August 1982  

TABLE OF CONTENTS

The C Reviews
- Small-C .................................................. 5
- Small-C+ .................................................. 6
- Q/C ..................................................... 7
- C80 ..................................................... 8
- Supersoft C .............................................. 9
- BDS C .................................................. 10
- Is Your Big Board in a State of Flux ................... 17
- Adding 6K of RAM ......................................... 17
- Viewing 50 Hz .......................................... 19

REGULAR FEATURES

- Letters ............................................. 2
- FORTHwords ....................................... 12
- Technical Tips ..................................... 17
- Want ads ............................................ 21
- On Your Own ....................................... 21
THE BIG BOARD PROJECT: Three years in the works, and maybe too good to be true. A tribute to hard headed, no compromise, high performance, American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M* Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8 inch disc drives, power supply, an enclosure, C.R.T., and you have a total Business System for about 1/3 the cost you might expect to pay.

FULLY SOCKETED!

**FEATURES:** (Remember, all this on one board!)

- 64K RAM
  - Uses industry standard 4116 RAM's. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.
- Z-80 CPU
  - Running at 2.5 MHz. Handles all 4116 RAM refresh and supports Mode 2 INTERRUPTS. Fully buffered and runs 8080 software.
- SERIAL I/O (OPTIONAL)
  - Full 2 channels using the 280 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 interrupt.
  - Price for all parts and connectors: $49
- BASIC I/O
  - Consists of a separate parallel port (280 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.
- BLANK PC BOARD — $149
  - The blank Big Board PC Board comes complete with full documentation (including schematics), the character ROM, the PFM 3.3 MONITOR ROM, and a diskette with the source of our BIOS, BOOT, and PFM 3.3 MONITOR.

PFM 3.3 2K SYSTEM MONITOR

The real power of the Big Board lies in its PFM 3.3 on board monitor. PFM commands include: Dump Memory, Boot CP/M*, Copy, Examine, Fill Memory, Test Memory, Go To, Read and Write I/O Ports, Disk Read (Drive, Track, Sector), and Search. PFM occupies one of the four 2716 EPROM locations provided.

Z-80 is a Trademark of Zilog.

**PRICE CUT!**

Digital Research Computers
(OF TEXAS)

P.O. BOX 401565 • GARLAND, TEXAS 75040 • (214) 271-3538

*TRADEMARK OF DIGITAL RESEARCH. NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE ORIGINATORS OF CPM SOFTWARE*

**1 TO 4 PIECE DOMESTIC USA PRICE.
Happy Birthday

We're One

I was rummaging through my stack of Micro C's this morning looking for issue #3 when it hit me, I had a stack of six magazines to search through. Six magazines, and of course issue #3 was on the bottom. That kind of problem I can live with.

The Single Board Systems Journal

You may have noticed that the masthead has changed a bit. As the computer world and you, our audience change, Micro C is changing. We are going to continue providing the world's best support for the Big Board and Big Board II (the new Ferguson board) but we are also planning to stay on top of the latest in other single board systems plus, of course, systems languages. (We'll let the other magazines support the minis, and other crumbs.)

We're going to do our best to support you. You are building and modifying the Big Board, the Xerox 820, and similar systems and you are deeply involved in some very interesting projects, all the way from writing new database management systems to designing satellite packet switching networks. And most of you are doing this at home.

You are engineers, software designers, and heavy weight hobbyists. Most of you are using your system both as a way to continue your education in the computer field and as the basis for that hoped-for business of your own. The rest of you are already consulting, or manufacturing and marketing something for the computer market.

Nearly all of you are proficient in two or more languages. Many of you are using Cobol, Fortran, Algol, assembly language, or even Basic on your jobs. But you are also very interested and proficient in one or more of the more modern structured languages. Of these languages, Pascal is by far the most popular with FORTH and C a distant 2nd and 3rd. FORTH and C interest appears to be quite regionalized. FORTH interest is strongest in California while there appear to be pockets of experienced C'ers all along the West Coast and in the Bell Labs area.

The information flow within the whole Micro C group is tremendous. Ideas are going through here at a rate I wouldn't have imagined a year ago. The number of pages in each issue of Micro C is limited mostly by the cost of production, mailing, and help.

Can You C?

This is the issue a lot of you have been waiting for. The feature this month is the review of some of the more popular C packages. I had hoped to begin working on the reviews in March but I'm glad I didn't. All but two of the packages (Small C and Small C+) are either new or have been substantially updated in the last couple of months.

Of course, change is the norm in the software business but C has seen more than its share of change lately. I'm glad to see it the changes because C is finally achieving a price/performance ratio that puts many other languages to shame. (Pascal also has a new package that will shake things up in that arena. See below for more information.)

Drive with Caution

Issue #8 will feature information on disks and disk drives, but I feel that the following can't wait. Think twice (or three times) before using Maxell disks.

It turns out that Maxell achieves its long data life by putting a hard, slightly abrasive surface onto its disks. This surface not only protects the disk but it keeps the heads clean by polishing them. So, not only do your heads wear out quickly (after a year of intermittent use), but the abrasive residue left on them substantially reduces the life of other brands of disks and disk drives.

We would very much like to review your CP/M compatible products for Micro C. Please send material to the Review Editor, Micro Cornucopia.

(continued on page 20)
Dear Editor,

Just a short note to express my appreciation for the fine job you're doing with Micro C. Without it I would still be floundering around trying to get the ole BB up and running.

Mark Stiegitz's SCBIOs (user disk #2) is the best thing you guys have supplied yet. It works like a dream! I have connected a u82A printer to the PIO port (SCBIOs provides the parallel print driver) as follows:

<table>
<thead>
<tr>
<th>u82A</th>
<th>Wire</th>
<th>u82A</th>
<th>BB JS</th>
<th>BB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal</td>
<td>Color</td>
<td>Pin</td>
<td>Pin</td>
<td>Signal</td>
</tr>
<tr>
<td>DSTB</td>
<td>B</td>
<td>1</td>
<td>4</td>
<td>ARDY</td>
</tr>
<tr>
<td>D1</td>
<td>Blue</td>
<td>2</td>
<td>6</td>
<td>D0</td>
</tr>
<tr>
<td>D2</td>
<td>C</td>
<td>3</td>
<td>8</td>
<td>D1</td>
</tr>
<tr>
<td>D3</td>
<td>Red</td>
<td>4</td>
<td>10</td>
<td>D2</td>
</tr>
<tr>
<td>D4</td>
<td>Purple</td>
<td>5</td>
<td>12</td>
<td>D3</td>
</tr>
<tr>
<td>D5</td>
<td>Light Yellow</td>
<td>6</td>
<td>14</td>
<td>D4</td>
</tr>
<tr>
<td>D7</td>
<td>Green</td>
<td>7</td>
<td>16</td>
<td>D5</td>
</tr>
<tr>
<td>D8</td>
<td>Black</td>
<td>8</td>
<td>18</td>
<td>D6</td>
</tr>
<tr>
<td>BUSY</td>
<td>GRY</td>
<td>9</td>
<td>20</td>
<td>D7</td>
</tr>
<tr>
<td>SIG</td>
<td>BLU</td>
<td>11</td>
<td>2</td>
<td>STB</td>
</tr>
<tr>
<td>CHASSIS</td>
<td>17</td>
<td>ODD</td>
<td>GND</td>
<td></td>
</tr>
</tbody>
</table>

Jumper BB J3 pins 1-2, 13-14, 15-16.

Mark C. Worley
1831 W Pioneer Apt 203
Irving, TX 75061

Dear Editor,

I enjoyed reading your critique of VEDIT, especially since I just received version 1.34. Unfortunately three bugs showed up.

First, the test wouldn't format. Second, I couldn't get the text to print via the 'print text' command. And third, the word wrap line size wouldn't configure correctly.

I called Rick Fourston at CompuView and he mentioned that several Big board users are having difficulty with VEDIT. Rick said he would contact you for some possible leads on solving these problems and if necessary, VEDIT will be customized for the Big Board.

By the way, the third bug results when the customization assumes you've entered a HEX value for line length (not documented) while the command mode assumes you are entering a decimal number.

Rick Kobbe
8909 Corbin Drive
Everett, WA 98204

Editor's note:

I haven't heard from CompuView so I don't know what the status is of the bug fixes. I haven't had any problem using the print command and my format command works fairly well. Its problem is that it occasionally chops the first character off some words. I haven't contacted them because they appear to be working in an understaffed/overworked mode so fixes don't get accomplished very quickly.

Dear Editor,

I bought a bare Big Board early in 1981 and over a period of about 6 months, accumulated enough parts to bring it up. I'm using it with a Keytronics word processor keyboard and a converted TV set.

One of the problems I had with the board was extreme instability in the video crystal oscillator. The fix was easy. I put a 100 pf capacitor between U11 pin 13 and ground.

Be very careful with the 4 MHz mod in issue #2 page 4. The asymmetrical clock does not satisfy Z80 specs and I had a lot of problems trying to get it to run (I wiped out the directory on a disk).

My next project for the Big Board is to interface a graphics display to the parallel port, probably similar to the Micrograph display described in Byte. Then I could emulate a Tektronix 4010 graphics terminal. I would be very interested if other Big board owners have ideas on the subject.

Ken Stephenson
Physics Division
Argonne National Laboratory
Argonne, IL 60439

Dear Editor,

Sometimes it is nice to have a software selectable alternate character set for the Big Board. I noticed that half of the character generator is filled with FF's for blanking the screen during retrace. I decided to use the chip select pin on the 2716 instead. I've modified my board so I can select different character sets such as US, Swedish, German etc.

Mods: Cut the trace between U60 pin 8 and U73 pin 19. Connect U73 pin 19 to a spare PIO pin. Cut the trace between U25 pin 3 and U25 pin 4. Connect U25 pin 12 to U60 pin 9. Connect U25 pin 13 to U25 pin 3. Connect U25 pin 11 to U25 pin 4. Now reburn the character generator so that you have one set in each half of the EPROM. (See issue #6 page 8 for more information on designing your own character set.)

Thomas Hameenaho
Djaknegatan 7
S-754 23 Uppsala
Sweden

(continued on page 11)
ANNOUNCING
THE BIG BOARD ADD-ON

**** FEATURES ****

Program 2708, 2716, 2732, and 2764 type EPROMS. With four programming sockets you can program lots of memory at once. Programs EPROMS sequentially or in parallel for small production runs.

Second bank (64K) of memory will allow fast screen swaps, larger EPROM program storage, etc. Memory is fully-static 6116 CMOS type RAMS which will allow RAM/EPROM intermixing. Battery back-up for CMOS RAM.

More goodies. Sixteen channels of both 8-bit A/D and D/A conversion. Connect any of the FCC approved modems by NOVATION directly into the board. Plus, there's an S-100 connector which will allow you to connect an S-100 card directly or interface with an S-100 motherboard. And speaking of features, voice output with the on-board VOTRAX phoneme generator chip.

All this plus: four serial channels, four parallel ports, everything socketed, and it runs at 4 MHz. (In fact, with all this, you may just forget about the Big Board altogether!)

This is the board you have been waiting for. This board is intended for the serious builder and the novice alike. It will be available in bare board, full kit, partial kits, and assembled and tested. The board has the same dimensions as the BIG BOARD so it piggy-backs into the same space. Available 3/20/82.

Bare board .............................................................$ 99.00
Complete package .................................................. CALL

All Prices Plus Postage

**** OTHER BIG BOARD ACCESSORIES ****

Big Board power supply kit (BB + 2 DRIVES + ) ..................$ 85.00
Big Board power supply A&T ........................................ 135.00
C.ITOH 8510 9xN matrix, graphics, 5 char sets printer (ser.) 645.00
C.ITOH 8510 same as above but par. interface .................... 595.00
4Mhz mod that WORKS.... $7.50 BIG BOARD PARTS.......... CALL

E.C.R.L.,INC.
P.O. BOX 387
CANBY, OREGON 97013-0387
503-266-4982 *24 HRS* or 503-656-3382
Introduction

By David Thompson

This is a rather hard introduction to write. Every time I get a chance to do anything in C, I am very impressed with it as an easy way to write things that I would otherwise write in assembly language.

