ETI for Electronics & Computing Enthusiasts

Electronics Today

INTERNATIONAL

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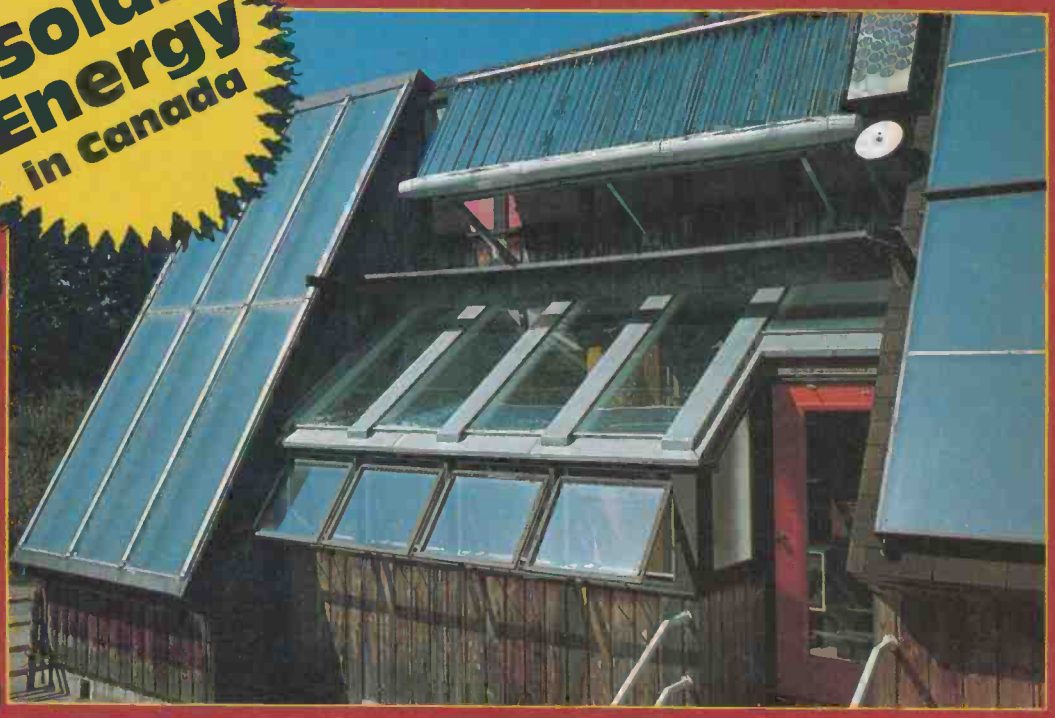
MM70924

November 1982

Bulletin Board update.

Solar Energy in Canada



Dolby C
Silence is golden!

RPM Meter
PROJECT
A revolutionary project

Pots
Circuits feature

Solid State Reverb
PROJECT
The springs have sprung

What is CP/M?
The universal DOS?

Apple III Review

0 57438 70924 11

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Computers at unbeatable prices!

APPLE II™ + w/48K RAM $1769.00

DISK DRIVE II W/DOS 3.3
$795
DISK DRIVE II
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Also check out our Multiflex drives
We provide our own 120 day warranty

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The Osbourne 1 computer is one of the most exciting developments in the field of small systems in the recent times. Its low prices, combined with its small size and large features make it in high demand all over the world. The hardware features include:* a Z80A CPU with 64K RAM * dual floppy disk drives with 90K storage * 5" CRT * RS232 interface * IEEE 488 interface * business keyboard. The software included is: * CP/M operating system * WORDSTAR word processor (c/w MAILMERGE) * SUPERCALC spreadsheet * CBASIC * MBASIC. And all this for the amazingly low price of just **$2495.** special, and this month only, we throw in a 12" Zenith green screen monitor at no extra cost. **DON'T MISS OUT ON THIS OFFER.**

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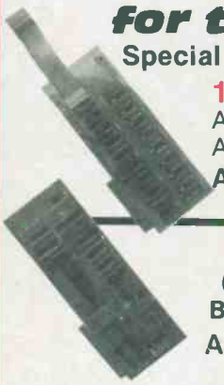

Special Limited Time Offer

16K RAM CARD $75
Allows you to expand your 48K Apple to 64K.
Assembled & Tested with 90 day guarantee

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(80 x 24)
Based on 6845 **$169**
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SA400L Disk Drive attractively packaged, ready to plug into an Apple Drive Controller Card (Compatible to Apple Drive). This month only **$389**

SA400L Packaged with Controller, DOS and Book. Special **$549**

Note: the above Specials only good for month of October.

Apple is a registered trade mark of Apple Computers Inc.

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13" Colour Monitor 90 day warranty. **ONLY $569**

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with 32 useful words

Special $149

Read about on page 23 in our catalogue.

Multiflex Z80 Card
for the Apple
$150.00
Software at extra cost

Multiflex EPROM Programmer
for the Apple
Programs 2716, 2732, 2764 . . . . . $150
with ZIF socket

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ORANGE ROMFONT CHIPS	35.00	VIDEX VIDEOTERM	445.00
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SPECTACULAR EXCELTRONIX INC. CATALOGUE
in this issue

U of T 6809 Board
Perfect as a starter

KIT PRICE **$375**

Requires RS232 Terminal

Includes 6809, 2 (6522) parallel ports, 2 (6551) serial ports, 48K of dynamic RAM, 4K of monitor.

Optional 8K of U of T Assembler and Editor available at $160 extra.

Read May 1982 ETI for review of this 6809 Board.

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SA400L $289
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SA200 . . . . . $285
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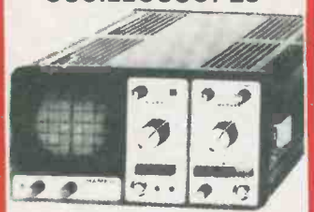
SA851 . . . . . $895
(8" DS Shugart)

CONTROL DATA

CDC 9409 . . . . . $399
(5¼" DS DD)

CDC 9406 . . . . . $595
(8" DS DD)

BEST PRICES ON OSCILLOSCOPES



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HAMEG
LEADER

Check out pages 34-37 in our Catalogue

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4116-200ns (1x16k) $1.95
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NOTE: 1 of these can do the job of 4 2114's but uses only one 24 pin socket
6116 (2k x8) $11.00
(same as above but CMOS)
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5101 CMOS $3.85
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2716 EPROM (2k) $5.50
2732 EPROM (4k) $8.95
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2764 EPROM (8K)300ns $17.95

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6502 CPU $7.89
68000 . . . . . $89.00

TTL

74LS00 . . . . . 25¢
74LS04 . . . . . 25¢
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Check our Catalogue

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MX80FT type III $869
MX82 type III $825
MX82FT type III $959
MX100 type III $1069

Note: All type III printers include graphics. All printers come with 90 day warranty.

Apple Interface card and cable for Epson printers $149

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Tec-Writer I. 80 column, tractor & friction feed, parallel and serial $645

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Tec-Writer III. Daisy-wheel, 40 c.p.s., 2K buffer $2450

Quantity Discounts Available. Please call.

NEW MULTIFLEX PRODUCTS

Extended Introductary Special. Prices good for November only

Multiflex Intelligent Terminal Kit

As described in this issue $195
Case: $45.00 Power Supply $38.00

New Improved Multiflex Kit
Great for beginners or pros **$369**

Comes with a motherboard and a S100 CPU card. Standard features:

Motherboard

Includes 32 keypad with 16 HEX and 16 control keys; HEX display; Cassette Interface; EPROM Programmer for 2708, 2716, 2732, 2532, 2764, 27128; Wire-Wrap area (space for about fifty 14-pin chips); Parallel Port (8255); S100 Connector (with space for three more).

CPU card includes

Z80A CPU, 2732 (EPROM with our monitor), 6116 (2K x 8 RAM) and all the circuitry. The CPU card has provision (but kit does not include the parts for) 64K of RAM, 4 sockets for EPROM/RAM (2732, 2764, 6116, 8255), parallel port and 8253 timer. Also piggyback board is available for this CPU with 2 serial ports, real time clock and much more.

Multiflex Floppy Controller Board Kit

Based on the 1793, can handle up to four 8" or 5¼" SS or DS. DD. disks, Shugart compatible. **$295**

CP/M and BIOS for this card $169
Multiflex 80 x 24 Video Board Kit $285
Uses Z80A, 8257, 8275 ASCII keyboard input provided.

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B. 64K of RAM (8 x 4164 200nS)
C. Video Board (80 x 24) as above
D. Floppy Controller
E. CP/M Software
F. SA400L 5¼" Disk Drive

$995

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Keyboard Case $25
Power Supply (5V 5A +12V 1A, -12V 0.5A) $99

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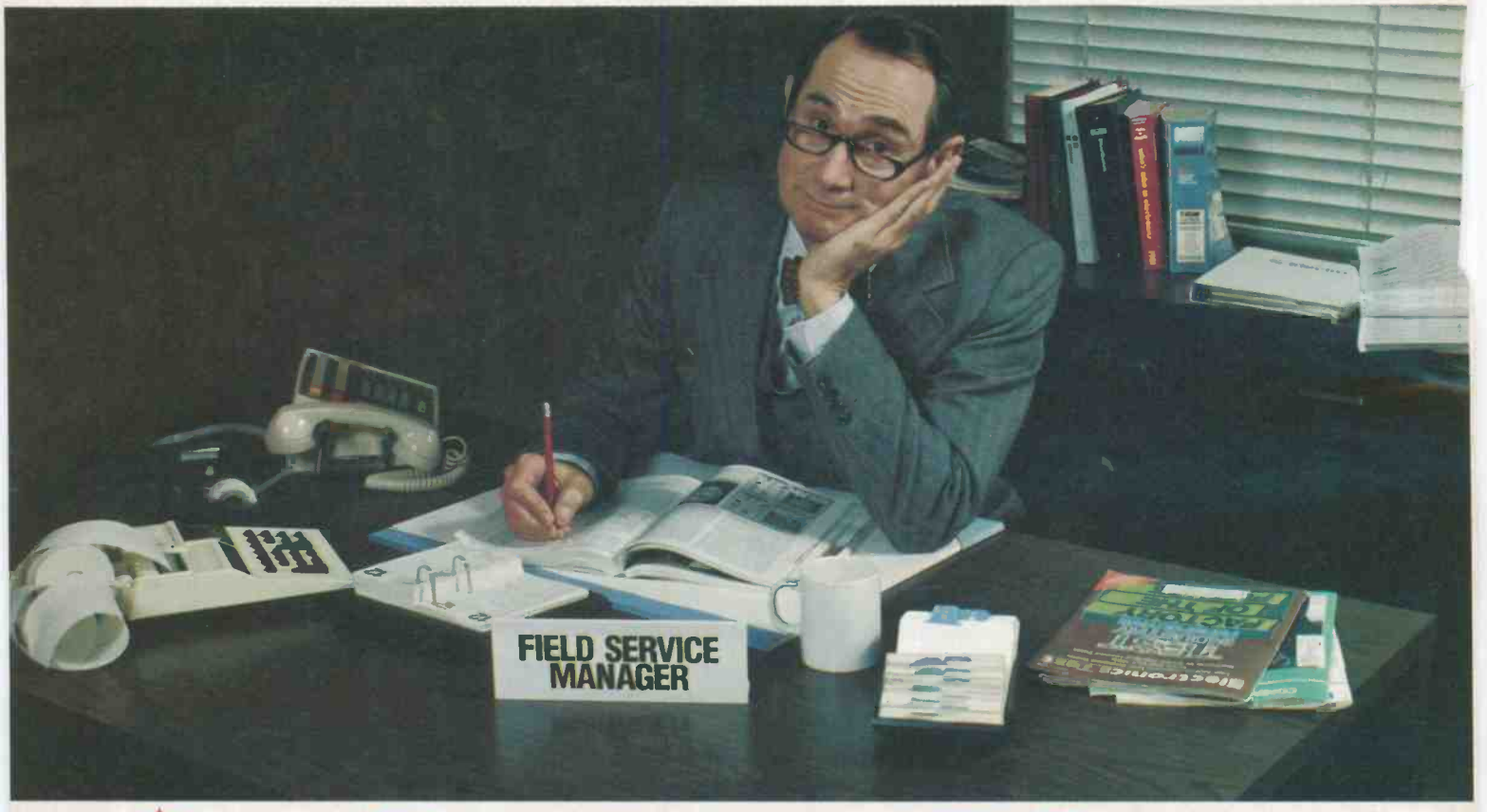

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Not since Hitachi introduced the dual trace, delayed sweep V-509. For only $2,590 you get a dynamic range of 8 full divisions. Sensitivity to 1 mV/div at 10 MHz. And sweep times down to 10 ns/div. For today's sophisticated electronics, computers and VTRs, it's the perfect field service tool.

Weighing a mere 11 pounds, in an 8.5″ x 4.3″ x 13.8″ package, the V-509 is, nevertheless, a heavyweight when it comes to performance. Auto focus, a built-in TV sync separation circuit and Channel 1 DVM output are standard. There's even a single-sweep function to reliably measure one-time events. Plus AC/DC operation and an optional battery pack, so you can take the V-509 wherever it's needed.

Hitachi's human engineering is evident in every facet of V-509 design. Its bright, 3.5″ diagonal CRT is easy to read. Functionally grouped front-panel controls make for fast, efficient use.

Also from Hitachi is the V-209, list price $1,450. A 20 MHz, dual trace, mini-portable scope with many of the same performance and ease-of-use features as the V-509.

So if you're thinking about purchasing a mini-portable scope, you know who to think of.

Hitachi Denshi Ltd. (Canada)
HEAD OFFICE:
65 Melford Drive
Scarborough, Ontario M1B 2G6
Tel. (416) 299-5900
Telex 065-25324

Circle No.21 on Reader Service Card.

ETI

The Magazine for Electronics & Computing Enthusiasts

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Vol. 6 No. 11
ISSN 0703-8984

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Features

Projects

Our cover. While fossil fuel is a form of solar energy, it is not nearly so favourable as using the stuff directly. This month, we consider the techniques. Photo by Steve Rimmer. Also, a look at the frequently long awaited Apple III.

pg.17

pg.40

Columns, News and Information

ADVERTISERS' INDEX

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

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

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

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

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

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

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News

Correction

In our October issue, the ad for General Electronics on page 83 appeared with incorrect prices. The ad should have read Regular -$795.00 Special -$725.00. We apologise for any inconvenience caused.

DIP Sockets

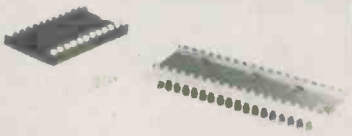
A broad family of closed-frame DIP sockets is now available from Thomas & Betts Corporation, Ansley Electronics Division. The sockets accommodate a wide variety of DIPs in pc board uses that require frequent removal and replacement of DIP devices.

Available in 6 through 40 positions, the sockets offer: extremely low profile (down to 4.32 mm, or 0.170"), precision-machined contacts for smooth entry and high reliability, four points of contact (edge wipe and side wipe), the ability to accept standard flat and round IC pins (from 2.54 to 3.94 mm long), polarity notch for identification and automatic insertion keying. For maximum packaging density, the sockets are end-to-end and side-to-side stackable.

Two basic closed-frame socket types are offered — sockets with solder tails and sockets with wrap-post tails. Sockets with wrap-post tails are available for 1-, 2-, and 3-wrap lengths. All sockets are made from tough glass-filled polyester (meets U.L. 94V-0); contacts are heat-treated beryllium copper with gold-over-nickel plating; the sleeve is made from brass with gold-over-nickel or tin-over-nickel plating.

The sockets are designed to operate at temperatures ranging from -65 to 125°C (gold sleeve) or from -40 to 100°C (tin sleeve).

For further information contact Customer Service, Ansley Electronics Division, Thomas & Betts Corporation, 920 Route 202, Raritan, NJ 08869, (201) 469-4000.



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

Printer

Lanpar Limited has announced the introduction of the Letterprinter LA 100, a new low cost matrix printer featuring high-resolution letter-quality copy, graphics and high-speed draft-quality printing. This lightweight, desk-top printer can be used with conventional small and medium-sized computer systems, personal computers and small business computer and word-processing systems.

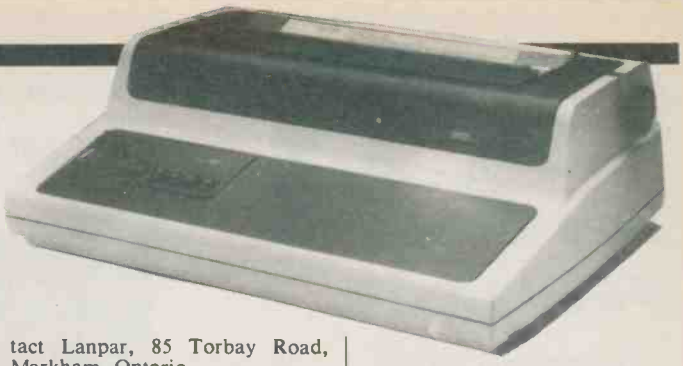
The Letterprinter LA 100 can produce typical 7 x 9 dot matrix quality output at a speed of 240 characters per second.

Near-letter-quality output is achieved by slowing down the LA 100's print speed and overlapping matrix dots to form smooth character shapes. In this mode, each character is formed by up to 33 dots horizontally and 18 dots vertically, at an average print speed of 30 characters per second.

The number of characters per inch as well as choice of fonts, tab settings, printing speeds and margins are program or user-selectable.

A new snap-in ribbon cartridge, with ten times the lifespan of conventional ribbons is available for the printer. The print head is user replaceable. The printer features an internal self-test so the user can check its proper operation at any time.

For more information, contact Lanpar, 85 Torbay Road, Markham, Ontario.



Satellite Surveyor

A transponder guide to all satellites has just been published by Mo'Day International giving full details of video and audio frequencies, polarities, satellite locations, all sub-carrier information together with programming notes and programmers addresses.

All T.V. and audio transmissions are constantly monitored on both U.S. and Canadian satellites while international listings are monitored by NORAD. Also included are military space activities of all the major powers.

Four quarterly issues are $17.95. Sample copy is $5.00 from Mo'Day International, 4023 Lakeview Drive, Lake Havasu City, AZ 86503. U.S.A. Additional Information from David Day, Editor (602) 453-3850.

Keyboard

Stackpole's KS200 keyboards and keyswitches are now available "off the shelf" from Canadian Stackpole Limited, Components Division.

The Stackpole keyboard program includes standard 54 and 62 key monolithic main arrays, a variety of ancillary arrays, discrete momentary and latching keyswitches.

This program, specifically geared to the needs of the Canadian market, features fast turnaround time on custom keycap legends, at moderate set up costs.

For further information, contact Canadian Stackpole Limited, Components Division. Consumer inquiries will be handled by Exceltronix, 319 College Street, Toronto, M5T 1S2; 416-921-5295.

Single-Board Computer

Intel Corporation have announced a complete eight-bit microcomputer on a single board that provides 64 kilobytes of memory capacity via JEDEC-compatible 28-pin sockets. The new board carries a high degree of I/O flexibility for a wide range of end-product applications.

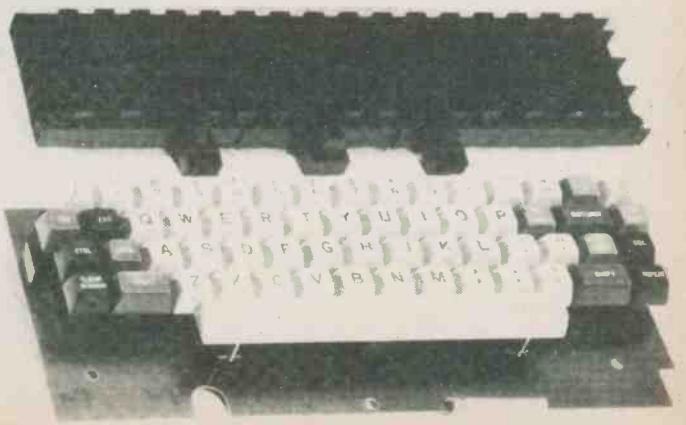
The new board is built around Intel's 8080A eight-bit, n-channel microprocessor. The board is designed as a highly integrated solution for OEMs that want to bring interlligent products to market with a minimal amount of development time.

The board provides designers with a high degree of memory flexibility. Six 28-pin JEDEC-compatible sockets for SRAM (2K x 8, 8K x 8), EPROM (including 27128), and E²PROM (2K x 8, 8K x 8) memory components provide capacity up to 64K bytes. The board contains two kilobytes of static RAM in one of the six sockets and has 48 programmable I/O lines; its USART channel is RS-232 compatible.

Plug compatible in most instances with previous Intel and other MULTIBUS vendor board products, the board allows OEMs to cost reduce their present system due to low board price and increased memory and I/O flexibility.

With two on-board iSBX bus connectors, the iSBC 80/16 board allows low-cost, modular I/O expansion via 14 Intel iSBX modules available from Intel. This I/O flexibility will allow OEMs to implement previous MULTIBUS I/O expansion via the iSBX bus, thereby also reducing overall system cost.

The iSBC 80/16 single-board computer is available now at a single-unit price of $540.



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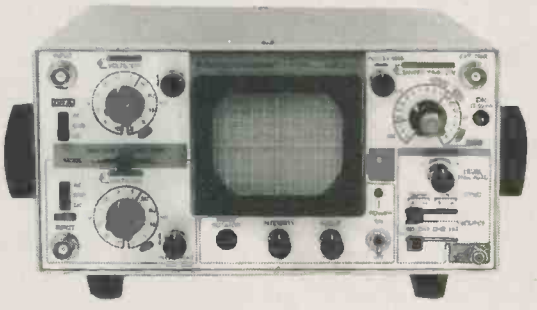

Dual Trace Portable Scope

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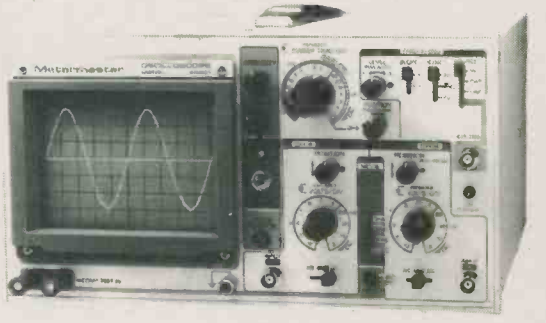
Probes and F.S.T. included

- 15 MHz (–3dB) Bandwidth
- X5 Sweep Magnifier
- Battery, 12 VDC & AC Operation
- 2 mV Vertical Sensitivity
- Trace Rotator

Model 65601



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Featuring At No Extra Cost .....'The Component Tester'

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- HF Rejection

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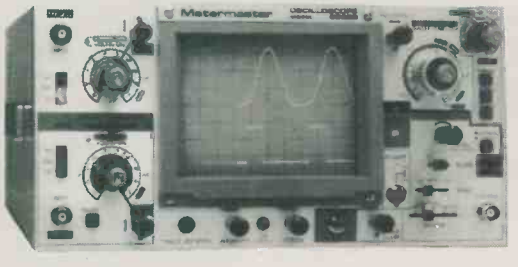

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Probes and F.S.T. included

- 45 MHz (–3dB) Bandwidth
- Delayed Sweep (selectable)
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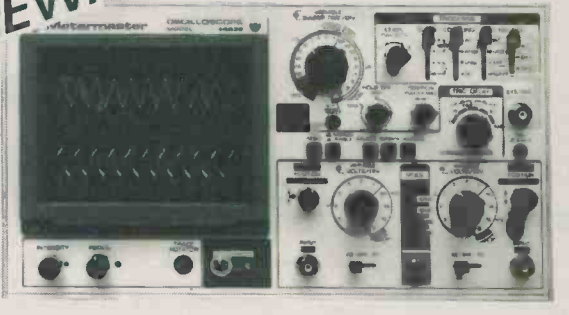
- Extremely Bright 5" CRT
- Illuminated Internal Graticule
- Optimal Sensitivity of 1 mV
- X–Y or X–Y–Z Operation
- 120 VAC Line Operation

Model 65635

NEW!



Dual Trace Bench/ Portable Scope

$995.00
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- 35 MHz (–3dB) Bandwidth
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Patent Data

"Over 10,000 U.S. patent abstracts, representing the world's most significant data processor technology, is assembled in 7 volumes," said Jay Harding, spokesman for Patent Data.

"In 10,000 DATA PROCESSOR PATENT ABSTRACTS Patent Data has for the first time collected abstracts of all patents devoted to electric digital data processors or calculating systems," he explained. "Since foreign companies also patent their most important ideas in the United States, we believe this set represents the most complete reference collection of data processor technology in the world today.

"Few people know that more than 80% of the technology revealed in patents does not appear in the technical literature—or anywhere else! Nor do most people know that a majority of the important discoveries are brought to light first in the patent literature.

"The set contains hundreds of software patents, too", Harding said, "a subject of great interest since the United States Supreme Court last year gave the green light to patenting certain classes of computer software."

"Because of the uniqueness of patent information and the completeness of this set, it should prove to be very useful to those in the data processor technical community trying to learn what is happening in the art and how to avoid reinventing the wheel," he explained. "However, perhaps the most intense use of our books will be to keep tabs on what competitors are doing", he predicted.

The 7 volumes will be published as a series. Volume 1 will be available in December 1982; the remaining 6 volumes will be available at 1 month intervals thereafter. The set will be updated periodically by the company.

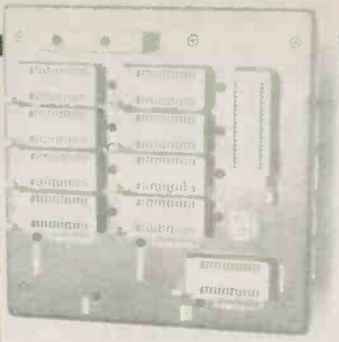
Send direct inquiries to Patent Data Publications, Inc. at 901A N. President Street, Wheaton, IL 60187, USA.

PROM Programmer

A new PROM programmer personality module that can simultaneously program either eight 24-pin MOS PROMs or eight 28-pin MOS PROMs has been announced by Pro-Log Corporation.

The new PM9076A Gang Personality Module replaces the earlier PM9076 module, which programmed only 28-pin devices. Like the earlier module, it works with Pro-Log's M980 and M910A PROM programmer master control units.

According to Roger Born, PROM programmer marketing manager, the PM9076A offers significant cost savings to those users programming both 24-pin and 28-pin PROMs. He said the new module accommodates 24-pin devices in the lower 24 pins of its 28-pin Zero Insertion Force sockets.



The 28-pin devices that can be programmed by the PM9076A are the 2564, 2764 and MK2764 PROMs; 24-pin devices include the 2516, 2532, 2716, 2732, 2732A, 2758, 27C16, 2808, 2816 and 48106 PROMs.

Pro-Log's generic gang personality modules can simultaneously program eight PROMs from any family of 5-volt MOS devices, including the latest E²PROMs. Programming algorithms and PROM pinouts are reconfigured simply be plugging in the appropriate 40-pin gang configurator (E² devices require two gang.)

Micro-Code Sequencer

An 8-bit Micro-Code Sequencer Integrated Circuit based on the bit-slice concept that permits simple expansion to a width of 24 bits has been announced by Motorola. The device — the MC10904 — is a member of the M10900 family of high-speed ECL circuits which, by virtue of LSI/VLSI architecture, offers state-of-the-art performance for computers, controllers and other digital logic systems.

The MC10904 contains two main sections: (1) condition input control, and (2) micro-code address control. It has a 4-level subroutine stack that can be pushed and popped simultaneously, and contains two direct data inputs for jump and conditional branch destinations.

A special P counter pin simplifies loading RAM writeable macroprogram memory. This input can also be used to hold the system on a microinstruction for diagnostics.

Each MC10904 handles up to six branch condition inputs divided into groups of four and two. One bit from each group (of four or two) can be used by itself or logically combined with a bit from the other group to determine branch condition status. For example, a single micro-code instruction could incorporate "branch if less than equal" by having an ALU sign bit on one set of condition inputs, and zero detect on the other. The six condition inputs expand with additional sequencer circuits. Two MC10904s can address 64K micro-code words and provide up to 12 conditional branch inputs.

The MC10904 is priced, in 100-999 quantities, at $100.00, immediate availability is from the factory and through authorized Motorola distributors.

PCB Trolls

PCB Trolls stole the printed circuit board design from the 150 watt amp article. We caught 'em, thrashed 'em within an inch of their scaly little lives and got the board back. It's included in this issue at the end of Computing Today.

Anyone know a way to shut up crying trolls?

Continued on page 26

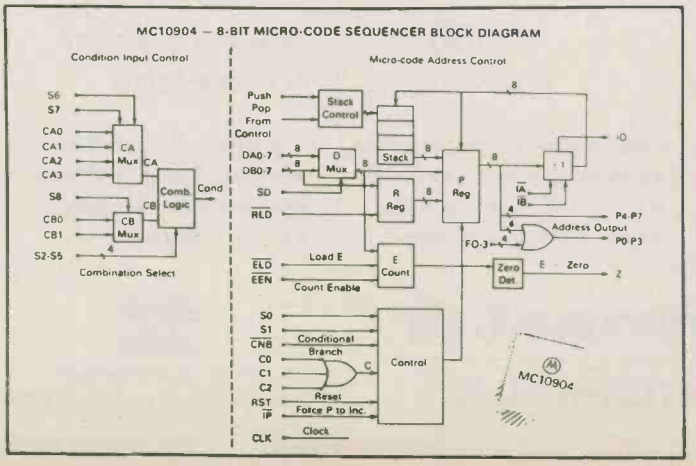
CMOS EPROMs

Intersil's semiconductor division has introduced the industry's first 8K CMOS EPROMs, the IM6657 and IM6658. Like Intersil's 4k versions, the IM6653 and IM6654, the new pin-compatible 8K devices feature on-chip address latches and chip select functions.

The IM6657 (2k x 4) and IM6658 (1k x 8) are fully decoded and erasable by exposure to ultraviolet light. Power comsumption is the lowest among existing EPROMs, and interfacing is greatly simplified by the use of the on-chip address latches. Devices may be order with access times of 450, 550, 600 or 650ns.

The two new EPROMs are offered in standard 24-pin CERDIP packages, with prices beginning at $6.05 each in 100-unit quantities for the commercial grade 650ns part.

For further information contact George Jennings at (408) 996-5679.



Also...

A draft report from a federal task force says that immediate action is needed to develop a Canadian-owned microelectronics industry. Efforts so far in the field "appear to be rudderless and the need for action is urgent". It recommends that the government create an independent centre for technology and that millions of dollars should be made available for this.

●

A survey reported in the *Globe and Mail* shows that the current recession is so bad that even the computer industry, until now regarded as immune, is hurting. A check by ETI with a number of companies shows that the worst hit seems to be the minicomputer field; mainframe companies show some slowing while the microcomputer end is still healthy.

●

Video game computers could turn out to be a craze as short-lived as skate-boards. The stock prices of companies in the field have fallen heavily in the last month or so. No one is pretending that computer games won't last, only that general purpose computers such as the VIC-20 and TRS-80 Colour Computer now offer very sophisticated games, cost much the same as the dedicated types and have the advantage that they are far more flexible.

●

RCA's advanced family of QMOS high-speed CMOS logic will be available in production quantities in early 1983. QMOS combines the power consumption of CMOS with the high speed of Schottky TTL.

●

Software that allows a computer to respond to anyone's voice has recently been announced from Votan, a California company. The system is expected to sell (in quantity) for $2000.

●

Bits and Bytes* is a 12-part TV series produced by TVOntario, the provinces educational network, which will be screened starting February 16th 1983 at 9.00 p.m. The TV series is itself part of a package and accompanies a comprehensive educational course in how to operate a computer and how to write simple programs. For details on the course contact: *TVO Academy on Computers in Education, Part-Time Learning, TVOntario, Box 200, Station Q, Toronto, M4T 2T1.

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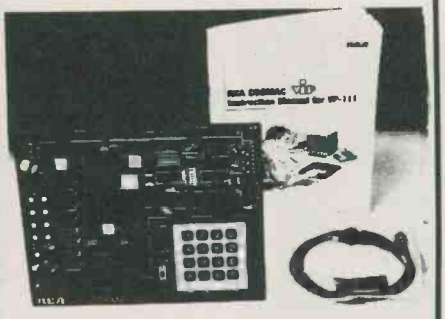

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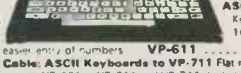

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Sinclair ZX81 Computer
ASSEMBLED $129.95
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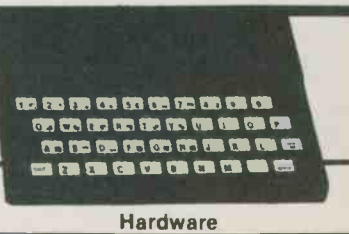

The ZX81's advanced capability.
The ZX81 uses the same fast microprocessor (Z80A), but incorporates a new, more powerful 8K BASIC ROM — the "trained intelligence" of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays. And the ZX81 incorporates other operation refinements — the facility to load and save named programs on cassette, or to select a program off a cassette through the keyboard.

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

16K Memory Expansion Kit (No P.C. Board) $69.95

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

ZX81 Printer $169.95

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

64K $249.95

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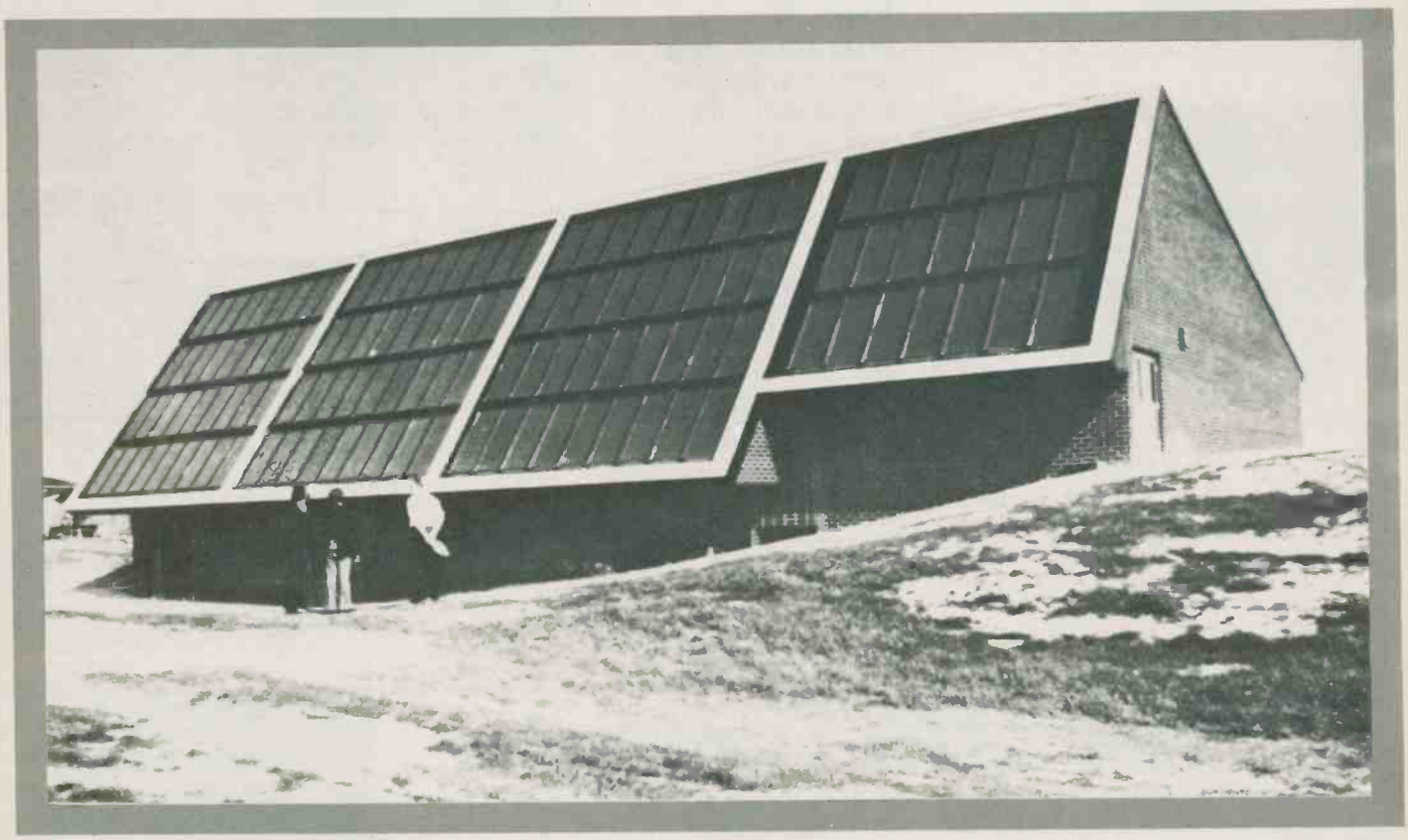

The ins and outs of collecting rays, and what to do with them, by Roger Allan.

WITH THE REALITIES of the Canadian weather, once described as a motley collection of extremes collated by a manic depressive footfall player, the application of solar energy techniques to housing design and heating and related matters is simply one of common sense. Historically, many cultures have utilized solar techniques to a greater or lesser extent, including the classical Romans and Greeks, the Eskimos and other North American native peoples. Even since Europeans reached North America, passive solar techniques have been used, to wit, the pioneer's earth shelters.

In Canada, the residential sector (home heating) accounts for approximately 20 percent of the energy consumed in Canada, with the bulk, even today, being derived from fossil fuels either as home heating oil, natural gas or coal generated electric plants. It is therefore simple common sense that solar techniques of heating, being non-polluting, renewable and relatively cheap, should be employed whenever possible.

There are three types of solar energy systems, active, passive and hybrid. The basic function of each is to provide space heating, water heating, day-lighting and in rare cases, the production of electricity. The state of the art being such as it is in regard to the production of electricity by solar cells, the emphasis, technologically and in this article, is on the passive and hybrid systems.

Basically, active systems employ hardware and mechanical equipment to collect and transport heat. Flat plate or focussing collectors, usually mounted on the roof of a building, and a separate heat storage unit, (rock bin, water tank or a combination of the two) are often the major elements of the system. Water or air, pumped through the collector, absorbs heat and transports it to the storage unit. This heat is then supplied from the storage unit to the spaces in a building by a completely mechanical distribution system.

Passive systems collect and transport heat by non-mechanical means. The most common definition of a passive solar heating and cooling system is that it is a system in which the thermal energy flows in the system are by natural means such as radiation, conduction and natural convection. In essence, the building structure or some element of it is the system. There are no separate collectors, storage units or mechanical elements. The most basic difference between the active and passive

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A solar school.

systems is in that the passive system operates on the energy available in its immediate environment and the active system imports energy, such as electricity, to power the fans and pumps which make the system work.

Hybrid, or passive hybrid systems involve passive collection and mechanically assisted distribution of the solar heated air.

Sunny Days

Fortunately, extraction of low grade heat from the sun's rays does not depend on sophisticated equipment. Essentially, a solar collector panel consists of a darkened absorber (backed with insulating material to minimize heat loss) through which is circulated a heat transport fluid (generally air or water) a covering of glass or transparent plastic transmits the visible light energy from the sun, but does not transmit the infrared or heat energy re-radiated from the absorber. The circulating fluid transfers heat to a storage unit (water in the case of water circulating systems, or rock in the case of an air system) from which heat is extracted as needed.

There are four further concepts in passive heating: direct and indirect gain, "glass and mass," and "light and tight".

The first and simplest approach to passive solar heating is the approach utilizing direct gain. Simply defined, the actual living space is directly heated by sunlight. When the space is used as a solar collector, it must also contain a method for absorbing and storing enough daytime heat for cold winter nights. In other words, with the direct gain approach, the space becomes a live-in solar collector, heat storage and distribution system all in one. One of the major advantages of the direct gain approach is that it is always working. This means it collects and uses every bit of energy that passes through the glazing, direct or diffuse. Because of this, it not only works well in sunny climates, but also in cloudy climates with great amounts of diffuse solar energy, where active systems can hardly perform as effectively.

In this approach, there is an expanse of south-facing glass and enough thermal mass, strategically located in a space for heat absorbtion and storage. Since a portion of this solar heat gain (sunlight) must be stored in the space for use at night (and during periods of cloudy weather) the floor and/or walls must be constructed of materials capable of storing heat.

Today, the two most common materials used for heat storage are masonry and water. Masonry thermal storage materials include concrete, concrete block, brick, stone and adobe, either individually or in various combinations. Typically, at least one half to two thirds of the total surface are in a space constructed of thick masonry. This implies that the interior be largely constructed of masonry to ensure that there is enough surface of exposed mass for adequate heat absorbtion and storage. Water storage, on the other hand, is usually contained in only one wall of space.

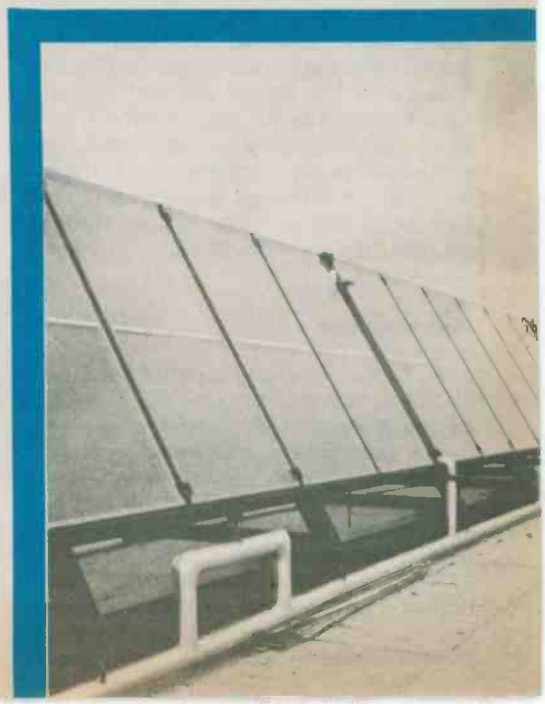
The water wall is placed in the space in such a way that direct sunlight strikes it for most of the day. Materials commonly used to construct the wall are plastic or metal containers. During the daytime, the mass is charged with heat so that at night when outdoor and space temperatures begin to drop, this heat is returned to the space.

A second approach to passive solar heating is the concept of indirect gain, where sunlight first strikes a thermal mass when it is located between the sun and the space. The sunlight absorbed by the mass is converted to thermal energy (heat) and then transferred into the living space.

There are basically two forms of indirect gain systems: roof ponds and thermal storage walls. The difference is that the location of the heat storage mass of the former is on the roof of the space to be heated, while in the latter is contained in a wall.

The basic requirements for a thermal storage wall system are a south facing glass area for maximum winter solar gain and a thermal mass, located 100 mm or more directly behind the glass, which serves for heat storage and distribution. Any one of a number of thermal storage materials can be used including masonry and water.

The most common version of



A Mc Solar powered water heating system.

this approach is the masonry thermal storage wall. It works by abosrbing sunlight on its outer face and then transferring this heat through the wall by conduction. The outside surface of the wall is usually painted black for the best possible absorption of sunlight. Heat conducted through the wall is then distributed to the space by radiation and to some degree by convection, from the inner face.

By the addition of vents to the wall, the distribution of heat by natural covection (technically known as thermocirculation) from the exterior face of the wall is also possible but only during the daytime and early evening. Solar radiation passing through the glass is absorbed by the wall heating its surface to temperatures as high as 150°F. This heat is then transferred to the air in the space between the wall and glass. Through openings or vents located at the top of the wall, warm air rising in the air space enters the room while simultaneously drawing cool room air through the low vents in the wall. In this way, additional heat can be supplied to a space during periods of sunny weather.

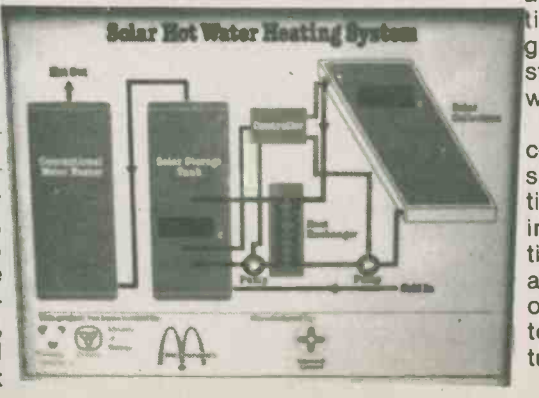
Solar Houses

The basic design of this is the Trombe house in Odeillo, France, constructed in 1967, and the design has subsequently been known as the Trombe wall. Its double glazed thermal wall is constructed of concrete, approximately two feet thick, and painted black to absorb the sunlight that passes through the glass. The house is heated primarily by radiation and convection from the inside face of the wall. Approximately 70% of this building's yearly heating needs are supplied by solar energy. As such, the systems efficiency is comparable to a good active solar heating system.

There are two other approaches to solar design known as "glass"and mass and "light and tight" methods.

The "glass and mass" approach involves the installation of a large area of glass on the south exposure and extra thermal and structural mass inside the house to absorb and then radiate the sun's heat. This approach is particularly popular in southern climates, where heat loss through glass is not a major concern.

The "light and tight" approach involves the use of less glass on the southern exposure, coupled with the maximum degree of insulation possible. This is a 'conservation first' approach, placing primary importance on making a house air tight and well insulted, and secondarily on the incorporation of passive solar features.



In an airtight house, certain precautions have to be taken to counter the possible build up of contaminants in the air and high humidity levels. One practical answer is the installation of an air-to-air exchanger which ventilates the house mechanically and also recovers heat from the exhausted air.

A "light and tight" house is characterized by high insulation levels, airtightness, and a continuous vapour barrier with mechanical ventilation.

The Land

At the site planning scale, passive solar design requires consideration of the principles of building orientation, solar access and landscaping.

There are basically three major considerations:

Orientation: During the winter, south facing glass surfaces allow for the maximum solar heat gain, east and west facing glass for very little, and north facing for none at all. Houses oriented within 20 degrees east or west of true south are within the range of optimum solar exposure. A house orientation slightly east of south allows for greater early morning solar gains in winter months. A more westerly orientation may increase the liklihood of overheating in summer.

Solar access: Low winter sun angles have to be taken into account when planning groups of houses or subdivisions to prevent shading effects from adjacent buildings. For typical groupings, houses should be 50 feet apart to allow for proper solar access in winter months, though this may not always be easy to achieve.

Landscaping: Decidious trees help provide shading to the south side of a house in summer, while still allowing for adequate sun penetration in winter. Coniferous trees make good wind breaks when planted strategicaly, taking prevailing winter wind directions into account.

In order to adapt the design and construction of a building to passive solar features, local climactic conditions must be fully understood. The importance of sun angles, wind direction and shading principles, outlined above, are clear, but other factors are often overlooked; humidity, ground temperature, frost depth, surface texture and wind speed.

Common sense dictates that spaces in which heat is generated, kitchens and bathrooms, should be

placed in the interior of a building. Spaces requiring heat and light, that is, general living spaces, should be exposed to the sun.

Outside building surface textures should be as smooth as possible to reduce the building's having a heat losing surface area. A textured concrete block, for example, has three times the surface area of a smooth one.

Practical Designs

Passive solar design techniques do not have to be exotic, primitive, slick or expensive. The desired goals can be achieved through good insulation,

South facing solar panels.

airtighness, and sound design and construction. Extra solar energy can be let into a building by opening up corners, by raising the basement floor level and by cutting back on the first floor.

A cube shaped house provides minimum surface area for the volume contained. Surrounding buildings can protect a new building from winter winds. Air lock entrances, particularly if the entrance is on the north side, can also by incorporated.

An energy efficient house that costs about $50 a year to heat was built two years ago in Kitchener for $53,000. It has a cut back first floor, cut down glazing in the basement area and the entire concrete mass of the house is used for heat storage. It also has an active heating system for back-up purposes. As the house was not expensive to build, similar approaches could be used in townhouse developments.

Attached greenhouses need a great deal of mass. Brick should be used as an interior rather than an exterior material. Insulation should be placed on the exterior of the building, not on the interior. This approach allows much more heat to be retained within the building.

But there are problems. Sixty percent of the houses that will exist in the year 2000 already exist: there is a large retrofit market for energy conservation improvements. This raises difficulties within the construction industry, which tends to stick to the tried and true rather than the novel or experimental. However, energy efficient housing should be a sought after commodity. It will depend on how well government and industry sell the energy saving story. People cannot make choices without good, sound information. Mortagage grantors, for instance, should consider the substantial savings to be realized by purchases of an energy efficient home and add energy to the guidelines of principal, interest and taxes.

Legal Difficulties

The law of Canada does not protect solar access for most urban landowners since there is no automatic right to the light which crosses the property of others. A landowner is entitled only to prevent obstruction of the airspace vertically above his property. The erection of new buildings is generally considered to be more important than the competing desire for unobstructed light and air.

It is possible under existing law for neighbours to agree in writing not to block one anothers sunlight. At best, however, such agreements are cumbersome, expensive, and legally complex. As such, an urban solar user is generally unable to obtain legally secure access to sunlight.

There are, however, a number of ways in which legislation can be made to protect a solar users access to sunlight. They are nuisance, easements, covenants and trespass.

Nuisance: Under the law of nuisance, landowners may generally prevent, or be compensated for, unreasonable interference with their use and enjoyment of their land, where the harm caused by the interference would be substantial.

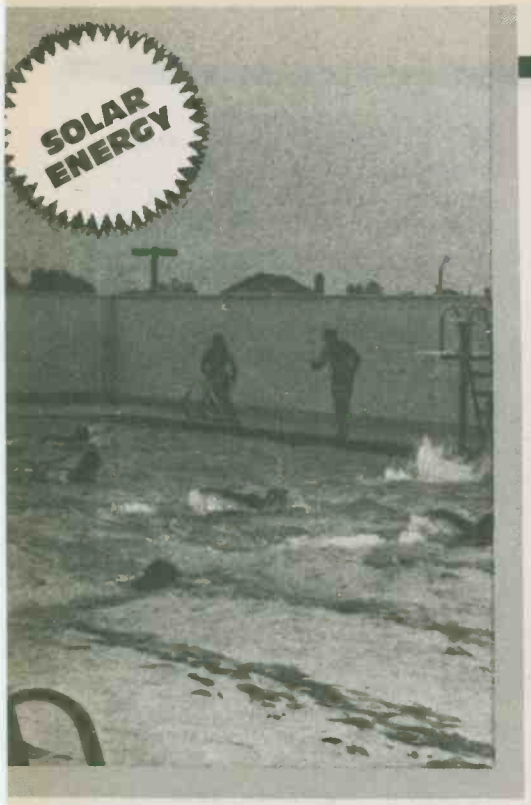
Easements: The only right to light at common law accrues through acquisition of separate easements of light. Such easements can prevent a neighbouring landowner from making any use of his land which would block the light to one's windows. However, virtually all such easements must be expressly created in writing by the owner of the restricted land and, therefore, are not common.

Convenants; Convenants are agreements between individuals, and do not run with the land, that is, they do not affect future owners of the land, unless the new owners so agree. They are expensive and difficult to enforce.

Trespass: The only general right to sunlight which exists in Canada today is the landowner's right to control the air space located vertically above the land surface which he owns. However, in Canada, no sunlight ever falls from directly overhead and the number of properties crossed by a ray of sunlight below the height of potential obstructions increases in the winter, when the demand for solar energy for space heating would be highest.

There are some potential mechanisms for the protection of an individual landowner's financial investment in solar energy technology

Rooftop solar collectors.



A solar heated pool.

for heating purposes.

Private Agreements: This would involve neighbours agreeing to present and future access to sunlight by one of the parties. Its major disadvantage is that landowners would be reluctant to sign a legal document encumbering the title of their property.

Easements of Light by Prescription: There is a tradltional right to light by which one landowner can restrain his neighbour from building an obstruction of his sunlight if he has used that sunlight continuously for many years. However, no such right may be acquired in Canada after March 5, 1880. The common law, "Doctrine of Ancient Lights", required that the use be the length of legal memory, i.e., since 1189 AD. This was reduced to 20 years, first by the judicial fiction of the 'lost modern grant' and then by the English *Prescription Act* of 1832. At any time during that period, the light may be interrupted by a neighbour (e.g. by erecting a structure on his land), and the solar user then loses his sunlight without compensation.

Prior Appropriation: Some writers have suggested that sunlight should be considered not as an incident of land ownership but as a natural resource. However, sunlight is unique in being mobile, ubiquitous and inexhaustible, and yet subject to obstructlon. As most conventionally regulated resources (such as fish, forest, mineral and petroleum) lack one or more of these characteristics, analogies are generally unhelpful. Only the allocation of surface water is similar. Prior appropriation could readily be adapted to solar rights in areas where all parties were familiar with its operation from its applicaiton to water.

Solar Zoning: Solar zoning is one of the most extensively analyzed and developed legal mechanisms for the protection of solar rights in North America. In solar zoning, municipalities define solar zones in which solar use is encouraged. As solar use may be compatible with a variety of neighbourhoods, they may be overlaid on existing zoning regulations. Within such zones, solar users may receive total or partial exemptions from existing restrictions which impede the cost effective use of collectors, such as height, set back lot coverage, aesthtic and use requirements. Exemptions may be granted for individual lots, or for groups of lots which are planned together for an energy efficient layout. Individual or shared solar use may also be made a permitted use in all zones. Its major disadvantage is that zoning of this type cannot be established or enforced by individuals, but only by municipal councils and therefore provides no protection for isolated solar pioneers or those with unsympathetlc councils. Its creation involves substantial government red tape.

Shade Control: In this potential mechanism, by-laws could automatically grant every solar user a specified solar right, effective upon the installation of his collector. If such a right took precedence over all rights of neighbouring landowners, it would provide the greatest protection to solar users at the least cost and trouble to themselves. However, it would be most unfair to neighbouring landowners, as the development value of their property (in some case including the right to install a collector of their own) could be taken from them unilaterally, without warning, without compensation and without appeal. Such an approach assumes that any use of sunlight by any solar collector is more valuable then every possible obstruction and therefore is as blindly onesided as the current law that not obstruction of light is wrong. It would, therefore, be as impossible to justify on economic grounds as it is on political ones.

Certification of Solar Sites: in contrast to zoning, which could limit shadowing in wide areas as a matter of public policy, certification would vest in individuals the right to protection of a specific site. Unlike private conveyances, certification could coerce the restraint of all neighbours of a solar user. After all affected landowners had been notified and given an opportunity to be heard, certificates could be granted for appropriate sites on whatever terms and conditions the certifying body saw fit to demand, possibly including compensation. To avoid excessive cost, compensation could be restricted to cases of hardship, or limited in amount. Upon registration of the certificate against his neighbours lands, the site owner would become entitled for a specific period, say 30 years, to unobstructed solar access through a defined three-dimensional space, subject only to existing buildings and to such other conditions as are set out in the certificate (such as summer shading by deciduous trees or to a named neighbours right to build a specified garage). Interference with the protected sunlight could be both a public and a private nuisance, permitting enforcement either by the site owner or by the municipality.

It is important to stress that access to sunlight is only one of many factors which can influence the degree of solar utilization in this country. Some steps to encourage solar use have already been taken by various governments, primarily in the funding of demonstration projects, as well as the dissemination of information, the removal of sales tax on solar hardware, with other projects currently under review or formulation.

ETI

Solid State Reverb

Where have all the spring lines gone? Gone to lesser projects in other magazines, that's where. Meanwhile we present this cheap, simple, but high-quality unit using solid state technology. Design by Charles Blakey.

AT LAST - a reverberation unit which is not a pseudo echo effect and does not suffer from the defects of spring line devices. The unit described below will interface with virtually any preamplified signal and is ideal for direct use with most musical instruments or for incorporating in the 'echo-send' line of mixers. The design has been made possible by a new 3328-stage bucket brigade device having six tapped delays and capable of producing a useful reverberation time of about three seconds.

Sound emitted in an enclosed space will be subjected to both simple and multiple reflections from internal surfaces. Since these surfaces are at varying distances, the time for these reflections to occur and then decay by absorption will vary. The effect is a build-up of sound known as reverberation. When playing a musical instrument in the home, small studio or some other venue, the decay time can be very small coupled with a high absorption loss; the result is a weak sound when compared to recorded music or to live music played in a large hall.

Until now the only low-cost method of simulating acoustic reverberation has been the use of spring lines. These units, however, are prone to vibration, require a high power consumption for effective driving and are prone to producing distorted resonant peaks. Furthermore it is not possible to adjust the reverberation time and in many instances a short reverberation can be very effective. Another option has been available for some years, namely, the use of bucket brigade devices to electronically delay signals. While claims have been made for reverberation effects based on these products, a realistic unit would require at least three dual 512-stage BBDs, such as the Reticon SAD1024A. The cost and complexity of the latter approach puts it beyond the reach of the average constructor.

Beyond The Pail

The reverberation unit utilises the MN3011, which is the latest in a series of bucket brigade devices for audio applications to come from National Panasonic. They are all fabricated in PMOS and for a start you can forget most of what you may have read about the disadvantages of PMOS BBDs. It is a fact that they are somewhat limited in clocking speed (10 kHz to 100 kHz) and also have a limited bandwidth, typically 10 to 12 kHz. The latter, however, is not usually a limitation since the bandwidth is often restricted by the desire for long delay times. What makes the series ideal for audio applications is their low insertion loss, low distortion and excellent signal-to-noise ratio and for the MN3011 the specified values are 0 dB, 0.4% and 76 dB respectively.

The IC is unusual in that it has 12 pins but is the length of a normal 18-pin package; the functional block diagram and pinout for the MN3011 is shown in Fig. 1. As is normal with such devices it requires two power supplies, V_{DD} and V_{CC}; the former may be up to -18 V with respect to ground while V_{GG} should be 1 V higher than V_{DD}. Bucket brigade, or charge coupled, devices are analogue shift registers which operate by sampling

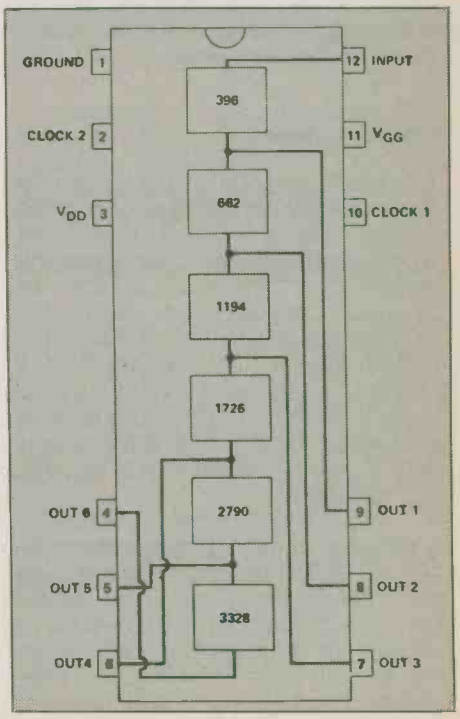
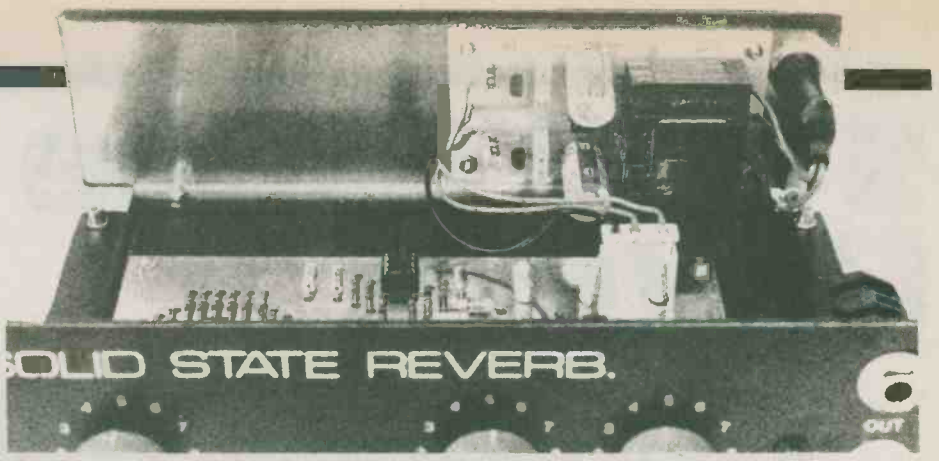


Fig. 1 Pinout and internal layout of the MN3011. The centre three pins on each side of this 18 pin package are absent.



the input signal at a rate determined by an external clock. The signal level at the time of sampling is stored on an internal capacitor; this charge is then clocked down a series of capacitors by means of internal switches. The transfer process is accomplished by a dual clock whose outputs are in antiphase and so are alternately opening and closing adjacent switches. It will be apparent that the slower the clock speed the longer the delay. Since the devices operate at high clocking speeds the input signals are faithfully reproduced at the output.

The most interesting feature of the MN3011 is that it has six tapped delays and Fig. 1 shows the number of stages for each tapping. The tappings are not evenly spaced since otherwise the reverberant sound would have a distinct flutter. If the device was being clocked at 10 kHz then the delays from outputs one to six would be 19.8, 33.1, 59.7, 86.3, 139.5 and 166.4 milliseconds respectively. If these delay times are mutiplied by 0.33 then one obtains the equivalent room path length for one trip, i.e. the longest delay is equal to a room length of 55 metres (181 feet). Reverberation time is usually measured as the time taken for the power to decay to one millionth of its initial level (60 dB down). For the present design the time was measured for the output level to fall to one hundredth of its initial level (-40 dB) and at the longest delay this was found to be about three seconds.

Blocks'n Clocks

The block diagram of the circuit for the reverberation unit is shown in Fig. 2. First there is the dual clock driver, which is another National Panasonic device, the MN3101. It has an oscillator, divider and wave form shaping and produces the dual clock pulses required by the MN3011. It reduces component count and is lower in cost than other alternatives, such as a 4007. A further advantage is that it also generates the required V_{GG} voltage.

The unit will operate satisfactorily with any input signal greater than 280 mV RMS and higher input signals are attenuated by the input potentiometer. The signal is also reduced by half an amplifier A1 and inputs higher than 140 mV to the first filter are indicated by a LED peak detector circuit. Although the MN3011 will accept signal levels up to 780 mV before the distortion value stated earlier is exceeded, it will become apparent that the effect of reverberation can lead to reinforcement of signals and consequently this has to be allowed for. The only preset in the circuit is used to apply a bias voltage to the signal. The precise value of this voltage is not very critical in the current design and the object is to keep the signal at a level where it will not be distorted or clipped within the BBD.

The main problem with BBDs is the inability to completely cancel out the clock pulses and these can form audible cross products with the input signal. In order to prevent this foldover distortion, the bandwidth of the input signal should be limited to between a half and a third of the clock frequency. Filter F1 in Fig. 2 is a lowpass filter with a cut-off frequency of 3.6 kHz. This may seem rather low but in fact it is equivalent to the upper reverberation limit of most spring lines and the BBD scores in respect of low frequency responses since springs usually give rise to 'booming' below 100 Hz. The limited bandwidth is compensated by mixing the original signal with the reverberated signal at the output stage. The filtered signal goes to the MN3011 and the six output stages are summed to give a composite signal with different delay times. The signal is again filtered with a lowpass filter with a cut-off frequency of 3.6 kHz, to remove residual clock glitches, prior to mixing with the original signal at the output amplifier, A2.

The most important feature, however, is that the signal from the longest delay is returned, slightly attenuated, to the input and subjected to further delays. This is the reverberation effect and with the times given earlier the sound will simulate the effect of the first reaching a surface 55 metres away (assuming slowest clocking rate) and then being reflected back as well as being reflected from other surfaces closer than the 55 metre surface. The whole process is repeated until the original delayed signal and its reflections die away. In the meantime new signals are being recycled and the overall effect is a build-up of sound — reverberation.

Construction

The construction is very straightforward but the following precautions should be observed. First, make sure you get the correct orientation of the ICs which are clearly shown on the component overlay. Second, the MN3011 is a CMOS device and with the advent of 'B' series devices we have all become rather careless as regards handling such ICs. For the MN3011, however, take the precaution of working on a grounded metal

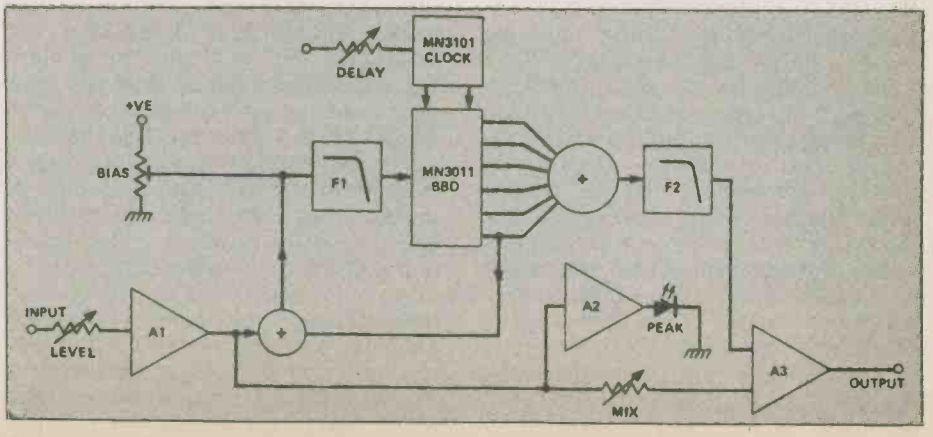


Fig. 2 Block diagram of the ETI Solid State Reverberation unit.

