Bonus: 80406 Family and Pentium CPU Pinout Reference

ComputerCraft

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New device turns any electrical outlet into a phone jack

An engineering breakthrough gives you unlimited phone extensions without dangerous wires or expensive installation fees...

by Charles Anton

You don't have to have a teenager to appreciate having extra phone jacks. Almost everyone wishes they had more phone jacks around their house.

When I decided to put an office in my home, I called the phone company to find out how much it would cost to add extra phone jacks to my house– $158!

No more excuses. Today, there are a thousand reasons to get an extra phone jack and a thousand excuses not to get one. Now an engineering breakthrough allows you to add a jack anywhere you have an electrical outlet. Without the hassle. Without the expense. Without the miles of unsightly wires.

What your mother never told you. Ma Bell never told you that you could use your home's existing wiring to transmit phone signals. Now you can add extensions with a remarkable new device called the Phonejak. It allows you to convert your phone signal into an FM signal and then broadcast it over your home's electrical wiring.

As simple as plugging in an appliance. Just plug the wireless Phonejak Transmitter into a phone jack and an electrical outlet. Then you can insert a Phonejak Receiver into *any* electrical outlet anywhere in your house. You'll be able to move your phone to rooms or areas that have never had jacks before.

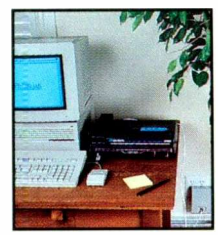
Phonejak gives you the freedom of cordless telephone technology, without the cordless phone. Unlike cordless phones which transmit radio waves through the air, the Phonejak uses your home's electrical wiring to transmit signals, giving you sound quality which far exceeds that of cordless phones.

Clear reception anywhere in your home. Your range extends as far as you have electrical outlets. Five feet. Or five hundred feet. If you have an outlet, you can turn it into a phone jack- no matter how far away it is. You'll get crystal clear reception throughout even the largest of homes. (The signal is terminated at your electrical meter so you can use your Phonejak in any electrical outlet in or around your home- even if they are on a different circuit.)

Unlimited extensions with no monthly charge. Most phone lines can only handle up to five extensions with regular phone jacks installed from the phone company. Not so with Phonejak. All you need is one wireless Transmitter and you can add as many Receivers as you want. Six, ten, there's no limit. And with Phonejak, you'll never have a monthly charge for your extra Receivers.

Works with any single-line phone device. This breakthrough technology will work for all of your single-line phone needs. It will operate your fax line, your answering machine and even your computer modem just by plugging them into your Phonejak Receivers.

This offer not available in stores. The wireless Phonejak System would carry a retail price of $119 if it were available in stores. But through a special promotional campaign we are introducing this amazing technology direct to the public at substantially reduced prices!



It's not just for phones. *It works with modems, answering machines, and fax machines too.*

For a limited time you can purchase the *Phonejak Transmitter* for only $49 which makes all your outlets "live" to the *Phonejak Receivers*. One Transmitter will work with an unlimited number of Phonejak Receivers priced at only $39 each.

'No questions asked guarantee.' With the Phonejak you get a complete *"No Questions Asked" 30-day money-back guarantee.* If it's not everything we say, just return it for a full refund. The Phonejak is also backed-up by a full one year manufacturer's warranty. Allow 5 to 10 days for delivery after receipt of your order.

Wireless Phonejak Transmitter ..... **$49** **$5 S&H**

Wireless Phonejak Receiver ..... **$39** **$4 S&H**

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Midlothian, Virginia 23113

Is the Phonejak right for you?

The Phonejak is designed for use with any single-line phone device. Could you use one in your situation?

- **Few jacks.** *You want more telephone extensions without the hassle and expense of calling the phone company.*
- **Bad location.** *You have jacks, but not where you need them.*
- **Renting.** *You want to add extensions, but you don't want to pay each time you move.*
- **Other phone devices.** *You have an answering machine, modem or fax you want to move to a more convenient place.*

HOW DOES IT WORK?

The wireless Phonejak utilizes advanced FM technology to make your home's electrical wiring "live" to phone signals, so you can plug in a jack anywhere you have an electrical outlet. One of the key components is the *Phonejak Transmitter*, which links an existing phone jack to a nearby outlet. The Transmitter converts your phone line into an FM signal. The signal is transmitted through your home's wiring upstairs or down, regardless of distance. This one Transmitter can provide phone signals to an unlimited number of *Phonejak Receivers* which simply plug into any electrical outlet.

The Phonejak System. *Includes a transmitter (right) and a receiver (left).*

With the Receivers in place you're ready to add phones anywhere around your home -for a lot less money and hassle than calling the phone company!

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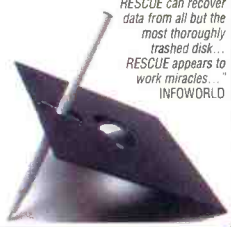

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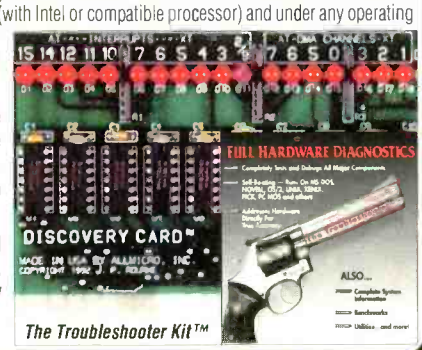

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PC MAGAZINE EDITORS' CHOICE July 1993

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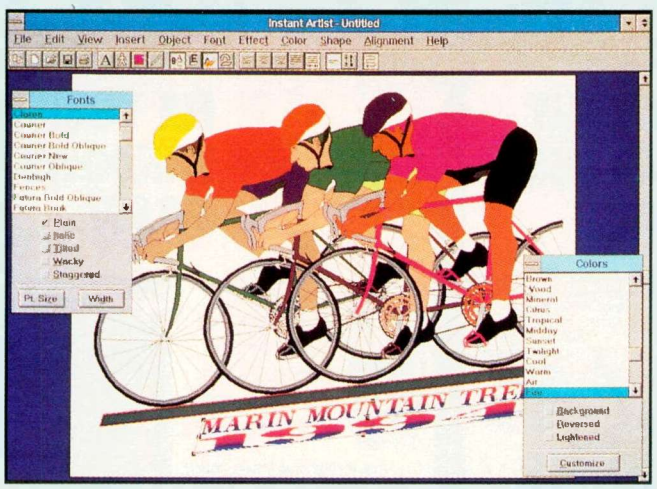
CIRCLE NO. 103 ON FREE INFORMATION CARD

ComputerCraft

Volume 3, No. 10, October 1993



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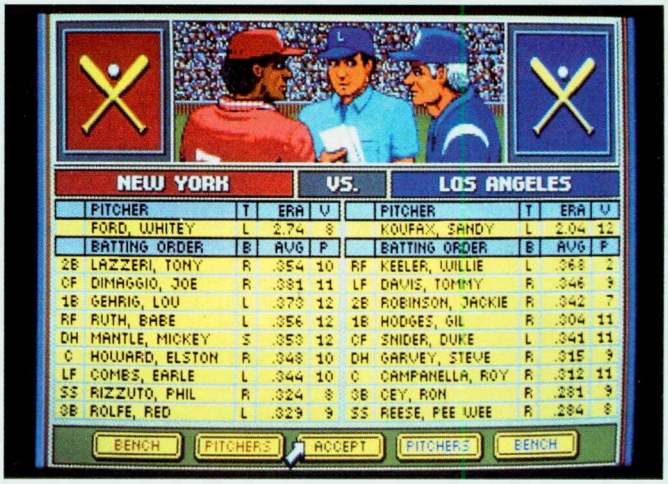

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UPGRADING & ENHANCING

APPLICATIONS

COLUMNS

DEPARTMENTS

ON THE COVER: The popularity of single-chip microprocessors, particularly Motorola's MC68705 series, has sparked large-scale interest in microcontrollers. To be able to use these devices for practical applications, their internal EPROMs must be programmed with the appropriate code. Details for building the stand-alone programmer shown here begin on page 16. It makes it economically possible for individual users to program their own MC68705s.

Cover Photo by Larry Mulvehill

ComputerCraft on MCI Mail

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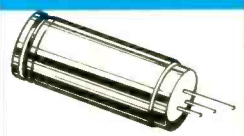
Collimator Pen



Output: 2.5 mW (max.); Current: 90-150 mA
Oper. Vclt: 2.2-2.5V; WL: 820nm – Infrared
Size: 11mm dia. x 27mm long; Data sheet inc.

STOCK#	1-9	10-24	25+
S81052	49.99	47.49	42.74

Collimating Lens

Black anodized aluminum barrel; Glass lens with 7.5mm focal length.
Fits 9mm laser diodes said below.
Easy to focus and install.

STOCK#	1-9	10-24	25+
LSLENS	24.99	23.74	21.37

Dual Mode Laser Pointer

Weighs less than 2 oz.; 0.5" dia. x 6.25" long
WL: 670nm @ <1 mW (6mm beam)
Switch from continuous to pulse mode.
Uses 2 AAA batteries (inc.); 1-year warranty.

STOCK#	1-9	10-24	25+
LP35	199.99	189.99	170.99

He-Ne Laser Tube

WL: 632.8nm (red)
Output: 0.5 mW – 3 mW (our choice)
Tested to mfr. specifications; 30-day warranty.

STOCK#	1-9	10-24	25+
LT1001	69.99	66.49	59.84

He-Ne Laser Pointer

7.2" L x 1.4" W x 2.2" H; Weighs just 12 oz.
WL: 632.8nm @ <1 mW (8mm beam)
Energized at 5kV, 1.2kV continuous.
Inc. batteries, pouch, guide, 1-year warranty.

STOCK#	1-9	10-24	25+
LP100	199.99	189.99	170.99

Laser Pointer

Just 0.75" dia. x 5.25" long; 670nm @ 3.5 mW
2.5-3.5" beam @ 100 yards
Uses 2 AAA batteries (inc.); 1-year warranty.

STOCK#	1-9	10-24	25+
LSPOINTER	159.99	151.99	136.79

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Economy Laser Pointer

0.75" dia. x 5.6" long; Weighs less than 3 oz.
670nm @ 1.9 mW (4mm x 0.6mm beam)
8 batteries included; 1-year mfr. warranty.

STOCK#	1-9	10-24	25+
LP3	129.99	123.49	111.14

Protoboard Design Station

Includes expanded instrumentation, breadboard, and power supply.
Ideal for analog/digital/microprocessor circuits. Frequency and function generators, variable outputs, logic indicators, speaker & more.
Size: 11.5" L x 16" W x 6.5" H
Weighs 7 pounds.

STOCK#	1-9	10-24	25+
PB503	299.99	284.99	256.49

WAO II Programmable Robotic Kit

Programmed directly via attached keypad.
Pen mechanism draws text and graphics.
128x4 bits RAM and 2K ROM included.
Uses 3 AA batteries (not included).
Optional Apple computer interface kit includes software, cable, card, and instructions.

STOCK#	1-9	10-24	25+
MV961	79.99	75.99	68.39
WIAP (interface)	39.99	37.99	34.19

Laser Diodes

Stock#	Mfr.	WL	Output	Oper. Current	Oper. Voltage	1-9	10-24	25+
LS9220	Toshiba	660nm	3 mW	85 mA	2.5V	129.99	123.49	111.14
LS9200	Toshiba	670nm	3 mW	85 mA	2.3V	49.99	47.49	43.19
LS9211	Toshiba	670nm	5 mW	50 mA	2.3V	69.99	66.49	59.84
LS9215	Toshiba	670nm	10 mW	45 mA	2.4V	109.99	104.49	94.04
LS3200	NEC	670nm	3 mW	85 mA	2.2V	59.99	56.99	51.29
LS022	Sharp	780nm	5 mW	65 mA	1.75V	19.99	18.99	17.09
SB1053	Phillips	820nm	10 mW	90 mA	2.2V	10.99	10.44	9.40

Laser Diode Module

Complete with collimating optics and drive electronics.
WL: 660-685nm @ 0.5, 1, 2, or 3 mW
Adjustable focal length.
Connects to 3-5.25 VDC.
Compact size: 0.64" dia. x 2" long.

STOCK#	1-9	10-24	25+
LDM135-.5 (.5mW)	179.99	170.99	153.89
LDM135-1 (1mW)	189.99	180.49	162.44
LDM135-2 (2mW)	199.99	189.99	170.99
LDM135-3 (3mW)	209.99	199.49	179.54

1/4-Ton IDC Bench Assembly Press

Rotating base plate and platen. No tools required to change plates/cutting accessories. Additional accessories available.
Weighs 5.5 lbs.
10" L x 8.75" W x 9" H

STOCK#	1-9	10-24	25+
PV505	149.99	142.49	128.24

Robotic Arm Kit

Fascinating and educational, with lift/lower, grab/release, and pivot left/right functions.
Uses 2 C batteries (not inc.); Apx. 10" long.

STOCK#	1-9	10-24	25+
YO1	43.99	41.79	37.61

41 Watt Switching Power Supply

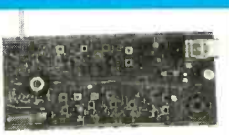
Input: 115/230V
Output: 5V @ 3.75A, 12V @ 1.5A, -12V @ 0.4A
Size: 7" L x 5.25" W x 2.5" H

STOCK#	1-9	10-24	25+
PS1003	19.99	18.99	17.09

EPROMS

STOCK#	1-24	25-99	100+
2764	3.49	3.32	2.99
27128	4.99	4.74	4.27
27256	4.59	4.36	3.92
27C256	4.09	3.89	3.50
27512	5.49	5.22	4.70
27C512	5.49	5.22	4.70
27C1024	8.99	8.54	7.69
27C2048	14.99	14.24	12.82

AM/FM Radio Kit



Includes assembly/lesson manual.
11.6" L x 5.25" W PC board;
Superheterodyne receiver.

STOCK#	1-9	10-24	25+
AMFM108	29.99	28.49	25.64

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CIRCLE NO. 102 ON FREE INFORMATION CARD

Green Computers

With the advent of portable computers, major steps were taken to conserve battery power. Along with CMOS circuits, a variety of power-saving software was developed to put a computer system into a lower-power "sleep" mode; battery life is conserved by automatically turning off a back lighted LCD screen and slowing CPU speed. New 3.3-volt power supplies were introduced, too, to displace 5-volt ones or to provide dual outputs.

Now the industry has shifted its power-saving efforts to desktop PCs. It's the greening of personal computers, the intent being to conserve our resources by using less electricity. The new energy-efficient machines will lower your electrical bill, saving you about $120 per year. A company with, say, 5,000 PCs could save $600,000 per year, which is a handsome sum. With potential industry savings of $1-billion per year if all PCs met Energy Star guidelines. Although PCs account for only 5% of commercial energy used in this country, it still totals to a princely sum, reducing the amount of energy used by our country without causing any sacrifices. An additional end-user incentive to use such energy-efficient models is the likelihood that public utilities will offer rebates to those who do use them.

Many of us keep our desktop machines on even when we're not using it. In fact, it's said that about one-third of the PCs in the U.S. are on 24 hours per day, unnecessarily burning power. (In many cases, it's necessary, though, such as with a BBS that's always active or a PC that's set up to receive faxes. Moreover, not turning on and off the machine reduces component stress that leads to earlier electronic breakdowns.)

In any event, the Environmental Protection Agency's (EPA) Energy Star Computer Program, launched June 1992, encourages the industry to build energy-efficient PCs—if they want to do business with the country's largest buyer, the federal government. You see, President Clinton signed an Executive Order directing agencies to buy only computers that meet the Program's guidelines.

Energy Star-compliant computers burn less than 30 watts of electricity in the sleep mode (plus 30 watts for the monitor), compared to 50 to 200 watts for conventional computers. Some computer makers are reportedly introducing PCs that use under 25 watts per hour in sleep mode and less than 60 watts when active.

In line with saving energy used when powering a PC, Intel Corp. has integrated SL microprocessor technology used in portables into all of its new 486 microprocessors. These SL Enhanced 486 devices have centralized power-management systems embedded into the microprocessor... at no premium.

The Energy Star program isn't limited to PCs, of course. Sun Microsystems, for example, is already shipping work stations that meet the EPA guidelines. Its SPARC classic system uses only 23 watts of power, the company reports, while its first color printer has standby energy consumption of only 12.8 watts. The color printer is also designed to print on recycled paper as well as plain paper and transparencies.

Furthermore, the Video Electronics Standards Association (VESA), formed in 1989 to standardize video and computer graphics, has addressed reducing energy use of video monitors with a Display Power Management Signaling (DPMS) proposal. Monitors consume even more power than desktop computers, 85 watts for a 14" monitor and 110 watts for a 17" monitor, compared to 60 watts for a conventional desktop computer.

DPMS is a signaling method used between the host system and display, enabling four different power-management states to be employed. These states are "on," "stand-by," "suspend" and "off." It follows the Microsoft/Intel Advanced Power Management Specification (APM) and uses horizontal and vertical synchronizing formats for monitoring purposes. This is the platform of the signaling method to initiate a power-management state. How it's implemented in a computer is left open to manufacturers, however, and power consumption levels aren't stated.

Industry support is strong for the energy-saving moves cited. The EPA hopes that by the year 2000, 70% of all U.S. computers will meet Energy Star standards. If done, the EPA claims that America could reduce carbon-dioxide pollution that's equivalent to eliminating 5-million automobiles, and the savings in electrical power would be enough to power the states of Vermont and New Hampshire. In Europe, such a change would reap triple the electric utility money savings to be enjoyed here.

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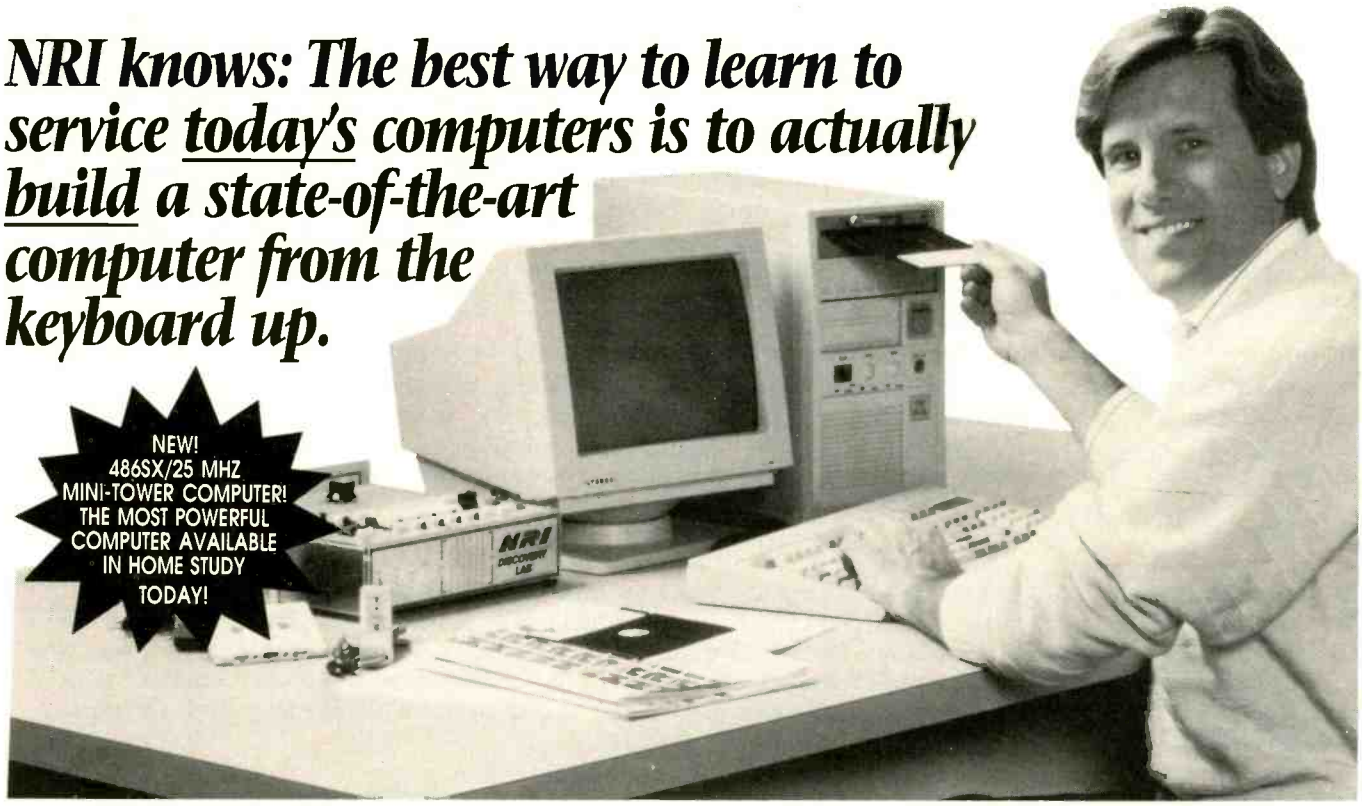

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C++ GROWING FAST. Businesses are moving toward C++, according to a study on trends in C and C++ development by Lucid, Inc. Research results in 63 organizations that span a wide range of industries show that 80% of the market is either using or in transition to C++. Of those surveyed, 20% use only C++, 25% use both C and C++, 35% are moving from C to C++ and 20% use only C. The study also revealed that 74% use more than 100,000 lines of code, with an overall average of 450,000 lines. For a free copy of the report, contact John DeArmon at Lucid at 415-329-8840, Ext. 5563 or dearmon@lucid.com.

MICROSOFT CERTIFIED PROFESSIONAL TRAINING. Transcender Corp, Nashville, TN has released "Examinator," an interactive Windows training program for studying for Microsoft's Windows certification examinations. The $89 (plus $4 S&H) program lets you take four complete simulated exams, analyzing responses and explaining the reasoning behind each answer. The package includes instructions for becoming certified so that you can add the "MCP" credential and logo to your business card or resume. Call 615-327-1858.

ON-LINE BOOKS. Ziff-Davis Publishing is making one of its best-selling books, "PC Magazine DOS 6 Techniques and Utilities," available in on-line digital form as part of a test. The book is download-able through ZiffNet, an information service on the CompuServe network. In printed form, the 1,035-page book with a 48-utilities disk retails for $39.95. The downloaded version, including special viewing and search software, costs $12.95 plus connect-time charge.

RADIO SHACK'S DO-IT-YOURSELF VOICE CHIP. Radio Shack now offers a powerful voice record/playback IC, the ISD1000A, for do-it-yourself designs. The $17.99 chip, developed by Information Storage Devices, requires only a few external components to build a complete voice record/playback system. Already built into the chip are preamplifiers, filters, agc, power amplifier, control logic and analog storage. Just add a few resistors and capacitors, battery, switches, microphone and speaker. The ISD1000A can record and play back up to 20 seconds of voice, music sound effects and tones.

WINDOWS NT DELAYED. Microsoft's new OS, Windows NT, hasn't made it to the marketplace yet, although the company originally planned to make its debut earlier, as noted here in the August issue. The latest Beta copies are the best Microsoft offers at this writing. Hopefully, it will have hit the market by the time you read this. The delay is hurting RISC systems, many of which are already configured to use it.

RIGHT-TO-LEFT WORD WRAP. Glyph Systems, Andover, MA announced that it is the sole authorized reseller for Microsoft Hebrew and Arabic language products in the US, including bilingual versions of Windows 3.1. Each includes TrueType scalable fonts in Hebrew and Arabic. Both products provide right-to-left character entry and word wrap. Hebrew Windows 3.1 costs $179, while Arabic Windows 3.1 is $149. For more information, call Glyph at 508-470-1317.

NEW COMPENDIUMS. Micro House has put its publications, The "Encyclopedia of Main Boards," "The Encyclopedia of Hard Drives" and "The Network Interface Technical Guide" onto a CD-ROM titled, "Micro House Technical Library." It sells for $889.95. Call 1-800-926-8299.... The Association of Shareware Professions details 1,100 shareware ("Try before you buy") products in a new book, "The Shareware Compendium." The massive book features detailed descriptions, hardware and software requirements, registration fees, hundreds of BBSes and disk vendors from whom evaluation copies can be obtained free or inexpensively, and separate appendices listing programs by author or company and how to contact them. The $24.95 book is in local bookstores. Contact Jan Abbott at 616-788-5131 for more information.... Burr-Brown's "High Performance Electronics Selection Guide" disk for IBM PC/compatible computers is available free of charge. It contains over 1,500 current component models, industry cross-reference, sales offices and prices. Product categories include analog-to-digital converters, op amps, an updated "PSpice" macro model library with 103 newest models and multipliers, among others. Call 1-800-548-6132.

Chip Source Oversight

• You failed to identify Micromint, Inc. as a source of 80C52-BASIC chips in your July 1993 application article, "Designing Microcontroller Circuits, Part 1: Core Circuits" by Jan Axelson. We market our chip, DIP and PLCC versions, for $25 in singles, $14.50 in 100s and ship from stock. Other interesting facts about Micromint's version of the 80C52-BASIC chip are that it is rated at the industrial temperature range (–40° to +85° C) and will operate from dc to 12 MHz!

Chris White
Technical Marketing Manager
Micromint, Inc.
Vernon, CT

XMODEM-CRC Feedback

• *ComputerCraft* is the only magazine I read cover to cover. The other computer magazines are too commercial and shallow. However, I'm writing to you now to express a differing opinion on Larry Cameron's "XMODEM-CRC on the 8031" that appeared in the May issue. I think Larry was committing overkill by setting up an XMODEM program on the 8031 just to transfer data between a PC and the 8031. Since I already use my own XMODEM transfer program for modem communications, I'm happy for the your other readers that you've included the algorithm in your magazine. But you left out the crucial algorithm on how to calculate the CRC using shift operations.

I can see how a controller can be used effectively for buffering data between a modem and a PC. Between the 8031 and the outside world, the XMODEM protocol can be used effectively, taking the load off the PC to do other tasks. But the PC still has to be alert enough to prevent the 8031's buffers from filling up. The PC can't leave the task completely up to the 8031 when the size of the file is hundreds of bytes.

Larry's article was aimed at making data transfer between a PC and 8031 more reliable. These transfers are performed under ideal conditions, unless the serial lines are very long or there's a lot of ambient interference. Under quiet conditions, glitches during PC-to-PC transfers hardly ever occur. All Larry needs to do is perform a single CRC calculation on the entire transfer at the end of the transfer and compare the sender's CRC with the receiver's CRC to verify the transfer. The penalty for retransmission s very smallwhen the frequency of error is so low and the speed of the transmission so high as it is in PC-to-PC transfers.

I think that you should clarify for your less-experienced readers when to use XMODEM for noisy transmissions and when to simply run CRC checks on files to verify their authenticity. CRC checks should be done with 32-bit CRCs that are compatible with PKZIP, and XMODEM with 16-bit CRCs because of the protocol. You can also point out to your readers that CRCs provide an excellent means for hashing keys of any size for password and database applications. Additionally, you'd do your less-experienced readers a service by spelling out the CRC algorithms in detail. The C-language version of the algorithm is far too concise to explain how it works. It has to be explained in terms of the holding registers, shift operations performed on the registers, exclusive-ORs with the data and constant table and the proper sequence of all these operations.

As always, I count the days until your next issue comes out on the newsstand. Keep up the good work.

Russell Stevens
Chicago, Il

Prospective Author

• I enjoyed your Editorial on writing for *ComputerCraft* in the July issue. Your comments about some of the authors reminds me of people I have managed over the years. Please send me a copy of your Writer's Guide as I have some potential articles for your magazine.

Eddie M. Zanrosso
Pasadena, CA

Likes GALs

• It was refreshing to see an introductory article on GALs in the June issue of ComputerCraft that didn't begin with a schematic and/or gate array of the OLMP. That information is pretty irrelevant to designing with these devices. All you need to know to start is how to write the logic equations so that the chip performs the desired logic functions. In its May 1992 *Elecktor Electronics USA* (no longer published here) ran a construction project on a GAL programmer that connected to the parallel port of a PC/compatible to program both 16V8 and 20V8 devices using software written for this purpose. The pc boards and software are still available from Old Colony Sound Laboratory, PO Box 243, Peterborough, NH 03458-0243. The $19 pc board is Part No. Z920030, and the $19 software, which includes OPAL Jr., is on three 360K diskettes is Part No. Z1701. The components to stuff the board will probably cost $60 to $70. I have been using this programmer and found it to work well.

If author Robert G. Brown plans to develop an inexpensive GAL programmer, I'd like to suggest that it include support for 22V10 devices. From reading trade magazines, it seems that only the low-density programmable-logic devices, specifically the 22V10, are showing any growth in sales, which could mean that the 16V8 and 20V8 will be phased out. If a low-cost programmer project supports the 22V10, I'd be interested in it.

I really enjoy ComputerCraft. Please keep up the great work. Jan Axelson's articles are super.

David B. Bley
Chattanooga, TN

Microcontroller Success

• Thank you for the clearly written and useful articles on microcontrollers. After reading back issues, I finally got up the courage to Wire Wrap your layout for Jan Axelson's 80C52AH board and it worked! I've added an LCD display, an 8255 I/O port, a clock and a keypad. Keep up the good work. Jan Axelson's column is a gold mine of information.

Jim Kreter
Riverside, CA

CD-ROM Standards

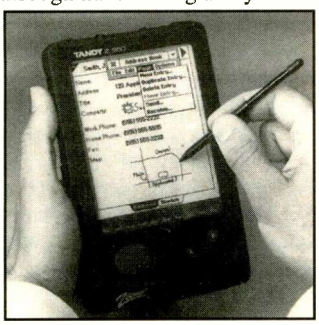
• In his article "CD-ROM for Everyone," Tom Benford used the word "proprietary" many times in his review of the various systems. Actually, the Compact Disc-Interactive system is the only standards-based system of the group he reviewed. The CD-I standard is one of several standards set forth by the consumer-electronics leaders. The standard is contained in the "Green Book," which defines hardware, software and the recording format of CD-I machines. The "Red Book" contains the standards for Compact Disk Digital Audio, and the "Yellow Book" contains the standards for CD-ROM players. Philips' CD-I development began in the early 1980s, along with Sony's, Matsushita's and Microware Systems'.

I also noted in several cases that the trademark-named "CD-I" was used in discussion of Tandy's VIS system. The VIS system will not play CD-I disks. One of the many reasons for this is that the information on CD-I disks is interleaved. Sectors of program code, sound files and graphics are interleaved. The old CD-ROM format used by the VIS system is not able to deal with data arranged this way. Another factor is that the CD-I machine runs under a real-time operating system with preemptive multitasking (OS-9), which is a distinct advantage when dealing with three simultaneous data streams and a joystick. Use of OS-9 and interleaved data on the disk also explains why a rather expensive ($500 or so) CD-I player operates so much smoother than a high-dollar PC with a CD-ROM drive.

Allen Morgan
Longview, WA

Pen-Based PDA

Tandy's Z-550 Xoomer PDA "personal digital assistant" combines the simplicity of pen and power with the logical power of a computer in a pocket-size device weighing less than one pound. It operates up to 100 hours on three standard AA cells and serves as an electronic notepad. Xoomer includes a date book, address book, bankbook, calculator, dictionary, thesaurus, world clock, language translator, and more. You can choose three different ways to enter information: text entry by tapping the Zoomer pen on a pop-up menu, electronic ink for handwritten notes, sketches or drawings using the pen, or text translated through handwriting analysis.

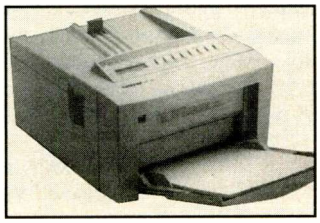


Built-in infrared transceivers provide wireless communication between two Xoomer units. In addition, an RS-232-compatible serial port allows information to be transferred to a personal computer, printer or other serial device. With an optional modem, you can retrieve data from America Online. Electronic mail can be sent and received. $699. *Tandy Corp., 1800 One Tandy Center, Fort Worth, TX 76102.*

CIRCLE NO. 1 ON FREE CARD

SOHO Laser

Brother's six-page-per-minute HL-6 300-dpi, PCL4-compatible desktop laser printer is targeted for the "small office, home office" (SOHO) market. Features include automatic interface and emulation switching, 60 fonts, data compression and low-power consumption. Other features include automatic emulation switching, automatic interface switching, power-save mode, advanced paper handling and setting status page. An optional PostScript emulator cartridge ensures compatibility with major personal-computer platforms and popular software applications.



The HL-6 comes standard with a serial port and has one HP-compatible font-cartridge slot that can accommodate a number of industry-standard cartridges. It uses the same Canon EPS toner cartridge as the HP IIP and IIIP. $999. *Brother Int'l. Corp., 200 Cottontail Lane, Somerset, NJ 08875; tel.: 908-356-8880; fax: 908-356-4085.*

CIRCLE NO. 2 ON FREE CARD

Programmable Keyboard

Maxi Switch's Tucson 101-PRO 101-key computer keyboard offers full programmability. All keys can be easily re-mapped so that the keyboard layout conforms to your personal work habits. Keys can also be programmed to perform special functions, such as diagonal cursor movement. With the "macro key" function, you can program any key to do in a single keystroke what normally require many keystrokes to accomplish. The keyboard's memory can hold up to 1,800 characters. Additionally, macro libraries can be created for various applications and stored on-disk for easy uploading and downloading. A reset button is available to undo customization and return the keyboard to its factory state. $95. *Maxi Switch, Inc., 2901 E. Elvira Rd., Tucson, AZ 85706; tel.: 602-294-5450; fax: 602-294-6890.*

CIRCLE NO. 3 ON FREE CARD

Enhanced Cordless Mouse

Logitech's new MouseMan cordless mouse features improved ergonomic shape and improved *MouseWare* software. It has been especially redesigned for long-term comfort by conforming perfectly to the shape of the palm of your hand, while the mouse buttons are contoured to allow your fingers to rest naturally and comfortably. Additionally, the ball has been moved forward to improve accuracy and control when manipulating the cursor.

MouseMan uses radio instead of infrared energy to transmit signals to the computer, eliminating the need for line-of-sight positioning between mouse and computer. The new software allows you to easily program the other two buttons with time- saving commands. It's menu-driven for ease of use. MouseMan is Microsoft-compatible. $149. *Logitech Inc., 6505 Kaiser Dr., Freemont, CA 94555; tel.: 510-795-8500; fax: 510-792- 8901.*

CIRCLE NO. 4 ON FREE CARD

Inexpensive Image Editing

Version 2.0 of OSCS Software's *NeoPaint* is a bitmap/raster graphics package that features an easy-to-use interface. Package enhancements include new smudge and blend tools; gradient fills with selectable dithering; editable rectangle; ellipse, polygon and three-dimensional object tools; a user-configurable cloning brush water color, charcoal and crayon tools; enhanced editing of Bezier curves; and new distort/skew, cropping, color similarity, full-screen editing and transparent cut/paste functions Zoom, clipart stamp and palette/pattern have been strengthened, and printer support has been greatly expanded.

The program runs on a 286 or later machine with EGA or better video display. $45. *OSCS Software Development, 354 NE Greenwood Ave., Bend, OR 97701-4631; tel.: 503-389-5489; fax: 503-388-8221.*

CIRCLE NO. 5 ON FREE CARD

WordPerfect Add-In

JASC's *PerfectKeys* add-in for *WordPerfet* 5.x is claimed to eliminate 50% of editing time through extensive single- keystroke command shortcuts that are reachable from the "home" keyboard position. Some common tasks that it simplifies include cursor movement, block/change text, transposition, apply styles, select fonts, switch keyboards, to name a few. Extensive on-line help includes a *WordPerfect* manual and PerfectKeys information. It's virtually invisible to the user, changing neither the functionality nor appearance of *WordPerfect.* $79. *JASC, Inc., 10901 Red Circle Dr., Ste. 340, Minnetonka, MN 55343; tel.: 612-930-9171; fax: 612-930-9171.*

CIRCLE NO. 6 ON FREE CARD

Unattended Power On/Off

Taskmaster from Remote Access can turn a DOS computer on, run any application(s) scheduled and power down, completely unattended. This combination software/hardware system includes a task-scheduling program that "memorizes" keystrokes needed to run an application. Operations range from simple to complex, including system applications, database index rebuilding, backups, polling and automated transmission to/from multiple sites. *Remote Access Corp., 10 Corey Ave., Bluepoint, NY 11715; tel.: 516-363-4719; fax: 516-363-8221.*

CIRCLE NO. 7 ON FREE CARD

Power Automatic On from Summit Trading automatically turns on within 1/60 second when receiving an incoming phone call to a fax machine, fax modem or telex machine. It automatically turns off the device when the call ends and can be used in security systems to remotely turn on other devices via telephone calls. $90. *Summit Trading Co., 15903 Lakewood Blvd., No. 103, Bellflower, CA 90706; tel.: 310-804-3232; fax: 310-804-9541.*

CIRCLE NO. 8 ON FREE CARD

MC68HC705C8 Programmer

Single Chip Solutions' PGM-HC05 programmer is a low-cost package for the MC68HC-705C8 microcontroller that connects to an IBM/compatible computer via a serial port. Power is provided by a 9-volt dc wall transformer. All programming voltages are generated and regulated on-board. The

programmer is supplied with a *Windows* programming interface that supports programming, verifying parts and uploading data from programmed parts. It's also compatible with the BURN05 software on Motorola's Freeware BBS. The programmer is available as a kit or assembled. From $100. *Single Chip Solutions, PO Box 680, New Hartford, CT 06057.*

CIRCLE NO. 9 ON FREE CARD

Tape-Drive Utility

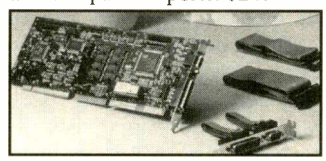
TAPEDISK from a company of the same name enables users of any *Windows* or DOS application to create, view, open, edit and save files on tape, using selected DAT and QIC-1000 tape drives. The tape drive appears as an additional hard disk to the applications. This is a unique software driver that runs under DOS 5.0 or later, *Windows* 3.1 and *Windows For Workgroups*. Average file access time is rated at approximately 15 seconds.

The program features a comprehensive suite of utilities for formatting tapes, loading and unloading drives, setting and tracking tape parameters, managing directories, restoring files, recovering from system crashes and more. It requires a 386 or better PC/compatible computer, a 100% compatible ASPI device driver and SCSI controller and LIM EMS Version 4.0 or later. $200. *Tapedisk, 2908 Fond du Lac Rd., Oshkosh, WI 54901; tel.: 414-231-3333; fax: 414-233-8699.*

CIRCLE NO. 10 ON FREE CARD

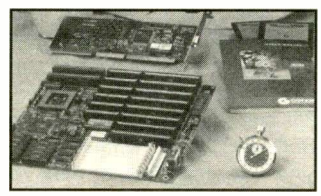
Local-Bus News

Genoa's M5 Veloce is a combination high-speed graphics accelerator and a five-way multifunction controller. The graphics accelerator component delivers 24-bit color at high resolution (16.8-million colors at 640 X 480) with 1M of DRAM. Based on Cirrus Logic's GD5426 chip, Genoa has special proprietary drivers for *Windows*, OS/2 and many popular application programs. The board also functions as a high-speed I/O and provides hard-disk and floppy drive control with two serial and one parallel ports. $249



Also from Genoa is the TurboExpress 486VL upgradeable motherboard. This VESA local-bus-compliant board permits direct on-board CPU upgrades through a full range of 486 CPUs. Simply swap CPU chips (including the clock-doubling DX/2 series) when it comes time to upgrade. It features eight slots, two of which are local-bus slots. Up to 32M memory is supported by the board, which also supports standard cache memory from 64K to 256K. AMI BIOS with setup utility is used. $290. *Genoa Systems Corp., 75 E. Trimble R., San Jose, CA 95131; tel.: 408-432-9090; fax: 408-434-0997.*

CIRCLE NO. 11 ON FREE CARD



Boca's VL-Bus SuperX VGA is a local-bus video add-on card designed to improve GUIs such as *Windows* and OS/2. It combines the enhanced speed of an accelerator chard with the throughput and performance capacity of VESA Local Bus. Available with either 1M or 2M of DRAM, SuperX runs at near-CPU speed. *Boca Research Inc., 6413 Congress Ave., Boca Raton, FL 334876; tel.: 407-997-6227; fax: 407-997-0918.*

CIRCLE NO. 12 ON FREE CARD

The Green PC: Making Choices That Make A Difference

By Steven Anzovin

(Windcrest/McGraw-Hill. Soft cover. 248 pages. $9.95.)

This is one of those little books that will make you stop and think when you read it. Written by an environmentalist, the book's production is consistent with its theme. It's printed on recycled paper with soy-based ink. Much of the book is devoted to saving energy and being more-cost effective in the name of conservation. Even if you-re opposed to environmentally-based choices, you might want to consider this book because its hints could save you large dollar amounts over the life of your computer and printer.

Chapter 1 gives a number of statistics on the volume of computers sold every year to the number or trees (9,000,000 and counting) it takes to supply the computer user's enormous thirst for paper. Chapter 2 covers 50 ways to save hardware, ranging from simple maintenance to upgrading instead of replacing. Chapter 3 is dedicated to saving power, with ideas ranging from turning off your PC at night to getting the most from air conditioning. Reducing paper consumption is the focus of Chapter 4. Recycling—everything from paper to printer consumables to PC plastics—is covered in Chapter 5. The benefits of telecommuting are discussed in Chapter 6.

Chapter 7 focuses on the health of the computer user, with topics ranging from eye-strain to carpal tunnel syndrome. PC pollution in the work place is tackled in Chapter 8, while Chapter 9 covers pollution in the computer industry. Chapter 10 is devoted to software that saves the earth. Chapter 11 lists resources for those tackling the environmental issues. The "green PC consumer" is the topic of Chapter 12, while environmental advocacy is discussed in Chapter 13.

There's a wealth of useful information in this book, once you get past the environmental politics (many would argue that such polemics are valuable, too). The most annoying thing about the books is that its type was set in a script-like font, which I find difficult to deal with for more than a few paragraphs. All in all, though, it's a useful book.

DOS Made Easy, Fourth Edition

By Herbert Schildt.

(Osborne/McGraw-Hill. Soft cover. 500 pages. $19.95.)

In spite of the title being an oxymoron, this book is useful. Updated to cover all the important new features in DOS 6, Shcildt provides DOS users with clear, step-by-step instructions for working with any version of DOS. For readers who are new to DOS, this book provides detailed descriptions of how to run DOS and working with the DOS prompt, the File System, DOS tree-structured directories and the DOS shell in step-by-step fashion.

For readers who are upgrading to DOS 6, the author focuses on tips for the best ways to use the DOS interface and command prompt, configuring DOS and the DOS Shell, managing fixed and floppy disks, along with insights into all the new features and capabilities of DOS 6.

The first four chapters (Part I) are devoted to computer and DOS basics. Part II deals with more-advanced DOS commands in six chapters that range from subdirectories to batch files to redirecting input and output. Advanced DOS features are covered in the four chapters that make up Part III. Topics include DOSKEY, file recovery, special configurations and defending against viruses. Managing your computer is detailed in Part IV's three chapters, with topics on floppy and hard disks and miscellaneous storage issues. Part V and its four chapters cover the DOS shell, including basic and advanced features of the file manager and program managers.

This book will be of more use to someone who has relatively little exposure to DOS than to an old hand.

PC Stepper Controller

MAS' PC-Step 2 is a combination stepper motor drive and digital I/O card. Designed to work with IBM/compatible computers, it includes driver and interactive electronics. Computer I/O signals are buffered from the drive signals. It features four normally-open digital input connections that can be used to sense end-of-travel conditions on X-Y tables. Its eight digital output lines can be configured to drive two unipolar stepping motors (six- or eight-wire) or one stepper and four output lines. Each output can internally sink up to 1.5 amperes. Demonstration software and the source code are included. The unit is available as 5-, 12- and 24-volt versions. $120. *MAS Electronics, 931 Lincoln Rd., Birdsboro, PA 19508; tel./fax: 215-582-4864.*

CIRCLE NO. 13 ON FREE CARD

Crossword-Puzzle Program

LYRIQ's *Crosswords-The Player's Choice, Premium Edition* crossword puzzle program offers a mix of expert, medium and easy puzzles drawn from such sources as the *Washington Post Magazine* and *Crossword Magazine*. Features include the "courteous cursor" that automatically places characters in the correct squares even if you don't start at the beginning of a word. You can add 50 more puzzles, your choice of difficulty, with optional Puzzler Packs. There's also an optional subscription that brings 25 new puzzles each month. Both DOS and *Windows* versions are available. System requirements are a PC/compatible computer using EGA or better displays. $50. *LYRIQ Int'l. Corp., 1701 Highland Ave., Cheshire, CT 06410; tel.: 800-886-8650.*

CIRCLE NO. 14 ON FREE CARD

Model-RR Software

Realroad from Digital Power is a locomotive simulator that operates model rail road trains. With this program, you enter

information about the type of locomotives and the size of train you want to simulate. *Realroad* uses this information and monitors throttle, brake switch, direction switch and many other user settings to control the model train, making it perform just as a real train of the same type would. It works with existing 8- to 20-volt dc model rail-road and track wiring. No modifications are necessary. An interactive calibration procedure allows the program to learn about each model locomotive.

Realroad comes with enough information to simulate 150 locomotives. Freight and passenger-car information is also included. You can modify or add to the list of possible cars, as desired. Multiple locomotives can be combined on the same train with varying numbers of cars, proving virtually endless train simulation possibilities.

Realroad's controller card installs in an empty PC/compatible slot, while power-supply and track connections are made via a terminal strip on the back of the card. From $280. *Digital Power, Inc., PO Box 130472, St. Paul, MN 55113; tel.: 612-698-7679; fax: 612-595-9772.*

CIRCLE NO. 15 ON FREE CARD

"Smart FM" Database

Chatham Research's *FM Gold* database program acts like Smart Radio, the digital encoding that provides information about the station's programming. Based on major airports in the US, *FM Gold* offers infor-

mation on frequency, call sign, format, city, state, signal strength (calculated for the airport location) and estimated range. The program allows you to select format (classical, for instance) for a given airport. It then provides a list of all area stations (around the airport) that follow the selected format, their frequency, call sign, etc. Three versions are available, listing stations for 31, 125 and over 400 stations; $10/$30/$50, respectively. *Chatham Research, PO Box 439, Oakton, VA 22124; tel.: 703-281-9699.*

CIRCLE NO. 16 ON FREE CARD

Professional Astrology Software

Halloran's *Natal Professional* astrology software program produces detailed Natal charts (requires optional $49 graphics-support package) and 30-page interpretative reports. The interpretative database was prepared by widely renowned professional astrologer Janice Barsky. It supports batch processing, which allows you to select and print an unlimited number of charts or reports while you're away from your computer. A Spirit Success Report option provides a more spiritual alter-

(Continued on page 74)

Upgrade Your Computer Printer And Save A Bundle

By Horace W. LaBadie, Jr.