However, Micro C’s requirements on my time keep getting in the way of any kind of serious programming. So I haven’t had a chance to really get up to speed with C the way I would like. Fortunately there are a number of strong C’ers in this area who were willing to lend a hand with these reviews.

What is C?

C is a structured language which looks in some respects quite similar to Pascal but unlike Pascal, C can also become incredibly cryptic.

While Pascal does a pretty good job of hiding the underlying system from the programmer (which encourages transportable code), C makes it relatively easy to pick bits. In fact, assembly language programmers should find the transition to C a happy one because they don’t lose control over the machine.

C Benchmark Program

All the benchmark times were taken on one Big Board running 4MHz. Object file size is the size of the file on the disk (could be inflated by up to 127 bytes when loaded onto the disk). I used the Unica LS.COM utility to make the measurement.

A low-level, high-level language

Notice how the shades of assembly language creep into C in the #define statements. Also, floating point seems to be about the last thing people add to their C packages (if they add it at all) which is just about the reverse of the more business and scientific oriented languages such as basic, cobol, and fortran. In fact folks here were impressed when they learned that the latest version of C80 supported unsigned integers.

Having floating point means that you can write just about anything imaginable without leaving the C environment. As far as I know, only Aztec C and Whitesmith’s have it built into the compiler. Whitesmith’s C sells for about $700, the floating point version of Aztec C is $199.

At this point there appear to be three major divisions in the C world.

First there is Whitesmith’s C, which is full-blown Bell Labs C, written and marketed by full-blown ex-Bell Labs compiler designers.

Second, is BDS C written by Leor Zolman and marketed by Lifeboat Associates. BDS C has been around long enough that it has developed quite a following, a user group with public domain software, and it has matured significantly as users have shaken loose bugs and deficiencies.

The third group began when Ron Cain wrote a C compiler called Small-C.

Small-C, a Beginning

Small-C has made C available to the masses because Ron Cain put it in the public domain. And even though it supports only a limited subset of C, people who try it are amazed at all the capabilities it does have and how well it works.

Small-C works so well for doing those small and not-so-small systems tasks (like writing extended C compilers) that it has spawned a number of extensions including Small-C+, CW/C, Q/C, C80, and probably Supersoft C.

Aztec C?

I have been looking forward to seeing what Manx Software Systems did with their latest version of Aztec C. Harry Suckow mentioned that they were working on a very complete "compete with Whitesmith’s" version with all the bells and whistles (floating point, pointers to pointers, structures ... ). All this for around $200.00 and designed for micros rather than being designed for PDP-11s and then wrestled down just enough to fit in a 64K system.

I just received word that Aztec C II is on its way and that Manx software is offering a $50 discount to Micro C subscribers only. Until September 1st you can purchase the floating point C II package for $149 instead of $199. They also mentioned that S-100 Micro Systems and Byte will have reviews of Aztec C in their September issues.

For more information, contact Manx Software Systems, Box 55, Shrewsbury, NJ 07701. 201-780-4004.

Original benchmark program in C.

```
/* Eratosthenes Sieve Prime Number Program in C */
/* Uses local (automatic) variables */
#define TRUE 1
#define FALSE 0
#define SIZE 8190
#define SIZEEP 8191

char flags[SIZEP1];

main()
{
   int i, prime, k, count, iter;
   /* variables defined here are local */
   printf("10 iterations n");
   for (iter = 1; iter<10; iter++)
   {
      count = 0;
      for (i = 0; i<=SIZE; i++)
      {
         flags[i] = TRUE;
         for (i = 0; i<SIZE; i++)
         {
            if (flags[i])
            {
               prime = i + i + 3;
               k = i + prime;
               while (k<=SIZE) {
                  if (flags[k])
                     flags[k] = FALSE;
                  k += prime;
               }
               count = count + 1;
            }
         }
      }
      printf("n%d primes", count);
   }
}
```

Micro Cornucopia, Number 7, August 1982
Learning C

Those of your unfamiliar with C should not expect to learn the language from the manuals that come with the following packages. If you've had any contact at all with C you've no doubt heard of The C Programming Language by Kernighan and Richie (Prentice Hall). Its fame is justly deserved because it's a rare example of really excellent documentation and it's a first-class learning guide.

We're trying to make this book (and some other unusually fine volumes) available through Micro C.

Last Minute C News

Just as we were finishing up the re-

view for details about the package.

I also had a last-minute talk with Tony Ozrelic (L.A. Software) and he agreed (I twisted his arm a little) to do a column. He would very much like to share the column with one or two other C'ers. Each column will include a short discussion about the language plus one or two short listings. If two more folks joined him, it would mean only two columns per year for each person.

Tony wrote the Programmer's Aid

package in Small-C (see his ad in this issue) and some of the columns will include his experiences using Small-C. In others he will cover utilities you can write for the Big Board and other systems using this powerful subset of C.

C Reviews

The primary thing I see as I look over the following reviews is the variety of inexpensive C packages which run under CP/M. Q/C shines for its documentation, utilities, and source. BDS C shines for its compiler. C80 shines for its price/performance ratio in a very substantial package. Small-C and Small-C+ are inexpensive ways to dig into a very interesting language.

Small-C (V 1.1)

Reviewed by Bill Randle

1985 SW Martin
Aloha, OR 97007

Written by — Ron Cain
Distributed by — The Code Works
Box 550
Goleta, CA 93017

Price — $19.95 (public domain)

Features

The feature set of Small-C is used as the basis for the other C reviews, so the following is a short description of the feature set of Small-C. (Also see the table.)

Data Types: Small-C supports char (8-bits) and int (16-bits) data types. In addition, it supports pointer to character (char *) and pointer to integer (int *) types.

Variables can be either local or global (static). Variables which are declared within a function are private (local) to that function and are reinitialized each time the function is called. Variables which are declared before the first function are global (static) and are their values are available to all the functions in the program (and they are not reinitialized while the program is running). These variables are assigned memory locations rather than being placed on the stack.

(continued next page)
C Reviews

Run Time and I/O Library
Small-C includes only a minimal set of routines to support I/O. They include: exit (exit program), fclose (close a file), fopen (open a file), getc (read character from a file), getchar (read character from console), gets (read string from console), putc (write character to file), putchar (write character to console), puts (write string to console).

Documentation
Small-C comes with an 11 page User's Manual that provides information on how to run the compiler, how to use the I/O library, how to interface with assembly language subroutines and an appendix describing the compiler specifications. The manual makes no attempt to explain the C programming language and assumes you are familiar with it. It includes a bibliography of articles on C.

Ease of Use
The Small-C compiler is easy to use; the compiler prompts you for the required information which you answer with "y" or "n" and then you enter the source filename. The compiler options are: C-text as comments in the asm listing, all or part of the program, stop after errors, and output filename. Input filenames are requested one at a time until the user indicates that there are no more. The output is 8080 assembly language which can be assembled by ASM or MAC.

I would prefer to use the command line for specifying the compilation options, and have the compiler set the rest to their default values. This way I wouldn't have to answer a series of questions each time I run the compiler. (On the other hand you don't have to go back and look up the options. Editor)

Code Size and Quality
Small-C is a single-pass compiler and thus does not optimizing. The compiler also does not calculate values at compile time, so the statement:

\[ zzy = 2 + 3; \]

generates the 8080 code required to load 2, add 3, and store it in zzy instead of just storing 5 in zzy.

Compiler library routines are called to do common operations such as get integers from the stack or compare two integers. The entire library must be included as one of the files during the compile process. This makes the assembly file pretty large.

Conclusions
The Small-C compiler is well suited to the user who is just getting into the C language and wants an inexpensive, yet very functional compiler.

Since you get the source code for the compiler you can make custom modifications or patches, and you can add to the I/O library (which is written in 8080 assembly). The compiler is also a good example of a large working C program.

If I were doing a lot of serious C programming, though, I would probably go with a compiler that supported a larger set of the C language and supplied a more complete run-time I/O library.

Benchmark Results
The benchmark as it appeared in the Byte article will not run directly on Small-C since Small-C does not support the "for" statement so we substituted the "while" in its place. In addition, the Small-C library does not have a "printf" function and so we wrote one using "putchar" and "puts."

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Small-C</th>
<th>Small-C+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compile Time</td>
<td>210 sec</td>
<td>210 sec</td>
</tr>
<tr>
<td>Assembly Time</td>
<td>49 sec</td>
<td>49 sec</td>
</tr>
<tr>
<td>Load Time</td>
<td>11 sec</td>
<td>11 sec</td>
</tr>
<tr>
<td>Run Time</td>
<td>53 sec</td>
<td>53 sec</td>
</tr>
<tr>
<td>-Original prog</td>
<td>30 sec</td>
<td>30 sec</td>
</tr>
<tr>
<td>-Static Var</td>
<td>2816</td>
<td>2816</td>
</tr>
</tbody>
</table>

Small-C+

Reviewed by
Robert S. Broughton
Box 5191
Beaverton, OR 97006

Publisher- Alpha Omega
Computer Systems
Distributed by- Micro Cornucopia
11740 NW West Rd
Portland, Or 97229
Price- $24.00

Small-C+ began as a home project by a couple of programmers at Alpha Omega (there is something about Ron Cain's little compiler that attracts programmers) and turned into a good basic extension of Small-C.

It has Small-C features plus command line parsing via "argc" and "argv" which allows compiles to be performed from submit files without the "interactive" initiation mode. In addition, it has "for" and "do-while" loops and the "switch—case—default."

Since it is a later release than Small-C, numerous bugs that have shown up in Small-C have been fixed.

Strengths
This is a bargain C compiler. It works, and provides a tremendous bang for the buck. This is a marvelous low-budget way to learn C, and a good way to learn systems programming (C's forte).

Compilation is much faster than Small-C because the library does not have to be compiled each time. However, for this reason, you will need the Microsoft assembler (M80) and linker (L80), so plan on making that purchase if you don't already have them.

Weaknesses
Frankly, for the price, I can't see many weaknesses. I really appreciated Small-C+’s addition of "case" and "for."

However, I find the "do-while" statement of marginal benefit. As a matter of style, I prefer to test a condition before entering a loop (with a while) rather than test it at the end of a loop (as with the do-while).

Small-C, and Small-C+ both suffer from one omission that will cause you to stand on your head from time to time (might help your circulation). The compiler does not support the unary not (!) operation. So, for example, when you would like to test for the negation of some condition, and would like to have written:

```c
if (!condition-name) a = a + 32;
```

you will have to write:

```c
if (condition-name); 
else a = a + 32;
```

Documentation
The 9 pages of documentation on disk is a little thin. Users of this package should look up the original articles on Small-C which appeared in Dr. Dobbs (Issues 45, 48, and 52). These articles provide the background you need to feel comfortable with Small-C+ (and Small-C).

Ease of use
The following are two of the options that you can specify when you run the compiler.

The first option tells the compiler to
interleave the C source (as comments) into the assembler language output file, so you can see the code generated by your C statements.

The second option (my favorite) instructs the compiler to stop at each error. (No more wondering about those things flying up the screen.)

**Code size**

This is a single-pass compiler, which means it will generate larger and probably less efficient code than a two-pass (optimizing) compiler. Inefficiencies like “store from” followed by “load to” the same register are possibilities, but the compiler isn’t totally ignorant about generating good code.

**Code quality**

Even if you are an ace assembly programmer, you might pick up some good ideas from the code generated by this compiler (true of Small-C, its parent also).

**General comments**

Ron Cain did a tremendous service to the small computing community with his public gift of Small-C. Everyone who uses a C compiler on a micro has been affected by his contribution.

If you’re going to be doing anything with C you ought to start with with at least this version of Small-C. Small-C’s extensions and maturity are a significant advantage over the original.

