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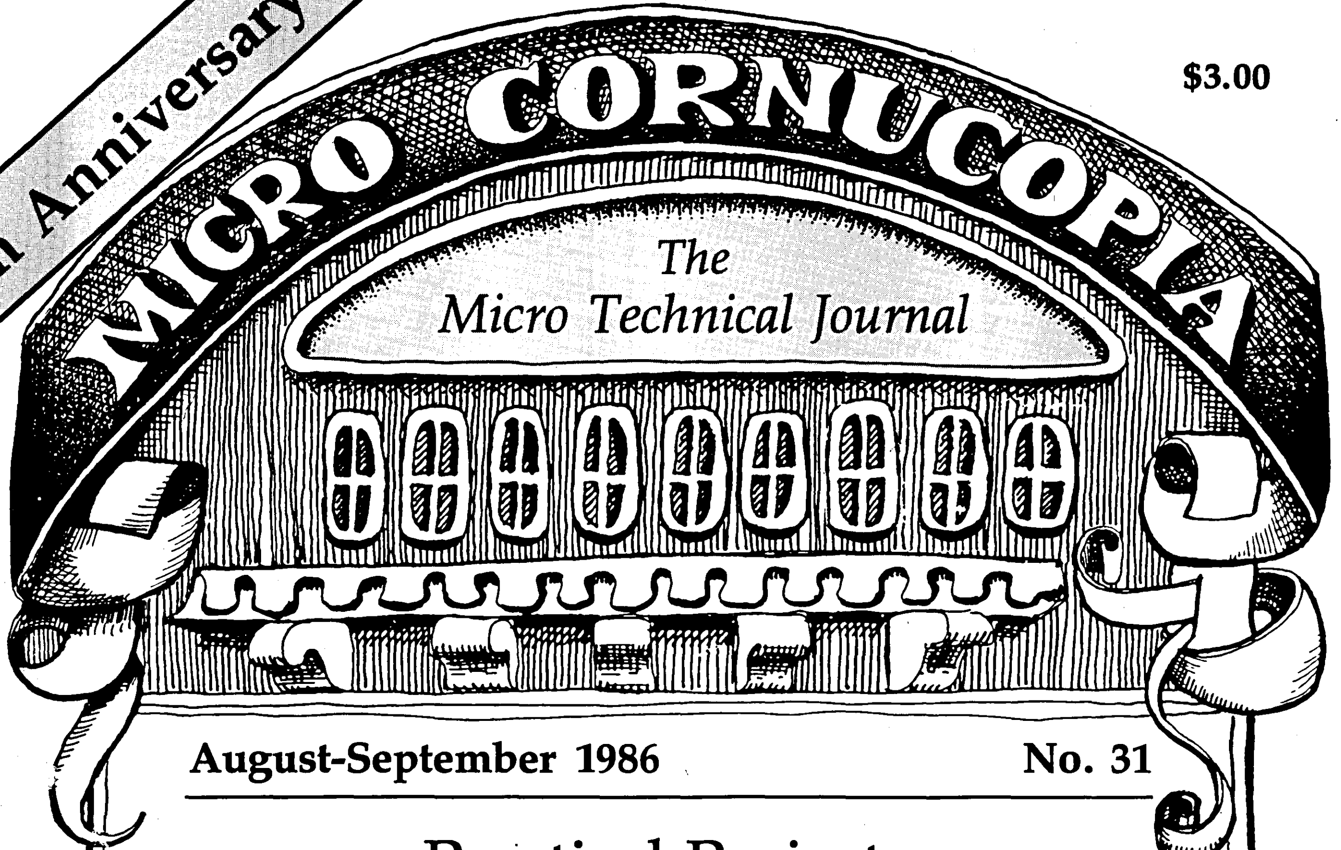
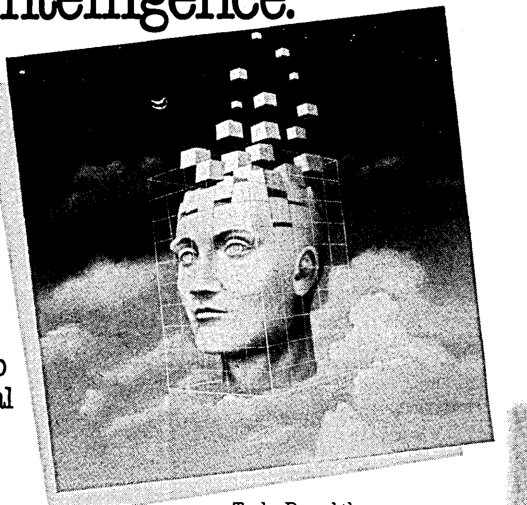


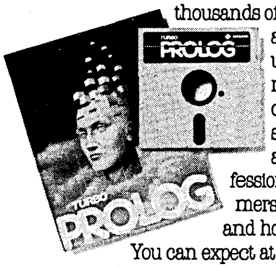
Micro Cornucopia

The Micro Technical Journal

August-September 1986 No. 31

Practical Projects

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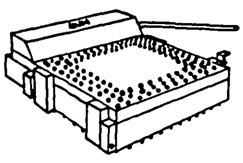

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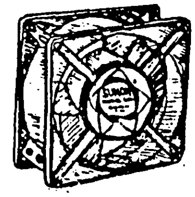

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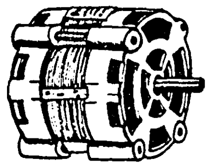

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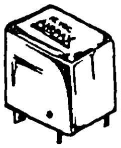

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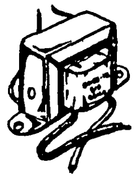

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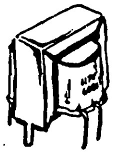

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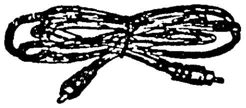

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EDITORIAL

By David Thompson

Tongue Tied

Well Said

"Hurry up and decide what you're going to talk about at SOG."

Gary was pushing me for a title to my SOG V talk. Last year I was more an interested observer than a participating speaker.

"SOG is the place where specialists stick their heads up and see what other people are doing. It also gives them a chance to speak about their own projects — about what they're really into," he continued.

It's easy for them to talk, I thought. What have I been doing? What am I excited about? What kind of unique information do I have? Good question.

I've traded my engineering bench for all the excitement of publishing. I've learned a lot about hiring and firing, finances, printers, typesetters, Kaypros, columnists, large mailing lists, running technical forums, and maintaining an office sprinkler system. (The grass really is greener on the neighbor's side.)

Fortunately, I've come into contact with some really super people who haven't traded in their benches for broader hats. People who have concentrated on one thing. They are the people who should (and will) speak at SOG.

Not that I mind speaking... It's a lot like writing except that people can hiss and throw things in real time. But subject is another question. If I talk about what I'm really working on (defective sprinkler valves) maybe Gary won't be so insistent next year.

Quiet

There is something very fragile about writing. It's a discussion with an imaginary someone — recorded for probable deletion.

In my case, this special conversation is very much affected by the situation. If I feel hassled, harried, then my writing gets choppy, curt. I become very literal because my mind pictures aren't working. This kind of copy isn't fun to read or edit.

When things are very quiet, very relaxed, and I'm not distracted by those little things that seem so important during the 8 to 5 office workout, words can take on a life, a collection of colors that make them an art form unmatched by any other.

It's A Racket

Unfortunately, one of the most constant things about computers, especially the latest, greatest, fanciest, and fastest, is that they are noisy. Those fancy little 135 watt supplies have buzzy little fans. Winchesters wind up like kids' tops.

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August-September 1986
Issue No. 31

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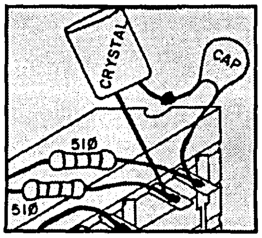
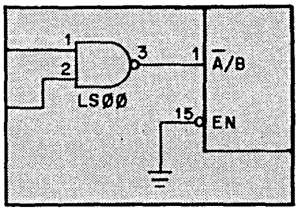
Features





Columns

Future Tense

By Gary Entsminger

Article Update

I received a letter from a reader requesting clarification of the part number of the transformer in my article "Monitoring A Modem With A Bridge" from Micro C issue #29. I find that Radio Shack no longer sells that part. I've done a quick test based on another part and find this can be used as an electrical substitute, though it may not fit in the pipe.

The part is a small 1000 to 8 ohm transformer (part #273-1380). The turns ratio will be about 11:1. I changed the 10K resistor to 2.2K and the 100 ohm resistor to 150 ohms, and overall voltage reduction was still okay, about 175:1. Actually, any transformer with a rated primary impedance of 500 to 2000 ohms and a secondary with equal or somewhat less impedance than the primary will work, as long as the turns ratio is taken into account. The overall reduction should be between 100 and 200:1. The turns ratio is the square root of the impedance ratio. The reduction ratio is the turns ratio times the ratio of the resistor, i.e., SqRt(1000/8)*((2200+150)=175.1 : 1 for this example.

Philip Elrod
3245 Spring Dr. NW
Doraville GA 30360

User's Guide Returns?

We were surprised to see mention of "User's Guide" in your editorial in issue #29. While it's true that "User's Guide" stopped publishing last November, and "PC User" never started, we have not disappeared. Both magazines were bought by Mach Gelt, Inc. (MGI) of New York, which has agreed to fulfill all paid subscriptions up to their expiration dates with a new magazine, slated to debut between July and September of this year. The magazine will cover CP/M, and we'll be writing for it, so subscribers will get something very similar to what they paid for.

We hope this new arrangement satisfies our subscribers.

Tony Bove and Cheryl Rhodes
Founders & Editors of "User's Guide"
P.O. Box 5245
Redwood City CA 94063

Wants Modula-2 Update

I read with great interest in Micro C issue #25 excerpts from a talk by Niklaus Wirth on Modula-2 in which he described his current work on a port of Modula-2 to the National Semiconductor 32000 family of CPU clusters. The match of such an elegant hardware implementation with the elegance and simplicity of Modula-2 seems an ideal partnership. However, I haven't seen or heard anything since that article. Do you know how I could find out more about this project?

Randy George
680 Harlan
Lakewood CO 80214

Editor's note:

Hoo boy! Wirth was working at Xerox Parc in Palo Alto, California (that's the place where the Mac interface was developed). I haven't heard anything out of Xerox lately, now that you mention it. Maybe they're waiting for someone to leave the organization and start a new company based on the research.

Cheap Floppies

Here's a tip if you use lots of floppy disks. Unitech charges 85 cents per disk for double sided disks boxed in lots of ten, labeled and with plain envelopes. I've been using them for several weeks and the quality seems very good. Their minimum order is $17 plus $3 shipping. (I used to buy in bulk from Spite Software, but they are slow and the minimum order is 100.) Unitech's address is 20 Hurley St., Cambridge, MA 02141.

Henry C. Davis
Box 532, 207 E. Market St.
Georgetown DE 19947

Micro C Kaypro Manual?

I have a sure-fire winning idea for Micro C. Why not compile all the letters, articles, Kaypro Columns, Technical Tips, etc. which have anything to do with the CP/M Kaypros? You could put these all together in one booklet and maybe add some new technical material to fill in the gaps. Then you could publish and sell this booklet. I'm positive it would be one of your biggest selling products. It wouldn't take that much work, since the bulk of the material is already written.

Walker Kennedy III
949 E. 800 S., Apt. 11
Salt Lake City UT 84102

Editor's note:

Heck of an idea, Walker. I think it would be a good seller. A year ago we were definitely thinking about doing this very thing. However, we decided to spend our time looking forward — learning, developing new contacts, changing the look and editorial direction of Micro C. You can see the results of that now, but because of that a lot of really good ideas have been put aside.

Poor Man's CompuServe

The Dorsai Embassy is an RBBS in New York City which caters to all micros and offers free public access. The system is standard XModem, Christensen protocol, and offers storyboarding and conferencing. To log on, type : and then 'help'. The bulletin board will tell you what to do next. Users have limited access until they register. Dorsai is currently negotiating with SIG/M and PC/Blue to put their internal library on the RBBS.

Charles Rawls, Sysop
41 Crosby St.
New York NY 10013
(212) 226-2394
(212) 966-6406
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Expansion Bay For A Tandy

I've been thinking of adding a 20 Meg hard disk in a separate cabinet to my Tandy 1000. Although the Tandy already has two floppy drives and memory expansion board, I'd like the 20 Meg in a separate cabinet to serve as an expansion bay so I can add full-length boards at my wallet's convenience.

I have three questions:

1. Is there any reason why I would want to retain both floppies in addition to the hard disk, and if so, would this set-up confuse MS-DOS (version 2.11)?

2. Could the hard drive be mounted

in the expansion bay and transmit the data across the cable which connects the bay (I assume the bay would be connected through a board which occupies one expansion slot in the computer and runs a cable of connections from the expansion bus out of the back of the computer)?

3. Is there any relatively cheap way to build an expansion bay without a lot of technical know-how? I've worked on CPU-controlled cash registers, so I'm not a complete idiot, but I don't feel extremely comfortable in a digital hardware environment which doesn't have step-by-step instructions.

Paul K. Vallandigham
2828 Dorothy Pl.
Orange CA 92669

Editor's note:

MS-DOS 2.11 certainly supports at least four floppies in addition to one or more hard drives, so software isn't a problem. Hardware might be, however. You mention extending the PC bus to a second cabinet. Someone was displaying such an expansion at Comdex last Fall. Unfortunately I didn't get the name, and I haven't heard about the expansion since.

Getting signals cleanly from one cabinet to the other would be a problem. You'd need a short, heavy, shielded cable. After all, you have power as well as signals on the bus. Capacitance between wires would also be a problem. This is not a trivial project.

Users Group Wanted

The Long Beach, CA area has needed a CP/M Kaypro users group for a long time. I'd really enjoy getting together with other users of any level of expertise for some technical talk and support. If you're a Kaypro user in the Long Beach area and want to share your technical knowledge, please contact me.

Skipp Miller
405 E. Pacific Coast Hwy.
Long Beach CA 90806
(213) 591-1173 Bus.
(213) 599-3663 Res.

Needs Reader Input

I'm looking for a speech synthesis device for a possible portable computer application and would appreciate leads on either a Kaypro 2000 unit that would fit where the optional Kaypro modem would go or a unit for one of the mini boards (Ampro LB, Ampro LB/186, MicroMint, Southern Pacific, etc.) that doesn't consume an I/O port (perhaps using a SCSI interface).

Can anyone help?

Meredith A. Cargill
URH 248 Sherman Hall
909 S. Fifth St.
Champaign IL 61820

Letter Of Thanks

If you can comprehend the gratitude of one who just saved a whole disk of articles copied from microfilm by reading through a microscope, you know how I feel about UNERA19. My overwhelming thanks.

Dorothy Hoard
110 Sherwood
Los Alamos NM 87544

■ ■ ■

New PC Speedup With RAM Resident Soft Switch

By Larry Fogg

Every once in a while an article just blows me away. This is definitely one of those articles. Larry not only figured out how to make his system into a screamer without affecting the system clock (or the signal to the color board), but he also came up with a memory resident program which changes system speed anytime it sees a special keystroke.

The hardware mod was very interesting, but writing the software was an even more involved project. Stay tuned while Larry walks you through the whole process.

Dave and I were lounging around the office a while back talking about speed. The subject came up because we'd had several requests for a PC speedup which wouldn't send the machine's real time clock (RTC) into warp speed.

We even had one person call to say that the original speedup (see Micro C issue 29) had no effect on his machine. Seems he'd used the RTC to time the benchmarks. Since the system clock and the RTC were both running faster the benchmark times didn't appear to change.

We consulted The Book of Intel (Component Data Catalog) and noticed that the PC clock generator, an 8284, could be switched between the normal crystal input and an external clock input. Off I went to dig into my computer. What follows is the results of my digging.

8284

The 8284 system clock chip supplies three different clock signals. CLK is the clock signal used by the processor, OSC feeds the expansion bus, and PCLK goes to the keyboard and RTC.

Switching from the 14.31818MHz crystal input to a higher frequency external source is easily done by toggling between high (5V) and low (ground) on the 8284's select pin. Unfortunately, this changes the value of all three clock outputs when we wanted to change only CLK.

The answer is to piggyback another 8284 on the existing one. The top 8284 will get the OSC output from the bottom one and will have its own higher frequency crystal oscillator circuit.

Now if we disconnect the CLK output of the bottom 8284 and instead supply the main board with CLK from the top 8284, a select signal to the top 8284 will switch between fast and slow CLK rates. The bottom 8284 is still providing OSC and PCLK to the system, so both the expansion bus and the RTC will stay happy.

Software/Hardware Interface

It would be good fun to control the clock speed with a software switch. No problem. There happens to be an unused bit in port B of the PIO. IBM says in their Technical Reference that it's bit 2, but a careful look at the schematic shows that bit 3 is really the one we want.

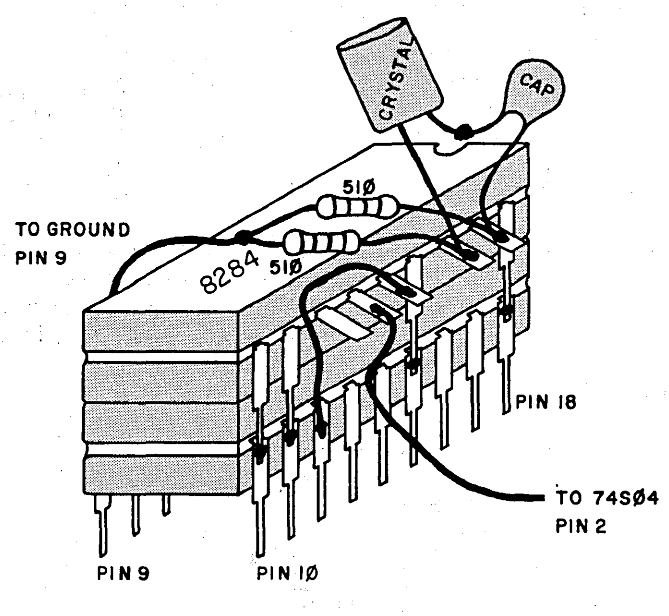
A wire from pin 21 (bit 3) of the PIO to the select pin of the top 8284 would finish the hardware end of the mod were it not for the fact that bit 3 is set high on power up. A high input to the top 8284 select will choose the external frequency which, in this case, is slow.

If there's one thing I can't stand it's watching a computer count through a memory check. So I added an inverter in the select line to finish things off. Now my box boots with blistering abandon.

On To The Nuts And Bolts

Take the main board out of your PC. You'll need to replace the 8088 with an

Figure 1 - Piggyback Should Look Something Like This



8MHz V-20 to handle the fast speed. Do it now, as the chip is much easier to install while the board is out.

The RAM chips are also sensitive to speed. You're all set if the RAMs are 150 microsecond parts or faster. If they are slower, replace them with 150us or 120us.

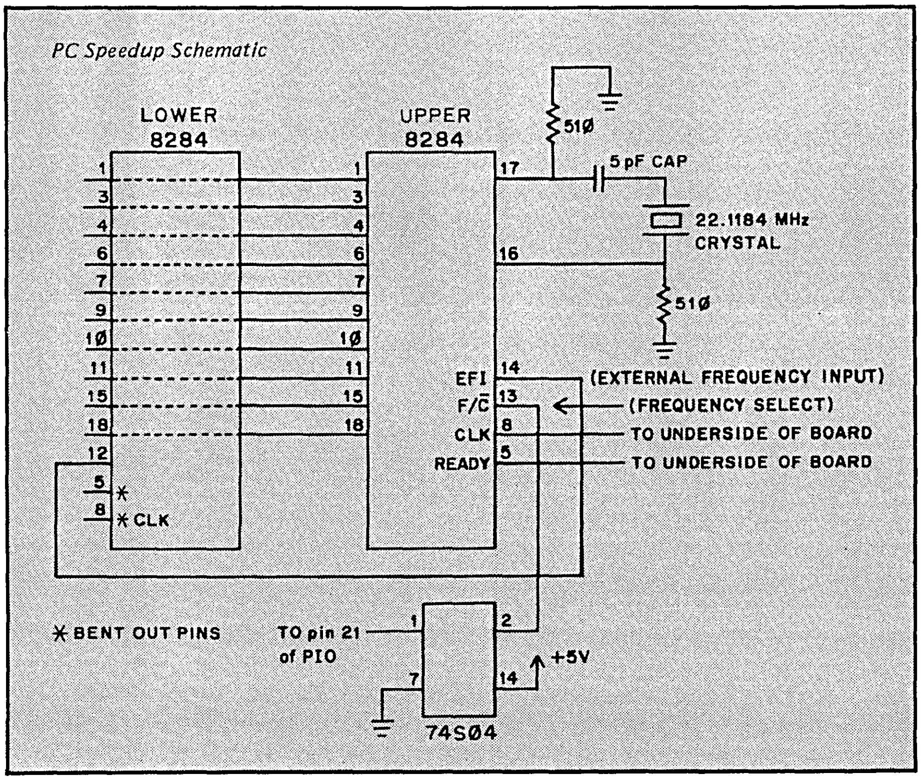
Remove the 8284. Bend out pins 5 (READY) and 8 (CLK) since these signals will be provided by the top 8284. Prepare the top 8284 by doing the following. Bend out and cut the narrow portion off of pins 2,5,8,12,13, 14,16, and 17. Sit the top 8284 on the bottom one and solder the remaining unbent pins to their downstairs neighbors. Check that none of the bent out pins is shorting out.

Solder a jumper wire from pin 12 of the bottom 8284 to pin 14 of the top 8284. This sends OSC from the bottom 8284 to the external input of the top 8284. Keep the jumper short, since it's carrying high frequency and could pick up "I Love Lucy" if it starts to look too much like an antenna. Wirewrap wire works well for all jumpers.

New Crystal Oscillator

Now comes the creative part. The top 8284 needs a crystal oscillator circuit to provide the higher frequency. I used the quick and dirty method (see Figure 1) and soldered directly to the pins of the top 8284. A small board would be much more aesthetic, but beware of long wires and high frequencies.

The fastest crystal I've been able to use is 22.1184MHz which gives a CLK (CLK = OSC/3) signal of 7.37MHz. With a 24MHz crystal the ROM signs on, but the drives go to lunch. Possibly the 5MHz DMA controller is failing.


PC Speedup Schematic

Plug the monstrosity back in. Run a wire from pin 5 of the top 8284 around to the bottom of the board. Solder it to pad 5 of the 8284 socket to provide READY to the system. Put in a similar jumper from pin 8 of the top 8284 to pad 8 of the 8284 socket. This is the CLK signal.

Select Circuit

We're almost there. The last step is to provide the select signal to the top 8284. I used a 74S04 to invert the signal since we have buckets of them in the office. Chop off all of its legs except 1,2,7, and 14. Pay no attention to those tiny screams.

Bend out pins 1 and 2 and look for a convenient place to piggy back the chip. Any 14 pin DIP will do. Solder pins 7 and 14 to the bottom chip. Then wire a jumper from pin 21 of the PIO (it will be labeled 8255) to pin 1 of the 74S04. Finally, jumper from pin 2 of the 74S04 to pin 13 of the top 8284.

Reinstall the main board and fire it up. If all is well the next step is to program the PIO as a speed switch.

Support Software

SPEEDSET.ASM (see Figure 2) does three things. First it takes control of the keyboard interrupt. Then it carves out a portion of memory and makes itself resident. Finally it looks at all keystrokes and programs the PIO if it sees either the character that means "speed up" or the one that means "slow down."

Let's Corrupt An Interrupt

To do so we need to know how they work. The PC devotes the first section of its memory to a table of four-byte vectors. Each of these vectors points to the code for one of the interrupts.

(continued next page)

(SPEEDSET.ASM on next page)

(continued from page 7)

When a program calls an interrupt, INT 9 for example, a jump to the address stored in location 0000:4*9 occurs. This address is the beginning of the code for interrupt 9, which is then executed. To take control of an interrupt, write the address of our replacement code to the vector table in place of the normal vector.

In this case we want the keyboard interrupt (INT 9) to function normally after each keystroke is inspected. So one of the first things we do in the setup procedure is save the original vector.

DOS function 35h returns the vector which is then stored in the variable old_int. Notice that we guard against installing the program more than once. This is easy because the interrupt vector points to a location in the ROM if no one has altered it.

The beginning of the ROM has a segment address of 0f000h, so if function 35h returns that value, the program has not been installed.

Now install a new vector which points to the start of our resident code using DOS function 25h. Any further calls to INT 9 will be redirected to the new code. The last two instructions in setup protect the resident code from being overwritten. Interrupt 27h does all the work and only has to know the amount of memory to protect.

Scan Codes Vs. ASCII

Once we have control of the keyboard interrupt what do we do?

Each key of the PC keyboard generates a unique scan code rather than ASCII. There is also a byte in memory called kb_flag which contains the status of the various shift keys. Between the scan code and kb_flag any keystroke can be identified.

New_int looks for Alt F9 and Alt F10 as the speed switches. It needs to know first if the Alt key has been pressed and then whether the scan code for either F9 or F10 is in the kb_data port.

If neither speed key is found, control is passed on to old_int. Otherwise we jump to one of the two parts of the program which actually does something.

Figure 2 - SPEEDSET.ASM

```
title SpeedSet

fast    equ     43h     ; scan code for f9 key
slow    equ     44h     ; scan code for f10 key
kb_data equ     60h     ; PIO port A - contains scan code
kb_ctl  equ     61h     ; PIO port B - contains unused bit
                        ; and keyboard acknowledge bit

code    segment         ; everything goes in code segment
        org     100h

        assume  cs:code


DOS_entry       label   far
        jmp     setup

old_int dd      ?       ; address of interrupt 9 code in ROM

new_int proc    far     ; beginning of our interrupt handler
        sti             ; INT 9 turns off interrupts, reenable
        push    ax      ; save registers
        push    bx
        push    dx
        mov     ah,2    ; tell INT 16 to return kb_flag
        int     16h             ; get kb_flag
        and     al,00001000b    ; mask bits except alt status
        cmp     al,00001000b    ; check alt key status
        jne     short no_act    ; don't act if alt not pressed
        in      al,kb_data      ; get scan code
        cmp     al,fast         ; is it the f9 key?
        je      short faster    ; speed up if it is
        cmp     al,slow         ; is it the f10 key?
        je      short slower    ; slow down if it is


no_act: pop     dx              ; restore registers
        pop     bx
        pop     ax
        jmp     old_int         ; let ROM code do it's thing

done:   in      al,kb_ctl       ; get keyboard status
        or      al,10000000b    ; set keyboard acknowledge bit
        out     kb_ctl,al       ; write it back to port
        pop     dx              ; restore registers
        pop     bx
        pop     ax
        jmp     old_int         ; jump to ROM code to finish

faster: in      al,kb_ctl       ; get value from PIO port B
        and     al,11110111b    ; reset unused bit
        out     kb_ctl,al       ; write it back to port B
        jmp     short done      ; finish

slower: in      al,kb_ctl       ; get value from PIO port B
        or      al,00001000b    ; set unused bit
        out     kb_ctl,al       ; write it back to port B
        jmp     short done      ; finish

new_int endp                    ; end of our interrupt
```

```
end_res_code:

sign_on db      13,10,18 dup (32),201,42 dup (205),187,13,10
        db      18 dup (32),186,'        SPEED SWITCH NOW '
        db      'INSTALLED          ',186,13,10,18 dup (32)
        db      186,' Alt F9 ',26,' Slow      ',1,'  '
        db      2,'    Alt F10 ',26,' Fast ',186,13,10
        db      18 dup (32),200,42 dup (205),188,13,10,'$'

err_msg db      13,10,'SPEED SWITCH ALREADY INSTALLED'
        db      13,10,'$'

        assume  ds:code

setup   proc    near            ; install our routine
                                ; as resident code
        mov     ax,3509h        ; get address of interrupt 9
        int     21h
        mov     ax,es           ; segment is returned in es
        cmp     ax,0f000h       ; is this address in ROM?
        je      short install   ; if so, install our code
        mov     dx,offset err_msg       ; if not, write msg
        mov     ah,9            ; that our code is already
        int     21h             ; installed
        int     20h             ; exit to DOS
install:mov     dx,offset sign_on       ; write sign on msg
        mov     ah,9
        int     21h
        mov     word ptr old_int,bx     ; save ROM address
        mov     word ptr old_int+2,es   ; of interrupt 9
        mov     dx,offset new_int       ; set up new
        mov     ax,2509h                ; interrupt vector
        int     21h
        mov     dx,offset end_res_code  ; make our code
        int     27h                     ; resident

setup   endp
code    ends
        end     DOS_entry
```

End of SPEEDSET.ASM

The code at labels "faster:" and "slower:" toggles bit 3 of PIO port B. This in turn toggles pin 21 of the PIO and selects between the two CLK rates. Finally new_int sets the keyboard acknowledge bit of PIO port B so it will be ready for the next keystroke.

EXE To COM Conversion

SPEEDSET.ASM was written to be assembled as an EXE file and then run through EXE2BIN to create a COM file. Those of you who feel adventuresome can use the assembler file as a shell to install your own memory resident programs. Replace the speed change code with your own and dive in. There are a few rules to keep EXE2BIN from choking on your EXE file.

Don't include separate stack or data segments. All segment registers should be assumed to refer to the code segment and any variables should be in the code segment.

Begin the program with "ORG 100h." Label the first instruction and end the program with "END label_name." And don't worry about the stack segment error from LINK. It's just confused.

Non-Resident Speed Switch

If you really don't care about a memory resident speed switch use DEBUG to create two small programs using the four lines of code at "faster:" and "slower:". Just replace the jump instruction at the end of each code segment with an INT 20h to exit to DOS.

Conclusion

I've had this mod running on my PC for a couple of months with no problems. The software works well. Most programs don't even care if the speed is changed in the middle of execution. I did manage to make Turbo Pascal gag during a compilation, but why anyone would want to change speeds then escapes me.

Good luck. When you're done, if the digital gods are smiling, you'll have a 7.37MHz PC that can actually tell time.

■ ■ ■

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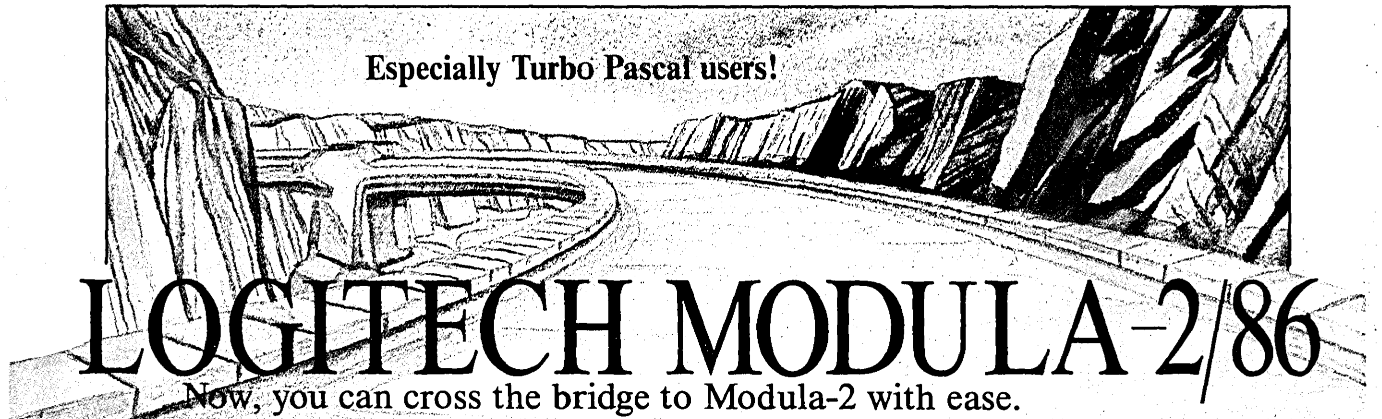

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Practical Programming In Modula-2:

By James W. Albert

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Controlling The Video On PCs

You may be wondering where we dug up a FORTRAN user who's still interested in programming (maybe it's because he's an anthropologist), but Jim actually turned himself in.

He's excited about Modula-2, and so am I. I too learned FORTRAN in school, and I too know its frustrations only too well. Read on as Jim does some interesting things using a very solid (and now inexpensive) implementation of this great new language.

When I asked a friend to teach me how to program a computer back in the mid '70s, he tried to teach me FORTRAN.

When I entered graduate school in the early '80s, I was again confronted with FORTRAN, but this time I had an incentive I lacked earlier: enormous amounts of data to process. So I learned.

When I bought my first micro, I bought a FORTRAN compiler for it. And when I landed my first sizeable programming contract, I wrote the code in FORTRAN. So why did I decide to move beyond FORTRAN?

Life After FORTRAN

First, the FORTRAN implementations I had didn't allow separate compilation of pieces of a large program. Routine libraries were possible, but clumsy in comparison to more modern languages.

Low-level operations were limited at best, graphics difficult. And while the formatted WRITE statement is fine for statistical programming, creating output for a "user-friendly" application is tedious. Recursion can be faked but results in truly opaque code. So it was time to go shopping for a new language.

I wanted these features — recursion, user-defined complex variable types, separate compilation of components of larger programs, low-level control of

Figure 1 - DEFINITION MODULE

```
DEFINITION MODULE MonoPage;

  FROM FileSystem IMPORT File;

  EXPORT QUALIFIED    (* variable types: *)
                        Window,
                        Page,
                        Pagepointer,

                      (* constants: *)
                        page0,

                      (* procedures: *)
                        MakePage,
                        UsePage,
                        SwapPage,
                        Store2Page,
                        RemovePage,
                        MergePage,
                        WriteWindowChar,
                        WriteWindowString,
                         ChangeWindowAttribute,
                        ClearWindow,
                        WritePageChar,
                        WritePageString,
                        ChangeCharAttribute,
                        ClearPage,
                        DumpPage,
                        LoadPage;

  CONST   page0 =       0B000H:0H;     (* this is the
                                   monochrome version! *)

  TYPE    Window =      ARRAY [ 0 .. 3 ] OF CARDINAL;

          Charrec =     RECORD
                          code,
                          attr  : CHAR;
                          END;

          Page =        ARRAY [ 1 .. 25 ],
                              [ 1 .. 80 ] OF Charrec;

          Pagepointer = POINTER TO Page;

  PROCEDURE MakePage   ( VAR page   : Pagepointer );
PROCEDURE UsePage    ( page   : Pagepointer );

PROCEDURE SwapPage   ( page   : Pagepointer );

PROCEDURE Store2Page ( VAR page   : Pagepointer );

PROCEDURE RemovePage ( VAR page   : Pagepointer );

PROCEDURE MergePage   ( basepage,
                        overpage     : Pagepointer;
                        VAR rsltpage : Pagepointer;
                        resolution   : CARDINAL );

PROCEDURE WriteWindowChar ( inpchar : CHAR;
                            page    : Pagepointer;
                            window  : Window;
                            row,
                            col     : CARDINAL );

PROCEDURE WriteWindowString ( string : ARRAY OF CHAR;
                              page   : Pagepointer;
                              window : Window );

PROCEDURE ChangeWindowAttribute ( attrib : CHAR;
                                  page   : Pagepointer;
                                  window : Window );

PROCEDURE ClearWindow ( page   : Pagepointer;
                        window : Window );

PROCEDURE WritePageChar ( inpchar,
                          attrib  : CHAR;
                          page    : Pagepointer;
                          row,
                          col     : CARDINAL );

PROCEDURE WritePageString ( string : ARRAY OF CHAR;
                            attrib : CHAR;
                            page   : Pagepointer;
                            row,
                            col    : CARDINAL );

PROCEDURE ChangeCharAttribute ( attrib : CHAR;
                                page   : Pagepointer;
                                row,
                                col    : CARDINAL );

PROCEDURE ClearPage ( page : Pagepointer );

PROCEDURE DumpPage ( page : Pagepointer );

PROCEDURE LoadPage ( fname : ARRAY OF CHAR;
                     page  : Pagepointer );


END MonoPage.
```

graphics, and support for my interests in laboratory instrumentation and control.

I had to have a good general-purpose language, and the code had to be readable and easily maintained.

In order to minimize the confusion inherent in large projects, I wanted strong type-checking of variables, but I also wanted enough control to corrupt the type-checking if I needed to.

All this added up, it seemed to me, to Modula-2. When Logitech lowered the price of their compiler to less than one hundred dollars, I ordered.

From WRITE To WRITELN

After playing with my new compiler for a while, I decided to translate a large FORTRAN program into Modula-2. There were 26 pages and a lot of lines starting with "WRITE". Unfortunately, the Modula-2 alternative, "WRITELN", convinced me to put the project on hold.

Modula has a number of procedures for handling output, and its modular structure allows for groups of procedures called (strangely enough) "modules" to be collected and compiled. These procedures can then be used by a program simply by explicitly importing them.

All input and output require importation of procedures, usually from the library modules InOut and Terminal. These procedures are type-specific: WriteCard, for example, writes only cardinal numbers.

None of these procedures issues a carriage return/line feed, so another procedure, WriteLn, must be used if you want to add one. With all the screen writing I had to do with this program, I needed more control.

What I wanted was a set of procedures that would allow me to write to specified locations on the screen, with full control of screen display attributes (bold, reverse, underlined, blinking).

I wanted to get the job done without ANSI.SYS or direct BIOS calls. And I wanted the ability to overwrite material on the screen and then restore it *a la* windows. Finally, I wanted to store entire screens in memory and then recall them when needed.

(continued next page)

(continued from page 13)

The Answer In Theory

PCs have essentially two types of video displays: monochrome and color. The former produces dense, highly readable text characters and an assortment of block graphics characters, while the latter offers less readable text but greater flexibility, with the possibility of 40 column text displays and dot graphics.

Most of the people I know have monochrome, since they primarily do word processing on their computers. So I write assuming mono.

The memory that represents your screen display lives on the video card. High resolution graphics are very memory expensive, so color and mono graphics cards contain lots of memory.

Since a display consisting of standard characters eats up only about 4K of memory when in "text mode," a bunch of bytes are left over. MS/PC-DOS allows this to be carved up into "pages" which can be selected for display with a BIOS command.

Since monochrome text always takes up the same 4K chunk of memory, that's all mono boards have on them. No pages are possible. PCs, on the other hand, usually have lots of memory (on the main board) for transient programs. The goal, then, is to use some of that memory to emulate pages, or create "virtual pages" if you will, in user RAM.

And In Modula

I learned from a couple of sources how to treat my screen as a big variable —

Define a record with two character elements, the first representing the character to display, the second its attribute. Set up a two-dimensional array using this record, resulting in a complex variable that represents the display.

Modula allows a memory location to be specified for a variable, and in this case we want to locate the screen variable on the monochrome video RAM. So, saying something like "screen [3, 10].character := 'P' " would put a capital P on the screen in the third row, tenth column.

Pointer variables are just what we need since they're defined as type "pointer to" another type and contain an address.

The "virtual pages" can be constructed (using the same screen-type variable) somewhere in memory by importing the procedures ALLOCATE and DEALLOCATE from the standard library module Storage, and using the call NEW (pointer) to reserve an appropriately sized chunk of RAM, with its address returned in pointer.

The screen referred to by the pointer can be directly manipulated by "dereferencing" the pointer by putting the hat symbol '^' directly after the variable name, thus: pointer^.

