Review: Borland's ObjectVision 2.0

ComputerCraft

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How To Choose A Microcomputer Chip

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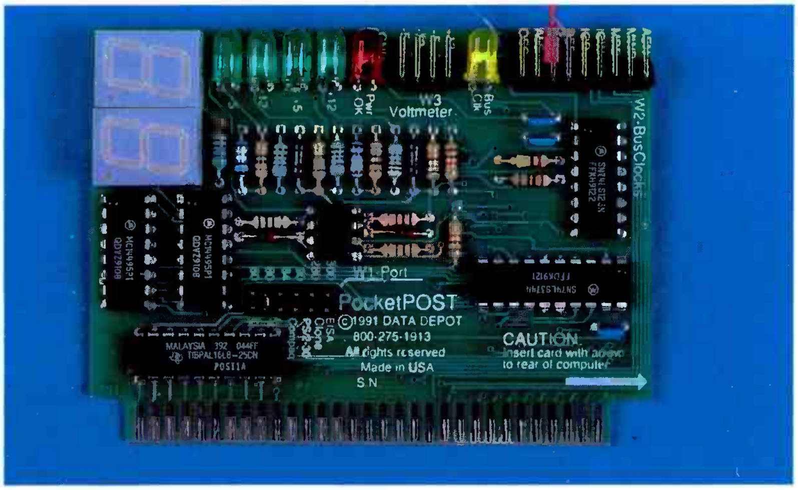
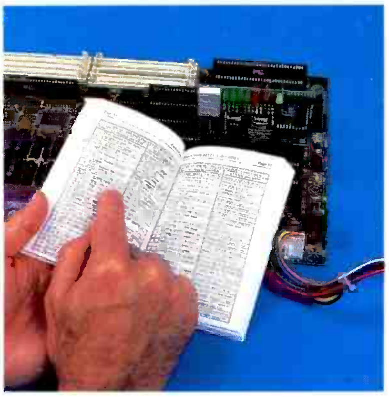
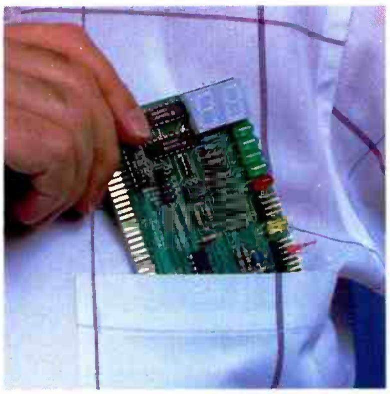
Aldus PageMaker 4.0 For Windows

Cut Troubleshooting Time to the Bone!



- Internal voltmeter and LEDs show status of power supply
- Bus Clocks LED show status of 9 major bus signals
- 2 Digit display pinpoints system self-test failures
- 170-page manual LOADED with troubleshooting info
- PC Certify Diagnostics- optional software finds failures after boot
- *Fast* and Easy - perfect for power users, technicians, systems Integrators, dealers, consultants, brand specifiers





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CURE: Home Control Concepts has been ordered by our doctor to hold the most unbelievable Stanley LightMaker sale ever seen in the history of home automation.

Mobile Control & Base

8-button handheld remote done in sleek 1990's styling. Transmits RF signal up to 100 ft. to plug-in base transceiver. Off-white color. HCC-2553 ONLY $37.49

Power Timer / Radio

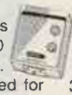
Programmable timer can schedule 4 lights and appliances up to twice a day. Manual control of 8 devices. Security feature for random on/off times. Delay feature turns off selected device at a later time... great for late night TV viewing! AM/FM clock radio with alarm and snooze feature. Illuminated ALL LIGHTS ON button. Attractive simulated woodgrain design. Battery backup. 180 units reserved for promo. Limit 6. HCC-2649 ONLY $34.95

Motion Detector & Base

Indoor/outdoor wireless motion detector mounts virtually anywhere. Transmits ON signal to base transceiver up to 66 ft. away. Operates 24 hrs. or only after dusk. Sensitivity adjustment and variable OFF delay. Detects 40 ft. at 110° arc. HCC-2653 ONLY $44.95

WITHOUT BASE HCC-2652 $29.95

Lamp Module



Plug-in lamp module controls incandescent lights up to 500 Watt max. Off-white color. Only 672 modules reserved for this promo, so order soon! Limit 8. HCC-2474 ONLY $8.99

3-Prong Appliance Module

Plug-in appliance module rated 15A resistive, 500W lamps, 1/3HP motors. Off-white. 672 reserved. Limit 8. HCC-2550 ONLY $9.99

HOME CONTROL CONCEPTS

STANLEY LightMaker

X-10 Compatible Home Controls

Wall Switch Module

Replaces existing wall switch. Controls incandescent lights up to 500 Watt max. Ivory color button. Only 672 modules reserved for this promo, so order now! Limit 8. HCC-2475 ONLY $9.99

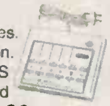
3-Way Wall Switch Set

Replaces existing switches controlling incandescent light from 2 locations. Ivory color buttons. HCC-2476 ONLY $12.99

Motion Detector with Floods

Detects motion, turns on floodlights, and sends up to four X10 on signals to modules located inside or outside the house. OFF delay (10 sec. to 35 min.), dusk/dawn and sensitivity adjustments. Detects 40 ft. at 110° arc. Weatherproof. Bulbs not included. 450 units reserved for promo. Limit 6. HCC-2651 ONLY $39.99

Home Control



Turns on/off up to 8 lights and appliances. Has Illuminated ALL LIGHTS ON button. Also has DIM/BRIGHTEN and ALL UNITS OFF buttons. Off-white color. 261 reserved for promo. Limit 8. HCC-2551 ONLY $8.99

Premier Home Control

Same features as Home Control (above); controls 16 devices. Handsome simulated woodgrain design with smoked flip-up keyboard dust cover. HCC-2549. ONLY $16.49

Power Timer

Same features as Power Timer / Radio (above left) without AM/FM radio. Limit 6. HCC-2552 ONLY $24.95

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Wireless RF Link

Manufactured by Linear, this low cost RF link is ideal for wireless control of your own projects, your home & car alarm, and even X10 modules (with addition of HCC-284)! Set security code on transmitter & receiver, apply power to receiver board, & you're ready for wireless control!

TRANSMITTER: Tiny keychain transmitter is approx. half the height of a matchbox! Transmitter has two buttons corresponding to channels 1 and 2. Includes two Lithium batteries.

RECEIVER: Board level receiver measures approx 3" square! Requires power supply of 8 to 24 VDC or 12 to 18 VAC. Two outputs (channels 1 and 2) can each switch up to 300 mA @ 18 VDC maximum to ground. Directly activate relays, drive bulbs, more.

HCC-RF1 Set includes transmitter, receiver, and complete documentation. ONLY $39!

HCC-284 X-10 Powerflash interface ONLY $19!

New! Leviton 6381-U

X-10 compatible. Control motor speed (e.g. ceiling fan) and dim low voltage lighting! Rated 500W incandescent; motors & transformers 2/3 HP or 500VA. White or ivory. HCC-6381U ONLY $48.64

HCC-6291 For fluorescents & appliances $48.64

Enerlogic *ES-1400e*

Intelligent X10 scheduler with 2-way interface. Monitors powerline and allows IF-THEN control. PC may be shut off once system is programmed! Use with HCC-2653 Stanley motion detectors! Powerful! New Model, New Software. HCC-1400 ONLY $359

X-10 Development Kit

Use to develop your own PC-based "smart" home automation system! Monitor status of home's lights & appliances and make intelligent decisions based on their on/off status. Develop a home control system with IF-THEN logic, even 1-button macros! Add Stanley motion detectors to give system input of room presence. Development software is interrupt based and includes compiled library routines & sample C-language source code.

Use with *PC to Infrared Interface* to develop a system which combines home automation and IR control; any X-10 controller can control infrared! Add *Voice Master Key*, for voice control of the home! Use X-10's *Sundowner* to give dusk/dawn input to your system. Add PC voice mail for X-10 control of your home from any phone in the world! Requires IBM or compatible computer with parallel port. Includes TW523 module, adapter, interface cable, development software, demo program & technical info/data. HCC-523K ONLY $69!

Thermostat Setback

X-10 energy saver! Pays for itself! Works with your existing thermostat! Installs quickly and easily. Use in summer and winter! Below dealer cost! HCC-2807 ONLY $9.99

We have GE Homeminders!

We believe we have the last 200 units in the universe! Originally sold for over $500! X10 compatible; schedule your home on your TV! Pictoral display of rooms & devices (coffee maker in kitchen, etc.) with on/off status. Remote phone interface, memo pad, security mode, message system, password protection, more. Complete with infrared remote control, cables, & warranty. Limited supply & going fast so order now! HCC-GE1 ONLY $149

HCC-GE2 With 2 Modules $159

Motion Switch

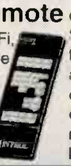
Heath Zenith switch senses motion & turns on light. Adjustable delay shut off. Great for hallways, basements, garages, laundry rooms, bathrooms, more. Photocell adjusts for night-only operation. HCC-6105 ONLY $14.95

PC to IR Interface Kit

This kit is great for development of your own infrared home control system! Allows your PC to "push buttons" on remote control! Combine PC based home automation with infrared control of your TV (volume, channel, etc), stereo, VCR, and more! Add whole-house IR repeater such as X-10's *Powermid*. Use with Covox *Voice Master Key* for voice control of your entertainment system! Combine with *X-10 Development Kit* to allow any X-10 controller to control your infrared devices! Use with voice mail system for remote control of IR from any telephone in the world! Possibilities are limitless!

Remote control links to PC's serial port. Use the SendIR program to transmit infrared signals (e.g. The dos command **SendIR TV MUTE** will mute the tv!). Write your software around SendIR or develop from scratch using sample source code. Complete with interface, cable, development software, sample C-language source code, technical info/data and documentation. Requires remote control (*One-For-All* or *1-Control*) and IBM or compatible computer with serial port. HCC-PCIR ONLY $69!

1-Control Universal Remote



Replaces 8 remotes! TV, cable, VCR, Hi-Fi, satellite converter, more! X10 compatible when used with HCC-3000. HCC-8255 ONLY $59

HCC-8256 Premium Version Replaces 4 remotes ONLY $77.90

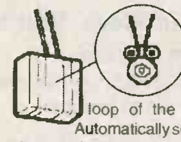
HCC-3000 IR Command Center $29.95!

Automation Book

"How to Automate Your Home" by David Giddings. Excellent! Reviews in Sept'91 Popular Science & Radio Electronics, Circuit Cellar INK, & Electronic House. 128 pages and 115 illustrations. Reg. $29.95 ONLY $26.95

Drapery Controller

This X-10 compatible quiet motor can be used to control draperies and vertical blinds. Installs in minutes. Mounts on the wall and takes up the loop of the drapery cord.



Automatically senses full open/full close. Can be stopped at any point in open/close cycle. Motor has two AC cords; one powers motor's "brains," the other plugs into an X-10 module or receptacle for control. Provides convenience, energy savings & security. Pre-schedule open/close times and/or use with an X-10 Sundowner. In summer have drapes close following the sun to keep home cool. In winter have drapes open following the sun to warm house. When away, open/close to give home "lived-in" appearance. Remotely close drapes while watching TV to reduce glare. Schedule a midnight "sweep" command to shut off all appliances, lights, & close all drapes. Slick for custom installer demos, or end-user home automation "showing off!" Manufactured for Kirsch, the famous name in draperies & blinds. HCC-DRP1 ONLY $269

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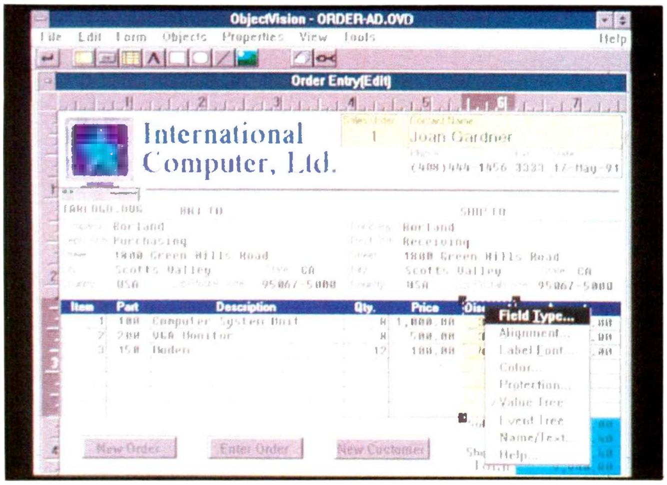

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ON THE COVER: Desktop video adds a powerful dimension to desktop computing. The computer-animated beach ball on the video screen at the right is overlaid on the live hand shown center foreground and picked up by the video camera at the left, with the result shown on the video screen in the background.

Cover Photo: by Liz Benford

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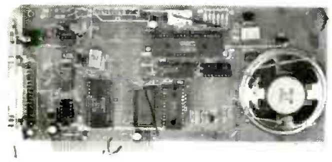

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8088	2.20	8279	2.25
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8155	2.25	8286	3.50
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8202A	8.00	8288	3.50
8212	1.25	8530	3.00
8214	2.00	8741	7.00
8216	1.25	8742	7.00
8224	1.25	8748	7.00
8228	1.75	8749	7.00
8237-5	2.80	8755	7.00
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(16550)	13.00	80287-10	135.00
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CIRCLE NO. 54 ON FREE INFORMATION CARD

Editorial

i486 Time

A few telephone calls to computer dealers have convinced me that the i486 microprocessor's time has arrived as a viable buying choice for many of us. Prices for these state-of-the-art systems and motherboards have dropped dramatically, to as low as $3,000 for a loaded system.

Replacement motherboards, are closing the gap between i486 and 386 technology. For example, a phone call to Altex Electronics to verify an advertised price in *ComputerCraft* of $1,049 for a 33-MHz 486 motherboard, revealed that the price is now $795! A 33-MHz 386DX motherboard is still selling for $459.

Unlike the move from an 80286 microprocessor to a 386SX or DX, an i486 CPU won't give you the keys to new software and operational opportunities. What it does have the potential to do is greatly speed up operations. I say "potential" because it depends on which 386 and which 486 type you compare things with. The same would be true when comparing a 286 chip with a 386SX microprocessor in terms of speed.

You'll still get better value with a high-speed 386DX type (33 MHz or 40 MHz), for example, than a 20-MHz 486SX (which, unlike the i486DX, doesn't have a built-in math coprocessor) because the older chip is slightly faster and a lot cheaper. So you have to know what you're dealing with.

There also are other factors to consider. In particular is the type of bus you want your machine to have. A standard AT-type, the ISA bus, is less costly, naturally. Because it has a 16-bit data path, it doesn't benefit from a 32-bit path that both 386DX and i486 microprocessors offer. It also costs upwards of $600 less for a motherboard built around it than for one with a 32-bit-path EISA or IBM MCA bus. This is a good enough reason to stick with ISA.

On the other hand, you must know that down the line you'll be yearning for a 32-bit data path that'll give you the potential for maximum performance. Since both ISA and EISA (the latter accepts both 16- and 32-bit boards) are both locked in to only an 8-MHz bus transfer speed, it's the latter's bus-mastering attribute, relieving work the CPU would have to do, that can greatly speed up operations.

It's always difficult to put yourself into someone else's shoes. If money is at the top of the list, and you don't have or foresee a pressing need for really fast operating speed, then you might forego an i486 type for even a 386SX computer, the lowest entry-level machine today for serious PC work in a DOS environment. If you can manage it, though, I'd suggest looking seriously at a 486DX machine with an EISA bus and a fast clock speed if you do math-intensive or graphics work, or want to use it as a network file server.

The foregoing isn't necessarily an immediate panacea for everything. There are better hard drives to consider buying, more memory to add (the more memory capability your new board allows the more sophisticated the applications software you'll be able to run in the future). Don't get a board that requires proprietary memory chips, however, or you'll lose full lower-cost expansion freedom later on.

For my desktop money, I'd get a 33-MHz 486DX tower system, plenty of SIMM RAM expansion and an EISA bus. No 486SX for me, and for that matter, I'll wait for a premium-priced 50-MHz 486DX. If I just can't manager the cash (or credit), I'd drop down to a 20-MHz 386SX. Notebook or laptop computers become a whole different story: will this be your only computer that will also plug into a color monitor? Just for word processing on the run? In this area, there are a number of other questions to be answered.

In any event, in light of the fact that the 486 price war has started, I believe that it's the route to go, especially since an upgraded, premium-price 486 is expected later this year with an internal clock doubler that allows the chip to work twice as fast internally as it does externally. (This higher internal speed will consume about 40% more power and require a heat sink; so it's not for portables). Additionally, Intel's "586" CPU is expected to debut next year for much more money.

Therefore, a 33-MHz i486, *et al*, will keep you up there for a bunch of years to come. It won't be at the leading edge, but it will be close enough to justify spending the extra money now. Just weigh price, features and what you expect to do with the computer a few years from now. Then bite the bullet. It's i486 time.

Art Salsberg

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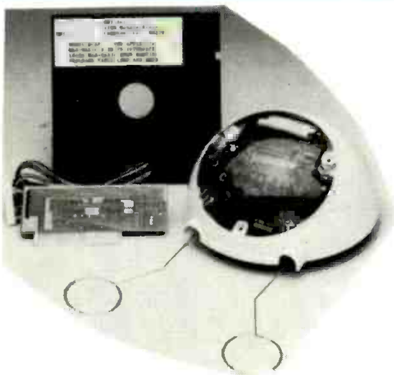
LS9200	TOSHIBA	670nm	3 mW	85 mA	2.3 V	49.99	47.99	43.19
LS9201	TOSHIBA	670nm	5 mW	80 mA	2.4 V	59.99	56.99	51.29
LS9211	TOSHIBA	670nm	5 mW	50 mA	2.3 V	69.99	66.49	59.84
LS9215	TOSHIBA	670nm	10 mW	45 mA	2.4 V	109.99	104.49	94.04
LS3200	NEC	670nm	3 mW	85 mA	2.2 V	59.99	56.99	51.29
LS022	SHARP	780nm	5 mW	65 mA	1.75 V	19.99	18.99	17.09
SB1053	PHILLIPS	820nm	10 mW	90 mA	2.2 V	10.99	10.44	9.40

WAO II PROGRAMMABLE ROBOTIC KIT

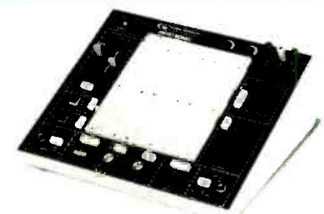


The pen mechanism included with the robot allows it to draw. In addition to drawing straight lines, it can also accurately draw circles, and even draw out words and short phrases. WAO II comes with 128 x 4 bits RAM and 2K ROM, and is programmed directly via the keypad attached to it. With its built-in connector port, WAO II is ready to communicate with your computer. With the optional interface kit, you can connect WAO II to an Apple II, IIe, or II+ computer. Editing and transfering of any movement program, as well as saving and loading a program can be performed by the interface kit. The kit includes software, cable, card, and instructions. The programming language is BASIC.

- Power Source – 3 AA batteries (not included)

STOCK #	DESCRIPTION	1-9	10-24	25+
MV961	*WAO II Programmable Robotic Kit*	79.99	75.99	68.39
WIIAP	*Interface Kit For Apple II, IIE, II+*	39.99	37.99	34.19

PROTOBOARD DESIGN STATION



- The total design workstation – including expanded instrumentation, breadboard and power supply.
- Ideal for analog, digital and micro-processor circuits
- 8 logic probe circuits
- Function generator with continuously variable size, square, triangle wave forms, plus TTL pulses
- Triple power supply offers fixed 5 VDC supply plus 2 variable outputs – +5 - 15 VDC and -5 - 15 VDC
- 8 TTL compatible LED indicators, switches
- Pulsers
- Potentiometers
- Audio experimentation speaker
- Multiple features in one complete test instrument saves hundreds of dollars needed for individual units
- Unlimited lifetime guarantee on bread-board sockets
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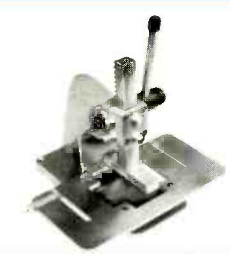
  +5 VDC @ 1.0 amp, ripple – 5 mV
- **Variable DC output**
  +5 – to +15 VDC @ 0.5 amp, ripple – 5 mV
- **Variable DC output**
  -5 – to -15 VDC @ 0.5 amp, ripple – 5 mV
- **Frequency generator**
  frequency range: 0.1 Hz to 100 KHz in 6 ranges
  output voltage: 0 to ± 10V (20 Vp-p)
  output impedance: 600 (except TTL)
  output current: 10mA max., short circuit protected
  output waveforms: sine, square, triange, TTL
  sine wave: distortion 3% (10 Hz to 100 KHz)
  TTL pulse: rise and fall time 25ns drive 20 TTL loads
  Square wave: rise and fall time ± 1.5 s
- **Logic indicators**
  8 LED's, active high, 1.4 volt (nominal) threshold, inputs protected to ± 20 volts
- **Debounced pushbuttons (pulsers)**
  2 push-button operated, open-collector output pulsers, each with 1 normally-open, 1 normally-closed output. Each output can sink up to 250 mA
- **Potentiometers**
  1 – 1K , 1 10K , all leads available and uncommitted
- **BNC connectors**
  2 BNC connectors pin available and uncommitted shell connected to ground
- **Speaker**
  0.25 W, 8
- **Breadboarding area**
  2520 uncommitted tie points
- **Dimensions**
  11.5" long x 16" wide x 6.5" high
- **Input**
  3 wire AC line input (117 V, 60 Hz typical)
- **Weight**
  7 lbs.

STOCK #	DESCRIPTION	1-9	10-24	25+
PB503	*Protoboard Design Station*	299.99	284.99	256.49

IDC BENCH ASSEMBLY PRESS



The Panavise PV505 1/4 ton manual IDC bench assembly press is a rugged, practical installation tool designed for low volume, mass termination of various IDC connectors on flat ribbon cable.

- Assembly base & standard platen included
- Base plate & platen may be rotated 90° for maximum versatility
- Base plates & cutting accessories are quickly changed without any tools required
- Additional accessories below
- Size – 10" W x 8.75" D x 9" H
- Weight – 5.5 lbs.

STOCK #	DESCRIPTION	1-9	10-24	25+
PV505	*Panavise Bench Assembly Press*	149.99	142.49	128.24

COLLIMATING PEN

A low power collimator pen containing a MOVPE grown gain GaAlAs laser. This collimator pen delivers a maximum CW output power of 2.5 mW at 820 nm.

The operating voltage of 2.2-2.5v @ 90-150mA is designed for lower power applications such as data retrieval, telemetry, alignment, etc.

The non-hermetic stainless steel case is specifically designed for easy alignment in an optical read or write system, and consists of a lens and a laser diode. The lens system collimates the diverging laser light 18 mrad. The wavefront quality is diffraction limited.

The housing is circular and precision manufactured measuring 11.0 mm in diameter and 27.0 mm long. Data sheet included.

As with all special buy items, quantity is limited to stock on hand.

STOCK #	DESCRIPTION	1-9	10-24	25+
SB1052	*Infra-Red Collimator Pen*	49.99	47.49	42.74

LASER DIODE MODULE

The LDM 135 integrated assembly consisting of a laser diode, collimating optics and drive electronics within a single compact housing. Produces a bright red dot at 660-685 nm. It is supplied complete with leads for connection to a DC power supply from 3 to 5.25 V.

Though pre-set to produce a parallel beam, the focal length can readily be adjusted to focus the beam to a spot.

Sturdy, small and self-contained, the LDM135 is a precision device designed for a wide range of applications. 0.64" diam. x 2" long.

STOCK #	DESCRIPTION	1-9	10-24	25+
LDM135-.5	*.5 mW Laser Diode Module*	179.99	170.99	153.89
LDM135-1	*1 mW Laser Diode Module*	189.99	180.49	162.44
LDM135-2	*2 mW Laser Diode Module*	199.99	189.99	170.99
LDM135-3	*3 mW Laser Diode Module*	209.99	199.49	179.54

COLLIMATING LENS

This economical collimating lens assembly consists of a black anodized aluminum barrel that acts as a heat sink, and a glass lens with a focal point of 7.5 mm. Designed to fit standard 9mm laser diodes, this assembly will fit all the above laser diodes. Simply place diode in the lens assembly, adjust beam to desired focus, then set with adhesive.

STOCK #	DESCRIPTION	1-9	10-24	25+
LSLENS	*Collimating Lens Assembly*	24.99	23.74	21.37

DUAL MODE LASER POINTER

New slimline laser pointer is only ½" in diameter x 6¼" long and weighs under 2 oz., 670 nm @ less than 1 mW produces a 6 mm beam. 2 switches, one for continuous mode, and one for pulse mode (red dot flashes rapidly). 2 AAA batteries provide 8+ hours of use. 1 year warranty.

STOCK #	DESCRIPTION	1-9	10-24	25+
LP35	*Dual Mode Laser Pointer*	199.99	189.99	170.99

He-Ne TUBES

New, tested 632nm He-Ne laser tubes ranging from .5mW to 3mW (our choice). Perfect for hobbyists for home projects. Because of the variety we purchase, we cannot guarantee specific outputs will be available at time of order. All units are new, tested, and guaranteed to function at manufacturers specifications.

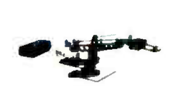
STOCK #	DESCRIPTION	1-9	10-24	25+
LT1001	*He-He Laser Tube*	69.99	66.49	59.84

POWER SUPPLY

- Input: 115/230V
- Output: +5v @ 3.75A
  +12v @ 1.5A
  -12v @ .4A
- Size: 7" L x 5¼" W x 2½" H

STOCK #	PRICE
PS1003	$19.99

ROBOTIC ARM KIT



Robots were once confined to science fiction movies. Today, whether they're performing dangerous tasks or putting together complex products, robotics are finding their way into more and more industries. The Robotic Arm Kit is an educational kit that teaches basic robotic arm fundamentals as well as testing your own motor skills. Command it to perform simple tasks.

STOCK #	PRICE
YO1	$43.99

AVOIDER ROBOT KIT

An intelligent robot that knows how to avoid hitting walls. This robot emits an infra-red beam which detects an obstacle in front and then automatically turns left and continues on.

STOCK #	PRICE
MV912	$43.99

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CIRCLE NO. 140 ON FREE INFORMATION CARD

RAM Chip Wars. More and more data can be stored in dynamic random-access memory chips as manufacturers vie with each other for technological leadership. Four-Mbit RAM devices pour off production lines, while 16-Mbit ones await their call. But the battle lines are really being formed with development of 64-Mbit devices (storing 64-million bits of information) by major RAM makers. Already making experimental ones are Fujitsu, Matsushita, Mitsubishi and Toshiba; Hitachi and Samsung are working on them, too. Perhaps leading the 64-Mbit race at this early stage, however, are IBM and Siemens, who collaborated with development work to produce a 64-Mbit DRAM that is reportedly in the production working design stage. Production is not anticipated for a few years, though.

Favorite Photos on Display. Integrated Concepts of Redding, CA (916-246-9013) translates your favorite photograph or drawing, color or black-and-white, to a database that displays the image on a computer screen (VGA only) every time you turn it on or on demand. Cost is $19.95, the image supplied on a diskette or downloaded by modem.

CD-ROM Bundle. CD-ROM libraries continue to grow. Corel Systems (613-728-8200), for instance, now has an enhanced version of its popular CorelDRAW 2.01 program on CD-ROM. It features more than 10,000 clipart and symbols, 200 fonts, multi-lingual versions, on-line help and versions for Microsoft Windows, 32-bit OS/2 and Unix. The company offers an interesting "Blockbuster Pack" to registered CorelDRAW owners for this CD-ROM version that is bundled with a Panasonic CD-ROM drive, appropriate drivers and interface kit for $595 (internal drive) or $695 (external drive).

Program Updates. OrCAD updated its Schematic Design Tools Release IV with version 4.10. The schematic-capture utilities collection that automatically checks electrical rules, creates a bill of materials list and plots and prints schematics is said to have a 35-percent-or-greater increase in speed of netlist operation and several new library parts (primarily analog devices). Also enhanced is the company's ESP Framework, a graphics-based file-management environment integrated with OrCAD's Release IV. It now includes a new hot-key capability and more help files.

Racal-Redac's MAXI/PC, a PCB CAD software package, has been upgraded with its Release 3.0 to make it easier to learn and use. The $995 integrated schematic-capture and PCB-layout software features a new interface that is said to anticipate the user's likely next move and defaults to the action. It also has an expanded parts library, menu bars and pull-down menus based on the OSF/Motif style.

GeoWorks and Borland International announced that Quattro Pro SE will be integrated into GeoWorks Pro, a $200 upgraded GeoWorks Ensemble package. Thus, the spreadsheet will work inside the GeoWorks environment, which includes GeoWrite word processor, GeoDraw object-oriented drawing tools, GeoComm communications and GeoManager file and personal-information manager.

Say You Saw It In ComputerCraft

Author Feedback

• After looking through my "BCD Word Generator" article in the January issue, I noticed an error in the circuit description that might be a source of some confusion. In the first column, the first full sentence should read: "With *S1* through *S4* in the normally-closed position, the enable inputs at pins 4 and 13 of *U2* through (*not* 'and' as printed) *U5* are held low." If the builder has available the pin labels of the 74LS75 or 74LS00, he won't be confused by this typo.

There's one connection missing from the Master Wiring List that will not hinder the builder since the schematic diagram is correct. The connections to pin 9 (GND) of *U1* don't list U8(7).

Lloyd W. Redman
Albuquerque, NM

• In my "Another Image-Capture View" on page 26 of the January issue, captions were transposed for two of the photos shown and can lead to confusion. The correct caption for the photo at the upper-right is shown under the photo at the lower-left and vice-versa.

SF Sparrow

Anti-CRT Display

• I learned that LCD screens are better for the human eye than CRTs since a liquid-crystal display doesn't emit the blast of electrons the way a cathode-ray tube does. Evidence abounds where long-term exposure to a CRT type of video display terminal can cause health problems for users.

With this so abundantly clear, why are most PC screens made with CRTs? The CRT does have a brighter image. I suspect that it's simply more profitable for computer manufacturers to use the cheap stuff (even if it does cause eye strain). Safety is for wimps.

This letter was typed on an electronic typewriter. I will never buy a computer with a CRT.

Robert Cavalier
Greeenbrae, CA

There's no solid evidence that CRTs are a health hazard for long-term exposure, though there are suspicions. A few companies, however, do offer CRT displays with protection against electromagnetic radiation. CRTs provide a vastly improved display compared with LCDs that go way beyond just better brightness. The benefits of LCD are only mechanical, providing smaller size and lighter weight.—Ed

Microcontrollers

• Your recent articles on microcontrollers have been very informative, and I will keep them as favorite reference material. This means that I will never throw them out. I congratulate Jan Axelson on a very readable style.

D. Macmillan
Ottawa, Ontario, Canada

• I was excited to see the article about the Morotola 6805 microcontrollers in the November issue of *ComputerCraft*. I've found this device to be an invaluable resource for many years.

J. Mark Wolf
Hicksville, NY

Amiga Forever

• Your magazine caters to the IBM crowd. I happen to have a Commodore Amiga that, in my opinion, is the best home computer going. When it comes to the term "user friendly," nothing comes close to the Amiga, even with *Windows*. After looking through *ComputerCraft*, it is plain to see that you do not live up to your name. I think a name like "Clone Craft" would be more appropriate.

John Strzykalski
S. Amboy, NJ

No arguments. The Commodore Amiga is, indeed, a fine computer. But it hasn't captured a large market in the U.S. for a host of reasons that have nothing to do with its capabilities.—Ed.

Why?

• Can you tell me why, in this day of modern computers, your December issue arrives in mid-October? Can you tell me why the results of the ComputerEyes *color* digitizer is shown in B&W on page 25 of the December issue?

Fred Parmenter
Medfield, MA

Most newsstand-type mgazines are issued well before their cover date. Actually it's a psychological ploy started eons ago to make newsstand issues, which are on sale for a month, appear to be current. The reason why the results of all image outputs, regardless of whether they were generated by a color or B&W board, are shown in B&W is because these results were printed on an ordinary laser printer. Moreover, some are limited to only B&W, so the playing field is level when all are compared in B&W.—Ed.

NOW YOU'RE TALKING!

The Code-Free Ham License is Here

Enjoy all Amateur Radio privileges above 30 MHz without having to pass a code test. All you have to do is pass a 55-question exam on basic radio and the FCC regulations. ARRL's new book, **Now You're Talking** makes understanding what is required on the test a snap! And there are exams given all over the country every weekend.

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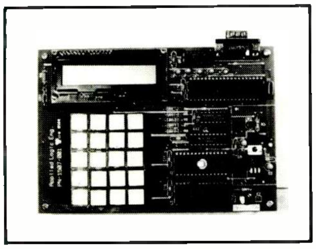
CIRCLE NO. 52 ON FREE INFORMATION CARD

What's New! By Peter R. O'Dell

Single-Board Computer

The RS-232 SBC from Applied Logic Engineering is an 80C32-based design that includes an on-board 1 × 16 LCD and 29-key keypad to provide user input and output capability. The board also includes a full RS-232 communication port to connect it to other embedded control systems or to personal computers. A single 9-volt battery can power the board.



The board is designed to accommodate a 27C256 EPROM for program storage and a 32K static RAM for memory expansion. Software is also provided on a disk for interfacing to the keypad, LCD and RS-232 communications port. $110. *Applied Logic Engineering, 13008 93 Pl. N., Maple Grove, MN 55369; tel./fax:, 612-494-3704.*

Circle (1) on Reply Card

RAM Tester Options

Computer Doctors has two new options for its RAMSTAR RAM tester. A new switchable 4-volt option allows the tester to simulate the effects of heating without actually heating the RAM, thus enabling you to quickly find heat-related intermittent faults in 5-volt RAM. A second option permits testing of any DRAM device capable of 4M operation (adapters are required and are available for most common forms). Custom adapter service is available. RAMSTAR tests most RAM types found in computers and peripherals. $249, RAMSTAR; $40, 4-volt option; $89, 4M option. *Computer Doctors, 9204-B Baltimore Blvd., College Park, MD 20740; tel.: 800-RAMSTAR.*

Circle (2) on Reply Card

DOS/Windows Graphics Capture & Conversion

HiJaak 2.1 from Inset Systems is a screen-capture and file-conversion utility that captures *Windows* and DOS screens and converts graphics files between more than 40 different formats, including TIFF, PCX, WPG, CGM and EPS. It features a new optimized palette algorithm for reducing the number of colors when necessary in a conversion. Version 2.1 has additional support for SVGA cards (a total of 20). Conversion to GEM files now produces files optimized for size. Color capabilities support the emerging 24-bit standards.

HiJaak 2.1 uses a flavor metaphor to handle the variety of TIFF files created by such applications as *PageMaker* 4.0 and *CorelDRAW* 2.0. It supports 26 fax cards, allowing conversion of most graphic formats to faxes. *HiJaak* 2.1 creates CMYK EPS from many sources, including *Windows* and DOS screen captures for use with *HiJaak ColorSep* 2.1. software.

HiJaak ColorSep 2.1, also from Inset Systems, is a bundle of *HiJaak* 2.1 and color-separation technology licensed from Kunkel Group, originally developed to facilitate color production of *PC Magazine*. It gives the IBM/compatible user control over the color-separation process. Separated files can be sent directly to an imagesetter or to a disk file for later imaging at a service bureau.

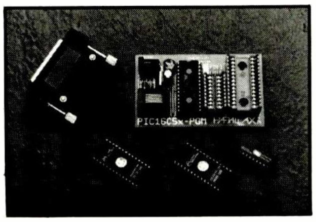
The program creates 300-dpi color-key alternatives using a color PostScript Language printer. Users can calibrate *HiJaak ColorSep* 2.1 to the output device using densitometer readings from an included test file for better imaging accuracy. Screen angles are easily modified by the user.

Also from Inset Systems, *HiJaak PS* 2.1 converts PostScript Language files to fax device formats. This version adds 15 new formats to support a total of 26 different fax devices. It now supports 35 PostScript fonts, up from 13 originally. When run from within a DOS program, it requires only 5K RAM until activated. $199, *Hijaak* 2.1; $695, *Hijaak ColorSep* 2.1; $349, *Hijaak PS* 2.1. *Inset Systems Inc., 71 Commerce Dr., Brookfield, CT 06804-3405; tel.: 203-740-2400; fax: 203-775-5634.*

Circle (3) on Reply Card

Inexpensive Microcontrollers

Parallax's PIC16C5x series of microcontrollers are inexpensive eight-bit CMOS devices that combine EPROM technology and fast CPU. Some notable features of the PIC family are bit and byte addressing for all I/O pins and registers, 18- and 28-pin packages, 12 or 20 tri-state I/O lines, 512- to 2,048-word EPROM, 3 μA sleep mode and dc to 8-MHz clock. Parallax has a comprehensive set of PC-based tools for the PIC16C5x family, including an assembler, programmer and emulator. $3 and up per unit. *Parallax, 6200 Desimone Lane No. 69A, Citrus Heights, CA 95621; tel.: 916-721-8217; fax: 916-726-1905.*



Circle (4) on Reply Card

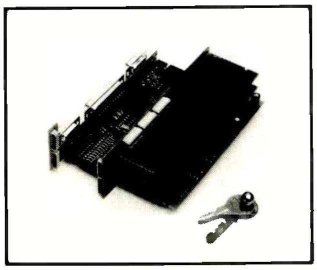
486SX Home/Office Computer

The Magnavox HeadStart 486SX computer features a 20-MHz Intel 80486SX processor, 2M of RAM (expandable to 8M), three drive bays (two external), three 16-bit expansion slots, 80M hard disk, 1.2M and 1.44M floppies, super-VGA with 256K video RAM, three-button mouse and 145-watt power supply. Bundled software pre-installed on the hard disk include *Windows* 3.0, MS-DOS 5.0 and *Q-BASIC*. $2,499. *Philips Consumer Electronics Co., One Philips Dr., Knoxville, TN 37914-1810. tel.: 800-722-6224.*

Circle (5) on Reply Card

Ultra-Small 386SX Board

Dover Electronics Manufacturing West has a new ultra-small 386SX motherboard dubbed the Smart SIM CPU Card that measures only 5.2″ × 2″ × 1.7″. The cards include a 386SX processor, on-board VGA that supports either LCD or standard monitors, integral power supply, IDE/floppy controllers, 2M to 16M of RAM, one serial and two parallel ports and keyboard and mouse controller boards. An evaluation kit is available for $1,995. *Dover Electronics, P.O. Box 1532, Longmont, CO 80502; tel.: 303-772-0354; Fax: 303-772-3697.*



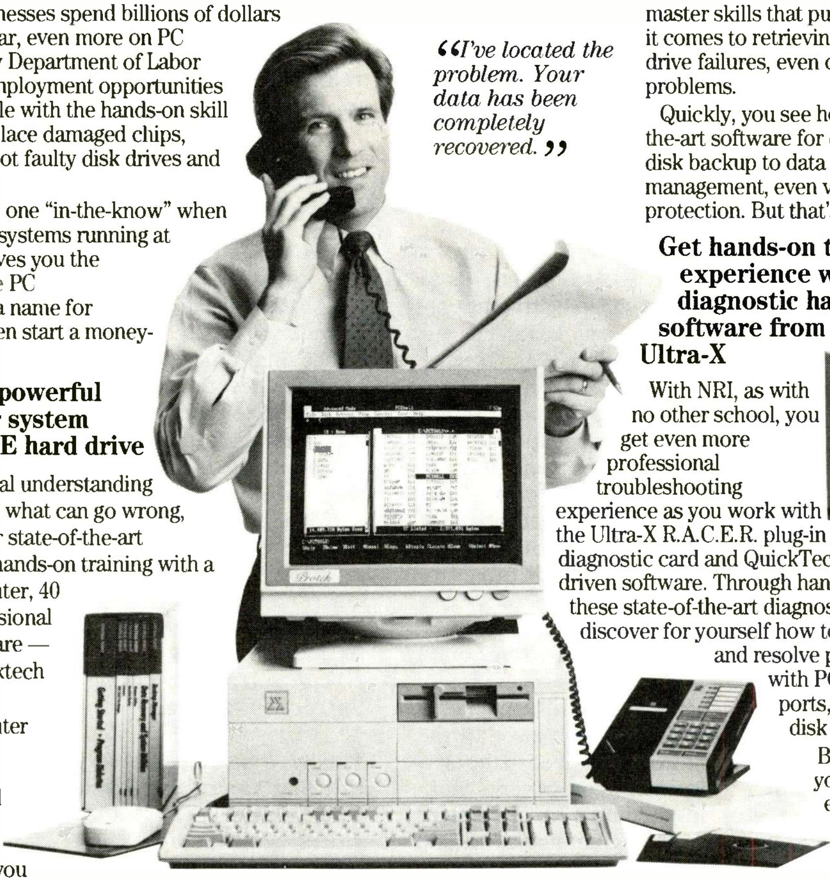
Circle (6) on Reply Card

Includes AT-compatible computer plus diagnostic hardware and software!

Earn good money full-time, part-time, on the job, or in a new career as a PC Troubleshooter!

There's no doubt about it: Businesses spend billions of dollars on personal computers each year, even more on PC service and support. That's why Department of Labor Statistics show skyrocketing employment opportunities for PC troubleshooters — people with the hands-on skill to diagnose system failures, replace damaged chips, retrieve lost data, or troubleshoot faulty disk drives and circuit boards.

Now with NRI, you can be the one "in-the-know" when it comes to keeping today's PC systems running at peak performance. Only NRI gives you the computer, the software, and the PC troubleshooting skills to make a name for yourself in your present job, even start a money-making new career.



"I've located the problem. Your data has been completely recovered."

Your training includes a powerful AT-compatible computer system complete with 40 meg IDE hard drive

NRI training gives you a practical understanding of today's PCs...how they work, what can go wrong, and why. Best of all, you master state-of-the-art troubleshooting skills through hands-on training with a powerful AT-compatible computer, 40 meg IDE hard drive, and professional diagnostic hardware and software — PC Tools, R.A.C.E.R., and Quicktech — all yours to keep!

As you work with your computer and software, you learn how to localize PC problems, identify faulty components, recommend system configurations, and replace the damaged parts that cause PC system failures. Plus you get hands-on experience with the diagnostic tools used by the pros to keep systems up and running in today's PC-driven business world.

No previous experience necessary — only NRI gives you everything you need to succeed

NRI's step-by-step lessons and unique hands-on Discovery Learning projects prepare you completely for the real-world challenges of PC troubleshooting. Backed by the full support of your personal NRI instructor, you begin by covering important computer fundamentals — hardware and software essentials, system configurations, plus methods and procedures that show you how to localize PC problems to specific circuit boards or replaceable parts.

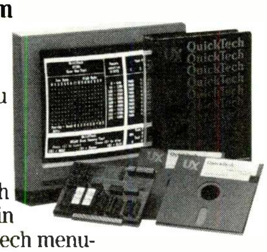
Then you move on to master vital PC system commands, using the MS-DOS software included in your course. You learn to resolve user error messages that commonly occur when working with spreadsheets, databases, word processors, and other PC applications. Then you take your skills further, discovering how to use DEBUG and assembly language programming to troubleshoot problems in PC operating systems and hardware. But that's not all...

Train with and keep today's top diagnostic and utilities software — PC Tools

With NRI training you get first-hand experience with professional diagnostic software that makes troubleshooting PCs easy and profitable. Using PC Tools — today's top utilities software package — you master skills that put you in command when it comes to retrieving lost data, handling disk drive failures, even correcting installation problems.

Quickly, you see how to use this state-of-the-art software for everything from hard disk backup to data recovery, disk and file management, even virus and memory loss protection. But that's still not all...

Get hands-on troubleshooting experience with in-demand diagnostic hardware and software from Ultra-X



With NRI, as with no other school, you get even more professional troubleshooting experience as you work with the Ultra-X R.A.C.E.R. plug-in diagnostic card and QuickTech menu-driven software. Through hands-on training with these state-of-the-art diagnostic tools, you actually discover for yourself how to test the system RAM and resolve problems that can occur with PC motherboards, parallel ports, video adapters, floppy disk drives, and more.

By the time you complete your course, you have every basic skill you need to diagnose PC system problems fast, efficiently, and economically. Plus you have the computer, the software, and the hands-on experience you need to start making money immediately as an NRI-trained PC troubleshooter.

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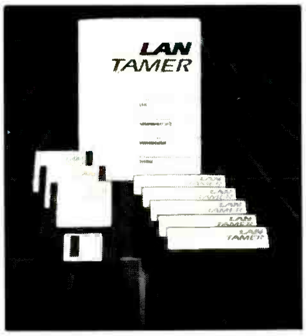
LAN Assistant

SoftShell's *LAN Tamer* is an alternative to batch-based menu systems for LAN administration. It runs on Novell NetWare and other major network operating systems with DOS-based workstations. The supervisor can set up, administer and test any user's menu from any workstation. *LAN Tamer* automatically installs the most popular application programs



in the appropriate menu category. It's compatible with virtually all application programs. The menu editor permits additions, deletions, modifications and rearrangement of menu items for individual users and workgroups. Access to the DOS prompt can be individually restricted. Administrators can quickly and easily personalize the application library and help system.

LAN Tamer runs in high memory, using no RAM in the 0 to 640K DOS area. Users can temporarily leave a program and enter another with a single keystroke. Transparent security features protect data from accidental erasure or modification. $995. *SoftShell, 1163 Triton Dr., Foster City, CA 94404; tel.: 415-571-9000.*

Circle (7) on Reply Card

More DOS 5 Books

PCM Gold PC Magazine DOS 5 Techniques And Utilities
By Jeff Prosise.
(Ziff-Davis Press. Soft cover. Utility programs on two 5 ¼" disks. 1,012 pages. $39.95.)

In its short life, DOS 5 has spawned enough books to wipe out a rainforest. Of all the books on the new incarnation of DOS, this one may very well be the best and most usable. Prosise has produced some of the best of *PC Magazine*'s utilities. In addition to programming skill, he's a writer's writer. Both talents are apparent in abundance in this book, which is divided into three parts.

