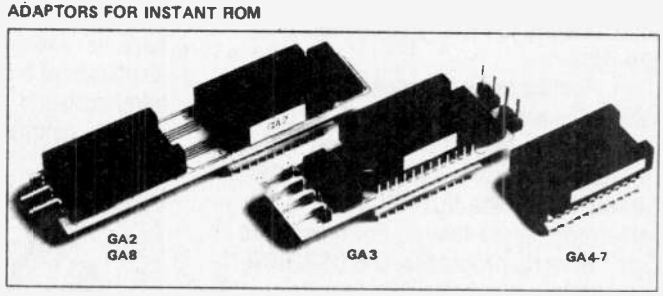
*Motorola Part No.



Package: 24-pin dual-in-line
Size: width 22.5mm, length 34.5mm (+5mm for pins)
height above socket 20mm (2K, 4K); 27mm (8K)
Pin-out: compatible with the ROMs/EPROMs shown above
Supply Voltage: 5V +– 0.25V
Current (typical): 35mA (accessed), 5mA (not accessed)
Battery Life: 10 years typical, 3 years guaranteed
Speed: max. 275nS (read or write)
Inputs: three extra pins (dia. 0.8mm), mounted at one end
Centre Pin: Write Enable (input), 74LSTTL. Active low
To write data to INSTANT ROM, the system Write line is temporarily connected to this pin.
The Write signal for any Static RAM in the system may be used for this purpose.
An Application Note is supplied.
Outer Pins: System reset (input), 74LSTTL. Active low
Connecting this pin to System Reset inhibits Write during the power-up reset period; the Write Enable lead may then be left permanently connected.
Two connecting leads (length 150mm) are supplied.
Full operating instructions are supplied with every INSTANT ROM. Specialised Application Notes are available.



ADAPTORS FOR INSTANT ROM



GA2: enables two INSTANT ROMs, ROMS, or EPROMs to occupy the same socket. ROM-switching is achieved by connecting a link, or under software control using GA3. **$45.00**
GA3: 8-bit Output Port, useful for software switching of ROMs using GA2. Shares a socket with any existing 24-pin ROM; the outputs are set to '0' or '1' by writing to the ROM (Write signal required). **$60.00**
GA4 'Socket Saver': INSTANT ROM may be plugged and unplugged many times without damage to ROM sockets. **$ 9.00**
GA5: 4K to 2K Adaptor. Permits the use of a 2332/2532 (4K) in a 2316/2516 socket. Hardware select of upper or lower half, or software select using GA3. **$15.00**
GA6: 4K to 2K Adaptor. For using a 2732 (4K) in a 2716 (2K) socket. Selection as GA5. **$15.00**
GA7: 8K to 4K Adaptor. For using a 2364 (8K) in a 2332/2532 (4K) socket. Selection as GA5. **$15.00**
GA8: For using two 4K devices in an 8K socket, or two 2K devices in a 4K socket. Selection is automatic. **$45.00**

COMMODORE COMPATIBLE PRODUCTS

INSTANT ROM Type GR 2516 (2k) and GR 2532 (4k) may be used directly in all PET Computers except old 'small keyboard' types. All the Adaptors described above may also be used in the PET. GA 8 is suitable for use in the VIC Computer. No soldering or modification is required.

GA 1	Adaptor to produce the 'Write Enable' signal in any PET. This is NECESSARY when using INSTANT ROM or GA 3 . . . . . **$18.00**
GSL 1	Set of spare leads for interconnection of the various devices . . . **$5.00**
GSW	Program (on tape) for quickly programming an INSTANT ROM (GR 2516) with a new Character "Chargen" Set for the PET. The GR 2516 may then be plugged into the Character Generator socket and used immediately **$29.00**
GCC 1	CLOCK—CALENDAR for the PET. Plugs into the User Port. Gives time (to 23.59.59) and date to 31.12.99 + day of week). Lithium battery back-up (life typically 10 years). Generates interrupts into CA 1 line at hardware selected intervals. Accuracy 10 secs/month . **$179.00**

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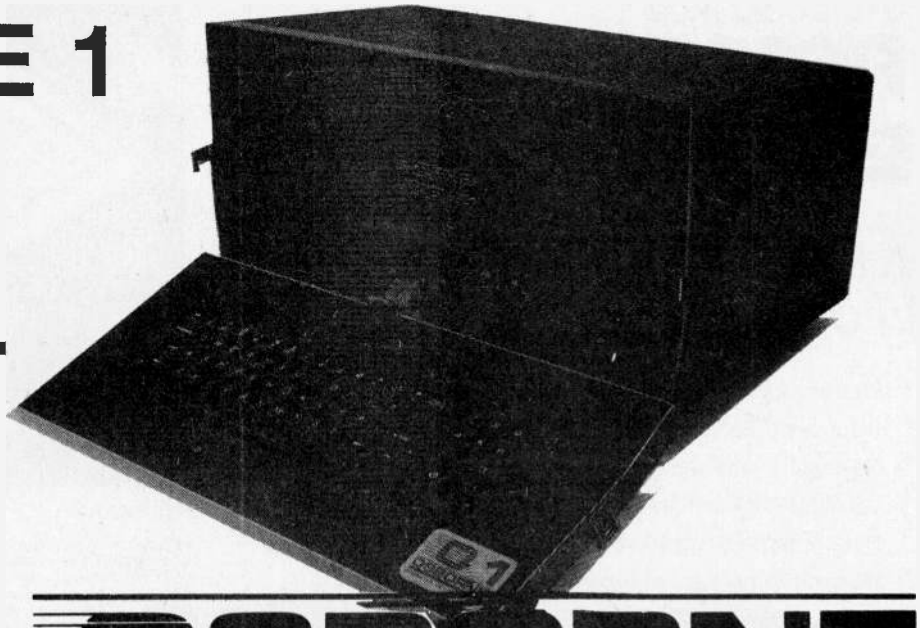
OSBORNE 1 Personal Business Computer $2595.00



Take a couple of minutes to see what's in the OSBORNE 1 Personal Business Computer. You'll then be able to see why it represents a new way to conduct business.

The OSBORNE 1 Computer packs a desktop computer system into a portable carrying case.

The system *includes* all the hardware and software you need to start working right away. The computer, disk drives, keyboard, and screen are all there. The OSBORNE 1 connects easily to a variety of printers, from inexpensive matrix units to letter-quality daisy printers.

And the most businesslike software solutions are provided, too. That includes the WORDSTAR® word processing system with MAILMERGE® features, and the SUPERCALC® electronic spreadsheet. For those who wish to write programs, the OSBORNE 1 comes with two powerful, easy-to-use BASIC dialects—MBASIC® and CBASIC®. Since the OSBORNE 1 includes the CP/M® operating system, you can also choose from literally thousands of programs available to run on computers with CP/M.

The only reason you would consider working without a computer like this one is price.

And we've fixed that. OSBORNE 1 sells for $2595, with all the features described above.

At that price, the computer won't have to save you much time, or increase your output a great deal to pay for itself quickly. The OSBORNE 1 *will* save a lot of your time. It *will* make you a lot more productive.

OSBORNE COMPUTER

The OSBORNE 1 combines productivity, portability and price in a package that means you can increase your business productivity *now*. The personal computer is no longer a toy or game. The OSBORNE 1 is the advent of the *Personal Business Computer*.

The increased personal productivity made available by the OSBORNE 1 will become essential to successful progress in all phases of business and government administration. Quite simply, how are you going to compete in your profession without one?

"Why I designed and built a new microcomputer."

"We do not need more powerful and more expensive microcomputers. We need a major price breakthrough. We need a microcomputer that uses existing technology, but has a much lower price tag. Such a machine can be built if we discard old design habits, inherited from the world of minicomputers and the days of expensive electronic logic.

THE OSBORNE 1 AT A GLANCE.

Standard Hardware

- Z80A® CPU
- **64K** bytes of **RAM** memory (60K available to the programmer)
- Two floppy diskette drives with 102K bytes of storage each
- Full business keyboard with 10-key numeric pad
- Built in 5" monitor. 52 column x 24 row memory mapped screen. Automatically scrolls horizontally across a 128 character line.
- **IEEE/488** interface (full implementation)
- **RS232C** interface
- Separate modem interface
- External video monitor interface
- External battery pack connector
- Two pockets to hold diskettes

Standard Software

- **CP/M®** disk operating system
- **WORDSTAR®** word processing with **MAILMERGE®**
- **SUPERCALC®** electronic worksheet
- **CBASIC®** and **MBASIC®**

Optional Hardware

- 12" external video monitor (52 column x 24 rows)
- Modem electronics with acoustic coupler
- Battery pack with up to five hours of processing
- Double-density diskette drives
- 12" external video monitor (80 column x 24 rows)
- Double-density double sided diskette drives

Trademarks:
OSBORNE 1: Osborne Computer Corporation
CP/M: Digital Research
WORDSTAR, MAILMERGE: Micro Pro
SUPERCALC: Sorcim Inc.
Z80A: Zilog Corporation
MBASIC: Microsoft
CBASIC: Compiler Systems
VISICALC: Personal Software
APPLE II, III: Apple Computer Corporation

Sinclair Software

CASSETTE 1 — GAMES
For ZX81 (and ZX80 with 8K BASIC ROM)

ORBIT — your space craft's mission is to pick up a very valuable cargo that's in orbit around a star.

SNIPER — you're surrounded by 40 of the enemy. How quickly can you spot and shoot them when they appear?

METEORS — your starship is cruising through space when you meet a meteor storm. How long can you dodge the deadly danger?

LIFE — one of the most famous programs in the computer world. Study the life, death and evolution pattern of cells.

WOLFPACK — your naval destroyer is on a submarine hunt. The depth charges are manned, but must be fired with precision.

GOLF — what's your handicap? It's a trickly course but you control the strength of your shots.

CASSETTE 2 — JUNIOR EDUCATION (7 to 11-year-olds)

For ZX81 with 16K RAM pack

CRASH — simple addition, with the added attraction of a car crash if you get it wrong.

MULTIPLY — long multiplication with five levels of difficulty. If the answer's wrong — the solution is explained.

TRAIN — multiplication tests against the computer. The winner's train reaches the station first.

FRACTIONS — fractions explained at three levels of difficulty. A ten-question test completes the program.

ADDSUB — addition and subtraction with three levels of difficulty. Again, wrong answers are explained and corrected.

DIVISION — with five levels of difficulty. Mistakes are explained graphically and a running score is displayed.

SPELLING — up to 500 words over five levels of difficulty. You can even change the words yourself.

CASSETTE 3 — BUSINESS & HOUSEHOLD

For ZX81 (and ZX80 with 8K BASIC ROM) with 16K RAM pack

TELEPHONE — set up your own computerised telephone directory and address book. Changes, additions and deletions of up to 50 entries are easy. You can search for entries by name or address - even by part-name or part-address.

NOTE PAD — a powerful, easy-to-run system for storing and retrieving everyday information. Use it as a diary, a catalogue, a reminder system, or as a directory.

BANK ACCOUNT — a sophisticated financial recording system with comprehensive documentation. Use it at home to keep track of 'where the money goes', and at work for expenses,' departmental budgets, etc.

CASSETTE 4 — GAMES

For ZX81 (and ZX80 with 8K BASIC ROM) with 16K RAM pack

LUNAR LANDING — bring the lunar module down from orbit to a soft landing. You control altitude and orbital direction — but watch the fuel! The screen displays your flight status — digitally and graphically.

TWENTYONE — a dice verison of Blackjack.

COMBAT — you're on a suicide space mission. You have only 12 missiles but the aliens have unlimited strength. Can you take 12 of them with you?

CODEBREAKER — the computer thinks of a 4-digit number which you have to guess in up to 10 tries.

SUBSTRIKE — on patrol your frigate detects a pack of 10 enemy subs. Can you depth- charge them before they torpedo you?

MAYDAY — in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

CASSETTE 5 — JUNIOR EDUCATION (9 to 14-year-olds)

For ZX81 (and ZX80 with 8K BASIC ROM)

MATHS — tests arithmetic with three levels of difficulty, and gives your score out of 10.

BALANCE — tests understanding of levers/fulcrum theory with a series of graphic examples.

VOLUMES — 'yes' or 'no' answers from the computer to a series of cube volume calculations.

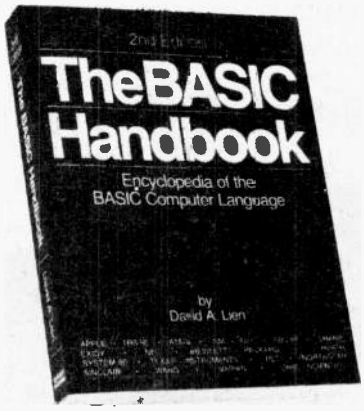
AVERAGES — what's the average height of your class/shoe size of your family/pocket money of your friends? The computer plotes a bar chart and distinguishes MEAN from MEDIAN.

BASES — convert from decimal (base 10) to other bases of your choice in the range 2 to 9.

TEMP — volumes, temperatures — and their combinations.

Price each $12.95

When your computer won't speak your language, you need a basic handbook.



As a matter of fact, everyone who works in BASIC needs THE BASIC Handbook. It is the definitive reference work on the subject of BASIC. The BASIC Handbook is an easy-to-use encyclopedia of nearly 500 words covering the "dialects" used by virtually every BASIC-speaking computer in the world. But more than that, it's a simple, step-by-step guide to translating programs from one computer to another. So now you can actually use software printed in magazines and elsewhere, no matter what computer you own.

Written by Dr. David A. Lien, author of the Tandy TRS-80 Level I User's Manual and the Learner's Manuals for the Epson MX printers, this completely revised Second Edition contains almost twice as many entries as the best selling First Edition, making it by far the most up-to-date BASIC reference book you can buy.

Extensively indexed and cross-referenced, The BASIC Handbook gives you 480 pages packed with the information you need to be a better programmer.

$29.95

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NOTES ABOUT ORDERING.
Personal cheques must clear bank before shipment. CODs are accepted when accompanied by 20% deposit. Shipments are fully insured. Cost of insurance and shipping is added to order — add 5% to cover estimated cost. ANY EXCESS WILL BE CREDITED.

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Ont. res. add 7% p.s. tax _____

(Est.) Shipping charge _____

TOTAL **$** _____

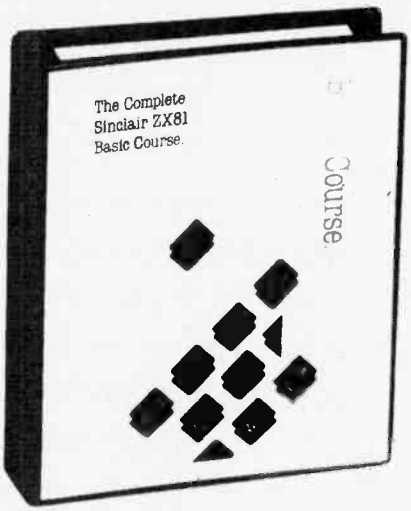
$20 DISCOUNT

On purchase of both

Sinclair ZX81 Computer

+

the Complete Sinclair ZX81 BASIC Course



The Complete Sinclair ZX81 BASIC Course (Reg. $44.95) with purchase of ZX81

$24.95 (BASIC PROGRAM TAPES OPTIONAL, $9.95)

Sinclair ZX81 kit now only **$109.95**
Assembled **$159.95**

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EASY TO USE ORDER FORM INSIDE

Heads & Tails

BUDGET PROJECT

This quick project takes the pain out of decision making — it's a heads and tails game which simulates the action of tossing a coin.

DO YOU OFTEN get into a quandary, not knowing whether to do one thing or the other? Well, if you do, this super-simple quick project could be the device you've been waiting for. It uses a seven-segment LED display to display a letter 'h' for heads or a 't' for tails.

To 'flip' the electronic 'coin' you press a button; when you release the button the 'coin' falls on one 'side' and the initial letter of that side is displayed.

There are no prizes for design complexity with this circuit. As you'll see in the diagram shown (Fig. 1) it's so simple it's almost untrue!

NOR gates IC1a & b are coupled together, along with capacitor C1 and resistor R1, as an astable multivator, oscillating at about 700 Hz. The frequency of oscillating of the astable is controlled by the values of components C1 and R1. If either component is increased in value, the frequency of oscillation decreases: if either component value is decreased, the frequency increases. Chosen frequency (i.e., 700 Hz) is not critical, incidentally, so don't be afraid to insert other values if you don't have the exact values specified.

The squarewave output of the astable is applied, via push-button PB1, to a bistable multivibrator formed by NOR gates IC1c & d. The two bistable outputs are in antiphase i.e., one is on when the other is off, and they control LED segments c and d of the seven-segment display.

LED segments e,f and g are coupled together, through a 680R resistor to 0V and are permanently on forming the letter 'b'; the seven-segment display will show the letters 't' or 'h' only when the push-button is operated.

Construction is simple. The project is built-up on a 10 strip by 24 hole piece of Veroboard (as shown in Fig. 2) and is powered by a 9V battery. It shouldn't take more than a couple of hours to build.

ETI

Once you've finished it, all you'll have to do, when faced with a seemingly impossible choice, is to pull it out of your pocket, press and release the push-button and there's your answer: heads you accept that drink you've been offered, tails you don't refuse it!

Now, if you could only make up your mind whether you should build it or not . . . .

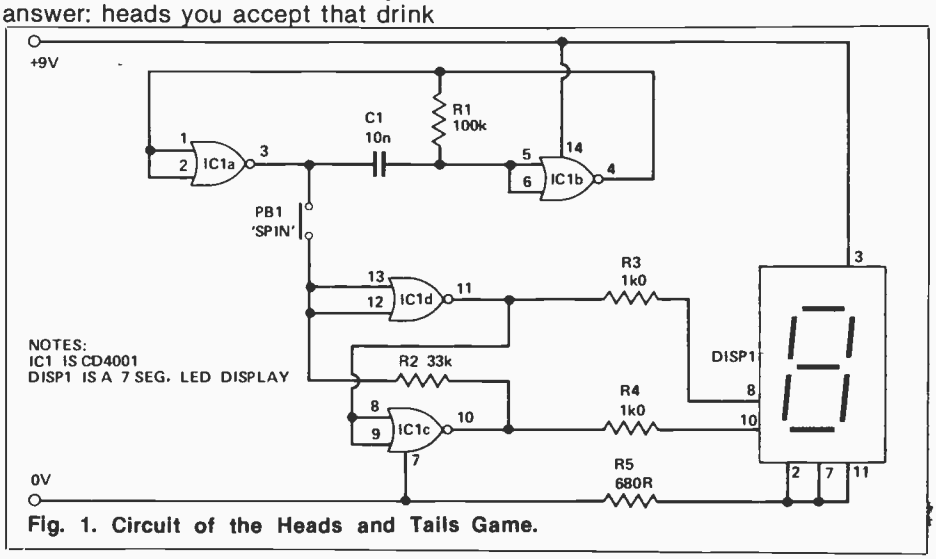


Fig. 1. Circuit of the Heads and Tails Game.

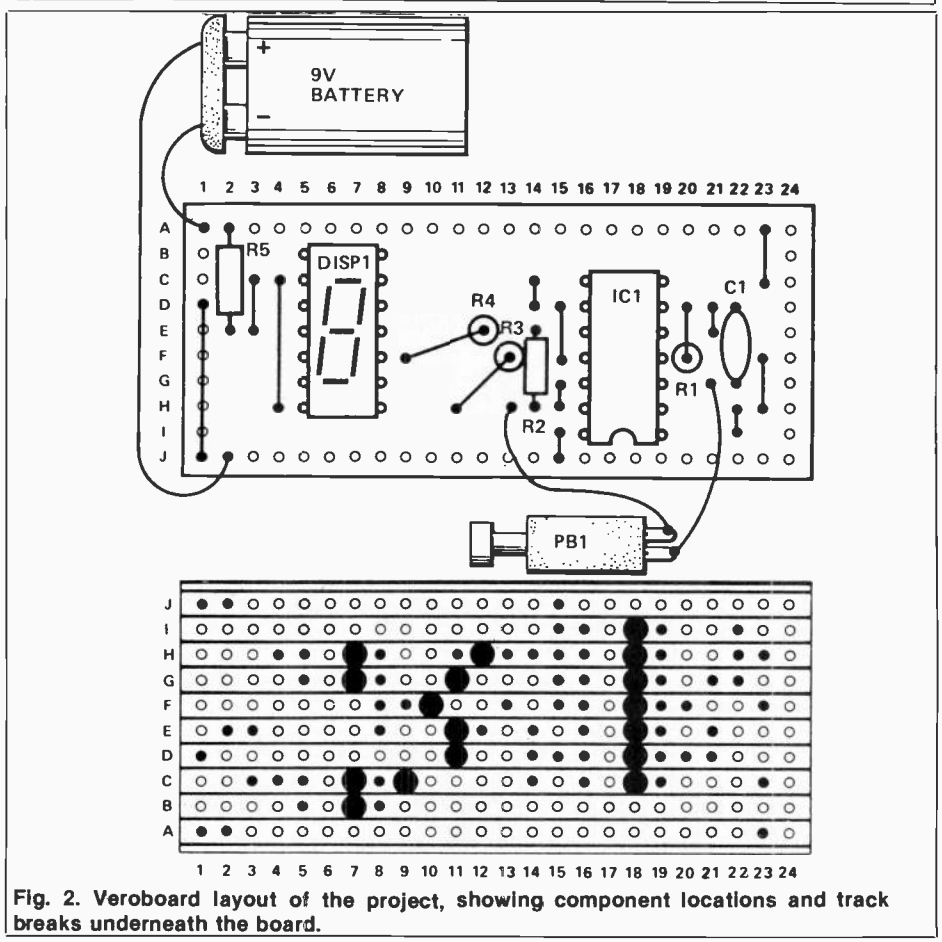


Fig. 2. Veroboard layout of the project, showing component locations and track breaks underneath the board.

Synthesizer Preview

The ETI synthesizer cometh next month. Prepare thyself: read this. A brief tome by Steve Rimmer.

BUILD A SYNTHESIZER is somewhat reminicent of building a subdivision; you start in one corner of the room and expand outwards until confronted by the walls or a foriegn country. An overall plan is, at best, a distraction, and may very well deter you at the start. The actual money invested in a versatile instrument is ruinously massive; it's far better not knowing the actual grand total and paying it out one module at a time.

The ETI synthesizer, which, if the gods continue to smile upon us, will be beginning next month, is a fully modular system capable of being set up to suit virtually any purpose, providing it's musical. It will be based, in part, around some rather sophisticated ICs made by E*u* which form the basis for very sophisticated VCOs, VCFs, VCAs and ADSRs. We'll be presenting a few modules each month.

The biggest hassle in building synthesizers in Canada is parts and we have become painfully aware of this as we've tried to get this project together. The ICs were bad enough, but keyboards were all but impossible. However, we think we've settled all of these little technicalities; several of our advertisers expect to be supplying the difficult components. However, as this issue goes to press there are still a few details to be ironed out. If the first modules have to be held off for a month, it will be because we didn't want to start the thing without the assurance that *all* the necessary bits were obtainable.

Being modular, the system relies on patch cords for patching . . . this is as opposed to switching matricies, pin boards or the ever popular solder and hookup wire approach. As is usually the case with patch cord systems, the versatility of the instrument is had at the expense of its ease of patching. Unlike "normalized" stage machines, every patch must be done by hand, making setting up a sound somewhat time consuming. As such, builders who want a "stage" instrument may wish to get the appropriate module PCBs together and wire them in a normalized configuration. While there is no reason why this can't be done, be aware that you're on your own if you try it.

Readers who undertake the synthesizer should be aware that we will be running the modules as we design them, that is, that we won't have a finished synthesizer here much before you do. Therefore, be prepared for a little bit of backtracking and fidgeting, should such become necessary.

Hall Effect

Semiconductors behave very strangely in the field — magnetic, that is. Ian Graham gives a brief explanation of the Hall effect.

OF ALL EFFECTS depending on the influence of a magnetic field on semiconductor charge carriers, the best known is probably the Hall effect. Edwin Herbert Hall (1855-1938), an American physicist, observed the result of applying a magnetic field to a semiconductor, through which he passed a current at right angles to the field. The arrangement is shown in Fig. 1.

In Fig. 1, a magnetic field of B Wm^{-2} (webers per square metre) in the Y-axis acting on a current (I) along the X-axis deflects 'holes' along the Z-axis to the bottom of the P-type semiconductor. Holes (vacant atomic positions in the crystal lattice) are the majority charge carriers in a P-type semiconductor. In N-type, the majority charge carriers, electrons, would be deflected to the bottom of the semiconductor.