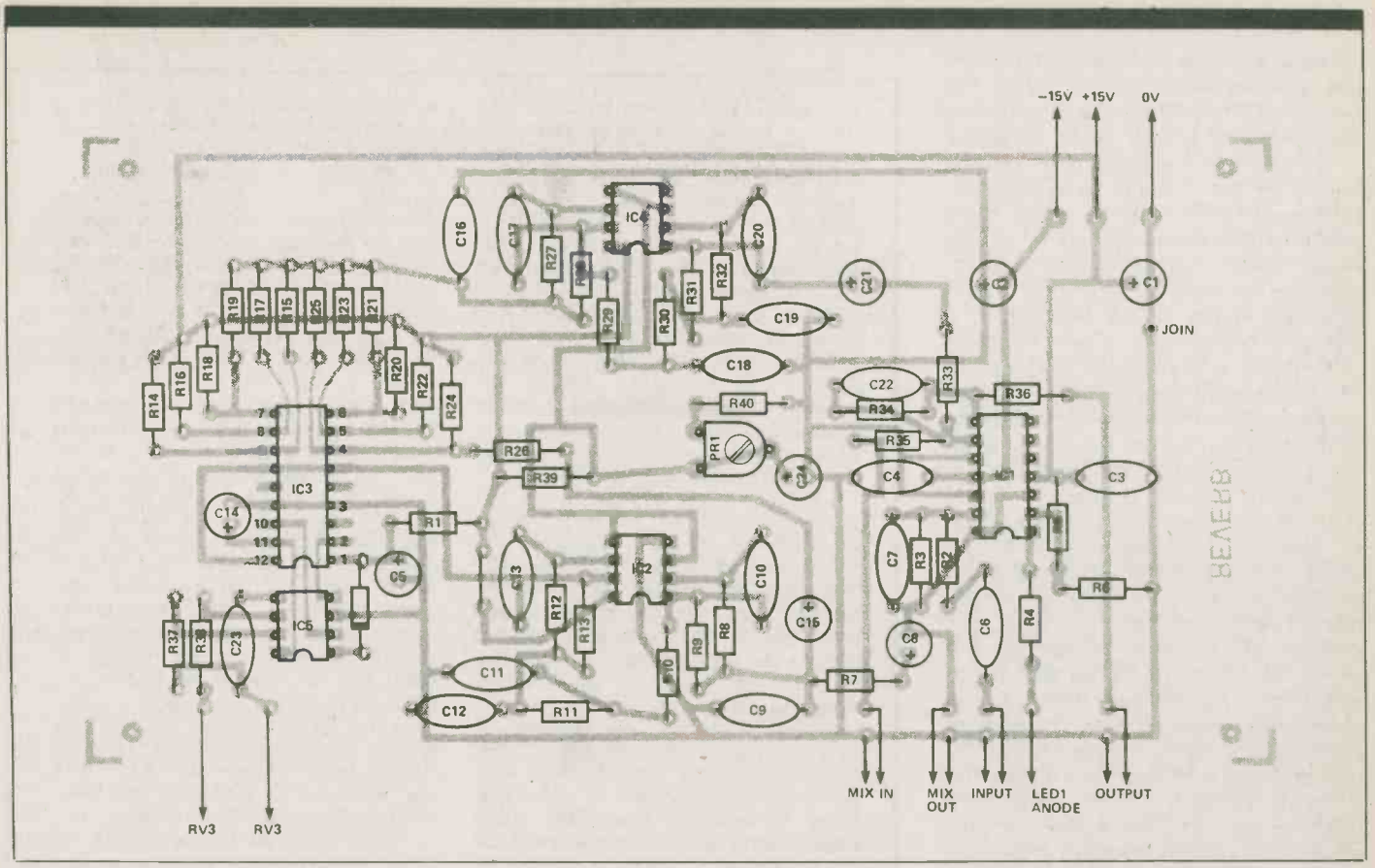


Fig. 3 Component overlay

PARTS LIST

Resistors (All ¼W, 5% except where stated)

R1	10R ½W
R2,5,7,9	
13,32,33,39	100k
R3,34	51k
R4	330R
R6	1k3
R8,12,27,31	33k
R10,29,37	47k
R11,30	56k
R14,16,18,20	
22,24	56k 1%
R15	100k 1%
R17	110k 1%
R19	120k 1%
R21	130k 1%
R23	150k 1%
R25	160k 1%
R26	200k
R28	82k
R35	18k
R36	1k0
R38	36k
R40	68k

Potentiometers

RV1	100k logarithmic
RV2	10k logarithmic
RV3	470k linear
PR1	47k miniature horizontal preset

Capacitors

C1,2	10u 35V PCB electrolytic
C3,4	100n polyester
C5	22u 35V PCB electrolytic
C6	220n polyester
C7,10,13, 20,22	220p polystyrene
C8,14,15 21,24	3u3 63V PCB electrolytic
C8,11,12 18,19	2n7 polystyrene
C16	2n2 polystyrene
C17	270p polystyrene
C23	33p polystyrene

Semiconductors

IC1	TL074
IC2,4	LM358
IC3	MN3011
IC5	MN3101
D1	1N4148
LED1	5 mm red LED

Miscellaneous

SK1,2 mono jack sockets
PCB; IC sockets; case

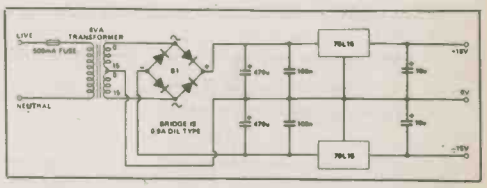


Fig. 4 Circuit diagram of a suitable PSU for this project.

POWER SUPPLY

PARTS LIST

Capacitors

C1,2	470u 35V PCB electrolytic
C3,4	100n polyester
C5,6	10u 35V PCB electrolytic

Semiconductors

IC1	78L15
IC2	79L15
BR1	0A9 DIL type

Miscellaneous

PCB; PCB-mounting transformer (15-0-15, 6 VA); 500 mA line fuse and chassis-mounting holder.

surface, such as a piece of aluminum foil, do not insert the IC with the power on and do not use a soldering iron on the PCB with the IC installed.

The PCB supplied with the kit has a ground plane to reduce interference from and to other electronic equipment as well as to reduce noise. This feature allows greater freedom in locating the unit, e.g. it does not have to be housed in a separate metal case. A ground plane comprises a metallized surface on the component side except for small areas around the holes for the components. Ensure that the component leads do not touch the ground plane — which is not difficult — and preferably solder the resistors and axial capacitors in place with a thin piece of card between the component and the board so that the former are not in physical contact with the ground plane. After soldering the card is removed. The latter step is not essential. The one wire link must be made with insulated wire. The ground plane has to be connected to the 0V line and some 15 mm from where the latter is connected to the PCB there is a hole marked 'join'. A piece of wire should be placed through this hole and soldered on both sides of the PCB.

HOW IT WORKS

The input signal is attenuated by RV1 and also by the inverting amplifier built around IC1a which has a gain of about 0.5. From IC1a the signal goes three ways. A comparator built around IC1b forms a peak detector to indicate optimum signal level, while RV2 and R35 allow mixing of the original signal with the reverberated signal in the inverting amplifier configured around IC1c. The component values in this section are such that equal proportions of the two signals may be mixed. Finally the signal also passes to two active filters constructed around IC2 which have a 12 dB/octave roll-off for each stage and a cut-off frequency of 3.6 kHz.

From the above filter stages the signal passes into the MN3011 and the six delay outputs are summed by the resistor network formed by R14 to R25. Note that the shorter the delay, the less the attenuation. From the longest delay (pin 4) the signal goes via R25 back to the input of the filter and thus provides recycling of the delayed signal in order to generate a true reverberation effect. The reverberated signal is filtered by two active filters constructed around IC4 and these have the same characteristics as the input filters. Between the active filter stages some passive filters have also been added to increase the roll-off; the loss in these filters is compensated by increasing the gain of the active filters.

The dual clock for the MN3011 is provided by IC5 and with the components shown, the clock frequency may be manually varied with RV3 over the range 10 kHz to 100 kHz, allowing maximum first pass delays from 16.64 to 166.4 milliseconds. Pin 8 of IC5 provides the V_{GG} voltage for the MN3011. Since both IC3 and IC5 are P-channel CMOS it would be normal to operate them from a -15V supply. Voltages are, however, relative and by connecting +15V to the ground pin and ground (0V) to the V_{DD} pin they will operate happily with positive signal inputs. R1 and C5 prevent clocking signals getting back into the power lines. The filters are also operated from a single +15V supply and this avoids any problems which may arise from excessive bipolar signals, ie they will be clipped at +15V or ground and not damage the BBD. The bias voltage required by the BBD and the filters is primarily to allow them to accept bipolar signals; this voltage is provided by the resistive divider using components R39, PR1 and R40 and is aplied to the non-inverting input of the filter op-amps.

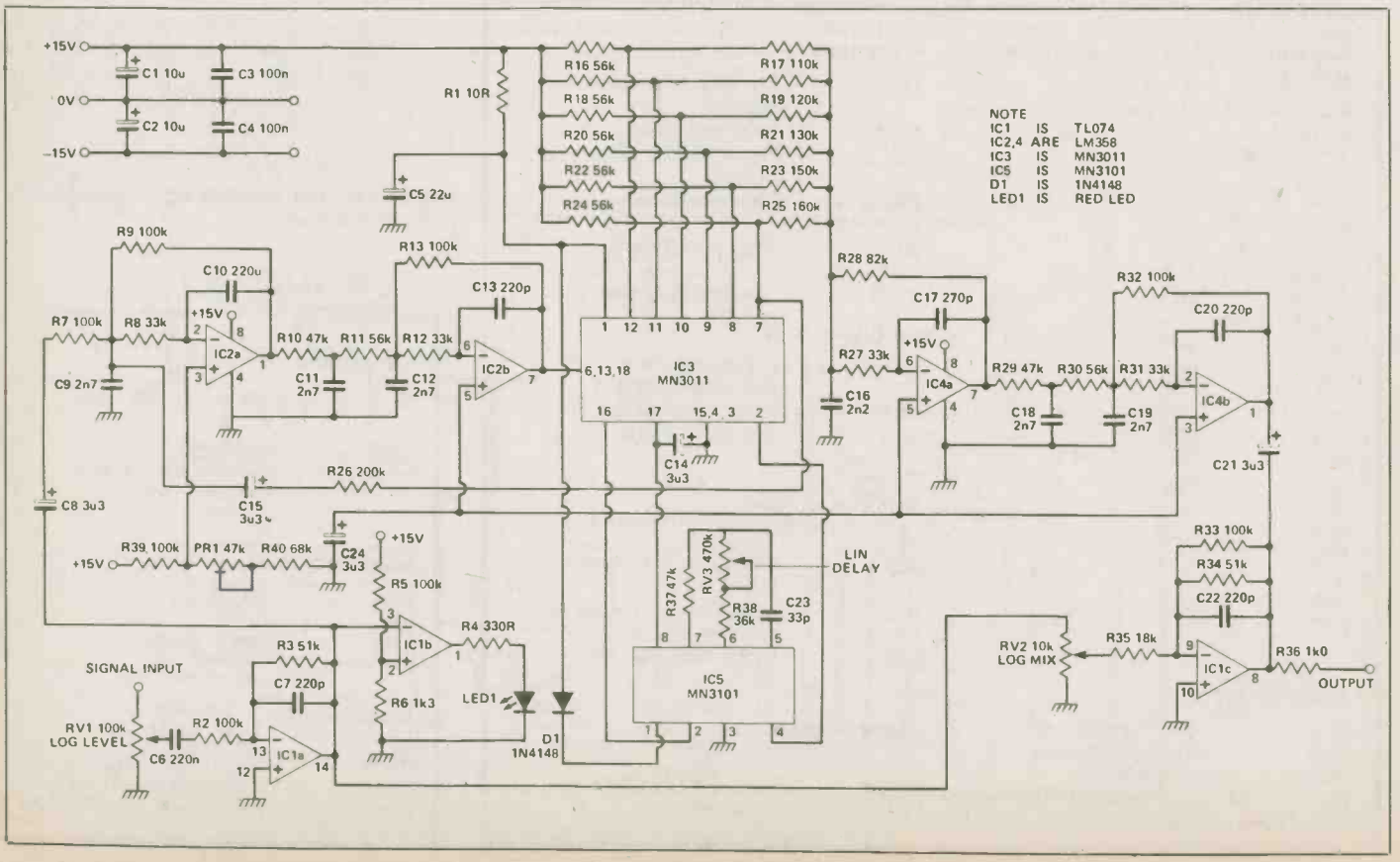


Fig. 5 Circuit diagram for the ETI Reverb.

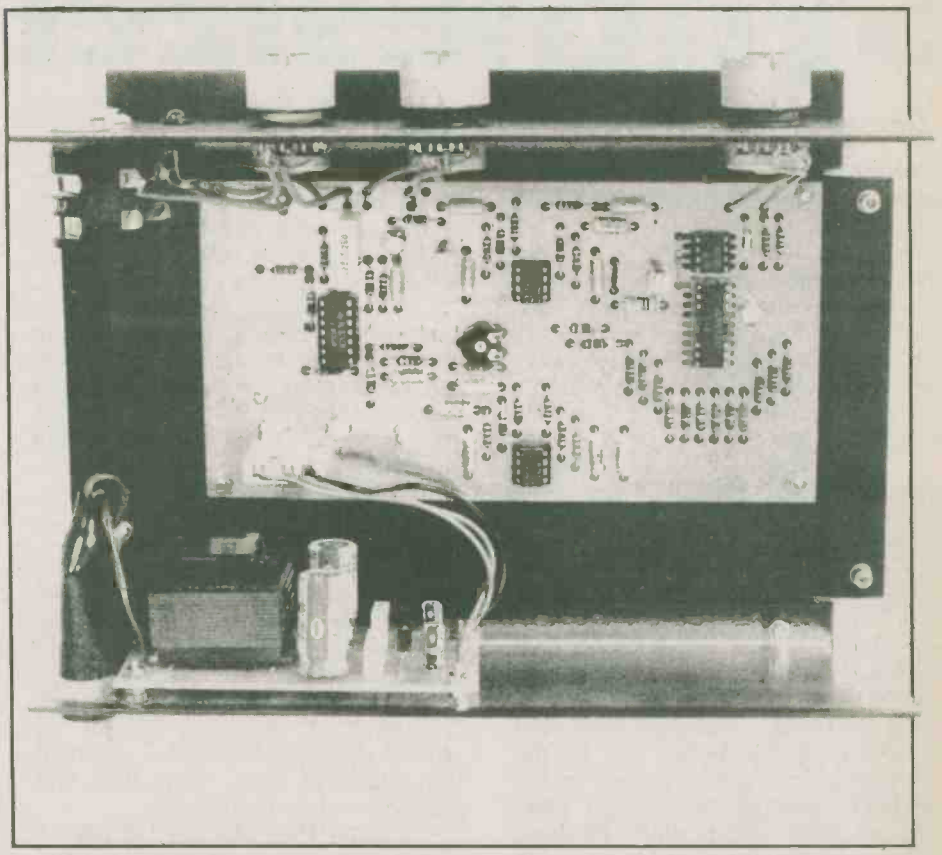
The PCB has been laid out such that the BBD and clock are as far away as practical from the signal input and output. This separation should be maintained if the unit is housed in a box and all wiring should be kept as short and as neat as practical, with the audio connections being made with miniature screened cable.

The unit requires a ±15 V power supply and the current consumption is a miserly 13 mA at +15 V and 9 mA on the -15 V line. If a separate power supply is required then a suitable PSU is shown in Fig. 4. A PCB-mounted transformer is preferred, and it should be mounted as far away from the BBD as practical.

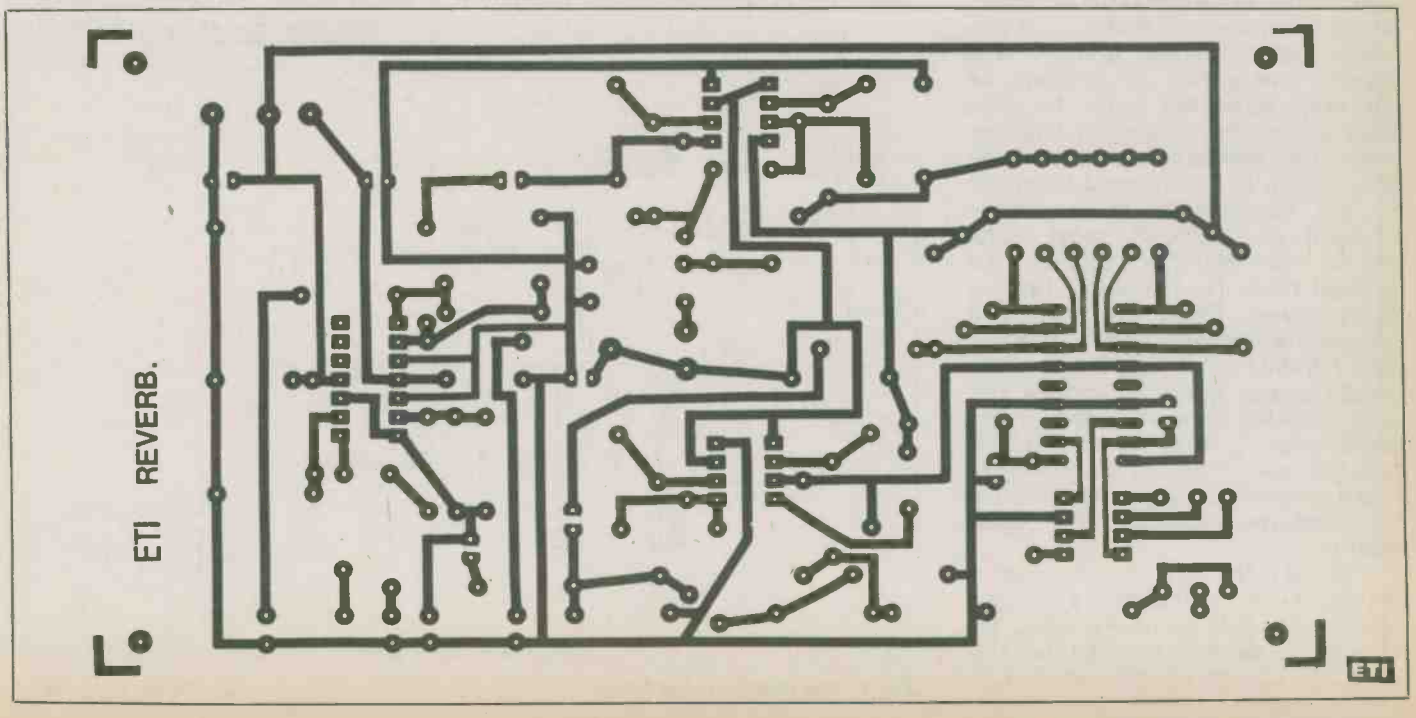
Setting Up And Use

The only setting up required is adjustment of PR1. If a sinewave source is available then the latter may be used as the signal source and PR1 adjusted by ear, or with an oscilloscope, for minimum distortion. Alternatively measure the voltage at the junction of PR1 and R40 and adjust PR1 to give a reading of 6V2.

The unit has a signal-to-noise ratio of better than 60 dB but this requires that it is operated with the peak indicator LED just glowing or occasionally illuminating. The output level will vary from about 0V5 to 1V RMS, depending on the amount of mixing of the original signal, and these levels should ensure adequate response from most amplifiers, mixers, and so on. In other words, by keeping input signals at maximum level the amplifier setting will be such that during periods of no signal the residual noise will not be obtrusive. This is common practice with recorders, many of which have much lower signal-to-noise ratios.



Inside the reverb unit.



Synthesizer III

PROJECT

Mellow out your synthesizer with a filter module By Steve Rimmer.

THERE WAS A BREIF hiatus in the flow of synthesizer modules last month ... there just wasn't time to get another one together. However, we haven't given up, as this month's installment should witness. This time around it's the filter.

The voltage controlled filter is avery important aspect of synthesis. Virtually all the interesting timbral things that happen in one of these things are the province of this module. Since waveforms consist of a pur sinusoidal fundamental, which sounds fairly dull on its own, plus assorted higher order harmonics, which liven things up, the filter is most useful as a low pass filter, that is, affecting the higher bits of the waveform. In fact, the two other possible configurations, high pass and all pass phase shift, do have some uses, and the board used in this moudle can be set up for these (the extra holes are there). We will, however, look at this another time, concentating on the low pass filter this time around.

The filter circuit is a four pole, 24 db per octave Butterworth deal. This has proven to be the optimun cutoff slope for electronic music ... it provides good timbral quality, and doesn't cost a mint. 48 db filters, on the other hand, are twice the price with almost no noticeable improvement. This makes some sense, if you think about it. The nearest harmonic to any fundamental is an octave about it, and, since the most useful music waveforms are square, the nearest harmonic is usually two octaves away. Thus, the filter can reduce the level of the first harmonic by a minimum of 24 db, which, while hardly inaudable, is a very drastic cut, and knocking it down further in an already sonicly rich environment isn't going to make much difference. What you'd probably get Is just a sine wave ... whlch you could have just begun with.

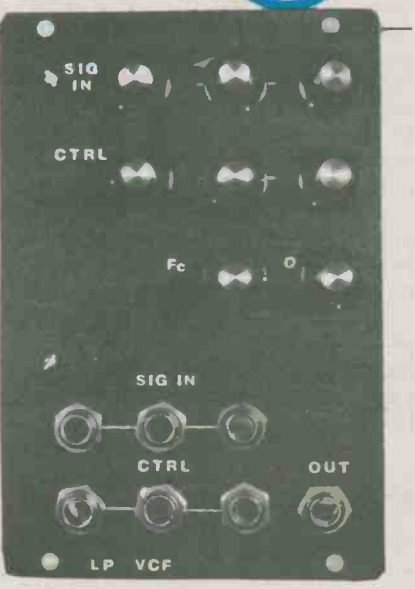
In fact, the filter is most useful when it is providing a rather shallower rolloff curve. As such, the Q is made variable. In this filter, the response can be almost flat, at one extreme, or, at the other, it can have a Q so high that it oscillates. Just prior to oscilation, this type of configuration produces a pronounced peak in its responce at the rollover frequency, which sounds quite pleasing.

For those not familiar with synthesizers, it should be pointed out that the filter is made to track the keyboard along with the VCO by feeding the same control voltage to it. As such, the timbre of the resultant waveform is independant of pitch.

Getting It Down

Getting this module together is not particularly difficult. There are no precision parts, although one should use five percent resistors, and make sure they're all from the same batch. The keyboard tracking is not as critical as that of the VCO ... a whole tone worth of error in the filter will probably not be noticeable.

Setting the filter up requires a single adjustment, the volts per octave trimmer. As with the VCO, it is probably a good idea to wait for the keyboard interface module before hassling with this. When you do come to set it up, it can be done just line the VCO by turning up the Q until the circuit oscillates and becomes a VCO. Then, just go for one volt per octave.



HOW IT WORKS

As with so many of these modules, most of the workings are one chip, in this case, the 2040 from SSM. This contains four separate filter sections, each ith its own OTA and buffer. If you piece through the circuit diagram, you will note that the capacitors and resistors are all connected up in a classic Butterworth configuration. This filter has a six db/octave roll off as it stands, so four of them together produce 24 db/octave.

R3 provides a feedback path, which, increases the Q of the circuit. The Q pot shunts some of the fed back signal to ground, varying the effective feedback around the filter, and hence the absolute Q.

The three op amps are simple buffers.

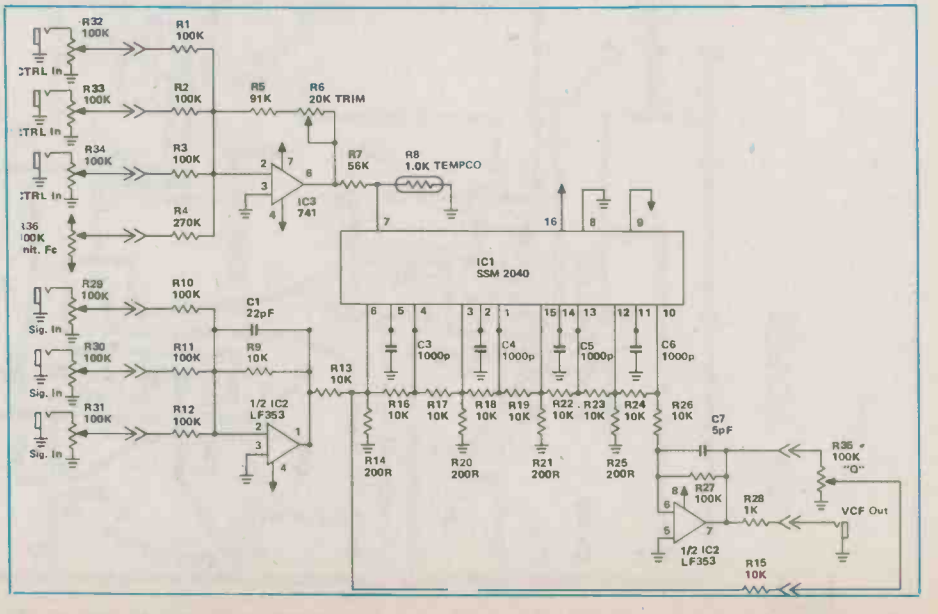


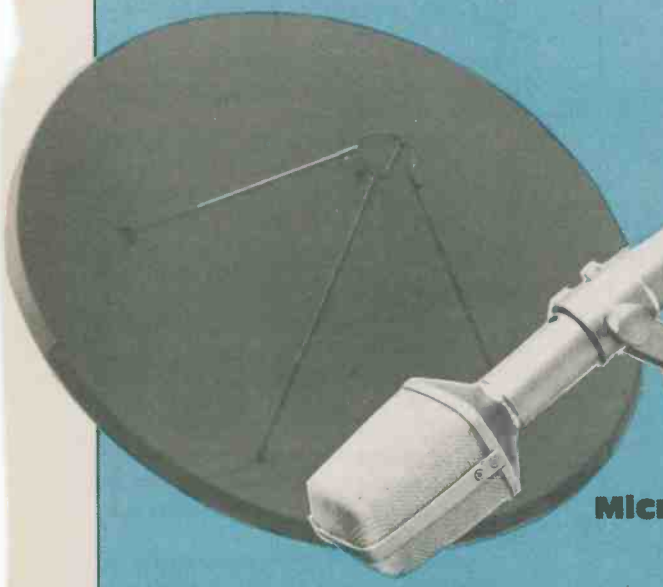
Fig 1. The circuit of the VCF

Continued on page 76

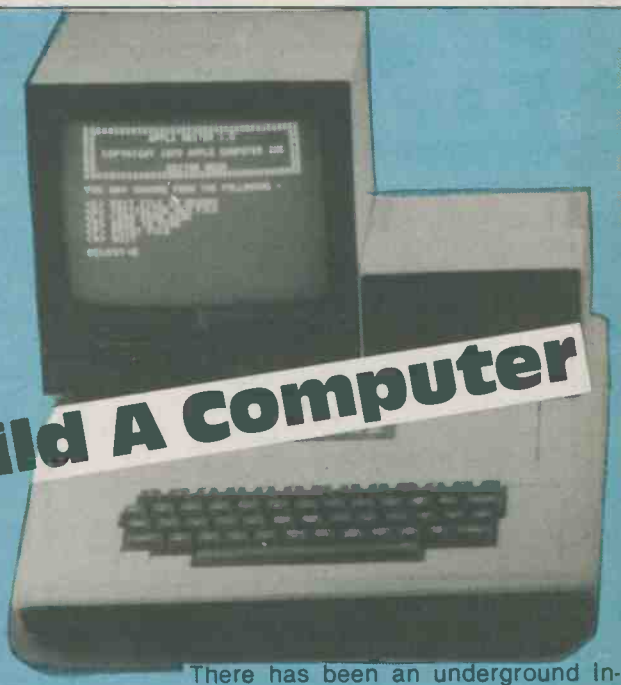
ETI next month

Satellite TV For The Home

The author of this article reportedly has tried a number of unusual approaches to home satellite reception. Ever notice, for example, how much the top of a grain silo looks like a dish antenna? A facinating look at this new technology.



Build A Computer



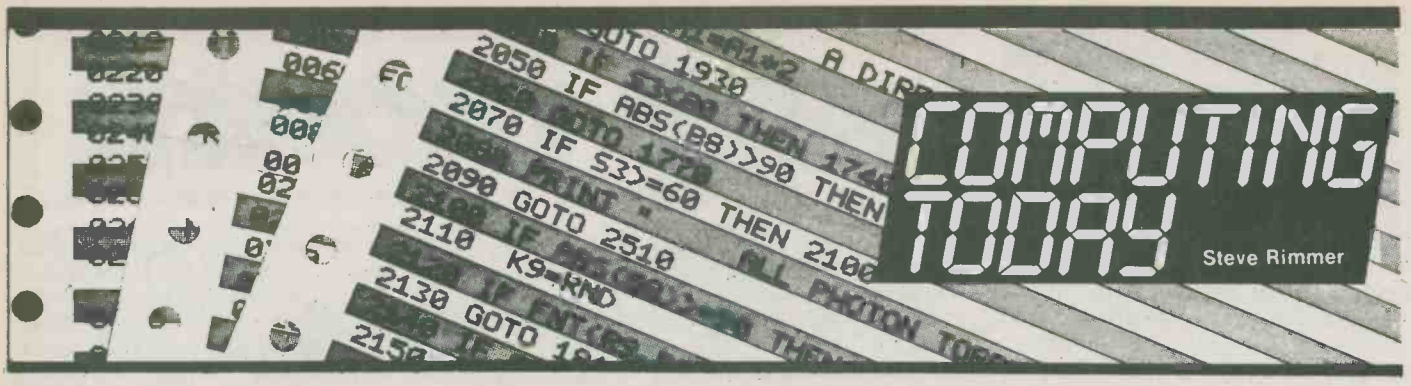
There has been an underground interest, of late, in building up copy versions of a certain very popular computer. While we are not allowed to say which one it is, its trade mark is a type of fruit. Next month, how to get the parts, which boards to use (and which to avoid) and the pitfalls of growing your own.

Microphones

The major difference between the three dollar plastic mike you got with your "Voice of Distortion" cassette recorder and a two thousand dollar Neumann is that absolutely no one will take yours seriously, not even the dog. Other, more subtle differences, however, do exist. . . as we'll see next issue.

Series 5000 Preamp

If you've ever wanted a pre-amp to totally decimate any pretensions your friends might have to high fidelity, this is the one. It has lights and buttons everywhere, uncountable inputs and outputs, and specifications so good it actually begs for mercy if you play Anne Murray through it.



THE VIC-20 is just loaded with hidden bits to mess with, and it's interesting how little it takes to dig them out at times. Case and point is the joystick port on the side. Requiring nothing more than a joystick . . . you might have figured that . . . and a nine pin D connector, this option is a very cheap peripheral, and is a gas for games, graphics and other interactive programs. It's certainly a lot better than using the keyboard to control your galactic planet cruncher.

High Tech

Assembling the joystick hardware should not tax even the least conscious . . . any joystick with 100K or so pots will suffice. Radio Shack sells one if you're stuck. The D connector will probably need to have its shell retaining tabs shaved down a bit to allow the plug to be pushed in all the way; this awesome task can be performed with a razor blade and brutish manual exertion. Hey . . . you can't do everything with software.

The VIC contains two built in analog to digital converters which sense the position of the joystick pots. The resulting numbers are loaded into two registers up in the VIC chip's chunk of the address bus, 36872 and 36873 for the X and Y coordinates repectively. The range of the joystick is from 0 to 128.

There are a lot of really interesting games that can be run using joysticks, and most are too huge to get into here. However, we are going to look at some of the considerations involved in interfacing the joystick to your programs. The holy grail shall be a gunners crosshair moving across the screen. From this point, you can write in the tanks, star cruisers, camels, etc. to blast away at.

The following is a BASIC joystick program. It places a crosshair on the screen, the position of which is determined, from moment to moment, by the position of the joystick.

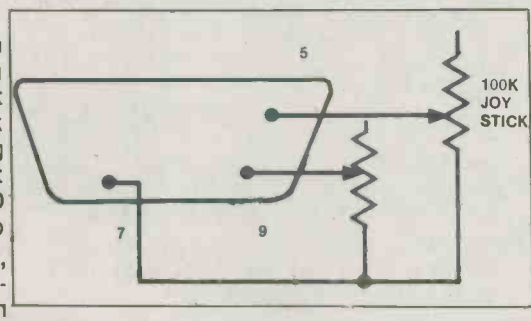


Fig. 1 The VIC Joystick interface.

Complex little beast, ain't it. Consider that all the machine code that follows does essentially the same thing.

First off, A$ is loaded with a series of characters such that, when it is printed, it will produce a crosshair. The abbreviations in the square brackets stand for control keys, to wit, [dn] is cursor down, [rt] is cursor right and [lf] is, yes, cursor left. The dash is a horizontal line in the middle of a character, and the "I" a vertical line. You just can't get PET graphics out of a word processor.

Line 20 makes the screen black and clears it. Line 30 is the beginning of the joystick loop. First off, there's a small loop which checks to see if the stick has moved since the last time the crosshair was printed. If it hasn't, the program stays in the line 30 loop. If it has, it breaks out and goes on to clear off the old crosshair and print a new one.

Lines 40 to 60 deal with the actual printing. Because of the VICs colour facility, it's not actually necessecary to erase the old crosshair before printing the new one . . . this is usually done by overprinting it with blanks. It's just as effective to overprint the old figure but in the same colour as the background. This, in fact, is not heavily important in the BASIC version, but it saves quite a bit of figuring in the machine code programs to follow, since it permits the use of just one string to be printed, with just the colour code byte altered.

As is usually the case in articles where one finds a simple BASIC program preceding a complex machine code one, the BASIC joystick controller doesn't work very well. The time involved in carrying out these operations is so long as to cause the crosshair to flicker when it moves, which looks very 1972, and lacks the mind rending sophistication usually desirable in contemporary video games.

This gets worse as the game gets more complex. The speed of BASIC is just too slow to allow multiple things to be happening on the screen and to have them appear to be simultaneous.

Thus . . . it's on to the code. Start your engines . . .

PROGRAM 1

```
Machine Language Joystick Program
For Vic 20 (c) 1982 Steve Rimmer

Uses two KERNAL calls, $FFD2 to
print and $FFE4 to read keyboard.
1. Routine to read joystick ports
and stuff converted values into
print location registers.
     1220 LDA $9009
     1223 LDX #$00
     1225 CLC
     1226 SBC #$04
     1228 INX
     1229 BCS $1225
     122B DEX
     122C STX $D6
     122E LDA $9008
     1231 LDX #$00
     1233 CLC
     1234 SBC #$05
     1236 INX
     1237 BCS $1233
     1239 DEX
     123A STX $D3
     123C RTS
```

In The Machine

These machine code routines do much the same things as the above program, but they do them a whole lot

faster, and in ways that are infinitely less easy to understand. In this version, the screen colour is not changed, and the crosshair will appear dark on a light background. This is to keep the VICMON monitor I was using happy, as, when the program BRK's, and returns control to the monitor, the screen colours are not automatically restored, and some of the monitor commands would, subsequently, become unreadable on a dark screen. Another routine could, of course, be incorporated to fix this. Just make sure to stuff a 1B in the screen colour register before the BRK.

In order to use these routines, you will pretty well have to have a monitor of some sort, either the public domain tape one, a derivative of Supermon, or the ROM pack deal.

This program is assembled starting at $1220 hex. This is an arbitrary start point . . . it's above the monitor, and near a page boundary ($1203 hex). You can, of course, relocate things if you want to, and probably will if you want to incorporate these routines into a more complex program.

PROGRAM 2

```
2. Routine to print cross hairs
using string starting at 123D.

        1250 LDX #$00
        1252 LDA $123D,X
        1255 JSR $FFD2
        1258 INX
        1259 CPX #$12
        125B BNE $1252
        125D RTS
```

The first routine reads the joystick port registers, calculates the proper values for the printing coordinates from the resulting bytes, and stuffs these numbers into the print location registers in zero page. In hex, the joystick registers are $9008 and $9009. As we've noted in the BASIC version of the program, the values in these registers can range up to 128. Unfortunately, the screen of the VIC is only 22 characters wide. The register values must, thus, be divided . . . an operation which is not immediately easy to do in machine code.

The code from $1225 hex to $122B is a simple divider, which, in effect, just performs multiple subtractions and counts the number of times #$04, the denominator, can be subtracted from the register contents, which have been stored in the accumulator back at $1220. The result is held in the X register, which is then stored in the first printing location register, $D6. The second register is handled the same way.

The second routine uses techniques we've peered at in the past . . . namely, indexed addressing, funky though it may be. It prints the string beginning at $123D and running for #$12 bytes. the string to produce the crosshairs is shown here too.

In indexed addressing, the base of the index, in this case $123D, is added to the index register, in this case the X, to produce the actual address for the instruction. The first time this instruction is encountered, the X register is zero, seen to by the instruction at $1250. The effective address is, thus, $123D + #$00, or . . . everybody get $123D? Next time, X having been incremented, it will be $123D + $123E, and so on. Once X hits #$12, the branch instruction will no longer bounce the program back to $1250, and the routine will stop.

This routine does cheat rather a lot, in the interests of simplicity, as it still uses the VIC's print routine, the vector for which is $FFD2. This is rather slow . . . not so slow as BASIC, but still a very complex way to get characters on the screen. Other considerations will be shoved forth presently.

The Master Routine

Starting at $1270 is the master routine. Thump . . . ugh . . . grovel. Yes, this the great, hulking chunk of raw software that mercilessly drives the other routines. Look at it, seething with might and nastiness. Straight out of Heavy Metal.

The program is executed by calling the master routine, to wit, G 1270.

The first two lines of this bit load the accumulator with #$93, the clear screen character, and print it, which, yes, clears the screen and exorcises stray demons from the CPU. This last is a little known function. The subroutine at $1220, which establishes the print location register values in terms of the joystick locations, gets called, and kind and

PROGRAM 3

```
3. String to hold characters that
make up cross hairs, including print
control characters.

123D 11 1D 1D C2 11
1242 9D 9D 9D C0 C0
1247 1D C0 C0 11 9D
124C 9D 9D C2 04 A2
note that last two bytes are irrelevant.
```

benificent numbers are stuffed into these two locations. Next, because subsequent printing operations will change the contents of the print registers, it is necessary to remember their unchanged contents so that, when the crosshair is overprinted to erase it, the overprinting takes place at the right spot. These values are just crammed into two otherwise unused bytes, $1265 and $1266, until later.

#$90 is the control character that makes the printing on the screen black. It is printed to turn on the printing (effectively) so that when $1250 is called, the crosshair shows up on the screen. After this is a short routine to scan the keyboard and BRK if a #$03, the stop key, is returned. In a full blown game, this would probably look for whatever is designated as the "Fire" button, and then RTS to a still more fundamental calling routine to fire a photon torpoedo or incinerate the known universe. It is necessery here because, without it, you'd never be able to get back to the monitor.

Carrying on, we find another call to the routine to establish the print locations . . . the first was, in fact, only to set up the initial location, and isn't actually called subsequently . . . followed by a bit that considers whether the stick has actually moved in the interval since the last check. After this is a second, and repeating, check for the break key.

If the stick has not moved, and the keyboard doesn't return a BRK, the routine jumps back to $1292 and looks to see if there's been any further activity in the stick ports. If there is no movement, the program will remain in this loop indefinitely.

If there is some discrepancy in the new stick position, the program goes to $12AE. This part of things first loads the accumulator with #$05 and prints it. This causes the print colour to be the same as the background colour. Then the old print location values are pulled from the RAM locations where they were stashed a while back, $1265 and $1266, and stuffed into the print location registers at $D6 and $D3. Then the string print routine is called. This overprints the visible crosshair with one which won't show up against the background. Then the program leaps

madly up to $1275 where it starts all over again, printing a visible crosshair in a new location.

It's real . . . it must be.

Further Manifestations

Obviously, after a few weeks of moving the crosshair around the screen, you might get bored of this amazing implementation of technology. Well, who could blame ya . . . you're probably a space pilot at heart.

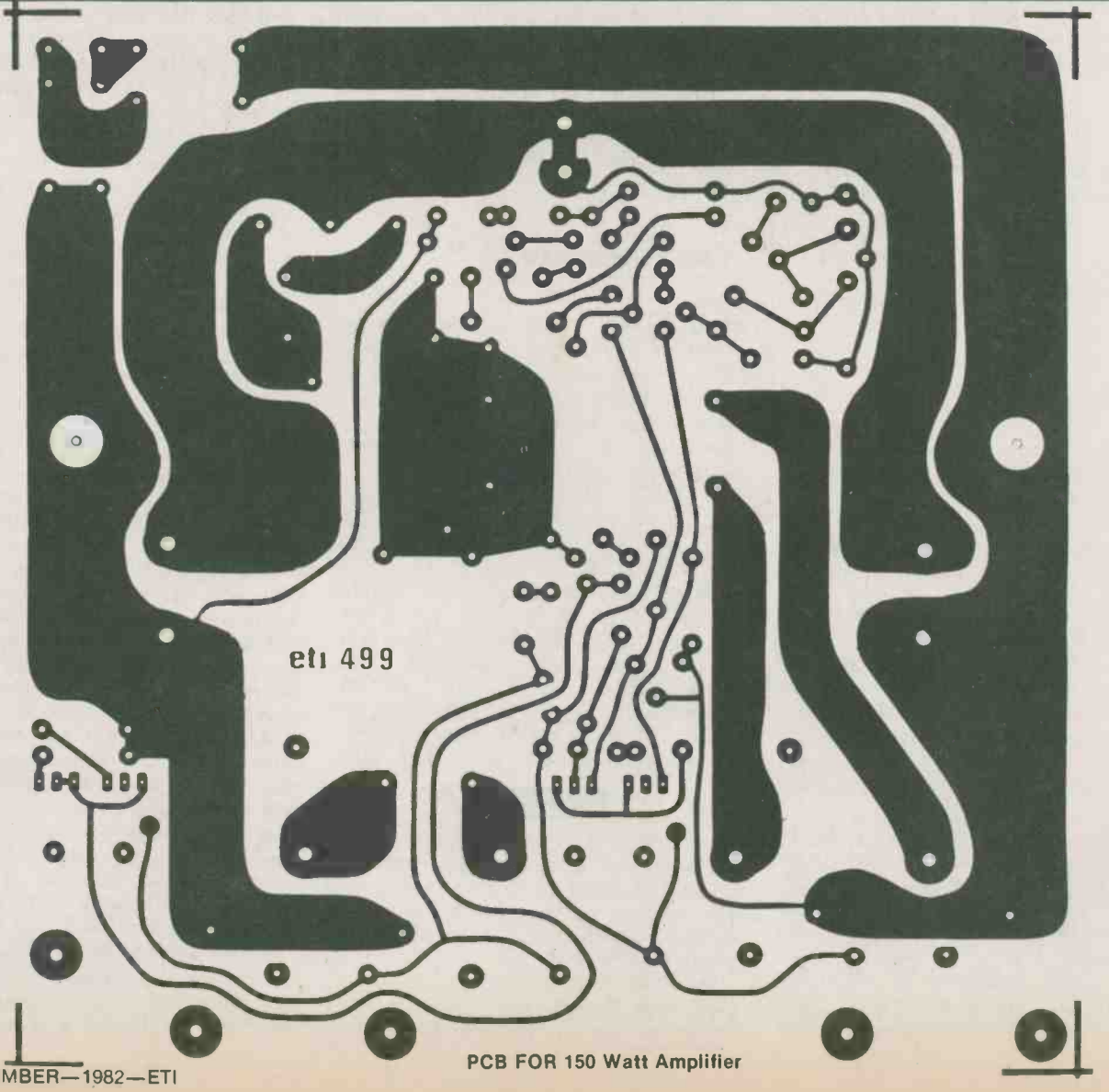
While it's beyond the scope of this column to actually present a whole video game, I did play a little further with this routine to invade other galaxies. For the authors of the next generation of starship blasters, here are some considerations involved in writing working video games.

This program is a subroutine, really, for a larger program. Instead of BRKing on the BRK key, you'd more likely want to RTS on a first button. At this point, you might fire a photon torpedo or something trendy along these lines. You'd also want to have something to shoot at moving around the screen, which would be a subroutine of this, presumably. If screen co-incidence between the crosshair and the target were to be detected, you'd want to get an explosion happening. This is very effectively done on the VIC by having the screen flash different colours . . . change the value in the screen colour register rapidly . . . and blow some white noise out of the speaker.

The first problem you'll encounter in writing a full blown video game is that the crosshair shown here is printed in low resolution block graphics characters, which means that when it overwrites whatever you're shooting at, it will erase part of it. Overcoming this involves getting the bit mapped graphics pak for the VIC. This will greatly complicate the string print routine, of course. However, this simple one really isn't fast enough for a decent game in any case; calling the VIC's kernel routines doesn't approach the full speed possible with machine language programming . . . although it is faster than BASIC. You can buy a bit more speed by cheating on the jump table. Instead of jumping to $FFD2, for instance, check out the bytes followed by the JMP instruction at this address and jump directly to them. However, this doesn't solve the resolution problem.

Secondly, this routine runs at the full speed of the proccessor, which, of course, varies, in effect, with the number of machine cycles in any given routine. Thus, if the program has to loop through a bunch of

Continued on page 76



PCB FOR 150 Watt Amplifier

Flat Screen T.V.

Flat TV without using a steam roller is now a practical proposition. We take a look at the Sinclair system.

THE POCKET-SIZED COMPUTER system is now very close to being realised with the development of a new visual display unit which consumes little power and is roughly the size of a pocket calculator. It is now possible to construct a pocket computer with printer, central processor unit, visual display, and printout on photo-sensitive paper.

"The slim-line pocket TV is here and is going into production", says Clive Sinclair, founder and director of the British company, Sinclair Radionics Ltd. The company, which is located in St. Ives, Huntingdon, has been responsible for developing pocket calculators, small TVs, etc., and has now overcome the formidable problems of designing and producing a miniature (20 mm thick) cathode ray tube (CRT).

A manufacturing plant is being set up in conjunction with a larger firm to produce a pocket TV/radio with a 75 mm diameter black and white screen. Owing to the radical design of the flat CRT, the brightness of the screen is three times that of the conventional CRT. This makes it ideal for use in projection TVs with up to 1250 mm diameter wall-mounted screens.

A great deal of energy and money has been spent over the last decade to produce a miniature VDU which consumes low power. The announcement by Sinclair of a flat CRT, where the electron gun is mounted to the side of the screen, is a breakthrough because the development of a low cost solid state device still seems years away. It is certainly possible to construct a complete screen from individual LEDs or liquid crystal elements, but the cost of manufacturing such a matrix and the complex circuitry needed to control it is prohibitive at the moment. In addition, such a system would inevitably give poor visual definition and if liquid crystal displays were used the contrast would be unsatisfactory.

Lateral Thinking

The Sinclair CRT is shown in Figure 1. It measures 150 x 50 x 20 mm and is half the volume, three times as bright and consumes one quarter to one tenth the power of a conventional

CRT of the same screen size. The device is constructed from a fairly conventional electron gun, collimator, and vertical and horizontal electrostatic deflection plates mounted at the side with the axis parallel to the phosphor screen. A positive electrode behind the screen and a negative electrode inside the front face cause electrons to be deflected towards the screen. The negative electrode at the front is made of a tin oxide coating which is transparent to light. The vacuum enclosure is made of glass and a plastic Fresnel lens is mounted outside the front surface.

Although the design concept is very simple, the fact that the electron beam does not strike the screen at right angles means that one or two tricks are needed to produce images which are well-defined and undistorted. First of all, good definition of a picture requires that the electron beam spot should be circular and as small as possible. The situation without the electrostatic field is shown in Figure 2a. It can be seen that at point A the angle of incidence is greater than at point B, so that the beam spot is much less elliptical here. Figure 2b shows the situation when an electrostatic field is applied. The angle of incidence is constant across the screen and the spot is therefore of constant size.

Achieving an undistorted image is difficult because the distance from the collimator to the screen is comparable to the screen dimensions. Without correction the shape of the scan would be as shown in Figure 3a. A combination of optical and electronic methods is used to rectify this shape as much as possible.

The vertical deflection angle of the beam is reduced to make the resulting image more nearly rectangular and the vertical dimension is then magnified optically by the Fresnel lens in front of the screen. The horizontal dimension is unchanged.

A modulation voltage is applied to the vertical deflection plates during each frame to change the image as shown in Figure 3b. Image MNOP changes to M'N'O'P', which is more nearly rectangular and distortions are therefore reduced to a minimum.

Design Advantages

Mr. Sinclair points out that the construction of the CRT lends itself to mass production technology in that, for example, connections to the electron gun and deflection assembly are screen-printed on the inside of the

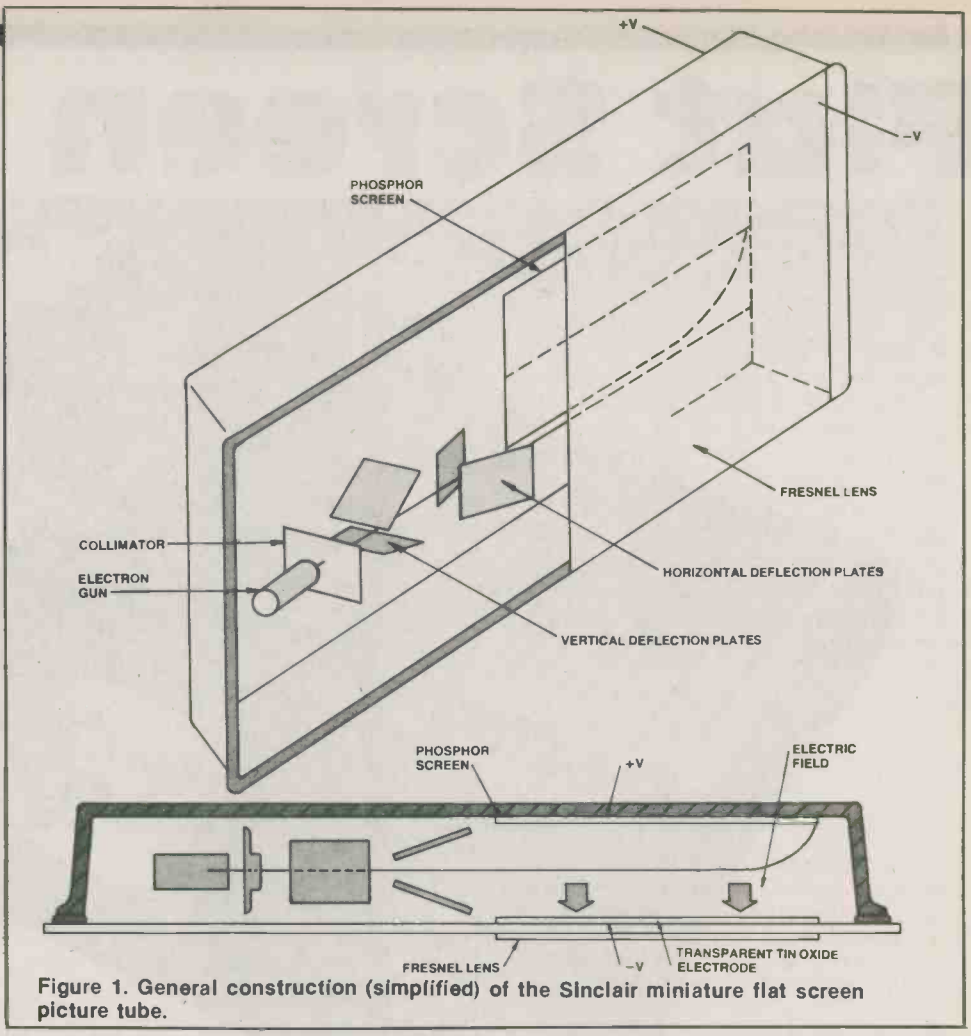


Figure 1. General construction (simplified) of the Sinclair miniature flat screen picture tube.

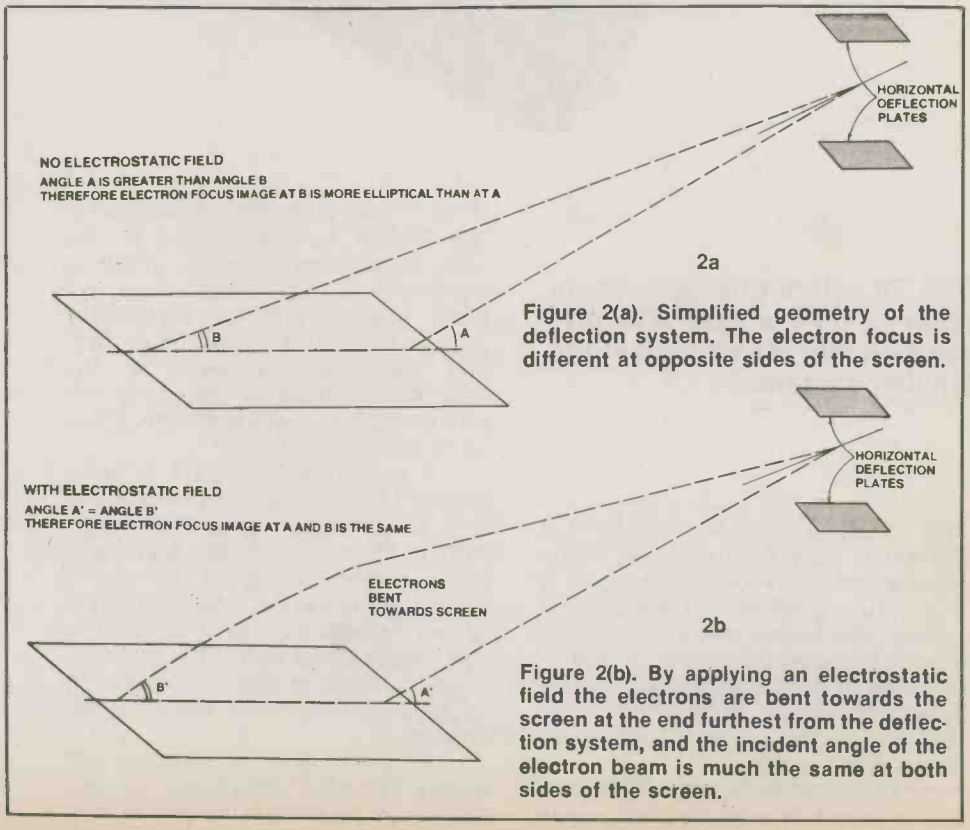


Figure 2(a). Simplified geometry of the deflection system. The electron focus is different at opposite sides of the screen.

Figure 2(b). By applying an electrostatic field the electrons are bent towards the screen at the end furthest from the deflection system, and the incident angle of the electron beam is much the same at both sides of the screen.

faceplate and the assembly is attached in a single operation by means of a conductive fret.

The feature that makes the CRT ideal for projection TV is that the image is viewed from the side of the phosphor that the electrons strike. This results in a much brighter image in comparison to the conventional CRT where the image is observed through the phosphor layer. It can be seen that a heatsink placed directly on the backing plate of the screen allows the phosphor to be driven much harder by the electron beam without thermal damage.

In the future the miniature CRT could well be used in pocket oscilloscopes and other test equipment once the techniques of obtaining perfectly distortion-free images are mastered.

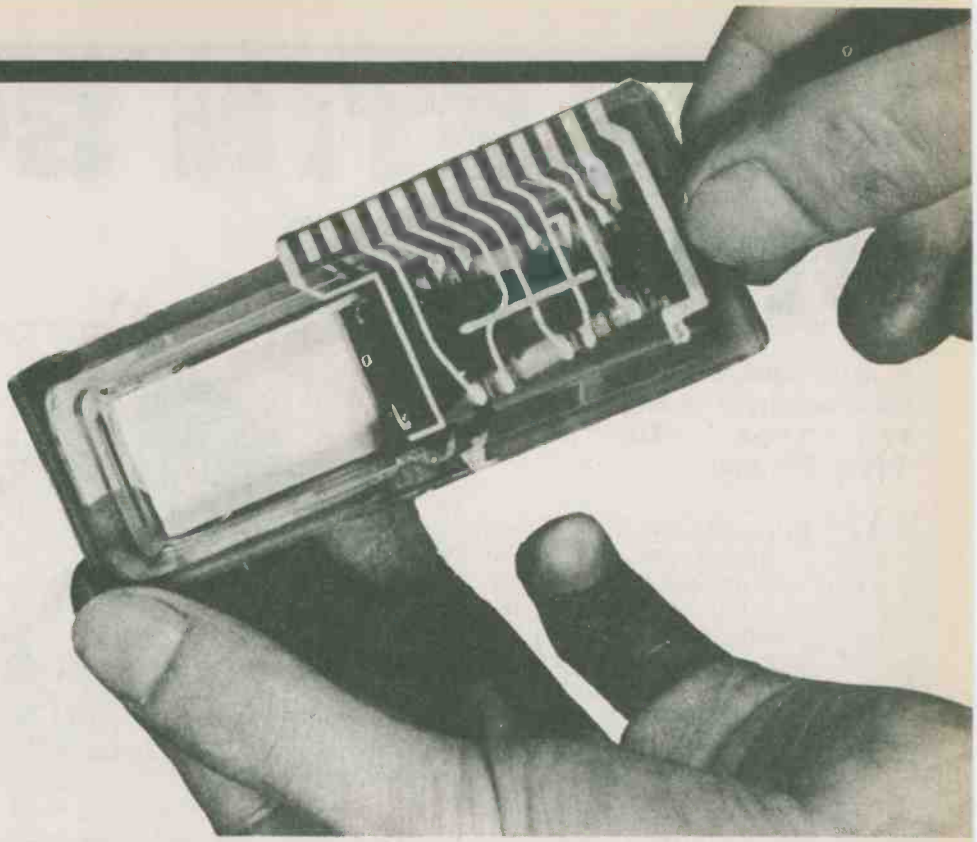


Figure 3(a). If no image correction system were applied the normally rectangular image would be distorted as shown on the top diagram, the side nearest the vertical deflection being shorter than that furthest from the vertical deflection.

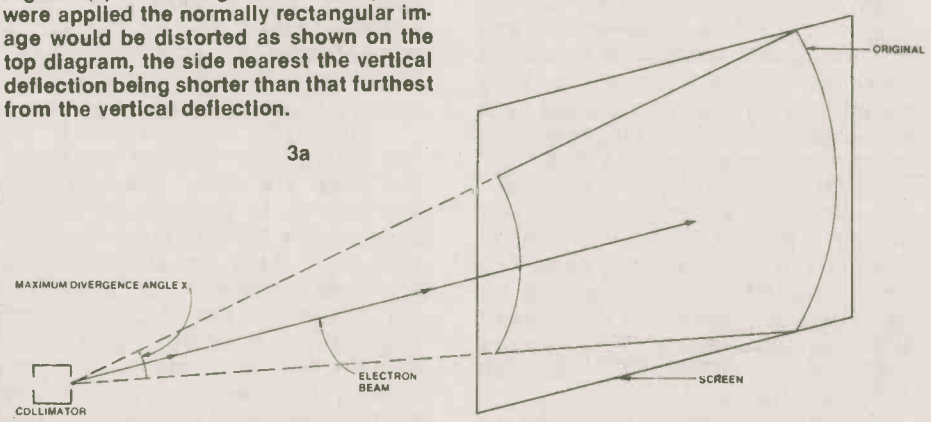
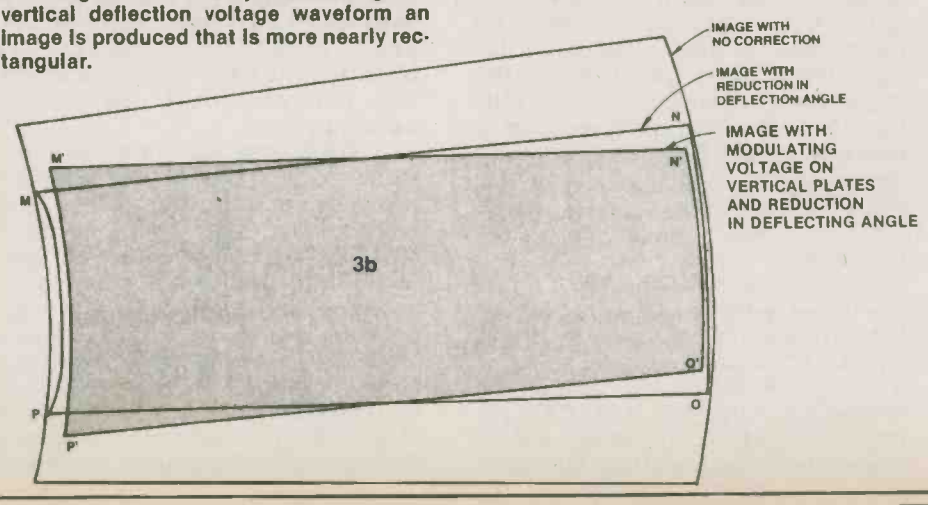


Figure 3(b). By both reducing the deflection angle and suitably modulating the vertical deflection voltage waveform an image is produced that is more nearly rectangular.



BULLETIN BOARD UPDATE

A brief look at the ETI BULL BBS, or why it freaks out when you type "DIR", by Steve Rimmer

THE ETI BULL BBS has been quite a success . . . after about three days of operation, the number of callers each night rose until, at present, the system is engaged virtually all the time it's up. It receives between twenty and fourty calls each evening, and has approached two hundred on the weekend. It has been a lot of fun . . . and a lot of work . . . all ways round.

Historically, the BULL's software was distilled from a package called CNODE, written in the C language. The chief troll involved in this was one Bob Schultz, a Toronto small systems guru who is rather fluent with these things. The CNODE package is strange, in terms of its command structure, and lacking a few things, such as a mailbox section, but it was fairly easy to adapt to our TRS-80 Model II computer and Novation Autocat modem. It took relatively little kluging to get the present system going.

In as much as most boards are of basically the same structure, we are rather pleased with the way the CNODE package has worked out, as, evolving with the system's strengths . . . and, albeit, trying to minimize its weaknesses . . . the BULL has turned out to be really unusual.

Some users, who have had difficulties with the system, have chosen words other than "unusual". For them, and for those who have yet to try the BULL, here's a brief outline of how the commands work.

All That Bull

When you first log on, you will get a short welcome message, after which the system will ask you for your full name. Don't be like one twit and type in "Your Full Name". Following this is the Message of the Moment, which changes every day or two. Usually it lists what's newest on the board. In both these messages, you will experience one of the features of the CNODE system, the MORE function. Every sixteen lines, the listing halts and asks you if you want to see more (N or any key). Typing N stops listing the file and goes onto whatever's next. Any other key causes the line with the question to be erased and the listing to continue. If you don't want the MORE function to keep derailing your train of thought, you can toggle it off once you get into the system proper by typing MORE, Typing MORE again toggles it back on.

When you are in the system, you will get a prompt, "%", which means that the thing wants a command. The two immediatly useful ones are LS and CAT. LS gives you a directory of what's on the disk, and CAT types the file of your choice. CAT must be followed by a name.

There are always new files to look at on the BULL, but there are a couple of old ones that never fade away, and it's useful to check them out to find out what's happening on the system, or just to get a feel for how things work. CAT INFO is the system information file. CAT MENU lists the files which are interesting to look at. CAT SOFTWARE will print out the software that's available for downloading. Checking out these files, plus what's mentioned in the Message of the Moment, will point you at whatever you're after.

There are a few tricky bits about the CAT command. First off, if you type CAT-X and then a file name, it will shut off the MORE function for the listing of that file. Also CAT will type squeezed files, those with a Q as the second letters of their file name extensions, without any prompting. If a file is being CATed, you can get out of it by typing a CTRL C (or, of course, by typing "N" at a MORE prompt). If you can't type a CTRL C . . . some systems without a CTRL key can still generate this using the BRK . . . *don't toggle off the MORE* or you might wind up stuck in a very long file.

The log on message is thirty nine characters wide. Most of the rest of the files are sixty five, although anything up to eighty is acceptable as far as the CNODE is concerned. If you don't have an eighty column screen do not despair. STTY is a function to get you out of this problem. Type STTY X,Y where X is one less than the number of characters in one line of your screen, and Y is one less than the number of lines you want the MORE to interrupt you at. If you don't care about the MORE length, type STTY X. For instance, a TRS-80 Model III user, with a sixty four column screen, would type STTY 63. If you just type STTY, with no parameters, the system will tell you what the current parameters are.

SEND and RCV are the commands to send files to your computer and receive files sent to the BULL respectively. They work using a MODEM7 type program at your end, and, if your terminal software can't generate this protocol, you should *not* call them. If you don't have a MODEM7 type program, you can still bring files down to your system by CATing them and capturing the text in an intelligent terminal. If you have a CP/M based system, we will assist

you in getting a MODEM7 up on it if you ask us nice.

We love to receive files.

Another command is TALK, which permits you to CHAT with the system operator. It will print a bar graph of periods for about one minute after being called, and, if no one has answered your call, will eventually drop you back into the board. Your best chance to get someone to TALK to is in the first hour after the system goes up each evening.

HELP will give you specific information about the system commands. If you want to know how CAT works, for example, type HELP CAT.

Lastly, there are BYE and LOGOUT, which are the same, and are used to sign off the board. They shut things down in an orderly manner, and keep the files correct ... they're a lot more civilized than just hanging up. When you log off, you can leave a message for the system operator. This can be as long as you want, with no specific format. You can tell us jokes, ask questions about the editorial in ETI, request files not presently on the system be put on, and so forth. Answers to questions will be left in a file named, as you might have expected, ANSWERS, and CAT ANSWERS will let you look at it. If you have a general message that you want put in the MESSAGES file, you can leave it in the logout file. This isn't as immediate as a mailbox, but it's faster than a carrier pigeon, and at least twice as reliable.

The disk file organization of the BULL is set up between two disk drives, 0 and 1. Disk 0 has the system files, and is where the uploads and the SYSOP's mailbox stuff goes. You can't log onto disk 0, and, in fact, it's totally impossible to access it over the phone. Disk 1 is what you see when you type LS. This arrangement keeps people from being able to read the stuff put in the SYSOP's box, and makes it at least a little difficult to mess with the system files.

In order to log onto the BULL, you will need some sort of terminal, and some sort of modem. Any 300 baud modem will work as far as we're concerned, and the procurement of same is your hassle, as it will have to be compatable with (a) your computer or terminal and (b) your bank account. A brief word follows on terminals.

A terminal can be a dedicated terminal, such as an ADM-3 or the ETI Multiflex terminal concluding in this month's issue. This has a lot of advantages in terms of convenience and the quality of the display you get, which is no small consideration when you plan to stare at the screen for a while. The latter is a very cheap way to get onto the BULL, and all the other BBS systems around the continent, and is ideal if you don't have a full blown microcomputer to use as a terminal and don't feel like buying one just now.

On the other hand, we suspect that there are those of our readers who do own computers, and many of these will be quite suitable for use as terminals with the proper software. Terminal software is just a program to send and receive characters from whatever port you've hung your modem on and display them in a useful manner on the tube while also dealing with the keyboard. If you check out our terminal project, you will note that there are enhancements to this concept, but this is the basic trip.

