Electronics Today

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MM70924

April 1987

Canada's Magazine for Electronics & Computing Enthusiasts

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BEST Computers

Made in Canada, IBM PC, XT & AT Compatible

FREE:
$395 ATI Graphics Solution Card with ALL BEST Computers
Dual Function Video: Hi-Res Monochrome and Colour. (Substitutes regular boards). See our new catalogue for full specs. Time Limited Offer.

Monitor not included.
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WARRANTY We have such confidence in the reliability of the BEST that we offer a full One Year Warranty. This far exceeds the 90 day industry standard. On-site service plan is available across Canada at extra cost through 3M of Canada Ltd.

Features common to BEST MK II, MK III & MK IV

- Superb IBM PC & XT Compatibility
- Canadian Made
- 256K RAM Standard minimum (uses 41256K RAM chips)
- Expandable on board to 640K RAM
- Parallel Port (for printer)
- Serial Port (for communications)
- Real Time Clock/Calendar (with Battery Backup)
- Presocketed for optional co-processor — such as 8087 Math Processor
- IBM Compatible Keyboard
- Reset Switch
- Phoenix BIOS as used in many major brand IBM compatible systems.
- 150 Watt Power Supply which will handle a Hard Drive without upgrade.
- 7 Slots
- Flip top case
- 2 Slimline DS,DD 5¼", 360K Disk Drives
- Colour Video (RGB & Composite) Board or Hi-Res Monochrome Card (customer choice)
- Disk Controller Board
- CSA Approved

$1000 off Advertised price

We will deduct $1000 off the price of an AVT286 with 40Meg HD (or any more loaded system with HD, including AVT10 systems) with the trade in of any complete 2-disk drive IBM or Compatible PC/XT (including PCjr) system.

$500 off Advertised price

$500 will be given off the price of BEST MkIV with 20Meg HD (or more loaded models, including AVT286 and AVT10 models with HD) with the trade in of any complete 2-disk drive Apple II, II+, IIe, IIc or compatibles or any IBM or compatibles listed above.

Offer open February 14, 1987 to March 31, 1987. In both above offers, only one trade-in per system is permitted.

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$1695.00
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Leasing Plan Available

4.77/8MHz DUAL SPEED

The FAST BEST MK III

As BEST MK II plus speed selectable: 4.77 and 8MHz (most software will run on the higher speed), uses 8088-2 processor.

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ULTRA FAST

SUPER-FAST BEST MK IV

As BEST MK III plus TRUE 16-Bit machine, 8086-2 processor, IBM compatible 8-Bit I/O channel bus, even faster than MK III due to 16-Bit architecture. With 640K standard.

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Other Configurations:
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The BEST Mk IV Main board processes data approx. 2.1 times faster than the IBM PC/XT or BEST Mk II.

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As Basic Configuration with fast stepping Hard Drives:
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BEST 1200/300 Plug-In-Modem ..... $ 249
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- 2Meg RAM
- Up to 4 Meg RAM on Board

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Superb IBM AT compatibility plus more:
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- (2) 5¼" disk drives (1 high density 1.2 meg, one standard 360K).
- Serial and parallel ports, high quality, keyboard, keyboard lock and status monitor.

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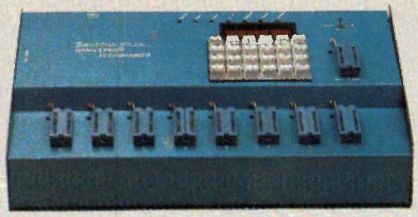
Circle No. 1 on Reader Service Card

Spectacular Gang EPROM Programmer & Emulator



Totally self-contained (has its own display, entry keypad and power supply).

Based on the Z-8 microprocessor.

Can program up to 8 EPROM simultaneously (anywhere from one to 8 EPROMs at the same time with the information in its own memory or master EPROM).

The Gang Programmer can handle a wide selection of EPROMs: 2716, 2732, 2732A, P2732A, 2532, 2764, 27128, 27128A and optionally upgradeable to handle 27256, 27512, 2758 and 2724.

Complete package with EPROM Emulator, 8 ZIF sockets, Gang Programmer with 16Kx8 of RAM and RS232. ..... **$995.00**

Gang EPROM Programmer with 8 ZIF sockets, 16Kx8 RAM and RS232, without Emulator **$695.00**

EMPROM Programmer with only one ZIF socket, 16Kx8 RAM and RS232, without Emulator. Able to do all the functions describe but can handle only one EPROM at a time **$499.00**

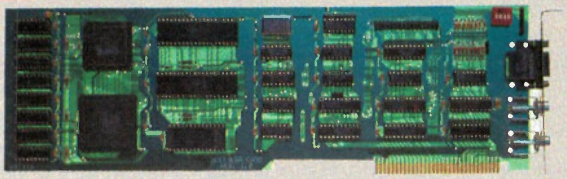
The BEST EGA - Enhanced Graphics Adapter

The BEST EGA card has several modes of video operation available on one card. 100% IBM EGA compatible: 640 x 350 pixels in 16 colours on the enhanced colour display.

✓ It supports functions of the IBM Colour graphics video adaptor and IBM monochrome display adaptor; 320 x 200 and 640 x 200 16 colour graphics on the colour graphics monitor; 640 x 350 four shade graphics on the monochrome display (black, normal, intensified and blank); flicker free display; split alphanumeric mode screen display; bit mapped graphics in four planes; up to 512 characters that can be user defined.

The BEST EGA card comes standard with 256K memory for flicker free, text and bit mapped graphics.

$299.00



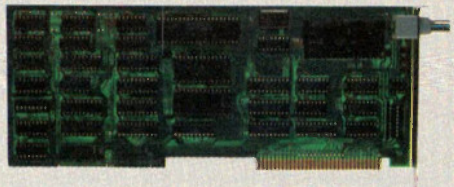
NIC Network Interface Card

The BEST NIC card allows any PC/XT or AT compatible system to operate in a network environment that supports the ArcNet topology. The BEST NIC uses the Standard Microsystems single chip ArcNet controller and LAN Transciever chip to conform to all ArcNet protocol requirements.

The NIC Card can be used with many versions of Advanced Novell Netware, as well there is space on the card for user installed firmware, which allows the card to work in a Waterloo Port environment. The User Installed firmware can also eliminate the need for floppy drives in the workstations, with the use of a Boot Prom.

The BEST NIC card has 3 LEDs mounted on the rear bracket to indicate network, and token passing activity. Also accessible from the rear of the system are network address selection switches, which allows the network address to be changed without opening the system case.

$299.00



EPROM PROGRAMMER (IBM COMPATIBLE)

MAIN EPROM PROGRAMMER CARD (WITH SOFTWARE)
With 2 standard EPROM sockets ..... **$ 99.00**

EPROM PROGRAMMER WITH ZIF SOCKETS (WITH SOFTWARE)
With one 24-pin. ZIF socket and one 28-pin ZIF socket with provision for serial port **$139.00**

EXTERNAL CARD
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720 x 348 Resolution • 12" Anti Glare Viewing Area

$169.00

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12" diagnoal screen • glare amber display • PC monochrome input (TTL) • 25 lines x 80 characters • 720 x 350 pixels • IBM PC & compatibles.

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12in. diagonal screen • non-glare green display • composite input • 25 lines x 40/80 characters

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13" Anti Glare Viewing Area **$499.00**

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Green/Amber/Full Colour Display Switch ... **$599.00**

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Scorpion External 60 MB Tape With Controller
Complete with FastBack Software **$1395.00**

Tallgrass units available now. Please call for current prices.

BEST MODEM

The BEST modem is a smart 1200/300 direct connect modem. It can either be a stand-alone unit in which case it requires a small wall adaptor, or it plugs in one of the IBM slots. When used as a stand alone unit, the modem looks like a Hayes 1200 Smart Modem, that is, it emulates the same instruction set. When it is used in the IBM, it looks like an intelligent serial communictions port which also supports a super-set of the Hayes instruction set.

The modem supports auto-dial, auto-answer, and auto-speed select directly from software control. The modem also has a speaker so that aural monitoring of the call is possible. There are also LED monitors so that the state of the modem can always be known. These LEDs are: Modem Ready, Auto-Answer enabled, Carrier Detected, Transmitting, Receiving, Data Set ready.

Software packages such as Crosstalk, PC-talk and Hayes' Smartcom II also will run with this modem.

300/1200 Baud **$249.00**
300/1200 Baud, Stand-Alone Unit, Attractively Packaged **$299.00**

The BEST IBM AT Compatible 4 Meg Memory Card

In order to take advantage of the memory addressing capabilities of the IBM AT or the BEST AVT 286 business computer, we developed a memory card to give the user up to 4 Megabytes of dynamic RAM. The memory card will run at speeds up to 18MHz, which is fast enough to meet the needs of any 80286 microprocessor on the market today. The design uses state-of-the-art (256K x 9) memory arrays, to allow for maximum memory in the smallest physical space. The ninth bit is used as a parity bit to insure the validity of the data. The card is available in memory sizes from 512K to 4 Megabytes in steps of 512K. Boundaries are switch selectable above 1 Meg in blocks of 512K.

With 512K Regular	$ 695.00	Special	$349.00
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(quantity discounts available)	
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NEW SILENT JU455 Shugart/Panasonic
5.25" slimline DS/DD Disk Drive with 360K
Ideal for IBM Computers **$149.00**

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Ideal for AT Compatibles **$199.00**

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Our 1987 catalogue gives full specifications on our IBM AT and XT compatible computers plus detailed specifications and prices on our other products. Also ask for our New Parts Flyer.

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Circle No. 2 on Reader Service Card

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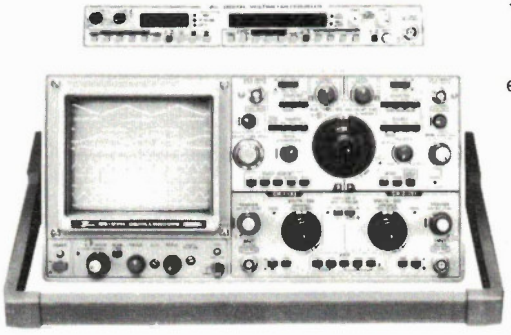
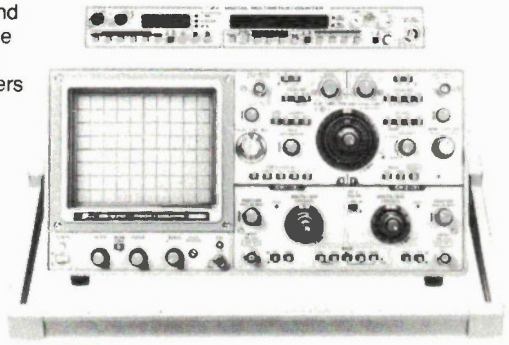
Price/Performance With Real Scopes



The SS-5710 and SS-5711 can be provided with exclusive counters and digital multimeters.



SS-5711 Reliability resulting from superb basic characteristics DC-100 MHz

- Typical frequency of from DC to 120 MHz, −3 dB, thereby having a 20 MHz margin over the specified frequency response
- Highly precise and stable deflection factor and sweep rate
- Reliable time difference between channels
- Jitterless circuitry for stable triggering
- Superb linearity
- 3 year warranty

$2319

SS-5710 4-input, 8-trace Portable Oscilloscope DC-60 MHz

- Typical frequency of from DC to 70 MHz, −3 dB, thereby having a 10 MHz margin over the specified frequency response
- Highly precise and stable deflection factor and sweep rate for a wide range of temperatures
- Superb linearity
- Reliable time difference between channels
- Built-in TV sync separator
- 3 year warranty

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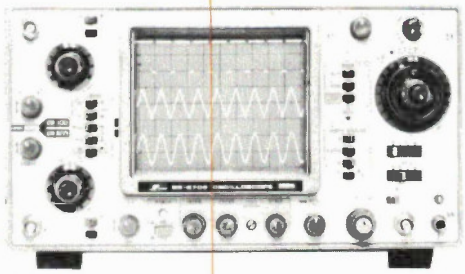

SS-5705 3-input, 6 trace Portable Oscilloscope, DC-40MHz

- 3-Input, 6-Trace
- 12KV Accelerating Voltage
- Versatile trigger capability with TV-SYNC
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- High accuracy for V and H (±2%)
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- 2 year warranty

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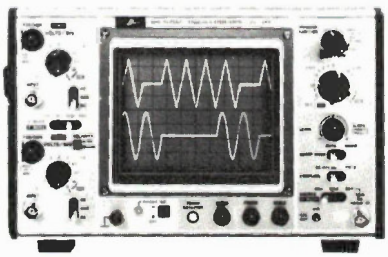

SS-5702 2-input, 2-trace Oscilloscopes, DC-20 MHz

- Compact and lightweight; low power consumption
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- Variable sweep length and dual X-Y operation facilities
- 1 mV/div-10 V/div deflection factor
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- TV-V trigger mode
- 2 year warranty

$741

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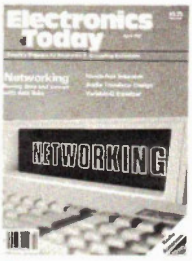
Circle No. 3 on Reader Service Card

Our Cover



The theme of Networking, the coming thing in computer systems, was designed and photographed by Ed Zapletal.

Electronics Today is Published 12 times a year by: Moorshead Publications Ltd. 1300 Don Mills Road, North York, Toronto, Ont. M3B 3M8 (416) 445-5600

Editor:	**William Markwick**
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Publisher: H.W. Moorshead; **Executive Vice-President:** V.K. Marskell; **Vice-President - Sales:** A. Wheeler; **Vice President-Finance:** B. Shankman; **General Manager:** S. Harrison; **Production:** Kevan Buss; Naznin Sunderji; **Accounts:** P. Dunphy; **Reader Services:** N. Jones, K. Parkinson, R. Cree, K. Barkwell; **Advertising Services:** H. Brooks.

Newsstand Distribution:
Master Media, Oakville, Ontario

Subscriptions:
$22.95 (one year), $37.95 (two years). Please specify if subscription is new or a renewal.

Outside Canada (US Dollars) U.S.A. add $3.00 per year. Other countries add $5.00 per year.

Postal Information:
Second Class Mail Registration No. 3955. Mailing address for subscription orders, undeliverable copies and change of address notice is:
Electronics Today, 1300 Don Mills Rd., Toronto, Ontario, M3B 3M8

Printed by Heritage Press Ltd., Mississauga
ISSN 07038984.

Moorshead Publications also publishes Pets Magazine, Computing Now!, Computers in Education, and Government Purchasing Guide.

Circulation Independently Audited by MURPHY & MURPHY Chartered Accountants.

Electronics Today

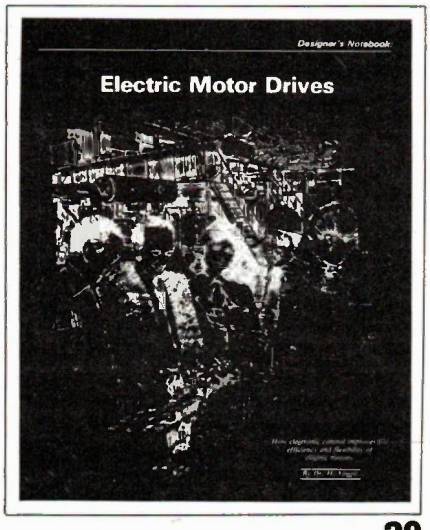
Canada's Magazine for Electronics & Computing Enthusiasts

April 1987 **Vol. 11 No. 4**

Features

Projects

Series



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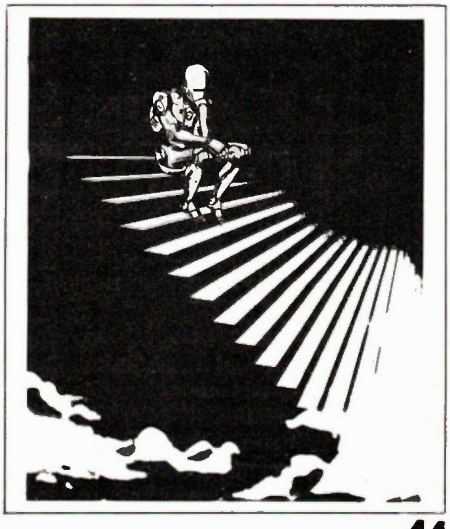

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Columns and Information

For Your Information

The Editor's Corner

By Bill Markwick

SOME cogitations on reliability. A friend of mine reports that a reliability study done on his company's electronic equipment showed that failures are caused mostly by connectors, far and above any other type of component. This makes sense if you consider the difficulty of making a breakable connection last forever. Small size is always requested, so you're really dealing with a flat spring that has to work within tolerances of less than a thousandth of an inch, never lose pressure, and never corrode. All this despite somebody pulling out and reattaching the thing at various intervals, not to mention stepping on the cable and putting enormous strain on the wires, pins, strain relief and mounting parts.

I really have to hand it to the makers of professional heavy-duty connectors. Whatever their drawbacks, the performance of multi-pin cable connectors is usually outstanding, even if you solder it up yourself in a hurry.

Then again, we have the accursed RCA phono jack, whose popularity must be based on simplicity and economy rather than anything else. They aren't too bad in the tangle behind your stereo set, assuming that you never move them, but they seem particularly unsuited to the job of feeding video signals from computers to monitors, probably because they get moved around more. When my computer screen starts to waver and joggle, I take out the phono cable and squeeze the shield contact together, buying some time before I have to replace the thing.

Frustration City: it isn't unusual for consumer product makers to have special connectors made up and molded to a cable. The connector pins themselves never seem to fail; what always seems to happen is that the wires fray just inside the molding. And there's nothing you can do about it, because if you try to cut away the molding to reterminate, you'll almost certainly damage the thing beyond repair.

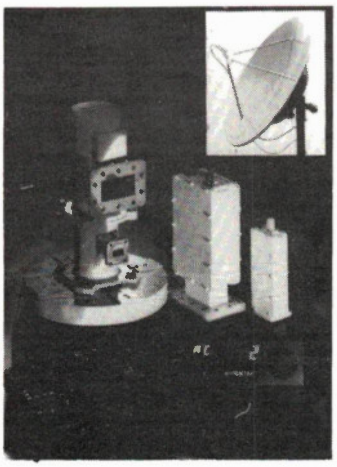
Then there's the standard old 115V household wiring connectors, and the less said about this rubbish the better. The British have solved the problem by overdoing it: their power plugs look like something you could use to power a wharf crane. It would be nice to hit it somewhere in between, but we're stuck with mediocre standards. There are some good plugs available from hardware stores, and I usually replace failed plugs with these, though they're a bit clunky for anywhere but the workshop.

Plug packs save you money because the manufacturer doesn't have to put a bulky power supply into a gadget, but what if you have two of them? Sometimes they'll fit in a duplex outlet, one up and one down, but usually you have to hunt for an extension cord for one of them.

Car connectors seem to be fairly reliable. I think this is because they snap together and lock, requiring a small charge of plastic explosive to open them up again.

That brings to mind the most reliable of all car parameters: you can be absolutely sure your muffler will fall out in the street two years after installation. I have this idea. You could mount a small servomotor on the frame beside the muffler, and after two years, a timer would activate the motor, sending a length of coathanger wire over to the opposite frame member, and then you wouldn't have to crawl under the car. At the same time, a light on the dash would come on, telling you that you're out of coathangers. ★

Dual Band TVRO System



Complete access to all satellite transponders in both C and Ku-bands is now possible with the Vexus Gold Medal Dual Band System.

The heart of the system is the VX-ESR-124H 4 and 12 GHz Antenna Feed. This unique component is precisely matched to the Vexus "D" series antennas (VX-2400D shown) offering superior performance in 12 GHz band reception. C and Ku-band feed apertures are co-located and skew compensation on both frequencies is controlled with a fully weatherized, surge protected servo.

System control is centralized with the VX-CDR-4/12DD microprocessor based, Remote Control Digital Satellite Receiver. The unit is fully expandable for multiple receiver and multiuser MTVRO applications, has optimized video and audio through DFF (Digital Frequency Feedback) synthesized tuning, and is fully compatible with both 4 GHz and 12 GHz DBS.

Noise temperature specifications for the C-band LNB are typically 70 - 75 degrees Kelvin. The unit is designed with an isolator on the input of the amplifier, yielding excellent load and temperature stability. The Ku-band LNB has a typical maximum noise figure of 2.0 dB.

The Vexus line of antennas includes 1.8, 2.4, and 3.0 meter models manufactured with ultra high tolerance molds and special metallized fibre cloth and polyester composites. This construction assures top gain performance for C-band as well as aperture efficiency and RMS standards necessary to optimize Ku-band reception.

For more information on the Gold Medal System contact: Vexus Telecommunications Corporation, 2240 Argentia Road, Mississauga, Ontario, L5N 2X6.

Circle No. 4 on Reader Service Card

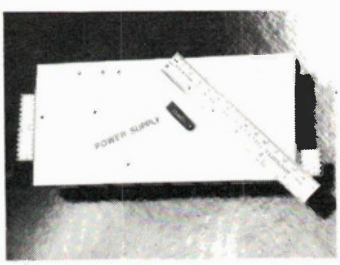
Spectrum Analyzer

The Tektronix 2710 is an under-20-pound portable spectrum analyzer with a range of 10kHz to 1.8GHz. It provides a wide 5MHz IF bandwidth filter, four-trace digital storage and a comprehensive time domain measurement capability.

The standard 2710 has resolution bandwidths down to 3kHz; there is an option for 300Hz resolution. Contact Tektronix Canada Inc., PO Box 6500, Barrie, Ontario L4M 4V3, (705) 737-2700.

Circle No. 5 on Reader Service Card

Switching PSU IC

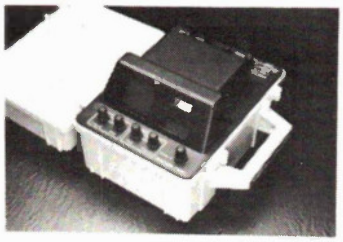


The LS405 is a plastic DIP IC for controlling switching power supplies, and features an overload shutdown comparator, remote shutdown, soft start, undervoltage and overvoltage shutdown and will drive MOS transistors directly. The VCO frequency range is 10kHz to 1MHz with 5 percent linearity. For more information, contact Sue Mercer, Linear Technology Inc., PO Box 489, Station A, Burlington, Ontario L7R 3Y3, (416) 632-2996.

Circle No. 6 on Reader Service Card

Continued on page 54

Cable Fault Locator



The Megger TDR1 is suited for use on telephone coaxial communication or cable TV distribution lines. Four terminals are provided, enabling good and faulty lines to be checked against one another. A CRT displays pulse trace and cursor alignment, while a four digit LCD display shows selection of velocity factor and distance to fault. A moving coil meter is provided for peak coincidence detection; power is from rechargeable batteries or any 12VDC source. Contact Metermaster division of R.H. Nichols Co. Ltd., 80 Vinyl Court, Woodbridge, Ontario L4L 4A3, (416) 851-8871.

Circle No. 7 on Reader Service Card

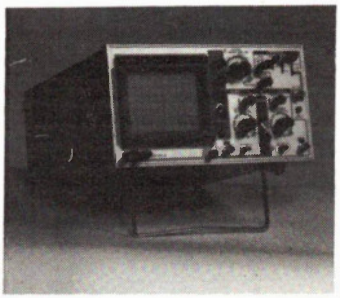
Micro Developer

The MICE series of development systems from Microtek are available for a wide range of CPUs, including the 8086/8088, the V20, the 80286, the 68000, the Z80, 6500 series, and the 80386. The units provide realtime emulation, emulation memory, realtime trace, triggering, breakpoints, debugging, logic state analysis and more. Contact Tracan Electronics, 1200 Aerowood Dr., Units 3 and 4, Mississauga, Ontario L4W 2S7, (416) 625-7752.

Circle No. 8 on Reader Service Card

20MHz Scope

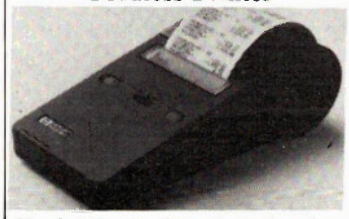
The BTL Model 2988 dual trace 20MHz oscilloscope features a built-in component tester for in-circuit or out-of-circuit testing. At only 7kg, the instrument is ideal for troubleshooting solid state circuits or components with no circuit



power. Contact Brunelle instruments, 73, 6th Range S., St. Elie d'Orford, Quebec J0B 2S0, (819) 563-9096.

Circle No. 9 on Reader Service Card

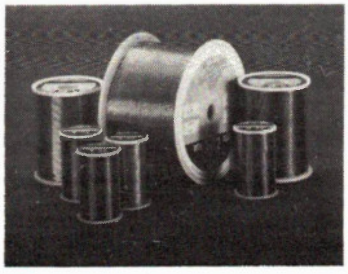
Cordless Printer



Hewlett-Packard has introduced a printer for their HP18C Business Consultant calculator, using infrared remote control. The 24-character printer is battery-powered, and works up to 18 inches away over a 60-degree arc. At $225 Canadian, it's said to be the first printer application of infrared technology. At HP calculator dealers, or contact Hewlett Packard Canada Ltd., 6877 Goreway Drive, Mississauga, Ontario L4V 1M8, (416) 678-9430.

Circle No. 10 on Reader Service Card

No-Residue Solder



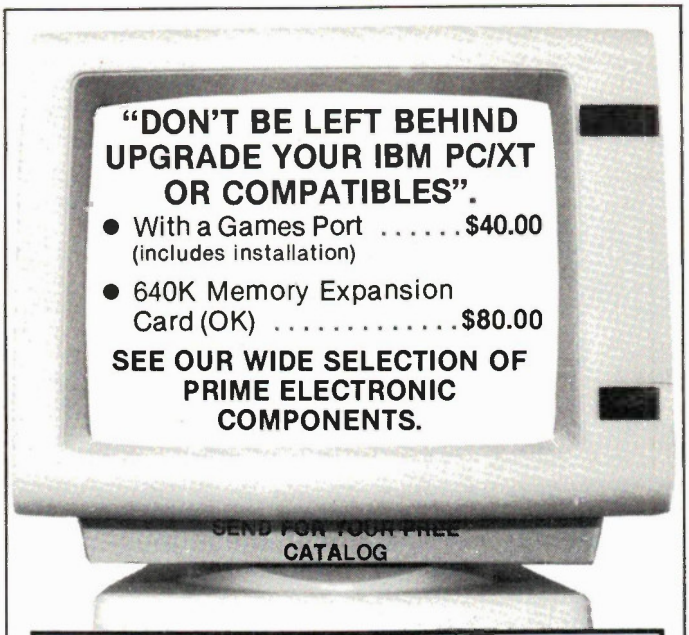
Ersin Multicore has introduced a new wire core solder that is compatible with its No-Residue X-32 flux used in wave soldering. It is a no-halide chemistry that leaves no residue; fumes are said to be reduced as much as 85 percent. Available in most gauges and alloys. Contact Ersin Multicore Canada, 12,230 Rue April, P.A.T., Montreal, Quebec H1B 5N5, (514) 645-2375.

Circle No. 11 on Reader Service Card

Zenith 386

Zenith Data Systems has introduced the Z-386 personal computer, using Intel's 80386 32-bit processor. The CPU operates at 16MHz with no wait states to bring supermini performance to desktop computing. There are ten bus slots, serial and parallel ports and sockets for 80287 or 80387 coprocessors. Contact Heath/Zenith, 1020 Islington Avenue, Toronto, Ontario M8Z-5Z3, (416) 232-2686.

Circle No. 12 on Reader Service Card



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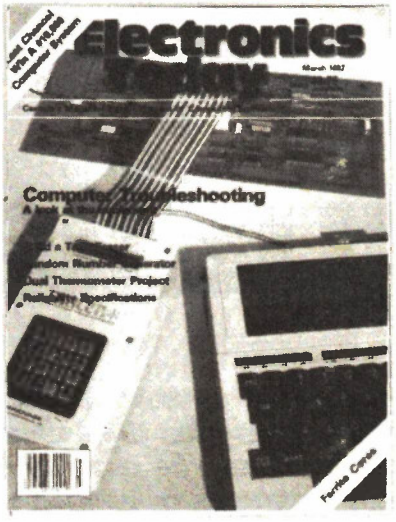
- They help us create the stars, the legends we need. Canadian magazines foster our own sense of ourselves.
- They present the best of the literature, prose and poetry that we produce.
- They express the regional differences that distinguish us from one another, and the national pride and purpose that link us together.
- They tie us together with a ribbon of print, and help us define who we are.
- They give us a vital voice of our own.



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But it's a fragile industry: At last count more than half of Canada's periodicals had circulations of fewer than 2,000 copies per issue, and only 110 periodicals had circulations of 100,000 or more per issue. Foreign publications still account for 77% of all English-language newsstand sales.

The threat to your magazine

The Government in Ottawa is now threatening to treat Canada's magazines as if they were so many widgets. It's threatening to eliminate the postal, tariff and tax-related incentives and supportive measures...to dismantle the very structure that past governments have worked so hard to build and maintain.

The Government in Ottawa is threatening the survival of the majority of Canada's magazines and considering measures that will significantly raise the cost to readers of those that survive.

Canada's magazines tell us about ourselves. They're a voice of our own. If the current Government in Ottawa were to treat Canada's magazines as if they were just another product, it would diminish (or even silence) that voice forever.

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Vari-Q Parametric Equaliser

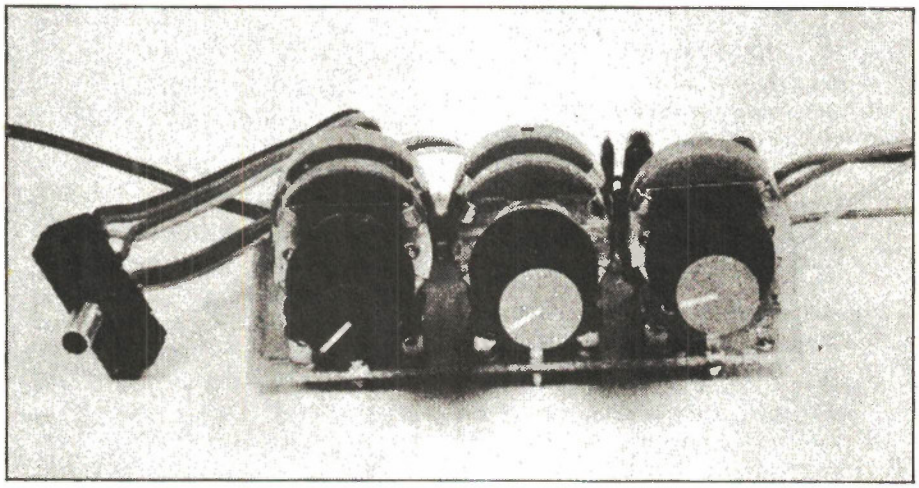
Does your guitar or keyboard need some equalisation to brighten the sound? Here's a module which can be used by itself on individual instruments or ganged to equalise your music system.

By Neale Hancock

GRAPHIC EQUALISERS are widely used and acceped by audio enthusiasts as a means of correcting the acoustic deficiencies of a listening space. They are also used (probably by the majority of us) to make a stereo system sound better, by making the bass thump and adding more sparkle to the treble. The graphic equaliser is one way of optimising the frequency response of a music system to give our ears what they want.

Equalisation is not a process solely used in hi-fi applications. It's also used in public address systems as a way of eliminating feedback and in recording studios as a way to give an instrument a desired sound. In recording situations the parametric equaliser is a very versatile instrument, because it can be cascaded to give overall equalisation of a recording or used individually on separate instruments.

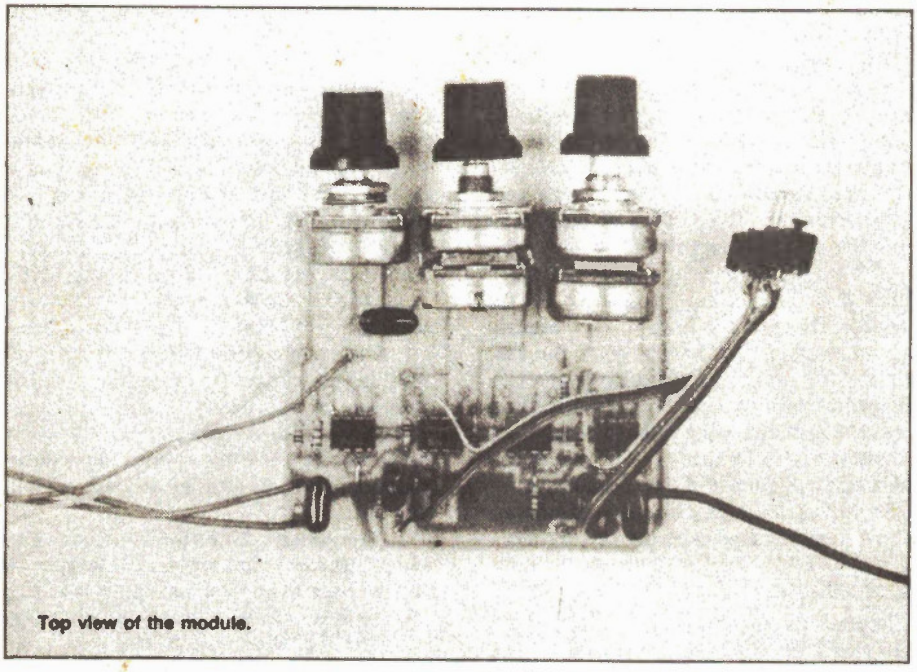
Both graphic and parametric equalisers use active bandpass filters to achieve equalisation. But whereas graphic equalisers use a number of preset bandpass filters called 'gyrators' (one for each slider on the front panel), parametric equalisers are tunable bandpass filters. This use of tunable bandpass filters in parametric equalisers allows each band to be more effective, thus reducing the number of bands required. And the increased efficiency allows a multiband parametric equaliser to be modular in design, with one bandpass filter in each module, making it more versatile than the graphic equaliser in the studio.