Facial Motion

This movement of charges to one face of the semiconductor produces a potential difference at right angles to both the current (Ix) and the magnetic field (By). This potential difference is called the Hall voltage (V_H) and is given by:

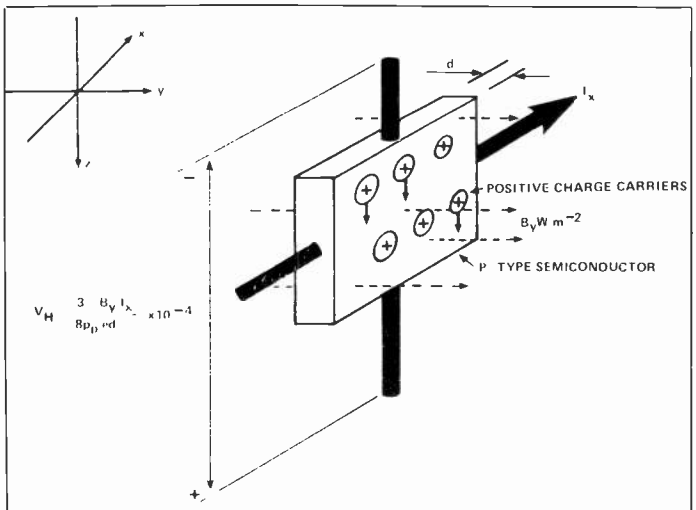


Fig. 1 Result of applying a magnetic field to a current-carrying semiconductor, i.e., the Hall effect.

$$V_H = \frac{3\pi B_y I_x}{8p.e.d} \times 10^{-4},$$

where e is the charge on an electron,
d is the thickness of the semiconductor (cm)
p is the hole density (cm^{-3}).

This strange behaviour of charges follows a well-known rule in physics, Fleming's Left Hand Rule, used to predict the behaviour of a current-carrying conductor in a magnetic field.

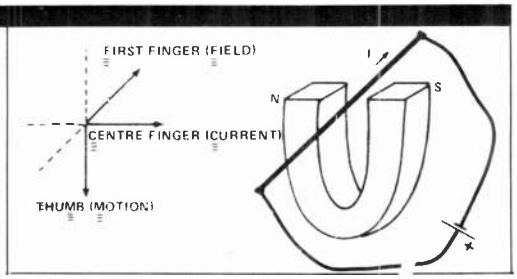


Fig. 2 In this example the direction of the force on the wire can be determined from Fleming's Left Hand Rule. Point your first finger in the direction of the magnetic field and your centre finger in the direction of the current. Your thumb should now be pointing downwards. The wire will be deflected downwards. If your thumb is pointing upwards, you've discovered Fleming's Right Hand Rule: change hands.

Applications

Hall discovered an interesting effect, but how can it be used? By fixing any two of the three variables the third can be measured. For example, an unknown magnetic field can be measured by finding how big a Hall voltage it produces compared with a reference field. Many of the devices available use indium antimonide or indium arsenide because they exhibit a large Hall effect and are not greatly affected by temperature.

The TL170C uses the Hall effect to sense steady-state magnetic fields. It has a built-in output transistor for use on voltages up to 30 V and requires a supply of 5 V at 4 mA (output high) to 6 mA (output low).

Max output current	
(output low)	20 mA
(output high)	20 uA (max)
Output voltage	
(at 16 mA, output low)	0.4 V

Table 1. Output characteristics of TL170C Hall effect switch. The TL172C is a normally-off switch. A positive-going magnetic field switches the output low.

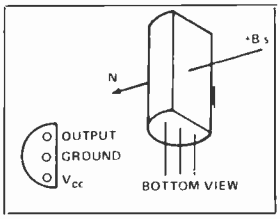


Fig. 3 Outlines of TL170C and TL172C Hall effect devices.

TYPE	SBV566	EA218	FA22E
Imax control (mA)	50	150	200
Hall emf (mV at mT at mA)	130 at 75 at 10	85 at 1000 at 100	120 at 1000 at 100
Control R (ohms)	30	3	2
Hall R (ohms)	30	1.5	1.5
Offset max (V/A)	1.0	0.005	0.002

Table 2. Characteristics of three readily-available Hall effect devices.

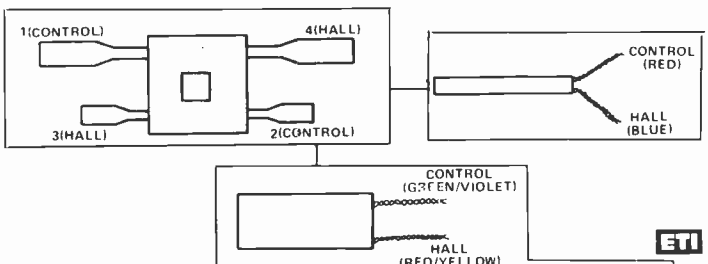
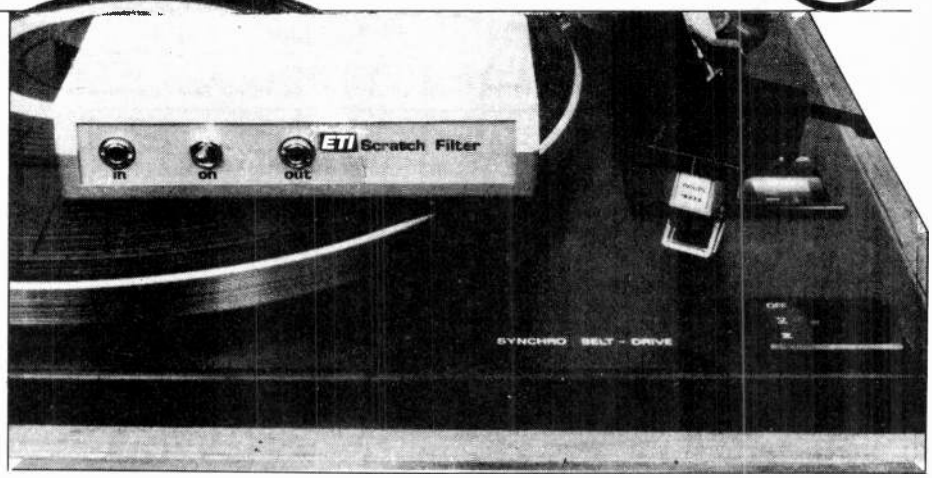


Fig. 4 Outlines of the three devices described in Table 2: SBV566 (left), EA218 (centre) and FA22E (right).

Scratch Filter

PROJECT

Hissssssss·····! That's what happens if you build this simple scratch filter and use it when you listen to noisy records. It can help to reduce surface noise picked up by your stereo.



IF YOU HAVE a record collection, you almost certainly have at least a few records that would benefit from the use of our scratch filter. The problem with disc recordings is that even if they are well cared for they inevitably show signs of wear in the quality of reproduction obtained. This loss of quality appears as a loss of treble response and a background of almost constant clicking and popping sounds. As these sounds consist largely of high frequency components it is possible to reduce them substantially using a filter having a response that attenuates high frequenies, but does not significantly affect lower frequencies. The price that has to be payed for the reduced noise is the slight loss of wanted treble signals as well. However, it is probably true to say that most people prefer noise-free reproduction even if there is a loss of treble output.

Construction

Following Fig. 2, make up the Veroboard. Start by breaking the tracks of the board at the shown positions. You can do this with a Veroboard cutting tool; alternatively a 1/8" hand-held drill bit can be used for the job.

Next insert and solder the components one at a time, starting with resistors followed by capacitors and then semiconductors.

Mark and drill your chosen case to fit the input and output sockets and the on/off switch. Two boards and two sets of input and output sockets are required for a stereo scratch filter, but the battery and on/off switches are common to both channels in this event.

Finally, wire up your project as shown in Fig. 2.

Using The Filter

Ideally the scratch filter should be connected between the preamplifier and power amplifier stages of the hi-fi amplifier or receiver, and in many cases this will be possible using the 'tape monitor' facility. However, as the circuit has a high input impedance it is possible to connect it between a crystal or ceramic pick-up and the input of the amplifier, and this method should also give good results.

It is also possible to use the filter between a magnetic cartridge and the input of the amplifier if you put a 100k resistor across the input of the filter to give a suitable input impedance to match the cartridge. However, this method is not recommended since it will give a significant reduction in the signal to noise ratio of the system, and it is quite likely that stray pick-up of AC hum and other interference will be a problem.

PARTS LIST

RESISTORS (All ¼W, 5%)

R1	1M0
R2	2M2
R3,4,5	4k7

CAPACITORS

C1	100n polyester
C2	1u, 25V electrolytic
C3	22n polyester
C4	3n3 polystyrene
C5	10u, 25V electrolytic

SEMICONDUCTORS

IC1	TL071CP low noise operational amplifier
Q1	MPS-A18 NPN transistor

MISCELLANEOUS

SW1	single-pole, single-throw toggle switch

Case to suit
Veroboard, 24 hole x 10 strip
Input and output sockets (SK1 and SK2) 9V battery + connector.

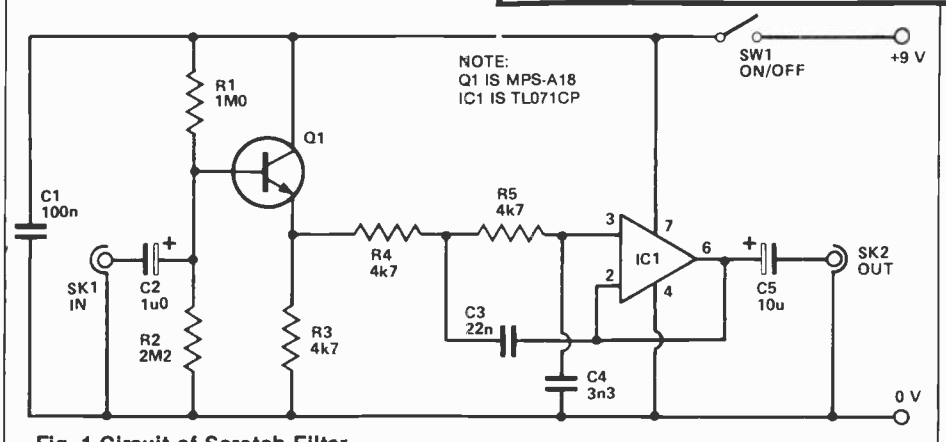
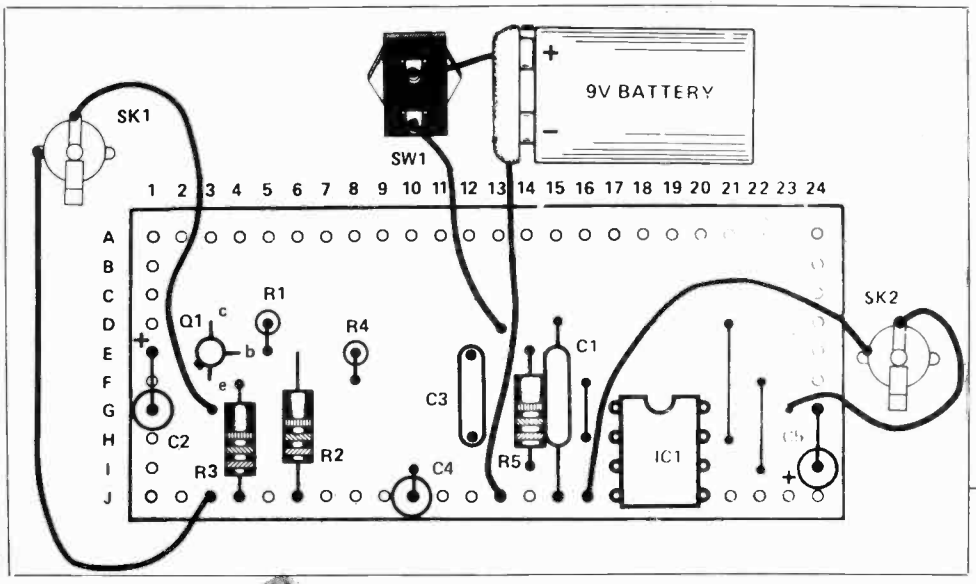
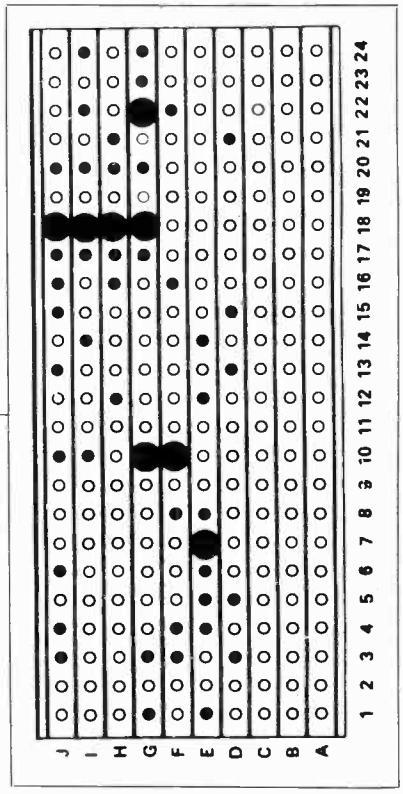


Fig. 1 Circuit of Scratch Filter.





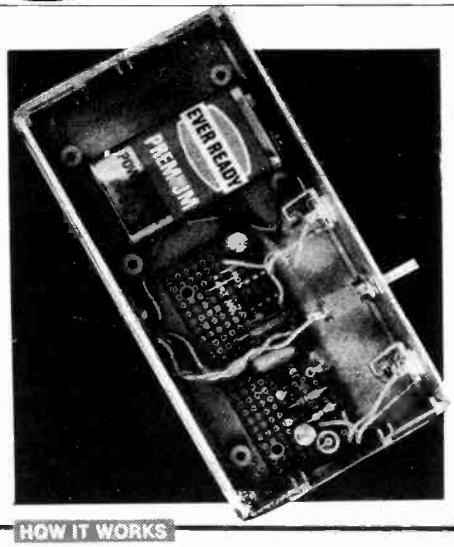


Fig. 2 Veroboard layout of the project, showing component locations and track breaks underneath the board.

HOW IT WORKS

A sound signal, obtained from the cartridge of a record player might have a 'flat' frequency response, so named because the output volume is level over a large part of the frequency spectrum. This output signal may contain surface noise from a worn record. However, noise (i.e., surface noise) consists of high frequency components.

Passing the signal through a scratch filter gives an output signal amplitude which, above a corner frequency, decreases with increasing frequency. Thus unwanted surface noise is reduced in volume compared to the majority of the sound signal.

Fig. 1 shows the circuit diagram of the filter, and this uses a conventional 12 dB per octave circuit (i.e., above the corner frequency, doubling the frequency causes a four-fold reduction in gain).

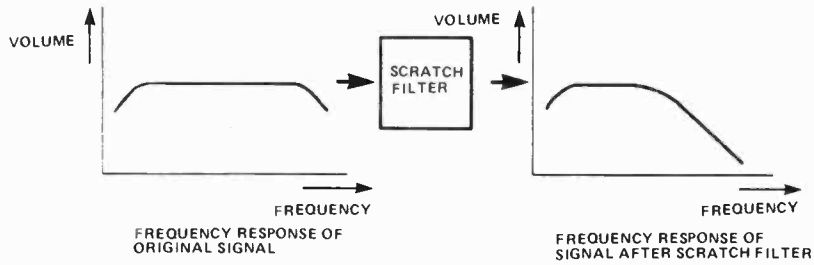
Transistor Q1 is used as an emitter follower buffer stage at the input which gives the circuit a high input impedance of about 500k, and ensures that the filter is fed from a relatively low source impedance and gives the requried response.

The filter circuitry uses R4 plus R5 in series, together with C4, to give a simple RC low pass filter action. Integrated circuit IC1 is used with 100% negative feedback from its output (pin 6) to its inverting input (pin 2) so that it acts as a unity voltage gain buffer stage, and prevents loading on the ouptut from affecting the response of the filter.

A simple RC filter provides a roll-off rate of only about 6 dB per octave, and tends to give only a very gradual initial roll-off, with the ultimate 6 dB per octave roll-off only being reached well above the point where the response starts to fall away significantly. This gives rather poor performance in practice with only limited noise reduction and a small but significant loss of signals at middle audio frequencies.

This problem is overcome by the inclusion of capacitor C3, which has no significant effect on the circuit at low frequencies.

The situation is very different at higher frequencies where C4 produces significant losses through R4 and R5, resulting in the output voltage change being less than that at the junction of R4, R5, and C3. Although C3 is always less than 100% efective, it does now have some effect on the circuit, producing additional losses through R4 at high frequencies.



ETI

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74LS00N	.25	74LS73N	.47	74LS147N	2.55	74LS221N	1.16	74LS321N	5.14
74LS01N	.29	74LS74N	.45	74LS148N	1.97	74LS222N	1.95	74LS322N	6.44
74LS02N	.29	74LS75N	.47	74LS151N	.55	74LS241N	1.69	74LS323N	7.07
74LS03N	.29	74LS76N	.55	74LS153N	.55	74LS242N	1.99	74LS324N	4.23
74LS04N	.35	74LS78N	.42	74LS155N	1.13	74LS243N	1.69	74LS348N	3.45
74LS05N	.29	74LS83N	.90	74LS156N	1.29	74LS244N	2.39	74LS352N	1.76
74LS08N	.29	74LS85N	1.09	74LS157N	.73	74LS245N	2.39	74LS353N	2.15
74LS09N	.36	74LS86N	.50	74LS158N	.73	74LS247N	1.09	74LS362N	12.94
74LS10N	.29	74LS90N	.51	74LS160N	.90	74LS248N	1.42	74LS365N	.68
74LS11N	.36	74LS91N	1.16	74LS161N	1.09	74LS249N	1.43	74LS366N	.68
74LS12N	.31	74LS92N	.62	74LS162N	1.43	74LS251N	.99	74LS367N	1.09
74LS13N	.38	74LS93N	.51	74LS163N	.75	74LS253N	.99	74LS368N	.68
74LS14N	.68	74LS95N	.62	74LS164N	.75	74LS257N	1.16	74LS373N	2.78
74LS20N	.41	74LS96N	.75	74LS165N	1.16	74LS258N	.73	74LS374N	2.78
74LS21N	.36	74LS107N	.55	74LS166N	2.86	74LS259N	1.68	74LS375N	.83
74LS26N	.68	74LS109N	.47	74LS170N	2.07	74LS260N	1.63	74LS377N	1.63
74LS27N	.38	74LS112N	.47	74LS173N	.77	74LS266N	.47	74LS378N	1.29
74LS30N	.48	74LS122N	.62	74LS174N	.57	74LS273N	2.13	74LS379N	1.42
74LS32N	.41	74LS123N	1.09	74LS175N	.64	74LS275N	5.10	74LS390N	1.37
74LS37N	.38	74LS125N	.57	74LS181N	2.59	74LS279N	.62	74LS393N	1.56
74LS38N	.38	74LS126N	.57	74LS189N	5.79	74LS280N	2.55	74LS395N	1.55
74LS42N	.57	74LS132N	.70	74LS190N	.94	74LS283N	1.19	74LS447N	.48
74LS47N	.88	74LS133N	2.18	74LS191N	.94	74LS290N	.94	74LS490N	2.46
74LS48N	1.29	74LS136N	.55	74LS192N	.83	74LS293N	.57	74LS620N	83.70
74LS51N	.31	74LS138N	.73	74LS193N	.83	74LS298N	1.14	74LS669N	1.09
74LS54N	.31	74LS139N	.73	74LS194N	.83	74LS320N	3.58	74LS670N	1.93
74LS55N	.31	74LS145N	1.42	74LS197N	1.14				

CMOS

CD4001BE	.24	CD4023BE	.24	CD4047BE	.91	CD4081BE	.24	CD4532BE	1.40
CD4002BE	.24	CD4024BE	.64	CD4049BE	.45	CD4085BE	.55	CD4539BE	.75
CD4006BE	.85	CD4025BE	.24	CD4050BE	.77	CD4093BE	.58	CD4543BE	1.68
CD4009BE	.38	CD4026BE	1.70	CD4052BE	.77	CD4510BE	3.10	CD4553BE	4.45
CD4011BE	.24	CD4027BE	.51	CD4053BE	.77	CD4510BE	.81	CD4555BE	.65
CD4012BE	.36	CD4028BE	.64	CD4060BE	.84	CD4511BE	.74	CD4556BE	1.05
CD4013BE	.43	CD4029BE	.82	CD4066BE	.63	CD4512BE	.74	CD4581BE	2.65
CD4014BE	.70	CD4030BE	.54	CD4068BE	.28	CD4514BE	1.69	CD4582BE	.70
CD4015BE	.70	CD4033BE	2.25	CD4069BE	.24	CD4515BE	2.40	CD4584BE	.55
CD4016BE	.40	CD4034BE	1.84	CD4070BE	.27	CD4516BE	.84	CD4585BE	1.10
CD4017BE	.75	CD4035BE	.92	CD4071BE	.24	CD4519BE	.64	74C85N	1.20
CD4018BE	.67	CD4040BE	.81	CD4072BE	.24	CD4520BE	.71	74C107N	.60
CD4019BE	.54	CD4041BE	.77	CD4073BE	.24	CD4522BE	1.40	74C161N	1.00
CD4020BE	.78	CD4043BE	.75	CD4075BE	.24	CD4526BE	1.40	74C163N	1.00
CD4021BE	.68	CD4044BE	.73	CD4076BE	.75	CD4527BE	1.00	74C173N	1.35
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LM555N-8	.38	LM3900CN	.84
LM556CN	.98	LM4136CN	1.54
LM567N-8	1.69	LM4558CN	.60
LM709CH	.84	ULN2003AN	1.09
LM723CN	.69	SN76477N	4.39
LM741CH	.89	SN76477NF	4.39
LM741CN 8	.49	SN76489N	10.49
LM747CN	.98	SN76489AN	7.49

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N-8 = 8 PIN-DIP, CH = TO-100

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		IN4150	.05	IN4004	.11	IN5403	.35
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		IN4152	.05	IN4006	.13	IN5405	.38
IN4753A — IN4764A (1 WATT)	.45	IN4153	.05	IN4007	.14	IN5406	.43
						IN5407	.47
SPECIFY EXACT P/N OR VOLTAGE						IN5408	.48

METAL CAN TRANSISTORS

2N404A	1.77	2N2906A	.27
2N718A	.41	2N2907A	.35
2N914	.57	2N3019	.65
2N1711	.50	2N3053	.50
2N2102	.50	2N3054	.95
2N2218A	.50	2N3055	1.06
2N2219A	.50	2N3439	1.06
2N2221A	.27	2N3440	.92
2N2222A	.35	2N3771	2.13
2N2369A	.35	2N3772	2.13
2N2904A	.45	2N3773	3.19
2N2905A	.64	2N5038	6.38

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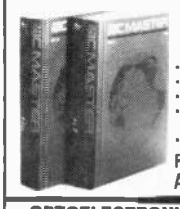

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News

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Cybernex Limited announces the availability of a Hazeltine compatible version of its XL-87 video terminal called the XL-87H.

The Cybernex XL-87H is designed to emulate the operation of a Hazeltine model 1510. In addition, it provides a rugged detached keyboard and high resolution non-glare green phosphor CRT which makes it ideal for continuous use environments.

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For further information, contact Cybernex Limited, 2457 Dunwin Drive, Mississauga, Ontario Canada L5L 1T1. Telephone: (416) 828-2810.

News From NESDA

Members of the National Electronics Service Dealers Association will soon be able to obtain instant technical information on their computer terminals as a result of an agreement reached May 1 between NESDA officers and Compu-Tips (formerly known as Compu-tel) to provide this service to NESDA members on a monthly fee basis.

The Compu-Tips National Network consists of a data base of technical tips inputed by the group of service dealers who formed this company last year. Electronic servicing information is being added to the data base at a rate of 500 tips per week. Presently, the system has close to ten thousand tips available for instant access via a phone call.

Technical tips are currently available for television sets, videotape recorders, video discs, TV games, audio products and auto sound.

For more information about NESDA member benefits, including the Compu-Tips, contact J.W. Williams at NESDA, 2708 W. Berry, Ft. Worth, TX, 76109, telephone (817) 921-9061.