Part I, "Using DOS," covers in detail the various functions of DOS. He has succeeded in making the obligatory "history of DOS" section interesting (no small feat). Chapter two covers configuring the system, essentially CONFIG.SYS and AUTOEXEC.BAT. The third chapter deals with memory management, particularly how to use 386/486-specific features of DOS 5 to squeeze the most out of a system. Disk and file management are the focus of chapters four and five. Chapter six deals with the human interface factor (screens, keyboards and printers). Using DOSKEY on the command line and redirection and piping round out the first part.

Part II deals with programming topics, but you may be surprised to find that it's as easy to understand as the portion on using DOS. The author is so skillful as a teacher and writer that he has introduced "programming thinking" in each chapter in such a way that the reader feels it's simple, straightforward and easy. Scattered throughout the five chapters of Part II are numerous sample programs with instructions on assembling them with either DEBUG (short programs only) or an assembler.

Two 360K disks included with the book have all the utilities described in the text, including source code, making it simple to experiment with programming. The final chapter in Part II covers TSRs, with sample programs for a work logger and a phone dialer. Most of the utilities are new for the book and have not appeared in *PC Magazine*. My favorite is "NUKE," which erases a directory and any files or subdirectories it may contain.

Part III covers the DOS 5 shell and QBASIC. Prosise provides a very balanced view of the merits and shortcomings of the DOS 5 shell without getting tangled in the debate over the value of shells in general. The chapter on QBASIC is a gem. Also demonstrated is how to make the most of this new BASIC interpreter, with emphasis on converting GW-BASIC and BASICA programs to the new environment. He shows how to develop a program in QBASIC and then compile it in Quick BASIC.

The final 200 pages of the book are devoted to a DOS command reference, device driver reference and reference for the utilities included with the book.

If you buy only one book on DOS 5, get this one.

DOS 5 Demystified
By James S Forney
(Windcrest/McGraw-Hill. Soft cover. 420 pages. $24.95.)

Finally, a book with a sexy title that accurately reflects what's inside! The author writes with authority on DOS, but it's authority tempered with whimsy. This results in a book that's both informative and entertaining. Rather than start off with some silly "history of DOS" as many authors are wont to do, Forney commences with a detailed discussion of what DOS is and how it functions. He keeps information and terminology at a level that a non-programmer can easily follow, though. You won't find layer after layer of jargon and double-talk.

After telling the reader what the hidden files and command interpreter do, he covers installing DOS 5. It's clear and concise, and he has several useful tips obviously culled from personal experience. The user is then led through properly configuring DOS and making intelligent use of its environment. Another part of the book covers productivity and is broken up into chapters on help, batch files, DOSKEY macros and memory management. Another section covers disk management, with chapters on the way disks are organized, directories (the new DIR options), file copying, disk disasters and more. A chapter on copying is particularly informative, revealing that this old standby command is more powerful than most users suspect.

Another section covers the DOS shell, EDLIN versus EDIT, *QBASIC* and DEBUG. Forney states that he even wrote a portion of the chapter on EDIT with EDIT and then merged the file into his word-processor file—something few would be so foolish to attempt with EDLIN. The final part of the book (about half the total number of pages) is devoted to an alphabetical listing of the DOS commands, with a description and examples of each.

If you aren't yet in the power-user category and you aren't a DOS programmer, this book is for you. There's a wealth of information, with writing so lucid and "user-friendly" that a beginner could make good use of the book, too. Highly recommended.

Analog Daughterboard

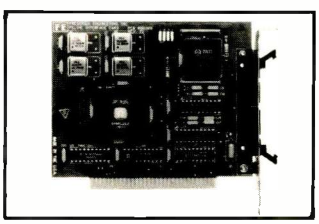
The Allen Systems AC-332 is an analog daughterboard that provides A/D and D/A capability for the CP-332 single-board computer built around the new Motorola 68332. Resources include an auto-calibrating four-channel 12-bit A/D converter and dual monolithic 12-bit multiplying D/A converter. A dual monolithic CMOS ADC7802 converter chip is configured for auto-calibrating and internal sample/hold with an 8.5-μs conversion time. Circuitry for each analog input can be configured as either low- or high-source impedance.

In the default configuration, the board's +5-volt analog supply line is tied to the ADC-7802 V_{ref+} input. Optionally, an AD586 can be selected to provide the reference voltage. The AC-332 measures 4.5″ × 5.5″ and attaches to the CP-332 via a 40-pin header. Power needs are +5, −5, +12 and −12 volts. $375. *Allen Systems, 2346 Brandon Rd., Columbus, OH 43221; tel.: 614-488-7122.*

Circle (8) on Reply Card

Dataline Monitor

Frederick Engineering's new Feline Plus is a PC-based dataline monitor and protocol analyzer offering 64K performance on a half-size card. Feline Plus offers the same user-



friendly interface software as other Feline products sport. It's compatible with all existing Feline Interface Pods for RS-232, V.35, Mil-188, ISDN T1 and CEPT. $1,495. *Frederick Engineering, Inc., 10200 Old Columbia Rd., Columbia, MD 21046; tel.: 301-290-9000; Fax: 301-381-7180.*

Circle (9) on Reply Card

Windows Monitor And Manager

Merasoft's *E'vent Manager* is a *Windows* utility that monitors events, executes commands and is a fully programmable task automatizer. The program monitors over 180 unique events and an unlimited number of combinations of events. A user can execute tasks while the computer is otherwise inactive. Among the items monitored are keystrokes, mouse clicks, number of open applications, number of open windows, date and time. *E'vent Manager* executes commands only when all specified conditions have been met, sends commands to one application or several and executes commands globally or specifically, depending on programming. An intuitive list-based interface allows for true "point-and-click" programming. *E'vent Manager* "learns" which events to monitor, which commands to execute and where a command should be sent via a full-feature recording and playback capability. All recordings are fully editable, even the mouse movements. $180. *Merasoft Corp., 384 E. 720S., Suite 204, P.O. Box 1918, Orem, UT 84059-1918; tel.: 801-225-9951; Fax: 802-225-9984.*

Circle (10) on Reply Card

Aqua Royal

ProGold 100 from Caig Laboratories is a gold conditioner and protector formulated to protect gold surfaces, base metals and other precious metals; reduce intermittent connection failures; reduce wear and abrasion; and provide a protective coating on connector contact surfaces. It enhances conductivity characteristics to efficiently transmit electrical signals. ProGold 100

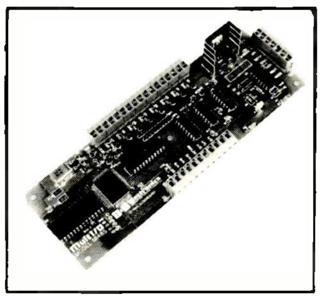
also coats the entire connector surface and reportedly provides superior protection from abrasion (insertion resistance), wear and atmospheric contamination. Pre-treating with ProGold 100 is claimed to reduce intermittent contact problems and increase reliability.

ProGold 100 is available in spray, liquid, precision dispenser wipes and pen applicators. $18, spray can. *Caig Laboratories, Inc., 16744 W. Bernardo Dr., Rancho Bernardo, CA 92127; tel.: 619-451-1799; fax: 619-451-2799.*

Circle (11) on Reply Card

Multiple-Device Control Card

MULTI/O from B&B Electronics has eight digital user-defined I/O lines, two eight-

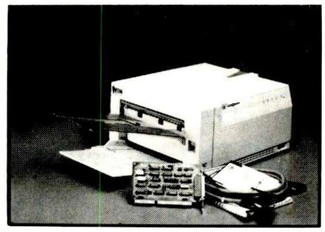


bit A/D channels and two eight-bit D/A channels. Up to 32 MULTI/O modules can be connected on a single RS-485 multi-drop line. The communications protocol is compatible with several other manufacturers of RS-485 multi-drop control modules. PC compatible communications and control software to set up module parameters is provided. Module control parameters are stored in EEPROM on each module. The board measures 8″ × 2.75″ and requires 10 to 30 volts dc for proper operation. $175 for board; $15 for MIPS3 power supply. *B&B Electronics Mfg. Co., 4000 Baker Rd., P.O. Box 1040, Ottawa, IL 61350; tel.: 815-434-0846.*

Circle (12) on Reply Card

Laser Printer For *Windows*

LaserMaster, long-time leader in the ultra-high-resolution laser printer market, now offers the WinPrinter 400. This is the first printer expressly designed for the *Windows* en-



vironment. WinPrinter 400 includes a LaserMaster Windows direct driver to optimize *Windows* printing as well as PostScript and PCL emulations. The printer provides 400 × 400-dpi output in 8.5″ × 11″ format at up to four printed pages per minute. Fifty Type-1 typefaces selected from URW, ITC and Digital Typeface Corp. are packaged with the unit. It also works with Adobe Type 1 and Type 3 typefaces, as well as PCL soft fonts. $1,995. *LaserMaster Corp., 6900 Shady Oak Rd., Eden Prairie, MN 55344; tel.: 612-944-9457; Fax: 612-943-3469.*

Circle (13) on Reply Card

Data Acquisition

BSOFT's new ANA100 is a low-cost, high-performance analog I/O plug-in board for IBM/compatible computers. Single-channel conversion speeds as fast as 2.5 μs are possible with the eight-bit A/D flash converter. It features a single-channel analog output, eight-bit D/A converter and 14 TTL digital I/O lines. The D/A analog output channel is jumper selectable for 2.5-, 5- or 10-volt output, full-scale. A disk of sample programs ships with the board. $99. *BSOFT Engineering, 444 Colton Rd., Columbus, OH 43207; tel.: 614-491-0832; fax: 614-497-9971.*

Circle (14) on Reply Card

Application By Tom Benford

Desktop Video

Part 1

Manipulating, combining and editing images, including computer video to TV video, video overlays, recording computer graphics and animation on videotape and PC-controlled VCR editing

Two NEC PC-VCRs interfaced to a 386 computer afford the ultimate in computer-controlled editing and scene transfer.

Loosely defined, desktop video means producing video (taped or live action) using a personal computer in some capacity for creating, editing, controlling, combining or manipulating some elements of the production. This blanket definition covers a lot of ground, but so does desktop video.

I first got involved with "desktop video" in 1983. Using a Commodore 64 computer and Hybrid 8 Special Effects Generator, I embellished my home videos with titles and simple graphics. Since the C-64 produced a composite output video signal, it was simple to "export" my computer graphics to a VCR using a simple cable terminated in phono plugs.

Because the Hybrid 8 SEG also supported composite video for input as well as output, it was a straightforward matter to connect a live video camera or VCR as source device A and the C-64 as source device B. I used the Hybrid 8 to handle wipe/fade transitions between sources to the output VCR (destination device C), which recorded the whole thing. While this setup wasn't fancy or very sophisticated, it was light-years ahead of paltry single-font title generators and magnetic and stick-on title lettering other home videophiles were using.

There were shortcomings, of course: 40-column width, poor resolution and limited colors. But times have changed considerably since then.

Unlike the venerable Commodore 64 and Apple II series computers that generated a composite video signal, IBM-compatible PCs support graphics that generate discrete RGB (red, green, blue) signals to achieve lifelike color palettes and image definition. A compatibility problem arises because RGB and composite (NTSC) signals are vastly different. This stems from their origins. TV displays are designed to show video and real-life images in motion, whereas computer displays show (primarily) still images of computer data with crisp detail. Since the two are incompatible, hardware that can bridge the gap between them is needed for desktop video to work.

VGA or super-VGA graphics is the way to go today. Unlike digital (TTL) graphics devices, like an EGA board, the input is analog, which then requires conversion to digital. This voltage-level-driven technique generates more colors and provides better resolution than the earlier EGA design.

The best bridging device is the video/overlay board—a combination super-VGA card and composite image output card. With one of these devices, you can overlay computer images and text over live and recorded video. You can also output computer animation or presentations directly to a VCR or TV monitor. In this installment, we'll be taking a look at three video/overlay cards and a high-end VCR that interface through the PC's serial ports for computer-controlled scene editing. We begin with a brief technical discussion of what's involved in converting PC video output to NTSC-compatible video. Understanding the elements of NTSC video is a good place to start.

NTSC

This is the North American video standard. NTSC is short for National Television Standards Committee. All video gear used in North America conforms to the specification set forth in the RS-170A standard. The NTSC spec ensures that TV receivers, video cameras, laserdisc players, camcorders and other video components are compatible with each other. European and Asian countries use other standards (PAL and SECAM) that aren't compatible with NTSC.

The NTSC specification was first originated and adopted for black-and-white imaging. An NTSC signal consists of 30 frames per second, each frame being composed of 525 horizontal scan lines. An interlaced signal format is used to broadcast image information efficiently. This simply means that the odd lines of a frame are displayed first, followed by display of the even lines.

The above is accomplished by the electron beam starting at the top line (line 1) on the screen and drawing image data from left to right. The beam shuts off when it reaches the right side, skips line 2, positions itself at the left corner and again starts drawing from left to right on line 3. The process is repeated all the way to the bottom of the screen, skipping each even line along the way, in a process called horizontal blanking.

When all odd lines have been drawn, the beam shuts off and goes back to the top of the screen, in a process called vertical blanking. The beam then turns on and starts drawing at the left edge of line 2, proceeding all the way to the right margin, shutting off and skipping line 3. All odd lines are skipped on this pass, where all even lines are drawn. Regardless of whether it's odd or even, every line is composed of pixels (short for picture elements).

Interlacing of odd and even lines separates each frame into odd and even fields. Each field takes $\frac{1}{60}$ second to appear, resulting in 30 complete frames per second.

In addition to horizontal and vertical placement, each pixel in an image must also convey a light/dark value to represent white, black or any of the myriad shades of gray between them. The light/dark value a are referred to as luminance and are governed by the amplitude of the electron beam. Full amplitude results in white, zero amplitude yields black, and any values between produce specific shades of gray. Conveying color-image information is more complex. In addition to luminance information color (chrominance or chroma) data must also be presented.

The three primary colors—red, green and blue (abbreviated RGB)—can produce any color when combined in varying combinations. A separate dedicated electron gun for each primary color is used to energize the red, green and blue phosphors that make up each pixel to create all the colors of the spectrum. NTSC pixels are rectangular (taller than they are wide) and have an aspect ratio of 0.86:1.

Chroma is a sine-wave signal whose phase determines actual color. Amplitude or saturation determines the amount of the color added to the luma information. By varying luminance and chroma information, it's possible to produce millions of variations of the same basic colors. For example, fire-engine red has lots of luma with lots of chroma, but pastel pink has lots of luma with little chroma.

Synchronization is necessary for all three elements to combine and work together properly. Each signal is synchronized to produce vertical sync, horizontal sync and color sync, all within the prescribed tolerances of NTSC specifications.

NTSC video is an analog signal. Sync, luminance and chrominance are all actualized through a continuous analog waveform with a range of 1-volt peak-to-peak into 75 ohms, and the IRE is the unit of measurement associated with it. The standard range corresponding to 1 volt is 140 IRE (−40 to +100). According to the NTSC spec, −40 IRE represents the sync pulse, 0 IRE represents horizontal blanking and luminance is represented between the ranges of 7.5 IRE (black) to 100 IRE (white).

NTSC video is also overscanned, which essentially means that the picture scans onto the screen beyond the screen's visible horizontal and vertical boundaries. The reason for overscan is that since the ratio of visible screen area varies from one TV receiver or monitor to another, it compensates for "wraparound" on the picture tube. A "safe titling area" is designated to ensure that text restricted to this area will be completely displayable regardless of the receiver or monitor used to view it.

Computer Video

Computer video is totally unlike NTSC video in three major respects. (1) All pixel information, including color values, is digitally represented by designated data bits for each red, green and blue component, as opposed to regulating chroma via amplitude. (2) Computer monitors are usually noninterlaced, and the horizontal and vertical sync rates are different from those used in NTSC video. Finally, (3) RGB computer displays aren't overscanned; the display area is rigidly confined to 640 × 480 (or 1,024 × 768) pixels, bordered by black on all four sides.

These three major differences immediately pose problems in making image interchanges. Pixel sizes are different as well, which affects how pictures are displayed. Since computer RGB displays have square pixels with 1:1 ratios, images that appear correct on a computer display will appear distorted (stretched vertically) on an NTSC device, and vice-versa.

Bridging devices that can compensate and convert between NTSC and computer RGB video in either direction are required to produce any kind of meaningful desktop video. In addition to handling format differences between composite and RGB, these devices also provide genlock and time-base correction circuitry to correct and adjust signal phases between two devices. Genlock slaves the sync signal on one video device to the sync of another master device. Timebase correctors compensate for timing deviations caused by slack or stretching of the video tape to restore sync signals to NTSC standard specifications.

Overlay Process

A video/overlay board converts the digital signal of the computer's VGA (or super-VGA) screen into an interlaced analog NTSC signal. An input source from a video camera, VCR or other device is processed by the board and the now-interlaced computer graphic is genlocked to the input video source. A color is selected from the background of the computer graphic and is replaced by the synchronized input video signal.

VGA graphics that aren't of the selected background color appear in the foreground, while the input video signal resides in the background. The result is the computer graphics overlaid on the input video in a combined signal can be displayed and recorded on an NTSC device. The process sounds deceptively simple, considering what's actually required to accomplish it.

A video/overlay board can also be used to transfer computer-generated images or animation to videotape or display on a TV monitor. In these applications, no composite video exists on which to overlay. The computer graphics are converted into composite signals and fed to a VCR or TV monitor via the video output port.

Three of the leading video/overlay boards available for PCs are the Truevision VideoVGA, the Everex Vision VGA w/Overlay and Willow Peripherals' VGA-TV GE/O. Let's take a closer look at each.

Video Overlay Boards

Truevision VideoVGA, $995 with 256K RAM, $1,195 1M RAM
Truevision, Inc.
7340 Shadeland Station
Indianapolis, IN 46256
Tel.: 1-800-858-TRUE

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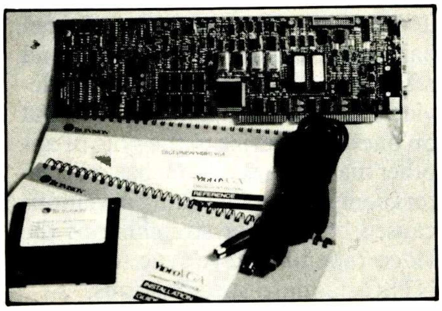

Truevision Video VGA board with break-out cable, software and manuals.

Truevision's Video VGA is a densely-populated full-length board that's available in 512K and 1M RAM versions. I used the 1M version and I was very impressed with its overall performance.

Sporting a Tseng 4000-series chipset, this high-end Super VGA card supports 1,024 × 768 resolution in numerous modes when connected to a multisync monitor. As you might expect, it also supports all standard display modes, including MDA, CGA, MCGA, EGA, VGA, Super-VGA and Extended-VGA, and can be used with any software that supports these modes.

The board's mounting bracket is loaded with I/O jacks, including a six-pin DIN connector for S-Video input and output, using the supplied break-out cable. Two phono jacks for composite video input and output are also provided, as is a 15-pin D-connector to accommodate the computer's VGA monitor. The board mounts in any 8- or 16-bit slot in a PC and automatically switches between 8- and 16-bit data-transfer rates, depending on slot location.

Installing the VideoVGA is the essence of simplicity from a hardware standpoint. Since there are no jumpers or DIP switches to set, all that's needed for installation is plugging it into any available full-length expansion slot and securing it in place, attaching the computer monitor cable and cables to composite video input and composite video output sources to complete hardware installation.

The entire installation process for both hardware and software is covered in excellent detail in the VideoVGA Installation Guide. This 50-page manual is exceptionally well-written and full of helpful diagrams that illustrate numerous equipment configurations for both composite and S-video gear. In addition to the great technical information it provides, the Installation Guide also explains the process of converting computer video to TV video and gives excellent information on various video modes and VGA color values.

A second, slightly thinner, VideoVGA Reference Guide provides supplemental information on video-conversion and overlay processes and tells how to use the supplied software programs. Chapter 3, devoted to basic video concepts and planning your video, is especially helpful. Key topics like overlaying, recording animations and CAD packages and adding sound to recordings are covered in easy-to-understand terms.

While the VideoVGA functions wonderfully as a high-end super-VGA-capable video card right out of the box, it doesn't do any of its video magic unless control software is loaded. This software is provided on both 5¼" and 3½" diskettes, which contain several programs.

The main program that activates the board is the TSR (Terminate Stay Resident) VGATSR.EXE utility that has three principle functions. It toggles on and off recordable VGA, toggles on and off the overlay feature and selects a "key" color to perform a video overlay. The key is the computer video color, which becomes "transparent" to allow the composite-video to show through in the overlay process. If no key color is selected, the default key is black (color 0).

VGATSR can be loaded manually prior to starting a video session, or can be incorporate into an AUTOEXEC.BAT file for automatic loading whenever you boot your computer. Since it doesn't require much memory (less than 10K), including it in your AUTOEXEC.BAT file is a good idea if you'll be doing lots of video work so that it's always loaded and ready for use.

VGATSR's three main functions are accessed by hot-key combinations using the F8, F9 and F10 keys in conjunction with the Shift and Ctrl keys. The TSR approach makes these vital functions for overlaying constantly available, even from within other applications.

Shift-Ctrl-F10 places on-screen a cursor you use for selecting a key color. Moving to any desired screen location and pressing a mouse key selects the screen background color for that particular pixel as the key color. Shift-Ctrl-F9 turns on and off the overlay feature to make it active only when you wish it to be. Shift-Ctrl-F8 turns on and off the ability to record. Using these hot-keys in combination can produce the following results:

The F8 keystroke combination is always required at least once during a video session. This is necessary because the VideoVGA boots up with the ability to record disabled and in default video Mode 3 (80 × 25 color text), which is a non-recordable mode for the card. Other modes available but not recordable with this card are Mode 30 (800 × 600 × 16 colors), Mode 37 (1,024 × 768 × 16 colors) and Mode 38 (1,024 × 768 × 256 colors; 1M of on-card RAM is required).

Additional modes that can't be recorded are: Mode 22 (132 × 44 text × 16 colors), Mode 23 (132 × 25 text × 16 colors) and Mode 24 (132 × 28 text × 16 colors). These are beyond the capabilities of NTSC devices to resolve.

Tseng Labs' (whose chip set is on the card) VMODE.COM, supplied on-disk, is used to set the card's video mode. Keying in VMODE at the system prompt produces a mode-selection menu that lists all available video modes for your monitor type. Typing VMODE ? displays a table that lists available text and graphics modes. Entering VMODE # (# is the appropriate number of the desired mode from the displayed

Table 1. Truevision VideoVGA Hot-Key Combinations

F8	F9	Display on NTSC Monitor
On	On	Recordable (VGA overlay)
Off	Off	No output to NTSC
On	Off	Recordable (VGA only)

table) selects and locks in that mode. Additional VMODE commands are also available for mode setting and are entered directly at the command line.

VMAIN.COM is the disk-based version of the VideoVGA PROM functions that set the board for the various modes. Though it runs faster than the ROM-based version because it runs in RAM, the trade-off is that it requires some RAM and, thus, reduces the amount of RAM for use by other applications. The utility is executed by typing VMAIN at the DOS prompt, which sets all video modes and attributes back to their default boot status, disabling all composite video output functions. I didn't find execution speed to be a problem; so I opted to keep all of my RAM available and wait an extra nanosecond or two if necessary.

An assortment of video drivers is also provided on the disks. They include dedicated drivers for Microsoft *Windows* 3.0, AutoDesk *AutoCAD*, Lotus *1-2-3*, Xerox *Ventura Publisher, WordPerfect, WordStar* and 8514/A Emulation. Complete instructions are provided for installing and configuring these drivers to work with their respective applications.

An EANSI.SYS device driver, an enhanced version of the ANSI file that supports the extended screen modes of VideoVGA, is also provided. The line DEVICE = EANSI.SYS is added to the CONFIG.SYS file to install this enhanced driver. Any existing ANSI.SYS driver line should be removed.

A Custom Font Loader/Editor supplied with the software permits changing the character set of the fonts displayed on-screen. For example, the letter "A" could be displayed or !!, which could be useful for scientific, mathematical and foreign-language applications.

FEDIT.COM is the font editor program used to create new fonts or modify existing ones. A Help option on FEDIT's main menu functions as an on-line user guide and provides detailed information on using the program.

FLOAD.COM, the font loader program, retrieves a selected font from disk and loads it into video memory. One at a time, you can store up to four fonts in video memory, with any one selected for display. Typing FLOAD with no parameters displays detailed usage information for the program.

Conclusion: VGATSR and VMODE are the real meat-and-potatoes as far as operational software goes for the VideoVGA board, and using the TSR hotkeys quickly became second nature. The card performed flawlessly and produces truly great overlays, as well as recordable VGA. Everything about Truevision's VideoVGA is top quality . . . using the product is a pleasure.

Everex Vision EV-626 VGA with Overlay, $855 with 512K RAM, $895 with 1M RAM
Everex Systems, Inc.
48431 Milmont Dr.
Fremont, CA 94538
Tel.: 415-683-2100
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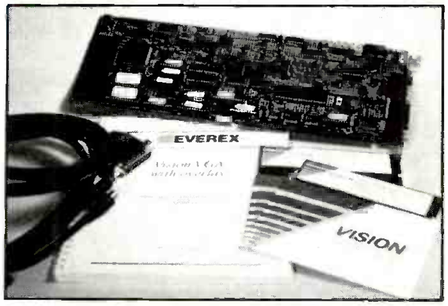
Another full-length board chock-full of components, Everex's Vision VGA with Overlay differs in some areas while sharing common ground in others with Truevision's VideoVGA board. Similarities are principally that the Everex board also uses



Everex Vision VGA with Overlay with software, documentation and cable.

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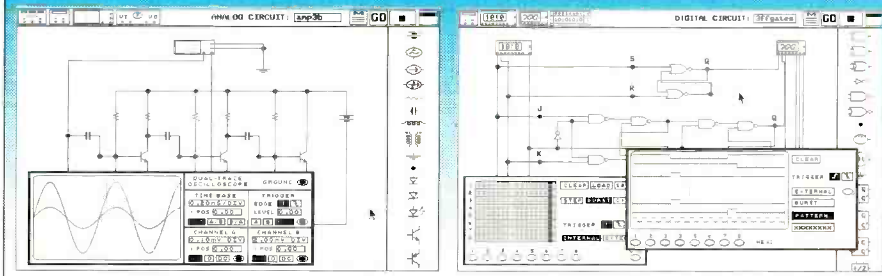

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Update on VideoLinx

In Part 1 of "PC Image Acquisition" (December 1991), I mentioned that the VideoLinx: Framebuffer was more than just a capture board. While it doesn't have image overlay or motion video capabilities, it can output captured "stills" and static computer graphics to composite video sources. In addition to "grabbing" a video image, it permits manipulation of the image and output to NTSC video. It's sort of a hybrid product that blends the features of an image grabber with those of a video board.

a Tseng-labs 4000-series video chip set and that it's a superb super-VGA video unit. Like its Truevision counterpart, the Everex Vision VGA with Overlay has automatic bus detection that senses whether it's in 8- or 16-bit slot and sets the data transfer rate accordingly. It, too, is available in 512K or 1M RAM versions. I worked with the 1M version and found it to be excellent and a great tool for output of computer video or overlaying to NTSC devices.

Unlike Truevision, which is entirely configured through software, the Everex Vision VGA with Overlay offers several options that can be configured physically on the board. It's outfitted with an eight-position DIP switch for selecting the monitor type with which it's used.

Depending on the monitor type selected through DIP-switch settings, only compatible video resolutions are displayed, a good feature to have so that mode options are preselected to match a monitor's capabilities. Available monitor types that can be switch set include super multi-frequency (default setting), multi-frequency, super-VGA, IBM PS/2 and 8514.

Other settings controlled through the DIP switch are for enabling/disabling the automatic 8/16-bit bus-detect feature for both RAM and ROM and setting on and off the input video termination.

In addition to the DIP switch, seven locations on the board can be jumper selected to open or close circuits. Their designations are summarized in Table 2. Some of these features (JP1, JP5 and JP7) are for tweaking the "studio-performance mode" to produce pristine broadcast-quality video output but don't require setting changes for normal desktop video applications.

The manual advises jumpers to be left as supplied unless one is extremely familiar with NTSC video standards since adjustments to the board's potentiometers may also be required. I heeded this warning and left all jumper settings in their factory-set conditions and changed only DIP-switch settings to match my multi-frequency VGA color monitor. Everything performed without a hitch.

All settings for both DIP switch and jumpers are clearly explained and abundantly illustrated in the excellent 130-page owner's manual/reference guide. Documentation is first-rate and includes detailed information on all board features. It has sections on programming, drivers and troubleshooting as well.

The backplane bracket of the Vision VGA with Overlay contains only a 15-pin D-type connector for the VGA monitor and a 25-pin D-type connector for handling video in and out. A supplied breakout cable attaches to the 25-pin port. It splits into a Y and has dual terminations at each branch of the Y. One branch is color coded with red plugs that designate video input; the other has black plugs that signify video output. Each branch is terminated with phono jacks (for composite video) and four-pin DIN connectors (for S-video devices).

After installation in a computer and connecting to it a video monitor, the board functions as a normal super-VGA card. If composite video sources (input and output) are connected to the card and turned on, the card is "transparent" in that it lets the input travel right through it to the output device as if the card isn't there. No computer video output or overlay functions are enabled without loading the board's application software.

The software comes on two 5¼" disk-

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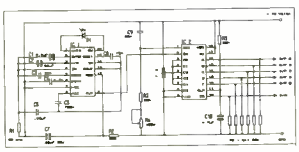
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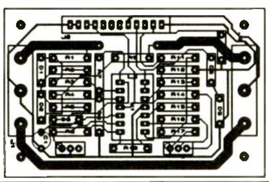

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Table 2. Everex Vision VGA Jumper Settings

Jumper	Function	Use
JP1	Horizontal drive select	Selects HDrive2 (Normal)
JP2	Factory use only	Function unknown
JP3	IRQ2 enable/disable	Disables IRQ2
JP4	Factory use only	Function unknown
JP5	Force genlock mode	Selects normal/studio mode
JP6	Factory use only	Function unknown
JP7	Sync on green	Enables/disables sync on green signal

ettes and consists of several programs, utilities and numerous software drivers. Like the Truevision board, TSR and mode-selection programs control enabling of the essential functions and features. Overall, the Everex software is a bit more awkward to use than that of the Truevision package. However, it provides more operating options and setting latitude, which offset this small hardship.

The main programs provided in the software package are as follows:

VTMODE—permits switching between different text and graphics modes other than those selected by the DIP switches. VTMODE is menu-driven and can also be run from the command line by typing VTMODE, followed by an appropriate argument. Any operational changes made with VTMODE are only temporary; the board is reset to the permanent DIP-switch selections anytime the PC is cold-booted (warm booting with CTRL-ALT-DEL doesn't reset the settings). In addition to setting video mode, it's possible to turn on and off the composite video output, enable and disable the flicker filter and turn on and off the underscan (on forces composite video output to fit within the displayable area of the screen horizontally).

VTRAM.COM—runs the Vision VGA's video BIOS in high-speed system memory, which enables many programs to run faster. It also provides support for the VESA SuperVGA BIOS extension. It must be installed if you wish to use software compatible with the VESA extension. As with the Truevision, I didn't find any appreciable difference in throughput speed; so I used the PROM-based BIOS on the card, rather than loading and running it from user RAM.

HELP.EXE—a quick on-line reference utility, can be invoked from the command line with either a "?" or an argument as a suffix. Entering a question mark as an argument lists all help modules available; entering the helpfile module desired after the command displays help for that particular subject. While not as intuitive as Truevision's help scheme, it's useful and provides quick reference without having to use the manual.

626INIT.EXE—must be loaded into memory before any of the genlocking features (overlay or video output) can be used. The necessary BIOS extensions are loaded into memory and this program can also be invoked from the AUTOEXEC.BAT file to automatically load upon booting for convenience if you'll be doing lots of desktop video work.

626UTIL.EXE—turns on and off genlock, toggles the flicker filter and toggles overlay colors for modes of 16 colors or less. It also permits adjustment of contrast, brightness, saturation and hue for the incoming video signal. A mouse is used to adjust and lock in the desired settings from a menu screen. Sliders are represented for contrast, brightness, saturation and hue settings. Moving the slider "lever" to the left and right decreases and increases, respectively, the level.

A toggle "button" is provided for turning on and off the flicker filter, and couple of lines of sample text are provided to display the effect of the filter setting. Another toggle button is provided on the menu screen for turning on and off genlock. A 16-color palette is also provided for selecting the overlay key color. All settings are updated when this program is exited and they become the default settings until reset again at some future time.

626TSR.EXE—is used to turn on and off genlock, toggle the flicker filter or set overlay color "on the fly." Since it's a TSR, it can be invoked from within any application, including a high-speed VGA game. 626TSR.EXE also permits altering contrast, brightness, saturation and hue by using various hotkey combinations.

The main hotkeys are ALT-E ALT-C, which activate the TSR. An additional instruction argument then follows to make the desired change. For example, ALT-E ALT-C G will toggle the genlock on or off, ALT-E ALT-C F toggles the flicker filter on or off, and ALT-E ALT-C O# (# is a number from 0 to 255 that represents a palette color) selects an overlay key color. The ALT combinations become familiar within a couple of minutes and overall are easy to use once you get the hang of it.

Numerous graphics drivers on the diskettes permit using the card to full advantage with such programs as AutoDesk *ADI*, GEM 3.X, Lotus *1-2-3* and *Symphony, Ventura Publisher* 2.0, Microsoft *Windows* 3.0, *WordPerfect* 5.1 and *DrawPerfect* 1.1 and OS/2 Presentation Manager. Complete instructions for loading and using these dedicated drivers are given in the manual.

Conclusion: The EV-626 Vision VGA with Overlay was a very easy board to use. It produced excellent overlay and export video output using the same equipment setup utilized with the Truevision. As far as quality output goes, it's a draw between the two boards. The Everex offers some extended features over the Truevision, but Truevison's software is a bit easier to use. Either of these boards is an excellent choice for producing recordable computer video or doing overlay work in desktop video.

Willow Peripherals VGA-TV GE/O, $895
Willow Peripherals
190 Willow Ave.
Bronx, NY 10454
Tel.: 800-444-1585 or 212-402-9500

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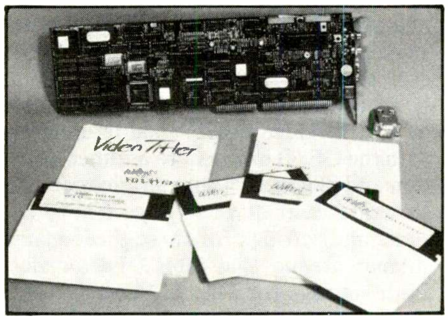

Willow Peripherals VGA-TV GE/O with software and documentation.

This is also a full-length board loaded with chips and other components. Like the others, the GE/O (short for genlock/overlay, pronounced gee-oh) also uses a Tseng Labs video chip (this board uses the Tseng ET3000AX, while the other two boards use the Tseng 4000 series chips). The only available configuration for the GE/O has 512K of RAM, which makes it unique compared to the 512K and 1M versions for the Everex and Truevision boards.

The board mounts in any full-length 8- or 16-bit slot and functions like a normal super-VGA card when it isn't being used for composite video output or overlaying. It supports a 256-color palette (of a possible range of 262,144 colors) and can produce RS-170A-compatible or S-Video output in resolutions to 640 × 480 using the 256-color palette.

MDA, CGA, EGA, MCGA, VGA and super-VGA display standards are sup-

Table 3. Jumper Settings/Functions for VGA-TV GE/O

Jumper	Position	Function
J11	Open*	Boots to VGA mode
	Closed	Boots to NTSC mode
J12	Open	V-Sync present (NTSC)
	Closed*	V-Sync suppressed (NTSC)
J91	Open	No 75-Ohm termination
	Closed*	75-Ohm termination (for video input)

ported, and a multi-frequency computer monitor is required. The GE/O can accept input from any NTSC input device, including video camera, camcorder, VCR, videodisc player and TV broadcast signal. It uses a default I/O port address of 310h, and address setting is jumper-configurable between 300h and 370h.

Additional jumpers, 12 in all, govern various configuration and use preferences. One jumper controls whether the GE/O card boots up in VGA or NTSC output mode and another suppresses or enables vertical sync output in NTSC mode. Some monitors (like the NEC Multisync II, 3D and others) don't require a vertical sync signal, while others (like the NEC Multisync I) need it to avoid video "jitter."

Yet another jumper determines whether or not the video input signal terminates with the GE/O or is sent to another location and places a 75-ohm termination resistor in the circuit when closed. The functions and settings for these three main jumpers are shown in Table 3. Factory default settings for J11, J12 and J91 are Open, Closed and Closed, respectively.

Jumpers J18, J19 and J20 determine the port address the board uses. Jumpers J14, J15, J16, J21 and J22 don't normally require changing by end users. All possible jumpering configurations and clear explanations of their uses and effects are covered in Chapter 5 of the excellent user manual.

I/O connections to the GE/O are handled by multiple ports on the card's backplane bracket. Two phono jacks at the top of the bracket handle composite video input and output. Below these is a DB-15F connector for connecting the computer monitor. Below it is a four-pin DIN connector for S-video output. The GE/O board is unique in that it supports only S-video output (Everex and Truevision support S-video input and output).

A supplied 75-ohm DB-15 terminating plug is used for terminating the computer monitor port when only the composite port is in use. Inclusion of this handy device makes it possible to terminate this video port without the need to change jumper settings on the board.

Three 5¼" software diskettes are supplied. One contains all required executable programs to utilize the board's features. Another contains dedicated drivers to use the board's various video modes with such programs as *AutoCAD, AutoShade, Ventura Publisher, WordPerfect*, Lotus *1-2-3* and *Windows* The last is a software demo for *ColoRIX*, a VGA paint program. Another supplied package contains a Video Titler user manual and program disk.

The main programs required for using the GE/O board are NTSC.COM, VGA.COM and GEO.COM. By typing either NTSC or VGA, respectively, the first two programs are invoked and signal output is switched according to which program is run. GEO.COM, a TSR, controls the board and features such as key color, border color, graphic image centering and toggling between output modes.

The GEO TSR program is probably the most useful, since it can be invoked while inside another application to tailor image positioning or alter mode settings if desired. When run and invoked through hotkeys, a pop-up window appears in the middle of the video display with adjustable slip, key and border parameters.

Slip governs moving the VGA image on both computer and TV monitor in up, down, left and right directions using the corresponding cursor control keys. This is handy for aligning images that aren't centered on the screen.

Key permits you to select any key color (the color that will be replaced by the video image) from among the 256 available colors. Upon highlighting "key" on the menu bar and pressing Enter, two methods of selecting the key color are provided. In one, the up- and down-arrow keys toggle through all colors (changing numeric values from 000 to 255) while you watch the effect of the video coming through the corresponding color. The alternate method involves entering a three-digit number of the desired color directly if you know which shade you want. Since the color palettes are dependent on the software application in use at the time, I found the first method to be the better because I could see the results immediately.

The border color can also be selected from the 256-color palette by highlighting the "border" option of the TSR pop-up. Border colors are selected by the same two methods as the the key color.

The TSR also permits switching between NTSC and VGA by simply typing N or V while the TSR window is present on the screen. Exiting the TSR is accomplished by pressing Esc to return to the currently running application.

Additional commands can be entered using the GEO command in nonresident mode, which is accomplished by entering GEO, followed by the appropriate argument. Available arguments include:

-k—change the hotkey (to any key other than Esc or Enter)
-h—display help file GEO.DOC
-u—uninstall TSR
-v—select VGA mode
-n—select NTSC mode
-nr (parameters) where the parameters can be:
-b {ccc}—select border color: ccc = 0 to 255
-k {ccc}—select key color: ccc = 0 to 255
-l {file name}—load configuration from file
-s {file name}—save configuration to a file (but only if TSR is already resident)
-x { + / – ccc}—slip horizontal (+ is right, – is left, ccc = three-digit number for amount of moves desired)
-y { + / – ccc}—slip vertical (+ is right, – is left, ccc = three-digit number for amount of moves desired

Additionally, commands can be stacked on the command line for multiple instructions. For example, to change to NTSC mode and to select border color 20 and key color 1, you enter:

```
geo -nr -n -b 020 -k 001
```

While the command structure at first seems a bit confusing, it's easy to master and becomes second nature after using the board for a while.

Overall, the supplied documentation is excellent, although it isn't bound. Willow Peripherals supplies a three-ring binder for the manual pages upon receiving the warranty registration card. The binder makes using the documentation much easier.

Conclusion: Although I didn't encounter any problems with the board's 512K RAM limitation, this might be troublesome for some heavy applications that require a 1M video card to display at full advantage. Remember, though, that NTSC video has recordable limitations that can't exploit such super extended VGA modes, anyway. Good board design, excellent performance

(continued on page 26)

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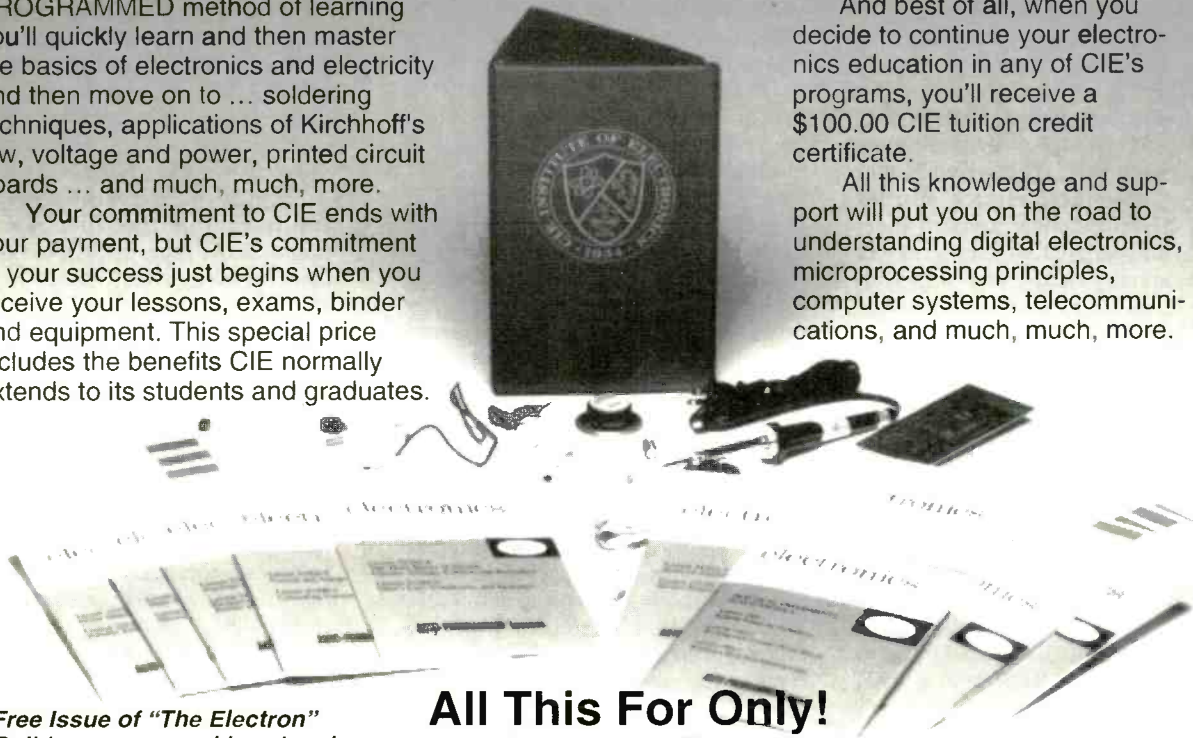

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Super VCR for Desktop Video

NEC PV-S98A PC-VCR, $1,995
NEC Technologies Inc.
1255 Michael Dr.
Wood Dale, IL 60191
Tel.: 1-800-366-3632

The steep price tag of this machine places it beyond practical reach of the average consumer with a PC who'd like to dabble in desktop video. However, you may well consider its purchase if you're interested in doing serious desktop video productions and are looking for a professional-caliber stereo VCR, you might want to purchase it.

All of the nifty features of the PC-VCR would take another article in itself to cover; so I'll just give a short sampling here of what it has: S-VHS playback and recording, digital auto tracking, infrared remote control, double azimuth four-video head design, 154-channel cable-ready frequency synthesized tuner with MTS, 21-day/8-event programmable timer, segment recording/delayed segment recording, VHS index search system, real-time counter, front-mounted dubbing terminals, flying erase head, camera control terminals, insert recording and lots more. As a VCR, it leaves virtually nothing to be desired.

What makes the PC-VCR not only unique but perfectly suited for desktop video is its built-in RS-232C I/O port that permits it to interface with and be controlled by a PC serial port capable of ASCII communication. In addition to PC control of all VCR operations, frame-accurate time-code indexing is also featured.

Housed in a bone-colored enclosure, the PC-VCR matches the color of most PC systems. Its footprint allows it to nestle atop the system unit of most desktop PCs. A flip-down front panel provides access to a control keypad and conceals the cassette door. Located under the cassette access door are audio recording level slider controls for left and right channels and the time adjustment switch for setting calendar/clock functions.

Switches for turning on and off remote control, setting it to PC-VCR 1 or 2 (so you can use a single remote controller for two decks), tape-remaining indicator switch for T120 or T160 video cassettes, edit on/off switch, line input selection (S-video or composite) and the S-VHS on/off switch are also found at this location.

The flip-down control keypad has soft-touch buttons for indexing, searching, stereo/simulcast selection, inserts, dubbing, counter reset, tape transport controls, VCR/TV selector, LED dimmer control, program, recording, channel selector, TV/CATV and other controls, including cursor keys for moving forward and backward through command screens. Eject, pause/still, recording mode select and program check switches are also on this keypad panel.

A smoked panel to the right conceals LED displays that indicate stereo, channel, week, day, time, level meters, index, transport activity and more. Another flip-down panel, under the smoked panel on the lower-right side of the VCR, gives access to controls for tracking, sharpness and headphone level and an automatic/manual tracking selector. Jacks are provided for headphones, camera control and S-video, composite video and left- and right-channel audio input.