(Windcrest/McGraw-Hill. Soft cover. 276 pages. $19.95.)

Although you may have no interest in upgrading your printer, you may want to consider adding this little gem to your library. It's divided into dot-matrix, inkjet and page printers and other hardware and software alternatives. Relatively few printer models are covered, but the ones chosen are popular and representative choices for their genre. The book covers how to add RAM, ROM, fonts and other accessory items to bring a printer closer to the newest and best. The genius of this book, though, is in the incidental information that the author drops in from time to time. It's simply a good read if you're at all curious about those amazing machines that put ink on paper.

Part 1 consists of the first six chapters and begins with a short discussion of dot-matrix printers. Chapter 2 covers expanding internal RAM, while Chapter 3 deals with expanding printer ROM. Interfaces are covered in Chapter 4, with particular emphasis on the parallel port and numerous "standard" serial ports. Chapters 5 and 6 are devoted to adding color printing capability and additional fonts, respectively.

Part 2 covers inkjet printers in two chapters. Chapter 7 is a simple (and fascinating) history of the technology, while Chapter 8 deals with upgrading RAM, ROM and the rest.

Part 3 is devoted to page printers (laser printers and similar technology). Chapter 9 provides a short overview of the laser printer and its cousins, while Chapter 10 is devoted entirely to expanding printer RAM. ROM expansion is the topic of Chapter 11, but the primary focus tends to be on PostScript and its emulators. There's also a fascinating subsection devoted to what produces a specific resolution (say 300 × 300 dpi) in a laser printer and what can be done to increase the resolution. It's far easier than you may think.

Part 4 covers miscellaneous hardware topics. Daisywheel and thermal printers are briefly mentioned in Chapter 12. Chapter 13 covers printer-sharing devices with mini-reviews of several of the more-popular models. A short Chapter 14 covers paper-handling options.

The final part and chapter covers software substitutes for hardware, like print spoolers.

The book concludes with two appendices that cover sources of parts and materials and font samples. You may have no intention of ever upgrading your printer, but this shouldn't stop you from considering this book. It has a wealth of information, and it's fun to read.

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Computer Systems

Altex makes it easy to choose the system that best fits your needs. With four different case styles and six different motherboard configurations to choose from.

Each system comes with 5-1/4" and 3-1/2" high density disk drives, IDE hard drive controller, 2 serial, 1 parallel, and 1 game port. Enhanced 101 key keyboard, case and power supply.

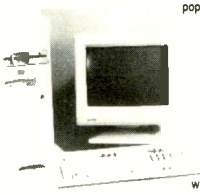
To complete your system, choose the amount of memory you need, the size of hard drive, and the kind of monitor and controller card. Computer Systems shown with Monitor MON-08 NOT INCLUDED

System I

System I is designed into the STC-16 case. This deluxe vertical system measures 24-1/4" high x 7-1/2" wide and 17" deep. With 6 external 5-1/4" drive bays and 2 external and 2 internal 3-1/2" drive bays makes this the perfect system for network fileservers or where heavy expansion capabilities are needed.

3SX33-16	386SX 33MHz System	$389
3DX33-16	386DX 33MHz System	459
3DX40-16	386DX 40MHz System	489
4DX33-16	486DX 33MHz System	799
4DX50-16	486DX 50MHz System	979
4DX66-16	486DX 66MHz System	1119

System II

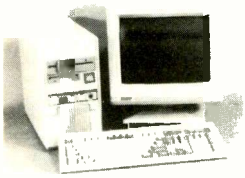


System II is designed into the STC-08 case. This is our most popular system measuring 18-1/2" high x 7-1/2" wide and 15-1/2" deep and comes with 3 external 5-1/4" drive bays and 2 external and 2 internal 3-1/2" drive bays. This is the perfect system for power users who want to save space.

3SX33-08	386SX 33MHZ System	$359
3DX33-08	386DX 33MHz System	429
3DX40-08	386DX 40MHz System	439
4DX33-08	486DX 33MHz System	769
4DX50-08	486DX 50MHz System	959
4DX66-08	486DX 66MHz System	1089

System III

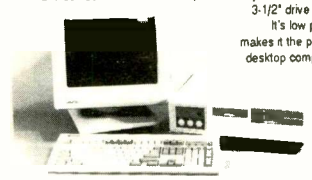
System III is designed into the STC-05 case. This mini-vertical system measures 13-1/2" high x 7-1/2" wide x 16" deep and comes with 2 external 5-1/4" drive bays and 2 external and 1 internal 3-1/2" drive bays. Our most inexpensive system is perfect for family uses and also networking stations.



3SX33-05	386SX 33MHz System	$329
3DX33-05	386DX 33MHz System	399
3DX40-05	386DX 40MHz System	409
4DX33-05	486DX 33MHz System	739
4DX50-05	486DX 50MHz System	929
4DX66-05	486DX 66MHz System	1059

System IV

System IV is designed into the STC-15 case. This slimline desktop system meausres 4-1/2" high x 17" wide x 16" deep and comes with 2 external 5-1/4" drive bays and 2 external 3-1/2" drive bays. It's low profile makes it the perfect desktop computer.



3SX33-15	386SX 33MHz System	$349
3DX33-15	386DX 33MHz System	419
3DX40-15	386DX 40MHz System	429
4DX33-15	486DX 33MHz System	759
4DX50-15	486DX 50MHz System	949
4DX66-15	486DX 66MHz System	1079

Memory Modules

Part#	Description	Each
256KX9-80	256K x 9-80 NS SIMM	$12.00
256KX9-80SP	256K x 9-80 NS SIPP	12.50
256KX9-70	256K x 9-70 NS SIMM	13.00
1MEGX8-80	1MB x 8-80 NS SIMM	40.00
1MEGX9-80	1MB x 9-80 NS SIMM	43.00
1MEGX9-80SP	1MB x 9-80 NS SIPP	43.50
1MEBX9-70	1MB x 9-70 NS SIMM	44.00
1MEGX9-70SP	1MB x 9-70 NS SIPP	45.00
1MEGX9-60	1MB x 9-60 NS SIMM	45.00
4MEGX9-60	4MB x 9-60 NS SIMM	194.00

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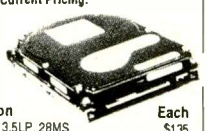
IDE Hard Drives



Part#	Description	Each
ST351A	42MB, IDE, 3.5LP, 28MS	$135
ST3120A	105MB, IDE, 3.5LP, 16MS	$229
ST3144A	120MB, IDE, 3.5LP, 16MS	$249
ST3283A	245MB, IDE, 3.5LP, 12MS	$439
ST2383A	338MB, IDE, 5.25HH, 16MS	$589
ST1480A	426MB, IDE, 3.5HH, 14MS	$949
ST3243A	212MB, IDE, 3.5x1", 15MS, 128K Cache	$369
ST3385A	341MB, IDE, 3.5x1", 12MS, 256K Cache	$639
ST3550A	452MB, IDE, 3.5x1", 12MS, 256K Cache	$689
ST3600A	525MB, IDE, 3.5x1", 10.5MS, 256K Cache	$999
ST9144A	128MB, IDE, 2.5x1", 16MS, 64K Cache	$359
ST9235A	209MB, IDE, 2.5x1", 16MS, 64K Cache	$579

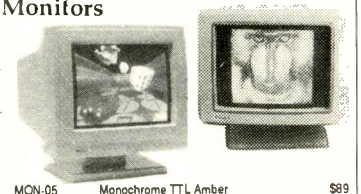
SCSI Hard Drives

Part#	Description	Each
ST1400N	331MB, SCSI, 3.5HH, 14MS	$888
ST1480N	426MB, SCSI, 3.5HH, 14MS	$949
ST4766N	676MB, SCSI, 5.25FH, 15.5MS	$1,189
ST41650N	1.65GB, SCSI, 5.25FH, 15MS	$1,849
ST3550N	452MB, SCSI, 3.5x1", 12MS, 256K Cache	$969
ST3600N	525MB, SCSI, 3.5x1", 10.5MS, 256K Cache	$1,029
ST1120N	1.05GB, SCSI, 3.5HH, 10.5MS, 256K Cache	$1,679

MFM Hard Drive

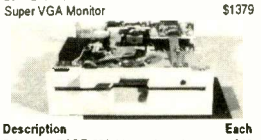
Part#	Description	Each
ST251-1	42MB MFM, 5.25HH, 28MS	$239

Monitors



MON-05	Monochrome TTL Amber (720 x 348) 12"	$89
MON-06	Paper White TTL 14"	$112
MON-09	14" Monochrome VGA Monitor (800 x 350, 400, 480)	$139
MON-07	VGA 41 Dot Pitch 640 x 480, 14"	$239
MON-08	14" Super VGA Monitor, 1024 x 768 Non-Interlaced	$359
MON-11	17" 1280x1024 Non-Interlaced, Super VGA Monitor	$879
MON-12	20" 1280x1024 Non-Interlaced Super VGA Monitor	$1379

Disk Drives

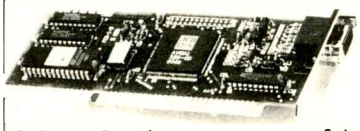


Part#	Description	Each
DDD-05	5 1/4 inch DSDD 360K beige faceplate	$49
DDH5-3	Dual Floppy Disk Drive reads both 3-1/2" and 5-1/4" Floppy Diskettes. Occupies only One 5-1/4" exposed bay.	$149
DDH-06	5 1/4 inch DSHD 1.2MB beige faceplate	$56
DDH-09	3 1/2 inch 720K beige w/bracket	$59
DDH-10	3 1/2 inch 1.44MB beige w/bracket	$53
DDH-11	Same as DDH-10 without 5-1/4" Mounting bracket. Fits in 3-1/2" bay	$48

3-1/2" Drive Mounting Kits

Part#	Description	Each
5.25KITFD	Mounts 3-1/2" Floppy drive in 5-1/4" bay	$9.95
5.25KITHD	Mounts 3-1/2" Hard drive in 5-1/4" bay	$9.95
RAIL01	AT Drive Rail Kit	$1.99
FP-BLK	1/2 Height Black Faceplate	$2.49

Video Boards



Part#	Description	Each
IFC-32	Mono Board w/printer port XT/AT	$16
IFC-33	Color graphics w/printer port XT/AT	$19
IFC-35	BOCA Dual Graphics Adapter	$35

BOCA dual graphics adapter supports MDA, CGA, Hercules compatible and performs color emulation on a monochrome TTL monitor. Parallel port can be configured as LPT1, LPT2 or disabled. Includes 132 column driver software.

IFC-42	640 x 480 VGA Card	$52

BOCA 640 x 480 - 16 color VGA card with 256K video RAM. 5 year warranty.

IFC-44	640 x 480 VGA Card	$42

640 x 480 VGA - 16 colors. 256K Display Memory. One Year Warranty. Full driver support.

IFC-46	1024 x 768 Super VGA Card	$79

1024 x 768 Super VGA - 256 colors. 1 MB Display Memory. One Year Warranty. Full driver support.

IFC-48	Accelerator Video Board	$139

11 times faster than Tseng ET 4000-based video boards! 1280 x 1024 resolution Interlaced, up to 1024 x 768 Non-Interlaced. Full driver support.

VMEG	PC Logic 1 MEG VGA Card	$99
VCOLOR	16.7 Million Color VGA Card with 1MB Memory	$109
VCOLORXL	PC Logic 1 MEG VGA Card	$139

16.7 million colors. Hardware driven

IIT Xgraphic

INTEGRATED INFORMATION

XGRAPHIC	IIT Xgraphic Accelerator	$229

For PCs working with Windows or CAD applications - 1 MB high speed VRAM - Speed, up to 20 times that of Super VGA - 65,536 Colors - Resolutions up to 1280 x 960

IIT Math Co-Processors

2C87-12	For 286 up to 12.5 MHz	$52
2C87-20	For 286 up to 20 MHz	60
3C87-25SX	For 386SX up to 25 MHz	62
3C87-33SX	For 386SX up to 33 MHz	68
3C87-25	For 386 up to 25 MHz	61
3C87-33	For 386 up to 33 MHz	69
3C87-40	For 386 up to 40 MHz	78

Colorado Memory Tape Back-Up Systems

TRAKKER-120	120MB External Parallel Port Back-Up System	$389
TRAKKER-250	250MB External Parallel Port Back-Up System	$469
DJ-10	120 MEG Internal Back-up System	$169
DJ-20	250 MEG Internal Back-Up System	$259
IOMEGA250	250MB 1IN Tape Back-Up System	$289

IOMEGA 250 MB Internal Back-Up, Fits in 3.5 inch mounting Slot. Connect to Floppy Disk Controller.

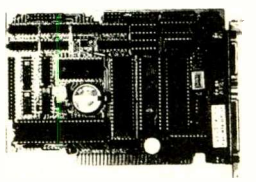
PT-25 2GB	PowerTape Back-Up Internal with SCSI Controller	$1129

2 Gigabyte Tape Back-Up Internal, 16 Bit SCSI Interface. Get up to 4GB per tape with data compression.

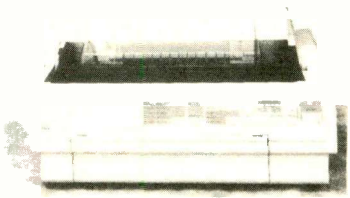
FC-10A	Add on Controller Board for DJ-10 or DJ-20	$99
TC-15	Add on Controller Board for DJ-10 or DJ-20 with High Speed Data Compression	$235
KE-10	External Kit for DJ-10 or DJ-20	$135

Disk Controller Boards

Part#	Description	Each
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-27-2	AT 2/IDE 2/Floppy Controller	$19
IFC-28	Fixed Disk Controller Board PC/XT	$47
ST-01	8-Bit SCSI Controller Board	$29
ST-02	8-Bit SCSI/Floppy Controller Board	$47
IN-2000	16-Bit SCSI Hard/Floppy Controller Board	$189
ISAPPORT	16-Bit ISA bus SCSI Host Adapter Card for 386, 486 systems	$139

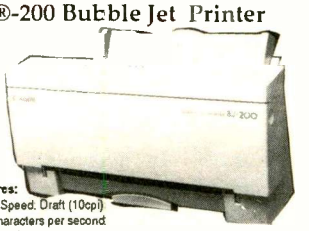


EPSON



AP2250	Action Printer, 9-pin Narrow Carriage	$119
FX-1170	9-Pin Printer, Wide Carriage	$379
AP3250	Action Printer, 24-Pin Narrow Carriage	$199
LQ-570	24-Pin Printer, Narrow Carriage 225 cps - Draft, 105 cps - Letter Quality	$249
LQ-1170	24-Pin Printer, Wide Carriage 300 cps - Draft, 138 cps - Letter Quality	$649
AL-1000	Epson Action Laser 1000 Printer	$769
AL-1500	Epson Action Laser 1500 Printer	$839

Canon BJ®-200 Bubble Jet Printer

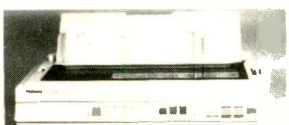


Features:
- Print Speed: Draft (10cpi) 248 Characters per second; High Quality (10cpi) 173 Characters per second; Super High Quality (10cpi) 124 Characters per second
- Print Resolution: 360 dpi, 64 nozzle print head
- Standard Emulations: Canon Native, Epson LQ, IBM X24E
- Buffer/RAM: 49KB
- Parallel Interface
- Plain Paper & Card Stock (17 - 28 lb), Transparencies (Canon recommended), Envelopes
- Paper Sizes: Letter, Legal, A4, #10 Envelopes
- Paper Handling: Standard 100-Sheet Feeder, 10 Envelopes in Sheet Feeder and Manual Feed
- Size: Width: 13.7 Inches; Height: 6.8 Inches; Depth: 7.6 Inches; Weight: 6.6 lbs.
- Ink Cartridge Life: Rated at 450 Pages
- 2 Year Limited Warranty

Laser Quality - Bubble Jet Price!

BJ-200	Bubble Jet Printer	$349
BC-02	Ink Cartridge Jet	$24.99

Panasonic



Part#	Description	Each
KXP-2180	9 Pin, 80 Column, 240 CPS DFT/32CPS NLQ	$179
KXP-1654	24 Pin, 132 Column, 375CPS DFT/125CPS LQ	$599
KXP-2123	24-pin, 80 Column, 240cps DFT/80cps LQ	$239
KXP-2124	24-pin, 80 Column, 320cps DFT/106cps LQ	$349
KXP-2624	24-pin, 132 Column, 300cpsDFT/100cps LQ	$419
KXP-4450I	Panasonic 11ppm Laser Printer	$1149
KXP-4410	Panasonic 5ppm Laser Printer	$659
KXP-4430	Panasonic 5ppm Laser Printer - 1 MEG RAM	$959

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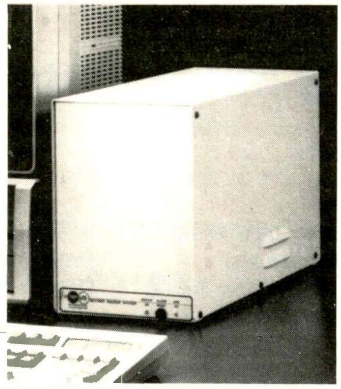
Part#	Description	Each
BC-250	250 VA, 2 Outlet	$105
BC-400	400 VA, 4 Outlet	169
BC-500	500 VA, 4 Outlet	194



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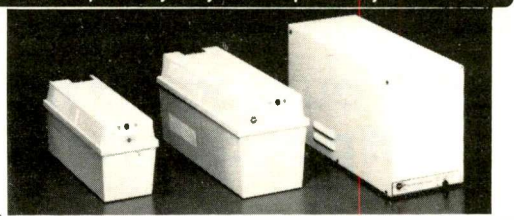
LAN Battery Back-up Systems



Same reliability as the BC Series but designed specifically for LAN's. Features remote channel output for the server shutdown. Proper cabling is available for any LAN system (not included). UL Approved

Part#	Description	Each
BC-500LAN	500 VA	$199
BC-600LAN	600 VA	269
BC-750LAN	750 VA	309
BC-900LAN	900 VA	379
BC-1250LAN	1250 VA	529
BC-4000LAN	4000 VA	2,549

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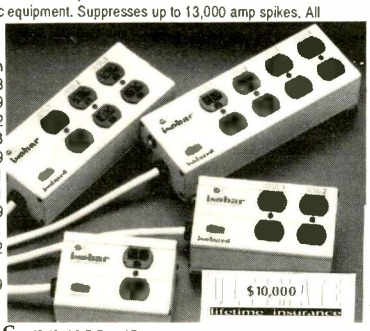
Isobars provide superior surge, RFI and EMI noise suppression and rejection with individual filter banks to safeguard against any interaction between your electronic equipment. Suppresses up to 13,000 amp spikes. All Isobars come with a lifetime warranty and UL listing.



Part#	Description	Each
IB2-0	2 outlet direct plug-in	$23
IB2-0/20	2 outlet, 20 amp, direct plug-in	39
IB2-6	2 outlet, 6 ft. cord Ultimate Warranty	32
IB4-4	4 outlet, 6 ft. cord Ultimate Warranty	43
IB4/220	4 outlet, 6 ft. cord	49
IB66	6 outlet, 6 ft. cord Ultimate Warranty	51
IB8	8 outlet, 12 ft. cord Ultimate Waranty	61
IB-8RM	8 outlet, 12 ft. cord with remote power switch	69
EUROBAR	4 outlet, 6 ft. cord, 220/240 Volt Euro connectors	52
IBR-12	12 outlet, 19" rack mountable	89

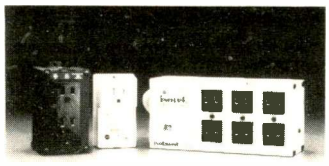
Isobar Ultra Diagnostic Surge Suppressors

Direct plug-in premium spike and noise suppressors with sine wave tracking. Unique diagnostic circuitry advises of: improper outlet wiring, damage to surge circuitry, loss of AC power. Ultimate Warranty.

Part#	Description	Each
IB4ULTRA	4 Outlet, 6' cord, Advanced diagnostics, 2 isolated filter banks, "cascade" circuitry	$50
IB6ULTRA	6 Outlet, 6' cord, Advanced diagnostics, 3 isolated filter banks, "cascade" circuitry	$56
IB8ULTRA	8 Outlet, 12' cord, Advanced diagnostics, 4 isolated filter banks, "cascade" circuitry	$65
ISOTELULT4	4 Outlet, 6' cord, Advanced diagnostics, 2 isolated filter banks, "cascade" circuitry dataline protection (RJ11 jacks)	$55
ISOTELULT6	6 Outlet, 6' cord, Advanced diagnostics, 3 isolated filter banks, "cascade" circuitry dataline protection (RJ11 jacks)	$62
ISOTELULT8	8 Outlet, 12' cord, Advanced diagnostics, 4 isolated filter banks, "cascade" circuitry dataline protection (RJ11 jacks)	$74
IB2ULT428	2 Outlet, Direct plug-in, 15 amp	$32
IB2ULTCOPY	2 Outlet, Direct plug-in, 20 amp model for copiers	$44
IB2ULTFAX	2 Outlet, Direct plug-in, RJ11 jacks for modem/fax	$39
IB2ULTCOAX	2 Outlet, Direct plug-in, Coax jacks for TV, VCR, Satellite	$39

Modem Fax Protectors

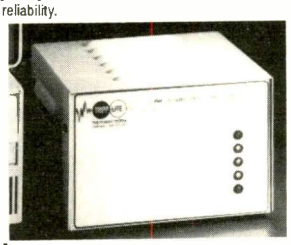
Protect your modems, telephone systems, and fax machines from telephone line spikes that damage equipment. All units exceed telephone line standards with a response time of less than 5 nanoseconds. 2 year warranty.



Part#	Description	Each
ISOTEL	Lifetime warranty. 4 outlet, 6 ft. cord and modem protector	$59
ISOTEL-8	8 outlet, 6 ft. cord and modem protector	$75
ISOFAX	ISOBLOK w/ Modem protector	$36
TSB	3 stage Modem/Fax protector	$38
MP	Economy Modem/Fax protector	$14
SMP	AC outlet w/modem/fax protector	$29
SMP-GS	Lifetime guarantee.	$35

Line Stabilizer/Conditioners

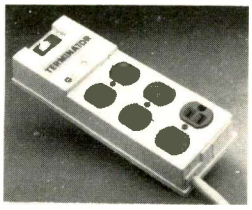
Maintain constant power levels during voltage sags and high voltage surges. Includes patented Isobar surge and noise protection and TrippLite reliability. UL listed and 2 year warranty.



Part#	Description	Each
LS-504	500 Watts, 230 Volt, 4 Outlets	$98
LS-600	600 Watts, 2 Outlets	77
LS-604	LS-600 with HI voltage regulation	98
LC-1200	1200 Watts, 4 Outlets	139
LC-1800	1800 Watts, 6 Outlets	188
LC-2000	2000 Watts, 208/220/240 Volt	243
LC-2000X	220/240 V, 2000 watts, 6 Outlets	243
LC-2400	2400 watts, 110 V, 6 outlets	243
LCR-2400	2400 watt rack mountable, 110 V, 14 outlets	287

Terminator

TrippLite 6 outlet surge & noise protection that fits any budget. Features MOV's, torroidal chokes, high and low frequency capacitors. An economical surge, RFI, EMI and noise suppressor with TrippLite reliability. Meets or exceeds IEEE 587 A and B specifications.



TERM-6	6 outlet, 6 ft. cord	$38

Isolators

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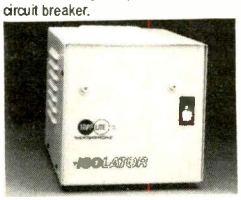
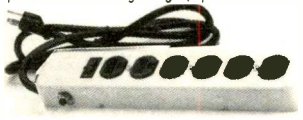


Part#	Description	Each
IS-200	200 watt, 13 lbs.	$89
IS-400	400 watt, 21 lbs.	129
IS-800	800 watt, 25 lbs.	169

Economy Surge Suppressor Outlet Strip

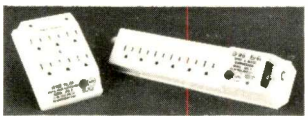
Full protection for surges and spikes. Comes with six foot heavy duty line cord, reset circuit breaker, lighted rocker switch and 3 wire grounded outlets to get full protection from voltage surges, spikes and other damaging electrical disturbances. UL listed.



EOS-6	6 outlet	$6.99

Spike Block & Spike Bar

Economical, yet effective surge and noise protection with TrippLite reliability. Suppresses up to 140 joule spikes at current levels of up to 6500 amps. 2 year warranty. Meets or exceeds IEEE 587 A and B specifications.



Part#	Description	Each
SK6-6	Spike Bar, 6 outlet, 6 ft. cord	$28
SK6-0	Spike Block, 6 outlet, no cord	22

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Build a Stand-Alone MC68705 Programmer

Lets you program these popular microcontrollers from a serial port on your PC

Of the many low-cost single-chip microprocessors that have become available in recent years, one of the least-expensive is Motorola's MC68705P3 eight-bit unit, which typically sells for $8.95 to $14.95. This microcontroller has 2K of EPROM, 128 bytes of RAM, three parallel ports and an eight-bit timer with prescaler ranging. Its 40-pin MC68705R3 brother offers an extra 2K of EPROM, four more I/O bits and an additional eight-bit input port, four bits of which can be used as inputs to an internal A/D converter. In addition, it even contains the programming software in an internal ROM.

All MC68705 series controllers require very few external parts because most of what's needed is already in these single-chip computers. To use these chips, their internal memories must be programmed. Motorola provides a schematic diagram for an MC68705 programming board with data sheet and at one time even supplied the printed-circuit board for assembling a programmer around this chip. The Motorola programming board can copy the contents of a programmed 2732 or 2764 EPROM into the MC68705 and program both the 28-pin P3 and the 40-pin R3 and U3 versions. The board uses few parts and is relatively simple to wire, but it requires an external 26-volt power supply or an expensive and difficult-to-find 5-volt to 26-volt converter. It also requires application of power and programming voltage in the correct sequences, which if not followed correctly can result in improperly programmed or damaged parts.

The MC68705 Programmer described here addresses the major shortcomings of the Motorola programmer. It loads files directly from any computer with a serial port and communications software. It eliminates the need to program an EPROM, as is normally required by the simpler programmers. And because it controls all aspects of the programming, it relieves you of having to remember power-switching sequences.

This type of programmer is well-suited to programming MC68705s. An MC68701 controls communication with the host PC since it has the necessary serial port. I used the existing Motorola programmer design for the MC68705 section to ensure compatibility with the programming software in the MC68705. The MC68701 also controls all power sequencing to the device being programmed, considerably reducing the possibility of damaging components during programming.

On-board 5- and 21-volt power supplies are built around inexpensive and readily-available discrete components, allowing the Programmer to be powered by a plug-in wall-type transformer. The programming software provides a user interface that permits S-records to be transferred to the board by most communications programs for PC/compatible and Apple computers.

Many inexpensive cross-assemblers for MC68xx series processors are available for less than $100 as shareware and public-domain software on many bulletin board systems and through the mail. Motorola also has an MC68705 cross-assembler for PC and Macintosh computers on its BBS. All Motorola cross-assemblers I've seen for the PC produce output in Motorola S-record format and use standard Motorola mnemonics.

About the Circuit

The three-part schematic diagram for the circuitry that makes up the Programmer includes: the MC68701 controller and the programmer's memory interface in Fig. 1(A); the power supplies and power-switching circuitry in Fig. 1(B); and the MC68705 programming socket wiring in Fig. 1(C). Refer to the appropriate part(s) as you read through the following circuit descriptions.

The MC68701 program that controls Programmer operation is available on the RE-BBS as an S-record file that can be programmed into a blank MC68701 microcontroller, using any programmer capable of programming the device. The code is also available from the source listed in the Note at the end of the Parts List.

On power-up, the MC68701 is reset by *Q6*. Programming pins P20, P21 and P22 are all pulled to +5-volts by SIP resistor network *Z2*, setting the chip to single-chip mode and selecting the internal EPROM program. The software initializes the Programmer and prompts for commands via the serial port.

Programmer timing is derived from 2.4576-MHz crystal *X1* and an oscillator inside *U1*. The oscillator's output is divided by 4 to produce the E clock that defines the basic memory operation cycle time (614,400 Hz). The E clock is also divided internally to provide the baud-rate clock to the UART. Baud rate is selected by a jumper connected to Bit 3 of Port 4. A grounded connection selects 4,800 baud, an open connection, 38,400 baud.

The MC68701 accesses RAM *U3* through a CMOS counter that's identical to the one used on Motorola's programming board. The processor supplies reset and clock signals to the counter on the same lines used by the MC68705 during programming. The MC68701's program keeps track of the count during loads and increments the counter during sequential byte loads. When a non-sequential address is loaded (such as the reset vectors), the program detects that the address isn't the next sequential address, resets the counter and increments it to the correct address.

The RAM's address lines connect to the outputs of counter *U4*. It isn't critical which addresses are connected to which outputs because the same counter is used for both loading the RAM and reading it during programming. The

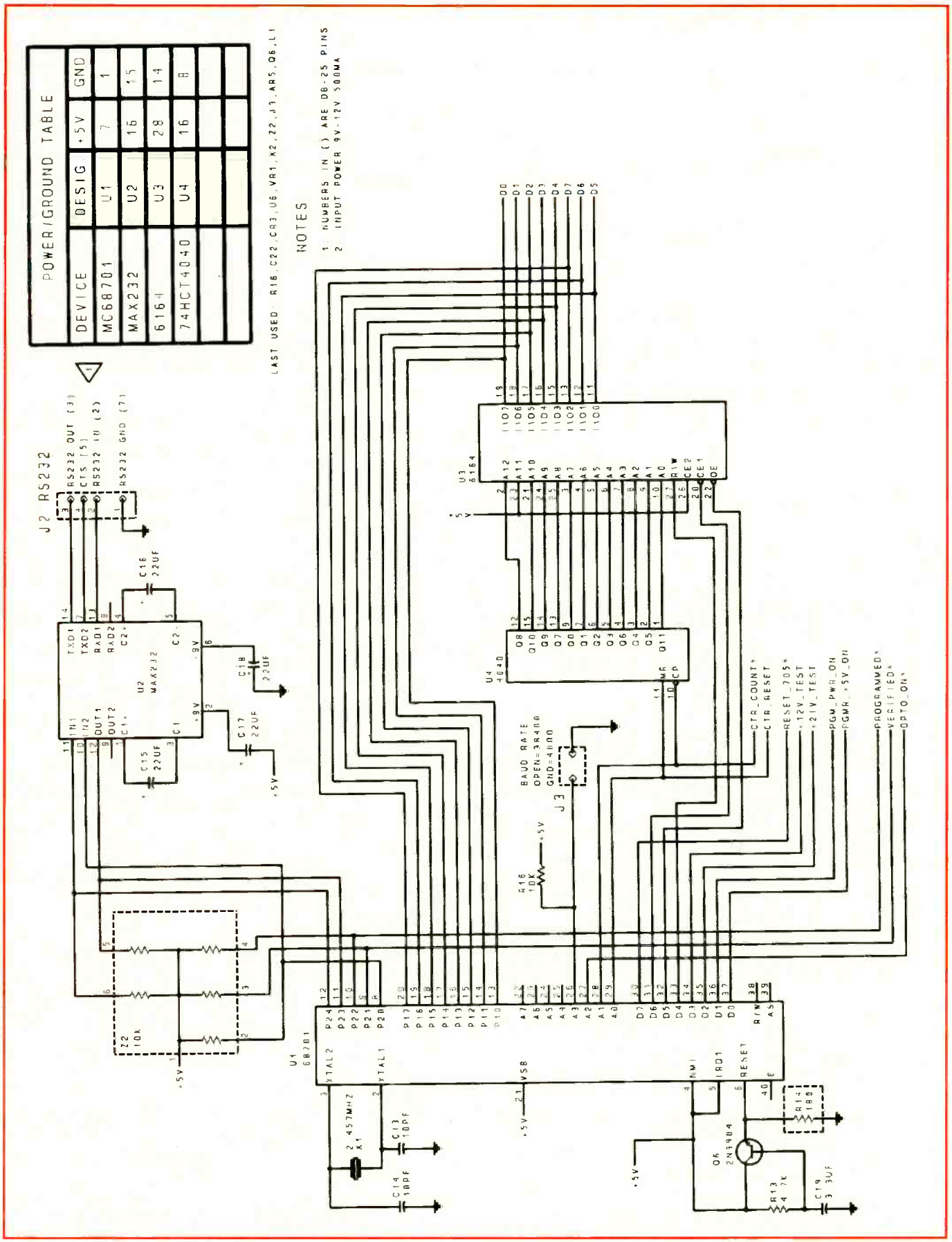

Fig. 1(A). Schematic details of the MC68701 controller and Programmer memory interface circuits.

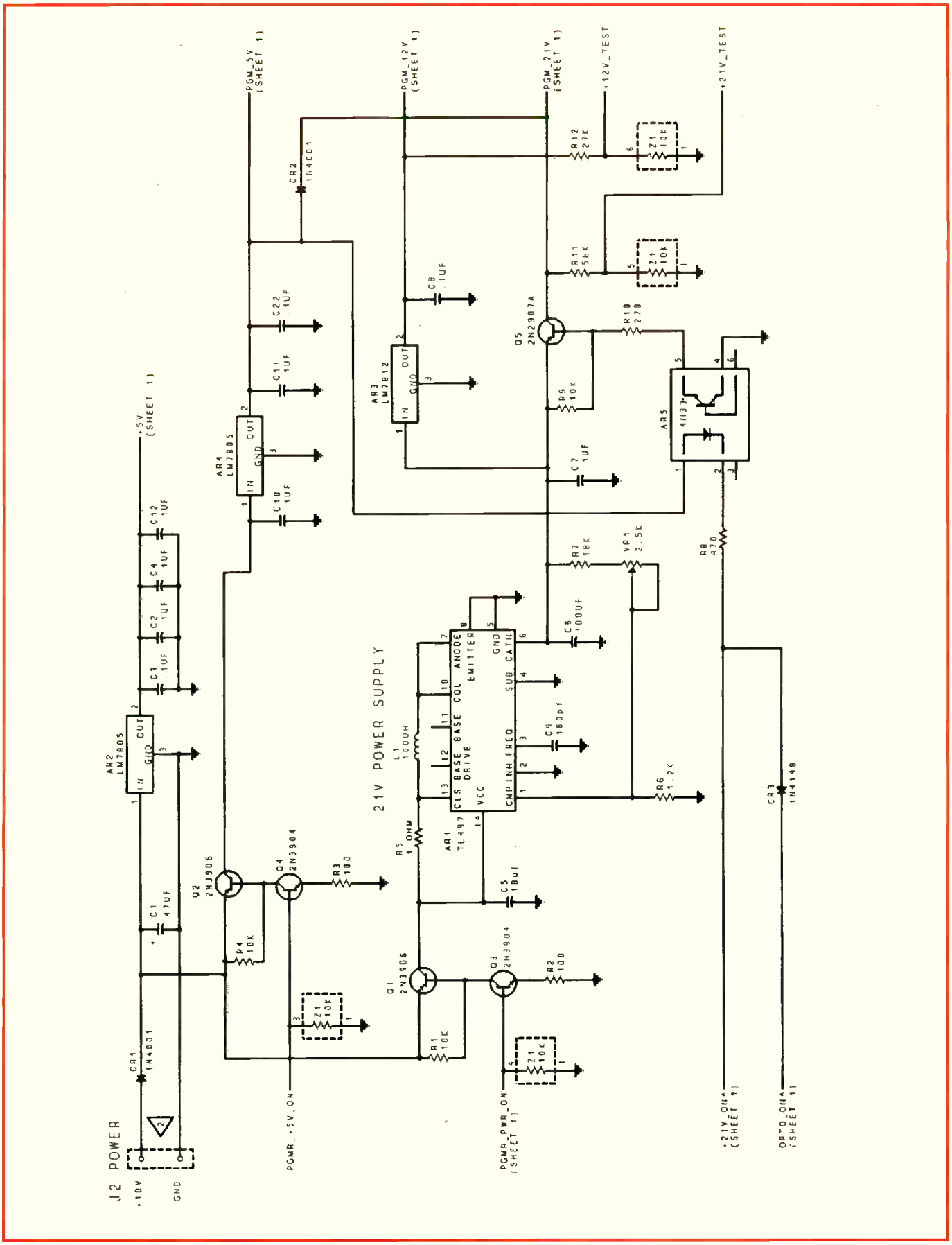

Fig. 1(B). Schematic details of the power-supply and power-switching circuits.

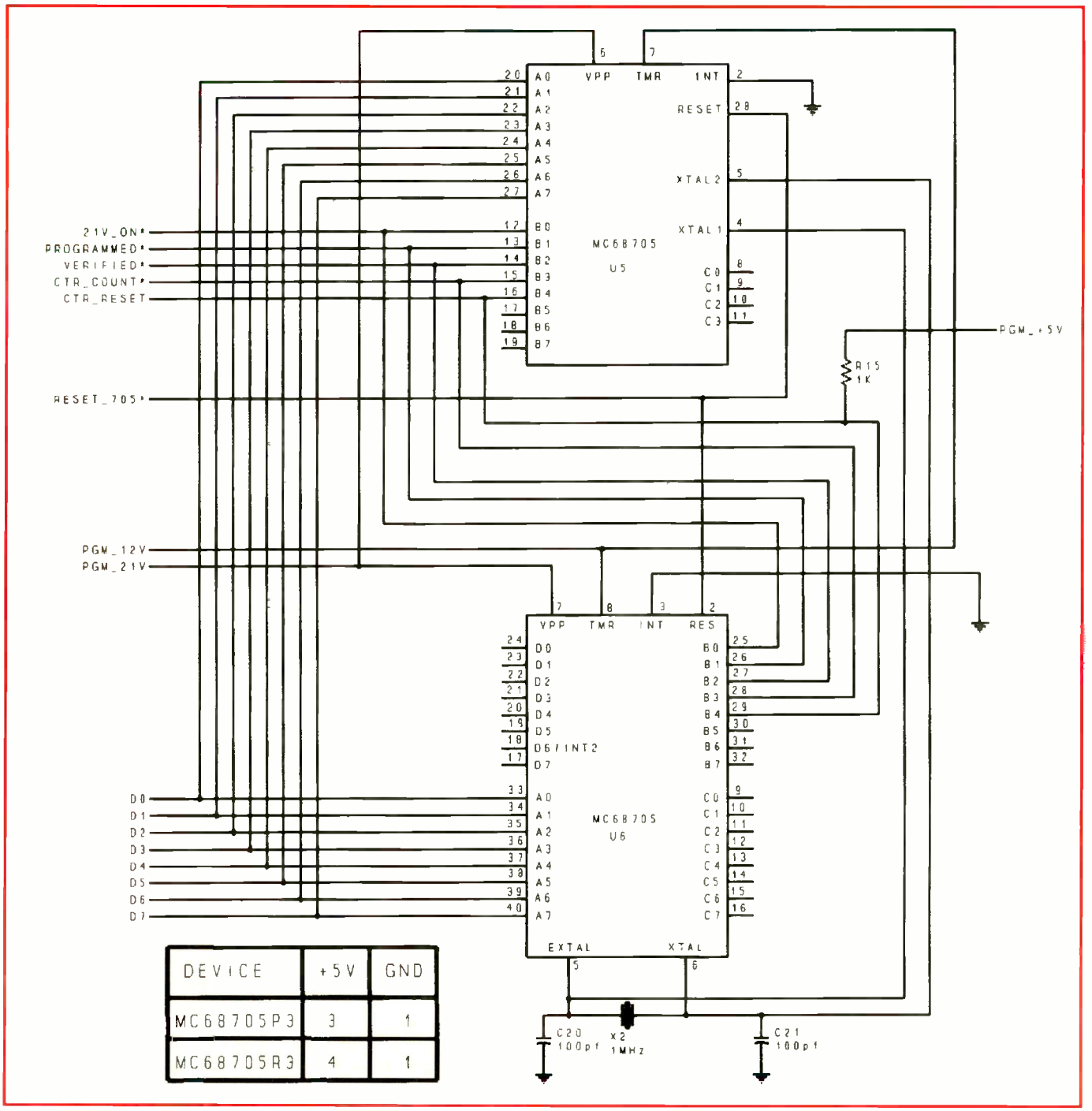

Fig. 1(C). Wiring details for Programmer's socket connectors.

only connection that must be maintained is the one for the data bits from the MC68701 to the corresponding data bits on the MC68705 sockets.

The communication interface provided by this Programmer is very simple. It uses the two data lines and the Clear To Send (CTS) line. The CTS line stops transmissions from the host PC when the Programmer is busy, which would occur when the counter is being adjusted for a non-sequential address, for instance. A receive-data buffer in the Programmer stores any extra characters that may have been transmitted by the host PC before CTS stopped transmitting. This allows the Programmer to easily keep up with a 38,400-baud data rate for the duration of a 4K-byte download session.

Some communications programs do not support hardware handshaking but have the ability to delay after a line of data is sent. This delay time at the end of each line transmitted to the Programmer can be used as an alternative to using CTS hardware handshaking, in which case, the time should be set to 50 ms.

Some computers, like older PCs and XTs, may not be able to keep up with the 38,400-baud transmissions from the Programmer to the computer. If this occurs, messages to the computer will be garbled. The 4,800-baud jumper must be

PARTS LIST

Semiconductors
AR1—TL497ACN switching power supply
AR2,AR4—MC7805CT fixed 5-volt regulator in TO-220 case
AR3—LM78L12A fixed 12-volt low-power regulator in TO-92 case
AR5—H11G2GE optical isolator in six-pin DIP
CR1,CR2—1N4001 or similar 50-volt, 1-ampere rectifier diode
CR3—1N4148 or similar switching diode
CR4—Red light-emitting diode
Q1,Q2—2N3906 silicon pnp transistor in TO-92 case
Q3,Q4,Q6—2N3904 silicon npn transistor in TO-92 case
Q5—2N2907A silicon pnp transistor in TO-92 case
U1—MC68701S microcontroller in 40-pin DIP
U2—MAX232CPE RS232 driver/receiver 16-pin DIP
U3—HM6264P-12 8K X 8 RAM in 28-pin DIP
U4—CD74HCT4040E 12-bit binary counter in 16-pin DIP

Capacitors
C1—47µF, 25-volt tantalum
C2,C3,C4,C7,C8,C10,C11,C12,C22—0.1µF, 25-volt ceramic disc
C5—10µF, 25-volt tantalum
C6—100µF, 35-volt tantalum
C9—390-pF, 50-volt ceramic disc
C13,C14—10-pF, 100-volt ceramic disc
C15 thru C18—22µF, 25-volt electrolytic
C19—3.3µF, 25-volt electrolytic
C20,C21—100-pF, 100-volt ceramic disc

Resistors (1/4-watt, 5% tolerance)
R1,R4,R9—10,000 ohms
R2,R3—100 ohms
R5—1 ohm (1/2-watt)
R6—1,200 ohms
R7—18,000 ohms
R8—470 ohms
R10—270 ohms
R11—56,000 ohms
R12—27,000 ohms
R13—4,700 ohms
R14—180 ohms
R15—1,000 ohms
R16—10,000 ohms
R17—470 ohms
VR1—25,000-ohm linear-taper pc-mount potentiometer
Z1,Z2—10,000-ohm, six-pin SIP resistor network

Miscellaneous
J1—2.1-mm power jack
J2—DB-25S female connector
L1—100-µH inductor (Radio Shack Cat. No. 273-102 or similar
S1—Miniature spst toggle switch
X1—2.4576-MHz crystal in HC-18 package
X2—1.000-MHz crystal in HC-33 or HC-18 package
Printed-circuit board or perforated board with holes on 0.1" centers and suitable Wire Wrap or soldering hardware (see text); suitable enclosure (optional; see text); DIP IC and ZIF sockets (see text); 12-volt, 500-mA dc plug-in wall-type power supply (see text); spacers; machine hardware; hookup; wire; solder; etc.

Note: The following items are available from Single Chip Solutions, PO Box 680, New Hartford, CT 06057: plated-through printed-circuit board, $60; programmed MC68701, $60; kit containing all components and wall transformer but not enclosure, $175; public-domain cross-assembler for PC, $3; source code for MC68701 on 5 1/4" PC diskette, $30. Also available is an assembled Programmer less enclosure for $200. Add $4.50 S&H for kit or assembled Programmer, $1 for disks. Connecticut residents, please add 8% sales tax. MC68705s may be obtained from the following sources:

American Design Components
62 Joseph St.
Moonachie, NJ 07074
Tel.: 800-524-0809

BG Micro
PO Box 280298
Dallas TX 75228
Tel.: 214-271-5546

Jameco Electronics
1355 Shoreway Rd.
Belmont, CA 94002
Tel.: 415-592-8097

installed on the programmer board for these PCs.

TTL signals from the MC68701 UART are converted to/from RS-232 levels by RS-232 transceiver *U2*, which contains a pair of voltage-level converters that generate ±9 volts from the 5-volt dc supply to power the RS-232 transmit driver. It's current draw from the 5-volt dc supply is typically 20 mA, making the MAX232 an excellent replacement for the more common MC1488 and MC1489 RS-232 driver and receiver chips. The MAX232 has two each transmit and receive buffers. One receive buffer and one transmit buffer are used for data, the other transmit buffer for the CTS signal.