Modula won't allow the passing of complex variables as parameters in function calls, but will allow the passing of pointers. This lets you build a library of procedures that manipulates screens.

I call this library module "MonoPage." (See Figures 1 and 2 for the complete Definition and Implementation modules.) It features procedures that create pages, move them into the current display, swap them with the current display, open windows on any of the pages, change attributes and clear pages and windows, write individual characters and strings, etc.

Then other goodies came to mind. Help screens are important, and the screen dump feature of the PC lets the user get a hard-copy of instructions, but the screen display attributes are lost (can you imagine the printer trying to figure out on its own what to do with a blinking character?). I also couldn't assume the user would have GRAPHICS.COM and an Epson-compatible printer.

I wanted a page dump routine that would boldface the bold, underscore the underlined, and italicize the reverse (and ignore blinking!). So I added DumpPage.

If you know where and how big a variable is, you can read or write its contents to and from a disk file. An elaborate screen can be created and saved, and then read back in by the application with no write-type coding in that program at all. This led to LoadPage.

I like using the block graphics characters for bar graphs. It would be neat to overlay two pages of graphs, but something needs to be done to resolve what happens when they overlap. All I've done so far is allow for direct, simple overlay in procedure MergePage.

Windows are handy little things, but what happens if you want to print an 85-character string to a window only 20 characters wide? To avoid unnatural breaks in words at the window's right edge, I wrote a WordWrap procedure as a private procedure of MonoPage (it can't be exported).

MonoPage isn't perfect, but it answers most of my needs for screen output. Most of the ideas behind it are simple and straightforward, if not downright obvious, but it would have been very difficult to do in FORTRAN. That a beginner in Modula programming could do so with relative ease speaks well for the power and simplicity of this language.

Further Thoughts Of Modula

Modula's library modules are implemented in two parts: a definition module, defining what procedures, constants, and types are available for export, and an implementation module that contains the working routines. Both need to be compiled, and the definition module must be compiled before the implementation module.

The definition module is all a user has to see to be able to use its procedures, with many details of the implementation, like the WordWrap procedure in my MonoPage, going largely unsuspected by the user.

Here, I think, is a fundamental difference between FORTRAN and Modula. Reuseable routines can be written and edited in FORTRAN, or assembly language can be called from a program. But these measures feel like appendages and are always recognizable as additions.

A well-conceived Modula module becomes indistinguishable from the other modules supplied with the language, and the sense is that the language itself is being extended. The programming environment therefore becomes "co-evolutionary."

Modula-2 could be hard to outgrow.

■ ■ ■

Figure 2 - IMPLEMENTATION MODULE

```
IMPLEMENTATION MODULE MonoPage;

  FROM SYSTEM     IMPORT TSIZE;

  FROM Terminal   IMPORT Read;

  FROM Storage    IMPORT ALLOCATE,
                         DEALLOCATE;

  FROM FileSystem IMPORT File,
                         ReadNBytes,
                         WriteChar,
                         Lookup,
                         SetRead,
                         SetWrite,
                         Close;

  CONST blank  = 040C;
        nOrmal = 015C;
        uNdrln = 011C;
        rEvers = 170C;
        normal = 007C;
        undrln = 001C;
        revers = 160C;
        blink  = 207C;(* "blink" is normal video,
                         normal intensity *)
        bLink  = 217C;(* "bLink" is normal video,
                         increased intensity *)
        flash  = 360C;(* "flash" is reverse video,
                         normal intensity *)
        fLash  = 370C;(* "fLash" is reverse video,
                         increased intensity *)
        ulc    = 311C;(* upper-left corner char *)
        urc    = 273C;(* upper-rt corner char *)
        llc    = 310C;(* lower-left corner char *)
        lrc    = 274C;(* lower-rt corner char *)
        hl     = 315C;(* horizontal line char *)
        vl     = 272C;(* vertical line char *)

  VAR screen [ page0 ] : Page;
      query            : CHAR;

  PROCEDURE DefineAttrib ( attrib : CHAR ): CHAR;

    VAR trnschar : CHAR;

  BEGIN

    CASE attrib OF
      'n' : trnschar := normal |
      'u' : trnschar := undrln |
      'r' : trnschar := revers |
      'N' : trnschar := nOrmal |
      'U' : trnschar := uNdrln |
      'R' : trnschar := rEvers |
      'b' : trnschar := blink  |
      'B' : trnschar := bLink  |
      'f' : trnschar := flash  |
      'F' : trnschar := fLash;
      ELSE  trnschar := blank;
      END;
  RETURN trnschar;
  END DefineAttrib;

PROCEDURE DefineWindow ( page   : Pagepointer;
                         window : Window );

  VAR i,
      top,
      bottom,
      left,
      right   : CARDINAL;

BEGIN

  top :=    window [ 0 ];
  bottom := window [ 1 ];
  left :=   window [ 2 ];
  right :=  window [ 3 ];

  WritePageChar (ulc, 'N', page, top, left);
  WritePageChar (urc, 'N', page, top, right);
  WritePageChar (llc, 'N', page, bottom,left);
  WritePageChar (lrc, 'N', page, bottom,right);

  FOR i := ( left + 1 ) TO ( right - 1 ) DO
    WritePageChar ( hl, 'N', page, top, i );
    WritePageChar ( hl, 'N', page, bottom, i );
    END;

  FOR i := ( top + 1 ) TO ( bottom - 1 ) DO
    WritePageChar ( vl, 'N', page, i, left );
    WritePageChar ( vl, 'N', page, i, right );
    END;

  END DefineWindow;

PROCEDURE Scroll ( strow,
                   edrow,
                   stcol,
                   edcol : CARDINAL;
                   page  : Pagepointer );

  VAR rp,
      rrp,
      cp,
      i,
      j,
      delay  : CARDINAL;

BEGIN

  delay := edcol - stcol;
  delay := delay * delay;
  FOR i := 1 TO 100 DO
    FOR j := 1 TO delay DO
      END;
    END;

  edrow := edrow - 1;
  FOR rp := strow TO edrow DO
    rrp := rp + 1;
    FOR cp := stcol TO edcol DO
      page^ [ rp, cp ] := page^ [ rrp, cp ];
      END;
    END;
```

(code continued next page)

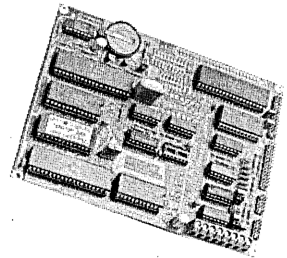
IMPLEMENTATION MODULE

(continued from page 15)

```
  edrow := edrow + 1;
  FOR cp := stcol TO edcol DO
    page^ [ edrow, cp ].code := ' ';
    END;

  END Scroll;

PROCEDURE WordWrap ( startrow,
                     endrow,
                     startcol,
                     endcol,
                     row        : CARDINAL;
                     VAR col    : CARDINAL;
                     page       : Pagepointer);

  VAR hold,
      step : CARDINAL;

BEGIN

  IF row = endrow THEN
    Scroll( startrow, endrow, startcol,
                           endcol,page);
    row := endrow - 1;
    END;

  col  := startcol;
  hold := endcol;

  REPEAT
    DEC ( hold );
    UNTIL page^ [ row, hold ].code = ' ';

  hold := hold + 1;

  FOR step := hold TO endcol DO
    page^ [ row + 1, col ] := page^ [row, step];
    page^ [ row, step ].code := ' ';
    INC ( col );
    END;

  END WordWrap;

PROCEDURE MakePage ( VAR page : Pagepointer );

BEGIN

  NEW ( page );
  ClearPage ( page );
  END MakePage;

PROCEDURE SwapPage ( page : Pagepointer );

  VAR holdpage : Pagepointer;

BEGIN

  NEW ( holdpage );
  holdpage^ := screen;
  screen := page^;
  page^ := holdpage^;
  DISPOSE ( holdpage );
  END SwapPage;
```

```
PROCEDURE UsePage ( page : Pagepointer );

BEGIN

  screen := page^;
  END UsePage;

PROCEDURE RemovePage ( VAR page : Pagepointer);

BEGIN

  DISPOSE ( page );
  END RemovePage;

PROCEDURE MergePage ( basepage,
                      overpage    :Pagepointer;
                      VAR rsltpage:Pagepointer;
                      resolution  :CARDINAL );
VAR i,
    j : CARDINAL;
(* THIS PROCEDURE HAS ONLY ONE "RESOLUTION"
 CURRENTLY IMPLEMENTED:SIMPLE, DIRECT OVERLAY
 OF THE BASE PAGE WITH THE OVER PAGE *)
BEGIN

  IF rsltpage = NIL THEN MakePage (rsltpage);
  END;
  FOR i := 1 TO 25 DO
    FOR j := 1 TO 80 DO
      IF overpage^ [ i, j ].code # blank THEN
          rsltpage^ [i, j] := overpage^ [i, j]
        ELSE
          rsltpage^ [i, j] := basepage^ [i, j]
        END;
      END;
    END;
  END MergePage;

PROCEDURE WritePageString (string:ARRAY OF CHAR;
                           attrib: CHAR;
                           page : Pagepointer;
                           row,
                           col  : CARDINAL );
  VAR i,
      loop : CARDINAL;

BEGIN

  attrib := DefineAttrib ( attrib );

  i := 0;
  WHILE i <= HIGH ( string ) DO

    WritePageChar ( string [ i ], attrib, page,
                                     row, col );

    IF col = 80 THEN
        IF string [ i ] # blank THEN
            WordWrap (1,25,1,80,row,col,page);
          ELSE
            col := 1;
          END;
        INC ( row );x
        IF row >= 25 THEN
          Scroll ( 1, 25, 1, 80, page );
          row := 25;
          END;
      ELSE
        INC ( col );
      END;

    INC ( i );

    END;

  END WritePageString;

PROCEDURE ClearPage ( page : Pagepointer );

  VAR i,
      j : CARDINAL;

BEGIN

  FOR i := 1 TO 25 DO
    FOR j := 1 TO 80 DO
      WritePageChar ( blank, 'n', page, i, j );
      END;
    END;

  END ClearPage;

PROCEDURE WriteWindowString (string:ARRAY OF CHAR;
                             page   :Pagepointer;
                             window: Window );

  VAR i,
      j,
      k,
      loop,
      row,
      col,
      endrow,
      endcol : CARDINAL;

BEGIN

  DefineWindow ( page, window );
  row :=    window [ 0 ] + 1;
  endrow := window [ 1 ] - 1;
  col :=    window [ 2 ] + 1;
  endcol := window [ 3 ] - 1;

  i := 0;
  j := row;
  k := col;

  WHILE i <= HIGH ( string ) DO
    WritePageChar ( string [ i ], blank,
                            page, j, k );
    IF k = endcol THEN
        IF string [ i ] # blank THEN
            WordWrap ( row, endrow, col,
                    endcol, j, k, page );
            INC ( j );
            IF j >= endrow THEN
              j := endrow;
              END;
          ELSE
            k := col;
            INC ( j );
            IF j >= endrow THEN
              Scroll ( row, endrow, col,
                          endcol, page );
              j := endrow;
              END;
          END;
      ELSE
        INC ( k );
      END;
    INC ( i );
    END;

  END WriteWindowString;

PROCEDURE ClearWindow (page   : Pagepointer;
                       window : Window );

  VAR i,
      j : CARDINAL;

BEGIN

  FOR i := window [ 0 ] TO window [ 1 ] DO
    FOR j := window [ 2 ] TO window [ 3 ] DO
      WritePageChar (blank, 'n', page, i, j);
      END;
    END;

  DefineWindow ( page, window );

  END ClearWindow;

PROCEDURE ChangeWindowAttribute (attrib : CHAR;
                         page   : Pagepointer;
                         window : Window );

  VAR i,
      j : CARDINAL;

BEGIN

  attrib := DefineAttrib ( attrib ) ;

  FOR i := window [ 0 ] TO window [ 1 ] DO
    FOR j := window [ 2 ] TO window [ 3 ] DO
      page^[ i, j ].attr := attrib;
      END;
    END;

  DefineWindow ( page, window );

  END ChangeWindowAttribute;
```

(code continued on next page)



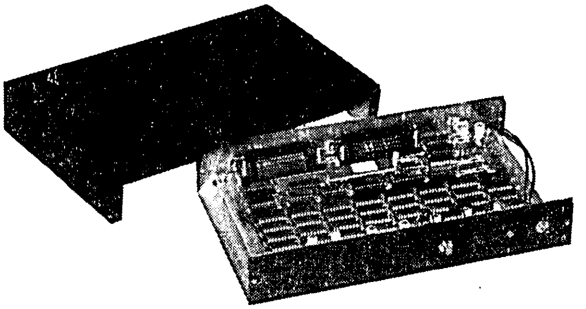
IMPLEMENTATION MODULE

(continued from page 17)

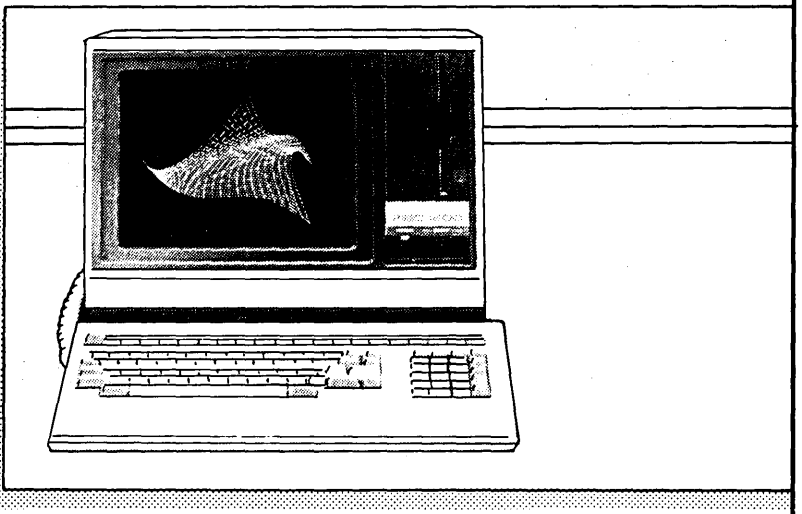
```
PROCEDURE WriteWindowChar (inpchar:CHAR;
                           page   :Pagepointer;
                           window :Window;
                           row,
                           col    :CARDINAL );

BEGIN

  row := window [ 0 ] + row;
  col := window [ 2 ] + col;

  WritePageChar (inpchar,blank,page,row,col);

  END WriteWindowChar;

PROCEDURE WritePageChar ( inpchar,
                          attrib : CHAR;
                          page   : Pagepointer;
                          row,
                          col    : CARDINAL );

BEGIN

  attrib := DefineAttrib ( attrib );

  page^ [ row, col ].code := inpchar;
  IF attrib # blank THEN
     page^ [ row, col ].attr := attrib;
     END;

  END WritePageChar;

PROCEDURE ChangeCharAttribute (attrib:CHAR;
                               page :Pagepointer;
                               row,
                               col  :CARDINAL );

BEGIN

  attrib := DefineAttrib ( attrib ) ;
  page^ [ row, col ].attr := attrib;

  END ChangeCharAttribute;

PROCEDURE DumpPage ( page : Pagepointer );

(* THIS DumpPage LACKS PRINTER CONTROL
 FEATURES    DUE TO THE LACK OF A COMMON
 STANDARD FOR SUCH CODES. ALL GRAPHICS
 CHARACTERS ARE ALSO FILTERED OUT *)

  VAR i,
      j,
      outval   : CARDINAL;
      prindump : File;
      outchar  : CHAR;
```

```
BEGIN

  Lookup ( prindump, 'PRN', FALSE );
  SetWrite ( prindump );

  FOR i := 1 TO 25 DO
    FOR j := 1 TO 80 DO
      outchar := page^ [ i, j ].code;
      outval  := ORD ( outchar );
      IF ( outval > 32 ) & (outval < 128) THEN
          WriteChar ( prindump, outchar );
        ELSE
          WriteChar ( prindump, blank );
        END;
      END;
    END;

  Close ( prindump );

  END DumpPage;

PROCEDURE LoadPage ( fname : ARRAY OF CHAR;
                     page  : Pagepointer );

  VAR readfile : File;
      size,
      got      : CARDINAL;

BEGIN

  size := TSIZE ( Page );
  got  := 0;
  Lookup ( readfile, fname, FALSE );
  SetRead ( readfile );
  ReadNBytes ( readfile, page, size, got );
  Close ( readfile );
  END LoadPage;

PROCEDURE Store2Page ( VAR page : Pagepointer);

BEGIN

  IF page = NIL THEN MakePage ( page ); END;
  page^ := screen;
  END Store2Page;


END MonoPage.
```

End of IMPLEMENTATION MODULE



GEM



Un-Blinking The PC's Blinkin' Cursor

A Simple Hardware Fix

By Sigi Kluger
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I hate my blinking cursor. Sandy hates her blinking cursor. Larry and Gary hate their blinking cursors. With all that hatred around, it's easy to see why there's trouble in the world. You can do your part to make the world better by changing your cursor.

But, you can't do it in software. The little turkey is wired to blink, and blink it shall. Sigi, however, didn't realize that hardware is sacred (he has a lot to learn), so he stifled his cursor. Hopefully he'll stifle a few more things on the PC before they find out that he has been poking amongst the chips.

Hi! I just switched computer systems (for the first time ever), and it's great fun.

I've been using S-100 computers of different varieties and with different operating systems since 1977. Now that I work for a company that produces IBM PC coprocessor cards, I decided that now's the time to switch to something PC-compatible. Right now I'm using a PC Tech 80186 machine, which is really nice and super fast (almost as fast as an AT!!!) but will get myself something more conservative to be able to plug in a V20 and run (nostalgia, yea!!!) some of my 8080 programs.

What I'm so long-windedly trying to get at is that I passionately hate blinking cursors — they drive me up the wall (cause headaches). Everyone I've talked to has told me, "That's the way it's designed, it's in hardware."

Surely it had to be done in hardware since the 6845 CRT controller can be programmed for two different blink rates — even non-blink! Unfortunately, these days it seems people are better with their fingers on the keyboard than on the chips.

I'm told even Peter Norton (who appears to be as much the IBM guru as Ward Christensen was the 8080/S-100/CP/M guru) said, "It couldn't be done." Now, are a few gates here and traces there THAT intimidating? Certainly not!

Unfamiliar Leads

Being a bit unfamiliar with TTL, having done no hardware work in a while (but catching up fast...), I was at first totally lost looking at the monochrome-graphics card I'm using (can't tell the brand — something Taiwanese I think). But after I got a look at a schematic (yes, some of the cheap Far East clones have tiny little schematics which are almost unreadable), I found the obvious solution to the blinking menace — a knife!

It appears as though most monochrome display cards (and graphics such as Hercules and "compatibles") use the same basic layout. This is roughly how it works, for those who have no schematics —

The CURSOR output (pin 19 of the 6845) goes into a 74LS174. There it's delayed (since the cursor location as output by the controller is normally at the location of the last character).

The cursor is delayed by one character position, so it's displayed just beyond the last character. This is done in two flip-flops in the '174. The cursor signal enters on D4, and the Q4 output is fed into D5.

The Q5 output is the delayed cursor signal. It's fed into a 7464, usually on pin 9.

The '64 consists of four AND gates feeding a NOR gate. Pins 9 and 10 are the inputs of a 2-input AND, and pin 10 is the blinkin' clock pulse.

To force this long story to an abrupt end, simply cut the trace leading to pin 10 of the 7464 and the cursor will quit blinking. You might want to do it right and pull pin 10 up to 5V via a 2.2K resistor after you've verified that it indeed works.

Don't Be Confused

There appears to be only one 7464 on the board, so you can't miss. Don't be confused by the board layout — the 64 may be clear on the other end of the board as seen from the 174! If your display card doesn't have a 7464, then you'll have to do some tracing. A schematic would be very helpful at this point.

In all the display cards I've seen so far, the cursor signal is delayed in a 74LS174 using two sections of the chip. The delayed cursor signal then enters an AND or NAND gate at one point.

If it's a 2-input gate, all you should have to do is CAREFULLY cut the trace leading to the other input. It is important to be able to reverse this procedure in case you cut the wrong trace. Beware, though, since traces may pass under chips and emerge at a different point on the other side, or even switch circuit board sides. The (N)AND gate may even be located at the other end of the board.

In tracing through a few more cards, I found an unnamed Taiwanese color graphics card where pin 19 of the 6845 goes to one section of a 74LS273 and from there to a 74LS00; cutting the other input to the '00 stopped the blinking.

More Info

Here is some more information, based on the IBM manuals:

1. Monochrome Display Adapter: cut trace going to pin 9 of U3 (LS08).
2. Color/Graphics Monitor Adapter: cut trace going to pin 12 of U49 (LS02).

One problem with turning the cursor blink off this way is that if your cursor is something other than an underline (like a block), you can't see the character immediately below the cursor if you move it around the screen!

Controlling Your Cursor

You may use the following code fragment to control the cursor under DEBUG or include it in programs:

```
MOV     AH,1
MOV     CX,cccc
INT     10H
```

Here are a few values for "cccc" for you to play with: (INT 10, subfunction 1 is explained in detail in various manuals and books, but no mention is made of bits 5 and 6 of register CH).

```
cccc = 600BH  -  slow blinking block
cccc = 400BH  -  fast blinking block
cccc = 000BH  -  steady block
cccc = 0B0BH  -  steady underline
```

As you can see, bits 6 and 5 of the CH register control blink:

BIT 6	BIT 5	
0	0	no blink
0	1	no cursor display
1	0	fast blink
1	1	slow blink

Poof!

I hope this has helped some people who, like myself, are suffering from blinking cursors. I might add that cutting traces on circuit boards makes your warranty vanish in a puff of greasy black smoke.

Fooling with electronic equipment not knowing what you're doing may make the equipment malfunction horribly, causing much grief and emptiness of the wallet, so you should attempt to unblink your cursor only if you are quite sure you know what you're doing. If all else fails ask a friend to do it for you. Just don't blame ME for breaking your computer, okay?

May this cure all your blinkin' cursors.

Editor's note: If the chips on your video card bear no relationship to anything living or dead, you might take a scope or logic probe and poke around the board. You'll be looking for a signal whose oscillation corresponds precisely with the blink of the cursor. Then pull out a pin or open a trace carrying that signal and see what happens. Again, as Sigi mentioned, you're on your own.

■ ■ ■

Game Theory Models In PROLOG And C:

Interfacing Between Languages

By Gary Entsminger

C and PROLOG are about as similar as IBM and Morrow, but that doesn't mean they have to spend their lives playing oil and water. Here Gary takes a look at combining the two. (As far as I know, the first time in publishing history these two have been mated.)

The theory of games is a branch of mathematics first formulated by Von Neumann and Morgenstern in 1944. It's been used in economics, evolutionary-, molecular-, and population-biology, linguistics, and physics to model interaction and conflict between variables (animals, genes, fluxes, particles).

Battles On Wildcat Mountain

For example, imagine a population of wildcats living on Wildcat Mountain in central Colorado. Let's say there are distinct populations of three species of wildcats. Each cat within a population has its own den and territory, but will sometimes wander beyond its own lot to find food, water, etc..

If it encounters members of its own species while outside its own territory, no problem. The two cats exchange wags or whisker rubs (or whatever wildcats exchange), and then go on about their business. But if a cat encounters another species, look out. All hell breaks loose; the fur flies; and (for simplicity, let's say) one or both of the cats dies.

When a cat dies in battle, we subtract him from the population of his species. When a cat wins a battle, we add one to the population of his species (for the offspring she/he will sire in staying alive through another battle).

"Wildcat Battles" is obviously a very simple system, but it illustrates a method for programming more elaborate "game theories" in PROLOG. Let's look first at a matrix of encounters below.

	X	Y	Z
X	case__	case01	case02
Y	case03	case__	case04
Z	case04	case05	case__

In cases ____, a wildcat has encountered a member of his own species, so there's no ensuing population change. In each of the other cases, the populations of the two encountering species do change reflecting the outcome of a battle.

In case01, for example, a wildcat from population X has wandered out of his territory, encountered a Y, and lost the battle. X's and Y's populations will change, while Z's will be unaffected.

Figure 1 - Conditions For case(01)

```
case(1) :-
   X= -1, Y = 1, Z = 0, T =1,
   _tracker(X,Y,Z,T,A,B,C,Tt), times(Tt),
   equal0(A,B,C,A1,B1,C1), shiftwindow(4),
   cursor(1,2), write(Tt),
   makewindow(1,7,0,"",2,2,3,A1),
   window_attr(112), readchar(_),removewindow,
   makewindow(2,7,0,"",6,2,3,B1),
   window_attr(112), readchar(_), removewindow,
   makewindow(3,7,0,"",10,2,3,C1),
   window_attr(112), readchar(_),removewindow.
```

Figure 1 shows the conditions for case(01) in Turbo PROLOG (Figure 2 shows the entire program with all cases). If you're a C or Pascal programmer, think this way — case is a procedure or function called with the value parameter: 1.

It will execute, assigning values to variables X,Y,Z, and T, then pass those values to _tracker, another procedure (or predicate in PROLOG). The variables — A,B,C, and Tt — will contain values on return from _tracker.

Next, two predicates (times and equal0) are called to check the timer for the game. I've arbitrarily chosen to stop the Wildcat Battle after 50 encounters.

The remaining code in case(1) pertains to the user interface. I've chosen to monitor the battle with three windows representing population sizes and one window representing time.

In Turbo PROLOG you make and remove windows with the built-in predicates "makewindow" and "removewindow". Change the window attribute with "window_attr", and open a window for writing or drawing with "shiftwindow". The predicate "readchar" halts execution until it reads a character from the keyboard. In case(1), any character (_) will be acceptable, and execution will resume. This allows me to step through the battle.

Two other predicates are important for the game (or model) — rand_1_9, which calls Turbo PROLOG's built-in random generator (see The Last Page for a better random generator), and main, which controls the flow of the program.

Each encounter is preceded by a call to rand_1_9 which generates a random number between 1 and 9 corresponding to our nine possible cases. After each encounter, the timer and arrays are updated and their values are displayed — the timer in a window at row=16 and column=60 and the values in the arrays as blocks (windows) in inverse video beginning at 2,2; 6,2; and 10,2. It's pretty flashy!

When we run the program, it begins executing at SETUP, the "GOAL" we specified at the end of the program. We could have specified any predicate as a goal (and consequently have started anywhere in the program). Sometimes, of course, it's better to begin in the beginning, but that's another story.

Interfacing PROLOG To C

In PROLOG, information is usually stored in a database. The database is built into standard PROLOG, but must be declared in Turbo PROLOG.

A database would be handy in large, mixed-data programs, but I wanted something simpler for my model — an array or structure. Unfortunately PROLOG has neither, nor an assignment statement equivalent to —

```
X = X + 1
```

or

```
++X
```

so I decided to let a C function handle the storage. See the figure below.

```
int _acrtused;
int pop_a[2]={0,0};
int pop_b[2]={0,0};
int pop_c[2]={0,0};
int time[2]={0,0};

tracker_0(x,y,z,t,a,b,c,tt) int x;
        int y; int z; int t; int *a;
        int *b; int *c; int *tt;
{
        pop_a[0]=pop_a[0] + x;
        *a=pop_a[0];
        pop_b[0]=pop_b[0] + y;
        *b=pop_b[0];
        pop_c[0]=pop_c[0] + z;
        *c=pop_c[0];
        time[0]=time[0] + t;
        *tt=time[0];
}
```

The function is simple (with an exception or two) —

Initialize four little arrays (one for each species of wildcats and one for time) to zero. When we call tracker_0, we pass it "x,y, z, and t", and it returns new values for "a,b,c,tt" when it's finished executing. Each array (pop_a, pop_b, pop_c) keeps track of the population of one species.

You might have noticed a couple of oddities in the C function — the variable, _acrtused, and the function name itself, tracker_0. Both are required for a successful interface between Turbo PROLOG and Microsoft C (the C compiler I used).

The function, acrtused, is generated by Microsoft C, which expects to have it resolved by one of its standard libraries at Linking. Unfortunately, Turbo PROLOG will currently allow linking only to its own library, PROLOG.LIB, so we have to handle any compiler- generated variables. In this case, there's only one, _acrtused, and we declare it to be an integer.

The underscore (_0) in tracker_0 is a cue used by Turbo PROLOG to recognize a function (or predicate) from another language. The "0" indicates that this "tracker" is the first function named "tracker" in the program. We could have multiple "trackers" named, "tracker_1", "tracker_2", etc.

Programming in Turbo PROLOG

Like Pascal, Turbo PROLOG is a strongly typed language. Databases, user-defined domains, and predicates are declared at the beginning of the program.

The C function (or any other function to be linked in from another language) must be declared as a global predicate, and its flow pattern must be specified —

```
global predicates
   _tracker(integer,integer,integer,
   integer,integer,integer,integer,
   integer) - (i,i,i,i,o,o,o,o)
   language c
```

Our flow pattern here states that four variables of type integer will be input to the C function (i,i,i,i,...), and four variables of type integer will be output from the C function (..,o,o,o,o).

Working In Two Languages

In order to interface the C function to our PROLOG program, we need to compile them separately (of course) to .OBJ files; then link them (along with several other files) to make an .EXE file. As you might expect, you need to follow a few rules to successfully create a standalone program.

First, compile the C function with the /AL (for large memory model) and /Gs (to remove the stack probe) options on the Microsoft C compiler. Case is important; "Gs" is not the same as "GS".

Then, choose the .OBJ compiler option in Turbo PROLOG when you compile WILDCAT.PRO. This will generate an .OBJ and a .SYM file.

Next, Link in all the files you need, using the /NOD option to eliminate stack checking —

```
Link /NOD INIT+WILDCAT+TRACKER+WILDCAT.SYM,WILDC,,PROLOG
```

WILDC will be the executable file; PROLOG is PROLOG.LIB; INIT, WILDCAT, and TRACKER are .OBJ files.

And that's it. We're done (maybe).

Debugging

Since the compile, link, execute sequence is so time consuming, I opted to utilize Turbo PROLOG's quickness when it compiles to memory by not making a .OBJ file until the program was reasonably clean.

I set up dummy predicates within the program to represent the interface to the C function. The program of course didn't do exactly what I wanted it to do, but it simulated it. Good enough for debugging. The compile, run, correct, and recompile sequence took a few seconds, instead of a lot of seconds, making debugging a pleasure.

In Figure 2 (the complete program) I've left in (between comment delimiters) the dummy function TRACKER and a case predicate, case(_) which satisfies any call to case in the program.

When I wanted to test the program quickly, I commented out the global predicate declaration for TRACKER and the complex case calls. When I wanted to test the interface, I commented out the dummy predicates (and their declarations).

In addition, Turbo PROLOG has a

(continued next page)

(continued from page 25)

TRACE feature which allows you to step through the program while it's executing. Very nice!

Bye

My intention has been to give you an idea of the flexibility and power of PROLOG, in this case by using Borland's very user-friendly (and powerful) Turbo PROLOG and Microsoft's excellent C.

For more information about Turbo PROLOG contact —

Borland International
4585 Scotts Valley Dr
Scotts Valley CA 95066
(408) 438-8400

For more info about Microsoft C —

Microsoft Corp
Redmond WA
(800) 426-9400

Thanks to Mike Floyd (PROLOG tech department at Borland) for help on the interface to Microsoft C.

Figure 2 - Beginning Of PROLOG Program

```
/* Program WILDCAT */

global predicates
   _tracker(integer,integer,integer,
   integer,integer,integer,integer,integer)
   - (i,i,i,i,o,o,o,o) language c

predicates

/* _tracker(integer,integer,integer,integer,
            integer,integer,integer,integer)
*/
   rand_1_9(integer)
   case(integer)
   equal0(integer,integer,integer,
        integer,integer,integer)
   equal1(integer,integer)
   times(integer)
   setup
   continue
   main

clauses
   setup:-
        makewindow(4,7,1,""Time'',16,60,3,8),
        main.

   rand_1_9(X):-
        random(Y), X = Y * 8 + 1.

   main:-
        rand_1_9(X), nl, case(X),
        readchar(_), continue.

   continue:-
        main.

/*
   case(_) :-
        X= 1, Y = 2, Z = 3, T = 1,
        _tracker(X,Y,Z,T,A,B,C,Tt), times(Tt),
        equal0(A,B,C,A1,B1,C1),
        shiftwindow(4), cursor(1,2),write(Tt),
        readchar(_), clearwindow,
        makewindow(1,7,0,"",2,2,3,A1),
        window_attr(112), removewindow,
        makewindow(2,7,0,"",6,2,3,B1),
        window_attr(112), removewindow,
        makewindow(3,7,0,"",10,2,3,C1),
        window_attr112), removewindow.

   _tracker(X,Y,Z,T,A,B,C,Tt):-
        A=X, Y=B, Z=C, T=Tt.
*/
   case(1) :-
        X= -1, Y = 1, Z = 0, T =1,
        _tracker(X,Y,Z,T,A,B,C,Tt), times(Tt),
        equal0(A,B,C,A1,B1,C1),
        shiftwindow(4), cursor(1,2), write(Tt),
        makewindow(1,7,0,"",2,2,3,A1),
        window_attr(112), readchar(_),removewindow,
        makewindow(2,7,0,"",6,2,3,B1),
        window_attr(112), readchar(_), removewindow,
        makewindow(3,7,0,"",10,2,3,C1),
        window_attr(112), readchar(_),removewindow.
   case(2) :-
        X= -1, Y = 0, Z = 1, T =1,
        _tracker(X,Y,Z,T,A,B,C,Tt), times(Tt),
        equal0(A,B,C,A1,B1,C1),
        shiftwindow(4), cursor(1,2), write(Tt),
        makewindow(1,7,0,"",2,2,3,A1),
        window_attr(112), readchar(_),removewindow,
        makewindow(2,7,0,"",6,2,3,B1),
        window_attr(112), readchar(_), removewindow,
        makewindow(3,7,0,"",10,2,3,C1),
        window_attr(112), readchar(_),removewindow.
   case(3) :-
        X= 1, Y = -1, Z = 0, T = 1,
        _tracker(X,Y,Z,T,A,B,C,Tt), times(Tt),
        equal0(A,B,C,A1,B1,C1),
        shiftwindow(4), cursor(1,2), write(Tt),
        mak^vindow(1,7,0,"",2,2,3,A1),
        window_attr(112), readchar(_),removewindow,
        makewindow(2,7,0,"",6,2,3,B1),
        window_attr(112), readchar(_), removewindow,
        makewindow(3,7,0,"",10,2,3,C1),
        window_attr(112), readchar(_),removewindow.
```

```
case(4) :-
    X= 0, Y = -1, Z = 1, T = 1,
    _tracker(X,Y,Z,T,A,B,C,Tt), times(Tt),
    equal0(A,B,C,A1,B1,C1),
    shiftwindow(4), cursor(1,2), write(Tt),
    makewindow(1,7,0,"",2,2,3,A1),
    window_attr(112), readchar(_),removewindow,
    makewindow(2,7,0,"",6,2,3,B1),
    window_attr(112), readchar(_), removewindow,
    makewindow(3,7,0,"",10,2,3,C1),
    window_attr(112), readchar(_),removewindow.
case(5) :-
    X= 1, Y = 0, Z = -1, T =1,
    _tracker(X,Y,Z,T,A,B,C,Tt), times(Tt),
    equal0(A,B,C,A1,B1,C1),
    shiftwindow(4), cursor(1,2), write(Tt),
    makewindow(1,7,0,"",2,2,3,A1),
    window_attr(112), readchar(_),removewindow,
    makewindow(2,7,0,"",6,2,3,B1),
    window_attr(112), readchar(_), removewindow,
    makewindow(3,7,0,"",10,2,3,C1),
    window_attr(112), readchar(_),removewindow.
case(6) :-
    X= 0, Y = 1, Z = -1, T = 1,
    _tracker(X,Y,Z,T,A,B,C,Tt), times(Tt),
    equal0(A,B,C,A1,B1,C1),
    shiftwindow(4), cursor(1,2), write(Tt),
    makewindow(1,7,0,"",2,2,3,A1),
    window_attr(112), readchar(_),removewindow,
    makewindow(2,7,0,"",6,2,3,B1),
    window_attr(112), readchar(_), removewindow,
    makewindow(3,7,0,"",10,2,3,C1),
    window_attr(112), readchar(_),removewindow.

case(_):-
    X= 0, Y = 0, Z = 0, T = 1,
    _tracker(X,Y,Z,T,A,B,C,Tt), times(Tt),
    equal0(A,B,C,A1,B1,C1),
    shiftwindow(4), cursor(1,2),write(Tt),
    readchar(_), clearwindow,
    makewindow(1,7,0,"",2,2,3,A1),
    window_attr(112), removewindow,
    makewindow(2,7,0,"",6,2,3,B1),
    window_attr(112), removewindow,
    makewindow(3,7,0,"",10,2,3,C1),
    window_attr112), removewindow.

equal0(A,B,C,A1,B1,C1) :-
    equal1(A,A1), equal1(B,B1),
    equal1(C,C1).

equal1(A,A1) :-
    A>0, A1 = A.
equal1(A,A1) :-
    A<=0,A1=4.

times(Tt):-
    Tt<=50.
times(Tt):-
    Tt>50, exit.

GOAL SETUP
```

End of WILDCAT

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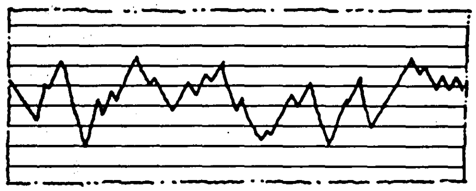
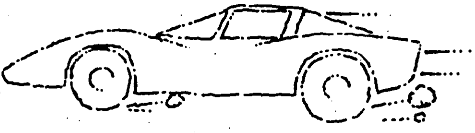
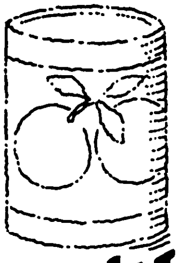
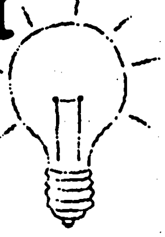
 The Navy charts new concepts with it...GM engineers the future with  it...  National Can preserves facts with it...GE has bright  ideas with it... Here's why you shouldn't be without it.

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Serial Communications Programs For CP/M And MS-DOS

By Greg Flothe
Northwest Microdesign
1010 S Whitman St #210
Tacoma WA 98465

Serial communications routines are pretty easy, once you get the hang of them. Unfortunately "getting the hang" isn't always easy. Greg wrote two serial communications programs, one for a CP/M Kaypro II, the other for a PC-compatible. This is a good example for those of you with data transfer problems.

In March of 1986, the company which publishes some of my software purchased a new Zenith Z-138 personal computer. It's a portable IBM PC-compatible with two 360K drives, 256K of RAM (which I helped them expand to the full 640K), and MS-DOS 3.0. I am very impressed with the Z-138's performance and price.

This publishing company already owned a Kaypro II with which they had generated megabytes of text and software. Unfortunately the company didn't have a disk-copying utility to convert from CP/M to MS-DOS or vice versa, so all the data was trapped in CP/M format.