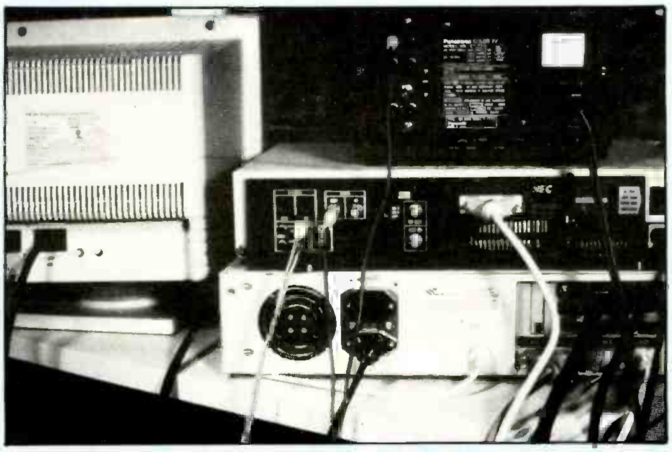
On the rear is a switched (200 watts maximum) grounded ac receptacle for turning on and off the monitor simultaneously with the VCR. Also on the rear panel are: a 25-pin RS-232C jack for connecting the PC-VCR to the serial port of a PC; video I/O jacks (DIN jacks for S-video input and output, BNC connectors for composite video input and output, phone jacks for index input and output and phono jacks for left and right audio input and output); connectors for antenna input and output; mini-phone jack for camera control; and channel (2/3/off) selector switch.

A supplied full-function wireless remote-control unit permits operating all VCR record and play features. A switch on the transmitter can be moved between either of two positions to permit control of two PC-VCRs, each of which is set to a corresponding 1 or 2 designation. A CVC button sets the VCR to Computer Video Control mode.

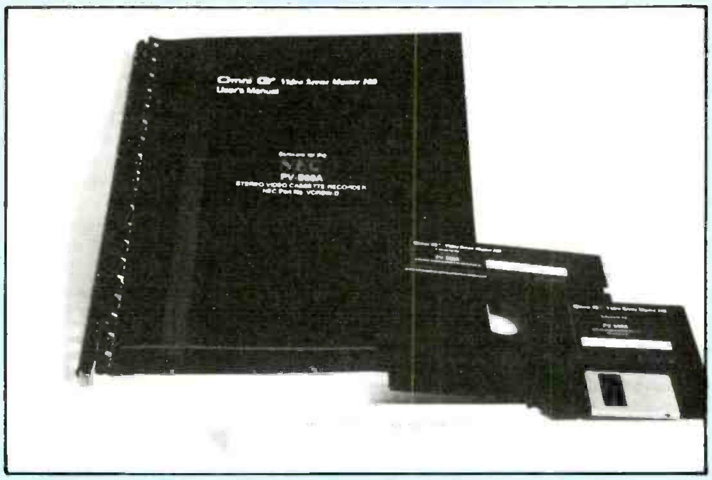
Such CVC functions as time and frame reference information for accessing any point on the tape, setting background color (instead of video "noise") for tape sections with no video information and cueing/indexing functions are all controlled through a CVC mode menu. While in CVC mode, the transmitter can override any computer-generated functions or commands that otherwise take precedence over commands issued by the remote controller.

People who think programming an ordinary VCR is a difficult task are likely to concede total defeat when it comes to the complexity and options afforded with the PV-S98A. A two-section 118-page user's manual accompanies the machine. Section 1, consisting of 54 pages, deals with the overall features, functions and controls of this VCR in its capacity as a high-end stereo VCR. Section II consists of 64 pages and is addressed entirely to the PC interface, and contains detailed information on how to operate the PV-S98A from a PC.

View of NEC PC-VCR with front panel open to show the cassette access door and keypad control section.


RS-232 cable connects the PC-VCR with computer via latter's serial port.

Say You Saw It In ComputerCraft



Omni Q Video Scene Master 100 software and manual for NEC PC-VCR.

An interface kit that contains the appropriate (IBM or Macintosh) serial cable to mate the VCR with a computer, application software and a 182-page software users manual are provided. Software comes on 5¼" and 3½" disks.

The serial cable is the link between the PC and the VCR(s). Communication between the two devices is accomplished using any modem software you wish or BASIC. The users manual is comprehensive on how to communicate with the VCR through the PC and gives detailed listings of function codes and their effects. This is for patient hackers who like to enter commands directly and don't mind spending considerable time just to create a title screen with the PC-VCRs built-in title generator.

Fortunately for non-hackers, the *Omni Q Video Scene Master 100* software supplied with the interface kit provides a much easier means of controlling the VCR through a PC. Two versions are supplied—DOS (SCNMAST.EXE) and *Windows* 3.0 (WINMAST.EXE). While both versions are equally easy to use, the *Windows* version is a bit more attractive and supports mouse control; it's also a prerequisite for controlling two PC-VCRs for assembly editing. I used this version extensively and found it to be quite easy to learn and use.

I ran into a problem when using two PC-VCRs simultaneously. Since each required a serial port for communication with the PC, both my COM1 and COM2 ports were required, so I disconnected my mouse. If you've ever tried using *Windows* without a mouse you can readily appreciate where this wasn't a livable situation. The solution was to plug a bus card into my PC and connect a bus mouse. If you're using a single PC-VCR and have two serial ports on your PC, you're all set, but if you want to add a second PC-VCR to your setup, you'll need either an additional serial port or a bus card to handle both VCRs and a mouse simultaneously.

When the software is loaded, an on-screen control panel lets you: fast forward, rewind, play, stop, freeze-frame, single-step forward, scan forwards and backwards, go to a time or a scene number, write an identifying header on each of your tapes and stripe your tapes with time-code addresses. A window displays a list of each scene (a scene list is stored on hard disk for each tape), and the program reads the header from the videotape in the VCR and calls up the correct list.

Each entry in a scene list consists of a scene number, start and end times and a text description of the scene (entered by you). You merely select a scene from the list, and the VCR searches to the start of it (a scene can consist of a single frame, a few seconds or a full-motion video of any length).

In a setup where two PC-VCRs are interfaced through a PC, the full power and editing potential of the PV-S98A can be realized. For example, you can create an edit list with scene numbers, punch-in and punch-out points. Working from this list, the software does an automatic, linear assembly edit onto one PC-VCR from the second unit. This is especially useful if your "source" tape has scenes scattered in different locations, since the software shuttles the tape to the beginning of each scene, simultaneously starts playback from the source and recording from the copy deck and precisely stops recording at the end of the scene. It then shuttles the source tape to the beginning (within ± 1 frames) of the next scene, and repeats the process.

Audio dubbing, insert editing and assembly editing are easily controlled through the *Video Scene Master 100* software, whose layout is intuitive. The software control panel is represented by control "buttons," which are activated by mouse clicks. Context-sensitive on-line help is always available if needed, and learning to use the program is straightforward and uncomplicated.

The built-in title generator is accessed via the serial port (the character generator cannot be used without a PC to program it). Programming the character generator is a slow and tedious process, even with a PC, as the example shown in Table A illustrates. The objective is to display "PV-S98A" on-screen. As you can see from the foregoing, programming the character generator is less than a straightforward process.

If you intend to use the PC-VCR's onboard character generator extensively, I suggest either writing a simple control program in Microsoft *QuickBasic* or some other language to initialize, create and store titling screens without having to enter each command by hand. For more limited applications, any macro keystroke utility (like Alpha Software's *Keyworks* or Borland's *SuperKey*) also simplify and speed up the control procedure greatly.

Titling and creating stunning graphics effects are accomplished more easily and with much better results using computer paint, illustration and animation programs rather than the monotonous-looking character generator fonts.

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Table A. Programming Example for PV-S98A VCR

Code Entered	Function
VM1	Mute video to selected background color
OC	Initialize character display function
CA00:00 'PV-S98A'	Location for display and display characters
VM0	Turn mute off
ELA	Erases the characters on display

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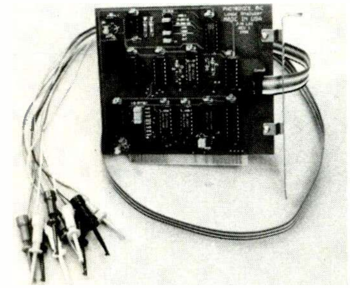

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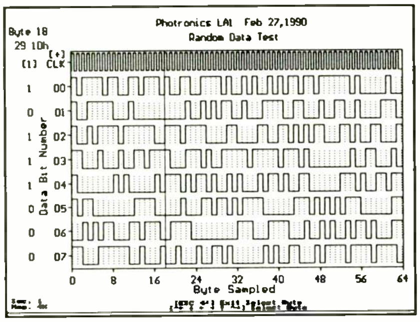

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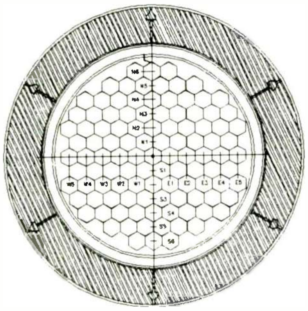

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and relatively easy-to-use software make the GE/O a good choice for video overlaying and exporting recordable video to NTSC devices.

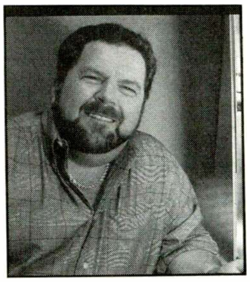
Practical Applications

Overlaying is an extremely useful capability to have in creating desktop video productions, which can range from instructional videos to video reference/repair manuals to product demonstrations to simulations to computer animation and so on. In short, virtually any type of video production that requires titling, subtitling, static or moving graphics or captioning requires overlaying one image (computer-generated) on another (TV video). Multiple overlays can also be accomplished by overlaying the first level on the TV video and taping the combined image output, overlaying the second level on the taped image and again taping the combined image, and so on.

Of course, to accomplish all this, you need a very good VCR to preserve image integrity through each copy layer, one that supports composite as well as S-video input and output. One such VCR is the NEC PC-VCR, which does all this and lots more. It also interfaces to a PC via a serial port for computer-controlled editing (JVC recently announced a PC-oriented VCR, too). For a capsule review of this video marvel, see the Super VCR For Video Productions box elsewhere in this article.

In Part 2, we'll take a close look at some of the more noteworthy software packages for creating graphics and titling, as well animation packages. We'll also cover some interesting "scripting" software for creating multimedia presentations and a couple of sound boards for adding audio to your productions. ■

All photos by Liz Benford



Tom Benford

A Tower of an Enclosure

Part 2

How to fill a computer tower case with transplanted innards of your present PC . . . assembling the ultimate computer . . . or anything in between

The build-it-yourself CYANCE vertical tower enclosure introduced last month can serve as a platform for launching a number of interesting and practical upgrades.

Using its small footprint and easy access to internal parts as a foundation starts you off the right way to do whatever you wish. This might be a bus-extension expansion system that attaches to an existing PC, transferring all parts from a traditional inflexible, desk-space-eating case to the tower, right up to putting together the ultimate dream PC.

Whatever the choice, the tower's unique front-load method of mounting expansion boards makes it as easy as possible to change cards and cables. Moreover, working on your own enclosure allows you to create the chassis and parts you wish to use. This installment focuses on assembling a computer type you select inside it. You'll be surprised to find how easy it is to do.

The Basics

If you've never tackled such a project and perhaps feel a bit queasy about doing it, read the "Build-It-Yourself Experience" box.

If you're operating on a shoe-string budget, start with an inexpensive motherboard. Then, as you become familiar with your new system and its performance capabilities (and perhaps manage to save a few extra bucks for expansion purposes), you can simply exchange your motherboard for later technology. On the other hand, you may want to jump right in and build your idea of the ultimate computing machine that takes advantage of the very latest in motherboard and expansion products.

The Power Supply

CYANCE was designed to utilize an industry standard PC power supply. The standard PC-type power supply is enclosed in a metal housing, complete with line cord connector, cooling fan, interconnect cables and a printed-circuit card. In the interest of making the CYANCE tower as compact as possible, your first step is to carefully disassemble the power supply you choose as follows.

Begin by removing screws that secure the two halves of its housing. Next, make some written notes regarding the internal connections between the line cord connector, power switch, line-voltage selector switch, fan, etc., to avoid making wiring errors when you reinstall these items inside the CYANCE enclosure. Finally, carefully remove the fan, power supply card, switches, line-cord connector, etc., from the housing and set them aside as a group. If you have to unsolder a connection, be sure to mark the removed lead and the point from which it was removed. You can now install the power supply inside the CYANCE enclosure.

Mount the ac line-cord connector on the rear panel of the enclosure, using two 4-40 or 6-32 × ¼" machine screws and nuts to attach the connector to the back-panel. Then mount the cooling fan on the rear panel. (You want the fan to exhaust hot air from inside the enclosure outward when the system is put into service. For now, don't worry how the fan is mounted. Later, when you power up your system, you can determine the direction of air flow and, if necessary, remount the fan.)

Mount the power supply card with 4-40 or 6-32 spacers. Make absolutely certain that the spacers you choose are long enough so that everything on the card is positioned far away from the top shelf metal work to avoid short circuits. Bear in mind that most power-supply cards have heat-sink tabs or "fins" that could short to the metal enclosure. Also, be sure to leave enough space beside the power-supply card for the disk drive cable, which must pass through the top shelf, alongside the power supply card and up to connect to the disk drive.

Realize, too, that potentially hazardous 117 volts ac appears at various points in the power-supply circuit. Therefore, all such locations must be fully insulated to prevent any possibility of shock hazard to you and any component inside the enclosure.

Next, mount the RESET and POWER pushbutton switches and POWER key-type switches on the front panel of the enclosure (see photos).

When wiring the power supply, make constant reference to any notes you made during disassembly. Reconnect everything exactly as it was in the supply before you began disassembling it. You must run new wiring from the ac line-cord connector, up past the fan, alongside the power-supply card, to the key-type POWER switch. Use a twisted-pair cable made from No. 20 stranded hookup wire or zip-type lamp cord for this run.

You want to use very neat work habits when wiring the 117-volt ac circuit, of course. Use plenty of solder on the line-cord connector and POWER switch, but use soldering heat judiciously to avoid damaging the plastic around the terminals.

You'll have to splice the power line you just ran into the wires from the power-supply card that originally went to the same components before disassembly of the supply. After making these connections, use heat-shrinkable tubing to insulate them. As you can see, you aren't adding anything new to the circuit, but you are replacing the paddle-type POWER switch that was in the original circuit with a key-type POWER switch.

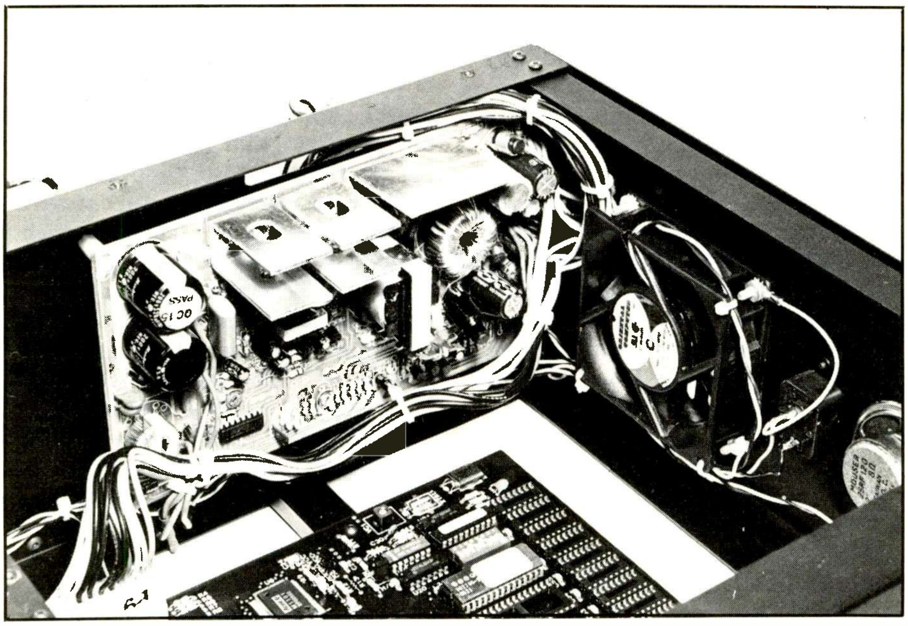
The 120/220-volt selector switch included in most PC-type power supplies permits selection between North American and European ac line-power voltages. You probably won't need this switch mounted on the outside of CYANCE. Because this is another location at which ac line power is present, be sure to use a large piece of heat-shrinkable tubing to cover the entire switch assembly (set it first to 120 or 220 volts, whichever is appropriate) if you leave it mounted on the power-supply card.

The fan is probably still connected to the power-supply card at this point. You can lace together the fan and ac line-cord connector conductors with 2″ tie-wraps along their lengths. Again, keep your work neat and form 90° angles wherever the cables bend.

To check out your wiring of the power supply, use a dc voltmeter or a multimeter set to the dc-volts function to measure the various voltage outputs on the standard PC interconnect cables. Your power supply will probably have four or more color-coded four-conductor cables that terminate in connectors that mate with the connectors on disk drives and two more multi-conductor cables that terminate in a different type of connector that go to the motherboard.

Set the POWER switch to OFF. Then plug the line cord into the ac connector on the rear panel and an ac outlet. Momentarily power up the supply by setting the POWER to ON and then, a second later, to OFF as you watch for the fan energize. If everything seems okay so far, power up again and measure voltages on the disk-drive and motherboard cable connector contacts. Use the black-insulated conductors as ground reference in each case and the colored conductors to determine if +5, −5, +12 and −12 volts are available at the various connector contacts.

If at any of the cited points you fail to obtain a reading, power down and carefully go over all your wiring. Correct any problem now, before proceeding to motherboard installation. When all voltages check out okay, power down.



Once disassembled, the PC-type power-supply components install in the enclosure with the circuit board on the underside of the top shelf with its disk-drive power cables routed through the nearby slot in the top shelf.

The Motherboard

You're now ready to install the motherboard of your choice inside the CYANCE enclosure. If you're building your computer from scratch, see the "Selecting A Motherboard" box

The Build-It-Yourself Experience

While many readers will jump at the opportunity to build their own computers from scratch, others may be concerned about their abilities to do so. I assure you that building a computer nowadays from component parts is a fairly simple procedure and, in the great majority of cases, a foolproof one. If you can read and follow printed directions, know how to solder and can measure dc voltages, you can successfully build a PC-type computer like the one described in the main article.

Ten years ago, building a computer was a major project filled with some serious risks. Back then, you actually had to wire together hundreds or even thousands of resistors, capacitors, ICs, etc., not to mention the amount of work involved in mechanically mounting everything into place. Today, the mechanical mounting operations may be essentially the same, but now you simply interconnect a number of circuit cards using ready-made cables. The procedure is just a bit more demanding—and in many cases a lot less confusing—than hooking up a video system composed of a TV receiver, videocassette recorder, cable box and satellite receiver.

There are, of course, some steps you must take to avoid certain pitfalls. These are amply covered in the main article. The bottom line, though, is that you *can* successfully build a computer yourself.

Selecting A Motherboard

Your choice of motherboard depends primarily on two factors: how much money you can spend and the processing power you need to accomplish your goals. Be objective when making your decision. Don't pay a premium for processing power you'll never need, but don't settle for a low-cost motherboard that won't meet your growing demands.

If your current use of a computer is modest, consider starting with an inexpensive motherboard with limited processing power. You can trade up later to better CPU technology as the need for it becomes apparent.

for selection tips. On the other hand, if all you're doing is transplanting your old computer's "guts" into the CYANCE enclosure, you must first disassemble your old computer.

Hold up your motherboard inside the CYANCE enclosure in the position and orientation in which it will be installed. You'll mount the motherboard on the left-front and motherboard brackets (see Part 1 and the photos presented here).

Temporarily install expansion cards in the first and last slots on the motherboard to serve as alignment references during the installation process. Your objective is simply to use ½" spacers to mount the motherboard in the CYANCE enclosure. To do this, you may need to move the motherboard mounting bracket toward the front or rear of the chassis.

Next, transfer mounting-hole positions on the motherboard to the chassis brackets and drill them to accommodate 4-40 or 6-32 screws. (Be sure to move the motherboard away from the drilling area and cover the power-supply card to avoid getting metal drill-cuttings on the circuitry. A small metal chip can be devastating!) Also, make sure to check the clearance provided by the ½" spacers. In some instances, component leads on the solder side of the motherboard can short to the metal work. If this is a problem, use longer spacers.

Mount the motherboard with screws and spacers. The expansion cards should now line up perfectly with the card bracket on the right-front side of the CYANCE enclosure. Next, mark and drill these holes to accommodate each of the expansion positions. Plug the connectors on the six-conductor cables coming from the power supply onto the connector block on the motherboard. If you're using a new motherboard, refer to the instructions that accompany it when connecting the power supply or see the Making The Transplant box for details if you're transplanting an existing computer into the enclosure.

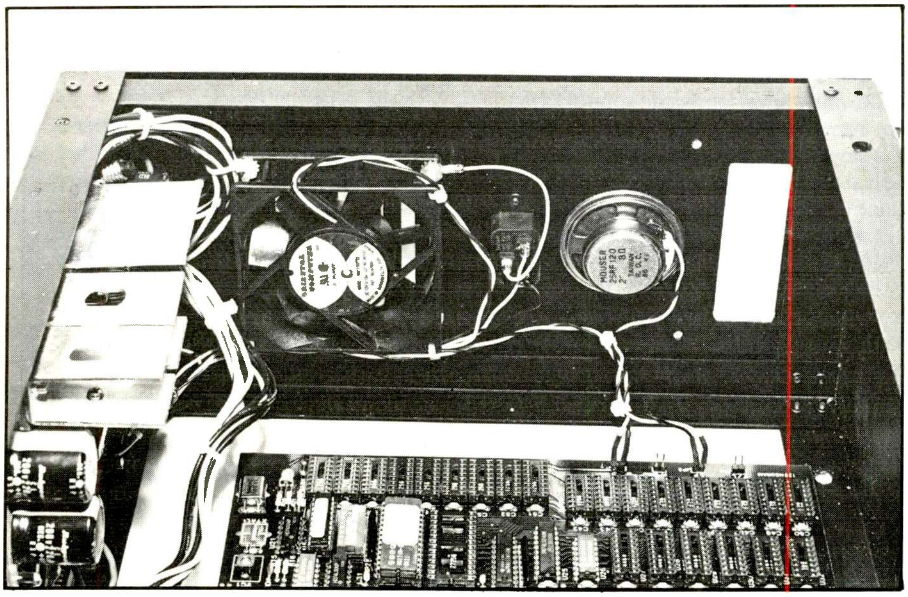
If you're transferring a motherboard from an old computer, simply refer to your owners manual or the notes you made during disassembly. On most motherboards, the two power connectors are polarized so that they can be installed in only one direction. Also, make sure the connectors are plugged in so that the black-insulated ground leads of each cable are beside each other. Double-check this very carefully; your motherboard will quickly go up in smoke if you reverse these connectors!

Before you can check out a new motherboard you just installed, you must decide on which options you wish to include. There are many types of motherboards. These include RESET and TURBO switches, TURBO and POWER indicators, KEY LOCK, etc.

Run a twisted-pair cable made up of stranded No. 22 hookup wire (use this size wire for all option cables) from the front-panel-mounted RESET switch back across the top shelf and down to the RESET pins on the motherboard. If you terminate the cable in a two-pin connector that matches the pins on the motherboard, plug it into place. Otherwise, solder the conductors of the cable to the pins on the motherboard and insulate the connections with heat-shrinkable tubing.

Run a second twisted-pair cable from the indicator light (6-volt incandescent type) connections on the RESET switch back across the top shelf and then down to the back side of the motherboard power connectors. Use a meter or your documentation to locate the +5-volt bus (usually three red-insulated wires located next to each other). Solder the RESET indicator leads directly to the motherboard. If you wish, you can solder these leads to the power-supply card or splice them into the power cables that go to the motherboard. Be certain you know which terminals are which on the RESET switch assembly. Needless to say, it would not be good to reset the motherboard by shorting the +5-volt bus!

Decide if you want to install a speaker inside your CYANCE enclosure. Some users find the speaker annoying and disable it. If you plan to use software that utilizes it, it's very simple to install the speaker. Secure the 2" speaker on the rear panel of the enclosure below the line-cord connector with fast-setting epoxy cement or



If you use a speaker in your computer, cement it to the rear panel of the enclosure between the ac receptacle and exit slot for any cables coming from expansion cards. Neatly route all cabling out of the way, and neatly time them together.

silicone adhesive. Then run a twisted-pair cable from the speaker to the appropriate pins on the motherboard. Lace the various wires with 2″ tie-wraps to keep things neat. There's no need to drill escape holes for the sound.

If you wish to use a TURBO switch, mount it on the front panel next to the RESET switch. Then run a twisted-pair cable from the TURBO switch to the appropriate pins on the motherboard. Likewise, if you want a TURBO LED on the front panel, connect it to the motherboard.

Install any other option that may be available to you with your choice of motherboard inside the CYANCE enclosure to make it active or give manual access to it. Remember to double-check all of your wiring when you're finished and "dress" it to make your installation look factory finished.

Finally, for the motherboard, consult the documentation that came with it for details on installing RAM and how to configure it. Follow the instructions carefully and double-check everything when you're finished.

The Disk Drives

Most PC users have at least one disk drive installed in their systems. CYANCE can house two disk drives, one floppy and one hard. Depending on your disk controller card, up to two external disk drives can also be used with this system. The internal floppy drive faces the front of the enclosure and provides access to the disk slot. The hard disk is enclosed on the rear end of the top shelf assembly. If you plan to use a high-density floppy or hard disk, be sure to use a disk-controller card that supports it.

Begin installation of the disk drive or drives by "spotting" holes for mounting it on the top shelf of the chassis. When you drill the holes, make sure no metal chips fall onto the motherboard or power-supply card.

For a single floppy drive system, plug the disk controller card into the motherboard and connect the 34 con-

Making The Transplant

Transplanting an existing computer from one enclosure to another is fraught with obstacles if you don't assiduously follow a logical procedure. Let's look at the things you should do in detail. Before you do anything else, however, make sure you have a paper pad and pencil or pen handy for making notes and drawings of everything you do as you disassemble your old computer.

Position the system unit from which you'll be removing the motherboard and its resources in front of you with the front of it facing you. Disconnect from it all external cables. Open the box and examine the layout of everything you see.

The easiest place to start disassembly is usually removal of the disk drives. Depending on your particular computer, you either have to remove the drives individually or remove a cage structure containing the drives. Whichever the case, start by making a note on your pad of the location of the color stripe on the flat ribbon cable that comes from the controller card to your floppy drives. Label each connector for the drive it goes to and orientation with respect to each drive. Disconnect the cable from the drive end only.

Next, unplug the four-conductor power cables from the floppy drives. You don't have to make note of the orientation of such cables; they plug into the drives in only one direction.

Remove hardware that secures the floppy drives or the cage assembly to the enclosure. If the drives are still mounted in a cage, remove them, one at a time, from it. Make a note on your pad of which drive is which if you're using mixed 5¼″ or 3½″ drives, and label each drive accordingly.

If your system has one or more hard disks, remove them next. Follow the same procedure outlined above for removal of the floppy-disk drives. However, keep in mind that here you'll usually be dealing with three cables for each drive: two ribbon types with different numbers of conductors and a four-conductor power cable. Make notes on every step you perform on your pad.

Remove the expansion cards plugged into the motherboard, leaving the disk-drive controller card(s) for last. Again, make a note of each step you take. If you have an old PC or PC/XT system you're transplanting to a new enclosure, you may have separate floppy- and hard-disk controller cards. If so, remove each card separately and make a note on your pad of the locations orientations of any cables plugged into it.

The only things left inside your old system box should be the power supply, speaker, wiring that goes to switches and indicators, and the motherboard itself. Remove and set aside the power supply and speaker.

You're now at the most critical point in the disassembly procedure. Carefully examine your motherboard. Don't do anything until you've read through the next three paragraphs.

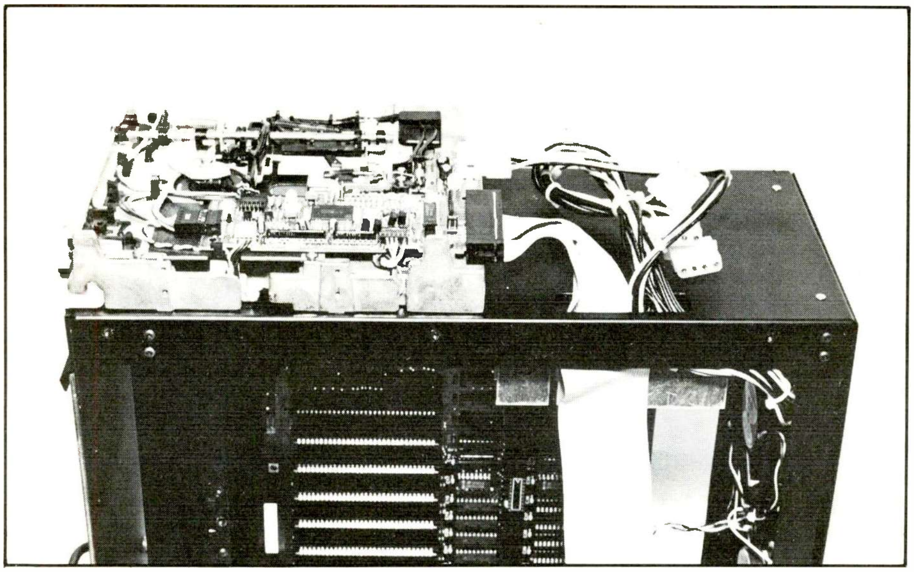
Make a drawing of the motherboard on your pad (it needn't be to scale; just make sure you can easily interpret it as you reassemble your computer inside the new enclosure), including all points to which cables connect. Trace any twisted cables back to the switches, indicators, speaker and off-board battery (the last, for AT-class machines only, is for power backup to system setup RAM) to which they connect and make a note of the function of each. As you make a note of its termination point on the motherboard, disconnect each cable. Include in your notes the color-coding scheme used for each cable.

There should now be just two six-conductor cables going from the power supply to a single connector block on the motherboard. Make absolutely certain that you label on your drawing the location of *each* conductor in both cables. If you mess up and plug cables onto the wrong connector pins on the motherboard, you'll destroy your motherboard!

Grasp one cable connector and gently but firmly pull straight up to remove it. Don't force it. If the cable doesn't release from the connector on the motherboard, pull it up as far as it will go and then tilt it to the right to release it. Do the same with the other cable.

Two or more screws and a number of plastic spacer/guides hold the motherboard in place inside the chassis. Remove the screws and set them aside. Then hold the motherboard by its left and right sides, gently push it toward your left until the spacer/guides disengage the slots in the enclosure and lift out the motherboard. Immediately install the motherboard inside your new enclosure. Don't leave it lying around where it can be "zapped" by static electricity.

Complete the "transplant" by installing the various items you removed from your old system-box enclosure. You do this simply by reversing the disassembly procedure outlined above. When you're done and power up, your computer should boot and operate just as it did when it was still in the old enclosure.



Disk drives (a single floppy drive is shown) mount on the top shelf of the CYANCE enclosure. Power and data cables route from the power supply and controller card in the main cavity of the enclosure to the drive(s) through a slot in the top shelf.

BILL OF MATERIALS

Qty.	Description	Part No.
1	Top shelf	4510
1	Bottom shelf	4511
2	Rear corner bracket	4512
1	Rear panel	4513
1	Front panel	4514
1	Switch cover panel	4515
1	Switch backing panel	4516
1	Front-right bracket	4517
1	Front-left bracket	4518
1	Card-holder bracket	4519
1	Mother-card bracket	4520
1	Top cover	4521
1	Left Side panel	4522
1	Right Side panel	4523
62	4-40 ¼" button-head screw	
22	4-40 Thread-Sert	4103
1	Large handle	4319
1	Small handle	4320
2	Threaded 4-40 × 1" spacer	4321
4	8-32 thumbscrew	4322
4	8-32 Keps Nut	4104
4	Rubber feet	
1	Key-operated switch	5006
1	Lighted pushbutton switch	5007

Note: The following items are available from U.S. Cyberlab, Inc., Rte. 2 Box 284, Cyber Rd., West Fork, AR 72774 (tel.: 501-839-8293 or 800-232-9865): Complete kit of all metal parts for CYANCE enclosure, $99.95; 10-MHz Turbo XT motherboard, $99.95; 16-MHz 80286 motherboard, $239.95; 16-MHz 386SX motherboard, $349; 33-MHz i486 motherboard, $1,395 (call for latest prices). MC/Visa accepted. Add $8.95 P&H for metal kit. Arkansas residents, please add 5% sales tax.

ductor ribbon cable to the connector on it. Connect the other end of this cable to the floppy drive, routing it through the slot in the top shelf assembly. This done, connect a power cable to the drive. Follow the disk-controller card instructions for any shunt changes required to configure the drive as A: or B:. If you're installing a hard disk, do so in the same manner as for the floppy disk. Carefully follow the instructions that came with the hard disk and controller card.

Checkout & Use

Connect a keyboard to the system. Plug a video card into an expansion slot and connect to it a video monitor. Note that the keyboard cable comes out the bottom of the front panel, and the video cable routs through an opening in the front panel and out through a slot in the rear of the enclosure.

When you turn on power, the green RESET indicator should light. You'll probably also notice a change in background brightness of your monitor. Depending upon the BIOS ROM software installed on the motherboard and video card, you should see a message appear on the screen of the video monitor. The system should go through the usual RAM check routine and attempt to "boot" drive A:. If no bootable disk is in drive A:, you'll see an error message on-screen. Put a DOS (bootable) disk in the floppy

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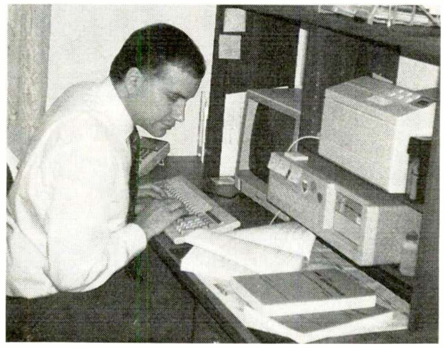

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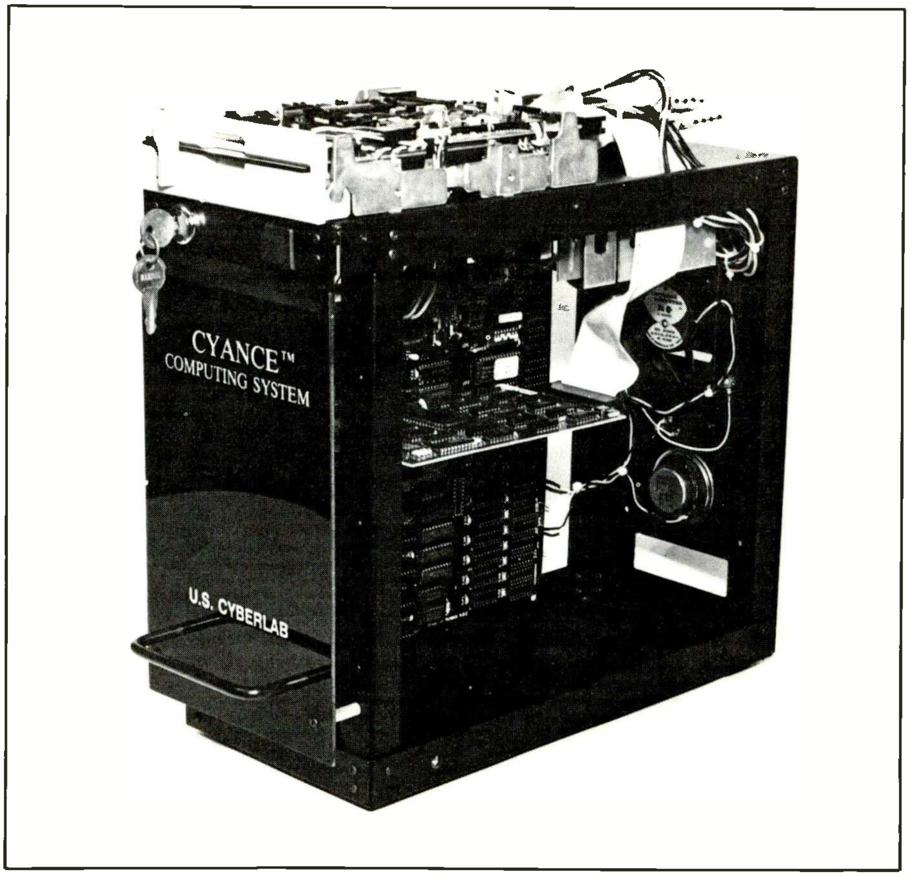

Nearing completion, your build-it-yourself computer system only requires mounting of the top-cover and right-side access panels and is then ready to be checked out and put into service.

drive and proceed with your checkout. If you experience any problems, refer to the manuals that came with your motherboard and expansion cards.

CYANCE was designed to be an easy-to-build and -use computer system. This PC-based computer gives you a wide range of expansion and peripheral products from which to choose. For scientific and commercial applications, where multiple CYANCE systems are "daisy chained," the units can be set side-by-side or stacked. If you use the computer on a production floor or in a harsh environment, add a small dust filter to the front bottom of the CYANCE chassis to prevent dust from entering the CYANCE unit.

In some commercial and scientific applications, it may be desirable to remove the front panel altogether. In other applications, you may want to replace the plastic outer front panel with your own dedicated instrument panel on which are mounted digital panel meters, analog and digital I/O connectors, etc.

CYANCE is great as a "server." It can be placed in a back room or some other out-of-the-way location. Bulletin boards, data-collection systems, industrial controllers, etc., can all be served well by CYANCE. Its "open" chassis and "front-load" capabilities make this unit perfect for ATE (automated test equipment) applications, too, in which rugged construction and close proximity to the system bus is desirable and perhaps necessary.

Next month, we'll present an expansion system for the CYANCE enclosure that lets you add eight expansion slots to your current PC system. ■

Nick Goss

Batch File Programming

Create batch files that make your computer more powerful and more fun to use

Whether you're a DOS expert or a relative newcomer to PCs, you probably know that two programming languages are included in almost every version of DOS. The BASIC interpreter, usually called QBASIC, GWBASIC or BASICA, requires a fair amount of study to use well. The other is much easier to use but normally overlooked.

When DOS boots up and initializes your system, it finishes the process by running a shell or command interpreter. Unless you've invested in an alternate program, DOS runs the default interpreter called COMMAND.COM. This program, by far the most used (and perhaps most criticized) program ever written, is fairly simple. It puts a prompt on-screen (usually C>) and waits for you to type an input. COMMAND.COM tries to match your input to its list of internal commands and subroutines that are part of the COMMAND.COM program. If the match is successful, it runs the appropriate command and then prompts for another input.

If your input doesn't match an internal command, COMMAND.COM looks for an executable file to run—.COM, .EXE or .BAT file (in this order) in the current directory with a name that matches your command. If no such file exists, it repeats the process in every directory included in your PATH setting.

When COMMAND.COM locates a matching file with a .COM or .EXE extension, it tells DOS to load and run the program. Once the program ends, COMMAND.COM displays a new prompt and waits for another command. But when a .BAT file matches the command, COMMAND.COM turns into an interpreter and accepts the file as a program it's supposed to execute itself.

Listing 1. Assembly-Language Program That Converts User Input to ERRORLEVEL Code

```
comment |
   Simple assembly-language program that gets
   a keystroke from the user and returns the
   keystroke as an Errorlevel value to Command.Com

   Save as Userkey.Asm
   To assemble:
        MASM Userkey;
        LINK Userkey;    (ignore no-stack warning)
        EXE2BIN UserKey.EXE UserKey.Com
        |

cseg segment
   assume cs:cseg

        org 100h             ;.COM file format
start:  mov      ah,8        ;DOS service 8: Get char.
p1:     int      21h         ;Get code in AL
        or       al,al       ;Did we get anything?
        jz       p1          ;No -- try again
        cmp      al,'a'      ;Lowercase 'a'?
        jb       p2          ;No -- jump ahead
        cmp      al,'z'      ;Lowercase 'z'?
        ja       p2          ;No -- jump ahead
        sub      al,32       ;Convert to uppercase
p2:     mov      ah,4ch      ;Exit from program with
        int      21h         ;  key in AL as exit code
cseg    ends
        end      start
```

When COMMAND.COM is interpreting a batch file, it follows a very specific set of procedures. It opens the .BAT file, reads a line and closes the file. It does a small amount of preprocessing to the line and then interprets the result as if you just typed it as a command. It executes the command (either an internal command or the name of an executable program to run) and then opens the .BAT file, proceeds to read the next line and repeats the process.

The process of closing the batch file after each line is read and then opening it again to read the next line means batch files run relatively slowly. However, COMMAND.COM uses this inefficient process to leave free as much memory and as many file handles as possible for any application pr ogram it's asked to run. Also, this inefficient process makes possible self-modifying batch files—programs that change or extend themselves while running.

One batch file deserves special mention. Every time you boot your computer, COMMAND.COM looks for an AUTOEXEC.BAT file before it displays the first command prompt. If AUTOEXEC.BAT exists, COMMAND.COM executes it before giving you control of your computer. AUTOEXEC.BAT is simply a collection of commands you want your computer to run every time it boots up. There's nothing else special about it or the way it executes the lines contained in it.

Using Batch Files

In general, a batch file is a group of commands you could type from the command line. In this sense, a batch file is a kind of macro command. You type the name of the batch file, which then types one or more commands for you. This is the simplest, and most used, kind of batch file.

Each line in a batch file is a command you'd normally type yourself. For example, suppose you have your applications programs on drive C: and your files on drive D:. You might want to write a batch file called DOLETTER.BAT that sets up everything to work on your correspondence. Using any text editor that can create ASCII text, your batch file might look like:

```
@ECHO OFF
CD C:\WP
D:
CD \LETTERS
C:WP
C:
CD \BATCH
```

The first line turns off batch file echoing so that you don't have to watch COMMAND.COM run each line of the batch file. The second line changes to the word-processor directory on drive C: to make available your word processor, spelling and grammar checker and other writing tools.

The third line makes drive D: the default, and the fourth line moves into your LETTERS subdirectory. The fifth line runs your word processor. The last two lines move back to the BATCH subdirectory on drive C: when you're done writing and printing your correspondence.

This kind of batch file is useful but not earthshaking. You can add more power by using some of the features available in batch files but not from the command line. One of the most powerful features is called replaceable parameters.

Many programs examine their own command line to determine the options you want to use or files on which they should operate. For example, if you start your word processor with the command WP CHRISTY.LTR, it may automatically load the file called CHRISTY.LTR when it starts. You can do the same thing with batch files.

Arguments on the command line are referenced with percent (%) signs and single-digit numbers. Using replaceable parameters, you could change the fourth line of DOLETTER.BAT to look like: C:WP %1. Now, if you type DOLETTER CHRISTY.LTR, your word processor will be launched and load the correct file for you. If all of your letters have a file extension of .LTR, you could make life even simpler by changing that line to C:WP %1.LTR and have the batch file add the extension for you when you type DOLETTER CHRISTY.

COMMAND.COM recognizes nine replaceable parameters, numbered from %1 to %9. It stores the name of the batch file itself in %0. If you need more than nine parameters, use the SHIFT command (see your DOS documentation).

Testing 1-2-3

The second example above always works. If you type just DOLETTER, COMMAND.COM sets the parameter %1 to a blank and runs your word processor normally. If you type the name of a file, the word processor will be called with the file name.

The third example isn't so friendly. If you omit the filename, COMMAND.COM executes the command C:WP .LTR, which will likely make your word processor complain about not finding the file you requested. You can avoid this by including a test in the batch file.

Batch files can test for identical strings and existence of a file. Using a string test, your batch file might look like this:

```
@ECHO OFF
CD C:\WP
D:
CD \LETTERS
IF '%1'=='' C:WP
IF NOT '%1'=='' C:WP %1
C:
CD \BATCH
```

The first IF line executes if no replaceable parameter is on the command line that starts DOLETTER because %1 will be blank. The second line is executed if %1 contains any value. But this still isn't very friendly.

You'd probably like a batch file that starts your word processor and, if you name a file, adds the .LTR extension if needed. The same file could also test to see if the file you named really exists. To do all this, you must introduce a test for the existence of a file and the ability to jump over some lines in the batch file.

The jump is done with the command GOTO plus a label name. The label must be on a line by itself and must follow a colon. If the label doesn't exist, the batch file will end. Here's one way to make the batch file friendly and powerful:

```
@ECHO OFF
CD C:\WP
D:
CD \LETTERS
IF NOT '%1'=='' GOTO
  GOTNAME
C:WP
GOTO CLEANUP

:GOTNAME
IF EXIST %1     C:WP %1
IF EXIST %1     GOTO CLEANUP

IF NOT EXIST %1.LTR GOTO
  NOFILE
C:WP %1.LTR
GOTO CLEANUP

:NOFILE
ECHO File %1 does not exist

:CLEANUP
C:
CD \BATCH
```

Notice that the CLEANUP portion of the batch file in the last two lines is run no matter how the rest of the batch file executes. Whether the word processor runs or not, you'll want to return to your batch directory to run the next batch file.

Using Return Values

All programs return a code to COMMAND.COM upon ending. Some, including most large applications, return a random number. Other programs, like utilities, DOS external

Listing 2. Script to Create Listing 1 Program

```
n userkey.com
a 100
mov ah,8
int 21
or al,al
jz 102
cmp al,61
jb 112
cmp al,7a
ja 112
sub al,20
mov ah,4c
int 21

r cx
16
w
q
```

commands and compilers, return an explicit code between 0 and 255. By convention, a 0 return code means the program was successful. Other return codes are meant to signal various kinds of errors.

You can use the return code from a program in a batch file to determine what should happen next. For example, the DOS XCOPY utility returns a 1 if no files are found to copy; a 2 if you press Ctrl-Break; a 4 to show a memory or syntax error; and a 5 to tell you that the program was aborted by pressing A in response to an "Abort, Retry, Fail" prompt.