Here are some of the systems that lend themselves to becoming terminals, and what is required to do them up. Please note that most of these haven't been tried here, and we aren't in a particularly good position to advise readers on bizzare combinations (e.g., how can I connect my 1802 perfboard Elf to a Hayes Smartmodem).

PET/CBM You can attach a modem to a PET through either the IEEE-488 bus connector or the user port with a simple adaptor. Note that these ports run at TTL levels, while regular modems are RS-232-C. An interface or a TTL level modem is called for. Terminal software for upgraded ROM PETs was written by a dude named Steve Punter, who runs a BBS of his own. It should be available through Commodore. It was published in their Transactor magazine, reprints of which might still be had.

Radio Shack Models I and III can use either TERM or STERM, TERMinal or Smart TERMinal, plus a modem. The Model III has an RS-232 port option which can drive a regular modem with no hassle. Model II's have a terminal program included with the DOS.

Apple requires a serial interface card to be plugged into one of the main board slots in order to be able to drive a modem. The software to drive it can be found in the June 1982 edition of BYTE.

CP/M Based Systems have a variety of programs that will serve as terminals. Most CP/M packages come with DUMBTERM, a dumb terminal. MODEM7 derivatives also function nicely as smart terminals ... in most cases, all you'll need to do is to set a few equates to adapt them to your system.

Some of the other popular computer systems, such as the Acorn ATOM and the ZX-81, do not have terminal packages available as of this writing, but they are coming. Owners of these systems should contact their distributors.

Coming On

If you try to call the BULL and get a busy signal, please call again. The system is probably not down ... it has actually only crashed twice ... but just busy. When the BULL is on line, it is generally waiting between calls for less than three minutes, so you may have to try quite a few times to get on.

When using the system, you should avoid sending untoward control characters ... CTRL Z, C and S are the only ones the system can make sense of. Also, you'll find that if you try any commands other than those listed, you'll get an error message for your trouble.

There is actually fairly little involved in using the BULL, and most of that will be explained as you go. So dig out that serial connector you made out of old lamp cord, warm up the relays in your PDP 1½ surplus computer, stick another nail in the horizontal oscillator coil of your 1952 Marconi TV set turned monitor and dial (416) 423-3265. The BULL is up from 5:00 pm to 9:00 am Monday to Thursday, and from 2:00 pm Friday until 9:00 am Monday morning, plus all day on holidays.

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ETI

Light Chaser.

FOSTEX REVIEW

The Fostex A-4 is a four track recorder for use in your favourite dungeon ... for the poorer George Martins of this world. By Steve Rimmer.

ABOUT THE TIME that the average musician trades in his Sears Les Paul copy for a second hand Tele, he (or she) begins to realize that there are finite limits to what can be done with a cassette deck ... even if it does have two speakers. One begins to hear talk about recording studios and overdubbing. Albums like Tubular Bells and The Six Wives turn up in which single players do all or most of the bits on a complex piece. There's a concept happening in this ... yes, we need more tracks!

Tape recorder tracks tend to multiply geometrically, as does the price of the machine including them. Mono recorders are usually free, or should be. From thence we go to two tracks, starting at about $500, four tracks, at $1500 and up, eight tracks at $4000 and up, sixteen tracks at numbers too huge to contemplate, and, from there, twenty four track machines using two inch tape that can only be owned by people too rich to know how to read (hence outside the scope of this article). It is very early on in this progression that most individuals run out of speculating capital ... for some, it's down there at mono machines ... and, so, the four track has become the standard for home studios. Four is the smallest number of tracks to provide track bouncing capabilities, and, if you save up and sell the dog, a four track is barely affordable.

Until a little while ago, there were very few four track systems around that weren't heavy, expensive studio deals. Most were made by TEAC in some incarnation, and, while nice and very pleasing to play with, they didn't incorporate the sort of features that made them easy to use if you were into toodling in the basement. The Fostex A-4 has come forth trumpeting to change all that ... which it does, partially.

The A-4 is a very small machine, first off ... thirteen and a half inches high by fourteen inches wide by six and three quarters inches deep, or about the size of a couple of shoe boxes. The case is plastic, rather than steel, so it's quite light, at twenty nine pounds. (These figures convert nicely into metric, but I don't). It uses seven inch reels of quarter inch tape, rather than the big ten and a half inch NAB hub deals, which it run at seven and a half and fifteen inches per second. At the time of this writing, it cost about two thousand dollars.

While fairly robust, the A-4 is decidedly a home, rather than a studio machine. However, in our testing, which was extensive ... it's fun playing around with this thing ... it didn't go wrangy even after eight or ten hours of constant use, and nothing smelled like it was burning inside.

In order to use the A-4, you need a mixer of some sort to permit monitoring the four channel outputs while you put down tracks, and, probably, a mike preamp, tone control of some sort, and whatever effects you want to add (like reverb). The machine only accepts line level signals (through rear mounted RCA phono jacks). Fostex makes a companion mixing board, the model 350, which we didn't check out.

Power Up

The tape path isn't particularly weird on the A-4, and the reel hold ons are the threading kind, which is quite convenient. You get to appreciate small things like this at two in the morning. The tape counter is a four digit LED readout which can be zero'd at any point. Thereafter, a "zero return" button automatically returns the tape to the zero position. The zero return proved accurate to +0 −2 counts, which amounts to less than three seconds at fifteen inches per second.

All of the tape movement buttons are solenoid operated, and worked real smooth like. It seems to be impossible to make the thing either break or spill the tape, even if you do gross things at very high speeds.

Other front panel buttons permit selecting the source or the tape for monitoring each channel, and setting up which channels are to be recorded. In addition, the tape monitoring can be set to either sync, playback from the record head, for overdubbing, or repro, playback from the playback head, for mixing down. There is also a switch for tape speed, and one marked EDIT to over-ride the tape tension switch and let tape spill while editing. This last is of limited usefullness, but it's small. Internal logic and cleverness makes it impossible to have the EDIT switch engaged and throw the thing into fast forward or reverse.

The other control on the front panel is the pitch control knob, which varies the speed of the tape by plus or

Continued on page 61

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APPLE III REVIEW

Picking the new Apple (mind the seeds), by Steve Rimmer.

The Apple III running Applewriter.

THERE'S THIS DISK, see, and it checks out the machine, see, and when it's done . . . it talks. It says "system normal . . . I'm okay" in a little squeeky voice from inside. They don't warn you about this function, and if you come across it on a Monday morning when you're half gone, it may damage your mind. Keep this in mind if you buy an Apple III.

The Apple II is clearly among the most popular of the small computers, and, while initially designed as a "home" system, there have been a lot of Apple II's used exclusively in business, engineering, scientific applications, and so on. However, designed many years ago, the Apple II is by no means state of the art, and, while it is still a very good home system, a credit to Mr. Wozniak, the tottering onrush of technology has made a better business system possible. As such, there has come forth the Apple III, a great white plastic brute with 128K of RAM and more stuff hanging in, on and around it than a sale at Mad Marvin's House of Tubes.

Since it's initial sallying forth, the Apple III has been plagued with problems, both hard and soft, and it has been withdrawn several times. The present incarnation, we are told, is the true and final word on the subject. While it has existed since last year, the present version has only been available for a short time . . . as such, we thought it would be a good trip to have a peer at it, and see if it's at least as much fun as the Apple II was/is.

As it turns out, this is guaranteed, as deep within the Apple III there lurks . . . among other things, an Apple II. It's intense, I know. Read on.

Hardware

The Apple III consists of the computer proper, which, while a bit unusual looking, does have some very interesting design aspects. The top doesn't pop off. The keyboard kind of juts out at one, and looks like it's detached from the rest of the machine, which it's not. The approved and blessed Apple monitor sits very comfortably on top of the main computer. The main machine has a built in 5¼ inch disk drive, with a port out the back to connect a second one externally. Also out the back is an interface for the "Silentwriter", essentially a Centronics 737 printer, a colour video connector (you can run a colour tube at the same time as the black and white one, if you feel like it) and an RS-232 port to drive a Modem, serial printer, terminal or high speed doodad. There are four openings in the back of the case, corresponding to four slots on the main board for peripheral cards . . . you can have externally accessible bits of these protruding comfortably through the back. There's also a red LED inside one of these openings, for heaven knows what reason.

Four slots may seem a bit skimpy, as compared to the eight found on the Apple II, but when you consider that the most common bits seen stuck into these slots in an Apple II, a Widex card, 16K RAM card and a serial interface card, are not really needed on the Apple III, this allotment seems adequate.

Possibly there are trolls in there.

The keyboard of the Apple III is certainly a good quality one, and is very pleasant to bang away on. It has auto repeat that is set with about the right delay for normal use. Aside from the usual QWERTY array, there's a numeric keypad and cursor control keys. There's also a pair of special function keys, with little half eaten apples on them, an alpha lock switch, four cursor position keys and a recessed RESET button. The only thing the keyboard lacks is a dedicated destructive backspace . . . a delete . . . which requires that one cursor left and type over to rub out. Not a major hassle, all told.

The main machine runs on a 6502B processor with variable clock speeds . . . neat, huh . . . which average out at about one and a half megahertz. In addition to the usual 6502 instructions, this system adds additional instructions external to the processor, which is certainly technological whether or not it does anything useful. It comes with 128K of RAM, which is bank selectable . . . you may have been wondering how you do this on an eight bit chip. This can be expanded internally, without

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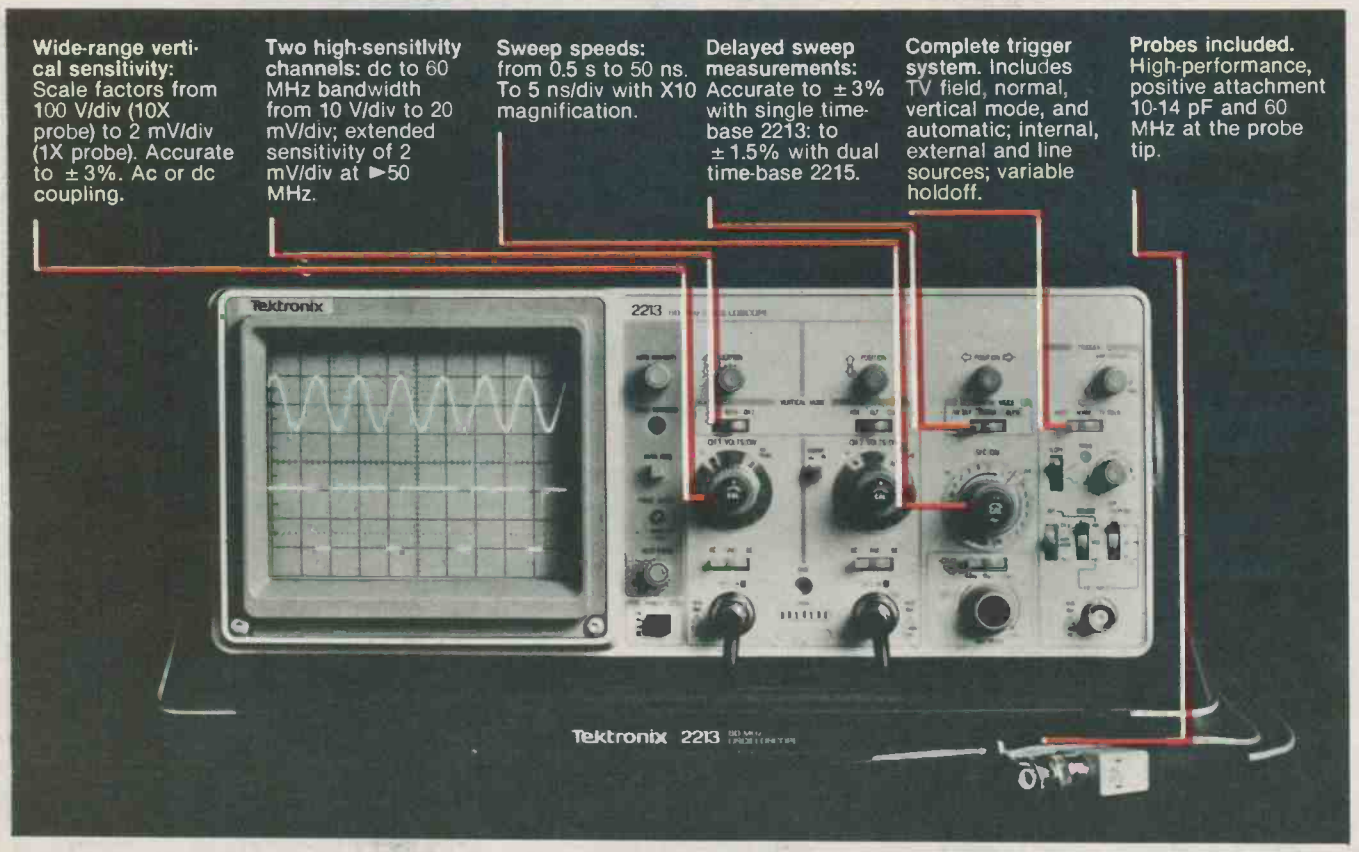

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using up a peripheral slot, to 256K, and, presumably, up to 512K if you really want to. This, among other things, appears to have provided some intrepid programmer with enough RAM to allow it to speak short phrases through its internal speaker. More practical applications will be found in word processing, graphics and spreadsheet and sorting programs.

The Apple III does not have BASIC in a ROM . . . in fact, there's only one ROM in the whole mess, and it just holds the boot up routine, diagnostics and a mysterious machine language monitor that the boys who wrote the documentation seem to have missed out on. Whatever language you use must be loaded in from the disk. This isn't that far removed from the Apple II, which, while it has BASIC in ROM, almost always ran with a disk BASIC or other system.

As for the mysterious monitor, there's no mention made of it anywhere, although it's quite powerful, and useful if you want to do some low level carpet crawling. It can be entered by depressing the CONTROL and the OPEN APPLE keys simultaneously, and then hitting the reset. It has a number of nice features, such as a dump facility which displays ASCII beside the HEX.

Finding this sort of stuff is one of the joys of playing with larger systems.

The Apple III's screen is basically a 40 by 24 deal, just like that of the Apple II. However, under control of the primary BASIC package, it becomes 80 by 24, with definable characters, lower case and the whole trip. The standard characters are pleasing to look at, and the monitor Apple offers to go with the machine is heavily non-glare and watchable for extended periods. The Business BASIC disk comes with four additional character styles, or fonts, which can easily be substituted for the standard character set, but these are pretty much of a basket case, as, while interesting, they are very hard to read. A better application of this capability is in defining specialized characters. It will be found that there are a number these already available in the standard set's range.

The physical construction of the Apple III *seems* pretty tight, and the whole system appears pretty rugged. However, the system which we had for review was rather frought with hardware bugs, probably due to loosening chips. Brute physical violence, such as thumping it in rage, often cured the various difficulties that these things caused, but it was not uncommon for the thing to fink out after half an hour, cheerfully dumping whatever one was working on at the moment. The ROM diagnostic function has a number of built in messages which come up at times like these . . . including ROM ERROR: CONTACT YOUR DEALER.

We are, in fact, prepared to consider that the hardware problems we encountered with the Apple III were restricted to our sample, as review machines tend to get the stuffing kicked out of them as they get bounced from one lucky soul to the next. However, prospective owners of the Apple III will want to ensure that they have a long "no questions asked" return option on the system should this crop up. Loose chips was, in fact, one of the reasons the earlier versions of the Apple III were recalled, and the sorts of things that dealers do in these cases, cleaning the pins, crimping the sockets, and so on does not cure the fault, and usually only buys time.

The hardware documentation that comes with the Apple III . . . system locations, useful ROM routines, page zero registers used and so on . . . is hard to comment on as it doesn't seem to exist. This is a drag for those into creating software, but of little consequence to those who just want to run software that already exists, or write programs in

BASIC or PASCAL. In reality, the Apple III is aimed predominately at the latter of these two groups, so this cannot really be considered a deficiency. Still, you wonder why . . .

Software

We got so much software for this thing . . . my desk is littered with disks.

The first thing one checks out when one turns one of these things on, after running the system demonstration to see all the pretty colours, is the BASIC package. The primary BASIC for the Apple III is called Business BASIC, although, using the APPLE II emulator disk . . . we'll get to that . . . Applesoft and Interger BASICs can be used. The Business BASIC is, to say the least, huge.

The documentation for Business BASIC is, in the typical Apple style, exhaustive . . . it may be a bit too detailed if you already know the language, occupying two manuals for a total of 335 pages. A third, overview manual would have been a nicer trip. What the manuals do lack are example programs for some of the unusual features of the BASIC, which would be very helpful in understanding some of this stuff.

The BASIC is very powerful, but also a bit weird in the way it handles some of the more involved functions. In many cases, such as renumbering the BASIC text, or using the graphics modes, one has to use the INVOKE command to call up a secondary file from the disk and run it. This has both advantages and disadvantages. First off, the process of drawing a frame around the screen becomes vastly complex, and debugging these things is none too easy. It slows down program execution for programs using these functions, as disk accesses are required to get everything up and flying. The explanation of these routines is not exactly lucid in the manual.

However, this approach does permit the BASIC proper to be considerably smaller than it would be if all the functions were included in it . . . of benefit, as, in most situations one wouldn't be using anywhere near all of them. Furthermore, whereas rewriting BASIC itself is probably not the sort of task one would like to undertake on a Sunday afternoon, updating these things or, in fact, creating new ones, is quite within the capacity of human reason. The INVOKE command used to call these routines is an unusually simple way of interacting with machine code routines.

The Business BASIC is a very complex little troll. It can handle intergers in the range of plus or minus 9223372036854775808 or there abouts, 19 digits total. Large nasty real numbers can use exponential notation, and can live in the range –1.7E38 to 1.7E38. It is not fast, by any means, but, using the speedier 6502B processor, its speed is similar to that of Applesoft, even though it's rather bigger.

The following are a few of the less common functions found in the Apple III's Business BASIC.

BUTTON(x) returns the state of an external button connected to one of the Apple's external ports. Likewise, there's PDL(x) for paddles.

CHAIN is like RUN but it doesn't disturb the values of the variables set by the previous program. It causes the specified program to be loaded from disk, and executed, but the new program will be able to use all the values set by the old one. This is good for breaking up large routines into lots of little ones, and obviates the need for setting up disk files to store the common data.

ENGRSPEC formats data into engineering specification notation. Similarly, there's SCISPEC, for scientific notation, and a more flexible FIXSPEC, which is adjustable.

EXFN is a bit like the more familiar USR(x) function, in that it executes a machine language routine loaded by INVOKE and then returns the value generated by the routine.

HPOS and VPOS return the cursor position, or can load a value for the cursor position, depending upon what side of the equal sign they're on.

INDENT . . . get this . . . defines the indent spacing for the listing of FOR NEXT loops to make them look nicer.

INSTR looks for a substring within a string and returns the number of characters along it is if it finds it.

KBD contains the character code of the last key struck.

LOCK and UNLOCK do a software write protect on specified disk files, pre-empting their accidental erasure.

POP removes the outermost subroutine pointer from the stack, permitting one to jump out of a loop without properly ending it. This can be very useful, and save a lot of time.

The Business BASIC package is not the friendliest BASIC I've encountered, although it's not nearly so gross as some. To edit, for example, one hits the escape key, cursors up to

ETI FACT FILE

Manufacturer:	Apple
Area of interest:	Business
Processor:	6502B
Screen size:	11"
Graphics:	up to 560 x 192 high resolution
Sound:	one channel
Display:	external monitor
Mass Storage:	1 5¼ inch disk SSDD
RAM:	128K
Number of keys:	74
Printer included:	No
Software included:	SOS
ROM pack facility:	No
RS-232 Port:	Yes
Parallel Port:	Yes
Printer interface:	Yes
DOS:	SOS
Number of units:	2
Documentation:	Extensive Mannuals
Price:	$6475 + BASIC ($250) + Monitor ($375)

ETI'S EVALUATION

We have evaluated our sample on a scale of one (poor) to five (exceptional). In making our assessment we have taken into account the class of user to which the computer is marketed.

Mechanical construction	● ●
Overall ease of use	● ● ●
Speed of operation	● ● ●
Software	● ● ● ●
Graphics capability	● ● ● ●
Suitability for beginners	●
Suitability for business	● ● ● ●
Manuals and instructions	● ● ● ●

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the line to be edited, hits the escape again, does the change, cursors to the end of the line and then hits ENTER to get the line into the input buffer (shades of the Acorn ATOM). A subsequent return wipes out the next line on the screen . . . it's not disturbed in RAM, of course, but it will usually require relisting the program after each edit.

The error handling aspects of the BASIC seemed to be pretty good, with English, as opposed to numeric, error messages.

All told, except for the frequent necessity of resorting to complex I/O to invoke the BASIC's more interesting features, this package was quite decent to use, and would most likely be suitable for any business-type situation where in one would want to create cheap custom software.

There is a second package, called Business Graphics, which can be used to create and store the usual sorts of charts, diagrams and other computer generated pictures normally associated with office, engineering and scientific presentations without going to the complexity of writing BASIC programs to produce them. This is quite well done . . . very speedy . . . and does extremely nice work with a minimum of typing.

The Applewriter III is the system's dedicated word processor. It's not a bad little sort, really. It's a bit complex to get into, and requires a bit more manual flipping to get all the functions together than one might like. I am a bit pre-disposed towards Wordstar, for CP/M machines, however. I think that if one got used to Applewriter it would be just as effective. Like most word processors, it has a good selection of features, almost all of which are too esoteric ever to be used, which is probably as it should be.

The Applewriter has a fairly complex HELP menu structure, which, after some playing, makes reasonable sense. It does not appear to do on-screen justification, which is a bit of a drag . . . I like this feature. However, it has several other nifties not found in many other word processors. Cheifly useful among these is a glossary, which permits frequently used phrases to be stored and thereafter inserted in a document by typing a control G and a single letter. It is interesting to note that the examples of the use of this function given in the manual give as the sample glossary entries Apple Computer, Inc, Signetics, Inc and Texas Instruments, Inc. If you had previously wondered whether engineers wrote the manuals . . .!

The Applewriter, along with the standard 128K complement of RAM in the Apple III, permits documents of up to about 64K in length.

There is also a Visicalc package available for the Apple III, and a mailing list system, neither of which we dug into too deeply. Both, however, ran . . . there isn't very much you can do to these things.

Another bit of software that calls for mention is the Apple II emulation disk. It permits the running of either Apple soft or Interger BASIC programs, and will deal with Apple II peripherals as well. Thus, the system can use the already existing library of Apple software.

Pick an Apple?

Now for the ultimate question . . . do you want an Apple III. Wouldn't you rather have a Lotus Europa with a racoon tail dangling from the antenna? Hmmm . . .

The Apple III is clearly a business oriented system, with all the bells and whistles tuned up for the software user, as opposed to the software writer. As a business system, it seems to be quite good. The software currently available for the Apple III is all from Apple . . . which is good, as it ensures that it's first rate stuff, but a bit worrysome, as there is only a limited amount of stuff they're likely to write. However, by the time this article reaches you, there may well be eight thousand software houses climbing lythly upon the bandwagon, obviating this concern.

While lacking the software flexibility of the CP/M based systems, the Apple III is speedier in many applications, and much of what it does is just "nicer". Some CP/M based deals, such as the if 800 we looked at last month, do have high resolution graphics, but, as yet, this software is no more transportable than that of the Apple, as everyone has different standards. The high res drivers don't operate through the CP/M BIOS, and, as such, are system dependant. None of the CP/M systems seem to have anything like the level of sophisticated software for graphics that the Apple III crops up here and there, and, if pretty pictures are a major consideration in buying a computer, the Apple III would certainly be a good choice.

Likewise, for many scientific, engineering and business applications, the Apple III's Business BASIC has more useful bells and whistles than do the usual MBASIC and BASIC-80 trips.

All told, the Apple III is an impressive beast, not without its problems, but certainly possessed of many good bits as well. If you need a large, brutish powerful system, it is certainly worth checking out.

ETI

A Word About Our Reviews

Every month, we have the pleasant task of choosing which computer we're going to review. For every one you see, we usually decide against two or three. It's our opinion that there is fairly little point in reviewing bad systems . . . if you read a bad review of a computer, you are probably not likely to buy it. However, this has brought you no closer to finding the one you *do* want . . . which is really what reviews are supposed to be for.

The Apple III with its Silentype printer.

ETI Intelligent Terminal part II

This month, the construction details of the Intelligent Terminal project are unveiled. Gentlemen, start your soldering irons. By Steve Rimmer.

LAST MONTH, as you will recall, we left the ETI/Multiflex terminal poised on the edge of the cliff, struggling with the evil doctor Moriarity, edging ever closer to the brink and certain doom. Continuing with our tale, we now find the single board system on a new table in the little room at the end of the hall at ETI Magazine connected to a monitor. How did it get there? A mystery!

This month, we present the construction details of the project.

Despite the amazing capabilities of the terminal, and the large number of parts involved, getting the thing together isn't much more complicated than doing a medium sized amp. The PCB has been very carefully designed to keep the traces as far apart as possible to minimize solder bridges, and everything's screened and obvious. All the usual mistakes were made in developing this thing, so you can avoid them.

First, solder in the keyboard, and the optional keys if you want them. See last month's article for an explanation of what these do. Be careful that the keys are sitting flush with the board ... it'd be a pain to have to try to pry the whole mess loose at a later time ... actually, it'd probably be impossible.

Next, install the IC sockets. It's handy, but not essential, if these go in the right way round, as it makes getting the IC's in correctly a bit easier ... which is essential. Don't put in the chips just yet.

The little bitsies, transistors, resistors and capacitors, go on pretty well as you'd expect. Make sure the polarized things are cool. These are actually just a couple of electrolytics, as there aren't any diodes. The transistors also want a second check to make sure they're on right. These sorts of things can cause a lot of hassle later on.

Next, solder in the two crystals, making sure you get them in the right spaces. The large two magaHertz one goes in nearest the CPU. When soldering these, make sure you heatsink the leads, lest you fry them ... they're fairly sensative to extreme warmth.

Solder in all the on board pins, and a video output lead. Put the RS-232 connectors in place. Note that these live on the underside of the board! Put'em in the wrong way and you might as well go home.

Lastly, install the trimmer pots. If you have sprung for the onboard power supply option, install these bits as well. Otherwise, proceed to the great plugging in.

Termination

The next step is the plugging in of the ICs. This is fairly painless if you make sure that you are putting the right chips in the right holes, and that they are going in the right way round. Don't fold the pins under the ICs ... an easy thing to do. There are several EPROMs in the project. It is, of course, essential that these wind up in the right sockets. They are clearly marked.

Finally, install the jumpers. These are little push-on deals that fit over pins on the board to select the various options and things. Configure them as shown for now ... once you figure out what you're doing, you can move them around if you want to.

The moment of truth has, thus, arrived. It is time to turn the project on. With the video output lead fed into a monitor, you should get a cursor of some description. There are a few pots to twiddle before the system will

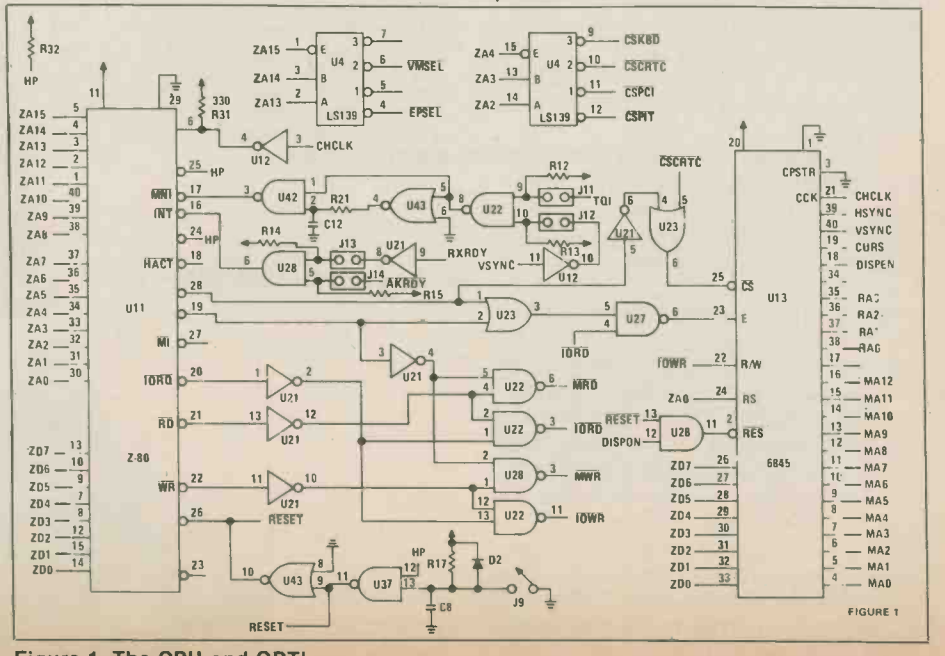

Figure 1. The CPU and CRTL.

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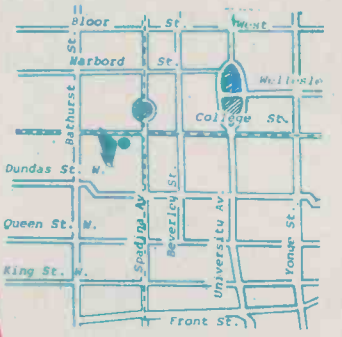

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Months have gone into the preparation of this catalog, and I hope the information included in it is of some value to you.

Yours sincerely,

Eugen F. Hutka

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182	— —	1.75	2.19	— —	LOOK-AHEAD CARRY GENERATORS
183	— —	3.30	— —	— —	DUAL CARRY-SAVE FULL ADDER
184	3.31	— —	— —	— —	BCD TO BINARY CODE CONVERTERS
185	2.87	— —	— —	— —	BINARY TO BCD CODE CONVERTERS
186	— —	— —	— —	— —	512 BIT PROGRAMMABLE ROM
187	— —	— —	— —	— —	1024 BIT ROM
188	— —	— —	3.95	— —	256 BIT PROGRAMMABLE ROM
189	3.20	6.20	3.95	— —	64 BIT RAM
190	1.26	1.20	— —	— —	SYNCHRONOUS BCD UP/DOWN COUNTERS
191	1.26	1.16	— —	— —	SYNCHRONOUS BINARY UP/DOWN COUNTERS
192	.98	1.00	— —	1.85	SYNCHRONOUS BCD UP/DOWN DUAL CLOCK COUNTER W/CLEAR
193	.98	1.00	— —	1.85	SYNCHRONOUS BINARY UP/DOWN DUAL CLOCK COUNTER W/CLEAR
194	1.12	1.00	— —	— —	4 BIT BIDIRECTIONAL UNIVERSAL SHIFT REGISTERS
195	.74	.75	1.77	— —	4 BIT PARALLEL ACCESS SHIFT REGISTER
196	1.10	1.10	3.75	— —	PRESETTABLE DECADE COUNTER/LATCH
197	1.10	1.10	2.65	— —	PRESETABLE BINARY COUNTER/LATCH
198	1.98	— —	— —	— —	8 BIT BIDIRECTIONAL UNIVERSAL SHIFT REGISTER
199	1.98	— —	— —	— —	8 BIT BIDIRECTIONAL UNIVERSAL SHIFT REGISTER

TTL IC's

SUFFIX DEVICE (XX)	74XX PRICE	74LSXX PRICE	74SXX PRICE	74CXX PRICE	DESCRIPTION
201	—	—	—	—	256 BIT RAM
221	1.30	1.30	8.00	2.30	DUAL MONOSTABLE MULTIVIBRATOR
225	—	—	—	—	ASYNCHRONOUS FIRST IN FIRST OUT MEMORIES (FIFO)
226	—	—	—	—	4 BIT PARALLEL LATCHED BUS TRANSCEIVER (TS)
240	—	1.60	2.47	—	OCTAL BUFFER/LINE DRIVER/LINE RECEIVER
241	—	1.60	2.45	—	OCTAL BUFFER/LINE DRIVER/LINE RECEIVER
242	—	1.60	3.20	—	QUAD BUS TRANSCEIVER (TS)
243	—	1.60	3.20	—	QUAD BUS TRANSCEIVER (TS)
244	—	1.70	3.79	—	OCTAL BUFFER/LINE DRIVER/LINE RECEIVER
245	—	2.70	—	—	OCTAL BUS TRANSCEIVER (TS)
246	—	—	—	—	BCD TO 7 SEGMENT DECODER/DRIVER
247	—	1.60	—	—	BCD TO 7 SEGMENT DECODER/DRIVER
248	2.50	1.60	—	—	BCD-TO 7 SEGMENT DECODER/DRIVER
249	2.50	1.60	—	—	BCD TO 7 SEGMENT DECODER/DRIVER
251	2.36	.95	1.22	—	DATA SELECTOR/MULTIPLEXER
253	—	.94	2.24	—	DUAL DATA SELECTOR/MULTIPLEXER
257	—	.95	1.25	—	QUAD DATA SELECTOR/MULTIPLEXER
258	—	1.05	1.25	—	QUAD DATA SELECTOR/MULTIPLEXER (TS)
259	—	1.20	—	—	8 BIT ADDRESSABLE LATCH
260	—	1.80	.98	—	DUAL 5 INPUT NOR
261	—	—	—	—	2 BIT BY 4 BIT PARALLEL BINARY MULTIPLIER
265	—	—	—	—	QUAD COMPLEMENTARY OUTPUT ELEMENTS
266	—	.55	—	—	QUAD 2 INPUT X-NOR (OC)
270	—	—	—	—	2048 BIT ROM
271	—	—	—	—	2048 BIT ROM
273	2.70	1.60	2.75	—	OCTAL D-TYPE FLIP-FLOPS W/COMMON CLOCK
274	—	—	—	—	4 BIT BY 4 BIT BINARY MULTIPLEIER (OC(
275	—	—	—	—	7 BIT SLICE WALLACE TREE
276	1.60	—	—	—	QUAD J-K FLIP-FLOP W/SEPERATE CLOCKS/COMMON CLEAR & PRESET
278	4.00	—	—	—	4 BIT CASCADEABLE PRIORITY REGISTERS
279	.95	.60	—	—	QUAD S-R LATCH
280	—	2.70	2.79	—	9 BIT ODD/EVEN PARITY GENERATOR/CHECKER
281	—	—	17.95	—	4 BIT PARALLEL BINARY ACCUMULATORS
283	1.60	1.10	3.95	—	4 BIT BINARY FULL ADDERS
284	4.95	—	—	—	4 BIT BY 4 BIT PARALLEL BINARY MULTIPLIER (USED W/285)
285	4.95	—	—	—	4 BIT BY 4 BIT PARALLEL BINARY MULTIPLIER (USED W/284)
287	—	—	2.50	—	1024 BIT PROGRAMMABLE ROM
288	—	—	2.50	—	256 BIT PROGRAMMABLE ROM
289	—	—	—	—	64 BIT RAM
290	1.29	1.19	—	—	DECADE COUNTER
293	1.30	1.19	—	—	4 BIT BINARY COUNTER
294	—	—	—	—	4 BIT BIDIRECTIONAL UNIVERSAL SHIFT REGISTER
298	—	1.30	—	—	QUAD 2 INPUT MULTIPLEXER W/STORAGE
299	—	2.87	—	—	8 BIT BIDIRECTIONAL UNIVERSAL SHIFT/STORAGE REGISTER
301	—	—	6.50	—	256 BIT RAM
323	—	6.95	—	—	8 BIT BIDIRECTIONAL UNIVERSAL SHIFT/STORAGE REGISTER
340	—	—	—	—	OCTAL BUFFER/LINE DRIVER (TS)
341	—	—	—	—	OCTAL BUFFER/LINE DRIVER (TS)
344	—	—	—	—	OCTAL BUFFER/LINE DRIVER (TS)
348	—	2.50	—	—	8 LINE TO 3 LINE PRIORITY ENCODER
351	3.50	—	—	—	DUAL 8 LINE TO 1 LINE DATA SELECTOR/MULTIPLEXER
352	—	1.69	—	—	DUAL 4 LINE TO 1 LINE DATA SELECTOR/MUTLIPLEXER
353	—	1.75	—	—	DUAL 4 LINE TO 1 LINE DATA SELECTOR/MULTIPLEXER (TS)
365	.76	.85	—	—	HEX BUS DRIVER (TS)
366	.79	.85	—	—	HEX BUS DRIVER (TS)
367	.76	.80	—	—	HEX BUS DRIVER (TS)
368	.76	.80	—	—	HEX BUS DRIVER (TS)
370	—	—	—	—	2048 BIT ROM
371	—	—	—	—	2048 BIT ROM
373	—	2.60	3.50	—	OCTAL D-TYPE LATCH
374	—	2.50	3.00	—	OCTAL D-TYPE FLIP-FLOP
375	—	.85	—	—	4 BIT BISTABLE LATCH
376	—	—	—	—	QUAD J-K FLIP-FLOP
377	—	1.79	—	—	OCTAL D-TYPE FLIP-FLOP
378	—	1.70	—	—	HEX D-TYPE FLIP-FLOP
379	—	1.79	—	—	QUAD D-TYPE FLIP-FLOP
381	—	—	—	—	ARITHMETIC LOGIC UNIT/FUNCTION GENERATOR
386	—	.49	—	—	QUAD 2 INPUT XOR
387	—	—	2.50	—	1024 BIT PROGRAMMABLE ROM
390	—	1.95	—	—	DUAL DECADE COUNTER
393	2.25	1.95	—	—	DUAL 4 BIT BINARY COUNTER
395	—	—	—	—	4 BIT UNIVERSAL SHIFT REGISTER (TS)
398	—	2.40	—	—	QUAD 2 INPUT MULTIPLEXERS W/STORAGE
399	—	1.30	—	—	QUAD 2 INPUT MULTIPLEXER W/STORAGE
412	—	—	—	—	MULTI-MODE BUFFERED 8 BIT LATCH
425	—	—	—	—	QUAD GATE
426	—	—	—	—	QUAD GATE
428	—	—	—	—	SYSTEM CONTROLLER FOR 8080A
438	—	—	—	—	SYSTEM CONTROLLER FOR 8080A
440	—	—	—	—	QUAD TRIDIRECTIONAL BUS TRANSCEIVER (OC)
441	—	—	—	—	QUAD TRIDIRECTIONAL BUS TRANSCEIVER (OC)
442	—	—	—	—	QUAD TRIDIRECTIONAL BUS TRANSCEIVER (TS)
443	—	—	—	—	QUAD TRIDIRECTIONAL BUS TRANSCEIVER (TS)
444	—	—	—	—	QUAD TRIDIRECTIONAL BUS TRANSCEIVER (TS)
448	—	—	—	—	QUAD TRIDIRECTIONAL BUS TRANSCEIVER (OC)
470	—	—	—	—	256 8-BIT WORD PROGRAMMABLE ROM
471	—	—	—	—	256 8-BIT WORD PROGRAMMABLE ROM (TS)
472	—	—	6.50	—	PROGRAMMABLE ROM (TS)
473	—	—	—	—	PROGRAMMABLE ROM (OC)
474	—	—	8.50	—	PROGRAMMABLE ROM (TS)
475	—	—	—	—	PROGRAMMABLE ROM (OC)
481	—	—	—	—	4 BIT SLICE PROCESSOR ELEMENT
482	—	—	—	—	4 BIT SLICE PROCESSOR ELEMENT
490	—	2.75	—	—	DUAL DECADE COUNTER
624	—	—	—	—	VOLTAGE CONTROLLED OSCILLATORS
625	—	—	—	—	DUAL VOLTAGE CONTROLLED OSCILLATORS
626	—	—	—	—	DUAL VOLTAGE CONTROLLED OSCILLATORS
627	—	—	—	—	DUAL VOLTAGE CONTROLLED OSCILLATORS
628	—	—	—	—	VOLTAGE CONTROLLED OSCILLATORS
629	—	5.50	—	—	DUAL VOLTAGE CONTROLLED OSCILLATORS
630	—	—	—	—	16 BIT ERROR DETECTION/CORRECTION CIRCUIT
631	—	—	—	—	16 BIT ERROR DETECTION/CORRECTION CIRCUIT (OC)
670	—	1.70	—	—	4 BY 4 REGISTER FILE

Memories

For current pricing on memory check our ad each month in ETI

STATIC RAMS

2101	250nS	256x4	22 PIN	4.69
2102L	250nS	1Kx1	16 PIN	2.19
2114	450nX	1Kx4	18 PIN	1.49
2114L	200nS	1Kx4	18 PIN	1.95
2149-045	45nS	1Kx4	18 PIN	15.75
2016	150nS	2Kx8	24 PIN	9.95
6116	150nS	2Kx8 CMOS	24 PIN	10.95
6116L	150nS	2Kx8 CMOS	24 PIN	14.95

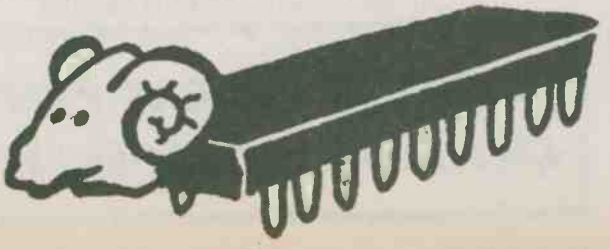
TTL PROMS listed in TTL above.

DYNAMIC RAMS

4116	200nS	1.95	16Kx1
4116	300nS	1.70	16Kx1
2118	200nS	7.85	16Kx1
2118	120nS	9.50	16Kx1
			SINGLE 5V
			SUPPLY
4164	200nS	9.95	64Kx1
4164	150nS	12.95	64Kx1
4164	120nS	15.95	64Kx1
41256	150nS	*	256Kx1

EPROMS

2708	1Kx8	450nS	6.95
2716	2Kx8	450nS	5.50
2716	2Kx8	350nS	7.50
2732	4Kx8	450nS	8.95
2732A	4Kx8	350nS	11.50
2532	4Kx8	450nS	9.95
2764	8Kx8	450nS	18.95
2564	8Kx8	450nS	36.95
27128	16Kx8	450nS	*



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LM302	Voltage Follower	4.20
LM306	Voltage Corparator	5.80
LM307	Op Amp	1.37
LM308	Precision Op Amp	1.90
LM310	Voltage Follower	2.63
uA311	Voltage Comparator	1.70
LM312	Op Amp	3.75
LM316	Op Amp	*
LM318	Precision High Speed Op Amp	3.09
LM319	High Speed Daul Comparator	3.60
LM321	Precision Amplifier	6.47
LM324	Quad Single Supply Op Amp	0.72
LM339	Quad Single Supply Comparator	0.72
LM343	High Voltage Op Amp	6.88
LM344	High Voltage Slew Rate Op Amp	*
LM346	Programmable Quad Op Amp	2.99
LM348	Low Power quad 741 Type Op Amp	1.40
LM349	Low Power Quad 741 Type Op Amp	1.40
LM355	JFET Input Op Amp	1.29
LF356	General Purpose J-FET Input Op Amp	1.29
LF357	20 MHz JFET Input Op Amp	1.29
LM358	Dual Verison of LM324 Quad	0.74
LM377	Dual 2 Watt Audio Power Amp	2.59
LM378	Dual 4 Watt Audio Power Amp	3.33
LM379	Dual 6 Watt Audio Power Amp	4.31
LM380	2 Watt Audio Power Amp	1.50
LM381	Low Noise Dual Preamp	2.25
LM382	Low Noise Dual Preamp & Resistors	1.82
LM386	Low Noise Audio Power Amp	0.99
LM387	Low Noise Dual Preamp	*
LM393	Dual Version Of LM339	1.77
LM555	Timer	0.41
LM556	Dual Timer	.80
LM558	Quad Timer	2.95
LM565	Phase Locked Loop	*
LM567	Tone Decoder Phase Locked Loop	1.35
uA709	General Purpose Op-Amp	0.83
uA711	Dual Channel Differential Comparator w/Strobes	1.72
LM725	Instrumentation Op-Amp	4.13
LM733	Differential Video Amp	1.19
LM734	Precision Voltage comparator	*
LM739	Stereo Pre Amp	1.89
LM741	8 Pin DIP Frequency Compensated Op Amp	0.42
LM741	14 Pin DIP Frequency Compensated Op Amp	0.84
LM747	Dual 741	0.91
LM748	High Performance Op Amp	0.75
LM749	Dual Audio Pre Amp	2.15
LM757	Gain Controlled IF Amplifier	*
LM759	Op Amp	2.15
LM760	High Speed Differential Comparator	*
LM771	Op Amp	*
LM776	Op Amp	2.95
LM798	Op Amp	1.89
LM802	8 Bit Multiplying D to A	*
LM1372	Colour Video Modulator	4.31
LM1405	A-D Converter Sub System	9.70
LM1408L8	8-Bit Multiplying D to A Converter	4.69
MC1439	High Slew Rate Op Amp	2.84
MC1456	High Performance Op Amp	1.72
LM1458	Dual 741	0.85
LM1488	Quad RS-232 Line Driver	0.85
LM1489	Quad RS-232 Line Driver	0.85
LM1495	Four Quadrant Multiplier	5.74
LM1496	Modulator/Demodulator	4.00
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LM1712	Wideband DC Amp	*
LM1733	Differential Video Amp	*
LM1741	General Purpose Op Amp (741)	*
LM147	Dual 741	*
LM1776	Programmable Op Amp	*
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LM1830	Fluid Level Detector	*
LM1889	Video Modulator	*
ULN2001	Darlington Transistor Array	*
ULN2002	Darlington Transistor Array	1.49
ULN2003	Darlington Transistor Array	1.49
ULN2004	Darlington Transistor Array	1.89
LM2904	Low Power Dual Op Amp	1.10
LM2917	Frequency To Voltage Converter	*
LM3046	Transistor Array (3 NPN & DIFF)	1.19
LM3054	Dual Differential Amp Array	*
LM3083	NPN Transistor Array	*
LM3084	PNP Transistor Array	*
LM3086	NPN Transistor Array	0.89
LM3130	COS/MOS Op Amp	*
LM3140	Mosfet Input/Bipolar Output Op Amp	*
LM3301	Quad Single Supply Op Amp	0.73
LM3468	Dual Low Power Op Amp	*
LM3476	Programmable Op Amp	*
LM3900	Quad General Purpose Amp	1.10
LM3905	Precision Timer	*
LM3909	LED Flasher	*
LM3911	Temperature Controller	*
LM3914	Linear Dot/Bar Display Driver	*
LM3915	Logarithmic Dot/Bar Display Driver	*
LM4136	Quad 741 Op Amp	1.32
LM4250	Programmable Op Amp	*
LM4558	Dual High Slew Rate Op Amp	*
LM4739		

Exar

PART NO.	PRICE	DESCRIPTION	PACKAGE STYLE
		PHASE-LOCKED LOOPS	
XR210CP	6.30	FSK Modulator/Demodulators	16 PIN-DIP
XR215CP	6.30	High Frequency Phase-Locked Loop	16 PIN-DIP
XR2212CP	6.52	Precision Phase-Locked Loop	16 PIN-DIP
XR2567CP	4.11	Dual Monolithic Tone Decoder	16 PIN-DIP
		FUNCTION GENERATOR	
XR205CP	12.63	Monolithic Waveform Generator	16 PIN-DIP
XR2206CP	4.55	Monolithic Function Generator	16 PIN-DIP
XR2207CP	4.26	Voltage-Controlled Oscillator	14 PIN-DIP
XR2209CP	5.76	Precision Oscillator	8 PIN-DIP
XR2242CP	2.28	Precision Waveform Generator	14 PIN-DIP
		TIMING CIRCUITS	
XRL555CP	1.72	Micropower Timing Circuit	8 PIN-DIP
XRL556CP	3.30	Dual Micropower Timing Circuit	14 PIN-DIP
XR558CP	2.60	Quad Timer Circuit	16 PIN-DIP
XR2556CP	4.81	Dual Timing Circuit	14 PIN-DIP
XR22242CP	2.28	Long Range Timer	8 PIN-DIP
		MULTIPLIERS and MODULATORS	
XR2208CP	7.81	Operational Multiplier	16 PIN-DIP
XR2228CP	3.31	Multiplier/Detector	16 PIN-DIP
		OPERATIONAL AMPLIFIERS	
XR356CP	3.17	Programmable Quad Op Amp	16 PIN-DIP
XR4202CP	6.28	Programmable Quad Op Amp	16 PIN-DIP
		DISPLAY DRIVERS	
XR2264CP	*	Pulse-Proportional Servo Circuit	14 PIN-DIP
XR2265CP	7.60	Pulse-Proportional Servo Circuit	14 PIN-DIP
XR13600	2.83	Dual Operational Transconductance Amp	16 PIN-DIP
XR2200	1.84	Hammer Driver	14 PIN-DIP

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PART NO.	UNIT PRICE	DESCRIPTION	PIN PACKAGE
TL044CN	3.10	Quad Low Power Operational Amp	16
TL061CP	.96	Op Amp, Low Power J-Fet Input	8
TL062CP	1.54	Op Amp, Low Power J-Fet Input	8
TL064CN	2.62	Op Amp, Low Power J-Fet Input	14
TL066CP	3.25	Adjustable Power J-Fet Input Op Amp	8
TL071CP	0.74	Op Amp, Low Noise J-Fet Input	8
TL072CP	1.38	Op Amp, Low Noise J-Fet Input	8
TL074CN	2.44	Op Amp, Low Noise J-Fet Input	14
TL075CN	3.45	Bi Fet Quad Op Amp Low Noise	14
TL080CP	0.67	Op Amp, J-Fet Input	8
TL081CP	0.60	Op Amp, J-Fet Input	8
TL082CP	2.25	Op Amp, J-Fet Input	8
TL083CN	1.74	Op Amp, J-Fet Input Dual Input	14
TL084CN	2.20	Op Amp, J-Fet Input Quad Input	14
TL085CN	2.32	Op Amp, Quad J-Fet Input	14
TL094CN	4.43	Programmable Version of TL084	16
TL095CN	2.75	Dual Programmable Version of TL084	16
TL096CN	2.74	Independently Programmable Version of TL084	18
TL170CLP	0.67	Bi Polar Hall Effect Switch	TO-92
TL172CLP	0.81	Normally Off Silicon Hall-Effect Switch	TO-92
TL173CLP	2.25	Linear Hall-Effect Sensor	TO-92
TL182CN	3.84	Twin SPST Bi-MOS Analog Switch (DG182)	14
TL191CN	3.84	Monolithic Analog Switch	14
TL311P	0.99	J-Fet Differential Comparators with Strobes	14
TL322CP	*	Dual Low Power Op Amps 3-36V Supply	8
TL331CP	0.67	Differential Comparator	8
TL430CLP	0.92	Adjustable Positive Voltage Regulator	TO-92
TL431CLP	1.22	Shunt Regulator	TO-92
TL441CN	3.41	Logarithmic Amplifier	14
TL489CP	1.59	Analog Level Detector	8
TL490CN	2.05	10-Step Adjustable Analog Level Detector	14
TL495CP	6.85	Switching Voltage Regulator to Boost Battery voltage from 1.5V - 9V	8
TL500CN	10.29	A/D Converter Building Block-analog	14
TL502CN	8.60	A/D Converter Building Block-Digital Processor	18
TL507CP	1.36	A/D Converter 7 Bit Resolution	20
TL604CP	1.75	P-MOS Analog Switch	8

Electrolytics

	16V	25V	35V	63V
.47uF				
1.0				.18
2.2				.18
3.3				.18
4.7	.13			
6.8			.18	
10.0		.13	.18	.20
15.0			.18	
22.0		.16		.27
33.		.16	.20	.35
47.0		.16	.21	
68				
100		.27	.24	.50
150	.48			
220		.41	.49	.74
330		.55	.58	.84
470	.45	1.02	.78	.88
680	.49		.78	
1000	.50	.78	.98	1.70
1500		1.08	1.16	2.10
2200	.99	1.1	1.30	2.98
3300		1.42	2.11	
4700	.99	2.11	2.69	

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Capacitors

CERAMIC PLATE CAPACITORS
100VDC

PART NUMBER	(pF)	TOLERANCE	PART NUMBER	(pF)	TOLERANCE
638 09188	1.8	±0.25pF	638 58151	150	±2%
638 09228	2.2	±0.25pF	638 58181	180	±2%
638 09278	2.7	±0.25pF	638 58221	220	±2%
638 09338	3.3	±0.25pF	638 58271	270	±2%
638 09398	3.9	±0.25pF	638 58331	330	±2%
638 09478	4.7	±0.25pF	630 03391	390	±10%
638 09568	5.6	±0.25pF	630 03471	470	±10%
638 09688	6.8	±0.25pF	630 03561	560	±10%
638 09828	8.2	±0.25pF	630 03181	680	±10%
638 10107	10	±2%	630 03821	820	±10%
638 10129	12	±2%	630 03102	1000	±10%
638 10159	15	±2%	630 03122	1200	±10%
638 10189	18	±2%	630 03152	1500	±10%
638 10229	22	±2%	630 03182	1800	±10%
638 10279	27	±2%	630 03222	2200	±10%
638 10339	33	±2%	630 03272	2700	±10%
638 10399	39	±2%	630 03332	3300	±10%
638 10479	47	±2%	630 03392	3900	±10%
638 10569	56	±2•	630 03472	4700	±10%
638 10689	*68*	±2%	63 VOC		
638 10821	82	±2%	629 03103	10 000	-20% +80%
638 10101	100	±2%	629 03223	22 000	-20% +80%
638 10121	120	±2%			

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FDC 1771		27.00
FDC 1791	Single/Double Density	68.00
1793	Single/Double Desnity	68.00
1795	Single/Double Density Double Sided	68.00
1797	Single/Double Density Double Sided	68.00

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COM 8116 +5 Only Version of COM 5016	13.99
4702	13.95

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AY-3-1015	6.99
A5-5-1013	6.99

R03-2513-001	64x8x5 Character Generator Upper Case	13.95
R03-2513-003	64x8x5 Character Generator Lower Case	13.95

CRT Controllers

uPD 3301	*
uPD 7220 D	122.00
uPD7220 DI	150.00

IEEE 488 Interface

uPD 7210	26.56

ADC

uPD 7001 8 Bit A/D	5.49
uPD 7002 12 Bit A/D	8.23

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Resistors

5% TOLERANCE EIA STANDARD VALUES

Ohms	Ohms	Ohms	Ohms	Ohms	Ohms	Ohms	Ohms	Meg.
2.7	16	100	620	3.9K	24K	150K	910K	5.1
3	18	110	680	4.3K	27K	160K	Meg.	5.6
3.3	20	120	750	4.7K	30K	180K	1	6.2
3.6	22	130	820	5.1K	33K	200K	1.1	6.8
3.9	24	150	910	5.6K	36K	220K	1.2	7.5
4.3	27	160	1K	6.2K	39K	240K	1.3	8.2
4.7	30	180	1.1K	6.8K	43K	270K	1.5	9.1
5.1	33	200	1.2K	7.5K	47K	300K	1.6	10
5.6	36	220	1.3K	8.2K	51K	330K	1.8	11
6.2	39	240	1.5K	9.1K	56K	360K	2	12
6.8	43	270	1.6K	10K	62K	390K	2.2	13
7.5	47	300	1.8K	11K	68K	430K	2.4	15
8.2	51	330	2K	12K	75K	470K	2.7	16
9.1	56	360	2.2K	13K	82K	510K	3	18
10	62	390	2.4K	15K	91K	560K	3.3	20
11	68	430	2.7K	16K	100K	620K	3.6	22
12	75	470	3K	18K	110K	680K	3.9	—
13	82	510	3.3K	20K	120K	750K	4.3	—
15	91	560	3.6K	22K	130K	820K	4.7	—

1% RESISTORS ARE AVAILABLE ON REQUEST

Prices

	IN STORE		MAIL ORDER	
	1-99	100-up	1-99	100-up
¼W	.03	.02	.06	.05
½W	.06	.05	.08	.06
1W	.10	.08	.15	.12
2W	.30	.27	.35	.30
5W	.35	.30	.40	.35
10W	.60	.50	.70	.60

SIP (single in-line package)

PART #	PINS	COMMON PIN #	
6-1-XXX	6	1	0.79
8-1-XXX	8	1	0.90
10-1-XXX	10	1	0.95

XXX = Value

DUAL INLINE PACKAGE

PART #	PINS	DESCRIPTION	
4114R-001-XXX	14	7 ISOLATED RESISTORS	1.25
4114R-002-XXX	14	13 RESISTORS, PIN 14 COMMON	1.25
4114R-003XXX	14	24 RESISTORS, DUAL TERMINATOR	1.25
4116R-001-XXX	16	8 ISOLATED RESISTORS	1.25
4116R-002-XXX	16	15 RESISTORS, PIN 16 COMMON	1.25
4116R-003XXX	16	28 RESISTORS, DUAL TERMINATOR	1.25

Disc Ceramic

CERAMIC DISK CAPACITORS (1000 VOLTS)
ALL VALUES IN PICO-FARADS

3.3	5	6	6.8	7.5	8
10	12	15	18	20	22
24	25	27	30	33	39
47	50	51	56	68	75
82	91	100	120	130	150
180	200	220	240	250	270
300	330	350	360	390	400
470	500	510	560	600	680
750	820	910	1000	1200	1300
1500	1600	1800	2000	2200	2500
2700	3000	3300	3800	4000	4300
4700	5000	5800	6800	7500	8200

All Values 9 cents each

Potentiometers

Values Available

OHMS			
250	5.0K	50K	750K
500	7.5K	75K	1.0M
750	10K	100K	1.5M
1K	15K	150K	2.0M
1.5K	20K	200K	2.5M
2K	25K	250K	5.0M
2.5K	35K	500K	10M

All $1.25

Specify Linear or Log track.

Trim Pots

P.C. MOUNT MULTITURN TRIMPOTS

RESISTANCE			
10	500	10K	200K
20	1K	20K	500K
50	2K	50K	1M
100	5K	100K	2M
200			

$1.65 ea.

TRIMPOTS

RESISTANCE				
100	1000	10K	100K	1M
250	2500	25K	250K	2.5M
500	5000	50K	500K	5M

OPEN CASE 35¢
ENCLOSED CASE 85¢

Electronic Mail Service

STARTING shortly we will have an electronic mail service available for those with a modem and either a terminal (such as the MULTIFLEX Video Display Terminal) or a computer. This system will allow users to check current stock, sale pricing, and new products within our store. This will provide a quick and highly efficient method for those who require parts quickly to avoid delays due to shortages of critical components. For all orders placed on this system (totalling $100 or more) EXCELTRONIX will reimburse the consignee for the phone charges which relate directly to placing of the order. Please note that this policy does not apply to time spent researching the order on the electronic catalogue or connect time to our other bulletin boards. Watch our ad in ETI for this special phone number.

Diodes

RECTIFIER DIODES

PART #	Im	PIV	PRICE
IN4001	1A	50	.09
IN4002		100	.095
IN4003		200	.10
IN4004		400	.105
IN4005		600	.110
IN4006		800	.115
IN4007		1000	.12
IN5059	2.5A	200	.120
IN5060		400	.20
IN5061		600	.21
IN5062		800	.92
IN5400	3.0A	50	.32
IN5401		100	.34
IN5402		200	.38
IN5403		300	.27
IN5404		400	.48
IN5405	3.0A	500	.30
IN5406		600	.64
IN5408		800	.30
MR750/P600A	6A	50	.69
MR751/P600B	6A	100	.87
MR752/P600D	6A	200	.92
MR754/P600G	6A	400	1.03
MR756/P600J	6A	600	1.72
MR758/P600K	6A	800	2.18
MR760/P600M	6A	1000	2.65
IN3209	15A	100	2.01
IN3210	15A	200	2.58
IN3212	15A	400	3.65
IN3214	15A	600	5.25

Crystals

MICROPROCESSOR QUARTZ CRYSTALS
HC-33/U CASE

1.000000 MHz	1.843200 MHz
2.000000 MHz	2.097152 MHz
2.457600 MHz	3.276800 MHz
3.579545 MHz	4.000000 MHz
4.194304 MHz	

HC-18/U CASE

1.000000 MHz	2.457600 MHz
3.276800 MHz	3.579500 MHz
4.000000 MHz	4.194304 MHz
4.915200 MHz	5.000000 MHz
5.017600 MHz	5.068800 MHz
5.120000 MHz	5.185000 MHz
5.714300 MHz	5.990400 MHz
6.000000 MHz	6.144000 MHz
6.400000 MHz	6.553600 MHz
8.000000 MHz	10.000000 MHz
10.240000 MHz	11.000000 MHz
11.674000 MHz	12.000000 MHz
14.318180 MHz	16.000000 MHz
18.000000 MHz	18.432000 MHz
20.000000 MHz	20.480000 MHz
22.118400 MHz	24.576000 MHz
28.356900 MHz	48.000000 MHz

REAL-TIME CLOCK CRYSTALS
32.768 kHz

All Crystals $5.30 each

Bridge Rectifiers

OUTPUT CURRENT	1.0A	2.0A	3.0A	6.0A	10.0A	25.0A
CASE STYLE	D-43	D-44	D-45	D-46	D-34	D-34
VOLTAGE						
50	-----	2KBP005 $0.95	DBPC1005 $1.46	KBPC6005 $2.18	100JB05L $3.25	250JB06L $3.25
100	1DMB10 $0.60	-----	----	-----	100JB1L $3.25	250JB1L $3.35
200	1DMB20 $0.65	2KBP02 $1.25	KBPC102 $1.55	KBPC602 $2.35	100JB2L $3.38	250JB2L $3.45
400	1DMB40 $0.69	2KBP04 $1.50	KBPC104 $1.70	KBPC604 $2.53	100JB4L $3.51	250JB4L $3.58
600	----	2KBP06 $1.65	KBPC106 $1.87	KBPC606 $2.85	100JB6L $4.55	250JB6L $4.75

SCR'S, DIAC'S & TRIAC'S

SCR's

2N5061	800mA	60	TO-92	.67
2N5062	800mA	100	TO-92	.75
2N5063	800mA	150	TO-92	.79
2N5064	800mA	200	TO-92	.85
2N6333	2A	50	TO-39	1.97
2N6334	2A	100	TO-39	2.05
2N6335	2A	200	TO-39	2.31
2N6336	2A	300	TO-39	2.51
2N6337	2A	400	TO-39	2.73
TIC106B	5A	200	TO-220	0.79
TIC106D	5A	400	TO-220	0.85
TIC116B	8A	200	TO-220	1.59
TIC116D	8A	400	TO-220	1.65
TIC116M	8A	800	TO-220	3.66
TIC126B	12A	200	TO-220	1.75
TIC126D	12A	400	TO-220	2.25
TIC126M	12A	600	TO-220	3.68

DIACS

D3202Y	
D3202U	2A
	2A

TRIACS

PART #	Im	PIV	CASE	
TIC206B	3A	200	TO-220	1.38
TIC206D	3A	400	TO-220	1.47
TIC216B	6A	200	TO-220	1.69
TIC216D	6A	400	TO-220	1.75
TIC226B	8A	200	TO-220	1.64
TIC226D	8A	400	TO-220	1.69
TIC236B	12A	200	TO-220	1.76
TIC236D	12A	400	TO-220	1.82
TIC263B	25A	200		3.04
TIC263D	25A	400		3.96

Tantalum Capacitors

DIPPED TANTALUM CAPACITORS

uF	WORKING VOLTAGE (V)					
	3	6.3	10	16	25	35
.1	—	—	—	—	—	.27
.15	—	—	—	—	—	.27
.22	—	—	—	—	—	.27
.33	—	—	—	—	—	.27
.47	—	—	—	—	—	.27
.68	—	—	—	—	—	.27
1.0	—	—	—	—	.27	.27
1.5	—	—	—	.27	.27	.34
2.2	—	—	.27	.27	.30	.37
3.3	—	.27	.27	.30	.37	.41
4.7	.27	.27	.30	.37	.41	.54
6.8	.27	.30	.37	.40	.51	.60
10	.27	.34	.40	.51	.64	.78
15	.34	.40	.48	.52	1.10	1.73
22	.37	.48	.52	.71	1.50	2.17
33	.40	.53	.71	.19	2.22	3.34
47	.48	.53	1.10	1.91	3.33	4.50
68	.58	.69	1.91	2.20	4.82	—

THE EXCELTRONIX BULLETIN BOARD

In addition to our electronic catalogue we will also shortly have in operation a number of computer bulletin boards (all operating on MULTIFLEX products) which can be accessed by the public. These bulletin boards will allow users to swap technical advice, software techniques, and public domain software. As well computer clubs are invited to use this bulletin board to leave information on their clubs, such as time and place of next meeting, cancellations, notice of special events, etc. MULTIFLEX owners may also wish to consult this board from time to time since a special file will be set up for machine language programs and subroutines which will run on the MULTIFLEX Z-80, U of T 6809 board and the new 68000/8086 computer. There will be no charge for the use of this system however maximum connect times may be established to allow a maximum number of users access to the system. When the system is running the phone numbers will be published in our ad in ETI.