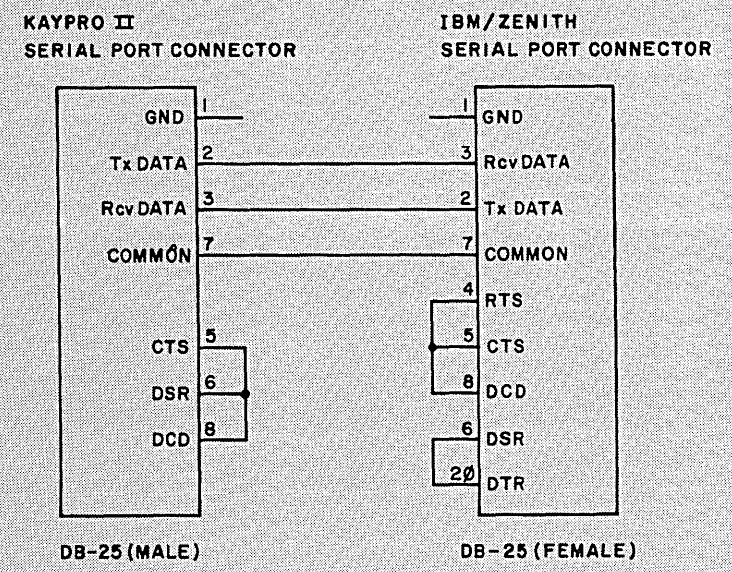
So I wrote two programs (one for each computer) so I could transfer files back and forth via the serial ports. These two programs lend themselves to a wide variety of applications (networks, bulletin boards, modems, etc.) besides basic file transfer.

The programs are written for Turbo Pascal, version 2.0 (CP/M) and version 3.0 (MS-DOS). Except for minor changes, the CP/M 80 code compiles on the MS-DOS machine (which is, incidentally, why I needed this transfer program in the first place).

How The Operation Works

The basic operation is fairly simple. Any type of file can be transferred in either direction. You have your choice of four baud rates, and data is stored on disk.

Figure 1 - Connecting The Two Computers



```
MSTRANS.PAS File Transfer Program: MS-DOS to CP/M
        Created 4/4/86 -- last edit 5/5/86
      Copyright (c) 1986 by Gregory C. Flothe
                All Rights Reserved
       Permission granted to copy for academic
           and educational purposes only.
```

```
PROGRAM Transfer;

CONST
BaudCode300=     2;
BaudCode1200=    4;
BaudCode4800=    6;
BaudCode9600=    7;
SOH=             1;
RecSize=         128;

TYPE
ModeType=        (send,receive);
regpack =    RECORD
               ax,bx,cx,dx,bp,si,di,ds,es,flags: integer;
             END;

VAR
Mode:            ModeType;
Source, Dest:    File;
Response:        Char;
RemBlks:         String[5];
FileName:        String[14];
Buffer:          ARRAY[1 .. RecSize] OF Byte;
PrintEnable,
OK,PrintOn:       Boolean;
Baud, Bytecount,
NewChar,
HighRem,StatWord,
Remaining:        Integer;
recpack:          regpack;
BaudByte,
  ah,al:          byte;

PROCEDURE LogOn;
BEGIN
  ClrScr;
  writeln('File Transfer Utility Program -- Version 1.0');
  writeln('for Zenith Z-130 and IBM PC-Compatibles');
  writeln('running under MS-DOS 3.1');
  writeln;
  writeln('Copyright (c) 1986 by Greg C. Flothe');
  writeln('All Rights Reserved');
  Delay(3000);
END;  {LogOn}

PROCEDURE InitPort;             {BaudByte contains current 3-bit Baud code}
BEGIN
  ah:= 0;                       {Init. port code -- '0' -- to high byte of AX}
  al:= BaudByte shl 5 + $03;    {Baud code, no parity, 1 stop bit, 8-bit char}
  WITH recpack DO
    BEGIN
      ax:= ah shl 8 + al;       {combine codes into AX register}
      dx:= 0;                   {DX contains serial port number}
    END;
  intr($14, recpack);           {interrupt & change serial port parameters}
  writeln('Serial Port Ready');
END;


PROCEDURE BaudRate;             {establish serial port speed with code}
VAR Baudtype: integer;
BEGIN
  writeln('Baud Rate currently at ', Baud);
  write('Change rate? '); readln(Response);
  IF UpCase(Response) = 'Y' THEN
    BEGIN
      write('Enter 1>300  2>1200  3>4800  4>9600: ');
      readln(BaudType);
      CASE BaudType OF
       1: BEGIN                 {Assign baud code constant by 1 .. 4}
            Baud:= 300;
            BaudByte:= BaudCode300;
          END;
       2: BEGIN
            Baud:= 1200;
            BaudByte:= BaudCode1200;
          END;
       3: BEGIN
            Baud:= 4800;
            BaudByte:= BaudCode4800;
          END;
       4: BEGIN
            Baud:= 9600;
            BaudByte:= BaudCode9600;
          END;
      END;
    END;  {if}
    initport;         {send Baud code to serial port}
    writeln('Baud Rate set to ',Baud,' BPS.');

END; {BaudRate}

PROCEDURE SetUpIO;     {Set Input/Output speed, flow}
BEGIN
  ClrScr;
  BaudRate;
  writeln; write('I/O MODE - ');
  CASE Mode OF
    send:     writeln('TRANSMIT');
    receive:  writeln('RECEIVE');
  END;
```

(code continued on next page)

Sending

The procedure SendHeader initiates the transfer process by sending an SOH (start of header) character (01). The transmitting machine then waits for a verifying echo.

When it receives the verification, the transmitter sends the low-order byte of the number of records to be transferred. If that byte is echoed correctly then it sends the high-order byte. When this byte is echoed properly, the transfer begins.

(Note: I used a two-byte block count so I could transmit files of up to 64K bytes. A single byte would limit me to 255 blocks (X 128 = 32K bytes).)

After the block count has been verified, I don't do any further error checking, although each block could be verified by a checksum.

There are numerous ways to handle error checking, but in a direct connect situation, errors are seldom a problem.

Receiving

The receiving system asks for a file name and then it opens the file. Procedure GetHeader then echoes the SOH, and the low and high bytes of the block count (file size).

Then it simply receives data until the number of blocks received equals the block count.

Hard Wire

These programs can easily be adapted for use with modems, although our application was hard-wired, using 25-pin 'D' connectors, one male (Kaypro) and one female (IBM, Zenith). Figure 1 shows how the two computers were connected.

Only four wires are required, although a fifth (shield wire) was also used in our case. The cable should be two twisted pairs (shielded, optionally) of solid #22 or #24 (telephone) wire. Note that one conductor from each pair ties to pin 7 (common); the other wire carries the signal.

(Editor's note: For cables under 50 feet, 3 wires should be sufficient. Just connect pin 7 to pin 7, pin 2 to pin 3, and pin 3 to pin 2.)

Be especially careful when wiring these connectors; it's easy to count the pins backwards (think of mirror im-

(continued next page)

(continued from page 31)

ages and you'll see the problem).

From the back, on the male (Kaypro) end, pin 1 is on the upper right; on the IBM/Zenith end, pin 1 is on the upper left. Plugging the connectors together may help to visualize their opposite relationship.

CPMTRANS.PAS

I started with the CP/M version because it was easier. The Kaypro II uses three ports to control serial communications: Port[0] for baud rate control, Port[4] for data input and output, and Port[5] for reading port status. Since Turbo Pascal can read and write to ports in the Port array, I declared these port addresses as constants.

Similarly, the baud rate codes are also declared constants. Any of these constants may be changed to fit the serial port address or baud rate codes of another machine, of course.

To detect a received character I test bit 0 of StatPort (Port[5]) by ANDing the byte from that port with hex 01. WaitForChar handles this task. To see if a character has been sent, we test bit 2 of StatPort by ANDing its byte with hex 04. WaitToSend does this.

If the result of the ANDing is greater than 0, then the condition is TRUE. Otherwise I stay in the loop. You can interrupt the loop (in case of an error, etc.) by pressing a key.

The byte at DataPort (Port[4]) is either our received character (IN or read operation), or transmitted character (OUT or write).

File Handling

To streamline things in file handling, I elected to use the BlockRead/BlockWrite commands, and to read each block into a buffer. The buffer is an array with a record size of 128, which is the value of constant RecSize. Procedures InBlock and OutBlock receive or send a block of buffer data from/to the serial port.

If the file is a text file, printout is suppressed from the first Ctrl-Z (end-of-file marker) onward if the last block is being transferred. That way you won't see garbage characters on the screen.

No check is made to ensure that the file to be printed is indeed printable,

MSTRANS.PAS

(continued from page 31)

```
  writeln; write('Change Mode (Y/N)? ');
  readln(Response);
  IF UpCase(Response) = 'Y' THEN
    BEGIN
      write('THIS terminal in SEND or RECEIVE mode? ');
      REPEAT
        readln(Response);
      UNTIL UpCase(Response) IN ['R','S'];
      CASE UpCase(Response) OF
       'R':  Mode:= receive;
       'S':  Mode:= send;
      END;
    END;
  writeln;
END;  {SetUpIO}

PROCEDURE TestPort(VAR StatWord: integer);
BEGIN
  REPEAT
  ah:= 3;                 {high AX = 03 -- test status code}
  WITH recpack DO
    BEGIN
      ax:= ah shl 8;
      dx:=0;              {DX register contains port number ('0' for COM1)}
    END;
  intr($14, recpack);
  WITH recpack DO
    OK:= (ax AND StatWord > 0);
  UNTIL KeyPressed OR OK;
END;  {testport}


PROCEDURE OutChar(VAR NewChar: integer);
BEGIN
  StatWord:=$2000;               {wait for xmit holding register to clear}
  TestPort(StatWord);
  ah:= 1;                        {out char. code -- '1' -- to high AX}
  al:= NewChar;                  {New Character in low AX byte}
    WITH recpack DO
       ax:= ah shl 8 + al;       {combine code with char. in AX register}
  intr($14, recpack);            {interrupt and send character to port}
END;  {outchar}


PROCEDURE InChar(VAR NewChar: Integer);
BEGIN
  StatWord:= $100;              {wait for data ready = true}
  TestPort(StatWord);
  {get char when OK}
  ah:= 2;                       {in char. code -- '2' -- to high AX}
  WITH recpack DO
    BEGIN
      ax:= ah shl 8;
      dx:= 0;
    END;
  intr($14, recpack);           {interrupt for serial port service}
  WITH recpack DO
     NewChar:= Lo(ax);          {New Char. returned in low AX byte}
END;


PROCEDURE GetHeader;
BEGIN
   REPEAT                 {wait for Start Of Header 'SOH' char.}
      InChar(NewChar);
   UNTIL KeyPressed OR (NewChar = SOH);
   OutChar(NewChar);      {echo SOH flag}
   InChar(NewChar);       {read low block count byte}
   Remaining:= NewChar;       {save lower byte}
   OutChar(Remaining);        {echo for confirmation}
   InChar(NewChar);           {get high block count}
   HighRem:=NewChar;          {save it}
   OutChar(NewChar);          {echo high count byte}
   Remaining:= HighRem shl 8  + Remaining;  {restore Remaining}
END;  {GetHeader}
```

```
PROCEDURE InBlock;
BEGIN
  Bytecount:= 1;
    WHILE Bytecount <= RecSize DO      {read a block from port}
      BEGIN
        InChar(NewChar);                  {get char}
        Buffer[Bytecount]:= NewChar;      {store it}
        OutChar(NewChar);                 {echo char}
          IF PrintOn THEN
            BEGIN
              IF ((Remaining = 1) AND (NewChar = 26)) THEN
                PrintOn:= false     {search for ^Z (EOF) to halt output}
                  ELSE
                    write(Char(NewChar));
            END;
        Bytecount:= succ(Bytecount);
     END; {while Bytecount}
END;  {InBlock}

PROCEDURE ReceiveFile;         {get a file from ser. port & store it}
BEGIN
  writeln; write('Name of file to be received? ');
  readln(FileName);
  writeln;
  IF FileName <> '' THEN
  BEGIN
    Assign(Dest, FileName);    {open file for write}
    Rewrite(Dest);
    writeln;
    write('Incoming File Ready (Y/N)? ');    {wait for cue}
    readln(Response);
    IF UpCase(Response) = 'Y' THEN
      BEGIN
        GetHeader;
        writeln;
        Str(Remaining:5,RemBlks);    {turn Remaining into a string}
        writeln('Blocks to be transferred: ', RemBlks);  {print it}
        writeln;
        PrintOn:= PrintEnable;          {send copy to screen if desired}
        WHILE Remaining > 0 DO
         BEGIN                     {Remaining is # of blocks to be read}
            InBlock;
            BlockWrite(Dest,Buffer,1);    {save complete record to disk}
            Remaining:= pred(Remaining);
         END;  {while Remaining}
       close(Dest);
       writeln;
       writeln; writeln('File ',FileName,' written to disk.');
     END;  {if Response}
   END  {if FileName <> ''}
    ELSE writeln('Aborting RECEIVE procedure.');
END;  {ReceiveFile}

PROCEDURE SendHeader;
BEGIN
  NewChar:= SOH;
  OutChar(NewChar);            {Send Start-Of-Header char.}
  REPEAT
    InChar(NewChar);
  UNTIL KeyPressed OR (NewChar = SOH);    {wait for echo}
  NewChar:= Lo(Remaining);
  OutChar(NewChar);            {Send low-order byte of Remaining}
  REPEAT
    InChar(NewChar);
  UNTIL KeyPressed OR (NewChar = Lo(Remaining));  {wait for confirm.}
  NewChar:= Hi(Remaining);
  OutChar(NewChar);            {High-order byte to serial port}
  REPEAT
    InChar(newChar);
  UNTIL KeyPressed OR (NewChar = Hi(Remaining));  {wait for confirm.}
END;  {SendHeader}

PROCEDURE OutBlock;                 {Send a block to serial port}
BEGIN
  Bytecount:= 1;
  WHILE Bytecount <= RecSize DO
```

(code continued on next page)

so be certain to switch off the print feature while transferring non-text files. Please also bear in mind that a CP/M .COM will not run on the PC (and vice versa) though they can be transferred back and forth.

MSTRANS.PAS

The same program flow was used when adapting the transfer program to the Zenith MS-DOS machine. A key difference is that the MS-DOS version uses interrupts to access the serial port. There are keyboard, video, and other interrupt services available (see Technical Reference Manual for your PC for more details, and the reference list at the end of this article).

Turbo Pascal's standard interrupt procedure relies on a typed record of 10 integers, representing the ten 16-bit registers in the 8088, in the order AX, BX, CX, DX, BP, SI, DI, DS, ES, and FLAGS. This record (recpack) becomes the second argument of the interrupt command:

```
intr(XX, recpack);
```

The XX is the interrupt vector number, which is hex 14 ($14) for the serial port routines. recpack's integers are loaded into the 8088's registers during the interrupt call.

The interrupt then selects which registers it needs. A different vector number (XX) activates a different set of service routines, so be thoroughly familiar with the interrupt scheme before fiddling with the interrupt routines in MSTRANS.

Interrupting: The Details

The code for the interrupt service routine is stored in the high byte of the AX register. This byte tells the system what to do: "0"— change port parameters; "1" — output a character; "2"— input a character; and "3" — read port status.

The port number (0) is stored in register DX. (The Zenith has only one port.) Additional ports, if installed, would be labelled (1), (2), etc. The other registers are not used, and should not be affected.

When a software interrupt ($14) is generated, the high byte of AX is read

(continued next page)

(continued from page 33)

for a service routine code. If a "0" is found there, a port parameter change is requested, and the "coding byte" in low AX is written to the serial port control byte.

Service routine "0" sets up the port parameters (speed, parity, stop bit(s), and character size).

We take our baud codes, shift them left 5 bits to positions 7, 6 and 5, and then add hex 03. Hex 03 (bits 0 - 4) tells the system that we want no parity, one stop bit, and an 8-bit character.

This baud rate (plus everything else) byte, gets stuck in the lower half of the AX register and gets sent out when the high byte of AX is 0 (that's service routine "0").

More Interruptions

Input and output with interrupts is almost the same, since all port operations are handled by interrupt 14. To test the port status (Procedure TestPort), a code of "03" is put in high AX, and the interrupt call returns with a 16-bit status word in AX which, among other things, tells if a character has been received (bit 8 set) and if a transmitted character has cleared (bit 13 set).

The OutChar procedure of MSTRANS, after testing for the (TBE) transmit buffer empty signal (ANDed with StatWord = $2000) loads the high AX byte with the "output character" code "01", puts the character in low AX, and sends it via interrupt 14.

The InChar procedure tests for a received character available signal (ANDed with StatWord = $100), then loads the high byte of AX with the "input character" code "02", and calls interrupt 14, which returns the character in the low half of AX.

The rest of the procedures are very similar to the CP/M version. Each file transfer begins with SendHeader, which sends the SOH start-of-header character, its verifying echo, and the number of blocks in two bytes. GetHeader reads those three bytes, and echoes them for verification. Once the transfer process has begun, it will continue automatically until all the blocks have been transferred.

MSTRANS.PAS

(continued from page 33)

```
      BEGIN
        NewChar:= Buffer[Bytecount];
        OutChar(NewChar);
        IF PrintOn THEN
           BEGIN
             IF ((Remaining = 1) AND (NewChar = 26)) THEN
               PrintOn:= false
               ELSE
                 write(Char(NewChar));
           END;
        InChar(NewChar);
        Bytecount:= succ(Bytecount);
      END;
END; {OutBlock}

PROCEDURE SendFile;    {get an MS-DOS file and transfer it}
BEGIN
  writeln;
  REPEAT
    writeln;
    write('Transfer from file name: ');
    readln(FileName);
    assign(Source, FileName);
        {$I-} reset(Source) {$I+};
          OK:= (IOresult=0);
          IF NOT OK THEN
              writeln('Cannot find file ',FileName);
  UNTIL (OK = true) OR (FileName = '');
  IF OK THEN
    BEGIN
      Remaining:= FileSize(Source);
      writeln; writeln('File ',FileName,' contains ',Remaining,' records.');
      writeln;
      SendHeader;
      PrintOn:= PrintEnable;
      WHILE Remaining > 0 DO    {send 1 block at a time until done}
            BEGIN
              BlockRead(Source, Buffer, 1);
              OutBlock;
              Remaining:=pred(Remaining);
            END;
      writeln;
      writeln; writeln('File ',FileName,' transferred.');
      close(Source);
    END  {if}
      ELSE
        writeln('Aborting SEND procedure.');
END; {SendFile}

BEGIN  {Transfer}            {main program begins here}
  LogOn;
  Baud:=1200;        {set up default parameters -- 1200 Baud, Receive Mode}
  BaudByte:=BaudCode1200;
  Mode:= receive;
  REPEAT
    SetUpIo;
      REPEAT
        writeln('If this is a TEXT file, would you like the file');
        write('displayed on the screen? ');
        readln(Response);
        IF UpCase(Response) = 'N' THEN
        PrintEnable:= false           {disable/enable screen output}
          ELSE
            PrintEnable:= true;
       IF Mode = send THEN
          SendFile
           ELSE ReceiveFile;
        writeln;
        write('Transfer another file (Y/N)? ');
        readln(Response);
      UNTIL UpCase(Response) = 'N';
      write('Change Parameters, (<N> to exit)? ');
      readln(Response);
  UNTIL UpCase(Response) = 'N';
  writeln;writeln('TRANSFER program done.');
END. {Transfer}
```

End of MSTRANS.PAS

```
          CPMTRANS.PAS File Transfer Program: CP/M to MS-DOS
              Created 4/1/86 -- last edit 5/22/86
            Copyright (c) 1986 by Gregory C. Flothe
                     All Rights Reserved
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                 and educational purposes only.
```

```
PROGRAM Transfer;
CONST
  RatePort=         0;          {Baud rate port address}
  DataPort=         4;          {Serial port data registers}
  StatPort=         6;          {Status register address}
  BaudCode300=      5;          {Codes for baud rate port}
  BaudCode1200=     7;
  BaudCode4800=     $0C;
  BaudCode9600=     $0E;
  SOH=              1;          {Start-Of-Header character}
  RecSize=          128;        {# of records in a block}

TYPE
  ModeType=         (send, receive);

VAR
  Mode:             ModeType;
  Source, Dest:     File;
  Response:         Char;
  RemBlks:          String[5];
  FileName:         String[14];
  Buffer:           ARRAY[1 .. RecSize] OF Byte;
  PrintEnable, OK,
  PrintOn:          Boolean;
  BufByte:          Byte;
  Baud, Bytecount,
  HighRem,
  Remaining:        Integer;

PROCEDURE LogOn;
BEGIN
  ClrScr;
  writeln('File Transfer Utility Program -- Version 1.0');
  writeln('for KayPro II running under CP/M 2.2');
  writeln('Copyright (c) 1986 by Greg C. Flothe');
  writeln('All Rights Reserved');
  Delay(3000);
END;  {LogOn}

PROCEDURE BaudRate;       {adjusts port speed with baud code byte}
VAR Baudtype: integer;
BEGIN
  writeln('Baud Rate currently at ', Baud);
  write('Change rate? '); readln(Response);
  IF UpCase(Response) = 'Y' THEN
    BEGIN
      write('Enter 1>300  2>1200  3>4800  4>9600: ');
      readln(BaudType);
      CASE BaudType OF      {Baud code sent to RatePort}
       1: BEGIN
           Baud:= 300;
           Port[RatePort]:= BaudCode300;
          END;
       2: BEGIN
           Baud:= 1200;
           Port[RatePort]:= BaudCode1200;
          END;
       3: BEGIN
           Baud:= 4800;
           Port[RatePort]:= BaudCode4800;
          END;
       4: BEGIN
           Baud:= 9600;
           Port[RatePort]:= BaudCode9600;
          END;
      END;
      writeln('Baud Rate set to ',Baud,' BPS.');
    END;  {if}
END; {BaudRate}
```

(code continued on page 37)

I hope this information has introduced the basics of serial communications to those of you who are curious or might like to try it yourself.

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■ ■ ■

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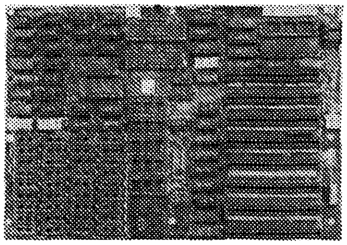

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CPMTRANS.PAS *(continued from page 35)*

```
PROCEDURE SetUpIO;      {change input/output parameters}
BEGIN
  ClrScr;
  BaudRate;
  writeln; write('I/O MODE - ');
  CASE Mode OF
    send:    writeln('TRANSMIT');
    receive: writeln('RECEIVE');
   END;
  writeln; write('Change Mode (Y/N)? ');
  readln(Response);
  IF UpCase(Response) = 'Y' THEN
    BEGIN
      write('THIS terminal in SEND or RECEIVE mode? ');
      REPEAT
        readln(Response);
      UNTIL UpCase(Response) IN ['R','S'];
      CASE UpCase(Response) OF
        'R':  Mode:= receive;
        'S':  Mode:= send;
      END; {case}
    END;
  writeln;
END;  {SetUpIO}

PROCEDURE WaitForChar;
BEGIN
  REPEAT
    OK:= (Port[StatPort] AND $01) = 1;  {wait for char.}
  UNTIL KeyPressed OR OK;
END;  {WaitForChar}

PROCEDURE WaitToSend;
BEGIN
  REPEAT
    OK:= (Port[StatPort] AND $04 > 0);  {ok to transmit?}
  UNTIL KeyPressed OR OK;
END; {WaitToSend}

PROCEDURE InBlock;     {read a block from serial port}
BEGIN
  Bytecount:= 1;
    WHILE Bytecount <= RecSize DO
      BEGIN
        WaitForChar;
        Buffer[Bytecount]:= Port[DataPort];   {read char. from port}
        WaitToSend;
        Port[DataPort]:= Buffer[Bytecount];   {echo character to port}
          IF PrintOn THEN
            BEGIN
              IF ((Remaining = 1) AND (Buffer[Bytecount] = 26)) THEN
                PrintOn:= false     {search for ^Z (EOF) to halt output}
                  ELSE
                    write(Char(Buffer[Bytecount]));
            END;
        Bytecount:= succ(Bytecount);  {increment byte pointer}
      END; {while bytecount}
END;  {InBlock}

PROCEDURE GetHeader;  {Set up incoming file for transfer}
BEGIN
  REPEAT
  UNTIL KeyPressed OR (Port[DataPort] = SOH); {test for SOH character}
  Port[DataPort]:= SOH;
  WaitForChar;
  Remaining:= Port[DataPort];  {read low remaining record count}
  Port[DataPort]:=  Remaining; {echo it}
  WaitForChar;
  HighRem:= Port[DataPort];    {read high remaining rec. count}
  Remaining:= HighRem shl 8 + Remaining; {re-join low & high bytes}
  Port[DataPort]:= Hi(Remaining); {echo high byte of record count}
END; {GetHeader}

PROCEDURE ReceiveFile;  {read a file from serial port and write to disk}
BEGIN
  writeln;
  write('Name of file to be received? ');
```

(code continued on next page)

CPMTRANS.PAS *(continued from page 37)*

```
  readln(FileName);
  writeln;
  IF FileName <> '' THEN
  BEGIN
    assign(Dest,FileName);
    Rewrite(Dest);
    write('Incoming file ready? ');    {wait for ready signal}
    readln(Response);
    IF UpCase(Response) = 'Y' THEN
     BEGIN
      GetHeader;   {Wait for SOH char., read # of blocks remaining}
      writeln;
      Str(Remaining:5,RemBlks); {convert Remaining to 5-digit string}
      writeln('Blocks to be transferred: ',RemBlks);
      writeln;
      PrintOn:= PrintEnable;     {turn on display if enabled}
      WHILE Remaining > 0 DO
      BEGIN         {read Remaining # of blocks until done}
        InBlock;
        BlockWrite(Dest,Buffer,1);    {write to new file on disk}
        Remaining:= pred(Remaining);
      END;  {while remaining}
      close(Dest);
      writeln;
      writeln('File ',FileName,' written to disk.');
    END;  {if}
  END
    ELSE writeln('Aborting RECEIVE procedure.');
END;  {ReceiveFile}

PROCEDURE OutBlock;      {send a block of data to serial port}
BEGIN
  Bytecount:= 1;
  WHILE Bytecount <= RecSize DO
      BEGIN
        WaitToSend;
        Port[DataPort]:= Buffer[Bytecount];     {send byte}
        WaitForChar;
        BufByte:= Port[DataPort];               {read echoed character}
        IF PrintOn THEN
           BEGIN
             IF ((Remaining = 1) AND (BufByte = 26)) THEN
               PrintOn:= false       {test for ^Z (EOF character)}
               ELSE
                 write(Char(BufByte));
           END;
        Bytecount:= succ(Bytecount);
      END;
END; {OutBlock}

PROCEDURE SendHeader;
BEGIN
  Remaining:= FileSize(Source);    {get # of records to transmit}
  writeln; writeln('File ',FileName,' contains ',Remaining,' records.');
  Port[DataPort]:= SOH;     {send start-of-header}
  REPEAT
  UNTIL KeyPressed OR (Port[DataPort] = SOH);     {wait for echo}
  Port[DataPort]:= Lo(Remaining);  {send low block count}
  REPEAT
  UNTIL KeyPressed OR (Port[DataPort] = Lo(Remaining));  {wait for verify}
  Port[DataPort]:= Hi(Remaining);  {send high block count}
  REPEAT
  UNTIL KeyPressed OR (Port[DataPort] = Hi(Remaining));  {wait for verify}
END;  {SendHeader}

PROCEDURE SendFile;          {send file to serial port}
BEGIN
  writeln;
  REPEAT
    writeln;
    write('Transfer from file name: ');
    readln(FileName);
    assign(Source, FileName);
        {$I-} reset(source) {$I+};
          OK:= (IOresult=0);
          IF NOT OK THEN
              writeln('Cannot find file ',FileName);
  UNTIL (OK = true) OR (FileName = '');
  IF OK THEN
    BEGIN
      SendHeader;
      PrintOn:= PrintEnable;      {turn on screen display}
      WHILE Remaining > 0 DO
            BEGIN
              BlockRead(Source, Buffer, 1);  {get a block from disk}
              OutBlock;                      {send it to serial port}
              Remaining:=pred(Remaining);    {until Remaining = 0}
            END;
      writeln; writeln('File ',FileName,' transferred.');
      close(Source);
    END {if}
      ELSE
        writeln('Aborting SEND procedure.');
END; {SendFile}

BEGIN {Transfer}          {main program begins here}
  Baud:= 1200;
  Port[RatePort]:= BaudCode1200;  {set up 1200 baud rate, receive mode}
  Mode:= receive;     {Default Mode = receive}
  LogOn;
  REPEAT
    SetUpIo;
      REPEAT
        writeln('If this is a TEXT file, would you like the file');
        write('displayed on the screen? ');
        readln(Response);
        IF UpCase(Response) = 'N' THEN
        PrintEnable:= false          {disable/enable screen output}
          ELSE
            PrintEnable:= true;
        IF Mode = send THEN
          SendFile
           ELSE ReceiveFile;
        writeln;
        write('Transfer another file (Y/N)? ');
        readln(Response);
      UNTIL UpCase(Response) = 'N';
      write('Change Parameters, (<N> to exit)? ');
      readln(Response);
  UNTIL UpCase(Response) = 'N';
  writeln;writeln('TRANSFER program done.');
END. {Transfer}
```

End of CPMTRANS.PAS

By Laine Stump
Development Foundation of Turkey
Tunali Hilmi Cad. 22
Ankara Turkey

Running Programs From Other Programs

Laine's back to his balcony and Turkish cherry juice. Laid back, feet propped up, he relaxes from the tribulations of his far eastern trip with a detailed description of how to call a program from within another program. Light and easy reading, this isn't — but interesting reading, this is.

I find it convenient, if not necessary, to execute one program while within another. I have two uses for external execution. The first is to call a program from a "mother" program to help mother do its job. The second is to temporarily escape what I'm doing to run another (possibly unrelated) program.

An example of each:

1. I have a backup program (I call FORMAT) that has to erase all the files on a backup disk before backing up files.
2. From the command line of the EXPRESS editor I let the user execute any DOS command. (Just type "!command")

These are two very different reasons for executing external programs, but both can be handled by a single routine.

Turbo Pascal

I've written this subroutine for three languages on two operating systems (see Micro C #28 for the Pascal CCP/M-86 version), but the first language I wrote it in was Pascal. After looking in the Turbo Pascal manual you'll probably say, "But why did you do that? Turbo already has an 'Execute' procedure, you dipstick." Sure it does, but read the fine print. It only executes other TURBO programs, you can't pass command line parameters, and it doesn't CALL the new program, it JUMPs to it. Yuch.

Calling Exec

Now that we have justification, what do we have to do? First, how do we want to call it? The simplest way would be like this:

```
ErrNum := Exec(CommandLine);
```

where CommandLine is any string and Errnum is an integer that returns a success/failure indication. So, given a command string, how do we execute it? We need to send the command string to DOS function 4Bh, "Execute Program". The way to do this in Turbo Pascal is with the built-in "MsDos()" procedure. We'll just put pointers to the command line (and a few other things explained in a minute) in software registers (actually a record of type REGISTER) and execute "MsDos(reg)". Simple enough.

What MS-DOS Needs

If you look up function 4Bh in your DOS Programmer's Manual (you have been looking at your manual, haven't you?) you'll see that DOS wants two pointers (in registers DS:DX and ES:BX). The first they call the "path" of the command, and the second is a parameter block. The PATH is actually the command that you want to execute. The parameter block contains a pointer to the "command line trailer," default FCBs for the trailer, and an

Figure 2 - TESTEXEC.PAS

```
{---------------- test program for Exec -----------------}
PROGRAM TestExec;

{$I PASEXEC.INC }

CONST Command : Array [1..5] of STRING128
                = ('dir/w','chkdsk','e','set','debug');

VAR Choice : CHAR; ct, ErrNum : INTEGER;

begin
REPEAT
    FOR ct := 1 to 5 DO
        writeln(ct,') ',Command[ct]);
    writeln; write('Enter your choice or <ESC> to quit: ');
    REPEAT
        read(kbd,Choice);
        UNTIL (Choice in ['1'..'5',^[]);
    IF (Choice <> ^[) THEN
        begin
        writeln(Command[ord(Choice)-ord('0')]);
        ErrNum := Exec(Command[ord(Choice)-ord('0')]);
        IF (ErrNum <> 0) THEN
            writeln ('Error #',ErrNum);
        end;    { choice <> escape }
    UNTIL (Choice = ^[);
writeln('Goodbye');
end.    { TestExec }
```

Figure 1 - PASEXEC.INC

```
{------------------------------------------------------------}
{                    Pascal version of Exec                   }
{------------------------------------------------------------}

TYPE
    string20  = STRING[20];
    string128 = STRING[128];

   Registers = RECORD
    CASE integer OF
        1:(AX,BX,CX,DX,BP,SI,DI,DS,ES,Flags : INTEGER);
        2:(AL,AH,BL,BH,CL,CH,DL,DH : BYTE);
        end;    { BDOSRegisters }

CONST
    CARRY = $0001;

FUNCTION Exec (Command : string128) : INTEGER;

TYPE
    ExecPacketRec = RECORD
        EnvironmentSeg : INTEGER;
        CommandPtr,
        FCB1,
        FCB2           : ^CHAR;
        end;    { ExecPacketRec }

VAR reg      : Registers;
    ComFile  : String20;
    ExecPack : ExecPacketRec;

    begin
    ComFile := '\command.com'+chr(0); { execute command.com }
    IF (length(command) > 0) THEN    { sending it this line }
        Insert ('/c ',command,1);    { put 'c' option for
                                       command.com }
    command[length(command)+1] := ^M; { line terminated
                                        with CR }

    ExecPack.EnvironmentSeg := $0000; { use parent's
                                        environment }
    ExecPack.CommandPtr := Ptr(seg(Command),ofs(Command));
    ExecPack.FCB1 := Ptr(0,0);
    ExecPack.FCB2 := Ptr(0,0);

    reg.DS := seg(ComFile[1]);  reg.DX := ofs(ComFile[1]);
    reg.ES := seg(ExecPack);    reg.BX := ofs(ExecPack);

    reg.AH := $4B;                       { Exec system call }
    reg.AL := $00;          { 'load and execute' subfunction }
    MSDOS (reg);                     { execute the process }
    IF ((reg.Flags and CARRY) = 0) THEN
        Exec := 0
    ELSE
        Exec := reg.AX;
    end;  { Exec }
```

"environment pointer." A diagram would ease the confusion a bit: ('—>' means 'is a pointer to')

```
AH     4Bh  Exec function call
AL      0   means 'load and execute'

DS:DX  -->
  name of command to execute

ES:BX  -->
  aa     (word) --> segment
                    of environment
  bb:bb (dword)--> command trailer
  cc:cc (dword)--> first default FCB
  dd:dd (dword)--> second default FCB
```

Break Time

I was just thinking about how wonderful life can be sometimes. I mean, here I am typing away on this column. One year ago I would have been in some hot sweaty room somewhere; 10 years ago I would have been using a typewriter; instead, here I am lying on a balcony on a couple of cushions listening to Rick James and drinking cherry juice with my little Toshiba T1100 portable PC on my lap and my toes wiggling in the Anatolian sunshine. My oh my....

Just figured out why the writing still isn't going so great. It's all that damn cherry juice. Just switched to Efes Pilsen and Little Stevie Wonder.

A note added later: know what wiggling my toes in the sunshine got me? One sunburned foot, that's what. The other one was in the shade.

Back At The Ranch

The way Microsoft has set up function 4Bh we could actually execute the program by grabbing the first name out of the command line and putting it in the PATH string, then parsing out the two FCBs and the command trailer. However, there are a few complications with doing it this way.

1. You have to parse the filenames in the command trailer and put them into FCB format yourself.
2. Since the PATH must have filename AND extension, you have to retry the Exec with EXE if COM doesn't work.
3. You must do BAT file processing yourself if it's to be done at all.
4. You don't have access to commands that are internal to COMMAND.COM.

(continued next page)

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5. You have to handle IO redirection yourself.

To make life easier, I've adopted the method of always using COMMAND.COM as the PATH. This way my Exec procedure is much less cluttered, I can execute BAT files, I don't have to parse the FCBs (COMMAND doesn't use the default FCBs), IO redirection is automatic, and I can use all the commands internal to COMMAND (like TYPE, DIR, etc.).

Using COMMAND.COM has its drawbacks, too. The most serious is that calling up COMMAND.COM an extra time uses about 15K more memory and extra disk access time. Also, you must always have a disk with COMMAND.COM in the drive. Since most of us have 640K anyway, I don't think the 15K extra is much problem, and the extra loading time isn't noticed at all if you have a winchester or a small RAM disk. Always having COMMAND.COM on the system is likewise no problem if you have a winchester or use a RAM disk program.

So, after all my confused explanation, here's the plan for what we give MS-DOS: send "¢COMMAND.COM" as the PATH, send the entire command line as the COMMAND, don't bother with the two FCB pointers, and send 0000 as the environment pointer (this says "use parent's environment").

Before we get all hot headed and spit out the code though, there are a couple details that need recognition:

1. The PATH string is a "C-style" 0 terminated string, not a Pascal string.

2. The COMMAND string is a Pascal string with an added Carriage Return (^M) at the end. We'll have to add the 0 and the ^M to the ends of the strings and send the address of PATH[1] instead of just PATH.

And Finally The Code

See Figure 1 for the Pascal procedure (actually it's a FUNCTION, so it can return an error code). It's a general purpose Exec for MS-DOS. I've been using this function for about six months now and I really can't imagine living without it. Things like menus and shell escapes just seem to flow off

Figure 3 - ASMEXEC.ASM

```
;---- EXEC - execute command line in string pointed to SI ---
;
;       Assembly Language version for MSDOS and Microsoft MASM
;
;       TO ASSEMBLE:    MASM ASMEXEC
;
;       TO LINK:        LINK/c:xxxx program+ASMEXEC
;               where xxxx is the # of paragraphs of extra
;               free memory your program will need.
;
;               If you want to make a COM file, also do:
;                       EXE2BIN program
;                       REN program.bin program.com
;
;       TO CALL:        MOV     SI,offset CommandString
;                       CALL    EXEC
;               where CommandString is a string in 'Pascal'
;               format(i.e. byte length followed by the chars)
;
;       On return, if CARRY is not set, AX will contain the
;       return code of the called program, if CARRY is set,
;       AX will conatin an error number corresponding to the
;       list in the MSDOS programmer's manual under function
;       call 4Bh
;
;       COMMAND.COM is assumed to be present in the
;       \ directory of the current default drive. Stay tuned
;       for a more general method using the environment
;       variable COMSPEC next issue.
;
CODE    segment byte public 'CODE'
        public  EXEC
        assume  cs:code

DEFPATH DB      '\command.com',0
PATH    equ     this    dword
    PATHOFS     DW      ?
    PATHSEG     DW      ?

COMMAND DB      0,'/c '
        DB      60 dup (?)

PARMS   DW      0,0,0,0,0,0,0
    comofs      equ     word ptr 2
    comseg      equ     word ptr 4

EXEC    PROC    NEAR

        PUBLIC  EXEC

        PUSH    BX
        PUSH    CX                      ;save all registers
        PUSH    DX
        PUSH    SI
        PUSH    DI
        PUSH    BP
        PUSH    ES
        PUSH    DS
        MOV     CX,CS           ;set up touse locals in CSEG
        MOV     DS,CX
        assume  ds:code

        CALL    FINDCOMSPEC     ;to be defined next issue

        MOV     CX,DS           ;set up the pointers
                                ;MSDOS wants
        MOV     ES,CX
        MOV     BX,offset PARMS
        MOV     comofs[BX],offset COMMAND
        MOV     comseg[BX],DS

        MOV     DI,offset COMMAND
        MOV     byte ptr [DI],0 ;initially assume ''
                                ;(blank string)

        MOV     CL,[SI]         ;length of string
        INC     SI
        XOR     CH,CH
        JCXZ    EXEC2           ;if string is blank
                                ;then bypass

        MOV     AL,CL
        ADD     AL,3            ;put length with extra
                                ;for '/c '
        STOSB

        ADD     DI,3            ;the '/c ' is already there
        REP MOVSB               ;move the rest

        MOV     AX,0Dh
        STOSB                   ;CR for good measure

EXEC2:  LDS     DX,PATH         ;get ptr to 'PATH'
        MOV     AX,4B00h        ;Load & Execute function call
        INT     21h
        JC      EXEC9           ;IF error then leave it in AX
                                ;for ERRNO

        MOV     AH,4Dh          ;ELSE wait for return code
        INT     21h
        OR      AX,AX           ;make sure carry is reset
EXEC9:  POP     DS
        POP     ES
        POP     BP
        POP     DI              ;unsave everything
        POP     SI
        POP     DX
        POP     CX
        POP     BX
        RET
FINDCOMSPEC:
        MOV     PATHOFS,offset DEFPATH  ;just use default
                                        ;for now
        MOV     PATHSEG,DS
        RET

EXEC    endp
CODE    ends
```

the fingertips now that I have this tool. See Figure 2 for an example program that uses the Exec procedure.