In batch files, the return code is stored in an ERRORLEVEL. COMMAND.COM can test whether ERRORLEVEL is equal to or greater than a specified value. For example, the following short batch file, called MYCOPY, displays a message if XCOPY fails to complete its job. Its syntax is the same as XCOPY's:

```
@ECHO OFF
XCOPY %1 %2 %3 %4 %5 %6 %7
  %8 %9
IF ERRORLEVEL 1 ECHO Error
  during file copy
IF NOT ERRORLEVEL 1 ECHO File
  copy was successful
```

One of the oddities of the IF ERRORLEVEL statement in a batch file is that COMMAND.COM sees the statement as true if the ERRORLEVEL code is equal to or greater than the number you specify. ERRORLEVEL 0 is always true; ERRORLEVEL 1 is true if the ERRORLEVEL code is set to any value other than 0. If you want to test for an ERRORLEVEL 5 (or any other specific value), use a line that begins IF ERRORLEVEL 5 IF NOT ERRORLEVEL 6. . . .

You can use ERRORLEVEL to get input to a menu in a batch file. To do so, you need a short program that accepts user input and converts it into an ERRORLEVEL code with which your batch file can work. Listing 1 is an assembly-language program that does just this. Listing 2 is a script that creates the program for you automatically, as long as you have DEBUG on your hard drive. Copy Listing 2 to a text file, making sure you include the blank line and then type DEBUG USERKEY.SCR.

Once you've created the program, look at Listing 3 to see how it can be used to implement a batch file menu. The program converts lower-case letters to upper-case but leaves all other keystrokes unchanged. If you want to know if a specific key has been pressed, look up the ASCII code for that key and test for it as an ERRORLEVEL code.

Multiple Batch Files

It's sometimes convenient—and necessary—to run one batch file from inside another. If one line in a batch file starts another batch file, COMMAND.COM terminates the first and forgets about it. But you may want the second batch program to run as a subroutine of the first and return to the first when the second is done.

If you're using DOS 3.3 or later, you can invoke a second batch file easily with the CALL command, as follows:

```
. . . batch file 1 commands
CALL BATCH2
. . . more batch file 1 commands.
```

If you're using an older version of DOS, you can do the same thing, but you'll have to give up some memory while the second batch file is running. The secret is to start a second copy of COMMAND.COM and ask it to run the second batch file. When the second batch file ends, the second copy of COMMAND.COM returns to the first batch file. The first batch file would look like this:

```
. . . batch file 1 commands
COMMAND /C BATCH2
. . . more batch file 1 commands.
```

The /C is necessary to tell the second copy of COMMAND.COM you want it to run one command (BATCH2) and then exit.

Batch Files and The Environment

The environment is a collection of ASCII information DOS maintains. Each entry in the environment is a name in upper-case, followed by an equal sign and some text. Some programs use environment entries to configure themselves. DOS uses several entries, including PATH and PROMPT, internally. If you want to see the current environment, type SET from the DOS prompt.

You can read, change, create and delete environment entries from within a batch file. If you place the name of an environment entry inside parentheses, COMMAND.COM replaces the name with the corresponding text from the environment before it executes the line. For example, if you want to display the contents of the current COMSPEC setting, you could include this line in your batch file:

```
ECHO Your COMSPEC is set to
  %COMSPEC%
```

One way you can use this capability is to temporarily save an environment value. For example, if you need to change your PATH setting while you run your word processor, then reset the PATH to its original value, you can do something like this:

```
SET OLD_PATH=%PATH%
PATH %PATH%;C:\WP\
. . . run word processor here
PATH %OLD_PATH%
SET OLD_PATH=
```

The first line creates a temporary environment entry called OLD_PATH and gives it the current value of PATH. The second line changes the PATH setting by adding the word-processor directory. The last two lines of this routine restore the PATH setting to its original value and then erase the temporary entry.

With a little trickery, you can also save the current directory in the environment. Once you've done so, you can move to a new directory, do some work and return to your current location in the directory tree automatically. There are several ways of performing this trick. This is one of the easiest.

First, create a new file call OLDDIR.STB (.STB stands for "stub" since this file won't do anything by itself). To create this file, enter the following commands:

```
C:> COPY CON OLDDIR.STB
SET OLD_DIR=    Z
```

The first line opens a new file called OLDDIR.STB and gets ready to copy from the keyboard to the file. The second line puts 12 characters into the file (SET OLD_DIR=) and then a Ctrl-Z, which closes the file. It's very important that the file not contain a closing carriage return nor any spaces before or after the equals sign.

Now, inside a batch file, add the following lines when you want to save the current directory:

```
COPY C:\BATCH\OLDDIR.STB
  C:\OLDDIR.BAT
CHDIR >> C:\OLDDIR.BAT
CALL C:\OLDDIR.BAT
DEL C:\OLDDIR.BAT
```

Line 1 makes a copy of the .STB or partial batch file. Line 2 uses the DOS redirection command to save the current directory setting in batch file. Line 3 runs the new batch file to create an environment entry called OLD_DIR. Finally, Line 4 erases the batch file that is no longer needed.

Now, in your main batch file, you can change to a new directory and perform any necessary activities. When you want to change to the original directory, you can use these commands:

```
CHDIR %OLD_DIR%
SET OLD_DIR=
```

The Forgotten Command

You probably know how to use wild cards in a DIR, DEL and COPY commands. Most DOS users quickly understand that DEL *.DAT can erase a lot of work in a hurry. But do you know how to copy all .DAT, .BAK and .BAT files to an archive disk with a single command? If you don't, you're not alone; few DOS users know how to use the FOR command.

If you type the following from the DOS command line, COMMAND.COM copies all .DAT and .BAK files from the current directory to drive B:

```
FOR %F IN (*.DAT *.BAK) DO
  COPY %F B:
```

Another way to use the FOR command is to run CHKDSK on all your hard drive volumes and save the results on your printer:

```
FOR %D IN (C: D: E: F:) DO
  CHKDSK %D > PRN
```

The FOR command is made up of the word FOR, a variable name made up of percent sign followed by a single letter, the word IN, a set in parentheses

Listing 3. Program to Convert Lower-Case Letters to Upper-Case Letters

```
@echo off
rem   This batch file shows how to use USERKEY.COM
rem   to add a menu to a batch file.  It assumes
rem   that USERKEY.COM is in the current directory
rem   or accessible through your PATH setting
rem

:start
cls
echo    Pick the Work You Want to Do
echo.
echo    1. Word Processing
echo    2. Spreadsheet
echo    3. Database
echo    4. Return to DOS

:getkey
echo    Enter your choice:
userkey

rem   Now that we have a key, we have to test to see
rem   which one the user selected.  The tests use the
rem      ASCII codes of the '1', '2', '3', and '4' keys

If Errorlevel 49 if not Errorlevel 50 goto Wordproc
If Errorlevel 50 if not Errorlevel 51 goto Spreadsheet
If Errorlevel 51 if not Errorlevel 52 goto Database
If Errorlevel 52 if not Errorlevel 53 goto DOS

rem   If the user pressed an unwanted key, we trap it
rem   here are wait for another key.
goto getkey

:Wordproc
rem   put the commands here to start the word processor
goto start

:Spreadsheet
rem   put the commands here to start the spreadsheet
goto start

:Database
rem   put the commands here to start the database
goto start

:DOS
rem   Fall off the end of the program and return to DOS
```

that may contain wild cards, the word DO and a command. You can use the %-letter variable name in the command. COMMAND.COM executes a FOR by expanding any wildcards inside the parentheses and making each filename a separate set item. After this, it executes the command once for each item in the set.

If you want to use FOR in a batch file, you must use two percent signs in the variable name. Otherwise, the command works the same from inside a batch file and from the command line prompt.

Because the FOR command accepts only a single command after DO, you can't normally use it to copy a file, test the ERRORLEVEL of the copy command, erase the original if copy was successful and then repeat. Other complex operations are equally impossible to perform.

However, you can use the single command to start a second batch file and send it the variable as one of its parameters. In the first batch file, you might have something like this:

```
FOR F in (*.DAT) DO MYBACKUP F
```

MYBACKUP.BAT receives the necessary file name as %1 (its first replaceable parameter) and do whatever testing or other work is necessary.

Conclusion

The DOS batch language interpreter certainly isn't a full programming language. It has severe limits, including a lack of loop constructions, arrays, numeric variables and true IF/THEN/ELSE structures. If you need those advanced features in a batch-like setting, you should investigate a programming language called *Personal REXX*. You might also want to consider replacing COMMAND.COM with a better and more powerful command interpreter, the best known being *4DOS*.

Despite the restrictions DOS puts on batch files, you can accomplish a lot more with them than most people realize. All you need is a clear understanding of the available commands and some cleverness to work around most of the restrictions. Some of the ideas I've presented here should jog your creativity enough to let you create batch files that make your computer more powerful and more fun to use.

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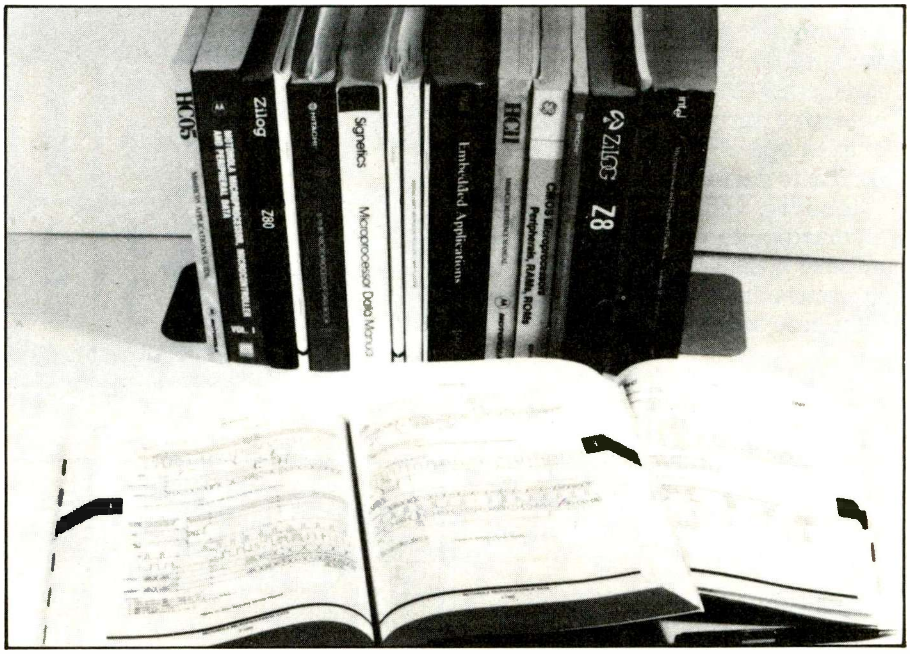
How to Choose a Microcomputer Chip

Tips on helping you through the difficult process of selecting just the right chip for your next project

Is there a project you'd like to get started on, if only you can decide on which microcomputer chip to use in your circuit? Do you wonder if there's a better device than the one you always use out of habit? Does it really make any difference if you choose Intel or Motorola; Zilog or Hitachi; 4, 8, 16 or 32 bits; on-chip ROM, EPROM, EEPROM or no ROM? Do you find the selection overwhelming, the part designations baffling?

This month, I'll help you through some of the confusion in selecting a microcomputer chip for a particular project. The goal is to find an easy-to-use, readily available, reasonably priced IC with abilities that match whatever it is you want to accomplish in your circuit.

The focus here is on single-chip microcomputers intended for use in single-purpose or embedded designs, where the computer executes a single program stored in an EPROM or other solid-state memory device. In other words, I won't be getting into topics like the debate between 68000-based versus 80x86-based personal computers. Instead, I'll focus on chip choices for smaller dedicated systems that you might build yourself.



The Basics

All microprocessors contain a central processing unit (CPU) that executes instructions that it reads from memory. The instructions are a defined set of binary words that tell the CPU to perform actions like arithmetic operations (add, subtract, multiply), logic functions (AND, OR, NOT), data moves (move the contents of a memory location to another location) and branching (jump to a new program location). A program consists of a series of these instructions, which the microprocessor executes in a controlled, timed sequence.

Microprocessors may differ in aspects like architecture (internal design), instruction sets (what instructions are available) and electrical characteristics (clock speeds, power consumption, and so on). In addition, as circuit technology has progressed, chip designers have been able to add more and more features, resulting in single-chip microcomputers that include a microprocessor, memory, the ability to access external peripherals and other special features, all on a single IC.

Many manufacturers offer full families of devices, where all members execute the same basic instructions but have different combinations of features optimized for different applications. For example, Motorola's popular 6805 family of microcomputers includes the basic 28-pin CMOS MC146805F2 with 1K of ROM and 64 bytes of RAM; the mid-range 40-pin HMOS MC68705R3 with 4K of UV-erasable EPROM and 112 bytes of RAM; and the top-of-the-line 52-pin HCMOS MC68HC805B6 with 6K of bulk-erasable EEPROM, 256 bytes of byte-erasable EEPROM and 176 bytes of RAM.

There are 6805 devices in DIP and PLCC packages, with as few as 16 or as many as 32 I/O lines, with 8- or 16-bit timers, and with or without serial communication interfaces and analog-to-digital (A/D) converters. The choices may seem confusing, but the result is that you can select and pay for only what you need.

Usually, a device family will be developed by a single manufacturer, but if the family is successful, others begin to offer compatible devices. For example, although Intel was the originator of the 8051, other manufacturers offer compatible chips, including Siemens' 80C517A, which has a 12-channel, 10-bit A/D converter and even an on-chip math coprocessor.

How do you know if a particular IC can meet the requirements of your proposed circuit? Or to put it another way, how can you find the IC that will do what your circuit requires, with few hassles and at a reasonable price?

The first task is to define what it is you need the chip to do. From there, you can look for the best match between what you need and what's available in the marketplace.

Here are some questions that will help you define your requirements.

Memory Questions

How much and what types of memory do you need? Computer memory can be divided into program storage, which holds the code that the computer executes, and data storage, consisting of values used in calculations, addressing memory, and performing other operations as a program executes. Memory can also be volatile or nonvolatile, reprogrammable or not and embedded in the microcomputer chip or not.

Nonvolatile memory, which can be ROM, EPROM, EEPROM or battery-backed RAM, retains its contents on powering down and is used to store programs and other unchanging information. EPROMs, EEPROMs and battery-backed RAMs are reprogrammable; so you can revise and update your program without having to replace the chip. All except UV-erasable EPROMs are programmable in-circuit. Mask-programmed ROMs and one-time-programmable (OTP) EPROMs can't be re-programmed and, thus, are suitable only for information that won't change.

Volatile memory (RAM) loses its contents on powering down. Therefore, it's useful only for temporary storage, such as holding a value for later use in a program.

The amount of program memory you need depends on the program's complexity, programming language you use and even how good a programmer you are. If you haven't yet written your program (and you can't write the program until you know which microprocessor you'll be using), estimating program size may seem like an impossible task.

To give you an idea of how much memory typical programs require, I searched my files—including back issues of this magazine—and found these examples of projects and the amount of nonvolatile memory contained in each:

1k byte—multi-line I/O controller, electronic name badge, speed controller for model train;

2k bytes—sine-wave look-up table, EPROM programmer, programmable-logic programmer;

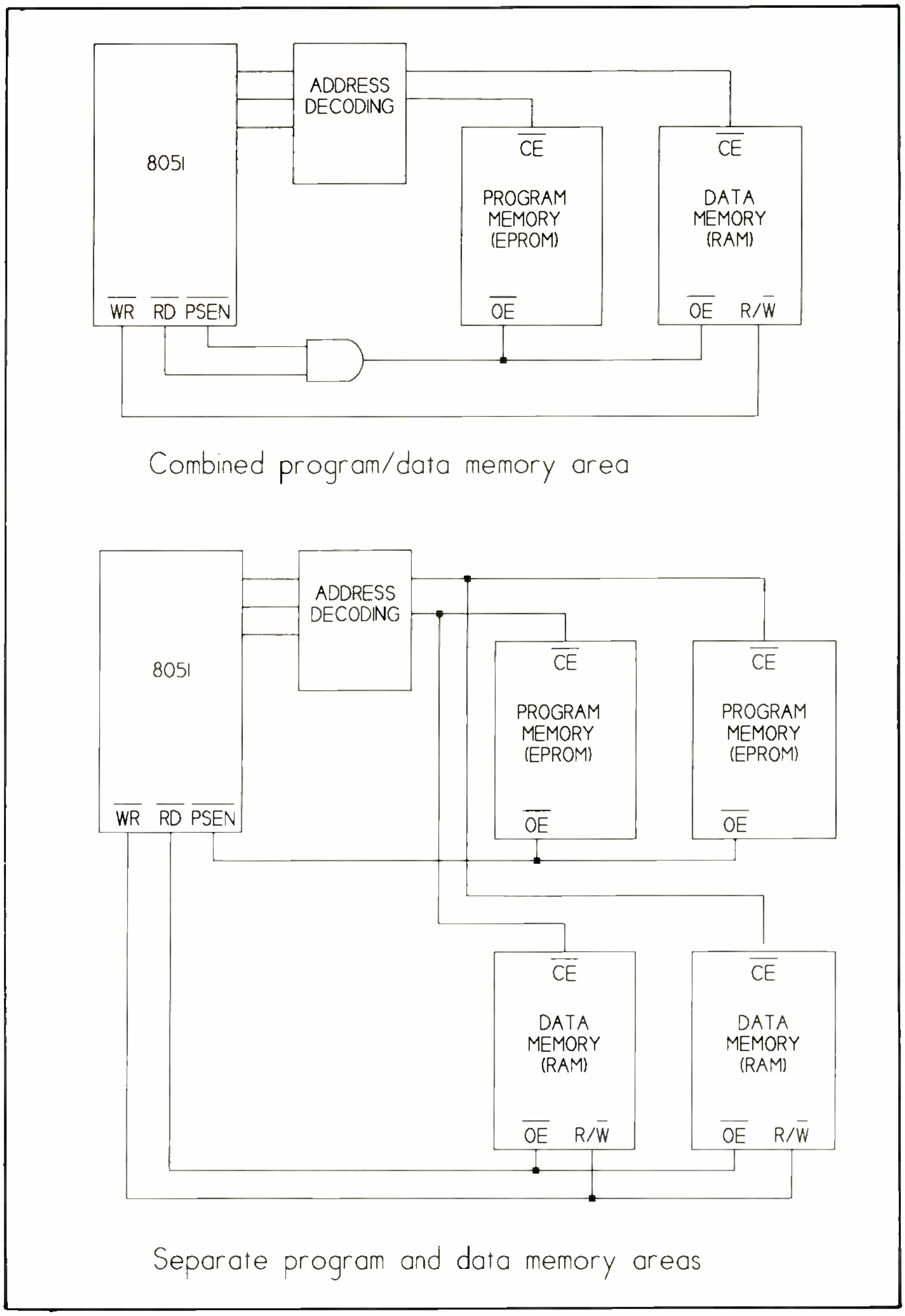


Fig. 1. With the 8051 and some other chips, you can double the amount of addressable memory by establishing separate program and data memory areas. Program memory is read with PSEN and cannot be written to. Data memory is accessed with RD and WR.

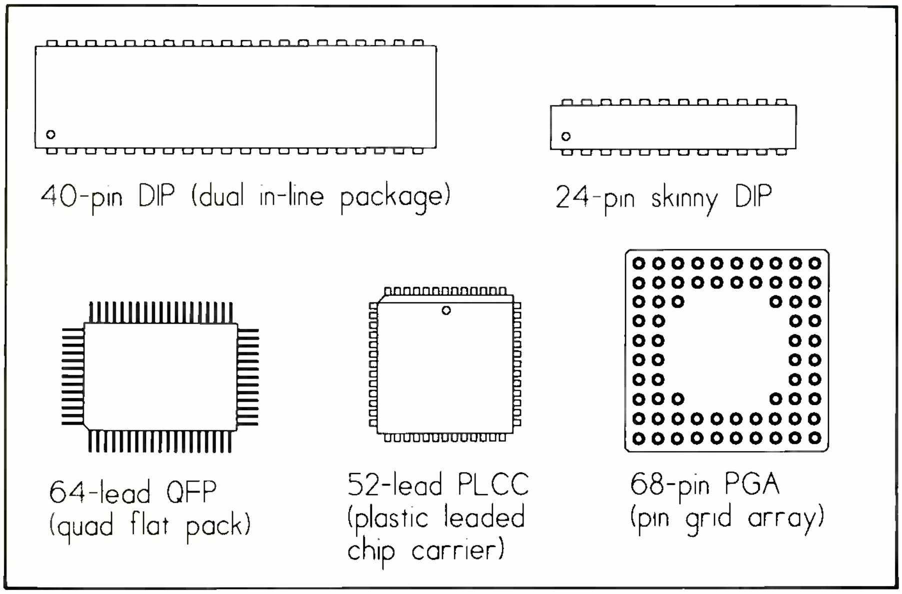


Fig. 2. Examples of popular packages for microcomputer chips.

4k bytes—RAM tester, darkroom timer;

8k bytes—MIDI sequencer, data logger, maze-running robot, LCD tester, car diagnostic tool, talking intruder alert, programmable waveform generator;

16k bytes—full-featured weather monitor.

Of course, these examples can give only a very rough idea of what to expect. When in doubt, estimate upwards from what you think you'll need. Often, the cost for more memory is small.

Programs you've written that are similar to your proposed one will give you an idea of the size of your current project. So the more experienced you become, the easier it will be for you to estimate program size.

The programming language you use will also affect program length. As a general rule, assembly-language programs are more concise than equivalent programs that were originally written in BASIC and other high-level languages, although modern compilers are doing a good job of generating concise code.

In addition to program memory, you must estimate how much data memory your project requires. Data memory may include numerical values to be used in calculations, memory locations to be addressed by the program and any information other than that used for program code. Sometimes, data memory must be nonvolatile—as, for example, when values stored by a data logger must be retained after powering down. Many projects can get by with very little data memory—a hundred bytes or less.

For small systems, you can often find a microcomputer that has all needed memory on-chip. If space-saving or simple hardware design is essential, you'll want to try to use on-chip memory exclusively. When this is impossible, you'll have to interface external memory to the microcomputer.

The amount of external memory a computer can address is determined by the size of its address bus. The address bus is a series of signal paths the CPU uses to specify memory locations to be accessed. A popular address-bus size is 16 lines (A0 through A15), which can address 2^{16} power, or 65,536 (64K) addresses. With eight address lines, you get just 256 memory locations, while 32 lines allows over 4-billion bytes of storage.

Some microprocessors increase the amount of addressable memory by defining more than one external memory area, with different control signals for each. For example, the 8051 and Z8 families permit you to distinguish between data and program memory areas, which doubles the amount of addressable memory (Fig. 1).

Execution Speed

Is execution speed a critical factor? For many projects, you don't really have to worry about how fast a program executes. A data logger that stores occasional sensor readings doesn't have to be blazingly quick. But if you're designing an engine controller that must read a dozen inputs, process the information and respond in microseconds, you need to know that your microprocessor can keep up with these demands.

Factors that influence how fast a program executes include the size of the microcomputer's data bus, clock speed, programming language used and efficiency of the CPU.

• *Data Bus Size.* The data bus is a series of signal paths on which the CPU reads and writes data. When adding, comparing or otherwise processing 32-bit values, a computer with a 32-bit data bus will be faster than one that has to process the data in four steps of eight bits at a time.

Many projects don't involve intensive processing of large values; so a 16-, 8- or even 4-bit data bus may be large enough. Devices with eight-bit data buses have been popular, since they're fast and powerful enough for many projects, yet low in cost.

• *Clock speed.* Each microprocessor instruction requires a defined number of clock cycles to execute. The faster the clock, the faster the program runs. The clock is based on the frequency of an external crystal or other high-speed frequency source. Be aware, though, that the external crystal's frequency may not be the same as the internal clock's frequency.

For example, HC11 microcomputers internally divide the crystal frequency by four to achieve the internal clock's frequency. This means that an HC11 instruction that requires two clock cycles actually requires eight cycles of the external crystal. So you can't necessary compare microprocessor speeds by the values of their external crystals.

• *Processor Efficiency.* In addition to clock speed, a factor affecting execution speed is efficiency, or how many clock cycles the CPU requires to perform a function. For example, in comparing three eight-bit microcomputers (Z8, 8051 and 6801), Zilog claims that its Z8 is more efficient because you can save all working registers with a single instruction and use any register as an accumulator or index register instead of having to funnel all values into and

Say You Saw It In ComputerCraft

out of one or two special-purpose registers.

Instruction sets of many microcomputers include Boolean instructions that permit quick and easy ANDing, ORing and complementing of single bits in memory. Using these functions can speed up execution (and programming) time as well.

Microprocessors that have dedicated instructions for multiplying and dividing are faster at these operations than devices that require them to be programmed in manually with shift and add instructions.

Without actual experience with a microprocessor, it can be difficult to judge how efficient it will be in your application. In general, devices with larger data buses are more likely to have larger instruction sets and, thus, be more efficient. You can also check the data sheets for clues about any special benefits offered by a particular instruction set.

• *Programming language.* Assembly language can generate fast-executing programs, as well as concise ones. So you'll want to consider using assembly language if fast execution is essential.

Input/Output

How many I/O lines do you need? Microcomputer chips are generally equipped with ports, which are external pins that you can read from and write to directly. Ports can be one-way (input-only or output-only) or bidirectional (input/output).

You can use port pins to interface to switches, displays, A/D converters or any device with digital inputs or outputs. If you use a data/address bus to interface to external memory, you can also use free memory locations to interface to peripheral devices like these.

What about interrupts? An interrupt is an event that causes a program to stop what it's doing and jump to a special interrupt-service routine in your program. Interrupts can occur unpredictably. For example, a security system might trigger an interrupt to sound an alarm when a door or window opens. Some circuit designs require no interrupts, while others require many.

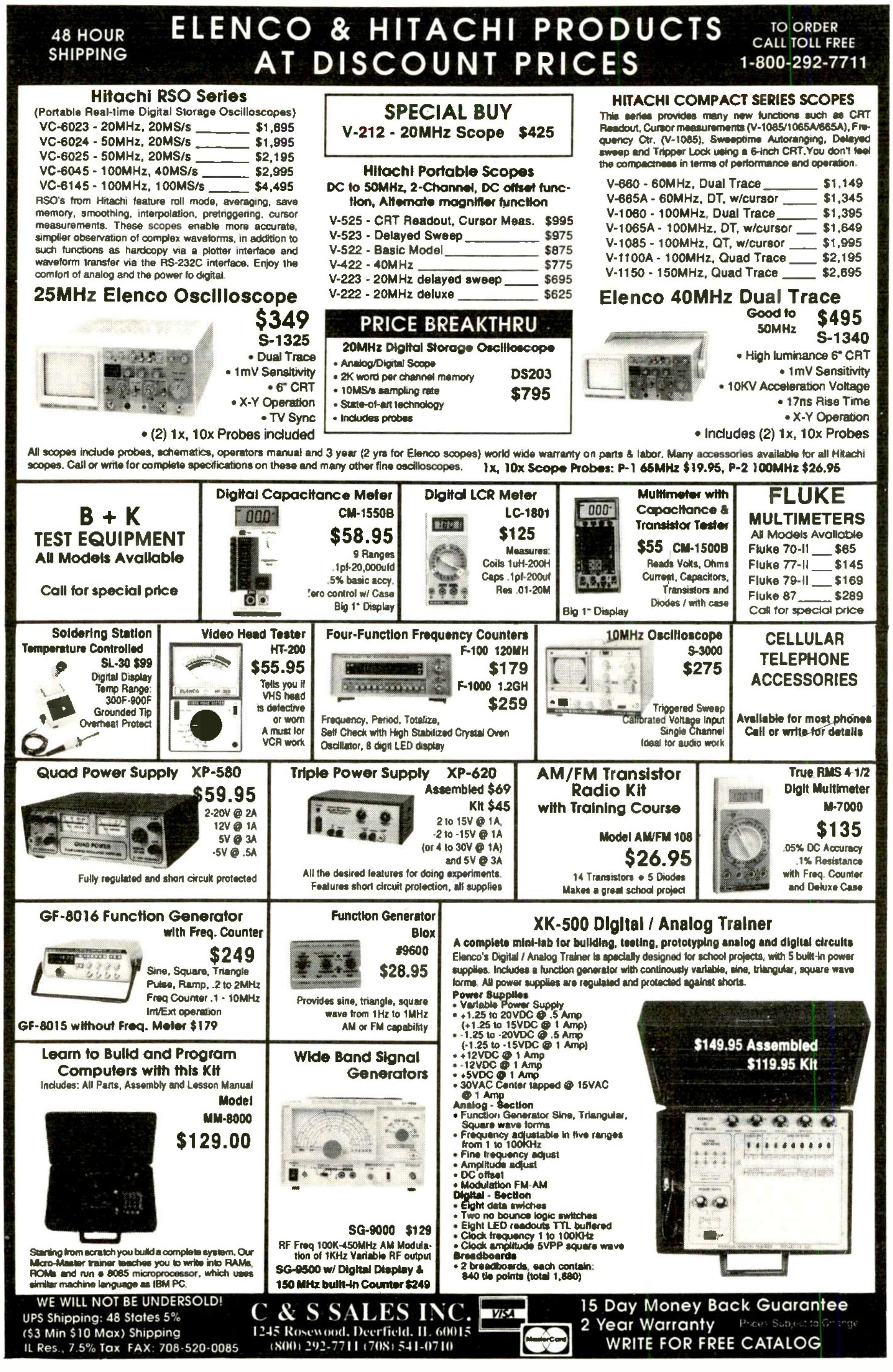
In addition, sometimes interrupts must be prioritized, to let the computer know what to do first if multiple interrupts occur simultaneously. In the security-system example, an interrupt indicating an alarm would have higher priority than an interrupt requesting a printout of status information or other routine functions.

Different microprocessors vary in number of interrupts and priorities allowed. Therefore, you must analyze your needs in this area and be sure that the chip you choose has the capabilities you need.

Special Features

What special features do you need or want? As chips are becoming more and more highly integrated, with increasing numbers of functions included on-chip, it's getting easier to find a single chip that includes many or all of the features you need. Typical extra features include these:

• *Serial Communications Interface*—Permits easy communication with other serial devices. Asynchronous serial interfaces are typically used to communicate with other computers via RS-232, RS-422 or RS-485 interfaces. One common function is to



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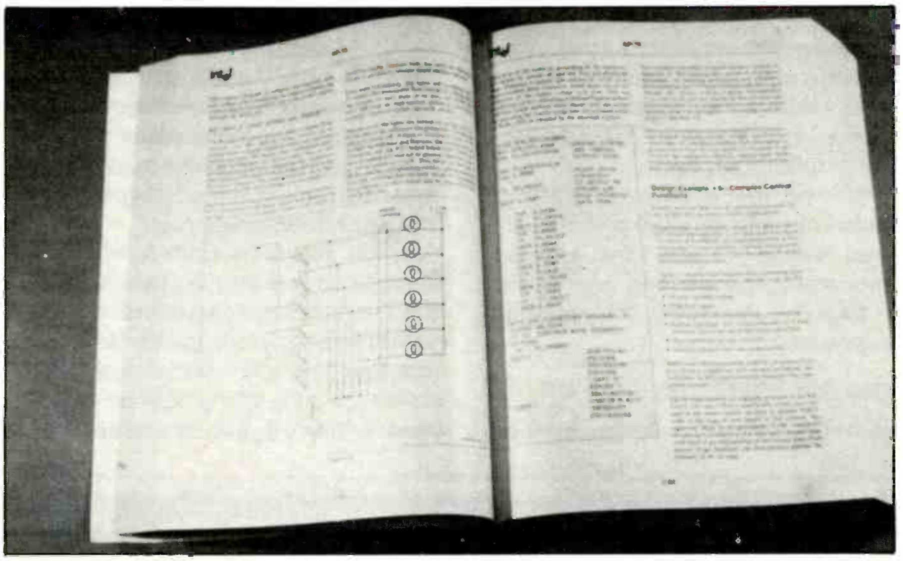

Fig. 3. Manufacturers' selection guides can help you decide which specific device to use within a family of devices.

communicate with a host computer during program development. Synchronous serial interfaces require a common clock signal and are more limited in the distances over which they can communicate, but they often can transmit faster.

• *Counter/Timers*—This category includes free-running timers, pulse accumulators (to count input pulses), event counters (to measure the time between pulses) and watchdog timers (to check for the presence of a periodic signal).

• *Power Management*—Special modes to reduce power consumption when the microprocessor is idle.

• *Analog-to-Digital Converter*—Used for measuring sensor outputs and other analog inputs.

•*Real-Time Clock/Calendar*—Used for time-keeping in hours, minutes and so on.

Because the number of pins on a chip is limited, some pins may have alternate functions to choose from. For example, general-purpose port pins may double as timers, serial interfaces or a data/address bus.

Electrical/Mechanical Considerations

Is limiting power consumption important? If your circuit is to operate on battery power, you'll want to keep power consumption to a minimum. Look for CMOS devices with built-in power-saving functions and as many circuit elements as possible on-chip.

What's the power-supply voltage? Most modern microcomputers operate from a single 5-volt dc supply, but some can use supplies as low as 3 volts dc, which is an advantage in battery-powered circuits.

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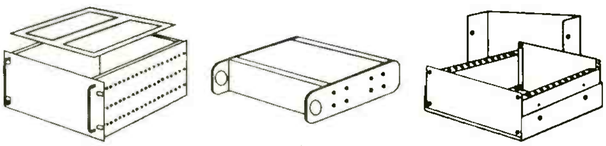

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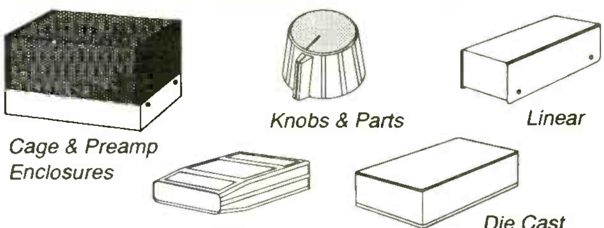

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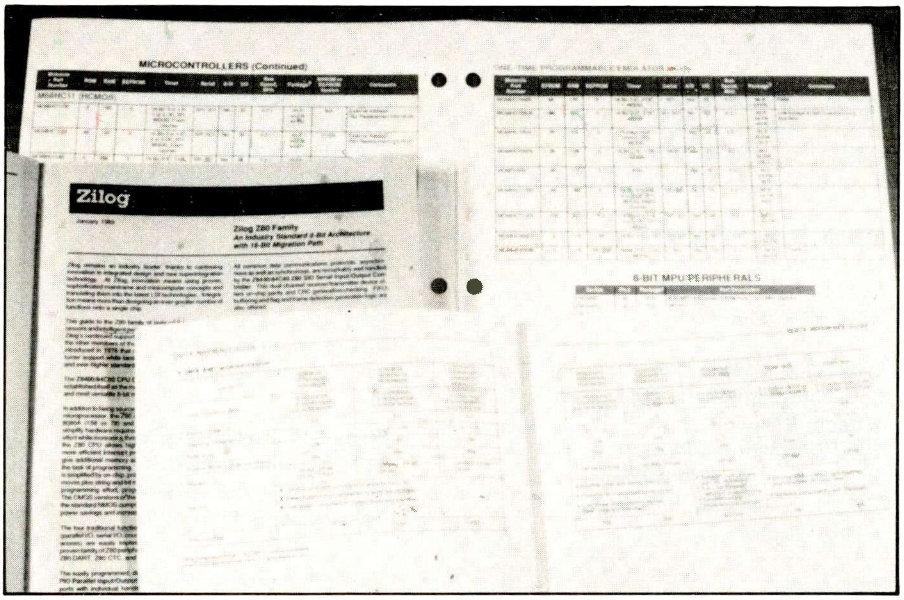

Fig. 4. Some data books include examples of hardware designs and programming code, which you can use or adapt in your own designs.

Which package type? Currently popular packages for microcomputer ICs include the traditional DIP (dual in-line package), as well as the PLCC (plastic leaded chip carrier), QFP (quad flat pack), SOIC (small-outline IC) and PGA (pin-grid array). Figure 2 shows examples.

DIPs have two rows of legs for inserting into a circuit board or IC socket, and are convenient for prototyping. DIPs are usually low in cost.

Surface-mount packages, including the SOIC shaped like a miniature DIP, and the QFP, with leads spaced 0.05″ or less (as opposed to the 0.1″ spacing for DIPs) on all four sides, are compact packages. Surface-mount ICs don't use through-holes; instead, they solder onto the component side of the pc board.

PLCCs are compact, square packages that can plug into through-hole or surface-mount sockets. Consequently, these are perhaps the most flexible type.

PGA packages provide a way of allowing many leads—sometimes more than 100—on a single package by spacing them along a grid on the underside of the chip.

Which package you choose depends on your application. For printed-circuit-board construction, you can use any package. However, for construction on perforated board, you'll probably want a DIP or a PLCC in a through-hole socket. If conserving space is essential, go with surface mount, PGA, PLCC or "skinny" DIP, depending on what's available for the device you want to use.

Making a Choice

Once you've decided what it is you're looking for in a microcomputer chip, it's time to see if your ideal product exists and, if not, what is the best choice out of the available options. To help in your research, start collecting data books. If you're starting from scratch, choose three or four manufacturers and order data books to get an idea of what's available.

Which ones to order? Everyone has opinions about which companies offer the best products. For many applications, especially simpler ones, you can use devices from any of a variety of sources with good results.

The "big two" sources for single-chip microcomputers are Intel and Motorola. Others include Zilog, National Semiconductor, Philips/Signetics, Harris/GE and Hitachi. The Sources box in this article lists addresses and telephone numbers for these and others.

If you're just starting out and are looking for a device family to learn about and experiment with, you won't go wrong with either Intel's 8051 or Motorola's 6800 family. Both are extremely popular eight-bit devices, and because of their popularity are available in many variations on the basic chips and many support tools. Zilog's Z8 is another good choice. Another Zilog chip that has long been popular for single-board designs is the Z80 microprocessor.

If you have friends or coworkers who have experience with similar projects, ask them for recommendations. When you see articles or other documentation for interesting projects, make a note of which devices they use. Find out which chips are available from your usual parts sources. These are probably popular ones, and you know they're readily available.

Most manufacturers publish a selection guide, either inside the data book or as a separate document, to help you decide which devices to use for a particular application. Figure 3 shows examples. The selection guides list the major features of the devices offered. When you find one that looks like a good candidate—in other words, it has enough on-chip memory, I/O lines, interrupts, special features and so on—the next step is to find out if it's readily available, affordable and easy to use. The following questions will help you determine this:

Is the IC readily available? The greatest chip in the world does you no good if you can't get it. Sometimes it can be difficult to track down a source for a chip, especially if you're buying in single or small quantities.

All manufacturers provide lists of distributors for their ICs, some of which accept orders in small quantities. In addition, some manufacturers take orders directly, and may even send samples at no charge. Also, check the sources I listed last month for microprocessors and other ICs.

Is it affordable? Prices for microcomputer ICs in small quantities range from a couple of dollars on up to $30 and more. Don't forget that a more-expensive chip may save you money in the long run if it has features and capabilities (on-chip memory, timers, low-power operation, etc.) that simplify your design.

What assemblers, compilers and interpreters are available? You can't use a microcomputer chip unless you have a way of writing programs, either in assembly or another programming language. For single-board designs, popular languages include BASIC, C and Forth. Like the choice of which chip to use, the choice of programming language is personal. In general, it's probably safe to say that BASIC is easy to program in but may produce programs that are slow to execute, while assembly language and C are more difficult to program in but more powerful and efficient.

Compared to assembly language, C has the advantage of being somewhat portable—its basic syntax and conventions are similar, no matter which C compiler you use. With assembly language, you have to learn a new set of mnemonics and conventions for each device family.

Forth is another popular language for embedded designs, partly because it allows you to extend the language easily, adding your own keywords that you customize to your application.

For most microprocessors, there's some form of freeware or low-cost assembler, compiler or interpreter, often available from BBSs. Motorola is especially good in this area. If you're on a tight budget, the existence of a free or low-cost programming language can be the deciding factor in choosing a microprocessor family.

Also don't overlook the value of familiarity in choosing a microcomputer chip. If you've designed four projects using Hitachi microcontrollers, you'll probably have an easier time with your fifth project if you stick with Hitachi, unless you have a compelling reason to switch.

Are development tools available to help you test and debug your project? Your project will come to life faster if it's easy to test and refine your design as you develop it. One popular form of development system consists of the target system (a circuit similar to the one you're developing) and a host system (a desktop computer) connected by a serial link. You write your program on the host system, download it into RAM on the target system, run it on the target, monitor what happens, modify as needed and try again until you have the desired results.

If you're considering a chip with an embedded EPROM, be sure your development system or EPROM programmer can program the EPROM. Many manufacturers as well as outside sources offer development systems for different device families.

Sources

Dallas Semiconductor
4350 S. Beltwood Pkwy.
Dallas, TX 75244-3292
Tel.: 214-450-0400 or 1-800-336-6933

Harris Semiconductor
P.O. Box 883
Melbourne, FL 32901
Tel.: 407-724-7800

Hitachi America, Ltd.
Semiconductor & IC Div.
Hitachi Plaza
2000 Sierra Point Pkwy.
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Motorola Semiconductor Products Inc.
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Jan Axelson

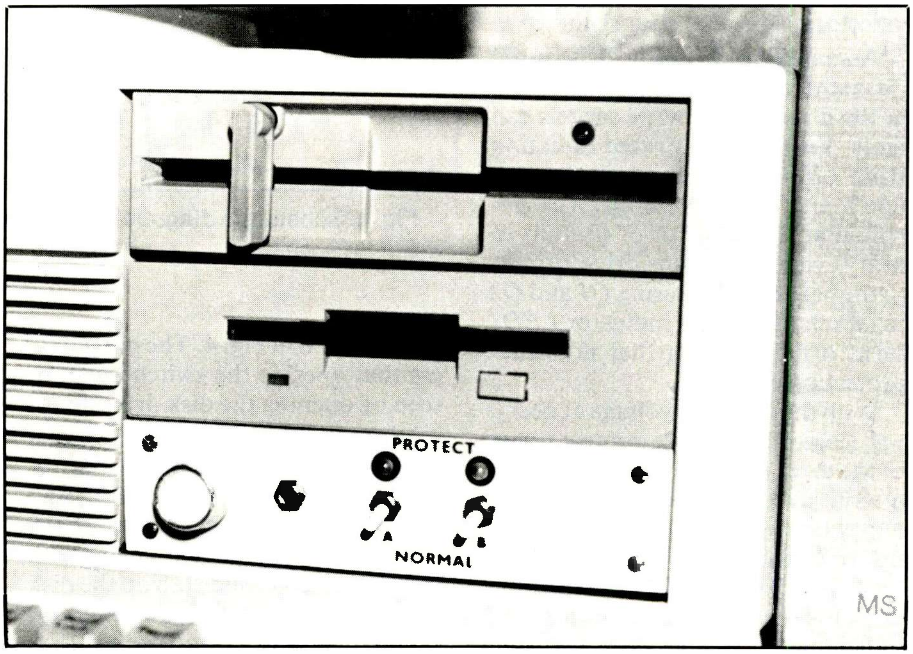
Add Write-Protect Switches to PC Floppy Drives

Simple disk-drive add-on allows you to manually write-protect floppy disks simply by flipping a switch

Write-protect tabs on 5¼" and slides on 3½" floppy disks provide positive assurance against writes to disk. They give you the ability to protect your disks against accidentally writing damaging data to a disk when you first explore file handlers, disk sector utilities and even new applications software. Too, they guard against, say, a word processor invoking a save-to-disk of a file you erroneously edited and, in the process, overwrite a text, batch or assembly file with errors. The caveat to all this safety is that you must remember to write-protect the disks you don't want altered.

Juggling the write-protect status of disks can be an annoyance, though. With 5¼" diskettes, you have to place a separate tab over the write-protect notch—assuming you can even locate the packet of write-protect tabs supplied with your disks. With 3½" diskettes, the task is simplified because the means for write-protecting them is built right into the disk housing; you simply move the plastic slider to the position that opens the write-protect hole in the housing (this is just the opposite procedure as that used with 5¼" diskettes).

There's a simple way around all of this juggling with write-protect tabs and slides. It's a hardware modification that entails installing a switch and write-protect status indicator for each disk drive you have in your system. When you want to protect a disk from writes, you simply flip the switch to the PROTECT position and the write capability of the drive(s) is disabled and the PROTECT indicator turns on (see lead photo). This eliminates on-disk write protection for all but archival disks. Disks that already have on-disk write protection override the switches.



About the Circuit

The write-protect circuit of a disk drive controls signal line WRP on the ribbon cable that connects the drive and FDC (floppy-disk controller). All floppy drives in a daisy-chain set-up access the common write-protect signal line. When DOS selects a drive for a write to disk, and if the disk is write-protected, logic circuitry on the selected drive senses these conditions and pulls low the WRP line. The FDC senses this active low and halts any attempt to write to disk and issues an interrupt to DOS that causes the familiar "disk write protected" error message to appear on the monitor screen. By flipping a switch in the modification described below the FDC is tricked into believing that a disk placed in the drive is write-protected, even though it may not have a write-protect tab or slide in place. A light-emitting diode lights when this is done, indicating that write-protection is active.

Shown in Fig. 1 is the circuitry that must be added to a 5¼" disk drive to accomplish the above. PROTECT switch *S1* for this drive is paired with status-indicating light-emitting diode *LED1*.

Note in Fig. 1 that a portion of the write-protect circuitry of the 5¼" drive is shown in the tint area at the left. When the disk is inserted, the write-protect notch along its edge aligns between phototransistor Q_a and photodiode LED_a on opposite sides of the disk in the drive.

The arrow at the top-left in Fig. 2 points to the phototransistor assembly in a typical 5¼″ drive. This arrangement has LED_a on the main board that mounts on the other side of the disk inside the drive. The photodiode and phototransistor function as an optical-interrupter. PROTECT switch *S1* in the add-on circuit bridges a trace that must be cut in the emitter ground return trace for the phototransistor on the drive circuit board. The WRP signal sensed by the logic on the disk drive appears at the collector of the phototransistor.

Assume that *S1* in Fig. 1 is closed (NORMAL position) and that the disk in the drive has no write-protect tab on it. Visible and infrared radiation from LED_a passes through the disk notch and switches on Q_a. The potential at the collector of Q_a falls to near 0 volt. This stops drive current to the base of *Q1*, causing *Q1* and *Q2* to switch off. Status indicator *LED1* turns off, indicating that no write-protection exists.