**Benchmark Results**

<table>
<thead>
<tr>
<th>Code Quality</th>
<th>Strengths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sm-C</td>
<td>Q/C</td>
</tr>
<tr>
<td>Q/C</td>
<td>Q/C</td>
</tr>
</tbody>
</table>

**Q/C (V 1.1)**

**Reviewed by** Bill Randle

19585 SW Martin
Aloha, OR 97007

**Published by** Quality Computer Systems

**Distributed by** The Code Works

**Price** $95.00

**Preprocessor**

<table>
<thead>
<tr>
<th>#define/undef</th>
<th>#include</th>
<th>#ifdef/ifndef</th>
<th>#if/else/endif</th>
<th>#asm/endasm</th>
</tr>
</thead>
<tbody>
<tr>
<td>x x x x x x</td>
<td>x x x x</td>
<td>x x x x x x</td>
<td>x x x x x x</td>
<td>x x x x</td>
</tr>
</tbody>
</table>

**Compiler output**

<table>
<thead>
<tr>
<th>ASM/MAC</th>
<th>M80/L80</th>
<th>Object</th>
</tr>
</thead>
<tbody>
<tr>
<td>x x x x x</td>
<td>x x x x</td>
<td>x</td>
</tr>
</tbody>
</table>

**Comp. Source**

| Q/C    | $20 | $24 | $95 | $50 | $200 | $150 |

**C at a Glance**

The following table is by no means an exhaustive list of the facilities of each package (it does not include the library, for instance) but should present a reasonable overview.

<table>
<thead>
<tr>
<th>Version</th>
<th>Sm-C</th>
<th>Sm-C+</th>
<th>Q/C</th>
<th>C80</th>
<th>Supr5</th>
<th>BDS C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unary/Binary op</td>
<td>Most</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>All</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Arrays</td>
<td>One dim.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Multi-dim.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Data types</td>
<td>Char</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Short</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Int</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Unsigned</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Pointers</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Long</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Float</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Double</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Extern</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Static</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>External</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Register</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Structure</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Union</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Initialize</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Casts</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Program Control</td>
<td>if</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>if-else</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>for</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>while</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>do-while</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>switch</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>break</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>continue</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>return</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>return (exp)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>goto</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

**Reviews**

which make it much closer to ‘standard’ C, the very complete I/O and function library, and the excellent documentation.

Bob Broughton also took a look at this

(continued next page)
C Reviews

version and he commented, “Beyond the compiler, the best thing about Q/C is the documentation. It is complete, and written in a delightful style that I really envy. It's super.”

“Plus the compiler lends itself well to serious program development. Because of the reasonably complete set of utilities and library functions, you can get to work right away after opening the box,” he noted.

The function library includes many data conversion routines, type checking, string manipulation, and system functions.

The I/O library includes all the standards such as getc, putc, fopen and fclose, and so on for pages. It’s incredibly complete.

The run time library is available as a .REL file which means that only the routines actually necessary are linked in to the object file. This keeps the file down to a reasonable size.

Weaknesses

The counterpart of the malloc (memory allocate) function “free” is not provided. This means that allocated memory space cannot be freed up to use over again. Once allocated, that’s it.

Documentation

The documentation supplied with Q/C is an 88 page User’s Manual with a one-page update for version 1.1. The manual is very well written and is divided into four chapters and three appendices. The chapters titles include, “Getting Started ... Fast,” “Using the Q/C Compiler,” “Q/C Library Functions and Compiler Operation.” The appendices include the differences between Q/C and full-blown C, Q/C Error Messages, and a Sample Compiler Output. The manual does not try to teach you the C language, however.

For a new user, chapter 3 which covers the library functions has a detailed description of each routine, its calling sequence and what is returned. For the expert who wants to go in and modify the compiler, the chapter on Compiler Operation provides the details of what’s going on, including the structure of the symbol table and other goodies (this package includes the compiler source written in Q/C).

The manual, although not typeset, is well formatted and attractive.

Ease of Use

The compiler accepts arguments on the command line. Included in the options are: choice of assembler, including C source in the assembly output and so on. A run time trace option is particularly handy when debugging new programs.

It announces on the screen when entering and exiting each function (subroutine). The +label# option allows specifying the starting label number for internally generated labels. This is useful for compiling programs in sections and linking them together later with the linker.

Code Size and Quality

The code is somewhat smaller and faster than Small-C since Q/C does some optimization. The compiler library functions set or reset the zero flag in the processor as well as returning a zero or non-zero value. This allows a quick check of the zero flag rather than testing the HL registers for zero. Register use in general is also optimized over standard Small-C. The total program size is larger, however, because of the size of the library.

Conclusions

The Q/C compiler is a vast improvement over the original Small-C compiler. The additional features, the enhanced I/O library and the excellent documentation make this package ideal for substantial programming in C.

Benchmark Results

<table>
<thead>
<tr>
<th>Section</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compile Time</td>
<td>27 sec</td>
</tr>
<tr>
<td>Assembly Time</td>
<td>21 sec</td>
</tr>
<tr>
<td>Link Time</td>
<td>62 sec</td>
</tr>
<tr>
<td>Run Time</td>
<td>49 sec</td>
</tr>
<tr>
<td>- Original</td>
<td>26 sec</td>
</tr>
<tr>
<td>- Static Var</td>
<td>15,744</td>
</tr>
</tbody>
</table>

C/80 (V2.0)

Reviewed by Andy Crump

Publisher — The Software Toolworks
14478 Glorietta Dr
Sherman Oaks, CA 91423

Price — 49.95

Memory Required — 48k CP/M

Walt Bilofsky has been giving the software market place fits with his low prices on quality software. It’s obvious that C80 Version II is a significant addition to the C marketplace, but at $50, it looks like he’s raising more fits.
General comments
This compiler for the C language is a very nice implementation for the 8080 CP/M system. It can generate M80 code or code for it's own assembler which is nice flexibility. I couldn't find any errors in the compiler but I only had time to try it out with a few programs.

It is one of the few C compilers for the 8080 that will run in a 40k TPA. The features that are not supported in C/80 are not really necessary for most systems programming or game development.

I would buy this compiler for all the above reasons plus the fact that hand optimizing can be performed on the assembly language code. I like this compiler and will use it for much of my systems development. (Editor's note: Up until now, Andy has been an outspoken BDS C supporter.)

Benchmark Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compile Time</td>
<td>21 sec</td>
</tr>
<tr>
<td>Assembly Time</td>
<td>17 sec</td>
</tr>
<tr>
<td>Link Time</td>
<td>29 sec</td>
</tr>
<tr>
<td>Run Time</td>
<td></td>
</tr>
<tr>
<td>-Original prog</td>
<td>25 sec</td>
</tr>
<tr>
<td>-Static Var</td>
<td>25 sec</td>
</tr>
<tr>
<td>Object File Size</td>
<td>11,520</td>
</tr>
</tbody>
</table>

Supersoft C is the most expensive package in this review, and as such bears close scrutiny. It has been available for over 8 months but this version arrived just recently. The earlier versions have had more than their share of bugs.

Strengths
The two-pass compiler-optimizer is one of Supersoft's strengths. The other is its ability to compile for either Digital Research or Microsoft assemblers.

Weaknesses
I would have liked to stop execution of the compiler by using control-c, but the compiler never checks the console for so. If you want to interrupt, it's necessary to reboot.

Also, error messages just fly by on the screen, because you have no provision for halting at the first error. (Editor's note: The documentation does not define any of the error messages so you aren't missing very much.)

There were lots and lots of multiply defined globals in the link step. Fortunately the linker ignores the redefinitions, but it does clutter up several screens with this garbage.

I probably should have removed or commented out the #include references to files that were already in the relocatable library.

Documentation
The 76 pages of documentation tried to cover the subject but it took several readings before I could follow what it was trying to say.

This appears to be a complex product but much of that complexity would disappear if the manual had been written by someone familiar with the compiler and with the English language. Plus, it contains some obvious contradictions.

(continued next page)
C Reviews

For instance, at the beginning of chapter 4 it talks about adding your own code to the runtime file. "The advantage of doing this is that operational routines need not be recompiled and re-optimized each time the program is recompiled."

Later in that chapter it talks about the functions you have just added to the runtime file. "However, you will always be compiling in these functions whether you want them or not."

Ease of use

The options for the command line are many, but not many would be required for normal use. The submit file listed in the documentation substantially reduces the effort.

Code size

Even a short source program can generate quite a large intermediate file and com file.

I should note that this compiler was only reviewed using the Microsoft assembler and linker. There wasn't room on an 8" single density disk to compile more than the smallest program for Digital Research's ASM or MAC.

On medium size programs you should expect to see 'cannot write, disk full' type error messages even when using M80.

Code quality

One of the good features of this compiler is its two-pass compiler-optimizer combination. With a peephole optimizer of this sort, the compiler can easily reduce the code size by twenty-five percent.

General comments

Would I buy it? Probably not, especially as a first version of C. Only after running to the limit of Small-C would you appreciate a C compiler that's as close to K&R (mentioned above) as this one. This compiler does have structures and records and these features are important for professional use.

Benchmark Results

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Compile Time</td>
<td>66 sec</td>
</tr>
<tr>
<td>Assembly Time</td>
<td>21 sec</td>
</tr>
<tr>
<td>Link Time</td>
<td>85 sec</td>
</tr>
<tr>
<td>Run Time</td>
<td></td>
</tr>
<tr>
<td>-Original prog</td>
<td>34 sec</td>
</tr>
<tr>
<td>-Static Var</td>
<td>20 sec</td>
</tr>
<tr>
<td>Object File Size</td>
<td>28,288</td>
</tr>
</tbody>
</table>

BDS C (V 1.46)

Reviewed by Andy Crump
3150 SW 180th Place
Aloha, OR 97060

Publisher- BD Software
Marketed by- Lifeboat Associates
1651 Third Ave
New York, NY 10028
Price- $150
Memory
Required ---- 32k CP/M

When he wrote BDS C and priced it at about one-quarter the going rate for Whitesmith's C, Leor Zolman made a major contribution to the layman's access to C. Over the years BDS C has become a true institution in the C community and has provided a first exposure for many now-experienced C hackers.

Strengths

BDS C features the following:
1. Conditional compilation.
2. Runtime command arguments including I/O redirections with special I/O packages.
3. Random access file I/O.
4. Dynamic storage allocation.
5. Comes with an relocatable assembler good only for use with the compiler.
6. Generates fast and small code.
7. Can generate ROMable code.

Weaknesses

BDS C supports only a limited number of data types, and function calls must have the same number of arguments as the called functions.

Documentation

The 175 page manual includes the Users guide, the handbook, an I/O tutorial, telnet manual (modem program), and bug fixes. This is a very complete document and is very helpful. It includes a list of common mistakes which is helpful for the beginning programmer.

The manual is delightfully written and experienced hackers find portions of it absolutely hilarious. It also includes lots of examples of compilations and techniques.

However, the manual has no index. It would be nice to have an index to the Standard Library functions for quick reference. Organization and packaging of the manual could be a lot better.

Ease of use

The compiler was easy to use even though it provides many options. The defaults are very reasonable for normal program compilation and rarely did I ever have to add a switch to do what I wanted. The compiler is quite fast because it is written in assembly language.

Code size

There is approximately 2k added to the code for basic runtime facilities, but I think this is acceptable. The code actually generated is relatively efficient compared to other C compilers for the 8080. In fact it is the best that I have seen in any C compiler under $200.

Code quality

This is difficult to say much about the code quality because BDS C produces a relocatable object module rather than an assembly code. However, it must be good enough since the .COM files are small and the code runs fast.

General comments

I personally think this is the best C compiler on the market for the money. It produces small and efficient code, and though you can't hand optimize, the compiler does a pretty good job. Besides, who really wants to do hand optimization every time you compile a program. The compiler runs on small CP/M systems (unlike most of the C compilers on the market).

I use BDS C most of the time for my systems programming. There is a lot of software out there written for BDS C, including the Mince editor which I'm using to write this review. The C USER's GROUP maintains public domain BDS C programs for distribution.

I can also transport BDS C programs to UNIX version 7 on a PDP 4/70. This extends the power of my micro so that I can do development at home and run it at work or vice-versa.