The Programmer requires a power source that delivers +9 to +12 volts. Any dc supply capable of providing at least 500 mA will work fine. Plug-in wall-type supplies that meet these specifications are available from many sources. Just make sure that the supply voltage doesn't exceed 14.5 volts. Rectifier *CR1* protects the Programmer from damage that might result from reverse application of power.

The continuously operating section of the Programmer gets it's power from regulator *AR2*, which supplies the MC68701, MAX232, CD4040 and RAM. A TL497 switching regulator operating in step-up mode generates the programming voltage and is set to 21 volts with *VR1*. It can easily supply the 30 mA required for programming the MC68705. Supply is current limited to about 160 mA by *R5*.

A transistor switch in the MC68701 controls +5-volt power to the MC68705 sockets. This switch connects the Programmer's input power source to regulator *AR4*, which provides the +5 volts for the programming sockets. The switch uses two transistors, a pnp as the pass element and an npn as the control element. Transistor *Q2* is held in cutoff by resistor *R4*.

The MC68701 turns on the switch by providing a high on the base of *Q2*, which is connected as an emitter-follower. This brings the voltage on the emitter to about the same level as the base. The current required for this flows through *R4* and the base-emitter junction of *Q2*, sending *Q2* into conduction. A low level on the base of *Q2* turns off the switch. A resistor to ground from the base ensures that the switch is off when the MC68701 is reset and the ports are tri-stated. This switching arrangement provides a high-impedance control input that can be connected directly to the MC68701, as well as a power switch that requires only five components.

The same type of transistor switch is used to control input power to switching regulator *AR1*. The regulator's output voltage is set by a resistive divider connected from output pin 6 to control input pin 1 to ground. Resistors *R6* and *R7* and trimmer potentiometer *VR1* make up the divider, which is set to provide a variable output that ranges from 19.2 to 21.7 volts. You must set *VR1* to provide +21 volts for Programmer operation. A software command is provided to turn on the power for the voltage adjustment.

The +12 volts required for selecting the programming mode on the MC68705 is derived from the +21-volt source via regulator *AR3*, a 100-mA version of the standard TO-220-packaged

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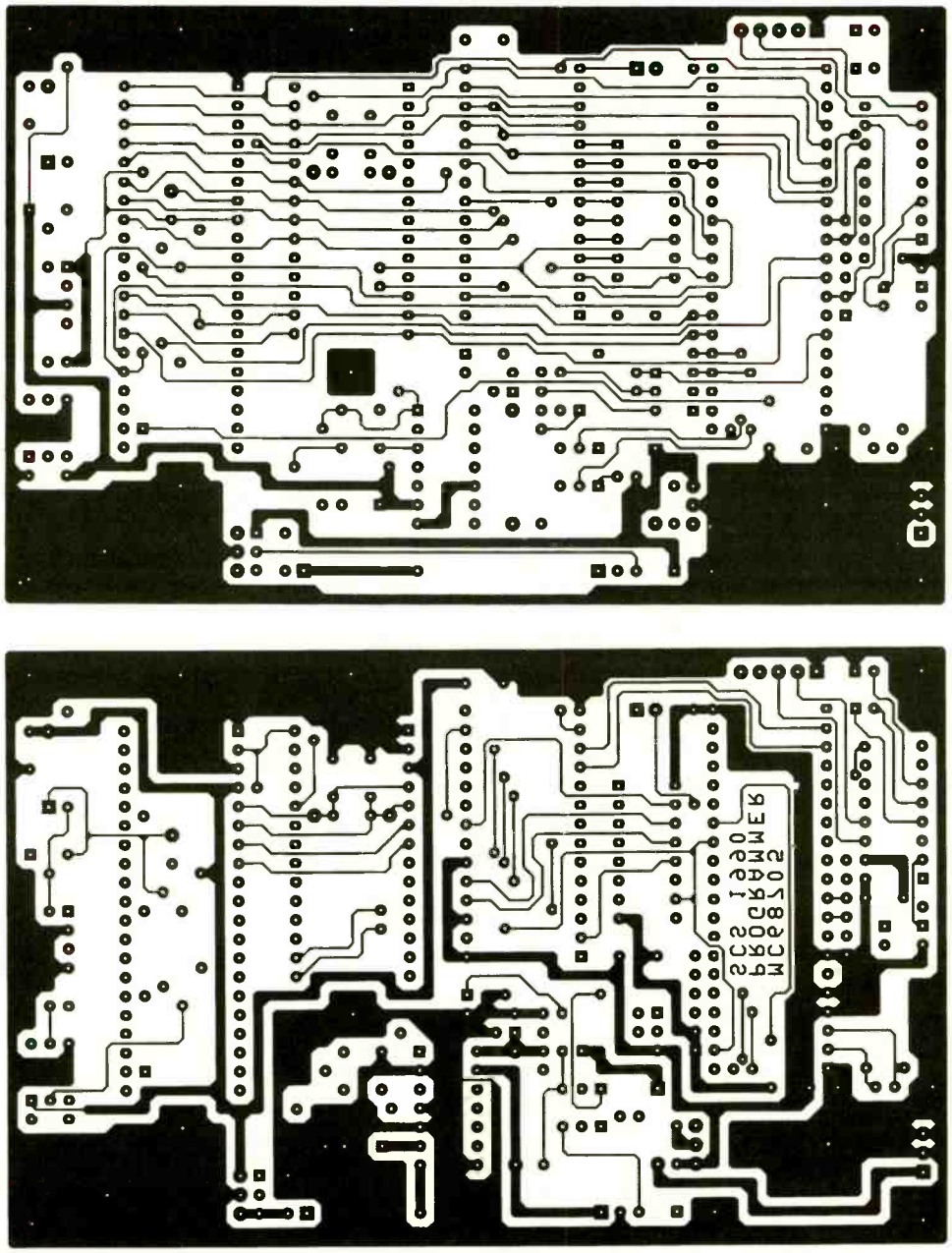

Fig. 2. Actual-size etching-and-drilling guides for Programmer's double-sided printed-circuit board. This board should have plated-through holes; otherwise, you must solder all connections on *both* sides of board and use short wire vias in areas where component leads/pins do not bridge from one side of board to other.

LM7812 regulator. The MC68705 requires only 100 a from this regulator. The +12 volts is generated whenever the +21-volt switching supply is enabled.

An additional transistor switch, under control of the MC68705 being programmed, provides the final programming voltage connection to the programming sockets. This switch uses optical coupler *AR5* as the control element, providing voltage isolation and logic inversion for the MC68705 control output. This allows the programming software in the MC68705 to control the application of programming voltage to the V_{PP} pin.

The optical coupler can also be controlled by the MC68701 through *CR3* connected to the 21-volt control pin of the MC68705 being programmed. This allows the MC68701 to control the programming voltage for built-in testing. This diode also prevents the logic high from the MC68701 from interfering with the MC68705 signal during the programming sequence.

No power is applied to the MC68705 sockets until you initiate a programming operation. You're prompted by the Programmer's status messages to plug in and remove the MC68705 at the appropriate times.

Construction

You can assemble the Programmer on a double-sided printed-circuit board or

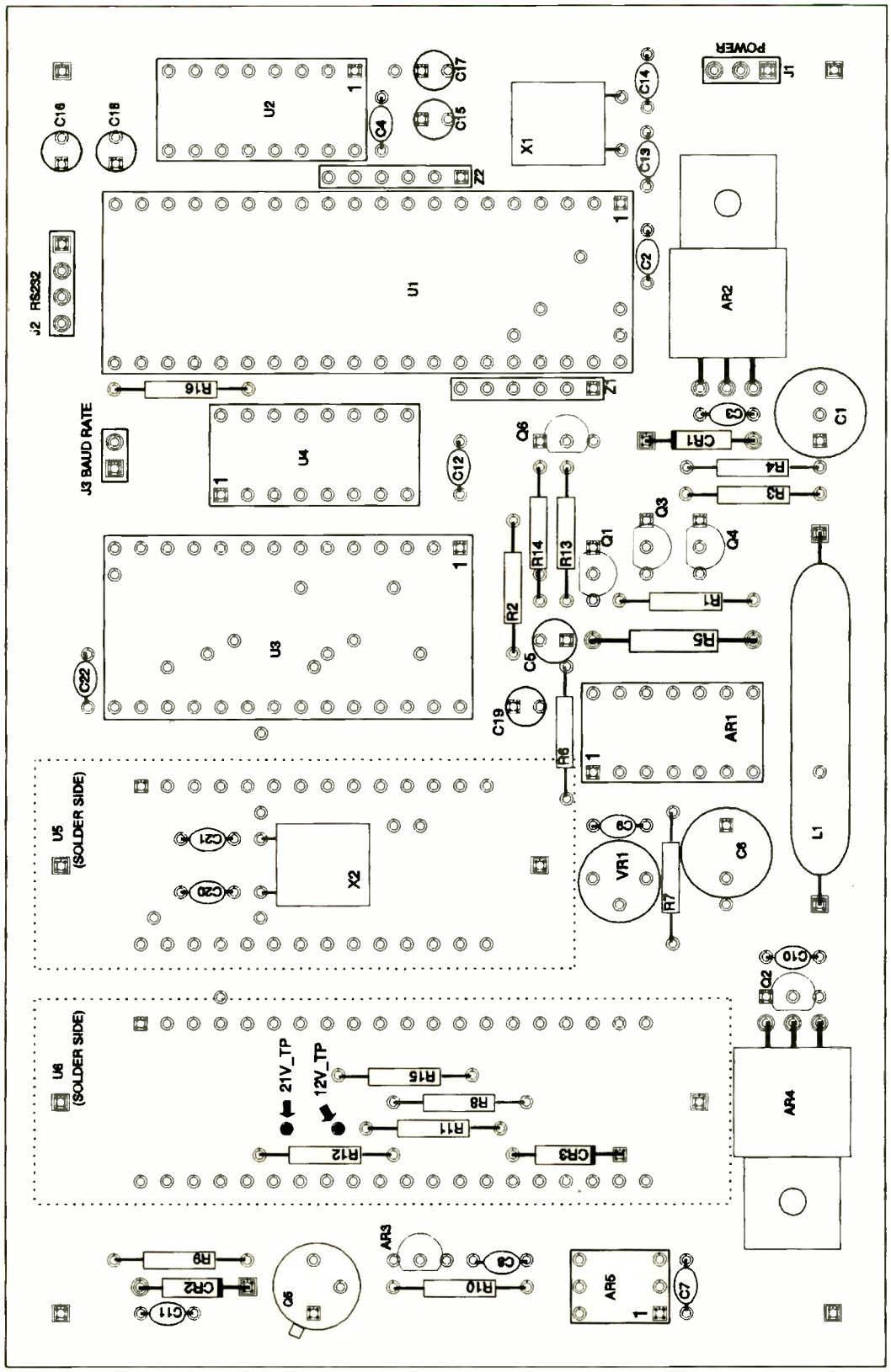

Fig. 3. Wiring guide for printed-circuit board. Note that ZIF sockets plug into standard solder-tail DIP sockets on *solder* side of board.

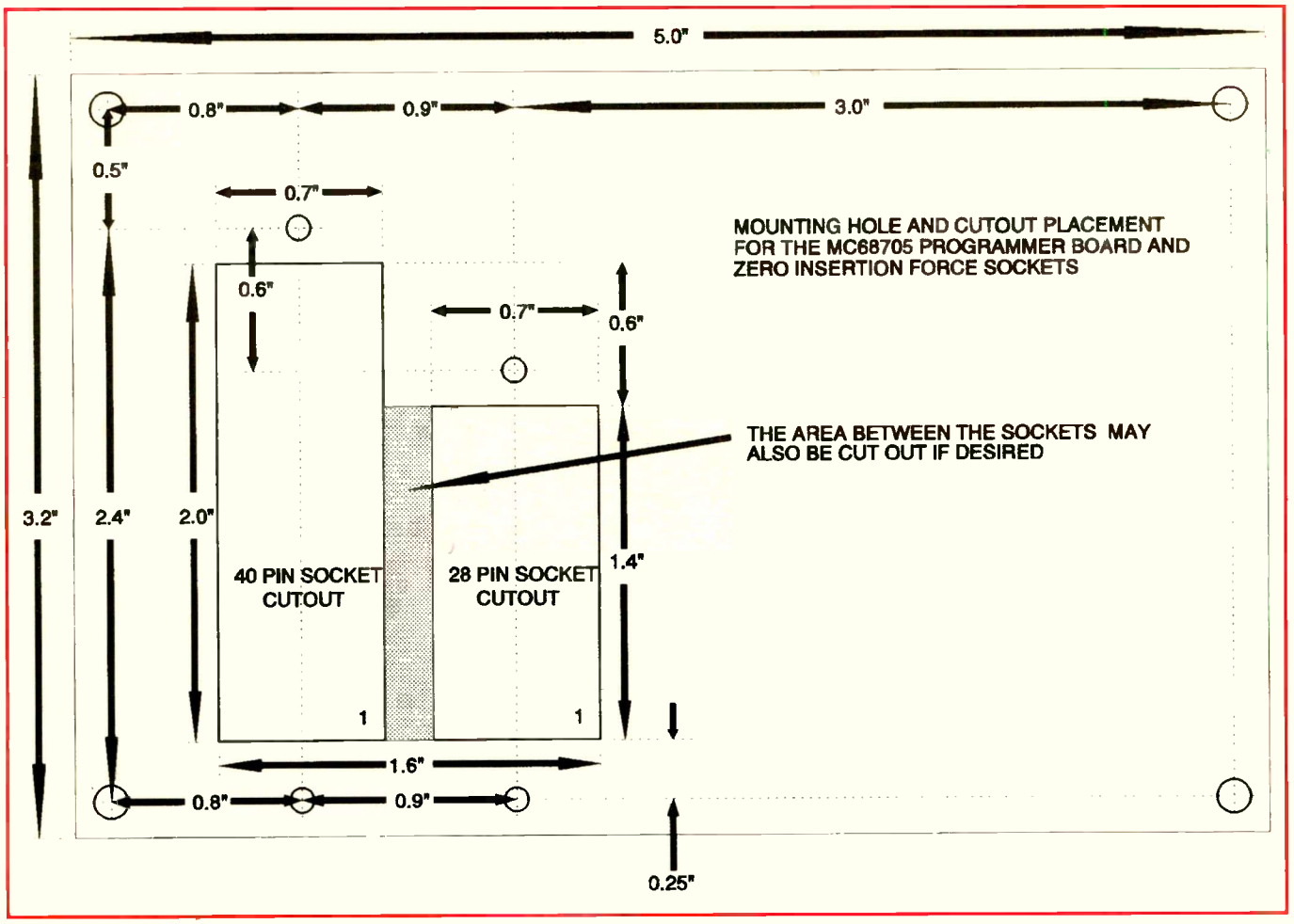

Fig. 4. Socket/pc-board mounting template.

perforated board that has holes on 0.1" centers using Wire Wrap hardware and techniques. The only critical connections are in the area of the two crystals. Keep the leads on the crystals and associated components as short as possible.

If you plan on fabricating your own pc board, use the actual-size artwork shown in Fig. 2, but be aware that you won't be able to plate-through the holes and will have to use appropriate hardware that permits you to solder component leads and pins to each and every hole through which they pass on *both* sides of the board. Additionally, wherever no component leads or pins pass through pads with a hole in them, you'll have to fill each hole with a short length of bare solid wire and solder it to the pads on both sides of the board. If you wish pc constriction but don't want to go to the bother of fabricating your own board, a ready-to-wire board with plated-through holes is available from the source given in the Note at the end of the Parts List.

Start assembly by mounting the IC sockets as shown in Fig. 3. Pin 1 in each case is identified by a square pad. Do *not* install the zero-insertion-force (ZIF) sockets for the MC68705s at this time. As you install the other sockets, adjust them so that they're snug against the surface of the pc board.

Next install the resistors, capacitors and inductor. Be sure to install the electrolytic capacitors in the correct orientations, plugging the + leads into the holes of the square pads. Then bend the pins of *AR4* and *AR2* bending at right angles to the regulator bodies. Position these regulators so that their flat sides are against the board, secure them in place with No. 4 machine hardware and solder their leads into place.

Install the regulator *AR3* exactly as shown in Fig. 3. Then install the three diodes with their cathode leads (marked by a line) plugged into the square pads.

Install the transistors in their respective locations, taking care to properly base them. Slightly bend the outside leads on their packages to match the hole pattern. The emitter lead is identified by a square pad Fig. 3. Bend the base lead of *Q5* outward from the body to fit the hole pattern on the board.

Bend the leads on the crystals so that they can be mounted flat on the pc board, and mount them using double-sided foam tape and soldering their leads into place. Make sure that the foam tape covers the entire crystal to prevent possible shorts to the conductor pattern on the pc board.

Trim the leads on the solder side of the board in the area where the MC68705 sockets are to be mounted to preclude the component leads from interfering with the programming sockets. Don't solder the ZIF sockets to the board. Instead, solder conventional sockets into place in these locations and plug the ZIF sockets into these. This provides space between the PC board and the ZIF sockets when mounting the Programmer in an enclo-

sure. When you mount the 40-and 28-pin sockets on the solder side of the board, solder them into place from the component side. Again, the square pads that denote pin 1.

If you plan on mounting the Programmer board inside an enclosure, make sure you select a non-conductive one. Machine the enclosure so that the IC sockets on the bottom of the board fit through an opening. Use Fig. 4 as a guide for cutting the holes in your enclosure. The size of the cutout may have to be adjusted to accommodate various manufacturer's IC sockets.

The ZIF sockets mount to the case with No. 2 screws. After doing this, you plug the circuit-board assembly into the sockets and secure it in place with four corner screws. If are the No. 2 screws long enough, they can also be secured to the circuit-board assembly.

If you don't plan on using an enclosure, plug the ZIF sockets into the conventional sockets on the solder side of the board and secure them with No. 2 screws, spacers and nuts through the holes in the board.

Connect a DB-25S connector to the board at *J2*, using about 12"-long stranded hookup wires. If you're using a standard modem cable to connect to your computer, use a DB-25S connector at the Programmer end. Wiring details for the connector are given Table 1 and illustrated in Fig. 5. Pin 1 on *J2* in Fig. 1(C) is shown as a square pad.

Locate the power switch, power indicator LED and power connector on the enclosure in which the Programmer is housed. Refer to Fig. 5 for details on how to wire the power circuit to the board.

Initial Testing

In the next steps, you'll apply power to the board. If the result of any step doesn't match the expected result, immediately remove power and correct any problems.

Do not plug the ICs into their sockets yet. Connect power to the board and use a dc voltmeter or multimeter set to the dc-volts function to measure between pin 1 (GND) and pin 7 (V_{CC}) of the MC-68701. If you obtain a reading between 4.75 and 5.25 volts, power down and plug *U1* through *U4* and *AR5* into their respective sockets. (Whenever you plug an IC into a socket, make sure it's properly oriented and that no pins overhang the socket or fold under between IC and socket.) Do *not* plug *AR1* into its socket at this time.

Connect your computer's RS-232 cable to the Programmer's DB-25S connector. If needed, place a jumper on *J3* to set the baud rate. Set your communications program to match the baud rate selected on *J3*. The data should be sent with eight bits and no parity. You must use CTS/RTS hardware handshaking protocol. When you apply power to the board, the message "MC68705 PROGRAMMER ON LINE" should appear on the screen of your video monitor. Type

Table 1. RS-232 Connections

Function	J2 Pin	DB-25S Pin
Input	2	2
Output	3	3
CTS	4	5
Ground	1	7

T to run the self-test procedure, and follow the instructions on the screen. All tests should pass, with the exception of the +21- and +12-volt tests.

If the above tests operate as expected, power down and plug *AR1* into its socket. Connect your meter between ground and the +21-volt test point identified in Fig. 3. Apply power and type S to turn on the 21-volt supply. Adjust *VR1* for a reading of 21-volts ±0.5 volts on your meter. Move the "hot" meter probe to the +12-volt test point and note if your reading is +12 volts ±0.5V. If it is, press the Enter key to shut off the power supplies. Then run the self-test procedure again. When all tests pass, you're ready to program MC68705s.

Operation

Operation of the Programmer is quite simple. Before applying power, connect the Programmer to a serial port on your computer. Configure the Programmer's RS-232 connector so that the Programmer is seen by your computer as a modem. Pins 2, 3, 5 and 7 are used, as shown

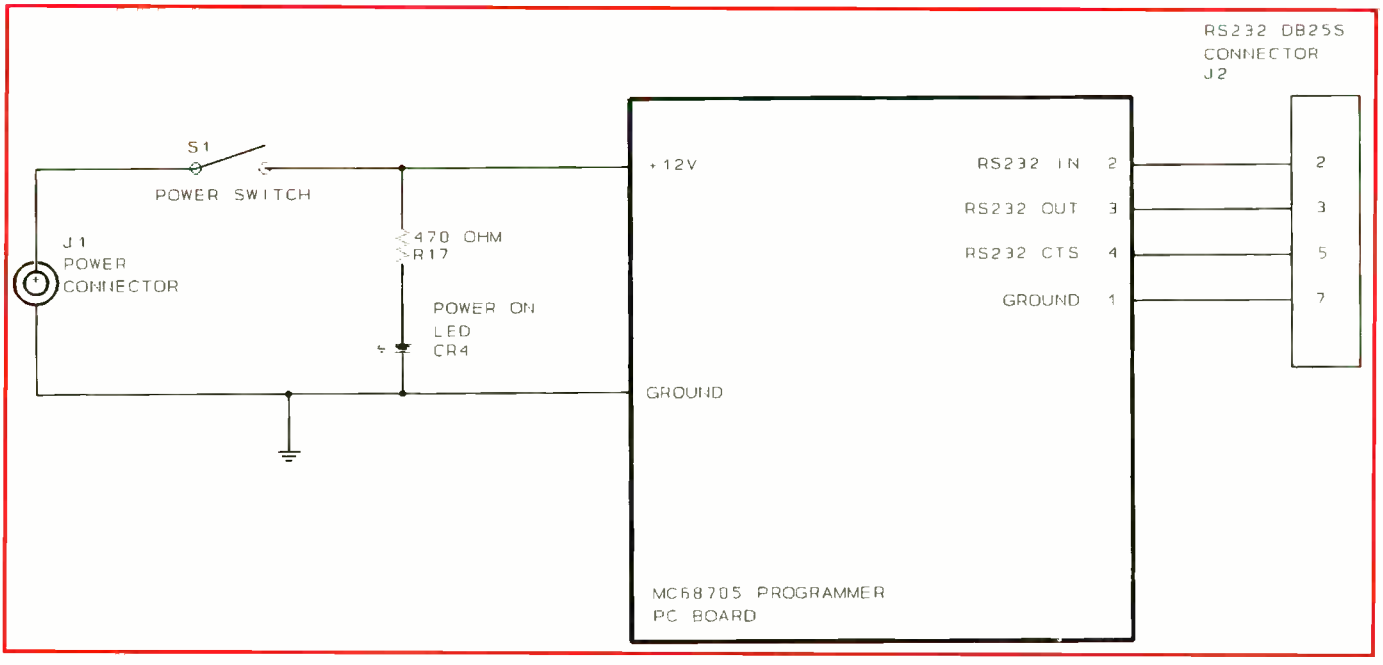

Fig. 5. Wiring details for power-switching/indicating and DB-25S connector circuits.

in Fig. 5 and detailed in Table 1.

Your communications program should set the IBM PC serial port to 38,400 baud, eight bits, no parity and RTS/CTS enabled. (RTS/CTS control is required to prevent data overruns during downloads. The Programmer won't download correctly if CTS isn't enabled.)

When power is applied, the Programmer clears the RAM, initializes the RS-232 interface and sends an ON LINE message to the computer. At this time, you can enter any of the available programmer commands listed in Table 2. Commands are executed when the letter is sent to the programmer followed by an Enter (or CR) character (the "L" command doesn't need an Enter). Any character other than Enter stops execution of the command.

Let's look at each of the commands listed in Table 2 in detail:

·Clearing Memory, Erased Check. The C command clears the Programmer's RAM. The cleared state is the same as the erased state of the MC68705. This allows the Programmer to perform an erased check on MC68705s by clearing the RAM and then performing the programming sequence (P command). The MC68705 being tested starts the programming sequence but skips any locations in the RAM that are in erased state. The part then performs a verify operation, comparing the cleared RAM to the EPROM. If the EPROM is erased, the Programmer return a an MC68705 VERIFIED message. The on-screen address counter increments quickly during the erase-check operation, indicating that locations aren't being programmed.

· Loading Data. An L sent from the computer initiates the load operation. Any characters sent after the L are ignored, unless they're valid S-records. You can also embed the L as the first character of an S-record file. You should then use your communications program to send the S-record data file to the Programmer. When data transmission is complete, the Programmer sends back the starting address of the last block of sent data,which is followed by the message LOAD COMPLETED.

The download can detect three types of errors: address out of range, checksum errors and data-storage errors. If these messages appear, there may be problems with the downloaded code or the Programmer. An address-out-of-range error indicates that the MC68705 code is assembled outside the 4K EEPROM space or that you're attempting to place code in RAM (between 0000 and 007F). Remember that MC68705 code must reside between 0080 and 0FFF (07FF maximum on the MC68705P3). A checksum error indicates a problem with the assembler output or user modified S-records or a corrupted data file. A data-verification error is caused by a mismatch when a byte of data stored in RAM is doesn't verify against the original byte sent from the host PC. This indicates a Programmer problem.

Table 2. MC68705 Programmer Commands

Command	Description
C	Clear Programmer RAM
L	Load S-Records Into RAM From Serial Port
P	Program MC68705 From RAM
S	Turn On Programming Voltage
T	Test Programmer Circuitry

Downloading is terminated by an S-record of S9 followed by an Enter or CR. Most assemblers automatically place the S9 and CR at the end of the file. S9 and CR can also be entered manually (if a file isn't being sent) to terminate a download.

· Programming the MC68705. The programming sequence is then started by sending a P to the Programmer. The Programmer then prompts you to plug an MC68705 into the appropriate socket. Doing this and typing a Y starts the programming sequence. The Programmer then turns on the +5-volt supply to the MC68705 sockets while holding low the reset line. The counter reset and clear lines from the MC68701 are tri-stated and the RAM is configured for a read by setting low the CS and OE pins. After a short delay, the +21-volt supply is turned on. When the supply stabilizes, the MC68705 reset line is brought high, starting the programming sequence.

The MC68705 takes over at this point. The presence of +12 volts on the timer pin places the part in programming mode and forces execution of an internal programming algorithm. The MC68705 resets the CD4040 counter and increments by 1 for each byte programmed.

The Programmer's MC68701 monitors the counter's clock line and provides a status display that indicates the loca-

tion being programmed. This display increments slowly for locations being programmed and quickly for locations that are blank. Therefore, it's advisable that you clear the Programmer's RAM before loading short programs to reduce the programming time.

The Programmer also monitors the state of the MC68705s programmed and verified output pins. The programmed output pin indicates that the programming cycle is complete. The verified output pin indicates that the part was programmed correctly. Both outputs are active-low since they were originally used to turn on LEDs.

The Programmer's software also performs three time checks to determine if a problem has occurred during programming. The first shuts down the Programmer if the counter clock pulse doesn't occur shortly after removing the MC68701 reset. If this timer times out, programming power is turned off and an error message is issued. The other two timers are on the programmed and verified signals. If they don't occur before the timer times out, a NOT PROGRAMMED CORRECTLY or NOT VERIFIED CORRECTLY message is issued.

The Programmer issues the messages PROGRAMMING COMPLETED and MC68705 VERIFIED if programming is completed without errors.

• **Self Test.** The Programmer has a limited diagnostic capability that tests the RAM, MC68701, counter and power switching. This test is initiated by sending a T to the Programmer. A PROCEED or TERMINATE message is sent back to the computer, after which, an answer of Y tests the Programmer. RAM contents are cleared during testing. Testing is performed in two parts: switching circuitry tests, followed by RAM tests. Status messages are issued and displayed at the end of each test.

The RAM test is an address-overlap test, followed by four data-pattern tests, leaving the RAM in the cleared (00) state. The address-overlap test checks for such addressing errors as opens or shorts. It also checks the counter and its control lines. The other RAM tests check the data bus.

Operation of the +12- and +21-volt supplies is tested through resistive dividers connected from the supplies to inputs on the MC68701. The circuitry provides on/off status of the supply during testing and programming. The MC68705's +5-volt supply is tested in a similar manner, using the counter reset line and a pull-up resistor connected to the MC68705's +5-volt regulator output. Each supply is tested to ensure that it's off or on when required.

Sample Sequence

To program a part, first load the S-record file to the Programmer by typing L on the host computer. Send the file to the port using your communications package upload command. If the file loads correctly, a LAST BLOCK LOADED=XXXX message is sent. The XXXX is the start address of the last block of data sent to the Programmer.

Type P, followed by Enter to start the programming sequence. The Programmer tells you when to plug the MC68701 into the socket. When this is done, press Enter again. The Programmer programs the part and displays the address being programmed on your video monitor. When programming is completed and the part is verified, the Programmer prompts you to remove the part. Its that simple.

Wireless Data Links

This is the first in a series on wireless communications PC environments with the focus on low-cost options

The idea of computer-controlled wireless communications is enticing. If you can send and receive information without having to run cables from point to point, the possibilities multiply. In a simple computer-controlled wireless link, the computer might send commands to devices that recognize and act on them. In the other direction, the devices might transmit to a computer that, in turn, processes and acts on the information received. A more-complex system would have two-way communication and, instead of being limited to pre-defined commands, would be able to send and receive all types of information.

This month, I begin a series of articles on wireless communicating, with the focus on lower-cost options that you can include in your own projects. This time, I'll cover what's involved in deciding on a wireless system and begin with a project that uses IR energy to send and receive four bits of information at a time. In future articles, I'll include links that use radio and other wireless media.

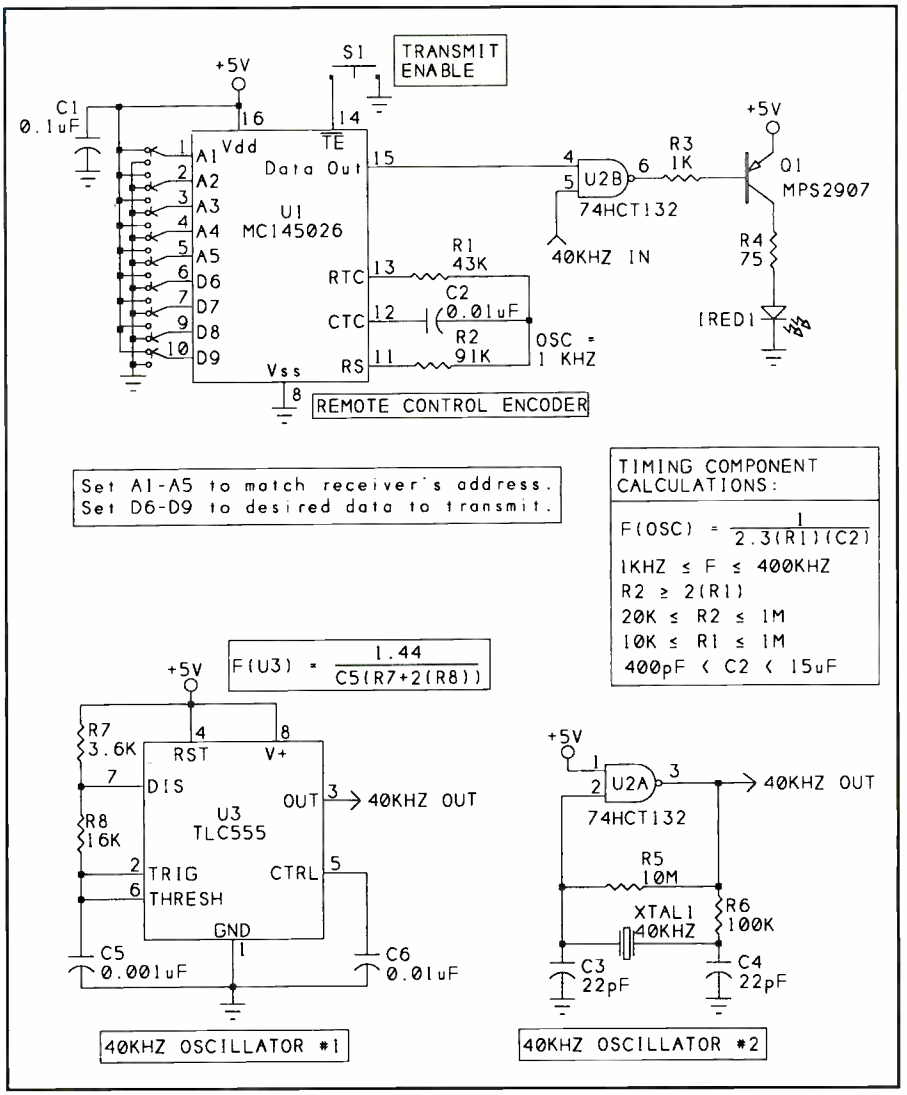

Fig. 1. This infrared transmitter sends four bits of data to a receiver identified by a five-bit address. Transmitted pulses are chopped at a 40-kHz rate. You can build a 40-kHz oscillator using a 555 timer or from a logic gate and 40-kHz crystal.

Why Go Wireless?

If you already have a need for a wireless link, you need no convincing of its usefulness. The reasons usually have to do with convenience (no cables to plug in or route), portability (easy to move) or physical limits (where stringing wires is impossible or impractical)—not to mention that wireless communicating is fun. There's something magical about sending and receiving information through the air, with no apparent connection between sender and receiver. Before you establish a wireless link, however, you must decide on three things: a transmission medium, interfaces to the medium and a data format.

- **The Medium.** To be useful, a transmission medium has to be able to carry the desired information to the receiver, at the desired speed, without errors and without causing interference or other problems in its surroundings. In many cases, a wired link meets these requirements very well and cheaply. This is why wired connections are so popular.

If you decide to go wireless, you have several options from which to choose. One way to achieve a wireless link is to use device that recognizes and synthesizes the human voice: in other words, something with which you can converse. But for many uses, a voice link is still too expensive, too difficult to implement or too slow to be practical.

For short range, line-of-sight links, beamed infrared energy is a popular medium. Ultrasound is another option for short-range communications. For longer

distances, for communicating beyond line-of-sight or other situations where infrared isn't practical, modulating information onto radio waves is a possibility.

Other links aren't really wireless but can be just as convenient since they use existing wiring or networks. With X-10 communication, you send information as high-frequency bursts on existing 60-Hz ac household wiring. And for long-distance communicating, don't forget the telephone network, which requires only a modem and computer at each end.

• **The Interface.** Besides choosing a medium, you need a way to translate between a computer's digital-logic voltages and a form that the medium can carry. For example, a voltage across an infrared-emitting diode, or IRED, causes current to flow through the IRED that, in turn, causes it to emit infrared energy. On the other end, a photodiode can convert the IR energy back into an electrical current that you can amplify and detect as a voltage across a resistor.

Other media require different interfaces. For radio transmissions, you need a radio-frequency transmitter and receiver to send the signals out and detect them at the other end.

• **The Data Format.** Most wireless communications use a serial format in which data is transmitted as a single stream of information. Getting one data path going is usually challenge enough, without the complications and expense of a parallel link, where multiple bits transmit at the same time.

The simplest wireless communications are on/off, where the presence of a signal has one meaning, and its absence another. For example, an alarm system might include an IRED that transmits to a detector. When the detector senses the transmitted beam, it knows that nothing is obstructing the path between emitter and detector. If the detector doesn't "see" the beam, an alarm sounds to announce that something is passing between the emitter and receiver. Alternatively, you can set up a system to issue an alarm when the path is clear, to announce the absence of something that should be blocking the beam. Links like these can also serve as level detectors, possibly to indicate when a container needs to be emptied or refilled.

These simple systems are limited. One way of doing more is to transmit a series of pulses that the receiver then interprets and acts upon. The pulses must use a defined format that the receiver can recognize. From modem communication, you may be familiar with data formats like 2,400 bps, 8N1, but there are many other ways to configure serial data.

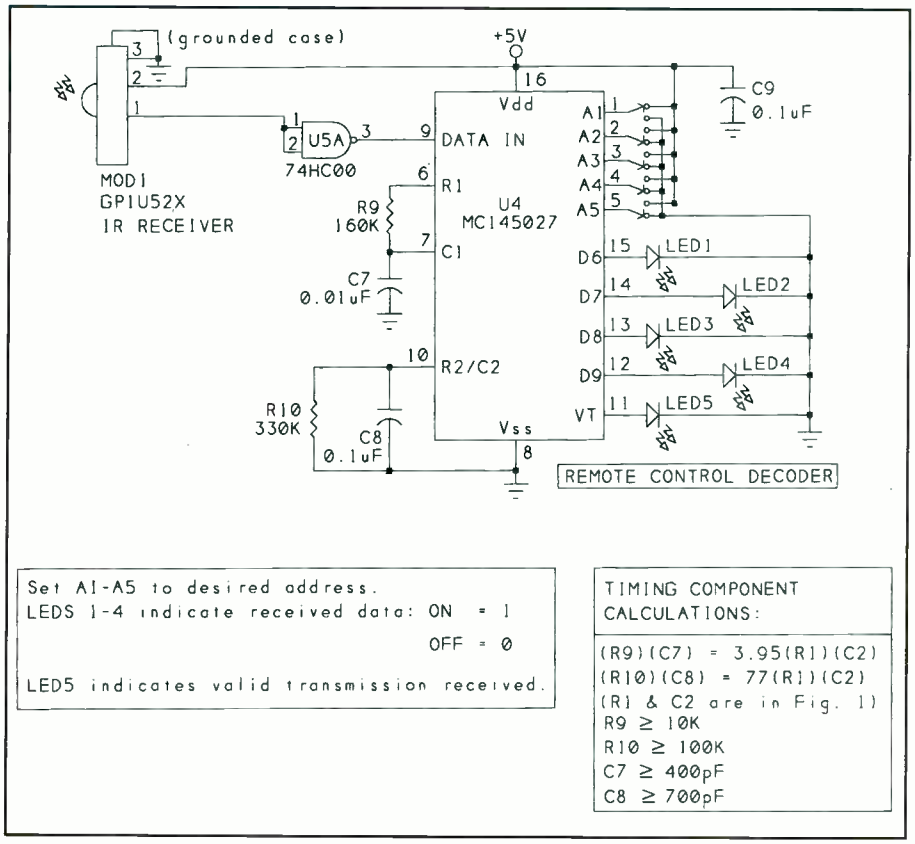

Fig. 2. This infrared receiver identifies transmissions intended for it and makes the received data available at D6 through D9.

Whatever format you use, you'll probably want to include some form of error detection to ensure that received data matches what was sent. In one simple form of error detection, you send the same series of bits twice and accept the transmission only if the two received transmissions are identical. Other options include calculating and transmitting parity bits or checksums and then recalculating and comparing these at the receiver to verify a valid transmission.

There are many ways of putting the basic elements into action. As a first example, let's look at a data link in which infrared energy is used as the transmission medium.

An Infrared Data Link

Over short distances and at slower speeds, infrared can often do the job. Figures 1 and 2 illustrate a link in which a transmitter sends four-bit messages to one or more receivers. Each receiver has a five-bit address, which enables the transmitter to send a message to a selected receiver, while other receivers ignore the message. The circuits are shown as independent modules controlled by manual switches or jumpers. This setup is a good way to get the link up and running. When this has been accomplished, you can replace the manual switches with computer control of the transmitter, receiver or both.

The circuit uses some specialized components that do a lot of the work of detecting, filtering, encoding, decoding and error-checking of the transmissions. Two of these are Motorola's MC145026 and MC145027 encoder/decoder pair, which are low in cost chips averaging $2 to $3 apiece, intended for remote-control applications. JDR is one source for the chips. For $1.50, JDR includes a data sheet that describes these and other chips in the series. (I include sources for many components in the circuits I describe, but most parts are available from a variety of vendors. So, check with your own favorite suppliers, and compare prices before you order.)

• ***Transmitter Circuits.*** Figure 1 is the schematic diagram for the infrared trans-

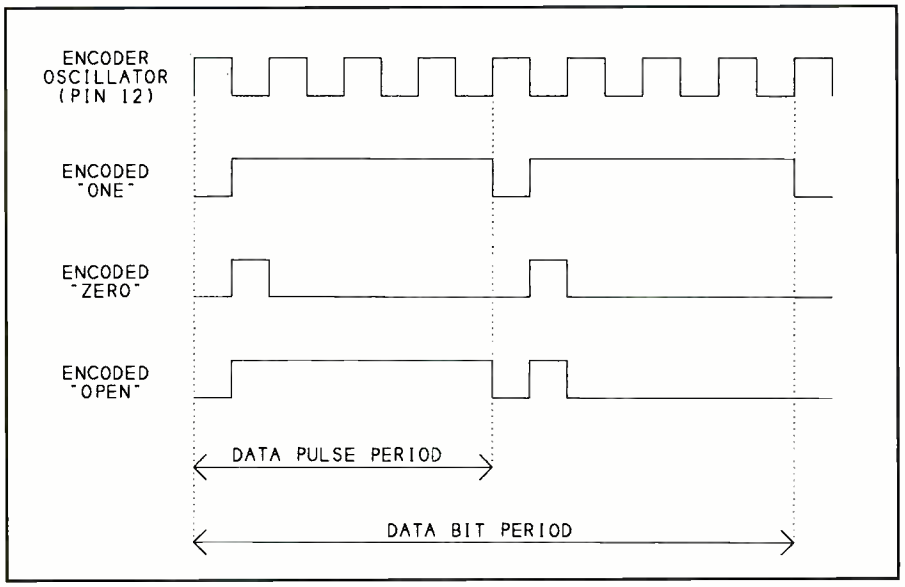

Fig. 3. The MC145026 trinary encoder outputs these pulse patterns to indicate logic 1, logic 0 and open-circuit conditions at its data and address inputs. Each bit requires eight oscillator cycles to transmit.

mitter circuitry. Encoder *U1* has five address and four data inputs, the states of which determine the transmitted address and data. The encoder outputs a different code for each of three states that the inputs may have: logic 0 (1.5 volts or less), logic 1 (3.5 volts or greater) and open (no connection). Figure 3 shows the transmissions for each of these states.

Because there are three possible states, the information is trinary (as opposed to binary, which has just two states). With five address inputs and three possible states for each, you can theoretically have 243 receivers, each with its own address. Although data inputs D6 through D9 also transmit in trinary form, the receiver decodes open inputs as logic 1s. So, in effect, the data bits are binary. For testing purposes, you can use jumpers or switches to +5 volts or ground or leave the pins open to set the data and address inputs.

Transmit Enable (TE on pin 14) has internal pull-up, which turns off the transmitter when pin 14 isn't connected. To enable transmitting, TE must pulse low for at least 65 ns. For manual operation, you can use a jumper or switch (*S1*) to bring TE to ground.

Oscillator components *R1*, *R2* and *C2* set the frequency of the on-chip oscillator. In turn, this controls the width of the transmitted pulses. The figure shows the data sheet's formulas and recommendations for selecting values for these components. In the calculations, express resistors in megohms and capacitors in microfarads. For best performance, use components with 5% or tighter tolerance.

With the values shown, the oscillator frequency is 1 kHz, which is at the low end of Motorola's recommended range for the chip. At this frequency, the narrowest transmitted pulses are 500 µs wide. I chose this value because it's at the high end of frequencies the infrared receiver module will reliably detect. If you have an oscilloscope or frequency counter, you can monitor the oscillator frequency at pin 12 of *U1*.

For each transmission, the encoder sends all nine address and data bits in sequence, waits three data-bit times (24 ms at 1 kHz) and then repeats the entire transmission. A complete transmission requires 182 ms to complete from the time that TE goes low. If you hold TE low, the encoder will transmit continuously; otherwise, the transmission ends after sending the information twice.

The encoder's output drives infrared-emitting diode *IRED1*. Instead of directly driving *IRED1* with the encoder's output (Data Out), NAND gate *U2B* combines Data Out with the output of a 40-kHz oscillator. The result is that the encoder's pulses transmit as bursts of 40-kHz pulses. As you'll see, the IR receiver is designed to reject stray signals that don't pulse at 40 kHz. Pulsing *IRED1* also saves power, since the IRED is never on constantly.

I've included a choice of two designs for the 40-kHz oscillator. One has a stable, accurate output but requires a special timing crystal, while the other uses more-common components but requires a constant power-supply voltage and accurate resistor and capacitor values for best stability and accuracy. You can choose whichever you prefer and connect the output to pin 5 of *U2*.

The crystal-controlled oscillator uses a 40-kHz quartz crystal and HCT132 Schmitt-trigger NAND gate *U2A* operated as an amplifier. The resistor and capacitor values shown work reliably for me. If you substitute a different inverter, you may have to experiment with component values to keep the oscillator from running at harmonics of two or more times the crystal frequency. Digi-Key is one source for the sometimes hard-to-find 40-kHz crystals.

The other option is *U3*, a TLC555 timer configured as a 40-kHz oscillator. Components *R7*, *R8* and *C5* determine the output frequency according to the formula shown. For accuracy and stability, use 5% or 1% tolerance values for these components. The timing error of the 555 can also add a few percent of error to the output frequency.

For best accuracy, use a CMOS timer like the TLC555, rather than the bipolar 555 version. For manual frequency adjustment, substitute a 50,000-ohm potentiometer for *R8*. Connect the center lug connected to the wiper and one other lead of the potentiometer in place of *R8*, and adjust the pot for a 40-kHz output. If you have no way to monitor the output frequency of *U3*, you can adjust *R8* later by observing the response of the receiver as you transmit.

The two inputs to NAND gate *U2B* are the 40-kHz oscillator and Data Out at pin 15 of *U1*. When *Data Out* is high, pin 6 of *U2B* pulses at a 40-kHz rate. When Data Out is low, pin 6 of *U2B* is high. The result is a form of modulation, with the presence or absence of the 40-kHz signal representing the logic levels at the encoder's output.

When pin 6 of *U2B* is low, pnp transistor *Q1* switches on and its collector current causes *IRED1* to emit infrared energy. When pin 6 of *U2B* is high, *Q1* and *IRED1* are off, with the result that *IRED1* pulses at 40 kHz when pin 15 of *U1* is high, and *IRED1* is off when pin 15 of *U1* is low.