The way Exec has been written, it will execute any single command it receives. If you send it a null string ('') it will "escape" temporarily to a new copy of COMMAND.COM that you can use until you give the "exit" command. A definite whistle for any program.

A Final Detail

One thing that hasn't been mentioned until now is Exec's need for "free" memory. What this means is that when Exec is called, there must be a sufficient amount of memory in the machine that has not been allocated to the currently running program. It just happens that if you don't tell Turbo any different, it will keep ALL of the available memory for itself and you'll get a big fat error when you try an Exec. This problem is easily solved with the m<A>ximum free memory setting in the compiler <O>ptions menu of Turbo. For most simple programs I can set it down to about 800, but you may have to put it at 1000 or higher for some large applications. But it should be at least low enough that it leaves enough memory for any programs you'll call from the program you're compiling (and for any programs that the programs may call, and ...)

Even if you write programs that don't use Exec you should set the free memory anyway, just in case you happen to be using the program with some multiwindow add-on or other schizo type of program. Politeness Man says: "Take only what you can use. And don't spit in your napkin again or I'll slap you."

Second Verse, Same As The First

Since I do at least as much programming in Assembly as in Pascal, I also have the same little trick sitting around for Assembly language. Most all of the same ideas and thoughts hold for the Assembly language version as the Pascal, just a bit of difference in the way of making sure enough memory is allocated.

(continued next page)

(continued from page 43)

Calling Exec In Assembly

The method for calling Exec in Assembly will be to put the address of the command line into registers DS:SI and call Exec:

```
MOV     SI,offset COMMAND
CALL    EXEC
```

On return, the error code will be in the AX register. Features and internal operation are otherwise exactly the same as the Pascal version.

Exec for Assembly language is in Figure 3. One little uniqueness of the code is that it can be linked with full fledged EXE files as well as COM files. This is possible because I put all the local storage for Exec in the CODE segment, save DS (data segment pointer) on entry, move CS (code segment pointer) to DS while Exec is active, and restore DS before exiting. I did this mainly because I like to make COM files as much as possible; they're much smaller. If you'll be doing only EXE files then you should put the data in a separate segment (called DATA maybe?).

LINK Segments

While I'm on the subject of segment names, I should mention the SEGMENT directives in both Exec and the test program. You'll notice first that both SEGMENT directives are exactly the same; this is the only way you can have both sections of code in the same segment (unless you associate the segments with the GROUP directive). Since Exec is declared as a NEAR procedure, it MUST be in the same segment as the main program. Of course, if your program were really huge, you could change it to a FAR procedure and put it in another segment.

Also note the use of PUBLIC in the SEGMENT directive. If you don't declare the two CODE segments as PUBLIC, the code of Exec will be assembled with origin 0 (since it has no ORG statement). This is no problem for the code since 8086 code is all totally relocatable (except FAR jumps and calls). The problem is the data in the segment; all references to the data addresses will be wrong! (I.e., references to code are all relative, but direct references to data are absolute within the current segment.) I spent about an hour on this one (why am I executing the bottom of the base page instead of COMMAND.COM?), but there's no reason you should, so just use PUBLIC and shut up. Okay????

Figure 4 - TEXTEXEC.ASM

```
;
;       TESTEXEC.ASM - test the exec procedure
;
        EXTRN   EXEC:NEAR

Code    segment byte public 'CODE'
        assume  cs:code,ds:code
TESTEXEC:
        MOV     BX,800h ;request 32k even though we'll
                        ;never need it
        MOV     AH,4Ah  ;actually we are 'freeing'
                        ;all but 32k
        INT     21h

        MOV     SI,80h  ;execute the command trailer
        CALL    EXEC    ;in the base page (CS:80h)

        MOV     AH,4Ch  ;(since this is a COM, CS==DS)
        INT     21h
Code    ENDS

        end     TESTEXEC
```

Taking Care Of Memory

If you're assembling to a COM file you'll have to add the following lines to the beginning of your program to free up extra memory:

```
MOV     BX,xxxxh
MOV     AH,4Ah
INT     21h
```

where xxxx is the total number of paragraphs of memory your program will use for data and code (a paragraph is 16 bytes). See the example in Figure 4.

If you're assembling to an EXE file then you can't release memory already allocated to your program; you'll have to make sure it's never allocated. Do this by using the /c option when you're linking something like the following:

```
LINK/c:1 program+ASMEXEC
```

The /C:1 option keeps one paragraph of extra memory BEYOND declared data for the calling program and frees the rest. For your program you may need to increase the number of paragraphs.

(Note: the /c option is only on Microsoft LINK v3.0 and above. It DOES NOT WORK on the old version 1.0 LINK included with MS-DOS 2.11 and older versions of MASM.)

Figure 5 - TESTEXEC.BAS

```
 5 DEFINT E
10 PRINT "Trying to run E.COM"
20 CALL EXTEXEC("E TEST.BAS",E)
30 PRINT "Returned from EXEC, ";
40 PRINT "ErrCode=";E
50 END
```

And Yet Another Exec

While I'm showing Execs for different languages I may as well show one for (shudder) Microsoft Compiled BASIC. Really, I swear I didn't write this one for myself. It was done because of a "request turned to dare." The only program I've used it with is the test program in Figure 5.

(continued on page 46)

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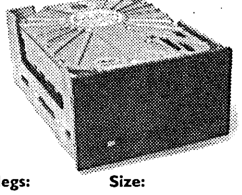

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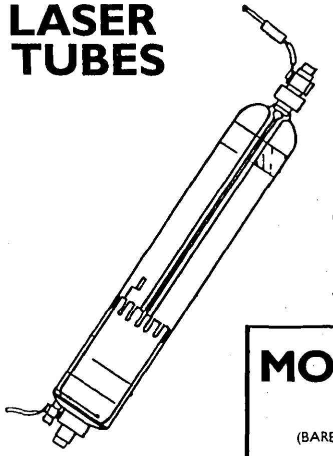

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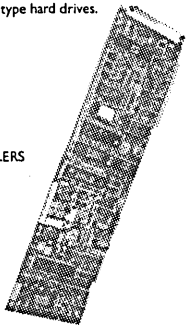

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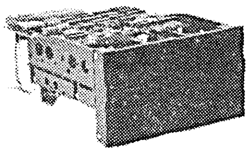

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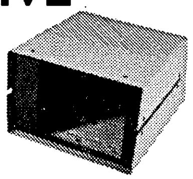

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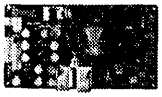

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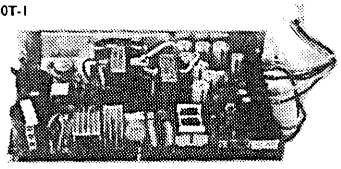

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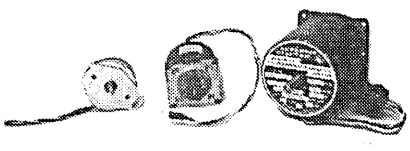

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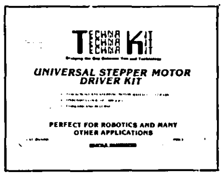

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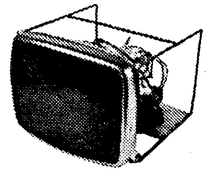

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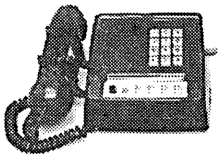

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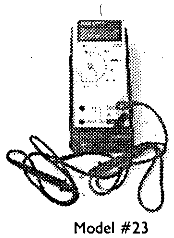

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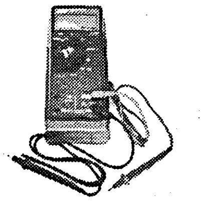

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(continued from page 44)

If you really want to know about the internals of calling Assembly language from BASIC then I suggest you read the manual because I don't have the patience to go through that hell again. Just be warned that the BASIC manual not only has typos, it has blatant, obnoxious misrepresentations too. Otherwise see Figure 6 for the BASIC version of Exec.

To use the BASIC version, you must assemble it with MASM and then link it with your BASIC object module with the following LINK statement:

```
LINK/c:1800    program+BASEXEC
```

Don't ask ME why BASIC needs 92K (1800h paragraphs) of extra free memory. It just DOES.

Other high level languages (especially Microsoft's) should use routines similar to BASIC's (i.e., passing the parameters on the stack), although the reasons behind their respective parameter passing methods will probably be less obscure.

Enough Is Enough Is Enough

Well, TRT (Turkish Radio and Television) is finished with the traditional music now and going on to European avant-garde jazz so I guess that's as good an excuse as any to stop shooting off my mouth and finish this up. Hopefully somebody somewhere will get some use out of my little contributions, otherwise at least I can be happy knowing that I have.

As DEVO once said: "Take this, brother, and may it serve you well."

Next Time: "Home, Home on the Range" and other topics in environmental awareness. See you at SOG.

■ ■ ■

Figure 6 - BASIC Version Of EXEC

```
;---- BASEXEC - execute command line in string
;               pointed to by stack
;
;       This routine is expected to interface with
;       Microsoft Compiled BASIC
;       calling conventions
;
;       Currently it is assumed that the system has
;       a drive C available (usually a winchester) that
;       contains COMMAND.COM in the \ directory.
;
;       CALL FROM BASIC:
;               CALL   EXTEXEC(CommandString,ErrCode)
;
;       where CommandString is a string & ErrCode is INTEGER;
;
;       On return, ErrCode will be 0 if everything went ok,
;       otherwise it will correspond to the error codes
;       documented in the MSDOS
;       programmer's manual under function call 4Bh
;
;       LINK PROCEDURE:
;               LINK/c:1800 program+BASEXEC
;
;       On entry to EXTEXEC, immediately after pushing BP,
;       the stack looks like the following:
;
;       +-----------+-----------+
;       +  ptr to CommandString  +   <--- SP+8  <--- BP+8
;       +-----------+-----------+
;       +     ptr to ErrCode     +   <--- SP+6  <--- BP+6
;       +-----------+-----------+
;       +     Return Segment     +   <--- SP+4  <--- BP+4
;       +-----------+-----------+
;       +     Return Offset      +   <--- SP+2  <--- BP+2
;       +-----------+-----------+
;       +          B P           +   <--- SP    <--- BP
;       +-----------+-----------+
;
CONST   segment byte public 'CONST'
CONST   ends

DATA    segment word public 'DATA'
DATA    ends

DGROUP  group   DATA,CONST

CODE    segment byte public 'CODE'
        public  EXTEXEC
        assume  cs:code, ds:dgroup

EXTEXEC PROC    FAR
        JMP     short EXTEXEC1

PATH    DB      'c:\command.com',0
COMMAND DB      0,'/c '
        DB      60 dup (?)
```

```
PARMS   DW      0,0,0,0,0,0,0
   comofs       equ     word ptr 2
   comseg       equ     word ptr 4

EXTEXEC1:
        PUSH    BP      ;BASCOM expects BP to be undamaged
        MOV     BP,SP   ;set up to allow accessing parameters
                        ; on the stack
        PUSH    ES

        MOV     DX,offset PATH
        MOV     BX,offset PARMS
        MOV     CS:comofs[BX],offset COMMAND
        MOV     CS:comseg[BX],CS

        MOV     CX,CS
        MOV     ES,CX
        MOV     DI,offset COMMAND       ;initially assume ''
                                        ; (blank string)
        MOV     CS:byte ptr [DI],0

        MOV     SI,8[BP]                ;ptr to string
                                        ;'descriptor'
        MOV     CX,[SI]                 ;length of string
        MOV     SI,[SI+2]               ;ptr to string
        JCXZ    EXTEXEC2                ;if string is blank
                                        ;then bypass

        MOV     AL,CL
        ADD     AL,3            ;put length with extra
                                ;for '/c '
        STOSB

        ADD     DI,3            ;the '/c ' is already there
        REP MOVSB               ;move the rest

        MOV     AX,000Dh
        STOSB                   ;CR, null for good measure
EXTEXEC2:
        PUSH    DS              ;point DS to CS as well
        MOV     CX,CS
        MOV     DS,CX
        MOV     AX,4B00h        ;Load & Execute function call
        INT     21h
        POP     DS
        JC      EXTEXEC9        ;IF error then leave it in
                                ;AX for ERRNO

        MOV     AH,4Dh          ;ELSE wait for return code
        INT     21h
        XOR     AX,AX           ;return 'no error' code
EXTEXEC9:
        MOV     SI,6[BP]        ;ptr to  ERRNO
        MOV     [SI],AX         ;store error code
        POP     ES
        POP     BP
        RET     4               ;get rid of 2 parameters
                                ;and return

EXTEXEC ENDP
CODE    ends
```

ON YOUR OWN

By David Thompson

Clipper, A Fast Solution To dBASE

A database lies at the heart of nearly every business related application, and for years the most popular database language has been dBASE II. So, it's not unusual to run into someone who wants a dBASE II (or dBASE III) system upgraded. I was faced with such a project recently and I learned a lot.

Two weeks before copy deadline for issue #30 the old BBII in the mailroom started showing signs of senility. That's the system we use for our mailing list (it's the only CP/M machine with a large enough winnie), so its health is critical.

I can't say it didn't give us some warning. Six months ago the BBII suddenly refused to run any submit type programs (EX14, Supersub...). That was irritating (and we never figured out why) but we learned to live with it.

Two weeks ago it died right in the middle of data entry. Cary paged me and I spent an hour or so finding out which files had been corrupted (hadn't been closed) and another four or five hours recovering as much as I could. (Cary would reenter the rest.)

After it quit two days in a row (we've never had a convenient way to back up the files on the winnie — which meant we lived dangerously), I decided I had to make the leap. I had to move all the dBASE II files onto a clone and run them under something. Hopefully that something would be faster and more dependable than dBASE II.

Clipper

At Comdex, Sandy saw a new version of Champion (a gigantic accounting package written in dBASE). It turned out that the new Champion wasn't running under dBASE any longer. Oh, the source code was pretty much the same, but it had been compiled by Clipper. The difference in performance was impressive.

Well, knowing how fussy these guys are about their program, and how much effort they had put into making dBASE work (wrote their own runtime package for dBASE II), I figured that if they liked Clipper then I probably ought to take a look at it.

So, a few months ago I got ahold of the Clipper folks and asked for a review copy. They sent version 1.0. (It turned out that the timing was great.)

Back At The Office

So I was faced with a dying BBII and an untried Clipper compiler. I could kill two birds with one stone, but I had to do it quickly. Orders weren't getting out because Cary couldn't make receipts, and Becky was trotting about the office clutching her calendar lest someone (I) might forget that May 1 was a typesetting deadline.

I started futzing over the files, and since I hadn't purchased dBASE III I knew I was facing a challenge. (dBASE III comes with a routine that translates dBASE II source into III.) Clipper only understands dBASE III syntax.

A trip to the bookstore turned up "Understanding and Using dBASE II & III" by Rob Krumm. I figured any book that dealt with both languages side by side would help me translate my code over from II to III. Boy, was I wrong. Within hours I was back at the bookstore.

I looked more closely this time. After an hour of careful digging I found a really good book — "dBASE III For The Programmer" by Nelson Dinerstein. (The book store was nice enough to take back Krumm's book. Hooray for Waldenbooks.)

Developing Code

The Clipper compiler spits out some pretty good error messages, which helps a lot when it's just you and a book and 100K of dBII code. A compiler isn't the fastest way to develop code, but with Becky and Cary (and all those orders) waiting, it didn't take too long. Old Faithful (my Challenger 186 board) definitely earned its keep during this project.

A Clipper batch file took care of the compilation and linking. So when I was ready, I'd just fire up the .bat file and take a 5 minute break. When it finished I had a standalone .EXE file.

One thing I always look at when trying out a new compiler is its overhead. How big a .COM or .EXE file do you start with before you can do something useful?

So I wrote a one-liner (program).

```
? "Hello World"
```

Now any self-respecting C compiler would recognize that immediately (I suspect that some C compilers are optimized for "Hello World") and generate an 8K .COM file. Clipper generated a 115K .EXE file. The compilation took 1 min. 31 sec. on Old Faithful. (The compiler reported 17 bytes of code, the rest was library.)

My database program is made up of 38 dBASE II (now dBASE III) files totaling a little over 100K of source. Total time to compile and link takes 5 min. 23 sec. Clipper generates a single 157K .EXE file. I can live with that since the finished product runs very, very fast.

How Fast Is It?

It's so fast that screens come and go instantly (while the same code running on a borrowed copy of dBASE III+ was very, very slow, significantly slower on the 6MHz clone than dBASE II was on the 4MHz Z80.) During data entry, file updates that take 15 or 20 seconds on the Z80 don't even break a typist's stride.

I wrote a program made up of three giant case statements. Its task was to save Cary six hours of hand counting.

We have to tell the post office how many subscribers we have in each zone (for each issue). There are eight zones (and about a dozen different ZIP code ranges for each zone). Plus, if a copy goes to an advertiser or my mother, then it must be counted differently. (Mothers don't realize what a pain they are — almost as bad as advertisers. But it's hard to do without them.)

Anyway, the Clipper-compiled program checked all 13,000+ entries in our database and printed out the totals in 12 minutes 0 seconds.

I then ran dBASE III+ on the same source code. After 1 hour and 20 minutes, I interrupted it to see how it was doing. It had checked 1302 records. At that rate it was going to take dBASE III over 13 hours to finish. Both times were taken on the same 6MHz, sped-up clone.

This trial, in fact, points out the strengths of both Clipper and dBASE III.

dBASE III is interruptable. You can check to see if something strange is happening by looking at the contents of all the variables. Plus it's an interpreter, so you're running again as soon as you make a change. No compiler to get in the way. These features make dBASE III a natural for software development. dBASE also lets you BROWSE through the database, making corrections or additions.

However, dBASE III is slow. Very, very slow. It would be slow on an AT; I don't know how people stand it on a PC or XT. Clipper, on the other hand, is very fast. In fact, you'd have trouble generating a faster .EXE file no matter what language you chose. Plus, Clipper doesn't charge you a fee every time you distribute a program. You just compile and ship.

General Feelings

I really like Clipper. I'm not sure I would have purchased it for $695 under normal circumstances, but considering the fix I was in and considering Champion's recommendation, I would have.

The speed difference between it and dBASE is astounding. You have to see it to believe it. Another plus — it seems to have few of the undocumented peculiarities that have been a trademark of dBASE. No question, this is a professional package.

However

Clipper is copy protected. Boo. The protection scheme is relatively easy to live with (it lets you put up to four copies onto any mix of floppies and winchesters, and it lets you uninstall any of those copies and move them).

Clipper also has at least one bug. A number of times, I had the 13th line of the display show up at the top of the screen. That was during the development process when I was also finding undefined variables or other strangenesses in my code. I haven't had the problem lately.

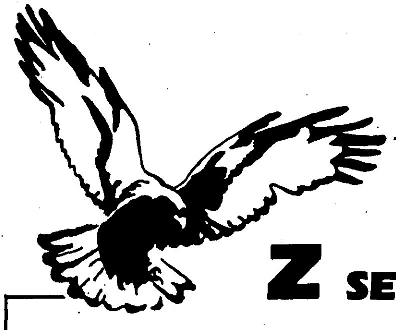
With any compiler, you lose the immediate mode of dBASE when you compile. BROWSE is gone; so is "display memory." These are nice touches, and important, especially during development.

Support

Nantucket definitely had paper saving in mind when they wrote the manual. It's the shortest thing I've seen since Cheerios sent Erin a free coloring book. There are almost no examples of how to use the compiler and linker directives, and I found the text very obscure. Fortunately, most of the time you'll be able to live with the defaults (still, an example, or a contact person who'd take a quick phone call would have saved me about 10 hours).

I also tried to use the built-in debugger. It offered a way of tracing through the code step by step, watching variables change, or triggering on

(continued next page)



(continued from page 49)

a breakpoint. Great, I thought, and turned to the chapter on using the debugger. The chapter turned out to be four partially-filled pages. I spent a whole day fighting the debugger. I still don't know how to make it do the fancy stuff.

When the 13th line problem started cropping up, I got serious about finding support. Page A1 of the manual states:

"Nantucket provides two sources of technical support for registered users.

"1. On-line assistance via The Source.

"2. Direct assistance from Nantucket. There is an additional charge for this service. A Mastercard or VISA is required."

Okay, I'm not a member of The Source (we don't have a phone access node in Bend for any commercial network), and I had no desire to join and pay monthly fees just to ask Clipper a question about its compiler.

So, VISA card in hand (I try my best to review like a user, not like a reviewer), I picked up the phone. Unfortunately there was no phone number on the support page. In fact, I didn't find a single phone number in the entire manual. (No address, either.)

I got the hint. (And things turned out pretty well.)

General Notes

1. Take your time futzing over dBASE II files. Get a good book and use it. The code isn't all that different, and once you get the hang of it you'll zip right along. But it has to be done and it takes time.

2. Translate all dBASE II data files into SDF (standard data format) and then reconstruct under Clipper. (dBASE III didn't translate back from SDF properly, at least not for Clipper.)

3. Clipper creates its own index files. They are not interchangeable with dBASE III (although dBASE has no trouble reading Clipper data files).

4. Networking is the big thing now for businesses. Any database package running on a network must support record locking so that several people can safely access the same database at the same time. According to the May 19 issue of InfoWorld, Lanlock (by Delta Contracting Services, whoever they are) is a $100 package that upgrades Clipper to support record locking for LAN use. Nantucket is supposed to be working on a similar add-on for Clipper. dBASE III+ is supposed to have an expensive upgrade which does record locking, but users are reporting that it doesn't work.

Finally

I didn't set out to look for nooks and crannies in Clipper. I used it to compile a major database program. Once I had made all the dBASE II to dBASE III translations, it worked.

I usually don't consider packages that are this expensive. After all, Turbo Pascal is more powerful than dBASE and much less expensive. There are also database packages for a lot less. But if you're familiar with this language and you need to get something out quickly, Clipper is not a bad way to do it. (Especially if you're already a member of The Source.)

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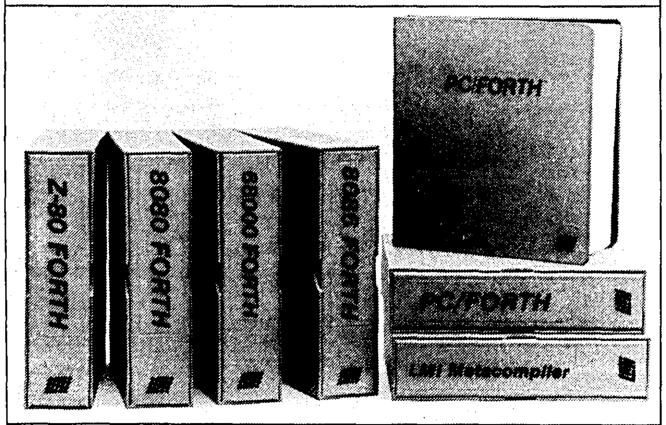

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By Philip Hess
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Lafayette IN 47904

Allocating Static Arrays At Run-time

If CP/M Turbo Pascal has a main weakness, it's the way it allocates memory at compile time. This is a second discussion of ways around the problem.

In the August '85 issue of Micro C, James Shiflett described how Turbo Pascal can dynamically use all of a CP/M system's memory by manipulating the run-time stack and heap pointers.

This is a fairly simple solution to the problem created when the Turbo compiler locates variables below the compilation ending address. This address must be set wastefully low to insure that the program will run on all systems regardless of size (system size varies from 59 1/2K to 64K on Kaypros alone).

(Editor's note: Turbo puts its variables at the very top of program memory. This causes a problem if you try to run a compiled Turbo program on a system with less program space. The classic way to get around this problem has been to explicitly set the size of the program area to, say, 48K, but in doing this you give up use of a substantial portion of memory.

However, Mr. Shiflett's approach can be used only with dynamic variables and forces the programmer to use pointers, which can unnecessarily complicate some programs.

An Array To Free Memory

Another approach would be to find a way to associate static variables (typically arrays) with whatever free memory is available to the program at run-time. A simple way to do this is as follows:

Insert the following declaration at the top of the program:

```
VAR
  TopOfData     : BYTE;
  BDOSaddr      : INTEGER ABSOLUTE $0006;
  InitialIndex  : INTEGER;
  MaxIndex      : INTEGER;
  BytesNeeded   : INTEGER;
```

Then, at the beginning of the main part of the program, insert something like this:

```
BEGIN
  {Assign or compute BytesNeeded here}
  InitialIndex := ADDR(TopOfData) + 256;
  MaxIndex := BDOSaddr - 1;
  IF (MaxIndex - InitialIndex + 1) <
                          BytesNeeded THEN
    BEGIN
    WRITELN('Not enough memory');
    HALT;
    END;
  {Call main menu here, for example}
END.
```

Now compile the program to a .COM file, using any reasonably small ending address. At run-time, any space left between the top of the program and the operating system will then be available to the program as an array of type BYTE which can be referenced using Turbo's built-in MEM array. Any portion of this array beginning with element MEM[InitialIndex] and ending with MEM[MaxIndex] can then be used freely by the program.

If an array of some other type than BYTE is needed, for example an array of type INTEGER, then add to the above declarations as follows:

```
VAR
  AnArray    : ARRAY [1..32767]
               OF INTEGER
               ABSOLUTE $0000;
```

Or, for a REAL array, use this declaration:

```
AnArray    : ARRAY[1..10922] OF REAL
             ABSOLUTE $0000;
```

Now, in the main body of the program, compute the initial and maximum allowable indices for the array:

```
InitialIndex := ((ADDR(TopOfData)
                              + 256) DIV
                SIZEOF(AnArray[1])) + 1;
MaxIndex      := ((BDOSaddr - 1) DIV
                SIZEOF(AnArray[1])) - 1;
```

This array can then be used just like any array as long as you stick to those elements between InitialIndex and MaxIndex.

(Note: TopOfData is not quite the same as the program's ending address, hence the use of 256 to make sure we're past the ending address. The exact number of bytes between the top variable and the ending address is 137 with Turbo version 3.0, but 256 can be used to be safe.)

Of Course There's A Risk

One disadvantage to these two approaches is the sacrifice of run-time index range checks. If a program has a bug in it which results in the use of an index value outside the range InitialIndex.MaxIndex and the program doesn't check for this, it could write over part of itself or the operating system in memory. Of course, this is also a risk in using pointers to dynamic variables.

And A Solution

A third approach, which retains run-time range checking below the array's smallest index and thereby reduces the chance of a program bug writing over part of the program, is as follows:

First compile the program as suggested in Mr. Shiflett's article to find the minimum ending address. Then declare a global array absolute to that address plus one:

```
CONST
  EndingAddrPlus1 = {ending address +
                          1 goes here}
VAR
  AnArray  : ARRAY [1..20000]
             OF INTEGER
             ABSOLUTE EndingAddrPlus1;
```

The beginning and ending array indices would then be:

```
InitialIndex := 1;
MaxIndex  := ((BDOS - EndingAddrPlus1)
            DIV SIZEOF(AnArray[1])) - 1;
```

A program bug causing a computed array index to drop below InitialIndex would generate a run-time error when attempting to reference the array, thereby preventing the program in memory from being corrupted and causing unpredictable results.

■ ■ ■

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By David Thompson

The Kaypro 84 Video Circuit: Yet Another Fix

It has to be an awfully dark cloud to be completely devoid of useful information, but my experience with a fussy Kaypro 10 had me wondering if I hadn't found a graphic case of just that kind of cloud. If your 10 or Kaypro 84 is having video problems, scan the following.

Sometimes it seems that Murphy is just waiting for me to get out of bed in the morning (which no doubt explains why I'm a night person). On one such morning, I headed down to MicroSphere to drop off one of our Kaypro 10s.

"Sure, it works fine," I said, setting it carefully on their bench (can't be too gentle with the winnie) and heading off for the Micro C office.

An hour later Don was on the phone.

"Your 10 doesn't display the sign-on menu."

'I never use the sign-on menu — it's just rusty.'

There was a long pause. Don doesn't understand computers the way I do.

However, the next day I got another call.

"Your 10 doesn't display the sign-on menu."

All right, already. Don was getting as monotonous as those ingrates who want us to go monthly. I headed over to the MicroSphere office expecting the problem to be video RAM or 6545 video controller or something common like that.

Unfortunately, Don had tried all those things (and had tried three different copies of menu).

Well, it wasn't as bad as it sounded. The menu was there, at least the text part — plus two or three extra characters scattered about the screen for special effect. However, the boxes that were normally drawn around the text were missing. Completely.

When Don ran Kaypro's demo game that uses the 84's graphics, everything worked but the graphics (the game was much less interesting).

The Video Circuit

At this point let's take a quick look at the video circuit.

Figure 1 is the schematic diagram for the video circuit in the 84 Kaypros (the 1, 2, 4, and 10 with modem). The video circuit for the older 10 is virtually identical except that the IC numbers are different and a dozen or so small TTL chips take the place of U10 (a custom IC designed to replace those small TTL chips).

U16, the 6845 (or the 6545 which is identical) directs the whole operation. The Z80 processor can say "hello out there" by pulling down on the the VIDCS* line (the * means the device is selected when the voltage is low).

Then the processor puts a byte on the data bus that tells the video controller to, for instance, put the following byte in video memory. (That's a very common thing to say to a video controller.)

The 6845 then sets its ENable output (pin 23) high and its R/W output (pin 22) high (for a read operation). U10 then raises the enable line on U14 (pin 11).

U13 and U14 are latches. U14 grabs a byte from the Z80's data bus (when pin 11 goes high). Then when its output is enabled (pin 1 goes low) it writes that byte onto the video data bus. Thus, the Z80 can write data into video RAM.

U13 does the opposite. It grabs data from the video data bus and outputs it to the Z80's data bus.

You'll notice that there are two video RAM chips, U15 and U23. U15 holds the character byte (e.g. 41H for an 'A'). At the same location in U23 there's an attribute byte (reverse, blinking, underline, half intensity) for the 'A'.

So, after the Z80 taps on the 6845's shoulder (VIDCS* line) the 6845 tells U14 to grab a byte from the Z80's data bus. Then the 6845 puts a value on the video memory bus (determines the location on the screen) and tells U14 to output the byte to the video data bus. If the byte is a character to be displayed, then U23 (character RAM) is told to read the byte from the video data bus. If the byte is an attribute, then U15 (attribute RAM) reads the byte.

Busy Controller

Meanwhile, the video controller is running the scan address lines (pins 34-38) and it's selecting one character after another (with the video address lines).

It uses the video address bus to select the proper locations in the character RAM and attribute RAM for the location currently being written on the screen.

When you figure that in one scan line it's selecting and writing to the screen 80 different characters, and it's writing a scan line in 1/19,000 of a second, then you understand how busy the 6545, RAMs, ROM, video address bus, and video data bus are.

This part of the computer is constantly running full blast, even when the screen is just sitting there, blank.

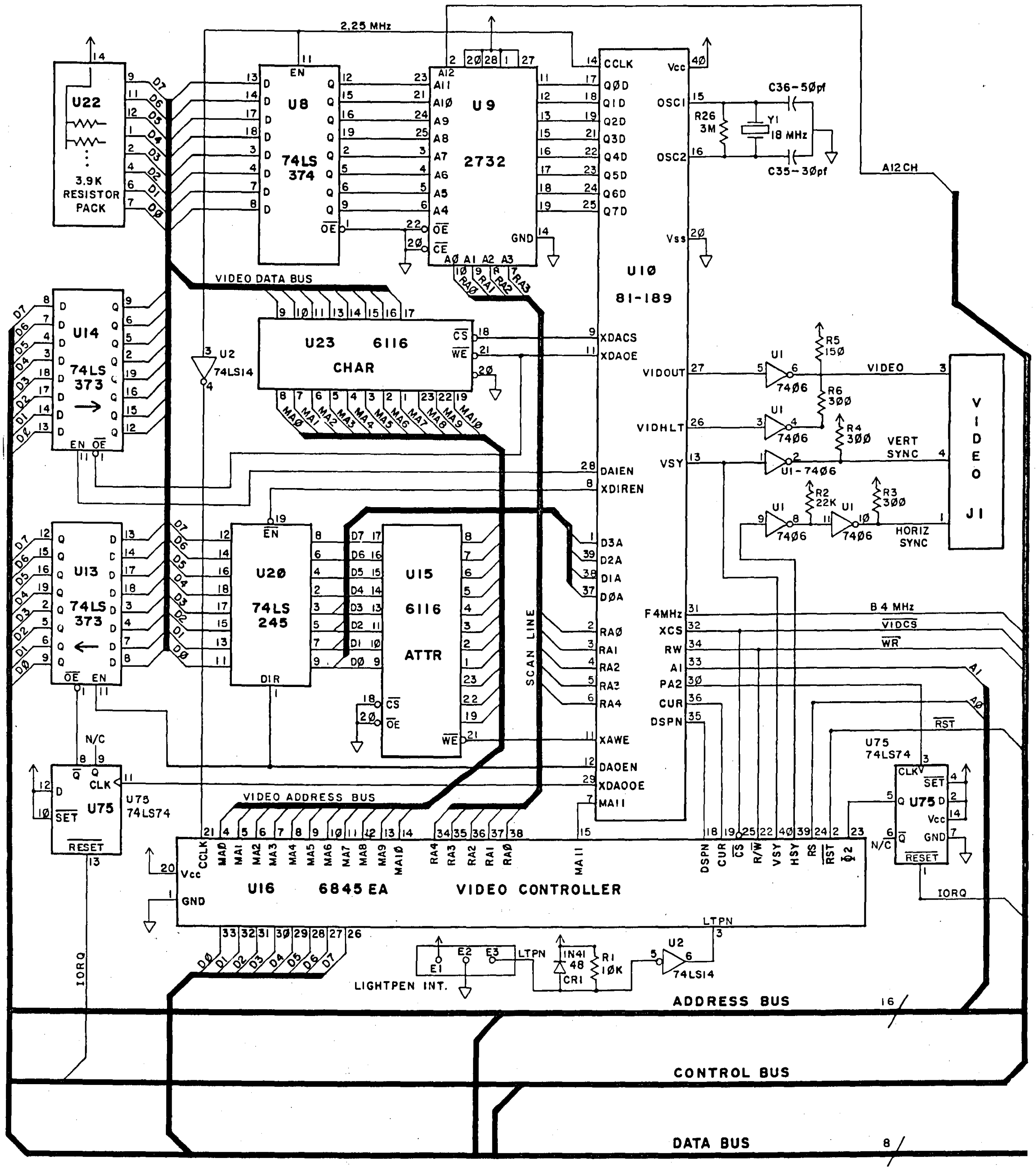
Generating A Character

The controller is addressing the proper location in character and attribute RAM, using the characters and the scan data as an address for the video ROM (U9) and then turning the output from the video ROM into a carefully timed stream of ones and zeroes (lit or unlit pixels). The attribute bytes determine how this stream of pixel data is treated.

Reverse video is produced by reversing the bits in the stream (upside

(continued on page 56)

Figure 1 - Kaypro 84 Video Section



(continued from page 54)

down, not backward). The circuit generates half-intensity by reducing the peaks of the video output.

Whew!

Things get particularly harried when the Z80 demands some attention, especially when the Z80 already has trouble meeting specs for getting information onto the data and address busses (a design feature of the 84 Kaypros).

So the Z80 is a bit slow, the 6845 a bit harried, and the whole thing has to work absolutely correctly or you get strange things in character and attribute RAM.

Back At MicroSphere

Our standard fixes for screen garbage have been to change the 6545 or 6845 to a 6545A or AE (a faster part). We've also had some success changing the 6116s to 150ns (or faster) parts, or even changing the Z80A to a Z80B.

However, Don had tried all the standard stuff. The graphics had gone from junky (about 50 percent there) to invisible when Don substituted faster 6116s. The 6545 and Z80 swaps didn't make much difference.

So we looked over the schematic. We seemed to be getting most of the garbage from the attribute section, so I suspected U20, the buffer between the attribute RAM and the video data bus.

But it was soldered in place, so I looked around for another possibility. U14 was the only other suspect, and it was socketed.

Don noticed that U13 (the video-out latch) was a 74ALS373 rather than a 74LS373. The ALS part is much more expensive than the LS part so there must have been a reason that Kaypro used it (faster, newer, more powerful...). He found one in a drawer and we plugged it in to U14's socket. Voila! Perfect graphics, no extra characters. (I wish I had drawers like his.)

A quick comment about ICs: The letters that follow the "74" on ICs tell you how fast the chips are, how much power they draw, how they were made, and so on. The numbers that follow the letters (if there are letters) tell you what the ICs do and what their pin outs are. So, a 74373 (standard TTL) can be replaced by — a 74S373 (Schottky), a 74LS373 (low-power Schottky), a 74C373 (CMOS), a 74HC373 (high-output CMOS), and so on. Thus, we knew that a 74ALS373 would directly replace the 74LS373.

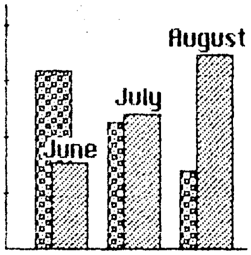
We even swapped back to the original 6116s, 6545, and Z80A, and the display remained as solid as a rock. No garbage. Full graphics. Everything.

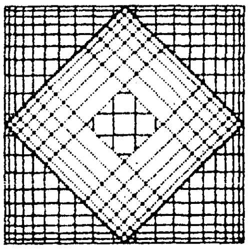
It's possible, therefore, that this might be the fix for those of you who've been frustrated in your attempts for clean, fast video. After all, 74ALS373s may be about $5 each, but for a clean screen...