Benchmark Results

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Compile time</td>
<td>19 sec</td>
</tr>
<tr>
<td>Link time</td>
<td>15 sec</td>
</tr>
<tr>
<td>Run Time</td>
<td></td>
</tr>
<tr>
<td>-Original prog</td>
<td>42 sec</td>
</tr>
<tr>
<td>-With -o compiler switch</td>
<td>27 sec</td>
</tr>
<tr>
<td>-Static variables and -o</td>
<td>15 sec</td>
</tr>
<tr>
<td>Object File Size</td>
<td>3456</td>
</tr>
<tr>
<td>-With -o compiler switch</td>
<td>3584</td>
</tr>
</tbody>
</table>

Note, this is the only compiler reviewed which allows speed optimization (-o compiler switch) by putting all code inline rather than using calls. Notice that the object code is slightly larger.
Dear Editor,

The following are my conclusions about Supersoft C and C/80 after putting both to substantial use.

Supersoft C appears to be a relatively complete version of C but many of its “features” are missing (including casts and sizeof). There are MANY significant bugs (including numerous new ones in version 1.1). Overhead is very high and if you don’t have M80 and L80, look out! Using ASM, makes assembly source files 100K and up. The documentation is ver-bose and crucial information is often im-bedded in thick text. Also, there is no in-dex.

I have called Supersoft approx 1,000,000 times and their technical staff is reasonable though they usually just admit that a bug exists. I was once told that the compiler was a dynamic project and was stabilizing (who are they kidding?) They also sell a floating point BCD package for $300 but it comes with no, none, zero documentation!

You may have detected my displeasure with Supersoft. I would recommend them to nobody.

C/80 is another story. It is very available—generates fast, compact code—has profile and trace for debugging and optimizing—has great error messages—and compiled programs support re-directable I/O.

Its weaknesses include—no free()—some utilities are not compatible with M80 (not difficult to fix)—no scanf()—and printf() does not do justification.

C80 has a few bugs—two routines in library.rel don’t have declared entry points—error messages when declaring global or static unions (but they compile properly)—and static functions should not be declared global for M80.

The manual is easy to read and formatted like The C Programming Language. It has very nice description of the error messages and, surprise, an index.

This compiler is very easy to use, and generates small, fast code. It has a clever way of dealing with auto variables making register variables almost unnecessary. On one of my programs (9K of source), Supersoft generates 20K of object code—C/80 generates 7K.

My conclusion is that C/80 is a giveaway at $50. It is the best deal in a C compiler that I’ve seen and I’ve also checked out BCS C and Whitesmith’s C.

Peter Baker
1954 Haultain St.
Victoria, BC Canada

Editor’s note:
I had to rewrite the above C information as a letter to the editor because it arrived too late to incorporate into the C articles.

Peter’s reviews were so well done and contained such a wealth of hands-on information that I’m sad I had to condense them. Thanks Peter.

Dear Editor,

I thought I’d let you know how I connected my Heathkit H-14 printer to my Big Board.

The printer ‘busy’ signal is inverted and though Heathkit has a modification
Since Arne wrote UNIFORTH, he should be the world authority on it. So I'll let him pass on many wonderful things to us about that version of FORTH. Which leaves me in the not-too-uncomfortable position of being the champion of ROM FORTH (RF). I have quite a debt to the ROM FORTH Group and this gives me some opportunity to work it off.

In this column we will look at disk I/O error recovery and turn-key operation of ROM FORTH.

Disk Errors and PFM

Disk errors are a fact of life—everything wears out. However, the system can usually recover from disk read errors by retrying the read a few times. PFM does a couple of retries automatically before returning an error code but after a few years of "polishing," heads begin to lose their ability to read disk data. (Editor's note, Hampton's drives have suffered through more than their share of Maxell disks.)

This is a progressive problem. Lower signal amplitude means higher error rates, which means more retries, which means more disk and head wear, which means lower signal amplitude . . .

PFM retries only twice before giving up, and this isn't always sufficient. Unfortunately, some programs assume that PFM is magic and that disk errors will never happen. Or, if errors do happen they throw up their hands and give up.

An example is ROM FORTH (RF). After PFM fails on the third read, it returns an error status to RF which promptly dumps the status report on the floor and continues on as if nothing happened. This can sometimes result in a buffer full of '@s instead of data. To make matters worse, FORTH may later try to write this bogus data over the original (but hard to read) data.

Remedies:

At RW1 + 4 replace

LD (HL),2 ;TWO RETRIES
With

LD (HL),0 ;256 RETRIES

This will give you 256 blessedly silent retries. If you need more retries than that, it's time to clean or replace the heads.

Another option, of course, would be to return the error status to the FORTH program and let it decide how to proceed. (Are you listening ROB?)

Turn-Key FORTH

You've just finished loading a 200-screen FORTH program which took a while. Now what? Wouldn't it be nice if you didn't have to load it again every time you brought up the system? Well, you don't have to.

Listing #1 is a new floppy bootstrap. It loads the first 64K from the drive into RAM, restores the Z80 stack pointer, restores the processor's status from the
stack, and then returns to the caller. Who called it? You did, of course, when you saved the entire contents of RAM onto the disk. Screen 186 contains the FORTH program to do that. Screens 187 and 188 contain a machine code assist routine.

The bootstrap has 2 entry points. PFM loads it at 0080H and jumps to it there. This causes the bootstrap to load the ROMs and still have full use of the RAM. Anyway, once you have done all this, you will be able to turn on your system. I have made no attempt to select the first several tracks of data. You might also note that PFM is not copied out to the disk but that ROM FORTH is copied. Anyway, you have done all this, you will be able to turn on your system, stick in your disk, type "B," and have both ROM FORTH and your application available immediately. Once this is set up, you can remove the ROMs that contain FORTH and still have full use of the language.

Caveats!
The routines as shown do not save the interrupt status of the Big Board. Also, they are being used on a single-drive system. I have made no attempt to select drive zero before merrily wiping out the first several tracks of data. You might also note that PFM is not copied out to the disk but that ROM FORTH is copied. Anyway, you have done all this, you will be able to turn on your system, stick in your disk, type "B," and have both ROM FORTH and your application available immediately. Once this is set up, you can remove the ROMs that contain FORTH and still have full use of the language.

'(continued next page)
UNIFORTH

UNIFORTH is the best implementation of the FORTH language available at any price--and it is now available specifically customized for the Big Board! Just look at these standard features:

- All source code is supplied except for a small kernel. You can easily modify, add or delete functions. Adheres to the FORTH-79 international standard. Fully optimized for the Z-80.
- Stand-alone. No operating system is needed. Exceptionally reliable disk I/O with error checking and fast access.
- Full IEEE-compatible single-precision floating point software. All functions are included, such as square roots, sines and logarithms.

Options include: fast disk copy, formatting (variable sector size), MetaFORTH cross-compiler, games, Programmer's Manual, source code listings/disks, and much more.

Prices:  
Version 1 (no floating point) $50  
Version 2 (floating point) $85  

All versions distributed on IBM 3740 standard eight-inch single-density floppy disk. Postage paid within the continental U.S., foreign orders slightly more.

Unified Software Systems  
P.O. Box 2644  
New Carrollton, MD 20784  
(301) 552-1295

(Letters continued)

The First Time

Since the routines copy the bootstrap code off the floppy, you have to get the bootstrap onto the disk before you try to save your RAM contents. I put the code in place by using PFM to load in the bootstrap sector "R0 0 1". Then I enter the data using the "M" command and then write the data back out by changing the read command by hand to a write command and again type "R0 0 1". DON'T FORGET TO RESTORE THE PFM READ VECTOR!

You're going to have to do this for every disk you want to use as a "system" disk. Just to be safe, I put a routine in my data disk bootstrap sectors which prints out a message saying that this is a data disk, not a system disk. (So they give me a message rather than a boot and thus do no damage.)

Future Columns

I future issues I will describe how to interface the Western Digital WD1000 Hard Disk Controller to the Big Board and ROMFORTH, how to use serial port A with the DC Hayes SmartModem, and how to read and write DEC format floppy's with the Big Board.

(Letters continued)

for the printer, it is very difficult once the kit is together. So I found an unused inverter (U118) on the Big Board.

The printer busy signal comes into the Big Board on J3 pin 4 (RTS). I placed a jumper between J5 pin 18 and U118 pins 9 and 10. I placed another jumper between U118 pin 8 and J5 pin 17. Using this mod along with the program PR.COM on user disk #1, I have my little printer going as fast as its little pins can print.

Now I have another problem. My Big Board generates a lot of interference on channel 5 and on my FM radio and intercom. Any solutions?

Wayne Roberts  
Box 178  
Morse, Saskatchewan  
Canada S0H 3C0  

Editor's note:  
Any computer operated in an unshielded, unfiltered environment will interfere with everything from your stereo to your false teeth. All those square waves racing about on the board are really multiples of odd harmonics that go on just about forever. This is why commercial computer manufacturers have such a difficult time reducing their EMI (Electro Magnetic Interference) to levels acceptable by the government.

Basically, you have to seal the whole thing up in metal. Be sure that all the metal cabinet parts make good electrical connection with each other and that there are no large holes. Shield the video output cable. Then bypass all lines (keyboard, RS232, but not the video out) going in and out of the cabinet with .001 uf ceramic disc capacitors.

Connect the capacitors between the the line and ground, making sure you keep the capacitor leads as short as possible. Use a standard power line filter for the 110/220V and you should have it.

If you still have trouble, use a hand radio and move it around the system to locate the places that need additional shielding (all the cables may have to be shielded). The alternative, of course, is to become a hermit or let your youngest fix the TV.

Note:  
Please mention Micro C when contacting advertisers

Micro Cornucopia, Number 7, August 1982
The Mega Super Computer

At last! A professional single board computer which offers everything you could ever desire and afford:

- 512K of D-Ram with Parity-Configurable as 8 Banks of 64K or as a high speed Electronic Disk
- Dual Density 1 or 2 sided Floppy Disk Controller (WD2797) - 8” or 5¼” - supports 3 drives for 4 MB’s of DATA
- Hard Disk Interface
- Six Serial Ports-with hand shaking
- Two Parallel Ports-with hand shaking
- 36 Additional Ports On expander BUS Plus Math Chip (9511), CTC, DMA, and Z80A Running at 5 MHZ-CPM/MPM Compatible

All this on a state of the art multi layer card-with accurate documentation. Bare Board-with documation & Frimware (PAL)-$400 Assembled & Tested Basic System $895 Dram-Disk $895 CPM $125

MEGA CO.

2318 S. Park Street, Madison, WI 53713 (608)255-7400
HIGH RESOLUTION MONITOR
FOR A LOW RESOLUTION PRICE

SUPER DEALS ON HIGH RESOLUTION TECO MONITORS.

Like Leedex or Zenith monitors, these 12 in. Teco monitors are complete, ready to connect to the Big Board's composite video output. Unlike the Leedex or the Zenith, however, the top of the line Teco features a 20 MHz bandwidth for unmatched resolution and P31 fast green phosphor. This model is crystal sharp even when displaying 132-characters per line.

However, if you insist on a display that our competition can match, we also have standard 15 MHz models with either P31 green or B&W phosphor.

These monitors are regular stock and include a complete money back guarantee. If you have any problems within three months, simply return the monitor for exchange or refund.

Also, ask about our quantity discounts on monitors and about our prices on Scientific, I-Ching, and game software.

CHECK THESE PRICES

- 20 MHz, green phosphor ... $138
- 15 MHz, green phosphor ... $128
- 15 MHz, B&W ............... $118

Add $8 for shipping & handling.

CAPITAL LIBRARY SERVICE
Computers & Peripherals
PO Box 459
Greenbelt, Maryland 20770

301-474-5346
(temp. number)
Is Your Big Board in a State of Flux?

By David Thompson

I’ve got a project for all of you who hand-soldered your boards and didn’t clean off the brown scummy residue. You need to clean your board.

That brown scummy residue is called flux. It is slightly acid to help clean the oxide off the parts you are soldering. However, it remains slightly acid forever and right now it is eating away at everything it’s touching (that means your Big Board). If you listen closely you may even hear gnawing sounds.

There are special fluorocarbon-based flux removers that you can purchase, but I (and the rest of humanity) would appreciate it if you wouldn’t use them. You see, any of these “innocuous” little cleaners you release into the atmosphere will spend the next 50 years doing a number on the ozone layer. The ozone layer filters out most of the ultraviolet radiation from the sun.

Fortunately, you can use good old isopropyl (rubbing) alcohol, even though it takes a little more effort (well worth it).