Zener Diodes

Vz VOLTS	½ Watt IN52XX	1.0 Watt IN47XX	5 Watt IN53XX	Vz VOLTS	½ Watt IN52XX	1.0 Watt IN47XX	5 Watt IN53XX
2.4	21			18	48	46	55
2.5	22			19	49		56
2.7	23			20	50	47	57
2.8	24			22	51	48	58
3.0	25			24	52	49	59
3.3	26	28	33	25	53		60
3.6	27	29	34	27	54	50	61
3.9	28	30	35	28	55		62
4.3	29	31	36	30	56	51	63
4.7	30	32	37	33	57	52	64
5.1	31	33	38	36	58	53	65
5.6	32	34	39	39	59	54	66
6.0	33		40	43	60	55	67
6.2	34	35	41	47	61	56	68
6.8	35	36	42	51	62	57	69
7.5	36	37	43	56	63	58	70
8.2	37	38	44	60	64		71
8.7	38		45	62	65	59	72
9.1	39	39	46	68	66	60	73
10	40	40	47	75	67	61	74
11	41	41	48	82	68	62	75
12	42	42	49	87	69		76
13	43	43	50	91	70	63	77
14	44		51	100	71	64	78
15	45	44	52	110	72		79
16	46	45	53	120	73		80
17	47		54				
	20¢	25¢	$1.85		20¢	25¢	$1.85

Switches

SWITCHES
MINIATURE TOGGLE

SOLDER TAIL PART#	PRICE	P.C. MOUNT PART#	PRICE	FUNCTION	ACTION
4030	2.50			SPST	ON-OFF
4031	2.70	4331	4.10	SPDT	ON-ON
4032	3.40	4332	3.80	SPDT	ON-OFF-ON
4033	4.10	4333	6.10	DPDT	ON-OFF-ON
4034	3.95	4334	5.50	DPDT	ON-ON
4231	2.90	4431	4.10	SPDT	ON-(ON)
4232	3.10	4432	4.15	SPDT	(ON)-OFF-(ON)
4233	4.50	4433	6.55	DPDT	(ON)-OFF-(ON)
4234	4.50	4434	6.55	DPDT	ON-(ON)
4235	3.50	4435	4.25	SPDT	ON-OFF-(ON)
4236	5.10	4436	6.85	DPDT	ON-OFF-(ON)

MINI-MINI TOGGLE SWITCHES

PART#	ACTION		
4050	SPST	1.90	RATED 3A
4051	SPDT	1.95	AT
4052	DPDT	2.20	125 VAC

DIP Switches

DIP SWITCHES
STANDARD AND RECESSED ROCKERS

NO. OF ROCKERS	SPST
1	—
2	—
3	—
4	$2.50
6	$3.00
8	$3.25
10	$3.50
12	—

TOGGLE SWITCH

NO. OF ROCKERS	SPST
1	—
2	—
3	—
4	—
6	$3.00
8	$3.25
10	$3.50
12	—

75 Series

75XX SERIES PERIPHERAL DRIVERS

75126	Seven Channel Line Driver	*
75127	Seven Channel Line Driver	3.57
75128	8 Channel Line Driver Active High	3.57
75129	8 Channel Line Driver Active Low	3.57

93XX SERIES

9307	7 Segment Decoder	2.95
9308	Dual 4 Bit Latch	3.25
9309	Dual 4 Input Multiplyer	1.81
9314	Quad Latch	1.70
9317	7 Segment Decoder/Driver	2.95
9318	8 Input Priority Encoder	4.69
9334	8 Bit Addressable Latch	5.75
9368	7 Segment Decoder/Driver/Latch	3.75
9370	7 Segment Decoder/Driver/Latch Open Collector	3.75
9374	7 Segment Decoder/Driver/Latch	3.75

SN7522N	2.10	Dual Channel Sense Amplifier	16
SN7524N	1.79	Dual Sense Amplifier	16
SN75107BN	1.65	Dual Line Receiver Active Pull Up	14
SN75108AN	1.65	Dual Line Receiver (Open Collector)	14
SN75109AN	1.63	Dual Line Driver	14
SN75110AN	1.82	Dual Line Driver	14
SN75113N	3.00	Dual Differential Drivers with 3-State Outputs	14
SN75115N	1.50	Dual Differential Line Receiver	16
SN75116N	3.49	Differntial Line Transceiver	16
SN75123N	1.72	Dual Line Driver (8T23)	16
SN75136N/ 8T26	2.86	Quad Bus Transceiver TriState—Use P/N N8T 26N	16
SN75138N	3.15	Quadruple Bus Transceiver	16
SN75150P	2.95	dual Line Driver Type RS-232-C	8
SN75152N	5.95	Dual Line Receiver Type RS-232-C	16
SN75154N	1.97	Quad Line receiver Type RS-232-C	16
SN75182N/ 8820	1.49	Dual Differential Line Receiver	14
SN75183N/ 8830	1.49	Dual Differential Line Driver	14
SN75188N/ MC1488L	.83	Quad Line Driver Type RS-232-C	14
SN75189AN/ MC1489AL	.83	Quad Line Receiver Type RS-232-C	14
SN75234N	1.39	Dual Sense Amplifier	16
SN75270N	3.10	7 Unit MOS to TTC Converter and Thermal Print Head Driver Array	16
SN75322N	3.72	Dual Positive And TTL to MOS Driver	14
SN75361AP	2.69	Dual NAND TTL to MOS Driver	8
SN75365N	1.61	Quad Ttl to MOS Driver 31 Ns	16
SN75369N	2.95	Dual MOS Driver	8
SN75450N	.70	Dual Peripheral Driver	14
SN75451BP	.53	Dual Peripheral Positive-AND Driver	8
SN75452BP	.53	Dual Peripheral Positive-NAND Driver	8
SN75453BP	.45	Dual Peripheral Positive-OR Driver	8
SN75454BP	.53	Dual Peripheral Positive-NOR Driver	8
SN75461P	.83	Dual Peripheral Positive-AND Drivers	8
SN75468N	2.25	Transistor Array TTL and 5V CMOS Interface	16
SN75472P	0.89	Dual Peripheral Positive-AND Drivers	8
SN75491AN	1.10	MOS to Visible LED Driver 50 Ma Source or Sink	14
SN75492AN	1.10	MOS to LED Driver (Quad Segment/ Hex Digit 250 Ma Sink	14
SN75497N	1.95	MOS to LED 7 Channel Driver	16

* Call us for price and availability.

Transistors

TRANSISTORS

DEVICE	PRICE	POL.		BVceo	Icmax	ft or Pdiss	hfe	CASE
2N697	.57	NPN	si	60V	1A	100 MHz	120 max	TO-5
2N706	.65	NPN	si	25V	200mA	400 MHz	60 max	TO-18
2N720	1.74	NPN	si	120V	1A	50 MHz	100 typ	TO-18
2N760	.70	NPN	si	45V	100mA	50 MHz	100 typ	TO-18
2N915		NPN	si	50V	———	250 MHz	250 max	TO-18
2N918	1.10	NPN	si	15V	50ma	500 MHz	40 max	TO-72
2N930	.45	NPN	si	45V	30ma	30 MHz	600 max	TO-18
2N964		PNP	Ge	7V	300ma	300 MHz	20 typ	TO-18
2N1040		PNP	Ge	50V	3A	20 W	200 max	TO-5
2N1303		PNP	Ge	25V	300ma	3 MHz	50 typ	TO-5
2N1304	3.30	NPN	Ge	25V	300ma	5 MHz	70 typ	TO-5
2N1379		PNP	Ge	25V	200ma	———	200 typ	TO-5
2N1893	.62	NPN	si	120V	500ma	50MHz	35 max	TO-5
2N2102	1.50	NPN	si	65V	1A	60 MHz	120 max	TO-5
2N2219A	.60	NPN	si	40V	800ma	250 MHz	300 max	TO-5
2N2221A	.34	NPN	si	40V	800ma	250 MHz	120 max	TO-18
2N2222A	.34	NPN	si	40V	800ma	300 MHz	300 max	TO-18
2N2239		NPN	si	40V	1A	———	30 min	TO-37
2N2270	.94	NPN	si	45V	1A	100 MHz	200 max	TO-5
2N2369A	.34	NPN	si	15V	200ma	500 MHz	120 max	TO-18
2N2428		PNP	G3	12V	100ma	1.2 MHz	130 max	TO-1
2N2432A		NPN	si	45V	100ma	20 MHz	50 min	TO-18
2N2483	.41	NPN	si	60V	50ma	60 MHz	120 max	TO-18
2N2484	.40	NPN	si	60V	50ma	60 MHz	500 max	TO-18
2N2614		PNP	Ge	40V	50ma	4 MHz	110 typ	TO-1
2N2641		NPN	si	45V	30ma	30 MHz	300 max	TO-99
2N2646	1.30	UJT	si	30V	2A	———	.75 max	TO-18
2N2647	1.38	UJT	si	30V	2A	———	.82 max	TO-18
2N2904	.59	PNP	si	40V	600ma	200 MHz	120 max	TO-5
2N2905	.60	PNP	si	40V	600ma	200 MHz	300 max	TO-5
2N2906	.34	PNP	si	40V	600ma	200 MHz	120 max	TO-18
2N2907A	.38	PNP	si	40V	600ma	200 MHz	300 max	TO-18
2N2920	4.98	NPN	si	60V	30ma	60 MHz	600 max	TO-99
2N2983		NPN	si	60V	700ma	60 MHz	250 max	TO-5
2N3014	1.66	NPN	si	20V	200ma	350 MHz	120 max	TO-52
2N3019	.75	NPN	si	80V	1A	100 MHz	300 max	TO-5
2N3053	.57	NPN	si	40V	700ma	100 MHz	250 max	TO-5
2N3054	1.54	NPN	si	55V	4A	25W	100 max	TO-66
2N3055	1.25	NPN	si	60V	15A	115W	70 max	TO-3
2N3117	.88	NPN	si	60V	50ma	60 MHz	900 max	TO-18
2N3227		NPN	si	20V	500ma	500 MHz	300 max	TO-18
2N3250	.43	PNP	si	40V	200ma	250 MHz	150 max	TO-18
2N3391A	.22	NPN	si	25V	100ma	90 MHz	375 typ	TO-98
2N3394	.48	NPN	si	25V	100ma	80 MHz	82 typ	TO-98
2N3415	.15	NPN	si	25V	500ma	———	360 typ	TO-98
2N3440	1.50	NPN	si	250V	1A	10W	80 typ	TO-5
2N3442	3.20	NPN	si	140V	10A	115W	38 typ	TO-3
2N3565	.57	NPN	si	25V	50ma	40 MHz	300 typ	TO-106
2N3566	.57	NPN	si	30V	50ma	40 MHz	300 typ	TO-105
2N3567	.57	NPN	si	40V	500ma	60 MHz	70 typ	TO-105
2N3568	.91	NPN	si	60V	500ma	60 MHz	70 typ	TO-105
2N3569	.61	NPN	si	40V	500ma	60 MHz	175 typ	TO-105
2N3638A	.57	PNP	si	25V	500ma	150 MHz	130 typ	TO-105
2N3641	.88	NPN	si	30V	500ma	150 MHz	70 typ	TO-105
2N3642	.59	NPN	si	45V	500ma	150 MHz	70 typ	TO-105
2N3643	.43	NPN	si	30V	500ma	250 MHz	140 typ	TO-105
2N3644	.63	PNP	si	45V	500ma	200 MHz	140 typ	TO-105
2N3645	.63	PNP	si	60V	500ma	200 MHz	140 typ	TO-105
2N3703	.17	PNP	si	30V	200ma	100 MHz	75 typ	TO-92
2N3704	.17	NPN	si	30V	800ma	100 MHz	300 max	TO-92
2N3705		NPN	si	30V	800ma	100 MHz	150 max	TO-92
2N3725	1.30	NPN	si	50V	1A	250 MHz	150 max	TO-5
2N3773	4.00	NPN	si	140V	30A	150W	30 typ	TO-3
2N3819	.60	N-JFET	si	25V	10ma	———	———	TO-92
2N3820	.69	P-JFET	si	20V	10ma	———	———	TO-92
2N3904	.22	NPN	si	40V	200ma	300 MHz	160 typ	TO-92
2N3905	.28	PNP	si	40V	200ma	200 MHz	100 typ	TO-92
2N3906	.22	PNP	si	40V	200ma	250 MHz	160 typ	TO-92
2N3947	.97	NPN	si	40V	200ma	300 MHz	160 typ	TO-18
2N4036	1.19	PNP	si	65V	1A	7W	76 typ	TO-5
2N4037	1.15	PNP	si	40V	1A	60 MHz	110 typ	TO-5
2N4062	.45	PNP	si	30V	30ma	———	170 typ	TO-92
2N4112		NPN	si	60V	5A	30W	140 typ	TO-3
2N4123	.20	NPN	si	30V	200ma	250 MHz	150 max	TO-92
2N4124	.20	NPN	si	25V	300ma	300 MHz	360 max	TO-92
2N4125	.20	PNP	si	30V	200ma	200 MHz	150 max	TO-92
2N4126	.20	PNP	si	25V	200ma	250 MHz	360 max	TO-92
2N4208	.85	PNP	si	12V	50ma	700 MHz	60 typ	TO-18
2N4222	2.24	N-JFET	si	30V	15ma	———	———	TO-72
2N4248	.75	PNP	si	40V	100ma	40 MHz	1000 max	TO-106
2N4250	.95	PNP	si	40V	100ma	50 MHz	800 max	TO-106
2N4339		N-JFET	si	50V	15ma	———	———	TO-18
2N4400	.22	NPN	si	40V	600ma	200 MHz	150 max	TO-92
2N4401	.22	NPN	si	40V	600ma	250 MHz	300 max	TO-92
2N4402	.22	PNP	si	40V	600ma	150 MHz	150 max	TO-92
2N4403	.22	PNP	si	40V	600ma	200 MHz	300 max	TO-92

TRANSISTORS

DEVICE	PRICE	POL.		BVceo	Icmax	ft or Pdiss	hfe	CASE
2N4416	1.75	N-JFET	si	30V	10ma	———	———	TO-72
2N4853		UJT	si	30V	50ma	———	———	TO-18
2N4856	2.30	N-JFET	si	40V	50ma	———	———	TO-18
2N4871	2.15	UJT	si	35V	1.5V	———	———	TO-92
2N4891	1.75	UJT	si	30V	1.0A	———	———	TO-92
2N5143	.40	PNP	si	20V	500ma	100 MHz	50 typ	TO-106
2N5172	.19	NPN	si	25V	100ma	120 MHz	500 max	TO-92
2N5195	2.83	PNP	si	80V	4A	40W	80 max	77-03
2N5210	.34	NPN	si	50V	50ma	30 MHz	600 max	TO-92
2N5232A	1.26	NPN	si	50V	100ma	———	375 typ	TO-98
2N5245	.67	N-JFET	si	30V	50ma	———	———	TO-92
2N5307	.77	NPN	si	40V	200ma	60 MHz	2000 min	TO-92
2N5356		PNP	si	25V	300ma	250 MHz	375 typ	TO-98
2N5369	.35	NPN	si	30V	500ma	250 MHz	175 typ	TO-92
2N5400	.25	PNP	si	120V	600ma	100 MHz	180 max	TO-92
2N5401	.30	PNP	si	150V	600ma	100 MHz	240 max	TO-92
2N5415	2.35	PNP	si	200V	1A	15 MHz	68 typ	TO-5
2N5447	.40	PNP	si	25V	200ma	500 MHz	300 max	TO-92
2N5457	.57	N-JFET	si	25V	10ma	———	———	TO-92
2N5458	.57	N-JFET	si	25V	10ma	———	———	TO-92
2N5459	.65	N-JFET	si	25V	10ma	———	———	TO-92
2N5485	.70	N-JFET	si	25V	10ma	———	———	TO-92
2N5525	1.74	NPN	si	40V	220ma	200 MHz	5000 min	TO-92
2N5550	.39	NPN	si	140V	600ma	100 MHz	250 max	TO-92
2N5770	.27	NPN	si	12V	50ma	900 MHz	40 min	TO-92
2N5771	.45	PNP	si	15V	50ma	850 MHz	35 min	TO-92
2N5772	.34	NPN	si	15V	300ma	350 MHz	30 min	TO-92
2N5881	3.94	NPN	si	60V	15A	160W	20 min	TO-3
2N5962	.37	NPN	si	45V	50ma	100 MHz	450 min	TO-92
2N6027	.43	PUT	si	40V	150ma	———	———	TO-92
2N6028	.43	PUT	si	40V	150ma	———	———	TO-92
2N6059	7.23	NPN	si	100V	12A	150W	18000 max	TO-3
2N6657	8.47	N-VFET	si	60V	2A	25W	———	TO-3
2N6658	10.00	N-VFET	si	90V	2A	25W	———	TO-3
MJ802	8.22	NPN	si	90V	30A	200W	100 max	TO-3
MJ2955		PNP	si	60V	15A	150W	70 max	TO-3
MJ3701		PNP	si	40V	1A	25W	100 max	TO-66
MJ4502		PNP	si	90V	30A	200W	100 max	TO-3
MJE340	1.76	NPN	si	300V	500ma	20W	240 max	77-03
MJE520		NPN	si	30V	3A	25W	25 min	77-03
MJE702		PNP	si	80V	4A	40W	750 min	77-03
MJE802		NPN	si	80V	4A	40W	750 min	77-03
MJE1093		PNP	si	80V	5A	70W	750 min	90-05
MJE1102		NPN	si	80V	5A	70W	750 min	90-05
MJE1103		NPN	si	80V	5A	70W	750 min	90-05
MPF102	.57	N-JFET	si	25V	10ma	———	———	TO-92
MPF105		N-JFET	si	25V	16ma	———	———	TO-92
MPS5172	.19	NPN	si	25V	100ma	120 MHz	500 max	TO-92
MPS6514	.17	NPN	si	25V	100ma	390 MHz	300 max	TO-92
MPS6515	.17	NPN	si	25V	100ma	390 MHz	300 max	TO-92
MPS6516	.18	NPN	si	40V	100ma	270 MHz	100 max	TO-92
MPS6519	.20	NPN	si	25V	100ma	420 MHz	500 max	TO-92
MPSA05	.17	NPN	si	60V	500ma	100 MHz	50 min	TO-92
MPSA06	.26	NPN	si	60V	500ma	100 MHz	50 min	TO-92
MPSA09	.17	NPN	si	50V	50ma	80 MHz	600 max	TO-92
MPSA13	.26	NPN	si	30V	500ma	125 MHz	10000 min	TO-92
MPSA14	.26	NPN	si	30V	500ma	125 MHz	20000 min	TO-92
MPSA18	.20	NPN	si	45V	200ma	100 MHz	1500 max	TO-92
MPSA20	.20	NPN	si	40V	100ma	125 MHz	400 typ	TO-92
MPSA42	.38	NPN	si	300V	500ma	50 MHz	40 min	TO-92
MPSA43	.38	NPN	si	200V	500ma	50 MHz	50 min	TO-92
MPSA55	.26	PNP	si	80V	500ma	100 MHz	50 min	TO-92
MPSA56	.32	PNP	si	80V	500ma	100 MHz	50 min	TO-92
MPSA65	.32	PNP	si	30V	300ma	175 MHz	20000 min	TO-92
MPSA70	.27	PNP	si	40V	100ma	125 MHz	400 typ	TO-92
MPSA92	.35	PNP	si	300V	500ma	50 MHz	25 min	TO-92
MPSU05		NPN	si	60V	2A	150 MHz	125 max	152-02
MPSU06		NPN	si	80V	2A	150 MHz	155 max	152-02
MPSU10		NPN	si	300V	500ma	60 MHz	25 min	152-02
MPSU51		PNP	si	40V	2A	50 MHz	50 min	152-02
MPSU55		NPN	si	60V	2A	100 MHz	160 typ	152-02
MPSU56		NPN	si	80V	2A	100 MHz	160 typ	152-02
MPSU60		NPN	si	300V	500ma	60 MHz	25 min	152-02
PN2222A	.17	Electrically Equivalent to 2N2222A						
TIP29B	.69	NPN	si	80V	1A	30W	40 min	TO-220
TIP29C	.71	NPN	si	100V	1A	30W	40 min	TO-220
TIP30C	.70	PNP	si	100V	1A	30W	40 min	TO-220
TIP31C	.70	NPN	si	100V	3A	40W	25 min	TO-220
TIP32C	.75	PNP	si	100V	3A	40W	25 min	TO-200
TIP33C	1.54	PNP	si	100V	10A	80W	100 max	CP-3
TIP34C	1.80	PNP	si	100V	10A	80W	100 max	CP-3
TIP35C	2.92	NPN	si	100V	25A	125W	50 max	CP-3
TIP36C	3.07	PNP	si	100V	25A	125W	50 max	CP-3
TIP41C	1.01	NPN	si	100V	6A	65²	75 max	TO-220
TIP42C	1.08	PNP	si	100V	6A	65W	75 max	TO-220

Continued on next page.

Transistors

DEVICE	PRICE	POL.		BVceo	Icmax	ft or Pdiss	hfe	CASE
TIP47	1.08	NPN	si	250V	1A	40W	25 min	TO-220
TIP48		NPN	si	300V	1A	40W	25 min	TO-220
TIP49	1.02	NPN	si	350V	1A	40W	25 min	TO-220
TIP50	1.02	NPN	si	350V	1A	40W	25 min	TO-220
TIP110	.89	NPN	si	60V	2A	50W	500 min	TO-220
TIP111		NPN	si	80V	2A	50W	500 min	TO-220
TIP115		PNP	si	60V	2A	50W	500 min	TO-220
TIP120		NPN	si	60V	5A	65W	1000 min	TO-220
TIP121	.99	NPN	si	80V	5A	65W	1000 min	TO-220
TIP122	1.01	NPN	si	100V	5A	65W	1000 min	TO-220
TIP125	.94	PNP	si	60V	5A	65W	1000 min	TO-220
TIP127	1.14	PNP	si	100V	5A	65W	1000 min	TO-220
TIP140		NPN	si	60V	10A	125W	500 min	CP-3
TIP141	2.65	NPN	si	80V	10A	125W	500 min	CP-3

DEVICE	PRICE	POL.		BVceo	Icmax	ft or Pdiss	hfe	CASE
TIP142	3.15	NPN	si	100V	10A	125W	500 min	CP-3
TIP146		PNP	si	80V	10A	125W	500 min	CP-3
TIP2955	1.26	PNP	si	60V	15A	90W	500 min	CP-3
TIP3055	1.15	NPN	si	60V	15A	90W	15 min	CP-3
TIS43		UJT	si	30V	50ma	———	———	TO-92
TIS58		N-JFET	si	25V	10ma	———	———	TO-92
TIS59		N-JFET	si	25V	10ma	———	———	TO-92
TIS62		NPN	si	12V	30ma	500 MHz	30 min	TO-92
TIS73		N-JFET	si	30V	50ma	———	———	TO-92
TIS74		N-JFET	si	30V	50ma	———	———	TO-92
TIS75		N-JFET	si	30V	50ma	———	———	TO-92
TIS84		NPN	si	30V	50ma	100 MHz	45 typ	TO-92
TIS86		NPN	si	30V	50ma	500 MHz	200 max	TO-92
TIS87		NPN	si	45V	50ma	500 MHz	150 max	TO-92

CMOS IC's

4001	.28	QUAD 2 INPUT NOR
4002	.28	DUAL 4 INPUT NOR
4006	.89	18 STAGE STATIC SHIFT REGISTER
4007	.39	DUAL COMPLEMENTARY PAIRS PLUS INVERTERS
4008	.95	FOUR BIT FULL ADDER
4009	.69	HEX BUFFER/CONVERTER (INVERTER)
4010	.69	HEX BUFFER/CONVERTER (NON-INVERTING)
4011	.28	QUAD 2 INPUT NAND
4012	.52	DUAL 4 INPUT NAND
4013	.49	DUAL D-TYPE FLIP FLOP
4014	.90	8 BIT STATIC SHIFT REGISTER
4015	.90	DUAL 4 BIT STATIC SHIFT REGISTER
4016	.49	QUAD BILATERAL SWITCH
4017	.90	DECADE COUNTER/DIVIDER
4018	.79	PRESETABLE DIVIDE BY N COUNTER
4019	.65	QUAD AND/OR SELECT GATE
4020	.95	14 STAGE BINARY/RIPPLE COUNTER
4021	.80	8 BIT STATIC SHIFT REGISTER
4022	1.09	DIVIDE BY 8 COUNTER DIVIDER
4023	.28	TRIPLE 3 INPUT NAND
4024	.90	7 STAGE BINARY COUNTER
4025	.29	TRIPLE 3 INPUT NOR
4026	2.00	DECADE COUNTER/DVIDER
4027	.60	DUAL J-K FLIP-FLOP
4028	.90	BCD TO DECIMAL DECODER
4029	1.00	PRESETABLE UP/DOWN BINARY/DECADE COUNTER
4030	.69	QUAD XOR GATE (74C86)
4034	3.25	8 STAGE UNIVERSAL BUS REGISTER
4035	.92	4 STAGE PARALLEL IN/OUT SHIFT REGISTER
4040	.83	12 STAGE BINARY/RIPPLE COUNTER
4041	.99	QUAD TRUE COMPLEMENT BUFFER
4042	.90	QUAD CLOCKED "D" LATCH
4043	.90	QUAD 3 STATE NOR R/S LATCH
4044	.90	QUAD 3 STATE NAND R/S LATCH
4046	.89	MICRO POWER PHASE LOCKED LOOP
4047	1.50	LOW POWER MONOSTABLE/ASTABLE MULTIVIBRATOR
4049	.55	HEX BUFFER/CONVERTER (INVERTING)
4050	.60	NO INVERTING HEX BUFFER
4050	.77	
4051	.85	SINGLE 8 CHANNEL MULTIPLEXER/DEMULTIPLEXER
4052	.77	TRIPPLE 2 CHANNEL MULTIPLEXER/DEMULTIPLEXER
4053	.90	TRIPLE 2 CHANNEL MULTIPLEXER/DEMULTIPLEXER
4060	.99	14 STAGE BINARY COUNTER/OSCILLATOR
4066	.75	QUAD BILATERAL SWITCH
4068	.28	8 INPUT NAND (74C30)
4069	.35	HEX INVERTER (74C04)
4070	.35	QUAD 2 INPUT XOR (74C86)
4071	.28	QUAD 2 INPUT OR
4072	.28	DUAL 4 INPUT OR
4073	.37	TRIPLE 3 INPUT GATE
4075	.39	TRIPLE 3 INPUT OR
4076	.99	4 BIT D-TYPE REGISTER (74C173)
4078	.32	8 INPUT NOR
4081	.35	QUAD 2 INPUT AND
4082	.35	DUAL 4 INPUT AND
4085	.95	DUAL 2 WIDE 2 INPUT AND-OR-INVERT
4086	.99	EXPANDABLE 4 WIDE 2 INPUT AND-OR-INVERT
4093	.75	QUAD 2 INPUT NAND SCHMITT TRIGGER
4099	1.35	8 BIT ADDRESSABLE LATCH
4502	.99	STROBED HEX INVERTER/BUFFER
4503	.69	
4508	2.50	DUAL 4 BIT LATCH (TS)
4510	1.00	BCD UP/DOWN COUNTER
4511	1.00	BCD TO 7 SEGMENT LATCH/DECODER/DRIVER
4512	1.00	8 CHANNEL DATA SELECTOR
4514	2.67	1 OF 16 DECODER MULTIPLEXER
4515	2.67	1 OF 16 DECODER MULTIPLEXER
4516	1.20	BINARY UP/DOWN COUNTER
4518	.95	DUAL BCD UP COUNTER
4519	.76	4 BIT AND-OR SELECT GATE
4520	1.15	DUAL BINARY UP COUNTER
4522	1.38	BCD DIVIDE BY N COUNTER
4526	1.75	4 BIT BINARY DIVIDE BY N COUNTER
4527	2.25	BCD RATE MULTIPLIER
4528	1.15	DUAL RETRIGGERABLE/RESETTABLE MONOSTABLE MULTIVIBRATOR
4531	1.15	12 BIT PARITY CHECKER GENERATOR
4532	1.39	8 BIT PRIORITY ENCODER
4539	1.66	DUAL 4 CHANNEL DIGITAL MULTIPLEXER
4543	1.49	BCD TO 7 SEGMENT LATCH/DECODER/DRIVER
4553	5.35	3 DIGIT BCD COUNTER
4555	.85	
4556	.95	
4581	2.59	248 4 BIT ALU
4582	.90	CARRY LOOK AHEAD GENERATOR
4583	.99	HEX SCHMITT TRIGGER
4584	.70	4 BIT MAGNITUDE COMPARATOR (74C85)
4585	.99	4 BIT MAGNITUDE COMPARATOR (74C85)
4702	15.95	PROGRAMMABLE BIT RATE GENERATOR
4724	2.80	8 BIT ADDRESSABLE LATCH SERIAL IN PARALLEL OUT

ADC—DAC IC's

PART #		RESOLUTION (BITS)	CONVERSION TIME	SUPPLY VOLTAGE(S)	PACKAGE	
ADC0800	16.19	8	50uS	+5,-12	18 PIN DIP	Differential Input
ADC0801	20.40	8	110uS	+5	20 PIN DIP	Differential Input
ADC0802	12.50	8	110S	+5	20 PIN DIP	Differential Input
ADC0803	7.50	8	110uS	+5	20 PIN DIP	Differential Input
ADC0804	4.85	8	110uS	+5	20 PIN DIP	Works w/5V Reference
ADC0805	6.21	8	110uS	+5	20 PIN DIP	8 Channel MUX
ADC0808	16.10	8	110uS	+5	28 PIN DIP	8 Channel MUX
ADC0809	6.02	8	100uS	+5	28 PIN DIP	16 Channel MUX
ADC0816	23.30	8	100uS	+5	40 PIN DIP	16 Channel MUX
ADC0817	14.30	8	100uS	+5	40 PIN DIP	4 Channel MUX Serial I/O
ADC0833B	15.30	8	80uS	+5 to +9	14 PIN DIP	Differential Input 8 Bit Bus
ADC1001B	26.89	10	200uS	+5	20 PIN DIP	
ADC1021	28.69	10	200uS	+5	24 PIN DIP	Can be Connected to Convert 10 Bits
ADC1210	65.60	12	100uS	+5 to ±15V	24 PIN DIP	In 30 uS
ADC1211	*	12	100uS	+5 to ±15V	24 PIN DIP	Polality an overrang 8 Bit bus Internal LEF
ICL7109	*	12	33uS	±5	40 PIN DIP	u/REF Unipolar Bipolar L/P
AD570J	*	8	25uS	+5 -15	18 PIN DIP	u/RED Unipolar Bipolar L/P
AD471J	*	10	25uS	15 to +15, -15	18 PIN DIP	Internal REF
AD ADC80	*	12	25uS	-5, -12 to -15	32 PIN DIP	uP Compatible 8 Bit Bus
AD 673	*	8	20uS	+5, -12 to -15	20 PIN DIP	uP Compatible Unipolar or Bipolar L/P
AD 573		10	15uS	+5, -17 to -15	20 PIN DIP	uP Compatible 8 Bit Bus
A ADC1140	49.59	8	15uS	+5	18 PIN DIP	2" x 2" A to D Converter System
		16	35uS	+5 ±15	32 PIN DIP	

PART NUMBER		RESOLUTION BITS	SETTLING TIME	SUPPLIES VOLTAGE	PACKAGE	
DAC0800	3.50	8	100nS	±t to ±15	16 PIN DIP	High Speed Multiplying
DAC0801	2.88	8	100nS	±5 to ±15	16 PIN DIP	High Speed Multiplying
DAC0802	4.95	8	100nS	5 to ±15	16 PIN DIP	High Speed Multiplying
DAC0808	2.88	8	150nS	±5 to ±15	16 PIN DIP	Multiplying
DAC1000	17.44	10	500nS	5 to 15	24 PIN DIP	uP Compatible Double Buffered
DAC1006	14.40	10	500nS	5 to 15	20 PIN DIP	uP Compatible Double Buffered
DAC1001	15.56	10	500nS	5 t 15	24 PIN DIP	uP Compatible Double Buffered
DAC1002	13.50	10	500nS	5 to 15	24 PIN DIP	uP Compatible Double Buffered
DAC1020	10.80	10	500nS	5 to 15	16 PIN DIP	4 Quadrant Multiplying
DAC1021	9.00	10	500nS	5 to 15	16 PIN DIP	4 Quadrant Multiplying
DAC1022	7.09	10	500nS	5 to 15	16 PIN DIP	4 Quadrant Multiplying
DAC1220	11.69	12	500nS	5 to 15	18 PIN DIP	4 Quadrant Multiplying
DAC1221	9.89	12	500nS	5 to 15	18 PIN DIP	4 Quadrant Multiplying
DAC1222	8.09	12	500nS	5 to 15	18 PIN DIP	4 Quadrant Multiplying
DAC1200	63.50	12	300nS I OUT 2.5uS V OUT	+5 ±15f	24 PIN DIP	Current or Voltage Mode
DAC 1208	20,28	12	1uS	5 to 15	24 PIN DIP	uP Compatible 4 Quadrant Multiplying
DAC1210	14.07	12	1uS	5 to 15	24 PIN DIP	uP Compatible 4 Quadrant Multiplying
DAC1230	20:28	12	1uS	5 to 15	20 PIN DIP	uP Compatible 4 Quadrant Multiplying
DAC1232	14.07	12	1uS	5 to 15	20 PIN DIP	uP Compatible 4 Quadrant Multiplying
DAC558	*	8	800nS	15V	16 PIN DIP	uP Compatible
AD7524	*	8		15V	16 PIN DIP	uP Compatible 2/4 Quadrant Multiplying
AD7522	*	10		+5V	28 PIN CIP	uP Compatible 2/4 Quadrant Multiplying Serial or Parallel L/P
AD1408	*	8	250nS	+5, -15	16 PIN DIP	Multiplying
AD DAC80-I	*	12	F2 300nS	+5, ±15	24 PIN DIP	Current
AD DAC80-V	*	12	300ns	-5, ±15	24 PIN DIP	VOLTAGE
AD DAC-08	*	8	85nS		15 PIN DIP	Multiplying
AD DAC100	*	10	225nS 8 Bit 275nS 10 Bit	±6 ±18	16 PIN DIP	w/Reference
AD 7528	10.67	8		5 to 15	20 PIN DIP	Dual Buffered Multiplying DAC
AD 567	*	12	500nS	±12 to ±15V	28 PIN DIP	uP Compatible
AD 7527	*	10		+7V	28 PIN DIP	uP Compatible 8 and 16 Bit Bus
AD 7111	*			+5	16 PIN DIP	CMOS Logarithmic O/A Converter

PART #	RESOLUTION	SUPPLY	PACKAGE		
ICL7106	3½ Digit	15V, -15V	40 PIN DIP	7 Segment LED Drive	$13.18
ICL7107	3½ Digit	6V, -9V	40 PIN DIP	7 Segment LED Drive	$13.18
ICL7116	3½ Digit	V+ toV-,15V	40 PIN DIP	7 Segment LED Drive w/Display Hold	$14.50
ICL7117	3½ Digit	6V, -9V	40 PIN DIP	7 Segment LED Drive w/Display Hold	$14.50

*** Call us for price and availability.**

Voltage Regulators

FIXED VOLTAGE REGULATORS
POSITIVE.

CURRENT	VOLTAGE	CASE	SERIES	
10.0A	5.0	TO-3	78PXX	14.08
5.0A	5.0,12.0,15.0	TO-3	78HXX	7.95
1.5A	5.0,12.0,15.0	TO-3	LM340	2.08
1.5A	5.0,6.0,8.0,12.0,15.0, 18.0,24.0	TO-220	LM340T	1.03
1.0A	5.0,6.0,8.0,8.5,12.0,	TO-220	78XXUC	.89
	15.0,18.0,22.0,24.0	TO-3	78XXKC	2.05
500mA	5.0,6.0,8.0,10.0,12.0,	TO-220	78MXXUC	.80
	15.0,20.0,24.0	TO-39	78MXXLA	2.39
500mA	5.0,12.0,15.0 (See Above)	TO-220	LM341	.73
250mA	5.0,12.0,15.0	TO-220	LM342	
100mA	2.6,5.0,6.2,8.2,9.0,12.0 15.0,18.0 24.0	TO-92	78LXX	0.51
100mA	5.0,12.0,15.0 (See Above)	TO-92	LM340T	.68
1A	5.0	TO-3	LM309K	2.64
	NEGATIVE			
3A	5.0	TO-3	LM345	11.95
1A	5.0,6.0,8.0,12.0,15.0, 18.0,24.0	TO-220	79XXUC	1.05
500mA	5.0,6.0,8.0,12.0,15.0,	TO-220	79MXXUC	0.99
	20.0,24.0	TO-39	79MXXLA	2.00

VARIABLE VOLTAGE REGULATORS
POSITIVE

CURRENT	MIN	MAX	CASE	SERIES
5A	5	20	TO-3	uA78HG
1.5A	1.2	37	TO-3	LM117
1.5A	1.2	37	TO-220	LM317
1A	5	30	TO-3	uA78G
500mA	5	30	TO-39 8 PIN DIP	78MGMM
125mA	2	37	14 PIN DIP	uA78S40

NEGATIVE

5A	-2.25	-24	TO-3	uA79HG
1.5A	-1.2	-37	TO-3	LM137
1.5A	-1.2	-37	TO-220	LM337
1.0A	-2.3	-30	TO-3	uA796
500mA	-2.2	-30	TO-39 8 PIN DIP	uA79MG

SWITCHING

1.5A	1.3	40	16 PIN DIP	uA7840

Call us for price and availability.

Wire Wrap Prototype Boards.

MULTIFLEX S-100 CARD

Provisions for mounting two TO-220 regulators with Heatsinks. Three separate voltage planes plus a ground are available on the wiring side of the board. A ground plane is provided on the component side for termination and screening. **$35.00**

Vero S-100 universal microprocessor square and board.

Provision for mounting two TO-220 regulators and Heatsinks. Primarily designed to accept DIP Sockets this board single pads on A 0.1 x 0.1 matrix. **$45.00**

10" x 12" wire wrap card capable of holding over 150 16 pin wire wrap sockets. The wiring side of the board allows the used up to 6 seperate supply rails plus A ground. The component side has an extensive ground which in addition to providing screening allows termination to ground. A set of 50 + 50 gold plated contact fingers on A 0.125 " pitch allow easy interface to the board via an S-100 connector. **$69.00**

Wire Wrapping

WIRE WRAP TERMINAL
100 pcs per pkg

WIRE WRAP WIRE

TRI-Color Dispenser - 3 Rolls of AWG 30 Wire In one dispenser, 50 feet each of blue, white, red. Unit has built In cutter and stripper. Part # WD-30-TRI. **$15.58**

Replacement roll set for above
Part # R-30-TRI *

Wire dispenser - 50 feet of AWG-30 wire indispenser with cutter and stripper. Available in blue, yellow, white or red Part # WD-30 *

Wire dispenser replacement rolls - replacement rolls for WD-30
Part # R-30-50 *

WIRE WRAP WIRE

Cut and strip tool - Ensures proper wrap length. Available in
26 guage OK-3907-26B **$31.84**
28 guage OK-3907-28B **$31.84**
30 guage OK-3907-30B **$31.84**

WIRE WRAP TOOLS

Battery wire wrap gun with bit and sleeve for modified wrap (AWG 30). Uses 2 "C" nicads
Part # BW-630 *
Replacement bit for BW-630 (AWG 30)
Part # BT-30 *
Replacement bit for BW-630 (AWG 26-28)
Part # BT-2628 *

Just Wrap™ wire wrapping-tool (AWG 30) Tool holds one fifty foot roll or wire, has built in cut off. Wire does not require stripping thus allowing point to point and daisy shan wire wrapping. Wire available In four colours, blue, white, yellow, red (wire included with tool)
Part # JW-1 **$27.97**

Just Wrap™ replacement rolls. (Soft) Available in four colours, blue, white, yellow, red
Part # R-JW **$6.03**

Just Wrap™ kit - contains just wrap™ tool, 50 ft each of blue, white, yellow and red wire and unwrapping tool
Part # JWK-6 *

Unwrapping tool - designed for uses with Just Wrap
JUW-1 **$6.47**

Hobby wrap tool - modified wrap - wire wrapping, stripping, unwrapping tool
Part # WSU-30M **$15.60**

Ribbon Cable

CONDUCTORS

10	20	26	40	*
14	24	34	50	
16	25	36	60	

Standard Ribbon Cable (Grey)
Colour Coded Ribbon Cable
Colour Coded Twisted Pair Ribbon Cable

*** Call us for price and availability.**

Connectors

Pin Connectors (Dual Row Hooded Headers)

PINS	SOLDER TAIL STRAIGHT	MALE RIGHT ANGLE	WIRE WRAP STRAIGHT	MALE RIGHT ANGLE	RIBBON CABLE FEMALE
20	2.09	2.09	2.97	2.97	2.70
26	2.69	2.69	3.65	3.65	3.42
34	3.50	3.50	4.29	4.29	4.44
40	3.97	3.97	4.83	4.83	5.22
50	4.76	4.76	5.63	5.63	6.50
60	5.75	5.75	6.78	6.78	8.16

IC Sockets

	8	14	16	18	20	22	24	28	40
SOCKETS SOLDERTAIL	16¢	28¢	32¢	36¢	40¢	44¢	48¢	56¢	80¢
SOCKETS WIRE WRAP	65¢	89¢	1.11	1.17	1.49	1.69	1.75	1.89	1.98
LOW PROFILE MACHINE CONTACT	1.69	2.50	2.75	3.50	3.89	4.00	4.75	4.75	5.95
COMPONENTS PLATFORM	——	1.99	2.50	——	——	——	3.39	——	5.85
DIP HEADER	——	2.35	2.75	——	——	——	3.50	——	5.60

D-Shell Connectors

D—SHELL CONNECTORS

SUFFIX PINS	(XX-Z) PART#	RACK/PANEL CONNECTORS RP-P	RP-S	INSULATION DISPLACEMENT ID-P	ID-S	PRINTED CIRC. MOUNT PC-P	PC-S
9	DE-9-XX-Z	3.63	3.67	5.28	5.70	——	——
15	DE-15-XX-Z	4.95	4.95	7.12	7.68	——	6.85
25	DE-25-XX-Z	6.50	6.50	9.50	9.50	10.50	8.50
37	DE-37-XX-Z	6.95	11.00	12.35	13.48	——	——
50	DE-50-XX-Z	9.00	14.95	——	——	——	——

SUFFIX NOTES:
RP = STANDARD SOLDERTAIL
ID = RIBBON CABLE
PC = PRINTED CIRCUIT MOUNT (RIGHT ANGLE)
P = PLUG
S = SOCKET

D—SHELLS

PART#	
SH-9-X	3.75
SH-15-X	2.05
SH-25-X	2.05

Edge Card Connectors P.C. Mount

● 100 Contact Spacing

No of Contacts	
10	
50	4.00
86	8.68
100	5.75

● 125 Contact Spacing

No of Contacts	
20	3.36
36	4.72
50	6.16
60	7.15
86	9.66
100	10.85

● 156 Contact Spacing

No of Contacts	
20	6.65
22	7.15
50	8.19
86	13.30

Opto Couplers

TRANSISTOR OUTPUT	
MCT26	.96
4N28	.85
4N26	.85
MCT2	1.02
4N38	1.16
4N37	1.16
4N25	.85
4N27	.85
4N35	1.16
4N36	1.16
DARLINGTON OUTPUT	
4N31	1.16
4N29	1.13
4N30	1.13
4N32	1.16
4N33	1.16
TRIAC DRIVER OUTPUT	
MOC3011	1.81
MOC3020	1.37
MOC3030	2.04
MOC3031	2.68
SCR OUTPUT	
MOC3002	1.81
MOC3003	2.60
OPTO	
TI ¾ Flashing LED	.95
JUMBO LED	
RED	.25
GREEN	.30
YELLOW	.35
ORANGE	.35
TI ¾	
RECTANGULAR	.45
ROUNDED RECTANGULAR	.45
7 SEGMENT DISPLAYS	
DL1416	34.71
FND500	2.04
FND507	2.04
FND501	2.04
FND508	2.04
TIL313	1.85

10 ELEMENT LINEAR DISPLAY

RBG - 1000	RED	4.50
OBG - 1000	HIGH EFFICIENCY RED	4.50
YBG - 1000	YELLOW	4.50
GBG - 1000	GREEN	4.50

All prices are in Canadian funds, Federal Tax included.

Microprocessor Chips

Continued from p.3

TMS9900		
TMS9900	64 PIN 16 Bit Microprocessor	52.39
TMS9900-40/TMS-980A	40 PIN 16 Bit Microprocessor w/8 Bit Data	39.50
TMS9981	Same Bus as TMS9980 w/Xtal Oscillator	44.08
TMS9985	40 Pin 16 Bit Microprocessor w/Single +5V supply and 256 Bits of RAM	48.00
TMS-9940E	40 PIN Single Chip Microcomputer	*
TMS9901	Programmable Systems Interface	14.15
TMS9-901-40	High Speed Programmable Systems Interface	*
TMS9902	Asynchronous Communications	8.95
TMS9-902-40	High Speed controller	14.15
TMS9903	Synchronous Communications Controller	42.00
TMS9904	4 Phase Clock Driver	*
TMS9905	8 to 1 multiplexer	*
TMS9906	8 bit latch	*
TMS9907	8 to 3 priority Encoder	*
TMS9908	8 to 3 Priority Encoder w/Tristate outputs	*
TMS9909	Floppy Disc Controller	79.00
TMS9911	Direct Memory Access Controller	32.85
TMS9914	GBIP Adapter	40.00
TMS9915	Dynamic RAM Controller Chip Set	*
TMS9916	92K Magnetic Bubble Memory Controller	72.52
TMS9922	250K Magnetic Bubble Controller	*
TMS9923	250K Magnetic Bubble Controller	*
TMS9927	Video Timer Controller	33.00
TMS9932	Combination ROM/RAM Memory	*
SBP9960	I/O Expander	*
SBP9961	Interrupt Controller/Timer	*
SBP9964	SBP9900A Timing Generator	*
SBP9965	Peripheral Interface Adapter	*
NS16000		
NS16008	CPU	*
NS16016	CPU	*
NS16032	CPU	$280.00
NS16081	Floating Point Unit	*
NS16082	Memory Management Unit	*
NS16201	Clock Generator	35.00
NS16202	Interrupt Controller Unit	*
NS16203	Direct Memory Access Controller	*
NS16204	Bus Arbiter	*

Power Supplies

BOSCHERT SWITCHING SUPPLY — **$275**
- +5V 18A, +12V, −5V 1A, −12V 1A
- Overvoltage protection on output
- Capable of driving full blown systems with disk drives

5 VOLT ONLY — **$45**
- 3 Ampere supply at 5 Volts
- Ideal for TTL experiments or the basic MULTIFLEX Z-80

MULTIFLEX 4 VOLTAGE SUPPLY — **$140**
- ±5 Volts, ±12 Volts
- Ideal for use with MULTIFLEX Video Display Terminal, MULTIFLEX Z-80 Computor, or the U of T 6809 computer.

POWERTEC — **$55**
- 18V or 20V or 24V
- 2 Ampere output current
- Overload protection

Music Sythesizer Chips

$9.95 each

SOLID STATE MICRO TECHNOLOGY

SSM 2010	Voltage Controlled Amplifier
SSM 2011	Mic Pre Amp/Level Detector
SSM 2012	Voltage Controlled Amplifier
SSM 2020	Dual Linear Antilog VCA
SSM 2022	Dual Linear Antilog VCA
SSM 2030	Voltage Controlled Oscillator
SSM 2031	High Frequency Oscillator/Voltage To Frequency Converter
SSM 2033	Voltage Controlled Oscillator
SSM 2040	Voltage Controlled Filter Circuit
SSM 2044	4 Pole Voltage Controlled Filter
SSM 2050	Voltage Controlled Transient Generator
SSM 2056	Voltage Controlled Transient Generator
SSM 2100	Two Precision Op Amps, A High Performance Transistor Pair, A Precision Bandgap Voltage Reference

AY-3-8910	$18.95
AY-3-8912	$18.02
SN76477	$5.35
SN76488	$7.00
SN76489	$17.00
8038	$6.65

The Analog Port

The Analog Port will be first of several data acquisition boards to come from MULTIFLEX. This unit will feature expandable RAM and EPROM space, CPU and real time clock. Built in monitor, LCD display, and keypad for stand alone use, either for data display or for easy entry of a user program. 16 buffered analog input channels, 2 buffered analog output channels are available (custom configurable with small, plug on, signal conditioning boards). Differential, current, x-y product (wattage) electrometer with phase sensitive detection. Photodiode input available (Femto Ampere resolution with phase sensitive detection). High impedance, fully protected inputs with switch selectable ranges. Equipped with a high speed serial port (RS-232-C compatible) for communication to a host processor. 24 digital I/O lines for monitoring status and control of external devices. Will digitize at up to 30 KHz rate (suitable for audio).

Features - power down mode allows operation as a self powered data logger over several months.
- uses include laboratory meter or process controller and monitor.

Also to come later, a high speed S-100 board with DMA for data acquisition and signal synthesis at up to 10 MHz.

Price to be announced - see ads in ETI

If you don't see what you want, contact us for pricing and availability

* Call us for price and availability.

Voice Synthesizers

NATIONAL SEMICONDUCTOR
MM54104 DIGITALKER VOICE SYNTHESIZER

DT1053	30.37
DT1054	30.37
DT1055	*
DT1057	30.37

VOTRAX
SC-01 $99.49

T.I. VOICE SYNTHESIS PROCESSORS

TMS 5200 *
- High Quality Voice Synthesis
- TTL Compatible 8 Bit Interface
- On Chip FIFO (16 Byte) Buffer
- Interrupt Driver Service Request Capability
- 1200 Bit/Second Data Rate

TMS 5220
- Male, Female, and childrens voices plus tones, chimes and sound effects
- 8 and 16 Bit Microprocessor Compatible
- On Chip FIFO Buffer
- 1200 Bits/Second Data Rate $26.95

TMS K201: TMS 5200 Evaluation Kit *
- Includes TMS 5200 Processor and A 32K EPROM Programmed with 35 Words/Phases
- Compatible with 8 and 16 Bit Microprocessors
- Complete Users Manual Covers Interfacing and Software Design

SPR000
Interface control logic serial to parallel conversion of address, parallel to serial conversion of data and other control logic allows. SP0256 to access data from industry standard, parrel memories. $7.35

USM2032
Complete speech synthesis module combines SP0250 digital speech synthesizer, 1650A microcomputer and RO-3-9333 ROM to store the speech data. The 3.25 x 5.0 inch board with 15 Pin edge connector forms a self sufficient speech synthesis. Evaluation unit with build in filter and amplifier. The programmed vocabulary of 32 words and syllables can be replaced with a custom ROM or EPROM. $282.33

SPEECH PROCESSORS (GENERAL INSTRUMENTS)

SP0250
6 Stage, Cascaded 12 Pole Programmable Filter Designed to Emulate the Human Vocal Tract 28 Pin Dip $13.25

SP0256
Combines SP0250 Speech Synthesizer, 16K ROM and Controller Into A Single 28 Pin Dip Based on Phonemes This Chip Provides A High Quality Male or Female Voice. $22.48

SP0232
Identical to the SP0256 but with 32K ROM $25.38

SP0200
Combines the SP0250 Synthesizer and Controller into a Single 28 Pin Dip can address up to 491K Bits of ROM $18.38

SPR016 *
16K Serial ROM (2Kx8) Serial In; Serial Out, Auto Increment Address register w/One Level Stack 16 Pin Dip

SPR032 *
32K (4Kx8) Version of SPR016 16 Pin Dip

SPR128 *
128K (16Kx8) Version of SPR016 24 Pin Dip

SPB512
8 Bit x 64 Word FIFO Buffer to Provide Data To SP0256 From Sources Other than above ROMS. This 40 Pin Dip allows address/control of the SP0256 EPROM processor base systems $20.85

SPB640 *
10 Bit x 64 word FIFO Buffer provides same function as SBP512 40 Pin Dip

*** Call us for price and availability.**

Clock Chips

NATIONAL
MM58167—Addressable Real Time-Counters And Latches
- Thousandths of Seconds
- Hundreds and Tenths of Seconds
- Seconds
- Minutes
- Hours
- Day of the Week
- Day of the Month
- Month

—Power Down Mode
—Require 32.768 KHz Crystal, Tuning Capacitor and Load Capacitor to form reference
—Four Year Calendar
—24 Pin Dip $16.52

MM58174—Independent Registers For
- Tenths of Seconds
- Seconds
- Tens of Seconds
- Minutes
- Tens of Minutes
- Day of Week
- Days
- Tens of Days
- Months
- Tens of Months

—Automatic Leap Year Calculation
—500ns Access Time
—Low Power Standby (2.2V, 10uA)
—16 Pin Dip $15.12

OKI5832
18 Pin Dip CMOS Realtime Clock/Calender
- Hours, Minutes, Seconds, Month, Date, Year, Day of Week.
- Standby Battery Operation Down To 2.2V
- 4 Bit Address Bus
- Interrupt Signal Outputs—1024, 1, 1/60, 1/3600 Hz
- 12/24 Hr Format $13.48

OKI58321
16 Pin Dip CMOS Realtime Clock Calender
- Advanced Version of the popular 5832 Chip
- Hours, Minutes, Seconds, 1/10 Seconds, Month, Years (automatic Leap Year Updating), Day of Week. $14.22

Exceltronix

Multiflex Products

Multiflex Z80 Computer Kit

MULTIFLEX's Z80 computer is a versatile and expandable stand-alone computer system designed and built right here in Canada. It uses the newest technology to provide the user with the most capabilities for the smallest price-tag. Its adaptability to any situation and extremely low cost allow it to be used in many applications ranging from a trainer to a complete CP/M-based computer comparable to the best on the market, at a fraction of the price.

The actual layout of the system is a two board design. One board (the "motherboard") contains a 24-line parallel I/O chip for interfacing to the external world, an RS232C serial port with baud rates selectable form 110 to 9600 baud, a hex address and data display, a hex keypad, 14 monitor function keys, 2 user definable keys, a 40-chip wire wrap area with full access to all the bus signals, on-board provision for regulators so that the board can be supplied with standard S-100 voltages, an EPROM programmer which will handle 2708 (1K x 8), 2716 (2K x 8), 2732 (4K x 8), 2532 (4K x 8), 2764 (8K x 8) and the brand new 27128 (16K x 8) EPROMs, a DC-to-DC converter to supply the programming voltage to the EPROM programmer and four (4) slots for IEEE S-100 compatible boards for further expansion. This is an extremely useful and important feature as it allows expansion of the system with all boards using this industry-standard bus structure, which are available from MULTIFLEX, as well as from hundreds of manufacturers worldwide.

The other board is the CPU card. This card plugs into one of the S-100 slots on the motherboard and is IEEE 696/S-100 compatible with the full 24-bit address path to allow up to 16 megabytes of memory to be addressed. The processor used is the Z80 (running up to 6 MHz) and there is provision on-board for 64K of dynamic memory (using 4164 chips) which will operate without wait states. Provided for as well is a 2 K to 32 K (selectable in 2K blocks) common resident area in memory for use with multiple memory banks. There are also 4 sockets on board which will handle 2732 (4K x 8) or 2764 (8K x 8) EPROMs or the new 6116/2016 (2K x 8) static RAMs (all of which can be software deselected if desired) to allow the user complete versatility in setting up the board to meet his own specifications. Also on board is 1 parallel port with 24 lines of I/O and 3 16-bit counter/timers for applications which require the unit to keep track of real time. Another feature of the CPU board is that it was designed by our engineers to run the CP/M 2.2 disk operating system so that if a floppy disk controller board is added to the system a fully configured CP/M machine can be set up for a very low cost.

The monitor software that comes with the kit is a well-written extensive package which allows the user to have complete versatility in machine language programming and execution as well as control of all the features on the board. The monitor functions include: examine/modify memory locations, memory block moves, compare 2 blocks of memory, examine CPU registers, examine I/O ports, load and save from cassette, calculate relative branch offsets, set breakpoints, single step programs, execute programs, and program EPROMs. Each of these processes is invoked by a single keypress. Also available to the user are 2 spare keys definable for special functions as required by specific applications and application programs.

Available as an option, there is a piggyback board which attaches to the CPU board and gives the user a real-time/time-of-day clock with battery back-up, memory management for up to 16M of memory in 4K blocks, 2 RS232C ports which have independant software selectable baud rates, vectored interrupts for the onboard I/O and clock devices, and a general interrupt controller designed to handle multiple interrupts from up to 7 other boards.

All these features make this a very impressive stand-alone unit and, when combined with other S-100 boards either from the MULTIFLEX line or from other manufacturers, give the user the potential for a very powerful microcomputer system.

The standard kit includes the CPU board with a Z80A (4HMz) processor, 2K of RAM (a 6116), and 4K of EPROM (a 2732) as well as the motherboard with all the features mentioned above except the RS232C port and the DC-to-DC converter. Also supplied are sockets for all IC's and 1 S-100 connector.

The MULTIFLEX Z80A, Model I was extremely successful and has proven itself so well that it is being used by many companies, universities and other educational institutions and hobbyists across Canada. The new MULTIFLEX kit is based on the previous one, but is enhanced in such a way that many of the features that present users suggested, and some others as well are included. This, we believe, makes it the best, most economical system available anywhere in the world. There are less expensive computers on the market. However, our new system is designed such that at the start you may pay more. But, in the long run, by the time you put together the entire system, you end up with a very powerful system at an extremely low cost.

Multiflex Colour Video Board Kit

This board is from the line of MULTIFLEX IEEE 696/S-100 products. The board uses the MC6847 for 11 different software-selectable modes ranging from a 16 line by 32 character alphanumeric display to a 256 by 192 pixel graphics display. A strobed parallel port is provided for the attachment of an ASCII keyboard and other I/O decoding is provided for user defined applications. The 6K of static RAM on-board is phantomed into the system to allow the user his full memory capability. A complete RF modulator is included so that the user can connect the board to a conventional TV set, as well as a colour monitor.

Colour Video Kit . . $250
A&T $325

Multiflex 256K - Byte RAM Card Kit

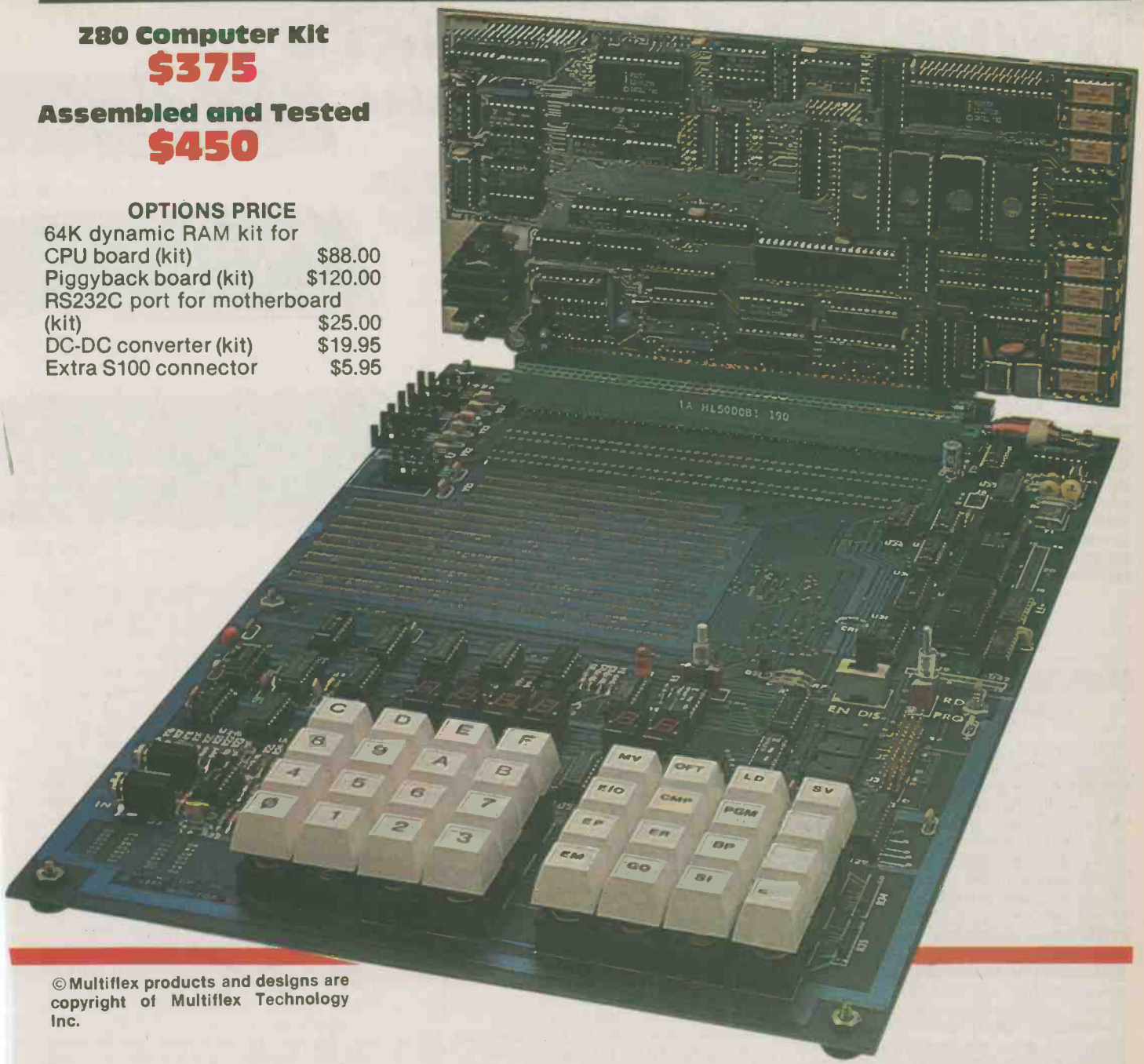
This is a brand new product from the MULTIFLEX line of state-of-the-art IEEE 696/S-100 compatible boards. This board gives the user up to 256K of dynamic RAM with full 24 bit addressing which can transfer data on an 8 bit wide path and in the new IEEE 16 bit method for 16 bit processors. The standard board includes 8 150 or 200ns 4164 64K x 1 dynamic RAM chips (ie. 64K of memory) which will run comfortably at 4 MHz and in some cases may be good up to 6 MHz. However, if it is intended to use this RAM Card solely at 6 MHz, we strongly recommend that you, when you order, specify 120ns 4164's, which can be supplied at a slight additional charge. The refreshing of the RAM can either be handled externally (if you use a Z80 processor) or internally. If no refresh signal is available on the bus (due to wait states or use of a processor that does not supply a refresh signal) the internal refresh acts as a fail-safe, by supplying the refresh signal to protect the contents of your memory. Wait states can be jumper selected in, so that memory not capable of running at the speed of the processor can be used if desired. Another important feature of this board is its compatibility with both the CP/M and MP/M operating systems and a bank-select feature for use of more than one of these boards in the system. There is also a write protect option which allows the user to

Z80 Computer Kit
$375

Assembled and Tested
$450

OPTIONS PRICE

64K dynamic RAM kit for CPU board (kit)	$88.00
Piggyback board (kit)	$120.00
RS232C port for motherboard (kit)	$25.00
DC-DC converter (kit)	$19.95
Extra S100 connector	$5.95



load something (eg. an operating system kernal) into memory and then protect it against accidental erasure. With all these features, you would expect to pay a great deal of money for this kind of board. But all this is available to you as standard items for an extremely low price so that you get the most for your system dollar.

Kit with 64K $295
A&T with 64K $395

The Exceltronix Bulletin Board

In addition to our electronic catalogue we will also shortly have in operation a number of computer bulletin boards (all operating on MULTIFLEX products) which can be accessed by the public. These bulletin boards will allow users to swap technical advice, software techniques, and public domain software. As well computer clubs are invited to use this bulletin board to leave information on their clubs, such as time and place of next meeting, cancellations, notice of special events, etc. MULTIFLEX owners may also wish to consult this board from time to time since a special file will be set up for machine language programs and subroutines which will run on the MULTIFLEX Z-80, U of T 6809 board and the new 68000/8086 computer. There will be no charge for the use of this system however maximum connect times may be established to allow a maximum number of users access to the system. When the system is running the phone numbers will be published in our ad in ETI.

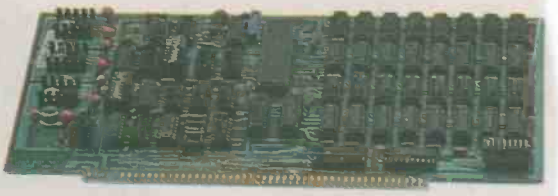
Excelitronix

Multiflex Products

A Comprehensive Range of Multiflex Boards to expand your Computer

Econoram Kit

64K Static RAM Card Kit



RAM 1 Kit

Multiflex Econoram Kit

The MULTIFLEX Econoram kit is a low cost way to add 64 Kbytes of RAM to your IEEE 696/S-100 Z80-based system. The board uses 8 150 or 200ns 4164 64K x 1 dynamic memory chips, refreshed by the signal supplied by the Z80, which allows the chip count to be kept to an amazing 25!! Since the chip count is so low, there is room on the board for a 28 chip wire-wrap area for custom user circuits. A latch address at I/O port FFH (supplied on each board) allows up to 16 such boards to be used in a system for a total of 1 Mbyte of memory. These boards may be used in a memory-mapped I/O system due to the inclusion of a phantom line which disables the board when activated. The other important feature of the board is that it requires only a +8V (jumperable to +5 if your power supply is already regulated) power supply. This board is superb for the person who wants to add extra memory, but doesn't want to spend extra money.

Kit $179
A&T $250

Remember, we maintain a professional service staff

Multiflex 64K/Static RAM Card Kit

This is one of the new high technology boards in the MULTIFLEX line of IEEE 696/S-100 compatible computer board kits. Using the new 2K x 8 static RAM chips, the user can have 64K worth of RAM in his system without having to worry about the timing problems caused by refreshing. In the standard kit the user is supplied with the NMOS 2016 chip, but for a slight additional charge CMOS 6116 chips will be supplied so that with the optional battery backup circuit, memory can be retained up to one year after a power down situation occurs. Other features include a deselect feature for each 2K chip (in the range C000H to FFFFH) so that the RAM card does not conflict with system EPROMs and the fact that any RAM chip can be replaced by a standard 2716 EPROM. A battery charger circuit is provided for the batteries used in the power-down back-up circuit. Also, the board may be disabled during memory-mapped I/O operations by use of the S-100 "phantom" signal. This board is a very inexpensive way to add 64K worth of RAM to your S-100 system.

Kit with 16K $325
Kit with 32K $400
Kit with 64K $499
A&T with 64K $599

Multiflex RAM 1 Kit

The RAM 1 kit from MULTIFLEX is the first in a series of IEEE 696/S-100 RAM cards. Based on the 8202 Dynamic Memory Controller chip, which minimizes wait states and allows on-board refresh, each board can hold up to a maximum of 64K bytes of 200nS 4116 memory chips (ie. 32 chips). The board has a software bank-select feature allowing up to eight (8) full boards to be used in a single system. If the user uses a slightly modified addressing scheme, any microprocessor can access up to 512 Kbytes of memory. To maximze flexibility, hardware jumpers are used to select certain functions on the board, allowing for variations in user applications. Firstly, the refreshing of the memory chips may be done internally by the 8202 (this is transparent to the system) or externally if the proper signals are available from some other board in the system. Secondly, the memory map on the board may be defined in 16K blocks by use of jumpers. This feature is used mainly with partially populated boards, however it may also be used as a limited write protect feature. As with all other boards in the MULTIFLEX line, the S-100 bus is fully buffered. All these features make this board an excellent way to add more memory to your S-100 system.