Resistor *R3* limits the base current of *Q1*. You can use any general-purpose pnp transistor for *Q1*. Resistor *R4* limits

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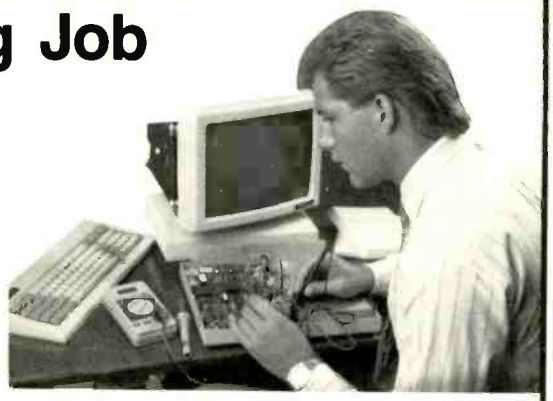

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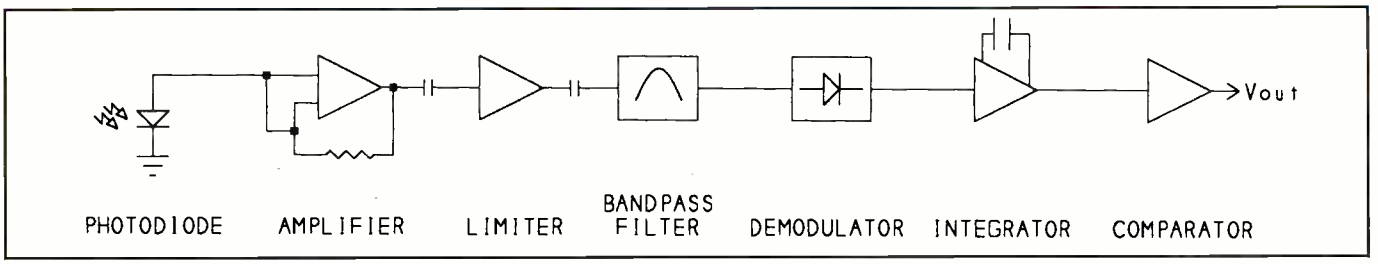


Fig. 4. The GP1U52X infrared receiver module is a detector, amplifier and filter in a three-pin package. When the module detects infrared energy pulsed at 40 kHz, V_{out} goes low.

the current through *IRED1* to about 50 mA, which is high enough for basic testing. If necessary, you can increase the IRED's current later for increased range.

For best results, use an IRED with a high-power output. Radio Shack's Cat. No. 276-143A high-output infrared LED is one possibility. Digi-Key also has a selection of IR emitters, including Harris's F5D1QT and F5E1QT. Devices with outputs at 880 or 940 nm are acceptable. Comparing devices from different manufacturers can be difficult because they define their power specifications differently. Look for a maximum continuous forward current of at least 100 mA.

• ***Receiver Circuits.*** The IRED transmits the encoded address and data. On the other end, you need to detect the transmitted signal, find out if the address matches and, if so, present the transmitted data in a usable format. Shown in Fig. 2 are the schematic details of a circuit that does these, using an infrared-receiver module and an MC145027 decoder that complements encoder shown schematically in Fig. 1.

Sharp GP1U52X infrared-receiver module *MOD1* has its circuits enclosed in a metal cube that measures about 1/2" square and has just three connections for power, ground and V_{out}. You can find this component at Radio Shack (Cat. No. 276137) and Pure Unobtainium, which includes a more complete four-page data sheet and also carries some other infrared emitters and receivers.

Another option for *MOD1* is Lite-On's LTM-8834-2, carried by Digi-Key. Because this component has a 32.7-kHz center frequency, rather than 40 kHz, you'll have to adjust the oscillator either by adjusting *R8* or changing *XTAL1*. Digi-Key has a 32.56-kHz crystal that's a good match for this receiver.

When *MOD1* detects IR energy that's pulsed at 40 kHz, its V_{out} is low. Otherwise, V_{out} is high.

Shown in Fig. 4 is a block diagram of what's inside the module. The photodiode emits a current when it senses IR energy in the range 880 to 1,080 nm. An optical filter on the photodiode blocks visible light to reduce responses to ambient light.

The module amplifies the detected signal and limits its peaks. A bandpass filter centered on 40 kHz eliminates or reduces the amplitude of signals outside of the range of 36 kHz to 44 kHz. A demodulator filters out the 40-kHz oscillations and recreates the original pulse pattern generated by the encoder. An integrator and comparator help to ensure a clean output signal at V_{out}.

The module does a good job of detecting transmitted infrared pulses at 40 kHz. Unfortunately, in spite of its optical filter, it also has some response to ambient light that causes brief, random pulses to appear at V_{out} even when an IRED isn't transmitting to the module. But as you'll see, these random pulses are rejected by the decoder chip, which looks for a specific pulse pattern to identify the transmissions intended for it.

To greatly reduce false triggering on ambient light, ground *MOD1*'s case by soldering a wire from pin 3 to the case. You can also add more optical filtering. Photographic film is a good, inexpensive filter that passes IR energy and blocks visible light. Cover the photodiode's window with an exposed, developed scrap of color print negative film or an unexposed developed scrap of (positive) color slide film.

The signal at pin 1 of *MOD1* is the same as *U1*'s Data Output, but inverted. HC00 NAND gate *U5A* inverts *MOD1*'s output so that pin 9 of *U4* matches *U1*'s Data Out. You can substitute just about any inverter here.

The timing of received pulses is altered somewhat by MOD1. With the modules I used, high pulses at pin 9 of *U4* were around 420 µs wide, rather than the 500-µs pulses transmitted. This is because *MOD1* takes longer to switch on (after detecting infrared) than to switch off (when the IR source is removed). Chip *U4* accepted the narrower pulses without problem, however.

Chip *U4* requires timing components to match *U1*'s oscillator frequency. Resistor *R9* and capacitor *C7* set the timing that discriminates between narrow and wide received pulses. Resistor *R10* and capacitor *C8* set the timing that detects the end of an encoded word and end of a transmission. Figure 2 shows Motorola's formulas for choosing these values.

Five address lines are available on *U4* (A1 through A5. These must match A1 through A5 on *U1*. As with *U1*, the inputs are trinary and may be logic high, logic low or open. For testing purposes, you can set these with jumpers or switches.

When *MOD1* transmits, *U4* examines the incoming bits at its pin 9. If the five address bits received match *U4*'s address, *U4* stores the next four bits and compares them to the previous four data bits received. If the data bits don't match, D6 through D9 don't change. If the data bits do match, the receiver latches the new data to D6 through D9 and brings VT (pin 11) high to indicate that a valid transmission was received. With this technique, the receiver doesn't latch D6 through D9 until it receives the same data twice in a row. This complements the behavior of *U1*, which automatically sends each transmission twice.

Requiring the receiver to see the same data twice prevents the receiver from accepting data that was garbled in transmitting. The only way an error can slip through is if the address transmits correctly both times, and the data contains the same error twice in a row—if a transmitted 0 shows up as a valid 1 at the receiver, for example. The chances of occurring this are small, especially since the 40-kHz modulation adds another layer of rejection of unwanted signals.

The data at D6 through D9 remains un-

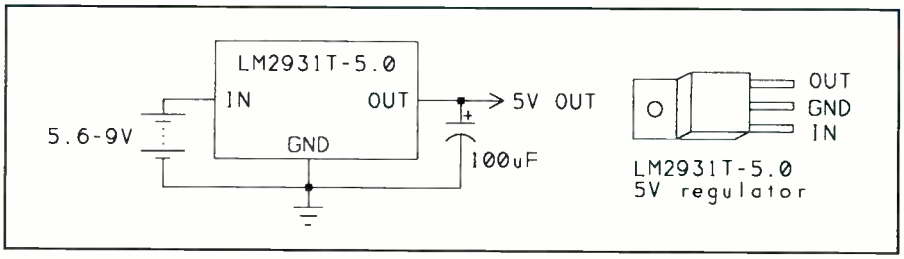


Fig. 5. The LM2931T-5.0 low-dropout voltage regulator creates a stable +5-volt supply with an input of 5.6 volts or greater.

til it's replaced by new received data. Remember that open inputs at D6 through D9 of *U1* are decoded as logic 1s. VT remains high until an error is detected or there's no input for four data-bit times (32 ms at 1 kHz).

Figure 2 shows LEDs at D6 through D9 and VT for monitoring these outputs during testing. Current-limiting resistors aren't required, since *U4* sources only about 5 mA through the LEDs. If you prefer an audible indicator to signal a valid transmission, you can replace *LED5* with a piezoelectric buzzer like Radio Shack's Cat. No. 273-065 or similar.

• ***Power-Supply Options.*** Figures 1 and 2 show the transmitter and receiver powered at +5 volts. Recommended supply potentials for *U1* and *U4* are 4.5 to 18 volts; for *U2* and *U5*, 2 to 6 volts; *U3*, 2 to 15 volts; and *MOD1*, 4.7 to 5.3 volts. This means that usable supply voltages for the transmitter circuit are 4.7 to 5.3 volts and 4. 5 to 6 volts for the receiver circuit.

Each circuit draws only a few milliamperes of current, though the test LEDs add about 5 mA each when they're on. Any regulated 5-volt supply that can output 50 mA is suitable for the transmitter or receiver.

Chances are that you'll want to operate the transmitter, receiver, or both, from batteries. Four Ni-Cd cells in series create a reasonably stable source at around 4.8 volts.

Using unregulated alkaline cells is less desirable because their voltage drops quite a bit as they discharge (from 1.5 to around 1 volt per cell) and there's no series combination of 1.5-volt cells that meets *MOD1*'s supply-voltage recommendation.

A regulated supply is another option. When the supply voltage varies, the output frequency of *U3* and frequency response of *MOD1* also vary slightly. A regulated supply eliminates these concerns.

Shown in Fig. 5 are schematic details for a 5-volt supply that uses five or six Ni-Cd or alkaline cells and National's 2931T-5.0 low-drop-out 5-volt regulator (available from Digi-Key). The regulator requires an input of just 5.6 volts for a 5-volt output at 100 mA. You can also use a 9-volt alkaline or 7.2-volt Ni-Cd battery to power the regulator. However, but due to the low capacities of these batteries, you'll get fewer hours of use.

Basic Tests

For testing and experimenting, you can build the transmitter and receiver using just about any construction method that suits you, including a solderless breadboard. If you have an oscilloscope or frequency counter, you can measure the frequency at pin 3 of *U3* or pin 3 of *U2A*. If you're using *U3*, adjust *R8* as needed to obtain a 40-kHz output. You can also measure at pin 12 of *U1* to verify that its oscillator is at 1 kHz.

To send a test transmission, set A1 through A5 identically at *U1* and *U4*, and set D6 through D9 to the values you want to transmit. The schematics show the components set up to transmit the value 1000 to address 00001.

Aim *IRED1* so that it points to *MOD1*'s photodiode window. To begin, place the transmitter and receiver a couple of feet apart. To transmit, press *S1* momentarily to pulse low pin 14 of *U1*. At *U4*, *LED5* should flash to indicate that a valid transmission is received. At D6 through D9, *LED4* should be on and *LED1* through *LED3* should be off to show that the value 1000 is received.

To change the data to transmit, move one or more jumpers or switches at D6 through D9 of *U1*. Pressing *S1* should cause and *LED1* through *LED4* to change to match. With these circuits, I was able to receive data from 12 feet away, with only casual aligning of the transmitter and receiver.

If you weren't able to measure and

adjust *U3*'s frequency, you can do so now. Jumper pin 12 of *U1* to ground to cause the transmitter to continuously transmit. With *IRED1* aimed at *MOD1*, slowly adjust potentiometer *R8* until *LED5* lights. Continue to adjust until *LED5* turns off and then return *R8* to about the middle of the range in which *LED5* is on. You can then keep *R8*, or replace it with a single fixed resistor whose value matches the value you found experimentally.

To add a second receiver, build another circuit identical to that shown in Fig. 2, but use a different scheme for the address inputs. This will let you transmit to a selected receiver by changing A1 through A5 at the transmitter. Even if a receiver detects a transmission meant for another receiver, it will ignore it because the address doesn't match.

Moving On

When you have the basic link working, you're ready to enhance it with computer control on one or both ends and interfaces to relays, switches and other devices that receive or send signals over the wireless link. You can also experiment with increasing the power to transmit over greater distances, using optics to broaden or narrow the beam, and establishing two-way communications. These are some of the topics I'll get to next month.

Motorola has a couple of free applications notes on infrared links. "Infrared Sensing and Data Transmission Fundamentals" (#AN1016) has theory and general tips, and "Evaluation Systems for Remote Control Devices on an Infrared Link" (#AN1126) includes printed-circuit-board layouts for some simple links.

You can reach me on CompuServe at 71163,3555, on Internet at 71163.3555@compuserve.com or by mail at Box 3374, Madison, WI 53704-0374. For a personal reply by mail, please include a self-addressed stamped envelope.

Sources Mentioned

Digi-Key
701 Brooks Ave. S.
PO Box 677
Thief River Falls, MN 56701-0677
Tel.: 1-800-344-4539

CIRCLE NO. 120 ON FREE INFORMATION CARD

JDR Microdevices
2233 Samaritan Dr.
San Jose, CA 95124
Tel.: 1-800-538-5000 or 408-559-1200;
fax: 1-800-538-5005

CIRCLE NO. 121 ON FREE INFORMATION CARD

Motorola Semiconductor Products
Literature Distribution
PO Box 20924
Phoenix, AZ 85036

CIRCLE NO. 122 ON FREE INFORMATION CARD

Pure Unobtainium
13109 Old Creedmoor Rd.
Raleigh, NC 27613
Tel.: 919-676-4525

CIRCLE NO. 140 ON FREE INFORMATION CARD

Build a Z8 BASIC Computer/Controller

Applications for this low-cost eight-chip project are limited only by your imagination and technical expertise

A simple and easily reproducible computer/controller can be very useful in many specialized applications, among them, alarm systems and robots. Regardless of the application, though, the attributes of a computer/controller are definitely more attractive than those of a dedicated, hard-wired control circuit. In this article, I'll discuss a build-it-yourself Z8 BASIC Computer/Controller that fits this need very nicely. It has a few attributes you might find attractive. One is that it's inexpensive. Another is that, using only eight integrated circuits, it's simple to build. Finally, and perhaps most important, it's easy to program in the BASIC language. Despite its simplicity, the Z8 BASIC Computer/Controller isn't lacking in features. For example, it has 32K of static RAM that's pin-for-pin compatible with the Dallas Semiconductor 8K nonvolatile RAM; a resident Tiny BASIC interpreter; an RS-232 asynchronous serial port; selectable baud rate; an eight-line, bit-programmable parallel I/O port; and a modular I/O system. Furthermore, there are no EPROMs to program.

You program the Z8 BASIC Computer/Controller through a serial RS-232 link between it and a terminal or host computer, using terminal-emulation software. You can use any MS-DOS-compatible computer and communication program, as long as you make sure that the serial port you use is set for eight data, one start and one stop bits and no parity.

The key to the design simplicity of this project is a Zilog Z8671 single-chip microcomputer around which it's built. This chip is a special member of the Z8 family that has an internal EPROM programmed with a customized version of the Dartmouth Tiny BASIC interpreter. The interpreter is programmed to use the internal registers for storing variables and command-level input lines and the internal UART for communication with a terminal or host computer. Because of this, the chip can operate in a stand-alone configuration with no external components, except for a reset circuit and the crystal used to generate the system clock.

Unless performed external to the circuit, the Z8671 also requires a TTL-to-RS-232 level converter for the UART transmit and receive lines. In this "No-RAM" mode, the chip attempts to store all program lines in the chip's limited internal memory. Because there are only 128 bytes into which the chip can put the input line, no program lines can be stored internally. Therefore, BASIC commands and statements can be executed only at command-line level.

By adding three extra ICs, the Z8671 can be given program memory outside its own 128 bytes. In this "external-RAM" mode, programs are stored external to the chip. The size of the program that can be written is determined only by the amount of external memory resident in the linear address space of the Z8671. In this design, two other chips are added to decode the upper 32K of the memory address space for I/O and to permit baud-rate selection via switch settings.

About the Circuit

As shown in Fig. 1, the heart of the system is Z8671 single-chip microcomputer *U1*. Internally, this chip contains 2K of ROM, a full-duplex UART, 128 bytes of RAM and two eight-bit counter/timers. The internal EPROM is programmed with a special version of the Dartmouth Tiny BASIC interpreter that's used as the central programming language for the computer.

The 128 bytes of internal RAM are used by the BASIC interpreter for variable storage, parameter storage, etc. The full-duplex UART is used by the BASIC interpreter as the primary communication medium with the programmer and user. One of the two internal counter/timers is used to generate the baud rate of the UART serial interface.

Because the chip is self-contained, the only external circuitry needed for the computer is used to support the memory and I/O interfaces that are to be used outside the chip's own memory and I/O structure.

The chip recognizes a single 64K linear memory-address space in which all memory and I/O must be located. Because of this, all I/O must be memory mapped (accessed like memory locations instead of I/O ports). To accommodate the I/O portions of the computer, the memory address range is split into two 32K sections, the lower section starting at address 0000h for external static RAM and the upper section for I/O.

To conserve pin count, the Z8671 uses a multiplexed data/address bus, which has the data and lower half address buses sharing the same pins. Data is separated from the address by machine-cycle status. In the first part of the machine cycle, AD0 through AD7 contain address information. In this part of the machine cycle, /AS is brought active-low to signify to the external circuitry that the bits on the multiplexed address/data bus are address bits. /AS is used to enable octal transparent latch *U2*, the output pins of which are used as the lower half of the memory address.

Chip *U2* has two pins that enable the input and output latches. The output latch-enable is active-low and the input-latch enable is active-high. Since /AS is active-low, it might initially make sense to simply connect it to the output latch-enable. However, further consideration

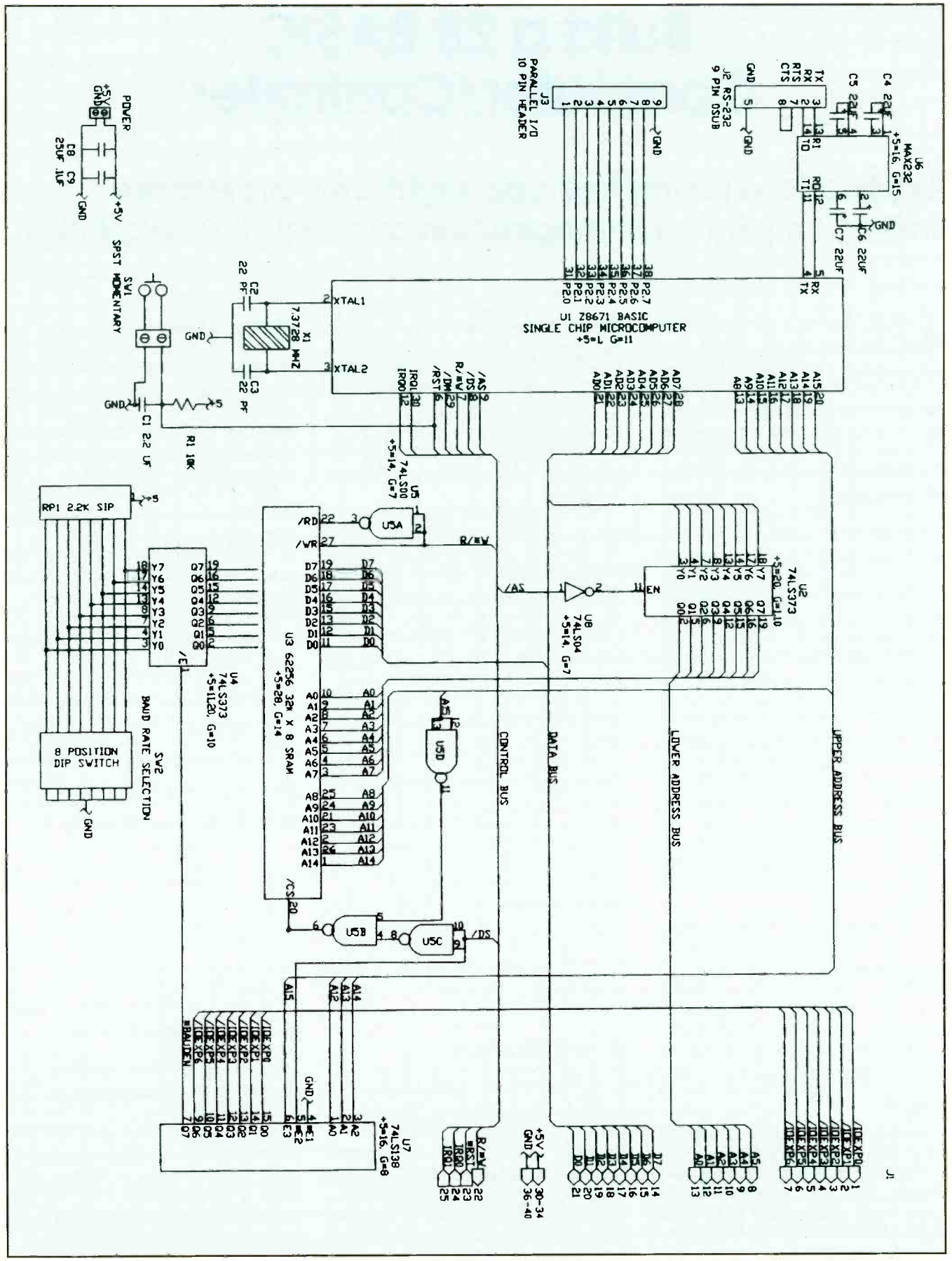


Fig. 1. Complete schematic diagram of Z8 BASIC Computer/Controller circuitry.

PARTS LIST

Semiconductors
U1—Z8671 eight-bit microcontroller
U2,U4—74LS272 octal transparent latch
U3—62256 32K static RAM
U5—74LS00 quad NAND gate
U6—MAX232 converter
U7—74LS138 three-to-eight-line encoder
U8—74LS04—hex inverter
Capacitors
C1—2.2-µF tantalum
C2,C3—22-pF ceramic disc
C4 thru C7—22-µF, 16-volt electrolytic
C8—25-µF, 16-volt electrolytic
C9—0.1-µF ceramic disc
Resistors
R1—10,000-ohm, 1/4-watt, 5% tolerance
RP1—2,200-ohm in-resistor pack
Miscellaneous
J1—40-pin Wire Wrap socket
J2—Nine-pin subminiature D-type connector
J3—10-pin Wire Wrap socket
SW1—Normally-open, momentary-action spst switch
SW2—Eight-station DIP switch
X1—7.3728-MHz crystal
Perforated board with holes on 0.1" centers; Wire Wrap sockets for all ICs; two-position connector blocks (2); SIP Wire Wrap strip for RP1; materials for communication cable (if needed; see text); spacers; machine hardware; Wire Wrap wire; bus wire; solder; etc.

Note: The Computer/Controller is available in kit form with all components required for construction and a complete technical manual that details wire-by-wire construction, complete programmer's reference (you wouldn't have to get the reference from Zilog) and series of application notes is available for $79.95 from Montgomery Engineering, 3845 SW 25th, Oklahoma City, OK 73108; tel: 405-681-9971 to place COD orders only.

reveals that if this is done, the output latch data would become invalid after /AS goes high, due to the tri-stating of the lines.

A more-desirable approach is to control the input latch with /AS and leave the output latch always active. In this way, when /AS is active, the latch is transparent and the data on the output latch is representative of the lower half of the address. When /AS is inactive, the input latch is disabled and the data on the output latch remains unchanged. To implement this operation, /AS must be inverted to active-high state to support the control of the input latch-enable. This is accomplished with inverter *U8*. If /AS is inactive-high, the information on AD0 through AD7 is data and *U2* is deactivated. This means that the outputs still contain the address information, despite the fact that the input pins contain data.

/DS is used to signal the external circuitry that data storage memory (64K memory address space) is being accessed. When /DS is active-low, the 32K static RAM and I/O can be decoded by the address pins. For instance, the memory device is located at address 0000h through 7FFFh (which is 32K).

If you look at the bit weighting of 7FFFh, you'll notice that the most-significant bit (corresponds to address line A15) is low, while all the others are high. This allows you to use a simple decoding technique, where A15 is gated inactive-low, with /DS active-low to form the chip-select of memory chip *U3*. Because *U3*'s chip-select is active-low, the logic equation for /CS (chip-select) is /CS = *A15 + */DS. This equation is transformed to a logic circuit using three NAND gates, the first two of which invert the *A15 and */DS signals to a high level to permit AND comparison by the third gate. If both inputs to the third gate are high (signifying that A15 and /DS are low), the output of the third gate is low. This output controls the /CS of *U3*.

If A15 is high, the Z8671 is accessing I/O space. Decoding for I/O space is exactly the same as for memory space, except that in the logic equation A15 is high. To facilitate decoding the 32K space into several segments for control of different I/O devices, three-to-eight-line decoder *U7* is used to split the 32K segment into 4K boundaries. At each boundary, the corresponding output of *U7* will go active-low. For instance, if an address is requested at 8000h, one location above memory and at the first boundary of the I/O segment, output Q0 would go low. If a device is decoded to this location, it would use output Q0 as a chip-enable signal.

No logic circuitry is required to decode *U7* because all decoding logic is internal. This chip has three enables that must be held in their active state for it to function. Two of these enables are active-low and one is active-high. Since A15 must be high to decode the I/O segment, A15 is connected to the high-enable for *U7*. Also, because /DS must be active-low to decode the I/O section (or memory section, for that matter), it's connected to one of the low-enables. The other low-enable is tied to ground so that it's always active.

Upon reset, one of the initialization functions of *U1* is to read a bit pattern at location FFFDh and set the internal baud rate according to this bit pattern. This might seem a little senseless at first, until you consider that a latch could be located at this address, which will put a bit pattern on the data bus corresponding to positions of switch in a DIP switch bank on the card, thus permitting the baud rate to be set manually. This feature is fairly easy to implement. First, consider that address FFFDh is located in the last boundary of the I/O segment. When accessed, this boundary will bring active-low output Q7 of *U7*. If this output is used to enable the output of a transparent octal latch, the contents of the inputs to the latch will be placed on the data bus. If the inputs are connected to a switch bank, the switch positions will be placed on the data bus.

By examining Fig. 1, you see that this is exactly how the circuit implements this function. When a switch is set to ON, the corresponding bit is 0, because the switches are tied to ground. If the switch is set to OFF, the corresponding bit is 1 because all switch outputs are pulled high by a 2,200-ohm pull-up resistor.

For this baud-rate selection to work correctly, the Computer must use a 7.3728-MHz crystal as its timebase because the Z8671 uses one of its internal counter/timer circuits as the bit clock for transmission and reception of serial data. The prescaler and load values for this counter/timer are set internally by programming in the Z8671 and are based on a 7.3728-MHz crystal frequency. To ensure that the crystal maintains oscillation at its designated frequency and not some harmonic of it, two 22-pF capacitors bypass both the active and inactive sides of the crystal to circuit ground.

The serial output and input of the Z8671's internal UART provide data at TTL voltage levels. Most computers and monitors that will be used as the data link for programming the Z8 BASIC Computer/Controller require this data to be at RS-232 voltage levels, which is accomplished with *U6*.

RS-232 level signals require about a ±8-volt swing. Older computer designs require a ±12-volt swing for RS-232 communications, in addition to the +5-volt supply required for operation of the logic circuits. Converter *U6* contains internal charge pumps that generate the

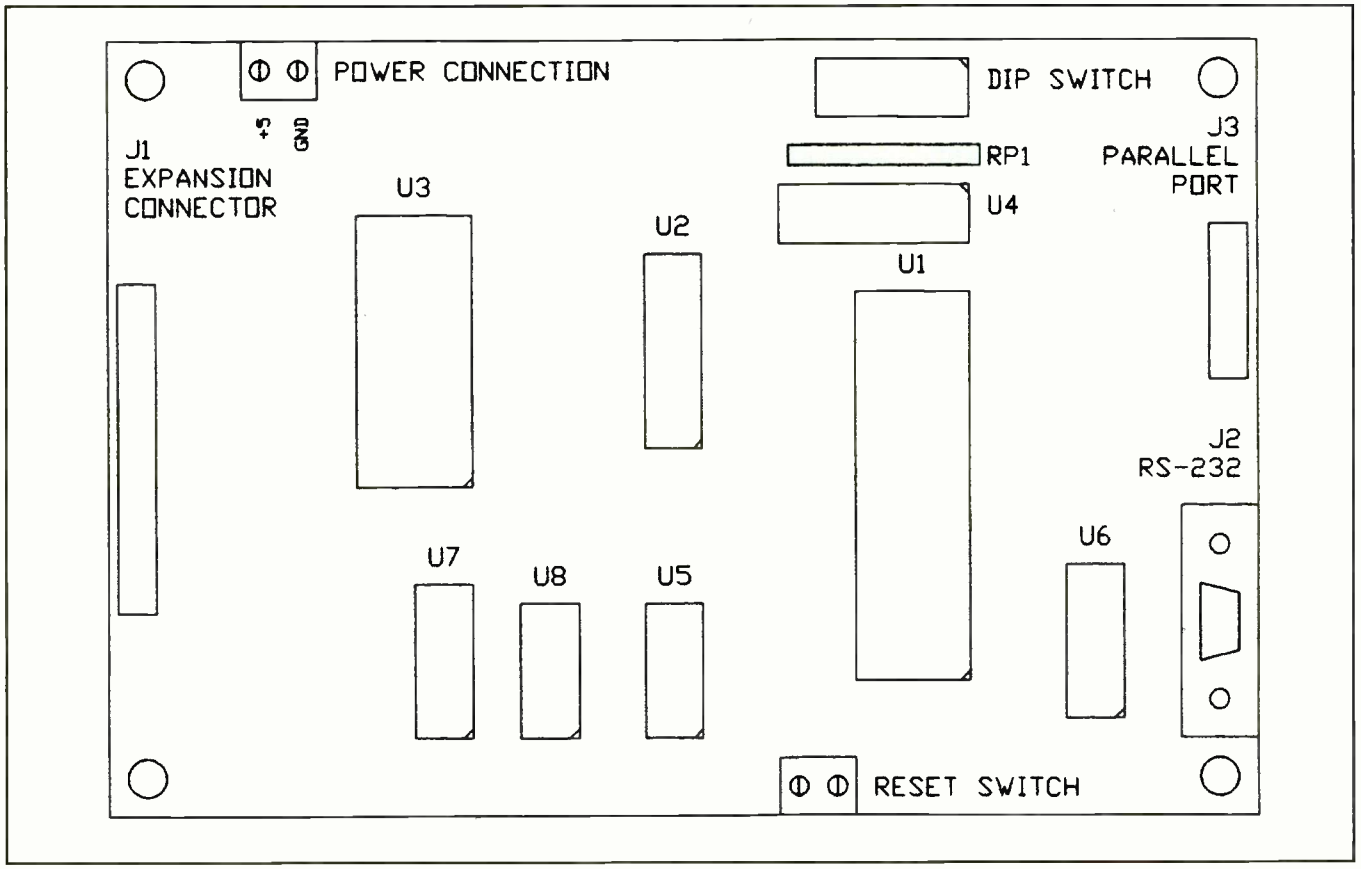


Fig. 2. Actual-size layout for components on perforated board that has holes on 0.1" centers.

positive and negative voltages required for RS-232 conversion from a single +5-volt supply. Thus, a single dc power supply is needed for the entire computer. Capacitors *C4* through *C7* are used by the internal charge pumps to generate these voltages.

Debouncing for the power-on reset and RESET switch is provided by *R1* and *C1*, the values of which provide an R/C time constant that's about 100 times the required reset time for the Z8671 and about 50 times the debounce time of the momentary-action switch. When power is applied, *C1* charges through *R1*, holding the reset line low for a 1(R1 × C1) time constant. Once *C1* charges, the reset line is returned to inactive-high and the Z8671 begins program execution. When momentary-action RESET switch *SW1* is closed, the reset line is held low. Releasing *SW1* allows *C1* to charge through *R1*. When *C1* is charged, the reset line is returned to inactive-high, just as in the power-up scenario.

Port 2 of the Z8671 isn't used for external interface and, therefore, is available to you to do with as you please. In this design, Port 2 is provided for general application through a 16-pin right-angle header. This bit-programmable port allows you to program any one of the eight port lines to be an input or an output.

The last detail I'll cover in this section is the expansion bus provided through 40-pin right-angle header *J1* in Fig. 1. This bus provides signals for decoding input and output in the I/O segment of the memory address range and for interfacing I/O devices to the Z8671. Interrupt lines are also provided here for more-advanced applications, although I won't cover these in any detail here. You can find details on interrupt operation in the *Z8 Family Data Book* from Zilog.

Construction

Because of the circuit's simplicity, and for speed of development, I used the Wire Wrap technique to build my prototype. I encourage to use this technique as well. Shown in Fig. 2 is an actual-size board layout you can use to help you in positioning and orienting the components used in this circuit. Of course, you can use any construction method and procedure that fits your needs and taste, but if your experience is limited, the general guidelines below should help you through the construction phase.

Assemble your circuit be on phenolic perforated board that has holes on 0.1" centers. Such boards are commonly available from Radio Shack and many local and mail-order electronics houses.

Start construction by cutting the board to the size of that shown in Fig. 2. Then photocopy Fig. 2, keeping in mind that photocopy machines inherently distort the image and produce a copy that may be larger or smaller than actual size, which should be 6" × 4". A small amount of distortion, in the range of 1% to 3% or so, won't make much difference. But if distortion is severe, you won't be able to use the copy, in which case, you can place the copy in this issue and use the actual printed artwork in the next step.

Trim your copy (or original) to the outline around the wiring guide. Then use a spray-on adhesive or paint-on rubber cement to affix the copy to the trimmed board. Use a $^{3}/_{16}$" bit to drill the mounting holes in the four corners of the

board. Likewise, use a $^{3}/_{32}$" bit to drill mounting holes in the *J2* location.

Hold the board up to a strong light, paper-coated side facing you, and use a straight pin to punch through the paper and into the holes around the perimeter of each IC socket (including the one that will accommodate DIP switch *SW2*) to clear the way for their pins. Stay within the outlines printed on the paper overlay. Do the same for the *RP1* SIP connector and *J1* and *J3* pins. This done, plug the pins of the Wire Wrap sockets into the holes in the their appropriate locations on the circuit board. Work carefully to avoid bending or distorting the pins.

Next, install *J3* the POWER and RESET switch connector blocks in their respective locations, and mount the female RS-232 connector into place with $^{1}/_{2}$" spacers and machine hardware. Don't punch the remainder of the holes until you're ready to install the various discrete components.

Now, referring to Fig. 3 (this is the view from the bottom of the board) and Fig. 1, run the insulated +5-volt and ground buses from the POWER connector block to the various points in the circuit as needed. The connections to +5 volts and ground are indicated as +5 = pin number and G = pin number next to or within the outline of each IC socket. To be able to do this, you'll have to strategically place Wire Wrap posts at various locations along the routes of the two buses. Don't forget to connect the ground bus to pin 5 of *J2* and pin 9 of *J3* and the +5-volt bus to the common connection on the *RP1* SIP socket.

As you're wiring the buses, don't forget to place a piece of electrical tape in the indicated location to prevent the buses from shorting to each other. Use 24-gauge insulated Wire Wrap wires for all wiring.

Place 0.1-µF bypass capacitors at locations specified in Fig. 3. Then wire *C4* through *C7* directly to the *U6* socket and the crystal between pins 2 and 3 of the *U1* socket, soldering their leads into place. Install and solder into place the bypass capacitors between the crystal and ground.

Begin wiring the reset circuit by plugging Wire Wrap pins through the top of the circuit board near the pins for the screw terminals to which RESET switch will be connected. Use bus wire to connect the Wire Wrap pins to the screw-terminal pins. Wire the resistor to one of the screw terminal pins and +5 volts and the capacitor to the same screw terminal pin and ground. Then wire the other screw terminal pin to ground bus.

Now carefully following Fig. 1 and Fig. 3, wire the remainder of the circuit, using additional Wire Wrap posts wherever needed. After you make each connection, use an ohmmeter or audible continuity tester to check that your work is okay. When you finish all wiring, check to make sure that you haven't created any short circuits between the +5-volt and ground buses.

When you're satisfied that your wiring is okay, mount a 1" spacer at each

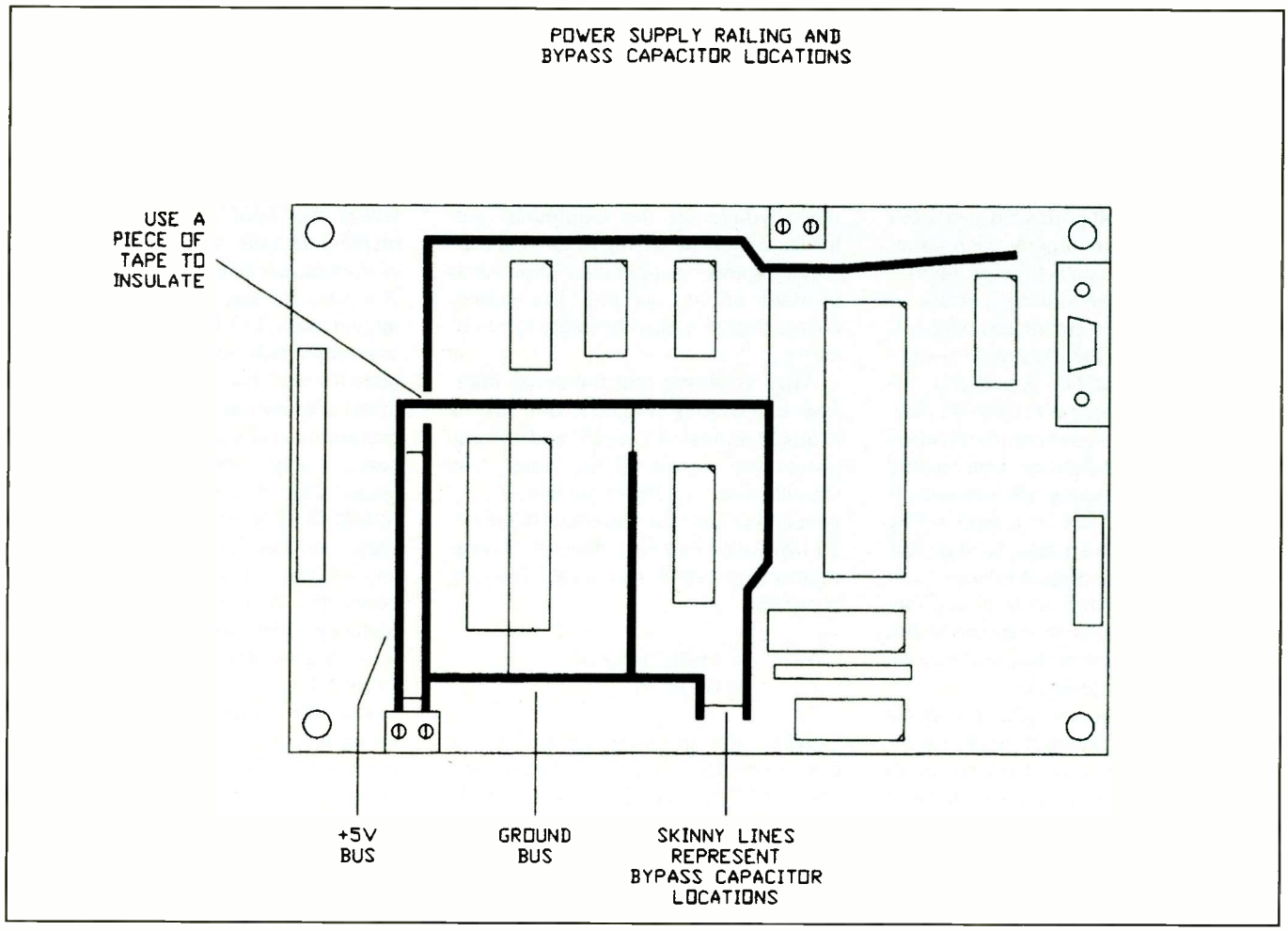


Fig. 3. Bottom view of board shows power-supply buses and locations of bypass capacitors.

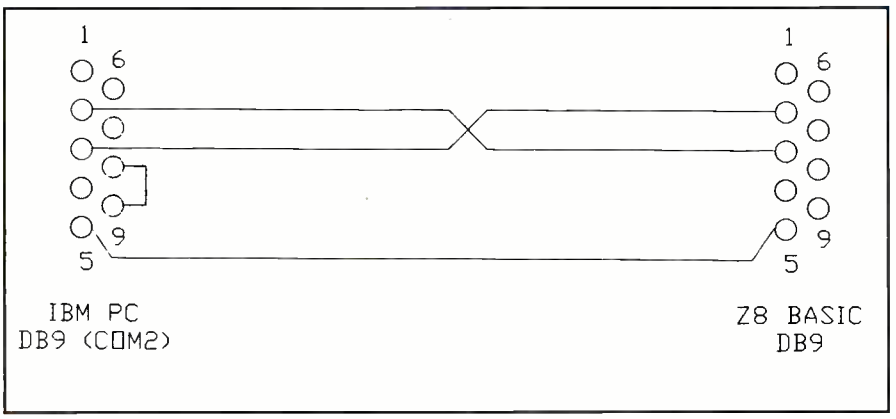


Fig. 4. Z8 BASIC to IBM PC serial interface cable wiring details.

of the four corners of the circuit-board assembly.

Checkout & Use

With no ICs plugged into any of the sockets on the board, connect a source of 5 volts dc to the POWER connector block, observing proper polarity. Clip the common lead of a dc voltmeter or multimeter set to the dc-volts function to any convenient ground point in the circuit. Power up the circuit and touch the "hot" probe of the meter to every point in the circuit that's supposed to be at +5 volts and note the readings obtained. (Refer to Fig. 1 for the locations of the +5-volt points.) If you don't obtain a +5-volt reading at each point, power down and correct the problem.

When you're absolutely certain of your wiring, power down and plug *U1*, *U6* and *SW2* into their respective sockets. Make sure each IC is properly oriented before pressing it fully into place. Wire a cable for serial communication between your computer or terminal and the Z8 BASIC Computer/Controller. If you're using a PC as a host, refer to Fig. 4 for instructions on how to wire the cable. Connect the project to your computer or terminal and set the baud rate of your communication software to 300 baud, power up the project and turn on your computer or terminal.

After a few seconds, you should see a ":" prompt on-screen. If other characters are displayed or no characters at all appear, change the baud rate setting of your communications software. If characters were initially displayed, you should be able to find a baud rate that works and displays the ":" prompt.

After each change in baud rate, strike a key or reset the Z8 BASIC Computer/Controller to cause a response to check for the correct setting. If you can't find a baud rate that produces and kind of display at all, check the operation of the serial port by connecting a logic probe to pin 5 of *U1* and reset the project. When you do this, you should see a series of pulses on the logic probe and then nothing, signifying that the initialization message is being sent and that the Z8671 is operating properly. In this case, power down and check the wiring associated with *U6*. Once you've corrected the problem, perform the above procedure again.

If no data is present on pin 5 of *U1* when you reset the Computer/Controller, check the wiring of the reset circuit and power-supply pins. If power is available at pin 1 and pin 11 is grounded, the problem must be in the reset circuitry.

After verifying that the serial interface is operating properly, turn off the project and install *U2*, *U3* and *U5* and power up again. This time, you shouldn't see a number prior to the ":" prompt because the Computer/Controller has found external memory. To test memory operation, key in the following program:

```
10 PRINT "HELLO"
20 GOTO 10
```

When you hit Enter, you may get an error in the form of a beep and the message "17!" displayed on-screen, indicating that no user memory is available. If this occurs, touch your logic probe to pin 20 of *U3* and then turn on or reset the Computer/Controller. If you don't notice a few short bursts at the very beginning, check the wiring associated with *U5* because, for some reason, the RAM device isn't being decoded properly.

If you find short bursts on pin 20 of *U3*, the problem must be in the wiring of *U3*. Check to ensure that the data and address buses are properly wired and that proper supply voltages appear at pins 14 and 28. If this is okay, try replacing the IC.

If you obtain no error messages, the program was stored. To verify that memory is retaining the data, type LIST and hit Enter to display the program.

The last thing to check on the project is operation of the baud-rate selection circuitry. Power down and install *U4*, *U7*, *SW2* and *RP1*. Set the switches according to the baud-rate setting given in Table 1, and set the baud rate on your computer to the same setting. Turning on the project should cause the ":" prompt to appear on-screen. Repeat this procedure for each of the baud rates.

If the baud-rate selection circuitry or memory interface fails to work, power down and check your wiring against Fig. 1. If your wiring is correct, replace the faulty component with a new one that works.

Programming

Table 2 contains a complete list of all BASIC commands and statements to which the Z8671 is programmed to respond. In spite of this limited number of commands and statements, this chip is a powerhouse. With it, you can do integer math, I/O, bit manipulations and assembler subroutine calls. It's complete for such tasks as robot control and home automation. Since the entire programming subject can't be covered here, I refer you to Zilog's *Z8671 Single-Chip BASIC Interpreter BASIC-/DEBUG Software Manual* (check the Parts List and Sources box for number and address). I will, however, briefly cover the line editor, variables and memory addressing techniques because these might not be immediately obvious from Table 2.

The line editor is a minimum-level utility that allows the program and data input to be done in immediate mode. If an error is detected before storing a line in memory, it must be corrected by back-spacing through the line buffer to the error and then re-keying the command. When a line is entered, the only method for correcting it is to re-key it correctly.

Table 1. Baud-Rate Selection Settings

Contents of Location %FFFD*	Baud Rate
1 1 1	300
1 1 0	110
1 0 1	1,200
1 0 0	2,400
0 1 1	4,800
0 1 0	9,600
0 0 1	19,200
0 0 0	150

*Right-most column indicates least-significant bit (LSB).

Once a line has been entered, it's stored in memory in line-number sequence. If you type in a new line that has a line number the same as a line already in memory, the new line replace the old one. If you type just the line number, the line that was in memory is erased.

Variables are integer numbers stored in designators A through Z. (You can use only A through Z as names for variables.) Each variable takes up two bytes of RAM and has a static range of +32767 to -32767.