However, the Vari-Q parametric equaliser module is designed to be used in any application where equalisation is required. These modules can be used independently or connected in series to form a multiband equaliser. The unit requires a signal of 100 mVrms line level or greater (up to 700 mV) to drive it, and runs from a ±15 volt supply. Casing details are left up to the user.

Circuit Concepts

As I mentioned earlier, the Vari-Q modules consist of tunable active band-



Top view of the module.

Table 1. Performance of Vari-Q

Range of centre frequencies	20 Hz to 19kHz	Continuously adjustable
Range of Q	1 to 10	
Cut	-23 dB	
Boost	+18 dB	
Roll off	15 dB/octave	
Dynamic range	100 dB	measured at maximum gain and maximum Q
SN ratio	90 dB	
Distortion	0.005%	

Measured at 1 kHz and a signal level of 500 mVrms.

pass filters. To make a bandpass filter tunable, parameters such as centre frequency, bandwidth and the amount of cut and boost are made adjustable. Graphic equalisers have the centre frequency and width of the band preset, with only the cut and boost variable.

The accompanying series of photographs shows the effect on the frequency response of changing the tunable parameters. All the photographs show the same range of frequencies being swept, with the lower frequency on the left (2.6 kHz) and the higher frequency on the right (7.5 kHz).

Figures 1 and 2 show the effect of shifting the centre frequency of the Vari-Q. Figure 1 shows the Vari-Q set on a high frequency which would result in a boost of the frequencies around the peak.

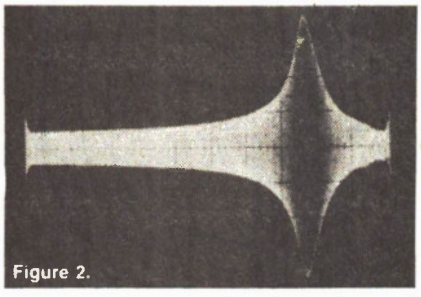


Figure 2.

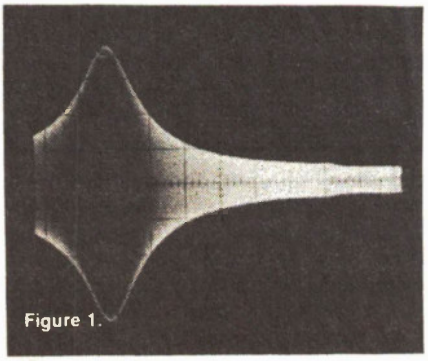


Figure 1.

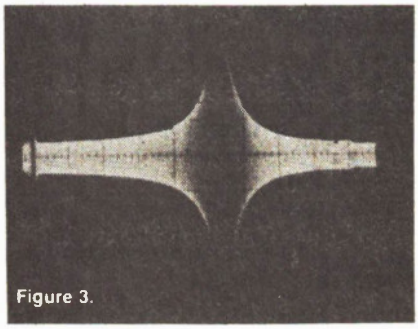


Figure 3.

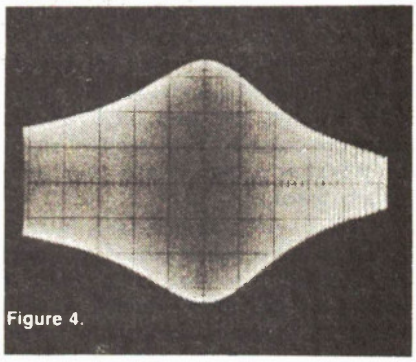


Figure 4.

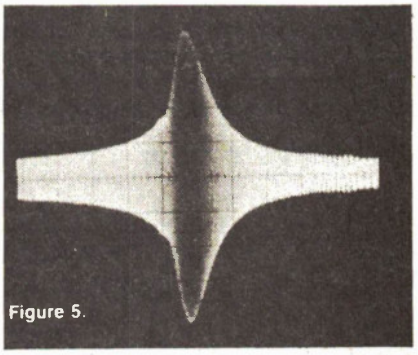


Figure 5.

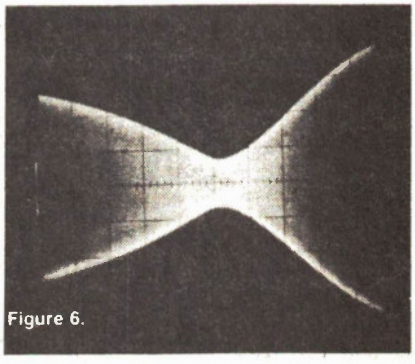


Figure 6.

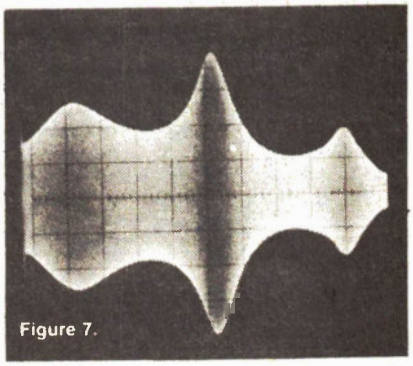


Figure 7.

Figure 2 shows it set to a lower frequency.

Figures 3 and 4 illustrate the effect of increasing or decreasing the width of the passband. This is also referred to as the Q. In Figure 3 the circuit has a high Q, thus a narrow range of frequencies around the peak is emphasised. Figure 4 has a low Q and shows a broad range of frequencies being emphasised.

Figures 5 and 6 show boost and cut of the range of frequencies. In Figure 6 the signal was amplified vertically so that the cut could be more closely observed.

The circuit for the Vari-Q is based on a state variable filter circuit. This type of filter features low pass, high pass and bandpass outputs. They are also capable of providing a high Q and they can be readily tuned.

To convert a state variable filter into a parametric equaliser, the circuit has to be modified to so that its Q, centre frequency and gain are all variable. Q can be varied by replacing the pair of resistors used to set it with a dual-ganging potentiometer. The centre frequency can be tuned by using switch to select the range and a dual-ganging potentiometer tune the centre frequency of the filter within that range. The range is selected by switching in different capacitor values and the dual-ganging potentiometer replaces the resistor pair used to set the centre frequency.

To enable the filter to have variable gain or attenuation (boost or cut) at the centre frequency, a gain stage is added to the state variable filter circuit. This gain stage allows the filter to have bandpass or band rejected characteristics.

The circuit has been designed using high performance op-amps, such as the NE-5534AN and the TL-071. Of these two op-amps the NE-5534-AN gives the best results for noise and distortion, but at a higher component cost. The specifications for the circuit using NE-5534-AN op-amps are listed in Table 1. The circuit can also use the good old 741 op-amp, however higher level of noise and distortion can be expected when using this device.

Construction

Commence construction by examining the pc board for broken tracks, and bridges between tracks. The first components to be mounted are the resistors, capacitors and the link. Next month the ICs, but first check their orientation with the overlay. To supply the voltage rails of the modules, the + 15 and -15 volt power supply is used.

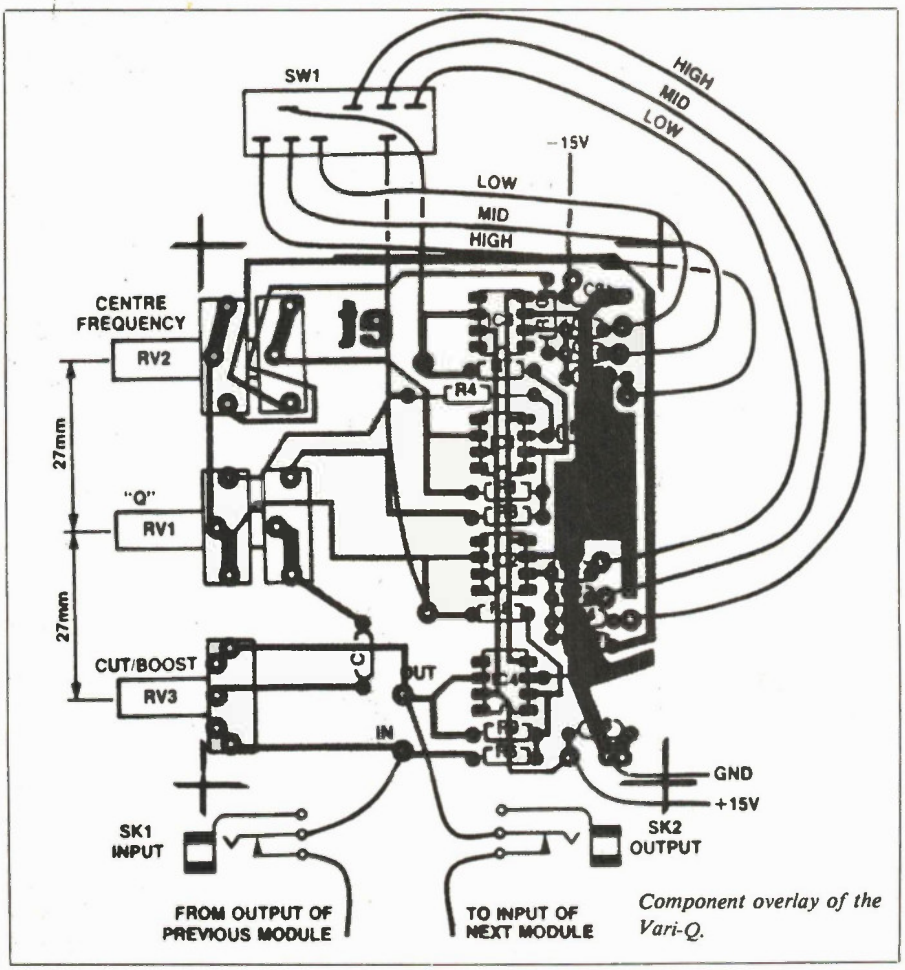
To keep the number of flying leads in the project to a minimum I have used pcb-mounting pots. The only hassle involved in using these pots is that you may need to drill 2 mm mounting holes in the pc board to accommodate their pins. After the mounting holes have been drilled the pots can be mounted on the board. If you can't find pcb mounting, dual-ganged 100k pots, Electro Sonic carries a suitable MIL style pot which can be wired in instead.

The triple-throw toggle switch can now be connected to the pc board. The best way of connecting the switch is to use ribbon cables as it makes the wiring neater and simpler. Try to obtain the thicker gauge cable as it is easier to work with in this case.

The wires connecting the input and output sockets and the power supply to the pc board can now be connected. It is best to leave these connections until you have decided what case to use.

The type of case used to house the unit depends largely on how you want to use it. For instance, if you use a single module as an independent unit, it should be housed in a case by itself. However, if you are constructing a multiband unit or integrating the modules into a music system, you will have to drill out your case to suit.

The component overlay shows the purpose of each pot, and what frequency range is selected by each position on the triple-throw switch. The overlay also shows how to connect the modules in series, using switched 3.5 mm or 6.5 mm phono jacks, to create a flexible multi-band parametric equaliser. The use of



Component overlay of the Vari-Q.

Parts List

Resistors all ¼W, 5%

R1, 7	100k
R2	3k9
R3-6, 8, 10	10k
R9	22k
RV1, 2	100k dual-ganging linear with pc mounting pins
RV3	10k linear with pcb mounting pins

Capacitors

C1	220n greencap
C2, 5	820p ceramic
C3, 6	8n2 greencap
C4, 7	82n greencap

Semiconductors

IC1-4 ....NE-5534AN or TL-071 (see text)

Miscellaneous

PC board; 3 x potentiometer knobs; 2 x switched phono sockets; dual-pole triple-throw switch; hookup wire; case to suit. Dual-ganged pots are available from Electro Sonic, Part #KKU1041, 1100 Gordon Baker Rd., Willowdale, Ontario, M2H 3G3 (416) 494-1555.

How It Works

As mentioned in the text, the circuit is based around an active state variable filter. The op-amps in this filter are ICs 1, 2 and 3. The output from IC1 is high pass, the output from IC3 is low pass and the output from IC2 is bandpass. The output from IC2 goes into the gain stage, which consists of IC4, R6, R9 and RV3.

The centre frequency of the parametric equaliser is determined by resistors RV2, R5 and R10 and capacitors C2 and C7. The frequency range is selected by switching in a pair of capacitors nsing a dual-pole triple-throw switch, SW1. The frequencies within the range are determined by the resistor pair R5 and R10 with the dual-ganging potentiometer RV2. The equation which sets the centre frequency, fc, is:

$$fc = 1/2(RV2 + R5)Cx$$

where Cx can be C2, C3 or C4.

This equation could also be written using R10, C5, C6 and C7 since all these components are the matching pairs of those in the equation.

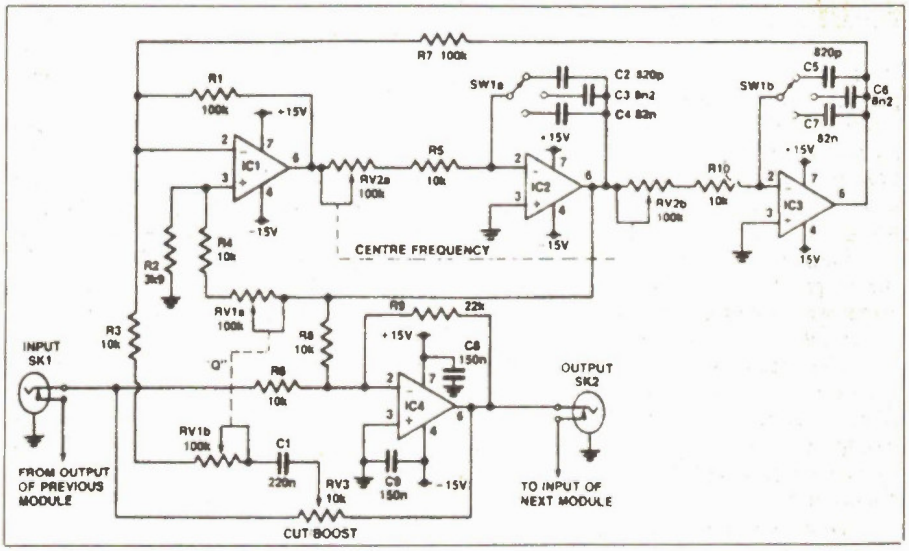
C2 and C5 select the frequency range of 2 kHz to 20 kHz, C3 and C6 select the range 200 Hz to 2 kHz and the pair C4 and C7 selects the range 20 Hz to 200 Hz. The frequencies within the ranges are obtained by using a dual-ganging potentiometer RV2. The highest frequency in the range is obtained when RV2 is turned fully clockwise, making RV2 equal to zero in the equation above. Therefore, R5 and R10 set the high end of the frequency range. When RV2 is turned fully anticlockwise its value is equal to 100k in the equation above, thus settling the low end of the frequency range.

The Q of the parametric equaliser is set by the combination of R2, R4 and RV1. The equation used to determine the Q of a state variable filter is as follows:

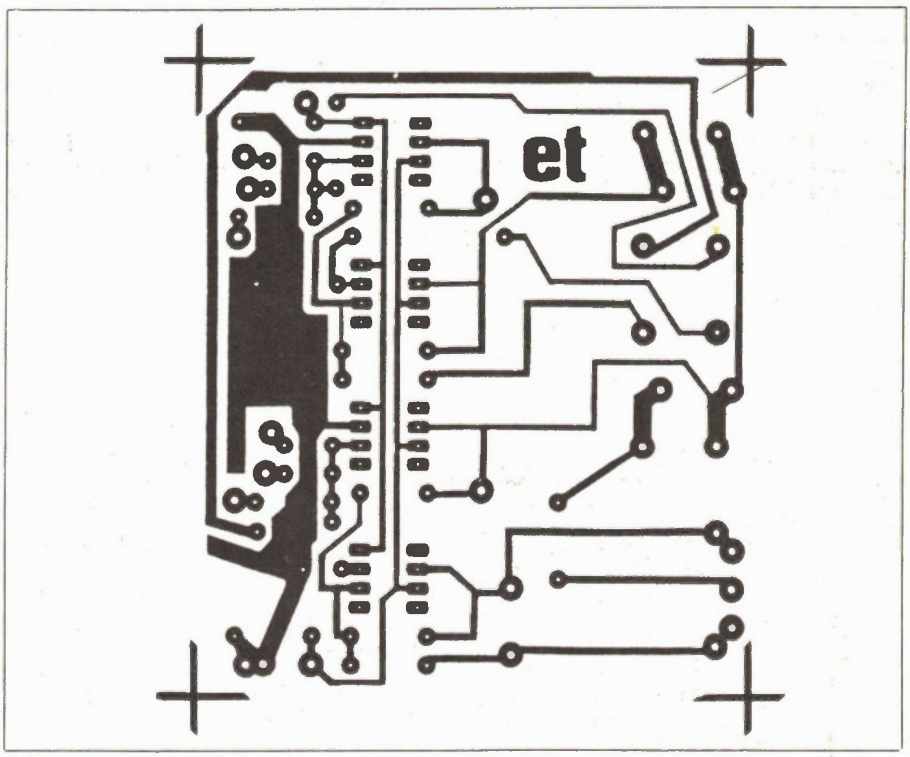
$$(R4 + RV1)/R2 = 3Q-1$$
$$1 + (R4 + RV1)/R2 = 3Q$$
$$(1 + (R4 + RV1)/R2)/3 = Q$$

By substituting in the values of R2 and R4 as well as the maximum and minimum values for RV1, a maximum value for Q is 10 and a minimum value for Q is 1.

The gain stage gives the parametric equaliser circuit the ability to cut or boost the frequencies to which the filter is tuned. RV3 gives control over the amount of cut or boost while R6 and R9 set the overall gain of this stage. The capacitors C8 and C9 are there to remove high frequency noise from the supply rails.



The complete circuit of the Vari-Q.



PCB artwork for the Vari-Q.

switched jacks between each module allows them to be used independently.

Using It

When using individual units to modify the sound of a musical instrument, first set the Q control to the centre position, the frequency range selection switch to its centre position and the cut/boost control either fully clockwise or fully anticlockwise.

Play a sustained note (preferably middle C) and turn the centre frequency control until you hear the sound of the note change. If the cut/boost control is turned fully anticlockwise, the effect will be a dulling of the note, alternatively the sound will be brighter if the cut/boost control is turned fully clockwise. By turning the Q control clockwise the range of notes dulled or brightened will be reduced. When it is turned anticlockwise the range of notes will be increased.

A good multiband parametric equaliser can be created by using three or four modules in series. Using such a multiband equaliser on orchestrated music would require a similar procedure to that outlined above. The only differences are that the input into the equaliser is different and that there are more bands to tune.

When using a number of modules in series each one increases the gain and the Q of the system. Make sure that the first module in the system does not have a high gain or Q; this applies to a lesser extent to each successive module. If the gain or the Q of the system is too large the result will be excessive distortion of the musical signal. ■

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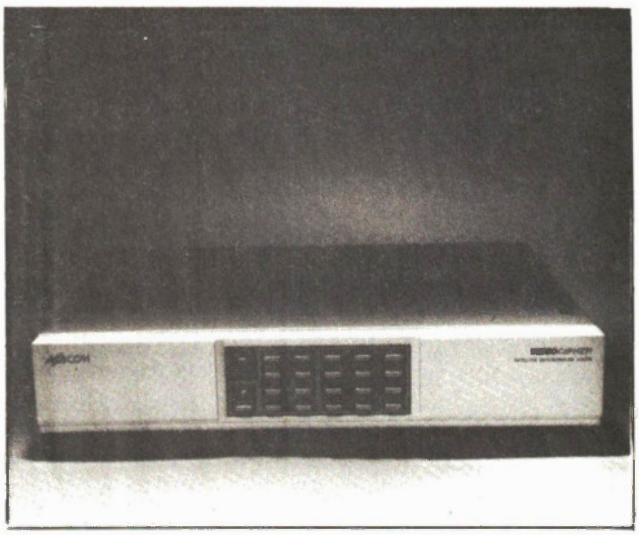

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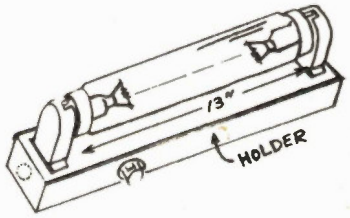

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Hands Off Intercom

You can keep in touch with this low-cost system

By Tony Smith

MOST published intercom systems use switching to allow a speaker to double up as a microphone, and a single amplifier to serve the entire system. This is certainly an economical way of achieving two-way communication, but it has two main disadvantages. Firstly the speech quality can be distorted, and secondly, the users need to switch over from "receive" to "speak" continuously throughout the conversation.

While this is quite satisfactory for many applications, there is sometimes a need for a system not requiring switching, and having a better audio quality.

The method suggested here uses two separate amplifiers and separate microphones and speakers. Cost has been kept in mind however, and the microphones used are modestly priced. The integrated circuits used for the amplifiers (ULN2283B) are low voltage devices, operating from 3V to 12V with a minimal quiescent current, making them reasonably economical for battery operation if required.

How It Works

Referring to the block diagram **Fig. 1.** Unit A, a self-contained microphone and amplifier, drives loudspeaker LSA which is located with Unit B in any required separate location. Unit B, a duplicate of A, drives speaker LSB, which is located with unit A.

Both amplifiers are in operation at the same time, allowing normal two-way conversation. A single battery or power-supply serves both units and can be located at any convenient point along the connecting fourway telephone cable.

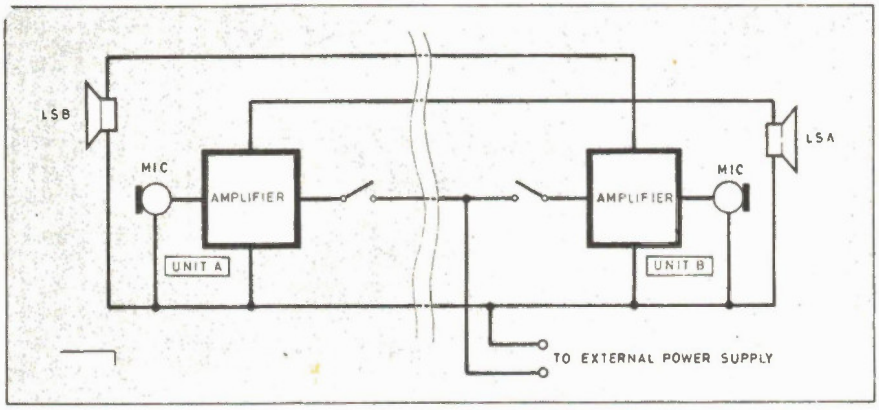


Fig. 1. Block diagram of the operating system for the Hands Off Intercom.

Circuit Description

The complete circuit diagram (one unit) for the Hands Off Intercom is shown in **Fig. 2.** Transistor TR1 is a pre-amplifier to enable the microphone to drive the main amplifier, IC1. Potentiometer VR1 controls the gain of the amplifier, and capacitor C3 by-passes to ground any radio-frequency signals picked up by the external wiring.

In the desk model, the microphone is a low-cost dynamic type, the sort sold as replacements for small cassette recorders. In the wall-mounting unit, an electret insert is used, and resistor R4 provides bias for the microphone. R4 is only required when an electret MIC is used.

Construction

All components are mounted on standard 0.1 in. matrix stripboard, as illustrated in **Fig. 3.** IC holders are used to avoid soldering the ICs directly to the boards.

It should be noted that a slightly different microphone wiring arrangement is required if an electret microphone is used. No detailed constructional information is given, as the shape and size of a terminal unit will depend on its particular location, and the needs of the user.

In the prototype installation two different versions were used. A desk model used a standard car speaker and dynamic microphone, mounted side by side on a polished wood base. A hole was cut in the base under the speaker and the circuit board was mounted there, with the switch and gain control on a small aluminium plate over another recess at the side of the speaker.

The second terminal was a small wall-mounting unit using a miniature 3 in. speaker with an electret microphone insert. The home-made wooden case had an internal wood divider to minimise acoustic feedback between the speaker and micro-

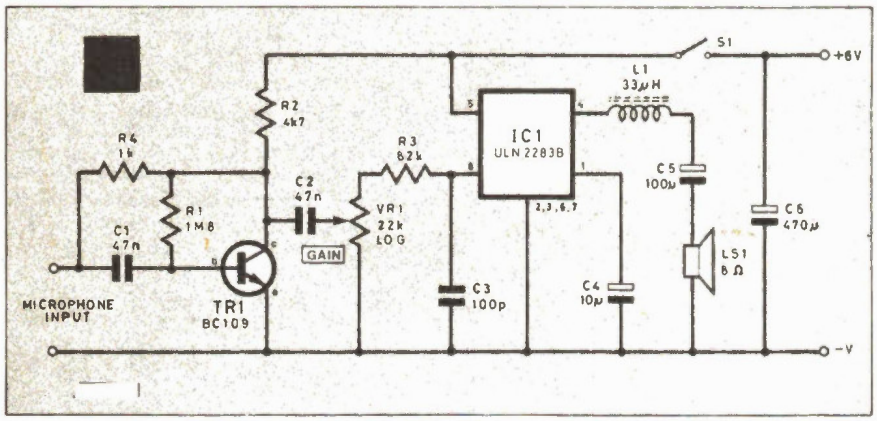


Fig. 2. Complete circuit diagram of the Hands Off Intercom (two units required). Resistor R4 is required when an electret microphone is used.

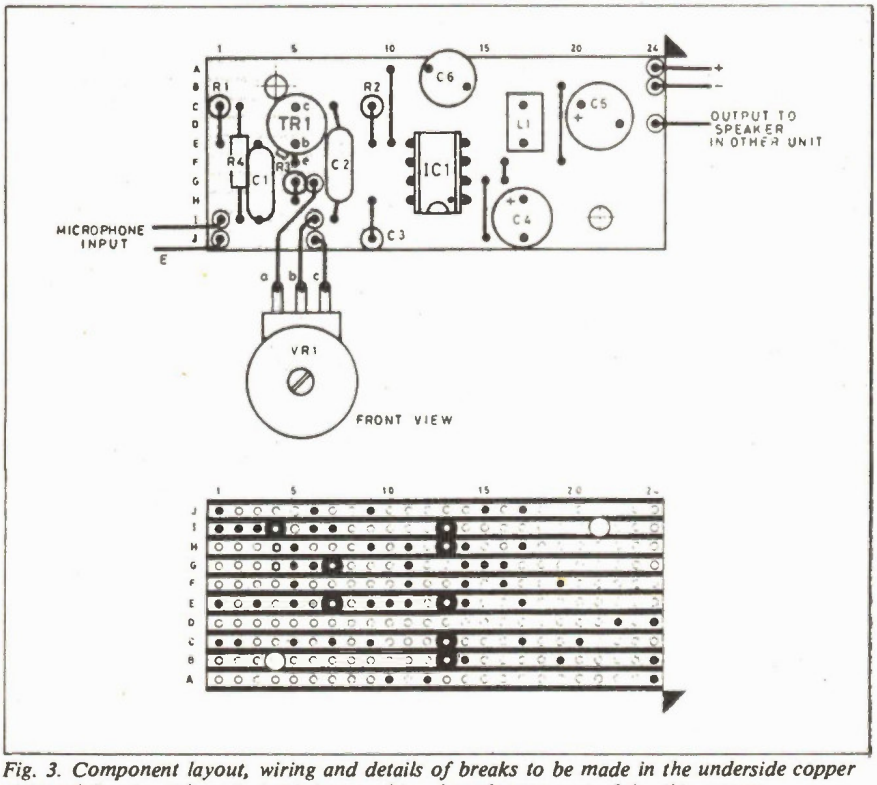


Fig. 3. Component layout, wiring and details of breaks to be made in the underside copper strips of the circuit board. A minimum of two boards are required for this system.

phone, see **Fig. 4.** In both versions the microphone should be located as far away from the speaker as possible, and face away from it.

The power supply can be conveniently located anywhere along the route of the connecting cable, where it can be placed out of sight. A 6V lantern battery should be satisfactory for occasional use. In the prototype system the total quiescent current at 6V was about 16mA.

For frequent use, it would be advisable to use a small plug pack supply capable of giving 50- 100mA at 6V.

Wiring and Setting Up

Four-core telephone cable should be used for inter-unit wiring. This can be inconspicuously laid and stapled along a route from one part of the house to another. In the prototype, one end was terminated in a small metal box having a 5-pin DIN socket. The desk model had a flexible lead terminating in a matching DIN plug, which enabled the intercom to be plugged in at this point.

Once the two units are connected up, and power switched on, it will be necessary to adjust the gain controls to ensure there is no acoustic feedback between the microphones and speakers. One person is required at each terminal for this adjustment.

The controls should initially be turned completely anti-clockwise. A gradual advancement of each should result in

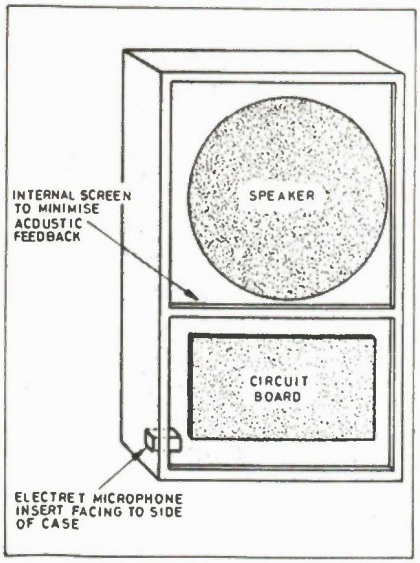


Fig. 4. Suggested arrangement for the wall-mounting unit.

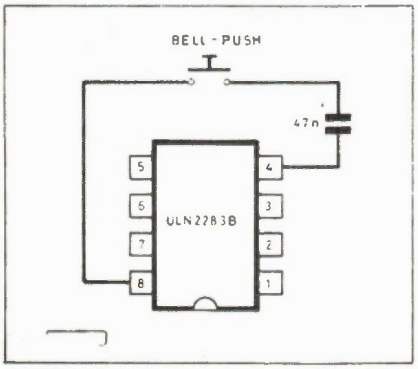


Fig. 5. Simple call-tone to use with street door intercom. The wires to the bell-push must be kept separate to avoid inter-wire capacitance and prevent unwanted oscillation. DO NOT twist wires together.

speech being heard from the other terminal. Too much gain will result in oscillation, and the controls should be backed off slightly to provide clear, distortion free amplification in each unit.

Using The System

The switches S1 enable users to activate the system from their end only, i.e. they cannot switch on the microphone at the other end. This feature helps prevent embrassing evesdropping, and ensures that speech from one end is transmitted only when those present wish it.

No call-system need be included as all that is necessary is to switch on and call into the microphone for a reply. The person called also switches on and it is then possible to hold a normal two-way conversation, either close to the units or from a few feet away.

Other Uses

The system offers possibilities as a street door intercom, linked with a push-button call-tone at the door (see **Fig. 5**), with all switching inside the house. Used as a oneway system it could function as a baby alarm, or serve as a monitor for intruders; telephone ringing; or simply knocks at the door; from one part of the house to another. Provided the microphone at the receiving end is switched off, the gain control of the monitor could be advanced to provide extra sensitivity without the probelm of audio feedback.

Units connected by flexible cable could provide an invaluable talk-back facility when adjustments, e.g. to TV antennas, have to be made from remote locations. Additional units cannot be added to the system without complicated additional circuitry, but extra outlets could be wired in at various points along the cable route to enable the two units to be plugged in for use in different locations as required, see **Fig. 6.** The applications are limited only by the ingenuity of the user. ■

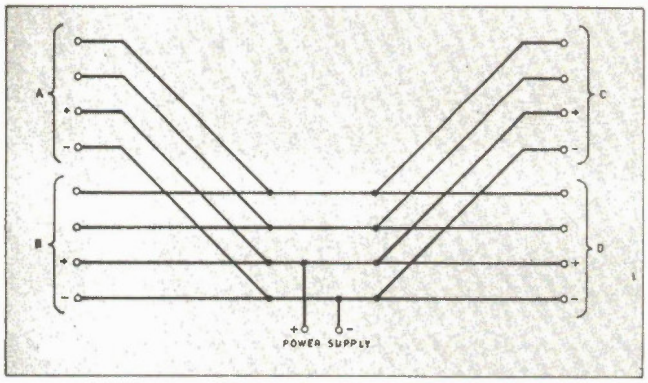


Fig. 6. Wiring to provide socket outlets in different locations. The units will connect between any two outlets.

Parts List

Resistors

R1	1.8M
R2	4.7k
R3	82k
R4	1k (only required if electret mic used)

All ¼W carbon ± 5%

Potentiometer

VR1	22k log.

Capacitors

C1,2	47n polyester (2 off)
C3	100p polystyrene
C4	10u 16V elec.
C5	100u 10V elec.
C6	470u 10V elec.

Semiconductors

TR1	2N3904 or BC 109 *npn* silicon
IC1	ULN2283B low power audio amp

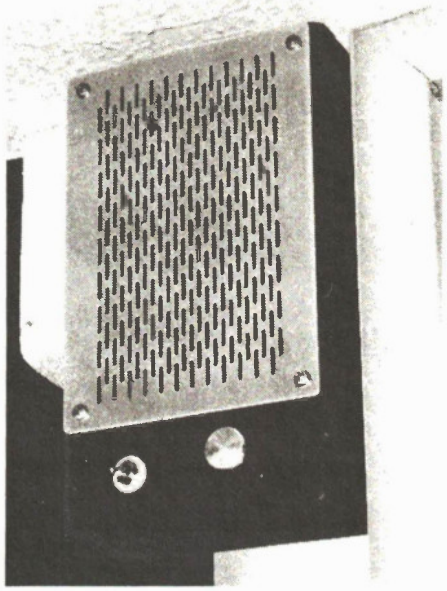
Miscellaneous

L1	Choke, 33uH-40uH
LS1	8 ohm loudspeaker, size to suit case chosen, see text.
S1	SPST miniature toggle
MIC1	electret microphone element or low cost dynamic microphone see text.

Stripboard, 0.1 in. matrix, 10 strips by 24 holes; 8 pin DIL holder; four-core telephone cable; length to suit installation; control knob; connecting wire; case or mounting to constructor's choice.