With the collector voltage at near 0 volt (logic 0), the write-protect signal of the drive isn't asserted, permitting a write-to-disk. If *S1* is now set to PROTECT (opened), the condition at the collector of Q_a goes to logic 1 (about +5-volts). This causes the drive to issue the write-protect status signal and precludes any write-to-disk operation. Simultaneously, *Q1* and *Q2* switch on and cause *LED1* to light to indicate that write-protection is in effect.

Internal impedance Z_{int} looking back from the collector of Q_a is in the megohm range, which dictated use of the Darlington-pair transistor arrangement shown as *Q1* and *Q2* and a large-value resistance for *R2* in the base circuit of *Q1*.

As you can see, the Fig. 1 circuit is powered from the 5-volt supply of the disk drive to which it is fitted.

A slightly different circuit design is required for a 3½″ floppy drive, as shown in Fig. 3. This type of drive uses a plunger-actuated mechanical switch instead of the costlier optical interrupter. To further economize, the write-protect switch SW_a and disk-ready switch SW_b make up one component that has three solder lugs, as illustrated in Fig. 4. The pin plungers that operate the switches can be seen by opening the disk drive door.

Disk-ready switch SW_b senses when a disk is inserted into the drive. The two actuating pins for SW_a and SW_b ride the bottom surface of the disk. The pin on the right aligns with the write-protect slide tab on the disk and is pushed down and opens SW_a when a disk that is not write-protected is in the drive. The plunger on SW_b rides the case of the disk and is pushed down to open this switch when the disk drops into place.

In the Fig. 3 circuit, *S2* connects in parallel with SW_a. Assume that the disk in the drive doesn't have its write-protect slide covering the rectangular hole in the case of the disk and that *S2* is set to NORMAL. With the disk in the drive, the plunger of SW_a is pushed down by the slide and opens the switch, causing terminal X of SW_a to go low. The base of *Q3* is now deprived of current, which causes this transistor and *LED2* to switch off. Drive logic senses that SW_a is open and doesn't issue a write-protect signal to the FDC, thus allowing disk read or write.

If *S2* is now closed, terminal X of SW_a goes high and causes the drive to issue a write-protect signal that precludes any attempt to write to the disk, even though the slide on the disk isn't set for write-protection. Transistor *Q3* now receives base drive current and switches on write-protect status indicator *LED2*.

If the disk in the drive is already write-protected, the plunger on SW_a occupies the hole and this switch remains closed. Under these conditions, the drive issues a write-protect signal that prevents disk writes while *LED2* is on.

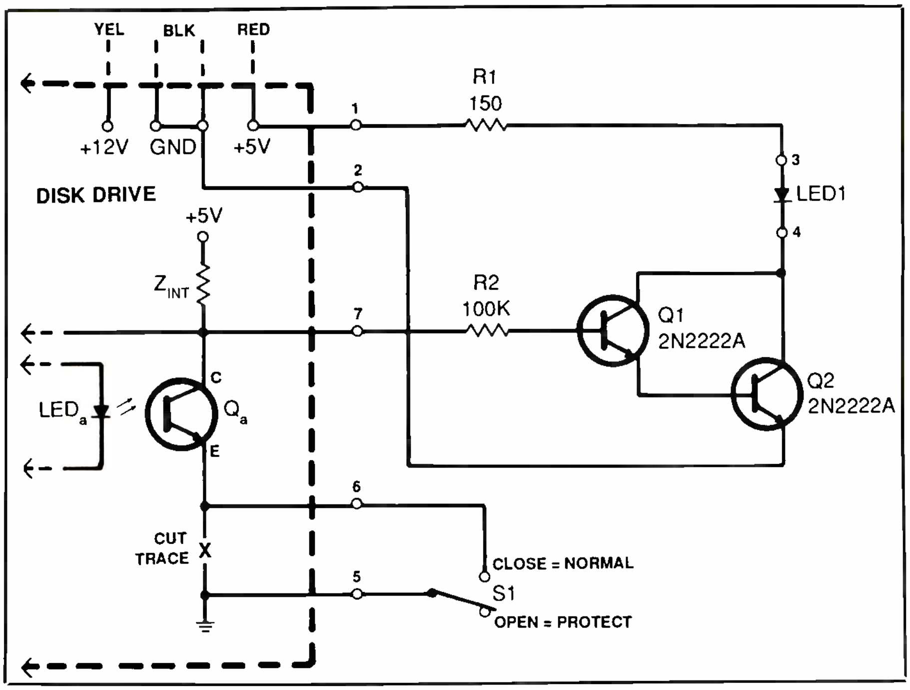


Fig. 1. Schematic diagram of write-protect circuitry for 5¼″ floppy drive.

PARTS LIST

Semiconductors
LED1,LED2—Red light-emitting diode
Q1,Q2,Q3—2N2222A general-purpose npn silicon transistor
Resistors (¼-watt, 10% tolerance)
R1,R3—150 ohms
R2—100,000 ohms
R4—4,700 ohms
Miscellaneous
S1,S2—Miniature spst toggle switch
Printed-circuit board or perforated board and suitable soldering hardware (see text); four-pin cable connectors (2); LED panel mounts; dry-transfer lettering kit; Wire Wrap wire; stranded hookup wire; solder; etc.

Preliminary Steps

Before you install either or both of

the add-ons described above, you must determine the requirements of the floppy-disk drives in your system. Therefore, perform the following tests to ascertain compatibility and to identify connecting points.

Begin by unplugging your computer and removing the cover of its system-unit box, and remove the clips that retain the drive at front of the chassis. This done, slide forward by several inches the 5¼" drive in the top bay. You will now note that the power cable and connector at the rear of the drive has four wires attached to it. The red (or red-orange) wire at one edge of the connector has +5 volts on it and the yellow wire at the other edge of the connector has +12 volts on it. The two black wires in the middle are for ground connections.

Locate the four solder pads on the main circuit board associated with the power connector and the write-protect photosensor assembly (top-left in Fig. 2) and identify the two connections. The sensor assembly may vary in appearance from one drive to another and may have two connecting wires instead of two circuit-board traces.

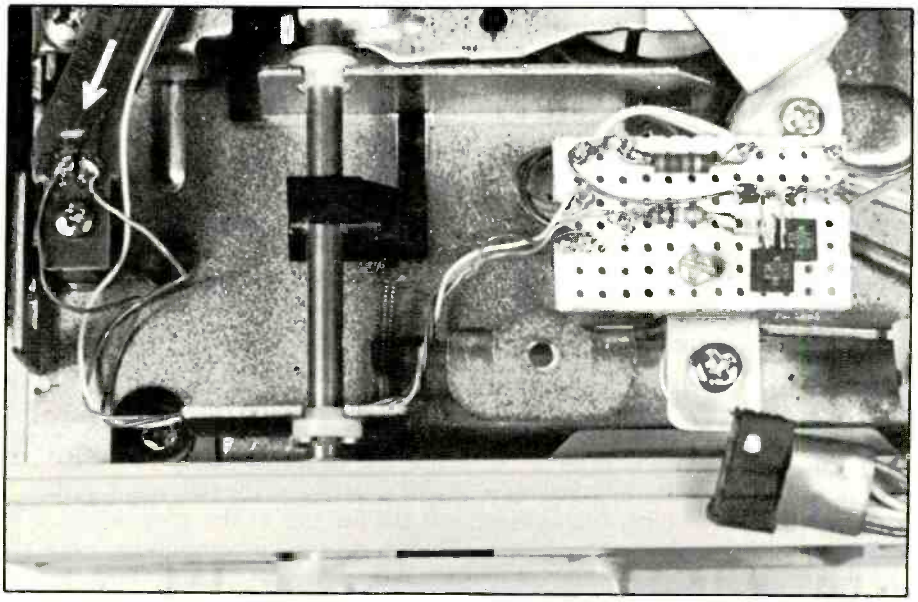
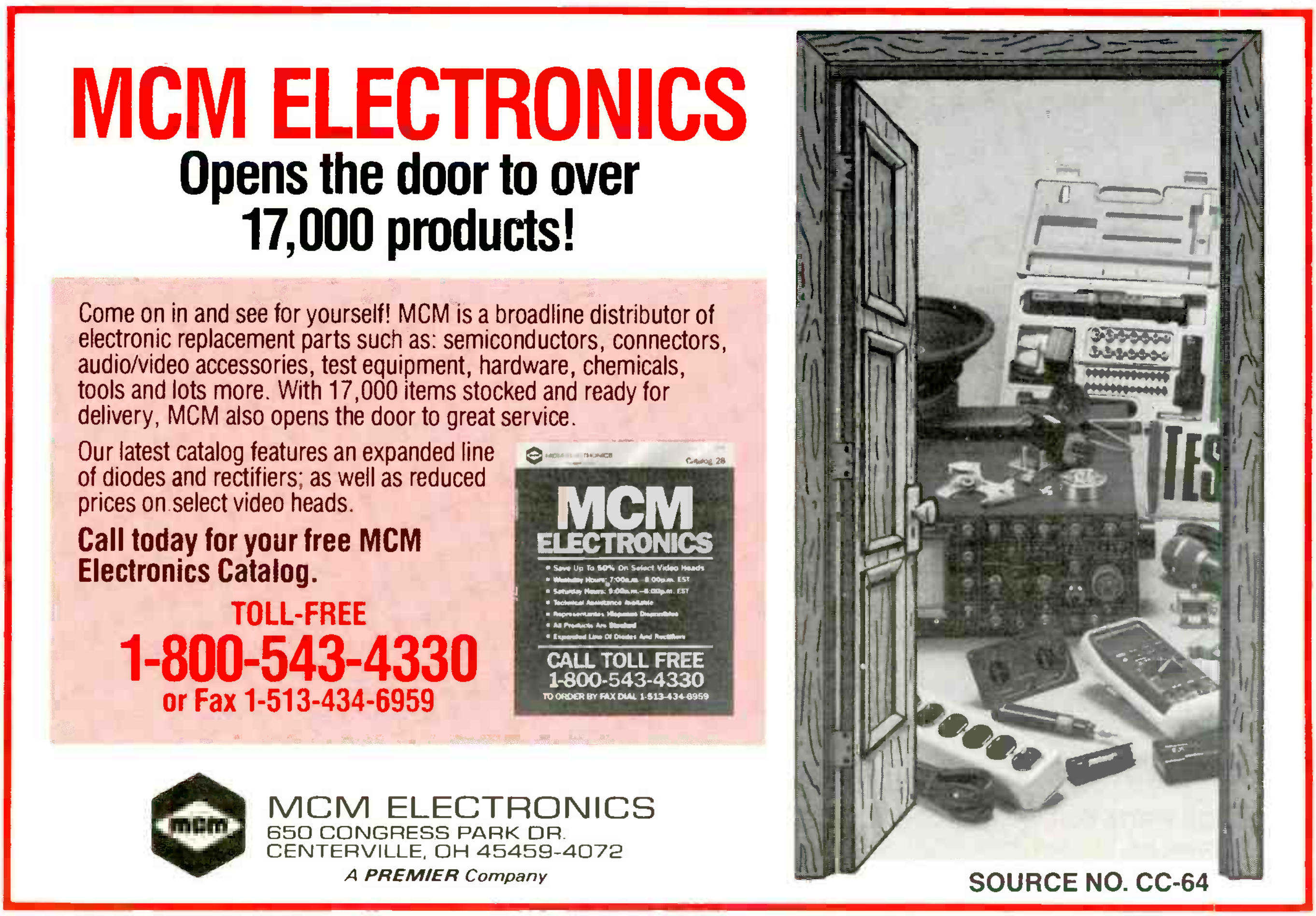


Fig. 2. White arrow (upper-left) points to copper trace on circuit board that must be cut per instructions in text and write-protect phototransistor assembly in a 5¼" Fujitsu floppy-disk drive. Circuitry for add-on LED status indicator is mounted on small perforated board, while cable disconnect is shown at lower-right.

With your computer turned on, use a dc voltmeter (or multimeter set to the dc-volts function) to verify the voltages at the solder pads of the power connector. Make a note of the one that has +5 volts on it. The ground pads that connect to the two



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black wires are connected together and neither goes to the metal chassis of the computer.

Power down your computer and unplug it from the ac line. Then touch one probe of an ohmmeter to the ground pad of the power-connector cable and the other probe to each terminal of the photosensor to determine which is the ground or emitter wire (see Fig. 1) and label it as such. The remaining terminal goes to the collector.

Plug the computer back into the ac line and turn it on. Insert a write-protected disk in the drive to have Q_a switch off. Use a high-impedance voltmeter (100,000 ohms/volt or better), measure from the collector to the emitter of Q_a. Connect the common lead of the meter to circuit ground at the emitter of Q_a and touch the "hot" probe to the collector of the transistor. You should obtain a reading of +3 volts or more.

Remove the disk from the drive. Doing this should cause Q_a to switch on and the measured voltage to drop to nearly 0 volt. This identifies the sensor as Q_a and not LED_a. Turn off the computer and unplug it from the ac line. Then remove the two connectors at the back of the drive, taking note of plug orientation, and remove the drive from the computer chassis, handling it carefully. Set it aside in a safe, clean place.

The write-protect switch is on the bottom of the 3½" drive. Usually supplied with the drive is an adapter that has black wires (for ground) and red (for +5 volts) for mating the drive with the existing power cable in the computer.

With your computer powered up, use the meter to verify the voltage and polarity of the two wires, either at the far end of the adapter power cable or on corresponding circuit board solder pads, if accessible. This done, unplug the computer and adapter cable from the power-supply connector, but leave the adapter cable attached to the disk drive. Disconnect the ribbon cable from the rear of the disk drive.

Remove the drive and place it bottom-up for inspection. Locate the write-protect switch and its solder pads (see Fig. 4). Because the power connector solder pads weren't accessible on the board, tests were made from power connector pins at the far end of the adapter cable. Place a disk that's not write-protected in the drive to force SW_a and SW_b to open.

Connect the + lead of your ohmmeter to the +5-volt red wire in the power cable and other lead to circuit ground. You should obtain a reading of approximately 0 ohm. Removing the disk from the drive and replacing it with one that's write-protected to close SW_a should provide a resistance reading from +5 volts to terminal X that is essentially 0 ohm.

If your tests don't agree with the above, check for possible circuit variations that may be inverses of the drive circuits shown in Fig. 1 and Fig. 3.

In Fig. 1, the collector of Q_a may be connected directly to +5 volts. If so, cut the collector lead trace and connect *S1* across the cut trace and then connect *R2* to the emitter of Q_a. In Fig. 3, terminal Z may be connected to ground.

Whatever the circuit variation, some generalizations apply. If either lead wire of the phototransistor is cut

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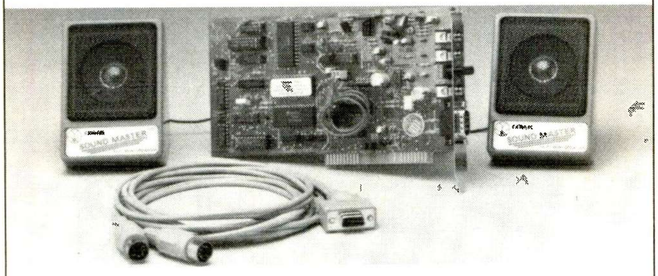

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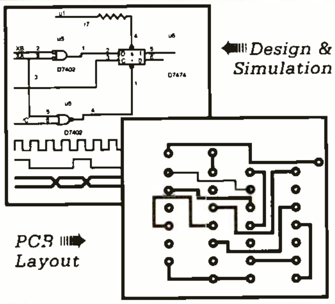

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and bridged by an spst switch, the open position of the switch always effects write-protection. For the mechanical switch in a 3½" drive, if the two terminals of a normally-closed write-protect switch are connected in parallel with an spst switch, the closed position of the spst switch always effects write-protection. If the LED indication becomes inverted, add an inverter gate or stage to the LED driver circuit to transpose lighting action (or use the LED as-is, just remembering that an extinguished LED means that write-protection is in effect).

Construction

Component layout and conductor runs aren't critical. Hence, you can use any assembly technique that suits you. For example, you can mount and wire together the LED driver circuits on printed-circuit boards of your own design. Alternatively, you can mount the components on ¾" × 2" pieces of perforated board with the aid of single-ended wrap posts for support of components and pick-off terminals (see Fig. 2 and Fig. 4).

There's ample space in floppy-disk drives to install the circuit if you take advantage of any unused mounting hole or ledge. The PROTECT switches and LEDs can be mounted on a plastic panel that can be used to cover an unused drive bay, as shown in the lead photo. These can also be mounted in the faceplate of the drive itself. If you don't wish to cut a trace on the circuit board in the 5¼" drive, omit *S1* in Fig. 1 and install only the LED status indicator circuit.

Test your wired circuits before installing them in the drives. For the Fig. 1 circuit, connect +5-volt board terminal 1 and −5-volt terminal 2 to a 5-volt dc power supply. Then use clip leads to connect *LED1* to board terminals 3 and 4. If the LED lights, leakage in *Q1* or *Q2* or both may be excessive. Try replacing *Q1* first. Jumper pin 7 to pin 1 on the board. The LED should light, provided it isn't installed in reverse polarity.

Test the Fig. 3 circuit in a similar manner. Install the circuit board in the 3½" drive. Strip ⅛" from one end and ½" from the other end of two 3" lengths of Wrap wire. Tin the ⅛" bare end allowing a small bead of solder to remain. Lap-solder the end of the wire to switch pad terminal Z. Solder the other end of the wire to board terminal 5. Similarly, connect switch pad terminal X to board terminal 6. Use red and black light-gauge stranded hookup wire for connections to the 5-volt drive power source.

If the solder pads aren't accessible, make connections to the power connector adapter cable wires or connector pins. Remove the male pin from the connector by slipping the brass tube of ball-point pen over the pin and work it around as you gently pull wire at the other end. Remove the red wire first and solder a suitable length of red wire to the shank of the pin. Push the pin back into the hole from which it was removed. Similarly, solder a length of black wire to the other connector pin. Be very careful to avoid reversing the wires or replacing them in the wrong hole.

Dress the wires along the adapter cable and tape together at the near end. Route the wires over and across the drive to the circuit board. Cut off excess wire length, strip the ends and solder to board terminals 1 and 2.

Use a suitable length of four-conductor color-coded ribbon cable to connect the circuit board to the remote switch and LED. Include a disconnect for the cable. A four-pin in-line disconnect can be made using a four-pin section of molded pc board header strip and a four-pin section cut from a DIP Wire Wrap socket. If possible, use a high-speed hand grinder and cutoff wheel to cut the DIP socket.

Figures 2 and 4 show the female disconnect plugs coded with a white dot. If you install the switch and LED in the faceplate of the 3½" drive, check for adequate component clearance before machining the faceplate. Remove the faceplate by cautiously releasing two plastic hooks. Tape the disk-release button to the faceplate before removal.

Install *S2* so that it closes with its toggle upward. Solder connecting wires to the switch and LED before replacing the faceplate. Route the wires to the circuit board, trim off excess length, strip the wire ends and solder to board terminals.

For the 5¼" drive, cut the emitter ground return lead of Q_a (see Fig. 1) with a safety or X-acto knife. The arrow at top-left in Fig. 2 points to the circuit-board trace to cut. Use insulated three colors of Wrap wire to connect board terminals 5, 6 and 7 to the drive circuit. Twist together the wires and route them so that they don't interfere with the drive door handle mechanism (Fig. 2).

Use lengths of red (+) and black

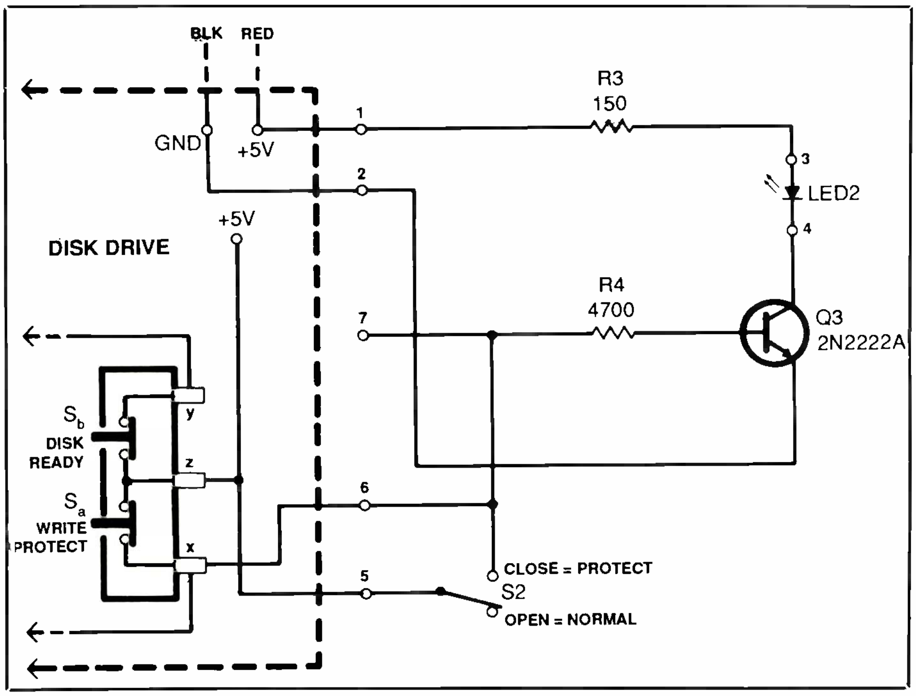

Fig. 3. Schematic diagram of write-protect circuitry for 3½" floppy drive.

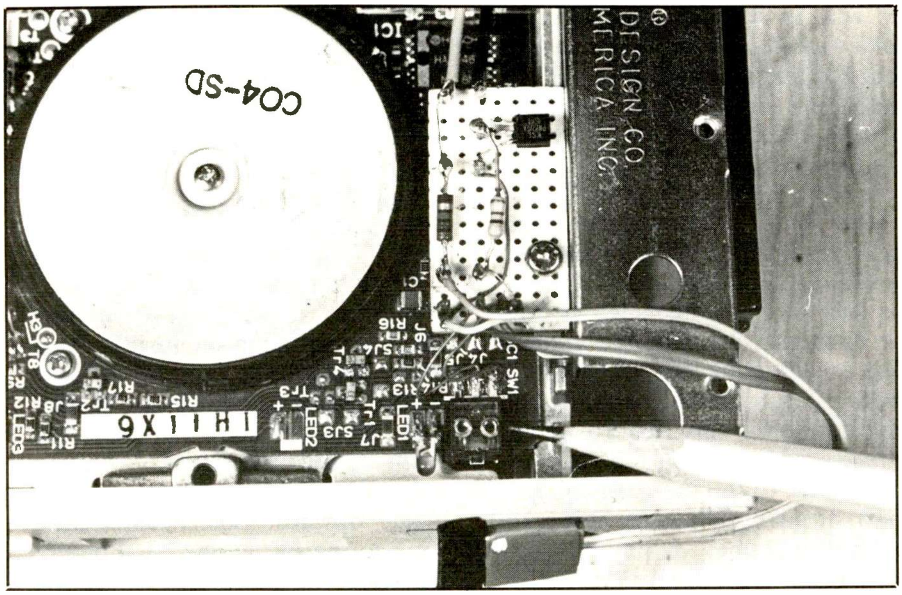

Fig. 4. Pencil points to combined disk-ready and write-protect mechanical plunger switches in a $3\frac{1}{2}''$ Toshiba floppy-disk drive. Cable disconnect is shown bottom-center.

(−) 26-gauge solid hookup wire to connect board pins 1 and 2 to the power-supply connector solder pads. Connect *LED1* and *S1* to the circuit as described above (include a disconnect). Install *S1* so that it opens with its toggle upward.

If you omit *S1*, make an external slide-in write-protect tab, as shown in Fig. 5. Cut a piece of $\frac{1}{32}''$-thick fiberboard insulation or similar material (do *not* use metal) to $\frac{15}{16}'' \times 2\frac{3}{4}''$. You can alter the $\frac{15}{16}''$ width so that the slide-in tab just fits between the left edge of the drive slot and left side drive door handle when the latter is in the closed position.

Position the strip lengthwise against the handle of a try-square with $\frac{3}{4}''$ overhanging the blade of the square. Bend down to 90° to form an L shape, with the short leg serving as a stop. Secure the plastic handle of a push-pin to the stop with epoxy cement. Label the drive bay panel using a dry-transfer lettering kit and follow with a clear protective coating over the labels using an artist's brush.

After checking all wiring to make sure it's correct, install the disk drives in the computer. Boot the computer and then insert write-protected disks in both drives. The LEDs should be on for either position of the switches. Insert disks that have no write-protection in both drives and set the switches to NORMAL. The LEDs should be off but should turn on when you switch to write-protect mode. If you made the slide-in write-protect tab, insert it fully on top of the disk at the left edge of the drive slot and verify that the LED turns on. If it fails to turn on, the slide-in tab may be too short or is improperly angled to the right. Ignore the LED status indication for an empty drive.

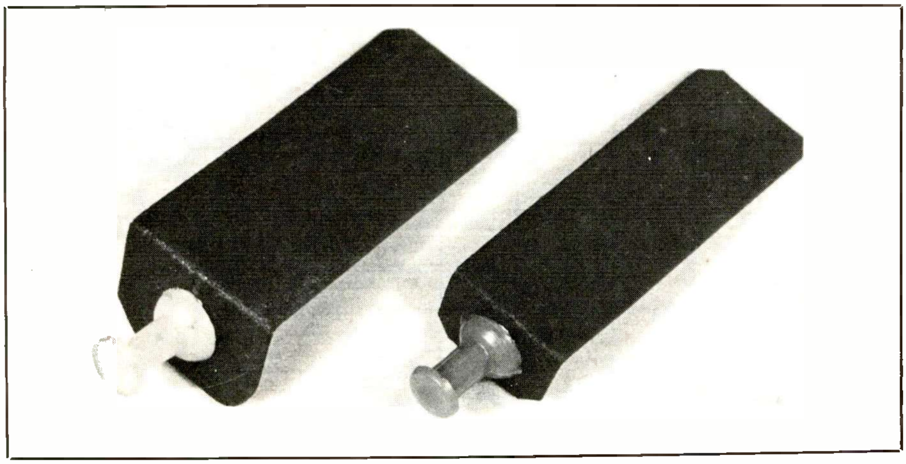

Fig. 5. Slide-in write-protect tabs can be used with $5\frac{1}{4}''$ drive in lieu of cutting circuit-board trace.

Using the Modification

Most application programs and certain DOS commands write to disks that must have no write-protection in effect. With the exception of original disks and filled back-up disks, all other disks are operated without on-disk write protection. The need to switch to write-protection at some point depends on the task at hand and your familiarity with the software being used. Such applications as disk sector utilities, file handlers and word processors can easily get you into trouble at the stroke of a wrong key. Therefore, always switch to write-protection when you aren't sure about whether you erred or what action will be taken. Also, switch to write-protection when you first explore an unfamiliar program.

Toggle the switches only when the disk drive isn't running. If you switch a drive to write-protect mode during a write-to-disk operation, the destination file will be scrambled. Even worse, the disk file allocation table (FAT) is almost certain to be corrupted as a result of interfering with disk housekeeping chores. This also applies to use of the slide-in write-protect tab.

Set the switches to your liking before booting up the computer. The switches are usually set to NORMAL before booting up in drive C: with drives A: and B: empty. Drives A: and B: are then loaded and the status of the disks noted on the LEDs. You can set the switches to write-protect at first and wait for the first occurrence of the write-protected error message. It's well worth knowing if and when a disk operation write takes place. Try running applications and DOS commands with the drives write-protected. Any application or

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command that creates and deletes temporary files will balk with write-protected disks.

In use, and prior to installation of *S1*, the slide-in write-protect tab performed without flaw with careful insertion in the horizontally mounted drive in my computer. The tab can be inserted before the 5¼″ disk is inserted and resides under the disk. Use of the slide-in tab without installation of the LED status indicator leaves some uncertainty unless you insert it fully and to the extreme left.

Use software methods to write-protect individual files, groups of files or entire non-system partitions on a hard drive. Software methods must be put into effect beforehand, demanding more of your attention, and thus can become an impediment in some circumstances. Files on floppy-disk and hard drives can be write-protected by altering the file attribute to read-only, using the DOS ATTRIB, as detailed in your DOS manual. File handlers and anti-viral utilities include provisions to write-protect files.

For hard disks, a utility like *Disk Manager* permits you to switch a non-system hard drive partition between read-only and read/write. Be sure to fully back up your hard drive and record partitioning and drive information before using this option for the first time because an inadvertent error may require you to reconstruct the drive from the back-up.

Because most computer systems are now fitted with hard drives, it's very easy to write off floppy drives and use them solely for installing programs and making backups. If this is your view, you're throwing away valuable resources and filling the hard drive too quickly with files that soon become fragmented and impair drive performance. If an application isn't particularly disk-intensive and doesn't really require the speed or space of the hard drive, store and run the application in a floppy drive and save valuable hard drive space. Move inactive files and utilities you don't use from the hard drive to categorized floppy disks.

Ultimately, the performance of your hard drive is in direct proportion to judicious utilization of the floppies that, in turn, benefit with the addition of manual write-protect switches. ■

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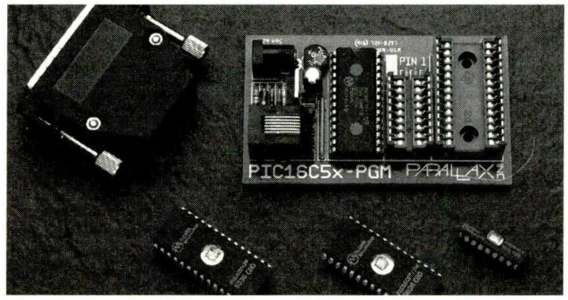

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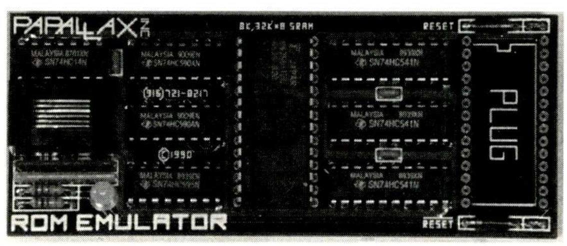

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Universal Numeric LED Display Tester

Lets you test seven-segment displays before you buy

Sooner or later, you're going to build a project that requires at least one seven-segment LED numeric display. Such displays are readily available, but they're usually expensive at retail price. Bargain-priced displays can be obtained at a computerfest or hamfest, but you can't be sure you won't end up buying defective ones. Fortunately, you can circumvent these problems and still go bargain hunting by taking along our battery-powered portable Universal LED Numeric Display Tester.

This Tester instantly determines the operating condition of all popular LED numeric displays *before* you buy. It accommodates all popular sizes from 0.3″ ones on up to "jumbo," regardless of whether they're common-anode or common-cathode in design. And, since economy is your cornerstone, the cost of building this project is quite low.

About the Circuit

Shown in Fig. 1 is the complete schematic diagram of the LED Display Tester circuitry. The circuit starts with *IC1*, a 4060 14-stage binary counter/divider with built-in oscillator. Resistors *R1* and *R2* and capacitor *C1* are the frequency-determining components for *IC1*'s internal oscillator. Because frequency stability isn't critical in this application, a ceramic disc capacitor is okay for *C1*.

Eight of the ten divided-down outputs of *IC1* are used to drive 7445 BCD-to-decimal decoder drivers *IC2* and *IC3*. Each 7445 converts the four-conductor BCD bus code to 1-of-10 outputs. Each of the 10 outputs has an open-collector transistor capable of sinking 80 milliamperes of current. All that are needed for each *IC2* and *IC3* output line is a 100-ohm pull-up resistor, (*R3* through *R12* for *IC2* and *R13* through *R22* for *IC3*).

The outputs from *IC2* and *IC3* are wired to test sockets *SO1* and *SO2*. Note that the circuit design calls for both 16- and 24-pin test sockets so that the Tester can accommodate a wide range of popular types of LED displays.

The 7445s strobe all 20 pins, one at a time, with a ground to activate a segment. All other pins on *IC2* and *IC3* are pulled up to +4.5 volts. In this manner, all segments of a LED numeric display under test (plugged into either *SO1* or *SO2*) are strobed, regardless of pinout or whether the display has a common anode or a common cathode. Any segment that fails to light test is defective.

The 4.5 volts coming from the battery supply is dropped to about 1.7 volts by resistors *R3* through *R22*, which limit current through each LED display segment under test to a safe level.

Power for the circuit is supplied by a bank of three 1.5-volt alkaline AA cells in series, shown as *B1* in Fig. 1, to obtain the 4.5 volts dc required to drive the circuit and display under test. Power is applied momentarily to the circuit and display under test through momentary-action pushbutton switch *S1*. Current drain of the LED Display Tester is 100 to 110 mA, depending on the color of the display being tested.

Construction

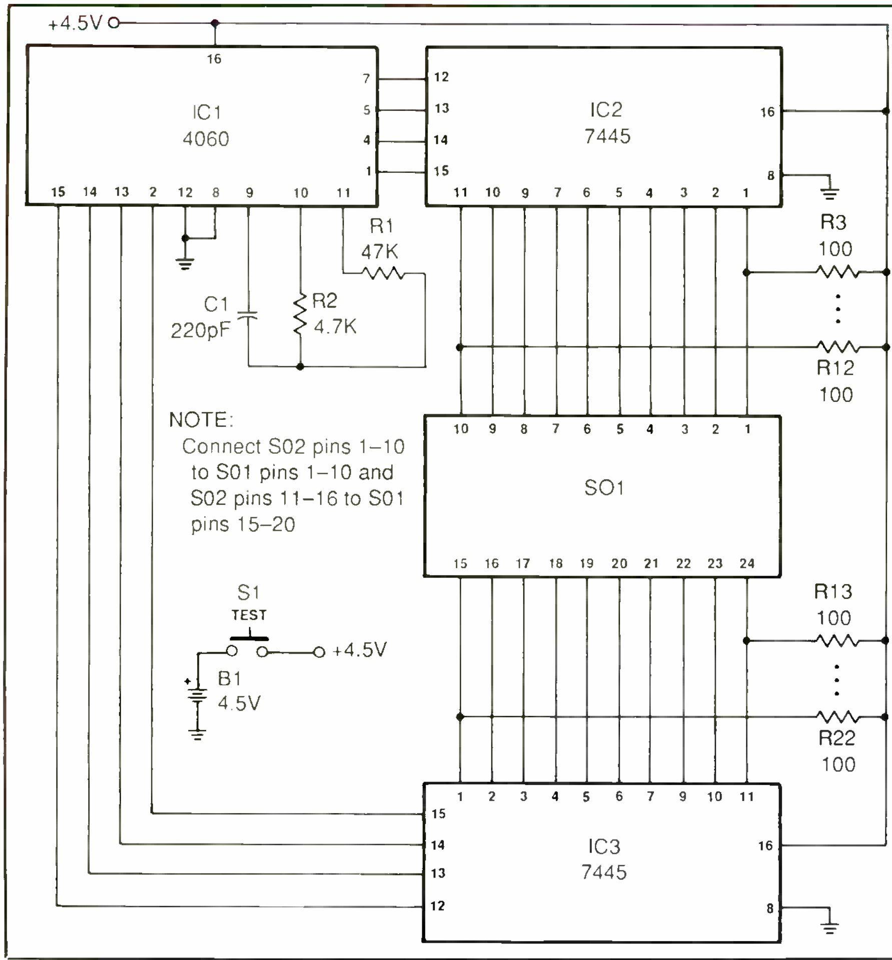
This project can be wired point-to-point or on a printed-circuit board. If you wish pc construction, fabricate the pc board using the actual-size etching-and-drilling guide shown in Fig. 2. Alternatively, if you choose point-to-point wiring, use perforated board that has holes on 0.1o centers and suitable Wire Wrap or soldering hardware and plan your layout to be roughly equivalent to that shown in Fig. 3. Whichever way you go, use sockets for the ICs.

From here on, it's assumed that you're using printed-circuit construction. Make suitable changes in what you read to conform to your needs if you use point-to-point wiring.

Because test sockets *SO1* and *SO2* must be mounted on the *conductor* side of the board, it's necessary to use Wire Wrap sockets or sockets that have extra-long pins on them so that you can space the sockets above the surface of the board to provide soldering access.

The sockets chosen for *SO1* and *SO2* are machined-contact type because their faces have exposed solid metal contacts. This makes it easy to test LED numeric displays without having to completely plug their pins into the socket receptacles. If you've ever spent time testing ICs, you'll appreciate the time and effort saved by using machined-contact sockets over conventional sockets. Also, although use of ZIF (zero-insertion-force) sockets would probably have been even better for this project, their cost is prohibitive for such a simple application.

When you have your pc board ready to be populated, place it *conductor* side up on a flat surface. Plug the pins of test socket *SO1* into the holes drilled for them. Space the sockets about ³⁄₁₆″ above the surface of the board. Make sure that you also have at least ⅛″ of pin length protruding from the holes on the component side of the board.



PARTS LIST

Semiconductors
IC1—4060 14-stage counter/divider and oscillator
IC2,IC3—7445 BCD 1-of-10 decoder/driver
Capacitors
C1—220-pF ceramic disc
Resistors (¼-watt, 5% tolerance)
R1—47,000 ohms
R2—4,700 ohms
R3 thru R22—100 ohms
Miscellaneous
B1—Three 1.5-volt alkaline AA cells in series
S1—Miniature spst normally-open, momentary-action pushbutton switch
SO1—24-pin machined-contact Wire Wrap or long-soldertail DIP IC socket (see text)
SO1—16-pin machined-contact Wire Wrap or long-soldertail DIP IC socket
Printed-circuit board or perforated board with holes on 0.1″ centers and suitable Wire Wrap or soldering hardware (see text); sockets for ICs; suitable enclosure (Radio Shack Cat. No. 275-1571 or similar; see text); triple AA-cell holder; machine hardware; hookup wire; solder; etc.

Fig. 1. Complete schematic diagram of LED Numeric Display Tester circuitry.

Carefully solder diagonally opposing pins of each socket and then check spacing again. If spacing is okay, carefully solder the remaining pins of both sockets to their respective copper pads.

Once the test sockets are in place, turn over the board and mount and solder into place the remaining IC sockets on the component side. Do *not* plug the ICs into the sockets until you've conducted voltage checks and are certain that your wiring is correct. Follow with *C1*, *R1* and *R2*. To make the project as compact as possible, the remaining resistors mount on-end. This being the case, trim one lead of 18 of the remaining 20 resistors to a length of ⅜″ and form a small hook in the lead stubs.

One lead of one of the resistors from which you didn't trim any lead length plugs into the hole labeled *R12*. Solder this lead into place, making sure the end of the resistor body butts against the top surface of the board. Then plug the long leads of *R3* through *R12* into the indicated holes and solder each into place, again making sure that the ends of the resistor bodies butt against the surface of the board. Trim away excess lead length.

Gently bend the long lead on *R12* toward the top end of *R13* and crimp the latter's hooked lead to the long lead. Solder the connection. Next, bend the *R12* lead toward the top end of *R14*, crimp the latter to it and solder the connection. Repeat this procedure for all remaining resistors in this bank. When you're done, bend the remaining lead length toward the board, plug it into the indicated COM1 hole and solder into place. If the lead is too short, add a length of solid bare hookup wire as needed.

Repeat the entire operation detailed above for the *R14* through *R22* bank of resistors.

Strip ¼″ of insulation from both ends of three 3″-long stranded hookup wires. Tightly twist together the fine conductors at both ends of all wires and sparingly tin with solder.

Plug one end of each of two wires into the holes labeled +4.5V and GND and solder into place. Crimp and solder the free end of the wire coming from the +4.5V hole to one lug of the pushbutton switch. Then crimp and solder the ends to the remaining lug on the switch and the + lug on the battery holder. Finally, crimp and solder the free end of the wire coming from the GND hole to the − lug on the battery holder.

Use solid bare hookup wire for the jumper wires.

Finish wiring the circuit-board assembly by interconnecting the pins of the two test sockets. Wiring details are given in the Note below the Fig. 3 wiring guide. You can use ordinary hookup wire or Wire Wrap wire to make these connections.

Wire the battery holder so that the three AA cells you'll be using to

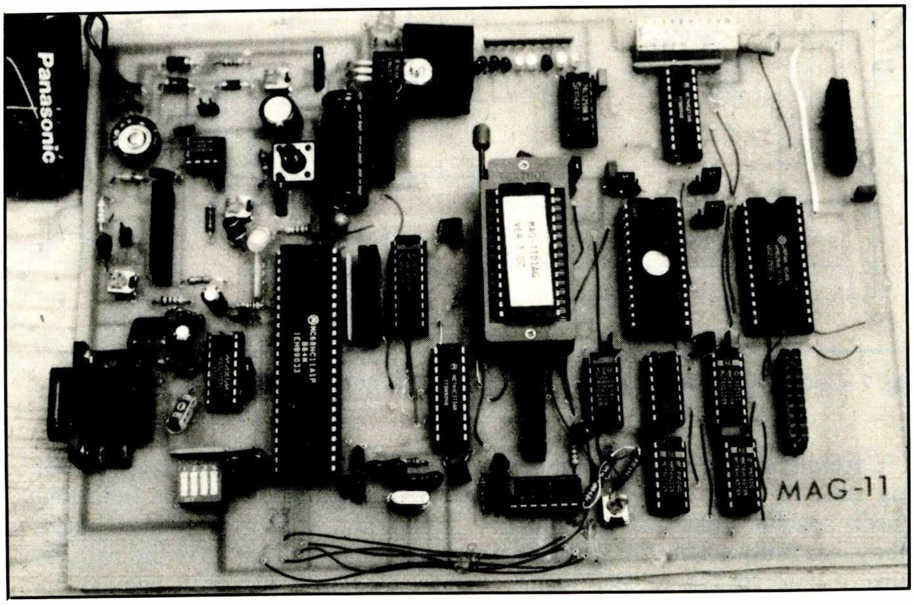
(continued on page 86)

Experimenting With Motorola's 68HC11 True Single Chip Computer

Part 3

Building and using the MAG-11 Single-Board Computer

This time around, our focus is on building the MAG-11 single-board computer introduced last month. Though its ultimate mission is to be a practical "working" board, MAG-11 incorporates simple features, like DIP switches and LEDs, that make it nearly ideal to use as a learning aid for the popular 68HC11 series of Motorola MCUs.



Construction

Though you can build a MAG-11 using perforated board, using the traditional point-to-point wiring technique, a printed-circuit board is highly recommended to minimize the possibility of costly wiring errors. You can make a pc board using the actual-size guides given in Fig. 3 or purchase a ready-to-wire one from the source given in the Note at the end of the Parts List.

Because I used the *PCBoards* pc-board design program to design and generate the artwork for making the MAG-11 board and had the files for them, I've included them on a PC-compatible diskette (see Parts List). With this disk and a Hewlett Packard LaserJet II/III or compatible laser printer, you can produce guides on transparency or vellum for direct use as exposure masks for making your own pc board.

If you make your own board, you can use a single-sided design (as was done with the original prototype shown in the lead photo). This makes construction more difficult, but it's much better than trying to build this project point-to-point. Use the solder-side guide shown in Fig. 3 for the board and component-side artwork as a jumper-installation guide.

Start populating a single-sided board by installing insulated hookup wire jumpers on the component side where no routing under IC sockets and connectors is required. Then install the remaining jumpers on the solder side. If you have a hot-melt glue gun, "tack" the wires to both sides of the board to keep the assembly neat.

The Parts List specifies *J1* through *J6* as 20-pin sockets. These are meant to mate with 20-pin matrix headers that have pins on 0.1″ centers to make it simple to expand the system to three layers (five boards maximum, although you should have little need for more than four boards total).

All you need is for the first plug-in board to use compatible 20-pin headers and pins 1″ or longer on both sides of the header's insulator. If the next expansion board has 20-pin sockets, you don't need additional wiring or connectors to connect it to the first board. If you use cables to connect MAG-11 to expansion boards, or if you need only one layer of expansion, *J1* through *J6* can be simple headers.

It's a good idea to use a 28-pin ZIF (zero-insertion-force) socket for *U7* to facilitate testing MAG-11's firmware. The ZIF socket need not be dedicated to this location. Rather, you can use a standard 28-pin IC socket at the *U7*

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location and plug the ZIF socket into it when needed. Then unplug the ZIF socket and move it to the *U10* socket as needed.

Refer to Fig. 4 as you populate the pc board. If you made a double-sided board, it won't have plated-through holes and, thus, requires that you solder all connections to the pads on both top and bottom of the board. Therefore, all DIP IC sockets must have long pins to permit raising them enough above the surface of the board to permit soldering access, or you must use Molex Soldercon socket pins whose open design gives soldering access on both sides of the board.

Install the sockets for the DIP ICs, jumper blocks and connectors. Do *not* plug ICs into the sockets until the board is completely wired and you've ascertained that your wiring is correct.

Next, install the resistors, resistor networks, trimmer controls, DIP switches, capacitors, diodes, light-emitting diodes, crystal and DB-9 connector. Make certain that the resistor networks are properly oriented and that electrolytic capacitors and all diodes, including LEDs, are properly polarized. Install the transistor, voltage regulator and voltage reference, making absolutely certain that they're properly based before soldering them into place.

A heat sink is needed for regulator *U4*. Use a 6-32 machine screw and nut to secure *U4* and its heat sink to the top surface of the board.

Use high-efficiency, low-current devices for all LEDs. You can use standard LEDs if you change the value of the respective current-limiting resistors to 390 ohms but they aren't recommended.

Visually inspect your wired circuit-board assembly for missed solder connections, suspicious connections, breaks in the copper traces and solder bridges. Solder any connections you missed and reflow the solder on all suspicious connections. Repair any breaks located and clear away any solder bridges with desoldering braid or a vacuum-type desoldering tool.