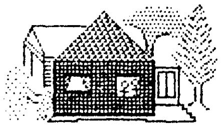
Note: If you're getting garbage on the printer during screen dumps you might try replacing U13 with a 74ALS373 (like Kaypro did on our 10). If you have an older Kaypro 10, its U45 is the same as U14 and its U46 is the same as U13.

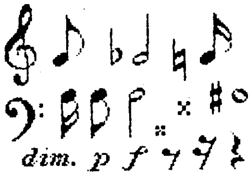
■ ■ ■

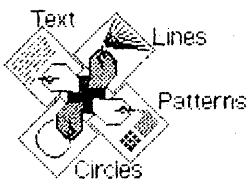
"Kaypro makes a nice computer– too bad it doesn't do graphics"

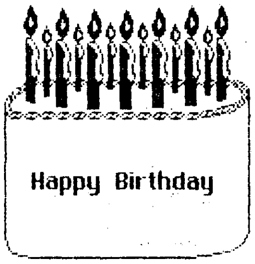










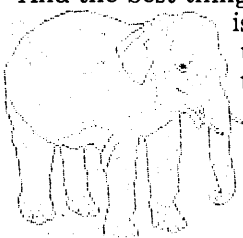


Make that *didn't* do graphics. SCS-Draw is here, bringing Macintosh-style graphics to the Kaypro computer. With SCS-Draw, you can use your Kaypro to draw a picture. Of anything.

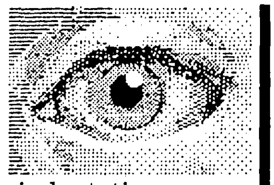
The first true drawing program for the Kaypro, SCS-Draw turns your computer screen into a sketchpad on which you can draw detailed images like those shown here. These images can be saved on disk or printed on your dot-matrix or letter-quality printer.

There are many applications of SCS-Draw. For example, you could use SCS-Draw to design and print party invitations, banners, or technical diagrams. You could also use SCS-Draw to promote your business or design your company logo.

And the best thing about SCS-Draw is that it's fun to use — when was the last time you had some *fun* with your Kaypro?

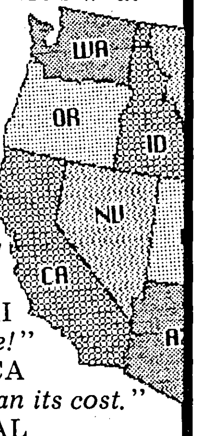


SCS-Draw gives you a variety of useful drawing tools to choose from. You can draw a detailed image dot-by-dot, or do a rough sketch with straight lines. Need a compass? SCS-Draw can draw circles of any size, wherever you need them For subtle shading effects, use one of 23 pre-defined patterns, or create your own.



Other features include block moves, four built-in fonts, and powerful print options like enlargement, indentation, mirror image and rotation. And with SCS-Draw's windowing feature, you can work on images much larger than your Kaypro's screen.

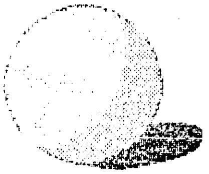
How good *is* SCS-Draw? Every day, we get unsolicited letters and phone calls from SCS-Draw users around the country — here's what *they* have to say:

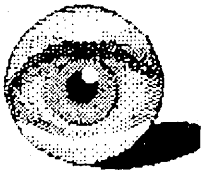


"*Very easy to use.*"
— G.H., WPAFB, Ohio
"*Keep it up ... the program is great fun.*"
— J.S., Roseburg, OR
"*A pleasure to use ... user-friendly, fun, well put together.*"
— D.A., Kalamazoo, MI
"*Everything is bug-free!*"
— D.C., Los Angeles, CA
"*Worth much more than its cost.*"
— B.H., Birmingham, AL

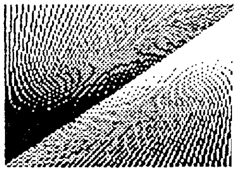
your
KAYPRO
can
draw

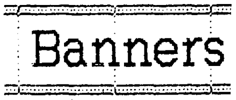
... with SCS-Draw! Available now for all '84, '85 and '86 Kaypro CP/M computers. Send $59.95 (check or money order) to Second City Software, Box 267960, Chicago, Illinois 60626. Call 312-577-7680 for COD orders or more information.

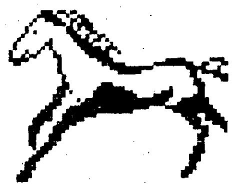




AAAaaa
BBBbbb
CCCccc
DDDddd







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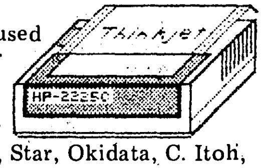
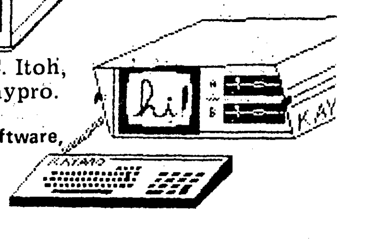
SCS-Draw can be used with most popular dot-matrix and letter-quality printers, including those from Epson, Star, Okidata, C. Itoh, Panasonic, IBM, HP, Diablo and Kaypro.





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Eight Booleans In A Byte:

By William Meacham
1004 Elm St.
Austin TX 78703

Bitwise Operations In Turbo Pascal

A boolean is a number that has two states, either true or false. So it's easy to represent a boolean with one bit. Easy, that is, unless the language you're using dedicates a whole byte to each boolean. So this article can save you some real space.

Also, just about everything we do at Micro C, whether it be hardware diagnostics, Z80 or 8086 Assembly language, or just speaking in hex (keeps the mailroom on its toes), requires an understanding of binary, hexadecimal, and decimal number systems.

Bill's thorough introduction to these number systems is as least as important as his Pascal routines, and it makes this an excellent article for you high-level folks who'd like to do some binary mucking with the rest of us.

Turbo Pascal can manipulate single bits of a byte. This article describes one application of this facility — using one byte to do the service of eight booleans — and shows how to implement it.

Since a boolean in Turbo is one byte long, you can save seven bytes. You might ask why anyone would want to save seven bytes; that's not much. But if you're building a data base that may contain 7,000 records, you're talking about 49,000 bytes, and that's a mouthful.

Review Of Numbers

Here's a quick review of theory for the newcomers. A byte is composed of eight bits, numbered 0 through 7, and each can be on or off, represented by 1 (on) and 0 (off), like this: 0011 1100.

The bits are shown in groups of four for clarity; bit 7 is the one on the far left (ultra liberal left) and bit 0 is the one on the far right (radical right). Each pattern of bits represents a number.

We've arbitrarily broken the 8 bits (they represent 0 - 255 decimal) into two groups of four bits.

Each group of four bits is a number ranging from 0 to 15 decimal. We created the hexadecimal number system so that we could represent those four bits as a single integer. Hexadecimal (base 16) numbers range from 0 to F, where 0 through 9 are the same as ordinary decimal numbers. Then follows A (10 decimal) through F (15 decimal). 10 hex equals 16 decimal. FF hex equals 255 decimal equals 1111 1111 binary.

(Note: a 'b' suffix means binary or bits — 'd', or no suffix, stands for decimal — 'h', or hex, stands for hexadecimal. In the range 0 - 9 there is no difference between decimal and hex.)

Thus, 0000b is 0, 0001b is 1, 0010b is 2, 0100b is 4, 1000b is 8, 1111b is F hex. 1111b = 8 + 4 + 2 + 1 = 15 decimal = F hex.

Turbo Operators

Turbo Pascal provides six bit operators — NOT, SHL (shift left), SHR (shift right), AND, OR, and XOR (eXclusive Or). They're disguised in the manual because it says they apply to integers, which are two bytes long (16 bits). But they allow you to set, clear, and test each bit in the integer. ("Set" means to make the bit a 1, "clear" means make it a 0, and "test" means to see whether it is 1 or 0.)

Now, first I was talking about bytes and here I am talking about integers. What gives?

Well, type "Byte" is a subrange of type "Integer," so all this integer talk applies to bytes as well. The Turbo manual gives examples of these operations on integers which are somewhat cryptic if you don't understand what's really going on, so here's a more detailed explanation. I'll talk about bytes from here on, because that's what I'm interested in, but remember this applies to integers as well.

NOT, SHL, & SHR

NOT flips all the bits in a byte.

NOT 0010 0010 —> 1101 1101

SHL shifts the bits to the left a specified number of places. Bits shifted out of the byte to the left are lost forever in the "bit bucket" and zeroes replace the bits on the right.

1000 0001 SHL 2 —> 0000 0100

SHR shifts the bits to the right. It is just like SHL except in the opposite direction.

0000 00100 SHR 2 —> 0000 0001

These three, NOT, SHL, and SHR, operate on one byte. The next three, AND, OR, and XOR, have to do with the relationship between the corresponding bits of two bytes.

AND, OR, XOR

AND is defined as follows:

```
1 AND 1 --> 1
1 AND 0 --> 0
0 AND 1 --> 0
0 AND 0 --> 0
```

In other words, the result is 1 if and only if both corresponding bits are 1. In other words:

```
       0101 0101 0101 0101 (5555h)
AND    0000 0000 1111 1111 (00FFh)
EQUALS 0000 0000 0101 0101 (0055h)
```

Note how the 0 bits in the second integer (actually, either integer) make sure that the corresponding bits in the answer are 0. The 1 bits in the second integer (again, either integer) mean that the bits in the answer are the same as the bits in the first integer.

OR is defined as follows:

```
1 OR 1 --> 1
1 OR 0 --> 1
0 OR 1 --> 1
0 OR 0 --> 0
```

In other words, the result is 1 if either bit (or both) is 1. This is used to set a bit to 1. If you OR a bit with 0 the result is the same as what the bit is, but if you OR a bit with 1, the result is always 1.

```
       0101 0101 0101 0101 (5555h)
OR     0000 0000 1111 1111 (00FFh)
EQUALS 0101 0101 1111 1111 (55FFh)
```

XOR is defined as follows:

```
1 XOR 1 --> 0
1 XOR 0 --> 1
0 XOR 1 --> 1
0 XOR 0 --> 0
```

In other words, the result is 1 if and only if the first bit or the second bit but not both is 1. You can use this to change a bit to its opposite or leave it the same as it was, without knowing what the original value of the bit is. If you XOR a bit with 1, the result is its opposite. If you XOR a bit with 0, the result is the same as the original.

```
       0101 0101 0101 0101 (5555h)
XOR    0000 0000 1111 1111 (00FFh)
EQUALS 0101 0101 1010 1010 (55AAh)
```

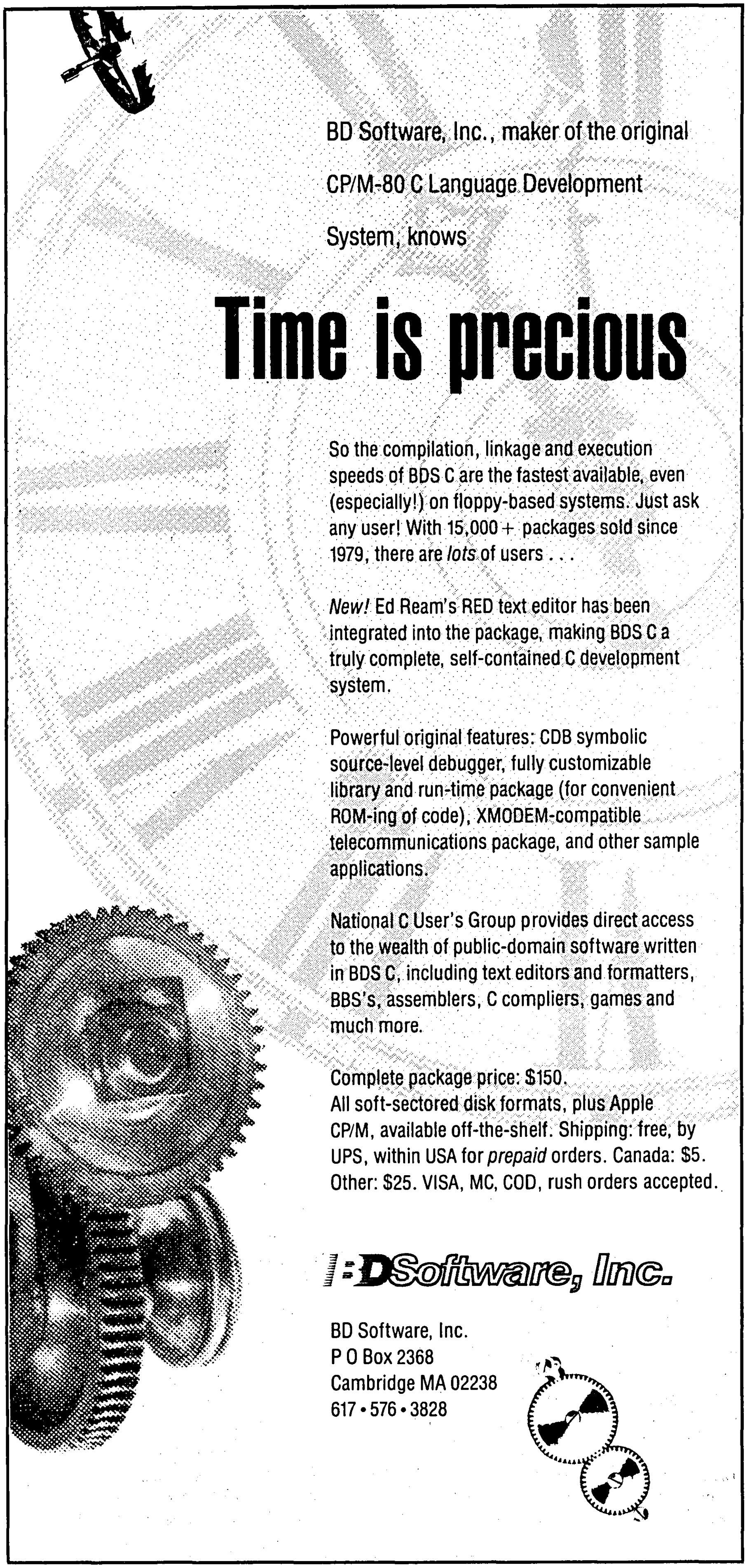
Practical Bits

Now for some practical applications. Instead of worrying about bytes and integers, what we really want to do is operate on individual bits.

The example program in Figure 1, SETBITS.PAS, contains two procedures, SETBIT and CLRBIT, and a function, TXTBIT. (If you know Pascal MT+ you'll recognize that these are borrowed from that compiler, where they're built-in procedures and functions.) In each case we use SHL to put a known bit in the position we want, then AND or OR the byte it's in with the target byte to get the result we want.

SETBIT takes a byte and sets a specified bit to 1. You pass it the byte

(continued next page)



(continued from page 59)

and an integer (n) between 0 and 7 (which bit to set). First the procedure creates an integer with the correct bit set by starting with the integer 1 (0000 0000 0000 0001b) and shifting it left n places. Then it ORs the result with the byte you passed to SETBIT. Here's a picture of SETBIT (FLAGS,2) where Flags is a byte.

```
    0000 0001
SHL         2
    ---------
    0000 0100

    xxxx xxxx  ("x" = unknown
 OR 0000 0100         value)
    ---------
    xxxx x1xx  (now we know bit
                   2 is set)
```

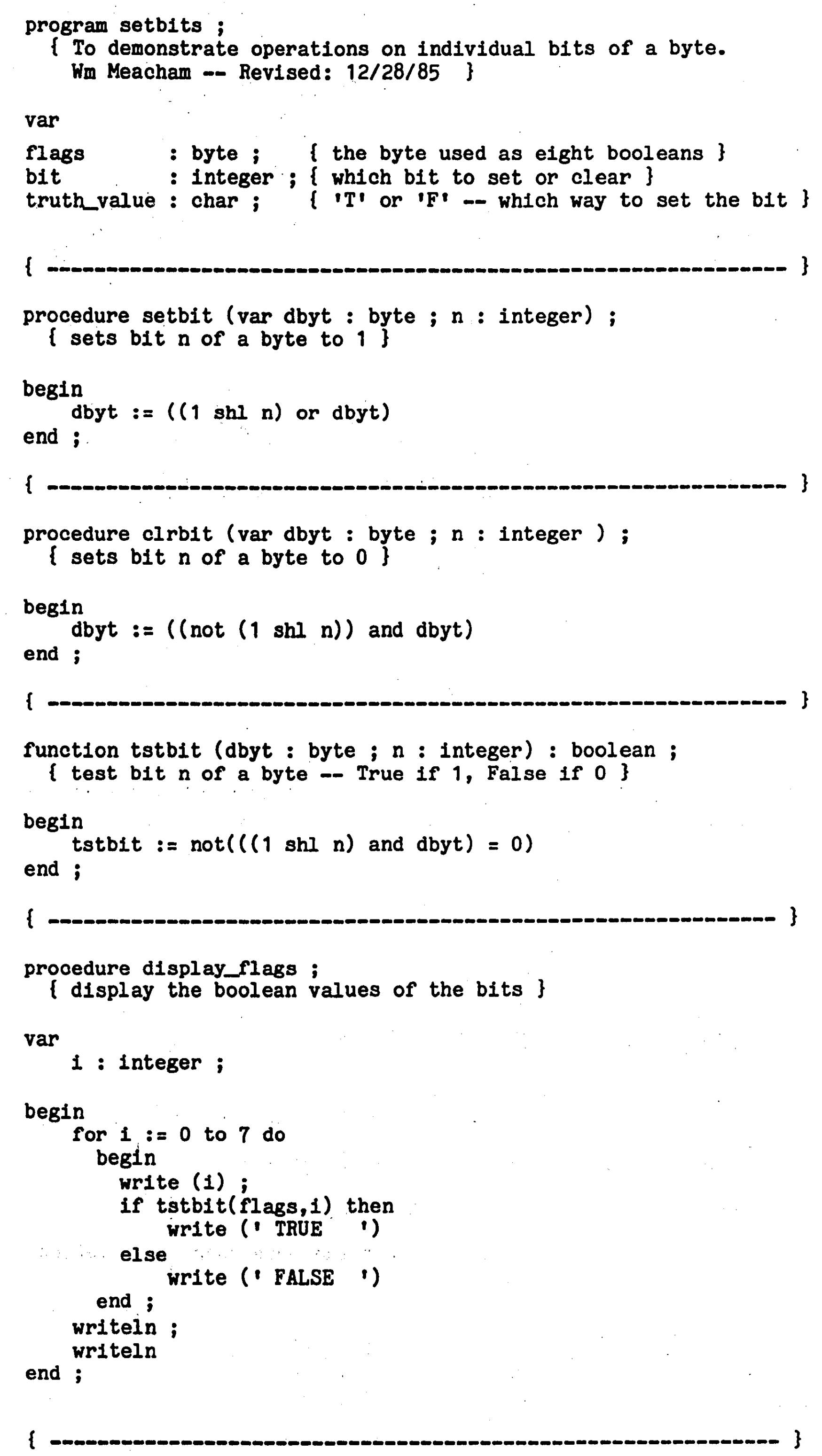
CLRBIT sets a specified bit to zero. First the procedure shifts 1 left n bits (to the bit we want to clear), then reverses (with NOT) all the bits. Finally it ANDs it with the byte. Here's a picture of CLRBIT (FLAGS,2):

```
    0000 0001
SHL         2
    ---------
    0000 0100

NOT 0000 0100  (flip all the
    ---------           bits)
    1111 1011

    xxxx xxxx
AND 1111 1011
    ---------
    xxxx x0xx  (now we know
                bit 2 is 0)
```

TSTBIT tests an individual bit. First it shifts 1 left n bits, to the bit we want to test. Then it ANDs it with the target byte. We know the result for all the bits (except the one we're testing) will be zero, because ANDing a bit with zero yields a result of zero, so all that remains is to see if the value of the byte after the AND is zero or not, and we'll know if the bit is a 1 or a 0. TSTBIT (FLAGS,2) looks like this:

```
    0000 0001
SHL         2
    ---------
    0000 0100

    xxxx xxxx
AND 0000 0100
    ---------
    0000 0x00 (now we know all
               but bit 2 are zero)
```

Figure 1 - SETBITS.PAS



```
program setbits ;
  { To demonstrate operations on individual bits of a byte.
    Wm Meacham -- Revised: 12/28/85  }

var

flags       : byte ;    { the byte used as eight booleans }
bit         : integer ; { which bit to set or clear }
truth_value : char ;    { 'T' or 'F' -- which way to set the bit }


{ ------------------------------------------------------------ }

procedure setbit (var dbyt : byte ; n : integer) ;
  { sets bit n of a byte to 1 }

begin
    dbyt := ((1 shl n) or dbyt)
end ;

{ ------------------------------------------------------------ }

procedure clrbit (var dbyt : byte ; n : integer ) ;
  { sets bit n of a byte to 0 }

begin
    dbyt := ((not (1 shl n)) and dbyt)
end ;

{ ------------------------------------------------------------ }

function tstbit (dbyt : byte ; n : integer) : boolean ;
  { test bit n of a byte -- True if 1, False if 0 }

begin
    tstbit := not(((1 shl n) and dbyt) = 0)
end ;

{ ----------------------------------------------------------- }

prooedure display_flags ;
  { display the boolean values of the bits }

var
    i : integer ;

begin
    for i := 0 to 7 do
      begin
        write (i) ;
        if tstbit(flags,i) then
            write (' TRUE   ')
        else
            write (' FALSE  ')
      end ;
    writeln ;
    writeln
end ;


{ ------------------------------------------------------------ }
{ ------- MAIN ------------------------------------------------ }

begin { program setbits }
    writeln ('This demonstrates setting individual bits of a byte.') ;
    write   ('Enter the number of the bit to set, ') ;
    writeln ('then how to set it -- True or False.') ;
    write   ('The bits are 0 through 7. Enter a number ') ;
    writeln ('outside this range to quit.') ;
    writeln ('They all start out False:') ;
    flags := 0 ;
    display_flags ;

    repeat
        write  ('Bit to set? (0 - 7)  ==> ') ;
        readln (bit) ;
        if bit in [0 .. 7] then
          begin
            repeat
                write  ('Truth value? (T or F) ==> ') ;
                readln (truth_value) ;
                truth_value := upcase(truth_value)
            until truth_value in ['T','F'] ;
            if truth_value = 'T' then
                setbit(flags,bit)
            else
                clrbit(flags,bit) ;
            display_flags
          end
     until not(bit in [0 .. 7])
end.

{ ------------------------------------------------------------- }
```

Figure 2 - Code Fragment

```
var
     mask     : byte ;
     category : array [0 .. 7] of boolean ;
     i        : integer ;

begin

{    user enters Yes or No to select categories to print  }

     mask := 0 ;                    { clear all the bits }
     for i := 0 to 7 do
         if category[i] then        { set the ones user has selected }
             setbit (mask,i) ;


     repeat                         { select records }
       { read a record from data file }
         if (mask and data.flags) > 0 then
             print_the_record ;
     until eof(datafile) ;

end ;
```

If the byte is not equal to zero, then the bit is a one. If it is equal to zero, the bit is a zero.

That's it! Now we have three useful additions to Turbo Pascal. The example program in Figure 1, SETBITS.PAS, gets user input and sets and clears bits accordingly. Then it writes out the values of each bit, interpreting a 1 as true and a 0 as false. (This is how Turbo implements a boolean, by the way. True is 0000 0001 and False is 0000 0000.)

Figure 2 is a fragment of code from a larger program that shows how you could use this facility. Each record in the data base has a byte that represents eight booleans, each of which is a selection criterion. They might be such things as "Environmentalist," or "Anti-Nuclear Activist," or "Democratic Party Member," etc.

If you want to print only those records that are Environmentalist, you enter Yes for Environmentalist and No for the other seven categories. If you want to print Environmentalists and Democrats, then enter Yes for both of these and No for the others. (Note that this would print all those who are Environmentalists or Democrats or both.) By constructing a selection mask and ADDing it with the flag byte in each record, you can easily make the selection.

Final Words

These procedures work equally well with integers; just declare the variable dbyt as an integer. Using integers gives you 16 booleans instead of 8.

Credit where credit is due: I figured out how to implement eight booleans in a byte by using powers of 2 to set the bits. My friend Steve Elliot showed me Setbit, Clrbit, and Tstbit. Thanks, Steve!

■ ■ ■

Hard Drives, The Service Perspective

By Rebecca Ozrelic

A lot has been written about hard drives. Most of the articles I've seen have been the "gee whiz" variety. Gee whiz, drives are getting cheap. Gee whiz, drives are holding a lot of data. Gee whiz, a lot of people are buying drives. But those articles usually don't deal with what happens when a drive dies. What is the seller's responsibility? Where do you turn if the seller can't (or won't) help? Which manufacturers are supporting end users and which aren't.

A hard drive is probably the most expensive accessory you'll purchase for your system. It's also probably the most difficult to maintain. After all, what other device operates at such tight tolerances, requires a clean room for mechanical repairs, and works with a controller board (which has its own problems). Stir in a dearth of servicing information for either the controller or the drive and you can get a real queasy feeling.

You find out quickly that you're really dependent on support from the dealer you bought the drive from. In some cases he's the only support you have. In other cases, however, the manufacturer is willing to help. I'll be covering both those situations.

In researching this article I spent lots of time on the phone finding out: first, just what are winchester (or hard) drives? Second, who is supporting their drives and who isn't.

How Winchesters Work

Hard disks come in all sizes and flavors: the early standard was 5 megabyte. Now the standard is 20 and moving rapidly toward 30 and 40 Meg. If you've been checking prices, you will have noticed that you can pick up a 20 Meg hard drive for little more than the price of a 10.

In fact, many manufacturers aren't even making 10 Megs anymore. Here's the reason: if you could make a 20 for almost the same price as the 10, would you make the 10? Of course not. Besides, anyone who can use 10 megabytes will sooner or later (usually sooner) find a use for 10 more.

Stepping Out

A 10 megabyte drive usually contains two aluminum platters. Each platter is covered, both sides, with an oxide coating. Four heads (one per surface) are connected to a single actuator arm and move in tandem across the platters.

In most drives, the actuator arm is driven by a small stepper motor (the system is similar to the stepper/head arrangement on floppy drives). For these drives, the step rate (time to step from one track to the next) is between 1 to 6 ms. (Most floppy steppers are happy at 3 or 6 ms.)

The step time is very important because most winchesters have over 400 tracks (compared with 40 tracks for 48 tpi floppies). And, as disk and head technologies improve, manufacturers are crowding more and more tracks (more and more data) onto the same number of platters. Meanwhile, steppin' out (especially all the way out) is taking longer and longer.

Positioner technology is also improving. Many of the larger capacity drives (30 Meg and up) have fancier steppers. Some of them are mechanical, but generally the newer, faster units use voice coils to move the heads and optical sensors to keep track of position.

Voice coils are simpler (less to wear out), more accurate (because of optical positioning), and faster (step rates in the micro second range). They are also more expensive (of course).

Hard Disks

Most drives contain either 3 1/2" or 5 1/4" platters. We'd been questioned by readers about manufacturers "sneaking" 3 1/2" platters into a drive designed to hold 5 1/4" platters. We wondered if manufacturers weren't pulling the wool over buyers' eyes. But according to Ron Schlitzkus, director of marketing for Microscience, a major hard drive manufacturer, the capacities of the two sizes of drive are virtually the same. In other words, if you buy a 20 megabyte hard drive, it doesn't matter if it contains 3 1/2" or 5 1/4" platters — you're still going to have a 20 megabyte hard drive.

Ron also explained that since the 3 1/2" are newer, some are more technologically advanced. They also weigh less, and have fewer components to go wrong. But then, the track and bit densities are higher. Manufacturers have gotten into trouble trying to squeeze higher and higher data densities out of the old (media, head design, and head positioning) technologies.

Interleave Factor

One more tidbit about access speed. Nearly all drives rotate their platters at 3600 RPM, so everyone's equal there. However, let's say the controller wants to read sectors 1, 2, 3, and 4, and let's assume the controller needs some time to deposit sector 1 in memory before it's ready to read sector 2. If the sectors are all lined up 1, 2, 3, 4, 5, 6... on the track, then the beginning of sector 2 would have already passed under the head by the time the system had finished with 1. Thus, the controller would have to wait a complete revolution of the disk between each sector.

Well, lining up the sectors 1, 2, 3... is called an interleave of 1 (it's really no interleave at all). An interleave of 3 means that the sector labelled sector 2 would show up 3 sectors after sector 1, sector 3 would show up 3 sectors after 2 and so on. It takes three revolutions of the disk to sequentially read all the sectors when a track has an interleave of 3. A common interleave for hard drives on MS-DOS systems is 7.

Interleave is generally a function of computer speed, not drive or controller speed. If the computer is fast enough to read and write sequential sectors with no interleave then, of course, it has a big advantage.

When you're formatting a hard disk you can usually select the interleave. If you start with an interleave of 7, you may find that disk access gets faster and faster as you reduce the interleave until you reach the optimum value. Then, reducing the interleave just one more notch drastically increases access time.

Taking The Plunge

Now that we know a little about hard disk drives, it's time to start comparing manufacturers, their attitudes, and policies.

First of all, you seldom buy a drive directly from the manufacturer. Most manufacturers prefer selling only to dealers or OEMs (Original Equipment Manufacturers. IBM is an OEM, which means it buys the components for its systems from component manufacturers, puts them together, and sells the final product under the IBM name.)

Chances are you'll be buying your hard disk from a dealer, and if you've perused the pages of Byte, Computer Shopper, Micro C, or practically any other publication, you'll see the dealers' ads hawking their wares. Literally dozens of them sell hard disks ranging in price from about $300 for a house brand 10 Meg on up to $2500 or so for an Iomega Bernoulli box.

As you go through the list of 800 numbers and talk to salespeople, you'll quickly learn which dealers know what they are selling and which don't.

You'll want to ask if the advertised price includes cables and controller card. Drives advertised for PCs and XTs nearly always include cables and controllers. Drives listed for the ATs don't, because most AT-style systems have controllers built in.

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Warranties

You'll also want to ask about warranties. Almost all manufacturers offer a one year warranty on the drives. Some, like Maynard, offer a one year warranty on the drive and a longer warranty (up to five years) on other parts, such as the drive's electronics and/or the controller card. However, dealers can substantially limit customer support.

For instance, let's say Rodime offers a one year warranty to the original purchaser. Rodime sells only to dealers and OEMs. A dealer buys a Rodime drive, then sells it to an end user and offers only a 6 month warranty. Let's say there's a problem with the heads 8 months after the end user buys it.

Since the drive is no longer under dealer warranty, the user will have to pay for repair or replacement. The dealer, in turn, sends the drive (which is still under the original warranty) back to the manufacturer and gets a new one free. This scenario assumes, of course, that the dealer sold the drive immediately after getting it from the manufacturer. It's very possible, however, the drive sat on a shelf in the dealer's warehouse for who knows how long before being sold. So when a dealer puts a 6 month warranty on a drive that originally had a 1 year warranty, he may actually be on the hook during part of the 6 months.

A word more on warranties: if you return a drive that's obviously been abused, or there are components missing, or you've monkeyed with the seal, kiss your warranty good bye. No manufacturer will honor the warranty in such a case. However, rewiring something on the drive, using different cabling, or something of this nature won't necessarily invalidate a warranty.

For instance, Priam, a hard drive manufacturer, will fix anything that's original to their drive. So if you alter the cabling or wiring, and that's the cause of the problem, you're out of luck. But if it's original components causing the problem, Priam will repair it.

Also, some manufacturers have been installing G-force detectors inside their units. If the drive is dropped, the detector will be permanently altered, and the warranty will be voided.

Drive Problems

The key to winchester technology is that manufacturers can pack lots and lots of whole bits (no half bits, because of the sharp edges) into a very small space. To do this manufacturers place a narrow head very close to (but not touching) the media. In fact, the head floats on a cushion of air about 1/10th of a hair's width above the spinning disk. Any dust (such as a particle of tobacco smoke) on the platter would be ground between the head and the media, probably damaging the media.

In fact, even the head could damage the media if the two touched while the platters were spinning.

So, the platters and heads are sealed in a dust free case and all repairs inside this case have to be done inside a clean room.

One of the reasons drive manufacturers don't like to deal with the public is that dealers should be better able to weed out the problems caused by defective controllers (and even then, about half the "defective" drives returned to the factory work fine).

Attitude Toward The User

Manufacturers' attitudes toward dealing with the end user vary greatly. From what we can tell, all manufacturers service their own drives. But most of them, such as Micropolis, prefer not to deal with the public, and will do so only as a last resort. Micropolis wants users to return drives to the authorized dealers, which are Hallmark on the East Coast and Wiley on the West Coast. But if for some reason the dealer is totally unhelpful, Micropolis will talk to you.

Other manufacturers, such as Microscience, have a strong relationship with their dealers and OEMs, and insist that users return drives to those dealers. However, Microscience makes up for this seeming inconvenience to the user by allowing authorized dealers (Wiley and Pioneer) to give the end user the full 1 year warranty Microscience offers to the dealer. Virtually none of the other manufacturers we talked to in preparing this article offered that kind of warranty to the end user. But remember, to get that warranty, you must buy through either Wiley or Pioneer.

Another plus for Microscience: they've recently negotiated with FRS, Inc., a large repair service in Sacramento, CA, to be an authorized Microscience service center. Repair rates vary depending on the problem. For tech questions, the end user has the options of asking the dealer, calling FRS (916) 920-1107, or calling Microscience directly (number listed below).

Maynard takes a slightly different approach. Though it sells through dealers only, you have the choice of taking a problem drive back to the dealer or shipping it directly to Maynard. It claims to provide 48-hour turnaround on non-clean room repairs (things like stepper motor, controller board, or disk drive board). Maynard sends clean room operations back to the manufacturer (Maynard is a rebrander), but meanwhile they will immediately ship you a new drive.

Xebec is another rebrander, and like Maynard, Xebec provides very decent support for the end user including an 800 number directly to the technical department (see list below).

Note: Maynard does not manufacture its own hard drives. Instead, it tests and uses such drives as Rodime, Seagate, Fugi, etc. in its systems. When sold, these drives may or may not bear the original label. Maynard claims that because it is constantly testing new hard drives, and that the quality of drive a manufacturer produces varies from model to model, it doesn't always stick to the same manufacturers. So if two people buy a Maynard drive, one may get a Seagate, the other a Rodime. But both will receive a controller board manufactured by Maynard expressly for that drive.

Thus, for simple technical questions, manufacturers generally don't mind a call from the end user, and seem pretty willing to help the little guy. However, virtually all of them, except Maynard, want you to take a problem drive to the dealer first, and only if that proves unsatisfactory, then to contact them.

Following is a list of some major manufacturers, along with their addresses and phone numbers.

Control Data *
8100 34th Ave. South
P.O. Box O
Minneapolis MN 55420
(612) 853-8100
Repair Center, Oklahoma City
(405) 324-3160 (tech help line)

Maxtor *
150 Riveroaks Parkway
San Jose CA 95134
(408) 942-1700
(408) 435-3354 (tech help line)

Maynard *
460 E. Semoran Bl.
Casselberry FL 32707
(305) 331-6402

Micropolis *
21123 Nordhoff St.
Chatsworth CA 91311
(818) 709-3300

Microscience *
575 E. Middlefield Rd.
Mountain View CA 94043
(415) 961-2212

Miniscribe *
1871 Lefthand Circle
Longmont CO 80501
(303) 651-6000

Priam *
20 W. Montague Expressway
San Jose CA 95134
(408) 946-4600

Quantum *
1804 McCarthy Bl.
Milpitas CA 95035
(408) 262-1100

Rodime *
901 Broken Sound Parkway NW
Boca Raton FL 33431
(305) 994-6200

Seagate *
920 Disc Drive
Scotts Valley CA 95066
(408) 438-6550

Tandon
20320 Prairie St.
Chatsworth CA 91311
(818) 993-6644
- no tech help number is available to the end user
- authorized dealers offer the end user a 90-day factory warranty on most winchesters

Xebec
2055 Gateway Pl.
San Jose CA 95110
(408) 287-2700
(800) 982-3232 (tech help line)

* offer 1 year warranty on drives to original buyer

If you have a tech help question about a drive manufactured by one of the above companies, call the tech help number (if one is given) or call the company's main number and ask for technical assistance. You'll be transferred to the right department.

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Purchasing And Installing A Hard Drive

By David Thompson

What Your Mother Didn't Tell You About Winnies

One thing Becky and I found out as we started poking around the hard drive arena is that there are a lot of drives out there — and a lot of people willing to give us information about those drives.

But most of the information wasn't very interesting. The really meaty stuff, like whose drives are dropping like flies, and whose controllers don't work with whose drives, wasn't volunteered. But, by listening between the lines, we managed to come up with some pretty solid suspicions. (Stay tuned so we can all be suspicious together.)

Finally, a number of you have wondered what it takes to attach a winnie to your clone (about $500). The last part of this article covers what to do on the morning after you've laid out all that cash.

I've read a lot of articles, talked to a lot of people. I've asked a lot of questions, all of them boiling down to: which winchesters are worth buying?

Here are the questions I asked: Which are the most dependable? Which are the easiest to get serviced if necessary? Which are the best value?

The people who knew most of the answers about reliability and serviceability were the repair shops. They weren't talking though, because they were afraid of being cut off from their sources of parts and schematics.

However, during my reading and interviewing I did learn the following:

1. If you buy a CMI drive, lotsa luck. IBM is no longer purchasing CMI drives (though they never admitted that the drives had problems). Anyway, CMI may disappear any day, but their drives (especially the pull-outs) will be hanging around the surplus market for quite a while.

PC Magazine devoted nearly a whole issue to the woes of their CMI drives. (CMI drives practically shut down their editorial department on a number of occasions.) PC Magazine suggested that AT owners use Priam drives to replace their CMIs.

2. The only thing worse than a CMI drive is an early Tandon. We had several of the early Tandons, and they nearly shut down the Micro C editorial department, which makes them even worse than CMI drives.

Kaypro found itself in the Tandon 10 Meg replacement business right after they started using them. (An average of three replacements per system, I believe.) If you have a Tandon winchester, don't breathe on it, the heads might fall out. Recently I've seen some Tandon 3 1/2" winnies in XT clones (they looked like 5 1/4 from the front). Beware of a package deal if the seller "doesn't know" what kind of drive you'll be receiving.

3. Hard drive failures aren't necessarily caused by problems with the drives themselves. The problems often result from controller or software incompatibilities, or from controller board failures. Xebec technical folks indicated that about half of the drives they receive from field engineers work just fine.

4. When a hard drive is defective, 60 percent of the time the problem is inside the bubble (the sealed area where the platters and heads reside). Of these bubble problems, 75 percent are head related, 25 percent are media (platter) problems.

The other 40 percent of the drive failures are caused by problems with the drive's electronics.

A Gold Mine

Allyn Franklin is my drive contact. He gets first shot at any questions I have (lucky guy). He suggested I talk to Stuart Eaton, a winchester drive repairer.

I did, but Stuart couldn't tell me much. Oh, he knew it all right. But there were those non-disclosure agreements and so on.

But he did turn me on to David Claridge, a senior technology analyst for Hambrecht and Quist of San Francisco.

All Business

David is more a business type than a technical type, but I must say that if I were planning to purchase stock in a hard drive company I'd call him first.

He didn't want to say anything bad about anyone, but it soon became apparent that he had reasons for not discussing some folks.