Note: The above components are for one unit only and should be repeated for the second unit.

The ULN2283B is available from Active Components, Part #54449.



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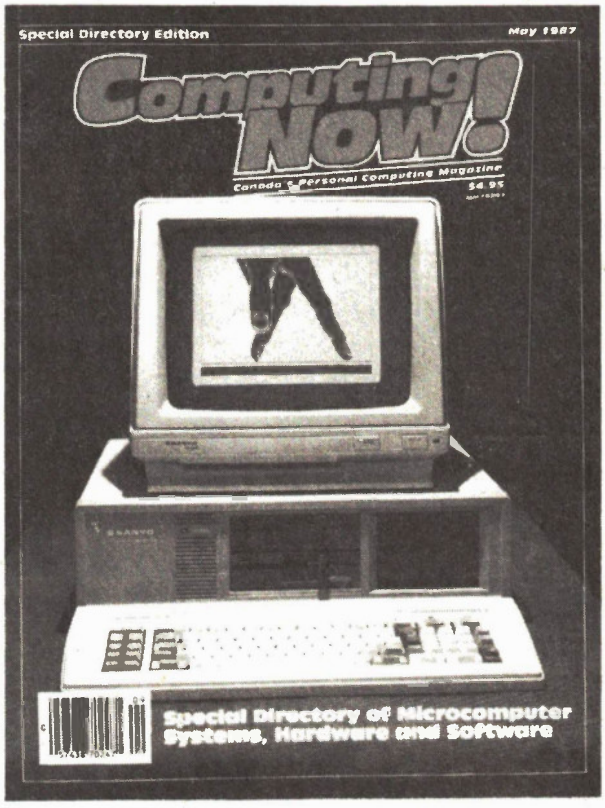

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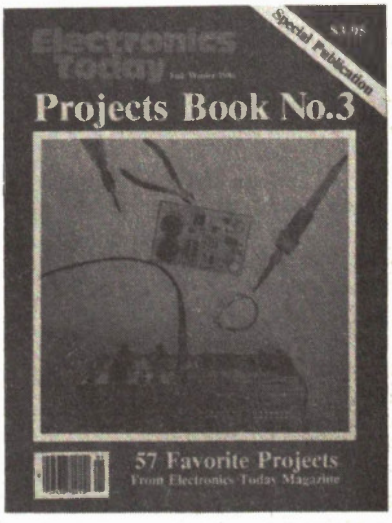

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Electric Motor Drives

How electronic control improves the efficiency and flexibility of electric motors.

By Dr. H. Virani

ELECTRIC MOTORS are the workhorses of modern society. In 1985 the electric sector consumed 35% of all the prime energy used in the United States, and of the electricity generated nearly two-thirds was used in electric motors. Thus, electric motors consumed about one-fifth of all primary energy used in the United States. The increasing financial and environmental costs of large generating stations together with other factors have provided powerful incentives for energy conservation through the introduction of new energy-efficient motors and the application of variable-speed drives to a wide range of processes. Electric drives were traditionally based on one of the two classes of electric machines, AC and DC, and the characteristics of the resulting drive were largely determined by the particular machine chosen. With only relatively rudimentary control systems possible, DC machines were much simpler to handle. Consequently most variable-speed drives used DC machines while constant-speed drives, the great majority, were left to AC synchronous and induction machines. Three-quarters and more of all electric motors in use are induction machines.

The advant of modern power electronic devices opened up a whole new range of solutions to the variable speed drive problem, and it became possible to control virtually any machine. A first, however, the balance of advantage still lay with the DC machine, more expensive in itself but requiring simpler and cheaper solid-state converters compared with the more complex and expensive inverter systems associated with AC machines.

Drives employing relatively cheap motors but hitherto relatively expensive converters and control circuits will become progressively more competitive: greater integration of motors, converter and control systems can be expected to bring cost and efficiency benefits.

Implementation of new control strategies and algorithms in microprocessor-based controllers make it possible to extend the capabilities of traditional AC machines, while new machine structures become practicable so that whole new families of machines are coming into existence. The application of radical new magnetic materials is having a substantial influence also on new machine designs.

The three general areas where current research and development are likely to have major impact on motor drive technology are: developments in switching devices, machine developments, and microprocessor applications with associated new control algorithms.

Switching devices

devices in widespread use today: the SCR, power transistors and power MOSFETS. Of these the SCR is quite clearly capable of handling the largest power but suffers from the fact that it cannot be turned off by a control signal applied to its gate. New forms of the SCR- ASCR (a symmetrical SCR), RCSCR (reverse conduction SCR) have not solved this particular problem but have improved its performance so that the total component count has been reduced and the turn off conditions have been greatly relaxed - 1 -2 S instead of 10 - 50 S for example. At the present time new fabrication techniques are making GTO - SCR (Gate Turn Off) possible with very high ratings and these promise to find wide spread use. GTOs with ratings of 2500 volts and 1000 a are now readily available and yet larger ones are under development. Power transistors are now available as Darlingtons with ratings of 1200 volts and 400A from a number of (Japanese) sources. An added feature of these transistors is their wide and well defined SOAE and RBSOZ curves so that totally fuseless protection becomes possible with no additional circuitry. Such protection is not simple to achieve with a GTO. The devices are supplied to a very tight specification so that parallel operation with no current-sharing emitter resistors is allowable. Up to perhaps 4 or 5 devices in parallel can be used to give a switch with a rating of 1200 volts at 1.5 KA.

These transistors are particularly easy to use as in most circumstances there is no restriction on rating for the forward dv/dt applied to them. Thus in principle no snubber protection is needed. In practice some simple snubbers are required to compensate for the inductance of the leads to the device in order not to exceed the voltage rating on turn-off. A disadvantageous feature of power transistors is their on-state voltage of 2 to 4 volts. This is much higher than that of an SCR or indeed a GTO. The voltage cannot be reduced by applying excess bare drive as the transistors must always be operated with a baker clamp to keep their switching times down - particularly the storage time.

Power MOSFETS have, quite simply, not achieved the potential that they promised some years ago. At low voltage ratings they do make excellent switches, but for higher voltages a number of compromises have to be made that seriously limit their application. For high voltage work the resistivity of the silicon subtrate used to make the device must be increased. To get the same on-state resistance the area of the device must then be increased. In fact, the area must be increased in proportion to the 5/2 power of the voltage.

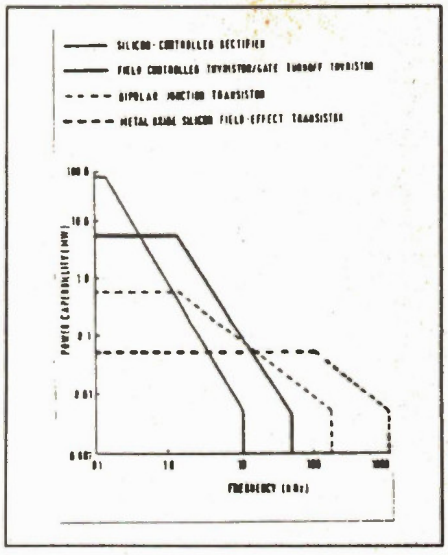


Fig. 1. Power-handling versus frequency of operation for various semiconductor devices.

Thus, at voltages above 600 volts, the on-state resistance would be too high to be practicable. Another disadvantage of the MOSFET is that there is an intrinsic inverse parallel diode produced as a necessary part of the manufacturing process. This diode may have very poor switching characteristics but in reality the situation is worse still - the diode is really a parasitic transistor. If the base of this transistor (connected to the substrate) is too high the transistor can be triggered on when the device is reversed biased. In our experience MOSFETs give good service at voltages below 200 volts. In other applications they are particularly useful for turning off GTO's and power transistors!

There has been a great deal of informal argument on the virtues of FETs versus transistors. The consensus at present is that the ultimate limit is the actual silicon itself and that the technology is presently only approaching the limit.

Other forms of MOSFET for example insulated gate transistors incorporate MOS devices and transistors in one package to give the easy drive characteristic of an FET with a low on-state voltage of a transistor.

These devices have had varied success but do not at present appear to be a major contender at voltages above 600 volts. The power-handling capabilities of the switching device discussed above are compared in **Figure 1.**

The Future

A new process recently announced in the UK uses ion-implantation methods to produce power devices with voltage ratings of 25 to 100 KV. The technology can also be applied to diodes to give the same high voltage ratings with zero on-state voltage

drop. This technology is new but quite clearly it will find widespread applications if the performance claimed about is achieved.

Apart from this a great deal of effort is going into GTOs, FETs, and the transistors in Europe, USA, Japan, and indeed China and the USSR. There is a great deal of interest in Field Controlled

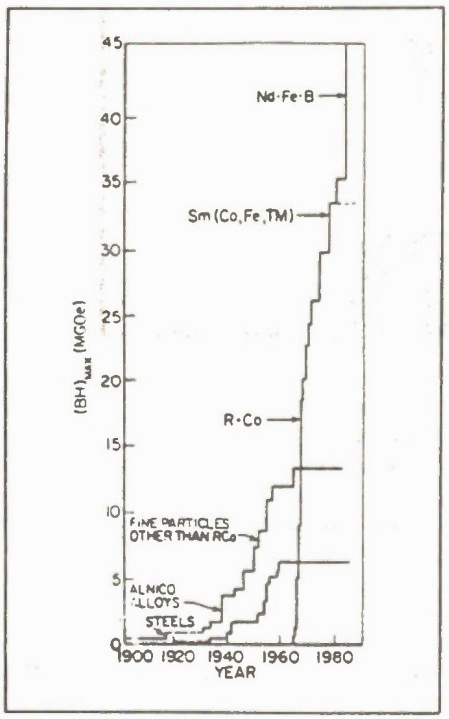


Fig. 2. The evolution of strength of permanent magnets during the last 80 years.

Thyristors (FCTs) on their own and in combination with FETs and bipolar transistors, and switching devices. Five years from now are likely to be radically different from those we use today.

Electrical Machines

Improvements in semiconductor materials have rather overshadowed some very dramatic recent developments in magnetic materials which are beginning to have a marked impact on electrical machine design. For soft magnetic materials there is the promise of substantial reductions in core loss with the use of amorphous alloys of FeNi B Si. Potential savings have been estimated as equalling 1.5 to 2% of all electricity consumed in the US. More important, however, has been the rapid evolution of powerful new permanent magnet materials, progressing from Alnico alloys to ferrites to the rare earth alloy Samarium-Cobalt. The 1983 discovery that Boron helps from ternary compounds with iron and light rare earths, such as Neodymium, has led to a new class of permament magnets for which it has been claimed: "The energy product is so large that it will revolutionise the design of motors".

Figure 2 shows the evolution of the energy product (a measure of strength) of permanent magnets during the last 80 years.

The rare earth magnets are used as stator poles in DC servo motors of conventional form, to provide much improved performance in a given frame size. A more versatile form of machine incorporates the permament magnet material into the rotor and with a conventional polyphase stator winding this may be thought of as a permanent-magnet synchronous machine.

However, if the stator windings are electronically commutated from a DC source with the aid of a shaft-mounted position sensor the combination is known as a "brushless DC machine".

DC Machines

The traditional DC shunt and series machines may of course be used with power electronic devices. Shunt machines are often used in Thyristor-Leonard configuration while series machines have widespread use in forklift trucks. These machines have changed but little as the switching technology have developed. Inside the outstanding probelm and limitation inherent in these machines, the commutator, has been the major incentive to develop all the other new machines.

AC Machines

- Squirrel-cage and wound-rotor induction
- High frequency induction
- Synchronous
- Permanent magnet
- Brushless DC
- Synchronous reluctance
- Stepper

Other machine types such as split-phase, shaded-pole etc. are not included here as they are in principle available only in small sizes. With the exception of the induction motor, the high frequency induction motor, and the brushless DC motor, all of these machines essentially have "angle" information present in their input. Thus these drives in principle offer speed and position control but the implementation of these control options may be expensive and complex.

It has been said that "a brushless DC machine is another name for a permanent magnet synchronous motor with rotor position feedback". The circuit of a brushless DC system for electric vehicle propulsion is shown schematically in **Figure 3.**

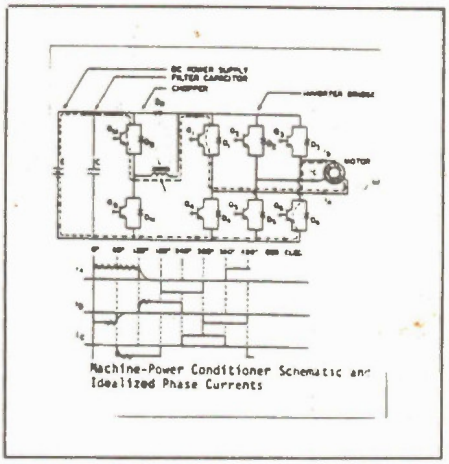


Fig. 3. The circuit of a brushless motor drive for electric vehicles.

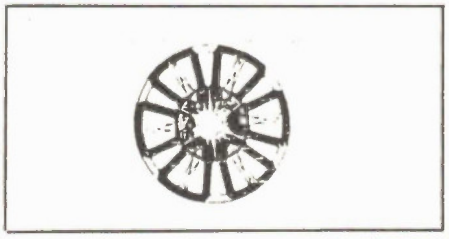


Fig. 4. The cross-section of a typical brushless motor.

Current is fed to the stator windings via a power conditioner which consists of a chopper for current magnitude control and a three-phase inverter-converter bridge. The power conditioner control logic receives information on the rotor position which is translated into one of six discrete current states as shown in **Figure 3,** corresponding to orientations of the armature spaced at intervals of 60 electrical degrees in the direction of rotation. This is the process of electronic commutation.

Brushless motors using samarium-cobalt motors have very high specific outputs to the point where they can outperform hydraulic motors, are highly efficient and require relatively simple inverters. The cross-section of a typical motor is shown in **Figure 4.**

The brushless DC motor is being applied to such tasks as machine tool spindle drives, electric vehicle propulsion, and flight control actuation in sizes of up to 30KW peak output. High efficiency designs of conventional induction motor have been successful in reducing motor losses by as much as 10% but further gains seem unlikely. Permament Magnet (PM) synchronous motors, however, have a potential for superior efficiency and power factor in high duty factor applications such as pump, fan, and compressor drives. Prototype self-storing PM motors using samarium-cobalt and ferrite mag-

Precision Audio Design

Optimizing the standard common emitter for professional performance.

By Bill Markwick

IN THE circuit of **Fig. 1** is the standard common-emitter amplifier that you've seen a thousand times before, used in everything from our projects to various commercial products. There really isn't anything wrong with it; the circuit AC and DC parameters are stable with variations in temperature and supply voltage and it does a good job of amplifying microphone or line level signals.

However, when it comes to applying the circuit to professional audio or instrumentation design, some circuit optimizing can better suit it to particular applications. Pro design is distinct from hifi, say; the major difference is the fact that the circuit must be able to function under all sorts of heavy duty circumstances. The stereo amplifier, by contrast, is generally used under polite conditions with all the operating parameters known, or at least well under control.

But before we can begin rebuilding the circuit, we have to know a lot more about all its specifications and the conditions it will need to meet.

And now, the disclaimer: it isn't possible in one short article to explain each step in depth, showing such things as a circuit model with the gain calculated to a fraction of a decibel. Referring to books on basic amplifier equations and basic feedback theory will shed a great deal of light on my gyrations as we mutate the circuit.

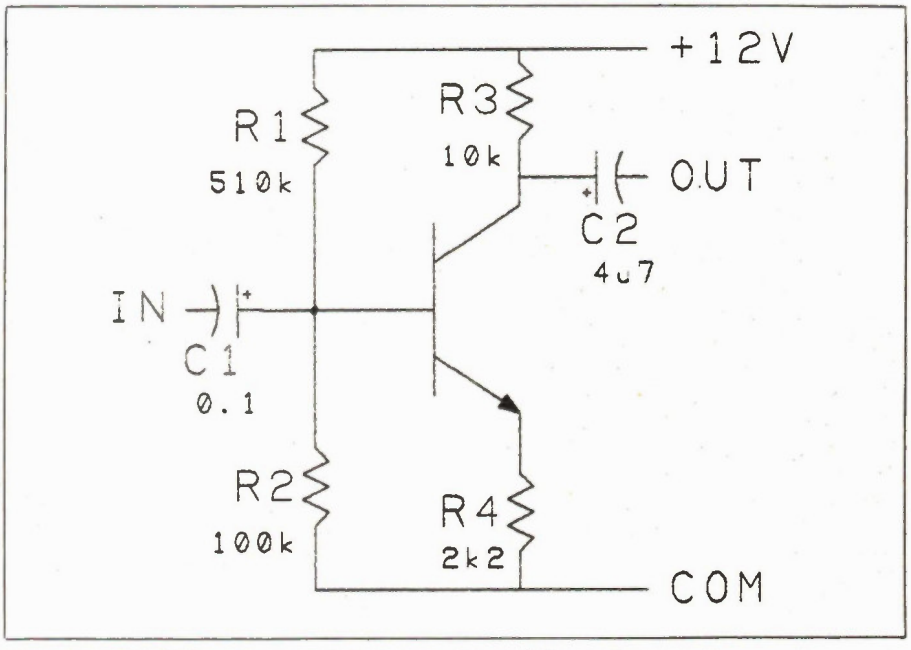


Fig. 1. The standard common emitter configuration used in countless circuits.

Dissection

First, it's best to view the amplifier as a black box; we aren't concerned with circuit niceties at the moment as much as we are the input and output characteristics. In other words, we want to know everything that's going to happen to our signal, good and bad, when we pass it through the box. The list of good things to know: input impedance, output impedance, gain, maximum output voltage, maximum input voltage and frequency response.

To keep the article to a reasonable length, I'm going to have to pull some equations out of a hat. You can find most of the basic calculations explained in various books on basic transistor and op amp design, though some of the shortcuts and rules of thumb may be missing. **Fig. 2** shows the circuit with various AC and DC parameters marked.

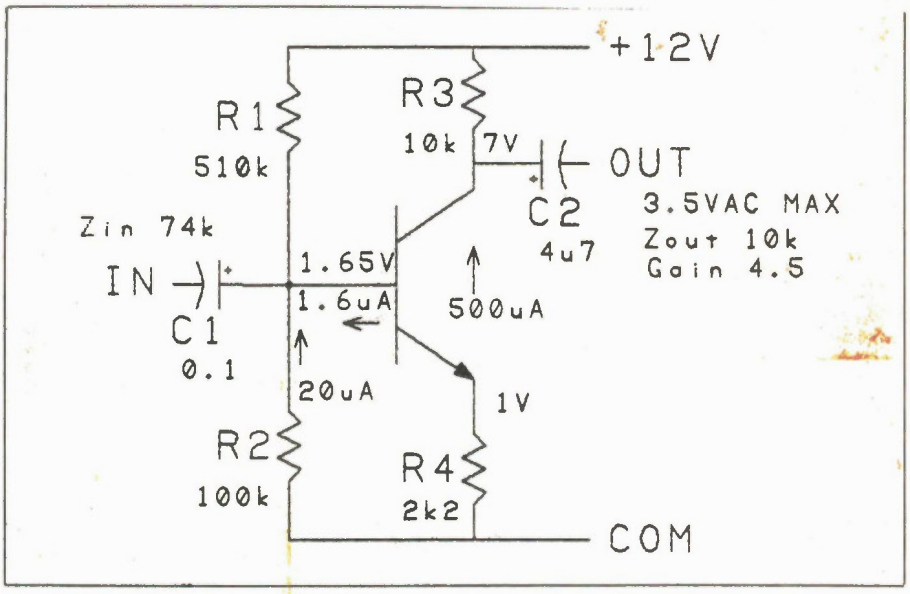


Fig. 2. The circuit of Fig. 1 with AC and DC parameters marked.

Input Impedance: The input impedance of Fig. 1 or 2 is basically R1 in parallel with R2 in parallel with the input impedance of the transistor. For our purposes, we can work with a ballpark figure just to see if the circuit is anywhere near a desired figure; if it's on the edge, you can always apply more complete equations. The impedance of a common emitter stage can be quickly estimated by multiplying the transistor's DC current gain (HFE or Beta) by the emitter resistor. 300 is a reasonable HFE estimate for small-signal audio transistors.

Our impedance is then 83.6k (the biasing resistors R1 and R2) in parallel with 300 times 2200. This boils down to about 74k.

A few corners have been cut, but at least the figure is within 20 percent or so, and we can class the amplifier as a medium-to-high impedance input type.

Output Impedance: The output stage of a common emitter is a current source (the collector lead) in parallel with a resistance (R3). Since the collector circuit of a small-signal transistor is rather high in resistance (above 100k), we can assume that the output impedance will be equal to the collector resistor, at any rate for collector resistors less than 10k.

Gain: A quick look at gain can be had by dividing the collector resistor by the emitter resistor, giving a gain in this case of about 4.5.

To get a little closer, we have to find the resistance of the transistor's internal emitter circuit, and at room temperatures, this can be estimated closely by 26/Ie, where Ie is in milliamps. This value is added to the external emitter resistor. For circuits such as ours, it won't make much difference in terms of a quick estimate (at 1mA, it adds only 26 ohms to the 2200 ohm emitter resistor).

These shortcuts only work if the output terminal is open-circuit and the collector resistor is 10k or less. If the stage is driving a load such as a volume control, you'll have to parallel the load's resistance with the stage's output impedance. See the next section.

Maximum Output: Knowing this value is important to designing a unit that won't be plagued with clipping distortion. For instance, I've tested an economy-model CD player which runs the audio output from the 5V logic supply to cut costs. The maximum output was just over a volt, forcing them to preset the average line output level to about 200mV to prevent clipping from the wide dynamic range. The volume of the CD player is then well below that of the turntable and tuner.

Assuming that the circuit is not driving an external load, the output voltage is a function of supply voltage. On positive half-cycles R3 will pull the output up to the supply rail, and on negative half-cycles, the transistor will pull the output down to ground. The RMS voltage value is then V+/2 times .707, or V+ times .353. In our circuit, this is about 4.2V.

This assumes perfect performance, which you won't get. The common-emitter output is inherently unsymmetrical; the transistor/emitter resistor can pull down to ground harder than the collector resistance can pull up to the supply rail, but the transistor can't really saturate to ground because of the emitter resistor. Any load connected to the output produces a sine wave with a flattened positive cycle as the output nears its maximum value.

But in any case, we have a figure to work with.

Headroom: This is related to the above (not to Max). If a 500mV signal out of our amplifier will drive the following stages to the required final output level, the headroom is defined as the difference in dB between our amp's maximum output and the 500mV output. It's a measure of how well the preamp can handle unexpectedly large signals, and the more, the better. In our case, assuming 3.5V maximum output, the headroom is about 17dB. This isn't spectacular, but acceptable.

Maximum Input: This is nothing more than the maximum output divided by the gain; in this case 4.2/4.5 or about 930mV. What this figure means to us depends on the application.

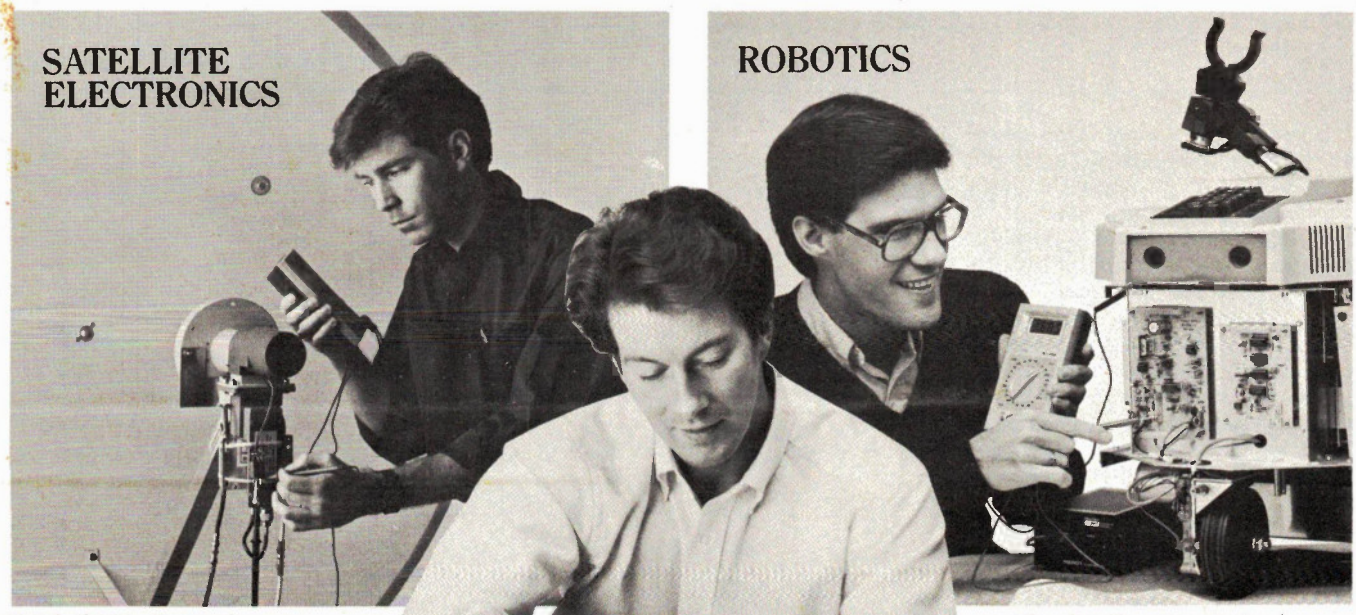
Frequency Response: Most small signal-signal transistors have very good current gain out to very high frequencies. The spec is known as Ft, the frequency at which the current gain falls to one, and is probably in the neighborhood of 300MHz. For purposes of audio, you will usually have a far wider frequency response than you need, though this may not be true with some op amps. A single-transistor stage like ours will probably have an upper limit of several hundreds of kilohertz. Designing with frequency response in mind will be covered in the future. The lower limit is discussed further on.

Decisions

Whether or not we tinker with the circuit depends on its final use and what the signal conditions will be like.

If it's used as a preamp, the input signals may be very wide-ranging in level, and to complicate things, the volume control comes later in the circuit and won't affect the input conditions.

Let's assume that the stage is to be used as a preamp for a high-impedance microphone. Microphones present a real challenge to the designer; the users will vary from a whisperer six feet away to a shouter swallowing the microphone. The resulting average signal level might vary



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from 30mV to 10V or more. This ten-volt figure might seem far-fetched, but it happens, especially if the incoming sound matches some internal resonance of the microphone. Another reason I chose a hi-Z mike, clever devil that I am, is that they aren't noted for low-noise performance, and get us around the problem of designing for best noise performance, which will have to wait until a future issue.

Suppose the manufacturer's microphone spec calls for a minimum input impedance of 100k and a maximum of 200k to avoid changing the frequency response.

Lastly, the preamp is to be used to drive a 10k volume control; in addition, the volume control feeds another stage with an input resistance of 20k. The signal level at the volume pot should be 500mV.

Begin the Tinkering

The first task is to decide on the voltage gain required; this will largely determine the type of design. If the mike output can be expected to swing from less than 30mV to several volts or more, we might take an average level of 100mV as a design centre. We then need a gain of five to feed 500mV to the volume pot. The circuit as it stands is fairly close to this.

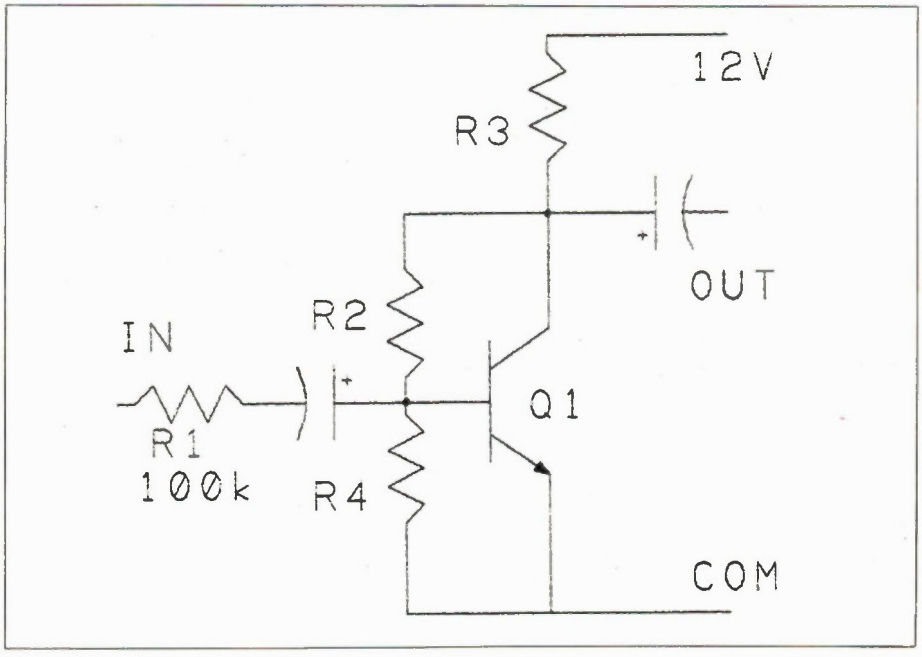

Fig. 3. A feedback version of the common emitter. There are some improvements over the standard, but gain is difficult to change and is affected by the source impedance.

However, when the sound source is too soft for enough output or loud enough to overload the amplifier, your only choice is to move the microphone, something that isn't always possible.

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variable gain, giving us much more control over varying signal levels. One way to do this, and a popular one, is to run the amplifier at high gain and then put an adjustable resistive attenuator on the input terminal. I'm not a fan of this method; it's fine for non-critical applications, but the signal to noise ratio is degraded because the amp runs full tilt all the time.

The circuit as shown had a measured gain of 4.3 and a maximum output of 3.5V RMS unloaded, giving a measured maximum input of 810mV. If a 10k load is connected, the maximum output falls to 1.6V. Already we have problems.

Emitter resistor R4 can be increased to lower the gain, and a switchable series resistor-capacitor from the emitter to ground could bring it back up to a desired value. Unfortunately, introducing extra resistance into the emitter circuit worsens the already poor maximum voltage swing; with R4 changed to 4k7 (and the biasing adjusted), the maximum swing is only 2.5V RMS, giving an input overload voltage of only 580mV. Not much for handling a high-output microphone.

How about increasing the power supply voltage? This is a good idea if you can arrange it. I chose 12V because it's a common value used in many projects and circuits, but if you're designing from scratch, a 24V supply is a better idea, or even a plus-and-minus 15V op amp supply. Each doubling of the power supply voltage increases the output capability by 6dB. However, as you'd expect, there are limits; high-voltage transistors may not be low-noise types, the power dissipated increases, and capacitor size and cost increases with voltage rating. For now, we'll work with the 12V rating.

One Small Step

How about running the transistor at full gain with no emitter resistor and using overall feedback? The circuit shown in **Fig. 3** would do; the input resistance is equal to R1, the gain is R2/R1, the DC biasing is very stable, and the output resistance is divided by the open loop gain minus the closed loop gain (see any book on basic feedback theory). R4 is a high-value resistor added to increase the DC current through R2 in case the base current of Q1 should wander with temperature (which it will).

Two new problems arise as if to cancel out some of our improvements. First, the circuit gain is set by R2/R1, and R1 is in series with the microphone impedance. This means that the gain will stray as the microphone impedance changes, and may change radically if a different type of microphone is used. Also, the thermal noise generated in R1 will be in series with the microphone, degrading the signal to noise; the gain can't be easily changed without affecting either input impedance or DC bias. Secondly, the new lower output impedance does nothing for the current handling; the clipping point will still be too low into the rated load.

If we accept the dubious placement of R1, the current handling can be improved by adding an emitter follower to the output. This will give us a more acceptable current swing into the rated load, and the circuit output impedance will be approximately equal to R3 divided by the HFE of Q2. The quiescent current through Q2 should be chosen so that it's greater than the required peak current into the rated load. **Fig. 4** shows a revision of the feedback method; a resistor is added in series with the gain pot to prevent it from shorting the feedback loop at its minimum setting.

Incidentally, the transistors in all the circuits of this article can be any 30V, 300mW low-noise types, such as BC109C,

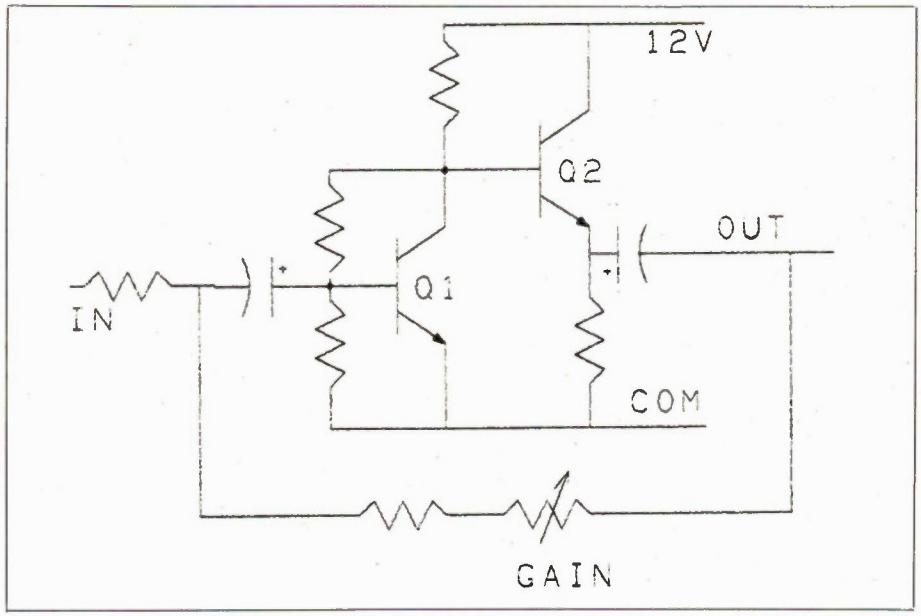

Fig. 4. A version of the feedback circuit in Fig. 3 with an emitter-follower added for current-boosting and the AC feedback loop moved outside to simplify gain changing. The input resistor remains a problem.