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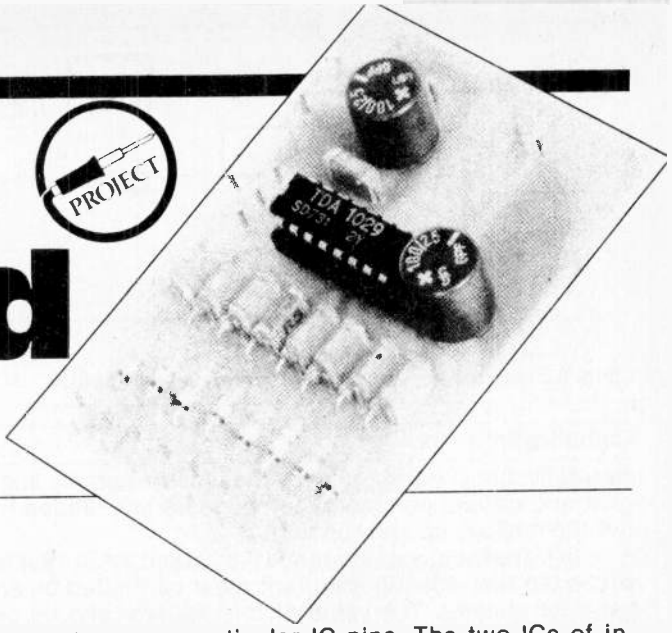


DC control of hi-fi — Keith Brindley looks at some ways and means of achieving it.

BACK IN THE OLD DAYS, an amplifier was an amplifier! It would have simple controls; volume, bass, treble, balance and a mode switch. The most expensive amplifier was the one which did its job (i.e., amplify) with the least amount of noise and distortion from linearity.

All of a sudden, manufacturers (particularly those on a faraway eastern island) got the knack of bettering their specs and the market became flooded with reasonable quality, reasonably priced systems. "Ah so, what next?" they thought, and the answer was gimmicks; little tricks which they could perform on an amplifier to make yours ever so slightly better than Mr. Jones' next door, and which makes Mr. Jones want to buy another one slightly better than yours.

In The Distant Future?

Two of the latest gimmicks are remote control and touch control (not just of amplifiers, but of TVs, videos and, presumably in the future, complete house electrical equipment). Now, most gimmicks. scratch filters, rumble filters, loudness controls and so on, don't add anything to the actual quality of the device; they merely colour the sound to suit the individual listener. To the hi-fi freak they are little more than useless!

However, remote or touch control can be highly desirable to the audiophile. You see, to control things at a distance or at a touch we need to be able to make all the adjustments with a mere change of voltage. In this way all the mechanical switches and potentiometers become obsolete. Even if mechanical controls are used they do not carry the AC audio signal, but only a DC control voltage. This means that once the signal is on the circuit board it stays there until the output. There are no signal-carrying leads to and from the pots, switches, or other controls and hence there will be less interference pickup, less interchannel crosstalk, better frequency response and fewer switching clicks and crackles, which means a dramatic improvement in amplifier quality.

Control Yourself

Recently, Signetics introduced a range of integrated circuits intended for use on DC-controllable, audio-frequency amplifiers whereby all the (usually) mechanical functions of preamplifiers are controlled by DC voltages on particular IC pins. The two ICs of interest here, the TDA 1028 and TDA 1029, are electronic switches which fulfil the functions of mode switches, filter switches, mute switches and so on.

The TDA 1028 contains two double-pole, double-throw switches and the TDA 1029 one double-pole, four-way switch. Figs. 1 and 2 show the simplified internal block diagrams of the ICs. If you bear in mind that these switches, although primarily intended for small-signal AC work, will also accurately switch analogue DC voltages, you will see that they are extremely versatile. The applications given later are all audio-frequency AC designs, but obvious DC suggestions lie in test or measuring equipment.

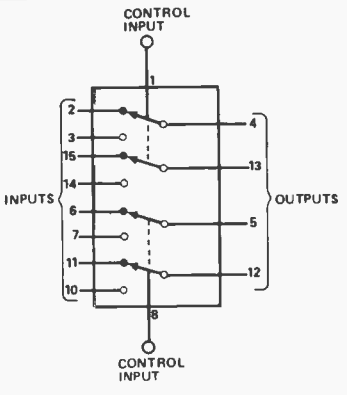


Fig. 1 Block diagram of the TDA 1028, a dual double-pole, double-throw switch.

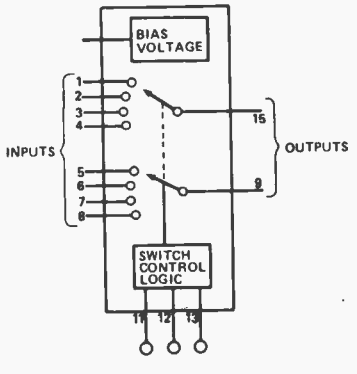


Fig. 2 Block diagram of the TDA 1029, a double-pole, four-way switch.

A Look Inside

Fig. 3 shows a more elaborate diagram of one of the internal signal paths. Basically, the input stage operates with a peak-to-peak input signal of something less than the supply voltage (i.e., typically between 3V and 19V). If a signal outside the supply range is applied, the diodes limit the signal, thus protecting the device.

A high impedance buffer follows the input stage and the output is connected via a 400R internal resistor which gives protection in the case of a direct short circuit. Overall gain of the signal path is close to unity and depends on the output load. For example, with a load impedance of 4k7 the gain is -1.5 dB (x0.84). Switching between one input and another is done by the internal logic, performing the simple function of connecting or disconnecting the power to the signal path in question.

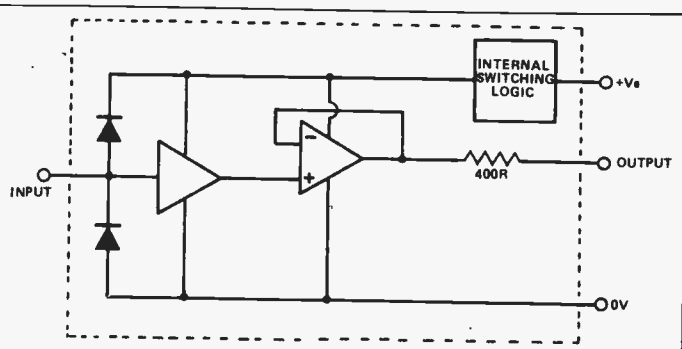


Fig. 3 Block diagram of a single internal signal path.

Complications

Naturally, life is not so easy as the block diagrams suggest and certain peripheral components are needed to get the devices up and running.

(i) If the input voltage range (i.e., about 3V to 19V) is exceeded then the input current must be limited by an external resistor. The value of this resistor should be calculated so that the average input current does not exceed 20 mA. In the case of the ICs' use within a preamplifier no limiting resistors are strictly necessary.

(ii) If the switches are intended for AC work then DC blocking capacitors should be used.

(iii) A 'floating' input might cause switching noise at the output, due to rapid DC variations. To prevent this all inputs should be biased, via a resistor, to a point midway between the input voltage limits; about 11V.

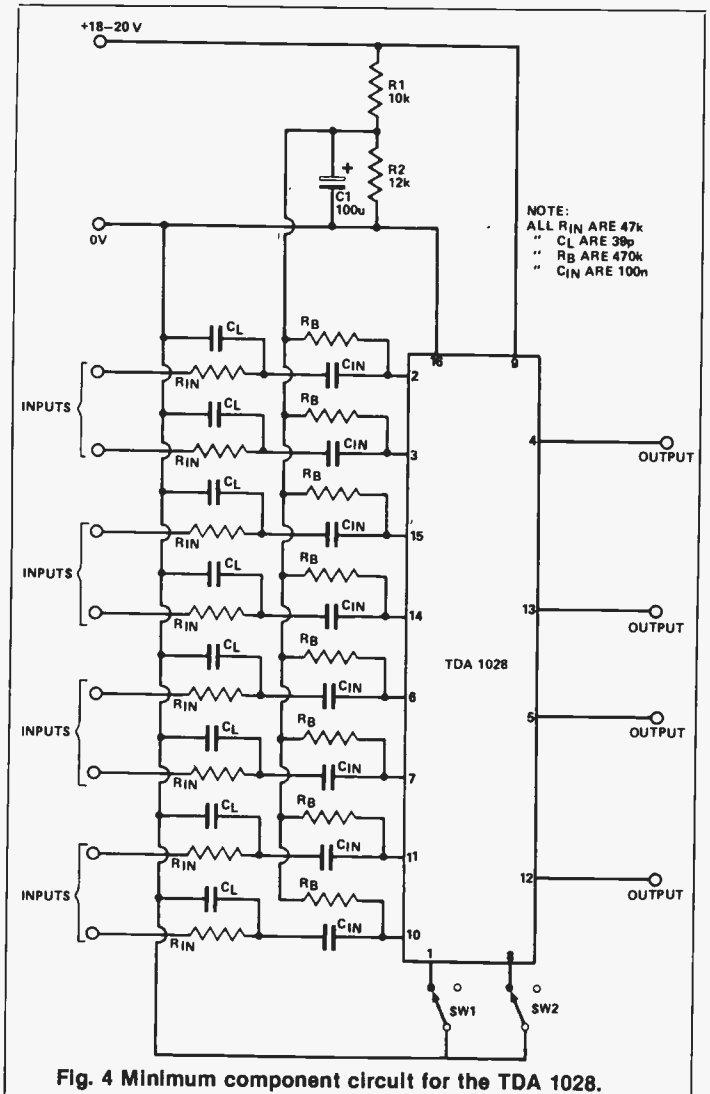


Fig. 4 Minimum component circuit for the TDA 1028.

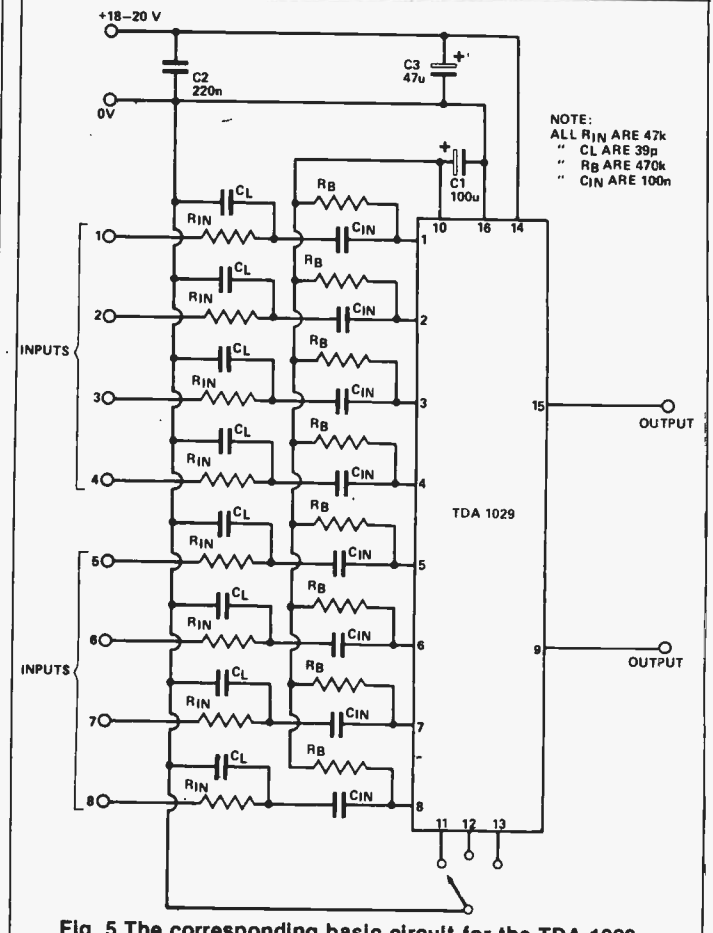


Fig. 5 The corresponding basic circuit for the TDA 1029.

Workable circuits, with the above points considered, are found in Figs. 4 and 5. Bias for the TDA 1029 is supplied from an internal reference. This reference is unstabilised and dependent on the supply voltage. Hum and other interference will therefore affect it so a filter capacitor (C1 in Fig. 5) is required. If the TDA 1028 is used in the same circuit as the TDA 1029 then all input biases can be taken from this internal source. Alternatively, or in a separate circuit, a simple voltage divider and filter capacitor will do the job (R1, R2, C1 in Fig. 4). Bias is supplied to all inputs via 470k resistors (R_B) and all input capacitors (C_{IN}) are 100n polycarbonates. For experimental work only, all input resistors are specified as 47k, and low-pass capacitors (C_L) can be used to eliminate RF interference in the input signal leads if required. These two circuits can be built for test purposes on the PCBs shown in the overlays in Figs. 6 and 7. Adjust the input resistors as required (47k is a suitable starting value), and for DC applications use jumpers instead of input capacitors. Incidentally, the boards are also suitable as bases if you intend to breadboard some of the following applications.

The final things to look at are the control inputs: they are internally connected to a high state and the simplest way to ensure the low state of an input is to connect it directly to 0V. Voltage control of the inputs requires less than 2V1 for a low state and greater than 3V3 for a high state; the inputs are therfore compatible with CMOS or TTL logic, and remote, touch, or even computer control of the signal paths is easy.

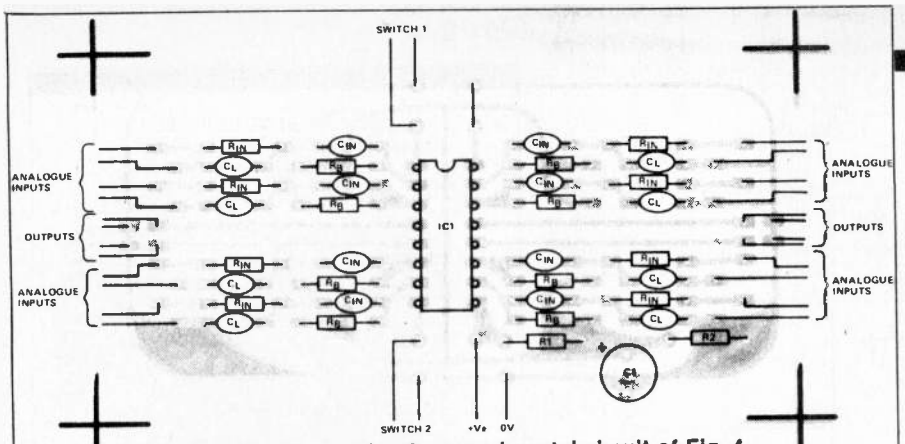
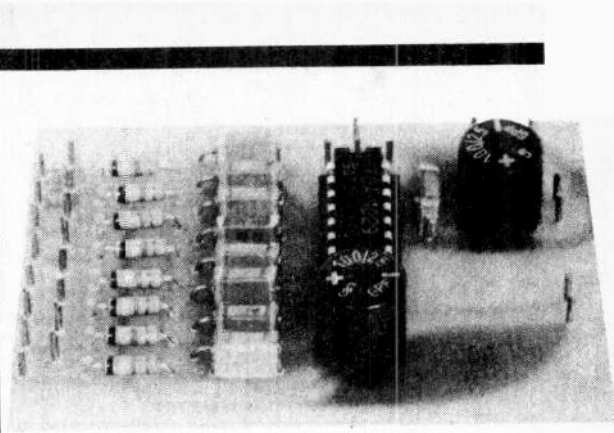


Fig. 6 suggested layout for the experimental circuit of Fig. 4.



paths is easy.

Table 1 gives a summary of the control inputs and consequent pin interconnections for the TDA 1028. Similarly, Table 2 gives the same for the TDA 1029. The control input of pin 11 has priority over those of pins 12 and 13. Pin 12 control has priority over pin 13, but not pin 11's control input.

Connected pins	Control voltages	
	Pin 1	Pin 8
2 — 4, 15 — 13	H	—
3 — 4, 14 — 13	L	—
7 — 5, 10 — 12	—	H
6 — 5, 11 — 12	—	L

Table 1 TDA 1028 interconnections and control levels.

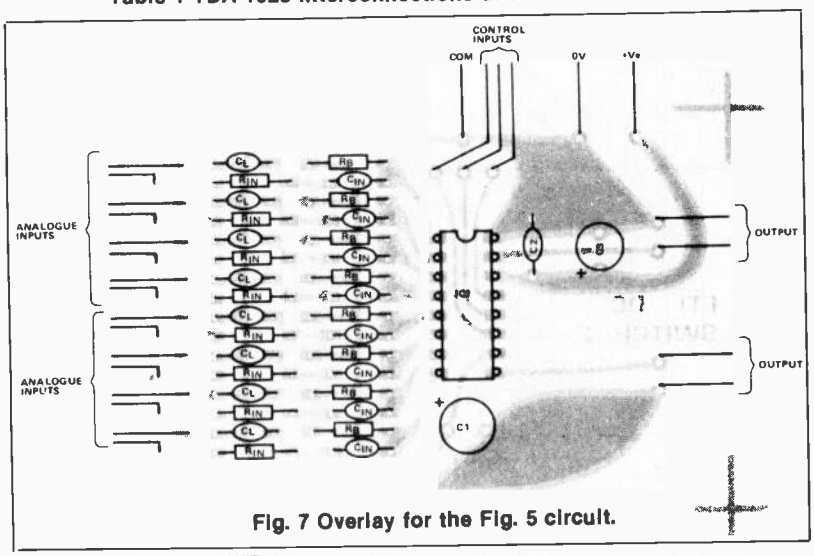
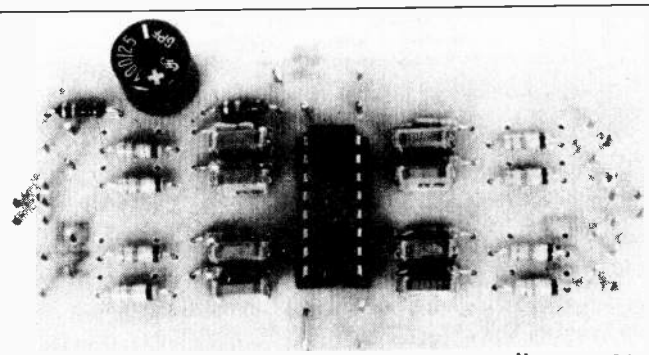


Fig. 7 Overlay for the Fig. 5 circuit.



The TDA 1028 PCB. Note that the low-pass capacitors are optional and have been left off our board.

Applications

Perhaps the simplest use of the TDA 1029 is as a four-input stereo signal-source switch connecting either a stereo tuner, phono, tape deck or auxiliary input to an amplifier. Although it all sounds rather complex, Fig. 8 shows that it is not. The tuner and auxiliary input signals are fed directly, via input capacitors, into the IC, however, the tape output has a relatively high impedance source and connecting leads are therefore quite susceptible to RF interference. A suitable input network (e.g., R1 and C1) connected as a low-pass filter eliminates the RFI. The output of the circuit is fed back to the tape deck via coupling capacitors and 820k resistors.

The pick-up input needs RIAA equalisation and amplification; this stage is shown as a block in the circuit. Suitable circuits for pick-up stages are common and no design for such is offered here.

It is possible to cascade the electronically switched signal paths of these two ICs, either within the same device (e.g., from one half of a TDA 1028 to the other half) or from one IC to another. In either case separate signal paths are best connected via capacitors to keep switching clicks as small as possible. Fig. 9 shows a typical example of a four-input stereo signal-source switch (using a TDA 1029) cascading into a monitor and stereo/mono switch (formed by a TDA 1028). A monitor switch allows comparison of recorded/played-back signals to and from a three-headed tape recorder. Thus it needs to be after the main signal-source switch but before the power amplifier, as shown.

The final two circuits given as application suggestions are switchable active filter circuits. Because each signal path is basically a unity-gain, non-inverting amplifier it is relatively easy to connect into standard filter circuits (a third-order Butterworth design being chosen) allowing electronic control of the preamplifier's frequency response.

By using each switch section of a TDA 1028 in separate filter modes (Fig. 10) a stereo high-pass/low-pass (rumble/scratch) filter can be built.

Similarly, the TDA 1029 can be used in filter modes, taking control of four separate filters; linear, subsonic, scratch and mute in the circuit of Fig. 11. Table 2 shows that the control pins have been chosen so that the mute signal has an overriding effect on all the other control signals (as it should), and the rumble filter signal overrides that of the subsonic filter.

In conclusion, the previous applications show the TDA 1028 and TDA 1029 to be very versatile devices. The simplicity and ease with which they can be used means that they will be popular.

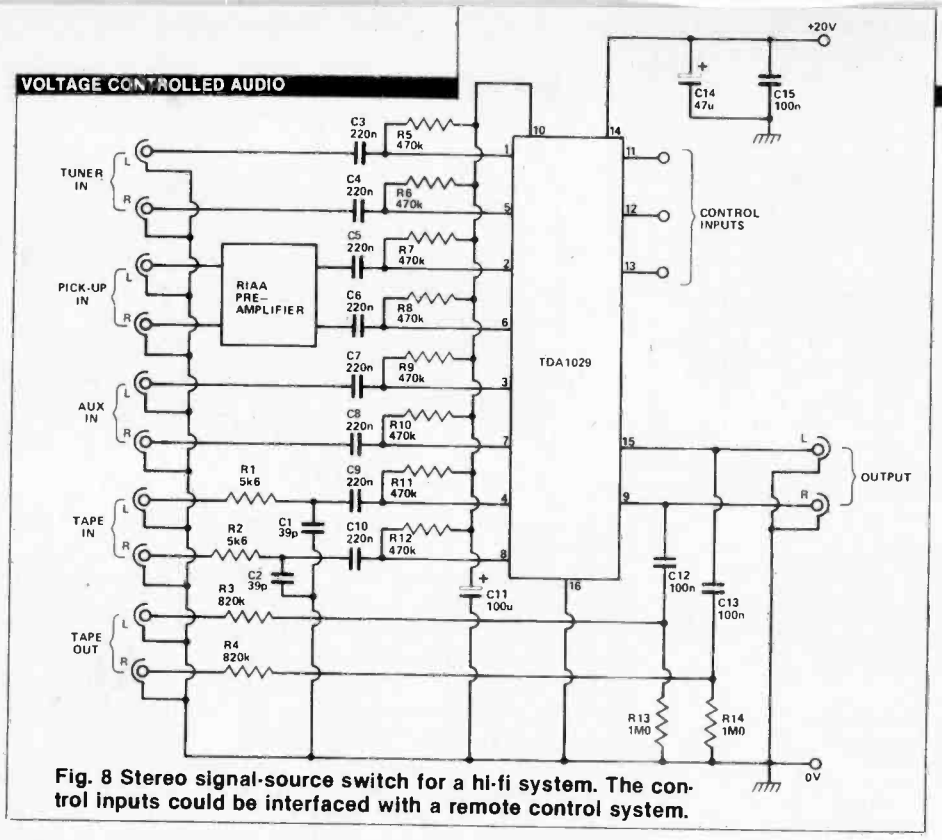
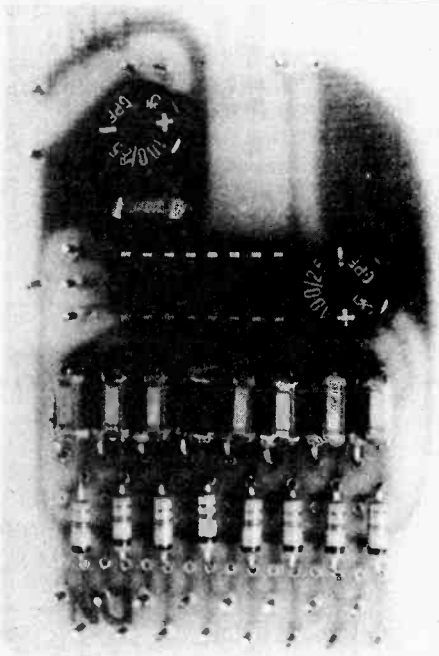


Fig. 8 Stereo signal-source switch for a hi-fi system. The control inputs could be interfaced with a remote control system.



Our prototype board for the TDA 1029. Once again, the optional low-pass capacitors have been omitted.