Kit with 16K $295
Kit with 64K $350
A&T with 64K $450

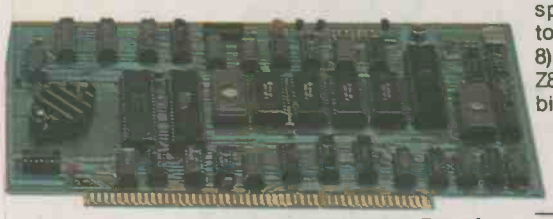
Multiflex Economy Video Board

This is yet another of the exciting new IEEE 696/S-100 compatible products from MULTIFLEX Tech. Inc. This board is an intelligent, I/O mapped, 80 x 24 Video Display Board. Based on the 8275 programmable CRT controller, the 8257 programmable DMA controller, and a Z80 processor, this board has many extremely useful features that are extremely simple for the user to implement. Provided on board is 8K of static RAM which gives the user 3½ screens of text. With simple commands, the user can easily scroll around in this buffer, clear the present page and home, home on the present page and go to the beginning of the buffer. There are also 4 field attributes (blink, reverse video, underline, and highlight) which can be turned on and off by software. Other software commands include a carriage return, line feed, clear to end of line; transmit cursor location; transmit character at cursor location; position cursor; disable control functions; reset control register; as well as all the standard functions such as tab return, line feed, and backspace. Also included in the software is a debug/setup program which completely tests the board and allows the user to set up various parameters on it. The output from the board is in either composite video or a video signal with separate horizontal and vertical sync signals (either normal or inverted). All this makes this board a superb value in an S-100 video board.

Kit $295
A&T $375

Floppy Disk Controller Kit

Zilog CPU Card Kit



Economy Video Board

Zilog CPU Card Kit

MULTIFLEX is pleased to announce its new IEEE 696/S-100 based processor card kit using the ZILOG series of processors and support chips. The Z80 processor can be jumper selected to run at 2 or 4 MHz. Also selectable, on 4K boundaries is the reset/power-on jump. There are 2 Z80-PIO parallel port chips on board which provide 32 fully programmable I/O lines. One (1) RS232 port and 1 TTL-level serial port are also provided for by use of a Z80-DART integrated circuit. If the user wishes to have syncronous serial data transfer, he can simply replace the Z80-DART with a Z80-SIO/0 and he will have all the standard features of the DART along with syncronous data transfer. There is no RAM provided for on-board, however there is a space for a EPROM which can be selected to be either a 2716 (2K x 8) or a 2732 (4K x 8). Also, the board takes full advantage of Z80 vectored interrupts and priority arbitration.

Kit $275
A&T $350

With every Multiflex Kit you get 2 hours free service.

Multiflex Floppy Disk Controller Kit

The MULTIFLEX floppy disk controller is a state-of-the-art IEEE 696/S-100 compatible board. It allows the user to interface, simultaneously, up to four (4) 8 inch or 5¼ inch disk drives in any combination to his system with the flexibility of single/double sided and single/double density operation. If desired, all operations can be done using DMA techniques with the optional on-board controller or under processor control. To assist the user in first setting up and using his board, the latest technology has been used. An auto-control phase lock loop single IC circuit has been included on the board, which means no setup or adjustment is necessary. The board is designed around the FD-1793 controller chip for easy use under any operating system. However, this board is especially designed for easy use with the CP/M or MP/M operating system (available as an option) and the MULTIFLEX Z80 computer kit. With all these features and its reasonable cost, this board is one of the best buys in a floppy disk controller board on the market today.

Kit $295. A&T $395
DMA Kit $29.00
CP/M (with BIOS) $169.00

Multiflex Video Character Display Board Kit

The MULTIFLEX Video Character Display Board is the first in a line of IEEE 696/S-100 compatible video display boards. With its own Z80 microprocessor and 6845 CRT controller, this board uses only 2 I/O ports with full handshaking and interrupt capability. There are 12 Kbytes of on-board RAM for screen buffering, with bus arbitration built in. This means that the on-board processor can access the screen RAM at any time without interfering with the display (or without encountering wait states), which make extremely rapid screen updates possible. There is provision for up to 16K of program EPROM (using a 27128), so the user can customize his software to his requirements. A standard keyboard connector is furnished for addition of an ASCII keyboard. A 4K EPROM character generator containing 128 ASCII symbols and 128 block graphic symbols is one of the standard features of the board. As well, a 4K RAM bank is set aside for the user to program up to 256 custom characters and symbols in software. This allows a choice of up to 512 displayable characters to be in the system (and on the screen) at any one time. Four displayable attritibutes are available to be used in any combination for any character on the screen. These are inverse video, blinking video, underlined and a 4 bit grey-scale which will give either bright or dim characters. The 4-bit grey-scale can be turned into colour if the optional piggyback board (described later) is added.

This board was developed to give the maximum flexibility so the user can meet his display requirements. To this end, there are numerous software selectable features. There are four selectable modes for screen display, which are 24 lines of 80 characters, 48 lines (interlaced) of 80 characters, 24 lines of 132 characters, or 48 lines (interlaced) of 132 characters. Also selectable is the character size. It can either be 5 x 7 pixels in a 6 x 10 block or 7 x 9 in an 8 x 12 block.

On a board with these superb text handling capabilities, one would not expect bit-map graphics. The MULTIFLEX Video Character Display does have that capability! The user can software select one of three modes: 320 x 240 pixels in 1 bit-plane; 256 x 192 pixels in 2 bit-planes; or 176 x 132 in 4 bit planes. Each bit-plane can either be used as part of a grey-scale (ie intensity, or colour select if the user has the piggyback board option) or as a separate screen of single intensity bit-map graphics.

Available as an option for the board is a piggyback board which gives the user some enhanced features over the standard unit. 2K of RAM is located on this board for the user to add his own custom subroutines to the software included in the board. This RAM can be loaded directly from the S-100 bus. Another 2K is available for use in a print spooler buffer which will allow the main processor in the system to perform more of the functions it was designed for and not be tied up doing mundane I/O chores. this print spool area is connected to a standard Centronics-type parallel printer port. Three (3) 16-bit counter-timers provide software selectable baud rates for a complete RS232C serial interface (which also includes extension connector), as well as real-time clock interrupts. When the piggyback board is added to the Video Display Board, colour then becomes available to the user. On the piggyback board are 16 12-bit registers which allow the user to software select 16 colours from the 4096 possible colours. An RGB colour monitor and NTSC-encoded UHF RF-modulator output are both provided for attachment of different monitors or even an unmodified TV. A light pen option is also built onto the board and this as well as all other devices have interrupt capability in the system.

All these features! But that is still not all! The MULTIFLEX Video Character Display Board also can be used as a stand-alone intelligent terminal with default set up parameters, set up by jumpers. The board can also be used as a terminal emulator in an IEEE 696/S-100 system with complete control commands and local editing. That's just one more thing which adds up to show that the MULTIFLEX Video Character Display Board is one of the best on the market, especially in its price range.

Main Board Kit $295
Piggyback Board Kit $195
Both A&T $649

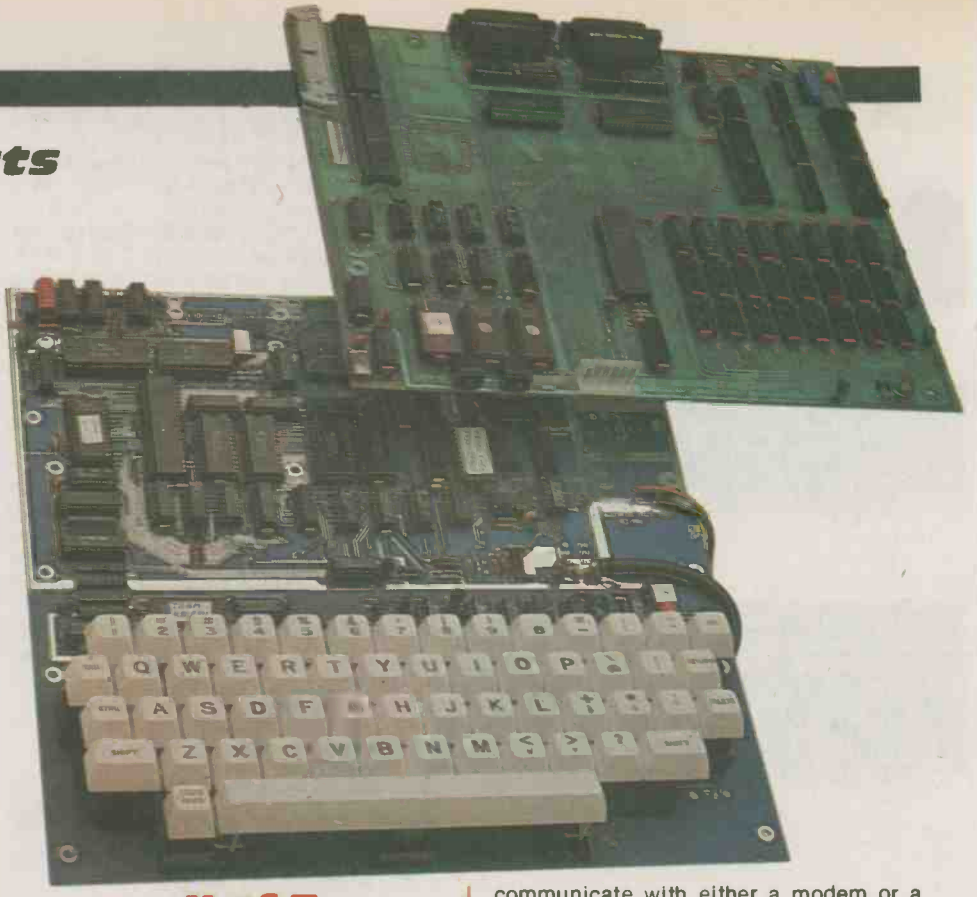
Excelltronix

Multiflex Products

Multiflex Economy Video Display Terminal Kit

Now available from MULTIFLEX is an economy video display terminal. Originally designed as a low cost access unit for our soon to be operational computerized mail-ordering and bulletin board system, this terminal is a semi-intelligent system which is controlled by a Z80A microprocessor and a 6845 CRT controller chip. The keyboard is fully ASCII encoded and the character generator contains the full 128-character set as well as a 128-character alternate set both of which are in the 5x7 dot matrix format. The screen display is 80 characters by 24 lines if the unit is hooked to an external monitor (not included) or 64 by 24 if run through an RF modulator to a TV. There are 3 software selectable attributes (dim, reverse video, and alternate character set) which can be chosen one at a time for the whole screen. This attribute can then be switched on and off for each individual character. A 2K buffer is provided for normal operation. However when the optional 6K memory upgrade is purchased, 4 screen pages can be loaded from the host machine, edited locaiy, and then downloaded back to the host again saving on connect time and phone line bills. Also included are 2 RS232 ports: one for a modem and one so that a printer can be attached to the terminal. The baud rates on these ports are software programmable and can range from 110 to 9600 baud. The MULTIFLEX Video Display Terminal has provision for an on board modem freeing a serial port. With all these features, you would expect to pay a lot for this kit, but all this is available to you, complete with a case, for an extremely low price.

Kit $259
Kit & Case $289
A&T plus case $369



U of T 6809 Single Board Computer

The 6809 Single Board Computer, designed at the University of Toronto and distributed exclusively by EXCELTRONIX, is a compact hardware unit which was designed originally as a lab board for teaching students about microprocessor systems. Its many features, however, make it an ideal unit for stand-alone control applications or software development systems as well.

The system is designed around the Motorola MC6809 microprocessor. This is an 8-bit processor with full 16-bit internal architecture, 2 index registers, 2 stack pointers, 2 8-bit or 1 16-bit accumulators, a direct page register and a wide range of addressing modes, including a program-counter-relative mode. This mode allows the user to write completely position independent software, important in systems software development.

There is provision for up to 48K bytes of dynamic RAM on-board. The refreshing of this RAM is controlled by an 8202 Dynamic RAM Controller. This chip allows for completely transparant refreshing of the RAM (ie. no wait states to slow the system down). There is also provision for up to 12K of EPROM using either 2532 or 2716 chips.

There are 4 complete I/O circuits built onto the board. 2 of them are serial (RS232); one is used for a terminal (which is required for use of the board with the supplied monitor software), and the other one is user defineable, but it is set up to communicate with either a modem or a printer. Also on-board are 2 6522 VIA chips. These provide 2 parallel ports per chip along with 2 16-bit timer/counters. One of the parallel ports and one of the timers are use by the monitor software to provide a cassette interface (which operates at 300 baud). The second parallel port on that chip is wired into a connector which is ideal for interfacing a parallel printer or keyboard. The 2nd VIA is not used at all and is completely free for the user. For further expansion of the system, a fully buffered version of the CPU signals (data, address, control lines and a signal indicating whether or not the current address is located on the board) is available at a cable connector.

The software provided with the system is in a 2532 EPROM and allows the user to: test the memory; dump blocks of memory; examine and modify single memory locations; read or write from the cassette port; set and examine breakpoints; single step and/or execute machine language programs and set and examine the processor registers. All this is accomplished through a 9600-baud terminal interface (one of the serial ports) Available as an option is a full screen editor/assembler which allows the user to work in 6809 assembly language rather than machine language. All this makes this board an ideal trainer, control unit or software development unit for just about anyone.

Kit with 16K $369
A&T with 48K $499
Editor/Assembler $169

Special Pricing is available when both items on this page are purchased together

Multiflex Products

Multiflex Single Board Computer System

Into the new era of computing, steps the MULTIFLEX Single Board Computer System. With its versatile features and state-of-the-art design, this unit will be a leader in the single board system field.

Designed around the IEEE 696/S100 bus for easy expansion, this unit uses a Z80 series processor and is capable of running at up to 6 MHz. An auto jump-on-reset to any 1K boundary (jumper selectable) gives the user complete flexibility in designing his own software to run the system. Another jumper option is the designation of no wait states on memory accesses, wait states on all operation code fetches, or wait states on all memory operations allowing the user to fill his system with slower, less expensive memory chips. Also furnished are four (4) sockets, jumper configurable for any mix of the following chips: 6116/2016 (2K x 8 static) RAM; 2716 (2K x 8), 2732 (4K x 8), or 2764 (8K x 8) EPROMs. Any combination of these sockets can be enabled to shadow all other memory which would address these locations, and any of these sockets can be software disabled if desired.

Full memory management is provided which will turn the Z80's 64K address space into 16M by allowing 16 4K blocks to be placed anywhere within the 24-bit address space allowed for in the IEEE 696/S-100 standard. It is also possible to create an area (ranging in size from 2K to 32K), within each standard 64K bank of memory, which is common to all banks, making the implementation of CP/M, MP/M or other operating systems a breeze. Also on-board is room for up to 256K of dynamic RAM, and the memory management applies to this RAM, all the other memory on-board and also to any memory located on the S-100 bus so that a full 16M multi-user system is possible.

For interfacing to the real world, the user again is given full flexibility to configure the system to his own needs. Supplied are 3 independent software or hardware controlled 16-bit timer/counters, 2 of which can be used as the base for software selectable baud rates for the 2 on-board RS232C serial ports. Both of these ports can be programmed for either syncronous or asyncronous operation. A full 24 line software controlled parallel port and a real time (time-of-day) clock, which can be backed up with batteries if the user wishes, are furnished as well.

A complete floppy disk controller is also included with the system. Any combination of up to four (4) 5¼ or 8 inch drives running single or double density and single or double sided can be attached to the board. The newest technology was used in designing the phase lock loop (data separator) giving a highly reliable all-digital circuit requiring no adjustments. A write precompensation circuit is also provided for proper operation in the double density mode.

The real-time clock, the floppy controller, the timers and any of the I/O ports can be chosen to operate with selectable priority interrupts. A second interrupt controller allows the on-board interrupts to function in a jumper selected priority scheme with up to 7 other interrupt-driven boards on the S-100 bus.

There is also a complete video section onboard, which includes an ASCII keyboard port and a Centronics-style printer port all controlled by a second Z80 processor to dump text to be printed to the print spooler and continue with its tributes with a 2K buffer. The printer port is controlled by the second Z80 and has a print spool area which allows the main processor to dump test, to be printed to the print spooler and continue with its main duties. The output of the video section is in either composite video or through an optional RF modulator.

In the near future, packaging will be available separately which will provide for 2 slim-line 5¼ inch disk drives, mounted side by side vertically, a nine inch video monitor in the middle, and internally at the other end, room for an S-100 backplane into which the Single Board Computer can plug (it is terminated in a S-100 male card-edge connector). This backplane can hold up to 6 additional S-100 boards (extra memory, A/D + D/A, colour video, etc.). A switching power supply will be mounted internally and a hinged external keyboard along the front will be part of the package. All this will result in a portable system which will run CP/M and all its compatible software and will be able to run off your car battery or fit under an airplane seat.

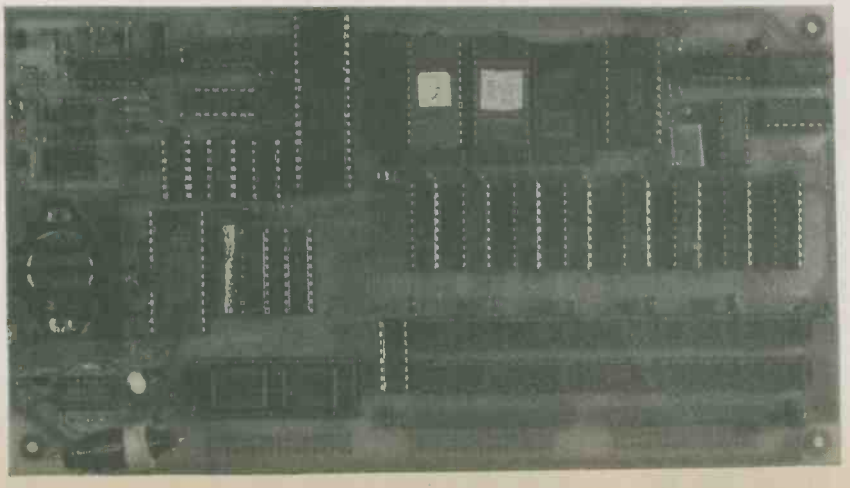
Overall, this system, with its numerous features, can be many things to many users. Its most attractive feature, however, is the price.

Kit with 64K $599
A&T with 64K $795
CP/M (with BIOS) $169

Multiflex Speech Evaluation Board

The MULTIFLEX Speech Evaluation Board is a 13.5mm x 24mm board requiring a single 8-12V supply based on the TMS5200 Voice Synthesis Processer and a 4MHz Z80 microprocessor. This combination allows the user to access up to 48K (using 3 27128 EPROMS) of preprogrammed speech data. Each EPROM socket is independantly jumpered to allow the user to use 2732 or 2764 EPROMs where large amounts of speech data are not required.

The Speech Evaluation Board can be controlled by either manual switches or an external processor. Using switches, up to 64 messages, each consisting of one or more words can be called. If the Board is controlled by an external processor, then up to 254 messages can be chosen.



Interfacing to the external 8 or 16 bit processor is done via a 24-line parallel port which can be custom programmed by the user. When using this feature, it is also possible for the user to store approximately 2k of data in the on-board buffer for execution by a single control signal.

Two on-board amplifiers are furnished, one for driving a small speaker, the other for driving larger speakers. A means for controlling the volume and the tone of the voice are also provided. Users may select words from the MULTIFLEX library for custom programming.

Kit with 32 word vocabulary $169
A&T $250
Extended vocabulary available at extra cost

Exceltronix

Multiflex Products

Multiflex Low-Cost Logic State Analyzer

You've just completed a microprocessor system, and it doesn't work. What next? You can use an oscilloscope to check for clock signals and the like, but if everything appears to be in order you can't go much further without sophisticated equipment. In these situations, professionals turn to their logic state analyzers, each of which cost thousands of dollars. MULTIFLEX has the answer for all those people who don't want to take a mortgage on their house just to get a computer working. The MULTIFLEX Logic State Analyzer has all the essential features of those more expensive units at a fraction of the cost. This is a high-quality piece of test equpment, suitable for industrial or scientific use, but its price is well within the price range of a hobbyist.

Easy to understand and operate, the Logic State Analyzer allows you to monitor 16 points in a digital system (ie. data and/or address bus, or control lines) which carry continually changing signals. You can select a bit pattern you expect will appear at these points. Once the pattern appears the Analyzer will trigger and record ("freeze") the next 1023 bit patterns so that they can be examined step by step even though data is no longer available in the unit being examined. For software development the Analyzer is invaluable, especially in dedicated systems. If you design a microprocessor system for a specific function, and you have no monitor, assembler or other such software, the best and often only way to debug the system is to use a logic analyzer. It will let you look closely at the data flow as a program is executing, or monitor the address lines to make sure that the instructions are being executed in the proper sequence. The various control lines such as memory read and write, DMA, interrupts, or enable and disable signals can also be examined. You can, of course, monitor any combination of these signals, such as the data bus and half of the address bus, or half of each plus 4 control lines. The combinations are endless.

A special feature of the MULTIFLEX Logic State Analyzer is that any number of units can be interconnected for dealing with larger input words. With two Analyzers, you can monitor the address and data bus of an 8-bit processor at the same time and have 8 spare signals to monitor the control lines, I/O signals or signals from external devices. Anyone who will be doing any systems debugging should take a close look at this unit, since its features and low price tag make it an asset.

Kit with case $295
A&T $395

Multiflex Industrial Timer

This stand-alone computer combines the functions of an electronic stopwatch (actually six of them, all implemented in software) with I/O hardware to allow event detection and control of external equipment under precise timing. All aspects of its operation are user-programmable, however no knowledge of conventional computer programming is required.

The unit contains six independent real-time clocks, each with a resolution of 1/100th of a second. An 8-digit LED display allows the time value of any of the clocks to be displayed, in either 24-hour format or 12-hour format with full AM/PM indication. A serial time-code output alows the use of external displays. Five of the clocks can time up to a maximum of 24 hours, while the sixth can go up to one full year.

A keyboard on the Timer allows the user to program its operation. The five 24-clocks may be started, stopped, or cleared for simple "stop-watch" functions, or preset to any starting time. Each clock may be programmed to count either forwards or backwards, and may be assigned a limit. The clocks can initiate various outputs to external devices upon reaching their assigned limits, and these actions are totally programmable by the user. One special feature of the Timer is that when a backwards-counting clock reaches it limit, it will automatically switch to forwards counting for an "elapsed time" indication.

Six pulse inputs are provided, which may be programmed to start, stop, or clear any combination of the clocks. These inputs can also be software-associated with the various outputs, allowing each of the clocks to start, stop, or clear other clocks. In this way complex or interactive timing routines can be programmed.

Kit $249
A&T $349

Multiflex Gang Programmer

This is a small unit, which plugs into the EPROM programming socket on your MULTIFLEX Z80 computer kit and attaches to the parallel port as well. It allows the user to program and verify a number of EPROMs of the same type with the data at the same time. This may be a simple item but it is very useful when doing mass production of sets of EPROMs. The unit, complete with software and instructions, sells for

Kit $150
with ZIF sockets
$250

Multiflex E + PROM Programmer

This low-cost stand-alone unit allows the user to program just about any EPROM or TTL prom on the market today. When the proper personality module is chosen, the data is sent, received and the unit controlled via the built-in RS232 port. This makes this unit ideal for low volume programming applications where a wide range of chips must be handled.

Kit $150.00
A&T $200.00

13 Slot Motherboard/ Backplane

This board was designed as an ultra-reliable S-100 backplane for small business and personal computer systems. Ideal for high speed applications, it was designed to:

1) Cut down on glitches and noise on the power supply lines through the use of bypass and decoupling capacitors on each of these lines.

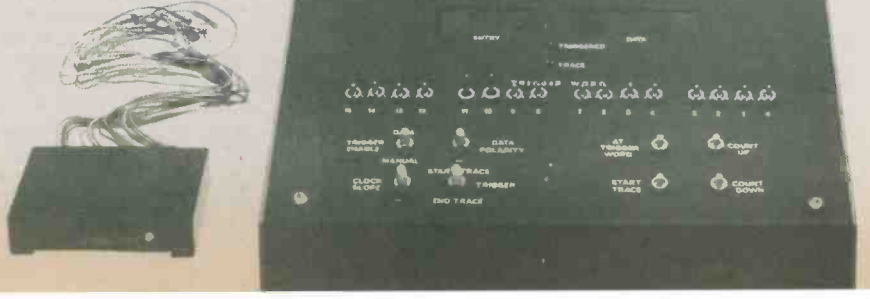
2) Stop reflection and noise on the signal lines with active termination by maintaining a terminal voltage, one each signal line.

3) Prevent crosstalk between signal lines with an interlaced ground system.

The overall size of the board is 8.5" x 11.5".

Bare Board $49.00

The Multiflex LSA



Multiflex 68000/8086
Single Board Computer

The MULTIFLEX 68000/8086 Single Board Computer allows the user to enter the world of 16-bit computing at a low cost, with the option of turning his system into a very powerful system very easily.

The most important feature of this system is the processors, or rather the choice of processors. The processors are on modules which can be plugged into the main board. As the title suggests there is a choice of two: a Motorola MC68000 or a Intel 8086. Both of these processors run at 8 MHz. The choice allows the user to pick the processor to fit his specific needs.

The 68000 is Motorola's venture into the world of 16-bit microprocessors. The 17 internal registers consist of 8 32-bit data registers (which are addressable as 8, 16, or 32-bits wide); 7 address registers and 2 stack pointers. There are two stack pointers supplied because the 68000 has two operating modes: a Supervisor mode, under which all instructions can be executed (this is the mode in which the operating system runs), and a User mode in which the privileged instructions of the operating system can not be executed. One stack pointer is supplied for each mode and the user cannot address the supervisor's stack pointer. Also, a separate 16-bit data path and 24-bit address path are supplied on the chip so that no external de-multiplexing is needed. These features make the 68000 ideal for a multitasking environment or development of high-level languages.

The 8086 is an upwards-compatible member of the 8080 family of microprocessors. This means software compatibility between the older 8-bit machines and this 16-bit unit. The registers in the machine have much the same layout as the 8080, only 16 bits wide instead of 8 bits. Directly, the 8086 can address up to 1M bytes of memory through its multiplexed data/address bus. With some of the standard operating systems, such as CP/M-86 or MS-DOS, the user can have access to the large amount of prepackaged software available for the 8086.

Memory on-board is available in a modularized form. Two types of modules are available. One is an EPROM/static RAM module which will handle a full 64K words of memory. This is the type of module that a monitor or the kernal of an operating system would sit in. The other module will have up to 128K words (256K bytes) of dynamic RAM. These modules can be added to the system whenever the user wants, so that memory expansion is a breeze. A memory management module is available as well so that the user can add more memory to the system through the fully configured IEEE 696/S-100 bus connector past the addressing range of the chip in question.

Many I/O features are also furnished on the board! A bus for interfacing ZILOG Z80 series chips is provided for the user to interface standard I/O devices to his system. Four sockets are provided on the board so the user can plug in 4 Z80-DARTs and have 8 serial ports on his system. These ports are fully software controlled, including the baud rate. Three 16-bit timer/counters and a 24 line parallel port are also provided on-board. A complete floppy disk controller is available on-board so the user can run any of the standard operating systems for the processor he has in the board.

Two complete video sections are standard with the 68000/8086 single board computer. One is an 80x24 alphanumeric display with terminal emulation features, and the other is a 256x256 dot-addressable graphics display. Both displays are hooked to two outputs: a composite video output and an RF output so that the board can be attached to a standard TV set.

Every mircocomputer system requires some software be on-board when it is powered up. The monitor software that is included with the single board computer includes a powerful set of instructions which allow manipulation of memory and machine language programs in either 68000 or 8086 machine code on a EPROM module.

All these features make this MULTIFLEX 68000/8086 Single Board Computer a superb unit for the person who wants to get into 16-bit computing at a low cost, yet have the capability to move up to a extremely powerful multi-user system.

Basic Kit $695
A&T $869

Osborne
$2395

Osborne 1 Personal Computer

Special: $2549 including 12" Monitors & Vidadapt

The OSBORNE 1 Personal Business Computer was designed, built and priced with just one objective: to make you more productive in your work, business or profession. The OSBORNE 1 system is delivered with the hardware and software you need to get to work right away. The programs supplied with the OSBORNE 1 are easy to learn, and easier to use. The OSBORNE 1 is totaly CP/M compatible which allows access to thousands of software packages that have been developed to run under this disk operating system.

The standard features include: * a Z80A microprocessor running at 4 MHz * 64 Kbytes of RAM * dual floppy disk drives each capable of storing 92 Kbytes of information (approx. 55 pages of typed, double-spaced text) * an RS232C asyncronous serial port for connection to serial printers, or any other device using this industry standard interface * a modem interface port for easy attachment of a modem which permits inter-computer communication * an IEEE 488 interface for data communication to test instruments or parallel printers * a clear, 5 inch, 24 row screen, which will display a 52 character window on a 128 character line with automatic scrolling * a standard typewriter style keyboard * a numeric keypad * cursor control keys * 10 programmable function keys * a fully portable case * a complete, well written users manual * and five (5) disks full of software!

The software packages included are:

CP/M: The world's most widely used disk operating system, which is now considered an industry standard. Not only do you get the disk operating software, also included is an ASCII file editor, an 8080 assembler, a Dynamic Debugging Tool (DDT) for use in machine language debugging/disassembling, a file transfer program, and lots more.

WORDSTAR/MAILMERGE: This powerful, easy-to-use word processor has been ranked one of the best on the market. MAILMERGE is an added feature for producing form documents and labels, and merging separate files of data into a single document.

SUPERCALC: SUPERCALC is a management-oriented software tool that provides the user with the means to manage and manipulate data interactiyely in the spread-sheet format.

CBASIC: A commercially oriented BASIC compiler/interpreter which comes with the compiler, a run-time, monitor and a cross referencer for listing all the variables in the source program.

MBASIC: (BASIC 80) The industry standard BASIC by MICROSOFT which supports enhanced features such as random disk I/O, line editing, single and double precision floating point math, and direct CPU, I/O or memory control.

Exceltronix

CP/M Software

All software requires SB-80™ or CP/M 80 compatible operating system (unless otherwise stated) Price: System + Documentation.

Accounts Payable (PTREE)	742
Accounts Payable (SSG)	1175
Accounts Receivable (PTREE)	742
Accounts Receivable (SSG)	1175
ALGOL-60	350
Property Management (Amer. Soft)	1395
Analyst	350
Angel	400
Apartment Mgmnt. (Cornwall)	1275
APL/V80	700
BASIC-80	469
BASIC Compiler	500
BASIC Utility Disk	109
baZic II	210
BD Software C Compiler	210
Benchmark	695
Benchmark Mail-list	559
BOSS Financial Accounting Package	3495
BSTAM	565
BSTMS	565
BUG and uBUG	179
CBASIC-2	175
CBS	550
CIS COBOL (standard)	1190
CIS COBOL (compact)	910
Nevada COBOL	210
COBOL-80	995
CONDOR	975
DataStar	490
Databook II	415
dBASE II	980
DESPOOL	115
DISILOG	155
DISTEL	155
Documate/+	245
EDIT	179
EDIT-80	139
FABS	275
FABSII	350
FORTH	350
FORTRAN-80	600
FPL	1043
General Ledger (PTREE)	742
General Ledger (SSG)	1175
Graf Talk	630
Guardian	175
Hard Disk Integration Modules	175
when purchased simultaneously with Lifeboat CP/M-80 version 2.X	80
HDBS	420
IBM/CPM	425
Interface Break-Out Monitor	149
Introduction To Pascal (BOOK)	14.95
Inventory (PTREE)	742
Inventory (SSG)	1175
KBASIC	820
Letteright	280
MAC	169
MACRO-80	225
Magic Wand	550
MAGSAM III	200
MAGSAM IV	415
MAGSORT	385
Mailing Address (PTREE)	742
Mail Merge for WordStar	210
Mail Merge wirh WordStar	800
MDBS	1275
MDBS.DRS	425
MDBS.QRS	425
MDBS.RTL	425
MicroLink-80	259
MicroSpell	350
Microstat	415
Mince	245
MP/M-II	630
M/SORT for COBOL-80	225
M/SORT with COBOL-80	1185
muLISP/muSTAR-80	295
muSIMP/muMATH-80	365
NAD	160
PAS-3 Dental	1395
PAS-3 Medical	315
JRT Pascal	315
Pascal/M	245
Pascal/MT	350
Pascal/MT + with SPP	700
Pascal/Z	550
PASM	180
Payroll (PTREE)	745
Payroll (SSG)	1175
PL/I-80	700
PLAN80	415
PLINK	180
PLINK II	490
PMATE	275
Postmaster	210
PRISM/LMS	350
PRISM/IMS	695
PRISM/ADS	1115
Professional Time Accounting	835
Property Management (PTREE)	1298
PSORT	140
QSORT	140
RAID	350
RBTE-80	1050
Reclaim	115
Sales Pro	490
S-BASIC	415
Selector III-C2	415
Selector IV	770
SID	169
Spellguard	415
Stiff Upper Lisp	230
Statpak	695
String Bit	105
STRING/80	135
Super Sort	315
TEX	149
Textwriter III	175
Tiny C	147
Tiny C Two	350
T/MAKER II	385
Ultrasort II	273
Series 8000 Dental Management	1050
Series 8000 Medical Management	1050
Series 9000 Dental Management	1330
Series 9000 Medical Management	1330
Series 9000 Insurance Agency Management	1330
Unlock	135
VISAM	280
Whitemiths C Compiler	1400
Wiremaster	210
WordIndex	546
WordMaster	203
WordStar	623
WordStar Customization Notes	693
XASM:05, 09, 18, 48, 51, 65, 68, F8. 400 (each)	280
XMACRO-86	385
ZAP80	245
ZDT	70
when ordered simultaneously w/Z80 Dev. Pack	49
ZSID	182
Z80 Development Package	182

Prices and specifications are subject to change without notice.

Multiflex Z80 Card for the Apple

New in the line of MULTIFLEX products for the APPLE II+ computer is the Z80 card. This card when installed in your APPLE give you an option on which processor you can use for a specific application, by giving you a Z80A processor in addition to the 6502 already on board. With the optional CP/M and an 80-column board (such as the MULTIFLEX Video80 board) you can have a fully configured CP/M system running on your APPLE.

$150

Multiflex EPROM Programmer for the Apple

This product from the line of APPLE II+ compatible products by MULTIFLEX allows the user to develop his own firmware with all the resources of the APPLE and then blow his own 2716 or 2732 EPROM right there in the system. All the software necessary to control the board is included with the board.

$150

TEC Products

TEC-Writer I — Dot Matrix Printer

$645

FEATURES

- Low Cost
- Excellent Print Quality
- 80 Characters per second
- Logical Seeking Bi-Directional
- Graphics Printing Capability
- Self-Diagnostic Capability
- 96 ASCII Character Set Plus Block Graphics Characters
- Long Life Print Head
- Variety of Interfaces
- Tractor and Friction Feed Standard

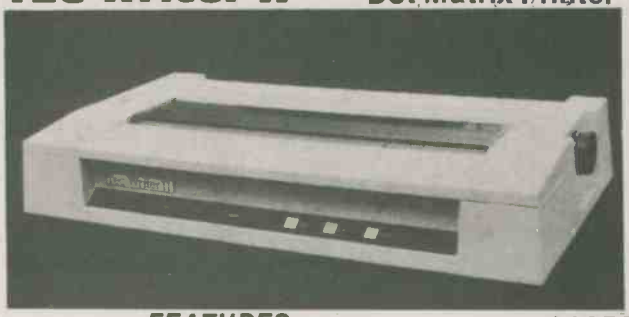
TEC-Writer III — Daisy Wheel Printer

$2450

FEATURES

- High quality print
- 8085A, CPM controlled
- High reliability
- Low profile, 6" height
- Industry standard daisy wheels ribbon cartridges
- 40 C.P.S. Print Speed
- Paper and ribbon out alert
- Cast aluminum frame
- Universal power supply
- Self test capability
- 2K buffer
- Friction feed
- Built in word processing functions
- Low noise

TEC-Writer II — Dot Matrix Printer



$1250

FEATURES

- Compact desk-top dot matrix printer
- 136-column print
- Light-weight
- Low power-consumption
- High-quality print
- Bit image graphics
- Graphic Symbols
- Prints in six different languages
- High reliability
- Low cost
- Friction and tractor feed
- High speed, 120 C.P.S.
- Logic seeking, Bi-directional
- Self diagnostic capability

Slim Line Disc-Writer

Works with Apple II

FEATURES

- Single Sided, Single Density
- Auto Select 13 or 16 Sectors (DOS 3.2, 3.3)
- Half Tracking
- Low Power
- Low Profile H 1.69" x W 5.88" x L 7.4"
- Capacity 125K Bytes
- Transfer Rate 125K Bits/Sec
- Operating Temperature 0 to +52°C
- Model AAA-1 with Controller $599.00
  Model AAA-2 without Controller $549.00

Versatile Communications Board

Communication between APPLE and peripherial equipments is made easy with the Versatile Communication Board (VCB-1)

The VCB-1 allows instant connections of both parallel and/or serial devices on to the Apple bus. CRT terminals, printers, modem, keyboard, A/D, D/A converters, machine tool controllers, and communication links can be connected directly to the VCB-1.

Operation are simplified by using the VCB-1 menu driven software utilities on diskette. With simple control commands, users can configure the 32 programmable I/O channels, control the two 16 bits timer/counters for time event applications, specify baud rate and to do file transfer between Apple telephone lines.

The VCB-1 represents the optimum use of the APPLE slot and is flexible enough to interface to almost any I/O devices without the need of additional extend logic.

FEATURES:

*Low cost and easy to use
*32 programmable I/O channels
*Two 16 bits programmable timer/counters
*High speed serial channel up to 1M baud
*Software selectable baud rates from 50 baud to 19.2K baud
*Asynchronous or Synchronous operation, including IBM "Bi-Sync"
*Full modem control signals, including DCD and DSR
*Serial I/O interface conforms to RS-232C
*Built-in data link diagnosis capabilities
*Prototype area provided on board for user development
*Menu driven programs on diskette
*Utilities for VCB-1 I/O configurations and files transfer between APPLE and other host systems

$285

Apple

Apple

THE APPLE II + HOME COMPUTER

The APPLE II + home computer is one of the world's most popular microcomputer systems. Its wide acceptance means that once you have your system, getting the hardware and software to do the special things you want it to do is very easy. With its 48K of RAM, APPLESOFT BASIC interperter, AUTOSTART monitor (which will boot a disk drive on power-up if one is attached to the system), high-resolution colour graphics, complete easy-to-use manuals and 8 I/O slots (for adding peripheral devices), the APPLE II + is a suberb computer for the businessman, the systems developer, the hobbyist, and the general person who just wants to learn about computers and wants to have fun doing it.

$1769

SPECIFICATIONS:

Mircoprocessor:	6502 (running at 1 MHz)
System RAM:	48 Kbytes
System ROM:	12 Kbytes (2K monitor, 10K APPLESOFT BASIC)
Keyboard:	52 key typewriter-style. Upper-case ASCII only. 2 key rollover.
Power Supply:	High efficency switching.
Text Video Display:	24 lines, 40 characters. Upper case only. 5 x 7 dot matrix. Memory mapped.
Graphics (High Res):	1920 blocks in a 40 x 48 array. 16 colours. Can be mixed with 4 lines of text.
Graphics (High Res):	53760 pixels in a 280 by 192 array. 6 colours. Can be mixed with 4 lines of text.
Video Output:	Composite video.
Inputs:	Cassette input. 3 single-bit TTL inputs. 4 analog inputs all connected to an A/D converter (usually used for game paddles.
Outputs:	Cassette output. Built-in speaker. 4 TTL outputs. Utility strobe.
System Bus:	APPLEBUS (consisting of 8 50 pin connectors).

Check out our low cost Multiflex drive for Apple on page 30.

APPLE][HARDWARE

PRODUCT	MANUFACTURER	PRICE
Grappler Printer Card	Orange Micro	223
VersaCard	Prometheus	243
Videoterm	Videx	495
Enhancer][	Videx	195
Function Strip	Videx	45
Thunderclock +	Thunderware	195
CPS Card	Mountain	350
MusicSystem	Mountain	565
The Clock	Mountain	400
A/D + D/A	Mountain	500
Romplus +	Mountain	225
Romwriter	Mountain	250
BP103 Serial	Pure Data	140
Z80 Softcard	Mircosoft	550
16K Ram Card	MULTIFLEX	89
Video 80 Card	MULTIFLEX	169
Joystick	T.G.	65
Paddles	T.G.	45
Keyboard Encoder	Orange Comp.	120

APPLE II + and APPLESOFT are trademarks of Apple Computer Inc.

APPLE DISK II

The APPLE DISK II is a mass storage floppy disk drive for APPLE II computers. Each unit can store up to 124K bytes of information per floppy diskette (under DOS 3.3). The DISK II can be supplied as drive #1 (with interface card, DOS 3.3 diskettes and manual) or as drive #2 (just the drive). each disk interface card can control up to 2 DISK II units, so that a total of 14 drives (or up to 1.7M bytes of on-line storage can be aded to your APPLE II.

With controller..... $795
Without controller..... $760

SSM APIO

This unit provides a standard Centronics-type connector for interfacing to a printer and a general purpose connector for user application of a parallel port for the APPLE II + .

$350

SSM AIO-II

This board provides two parallel and one serial port with serial connectors for interfacing to a terminal or modem. A Centronics-style and a general purpose connector are provided for the parallel ports. The firmware on-board emulates the current APPLE conventions and supports simultaneous use of the parallel and serial ports.

$325

ADVENTURE INTERNATIONAL	
Adventures #1,2,3	55.95
Adventures #4,5,6	55.95
Adventures #7,8,9	55.95
Adventures #10,11,12	55.95
Adventure Hint Book	10.95
Planetoids	27.95
Mission: Invasion Force	29.95
Back 40-III	27.95
Poker Tournament	29.95
Eliminator	39.95
Pro-Pix	34.95

APPLE	
Pascal	350.00
DOS Tool Kit	89.00
Apple Writer	89.00
Dow Jones Portfolio	99.95

AUTOMATED SIMULATIONS (EPYX)	
Starfleet Orion (Integer BASIC)	26.95
Invasion Orion	26.95
Temple of Apshai	42.95
Upper Reaches of Apshai	21.95
Hellfire Warrior	42.95
The Keys of Acheron	21.95
Introductory 3-Pak (contains next 3)	53.95
The Datestones of Ryn	21.95
Morloc's Tower	21.95
Rescue at Rigel	32.95
Dragon's Eye	26.95
Sorcerer of Siva	32.95
Star Warrior	42.95
Crush, Crumble & Chomp	32.95
Tuesday Morning Quarterback	32.95
Ricochet	21.95
Jabbertalky	32.95

BEAGLE BROS.	
Doss Boss	34.95
Utility City: Tip Book #3, Peek/Poke chart	39.95
Alpha Plot: Tip Book #4, Peek/Poke chart	54.95

BRODERBUND SOFTWARE	
Galactic Empire	34.95
Galactic Trader	34.95
Galactica Revolution	34.95
Tawala's Last Repost	41.95
Apple Panic	41.95
Space Warrior	34.94
Genetic Drift	41.95
Space Quarks	41.95
Red Alert	41.95
Star Blazer	42.95
Arcade Machine	59.95
David's Midnight Magic	47.95
Track Attack	41.95

CALIFORNIA PACIFIC	
Raster Blaster	42.95
Ultima	54.95
Appleoids	42.95
Akalabeth - World of Doom	47.95
Trilogy (Night Driver, Pinball, Spacewar)	42.95
Space Album (Death Star, Solar Shootout, Tail Gunner, Asteroids)	54.95
Fender Bender (was Head On)	34.95

Software

DATAMOST

County Fair	41.95
Snack Attack	41.95
Thief	41.95
Casino	54.95
Swashbuckler	47.95
Write-on	179.95
Expandaport	89.95
Micropainter	47.95
Refill Album #1 (X-rated)	27.95
Refill Album #2 (Cars)	27.95
Apl-1-isp	174.95
Mychess (requires Z80 card)	47.95

EDU-WARE

Algebra 1	54.95
Compu-Math (Arithmetic Skills)	68.95
Compu-Math (Fractions	54.95
Compu-Math (Decimals)	54.95
Compu-Spell (No data disks)	41.95
Compu-Spell Data Disks (level 4,5,6,7,8 or adult/sec.)	26.95
Compu-Read 3.0	41.95
Statistics 3.0	41.95
Perception 3.0	34.95
Metri-Vert	21.95
Uni-Solve	34.95
Counting Bee	41.95
Spelling Bee	41.95

HAYDEN

Accountant	1400.00
Alibi	20.95
Assembly Language Dev. System	55.95
Applesoft Compiler	245.00
Applesoft Utility (Tape)	41.95
Asteriod Blaster (32K)	27.95
Batter Up!	20.95
Blackjack Master	41.95
Championship Golf	34.95
Complex Math (Tape)	20.95
Consultant (CP/M)	1400.00
Data Graph	69.95
Data Manager	69.95
Dentistaid	1400.00
6502 Disassembler	55.95
Disk Certifier Copier	27.95
Double Percision Float. Pt. Math	41.95
Engineering Math	20.95
General Math 1	20.95
Histograph	41.95
Inventory Control	245.00
King Cribbage	34.95
Klondike 2000	34.95
Law-1 Legal (CP/M)	1400.00
Mcap (Tape)	34.95
Design of Active Filters (Tape)	23.75
Microtyping (Tape)	15.35
Op-Amp Design (Tape)	23.75
Pie Writer Standard Version	181.95
Pie Writer Double Vision Version	181.95
Pie Writer Sup'r' Term Version	181.95
Pie Writer Videoterm Version	181.95
Pie Writer Smarterm Version	181.95
Pie Writer Full View Version	181.95
Pie Writer Vision-80 Version	181.95
Renumber & Append (Tape)	20.95
Reversal	48.95
Reversal (Tape)	41.95
Revive (Tape)	27.95
Sargon II	48.95
Sargon II (Tape)	41.95
Slow List/Stop List (Tape)	16.75
Songs in the Key of Apple (Tape)	15.35
Star Traders	27.95
Super Apple BASIC	55.95
Super FORTH	69.95
Tetrad	27.95

INFOCOM

Zork I	54.95
Zork II	54.95

I.D.S.I.

Pool 1.5	32.95
Shuffleboard	31.95
Trick Shots	42.95

MICROPRO

WordStar	475.00
MailMerge	160.00
SpellStar	250.00
CalcStar	250.00
DataStar	375.00
SuperSort	255.00

N.B. All the above require the Microsort Z80 Softcard and either the Videx Videoterm or the M&R Sup'r' Term.

MICROLAB

Data Factory	199.95
Mini Factory Upgrade	121.95
Invoice Factory	134.95
Learning System	199.95
Dogfight	41.95
Crown of Arthain	48.95
Mad venture	34.95

MICROSOFT

Typing Tutor II	27.95
Adventure	32.95
FORTRAN-80 (CP/M)	214.95
A.L.D.S. (CP/M)	137.95
BASIC Compiler (CP/M)	450.95
muMATH/muSIMP (CP/M)	275.95
Olympic Decathlon	32.95
COBOL-80 (CP/M)	850.00
M/SORT	214.95
TASC	195.95
Time Manager	165.95

MUSE

Super Text 40/80	186.95
Form Letter	106.95
Address Book	53.95
Data Plot	63.95
Appilot Edu-disk	106.95
Elementary Math	42.95
Castle Wolfenstein	31.95
Robotware	42.95
ABM	26.95
Three Mile Island	42.95
The Voice	42.95
Best of Muse	42.95
U-Draw II	42.95

OMEGA

The Inspector	59.95
Locksmith	115.00

ON-LINE SYSTEMS

Hires Adv. #0 (Mission Asteriods)	27.95
Hires Adv. #1 (Mystery House)	34.95
Hires Adv. #2 (Wizard & the Princess)	49.95
Hires Adv. #3 (Cranston Manor)	48.95
Hires Football	55.95
Hires Cribbage	34.95
Superscribe II	182.95
Missle Defense	42.95
Jawbreaker (Gobbler)	42.95
Hires Soccer	42.95
Sabatoge	34.95
Expiditer II	139.95
Softporn Adventure	42.95
Threshold	55.95
Pegasus II	42.95
Lisa 2.5	114.95
Speed Asm	55.95
Time Zone	139.95

QUALITY

Beneath Apple DOS	21.95
Bag of Tricks	42.95
Beneath APPLE Manor	21.95
Satelitte Tracking	53.95
Fastgammon	26.95

PERSONAL SOFTWARE (VISICORP)

Bridge Challenger (Tape)	25.95
Bridge Challenger (Disk)	30.95
Chekcker King (Tape)	25.95
Chekcker King (Disk)	30.95
Gammon Gambler (Tape)	25.95
Gammon Gambler (Disk)	30.95
Microchess 2.0 (Tape)	25.95
Microchess 2.0 (Disk)	30.95
Visicalc 3.3	252.95
Visidex	252.95
Visiplot	226.95
Visiterm	195.95
Visitrend/Visiplot	329.95
Desktop Plan II	352.95

SIRIUS

Phantoms Five	39.95
E-Z Draw 3.3	59.99
Space Eggs	35.95
Pulsar II	35.95
Orbitron	35.95
Autobahn	35.95
Gamma Goblins	35.95
Gorgon	47.95
Sneakers	35.95
Epock	35.95
Pascal Graphics Editor (PGE)	120.00
Copts and Robbers	41.99
Outpost	35.95
Beer Run	41.99
Hadron	41.99
Dark Forest	35.95
Twerps	35.95
Snake Byte	35.95
Borg	35.95
Computer Foosball	35.95
Joyport	89.95

SENSIBLE

Super Disk Copy	43.95
Multi-disk Catalog	27.90
Back It Up II +	26.95
DOS +	27.95

SOFTAPE

Magic Window	109.95

SOFTWARE PUBLISHING CORP.

PFS: The Personal Filing System	150.00
PFS: Report	114.95

SYNERGISTIC

Wilderness & Dungeon Adventures	44.95
Odyssey	41.95
Doom Cavern/Sorcerer's Challange	27.95
Tank Attack/Death Run	27.95
Escape from Acturus	47.95
Higher Graphics I	34.95
Higher Graphics II	47.95
Higher Text II	54.95
Program Line Editor	54.95
Directory Manager	41.95
The Linguist	54.95
Star Gazer's Guide	41.95
Planetary Guide	41.95

SYNTONIC

Interlude	27.95

VIDEX

Visicalc 80-column pre-boot	71.00
Visicalc 80-column & memory expansion	129.95
Apple Writer][80-column pre-boot	27.95
Videoterm Utilities Disk	53.69
Micromodem Firmware	41.95

Multiflex Products

Multiflex Video 80 Card

The MULTIFLEX 80-column card allows the user of an APPLE][computer to display his text in lower case and 80 columns. This board has all the features of the boards on the market and then some. And you can get all this for the incredibly low price of

$175

16K RAM CARD

Expand your 48K APPLE to 64K. The MULTIFLEX 16K RAM Card allows other languages to be loaded into your APPLE from disk or tape. Allows APPLE CP/M users to run CP/M 56.

$89

Multiflex Drive for the Apple

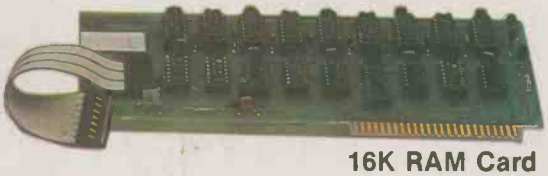
This is a completely compatible replacement disk drive for the Apple II computer. Based on the SA400 disk drive, the MULTIFLEX drive will run all the programs that run on a standard DISK II for the Apple at a fraction of the cost. Attractively packaged disk drive ready to plug into a controller, as a first or second drive.

With Contoller, phone for pricing
Without Cont. $389

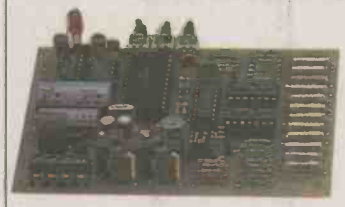
Multiflex Drive for Apple

See page 26 for details on EPROM Programmer ($150) and Z80 Card ($150).

Proto Wire Wrap Card



16K RAM Card

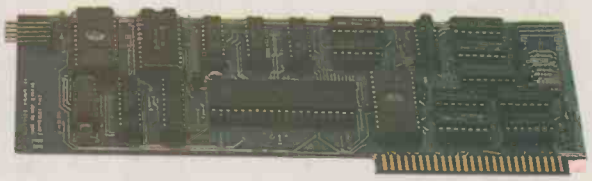


Multiflex Modem

Multiflex Proto Card for the Apple

This is a standard size wire-wrap card which allows the hobbyist to create his own interface circuits for the APPLE][computer.

$18



Video 80 Card

Multiflex Modem

- 300 Baud
- Full & Half Duplex
- Originate/Answer Modes
- Direct Connect Design
- MC6860 Based
- Full RS-232-C Handshake

Kit $149

Versatile Videotape / Videodisk Controller

COMPUTER for education and training .....

The Versatile Videotape/videodisk controller card (VVC-1) is designed solely for computer for education and training in mind.

Now, APPLE II users can ultilise their computers more effectively for computer aided education or computer aided training. The VVC-1 allows the APPLE II computer to have full control of the industry standard Videotape and/or videodisk equipment. The VIC-1 can effectively increase the versatility of the tape player; because, the VVC-1 can do a random access of any video frames on tape, to do an accurate search of a video frame to ±2 frames and to control two channels of audio. Video switching (switch between the computer video and the videotape/videodisk video) is on the VVC-1 card.

The VVC-1 card allows the APPLE II computer to act as a stand alone training terminal, but the capability of the VVC-1 card does not end there. Because of the on card RS232C interface, the VVC-1 card makes a low cost training system with multi-terminals a reality. Each APPLE II computer when coupled with a VVC-1 can then act as a training station whereas the training material can be downloaded from a main station which could be an APPLE II or even a mainframe computer.

The VVC-1 card for your APPLE II computer is designed and manufactured in CANADA. The VVC-1 card can be used for most industrial solenoid driven type videotape recorders e.g. SONY SLO 320,323; SLP 300,303; PANASONIC NV8200, 8170.

FEATURES

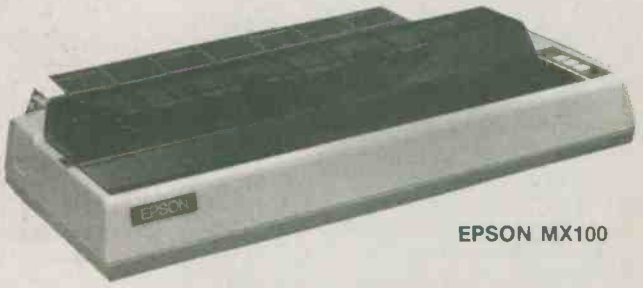
Two parallel ports, 16 bits individually programmable
One user programmable synchronous or Asynchronous serial interface
Control all functions available on the video tape recorder
On card video switching between VTR video and computer video
Computer is available during VTR searching
Can be designed as a turnkey system
VTR fast search is possible without sacrifice search error
Search error is very low
Two individually controlled audio channels
The audio channels can directly drive ordinary loudspeakers
Monitor all functions of the VTR at any time

$535

Printers

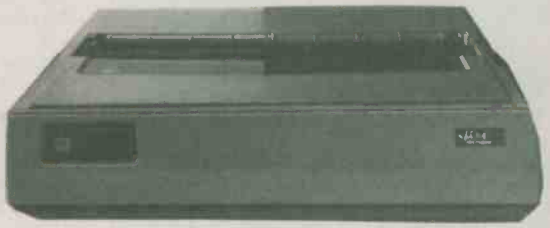
	MX 80	MX 80F/T	MX 100	OKI 82A	OKI 84
Bidirectional printing	X	X	X	X	X
Logic seeking	X	X	X	X	X
Disposable print head	X	X	X	X	X
Speed (in cps)	80	80	100	120	200
9x9 dot matrix	X	X	X	X	X
Friction feed		X	X	X	X
Tractor feed	X	X	X	X	X
6 LPI	X	X	X	X	X
8 LIP	X	X	X	X	X
Line spacing to n/216"	X	X	X		
Programable form length	X	X	X	X	X
Programable horizontal tabs	X	X	X	X	X
Skip over perforation	X	X	X		
96 ASCII characters	X	X	X	X	X
International character sets	X	X	X	X	X
Italics	X	X	X		
Normal, Emphasized, Double-strike and double/emph. print modes	X	X	X		
Subscript/superscript	X	X	X		
Underlining	X	X	X		
10 CPI	X	X	X	X	X
5 CPI	X	X	X	X	X
17.16 CPI	X	X	X		
8.58 CPI	X	X	X	X	X
16.5 CPI				X	X
Block graphics				X	
Line graphics	X	X	X		
Dot addressable graphics	X	X	X		X
Software reset	X	X	X		
Adjustable right margin	X	X	X		
True back space	X	X	X		
Parallel interface	X	X	X	X	X*
Serial interface				X	X*
	$759	**$1069**		**$**	*
		$869		**$795**	

* To be specified at time of order



EPSON MX100

EPSON MX80



OKIDATA ML84

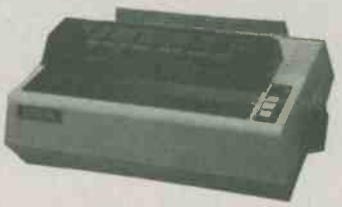
Check our ads in ETI each month

Smith Corona TP-1: $1080

- *Low cost daisy wheel printer*
- *Microprocessor controlled*
- *Serial or parallel interface*
- *5 low-cost 10c.p.i. print wheels available*
- *5 low-cost 12c.p.i. print wheels available*
- *Low-cost replacement ribbon cartridge*

*** Call us for price and availability.**

EPSON TYPE III PRINTERS



The EPSON MX-80 Type III is the newest version of the world's best selling printer. It comes complete with all the software to print high-resolution pictures, print text in italics, backspace, do underlining, superscripts, subscripts, and other special print modes. The MX-100 is a larger (15" carriage) version of the MX-80 which is faster and has all the features in a better package.

Exceltronix

Modems

Hayes Smartmodem

This is an RS232, 300 baud direct connect intelligent moden. It can answer calls, dial numbers, receive and transmit data and disconnect ... all automatically. The SMARTMODEM is also a true direct connect modem — it plugs directly into a modular telephone jack, not into a telephone. This means less noise and more reliable reception.

$399

Hayes Micromodem II

This unit has all the features of the Hayes Smartmodem, but is on a single card which plugs directly into one of the expansion slots in the APPLE][+ computer. It comes complete with software to allow use of the modem as soon as you install it in the computer and to help you to develop your own application programs.

$499

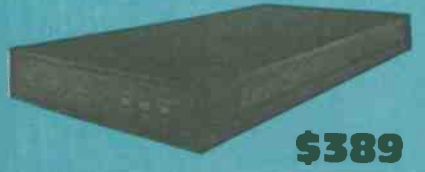
Novation Apple-Cat

An intelligent modem which plugs right into your APPLE II+ computer. All auto functions, selectable baud rates (up to 1200 with optional extra board), an RS232 port, a BSR X-10 controller and self prompting software are all standard with this unit.

$569

Novation Auto-Cat

A truly automatic direct-connect modem using a state-of-the-art, all digital, crystal controlled design. All you need to do is plug it into your computer and a modular telephone jack and away you go!



$389

Novation Acoustic Cat

The Novation Acoustic Cat is a reliable low cost, 300-baud acoustically coupled modem. It will operate in the answer or the originate mode, and full or half duplex. A self-test feature is built-in.

$249

See Multiflex Modem on page 30.

Disk Drives

5¼ INCH			
CDC			
9409	DS DD		$399
MICROPOLIS			
1117 MODEL II	SS	100 TPI	*
1117 MODEL IV	DS	100 TPI	*
1117 MODEL V	SS	96 TPI	*
1117 MODEL VI	DS	96 TPI	*
SHUGART			
SA200	SS	$295	
SA400	SS	$390	
SA400L	SS	$295	
SA410	SS	$495	
SA450	DS	$489	
SA460	DS	$595	
TANDON			
TM100-1	SS	48 TPI	$355
TM100-2	DS	48 TPI	$475
TM100-3	SS	96 TPI	*
TM100-4	DS	95 TPI	$620
8 INCH			
CDC			
9406	DS DD		$650
SHUGART			
SA801	SS DD		$669
SA851	DS DD		$895
SLIMLINE			
810	SS DD		$816
860	DS DD		$948
TANDON			
TM848-1	SS DD	48 TPI	$655
TM848-2	DS DD	48 TPI	$840

HARD DRIVES
5.25"

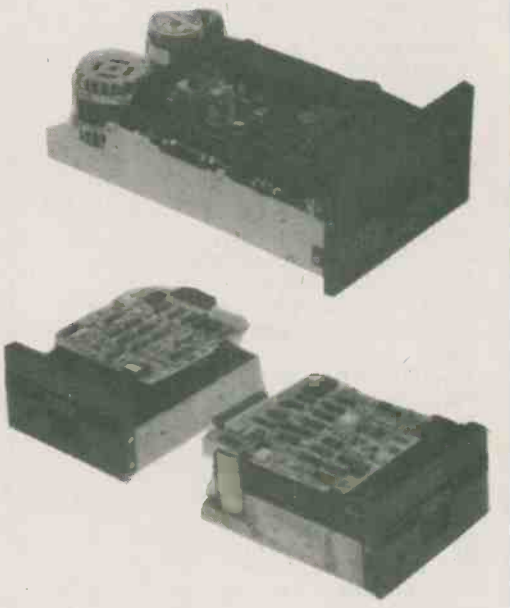
SHUGART		
SA604	6.6 MB	2040.00
SA606	10 MB	2400.00
TANDON		
TM600	*	

8"

SHUGART		
SA1002	5MB	2388.00
SA1004	10MB	2892.00

14"

SHUGART		
SA4004	14.5 MB	3264.00
SA4008	29.0 MB	4080.00



Store Hours
Mon-Wed 9.00-6.00
Thurs, Fri 9.00-9.00
Saturday 9.00-6.00

Contact us for custom design and manufacture of computer products

Watch for our regular specials featured in our ads in ETI each month

Contact us for package deals

*** Call us for price and availability.**

Terminals (See also Multiflex Terminal on page 22)

HAZELTINE ESPRIT
UPPER & LOWER CASE
$889

FEATURE	ADM 3A	ADM 5	HAZELTINE 1410	HAZELTINE 1420	HAZELTINE 1500
UPPER CASE	YES	YES	YES	YES	YES
LOWER CASE	OPT.	YES	NO	YES	YES
DOT MATRIX	5x7	5x9	5x7	5x8	5x7
SCREEN SIZE	12"	12"	12"	12"	12"
FORMAT	80x24	80x24	80x24	80x24	80x24
BAUD RATE	9600	9600	9600	9600	9600
X/Y CURSOR	YES	YES	YES	YES	YES
REVERSE VIDEO	NO	YES	NO	NO	YES
DUAL INTENSITY	NO	YES	NO	YES	YES
TYPEWRITER KEYBOARD	YES	YES	YES	YES	YES
KEYPAD	NO	YES	YES	YES	YES
CURSOR CONTROLS	NO	YES	NO	YES	YES
FUNCTION KEYS	NO	NO	NO	YES	YES
LOCAL EDITING	NO	YES	NO	NO	NO
AUXILARY OUTPUT	YES	YES	NO	NO	YES
	$895	**$989**	**$1410**	**$1349**	**$1499**

Monitors

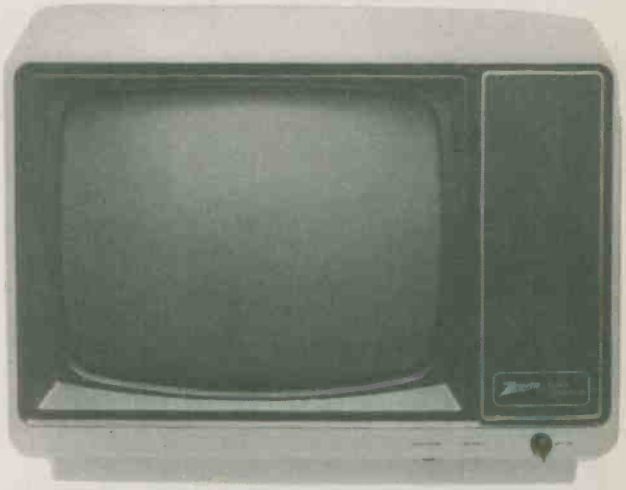
Zenith Monitors complete with housing and power supply ready-to-use with any composite video signal 12" green phosphorus screen switch selectable for 40 or 80 characters. 90 day warranty; quantity discounts available.

ONLY $165

AMDEK
COLOUR 1 MONITOR

13" Colour Monitor 90 day warranty.

ONLY $569



Switching Power Supply

Output V1	V2	V3	V4
+5V Adjustable 5A	+12V Fixed 1A	-5V Fixed 1A	-12V Fixed 1A

Protection for overload

$99.00

SYM-1

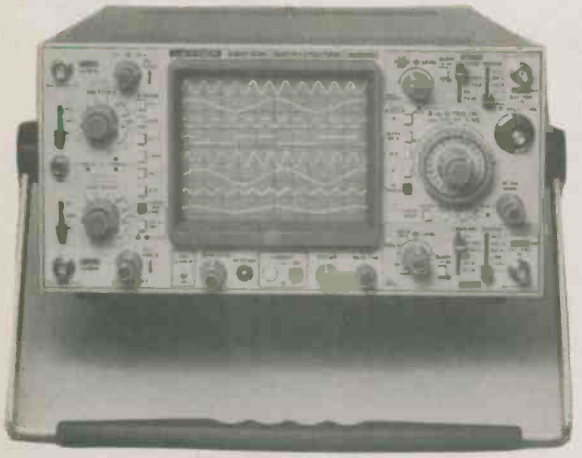
SYM-1 Computer $389.00

- 6502 based
- 1K static ram expandable to 4K on board
- Audio cassette interface
- 4K resident monitor
- 6 digit display
- 28 key keypad
- RS-232-C compatible interface
- System expansion bus
- Operates on a single +5V supply
- 51 I/O lines, expandable to 71 on board

Exceltronix

Leader Oscilloscopes

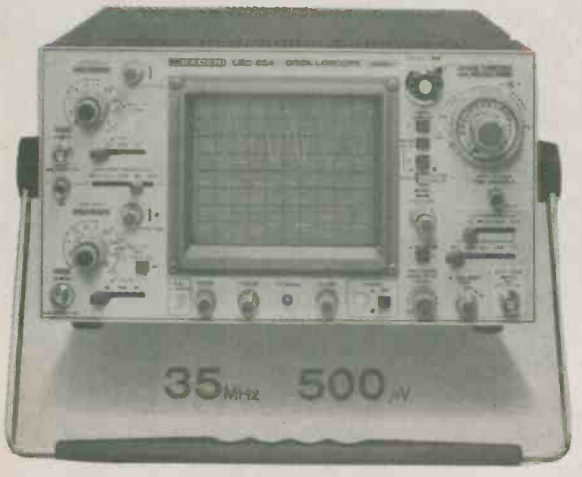
LBO-518



This is a 100MHz, 5mV/div oscilloscope (500 uV/div at x10 MAG) and maximum horizontal sweep speed is 2 n-sec at x10 MAG. Its applications cover not only production and service maintenance but also research/development.