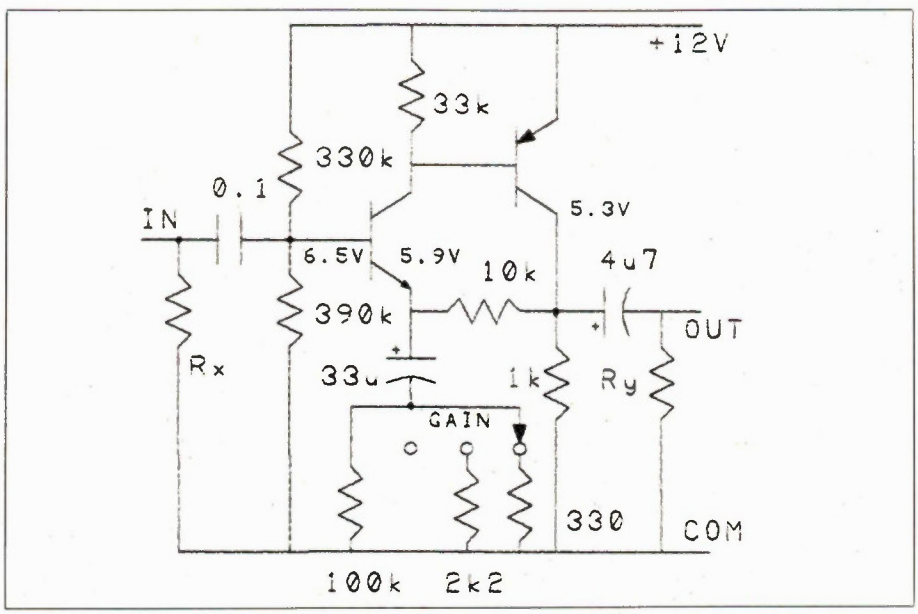

Fig. 5. A two-transistor version with variable gain, fixed input impedance and an improved output capability. The few added components give a considerable improvement over the other versions.

BC549, 2N3904, etc. for the NPN, and BC559 or 2N3906 for the PNP.

This isn't the most elegant of circuits, but it has distinct improvements over the single-transistor version.

Getting It Together

We're almost there. We have only to solve that irritating input resistor problem and we'll have a circuit that matches nearly all our requirements.

We could always put the input biasing resistors back the way they were in Figure 1, but we'd still have the gain-changing/signal swing problem. Let's see if we can't wring a bit more performance out of Q2. After all, at the moment it isn't doing much more than providing current gain into the load resistance. If we're going to add another transistor, we might as well exploit its voltage gain possibilities and take our feedback idea one step further.

Fig. 5 shows the emitter-follower stage changed to another common-emitter (Q2 becomes a PNP to simplify AC and DC feedback to Q1's emitter). The output resistor is chosen as 1k, giving Q2 a collector current of about 5mA. The output is then fed back to Q1 through the 10k feedback resistor; both AC and DC feedback use the same resistor. The collector current of Q1 is basically the current out of Q2's base; I've increased this current by adding the 33k resistor to minimize current variations due to temperature. The 330k and 390k set the bias to give Q2 a symmetrical voltage swing at full output. The voltage drop of 0.6V across the 10k feedback resistor is caused by Q1's collector current of 60 microamps (part of which goes through the 33k and part into Q2's base).

If we neglect the 33u capacitor and associated resistors, what we have now is a very high gain amplifier which is forced to unity gain by total feedback through the 10k. The input impedance is determined by the parallel combination of the 330k and 390k, or 180k ohms; the reason for this is that the feedback at Q1's emitter bootstraps the transistor's input impedance to a high enough value to be negligible. The output impedance is dropped to a very low value by the feedback; it'll be in the neighborhood of 100 ohms or less, depending on the gain setting. The 5mA quiescent current through Q2 gives full signal swing (about 3.9V RMS) into the following load.

Now we'd like to be able to control the gain. This is where the 33u, the switch and the three resistors come in. I've chosen three resistors to simplify things, but there can be as many positions as you'd like, or you can substitute a pot for the gain switching resistors. The disadvantage to using a pot is that a value large enough to give low gain crams all the high-gain adjustment into one end of its travel; a reverse-log pot may be better here (if you can find one).

There's a 100k resistor permanently in the gain circuit; its purpose is to stop clicks in the signal caused by DC shifts as the switch is moved. The minimum gain with this 100k in circuit is about 1dB, for a maximum input signal of about 3.5V, adequate for average high-Z microphone use. When the 2k2 resistor is switched in, it shunts some of the feedback away from Q1's emitter, raising the gain to 5.5 (15db); similarly, the 330 ohm raises the gain to 31 (30dB). The equation for the gain is 1 + 10k/R, where R is the gain resistor to ground. A gain of about 300 (50dB) is the most you should go for; the circuit isn't optimized for the very best of distortion figures, and total harmonic distortion rises over 0.1 percent above 50dB.

Rx is optional; its purpose is to prevent clicks from the charging of the input capacitor when a mike is plugged into a live amp; it should be 1 megohm or more. Any thermal noise should be shunted by the microphone impedance. Similarly, Ry has a typical value of 47k, and prevents clicks if the output is switched; it can be omitted if the circuit is permanently wired to a volume pot.

The circuit will also make a good preamp for low-impedance unbalanced microphones. The output of a low-Z mike is small enough that more gain may be required, perhaps up to 50dB, and some low-Z microphones exhibit a rising frequency response above 10kHz if they're run into a hi-Z input; a 1200 ohm resistor in place of Rx will prevent this.

If you'd like take the wise step of running the preamp at a higher voltage, say 24V, you probably don't even need to modify it. The various currents will double, and this is well within the capabilities of small-signal transistors. Make sure the capacitors have a voltage rating equal to or greater than the supply voltage.

Response and Stability

The 0.1u capacitor on the input gives a low frequency cutoff of 16Hz; the output 4u7 gives a lower limit of 5.6Hz into a load of 6000 ohms. These figures are reasonable for general use; sometimes the preamp is used to roll off the bass below 30 or 50Hz to minimize breath noise or handling rumbles. If so, the preamp is a

Continued on page 30

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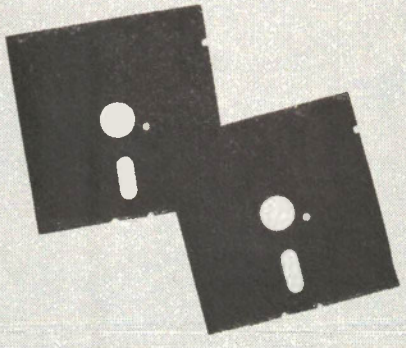

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VOLUME 22

Calendar This program prints up a calendar for any month in the twentieth century. It's very useful if you want to know which days people were being idle on in 1921, for example.

DFA This is a really strange disk accelerator program which attempts to anticipate which sectors your software will call for and fetch them when the computer isn't busy. It can speed up some sorts of programs quite noticeably.

FSDebug Essentially this thing does the same thing as the DOS DEBUG program, but it does it so nicely. You can scroll forward and backward through a disassembly, set breakpoints, trace code and so on, all with a full screen display.

GRAB.ASM This is the source file for the graphics grab program in the March 1987 edition of Computing Now! Requires MASM to assemble.

Scroll This is a resident scroll lock key enhancement. It's not all that exciting, but, then, at two hundred and forty-seven bytes it's not all that big either.

Sideways This thing lets you print awkward sized documents sideways on an Epson printer.

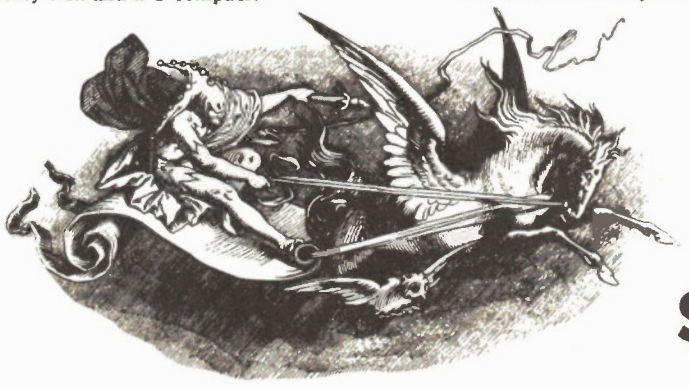
PLAYSONG This is the source code for the linkable interrupt driven music playing package from the March 1987 edition of Computing Now! It also includes the MUSIC.C demonstration program. Requires MASM to assemble and a C compiler to deal with the demo.

ZapDraw2 This is the C language source file and updated header file for the text and graphics module from the February edition of Computing Now! It embodies several significant enhancements over the published version, including a writing speed increase of about ten times. Requires ZAP 1.C from ourvolume twenty disk and a C compiler.

PINBALL2 If you wasted a meaningful part of your life on the pinball game simulation from our volume seven disk, this one will help you ruin what's left of it. It's the fastest, most colourful... weirdest... pinball program to date.

Macshow This program allows you to look at Macintosh MacPaint image files on a PC. It will also print them and convert them to PC compatible bit maps. Several sample pictures are included. Requires a colour card.

Willy The Worm This is a really fast graphic game in which you try to get willy the worm home. It's extremely strange.



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VOLUME 21

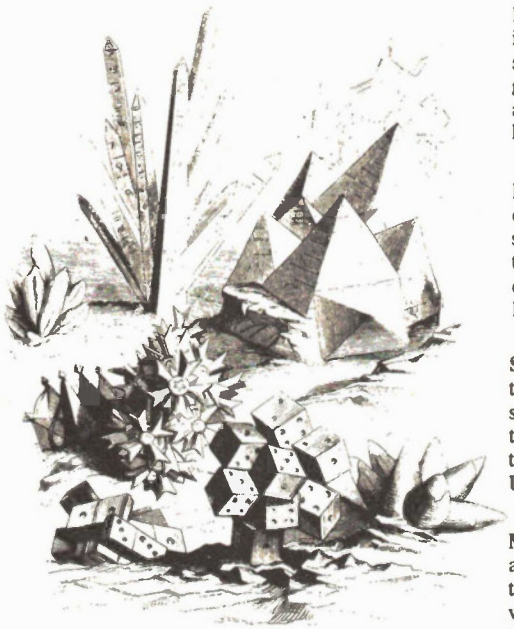
Cache A disk cache program allows one to vastly speed up the disk access of a PC by stashing frequently used sectors in memory. This public domain cache program is extremely fast and fairly intelligent as to which bits of oxide it decides to retain.

Corewars Perhaps the first program to truly embody the spirit of the phrase "computer game", Corewars pits two programs against each other. The object of the game is to crash the other code. Quite a blast when space invaders has lost its allure.

Emacs This is the very last word in well executed programmers' text editors. It has multiple windows, macros and will even create a DOS shell for you so that you can skip out for a while to execute another task. Requires NANSI.SYS, below.

MTS The drag about DOS is that it only wants to let you run one program at a time. With MTS you can run two, flipping back and forth between them at the stab of a key. This is the first one of these things we've seenthat's bug free.

View This is the fastest full screen file browser in creation. It allows you to page back and forth through a file... it's a much slicker approach than the DOS TYPE command. Requires NANSI.SYS, above.



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NANSI.SYS. A replacement of ANSI.SYS, the improvements in the performance of your system that NANSI can lay down are almost godlike. It includes a high speed screen driver and additional escape sequence screen handlers.

MIDIzap Figuring out the secret codes that drive some of the more sophisticated MIDI instruments is a lot easier if you have something to send and receive them with. This little MIDI debugger runs with the popular Roland MPU-401.

Shell This is a COMMAND.COM replacement that implements a Unix-like environment. It supports a lot of features that DOS would like to have, and a much tighter command structure. It's surprising how easy it is to get to like Unix.

Musicsystem This is a pair of programs which allow you to edit and play three voice music on the PC. You may wonder how one gets three voices on the PC's speaker... it's tricky, but this code manages it. Several sample songs are also included. Not terribly happy with PC/ATs.

Dev This a tiny utility that will locate the device drivers in your system's memory. Includes the assembler source code.

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VOLUME 20

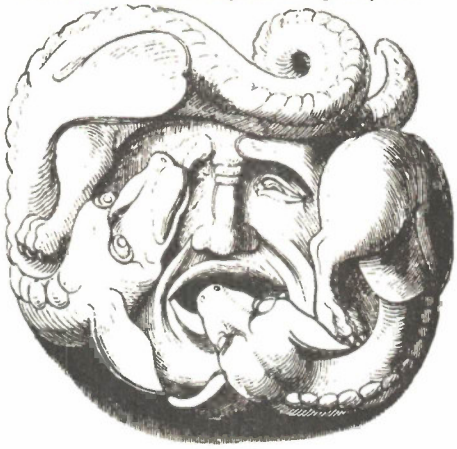
ARTIFICIAL ART This is one of the most useless programs anyone's ever written, but you'll probably spend a lot of time running it. It generates an ever changing graphic image on your PC - with accompanying sound. While it may seem a bit pedestrian, it's a gas to watch. Requires a colour graphics adapter.

AsEasy This is a public domain spreadsheet package, very similar in its abilities to the more popular functions of Lotus 1-2-3. Unlike Lotus, it doesn't cost anything and it isn't copy protected.

ASYNC This is an assembler file which creates a device driver to make the PC's serial ports behave as they should, with interrupt driven buffered inputs and outputs. This is a programmer's delight. Requires MASM to use.

ZAPDRAW This is the C source code for the Graphics in C article from the January 1986 edition of Computing Now!. It creates a general purpose high speed PC graphics library, suitable for use on both the colour card and the Hercules board. Requires Lattice C or something similar.

ChessII This is one of the best chess programs yet devised for the PC. Aside from being small and fast, it lets you physically pick up the pieces and move them rather than entering board co-ordinates. Plays an evil game, too.



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PITFALL This is a supremely clever ASCII game. Aside from being an absolutely superb game in itself, it's a clever use of the PC's screen. You get to pilot a spaceship down a winding, rather nasty pit. More fun than being beamedginto a supernova.

RAMDISK Once you've installed a normal RAM disk, it's there for the duration. This one allows you to change the size of the disk on the fly, or blow it away all together, without having to reboot anything.

HAUNT This is a haunted house adventure game. You wander around looking for the mysterious pumpkin man while picking up things, encountering ghosts and, if you're not careful, getting busted for shoplifting. Very nicely executed, and it doesn't require any graphics facilities.

LPTX The most flexible printer redirection program imaginable, this thing lets you set up virtual printers, that is, disk files to capture the output of things that think they're printing. Includes both executable and source files.

VOLUME 19

BOTH If you print out a lot of documents, manuscripts, program listings or other manifestations of hard copy, you'll have noticed that the backs of the pages usually look a bit bare. This program can slash your paper bill by allowing you to print long files on both sides of the sheets

DIAGS Written by the author of Z80MU, this collection of tools will be nirvana for the experienced PC programmer. It does things like generate an annotated list of all the interrupt vectors in your PC, let you meddle with the 6845 registers, test most of the ins and outs of your system and so on. It's a brilliant bit of work.

GRCP Graphic cut and paste is a memory resident tool that allows you to scoop things from a PC high resolution graphic screen and pop them into other applications. Shades of the Macintosh.

LOCKERUP This tiny microbe of code sleeps in your system until you have to leave your PC for a while. Then it enables you to irrevocably lock up your keyboard until you come back to restart it. It's perfect for offices where there are more fingers than hands to contain them.

MEGAPEDE Just when you thought that it was safe to play ASCII games again... This one is a sophisticated variation of the classic "snake" programs and it plays with the speed of a boa constrictor. Don't count on winning for a while.

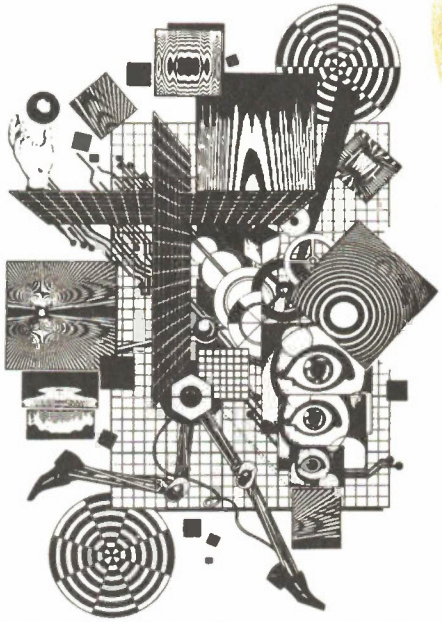
MURPHY Sort of an iconoclast in a can, this program will print a random selection of several hundred of murphy's laws, corollaries and commentaries thereon each time it's run. If you put it in your AUTOEXEC file it will say something clever each time you start your computer. Slaughters more sacred cows than McDonalds ever will.

QUEBERT This fast PC implementation of the classic arcade game is every bit as exciting as the real thing but lacks a coin slot. Jump down the mountain, avoid the snake and try not to get clobbered with fresh fruit. Sounds like real life...

SAT This is a powerful, menu driven satellite data downlink terminal, as discussed in the December 1986 edition of Computing Now!.

SCAV This is a great program for people who buy economical floppy disks and just about everyone else who can't afford a clean room for their PCs. It cruises through one's disks locking out bad sectors and restores previously 'fried' disks to usefulness. The ASM source code is included, as well as a COM file.

SimCGA If you own a Hercules card you'll have encountered the intense frustration of not being able to use programs written to employ the graphics of a standard colour card. This utility does an astoundingly good job of making the Herc card behave like a colour graphics adapter for quite a lot of software.



STUFFIT Stuffit is a disk management utility which stuffs files into the inner tracks of a floppy disk, allowing the outer tracks to be used for work space. This improves the disk access times and the reliability of mostly full disks considerably.

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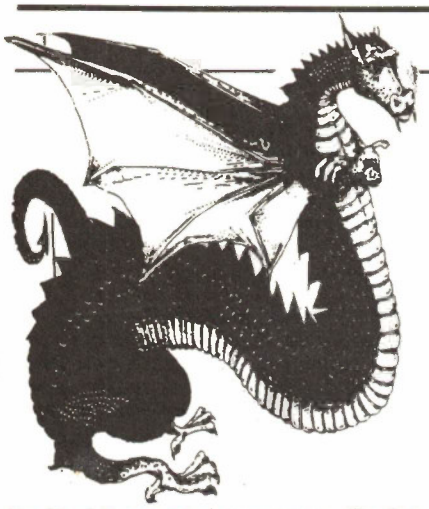


Bradford Fancy printing programs, like Printrix and Fancy Font, are slick but expensive. This public domain version does much of what they do, but it does it for free. Requires an Epson or Gemini dot matrix printer.

ZOARRE This is another dungeon game, but terrifically well done and very intricate. It displays a picture of the room you're in, zaps you with various monsters and generally tries its very best to kill you. If you liked Castle you'll freak over this one.

DIVERTFN This is a tiny program which doubles the effective screen printing speed of most programs which print through DOS.

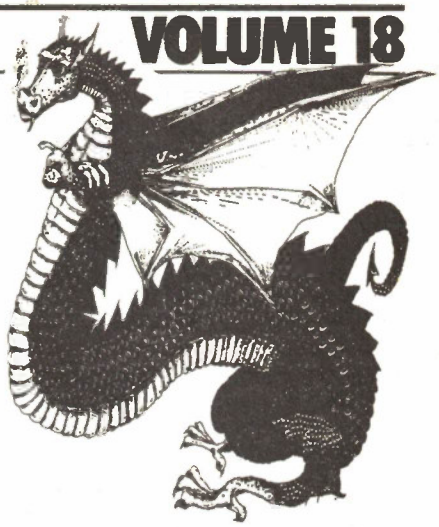
DONKEY KONG This is a pretty snappy public domain implementation of the classic arcade game. Getting squashed by oil drums is more fun than anything. Requires a colour card.

MASTERKEY The Norton utilities are extremely handy, but they're also expensive. This public domain disk manipulation program offers much the same power for nothing. It offers track and sector editing, unerasing files, and all the general low level fiddling that the expensive programs do.

POPCALC This is a clever bit of resident code that implements a moderately sophisticated calculator which pops up whenever you hit "ALT-C". It's fast, harder to lose than a real calculator and takes up a minimum of system overhead.

PRINTER This is the PRINTER.BAS program from the December 1986 edition of Computing Now!. It reprograms the high end characters of an Epson FX-80 (or compatible) printer to make them print IBM PC screen block graphics.

VOLUME 18



QUICKEY This little program speeds up the keyboard action.

Card This is the draw poker machine program from the December 1986 edition of Computing Now!. It's included here both as an executable COM file and as source code in C.

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VOLUME 17

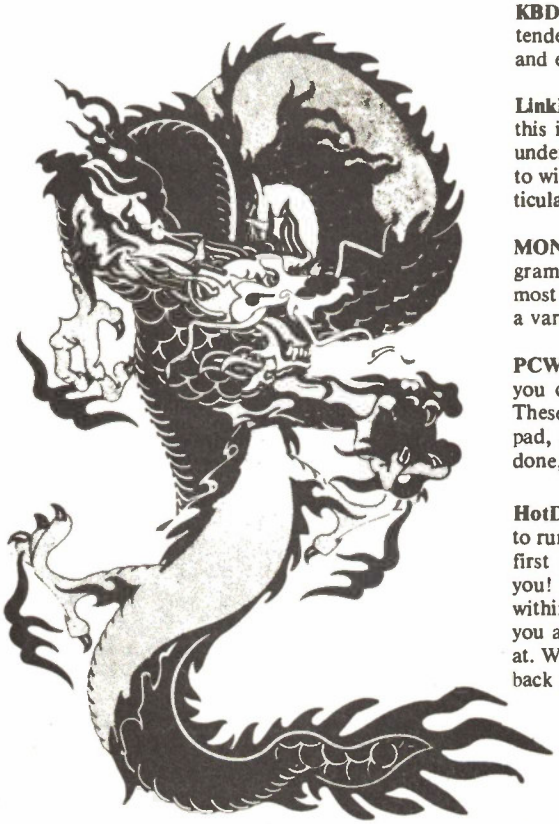
ARC512 This is the latest version of the de facto standard PC file compression and archiving utility. It will create, maintain and crack unpack ARC files, providing a convenient way to reduce the size of files and to merge pots of little files into a single larger one. See the November 1986 edition of Computing Now! for more about this.

ATC ATC stands for "Air Traffic Controller". In this colourful simulation of the rigors of managing the planes at a busy airport may, among other things, renew your interest in train travel.

Draw Poker This is a really slick little poker machine simulation. The graphics are good, the play is fast and the machine doesn't always win. It's a shame it won't spew silver dollars out of your disk drives.

HercBIOS This set of routines will allow you to display text on a Hercules card when it's in one of its graphics modes - just as you can with a colour card. It will intercept the 10H interrupt vector so that anything that normally tries to print to the colour card will also work for the Hercules card.

PD This program redirects the output of one's system from the printer port to a disk file. It lets you to use things that normally insist on having a printer on line even if you don't own one, or don't want hard copy.



KBD This is a very tiny keyboard buffer extender. It's a useful few bytes to have around, and extremely tiny.

LinkFour A simulation of "Connect Four", this is a deceptively simple game. It's easy to understand, but requires practice if you want to win. The graphics and sound effects are particularly good.

MONEY Yet another Canadian mortgage program, this easy-to-use program is surprisingly most colourful. It will also calculate charts for a variety of financial situations.

PCWindow This is a resident utility which lets you call up a number of useful "windows". These include an elaborate event timer, a note pad, an ASCII code chart and so on. It's well done, fast, and fairly small.

HotDos If you've ever found yourself wanting to run a second program without quitting your first application, then HotDos was made for you! Hit its control key combination from within most popular programs and it will give you a DOS prompt to run any other program at. When you're done, type EXIT and you'll be back in your first application.

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ARCDIR The archive file compression system is the most efficient way to store large files in a small space. However, it's weird and complicated. This simple ARC directory utility was featured in the November 1986 edition of Computing Now!. Aside from being useful, it includes both a COM file and the source code so you can see how it works. Requires a C compiler if you want to meddle with it.

BRICKS The "Little Brick Out" game is one of the classic programs for microcomputers. This splendid version will get you turned onto simple games all over again.

DX This is a small DX-7 voice librarian, as found in the Book of Computer Music. It includes both a COM file and the assembler source code.

MOREROOM If you have a hard drive system you may have noticed that it's extremely inefficient with small files. Here's a collection of tricks to get substantially more space on your disk.

E88 While huge word processors like WordStar and PC-Write can be used as text editors, they're hardly very good at the task and they gobble a lot of disk space. If you're trying to manage a C compiler or an assembler on a pair of floppies you've probably encountered this. E88 is a tiny - but powerful - text editor.

EXPERT Commercial Expert Systems software is still in its technological infancy. If you're interested in learning about expert systems and how they relate to your computing needs, you should try this simple program.

FULLDOS A DOS enhancement program that makes the DOS user interface behave in a rather more friendly manner. It creates a command stack and lets you re-execute previous commands.

K9 This is yet another resident keyboard enhancer - with a difference. Aside from expanding the keyboard buffer, installing a screen timeout and so on, it makes a number of the alternate keys 'hot', giving you dozens of unique functions.

InstantMENU This is the code for the Instant Menus article which appeared in the November 1986 Computing Now!. With it, you can create elaborate batch file menus with absolutely no tricky programming. The menus can be easily altered with a text editor or word processor. Source code is included.

PALERT We've all occasionally run out of disk space while inside an application and discover that we've been dumped back to DOS unexpectedly. This is a serious drag if you've left a few hours of work behind you trashed in memory. This program warns you of an impending full disk.

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VOLUME 15

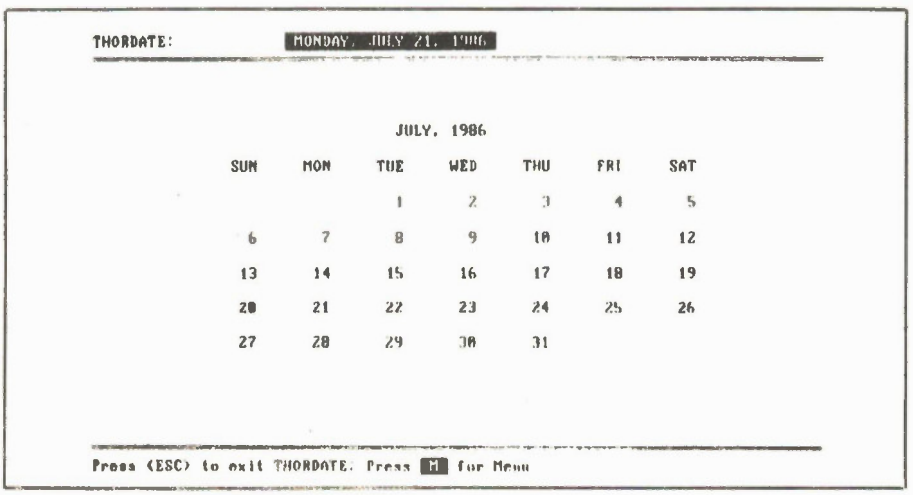
There is a lot of good stuff on this disk... but most important, there are two dynamite games herein. We could get into the graphics package, the CP/M emulator, the fractal program in C... however, it's the games that do it. Plan to lose at least a weekend over this one.

Altamira is one of the nicest public domain paint box programs available for the PC. Unlike most of the so called graphics packages available for the PC, this one isn't restricted to doing bar charts and graphs. It does first rate pictures. Requires a colour card.

Fractal is the source code for the fractal generator in C that we looked at in the August 86 edition of Computing Now!. It's useful even if you don't like fractals, as it illustrates the use of high resolution graphics in C. Requires a C compiler and a colour card.

NEMON is a really weird game. You get stuck in the catacombs of king Nemon with nothing more than your wits and a flashlight. You have to find some keys, some treasures and, hopefully, a way around a host of arcade game nasties.

Thor used to be the god of thunder. Now he appears to be the world's most sophisticated desk calendar program. He'll remind you of appointments, keep track of your agenda and do things that would usually require a host of low tech objects, like pencils and note pads.



Round 42 is a wholly bizzarre variation on the theme of space invaders. No longer the dusty arcade game that it once was, this thing breaths new and rather ichorous life into the ceaseless battle between you and the phospore aliens. This is one of the best computer games in creation. Requires a colour graphic card.

V20 is a CP/M emulator for users of the NEC V20 chip. Replace your existing 8088 with a V20, score this little program and most CP/M software will run on your system as if someone had stolen half the bits out of your PC. Regular MS-DOS isn't affected. Requires a V20.

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VOLUME 14

Cut and Paste is a memory resident program that allows you to grab text from the screen of any application and paste it into any other application that accepts characters for input. You could, for example, copy part of a Lotus spreadsheet and paste it into a WordStar document.

INT13 will help you unravel the copy protection schemes of your software so you can make archive copies... just in case the cat takes a fancy to your masters. It prints a log of direct disk accesses and where they're called from so you can check out the code that's going after specific tracks, the heart of most protection systems. Includes the assembler source code.

PMAP tells you what's living in the memory of your system and where it's at. It will help you to find the resident utilities you have loaded and, more important, is great for sorting out peculiar interactions between multiple resident programs.

SoftTouch is a keyboard macro program not unlike ProKey. It allows you to store up to twenty-five thousand key strokes, has a built in screen blanker and great wandering herds of other features.

Sub Chase is a first rate graphics arcade game. One sails across the clear blue sea... or green sea, depending on what sort of monitor you have... heaving depth charges off the stern to blow up subs. It's a lovely bit of carnage, and it has a panic button to clear the screen should the boss walk in. Requires a colour graphics card.

The Draw is an ANSI screen editor. It allows you to create and edit full colour screens of text and graphics which can subsequently be typed to make them appear... in full colour... or integrated into programs. It's a supremely brilliant program, and more fun than a baboon with a box of plastic bananas. Requires DOS two or better, ANSI.SYS and is more fun with a colour monitor.

Trek is the best Star Trek game anyone has yet devised for the PC. The graphics are stunning, the complexity is intense and the action scoots along at warp nine as soon as the program gets going. Requires a colour card.

Crossword is a utility to translate text files from one application to another. It covers several of the more popular word processors, including WordStar, WordStar 2000, Multimate, XYwrite, SideKick and straight ASCII. It saves ages worth of reformatting and does some useful things besides.

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VOLUME 12

CV is a small utility for changing the volume name on disks. Since most of us never bother to specify volume names when formatting disks, this six hundred byte program provides a second chance.

Breakout Box is an assembly language program that hides in memory and shows you what your serial ports are doing. It's a valuable troubleshooting utility for pin pointing serial printer and modem problems.

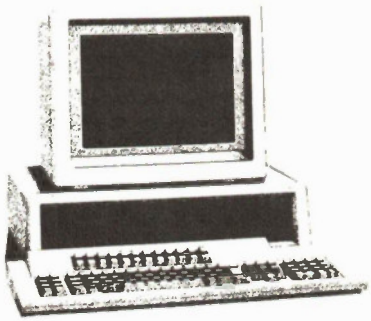
Icon Maker allows you to generate sophisticated bit-mapped images. Its' easy to use and extremely colourful, producing data that can be incorporated into other programs.

Shell is another DOS menu program. This one is very fast, free of 'snow', and provides easy access to virtually all DOS features.

Striker is an experience. It's a brilliantly written helicopter game in the style of Choplifter, complete with professional high resolution graphics and running spies. This is one of the best public domain games we've ever encountered.

Ramset is a RAM expansion program from the July 1986 edition of Computing Now!. It allows you exceed the PC's 640K memory limit. Ramset also lets you bypass the PC's time-consuming memory check.

Trap is the high-resolution Gemini patch program from the May edition of Computing Now!. It makes the Gemini 10x suitable for use with Personal Composer, but is easily modified to fix most bit-mapped printing problems. MASM and Link are required to assemble the program.



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VOLUME 11

Pac Girl is, predictably, a variation on the almost mythical Pacman game. This one moves fast, and plays much like the arcade version.

Menu lets you create a menu-driven tree-strctured environment that is friendlier and more manageable than is DOS. It's ideal creating interactive systems for non-technichal users.

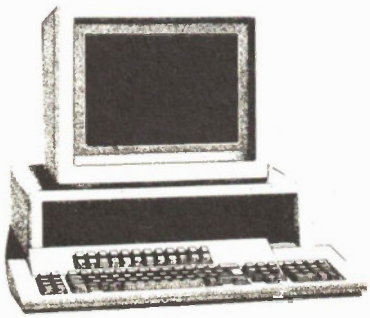
Z80MU is one of the most brilliant pieces of software we've ever encountered - free or not. It actually emulates a Z80-based computer running CP/M on the PC with no additional hardware - you don't even need a V20. It will run almost all CP/M software, including old favourites like WordStar and dBase. However, Z80MU also includes features lacking in both C/PM and MS-DOS operating systems.

SERIO is the assembler file from the July edition of Computing Now! that implements an interupt-driven terminal in higher level languages such as C. It's also suitable for use with compiled BASIC. Both MASM and Link are requred to use SERIO.

Breakdown is a peculiar program which takes meaningful text, analyzes it and generates meaningless, but profound-sounding prose from it. If you've been wondering if your co-workers *really* read your office memos and reports, try filtering your prose through this program. The effects will be astounding.

XMODEM is a C language implementation of the XMODEM file transfer protocol, from the July 1986 edition of Computing Now!. It can be integrated into other programs to ailow easy access to telecommunications facilities. This code requires SERIO (see above) and version three Lattice C.

GRABIT is the screen grab program from the July 1986 edition of Computing Now!. It will make a useable text file from the contents of ones screen at the touch of a key. MASM are Link are required.



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VOLUME 10

Monopoly is the first working implementation of the classic board game that we've come across - and we've had several that bombed pretty colourfully. This one is great, though, with fast and occasionally sarcastic play, a graphic board display and pretty good sound effects.