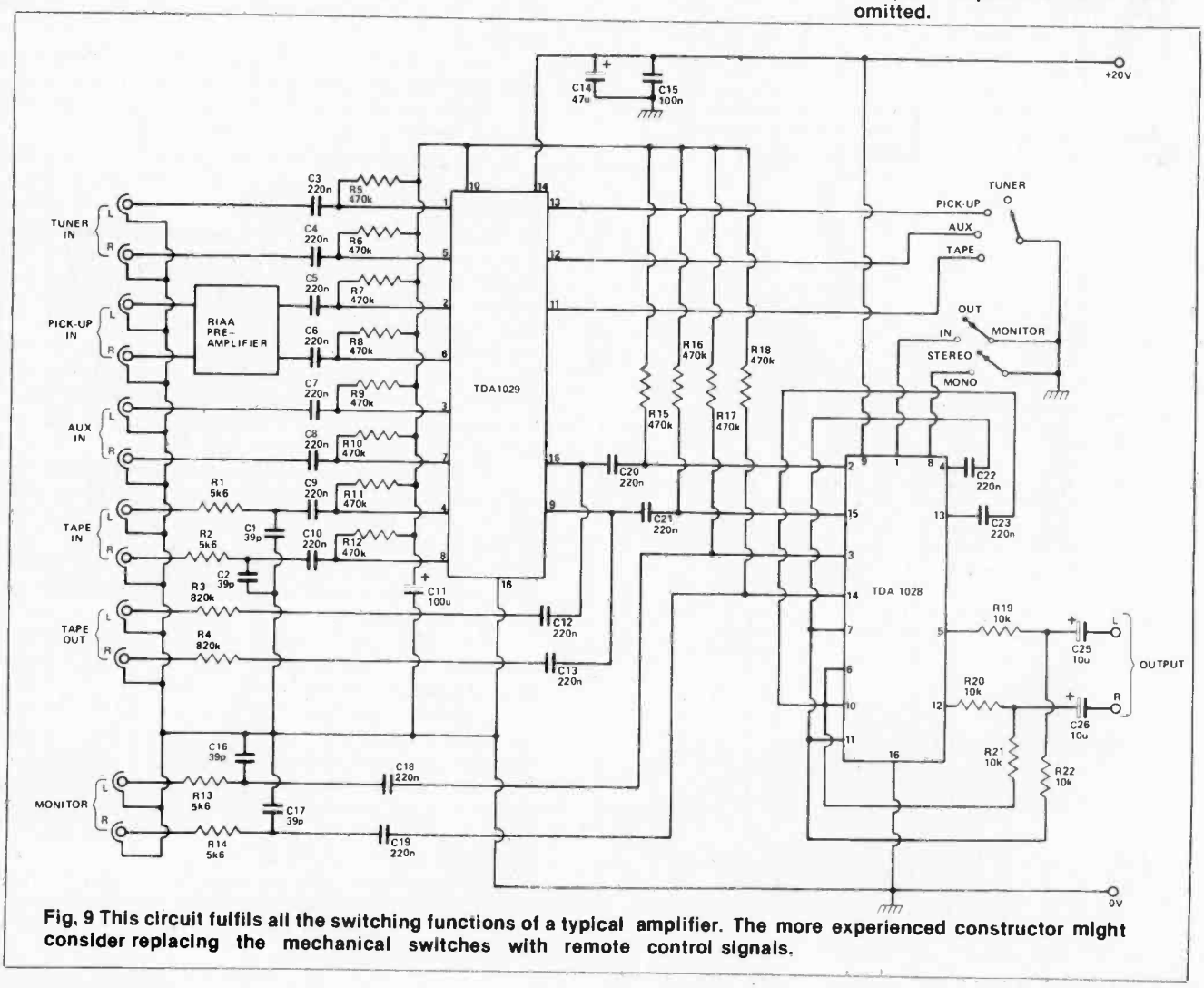


Fig. 9 This circuit fulfils all the switching functions of a typical amplifier. The more experienced constructor might consider replacing the mechanical switches with remote control signals.

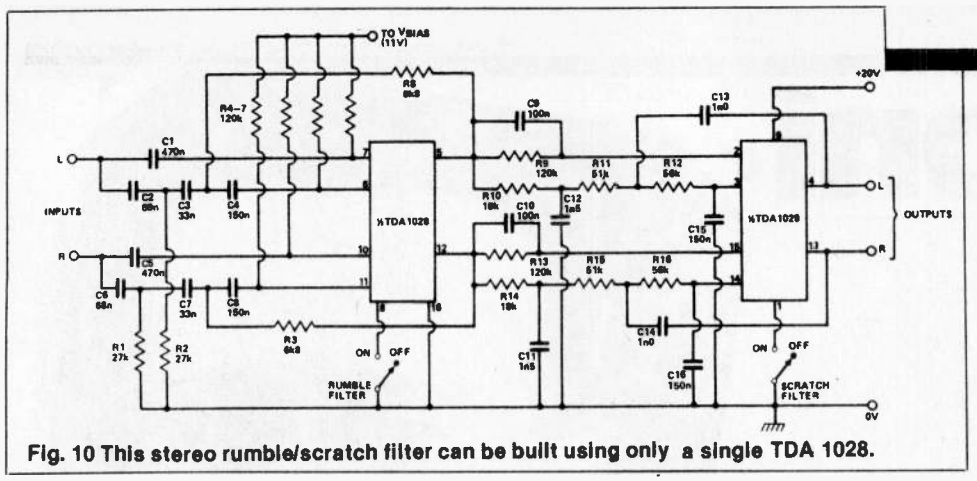
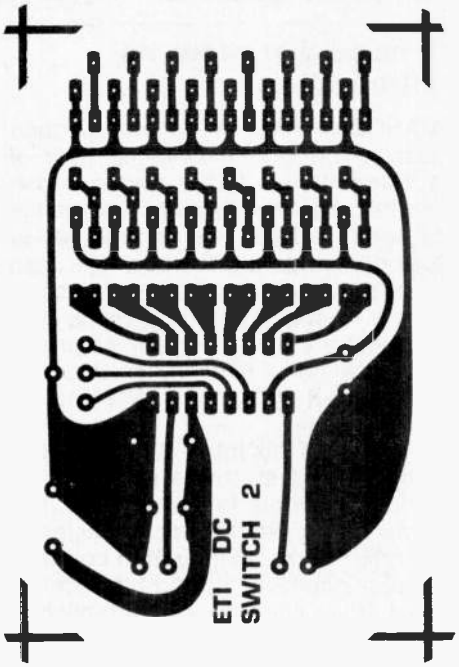


Fig. 10 This stereo rumble/scratch filter can be built using only a single TDA 1028.



Connected pins	Control voltages		
	Pin 11	Pin 12	Pin 13
1 — 15, 5 — 9	H	H	H
2 — 15, 6 — 9	H	H	L
3 — 15, 7 — 9	H	L	H
3 — 15, 7 — 9	H	L	L
4 — 15, 8 — 9	L	H	H
4 — 15, 8 — 9	L	H	L
4 — 15, 8 — 9	L	L	H
4 — 15, 8 — 9	L	L	L

Table 2 TDA 1029 interconnections and control levels.

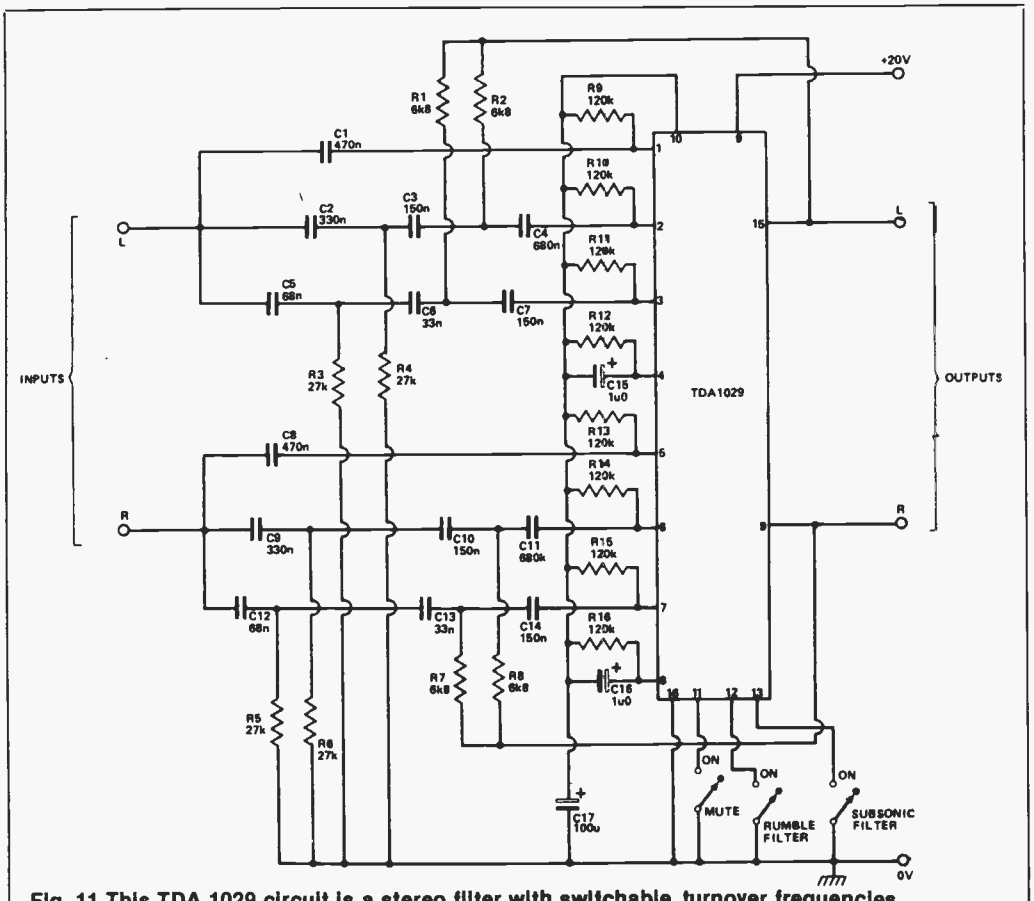
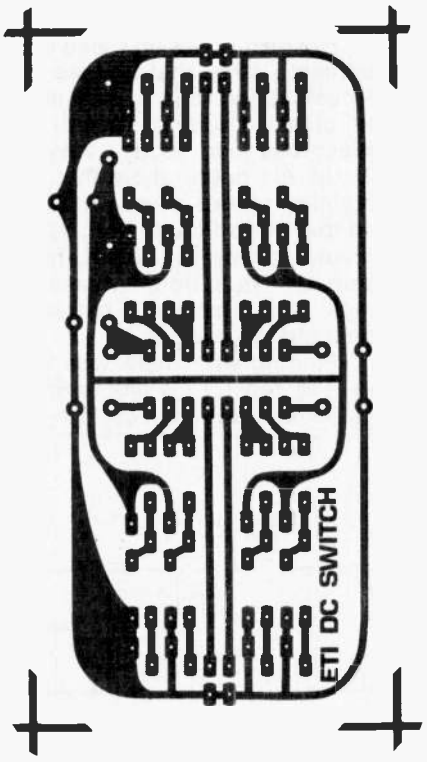


Fig. 11 This TDA 1029 circuit is a stereo filter with switchable turnover frequencies.



Marconi

Pioneers of Electronics Series

A name that needs no introduction.

MARCONI HAD A decidedly good start to life. Born in Bologna, Italy, of a titled Italian father and an Irish mother, he was brought up on his father's estate and educated in Bologna and in Florence. He then went to technical college in Leghorn, where he specialized in physics (still the best grounding for any engineer) and interested himself, particularly, in the work of Maxell, Hertz and Sir Oliver Lodge.

By 1894, his interest in radio was such that he started a series of experiments at his father's estate. His transmitter used the classic design of Heinrich Hertz, an induction coil with a spark-gap (Fig. 1), and his receiver used the equally well-established coherer (Fig. 2). What distinguished Marconi's work from that of the many other pioneers, working with the same equipment at the same time, was his particular interest in aerials, an interest which had sprung from his study of Maxwell's beautifully symmetrical equations of electromagnetic radiation.

His own notes on these early experiments show that he was using a vertical aerial with a ground plane, the classic type of aerial still in widespread use today. Very significantly, his notes show that he was obtaining ranges of about 1½ miles and that he had found that, by using a reflector behind an aerial, he could beam the radiation, increasing the range and obtaining better directional characteristics.

Finding that there was little interest in Italy for his pioneering work, in 1896 he travelled to London to work with Sir William Preece, then Chief Engineer of the Post Office. The Post Office, at that time, was taking a keen interest in the new developments, and Preece encouraged the young Marconi to file patents on his work. Marconi backed up his patents with a series of demonstrations which indicated the increased ranges that were possible by the use of aerials held up by balloons or kites. He achieved a range of four miles on Salisbury Plain, nine miles down the Bristol Channel and, in 1897 at Le Spezia, was able to demonstrate communication between warships at sea and a land station 12 miles away.

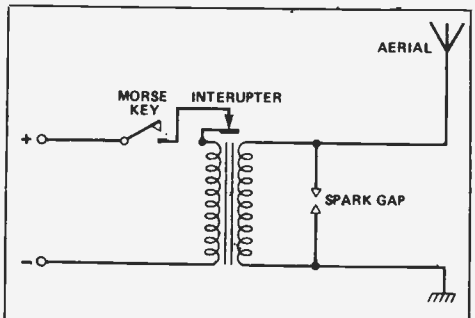


Fig. 1. The classic spark-coil transmitter. The spark gap used two spheres, which had enough capacitance between them to tune the secondary of the coil to some extent.

The Wireless Telegraph Co.

By this time, Marconi and his coworkers were convinced that radio could be put to serious use so Marconi and his cousin, Jameson Davies, an engineer, financed a number of patent applications and formed the Wireless Telegraph and Signal Company Ltd. In 1900 the company changed its name to Marconi Wireless Telegraph Co., a name which it retained up to the 60s.

During this time, each demonstration by Marconi indicated a greater, and therefore more useful, range of communication; 75 miles, between battleships in 1899, for example. Transmission and reception conditions proved to be better at sea than on land so that, after several demonstrations of this type, the Marconi International Marine Co. (MIMCO) was formed specifically to equip and maintain radio in sea-going vessels. For the first time, it had been possible to communicate between ships which were not visible to each other and, given the importance of sea transport at that time and the length of sea journeys, it was a most sensible approach. Another clutch of patents followed, the most significant of which described the principles of tuning both the transmitter and the receiver so that it was possible for several transmitters to operate at the same time on different wavelengths without interfering with each other.

Several navies around the world were now installing the 'Marconi Apparatus', as radio was known, and the design of transmitters, receivers and aerials was progressing with every new model that was constructed. Marconi, however, was not satisfied with gradual development and insisted that nothing short of a signal sent across the Atlantic would convince his many sceptical opponents that radio was an invention of real importance. His proposals were scoffed

at, because enough was known of radio waves to make it clear that they travelled, like light waves, in almost straight lines and were most unlikely to follow the curvature of the Earth across the Atlantic. Marconi, however, seems to have had different ideas, probably due to the long ranges he had already achieved at sea. Oddly enough, the work of the shy genius Oliver Heaviside, decades earlier, had showed that long-range radio communication would be possible because of the probable existence of an 'ionosphere', a layer of split atoms high above the atmosphere which would reflect long-wave radio signals like a sheet of chicken-wire. Very few engineers, however, had read Heaviside's report and fewer still could follow his arguments, so that it seems likely that Marconi was not familiar with the theoretical basis of his experiment. In December 1901, amid foul weather on each side of the Atlantic, he succeeded in transmitting one signal, the Morse coded letter S (three dots) from St. John's in Newfoundland to Poldhu, Cornwall, establishing for the first time that long-distance radio communication was possible and in the process knocking thousands of pounds off the shares of companies concerned with trans-atlantic cables!

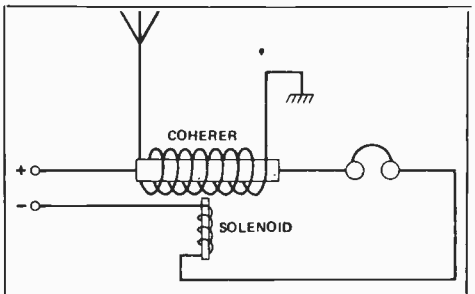


Fig. 2 The coherer. The input from the aerial is interrupted continuous waves, and each pulse caused the iron filings in the tube to cling together, carrying current to the earphone and operating the solenoid which loosened the particles again ready for the next burst of RF.

This success gave Marconi the impetus to press ahead with the development of long-range radio and he installed equipment of his latest design in the liner 'Philadelphia', which was then able to attain 300 miles by day and a staggering range of 2000 miles by night. It was this difference between day and night ranges, incidentally, which helped to confirm Heaviside's idea of the ionosphere (Fig. 4), which then gained support from a number of distinguished physicists.

Patents continued to pour out from the Marconi development laboratories, including improved detectors and, significantly, a horizontal directional aerial system. The first spectacular broadcast across the Atlantic was followed by events which captured the imagination of the public; the capture of the mass murderer Crippen on board ship, thanks to a radio message sent out from London, and the use of radio during the sinking of the Titanic in 1912. The Titanic disaster eventually led to the full-scale installation of radio in all ocean-going ships and the establishment of an emergency wavelength which was kept clear at all times and which operators were obliged to monitor for distress calls. The Marconi Marine Co., then as now, not only supplied equipment but trained operators and service engineers and a 'Marconi man', with this enviable background, had a passport to work anywhere in the world. By 1916, Marconi was working with shorter wavelengths (around 15 metres) and was demonstrating beam aerials with very strong directional characteristics. In 1918 the ultimate long-distance signal, England to Australia, was achieved. Marconi had, like Puck in A Midsummer Night's Dream, encircled the Earth.

By this time Marconi, awarded the Nobel Prize in 1909, could have retired, assured of fortune and fame in equal proportions and with the inherited Italian title of Marchese. The work of the true pioneer, however, is always concerned with the next step and by the end of the First World War, Marconi was ready with more new ideas. By this time too, his employee David Sarnoff, in the USA, was convinced that radio had an equally bright future as an entertainment medium. Marconi was totally opposed to this, though he took an interest in the first demonstration of public broadcasting from Writtle (near the Marconi works in Chelmsford) when the diva Dame Nellie Melba, using a microphone hastily rigged up with a cigar-box mouthpiece, made what was almost the first broadcast using amplitude modulation (she had been preceded by one of the office secretaries who had been asked to test the equipment before Melba arrived). Marconi, however, refused to consider inovlving the Marconi company in the business of public radio reception and defined the firm's role as that of providing transmitting equipment and specialised receivers for communications only. Sarnoff resigned to form his own company, the Radio Corporation of America, but Marconi sold the use of his name for domestic receivers. This was a step that his fellow-directors bitterly opposed and, after Marconi's death, the Company tried to buy back the Marconiphone trademark, without success.

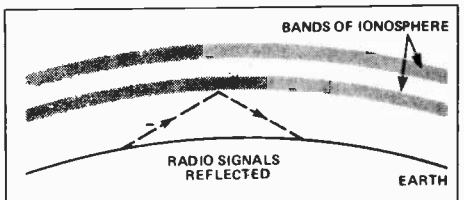


Fig. 4. The ionosphere. The layers of ionized (conducting) gas above the Earth act as reflectors of waves, particularly the longer wavelengths. The reflecting action is more pronounced at night when the remaining ionization is further away from the surface of the Earth.

Moving on with more experiments, Marconi converted his steam yacht, the Elettra, to act as a floating laboratory for the development of short-wave transmitters and receivers. By 1924, he had obtained a contract from the English post office to manufacture short-wave transmitters and receivers for the cablegram service and, by 1932, he was working with half-metre wavelengths, getting close to the wavelengths that would soon be used in the early radar experiments. There is little doubt that Marconi himself would have taken the initiative in radar had his health been better. As it was, he died in 1937, surrounded by the tangible evidence of his success and with a worldwide organisation centred on his adopted home town of Chelmsford, Essex.

As a footnote, the career of the yacht Elettra is worth recording. She was used as a test laboratory by MIMCO after Marconi's death but met her end, like so many others of her age, at Dunkirk. After the Second World War, a converted motor torpedo boat was bought and named Elettra II, to be used for the same purposes. It was a remarkable hulk, so top-heavy with aerials and radar equipment that when it rolled, there was a sickening delay before it righted itself. Then, after a tour of Norway, it was found that all but one of the stringers (the longitudinal beams that were supposed to hold the ship together) were broken! Shortly after that it was scrapped and a new Elettra III commissioned. ETI

Into Linear ICs

part 7

In this part of Into Linear ICs, Ian Sinclair looks at voltage regulators.

THE LAST BIG important group of linear ICs we need to take a look at is the voltage stabiliser IC. Before we can start on them, though, we need to know why and how voltage supplies are stabilised. Stabilising a voltage supply means controlling it so that output voltage doesn't change. Why should it change? For one thing, the line AC voltage isn't absolutely constant; you may have seen the way a kitchen light dims when an electric kettle is switched on. More important, any power supply will have some resistance, often called its internal resistance. This resistance behaves like a resistor wired in series with the power supply (Fig. 1) so that when current is taken from the supply, the output voltage drops. There's nothing we can do to eliminate this resistance; all we can do is to use tranformers with low resistance secondary windings, rectifier diodes with low resistance, and so on. As far as battery supplies are concerned, rechargeable cells like lead-acid cells, but we still have this internal resistance present.

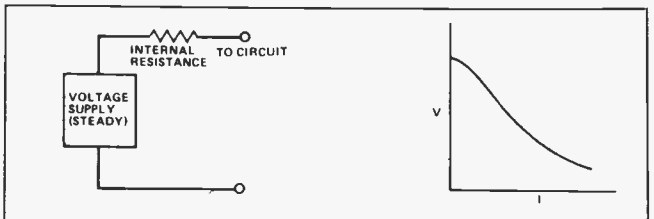


Fig. 1 Internal resistance. (a) Any power supply behaves as if it had two components, a steady voltage supply and a resistor in series. (b) This causes the output voltage to decrease as more current is drawn.

Now a lot of problems are caused by this internal resistance. For one thing, if any pieces of electronic circuitry takes a varying current and the internal resistance of the supply will cause the DC supply voltage to vary when the current varies. Class B amplifier stages, for example, take much more current when they're working at full volume than when they're just ticking over, which means that they have to put up with a lower supply voltage when they're going full blast — and that's not exactly ideal. For one thing it usually means that your stereo amplifier which claims to give 50 watts per channel will have a hard time to deliver 35W per channel when both channels are working hard — the makers usually point this out in very small print.

Digital circuits which operate with brief pulses of current also suffer when these pulses of current are converted to voltage pulses by the internal resistance of the power supply, because these pulses can cause unwanted feedback. The remedy in each case is a voltage stabiliser.

Now a voltage stabiliser isn't magic, it can't raise the amount of volts on the supply line above the amount the power-pack can supply. What it can do, however, is to keep the supply line voltage steady at a voltage equal to the lowest voltage it would normally drop to.

RASIN THE CURRENT

Let's explain that a bit more clearly. Suppose we have a circuit (Fig. 2) which works on a 12 V supply, but because of sudden current pulses, the supply voltage can drop to 9 V. Nothing we can do can make this 9 V rise to 12 V while a lot of current is being taken, but if we started, say, with a 15 V supply, with a bit of luck it might only drop to 12 V at full current. What a voltage stabiliser can do is to regulate the 15 V supply down to 12 V when the circuit is not drawing much current, and to relax control when full current is being drawn, so that the voltage supplied to the circuit is still 12 V. In practice we would probably settle for a 18 V input to the stabiliser circuit to ensure that we could keep the output at 12 V even when the circuit was drawing its maximum current and the line voltage was a bit low.

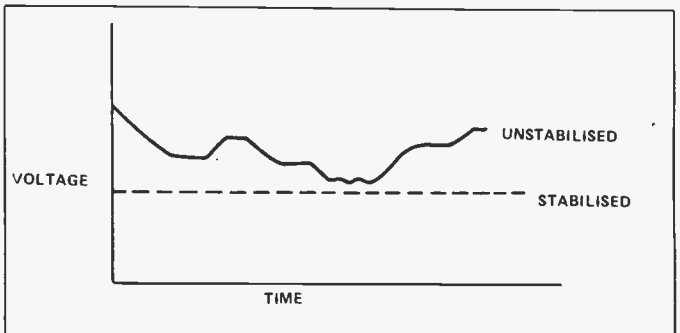


Fig. 2 How a stabiliser works. The graph shows how the output voltage of a power pack might vary over some time. The dotted line shows the output from a stabiliser fed from the same supply. The stabilised voltage is lower than the lowest voltage to which the supply can drop.