I asked him to name the manufacturers (not the re-branders) he was comfortable with. He listed the following:

Control Data
Seagate
Maxtor
Micropolis
Miniscribe
Priam
Quantum
Rodime

He noted that the first four are U.S. companies, but they are having their drives built somewhere in Asia. Micropolis and Priam, on the other hand, are building drives here. Quantum is partly here, partly in Asia. Rodime is manufacturing in Florida and in Scotland (an interesting country to visit, but can they build drives?).

Added to that list are four Japanese firms he thinks are, or will soon be, major players.

Hitachi
Fujitsu
NEC
Siemens

Increasing Reliability

I told him I was concerned about drive reliability. He appeared unconcerned about that.

"Reliability has been improving. A couple of years ago you were lucky to get 10,000 hours between failures (MTBF). That figure has risen to the point that failures aren't much of an issue.

"As long as the use isn't very heavy (8 hours per day intermittent use) there isn't much difference between the low end drives.

"Look at Seagate: they've shipped an incredible number and they've been solid. (I think the number is about 1.25 million drives for Seagate. MTBF for the ubiquitous 20 Meg ST225 is reportedly 20,000 hours.)

"Then there are the mid-range drives. They have faster access times but are still stepper actuated, like Quantum.

"On the high end is the 85 Meg Micropolis drive. It's probably the most reliable drive on the market. It has an MTBF of 50,000 hours. (That's 5 1/2 years at 24 hours per day.) A truly outstanding drive. They're built in the U.S., but the company is ramping up in Singapore."

A Commodity Product

David noted that during the '60s and '70s price/performance was improving about 25 percent per year. During the '80s that's risen to between 40 and 60 percent per year. The reason is that winchesters have become a volume business. Thus:

1. There's capital to research new technology.

2. There are intense competitive pressures from offshore manufacturers.

The 3 1/2" Winchesters

David predicts that the 3 1/2" winnies will take over the low end of the market at some point. In fact, the smaller drives are only one of the ways manufacturers are cutting costs. The latest 5 1/4" Seagate 10 Meg reportedly has only two heads and a single platter, down from four heads and two disks just a few months ago.

The move to smaller, simpler drives is made possible by changes in head and media design. For instance, manufacturers are moving to plated media. In this process, solid metal is plated

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onto an aluminum platter (just like chrome used to be plated onto steel bumpers).

Oxide media, the current favorite, is made of tiny particles of iron oxide suspended in a polymer binder rather than solid magnetic material. Data density is much lower with the oxide technology.

Coming Shortly

David was particularly excited about the upcoming announcement of the new 40 Meg Seagate drives. They're supposed to cost no more than the current 20s (that would put them at about $350 each without controller) and have a 40 ms average access time (compared with 80 ms for the 20s).

What's surprising everyone in the industry is that Seagate will be using a common little stepper motor. But it's a faster stepper than anyone would have imagined only a short time ago.

So

What should you purchase? A drive and controller that work together, obviously. Something dependable, obviously.

We have five 20 Meg Seagates in and about the office. They've been solid, quick (not super-quick, just quick) performers. We've got them connected to both Western Digital and DTC winchester controllers. Don (at MicroSphere) thinks the DTC controllers are best. I can't say. Ours all work fine.

Best of all, they're cheap. Really cheap. Just about every $550 (and under) 20 Meg winchester and controller board package for the XTs and clones contains a Seagate 225 (20 Meg) and either a DTC or Western Digital controller.

Firing Up A New Winnie

This is the part a lot of folks are worried about. Connecting it, formatting it (if necessary), and copying over MS-DOS so you have a runnable, bootable winnie.

It isn't hard, believe me. Manufacturers have taken practically all the sweat out of the operation (you can even add a second winnie to the same controller).

Winnie A La Formatte

1. Plug the controller board into a free slot. (Use any slot except the one closest to the power supply — it's reserved for adding ROMs to the system.)

2. Mount the winnie in the computer. (I leave the details as a problem for the student.) It's best not to have anything on top of the winnie because it can get a bit heated if someone's cutting off its circulation. Normally the drive will arrive jumpered correctly (jumpered as drive 0). If you're at all queasy about what's going on, you might stick it into place but not bolt it down until it's working.

3. The 34-pin ribbon cable runs between the controller and the drive (cables usually come as part of the package). Note that the red edge of the cable connects to pin 1. Look for a small '1' and/or '2' on the controller board near one end of the 34-pin male connector. These mark pins 1 and 2. On the drive you'll see a slot cut into the 34-pin edge connector. The slot is nearest the pin-1 end.

4. Connect the 20-pin ribbon cable between the controller and the drive. Again, the red edge is pin 1. Watch for the '1' or '2' on the controller and the slot in the drive's connector. There are two 20-pin male connectors on the controller, one for each of the two drives it will control. Use the male connector closest to the 34-pin connector for the first (or only) winnie. This 20-pin interface carries data back and forth between the drive and the controller.

5. Fire up the system. You'll need to have a bootable disk in drive A. On that disk you'll need DEBUG, FDISK, and FORMAT from the MS-DOS master disk.

6. From the A> prompt enter DEBUG. After DEBUG signs on enter:

```
g=c800:5
```

This gets you into the hard disk controller's formatting utility (it's in the ROM). The utility will ask for the hard disk type (it's '2' for the ST225) and for the interleave ('6' is a good choice for 4.77MHz clones). Then the controller does the low level format.

7. Run FDISK. Don't be confused by this routine. Just select the defaults. (It's just making sure you want to use the whole winnie under MS-DOS.) If the disk was properly formatted in step 6 then FDISK will be happy.

8. Now, enter:

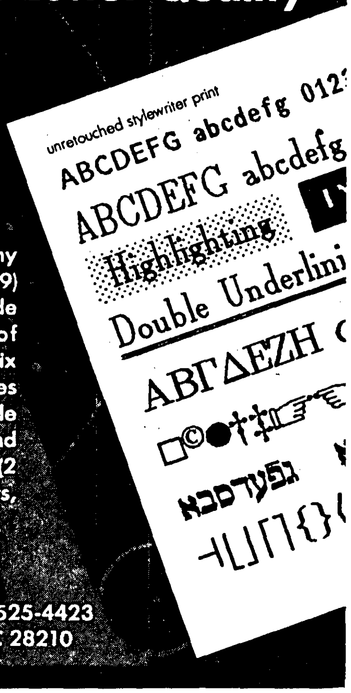
```
FORMAT C:/s
```

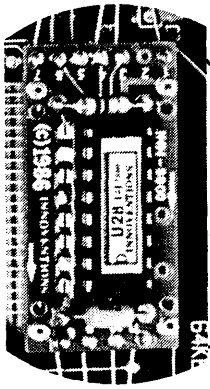
When this finishes you'll have a winnie that you can boot, save files on, and otherwise enjoy.

More Information

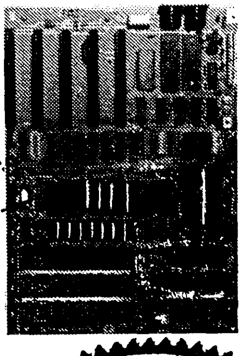
When you are purchasing your drive and controller be sure to let the seller know you want the installation manuals. They get them. You need them. If they say they don't have them, or won't send them, deal with someone else.

■ ■ ■





IBM-PC motherboard



By Stephen M. Leon
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Languages, The Usual, The Unusual

This time Steve covers the availability of unusual languages, Japanese software, property management, and REC.

One morning some months ago while I was waiting for the 6:26, a strange little man came up to me and asked, "Whatever happened to Unix?" What a way to start a day! All day long I pondered the question. Had this wave of the future passed me by while I wrestled with CP/M and DOS?

I didn't know then and I don't know now the answer to the question. My suspicion is that as more and more of the features of Unix appear in DOS, Unix for the micro will be unnecessary. However, maybe you too have noticed a trend, and perhaps that trend is where computing will be in the not too distant future.

Certain languages seem to be "in" — especially C. (The buzzword set is hot on anything even remotely connected with Artificial Intelligence. But as long as you're not writing in either BASIC or Assembly language, you're *au courant* as far as computing is concerned.) Thus, while Unix may not be "in," C (the heart of Unix) is definitely "in."

Language Software

The starting point for learning C is the public domain Small C. A Small C compiler for Z80 CP/M is available on SIG/M volume 224. Small C for an 8086 machine is on SIG/M 149. The latest version of Small C for MS-DOS is on PC/Blue 192.

Small C is just that, a subset, and once you leave the initial learning phase, chances are you'll want to go into a commercial package. However, if you want to polish your skills, it may well pay to stick with and try adapting some of the programs in the library to Small C. Whatever you decide, there's a lot of good C code in the SIG/M library.

XLISP in CP/M 80 on SIG/M 118 and CP/M 86 on 153, written in C, is both a language and an opportunity to study some good C code. Same thing with PISTOL on 114. You might also get some ideas from CITADEL, a BBS system, on SIG/M 150. YAM in CP/M 86 on SIG/M 158 and CP/M 80 on 183 are modem programs in C. Want to see how how a pro writes a text formatting program in C? Try ROFF on 174. Doing an editor in C? Take a look at SIG/M volume 76.

Unless you enjoy reinventing wheels, the availability of source code with these public domain programs not only lets you customize programs, but it also lets you see how others write in C. For example, take a look at SIG/M volume 271, "Some C Programming from Japan." The same holds true with the Australian C code available throughout the collection.

Other Languages

Some other languages available in the SIG/M library include TIMCMP & PIDGIN (43), SAM76 (53), Little Ada (92), JRT Pascal (129), TINCMP and META in CP/M 86 (159), Concurrent Pascal-S (162), FORTH (204), META4 for 8080 (207), COBOL (209) and Small PROLOG (242).

The PC/Blue library has FIG-FORTH (54), XLISP (146), ESIE — Expert Systems Interference Engine (176), LISP (188), and ICON — a SNOBOL like language (192), in addition to Small C on 192.

New From Japan

I did a paper in graduate school that involved a queuing simulation of the school cafeteria to demonstrate why the professor should let the class out early for lunch. The Japan Users Group (CP/M) recently contributed a four volume General Activity Simulation Program (GASP) to SIG/M (volumes 256 to 268). For those of you who are also into queuing, this set is quite a find. Unfortunately, it's written in FORTRAN (both for CP/M 80 and CP/M 86). However, it works and it works well.

Also from Japan, there's Statistical Distribution and Multiple Regression (SIG/M 269). The code is FORTRAN 80, which again is unfortunate. SIG/M 270, however, has some Turbo Pascal programming from Japan which shows that Borland's influence is spreading.

Property Management

For at least a year there's been a stack of blank disks on my desk from people who wanted a copy of the SIG/M Property Manager program (SIG/M volumes 199 and 200 and PC/Blue 75) in dBASE3. I'd promised to write a dB3 version, but, well, you know how much work it takes to do it right.

I finally made the time to do it. It seems to work quite well and will be out in the PC/Blue library before the end of the year. If you manage real estate and have a PC it's a dandy program that produces everything from rent bills to financial statements. If you can't wait until its official release, send me two 5" disks and return postage and I'll send you a copy. One disk has the program for dBASE III+, the other is compiled with Clipper.

REC Surfaces Again

When we were talking about languages, perhaps we should have mentioned REC. While not a language by strict definition, Regular Expression Compiler from Prof. Harold McIntosh at the Universidad Autonoma de Puebla, Mexico, is the closest thing to a language.

REC appears in quite a number of places in the SIG/M library. The most current versions, with and without floating point math, in CP/M 80 and CP/M 86, appear on SIG/M 214 and

215. However, using REC and its adjunct CNVRT (see SIG/M 215), McIntosh has done quite a number of other programs including Maze demonstrations (245), a giant game of Life that plays out over a period of days (246), multi-column and multi-file printing (254), a CP/M 80 to CP/M 86 translator (203), etc., etc., etc.

Anyway, the school finally bought the good doctor a PC (a Columbia, I think) and he now has a version of REC for MS-DOS. It's available on PC/Blue 211 and 212. This is not for the appliance user. However, in the hands of a hacker REC can be one of the most powerful tools one can get for the PC.

New Demon Shareware

A number of programs of interest are in the new batch of PC/Blue releases. There is a Ham Radio package on 219, and an RBASE clone called PC-RIM on 204, 205, and 206. (RBASE is a pretty good data management system. PC-RIM is similar, although slower.)

PC/Blue 203 has a pretty good program in Turbo Pascal called Reliance Mailing List. To show you how good I think it is, Bill Meacham (the author) sent SIG/M two copies of the program. One was for the PC and the other for CP/M. We gave Hank Kee his copy for PC/Blue and will put out the CP/M version very shortly. But I'm still pondering over the fact that the program requests a modest donation. Do we leave in the request, or recompile the code and delete it?

Version 2.6 of PC-Write complete with laser printer support is on PC/Blue 202. MR. BILL, a billing program by Dave Alexander, is on 207 and 208. Dave's CK, a time tracking program, is on 209 and 210. Hank Kee and I disagree on these programs. Dave sent them to me for Hank. While they do perform their function, I thought the screen displays were too poor to be used in a professional environment. I also thought that source code is almost mandatory for this type of program because of the need to customize.

Maybe this gets to the heart of the shareware concept. (As an aside, one letter from a reader asked me to define shareware. Shareware is the software equivalent of a bag lady. She sits there and asks for a handout and then curses you if you say no or ignore her.)

I'm sure that Dave Alexander wrote this program for his own use in his law practice. Since I also practice law and write software, I can assure you that law is much more lucrative. In the world of CP/M, people write software for their own use and then let their fellow computerists have a copy of it — by donating it to the public domain. The IBM people think every program they write is another Lotus. Come on, guys and gals — let's release the source code in the CP/M tradition and forget about trying to be a bag lady.

Of Toxic Gas, Pianos, Etc.

When I was a kid, my piano teacher quit on me. Perhaps that is why PianoMan on PC/Blue 216 played flat on my computer. I guess a tone deaf person has a non-musical computer. It does look cute, but I suspect that the quality of your audio is a factor in using it. PC-Key-Draw version 3.0 producing keyboard to screen graphics is on 217. There's an update to Genealogy on Display on 218 and a Toxic Gas Emergency Program from Canada is on 220.

Volume 201 contains something called Still River Shell, a file and directory management program, and Calc2, an extended precision calculator. You can do without both very easily. However, the Wagner File Utility is also on the disk. It gives you an overall view of your hard disk. Volumes 211, 212, and 213 contain something called AnalytiCalc. If you don't have a spreadsheet, you could use this.

Other Odds And Ends

I had noted earlier that the Everex Graphics Edge card in my PC did not support screen blanking. Mark Hersey of Hersey Micro Consulting, Inc. sent over a copy of Fansi-Console to solve the problem. If you have the same problem, the program is available on PC/Blue 161.

I watched Bill Cull demonstrate a ZCPR2 loader at the Trenton Computer Festival. He sent over a copy of it (called ZWDC) to play with. Unfortunately, it did not work on the Compu-Pro. However, if you have a Kaypro and haven't the skills to install ZCPR, you may want to contact Bill at 104 Burleigh Drive, Ithaca, NY 14850. He also promised a copy of a universal hard disk driver for the SIG/M library.

Getting The Software

Magazines are filled with advertisements for public domain software for purchase or lease. Most of those advertising are commercial companies. However, as long as their price is competitive and their service satisfactory, they are a good source of software. And they usually have a variety of formats.

You can get SIG/M and PC/Blue volumes through local distributors or BBS systems. They are not-for-profit computer clubs and provide these volumes as a public service. Or you can order directly from SIG/M (the Amateur Computer Group of New Jersey) or PC/Blue (the New York Amateur Computer Club).

SIG/M volumes are available on 8" SSSD disks for $6 each ($9 foreign) directly from SIG/M, Box 97, Iselin, NJ 08830. They are also available in most 5" formats. The charge for 5" disks is $7 per volume. However, for SSSD formats, or any format which requires more than one disk, please add another $2 per volume. Printed catalogs are $3 each ($4 foreign).

PC/Blue volumes are $7 each ($10 foreign). The printed catalog is $5. Both are available from the New York Amateur Computer Club, Box 100, Church Street Station, New York, NY 10008. Both groups have a disk catalog (Volume 0) available at the price of a standard disk volume. This catalog volume is usually more current and easier to get than the catalog.

■ ■ ■

By Dave Hardy
736 Notre Dame
Grosse Pointe MI 48230

A Z80 Slave Board

The TurboDos reviews continue. Plus, Dave covers sources of S-100 information, S-100 boards, and discusses power supply filter problems.

In this column, I'll be answering some questions from the reader mailbag before it explodes all over my desk. But first, let's take a quick look at Earth Computers' S-100 Z80 TurboSlave I board.

The TurboSlave I

Liked by its users, the TurboSlave I can run not only as a TurboDos slave, but also as just about anything else that's written in 8080 or Z80 code.

A built-in on-board monitor allows the board to be immediately powered up in an S-100 frame to take commands from a terminal connected to one of its serial ports. The board can boot immediately in a TurboDos environment, and can be told to boot other operating systems from the host machine with a simple monitor command.

Also built into the TurboSlave I is a set of diagnostic routines that will automatically check the board and flash an error message (or an 'OK' message) on an on-board LED. The tests include checks for a failed EPROM, bad RAM in either bank, the FIFO buffer, and the DUART serial I/O.

Here are the specifications:

* 8 MHz Z80H processor

* 64K or 128K of on-board 4164 dynamic RAM with up to 16K common area and parity error detection

* 2732 EPROM monitor (also accepts 2764 or 27128 EPROM)

* Two serial ports with software programmable baud rates (2681 DUART)

* A 2Kx8 FIFO buffer between the host processor and the TurboSlave I's port-mapped I/O

* On-board vectored interrupt capability to on-board Z80 CPU

* Built-in diagnostics (as mentioned above)

* Uses only two 8-bit I/O ports in the host processor

* Fully IEEE-696 compatible (of course)

* Requires 1.25A at 5V, 100mA at -16V maximum

Like most TurboDos slave processors, the TurboSlave I requires only two serial ports to talk to the host processor. Information is provided in the manual to allow the slave board to load just about any program or operating system from the host processor via the port-mapped interface as if it were a simple I/O device (which it actually is).

The TurboSlave I comes with a complete manual, including full schematics, a detailed theory of operation, sample drivers, and a disk full of TurboDos drivers and additional documentation.

Reader Mail

Several times, in past S-100 Bus columns, I've recommended to those interested in the S-100 IEEE-696 bus a book called "Interfacing to the S-100 IEEE-696 Bus" by Sol Libes and Mark Garetz. This book is really the definitive source of S-100 bus information, and even includes a copy of the IEEE-696 standard (as it was proposed when the book went to press). Many readers have written to tell me that they are unable to get the book from their local book stores. Unfortunately, I am told, it is out of print (and not likely to be reprinted), and therefore unavailable to new S-100 users who would almost certainly be interested in its contents.

Fortunately, copies of the IEEE-696 standard are still available from the IEEE, so at least the technical facts about the S-100 bus are still in print (and of course, you can always ask about it in "The S-100 Bus").

S-100 Board Sources

Many readers have also asked for sources of S-100 components, including boards, frames, and replacement parts. Well, there are many sources, although some of the old "standard" suppliers may have dried up. Readers interested in information about S-100 items can check those periodicals that support it (Micro C comes to mind as one...), write to or call S-100 manufacturers (there are still lots of them), or check with some of the many mail order houses that sell S-100 (for example, Priority One, Jameco, etc.).

TurboDos + SBCs

A very interesting letter from John G. Hall brings up the question of whether it's possible to use a single board computer (SBC) in place of a slave processor in a TurboDos system. In his letter, John also mentions that he thinks SBCs linked to a TurboDos system could be of great use in machine control applications where each might control a sophisticated production machine.

Well, I've never seen a stand-alone SBC linked directly into a TurboDos-based machine, but it's certainly possible. Since most slave processors used in TurboDos-based systems use only a few simple I/O ports, connection of an external SBC could be done with ease, as long as the proper transmission lines were established between the TD system's bus and the SBC.

There are already networking systems available for TurboDos that use twisted-pair or coaxial links between machines (even IBM PCs can run on them), so it would be possible, I suspect, to interface almost any SBC the same way. Peak Electronics (I believe) is even working on a 68000 SBC for TurboDos.

The Ripple Effect

Something to watch out for in older S-100 frames is the failure of the large filter capacitors that are used in the unregulated S-100 power supplies. Unlike the rather easy-to-detect failures in most other computers that use regulated power supplies, problems in the supply of an S-100 machine can cause insidious troubles that will lead to hair pulling.

Common symptoms of S-100 power supply failures include erratic disk operation, unpredictable system crashes, programs that begin behaving strangely, and very often, serial communications failures.

Interestingly, the capacitor that most often fails and causes these problems is the one that filters the -16 volt supply. Perhaps this is due to the fact that this supply is usually the least used, but often has a very large filter capacitor.

Very often, monitoring the suspect supply with a DC voltmeter will NOT find this kind of problem. An oscilloscope comes in handy for finding this trouble (which looks like excessive ripple or the output of an unfiltered bridge rectifier), but with a simple voltmeter, the problem will appear only as an unusually low voltage, or one that varies depending on the load from the S-100 boards.

I've seen this problem many times, in old Imsai and Altair frames mostly, and each time, accompanied by the above mentioned symptoms. If you are using an old S-100 frame, you may want to check the capacitors in the power supply and replace them while you still have your sanity.

Next Time

More S-100 mini-reviews, including more on TurboDos-compatible slave processor boards. If you'd like to see a mini-review of a certain S-100 product, please let me know, and I'll be happy to give it the once-over.

Of course, we'll also have more letters, including feedback, S-100 tips, and hints.

As always, I encourage reader feedback, and welcome questions, suggestions, comments, and ideas for future S-100 Bus columns. You can contact me c/o Micro C, on CIS 70150,102, Source TCH054, via GEnie mail at DJHARDY, or at the above address.

■ ■ ■

Poor Man's Networking:

By Doug Anderson
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Ottawa Ontario Canada K2B 6R1

Connecting Two CP/M Machines

Fancy new networks are showing up right and left, but they aren't for the price conscious or for CP/M users. This one is. With a serial port and a disk of software you too can connect two 8080/Z80 machines and make them talk. Doug tells us about his super-cheap home-brew networking scheme.

Like so many others, I've yearned for a multiuser or networked system, but I've never had the money. This article describes a package I developed to allow CP/M computers to be networked for almost nothing.

Networking?

A network lets computers share resources. For example, you could sit at one computer and access another system's data files. You could run WordStar, Express, or dBASE on one computer and print the output on a printer connected to another.

Commercial networks usually have one or more computers (with hard disks) acting as "servers" or "masters," and several other computers ("workstations" or "slaves") sharing the masters' resources.

Usually each slave and each master has to have a network interface board (costing between $300 and $500). These special interface boards often require coaxial cable to handle the high speed data transfers. All told, this kind of system costs big bucks.

I Can't Do It On The Ritz

I own an Altair with a Compupro Interfacer 4 and a Big Board. Both have serial and parallel ports. I have access to an Apple II clone, a NorthStar Advantage, and a Kaypro II, all of which have serial ports.

The serial port is the common link. All of the above computers are capable of communicating at 19,200 baud, fast enough to handle a large amount of information in a reasonable amount of time. Even 9600 baud is usable, but below that, response time becomes a problem.

System Requirements

After fiddling with the requirements for a network, I came up with this list:

1. Must be cheap.
2. Must not involve buying any additional hardware.
3. Must not take too much memory.
4. Must work acceptably fast.
5. Must be cheap.
6. Must not require a hard disk.
7. Must allow sharing of printers and disk drives.
8. Must work with an unaltered CP/M 2.2.
9. Must work without interrupts and be easy to install.
10. Must be cheap.

Networking For Poor Folk

My Poor Man's Network is simply a BIOS extension that's loaded into memory just below the CCP. (Or you can move your CP/M down by 6K and load the network software above CP/M.)

It's a generic BIOS extension, since it contains no disk parameter tables, just space for them. The disk specifications are loaded into the tables as they are received from the remote computer.

Capabilities

Poor Man's Network allows you to read files from or write files to another computer, even though the systems may have different types of drives.

For example, one computer might have 8" drives, while the other has 5" drives. You use the remote's disk drives by specifying the appropriate drive letter, as if it were your own drive.

Or you can share one or more drives with another computer on a Read Only basis. For example, you may allow the remote computer to run programs off your A: drive, while you retain read access to that drive.

Additionally, you can redirect output (LST: and TTY:) to another computer. This allows you to use the other computer's printers or plotter. Or you can redirect input (RDR:) from another computer, useful for sharing paper tape readers, digitizers, or other input devices.

You can also send one-line messages to the other computer.

A special driver section defines the actual interface to the port; there is nothing inherent in the package itself which implies the use of a particular kind of port. Nor is there a requirement for a hard disk, and no limitations are made on the number or types of disks.

What It Isn't

As with all things in life, you don't get anything without limitations. Following are a few of them:

— To simplify the programming, only two computers can reside on the network.

— Both computers must be running CP/M 2.2. Other versions of CP/M and other operating systems (including CP/M emulators on clones) are not yet supported.

— No alterations are made to CP/M, other than copying and replacing the BIOS vector table.

— 6K of memory is required, which may be located above CP/M (if you can move your CP/M down 6K) or in residence below the Console Command Processor (CCP), which itself takes 2K.

— Disks may not be removed while the network is active.

— Programs which bypass the normal CP/M calls to access the disk I/O directly can't be used in a network environment. These include formatters, track by track copy programs, some disk inspection/alteration programs, and disk test programs.

For example, if you run a copy program that directly accesses the disk controller on your machine, and you attempt to copy from your disk to a drive on the remote computer, you will probably wind up copying onto a disk on your own system.

— Data sharing is on a drive basis, not a file basis. That is, you give the remote user access to an entire drive. You may restrict access to Read Only or allow both Read and Write. If you give the other computer read access, you retain read access yourself. If you give read/write access, you lose all access to that drive until the network is terminated.

Using It

To start Poor Man's Network, each user enters a SIGNON command which specifies how the drives and printers, etc., are to be shared.

For example, suppose we have a SuperKludge 80 with three 8" drives, and a KayPlunk II with two 5" drives. On the SuperKludge, you might enter —

```
SIGNON B:R C:W H:
```

which means "my drive B: is available to the KayPlunk on a Read Only basis, my drive C: is available on a read/write basis, and I want a drive (H:) on this computer."

On the KayPlunk, you might enter —

```
SIGNON A:R F: G:
```

which means "my drive A: is available to the SuperKludge on a Read Only basis, and I want two drives (F: and G:)."

Poor Man's Network on the SuperKludge will communicate with its alter ego on the KayPlunk and match up the drive requests. Thirty seconds after typing the SIGNON command, each computer will respond with "Network successfully established," and the fun begins.

On the SuperKludge, you can do things with drives A: (which you kept), B: (which you are sharing), and H: (which is really the KayPlunk's drive A:). If you try to read from or write to your drive C:, you will get an "Access denied" error message, then a BDOS Select Error, and a warm boot. Since you gave write access to that drive to the KayPlunk, you no longer own it (at least until you type SIGNOFF or hit the reset button). The same thing will happen if you try to write on your drive B: or drive H:, because both of these are Read Only.

The KayPlunk has access to its own drive A: (Read Only), drive B: (Read/Write), drive F: (Read Only) and drive G: (Read/Write).

You can run any normal CP/M program as usual, specifying the drive letter for any of the drives to which you now have access. For example, on the SuperKludge, you can copy a file from the KayPlunk's drive A: (your drive H:) to your drive A: by typing a PIP command —

```
PIP A:=H:GRONK.TXT
```

Or you can run programs from the KayPlunk's disk A: by preceding the program name with H: —

```
H:STAT B:*.*
```

You can even make his disk your currently logged drive by entering —

```
H:
```

Amazing, isn't it?

What's more, there is no requirement that the disks be floppies. If you want to share a hard disk, or a RAM disk, it works just as well.

Sharing of printers, paper tape readers, etc., is done similarly; if you add the parameter LST:R to the SIGNON command, you're saying "my printer is available to the remote"; if you just specify LST: then you're saying "I want a printer."

How It Works

Poor Man's Network consists of three main modules — Setup, Debug, and NetBios, which are combined to make a single load module called SIGNON.COM.

Each module has a constant and an instruction part. The constant part contains all the variables and messages used by the module; the instruction

(continued next page)

(continued from page 75)

part contains all the machine instructions required for that module.

Setup gets control when SIGNON.COM is first executed. It analyzes the parameters specified on the SIGNON command and complains if it doesn't understand.

If the parameters are okay, it checks to see which disk drives are available and then stores the disk parameter tables in NetBios. This means that once the network is running you can't change disks. After all, changing a disk would invalidate the disk tables.

Setup then relocates NetBios (and optionally Debug) to the top of memory. If you know how to create a CP/M system 6K smaller than normal, you can tell Setup where to put NetBios by specifying the actual address in a variable in the overlay file. Otherwise, Setup checks to see if any other BIOS extensions are loaded, and relocates NetBios below the lowest extension or below the CCP. If debugging is called (a parameter when starting SIGNON), the code uses an additional .75K.

Setup now tries to talk to the other computer. It always politely listens before talking. If you invoke the debugging option, you can watch this process. If a minute passes without a response, setup displays "Failed to communicate with remote!" and dumps you back into CP/M.

If communications are established, the systems exchange system IDs and version numbers. (Thus, an upgraded version could support multiple computers.)

One system becomes the "master" and the other the "slave." The only difference is that the slave will listen a little longer before talking. (Helps keep the two systems from talking at once.)

Then the two computers exchange drive tables and Setup creates its vector tables. The CP/M BIOS vector table is copied into the relocated NetBios, and the NetBios vectors are copied into CP/M. The address at location 6 is altered to protect NetBios (if NetBios is located below the CCP), and then the program bails back into CP/M with a warm boot.

Control

NetBios takes control every time a CP/M BIOS routine is called. That is, every call to check console status, input or output a byte, read or write a disk, or whatever, is intercepted by NetBios. This is invisible to users, because NetBios maintains a type ahead queue to prevent keystrokes from getting lost. Each time there's a call, NetBios checks to see if the request is coming from the local keyboard or from the remote system.

Disk activity with CP/M consists of several calls to BIOS routines to set the track, set the memory address, set the disk number, etc. All of these calls are stored until there's a read or write request. When the request arrives, SetBios checks to see if the request is local or remote.

If it's local, the operation is performed immediately and the results returned. If it's remote, then a request record is built and transmitted to the remote computer, which performs the action, and returns a status record and possibly a data sector.

Installation

Before Poor Man's Network can be used, it must be installed with the appropriate I/O drivers. Drivers are provided on the distribution disk for Big Board I and II; Kaypro II, 2X, 4, and 10; Apple II with Super Serial board; Televideo 803 and Portable I; Compupro Interfacer 4; NorthStar Horizon; and NorthStar Advantage. You get both Assembler source and hex, so you can edit and reassemble the source driver if you wish.

You install the hex driver with DDT. You can alter the screen parameters and several other operational defaults with DDT. If you have another kind of computer, you will have to provide your own driver, either by modifying one of the drivers supplied, or by writing one from scratch. (Note that the drivers in MODEM7 are very similar to mine.)

Poor Man's Network is available for $69 from me at the above address.

■ ■ ■

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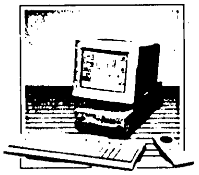

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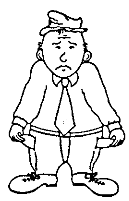

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Poor Man's Network works best with bidirectional parallel ports, or standard serial ports at 9600 baud or greater. Present version supports two computers only, and requires CP/M 2.2 on each computer. Uses only 6K of memory. Does not require a hard disk; runs on 8080, 8085, Z-80, HD-64180.

Poor Man's Network comes ready to run on BigBoard I and II, Xerox 820, NorthStar Horizon, NorthStar Advantage, Televideo TPC I, Kaypro (not 2000), Apple II (Super Serial required), S-100 with Compupro Interfacer 4. Can be installed on other computers by altering one of the assembler overlay files provided. Each disk contains drivers for all the specified computers.

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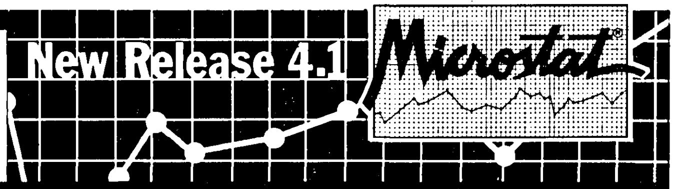

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A Cheap Megabyte For The Slicer

By Shawn McCutcheon
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This is another one of the cheap upgrades. In fact, if there's any way to make a system faster and bigger and cheaper, we'll soon hear about it. Shawn wins cheap honors this issue with this 1 Meg RAM upgrade for the Slicer.

I wanted to bring up Concurrent CP/M 86 on my Slicer, but I knew from Laine Stump's column (86 World) that my 256K wouldn't provide enough elbow room for CCP/M 86. I needed more memory. I couldn't afford a megabyte expansion board ($800 then), so I decided I'd have to scheme my own extra RAM.

Laine mentioned a 512K upgrade in issue #26 of Micro C, dubbing it the "Thick Slice" (you've heard of the Fat Mac?). I dug in.

How much RAM? Well, 512K would give room for a 250K RAM disk and a few concurrent processes, but a full Meg sure had a nice ring to it. Besides, I really needed room for an additional process — to get my techniphobic housemates up and running.

This article shows you how to upgrade to either 512K or a full megabyte.

The Trick

The existing Slicer RAM system is shown in Figure 1. Nice, clean, fast — 256k. But the irony of DRAM is that it's so reliable, yet forgets itself a few hundred times a second. So, enter the TMS 4500 RAM controller to remind the RAM. ("Hey RAM, remember that bit?")

The trick to this upgrade is to fool the 4500 into refreshing and controlling two or four times as much RAM.

This upgrade is possible because:

1. 256K chips are pin compatible with 64K devices. Pin 1 wasn't used on 64Ks, and is used as the 9th multiplexed address line (MA8) on 256K chips.

2. Only multiplexed address lines M0-M6 are used for the internal refresh address on the 256K chips (and most 64Ks, excluding TI and Micron Tech chips). So the extra multiplexed address line (MA8) isn't even involved in DRAM refreshing. Your old DRAM controller will continue to serve faithfully.

Now, since the DRAM refreshing is the same, we have to accomplish only two things:

1. Select the DRAM controller and support chips over the full range of RAM addresses.

2. Generate address multiplexed signal MA8. For 1 MByte: multiplex A18 and A19. For 512K (permanent or temporary): MUX A17 and A18.

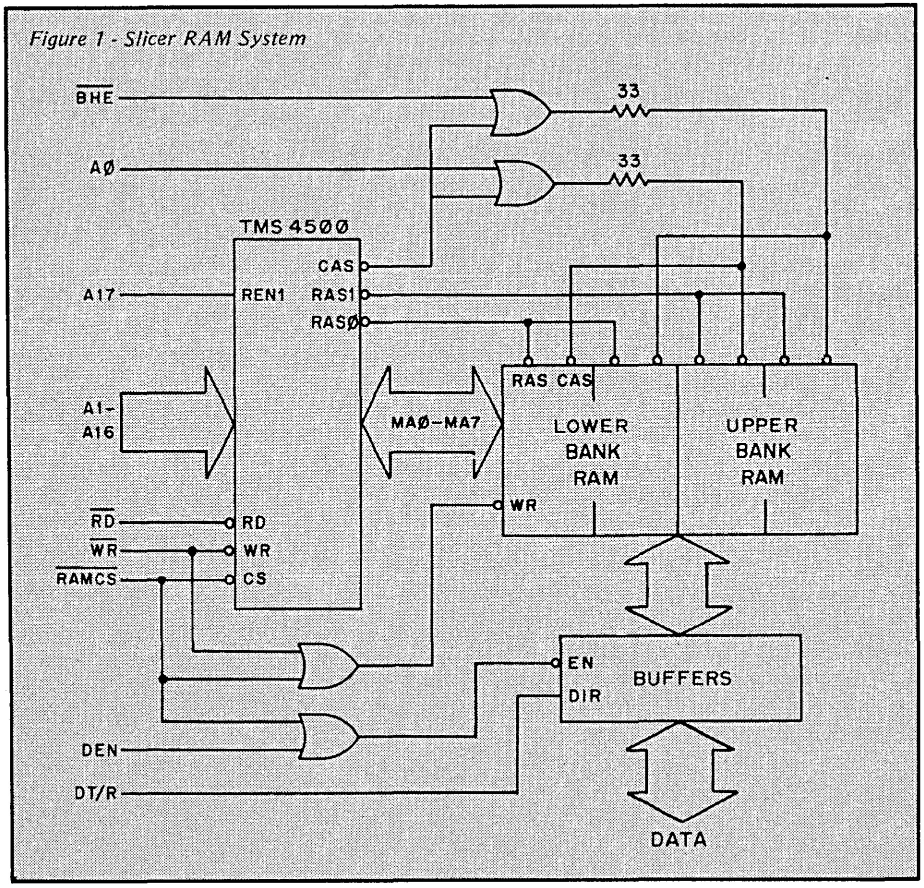
RAM Select

The chip selecting problem would be most elegantly fixed with a software change (the 80186 has programmable memory select lines), but the maximum space programmable to a single select line is 256K, so that doesn't help. We'll have to do a hardware mod.

Refer to Figure 2. I latched the CPU's S2 signal with a spare portion of the LS373 latch at U12 (ALE triggered). Since S2 is essentially "memory select," NANDing it with UCS/ (ROM chip select not) gives us RAMCS/.

In summary: Just NAND UCS/ with a latched S2.

Figure 1 - Slicer RAM System



Multiplexing

My first (successful) multiplexing strategy was to let the CAS signal drive the multiplexer. However, CAS must not reach the RAM before MA8 settles, so CAS has to be delayed.

Thanks to Mark York (CA), who has 512K up reliably, I found another approach. He suggested that since RAM latches the row address on the falling edge of RAS/, RAS/ can do the multiplexing too. By the time the addresses are multiplexed, the RAM will have latched the (old) row address.

So I used (RAS0/ NAND RAS1/) to drive the MUX select line of the LS157. The muliplexing takes about 25ns (from falling edge of RASx/ to MA8); RAM requires 20ns row address hold time (from falling edge of RAS). A bit tight, so DON'T use ALS parts!

Power Trips

Hey, before you get into the middle of this, make sure your power supply can handle the extra current required by the bigger RAMs. My data manual suggests that 256K chips use about twice as much current as the 64Ks, so your power supply must deliver about an extra amp (for the 1 Mbyte upgrade, half that for the 512K).

Details

My upgrade fits on a small daughterboard (see Figure 3), mounted on top of the Slicer at socket U12. You did use a socket at U12, didn't you? Oh well, nothing a solder sucker can't fix.