D20 is the latest version of Steve's sorted directory program. This one uses DOS two calls and handles subdirectories.

Edit is a lightning fast full screen editor, ideal for editing program source files, dBASE stuff or other ASCII phenomena.

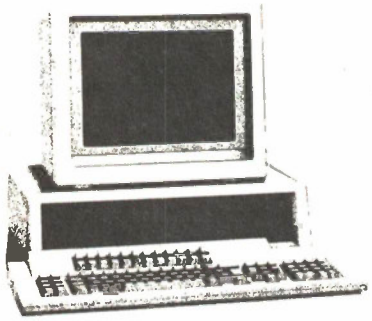
Banner takes mere text and prints it sideways on your printer - in gargantuan block letters that can be read from miles away if you have a good set of binoculars. It's not the sort of thing that you'd want to publish a book with, but sign makers will love it.

Mortgage is another utility to help you understand just what you've gotten yourself into. Its one of the nicest mortgage programs we've seen so far - lifelong debt and ruination has never been so well formatted.

Quick speeds up your PC quite a bit. It hooks into the video and makes it run a great deal faster, eliminating at least some of the glacial slowness that makes an IBM what it is.

Speech is a rather remarkable little germ of code. It talks through the PC's internal squeaker speaker. The voice isn't exactly human, but it's understandable on most machines. This is an interesting bit of work, one that can be accessed from within other programs to create talking applications.

PC-AR is an accounts receivable package for the PC. While not the equal of some of the commercial software that handles this function, it will take care of the records for a small or medium sized business quite well.



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VOLUME 9

Small C If you've ever wanted to try writing programs in the C language, this compiler will fascinate you. It's a restricted implementation of C, producing code which is compatible with Microsoft's MASM and LINK programs -you'll need these to get it going.

Map is an interesting little utility which will check how DOS is situated in the memory of your computer and tell you a number of things about it. It's a useful programming tool, especially helpful if you're debugging software which interacts directly with DOS.

Note is the source file for the memory resident note pad which appeared in the March 1986 edition of Computing Now! It requires MASM and LINK to use. It will create a resident memo page that you can call up from within any application.

Pango is one of the wildest games we've come across for the PC. While its premise is a bit improbable, it's fast and *weird* - hours of fun.

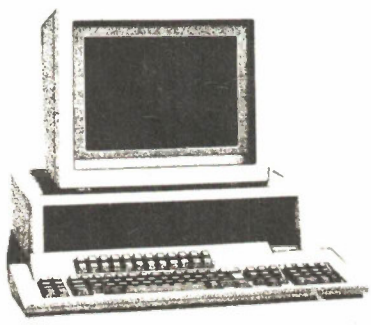
PC-Spell is a spelling checker written in BASIC. Despite its pedestrian sounding origins, it's fast, accurate and easy to use. It can be listed if you want to see how it works, and comes with a large dictionary file and a utility to assist you in customizing it.

Peacock is a memory resident program which allows you to change the colours of your screen with alternate function keys. It's useful, for example, if you run software which insists on using eye-straining screen colours.

Recover is a utility which assists you in getting data back from damaged files. It lets you look at your files one sector at a time in order to put the pieces back together.

Tally is a program which accurately counts the number of characters, words and lines in a file -all within your lifetime.

Xeno edits the tracks and sectors of your disks in a user friendly format - or, at least, one that doesn't lunge for your throat every time you boot it. You can use it to explore DOS, fix trashed disks, unerase files and do all the other low level magic that sector editors are renowned for.



ONLY
$19.95

VOLUME 8

Load-Us allows users of the popular Lotus 1-2-3 and Symphony programs to run them on a hard drive. This preboot program does not "crack" Lotus's copy protection scheme, but it does help legitimate users overcome the inconvenience of keeping a "key" disk in a floppy drive while running Lotus or Symphony on a hard drive.

DDCal is a very clever perpetual calendar and desk diary. It keeps track of your appointments and performs several other functions that you probably thought could only be done on the backs of match books.

PC-Key Draw is a remarkable public domain paintbox program which compares favorably with many commercial applications. It'll handle multiple screen images, business graphics and superb computer art - all in full colour. It's worth the cost of this disk all by itself.

CPU is a tiny program which tells you the effective speed of your system.

Xray is a remarkable co-resident utility which monitors what a program is doing while it's busy doing it. It allows you to interrupt the execution of your code and have a look inside.

Game - well, there are no words for this program, or, at least, none that are printable. This game is a bit rude - depending on just how weird your mind is, it can get pretty bizarre. This program does use some suggestive language, and we recommend that young or sensitive users not boot it.

Tune is a very small music generator which makes noises from within batch files. It's useful to see where things are in a complex process.

Chasm, or cheap assembler, is just the thing if you want to get into assembly language programming but don't want to spring for the Microsoft macro assembler package. It's reasonably fast, not too huge - it'll run in as little as sixty-four kilobytes - and, above all, it's cheap.

Getdir is a resident directory utility. It allows you to see what files are on your disks, even if you're in the middle of doing something else.

CopyPC, not to be confused with the commercial Copy II PC, is a quick disk backup utility.

Lookit is a full screen browsing program which lets you scroll forward and backwards through text files - sort of like a tiny word processor with no editing features.

Syslock is a security device for hard disk users. By running this utility on your XT or compatible, access to your computer will only be granted to users with a valid password.

ONLY
$22.95
(TWO DISK SET)

Moorshead Publications Software, 1300 Don Mills, North York (Toronto), Ont. M3B 3M8

VOLUME 7

BLACKJACK is a BASIC implementation of this popular card game. It's both interesting to play and enlightening to dismantle. It can, of course, be easily listed so you can see how it works.

EDSCR is a screen editor which can be used with virtually any programming language from assembler to dBase III. The program lets you 'paint' PC screens with block graphics and saves them as .DAT files which can be easily adapted to work in most languages. An example screen is included.

FK allows you to make the function keys of your PC do more useful things under DOS. They can be redefined to execute commonly used commands and command sequences.

FXMASTER is a printer program for the popular Epson FX Series and compatible printers. It uses a full screen menu to enable you to easily change printer settings and modes.

INDEX allows you to generate indexes from WordStar documents... or text files from any other text editor. It's an invaluable writer's tool.

KEYCLICK is a memory co-resident program which will make your keys click. Small and easily included in an AUTOEXEC file, KEYCLICK solves many problems associated with clone keyboards.

PCBW is a small utility which makes colour screen displays show up in monochrome video. Great for users with colour graphics cards and monochrome monitors.

PINBALL is a pinball simulation that is easily worth the cost of this disk all by itself. The game plays much like a real pinball machine... but its hard to tilt.

QUICKGRAF is a powerful business graphics package which generates complex bar, line and scatter charts in medium and high resolution. An Epson with GrafTrax or compatible printer is necessary to produce hardcopy.

SERPENT is a variation on the classic snake game. Written in BASIC, this one is weird, but very fast.

SHOWCLK is yet another clock program... its the smallest one yet, and it beeps to chime the hour.

VTREE is a graphic TREE program that shows you how the subdirectories are set up on your disk... in a fashion more easily understood than the MS-DOS TREE utility.

WORLD is a remarkable program which incorporates a world map. It allows you to zoom in on specific areas of the globe, locate major cities and perform a number of useful calculation. It also has a feature for tracking hurricanes... tracked any good hurricanes lately?

ONLY $19.95

VOLUME 6

3-DEMON is one of the most interesting variations on Pac-Man in the known universe. Instead of simply looking at a map of a maze, this program shows you a three dimensional view of it. You wander through endless corridors, munching food pellets or granola bars... your choice... and avoiding the deadly ghosts.

DU was one of the most powerful CP/M-based disk utilities ever created. This version for the PC captures much of its power and flexibility. It allows you to see what the tracks and sectors on your disks look like, recover erased or damaged files, and meddle with the system tracks.

General Ledger This is a complete general ledger accounting program. Written in BASIC, the program possesses most of the features found in commercial packages. An enormous documentation file is also included.

PC-CHESS is a slick chess program which makes good use of the PC's colour graphics abilities and boasts a running chess clock.

RAMDISK is the assembler source code for a memory disk program. If you've always wanted to know how these things work, or have a secret desire to write your own variation of this useful utility, here's your chance.

VFILER is a file management utility which lets you view files in a directory and allows you to COPY, TYPE and even run programs... in short, it does almost everything DOS does but it's user-friendly.

QMODEM is unquestionably the best telecommunications package in existence. The most recent version of it is replete with windowing, multiple protocols, definable function keys. And the code is unspeakably well debugged.

ARC is a sophisticated file archiving program which stores several files in single library files. As an added bonus, ARC applies one of four data compression techniques to each file in order to optimize disk space.

ZAPLOAD is a utility for programers to handle Intel standard HEX files. Very fast and well documented.

SOPWITH Using superb graphics, SOPWITH lets you pilot a World War I biplane on dangerous bombing missions.

JSB Another BASIC music program for your collection. This one plays a soothing sonata.

ALSO: Star, Surface, Op.

ONLY
$24.95
(TWO DISK SET)

VOLUME 5

AREACODE is a useful tool if you use the telephone a lot. Give it an area code and it will match it with the city in which the code is used.

D in another sorted directory program. This one emulates the CP/M style D, which is arguably more useful for most applications.

FRACTALS An amazing implementation of the Mandlebrot Microscope, which generates unearthly images on your screen.

HIDE is a set of utilities which let you create, enter and remove invisible DOS directories. This allows you to set up a hard drive system with secure areas which can only be used by people who know about them.

LAR is a library utility that allows you to concatenate several small files into a library to save on disk overhead. Individual files can be extracted as they are needed.

MAIL1 is a mailing label utility written in BASIC.

MORERAM This is an assembler program. You need MASM and LINK to make it work. It lets you alter the memory setting on the PC's motherboard to enable it to use more than 640K RAM. It will even let you set the switch settings to 64K to speed up disk boots and then change the RAM setting after bootup.

MORTGAGE generates amortization charts.

MXSET lets you control the parameters of Epson printers form the DOS command line. It's a lot easier than LPRINTing characters from BASIC every time you want to change print modes.

NUSQ unsqueezes files that have been previously compressed to save space. Should be of primary interest to bulletin board users.

PARCHK is an assembler program which requires MASM and LINK to work. It installs a trap for parity errors in your computer. A vital aid to help locate suspect RAM chips.

VDEL is a Delete with Verify program. You could type VDEL *.BAK and it would show them name of every .BAK file in the current directory and ask you if you want it deleted.

WHEREIS finds files in a complex hard disk system.

ZAXXONPC This is an incredible implementation of one of the most popular micro games ever created.

ONLY
$19.95

ALMOST FREE PC SOFTWARE

VOLUME 4

BUGS is an off the wall ASCII game in which a player uses the cursor pad keys to move a 'nuclear fly swatter' around the screen blowing up a long crawling bug.

CLOCK is a useful tutorial in writing character oriented device drivers for the PC. In addition, the program is an improved replacement CLOCK.SYS file which works with many real time clocks. The ASM file is included.

DEFRAG is a utility that lets you "defragment" your disks to make your applications run faster. The utility reorganizes a disk, connecting up the fragments of files created by DOS.

DOSEDIT is one of the most useful DOS utilities available. it enhances the command line facility of MS-DOS by creating a command stack. Instead of merely being able to recall a command with the F3 key, DOSEDIT lets you use the cursor arrow keys to scroll through a whole stack of previously entered commands, re-executing the ones you need.

DUmp is a utility program designed to produce Hex dumps of object files. Useful in its own right, the program also serves as a good example of how to use DOS disk service calls. The ASM file is also included.

FREE is a tiny file which tells you how much space is left on a disk... without having to view an entire directory listing. Its especially handy for hard disk systems.

LABEL changes the labels on disk drive volumes. It's a simple utility, but useful if you use volume labels to keep track of your disks.

LIST is an improved version of the DOS TYPE command which shows you the contents of a file page by page.

MEMBRAIN is the most sophisticated RAM disk program we've seen yet. It lets users install variable sized disks and provides control over several other parameters.

SPACE INVADERS A fast variation of this popular arcade game. the graphics are superb.

SPEED is a simple program which changes some of the PC's floppy disk parameters and effectively speeds up disk accesses for some applications.

WIZARDS is an adventure game in the classic style, except that it ranks as one of the most sarcastic programs in creation. The program is vast.. you can wander about its darkened corridors for hours.

ALSO: Backscroll, Bigcal, Crypto, Kbfix, Monoclok, Move, Newbell, Nuxq, Parchk, and Sp.

ONLY $19.95

VOLUME 3

FIXWS is a simple utility which modifies WordStar files so that they can be used by programs which work with ordinary ASCII files.

WRT DOS 2.0 allows for each file to have a 'read only' flag, but it lacks a way of manipulating them. This pair of utilities allows you to set and unset this flag, protecting important files from accidental erasure.

BROWSE is a timesaving program which provides a useful alternative to the DOS 'TYPE' command. BROWSE allows you to easily scroll up and down through text files, saving you the effort of running your word processor just to get a quick look at a text file.

CAT If the **DIR** display is too dull for your taste, **CAT** may be just what you need. It will tell you everything you could possibly want to know about the files on your disks.

CGCLOCK is a simple little program which displays the running time in the upper right hand corner of your screen. In addition, the program has lots of display options and works with the colour graphics card.

CURSOR A tiny twenty-four byte program which displays a large cursor on your monitor.

CMP This program does a very elaborate comparison of two files and reports their differences. It can for example, spot corrupted files and may prove useful when dealing with files created by redirection.

JUMPJOE A bit like "Miner 2049'er", this game is certain to damage your mind. You get to be the janitor of a space station and must deal with berserk robots and other weirdness. It's a hoot!

CASTLE Wander through a deserted castle collecting treasures... but mind you don't get killed by the nasties. A solution is included should frustration set in.

78INT This is a small BASIC program to calculate interest using the rule of seventy-eight.

MOON is one of the nicest lunar lander games we've come across. This version uses high resolution graphics and startling sound effects to hurl you to your doom in style.

PERTCHT is a BASIC program which prints **PERT** charts. It should interest anyone involved in project management and scheduling.

DATNOIDS is one of the strangest games ever put on a disk. In fact, mere words don't serve to describe it: you'll have to try it for yourself.

NUK-NY This is one of the nastiest bits of software we've ever seen. It produces a full color high resolution simulation of a nuclear attack on New York City.

ONLY $19.95

VOLUME 2

SWEEP is a disk utility which virtually replaces the DOS Copy command. It lets you COPY, REN, TYPE and DEL files quickly and easily from a simple menu.

Worldmap is a sophisticated graphics program which draws a very detailed map of the world. It can display its wares on your monitor, or send them out to a dot-matrix printer.

ANITRA plays Anitra's Dance by Edvard Grieg. A beautiful addition to your computer music collection.

RAMDISK is one of the most useful utilities you'll ever plug into your PC. Once installed, it creates a virtual drive in memory on your PC. Files can be copied to the RAM-disk and accessed in less time than real drives take to turn on their LEDs.

Allen plays a bizarre adventure game and will lead you into some of the most exotic spots in the universe. It comes with a massive data file for an adventure that you won't get tired of 'til the dragons come home for the evening.

ASMGEN is one of the best text disassemblers we've come across. It takes any executable COM or EXE file and produces an assembler listing. It's surprisingly good at distinguishing between code and embedded data or text.

Jukebox represents yet another PC music system. This one comes with a host of songs to play and some really electric graphics.

FOS is a well designed personal finance manager which will do much to help you tame your cheque books.

STRUCT will appeal to the rabid programmer in everyone. It enables MASM to be used to assemble a higher level language. Included also is a test file to illustrate the syntax.

PRTSC replaces the internal PC screen dump code with something more suited to reality. It allows one to hit the PrtSc* key and then select the print quality from a menu. It supports a number of popular printers.

BREAKOUT plays a PC version of the popular game. It will accept input from either a joystick or the keyboard. The graphics are good and the action is adjustable from a beginner's level right up to 'fast and nasty'.

UTIL is a collection system utilities which can be accessed from a single menu. Among its many talents are a sorted directory, keyboard redefinition and the facility for scrolling up and down through a text file.

ONLY $19.95

VOLUME 1

PC-Write An earlier, compact version of this well-known word processor - perfect for program editing. PC-Write comes extremely close to equalling the power of commercial word processors costing several hundred dollars. With full screen editing, sophisticated cursor movement, PC-Write also boasts features such as user-definable help screens and a 'printer ruler file' which can be customized to work with virtually any printer.

SOLFE is a small BASIC program that plays baroque music. While it has little practical use, it's a lot of fun. It's also a fabulous tutorial on how to use BASICA's sound statements.

PC-TALK Telecommunications packages for the IBM PC are typically intricate, powerful and huge. This one is no exception. It has menus for everything and allows full control of all parameters. It does file transfers in both ASCII dump and MODEM7/XMODEM protocols. And, it comes with a large documentation file.

SD This sorted directory produces displays which are a lot more readable that those spewed out by typing DIR.

FORTH This is a small FORTH, written in Microsoft BASIC. A good tool for teaching the ideas and concepts of this esoteric, but useful language.

LIFE This is an implementation of the classic ecology game written in 8088 assembler code. While you may grow tired of watching the cells chewing on each other, the source code provides a good example of how to write assembler applications.

MAGDALEN This is another BASIC music program. We couldn't decide which of the two we liked better, so we wound up putting both of them on the disk.

CASHACC is a fairly sophisticated cash acquisition and limited accounting package written in BASIC. It isn't exactly BPI, but its a lot less expensive and suitable for use in many small business applications.

DATAFILE is a simple data base manager, written in Microsoft BASIC.

UNWS WordStar has an unusual propensity for setting the high order bits on some of the characters in the files it creates. Here's a utility to strip the bits and 'un-WordStar' the text. The assembler source code is also provided.

HOST2 This program includes BASIC source and documentation files to allow users with SmartModems to access their PC's remotely.

ONLY $19.95

ALMOST FREE BUSINESS SOFTWARE

MA.BAS The Micro Accountant is a complete, working accounting and check register program, with a 25K documentation file.

PCWNDW22 A "Sidekick"-like co-resident window utility. Pop-up window functions include ASCII table, stopwatch, alarm, printer setup utility and notepad. The entire program takes up less than 30K of space on your disk.

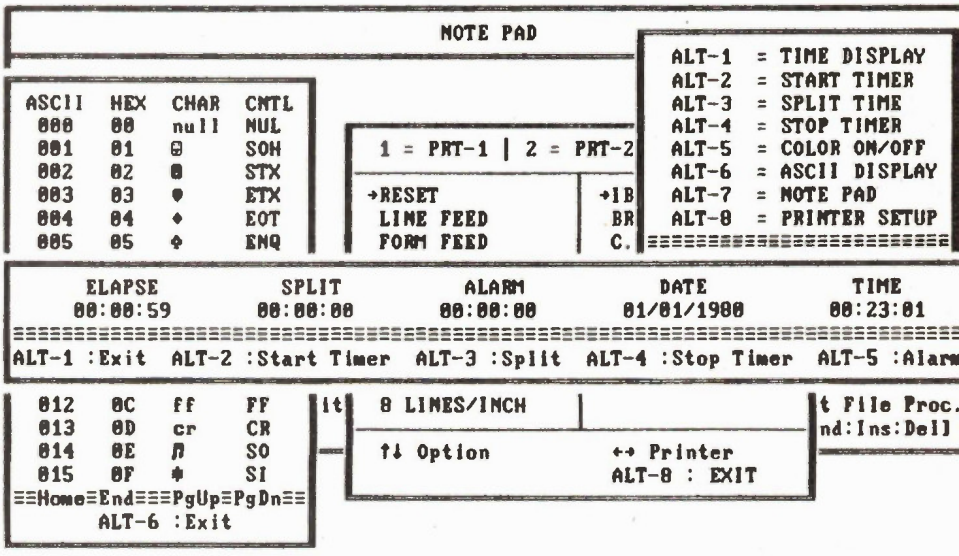
PSHIFT A time saving and convenient 'memory partition' utility. Lets you define up to nine memory areas. Load programs such as dBase II and WordStar into separate partitions and 'flip' between them instantly with simple keystrokes.

PC-TOUCH.BAS Increase typing speed and accuracy with this easy-to-use typing tutor. Also provides accuracy and speed statistics.

PCYEARBK.EXE Appointments and reminder program to help you keep track of your time.

TASKPLAN.BAS Project management software which lets you track up to 50 tasks over 50 time periods (days, weeks or months).

NOCOLOR A handy little utility for users with monochrome monitors and colour software.



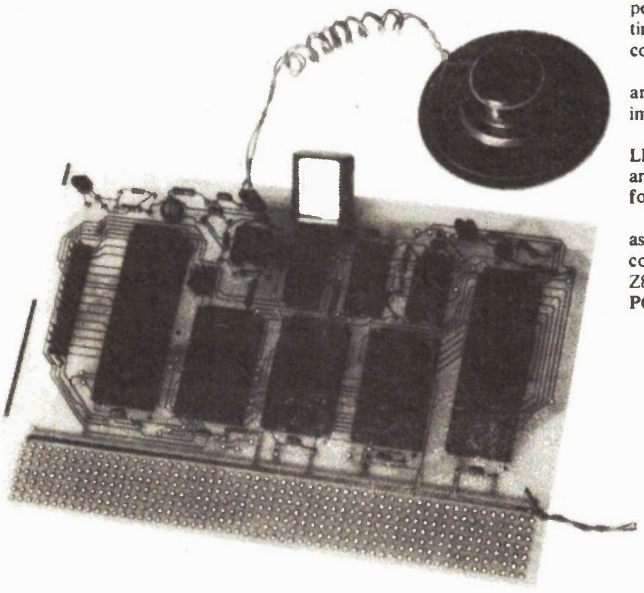
MAXIT A simple but subtle game for two human opponents, or one player and the computer. Hours of fun!

PERTCHT A sophisticated project management tool using the Program Evaluation Review Technique (PERT).

PLUS More utilities to help organize maintain and copy your files, including a "monitor saving" program which blanks out your screen when it is not in use.

ONLY $19.95

The Learning Computer



Computers can do a lot more than play video games and run spreadsheets. Specialized dedicated microprocessor boards are at the hearts of the latest generation of television sets, appliances, cars and sophisticated industrial controls.

The design of these boards is a large undertaking and, as such, few programmers ever get a chance to learn the art of writing dedicated system firmware first hand. However, with the increasing use of microprocessors in all sorts of high technology, there is a growing need for people to write "ROMmable" code.

The Sloth board is a small dedicated microprocessor board which has been designed to be a general purpose small control board of the sort found in industry. It's not a trainer... it can be made to do the sorts of tasks that similar custom boards are doing in the real world. However, carefully documented and thought out, the Sloth is the ideal board for learning about this powerful aspect of programming.

The Sloth is based on the popular Z-80 microprocessor. It's programmed with inexpensive... and reusable... 2716 EPROMs. It has two kilobytes of RAM, three counter timers and twenty-four lines of I/O. It also has a speaker driver, and the Sloth package comes with an auxillary six digit LED display board.

The board can be populated with easy to find parts. It can be programmed to be anything from a frequency counter to a video tape recorder timer to whatever one's imagination runs to.

The Sloth package available from us includes a bare Sloth main board and a bare LED display board, a parts list and overlay, a large easy to read schematic and a series of article reprints which document the board in great detail. This includes a source listing for a sample program to illustrate how the various devices on the board are accessed.

In addition to the Sloth itself, you'll need a system to develop Z-80 or 8080 assembler code and subsequently to burn it into EPROMs. We recommend an Apple compatible system running CP/M with a Multiflex PROM burner or an IBM PC running Z80MU and a PC compatible EPROM programmer. Z80MU, a CP/M emulator for the PC, is available separately from our almost free software service for $19.95.

the board package costs

$37.95

plus 7% Ontario sales tax

Moorshead Publications
1300 Don Mills Road
Toronto, Ontario M3B 3M8

Or you can order by phone. Please have your Visa, MasterCard or American Express card handy.

(416) 445-5600

please allow four to six weeks for delivery

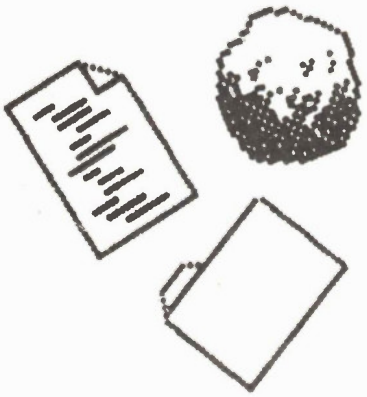
ALMOST FREE MACINTOSH SOFTWARE

VOLUME 1

ASTEROIDS This is a splendid implementation of one of the most popular arcade games of all time. The graphics and sound effects are amazing.

RED RYDER Telecommunication on the Mac has never been this easy. RED RYDER includes XMODEM and Kermit protocols and many other features.

MacCLONE Many users have found the Mac's disk copy routine to be less than perfect. This is a vast improvement. It even defeats a number of copy protection schemes.



BINHEX is a utility for RED RYDER which converts applications files to binary files and back again to allow them to be transferred over phones lines.

LIFE is one of the classic computer programs, and this version is exceedingly well done.

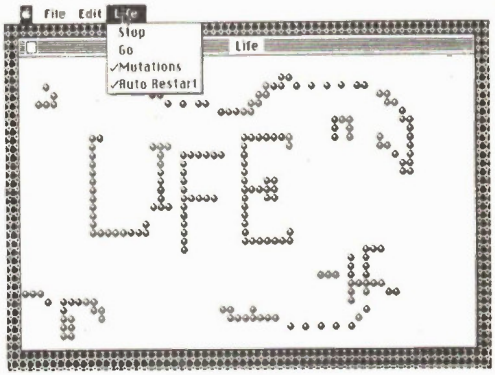
VIEW PAINT Ever wanted to look at a MacPaint drawing without getting into MacPAint. This utility lets you sneak peeks at your drawing files without fussing about.

RESOURCE EDITOR Macintosh icons and other resource items just cry out to be personalized. This little tool will help you make your Mac look its best for you.

SCREEN MAKER Moving text from MacWrite to MacPaint can be a bit disappointing... something gets lost in the clipboard. This utility helps your words make the trip unscathed.

FONT EDITOR For those longing to make their own fonts... and for those who just want to adjust the ones they have... this editor lets you shuffle fat bits to your heart's content.

MENU EDITOR A handy utility for editing the words in Macintosh application menus.



ONLY
$24.95

VOLUME 2

FONT LIBRARIAN A splendid alternative to the Macintosh system font mover, this utility makes it easy to create custom collections of Macintosh fonts.

WIZARD'S FIRE This is a lively game which comes with still more lively games tucked away in the desk accessories. Get the magic rays before they get you!

SWITCHER Multitasking on a Mac? Why not. SWITCHER lets you run up to four applications concurrently on a 512K 'Fat Mac'.

RAMSTART Creates a RAM disk of any size on a fat MAc, and effectively increases the speed of most applications several times over.

MADONNA A MacPAint picture of the popular pop star.

MOCK CHART A desk accessory to handle the creation and printing of small business charts.

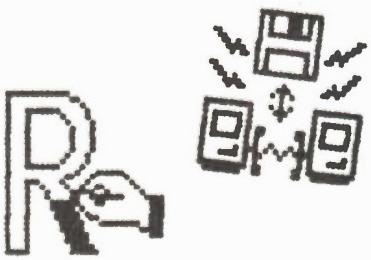
DAM A *D*esk *A*ccessory *M*anager for setting up the Apple menu on your Macintosh the way *you* want it.

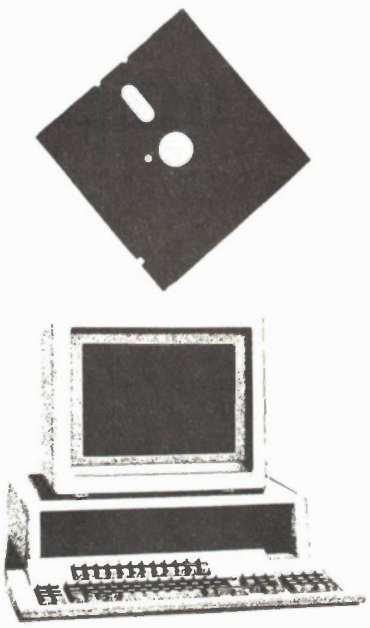
MOCK TERMINAL A desk accessory for telecommunication functions from *within* another application.

HP CALC Add a simulated Hewlett-Packard calculator to your Mac.

REdit A slick resource editor. See the December 1985 issue of Computing Now! for an in depth look at this esoteric art form.

ORION This one is worth the price of the disk all by itself. It simulates a star ship cruising around the galaxy at the speed of light. Stars fly past like white lines on the highway ... with or without star names fluttering like celestial flags. The heavens are accurately mapped and the star ship handles like any other warp drive star Chevy.





ONLY
$24.95

VOLUME 3

Icon Collector is a peculiar program that allows you to locate icons in applications and capture them to disk for use in other programs.

Billiard Parlor is worth the cost of this disk all by itself. It's an excellent simulation of a billiard table. It will play most of the usual variations of pool and billiards, and simulates the movement of the balls with unspeakable realism.

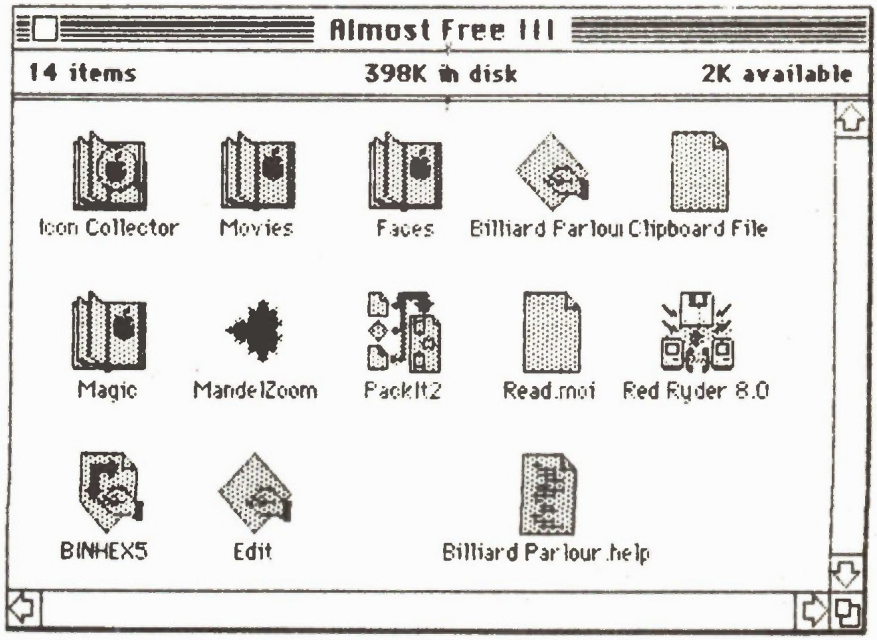
MandelZoom is the nicest Macintosh fractal generator we've come across. It's surprisingly fast, considering the nature of the Mac's floating point library.

Red Ryder This is the latest version of this popular communications program. It runs perfectly, giving you a sophisticated terminal with download facilities, macros and dozens of other features.

PackIt2 - not to be confused with PackIt - will compress and uncompress P2T libraries which have been downloaded from bulletin boards. An essential utility for telecommunications.

BINHEX5 is a file manipulation utility which allows Mac files to be sent over a modem.

Edit is the most sophisticated text editor available for the Mac. Operating similar to MacWrite, it allows you to edit documents in multiple windows. Ideal for program editing, Edit produces clean text files which can be compiled.



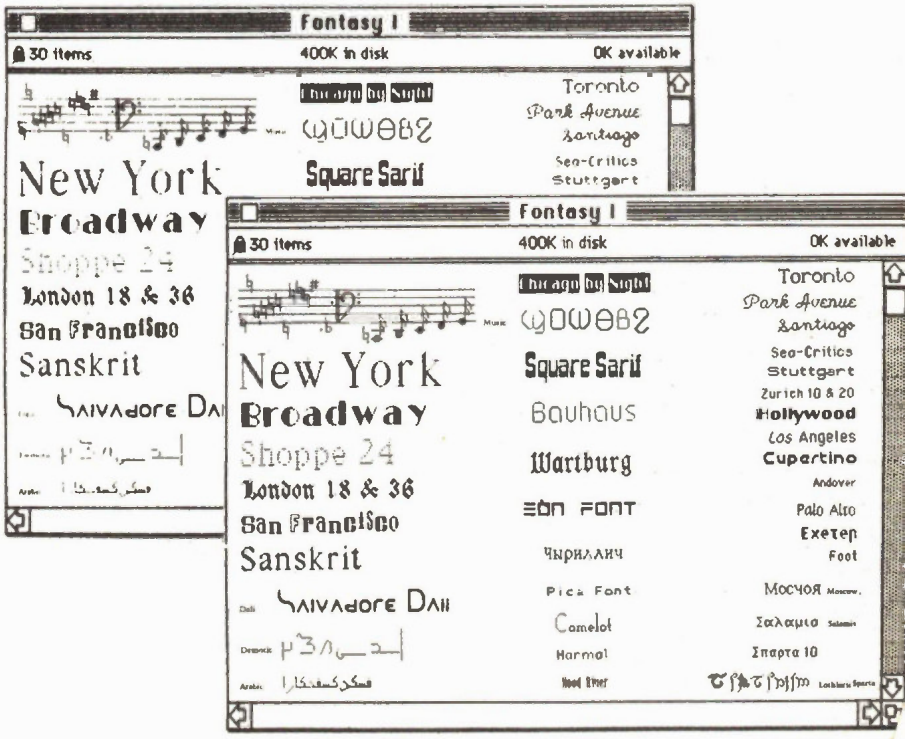
ONLY
$24.95

VOLUME 4

One of the most interesting aspects of the Macintosh is its ability to use software-based character sets. While there are a number of commercial font packages for the Mac, we feel that this collection of public domain fonts ranks among the best. This disk is filled - to the last byte with thirty-eight unique fonts. We've selected a variety of body copy and display typefaces, spanning traditional display typefaces, spanning traditional and avant garde designs, along with a number of special purpose sets.