PARTS LIST

Semiconductors
D1,D4—1N5817 Schottky barrier rectifier diode
D2—1N4001 silicon rectifier diode
D3—1N4733A 5.1-volt 1-watt zener diode
LED1,LED2,LED4,LED5,LED9, LED10—Green low-current, high-efficiency light-emitting diode
LED3,LED6,LED7,LED8,LED11—Red low-current, high-efficiency light-emitting diode
Q1—2N2222A npn silicon transistor
U1—MC68HC11A1P single-chip microcomputer
U2—MAX690CPA
U3—MAX232 IC (optional—see text)
U4—LM2931Z differential fixed +5-volt regulator
U5—74HC245
U6,U11—74HC373
U7—27C256 EPROM (programmed—see text)
U8—74HC138
U9—6264LP 8K RAM (optional—see text)
U10—27C256 32K EPROM or 32K RAM (optional—see text)
U12—74HC259
U13—74HC4078
U14,U15—74HC04
U16—74HC32
U17—74HC11
U18—LM336-5.0 precision +5-volt reference

Capacitors
C1—1,000-μF, 25-volt electrolytic
C2—47-μF, 16-volt electrolytic
C3—10-μF, 16-volt electrolytic
C4,C11—1-μF, 100-volt metalized polyester
C5—0.01-μF, 50-volt monolithic ceramic
C6,C9,C10,C18,C20 thru C32—0.1-μF, 50-volt monolithic ceramic
C7,C8—15-pF, 500-volt dipped mica
C12 thru C16—22-μF, 25-volt electrolytic
C17—100,000-μF (0.1-F), 5.5-volt Panasonic Gold
C19—1,000-pF, 50-volt monolithic ceramic

Resistors (¼-watt, 5% tolerance)
R1—330 ohms
R3,R17—1,200 ohms
R4—1-megohm
R5,R11—1,000 ohms
R7—150 ohms
R8—10 megohms
R9—4,700 ohms
R12—3,300 ohms (optional—see text)
R14—4.7 ohms
R15—1,500 ohms
R16,R18—10,000 ohms
R2,R6—1,000-ohm pc-mount trimmer potentiometer
R10—500-ohm pc-mount trimmer potentiometer
R13—10,000-ohm pc-mount trimmer potentiometer
R_{TH}—1,000-ohm at 25° C thermistor (Fenwall No. JB31J1 or equivalent)
RN1—Nine-element 4,700-ohm SIP resistor network
RN2—Five-element 4,700-ohm SIP resistor network
RN3—Five-element 4,700-ohm SIP resistor network
RN4—Nine-element 4,700-ohm SIP resistor network
RN5—Nine-element 4,700-ohm SIP resistor network

Miscellaneous
J1 thru J6—20-contact, dual-row female connector with contacts on 0.1″ centers (male headers optional—see text)
J7—Right-angle, pc-mount DB-9 connector
JP1,JP2,JP4 thru JP7,JP12—3-position jumper block with pins on 0.1″ centers
JP8,JP10,JP11—2-position jumper block with pins on 0.1″ centers
S1—10-position DIP switch
S2—4-position DIP switch
S3—Normally-open, momentary-action spst pushbutton switch
SO1—Socket for external ac power-supply cable
XTAL1—3.6864-MHz crystal (4-MHz optional—see text)
Printed-circuit board, sockets for all DIP ICs; 10 shorting jumpers; heat sink for U4; four 1″ threaded metal spacers; four small screw-on rubber feet; machine hardware; hookup wire; solder; etc.

Initial Tests

Jumper positions 2 and 3 of *JP2*, leave *JP8* with no jumper and set position 9 of *S1* to ON and all other positions of this switch to OFF. Connect a 9- to 12-volt, 250-mA power source to the circuit via *SO1*, making certain it's properly polarized. To check out the new circuit, you should ideally use a variable power supply with meters that continuously monitor voltage and current. When you go "on-line," you can use any standard 9- to 12-volt dc wall transformer or 9-volt alkaline battery.

With the circuit powered, POWER *LED9* should light. Connect the common lead of a dc voltmeter or multimeter set to dc volts to circuit ground. Touching the positive probe to pin 48

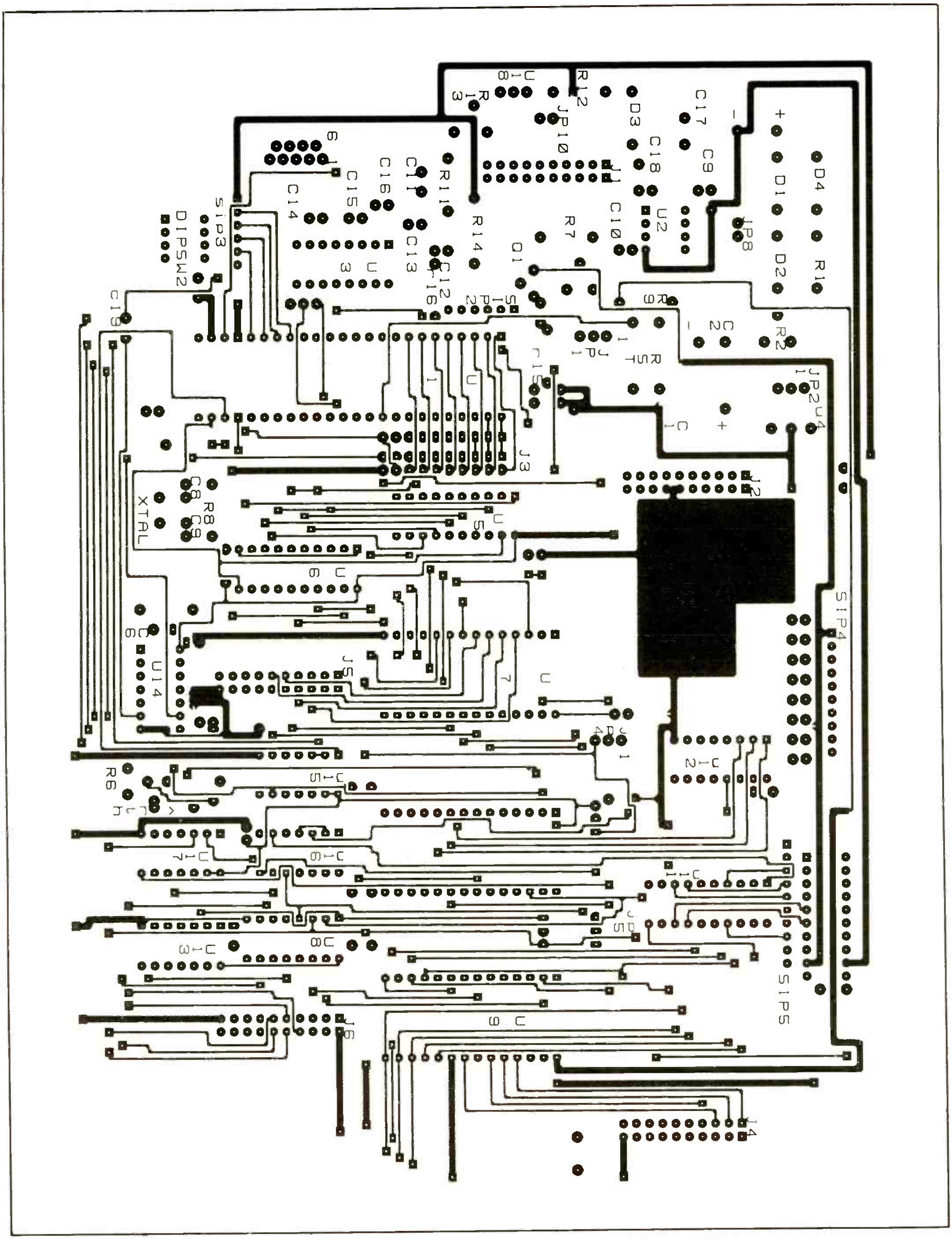
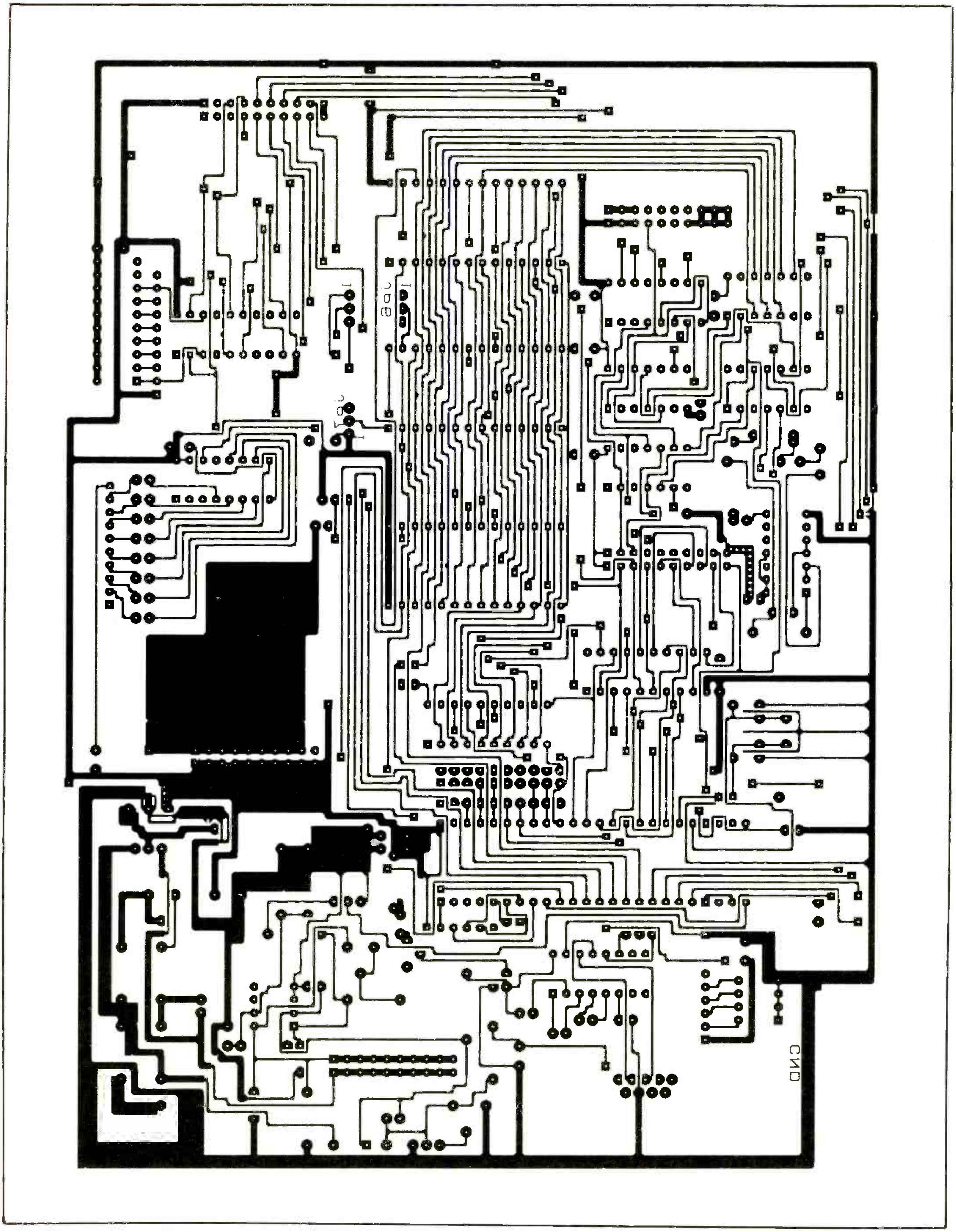


Fig. 3. Actual-size etching-and-drilling guides for component (A) and solder (B) sides of MAG-11 pc board.



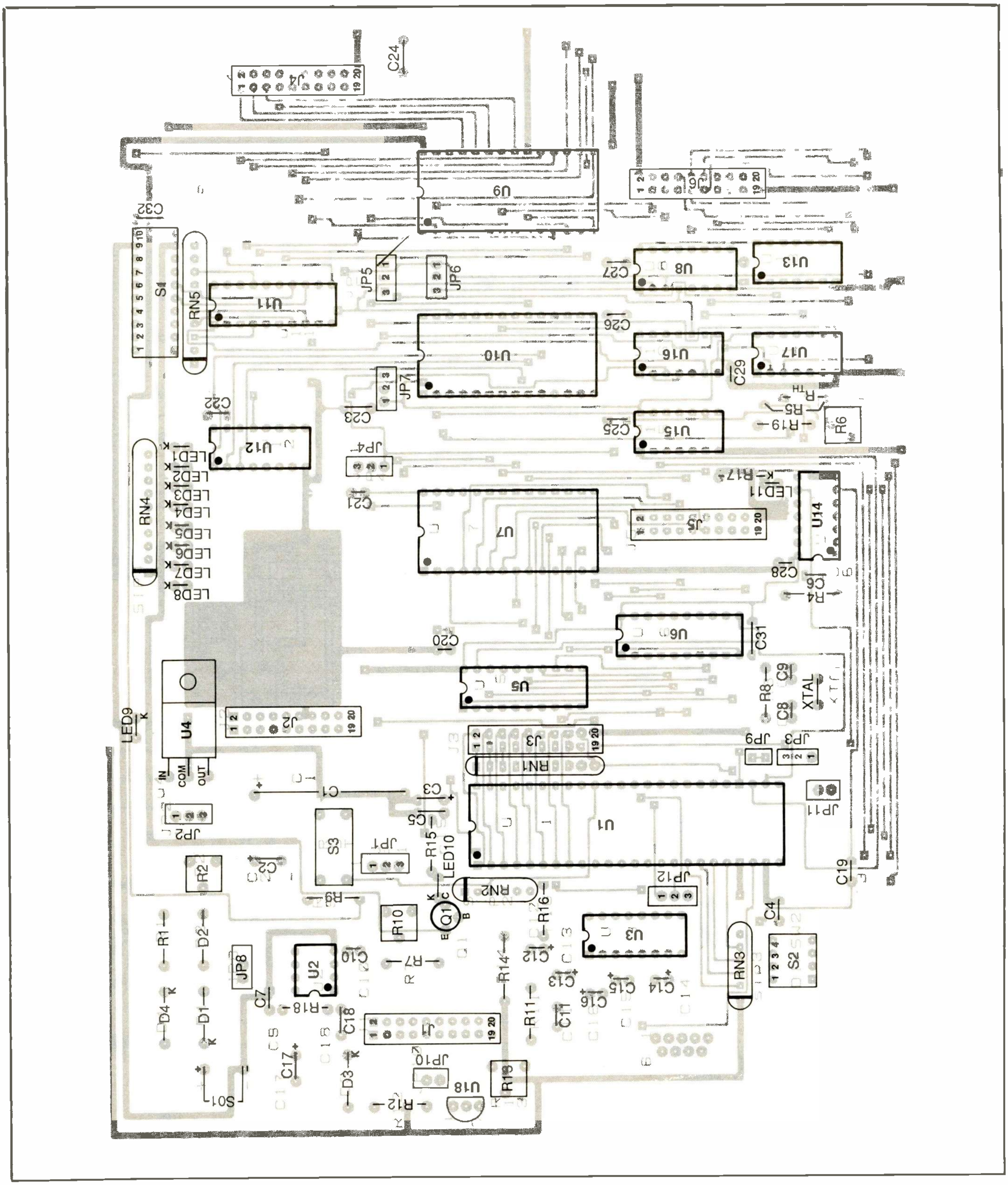


Fig. 4. Wiring guide for pc board.

of the *U1* socket, you should read +4.5 to +5.5 volts.

Then take measurements at pin 28 of the *U7* and *U10* sockets; pin 20 of the *U5, U6* and *U11* sockets; pin 16 of the *U3, U8* and *U12* sockets; pin 14 of the *U13, U14, U15, U16* and *U17* sockets; and pin 2 of the *U2* socket. If you fail to obtain a reading of approximately +5 volts at all locations, check the board again for continuity.

Next, check the pins connected to ground. This voltage should ideally be 0, though any measurement less than 0.02 volt is okay. Check these socket pins for 0 volt: 21 and 23 of *U1*; 14 of *U7, U9* and *U10*; 10 of *U5, U6* and *U11*; 8 of *U12*, 5 and 8 of *U8*; 15 of *U3*; 7 of *U13, U14, U15, U16* and *U17*; and 3 and 4 of *U2*.

If voltages are okay, disconnect power and then use an ohmmeter or audible continuity tester to double-check for continuity between the "ground" points mentioned in the above paragraph and actual circuit ground.

Initial Setup

Make sure no power is applied to the circuit board. Plug a 27C256 or 27128 EPROM with MAG-11DIAG firmware into the *U7* socket. (See the Handling Static-Sensitive Devices box elsewhere in this article.) Set jumpers as indicated in Table 1. Plug the ICs—except *U3, U9* and *U10*—into their respective sockets. Make sure each is properly oriented and that no pins overhang the socket or fold under between IC and socket.

Set position 9 of *S1* to ON and all other positions to OFF. Connect a suitable 9- to 12-volt dc power source via *SO1*, making sure it's properly polarized. It's a good idea to monitor current as you proceed so that if the circuit draws more than 150 mA, you can immediately disconnect power and correct any problem.

With power applied, *LED9* should light. With switch and jumper settings made as directed above, MCU CHECK *LED10* should repeatedly flash on and off for a second at a time. If *LED10* doesn't perform as stated, check *LED11*; if it's on or flashes intermittently, the reset circuit may be defective (check *U2*) or a problem may exist in the clock (use an oscilloscope to observe the enable signal at pin 27).

If *LED11* doesn't light and *LED10* doesn't perform as described, disconnect power and use an ohmmeter to check the circuit against the schematic shown in Part 2. First, check for continuity and then for possible shorts. If everything appears to be okay, an IC may be defective.

Using the Firmware

For this discussion, refer to Fig. 5. All "positions" referred to in the following discussion refer to switch *S1*.

• *Display* CONFIG *Register*. With jumpers set as described under Initial Tests, set positions 2 and 9 to ON and all other positions to OFF. As shipped, MC68HC11A1P should light *LED1, LED3* and *LED4* a second or so after power-up. All other LEDs should remain off. This display results in binary 00001101 ($0D hex) being stored in the CONFIG register. (Part 1 of this series discussed the CONFIG register.) Also, MCU CHECK *LED10* should slowly flash on and off.

• *Test Internal RAM & A/D Converter*. Set positions 1 and 9 to ON and all other positions to OFF. If internal RAM is okay, green *LED2* should light; if there's a problem, red *LED6* lights. If the A/D converter is operating properly, green *LED4* lights; but if it isn't up to specs, red *LED7* lights.

• *Test Internal RAM Backup*. The previous test checked every bit at every address not in use, but it didn't check for memory retention when power is removed. This test routine stores $0F at memory addresses 0 through $3F and then checks to make sure locations 0 through $3F have $0F stored at them. This is a two-phase test:

Phase 1: With power on, set positions 6 and 9 to ON and all other positions to OFF. Green *LED2* should light, indicating that locations 0 through $3F have $0F. If an error is detected, red *LED6* lights.

Phase 2: Shut off power. Set position 5 to ON, and leave positions 6 and 9 set to ON. Wait at least 2 minutes and then turn on power. If the contents in memory were retained, green *LED2* will light. If one or more errors were detected, red *LED6* lights.

In actual tests on super-capacitor backup, I tried to determine just how long 0.1-F *C17* would be able to supply enough energy to keep internal RAM from losing data. Apparently, it's a long time because it retained data for more than a day, which is substantially longer than specs indicate.

• *Test External RAM at U9*. Try this test first with the *U9* socket empty. Set positions 7 and 9 to ON and all other positions to OFF. Red *LED3* should light to indicate a bad or missing RAM at socket *U9*.

Disconnect power and plug a 6264LP-15 8K or equivalent RAM chip into the *U9* socket and power up. Because of the large number of bits being tested, this test will take a few minutes to complete. If the IC is good, green *LED5* should light; if bad, red *LED3* lights again.

To check *U9*'s backup capability, turn off power and then set position 5 to ON. Wait at least 2 minutes and switch on power. If backup is successful, green *LED5* should light, but if an

Handling Static-Sensitive Devices

Regardless of type, all ICs can be damaged by static electricity, but MOS and CMOS and similar devices like EPROMs, RAMs, MPUs, etc., are particularly ssensitive to this. ICs used in MAG-11 are MOS-type devices and, therefore, are extremely sensitive to the effects of static electricity. Keep in mind that you don't have to "feel" a static shock to damage an IC. So always handle ICs with extreme care and follow some basic safety procedures.

Let's review the "minimum" precautionary requirements, as listed here, which with average humidity are generally sufficient. If humidity is low, take extra precautions. A grounded wrist strap is often recommended. This will protect ICs, but keep in mind that you run the risk of serious shock if you inadvertently touch a "hot" ac line. Consequently, a grounded wrist strap is *not* recommended. Simply by following these precautions, you should have no worries about damaging sensitive MOS devices:

(1) Sit calmly at your work station for at least 5 minutes before touching any sensitive electronic part.

(2) Touch a good ground with one hand and the work surface and circuit board with the other. With one hand still touching a ground, pick up the protective package that contains the IC with your other hand. This should lower the potential voltage to an acceptable value. Let go of the ground and touch the circuit board and work surface again.

(3) Slowly take the IC from its protective package and, without letting go of it until it's installed in a socket, straighten any bent pins. Then plug the IC into its socket.

Treat the board itself with care because even installed ICs can be damaged if the board is subjected to a moderate jolt of static electricity.

If you follow the above procedures, you should never experience a "blown" MOS device resulting from static-electricity discharges.

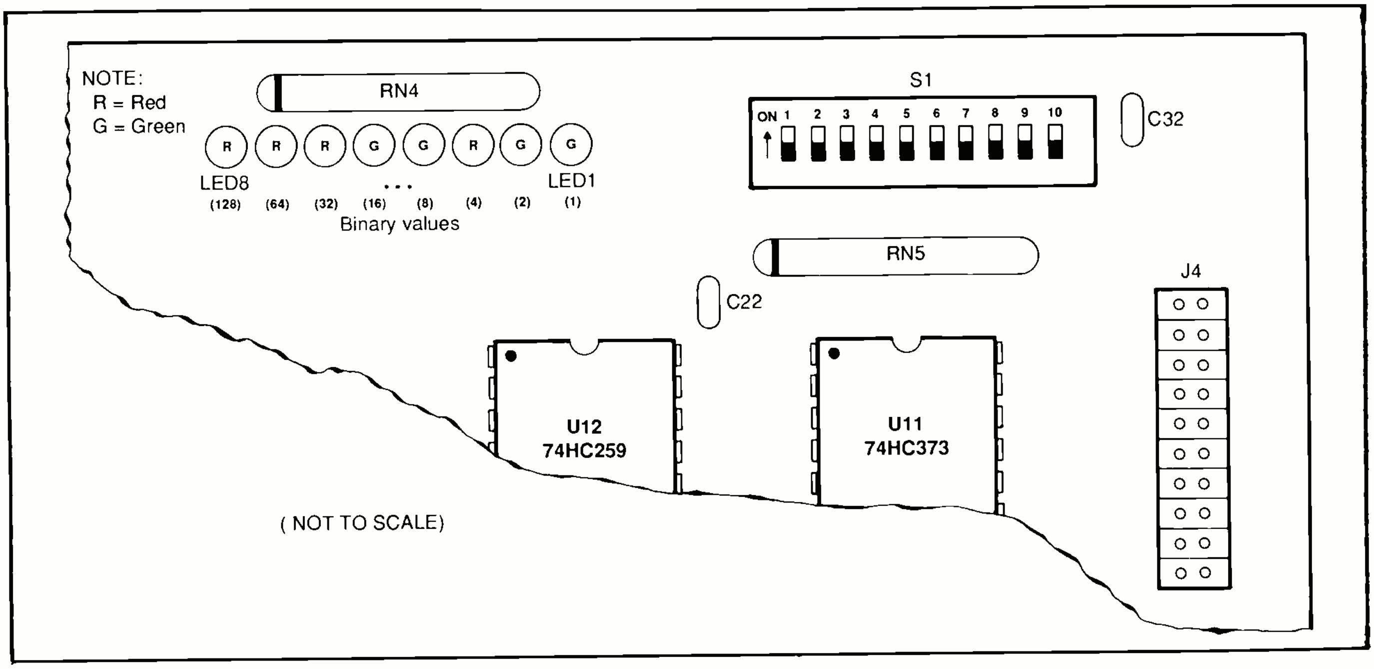


Fig. 5. Close-up details of DIP-switch S1 and LED display system.

error is detected red *LED3* lights.

• *Binary Thermometer.* Set positions 5 and 9 to ON and all other positions to OFF. Place the sensing end of an accurate thermometer adjacent to the thermistor R_{TH}. Adjust *R6* until *LED1* through *LED8* indicate the binary temperature in °F, with *LED1* through *LED7* displaying bits 0 through 7 in that order.

Each LED has a specific power-of-two value expressed in decimal format as 1, 2, 4, 8, 16, 32, 64 and 128 for *LED8* through *LED1* in this sequence. To find the decimal value of the display, simply add the decimal values of any LEDs that are lit. For example, if *LED3, LED5* and *LED7* are on, you add 4 + 16 + 64, respectively, to obtain 84, which it the number of °F the circuit is measuring.

The decimal-value range of this thermometer is 0° to 255° F. At temperatures less than 0° F, *LED1* slowly flashes, while *LED8* slowly flashes at temperatures greater than 255° F. If you calibrate between 50° and 80°F, accuracy is roughly ±3°F between 32° and 100° F.

This Binary Thermometer provides a quick and easy way of checking out *U1*'s sophisticated Programmable timer. It's also an aid to understanding how the timer's input-capture feature performs (see Part 2).

While other practical uses of this circuit are limited, if R_{TH} is in intimate contact with *U1*, it can be used to monitor the MCU's temperature (*U1* is rated for a maximum of 185°F, which means if *LED8, LED6, LED5* and *LED4* are all on, the temperature is approaching maximum for *U1*).

• *Enable Clock Monitor.* Assuming jumpers are set for Normal Expanded Multiplex Mode and not Special Test Mode, when position 3 is set to OFF, the clock monitor is enabled. When enabled, an interrupt occurs if the clock fails or runs slow. With MAG-11DIAG firmware, this causes a system reset to occur and *LED8* to light (assuming there's at least a semblance of a clock after system reset).

• *Setting IRQ Interrupt for Level Sensitivity.* When position 8 is set to ON, the IRQ interrupt is falling-edge-sensitive (triggers on high-to-low transition). When set to OFF, it's low-level sensitive (triggers on detection of less than about 1 volt). When there's more than one source of IRQ interrupt, configuring for level-sensitive operation is mandatory. (For details, see Part 1 and the M68HC11 Reference Manual.)

Special Test Mode

MAG-11DIAG firmware requires that the MAG-11 board be in the Special Test Mode for certain operations to occur. To place MAG-11 in this mode, jumper positions 2 and 3 of *JP1*. When in Special Test Mode and positions 1 and 5 of *S1* are set to ON, a "test" opcode is sent, which causes the program counter to count backwards (decrement). Though this test is limited in terms of applications, it's fascinating.

To see what a 68HC11 looks like after it's been issued a STOP instruction, set positions 5 and 3 of *S1* to OFF and press RESET switch *S3*. If you're monitoring the current drawn by MAG-11, notice its substantial reduction. To further reduce power drain, set position 9 of *S1* to OFF. Recovery from STOP can be accomplished with a RESET, XIRQ or an unmasked IRQ. With MAG-11, recovery is accomplished by pressing the RESET switch.

With position 2 set to ON, the COP Watchdog system is set for the longest time-out period. If position 2 is set to OFF, the shortest period is set. If position 1 is set to OFF, the program instructs the CPU to change to Normal Expanded Mode and then proceeds normally to the beginning of the test routines. If position 1 is set to ON, it proceeds to the test routines while in Special Test Mode.

Adding Your Own Program

One of MAG-11's most appealing features is that it lets you easily get into programming a 68HC11 in assembly or even machine language. Most basic, but often confusing, housekeeping chores have been already accomplished by MAG-11DIAG, as detailed in Part 2. This lets you get right down to writing a program as you leave the pedestrian details to MAG-11DIAG.

To produce your own program, you need an erased 27C256 EPROM and a computer, text editor or word processor capable of producing files in ASCII format, 68HC11 cross-assembler and EPROM programmer. You probably have a suitable text editor or word processor for your computer. A PC-compatible 68HC11 cross-assembler is available from Motorola's Freeware BBS for just the cost of a phone call to Texas. This freeware cross-assembler and many other files are also available on a PC-compatible disk from the source given in the Note at the end of the Parts List.

When writing a program, start at location $2000. You do this in assembly language with the directive ORG $2000. After programming your EPROM, disconnect power and plug it into the *U10* socket and jumper positions 1 and 2 of *JP5, JP6* and *JP7*.

To run your program, set position 4 to ON and make sure positions 1 and 2 are set to OFF. To enable the LEDs, set position 9 to ON. Press the RESET switch. If all's well, in a second or so your program will take over MAG-11's mind! After pressing the RESET switch, observe red *LED6*. If it lights, an illegal opcode has been detected in your program or *U10*.

MAG-11 can be the main controller board for a virtually unlimited number of projects. However, for most practical applications, you must add at least one expansion board. If you write a program to be used by MAG-11 alone, enter the inputs via positions 1 through 8 of *S1*, positions 1 through 4 of *S2* or pin 2 of RS-232 interface DB-9 connector *J7*.

Positions 1 through 4 of *S2* are inputs to Port E (address $100A), which also functions as the A/D converter inputs. Positions 1 through 4 connect to Bits 3 through 0 of Port E. If all switches are set to ON, a read to Port E results in xxxx0000 (binary) or x0 (hex) being loaded into an accumulator (*x* stands for either 1 or 0).

Outputs for MAG-11 are *LED1* through *LED8* and *LED10* (*LED9*, *LED11* can't be controlled directly by the program) and pin 3 of *J7*. As you can see, unless you connect an add-on board via *J3* through *J6*, utilitarian uses of MAG-11 are limited. However, MAG-11 alone has sufficient inputs and outputs for trying numerous programs for you to learn about the internal workings of the increasingly popular 68HC11 series of MCUs.

Coming Up

In Part 4, I'll describe construction and use of the MAG-11BAT Battery Backup/Eight-Channel Logic Probe board that adds to the basic MAG-11 system. I'll also detail how to add other expansion boards and provide a complete memory map and give details on MAG-11's RS-232 interface.

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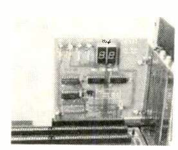

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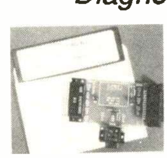

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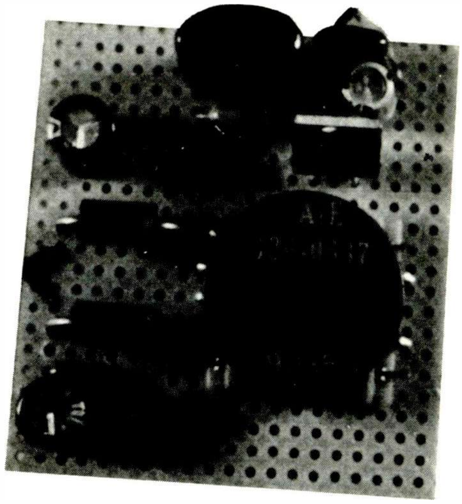
A Tiny Switching Power Supply

Mighty mite adds versatility to digital electronic experimenting and projects



Most digital ICs may have standardized their power requirements at +5 volts, but the analog world still has many chips that require power of greater voltage, some even requiring positive and negative voltages referenced to ground. If you work with circuits that mix both analog and digital ICs, you may sometimes be faced with a finding a means to provide different voltages at an economical price. This is where our Tiny Switching Power Supply can come to the rescue.

Our Tiny Switcher is designed to output +12 and −5 volts from a single 5-volt dc source. You can build it from a handful of standard and inexpensive components.

The Tiny Switcher is small enough to fit into the corner of an analog assembly. Another advantage to using this supply in an analog/digital circuit is that it permits distribution of power sources. Distributed power systems limit ground-loop problems, reduce the noise radiated by the power supply and provide wide flexibility and control over subsystems.

Until fairly recently, building a switching power supply involved manipulation of mathematical formulas to determine core permeability, hysteresis, constant-feedback loop gain, compensation RC network component values, etc. All that is in the past. Now you can obtain guaranteed output voltages simply by selecting standard components. If you want more information on the chip used in our Tiny Switcher, check out literature on the new Simple Switcher regulators from National Semiconductor, which manufactures a complete line of buck, boost and adjustable regulators.

About the Circuit

The Tiny Switcher isn't very complex in terms of circuit design, as illustrated in Fig. 1. The circuit essentially chops a dc voltage (5 volts, in this case) and presents the chopped voltage waveform to the primary of a step-up transformer. In turn, the transformer boosts the voltage at its primary to deliver a different voltage/current ratio at its secondary.

At the heart of the Fig. 1 circuit is National Semiconductor's LM2577T-ADJ adjustable switchable regulator, shown as *U1*. This chip contains a 52-kHz oscillator, a critical component in chopping the +5 volts applied to the circuit at pin 5.

A small portion of the voltage from the primary of *T1* is coupled to feedback pin 4 of *U1*. This voltage is compared against an internal 1.23-volt reference with an internal differential amplifier. The difference signal resulting from comparing the feedback and reference voltages is then compared internally against the internal oscillator. The output of this comparator is then used to drive the main on-chip current switch.

The main switch can handle up to 3 amperes of current. The chip also contains internal thermal protection, thermal compensation and current limiting. Additionally, it has a TTL-level on/off input for logical control of the device. This feature can be use-

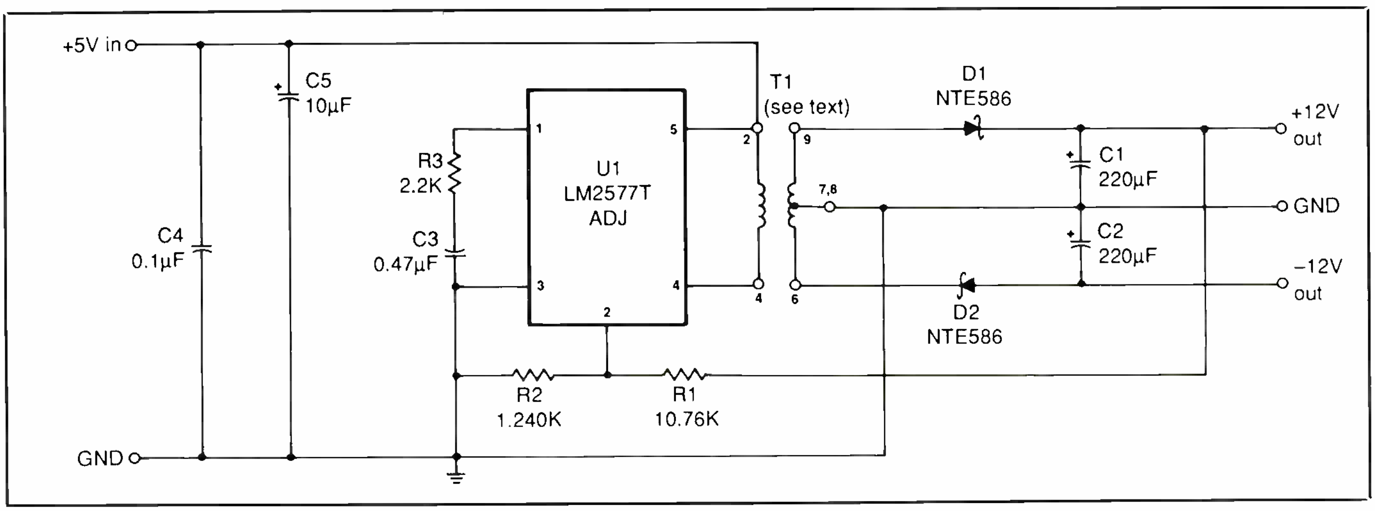


Fig. 1. The complete schematic diagram of the circuitry used in the Tiny Switcher.

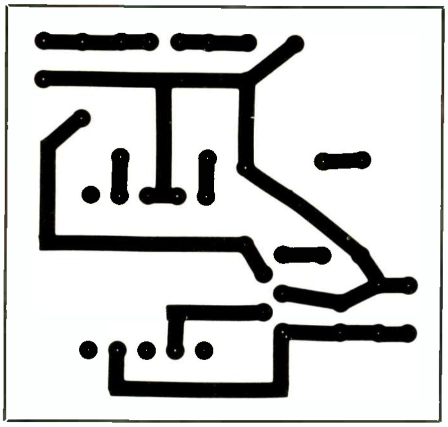


Fig. 2. Actual-size etching-and-drilling guide to use for fabricating a printed-circuit board for the Tiny Switcher.

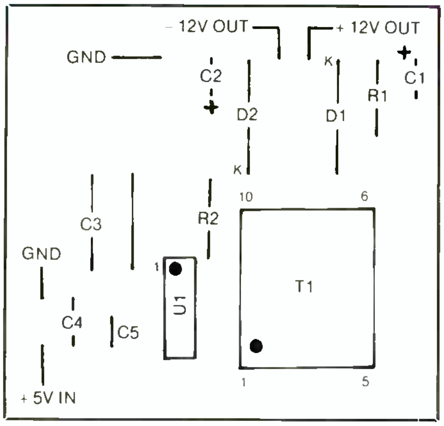


Fig. 3. Wiring guide for pc board. Use this as a rough guide to component placement if you wire the circuitry on perforated board and use point-to-point wiring.

PARTS LIST

Semiconductors
D1,D2—NTE586 fast-recovery Schottky diode (If not obtainable, substitute ECG586 or 1N5821)
U1—LM2577T-ADJ adjustable switchable regulator
Capacitors
C1,C2—220-μF, 25-volt electrolytic
C3—0.47-μF polyester
C4—0.1-μF polyester
C5—10-μF, 25-volt electrolytic
Resistors (¼-watt)
R1—10,760 ohms, 1% tolerance
R2—1,240 ohms, 1% tolerance
R3—2,200 ohms, 5% tolerance
Miscellaneous
T1—AIE No. 326-0637 pc-mount transformer
Printed-circuit board or perforated board with holes on 0.1″ centers and suitable soldering hardware (see text); hookup wire; solder; etc.
Note: The following items are available from Atronix, Box 221393, Sacramento, CA 95822: LM2577T-ADJ, $12 and AIE No. 326-0637, $35. Add $2.50 P&H per order. California residents, please add state sales tax.

ful for controlling the output voltage of the Tiny Switcher, as required by the host system. The high amount of integration in the LM2577T-ADJ chip is responsible for making the external-component circuitry so simple.

Diodes *D1* and *D2* half-wave-rectify the output voltage from the secondary of *T1*. Capacitors *C1* and *C2* smooth the pulsating dc waveform from *D1* and *D2* to produce a dc waveform.

Resistors *R1* and *R2* make up a precision voltage divider for the *U1* feedback circuit at pin 3. Capacitors *C4* and *C5* control initial turn-on current to provide a "soft start" and decouple the 5-volt dc source from any r-f from inside *U1*. Finally, resistor *R3* and capacitor *C3* make up a series RC network that's used by the error amplifier inside *U1*.

Construction

The circuitry of the Tiny Switcher is simple enough to be point-to-point wired on perforated board that has holes on 0.1″ centers using suitable soldering hardware. Do *not* use Wire Wrap hardware. The wire conductors used in Wire Wrap can't safely handle the currents this circuit is designed to handle.

If you're more ambitious, you can fabricate a printed-circuit board on which to mount and wire together the components that make up the circuit. If you go this route, use the actual-size guides shown in Fig. 2.

Referring to Fig. 3, begin populating your circuit board by installing the resistors, capacitors and diodes. Make certain that the electrolytic capacitors and diodes are properly oriented before soldering their leads into place. Also, when mounting *D1* and *D2*, leave about ⅛″ or so of space between them and the surface of the board to permit air circulation. If you're using point-to-point wiring, use Fig. 3 as a rough component layout guide and strike off each component and conductor run as you make them on a photocopy of Fig. 1.

Next, install and solder into place the switching IC. Make absolutely certain that you properly orient this IC (that is, match pin 1 with the pin-1 location identified on the board in Fig. 3) before soldering its pins into place. Now mount transformer *T1* in the indicated location, matching its pins as shown.

Finally, install the wires that will be used to interconnect the circuit-board assembly with the circuit with which it is to be used. Use stranded color-coded hookup wire (red insulation for +5 volts, black insulation for ground on the input side of the supply and two other colors for +12 and −12 volts on the output side, with black insulation once again for the output ground connection) of appropriate length for these wires. Strip ¼″ of insulation from both ends of the wires. Then tightly twist together the fine conductors at both ends of all wires and sparingly tin with solder. Plug one end of these wires into the indicated holes in the board and solder into place.

It's a good idea to test the Tiny Switcher before you actually connect it to the circuit in which it's to be used. To do this, you need a source of 5 volts dc and a dc voltmeter or multimeter that can be set to a dc-volts function.

Place the Tiny Switcher on a nonconductive surface and clip the common lead of the meter to circuit ground on the board. Taking care to properly polarize the connections, connect the input leads to the 5-volt power supply. Turn on the power supply and touch the "hot" probe of the meter to first the +12- and then the −12-volt output leads while observing the meter's display. If you fail to obtain readings during these tests of almost exactly +12 and −12 volts, respectively, power down and rectify the problem.

You'll soon discover that the Tiny Switcher gives you an inexpensive and simple solution to the powering problems in system that use mixed analog/digital circuitry, especially if the analog portions require a split supply. The small size of the circuit-board assembly and ease with which it can be integrated into the analog portions of your circuit designs are complemented by the benefits of a distributed power system.

PageMaker 4.0 for Windows: Powerful Desktop-Publishing Package Delivers Significant Enhancements

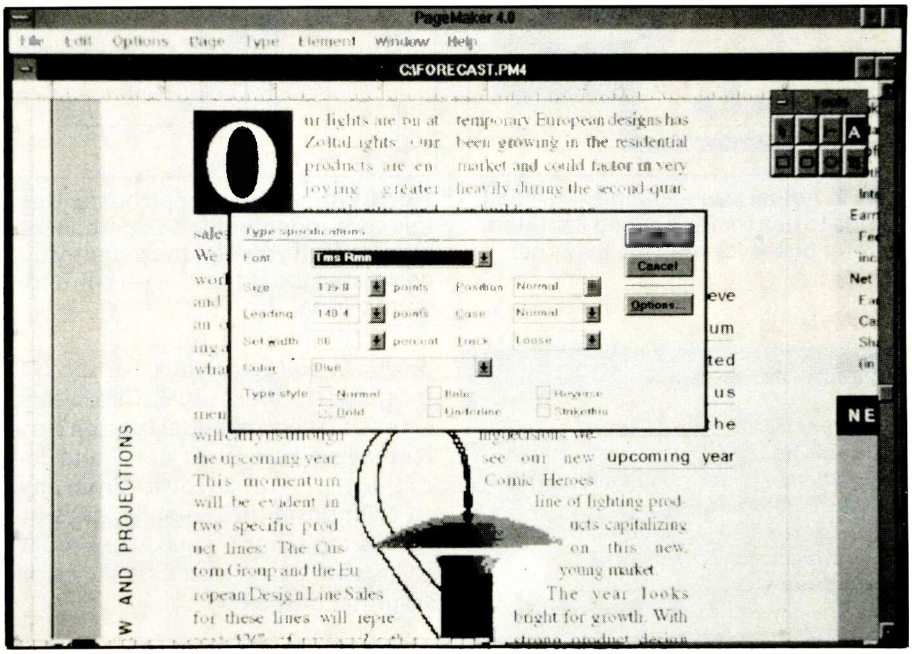
You can use a PC to efficiently produce flyers, newsletters, manuals, catalogs and books. Desktop publishing (DTP) page-make-up software to prepare such matter is available in a variety of flavors. The more functions provided, the greater the cost. Among high-end packages for the PC is Aldus's *PageMaker*, whose closest rival in "full-strength" DTP popularity is Xerox's *Ventura Publisher*.

PageMaker was first offered some years ago for graphics-oriented Macintosh computers, which, with Apple Computer's PostScript LaserWriter printer, launched micro desktop publishing. It took some time for PCs to add functional DTP to their applications capabilities, but new graphics hardware and software, flexible page-layout programs, *Windows* 3.0 and laser printers with PostScript capability now make PCs a viable alternative to Apple Macs for desktop publishing. The latest PC version of *PageMaker—Pagemaker* 4.0 for *Windows*—made its debut this year with about 75 new features and enhancements (see New Features box).

Like other DTP software, *PageMaker* is designed to make page layout easier to do on a computer than with, say, a word processor (or, perish the thought, sending copy to a typesetter and then to illustration and layout artists). Using imported text from a word processor, pulled-in illustrations from a computer drawing package, images from a scanner, financial figures captured from a spreadsheet, *et al*, the software enables you to move and size all elements of a page on-screen to create the layout you want. High-end software like *PageMaker* adds a variety of layout tools that enhance operation, appearances and preciseness.

The main areas of improvement in the latest *PageMaker* version are word-processing capability, enhanced typographic controls and support for color and production of long documents. *PageMaker* 4.0 runs under Microsoft *Windows* 3.0. Aldus suggests it be used on an 80386-based computer with at least 2M of RAM, 40M or larger hard disk, EGA or better video adapter and a mouse or other pointing device. In a pinch, though, it can work on an 80286 PC with a 20M drive.

Our copy of *PageMaker* 4.0 came with six 3½" double-density floppy disks, six manuals, quick reference guide and separate disk with PCL4, PCL5 and PostScript printer drivers for *Windows* 3.0. Also included was a free copy of the Adobe *Type Manager* (part of a limited-time promotion). Suggested retail price is $795 (direct-mail "street price" is less than $500). Registered owners of any older version of *PageMaker* can upgrade to the new release for $150 (call 1-800-243-3173 for details).



PageMaker 4.0 offers sophisticated typographic controls like text rotation, character-width control and track kerning. Special features can be printed to both PostScript-language and PCL-based printers through Adobe TypeManager.

4.0 Overview

PageMaker is a WYSIWYG desktop-publishing program, which means that what you see on screen, in effect, is what you get on your printer. It also means that you work directly with the publication you're creating and immediately see results of any changes you make. You don't have to embed special codes in the text or jump back and forth between very different text and graphic views of the page content.

PageMaker uses a pasteboard metaphor, a familiar setting for paste-up artists and graphics designers. This electronic pasteboard comes complete with ruler guides and a set of design tools. Pages that you work with lay on the pasteboard.

With each new version, *PageMaker* has become richer in features. Version 4.0, however, represents a substantial improvement, not just some added refinements.

