VOL. 2 No. 3 March 1985

COMPUTER DIGEST

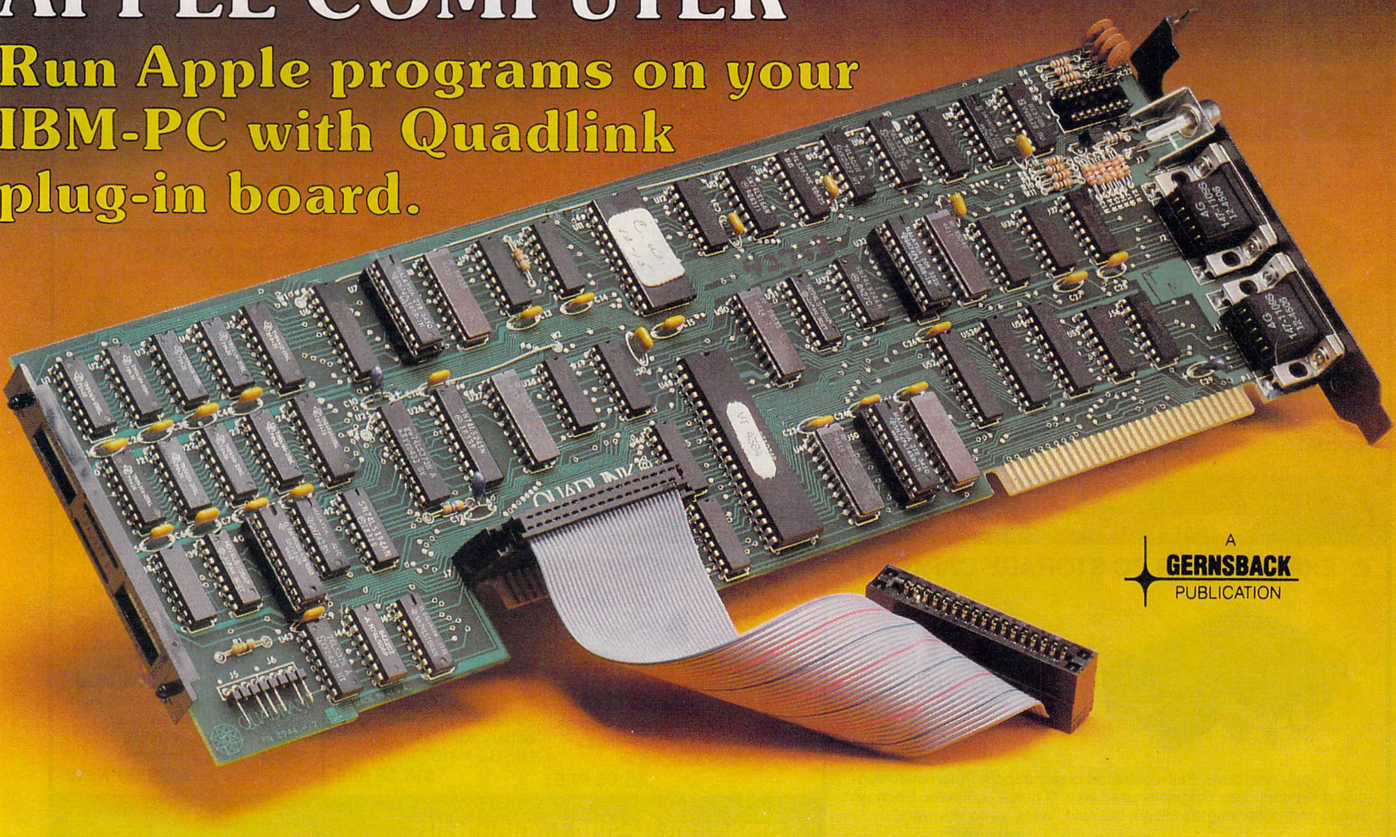
NEW KIND OF MAGAZINE FOR ELECTRONICS PROFESSIONALS

PUT AN END TO YOUR RS-232 INTERFACING PROBLEMS

Smart Cable lets you connect your peripherals without thinking twice

TURN YOUR IBM-PC INTO AN APPLE COMPUTER

Run Apple programs on your IBM-PC with Quadlink plug-in board.



A GERNSBACK PUBLICATION

MACHINE CODE DEVELOPMENT SYSTEM

Build this add-on and put your Timex/ Sinclair ZX81 computer to work as a development system and an EPROM programmer and emulator.

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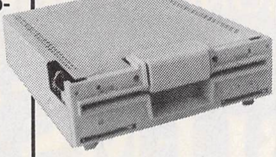

Original equipment drive, compatible with Apple 2e, 2+, and 2c.

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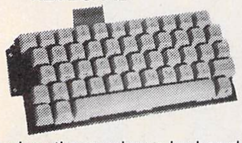

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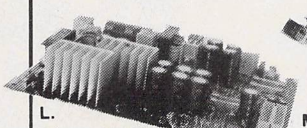

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+5V @6A
−5V @1A
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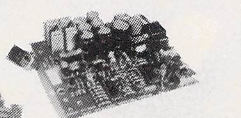

M. +12V @.350A
+5V @1.2A
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Input: 115VAC when used with AC wall transformer (supplied) **$6.95** NEW

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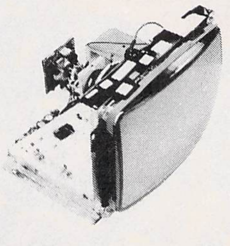
Harmonic neutralized. 500 VA, provides 120V/60Hz continuously, with input variations as great as ± 15%. Input Voltage: 95-130 or 190-260 VAC, 60 Hz. (accepts either voltage). Mfr: Sola. **$99.00** NEW

O. 19" COLOR X-Y DISPLAY



Originally designed for use in Atari coin-operated games. Contains a 19VLUP22 3-gun color tube, focus and brightness controls. Has electromagnetic deflection and solid state circuitry with three "Z" amp inputs (red, green, blue). Ideal for arcade replacement or, with the addition of external circuitry, for color graphics display. Manual included.

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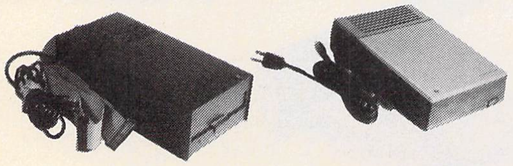

$5^{1}/_{4}$" floppy disc drive. Self-contained power supply. Plus...matching disc drive controller. Originally used with TI home computer. Each unit tested and in working condition, but sold "as is"—no warranty.

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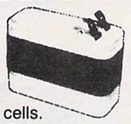

12V @450Ma.
Contains 10 AA cells.
Recharge rate 45Ma, 16-18 hours.
Case with tab output connections.
Dim: $2^{1}/_{16}$"H x $1^{1}/_{4}$" x $2^{15}/_{16}$"L.
Mfr. GE #123233 or equiv.
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13.2V @1.65AH
Contains 11 C cells.
Portable computer battery back up.
Mfr. GE # 41B03JBB00101
$15.95 RFE

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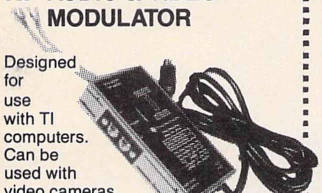

Designed for use with TI computers. Can be used with video cameras, games, or other audio/video sources. Built in A/B switch enables user to switch from T.V. antenna without disconnection. Channel 3 or 4 selection. Operates on 12VDC. Schematic included. IBM and Apple compatible. Mfr. TI #UM1381-1

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CONTENTS

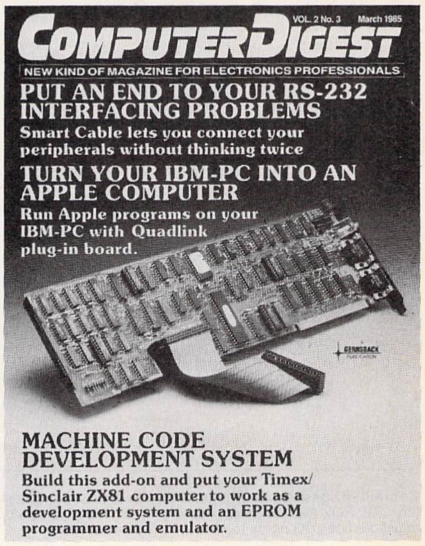
Vol. 2 No. 3 March 1985

See page 10.

See page 13.