Bid fairwell to the placid exterior of Chicago, the mild amusement of Geneva, the unadventurous disposition of Athens and plug your Mac into this typesetter's pipe dream.

A powerful font librarian is also included to assist in adding the fonts you want to your system.



ONLY
$24.95

ALMOST FREE SOFTWARE (CP/M)

VOLUME 1

MODEM 7 Allows you to communicate with any CP/M-based system to download and upload files. Complete details for this program first appeared in the November 1983 issue of Computing Now!

PACMAN You really can play PACMAN without graphics... and it works pretty fast.

FORTH An up-to-date version of FIG FORTH, complete with its own internal DOS.

DUU The ultimate disk utility, DUU lets you recover accidentally erased files, fix corrupted files, and modify the system.

D A sorted directory program that tells you how big your files are and how much space is left on the disk.

USQ/SQ Lets you compress and un-compress files. You can pack about 40 more data on a disk with this system.

FINANCE A fairly sophisticated financial package written in Microsoft BASIC.

BADLIM Ever had to throw out a disk with a single bad sector? BADLIM isolates bad sectors and allocates them to an invisible file, making the rest of the disk useable.

DISK Allows you to COPY, MOVE, DELETE and VIEW files with a simple command structure.

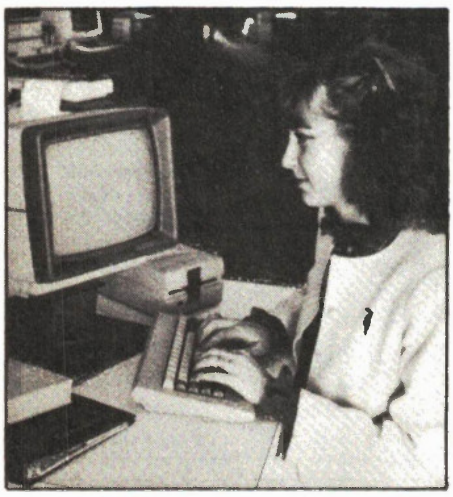
QUEST Similar to "Dungeons and Dragons", QUEST provides hours of glorious adventure.

STOCKS A complete stock management program written in BASIC.

SEE Also known as TYPE17, this utility will TYPE any file, compressed or not, allowing you read documents which are stored in a compressed form.

ONLY
$19.95

Call or write for available formats.



VOLUME 2

BISHOW is the ultimate file typer. This version will type squeezed or un-squeezed files and allow you to type files which have been archived with utilities such as LU (see below). BISHOW even lets you scroll up and down through typed files.

LU is a library utility which stores multiple files under a single file name in order to save disk space. Files can be removed from the library as they are needed.

MORTGAGE is a fancy mortgage amortization program which produces a variety of useful tables.

NBASIC Large, commercial BASIC's are powerful, but expensive. This one however is free, and every bit as flexible as many commercial packages. It's also compatible with North Star BASIC.

Z80ASM is a complete assembler package which uses true Zilog Z80 mnemonics. It has a rich vocabulary of pseudo-ops, permitting you to use features of your Z80-based machine which are unavailable with ASM or MAC.

VFILE Easily the ultimate disk utility, VFILE gives you a full screen view of the files on your disk and allows you to do mass COPY and DELETE operations using a two-dimensional cursor. It has lots of 'extras', a built-in help file and it's fast.

ROMAN Though some say it's silly, this novel little program is a fun way to convert ROMAN numerals into decimal numbers.

CATCHUM If you like the fast pace and incredible realism of Pacman, you'll go quietly insane over CATCHUM... which plays basically the same game using ASCII characters. Watch little "C"'s gobble periods, while you try to avoid the delay "A"'s.

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OIL An interesting simulation of the working of the oil industry. It can be approached either as a game or as a fairly sophisticated model.

CHESS This program really does play a mean game of chess. It has an on-screen display of the board, a choice of colours and selectable levels of play.

DEBUG The DDT debugger is good, but this utility adds many new facilities, including symbolic debugging. It's almost like being able to step, trace and disassemble through a source listing.

DU87 This version overcomes several limitations of the older DUU program and adds some new features. It will adapt to any system and can search, map and dump disk sectors or files. Its invaluable in recovering damaged files too.

ELIZA Written in MBASIC, this classic program is a microcomputer analyst. With a little imagination you will be able to believe you are conversing with a real psychiatrist.

LADDER Fast, bizarre and probably a major cause of eye strain. This program plays like Donkey Kong with ASCII characters.

QUIKKEY Programmable function keys let you hit one key to issue a multi-character command. This tiny utility lets you define as many "macros" as you want, with seldom used control codes. Keys can be redefined at any time... even from within another program.

RESOURCE While a debugger will enable you to disassemble small bits of code easily enough, only a true text based disassembler can take a .COM file and make source out of it again. This is one of the best ones available.

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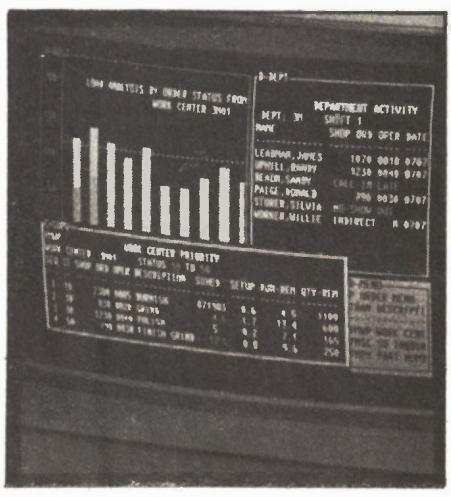

A TEACHER FOR THE APPLE

Specifically developed for the educational market, this disk introduces both teachers and students to the Apple II series and compatible systems.

It is designed to show you how to make the computer work for *you*.

After introducing you to the computer, it goes on to explain the BASIC programming language. With step-by-step instructions it shows you the ins-and-outs of Apple programming and explains the workings of DOS and high resolution graphics.

Designed for new computer users, just turn on the computer, slide in disk, and enter the world of Apple programming.

Requires Applesoft BASIC, 48K RAM and one disk drive.

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Available for MS/PS DOS with GWBASIC or Apple II systems with Applesoft BASIC.

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STEVE'S WUNDERDISK

Over the years many first rate program listings have graced the pages of Computing Now! And we have many which have never been published. We've collected the best of these and put them on one disk. Included are programs like STAR, for setting up a Gemini 10 printer, the Last WordStar Unhook, CPMAP and the CP/M HOST program, complete with several unreleased support programs.

The Wunderdisk is an excellent collection of tricky CP/M routines. It's deal for anyone who wants to make their CP/M system sing! And the programs on the disk are well documented... most of them have been explored and explained in the pages of Computing Now!

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MDM730 FOR APPLE CP/M

First featured in the July 1984 issue of Computing Now!, MDM730 is one of the most powerful MODEM7 programs available. Our version incorporates features not available in the public domain. MDM730 is an efficient, easy-to-use software tool for anyone interested in telecommunications, bulletin boards and downloading software. Consider these features:

- Terminal program which works at any baud rate.
- Ten programmable macro function keys.
- A Phone number library for 36 numbers.
- Christensen software transfer protocol.
- User selectable toggles for linefeeds, ON-XOFF, etc.
- Extensive help menus.
- Baud rate selection on the fly.
- ASCII dump and capture.
- Status menu.

In addition, we've added dialing support for the Apple version. While the standard MDM730 can not dial unless it's hooked to a Hayes Smartmodem, we've added patches to allow it to do pin twenty-five pulse dialing and to dial through the Hayes Micromodem II and the SSM card. The Computing Now MDM730 will also:

- Select a number form the library and dial it.
- Dial manually entered numbers.
- Log you on to a remote system if it's free.
- Optionally autodial if the remote system is busy.
- Keep track of the number of re-dial attempts.

The Computing Now! MDM730 package is available for:

- The Hayes Micromodem II card.
- The SSM 300 Baud modem card.
- The PDA 232C serial card with external modem.

The PDA 232C package includes versions supporting both the Smartmodem and a dumb modem with pin twenty-five control, such as the Novation AutoCat.

Each package also includes utilities for updating the phone number library and redefining the function key macro strings, as well as an extensive help file.

The source code for this program is over one hundred and fifty kilobytes long and can not be hacked on a standard Apple system. We patched it on a larger machine and downloaded it. We're confident you won't find MDM730 with these features anywhere else.

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Available for Apple II series and compatibles with CP/M. Specify Hayes Micromodem II, SSM or PDA 232C.

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good place to do it so that LF noise doesn't overload any following stages (particularly bass boost sections).

Any following stages require a surprisingly low LF cutoff figure. The reason is that audio equipment may have six or more stages, and if they all cut off at 15Hz, you have the effect of cascaded highpass filters, rolling the bass off as high as 100Hz.

Finally, the circuit may be stable on a breadboard but not as part of a high-gain unit. High-frequency stability requires some experimenting, but the usual method is to start by placing a 100pF capacitor across the 33k, or a 10 to 30pF capacitor across the 10k feedback resistor. It all depends on the final conditions of use; the idea is to roll off the very-high-frequency open loop gain before phase shifts can make the negative feedback go positive and create oscillations.

Radio interference plagues all preamps, particularly with high impedance microphones. The best cure for this is to bypass the RF around the spot where it causes the most trouble: the base-emitter junction of Q1. Try a value of 5000pF across the B-E leads and most RF troubles will disappear; there's little effect on the audio response because the capacitor is effectively bootstrapped out of the way by the feedback. In severe RF situations, ferrite beads on the input (base) lead may help. Small capacitors from the input to ground may or not work; sometimes they resonate with cable inductance to produce a tuned circuit, making everything worse. Do lots of experimenting.

This example is by no means the definitive way to design a high-performance audio preamp, nor did I come up with every possible improvement for the circuit. However, it's certainly a long way from the single-transistor version, and is meant to demonstrate one design approach: find out what you can about the operating conditions and then change the amp's parameters to suit them.

In the next instalment, besides looking at designing for signal-to-noise, I'll take the above approach with op amp circuits and see if we can't arm-wrestle some better performance out of them, too. ■

Continued from page 22

nets have been built and tested to establish whether the increased capital cost of motors in the range of 1 to 125 hp can be recovered in operational cost savings over times shorter than 2½ years with operation at a 50% duty cycle. The results of the study were positive using ferrite magnets, but the cost of rare earth magnets is till too high to make their use an economic proposition for this purpose.

Conclusion

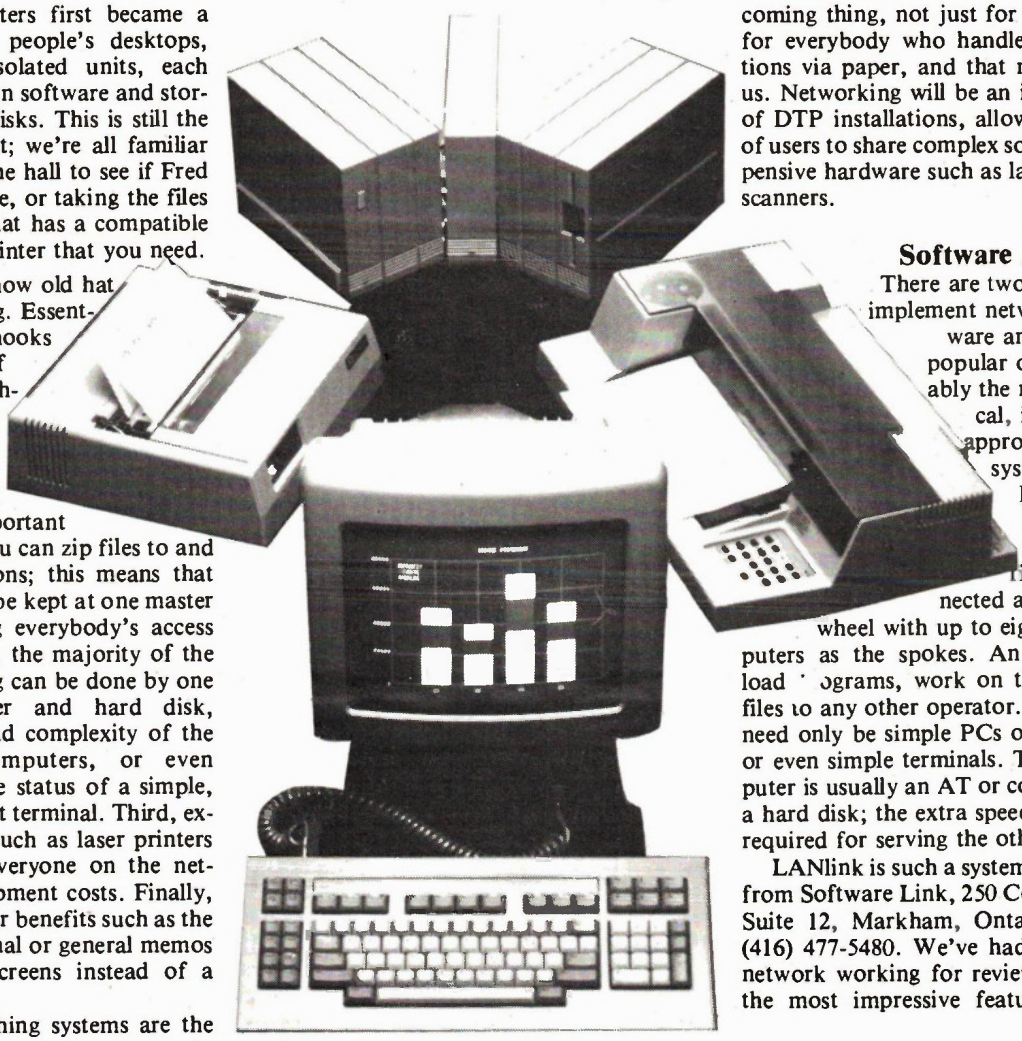
It will be seen that while improvements in magnetic materials have had an effect, recent developments in electrical machines have been principally a response to the possibilities opened up by improvements in power switching devices and power converters, together with the capacity to tailor the overall drive system characteristics in the microprocessor control electronics. Reductions in size and weight will result, together with greatly-enhanced control characteristics and improved overall drive efficiency. ■

NETWORKING

Connecting computers together is becoming a necessity with today's technology.

By Bill Markwick

WHEN microcomputers first became a standard fixture on people's desktops, they were largely isolated units, each operating from its own software and storing files on its own disks. This is still the case to a great extent; we're all familiar with heading down the hall to see if Fred has the latest database, or taking the files disk into an office that has a compatible computer with the printer that you need.



Much of this is now old hat thanks to networking. Essentially, the technique hooks together a number of computers and peripherals, generally by using the available serial ports. This communications link has a number of important advantages. First, you can zip files to and from different stations; this means that programs need only be kept at one master location, simplifying everybody's access to software. Second, the majority of the work of file handling can be done by one high-speed computer and hard disk, reducing the cost and complexity of the individual microcomputers, or even reducing them to the status of a simple, inexpensive intelligent terminal. Third, expensive peripherals such as laser printers can be shared by everyone on the network, reducing equipment costs. Finally, there are some smaller benefits such as the ability to send personal or general memos via the screen or screens instead of a Niagara of paper.

Desktop publishing systems are the coming thing, not just for publishers but for everybody who handles communications via paper, and that means most of us. Networking will be an important part of DTP installations, allowing a number of users to share complex software and expensive hardware such as laser printers or scanners.

Software Approaches

There are two main ways to implement networking, hardware and software. A popular one, and probably the most economical, is the software approach. With this system, one main IBM computer or compatible becomes the file server, connected as the hub of a wheel with up to eight other computers as the spokes. An operator can load programs, work on them and send files to any other operator. The terminals need only be simple PCs or compatibles, or even simple terminals. The main computer is usually an AT or compatible with a hard disk; the extra speed and power is required for serving the other computers.

LANlink is such a system. It's available from Software Link, 250 Cochrane Drive. Suite 12, Markham, Ontario L3R 6B7, (416) 477-5480. We've had the LANlink network working for review, and one of the most impressive features is that it

reduces all the necessary hardware down to a single 3-conductor cable. The transfer rate was 115,200 bits per second, with data compression giving an effective rate of up to twice as fast. This was fine for most applications, though a little more speed would have been good for fullscreen scrolling of textfile pages. The newer versions of the link can handle graphics, unlike the earlier versions which were restricted to ASCII.

The LANlink installation can be expanded quite a bit by adding Software Link's MultiLink. This is another software system, and it's used to reconfigure the memory of a PC or AT into a number of partitions. Each partition is like a computer on its own, except that it shares the CPU and other common gadgetry. It's then possible to have some partitions communicating with other computers while others run various programs. It's true multi-tasking; for instance, a spelling checker in one partition can go merrily along with the checking while the operator uses another partition to communicate with a distant computer via a modem and a telephone line, plus having LANlink working through another partition. This is a great advantage over simpler multitasking software which simply freezes the programs in the background as it attends to the operator's immediate needs. By using both MultiLink and LANlink, you get the equivalent of a midicomputer installation at a great saving in dollars. Software Link also supplies suitable terminals; these look like a monitor with a keyboard, and cost considerably less than an IBM PC. All file handling and storage is done by the main computer.

All you need is personal computers with serial ports. Since the CPU on the main unit is shared for multitasking, the computer's operating speed will be divided by the number of programs you have running at once; three programs drop the speed per program to one-third and so forth. For this reason, an AT or other high-speed compatible is preferred for the main unit. We reviewed the two software systems in the October, 1986 issue.

AppleTalk

Apple has long been a leader in desktop publishing, largely because the Macintosh was a computer well-suited to the task and their laser printer was one of the first to provide near-typeset quality print. In order to reduce the cost of a large installation, they also provide the AppleTalk network. It allows computers to share peripherals and files within a work area of approximately 1,000 feet. It can also link to other networks.

A single AppleTalk network connects up tp 32 devices, with the computers and peripherals configured in any combination. Personal computer users can share peripherals such as file servers or printers. Even larger networks can be installed by bridging together two or more AppleTalk networks.

Manufacturers are making products for connecting Apple computers with IBM PCs, and interface to the Ethernet local network, a Unix file server and others.

To facilitate the sharing of information in groups, Apple has introduced the AppleShare file server meant to work with a Macintosh Plus. They also have announced a print spooler, the LaserShare, which simplifies multiple accesses to their LaserWriter printer. It offloads the printing queue to a server, freeing individual workstations for other tasks.

The AppleTalk system also uses simplified cabling; only a shielded two-conductor wire is needed. To avoid "collisions", the connected devices follow a special hardware/software routine to be sure that only device uses the line at one time. Waiting devices will keep testing the line until it is free. Transfer rate is 230kbits per second.

For more information, contact Apple dealers, or Apple Canada at (416) 444-2531.

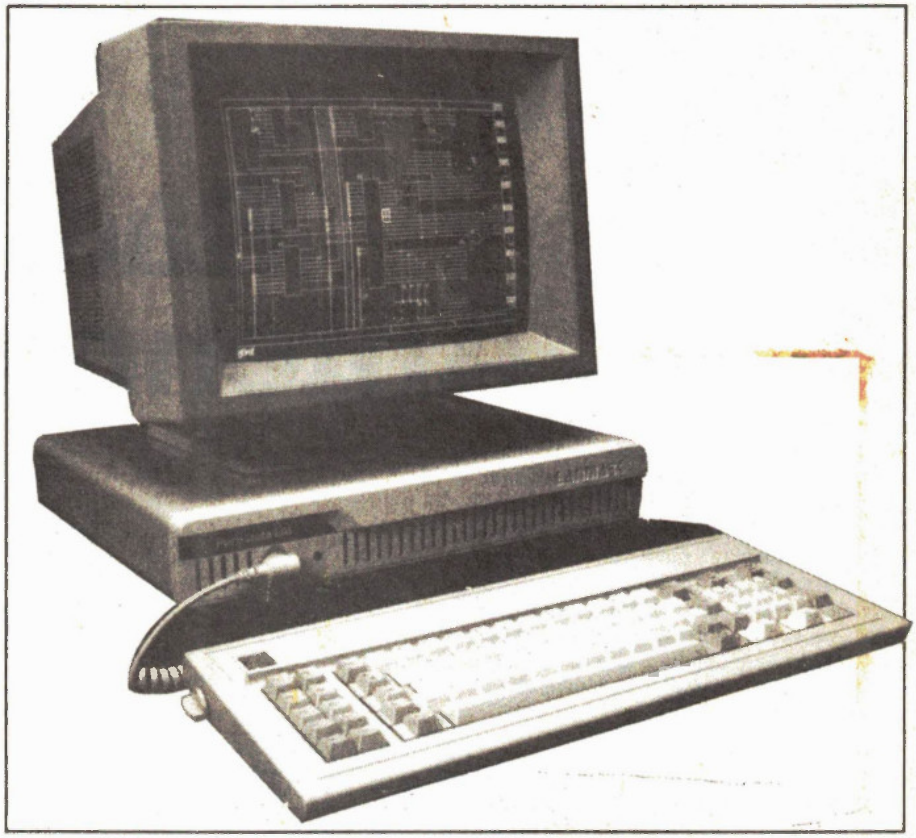
Pure Data

Pure Data is a Canadian company that's a leader in networking technology. Their Arcnet Local Area Network for the IBM PC or compatibles is now available with fibre optics instead of coaxial or cable twisted pairs. This has the advantage of very high data rate capability and is impervious to electromagnetic interference. In addition, it offers the best security since the signal cannot be tapped off from a fibre optic cable. Distances between stations can be 1km or more without a repeater station.

The Arcnet LAN uses Pure Data's interface cards; this hardware approach means that the user does not have to configure the machine each time it is powered up (usually by means of the Batch files that are used with software systems). As of a year ago, the Arcnet system accounted for 27 percent of the LAN systems installed for microcomputers.

Pure Data also supply a terminal, the Lanmark Network Workstation. It features a built-in Arcnet interface, two megabytes of no-wait-state memory (with the memory above 640k adhering to the Lotus/Intel EMS standard) and has a wide range of display options, including IBM's EGA specification. It's about half the cubic volume of a regular PC. The Lanmark is a 16-bit, 8MHz AT-compatible machine.

For further information, contact Pure Data Ltd., 860 Denison St., Markham, Ontario L3R 4H1, (416) 475-3370.



The Lanmark workstation from Pure Data is an alternative to using a full computer as a terminal.

More Arcnet

The token-passing network is another method of sharing the networking among multiple users, as opposed to the collision-avoidance system. The 'token', or code, lets everyone on the network know that the line is in use; it's passed on to the next user after a certain length of time, depending on how the system's architecture is designed.

Standard Microsystems makes PCB cards for both the IBM-type computers and the S100 types. Up to 255 computers can access the Arcnet token ring. The Arcnet-Link is a self-contained unit that

The D-Link System local area network connects up to 255 IBM-type computers.

Radio Antennas

A variety of antenna designs for catching those elusive signals.

By Arthur Cushen

THE TWO MAIN considerations in constructing or selecting an antenna are the space available to you and the frequencies you are interested in. Generally, the lower the frequency (and the longer the wavelength) the greater the space you will require. If space is the main limiting factor, the ground plane, inverted V and loop antennae are the ones to look at. Those with plenty of outdoor area can play around with the long wire antenna and its variations, the beveridge and inverted L antennae.

Long Wire Antenna

A long wire antenna is, as its name suggests, a long wire strung from your 'rig' to a conveniently located post or something similar. The length of the long wire should be one wavelength or more of the lowest frequency of interest. The appropriate formula is:

$$\text{metres (length)} = \frac{71.5}{\text{f(MHz)}}$$

A typical long wire installation is illustrated in **Fig. 1**. The actual height and length depend entirely on our circumstances. A piece of 50 mm by 100 mm post is painted and bolted to a fence post or other support, as far from your receiver installation as you can reasonably manage it. A pulley, obtainable at almost any hardware store, is fixed to the top and a loop of good quality hemp rope threaded through it, before erection.

An egg or strain insulator is attached to one end of the antenna which is also tied. The other end of the antenna is erected near the receiver installation. An insulator is also attached at this end and the lead-in taken down from it to the receiver installation. The antenna is then supported from this end by tying it off to a chimney, as illustrated, or to a screw-eye in the facia-board of the house. Having one end of the antenna higher than the other is of little consequence; it'll still work.

The lead-in should be taken in such that it clears the house guttering and may be fed through a ventilator opening or over a window sill - whatever is convenient. Avoid running it for any distance clamped to a wall or parallel to metal guttering, pipes or wiring. The more direct, the better.

Once your long wire is up you're ready to go! The end of the lead-in can simply be attached directly to the antenna terminal of your receiver or it can be connected to your receiver via an antenna tuner. Antenna tuning is merely a way of varying the reactance of the tuner to optimize for the particular frequency you want to receive.

Inverted L Antenna

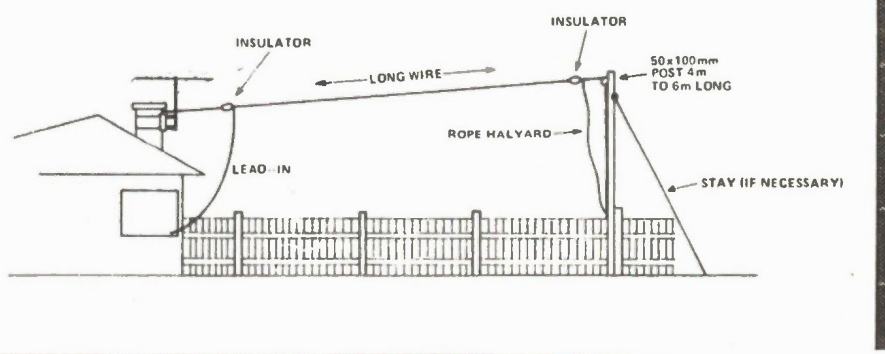
The inverted L antenna (**Fig. 2**) is a form of long wire that is bent at 90 degrees about half way along its length. The formula for calculating the total length of wire you need is:

$$\text{metres} = \frac{71.5 \times (1.1 \text{ to } 1.3)}{\text{f(MHz)}}$$

The advantage of the inverted L antenna over the long wire is that it is simpler to tune requiring only a single variable capacitor.

Beveridge Antenna

For those fortunate enough to live in areas with little space limitation, another form of long wire antenna, the beveridge, has proved to be efficient especially on



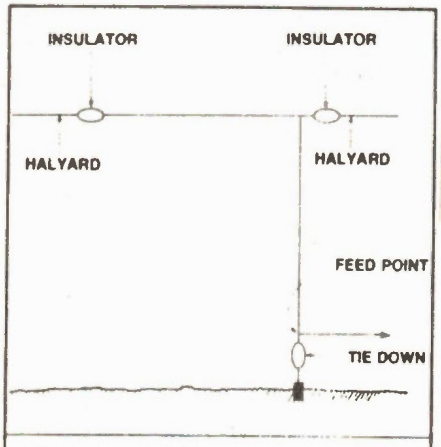


Fig. 2 Inverted L antenna.

tuner is necessary.

Good signals will be picked up by this antenna right down to 2 MHz, but at these low frequencies, there's no substitute for size and different antennae, designed to operate in these regions, usually provide better performance.

Construction is quite simple. Again a 4 or 6 m length of 50 x 100 mm post is erected against a suitable support - shown here as the side of a house. A fence or garage is just as good.

If you can attach a length of aluminum pipe to a chimney mount or to your house gable - well and good. Just get the centre up as high as you reasonably can.

Each leg of the inverted V should be 6 metres long. The legs can be shorter

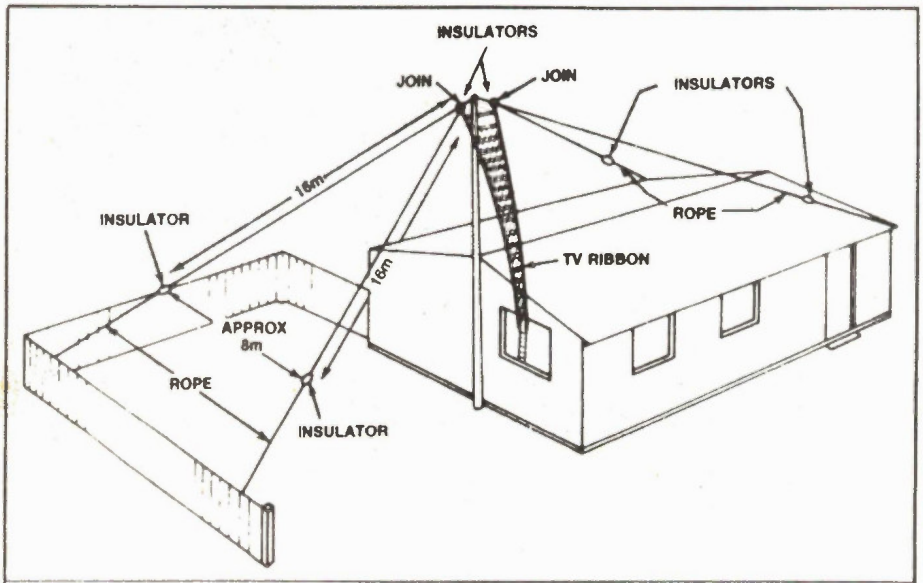


Fig. 3 Inverted V antenna.

mediumwave.

Like the long wire this antenna is stretched horizontally, but is grounded at its end. Length is not critical, but direction is. The greater the length of the antenna, the more defined is the area of reception. Thus its erection should be based on compass bearings; the antenna should be pointed towards the part of the world from which the signal of interest is received.

The beveridge antenna need not be high above the ground but it should be held in place by several short poles up to 5 metres high. Grounding the antenna at the far end relies very much on experimentation to improve reception.

Inverted V Antenna

A wideband inverted V style of antenna is illustrated in **Fig. 3**. This works extremely well across the range from about 5 MHz up to 30 MHz and uses ordinary TV ribbon for a feedline. However, an antenna -whatever you can fit, but the performance at low frequencies suffers.

The TV ribbon is connected where the opposite legs of the antenna join at the apex. Support the ribbon with standard screw-in TV ribbon insulator standoffs.

Each leg should be individually tensioned with the rope strainers as indicated. Large screw-eyes, obtainable from most hardware stores, screwed into the supports as illustrated serve as excellent anchor points and allow the rope to be tightened using an appropriate slip knot (a round turn and two half-hitches is excellent).

Ground Plane Antenna

The ground plane antenna was originally designed as a high frequency transmitting antenna, but makes a fine receiving antenna and covers a wide frequency range. Response from 13 to 49 metres has been found better than with a long wire. Below 49 metres performance falls off but the antenna compensates by almost eliminating TV interference on 60 metres.

It is also a useful shortwave aerial for the listener who has little room available, because it can be placed on the roof of a house without extensive guy wires running everywhere. The vertical portion used is 3/4 or 1-inch square aluminum tubing; 5 metres long is light and strong. The length is determined as being equivalent to quarter of the wavelength of 19 metres (5 metres approximates 1/4 wavelength = 15.2 MHz).

Ground radials are copper wire 5 metres long, at right angles to each other at the base of the antenna. They do not have to be horizontal, in fact it seems preferable that they be up to 45 degrees down from horizontal, that is 135 degrees from the vertical.

TV ribbon provides a matched lead-in for the antenna, one side linking the vertical to the antenna jack on the receiver, the other side linking the four radials to the ground of the receiver. By having the receiver grounded, performance is improved and noise level reduced. However some sets may work better without the connection to ground. Breaking strain nylon is used to support the vertical, rather than affect the balance and performance of the antenna.

This antenna has produced some good catches already. Signals have been heard on 13 and 16 metre bands which were inaudible with a 35 metre long wire.

Tuned Loop Antenna

This antenna typically consists of a number of turns of insulated wire on a former about 0.75 metres in diameter. It can be tuned with a single parallel capacitor. Its particular advantages are easy construction and its portability. This aerial is highly directional so it should be mounted vertically with the edge of the loop pointed towards the station of interest.