$3589

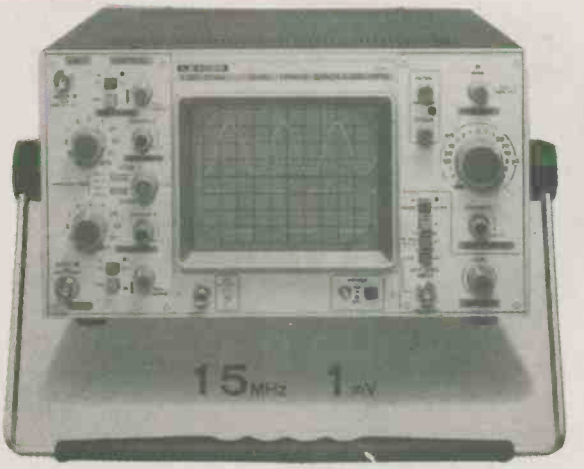
LBO-524/524L



- CRT: 150mm, Rectangular, Internal-graticule (8 x 10div: 1div = 1cm), Post-acceleration (7kV), Flat-face, Metal-back, Dome-mesh, % Scale, Scale Illumination, Beam Rotation.
- Delayed Sweep (Continuous/Triggered) • Wide Bandwidth: 35MHz (5mV, 8div Ref.) • Max. Sensitivity: 500uV (MAG x 10, 5MHz) • Max, Sweep Speed: 20ns/div (MAG x 10) • TV-V, TV-H Sync. Separation • ALT Trigger • Hold-off Variable • X-Y Operation • PRESET Synchronization • Linkage of Frequency Counter Using CH-1 OUT, • TTL Level Z MOD. • The model LBO-524L offers a signal delay line which permits viewing the leading edges of pulses.

LBO-524 $1695
LBO-524L $1939

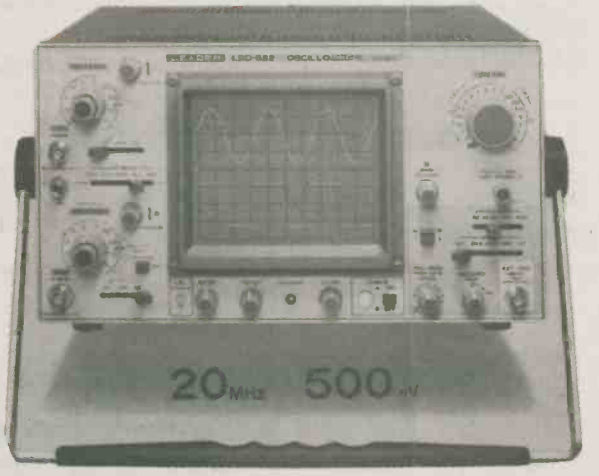
LBO-514A



- CRT: 130mm Round, Stabilized Acceleration 1.8kV, High Brightness & Clear Sharp Trace, Flat-face, Beam-Rotation
- Wide Bandwidth: 15MHz (5mV, 6div Ref.)
- Max. Sensitivity: 1mV (MAG x 5, 6MHz)
- Max. Sweep Speed: 100ns/div (MAG x 5)
- HF-REJ trigger for stable display which includes HF-noise & TV-Vert.
- X-Y Operation • TTL Level Z MOD.

$919

LBO-522



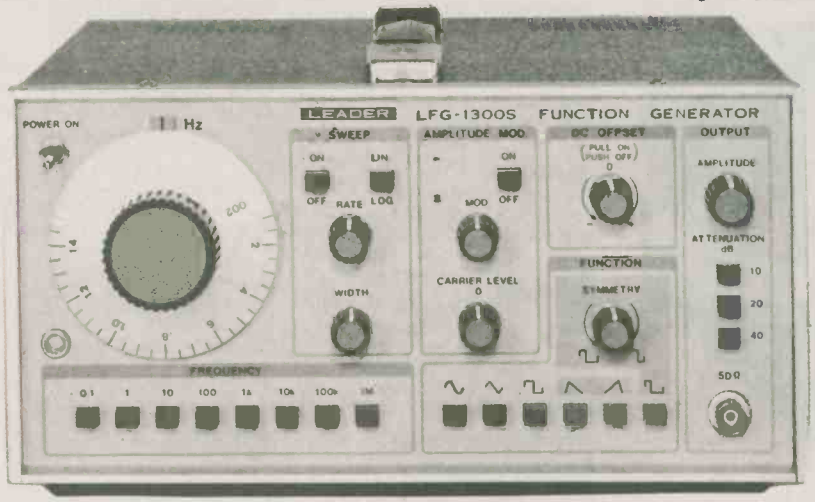
- CRT: 150mm, Rectangular, Internal-graticule (8 x 10div: 1div = 1cm), Post-acceleration (7kV), Flat-face, metal-back, Dome-mesh, % Scale, Scale Illumination, Beam Rotation
- Wide Bandwidth: 35 MHz (5mV, 8div Ref.) • Max. Sensitivity: 500uV (MAG x 10, 5MHz) • Max. Sweep Speed: 20ns/div (MAG x 10)
- TV-V, TV-H Sync. Separation • ALT Trigger • Hold-off Variable
- X-Y Operation can be controlled Manually & by REMOTE
- PRESET Synchronization • Linkage of Frequency Counter Using CH-1 OUT.
- TTL Level Z MOD.

$1049

Leader Test Gear

2MHz Sweep Function Generator

$949

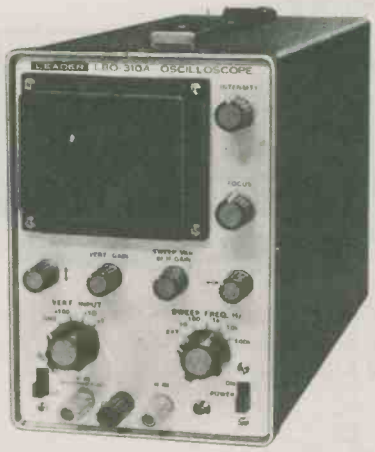


The LFG/1300S is a general-purpose signal source with a broad range of research, design and service applications. Outputs include sine, square, triangle, ramp and pulse signals. Pulse symmetry is variable over a 9:1 range and, unlike many other instruments, changing the symmetry does not appreciably affect the output frequency. Linear and logarithmic sweep frequency outputs are available with sweep widths up to 1,000:1. Output level is controlled by a calibrated 70-dB attenuator (10-dB/step) with continuous adjustment between steps. The output may be frequency or amplitude modulated by an external signal. A level control also provides suppressed carrier outputs. The LFG-1300S is housed in a sturdy metal housing with a "human-engineered" front panel for convenient, simple operation.

General Purpose 'Scopes

The LBO-310A is a compact, general purpose instrument designed to provide long, reliable service in production test, repair, and educational applications. Its simple front panel with a minimum of controls makes it ideal for use by production personnel, students, and non-technical operators. Its low cost opens up many applications where waveform monitoring might otherwise be economically prohibitive. Sensitivity is 20 mV/division. Sweep frequencies range from 10 Hz to 100 kHz.

$349



LBO-310A

LBO-510A

The LBO-510A is a best buy general purpose oscilloscope. Ideal for service, education and communications. Solid State design delivers H MHz vertical bandwidth plus 20 mVp-p/Div vertical sensitivity. Bright, easy to read display — use multiple units for monitoring several phenomena simultaneously.

$529

3½ Digit LCD Multimeter

SPECIFICATIONS

DC Voltage
100μV — 1000 V 5 ranges
Accuracy
± 3% rdg ± 1 dgt
(100μV — 200 V)
± 6% rdg ± 1 dgt (200 V — 1000 V)

AC Voltage
100μ V — 1000 V 5 ranges
± 0.5% rdg ± 2 dgt
(100μV — 200 V)
± 0.8% rdg ± 4dgt. (200 V — 1000 V)

DC Current
1μ A — 2A 4 ranges
Accuracy
± 0.4% rdg ± 2 dgt.
± 1.5% rdg ± 2 dgt.

AC Current
1μ A — 2A 4 ranges
accuracy
1.8% rdg ± 3 dgt.

Resistance
0.1 ohm — 20 M ohm 5 ranges
accuracy
± 0.3% rdg ± 2 dgt.
(0.1 — 2 M ohm)
± 0.6% rdg ± 2 dgt.
(2 M ohm — 20 M ohm)

Compact, rugged and accurate; the LDM-853 is uniquely suited for both laboratory and field work with either AC or battery power. Operation is easy and straightforward. The LDM-853 features high accuracy of 0.3% (D.C.V.) and employs 0.2V ranges which are capable of 100μV resolution. Current measurement to 2 amp on both AC and DC ranges. Automatic polarity and automatic zero are also provided for your convenience.

$359

Exceltronix

Hameg Oscilloscopes

HM 307

Specification

Vertical Deflection (Y)
Bandwidth: DC to 10MHz (−3dB).
DC to 15MHz (−6dB).
Risetime: approx. 35ns.
Overshoot: max. **1%**.
Deflection coefficients: 12 calibr. steps, 5mV/cm to 20V/cm in 1-2-5 sequence, accuracy better than ±5%.
Input impedance: 1MΩ//25pF.
Input coupling: DC-AC-GD.
Input voltage: max. 500V (DC + peak AC).

Timebase
Time coefficients: 18 calibrated steps, 0.5µs/cm to 0.2s/cm in 1-2-5 sequence, with variable control uncalibr. to 0.2µs/cm, accuracy better than ±5% (in cal. position). Normal length of baseline: approx. **6 cm**.
Trigger System
Source: Internal or external.
Slope: positive or negative.
Modes: Manual Trigger level control, Automatic Triggering (AT).
Sensitivity: 3mm (2Hz to 30MHz). external: 0.5-5V, AC only.

Horizontal Deflection (X)
Bandwidth: 1 Hz to 1 MHz (−3dB).
Deflection coefficient: approx. 0.75V/cm.
Input impedance: approx. 1MΩ//25pF.

Component Tester
Test voltage: max. 8.6 V rms (open circuit).
Test current: max. 28 m A rms (shorted).
Test frequency: 50 resp. 60Hz.
Test circuit grounded to chassis.

General Information
Cathode-ray tube: 3RP1A, 7cm dia.
Accelerating potential: approx. 1kV.
Built-in square-wave generator 1kHz for probe alignment (0.2V ± 1%).
Electric regulation for all important supply voltages incl. high voltage.
A.C. Supply voltages: 110, 127, 220, 237V AC.
Maximum A.C. Supply: fluctuation: ± 10%
A.C. Supply frequency: 50 to 60 Hz.
Power consumption: approx. 24W.
Weight: approx 8¼ lbs.
Dimensions: 4.5" × 8.3" × 12".
Finish: dark grey.
With handle and tilt stand.

Subject to change.

$489

HM 203

Specification

Vertical Deflection (Y)
Bandwidth of both channels
DC-20 MHz (-3dB), DC 28 MHz (-6dB).
Rise time: 17.5 ns (approx.)
Overshoot: 1% (maximum).
Deflection coefficients: 12 calibr. steps, 5mV/cm- 20V/cm (1-2-5 sequence), accuracy better than ± 3%.
Input impedance: 1 Megohm II 25 pf.
Input coupling: DC-AC-GND.
Input voltage: max. 500V (DC + peak AC).
Operating modes
Channel I, Channel II, Channel I and II, alternate or chopped (approx. 120kHz).
X-Y operation: sensitivity ratio 1:1

Timebase
Time coefficients: 18 calibrated steps, 0.5 us/cm-0.2 s/cm (1-2-5 sequence), with variable control uncalibr. to 200 ns/cm, with magnifier x5 uncalibr. to 40ns/cm, accuracy better than ± 3% (in cal. position)
Ramp pulpul. 5V (approx.).

Trigger System
Modes: automatic or variable trigger level.
Sources: Channel I, Ch. II, line, external
Slope: positive or negative.
Coupling: AC or TV-low-pas-filter
Sensitivity, int. 3mm, ext. 0.7V (approx.).
Bandwidth: 30 Hz (auto), 5 Hz (level) up to at least 30 MHz.

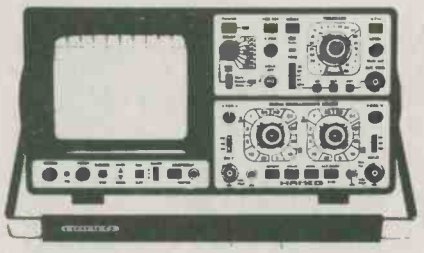
Horizontal Deflection (X)
Bandwidth: DC-2 MHz (-3dB).
Input: via Channel I.
for other data see Y deflection spec.
X-Y phase difference < 3° up to 100 kHz.

Miscellaneous
Cathode-ray tube: 130 BXB31, 13 cm ∅.
Accelerating potential: 2000V
Calibrator: square-wave generator 1 kHz, 0.2V ± 1%, for probe compensation.
Trace rotation: adjustable at front panel.
Regulated DC power supplies: all operating voltages including the EHT.
Line voltages 110, 125, 220, 240V AC.
Line fluctuation ± 10% (maximum).
Line frequency range 50-60 Hz.
Power consumption: 36 Watts (approx.).
Weight: 6 kg (approximately)
Dimensions (mm): H 145, W 285, D 380
Finish: dark grey.
With handle and tilt stand

Subject to change.

$750

HM204



- 2x 20MHz, max. 2mV/cm — max. 1% Overshoot
- Timebase 20ns/cm-2s/cm — incl. Magnification x10
- Component Tester — One-Button Operation
- Trigger Bandwidth 50MHz — internal at 5mm
- 8x10cm, Rectangular CRT — Internal Graticule (Illum.)
- Delayed Sweep 100ns—1s

The new HM204 demonstrates the exceptionally high quality and operating standards set by HAMEG, providing **a multitude of features** normally found only in more expensive scopes. The rectangular **8x10cm CRT** has a quick heating cathode, burn-in resistant Phosphor, and an internal graticule, which can be illuminated. Each channel is electronically switched to the vertical final amplifier in either **alternate** or chop mode.
Although the bandwidth of the HM204 is rated at **20MHz** (-3dB 1/70% of 80mm), the 50MHz bandwidth of the preamplifiers permits viewing of signals up to 40MHz at smaller display heights. HAMEG's **overscan indication** is superior to the common beam finder, as it will also show the presence of signal components or fast spikes outside the vertical limits of the CRT screen.
The HM204 **may be operated as a single** or dual trace **oscilloscope**. The **sum** of two channels (I, inclusive) in **Add Mode**, their difference by using the **invert** function of Channel II. In **X-Y Mode**, both channels have equal input impedance and sensitivity ranges.
The wide timebase range from 20ns/cm incl. **Magn. x10** to 2 s/cm provides excellent resolution of all signals. HAMEG's new LPS trigger technique ensures reliable triggering even on small signal heights (5mm) up to 50MHz. Normal and fast **Automatic Peak Value Triggering** and **Variable Hold-Off** time permit stable displays of very complex or aperiodic signals. The **Alternate Trigger Mode** ensures jitter-free display of two asynchronous signals, while the **Single Sweep** facility allows the investigation of single events and accurate photography.
The **Sweep Delay** is particularly useful for the analysis and expansion of complex waveforms, offering almost all the advantages of a second timebase at much lower cost.
Component Tester, Z-modulation, raster illumination, ramp output, trace rotation and **built-in** calibrator are standard with this most versatile and competitive scope.

Accessories included:
2 **switchable Probes** — Operating Manual, Line Cord
1 **Multipurpose** x10 — Pair of Tester Leads

Accessories optional:
Probes x1; x10; x100, Oscilloscope Probe, various
Test Cables, Viewing Hood, Carrying Case, etc.

$1145

HM 705

Specification

Vertical Deflection (Y)
Bandwidth of both channels:
DC-70MHz (-3dB), DC-90MHz (-6dB).
Risetime: approx. 5ns.
Overshoot: maximum 1%.
Deflection Coefficients: 12 calibr. steps 5mV/cm-20V/cm (1-2-5 sequence), with variable control (1 2.5) to 2mV/cm.
Accuracy within 3% in cal. position.
Input Impedance: 1 Megohm II 25 pF
Input Coupling: DC-AC-GND
Input Voltage: max. 500V (DC + peak AC).
Overscanning indication by 2 LED's
Delay Line: to view leading trigger edge

Operating Modes
Channel I, Ch. II, Ch. I and Ch. II, alternate or chopped (approx. 1 MHz)
Algebraic Addition: Ch. I + II, CH —I + II.
Difference: with Channel I inverted.
X-Y display: X via Ch. II, Y via Ch. I.

Timebase
Time Coefficients: 23 calibr. steps, 50 ns/cm - 1 s/cm (1-2-5 sequence), with variable control (2.5: 1) to 2.5s/cm.
With expansion x10 to 5ns/cm.
Accuracy, within 3% in cal. position
Ramp Output: approx. 5V (positive-going).

Trigger System
Modes: Automatic or Normal Triggering
Sources: Ch. I or II, alt. I/11, line, ext
Slope: positive- or negative-going edge.
Coupling: AC, DC, HF, LF.
Sensitivity: int. 5mm, ext. approx. 0.5V.
Bandwidth: DC to at least 70 MHz.

Bandwidth: DC to at least 70 MHz.
Trigger Action: indicated by LED.
Single Sweep: Single-Reset buttons with LED.
Holdoff Time: 10:1 variable control.

Sweep Delay
Ranges: 7 decade steps 100 ns-0.1s, with variable control 10 1 to 1s.
(Delay time measurable with timebase.)
Modes: normal, search, delayed (LED indic.).
2nd Triggering "after delay":
with variable level, pos. or neg. slope, int. or ext., disconnectible to "free run"

Horizontal Deflection (X)
Bandwidth: DC-5MHz (-3dB)
Input via Channel II
X-Y Phase Shift: <3° up to max. 100kHz
(Other values see Vertical Deflection.)

Miscellaneous
Cathode-Ray Tube: D14-654 (P31 or P7), rectangular screen with internal graticule.
Total Acceleration Voltage: 14kV
Trace Rotation: adj. on front panel.
Z-Modulation Input: pos. TTL-level.
Scale Illumination: three-position switch.
Calibrator: square-wave generator 0.2V ± 1%, approx. 1 kHz, for probe compensation.
Regulated Power Supply incl. high voltage.
AC Power Source: 110, 125, 220, 240V.
Line Fluctuation: maximum ± 10%.
Line Frequency: 50 to 60 Hz.
Power Consumption: approx. 42W.
Weight: approx. 10 kg.
Dimensions (mm): **W** 212, H 237, D 380
Finish: dark grey, with handle and tilt stand.
Accessories incl.: Manual, 2 probes **X10/X1.**

Subject to change.

$1595

Hitachi Scopes

Literature available on request.

V-209
DC-20 MHz, Mini-Portable, Dual Trace

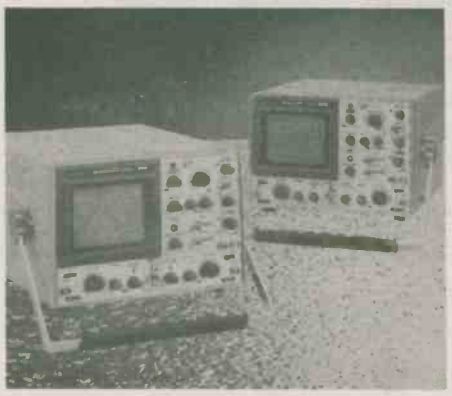
$1305

V-1050
100MHz, Quad Trace, Delayed Sweep

$2826

V-509
DC-50 MHz, Delay Sweep, Mini-Portable, Dual Trace

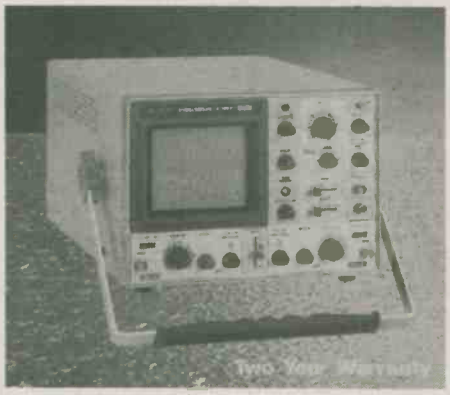
$2331



V-353F
35MHz, Dual Trace Delayed Sweep

V-203F
20 MHz, Dual Trace Delayed Sweep

V-353F $1356
V-203F $1033



V-352F
DC-35 MHz, 1mV/div, dual trace
V-202F
DC-20 MHz, 1mV/div, dual trace
V-302F
DC-30 MHz, 1mV/div, dual trace
V-152F
DC-15 MHz, 1mV/div, dual trace
V-151F
DC-15 MHz, 1mV/div, single trace

V-352F $1282.00
V-202F $976.50
V-302F $1129.50
V-152F $828.00
V-151F $675.00

Logic Probes

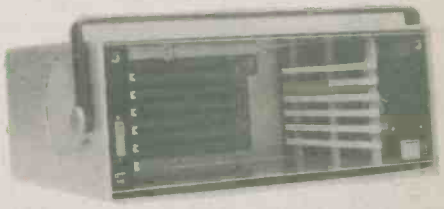
OK MACHINE
PRB-1 LOGIC PROBE
- DC TO ► 50 MHz
- 10 Nsec Pulse Response
- 120 Kr I/P Impedance
- Pulse Stretching to 50 Msec
- Supply Range 4-15 VDC
- Open Circuit Detection

$78.95

PLS-1 LOGIC PULSER
- Single Pulses or Pulse Trains
- Auto Polarity Sensing
- 2uS Nominal Pulse Width

$108.50

S-100 Card Cage



- Holds 6 S-100 cards
- Extra deep allowing room for front panel
- Room in rear for power supply
- Vents in side, mount for optional fan
- Power switch and 2 convenience outlets on front
- Attractive, sturdy, portable case

$150

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Dimensions, Weight:	3207: 150H×60W×12D mm, Approx. 120g 3208: 170H×76W×20D mm, Approx. 250g
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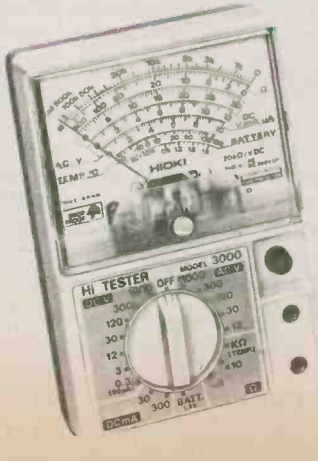
Display:	8 digits sign or 5 mantissa and 2 exponent with sign
Accessories:	Test Leads, 3207: Soft Case 3208: Carrying Case Fuse (0.3A)

3000 Hi Tester 20kohm/v



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Versadigital Signs

The sign that also talks

Every business needs attention. In today's competitive marketplace you need to get the customers' attention and you need to get your message across - as boldly and as dynamically as possible.

Two versions are available, single and double row. Each row holds up to 21 standard characters and can be expanded to up to 42 characters. The LED (Light Emitting Diode) display is available in red (standard or extra bright), green and yellow. Standard, wide (2", upper and lower case) and bold tall (4", upper case) come with the display. All can be displayed normally or in inverse (black characters on a lit background) image format. You can even program your own characters and graphic symbols. As well as the standard LED display, larger, brighter incandescent light bulb displays can be built to your specifications. All programming features are retained, and the standard LED display is included for ease of programming.

A wide variety of features allow you to catch the public's attention — choose from Wipe-On and Wipe-Off, Spell-On, Flash and Blink, Shift left and right, Scroll up and Down — in any order and at individually selectable speeds.

Up to six different events can be displayed simultaneously within dynamically selectable boundaries. Up to 128 labelled messages can be stored within the units memory for display at any preselected time and date and in any order. 12,288 character memory is standard on the Versadigital Display. This can be expanded to 36,864 with optional external read only memory modules.

Text can be entered through the Display's own keyboard, from an ordinary cassette recorder, from optional external memory modules, or optionally over telephone lines, radio or infra-red link or over AC wiring. A comprehensive set of commands allow complete control over the display's facilities. A powerful word processor type editor lets you easily write, edit, run, save (on cassette) and transmit messages.

Use It Alone . . .

Using the Display's own keyboard, you can enter messages, or modify old ones, any time you wish. You can create messages weeks in advance and store them on cassette for subsequent use.

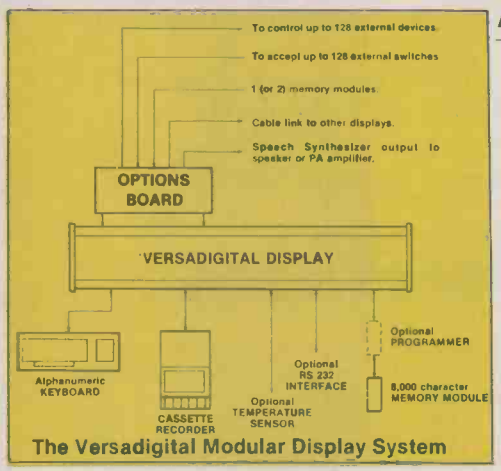
You can program, say, a set of store specials to appear at selected times throughout the day and then just leave it alone. The Display's internal clock does the rest. You can even program it to turn itself off at night and back on in the morning. The Versadigital Display's optional voice capability ensures that your messages will be noticed as they come up.

. . . Or Use a Lot Simultaneously

An optional link enables additional displays to echo a single central display, at distances of up to 4,000 feet. You can disperse displays around a bus terminal, shopping plaza or throughout a train and update them all by simply updating one.

Unprecedented Programming Flexibility

Versadigital offers a variety of methods for programming your Display. Aside from standard keyboard and cassette interface, the Display can be programmed (by means of an RS-232 port) via telephone lines, infra-red or radio link or over AC wiring. Ideal for multibranch use as it allows updating across the city, or across the country.



The Versadigital Modular Display System

Optional Programmable External Memory Modules expand the Display's internal memory and allow preprogramming weeks in advance. Unlike audio cassettes, these require no special reader, but can be plugged directly into the Display. One module can be added without modification, two more plus an options board expand the Versadigital's memory to a whopping 36,864 characters. Modules can be read directly by the Display, or programmed via an optional programmer module. Modules can be programmed weeks in advance and then mailed out to branches for displaying.

The modules are completely re-usable and are erased by a half hour's exposure to ultraviolet light.

The Sign That's Portable

The Versadigital Display can be optionally run from any 12 volt automobile supply. Take it on the road! To outdoor rallies, fairs and other events. Anywhere you can go, you can take the Versadigital Display with you.

The Sign That Can Sell Your Product

Research has shown that digital displays can increase sales by up to 30%. The Versadigital Display virtually assures that figure by increasing the readers' involvement. An optional interface allows up to 128 switches to be connected to the Display, enabling customers to select specific messages without having to wait for the sign to cycle through its repertoire.

A revolution in sign technology

The optional External Accessory Interface allows you to write messages that actually point to the product being discussed. At selected points within your message you can program the Display to turn on an external light or a bell. Thus your message might be saying "You won't find these shoes anywhere else . . ." and the Display will then activate a lamp high-lighting the product. Up to 128 external devices can be controlled in this fashion. This feature alone makes the Versadigital Display the most effective sales tool you can have.

The Sign That Protects Your Message

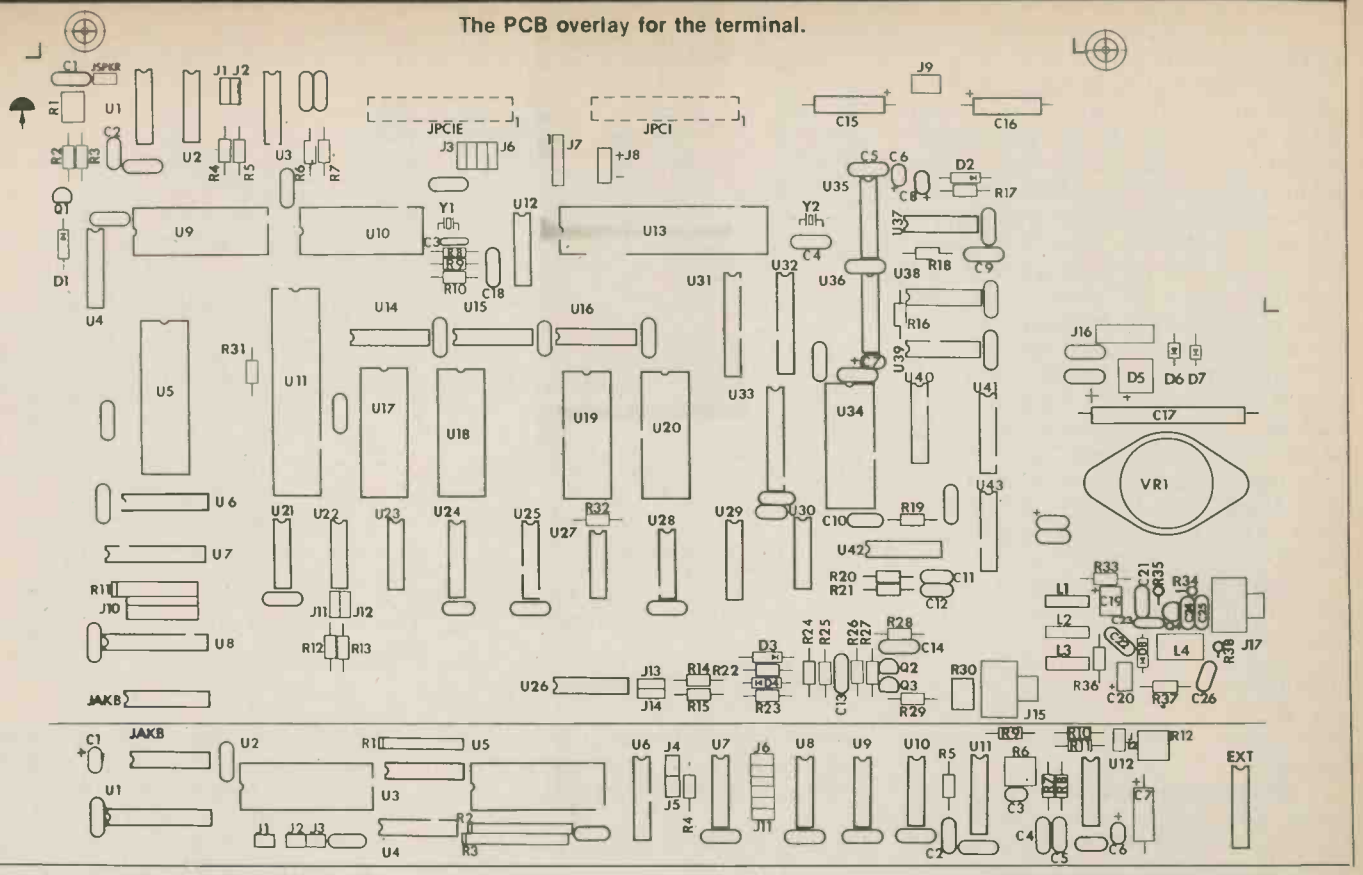
In the event of a power failure, the Versadigital Display's memory back-up keeps the Display's memory intact for six hours. The Display will also keep proper time. With this feature, you can unplug your sign to move it without losing any messages.

We believe that the Versadigital Display is the most advanced digital sign available today. It has all the features and capabilities you'll ever need in an electronic sign, and if it doesn't, tell us, and we can build to your specifications.

Versadigital Technology also manufactures Time and Temperature displays and can build dynamic plaza maps to your specifications. Our extensive engineering experience enables us to design to a wide variety of situations. Whether it is modifying a current product, or designing new equipment, tell us what you need, we can deliver!

VERSADIGITAL TECHNOLOGY INC.

The PCB overlay for the terminal.



HOW IT WORKS

Understanding how the terminal functions may wind up being an order of magnitude trickier than just building it. However, for those who just have to know, here goes.

We'll go through the operation of the sections of the terminal, presented in figures one through six. We won't look at the actual terminal software, as it is both too complex and also proprietary.

Figure 1 is the heart of the matter, the Z-80 microprocessor and the 6845 video controller chip. No mean pair, this. The Z-80 communicates with the rest of the system via address lines ZA0 to ZA15, the address, and ZD0 to ZD7, the data. Note that the data lines make it over to the 6845 immediately. The address lines are decoded and multiplexed by figure 3 . . . which we'll get to . . . which results in the two chips each having access to the RAM buffer, also in figure 3, without either of them having to wait. U4 decodes the enables for the EPROM that holds the software, the aforementioned RAM and the I/O devices, which includes the 6845, in turn producing the MA0 to MA12 addresses, the RA0 to RA3 row addresses and the sync. Those parts of U42,43 and 22 associated with the Z-80's NMI line generate the reset. The remaining gates allow the Z-80 to control its memory and I/O.

Figure 2 is actually three separate bits. The 2732 (or 2764, if you want to customize the works) holds the operating system software for the terminal. The address, data and control lines come from figure 1. The 8253 is a triple sixteen bit software programmable counter array, which divides down the two megahertz crystal oscillator made out of part of U12. This provides the CTRL G beep, through some more of U12 (tireless worker) and Q1, using the second counter. The first one, not used in this configuration of the terminal, but available for custom applications, provides an optional interrupt clock for the Z-80. Counter 0 generates the baud rate clock for the serial port.

The 8251 runs said port. U3 drives the port, and U1 and 2 receive from it. JPCI is the primary port connector, with JPCIE being used for a secondary device, such as a printer.

Figure 3 is the RAM buffer and the multiplexing circuitry, which switches between the address lines of the processor and those of the video controller. Not much to this, really.

In figure 4, U32 is the write buffer and U31 the read buffer for the RAM one figure ago. The 2732 is the character generator EPROM, which is addressed by the 6845 through U33, a latch. U40 receives this data, and then shifts it out at the dot clock rate. The resulting signal is combined with the attribute function and cursor and blanking from the CRT controller by U30. U33 and 34 delay the resulting signal by a few dots to sync up with the character dots. U41 shortens the sync pulse, and the whole thing is fed through driver transistor Q3.

Figure 5 contains the dot clock, made up of U35, which runs at 10 megahertz. U36 divides this by six providing the main timing for the terminal. U6 stores the selected attributes. JKB is the keyboard input, not a real jack, in fact, and is read by the Z-80 through buffer U8.

Figure 6 is the keyboard encoder, and observant souls may note that it is entirely self standing . . . the PCB for the terminal may be cut so that the keyboard is separate. Counter U4, driven by the oscillator formed out of U12, scans the keyboard matrix through decoder U6. The output from the matrix columns is selected by decoder U5. One shot U11 and flip flop U8 provide the debounce delay, stopping the oscillator. U8 also latches the key hit line, releasing it when it gets an ACK from the Z-80. U11 also provides the auto repeat delay, set by R6, and U12 generates the repeat rate. U3 latches the keyboard control keys and addresses the 2716 encoder EPROM together with the scanning counter. The data output from the EPROM consists of the appropriate corresponding ASCII which is sent out over the connector through buffer U1.

Buylines

A complete kit of parts is available for this project for $195.00 from Exceltronix, 319 College Street, Toronto, Ontario, M5T 1S2. This includes the PCB, all components, the keyboard and the (programmed) EPROMs. A punched, drilled and painted case is $45.00 extra, and the components for the on board power supply are $38.00. The individual parts are also available . . . contact the supplier for prices.

be ready to roll.

R30 sets the video output level. If you aren't getting any picture, this thing may be set all the way down. Adjust it for stable sync, and a clear picture without any weirdnesses. In a little while we'll get into making the terminal generate half brightness characters, and you may want to play with this pot a bit more to get the level of these right. At this point, just set everything up so it's running.

The other two adjustments are near the keyboard. R12, the horizontal trimmer, adjusts the rate of the repeat key. R6, the vertical one, adjusts how long the keyboard waits, with a key held down, until it starts repeating. Both of these controls should be set to suit your preferences.

You should now be able to type your brains out and get a full character set.

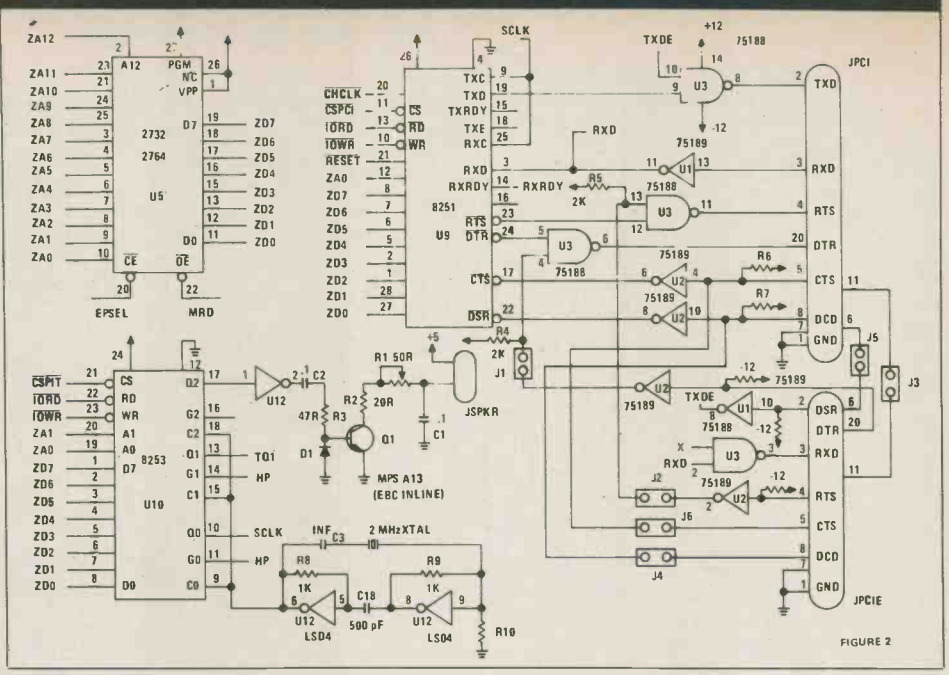


Figure 2.The EPROM, timer and I/O.

Functions

Okay, now ... here's what should happen.

The terminal defaults to the local mode, so it echos back on itself. By striking the control key at the same time as other keys on the board, you can get the system's various function to come to pass. See Table 1 for a list of these.

TABLE 1
Terminal Control Codes

CTRL H Non destructive backspace
CTRL J Line Feed (Cursor Down)
CTRL K Cursor Up
CTRL L Cursor Right
CTRL I Tab
CTRL P End of Line
CTRL carrot Home
CTRL T Transmit buffer over RS-232
CTRL A Abort buffer transmission
CTRL Q Clear Screen
CTRL G Bell Character
CTRL D Stop Attributes
CTRL F Start Attributes
CTRL X Scroll Up (local only)
CTRL E Scroll Down (local only)
CTRL C Next page (20 lines, local)
CTRL R Previous page (local)
CTRL @ Get status line

Most of these will be fairly self explanatory. A few, however, are tied in with the operating system of the terminal, and will require some elaboration.

If you type CTRL @, the cursor will leap to a new line and print a "status line" make sure that you do this at the bottom of your text ... if the cursor is positioned in the middle of a block of characters, you'll loose several lines. This status line will give you the various parameters of the system. It looks like this:

LOC scrn STD atr DIM 300 Baud data B par OFF stop 1

Deciphering this, we find that the terminal is in the local mode, the screen is standard, the attributes are dim characters and the port configuration is 300 Baud, 8 bit characters, no parity and one stop.

Now, these things can be changed. You'll find that while it's in the status line submode, most of the keyboard's keys will be ignored. However, seven of them can be used to change these parameters.

M-toggles the terminal from local to remote mode and back again.

R-toggles the screen from white on black to black on white ... or green, depending on your tube.

A-decides what the attributed characters will look like. The choices are standard, reversed, dimmed or alternate. Since there is no alternate character set currently in the character generator ROM (you can add one if you want), this option pro-

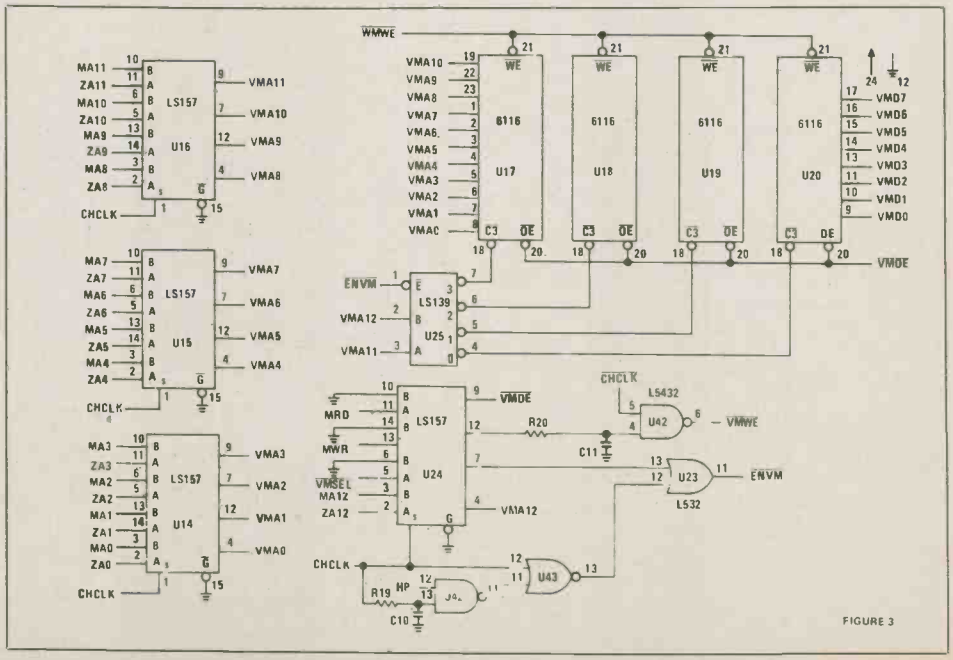


Figure 3. RAM buffer and multiplex.

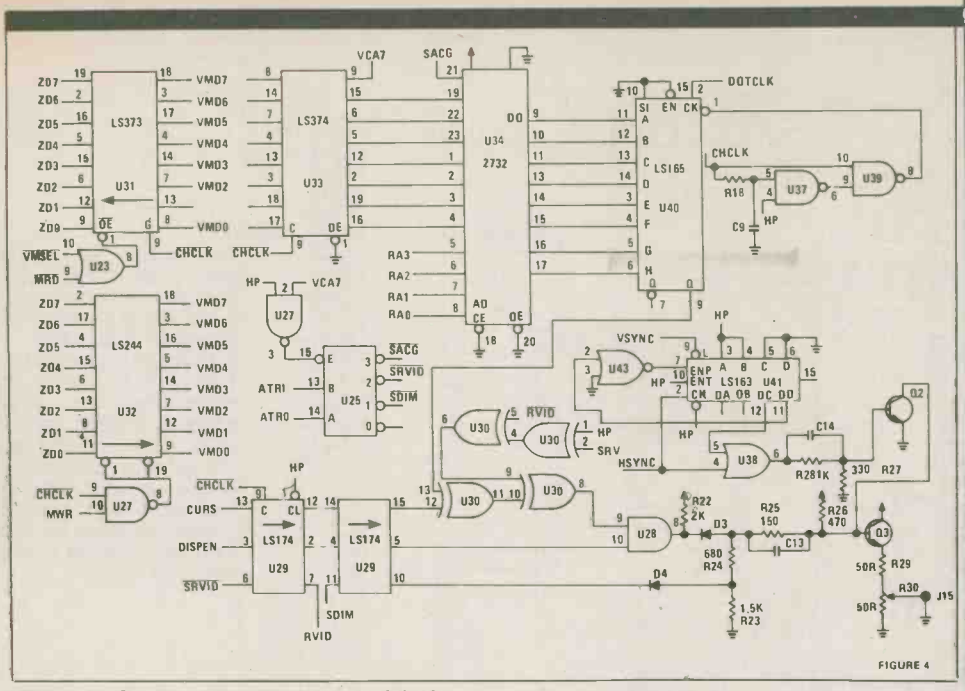


Figure 4. Character generators and buffers.

duces weird bit mapped thingies.

B- steps through the baud rate options

D- selects the number of bits per character (7 or 8).

P- selects odd, even or no parity.

S- selects the number of stop bits.

A second CTRL @ gets out of the status line submode, erases the line and returns the cursor to its previous position.

The last thing that will want playing with is the character attributes. Set the *atr* function on the status line for DIM. Then type some stuff. Somewhere along the line, hit a CTRL F. The following characters should come up at half brightness. You may want to fidget with the video level control to pretty them up a bit. A CTRL D will stop the attribute. If you now get back to the status line and step through the attribute selections, the attributed characters you just typed will change their attributes from dim to weird to standard to inverse and so on.

There are a few bits to keep in mind when using the buffer transmit feature. First off, the lines of characters must not have a character in the last column. Secondly, the switch from local to remote mode should be done while the cursor is on the first page (from lines 0 to 23). If anything gets bizarre, hit a CTRL A to abort this function.

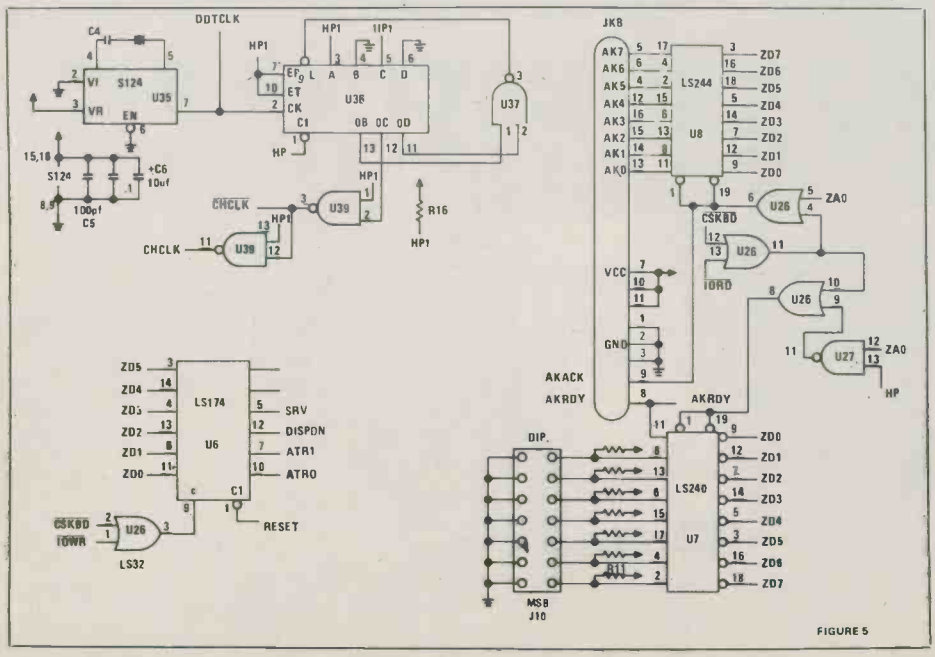


Figure 5. Dot clock and keyboard interface.

Powering Down

The terminal project should provide you with a very powerful computer peripheral whether you plan to use it for accessing remote system, text editing, talking to your own micro or just learning about dedicated microprocessor systems. If it is well received, we hope to be running a companion MODEM project in a little while.

If you do run into any difficulties in getting the terminal going, Exceltronix is offering free troubleshooting on kits that have been properly constructed.

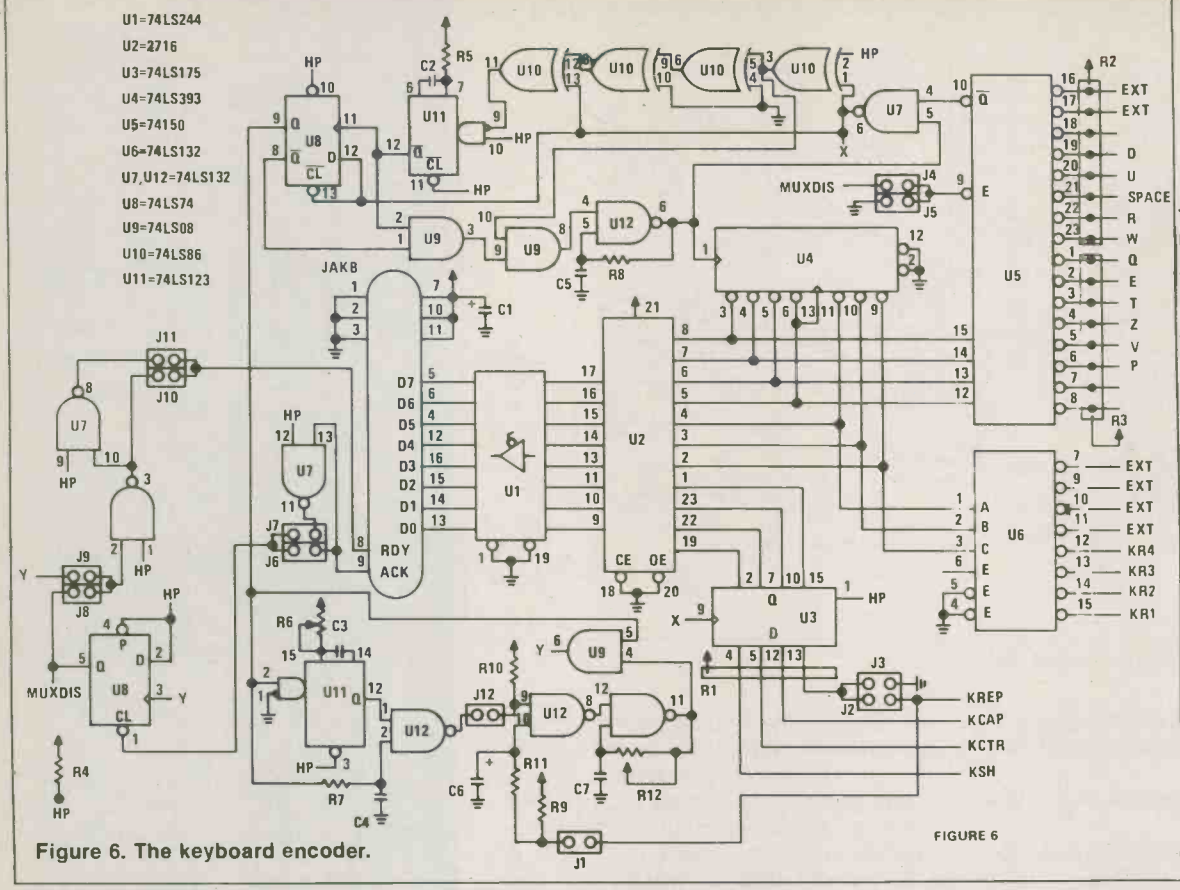


Figure 6. The keyboard encoder.

FIGURE 6

ETI

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74LS00N	.32	74LS42N	.67	74LS138N	.84	74LS191N	1.12	74LS283N	1.28
74LS01N	.33	74LS47N	1.09	74LS139N	.75	74LS192N	1.12	74LS298N	1.50
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74LS03N	.36	74LS74N	.48	74LS151N	.63	74LS194N	1.12	74LS362N	15.18
74LS04N	.38	74LS75N	.69	74LS153N	2.29	74LS221N	1.35	74LS365N	.89
74LS05N	.38	74LS76N	.66	74LS155N	1.37	74LS240N	1.81	74LS366N	.89
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74LS09N	.38	74LS86N	.53	74LS158N	.72	74LS242N	1.81	74LS368N	.89
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74LS12N	.38	74LS93N	.82	74LS163N	.88	74LS245N	2.98	74LS375N	.97
74LS13N	.55	74LS96N	1.09	74LS164N	1.35	74LS251N	1.05	74LS377N	1.91
74LS14N	.73	74LS107N	.63	74LS165N	2.50	74LS253N	1.05	74LS378N	1.50
74LS20N	.44	74LS112N	.55	74LS166N	2.24	74LS257N	1.05	74LS390N	2.19
74LS21N	.40	74LS122N	1.05	74LS170N	2.24	74LS259N	2.27	74LS393N	2.19
74LS26N	.38	74LS123N	1.01	74LS173N	.66	74LS266N	.63	74LS447N	1.35
74LS30N	.51	74LS125N	.68	74LS174N	.69	74LS273N	1.81	74LS624N	2.52
74LS32N	.40	74LS132N	.74	74LS175N	.68	74LS279N	.66	74LS670N	1.92
74LS38N	.43	74LS133N	.74	74LS189N	5.22	74LS280N	2.99		

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74F02PC	1.44	74F11PC	1.44	74F158PC	3.24	74F353PC	3.51
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74F08PC	1.44	74F138PC	3.24	74F241PC	6.75	74F379PC	5.04
74F10PC	1.44	74F139PC	3.24	74F243PC	7.88	74F381PC	11.48
				74F257PC	3.51	74F534N	8.78

9300 SERIES TTL

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9305PC	2.44	9316DC	4.74	9334PC	5.95	9374PC	3.82
				9368PC	3.82	93S160M	4.88

CMOS

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4002	.39	4024	1.14	4049	.83	4085	.99	4539	1.35
4006	1.49	4025	.39	4051	1.35	4093	1.05	4543	2.48
4009	.69	4026	2.93	4052	1.43	4104	5.63	4553	8.03
4011	.39	4027	.90	4053	1.43	4510	1.49	4556	1.13
4012	.38	4028	1.13	4060	1.50	4511	1.35	4582	1.38
4013	.77	4029	1.35	4066	.51	4512	1.39	4584	.98
4014	1.25	4030	.98	4068	.51	4514	2.99	4585	1.22
4015	1.25	4033	4.05	4069	.39	4516	1.39	74C85	2.18
4016	.71	4034	3.00	4070	.39	4519	1.13	74C107	1.13
4017	1.35	4035	1.65	4071	.39	4520	1.28	74C161	1.80
4018	1.20	4040	1.43	4072	.39	4522	1.80	74C163	1.80
4019	.98	4041	1.35	4073	.39	4526	2.25	74C173	2.40
4020	1.41	4043	1.35	4075	.39	4527	1.80	74C193	1.80
4021	1.23	4044	1.31	4076	1.35	4528	1.61	80C97	1.04
4022	1.43	4045	1.39	4078	.48	4528	1.61	80C98	1.04

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74HC04N	.96	74HC107N	1.75	74HC166N	4.10	74HC259N	4.40
74HC08N	.96	74HC138N	2.90	74HC174N	3.20	74HC273N	6.50
74HC10N	.96	74HC139N	3.30	74HC175N	3.20	74HC365N	2.15
74HC11N	.96	74HC151N	3.30	74HC192N	2.90	74HC366N	2.15
74HC20N	.96	74HC155N	3.30	74HC193N	2.90	74HC367N	2.15
74HC21N	.96	74HC157N	2.15	74HC194N	3.35	74HC368N	2.15
74HC27N	1.10	74HC158N	2.15	74HC240N	6.75	74HC373N	5.90
74HC32N	1.10	74HC160N	3.35	74HC241N	6.75	74HC374N	5.90
74HC42N	2.40	74HC161N	3.35	74HC242N	2.90	74HC375N	3.60
74HC51N	.96	74HC162N	3.35	74HC243N	2.90	74HC390N	4.40
						74HC393N	4.40

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309KC	2.54	358TC	.80	739PC	1.97	3403PC	2.84
311TC	.85	380PC	1.65	741TC	.44	4136PC	1.34
317KC	3.43	393TC	.68	747PC	.73	4151TC	1.34
317UC	1.82	555TC	.45	776TC	2.97	N8T26N	2.18
318TC	1.82	556PC	.83	1458TC	.55	AM26LS31CN	4.33
323KC	6.87	567TC	1.36	1489PC	.98	AM26LS32CN	4.33
324PC	.68	709HC	.89	1489APC	.98	ULN2002AN	1.62
				2211PC	4.11	ULN2004AN	1.91

KC = TO3, UC = TO220, HC = TO5, TC = 8 PIN MINI DIP, N or PC = DUAL IN LINE IC

TRANSISTOR SPECIALS

2N404A	1.87	2N5086-5089	.24	MPSA64	.32
2N697	.45	2N5209-5210	.28	MPSA65	.32
2N718A	.43	2N5219-5221	.15	MPSA70	.27
2N918	.82	2N5223	.15	MPSA92	.32
2N930	.41	2N5226	.15	MPSA93	.32
2N1613	.54	2N5227	.15	MPS3638	.27
2N1711	.53	2N5400-5401	.28	MPS3638A-5	.27
2N1893	.54	2N5449	.43	MPS3646	.29
2N2102	.53	2N5550-5551	.40	MPS3704	.23
2N2218A	.53	2N5770	.27	MPS5172	.23
2N2219A	.53	2N5771	.48	MPS5551M	.24
2N2221A	.29	2N5830	.59	MPS6513	.23
2N2222A	.38	2N5832-5833	1.20	MPS6514	.23
2N2369A	.38	2N5961-5962	.28	MPS6515	.23
2N2484	.41			MPS6516	.23
2N2904A	.48	TIS75	.59	MPS6517	.23
2N2905A	.68	TIS90	.54	MPS6518	.23
2N2906A	.29	TIS91	.42	MPS6519	.23
2N2907A	.38	TIS92	.42	MPS6520	.23
2N3019	.69	TIS93	.42	MPS6521	.23
2N3053	.53	TIS96	.44	MPS6522	.23
2N3054	.99	TIS97	.50		
2N3055	1.12	TIS98	.36	PN2222A	.21
2N3702-3711	.18	TIS111	.36	PN2369A	.21
2N3771	2.25			PN2907A	.21
2N3772	2.25	MPF102	.52	PN3563	.23
2N3773	3.38	MPF103	.52	PN3565	.23
2N3819	.63	MPSL01	.21	PN3567	.23
2N3903-3906	.24	MPSA05	.21	PN3568	.23
2N4058-4062	.30	MPSA06	.26	PN3643	.23
2N4033	.93	MPSA10	.24	PN3644	.23
2N4036	.98	MPSA12	.31	PN3645	.23
2N4037	.98	MPSA13	.25	PN4121	.23
2N4093	.89	MPSA14	.36	PN4248	.23
2N4123-4126	.21	MPSA18	.24	PN4249	.23
2N4400-4403	.21	MPSA20	.21	PN4250	.23
2N4410	.24	MPSA42	.36	PN4275	.23
2N4996	.24	MPSA43	.36	PN4888	.23
2N5064	.30	MPSA55	.23	PN4916	.23
		MPSA56	.32	PN4916-5	.23
		MPSA63	.32	PN4917	.23

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P4060-30	4K	(4K x 1)	300 NS 22 PIN		5.25
P4116-15	16K	(16K x 1)	150 NS 16 PIN		3.57
P4116-20	16K	(16K x 1)	200 NS 16 PIN		2.87
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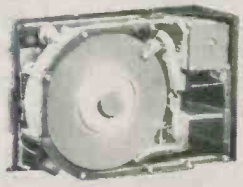

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01 34555

Can you rearrange those numbers to make a well-known phrase or saying? Of course, it's an anagram of the 3140 MOSFET (Metal Oxide Semiconductor Field Effect Transistor) operational amplifier and the familiar 555 timer. The advantages of the 3140 over the less-expensive 741-type of op amp are: its common mode input range which includes the negative supply rail, faster output slew rate and very high input impedance — millions of megohms. All these characteristics are exploited in this design so don't use a 741 — it won't work.

Construction

Build up the printed circuit board (PCB) first. Insert and solder resistors followed by capacitors. Capacitor C5 is polarised, so make sure you get it the right way round. Figure 2 gives details of component locations.

Next, insert and solder PCB pins at the nine points where off-board connections are made. This may seem unnecessary but it means that you can make (and remake if needed) all connections after the board has been fitted into the box so that all wiring is neat, and not in a 'bird's-nest' state.

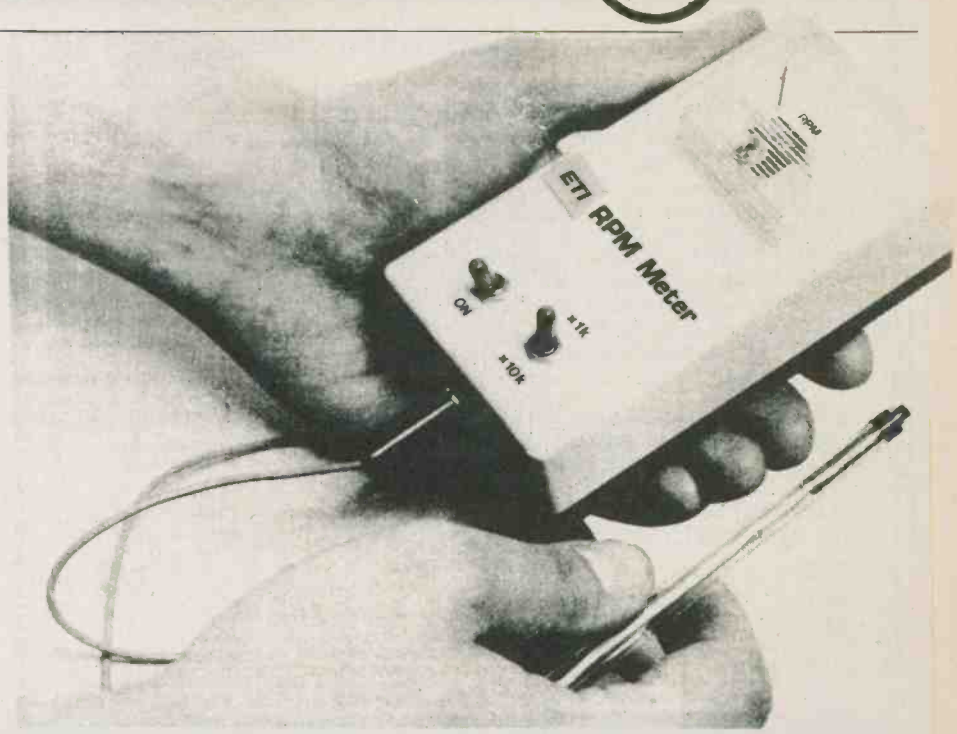
Now solder in zener diode ZD1, making sure that it is the right way round.

Use integrated circuit sockets to hold the two ICs. As well as making it easier to substitute and test ICs, the sockets enable you to whip out the chips if they are required for another project without having to attack the finished unit with a hot soldering iron. (Note that despite the use of MOS transistors in the 3140, the device is not susceptible to damage from static electricity and no special handling precautions are required.)

Mark and drill the case for the meter and two switches. Fit these, the PCB and the battery into their final postions. Two or three self-adhesive foam pads are ideal to hold the circuit board and battery.

Now, wire up the project as the connection details in Fig. 2 show.

Finally, mount the photo-transistor in an old felt-tip or ball-point pen, after covering the body of the sensor transistor (see Fig. 3) with a short length of opaque sleeving to cut down ambient light. Readily-obtainable heat-shrink, or rubber, sleeving is ideal, but if you can't obtain this a few turns of insulating tape, neatly wrapped round, will do the job.



Calibration And Use

Calibration is very simple. All you need to do is switch to the 0—3,600 RPM range and point the sensor at an electric light bulb. The light from the lamp will be modulated at the 60 Hz line frequency corresponding to a 3,600 RPM signal (60x60). Wait a moment for the auto-Schmitt input stage to adjust itself, you may have to point the sensor away from the lamp slightly, until the meter gives an indication. Then adjust RV1 for a reading of 3,600

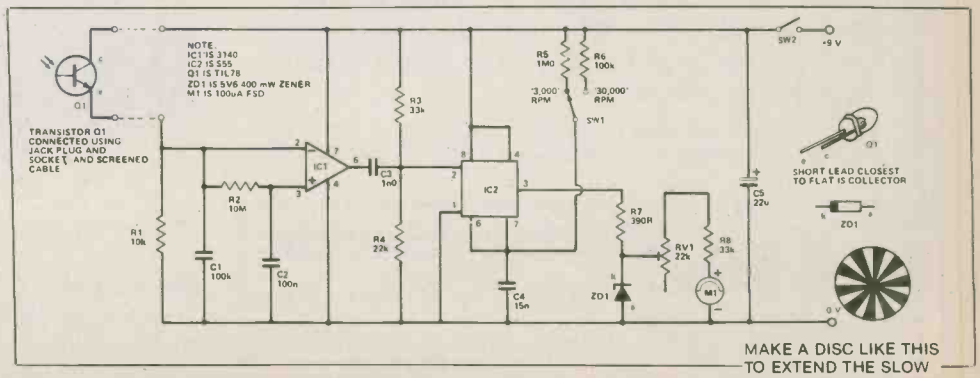
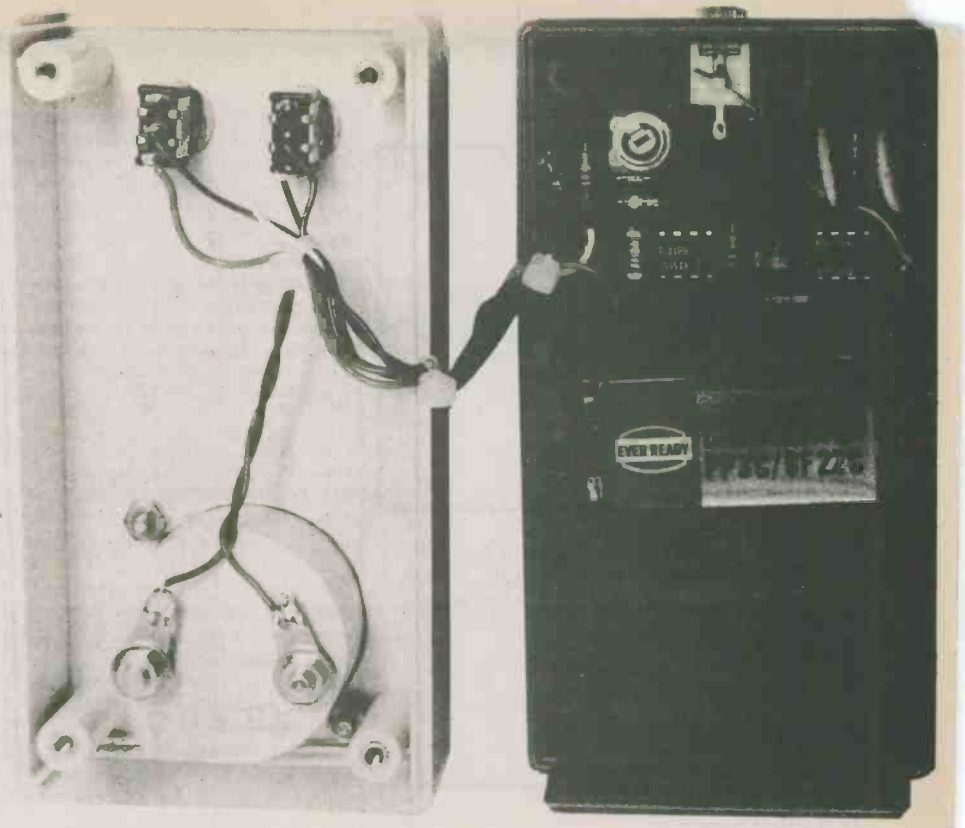


Figure 1. Circuit of the ETI RPM Meter.