ON THE COVER

If you've been looking jealously at some of the Apple software and wishing that your IBM-*PC* could handle some of it, look no longer! The *Quadlink* plug-in board lets your *PC* run Apple programs! See page 7.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EDITORIAL

When all else fails, read the instructions.

■Your editor got his writing career started many, many years ago, working in the publications department of a major electronics equipment manufacturer. The hardest part of the job was getting people to read the instruction manuals.

Take the guy who sent his brand new transmitter back because it "smoked"when he turned it on. Obviously, this dude never read the section titled "Unpacking:" The final amplifier tubes were still surrounded by cotton wadding, put there to protect them during shipment. It was *still* there, but now burned to a crisp. We told him to "tune for minimum smoke!"

In one case, we even had a jumper wire taped to the last page of the instructions, which, when properly installed alongside the AC input, would complete the primary circuit so the power *could* be turned on!

Take a careful look at the instruction manuals that come with your new computer equipment, and you'll see that the manufacturers go to great and costly lengths to make those instructions as palatable as they can. (At least *some* of them do!) They spot little fetching cartoons throughout the pages, copiously use photographs, add color where they can, and the writing is light and breezy, written to express, not to impress. They do whatever they can to *make* you read the instructions, and hopefully, read them in detail before you throw the big switch for the first time.

The fact of the matter is that by spending some time reading the instructions, you're going to save yourself a lot of time when you power up and go online. That little bit of familiarization can be of tremendous help and add to your previous knowledge.

It's a good idea to begin by unpacking the unit just enough to gain access to the instruction booklet and then stop. Take the book out, and go through it a few times until you know that piece of equipment like the back of your hand. Then and *only* then should you proceed with the unpacking and really make friends with the equipment you've spent your bucks for.

You'll probably save a small fortune in telephone calls to the manufacturer's service department too.

Byron G. Wels

Byron G. Wels
Editor

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LETTERS

ZX81's OK!

I am a long-time admirer of the enthusiastic and talented work of those who contribute to putting **Radio-Electronics** in my mailbox each month. More recently, I have added the people who put together **ComputerDigest** to that category of "good company."

With that truthfully said, and with the hope that the truth will not only set one free, but get the recipient to the next paragraph, I would like to offer a comment or two to Mark Latham's comments contained in his worthwhile article, "Machine code Development System" in the January issue.

Mr. Latham commented in the second paragraph of his article that the lack of speed (in loading and running programs) really prevents the *ZX81* and/or the Timex Sinclair *1000* from serving any useful purpose.

First, may I say that he and I are, apparently, of one mind in our desire to find useful purposes for the *ZX81*. It seems to possess great speed and capability. We diverge though at the point of the program-running ability in terms of speed.

The text characters being manipuluated to produce them in acceptable written form and send them on to you are being done in BASIC and at a speed which is comparable with that which I can get on paper with the IBM in the closet; and with less effort.

Once "finalized", it goes to a Gemini printer at 4600 baud via a Byte-Back RS-232 Serial device; at a speed that is very fast.

I have a quarterly federal and state estimated tax program jammed within the perimeters of VU-CALC which allows me to perform that chore four times yearly in at least a twentieth of the time it would take me without it; and, from what I'm able to read, the expensive machines could not really do it substantially quicker.

I therefore find that the *ZX81*, despite the negative comments by both friends and non-friends, as to running speed, do not correspond to my own experience. Further, when one weighs the cost vs. utility factor, there simply is no contest for home use.

As to loading: The approximately 200-baud loading speed is a tad slow for most programs. However, for a modest sum, fast loading programs and devices are available and in constant use by many of us who spend much time at the *ZX81*.

Recently, I was amazed to read, I think the article was by Mr. Friedman, in another publication, that it took him 72 seconds to disk-load CP/M to, I presume, one of those more costly machines. Honestly, and excuse my naivete, from the many, many articles I had read to that time, I believed that a "slow" disc loading took 10 seconds while the fast one probably took 5 seconds.

My "amazement" changed rather quickly to smugness as I realized that I have been loading three-16 programs back-to-back, accessible to each other and run-able (48K's worth) in 76 seconds flat (and that's with a $23.00 cassette recorder and an under-$1.00 data cassette tape).

In conclusion, I wish to say that the *ZX81* is not as slow running as many say and for one-one-hundreth the cost of a disc drive, is not slow loading either.

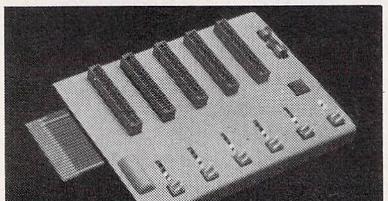
J.E. JUERGENS, *Pacifica, CA*

COMPUTER PRODUCTS

For more details use the free information card inside the back cover

FIVE-SLOT EXPANSION INTERFACE, the *CARDBOARD/5*, is designed for the Commodore *64*. It allows the user greater flexibility to switch-select any cartridge slot or combination of cartridge slots. Twenty-two LED's are used to give status indication. Each slot has four LED's and two toggle switches for indication and control.

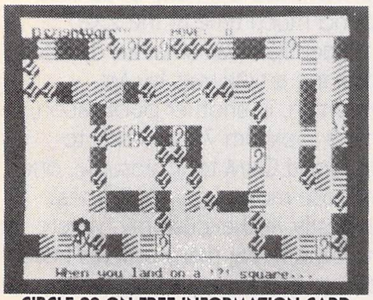
The different-colored LED's indicate the status (on/off) that the cartridge in that slot is requesting on the XROM and GAMERON LINES. The user has the choice of honoring that request by turning on one of the toggle switches; when the green LED is lit, that shows that the request is being honored. Two master amber LED's are at the rear of the board, and will show the cumulative status of all the slots selected. The second toggle switch at each slot enables the power to reach the cartridge, and the fourth LED (red) indicates power-on condition. The user can supply power to a cartridge without allowing it to auto-start or to affect other operations. In addition, there are two master toggle switches that allow the user to manually override any situation and set the lines as desired.



CIRCLE 21 ON FREE INFORMATION CARD

The *CARDBOARD/5* is priced at $79.95.—**Cardco, Inc.,** 313 Mathewson, Wichita, KA 67214.

THE *GRAMMAR EXAMINER* is an educational journalism game designed to help kids ages 10-14 improve their basic grammar skills. The player starts by landing a job as a cub reporter with *The Grammar Examiner* newspaper. Editing copy and answering questions pay off as the junior reporter earns promotions and moves his way to the top spot on the masthead



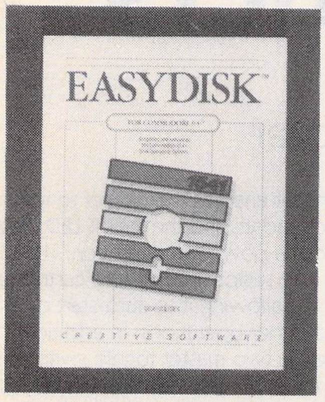
CIRCLE 22 ON FREE INFORMATION CARD

To edit copy, the reporter moves the cursor through the given paragraph, stopping to revise faulty punctuation and incorrect words. The computer either approves the entire amended text or flashes the proper answer where mistakes were made.

The Grammar Examiner has a suggested retail price of $44.95.—**DesignWare,** 185 Berry Street, San Francisco, CA 94107.

UTILITY PROGRAM, *EasyDisk,* simplifies the disk-operating system of the *Commodore 1541.* It enhances and extends that system by providing features that allow users to back up disks, print both program and sequential files, and display them on the screen. The program, which is accessed by a

EASYDISK



CIRCLE 23 ON FREE INFORMATION CARD

keystroke, does not interfere with the normal operation of the computer.

EasyDisk is currently available for the *Commodore 64* at a retail price of $29.95.— **Creative Software,** 230 East Caribbean Drive, Sunnyvale, CA 94089.

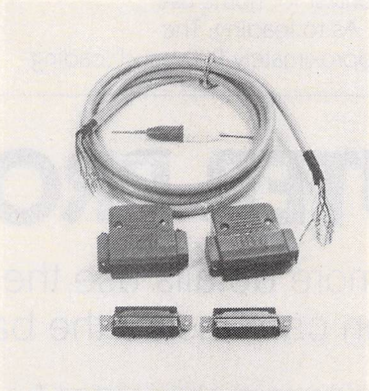
ENU SYSTEM, the *Magic Menu,* enables users of IBM *XT,* IBM *PC,* and PC-comptible computers to move

CIRCLE 24 ON FREE INFORMATION CARD

from a word-processing program to a spreadsheet program to a payroll program without dealing with DOS or consulting manual. *Magic Menu* interfaces between the user and the DOS (version 2.0 or later) and allows any application with just a few keystrokes.