So go down to the local “five and dime” and get a BIG box of cotton balls and a pint (not a fifth) of alcohol. Now saturate a cotton ball etc. with alcohol and start rubbing. I usually work a small area at a time, making one pass over it to get it moist with the alcohol and then going back over it joint by joint until they all sparkle.

As you do this you have to keep turning the cotton so that you are really picking up the dissolved flux rather than just smearing it around. This is why you got a BIG box of cotton. Use it.

This is slow, uninteresting work, which makes it go well with Monday night baseball. In fact, a good extra-innings pitcher’s duel narrated by Howard should leave you with an absolutely spotless board.

This also wouldn’t be a bad project for any other equipment you have that’s in a state of flux.

WANT ADS

The following folks are reaching you for only 20 cents per word. If you would like to reach the same audience, send your words and 20 cents per each to Micro Cornucopia.

Want used printer to run with the BB. Who’s running a BB in my neighborhood? I need software.

Siegfried Sieffert
100 Seaview Ave
Monmouth Beach NJ 07750
201-222-7659

EPROM PROGRAMMER BOARD. (See Issue #6 Micro C.) Complete kit with all parts including sockets, ZIF for PROM, and instructions, $75.00. Bare PC board with instructions, $35.00. Pin-for-pin connection to PIO. Program controllable Vcc and Vpp. Requires only 5V with optional 25V chip.

Jim Chamberlain
PO Box 81
Pittsford, NY 14534
716-377-0369

Adding 6K of RAM

By Christopher Brock
709 Gridley St
San Jose, CA 95127

If you are not using the last three ROM sockets, you can install 2716 compatible rams such as the Hitachi 6116. All it takes is one trace cut and one wire jumper.

Cut the trace on the bottom of the board between pins 21 and 24 of U67. This disconnects pin 21 of all the ROM sockets from the 5V line. Add a jumper from U59 pin 10 to U70 pin 21. This ties all the ROM sockets to the write enable signal. Now just plug in the 6116s. (The PFM ROM remains in U67.)

You can use PFM’s memory test program to test this RAM. First lift out U111 and bend pin 7 out to the side before reinstalling. Now when you power up the system the lower 16K block is permanently switched out and you are in the ROM (and video RAM) bank.

Since PFM resides in the top part of memory, it signs on just like usual so you can use it to test the 6116s. Just for fun, you can also “F”ill locations 3000-3FFF (video RAM) with an ASCII character. (I’ll bet you didn’t know your video was so fast.)

When you are through testing and playing around, just return pin 7 of U111 to its rightful place. Now you can access this RAM anytime you set the bank select bit (bit 7 on the system PIO).

(Endor’s note, this might be an interesting place to keep data that had just scrolled off the screen, so you could scroll back a screen or two during a “TYPE” command etc.)

Inverted keyboard

Also quick comment about interfacing inverted keyboards. The Big Board has provision for inverted/non-inverted keyboard strobes but no provision for inverted keyboards. If you could replace U112 and U114 with non-inverting buffers that would take care of the problem. But the only pin-for-pin compatible replacements require pull up resistors. So I modified my PFM ROM. I changed location F499 from a 2F (complement A) to a 00 (no-op) and presto it worked. (Beats typing upside down. Ed)
YOU CAN RELY ON QUALITY
BIG BOARD ADD-ONS FROM
THE BIG BOARD’S ORIGINAL
SOFTWARE DESIGNER—RUSSELL
SMITH. SOFTWARE PUBLISHERS’
LATEST COLLABORATION PRODUCED AN
EASILY-INSTALLED, ADD-ON DUAL DENSITY
BOARD. SPECIFICATIONS:

▶ An assembled and tested Daughter board that replaces the
1771, plugging into the 1771 socket, enabling you to run
either single or double density.

▶ Uses a 1791 disk controller plus a field-proven digital data
separator and write precompensation circuit.

▶ Requires absolutely no Big Board modifications.
Runs with 2.5 or 4 MHz clock and standard PFM monitor.

▶ Includes a disk that contains:
  • DDSYSGEN—A double density SYSGEN program
  • DDINIT—A disk initialization and verification
    program. Allows disks to be formatted
    in all standard single and double
    density formats.

▶ Available for 5¼” and 8” drive systems. (5¼” DUAL
DENSITY board includes a 50 to 34 pin cable adapter.)
  • 8” disks have up to 674K of user storage.
  • 5¼” disks have up to 185K of user storage.

SOFTWARE PUBLISHERS, INC.
2500 E. Randol Mill Rd., Suite 125
Arlington, Texas 76011
(817) 469-1181

$199.95
Those of us living in the 50 Hz part of the world have a video wiggle problem even after changing to the new crystal. In fact, our problem is a 10 Hz wiggle produced by the beat between the 60 Hz vertical from the Big Board and our 50 Hz line frequency. Of course part of my problem might have been that I was using a modified portable TV.

So I took a close look at the video circuitry and found that U22 (74LS290) was used as a divide-by-ten. If I could change that chip to something that divided by 12 I would get 50 Hz.

The TTL data book indicated that a 74LS293 could divide by 12 so I removed the 74LS290 from U22, and cut the run between U22 pin 3 and U22 pin 12 (top of the board). Then I jumpered U22 pin 4 to U22 pin 12 and jumpered U22 pin 8 to U22 pin 13 and plugged in the 74LS293.

Those of us living in the 50 Hz part of the world have a video wiggle problem even after changing to the new crystal. In fact, our problem is a 10 Hz wiggle produced by the beat between the 60 Hz vertical from the Big Board and our 50 Hz line frequency. Of course part of my problem might have been that I was using a modified portable TV.

So I took a close look at the video circuitry and found that U22 (74LS290) was used as a divide-by-ten. If I could change that chip to something that divided by 12 I would get 50 Hz.

The TTL data book indicated that a 74LS293 could divide by 12 so I removed the 74LS290 from U22, and cut the run between U22 pin 3 and U22 pin 12 (top of the board). Then I jumpered U22 pin 4 to U22 pin 12 and jumpered U22 pin 8 to U22 pin 13 and plugged in the 74LS293.

Modified vertical sync generator.

**Theory of Operation**

The 74LS293 counts up until outputs C and D go high (binary 12). At this point the reset inputs restart the counter. If you want to change it back to 60 Hz, jumper U22 pin 12 to U22 pin 5 (instead of pin 4). Now it will count to 10.

Note: U96 is also a 74LS293 and it is the chip you remove when you do the standard 4 MHz modification so you might have a spare lying around.

**Other Video Changes**

I reduced the effective value of R25 (3.9K) to about 800 ohms by soldering a 1K resistor in parallel with it. This increased the size of the sync pulses which helped my monitor maintain sync. Plus, I removed C142 (33pF) to increase the sharpness of the characters. (You can also replace C142 with a small variable capacitor and then adjust it for the best looking characters.)

---

**UNIVERSAL ENCLOSURE**

12" Green Ball Brothers monitor with enclosure measuring 19" x 16.5" x 14". Room inside to mount a Ferguson single board computer or small SS-50, S-100 system. (Power supply available, see below.) Requires +15 volts DC. @ 1.5 amps, noncomposite (separate sync) input. A sync separator schematic is available. It is also possible to mount a single 8" disk drive or two of the new slim line 8" disk drives in this enclosure. All units are used, and have been 100% tested.

*Shipping weight 35# ............ $65.00*

ASCII Keyboard (used with enclosure to match above monitor. 77 keys, 7 lighted pushbuttons, on/off sw. Requires 5 volts DC. Schematic included. Includes shift, tab, control and cursor control keys. Size; 19 x 4 x 5 1/2"

*Shipping weight 8#.......................... $35.00*

Modular power supply (missing regulator card) fits inside above monitor enclosure. Includes large transformer that outputs +8.5 volts @ 17 amps, +/−18 volts @ 1.5 amps each, +15 volts @ 1.5 amps for monitor), three large capacitors (1-18kuf, 2-8kuf), 1-30 amp, 2-3 amp bridge rectifiers. The transformer and rectifiers/capacitors make a perfect unregulated SS-50/S-100 power supply. The schematic for the regulator card is available.

*Shipping weight 25# ............ $25.00*

D & W ASSOCIATES
PO Box 60, Rome NY 13440
(315) 339-2232 or 337-7968
Please call either number evenings only

**D & W 1982 CATALOG**

**VIDEO MONITORS & KEYBOARDS**

12" GREEN BALL BROTHERS WITH ENCLOSURE AND MATCHING KEYBOARD WITH ENCLOSURE, SEE ENCLOSED DATA SHEET. MONITOR AVAILABLE SEPARATELY, KEYBOARD AVAILABLE ONLY WITH PURCHASE OF MONITOR (DUE TO LIMITED QUANTITIES). SCHEMATICS AVAILABLE WITH PURCHASE OR SEND SASE TO D&W ASSOCIATES, PO BOX 60, ROM, NY, 13440.

SCB ASCII KEYBOARD FULL ASCII, SHIFT LOCK, 5 VOLT ONLY, PLENTY OF EXTRA NONENCODED KEYS FOR YOUR SPECIAL REQUIREMENTS. INCLUDES FACE PLATE, APPROXIMATELY 3 x 21 INCHES. THIS IS A FAIL EFFECT TYPE . . . . . . . . . . . .50.00

**SHIPPING**

PRINTERS ARE SENT TRUCK FREIGHT COLLECT. VIDEO MONITORS ARE SENT UPS SURFACE YOU PAY SHIPPING. CHECK WITH UPS FOR COSTS, WEIGHTS INCLUDED OR DATA SHEET ENCLOSED. KEYBOARDS CAN BE SENT VIA U.S. MAIL OR UPS SURFACE (OR UPS AIR).

**INTEGRATED CIRCUITS**

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>85.00</td>
</tr>
<tr>
<td>280A</td>
<td>5.00</td>
</tr>
<tr>
<td>2708</td>
<td>450ns</td>
</tr>
<tr>
<td>2716</td>
<td>5v</td>
</tr>
<tr>
<td>2731</td>
<td>5v</td>
</tr>
<tr>
<td>6114-3</td>
<td>8</td>
</tr>
<tr>
<td>6114</td>
<td>8</td>
</tr>
<tr>
<td>6114-3</td>
<td>30ns</td>
</tr>
<tr>
<td>6114-6</td>
<td>8.25</td>
</tr>
<tr>
<td>111D-12</td>
<td>8.25</td>
</tr>
<tr>
<td>111D-12</td>
<td>8.25</td>
</tr>
</tbody>
</table>

**SOCKETS & SWITCHES**

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 pin sockets</td>
<td>30.00</td>
</tr>
<tr>
<td>16 pin sockets</td>
<td>30.00</td>
</tr>
<tr>
<td>20 pin sockets</td>
<td>10.00</td>
</tr>
<tr>
<td>8 position dip switch</td>
<td>12.00</td>
</tr>
<tr>
<td>14 pin ic type header, gold pin, fiberglass body</td>
<td>3.00</td>
</tr>
</tbody>
</table>

**ORDER information**

*MINIMUM ORDER FOR ANY OF THE ABOVE IS $25.00. PLEASE INCLUDE $2.50 FOR PACKING AND SHIPPING. ORDERS SENT VIA U.S. MAIL OR UPS. WE ALSO SHIP COD.
FROM CAPITAL LIBRARY SERVICE
***: ANNOUNCING FOR YOUR C.P.U. ! ***
---------------------------------------------
*** : -> ! EXPAND YOUR SENSES ! <-***:
GIVE YOUR BIG-BOARD IT’S CONTROL-G HARDWARE BELL

AN ADD ON BOARD OF MODERATE SIZE : E A S I L Y I N S T A L L E D ! ! !
WHICH WILL GIVE Y O U A TRUE 2 KHZ, .60 SECOND HARDWARE BELL ! ! !
ATTACHES TO THE PIO 'SIDE B' OUTPUT WITH ONLY ONE SOLDER CONNECTION.
HAS ON BOARD REGULATOR, FILTERING, AND RUNS OFF +12 VOLT BIG-BOARD SUPPLY.
YOUR COST ASSEMBLED & TESTED IS ONLY-
$39.95 POSTPAID (check OR money order)
OR $29.95 IN KIT FORM UNTESTED
USES ONLY THE FINEST QUALITY PARTS FOR EXTRA RELIABILITY!
OUTPUTS A PLEASANT 'BEEP' WHENEVER AN ASCII 07 IS OUTPUT TO THE CONSOLE.
YOU WILL FIND IT INVALUABLE FOR WORD PROCESSING LINE END MESSAGES AND IT
WILL ADD PERSONALITY TO YOUR C.P.U. AND MAKE IT SOUND LIKE A ZEROX 820!
SEND/RECEIVE MORSE CODE PACKAGE & CASSETTE INTERFACE TO GO WITH BEEPERBOARD COMING SOON!