Generally

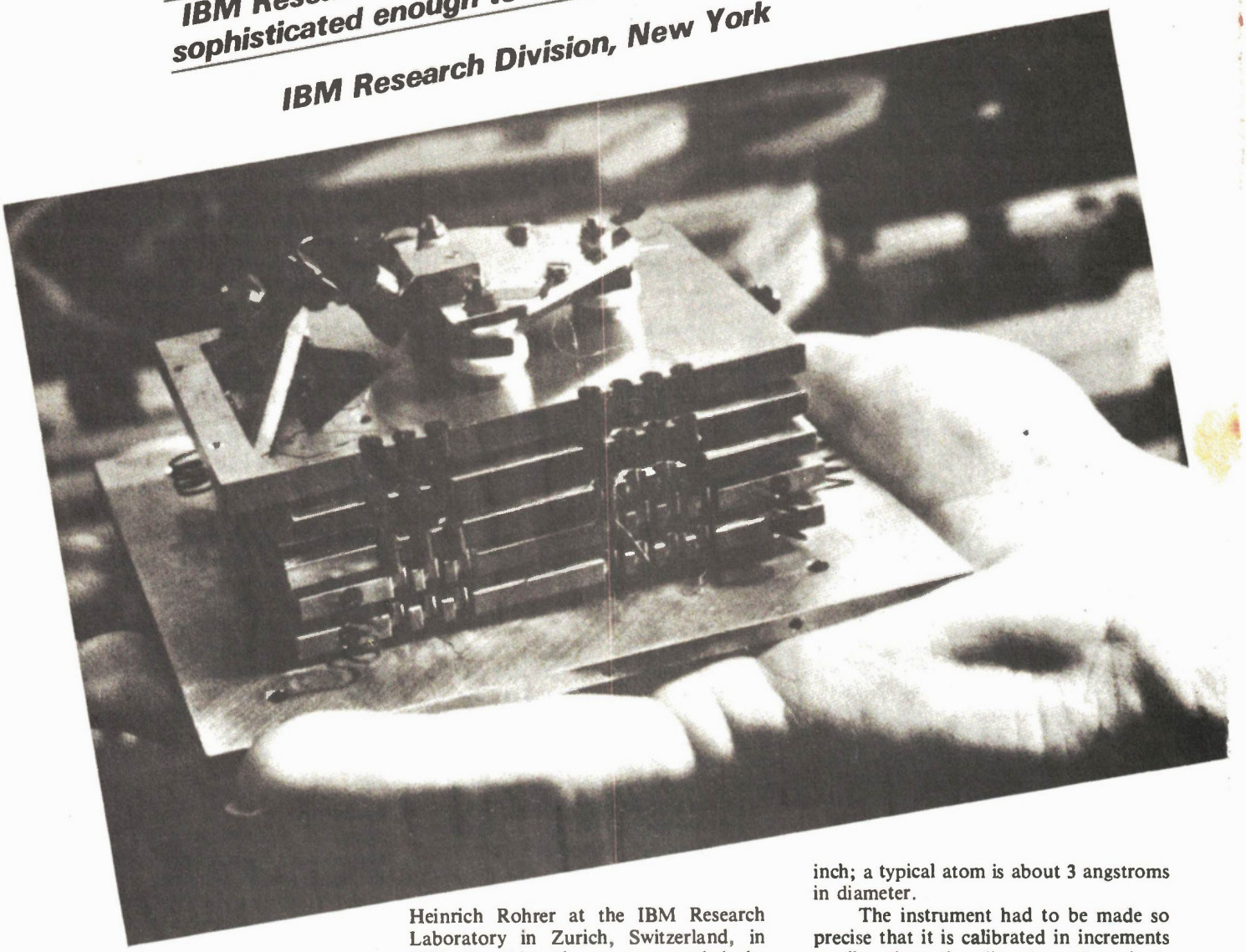
Long wire antennae including inverted Ls and beveridges are generally more suitable for mediumwave reception. Those best suited to shortwave are the ground plane, tuned loop and dipole (which we haven't mentioned here).

In constructing an aerial, rules of thumb are to have it as high as possible and clear of any obstructions such as power lines. The wire between the two insulators can be copper or insulated; lead in should be covered wire. Most importantly, make sure the aerial touches no metal objects. One further precaution is to fit a lightning arrestor which short circuits any unwelcome current. ■

The Scanning Tunneling Microscope

IBM Research's new microscope technique is sophisticated enough to show individual atoms.

IBM Research Division, New York



SCANNING tunneling microscopy is a powerful new technique for making images of surfaces in such detail that individual atoms can be seen. The technique was invented by Gerd K. Binnig and Heinrich Rohrer at the IBM Research Laboratory in Zurich, Switzerland, in 1981. In 1986, they were awarded the Nobel Prize in physics for this and following work.

The instrument on which the technique is based, the Scanning Tunneling Microscope (STM), can accurately depict a "landscape" only 100 angstroms square, where the hills are individual atoms as they actually exist on the surface. An angstrom is one ten-millionth of a millimetre, or about 4 billionths of an inch; a typical atom is about 3 angstroms in diameter.

The instrument had to be made so precise that it is calibrated in increments smaller than the diameter of a single atom. Through further development, researchers at IBM have produced images that simultaneously show both surface atoms and the electron bonds that hold them together and permit chemical reactions. In 1985, IBM researchers at IBM miniaturized the STM to handheld size and simplified its basic mechanism to allow its use in a wider variety of scientific investigations.

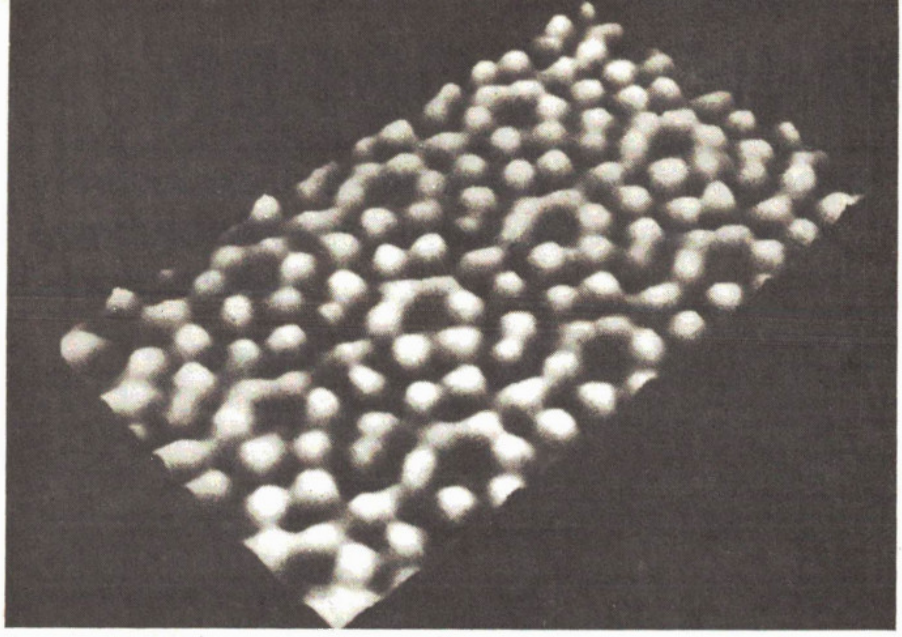


Fig. 1. Silicon surface atoms magnified millions of times. The image is computer-generated from data produced by a Scanning Tunneling Microscope, invented by IBM scientists in Zurich, Switzerland.

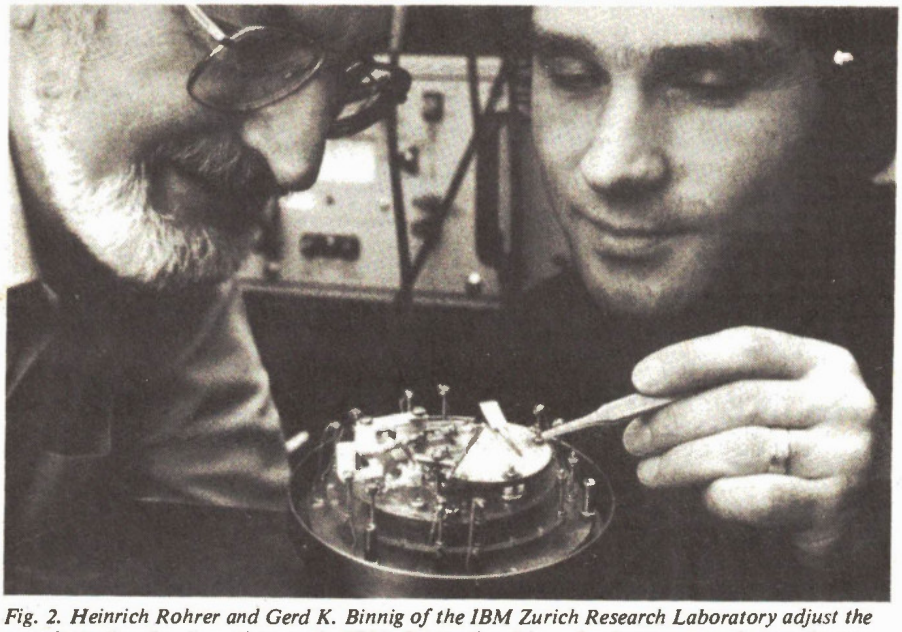


Fig. 2. Heinrich Rohrer and Gerd K. Binnig of the IBM Zurich Research Laboratory adjust the sample in the chamber of an early STM. It was for this and subsequent work that the two physicists were awarded the Nobel Prize in physics in 1986.

IBM has shared the techniques of scanning tunneling microscopy to encourage its use and further development by scientists at many research institutions. Currently, STMs are being used or are being built by some 50 research groups in universities and industrial laboratories throughout the world in a broad range of physical, chemical, biological and technical studies. The knowledge that STM can provide is expected to be important in developing the process for future integrated circuits and high-density storage.

How It Works

The STM makes uses of a phenomenon called electron tunneling, which involves the passage, or "tunneling" of electrons between two materials; the rapid movement of the electrons causes them to spill out slightly beyond the surface of the material. If two surfaces are brought into contact so that their electrons overlap and a voltage is then applied, the electrons will move between the materials.

The microscope uses a metal probe tip which ends in a single atom. The amount of current that flows between the tip and the surface rises and falls dramatically as the tip is brought closer or farther from the surface being investigated. As the tip is moved, or scanned, across the surface, the current would peak as an atom "looms" up from the surface and would drop as a valley falls between atoms.

Rather than have the current rise or fall, the STM tip moves up and down so that the current remains constant. This fluctuation is directly proportional to the invisible atomic landscape, which is traced, line by line, by the tip's movements. When processed by a computer, the lines are transformed into a three-dimensional map of the surface.

Construction

The STM's tip is formed by a gaseous deposition process in which a single atom can be placed on the apex of pyramid of tungsten atoms. This monoatomic tip should give the ultimate lateral resolution inasmuch as the spatial limitation of the tunneling current can be associated with the electronic structure above "one" single atom.

To move the tip accurately over an area on the atomic level, piezoelectric elements are mounted with stainless-steel cubes in an arrangement like a checkerboard; biasing the elements produces the desired X-Y movement. This unit is then mounted onto the microscope via several other piezoelectric elements, giving control of motion in any direction. The resulting structure has a practical scanning limit of 3000 by 3000 square angstroms.

Freedom from external vibrations is obtained by making the construction compact and rigid, with internal resonance frequencies as high as possible. It is also mounted on a soft spring system which attenuates acoustic waves propagating in the springs.

Surface Discoveries

With the Scanning Tunneling Microscope, scientists have obtained previously unseen images of gold, silicon, nickel, and carbon atoms. Some of the STM pictures revealed flaws and contaminants in the atomic surface structure. Others showed the basic structure of semiconducting or metallic surfaces. Such detailed views of 3-D atomic landscapes will significantly alter today's understanding of surface physics and chemistry and will affect fields as varied as metallurgy, the study of magnetism, semiconductor technology and biology.

Before the invention of the STM, scientists had been puzzled about the exact surface structure of silicon, the basic material of computer chips. These scientists had proposed conflicting surface models for many years. When the STM was first used to "map" the surface, it eliminated most of the proposed models and the issue was settled, IBM scientists say.

(Additional material on the construction of the STM was excerpted from the IBM Journal of Research and Development, Vol. 30, No. 5.) ■

NEW & REVISED

BABANI BOOK OFFER

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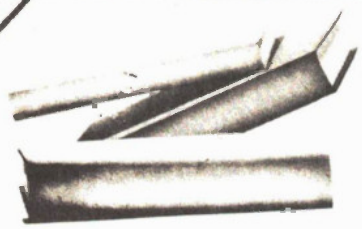

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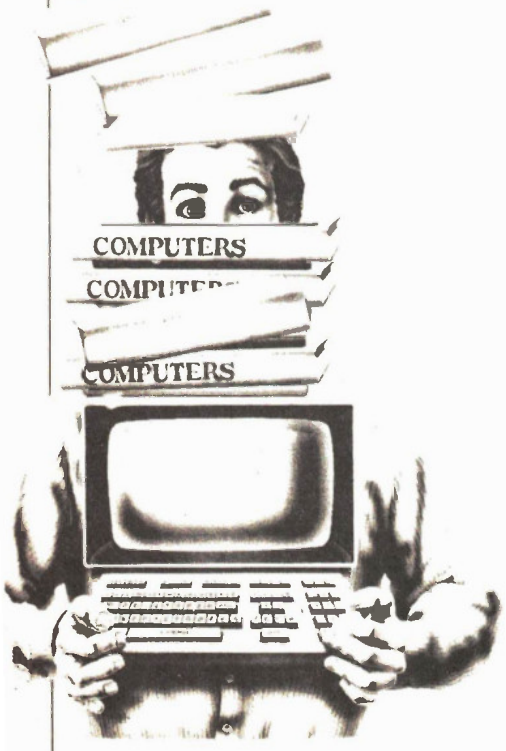
The popular 6502 microprocessor is used in many home computers; this is a guide to beginning assembly language.

BP150: AN INTRO. TO PROGRAMMING THE SINCLAIR QL $7.80
Helps the reader make the best use of the Sinclair QL's almost unlimited range of features. Complements the manufacturer's handbook.

BP22S: A PRACTICAL INTRODUCTION TO DIGITAL ICs $7.00
This book deals mainly with TTL type chips such as the 7400 series. Simple projects and a complete practical construction of a Logic Test Circuit Set are included as well as details for a more complicated Digital Counter Timer project.

BP130: MICRO INTERFACING CIRUITS - BOOK 1 $9.00
Aimed at those who have some previous knowledge of electronics, but not necessarily an extensive one, the basis of the book is to help the individual understand the principles of interfacing circuits to microprocessor equipment.

BP47: MOBILE DISCOTHEQUE HANDBOOK $7.80
Divided into six parts, this book covers such areas of mobile "disco" as: Basic Electricity, Audio, Ancillary Equipment, Cables and Plugs, Loudspeakers, and Lighting. All the information has been considerably sub-divided for quick and easy reference.



BP131: MICRO INTERFACING CIRCUITS - BOOK 2 $9.00
Intended to carry on from Book 1, this book deals with practical applications beyond the parallel and serial interface. "Real world" interfacing such as sound and speech generators, temperature and optical sensors, and motor controls are discussed using practical circuit descriptions.

BP111 AUDIO $14.00
This one is ideal for readers who want to really get into sound. A wide range of material is covered from analysis of the sound wave, mechanisms of hearing, room acoustics, microphones and loudspeakers, amplifiers, and magnetic disc recording.

BP141: LINEAR IC EQUIVALENTS AND PIN CONNECTIONS ADRIAN MICHAELS $23.80
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This book carries on from its predecessor and provides a further selection of useful circuits, mainly of a simple nature. the book will be well within the capabilities of the beginner and more advanced constructor.

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Several fascinating applications with complete electronic and practical details on the simple, and inexpensive construction of Heterodyne Metal Locators.

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Further Practical Electronics Calculations and Formulae $5.00
This book covers many aspects of electronics where a knowledge and familiarity of the appropriate formulae is essential for a fuller understanding of the subject. An essential addition to the library of all those interested in electronics be they amateur, professional or student.

ELEMENTS OF ELECTRONICS — AN ON-GOING SERIES
F.A. WILSON, C.G.I.A., C.Eng.,

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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.

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BOOK 3. Follows on semiconductor technology, leading up to transistors and integrated circuits.

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BOOK 5. A book covering the whole communication scene.

PROJECTS

BP48: ELECTRONIC PROJECTS FOR BEGINNERS $7.80
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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.

BP37: 50 PROJECTS USING RELAYS, SCR's & TRIACS $7.80
F.G.RAYER, T.Eng.(CEI),Assoc.IERE
Relays, silicon controlled rectifiers (SCR's) and bi-directional triodes (TRIAC's) 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.

BP221: 28 TESTED TRANSISTOR PROJECTS $11.80
R.TORRENS
Mr. Richard Torrens is a well experienced electronics development engineer and has designed, developed, built and tested the many novel and interesting circuits included in this book. The projects themselves can be split down into separate 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.

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BP71: ELECTRONIC HOUSEHOLD PROJECTS $7.00
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.

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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.

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BP90: AUDIO PROJECTS $7.80
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.

BP 174: MORE ADVANCED ELECTRONIC MUSIC PROJECTS $19.95
Complementing Book BP74, "Electronic Music Projects", BP174 provides more advanced projects, such as a flanger, a phaser, mini-chorus and ring modulators, percussion synths, etc. Each project has an introduction, circuit diagram and constructional notes.

BP74: ELECTRONIC MUSIC PROJECTS $10.00
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.

BP44: IC 555 PROJECTS $10.00
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.

BP82: ELECTRONIC PROJECTS USING SOLAR CELLS $7.80
A collection of simple circuits which have applications in and around the home using the energy of the sun to power them. The book deals with practical solar power supplies including voltage doubler and tripler circuits, as well as a number of projects.

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BABANI BOOKS

BP49: POPULAR ELECTRONIC PROJECTS $10.00
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.

BP94: ELECTRONIC PROJECTS FOR CARS AND BOATS
R.A. PENFOLD $7.80
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.

BP95: MODEL RAILWAY PROJECTS $7.80
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: striboard layouts are provided for each project.

BP93: ELECTRONIC TIMER PROJECTS $7.80
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.

BP113: 30 Solderless Breadboard Projects-Book 2
R.A. Penfold $9.00
A companion to BP107. Describes a variety of projects that can be built on plug-in breadboards using CMOS logic IC's. Each project contains a schematic, parts list and operational notes.

BP104: Electronic Science Projects
Owen Bishop $9.00
Contains 12 electronic projects with a strong scientific flavour. Includes SImple Colour Temperature Meter, Infra-Red Laser, Electronic clock regulated by a resonating spring, a 'Scope with a solid state display, pH meter and electro-cardiograph.

BP110: HOW TO GET YOUR ELECTRONIC PROJECTS WORKING $7.80
R.A. PENFOLD
We have all built circuits from magazines and books only to find that they did not work correctly, or at all, when first switched on. The aim of this book is to help the reader overcome just these problems by indicating how and where to start looking for many of the common faults that can occur when building up projects.

BP84: DIGITAL IC PROJECTS $7.80
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 $11.80
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 values obtained from a great range of devices. This book many applications and projects using various types of numeral displays, popular counter and driver IC's etc. are considered.

BP99: MINI—MATRIX BOARD PROJECTS $7.60
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This book allows the reader to build 21 fairly simple electronic projects, all of which may be constructed on the same printed circuit board. Wherever possible, the same components have been used in each design so that with a relatively small number of components and hence low cost, it is possible to make any one of the projects or by re-using the components and P.C.B. all of the projects.

BP107: 30 SOLDERLESS BREADBOARD PROJECTS — BOOK 1 $9.00
R.A. PENFOLD
A "Solderless Breadboard" is simply a special board on which electronic circuits can be built and tested. The components used are just plugged in and unplugged as desired. The 30 projects featured in this book have been specially designed to be built on a "Verobloc" breadboard. Wherever possible the components used are common to several projects, hence with only a modest number of reasonably inexpensive components it is possible to build, in turn, every project shown.

BP106: MODERN OP-AMP PROJECTS $7.80
R.A. PENFOLD
Features a wide range of constructional projects which make use of op-amps including low-noise, low distortion, ultra-high input impedance, high slew-rate and high output current types.

CIRCUITS

How to Design Electronic Projects
BP127 $9.00
Although information on standard circuit blocks is available, there is less information on combing these circuit parts together. This title does just that. Practical examples are used and each is analysed to show what each does and how to apply this to other designs.

Audio Amplifier Construction
BP122 $2.25
A wide circuits is given, from low noise microphone and tape head preamps to a 100W MOSFET type. There is also the circuit for 12V bridge amp giving 18W. Circuit board or stripboard layout are included. Most of the circuits are well within the capabilities for even those with limited experience.

BP80: POPULAR ELECTRONIC CIRCUITS — BOOK 1 $11.80
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 Circuits, Household Project Circuits and Miscellaneous Circuits.

BP98: POPULAR ELECTRONIC CIRCUITS, BOOK 2 $9.00
R.A. PENFOLD
70 plus circuits based on modern components aimed at those with some experience.

Electronic Circuits for the Computer Control of Robots $12.00
The main stumbling block for most would-be robot builders is the electronics to interface the computer to the motors, and the sensors which provide feedback from the robot to the computer. The purpose of this book is to explain and provide some relatively simple electronic circuits which bridge the gap.

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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.

BP162: COUNTING ON QL ABACUS $10.00
This book is designed to introduce the beginner to the use of spreadsheets in general and Abacus on the Sinclair QL in particular. It assumes no previous experience in computing or spreadsheets. Practical examples show the calculations for domestic, small business and technical applications.

BP87: SIMPLE L.E.D. CIRCUITS $5.40
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.

BP88: HOW TO USE OP AMPS $11.80
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.

BP65: SINGLE IC PROJECTS $6.00
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.

223: 50 PROJECTS USING IC CA3130 $5.00
R.A.PENFOLD
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BP117: PRACTICAL ELECTRONIC BUILDING BLOCKS BOOK 1 $7.80
Virtually any electronic circuit will be found to consist of a number of distinct stages when analysed. Some circuits inevitably have unusual stages using specialised circuitry, but in most cases circuits are built up from building blocks of standard types.
This book is designed to aid electronics enthusiasts who like to experiment with circuits and produce their own projects rather than simply follow published project designs.
The circuits for a number of useful building blocks are included in this book. Where relevant, details of how to change the parameters of each circuit are given so that they can easily be modified to suit individual requirements.

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Written for machine language programmers who want to expand their knowledge of microprocessors. Outlines history, architecture, addressing modes, and the instruction set of the 6809 microprocessor. The book also covers such topics as converting programs from the 6800, program style, and specifics of 6809 hardware and software availability.

BP118: PRACTICAL ELECTRONIC BUILDING BLOCKS - Book 2
R.A. PENFOLD $7.60
This sequel to BP117 is written to help the reader create and experiment with his own circuits by combining standard type circuit building blocks. Circuits concerned with generating signals were covered in Book 1, this one deals with processing signals. Amplifiers and filters account for most of the book but comparators, Schmitt triggers and other circuits are covered.

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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.

RADIO AND COMMUNICATIONS

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A TV-DXers Handbook $18.00
This book will be a practical guide for the beginner and a source of reference for the established TV-DXing enthusiast. The possibilities and problems of receiving television signals over long distances and resolving of such pictures with the minimum of distortion is discussed. Also included are many units and devices which have been designed by experienced enthusiasts.

BP91: AN INTRODUCTION TO RADIO DXing $7.80
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.

BP105: AERIAL PROJECTS $7.80
R.A. PENFOLD
The subject of aerials is vast but in this book the author has considered practical designs including active, loop and ferrite aerials, which give good performances and are reasonably simple and inexpensive to build. The complex theory and math of aerial design are avoided.

OTHER PUBLISHERS

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K. DORRICOTT **$11.95**
Written by the managing director of Deloitte, Haskins & Sells, a Canadian partnership of public accountants and other professional advisors to management, this book is one of the most complete comprehensive guides to microcomputers available. Starting with a general overview of microcomputers and their business applications, the author helps you assess your computer needs, compares and evaluates computer systems and application packages, and gives you tips on "doing it right". A must for anyone thinking of purchasing a microcomputer for business.

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TAB No. 1200 **$16.45**
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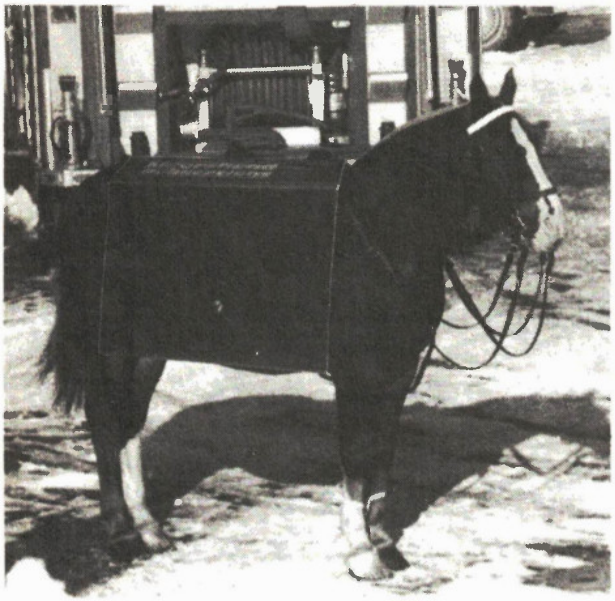

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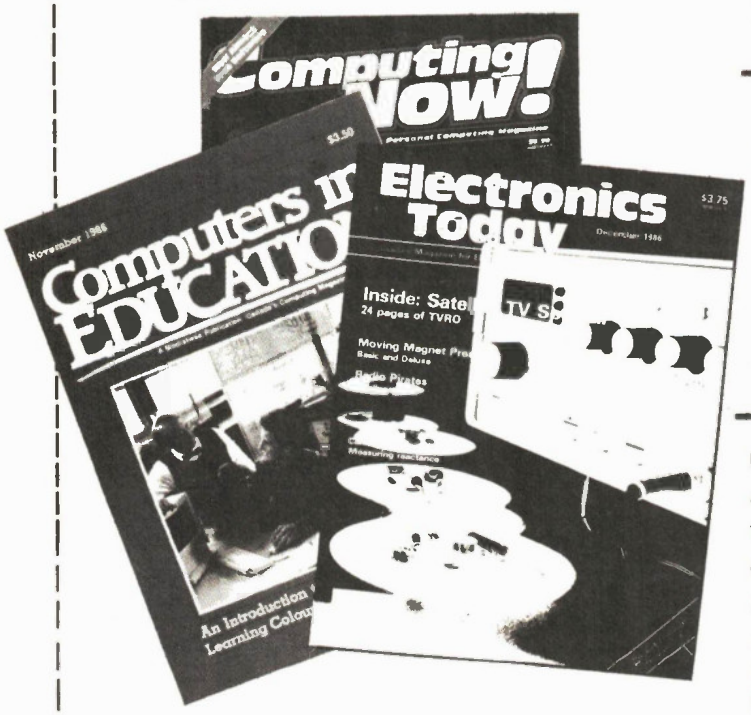

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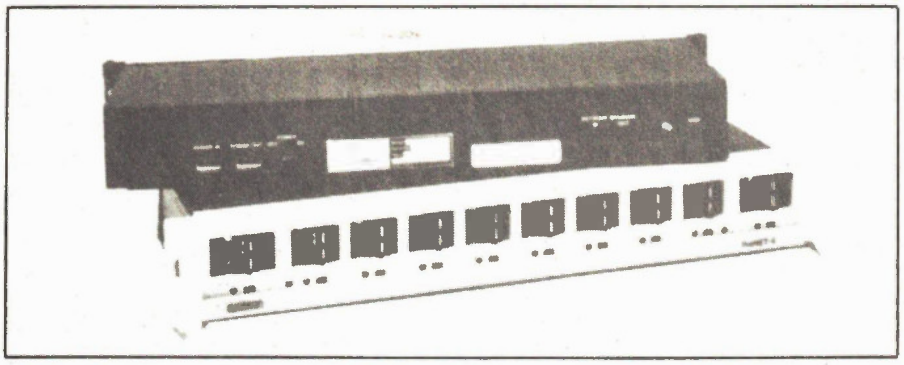

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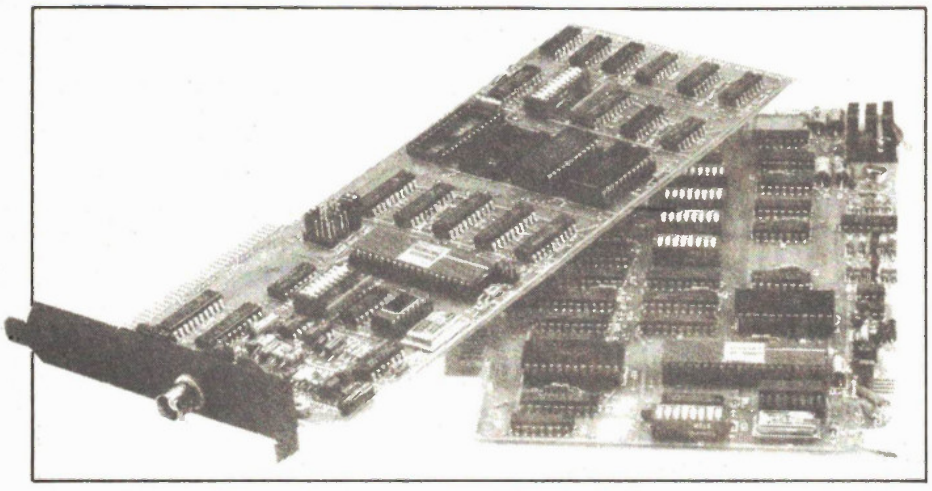


The Arcnet products from Standard Microsystems.

provides an interface between equipment with a programmable RS-232 port and an Arcnet local area network.

Standard is represented in Canada by Haltronics LImited, with outlets in most provinces, or contact their head office at 1085 North Service Road East, Oakville, Ontario L6H 1A6, (416) 844-2121.

Paranet

A simple network for IBM-type and Wang-type computers is the Paranet. It lets you transfer data between two computers through their parallel ports, saving you the cost of serial port cards. Data can be transferred between the two at about 200 kilobaud. It's an inexpensive approach to data exchange, backing up slave hard drives with one master, accessing a large database, changing disk formats and so on. $150 from Comtek Datasystems Ltd., Suite 701, 280 Albert St., Ottawa, Ontario, (613) 236-1487.

D-Link

Basonje Systems announces the availability of D-Link, another IBM-compatible network. The D-Link is a half-size PCB card with a Novell Netware emulator, making it compatible with the IBM PC network, Token Ring Network, and other multi-user applications written for use with PC-DOS or MS-DOS. It can link up to 255 workstations to a distance of 4,000 feet, transferring data at one megabit per second on twisted-pair cables. It uses the collision-avoidance protocol. Contact Basonje Systems, 138 Huron St., Toronto, Ontario M5T 2B2, (416) 598-7992.

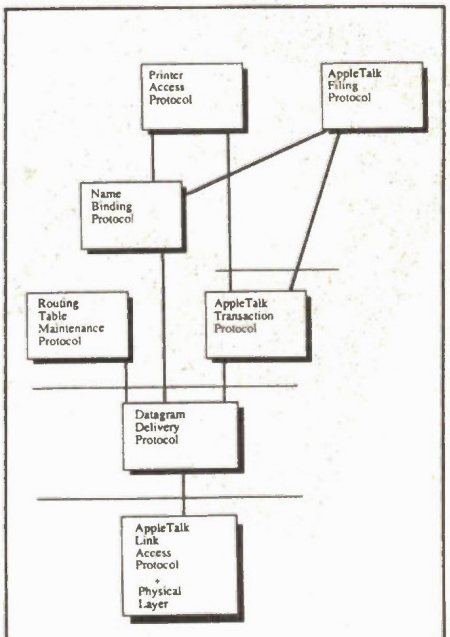
Hewlett-Packard

HP makes a comprehensive line of networking equipment for large, wide-area networks. Entire large companies with widely spaced locations can be connected together using the X.25 system. Most types of computer equipment can access the network, including IBM-types, the Vax, IBM mainframes and various types of HP computers.

HP has introduced a number of networking solutions for various needs, including sales/service, manufacturing, office facilities, etc., integrating them all through the X.25 standard. For further information on their local and wide area network systems, contact Hewlett-Packard Canada Ltd., 6877 Goreway Drive, Mississauga, Ont. L4V 1M8, (416) 678-9430.

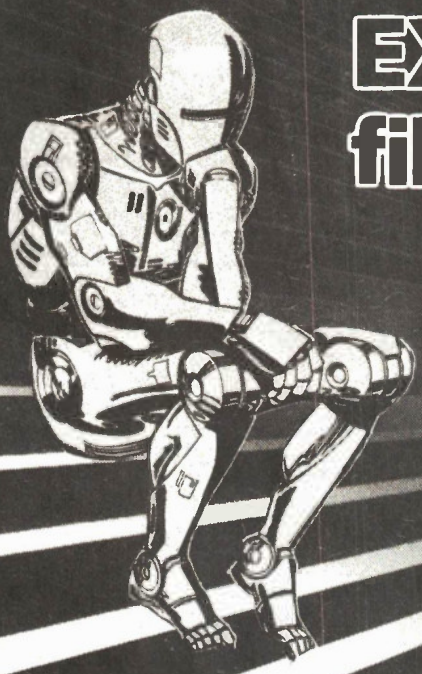
Proteon

The ProNet-4 from Proteon is a four megabit per second LAN that's fully compatible with IBM's token-ring network. It runs on the IBM cabling system, fibre optics, twisted pair cables and other media. Interfaces are available for PC/AT types, Multibus and VMEbus computers, and Digital's Unibus. It supports popular protocols such as the Novell Advanced Netware. They can be contacted at Proteon, Inc., Two Technology Drive, Westborough, MA 01581, (617) 898-2800. ■



The protocol of the AppleTalk network.

8088 Programming: EXE and COM files



Exploring the mysteries of programming with memory segments.

By E. Penn

I KNOW you toss and turn at night, trying to grasp the difference between COM and EXE files in MS-DOS. Your troubles are over. Here it is, all at once:

COM files are: very compact when assembled, limited to one segment (64K) in size, load at location 0100 of the code segment and are not worried about such complications as setting up the registers for entry and exit (DOS takes care of this).

EXE files are: large when assembled (minimum size 640 bytes), able to grow to any size by using segments, load at location 0000 and are fussy about having precise entry and exit instructions.

In addition, different sections of the EXE program can be written in separate parts and then linked together into one by the LINK part of the assembler. There you are, Mr. Editor. That will be $500, please, in cash.

What? Another three pages to go? Spoilsport.

A Sample COM

First, a COM file is nothing more than a string of 8088 instructions that are loaded into location 0100 of the CS (code segment) and executed until the CPU hits an INT 20 exit instruction. You saw stuff like this in previous chapters when short programs were concocted using DEBUG.

However, DEBUG takes care of loading and exiting instructions; all you have to do is enter the bytes and you're off. If you decide to write in assembly language, by writing a word processor file with the extension .ASM, you have to tell the assembler (ASM or MASM or similar) a few things about what a COM file really is. I know, the assembler should figure this out for itself, but it doesn't know what sort of file you want to end up with; you'll do this yourself later with LINK and EXE2BIN.

So here is a sample COM file that prints a period on the screen. If you want to test the whole procedure outlined here, you'll need a word processor, MASM.EXE, LINK.EXE and EXE2BIN.EXE. Your word processor should generate pure ASCII without the high bits set or anything. I use WordStar in the non-document mode, and the assembler is put in a RAMdisk to speed it up, which is why the programs in the listings come from the C: drive.