Sequence screens allow automatic execution of a series of menu entries, while password security can be provided for any and all applications. *Magic Menu* also provides automatic screen blanking, dynamic variables for customizing general entries, speed entries for advanced users, and a host of other features. It is priced at under $100.00.—**DeereSoft, Inc.,** PO Box 1360, Melbourne, FL 32901.

ADAPTABLE CABLE, the Data Spec *Easy Match,* is a cable assembly kit for microcomputer use. The shielded-cable assembly kit includes a 6′ or 12′



CIRCLE 25 ON FREE INFORMATION CARD

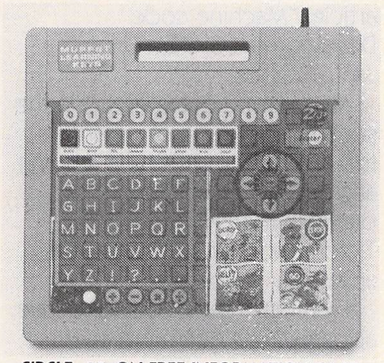
color-coded, 9-conductor shielded cable with pins attached to the conductors. Those pins can be inserted into any location in the connector block, with the aid of a special tool. The tool is included with the kit, and can also be used to remove the pins for reconfiguration.

The kit contains two 3-pin jumper leads for handshaking and other purposes, plus Data Spec hood assemblies, which feature clamp-style strain relief.

The kit comes in either 6′ or 12′ lengths, in male/male (model *ARU-MM-6*) or male/female (model *ARU-MF-6*). List price of the 6′ kit in model *ARU-MM-6* is $22.95 and for model *ARU-MF-6* is $23.95.—**Data Spec,** Alliance Research Corporation, 18215 Parthenia St., Northridge, CA 91325.

MUPPET LEARNING KEYS, is a computer keyboard that helps children aged three and up learn letters, numbers, and colors with the Muppets.

The keyboard simulates the contents of a child's school desk—ruler, watercolor set, penmanship slate, compass, and arithmetic exercise book. There is even a comic book on the desk to provide key commands for the programs. Kermit the Frog, Miss Piggy, Gonzo, and Fozzie Bear provide friendly and humorous instruction.



CIRCLE 27 ON FREE INFORMATION CARD

Muppet Learning Keys has a price of $79.95.—**Koala Technologies Corp.,** 3100 Patrick Henry Drive, Santa Clara, CA 95052-8100.

COLOR-DISPLAY MONITOR, the Sakata model *SC-100,* is compatible with Apple *II,* Apple *IIE,* Commodore-*64,* or *VIC-20,* NEC-*PC,* Atari-*800,* and other personal computers. The model *SC-100,* has a 13″ CRT with a 0.65mm dot pitch, and accepts composite video signals. It is designed for the home, at school, or in any business.

CIRCLE 26 ON FREE INFORMATION CARD

The model *SC-100* is priced at $329.00.—**Sakata USA Corporation,** 651 Bonnie Lane, Elk Grove Village, IL 60007A

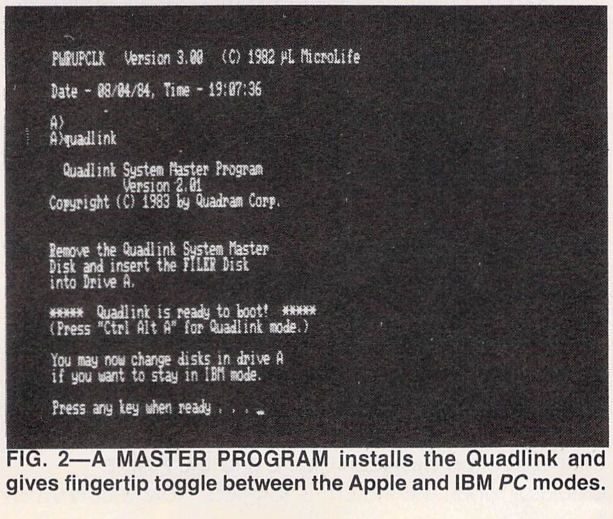
TURN YOUR IBM-PC INTO AN APPLE COMPUTER

Now you get two from one
—A bargain in any man's language!

HERB FRIEDMAN

■The term *obsolete* has really taken on a new meaning when applied to personal computers. For anything else it can mean a product that hasn't all the modern bells and whistles but is still usable. For personal computing, the popular press has made *obsolete* synonymous with *unusable*.

The concept is incorrect. The software might be obsolete in the sense that it won't run properly on some of the newer computer models, but it will certainly work on the computer it was designed for. The spreadsheet will still function as a spreadsheet, the word processor will still function as it did before, and a database will still manage data, because software obsolescence is generally not a function of it's features or performance, but of the non-compatibility of the hardware—the computer.



```
PWRUPCLK   Version 3.00   (C) 1982 µL MicroLife

Date - 08/04/84, Time - 19:07:36

A)
A)quadlink

  Quadlink System Master Program
             Version 2.01
Copyright (C) 1983 by Quadram Corp.


Remove the Quadlink System Master
Disk and insert the FILER Disk
into Drive A.

*****  Quadlink is ready to boot!  *****
(Press "Ctrl Alt A" for Quadlink mode.)

You may now change disks in drive A
if you want to stay in IBM mode.

Press any key when ready . . . . _
```

FIG. 2—A MASTER PROGRAM installs the Quadlink and gives fingertip toggle between the Apple and IBM *PC* modes.

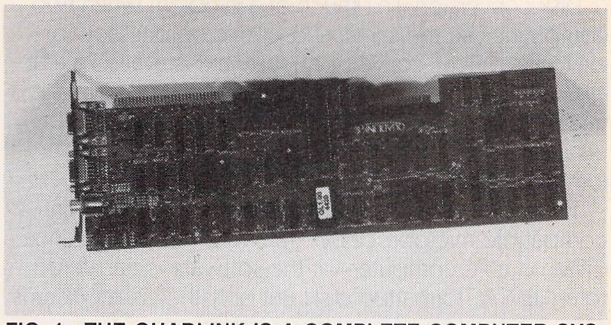


FIG. 1—THE QUADLINK IS A COMPLETE COMPUTER SYSTEM with its own CPU, disk controller, and RAM. It takes up only one *PC* expansion slot.

Perhaps the greatest area of non-compatibility is that of the Apple and IBM computers. For many years Apple computers were the primary school and business computer. By some "expert's" count, there is more educational and business software available for Apple computers than for all others.

But the picture is changing rapidly. The IBM *PC* has become the de facto standard computer for business, and it is rapidly becoming the standard school computer since the *PCjr* was upgraded to run virtually all *PC* software.

Regardless of what is accepted as the new standard computer, the older machines do exist, along with a mountain of effective applications software that's not going to be scrapped. And let's not forget the weeks and months that went into learning how to maximize the performance of the older software; few users of personal computers have the money or time to do it all over again.

If you're caught in a software bind created by having added IBM *PC's* to an installed base of Apple computers, the answer to your software problems might very well be Quadram's (4355 International Blvd., Norcross, GA 30093) *Quadlink*, an Apple emulator for the IBM *PC*. That device allows a *PC* to function as an Apple computer (see Fig. 1).

The *Quadlink*, which takes up a single expansion slot in a *PC* or *PC/XT*, is essentially a complete computer that emulates an Apple. The board contains a 6502 CPU, 64K of RAM, and a disk controller. The *Quadlink* is essentially the complete guts of an Apple *II+* computer. Switching loop-through circuits use the *PC's* disk drives, speaker, and color/graphics adapter for both *PC* and Apple operation. Simply touching a few keys toggles the *PC* between the IBM and Apple operating modes (see Fig. 2).

Yes, "toggle" is the correct word. Since the emulator has its own CPU and its own RAM, the user can actually run two programs in RAM at the same time—one in the IBM mode, the other in the Apple mode—and toggle back and forth while they are running.

The *Quadlink* provides full emulation of an Apple computer right down to the disk drives. Since one of the verities of personal computing is that non-identical disk formats aren't compatible, perhaps we should first look at how the *Quadlink* accommodates both the *PC* and the Apple disk formats on the same disk drive.