ALSO SPECIAL SOFTWARE OFFER !
The Classic Game of Hangman in BASIC-E Complete Package includes all this:
Source Code for the Game, Documentation and the BASIC-E Compiler itself with
User’s Documentation for the Language !
This is a full featured version of Hangman with a user customizable Word
List of up to 500 Words and the Best Graphics you’ll ever see on a Big-Board
Absolutely great as a Learning Tool and Example of BASIC-E Compiler Syntax !
The BASIC-E Compiler is full featured Basic: Extremely Fast for CP/M 2.2.
The Documentation provided is what makes it really usefull ! ! !

ALL ON Bin SD Disk For ONLY $39.95 !
< S E N D Y O U R O R D E R S T O D A Y T O >
CAPITAL LIBRARY SERVICE
Post Office Box 457
GREENBELT, MARYLAND, 20770
OR TELEPHONE (301) - 474 - 5346 ask for Mr. Goldstein

WE LOVE OUR FOREIGN CUSTOMERS, BUT IT COSTS US MORE TO FLY TO
YOU, PLEASE SEND $ 5.00 ADDITIONAL WITH ORDER, THANK YOU
MARYLAND RESIDENTS ADD 5% SALES TAX

(EDITORIAL CONTINUED)

disks. (If you want long-life media and long-life heads, see issue #8.)

If you have more inside information or have had some good or bad experiences
with Maxells or other disks, please drop me a note or call right away. We’ll in­
clude your information in issue #8.

NEW FEATURES

“Technical Tips” is a new regular feature replacing The Designer’s Corner.
I’m making this change for two reasons.
First, most of the Designers Corners have been technical tips; and second,
Frank Gentges sent in a disk containing 8 really spectacular technical tidbits. You’ll see
the first of these in this issue. (But don’t be afraid to send in some of your own.)

“On Your Own” will cover a lot of the topics that I discuss with folks on a daily
basis. This column will cover some of the business aspects of setting up and running
your own computer-oriented mail order, designing, or consulting firm.

FUN

I have to admit that as much as I enjoy writing and editing and writing and editing
and writing, . . . into the wee hours of

the morning, I also enjoy an occasional game of adventure.

Actually, there are many versions of adventure. My introduction to this sport
was called Dungeons and it ran on a DEC 11-44. Dungeons was so large that only
two users could play it at a time without bringing the machine to its knees.

If you think you might have an appropriately conniving, scheming, crafty,
mind and if you accept the absurd as obvious, then you ought to either write for
Micro C or check out the Adventure that DRC (of Texas) is selling for $29.95. (See
the Adventure ad in issue #6.)

For those of you just starting in this field, a few tips. Maps or direction tables
are invaluable (even the maze of ‘passages all alike’ is mappable if you drop
the right hints in the right places). Also, keep track of the words the program un­
derstands. Even though a word might not do anything in your present situation,
it will no doubt be useful sometime.

Happy adventuring.

ALSO FOR $29.95

You can probably imagine my disbelief when I came across a full-blown Pascal
Compiler for $29.95. I mean, a full ISO standard Pascal with 14 digit floating
point, a very versatile linker, and a 130 page manual for less than the price of a
Pascal MT+ manual!

I called Jim Tyson at JRT Systems Inc. and asked him if his compiler were really
$29.95 or if his decimal place were having an “off by one” problem. (At $299.50
it still would have been the best deal on the market.) He verified the price and in­
dicated that an earlier version had been on the market for $295, but he said that at
$295, he couldn’t compete with the big outfits with their big advertising budg­
ets. So he improved the product and cut the price by 90 percent.

All I can say is, hooray for the small entrepreneur. The folks who distribute
Pascal M, Pascal MT+, and Pascal Z should be shaking in their three piece suits.

Happy Computing.

David Thompson
Editor & Publisher

Micro Cornucopia, Number 7, August 1982
On Your Own
By David Thompson

If Micro C seems like a strange place for a column on working for yourself, consider the following: most of you are engineers of one stripe or another, and most of you are already moonlighting to pick up some extra shekels. So you are already working for yourselves.

Please feel free to contribute your ideas, experiences, and questions in this area. Also, let me know if you know about particularly good or bad information sources or opportunities in this area. This issue we’ll talk about fees.

Charging for your services
As a consultant you should charge somewhere between three and four times what the job would pay if you were a full-time employee. You see, an employee who receives $12.00 per hour costs a company about $25.00 per hour figuring space, supervision, support, and benefits.

Plus:
1. A full-time employee is only about half as productive per hour as an independent contractor (coffee breaks, dental appointments, meetings, birthday parties, in-house battles, etc.)
2. The company has to keep the employee around even when there is a lull in the work load.
3. By using consultants, a company can get expertise for a project that it couldn’t otherwise afford or expertise that it needs for only a short time. (This is especially important for small and startup companies.)

So, even at four times your normal wage you usually cost your client less per project than if the client added an employee. Plus, the project usually gets finished sooner.

There are some advantages and disadvantages to charging $40 and up per hour. The advantages include status and support.

For instance, if you ask for help drafting a schematic you’ll get it. The client can’t afford to pay you to do the drafting and he can’t afford to have you sitting around.

Many new clients will try to dicker with you once you’ve told them the price. If they don’t dicker then you’ve either come highly recommended or you’re charging less than they expected. If they do dicker, be firm on your rate, you are basically telling your client that you are worth what you are asking. Also, no matter what price you set, some clients won’t be satisfied, and others simply won’t share more than the tiniest crumb with the person doing the work.

A local software outfit rummaged around for months trying to find someone who would write a standard CBIOS for $2,500. While they were rummaging, project completion slid farther and farther out and the end user was anxious. Meanwhile, the software outfit was charging the end user $25,000 for that CBIOS.

The fixed fee arrangement (can be lucrative if you know how to negotiate and estimate) is just one method companies use to minimize project expenses. Another way companies minimize expenses is by continually calling you on the phone for “a couple of quick questions” figuring you won’t be charging them for that time. If it’s a problem, tell them that you will be billing them for every minute after “hello” (and always say “hello” when you pick up the phone).

The fixed fee basis is particularly dangerous if there is any way for system requirements to change during the project. Any project you get involved with should be well defined from the beginning but when you contract for a fixed amount it should be spelled out absolutely to the letter. You or the client can still change the specifications during the project but do it by mutual written agreement only and make sure to include an adjustment of the fee in the negotiation.

All you’re given in this world are time and smarts (and the resulting experience). If you want to give away your time and smarts and experience, that’s fine, but know what you are giving away and at least make it a good cause.

Next issue we’ll discuss how to make reasonably sure you get paid.

WRAM Computers
SUMMER SALE!
3M DISKETTES
740-0 8" CASE $119.95
744-10 5" CASE * $113.95
744-0 5" CASE * $113.95
F.O.B. PORTLAND, OR * WITH HUB RINGS

DEMONSTRATOR SALE
North Star Horizon
48K, 2 Drive with Soroc IO-120 CRT.
$2495.00
North Star HD-18 Hard Disk, 18 megabyte.
$2895.00
Hewlet-Packard HP-85
$1695.00
Teletype TTY-43 RO
$500.00

WRAM Computer Corp.
P.O.Box 19281
Portland, OR 97219
(503)244-2168

Dealers for Morrow, North Star, Godbout, Tarbell, PMMI, A.C.E., TALLY, and 3M.

Prices good thru Sept. 21, 1982
**$125.00 CASH REBATE**
on your purchase of
**dBASE II**

price before rebate  $590.00
Less rebate  125.00
**YOU PAY**  $465.00

Other Specials for dBASE II users:

- dBASE User's Guide  $27.50
- Quickscreen  $125.00
- Quicksave  $65.00

**Word Processing**

<table>
<thead>
<tr>
<th>Fontnote</th>
<th>$110</th>
<th>Supercalc</th>
<th>$410</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grammatik</td>
<td>$185</td>
<td>Plan 50</td>
<td>$410</td>
</tr>
<tr>
<td>MailMerge</td>
<td>$40</td>
<td>CallStar</td>
<td>$180</td>
</tr>
<tr>
<td>Palantir</td>
<td>$430</td>
<td>DataStar</td>
<td>$200</td>
</tr>
<tr>
<td>Proofreader</td>
<td>$106</td>
<td>DataBase Managers</td>
<td>$265</td>
</tr>
<tr>
<td>Spellfinder</td>
<td>$107</td>
<td>Condor I</td>
<td>$213</td>
</tr>
<tr>
<td>Spellcheck</td>
<td>$200</td>
<td>DataStar</td>
<td>$210</td>
</tr>
<tr>
<td>Spellguard</td>
<td>$212</td>
<td>dBASE II</td>
<td>$245</td>
</tr>
<tr>
<td>SpellStar</td>
<td>$120</td>
<td>The Word</td>
<td>$60</td>
</tr>
<tr>
<td>The Word</td>
<td>$100</td>
<td>Selector IV</td>
<td>$215</td>
</tr>
<tr>
<td>WordStar</td>
<td>$282</td>
<td>Selector V</td>
<td>$266</td>
</tr>
<tr>
<td>Accounting</td>
<td>$450</td>
<td>Communications</td>
<td>$110</td>
</tr>
<tr>
<td>Palantir</td>
<td>$464</td>
<td>Remote</td>
<td>$110</td>
</tr>
<tr>
<td>Palantir</td>
<td>$90</td>
<td>Lync</td>
<td>$90</td>
</tr>
</tbody>
</table>

**Worksheets**

| Supercalc | $198 | DataStar | $210 |
| Plan 50 | $410 | dBASE II | $245 |
| CallStar | $180 | The Word | $60 |
| DataStar | $200 | Selector IV | $215 |
| DataStar | $265 | Selector V | $266 |

**Languages**

| CB-80 | $419 | IBM 2 | $98 |
| Basic B | $282 | ADA | $106 |
| PL/1-B | $140 | CP+ | $128 |
| Unix | $40 | Misc | $60 |
| Supercalc | $273 | Smartkey | $39 |
| Spellcheck | $225 | CP/M Power | $75 |
| Spellguard | $240 | NW Stat Pak | $356 |
| SpellStar | $255 | Mathcad | $70 |
| The Word | $215 | dPATCH | $76 |

**Accounting**

| $265 | | | |
| $200 | | | |
| $110 | | | |
| $75 | | | |

**Other Specials**

- dBASE User's Guide  $27.50
- Quickscreen  $125.00
- Quicksave  $65.00

**Medi - over 60 packages**

- Sales Tracking and Analysis  CALL
- Real Estate  CALL

**Digital Research Computers**

PO Box 401565
Garland, TX 75040
(214) 271-3538

**IS YOUR DISK DRIVE WORKING OVERTIME WITH ONLY MEDIA WEAR TO SHOW FOR IT?**

Your floppy drives rotate disks constantly, grinding dirt into the delicate surface which contributes to shortened media life while generating unnecessary noise.

Our Drive Control Unit energizes the drive only when disk access is absolutely necessary. Media lasts longer and the system is quiet.

DCU is the best solution for disk drives and the system is quiet. DCU mounts on the disk plate and energizes only on zero crossings. Aux output available for 2nd drive. DCU controllers and state type drives are available in your system.

DCU is available in kit form for $19.95, or assembled $29.95. For 2nd drive, Big Board should have the DCU option.

Stock horizontal drive in stock.

**For Sale**

- Bare Big Boards, parts, disk drives in stock.
- Integrand 700DV vertical drive cabinet with power supply. Room for 2 or 3 drives & Big Board $275.