Until now, *PageMaker*'s word-processing capabilities were severely limited. Version 4.0 eliminates this limitation with a feature called the Story Editor. This Editor is a text-only view of selected text in the document. It offers quick text editing (compared to normal editing in page-layout mode) and other word-processing functions, such as search and replace. Story windows can be reduced to icons for quick reopening of stories in a publication. Included with Story Editor is a 100,000 word spelling checker.

PageMaker 4.0's typographic controls have been greatly improved as well. Two that are important to casual users are a wider range of type sizes (4 to 650 points) and text rotation in 90° increments. Others that are more valuable to professional users include two levels of pair kerning over user-definable ranges (1/25 and 1/100 em), the ability to set character widths (from 5% to 20% and built-in point-size-dependent tracking (see the the Elements of Typography box for more details.)

A big advance for *PageMaker* 4.0 is in

New Features in PageMaker 4.0 for Windows

PageMaker 4.0, which runs under *Windows* 3.0, includes 75 new features. Listed below are the majority of the features by category that have either been added or enhanced in this new release.

Ease of Use

- More than 35 pre-designed templates, including newsletters, proposals and other business communications
- Context-sensitive Help
- Full WYSIWYG (what you see is what you get) display
- Eight page-size displays, from 25 to 400 percent

Page Layout

- More than 40 import/export filters for integrating text and graphics from many sources
- In-line graphic support for tying graphics to text
- Text wrap-around graphics on master pages
- Ability to regulate how text and graphics break in a paragraph, column or page
- Type-management support for accurate display of text in all page views
- Enhanced printer support of expanded, condensed, rotated and reversed text and large point sizes
- Paragraph controls for tying ruled lines to text

Publication Management

- Support for dynamic data exchange and DDE-like capabilities:
- Links management for obtaining status of imported text and graphics files, and automatically updating them
- Option for linked files to be automatically updated when switching between applications
- Ability to sub-launch a Table Editor utility and update tables from within a *PageMaker* publication
- DDE support of Microsoft *Excel* charts and spreadsheets
- "Book" feature for easily combining multiple *PageMaker* files to chain-print, automatically renumber pages and create common table of contents and index
- Automatic index generation, with extensive editing capabilities, and table of contents generation even over multiple-file publications
- Ability to accept "tagged" formats imported from word-processing, database and spreadsheet applications
- Automatic page numbering, with five numbering schemes
- Ability to build individual files up to 999 pages—limited only by disk space
- Automatic date and time stamping

Word Processing

- Story Editor, fully integrated, for extensive word processing in special text-only view of the page layout
- Table Editor for easily building tables or automatically converting Lotus *1-2-3* or Microsoft *Excel* files into tables—with dynamic link within *PageMaker* for editing and automatic updating
- Ability to check spelling automatically, based on a 100,000-word dictionary that includes common scientific and technical terms
- Ability to install additional English spelling dictionaries that cover law and medicine
- Spelling dictionaries currently available in 12 additional languages (*PageMaker* can check spelling and apply appropriate hyphenation in as many languages as you have dictionaries installed)
- Find/Change—search and replace words, phrases, fonts, point sizes, paragraph styles
- Full control over widow and orphan lines
- Export option for sending text and style sheets to a word processor such as Microsoft *Word* or *WordPerfect*
- Soft carriage return to end a line without ending a paragraph
- Up to 40 tab settings per line of text, for enhanced spreadsheet and database support
- User-definable font and point-size display for Story Editor
- "Next style" attribute to specify that one style automatically follow another
- Common word-processing shortcuts

Typography

- Type sizes from 4 to 650 points in 0.1-point increments
- Individual or global changes for all type specifications, including font, size and style or any paragraph attribute, such as color, track and alignment
- Ability to set small caps, subscript and superscript as a percentage of point size
- Complete control over leading, in 0.1-point increments, with choice of measurement standards
- Kerning (automatic and manual) for pairs or a range of text to within 0.01 em
- Five levels of true typographic (point-size-dependent) tracking for specific fonts
- "Set width" to condense or expand type, from 5% to 250% of a character's width
- Justification, left-alignment, right-alignment, centering and forced justification controls
- Automatic ranked hyphenation for all installed dictionaries
- Ability to select zone and degree of hyphenation and limit number of consecutive hyphens
- Automatic letter, word and paragraph spacing as paragraph attributes
- Text rotation in 90° steps
- Ability to show loose/tight lines

Graphics and Color

Pantone Color charts, plus RGB, HLS and CMYK color models
- Ability to import and display color images and illustrations, including 24-bit color TIFF images and EPS graphics (screen display quality depends on graphics adapter card installed)
- Ability to compress imported TIFF images automatically, reducing file size significantly
- Ability to display images and illustrations in normal, high-resolution, or grayed-out modes

Printing

- Ability to print miniature page representations, or "thumbnails" (PostScript-dependent)
- Support for printers that offer double-sided (duplex) printing
- Ability to print black-and-white laser proofs of color documents to a laser printer, or color comprehensives to desktop color printer
- Ability to chain-print multiple *PageMaker* publications
- Ability to print odd- and even-numbered pages separately
- Ability to print separate overlay pages for each color with or without knockouts

its handling of color. Version 4.0 supports display and output of full-color graphics and images, including 24-bit color TIFF (tagged image file format) images and EPS (encapsulated PostScript) graphics. In addition to supporting HLS, CMYK and RGB color models, Version 4.0 also provides Pantone Color charts. (See Printing Colors With PageMaker box.)

PageMaker 4.0 has enhanced support for long documents, an area where previous versions took a back seat to *Ventura Publisher*. A "Book" feature lets you combine multiple *PageMaker* files to chain-print, automatically renumber pages

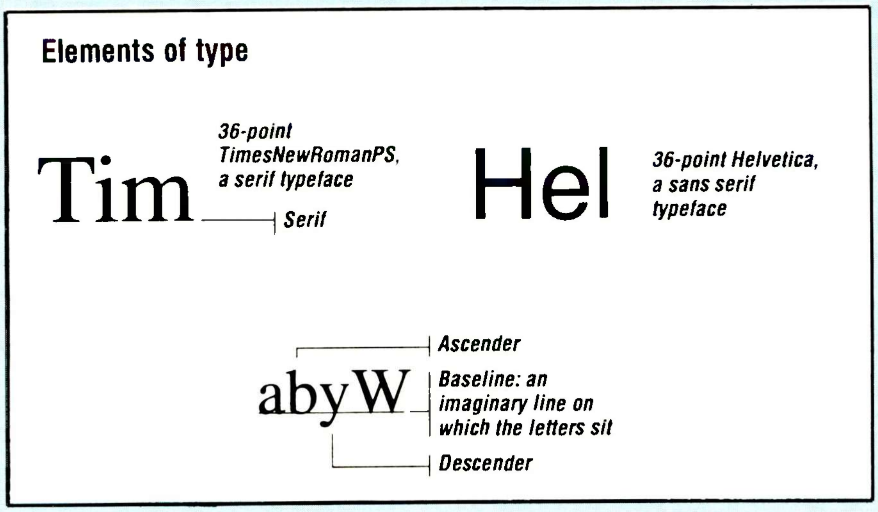
Elements of Typography

The kind of type used in a publication often determines how appealing a publication looks and how easy it is to read. The typeface typically used in magazines, newspapers and other periodicals is Times Roman, which is a serif typeface. (Serifs are the tiny appendages projecting from a character.) Thousands of typefaces exist, but most can be categorized as serif or sans serif (without serifs).

Type is measured in points and picas. Points are used to measure character height and space between lines. Picas are used to measure margin and column widths and spacing between columns. In desktop-publishing programs like *PageMaker*, a point is exactly equal to 1/72 inch, and one pica is equal to 12 points, with 6 picas equal to 1 inch.

Type style refers to the weight or slant of a letter—whether it's bold or italic—and its attributes, such as underlining or strike-through. The term "font" refers to a set of characters that have a particular typeface, size and style, as, for example, 10-point Times Roman bold.

An important way to enhance the look of type on a page is through kerning and leading. Kerning refers to the amount of space between characters, and leading refers to the amount of space between lines. Track kerning, a new feature in *PageMaker* 4.0, is a method of uniformly increasing or decreasing the amount of letter and word spacing over a range of text, depending on specific font and size.



This illustration shows the important elements of type.

and create a common table of contents and index. *PageMaker* can also build individual files up to 999 pages long—limited only by disk space.

This latest version of *PageMaker* lets you place graphics in-line with text. With this feature, a graphic moves with adjacent text characters when the text is moved.

A separate Table Editor utility is used to create professional-quality tables. Like a spreadsheet, Table Editor lets you organize information into rows and columns that can be inserted, deleted and re-sized. Tables can be saved in text, PICT (Macintosh), *Windows* Metafile or native (.TBL) file format, which can be placed as graphics into *PageMaker*.

Aldus recognizes the fact that not everyone is a graphics designer. To this effect, *PageMaker* includes a variety of pre-designed templates (35 in the current version) to help users produce professional-looking layouts quickly and easily.

Installation & Use

PageMaker installs with the *Windows* RUN command. Installation takes a fair amount of time because it comes on six disks crammed with compressed files. The program also takes a fair amount of space, about 8M on a hard disk. After installation, *PageMaker*'s printer drivers must be installed for PCL4, PCL5 or PostScript through the *Windows* Control Panel.

We tested *PageMaker* 4.0 on an ALR PowerFlex 486 with 4M of RAM. We attempted to lay out a 15-page article on basic electronics, which was originally typed into *WordPerfect* 5.1. The article included several equations, which we constructed with *WordPerfect*'s built-in Equation Editor.

Setting up *PageMaker* for page layout is simple. First you select the approximate number of pages needed and then create right and left master pages. We chose a two-column layout of text on each page.

To begin any type of layout with *PageMaker*, you select Place from the File menu. In this case, we were "placing" our *WordPerfect* file into *PageMaker*. This operation is the same, regardless of the word processor used. Several problems surfaced right away. The first concerned margins. *PageMaker* 4.0 picked up the margin settings from the *WordPerfect* document, even though we selected different margins in *PageMaker*. Thus, our first layout attempt showed a column of text within the column we specified in the layout. Only two or three words were placed on each line.

Going back to *WordPerfect*, we deleted margin settings. Returning to *PageMaker*, we selected Links from the File menu (*PageMaker* 4.0 automatically links to outside documents). A dialog box informed us that changes had been made to the document, but no request had been made to *PageMaker* for an update. We clicked on the Update button, and the document laid out perfectly. This linking capability is a very important new feature of *PageMaker* 4.0. It's especially useful when several people are working on a publication and making changes to stories.

Our next difficulty dealt with *PageMaker*'s lack of support for the *WordPerfect* Equation Editor. Although *PageMaker* 4.0 supports *WordPerfect* 5.1, it doesn't recognize graphics produced by the Equation Editor. Because we couldn't solve this problem, we lost all our equations. An expensive solution is to purchase a third-party program specifically designed to produce equations for *Windows*-based products. An equation editor would be a welcome addition to *PageMaker*, since there's no easy way to produce equations in the program now.

One final problem surfaced when we tried to place our *WordPerfect* document into *PageMaker*. It concerned units of measurement used in the document. We expected *PageMaker* 4.0 to translate the Greek letters pi, mu (for micro) and omega (for ohms) from the *WordPerfect* file. These symbols were originally entered in the *WordPerfect* file with the Ctrl-V Characters feature. (Other word processors use different methods to include ASCII symbols in a document.) *PageMaker* ignored them.

We then tried entering the symbols into the *WordPerfect* document using the PostScript font named Symbols. *WordPerfect*, as well as other major word processing programs, includes commands for changing fonts used in a document. This technique worked.

Then *PageMaker* 4.0's Story Editor was used to add three paragraphs to the article. To engage Story Editor, you simply choose Edit Story from the Edit menu. If the document contains more than one

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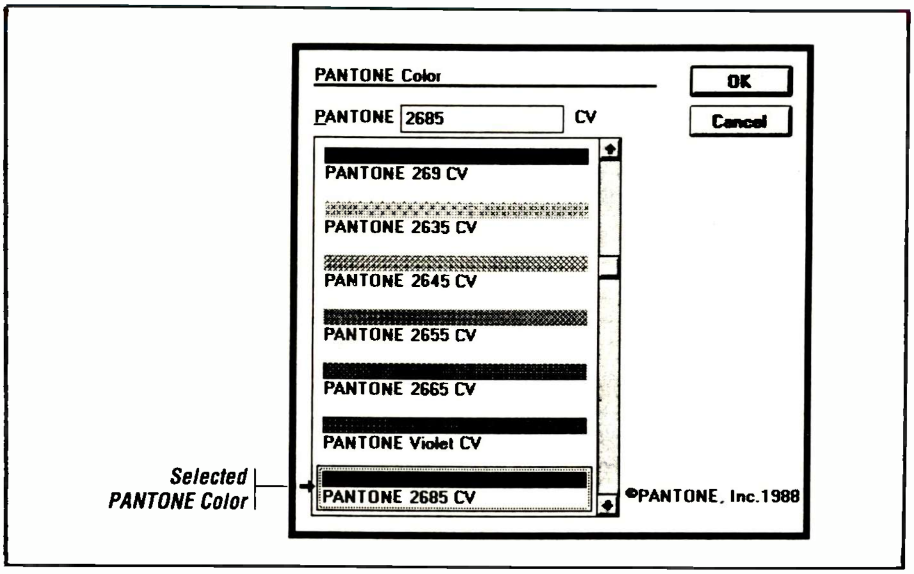


Fig. 1. To use a Pantone color, you must first select it from a dialog box.

story, the Editor selects the one on which you're currently working. The Editor brings up the story in text mode. If you have a headline, for example, it appears as standard-size text. Typing with Story Editor is quick and easy and is a welcome and much-needed addition to *PageMaker*.

A nice feature of Story Editor is that you don't have to open and close it constantly. Instead, you can make it an icon. There's a small annoyance with this because the icon can easily disappear behind the pasteboard and be difficult to locate when you need it.

Story Editor's search and replace feature can search for characters, words, fonts, type sizes, paragraph styles and type styles in any combination, including such special characters as carriage returns, tabs and hyphens inserted by *PageMaker*. To gauge this feature's speed, we replaced all periods in the text with an exclamation point. This took 12.8 seconds to accomplish, which is very slow. As a comparison, the same operation in *WordPerfect* takes less than a second.

We tried a couple of *PageMaker* 4.0's new typographical features. Changing text to an odd size, like 17 points, is a cinch. You do this easily by selecting Type Size Other and entering the desired size. To rotate text, you select Text rotation... from the Element menu. Text can be rotated in only 90° increments. For best hard-copy results with this feature, Aldus suggests a PostScript or PCL 5 printer, or type-manager software.

Color can be applied to both text and graphics. To use a Pantone color, you must first select it from a dialog box like the one shown in Fig. 1.

Table Editor is a separate program you start by clicking on its icon. We used it to create a small table that we incorporated into our *PageMaker* document. Table Editor lets you manipulate text attributes and add borders, lines and shading to a table rather easily. To bring a table into *PageMaker*, you use the Place command, just as you would with any other file.

Table Editor can also be used as a stand-alone program to produce attractive tables like the expense report shown in Fig. 2.

To help you learn how to use *PageMaker*, an included Getting Started manual on how to create a newsletter with files is provided by Aldus. The company also provides a list of training centers, educational institutions and consultants who are members of the Aldus Authorized Training Program.

To create professional-looking newsletters and other types of publications, you need a laser printer. If you don't have one, or desire better quality than a typical 300-dpi laser can provide, you may want to send your files to an imaging center. *PageMaker* comes with a list of Aldus Authorized Imaging Centers that includes image setting service bureaus, slide service bureaus and color process houses throughout the country.

Conclusions

Although we didn't thoroughly test all the new features available with *PageMaker* 4.0, our examination did remind us of how frustrating this very-powerful program can be at times. Problems like the ones we had with equations, margins, symbols and icons need to be worked out over a period

Printing Colors With PageMaker

If you use a desktop color printer with *PageMaker*, you can print essentially what you see on the screen. However, if you intend to use a commercial printing service, you decide decide whether your publication will use spot color, process color or both.

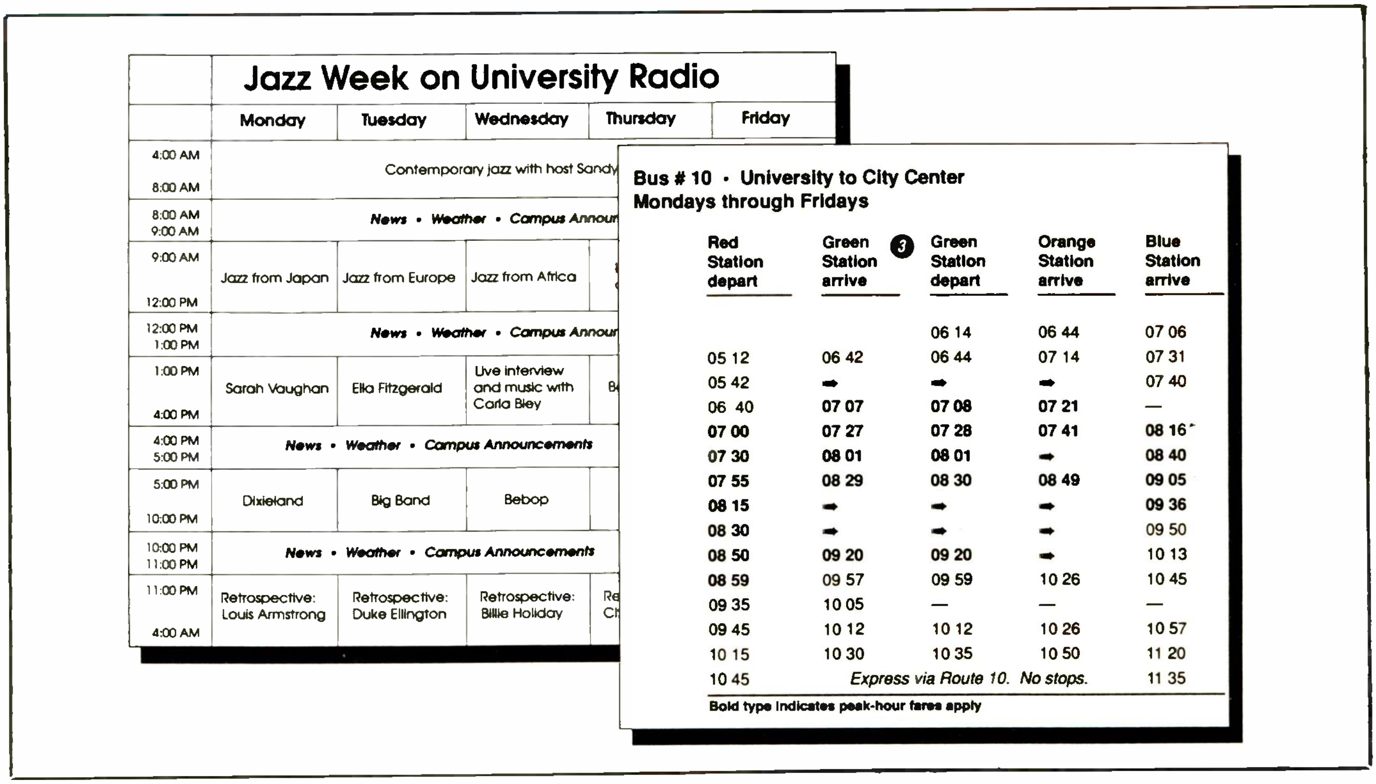
Spot color is a single color on a page. Sometimes you see spot color used for headlines, subheads or other elements of a publication. Using *PageMaker*'s print options, you can have your publication's colors printed as spot colors. *PageMaker* prints an overlay for each spot color from which a printing plate is prepared from each overlay.

If pages of your publication contain color photos, a commercial printer will use process colors (cyan, magenta, yellow and black) to print your publication. The printer creates color separations of these pages, with a separate printing plate prepared for each of the process colors. When ink from each plate is printed, the colors of the original photos are recreated through the combination of the four process colors.

If you have an accent color on a page in addition to color photo, you can do either of two things: have the accent color separated into its process color components and re-created using process inks, or you can print the accent color as a spot color using a separate (fifth) printing plate.

If you want to use process color, you should send your publication to a service bureau or color house that specializes in creating process-color separations of desktop publications.

A color model is a way of describing the colors you apply or create in your publication. *PageMaker* provides four color models: RGB, HLS, CMYK and Pantone. With any of the first three, you create your own colors. With Pantone, you select from a pre-defined list of colors. RGB defines colors as percentages of red, green and blue light. HLS defines colors as a degree (0 through 360) of hue and percentages of lightness and saturation. CMYK defines colors as percentages of the process color inks: cyan, magenta, yellow and black. The Pantone Matching System (PMS), developed by Pantone, Inc., is a set of more than 700 standard spot colors used by designers, ink manufactures and commercial printing services.



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8:00 AM – 9:00 AM	*News • Weather • Campus Announ*				
9:00 AM – 12:00 PM	Jazz from Japan	Jazz from Europe	Jazz from Africa		
12:00 PM – 1:00 PM	*News • Weather • Campus Announ*				
1:00 PM – 4:00 PM	Sarah Vaughan	Ella Fitzgerald	Live interview and music with Carla Bley	B	
4:00 PM – 5:00 PM	*News • Weather • Campus Announcements*				
5:00 PM – 10:00 PM	Dixieland	Big Band	Bebop		
10:00 PM – 11:00 PM	*News • Weather • Campus Announcements*				
11:00 PM – 4:00 AM	Retrospective: Louis Armstrong	Retrospective: Duke Ellington	Retrospective: Billie Holiday	Re Ch	

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08 30	➡	➡	➡	09 50
08 50	**09 20**	**09 20**	➡	10 13
08 59	09 57	09 59	10 26	10 45
09 35	10 05	—	—	—
09 45	10 12	10 12	10 26	10 57
10 15	10 30	10 35	10 50	11 20
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Fig. 2. Table Editor can also be used as a stand-alone program to produce attractive tables like this expense report.

of time before you can take advantage of *PageMaker*'s full power.

Version 4.0 is, indeed, a significant product upgrade. Among its most impressive additions are an integrated word processor, support for Pantone colors, style templates and the ability to handle long documents. Beyond these, however, there are many other features that make *PageMaker* 4.0 a much better product than its predecessor (see New Features box).

Whether or not *PageMaker* 4.0 is a good choice for you depends upon your application and how much desktop-publishing power you really need.

This is, indeed, a full-powered program that offers extreme versatility. As such, to take full advantage of what you're paying for, you'll have to use it regularly in order to master all its nuances. You'll have to work a little harder at the beginning, too, because *PageMaker* 4.0 isn't an especially intuitive program. Nor does its *Windows*-environment design provide you with flashy speed, as one would have hoped it would. In fact, it moves along a bit clumsily. But *Windows* does reduce training time and gives your personal memory of commands some respite. And as outlined above, you may encounter some challenges when using *PageMaker* that aren't easily solved. At the same time, *PageMaker* 4.0 is a sophisticated program that offers features not readily available in competing products.

In Brief

Aldus PageMaker 4, $795 ($150 upgrade)
Aldus Corp.
411 First Ave. S.
Seattle, WA 98104
Tel.: 206-622-5500
Minimum Requirements: *Windows* 3.0, 286-based PC, 2M RAM, 20M hard disk; EGA adapter.
Comments: A sophisticated program that offers significant improvements and features not readily available in competing products.

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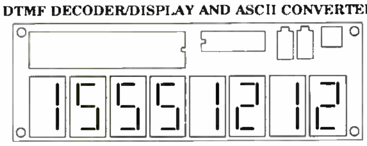

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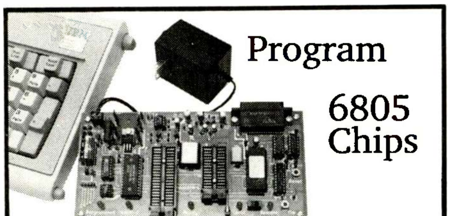

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Ted Needleman

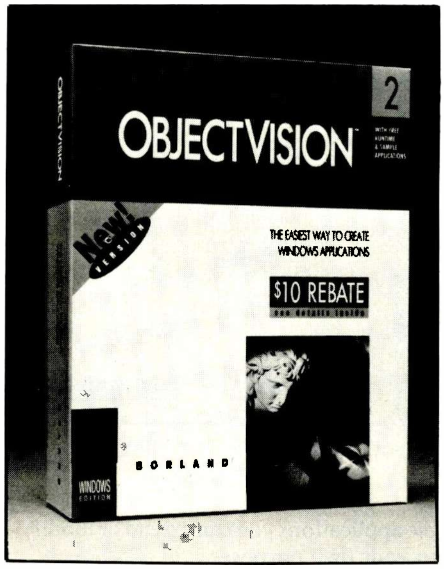
Borland's ObjectVision 2.0: A Different Approach To Looking at Your Applications

Depending upon which reports you read and believe, it appears that Microsoft has delivered somewhere in the neighborhood of 10-million copies of *Windows*. A good number of these copies have been included in software bundles with PCs, but even if only half the units delivered are actually being used, *Windows* certainly enjoys a position as a popular operating environment. To some extent, its popularity is a result of its graphical interface. However, *Windows* offers several additional benefits to developers and users that are of more immediate concern to this month's column.

From a developer's point of view, *Windows* is both an advantageous environment to create software for and a sometimes frustrating one. *Windows*, like many of the most-recent operating systems and environments, provides a high level of buffering between the application and the underlying system and hardware. This layer is comprised of a number of points called Application Program Interfaces, or APIs. While an operating system, such as MS-DOS, provides a level of device handling routines in its BIOS (Basic Input/Output System) that handles many of the details when an application needs to write to an I/O device like a disk, screen or printer, the developer must still include code in the application to account for the large variety of I/O devices that might be attached to a particular PC.

All of us have performed installation routines that prompted us for the specifics of our particular system—type of video being used, type of printer attached, etc. As a result of this process, the install program selected blocks of code that sent output to the parallel printer port or serial port (as appropriate) and formatted the screen display according to the type of video specified. When new devices, such as SVGA (super-VGA) and laser printers became available, the applications had to be updated with new blocks of code to handle the additional features and functions these devices provided. Often, this update process also necessitated a reinstallation of the application.

With APIs, a programmer writes the application so that when it must display a screen, the information is sent to a screen-handler API. Under *Windows*, the process of setting up *Windows* also tells the APIs what type of hardware is being used. When



the screen-handler API receives data from the application to be displayed, it looks to this setup information to determine how to format the display. The same process holds true for other APIs.

The developer needn't concern himself with how the PC is configured (or have to write code for hundreds of different printers and displays), and the user sets up *Windows* once, rather than having to configure every application. And when the hardware configuration changes, it's a simple task to just install one new driver in *Windows*. APIs are the good part of *Windows*.

Where things get frustrating for a developer is in the second benefit *Windows* provides its users—an object orientation. By now, you've probably come across two terms that have become the buzzwords of computing in the 90's—OOPS and OLE. Both refer to an operating environment or application system that has an object orientation. OOPS stands for Object Oriented Programming System, while OLE is an acronym for Object Linking and Embedding. But what is this "object" to which they both refer?

To simplify things somewhat, and bypass a detailed technical discussion about programming and system design philosophy, I'm going to define an object as anything that the application or environment permits to be treated as a discrete element. Depending upon the application, an object can be a document, graphic, data file or field or even a program subroutine performing a complex task.

Looking at data components and procedures as objects provides an unusual and effective perspective on many applications. For example, defining a spreadsheet (or a portion of one) as an object allows you to forget about cutting and pasting or establishing DDE links between applications. Just include (embed) the spreadsheet object in your document and it will appear when you bring up the document in your word processor. Not only that, the dynamic linking process that *Windows* provides will be automatically established and maintained. Change a figure in your spreadsheet, and the change will appear in the object embedded in your document as well.

Defining a procedure as an object allows you to embed a complex task behind a simple task button. When you click on this button with a mouse, the code that performs the task is executed. In fact, in the macro view, the entire application as represented by its *Windows* icon is also considered to be an object.

Windows' object orientation provides a great deal of flexibility in presenting an application. But it can be a bear to program applications within the visual interface while embedding complex task procedures behind innocent-appearing buttons. With the popularity of *Windows*, lots of new tools for creating applications in this environment have appeared, *Visual BASIC, Realizer*, and Microsoft's *Quick C++* among them. For a non-programmer, who just needs to get the job done, most of these are over-kill. Fortunately, the folks at Borland have come up with an unusual and affordable application builder for the *Windows* environment—*ObjectVision* 2.0.

ObjectVision 2.0

There are currently a number of approaches a non-programmer can take to create an application. Three of the most popular are database software, forms packages and spreadsheets. Each has advantages and disadvantages, and none is ideal for every application.

Database packages like *dBASE, FoxPro* and *Paradox* are a very common solution to quickly generating an application. At their simplest use, they let you rapidly set up an input screen, file structures, reports and capture information. Where they fall short somewhat is in the amount of effort and learning curve needed to produce a finished application. Complex calculations are difficult for an inexperienced user to perform easily.

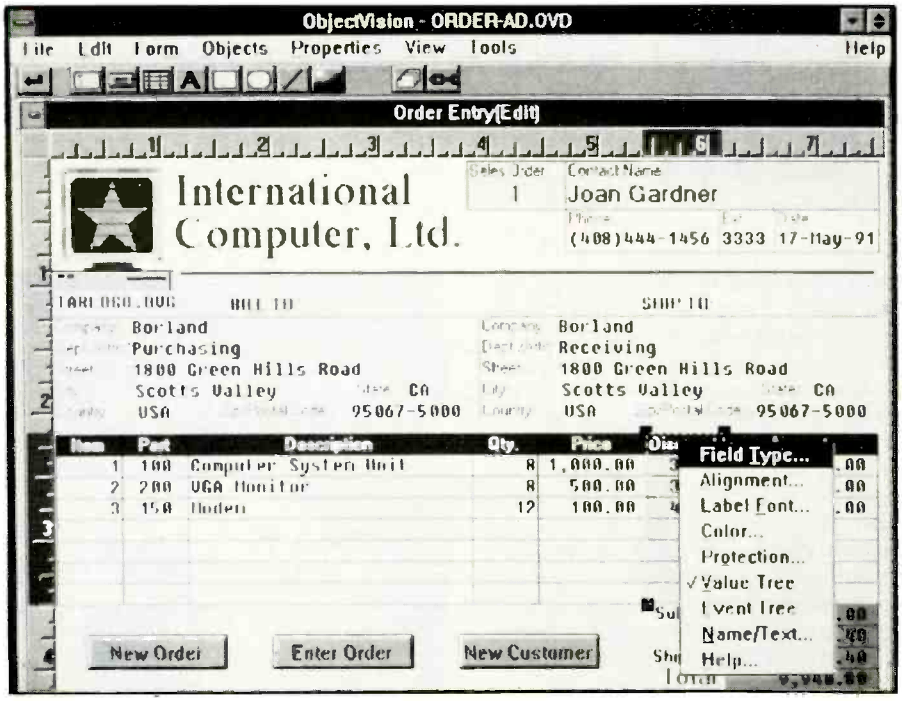
Relational databases like those mentioned, which allow you to establish links between different data files and draw information from one into another, often are accompanied by complex procedural languages necessary to accomplishing many tasks beyond simple data entry and reporting. In fact, in many ways, the more able a database package is, the more likely it is to resemble a programming language.

Spreadsheets offer another quick way to cobble together an application. They're simple to use and easy to modify. In fact, a large number of *ad-hoc* applications exist today completely written in Lotus *1-2-3* or another spreadsheet. When you're happy with your application, you can compile it into executable form with a spreadsheet compiler like *Baler* from Baler Software Corp. (1400 Hicks Rd., Rolling Meadows, IL 60008; tel.: 708-506-9700). Worksheets compiled with *Baler* don't require *1-2-3* to be run, and you can even customize the worksheet so that anyone who uses it isn't aware the application is programmed using a spreadsheet.

Spreadsheets are among the most widely used application development tools, but are generally weak when it comes to large databases. The newest versions of popular spreadsheets, like Lotus *1-2-3* R3.1+ and *Excel* 3.0, have extensive calculation capabilities and graphics, but even with their ability to consolidate or merge several levels of worksheets, they have nowhere near the extensive multi-file capabilities of a relational database.

The last informal application development tool on our list is a forms manager. This popular class of software lets you create a representation of a form on-screen, enter and save data into it and print output documents. Some more powerful forms packages allow you to draw information out of one form and put it into the form you're currently working on. An example of this feature is when you wish to have customer information, like name, address, etc., pulled into your current form when you enter the customer number. Where forms packages generally fall short is in support for complex database structures and report-generating capabilities.

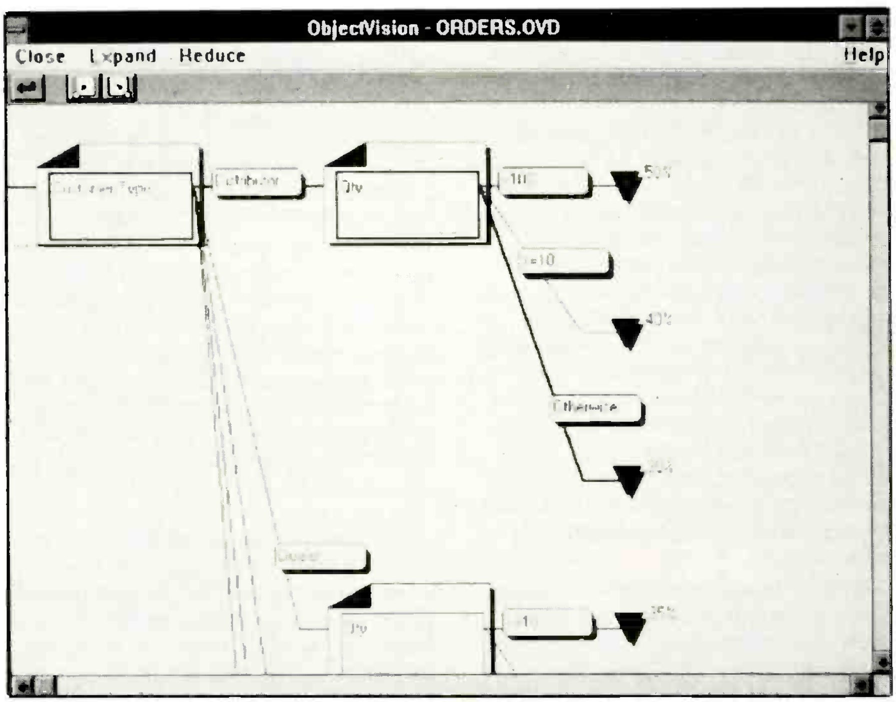
With *ObjectVision*, Borland has created a *Windows*-based product that gives you most of the good features of each of these three product classes in a single package that can be used by a non-programmer to construct some very sophisticated applications. In fact, they even provide 20 sample applications you can extend or modify to your own purposes.



ObjectVision's FORMTOOL is used to create an application's forms and menus.

Borland has chosen the forms orientation as its user interface. Of course, a form doesn't have to be an analog of an existing paper document. It can also take the appearance of a data entry screen or a report. One interesting format *ObjectVision* demonstrates very aptly is a form that serves as the menu for demonstrations of eight of the included sample applications. This "form" consists of a screen that contains eight buttons, each labeled with a sample application. A click on a button launches the selected application.

ObjectVision also borrows heavily from spreadsheet technology. There are a wide number of commands available, including



The Value Tree determines what computations and actions will take place.

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just about all data and numerical manipulation commands you'd find in *1-2-3* or Borland's own *Quattro Pro* spreadsheets.

Finally, Borland hasn't neglected database technology in creating *ObjectVision*. The underlying records created by forms used for data entry are kept in database file format. Normally, *Paradox* format is used, but you can specify a link to files created by *dBASE*, in Btrieve or ASCII format, or a DDE link to other *Windows* applications simply by clicking on a button. This permits you to quickly build an *ObjectVision* front end onto another application that creates files in one of these formats or use a database-management package like Borland's own *Paradox* to create complex reports (though by clever designing of an output "form," you can create some pretty complex reports with *ObjectVision*).

Using *ObjectVision* isn't particularly complex, but using it well isn't all that easy. Just as it takes time to effectively use a spreadsheet package, the richness in features that *ObjectVision* provides makes the learning curve somewhat steep, especially for someone who lacks a fair amount of application-creation experience.

The first step in creating any application is to thoroughly think things through. Creating the application is the easy part; designing a good application is much more difficult. Once you know what data you need to capture, and what needs to be done to it when you have it, you can begin to think about data entry forms, menus, reports and processes.

You create a form with *ObjectVision* by using the Tools pull-down menu to create fields, buttons and graphics. Graphics can be imported, such as a scanned-in logo, or created using rudimentary draw tools included with *ObjectVision*. Once you've created your form, you define each "object's" properties. Each element on your form (field, button and graphic) is an individual object, each of which can have a variety of properties.

As an example of the above, you can link a field to another form, link it to another application (through *Windows*' DDE), place it or retrieve it to/from a database, use it within a spreadsheet-like command or use it as the basis of a decision to perform another process. Likewise, graphics can have all sorts of properties. They can be static, such as a logo, or can be used as a button to perform a series of processes (or even launch other programs).

ObjectVision easily creates and handles large tables, but its most unusual feature is the decision tree that lies behind the design of every *ObjectVision* application. The program provides two classes of trees: value and event. A value tree is an expression used to calculate the value of a field based upon the value of one or more other fields. Value trees consist of branches, conditions and conclusions. Combinations of branches (logical choices) and conditions yield a conclusion (the field's value). Value trees comprise the logical construction of an application and can be used for such things as determining whether to charge sales tax and, if so, at what rate.

Event trees are used in application construction to determine an action. They're similar to value trees, but they don't usually return a value. Most of the time, you use an event tree to trigger a process.

Once you've designed your forms, created your fields and objects and have linked them to the calculations and processes, your application is pretty much complete.

ObjectVision is a very unusual product. It's a tremendously powerful application development tool, but it does require a different approach to looking at your applications. To some extent, it offers a purer tool than conventional programming because it closely follows the systems-development methodology.

The systems approach is to flowchart the processes and links between information as it flows through an application or system, rather than the individual program components and modules as done with conventional flowcharting. Because *ObjectVision* treats data elements as an object, and addresses how the application deals with the object, using the product encourages you to look at an application from a systems point of view.

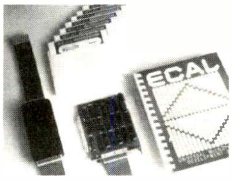
Borland's documentation is very good. It consists of both a Getting Started manual and Reference Manual and a short but complete tutorial in a Getting Started manual. There's even a handy reference card to leave on your desk while you're using the package. And when your application is finished, you can distribute it to others because a free run-time version of *ObjectVision* is included to let users run (but not modify) your application.

I've been using this latest version for only a few weeks, but I like it very much. Just keep in mind that there's no free lunch. To use any sophisticated software package (and this one certainly qualifies), you have to make a commitment in time and effort. With *ObjectVision* 2.0, this commitment can pay big dividends. ■

In Brief

ObjectVision 2.0, $149.95
Borland International, Inc.
1800 Green Hills Rd.
P.O. Box 660001
Scotts Valley, CA 95067-0001
Tel.: 408-438-8400

Universal Emulator Assembler



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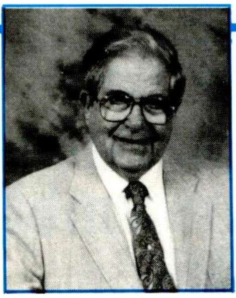

More On Low-Cost, High-Speed Modems

In December of last year, I briefly discussed the various designations for speed and compression standards for the new high-speed, low-cost modems—the V-dot (V.) and MNP codes you see associated with modems. From letters and E-mail I've received, I realize that the waters are still very muddy. So, I'm devoting this column to clearing up this confusion and giving you some more complete definitions.

First, the whole process of telecommunications is concerned with passing data between various interfaces and transmission channels without loss of information. We're mainly concerned with the interface between the device that originates or receives the information and the transmission channel. The receiving or originating device is called the Data Terminal Equipment (DTE), whether or not it looks like a CRT, printer terminal or a computer.

The modems are called Data Communications Equipment (DCE) because their function is to communicate the data, rather than compute, or change the data in any way (although they may compress the data for transmission purposes or decompress it upon receipt.)

Terms like RS-232C, V.42, V.32bis and MNP, etc. are designations for standards or recommendations made by such industry bodies as the Electronic Industries Association (EIA) and the International Consultative Committee on Telegraphy and Telephony (CCITT). Older designations, such as Bell 212A and Bell 103, were standards set by the Bell System. In addition *de facto* standards, such as Microcom Networking Protocol™ (commonly called MNP), are used for data compression and error correction.

The following is a brief explanation of some of these terms:

- V.21. This is the CCITT standard for 300-bps communications. In the U.S., Bell Standard 103 is used for modems operating at 300 baud. Some modems can be set to V.21 for overseas calls.
- V.22. The CCITT standard for 1,200 bps is comparable to the U.S. Bell 212A standard used in the U.S. and Canada.
- V.32. CCITT standard for modem communications at 9,600 or 4,800 bps. V.32 modems fall back from 9,600 to 4,800 bps when there's a degradation of line quality.
- V.32bis. CCITT standard for modem communications at 14,400, as well as 12,000, 9,600, 7,200 and 4,800 bps. V.32bis modems fall back to the next lower speed when line quality degrades and continue to fall back as necessary. When line quality improves they fall forward to the next faster speed.
- V.42. CCITT standard for error detection and control, V.42 LAP-M also supports MNP 2-4 error control.
- V.42bis. An extension of V.42 that defines a specific data compression scheme for use with V.42 and MNP error control. MNP2-5 Microcom Networking Protocol, defines error control. MNP-5 defines data compression.

There's also confusion between half- and full-duplex modes of operation. In half-duplex, transmission occurs in only one direction at a time. When the transmitter is finished and wants a reply, the channel must be turned around. This requires additional handshaking between transmitter and receiver and slows transmission. Typically, FAX transmissions employ half-duplex.

In full-duplex transmission both directions can operate simultaneously over different carrier frequencies. Handshaking has to be done only once when the connection is established. It should be noted that some modems are capable of both FAX and full-duplex data transmissions.

The theoretical maximum asynchronous transmission speed of data under RS-232C over the dial-up network is 20,000 bits-per-second (bps); we consider the practical maximum speed to be 19,200 bps. We're rapidly approaching this speed through communications technology. It was only a decade ago that 300 bps was considered to be maximum practical transmission speed over a telephone network. Today 9,600 bps is common, and data compression allows us to actually transmit 14,400 bps between computers.

One of the most confusing things in a discussion of telecommunications is the relationship of "baud rate" to "bits per second." Baud rate is the number of signaling elements (bits) per unit time. At slow transmission speeds it's roughly equivalent to bits per second. However, because at higher transmission speeds bit rate is increased, more than one bit per second is transmitted. The signaling rate for voice-grade channels has a bandwidth of approximately 3,000 Hz (voice frequency range is about 30 to 3,400 Hz). Voice-grade channels have a fixed maximum baud rate of about 2,400 baud.

The solution to the problem of higher speeds is to pack more than one data bit into each signaling element, or two or more bits per baud. Today, the tendency in discussing transmission speeds above 300 baud is to use "bps," rather than baud. It's a lot less confusing.

If we're limited in data-transmission speed by the bandpass of voice-grade telephone channels, we can increase the amount of information that can be transmitted per unit time. We do this by compressing the data so that it's roughly equivalent to double the data speed rate.

For the data compression to work properly, the computer (DTE) equipment must supply data to the modem (DCE) at a speed of 38,400 bps. To do this, the data is buffered, compressed and transmitted as required to maintain the 9,600-bps transmission speed.

Telephone line conditions are constantly monitored, and line equalizers make corrections for minor line variations. When telephone line conditions are degraded for any reason so that maximum transmission speed can't be maintained, the modem falls back to a lower speed where it can maintain communication. Some modems can also "fall forward" to the next higher maintainable speed, while some will remain at the slower speed until reset for the next message.

Modem-to-modem connections are established by a process called "handshaking" (sometimes called "training"). During this process, the modems transmit and receive signals to test the phone line and tell each other their respective capabilities.

The V.42 error-correction specification covers two methods of error correction, called LAP-M and MNP-4 (as a fallback). During handshaking, the modems determine and establish the best technique to be used. This involves a two-step process: detection and negotiation. The modems first exchange a sequence of patterns that verify their capabilities. Consequently, during negotiation, configuration information is exchanged.

V.42bis and MNP-5 data-compression techniques are also engaged during handshaking. V.42bis is used only with LAP-M error correction, MNP-5 only with

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MNP-4 error correction. Using the V.42bis technique can quadruple data throughput when transferring compressible data.

When downloading software that has been previously-compressed (.ARC and .ZIP files), don't use MNP-5 compression. It takes longer to transfer the file. V.42bis can be used, although transfer speed will be the same with or without it. Modem compression must be turned off *before* that call is made to download because it can't be turned off during the session.

The world of data transmission was a lot simpler in the days when it was believed that 300 baud was the maximum transmission speed over the dial-up network. However, even today's complicated specifications, protocols and techniques are nothing to what's just around the corner when the wired telephone companies, cellular phone companies, satellite-communications companies and paging companies all get into the act. A bit further down the road lurk the TV Cable companies with interactive cable and satellite TV.

I'd like to thank Tina Jacobs and Bruce Quigley of Image Communications and U.S. Robotics for their help and information in collecting all this information. I suggest you save it, because finding all these numbers in one place isn't easy.

This month, I'm pleased to recommend one of the most useful pieces of software I've ever used. It's *Carpenter's Dream*, which figures out all kinds of building material for you. Just give it the dimensions of a job you have in mind, and it tells you how much material to buy, including waste and cut allowances. It can handle lumber, roofing material, regular and irregular cast concrete jobs, wiring, pipe shingles and roof pitches. If you own a house or build homes, you need *Carpenter's Dream*. It's been a commercial program for two years and now is being released as Shareware. Contact PC SIG or Workhorses (805 14 St., Suite B, Golden, CO 80401 (tel.: 303-279-8551) to try a copy. It will become a best download on BBS soon but why wait?

In the On-Line World you can contact me as: S Veit on Delphi, MCI Mail, The Well and America On Line. I'm no longer on Prodigy. I have a new CompuServe number, I am now a Sysop in the *Computer Shopper* area of Ziffnet, which runs on Compuserve. The new number is 72241,400.