Disk conversion isn't much of a problem when two computers use the same kind of microprocessor. For example, much "conversion" software is available that allows a CP/M computer to run "foreign" software if it is transferred to a compatible disk format. If you can transfer the software from computer X to the disk format of computer Y, it will run on computer Y.

There is even a hardware device that will run non-compatible microprocessor software—in this instance CP/M on a *PC* computer—if the software is transfered to an IBM *PC* formatted disk. But only the *Quadlink* runs software for non-compatible microprocessors directly from the original disk because the user uses *PC*-formatted disks when the computer is in the *PC* mode, and Apple-formatted disks when the computer runs as an Apple. That is accomplished by a separate disk controller for the Apple emulation. When the *PC* is toggled for the Apple mode, the emulator switches the disk drives to the emulator's controller. As far as the emulator is concerned, the *PC's* disk drives are correct for the Apple format.

The design of a *PC's* disk drive however, puts limits on how far the Apple disk emulation can be carried. The *Quadlink* can only be used with software from the Apple *II* and Apple *II+* computers, but not usually from the Apple *IIe*. The Apple *IIe* uses what is called half-stepped disk drives, meaning data or information—usually for copy protection—can be recorded between the usual track locations. Since the *PC's* disk drives were not designed to half-step they will not read half-stepped Apple *IIe* software. However, there is non-protected Apple *IIe* software that is not half-tracked, and such software can often run on the *PC*.

The *Quadlink* is furnished on a single printed-circuit board along with a disk containing the initializing software, a disk of Apple utility programs that also contains floating point (Applesoft) and integer BASIC, and three jumper cables; those are for sound, video, and the disk controller.

Installation of the *Quadlink* could not be easier, involving only the *PC* board itself and the three plug-in adapter cables. The board installs in a *PC* expansion slot, while the three cables simply plug into existing connectors. There is no alignment.

Because of the way the *Quadlink* must be connected to the IBM disk adapter (card), the first step is the relocation of the cable that connects the *PC's* disk adapter to the drives. The cable is disconnected from the IBM disk adapter and plugged into the *Quadlink*. The *Quadlink* adapter board is then installed in the *PC's* expansion slot that is immediately adjacent to the slot having the *PC's* disk adapter card. Then, a short cable from the *Quadlink* is plugged into the IBM disk adapter, completing the disk system loop-through. You use the specified *PC* slot not for electrical reasons, but because it's the only slot the adapter's cable will reach.

The sound is looped through the *Quadlink* by moving the speaker wire's connector from its mate—which is located on the *PC's* motherboard near the speaker—to a connector on the *Quadlink*. A short supplied jumper connects the *Quadlink* to the *PC's* original motherboard connection.

Finally, the video from the *PC's* color/graphics monitor adapter is looped through the *Quadlink* via a supplied jumper cable that connects the RGB connector on the back of the *PC's* color/graphics adapter to a matching connector on the *Quadlink*. The backplate of the *Quadlink* provides both an RGB monitor output, and a composite video output that can be used for either a monochrome or a composite color display (see Fig. 3).

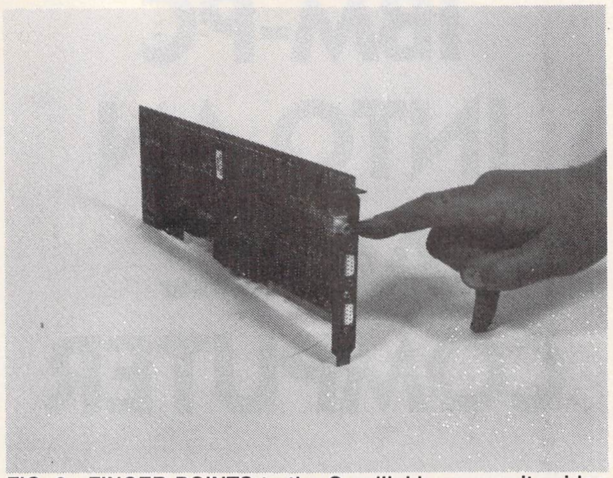


FIG. 3—FINGER POINTS to the Quadlink's composite video output, which can be used for monochrome or composite color monitors. Note the two DB connectors below, which provide the *PC* loop-through and RGB color output.

Essentially, the *Quadlink* now serves as a switching center for the *PC* peripherals: Software determines whether the peripherals will be used by the *PC* or the Apple emulator.

The primary functional difference between a real Apple computer and the *Quadlink* emulator is the first 16K of memory. All 64K of *Quadlink's* memory—including the first 16K—is RAM. In the Apple *II* and Apple *II+* computers, only the memory from 16K to 64K is RAM; the first 16K is ROM, which contains integer or Applesoft BASIC (depending on the specific computer), the high-resolution graphic routines, and the monitor. (Apple DOS for the disk system loads into high memory.)

The *Quadlink* emulator does not use Apple's ROM. Instead, the *Quadlink* uses software to create an image of the Apple ROM in the first 16K of RAM, while DOS 3.3—which is supplied with the *Quadlink*—loads into high memory, again emulating the Apple.

Disk control is somewhat easier in the emulator than in a real Apple. Apple computers use a plug-in controller card that must be initialized. The *Quadlink* has the controller built in and functioning as "PR#6"—the "#6" slot in Apple computers.

The *Quadlink* emulates everything about a disk-equipped Apple except for the video display and sound.

Figure 4 shows how the disks, the sound, and the video are handled by the Quadlink. Both the sound and video are looped through the Apple emulator along with the *PC's* disk drives. The emulator switches their operation between the *PC* and the Apple emulator when the system is toggled. Note that RAM is not toggled; the *PC's* RAM always functions as the *PC's* RAM, while the *Quadlink* emulator has its own RAM. Pressing the CTRL-ALT-A keys toggle the Apple mode and

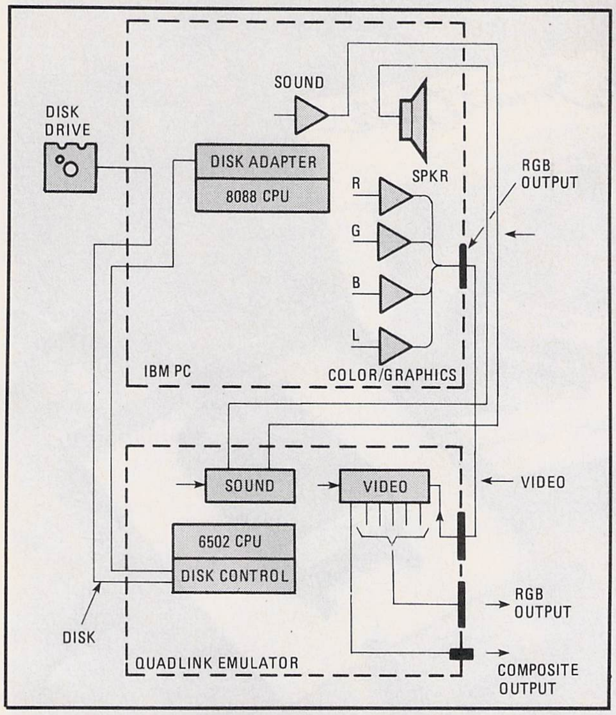
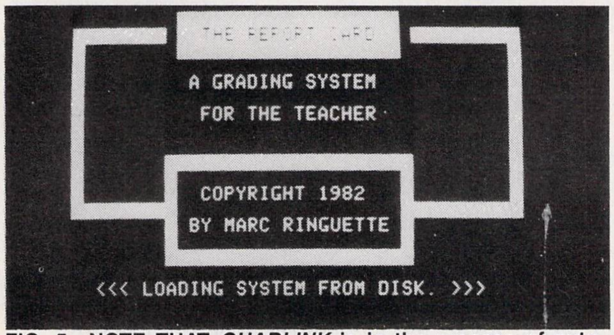


FIG. 4—THREE CABLES PROVIDED BY QUADRAM break into the *PC's* circuits to loop the disk, sound, and video display connections through the *Quadlink*. All connections are direct plug-in: There is no soldering or trace cutting. Remove the *Quadlink*, and the *PC's* connections can be automatically restored.