Variables can be represented in either decimal or hexadecimal format. To represent a number in hex, place the "%" identifier before the number. Here are some examples of proper decimal and hex variable declarations:

```
A=123      A=256      A=32767

A=%7B      A=%100     A=%7FFF
```

Memory addressing can be done directly or indirectly via a register. To examine memory contents directly, use the "@" symbol followed by an address in any declarative statement. For instance:

```
   PRINT @%FFFD    'READS BAUD
RATE SWITCHES
      - OR -
   A=@%FFFD        'A=BAUD RATE
SWITCHES
   PRINT A         'SHOW THEM
```

To indirectly access memory contents, use "^^" followed by a register number. For instance:

```
PRINT ^^8    'REGISTER 8 POINTS TO
START OF BASIC
             'PROGRAM.  THIS LINE
PRINTS THE FIRST
             'BYTE OF THAT PROGRAM
      - OR -
A=^^8        'GET BYTE IN A
PRINT A      'PRINT IT
```

You can alter memory contents using these accessing techniques as well. For example:

```
@%100=255    'MEMORY LOCATION
100H=255 NOW (DIRECT)
^^8=255      'FIRST BYTE OF PRO-
GRAM = 255  (INDIRECT)
```

Since your I/O space lies in the upper 32K of the memory region, you can use these same techniques to address I/O.

That about does it for the programming section. For further information, you to the programmer's guide mentioned above. It's an invaluable tool for programming this little beauty.

Conclusion

In this article, I've described construction of a very inexpensive Computer/Controller that's easy to build by even a novice hobbyist with a minimum of electronic gear. Even though it's very simple, it can be put to as many applications as you have ideas. I originally designed it for robot control, a task in which it still provides loyal service. If you're interested in robotics and would like a chat or to find out about other information about bulletin boards or groups, please drop me a line at the address given in the Note at the end of the Parts List. I'm also interested in hearing from you if you have any interest in future articles on robot construction or associated material. ■

Table 2. BASIC Commands & Statements Programmed into Z8671 Microcontroller

Command	Operator
GO@	* (Multiply)
GOSUB	/ (Divide)
GOTO	+ (Add)
IF - THEN	- (Subtract)
IN	= (Equals)
INPUT	<= (Less Than,
Equal To)	
LET	< (Less Than)
LIST	<> (Not Equal)
NEW	> (Greater Than)
PRINT	>= (Greater Than,
Equal To)	
REM	
RETURN	
RUN	
STOP	
AND	
USR	

IRQ Sharing

Adding a simple circuit to a peripheral card lets two hardware devices share the same IRQ

Many peripheral controllers in MS-DOS computers require use of one or more IRQ (interrupt request) lines to interrupt the processor when a device needs service. A typical serial-port adapter, for example, needs to interrupt the processor when a character has been received and is waiting in the I/O port buffer so that the character will be transferred to RAM before another character is received. Failure to act promptly results in an overrun, meaning that the next character will overwrite the previous character in the port buffer.

Adapter cards for an eight-bit ISA bus, which are very common, are limited to using IRQ2 through IRQ7 and are often configured to use only the standard DOS IRQs for the particular device. Some serial I/O cards can be configured to use only IRQ3 or IRQ4. With many cards in a PC's expansion slots, a problem often arises due to the limited number of available IRQ lines. The obvious solution to such a situation is to have two or more ports share a single IRQ. Though this may be possible, care must be taken to assure that the system will work.

User manuals that come with adapter cards usually go to great pains to warn against configuring more than one device to use the same IRQ. Sharing IRQs simply won't work unless the adapter card is designed to permit interrupt sharing. In such a case, the two adapters will battle each other, one trying to pull the line low while the other is trying to hold it high.

Since DOS doesn't make use of an interrupt to send data to a parallel printer, there's no need to configure a parallel port adapter to use an IRQ line, unless the parallel port is to be used for input (see "Bidirectional Parallel Port Operation," *ComputerCraft*, December 1992). Connecting to an IRQ line will unnecessarily preclude use of that IRQ by another adapter if the port is used for only a printer.

A multi-port card, like those that have two serial ports and possibly a parallel port on them, can readily be modified to permit two ports to share an IRQ line. An interrupt request is signaled by driving an IRQ line high. A circuit that uses two inputs to drive a single IRQ line must hold the line low when both inputs are low and drive the line high when either input goes high.

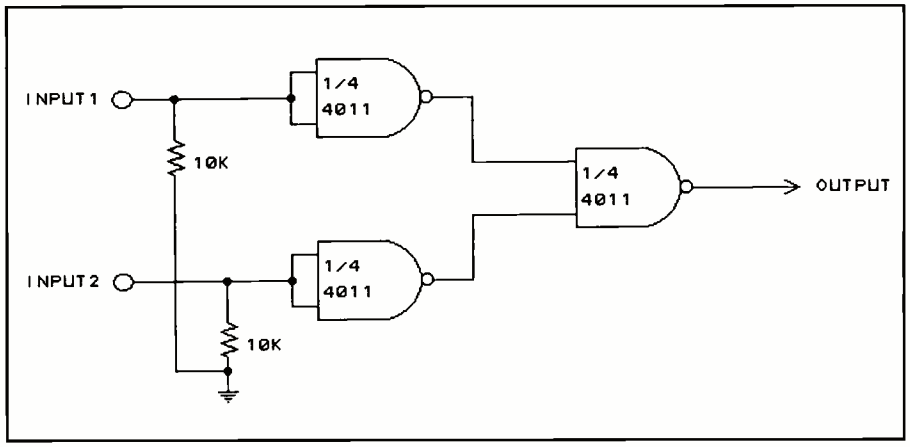


Fig. 1. Schematic details of a circuit you can use to have two devices share the same IRQ.

The circuit shown in Fig. 1 uses a 4011 CMOS NAND-gate chip to permit two ports share the same IRQ. In this circuit, two gates are connected as inverters with 10,000-ohm resistors that hold the inputs at ground level unless the input is connected to a source that's at a logic high (greater that 2.5 volts). The third gate has its inputs connected to the outputs of the inverters. Accordingly, the output from the third gate is low when both inverter inputs are low and goes high when either inverter input goes high.

Simple Modification

An easy way to modify an adapter card with the Fig. 1 circuit is to piggy-back mount the 4011 on another chip that already exists on the card and solder power pin 14 and ground pin 7 to the corresponding pins of the on-board chip. If a 14-pin TTL chip is on the card, the power and ground pin-numbering scheme will probably match that of the 4011 chip.

Look for a 7400 or 7402. If you can't find an on-board chip with matching power and ground pins, simply solder one of the two pins to the correct pin on the on-board chip and connect the other pin to the correct pin on the card with a short wire lead. Then bend the remaining pins of the add-on 4011 chip outward so that they don't touch anything, and solder short wire leads to them to make the required connections, as illustrated in Fig. 2.

You can position the two resistors as shown and solder their leads directly to the pins of the 4011. It's convenient to use Wire Wrap wire for the input and output leads. Most adapter cards have jumpers that connect IRQ lines to the IRQ driver(s). You can wrap input and output leads onto the pins that are meant for the jumpers. If your card uses DIP switches instead of jumpers, you'll have to solder the leads to the correct traces.

To figure out the pins or traces to

The 80x86 Microprocessor Family Part 3: The 80486 and Pentium

This is the ninth in our series of special-bonus pull-outs. This time around, we continue our tour of the 80x86 microprocessor family, with a guide to 80486 chips and a look at Intel's new Pentium microprocessor and supply a chart that compares the features of all major members of the 80x86 family.

Prepared By Jan Axelson.
76 North Broadway, Hicksville, NY 11801

80486DX/SX

Summary

The 80486DX enhances the 80386's architecture by adding an on-chip math coprocessor and an 8K memory cache that speeds operation by reducing external memory accesses. The lower-cost 80486SX has no math coprocessor.

Features

80386-compatible core
Up to 50-MHz clock (66 MHz with clock doubler)
On-chip floating-point unit (math coprocessor; DX only)
8-K-byte code and data cache
Reduced instruction-cycle times
Burst-transfer mode for fast memory access
Built-in self-test and debugging aids
Support for boundary scan test (IEEE Std. 1149.1)
Physical address space: 4G bytes
168-pin PGA package; SX also available in 196-lead PQFP
Low-power CMOS technology

Related Chips:

Intel's 80486DX was the original '486 chip, followed by the lower-cost 80486SX. The 80486DX2 has a clock doubler that doubles the speed of internal operations. All have 32-bit data paths. Low-power versions are also available.

Cyrix has released a variety of '486 chips. Its Cx486DLC uses a 132-pin PGA package, with a '486SX-compatible instruction set, 1K-byte cache and no math coprocessor. The Cx486SLC is similar but is housed in a 100-lead PLCC with a 16-bit external data bus. The Cx486SLC/E adds power management. The Cx486DRu² is a '486 direct replacement upgrade for '386DX's.

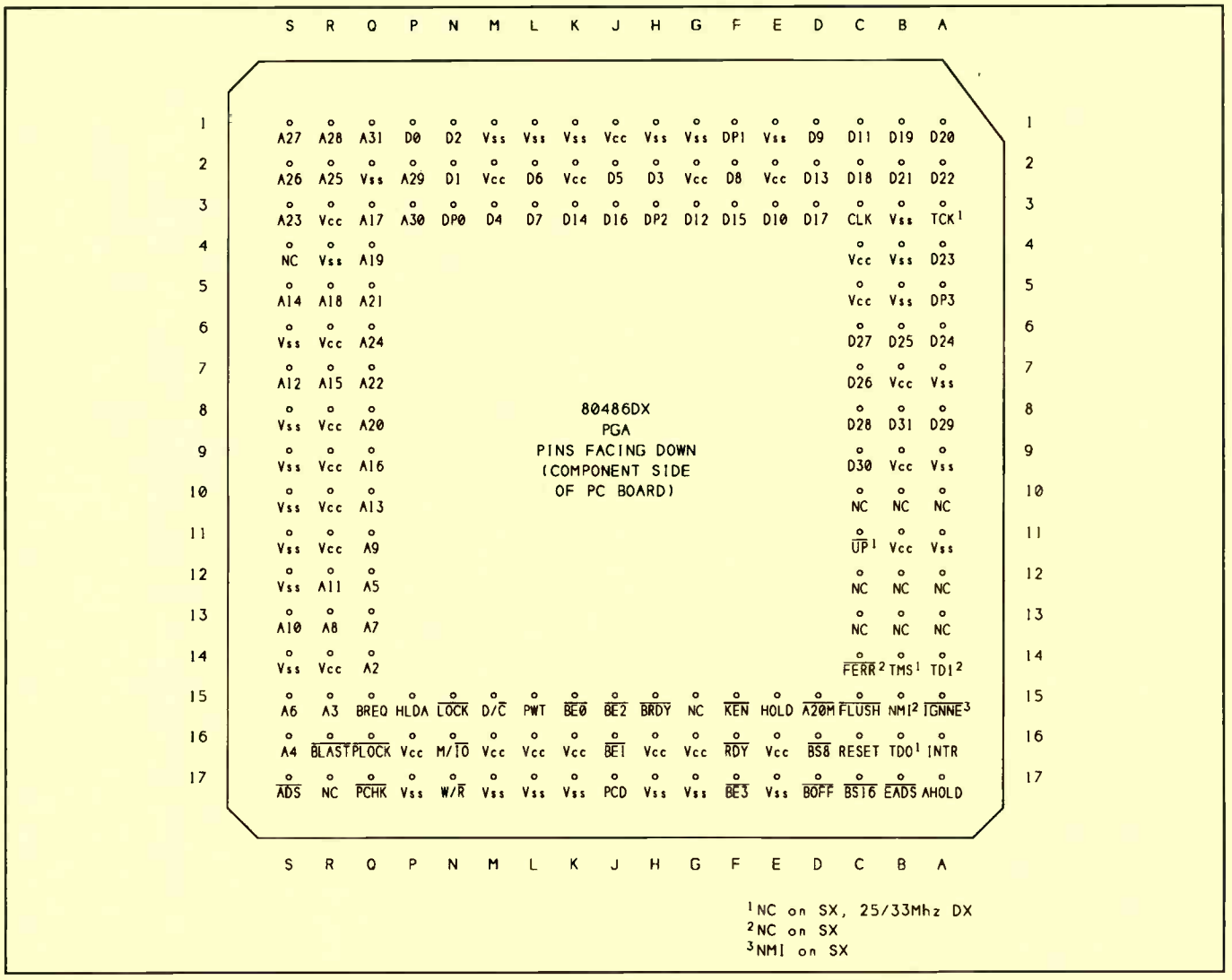
AMD has '486's at 33 and 40 MHz, and at 50 MHz with clock-doubling.

IBM's 486SLC has power management and a 16-bit external data bus and operates at 5 or 3.3 volts.

80486 Pin Reference

Address	Location	
	PGA	PQFP (SX Only)
A2	Q14	146
A3	R15	150
A4	S16	152
A5	Q12	154
A6	S15	158
A7	Q13	159
A8	R13	161
A9	Q11	163
A10	S13	165
A11	R12	172
A12	S7	174
A13	Q10	176
A14	S5	178
A15	R7	180
A16	Q9	181
A17	Q3	183
A18	R5	189
A19	Q4	191
A20	Q8	193
A21	Q5	2
A22	Q7	3
A23	S3	4
A24	Q6	5
A25	R2	7
A26	S2	8
A27	S1	9
A28	R1	10
A29	P2	12
A30	P3	13
A31	Q1	14

Data	Location	
	PGA	PQFP (SX Only)
D0	P1	17
D1	N2	18
D2	N1	20
D3	H2	23
D4	M3	25
D5	J2	26
D6	L2	27
D7	L3	29
D8	F2	31
D9	D1	32
D10	E3	35
D11	C1	37
D12	G3	38
D13	D2	39
D14	K3	41
D15	F3	42
D16	J3	44
D17	D3	45
D18	C2	46
D19	B1	47
D20	A1	48
D21	B2	51
D22	A2	53



D23	A4	55
D24	A6	59
D25	B6	61
D26	C7	63
D27	C6	65
D28	C8	67
D29	A8	69
D30	C9	71
D31	B8	74

Control	Location PGA	PQFP (SX Only)
-A20M	D15	104
-ADS	S17	145
AHOLD	A17	129
-BE0	K15	117
-BE1	J16	116
-BE2	J15	115
-BE3	F17	113
-BLAST	R16	144
-BOFF	D17	137
-BRDY	H15	138
-BREQ	Q15	118
-BS8	D16	135
-BS16	C17	136
CLK	C3	123
D/-C	M15	110
DP0	N3	16
DP1	F1	30
DP2	H3	43
DP3	A5	57
-EADS	B17	105
-FERR	C14 (DX, DX2 Only)	—
-FLUSH	C15	102
HLDA	P15	122
HOLD	E15	130
-IGNNE	A15 (DX, DX2 Only)	—
-INTR	A16	101
-KEN	F15	132
-LOCK	N15	142
M/-IO	N16	111
NMI	A15 (SX Only)	100
NMI	B15 (DX, DX2 Only)	—
-PCD	J17	106
-PCHK	Q17	139
PWT	L15	108
-PLOCK	Q16	143
-RDY	F16	133
RESET	C16	103
-UP	(DX2, 50-MHz DX Only)	—
-W/-R	N17	120

Note: Leading hyphen means a signal is active low

Test	Location PGA	PQFP (SX Only)
TCK	A3 (DX2, 50-MHz DX Only)	128

TDI	A14 (DX2, 50-MHz DX Only)	185
TDO	B16 (DX2, 50-MHz DX Only)	80
TMS	B14 (DX2, 50-MHz DX Only)	187

No Connection	Location	
	PGA	**PQFP (SX Only)**
N.C.	A3 (SX, 25/33-MHz DX Only)	15
	A10	34
	A12	52,56
	A13	60,64,68
	A14 (SX, 25/33-MHz DX Only)	72,73,75 thru 79
	B12	81-83,85,87 thru 89
	B13	90-92,94,97
	B14 (SX, 25/33-MHz DX Only)	124,127
	B15 (SX Only)	134
	B16 (SX, 25/33-MHz DX Only)	140,149
	C10	151,153,155,157
	C13	160,162,166,169
	C14 (SX Only) 171,173	
	G15	186,188
	R17	190,192,195
	S4	

Power	Location	
	PGA	**PQFP (SX only)**
V_{cc}	B7	6
	B9	19
	B11	24
	C4	28
	C5	36
	E2	49
	E16	54
	G2	62
	G16	70
	H16	84
	J1	93
	K2	98
	K16	107
	L16	112
	M2	119
	M16	125
	P16	131
	R3	147
	R6	164
	R8	170
	R9	175
	R10	179
	R11	184
	R14	196
V_{ss} (GND)		
	A7	1
	A9	11
	A11	21
	B3	22
	B4	33
	B5	40
	E1	50
	E17	58
	G1	66
	G17	86
	H1	95
	H17	96
	K1	99
	K17	109
	L1	114
	L17	121
	M1	126
	M17	141
	P17	148
	Q2	167
	R4	168
	S6	177
	S8	182
	S9	194
	S10	
	S11	
	S12	
	S14	

80486 Pin Descriptions

Symbol	Type	Function
A4 Thru A31	I/O	Address Bus, Address Inputs for Cache-Line Invalidation
A2-A3	Output	Address Bus
-A20M	Input	Address Bit 20 Mask for 8086 Emulation
-ADS	Output	Address Status (First Clock of Bus Cycle)
AHOLD	Input	Address Hold for Cache-Invalidation Cycle
-BE0 Thru BE3	Output	Data Byte Enable (0 Thru 3)
-BLAST	Output	Last Burst Cycle
-BOFF	Input	Back Off (Bus Float)
-BRDY	Input	Burst Ready (Bus Cycle Complete)
BREQ	Output	Bus Request
-BS16	Input	Data Bus Size 16
-BS8	Input	Data Bus Size 8
CLK	Input	System Clock
D0 Thru D31	I/O	Data Bus
D/-C	Output	Bus Data/Control Select
DP0 Thru DP3	I/O	Data Parity (0-3)
-EADS	Input	External Address Strobe for Cache-Invalidation Cycle
-FERR	Output	Floating-Point Error (DX, DX2 Only)
-FLUSH	Input	Flush Internal Cache
HOLDA	Output	Bus Hold Acknowledge
HOLD	Input	Bus Hold Request
-IGNNE	Input	Ignore Numeric Error (DX, DX2 Only)
INTR	Input	Interrupt Request
-KEN	Input	Cache Enable
-LOCK	Output	Bus Lock
M/-IO	Output	Memory or I/O Select
N.C.	—	No Connection
NMI	Input	Nonmaskable-Interrupt Request
PCD	Output	Page Cache Disable
-PCHK	Output	Parity Status Check
-PLOCK	Output	Pseudo Bus Lock for Long Reads and Writes
PWT	Output	Page Write-Through
-RDY	Input	Non-Burst Bus Ready (Bus Cycle Complete)
RESET	Input	System Reset
TCK	Input	Test Clock (Not Present on 25- and 33-MHz DXs)
TDI	Input	Serial Test Data Input (Not Present on 25- and 33-MHz DXs)
TDO	Output	Serial Test Data Output (Not Present on 25- and 33-MHz DXs)
TMS	Input	Test Mode Select (Not Present on 25- and 33-MHz DXs)
-UP	Input	Upgrade Processor Present (DX2 Only)
Vcc	Input	System Power (+5 Volts)
Vss	Input	System Ground
W/-R	Output	Bus Write/Read Select

Note: Leading hyphen means a signal is active low

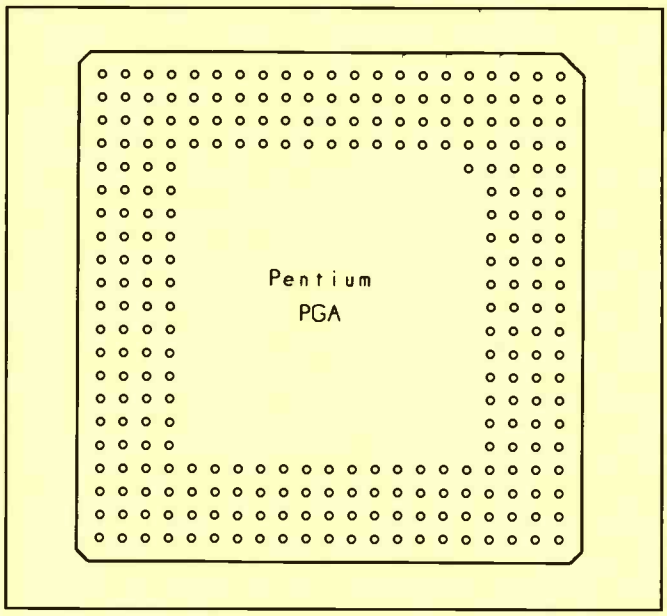
Pentium

Summary

The latest development in 80x86 chips is the Intel Pentium, which has faster performance, a 64-bit external data bus and expanded test and debugging features. Its superscalar architecture has a dual pipeline that can execute multiple instructions simultaneously. The chip is manufactured with a BiCMOS process technology that combines bipolar transistors for speed and CMOS technology for low power and high density.

Features

Code-compatible with 80x86 chips, with improved performance
60- and 66-MHz clock
64-bit external data bus, 32-bit internal
Physical address space: 4G bytes
Separate 8K-byte code and data caches
Superscalar architecture for increased speed
Branch prediction anticipates and pre-loads instructions
Enhanced floating-point unit (math coprocessor)
Reduced instruction-cycle times
Expanded test and debugging aids
273-pin PGA package
BiCMOS technology



Manufacturer Addresses

For more information about the 80x86 chips described in this series, contact the manufacturers listed below:

AMD (Advanced Micro Devices)
901 Thompson Pl.
Sunnyvale, CA 94088
Tel.: 408-732-2400; 1-800-222-9323 (Literature)

Chips & Technologies
3050 Zanker Rd.
San Jose, CA 95134
Tel.: 408-434-0600

Cyrix Corp.
2703 N. Central Expwy.
Richardson, TX 75080
Tel.: 214-234-8387

Fujitsu Microelectronics
Integrated Circuits Div.
3545 N. First St.
San Jose, CA 95134
Tel.: 408-922-9000

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

Intel Literature
(Currently the only source of information on the Pentium)
P.O. Box 7641
Mt. Prospect, IL 60056-7641
1-800-548-4725
Tel.: 408-765-1596

NEC Electronics
401 Ellis St.
P.O. Box 7241
Mountain View, CA 94039
415-960-6000
Tel.: 1-800-632-3531 (Literature)

Siemens Components
2191 Laurelwood Rd.
Santa Clara, CA 95054
Tel.: 408-980-4500

Feature Summary of 80x86 Microprocessors

Chip	Data Path, Internal (Bits)	Data Path, External (Bits)	Address Bus (Bits)	Clock Speed (MHz)	On-Chip Coprocessor	On-Chip Cache (Bytes)	Power Supply (Volts)	Package	Process	Comments
8088	16	8	20	10	No	No	+5	DIP	NMOS, CMOS	Low System Cost
8086	16	16	20	10	No	No	+5	DIP	NMOS, CMOS	Original Chip
80188	16	8	20	10	No	No	+5	LCC,PGA, PLCC	NMOS, CMOS	On-Chip Peripherals
80186	16	16	20	10	No	No	+5	LCC,PGA, PLCC	NMOS, CMOS	On-Chip Peripherals
80286	16	16	24	25	No	No	+5	LCC,PGA, PLCC	NMOS, CMOS	Fast 8086
80386SX	32	16	24	40	No	No	+5,+3.3	PQFP	CMOS	Low-Cost '386
80386DX	32	32	32	40	No	No	+5,+3.3	PGA	CMOS	Improved Memory Management
80486SX	32	32	32	40	No	8	+5,+3.3	PGA,PQFP	CMOS	Low-Cost '486
80486DX	32	32	32	40	Yes	8	+5	PGA,PQFP	CMOS	Burst Transfer Mode
80486DX2	32	32	32	33 Ext. 66 Int.	Yes	8	+5	PGA	CMOS	Clock Doubler
Pentium	32	64	32	66	Yes	Two 8K	+5	PGA	BiCMOS	Superscalar Architecture

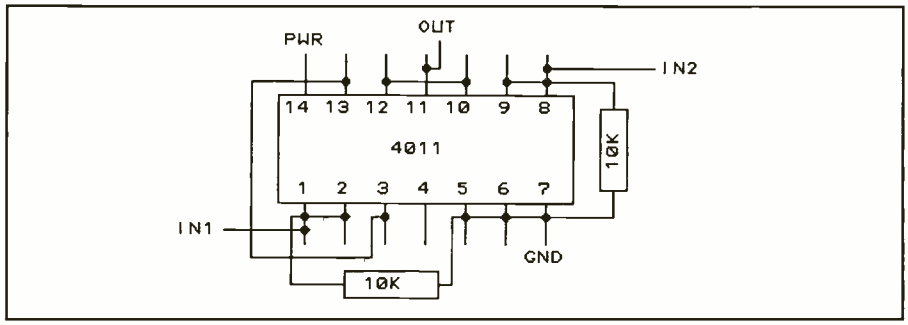


Fig. 2. Wiring details for the add-on IRQ-sharing circuit.

which to connect, examine the card to determine what would be connected to what when the card is configured for a specific IRQ. The only thing that can be depended on to be the same for all cards is the bus (expansion slot) connector. The connector positions for the IRQ lines are as follows:

B4	IRQ2
B21	IRQ7
B22	IRQ6
B23	IRQ5
B24	IRQ4
B25	IRQ3

These are all on the solder side of the board (the side with no components on it, called side "B") and are counted starting with the ground connector (B1) that's closest to the end of the board with the mounting bracket. Be sure to count spaces where there are no conduct "fingers." A ruler divided into 0.1" segments is helpful here. (Since IRQ6 is usually used for the floppy disk controller, it probably won't be available.)

Connect the output lead from pin 11 of the 4011 to one of the IRQ lines you identified as discussed above. Then connect the two input leads to the pins or traces that would connected to this IRQ line through a jumper or switch if the board is to be configured for the two devices to use that IRQ.

The second consideration is software. If all devices that share an IRQ are to be enabled (in use) at the same time, you must use a device driver that's designed for such use. If two device drivers attempt to use the same interrupt, the first one to be initialized will be disabled when the second is initialized because the interrupt vector will be reset to point to the second driver's service routine.

If only one device will be used at a time, one serial port being used by a terminal program for example, there will be no conflict. Assembly-language programmers can write their own device drivers to service multiple devices. All that's required is to have the interrupt service routine poll each device to see if it needs service and maintain separate input buffers.

In Closing

As you can see from the foregoing, you can, indeed, have two hardware devices in your PC system share the same IRQ. All it takes to accomplish this is the simple circuit given here. ■

Backup Software For The 90s: Better Than Ever

If you have a hard disk with priceless data on it, you should get a backup program before it's too late

By TJ Byers

Your data files are the most-important part of your computer system. Unlike application programs, which can be replaced or upgraded, they contain information that's unique to only you. Lose your files, and you could lose your job or even your company.

You shouldn't have to spend precious working hours just to make sure your data is secure, which means that stuffing your PC with a steady stream of floppy disks to satisfy the backed-up data's appetite is out of the question. This is especially true nowadays, where the average hard disk holds 100M of critical information. A good backup system should be able to backup automatically, without you giving it a second thought. This pretty well limits your choices to those backup programs that support a streaming tape drive, in addition to floppy-disk backup. You'll be happy to know that the majority of backup software available today does just that. It lets you set and forget.

In this review, I'll give you a look at eight popular backup programs that deliver the goods. Five of the programs run under DOS and three run under *Windows*. They include *Back-It 4*, *Back-It for Windows*, *Central Point Backup*, *Fastback Plus*, *PC Tools for Windows*, *Norton Backup for DOS*, *Norton Backup for Windows* and *Sytos Plus*.

Price Performance

While cost isn't (or shouldn't be) an overwhelming factor in choosing one of these backup programs, you have to find the right combination of cost, backup features and ease of use if you're to get the most from your investment. If you're looking for rock-bottom price, you won't find any cheaper than Gazelle's *Back-It 4* and *Back-It for Windows*. Both list for just $79 each. Holding the middle ground at $129 and $149, respectively, are Symantec's *Norton Backup for DOS* and *Norton Backup for Windows*. Central Point *Backup for DOS* lists for $129, too, and *PC Tools for Windows* 1.0 provides *Windows* backup at a list price of $179. Topping the list at $225 is Sytron's *Sytos Plus*. You should be able to find these products discounted by about 28% through discount stores and mail order.

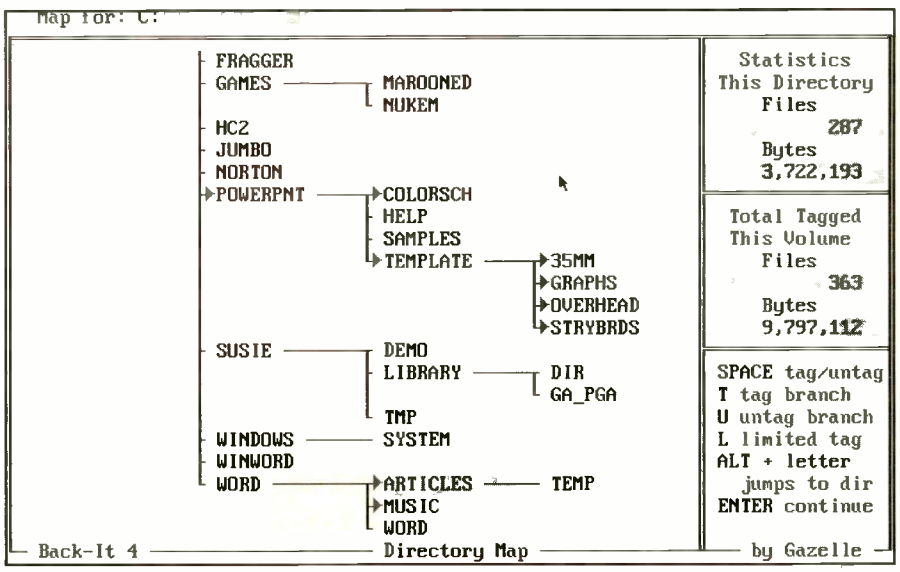
To take advantage of the unattended backup offered by a QIC-80 drive, the backup software must have a scheduler similar to the kind used by VCRs to record TV programs in your absence. All the programs make scheduling backup sessions easy enough by letting you click on a date and time or by filling in your choices on a scheduling form. Three of the programs run under *Windows*, which lets you backup in the background while your regular *Windows* applications run in the foreground. This is handy if you want to backup during work hours but don't want to have to quite your application to do it.

Lastly but far from least, is ease of use. Since these programs are designed to be set and forgotten, the setup procedure can't be so complicated that it requires a back-to-the-books or a refresher course to figure out how to make adjustments and changes. The winners for ease of use are *Norton Backup for DOS* and *Norton Backup for Windows*.

Now let's look at how these backup programs stack up individually.

Back-It 4 Version 1.4

If you don't have a lot of money to spend and can live without bells and whistles, you might want to consider the $79 *Back-It 4* from Gazelle, especially if



Back-It's drive map only hints at how simple this program is to use.

you're sights are set on the higher-capacity DC-6000 SCSI or DAT (digital audio tape) drives.

Despite its simple structure, the program is only fairly easy to use. This is because of its layered menus that you navigate through both forward and backward. There are no shortcuts. And while the directories are displayed as a tree, you can't select individual files from it. To choose a single file, you have to select its directory and then type the file's name into the include list. You can also choose included and excluded files by wildcards and dates.

While restore lists the files by name, size and date, you have to rummage through the tape's backup sets manually, one at a time, requesting file lists until you find the set that contains your file. Fortunately, there's a history search that finds all occurrences of a specific file or wildcard combination.

The scheduler is easy to program but a bit limited. For example, you can schedule only one backup per day, and all backups must occur at the same time. You can't automatically back up at 6:00 p.m. one day and 11:00 p.m. the next. Nonetheless, it gets the job done, and requires a scant 2K of RAM.

Cheap and dependable pretty well sums up *Back-It 4*. But check out its *Windows* sibling before plunking down the greenbacks.

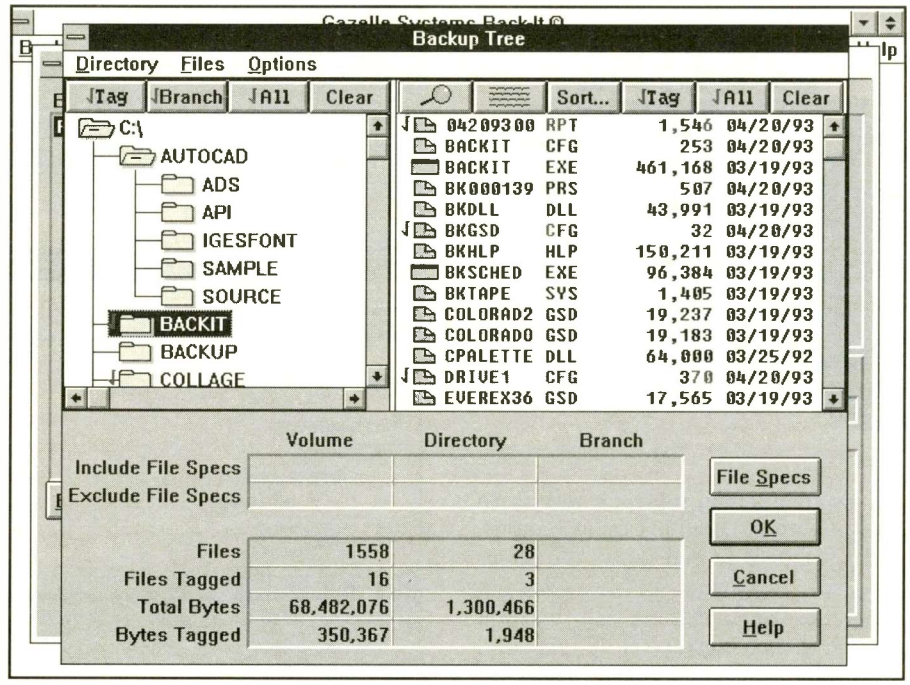
Back-It for Windows 1.2

Although *Back-It for Windows* sells for the same low $79 as its DOS counterpart, the two programs aren't twins. The *Windows* version has improved on some features, dropped others and added virus scanning. Happily, support for high-capacity SCSI and DAT drives isn't changed.

The biggest improvement is in the backup directory tree that now lists files by name, size and date, which makes it a lot easier to use than its DOS sibling. Tagging a single file is a simple point-and-click operation. Like *Back-It 4*, backup strategies in *Back-It for Windows* are created using the attribute type. But this time, you can save the backup set as a *Windows* icon, and place it in your Startup box or any other *Windows* group. Clicking on the icon automatically runs the backup program.

Unfortunately, restore wasn't touched. File searches must still be done manually, one backup set at a time. Except for a facelift, the scheduler also misses the upgrade bus. You're still limited to one automatic backup per day, all at the same hour.

Low cost, included virus checking and support for SCSI and DAT drives make this one attractive package.



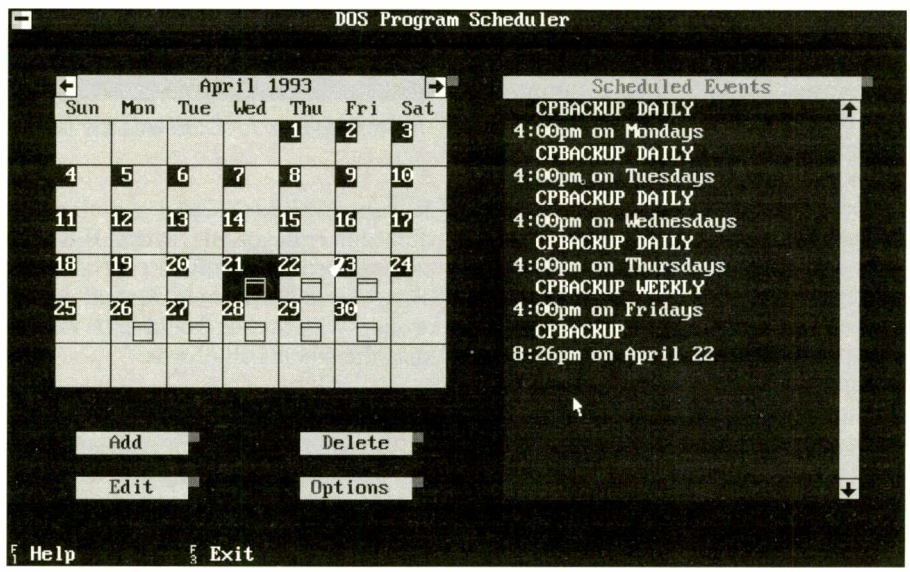
Back-It for Windows' major improvement is its Backup Tree.

Backup 8.0

Although Central Point sells five different versions of its backup software, some of which finds their way into tape drives as bundled software, Version 8.0 is the latest and greatest for DOS. It provides terrific backup protection and supports the most-popular tape drives, including QIC-40/80 and Conner Accutrak (previously Irwin Servo) drives. In addition, it supports a number of high-capacity SCSI tape drives.

Backup scheduling is accomplished using a wall-like calendar that displays a month's worth of events at a glance. Simply click on a date to schedule as many different or same events as you wish for a given day, or for any daily, weekday, weekly, monthly or bi-weekly pattern.

There are two user-interface screens.



Scheduling is accomplished in *Backup* using a wall-like calendar.

An express screen replaces pull-down menus with streamlined radio buttons, and a standard screen shows the directory tree, along with its files. Creating setup files from either is a snap, and you can name each backup set individually, which makes it easy to locate a specific file to restore. But don't panic if your mouse click doesn't produce instant results; scrolling and tagging responses are slooooow.

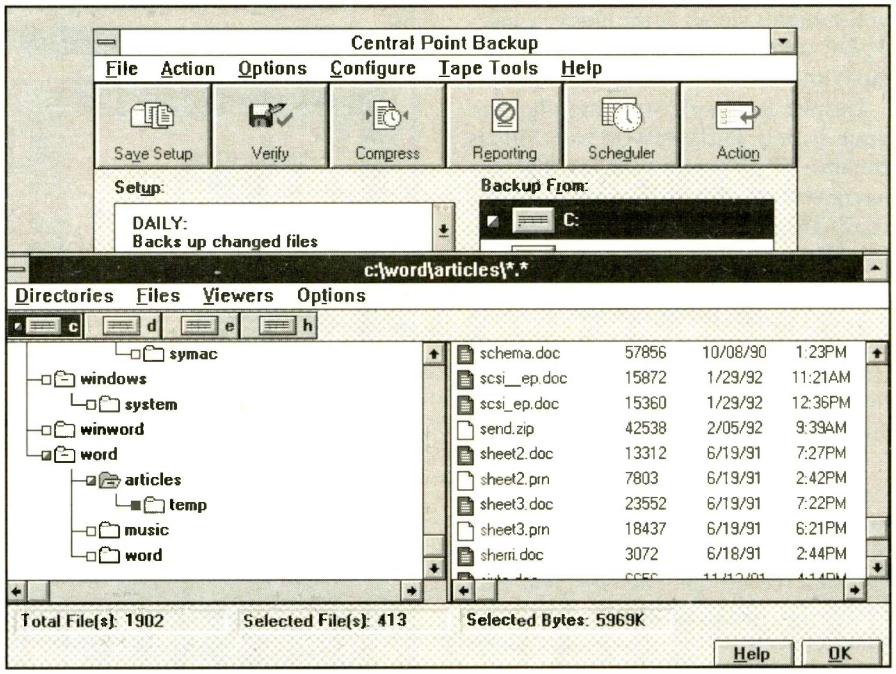
As a stand-alone package, this dynamite backup program lists for $129. But for just $50 more ($179), you can buy Central Point's *PC Tools* 8.0 software that includes the Central Point *Backup* program *plus* a treasure-chest chock-full of data-recovery tools, virus scanning, a disk optimizer and lots more. Whichever way you go, you get one fantastic backup program.

PC Tools for Windows 1.0

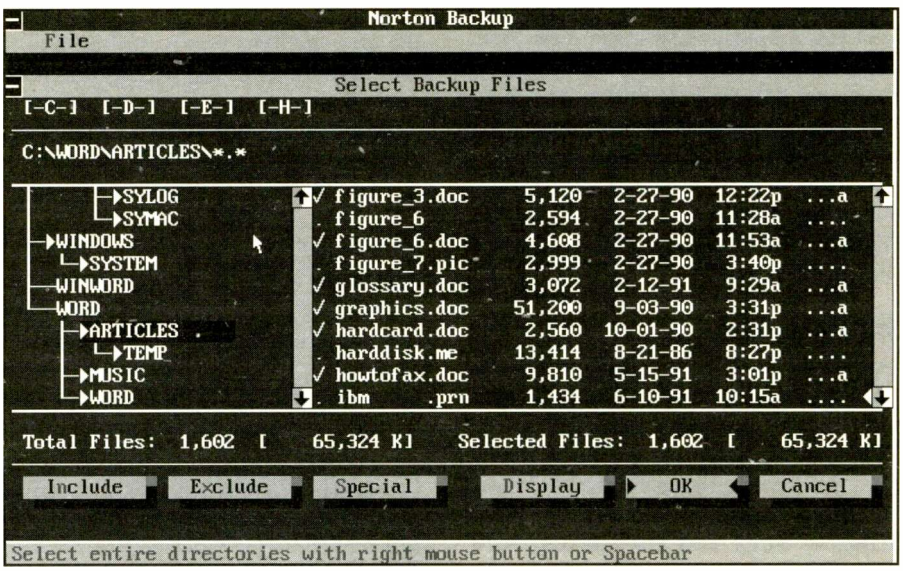
If you're a real *Windows* power user, you've got to test drive *PC Tools for Windows* if not for its top-notch backup program, superb *Windows* desktop collection that includes a disk optimizer, data recovery tools, virus scanning, data compression, and much more.

Like Central Point *Backup for DOS*, the *Windows* scheduler uses a monthly calendar. The backup program comes with a handful of backup sets already configured to run the most-popular backup strategies. Editing the backup sets to include more than one drive is just a couple mouse clicks away. Because it's *Windows*-based, backup can run in the background while you keep on working. Lost a file? Simply click on its name from its backup set, or have the Search History button find it for you.

While there is a stand-alone version of Central Point *Backup for Windows* that lists for $50 less ($129), it wasn't available at the time of this review. But once you've seen the full *PC Tools for Windows* collection in action, you'll wonder why anyone would settle for less than the whole ball of wax.



PC Tools for Windows includes top-notch backup.



Norton Backup for DOS was the fastest backup program tested.

Fastback Plus 6.0

Fifth Generation Systems invented the PC-backup genre with its first release of *Fastback*, and it still has a hefty share of the market. *Fastback Plus*, which lists for $149, is its latest incarnation of this venerable product.

In response to user complaints about Version 3.04's Express interface, *Fastback* 6.0's Express screen has the simplistic look and feel of previous *Fastback* versions. You can select files from a single screen by clicking on a directory tree or by typing in a file name or wild-card selections. Like its predecessors, *Fastback Plus* can restore backups made with *Fastback II*'s Mac version. New to the package is Fifth Generation's *Untouchable* anti-virus protection program.

The scheduler is a program unto itself, backing up from the DOS prompt or by

shelling to DOS from an application—if you add its name and shelling commands to the scheduler line in your AUTOEXEC.BAT file. Setup is divided into two separate steps. The first lists the drives and files to be backed up. The second is created by a macro recorder that remembers the moves you made to create a particular backup strategy. You can link the two processes through the macro or run them individually from a batch file, making it easy to create a large number of backup variations using a minimum number of setup files. The scheduler lists macros for backup line by line, rather than by the popular calendar method. Nonetheless, point-and-click selection makes it easy to use, and patterns can be repeated by the day, month and year.

By the time you read this, Fifth Generation will have released its *Windows* version of *Fastback*, which also lists for $149. A look at a beta version of the *Windows* program shows it to be as versatile and easy to use as *Fastback Plus* for DOS. Good design with an ear to user input guarantees that *Fastback* will continue to garner a lion's share of the market.

Norton Backup for DOS 2.2

For a backup program that's bursting with features, Symantec's *Norton Backup for DOS* 2.2 is surprisingly easy to install and use. It's also the fastest backup program in this review.

Creating backup sets with *Norton Backup for DOS* couldn't be faster or easier. Ninety percent of all setup para-

Buying Smart

What makes one backup system better than another? There's the obvious factors of price, performance, and use of use, of course. But it's sometimes the subtle things that give a system the edge. Here's what I looked at when rating these programs.

Ease Of Use

Ease of use is critical to the success of any backup system, and it begins with an easy installation and setup. While all the software reviewed in the main article uses a setup program to transfer the backup software from floppies to a hard disk, not all setup programs are equal. *Sytos Plus* is the easiest to install because it does all the work for you. The most-difficult is Gazelle's *Back-It 4*, which forces you to install the tape drive from a separate setup program, making it a two-step process.

More important than installation, is the ease of creating backup sessions. All the programs reviewed make scheduling backup easy by either letting you click on a date and time or letting you fill in your selection on a scheduling form. Setup files contain all the information needed to perform an unattended backup, including drives, directories and files. While it's simple enough to backup all changed files on a hard disk, you can save time and tape space by backing up only those files you consider to be important and excluding those that aren't important—for instance, .BAK and temp files. Ideally, you should be able to include and exclude files using wildcards and dates or select your files from a tree directory.

Hopefully you'll never have to use the restore function, but if you do, you want it to be as easy to use as possible. Since most restores will be an accidentally erased file or two, rather than full disk reconstruction, having a tree directory to click on is almost a must. Being able to restore files to another drive or directory or under a new file name is a handy tool. It lets you compare files side by side in detail.

Data Security

The whole point of backing up is to secure your data from becoming lost or corrupted, which means you have to consider all the links in the backup chain. For example, every product here, except Sytron's *Sytos Plus*, checks the hard disk's integrity before backing up to make sure you're not backing up disk errors. And all but *Sytos Plus* let you integrate a virus check. If you do floppy backups, it's good to know that you can complete a restore even if you have a damaged disk in your backup set or from sets that have disks missing.