A simple stabiliser circuit is shown in Fig. 3, using a comparator and a pair of transistors which keep the output voltage steady. It works something like this. One input of the 741 is returned to a steady voltage which is the voltage across a zener diode. A zener diode has a steady voltage across its terminals, even when the current through the diode varies by quite a large amount. The other input of the comparator is fed with a fraction of the voltage at the output of the stabiliser, so that the comparator will switch over when these two voltages are equal. In the circuit of Fig. 3 if the output voltage is low, then the voltage at the — input of the comparator is lower than the voltage fixed by the zener diode at the + input of the comparator, and the comparator output is high. This, in turn, causes the transistors to be biased so that more current can flow, raising the output voltage (because more current through the load

must, by Ohm's law, mean more voltage across the load). On the other hand, if the stabiliser output voltage is too high, the — input of the comparator is at a higher voltage than the + input, the comparator output voltage is low, the transistors cut off, and the current shuts off or is throttled back, so allowing the voltage at the output of the stabiliser to drop. As a result, the output voltage of the stabiliser settles at a level which makes the voltages at the two inputs of the comparator equal, and keeps them that way.

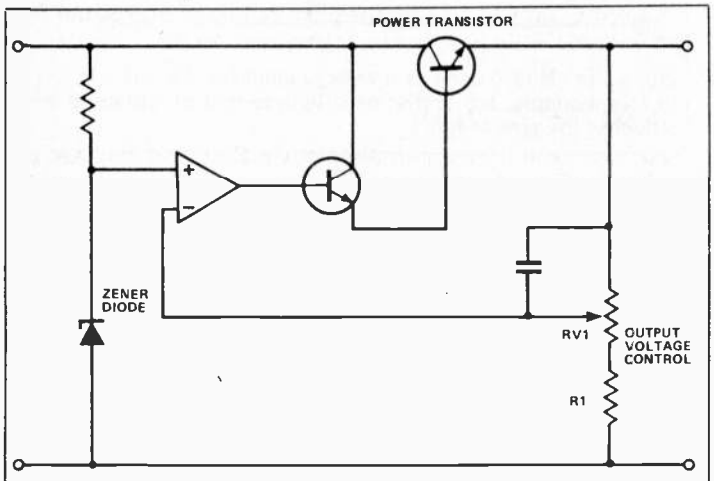


Fig. 3 A simple stabiliser circuit. RV1 varies the output voltage. The minimum possible output voltage in this circuit is equal to the zener diode voltage. The value of R1 has to be calculated so that the stabiliser will still operate correctly when RV1 is turned to the maximum voltage setting.

The stabiliser circuit of Fig. 7.3 has used separate transistors, but it's much easier to make the whole circuit in integrated form. Another advantage is that it becomes possible, at practically no extra cost, to incorporate various types of protection circuits into the IC, protecting the IC in the event of overheating or excessive current. Voltage stabilisers operate with several volts between the input and the output, and quite large currents can flow, so that there is often a large power dissipation. For example, a 5 V stabiliser working from a 9 V supply and passing 0.5 A has a voltage across it of 9—5 = 4 V, and a power dissipation, given by VOLTS x AMPS equal to 4×0.5=2 W. Stabilisers which are intended for this sort of use are provided with metal tabs or studs so that heat-dissipating fins can be attached. The packages which are used for stabilisers are generally the same as those used for power transistors, since the heat dissipating problems are so similar.

THE 78 SERIES

One very popular family of stabilisers carries type numbers such as 7805, 7812, 7815; the 78 prefix is the family number, and the last two digits indicate the stabilised output voltage. Fig. 4 shows the connections for a 7812 12 V stabiliser. The unstabilised input from the rectifiers and smoothing capacitors must not fall to less than 14.5 V with 1 A flowing, and must not exceed 30 V when no load is connected. The IC has short-circuit protection, so that with the output shorted, the current which can flow is limited to 350 mA. Two styles of case can be obtained, the flat plastic type of the 'top-hat' can; output voltages from 5 V to 24 V are standard. Table 1 shows the output voltages, minimum and maximum DC input voltages and the code numbers for these voltage regulator ICs.

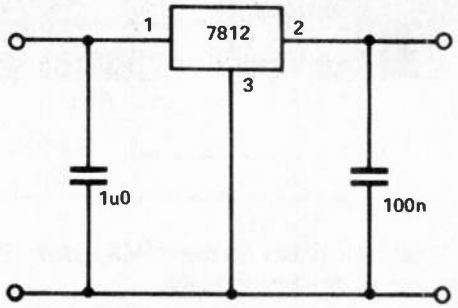


Fig. 4 The connections for a 7812 regulator. The capacitors must be wired as close to the pins of the IC as possible. They do not replace the smoothing capacitor but are essential for stability.

Type No.	Voltage out	Max. Current	Ripple rejection	Input range
7805	5 V	100 mA	62 db	7 V-30 V
7812	12 V	100 mA	54 db	14.5 V-35 V
7815	15 V	100 mA	51 db	17.5 V-35 V

These figures are for the lowest-power stabiliser ICs. The power ratings are indicated by letter codes which differ from one manufacturer to another. For example, the 1 A output ICs are labelled UC by one manufacturer, P by another, and CP by a third, so that careful study of the specification is needed if you are looking for stabiliser ICs with more than 100 mA output.

TABLE 7.1 STABILISER ICs

SPEED REGULATION

Now for something quite different. Many high-quality modern record players and stereo cassette recorders use DC motors whose speed is electronically regulated. This method of providing a constant speed drive has many advantages over the methods which were previously used, such as mechanical governors or AC motors. The speed regulator supplies the motor with current, and the current supply is regulated so that the motor speed remains constant even if the supply voltage, the load on the motor and the temperature of the motor all vary. Regulators of this kind are particularly important for cassette players that are intended to be used in cars, because the voltage of a car battery can vary from less than 12 V (everything on, engine not running) to more than 16 V (charging heavily), and there is also a very large range of temperature inside a car, ranging from well below freezing point (in winter) to 35° C or more for a car parked in the sun in summer.

The speed regulator operates by sampling the voltage across the motor, which is proportional to the motor speed, and regulating the current to the motor so as to keep this voltage constant. Fig. 5 shows the circuit which is used. The resistor R1 has a value which is about equal to the resistance of the motor, and the variable RV1 then acts as the speed control.

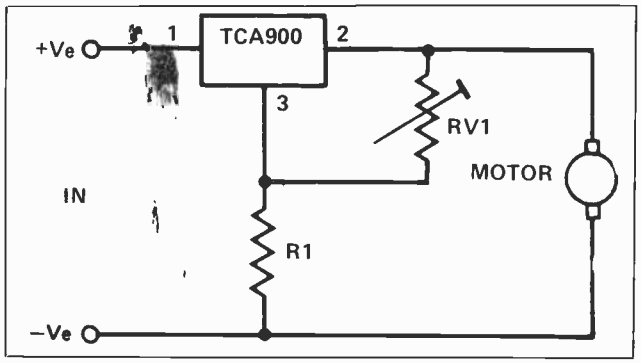


Fig. 5 Using the TCA900 motor speed controller. The resistors RV1 and R1 have to be chosen to match the motor resistance.

CURRENT DIFFERENCE AMPLIFIERS

Current-difference amplifiers (CDAs) are a type of operational amplifier which for some applications can be more versatile than the 'old faithful' 741. Typical, and by far the best known, of these CDAs is the LM3900 by National Semiconductor (a similar IC is made by Motorola) which consists of four CDAs in a single 14-pin DIL package. What makes CDAs different is that they don't need the two separate power supplies of the 741, nor do they need a 'half-supply-voltage' on the + input when a single supply voltage is used. Another important feature is that the output voltage of a CDA can be taken much closer to the supply voltage limits than is possible with a 741. We can, for example, run a LM3900 from a 15 V supply, and drive the output voltage as low as 0.1 V or as high as 14.2 V. A 741 operated from the same supply voltage could not be made to give output voltages so high or so low when single supply voltage is used.

At first sight, the CDA looks as if it's identical to any other operational amplifier, but there is a very important difference which is implied by the name — current differencing amplifier. The output voltage of the CDA is controlled by the difference in the currents fed to the two inputs, not the difference in voltage (which is never large enough to be measurable). This makes the bias arrangements for the LM3900 very much simpler than those used for the 741, and the low currents which are needed allow us to use very large resistor values in the bias circuits.

The actual voltage at both inputs is about 0.6V above ground (assuming a single supply line), which is the voltage across a IC transistor junction, and the minimum amount of current which is needed at each input is very small, around 30nA (a nanoamp, nA, is one thousandth of a microamp). The output can supply a current of up to 10 mA, or sink a current (that is a current going into the output terminal) of just over a milliamp.

Fig. 6 shows a typical LM3900 circuit for a voltage amplifier. The bias system for the + input is very simple — just a resistor connected from the + input to supply positive. This has to be a large value resistor to avoid passing excessive current, and will usually be around 1M to 4M7. As usual, the operating conditions are stabilised by feedback to the — input, but we have to remember that this is feedback of current, and we're aiming to have the same current flowing into the — input as flows into the + input. Now the current into the + input is fixed by the value of the supply voltage and R1 — it's equal to supply voltage divided by the value of R1

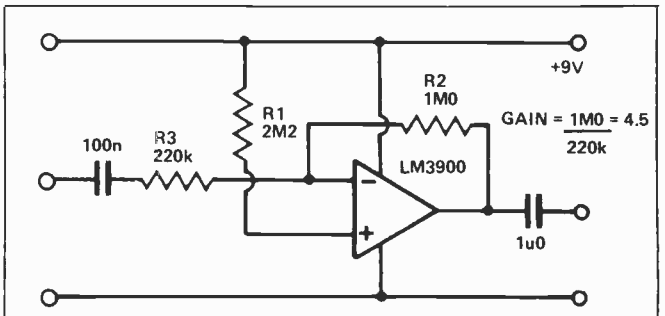


Fig. 6 The LM3900 used as a voltage amplifier. The gain is low in this example, but higher gain figures can be obtained by reducing the size of R3.

— and if we made the value of R2 the same as that of R1, the output voltage would have to be the same as the supply voltage to pass the same current. If we make R2 equal to half of R1, though, we need only half of the supply voltage at the output to pass the same current through R2 as the full supply voltage can pass through R1. This sets the normal output voltage, with no signal input, at half supply voltage, the value we need for good linear amplification. It's so much simpler than the 741 that you begin to wonder why the LM3900 isn't used to a much greater extent, especially when you get four amplifier units in one IC. As it happens there are some applications for which the LM3900 can't really replace the 741, and the very high resistor values are sometimes a nuisance, particularly now when so few components suppliers keep resistors or more than 1M in stock. Nevertheless, many of the uses we have for operational amplifiers can be filled more easily by the LM3900.

In the circuit shown in Fig. 6 the gain is given by the resistor ratio R2/R3. The input resistance is practically equal to R3, and capacitor coupling is needed because there is a small bias voltage (0.6 V) at the — input. With the values shown the voltage gain is 4.5 and the input resistance is 220k.

A complete listing of all the possible LM3900 circuits would take more space than we have, but Fig. 7 shows an interesting circuit—an amplifier with its gain controlled by a bias voltage. The input is to C1, but a small DC bias to R2 will alter the gain of the amplifier from around zero, when Vdc = 0, to about 12 times when Vdc is about 1V.

ETI

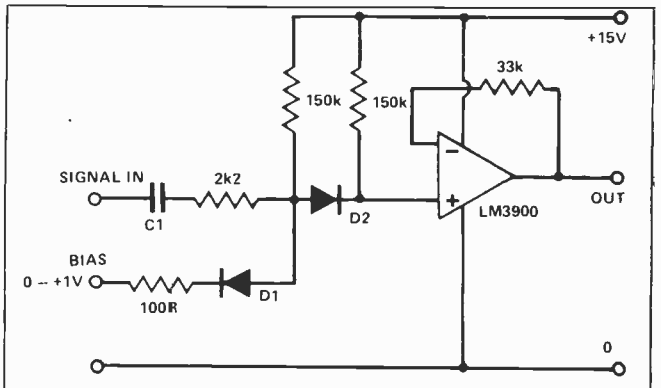


Fig. 7 The LM3900 used as an amplifier whose gain is controlled by a DC bias.

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E.A. PARR, B.Sc., C.Eng., M.I.E.E.
A newcomer to electronics tends to be overwhelmed when first confronted with articles or books on microprocessors. In an attempt to give a painless approach to computing, this small book will start by designing a simple computer and because of its simplicity and logical structure, the language is hopefully easy to learn and understand. In this way, such ideas as Relative Addressing, Index Registers etc will be developed and it is hoped that these will be seen as logical progressions rather than arbitrary things to be accepted but not understood.

BEGINNERS GUIDE TO MICROPROCESSORS
TAB No.995 **$10.45**
If you aren't sure exactly what a microprocessor is, then this is the book for you. The book takes the beginner from the basic theories and history of these essential devices, right up to some real world hardware applications.

HOW TO BUILD YOUR OWN WORKING MICROCOMPUTER
TAB No.1200 **$16.45**
An excellent reference or how-to manual on building your own microcomputer. All aspects of hardware and software are developed as well as many practical circuits.

BP78: PRACTICAL COMPUTER EXPERIMENTS **$7.30**
E.A. PARR, B.Sc., C.Eng., M.I.E.E.
Curiously most published material on the microprocessor tends to be of two sorts, the first treats the microprocessor as a black box and deals at length with programming and using the "beast". The second type of book deals with the social impact. None of these books deal with the background to the chip, and this is a shame as the basic ideas are both interesting and simple.

This book aims to fill in the background to the microprocessor by constructing typical computer circuits in discrete logic and it is hoped that this will form a useful introduction to devices such as adders, memories, etc. as well as a general source book of logic circuits.

HANDBOOK OF MICROPROCESSOR APPLICATIONS
TAB No.1203 **$14.45**
Highly recommended reading for those who are interested in microprocessors as a means of a accomplishing a specific task. The author discusses two individual microprocessors, the 1802 and the 6800, and how they can be put to use in real world applications.

MICROPROCESSOR/MICROPROGRAMMING HANDBOOK
TAB No.785 **$14.45**
A comprehensive guide to microprocessor hardware and programming. Techniques discussed include subroutines, handling interrupts and program loops.

BP102: THE 6809 COMPANION **$8.10**
M. JAMES
The 6809 microprocessor's history, architecture, addressing modes and the instruction set (fully commented) are covered. In addition there are chapters on converting programs from the 6800, programming style, interrupt handling and about the 6809 hardware and software available.

AN INTRODUCTION TO MICROPROCESSORS EXPERIMENTS IN DIGITAL TECHNOLOGY
HB07: **$15.85**
SMITH
A "learn by doing" guide to the use of integrated circuits provides a foundation for the underlying hardware actions of programming statements. Emphasis is placed on how digital circuitry compares with analog circuitry. Begins with the simplest gates and timers, then introduces the fundamental parts of ICs, detailing the benefits and pitfalls of major IC families, and continues with coverage of the ultimate in integrated complexity — the microprocessor.

DESIGNING MICROCOMPUTER SYSTEMS
HB18: **$15.85**
POOCH AND CHATTERGY
This book provides both hobbyists and electronic engineers with the background information necessary to build microcomputer systems. It discusses the hardware aspects of microcomputer systems. Timing devices are provided to explain sequences of operations in detail. Then, the book goes on to describe three of the most popular microcomputer families: the Intel 8080, Zilog Z-80, and Motorola 6800. Also covered are designs of interfaces for peripheral devices, and information on building microcomputer systems from kits.

S-100 BUS HANDBOOK
HB19: **$22.75**
BURSKY
Here is a comprehensive book that exclusively discusses S-100 bus computer systems and how they are organized. The book covers computer fundamentals, basic electronics, and the parts of the computer. Individual chapters discuss the CPU, memory, input/output, bulk-memory devices, and specialized peripheral controllers. It explains all the operating details of commonly available S-100 systems. Schematic drawings.

BASIC MICROPROCESSORS AND THE 6800
HB06: **$21.45**
Provides two books in one: a basic guide to microprocessors for the beginner, and a complete description of the M6800 system for the engineer.

Each chapter is followed by a problem section.

DIGITAL INTERFACING WITH AN ANALOG WORLD
TAB No.1070 **$14.45**
You've bought a computer, but now you can't make it do anything useful. This book will tell you how to convert real world quantities such as temperature, pressure, force and so on into binary representation.

MICROPROCESSOR INTERFACING HANDBOOK: A/D & D/A
TAB No.1271 **$14.45**
A useful handbook for computerists interested in using their machines in linear applications. Topics discussed include voltage references, op-amps for data conversion, analogue switching and multiplexing and more.

COMPUTER TECHNICIAN'S HANDBOOK
TAB No.554 **$17.45**
Whether you're looking for a career, or you are a service technician, computer repair is an opportunity you should be looking at. The author covers all aspects of digital and computer electronics as well as the mathematical and logical concepts involved.

HOW TO TROUBLESHOOT AND REPAIR MICROCOMPUTERS
AB013 **$10.45**
Learn how to find the cause of a problem or malfunction in the central or peripheral unit of any microcomputer and then repair it. The tips and techniques in this guide can be applied to any equipment that uses the microprocessor as the primary control element.

TROUBLESHOOTING MICROPROCESSORS AND DIGITAL LOGIC
TAB No.1183 **$13.45**
The influence of digital techniques on commercial and home equipment is enormous and increasing yearly. This book discusses digital theory and looks at how to service Video Cassette Recorders, microprocessors and more.

HOW TO DEBUG YOUR PERSONAL COMPUTER
AB012 **$10.45**
When you feel like reaching for a sledge hammer to reduce your computer to fiberglass and epoxy dust, don't. Reach for this book instead and learn all about program bug tracking, recognition and elimination techniques.

COMPUTERS
(SOFTWARE)

HOW TO PROFIT FROM YOUR PERSONAL COMPUTER: PROFESSIONAL, BUSINESS, AND HOME APPLICATIONS
LEWIS
HB01 **$17.00**
Describes the uses of personal computers in common business applications, such as accounting, managing, inventory, sorting mailing lists, and many others. The discussion includes terms, notations, and techniques commonly used by programmers. A full glossary of terms.

PROGRAMS FOR BEGINNERS ON THE TRS-80
BLECHMAN
HB02 **$13.05**
A valuable book of practical and interesting programs for home use that can be understood and used immediately by the beginner in personal computer programming. You'll learn step-by-step how 21 sample TRS-80 programs work. Program techniques are described line-by-line within the programs, and a unique Martri-Dex™ matrix index will enable you to locate other programs using the same BASIC commands and statements.

THE JOY OF MINIS AND MICROS: DATA PROCESSING WITH SMALL COMPUTERS
STEIN AND SHAPIRO
HB03 **$15.85**
A collection of pieces covering technical and management aspects of the use of small computers for business or science. It emphasizes the use of common sense and good systems design for every computer project. Because a strong technical background is not necessary, the book is easy to read and understand. Considerable material is devoted to the question of what size computer should be used for a particular job, and how to choose the right machine for you.

BEGINNER'S GUIDE TO COMPUTER PROGRAMMING
TAB No.574 **$16.45**
Computer programming is an increasingly attractive field to the individual, however many people seem to overlook it as a career. The material in this book has been developed in a logical sequence, from the basic steps to machine language.

USING MICROCOMPUTERS IN BUSINESS
VEIT
HB04 **$14.45**
An essential background briefing for any purchaser of microcomputer systems or software. In a fast-moving style, without the usual buzz words and technical jargon, Veit answers the most often asked questions.

BASIC FROM THE GROUND UP
SIMON
HB15 **$17.00**
Here's a BASIC text for high school students and hobbyists that explores computers and the BASIC language in a simple direct way, without relying on a heavy mathematical backbround on the reader's part. All the features of BASIC are included as well as some of the inside workings of a computer. The book covers one version of each of the BASIC statements and points out some of the variations, leaving readers well prepared to write programs in any version they encounter. A selection of exercises and six worked out problems round out the reader's experience. A glossary and a summary of BASIC statements are included at the end of the book for quick reference.

BASIC COMPUTER PROGRAMS FOR BUSINESS: STERNBERG (Vol. 1)
HB13 **$15.85**
A must for small businesses utilizing micros as well as for entrepreneurs, volume provides a wealth of practical business applications. Each program is documented with a description of its functions and operation, a listing in BASIC, a symbol table, sample data, and one or more samples.

BP86: AN INTRODUCTION TO BASIC PROGRAMMING TECHNIQUES **$8.25**
S. DALY
This book is based on the author's own experience in learning BASIC and in helping others, mostly beginners, to program and understand the language. Also included are a program library containing various programs, that the author has actually written and run. These are for biorhythms, plotting a graph of Y against X, standard deviation, regression, generating a musical note sequence and a card game. The book is complemented by a number of appendices which include test questions and answers on each chapter and a glossary.

THE BASIC COOKBOOK.
TAB No.1055 **$9.45**
BASIC is a surprisingly powerful language . . . if you understand it completely. This book, picks up where most manufacturers' documentation gives up. With it, any computer owner can develop programs to make the most out of his or her machine.

PET BASIC — TRAINING YOUR PET COMPUTER
AB014 **$16.45**
Officially approved by Commodore, this is the ideal reference book for long time PET owners or novices. In an easy to read and humorous style, this book describes techniques and experiments, all designed to provide a strong understanding of this versatile machine.

PROGRAMMING IN BASIC FOR PERSONAL COMPUTERS
AB015 **$10.45**
This book emphasizes the sort of analytical thinking that lets you use a specific tool — the BASIC language — to transform your own ideas into workable programs. The text is designed to help you to intelligently analyse and design a wide diversity of useful and interesting programs.

COMPUTER PROGRAMS IN BASIC
AB001 **$14.45**
A catalogue of over 1,600 fully indexed BASIC computer programs with applications in Business, Math, Games and more. This book lists available software, what it does, where to get it, and how to adapt it to your machine.

PET GAMES AND RECREATION
AB002 **$12.45**
A variety of interesting games designed to amuse and educate. Games include such names as Capture, Tic Tac Toe, Watchperson, Motie, Sinners, Martian Hunt and more.

BRAIN TICKLERS
AB005 **$8.00**
If the usual games such as Bug Stomp and Invaders From the Time Warp are starting to pale, then this is the book for you. The authors have put together dozens of stimulating puzzles to show you just how challenging computing can be.

PASCAL
TAB No.1205 **$16.45**
Aimed specifically at TRS-80 users, this book discusses how to load, use and write PASCAL programs. Graphic techniques are discussed and numerous programs are presented.

PASCAL PROGRAMMING FOR THE APPLE
AB008 **$16.45**
A great book to upgrade your programming skills to the UCSD Pascal as implemented on the Apple II. Statements and techniques are discussed and there are many practical and ready to run programs.

APPLE MACHINE LANGUAGE PROGRAMMING
AB009 **$16.45**
The best way to learn machine language programming the Apple II in no time at all. The book combines colour, graphics, and sound generation together with clear cut demonstrations to help the user learn quickly and effectively.

Z80 USERS MANUAL
AB010 **$14.45**
The Z80 MPU can be found in many machines and is generally acknowledged to be one of the most powerful 8 bit chips around. This book provides an excellent 'right hand' for anyone involved in the application of this popular processor.

HOW TO PROGRAM YOUR PROGRAMMABLE CALCULATOR
AB006 **$10.45**
Calculator programming, by its very nature, often is an obstacle to effective use. This book endeavours to show how to use a programmable calculator to its full capabilities. The TI 57 and the HP 33E calculators are discussed although the principles extend to similar models.

Z-80 AND 8080 ASSEMBLY LANGUAGE PROGRAMMING
SPRACKLEN
HB05 **$14.25**
Provides just about everything the applications programmer needs to know for Z-80 and 8080 processors. Programming techniques are presented along with the instructions. Exercises and answers included with each chapter.

BASIC COMPUTER PROGRAMS IN SCIENCE AND ENGINEERING
GILDER
HB08 **$15.85**
Save time and money with this collection of 114 ready-to-run BASIC programs for the hobbyist and engineer. There are programs to do such statistical operations as means, standard deviation averages, curve-fitting, and interpolation. There are programs that design antennas, filters, attenuators, matching networks, plotting, and histogram programs.

GAME PLAYING WITH COMPUTERS SECOND EDITION
SPENCER
HB11 **$31.25**
Now you can sharpen programming skills through a relaxed approach. Completely devoted to computerized game playing, this volume presents over 70 games, puzzles, and mathematical recreations for a digital computer. It's fully illustrated and includes more that 25 game-playing programs in FORTRAN or BASIC complete with descriptions, flowcharts, and output.