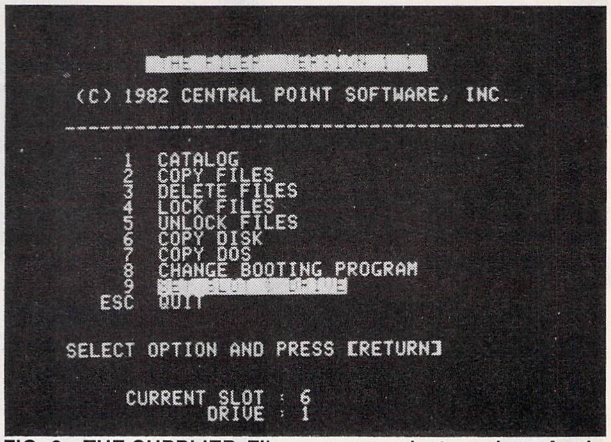
```
THE REPORT CARD
A GRADING SYSTEM
FOR THE TEACHER
COPYRIGHT 1982
BY MARC RINGUETTE
<<< LOADING SYSTEM FROM DISK. >>>
```

FIG. 5—NOTE THAT *QUADLINK* is in the process of auto-loading a school program.

the screen display actually resembles that of the Apple, right down to the screen prompt character (see Fig. 5). Pressing the CTRL-ALT-I keys toggle the *PC* mode, and the screen reverts to the standard *PC* display. Programs running in RAM keep running even when the function is toggled because—except for the sound, the video display, and the disk system—the computers are actually independent.

When the *Quadlink* is toggled for Apple emulation, the *PC's* disk drives function as Apple drives running under DOS 3.3. When the *PC* mode is toggled the dives revert to the IBM DOS. Switching between the two DOS systems is done by the emulator.

If the Apple software was originally self-booting it will self-boot on the *PC* when the Apple mode is toggled because the *PC*-derived Apple works just like "the real thing." The *Quadlink* is supplied with an



```
(C) 1982 CENTRAL POINT SOFTWARE, INC.
-----------------------------------------

       1  CATALOG
       2  COPY FILES
       3  DELETE FILES
       4  LOCK FILES
       5  UNLOCK FILES
       6  COPY DISK
       7  COPY DOS
       8  CHANGE BOOTING PROGRAM
       9  [illegible]
     ESC  QUIT

SELECT OPTION AND PRESS [RETURN]

     CURRENT SLOT : 6
             DRIVE : 1
```

FIG. 6—THE SUPPLIED *Filer* program selects various Apple functions and utilities by cursor or number. Notice that the characters are more legible than those of the *PC*: The Quadlink has its own character generator.

Apple-licensed software package called *The Filer* (See Fig. 6), which contains DOS 3.3, Applesoft and integer BASIC, a disk system check, a disk speed check, a super-fast copy program, file utilities (Copy, Lock, Unlock), and a program called "Quadcopy" that copies ASCII text and binary files from Apple formatted disks to *PC* formatted disks and vice versa. While you, of course, cannot run an Apple binary file on the *PC* because the CPU's are incompatible, the ASCII text files are fully compatible; if you use the same word processor for both computers, the files can be exchanged between the two.

Since the *Quadlink* specifically emulates the Apple *II+* computer, it is downward compatible and will run software from the *Apple* and *Apple II* computers. Software that is half-tracked or which uses the enhancements of the Apple *IIe* will not run; for example, the Apple *II+* version of *VisiCalc* runs on the *Quadlink*; *VisiCalc* for the Apple *IIe* won't run. However, software written on an Apple *IIe* that does not use the *IIe's* enhancements will often run on the *Quadlink* (because without the enhancements, the *IIe* software is effectively *II+*). Copy-protected software that uses half-tracking won't run at all.

Quadram will provide a list of the *Quadlink* compatible software. If you're interested in specific commercial software, make sure you check with Quadram first. If the software is a program you developed yourself for school, business, or home use, it will most likely run on the *Quadlink* if the original computer was an *Apple*, Apple *II*, or Apple *II+*.

As far as we could determine from experimentation, the *Quadlink* runs as intended if the *PC* is equipped with IBM and/or Quadram expansion adapters. We had some unusual and inconsistent problems with some adapters from other sources: everything from disk emulators and serial I/O's simply failing to operate, or one adapter affecting another. We have no explanation except to say that no problems were encountered as long as all adapters were Quadram or IBM.

SMART CABLE

Here's how one manufacturer solves the RS-232 confusion!

MARC STERN

■How many times have you seen the words "RS-232-compatible" in personal-computer advertising or documentation? The RS-232 communications "standard" was formulated by the EIA (*E*lectronic *I*ndustries *A*ssociation) so that various peripheral devices could be interfaced compatibly.

In some ways, today's RS-232 standard bears little resemblance to the original standard drawn in the late 1960's. Yes, the signal lines and names are still the same. A DB-25 D-type connector is still used, but each computer manufacturer seems to use some of the lines and the connector for its own purposes.

For instance, according to the RS-232 standard, Line 4 is called Request To Send and Line 20 is Data Terminal Ready. (See Fig. 1 for a complete listing of the RS-232 signals.) Both of those lines are supposed to tell one device that another is ready to accept data. At the same time, Line 5 is Clear To Send and Line 6 is Data Set Ready. Again, this second set of lines is used to indicate a device is ready to handle data.

It all seems pretty clear with little room for misinterpretation. If all things were equal, it would be. It should be a simple matter to tie the devices together using the RS-232 lines. After all, those lines are part of the "standard" interface, so, tying the pieces of equipment together should only be a matter of buying a standard cable and hooking things up.

It's not that simple.

All things in the world of computers aren't so simple and clear cut. Over the years, different computer manufacturers have come up with their own ways of handling the RS-232 lines. Some use Lines 5 and 20 to enable devices to indicate when they are ready to accept data. Others use Lines 5, 6, and 20; and still others use Lines 4, 5, and 6, as well as other lines, such as Line 8 and Line 11. About the only thing now common about the RS-232 "standard" is grounding (Lines 1 and 7)!

Let's be more specific and look at the IBM *Personal Computer*. To correctly interface a *PC* with another serial device, you must use Lines 5 and 20 and—sometimes—Lines 5, 6, and 20. That seems reasonably straightforward. It would seem all you have to do is connect Line 20 on one side of the connector to Line 20 on the other and Lines 5 and/or 6. But, that isn't the way it works because Line 20 on the peripheral side of the connector must be connected (jumpered) to Line 5 on the IBM *Personal Computer*. And that is only to implement handshaking—Data Terminal Ready. So, although the connectors may look the same, the pinouts are entirely different.

PIN NO.	EIA NAME	CCITT NAME	DESCRIPTION	TYPE	DIRECTION
1	AA	GND	Protective Ground (bonded to chassis)	Ground	N/A
2	BA	TD	Transmitted Data	Data	To DCE
3	BB	RD	Received Data	Data	From DCE
4	CA	RTS	Request To Send	Control	To DCE
5	CB	CTS	Clear To Send	Control	From DCE
6	CC	DSR	Data Set Ready	Control	From DCE
7	AB	GND	Signal Ground (common return)	Ground	N/A
8	CF	DCD	Received Line Signal Detector	Control	From DCE
9	—	—	(reserved for data testing)	—	
10	—	—	(reserved for data testing)	—	
11	—	—	(unassigned)	—	
12	SCF	(S)DCT	Secondary Received Line Signal Detector	Control	From DCE
13	SCB	(S)CTS	Secondary Clear To Send	Control	From DCE
14	SBA	(S)TD	Secondary Transmitted	Data	To DCE
15	DB	TC	Transmission Signal Element Timing	Timing	From DCE
16	SBB	(S)RD	Secondary Received Data	Data	From DCE
17	DD	RC	Receiver Signal Element Timing	Timing	From DCE
18	—	—	(unassigned)	—	
19	SCA	(S)RTS	Secondary Request To Send	Control	To DCE
20	CD	DTR	Data Terminal Ready	Control	To DCE
21	CG	SQ	Signal Quality Detector	Control	From DCE
22	CE	RI	Ring Indicator	Control	From DCE
23	CH/CI	—	Data Signal Rate Selector	Control	(CH) To DCE (CI) From DCE
24	DA	TC	Transmitter Signal Timing	Timing	To DCE
25	—	—	(unassigned)	—	

FIG. 1—PIN ASSIGNMENTS FOR THE RS-232 STANDARD. Timing circuits are used for synchronous communications.

It gets more complicated. Suppose you would like to interface a printer with your computer. To do this you would enable Lines 2 and 3, Transmit and Receive. Again, it seems pretty straightforward, but wait. The printer is also using Lines 2 and 3 for the same things, so you have to reverse the lines in your computer connector 3 to 2 and 2 to 3. However, if you're interfacing a modem, then you leave things alone.