Since it's human to err, look for a program that guards against operator error, such as programs that pop up a warning before restoring over existing files. Since some applications still use hidden files for software protection, the ability to include or exclude hidden files is a big plus. For those sensitive files, password protection or data encoding is a must. Every program, expect Gazelle's *Back-It* ones, is up to the task.

While infrequent, backed-up data does sometimes become corrupted, usually because a byte or two gets dropped during the copy process or the media is damaged as a result of mishandling. As it happens, tape is more susceptible to these kinds of errors than other media. Fortunately, an error-correction code (ECC) written to the tape can make good data out of bad, or at the least cut the loses. You can also use ECC with floppies and other removable-media drives, but at a 5% to 10% percent in available storage space.

Scheduled Backup

Another human frailty is memory. No matter how disciplined we think we are, we sometimes forget things. So why should you have to remember to back up? If you're forced to depend on your memory, chances are you'll forget the one time you really need it. Fortunately, all of the backup programs reviewed here let you schedule just once and forget. From then on, the backups will take care of themselves.

Because they can't back up in the background, DOS programs prompt you to shut down your other applications when their scheduled backup time arrives. *Windows* backup products, on the other hand, simply do their job in the background while you're working on other applications in the foreground. However, all the time your background backup is running, performance in your primary application is slowed noticeably. Typically, things slow down by about half. You'll see less degradation if you're working in a DOS window. So if you back up more than 1M at a time, it makes sense to schedule your backups for off hours. To make sure you get the full backup done on your lunch hour, temporarily disable the screen saver to keep the backup running at top speed.

Speed

When choosing one of the programs discussed in the main article, speed is definitely at the bottom of the list in importance. Because backups can be scheduled to run during in the background or off hours, it makes little difference whether it takes 2 minutes or 10 minutes to do the job. But if you plan on doing a backup in the *Windows* background while you work, you have to take this into consideration because the CPU's time is shared. So the faster it gets done, the sooner you throttle up to full speed.

Drive Support

While the prerequisite for making this review was tape-drive backup support, I don't expect all readers to fall into a fixed pattern. Many users can still make do with floppy-disk backup, with an eye for buying a backup program that will let them add a tape backup drive as their needs increase, while other users may find the QIC-40/80 format too limiting. The bottom line is: the wider the range of media support, the better.

meters, including the directory tree, are a single mouse click away. Seldom do you have to travel more than a layer deep to find the tools you need. For example, choosing a file for backup is a simple point-and-click operation. In addition, you can select files using wildcards or date-range searches. Clever icons indicate which files are *Norton*-selected and which are user-selected. Selecting files to restore are just as easy to find and mark, but it's faster to let *Norton* do the job for you.

Like Central Point's *Backup* programs, *Norton Backup* uses a monthly calendar for automatic backup and restore. Clicking on a date lets you schedule as many different or same events as you wish for that day, and you can repeat the pattern daily, weekdays, weekly or monthly. This is simplicity at its best. Furthermore, there's a custom option that lets you create odd repetition patterns, such as every other Tuesday.

In my opinion, this is the best backup program in the review. It's fast, full featured, easy to use and can be found on the street for less than $100. *Norton Backup* can also be found in the award-winning *Norton Desktop for DOS*.

Norton Backup for Windows 2.2

To create Norton Backup for Windows, Symantec simply ported the *Norton Backup for DOS* code to the *Windows* platform. This is a smart move because there are no speed hits or compromises in the translation. The program runs faster under *Windows* than most DOS backup programs, and it's every bit as easy to install and use as its DOS counterpart.

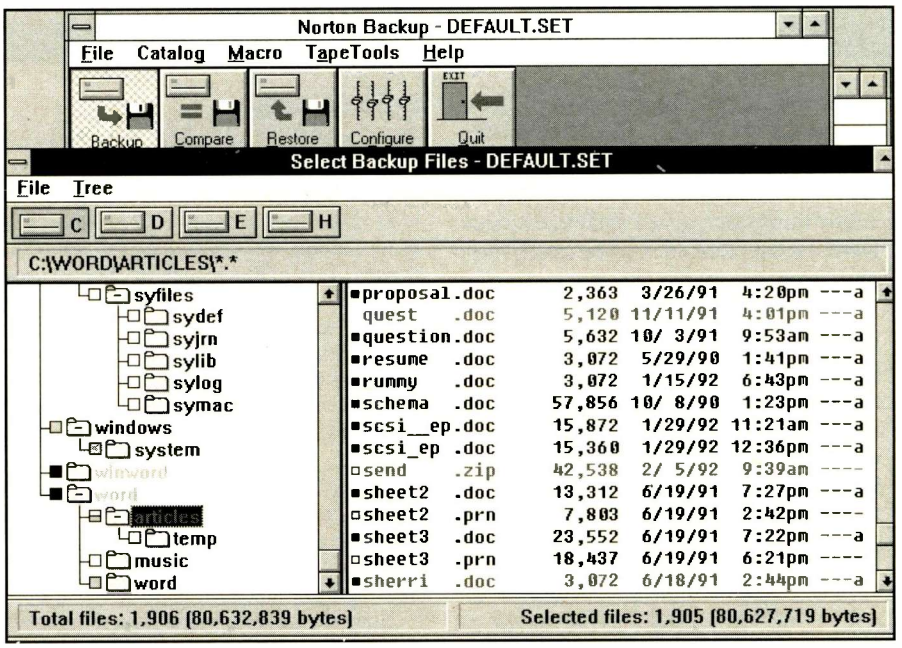
However, done a better job could have been done on the interface, where it takes more mouse clicks to get to the directory tree than it does in the DOS version. But this is a small price to pay for background operation that lets you backup while continuing with your daily work. And once you've set up your schedule, chances are good you'll never have to bother with it again.

The scheduler is identical to its DOS sibling in every respect. You still have daily, weekdays, weekly and monthly backup options. You also get the custom option that lets you roll your own.

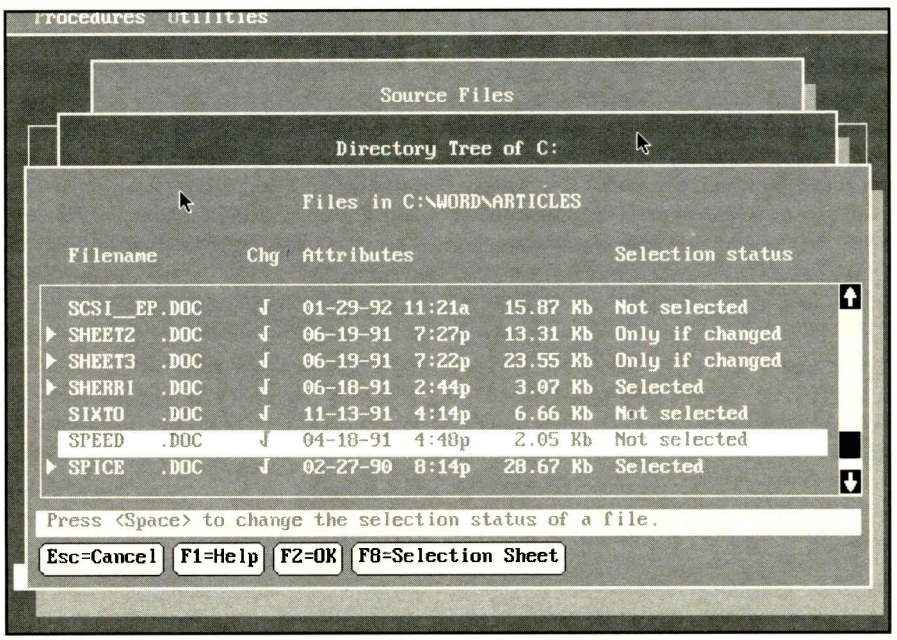
If you're a *Windows* user who likes what *Norton Backup for DOS* offers, *Norton Backup for Windows* is the ticket. Symantec tags on an extra $20 for its efforts, listing *Norton Backup for Windows* for $149. It's almost embarrassing to suggest that you purchase the $179 *Norton Desktop for Windows* 2.2 package that includes the full backup program plus data recovery tools, virus scanning and lots more.

Sytos Plus 1.41

Sytron has long been a player in the tape-backup arena and has come to gain the respect it deserves. So when you buy *Sytos Plus*, you know it's a quality product with no surprises. Moreover, it has the widest range of support for high-



Norton Backup for Window runs faster than most DOS backup programs.



Sytos Plus has great support for high-capacity SCSI and DAT tape drives.

Backup Software Reviewed Here

	Central Point Backup 8.0	Central Point PC Tools for Windows 1.0	Fifth Generation Fastback Plus 6.0	Gazelle Back-It 4 1.4	Gazelle Back-It for Windows 1.2	Symantec Norton Backup for DOS 2.2	Symantec Norton Backup for Windows 2.2	Sytron Sytos Plus 1.41
Features								
List price	$129	$179	$149	$79	$79	$129	$149	$225
RAM used	8K	none	1K	2K	1K	9K	none	2K
Windows application	N	Y	N	N	Y	N	Y	N
Checks hard disk	Y	Y	Y	Y	Y	Y	Y	N
Virus scanning	Y	Y	Y	N	Y	N	N	N
Restores from damaged floppy	Y	Y	Y	Y	Y	Y	Y	N
Warns before overwriting newer file	Y	Y	Y	Y	Y	Y	Y	Y
Can include and exclude hidden files	Y	Y	Y	N	N	Y	Y	Y
Password protection	Y	Y	Y	N	N	Y	Y	Y
Encryption	Y	Y	Y	N	N	N	N	Y
Backup								
Select files from tree display	Y	Y	Y	N	Y	Y	Y	Y
Select files by wild card or date	Y	Y	Y	Y	Y	Y	Y	Y
File list shows size, date, time.	Y	Y	Y	N	Y	Y	Y	Y
Estimates backup time and size	Y	Y	Y	Y	Y	Y	Y	Y
Restore								
Restores files to different drive or directory	Y	Y	Y	Y	Y	Y	Y	Y
Restores to subdirectories under new file name	Y	Y	N	N	N	N	N	Y
Select directories and files from tree display	Y	Y	Y	N	N	Y	Y	Y
Select files by wild card	Y	Y	Y	Y	Y	Y	Y	Y
Select files by date	Y	Y	Y	N	N	Y	Y	Y
Estimates restore time	Y	Y	N	N	N	Y	Y	N
Backup media supported								
Floppy disk	Y	Y	Y	Y	Y	Y	Y	Y
QIC 40/80	Y	Y	Y	Y	Y	Y	Y	Y
SCSI	Y	Y	Y	Y	Y	N	N	Y
DAT	Y	Y	Y	Y	Y	N	N	Y

capacity SCSI and DAT tape drives of any program in this review. But you pay a high price for it in cost and ease of use.

To create and edit backup sets, you must negotiate several screens to reach the directory tree, where the file listings reside. The path back to the main menu is just as winding. Finding files to restore is similarly tedious, except that this time, you wade through backup sets instead. Unlike Gazelle's *Back-It*, however, *Sytos Plus* will do the restore-file search for you, examining each backup set from first to last until changed or missing files are found. This means that a partial restore can take longer than a full backup. Fortunately, it will run by itself if you want to slip out for lunch instead of waiting.

The scheduler is eloquently simple yet just as powerful as those found in Central Point and *Norton* backup programs. Instead of calendar pages, *Sytos Plus* uses a form that has ruled lines for every hour of the day. To schedule a backup, simply enter the name of the backup set on the desired time line. Like all good schedulers, you can use one day as a template to replicate the same schedule daily, weekly or monthly.

Unfortunately, *Sytos Plus* won't run if there's any CPU activity whatsoever. In other words, you can't load your modem TSR before going home if *Sytos Plus* is scheduled to back up your hard disk that night. But it does have some charming features, such as a move function that copies files to the backup media, compares them and then erases the originals. It's also the easiest backup program to install.

Two years ago, *Sytos Plus* was a hot item because it supported high-capacity SCSI and DAT drives. Unfortunately, this isn't enough to cut it in today's highly competitive marketplace. Its high $225 sticker price and difficulty of use simply make it unattractive. ■

What About DOS 6.0 Backup?

Although Microsoft's MS-DOS 6.0 backup program is licensed from Symantec's *Norton Backup for DOS*, it doesn't support tape drives. Microsoft took out all the features it thought would engender a call to technical support. So tape support got the ax. And while it supports floppy-disk backup, it does it without ECC (error-correction code), DMA (direct memory access) or data compression.

"My fortune cookie says, 'You can never have enough memory or too many drive bays."

Addresses

Central Point Software
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Beaverton, OR 97006
Tel.: 503-690-8088; fax: 503-690-8083

CIRCLE NO. 131 ON FREE INFORMATION CARD

Fifth Generation Systems, Inc.
10049 N. Reiger Rd.
Baton Rouge, LA 70809
Tel.: 504-291-7221; fax:504-295-3268

CIRCLE NO. 132 ON FREE INFORMATION CARD

Gazelle Systems, Inc.
305 N. 500 West
Provo, UT 84601
Tel.: 800-786-3278; fax: 801-373-6933

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Symantec Corp.
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Cupertino, CA 95014
Tel.: 408-253-9600; fax: 408-446-9750

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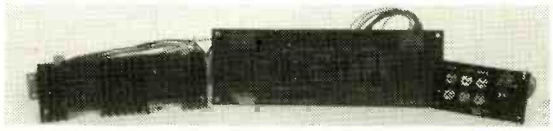

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LS04	.19	LS125	.30	LS253	.40
LS05	.19	LS126	.35	LS257	.35
LS08	.19	LS132	.35	LS258	.45
LS09	.19	LS133	.35	LS259	.50
LS10	.19	LS136	.28	LS60	.40
LS11	.19	LS138	.35	LS266	.30
LS12	.20	LS139	.35	LS273	.55
LS13	.30	LS145	.50	LS279	.30
LS14	.35	LS148	.35	LS280	.70
LS15	.25	LS151	.35	LS283	.35
LS20	.19	LS153	.35	LS290	.50
LS21	.21	LS154	1.00	LS293	.50
LS22	.21	LS155	.40	LS298	.65
LS26	.19	LS156	.40	LS299	1.00
LS27	.25	LS157	.35	LS322	1.30
LS28	.20	LS158	.25	LS323	1.25
LS30	.19	LS160	.25	LS348	.75
LS32	.20	LS161	.35	LS353	.75
LS33	.25	LS162	.45	LS357	.80
LS37	.24	LS163	.36	LS363	.75
LS38	.24	LS164	.45	LS364	.75
LS42	.35	LS165	.50	LS365	.30
LS51	.20	LS166	.50	LS366	.28
LS54	.20	LS169	.70	LS367	.35
LS55	.20	LS170	.45	LS368	.30
LS73	.33	LS173	.37	LS373	.55
LS74	.25	LS174	.35	LS374	.55
LS75	.25	LS175	.35	LS375	.55
LS83	.30	LS181	1.25	LS377	.70
LS85	.40	LS191	.45	LS378	.80
LS86	.20	LS192	.50	LS390	.70
LS90	.35	LS193	.50	LS393	.60
LS92	.30	LS194	.50	LS399	.70
LS93	.25	LS195	.52	LS541	.80
LS95	.30	LS196	.40	LS640	.55
LS96	.33	LS197	.40	LS45	.75
LS107	.28	LS221	.45	LS646	.75
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Modems and Protocols

What you need to know to put the world at your fingertips

Adding a modem to your computer system gives you a gateway to fast communications, billions of bytes of on-line information—and enduring frustrations. Even if someone else does all the work and thought for you, sets up your computer and modem and writes a batch file that logs you onto MCI Mail, CompuServe or a favorite BBS, you'll eventually run into the industry's mish-mash of buzzwords and quasi-standards. You may be at a user group meeting, for example, and hear someone say that his BBS runs at 8N1, uses a V.32bis modem with MNP5 and now has full Kermit, XModem, YModem and ZModem support. Is this cause for celebration and congratulations? Or should you just shake your head at this megadose of technobabble?

Modems and modem communication can be confusing, partly because of rapid technological advances and partly, I suspect, because they're one of the last refuges of techie hobbyists. After all, even the fastest CPUs and video screens are no longer much more than computer store commodities. But almost every month brings a new wrinkle to modem communications, one that can be debated, tested and either accepted or rejected by technical users.

If you don't know the language and at least some of the standards, you can end up paying far too much for an underpowered modem or unnecessary long-distance charges. A little knowledge can be a powerful tool for getting the best deals.

Error Detection, Correction and Data Compression Standards

MNP Level 1	Half duplex (one direction transmission at a time) error checking. Slows transmission by about 30%.
MNP Level 2	Full duplex error checking. Slows transmission by about 16%.
MNP Level 3	Synchronous full-duplex between modems. Puts data in packets and removes UART control bits. Speeds transmission by about 8%.
MNP Level 4	Either synchronous or asynchronous. Adjust packet size to line conditions. Smaller packet overhead than Level 3. Includes automatic error correction. Speeds transmission by up to 22%.
MNP Level 5	Same error correction and packets as Level 4. Also has on-the-fly data compression and decompression. Slower than Level 4 with files that are already compressed. Up to twice as fast with uncompressed files.
MNP Level 6 Through 9	Increased data compression and error correction, plus refinements for use with V.32 modems.
MNP Level 10	Used only for Microcom's cellular modem.
LAPM	Error detection and correction specified in CCITT V.42 standard. V.42 modems use MNP Levels 4 through 1 when an LAPM connection can't be made. The V.42bis standard adds data compression.

Communication Parameters

A modem's job is to convert serial data from your computer into tones that can be sent over a telephone line. The modem on the other end of the line interprets these tones, converts them back into serial data and sends the data to its computer.

In a PC-compatible computer, the internal translation from computer data to a serial bit stream is handled by a UART (universal asynchronous receiver and transmitter) chip that essentially controls a serial port on your computer. It's the UART's job to turn a byte of data into a stream of serial bits or to turn a stream of bits into a byte of data.

Because the data transmission is asynchronous, which means that data is sent and received at random times instead of synchronized to a shared clock tick, each byte needs a digital "frame." The sending and receiving UARTs use this frame to identify the beginning and end of each byte.

Each package or frame of data must have a start bit. It can have from five to eight data bits. Five bits were used by old teletype machines to transmit uppercase letters and a few pieces of punctuation. Seven bits per data are sufficient for transmitting normal ASCII data, while eight bits are needed from compressed files, graphics images, program files and other non-ASCII data.

Data bits can be followed by an optional parity bit, which can be turned on if the number of 1s in the data block is even or odd, and by 1, 1.5, or 2 stop bits (1.5 bits can be used only with frames that hold five data bits).

It's important to set the frame parameters the same for both sending and receiving UARTs. If they're not set the same, the receiving UART will misinterpret the data it receives and the transmission will be garbled. The most-common set of parameters used today are 8N1 (eight data bits, no parity bit, one stop bit), which is used by most BBSes and some on-line services, and 7E1 (seven data bits, even parity, one stop bit), which is used by on-line services like CompuServe. Most communication program let you attach a set of UART parameters to each telephone number you call frequently so that communication proceeds automatically once you select a number to call.

The UART also has a speed setting, measured in bits per second (bps) that's the speed the computer uses to communicate with the modem. Often, but not always, it's also the speed at which the sending and receiving modems use to communicate with each other. The speed choices range from 110 to 115K bps, a range of three magnitudes. If computer-to-modem, or UART, communication

Modulation Standards

Speed	US	Europe
300 bps	Bell 303	CCITT V.21
1,200 bps	Bell 212A	CCITT V.22
2,400 bps	CCITT	V.22bis
4,800 bps	CCITT	V.32
9,600 bps	CCITT	V.32bis
28,800 bps	CCITT	V.Fast (Not Yet Finalized)

rate isn't at least as fast as the modem-to-modem rate, communication will slow down. Your modem will be starved for data when it's sending because your computer won't be able to keep up with it. On the other hand, your computer will be overwhelmed with data when it's receiving and will probably lose much or all of the data being transmitted.

Compared to the relatively simple UART, the modem has a difficult task. Its most important job is to work as both a D/A and A/D converter, turning digital data from the computer into analog data that can be sent over the phone lines. But, unlike most converters, it must work with analog tones, not voltages. Also, a modem has to be prepared to deal with the vagaries of phone lines—both the trunk lines, which can include satellite links with noticeable delays, and the local "loops" that run from the telephone company switching office to each home and business. The bandwidth of telephone lines is strictly limited, which allows the phone company to multiplex many calls over each physical line.

Because a modem works with tones rather than voltages, it's technically a MOdulator/DEModulator (hence its name). Modems use tones in a way specified by US and international standards. US standards for early modems were specified by Bell Labs. For the past several years, modem makers have followed international standards established by CCITT (the Consultative Committee on International Telephony and Telegraphy).

Like UART speeds, modem speeds are measured in bits per second. You may hear the word "baud" as a synonym for bps. It really isn't. A baud is a change of state and is a measure of how fast the tones change that the modem has generated. The 300-bps modems that were popular more than a decade ago put one bit into every baud, changing the tone from one pitch to another to indicate a 0 or 1 bit. But when a modem runs at 1,200 bps or faster, which includes almost every modem in use today, it sends more than one bit per baud. Although modems that can run at 14,400 bps or faster are easily available, no modem uses a baud rate that even comes close to this speed.

The 300-bps modems followed the Bell 103 standard. The calling modem claimed a pair of tone frequencies and the answering modem claimed another

pair. Each modem used one frequency to send a 1 and the second frequency to send a 0. The standard specified which frequencies each modem could use.

Most 1,200-bps modems manufactured in this country followed the Bell 212A standard, packing two bits per baud. The Bell standards were widely accepted in the US, but European manufacturers followed the incompatible V.21 and V.22 CCITT standards for 300- and 1,200-bps modems.

When manufacturers began to develop 2,400-bps modems in the late 1980s, there was no Bell standard to follow. Also, since overseas modem calls were become frequent, there was no reason to keep the US on a different standard. Consequently, they adopted the CCITT V.22 and V.22bis standards. V.22 was used when the modems ran at 1,200 bps; V.22bis for 2,400 bps. Both run at 600 baud, stuffing either two or four bits into each state change.

Virtually all modern modems can perform at 2,400 bps or faster. The slower speeds are kept only to maintain compatibility with some older and slower modems. When two modems connect over a telephone line, they negotiate what speed and other features to use, trying to maintain as fast a data flow as possible. Most modems will drop down to 2,400, 1,200, and eventually 300 bps to find a compatible speed with the machine on the other end of the line.

So far, things are easy with two generally unused standards for 300 bps, two more for 1,200 bps and a worldwide standard for the popular 2,400 bps. But manufacturers developed a number of techniques to increase both the reliability and the data flow of 2,400 bps modems. Both led to a number of proprietary, public-domain and CCITT-recognized standards.

Telephone lines are inherently noisy. Static, crosstalk from multiplexed conversations, satellite link delays and other everyday problems make modem communication less than 100% reliable. But if a modem can detect an error, or perhaps even correct errors in the data it receives, users can have much more confidence in the data they receive through their modems.

Modem-based error detection requires that both sending and receiving modems use the same data protocols and that the receiving modem can ask the sender to re-transmit data that appears to contain errors. The sending modem retransmits the data until it's either correctly received or a time-out is reached, either at the end of a specified amount of time or a certain number of unsuccessful re-transmissions. If the modems time-out, they agree to disconnect.

The first type of error detection you might see is ARQ or automatic request for repeat. This is a generic name for the error-detection schemes discussed below. Some USR and Hayes modems report "CONNECT/ARQ" when they con-

nect to another modem and agree to use any error-detection or error-correction technique.

The best-known error-checking technique is called MNP (Microcom Network Protocol), which was developed by Microcom for its own modems. Microcom has placed MNP Levels 1 through 4 in the public domain, and they have become part of a CCITT standard. All four of these protocols, which are almost always implemented on a ROM chip inside the modem, can detect errors and request the transmitting modem (if it supports the same MNP level) to retransmit data.

Beginning with MNP Level 4, the receiving modem can detect errors and often fix them without requiring retransmission. MNP Level 5 and up, over which Microcom has proprietary control, add various kinds of data compression. The sending modem compresses data in much the same way as disk-compression programs compress files. The receiving modem reconstructs the original data. Since it's faster to compress or decompress data than it is to transmit it over a phone line, these compression techniques speed up transmission rates for most files. However, if they're used to transmit data that has already been compressed—for example, a .ZIP file—they can actually slow transmission as they struggle to remove redundancy from a file that has none.

Since Microcom retains license rights to MNP Level 5 and greater, manufacturers on the CCITT modem committee needed a different standard to compete. They developed standard V.42, which includes error detection and correction using LAPM (Link Access Procedure for Modems). The improved standard, V.42bis, adds data compression. A V.42 or V.42bis modem first tries to establish an LAPM link to the modem on the other end of the line. If this fails, it falls back to MNP Level 4 and, if necessary, works down through MNP Levels 3, 2 and 1. If all these attempts fail, it establishes a "normal" connection with the other modem. These connection negotiations occur quickly as the two modems try to connect to each other.

V.42 and V.42bis are error-detection/correction and data-compression standards. With the proper kinds of files (most often, spreadsheets and some databases), use of V.42bis compression or one of the higher MNP levels of compression, can triple the data transmission speed. A 2,400-bps V.42bis modem can transmit some files at an average throughput speed of 9,600 bps, for example. But be careful that you don't buy one thinking you're getting a true 9,600 bps modem.

The V.42 standards don't specify an underlying speed. Any modem from rated at 1,200 to 14,400 bps or faster can follow the V.42 standards. The language used to advertise such modems can be truthful, follow the CCITT standards and still be very confusing for consumers. A modem that is "V.42-compliant" is one that can use LAPM for error correction and detection and can use MNP Levels 1 through 4 as a backup. One that's "V.42-compatible" is simply a modem that includes support for MNP Levels 1 through 4 and doesn't support LAPM for faster throughput. And a modem that's "V.42bis compatible" uses CCITT data-compression techniques when it's connected to another V.42bis modem.

The real speed demons in the modem world follow the relatively new V.32 and later standards. V.32 modems transmit at a true 9,600 bps and have become the "standard" and often cost only a small amount more than almost-outdated "standard" 2,400-bps modems of a year or two ago. V.32bis modems, which are already popular, run at 14,400 bps. V.32terbo, which is not a CCITT standard but was developed by AT&T, Penril and Data Race, runs at 19,200 bps. It appears that other manufacturers may ignore this pseudo-standard.

Finally, CCITT is developing a V.fast standard. When the standard is completed and V.fast modems start appearing in six months to a year, they'll run at 28,800 bps. Don't confuse V.fast with Codex V.Fast, a 24,000-bps modem manufactured by Motorola.

All of these fast modems can include MNP and/or V.42 and V.42bis support to increase data transmission speeds even more. Also, most modern modems include built-in fax capabilities. The fax portion of the modem should meet CCITT standards V.17 (14,400 bps, which is a new and emerging standard), V.29 (9,600 bps, the "standard" of the last several years) or V.27ter (4,800 bps, which is an outmoded fax standard still found in older machines).

Any modem that includes data compression (MNP 5, V.42bis, etc.), should have two speed ratings. The first is the speed the modem will use to optimally exchange data with another modem. The second is the rate of data exchange with your computer. If a modem can compress data and send the result at 9,600 bps, it will need more than 9,600 bps from your computer, often called DTE Most V.32bis modems that include some kind of data compression have DTE speeds in excess of 57,000 bps. Some have DTE speeds of 115,000 bps. But remember that you'll rarely use the full DTE speed capability. The data transmission speed will continue to be the limiting factor.

Software Protocols

Modems are (usually) controlled by communication programs, which can use the modem to dial telephone numbers, automatically send log-on sequences and passwords and provide a number of other amenities. While it's possible to run a modem directly from the DOS prompt with no intervening communication program, it's rarely convenient to do so.

Whether you're calling a BBS, national mail service or on-line service, when two communication programs first make contact with each other through their respective modems, they're in command or chat mode. Each program normally sends a character or a line at a time, and you, as the computer operator, have the ability to control the flow and speed of the communication.

This single-line mode is great for interactive use of a BBS or on-line service. But it's useless if you want to transfer a file. The communication programs have to agree on how the file is named, how it will be sent, how both sides will know that it arrived without any lost or damaged bytes and how both programs will know when transfer is complete.

Most communication programs include several file-transfer protocols, and most BBSes and on-line services support several different protocols. The trick is to select the protocol that will move the file from one computer to the other most quickly and with the least chance of corruption.

The oldest and best-known file-transfer protocol for microcomputers is X-Modem, which was written in 1977 for CP/M computers. It has since been implemented, in one of its many forms, in thousands of communications programs, BBSes and on-line services.

In an XModem (which is occasional-

ly called Modem7) file transfer, a file is divided into 128-byte blocks. After some very short preliminaries, the sending program puts each block into a packet that contains a header, the packet number, the 128 bytes of data and a one-byte checksum. The receiving program verifies the packet number and then calculates the checksum on the data it receives. If both checksums agree, the receiving program adds the data to the file it's receiving on-disk or in memory. It then sends an acknowledgment (ACK) that the packet arrived safely.

If the checksums don't agree, the receiving program sends a negative acknowledgment (NAK). It then waits for the sending program to transmit the packet again. Either side can abort the transfer if too many retries are necessary or if a packet or acknowledgment isn't received within a specified time.

Because the XModem protocol uses a simple checksum, there's about a 5% chance that a corrupted packet will be accepted as valid. An enhancement called XModem/CRC uses a two-byte CRC calculation instead of an eight-byte checksum to validate each packet. This enhancement decreases the chance of an "acceptable" corrupted packet to less than 1%.

One of the least-efficient parts of XModem file transfers is the delay between the time the sender transmits the last byte of a packet and when the receiver sends the ACK (or NAK) to signal that it wants the next packet (or a re-transmission). A somewhat more-efficient form of XModem, called WXModem or Windowed XModem, reduces the delay by letting the sender start the next transmission before it receives verification of the previous packet. WXModem allows the sender to be up to four or five blocks of the receiver. Because each ACK or NAK includes the packet number in question, neither side should ever become confused about how to handle the next step in transmission. On a relatively clear phone line, WXModem can be significantly faster than standard XModem.

A second, related protocol, called YModem, is most useful for transferring large files. It uses 1,024-byte blocks and is faster when there are few errors. However, if the sender has to re-transmit several blocks, YModem can be slower than XModem.

YModem-G and some other forms of YModem are streaming, which means they send data without any error checking. Therefore, YModem is often used when the modems perform error detection or correction themselves. YModem can have some problems with MNP Level 5 but works very well with modems that support MNP 4.

ZModem is generally faster than implementations of XModem and YModem because it doesn't rely on ACKs from the receiving computer. Instead, it assumes that its 512- or 1,024-byte blocks have been successfully received. It does react to NAKs from the receiving modem, using them as a signal to retransmit a block. ZModem, like YModem, is a good choice to use with hardware error detection and correction.

The Kermit protocol, created at Columbia University in 1981, is enjoying something of a resurgence. Kermit (named after the frog) was designed to work well on mini- and microcomputers, mainframes and time-share systems. It can use either seven or eight data bits (all of the above protocols shift the UART into eight-bit mode for file transfers) and variable-length data packets and can adapt itself to various line conditions. Kermit can even re-synchronize a transmission that has been interrupted by severe line noise, something the other protocols can't do.

Finally, there are many dozens of proprietary protocols that are either meant to be used with a specific communications package or are optimized for a particular on-line service. For example, B Protocol (actually, a family of protocols) is much more efficient for file transfers through the multiple layers of CompuServe's networks than any of the popular BBS protocols. But this doesn't mean that B would be a good choice for a local BBS. ZModem would almost always be faster.

Selecting and Using a Protocol

Almost all communication programs include several file-transfer protocols, as do almost all BBSes and on-line services. When you want to transfer a file, you must select a protocol that both sides recognize and can use. If your computer is using XModem and the remote computer is using Kermit, for example, nothing but chaos will result.

Even with this minor restriction, you'll likely find that you have two or three protocol choices for every download. Which should you pick? If you're using a service like CompuServe that has its own proprietary protocol, use this if you can. It will almost always be the fastest, most-efficient choice. Otherwise, select the protocol that best fits your modem. ZModem is almost always a good choice if it's available. Also, YModem-G works well if both modems are using MNP Level 4. When I'm not sure about the capabilities of the modems, I almost always turn to XModem simply because I've used it so many times over the years. XModem and Kermit will almost always work, although they may not be the fastest choices available to you.

Unfortunately, file-transfer protocols don't specify a required user interface. For some, you use a menu or command structure to tell the remote computer what file to send to you or what to call the file you're going to send to it. Then issue whatever commands your software requires to start the transfer and give the name of the file on your end.

Other protocols require that you tell either your computer or the remote computer both file names. Then the computers negotiate the transfer without further intervention from you. You'll have to read the documentation for your communication program to see how it works. Luckily, most BBSes and on-line services do everything they can to make the file-transfer commands easy for both novices and experienced users to use.

If you really have trouble, most BBSes and on-line services have message boards where you can post requests for help. Everyone one the system once needed help, and almost everyone will be happy to offer advice. On-line services usually have a technical-support telephone line. You can use such lines to discuss your difficulties with real people, not computers and modems.

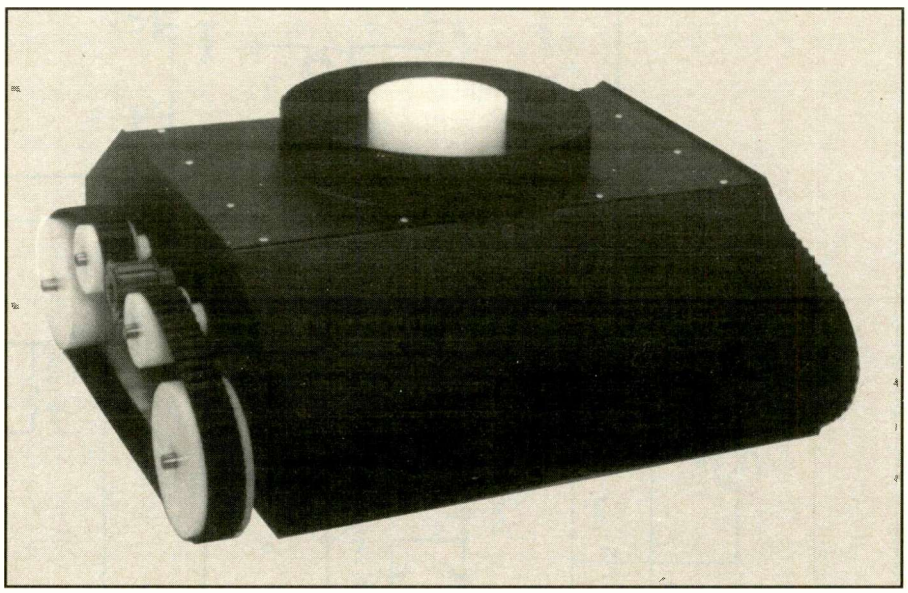
If you aren't familiar with modems, communication programs and file protocols, it probably sounds incredibly complicated. It really isn't. Once you have your hardware and software, you'll probably find them so convenient to use that you'll forget the details and just enjoy the benefits of both. Without them, your computer is isolated, but with them, you will have the entire world at your fingertips. ■

Build a Real-World Work Robot

Part 2

Adding the tractor-motor drive and batteries

Last month in Part 1 of this article, I detailed the mechanical construction of the RONAR (Remotely Oriented Numerically Actuated Robot) Robot's tractor drive base. This month, I'll show you how to construct the drive-motor electronics and hook up the batteries.



Drive Theory

Because you'll want to be able to use your Robot as the basis for many different types of tasks and experiments, you need a flexible and reliable track-motor controller. The RONAR Robot can be made to move forward and backward at 10 different digitally-controlled speeds and turn left and right while moving forward, backward and even standing still. Making turns is accomplished by rotating the left or right track motor while holding the other track motor stationary. Operating like a military tank or bulldozer, RONAR is easy to control and can be used on a variety of surfaces.

The standard drive-base track configuration is ideally suited for wood, carpet, concrete and asphalt surfaces. Because RONAR's electronic drive system is pro-active, it can drive the two tracks in opposite directions simultaneously. This is particularly important when turning the Robot in tight spaces and when "station-keeping" while the RONAR is tracking a moving object.

RONAR uses reversible "gear-head" dc track-drive motors. Although designed to use a 12-volt battery system, you can modify the Robot to operate on 24 volts if you need greater speed and power.

Shown in Fig. 1, is the schematic diagram for the motor controller circuitry. MC68HC705C8P microcontroller *U2* is at the heart of the pulse-width-modulated (PWM) motor speed controller circuit. A separate drive card is needed for each track to simplify system software requirements and keep the unit as modular as possible.

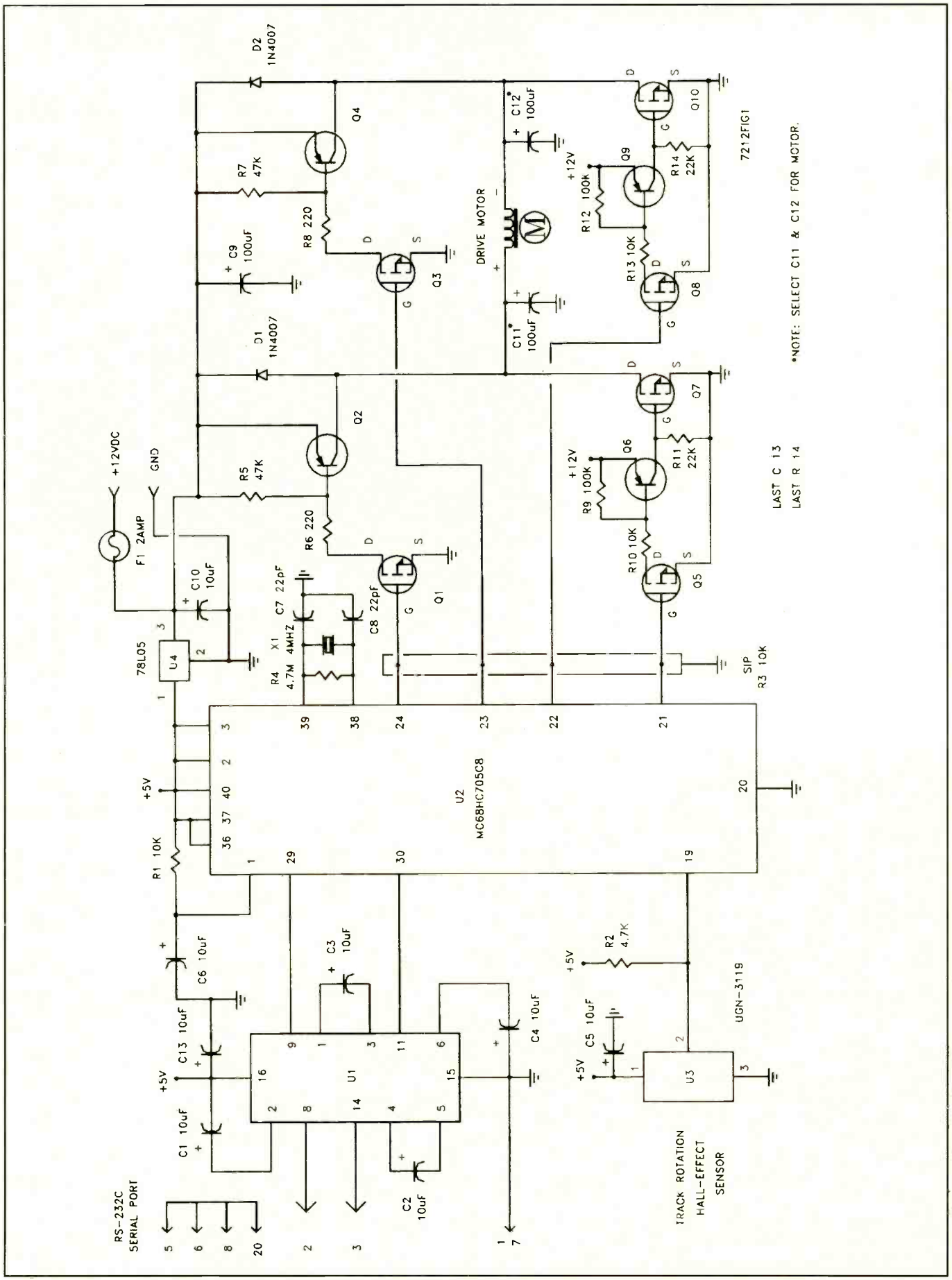
Firmware in *U2* accepts digital motion-control commands from the MAX-232 *U1* interface chip. Use of a MAX-232 lets RONAR be controlled directly from a standard RS-232C serial port. If you wish to drive the card directly from an on-board serial port (TTL signal levels), eliminate *U1* and jumper across the input and output pins.

The internal oscillator frequency of *U2* is set by 4-MHz crystal *X1*, resistor *R4* and capacitors *C7* and *C8*. The power-on reset function is provided by timing capacitor *C6* and resistor *R1*. It's applied to *U2* at pin 1. Fixed +5 volt regulator *U4* converts +12 volts from the batteries into a stable +5-volt source for *U1*, *U2* and *U3*.

Hall-Effect Sensor *U3* connects to *U2* at pin 19. Resistor *R2* provides pull-up for *U3*'s output pin. One or more pellet magnets, mounted on the rear 4" UHMW drive wheel, interact with *U3* and provide *U2* with positional data. This closed-loop approach ensures that RONAR knows exactly how far it has moved in a particular direction. Additionally, if RONAR is carrying a heavy load, *U2* can compensate by supplying enough power to one or both tracks to maintain normal drive speed. When parked on a grade or incline, RONAR can be made to apply its "parking" brakes, which works by applying enough energy to the drive motors to hold them in position without letting the unit move or roll.

Don't let the rather complex arrangement of power devices intimidate you. The circuit is really very easy to understand when you break it into sections. Firstly, only four digital outputs from *U2*, at pins 21 through 21, control motor speed and direction as follows: Pin 21 provides PWM forward speed control; pin 22 provides PWM backward speed control; pin 23 provides a move-backward control signal and is active-high; and Pin 24 provides a move-forward control signal and is also active-high.

Connecting a 12-volt battery to the drive motor makes the motor rotate in one direction. To reverse direction, you simply reverse the positive and negative battery lines to the motor. RONAR electronically switches battery polarity to the motor to effect reversal. Field-effect transistors *Q7* and *Q8* are grounded through their source leads. When +12-volts is applied to the bases of these FETs, their drain leads are able to sink current to ground.


D2 1N4007
Q4
R7 47K
R8 220
C9 100uF
Q3
D1 1N4007
C12* 100uF
C11* 100uF
DRIVE MOTOR
Q10
Q9
R14 22K
R12 100K
+12V
R13 10K
Q8
7212FIG1
*NOTE: SELECT C11 & C12 FOR MOTOR.
Q2
R5 47K
R6 220
Q1
Q7
Q6
R11 22K
R9 100K
R10 10K
Q5
LAST C 13
LAST R 14
+12VDC
GND
F1 2AMP
C10 10uF
78L05
U4
X1 4MHZ
C7 22pF
C8 22pF
R4 4.7M
SIP R3 10K
U2 MC68HC705C8
R1 10K
+5V
C6 10uF
C3 10uF
C13 10uF
C1 10uF
U1
C2 10uF
C4 10uF
R2 4.7K
C5 10uF
U3
UGN-3119
TRACK ROTATION HALL-EFFECT SENSOR
RS-232C SERIAL PORT

PARTS LIST

Semiconductors
D1,D2—1N4007 rectifier diode
Q1,Q3,Q5,Q8—VN0300 HexFET (Siliconix)
Q2,Q4—MJE-2955 pnp power transistor
Q7,Q10—IRF-512 HexFET (IR)
Q6,Q9—MPSA56 pnp signal transistor
U1—MAX-232 serial interface
U2—Pre-programmed MC68HC705C8P (Motorola)
U3—UGN-3119 Hall-effect sensor
U4—78L05 fixed +5-volt regulator

Capacitors
C1 thru C6,C10,C13—10-µF, 16-volt electrolytic
C7,C8—22-pF, 50-volt ceramic disc
C9,C11,C12—100-µF, 16-volt electrolytic

Resistors (1/4-watt, 5% tolerance)
R1,R10,R13—10,000 ohms
R2—4,700 ohms
R3—10,000 SIP Pack
R4—4.7 megohms
R5,R7—47,000 ohms
R6,R8—220 ohms (1/2-watt)
R9,R12—100,000 ohms
R11,R14—22,000 ohms

Miscellaneous
F1—2-ampere miniature fuse and holder (size depends upon motor used)
X1—4-MHz crystal
Printed-circuit board (see text); two TO-220 heat sinks; four 4-40 x 3/8" screws; four 4-40 Keps nuts; heat-sink compound; 40-pin IC socket; 1/2" round Hall-effect magnets; machine hardware; hookup wire; solder; etc.

Note: The following items are available from CYANCE KIT, 14786 Slate Gap Rd., West Fork, AR 72774 (tel.: 501-839-8293 voice mail or 501-839-8221 fax): Ready-to-wire Motor Controller printed circuit board, $9.95; preprogrammed MC68HC705C8P, $19.95; complete kit of all parts for one complete RONAR Motor Controller card (includes pc board, preprogrammed IC, semiconductors, resistors and capacitors), $64.95. Add $5.89 insured UPS S&H (continental US).Arkansas residents, please add state sales tax. Call for information on complete RONAR kits or our new color catalog of over 70 kits. Check, money orders, MC/ Visa welcomed.