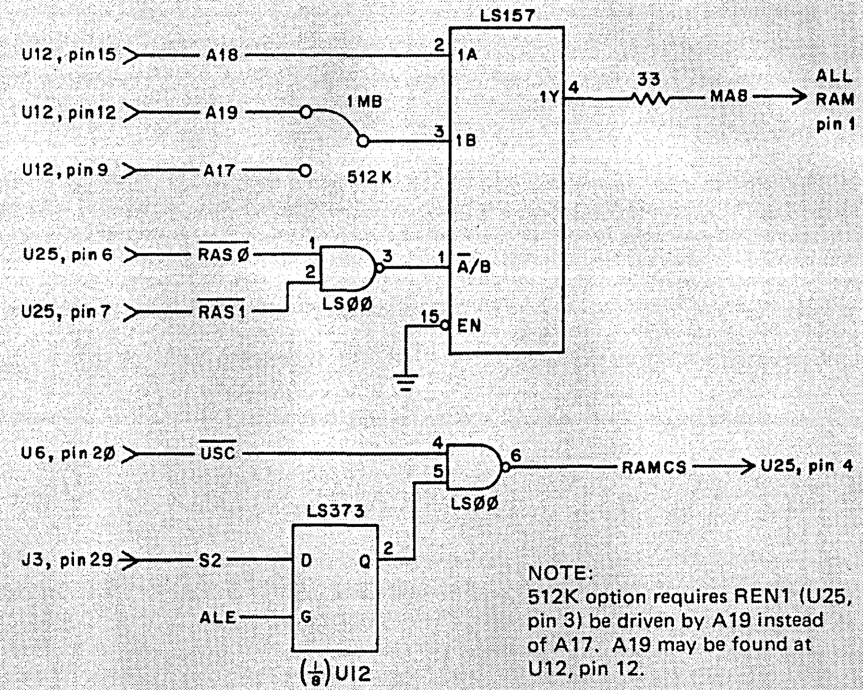
The daughterboard gets power and ground through U12, plus access to 3 addresses and latched S2. In addition, 5 signals (RAS0, RAS1, UCS, RAMCS, and MA8) must be hardwired to the board.

If there's enough interest, I'll build and sell the daughterboards (rough guess: $25 AT, $18 kit, $12 PC board). Please drop a line or post card if you're interested, and I'll get back to you.

For a megabyte, you'll need double stacked sockets, or you'll have to solder RAM chips piggyback, like in the DSI memory upgrade (Micro C,

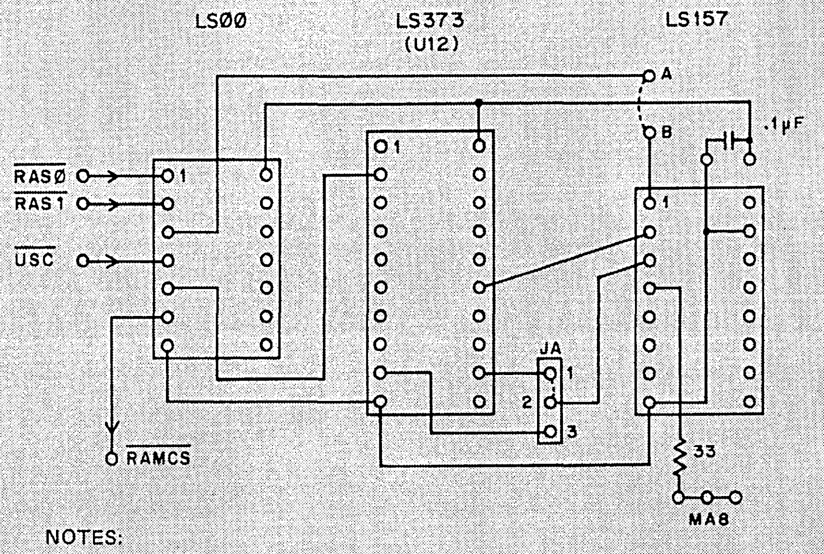
(continued next page)

Figure 2 - RAM Select Mod



NOTE:
512K option requires REN1 (U25, pin 3) be driven by A19 instead of A17. A19 may be found at U12, pin 12.

Figure 3 - Upgrade On A Daughterboard



NOTES:

1) Remember: This is a top view of the trace artwork on the bottom of the PCB.
2) The jumper at JA determines RAM configuration. Strap 1 to 2 for a megabyte, or 2 to 3 for 512K.
3) The resistor (current limits MA8) is mounted on the bottom of the board.
4) Add a jumper wire from point A to B, and don't forget the decoupling cap.
5) For 512K'ers, you may get A19 (for the 4500 REN1 input) from JA pin 3.

(continued from page 79)

issue 26, p. 51). Don't bite off more than you can solder.

I used Fujitsu MB81256-15 RAM chips (150ns) at about $2.90 each. I bought them from MicroProcessors Unlimited (who gave excellent service and chip installation advice). (Editor's note: be sure to get Japanese RAMs; U.S. 256K parts have been very poor quality.)

READ THIS: Buy plastic chips. The double stacked sockets won't accommodate the somewhat larger ceramic chips, and the ceramics I received had metal tops, so the lower socketed chips shorted the upper ones.

Flight Restrictions

Any expansion board RAM will be a prime target for conflict, due to contending (offending?) memory selects.

I called Slicer for help determining restrictions for all those additional boards I don't own. They were very helpful:

1. Those of you with the old 256K RAM expansion board may do the 512K main board mod. Jumper the expansion RAM to start at segment 8000. Then generate the main board RAMCS/ signal with: A19/ (latched) NAND S2 (latched). Note: grab A19 from U12 (pin 12) and invert it with a spare LS00 gate on the daughterboard to make A19/.

2. Those with the video board: video RAM starts at segment B000h, so you may do the 512K main board upgrade too. You'll have to generate the RAMCS/ signal the same as the 256K RAM expansion folks above.

3. No, you megabyte expansion board folks can't get another meg. You already have yours. Go away. (However, if you blow your own expansion board PROM, bank switch all the expansion board RAM, and devise your own RAMCS/ signal for the appropriate range, it might be possible to get 1.8 Meg. But don't quote me.)

Here's the small print (disclaimer time): as far as I know, the Slicer modifications I describe will work on all Slicer versions. I disclaim any warranties, expressed or implied ... squirm, squirm.

Theory To Reality

To begin, you'll need: a weekend, a very small soldering iron (and a soft touch), RAM (16 or 32 pieces plus spares), and prototyping equipment.

I suggest you construct your daughterboard using rub-on transfers on a single sided copper PCB. Transfers, PCB, and etchant are under $10 at Radio Shack. Just follow the layout in Figure 3.

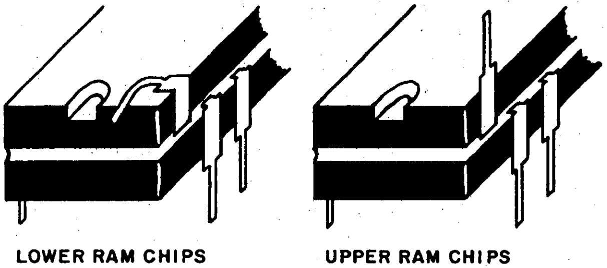
Voiding The Warranty

I found the RAM replacement and connection to be the most tedious part of this project. Double stacked sockets are awful to work with. No wonder they can't get auto-insertion tooling to do it. I'd heard that the unions are too strong these days ...

The biggest problem stems from the fact that the PC board was laid out with pin 1 tied to ground (for power bus convenience); remember pin 1 wasn't used with the 64K chips. So, you'll have to CAREFULLY bend every RAM chip's pin 1 as shown in Figure 4. For the lower socketed chips, flatten pin 1 onto the chip's back, then bend it north. For the upper chips, just bend straight up. (Editor's note: you may only get one shot at the bending. The second time the leg breaks.)

I know, it makes you woozy to deface $120 in chips, but it's the most painless way I can think of. If you've got a better idea (more respectful to the chips, nicer looking, etc.) let me know!

Figure 4 - Bending Pin 1 On The RAM Chips



Construction

1. READ your RAM distributor's static precautions. The smaller geometry necessary to develop the 256K chips also leaves them more susceptible to static.

2. Disconnect your Slicer board and get comfortable. Remove existing RAM; kiss good-bye.

3. Bend pin 1 for all RAM, as shown in Figure 4. If you have double stacked sockets, cut an eighth of an inch from the rest of the pins (see Slicer manual for help). Now install the first (only?) 512K in the lower sockets (U40-U55). Finally, solder all pin 1s together with a jumper wire (makes your Slicer look like it has braces).

4. Temporarily tie RAM pin 1 (MA8) to ground and power up to see a whopping 128K! That's good! If RAM errors appear (oops), use the memory test (MT) portion of the monitor to isolate and replace the bad chip (you did buy a couple extra RAM chips, didn't you?).

5. Full megabyte upgraders: Put the top set of RAM chips in, and again bus the pin 1s together. Make sure that upper RAM chip legs don't short out on lower chip legs. Tie all pin 1s to ground, flame on, and see your 256K back up and running. Your Slicer is usable while you work on the next step.

6. Build the daughterboard, as shown in Figures 2 and 3. It will contain the new RAMCS/ and address multiplexing circuitry. Install a wire wrap socket in the center position, with solder tail sockets for the LS00 and LS157. Populate the daughterboard and strap the address configuration jumper for the 512K or 1 Meg option now. You expansion board users: build your additional mods into

the daughterboard.

Note: I'll give signal origins below, but I found it easier to solder to feedthroughs to get signals to/from the daughterboard. Follow traces carefully, and do continuity checks.

7. 512K only: For 512K (permanent or temporary), you must replace A17 with A19 at the REN1 input (U25, pin 3). You'll find a convenient feedthrough between pins 10 and 11 of U25. Cut this trace and apply A19 (U12, pin 12). This mod will select the lower socketed bank over the first 512K.

8. Find S2 at J3 (pin29) and jumper it to the latch at U12 (pin 3).

9. Prepare to install the daughterboard by soldering a jumper wire to the following signals:

- RAS0/ : U25, pin 6
- RAS1/ : U25, pin 7
- UCS/ : U6 (ROM), pin 20 (socket pin 20, not chip pin 20; the chip is smaller than the socket)
- RAMCS/: U25, pin 4. On the solder side, follow the trace (toward the 80186) to the first feedthrough. Turn the board to the component side, grab the signal at the feedthrough, and cut the connecting trace (ouch).

10. Remove the chip at U12, install it in your daughterboard. Connect the RAS0/, RAS1/, UCS/, and RAMCS/ signals to the daughterboard. Jumper MA8 from the daughterboard to the RAM (pin 1). Remove the temporary jumper from MA8 to ground.

11. Plug the daughterboard into the U12 socket. Cross your fingers, meditate, pray, etc. Now power up and see your 512K or 992K (1 Meg minus ROM space).

12. Boot up, use the Setup program to configure yourself a 300K or 750K RAM disk. Reboot and copy your whole A: drive to the RAM disk. Be impressed. Oooo, tubular. That's a totally awesome RAM disk fer sure!

Debugging

Do you have the right signals? Check continuity and solder joints. Use the monitor and a scope to check signals RAMCS/ and MA8.

Short section, huh? I had zero problems, so I have no brilliant insight.

Wrap-up

Believe it or not, both my first PC boards (CAS MUX and RAS MUX methods) worked right first time!

I haven't purchased CCP/M 86 yet, and although it's a bit ridiculous, I've configured myself a 750K RAM disk. Funny, I never thought I'd use that much, but of course I already have (though I sometimes run out of directory space before I run out of disk space).

Note: I wrote this article glitch free on on my upgraded Slicer.

References

Slicer manual: DRAM installation.

MicroProcessors Unlimited : DRAM notes.

■ ■ ■

Build Your Own Inexpensive Logic Analyzer

Part 2, The Software

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The crickets are chirping, the air conditioner is running (it gets HOT in Missouri) and, once again, Don is working. With computers. Hardware won't work without software (sometimes it doesn't work with it), so here's a bare bones program to drive last issue's logic analyzer.

To run the software you'll need a computer, display (orange, lime, any flavor), and the logic analyzer card. The program will run without the logic analyzer card; the data won't mean much (third dimension information perhaps), but it will run.

The program in Figure 1 is intended to be a base to build upon. You can add bells and whistles to configure the software to your needs. You can input the necessary configuration data, trigger the card, and display the data. Additional features might include file or printer dump, timing diagram display (if you have a color card or Hercules compatible graphics card), disassembler, etc.

The program will accept the trigger words, clock qualifiers, and clock edge data and transfer the information to the logic analyzer. The analyzer is then released to acquire a 1024 by 32 bit block of data. When the data is loaded, control is returned to the software driver. An out is provided in the program to allow the software to regain control if the analyzer card hangs. (Say, a trigger word doesn't occur.)

After the data is latched into the analyzer, the software driver transfers and displays it. Then, of course, the whole process can be repeated.

If you have any questions or problems, feel free to call before 11 p.m. Missouri time. I hope you have as much fun building and using the analyzer as I did designing it. See you at the SOG.

■■■

Figure 1 - IBMSOFT.PAS In Turbo Pascal

```
Program Ibmsoft;

const
 In1     : Integer = $320;
 In2     : Integer = $321;
 In3     : Integer = $322;
 In4     : Integer = $323;
 In5     : Integer = $324;


 Out1    : Integer = $320;
 Out2    : Integer = $321;
 Out3    : Integer = $322;
 Out4    : Integer = $323;
 Out5    : Integer = $324;
 Restart: Integer = $325;



Type Infile  = Array [0..1023, 0..3] of Byte;  {storage for input data}

var
   FilePtr                                     : ^Infile;
   Test,Again                                  : char;
   Trig1,Trig2,Dontcr1,Dontcr2,Qual,Clkedg : Integer;
   Style                                        : Integer;

Procedure Trig_In (var Trig1,Trig2,Dontcr1,Dontcr2 :Integer);

var  Tempin        : Char;
     LoopCnt       : Integer;
     Bit_val, Code : Integer;
     Answer        : Integer;



Begin
     Trig1   := 0;
     Trig2   := 0;
     Dontcr1 := 0;
     Dontcr2 := 0;
     ClrScr;
     GotoXY (25,5);
     WriteLn('Input Trigger Words');
     GotoXY (15,7);
     WriteLn('Enter an X, 0, or 1 for each bit location');
     GotoXY (12,10);
     WriteLn('0- 1- 2- 3- 4- 5- 6- 7- 8- 9- 10-11-12-13-14-15');
     GotoXY (12,11);
     LoopCnt := 0;
     Answer  := 1;
     For LoopCnt := 0 to 7 Do
       Begin
        Read(Kbd,Tempin );
        Write(Tempin,'  ');
        Val (Tempin,Bit_val,Code);
        If LoopCnt = 0
          Then Answer := Answer
          Else Answer := Answer*2;
        If Code = 1                      {Don't Care}
          Then Trig1 := Trig1+Answer
          Else                           {0 or 1}
            Begin
              Trig1 := Trig1+Bit_val*Answer;
              Dontcr1 := Dontcr1+Answer;
            End;
       LoopCnt := LoopCnt+1;
       End;
     LoopCnt := 0;
     Answer  := 1;
     For LoopCnt := 0 to 7 Do
       Begin
        Read(Kbd,Tempin );
        Write(Tempin,'  ');
        Val (Tempin,Bit_val,Code);
        If LoopCnt = 0
          Then Answer := Answer
          Else Answer := Answer*2;
        If Code = 1                      {Don't Care}
          Then Trig2 := Trig2+Answer
          Else                           {0 or 1}
            Begin
              Trig2 := Trig2+Bit_val*Answer;
              Dontcr2 := Dontcr2+Answer;
            End;
       LoopCnt := LoopCnt+1;
       End;
     WriteLn(' ');

end;

Procedure Qual_Clock (var Qual,Clkedg : Integer);

var
   LoopCnt,Answer,Bit_val,Code     : Integer;
   Tempin                          : Char;

Begin
   GotoXY (20,14);
   Qual := 0;
   WriteLn('Qualifiers -> 0 - 1 - 2 - 3');
   GotoXY (34,15);
   LoopCnt := 0;
   Answer  := 1;
   For LoopCnt := 0 to 3 Do    {Get Qualifiers}
       Begin
        Read(Kbd,Tempin );
        Write(Tempin,'  ');
        Val (Tempin,Bit_val,Code);
        If LoopCnt = 0
          Then Answer := Answer
          Else Answer := Answer*2;
          Qual := Qual+Bit_val*Answer;
        LoopCnt := LoopCnt+1;
       End;
   GotoXY (17,18);
   Write('Enter clock edge (+ = 1 , - = 0) ->');
   Read(Kbd,Tempin);
   WriteLn(Tempin);
   Val (Tempin,Clkedg,Code);
End;

Procedure Configuration(Trig1,Trig2,Dontcr1,
             Dontcr2,Qual,Clkedg : Integer);

var
   Bittest,Config,Key,J   : Integer;

Begin
   Port[Out1]   := Dontcr1;
   Port[Out2]   := Dontcr2;
   Port[Out3]   := Trig1;
   Port[Out4]   := Trig2;
   {set up qualifiers and addr inc}
   Config := (Qual + Clkedg*16) + 32;
   Port[Restart] := 0;   ClrScr;
   GotoXY(25,15);
   Write('KIT ANY KEY TO STOP PROCESS');
   Repeat  {Wait until data input is complete}
     Bittest       := Port[In5] And 1;
     If KeyPressed Then Key := 0
     Else Key :=1;
   Until (Bittest And Key) = 0;
   If Key = 0 then Read(Key);
   Port[Out5] := $90;  {Then get the data}
   New(FilePtr);       {Set up array}
   For J := 0 to 1023 Do
       Begin
         FilePtr^[J,0] := Port[In1];
         FilePtr^[J,1] := Port[In2];
         FilePtr^[J,2] := Port[In3];
         FilePtr^[J,3] := Port[In4];
         Port[Out5]    := $B0;
         Port[Out5]    := $90; {Toggle next address}
       End;
End;

Procedure Display(Style : Integer);

var
    J             : Integer;

Begin
    ClrScr;
    WriteLn('Sample  0-7  8-15   16-23   24-31');
    WriteLn (' ');
    For J := 0 to 1023 Do
      Begin
        Write(J,'       ',FilePtr^[J,0],'   ');
        Write(FilePtr^[J,1],'  ',FilePtr^[J,2],'   ');
        Writeln(FilePtr^[J,3]);
      End
End;

Begin {Ibmsoft}

{First Get The Configuration data}
  Repeat
    Test := 'N';
    While Test = 'N' Do
    Begin
      Trig_In (Trig1,Trig2,Dontcr1,Dontcr2);
      Qual_Clock (Qual,Clkedg);
      GotoXY (17,21);
      Write('Is the data entered correctly (Y/N) ->');
      Read (Kbd,Test);
      Test := UpCase (Test)
    End;

{Then Set up the Analyzer, and get a block of data}

    Configuration(Trig1,Trig2,Dontcr1,
                  Dontcr2,Qual,Clkedg);
    Style := 0;
    Display (Style);              {Display Data}
    ClrScr;    GotoXY(25,15);
    Write('DO AGAIN? (Y/N)');
    Read(Kbd,Again);
    Again := UpCase(Again);
  Until Again = 'N';

End.
```

End of IBMSOFT.PAS

By Ron Miller
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Large Memory Space From A Small Memory Model

Small model, large model. There's a lot of difference when you're pricing a new C compiler. Fortunately you're not necessarily restricted to 64K with the small model compiler. In fact, Ron brings us 32-bit, 640K, unsegmented addressing on an 8088! With a small model C!

In a previous issue I mentioned the hobbyist's dilemma of whether to stick with a "small model" C in MS/PC-DOS or to spring for a high-priced compiler with far-this/long-that goodies and full 640K capabilities. Being sorely tempted by any chance to bully a new techno-toy into shape, I've been trying ever since to justify the expenditure, and I just can't. Not that our choice of playthings is strictly economic.

A year from now I'm likely to have an AT clone whirring on my desk, but buying a 286 machine — nothing less than an 8 or 10MHz version would do, of course — mostly to process words is like buying a Porsche to plow your garden. Still, my little business does need another compatible, but what on earth can I do with a large model C that I can't do with the small?

Who Needs More?

I don't know about you, but I've never written a C program that needed more than 64K worth of code. In a month or so of mad abandon I once soared up to the low 40s, and that CP/M utility became so convoluted that even its creator forgot all its nooks and crannies. It quickly became a recursive version of Dungeons and Dragons, with the operating system playing "gotcha" every once in a while.

Maybe if I wanted to compete with the Lotus Development Corporation on my weekends I'd run smack into the code-length barrier. But for me the fun of C is its elegance, directness, and compactness, and when I start generating 30+ K worth of code, things are getting tight-lipped and serious. On a few occasions I've fantasized about having more than 64K worth of data for monster arrays. I always find, however, that not all the work areas are being used at once, and a little pointer magic lets the data space serve double purpose.

More frustrating in the long run is my hankering after 32-bit pointers for swapping interrupt vectors and diddling with screen buffers, yet MS-DOS provides function calls to do those very jobs, and at Assembly language speeds, too. It would be fun, I admit, to "*ptr++" from time to time across the CRT display, tossing characters and attributes as I go. However, is that millisecond of delight really worth $250? I doubt it.

The only real hangup comes from the heap. Even programmers of moderation find that databases tend to exceed 64K very quickly. Long databases accessed in memory require long pointers. With this convenient need in hand can the purchase of a new compiler be excused?

Moving Instead Of Pointing

Alas, no. You can get around the 64K heap limit if your small version of C offers you a utility to move runs of memory from one place to another within the entire 640K. With this "move far" call you possess extended peek and poke capabilities. (Well, that's what my Toolworks C calls them. Those of you suffering from flashbacks to BASIC can substitute less painful names.)

If these two operations don't explicitly come with your package and you have access to in-line code or to a linking assembler, they are trivial to write. Just load ES:SI and DS:DI with pointers to source and to destination, load CX with the length of the run, and do a REP MOVSB. The 8086 family iterated move statement is unbelievably fast.

To illustrate the relative ease of substituting long moving for long pointing with small C, I'd like to create a binary tree that can exploit the full 640K. I'll assume you know what a binary tree is and how effortlessly new application routines can be written once the basic tree has been designed.

Editor's note: For those of you who weren't around when the first computers were created, the binary tree was the first source of fresh bits (of both types). There were whole fields of binary trees (bit fields) and their bits were stored in cores (if memory serves me correctly). Now, of course, they've synthesized bits, so we've turned to using binary trees for searching and other sorted affairs.

The operations shown in Figure 1 are vacuous, but once you see how to do it, no doubt you'll think of uses.

Bargain Basement Far Pointers

To store addresses in the left and right branches of every member, we will need a 32-bit data type. I'll use the long — redefined as a "farpointer" — as a pigeonhole, with the segment address as the high word and the offset as the low. Those of you who have very, very small Cs without the long data type can define a two-integer structure to do the same job, though the code will become a little more cluttered.

Every time the heap pointer (another long masquerading as a "farpointer") is incremented, I'll adjust the high and low words with modulo 16 arithmetic to avoid segment boundary problems. Once that's done, to all events and purposes the heap exists in unsegmented memory addressed by a 32-bit pointer.

The heap will begin at the first paragraph of free memory, which is returned in the AX register by MS-DOS function call 48H. We will need to make that function call anyhow to let MS-DOS know we want the free memory to play in: don't ask, and the cutest error messages show up when you try to return to the operating system.

If you are really pushed for space you can lower your stack pointer and start the heap deep within your data segment — but that gets delicate and complicated, and this column is becoming technical enough without further allocation acrobatics. Suffice it to say that with a bit of care you can overlay everything but the code itself, the statics at the bottom of the data segment, and a tiny bit of stack to support recursion. The sacrificial section of COMMAND.COM may take a beating, but it's used to that.

Since binary trees are built (surprise!) on binary comparisons, we'll need two buffers within the data segment: one for the primary database element in question, and one for the element with which it's being compared. To add to the database, just poke the element from the primary buffer up to the top of the heap and push the heap pointer up by one unit's length.

To alter the pointers within a node, just peek the member down into the secondary buffer, change the right or left farpointer, and poke it right back where it came from.

The only other complication that comes with this shuffling is that the "equals" sign won't work as it does when honest pointing is going on. Consider, for example, the usual trick of using the recursive function return of the address of database branches to set the right or left pointers of nodes. The traditional way to build trees is to set up a routine like so:

```
if(pointer null) {
    add member at top of heap
    return address
    use equals to set right or
       left pointer of previous
       node to address
  }
 else if(test yields less than)
        set left member equal to
        next function call
      else
        set right member equal to
        next function call
```

Elegance in action. Unfortunately, through the magic of high-speed shuffling, the various elements all have the same working location, the secondary buffer inside the data segment. Any recursive function call returns a heap address of a branch to that branch itself. That bit of circularity makes for strange binary trees indeed.

What one must do instead is keep track of (a) a global storage area containing the 32-bit address of the previous node examined and (b) a flag telling whether the branching there was from the right or the left. So long as one is hopping merrily from node to node, no changes need be made. But when an unoccupied branch is finally reached, the secondary buffer must have its resident right or left farpointer altered, and the node must then be poked back up where it belongs.

A lesser complication occurs on all recursive searches. To point to an element is in fact to load it into a buffer. Hence the buffer contents change both as one climbs out upon and as one returns back along the various branches. The traditional binary tree operation —

```
if(pointer not null){
  do it to element pointed to by
    left pointer
  do it
  do it to element pointed to by
    right pointer
  }
```

must therefore be modified to —

```
if(pointer not null){
  load element
  do it to element pointed to by
    left pointer
  reload element
  do it
  do it to element pointed to by
    right pointer
  }
```

How Much Slower?

The printem() function in Figure 1 illustrates this twist. All this sleight of hand sounds complicated and, worse than that, slow. But it's really not. The efficiencies of recursion are still available to you, and it's fast enough with the 8086 string move calls that you'll never notice the difference, since binary searches in trees involve a minimal number of recursive calls.

I tried to measure the overhead of the method by doing repeated simple linear searches through the entire 2500 member database from beginning to end. Granted, it's a gross misuse of the tree structure, but it does measure the "pointing" overhead rather directly. The tree generated below took about 3.4 seconds to run through. For comparison I created an identical tree in Turbo Pascal, which uses long pointers directly, and the trek took about 0.8 second.

Since no practical use of binary trees I can think of spends more than one percent of the CPU time doing searches, who cares if finding a member takes forty milliseconds rather than ten? The important things are access and capacity, and those we have in abundance.

Complications

As I said, those of you patient enough to follow me this far have had at least a tad of experience with binary trees and can see the method and adapt it to practical situations. If you don't mind working with headers and doubly linked lists, you could go all the way and simulate the standard Unix-style malloc() and free() functions, though I find it easier to flag a database member I don't want to "see" and get rid of it permanently while rewriting back to disk. The space saved not having to deal with allocation headers more than makes up for the occasional hole in the heap: just stack 'em up like pancakes.

Figure 1 shows how I create the database with a random number routine and then list the integers to be sure the tree was properly formed.

Once you see how the tree is created, examining and modifying database elements is easy. You may still decide to buy a "long" C compiler anyhow, but you'll not be able to use database operations as your excuse.

■ ■ ■

Figure 1 - Binary Tree Program on pages 86 and 87.

```
#define MAX 2500      /* a suffiently large number */
#define LEFT -1
#define RIGHT 1
#define ROOT  0
#define NIL 0x0L      /* to steal a term from Pascal. Just */
#define farptr long        /* a simple "0" won't do */
#include "stdio.h"
#include "regs.h"    /* header to define structure to hold
                              registers for interrupt calls */
struct record{
   char stuff[126];      /* the primary database element */
   int t;
   farptr left,right;
   }prim_buff,sec_buff;
 struct pointer{
   int _ofs,_seg;        /* a convenience for overlaying longs */
   };
 farptr rootptr,heapptr,last,alloc_far();
 int size;
 struct regs rr;        /* register storage */
/********************************/
main()
{
  int i;


  size=sizeof(struct record);
  rr.bx=0x7000;
  rr.ax=0x4800; /* Dear MSDOS, may I have 70000H bytes to play with? */
  interrupt(0x21,&rr);  /* MSDOS function call */
  heapptr=0x10000*rr.ax; /* initial segment address to high byte */
  for(rootptr=NIL,i=1;i<=TOP;i++){
    prim_buff.left=prim_buff.right=NIL;   /* the actual tree formation */
    prim_buff.t=rand();               /* Here's where you'd get practical */
    treemake(rootptr,ROOT);
    }
  printem(rootptr);  /* trivial test to see if it worked */
 }
/************************/
treemake(next,hand)
 farptr next;
 int hand;
{
 if(next == NIL ){
   if(hand==LEFT) sec_buff.left=heapptr;
    else if(hand==RIGHT) sec_buff.right=heapptr;
    else rootptr=last=heapptr;             /* special treatment for root */
   unyank(&sec_buff,last,size);            /* last node sent back home */
   unyank(&prim_buff,alloc_far(size),size); /* new member to the top of  */
   }                                        /* the heap */
  else{
   yank(&sec_buff,next,size);         /* try the node */
   last=next;                         /* store address of last node */
   if(prim_buff.t<sec_buff.t) treemake(sec_buff.left,LEFT);
    else if(prim_buff.t>sec_buff.t) treemake(sec_buff.right,RIGHT);
   }
}
```

```
printem(pp)
  farptr pp;
{
 if(pp != NIL){
  yank(&prim_buff,pp,size); /* see text for explanation of the second "yank" */
  printem(prim_buff.left);
  yank(&prim_buff,pp,size);
  printf("%d\n",prim_buff.t);
  printem(prim_buff.right);
 }
}
/*****************/
yank(place,ptr,n)
  char *place;
  farptr ptr;
  int n;
{                                  /* In my implementation, "place" is the */
 peek(seg(ptr),ofs(ptr),place,n); /* buffer address inside data segment. */
}                            /* This would be a nice place for inline code. */
/*****************/
unyank(place,ptr,n)
  char *place;                /* see "yank" */
  farptr ptr;
  int n;
{
 poke(seg(ptr),ofs(ptr),place,n);
}
/*****************/
farptr alloc_far(len)     /* boosts heap pointer by length of */
  int len;                /* element & returns pointer to cubbyhole */
{                         /* just below top of heap */
   farptr bottom;
   int inc;
                          /* normalizing addresses with modulo 0x10 work */
   bottom=heapptr;        /* shifts and and's are just faster */
   inc = ofs(heapptr) + len;
   heapptr = ( seg(heapptr) + (inc >> 4) )*0x10000 + (inc & 0xf);
   return bottom;
}
/***************************/
int seg(fp)
 farptr fp;
{
  struct pointer *pp;

  pp = &fp;
  return pp->_seg;        /* return high byte of long */
}
/************************/
int ofs(fp)
 farptr fp;
{
  struct pointer *pp;

  pp = &fp;
  return pp->_ofs;       /* return low byte of long */
}
```

End of Binary Tree Program

The Green Hills C Compiler

Full Optimization For The 32032

Reviewed by Dave Rand
72 Longfellow St.
Thousand Oaks CA 91360

There are three commercial compilers available for the DSI-32 board, all of them from Green Hills: Pascal, FORTRAN, and C. Of the three, the one most used by the Definicon staff is the C compiler. Dave covers the strengths of this implementation of the language.

One of the compilers available for the Definicon DSI-32 board is the Green Hills C compiler. This single pass, fully optimizing compiler uses advanced techniques and is a full implementation of the C language, as defined in "The C Programming Language" by Kernighan and Ritchie. In addition to the standard, several extensions have been included.

Whenever people discuss "The C Programming Language" by K&R in relation to a particular implementation of C, a few tempers are bound to flare. Some C compilers implement K&R, but leave out bit fields. Others don't have floating point. But the Green Hills compiler has all the language features. In addition, the Definicon MS-DOS interface brings features of the Unix implementation of C to the DSI-32.

The Preprocessor

The Green Hills compiler also includes another feature of the Unix C compiler — the preprocessor. In fact, since the Green Hills compiler is a single pass compiler, the preprocessor is actually part of it, rather than a separate program. This speeds up compile times for large programs.

The preprocessor has two reserved variables: ___FILE___ and ___LINE___.

___FILE___ contains the current filename of the program being compiled, and ___LINE___ contains the integer representation of the current line number. During debugging, the following code could be used:

```
if (a > b) printf
   ("Warning: line %d in %s, a>b!\n",
    __LINE__,__FILE__);
```

which would print an error message if 'a' was greater than 'b,' containing the current filename and line number.

Enumerated Data Types

Enumerated data types are supported as well, allowing you to define your own type of variable. For example, if you were writing a traffic control program, you might wish to have a variable contain the current traffic light color. You can do this as follows:

```
enum color {red, yellow, green} light;
```

This creates two items: an enumeration identifier (color), and an enumeration variable (light). To make the light red, we simply assign red to the variable light:

```
light = red;
```

Since we have a new enumerated type defined, we can declare another "color" variable easily:

```
enum color light2;
```

Note that since the color identifier is already associated with the values red, yellow, and green, we don't need to reiterate them. The variable light2 may now be used as light is in the previous example. As you can see, the enum keyword operates in much the same way as the struct keyword.

More Features Of Green Hills C

Bit fields are often not implemented in C compilers. Not so in the Green Hills compiler! To declare a bit field in a structure, follow the variable name with a colon, and the length (in bits) of the bit field:

```
struct BITS
{
   int active:1;
   int ready:1;
   int count:4;
   int last:2;
} tape;
```

This declares the structure tape. To use BITS, treat it as a normal structure reference:

```
tape.active = 1;
tape.ready = 0;
tape.count = 7;
tape.last = 0;
```

In the Green Hills compiler, a bit field may have a maximum length equal to the least amount of storage possible.

Bit fields can be used to save data space. Imagine a program that records Yes or No responses to a number of questions. By using an array of structures with bit fields, the amount of memory (and disk space) used for each set of questions can be reduced significantly.

Bit fields are also used in graphics. On the IBM Color Graphics adapter, either one or two bits are used in graphics modes. By having an array of structures of bit fields, you can represent the entire bit image of the graphics adapter in your C program.

The ASM Function

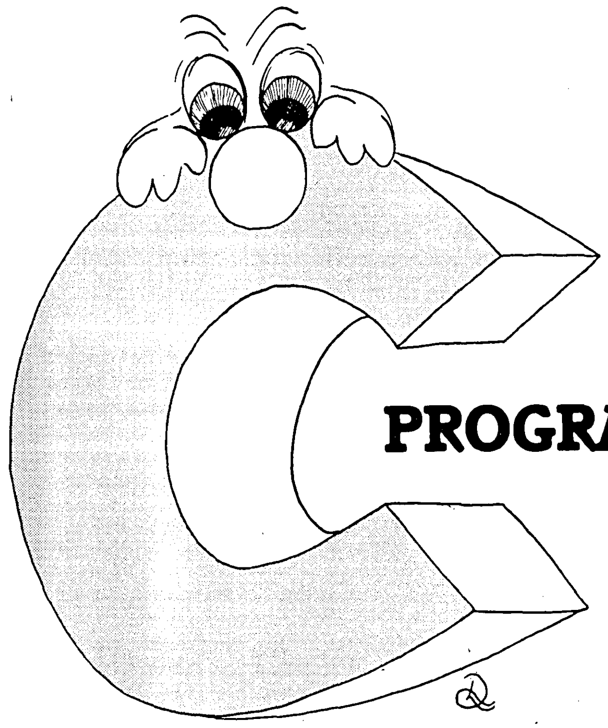
Another feature of the Green Hills compiler is the ASM function. This function permits the use of assembly language directly from C, as follows:

```
main()
{
   printf("Hello, world!");
   asm("movqd 0,r1");
   asm("movd 15,r0");
   asm("SVC");
}
```

On the DSI-32, this would cause a "terminate" service call. The ASM function allows code to be written to take advantage of machine instructions, not normally generated by C.

■ ■ ■

MICRO CORNUCOPIA'S C CONTEST



If you've been going so hard you just can't C straight, then drop everything, dig out the old compiler, brush off the cobwebs, and C what you can C.

Any kind of C. From Small-C to large, from a hundred lines up, this is your chance to C'cure fame and glory (plus valuable prizes).

PROGRAMMING CONTEST

SCORING — The programs will be judged by the Micro C staff on the following:

0-15 for ALGORITHM
0-25 for CODE ORGANIZATION & READABILITY
0-40 for PROGRAM FUNCTION
0-20 for USER DOCUMENTATION

GRAND PRIZE:

- DSI-32, 1 meg, 10 Mhz 32032 computer board with assembler/linker from Definicon Systems
  21042 Vintage St., Chatsworth, CA 91311
- Optimizing C Compiler (large model)
  from Manx Software, Box 55, Shrewsbury, NJ 07701
- Essential Software's C Library
  (graphics, I/O, everything)
  from Essential Software, Inc.
  Box 1003, Maplewood, NJ 07040
- 3 year subscription to Micro C

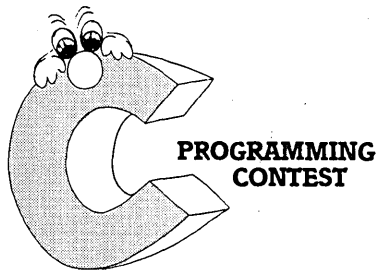
1st & 2nd Place

- Optimizing C Compiler (large model)
- Essential Software's C Library (graphics, I/O, everything)
- 2 year subscription to Micro C

3rd - 5th Place

- Aztez C Prime Package
  (interpreter & compiler)
  from Manx Software
- 1 year subscription to Micro C

--------- CONTEST DEADLINE November 1, 1986 ---------



ENTRY FORM

Program Title ____________________________

Purpose ____________________________

Which C compiler? ______________ Target system(s) ______________

Please include source and object files on disk.

NOTE:
I hereby release this program to the public domain and give Micro Cornucopia the right to print the listing.

Signature ____________________________

Name ____________________________

Address ____________________________

City ______________ State __________ Zip __________

MICRO CORNUCOPIA
P.O. Box 223
Bend, Oregon 97709

EDITORIAL

(continued from page 2)

I've spent years perfecting my working space. My #2 Big Board has been allowed to remain because it's very, very quiet (and very, very heavy).

When I work on a PC I often use personal noise reducers: ear plugs and earphones. They help, especially if the music is right, but that's not the whole answer. The Kaypro 2000 is very quiet (it doesn't have a fan) so I purchased a base unit for it. Unfortunately the base unit has a nasty, uncouth blade spinner that runs constantly, even when the 2000 is turned off.

I'm sure there are quiet fans. We're talking about moving air here, not calling out the volunteer fire department.

ARC Enemy

There's reportedly a version of ARC (fancy MS-DOS library utility often used in conjunction with bulletin boards) that erases the system tracks on hard drives. (Heavy duty worm ware.)

The latest valid version of ARC is version 5.12. The worm ware version identifies itself as 5.13, but there's no way to get it to identify itself without exposing your system tracks to its malevolence.

However, the good version of ARC.COM (which splits itself up into ARC.EXE and ARC.DOC) is 59K. The worm version is 34K (and doesn't split). The copy on the Micro C bulletin board works fine.

1.2 Meg Floppies On XTs

Bob Carol called me one afternoon and mentioned that Newport Components of Newport Beach CA was selling a special 1.2 Meg drive and support software to run on PCs and XTs. Well, at 1.2 Meg per disk, you have a decent way of backing up winchesters. At $190, the price seemed reasonable.

I called them and asked if I could borrow one to review. "Sure," they said.

Well, it came. The software worked okay; the drive, on the other hand, didn't.

The drive looked like a cheap version of a standard floppy. It connected to a standard XT floppy controller which meant that, unlike the AT drives (which transfer data at 500K bits/sec), it was moving data bits at 250K/sec. So the spindle had to turn at half the rate of the normal 1.2 Meg AT drive.