The RS-232 standard not only covers transmission and receiving lines, but two different types of equipment, DCE or Data Communications Equipment (such as modems) and DTE, or Data Terminal Equipment (such as terminals or computers). When you're interfacing one type of device to the other, the cable goes "straightthrough." That means that Line 2 of one device goes to Line 2 of the other, and Line 3 of one device goes to Line 3 of the other. It's pretty easy to set up one of these devices with your computer.

But what happens if your computer is set up as a DCE device and the device you're trying to interface is DCE? The answer is that you have to reverse lines to get it to work correctly. You can do that by using a null-

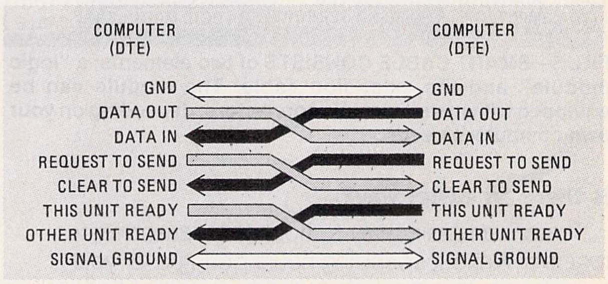


FIG. 2—TO CONNECT TWO DCE OR TWO DTE devices together, you'll need what is known as a null-modem cable.

modem cable, as shown in Fig. 2. You might wonder why you would want to connect two DCE or two DTE devices together. After all, didn't the people who thought up the standard think about such things? There are lots of reasons you'd want to hook up two similar devices together. That becomes very clear when you realize that both computers and printers (and other non-modem devices) are DTE devices. Why didn't the developers of the standard think about that? Well, it's because things were different back then. Printers were usually connected to auto-answer modems, and personal computers didn't even exist!

Confused?

At this point, we won't blame you if you're confused. But the problem is that the computer world has changed quite a bit from the days when the standard was developed. And the problem is only made worse by manufacturers who use their RS-232 signals for non-standard applications.

One thing that you should remember is that when you are transmitting, the data line (Line 2) always goes to the DCE device and received data (Line 3) always runs from it. Most microcomputer printer ports are DTE and they are *usually* indicated by male DB-25 connectors. DCE devices are *usually* indicated by female connectors.

One last thing about this "standard" that we should mention is that it's expensive. Because of the many variations, nearly every device requires its own special cable. Unless you're willing to spend time with a soldering iron and more time checking to see whether you've made the correct connections, you'll spend between $35 and $65 for special cabling. It can get very expensive if you must have special cables made up for a printer (or printers), modem and plotter, or other device.

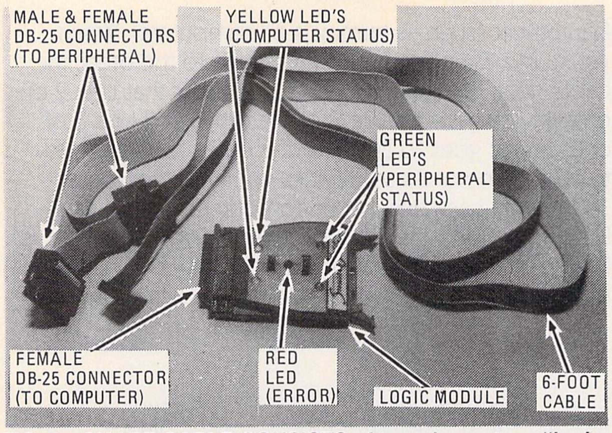

MALE & FEMALE DB-25 CONNECTORS (TO PERIPHERAL)
YELLOW LED'S (COMPUTER STATUS)
GREEN LED'S (PERIPHERAL STATUS)
FEMALE DB-25 CONNECTOR (TO COMPUTER)
RED LED (ERROR)
LOGIC MODULE
6-FOOT CABLE

FIG. 3—SMART CABLE CONSISTS of two elements; a "logic module" and the extension cable. The module can be equipped with male or female connectors, depending on your own computer's needs.

Is there an easier way?

There is an easier way to hook two serial devices together without spending hours poring over your equipment documentation. A device called *Smart Cable* takes all the worry out of configuring RS-232 cables. It costs $89.95 and is available from IQ Technologies (11811 N.E. First St., Bellevue, WA 98005).

Smart Cable consists of two elements, the "logic" module and the extension cable (See Fig. 3). The logic module can be equipped with either male or female DB-25 connectors, depending on your computer, while the extension cable is fitted with a header connector to attach to the logic module and is terminated in both male and female connectors.

Inside the logic module is what can best be described as a breakout box—an automatic breakout box. It checks each end of the link for different voltage states and handshake signals and then finds a suitable connection at the other. The voltages are fed first to a test circuit, which passes them to a pattern comparator, which compares those voltages to known values. Once those values are determined, the interconnection circuit takes care of the interface.

Using the Smart Cable

The best thing about *Smart Cable* is that it's easy to use. In fact, you might even be able to get by without reading the instruction manual because the abbreviated instructions printed on the logic module's case take care of most setups. As you can see in Fig. 3, the logic module sports five LED's (two green, two yellow, and one red) and two switches. The LED's are used to indicate the state of the RS-232 connection. In effect, they tell you how to set up the switches.

The first step is to power up both pieces of equipment and make sure that the word length, parity, etc. are properly matched. (*Smart Cable* is transparent to such settings.) You then connect the ribbon cable to the logic module and plug the logic module into your computer. (The logic module is available in either a male or female configuration. If you use it with a different computer, you *may* need a gender reverser.) Next, the other end of the ribbon cable is connected to your peripheral. (Both male and female DB-25 connectors are supplied.)

Once the cable is connected between the two devices, you'll use the LED's on the logic module to set the switches correctly. Unfortunately, if your port is located at some inconvenient place at the back of the computer, doing that will be a bit inconvenient.

The bottom switch (between the two green LED's) should be set in its center position. If both of the top (yellow) LED's are lit, the top switch is in the correct position. If only one light is on, the switch between them should be set to the position most-distant from that light. Both yellow lights should then come on, indicating that the top switch is now in the correct position. If *neither* yellow LED comes on, check the port on the computer. You are probably plugged into a parallel instead of a serial port. If only one yellow light comes on in either switch position (as will be the case with a receive-only printer), you'll have to try sending data in each switch position. The one that permits data flow is (obviously) correct.

If only one of the bottom (green) LED's is on, slide the bottom switch towards that light. If neither green light is on, leave the switch in the center position.

If the center red light comes on, it indicates that something *might* be disabling data transfer. The red light will flicker during normal operation. And some systems operate with the red light on constantly. If your red light remains on but data transfers properly (as we found in many cases), don't worry about it.

When both switches are set and the red light is off, the installation is complete. Leave *Smart Cable* in place as long as you like.

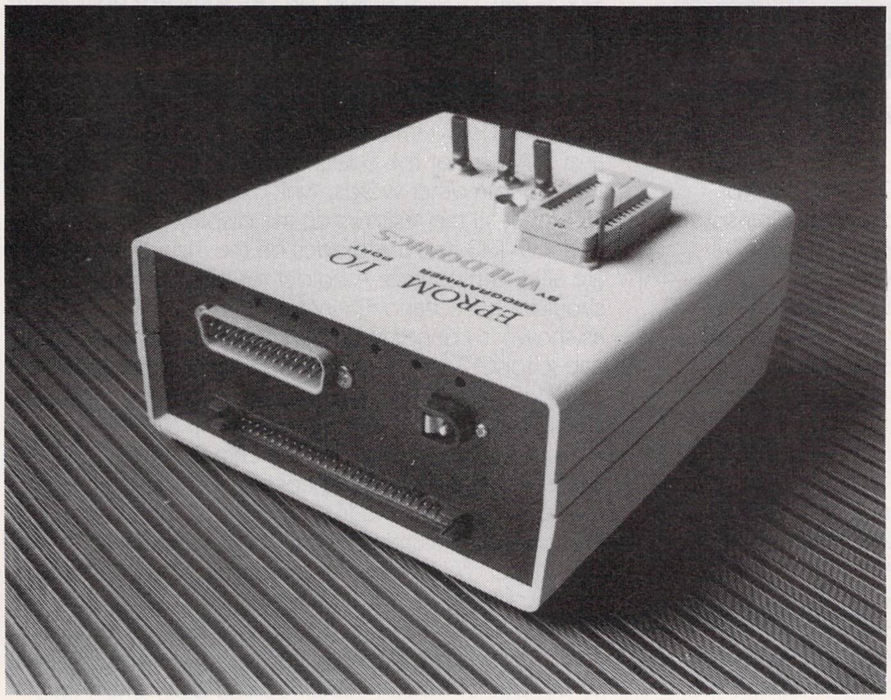
Now that sounds really simple—and it is. But things can go wrong. For example, when we were transferring data to a plotter, it seemed that everything was working fine. But then the printer came to a standstill and flashed its ERROR light. The reason? The BUFFER FULL signal was of the wrong polarity, and had to be changed at the plotter. (*Smart Cable* couldn't do anything about it.) Luckily, the instruction manual covered just that occurrence. The instruction manual, incidentally, is not bad. Along with a diagnostic guide is a glossary, setup examples, and other useful information.