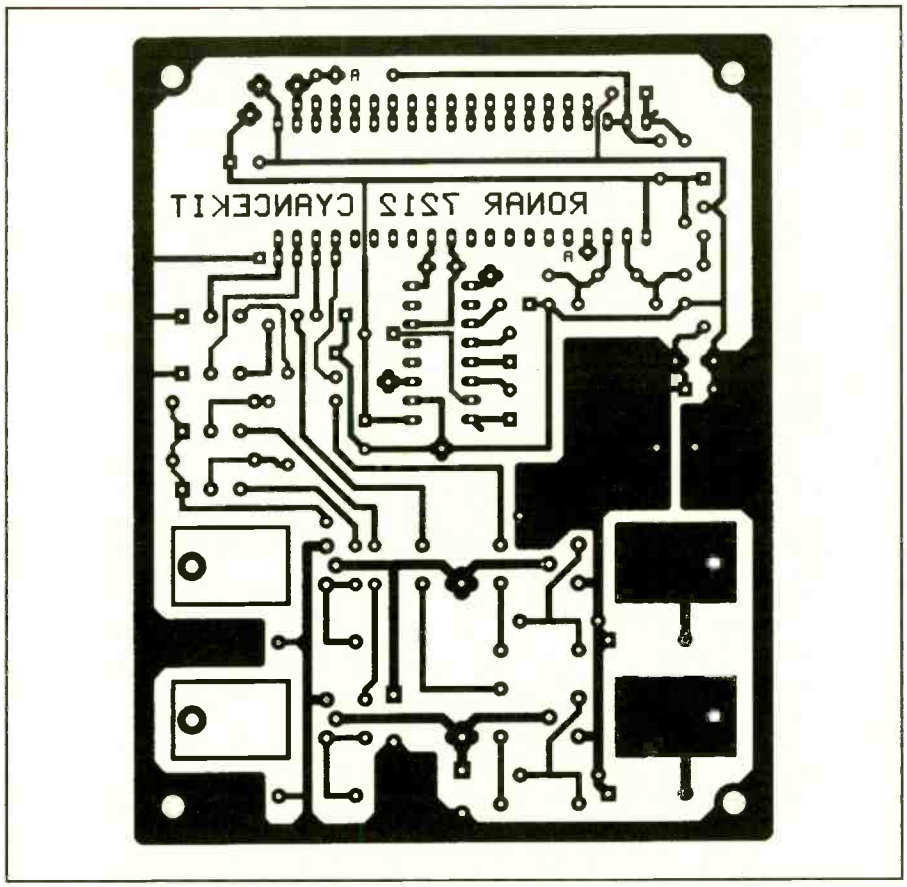


Fig. 2. Use this actual-size artwork for fabricating your own printed-circuit board on which to wire the motor-drive circuit.

Imagine for a moment that the + side of the motor is connected to +12 volts. If you were to connect the – side of the motor to ground, the motor would rotate in a clockwise direction. Now, if you disconnect the – side of the motor and let *Q10* do the grounding, when *U2* wants to move RONAR backward, it simply applies +5 volts to the base of *Q10*. As *Q10* switches into conduction and its drain falls to near ground potential, motor current increases and RONAR moves backward. In a similar fashion, *Q7* can be employed as a switchable ground to move RONAR forward.

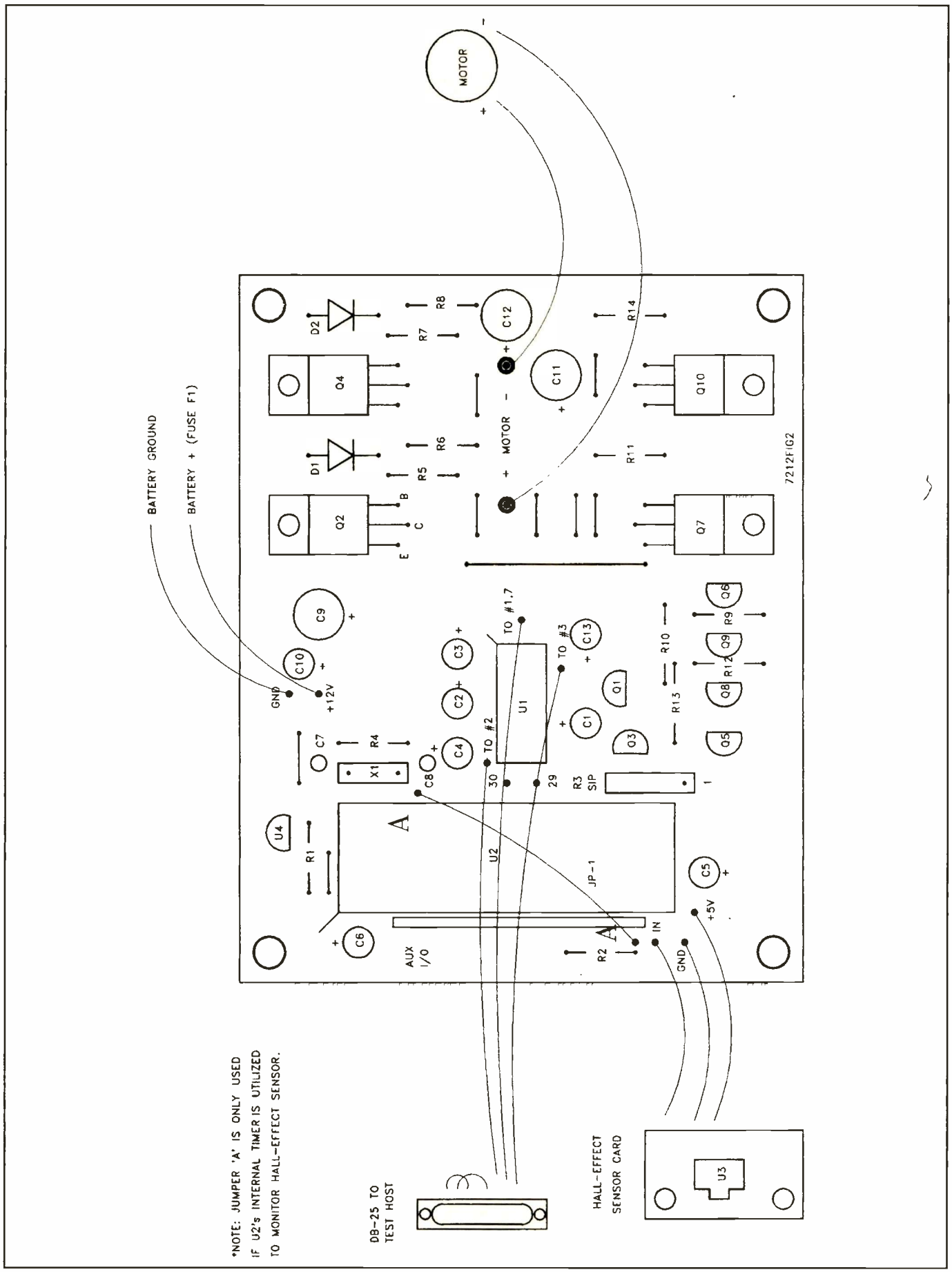
Because *Q7* and *Q10* require more than +5 volts to switch reliably, FETs *Q5* and *Q8* and pnp transistors *Q6* and *Q9* are required to level-shift the +5 volt control output from *U2* to the needed +12 volts. Notice that the source of *Q5* is grounded and that the base is connected directly to pin 21 of *U2*. As *U2* applies a "high" (+5 volts) to pin 21, *Q5* switches on and pulls its drain toward ground. The Base/Emitter current in *Q6*, limited by *R10*, causes the collector to pull-up and gate on *Q7*. A similar action in *Q8* and *Q9* switches *Q10* whenever pin 22 of *U2* goes high.

FET Q1 also has its source connected directly to ground. In this configuration, *Q1* is able to sink current directly from the base/emitter of pnp transistor *Q2*. As base/emitter current increases through *Q2*, the collector begins to pull-up toward the +12-volt rail and sources current to the motor. Diodes *D1* and *D2* prevent negative spikes, created by back-emf in the motor, from damaging *Q2* and *Q4*. Transistors *Q3* and *Q4* work exactly like *Q1* and *Q2* and pull up the –side of the motor. This type of circuit is commonly called a "bridge." It directs current through the motor in either direction under control of *U2*.

To control the rate of rotation, or speed, of the motor, a technique known as pulse-width modulation (PWM) is used. By varying the width of a series of pulses at pin 21 or 22 of *U2*, the Robot can vary the amount of energy made available to the drive motor. This effective technique lends itself well to software control.

If you want RONAR to move forward, the software in *U2* sends pin 24 high and pin 23 low. This applies +12 volts to the + side of the motor. RONAR then applies a series of variable-width pulses to pin 21 while holding low pin 22. To reverse

← **Fig. 1.** Complete schematic diagram of drive-motor circuitry.


MOTOR
BATTERY GROUND
BATTERY + (FUSE F1)
+ MOTOR -
7212FIG2
GND
+12V
TO #1.7
TO #3
TO #2
30
29
R3 SIP
1
AUX I/O
IN
+5V
GND
JP-1
A
U1
U2
U3
U4
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
D1
D2
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
R1
R2
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
X1
B
C
E
*NOTE: JUMPER 'A' IS ONLY USED
IF U2's INTERNAL TIMER IS UTILIZED
TO MONITOR HALL-EFFECT SENSOR.
DB-25 TO
TEST HOST
HALL-EFFECT
SENSOR CARD

← **Fig. 3.** Wiring guide for motor-drive circuit board.

motor direction, RONAR sends high pin 23 high and low pin 24 low, applying +12 volts to the – side of the motor. The Robot then pulse-width modulates the signal at pin 22 while holding pin 21 low.

Fuse *F1* is very important for a couple of reasons. It provides a means of limiting the current supplied to the power section of the motor circuit in case any of the power semiconductor devices fails. With batteries that can deliver 10 to 20 amperes of current, a semiconductor failure could "smoke" RONAR's power section. Also, the control signals generated by *U2* are critical in that it's possible to turn on *Q2* and *Q7* (or *Q4* and *Q10*) simultaneously, which would create a condition that would quickly draw excessive current from the batteries. In either case, an appropriately selected fuse rating (2 amperes, for example) provides adequate protection for your drive circuit.

The rating of the fuse is determined by the size of the track motor you're using. A 2-ampere fuse, which is about right in most cases, can be mounted in a miniature fuse holder on the outside of the drive base enclosure for easy access.

Never use the Robot without the fuse! Always keep in mind that *U2* could fail or that a software error in *U2*'s firmware could cause anomalous control outputs at pins 21 through 24. If such a failure should occur, the fuse will quickly blow and, in so doing, instantly eliminate hazardous excessive current.

As RONAR moves, its tracks may slip on the floor or ground surface. Software in *U2* monitors the Hall-effect sensor input at pin 19 for such slippage. If the track is slipping, the Robot can apply a longer-duration run or may decide to increase track speed. The strategy for controlling RONAR's track motors doesn't necessarily have to reside in the motor controller IC itself. Because RONAR is highly modular and utilizes a distributed-intelligence approach to autonomy, it's up to you to decide how much or little control to give to any particular controller in the system.

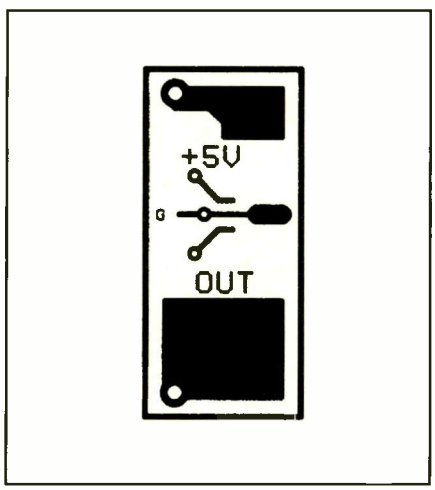


Fig. 4. Actual-size artwork for Hall-effect sensor assembly.

Construction

The motor controllers use single-sided printed-circuit boards that you can fabricate, using the actual-size artwork provided in Fig. 2. You need two cards, one each for the left and right tracks. If you prefer not fabricate your pc boards, you can obtain ready-to-wire ones from the source given in the Note at the end of the Parts List.

Referring to Fig. 3, start populating the board by installing the resistors and capacitors. Then move on to the active devices. If you elect to use IC sockets, be sure to specify high-quality gold-plated ones.

Be sure to use heat-sink compound under transistors *Q2* and *Q4*. These devices become hot as they dissipate energy. If you decide to use larger motors in your Robot, be sure to increase the surface area of the *Q2* and *Q4* heat sinks. FETs *Q7* and *Q10* probably won't need heat sinks when used with the motors specified because they'll be switching less than 1 ampere of current.

When installing the components in the pc board, be sure to include SIP resistor *R3*. These pull-down resistors are important during power-up, when *U2*'s outputs are at high-impedance. The floating gates of the various FETs might inadvertently trigger and cause the motor fuse to blow!

Building the Hall-effect sensor card is easy. Simply fabricate the *PC* board from the full-size artwork provided Fig. 4. Then refer to Fig. 3 for details on installing the components on the board. Solder surface-mount IC *U3* directly onto the foil side of the board. Be careful not to overheat the device by leaving your iron on the leads too long. Then use a 2-foot length of three-conductor shielded cable to connect the Hall-effect board to the control card. Make sure that you connect the wires to the correct positions on the control card because if you mis-wire them, you may damage *U3*!

Checkout & Installation

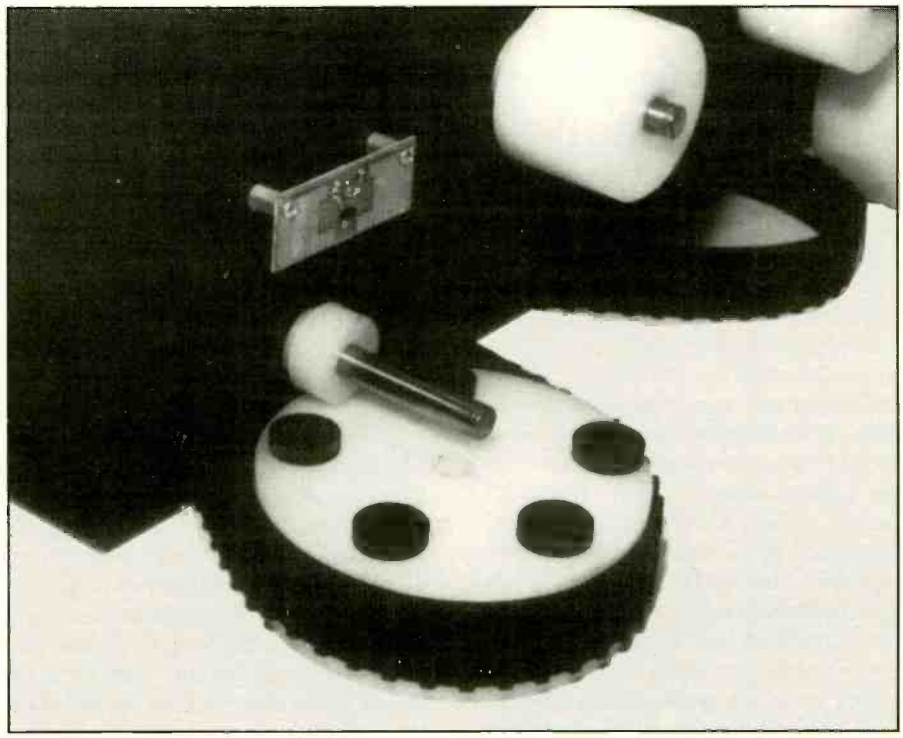
You need a PC or suitable microcomputer to test the motor controller card assembly. With *U2* not installed, briefly apply +12 volts to the appropriate pads on the motor controller card. Monitor pin 40 of the *U2* socket with a scope, DMM or voltmeter. The 78L05 voltage regulator should be delivering a clean +5 volts to this pin. If everything looks okay, check for the presence of +5 volts on pin 16 of *U1*. If everything still looks okay, probe around the pc board while checking for the proper voltages.

When you're satisfied that there are no power-supply-related short circuits, remove power from the board and plug a preprogrammed *U2* into its socket. These devices can be obtained from the source given in the Note at the end of the Parts List or you can program your own using the Cyber HC5 Development System.

With *U2* installed, apply power and double-check the voltage levels around the card. Next, connect a serial cable to the card, as indicated in Fig. 1. The pinouts listed are for a DB-25 connector. If you're using a DB-9 connector, you must change the pin numbers or use a 25-to-nine-pin adapter. If you have a serial card on which pins 2 and are reversed, you must swap pins 2 and 3 at the motor controller card's input.

After connecting the unit to your computer and re-applying power to the motor controller, run your communications program so that you can send commands to the controller card. The preprogrammed *U2* IC comes with instructions and a command interpreter Token list. For example, if you want the track motor to run at full forward speed, you'd type and send the command F9 and hit Enter to tell the motor controller to move RONAR forward (F) at the top speed of 9 (within the range of 0 through 9). If you want to then slow to half speed, issue the command F4 and hit Enter. To stop the track, issue F0 or R0 and hit Enter. To reverse the motor at full speed, use R9 and hit Enter, etc., for the various speeds and directions.

To take full advantage of the motor controller's capabilities, you could use a Cyber HC5 Development System to write a sophisticated control routine tailored to your specific needs. Using the source code included with the pre-programmed *U2* as a guide, this is an easy



Magnets mounted in holes in drive wheels trip Hall-effect sensor on small pc board located just above wheel axle.

process that quickly familiarizes you with the various aspects of digital motor control. If you plan to fully exploit the motor controller design, you must mount the Hall-effect sensor card on the base assembly, behind the rear drive wheel, using 4-40 X 3/8" threaded spacers and screws. You can use a single position magnet to indicate each complete revolution of the drive wheel or as many as 10 magnets.

To mount the magnets, simply drill a shallow hole that's slightly larger than the diameter of the magnet and use fast-setting epoxy to cement it into place. Be sure to keep the depth of the holes for the magnets consistent, particularly if you're using multiple magnets. The software you install in *U2* can then keep track of the rotation of the drive wheel in real-time.

Because each track-motor uses a separate motor controller, you must test the cards individually or use two RS-232C ports for testing. In upcoming installments, I'll discuss construction of the On-Board Computer (OBC) that oversees all of RONAR's activities and serves as the "brain" of the Robot. If you wish, experiment with your own microcomputer or microcontroller.

As you can see, it only takes two digital inputs to control RONAR's motion and two outputs to receive track/motion-status information. If all you need is a track platform, you're finished with this project. I suggest looking over the details of the "Cyberbot" neural-network robot featured in the November 1992 issue of *ComputerCraft*. The neural network described in that article can be retrofitted into RONAR and will provide you with a formidable "neural" machine.

Coming Up

Next month, I'll detail the battery system, an automatic charging pod and the torso assembly complete with motors. In a later issues, I'll present fully articulated arms and grippers and a stereo CCD imaging system and show you how to build your own virtual-reality headset and r-f data control link. ■

Nick Goss

Assembling the BASCOM1 80C52-BASIC SBC

Some hints and cautions for the do-it-yourselfer

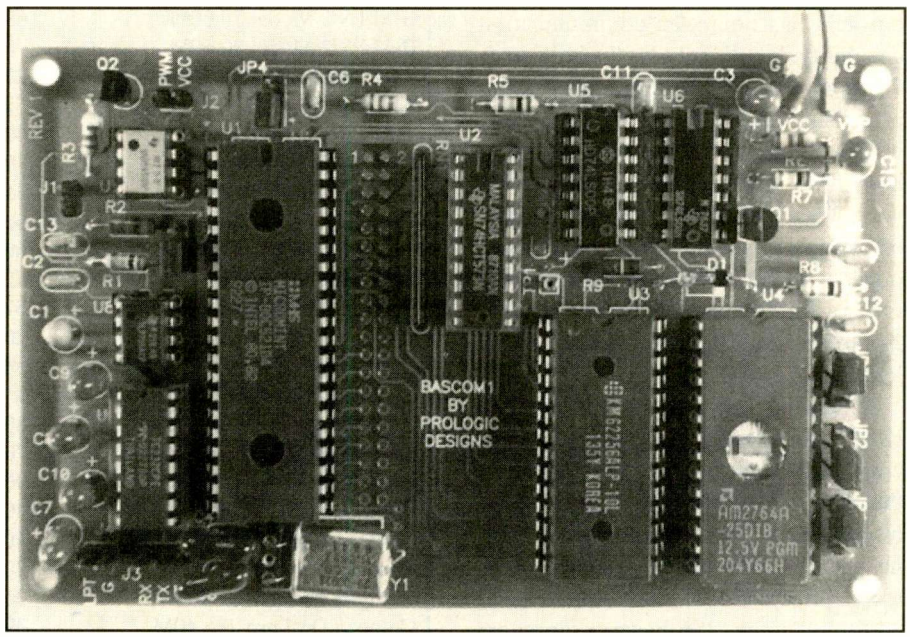
If you enjoy building things yourself, and if you want to take advantage of the new 8052/80C52 single-board computers, I'll tell you how you might save some time and money in this article.

I decided to shop for a bare-board kit with a BASIC interpreter. Since my computer isn't an IBM or compatible machine, I had to be able to "talk" to the programmer board in ASCII text BASIC. Although it isn't mentioned very often, any computer that will output ASCII text through its RS-232 port can be used to program an 8052-BASIC-based SBC.

With the foregoing in mind, I selected Prologic Designs' BASCOM1 single-board computer. Like Goldie Locks and the three bears, some kits were too much, some were too little and BASCOM1 seemed to be just right. It has an 80C52-BASIC MPU with an internal BASIC interpreter and features on-board EPROM programming. It has a socket for a 32K × 8 static-RAM chip and even a separate driver for audio. Moreover, a 40-pin expansion socket is included for just about anything you want to do with this SBC. The bare board, manual and diskette are available and very reasonably priced at $27.95. An 80C-52-BASIC chip costs $25.95.

The printed-circuit board measures about 3½" × 4¾". This pc board is well-designed and well-printed. It has solder masks and is silk-screened for easy component placement. In fact, the board looks beautiful.

The ICs and other components that you may not have can be mail-ordered from any well-stocked supplier. The one exception is a Texas Instruments TL7705 power-monitor chip that apparently has to come from Prologic Designs. I wasn't able to locate it in any mail-order catalog. If you plan on building the BASCOM1, you might as well order the 80C52-BASIC chip from the same place while you're at it.



Building It

The bare-board kit comes with a PC-based 8052 assembler on a floppy diskette and a large 43-page manual. The manual contains full instructions for putting the board together, plus complete schematic diagrams and sample programs.

The manual reminded me of the fine examples of manuals that accompany Heathkits. It starts with an introduction, a parts list and a drawing of the board that shows the location and orientation of each component. Electrolytic capacitor polarity is noted. There's also a discussion on parts substitution and a check-off box for each component as you install it. You can hardly go wrong with this kit.

Following instructions, I populated the board with the sockets and components. It took me only a few hours to complete the assembly task.

I plugged the ICs into their respective sockets and set a few jumper blocks on the board, as instructed. Since the board has its own build-in BASIC interpreter, all you have to do at this point is connect it to your computer's RS-232 serial port and send to it a carriage return (CR). When you do this, you should get a sign-on message on your computer's video screen. For me, nothing occurred!

On examining the ink drawing of the board, I noticed that jumper JP4, the EA signal on pin 31 of the 80C52, is backwards from the other jumper blocks. Since JP4 isn't labeled "P3-P2-P1," it's easy to make an error on this one jumper. According to the Intel handbook, EA should be held at V_{cc} for the 80C52 to run from its internal BASIC interpreter. I powered down, change the jumper setting and powered up again. Then I sent the board a CR. Once again, nothing happened!

(Continued on page 84)

AmCoEx Index of Used Computer Prices

In the palmtop computer marketplace, one of the most popular systems has been the Hewlett-Packard 95LX. The company has recently upgraded the system to the 100LX. The newer system is faster, runs standard DOS operating system and has improved communication capability. It still includes the built-in *1-2-3* spreadsheet software, and the list price is still $749. However, many feel it falls far short of Apple's much-ballyhooed Newton system expected later this year. The pen-based Newton is expected to include several software applications, as well as cellular-telephone technology for fax and data transmission. Apple has stated the Newton will sell for less than $1,000.

Following other computer makers, IBM is expected to drop all 386-based computers from its PS/2 line. Some of the older 486 systems are expected to be discontinued. The company will continue to offer 386-based systems in its lower-priced ValuePoint computers. In addition, some 386-based computers may be available from IBM soon in its lowest-priced Ambra line. While it is currently selling the Ambra computers only in Europe and Canada, many feel the company will introduce the line in the U.S. soon.

Apple Computer has shown interest in making the Macintosh interface available on numerous new hardware platforms. To operate on 486-based computers, Apple may link the Mac interface with Novell's DR-DOS operating system. In addition, the Macintosh interface is expected to be available soon with the UNIX operating system. Because UNIX is now owned by Novell, this cozy coincidence has renewed rumors of an Apple/Novell merger. It is no secret that Novell has been seeking a merger partner for several years. This coalition would present a formidable foe to software giant Microsoft.

Apple recently stated it expects to sell more than one-million computers next year using the new PowerPC chip. This chip is comparable in power to the new Intel Pentium. Industry observers expect fewer than 200,000 Pentium-based machines to be sold in 1994.

Initial tests of Pentium-based computers have yielded disappointing results. Performance gains over the fastest 486 systems have been between 40% to 90%. Gains were expected to be from 100% to 200%.

As expected, IBM announced its clock-tripling CPU chips at Comdex last month. The 33/100-MHz 486 chip was dubbed Blue Lightning. The performance of this chip rivals that of Intel's new Pentium with a lower price tag.

Machine	Average Buyer's Bid	Average Seller's Ask	Close	Change
IBM AT 339	200	475	400	-25
IBM PS/2 Model 30/286 20M	300	575	500	-25
IBM PS/2 Model 50Z 30M	375	650	550	**
IBM PS'2 Model 70 60M	600	875	700	-50
IBM PS/2 Model 80 60M	700	900	750	-25
AST 286/12, 40M	275	675	450	-50
AST 386/20, 80M	550	950	875	**
Dell 325SX, 50M	400	800	600	**
Dell 386/20, 120M	800	1,200	1,000	-50
Gateway 286/16, 40M	350	700	400	-50
Gateway 386SX/20, 80M	600	950	825	**
Gateway 386/25, 80M	600	1,000	900	-50
Zeos 386SX/20, 85M	525	900	825	-25
Zeos 386/25, 85M	675	1,050	950	**
Clone AT 20M	200	500	400	-50
Clone Notebook 386SX, 40M	500	1,150	1,050	-50
Clone 386/SX 40M, VGA	450	950	825	-25
Clone 386/25 40M, VGA	600	1,100	1,075	**
Clone 386/33 40M, VGA	700	1,150	1,125	-50
Clone 486/25 80M, VGA	900	1,400	1,325	**
Compaq SLT/286 20M	400	800	500	-25
Compaq LTE 286 40M	500	775	550	-25
Compaq Portable II 20M	200	600	300	**
Compaq Portable III 40M	350	850	375	-25
Compaq Deskpro 286 40M	300	650	450	-50
Compaq Deskpro 386/20e, 100M	1,000	1,700	1,100	-50
Macintosh SE 20M	450	950	500	-25
Macintosh SE/30 40M	900	1,400	975	-100
Macintosh II 40M	900	1,450	1,000	-25
Macintosh IIcx 80M	900	1,500	1,300	**
Macintosh IIci 80M	1,800	2,400	1,900	-100
LaserWriter IINT	900	1,400	1,000	-100
Toshiba 1200HB	400	750	625	**
Toshiba 1200XE	700	1,050	750	-50
Toshiba 1600	500	900	550	-25
Toshiba T-3100SX	800	1,100	825	**
Toshiba 5200	1,000	1,550	1,150	-50
HP LaserJet II	400	850	700	**
HP LaserJet IIP	325	950	700	**
HP LaserJet III	750	1,200	1,075	-25

More importantly, IBM was able to take a cheaper 25-MHz 486 and run it at 75 MHz. This chip outperforms the more-expensive Intel 66-MHz 486. These chips should force the prices of all Intel chips lower. In addition, the Blue Lightning may be most popular in notebooks. Due to significant heat dissipation, the Pentium chips may not be used in small portables for the foreseeable future.

IBM also demonstrated its new PowerPC CPU chips. In one benchmark, this new chip ran seven times faster than the 66-MHz 486 chip. As distinctions between computer makers continue to blur, Apple has announced it will phase out its use of the NuBus slots on the Macintosh. It will gradually adopt Intel's PCI standard. As other PC makers adopt this standard, it will enable users to interchange boards between PCs and Macs.

Apple Computer has been spending more money on research and development than any other micro maker. In a recent quarter, Apple spent more than four times as much as Compaq Computer for R&D. Some feel this spending is for the PowerPC version of the Macintosh, while others think it is an investment in the new personal digital assistant called Newton. The results of this spending should become apparent later this year.

Following Apple and IBM's lead, Compaq is expected to announce a new low-cost brand of computers in August. The new line will be marketed through chains like Office Depot and through direct mail.

Hewlett-Packard currently sells almost 80% of all color printers. It appears poised to increase this market share with the new DeskJet 1200C. This under-$2,000 printer can print six pages per minute for black-and-white copies and almost one page per minute for color.

What is the most expensive micro? Sequent Computer Systems will soon sell a system using 30 Pentium CPU chips for $1 million. The computer can do the work of a $16-million mainframe.

The chart prices are for July 1993. ■

John Hastings is the president of the American Computer Exchange Corporation. The American Computer Exchange matches buyers and sellers of used microcomputer equipment. For more information contact the American Computer Exchange Corp. at 404-250-0050 or 800-786-0717.

native set of interpretations. Other optional report packages are being developed, and up to 10 alternative report packages can be supported and used. Advanced astrologers can develop their own interpretation sets. $178. *Halloran Software, PO Box 75713, Los Angeles, CA 90075-0713; tel.: 800-SEA-GOAT; fax: 818-501-5667.*

CIRCLE NO. 17 ON FREE CARD

Electronics Artwork

Two packages of electronic artwork are available from Softronix. *Integrated Circuits* includes more than 85 professionally-drawn and -scanned illustrations of ICs. *Transistors* contains more than 70 illustrations of various transistors. Included are views of different devices from top, bottom, side, end and diagonal angles. All images are supplied in .PCX format for importing them into most graphics, word-processing and page-layout software. $20 each. *Softronix, Inc., 107 E. Vallette, Ste. 1301A, Elmhurst, IL 60126; tel.: 708-834-1800; fax: 708-834-1808.*

CIRCLE NO. 18 ON FREE CARD

New BBS Version

Galacticomm's *The Major BBS* Version 6.1 offers callers a choice of either EGA/VGA graphics or standard ANSI text, both on the same BBS. A new multi-lingual/multi-protocol architecture gives users power to select their own interface. Sysops can easily add alternative languages, such as Spanish or French, and also offer support for graphical presentation standards, such as RIPscrip and NAPLPS. Another feature of Version 6.1 is the addition of "Doors" to a separate machine. Now sysops can run one of the many hundreds of door programs that are available through third-party developers. This feature uses an additional channel of the BBS to call out to another computer connected via null modem cable. System requirements include a 286 or better PC, 2M of extended memory, DOS 3.3 or later and a hard drive. *Galacticomm, Inc, 4101 SW 47 Ave., Ste. 101, Ft. Lauderdale, FL 33314; tel.: 305-583-5990; fax: 305-583-7846.*

CIRCLE NO. 19 ON FREE CARD

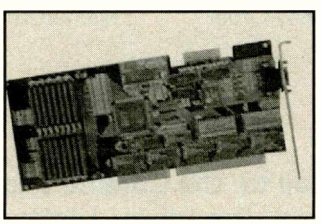
Multimedia Modem

Boca's Multimedia modem is a combination voice/data/fax modem that allows businesses to set up inexpensive message-handling systems on PCs. With embedded voice-mode "AT" command set, the host computer can emulate basic answering-machine functions through voice software. Up to 999 mailboxes can be set up. A myriad of fax services are supported, including Group 3 Class 1 fax, send and receive 9,600-bps and V.29 and V.27. The intelligence built into the modem detects voice and fax transmissions or a combination of the two. All data speeds up to 2,400 bps are supported as are MNP-5 and V.42bis standards. $169/$215, internal/external. *Boca Research Inc, 6413 Congress Ave., Boca Raton, FL 334876; tel.: 407-997-6227; fax: 407-997-0918.*

CIRCLE NO. 20 ON FREE CARD

Windows Video Accelerator

Volante's Warp24 ISA video board offers as maximums 93-kHz horizontal scan, 80-Hz vertical refresh and 135-MHz bandwidth (pixel clock). In addition to basic *Windows* functions, such as BitBlt, Hardware Cursor and Line Draw, Warp24 is claimed to increase the speed of such complex functions as color dithering, object shading, surface mapping, polygon pattern fills and clipping. The board delivers up to 1,024 X 768 non-interlaced, as well as 1,280 X 1,024 interlaced super VGA resolutions. At up to 800 X 600 resolution, the Warp24 offers a full palette of 16.7-million colors, while at 1,280 X 1,024, it offers 256 colors. It ships with a wide range of utilities, drivers and applications. $399/$499 with 1M/2M of VRAM. *Volante, 1515 Capital of Texas Hwy. S., Austin, TX 78746; tel.: 512-329-5055; fax: 512-329-6326.*



CIRCLE NO. 21 ON FREE CARD

Hand-Held Point-of-Service Computer

Data General's Model 5221 Series hand-held Point of Service computer allows users to work with essential data while in the field. It requires no computer skills and an be operated with one hand and is appropriate for any application that involves collecting, retrieving and managing data. It weighs less than a pound and measures only 7½" X 3" X 1". A standard RS-232 interface makes it compatible with virtually any computer system.

The Model 5221 runs up to three months on ordinary AA cells. A single-thumb design permits simple point-and-select operation. The menu-driven software is easy to follow, and the user interface is intuitive. A well-organized screen virtually eliminates the need for training. Applications can be written on almost any computer system,including IBM/compatibles. $589. *Data General Corp., 3400 Computer Dr., Westboro, MA 01580.*

CIRCLE NO. 22 ON FREE CARD

Braille Printing Software

MegaDots from Raised Dot Computing enables persons who are unfamiliar with Braille to produce high-quality Braille copy. Other Braille production methods (manual and computer-assisted) require a high degree of background in Braille. With the advent of the Americans with Disabilities Act (ADA), it's essential for many smaller companies (15 or more employees) to be able to produce Braille copy.

MegaDots uses a style-based word processor for formatting. Since the styles contain inkprint and Braille formatting information, the act of formatting for inkprint is the same as formatting for Braille. *MegaDots* recognizes and imports from more than 90 different file formats. As a demonstration project, *MegaDots* was used to translate the text of *War And Peace* (more than 3-million keystrokes) into accurate Braille in 80 seconds with a 33-MHz 486 computer. Braille output from a computer requires a Braille printer. $500. *Raised Dot Computing, 408 S. Baldwin St., Madison, WI 53703; tel.: 800-347-9594; fax: 608-241-2498.*

CIRCLE NO. 23 ON FREE CARD

.INI Manipulator

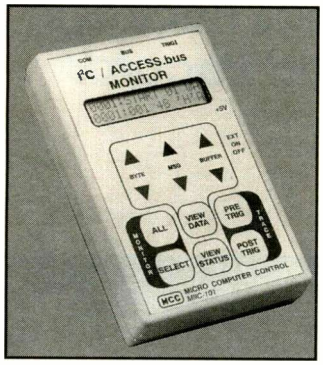
IniTyme from Computer Tyme is a *Windows* .INI file manipulator for use by network administrators to mass update users .INI files. Using *Windows* in a networking environment requires special considerations since many .INI files are created in a myriad of directories. This makes maintaining *Windows* a labor-intensive process for network administrators.

IniTyme creates a changes file that contains a list of context-sensitive changes you wish to apply to your target file. The target file can be either a specific .INI file or a file containing a list of .INI files. *IniTyme* then applies the desired changes to all indicated files. These files can be located across a WAN for worldwide updating. $495. *Computer Tyme, 411 N. Sherman, Ste. 300, Springfield, MO 65802; tel.: 417- 866-1222.*

CIRCLE NO. 24 ON FREE CARD

Bus Monitor

MCC's 101 Bus Monitor standalone troubleshooting tool for the I²C serial bus was developed by Philips Semiconductor and the ACCESS.bus as an industry standard for connecting multiple I/O devices to a PC via a single port. When connected to an I²C bus or ACCESS network, the MCC 101 can collect, display or

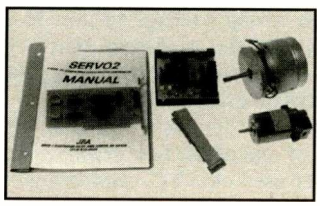


upload information on all bus activity. It includes a display and keypad for stand-alone operation. Alternatively, the built-in RS-232 interface allows the unit to be remotely controlled from a PC. In trace mode, it can collect bus messages directed to one or all bus device addresses. Data collection can start or stop with an external trigger input to synchronize the unit with network events. Internal storage can buffer up to 2,700 messages. Remote operation can upload messages to a PC while collecting network traffic. $667. *Micro Computer Control Corp., PO Box 275, Hopewell, NJ 08525; tel.: 609-466-1751; fax: 609-466-4116.*

CIRCLE NO. 25 ON FREE CARD

Two-Axis Servo Controller

JRA's Servo2 PC/compatible two-axis servo motor controller plugs into any available expansion slot. Capable of independently controlling two motors, it receives feedback from incremental optical encoders on the motor shaft. In position mode, you enter maximum motor speed in rpm and final position in encoder counts. In velocity mode, you select motor speed and direction. Using JRA motors, the Servo2 is claimed to accurately control speed from 0 to 2,700 rpm with a position resolution of 0.17°. Motor movement is smooth and



vibration-free throughout the velocity range.

Software included in the package allows you to read motor position or velocity in real-time, run motors simultaneously, create motion sequences, plot position versus time, teach moves via the keyboard, and more. *Quick Basic* program listings are included. $330. *JRA, 3602-1 Partridge Path, Ann Arbor, MI 48108; tel./fax: 313-973-0928.*

CIRCLE NO. 26 ON FREE CARD

Large-Screen Filters

3M computer filters are now available in a variety of sizes up to 19" to accommodate larger computer screens. All models are available in two sizes: one for 10" to 13" screens, the other for 16" to 19" screens. 3M's universal mounting system uses no adhesive or fasteners. A simple adjustment custom-fits the filter to the monitor. The PF400 "privacy" series filters allow you to see on-screen data only when viewed from directly in front of the monitor. It's especially useful for individuals working with sensitive data.

In addition to privacy viewing, the PF400 is claimed to virtually eliminate glare and provide good screen contrast, even in brightly-lit offices and in situation where window light causes washout. It also blocks more than 99% of elf/vlf E-field radiation and stops static charge and dust buildup. From $60. *3M Optical Systems, 3M Center, Bldg. 225-4N-14, St. Paul, MN 55144; tel.: 800-553-9215.*

CIRCLE NO. 27 ON FREE CARD

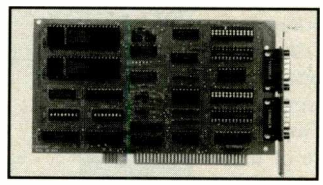
B&W Frame Grabber

Digital Vision's Computer Eyes/RT Monochrome is a real-time grayscale video frame grabber for IBM/compatible computers. It requires minimal hardware (XT with 640K of RAM and VGA) and is a standard-bus I/O device, with no interrupt, memory, or DMA conflicts. DOS and *Windows* software feature support for all common image files, (.TIF, .PCX, .TGA, .GIF, .BMP, JPEG etc.). Motion capture is also supported in both DOS and *Video For Windows* formats. An extensive developers package is available. $400. *Digital Visions, Inc., 270 Bridge St., Dedham, MA 02026; tel.: 617-329-5400; fax: 617-329-6286.*

CIRCLE NO. 28 ON FREE CARD

Intelligent Serial Board

Sealevel's Comm+2EX two channel serial input/output board for IBM/compatible provides two extra serial ports for modems, printers, terminals, etc., with extended interrupt support and is field selectable for RS-232 or RS-422/485. Features include selectable ad-



dress up to 3FF (hex) and selectable/sharable interrupts (IRQ2 through IRQ7, IRQ10, IRQ11, IRQ12 and IRQ15). $239. *Sealevel Systems, 102 W. Main St., Liberty, SC 29657; tel.: 803-843-4343.*

CIRCLE NO. 29 ON FREE CARD

Enhanced GPIB Controller Card

ICS has an improved version of its Model 488-PC2 IEEE 488 Bus Interface Card that's a full IEEE 488.2 controller, including driver libraries for the four most-popular programming languages and is compatible with all of the newer SCPI instruments. Interrupt processing has been improved for real-time control of GPIB bus devices. It operates in any PC/compatible computer slot. DMA data-transfer rate has also been improved on the new card, which retains full backward compatibility with the original model.

New commands have been added to the software for the controller protocols to simplify interrupt handling and writing SRQ service routines. Optional linkable libraries are available for Pascal and *Visual Basic*. $345. *ICS Electronics Corp., 473 Los Coches St., Milpitas, CA 95035; tel.: 408- 263-5500; fax: 408-263-5896.*

CIRCLE NO. 30 ON FREE CARD

Device-Independent Cache

C&D Programming's *CacheAll* is a technology-independent caching program that works with virtually all storage devices, locally or over a network. *CacheAll* requires only 21K of user RAM. It can be loaded high, and it supports cache sizes up to 64M using extended memory, EMS or swap files. Using a swap file to cache devices that are slower than hard drives allows conservation or RAM and performance-balancing across slow and fast devices. When run on workstations of any network, *CacheAll* is claimed to reduce network traffic and server loading.

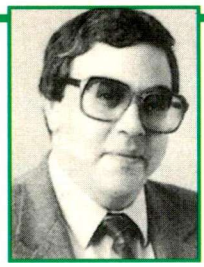
C&D claims that you need no technical expertise to use the program. You just install, and it starts working immediately. *ChacheAll*'s options permit you to customize the program for maximum system performance under your applications, even when subsequently adding additional devices. $129. *C&D Programming Corp., 1611 Mayfair Cir., PO Box 581012, Salt Lake City, UT 84158; tel.: 800-847-5676.*

CIRCLE NO. 31 ON FREE CARD

File-Transfer Program

Pc2pc from RAC uses a special on-line data compression process to reduce transmission time by up to 85%, depending on file contents, when transferring files from one PC to another. This product incorporates automatic error correction and adjustment to line noise levels for maximum efficiency under poor line conditions, eliminating the need for MNP-type modems. Designed to be totally modular, it can be added on to any remote communications software already in use. It has an auto-restart feature for those times when a transfer is interrupted. *Remote Access Corp., 10 Corey Ave., Blue Point, NY 11715; tel.: 516-363-4719; fax: 516-363- 8221.*

CIRCLE NO. 32 ON FREE CARD



Ted Needleman

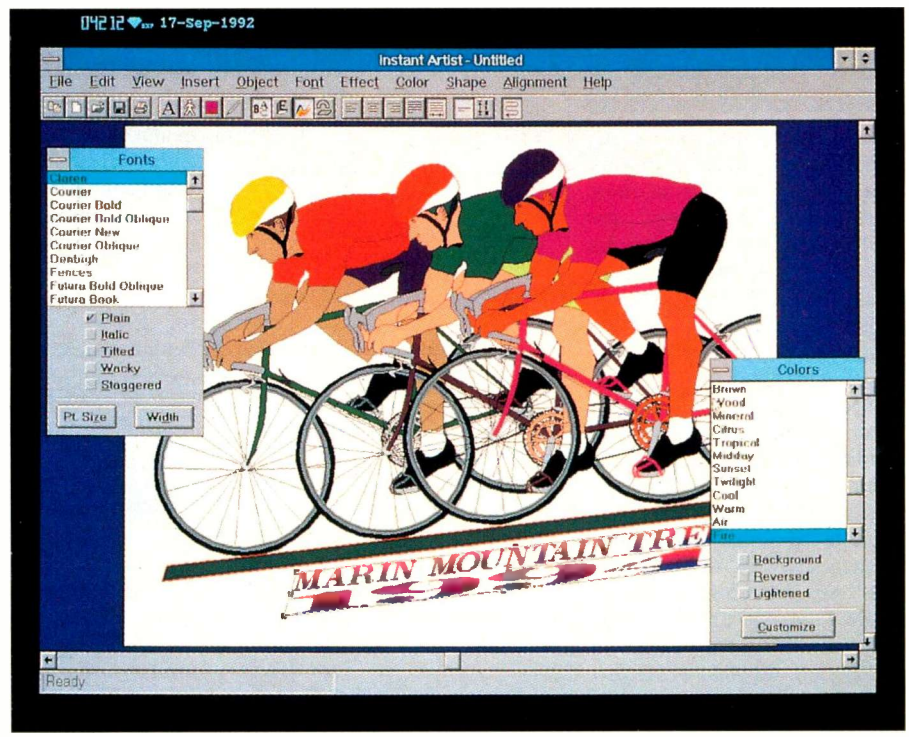
Autodesk's *InstantArtist* Graphics Package and *The Guinness Book of World Records* on Multimedia CD-ROM

It's trite and probably something you've heard many times before, but if there's one thing I've learned in the more than the quarter of a century during which I've been using computers, there's no one universal program that will let me accomplish everything I want to do. Sure, there have been attempts at producing such a package. Over the years, I've seen several such "everythingware" products come and go. Some have been more successful than others, but none has achieved anything near overwhelming success.

There are several good reasons for the foregoing. Probably the most important is that different users need to accomplish different things. Probably just as important is that the same user will have to accomplish different things at different times. So how can any one package that, by virtue of its design, has to place emphasis on some features over others be able to be all things to all people at all times? Obviously, it can't. And heavy computer users, myself included, frequently find that we have two, three or even a dozen somewhat similar packages residing on our hard disks, all of which we actually make use of at one time or another.

The trigger to this somewhat less-than-amazing revelation was the installation of yet another graphics package on my groaning overstuffed hard disk. You might think that half a gigabyte of disk storage should be more than sufficient for anyone who isn't tracking the national debt or plotting spacecraft orbits for NASA. A couple of years ago when I added a 200M hard drive to the 300M unit that was already in my 33-MHz 486 computer I would have predicted it would hold me for a while. But with a total of less than 80M now free out of the 500M or so I currently have, I find myself erasing software every month or so just to maintain a *status quo*.

Strangely enough, though, the software I usually wind up erasing most of the time is review material that's a couple of month's old. Only about 25% or 30% of the stuff I review actually gets used beyond the writing of the review. If it does, however, I hate to blow it off of my hard disk because the odds are pretty good that I'll want it—usually about 10:00 PM at night—to aid in preparing a report or presentation. When this scenario occurs (and it does so frequently enough to make me leave a fair amount of software on my hard disk), I'm usually pretty pressed for time and not very amenable to searching for a package that I first have to install.