There are some mysterious labels which seem to have nothing to do with printing a dot. In fact, they don't. They're instructions to the assembler, cluing it in to the fact that the code is a COM file and will live entirely in the CS segment. The first two lines and the last two are required by the Microsoft ASM or MASM syntax. If you use some other assembler, you'll have to follow their instructions.

```
PROGNAM SEGMENT

        ASSUME CS:PROGNAM

        MOV AH,2H
        MOV DL,2EH
        INT 21H
        INT 20H

PROGNAM ENDS

END
```

Fig. 1. The structure required by the assembler for a COM file.

That's it for writing COM assembler files. Put PROGNAM (*not* "Program") SEGMENT and the ASSUME statement at the beginning, the two ending statements at the end, and your code in between.

When DOS sees the COM extension (which we'll add in a moment), it takes care of (a) loading at location 0100 in the code segment, (b)running the program and putting any code that's PUSHed into the stack at the top of the CS segment, and (c) putting everything in order for an exit to the prompt when it comes across the INT 20 instruction.

Now to start the process of turning our DOT.ASM word processor file into a COM. **Fig. 2** shows the procedure. After loading, MASM will wait after "Object filename" to see if you agree with the default name of the file it's going to make (DOT.OBJ). Type a Return for "yes". If you want a copy of your .ASM file with a list of the bytes used, type "DOT.LST" for the next line; otherwise NUL.LST means you don't get one. Type another Return for NUL.CRF because we aren't cross-referencing, and away it goes.

If you didn't make any typing booboos, you'll see the rewarding zero-error message. Type DIR and there's your object file.

An object file is sort of in-between. It's the 8088 instructions converted to hex bytes, but also contains some information the assembler needs for the next step. If you want, haul it into DEBUG and type D to see your eight-byte program starting at location 0123, embedded in a bunch of notes for the assembler.

Now, type LINK DOT as in **Fig. 3.** This will convert the object file to an EXE file, along with an unnerving error message which isn't really an error message. The assembler wants an EXE file to have a segment reserved for the stack, and we didn't do that because DOS puts the stack at the top of the code segment in COM files. This throws an error message that means nothing. So, why do we go through this convolution when all we want is to directly make a COM file? Because the guys who write assemblers don't *care.*

Type DIR and you'll see the addition of DOT.EXE. If you don't, you've made a typo somewhere. Could we run this EXE file? Yes, we could, and it would write a period to the screen, but (a) it's 640 bytes long, and (b) it will hang the system on exiting because on an EXE file, DOS expects the registers to be put back neatly the way you found them, and our file just jumps out the back door, leaving a mess behind.

To let DOS do the required housekeeping, our last step is to pare down the EXE

```
B>c:masm dot
The Microsoft MACRO Assembler
Version 2.04 (C)Copyright Microsoft 1982

Object filename [DOT.OBJ]:
Source listing  [NUL.LST]:
Cross reference [NUL.CRF]:

Warning Severe
Errors  Errors
0       0

B>dir dot.*

 Volume in drive B has no label
 Directory of  B:\

DOT      OBJ        49   1-01-80  12:25a
DOT      ASM       128   1-01-80  12:11a
        2 File(s)     73728 bytes free

B>
```

Fig. 2. Assembling the ASM file into Object code.

```
B>c:link dot

   Microsoft Object Linker V1.10
(C) Copyright 1981 by Microsoft Inc.

Run File [DOT.EXE]:
List File [NUL.MAP]:
Libraries [.LIB]:
Warning: No STACK segment

There was 1 error detected.

B>dir dot.*

 Volume in drive B has no label
 Directory of  B:\

DOT      OBJ        49   1-01-80  12:25a
DOT      EXE       640   1-01-80  12:26a
DOT      ASM       128   1-01-80  12:11a
        3 File(s)     72704 bytes free

B>
```

Fig. 3. Linking the Object code into an EXE file.

```
B>c:exe2bin dot dot.com

B>dir dot.*

 Volume in drive B has no label
 Directory of  B:\

DOT      OBJ        49   1-01-80  12:25a
DOT      EXE       640   1-01-80  12:26a
DOT      COM         8   1-01-80  12:28a
DOT      ASM       128   1-01-80  12:11a
        4 File(s)     71680 bytes free

B>dot

B>
```

Fig. 4. The final step: converting the EXE to COM format.

into a COM. Fig. 4 shows this. The final filename, DOT.COM, has to be typed in manually in the command line; otherwise you'll have to use the REN command to rename it. Honestly, you have to tell these assemblers *everything*.

Type DIR to confirm the existence of DOT.COM, and then run it. Your reward is a dot and a clean return to the prompt. Hot stuff.

Now you can delete the unwanted EXE and OBJ files. A batch file will let you go through the whole rigamarole and automatically delete things as you go. It doesn't matter if the COM file doesn't work because you'll have to rewrite all the files anyway. But don't kill the .ASM file. You never know when you'll want it.

The Fearsome EXE

As mentioned, you can't exceed one segment (64K) in size with a COM file. All stack manipulation and subroutine calls must occur within the code segment. Well, actually, you could get a COM file to step outside the bounds and roam around other segments by setting the various segment registers to the appropriate values, but it seems pointless to do this when DOS is ready and willing to do it for you.

All you have to do is give the assembler a page of instructions telling the simple-minded thing where to put stuff. The code goes in the code segment, the stack goes in the stack segment, and so on. No, I don't know why it's so dumb either, but you have to keep telling it things that are obvious. That's why you'll find an "H" after numbers that are supposed to be hex; the assembler's default is decimal, and besides, it gets confused between hex numbers and register labels - if you enter the hex number AD, for instance, the assembler may tell you that there's no such register. Typing ADH makes it happy again.

In Fig. 5 is the standard form of an EXE file. They all look like this, and the assembler's syntax requires the instructions to be in exactly the format shown. All you can change safely is the spacing and indentation; it doesn't care about that.

Let's do a basic unravel of the necessary statements to make an EXE file get along with DOS.

First, we put the EQU statements right after the title and remarks. Some programmers use memory-jogging EQUs such as DOSCALL instead of INT 21. I know, it's easier to type INT 21, but it makes readability better, and six months from now you won't remember beans about how your file works.

Next we tell the assembler where to assign the stack segment. The DB ("Define Byte") and DUP part prints the word "STACK" (plus three spaces) 20 times in the stack segment (whose address is determined by DOS). This makes it easy to find the stack when you're using DEBUG to troubleshoot.

The DATAREA part tells the idiot program that data goes in the data segment. This is where you might put long strings of text or bunches of graphics data or similar.

PROGNAM SEGMENT tells the nerd in charge that code goes in the code segment (the ASSUME statement) and that the MAIN PROCedure can be expected to make FAR calls and returns to and from other segments. The next bit of code pushes the original values in the registers onto the stack as the program loads so DOS can restore them on the exit.

Finally, you get to insert your program, and that's it, folks. Any subroutines you care to insert follow on, and then the last two lines begin the exit routine.

Segments, as pointed out in a previous article, can be anywhere and any size from a minimum of 16 bytes to a maximum of 64K each. They can even overlap each other; DOS takes care of assigning suitable addresses for them so everything works.

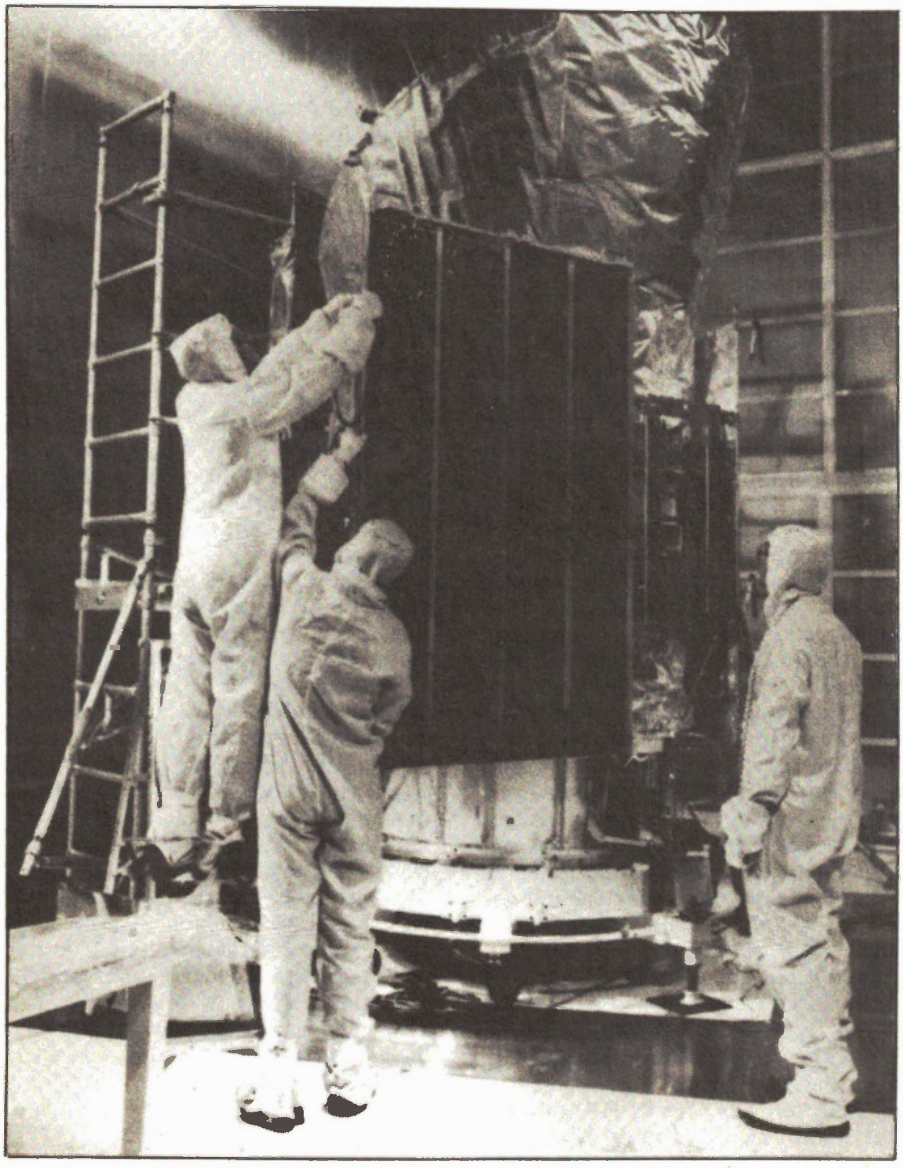
Make an EXE

We're running out of space and can't even begin to describe the finer points of writing an EXE, which is why the other guys take whole books to do it. However, we can make our DOT.ASM into a

Advances in Infrared Astronomy

Looking at the universe despite obstacles to infrared light.

By Martin Redfern, Science Unit, BBC External Services.



Preparing the Infrared Astronomical Satellite (IRAS) for launch at Vandenberg, the United States Air Force base in California.

TAKE narrow beam of sunlight, pass it through a glass prism, as Sir Isaac Newton once did, and you produce a rainbow spectrum of the different colours or wavelengths. Yet there are far more aspects of this action than are immediately apparent.

Take a thermometer and hold it in the dark, just past the red end of the spectrum, and it registers heat. Heat, or infrared radiation, fills the gap in the spectrum between visible light and radio waves. It is, furthermore, a very large gap. Visible light spans wavelengths from about 0.3 to 1.0 um. Infrared occupies the much wider band from 1.0 to 1000 um.

As far as infrared astronmy is concerned, however, there are certain difficulties. Only a small fraction of the heat rays of a star penetrate all the way through the atmosphere to ground level. Most are absorbed by water vapour on the way down. Also, anything that is not at absolute zero, itself radiates in the infrared. This includes the structures of telescopes and even the sky. This being so, some clever tricks are needed to build a good infrared telescope.

Astronomers in the United Kingdom needed such an instrument a decade ago and the country's Science and Engineering Research Council (SERC) made some funds available. This resulted in the formation of the United Kingdom Infrared Telescope (UKIRT). For the money available, the astronomers, led by the Royal Observatory at Edinburgh, in Scotland, could have built a fairly standard conventional telescope, yet they wanted the biggest and best infrared telescope in the world, and to obtain it they had to take some risks.

Primary Mirror

Instead of building the main mirror of the telescope out of a very thick - and conse-

quently very heavy - block of glass they pioneered thin mirror technology. The great curved primary mirror of UKIRT is 3.8 m in diameter.

In many telescopes of this size, the mirror would weigh as much as 16 tonnes. In the case of UKIRT it weighs only six tonnes and was constructed for about one sixth of the price of a conventional mirror. This type of construction required special mountings which would allow the glass to bend very slightly, so the perfect curvature of the mirror was only achieved once it was hung in the telescope.

The telescope's structure is also very light. There is none of the heavy metalwork surrounding the top that is usually found in an optical telescope as this would itself radiate heat and spoil the images. Though the construction is novel, the design for an infrared telescope is very similar to that of an optical one. However in the case of UKIRT, the big primary mirror is coated with gold rather than aluminium to give a surface that reflects infrared with the greatest efficiency.

Having kept radiation from the telescope itself to a minimum, there is then the problem of the sky. Even at night this is often a million times brighter in infrared wavelengths than the stars.

Professor Jim Ring of Imperial College, London, describes studying stars in the sky as being like trying to see "a spot of luminous paint in a blast furnace".

This is overcome by the secondary mirror at the top of the telescope wobbling or chopping to and fro about three times a second, so that it is alternately viewing the star, the sky and the star again. By comparing the two this way, the tiny signal from the star can be picked

Secondary Mirror

That chopping secondary mirror reflects the heat of the star down through a hole in the main mirror to detectors beneath. Instead of having just one detector, there is a third mirror which can direct the radiation to one of four detectors so the astronomers do not need to waste time changing their instruments to make different observations.

It is also useful if the atmospheric conditions change and the astronomers can no longer continue with their original set of observations.

Two types of detector are used; one is essentially like a thermometer the other, more like a radio receiver. At present there is just a single sensor in each, so to build up a picture of an object requires many separate observations. But researchers at Edinburgh University hope soon to have a detector consisting of 3000 separate elements, which will be able to make infrared images of the sky.

Until then, most of the observations are of infrared spectra in which the infrared intensity is measured at a range of different wavelenghts, producing a characteristic "heat profile" of the object being studied.

It would be impossible to carry out good infrared astronomy from a telescope in Britain. A high, dry, mountain site is needed and the best sites are on oceanic islands where the air flow is smooth and where a mountain stands out above the clouds. The best site of all is Mauna Kea, the highest point on Hawaii, 4300 m above the Pacific. It is in the rarified atmosphere there that the British astronomers go to use UKIRT.

They do not all have to visit Hawaii, however. There is now a remote control system via statellite telephone links to researchers at any British university and this is part of the Starlink computer network. One astronomer at the University of Kent in southeast England, was even able to make observations using UKIRT from his home by means of a home computer connected by telephone to his university computer and then via Starlink to Hawaii. In this way, night time observations in Hawaii can be made from Britain during normal office hours, thanks to the ten hour time difference.

High Mountain

But even the high mountain site of Hawaii is not ideal. Best of all is space itself. In 1983 Britain, the United States of America and the Netherlands launched a satellite that was to revolutionise infrared astronomy, the Infrared Astronomy Satellite (IRAS). It contained a fairly small, 60 cm infrared telescope built in the United States and placed aboard a Dutch satellite. Britain was responsible for ground control, which was carried out from the Rutherford-Appleton Laboratory near Oxford where, each day as IRAS passed over head, enough data was relayed back to fill a large encylopaedia.

From space, there were some major advantages. There was no problem from water vapour and the sky was completely cold. It was also possible to cool the telescope itself so that it did not produce an infrared glow. This was done using a tank of 700 litres of liquid helium, slowly boiling away and keeping the detectors just two degrees above absolute zero.

It was the capacity of this thermos flask of helium that set the lifetime of IRAS. Though the planned life was 200 days, the satellite in fact continued operating for 300 days in 1983. It was 1000 times more sensitive than any telescope on Earth, a difference comparable to the difference between Galileo's first telescope and the best now available.

It was not possible at once to analyse all the data returned. Dr. Peter Clegg, an infrared astronomer from Queen Mary College, London, described it as being like standing under a waterfall of data. It was only possible therefore to sample a little at a time.

Through expert use of the computer, however, some very exciting results did emerge in those first days. IRAS spotted new comets; rings of dust around the solar system, gas clouds where stars were being born; some stars that might have planets forming around them; wispy clouds of dust throughout the galaxy and thousands of other galaxies shining brightly in the infrared.

Full Data

The full complement of IRAS data has now been published in a catalogue of the infrared sky and new finds are still emerging from it.

IRAS's main task was to survey the sky and it did this twice over. It was rather similar to a wide angle lens on a camera which was unable to see phenomena in fine detail. The astronomers now need a telephoto lens to probe the most exciting, mysterious objects in much greater detail. The European Space Agency is planning just such a mission. Called the Infrared Space Observatory (ISO), its launch is planned for 1992.

But long before that, big telescopes on Earth such as UKIRT have been able to follow up IRAS finds in great detail. In particular, UKIRT has been probing the details of the birth of stars. These form out of vast clouds of gas and dust and that makes the process invisible at optical wavelengths. The dust particles are larger than the wavelength of light so it cannot shine past them. But infrared waves are longer and can penetrate this dust.

Clouds such as those in the Orion nebula are in some way shocked, perhaps as they pass through the spiral arms of our galaxy. That moves the particles in the clouds closer together and gravity begins to take over. As they collapse, the protostars begin heating up and eventually, nuclear fusion begins as hydrogen burns. The heating continues to give temperatures as high as 10 million°. The dramatic changes that overtake a new star at this point result in instabilities and material is lost from the outside, blowing out as a wind and clearing the dust from around the star so that it can at last shine in visible light.

Star Birth

In our own galaxy, star birth is occurring in relatively small clouds. In some galaxies, discovered for the first time by IRAS,

it seems to be happening everywhere. No-one is yet sure exactly what triggers these so-called star-burst galaxies, but thousands of them have now been discovered.

Some appear to be closely associated with neighbouring galaxies and the star formation could result from collisions of entire galaxies. However, in others, there is no obvious neighbour and the trigger might be a violent outburst from the core of the galaxy, perhaps concealing a massive black hole.

At longer and longer wavelengths, infrared technology becomes more and more like radio astronomy. There is still one small but significant gap between the infrared and radio and that is millimetre wave astronomy. A few hundred metres down the mountain from UKIRT, a new telescope is also nearing completion. It is the United Kingdom/Netherlands millimetre wave device known as the James Clark Maxwell telescope and it has a vast dish or mirror 15 m across.

The technology is between that of radio and optical instruments. The surface of a radio dish does not have to be highly polished, although that of an optical telescope does. In the case of the James Clark Maxwell telescope, the primary dish is made up of finely machined aluminum sections, each supported on a framework with three precision motors which can keep the sections perfectly aligned.

It should have a surface accuracy fine enough to work well at wavelengths as short as a third of a millimetre, linking radio and infrared astronomy for the first time.

Due to begin operation in 1987, the telescope was designed at Cambridge and the Rutherford-Appleton Laboratory. It will be fabricated in the Netherlands and later assembled on Hawaii to be operated by sicentists from the Royal Observatory in Edinburgh. It should allow astronomers to peer into even darker clouds of dust and see cooler objects and perhaps, still younger stars. ■

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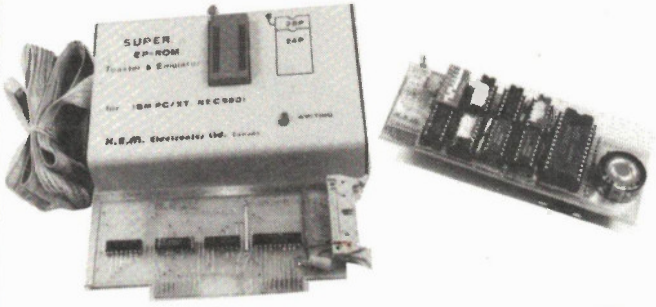

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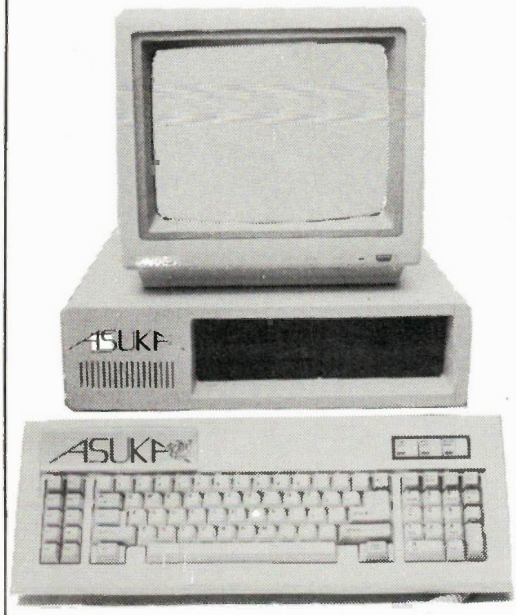

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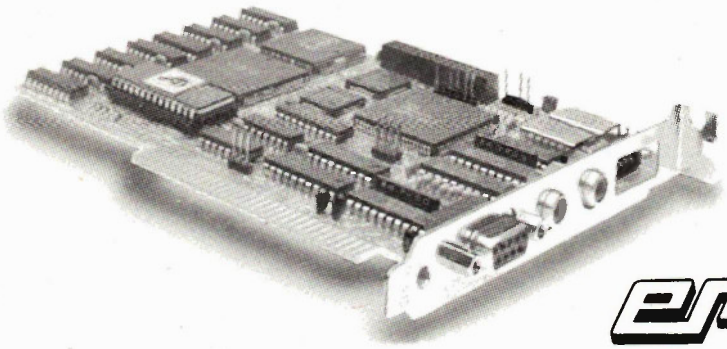

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```
;STANDARD 8088 TEMPLATE FOR EXE PROGRAMS
;Add any descriptive notes here

;put all EQU statements in this area

;****************************************

ST_SEG SEGMENT STACK     ;sets up stack

       DB       20 DUP   ('stack   ')

ST_SEG ENDS

;****************************************

DATAREA SEGMENT          ;data entered in
                         ;this section goes
;enter data here         ;in DS

DATAREA ENDS

;****************************************

PROGNAM SEGMENT          ;code entered in
                         ;here goes to CS
;----------------------
MAIN PROC FAR

ASSUME CS:PROGNAM,DS:DATAREA

START:

;next part sets the stack for a tidy exit

     PUSH DS             ;saves old values
     SUB AX,AX
     PUSH AX

     MOV AX, DATAREA     ;sets DS reg. to
     MOV DS,AX           ;new data segment
;your program goes here

RET  ;return to DOS

MAIN ENDP           ;end of main part
;-------------------------------------
SUBR1 PROC NEAR   ;defining a subroutine

;your optional subroutine would go here
SUBR1 ENDP
;-------------------------------------
PROGNAM ENDS      ;code segment ends
END START         ;all done. Whew!
```

Fig. 5. A template for the basic structure of an EXE assembler file.

workable EXE file as a demonstration of using our template.

First, I started a new file called DOT2.ASM and entered the EXE template shown in Fig. 5. Then I put in the same code as in DOT.ASM, but without the Prognam stuff. Here it is:

```
MOV AH,2H
MOV DL, 2EH
INT 21
```

It goes in place of the line that says "your program goes here". Note the lack of INT 20 compared to our DOT.ASM; this will just make trouble with an EXE file's exit routine. Now run MASM DOT2 to produce the OBJ file and LINK DOT2 to produce DOT2.EXE. Run it, see a dot on the screen and rejoice. To see the segment registers being manipulated, load DOT2 into DEBUG and use the T command to Trace each step.

In the limited space available, and personally I think they should give me an issue to myself, I couldn't cover anything but the barest bones of the EXE format. There's lots more to cover, such as working with the various segments, linking, macros, etc., but then I have an excuse to come back. Watch the typos and enjoy. ■

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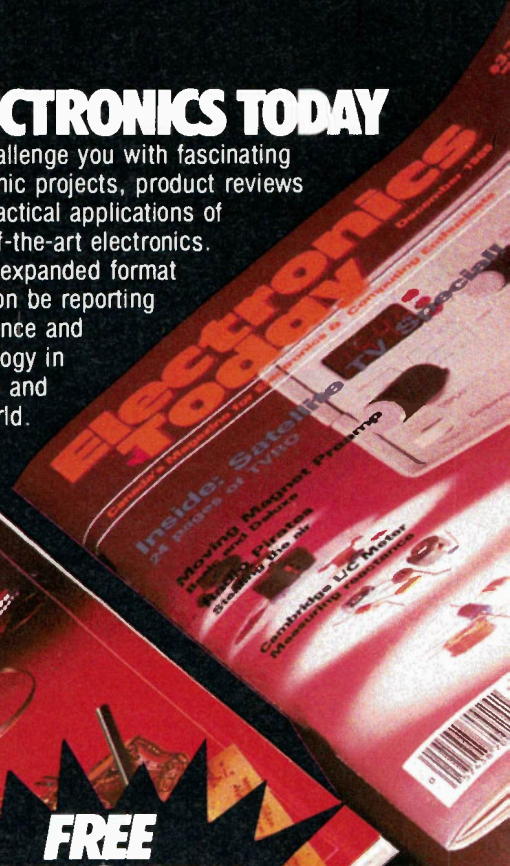

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High Power Laser

by David P. Dempster

Microwave radiation power levels were boosted more than 250,000 percent in a free-electron laser amplifier developed by a team of researchers from the Lawrence Berkeley Laboratory and the Lawrence Livermore National Laboratory.

A joint effort led by LBL accelerator theorist Andrew M. Sessler and the LLNL laser experimentalist Donald Prosnitz sent a microwave signal through the unique laser amplifier and raised the signal's power from 30,000 watts to more than 80 million watts. The amplified signal was measured by three different methods to be certain of its immense power output.

"This is the first operation of a free-electron laser as a high-gain microwave amplifier," says Sessler. "Experiments at the Naval Research Laboratory achieved similar high power microwaves, but they required an additional magnetic field that cannot be used for shorter wavelength radiation. Other experiments in microwave amplification saw power gains of only a few percent."

A free-electron laser amplifier is a device that can transfer energy from a beam of electrons travelling at near light speed (186,000 miles per second) to a beam of electromagnetic radiation, such as microwaves or visible light. The added energy increases the intensity of the electromagnetic beam.

The advantage of a free-electron laser is its efficiency in converting electrical energy into laser light and its ability to be tuned over a wide range of wavelengths. The LBL-LLNL approach offers the additional benefit of being able to produce high-powered pulses of laser light.

Microwaves from a free-electron laser might drastically reduce the length and power requirements of linear accelerators, and could also help confine the fuel in certain types of magnetic fusion reactors.

Most significant to the researchers, however, is their expectation that the demonstration of their high-gain free-electron microwave amplifier will lead to success at shorter wave lengths along the electromagnetic spectrum, including infrared, visible and ultraviolet light, where the amplifier could be used for many laser applications.

Sessler and Prosnitz conducted their experiments at Livermore, using LLNL's 5 million electron volt Experimental Test Accelerator as their source of fast-moving electrons. The amplified microwave had a wavelength of 8.67 millimetres, a frequency of 34.6 billion cycles per second. Energy was extracted from the electrons at an efficiency of about five percent, which is higher than any extraction efficiency rate previously reported.

A 10-foot-long array of dipole magnets with alternating north and south poles, called a "wiggler", is the key to transferring the energy from the electron beam to the microwave signal in the tests by Sessler and Prosnitz. Free electrons (those not attached to any atom) are forced to oscillate back and forth when they pass through the wiggler. This regular change of motion causes the electrons to emit light that is characteristic of the oscillation.

If an electron beam is accompanied by electromagnetic radiation with a wavelength that exactly matches the electron's oscillatory motion, the electrons give up some of their energy to the electromagnctic radiation. The energy transfer makes the radiation more intense and, at the same time, slows the speeding electrons slightly.

In their tests the scientists found that amplification occurred mainly in the first seven feet of the wiggler. This is because the electron oscillations drift from their precise synchronization with the laser wavelength as they lose energy passing through the wiggler.

To compensate for electron energy loss, the researchers plan to test the amplifier using a 13-foot-long "tapered" wiggler.

"The taper is magnetic, not physical," says Prosnitz. The magnetic field along the length of tapered wiggler gradually decreases to match the reduced energy of the electron beam. The result is to keep the electron oscillations in perfect synchronization with the laser wavelength through the entire length of the wiggler.

The combinations of the properly tapered magnetic field and added length is expected to significantly increase the power and efficiency of the LBL-LLNL free-electron laser amplifier.

According to Sessler, the researchers plan to expand their efforts from microwave signals to the shorter wavelengths of infrared light, using LLNL's powerful 50 million electron volt Advanced Test Accelerator as their electron source.

Since this new free-electron laser amplifier concept can operate powerfully at relatively short microwave lengths, Sessler says it might be able to be used in place of klystron tubes to power future high-energy linear accelerators.

Sessler also proposes a "two-beam" particle accelerator that would use two parallel beams of electrons; one an intense but low energy beam from a free-electron laser, the other a beam of compact bunches of high-energy electrons. Microwaves from the free-electron laser would be fed into the high-energy electron beam every twelve inches or so (compared to a ten-foot spacing with today's klystrons), in order to accelerate the high-energy electrons to the even higher energy levels needed for scientific research.

The result would be a high-energy linear accelerator, more efficient than present machines, and either 10 times shorter in length or 10 times more energetic.

As a source of microwave power, free-electron laser amplifiers offer a possible alternative to gyrotrons for heating electrons in magnetic mirror fusion reactors. In this type of reactor, electrons are heated to create thermal barriers that can confine a heated cloud of ionized hydrogen gas (called a plasma) long enough for nuclei in the plasma to interact.

In fusion, the energy process to the sun and stars, light nuclei come together to form heavy nuclei, releasing enormous quantities of energy in the process. Carefully controlled, fusion could serve as a virtually limitless source of energy, generating vast amounts of electrical power.

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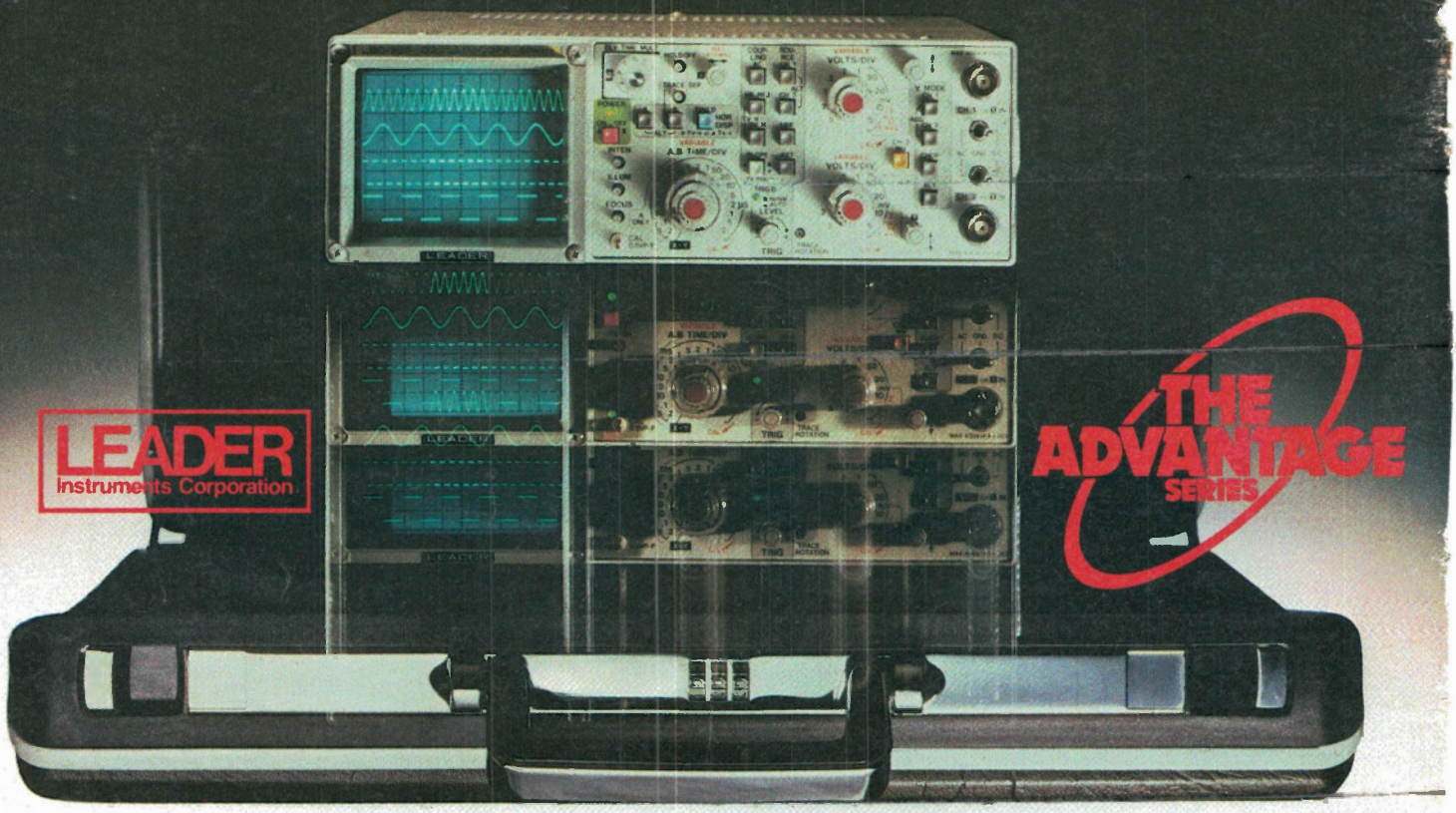

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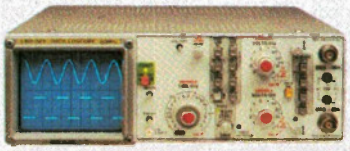

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