Do you really need it?

With a price tag of about $90, *Smart Cable* is not inexpensive. It doesn't cost too much more than a custom made cable, but it's a *lot* more expensive than a home-made cable. If you need a cable to link your computer and printer, then a dedicated cable is the way to go—whether you make it yourself or buy it custom made. However, if you often switch peripherals and try out new devices, *Smart Cable* will save you lots of set-up time. (Breakout boxes can take some time to set up, and making a custom cable just to test something out is not the way to go about things.) Computer clubs, computer stores (especially!), and any computer hardware hacker will really love the device because it makes connecting two devices together (even two devices you've never seen before) nothing short of simple.

MACHINE CODE DEVELOPMENT SYSTEM

FOR YOUR TIMEX SINCLAIR 1000 PART II



BACK VIEW OF UNIT shows clean, uncluttered look. Refer to text for clarification of connectors.

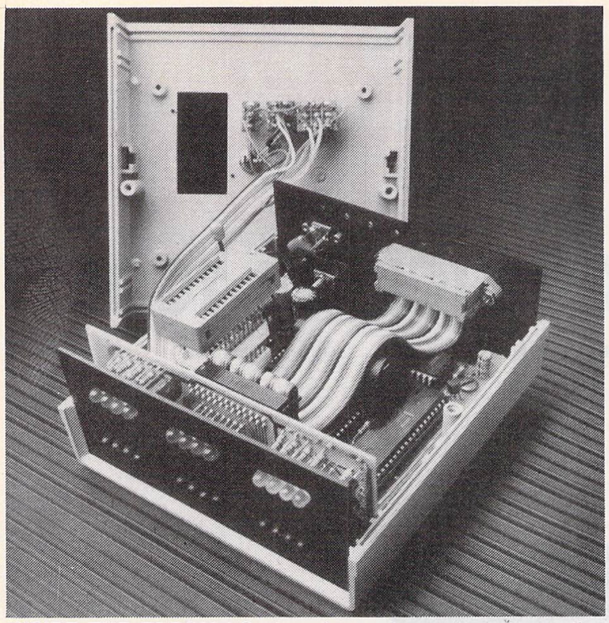
MARK W. LATHAM

Back in January, we started an interesting and important article on how to build a machine code development system for the Timex Sinclair 1000. We promised to complete the article with the second part, in the February Issue.

But something slipped, and the February Issue went to press without the rest of that important information.

For those of you who may have been wondering what happened to the rest of the article, or who had started it and were hoping to complete it, the remainder of the information is all here, in this issue. We apologise for any inconvenience that this may have caused.

The fact of the matter is, that while at one time, Timex was shipping 100,000 units a month. The price was right, and lots of people bought real keyboards and extra RAM to make thse units work like real business or entertainment machines. Others were content to simply fool around with whatever they could hook up to the back of the unit.



INSIDE THE EPROM I/O, the picture is total neatness that reflects care in assembly. Follow the layout guides and refer to the text for parts positioning.

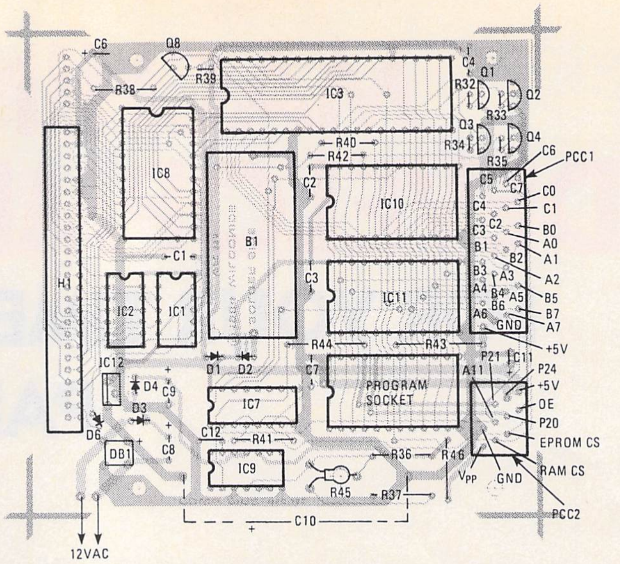


FIG. 4—PARTS PLACEMENT ON THE MAIN BOARD is shown in this diagram. Take care to observe the proper polarities for all components.

The three tricolor LED's (LED3–LED5) are used to monitor the RAM $\overline{CS}$, EPROM $\overline{CS}$, and $\overline{OE}$ lines. Transistors Q5–Q7 reverse the current flow through those LED's when the associated outputs of IC6 are high. Those LED's will be green if the corresponding line is high (inactive) and red if the line is low (active). If the line is rapidly changing, the LED will appear to be yellow.

All the software for controlling the I/O port, block data moves, and EPROM programming can be permanently stored in IC8, the resident EPROM. IC1-b, IC2-a and IC2-b decode the Z80A $\overline{MREQ}$ and address A11–A15 signals to place the resident EPROM in the 8–10K area. IC1-a and D6 hold the computer's $\overline{ROMCS}$ line high during the resident EPROM read to prevent bus contention. (The computer is wired to see the 8K ROM anywhere in the 0–16K area.) If the program is written at the machine-language level (the EPROM I/O operating system provided by the supplier listed) you will have an I/O-port/EPROM-programmer that is fast, easy to use, and ready to go the second you plug it in.

Construction

The circuit shown in Fig 1 can be built using perforated construction boards. A better method, however, would be to use double-sided printed-circuit boards such as the ones shown in Figs. 2 and 3.

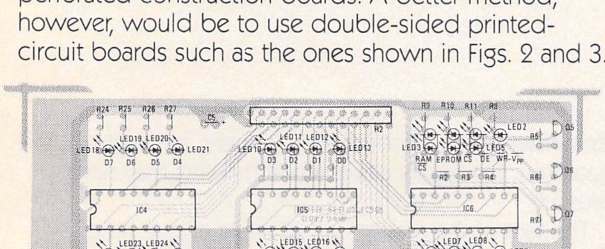


FIG. 5—PARTS POSITIONING ON THE SMALL BOARD is shown here. Placement of the LED's is fairly critical as they must show through front panel holes.

Using the PC boards is the easiest way to go. A parts-placement diagram for those boards is shown in Figs. 4 and 5. Note that the board identifies the functions of the LED's (in other words, which lines they monitor). Note that all the resistors on the display board (Fig. 4) and R39–R43 and the diodes on the main board (Fig. 5) are all end-mounted. A holder for the lithium battery should be used-and 4/32-inch alignment holes is drilled as shown. Depending on the case you use, filter capacitor C10 can be positioned either to the side or above IC9 and R45. A 1/8-inch hole through the PC board and the bottom of the case will allow you to adjust R45 without opening the enclosure.

Mount all of the passive components first, then the diodes, transistors and IC's. A heat sink for IC12 can be made of angle aluminum and placed above H1. Sockets for the IC's are recommended. If you are going to mount the CMOS IC's directly to the board, save them for last and be sure to ground the soldering iron to the board's ground (alligator clips work fine.) With a 26-conductor ribbon cable you can daisy chain the main board (via PCC1) to the display board (H2) to the DB-25 connector at the back of the unit (in this application the DB-25 is not used as an RS-232 connector). The outside wire, 5-volts, should be torn away from the others before insertion into the DB-25 connector.

If you are going to place the PC boards in a project case you will need to raise the program socket through the top by replacing it with its wire wrap counterpart or by soldering extended posts to its base. The switches and LED1 (in a panel clip) can be mounted directly to the top of the case and wired to the board with a 10-conductor ribbon cable PC board connector assembly. The ribbon cable connects to the board at PCC1; which wires connect to which pads is shown in the parts-placement diagram. The switches, which are mounted on the case, should be wired according to the schematic diagram. Note that R1, R47, C13, and D5 are mounted directly on the switches at the top of the case.