A typical screen from Autodesk's *InstantArtist*, with drop-down menus displayed.

InstantArtist From Autodesk

With my lengthy opening statement out of the way, perhaps you now understand why I have about a dozen different graphics packages residing on my hard disk and why I find it so difficult to abandon any of them. Each one takes a somewhat different approach to solving a given graphic problem. There are fairly straightforward, very powerful draw programs like Arts & Letters *Editor* and *Apprentice*, *CORELDraw* and Micrografx *Designer*. While I make very infrequent use of any of these, when I do need this amount of sophistication, they're there for the using.

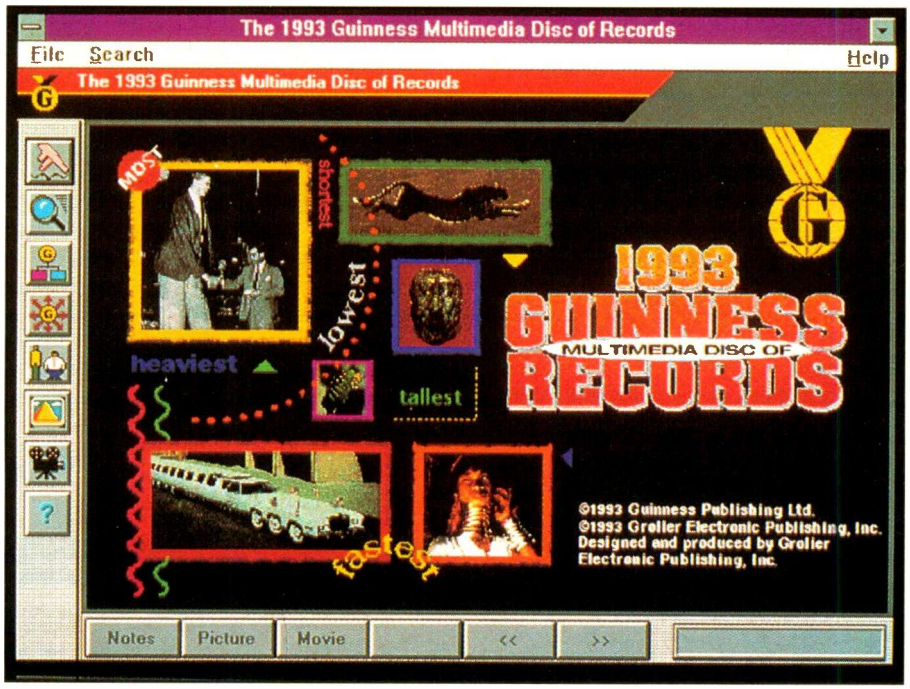
More frequently, though, I rely on packages that give slightly less draw flexibility but do a lot more of the graphics work for me. *Freelance Graphics for Windows* 2.0 is my first choice for preparing most presentations. This package's SmartMaster sets take away all the guesswork about how a presentation should look. All I need to do is figure out what it should say!

The other graphics packages that are my mainstays, like Computer Support's *Picture Wizard* and *Scenario*, Bitstream's *Face Lift* and Micrografx *DRAW!*, all tend to provide a very strong pre-designed foundation on which I can build. They differ enough in clipart libraries and orientations that I feel very comfortable keeping all of them resident, and I've used every one several times in the last few months.

I've also added a newcomer to what seems like permanent residence on my hard disk: *InstantArtist* from Autodesk. In some ways, *InstantArtist* is the least-sophisticated of the bunch. If the majority of your graphics projects involve straightforward freehand drawing, you'll find that *InstantArtist* is the wrong package to use. Even Windows Paint, the accessory that's include with *Windows*, offers more flexibility for this particular graphics approach.

InstantArtist's approach reminds me very much of one of the first graphics programs I ever used on a PC—Broderbund's

Some of the things you can do with *InstantArtist*.



Opening screen from Grolier's *1993 Grolier Multimedia Disc of Records*.

Print Shop. Still around and considerably improved over the years, *Print Shop* lets you quickly assemble a graphic from clipart and text components. *InstantArtist* takes the same approach. When you first bring up the program, you can choose from a variety of document types, including signs, greeting and business cards, banners, letterheads and envelopes, certificates and much more. When you make your choice, you're then presented with a variety of different types of the documents you've selected. To illustrate this, let's say you've chosen greeting cards. You can then select from a second menu the type of card you're interested in, such as birthday, get well, etc. The individual designs provided are very attractive and quite usable for a wide number of purposes.

These designs are just the jumping off place. The documentation set for *InstantArtist* consists of two manuals, which include a User's Guide and a manual titled *Imagination*. The latter book, basically a guide to the clipart and background components, goes much further. It shows you how the sample documents (all of those cards, letterheads, advertisements, etc.) were put together and offers some very good hints and tips for modifying them for your particular use or even designing from scratch. This process is pretty simple, you just plug in the individual graphic components, add some text and apply fancy text effects, if desired. I admit I was pretty surprised (and impressed) by the software's text-effect capability. It's easy to do spiraling and vanishing text, change colors in a text spiral and accomplish effects that are usually found only in much more expensive software or a package like Bitstream's *Face Lift*, which is specifically geared to creating spectacular text effects.

If I had to recommend just two inexpensive graphics packages I think most users would find helpful and fun, this would probably be one of them (Computer Support's *Scenario/Jurassic Art* would be the other.) At a retail price of $139.95 for the *Windows* version ($89.95 for the somewhat less-comprehensive DOS version), you should be able to find *InstantArtist* in the neighborhood of just over $100 or so at a superstore or from a mail-order house. The version I reviewed requires *Windows*. Because it's *Windows*-based, it supports almost every printer available, including color dot-matrix printers like the Epson LQ-860 my kids use. The DOS version supports a wide range of black-and-white and color printers.

InstantArtist doesn't give you great art. But it does produce a whole lot better graphics than I've ever been able to do on my own. If you're looking for a graphics package that will give you nice-looking signs, invitations and the like, give *InstantArtist* a good look see. You won't be sorry you did.

Records on CD-ROM

Next to the Bible, *The Guinness Book Of World Records* is the second best selling book in the world. Published since 1955, it has sold more than 71-million copies in 30-plus countries. I guess its popularity means that I'm not the only information junky around. Some of those sales no doubt come from people who are in the book, or who would like to get their small bit of fame by setting some kind of record that will land them in the *Guinness*. Most purchasers, however, buy the book for the sheer enjoyment of finding out what the limits are—the limits of human endeavor, of physical possibility and of the information trivia that a volume like this collects.

Grolier Electronic Publishing has taken the enormously popular book, put it on CD-

ROM and greatly enhanced it by raiding its multimedia encyclopedia to add lots of multimedia pieces to *The Guinness Book of World Records*. The paper version of *The Guinness Book* is interesting. The *1993 Guinness Multimedia Disc Of Records* is fascinating! It contains every word of the paper version and more than 600 pictures and dozens of *Video For Windows* "movies." Not only can you read about the last moon walk (Apollo 17), but by clicking on the Movie button, you see and hear it. Even though the video movies are relatively small (about an 1¾"-square on my monitor), they really add a lot of impact over just reading a few paragraphs of text.

Installing the software from CD-ROM takes just a few minutes. During installation, you're given the choice of whether you want the software to run at its fastest, which takes more hard disk space, or run primarily from the CD-ROM, which is a slower way to go but takes only a few megabytes on your hard disk. Once installed, you click on the icon to run the program.

There's not much documentation with this CD-ROM, just a two-sided "reference" card. The front of the card tells you how to install the program (just use the File/Run command in the *Windows* Program Manager.) The back of the card pictures the program's seven-icon toolbar, which runs down the left side of the screen. There's a short explanation of what each icon does, none of which is longer than about a dozen words or so. It doesn't really matter because operating the program is pretty much intuitive, once you know the icons' names, and the standard *Windows*-based on-line help system is available if you can't figure out how to use the walking fingers "Browse" icon.

After using the *Guinness Disc* for a while, I really like it and have gotten hours of enjoyment "browsing" through it. However, there are two things about it that bother me a bit. The first is that there seems to be no way to cut-and-paste or copy from the CD-ROM to another application. Unfortunately, this isn't the only CD-ROM I've come across that has this limitation, but it seems that a reference-oriented product becomes somewhat less useful if you need to write down information by hand to use it in a report or other document.

The second thing that bothers me is what might not be in the book/CD-ROM. When I received this ROM for review, I wrote down 10 items I wanted to check. Nine of them, like the fastest jet plane (the SR-71 Blackbird), were easily found. The tenth item, the Smartest Human Being, doesn't seem to be in here. There's information about the tallest and shortest humans; about the oldest humans; even about one man who was both medically recorded as both a dwarf and a giant (he was a dwarf until he reached his twenties and then grew to a height of more than seven feet!). There's an entry for the youngest college student (Michael Tan of New Zealand, who started studying for a degree in mathematics at seven years and 11 months of age.) But nothing about the World's Smartest Person. Too bad. It would be nice to know who to write too for an explanation of why things sometimes get so strange.

All kidding aside, there are a few occasional rough edges, like charts that come up with no exit button in the upper-left corner. There's no explanation of how to get out of these charts in the Help screens, but if you click off to the side while one's on-screen, they seem to go away. If you move the mouse while one of the multimedia movies is playing, the bottom part of the movie gets a little screwy. None of these is a major annoyance, and considering that this is a new product, it's in pretty good shape.

A fairly hefty system is require to really get the most use out of the *1993 Grolier Multimedia Disc of Records*. Obviously, since it's a multimedia product that's distributed on CD-ROM, the first requirement is that you have a CD-ROM drive that meets MPC specs (350-ms access time and 150 KB/sec data-transfer rate). Since there are so many movies with sound, an Ad Lib, Sound Blaster or compatible compatible sound card is a big plus. Finally, to get the best display of the 600 or so photos, you'll need SVGA video with 640 X 480 resolution with 256 colors. Actually, many of you may already have this capability but not be using it because the required SVGA driver hasn't been installed in *Windows*. Look at your documentation to see if your video card and monitor can display the large number of colors (or grayscales) at standard VGA resolution. If yours can, be sure to install the correct driver using the *Windows* Setup icon in the Main group. Doing this makes a tremendous difference in the appearance of almost all pictures displayed in just about every multimedia product I've come across.

The biggest deterrent to your enjoyment of the *1993 Grolier Multimedia Disc of Records* is its price, which is $99. Older versions can be upgraded for $49. You should be able to find this CD-ROM package in the mail-order channel or at a store like EggHead for $70 to $80. But this is still a bit steep for what's essentially an entertainment product. The paper-based version, while not as glitzy, is less than a third the price. I like the Grolier CD-ROM. It's not really over-priced—just a bit expensive. At $49, it would be a must-have for anyone with a multimedia setup. At $80 to $90, try it before you buy. ■

Products Mentioned

InstantArtist, $89.95 (DOS); $139.95 (*Windows*)
Autodesk Retail Products
11911 N. Creek Pkwy. S.
Bothell, WA 98011
Tel.: 800-228-3601

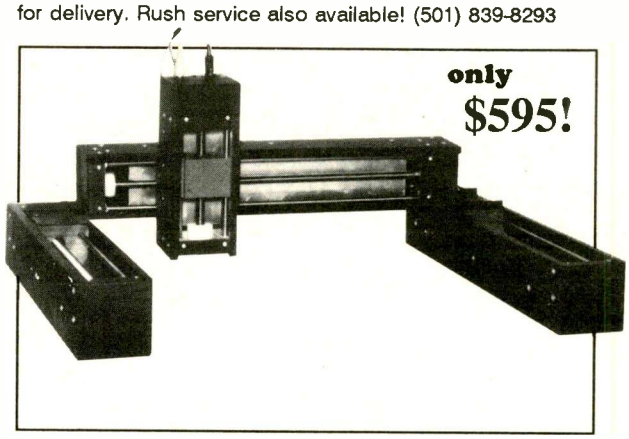
CIRCLE NO. 123 ON FREE INFORMATION CARD

1993 Grolier Multimedia Disc of Records, $99.
Grolier Electronic Publishing, Inc.
Sherman Tpke.
Danbury, CT 06816
Tel.: 800-285-4534

CIRCLE NO. 124 ON FREE INFORMATION CARD

DESKTOP CNC MACHINING CENTER!

Imagine being able to machine three dimensional parts in wood, plastic and light metals! This easy to assemble kit CNC X,Y & Z drilling/milling machine turns your PC computer into a Desktop Manufacturing System! The patent-pending 24" by 24" by 6" NEURACTOR(tm) Linear Actuators translate CAD generated files into actual working parts! Machine three dimensional prototype or production parts automatically! Cash-in on this new revolution in micro-manufacturing. Make signs & plaques, do wood carvings, create 3-D "lost wax" mold masters, drill printed circuit boards, etc. Unit comes complete with 5 amp power supply, four CNC-CYMOTOR controllers, four .0005" linear-accuracy stepper motors, pre-machined steel & UHMW actuator mechanisms, pre-painted aluminum enclosure and all hardware! Solder-in a few parts, tighten a few screws and you're in business! BASIC "host" program reads ASCII "plotter" files. If you want a full-featured CAD-CAM environment, we bundle a FREE shareware 3D CAD/CAM! Use your Neuractor CNC-III with a standard DREMEL tool or flex-shaft router (not included). You build it, you calibrate it, you can customize it! Act now while we hold-down the price on this break-through technology! Complete kit $595! Add $22.95 UPS S/H. Please allow four to six weeks for delivery. Rush service also available! (501) 839-8293



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Tired of having to reach around your PC to get at the cables and expansion cards? The Patent Pending Cyance Chassis offers you exclusive UP-FRONT access to your expansion cards and cables by remounting your motherboard "backward" in the front of the chassis. As featured on the cover of February '92 ComputerCraft, the Cyance Chassis can also be used to house the Cyance Expander. This amazing kit uses an 8 slot passive motherboard, and "buffered" daughter cards, to expand your existing PC motherboard bus. Imagine having those extra slots for additional cards, or using them for bench-top PC breadboarding! The Cyance Expander kit is easy to assemble and comes complete with cables, PC boards, all ICs and passive components (without case) for $169.95. The Cyance Chassis comes as a professional aluminum pre-painted and assembled enclosure for $99.95. Please add $7.95 UPS S&H for the Expander and $9.95 for the Chassis. Please allow four to six weeks for delivery. Rush service also available! Check, COD, MasterCard/Visa welcomed. (501) 839-8293. U.S. Cyberlab, Inc., 14786 Slate Gap Rd. West Fork, AR 72774

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Joseph Desposito

A GENDAC, New Supervisory ICs, Distance-Measuring Sensors, 3.3-Volt PROMs and Pentium Cache RAMs

What do you get when you cross a clock generator and a RAMDAC? Why a GENDAC, of course, which is the subject of the lead-off item this month.

Clock/RAMDAC Solution

Integrated Circuit Systems, Inc. (ICS) and S3, Inc. (2880 San Tomas Expwy., Santa Clara, CA 95051) have announced a collaboration to produce and separately market a single-chip RAMDAC plus clock generator, called the S3 708 GENDAC chip and ICS 5300 GENDAC chip. The new product is tightly coupled with S3's graphics accelerators and is fully supported by the company's software suite. It will provide systems and add-in board customers with a more complete solution than is currently available. It operates with a broad range of graphics controller.

The GENDAC solution integrates a dual-clock generator and a RAMDAC. The alternative would be to use a separate clock generator and a RAMDAC device to achieve the same functionality.

A pixel-clock produced by the dual-clock generator is used for display screen refresh. The dual-clock generator also produces a memory-clock for synchronizing read and write accesses to video memory.

The RAMDAC takes pixel data input from video memory to address specific color-palette RAM locations. The DAC portion transforms the digital data stored in these locations into analog signals that are used for driving the display monitor.

This GENDAC solution provides designers with a higher level of integration than a multiple-chip solution. Fully supported in S3's BIOS and drivers software, the chip is best suited with S3's 801, 805, 928 and 928PCI accelerators. When used with any of these accelerators, the new chip requires a total of only six devices, including video memory, to construct a complete graphics subsystem.

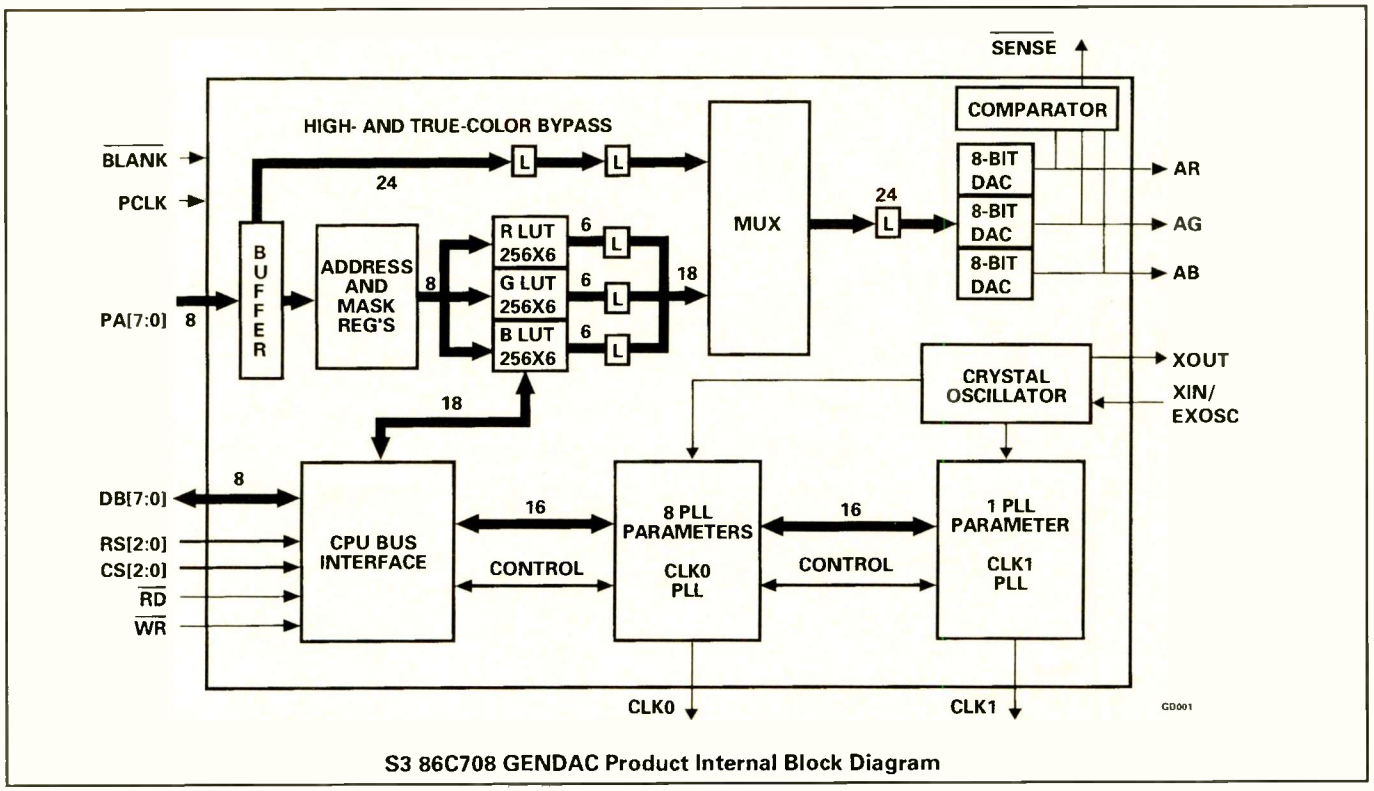
Flexibility is provided by the GENDAC's dual independently programmable pixel-clock and memory-clock outputs (see Fig. 1). Programmable clocks let designers precisely specify different screen resolutions and provide greater flexibility in interfacing to video memory of different speeds. For low-power operation, the DAC block and color palette RAM can be turned off under software control, while still preserving the data in the RAM.

Also supported by the GENDAC chip is a broad range of color modes—including true-color (24 bits/pixel), high-color (15-16 bits/pixel) and pseudo-color (eight bits/pixel). True-color and high-color modes are supported via a color look-up table bypass path for direct transmission of pixel data to the DACs.

The GENDAC is packaged in an industry-standard 44-pin PLCC and is available in 80- and 110-MHz maximum pixel clock rates. The GENDAC is priced at $8.75 in quantities of 1,000.

Supervisors Generate Active-High Resets

Maxim Integrated Products' (120 San Gabriel Dr., Sunnyvale, CA 94086) MAX-805L and MAX813L microprocessor-supervisory IC generate active-high reset outputs (RESET) when V_{cc} drops below 4.65 volts (5 volts +5%), for all conditions of power- up, power-down, brownout and



S3 86C708 GENDAC Product Internal Block Diagram

Fig. 1. Integrated Circuit Systems' and S3's GENDAC chip offers flexibility with its dual independently programmable pixel and memory clock outputs.

Fig. 2. Acuity Research's AccuRange 3000 sensors can be used in a wide variety of distance-measuring applications.

momentary power interruption. Active-high resets are required by many Intel microprocessors, such as the 8051 series. Predecessors to the MAX805L and MAX813L (the MAX690A and MAX705) produce active-low resets.

The MAX813L has a debounced manual-reset input (MR) that's capable of generating resets on command, and the MAX-805L's battery switch-over accommodates backup-battery power for SRAM and real-time clocks. Reset pulses are 140 ms minimum, guaranteed for V_{cc} as low as 1 volt. Each device has an independent comparator/reference circuit that's designed to monitor a battery, regulator input or any other voltage. Each includes a watchdog timer that monitors software execution by issuing a reset whenever 1.6 seconds elapses without evidence of activity on a selected I/O line.

MAX805L and MAX813L come in eight-pin DIP and SO packages, screened for the commercial, extended-industrial and military temperature ranges. Prices start at $3.26 for the MAX805L and $1.61 for the MAX813L for quantities of 1,000 and up.

Distance-Measuring Sensors

Acuity Research, Inc. (20863 Stevens Creek Blvd., Cupertino, CA 95014) now has an AccuRange 3000 line of laser diode-based range-finding sensors (Fig. 2). The devices are suitable for use in distance-measuring systems and applications at ranges from 0 to 20 meters. They're designed to be components in automated industrial positioning and scanned 3D vision systems and to be used in robotic, autonomous vehicle and laboratory testing applications.

AccuRange 3000 transmits a focused, modulated beam of light that's reflected from the target surface. Distance is converted to a frequency that can be easily measured with hardware or software, with resolution that depends only on the sample rate and measurement method. Other outputs include 0-to-10-volt analog measurements of the received signal strength, ambient background light and the internal sensor temperature.

AccuRange 3000 has a standard deviation of indicated range as low as 0.25 mm. The device's nominal 20-meter range can be extended with retroreflective targets.

Measuring 5½"L X 3" diameter, the sensor is housed in a rugged aluminum enclosure. It weighs 18 ounces. Power requirements are 5 volts at 0.25 amperes and 9 to 15 volts at 50 mA.

Acuity also announced availability of a SCSI-bus based interface board for the AccuRange sensors. This PC-form-factor board connects to any computer with a SCSI interface and can be used stand-alone or be installed in an IBM PC-compatible computer. The board includes hardware for measuring the frequency and other outputs of AccuRange at programmable rates up to 312,500 samples per second, precision voltage power supplies for the sensor, an input data buffer and optional 2-channel DC motor control and encoder sampling circuitry for use in 3D scanning systems.

Uses for the sensor and interface in industry include automated positioning and determination of part orientation in bin picking and conveyor-belt applications. In robotics, uses include machine vision for position control and autonomous vehicle and aircraft navigation and obstacle avoidance. When combined with scanning hardware, the sensor can be used in such applications as morphological and virtual-reality database acquisition and object recognition. As a test and measurement instrument, AccuRange can capture high-speed transient events.

3.3-Volt 70-ns UV-Erasable PROM

WSI's (47280 Kato Rd., Fremont, CA 94538) fast 3.3-volt UV-erasable CMOS PROMs with a maximum read access time (t_{AA}) of 70- or 90-ns, and a chip- select-to-valid-data-out time (tcs) of 20 or 30 ns, respectively. These 2K X 8 devices are claimed to meet or exceed the access time required for zero-wait-state operation with any 3.3-volt microcontroller, microprocessor or DSP.

The devices are especially well-suited to DSPs, such as the TMS320LC15, where fast access times are critical to zero-wait-state operation. In addition, faster 3.3-volt look-up tables, state machines and function generators can be implemented with these low-voltage PROMs.

WSI's low-voltage PROMs are suitable for real-time battery-operated products, such as hand-held telecommunications equipment, portable data recording equipment and embedded mobile applications. They support 3.3-volt processors with clock speeds between 12 and 15 MHz in laptops, palmtops and personal organizers with no wait states. They can also help to further extend battery life by reducing the power requirements of small disk drives and other low-power peripherals that are used with portable computers.

These fast new 3.3-volt PROMs are available in a 24-pin windowed CERDIP package in a commercial temperature range. Prices for the WS57LV291C-70T and WS-57LV291C-90T are $6.30 and $5.40 in quantities of 100 and up, respectively.

Fast Cache Data RAMs for Pentium

Fast cache data RAMs, tailored to interface directly with the family of Intel Pentium microprocessors without a wait state have been announced by start-up Integrated Circuit Works, Inc. (3725 N. First St., San Jose, CA 95134). Designated ICW79B586, these cache RAMs were developed around high-speed static-RAM technology.

Featuring a clock-to-output access time of 9.0 ns, this new family of 32K X 9-bit static synchronous cache RAMs has been designed to meet setup-time and hold-time requirements when interfacing directly between external cache controllers and high-speed Pentium processors operating at 66.6 MHz. These cache RAMs are also designed to support burst sequence addressing.

In these cache RAMs, an internal burst address counter follows the burst sequences of their associated processors. When the first address cycle is received from the processor, the subsequent address locations are cycled on the rising edge of the system clock, using the processor burst address sequence.

Fabricated with IC Works' advanced sub-micron BiCMOS process, the new cache RAMs feature very low operating current—less than 250 mA for the 9- and 10-ns versions and less than 200 mA for the 12-ns version. The devices are available in a standard 44-pin PLCC. When ordered in lots of 1,000 or more, prices are as follows: 79B586-9L, $52; 79B586-10L, $45.60; and 79B586-12L, $32.30. ■

SuperMart

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even wind effects. Furthermore, *Ultimate Baseball* is licensed by the MLBPA and was voted 1992 Sports Game of the Year by *Computer Gaming World* magazine.

That was the original version of *Ultimate Baseball*. A second version simply improved on a good thing. It added better batting perspective that looks over the batter's shoulder, more visual field view, close-up camera angles, double-play pivots and more overall detail. There are a new MLBPA players expansion disk and a fantasy draft expansion disk.

Second on the roster is a double header from Micro League. Its two computerized hitters are *Fantasy Manager* and *Baseball, The Manager's Challenge*. *Fantasy Manager* is designed to let you run a fantasy league from start to finish. You can start building your team at draft opening right through to your final report at the end of the season. You can keep your player statistics current by subscribing to the *Computer Sports World* or by stat disks from Micro League.

Playing a supportive role to *Fantasy Manager* is *The Manager's Challenge*. It puts you into the analytical mind of managing a baseball team. You must counter any strategic moves by the opposing forces. If the other guys put in their best pinch hitter, you adjust your team accordingly. *Manager's Challenge* illustrates the intellectual side of baseball and let's you indulge your mental skills to win a game.

Ultimate Baseball, *Fantasy Manager* and *Manager's Challenge* is Radio Shack's triple play. All three members of the package are original-version computer games (newer versions have many improvements). If this fact keeps you off the playing field, consider a little signing bonus. Radio Shack tosses in a baseball, autographed by Nolan Ryan in honor of his five-thousandth strikeout, three-hundredth win and twenty-seventh major league season. If this Ryan baseball doesn't yank your glove, maybe you're not a real baseball fan.

Total Baseball

What do baseball fans want more than a vintage Willie Mays trading card? What do baseball mavens want more than a baseball signed personally by Nolan Ryan? They want information, that's what. Baseball and other sports enthusiasts want statistics, articles and photos. They want to absorb the game and its participants.

The compact disc is the ideal medium for large amounts of information. Creative Multimedia Corp., a publisher of CD-ROM software, provides a torrent of baseball data on CD-ROM. The title is *Total Baseball*. It supplies the entire statistical record of major-league baseball from its inception in 1871 through the 1992 season, including League Championship Series and the World Series. The disc contains more than 2,000 pages of statistics and articles and more than 600 photographs of players, teams and ballparks. While browsing through the images on this CD-ROM, you can listen to sound tracks from a collection of 20 sound clips.

Some of the photos on the *Total Baseball* CD-ROM include the likes of Ty Cobb, Mel Ott and Cy Young. You'll see pictures of historic parks like Ebbets Field and Wrigley Field. You'll hear sound clips of Hall of Fame announcer Red Barber, who will live in the memory of every student of baseball; Dick Sisler's tenth-inning home run against the Brooklyn Dodgers to win the 1950 National League Pennant for the Philadelphia Phillies; Reggie Jackson's three home runs in a 1977 World Series game; and more.

Total Baseball is a comprehensive informational feast for anyone who is interested in the history of the game. It has an easy search-and-retrieve system so that specific data can be found without difficulty. The only shortcoming of *Total Baseball* is that it lacks moving images. Imagine watching some of the game's great players while listening to the nostalgia at the same time. Even with the lack of video clips, *Total Baseball* will feed your quest for information and trivia for many seasons to come.

Tom Landry Strategy Football

A football game bearing the name of the Dallas Cowboys ex-coach isn't entirely surprising. Given the plethora of computerized versions of the gridiron game, like those from John Elway, Joe Montana and John Madden, one wonders what took Landry so long. Dallas-based Merit Software issues the football game, with the blessings of Tom Landry. I won't bother to review Landry's qualifications for authoring a football game.

Landry's football game has all the basics. It starts with a simple point-and-click interface, allowing for fast selection of plays. You can match your skills against the game computer or another person. You can scout your opponent, reviewing his roster to get an idea of his strengths and weaknesses. You can view season statistics and records and then save them to your hard drive if you wish. A scenario editor lets you play the theorist in building hypothetical situations and seeing what occurs. You can design your own plays, invoke instant replay and even play a game

Assembling the BASCOM1 80C52-BASIC SBC

(from page 71)

Again, I examined the instruction manual. There seemed to be another "typo." The Parts List in the front of the manual specifies the 32K×8 static RAM as part number P65256. However, the schematic in the back of the manual shows the RAM as part type P62256. I had ordered from the Parts List.

The supplier from which I ordered the IC sent me a "pin-for-pin" substitute for the P65256. It could have been that the substitute RAM chip just wasn't compatible with the BASCOM1 board. Since the supplier wasn't able to supply the P65256 RAM, I ordered the other possibility: a P62256.

When the P62256 chip arrived, I installed it and powered up my BASCOM1 SBC. I sent to it the required carriage return and, thankfully, that did it! I was greeted with the sign-on message and the board was ready to go. Next, I checked MTOP (available program memory), which revealed that 32K was waiting for me to use.

Finally, I programmed an EPROM from the program in the manual. It worked perfectly.

The company informed me that it would include an errata sheet with all its kits until a new instruction manual could be printed. It even plans to silk-screen numbers on the shorting blocks with the next batch of board printings.

In Conclusion

This experience should help you assemble Prologic Designs' BASCOM1 single-board computer without grief. I judge this to be a good-value board for the money it cost me. Just remember to jumper JP4 to Vcc, not ground. Get your 80C52-BASIC MPU chip and TL7055 ($3 for the latter) from Prologic Designs at the same time you order the bare board. Finally, be sure to order the P62256 static RAM chip. Have fun! ■

Bird's Eye View

Triple Play, $49.95
Tandy Corp.
1800 One Tandy Center
Fort Worth, TX 76102
Tel.: 817-390-3011

Requirements

Memory	640K, Hard Drive
Graphics	EGA
Sound	PC Speaker
Controllers	Mouse, Keyboard
Documentation	Good

Evaluation

Graphics	Good
Learning Curve	Medium
Complexity	Medium
Playability	Good

In Brief: A trio of choice baseball games in a package collection, complete with a Nolan Ryan baseball. Recommend at least a moderately-fast 386 PC for best performance.

CIRCLE NO. 125 ON FREE INFORMATION CARD

Bird's Eye View

Michael Jordan In Flight, $59.95
Electronic Arts
1450 Fashion Island Blvd.
San Mateo, CA 94404
Tel.: 800-245-4525

Requirements

Memory	640K, 1,024 EMS
Graphics	VGA
Sound	Sound Blaster & Pro, Pro Audio Spectrum, AdLib, Roland
Controllers	Keyboard, Mouse

Evaluation

Documentation	Good
Graphics	Good
Learning Curve	Medium
Complexity	Medium
Playability	Good

In Brief: Interesting and unusual approach to computer basketball, featuring Michael Jordan technique. Recommend at least a moderately-fast 386 PC for best performance.

CIRCLE NO. 128 ON FREE INFORMATION CARD

Bird's Eye View

Ultimate Challenge Golf, $59.95
Friendly Software, Inc.
5955 Winslow Rd.
Whitehouse, OH 43571
Tel.: 800-968-4654

Requirements

Memory	640K, Hard Drive
Graphics	GA
Sound	None
Controllers	Keyboard

Evaluation

Documentation	Good
Graphics	Fair
Learning Curve	Medium
Complexity	Medium
Playability	Excellent

In Brief: High quality golf game that takes a purely instructional approach. Excellent play for the golf strategist. Recommend at least a moderately-fast 386 PC for best performance.

CIRCLE NO. 129 ON FREE INFORMATION CARD

Bird's Eye View

Total Baseball, $69.99
Creative Multimedia Corp.
514 NW Eleventh Ave.
Portland, OR 97209
Tel.: 503-241-4351

Requirements

Memory	500K, Hard and CD-ROM Drives
Graphics	VGA
Sound	CD-ROM Drive Output

Evaluation

Controllers	Keyboard
Documentation	Good
Graphics	Good
Learning Curve	Short
Complexity	Easy
Playability	N/A

In Brief: Comprehensive database of baseball statistics and images. Recommend at least a moderately-fast 386 PC for best performance.

CIRCLE NO.126 ON FREE INFORMATION CARD

by modem. In this age of speeding computer game technology, all of these features are to be expected.

Landry Football plays well enough and includes acceptable graphics and support for audio such cards as Sound Blaster and AdLib. The designers have done a fine job of slanting the game toward the Landry school of thought and execution. Although providing all the basics, the game fails to raise itself above the level of average when compared to other computer football games currently on the market. The designers of the game missed an excellent opportunity to delve deeper into the mind of Landry the strategist and call forth details and philosophy of Landry's offensive strategy and his famous Flex defense. Often has it been said in the Dallas area that no one except Landry truly understands the Flex. Landry's football game could serve as an excellent platform for education and experimentation.

Also missing from the game is authenticity. All the teams have the right colors but lack official NFL markings. The Cowboys appear in traditional costume, but there's no star on their helmets, and player names aren't used. Realizing, though, that official NFL connections might require lengthy business negotiations and probably a lot of trouble, these particular oversights are understandable. If you're a Tom Landry fan, don't pull your six-shooter just yet. *Landry Football* isn't a bad game. It simply doesn't score a touchdown in delivering the full flavor and brilliance Landry the coach.

Jordan In Flight

Basketball star Michael Jordan adds another arrow to his increasing quiver of commercial interests. The new interest is a computerized basketball game appropriately called *Michael Jordan in Flight*. As basketball games go, *Jordan*'s version initially appears typical in appearance and play. However, there's a difference that manifests itself in a two-fold manner. The first difference is that *Jordan In Flight* is a game of three-on-three. Most basketball games of a graphic nature end up testy one-on-one battles, similar to *Jordan Vs. Bird*, a predecessor of *Jordan In Flight*. The three-on-three technique occurs on a half court, with designed plays and play calling. You can control Jordan himself or any player who has the ball. The objective of the game is to simulate Jordan's skill and allow computer players to take part in offense, defense, rebounding and shooting.

The second difference seen in this game is a very interesting simulation of camera views. As game action proceeds, the on-screen view pans and zooms to follow the action, much like what's seen on real televised games. In reality, you control digitized images of Jordan and other athletes.

Players perform moves that are fluid in appearance. This visual technique is im-

pressive to watch and appears so lifelike as to be eerie. The action is fast-paced but graphically smooth. It takes some practice to synchronize the moving video with player position and mouse or keyboard control. Combine strategic plays with panning and swiveling camera work, and you get a basketball game that's interesting to the point of being unique.

New Golf Ideas

Golf games have exploded into many varieties during the last couple of years. Most of them are graphics-oriented, concentrating on the pleasure of the game while presenting stunning graphics. A leader in this kind of golf game is Access Software, which released *Links 386 Pro*, its newest golf simulation and successor to *Links*. A flurry of new course disks followed the fresh version of *Links*. The three most-recent courses are Pinehurst, Mauna Kea and Banff Springs.

Pinehurst Resort & Country Club is one of the finest golf resorts in the world, owning seven championship courses. Golfers like to play there. Mauna Kea, built on a 5,000 year old Hawaiian lava flow, is one of the more-dramatic courses a golfer will see. You open the game with a forceful drive that launches the ball over a rich blue Pacific inlet.

If you can stay away from Big Rock Brewery long enough to play a few rounds, Banff Springs offers a course of magnificent beauty, surging over a mile up into the Canadian Rockies near British Columbia. After following the course over gentle hills and under snow capped Sulphur Mountain, you can face the crystal waters of "The Devil's Cauldron." Maybe you'll see your own golf ball staring at you from the bottom of the lake.

An alternative to dazzling graphics and playing for pleasure is the instructional golf game. While visually acceptable, instructional games direct player efforts toward actually helping improve your golf game. One of the better games on instructional golf is *Ultimate Challenge Golf*, published by Friendly Software, Inc. *Ultimate Challenge* accomplishes the feat of allowing you to use individual course-management strategies, just as you would on a real golf course. It focuses attention on your golf stroke, rather than on recreating the appearance of golf play. The program considers golfing variables from stance, swing, angle, right down to the dimple arrangement on the ball. The result is a collection of shots determined over the course of play that accurately parallels the results you'd obtain on an actual golf course. This approach is distinctly different from that used in *Links*. Your shots depend on your keyboard's spacebar or your left mouse button to make a good shot. If you're a serious golfer and have the mind of a strategists, *Ultimate Challenge Golf* is for you. ■

Bird's Eye View

Tom Landry Strategy Football, $49.95
Merit Software
13635 Gamma Rd.
Dallas, TX 75244
Tel.: 214-385-2353

Requirements

Memory	640K, Hard Drive
Graphics	VGA
Sound	AdLib, Sound Blaster
Controllers	Keyboard, Mouse

Evaluation

Documentation	Good
Graphics	Good
Learning Curve	Medium
Complexity	Medium
Playability	Good

In Brief: Enjoyable but incomplete attempt to translate the mind of Tom Landry into a computer game. Recommend at least a moderately-fast 386 PC for best performance.

CIRCLE NO. 127 ON FREE INFORMATION CARD

Bird's Eye View

Pinehurst Championship Course; *Mauna Kea Championship Course*; *Banff Springs Championship Course*, $29.95 each
Access Software, Inc.
4910 Amelia Earhart Dr.
Salt Lake City, UT 84116
Tel.: 800-800-4880

Requirements

Memory	640K, Hard Drive
Graphics	SuperVGA, VESA
Sound	RealSound and All Major Cards
Controllers	Keyboard, Mouse

Evaluation

Documentation	Good
Graphics	Excellent
Learning Curve	Medium
Complexity	Medium
Playability	Good

In Brief: New Links courses with brilliant graphics in SuperVGA. Requires Links 386 Pro. Recommend at least a fast 386 PC for best performance.

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CQ Books and Videos

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Enjoy nostalgia with this visual celebration of amateur radio's favorite accessory. Written by the well-known author and CQ columnist Dave Ingram, this book is full of pictures and historical insight that only K4TWJ can provide. If you've ever wondered about the old days of Morse, this book's for you.
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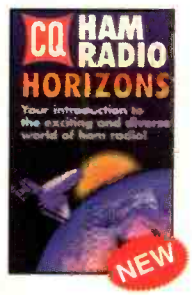

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(Continued on page 84)

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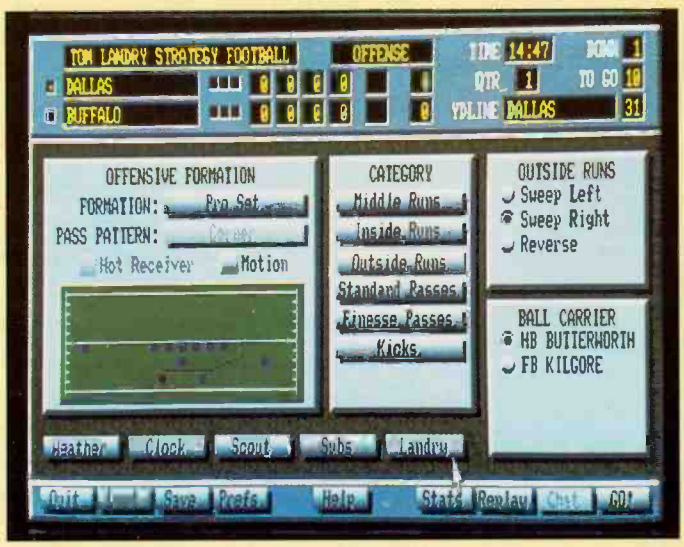

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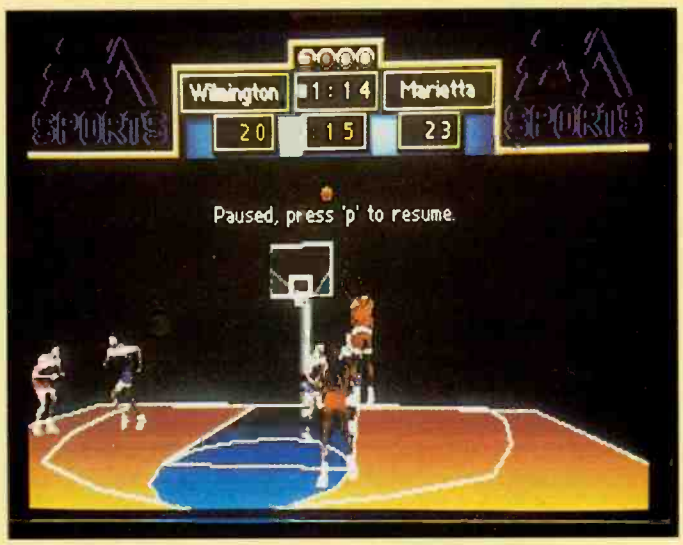

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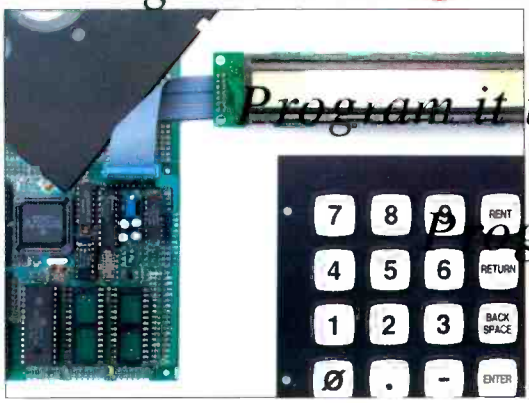

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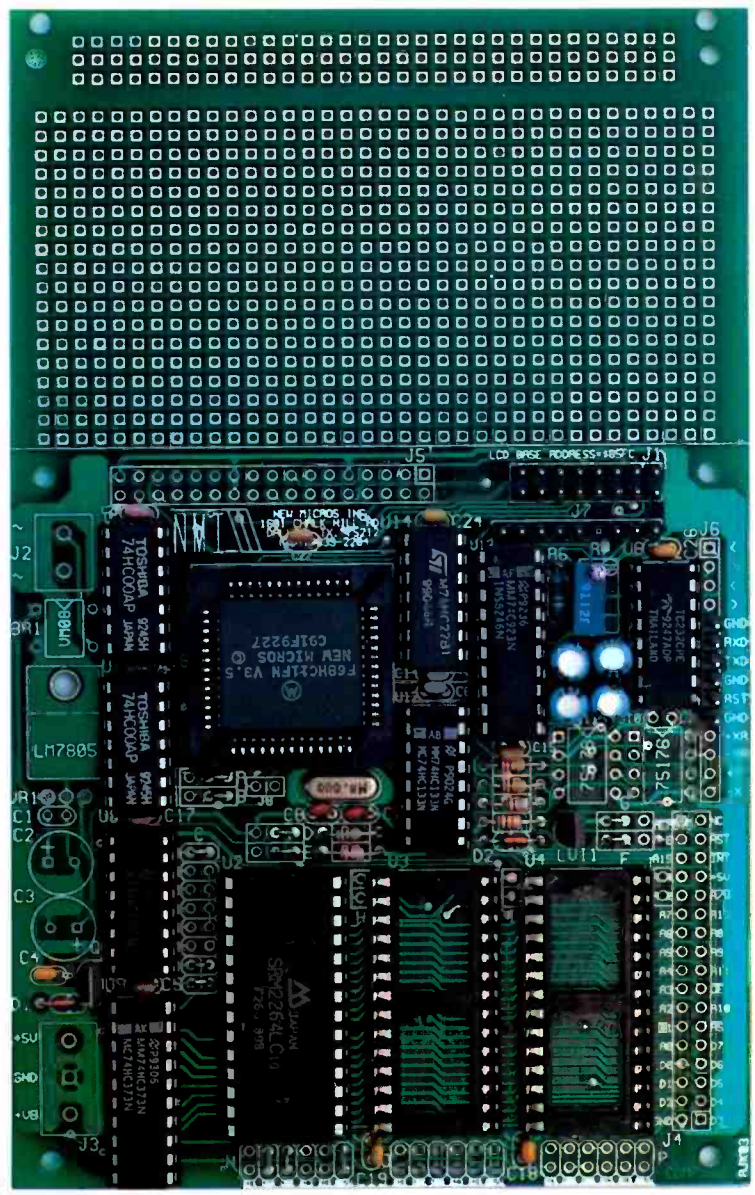

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