RPM, full-scale on the meter. In fact, because the lamp brightens for each half-cycle of the mains, its output frequency is 120 Hz. However, on the 3,600 RPM range, the unit is unable to respond to a 120 Hz input and indicated 3,600 RPM. By switching to the 36,000 RPM range, you should obtain a true reading of 7,200 RPM. For this reason you should always commence your measurements with the unit switched to the 36,000 RPM range.

In use, the object to be measured is arranged so that the sensor sees an increase in reflected light once per revolution. For example, you can measure the speed of an electric motor by slipping a short length of black sleeving over its shaft. Paint one side of the sleeving with white paint so that the sensor sees white and black sections alternately as the shaft revolves. Although the input stage will compensate automatically for various lighting conditions it may sometimes be helpful to illuminate the shaft with the light from a small pocket torch. One of those with a lens-end pre-focus bulb is ideal.

To obtain a 0-360,000 RPM range, use a 10k resistor for R5. To measure slower revolutions, simply arrange for more black/white transitions per revolution using striped paper wrapped around the shaft or a radially patterned disc mounted on a rotating wheel. Ten black/white stripes per revolution give a 0-360 RPM range and so on. There are many techniques for measuring the speed of rotating objects. This unit is cheap and simple to build and calibrate providing an excellent introduction to electronic measurement systems. Build one for your lab or workshop or just for fun—amaze your friends with a 'revolution' in electronics!



Internal view of the ETI RPM Meter.

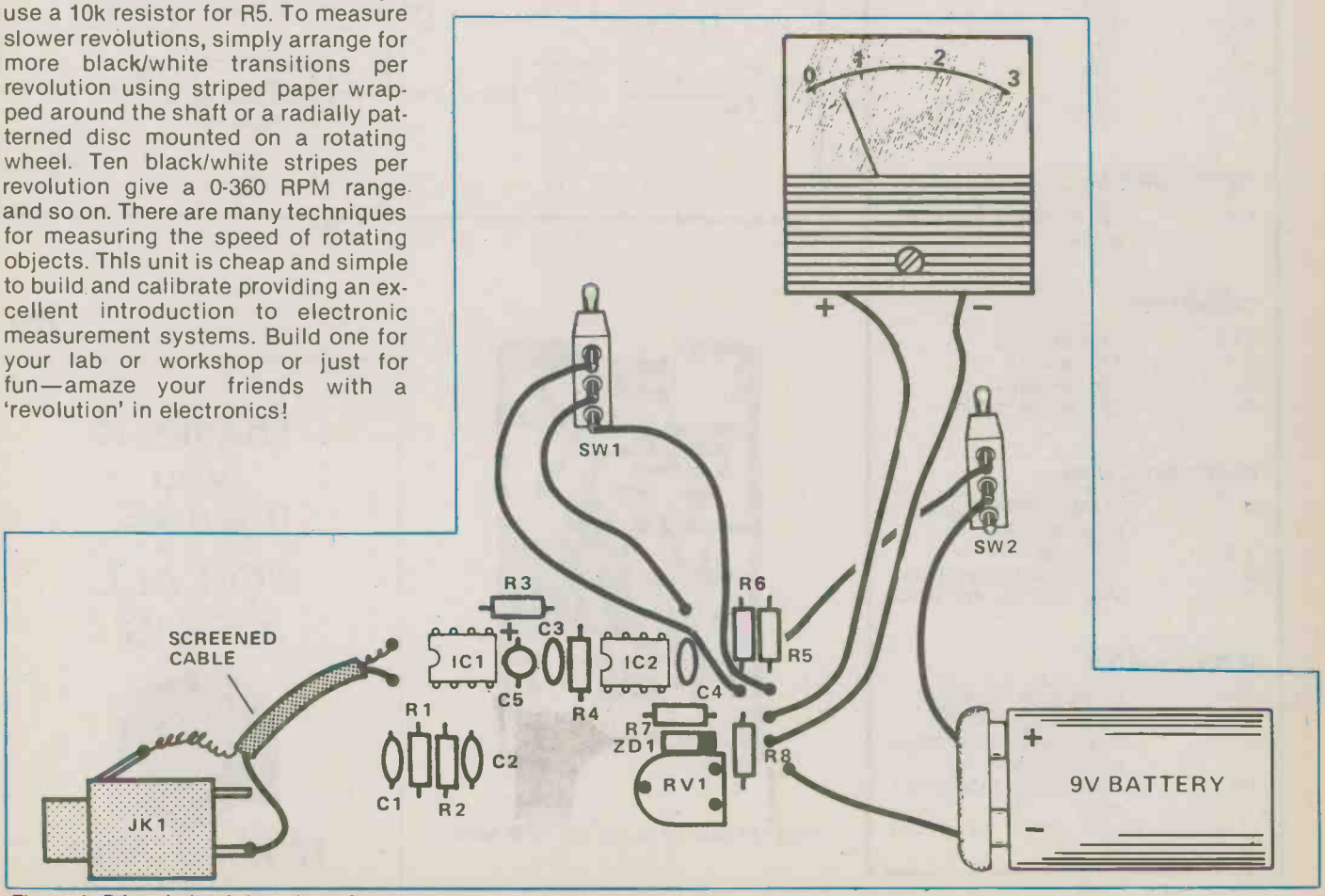


Figure 2. Printed circuit board overlay along with connection details of the project.

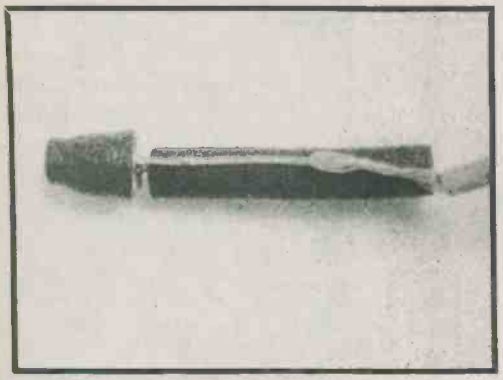


Figure 3. Close-up details of the phototransistor, insulated with rubber sleeving, prior to insertion into a pen body.

PARTS LIST

RESISTORS

R1	10k
R2	10M
R3,8	33k
R4	22k
R5	1M0
R6	10k
R7	390R

POTENTIOMETER

RV1	22k miniature horizontal preset

CAPACITORS

C1,2	100n ceramic
C3	1n0 ceramic
C4	15n polyester
C5	22u, 16V tantalum

SEMICONDUCTORS

IC1	3140E MOSFET operational amplifier
IC2	555 timer
Q1	TIP 78 photo-transistor
ZD1	5V6, 400mW zener diode

MISCELLANEOUS

SW1	single-pole, double-throw toggle switch
SW2	single-pole, single-throw toggle switch
M1	100 uA FSD moving-coil meter

3.5mm jack plug X socket (or similar)
Case to suit.

HOW IT WORKS

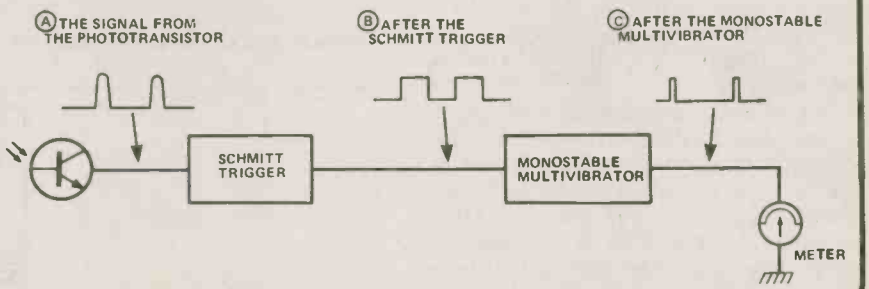
The input signal is 'squared up' by the Schmitt trigger whose output drives a monostable multivibrator; ie, each time the monostable is triggered by the Schmitt trigger it produces an output pulse whose period is determined by the associated resistor. A simple changeover switch selects the appropriate timing resistor for the selected measurement range. The output from the monostable is used to drive a meter — the closer the pulses (ie, a greater RPM), the more the meter needle moves.

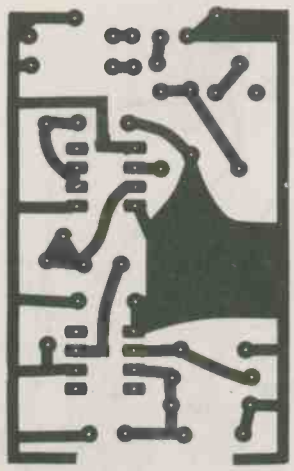
Light falling on transistor Q1 causes a current to flow through it (because it is a photo-transistor) and a voltage is developed across resistor R1. If the light is modulated ie, goes brighter and dimmer, the voltage across R1 will rise and fall in sympathy. Capacitor C1 removes any noise spikes which may have been picked up by the connecting leads and the resultant signal goes to the inverting input of IC1. This is an op amp used as a comparator; comparing the voltage at the inverting input. We obtain the reference voltage by low-pass filtering the input voltage with R2 and C2. An input signal producing a voltage across R1 which ranges from 1V to 4V will result in a reference voltage of about 2.5 V, the average of the peak and trough values. The exact reference voltage will also be a function of the input's mark-to-space ratio which should ideally be 50% (ie, equal light and dark areas on the rotating surface).

The output of IC1 consists of a squarewave at the same frequency as the input signal. This output signal triggers the 555 timer on each falling edge. A differentiating circuit C3, R3 and R4 is used to produce a short trigger pulse. The 555's monostable output pulse is a function of range setting resistors R5 and 6.

To make the unit less sensitive to falling battery voltage the output of IC2 is clipped by ZD1, a 5V6 zener diode, and the meter is driven from this voltage through a current-limiting series resistance comprising RV1 and R8.

Current pulses from IC2 are averaged in the meter, the deflection of which indicates the input frequency scaled in RPM. To allow for variations in component tolerances, full-scale deflection is obtained from an 80% duty cycle. The supply is smoothed by C5 which should be mounted close to IC2.





PCB foil pattern of the ETI RPM Meter.

ETI

What is CP/M?

CP/M has been with us for some time now, and is quickly becoming a domestic computer standard — but few people (other than CP/M users) actually know what CP/M is. Phil Cohen found out . . .

CP/M MEANS 'control program for microprocessors' and describes two things; firstly, it is a standard for recording information on disks (in the same way that the S100 bus is a standard for transmitting information along wires). It also stands for a series of programs that go to make up an 'operating system' — a collection of software that looks after disk storage and the other 'nitty gritty' bits of computing — and lets the user get on with writing software or whatever.

CP/M was developed by a company called Digital Research in California (where else?). In order to use CP/M, you need an 8080- compatible computer with at least 16K of RAM and at least one disk drive.

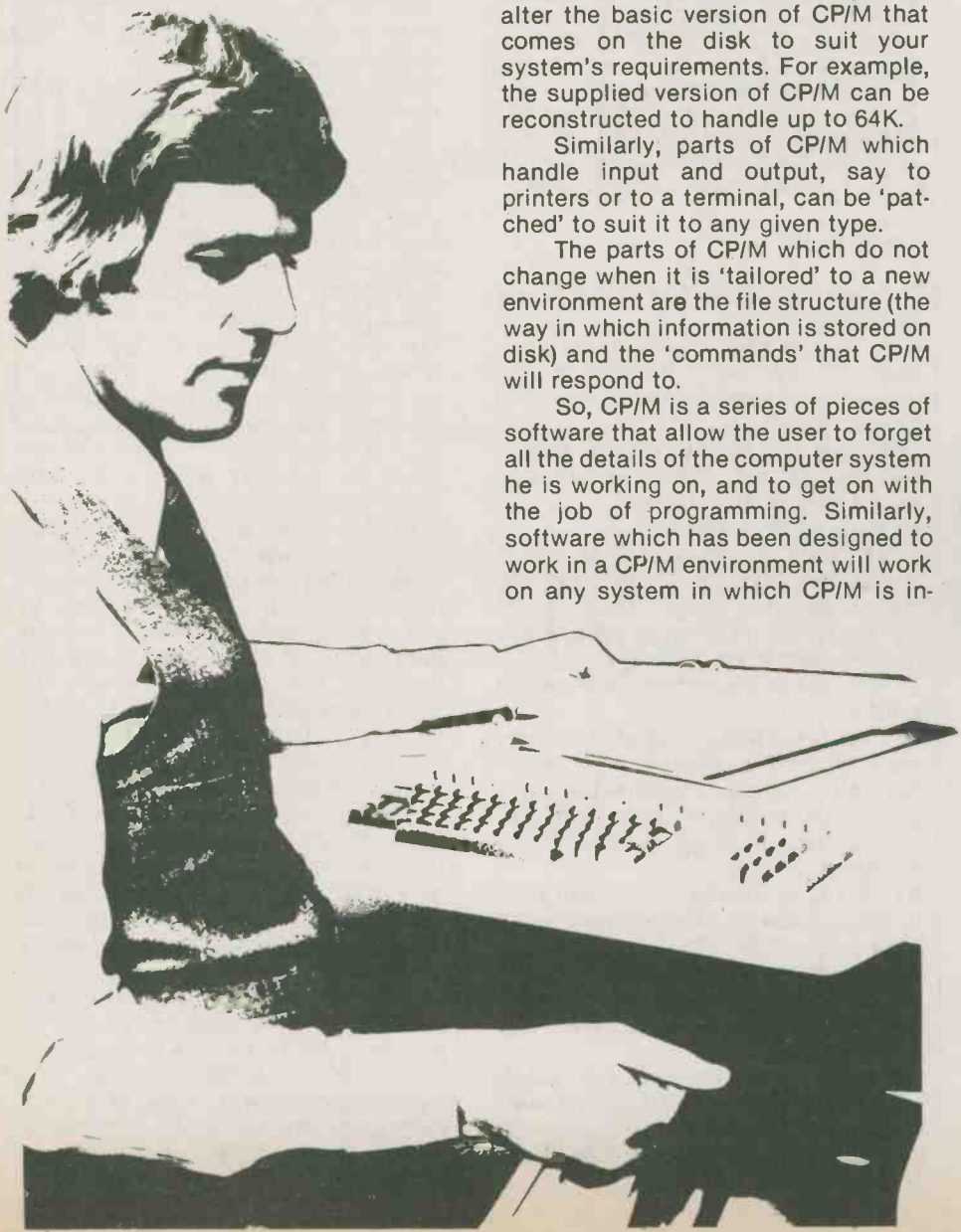
CP/M comes as a disk with all the related programs on it, and a full set of manuals. All you have to do to 'install' CP/M in your system is to insert the disk into one of your system's drives.

The CP/M 'suite' of programs includes software that allows you to alter the basic version of CP/M that comes on the disk to suit your system's requirements. For example, the supplied version of CP/M can be reconstructed to handle up to 64K.

Similarly, parts of CP/M which handle input and output, say to printers or to a terminal, can be 'patched' to suit it to any given type.

The parts of CP/M which do not change when it is 'tailored' to a new environment are the file structure (the way in which information is stored on disk) and the 'commands' that CP/M will respond to.

So, CP/M is a series of pieces of software that allow the user to forget all the details of the computer system he is working on, and to get on with the job of programming. Similarly, software which has been designed to work in a CP/M environment will work on any system in which CP/M is installed — this means more readily available software for general consumption.

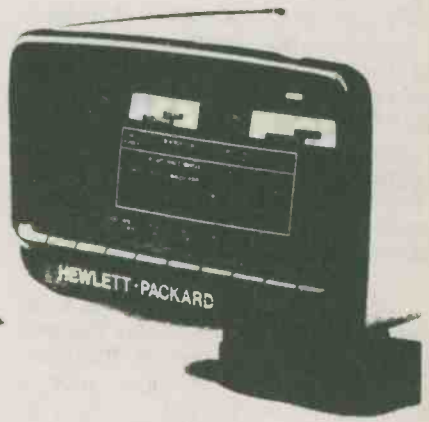


How does it work?

First let me define the word 'file'. A file of information — in the computing sense — is a string of characters (including carriage returns, with no effect), which (in CP/M) is up to 8 Mbytes long. The file is known to the user by a 'filename', which is a sequence of up to 11 characters. For example, a file which holds the data for a lotto draw might be called "datalott".

These files are stored on disk, and CP/M allows the user to shift them from disk to disk into and out of RAM, etc. The user specifies which file he wants to move re referring to it by its filename.

Now, as well as containing one or more of these files, a disk may also contain a version of CP/M. When a disk of this type is put into one of the disk drives and the system is 'booted' at this drive, the first thing that happens is that CP/M is loaded from the disk into RAM — any further input to the terminal is then treated as a command to CP/M.



There are two types of commands to CP/M. The first type is 'built-in command' — these are commands which are executed by CP/M on its own. The second type of command is a 'transient' command (I'll explain why later). Transient commands are actually files which contain machine code programs. Giving CP/M a command of this type will cause it to load the file from disk into part of RAM, and then send the processor into the RAM.

The files which hold the standard CP/M 'transient' commands come on the 'distribution disk' (the one that comes with the handbooks). The user can also generate his own transient commands later.

Two of the transient commands which come with CP/M can be used to gererate new CP/M systems. The first is MOVCPM, which allows the user to generate a version of CP/M for use with a particular amount of RAM; for example, the version of CP/M which comes on the distribution disk is configured for 16K of RAM (the minimum in which CP/M will run). The MOVCPM can be used to generate CP/M systems which operate anywhere up to 64K of RAM. The MOVCPM program can even find out how much RAM is available automatically!

Another transient command of this type is SYSGEN. This puts CP/M onto an otherwise blank disk, so that the system can be 'booted' from any disk the user chooses.

Internals

When CP/M is loaded into RAM, it looks like Figure 1. The areas of RAM are split up as follows:

BIOS*: Basic I/O System — this is the part of CP/M that tells it how to drive your printer, terminal, etc.

BDOS*: Basic Disk Operating System — this part describes how to run your disk drive(s).

CCP: Console Command Processor — analyses the commands that you enter into your system and executes them as CP/M commands (see later).

TPA: Transient Program Area — this is the rest of your RAM, an area where programs can be run.

(*The BIOS and BDOS described above are combined into a program called FDOS, and this resides at the top of your system memory.)

As I said before, one of the most important features of CP/M is the way in which it stores files on the disk. Not that there's anything unique about the method used — it's just that it has become very common, and that's a virtue in itself.

Up to 64 files can be stored on a disk. CP/M allows the user to call up the 'directory' of the disk (i.e: a list of all of the files currently on the disk).

That's why machine language program files are called 'transient', by the way—because they are loaded into the TPA before execution.

Although it appears to the user that the files are all that is on the disk, the directory itself is a file, and there are other things on the disk which are 'opaque' to the user. This is the real power of such a system—it allows the user to forget about the way things actually operate, and to get on with the job.

In order to simplify commands, the user is 'logged' into one disk drive at a time—this is shown by the 'prompt' on the screen. Drives are known as A,B,C, etc. When the system starts up, the user will be 'logged' into drive A—and an A will appear on the left of the screen.

By typing in the letter of another disk (followed by a colon), the user can 'log' himself into another disk. Being logged into a disk means simply that any file names used in CP/M commands will be assumed to refer to the directory of the logged disk.

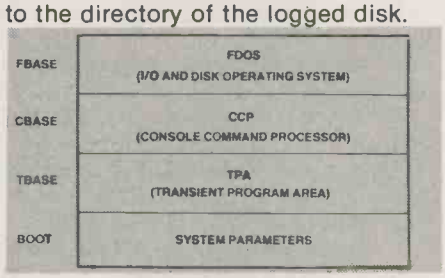


Figure 1. What CP/M looks like in RAM.

Commands

The built-in commands of CP/M are as follows:

ERA: erases a file. In actual fact, this does not over-write the file on the disk—it just removes the entry in the directory file.

DIR: lists the directory of a disk. It can also list only those files starting with a particular letter, etc.

REN: renames a file.

SAVE: puts an area of RAM into a named file. The LOAD transient command (see later) allows the file to be put back into the area of RAM where it was taken from originally.

TYPE: lists a file on the terminal (or printer).

As I mentioned before, transient commands are merely files which happen to contain machine code programs, and so are not uniquely 'CP/M' — but the following come with the standard version:

STAT: allows the user to find out such things as how much area remains on a particular disk, etc.

LOAD: copies a file into RAM.

PIP: copies a file from one disk drive to another, or in fact, from any peripheral

SYSGEN: puts the current RAM-resident version of CP/M onto a disk.

MOVCPM: allows the user to generate new version of CP/M of different sizes.

MP/M

MP/M is an operating system somewhat similar to CP/M (and in fact fully compatible with CP/M). The difference is that it allows more than one user to access the system *at the same time*.

This doesn't only mean more than one person using a machine — it means that even a single user can speed throughput by, for example, 'spooling' printout. This means that while you are printing one file you can be doing something else at the same time.

Not only does MP/M allow multi-user support, it can also be given tasks to perform at particular times (MP/M is 'aware' of the time). This means that, in large systems, a program can be entered *once* which will 'back up' all system files at three in the morning every morning, without operator intervention.

MP/M is really the last link in the chain — it holds almost all the features that up to now have separated domestic computers from 'mainframes'.

DUMP: lists a file in hex on the terminal (or printer).

In addition to the above, the manual lists the following as transient commands—but I think they deserve a deeper coverage.

ASM: is a fully-fledged 8080 assembler, using standard Intel mnemonics. It takes in a file of assembly language statements and puts out a file which contains the hex machine code equivalent plus the original assembly statements. This output file can then be edited to separate the machine code characters and load them into RAM.

ED: is a powerful contextual editor, which allows the user to alter files, copy files, etc. One feature which is designed for use with ASM output files is the ability to remove the left-most part of each line (i.e: the part which contains the machine code).

SUBMIT: the SUBMIT command passes a named file to the CCP—in other words, to CP/M it is as if the commands in that file were being input directly at the console. So whole sequences of CP/M commands can be stored, and executed one after the other automatically. This sort of thing is very useful for such 'operator' tasks as backing up the latest versions of files onto an 'archive' disk.

All in all, not only does CP/M contain all the commands and features necessary for the operation of a complete disk-based system, it also comes with enough utility software to keep most domestic users happy for some time.

CP/M is not only important because of its usefulness in an isolated system; in the same way that the S-100 buss has enabled the domestic computer industry to produce an enormous variety of compatible hardware, CP/M will allow software to suit.

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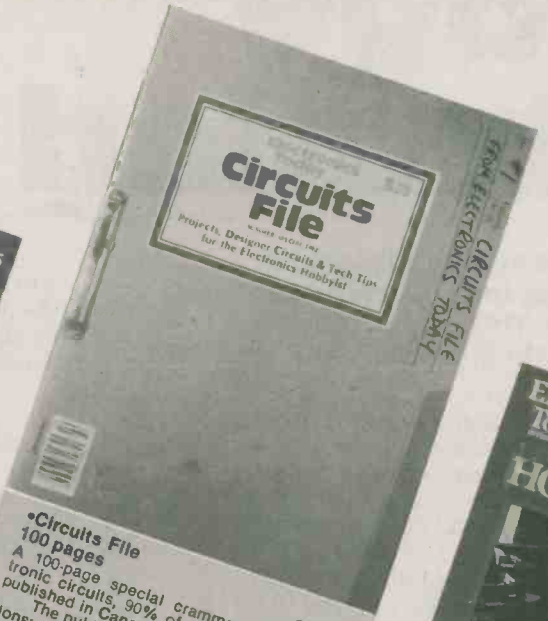

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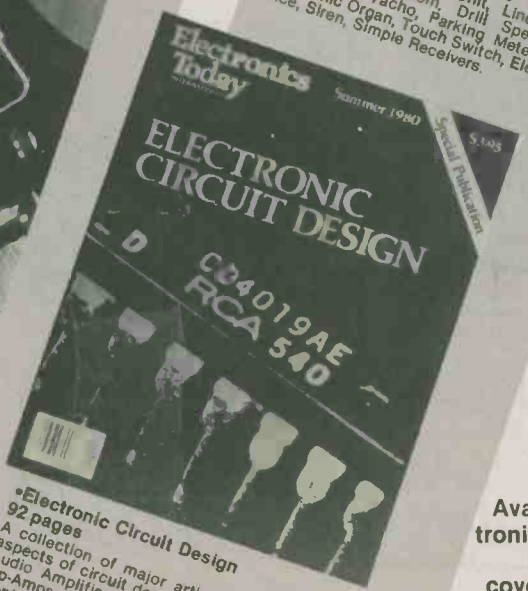

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Voltage Controlled Pots

Normally pots are used to control voltage, but as Keith Brindley explains, the TDA 1074 uses voltage to control pots. This circuit design feature should put new life into your hi-fi.

IN AN ORDINARY, manual preamplifier most functions are provided by potentiometer control — the pot simply acting as a variable potential divider of the signal. Inevitably, because the pot is mounted away from the PCB (or at best, on it), a loop is formed through the pot which tends to pick up interference. Techniques such as screened cabling, PCB mounting of pots and so on reduce the amount of interference pickup, but only to a limited extent. Electronic potentiometers, however, can create a further, significant reduction in interference, since they are voltage-controlled and have no interference.

Signetics' IC, the TDA1074, can act as four voltage-controlled pots ganged into two completely separate double electronic pots. Use of the IC thus allows the active controls to be at PCB level, and coupled with good board design this means that few or no interference loops will be formed. Control of the 'wiper' position of the pots is by DC control voltage, making them an ideal choice in the volume and tone control stage of a remote, touch, or computer-controlled high-fidelity preamplifier.

Go For The Pot

Signetics' principle of voltage-controlled potentiometers is quite straightforward: the position of the 'wiper' of a potential divider within the IC is controlled electronically by a DC control voltage and the output from this wiper feeds an inverting op-amp. Figures 1 and 2 show how this principle can be used in two ways. In both configurations we can divide the potential divider into two parts: α, and $(1 - \alpha)$ where α is the ratio of resistance to one side of the wiper and $(1 - \alpha)$ is the ratio of resistance to the other side.

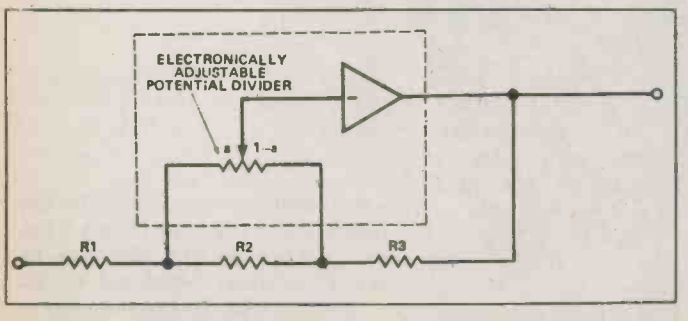

Figure 1. One of the two basic ways in which the gain block (the part of the circuit shown within the broken lines) of the TDA1074 can be used as a voltage-controlled potentiometer.

Inserting imaginary values of resistors (R1 = R3 = 10k, R2 = 1M0) into Fig. 1 we can calculate the gain (G) of the circuit. By inspection, when $\alpha = 1$, i.e. when the wiper is at the far right of the potential divider,

$$G = -\frac{R3}{R1 + R2} = -\frac{10k}{10k + 1M0} = -\frac{1}{100}$$

The negative sign is required because we are using an inverting amp. Similarly, when $\alpha = 0$,

$$G = -\frac{R2 + R3}{R1} = -\frac{1M0 + 10k}{10k} = -\frac{1}{100}$$

So the range of gain in this imaginary example is approximately ± 40 dB.

The gain of the circuit of Fig. 2 can also be calculated by inserting imaginary resistor values (R1 = R4 = 10k, R2 = R3 = 1M0).
When $\alpha = 1$

$$G = -\frac{R4}{R3} = -\frac{10k}{1M0} = -\frac{1}{100} = -40\ dB$$

And when $\alpha = 0$,

$$G = -\frac{R2}{R1} = -\frac{1M0}{10k} = -\frac{1}{100} = +40\ dB$$

(Once again the output is inverted). So in this imaginary example, the range of gain is also ± 40 dB.

Setting The Tone

These two examples show how voltage-controlled amplifiers/attenuators can be easily made. Their frequency responses will be level. In contrast, the frequency responses of tone controls are not level — the circuit will have different gains at different frequencies. For example, turning the treble control up in an amplifier

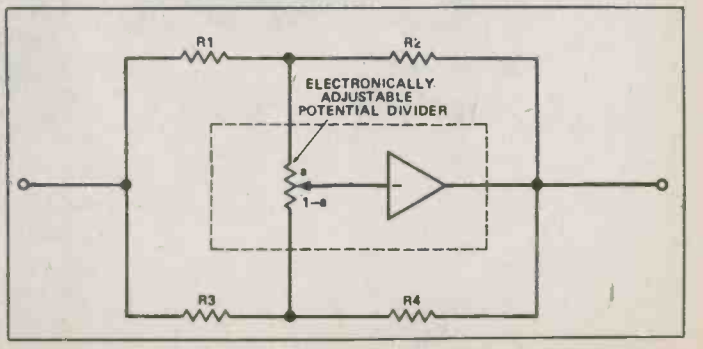

Figure 2. The second way in which a gain block of the TDA1074 can be used to form a voltage-controlled potentiometer.

system increases the amplitude of the higher frequency components in the applied signal; turning the control down decreases the amplitude.

The circuits of Figs. 1 and 2 can be adapted to form variable-slope filters such as tone controls, simply by replacing one or more of the resistors in the circuits with capacitors. Of course, a capacitor has a 'resistance' (correctly speaking, a reactance) which varies with frequency, so the gain of the circuit will also vary with frequency. Replacing all resistances with Z values (where Z can be the resistance of a resistor or the reactance of a capacitor, both measured in ohms) the gain of the circuit of Fig. 1, at any one frequency, will vary between the limits

$$G = -\frac{Z3}{Z1 + Z2} \quad \text{to} \quad \frac{Z2 + Z3}{Z1}$$

depending on the position of the potential divider wiper.

Similarly, the gain at any one frequency of the Fig. 2 circuit will vary between the limits

$$G = -\frac{Z2}{Z1} \quad \text{to} \quad -\frac{Z4}{Z3}$$

depending on the position of the wiper. In other words, the circuits can be used to form voltage-controlled variable-slope filters. Such filters will be discussed later in the applications section.

Figure 3 shows a simplified internal circuit of the TDA1074 built up using the basic op-amp stages of Figs. 1 and 2. Op-amps 1a and 1b form one double-ganged pot, whose output is at $V_{ss}/2$. Decoupling/smoothing capacitors are required from pins 1 and 8 for this voltage.

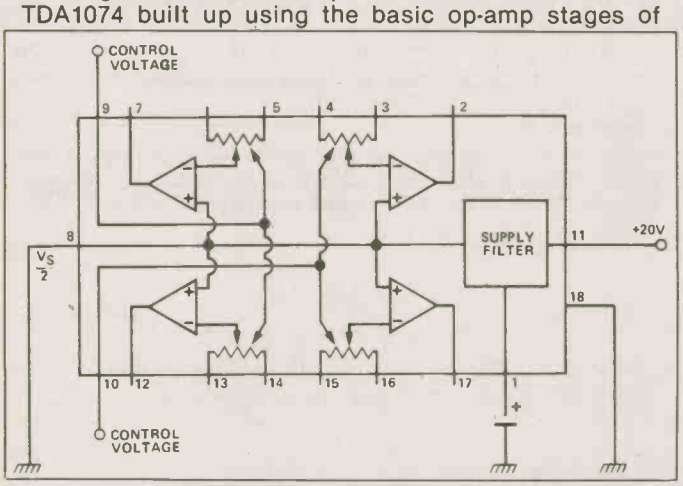

Figure 3. Simplified internal diagram of the TDA1074. Four of the basic gain blocks are internally connected as two, double-ganged, electronic potentiometers.

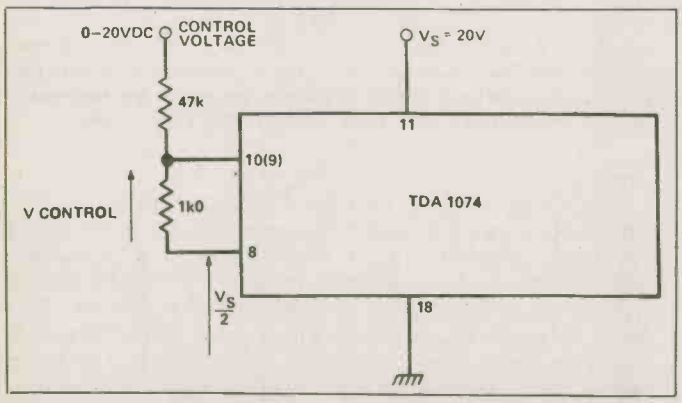

Figure 4. A simple potential divider circuit of only two resistors means that a control voltage range of 0 — 20 V DC can be used. Other voltage ranges can be selected by a suitable choice of resistors.

Maximum control voltage range (applied directly to pin 9 or 10) is ± 1 V of half-supply (e.g. using a supply voltage of say, 20 V, the control voltage range is 9-11 V) but most gain change occurs within ± 200 mV of $V_{ss}/2$. The most convenient way to derive a suitable control voltage range of 9V8 to 10V2 is by using a voltage divider from the power supply and the output from pin 8 (the filtered $V_{ss}/2$ supply). Fig. 4 shows the idea.

Applications

Volume and balance controls can be made by straightforward adaptation of the gain block circuit of Fig. 1. By having no resistance for R3 the maximum value of gain bcomes R2/R1, and the minimum, 0.If R2 = R1, as in Fig. 5, then the circuit acts as volume control with a range of zero to unity gain.

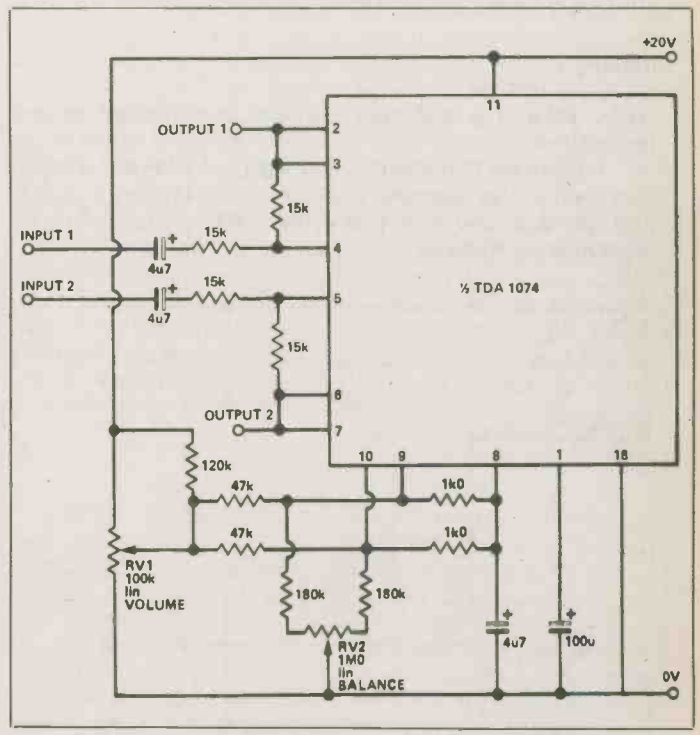

Figure 5. Stereo volume and balance controls obtained with only one half of the TDA1074.

Balance between two parallel audio channels is most easily achieved by adjusting the ratio of DC control voltages between the two. In Fig. 5, pot RV2 reduces one control voltage down toward 0 V more than the other, depending on the position of its wiper.

A superior balance control is achieved by separating it from the volume control into its own circuit. Figure 6 gives the circuit with suggested component values. At a control voltage of 10 V, the two halves of circuit each have unity gain. At the extreme ranges of the control voltage, one channel will have a gain of about 2 (+6 dB), as opposed to 1/30 (-30 dB) for the other.

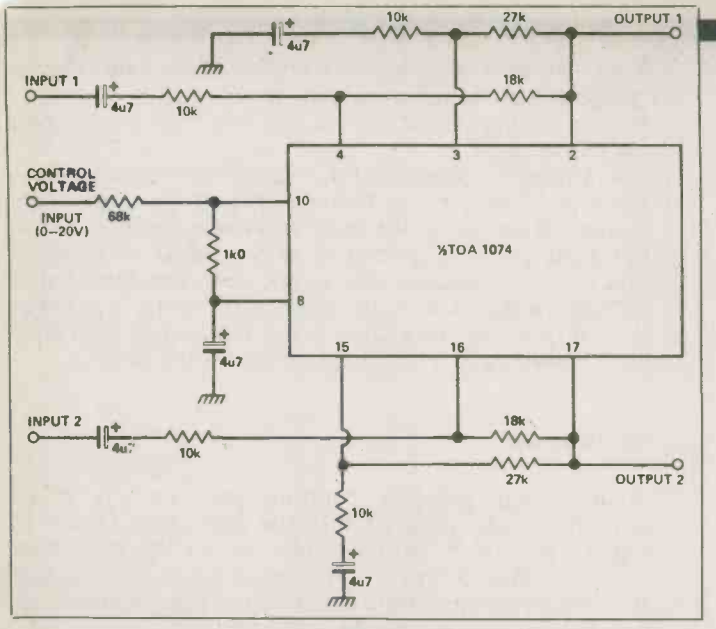

Figure 6. Superior balance control. A control voltage input of 10 VDC gives equal signal gains from both channels.

Mixing it

The basis of a high-quality voltage-controlled stereo mixer is shown in Fig. 7. The standard gain block is used to increase the level of one signal whilst decreasing the level of the other. At an input control voltage of 10 V the gains of the circuit are the same. Stages can be cascaded if required

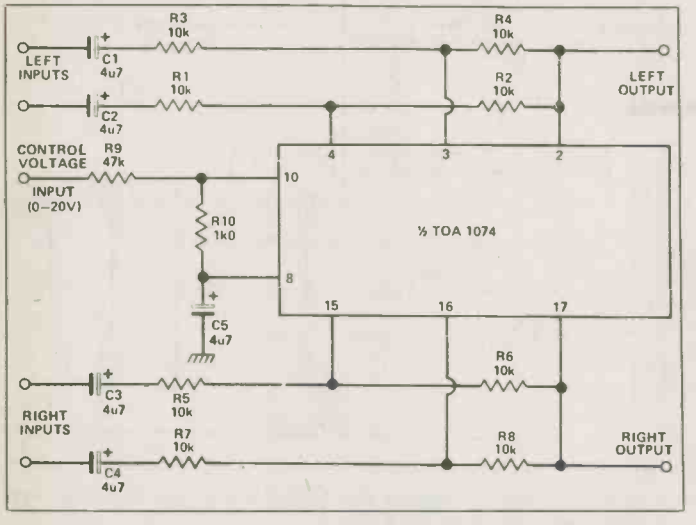

Figure 7. Voltage-controlled stereo mixer application using the TDA1074.

Maximum gain of each input is defined by the ratio of feedback resistor to input resistor on the input, e.g. R2/R1, R4/R3 . . . Unity gain is thus obtained when R2 = R1, R4 = R3 and so on.

A variable stereo image width control is shown in Fig. 8. This can be used in place of a stereo/mono switch if fully variable control of signals is desired between the two extremes of stereo (complete separation) and mono (complete crosstalk). The effect is produced by feeding a controlled portion of the input of one channel to the input of the other. Varying the control voltage alters the amount of this crosstalk so maximum and minimum separation occurs.

Voltage Controlled Filters

By replacing certain resistances with reactances as explained previously, bass and treble tone controls can be formed. The treble controls in Fig. 9 are, in fact, adaptations of Fig. 2 with capacitors added (in parallel with R2 and R3 of Fig. 2), forming frequency dependent potentiometer. Similarly, the bass controls in Fig. 9 are taken from Fig. 1 (with a capacitor in parallel with R2.)

Frequency response curves of the whole circuit are given in Fig. 10. Maximum cut and lift of the controls are seen to be about ±14 dB at 60 Hz and 10 kHz and are completely variable, electronically, between these ex-

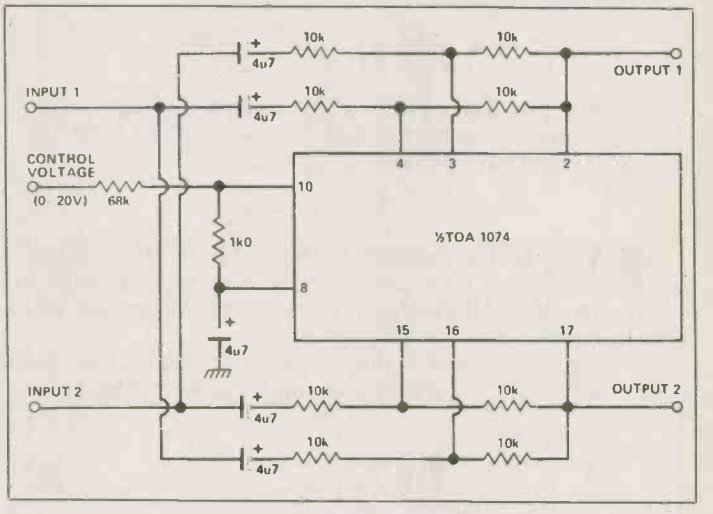

Figure 8. A completely variable stereo/mono control. A full stereo output is obtained when the applied control voltage is 20 V DC. Mono output occurs with a control voltage of 0 V DC.

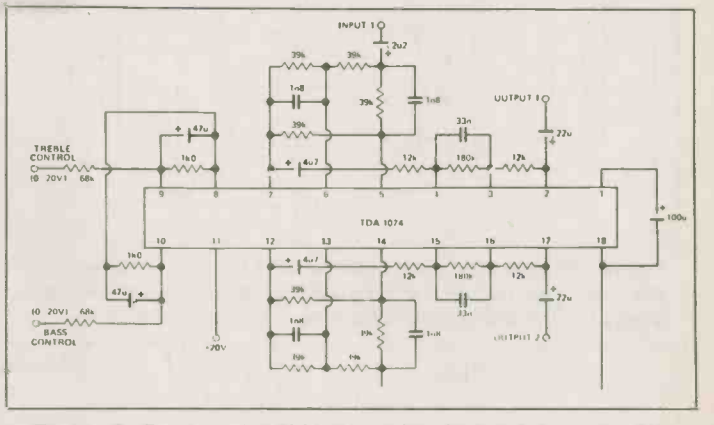

Figure 9. Bass and treble controls obtained by replacing chosen resistances from Figs. 1 and 2 with reactances.

tremes.

Finally, to show that the TDA1074 can be used in other voltage-controlled filter applications, a presence control is given in Fig. 11. Presence is an effect where amplification of frequencies around 1 kHz takes place with little or no amplification of other frequencies. The effect is used mainly in live music work, where it can apparently boost (give presence to) the level of a singer's voice, compared with the backing music. Frequency response curves for the circuit are shown in Fig. 12.

In conclusion, it is apparent that many more applications of this IC are possible and depend only on the designer's ingenuity. You can see from the basic gain

block circuits of Figs. 1 and 2 how easy it is to make voltage-controlled amplifiers and filters by the simple choice of resistances or reactances.

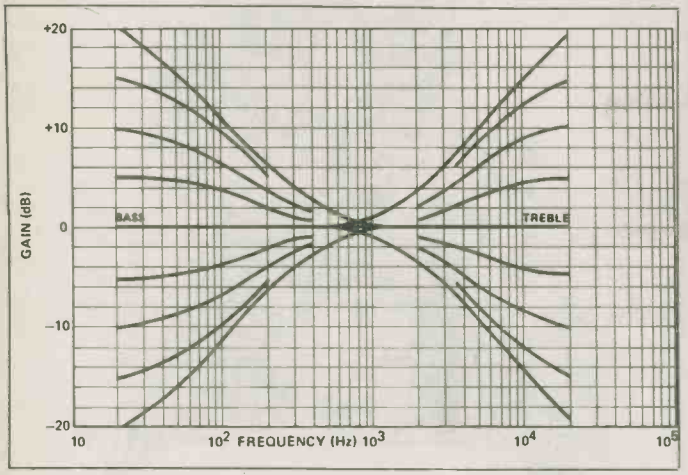

Figure 10. Frequency response curves obtained with the circuit of Fig. 9.

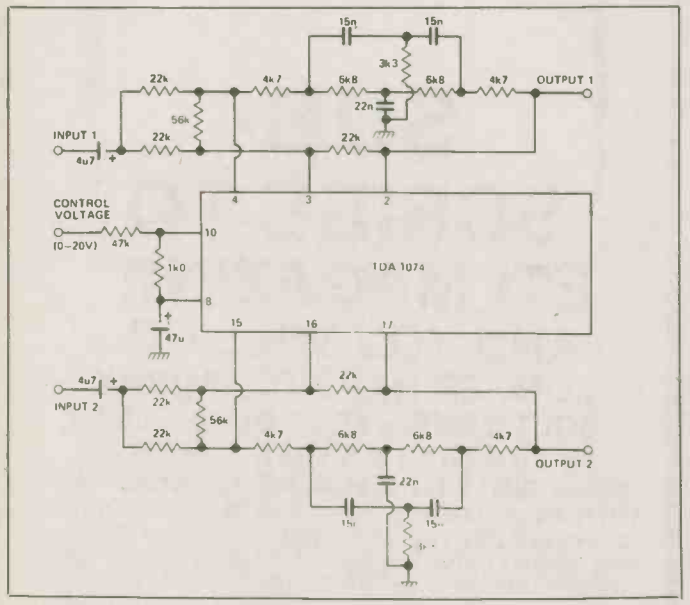

Figure 11. Voltage-controlled presence control to boost frequencies around 1 kHz.

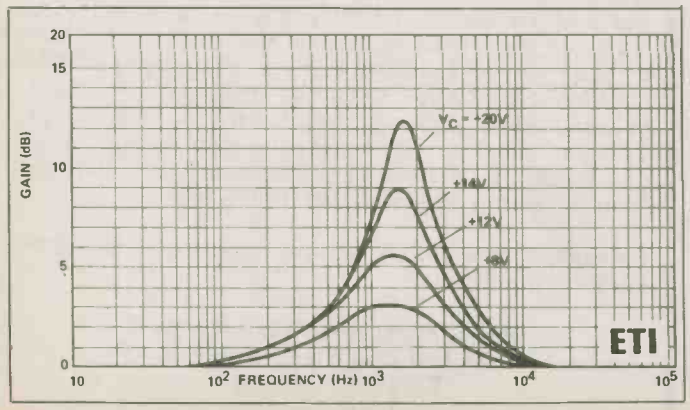

Figure 12. Frequency response curves of the voltage-controlled presence circuit of Fig. 11.

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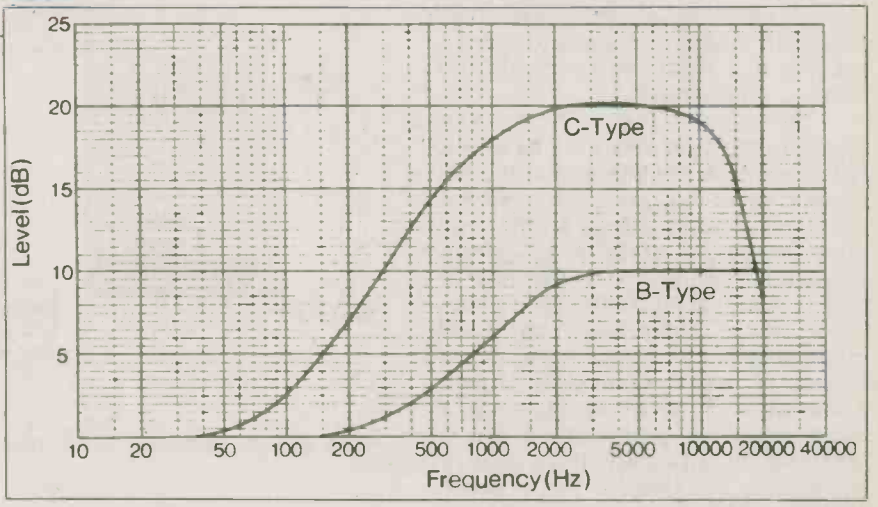
Dolby C

The Dolby B-type noise reduction system was introduced to the consumer in 1968, and the first cassette decks employing it appeared in 1970. The Dolby technique is the most widely used noise reduction system employed in domestic and commercial recording today, the number of products carrying the Dolby 'double-D' logo probably numbering in the hundreds of millions. Recently, Dolby laboratories came up with an improvement based on cascading B-type circuitry. Here's how it works.



Dolby low-level encoding frequency response. Note that the maximum amount of compression in the C-type system diminishes above 10 kHz and crosses the B-type curves at 20 kHz. The 'spectral-skewing' circuit reduces the high frequency compression, preventing high frequency tape overload and intermodulation distortion.

THE DOLBY C noise reduction system for domestic tape recorders has been developed from the well-established Dolby B system. Essentially, Dolby C comprises two Dolby B-type stages in cascade, giving an overall 20 dB reduction in noise instead of the 10 dB achieved with a single Dolby stage. The two stages of the Dolby C system have slightly different characteristics from Dolby B, and there are two additional signal processing networks, but a Dolby C system can still be based on two Dolby B integrated circuits, which helps to keep the cost down.

First, Dolby B

Before going into the details of Dolby C, a quick review of the Dolby B circuit will be useful. Like all noise reduction systems, Dolby B is a compander (compressor/expander) system, where compression of the dynamic range before recording keeps the recorded levels above the noise floor of the tape and below its saturation celling; expansion before playback restores the original dynamic range. Dolby B gives a maximum compression and expansion of 10 dB, with a consequent maximum reduction in noise of 10 dB.

Simple companders, which apply the same amount of compression and expansion to all levels, have a number of unpleasant side-effects, most notably the expansion of tape hiss when the system reproduces loud bass notes. The Dolby B system avoids this problem by varying the amount of compansion (i.e: compression and expansion) according to the signal level. Low-level signals are companded (i.e: compressed and expanded) more than high levels. Also, the frequency range which is companded depends on the signal level. High frequencies, and frequencies below about 300 Hz are never companded. As the signal level is increased, the lower cutoff frequency is raised. Dolby call this the 'sliding band' technique. It's overall effect is to minimise the 'noise modulation' effects produced by simple compansion, and to give a subjectively acceptable spectral distribution to whatever noise still remains after compansion.

Two B, or C

The Dolby C system has two signal processing stages which are both similar to the Dolby B-type circuit. The first, or 'high level' stage responds to signals in roughly the same way as a Dolby B circuit, reducing the amount of compansion at relatively high levels. The second stage is called a 'low level' stage, because it only applies full compansion to signals 20 dB or more below the highest levels that are fully companded in the first stage. Roughly, the first stage applies 10 dB of compansion to signals between -15 dB and -35 dB (referred to the standard 0 dB recording level), and the second stage applies an additional 10 dB of compansion to signals between -35 dB and -55 dB. At low signal levels, the system acts only as a fixed gain amplifier with no compansion.

In both stages of the Dolby C system the variation of compansion with frequency is different from that of the Dolby B system. Dolby B begins to take effect in the 300 Hz region and increases its compansion with frequency until a maximum of 10 dB noise reduction is achieved at around 4 kHz. Each stage of the Dolby C system takes effect nearly two octaves lower, around 100 Hz, and gives maximum (10 dB) compansion at and above 2 kHz.

The different frequency/compansion characteristic of Dolby C has two advantages. First, it produces a subjectively even spectral distribution of what little noise remains. Second, it is better adjusted to cope with half-speed microcassette recorders, where the spectral distribution of tape noise is shifted down one octave compared to that from compact cassettes.

Tracking

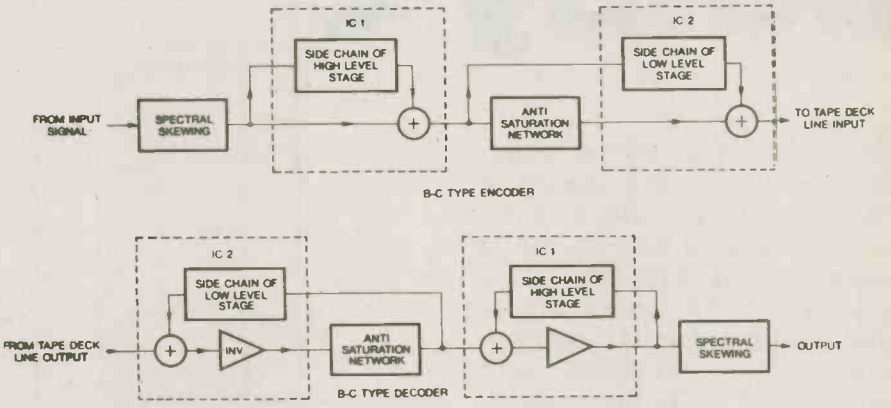
In any noise reduction system, it is important that the expander tracks the compressor precisely. In other words, the decoder must read the

level of the encoded signal and apply just enough expansion to restore it to the level of the original, uncoded signal. Unfortunately, the signal is encoded on magnetic tape, and there's many a slip twixt the head and the tape(. . . so to speak).

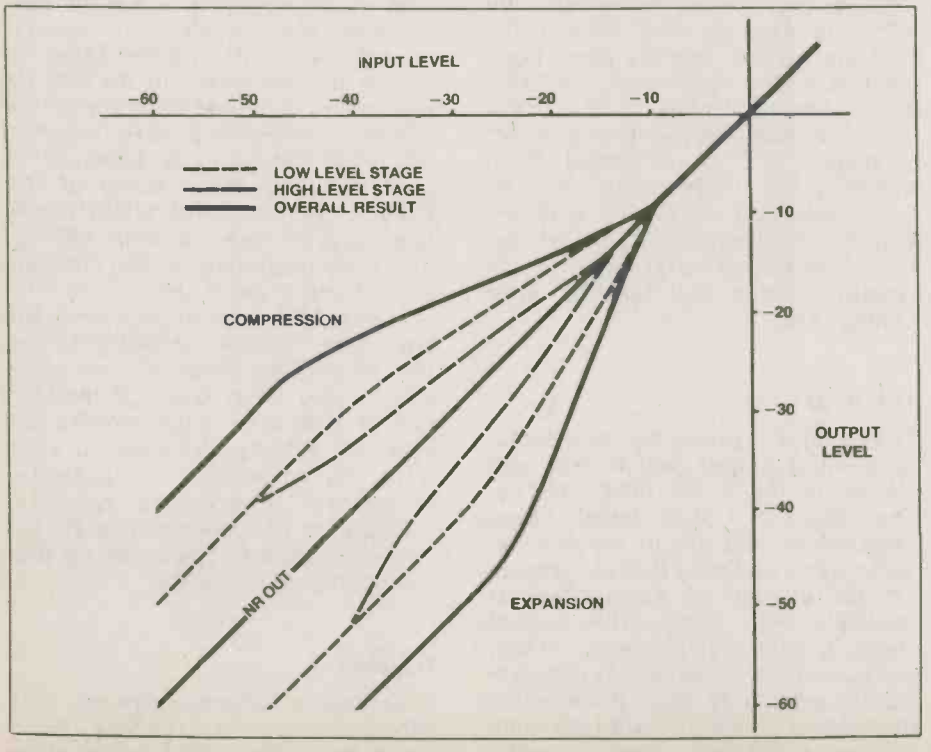
The signal that the decoder reads from the tape may not be exactly the same as the signal that the encoder tried to impress on. Inaccurate encoding of signal levels on the tape is really only a problem at certain levels and frequencies. If the level is higher than the saturation level of the tape, then obviously the tape magnetisation won't be an accurate record of the magnetising signal. Above about 10 kHz, the response of many head/tape combinations is unpredictable, particularly if the tape is not exactly suitable for the recorder or the heads are worn or dirty. At low frequencies, also, different recorders produce different variations in the magnetisation level. Any anomalies in magnetisation are exaggerated by expansion, so the Dolby C system restricts its operation to the range of frequencies and levels where the performance of a cassette recorder is accurately predictable.

Tracking problems at low frequencies are avoided by sharply curtailing the action of the Dolby C system at frequencies below 100 Hz, where the human ear is in any case relatively insensitive to noise. Dolby C also includes two pairs of networks designed to prevent mistracking at high frequencies and high levels. These are called spectral skewing and antisaturation circuits.

Spectral skewing is a high frequency rolloff introduced before the first stage of compression. To avoid errors caused by unpredictable tape response at high frequencies, the spectral skewing network gradually reduces the effectiveness of the noise reduction above 10 kHz, so that the overall noise reduction above 15 kHz is only about 10 dB. A complementary boost of high frequencies is applied after expansion on playback to maintain a flat frequency response. Spectral skewing obviously leaves a disproportionate amount of residual noise above 10 kHz, but this is not noticeable because the amount of noise reduction falls off more slowly with frequency than the natural sensitivity of the human ear. There is more noise at high frequencies, but it sounds like less.



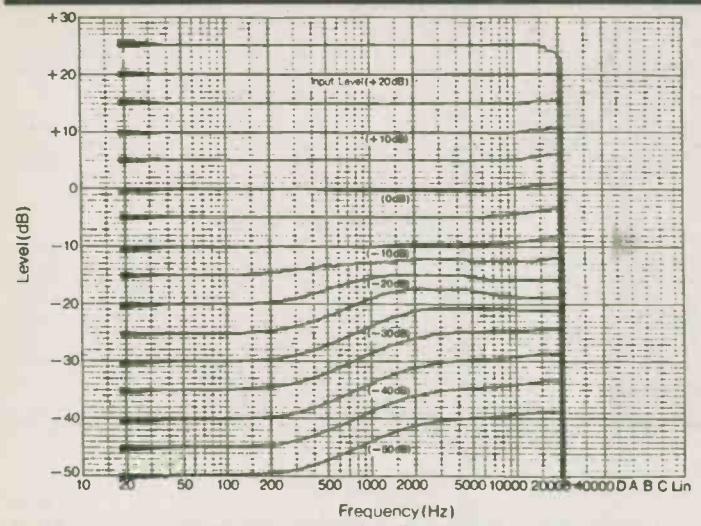
Block diagram of the Dolby B-C type noise reduction system.



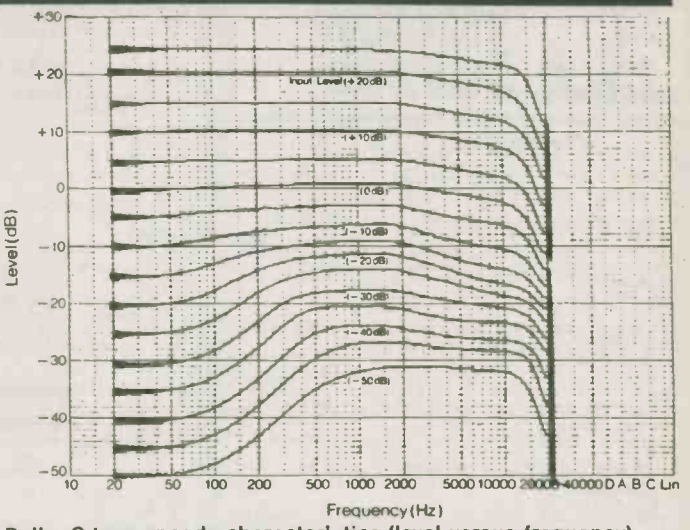
Dolby C-type transfer characteristics, showing how the effects of the two stages combine to produce 20 dB of compansion.

Anti-saturation, as its name implies, helps to keep the tape magnetisation below its saturation level. This is desirable not only to prevent the expander mistracking the compressor, but also to minimise the intermodulation distortion which antisaturation network is placed between the two stages of compression. It measures the level of the signal after the first stage of compression and splits high-level signals into two parts, one part going to the second compression stage and the second part being rolled off gently above 1.5 kHz. The two parts are then summed before recording. There is a complementary network in the replay stage to maintain a flat frequency response.

Because the Dolby C system is based on two companion networks which are very similar to the Dolby B networks, it can easily be reconfigured as a Dolby B system for replaying Dolby B-processed recordings, or for making tapes to be replayed on equipment (car cassette players, for instance) that can only decode Dolby B-processed recor-



Dolby B-type encode characteristics (level versus frequency).



Dolby C-type encode characteristics (level versus frequency).

dings. Conversion from Dolby C to Dolby B operation can be accomplished with a single multipole switch which bypasses the second stage of compression (as well as the spectral skewing and antisaturation networks) and selects different components for the first compression network to give it the characteristic Dolby B compression bandwidth. It's worth noting here that the Dolby C system is so designed that recordings encoded with it sound acceptable (but obviously not perfect) when replayed through Dolby B decoders or even without any decoding at all.

The structural similarities of Dolby B and Dolby C result in some cost savings for manufacturers installing the Dolby C system, since they can make use of ICs already developed for Dolby B (and Dolby do not require any extra royalties from Dolby B licensees who also make Dolby C systems). However, any system that provides an overall noise reduction of 20 dB demands a superior performance from the equipment in which it is installed. Noise levels of all amplifier stages in cassette recorders must now be some 10 dB lower than was necessary before, because noise which would once have been masked by tape noise may be exposed by Dolby C.

FOSTEX REVIEW

minus ten percent from the nominal. There's a centre detent to set the knob to the nominal speed. This is about the most brilliant thing available on any four track . . . it's not available on most other machines, and it's usually a pain to add . . . as the sonic possibilities arising out of variable pitch recording and syncing are very nearly unlimited. You've got to play with this to find out just what its capabilities are.

There are two other features of the A-4 that are worth mentioning. The first is that there is a rear mounted DIN plug to attach a Dolby C noise reduction unit, which is pretty well essential if you are going to do a lot of track bouncing (dbx would be a better trip, but doesn't seem to be happening). The second is a facility for a remote control until . . . this is a lot nicer than getting up to pet the recorder every time you want to do something. There's also a plug for a foot switch that permits remote punch-ins.

Playing

In use, the A-4 was a gas. The seemingly gimmicky features, like the automatic zero return and the punch-in pedal, save an amazing amount of time. There is muting on the outputs during rewinding so the chipmunks don't chatter in your ears . . . a joy, this. All the controls are smooth.

Technically, the machine is not exemplary, but it's more than satisfactory. The noise is low, at 63 db signal to noise against a zero db setting at three percent distortion, and you can bounce tracks four or five times before there's a noticeable buildup even on quiet bits. The optional noise reduction system would likely improve this further. You have to have pretty good equipment and be quite careful with wiring to see that the noise coming into the machine from beyond is less than this. There was no discernable hum output, but the clock oscillator that drives the capstan motor could be barely heard when the machine was in its sync mode. This was about the only major glitch we found, and it's not really meaningful.

One thing which you aren't supposed to do with quarter inch four tracks is to bounce to adjacent tracks. That is, you can mix one and two onto four, but not one, two and three onto four as there is a feedback path from four to three. In practice, most machines let you get away with this to some degree. With the A-4, it works so long as track three is recorded hot and mixed low so there isn't very much gain involved. The crosstalk between channels is quoted at 50 db, which is pretty good.

The erase, quoted at 70 db, worked about as well as an erase can . . . you couldn't hear anything afterwords.

All told, the Fostex A-4 is a very fun tape recorder, and is certainly capable of producing tight, high quality stuff. It is much better suited to home use than, say, an A-3340, as its extra gadgets and whizzbangs make a lot of difference when you're trying to engineer your own works . . . which is what having your own four track is about. For more information, contact interlake Audio Inc., 620 King Edward Street, Winnipeg, Manitoba, telephone (204) 775-8513.

It won't make you into Walter Carlos, but then, even Carlos would need surgery to do that.

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AB008 **$17.45**
A great book to upgrade your programming skills to the UCSD Pascal as implemented on the Apple II. Statements and techniques are discussed and there are many practical and ready to run programs.

APPLE MACHINE LANGUAGE PROGRAMMING
AB009 **$19.45**
The best way to learn machine language programming the Apple II in no time at all. The book combines colour, graphics, and sound generation together with clear cut demonstrations to help the user learn quickly and effectively.

ALL PRICES INCLUDE SHIPPING

Z80 USERS MANUAL
AB010 **$21.45**
The Z80 MPU can be found in many machines and is generally acknowledged to be one of the most powerful 8 bit chips around. This book provides an excellent 'right hand' for anyone involved in the application of this popular processor.

HOW TO PROGRAM YOUR PROGRAMMABLE CALCULATOR
AB006 **$12.45**
Calculator programming, by its very nature, often is an obstacle to effective use. This book endeavours to show how to use a programmable calculator to its full capabilities. The TI 57 and the HP 33E calculators are discussed although the principles extend to similar models.

Z-80 AND 8080 ASSEMBLY LANGUAGE PROGRAMMING
SPRACKLEN
HB05 **$14.25**
Provides just about everything the applications programmer needs to know for Z-80 and 8080 processors. Programming techniques are presented along with the instructions. Exercises and answers included with each chapter.

BASIC COMPUTER PROGRAMS IN SCIENCE AND ENGINEERING
GILDER
HB08 **$15.85**
Save time and money with this collection of 114 ready-to-run BASIC programs for the hobbyist and engineer. There are programs to do such statistical operations as means, standard deviation averages, curve-fitting, and interpolation. There are programs that design antennas, filters, attenuators, matching networks, plotting, and histogram programs.