Morse Code Practice On Your Commodore 64.

Here's one way to lure a computer-oriented son back to amateur radio!

BOB WOODS, W5QPD

■In an effort to reinterest my 13-year old son in amateur radio after he succumbed to the siren song of a microcomputer, I wrote the following program for our Commodore *64*. The computer has a built-in audio capability, and while I *did* have a lot of fun writing the program, and spend a lot of time using it myself, the idea didn't work. Our computer freak in residence tried it out and went back to the monitor.

You select the speed, the program sends five-letter word groups, and displays them on your screen. After 50 such groups, it pauses, so you can correct your copy. Then when you are ready, it sends a new set. If you're using a monitor without sound capability, use the built-in interface that comes with the Commodore, and any TV set. Your Commodore provides a port that permits you to connect through an interface to any television receiver, permitting that receiver to be used in place of a monitor. As the TV receiver *does* have audio capability, the problem is thereby solved.

The heart of the program is in statements 230 to 330 where the number of elements (dits or dahs) in the letter, number or punctuation mark are counted and loaded in sequence into successive values of array EL(I). A dit is a value of one, a dah is three. These are used in statements 350 to 430, where the values of the elements of EL—renamed XX—are multiplied by S, the speed, and used to control the duration of the sound produced by the monitor or TV.

Tone characteristics are set by the statements ending in 120. The *64* has three "voices," but as we do not want to interfere with the pure tone, we silence voices two and three with statements 30 through 60. Statements 80 and 90 set voice one to one kilohertz. Statement 110 provides a steady tone instead of one with amplitude modulation, and 120 provides a sharp make and break. You can putter with these statements and try to reproduce the sound of an underpowered "peanut whistle" transmitter if you like. Statement 100 sets the volume.

There are 41 letters, numbers and punctuations in the data table. Statement 210 selects these at random by picking values of NO (the number of the table entry) and then jumping to the table.

Statement 320 might be confusing. The digits of X are stripped off and entered in sequence as values of EL(I). This is done by first finding the two numbers that are gotten by moving the decimal point in X one and then two places to the right and discarding the decimal fraction. The smaller number is then multiplied by ten and subtracted from the larger. This leaves only the single digit that was to the left of the decimal, which will be one or three, to encode a dit or a dah.

Let's also explain statements 160 through 200. S is used to control transmission speed. This is related to words-per-minute, entered as SS in statement 150,

TABLE 1
PROGRAM

```
  30 POKE 54279.0
  40 POKE 54286,0
  50 POKE 54280,0
  60 POKE 54287,0
  70 REM 2 & 3 SILENCED
  80 POKE 54272,20
  90 POKE 54273,64
 100 POKE 54296,15
 110 POKE 54278,240
 120 POKE 54277,0
 130 WO=1 : LE=1
 140 PRINT "W.P.M. (APPROX). 5 TO 20"
 150 INPUT SS
 160 IF SS<9.5 THEN GOTO 200
 170 S=226.4-27.67*SS+1.5*SS^2
 180 S=S-.0377*SS^3+.000353*SS^4
 190 GOTO 210
 200 S=231.7-17.02*SS
 210 NO=INT (RND (9) *41)
 220 GOTO 1000
 230 N=6
 240 M=N-1
 250 R=INT(X/10^M)
 260 IF R<>0 THEN GOTO 290
 270 N=N-1
 280 GOTO 240
 290 EL (1)  =R : FOR 1=2 TO N
 300 P=N-1
 310 Q=P+1
 320 EL (I)  =  INT (X/10^P)-INT (X/10^Q)*10
 330 NEXT I
 340 PRINT A$;
 350 FOR K=1 TO N
 360 XX=EL(K)
 370 POKE 54276,17 :REM TURN ON
 380 FOR L=O TO S*XX : NEXT L
 390 POKE 54276,16 : REM TURN OFF
 400 FOR L=O TO S : NEXT L
 410 NEXT K
 415 FOR L=O TO S : NEXT L
 420 LE=LE+1
 430 IF LE<6 THEN GOTO 210
 440 FOR L=0 TO 500:NEXT L
 450 LE=1
 460 PRINT " ",
 470 WO=WO+1
 480 IF WO<50 THEN GOT TO 210
 490 END

1000 IF NO=0 THEN A$="A":X=13: GOTO230
1001 IF NO=1 THEN A$="B":X=3111: GOTO230
1002 IF NO=2 THEN A$="C":X=3131: GOTO230
1003 IF NO=3 THEN A$="D":X=311: GOTO230
1004 IF NO=4 THEN A$="E":X=1: GOTO230
1005 IF NO=5 THEN A$="F":X=1131: GOTO230
1006 IF NO=6 THEN A$="G":X=331: GOTO230
1007 IF NO=7 THEN A$="H":X=1111: GOTO230
1008 IF NO=8 THEN A$="I":X=11: GOTO230
1009 IF NO=9 THEN A$="J":X=1333: GOTO230
1010 IF NO=10 THEN A$="K":X=313: GOTO230
1011 IF NO=11 THEN A$="L":X=1311: GOTO230
1012 IF NO=12 THEN A$="M":X=33: GOTO230
1013 IF NO=13 THEN A$="N":X=31: GOTO230
1014 IF NO=14 THEN A$="O":X=333: GOTO230
1015 IF NO=15 THEN A$="P":X=1331: GOTO230
1016 IF NO=16 THEN A$="Q":X=3313: GOTO230
1017 IF NO=17 THEN A$="R":X=131: GOTO230
1018 IF NO=18 THEN A$="S":X=111: GOTO230
1019 IF NO=19 THEN A$="T":X=3: GOTO230
1020 IF NO=20 THEN A$="U":X=113: GOTO230
1021 IF NO=21 THEN A$="V":X=1113: GOTO230
1022 IF NO=22 THEN A$="W":X=133: GOTO230
1023 IF NO=23 THEN A$="X":X=3113: GOTO230
1024 IF NO=24 THEN A$="Y":X=3133: GOTO230
1025 IF NO=25 THEN A$="Z":X=3311: GOTO230
1026 IF NO=26 THEN A$="1":X=13333: GOTO230
1027 IF NO=27 THEN A$="2":X=11333: GOTO230
1028 IF NO=28 THEN A$="3":X=11133: GOTO230
1029 IF NO=29 THEN A$="4":X=11113: GOTO230
1030 IF NO=30 THEN A$="5":X=11111: GOTO230
1031 IF NO=31 THEN A$="6":X=31111: GOTO230
1032 IF NO=32 THEN A$="7":X=33111: GOTO230
1033 IF NO=33 THEN A$="8":X=33311: GOTO230
1034 IF NO=34 THEN A$="9":X=33331: GOTO230
1035 IF NO=35 THEN A$="0":X=33333: GOTO230
1036 IF NO=36 THEN A$=".":X=131313:GOTO230
1037 IF NO=37 THEN A$=",":X=331133:GOTO230
1038 IF NO=38 THEN A$="?":X=113311:GOTO230
1039 IF NO=39 THEN A$="-":X=31113: GOTO230
1040 IF NO=40 THEN A$="/":X=31131: GOTO230
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through the expression starting in 170 and continuing in 180. For those of you interested in mathematics, this is a Chebychev polynomial fitted to data that were taken to explore the relationship between S and transmission speed. To obtain the data, we wrote a program that transmitted 100 dahs and clocked the time this took for various values of S. The information was combined with the knowledge that the number of dahs in a five-second period roughly equals code speed in Words Per Minute (WPM). The relationship seemed linear for under 9.5 WPM, hence the branch at statement 160.

Actual character transmission occurs at statements 350 through 410. Memory location, at 54276 is the "switch." Statement 370 turns on the tone and, after killing the proper length of time in statement 380, 390 turns it off.

Of course, entering the data can be tedious. If you are new at this, you might not have noticed that the easiest way is to key in the first line, and after you "ENTER" it, go back, make the few changes needed, and enter it as the next line. Continue this until you have entered the whole table. Anybody experienced with morse code will automatically punch in the proper patterns of 3's and 1's corresponding to dahs and dits.

There is no need to restrict the data table to the 41 lines shown. If certain characters give you trouble in copying (such as double dashes) enter them several times. This will cause those characters to be transmitted more frequently. The only other change required, is to increase the constant (now 41) in line 210 until it is one more than your new maximum value of NO in the data table.