Stock horizontal drive cabinet with Borchert Power supply. Room for 2 horizontal drives and Big Board, $275.

**The Electronics Shop**

131 North Decatur
Olympia, WA 98502
206-357-6304
206-352-7530 CBBS

**IS YOUR DISK DRIVE WORKING OVERTIME WITH ONLY MEDIA WEAR TO SHOW FOR IT?**

Your floppy drives rotate disks constantly, grinding dirt into the delicate surface which contributes to shortened media life while generating unnecessary noise.

Our Drive Control Unit energizes the drive only when disk access is absolutely necessary. Media lasts longer and the system is quiet.

DCU is the best solution for drive A.C. control.

Big Board owners no longer have to look for connectors, relays, and a place to put them. DCU comes complete with everything and is designed to be easily installed within all popular 8 in. drives.

DCU mounts on the disk AC connector and energizes only on zero crossings. Aux output available for 2nd drive. (Big Board should have the DCU option)

Please order DCUBB for Big Board systems and all other systems order DCU and state type of drives and controller used in your system.

DCU is available in kit form for $19.95, or assembled $29.95.

For 2nd drive, Big Board should have the DCU option.

Please order DCUBB for Big Board systems and all other systems order DCU and state type of drives and controller used in your system.

DCU is available in kit form for $19.95, or assembled $29.95.

For 2nd drive, Big Board should have the DCU option.

**THERE'S GOLD IN OLD COMPUTERS**

WE RECOVER AND RETURN

$125.00 CASH REBATE

$125.00 CASH REBATE

**THE ELECTRONICS SHOP**

131 North Decatur
Olympia, WA 98502
206-357-6304
206-352-7530 CBBS
BIGBOARD 5 MEGABYTE WINCHESTER DISK

THE DUTCH CONNECTION IS READY

The DUTCH CONNECTION announced in the last issue of Micro Cornucopia will be in Portland on July 24th. Andy Bakkers of the Netherlands will be there to demonstrate and sell host adapters on the spot.

The DUTCH CONNECTION consists of a host adaptor PC board to connect your BIG BOARD PIO output to an industry standard SASI (Shugart Associates Standard Interface) bus. You also get a CBIOS to integrate the Winchester disk with your CPM. And there are software utilities to system generate your new operating system; and utilities to check the disk hardware.

The price of The DUTCH CONNECTION is $239.50. This includes the PC Board, software and manual on an 8" floppy. Ribbon cable (40 wire with female end connectors) and shipping are extra.

You can get Winchester Drives and SASI standard controllers from a number of suppliers. The DUTCH CONNECTION as been tested with an XEBEC controller and a number of 6 megabyte drives. (XEBEC has advertised a controller and drive for $999.00.)

See it, try it, and buy it, at Portland on the 24th of July. Watch for dealer announcements in Micro Cornucopia.

Or order it direct from the North American importer:

Applied i

200 California Ave, Suite 205
Palo Alto CA, 94062 (415) 325-4800

Real Time Clock
For
Big Board Users
$25.00

★ No extra hardware required - uses onboard Z80 CTC channels 0 and 1
★ Easy setup of time and date
★ Allows timestamping of files and listings
★ Uses memory at EFOO - EFFF hex
★ Unix-like user interface through the use of CP/M .COM files - no assembly language experience needed
★ For CP/M 2.2 8" single sided, single density disk systems

Programmer’s Aid
Package For
CP/M Users
$45.00

★ Unix-flavored utilities designed to make documentation and text processing easier
★ Utilities include: text formatter, “pretty” printer, file transliteration, word and character counting, file encryption/decryption and more - 9 programs in all
★ For CP/M 2.2 8" single sided single density disk systems - 48k RAM or more
★ Users Manual only: $3.00 (refundable towards purchase)

To order, send check or money order for the appropriate amount to:

L.A. Software
6706 Melrose
Los Angeles California 90038
213/932-0817

California residents add 6% sales tax
CP/M is a trademark of Digital Research
Unix is a trademark of Bell Telephone Labs
Copyright 1982 L.A. Software
Especially For The Big Board From Micro C

USER'S DISK #1 .......................... $15.00 $20.00
Over 200K of software especially for the Big Board.
Including:
1-Two fast disk copiers.
3-Convent BASIC programmer.
5-A summer calendar.
6-Serial line terminators.
7-Modem software.
8-Documentation for all the above.

USER'S DISK #2 .......................... $15.00 $20.00
Especially for folks with single-drive systems and those who want to try their hand at extending an assembler. Also a new CBIOS with parallel printer interface. Returns to default drive on reboot, stifles head banging, supports CP/M 2.2 and 1.4. Step by step instructions for the simple incorporation into your CP/M (using only DDT and SYSGEN). CBIOS source also included.
Including:
1-Two single-disk copy programs, both with source.
2-The source of the Crowe Assembler.
3-New Crowe.com file with larger symbol table.
4-New CBIOS for CP/M 1.4 and 2.2 (boot).
5-Disk mapper with source.
6-Documentation for all the above.

USER'S DISK #3 .......................... $15.00 $20.00
This is the disk for folks who are building Jim Monesmith's ROM programmer. Two versions of programmer software plus a disk file CRC checker. Also contains a sophisticated disk utility (DUD77) and source for a substantially updated fast copy routine, plus more. (And documentation.)
Including:
1-Unmodified ROM programmer.
2-ROM programmer with CRC.
3-Disk file CRC checker.
4-Source of new fast copy.
5-Utility isolates bad disk sectors.
6-Reset bit 7 (unWordstar a file).
7-Print fancy page headings.
8-And more.

FREE
Your choice of either user's disk or the deluxe character ROM free if you send an article or software and a ROM or extra disk.

FORTH IN ROM .......................... $65.00 $70.00
in fast ROM .......................... $80.00 $85.00
Now, what you've all been waiting for—FORTH in ROM. This is standard FORTH in three 2716's. FORTH is standalone FORTH so you don't use CP/M at all. If you have disks, FORTH handles the disk I/O. If not, you can still enjoy a most fascinating language. A simple FORTH line editor and a decompressor are available on disk.

FORTH editor & decompressor disk .......................... $15.00 $20.00

TINY BASIC IN ROM .......................... $35.00 $40.00
in fast ROM .......................... $45.00 $50.00
This two-ROM set takes control of the system just like FORTH does, handling its own I/O, loading Basic programs and object code routines on and off the disk or out of the third ROM. This little Basic is great for controller and utility applications.

MORE ROMS
Fast monitor ROMs for speed freaks and our famous 'better than Texas' character ROM for screen freaks.

Fast Monitor ROM .......................... $25.00 $30.00
Version 2.2 Character ROM .......................... $25.00 $30.00

Send Big Board number with monitor ROM orders.

Monitor & char. ROMs $5.00 each if you send a fast ROM and a stamped, self-addressed return envelope.

BACK ISSUES (each) .......................... $3.00 $5.00
Because of the demand from new subscribers (bless their hearts) we are keeping back issues in print.

ISSUE #1 .......................... $3.00
Power Supply
RAM Protection
Video Wiggle
1/2 PFM.PRINT
Plus More (16 pgs)

ISSUE #2 .......................... $4.00
Parallel Print
Drive Motor Cont.
Shugart Jumpers
1/2 PFM.PRINT
Plus More (20 pgs)

ISSUE #3 .......................... $5.00
Four MHz Mods
Configuring Modem 7
Safer Formatter
Reverse Video Cursor
Plus More (20 pgs)

ISSUE #4 .......................... $6.00
Keyboard Translation
More 4 MHz Mods
Modems, Lync & SIOs
Undoing CP/M ERASE
Plus More (20 pgs)

ISSUE #5 .......................... $7.00
Word Processing
Two Great Spells
Two Text Editors
Scribble, a Formatter
Plus More (20 pgs)

ISSUE #6 .......................... $8.00
EPROM Programmer
Customizing Characters
Double Density update
Terminal in FORTH
Plus More (24 pgs)

Screen Editor in Small C .......................... $39.00 $44.00
A simple but full-function screen text editor plus a text formatter, all written in Small C by Edward Ream. This package includes the editor and formatter. COM files setup for the Big Board, Small C itself, and source code for all. With the documentation this is over 400K on a floppy disk. Edward is selling this package for $50, you can buy it from us for $39 (and Ed gets a royalty). Where else can you get an editor, a formatter, a C compiler, and source for all for under $40?

They're Shipping!

On Saturday, July 9, I picked up the phone to hear a very excited voice cry "They've come, they've come!" Fortunately Paul Revere gave better notice.

Anyway, Cal-Tex is shipping the new system (now called the Big Board II) and there are suddenly a number of busy little parts collectors scurrying around collecting busy little parts. Such fun!

You can reach Cal-Tex at 780 Trimble Road, Suite 504, San Jose, CA, 95131. (408) 942-1424.

New From Micro C

Your Fortune in the Microcomputer Business

Prices $15.95 each plus $1.00 postage or $24.95 plus $1.50 postage for the pair.

Small-C+

Small-C+ is now available through Micro C. This is a simple, cleaned up version of Small-C with a some pretty neat extensions. For more information see the C reviews in this issue.

Price - $24.00 $29.00

US,CAN,MEX Other Foreign
ANNOUNCING
DOUBLE DENSITY DISK INTERFACE
FOR THE BIG BOARD

New floppy interface package for the Big Board lets you read and write single and double density disks with 128, 256, 512, and 1024 bytes/sector.

The package includes:
1. Fully assembled and tested board, cable and connector to replace the 1771. Board contains 5 ICs including a Western Digital 1795.
2. An extended monitor in two 2716s.
3. A disk containing:
   - Disk formatting program. (128, 256, 512, 1024 bytes/sector)
   - Disk copying program.
   - An overlay for MOVCPM.COM
   - A double density SYSGEN
4. Documentation
   - Dependable 4 MHz mod
   - New Big Board Jumpers
   - Complete Source for BIOS & Mon.

Sector size is determined by how the disk was formatted and is totally transparent to the user.

Disk capacity range from 241K for SS SD, 128 bytes/sector - to 1.3 Mbyte for DS, DD, 1024 bytes/sector.

Requires minor modification to Big Board and requires that Big Board run 4 MHz.

Price: $220

Otto Hiller Co.
Scientific Equipment
P.O. Box 1294
Madison, WI 53701
608-271-4747 3-5 pm

Bring the flavor of Unix To your Z80-based CP/M system with Unica

"Unica: a thing unique in its kind, especially an example of writing. Unica: the plural of unicum."

The Unica: a unique collection of programs supporting many features of the Unix operating system never before available under CP/M. The Unica are more than software tools; they are finely crafted instruments of surgical quality. Some of the Unica are:

bc - binary file compare
cat - catenate files
cp - copy one or more files
dm - disk map and statistics
hc - horizontal file catenation
ls - create file links (aliases)
ls - directory lister
mv - move (rename) files, even across users
rm - remove files
sc - source file compare, with resynchronization
sr - in-memory file sorter
sr - search multiple files for a pattern
sp - spelling error detector, with 20,000 word dictionary

Each Unica understands several flags ("options" or "switches") which control program alternatives. No special "shell" is needed; Unica commands are typed to the standard CP/M command interpreter. The Unica package supports several Unix-like facilities, like filename user numbers:

```
sc data.bas;2 data.bas;3
```

(comparis files belonging to user 2 and user 3);

Wildcard patterns:

```
rm "tmp" -w
```

(twotypes each filename containing the letters TMP and asks whether to delete the file);

I/O redirection:

```
ls -a -l list
```

(writes a directory listing of all files to file "list");

```
P i e s :
cat chap\1 sp \1 sr t \1s:
```

(concatenates each file whose name starts with "chap", makes a list of misspelled words, sorts the list, and prints it on the listing device).

The Unica are written in XM-80, a low level language which combines rigorously checked procedure definition and invocation with the versatility of Z80 assembly language. XM-80 includes a language translator which turns XM-80 programs into source code for MACRO-80, the industry standard assembler from Microsoft. It also includes a MACRO-80 object library with over forty "software components", subroutine packages which are called to perform services such as piping, wildcard matching, output formatting, and device-independent I/O with buffers of any size from 1 to 64k bytes.