Incidentally, if you're searching for review information or articles that appeared in *PC, PC Computing, PC Week, MacWeek, Mac User, Computer Shopper* or *PC Sources*, Ziffnet is the place to find it. The entire Public Brand collection of Shareware is available there also. You can get there from Compuserve by entering Go Ziffnet, or you can subscribe without being a member of Compuserve. ■

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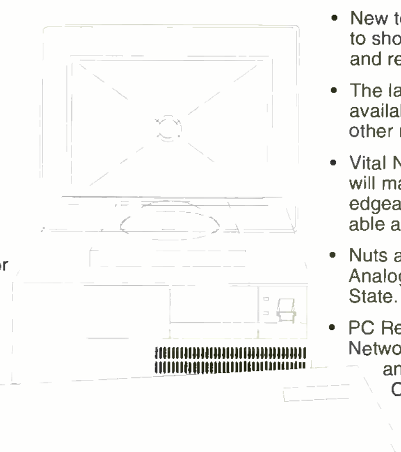

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A GUI Accelerator; Kit That Simplifies Motor Drive Design; Converter For Programming Voltages; PC-Compatible Digital-to-Synchro/Resolver; LED Display Driver; and 5-Volt Megabit Flash PEROM

We open this time with a chip that promises to make your *Windows* computing a lot more responsive. Of the other chips and devices discussed here, one adds a new term to the electronic lexicon: PEROM.

GUI Accelerator

The 86C911 from S3 (2933 Bunker Hill Lane, Santa Clara, CA 95054) is a high-performance graphical user interface (GUI) accelerator that's specifically designed to accelerate applications running under *Windows, Presentation Manager* and *X*. While maintaining VGA compatibility, it delivers a 30% performance improvement over IBM's XGA GUI accelerator, according to the manufacturer.

As a motherboard solution, the 32-bit interface allows the 86C911 to be connected directly to the 80386DX or 80486 local bus (see Fig. 1). In addition to the local bus connection, ISA and 16-bit MCA bus interfaces are integrated on-chip, making it an ideal add-in board solution as well. A complete high-performance VGA-compatible system can be built with as few as 11 chips, including memory.

The S3 GUI Accelerator enables design of cost-effective, VGA-compatible, high-performance graphics systems based on VRAMs. A complete VRAM interface is integrated on-chip, including all multiplexers and serializers. The interface supports 512K and 1M of VRAM.

Featured in the 86C911 is an advanced multiple FIFO architecture. One FIFO is a command/data queue that maximizes the bandwidth available to the CPU. A second FIFO provides a reservoir for BitBlt or screen refresh data, which improves fundamental graphics performance.

The 86C911 is 100% register-level VGA and backward-compatible with CGA, Hercules and MDA standards. This enables OEMs to support a single graphics system that's compatible with most popular PC application software.

High-performance features of the 86C911 include a hardware cursor that's fully compatible with Microsoft *Windows* and OS/2 PM. It speeds up both cursor and icon performance and accelerates all graphics operations by eliminating the software overhead associated with manipulating the cursor. High-speed image transfer and high-performance BitBlt make the process of opening up windows, re-sizing, pulling down menus, dragging and scrolling virtually instantaneous.

The raw "hardware line drawing" speed of the 86C911 is nearly 10 times faster than line drawing on a super-VGA, according to the manufacturer. Using "rectangle fill," the process of painting the menu background is sped up significantly. Max-

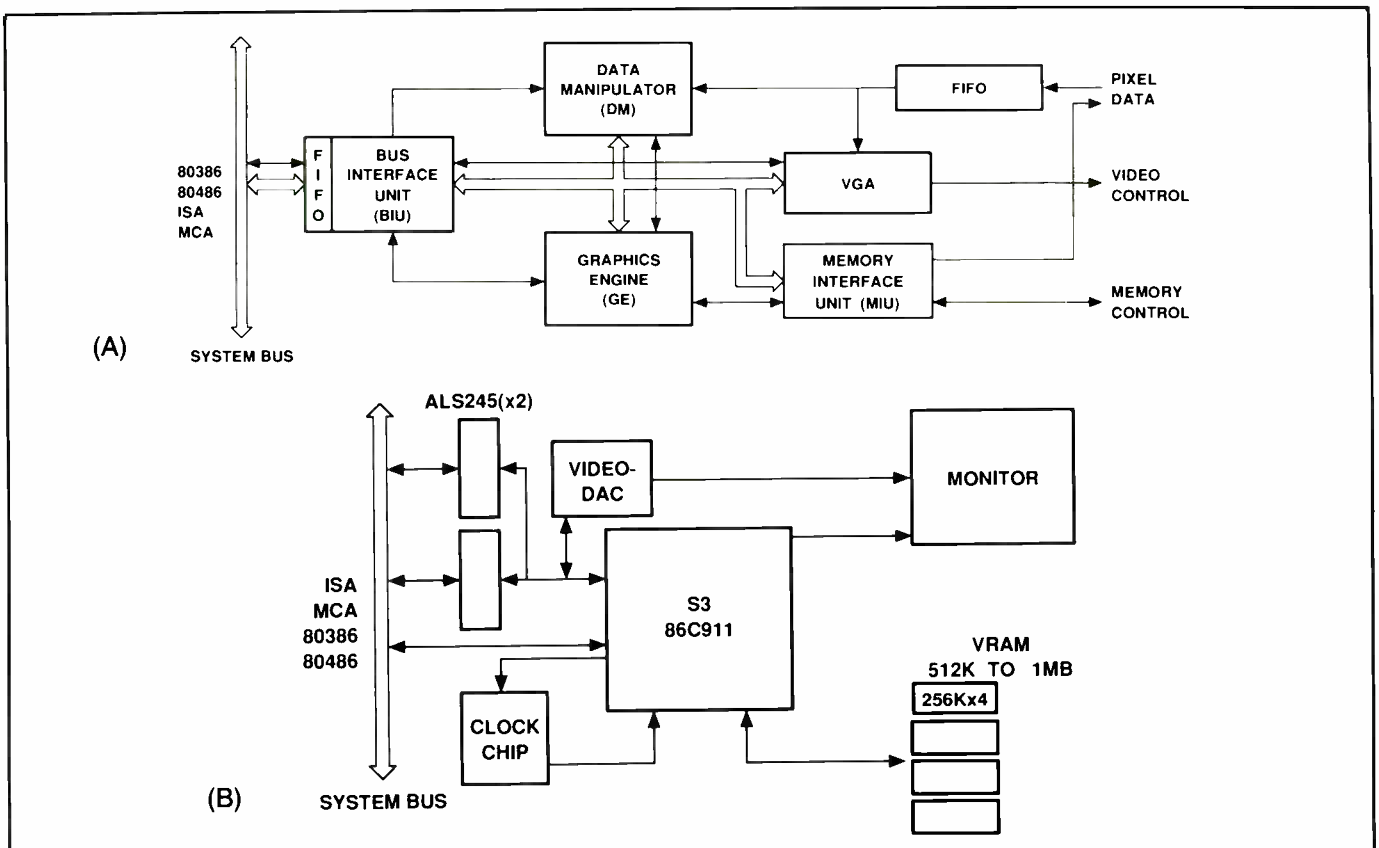

Fig. 1. Block diagrams of S3's 86C911 GUI accelerator chip: (A) chip only and (B) chip interfaced with other devices to make up a system.

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imum rectangle-fill rates are as high as 27.5M bytes/s.

Resolutions up to 1,024 × 768 × 256 colors (non-interlaced) are supported by the 86C911 when using 1M of VRAM. It also supports the new XGA 640 × 480, 65,536 color mode. In addition, extended-VGA text modes up to 132 columns × 43 rows are supported. Vertical refresh rates up to 72 Hz eliminate annoying flicker. Integrated support for Inmos and Brooktree video-DACs and compatibles and the Sierra 15/16-bit/pixel video DAC, minimizes the amount of glue logic normally associated with the video-DAC interface.

S3 provides comprehensive product support, including high-performance *Windows* 3.0 drivers, an extensive set of DOS application drivers and OS/2 PM drivers. An evaluation board is also available.

Simplifying Motor-Drive Design

Motorola (MD-D136, 5005 E. McDowell Rd. Phoenix, AZ 85008) has two new motor-drive evaluation kits: the Logic to Motor Interface Kit and Analog to Motor Interface Kit. These Kits simplify motor-drive design by providing completed circuitry for driving motors rated at up to ¼ horsepower with control over speed in both directions.

Typical motor applications for these drive schemes include many types of automated industrial equipment, copy machines, printers and automobile seat positioners. Control signals to drive these motors can be provided through either a digital or an analog interface.

The Logic to Motor Interface Kit contains an evaluation board that provides an interface between microprocessor control signals and the MPM3002 ICePAK complementary p-channel/n-channel MOSFET H-bridge. This circuit provides a ready-to-go interface design from 5-volt logic control signals to the H-bridge using an MC34151 TMOS driver. The circuit solves the important design considerations necessary to properly drive complementary H-bridges from digital systems, including diode snap, ground bounce, noise suppression and lock out of invalid inputs.

The Analog to Motor Interface Kit includes an evaluation board that provides an interface between analog control signals and the MPM3002 ICePAK module using an MC33033 control IC. An analog interface is the obvious choice when analog circuitry provides the control signals, but it can also be used with some digital systems to allow the system to decouple the processor PWM frequency from the motor PWM frequency. The analog to motor interface circuit provides a complete design alternative, including solutions to diode snap, ground bounce and noise suppression to properly drive the complementary H-Bridge from analog control signals.

Each kit contains a completely assembled evaluation board and supporting application and technical literature. In addition, information on how to get software to provide control signals for these boards is included. The motor drive kits are available through Motorola's Literature Distribution Center (1-800-441-2447) for $95. They can be ordered using the kit numbers KITDEVB103/D for the Logic to Motor Interface Kit and KITDEVB118/D for the Analog to Motor Interface Kit.

Programming Voltage Generator

Linear Technology Corp.'s (1630 McCarthy Blvd., Milpitas, CA 95035) LT1109 5- and 12-volt fixed output step-up dc-to-dc converters are available in eight-pin DIP, SO-8 surface-mount and three-lead TO-92 packages. They require a single surface-mount inductor, diode and capacitor to construct a complete step-up converter.

A 12-volt output at 60 mA (enough to program two flash memory chips) can be generated from a 5-volt, ±0.5-volt, power supply. Eight-pin versions also feature a shutdown pin that reduces supply current to just 320 μA, making the device ideal for cost-sensitive applications in which stand-

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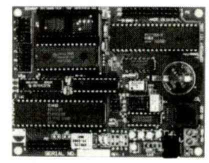
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by current must be kept to a minimum.

Other applications for the LT1109 include 3-to-5-volt and 5-to-12-volt converters and battery-sourced switching power supplies for disk drives, PC plug-in cards, peripherals and other battery-powered equipment.

A gated oscillator design feature of these devices requires no frequency compensation components. The LT1109's 130-kHz oscillator frequency permits using small, lower-cost surface-mount inductors and capacitors in the converter circuit.

Pricing for the LT1109-5 and LT1109-12 is $2.65 in 100-plus quantities for the eight-pin plastic DIP and $2.90 for the SO-8 surface-mount package.

Digital-to-Synchro/Resolver

A new versatile full-size IBM PC card designed for one to six channels of digital-to-synchro/resolver conversion is available from ILC Data Device Corporation (105 Wilbur Pl., Bohemia, NY 11716). The multi-channel DSC-36020 is designed for use in test systems, high-performance simulation systems and control systems and can be used to accommodate many applications, including motor control, antenna positioning, CNC machine tooling, robot axis control and process control.

The DSC-36020 is a standard, full-size IBM PC/XT/AT card that accepts a digital input through memory-mapped I/O space. Two bytes of angular information (16 bits) are required for each converter. Each converter is independent and can be jumper configured to produce 6.8- or 11.8-volt four-conductor resolver or 11.8-volt three-conductor synchro information with accuracies up to 1 arc minute.

The DSC-36020 uses either the DSC-11520 series hybrid converters for low-power applications or DSC-11524 series converters if greater drive capability is required. Use of an external transformer produces a 90-volt output.

Demonstration software that demonstrates the capabilities of the DSC-36020 is available. Pricing starts at $950 in one-to-nine-piece quantities.

LED Display Driver

Maxim Integrated Products' (120 San Gabriel Dr., Sunnyvale, CA 94086) new MAX7219 eight-digit, seven-segment LED display driver is designed to easily interface to any microprocessor. It has a user-friendly three-line serial interface that permits multiple chips to be cascaded for larger arrays. The serial interface has a fast 100-ns access time that permits data to be directly loaded. Data is sent to the chip in 16-bit packets. A typical application circuit is shown in Fig. 2.

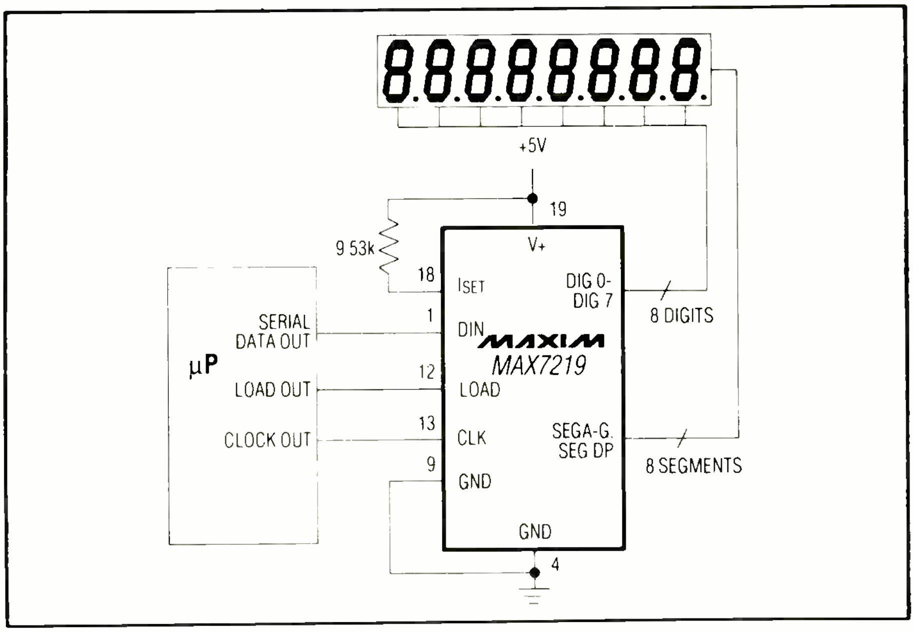

Fig. 2. An eight-digit microprocessor display circuit arrangement using Maxim's serially interfaced eight-digit LED display driver.

A power-saving shutdown mode in which the supply current is only 150 μA is featured. The MAX7219 powers up in this mode (display off) and enters normal operation within 250 μs. Sixteen levels of digital brightness control are provided. Maximum display current can be set with an external resistor or potentiometer. Seven-segment or no-decode mode is individually selectable for each digit for more flexibility. The MAX7219 can be programmed to scan between one and eight digits, with a typical scan rate of 1300-Hz for eight digits. The chip also has a built-in display test mode that turns on the display's LED segments to test them.

The MAX7219 saves space over discrete solutions that require multiple transistors. It's available in 24-pin narrow DIP and small-outline packages and is priced at $3.99 for 1,000-and-up quantities.

Megabit Flash PEROM

Atmel Corp.'s (2125 O'Nel Dr., San Jose, CA 95131) 5-volt 1M-bit flash-type memory is called a Flash PEROM (programmable erasable read-only memory). The AT29C010 is organized as 128K × 8 and offers system designers speeds to 90 ns. It requires only 50 mA of current in active mode, with standby power of 100 μA.

Flash memories offered by other manufacturers require both 12 and 5 volts and use of non-standard programming algorithms. Atmel's PEROM reads and programs with only 5 volts, has fast sector programming and software write protection, and is packaged in industry-standard through-hole and surface-mount packages.

This device is ideal for users who have only 5 volts in their systems or require a nonvolatile memory with a simple user interface. At 90 ns, the AT29C010 is fast enough to eliminate wait states in today's systems and systems that are now in the design stage.

An internal automatic erase feature simplifies programming since the user doesn't have to erase memory bytes to change them. This makes erasing invisible to the user and simplifies the programming algorithm. Other flashes require complete device erasure prior to any writes.

The AT29C010 is organized as 1,000 128-byte sectors, each programmed in 10 ms. This gives the device an effective byte/write time of 78 μs. Automatic erase and sector write give the AT29C010 its fast byte programming speed.

This Flash PEROM fills the price and performance gap between the difficult-to-revise in-system EPROM and the more expensive EEPROM.

The new Atmel device is available in a 32-pin DIP and a plastic leadless chip carrier (PLCC). Prices in 100-and-up quantities for 200-ns, commercial temperature range plastic DIP and PLCC are $38.55 and $41.90, respectively. The device is also offered in industrial and military temperature ranges. In addition to the 1M-bit flash, Atmel produces the 256K-bit AT-29C257 that permits users to directly upgrade to the 1M-bit as their system density requirements increase. It's configured 32K × 8 and is pin-compatible with the 29C010. ■

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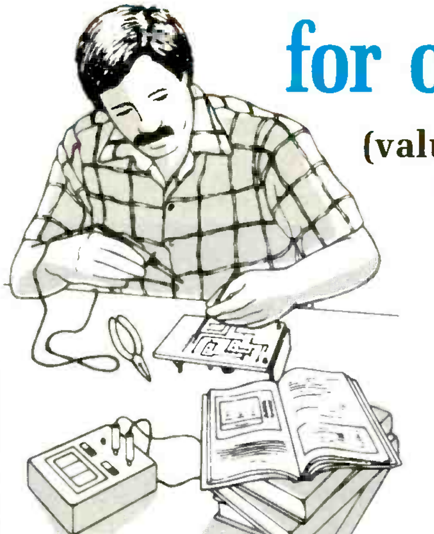

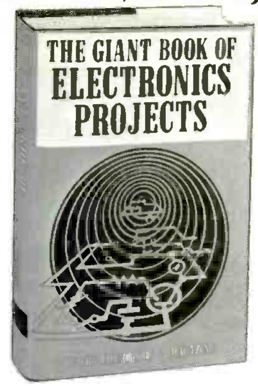

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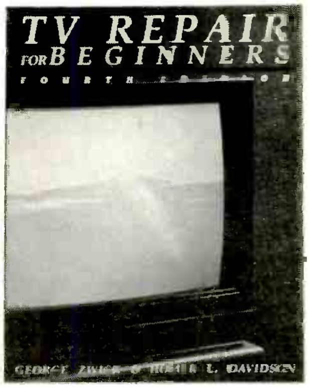

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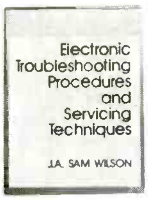

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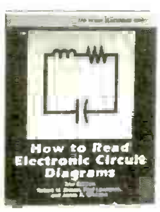

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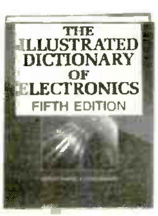

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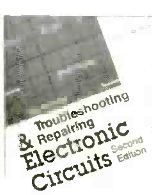

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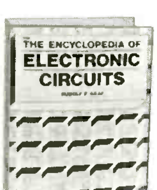

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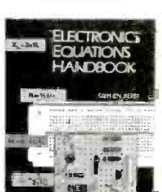

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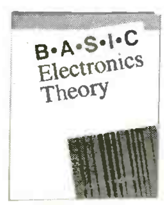

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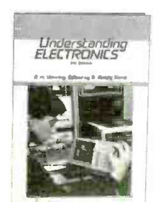

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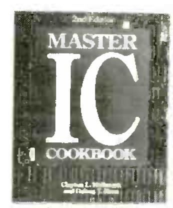

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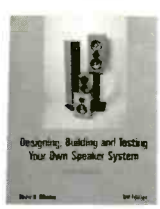

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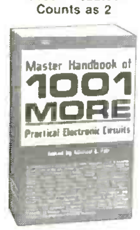

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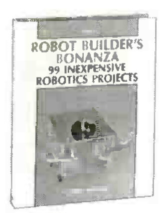

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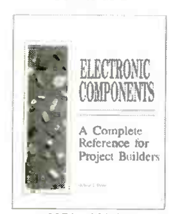

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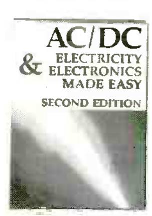

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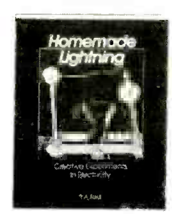

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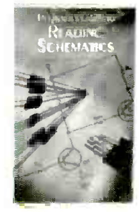

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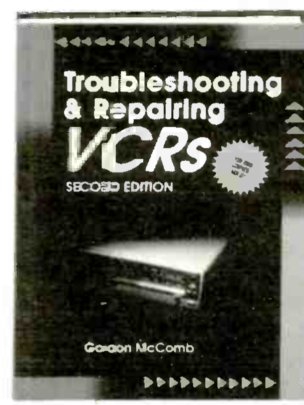

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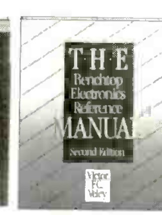

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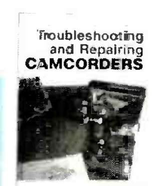

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Techno-Gaming: Wing Commander II

The cinematic experience of the original *Wing Commander* exploded into the air space of computer games. It's highly-detailed graphics, rousing musical score and evolving story line flung the product into the stratosphere of extreme high tech. Shortly after its release, *Wing Commander* was joined by succeeding installments that continued the ever-changing story. Dubbed the *Secret Missions*, these installments relied on *Wing Commander* as its vehicle for play. Equipped with a medium-speed '386, an average hard drive, VGA graphics and sound card, action-game players had the most thrilling experience ever to hit personal-computer gaming. Playing *Wing Commander* is like participating in an exciting science-fiction movie.

Not long after *Wing Commander* hit the market, Origin, its maker, announced the coming of *Wing Commander II: Revenge of the Kilrathi*. Kilrathi is the name given to a race of warrior felines bent on universal conquest; that on the backs of enslaved sentients, including Terrans. *Wing Commander*'s sequel was taken by some gamers as simply more of a good thing. After all, the original *Wing Commander* blew the airlocks off every other space combat game and most other games, too. So what was there to improve? A new story would have been enough.

However, sincere thanks go to game designer Chris Roberts and the *Wing Commander* team, who didn't rest on success, even though original *Wing Commander* still remains ahead of other computer games. Quite surprisingly, *Wing Commander II* has so many improvements that it's almost a new experience.

Ex-wingman Colonel "Angel" Devereaux orchestrates the missions.

Improvements

In its original rendition, *Wing Commander*'s graphics were "eye-popping." VGA graphics were the only way to appreciate the skillful coloring and shading that gave low-resolution VGA so much depth that it didn't look like low-resolution VGA. This masterful artwork was nowhere better appreciated than when locked in deadly combat with Kilrathi fighters. Highly-detailed enemy vessels streaked by, set against brilliant planets, nebulae and meteors. Explosions of enemy ships flashed like untamed fire, leaving behind scattering debris and twisted metal.

Wing Commander II noticeably im-

Prince Drakkath plans the demise of humanity.

Target lock on Kilrathi fighter.

proves on graphics—a feat in itself. Graphics appear to be more detailed, while evidently keeping the same low-resolution VGA. Shading is more precise, especially when faces of game characters fill the screen. Explosions are more spectacular, saturated with fire and smoke. Yet the visuals scroll and pan smoother than before. Such accomplishments make those who are reasonably knowledgeable of programming technique wonder exactly how this was done.

The most significant improvement is to *Wing Commander*'s audio. Music in the original game was orchestrated and well-synchronized to action and dialogue. It accompanied players through danger, victory and even death. It was at times thrilling, other times exciting and, yes, even sad. But it never was obnoxious. Harmonious music, playing duet with other more conventional sounds of weapons and explosions, represented a vital factor to game enjoyment. *Wing Commander II* again makes improvements—large ones. It quantum-leaps to music plus full-fledged, articulated digitized human speech.

The game's opening sequence amply illustrates how effective can be speech and other digitized sounds. It tells the story, from Kilrathi point of view, of the destruction of the beloved Tiger's Claw. The Tiger's Claw, as veteran players will recall, was the pride and home of Terra's most-capable strike force. The game's hero, you, and a few others survive, but you're branded a coward with little opportunity to clear your name.

The Kilrathi commander outlines his plans for Terran conquest in a gruff manner of speech that befits his his merciless appearance. Movements of human mouth and Kilrathi snout are well synchronized. Other game characters, including wingmen from missions past, have their own voices and ways of speaking, and it's a pleasure to hear them. Add to this another provocative musical score, more combat sounds and digitized speech. These factors combine to give another dimension to this already sensually overwhelming game.

Scintillating as it is, *Wing Commander* would have been far less emphatic if not for interesting characters and changing story. At first, the story wasn't much: war with the Kilrathi. No time for distracting emotions or human problems. Just get out there and kill some cats! That sprinkling of plot was enough because each mission saw a turn in plot development. A successful mission had positive plot twists; failures meant down-turns. Therefore, the plot depended almost completely on the player. In addition, the game's non-player characters, wingmen who battled at your side, evolved as well. Some of them even died. An interesting comradeship formed between wing commander and wingman.

Wing Commander II keeps the changing story and continues using the player as focal point. But the story is deeper, more extensive and riddled with emotion. There's even a love interest. Furthermore, the familiar wingmen of old return in different and more interesting roles. And hearing your "old friends" talk to you via digitized speech is unique.

What Price Sensuality?

Wing Commander undoubtedly introduced a new breed of computer game that offers direct appeal to the senses. Not only Origin, but other game makers as well, are planning to orchestrate sensuality of sight and sound. Virtual reality games are right now marching to market. As life seems to invariably dictate, a price must be paid for such intense stimulation. The cost, in this case, is purchase of capable technology.

For *Wing Commander* fans, this means having a '386 computer in the medium to fast range, preferably 33 MHz; at least 20M of free disk space to accommodate crisp, detailed graphics and perfect digitized speech; and enough memory to divvy up between expanded for extra game features and disk caching to help make the game run smoother. It also means purchasing the Sound Blaster sound card for which *Wing Commander*'s digitized speech package was solely written and placing a firm grip around a top-of-the-line joystick that gives sure response and solid longevity.

Getting the most out of *Wing Commander II* may also mean buying a small stereo amplifier just for your computer, or maybe an extra pair of speakers as add-on to an existing system. In the near future, it will mean getting a CD-ROM drive, as several game makers are working on specific applications for this medium. As you can see, the price for participating in "techno-gaming" can be steep.

It's safe to say that most home-computer users don't have the upper-class machines and all the latest gadgets required to take full benefit of *Wing Commander II*. Not being well-heeled, some gamers just have to make do until things get better. But there's a class of computer game enthusiast who seems to always get the newest technology, albeit sometimes at significant sacrifice. *Wing Commander* was meant for that audience. They're the ones who'll shell out big bucks for a good game without a qualm. But it has to be good game.

Note that *Wing Commander* supports only VGA and EGA graphics. It doesn't work with archaic graphic standards like CGA or Hercules. Its manufacturer recommends a fast computer and expanded memory, which is almost unprecedented for a game. Other game makers have also dropped support for lesser machines and lesser graphic formats. Some games work with only '386 and i486 machines equipped with VGA graphics and hard drive.

The recent shift in game methodology is to harness the power of newer technology. For many game players, this shift comes none too soon. Games have lagged pitifully behind other software development for too long. Now, in stark contrast, the arrival of sound cards, affordable high-end graphics systems, lower-cost storage space and memory at reasonable prices is spawning a renaissance in computer games.

In the spirit of improvement and dogged success, Origin is working on *Special Operations*, which are future installments for *Wing Commander II*. *Special Operations* are to *Wing Commander II* what the *Secret Missions* were to original *Wing Commander*. As I was writing this, beta testing for *Special Operations* has begun.

Here's hoping that Origin and other game producers continue the fine art of pressing computer gaming to its technological limits. After all, isn't that really why computers were built? ■

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Bird's Eye View

Wing Commander II, $79.95
Speech Accessory Pack, $19.95
Special Operations, $39.95
Origin
110 Wild Basin Rd., Suite 330
Austin, TX 78746
Tel.: 512-328-0282

Requirements

Memory	640K
Graphics	VGA, MCGA, EGA
Sound	AdLib, Roland, Sound Blaster; Speech Accessory Pack for Sound Blaster only
Controllers	Joystick, Mouse

Evaluation

Documentation	Good
Graphics	Excellent
Learning Curve	Short
Complexity	Medium
Playability	Excellent

In Brief: An outstanding space-combat simulation, with excellent graphics, hot action, superb sound and a good story. Computer gaming at its best.

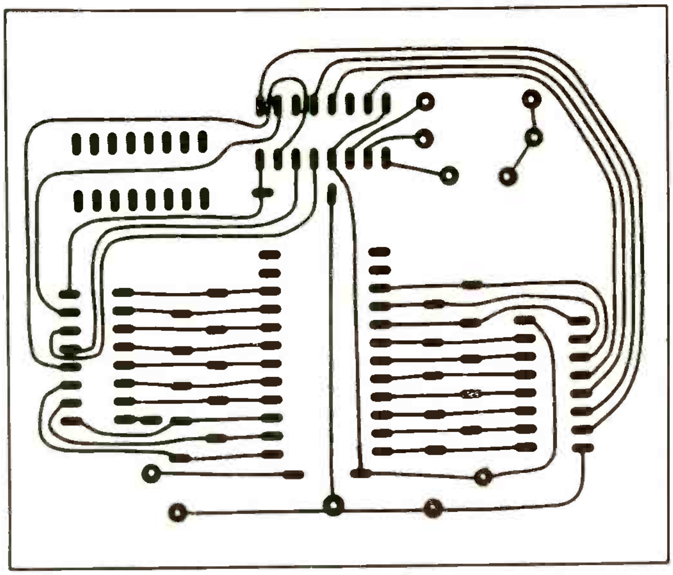

Fig. 2. Actual-size etching-and-drilling guide for fabricating a printed-circuit board for the project.

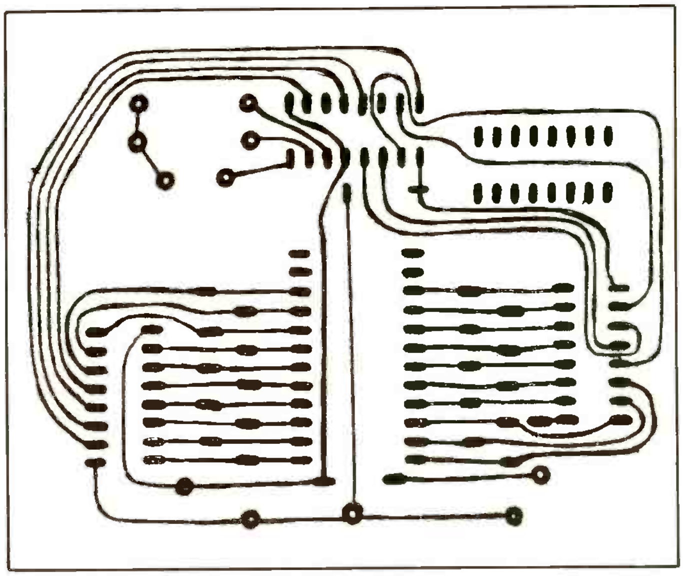

Fig. 3. Wiring guide for pc board. Most resistors mount on-end to conserve space and individual wires must be used to interconnect the test sockets.

power the project will be in series with each other. When you're done, plug the cells into the holder and use a dc voltmeter or multimeter set to the dc-volts function to make sure that polarity is correct and that you obtain approximately 4.5 volts.

You can house the project in any type of enclosure that will accommodate the circuit-board assembly and battery and has adequate panel space on which to mount the TEST switch and through which cutouts can be made for accessing the test sockets. Machine the enclosure as needed. First, drill mounting holes for the battery holder through the floor panel. Then, drill mounting holes for the

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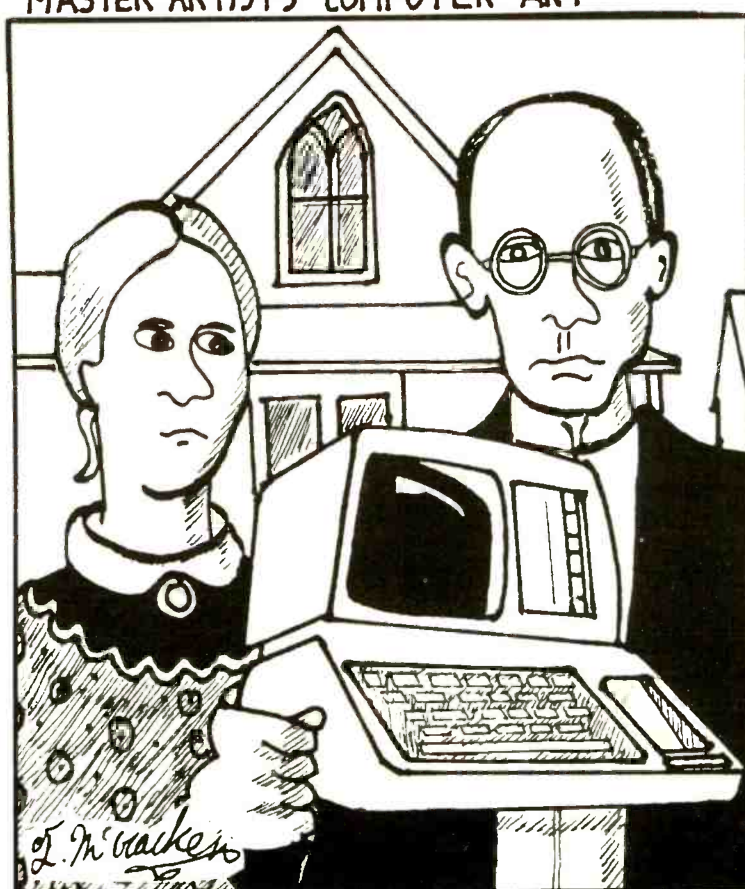

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TEST switch and circuit board assembly and access slots for the test sockets through the top panel of the enclosure. If you use a metal enclosure, deburr the hole and cutouts to remove sharp edges.

Mount the battery holder in place using suitable machine hardware. Then mount the TEST switch in its hole in the top panel, and use ½0 spacers and 4-40 machine hardware to mount the circuit-board assembly to the panel.

Identify and permanently label the pin-1 locations of both test sockets on the top panel. One way to do this is to very carefully drill a small hole almost but not all the way through the panel in each location and fill it with white or a contrasting color paint. As the paint dries, gently wipe its surface away to keep it flush with the surface of the panel.

Checkout & Use

Clip the common lead of your meter set to the dc-volts function to the − lug on the battery holder. Press and hold down the TEST switch button as you touch the "hot" probe to pin 16 of all three IC (not test) sockets and observe the readings obtained. If you fail to obtain a reading of approximately +4.5 volts at any or all pins, release the TEST switch button and correct the problem. Do not proceed until you're sure the circuit is properly wired.

Plug the ICs into their respective sockets. Make sure each is correctly oriented and that no pins overhang the sockets or fold under between ICs and sockets.

If you have one handy, test a known-good LED numeric display with the project. If everything is okay, all LED segments will light. If not, you'll have to correct the problem so that all segments do light when the display is again tested.

In use, remember that 16-pin test socket *SO2* accommodates all 0.3″ and 0.4″ LED numeric displays. Though these displays usually have only 14 pins on them, use of a 16-pin socket gives the LED Display Tester the ability to accommodate newer displays that in the future might have 16 pins on them.

Also keep in mind that 24-pin socket *SO1* accommodates "jumbo"-size LED displays that have up to 20 pins on them. If you wish, you can make pins 11 through 14 on this socket duplicates of pins 1, 2, 23 and 24 to eliminate any "dead" pins.

To test a LED numeric display, press it against the contacts on the appropriate test socket and press the button on the TEST switch and observe the display. If any or all segments fail to light, the LED is bad. It's as simple as that. One final note: You won't obtain full brightness on some older displays because the Tester strobes from a somewhat low power source. However, the display should be bright enough to show the condition of the various segment elements in it.

The next time you go bargain hunting for LED numeric displays, bring along your LED Numeric Display Tester. You won't be sorry you did when you come home with only fully operational displays. Your first buying expedition is likely to save you as much money as it cost you to build the project. ■

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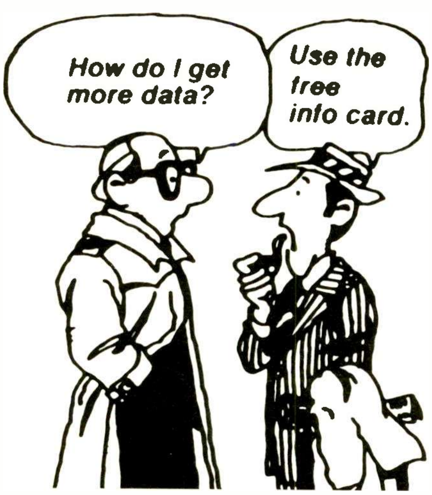

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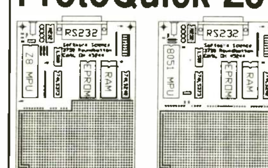

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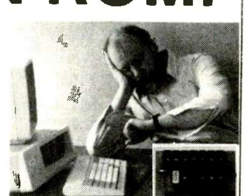

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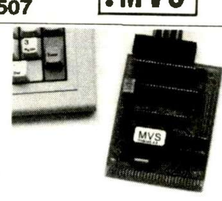

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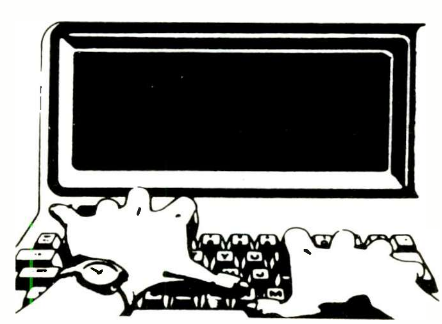

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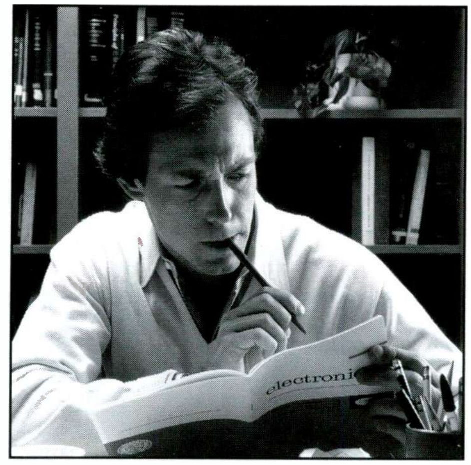

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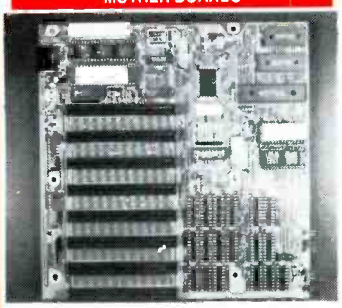
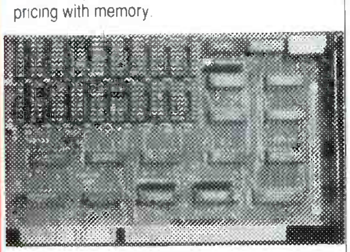


Part#	Description	Each
D11-XT	Turbo 10 MHz Mini XT Motherboard	$69
D11XT-640	Same as D11-XT w/640K installed	$109
DFI286-12/E	12 MHz 286 Mini Motherboard	$99
DFI286-16/E	16 MHz 286 Mini Motherboard	$109
MB386SX	Turbo 386 16 MHz SX Motherboard	$229
MB386-25	386 25 MHz Motherboard	$369
MB386-33C	386 33 MHz Motherboard	$459
MB486-33	486 33 MHz Motherboard	$799

MEMORY BOARDS

All memory boards come with 0/K. Call for pricing with memory.



Part#	Description	Each
MEMO-576	576K Ramboard	$23
MEGALITH	Enhanced EMS Memory Board. 4 MEG AT	$119
IFC-47A	BOCA 128K AT Memory Board	$79
IFC-60	AT Plus - Up to 8 MEG RAM	$119
IFC-60A	AT Memory Board 8 MEG Using SIMMS	$119
IFC-62	PS-2 MOD 50 60 EMS up to 2 MEG	$129
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3C87-25	For 386 up to 25 MHz	169
3C87-33	For 386 up to 33 MHz	179

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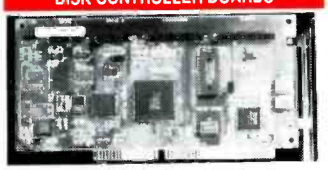
DISK CONTROLLER BOARDS



Part#	Description	Each
IFC-16	2 Floppy Controller Board XT/AT	$25
IFC-14	2 Floppy Controller Board PC/XT	$13
IFC-15	Disk I/O Board Serial, Parallel, Clock, Game PC/XT	$25
IFC-24	Fixed Disk MFM/2 Floppy Controller AT	$55
IFC-26	Floppy, Fixed Disk RLL Controller AT	$59
IFC-27-2	AT 2 IDE, 2/Floppy Controller	$19
IFC-27X	XT 2/IDE Controller	$69
IFC-28	XT MFM Hard Drive Controller Board	$47
IFC-29	RLL Fixed Disk Controller Board PC/XT	$57
IFC-54	Add On Floppy Board XT/AT	$49
ST-01	8 Bit SCSI Controller	$29
ST-02	8 Bit SCSI/Floppy Controller Board	$47
IN-2000	16 Bit SCSI Hard/Floppy	$225

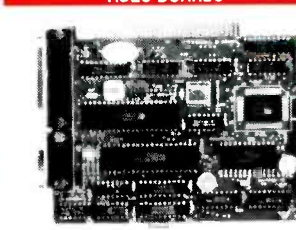
EXPANSION BOARDS

Part#	Description	Each
IFC-12	Serial Board PC/XT	$11
IFC-12A	Second Serial Port Kit for IFC-12	$6
IFC-25	2 Serial, Parallel, Game Board XT/AT	$16
IFC-13	Parallel Board XT/AT	$9
IFC-19	Clock Board PC/XT	$10
IFC-19B	Chipchip for PC/XT	$24
IFC-20	Game Board XT/AT, 2 Ports	$9

COMMUNICATION BOARDS

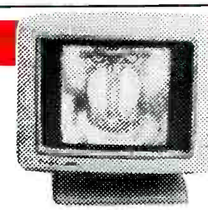
Part#	Description	Each
MS-400A	Multi-Serial Board for PC/AT	$99
MS-422A	Dual RS-232/422 Serial Card for PC/AT	$69
MU-440	Multi-User Board	$139

VIDEO BOARDS



Part#	Description	Each
IFC-32	Mono Board w/printer port XT/AT	$16
IFC-33	Color Graphics w/printer port XT/AT	$25
IFC-42	640x480 VGA Card	$69
IFC-42C	BOCA Super VGA Card	$159
VG-7000	Super VGA w/512K	$139

RELISYS MONITORS

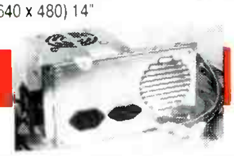


RM9502	Monochrome PS/2 (800 x 350, 400, 480)	$149
RE-9514	Super VGA (1024 x 768) Unlimited Colors	$359
RE1520	15" Super VGA Monitor Noninterlaced up to 1024x768)	$469

LASER MONITORS

Part#	Description	
MON-05	Monochrome TTL Amber 12"	
MON-06	Paper White TTL 14"	$112
MON-10	CGA/RGB (640 x 240) 14"	$239
MON-07	VGA .41 Dot Pitch (640 x 480) 14"	$269

POWER SUPPLIES



PS-150	150 watt XT Power Supply	$32
PS-150UL	Same as PS-150 - UL Listed	$69
PS-200M	200 watt XT power Supply	$36
PS-200MUL	Same as PS-200M - UL Listed	$89
PS-200	200 watt AT Power Supply	$42
PS-200UL	Same as PS-200 - UL Listed	$89
PS-220	220 watt Vertical Case Power Supply	$79
PS-230UL	230 watt Vertical Case Power Supply - UL Listed	$99
PS-200MINI	200 watt Baby Vertical Case Power Supply	$59

DISK DRIVES

Part#	Description	Each
DDD-04	5 1/4 inch DSDD 360K black faceplate	$59
DDD-05	5 1/4 inch DSDD 360K beige faceplate	$59
DDH-06	5 1/4 inch DSHD 1.2MB beige faceplate	$59
DDH-09	3 1/2 inch 720K beige w/brkt	$68
DDH-10	3 1/2 inch 1.44MB beige w/brkt	$59
DDH-11	Same as DDH-10 without 5-1/4" mounting bracket. Fits in 3-1/2" bay	$55
RAIL01	AT Drive Rail Kit	$1.99
FP-BLK	1/2 Height Black Faceplate	$2.49

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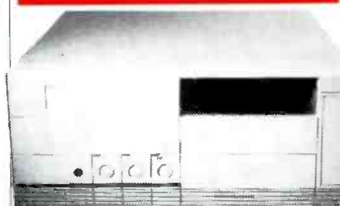
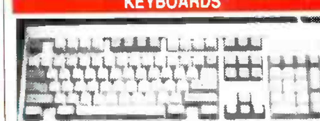
Part#	Description	Each
5.25KITFD	Floppy Drive Kit	$9.95
5.25KITHD	Hard Drive Kit	$9.95

COMPUTER CASES



Part#	Description	Each
STC-03	Baby AT Case	$39
STC-04	Regular AT Case	$59
DAB-103	DFI Slimline Case w/200 Watt Power Supply	$139
STC-05	Baby Vertical w/200 Watt Power Supply	$89
STC-08	Medium Vertical Case w/230 Watt Power Supply	$119
CASE-TH8	Regular Vertical w/250 Watt Power Supply	$249

KEYBOARDS



KBY-60	AT Style 10 Function Keys XT or AT	$19
KBY-39	Enhanced Style 12 Function Keys XT or AT	$49
K-156	(XT.AT) 101 keys with regular footprint for XT or AT. Size: 20 1/2"L x 7 7/8"W x 1 13/16"H.	$35
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HARD DRIVES

Part#	Description	Each
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ST-238	30 MB RLL 65 MS Hard Drive 5-1/4"	$219
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