MICROCOMPUTERS AND THE 3 R'S
DOERR
HB09 **$14.25**
This book educates educators on the various ways computers, especially microcomputers, can be used in the classroom. It describes microcomputers, how to organize a computer-based program, the five instructional application types (with examples from subjects such as the hard sciences, life sciences, English, history, and government) and resources listings of today's products. The book includes preprogrammed examples to start up a microcomputer program; while chapters on resources and products direct the reader to useful additional information. All programs are written in the BASIC language.

GAME PLAYING WITH BASIC
SPENCER
HB10 **$15.25**
The writing is nontechnical, allowing almost anyone to understand computerized game playing. The book includes the rules of each game, how each game works, illustrative flowcharts, diagrams, and the output produced by each program. The last chapter contains 26 games for reader solution.

SARGON: A COMPUTER CHESS PROGRAM
SPRACKLEN
HB12 **$25.00**
"I must rate this chess program an excellent buy for anyone who loves the game." Kilobaud.

Here is the computer chess program that won first place in the first chess tournament at the 1978 West Coast Computer Faire. It is written in Z-80 assembly language, using the TDL macro assembler. It comes complete with block diagram and sample printouts.

A CONSUMER'S GUIDE TO PERSONAL COMPUTING AND MICROCOMPUTERS, SECOND EDITION
FREIBERGER AND CHEW
HB14 **$14.45**
The first edition was chosen by Library Journal as one of the 100 outstanding sci-tech books of 1978. Now, there's an updated second edition!

Besides offering an introduction to the principles of microcomputers that assumes no previous knowledge on the reader's part, this second edition updates prices, the latest developments in microcomputer technology, and a review of over 100 microcomputer products from over 60 manufacturers.

THE BASIC CONVERSIONS HANDBOOK FOR APPLE, TRS-80, AND PET USERS
BRAIN BANK
HB17 **$11.75**
Convert a BASIC program for the TRS-80, Apple II, or PET to the form of BASIC used by any other one of those machines. This is a complete guide to converting Apple II and PET-programs to TRS-80, TRS-80 and PET programs to Apple II, TRS-80 and Apple II programs to PET. Equivalent commands are listed for TRS-80 BASIC (Model I, Level II), Applesoft BASIC and PET BASIC, as well as variations for the TRS-80 Model III and Apple Integer BASIC.

SPEAKING PASCAL
BOWEN
HB16 **$17.25**
An excellent introduction to programming in the Pascal language! Written in clear, concise, non-mathematical language, the text requires no technical background or previous programming experience on the reader's behalf. Top-down structured analysis and key examples illustrate each new idea and the reader is encouraged to construct programs in an organized manner.

BP33: ELECTRONIC CALCULATOR USERS HANDBOOK **$4.25**
M.H. BABANI, B.Sc.(Eng.)
An invaluable book for all calculator users whatever their age or occupation, or whether they have the simplest or most sophisticated of calculators. Presents formulae, data, methods of calculation, conversion factors, etc., with the calculator user especially in mind, often illustrated with simple examples. Includes the way to calculate using only a simple four function calculator: Trigonometric Functions (Sin, Cos, Tan) Hyperbolic Functions (Sinh, Cosh, Tanh) Logarithms, Square Roots and Powers.

THE MOST POPULAR SUBROUTINES IN BASIC
TAB No.1050 **$10.45**
An understandable guide to BASIC subroutines which enables the reader to avoid tedium, economise on computer time and makes programs run faster. It is a practical rather than a theoretical manual.

PROJECTS

BP48: ELECTRONIC PROJECTS FOR BEGINNERS **$5.90**
F.G. RAYER, T.Eng.(CEI), Assoc.IERE
Another book written by the very experienced author — Mr. F.G. Rayer — and in it the newcomer to electronics, will find a wide range of easily made projects. Also, there are a considerable number of actual component and wiring layouts, to aid the beginner.

Furthermore, a number of projects have been arranged so that they can be constructed without any need for soldering and, thus, avoid the need for a soldering iron.

Also, many of the later projects can be built along the lines as those in the 'No Soldering' section so this may considerably increase the scope of projects which the newcomer can build and use.

221: 28 TESTED TRANSISTOR PROJECTS
R.TORRENS **$5.50**
Mr. Richard Torrens is a well experienced electronics development engineer and has designed, developed, built and tested the many useful and interesting circuits included in this book. The projects themselves can be split down into simpler building blocks, which are shown separated by boxes in the circuits for ease of description, and also to enable any reader who wishes to combine boxes from different projects to realise ideas of his own.

BP49: POPULAR ELECTRONIC PROJECTS **$6.25**
R.A. PENFOLD
Includes a collection of the most popular types of circuits and projects which, we feel sure, will provide a number of designs to interest most electronics constructors. The projects selected cover a very wide range and are divided into four basic types: Radio Projects, Audio Projects, Household Projects and Test Equipment.

EXPERIMENTER'S GUIDE TO SOLID STATE ELECTRONIC PROJECTS
AB007 **$9.45**
An ideal sourcebook of Solid State circuits and techniques with many practical circuits. Also included are many useful types of experimenter gear.

BP71: ELECTRONIC HOUSEHOLD PROJECTS **$7.70**
R. A. PENFOLD
Some of the most useful and popular electronic construction projects are those that can be used in or around the home. The circuits range from such things as '2 Tone Door Buzzer', Intercom, through Smoke or Gas Detectors to Baby and Freezer Alarms.

BP94: ELECTRONIC PROJECTS FOR CARS AND BOATS **$8.10**
R.A. PENFOLD
Projects, fifteen in all, which use a 12V supply are the basis of this book. Included are projects on Windscreen Wiper Control, Courtesy Light Delay, Battery Monitor, Cassette Power Supply, Lights Timer, Vehicle Immobiliser, Gas and Smoke Alarm, Depth Warning and Shaver Inverter.

BP69: ELECTRONIC GAMES **$7.55**
R.A. PENFOLD
In this book Mr. R. A. Penfold has designed and developed a number of interesting electronic game projects using modern integrated circuits. The text is divided into two sections, the first dealing with simple games and the latter dealing with more complex circuits.

BP95: MODEL RAILWAY PROJECTS **$8.10**
Electronic projects for model railways are fairly recent and have made possible an amazing degree of realism. The projects covered include controllers, signals and sound effects. Stripboard layouts are provided for each project.

BP93: ELECTRONIC TIMER PROJECTS **$8.10**
F.G. RAYER
Windscreen wiper delay, darkroom timer and metronome projects are included. Some of the more complex circuits are made up from simpler sub-circuits which are dealt with individually.

110 OP-AMP PROJECTS
MARSTON
HB24 **$11.75**
This handbook outlines the characteristics of the op-amp and present 110 highly useful projects—ranging from simple amplifiers to sophisticated instrumentation circuits.

110 IC TIMER PROJECTS
GILDER
HB25 **$10.25**
This sourcebook maps out applications for the 555 timer IC. It covers the operation of the IC itself to aid you in learning how to design your own circuits with the IC. There are application chapters for timer-based instruments, automotive applications, alarm and control circuits, and power supply and converter applications.

110 THYRISTOR PROJECTS USING SCRs AND TRIACS
MARSTON
HB22 **$12.05**
A grab bag of challenging and useful semiconductor projects for the hobbyist, experimenter, and student. The projects range from simple burglar, fire, and water level alarms to sophisticated power control devices for electric tools and trains. Integrated circuits are incorporated wherever their use reduces project costs.

110 CMOS DIGITAL IC PROJECTS
MARSTON
HB23 **$11.75**
Outlines the operating characteristics of CMOS digital ICs and then presents and discusses 110 CMOS digital IC circuits ranging from inverter gate and logic circuits to electronic alarm circuits. Ideal for amateurs, students and professional engineers.

BP76: POWER SUPPLY PROJECTS **$7.30**
R.A. PENFOLD
Line power supplies are an essential part of many electronics projects. The purpose of this book is to give a number of power supply designs, including simple unstabilised types, fixed voltage regulated types, and variable voltage stabilised designs, the latter being primarily intended for use as bench supplies for the electronics workshop. The designs provided are all low voltage types for semiconductor circuits.

There are other types of power supply and a number of these are dealt with in the final chapter, including a cassette power supply, Ni-Cad battery charger, voltage step up circuit and a simple inverter.

BP84: DIGITAL IC PROJECTS **$8.10**
F.G. RAYER, T.Eng.(CEI),Assoc.IERE
This book contains both simple and more advanced projects and it is hoped that these will be found of help to the reader developing a knowledge of the workings of digital circuits. To help the newcomer to the hobby the author has included a number of board layouts and wiring diagrams. Also the more ambitious projects can be built and tested section by section and this should help avoid or correct faults that could otherwise be troublesome. An ideal book for both beginner and more advanced enthusiast alike.

BP67: COUNTER DRIVER AND NUMERAL DISPLAY PROJECTS **$7.55**
F.G. RAYER, T.Eng.(CEI), Assoc. IERE
Numeral indicating devices have come very much to the forefront in recent years and will, undoubtedly, find increasing applications in all sorts of equipment. With present day integrated circuits, it is easy to count, divide and display numerically the electrical pulses obtained from a great range of driver circuits.

In this book many applications and projects using various types of numeral displays, popular counter and driver IC's etc. are considered.

213: ELECTRONIC CIRCUITS FOR MODEL RAILWAYS **$4.50**
M.H. BABANI, B.Sc.(Eng.)
The reader is given constructinal details of how to build a simple model train controller; controller with simulated inertia and a high power controller. A signal system and lighting for model trains is discussed as is the suppression of RF interference from odel railways. The construction of an electronic steam whistle and a model train chuffer is also covered.

BP73: REMOTE CONTROL PROJECTS **$8.60**
OWEN BISHOP
This book is aimed primarily at the electronics enthusiast who wishes to experiment with remote control. Full explanations have been given so that the reader can fully understand how the circuits work and can more easily see how to modify them for other purposes, depending on personal requirements. Not only are radio control systems considered but also infra-red, visible light and ultrasonic systems as are the use of Logic ICs and Pulse position modulation etc.

BP99: MINI — MATRIX BOARD PROJECTS **$8.10**
R.A. PENFOLD
Twenty useful projects which can all be built on a 24 x 10 hole matrix board with copper strips. Includes Doorbuzzer, Low-voltage Alarm, AM Radio, Signal Generator, Projector Timer, Guitar Headphone Amp, Transistor Checker and more.

CIRCUITS

BP98: POPULAR ELECTRONIC CIRCUITS, BOOK 2 **$9.35**
R.A. PENFOLD
70 plus circuits based on modern components aimed at those with some experience.

BP80: POPULAR ELECTRONIC CIRCUITS — BOOK 1 **$8.25**
R.A. PENFOLD
Another book by the very popular author, Mr. R.A. Penfold, who has designed and developed a large number of various circuits. These are grouped under the following general headings; Audio Circuits, Radio Circuits, Test Gear Circuits, Music Project Circuits, Household Project Circuits and Miscellaneous Circuits.

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ETI book shelf

The GIANT HANDBOOK OF ELECTRONIC CIRCUITS
TAB No.1300 **$24.45**
About as twice as thick as the Webster's dictionary, and having many more circuit diagrams, this book is ideal for any experimenter who wants to keep amused for several centuries. If there isn't a circuit for it in here, you should have no difficulty convincing yourself you don't really want to build it.

BP39: 50 (FET) FIELD EFFECT TRANSISTOR PROJECTS **$5.50**
F.G. RAYER, T.Eng.(CEI),Assoc.IERE
Field effect transistors (FETs), find application in a wide variety of circuits. The projects described here include radio frequency amplifiers and converters, test equipment and receiver aids, tuners, receivers, mixers and tone controls, as well as various miscellaneous devices which are useful in the home.

This book contains something of particular interest for every class of enthusiast — short wave listener, radio amateur, experimenter or audio devotee.

BP87: SIMPLE L.E.D. CIRCUITS **$5.90**
R.N. SOAR
Since it first appeared in 1977, Mr. R.N. Soar's book has proved very popular. The author has developed a further range of circuits and these are included in Book 2. Projects include a Transistor Tester, Various Voltage Regulators, Testers and so on.

BP42: 50 SIMPLE L.E.D. CIRCUITS **$3.55**
R.N. SOAR
The author of this book, Mr. R.N. Soar, has compiled 50 interesting and useful circuits and applications, covering many different branches of electronics, using one of the most inexpensive and freely available components — the Light Emitting Diode (L.E.D.). A useful book for the library of both beginner and more advanced enthusiast alike.

BP82: ELECTRONIC PROJECTS USING SOLAR CELLS **$8.10**
OWEN BISHOP
The book contains simple circuits, almost all of which operate at low voltage and low currents, making them suitable for being powered by a small array of silicon cells. The projects cover a wide range from a bicyle speedometer to a novelty 'Duck Shoot'; a number of power supply circuits are included.

BP37: 50 PROJECTS USING RELAYS, SCR's & TRIACS **$5.50**
F.G.RAYER, T.Eng.(CEI),Assoc.IERE
Relays, silicon controlled rectifiers (SCR's) and bi-directional triodes (TRIACs) have a wide range of applications in electronics today. This book gives tried and practical working circuits which should present the minimum of difficulty for the enthusiast to construct. In most of the circuits there is a wide latitude in component values and types, allowing easy modification of circuits or ready adaptation of them to individual needs.

BP44: IC 555 PROJECTS **$7.55**
E.A. PARR, B.Sc.,C.Eng., M.I.E.E.
Every so often a device appears that is so useful that one wonders how life went on before without it. The 555 timer is such a device. Included in this book are Basic and General Circuits, Motor Car and Model Railway Circuits, Alarms and Noise Makers as well as a section on the 556, 558 and 559 timers.

BP24: 50 PROJECTS USING IC741 **$4.25**
RUDI & UWE REDMER
This book, orlginally published in Germany by TOPP, has achieved phenomenal sales on the Continent and Babani decided, in view of the fact that the integrated circuit used in this book is inexpensive to buy, to make this unique book available to the English speaking reader. Translated from the original German with copious notes, data and circuitry, a "must" for everyone whatever their interest in electronics.

BP83: VMOS PROJECTS **$8.20**
R.A. PENFOLD
Although modern bipolar power transistors give excellent results in a wide range of applications, they are not without their drawbacks or limitations. This book will primarily be concerned with VMOS power FETs although power MOSFETs will be dealt with in the chapter on audio circuits. A number of varied and interesting projects are covered under the main headings of: Audio Circuits, Sound Generator Circuits, DC Control Circuits and Signal Control Circuits.

BP65: SINGLE IC PROJECTS **$6.55**
R.A.PENFOLD
There is now a vast range of ICs available to the amateur market, the majority of which are not necessarily designed for use in a single application and can offer unlimited possibilities. All the projects contained in this book are simple to construct and are based on a single IC. A few projects employ one or two transistors in addition to an IC but in most cases the IC is the only active device used.

BP97: IC PROJECTS FOR BEGINNERS **$8.10**
F.G. RAYER
Covers power supplies, radio, audio, oscillators, timers and switches. Aimed at the less experienced reader, the components used are popular and inexpensive.

BP88: HOW TO USE OP AMPS **$9.35**
E.A. PARR
A designer's guide covering several op amps, serving as a source book of circuits and a reference book for design calculations. The approach has been made as non-mathematical as possible.

IC ARRAY COOKBOOK
JUNG
HB26 **$14.25**
A practical handbook aimed at solving electronic circuit application problems by using IC arrays. An IC array, unlike specific-purpose ICs, is made up of uncommitted IC active devices, such as transistors, resistors, etc. This book covers the basic types of such ICs and illustrates with examples how to design with them. Circuit examples are included, as well as general design information useful in applying arrays.

BP50: IC LM3900 PROJECTS **$5.90**
H.KYBETT,B.Sc., C.Eng.
The purpose of this book is to introduce the LM3900 to the Technician, Experimenter and the Hobbyist. It provides the groundwork for both simple and more advanced uses, and is more than just a collection of simple circuits or projects.

Simple basic working circuits are used to Introduce this IC. The LM3900 can do much more than is shown here, this is just an introduction. Imagination is the only limitation with this useful and versatile device. But first the reader must know the basics and that is what this book is all about.

223: 50 PROJECTS USING IC CA3130 **$5.50**
R.A.PENFOLD
In this book, the author has designed and developed a number of interesting and useful projects which are divided into five general categories: I — Audio Projects II — R.F. Projects III — Test Equipment IV — Household Projects V — Miscellaneous Projects.

224: 50 CMOS IC PROJECTS **$4.25**
R.A. PENFOLD
CMOS IC's are probably the most versatile range of digital devices for use by the amateur enthusiast. They are suitable for an extraordinary wide range of applications and are also some of the most inexpensive and easily available types of IC.

Mr. R.A. Penfold has designed and developed a number of interesting and useful projects which are divided into four general categories: I — Multivibrators II — Amplifiers and Oscillators III — Trigger Devices IV — Special Devices.

THE ACTIVE FILTER HANDBOOK
TAB No.1133 **$11.45**
Whatever your field — computing, communications, audio, electronic music or whatever — you will find this book the ideal reference for active filter design.

The book introduces filters and their uses. The basic math is discussed so that the reader can tell where all design equations come from. The book also presents many practical circuits including a graphic equalizer, computer tape interface and more.

DIGITAL ICS — HOW THEY WORK AND HOW TO USE THEM
AB004 **$10.45**
An excellent primer on the fundamentals of digital electronics. This book discusses the nature of gates and related concepts and also deals with the problems inherent to practical digital circuits.

MASTER HANDBOOK OF 1001 PRACTICAL CIRCUITS
TAB No.800 **$20.45**
MASTER HANDBOOK OF 1001 MORE PRACTICAL CIRCUITS
TAB No.804 **$19.45**
Here are transistor and IC circuits for just about any application you might have. An ideal source book for the engineer, technician or hobbyist. Circuits are classified according to function, and all sections appear in alphabetical order.

THE MASTER IC COOKBOOK
TAB No.1199 **$16.45**
If you've ever tried to find specs for a so called 'standard' chip, then you'll appreciate this book. C.L. Hallmark has compiled specs and pinout for most types of ICs that you'd ever want to use.

ELECTRONIC DESIGN WITH OFF THE SHELF INTEGRATED CIRCUITS
AB016 **$10.45**
This practical handbook enables you to take advantage of the vast range of applications made possible by integrated circuits. The book tells how, in step by step fashion, to select components and how to combine them into functional electronic systems. If you want to stop being a "cookbook hobbyist", then this is the book for you.

AUDIO

BP90: AUDIO PROJECTS **$8.10**
F.G. RAYER
Covers in detail the construction of a wide range of audio projects. The text has been divided into preamplifiers and mixers, power amplifiers, tone controls and matching and miscellaneous projects.

HOW TO DESIGN, BUILD, AND TEST COMPLETE SPEAKER SYSTEMS.
TAB No.1064 **$13.45**
By far the greatest savings in assembling an audio system can be realized from the construction of speakers. This book contains information to build a variety of speakers as well as instructions on how to design your own.

205: FIRST BOOK OF HI-FI LOUDSPEAKER ENCLOSURES **$3.55**
B.B. BABANI
This book gives data for building most types of loudspeaker enclosure. Includes corner reflex, bass reflex, exponential horn, folded horn, tuned port, klipschorn labyrinth, tuned column, loaded port and multi speaker panoramic. Many clear diagrams for every construction showing the dimensions necessary.

BP35: HANDBOOK OF IC AUDIO PRE-AMPLIFIER AND POWER AMPLIFIER CONSTRUCTION **$5.50**
F.G.RAYER, T.Eng.(CEI),Assoc.IERE
This book is divided into three parts: Part I, understanding audio IC's, Part II, Pre-amplifiers, Mixers and Tone Controls, Part III Power Amplifiers and Supplies. Includes practical constructional details of pure IC and Hybrid IC and Transistor designs from about 250mW to 100W output.

BP47: MOBILE DISCOTHEQUE HANDBOOK **$5.90**
COLIN CARSON
The vast majority of people who start up "Mobile Discos" know very little about their equipment or even what to buy. Many people have wasted a "small fortune" on poor, unnecessary or badly matched apparatus.

The aim of this book is to give you enough information to enable you to have a better understanding of many aspects of "disco" gear.

HOW TO BUILD A SMALL BUDGET RECORDING STUDIO FROM SCRATCH. . .
TAB No.1166 **$16.45**
The author, F. Alton Everest, has gotten studios together several times, and presents twelve complete, tested designs for a wide variety of applications. If all you own is a mono cassette recorder, you don't need this book. If you don't want your new four track to wind up sounding like one, though, you shouldn't be without it.

BP51: ELECTRONIC MUSIC AND CREATIVE TAPE RECORDING **$5.50**
M.K. BERRY
Electronic music is the new music of the Twentieth Century. It plays a large part in "pop" and "rock" music and, in fact, there is scarcely a group without some sort of synthesiser or other effects generator.

This book sets out to show how electronic music can be made at home with the simplest and most inexpensive of equipment. It then describes how the sounds are generated and how these may be recorded to build up the final composition.

BP74: ELECTRONIC MUSIC PROJECTS **$7.70**
R.A. PENFOLD
Although one of the more recent branches of amateur electronics, electronic music has now become extremely popular and there are many projects which fall into this category. The purpose of this book is to provide the constructor with a number of practical circuits for the less complex items of electronic music equipment, including such things as a Fuzz Box, Waa-Waa Pedal, Sustain Unit, Reverberation and Phaser-Units, Tremelo Generator etc.

BP81: ELECTRONIC SYNTHESISER PROJECTS **$7.30**
M.K. BERRY
One of the most fascinating and rewarding applications of electronics is in electronic music and there is hardly a group today without some sort of synthesiser or effects generator. Although an electronic synthesiser is quite a complex piece of electronic equipment, it can be broken down into much simpler units which may be built individually and these can then be used or assembled together to make a complete instrument.

ELECTRONIC MUSIC SYNTHESIZERS
TAB No.1167 **$10.45**
If you're fascinated by the potential of electronics in the field of music, then this is the book for you. Included is data on synthesizers in general as well as particular models. There is also a chapter on the various accessories that are available.

TEST EQUIPMENT

BP75: ELECTRONIC TEST EQUIPMENT CONSTRUCTION **$7.30**
F.G. RAYER, T.Eng. (CEI), Assoc. IERE
This book covers in detail the construction of a wide range of test equipment for both the Electronics Hobbyists and Radio Amateur. Included are projects ranging from an FET Amplified Voltmeter and Resistance Bridge to a Field Strength Indicator and Heterodyne Frequency Meter. Not only can the home constructor enjoy building the equipment but the finished projects can also be usefully utilised in the furtherance of his hobby.

99 TEST EQUIPMENT PROJECTS YOU CAN BUILD
TAB No.805 **$14.45**
An excellent source book for the hobbyist who wants to build up his work bench inexpensively. Projects range from a simple signal tracer to a 50MHz frequency counter. There are circuits to measure just about any electrical quantity: voltage, current, capacitance, impedance and more. The variety is endless and includes just about anything you could wish for!

HOW TO GET THE MOST OUT OF LOW COST TEST EQUIPMENT
AB017 **$9.45**
Whether you want to get your vintage 1960 'TestRite'signal generator working, or you've got something to measure with nothing to measure it with, this is the book for you. The author discusses how to maximize the usefulness of cheap test gear, how to upgrade old equipment, and effective test set ups.

THE POWER SUPPLY HANDBOOK
TAB No.806 **$16.45**
A complete one stop reference for hobbyists and engineers. Contains high and low voltage power supplies of every conceivable type as well mobile and portable units.

ALL PRICES INCLUDE SHIPPING

BP70: TRANSISTOR RADIO FAULT-FINDING CHART $2.40
CHAS. E. MILLER
Across the top of the chart will be found four rectangles containing brief descriptions of various faults; vis: — sound weak but undistorted; set dead; sound low or distorted and background noises. One then selects the most appropriate of these and following the arrows, carries out the suggested checks in sequence until the fault is cleared.

ELECTRONIC TROUBLESHOOTING HANDBOOK
AB019 $9.45
This workbench guide can show you how to pinpoint circuit troubles in minutes, how to test anything electronic, and how to get the most out of low cost test equipment. You can use any and all of the time-saving shortcuts to rapidly locate and repair all types of electronic equipment malfunctions.