That's a pretty heavy handicap. The intensity of signal is proportional to the velocity of the disk under the head. That's why marginal drives usually have problems on the inner tracks.

I checked out the system. Sure enough, it formatted and wrote, but when it came time to verify the data, it choked. On the inner tracks. And it did it on super quality 1.2 Meg certified, unfolded, very expensive disks.

I returned the drive. I still have the disks. They work great on our 286i (but not at all on standard DD or QD systems). Oh well.

Meanwhile, the word is that MS-DOS 3.20 ($75) comes with a driver for quad density drives. You get 720K per disk and you can use all those generic, off the shelf, under the counter, and over the wall disks that have been just itching to hold data again.

Cheap Clones

I've been watching prices of clones and clone boards lately. The figures I've seen lately in PC, PC World, Computer Shopper, and Byte have been about double the prices listed by Taiwanese manufacturers. In other words, a $695 system in Byte (a small empire) would cost about $350 in Taiwan (also a small empire).

However, there have been predictions that minimum level 4.77MHz clones will be available for $300 before Christmas (here in the U.S.). It'll be interesting to see if it happens.

I know, for a fact, that you'll be seeing some excellent prices on ATs and 80186 equivalents of ATs. In fact, board prices for these units will soon be approaching the prices of standard 8088 units.

I've been watching the advertising flyers that have been going through the office. May Computers Corporation has some interesting prices. I've called them and they sound real, but I haven't ordered from them so I can't attest to their service.

Anyway, in addition to their regular (very competitive) price sheet they also include a sheet of specials. In their latest mailing one of the specials was an EPROM programmer card with software for $50. It burns 2716s through 27128s (both unleaded and regular). Another special was a Selectric style keyboard for only $40.

May Computers
8210 Katella Ave #D
Stanton CA 90680
(714) 897-2037

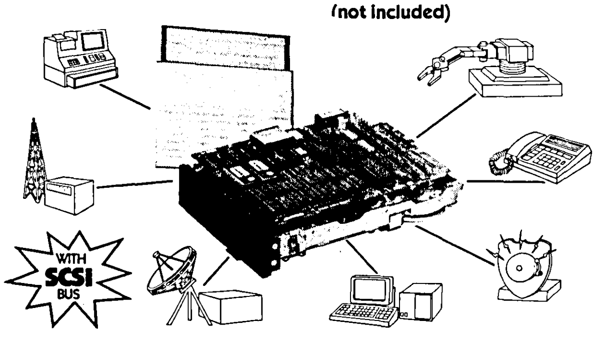
I'm still happy with the service we've been getting from Sky High. The only complaint I've heard about them is that communications on the phone can be a bit of a struggle (it helps if you put it down on paper and mail it). If you get the wrong thing, they'll exchange it. See the Sky High ad in this issue.

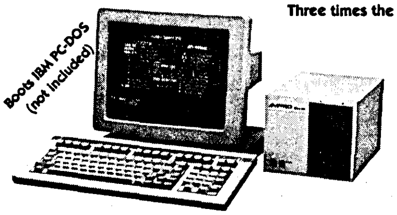
Also, I just saw an ad for a 1200 baud, standalone, Hayes compatible, almost lookalike, modem for $129. (When the Duck finds out, feathers will fly.) Unfortunately I misplaced the $129 ad. Oh well, by the time I find it there'll be a $99 ad for me to lose.

(Wait a minute, I remember where it is... Somewhere. Here. BCE Liquidation is selling a General DataCom Aculine 1200. It's a 1200 baud, standalone, Hayes compatible with software for $129. 15 day trial, 2 year warranty etc. etc. etc. I haven't dealt with them, so you're pioneering on this one. Let me know how you make out.)

BCE Liquidation
3233 K St NW
Washington, DC 20007
(800) 545-7447

(continued next page)





EDITORIAL

(continued from page 91)

Reflections On Mirror

Last issue I mentioned Mirror, the $49.95 super communications package. I also mentioned that it was slow writing to disk. Well, it turns out that it opens and closes the file each time it writes. It can't leave its file open because it might be running in the background (and with open files spotted about, things get very messy for MS-DOS). This is definitely my favorite modem package, and at $49.95...

Anyway, a number of you called to find out how to contact SoftKlone (the Mirror folks).

SoftKlone
(800) 538-8157
(800) 676-3470 CA

Advertisers

All of this talk of packages and cheap boards brings us to advertisers. The good ones are great. I love reading the ads in Micro C, Byte, and Computer Shopper. I love reading good catalogs. Hey, children don't have a monopoly on the wish books.

On the other hand, the bad advertisers are a pain. I mean, you're all ready for Christmas (whenever it is) and you get junk, or nothing at all, or they didn't tell you the most important part.

"Oh, it doesn't work? But it will — all you have to do is replace the drive controller board." (Which in our case means also replacing the serial port, parallel port, and real-time clock.)

The technician on the other end of the line wasn't upset. He didn't have to be; I was upset enough for both of us. Putting a tape backup on a clone should be trivial, but I'd already spent two months trying to figure out why their software wouldn't select their drive. MS-DOS didn't have any trouble.

"Of course, I still can't guarantee that it'll work. We haven't completely figured out when it will work and when it won't."

They didn't say that up front. When Larry placed the order.

"Hey, our tape drives are turkeys, but if you want to piddle around with one, and try to make it work — then we'll agree to send one. Eventually."

They didn't say that. But they should have.

Fortunately, I didn't see their ad in Micro C. In fact, I asked them if they'd ever heard of Micro C. They hadn't.

"Good," I said. "It's a bad place to advertise."

If you'd like to know who I'm talking about, it's Micro Design International in Winter Park, FL. It turns out that they are selling the Alloy APT-40, a 40 Meg tape drive manufactured by Peripheral Technology. (Peripheral Technology also wrote the buggy software.) I'd avoid anything with an Alloy drive in it for the time being.

Amiga Watch

I've been assuming that Amiga and the ST are thrashing it out, blow by blow. I've been figuring that if the Amiga goes down it'll be at the hands of Atari (or vice versa).

But I might be wrong. As long as the Amiga remains a home machine (a majority of the sales so far) its real competition is the Commodore 64 and 128. (You've heard of the Commodore 64. It's the only computer slow enough to run alongside an Apple II without snickering.)

Insiders are attributing most of Commodore's $36 million loss last quarter to the Amiga. In fact, word is that Commodore has cancelled several large Amiga software projects because of poor hardware sales.

Commodore had a 2-month $500 off special on the basic system with color monitor ($1295 for the package) in an attempt to get systems off dealers' shelves and into the hands of folks who might purchase software (so there'd be more software sales and more hardware sales and more software and more hardware...).

Company officials noted that they weren't going to be continuing the special because they couldn't live on $1295. Dealers, on the other hand, weren't sure they could make a living selling a games machine for $1795.

Of first quarter industry software sales, 3.4 percent were for the Amiga, 24 percent were for the 64 and 128 (source Micro Marketworld). Atari ST software accounted for a mere 1.5 percent.

Finally

Insiders are telling interesting stories. Commodore is planning to sell its IBM clones in the U.S. (they've been doing well in Europe). And, the company may be trying to kill the Amiga by simple neglect.

The long-awaited software package that lets the Amiga emulate the PC is now available, but it suffers the same problems as the SWP 8088 board. It doesn't support sound or graphics. Commodore has published a list of the programs (and versions of programs) that do run, but the list isn't very long. Also, PC programs take 2 to 4 times longer to run on the Amiga than they take on the PC.

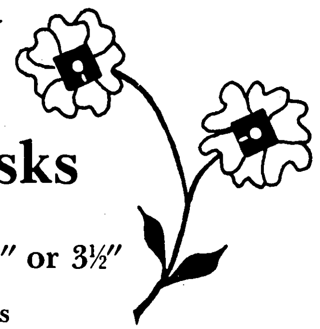
Editors of Commodore mags feel that the Amiga would have to be priced at $595, complete, to become a significant player in the home market. And even then it has a problem because there isn't an upgrade path from the 128 to the Amiga.

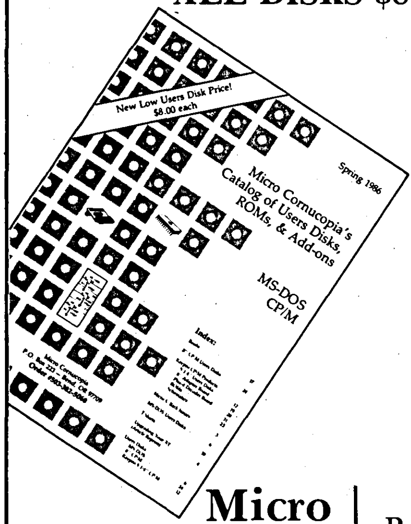
Perhaps Commodore should have come out with a 64 emulator rather than a PC emulator. That way no one would have noticed how slowly it ran.

Meanwhile, Commodore can count on continuing sales of the 64 and 128 (continuing at least until PC clones become cheaper than the 128, which shouldn't happen before, say, September).

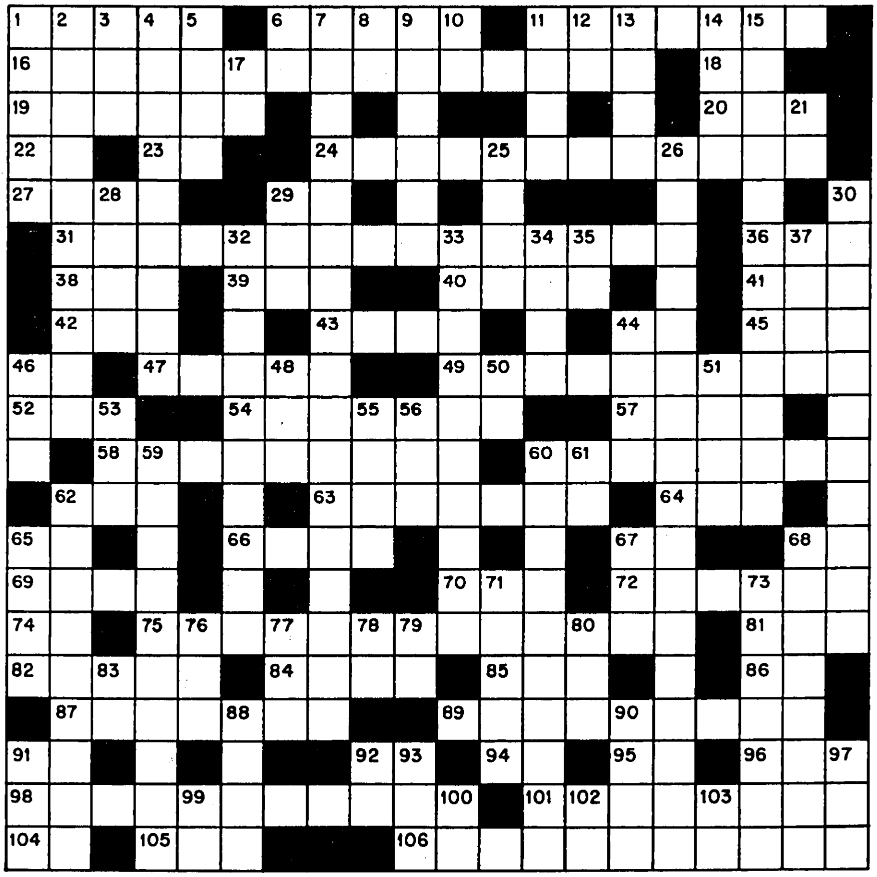
I don't think I'd buy any Commodore stock right now.

■ ■ ■




New Low Users Disk Price! $8.00 each
Spring 1986
Micro Cornucopia's Catalog of Users Disks, ROMs, & Add-ons
MS-DOS
CP/M
Index:

Technical Torture



Across

1 LIFO storage
6 Language whose lines are numbered
11 Hackers' projects
16 Lowest form of communication
18 Short for GA, GA
19 Someone who can sell IBMs at list
20 RS-232 ""may I send " line
22 Load instruction
23 Post script
24 Two mice
27 Greek harp
29 Fe, _____, Fo, Fum
31 4-bit broad
36 Address Latch Enable
38 Government authorized lady
39 CP/M command
40 Cat talk
41 Kingdom by the _________
42 Complement of Write Only Memory
43 Slimy vegetable
44 Emergency room
45 Compound statement delimiter
46 French Freud potatoes
47 Herbert _________, AI man
49 Short version of 26 Down
52 Logoff
54 Field location after five doubles
57 Not all
58 80186
60 Where 1's and O's grow
62 Florida Technological University
63 Of the fourth degree
64 Officers Training School
65 Irrational ratio
66 Expensive papers
67 Code, Art, or Amp
68 Bit set value
69 Drop this in Adventure to get bird
70 If it ain't on, it's _________
72 Smile again
74 Low power Schottky
75 Grumpy computerist
81 Souffle staple
82 Baby bringer
84 Repeat while equal
85 Talking horses
86 White Mountain State
87 Sews shorts
89 Chernobyl heat source
91 One of the Kettles
92 Magnum
94 4B4C
95 Lithium
96 Major distress
98 Going between
101 Taiwanese ROM
104 Acceptable
105 Serial input/output
106 Famous July celebrations

Down

1 Micro
2 The late S-100 columnist
3 What thespians do
4 IC tests
5 Keep it stupid, simple
6 To _____ or not to _____
7 A boolean oxymoron
8 Peru's continent
9 _____ _________'s Way
10 Center of Gravity
11 Hitler's party
12 For example
13 Ties the knot
14 Adventurer's foe
15 Access charges
17 Old Testament sequel
21 Samarium
25 Positively charged carrier
26 Long version of 49 Across
28 If at first you don't succeed . . .
29 Hard to negotiate; harder to collect
30 Soft helmet
32 Hot memories
33 Predecessor of PROLOG
34 Chrome _________
35 Famous root beer
37 Fine linen fabric
44 _________ while
46 Itty Bitty Machine Co.
48 Boatman's boolean
50 Chicken with its vowel removed
51 Leave out
53 Extra Special Transistors
55 French loot
56 What you never have enough of
59 Four Tandons
60 Binary player
61 Circuit on a chip
62 Memory savings and loan
65 Programmable friends
67 No C in core
68 Businessman's lunch
71 Ultimate nerd
73 One-armed serial chip
76 His machine beat Adlai
77 Wrath
78 Wire service
79 French article
80 Measurement of pressure
83 Logic gate
88 First In First Out
90 After Lying Stand Up
91 Fast port
92 16th Greek letter
93 _________ and outs
97 Snake sound
99 Rhode Island
100 A pebble game
102 Rhenium
103 Prefix for two

By Gary Entsminger

Statistics And Warfare, A Little Calculated Fun

With all those really useful languages around, is anyone still using BASIC? Yep. And they've written a statistical (not sadistical) package with it. Not a bad one.

Plus, you've no doubt heard about all those fun people who create worms (those nasties that zap screens and disks). Well, now you too can be a fun person by creating worms that wipe out your opponent's worms.

If you're looking for a first-rate, inexpensive statistical package for your PC, try Number Cruncher Statistical System. Despite its mouth-garbling title and low price ($79.95), it's a full-featured, easy-to-use, speedy system.

NCSS (for short) was written in Compiled BASIC (someone has been taking BASIC seriously) over the last six years (I tested version 4.21). It requires 196K of memory and allows you to analyze up to 250 variables and 32000 observations.

You can create a database within NCSS by responding to the prompts of menus or transfer data into the database from properly formatted ASCII files. Once the data's in the database, you can analyze it with a wide range of statistical functions (again by responding to menus).

These functions include —

Descriptive Statistics — univariate, multiway univariate, cross tabulation, histograms;

Correlation/Regression Analysis — bivariate, correlation analysis, multiple regression, interactive variable selection, robust regression, discriminate and principal component analyses;

Analysis of Variance — t-tests, one-way-, twoway-, and nway- ANOVA, repeated measure;

Time Series Analysis;

Nonparametric Statistics — sign test, Wald-Wolfowitz runs, Wilcoxon matched pairs test, Mann-Whitney two sample tests, Kruskai-Wallis test, Friedman's block/treatment test, and nonparametric correlations.

In addition, you can graph data in box and scatter plots.

The NCSS database is flexible. You can sort, back up, transpose, and delete it. You can merge or join it with other databases, and you can even copy individual columns between databases if you need to.

NCSS includes a fullscreen editor for viewing and modifying databases and an excellent command-by-command tutorial.

The package isn't flashy — a small spiral-bound notebook and disks — but it's outstanding for the price ($79.95).

For more info contact —

Dr. Jerry L. Hintze
865 East 400 North
Kaysville UT 84037
(801) 546-0445

Core Wars

No doubt some of you are spending too much of your time "working" before your terminals (and monitors). If so, take a break, and exercise your mind and your computer's memory with Core Wars (available on the Micro C bulletin board and on MS-DOS disk 24).

Each of two players writes a program in a low-level Assembly-language-like language. These two programs are loaded into a circular area of memory (actually an array of several thousand locations whose last address is contiguous to the first), and executed alternately, one instruction at a time.

The object of the game is to wipe out your opponent's program. Whoever's program stops executing first loses.

Nine instructions —

```
MOV     A       B
ADD     A       B
SUB     A       B
JMP     A
JMZ     A       B
JMG     A       B
DZJ     A       B
CMP     A       B
DAT             B
```

and three addressing modes —

```
Direct   (default)
Indirect (""@'')
Immediate(""#'')
```

are your weapons.

For example, the simplest battle program is —

```
    MOV     0       1
```

which copies the current location to the next, and then advances to the next location and repeats itself, writing over everything in its path. Eventually, if unchecked, it will write over the opposing program and win the CORE WAR.

Sound crazy (and fun)? It is.

Several sample programs on the BB (and MS-24) will get you started.

Happy battling, and may all your wars occur in cores.

For further reading —

A.K. Dewdney's Computer Recreations ("Scientific American", May 1984 and March 1985)

MS-DOS Express 2.0

Thank your Aunt Molly (or Uncle Alfred) that high-quality software at least sometimes comes at affordable prices. Take MS-DOS Express, for example, a full-screen editor worth twice its price ($39.95).

Express 2.0 is the commercial version of Laine and Cecil Stump's speedy little public domain editor (Express 1.0). It includes access to DOS functions (DIR, TYPE, etc.), an excellent macro-key facility, very fast search and replace, and flashy variable-speed, bi-directional scrolling. It's configurable, so you can make it look like WordStar.

In order to see how Express stacked up to more expensive editors, I decided to abandon my favorite (VEDIT Plus) for one issue and use Express exclusively. Happily, I made it through, missing VEDIT Plus only occasionally.

Express doesn't have all the features of WordStar or VEDIT Plus, but it has most of them and it's faster. For example, it loaded a 15K file in 6.5 seconds to VEDIT's 16.5 and WordStar's 15.0. And it saved a 15K file and exited to DOS in 10.0. VEDIT Plus performed the same trick in 12.0 seconds, WordStar in 19.0.

In sum, Express is an impressive editor, and in conjunction with ROFF4 (a text formatter available in the public domain) will fulfill most of your editing needs.

For more info —

TCI
17733 205th Ave NE
Woodinville WA 98072

20 Megabytes For The X16

If you're thinking about adding a hard disk to your X16 (PC Tech's 80186 version of the clone), you might benefit from Dick Simpson's experience. He writes —

"You gave me the name of two suppliers, and I hit paydirt with PROTO, Inc. My call to them was answered by Mary Jo, an enthusiastic, helpful person who knows all about the X16. I bought a Seagate 225 20 Meg hard disk for $338 and an Ompti 5100 controller for $168, probably the best prices around. The Ompti is a true controller and the fastest one supported by the X16B ROM. And it runs with an interleave of 1:1! This thing is fast.

"By the way, the IBM XT type enclosure wasn't designed to take a SCSI controller (as PC Tech points out). But I was able to fabricate a very satisfactory mount.

"I cut 2 pieces of 1/4 inch aluminum rod 11 7/8 inches long, then drilled and tapped each end for 6-32 screws.

"I then drilled holes through the rods to clear 4-40 mounting screws and mounted them over the drives so that the 34-pin header on the controller card was directly over the 34-pin connector on the hard drive (the 20-pin connector is offset with this method, but you can easily manipulate it).

"This gives you a stable and neat installation. The 50 trace cable furnished with the controller is long enough to go from the mother board, across the cabinet, and up over (with a 90 degree bend) and into the header on the controller."

Thanks, Dick.

For more info —

PC Tech
P.O. Box 128
904 North 6th St
Lake City MN 55041
(612) 345-4555

Proto PC
2439 Franklin Ave
St. Paul MN 55114
(612) 644-4660

And that's Tidbytes (oops, I mean bits).

■ ■ ■

BIOS Patch

This program allows Turbo Pascal V3.0 to work with Z80 systems where the BIOS uses IX and IY without restoring them. The patch is installed at location 0040H (this space is reserved by Digital Research for patching CBIOS). I use the program so Turbo will work on a Bondwell 2 lap portable.

John Newgas *Turbo Pascal BIOS Patch Shown at Right*

```
Z80
ASEG
;
        ORG     100H            ;Conventional TPA start location
        DI                      ;Disable interrupts in case of accidents
        LD      HL,(0001H)      ;BIOS warm boot vector location
        LD      DE,000AH        ;WBOOT to conout difference
        ADD     HL,DE           ;HL now has address of vector to conout
        LD      A,(HL)          ;Low byte of real conout
        LD      (FCALL+1),A     ;Saved in FCALL+1
        INC     HL              ;Point to high byte of conout addr
        LD      A,(HL)          ;Get high byte
        LD      (FCAL+2),A      ;Saved in FCALL+2
        PUSH    HL
;
;
        LD      DE,0040H        ;Patch location
        LD      HL,ROUTN        ;Move from ROUTN
        LD      BC,REND-ROUTN   ;Length of routine
        LDIR
        POP     HL              ;Pointer to high byte in conout
        LD      (HL),00H        ;Change high byte
        DEC     HL              ;Point to low byte in conout
        LD      (HL),40H        ;Change low byte
        EI                      ;Interrupts are back
        JP      0               ;Warm boots
;
;
ROUTN:  PUSH    IX              ;Save index registers
        PUSH    IY
FCALL:  CALL    $-$             ;New conout address
        POP     IY              ;Returns here from conout
        POP     IX              ;Index registers restored
```

Tip For Microline Users

Microline 92 printers are available with standard and IBM Plug-N-Play software. By burning both versions into Q4 and Q5 and using the lower and upper half of a 27128, you can enjoy the best features of either one.

To do this, toggle pin 26 (A13) of Q4 and Q5 between 5V and ground. Simply cut the 5V traces between pins 26 and 27 of Q4 and Q5 (on the back of the board). This will isolate pin 26 of both chips.

Connect pin 26 of Q4 to pin 26 of Q5. Also connect a 1K pullup between pin 26 of Q4 and 5V (pin 28 of Q4).

Finally, connect a short (8″) piece of wire to pin 26 of Q4 (solder it to the resistor). Connect another piece (use 2 conductor ribbon wire) to ground (pin 14 of Q4). Insert the new 27128 EPROMs.

Add a miniature switch to the end of the wires and mount it in the slotted hole available in the back of the printer. Use a large washer here. You may prefer to drill a mounting hole in a removable cover plate instead. There is just enough clearance to re-insert the board.

Now by simply turning the printer off and throwing the switch, either version can be booted up.

Joseph Malik
221 Bradley Dr.
Wilmington NC 28403

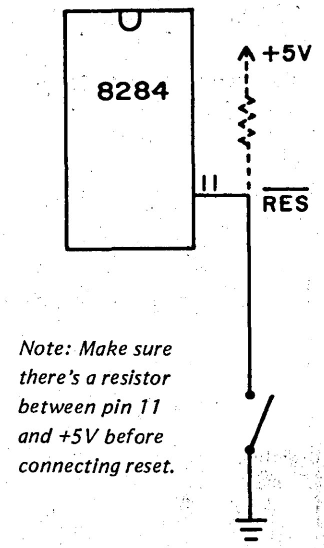
PC Reset Switch

A good hardware reset is invaluable when when you're thrashing around in low memory on Personal Clones. Simply shorting the power supply's PWRGOOD line to ground should do the trick and probably will if your machine is a True Blue PC. The clones are another story. Many boards don't look at PWRGOOD so we need to go elsewhere. Pin 11 on the clock generator is the reset line. Shorting this line to ground through a momentary contact switch (see figure) will guarantee a reset on all systems. Look for the clock generator (it's an 8284) by the power connectors on the rear right corner of the main board.

Micro C Staff

■ ■ ■

Schematic of Reset Switch



Note: Make sure there's a resistor between pin 11 and +5V before connecting reset.

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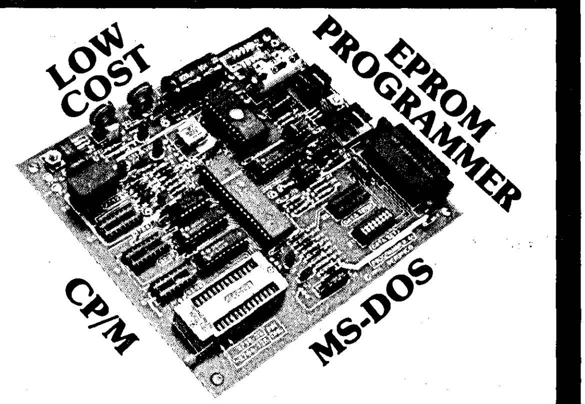

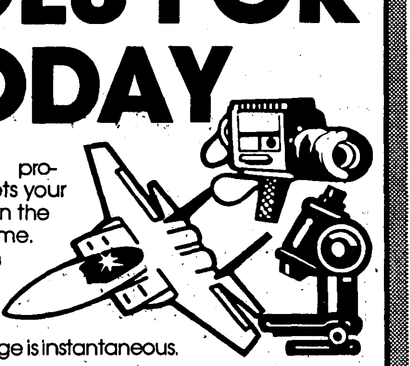

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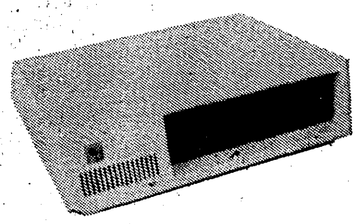

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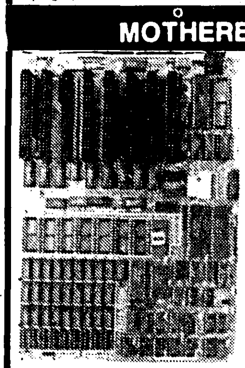

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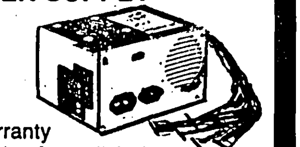

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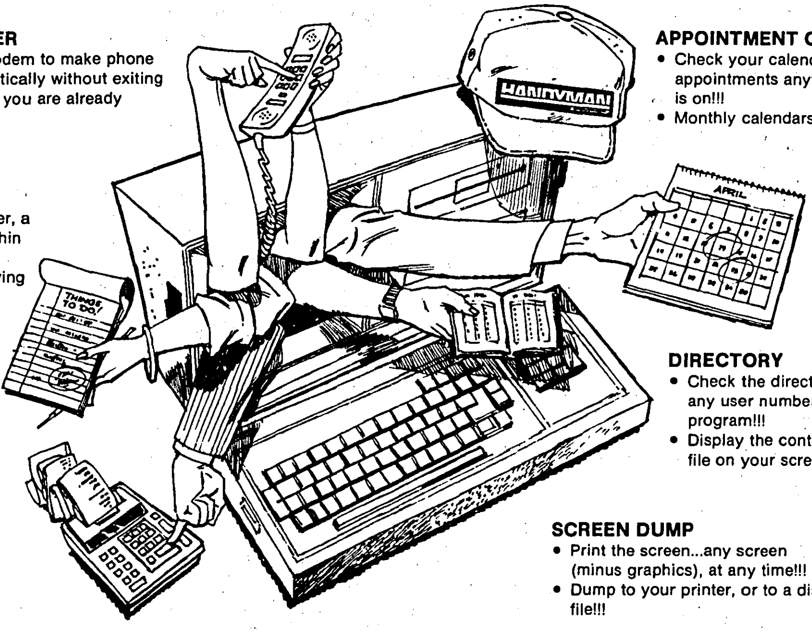

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January 1986

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ADVERTISER'S INDEX

THE LAST PAGE

By Gary Entsminger

In Search Of The Truly Random

A number in itself is hardly random. Seriously, folks. Is 26 random? 1984? 1958?

What we're really talking about when we say "random number" is a random series of numbers. Which leads one to as!:, "When is a series random?"

For example, is —

1,8,5,3,7,9,2,4,5,3,10

random in a range of 1 to 10?

Is —

11,13,12,13,12,13,15,11,11,15

random in a range between 11 and 15?

Testing A Random Generator

You can determine the probability that a series is random with a chi-square test, which compares the expected with the observed number of occurrences. This comparison is calculated in the formula —

$$V = \sum_{i=1}^{N} \frac{(O_i - E_i)^2}{E_i}$$

and then compared to a chi-square table of values to determine the probability of randomness.

In my two example sequences, the first (1,8,5,3,...) has about a 50 percent chance of having been generated randomly. The second has about a 5 percent chance.

Generating a truly random series is tricky. So let's start by writing a "pseudo-random" generator.

Random In Pascal

We can create a pseudo-random series generator in Turbo Pascal using the linear congruential method (it's a mouthful, I admit, but simple) —

```
function Random(Var R: integer):real;

begin
   Random :=S MOD R + 1;
   S:=(125 * S + 1) MOD 4096;
   {New S for next call to Random}
end; {Random}
```

We call the generator (function Random) with R equal to the highest number we want to allow in the random series.

S (the seed) is declared and initialized arbitrarily in the main program. But since we've chosen S we can easily determine what the first number returned from Random will be. And since each new generation is determined by its predecessor, our series will always be pseudo-random.

A pseudo-random series will be good enough for most purposes (simple games, for example), but let's try to do better. Fortunately, there's an interesting way out of the depths. But first, let's digress long enough to introduce a PROLOG version of Random.

Random In PROLOG

As in Pascal's Random, we pass R (the range delimiter) to Random. The number generated for our random series will be passed back to our main program as N.

```
Seed(13). /* arbitrary
           initialization of S */
Random(R,N):-   /* "":-''
                means ""if'' */
   Seed(S), /* "",'' means ""and''*/
   N = (S MOD R) + 1,
   retract(Seed(S)),
   NewSeed = (125 * S + 1) MOD 4096,
   asserta(Seed(NewSeed)),!.
```

The "predicate" Random is true if Seed(S) and each subsequent clause within the body of Random is true.

The two unusual predicates (retract and asserta) delete the old seed, S, and add a new seed, NewSeed, to a database built into PROLOG. The next time we call Random, Seed will be passed the new seed, S.

Seeding With The System Clock

But Random needs help if we're going to generate truly random sequences. A solution — access the system clock and let time seed the generator.

The clock count is kept in low memory at address 0000:046C on the PC. You can watch it tick away easily with DEBUG —

```
DEBUG
-d0000:046C
```

and dump again —

```
-d0000:046C
```

You keep dumping; it keeps changing.

Or you can get the clock count by using bios interrupt 26, service 0. Call the interrupt with 0 in register AH. (Note: you can set the clock count by calling interrupt 26 with 1 in AH.) The high order byte of the clock count is returned in CX; the low order byte is returned in DX (and the "midnight counter" is returned in AL).

Turbo Pascal and Turbo PROLOG both provide direct access to bios interrupts via an "intr" procedure (MS-DOS Pascal) and a "bios" predicate in PROLOG.

In PROLOG —

```
bios(26,reg(0,_,_,_,_,_,_,_),
     reg(AX,_,CX,DX,_,_,_,_))
```

will do the trick; let S (our seed) equal the value in CX, an unpredictable value.

```
Random(R,N):-/* "":-'' means ""if'' */
  bios(26,reg(0,_,_,_,_,_,_,_),
  reg(AX,_,CX,DX,_,_,_,_)),
  S = DX,
  Seed(S), /* "",'' means ""and''*/
  N = (S MOD R) + 1,
  retract(Seed(S)),
  NewSeed = (125 * S + 1) MOD 4096,
  asserta(Seed(NewSeed)),!.
```

We can even randomly reseed Random to edge closer to the truly random by recalling the bios interrupt randomly (as often as the value returned in CX on our initial call, for example).

By Way Of Closing

A question — does computer generated randomness have anything to do with artificial intelligence?

■ ■ ■

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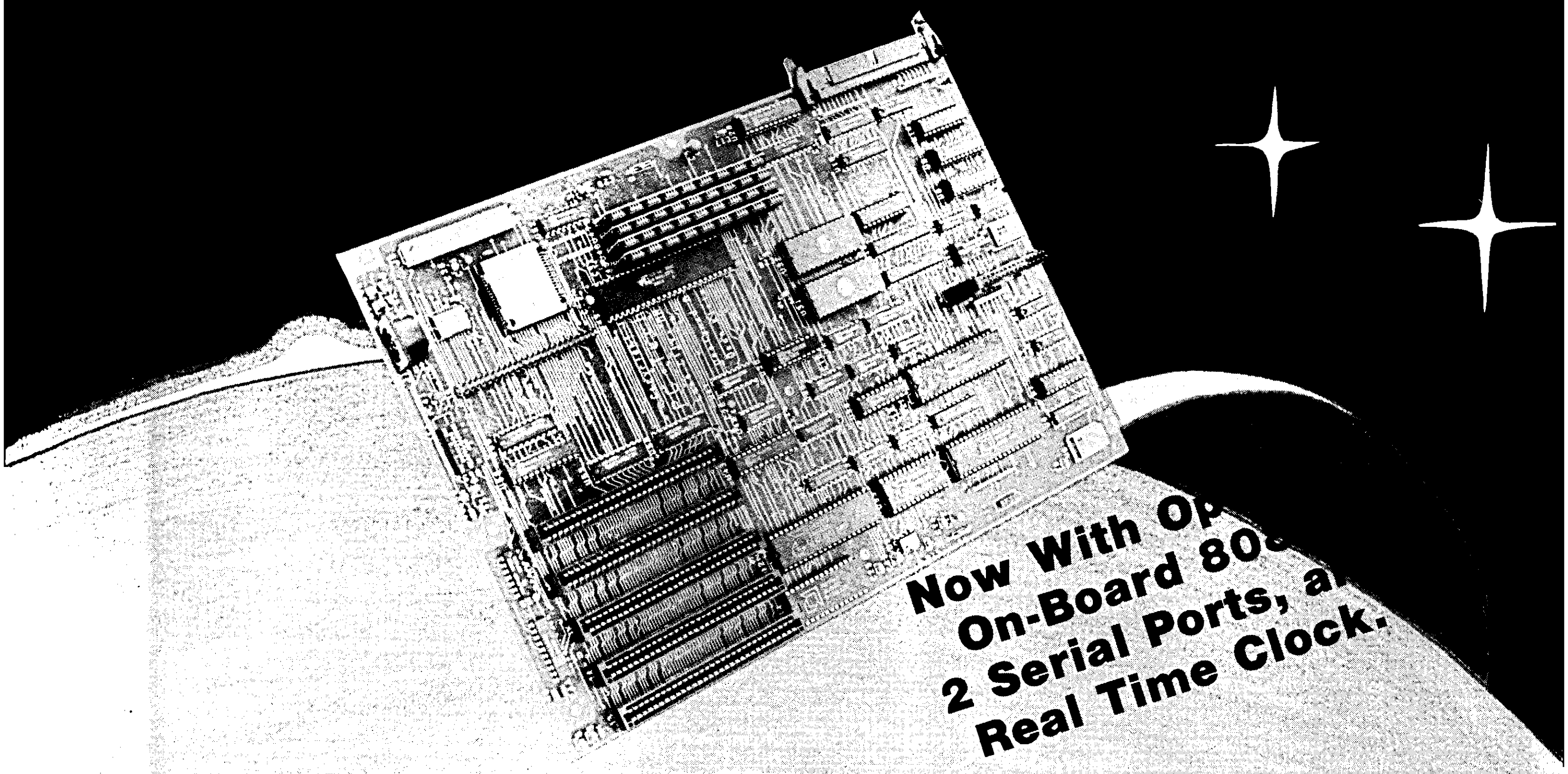

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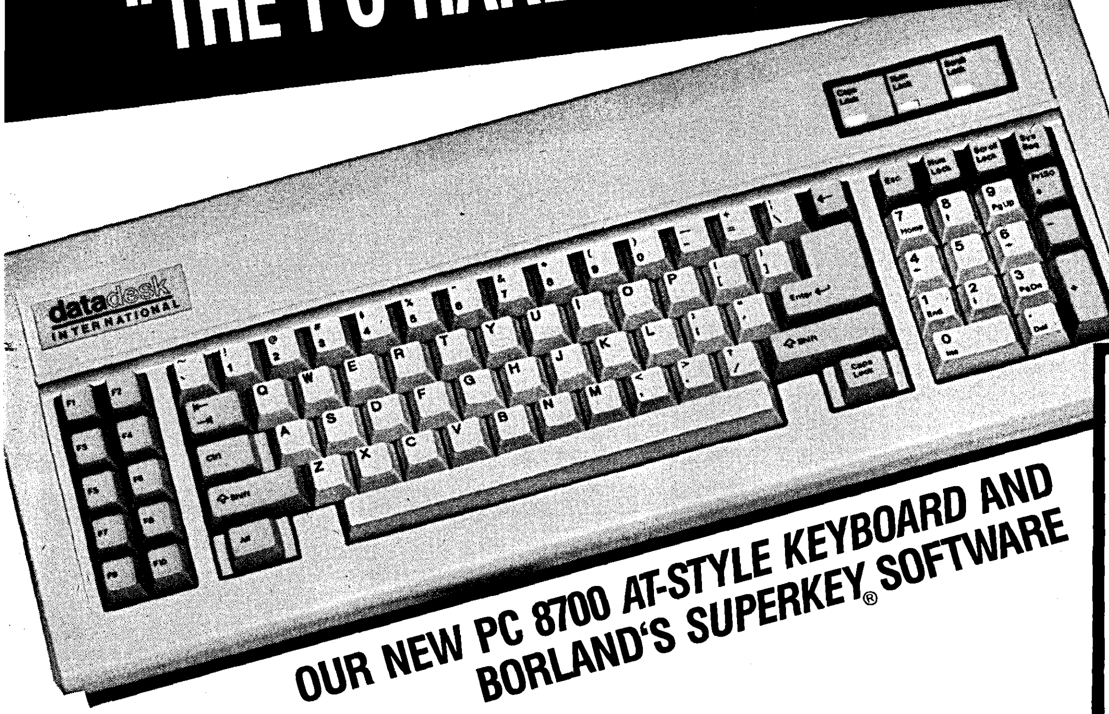

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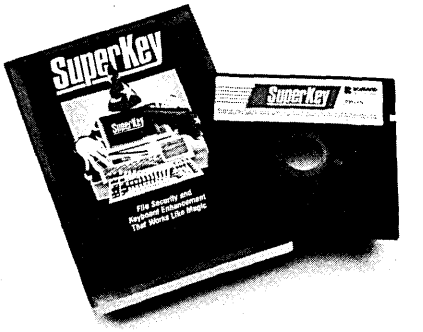
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