GAME PLAYING WITH COMPUTERS SECOND EDITION
SPENCER
HB11 **$31.25**
Now you can sharpen programming skills through a relaxed approach. Completely devoted to computerized game playing, this volume presents over 70 games, puzzles, and mathematical recreations for a digital computer. It's fully illustrated and includes more that 25 game-playing programs in FORTRAN or BASIC complete with descriptions, flowcharts, and output.

MICROCOMPUTERS AND THE 3 R'S
DOERR
HB09 **$14.25**
This book educates educators on the various ways computers, especially microcomputers, can be used in the classroom. It describes microcomputers, how to organize a computer-based program, the five instructional application types (with examples from subjects such as the hard sciences, life sciences, English, history, and government) and resources listings of today's products. The book includes preprogrammed examples to start up a microcomputer program; while chapters on resources and products direct the reader to useful additional information. All programs are written in the BASIC language.

GAME PLAYING WITH BASIC
SPENCER
HB10 **$15.25**
The writing is nontechnical, allowing almost anyone to understand computerized game playing. The book includes the rules of each game, how each game works, illustrative flowcharts, diagrams, and the output produced by each program. The last chapter contains 26 games for reader solution.

SARGON: A COMPUTER CHESS PROGRAM
SPRACKLEN
HB12 **$25.00**
"I must rate this chess program an excellent buy for anyone who loves the game." Kilobaud.

Here is the computer chess program that won first place in the first chess tournament at the 1978 West Coast Computer Faire. It is written in Z-80 assembly language, using the TDL macro assembler. It comes complete with block diagram and sample printouts.

A CONSUMER'S GUIDE TO PERSONAL COMPUTING AND MICROCOMPUTERS, SECOND EDITION
FREIBERGER AND CHEW
HB14 **$14.45**
The first edition was chosen by Library Journal as one of the 100 outstanding sci-tech books of 1978. Now, there's an updated second edition!

Besides offering an introduction to the principles of microcomputers that assumes no previous knowledge on the reader's part, this second edition updates prices, the latest developments in microcomputer technology, and a review of over 100 microcomputer products from over 60 manufacturers.

THE BASIC CONVERSIONS HANDBOOK FOR APPLE, TRS-80, AND PET USERS
BRAIN BANK
HB17 **$11.75**
Convert a BASIC program for the TRS-80, Apple II, or PET to the form of BASIC used by any other one of those machines. This is a complete guide to converting Apple II and PET-programs to TRS-80, TRS-80 and PET programs to Apple II, TRS-80 and Apple II programs to PET. Equivalent commands are listed for TRS-80 BASIC (Model I, Level II), Applesoft BASIC and PET BASIC, as well as variations for the TRS-80 Model III and Apple Integer BASIC.

SPEAKING PASCAL
BOWEN
HB16 **$17.25**
An excellent introduction to programming in the Pascal language! Written in clear, concise, non-mathematical language, the text requires no technical background or previous programming experience on the reader's behalf. Top-down structured analysis and key examples illustrate each new idea and the reader is encouraged to construct programs in an organized manner.

BP33: ELECTRONIC CALCULATOR USERS HANDBOOK **$4.25**
M.H. BABANI, B.Sc.(Eng.)
An invaluable book for all calculator users whatever their age or occupation, or whether they have the simplest or most sophisticated of calculators. Presents formulae, data, methods of calculation, conversion factors, etc., with the calculator user especially in mind, often illustrated with simple examples. Includes the way to calculate using only a simple four function calculator: Trigonometric Functions (Sin, Cos, Tan): Hyperbolic Functions (Sinh, Cosh, Tanh) Logarithms, Square Roots and Powers.

THE MOST POPULAR SUBROUTINES IN BASIC
TAB No.1050 **$10.45**
An understandable guide to BASIC subroutines which enables the reader to avoid tedium, economise on computer time and makes programs run faster. It is a practical rather than a theoretical manual.

PROJECTS

BP48: ELECTRONIC PROJECTS FOR BEGINNERS **$5.90**
F.G. RAYER, T.Eng.(CEI), Assoc.IERE
Another book written by the very experienced author — Mr. F.G. Rayer — and in it the newcomer to electronics, will find a wide range of easily made projects. Also, there are a considerable number of actual component and wiring layouts, to aid the beginner.

Furthermore, a number of projects have been arranged so that they can be constructed without any need for soldering and, thus, avoid the need for a soldering iron.

Also, many of the later projects can be built along the lines as those in the 'No Soldering' section so this may considerably increase the scope of projects which the newcomer can build and use.

221: 28 TESTED TRANSISTOR PROJECTS
R.TORRENS **$5.50**
Mr. Richard Torrens is a well experienced electronics development engineer and has designed, developed, built and tested the many useful and interesting circuits included in this book. The projects themselves can be split down into simpler building blocks, which are shown separated by boxes in the circuits for ease of description, and also to enable any reader who wishes to combine boxes from different projects to realise ideas of his own.

BP49: POPULAR ELECTRONIC PROJECTS **$6.25**
R.A. PENFOLD
Includes a collection of the most popular types of circuits and projects which, we feel sure, will provide a number of designs to interest most electronics constructors. The projects selected cover a very wide range and are divided into four basic types: Radio Projects, Audio Projects, Household Projects and Test Equipment.

EXPERIMENTER'S GUIDE TO SOLID STATE ELECTRONIC PROJECTS
AB007 **$10.45**
An ideal sourcebook of Solid State circuits and techniques with many practical circuits. Also included are many useful types of experimenter gear.

BP71: ELECTRONIC HOUSEHOLD PROJECTS **$7.70**
R. A. PENFOLD
Some of the most useful and popular electronic construction projects are those that can be used in or around the home. The circuits range from such things as '2 Tone Door Buzzer', Intercom, through Smoke or Gas Detectors to Baby and Freezer Alarms.

BP94: ELECTRONIC PROJECTS FOR CARS AND BOATS **$8.10**
R.A. PENFOLD
Projects, fifteen in all, which use a 12V supply are the basis of this book. Included are projects on Windscreen Wiper Control, Courtesy Light Delay, Battery Monitor, Cassette Power Supply, Lights Timer, Vehicle Immobiliser, Gas and Smoke Alarm, Depth Warning and Shaver Inverter.

BP69: ELECTRONIC GAMES **$7.55**
R.A. PENFOLD
In this book Mr. R. A. Penfold has designed and developed a number of interesting electronic game projects using modern integrated circuits. The text is divided into two sections, the first dealing with simple games and the latter dealing with more complex circuits.

BP95: MODEL RAILWAY PROJECTS **$8.10**
Electronic projects for model railways are fairly recent and have made possible an amazing degree of realism. The projects covered include controllers, signals and sound effects: striboard layouts are provided for each project.

BP93: ELECTRONIC TIMER PROJECTS **$8.10**
F.G. RAYER
Windscreen wiper delay, darkroom timer and metronome projects are included. Some of the more complex circuits are made up from simpler sub-circuits which are dealt with individually.

110 OP-AMP PROJECTS
MARSTON
HB24 **$11.75**
This handbook outlines the characteristics of the op-amp and present 110 highly useful projects—ranging from simple amplifiers to sophisticated instrumentation circuits.

110 IC TIMER PROJECTS
GILDER
HB25 **$10.25**
This sourcebook maps out applications for the 555 timer IC. It covers the operation of the IC itself to aid you in learning how to design your own circuits with the IC. There are application chapters for timer-based instruments, automotive applications, alarm and control circuits, and power supply and converter applications.

110 THYRISTOR PROJECTS USING SCRs AND TRIACS
MARSTON
HB22 **$12.05**
A grab bag of challenging and useful semiconductor projects for the hobbyist, experimenter, and student. The projects range from simple burglar, fire, and water level alarms to sophisticated power control devices for electric tools and trains. Integrated circuits are incorporated wherever their use reduces project costs.

110 CMOS DIGITAL IC PROJECTS
MARSTON
HB23 **$11.75**
Outlines the operating characteristics of CMOS digital ICs and then presents and discusses 110 CMOS digital IC circuits ranging from inverter gate and logic circuits to electronic alarm circuits. Ideal for amateurs, students and professional engineers.

BP76: POWER SUPPLY PROJECTS **$7.30**
R.A. PENFOLD
Line power supplies are an essential part of many electronics projects. The purpose of this book is to give a number of power supply designs, including simple unstabilised types, fixed voltage regulated types, and variable voltage stabilised designs, the latter being primarily intended for use as bench supplies for the electronics workshop. The designs provided are all low voltage types for semiconductor circuits.

There are other types of power supply and a number of these are dealt with in the final chapter, including a cassette power supply, Ni-Cad battery charger, voltage step up circuit and a simple inverter.

BP84: DIGITAL IC PROJECTS **$8.10**
F.G. RAYER, T.Eng.(CEI), Assoc.IERE
This book contains both simple and more advanced projects and it is hoped that these will be found of help to the reader developing a knowledge of the workings of digital circuits. To help the newcomer to the hobby the author has included a number of board layouts and wiring diagrams. Also the more ambitious projects can be built and tested section by section and this should help avoid or correct faults that could otherwise be troublesome. An ideal book for both beginner and more advanced enthusiast alike.

BP67: COUNTER DRIVER AND NUMERAL DISPLAY PROJECTS **$7.55**
F.G. RAYER, T.Eng.(CEI), Assoc. IERE
Numeral indicating devices have come very much to the forefront in recent years and will, undoubtedly, find increasing applications in all sorts of equipment. With present day integrated circuits, it is easy to count, divide and display numerically the electrical pulses obtained from a great range of driver circuits.

In this book many applications and projects using various types of numeral displays, popular counter and driver IC's etc. are considered.

BP73: REMOTE CONTROL PROJECTS **$8.60**
OWEN BISHOP
This book is aimed primarily at the electronics enthusiast who wishes to experiment with remote control. Full explanations have been given so that the reader can fully understand how the circuits work and can more easily see how to modify them for other purposes, depending on personal requirements. Not only are radio control systems considered but also infra-red, visible light and ultrasonic systems as are the use of Logic ICs and Pulse position modulation etc.

BP99: MINI—MATRIX BOARD PROJECTS **$8.10**
R.A. PENFOLD
Twenty useful projects which can all be built on a 24 x 10 hole matrix board with copper strips. Includes Doorbuzzer, Low-voltage Alarm, AM Radio, Signal Generator, Projector Timer, Guitar Headphone Amp, Transistor Checker and more.

CIRCUITS

BP98: POPULAR ELECTRONIC CIRCUITS, BOOK 2 **$9.35**
R.A. PENFOLD
70 plus circuits based on modern components aimed at those with some experience.

BP80: POPULAR ELECTRONIC CIRCUITS — BOOK 1 **$8.25**
R.A. PENFOLD
Another book by the very popular author, Mr. R.A. Penfold, who has designed and developed a large number of various circuits. These are grouped under the following general headings; Audio Circuits, Radio Circuits, Test Gear Circuits, Music Project Circuits, Household Project Circuits and Miscellaneous Circuits.

SEE ORDER FORM ON PAGE 56

ETI book shelf

The GIANT HANDBOOK OF ELECTRONIC CIRCUITS
TAB No.1300 **$24.45**
About as twice as thick as the Webster's dictionary, and having many more circuit diagrams, this book is ideal for any experimenter who wants to keep amused for several centuries. If there isn't a circuit for it in here, you should have no difficulty convincing yourself you don't really want to build it.

BP39: 50 (FET) FIELD EFFECT TRANSISTOR PROJECTS **$5.50**
F.G. RAYER, T.Eng.(CEI),Assoc.IERE
Field effect transistors (FETs), find application in a wide variety of circuits. The projects described here include radio frequency amplifiers and converters, test equipment and receiver aids, tuners, receivers, mixers and tone controls, as well as various miscellaneous devices which are useful in the home.

This book contains something of particular interest for every class of enthusiast — short wave listener, radio amateur, experimenter or audio devotee.

BP87: SIMPLE L.E.D. CIRCUITS **$5.90**
R.N. SOAR
Since it first appeared in 1977, Mr. R.N. Soar's book has proved very popular. The author has developed a further range of circuits and these are included in Book 2. Projects include a Transistor Tester, Various Voltage Regulators, Testers and so on.

BP42: 50 SIMPLE L.E.D. CIRCUITS **$3.55**
R.N. SOAR
The author of this book, Mr. R.N. Soar, has compiled 50 interesting and useful circuits and applications, covering many different branches of electronics, using one of the most inexpensive and freely available components — the Light Emitting Diode (L.E.D.). A useful book for the library of both beginner and more advanced enthusiast alike.

BP82: ELECTRONIC PROJECTS USING SOLAR CELLS **$8.10**
OWEN BISHOP
The book contains simple circuits, almost all of which operate at low voltage and low currents, making them suitable for being powered by a small array of silicon cells. The projects cover a wide range from a bicyle speedometer to a novelty 'Duck Shoot'; a number of power supply circuits are included.

BP37: 50 PROJECTS USING RELAYS, SCR's & TRIACS **$5.50**
F.G.RAYER, T.Eng.(CEI),Assoc.IERE
Relays, silicon controlled rectifiers (SCR's) and bi-directional triodes (TRIACs) have a wide range of applications in electronics today. This book gives tried and practical working circuits which should present the minimum of difficulty for the enthusiast to construct. In most of the circuits there is a wide latitude in component values and types, allowing easy modification of circuits or ready adaptation of them to individual needs.

BP44: IC 555 PROJECTS **$7.55**
E.A. PARR, B.Sc.,C.Eng., M.I.E.E.
Every so often a device appears that is so useful that one wonders how life went on before without it. The 555 timer is such a device. Included in this book are Basic and General Circuits, Motor Car and Model Railway Circuits, Alarms and Noise Makers as well as a section on the 556, 558 and 559 timers.

BP24: 50 PROJECTS USING IC741 **$4.25**
RUDI & UWE REDMER
This book, originally published in Germany by TOPP, has achieved phenomenal sales on the Continent and Babani decided, in view of the fact that the integrated circuit used in this book is inexpensive to buy, to make this unique book available to the English speaking reader. Translated from the original German with copious notes, data and circuitry, a "must" for everyone whatever their interest in electronics.

BP83: VMOS PROJECTS **$8.20**
R.A. PENFOLD
Although modern bipolar power transistors give excellent results in a wide range of applications, they are not without their drawbacks or limitations. This book will primarily be concerned with VMOS power FETs although power MOSFETs will be dealt with in the chapter on audio circuits. A number of varied and interesting projects are covered under the main headings of: Audio Circuits, Sound Generator Circuits, DC Control Circuits and Signal Control Circuits.

BP65: SINGLE IC PROJECTS **$6.55**
R.A.PENFOLD
There is now a vast range of ICs available to the amateur market, the majority of which are not necessarily designed for use in a single application and can offer unlimited possibilities. All the projects contained in this book are simple to construct and are based on a single IC. A few projects employ one or two transistors in addition to an IC but in most cases the IC is the only active device used.

BP97: IC PROJECTS FOR BEGINNERS **$8.10**
F.G. RAYER
Covers power supplies, radio, audio, oscillators, timers and switches. Aimed at the less experienced reader, the components used are popular and inexpensive.

BP88: HOW TO USE OP AMPS **$9.35**
E.A. PARR
A designer's guide covering several op amps, serving as a source book of circuits and a reference book for design calculations. The approach has been made as non-mathematical as possible.

IC ARRAY COOKBOOK
JUNG
HB26 **$14.25**
A practical handbook aimed at solving electronic circuit application problems by using IC arrays. An IC array, unlike specific-purpose ICs, is made up of uncommitted IC active devices, such as transistors, resistors, etc. This book covers the basic types of such ICs and illustrates with examples how to design with them. Circuit examples are included, as well as general design information useful in applying arrays.

BP50: IC LM3900 PROJECTS **$5.90**
H.KYBETT, B.Sc., C.Eng.
The purpose of this book is to introduce the LM3900 to the Technician, Experimenter and the Hobbyist. It provides the groundwork for both simple and more advanced uses, and is more than just a collection of simple circuits or projects.

Simple basic working circuits are used to introduce this IC. The LM3900 can do much more than is shown here, this is just an introduction. Imagination is the only limitation with this useful and versatile device. But first the reader must know the basics and that is what this book is all about.

223: 50 PROJECTS USING IC CA3130 **$5.50**
R.A.PENFOLD
In this book, the author has designed and developed a number of interesting and useful projects which are divided into five general categories: I — Audio Projects II — R.F. Projects III — Test Equipment IV — Household Projects V — Miscellaneous Projects.

224: 50 CMOS IC PROJECTS **$4.25**
R.A. PENFOLD
CMOS IC's are probably the most versatile range of digital devices for use by the amateur enthusiast. They are suitable for an extraordinary wide range of applications and are also some of the most inexpensive and easily available types of IC.

Mr. R.A. Penfold has designed and developed a number of interesting and useful projects which are divided into four general categories: I — Multivibrators II — Amplifiers and Oscillators III — Trigger Devices IV — Special Devices.

THE ACTIVE FILTER HANDBOOK
TAB No.1133 **$11.45**
Whatever your field — computing, communications, audio, electronic music or whatever — you will find this book the ideal reference for active filter design.

The book introduces filters and their uses. The basic math is discussed so that the reader can tell where all design equations come from. The book also presents many practical circuits including a graphic equalizer, computer tape interface and more.

DIGITAL ICS — HOW THEY WORK AND HOW TO USE THEM
AB004 **$11.45**
An excellent primer on the fundamentals of digital electronics. This book discusses the nature of gates and related concepts and also deals with the problems inherent to practical digital circuits.

MASTER HANDBOOK OF 1001 PRACTICAL CIRCUITS
TAB No.800 **$20.45**
MASTER HANDBOOK OF 1001 MORE PRACTICAL CIRCUITS
TAB No.804 **$19.45**
Here are transistor and IC circuits for just about any application you might have. An ideal source book for the engineer, technician or hobbyist. Circuits are classified according to function, and all sections appear in alphabetical order.

THE MASTER IC COOKBOOK
TAB No.1199 **$16.45**
If you've ever tried to find specs for a so called 'standard' chip, then you'll appreciate this book. C.L. Hallmark has compiled specs and pinout for most types of ICs that you'd ever want to use.

ELECTRONIC DESIGN WITH OFF THE SHELF INTEGRATED CIRCUITS
AB016 **$11.45**
This practical handbook enables you to take advantage of the vast range of applications made possible by integrated circuits. The book tells how, in step by step fashion, to select components and how to combine them into functional electronic systems. If you want to stop being a "cookbook hobbyist", then this is the book for you.

AUDIO

BP90: AUDIO PROJECTS **$8.10**
F.G. RAYER
Covers in detail the construction of a wide range of audio projects. The text has been divided into preamplifiers and mixers, power amplifiers, tone controls and matching and miscellaneous projects.

HOW TO DESIGN, BUILD, AND TEST COMPLETE SPEAKER SYSTEMS.
TAB No.1064 **$13.45**
By far the greatest savings in assembling an audio system can be realized from the construction of speakers. This book contains information to build a variety of speakers as well as instructions on how to design your own.

205: FIRST BOOK OF HI-FI LOUDSPEAKER ENCLOSURES **$3.55**
B.B. BABANI
This book gives data for building most types of loudspeaker enclosure. Includes corner reflex, bass reflex, exponential horn, folded horn, tuned port, klipschorn labyrinth, tuned column, loaded port and multi speaker panoramic. Many clear diagrams for every construction showing the dimensions necessary.

BP35: HANDBOOK OF IC AUDIO PRE-AMPLIFIER AND POWER AMPLIFIER CONSTRUCTION **$5.50**
F.G.RAYER, T.Eng.(CEI),Assoc.IERE
This book is divided into three parts: Part I, understanding audio IC's, Part II, Pre-amplifiers, Mixers and Tone Controls, Part III Power Amplifiers and Supplies. Includes practical constructional details of pure IC and Hybrid IC and Transistor designs from about 250mW to 100W output.
Out of stock until December 1982.

BP47: MOBILE DISCOTHEQUE HANDBOOK **$5.90**
COLIN CARSON
The vast majority of people who start up "Mobile Discos" know very little about their equipment or even what to buy. Many people have wasted a "small fortune" on poor, unnecessary or badly matched apparatus.

The aim of this book is to give you enough information to enable you to have a better understanding of many aspects of "disco" gear.

HOW TO BUILD A SMALL BUDGET RECORDING STUDIO FROM SCRATCH. . .
TAB No.1166 **$16.45**
The author, F. Alton Everest, has gotten studios together several times, and presents twelve complete, tested designs for a wide variety of applications. If all you own is a mono cassette recorder, you don't need this book. If you don't want your new four track to wind up sounding like one, though, you shouldn't be without it.

BP51: ELECTRONIC MUSIC AND CREATIVE TAPE RECORDING **$5.50**
M.K. BERRY
Electronic music is the new music of the Twentieth Century. It plays a large part in "pop" and "rock" music and, in fact, there is scarcely a group without some sort of synthesiser or other effects generator.

This book sets out to show how electronic music can be made at home with the simplest and most inexpensive of equipment. It then describes how the sounds are generated and how these may be recorded to build up the final composition.

BP74: ELECTRONIC MUSIC PROJECTS **$7.70**
R.A. PENFOLD
Although one of the more recent branches of amateur electronics, electronic music has now become extremely popular and there are many projects which fall into this category. The purpose of this book is to provide the constructor with a number of practical circuits for the less complex items of electronic music equipment, including such things as a Fuzz Box, Waa-Waa Pedal, Sustain Unit, Reverberation and Phaser-Units, Tremelo Generator etc.

BP81: ELECTRONIC SYNTHESISER PROJECTS **$7.30**
M.K. BERRY
One of the most fascinating and rewarding applications of electronics is in electronic music and there is hardly a group today without some sort of synthesiser or effects generator. Although an electronic synthesiser is quite a complex piece of electronic equipment, it can be broken down into much simpler units which may be built individually and these can then be used or assembled together to make a complete instrument.

ELECTRONIC MUSIC SYNTHESIZERS
TAB No.1167 **$10.45**
If you're fascinated by the potential of electronics in the field of music, then this is the book for you. Included is data on synthesizers in general as well as particular models. There is also a chapter on the various accessories that are available.

TEST EQUIPMENT

BP75: ELECTRONIC TEST EQUIPMENT CONSTRUCTION **$7.30**
F.G. RAYER, T.Eng. (CEI), Assoc. IERE
This book covers in detail the construction of a wide range of test equipment for both the Electronics Hobbyists and Radio Amateur. Included are projects ranging from an FET Amplified Voltmeter and Resistance Bridge to a Field Strength Indicator and Heterodyne Frequency Meter. Not only can the home constructor enjoy building the equipment but the finished projects can also be usefully utilised in the furtherance of his hobby.

99 TEST EQUIPMENT PROJECTS YOU CAN BUILD
TAB No.805 **$14.45**
An excellent source book for the hobbyist who wants to build up his work bench inexpensively. Projects range from a simple signal tracer to a 50MHz frequency counter. There are circuits to measure just about any electrical quantity: voltage, current, capacitance, impedance and more. The variety is endless and includes just about anything you could wish for!

HOW TO GET THE MOST OUT OF LOW COST TEST EQUIPMENT
AB017 **$9.45**
Whether you want to get your vintage 1960 'TestRite'signal generator working, or you've got something to measure with nothing to measure it with, this is the book for you. The author discusses how to maximize the usefulness of cheap test gear, how to upgrade old equipment, and effective test set ups.

THE POWER SUPPLY HANDBOOK
TAB No.806 **$16.45**
A complete one stop reference for hobbyists and engineers. Contains high and low voltage power supplies of every conceivable type as well mobile and portable units.

ALL PRICES INCLUDE SHIPPING

BP70: TRANSISTOR RADIO FAULT-FINDING CHART $2.40
CHAS. E. MILLER
Across the top of the chart will be found four rectangles containing brief descriptions of various faults; vis: — sound weak but undistorted; set dead; sound low or distorted and background noises. One then selects the most appropriate of these and following the arrows, carries out the suggested checks in sequence until the fault is cleared.

ELECTRONIC TROUBLESHOOTING HANDBOOK
AB019 $12.45
This workbench guide can show you how to pinpoint circuit troubles in minutes, how to test anything electronic, and how to get the most out of low cost test equipment. You can use any and all of the time-saving shortcuts to rapidly locate and repair all types of electronic equipment malfunctions.

COMPLETE GUIDE TO READING SCHEMATIC DIAGRAMS
AB01B $10.45
A complete guide on how to read and understand schematic diagrams. The book teaches how to recognize basic circuits and identify component functions. Useful for technicians and hobbyists who want to avoid a lot of headscratching.

RADIO AND COMMUNICATIONS

BP79: RADIO CONTROL FOR BEGINNERS $7.30
F.G. RAYER, T.Eng.(CEI),Assoc.IERE.
The aim of this book is to act as an introduction to Radio Control for beginners to the hobby. The book will commence by dealing with the conditions that are allowable for such things as frequency and power of transmission. This is followed by a "block" explanation of how control-device and transmitter operate and receiver and actuator(s) produce motion in a model.

Details are then given of actual solid state transmitting equipment which the reader can build. Plain and loaded aerials are then discussed and so is the field-strength meter to help with proper setting up.

The radio receivlng equipment is then dealt with which includes a simple receiver and also a crystal controlled superhet. The book ends with the electro-mechanical means of obtaining movement of the controls of the model.

BP96: CB PROJECTS $8.10
R.A. PENFOLD
Projects include speech processor, aerial booster, cordless mike, aerial and harmonic filters, field strength meter, power supply, CB receiver and more.

BP91: AN INTRODUCTION TO RADIO DXing $8.10
This book is divided into two main sections one to amateur band reception, the other to broadcast bands. Advice is given to suitable equipment and techniques. A number of related constructional projects are described.

BP92: ELECTRONICS SIMPLIFIED—CRYSTAL SET CONSTRUCTION $7.30
F.A. WILSON
Aimed at those who want to get into construction without much theoretical study. Homewound coils are used and all projects are very inexpensive to build.

AUDIO AND VIDEO INTERFERENCE CURES
KAHANER
HB21 $9.05
A practical work about interference causes and cures that affect TV, radio, hi-fi, CB, and other devices. Provides all the information needed to stop interference. Schematic wiring diagrams of filters for all types of receivers and transmitters are included. Also, it supplies simple filter diagrams to eliminate radio and TV interference caused by noisy home appliances, neon lights, motors, etc.

Book Of The Month

Digital ICs ..... AB004 ..... $10.95
Op amps are neat; you put a signal in, and, if the chip hasn't been installed backwards, something comes out. Digital ICs aren't nearly that simple. They're up to their clavicals in square waves, and the pickiest litte things seem to make them go wrangy.

Digital ICs - How they work and how to use them is a useful introduction to digital circuitry. It begins with the nature of chips, gets into symbolic logic, IC types and logic families, flip flops, counters, memory, ROM, multiplexers, binary arithmatic, digital to analog conversion and many other complex topics with chips you could have otherwise probably blown up. If you don't understand digital ICs after reading this book you've been holding it upside down.

BP46: RADIO CIRCUITS USING IC's $5.90
J.B. DANCE, M.Sc.
This book describes integrated circuits and how they can be employed in receivers for the reception of either amplitude or frequency modulated signals. The chapter on amplitude modulated (a.m.) receivers will be of most interest to those who wish to receive distant stations at only moderate audio quality, while the chapter on frequency modulation (f.m.) receivers will appeal to those who desire high fidelity reception.

REFERENCE

THE BEGINNER'S HANDBOOK OF ELECTRONICS
AB003 $10.45
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Into Digital Electronics

Down to practicalities this month. Ian Sinclair looks at the LS132 NAND gate and some of the circuits we can build with it.

CHIP OF THE MONTH, folks, is one whose full number is SN74LS132; its full name is a quad two input Schmitt NAND gate. Either way, it's quite a mouthful, and we'll refer to it as the LS132. Since this is a strictly practical series, we'll start in a practical way by finding out what this particular IC does. (Note: Non 'LS' types are OK).

BOARD CONNECTIONS:
1A LED ANODE (4)
3A LED ANODE (3)
5A LED ANODE (2)
7A LED ANODE (1)
} CATHODE LEADS ON Y1

1k0 RESISTORS BETWEEN:
1A AND 1B
3A AND 3B
5A AND 5B
7A AND 7B
DIL SWITCH BETWEEN COLUMNS C AND D, LINES 1 TO 8
LINKS BETWEEN:
X1 AND X2
Y1 AND Y2

Fig.2.1. A reminder of the wiring round the LEDs — this must be completed, along with the switch wiring (shown in previous part) before any further work can be done.

Start by checking the connections of the switches and LEDs which you should have from last month. Figure 2.1 is a reminder, showing where each component is located and which lines are linked by wires. Remember to use only single core wire, 0.5mm diameter or so; because stranded wire will get caught up in the clips of the breadboard.

Disconnect the battery and find out where pin number 1 of the IC is. Figure 2.2 shows you how you find the pin 1 of any IC which is in this block form (the DIL package). There's an identifying notch cut at one end of the IC — the end which has pin number 1 and also the last pin (14 on the LS132, 16 on some others we'll use). Now if you place the IC legs down as it's shown in the drawing of Fig. 2.2 the position of pin 1 is to the left of the notch. Some manufacturers also mould a little hollow next to pin 1. Don't be confused if there is what looks like a notch at each end — only the one which is sunk into the plastic is the true one!

Now that you've located pin 1, place the LS132 on the breadboard so that pin 1 is on line A19 and pin 14 is on line B19. You don't need to use tweezers to avoid handling the pins, because these are TTL ICs, not the CMOS ones which can be so easily damaged. When you've got the IC correctly placed, push it gently down, rocking it a bit from end to end, so that the pins go into the breadboard holes until the chip is right down on to the board. Check again that the pins are in the right holes, because all of the wiring instructions in this part, and all the following parts, assume that each IC is in exactly the place we've specified.

All You Need Are The Right Connections

We can now start making the connections which create a digital circuit. We're going to use just one of the four identical digital circuits which are on the LS132 chip, and we can make up the circuit by using just three wire links. One useful point about digital IC circuits is that most of them consist of just these links between ICs, with only a few odd resistors and capacitors to worry about. The only point to worrry about now is, how do we know which connections to make? If you're building a circuit from scratch, to your own design, then you have to do it all the hard way, by tracing which pins you need to connect. For this series we'll use the easy way, using the breadboard line letters and numbers.

Now there are two ways of showing how to make these connections, and Fig. 2.3 shows both. One is a table of connections (Fig.2.3a) which shows which breadboard lines need to be linked with wires. The other way, which is a lot more useful, is to write the breadboard line numbers onto a circuit diagram. Why is it more useful? Because it gets you used to digital circuit diagrams, that's why. Once this series is finished you're on your own in the big bad world where there aren't any tables of breadboard connections, so we're training you to read the circuit diagrams and eventually to be able to fill in breadboard

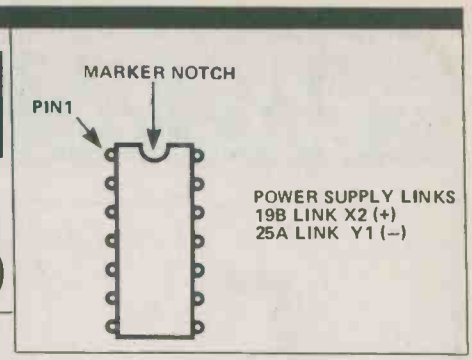

Fig.2.2 How to find Pin 1 of an IC. The links shown are for supplying power to the 74LS132.

line numbers for yourself.

Fig.2.3(b), then, shows the circuit symbol for the digital device we're using. It's called a NAND gate, and this particular example has two inputs and one output. In the circuit shown, the inputs are connected to the switches 1 and 2, and the output is connected to LED 1. Since we have only two signal levels to worry about, a switch is all we need to provide an input. The way we've wired our switches, up causes the switch to provide logic 1, down provides logic 0; and the LED lights when the output is at logic 1.

The Truth Is On The Table

Now if this were a linear circuit, like an amplifier, we would probably want to measure some quantities like the voltage gain. We don't have to worry about such things when we use digital circuits, because the only quantities that exist are the two voltage levels 0 and 1. We can see what voltage levels we have at the inputs, because they're set by the switches, and at the output the LED shows whether we have a 1 or a 0. The only thing we need to know about a digital IC like this is what combina-

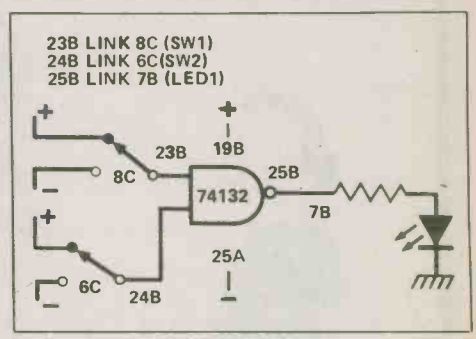

Fig.2.3. Link diagram (a) and circuit diagram (b) for a gate-test circuit. Only three wire links are needed to wire this up, because the switches and LEDs are already in place. This scheme assumes that the IC is in the correct place on the board.

Continued on page 70

The Fun of Electronics

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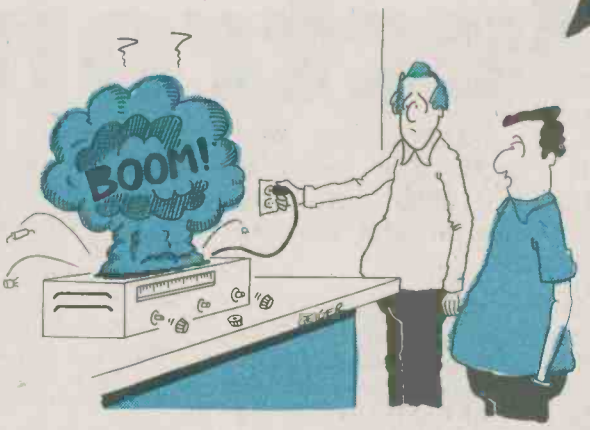

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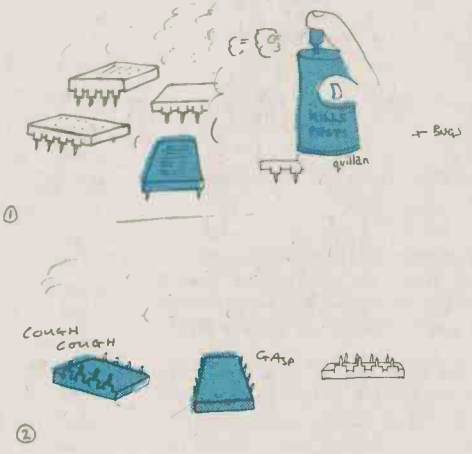

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Continued from page 67

tion of inputs gives what output. Let's make that a bit clearer. If we have one input, we would want to know what the output was for a 0 at the input, and what the output was for a 1 at the input. With two inputs, there are four possible combinations of zeros and ones which we could have at the inputs, and it's a bit easier to see what's happening if we write them down in the form of a table (Fig.2.4).

We can now try out each combination of signals at the inputs, and find what output we get for each line of the table. This is now a 'truth table' for the digital IC — it shows what combinations of inputs produce 1 and which combinations produce 0. Showing this information in the form of a truth table is neater and simpler than describing what happens in words, though not so brief as the mathematical method called Boolean Algebra.

Come back, don't panic — we're not going to do any Boolean Algebra,

SW1	SW2	LED1
0	0	
0	1	
1	0	
1	1	

SWITCHES UP FOR 1
DOWN FOR 0
LED LIT FOR 1
UNLIT FOR 0

Fig.2.4 A blank truth table, ready for you to fill in.

I just mentioned it!

Now how do we go about finding the truth table for a circuit like the one in Fig.2.3? The obvious place to start is with both switches at zero (sliders down). If the LED is lit, then a 1 goes into the output column on the line which as A and B inputs both 0; if the LED is not lit, then a 0 goes in the output. The next step is to try one of the switches at 1 (slider up), and we usually work from the right hand side, making A = 0, B = 1. Note the output for this one, then set A = 1, B = 0 and note the output for this, the third line of the truth table. Finally set both switches up so that the inputs are A = 1, B = 1 and see what the output is. Fill in this value, and your truth table is complete.

That really does tell you all you need to know about the way this gate works. The output is 1 unless both inputs are 1. When both inputs are 1, then the output is 0. That's all! It's called a NAND gate, for reasons we'll look at later.

Can you think of a use for this? Imagine that you have two oscillators, one supplying a signal to input A of this gate, and the other feeding its signals to input B. Could you tell when the oscillators were exactly in step? Yes, because the LED would be only dimly lit. When the oscillators are out of step, with one input of the gate high, logic 1, keeping the LED shining reasonably brightly. When the oscillators are exactly in step, though, the LED is on when both signals are at their negative peak and off when both signals are at their positive peak (Fig.2.5), so that the eye sees the average brightness, somewhere between fully on and fully off.

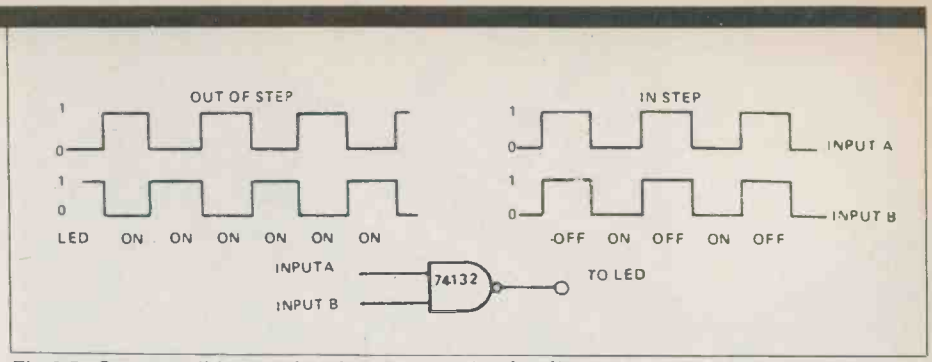

Fig.2.5. One possible use for the simple gate circuit.

Another application? Take a look at Fig. 2.6. Here one input of the 74LS132 is from a switch and the other is from a signal generator. If the switch keeps input A at 0, then there is no signal output, because the output stays at 1. If the switch keeps input at 1, however, the output goes to 0 when ever input B goes to 1 (check the truth table to see that this is so), and the output goes to 1 whenever output B goes to 0. This is a typical gating action, opening or shutting a gate to let a signal pass or to prevent it.

Upside-Down Logic

That brings us to another very useful action of this gate. Suppose we use just one input, and forget about the other one? As it happens, we can't just forget about it, because if a TTL input is not connected, then it behaves as if it were connected to logic 1. Figure 2.7 shows the breadboard arrangement for trying this out,

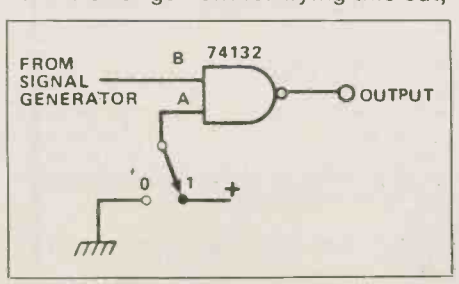

Fig.2.6. Using the gate as a signal relay.

using switch 1 to set the remaining input, and LED 1 to indicate what the output is. The truth table for this is pretty simple, just two lines, one for A = 0, the other for A = 1. Try it for yourself, and fill in the output values.

Fig.2.8 shows a variation on this. Both of the inputs of the gate are connected to the same switch, so that we are using them as a single input. Try it out, and fill in the truth table.

By this time, you should be getting the hang of the simple breadboard method of connecting up, and we're going to use just the diagrams from now on. Remember that all the

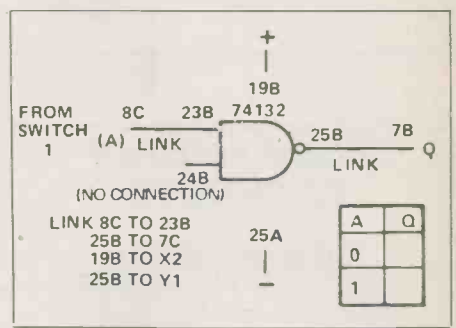

Fig.2.7. Using the gate as a signal inverter — another truth table for you.

breadboard numbers and letters shown on one line of a diagram mean that these breaboard lines are linked by wire — that's all there is to building circuits this way.

Back to the digits. The action of the circuits of Fig.2.7 and Fig.2.8 is called inversion, and it's not hard to see why. For a 1 at the input, you get 0 at the output, and for a 0 at the input you get 1 at the output. The output is the inverse of the input, the other logic signal. Another name for this action is NOT, because NOT 0 must be 1 (there's nothing else) and NOT 1 must be 0 (same reason). A circuit which does this action only is called an inverter or NOT-gate, and its symbol is shown in Fig.2.9. The little circle at the output is what tells you that there is inversion, without the circle,

Continued on page 72

New ETI Loose Leaf Binder Punch

We here at ETI realize that money is scarce, and that there are plenty of our readers who would rather not spring for binders to preserve their copies of this precious publication. Well, that's cool, and there is always the time worn solution of digging out those filthy loose leaf binders you used in high school, the ones with the smeared anatomical renderings etched into the vinyl in greasy ball point pen, and giving over to their tender embraces your clean, shiny issues of Electronics Today. The only hassle is getting the holes punched.

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Continued from page 70

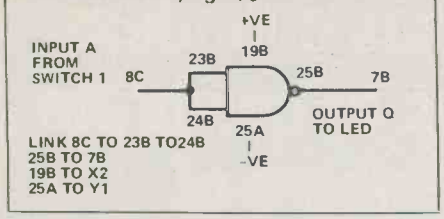

Fig.2.8. Another type of inverter connection.

the output of such a gate would be the same as the input. The same small circle occurs in the NAND gate symbol (Fig.2.8) which tells you that the NAND gate contains an inverter. More of that shortly.

Back to the board. Since we have a total of four NAND gates in one 74LS132, we can use more than one in a circuit.

Strip off all the links which go to the 74LS132, leaving only the switches and LEDs as they were. This clears the decks for the next circuit, and in future we'll assume that you've cleared the board before each circuit. Sometimes you'll find that the same links are used again but until you really get used to it it's always better to start with a clear board.

Try out the one shown in Fig.2.10. This has the circuit which you used before, with another gate used as an inverter at the output. Connect up and try it out, filling in the truth table for yourself. The action of this arrangement is an AND-gate, because the output is 1 only when both input A and input B are at 1. By using the second gate as an inverter, we have cancelled the inverting action inside the NAND-gate. Yes, that's right, NAND is short for NOT-AND.

Something a bit more ambitious now — making use of three of the four gates of the 74LS132. The circuit shown in Fig. 2.11, with two gates used simply as inverters, but this time at the inputs rather than at the outputs. Does this have the same effect as the circuit of Fig.2.10? Try it out,

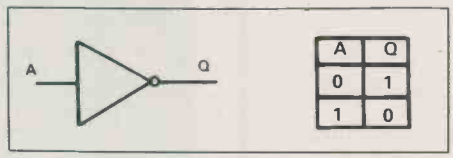

Fig.2.9. Inverter symbol and truth table.

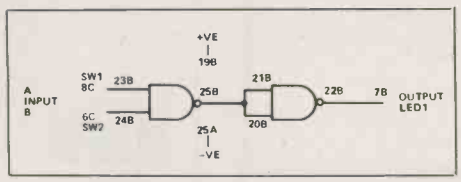

Fig.2.10. A circuit using two of the gates on the 74LS132. Construct your own truth table!

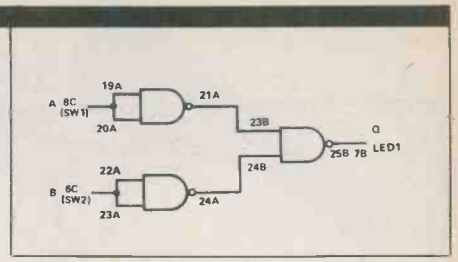

Fig.2.11. Another gate circuit. Does this one carry out the same action as the one in Fig.2.10?

filling in the truth table so that you can compare them. Not the same, are they? In fact the truth table of Fig.2.11 shows that the output is at 1 if A or B is at one, and it's the truth table of a type of gate called the OR gate (Fig.2.12).

A	B	Q
0	0	0
0	1	1
1	0	1
1	1	1

Fig.2.12. The OR-gate truth table.

Uses? Well just imagine you want a circuit to switch a LED on from either of two switches. If that's too simple, imagine this combined with a NAND gate, so that a signal can be stopped or passed using either of two switches. ETI

To be continued.

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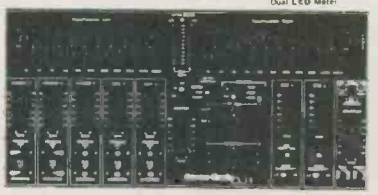

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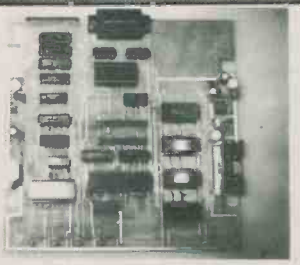

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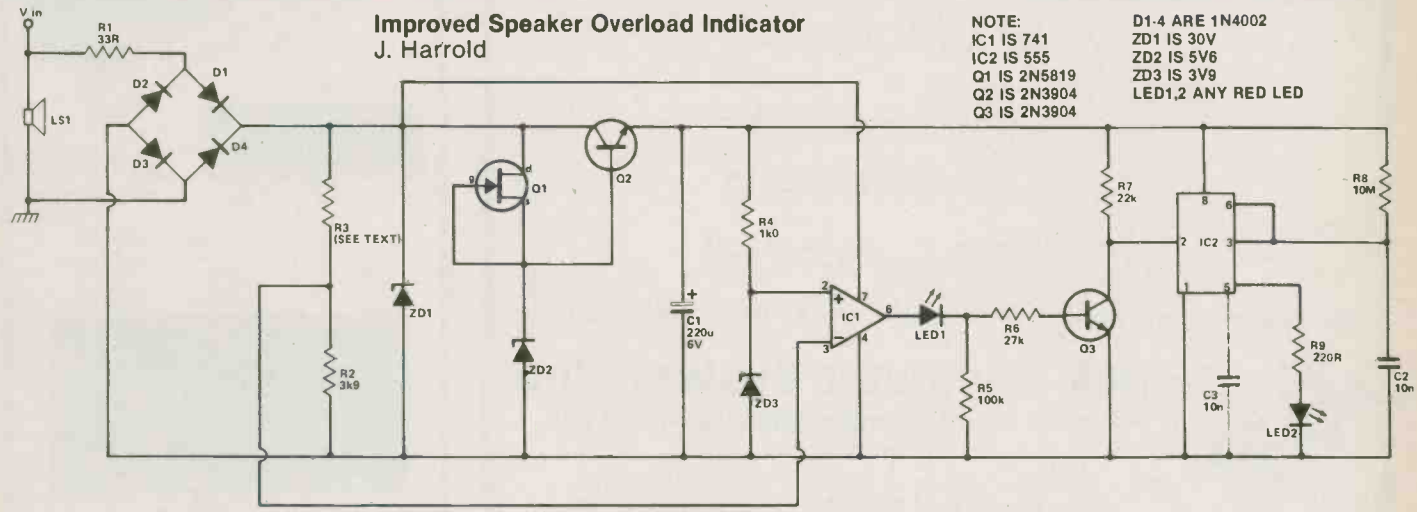


This circuit is based on a design by J.P. Macaulay. This one offers an improvement in performance, which is low cost and does not introduce an external DC power supply.

The voltage at the speaker output terminals is rectified and then passed to potential divider R2, R3. ZD1 provides 'last ditch' protection for Q1 and IC1 (this method is not suitable if indication of overloads of greater than 50 W is required). Q1 is used as a voltage variable resistor and with ZD2, series pass transistor Q2 and C1, provides a regulated supply. This supply improves the stability of the 3V9 reference potential at the inverting input of IC1 and also provides a stable supply for IC2 and its timing components R8, C2. C1 cannot be placed between 0V and the collector of Q2 as this would have an adverse filtering effect on high frequency signals. When the voltage across R2 is less than 3V9, the output from comparator IC1 is low (about 1V5) and this voltage is dropped across forward biased red LED 1 (or alternatively any three silicon diodes in series). Q3 is off and the trigger (pin 2) of IC2 is high. When the voltage across R2 exceeds 3V9, IC1 output goes high and Q3 is turned on, lowering the voltage at IC2 pin 2, triggering the monostable and lighting LED 2 for a period dependent on R8, C2 (about 100 mS with given values). C2 must be a low leakage type (not ceramic).

$$R3 = (\sqrt{2PR} - 3.9)\ \text{kilohms},$$

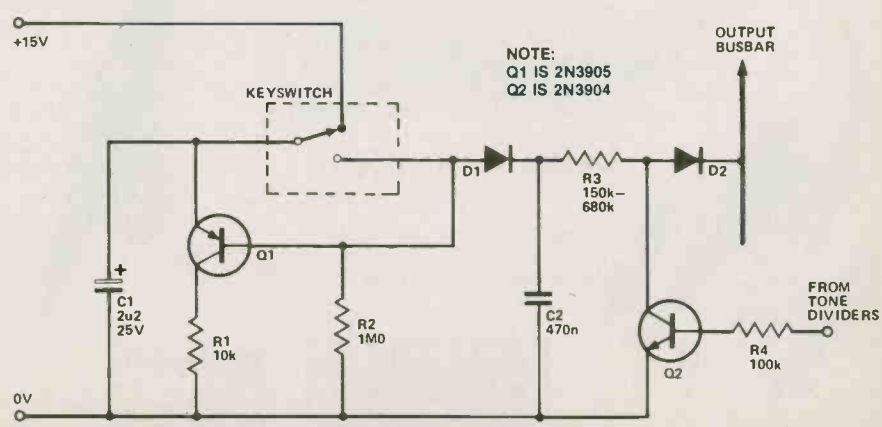
where P is the power output and R is the speaker impedance.

Touch-sensitive Piano Keying

J. Cozens

The circuit is operated by a single-pole change-over key switch. When the key is in the fully released position C1 is held charged from the 15V rail. Q1 is turned on by the bias current supplied by R2. When the key is depressed C1 is disconnected from the 15V rail and starts to discharge through Q1 and R1. When the key is fully depressed Q1 is turned off and the remaining voltage on C1 then charges up C2 via D1. Both capacitors then discharge via R3. The envelope produced by this decaying voltage is chopped by Q2, driven directly from the tone dividers. Upon the release of the key, C1 is disconnected from the chopper circuit and C2 discharges rapidly via R3, simulating the action of the dampers. D1 is included to prevent C2 discharging through R2 when the key is released and D2 prevents interaction with other keying circuits.

As the voltage remaining on C1 at the completion of a keystroke depends on the key velocity, a degree of touch-sensitivity is obtained with this circuit.



Circle No.15 on Reader Service Card.

Continued from page 26

PROGRAM 4

4. Main routine to decide whether stick has moved. Locations 1265 and 1266 are used as temporary storage for the print location data.

```
1270 LDA #$93      129A BNE $12AE
1272 JSR $FFD2     129C LDA $D3
1275 JSR $1220     129E CMP $1266
1278 LDX $D6       12A1 BNE $12AE
127A STX $1265     12A3 JSR $FFE4
127D LDX $D3       12A6 CMP #$03
127F STX $1266     12A8 BNE $12AB
1282 LDA #$90      12AA BRK
1284 JSR $FFD2     12AB JMP $1292
1287 JSR $1250     12AE LDA #$05
128A JSR $FFE4     12B0 JSR $FFD2
128D CMP #$03      12B3 LDX $1265
128F BNE $1292     12B6 STX $D6
1291 BRK           12B8 LDX $1266
1292 JSR $1220     12BB STX $D3
1295 LDA $D6       12BD JSR $1250
1297 CMP $1265     12C0 JMP $1275

G 1270 to clear screen and start program.
```

subroutines at any given point, the action on the screen will slow down noticeably. To correct this, the program must be made interrupt driven. One way of doing this is to figure out the maximum number of machine cycles that can occur in the ultimate program's major loop, and then arrange a free running timer . . . one of the VIA's clocks will do . . . so that there is a regulator interrupt to the program at intervals slightly longer than this. The program waits on this. After each cycle of the loop, the program goes into a holding pattern until the interrupt comes down. Thus, no matter how many cycles are in the loop in actuality, the whole mess will take the same amount of time.

Crude this, but a beginning.

For all machine code authors, or authors to be, on the VIC, there is a really splendid book which answers 95% of everything you've ever wanted to know about the VIC's operating system but couldn't worm out of the salesman (who doubtless needed a three day seminar to learn how to turn the thing on). Called the VIC-20 Programmer's Reference Guide, it is full of useful information on VIC BASIC, including the statements they don't say much about in the owner's manual, an I/O section, a mass of tables, charts and listings, a schematic plus one of the most useful 6502 machine code sections about, which will gracefully walk you into writing code, and provide you with an instruction list for the CPU. It's worth the $25.00 or so that it costs, and should be given serious consideration if you want to get into some serious VIC programming.

Live long and prosper.

```
10 A$="[dn][rt][rt] [dn][lf][lf]--[rt]--[dn][lf][lf][lf]"
20 POKE 36879,9 : PRINT "[cl]"
30 IF X=PEEK(36872) AND Y=PEEK(36873) THEN 30
40 J=X : X=PEEK(36872) : K=Y : Y=PEEK(36873)
50 POKE 221,(J/5.8) : POKE 214,(K/5) : PRINT"[bl]"A$
60 POKE 221,(X/5.8) : POKE 214,(Y/5) : PRINT"[wh]"A$
70 GOTO 30
```

Joystick program referred to on page 24.

ETI

SYNTHESIZER

Continued from page 22

PARTS LIST

Resistors (All 5%, ¼ watt unless notes)

R1,2,3,10, 11,12,27	100K
R4	270K
R5	91K
R6	20K trimmer, Bournes 3329P1-203
R7	56K
R8	1.0K 3600 ppm TEMPCO
R9,13,15,16, 17,18,19,22, 23,24,26	10K
R14,20,21,25	200R
R28	1K
R29-36	100K panel mounting pots

Capacitors

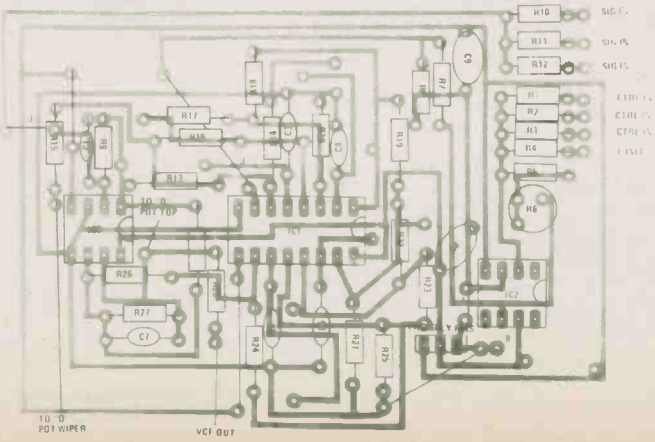
C1	22pf ceramic
C3,4,5,6	100pf ceramic
C7	5pf ceramic
C8,9	.05 uf poly

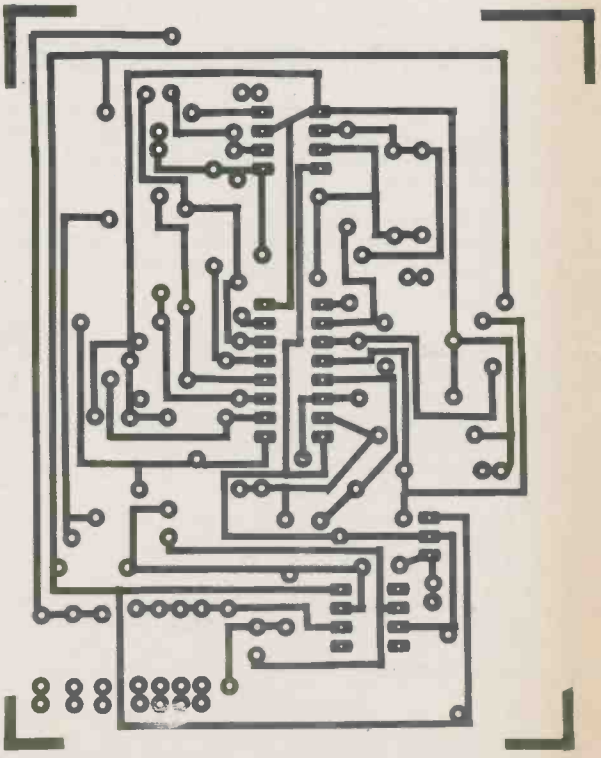
Semiconductors

IC1	SSM 2040
IC2	LF353
IC3	741N

Miscellaneous

¼ inch phone jacks (7), pcb, sockets, AP header pins, front panel (Hammond 1421-B). IC1 and the 1.0K TEMPCO are available from Exceltronixs, 319 College Street, Toronto, Ontario. M5T 1S2.





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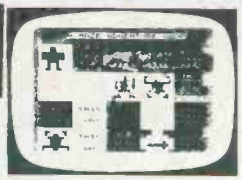

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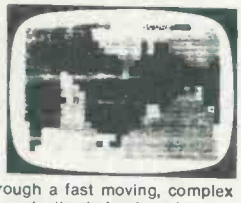
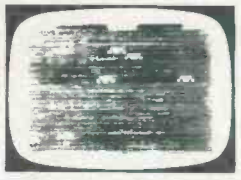


Pilot your space craft through a fast moving, complex space maze. Watch out for missiles being fired from all directions. You can shoot back or evade them. Written in machine code for fast-paced excitement.

GALAXY INVADERS $17.95



An excellent version of the classic space game. Protect your seven lives against fleets of hostile invaders, who swoop down and attack quickly. This version is an excellent demonstration of the capabilities of the ZX81 or TS1000 to entertain and excite for hours.
As an added bonus, there is a version of Invaders included on this tape!

ZX CHESS (Enhanced) $15.95

Full graphic display of chess board. Six levels of play, two of which play within competitive time limits. You choose black or white. Plays all legal moves including castling and en-passant. You can save games in progress on cassette. Displays moves of game on screen, or output yo printer, for analysis. Board can be set up in any position, you can even change sides mid-game. Clear entire board with one command: for end game analysis. Written totally in machine code, ZX CHESS (Enhanced) is a superb game for the advanced chess player.

ZX CHESS II (CHESS MASTER) $29.95

The strongest chess game available on ZX81. ZXCHESS II has not ben beaten. All the features of ZX CHESS (Enhanced), plus much more. Has a book of 32 opening moves. Can play at 7 levels, four of which play within competition time limits. A move is suggested by the ZX81 If requested.

1K ZX CHESS $15.95

A good introduction to chess for 1K ZX81/TS1000 owners. Even within this limited memory space, a full graphic representation of the chess board is included. Single level of play. Does not accept castling or en-passant moves.

ZX PROGRAMMERS TOOLS

TOOLKIT
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RENUMBER. This routine renumbers a program in any step and from any line up to 9999
DELETE. This command deletes a group of lines in a program.
MEMORY. Prints how much spare memory is available.
DUMP. Displays current values of string and numerical values, except arrays.
FIND. Will find any string of up to 255 characters and list each line containing that string.
REPLACE. Replaces any string of up to 255 characters by any other string.
SAVE. Transfers program in computer to below RAM-TOP.
APPEND. Allows two programs to be joined.
REMKILL. Removes all REM statements from a program, otherwise leaving it unchanged, preserving memory.

ZX FORTH $39.95
Simplicity of BASIC with the Speed of Machine Code

A complete implementation of the FORTH language for the ZX81 and TS1000 computer.
FORTH's most distinctive feature is its flexibility. The basic unit is the word — the programmer uses existing words to define his own which can then be used in further definitions. FORTH is a compiled language so programs run very fast (typically five times faster than BASIC).
ZX-FORTH is supplied on cassette and is accompanied by extensive documentation:
56-page Users Manual
8-page Editor Manual

ZXAS Assembler $12.95

Now you can use the full power of the Z80 microprocessor without having to laboriously POKE in instruction codes. This full specification Z80 assembler assembles all the standard Zilog mnemonics, which are simply written into REM statements (more than one per line is allowed) within your BASIC program. When assembled, the assembly listings, together with assembled codes and addresses, are displayed on the screen. The assembled code is executed by USR. The program occupies 5K, Is situated at the top of the memory, and Is protected from overwriting. This means that ZXAS may be used In conjunction with ZXDB (see below), providing an extremely powerful machine code system normally only found on very expensive computers.
The program is available for both the ZX81 and the 8K ROM ZX80, and In both cases, the 16K RAM pack Is required. Despite the low price, ZXAS Is a FULL SPECIFICATION assembler, and is a must for all serious ZX users. Full documentation on how to use the assembler (including a list of the mnemonics) is supplied.

ZXDB Disassembler/ Debugger $12.95

The perfect complement to the ZXAS assembler, ZXDB is a complete combined machine code disassembler and debugging program. Like ZXAS, it Is itself written in machine code for compactness, and may be used in conjunction with ZXAS, still leaving about 9K of memory for your own program.
Apart from the DIASSEMBLER, the program has features including SINGLE STEP, BLOCK SEARCH, TRANSFER AND FILL, HEX LOADER, REGISTER DISPLAY and more, all of which are executed by simple one key commands from the keyboard. All in all, an extremely powerful programming aid, well worth the money for the disassembler alone!

Z-AID 1.0 $19.95

A machine language programming aid on cassette.
Includes the following routines:
VERIFY confirms whether a program has been recorded properly on tape. The program In memory is unaffected, and a further "save" can be made if necessary.
Mload/Msave enables a specified block of memory to be saved. VPTR can be used within a BASIC program to eliminate many tedious POKEs and PEEKs in finding the addresses where variable values are stored.
CHAIN allows the second part of a BASIC program to be loaded and tacked onto the end of the first part.
Z-AID 1.0 is convenient to use, being loaded from tape, and residing at the top of 16K memory. The user accesses the various routines with USR calls while loading, running, editing and saving BASIC programs normally.

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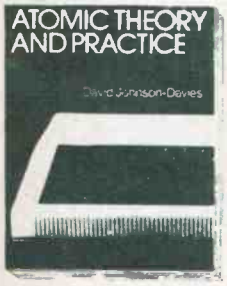

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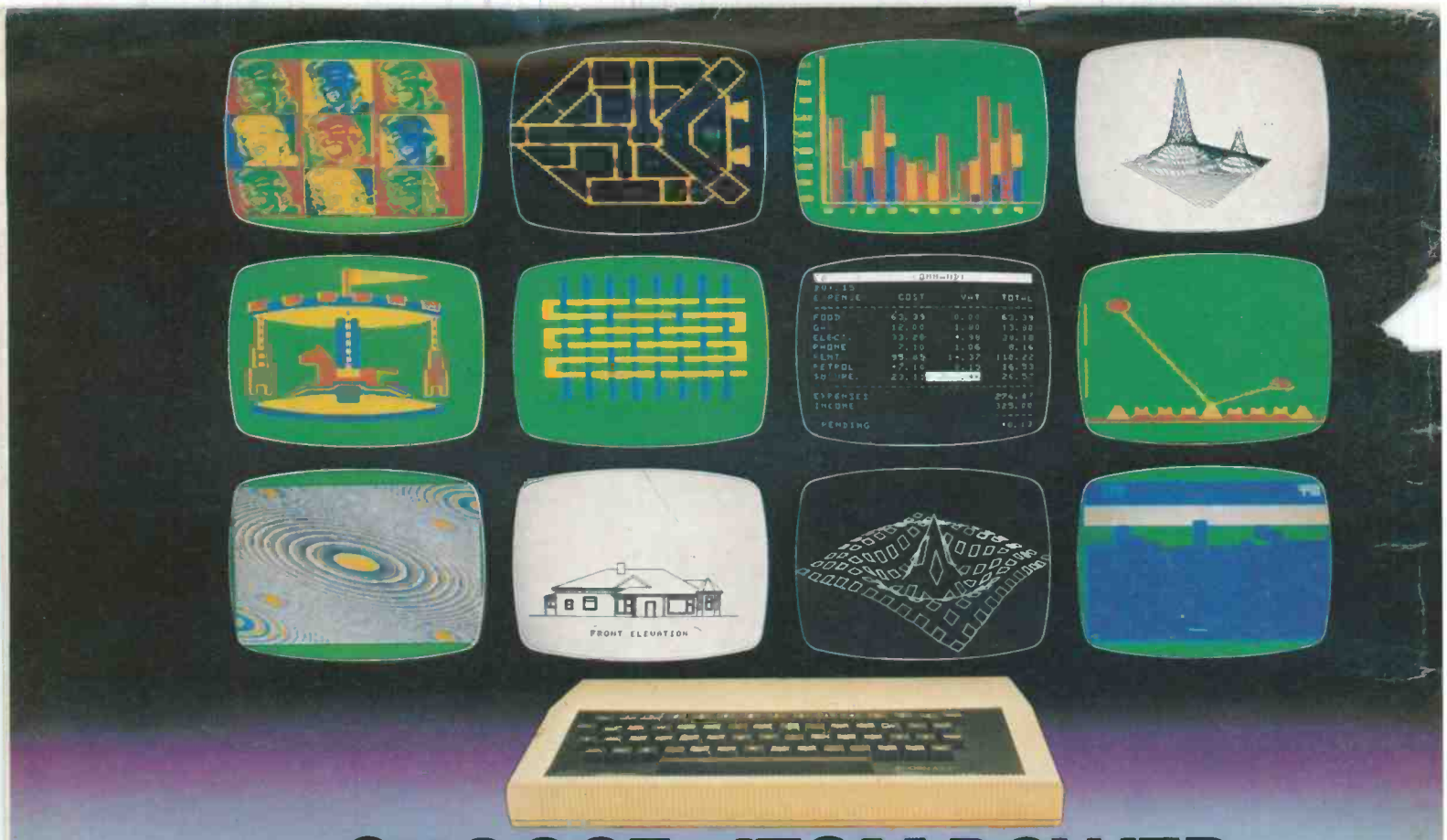

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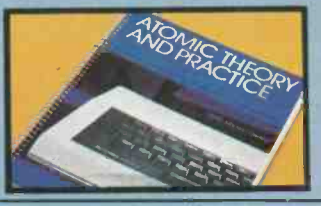

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