COMPLETE GUIDE TO READING SCHEMATIC DIAGRAMS
AB018 $9.45
A complete guide on how to read and understand schematic diagrams. The book teaches how to recognize basic circuits and identify component functions. Useful for technicians and hobbyists who want to avoid a lot of headscratching.

RADIO AND COMMUNICATIONS

BP79: RADIO CONTROL FOR BEGINNERS $7.30
F.G. RAYER, T.Eng.(CEI),Assoc.IERE.
The aim of this book is to act as an introduction to Radio Control for beginners to the hobby. The book will commence by dealing with the conditions that are allowable for such things as frequency and power of transmission. This is followed by a "block" explanation of how control-device and transmitter operate and receiver and actuator(s) produce motion in a model.

Details are then given of actual solid state transmitting equipment which the reader can build. Plain and loaded aerials are then discussed and so is the field-strength meter to help with proper setting up.

The radio receiving equipment is then dealt with which includes a simple receiver and also a crystal controlled superhet. The book ends with the electro-mechanical means of obtaining movement of the controls of the model.

NEW

BP96: CB PROJECTS $8.10
R.A. PENFOLD
Projects include speech processor, aerial booster, cordless mike, aerial and harmonic filters, field strength meter, power supply, CB receiver and more.

BP91: AN INTRODUCTION TO RADIO DXing $8.10
This book is divided into two main sections one to amateur band reception, the other to broadcast bands. Advice is given to suitable equipment and techniques. A number of related constructional projects are described.

SHORTWAVE CIRCUITS & GEAR FOR EXPERIMENTERS & RADIO HAMS
No. 215 $3.70
Covers constructional details of a number of projects for the shortwave enthusiast and radio "Ham". Included are: an add-in crystal filter, adding an "S" meter in your receiver; crystal locked H.F. Receiver; AM tuner using phase locked loop; coverter for 2MHz, 40 to 800 MHz RF amplifier, Aerials for the 52, 144MHz bands, Solid State Crystal Frequency Calibrator, etc.

NEW

BP92: ELECTRONICS SIMPLIFIED—CRYSTAL SET CONSTRUCTION $7.30
F.A. WILSON
Aimed at those who want to get into construction without much theoretical study. Homewound coils are used and all projects are very inexpensive to build.

NEW

AUDIO AND VIDEO INTERFERENCE CURES
KAHANER
HB21 $9.05
A practical work about interference causes and cures that affect TV, radio, hi-fi, CB, and other devices. Provides all the information needed to stop interference. Schematic wiring diagrams of filters for all types of receivers and transmitters are included. Also, it supplies simple filter diagrams to eliminate radio and TV interference caused by noisy home appliances, neon lights, motors, etc.

Book Of The Month

Crystal Set Construction .....BP92 .....$7.30

How often have you leaned back from your twelve giga-dollar microcomputer, switched off your 10,000 watt national debt stereo, told the robot to go kill compact cars and thought how long it's been since you've built a crystal radio? Not very often, right? You need this book. It's therapeutic, practical and, at the very least, it will help you build something you can actually understand.

This book is ideal for both the beginner just getting into electronics and the experienced soldering iron cavalier who just wants to stop slaying IC's for a while. All the aspects of crystal sets are covered, from simple circuits to multiband sets, plus their history and some radio theory. Simple, easy to get parts are specified throughout.

BP46: RADIO CIRCUITS USING IC's $5.90
J.B. DANCE, M.Sc.
This book describes integrated circuits and how they can be employed in receivers for the reception of either amplitude or frequency modulated signals. The chapter on amplitude modulated (a.m.) receivers will be of most interest to those who wish to receive distant stations at only moderate audio quality, while the chapter on frequency modulation (f.m.) receivers will appeal to those who desire high fidelity reception.

REFERENCE

THE BEGINNER'S HANDBOOK OF ELECTRONICS
AB003 $9.45
An excellent textbook for those interested in the fundamentals of Electronics. This book covers all major aspects of power supplies, amplifiers, oscillators, radio, television and more.

ELEMENTS OF ELECTRONICS — AN ON-GOING SERIES
F.A. WILSON, C.G.I.A., C.Eng.,
BP62: BOOK 1. The Simple Electronic Circuit and Components $8.95
BP63: BOOK 2. Alternating Current Theory $8.95
BP64: BOOK 3. Semiconductor Technology $8.95
BP77: BOOK 4. Microprocessing Systems And Circuits $12.30
BP89: BOOK 5. Communication $12.30
The aim of this series of books can be stated quite simply — it is to provide an inexpensive introduction to modern electronics so that the reader will start on the right road by thoroughly understanding the fundamental principles involved.

Although written especially for readers with no more than ordinary arithmetical skills, the use of mathematics is not avoided, and all the mathematics required is taught as the reader progresses.

Each book is a complete treatise of a particular branch of the subject and, therefore, can be used on its own with one proviso, that the later books do not duplicate material from their predecessors, thus a working knowledge of the subjects covered by the earlier books is assumed.

BOOK 1: This book contains all the fundamental theory necessary to lead to a full understanding of the simple electronic circuit and its main components.

BOOK 2: This book continues with alternating current theory without which there can be no comprehension of speech, music, radio, television or even the electricity utilities.

BOOK 3: Follows on semiconductor technology, leading up to transistors and integrated circuits.

BOOK 4: A complete description of the internal workings of microprocessor.

BOOK 5: A book covering the whole communication scene.

BP85: INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE $12.25
ADRIAN MICHAELS
This book will help the reader to find possible substitutes for a popular user-orientated selection of modern transistors. Also shown are the material type, polarity, manufacturer selection of modern transistors. Also shown are the material type, polarity, manufacturer and use. The Equivalents are sub-divided into European, American and Japanese. The products of over 100 manufacturers are included. An essential addition to the library of all those interested in electronics, be they technicians, designers, engineers or hobbyists. Fantastic value for the amount of information it contains.

BP1: FIRST BOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES $2.80
B.B. BABANI
This guide covers many thousands of transistors showing possible alternatives and equivalents. Covers transistors made in Great Britain, USA, Japan, Germany, France, Europe, Hong Kong, and includes types produced by more than 120 different manufacturers.

BP14: SECOND BOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES $4.80
B.B. BABANI
The "First Book of Transistor Equivalents" has had to be reprinted 15 times. The "Second Book" produced in the same style as the first book, in no way duplicates any of the data presented in it. The "Second Book" contains only additional material and the two books complement each other and make available some of the most complete and extensive information in this field. The interchangeability data covers semiconductors manufactured in Great Britain, USA, Germany, France, Poland, Italy, East Germany, Belgium, Austria, Netherlands and many other countries.

TOWER'S INTERNATIONAL OP-AMP LINEAR IC SELECTOR
TAB No.1216 $13.45
This book contains a wealth of useful data on over 5,000 Op-amps and linear ICs — both pinouts and essential characteristics. A comprehensive series of appendices contain information on specs, manufacturers, case outlines and so on.

CMOS DATABOOK
TAB No.984 $14.45
There are several books around with this title, but most are just collections of manufacturers' data sheets. This one, by Bill Hunter, explains all the intricacies of this useful family of logic devices . . . the missing link in getting your own designs working properly. Highly recommended to anyone working with digital circuits.

MISCELLANEOUS

BP68: CHOOSING AND USING YOUR HI-FI $7.25
MAURICE L. JAY
The main aim of this book is to provide the reader with the fundamental information necessary to enable him to make a satisfactory choice from the extensive range of hi-fi equipment now on the market.

Help is given to the reader in understanding the equipment he is interested in buying and the author also gives his own opinion of the minimum standards and specifications one should look for. The book also offers helpful advice on how to use your hi-fi properly so as to realise its potential. A Glossary of terms is also included.

NEW

BP101: HOW TO IDENTIFY UNMARKED IC'S $2.70
K.H. RECORR
Originally published as a feature in 'Radio Electronics', this chart shows how to record the particular signature of an unmarked IC using a test meter, this information can then be used with manufacturer's data to establish the application.

NEW

SIMPLIFIED TRANSISTOR THEORY
TRAINING SYSTEMS, INC. AND LEVINE
HB20 $10.25
This book is designed to provide thorough comprehension of the physical theory and basic operating principles of transistors and transistor circuits. The book assumes no previous knowledge of the subject other than an understanding of basic electricity.

The information is presented in a series of brief, logically-developed steps, or frames—over 400 in all. A concluding summary section provides both a concise review and a convenient reference source for future use.

NEW

BASIC TELEPHONE SWITCHING SYSTEMS
TALLEY
HB27 $15.25
The Revised Second Edition of this book, for trainee and engineer alike, includes updated statistical data on telephone stations, and new and improved signalling methods and switching techniques. It also includes E & M signaling interface for electronic central offices and automatic number identification methods used in step-by-step, panel and crossbar central offices.

NEW

INTERRELATED INTEGRATED ELECTRONICS CIRCUITS FOR THE RADIO AMATEUR, TECHNICIAN, HOBBYIST AND CB'ER
MENDELSON
HB29 $11.35
This book provides a variety of appealing projects that can be constructed by anyone from the hobbyist to the engineer. Construction details, layouts, and photographs are provided to simplify duplication. While most of the circuits are shown on printed circuit boards, every one can be duplicated on hand-wired, perforated boards. Each project is related to another projects so that several may be combined into a single package. The projects, divided into five major groups, include CMOS audio modules, passive devices tohelp in benchwork, test instruments, and games.

NEW

BASIC CARRIER TELEPHONY, THIRD EDITION
TALLEY
HB28 $14.45
A basic course in the principles and applications of carrier telephony and its place in the overall communications picture. It is abundantly illustrated, with questions and problems throughout, and requires a minimum of mathematics.

ROBOTICS

THE COMPLETE HANDBOOK OF ROBOTICS
TAB No.1071 $13.45
All the information you need to build a walking, talking mechanical friend appears in this book. Your robot can take many forms and various options — light, sound, and proximity sensors — are covered in depth.

HOW TO BUILD YOUR OWN SELF PROGRAMMING ROBOT
TAB No.1241 $13.45
A practical guide on how to build a robot capable of learning how to adapt to a changing enviroment. The creature developed in the book, Rodney, is fully self programming, can develop theories to deal with situations and apply those theories in future circumstances.

BUILD YOUR OWN WORKING ROBOT
TAB No.841 $11.45
Contains complete plans — mechanical, schematics, logic diagrams and wiring diagrams — for building Buster. Buster is a sophisticated experiment in cybernetics you can build in stages. There are two phases involved: first Buster is leashed, dependent on his creator for guidance; the second phase makes Buster more independent and able to get out of tough situations.

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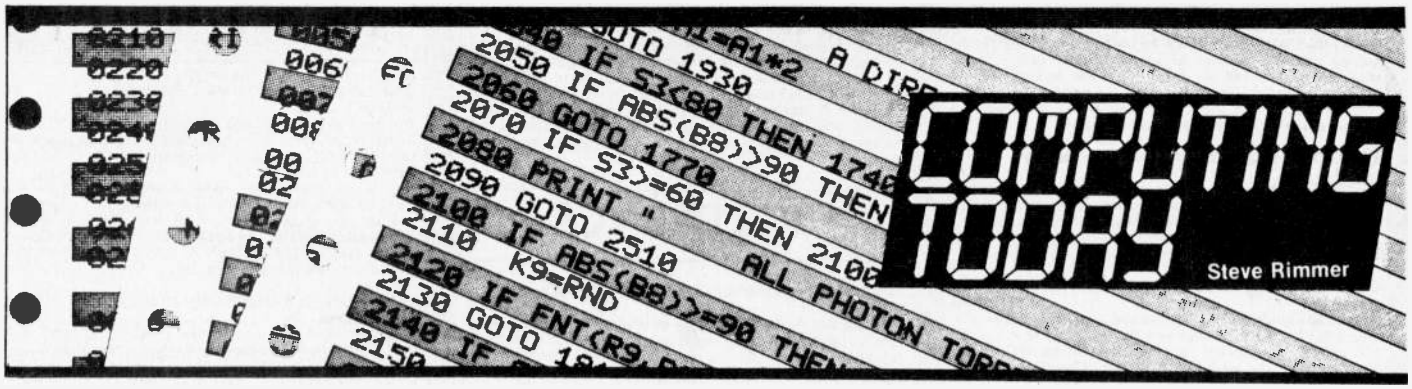

AH, THE JOYS of PET computers, the older the better. They surely mellow with age, like a fine bottle of home made gin. This month, a celebration of the techniques of confusing a PET. We place before you three machine language utilities for the unadorned 8K PET 2001; they'll also work on most other CBM machines with some modifications.

All three programs reside in the second cassette buffer, beginning at decimal location 826 (hex 33C), and SYS826 activates them. Since the essence of true PET karma is trying to figure out what an undocumented routine does, we're not going to get heavily into explaining these; enjoy them as they stand, or get out the code book and pick them apart if you feel industrious.

Repeat Key

There are actually two versions of this program here; the source code listing lives in the cassette buffer, while the little block of op is actually the same routine relocated up in high memory; you'll want to adjust the pointers in locations 134 and 135 if you use this second version so BASIC doesn't trample it. Any key held down will be repeated until you release it.

```
03A4:  78        SEI
03A5:  AD 19 02  LDA  $0219
03A8:  49 32     EOR  =$32
03AA:  8D 19 02  STA  $0219
03AD:  AD 1A 02  LDA  $021A
03B0:  49 E5     EOR  =$E5
03B2:  8D 1A 02  STA  $021A
03B5:  58        CLI
03B6:  60        RTS
03B7:  AD 23 02  LDA  $0223
03BA:  C9 FF     CMP  =$FF
03BC:  F0 0B     BEQ  $03C9
03BE:  AD FF 03  LDA  $03FF
03C1:  F0 0E     BEQ  $03D1
03C3:  38        SEC
03C4:  ED 27 02  SBC  $0227
03C7:  B0 02     BCS  $03CB
03C9:  A9 09     LDA  =$09
03CB:  8D FF 03  STA  $03FF
03CE:  4C 85 E6  JMP  $E685
03D1:  20 EF 03  JSR  $03EF
03D4:  A2 0A     LDX  =$0A
03D6:  A4 FF     LDY  $FF
03D8:  AD 23 02  LDA  $0223
03DB:  C9 FF     CMP  =$FF
03DD:  F0 0A     BEQ  $03E9
03DF:  88        DEY
03E0:  D0 F6     BNE  $03D8
03E2:  CA        DEX
03E3:  D0 F1     BNE  $03D6
03E5:  CA        DEX
03E6:  8E 03 02  STX  $0203
03E9:  20 EF 03  JSR  $03EF
03EC:  4C 85 E6  JMP  $E685
03EF:  A2 DF     LDX  =$DF
03F1:  EC 40 E8  CPX  $E840
03F4:  30 FB     BMI  $03F1
03F6:  A4 E2     LDY  $E2
03F8:  B1 E0     LDA  ($E0),Y
03FA:  49 80     EOR  =$80
03FC:  91 E0     STA  ($E0),Y
03FE:  60        RTS
```

```
      0  1  2  3  4  5  6  7
1FA4  78 AD 19 02 49 32 8D 19
1FAC  02 AD 1A 02 49 F9 8D 1A
1FB4  02 58 60 AD 23 02 C9 FF
1FBC  F0 0B AD FF 1F F0 0F 38
1FC4  ED 27 02 B0 02 A9 09 8D
1FCC  FF 1F 4C 85 E6 20 EF 1F
1FD4  A2 0A A4 FF AD 23 02 C9
1FDC  FF F0 0A 88 D0 F6 CA DC
1FE4  F1 CA 8E 03 02 20 EF 1F
1FEC  4C 85 E6 A2 DF EC 40 E8
1FF4  30 FB A4 E2 B1 E0 49 80
1FFC  91 E0 60
```

Quicker DATA

This program allows you to partially RESTORE your DATA. If you have several lines of DATA, RESTORE#n, where n is the line number of one of the DATA statements will set the DATA reading pointer back to the first element in the designated line. Freaks you right out.

The BASIC loader with all the DATA statements in it will POKE the code, shown as source here, into the cassette buffer. The sample program illustrates the astounding capabilities of this great leap forward in Western civilization.

```
033A  A5 79     LDA$79
033C  49 85     EOR#$85
033E  85 79     STA$79
0340  A5 7A     LDA$7A
0342  49 77     EOR#$77
0344  85 7A     STA$7A
0346  A5 7B     LDA$7B
0348  49 B3     EOR#$B3
034A  85 7B     STA$7B
034C  60        RTS
034D  C9 8C     CMP#$8C
034F  F0 07     BEQ$0358
0351  C9 3A     CMP#$3A
0353  B0 F7     BCS$034C
0355  4C 7D 00  JMP$007D
0358  A0 00     LDY#$00
035A  20 70 00  JSR$0070
035D  B1 77     LDA($77),Y
035F  C9 23     CMP#$23
0361  F0 0C     BEQ$036F
0363  38        SEC
0364  A5 28     LDA$28
0366  E9 01     SBC#$01
0368  A4 29     LDY$29
036A  20 8C 03  JSR$038C
036D  D0 18     BNE$0387
036F  20 70 00  JSR$0070
0372  20 73 C8  JSR$C873
0375  20 2C C5  JSR$C52C
0378  B0 03     BCS$037D
037A  4C EB C7  JMP$C7EB
037D  38        SEC
037E  A5 5C     LDA$5C
0380  E9 01     SBC#$01
0382  A4 5D     LDY$5D
0387  68        PLA
0388  68        PLA
0389  4C C4 C6  JMP$C6C4
038C  B0 01     BCS$038F
038E  88        DEY
038F  85 3E     STA$3E
0391  84 3F     STY$3F
0393  60        RTS
```

```
SYS 826:
10 DATA 10
20 DATA 20
30 DATA 30
40 DATA 40
50 RESTORE#30
60 READ A
70 PRINT A
30
```

```
 10 FOR I=826 TO 915
 20 READ A
 30 POKE I,A
 40 NEXT
 50 DATA165,121,073,133,133,121,165,122
 60 DATA073,119,133,122,165,123,073,179
 70 DATA133,123,096,201,140,240,007,201
 80 DATA058,176,247,076,125,000,160,000
 90 DATA032,112,000,177,119,201,035,240
100 DATA012,056,165,040,233,001,164,041
110 DATA032,140,003,208,024,032,112,000
120 DATA032,115,200,032,044,197,176,003
130 DATA076,235,199,056,165,092,233,001
140 DATA164,093,032,140,003,104,104,076
150 DATA196,198,176,001,136,133,062,132
160 DATA063,096
```

Mad Artist

This routine is useful (somewhat) for composing pictures out of PET graphics. It shifts the keyboard, making the symbols more accessible, and de-activates the RETURN so you don't keep getting "SYNTAX ERROR" all over your pretty pictures.

```
033A  AD 0D 02  LDA  $020D
033D  8D 24 02  STA  $0224
0340  F0 F8     BEQ  $033A
0342  AD 27 02  LDA  $0227
0345  D0 0B     BNE  $0352
0347  EE 27 02  INC  $0227
034A  A4 E2     LDY  $E2
034C  B1 E0     LDA  ($E0),Y
034E  49 80     EOR  =$80
0350  91 E0     STA  ($E0),Y
0352  20 E4 FF  JSR  $FFE4
0355  C9 8D     CMP  =$8D
0357  D0 01     BNE  $035A
0359  60        RTS
035A  49 80     EOR  =$80
035C  20 D2 FF  JSR  $FFD2
035F  18        CLC
0360  90 D8     BCC  $033A
```

```
10 FORA=826TO866 READ B POKEA,B NEXT
100
120 DATA 173,13,2,141,36,2,240,248,173,39,2,208,11,238
140 DATA 39,2,164,226,177,224,73,128,145,224,32,228,255
160 DATA 201,141,208,1,96,73,128,32,210,255,24,144,216,234
```

Scroll

Eastern House Software is offering a somewhat useful thingy to users of Commodore machines (PETs, CBMs and VICs). For six dollars U.S. you can have a copy of "Scroll", a utility which permits scrolling through BASIC text. It also provides repeat key functions while it's running. Works real good (we got one). All they ask, in addition to this small wad of pelf, is that the proud owner of Scroll make five copies of their ad and mail them to friends so they don't have to spring for advertising.

If you pop for Scroll, be sure to tell them exactly what kind of machine you are using, as there are slightly different Scolls for each Commodore incarnation. Eastern House Software, 3239 Linda Drive, Winston-Salem, N.C. 27106.

ETI

ETI ORDER FORM

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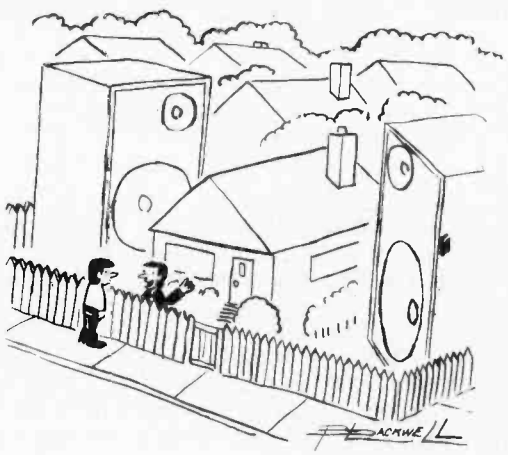

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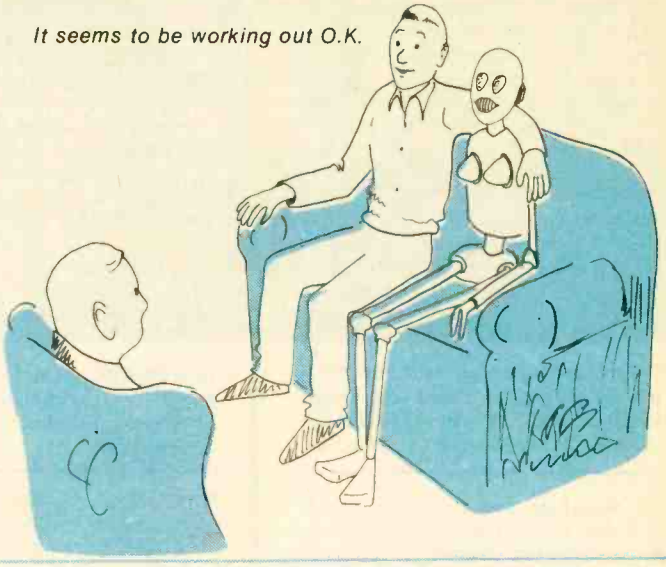
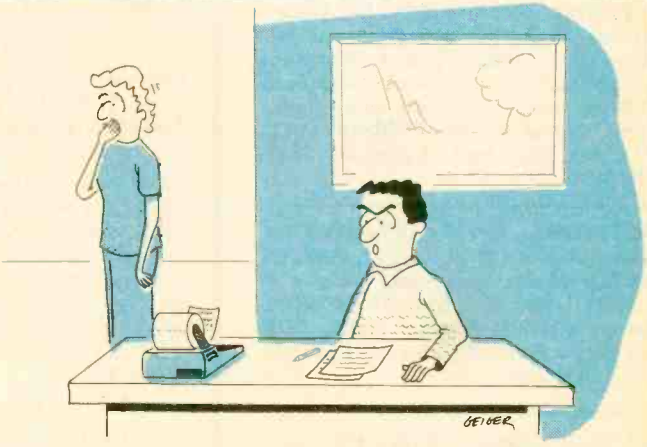
The Fun of Electronics

The neighbours' committee has come up with two possible courses of action. The first is to ask you to stop your ham radio from interfering with our TV reception.

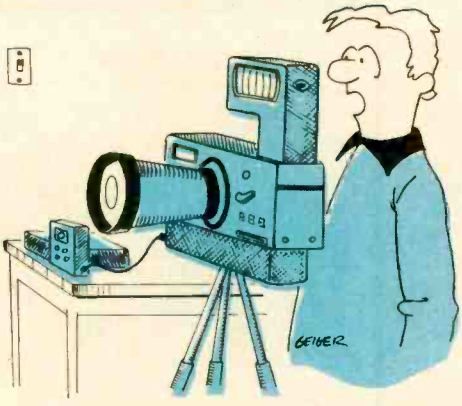


It seems to be working out O.K.

Philip's never been quite the same since he built that robot!