The source code for each Unica main program (but not for the software component library) is provided. With the Unica and XM-80, you can customize each utility to your installation, and write your own applications quickly and efficiently. Programs which you write using XM-80 components are not subject to any licensing fee.

Extensive documentation includes tutorials, reference manuals, individual spec sheets for each component, and thorough descriptions of each Unica.

Update policy: each Unica owner is informed when new Unica or components become available. At any time, and as often as you like, you can return the distribution disk with a $10 handling fee and get the current versions of the Unica and XM-80, with documentation for all new or changed software.

The Unica and XM-80 (which requires MACRO-80) are priced at $195, or $25 for the documentation. The Unica alone are supplied as .COM executable files and are priced at $95 for the set, or $15 for the documentation. Software is distributed on 8" floppy disks for Z80 CP/M version 2 systems.

Knowlogy "Shaping Knowledge for Evolving Worlds"
P.O. Box 283
Wilsonville, Oregon 97070

Visa/Mastercard customers call (503) 639-3420 after hours for next day shipment.

CP/M is a trademark of Digital Research; Unix is a trademark of Knowlogy; Unica is a trademark of Bell Telephone Labs; XM-80 is a trademark of Scientific Enterprises; Z80 is a trademark of Zilog Inc.
LEAP INTO A NEW DIMENSION
WITH AZTEC CII

Full implementation of "C" with standard floating point, library, and I/O subroutines. UNIX VER 7 compatible. Produces relocatable 8080 (optional 0280) assembler code. Relocating assembler and linker supplied with package or use Microsoft M80 and L80, SIDI/ZSID debugger interface. FAST Compilation AND EXECUTION.

AZTEC CII FOR CP/M $199

MANX
software systems
Box 55, Shrewsbury, N.J. 07701
(201) 780-4004

Also available for Apple DOS, HDOS, CP/M-86, PC-DOS

Now—a Complete CP/M Pascal—for Only

$29.95!

Goodbye BASIC, PL/1, COBOL—hello PASCAL! Now, to make this most advanced language available to more micro users, we're slashing our price—to an amazing $29.95! This astonishing price includes the complete JRT Pascal system on 8" SSSD diskette and the comprehensive new user manual. Not a subset, it's a complete Pascal for CP/M.* Check the features:

- Separate compilation of external procedures
- Auto-loading
- 14 digit FLOATING POINT arithmetic
- True dynamic storage
- Verbal error messages
- Fast one-step compiler: no link needed
- Graphing procedures
- Activity analyzer prints histogram of program use
- Advanced assembler interface.

THIS IS THE SAME SYSTEM WE SOLD FOR $295!

So how can we make this offer?—why the unbelievable deal? Very simply, we think all software is overpriced. We want to build volume with the booming CP/M market, and our overhead is low, so we're passing the savings on to you.

AND AT NO RISK!

When you receive JRT Pascal, look it over, check it out. We invite you to compare it with other systems costing ten times as much. If you're not completely satisfied, return the system—with the sealed diskette unopened—within 30 days and your money will be refunded in full! THAT'S RIGHT—COMPLETE SATISFACTION

GUARANTEED OR YOUR MONEY BACK!

In addition, if you want to copy the diskette or manual—so long as it's not for resale—it's O.K. with us. Pass it on to your friends! BUT ACT TODAY—DON'T DELAY ENJOYING PASCAL'S ADVANTAGES—AT $29.95, THERE'S NO REASON TO WAIT!

To: JRT Systems
1891-23rd Avenue
San Francisco, CA 94122

O.K. You've sold me—I can't resist your unbelievable offer. Send me JRT Pascal by return mail. I understand that if I'm not completely satisfied, I can return it within 30 days—with the sealed diskette unopened—for a full refund. Payment is enclosed by:

- Check
- Mastercharge
- VISA

Amount: $__________

(Shipping outside North America, $6. CA residents add sales tax.)

Card #__________ Exp. ________

Signature__________________________

Name___________________________

Address_________________________

City________________________State_________Zip_________

*CP/M is a Digital Research trademark. A 52K CP/M system is required.
SUBSCRIPTION FORM
(It’s OK to brag!)

☐ I own a big board (Hooray!)
☐ I don’t own a Big Board but am very interested (There’s hope)

<table>
<thead>
<tr>
<th>EXPERTISE</th>
<th>INTEREST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software Systems</td>
<td>Guru=5 None=0</td>
</tr>
<tr>
<td>Software Applications</td>
<td>None=0</td>
</tr>
<tr>
<td>Languages</td>
<td>None=0</td>
</tr>
<tr>
<td>Hardware</td>
<td>None=0</td>
</tr>
</tbody>
</table>

Are you willing to be a resource in the areas where your expertise is 4 or 5?
- love to ☐
- probably ☐
- maybe ☐
- no ☐

What are your hardware/software needs now?

In the near future?

What kind of exciting adventure (misadventure) are you working on?

If you get the idea that this document is as interested in enlisting your aid and ideas as it is in getting a subscription, you’re right. Lots of people are willing to subscribe, lots of people have ideas - and we’d like to encourage lots of people (especially you) to take an hour or two and put ideas and needs and accomplishments down on paper or disk. Then we can pass them along to others and that’s what this journal is all about.

Send me six issues (1 yr.) of MICRO CORNUCOPIA. I understand that I can cancel at any time and receive a refund for the balance of the subscription. (Issue #1 was published in August 1981.)

U.S. ☐ $16.00 ☐ $20.00 (1st class mail)
☐ Back issues, Specify #s $3.00 each (U.S. funds)

Canada & Mexico ☐ $20.00 (U.S. funds)
☐ Back issues, Specify #s $3.00 each (U.S. funds)

Other Foreign ☐ $26.00 (U.S. funds)
☐ Back issues, Specify #s $5.00 each (U.S. funds)

SEND ME: Six issues (1 yr.) of MICRO CORNUCOPIA.

NAME __________________ PHONE (?) ____________

ADDRESS ______________________________________

CITY ____________________________ STATE _______ ZIP ______

☐ Renewal MICRO CORNUCOPIA • 11740 N.W. West Rd • Portland, Oregon • 97229
**ORDER FORM**

**USER'S DISK #1** ........................ US, CAN, MEX  Other Foreign  
Over 200K of software especially for the Big Board.  
Including:  
1-Two fast disk copiers.  
2-The manual for Small C+.  
3-A Z80 assembler.  
4-Two disk formatters.  
5-Othello.  
6-A serial print routine.  
7-Modem software.  
8-Documentation for all the above.  
Send Big Board number with monitor

**USER'S DISK #2** ........................ US, CAN, MEX  Other Foreign  
Especially for folks with single-drive systems and those who want to try their hand at extending an assembler. Also a new BIOS with parallel printer interface. Returns to default drive on reboot, stifles head banging, supports CP/M 2.2 and 1.4. Step by step instructions for the simple incorporation into your CP/M (using only DDT and SYSGEN). BIOS source also included.  
Including:  
1-Two single-disk copy programs, both with source.  
2-The source of the Crowe Assembler.  
3-New Crowe.com file with larger symbol table.  
4-New BIOS for CP/M 1.4 and 2.2 (& boot).  
5-Disk mapper with source.  
6-Documentation for all the above.

**USER'S DISK #3** ........................ US, CAN, MEX  Other Foreign  
This is the disk for folks who are building Jim Monesmith's ROM programmer. Two versions of programmer software plus a disk file CRC checker. Also contains a sophisticated disk utility (DU7) and source for a substantially updated fast copy routine, plus more. (And documentation.)  
Including:  
1-Unmodified ROM programmer.  
2-ROM programmer with CRC.  
3-Disk file CRC checker.  
4-Source of new fast copy.  
5-Utility isolates bad disk sectors.  
6-Reset bit 7 (unWordstar a file).  
7-Print fancy page headings.  
8-And more.

**FREE**  
Your choice of either user's disk or the deluxe character ROM free if you send an article or software and a ROM or extra disk.

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>DESCRIPTION</th>
<th>PRICE EACH</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**US, CAN, MEX**  Other Foreign  
FORTH IN ROM ........................ US, CAN, MEX  Other Foreign  
Now, what you've all been waiting for—FORTH in ROM. This is standard FIG FORTH in three 2716's. FIG FORTH is standalone FORTH so you don't use CP/M at all. If you have disks, FIG FORTH handles the disk I/O. If not, you can still enjoy a most fascinating language. A simple FORTH line editor and a decompiler are available on disk.

| FORTH editor & decompiler disk ........................ US, CAN, MEX  Other Foreign |
|---------------------------------|--------------|
|                                | $15.00 $20.00 |

**TINY BASIC IN ROM** ........................ US, CAN, MEX  Other Foreign  
This two-ROM set takes control of the system just like FORTH does, handling its own I/O, loading Basic programs and object code routines on and off the disk or out of the third ROM. This little Basic is great for controller and utility applications.

**MORE ROMS**  
Fast monitor ROMs for speed freaks and our famous 'better than Texas' character ROM for screen freaks.

| Fast Monitor ROM ........................ US, CAN, MEX  Other Foreign |
|----------------------|--------------|
| Version 2.2 Character ROM ........................ US, CAN, MEX  Other Foreign |

- Send Big Board number with monitor ROM orders.  
- Monitor & char. ROMs $5.00 each if you send a fast ROM and a stamped, self-addressed return envelope.

| BACK ISSUES (each) ........................ US, CAN, MEX  Other Foreign |
|---------------------|--------------|
|                     | $3.00 $5.00  |

Because of the demand from new subscribers (bless their hearts) we are keeping back issues in print.

<table>
<thead>
<tr>
<th>ISSUE #1</th>
<th>ISSUE #2</th>
<th>ISSUE #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply</td>
<td>Parallel Print</td>
<td>Four MHz Mods</td>
</tr>
<tr>
<td>RAM Protection</td>
<td>Drive Motor Cont.</td>
<td>Configuring Modern 7</td>
</tr>
<tr>
<td>Video Wiggles</td>
<td>Shugart Jumpers</td>
<td>Safer Formatter</td>
</tr>
<tr>
<td>1/2 PPM.PRN</td>
<td>1/2 PPM.PRN</td>
<td>Reverse Video Cursor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ISSUE #4</th>
<th>ISSUE #5</th>
<th>ISSUE #6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keyboard Translation</td>
<td>Word Processing</td>
<td>EPROM Programmer</td>
</tr>
<tr>
<td>More 4 MHz Mods</td>
<td>Two Great Spells</td>
<td>Customizing Characters</td>
</tr>
<tr>
<td>Modems, Lync &amp; SIOs</td>
<td>Two Text Editors</td>
<td>Double Density update</td>
</tr>
<tr>
<td>Undoing CP/M ERASE</td>
<td>Scribble, a Formatter</td>
<td>Terminal in FORTH</td>
</tr>
<tr>
<td>Plus More (20 pgs)</td>
<td>Plus More (20 pgs)</td>
<td>Plus More (24 pgs)</td>
</tr>
</tbody>
</table>

**Screen Editor in Small C** ........................ US, CAN, MEX  Other Foreign  
A simple but full-function screen text editor plus a text formatter, all written in Small C by Edward Ream. This package includes the editor and formatter .COM files setup for the Big Board, Small C itself, and source code for all. With the documentation this is over 400K on a floppy disk. Edward is selling this package for $30, you can buy it from us for $39 (and Ed gets a royalty). Where else can you get an editor, a formatter, a C compiler, and source for all for under $40?

| Screen Editor in Small C ........................ US, CAN, MEX  Other Foreign |
|----------------------------|---------------|
|                            | $39.00 $44.00 |

Prices include media, package & 1st class postage (air mail for Other Foreign)

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>DESCRIPTION</th>
<th>PRICE EACH</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL ENCLOS**

**NAME**  
**ADDRESS**  
**CITY**  
**STATE**  
**ZIP**  
**U.S. funds only, please (payable on a U.S. bank)**

<table>
<thead>
<tr>
<th>NAME</th>
<th>ADDRESS</th>
<th>CITY</th>
<th>STATE</th>
<th>ZIP</th>
</tr>
</thead>
</table>

**MICRO CORNUCOPIA**  
• 11740 N.W. West Rd  • Portland, Oregon  • 97229