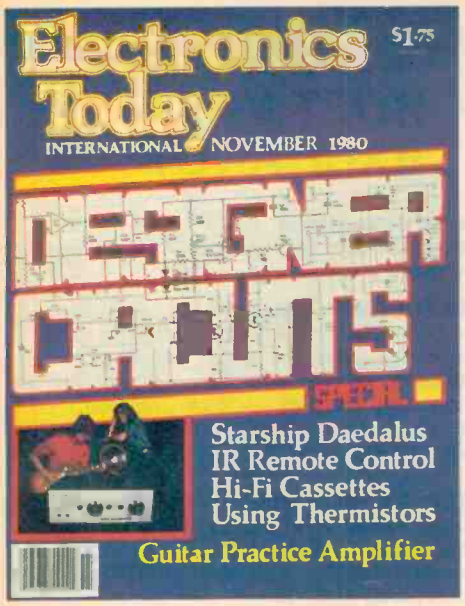


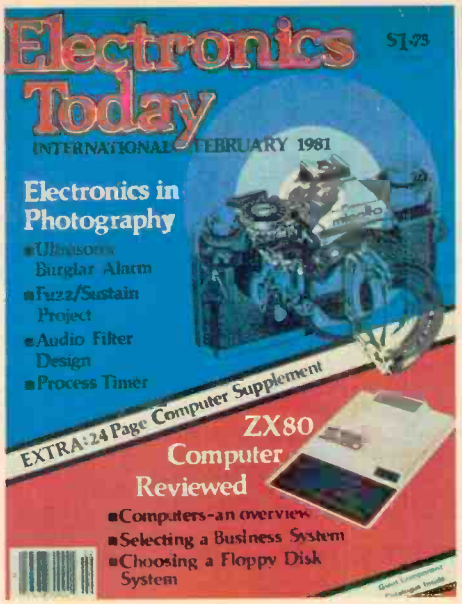
What's this roll of toilet paper doing in my adding machine, and where's my expensive calculator paper?



We have to take the pictures over again. I was so busy working the automatic light meter, the digital shutter speed control, the ultrasonic focuser and the electronic flash, that I forgot to take the lens cap off.

Don't look now, but I think Fred finally got his degree.





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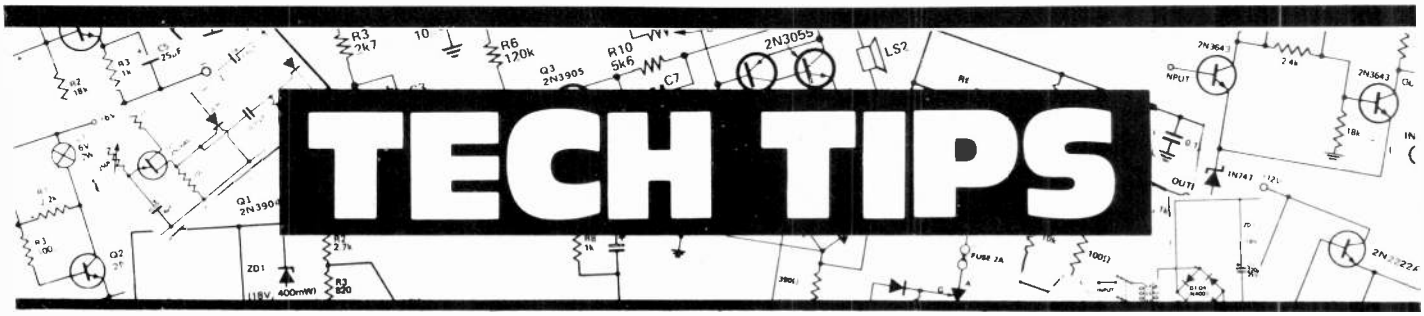


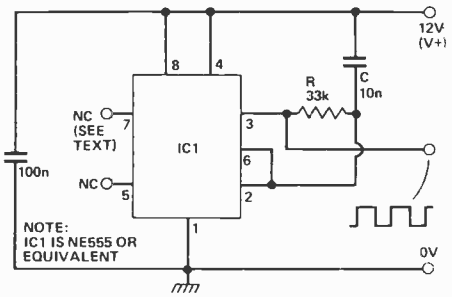
Surgeless 555 Clock

H.B. Broughton

The CMOS version of the 555 has two major advantages over the bipolar type: a) it is a micropower device; b) it is largely free of the supply current surges generated by an ordinary 555 every time its output changes state. This is important because the surge can upset other circuits powered from the same supply, but the problem can be avoided by using the rather unusual configuration shown, saving 60¢ an oscillator over the CMOS answer to this difficulty!

Experiment has shown that the supply surge (typically 300 mA by 100 ns) is roughly halved by using pin 3 (OUTPUT) of the 555 to charge/discharge the capacitor rather than pin 7 (DISCHARGE) and a resistor to V+, and is then small enough to be removed by a 100 nF capacitor between the supply rails.

This gives the circuit shown, a 'surgeless' clock with frequency



$f = 6RC$ (R in ohms, C in microfarads), mark/space ratio of typically 3:2, and voltage swing of 1 to 11V. These figures were found using a load impedance of 330k; the frequency is affected if load impedance is less than about 10 x R, but if low impedances are to be driven, pin 7 can be used and the load wired from pin 7 to power: alternatively, a 1k5 resistor can be taken from pin 7 to power and the load put between pin 7 and ground, though this reduces the available voltage swing at pin 7.

With the component values shown, this clock runs at 2 kHz and produces a nice clean square wave with low rise times.

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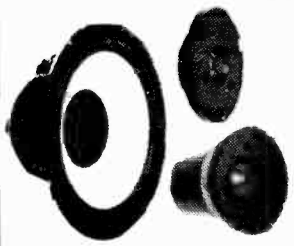
SAVE OVER 50% ON SELECTED PHILIPS SPEAKERS

Philips Speakers



PHILIPS SPEAKERS. Gladstone Electronics has long been known for its extra low prices on Philips speakers. Now save even more with our Summer Speaker Sale! Limited time, limited quantity. "MSL" refers to manufacturer's suggested list price and is given for reference only.

TWEETERS

4" textile dome tweeter. 6 oz. magnet. 40 watts power. Response 1300-22000 Hz. Model AD0141T8. 8 ohms. MSL $20.50 **SALE $9.95.**

4" textile dome tweeter with diamond cut cast-aluminum mounting plate. 10 oz. magnet. Handles 50 watts. Philips best tweeter. 8 ohms. Model AD01635T8. MSL $65.00 **SALE $19.95.**

4" Exposed dome tweeter. With wide radiating pattern due to flat front and forward dome. Response 2000-22000 Hz. 50 watts. Model AD01605T8. MSL $25.90 **SALE $12.95.**

MIDRANGE

Textile dome midrange in self-enclosed case. Very wide radiating pattern. Response 550-5000Hz. 60 watts. Model AD02110SQ8. MSL $50.30 **SALE $24.95.**

WOOFERS

12" 70 watt RMS (120 watt maximum) woofer with 40 oz. magnet, 2" voice coil. Foam surround. One of our best selling speakers at a reduced price! Model AD12249W8. MSL $93.20 **SALE $49.95.**

7" Woofer/midrange handles 40 watts, response 60 - 3000 Hz. Resonant frequency 45 Hz. Ideal for compact or auto systems. Model AD70650/W8. MSL $41.60 **SALE $22.95.**

5" Woofer handles 15 watts RMS for excellent sound from a mini sized box. Model AD5060/W8. MSL $27.40 **SALE $13.95.**

CROSSOVERS

2-way 30 watt crossover. 3000 Hz. Model ADF3000/8. MSL $11.70 **SALE $6.95.**
3-way 65 watt crossover. 500 and 4500 Hz. Model ADF500/4500. MSL $23.00 **SALE $11.95.**
3-way 150 watt crossover. 700 and 3600 Hz. Model AD3WXSP. MSL $49.95 **SALE $29.95.**

Motorola

Piezo Ceramic Tweeters

No crossover network required. Handle up to 100 watts RMS. No magnets. No voice coils. High reliability.
3 ½" Square Front Mount horn. 4-27KHz response. Ideal for hifi and sound reinforcement. KSN1005. **$14.95.**
7" x 3¼" wide dispersion horn. 1.9 - 40KHz. KSN1025 **$26.95.**

KEF

Loudspeakers. If you're serious about sound .... we recommend KEF loudspeakers. Backed by a ten-year warranty. KEF products make use of superior materials (i.e. becstryne cones) backed up by constant tests and greater care.
8" Woofer. 50 watts RMS. Response 25-3500 Hz. **Model B200 $59.95.**
9" x 13" Woofer. An unusual design, still unequalled for performance after nearly 15 years on the market. Superb for reflex and transmission line systems. Response 20-1000 Hz. **Model B139. $129.95.**
5" Woofer/midrange. A remarkable speaker for use as a midrange in a three-speaker system, or as a woofer for compact systems (as used in LS3/5A). 50 watts. Response 55-3500 Hz. Model **B110. $54.95.**
4" Dome tweeter with superior imaging and dispersion characteristics. Response 3500-40,000 Hz. **Model T27 $39.95.**

AUDAX

HD 12x9 D 25

SOFT DOME TWEETERS:

Audax dome tweeters utilize a specially developed synthetic dome material for ruler straight response. Used by manufacturers all over the world in production.

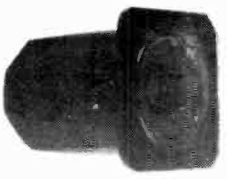
RECTANGULAR:

Response of 550hz-20Khz, will handle 50W. but is usable over 800Hz. Sens. is 89db. HD12X9D25: **$28.00**

MHD12 P 25

ROUND:

Response as above, but rated at 30 Watts. Sens. is 91.5 db. HD100D25HR: **$24.56**
A higher power version of above, rated at 50W. Response is 750 to 20Khz. Magnet weight is .725Kg. (almost 2 pounds!) Super high sens. of 92.5 makes it useable for any application. HD13D34H: **$64.56.**



HIF 87 B SQ

SOFT DOME MID-RANGE:

The highest quality dome midrange we have encountered! Operates in the 440hz-17.5Khz range; rated at 50W. Sens. is 89 db. HD13D37R: **$63.00.**

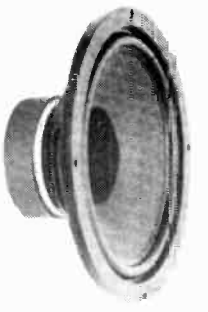
PAPER MID-RANGE:

A 3.5" linear mid-range speaker, operating form 130-11Khz, for 20W app. HIF87BSQ: **$18.00**
Sub-enclosure (mounts on back for Isolation) **$11.75.**
A 5" mid. offering foam surround. Operates in the 220-12.5Khz range, handles 50W, includes sub-enclosure. MHD12P25FSM: **$49.50.**

MHD 21 B 37 R 2

HEAVY DUTY WOOFERS:

First choice for automotive use, and for rugged applications. Both handle 30W, @ 88db.
5" With foam surround, operates from 80-5.5Khz. HIF13JSM2CA12: **$36.00.**
8" version with rubber surround. Operates from 51-5.6Khz. HIF20HSCA12: **$59.00**



HIF 20 HSC 2 CA

BEXTRENE WOOFERS:

6.5" rated for 30W with a 348g. magnet. Operates 86-8.8Khz, @ 86.8 db. HIF17JS: **$39.50**
A heavy duty magnet version of above (.725Kg.) Operates from 50-6.4Khz, @ 84 db. HD17B25H2CA12: **$61.00**
The world famous Audax 8"! Rated 30W, with esp. of 46-5.6Khz @ 89 db. Mag. weight is .560Kg. MHD21B37T2CA12: **$99.50.**
An incredibly smooth 10" woofer with a .870Kg magnet! Fundamental res. is a low 23 Hz, and is most linear from 55-3Khz. Takes 50W, @ 92.6db. HD24B45T: **$117.00.**
All frequency measurements are taken at -4db from flattest part of the manufacturer's published data.

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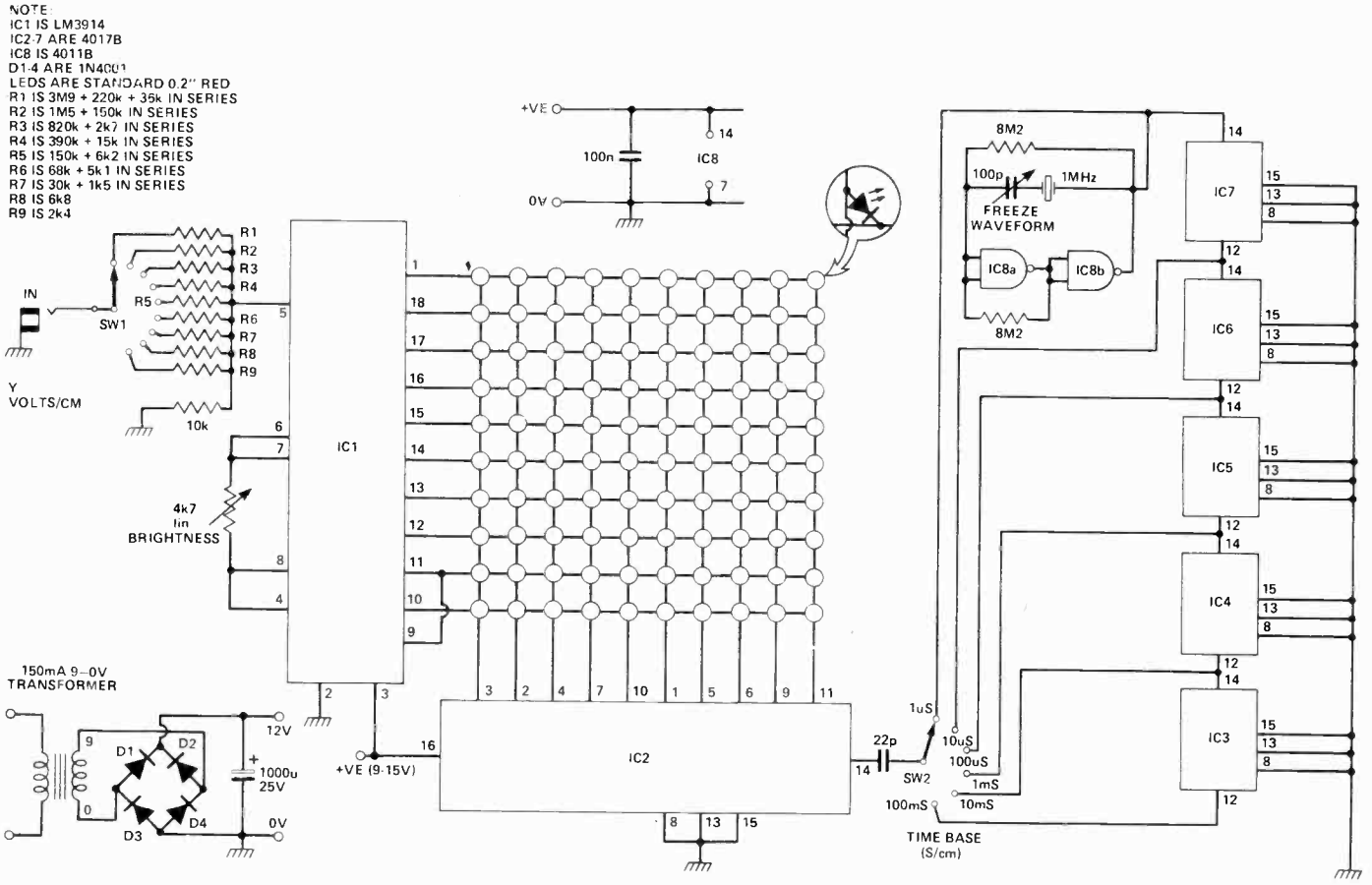
Solid State Scope Using LEDs

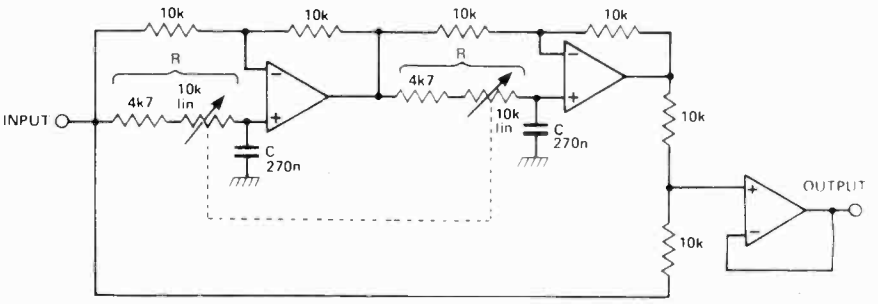
G. Durant

This 'scope' is completely solid state, with the absence of the cathode ray tube. The tube is replaced by a 10 by 10 matrix of LEDs which provide a smaller, more robust substitute. The Y input is connected via a series resistor to IC1, an LM3914 which is an LED bargraph driver. The IC is used in the dot mode and therefore, if a waveform is applied to the Y input, a single 'dot' will appear to move up and down with the voltage from the wave. Input sensitivity is adjusted via SW1, which brings different series resistors into circuit. The resistors are odd values and are made up by placing two or three in series. If 1% resistors are used, an accuracy of about 0.25% can be achieved.

The LEDs must be spaced 1cm apart, both on the X and Y axis. The use of an LED matrix screen means that the scope can be very thin, in fact pocket-size. Also, an LED screen does not need very high voltages to work it, so batteries could be used. The only problem is that at high frequencies the resolution is not as good as it could be, although the scope can be used nevertheless at frequencies up to 1 MHz.



Notch filter



The time base uses a crystal-controlled CMOS clock running at 1 MHz. This is broken down into lower frequencies by a string of divide-by-10 chips, in this case 4017s. These frequencies go to a six-way selector switch which selects the timebase frequency. The time base is variable from 100 mS right down to 1 uS in steps of 10. A 100pF variable capacitor, marked 'freeze waveform', is used to fine-tune the main oscillator, so the waveform can be frozen.

The scope can be expanded to use more LEDs, or to have a trigger device. For the beginner, however, the scope shown would be sophisticated enough to be of great service.

An audio notch filter has many and varied applications. This circuit will provide a very 'deep' (high attenuation) notch in the input-to-output response at a frequency set by the vlaue of the ganged-pot sections. With the circuit values shown, it is tuneable over a range from about 40 Hz to 125 Hz. Varying the value of C will shift the range up or down the audio spectrum. If you use internally compensated op-amps then no extra frequency compensation will be required. Types such as the NE5534 (N or AN) or TL071 are suitable, or multi-op-amp packs such as the LM324 or TL074 may be employed. Note that C should be a good-quality film or polycarbonate capacitor.

ILP POWER AMPLIFIERS

- State-of-the-art performance
- Built-in heatsinks
- Encapsulated circuitry
- No external parts required
- Five-year warranty

MOSFET AMPLIFIER MODULES:

60, 120 and 240 watt amplifier utilizing the latest technological advance in audio . . . the MOSFET. They provide faster slew rate and complete absence of crossover distortion. They are immune to thermal runaway, increasing long term reliablity and eliminating the need for complicated protection circuitry which can add distortion. Can operate into complex loads

PERFORMANCE SPECIFICATIONS:

Frequency response — 15 Hz — 100 KHz (– 3 db). THD (Typical at 1 KHz) — 0.005%. IM (60 Hz and 7 KHz sinewave, 4:1 ratio) — .006%. S/N Ratio (DIN standard) — 100 db. Slew rate — 20 V/uS. Rise time — 3 uS. Input sensitivity/impedance — 500 MV/100k ohm. Output impedance — 4 ohms to infinity. Damping factor — 400.

MOS120 60 watt MOSFET Power Amplifier (8 ohms)	$ 95.00
MOS200 120 watt MOSFET Power Amplifier (8 ohms)	$162.00
MOS400 240 watt MOSFET Power Amplifier (40 hm)	$252.00

POWER SUPPLIES

PSK1. For 1 or 2 HY60	$44.95
PSK2. For 1 or 2 HY120/HD120	$64.95
PSK3. For 1 HY200/400/HD200/400	$73.95
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"BRIDGING" MODULE Combines output of any two same model ILP module. FP480. $25.00

5-YEAR WARRANTY CABINET

Attractive, rugged, professional 19" rack-mount cabinet for easy assembly of your ILP amplifier system. Amplifier modules (2 of) mount on pre-cut back panel. Power supply unit mounts inside chassis. Complete assembly and wiring is a breeze, taking about one hour! Specify which amplifier you will be using: HY120, HY200, HY400, MOS120, MOS200 or MOS400.

L1905 ILP CABINET. $49.95
Backplates (Specify modules) $9.95

BIPOLAR AMPLIFIER MODULES

Choose from five modules, all featuring built-in heatsinks, fully protected circuitry, five simple connections, and five year warranty.

PERFORMANCE SPECIFICATIONS:

Frequency response — 15 Hz — 50 KHz (– 3 db). THD (Typical at 1 KHz) — 0.1%. IM Distortion — 0.006%. S/N ration — 100 db. Slew rate — 15V/uS. Rise time — 5 uS. Input sensitivity/Impedance: 500 Mv/100 Kohms. Damping factor — 400. Power rated into 8 ohms (except HY400 rated into 4 ohms).

HY30 (15 watts RMS)	$29.95
HY60 (30 watts RMS)	$34.95
HY120 (60 watts RMS)	$67.50
HY200 (120 watts RMS)	$93.50
HY400 (240 watts RMS)	$117.50
FP480 "Bridges" 2 HY400s for 480 watts RMS at 8 ohms.	$25.00

SOUND INSTALLERS & DEALERS: Contact us for quantity purchase prices.

HEAVY DUTY Similar in performance to Bipolars, with additional circuitry making them totally short-proof! Recommended for professional sound applications, instruments, etc.

HD120	60 watts RMS into 8 ohms	$ 79.95
HD200	120 watts RMS into 8 ohms	$ 99.95
HD200	240 watts RMS into 4 ohms	$144.50

Compact and versatile preamps and mixers for every audio application!

These modules are complete in cases and include latest design clip-on edge connectors. Save you time and money and give excellent performance. All modules fully compatible with each other and with ILP power amplifiers and power supplies. Typical performance of all types include frequency response 15 Hz - 50 KHz, distortion typically less than 0.005% (at 1 KHz), and signal/noise ratjon better than 80 db. Modules HY6 to HY13 measure 1¾ x ¾ x 1¾". HY66 to HY77 measure 3½ x ¾ x 1¾". Complete connection data provided. All modules operate from ± 15V to ± 30V maximum.

HY6 Mono PreAmp. Mic/Mag. cartridge/Tuner/Tape/Aux + Volume/Bass/Treble. 10 mA. $25.95

HY7 Mono Mixer. To mix eight signals into one. 10 mA. $24.95

HY8 Stereo Mixer. Two channels, each mising five signals into one. 10 mA $28.95

HY9 Stereo Preamp. Two channels mag. cartridge/Mic + Volume. 10 mA. $31.95

HY11 Mono Mixer. To mix five signals into one + Bass/Treble controls. 10 mA. $33.95

HY12 Mono Preamp. To mix two signals into one + Bass/Midrange/Treble. 10 mA. $31.95

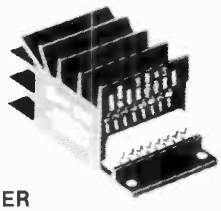
HY13 Mono VU Meter. Programmable gain. LED overload driver (meter not included). 10 mA. $28.95

HY66 Stereo Preamp. Mic/Mag. carridge/Tape/Tuner/Aux + Volume/Bass/Treble/Balance. 20 mA. $59.95

HY67 Stereo Headphone Amplifier. Will drive headphones in the range of 4 ohm - 2K ohm. 80 mA. . . $59.95

HY68 Stereo Mixer. Two channels, each mixing 10 signals into one. 20 mA. $37.95

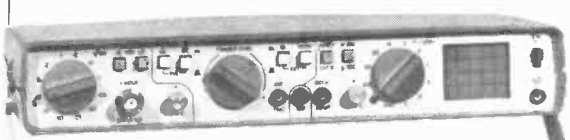
HY69 Mono Preamp. Two input channels of mag. cartridge/Mic + Mixing/Volume/Treble/Bass. 20 mA. $49.95



Model C15 Autosound
15 WATT AMPLIFIER

Finally clean power for your car! 15 watts RMS at 0.1% THD. Use as either booster amp or booster! 12VDC required. Built-in heatsinks. 5 year warranty! $39.95.

2" Oscilloscope



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Sweep Speeds	0.1 μsecs/division to 0.5 secs/division
Power Requirements	4 to 10VDC from 4 'C' cells or AC adaptor
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